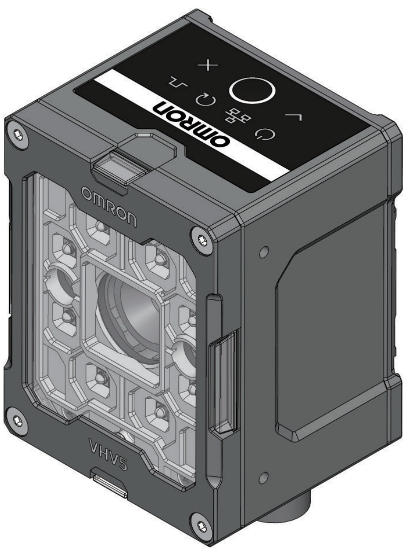
Autofocus Multicode Reader

VHV5-F Series

User Manual



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Introduction

Thank you for purchasing the VHV5-F Code Reader.

This manual contains information that is necessary for using VHV5-F Code Reader.

Please read this manual and make sure you understand the functions and capabilities before you attempt to use it in a control system.

Keep this manual in a safe place where it will be available for reference during operation.

Intended Audience

This manual is intended for the following personnel, who must also have knowledge of electrical systems (an electrical engineer or the equivalent).

- Personnel in charge of introducing barcoding systems.
- Personnel in charge of designing barcoding systems.
- Personnel in charge of installing and maintaining barcoding systems.
- Personnel in charge of managing barcoding systems and facilities.

Applicable Products

This manual covers the following products:

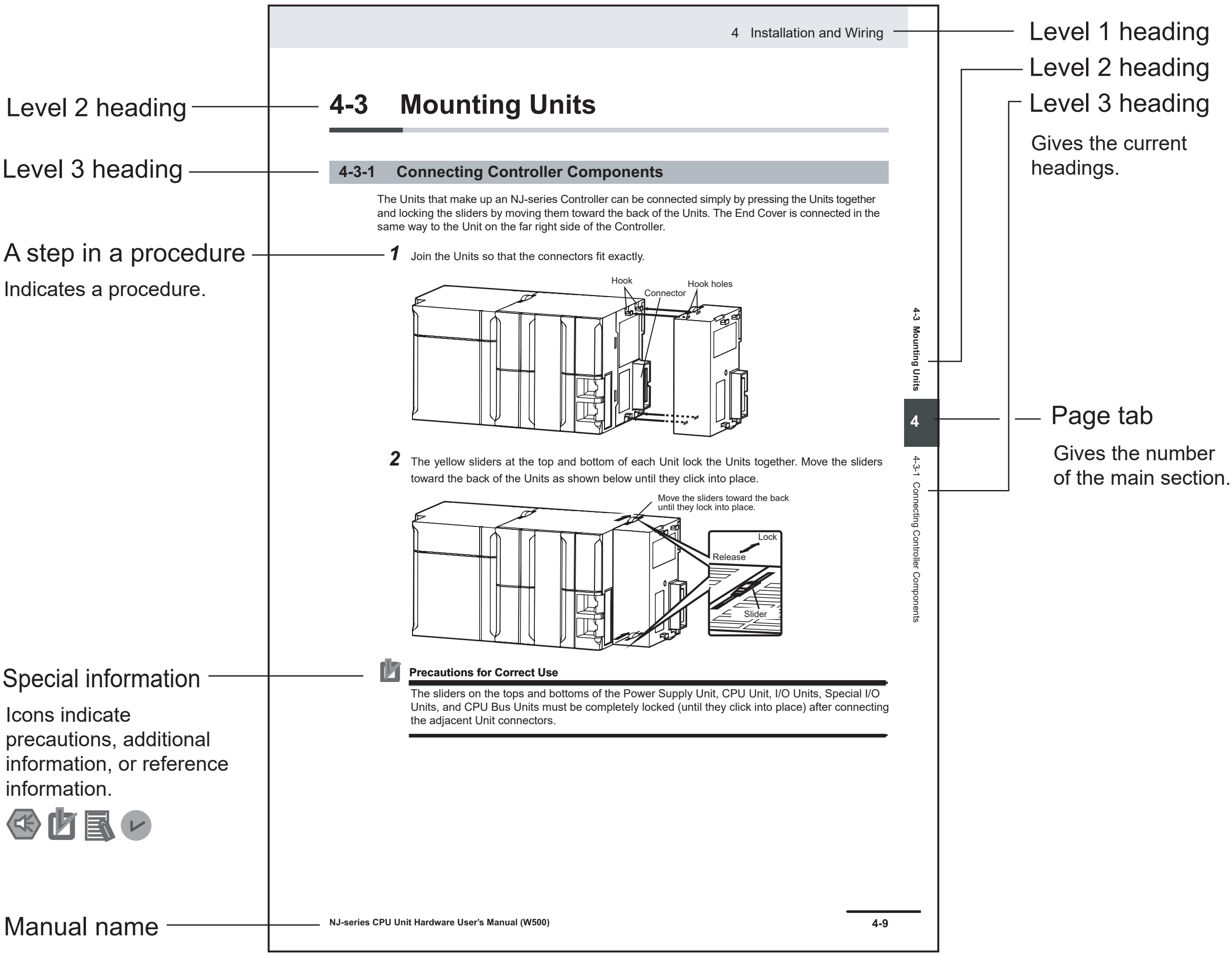
- VHV5-F Code Reader

Parts of the specifications and restrictions for each product may be listed in other manuals. Please refer to *Related Manuals* on page 35.

Manual Structure

Page Structure

The following page structure is used in this manual.



Note : This page is a sample for the purpose of describing the page structure. It differs in its actual content.

Icons

The icons used in this manual have the following meanings.

Precautions for Safe Use

Precautions on what to do and what to avoid doing to ensure the safe use of the product.

Precautions for Correct Use

Precautions on what to do and what to avoid doing to ensure proper operation and performance.

Additional Information

Additional information to read as required.
This information is provided to increase understanding or make operation easier.

Version Information

Information on differences in specifications and functionality for Product with different product versions is given.

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Terms and Conditions Agreement

Warranty, Limitations of Liability

Warranties

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  Omron's exclusive warranty is that the Products will be free from defects in materials and workmanship for a period of twelve months from the date of sale by Omron (or such other period expressed in writing by Omron). Omron disclaims all other warranties, express or implied.

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Change in Specifications

Product specifications and accessories may be changed at any time based on improvements and other reasons. It is our practice to change part numbers when published ratings or features are changed, or when significant construction changes are made. However, some specifications of the

Product may be changed without any notice. When in doubt, special part numbers may be assigned to fix or establish key specifications for your application. Please consult with your Omron's representative at any time to confirm actual specifications of purchased Product.

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Information presented by Omron Companies has been checked and is believed to be accurate; however, no responsibility is assumed for clerical, typographical or proofreading errors or omissions.

Safety Precautions

Definition of Precautionary Information

The following notation is used in this manual to provide precautions required to ensure safe usage of the VHV5-F Autofocus Multicode Reader.
The safety precautions that are provided are extremely important for safety. Always read and heed the information provided in all safety precautions.
The following notation is used.

WARNING	Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury. Additionally, there may be severe property damage.
Caution	Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury, or property damage.

Symbols

	General Prohibition Indicates general prohibitions, including warnings, for which there is no specific symbol.
	General Caution Indicates general cautions, including warnings, for which there is no specific symbol.
	Electrical Hazard Indicates the possible danger of electric shock under specific conditions.
	High Temperature Indicates the possibility of injuries by high temperature under specific conditions.
	General instructions Instructions on unspecified general action.

WARNING

WARNING

This product must be used according to this document. Failure to observe this may result in impairment of functions and performance of the product.

This product is not designed or rated for ensuring safety of persons. Do not use it for such purposes.	
When using equipment that is connected to an AC power source such as an AC adapter or PoE injector, use it within the rated voltage range. Usage with a voltage higher than what it is rated for may cause serious personal injury due to electric shock, or serious physical damage due to fire or equipment failure. Do not touch any part of the device while in operation, or immediately after turning OFF the power.	

Security Measures

Anti-virus protection
Install the latest commercial-quality antivirus software on the computer connected to the control system and maintain to keep the software up-to-date.

Security measures to prevent unauthorized access
Take the following measures to prevent unauthorized access to our products.
- Install physical controls so that only authorized personnel can access control systems and equipment.
- Reduce connections to control systems and equipment via networks to prevent access from untrusted devices.
- Install firewalls to shut down unused communications ports and limit communications hosts and isolate control systems and equipment from the IT network.
- Use a virtual private network (VPN) for remote access to control systems and equipment.
- Adopt multifactor authentication to devices with remote access to control systems and equipment.
- Set strong passwords and change them frequently.
- Scan virus to ensure safety of USB drives or other external storages before connecting them to control systems and equipment.

Data input and output protection
Validate backups and ranges to cope with unintentional modification of input/output data to control systems and equipment.
- Checking the scope of data
- Checking validity of backups and preparing data for restore in case of falsification and abnormalities
- Safety design, such as emergency shutdown and fail-soft operation in case of data tampering and abnormalities

Data recovery
Backup data and keep the data up-to-date periodically to prepare for data loss.

When using an intranet environment through a global address, connecting to a SCADA or an unauthorized terminal such as an HMI or to an unauthorized server may result in network security issues such as spoofing and tampering. You must take sufficient measures such as restricting access to the terminal, using a terminal equipped with a secure function, and locking the installation area by yourself.

When constructing an intranet, communication failure may occur due to cable disconnection or the influence of unauthorized network equipment. Take adequate measures, such as restricting physical access to network devices, by means such as locking the installation area.

When using a device equipped with the SD Memory Card function, there is a security risk that a third party may acquire, alter, or replace the files and data in the removable media by removing the removable media or unmounting the removable media. Please take sufficient measures, such as restricting physical access to the Controller or taking appropriate management measures for removable media, by means of locking the installation area, entrance management, etc., by yourself.

Software

To prevent computer viruses, install antivirus software on a computer where you use this software. Make sure to keep the antivirus software updated.

Keep your computer's OS updated to avoid security risks caused by a vulnerability in the OS.

Always use the highest version of this software to add new features, increase operability, and enhance security.

Manage usernames and passwords for this software carefully to protect them from unauthorized uses.

Set up a firewall (E.g., disabling unused communication ports, limiting communication hosts, etc.) on a network for a control system and devices to separate them from other IT networks. Make sure to connect to the control system inside the firewall.

Use a virtual private network (VPN) for remote access to a control system and devices from this software.

Caution

⚠ Caution

Danger of burns. Do not touch the case while the code reader is running or just after power is turned OFF, since it remains extremely hot.

Be careful when connecting devices to the external light connector. The connector provides 1.5A @ 24V.

Consignes de sécurité

Définition des informations de précaution

La mention suivante est utilisée dans ce manuel pour indiquer les précautions à prendre pour garantir une utilisation sûre du lecteur de codes VHV5-F.
Les précautions indiquées sont extrêmement importantes pour la sécurité. Lisez et respectez toujours les informations fournies dans toutes les consignes de sécurité.
La notation suivante est utilisée.

AVERTISSEMENT	Indique une situation potentiellement dangereuse qui, si elle n'est pas évitée, peut entraîner la mort ou des blessures graves. En outre, des dommages matériels importants peuvent être causés.
Attention	Indique une situation potentiellement dangereuse qui, si elle n'est pas évitée, peut entraîner des blessures mineures ou modérées, ou des dommages matériels.

Symboles

	Interdiction générale Indique des interdictions générales, y compris des avertissements, pour lesquelles il n'existe pas de symbole précis.
	Précautions générales Indique des mises en garde générales, y compris des avertissements, pour lesquelles il n'existe pas de symbole précis.
	Danger électrique Indique le risque possible de décharge électrique dans des conditions spécifiques.
	Température élevée Indique la possibilité de blessures causées par des températures élevées dans des conditions précises.
	Instructions générales Instructions liées à une action générale non précisée.

AVERTISSEMENT

AVERTISSEMENT

Ce produit doit être utilisé conformément au présent document. Le non-respect de cette consigne peut entraîner une altération des fonctions et des performances du produit.	

Ce produit n’est pas conçu ni évalué pour assurer la sécurité des personnes. Ne l’utilisez pas à de telles fins.

Lorsque vous utilisez un équipement connecté à une source d’alimentation CA, comme un adaptateur CA ou un injecteur PoE utilisez-le dans la plage de tension nominale. L’utilisation d’une tension supérieure à celle pour laquelle l’appareil est conçu peut provoquer des blessures graves par électrocution ou des dommages physiques importants par incendie ou défaillance de l’équipement. Ne touchez aucune partie de l’appareil lorsqu’il est en fonctionnement ou immédiatement après l’avoir éteint.

Mesures de sécurité

Protection antivirus
Installez le plus récent logiciel antivirus de qualité commerciale sur l’ordinateur connecté au système de contrôle et maintenez-le à jour.

Mesures de sécurité visant à empêcher tout accès non autorisé
Prenez les mesures suivantes pour empêcher l’accès non autorisé à nos produits.

- Installez des contrôles physiques afin que seul le personnel autorisé puisse accéder aux systèmes et équipements de contrôle.
- Réduisez les connexions aux systèmes et équipements de contrôle via les réseaux afin d’empêcher l’accès de dispositifs non fiables.
- Installez des pare-feu pour fermer les ports de communication inutilisés, limiter les hôtes de communication et isoler les systèmes et équipements de contrôle du réseau informatique.
- Utilisez un réseau privé virtuel (RPV) pour l’accès à distance aux systèmes et équipements de contrôle.
- Adoptez l’authentification multifactorielle pour les dispositifs d’accès à distance aux systèmes et équipements de contrôle.
- Définissez des mots de passe solides et changez-les fréquemment.
- Effectuez une analyse antivirus pour garantir la sécurité des clés USB ou d’autres supports de stockage externes avant de les connecter aux systèmes et équipements de contrôle.

Protection de l’entrée et de la sortie des données
Validez les sauvegardes et les gammes pour faire face aux modifications involontaires des données d’entrée/sortie des systèmes et équipements de contrôle.

- Contrôle de la portée des données
- Contrôle de la validité des sauvegardes et préparation des données à restaurer en cas de falsification ou d’anomalie
- Conception de sécurité, comme l’arrêt d’urgence et le fonctionnement en mode « à sûreté intégrée » en cas de falsification des données et d’anomalies

Récupération de données
Effectuez des copies de sauvegarde des données et tenez-les à jour régulièrement pour vous préparer à une perte de données.

Lors de l’utilisation d’un environnement intranet par le biais d’une adresse globale, la connexion à un SCADA ou à un terminal non autorisé comme une IHM ou à un serveur non autorisé peut entraîner des problèmes de sécurité du réseau comme l’usurpation et la falsification. Vous devez prendre des mesures adéquates comme restreindre l’accès au terminal, utiliser un terminal équipé d’une fonction de sécurité et verrouiller vous-même la zone d’installation.

Lors de la construction d’un intranet, des pannes de communication peuvent se produire en raison d’une déconnexion de câble ou de l’influence d’un équipement réseau non autorisé. Prenez des mesures adéquates, comme la restriction de l’accès physique aux dispositifs réseau, par exemple en verrouillant la zone d’installation.

Lorsque vous utilisez un appareil doté d'une carte SD, il existe un risque de sécurité qu’un tiers puisse acquérir, modifier ou remplacer les fichiers et les données du support amovible en retirant ou en démontant le support amovible. Veuillez prendre des mesures adéquates, comme restreindre l’accès physique au contrôleur ou prendre des mesures de gestion appropriées pour les supports amovibles, en verrouillant la zone d’installation, en gérant les entrées, etc.

Logiciel
Pour éviter les virus informatiques, installez un logiciel antivirus sur l’ordinateur où vous utilisez ce logiciel. Veillez à ce que votre logiciel antivirus soit toujours à jour.

Maintenez le système d’exploitation de votre ordinateur à jour pour éviter les risques de sécurité causés par une vulnérabilité du système d’exploitation.

Utilisez toujours la version la plus récente de ce logiciel afin d’ajouter de nouvelles fonctionnalités, d’améliorer l’efficacité opérationnelle et de renforcer la sécurité.

Gérez soigneusement les noms d’utilisateur et les mots de passe de ce logiciel afin de les protéger contre les utilisations non autorisées.

Mettez en place un pare-feu (par exemple, pour désactiver les ports de communication inutilisés, limiter les hôtes de communication, etc.) sur le réseau du système et des dispositifs de contrôle afin de les séparer d’autres réseaux informatiques. Veillez à vous connecter au système de contrôle à l’intérieur du pare-feu.

Utilisez un réseau privé virtuel (RPV) pour accéder à distance au système et aux dispositifs de contrôle à partir de ce logiciel.

Attention

⚠ Attention

Risque de brûlures. Ne touchez pas le boîtier lorsque le lecteur de codes est en marche ou juste après la mise hors tension, car il reste extrêmement chaud.

Soyez prudent lorsque vous connectez des appareils au connecteur de lumière externe. Le connecteur fournit 1,5 A à 24 V.

Precautions for Safe Use

Conditions for the Safe Use of This Product

- Be careful when handling product. Dropping it may cause injury to you or others or may cause the product to malfunction.
- Be careful when unpacking and handling product. Avoid sharp edges that may cause injury.
- Ensure the product is mounted securely and all mounting hardware is firmly attached when installing and using the product.
- Use only with a correctly functioning power supply. Application of a voltage that exceeds the specification may damage the product and cause it to malfunction.
- Use only cables that are designed for the application. Use of cables that are longer than needed may introduce excess noise into the image.
- Do not bend cables more than recommended by the cable specifications. The product may malfunction.
- Always use the lens cover when storing the product.
- While the power is ON or immediately after the power is turned OFF, the case is still hot. Do not touch the case.
- Do not look directly into the lens of this product. The lights may be bright enough to cause discomfort or injury to the eyes and eyesight.
- When disposing of the product, treat it as an industrial waste.

Précautions à prendre pour une utilisation adéquate et sécuritaire

Conditions d’utilisation sécuritaire de ce produit

- Manipuler le produit avec soin. Le laisser tomber peut causer des blessures à vous, à d’autres personnes ou peut causer un dysfonctionnement du produit.
- Déballez et manipulez le produit avec prudence. Évitez les côtés et coins pointus qui peuvent causer des blessures.
- Assurez-vous que le produit est monté en toute sécurité et que tout le matériel de montage est fermement attaché lors de l’installation et de l’utilisation du produit.
- Utilisez uniquement avec une alimentation fonctionnant correctement. L’application d’une tension qui dépasse les spécifications peut endommager le produit et le faire mal fonctionner.
- Utilisez uniquement les câbles conçus pour l’application. L’utilisation de câbles plus longs que nécessaire peut introduire un excès de bruit dans l’image.
- Ne pliez pas les câbles plus que ce qui est recommandé par les spécifications du câble. Le produit peut mal fonctionner.
- Protéger adéquatement la lentille avec un couvercle avant l’entreposage.
- Lors de la mise en tension, boitier devient chaud et reste chaud un certain temps lors de la mise hors tension. Ne touchez pas le boitier.
- Ne regardez pas directement dans la lentille de ce produit. Les lumières peuvent être suffisamment brillantes pour causer de l’inconfort ou des blessures aux yeux et à la vue.
- Traitez ce produit comme un déchet industriel pour en disposer.

Precautions for Correct Use

Conditions for the Correct Use of This Product

- Install, store and use the product in a location that meets the following conditions:
  - The ambient temperature does not fall below 0°C. (-25°C for storage)
  - The ambient temperature does not rise above +45°C (+65°C for storage)
  - Relative humidity of between 25% to 85%
  - No rapid changes in temperature (dew does not form)
  - There is no presence of corrosive or flammable gases
  - Is free of dust, salts and iron particles
  - Is free of vibration and shock
  - Is out of direct sunlight
  - Product will not come into contact with water, oils or chemicals
  - Product will not be affected by strong electro-magnetic waves
  - Is not near to high-voltage, or high-power equipment
- Be careful when connecting or removing cables. Applying excessive force to the cables or connectors may cause damage or injury.
- Use only cables that are designed for the application and that are in good condition. Use of poor quality or worn cables may cause damage to the product or cause it to malfunction.
- Be careful when connecting or removing cables. Pinching or other injury may occur.
- If you notice any abnormalities, immediately stop use, turn OFF the power supply, and contact your OMRON representative.
- If using this product in an area where airborn oils or water are present, clean the lens and the exterior surface of the product frequently and inspect for deterioration of the plastics. Stop using the product if damage is identified.
- For good heat dissipation, maintain adequate clearance around the product.
- Do not use this product in an environment with excessive noise.
- Turn OFF the power to ensure safety before maintenance.
- Use an airbrush to clean the lens.
- Do not attempt to dismantle, repair, or modify the product.

Précautions à prendre pour une utilisation efficace

Conditions pour une utilisation efficace de ce produit

- Installez, stockez et utilisez le produit dans un endroit qui répond aux conditions suivantes:
  - La température ambiante ne descend pas en dessous de 0°C. (-25°C pour le stockage);
  - La température ambiante ne dépasse pas +45°C (+65°C pour le stockage);
  - Humidité relative entre 25% et 85%;
  - Pas de changements rapides de température (il ne se forme pas de rosée);
  - Il n’y a pas de présence de gaz corrosifs ou inflammables;
  - Est exempt de poussière, de sels et de particules de fer;
  - Est exempt de vibrations et de chocs;
  - Est à l’abri de la lumière directe du soleil;
  - Le produit n’entrera pas en contact avec de l’eau, des huiles ou des produits chimiques;
  - Le produit ne sera pas affecté par les fortes ondes électromagnétiques;
  - N’est pas à proximité d’un équipement à haute tension ou à haute puissance.
- Soyez prudent lors de la connexion ou du retrait de câbles. L’application d’une force excessive aux câbles ou aux connecteurs peut causer des dommages ou des blessures.
- Utilisez uniquement les câbles conçus pour l’application et en bon état. L’utilisation de câbles de mauvaise qualité ou usés peut endommager le produit ou le faire mal fonctionner.
- Soyez prudent lors de la connexion ou du retrait de câbles. Des pincements ou d’autres blessures peuvent survenir.
- Si vous remarquez des anomalies, arrêtez immédiatement l’utilisation, éteignez le bloc d’alimentation et contactez votre représentant OMRON.
- Si vous utilisez ce produit dans un environnement où des huiles ou de l’eau sont présentes dans l’air, nettoyez fréquemment la lentille et la surface extérieure du produit et inspectez la détérioration des plastiques. Arrêtez d’utiliser le produit si des dommages sont identifiés.
- Pour une bonne dissipation de la chaleur, maintenir un dégagement adéquat autour du produit.
- N’utilisez pas ce produit dans un environnement avec un bruit excessif.
- Éteignez l’alimentation pour assurer la sécurité avant l’entretien.
- Nettoyer la lentille à l’aide d’air comprimé.
- N’essayez pas de démonter, de réparer ou de modifier le produit.

Regulations and Standards

Using Product Outside Japan

This regulation applies to the VHV5-F and peripheral devices.
If you export (or provide a non-resident with) this product or a part of this product that falls under the category of goods (or technologies) specified by the Foreign Exchange and Foreign Trade Control Law as those which require permission or approval for export, you must obtain permission or approval (or service transaction permission) pursuant to the law.

Conformance to EC/EU Directives

This regulation applies to the VHV5-F and peripheral devices.

- This product is in compliance with all applicable directives, 2014/30/EU, 2014/35/EU, and 2011/65/EU.
- This product complies with EC/EU Directives. EMC-related performance of the Omron devices that comply with EC/EU Directives will vary depending on the configuration, wiring, and other conditions of the equipment or control panel on which the Omron devices are installed.
- The customer must, therefore, perform the final check to confirm that devices and the overall machine conform to EMC standards.

Conformance to Standards

This regulation applies to the VHV5-F and peripheral devices.

- This product complies with UL Standards.
  UL60950-1 2nd-edition, 2014 (Class III).
- IEC/EN 62368-1, 2nd and 3rd Ed
- UL 60950-1, 2nd Edition, 2019-05-09 (Information Technology Equipment - Safety - Part 1: General Requirements)
- CAN/CSA C22.2 No. 60950-1-07, 2nd Edition, 2014-10 (Information Technology Equipment - Safety - Part 1: General Requirements)

RISK GROUP 2
Retinal blue light hazard - 300 nm to 700 nm.
CAUTION: Possibly hazardous optical radiation emitted from this product. Do not stare at operating lamp. May be harmful to the eyes.

Caution: Use of controls, adjustments, or performance of procedures other than those specified herein may result in hazardous radiation exposure.

Korean Radio Regulation (KC)

사 용 자 안 내 문
이 기기는 업무용 환경에서 사용할 목적으로 적합성평가를 받은 기기로서 가정용 환경에서 사용하는 경우 전파간섭의 우려가 있습니다.

Guide for Users

This equipment has been evaluated for conformity in a commercial environment. When used in a residential environment, it may cause radio interference.

Règlements et normes

Utilisation du produit en dehors du Japon

Ce règlement s'applique au lecteur de codes VHV5-F et à ses périphériques.
Si vous exportez (ou fournissez à un non-résident) ce produit ou une partie de ce produit qui entre dans la catégorie des biens (ou technologies) spécifiés par la loi sur le contrôle des changes et du commerce extérieur comme étant ceux qui nécessitent une autorisation ou une approbation pour l'exportation, vous devez obtenir une autorisation ou une approbation (ou une autorisation de transaction de service) conformément à la loi.

Conformité aux directives CE/UE

Ce règlement s'applique au lecteur de codes VHV5-F et à ses périphériques.

- Ce produit est conforme à toutes les directives applicables, 2014/30/UE, 2014/35/UE et 2011/65/UE.
- Ce produit est conforme aux directives CE/UE. Les performances des appareils Omron conformes aux directives CE/UE en matière de CEM varient en fonction de la configuration, du câblage et d'autres conditions de l'équipement ou du panneau de commande sur lequel les appareils Omron sont installés.
- Le client doit donc effectuer le contrôle final pour confirmer que les appareils et l'ensemble de la machine sont conformes aux normes CEM.

Conformité aux normes UL

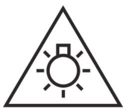
Ce règlement s'applique au lecteur de codes VHV5-F et à ses périphériques.

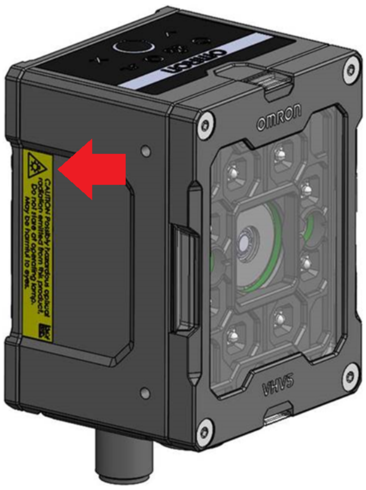
- Ce produit est conforme aux normes UL.
- UL60950-1 2e édition, 2014 (classe III).

GROUPE DE RISQUE 2

Risque de lumière bleue rétinienne – 300 nm à 700 nm.

ATTENTION : Possibles rayonnements optiques dangereux émis par ce produit. Ne pas regarder fixement la lampe. Peut être dangereux pour les yeux.





Attention : l'utilisation de commandes, de réglages ou l'exécution de procédures autres que celles spécifiées dans le présent document peut entraîner une exposition dangereuse aux rayonnements.

Règlement coréen sur les équipements radio (KC)

사 용 자 안 내 문
이 기기는 업무용 환경에서 사용할 목적으로 적합성평가를 받은 기기로서 가정용 환경에서 사용하는 경우 전파간섭의 우려가 있습니다.

Guide pour les utilisateurs
La conformité de cet équipement a été évaluée dans un environnement commercial. Utilisé dans un environnement résidentiel, il peut provoquer des interférences radio.

Radio Frequency Interference Requirements: FCC

This equipment has been tested for compliance with FCC (Federal Communications Commission) requirements and has been found to conform to applicable FCC standards. To comply with FCC RF exposure compliance requirements, this device must not be co-located with or operate in conjunction with any other antenna or transmitter. Changes or modifications not expressly approved by the party responsible for compliance could void the user’s authority to operate the equipment.

Class A Statement

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Class B Statement

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:
Reorient or relocate the receiving antenna.
Increase the separation between the equipment and receiver.
Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
Consult the dealer or an experienced radio/TV technician for help.

Radio Frequency Interference Requirements: Canada

This device complies with Industry Canada ICES-003. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation. Cet appareil est conforme à la norme ICES-003 d'Industrie Canada. Son fonctionnement est soumis aux deux conditions suivantes: (1) l’appareil ne doit pas produire de brouillage, et (2) l’utilisateur de l’appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d’en compromettre le fonctionnement.

Related Manuals

The followings are the manuals related to this manual. Use these manuals for reference.

Name of Manual	Cat. No.	Model	Usage	Description
VHV5-F Autofocus Multicode Reader User Manual	Z476	VHV5-F	When you want to know the product specifications and basic settings for using the VHV5-F.	VHV5-F specifications, getting started, explanation of settings, command parameters.
VHV5-F Autofocus Multicode Reader Communication Manual	Z477		When you want to operate the VHV5-F from an external device.	It describes the system configuration, control methods, I/O specifications, supported network types and communication setting for using the VHV5-F.

Revision History

A manual revision code appears as a suffix to the catalog number on the front and back covers of the manual.

Cat. No.	Z476-E-06 (84-9000470-02 Rev F)

Revision code

Revision code	Date	Revised content
01	April 2024	First publication.
02	May 2024	General improvements.
03	July 2024	General improvements.
04	May 2025	Added "Section 8 - In-Line ISO/IEC Verifier" and "Section 9 - Scripting".
05	October 2025	Revised Sections 1 through 9 to reflect 1.2.1 updates.
06	January 2026	Added 6.42 mm Wide Lens option.

1

Introduction

1-1 Feature Overview

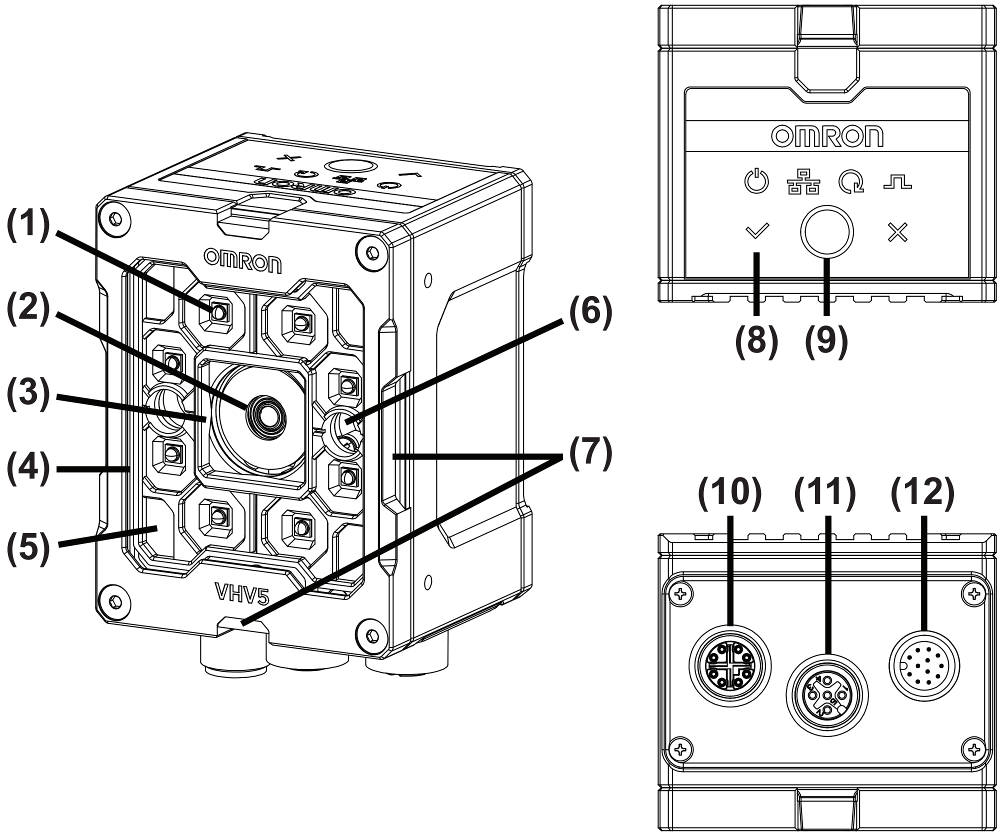
The VHV5-F Code Reader is designed to meet the diverse needs and demands of industries such as Food and Commodities, Automotive, Electronics, Logistics, and Clinical. With this solution, you can cover every application across your factory floor with just one code reader.

1-1-1 Key Features and Benefits

1. **Versatility:** The VHV5-F features a robust algorithm that can read labels and direct part marks. Choose from various models within the code reader product family that most closely matches your application requirements.
2. **Easy to Use:** The VHV5-F comes with a single software interface that runs on all models and can handle all applications. With a simple and intuitive mode of usage, operators and technicians can quickly learn and operate the code reader.
3. **Flexible Installation:** The VHV5-F is designed to be installed in any environment. It is IP69K-rated, ensuring durability and protection against dust and water. Choose from various mounting options to suit your specific needs.
4. **Superior Imaging and Processing:** The VHV5-F offers superior imaging, processing, and setup capabilities. With options like ultra-uniform lighting and front window options, you can achieve high-quality images. The X-Mode algorithm enables reading codes on both labels and directly marked parts. WebLink 4.0 software simplifies the setup process, allowing you to get your code reader into production quickly.
5. **High-Speed Performance:** The VHV5-F is designed to meet the demands of high-speed production lines. Achieve and maintain high production rates with the VHV5-F, capturing images with very short exposure times and providing non-stop image acquisition and fast decoding.
6. **Robust Reading:** The VHV5-F ensures a high read success rate for both good and poor quality codes. With the X-Mode 5.0 algorithm, this solution covers damaged, distorted, or low-contrast codes. Smart Assist and Advanced Decode Settings further optimize the read rate, even in challenging conditions.
7. **In-Line ISO/IEC Code Verification:** The VHV5-F, when equipped with a Verification License, can perform full ISO/IEC Verification, calibrated using the latest ISO/IEC 15415, 15416, and 29158 verification standards. Verification speeds can be up to 1,000 parts per minute.
8. **Easy Integration:** Integrating the VHV5-F into your assembly line is easy. Save time and cost with easy connections to PLCs through multiple communication channels. The intuitive setup and monitoring tool, WebLink, eliminates the need for complex PC tool installations. The Digital Softscope provides a display of the entire read cycle, aiding in system health monitoring and debugging.

1-2 VHV5-F Reader and Accessories

1-2-1 Description of Reader



#	Name	Description	Options
1	**Lighting**	Illuminates part to be read.	Red or white.
2	**Autofocus Lens**	Focuses on part to be read.	6.42, 8.5, 12.5, and 20 mm focal length.
3	**Sensor**	Captures image of part.	2.3 MP and 5.0 MP.
4	**Front Window**	Encloses camera; provides mounting area for filters.	Flat for 6.42 and 8.5 mm lens. Focused for 12.5 and 20 mm lens.
5	**Filter Accessories**	Modifies lighting for different applications.	None, Diffuser, Full Polarizer, Half Polarizer.
6	**Targeting Optics**	Indicates the center of the reading field of view.	
7	**360 Degree Pass/Fail Indicators**	Indicates whether the Read Cycle has passed or failed.	
8	**Membrane Indicators**	Shows power, network connectivity, reader online/offline status, trigger indicator, pass and fail status.	
9	**Membrane Button**	Multifunction Control button. Resets reader IP address to factory default.	
10	**X-Coded Ethernet Port**	1000BASE-T Ethernet port; Power over Ethernet (PoE).	
11	**External Light Port**	Provides power and strobe signal to external lighting.	
12	**DIO (Parallel IO) Port**	Breakout for power, trigger, digital inputs/outputs, RS-232.	

Targeting Optics

The VHV5-F is equipped with targeting optics to provide a visual reference when mounting the camera. The targeting optics consist of two bright green parallel spots which indicate the center of the reading area, as well as the orientation of the camera relative to the part.

Reader Status Indicators and Control Button Functions

● Reader Status Indicators 1 - 6

Reader Status Indicators		
#	Name	Status Indication
1	**Power**	**Off –** No power; **Solid Green –** Unit has powered up.
2	**Network**	**Off –** No network connection; **Solid Amber –** Unit has a network connection; **Flashing Amber –** Unit is communicating.
3	**Mode**	**Off –** Unit is offline; **Solid Green –** Unit is online with loaded job.
4	**Trigger**	**Off –** Waiting for trigger; **Blinking Amber –** Unit has received a trigger.
5	**Pass**	**Off –** In Read Cycle; **Solid On or Blinking Green –** Read Cycle has passed.
6	**Fail**	**Off –** In Read Cycle; **Solid On or Blinking Red –** Read Cycle has failed.

● Control Button Functions - 7

Control Button Functions		
#	**Name**	**Function**
7	**Button**	• **Trigger –** Press and immediately release the control button to trigger the VHV5-F. This works when the Read Cycle is set to Triggered mode. Note that if Disable External Trigger is turned off in the WebLink UI, then the camera will not trigger. • **Reset IP Address to Factory Default –** Press and hold the control button for ~5 seconds. Wait until the 360 degree lights do a double flash and then release the button. The unit will now be reset to factory IP (192.168.188.2, 255.255.0.0).

1-2-2 Model Number Structure

Use the table below to determine the product specifications of your reader or verifier from the model number on the label.

Important: Please see the next section for the full list of orderable model numbers. All other variations should be assembled using standard models combined with available accessories.

VHV5-F – Autofocus Multicode Reader, IP69K Enclosure, 24V/PoE, Serial, Digital IO, Ethernet.

VHV5-F□□□□□□□□-□□□-□

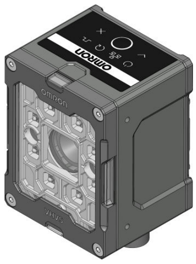
1 2 3 4 5 6 7

No.	Classification	Code	Meaning
1	Focus Distance (mm)	000	Autofocus
		###	Focus Distance in mm
2	Lens / Field of View	W	Wide
		M	Medium
		N	Narrow
		L	Long Range
3	Sensor Type	023M	2.3 Megapixel, Monochrome, Global Shutter
		050M	5 Megapixel, Monochrome, Global Shutter
4	Front Window Filter Type*1	S	Clear Front Window
		D	Light-Diffusing Front Window
		P	Polarizing Window to Eliminate Glare
		H	Half-Polarizing Window (Gives the user the option to use either polarized or standard lighting in the same unit)
5	Light Color	N	None
		R	Red
		W	White
6	License	X, V	X = High-Speed X-Mode Reader V = High-Speed X-Mode Reader and ISO In-Line Verifier
7	Custom (0 – Z)	D	Reserved
		0 to 9, A to Z	OEMs and Large Customers

*1. See *2-2 Hardware Selection and Installation Flow* on page 2-8 for reader mounting and lighting.

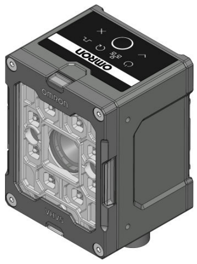
1-2-3 Standard Orderable Reader Models

Standard Red 2.3 MP and Standard Red 5 MP

Appearance	Standard Red 2.3 MP	Part Number
	VHV5-F, Autofocus, Wide Lens, 2.3 MP, Standard Red Light, X-Mode Reader	VHV5-F000W023M-SRX
	VHV5-F, Autofocus, Medium Lens, 2.3 MP, Standard Red Light, X-Mode Reader	VHV5-F000M023M-SRX
	VHV5-F, Autofocus, Narrow Lens, 2.3 MP, Standard Red Light, X-Mode Reader	VHV5-F000N023M-SRX
	VHV5-F, Autofocus, Long Lens, 2.3 MP, Standard Red Light, X-Mode Reader	VHV5-F000L023M-SRX
	Standard Red 5 MP	**Part Number**
	VHV5-F, Autofocus, Wide Lens, 5.0 MP, Standard Red Light, X-Mode Reader	VHV5-F000W050M-SRX
	VHV5-F, Autofocus, Medium Lens, 5.0 MP, Standard Red Light, X-Mode Reader	VHV5-F000M050M-SRX
	VHV5-F, Autofocus, Narrow Lens, 5.0 MP, Standard Red Light, X-Mode Reader	VHV5-F000N050M-SRX
	VHV5-F, Autofocus, Long Lens, 5.0 MP, Standard Red Light, X-Mode Reader	VHV5-F000L050M-SRX

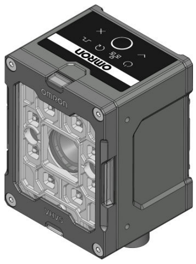
Note 1: VHV5-F readers are sold without cables or mounting. These items can be found in later sections.
Note 2: The VHV5-F uses the same Parallel IO cables and interconnect accessories as the MicroHAWK V430-F and V440-F.
Note 3: X-Mode is suitable for all labels as well as low-print-grade codes and DPM.

Standard White 2.3 MP and Standard White 5 MP

Appearance	Standard White 2.3 MP	Part Number
	VHV5-F, Autofocus, Wide Lens, 2.3 MP, Standard White Light, X-Mode Reader	VHV5-F000W023M-SWX
	VHV5-F, Autofocus, Medium Lens, 2.3 MP, Standard White Light, X-Mode Reader	VHV5-F000M023M-SWX
	VHV5-F, Autofocus, Narrow Lens, 2.3 MP, Standard White Light, X-Mode Reader	VHV5-F000N023M-SWX
	VHV5-F, Autofocus, Long Lens, 2.3 MP, Standard White Light, X-Mode Reader	VHV5-F000L023M-SWX
	Standard White 5 MP	**Part Number**
	VHV5-F, Autofocus, Wide Lens, 5.0 MP, Standard White Light, X-Mode Reader	VHV5-F000W050M-SWX
	VHV5-F, Autofocus, Medium Lens, 5.0 MP, Standard White Light, X-Mode Reader	VHV5-F000M050M-SWX
	VHV5-F, Autofocus, Narrow Lens, 5.0 MP, Standard White Light, X-Mode Reader	VHV5-F000N050M-SWX
	VHV5-F, Autofocus, Long Lens, 5.0 MP, Standard White Light, X-Mode Reader	VHV5-F000L050M-SWX

Note 1: VHV5-F readers are sold without cables or mounting. These items can be found in later sections.
Note 2: The VHV5-F uses the same Parallel IO cables and interconnect accessories as the MicroHAWK V430-F and V440-F.
Note 3: X-Mode is suitable for all labels as well as low-print-grade codes and DPM.

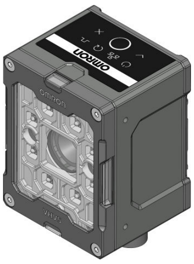
Standard Red 2.3 MP with Half Polarizer and Standard Red 5 MP with Half Polarizer

Appearance	Standard Red 2.3 MP with Half Polarizer	Part Number
	VHV5-F, Autofocus, Wide Lens, 2.3 MP, Standard Red Light, Half-Polarized Window, X-Mode Reader	VHV5-F000W023M-HRX
	VHV5-F, Autofocus, Medium Lens, 2.3 MP, Standard Red Light, Half-Polarized Window, X-Mode Reader	VHV5-F000M023M-HRX
	VHV5-F, Autofocus, Narrow Lens, 2.3 MP, Standard Red Light, Half-Polarized Window, X-Mode Reader	VHV5-F000N023M-HRX
	VHV5-F, Autofocus, Long Lens, 2.3 MP, Standard Red Light, Half-Polarized Window, X-Mode Reader	VHV5-F000L023M-HRX
	Standard Red 5 MP with Half Polarizer	**Part Number**
	VHV5-F, Autofocus, Wide Lens, 5.0 MP, Standard Red Light, Half-Polarized Window, X-Mode Reader	VHV5-F000W050M-HRX
	VHV5-F, Autofocus, Medium Lens, 5.0 MP, Standard Red Light, Half-Polarized Window, X-Mode Reader	VHV5-F000M050M-HRX
	VHV5-F, Autofocus, Narrow Lens, 5.0 MP, Standard Red Light, Half-Polarized Window, X-Mode Reader	VHV5-F000N050M-HRX
	VHV5-F, Autofocus, Long Lens, 5.0 MP, Standard Red Light, Half-Polarized Window, X-Mode Reader	VHV5-F000L050M-HRX

Note 1: VHV5-F readers are sold without cables or mounting. These items can be found in later sections.
Note 2: The VHV5-F uses the same Parallel IO cables and interconnect accessories as the MicroHAWK V430-F and V440-F.
Note 3: X-Mode is suitable for all labels as well as low-print-grade codes and DPM.

1-2-4 Standard Orderable Reader / ISO In-Line Verifier Models

Red 2.3 MP and Red 5 MP In-Line Verifier

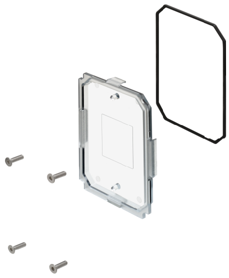
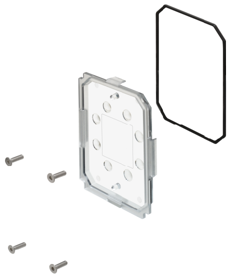
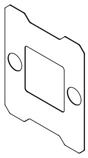
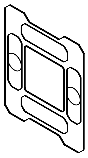
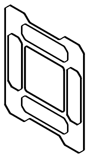
Appearance	Standard Red 2.3 MP	Part Number
	VHV5-F, Autofocus, Medium Lens, 2.3 MP, Standard Red Light, In-Line Verifier	VHV5-F000M023M-SRV
	VHV5-F, Autofocus, Narrow Lens, 2.3 MP, Standard Red Light, In-Line Verifier	VHV5-F000N023M-SRV
	VHV5-F, Autofocus, Long Lens, 2.3 MP, Standard Red Light, In-Line Verifier	VHV5-F000L023M-SRV
	Standard Red 5 MP	**Part Number**
	VHV5-F, Autofocus, Medium Lens, 5.0 MP, Standard Red Light, In-Line Verifier	VHV5-F000M050M-SRV
	VHV5-F, Autofocus, Narrow Lens, 5.0 MP, Standard Red Light, In-Line Verifier	VHV5-F000N050M-SRV
	VHV5-F, Autofocus, Long Lens, 5.0 MP, Standard Red Light, In-Line Verifier	VHV5-F000L050M-SRV

Note 1: VHV5-F In-Line Verifiers are sold without cables or mounting. These items can be found in later sections.
Note 2: The VHV5-F uses the same Parallel IO cables and interconnect accessories as the Micro-HAWK V430-F and V440-F.
Note 3: These models are suitable for Labels and Direct Part Mark verification.
Note 4: The wide lens is not recommended for in-line verification.

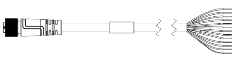
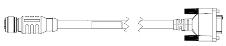
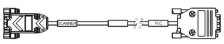
1-2-5 Mounting Accessories

Appearance	Type	Part Number
	VHV5-F L-Bracket Adjustable Angle Mounting Kit (VHV5-F only)	VHV5-AM0
	Universal Mounting Block and Heatsink Kit (VHV5-F only)	VHV5-AM1
	VHV5-F APG Pan and Tilt Camera Mount Kit (VHV5-F only)	VHV5-AM2

1-2-6 Front Window Accessories

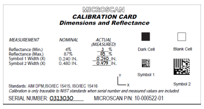
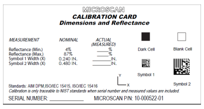
Appearance	Type	Part Number
	VHV5-F Standard Window (for Wide and Medium Lens Models)	VHV5-AF0
	VHV5-F Lensed Window (for Narrow and Long Lens Models)	VHV5-AF1
	VHV5-F Diffuser Accessory	VHV5-AF2
	VHV5-F Polarizer Accessory	VHV5-AF3
	VHV5-F Half Polarizer Accessory	VHV5-AF4

1-2-7 Cables

Appearance	Category	Length / Spec	Part Number
	X-Code to RJ45 Ethernet Cable (High Flex, Straight, Black Jacket)	1 Meter	61-9000134-01
		3 Meters	61-9000134-02
		5 Meters	61-9000134-03
		10 Meters	61-9000134-04
	X-Code to RJ45 Ethernet Cable (High Flex, Straight, Black Jacket)	2 Meters	FHV-VNB2 2M
		3 Meters	FHV-VNB2 3M
		5 Meters	FHV-VNB2 5M
		10 Meters	FHV-VNB2 10M
		20 Meters	FHV-VNB2 20M
	X-Code to RJ45 Ethernet Cable (High Flex, Right-Angle, Black Jacket)	2 Meters	FHV-VNLB2 2M
		3 Meters	FHV-VNLB2 3M
		5 Meters	FHV-VNLB2 5M
		10 Meters	FHV-VNLB2 10M
		20 Meters	FHV-VNLB2 20M
	M12 to Flying Leads Cable – Parallel IO (Power, DIO, RS-232)	3 Meters	V430-W8-3M
		5 Meters	V430-W8-5M
		10 Meters	V430-W8-10M
	M12 to Flying Leads Cable – Parallel IO (Power, DIO, RS-232) – Right Angle Back	3 Meters	V430-W8LD-3M
	M12 to Flying Leads Cable – Parallel IO (Power, DIO, RS-232) – Right Angle Front	3 Meters	V430-W8LU-3M
	Reader M12 to RS-232 Breakout Cable	1 Meter	V430-WR-1M
		3 Meters	V430-WR-3M
	VHV5-F to External Light – 5 Pin M12 Plug to 5 Pin M12 Socket	1 Meter	61-000184-01
	Cable, Adapter, Omron PLC	2 Meters	V430-WPLC-2M

***Important:** Standard Omron FJ-VSG Ethernet cables are available in alternative and longer lengths.

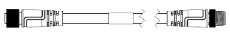
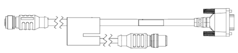
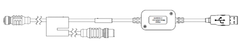
1-2-8 Verification Accessories

Appearance	Category	Spec	Part Number
(File)	Verification License upgrade for VHV5-F Readers	License Key delivered as a .LIC file	LIC-0801-009
	Kit – NIST-Certified Calibration Card	NIST-Certified Calibration Card	98-000265-01
	Kit - Calibration Card	Standard Calibration Card	98-000265-02

1-2-9 Power Supplies

Appearance	Category	Length / Spec	Part Number
	Standard Reader 24V Power Supply (2.1 A)	1 Meter, U.S. / Euro Plug	97-000012-01
	Single Port PoE Injector, 30W, IEEE802.3at Compliant, 2 x RJ45 Connector, 90 to 264VAC	Power Cord NOT Included	98-9000311-01

1-2-10 Legacy QX-1 Cabling and Accessories

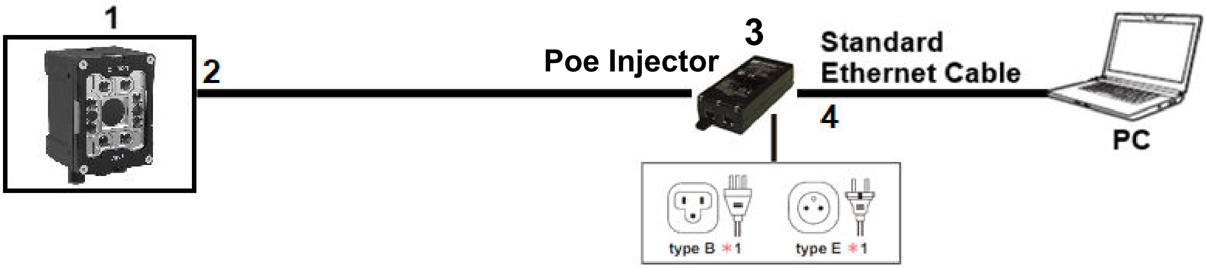
Appearance	Category	Length / Spec	Part Number
	QX-1 Interconnect Module – Power Input, Photo Sensor and Trigger Input, Smart Light Control (Power and Strobe)	N/A	98-000103-02
	Reader to QX-1 Interconnect Cable – M12 Socket to M12 Plug (QX-1 is used as breakout module for Power input, Trigger input, and Strobe Output	1 Meter	V430-WQ-1M
		3 Meters	V430-WQ-3M
		5 Meters	V430-WQ-5M
	Reader to QX-1 Interconnect Cable – M12 Socket to M12 Plug – Right Angle Back	1 Meter	61-000162-03
		3 Meters	61-000148-03
	Reader to QX-1 Interconnect Cable – M12 Socket to M12 Plug – Right Angle Front	1 Meter	61-000162-04
		3 Meters	61-000148-04
	Reader to QX-1 Interconnect Cables with RS-232 Breakout	3 Meters	V430-WQR-3M
		5 Meters	V430-WQR-5M
	Reader to QX-1 Interconnect Cables with USB Keyboard Wedge Breakout	3 Meters	V430-WQK-3M
	QX-1 Photo Sensor, M12 4-Pin Plug, NPN, Light ON / Dark ON	2 Meters	99-9000016-01
	QX-1 Field-Wireable M12 4-Pin Plug for Any Trigger Source or Photo Sensor	Screw Terminal Connector	98-9000239-01

2

System Configuration and Setup Flow

2-1 System Configurations

2-1-1 Minimum Configuration to Set Up the VHV5-F with WebLink UI



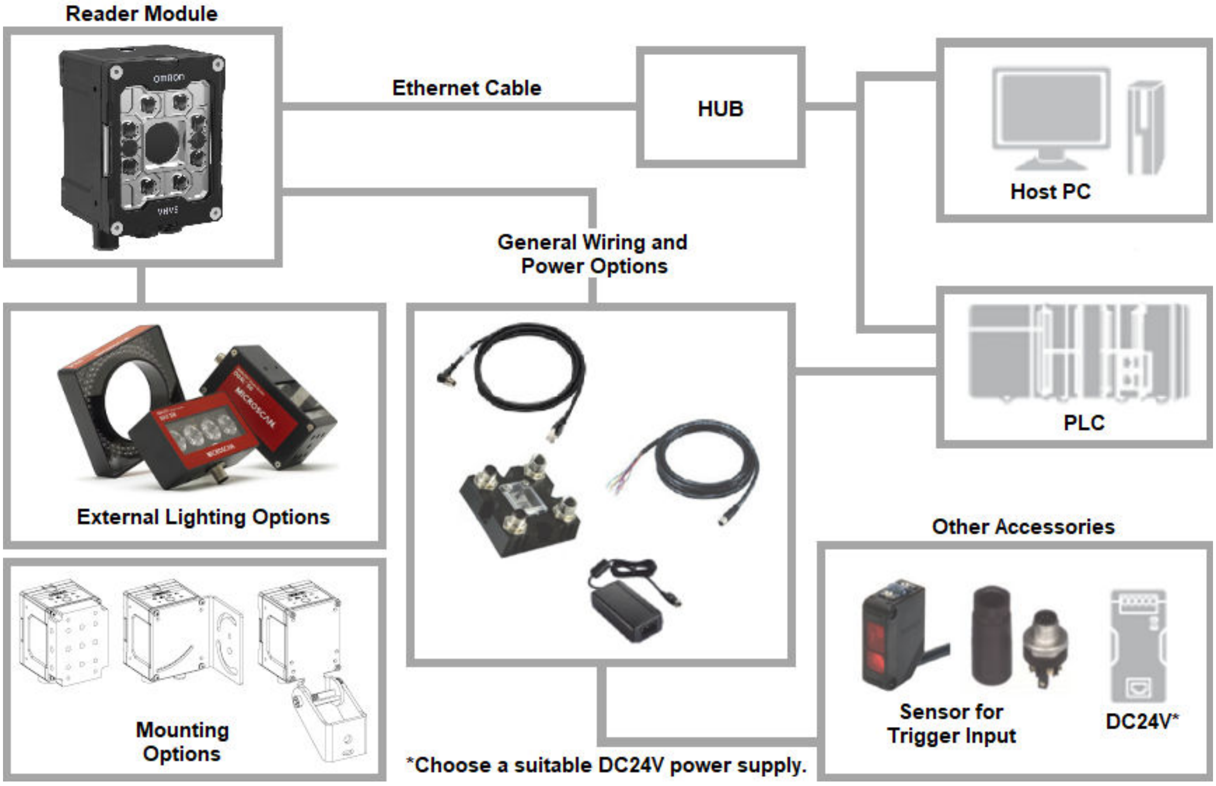
Drawing Reference	Category	Part Number
1	VHV5-F Reader or In-Line Verifier	VHV5-F□□□□□□□□-SRX or -SRV
2	Industrial GigE X-Code Ethernet Cable, M12 to RJ45 Connector	61-900013□-0□ (Black) or FHV-VNB2, FHV-VNLB2 (Black)
3	Single Port PoE Injector, 30W, IEEE802.3at Compliant*1	98-9000311-01
4	Standard or Industrial Ethernet CAT5E or CAT6 Network Cable	Example: XS6W-5PUR8SS□□□□CM-G

*1. Power cord NOT included with 98-9000311-01. There are many types of outlet plugs for the PoE Injector (C13 connector required). Select a suitable plug type for your environment.

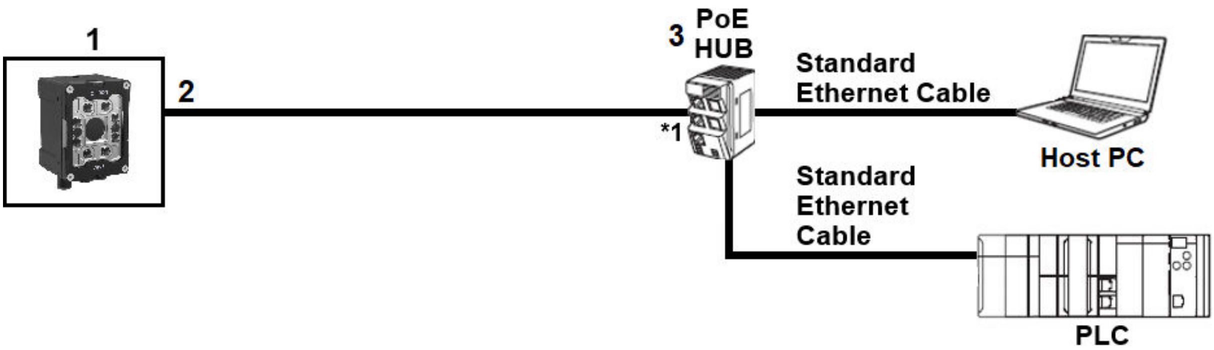
C13 Connector

Description	Part Number
AC Power Cable, 1.8 M, Japan, C13 Conn.	12-9001046-01
AC Power Cable, 1.8 M, U.S., C13 Conn.	12-9000959-01
AC Power Cable, 1.8 M, EU, C13 Conn.	12-9000960-01
AC Power Cable, 1.8 M, UK, C13 Conn.	12-9000961-01
AC Power Cable, 1.8 M, China, C13 Conn.	12-9000962-01

2-1-2 Runtime Configuration Options

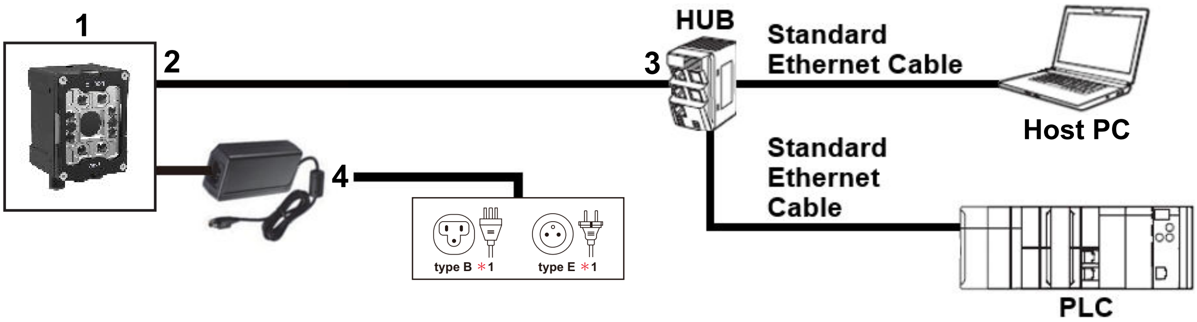


2-1-3 Minimum Power over Ethernet (PoE) Configuration



Drawing Reference	Category	Part Number
1	VHV5-F Reader or In-Line Verifier	VHV5-F□□□□□□□□□-SRX or -SRV
2	Industrial GigE X-Code Ethernet Cable, M12 to RJ45 Connector	61-900013□-0□ (Black) or FHV-VNB2, FHV-VNLB2 (Black)
3	PoE (Power over Ethernet) HUB that supports Power over Ethernet (IEEE 802.3at-compliant)	Example: Cisco, Netgear, etc.

2-1-4 Minimum Direct Power Configuration



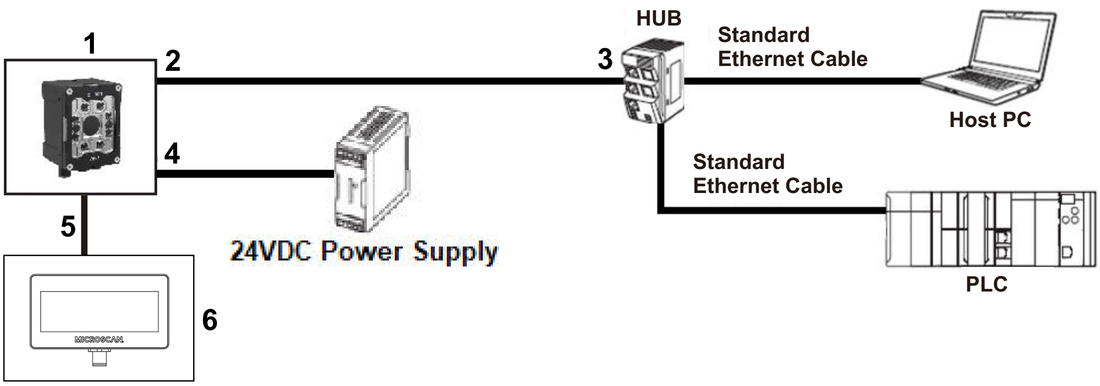
Drawing Reference	Category	Part Number
1	VHV5-F Reader or In-Line Verifier	VHV5-F□□□□□□□□-SRX or -SRV
2	Industrial GigE X-Code Ethernet Cable, M12 to RJ45 Connector	61-900013□-0□ (Black) or FHV-VNB2, FHV-VNLB2 (Black)
3	Industrial Switching HUB	Example: W4S1-□□□ Series
4	Power Supply, 100-240VAC, +24VDC @ 2.1A, M12 12-Pin Socket*1	97-000012-01

*1. There are many types of outlet plugs for the power supply (C13 connector required). Select a suitable plug type for your environment.

C13 Connector

Description	Part Number
AC Power Cable, 1.8 M, Japan, C13 Conn.	12-9001046-01
AC Power Cable, 1.8 M, U.S., C13 Conn.	12-9000959-01
AC Power Cable, 1.8 M, EU, C13 Conn.	12-9000960-01
AC Power Cable, 1.8 M, UK, C13 Conn.	12-9000961-01
AC Power Cable, 1.8 M, China, C13 Conn.	12-9000962-01

2-1-5 Direct Power Configuration with External Light

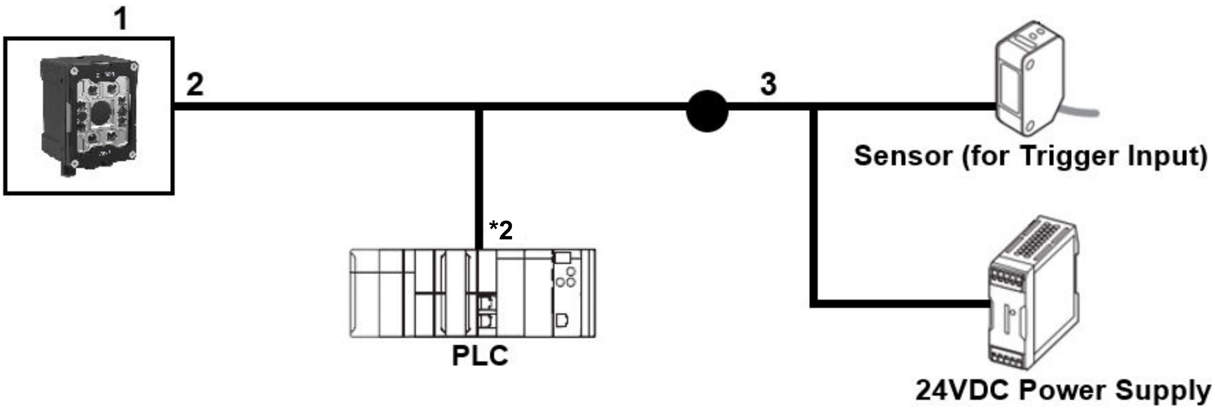


Drawing Reference	Category	Part Number
1	VHV5-F Reader or In-Line Verifier	VHV5-F□□□□□□□□-SRX or -SRV
2	Industrial GigE X-Code Ethernet Cable, M12 to RJ45 Connector	61-900013□-0□ (Black) or FHV-VNB2, FHV-VNLB2 (Black)
3	Industrial Switching HUB	Example: W4S1-□□□ Series
4	M12-to-Flying Leads Cable	V430-W8□□□-□M
5	VHV5-F to External Light – 5 Pin M12 Plug to 5 Pin M12 Socket	61-000184-01
6	NERLITE Smart Series Light (Example: Smart Series MAX, 100 mm, Red, M12 Connector)	Example: NER-011660201G

Precautions for Correct Use

Must use direct 24V power when using external light option to ensure adequate power to run the light and reader.

2-1-6 RS-232C Configuration

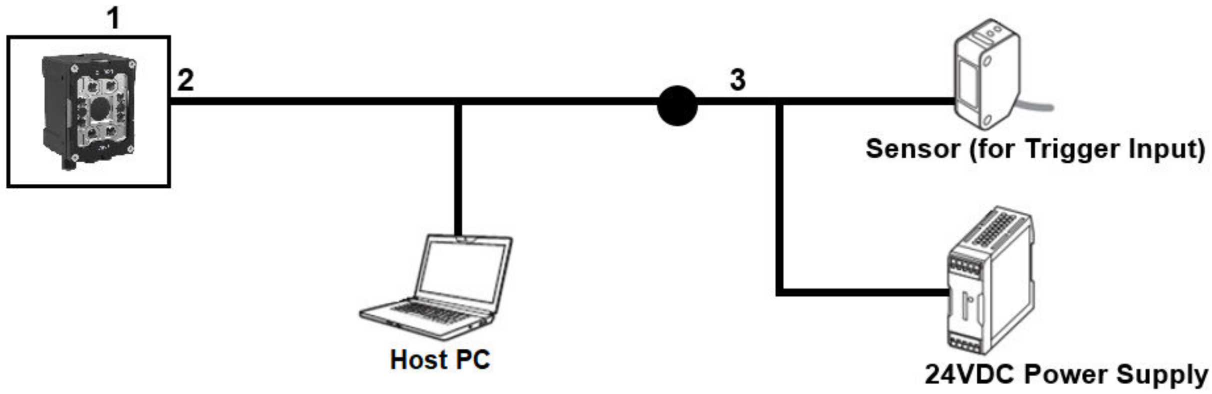


Drawing Reference	Category	Part Number
1	VHV5-F Reader or In-Line Verifier	VHV5-F□□□□□□□□-SRX or -SRV
2	Reader-to-QX-1 Interconnect Cable with RS-232 Breakout	V430-WQR-□M*1
3	M12-to-Flying Leads Cable	V430-W8□□□-□M
4	RS-232C Conversion Cable Required for Legacy Omron PLCs	V430-WPLC-2M*2

*1. Insert the V430-WQR-3M cable between the VHV5-F and the V430-W8□□□-□M cable.

*2. When connecting Omron’s CS/CJ/NJ Legacy Controller, the additional RS-232C conversion cable is required. If connecting to Omron’s current-generation NX Machine Automation Controller, no additional RS-232C cable is required.

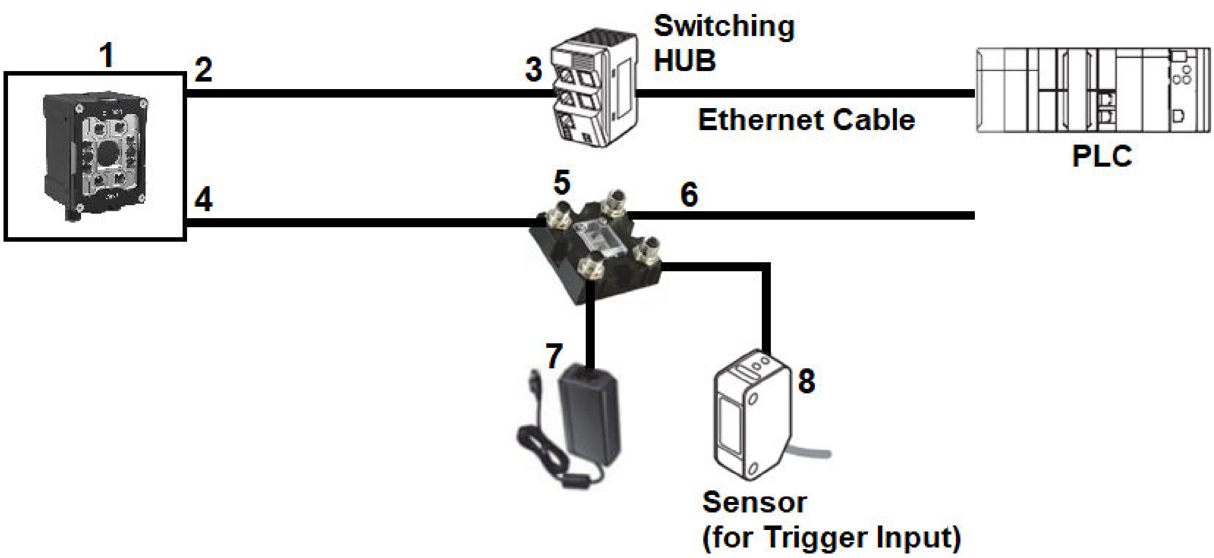
2-1-7 USB Keyboard Wedge Configuration



Drawing Reference	Category	Part Number
1	VHV5-F Reader or In-Line Verifier	VHV5-F□□□□□□□□-SRX or -SRV
2	Reader-to-QX-1 Interconnect Cable with USB Keyboard Wedge Breakout	V430-WQK-3M*1
3	M12-to-Flying Leads Cable	V430-W8□□□-□M

*1. Insert the V430-WQK-3M cable between the VHV5-F and the V430-W8□□□-□M cable.

2-1-8 Typical Configuration using Legacy QX-1 Cables and Accessories



Drawing Reference	Category	Part Number
1	VHV5-F Reader or In-Line Verifier	VHV5-F□□□□□□□□-SRX or -SRV
2	Industrial GigE X-Code Ethernet Cable, M12-to-RJ45 Connector	61-900013□-0□ (Black) or FHV-VNB2, FHV-VNLB2 (Black)

Drawing Reference	Category	Part Number
3	Industrial Switching HUB	Example: W4S1-□□□ Series
4	Reader-to-QX-1 Interconnect Cable (Various)	V430-WQ□-□M
5	VHV5-F-to-External Light – 5-Pin M12 Plug to 5-Pin M12 Socket	61-000184-01
6	M12-to-Flying Leads Cable	V430-W8□□□-□M
7	Power Supply, 100-240VAC, +24VDC @ 2.1A, M12 12-Pin Socket	97-000012-01
8	QX-1 Photo Sensor, or QX-1 Field-Wireable Trigger Connector Input	99-9000016-01
		98-9000239-01

2-2 Hardware Selection and Installation Flow

This flow is designed to guide the user through 1) Selecting the correct VHV5-F reader model to meet the field of view and resolution application requirements; 2) Mounting, wiring, and powering the reader; 3) Setting up a network connection between the reader and a PC; and 4) Starting the WebLink user interface to program the reader.

Section 5 Quick Start Guide for Programming the Reader on page 5-1 provides a similar quick start flow for programming the reader for the first time.

#	Hardware Selection and Installation Flow	Reference
1	Determine the Correct Model for the Application	page 2-8
2	Mount the Reader	page 2-14
3	Wire and Power the Reader	page 2-17
4	Set Up Network Connection between Host PC and Reader	page 2-27
5	Starting WebLink User Interface using the DDU or Browser	page 2-33

2-2-1 Determine the Correct Model for the Application

There are eight basic models of the autofocus VHV5-F. The models are derived from two sensor resolutions: **2.3 MP** and **5.0 MP**; and four different autofocus lenses: **Wide**, **Medium**, **Narrow**, and **Long**. The charts below show the key specifications for the two sensors and four lenses.

Sensor	Pixels	Pixel Size	Frame Rate
2.3 MP	1920 x 1200	3.0 μm	80 FPS
5.0 MP	2472 x 2048	2.74 μm	40 FPS

Lens Name	Lens Focal Length (mm)	Focus Range (mm)
Wide	6.42	55-500
Medium	8.50	55-500
Narrow	12.50	100-1,000
Long	20.00	100-2,000

These models, derived from the two sensor types and four lens types, provide maximum flexibility to match the reader to the application.

Step 1 – The first step in determining the correct model is to evaluate the application by collecting key pieces of information. This process is described in the section below titled *Evaluate the Application* on page 2-9.

Step 2 – The second step is to use that data to look up the best sensor / lens combination in the *Distance, Field of View, and Readability Tables** on page 2-10 section below that best satisfies the application requirements.

Evaluate the Application

To choose the correct reader, perform an application evaluation and gather the following information:

- **Desired Mounting Distance –** Measured from the front of the reader to the code. Distance is usually dictated by mounting constraints.
- **Required Field of View –** View area required to see all codes. This should include the nominal code position, size, and expected variation in position while running.
- **Code Type –** Either 1D or 2D. Composite codes count as 2D.
- **Code Quality –** Two levels: (1.) High-quality, high-contrast codes. (2.) Lower-quality, lower-contrast codes marked with laser, dot peen, etc., generally referred to as direct part marks (DPM).
- **Code Size (Mils) –** For 1D codes, code size is the width of the narrowest bar in the code. For 2D codes, code size is the width / height of an individual cell or block (square element) in the code. Code size is typically specified in Mils, where 1 Mil = 1/1,000th of an inch. (0.0254 mm).
- **Code Color –** Code color can sometimes be a consideration. The most common light color for code readers is red. However, in the case of red print, Red light will cause the red print to disappear. The user should take this into consideration and order the unit with white LEDs instead.

- **Key Point:** Code Size is not the overall size of the code, but is the size of the smallest element in the code. The example below shows that for 1D codes, the Code size specified as the width of the thinnest bar or space. For 2D codes, Code Size is the width / height of one of the black or white squares.

1D Barcode *2D Code*

Choose the Model

The readability tables below show the sensor/lens combinations for VHV5-F models. For each reader-to-part distance, the tables show the resulting field of view, as well as the smallest code size that can be decoded reliably at that Distance in that Field of View.

Use the distance and field of view requirements determined in your application evaluation to choose the model that will provide the highest resolution for reading your Code Type (1D or 2D) and Code Quality (High-Contrast Label quality, Lower Contrast, DPM quality).

Note: Codes with sizes that are larger than the stated minimum can be assumed to be readable.

The following chart shows how the minimum code sizes in the readability tables have been determined. High-contrast (label-quality) marks need fewer pixels per element (lower PPE) to be decoded reliably. Low-print-quality and DPM (direct part mark) codes often require a higher PPE to get the same high read rates. Code grading, which involves actual measurements of the cells themselves, requires an even higher PPE (see Section 8 for more complete details).

Code Type	Minimum PPE	Preferred PPE	PPE for Code Grading
1D Code – Label Quality	1.6	2	6 to 8
1D Code – Direct Part Mark	2	2.5	6 to 8
2D Code – Label Quality	2.75	3.5 to 5	8 to 10
2D Code – Direct Part Mark	3.5	4 to 5	8 to 10

Distance, Field of View, and Readability Tables*

Use the following tables to identify the Sensor/Lens combination that most closely matches the reading application requirements. The tables below use the Minimum PPE values for reading from the table above.

Example: If the Code Type is a 2D DPM, and the Code Size is 15 mils, the Medium Lens table below shows that a code as small as 13.9 Mils can be read out to 250 mm, in a field of view of 181 x 113 mm.

***Use the tables in "Distance and Field of View to Determine Camera Model for Verification" in Section 8 for Verification applications where higher PPE is required.**

● 2.3 MP Sensor Readability Tables

Wide Lens – 2.3 MP		Minimum Readable Code Size				
Distance [mm]	Field of View [mm x mm]	1D Label [Mils (mm)]	1D DPM [Mils (mm)]	2D Label [Mils (mm)]	2D DPM [Mils (mm)]	1D/2D for Max FOV [Mils (mm)]*
55	64 x 40	2.1 (0.053)	2.6 (0.066)	3.6 (0.091)	4.6 (0.116)	4.6 (0.117)
75	82 x 51	2.7 (0.068)	3.3 (0.085)	4.6 (0.117)	5.9 (0.149)	4.9 (0.124)
100	104 x 65	3.4 (0.087)	4.3 (0.108)	5.9 (0.149)	7.5 (0.190)	5.2 (0.132)
150	149 x 93	4.9 (0.124)	6.1 (0.155)	8.4 (0.213)	10.7 (0.271)	5.9 (0.150)
200	194 x 121	6.4 (0.161)	7.9 (0.202)	10.9 (0.278)	13.9 (0.353)	6.8 (0.173)
250	239 x 149	7.8 (0.199)	9.8 (0.249)	13.5 (0.342)	17.1 (0.435)	7.8 (0.198)
300	284 x 177	9.3 (0.236)	11.6 (0.295)	16.0 (0.406)	20.3 (0.517)	8.9 (0.226)
350	328 x 205	10.8 (0.274)	13.5 (0.342)	18.5 (0.470)	23.6 (0.599)	10.1 (0.257)
400	373 x 233	12.2 (0.311)	15.3 (0.389)	21.0 (0.535)	26.8 (0.680)	11.3 (0.287)
450	418 x 261	13.7 (0.348)	17.1 (0.436)	23.6 (0.599)	30.0 (0.762)	12.5 (0.318)
500	463 x 289	15.2 (0.386)	19.0 (0.482)	26.1 (0.663)	33.2 (0.844)	13.7 (0.348)

*Recommended minimum code size for optimal performance at the edges of the field of view (FOV).

Medium Lens – 2.3 MP		Minimum Readable Code Size			
Distance [mm]	Field of View [mm x mm]	1D Label [Mils (mm)]	1D DPM [Mils (mm)]	2D Label [Mils (mm)]	2D DPM [Mils (mm)]
55	48 x 30	1.6 (0.040)	2.0 (0.051)	2.7 (0.069)	3.5 (0.088)
75	62 x 39	2.0 (0.052)	2.5 (0.065)	3.5 (0.089)	4.5 (0.113)
100	79 x 49	2.6 (0.066)	3.2 (0.082)	4.5 (0.113)	5.7 (0.144)
200	147 x 92	4.8 (0.122)	6.0 (0.153)	8.3 (0.210)	10.5 (0.268)
250	181 x 113	5.9 (0.151)	7.4 (0.188)	10.2 (0.259)	13.0 (0.329)
300	215 x 134	7.0 (0.179)	8.8 (0.223)	12.1 (0.307)	15.4 (0.391)
350	248 x 155	8.1 (0.207)	10.2 (0.259)	14.0 (0.356)	17.8 (0.453)
400	282 x 176	9.3 (0.235)	11.6 (0.294)	15.9 (0.404)	20.3 (0.515)
450	316 x 198	10.4 (0.263)	13.0 (0.329)	17.8 (0.453)	22.7 (0.576)
500	350 x 219	11.5 (0.292)	14.4 (0.365)	19.7 (0.501)	25.1 (0.638)

Narrow Lens – 2.3 MP		Minimum Readable Code Size			
Distance [mm]	Field of View [mm x mm]	1D Label [Mils (mm)]	1D DPM [Mils (mm)]	2D Label [Mils (mm)]	2D DPM [Mils (mm)]
100	50 x 31	1.6 (0.042)	2.1 (0.052)	2.8 (0.072)	3.6 (0.092)
150	73 x 46	2.4 (0.061)	3.0 (0.076)	4.1 (0.105)	5.3 (0.134)
200	96 x 60	3.2 (0.080)	3.9 (0.100)	5.4 (0.138)	6.9 (0.176)
250	119 x 75	3.9 (0.099)	4.9 (0.124)	6.7 (0.171)	8.6 (0.218)
300	142 x 89	4.7 (0.119)	5.8 (0.148)	8.0 (0.204)	10.2 (0.260)
350	165 x 103	5.4 (0.138)	6.8 (0.172)	9.3 (0.237)	11.9 (0.302)
400	188 x 118	6.2 (0.157)	7.7 (0.196)	10.6 (0.270)	13.5 (0.344)
450	212 x 132	6.9 (0.176)	8.7 (0.220)	11.9 (0.303)	15.2 (0.386)
500	235 x 147	7.7 (0.195)	9.6 (0.244)	13.2 (0.336)	16.8 (0.428)
600	281 x 175	9.2 (0.234)	11.5 (0.292)	15.8 (0.402)	20.1 (0.512)
700	327 x 204	10.7 (0.272)	13.4 (0.340)	18.4 (0.468)	23.4 (0.596)
800	373 x 233	12.2 (0.311)	15.3 (0.388)	21.0 (0.534)	26.8 (0.680)
900	419 x 262	13.7 (0.349)	17.2 (0.436)	23.6 (0.600)	30.1 (0.764)
1000	465 x 291	15.3 (0.387)	19.1 (0.484)	26.2 (0.666)	33.4 (0.848)

Long Lens – 2.3 MP		Minimum Readable Code Size			
Distance [mm]	Field of View [mm x mm]	1D Label [Mils (mm)]	1D DPM [Mils (mm)]	2D Label [Mils (mm)]	2D DPM [Mils (mm)]
100	31 x 20	1.2 (0.029)	1.3 (0.033)	1.8 (0.045)	2.3 (0.057)
150	46 x 29	1.7 (0.043)	1.9 (0.048)	2.6 (0.066)	3.3 (0.083)
200	60 x 38	2.2 (0.056)	2.5 (0.063)	3.4 (0.086)	4.3 (0.110)
250	75 x 47	2.8 (0.070)	3.1 (0.078)	4.2 (0.107)	5.4 (0.136)
300	89 x 56	3.3 (0.083)	3.6 (0.093)	5.0 (0.127)	6.4 (0.162)
350	103 x 65	3.8 (0.097)	4.2 (0.108)	5.8 (0.148)	7.4 (0.188)
400	118 x 74	4.3 (0.110)	4.8 (0.123)	6.6 (0.169)	8.5 (0.215)
450	132 x 83	4.9 (0.124)	5.4 (0.138)	7.5 (0.189)	9.5 (0.241)
500	147 x 92	5.4 (0.137)	6.0 (0.153)	8.3 (0.210)	10.5 (0.267)
600	175 x 110	6.5 (0.164)	7.2 (0.183)	9.9 (0.251)	12.6 (0.320)
700	204 x 128	7.5 (0.191)	8.4 (0.213)	11.5 (0.292)	14.7 (0.372)
800	233 x 146	8.6 (0.218)	9.6 (0.243)	13.1 (0.334)	16.7 (0.425)
900	262 x 164	9.7 (0.245)	10.7 (0.273)	14.8 (0.375)	18.8 (0.477)
1000	291 x 182	10.7 (0.272)	11.9 (0.303)	16.4 (0.416)	20.9 (0.530)
1100	319 x 200	11.8 (0.299)	13.1 (0.333)	18.0 (0.457)	22.9 (0.582)
1200	348 x 218	12.9 (0.326)	14.3 (0.363)	19.6 (0.499)	25.0 (0.635)
1300	377 x 236	13.9 (0.353)	15.5 (0.393)	21.3 (0.540)	27.1 (0.687)
1400	406 x 254	15.0 (0.380)	16.6 (0.423)	22.9 (0.581)	29.1 (0.740)
1500	435 x 272	16.0 (0.407)	17.8 (0.453)	24.5 (0.622)	31.2 (0.792)
1600	463 x 290	17.1 (0.434)	19.0 (0.483)	26.1 (0.664)	33.3 (0.845)
1700	492 x 308	18.2 (0.461)	20.2 (0.513)	27.8 (0.705)	35.3 (0.897)
1800	521 x 326	19.2 (0.488)	21.4 (0.543)	29.4 (0.746)	37.4 (0.950)
1900	550 x 344	20.3 (0.515)	22.5 (0.573)	31.0 (0.787)	39.5 (1.002)
2000	579 x 362	21.4 (0.542)	23.7 (0.603)	32.6 (0.829)	41.5 (1.055)

● 5.0 MP Sensor Readability Tables

Wide Lens – 5 MP		Minimum Readable Code Size				
Distance [mm]	Field of View [mm x mm]	1D Label [Mils (mm)]	1D DPM [Mils (mm)]	2D Label [Mils (mm)]	2D DPM [Mils (mm)]	1D/2D for Max FOV [Mils (mm)]*
55	74 x 62	1.9 (0.048)	2.4 (0.061)	3.3 (0.083)	4.2 (0.106)	6.9 (0.175)
75	95 x 80	2.4 (0.062)	3.1 (0.078)	4.2 (0.107)	5.4 (0.136)	7.3 (0.185)
100	121 x 101	3.1 (0.079)	3.9 (0.099)	5.4 (0.136)	6.8 (0.173)	7.5 (0.191)
150	173 x 145	4.5 (0.113)	5.6 (0.142)	7.7 (0.195)	9.8 (0.248)	7.8 (0.198)
200	226 x 189	5.8 (0.147)	7.3 (0.184)	10.0 (0.254)	12.7 (0.323)	8.4 (0.213)
250	278 x 233	7.2 (0.182)	8.9 (0.227)	12.3 (0.312)	15.6 (0.397)	9.1 (0.231)
300	330 x 276	8.5 (0.216)	10.6 (0.270)	14.6 (0.371)	18.6 (0.472)	10.1 (0.257)
350	382 x 320	9.8 (0.250)	12.3 (0.312)	16.9 (0.430)	21.5 (0.547)	11.2 (0.284)
400	435 x 364	11.2 (0.284)	14.0 (0.355)	19.2 (0.488)	24.5 (0.621)	12.5 (0.318)
450	487 x 407	12.5 (0.318)	15.7 (0.398)	21.5 (0.547)	27.4 (0.696)	13.8 (0.351)
500	539 x 451	13.9 (0.352)	17.3 (0.440)	23.8 (0.606)	30.3 (0.771)	15.1 (0.384)

*Recommended minimum code size for optimal performance at the edges of the field of view (FOV).

Medium Lens – 5 MP		Minimum Readable Code Size			
Distance [mm]	Field of View [mm x mm]	1D Label [Mils (mm)]	1D DPM [Mils (mm)]	2D Label [Mils (mm)]	2D DPM [Mils (mm)]
55	56 x 47	1.5 (0.037)	1.8 (0.046)	2.5 (0.063)	3.2 (0.081)
75	72 x 60	1.9 (0.047)	2.3 (0.059)	3.2 (0.081)	4.1 (0.103)
100	92 x 77	2.4 (0.060)	3.0 (0.075)	4.1 (0.103)	5.2 (0.132)
150	131 x 110	3.4 (0.086)	4.2 (0.107)	5.8 (0.148)	7.4 (0.188)
200	171 x 143	4.4 (0.112)	5.5 (0.140)	7.6 (0.192)	9.6 (0.244)
250	210 x 176	5.4 (0.137)	6.8 (0.172)	9.3 (0.236)	11.8 (0.301)
300	250 x 209	6.4 (0.163)	8.0 (0.204)	11.0 (0.281)	14.1 (0.357)
350	289 x 242	7.4 (0.189)	9.3 (0.236)	12.8 (0.325)	16.3 (0.414)
400	329 x 275	8.5 (0.215)	10.6 (0.269)	14.5 (0.369)	18.5 (0.470)
450	368 x 308	9.5 (0.241)	11.8 (0.301)	16.3 (0.414)	20.7 (0.526)
500	408 x 341	10.5 (0.266)	13.1 (0.333)	18.0 (0.458)	22.9 (0.583)

Narrow Lens – 5 MP		Minimum Readable Code Size			
Distance [mm]	Field of View [mm x mm]	1D Label [Mils (mm)]	1D DPM [Mils (mm)]	2D Label [Mils (mm)]	2D DPM [Mils (mm)]
100	58 x 49	1.5 (0.038)	1.9 (0.048)	2.6 (0.066)	3.3 (0.084)
150	85 x 71	2.2 (0.056)	2.7 (0.070)	3.8 (0.096)	4.8 (0.122)
200	112 x 94	2.9 (0.073)	3.6 (0.092)	5.0 (0.126)	6.3 (0.160)
250	139 x 116	3.6 (0.091)	4.5 (0.114)	6.1 (0.156)	7.8 (0.199)
300	166 x 139	4.3 (0.108)	5.3 (0.135)	7.3 (0.186)	9.3 (0.237)
350	193 x 161	5.0 (0.126)	6.2 (0.157)	8.5 (0.216)	10.8 (0.275)
400	219 x 184	5.6 (0.143)	7.1 (0.179)	9.7 (0.247)	12.4 (0.314)
450	246 x 206	6.3 (0.161)	7.9 (0.201)	10.9 (0.277)	13.9 (0.352)
500	273 x 229	7.0 (0.179)	8.8 (0.223)	12.1 (0.307)	15.4 (0.391)
600	327 x 273	8.4 (0.214)	10.5 (0.267)	14.5 (0.367)	18.4 (0.467)
700	380 x 318	9.8 (0.249)	12.2 (0.311)	16.8 (0.427)	21.4 (0.544)
800	434 x 363	11.2 (0.284)	14.0 (0.355)	19.2 (0.488)	24.4 (0.621)
900	488 x 408	12.6 (0.319)	15.7 (0.399)	21.6 (0.548)	27.5 (0.697)
1000	541 x 453	13.9 (0.354)	17.4 (0.442)	23.9 (0.608)	30.5 (0.774)

Long Lens – 5 MP		Minimum Readable Code Size			
Distance [mm]	Field of View [mm x mm]	1D Label [Mils (mm)]	1D DPM [Mils (mm)]	2D Label [Mils (mm)]	2D DPM [Mils (mm)]
100	37 x 31	1.0 (0.027)	1.2 (0.030)	1.6 (0.041)	2.1 (0.052)
150	53 x 45	1.5 (0.039)	1.7 (0.044)	2.4 (0.060)	3.0 (0.076)
200	70 x 59	2.0 (0.051)	2.3 (0.057)	3.1 (0.079)	3.9 (0.100)
250	87 x 73	2.5 (0.063)	2.8 (0.071)	3.8 (0.098)	4.9 (0.124)
300	104 x 87	3.0 (0.075)	3.3 (0.085)	4.6 (0.116)	5.8 (0.148)
350	120 x 101	3.5 (0.088)	3.9 (0.098)	5.3 (0.135)	6.8 (0.172)
400	137 x 115	3.9 (0.100)	4.4 (0.112)	6.1 (0.154)	7.7 (0.196)
450	154 x 129	4.4 (0.112)	5.0 (0.126)	6.8 (0.173)	8.7 (0.220)
500	171 x 143	4.9 (0.124)	5.5 (0.139)	7.5 (0.192)	9.6 (0.244)
600	204 x 171	5.9 (0.149)	6.6 (0.167)	9.0 (0.229)	11.5 (0.292)
700	238 x 199	6.8 (0.173)	7.6 (0.194)	10.5 (0.267)	13.4 (0.340)
800	271 x 227	7.8 (0.198)	8.7 (0.222)	12.0 (0.305)	15.3 (0.388)
900	305 x 255	8.7 (0.222)	9.8 (0.249)	13.5 (0.342)	17.2 (0.436)
1000	338 x 283	9.7 (0.246)	10.9 (0.276)	15.0 (0.380)	19.0 (0.484)
1100	372 x 311	10.7 (0.271)	12.0 (0.304)	16.4 (0.418)	20.9 (0.532)
1200	405 x 339	11.6 (0.295)	13.0 (0.331)	17.9 (0.455)	22.8 (0.580)
1300	439 x 367	12.6 (0.320)	14.1 (0.359)	19.4 (0.493)	24.7 (0.628)
1400	473 x 395	13.5 (0.344)	15.2 (0.386)	20.9 (0.531)	26.6 (0.676)
1500	506 x 423	14.5 (0.368)	16.3 (0.413)	22.4 (0.568)	28.5 (0.724)
1600	540 x 451	15.5 (0.393)	17.4 (0.441)	23.9 (0.606)	30.4 (0.771)
1700	573 x 479	16.4 (0.417)	18.4 (0.468)	25.3 (0.644)	32.3 (0.819)
1800	607 x 508	17.4 (0.442)	19.5 (0.496)	26.8 (0.682)	34.1 (0.867)
1900	640 x 536	18.4 (0.466)	20.6 (0.523)	28.3 (0.719)	36.0 (0.915)
2000	674 x 564	19.3 (0.491)	21.7 (0.550)	29.8 (0.757)	37.9 (0.963)

2-2-2 Mount the Reader

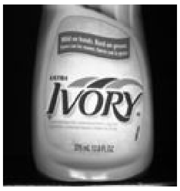
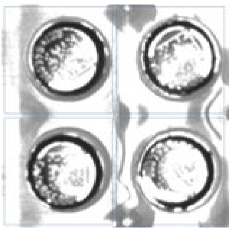
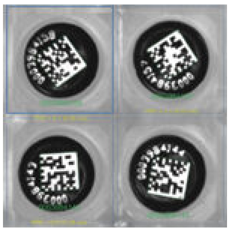
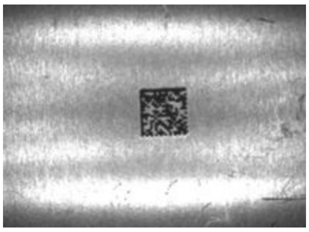
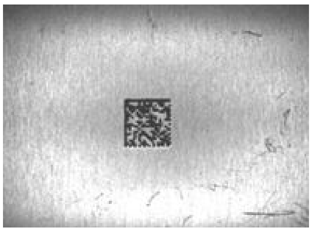
Proper Mounting Considerations and Techniques

The entire front face of the reader is a light. The primary goal for the user is to mount the reader at the optimum angle relative to the part, and/or with the correct front window accessory, that results in the highest-contrast view of the code relative to the background of the part, ensuring that the codes are read quickly and accurately.

The Common Code Reading Lighting Problems and Solutions table below illustrates basic lighting and imaging concepts, the problems that can occur, and the common solutions using either mounting angle or front-end light accessories.

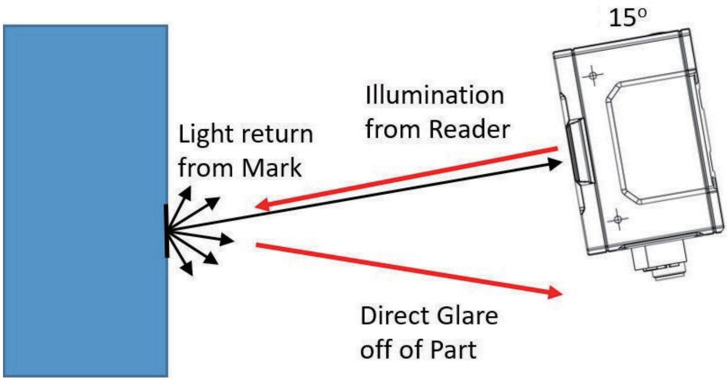
This is followed by four depictions of industry standard mounting scenarios using the built-in light, the built-in light along with the diffuser, polarizer, or half-polarizer accessory, or with only an external light.

Common Code Reading Lighting Problems and Solutions

Problem: Standard Window, Perpendicular Mounting	Solution: Change Mounting Angle and/or Use Front Window Filter Accessory	Description – Problem and Solution
Standard Window Reader at 0° 	**Standard Window** Reader at 15° 	When readers are mounted perpendicular to semi-reflective parts, they are subject to glare directly off the part face. Mounting the reader at an angle to the part is an easy way to eliminate glare, obtaining a good image of the part and the code.
Standard Window Reader at 0° 	**Polarizer or Half-Polarizer Window** Reader at 0° 	When readers are required to be mounted perpendicular to a reflective part, direct glare can make the code unreadable. Adding the cross-polarizing filter accessory, which covers both the reader light and lens, is capable of blocking 99% of the glare reflecting off the part.
Standard Window 	**Diffused Window** 	Readers viewing reflective parts, especially ones with underlying texture, often see highlights from the individual LEDs on the reader, making the code and background non-uniform. Adding a diffuser blends all the individual LEDs into one large light, eliminating the highlights, and making the code and background more uniform.

Angled Mounting Using Standard Light

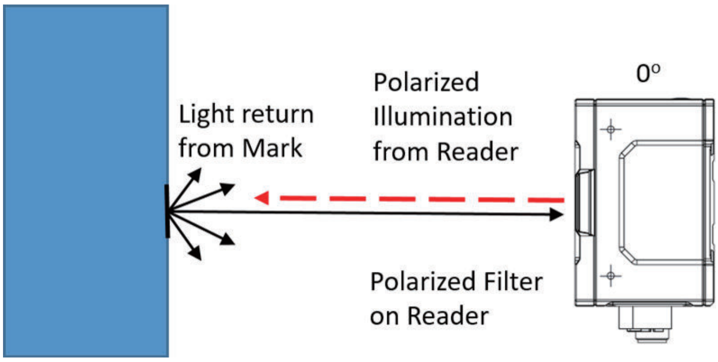
Install the reader at an angle of 15° relative to the surface of the part to avoid direct reflections from the part back into the camera. The light will still provide sufficient illumination to read the code.



Perpendicular Mounting Using Polarized Light Accessory

When it is required or preferable to mount the reader directly perpendicular to the part (0°), install the polarizing filter accessory on the front face of the reader. The polarizer will eliminate all glare and will provide a clear view of the code.

Note: Polarization reduces overall light intensity. It may be necessary to apply extra gain to achieve sufficient contrast when low exposure times are already being employed to reduce motion blur.

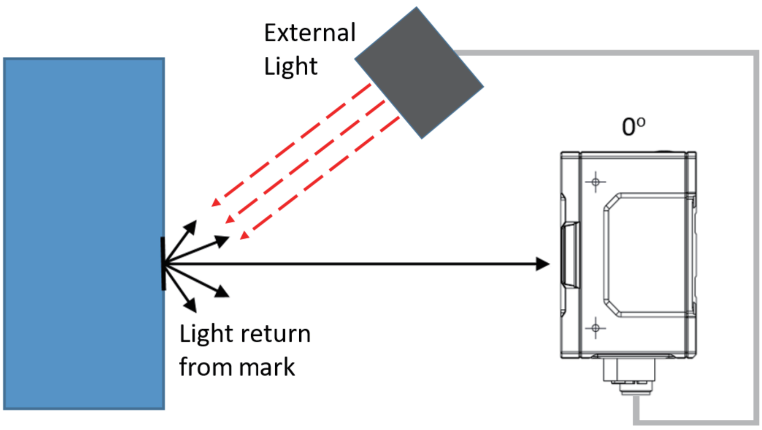


Flexible Mounting Using Half-Polarizer Accessory

The half-polarizer accessory allows maximum flexibility, giving you the choice to use either standard or polarized lighting. Two of the four light banks are used for standard lighting, and two are used for polarized lighting. You can switch between the two in WebLink's lighting control dialog.

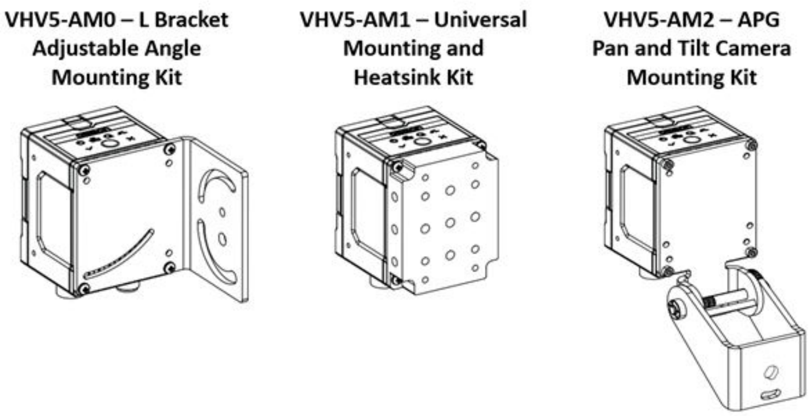
Mounting with External Light

The reader can be used with external lights. External lights can be used to accomplish lighting geometry configurations not achievable by using the reader's built-in illumination alone. 24V continuous or strobe lights can be wired directly to the reader's External Light Port connector.

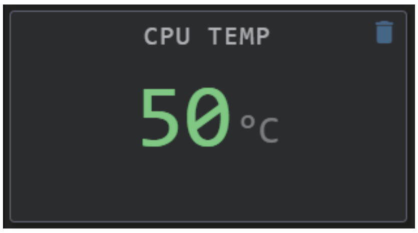


Mounting and Heatsinking Accessories

The Universal Mounting Block and Heatsink, L-Bracket Adjustable Angle Mounting Kit, and APG Pan and Tilt Camera Mount are three versatile mounting accessories that allow you to achieve the angles shown in the previous three sections.



Heatsinking Considerations



The CPU temperature can be checked in the Dashboard view. If the CPU temperatures rises above 55-60C, mount the camera to directly to metal, or using one of the camera mounts shown above. Proper mounting and heatsinking will allow the camera to be used in ambient temperature environments up to 45C , as well as under the most stressful lighting and processing conditions.

It is not necessary to provide additional heatsinking for the reader when it is operating under normal conditions, although it is always the best practice to mount the camera to a sturdy metal base for stability, and to keep it as cool to the touch as possible.

For example, when unmounted, with ambient temperature < 75F (24C), with high power strobe enabled, and when running under a medium to heavy processing load, the CPU temperature will normally be between 45-55C. The CPU temperature is allowed to reach 85C.

2-2-3 Wire and Power the Reader

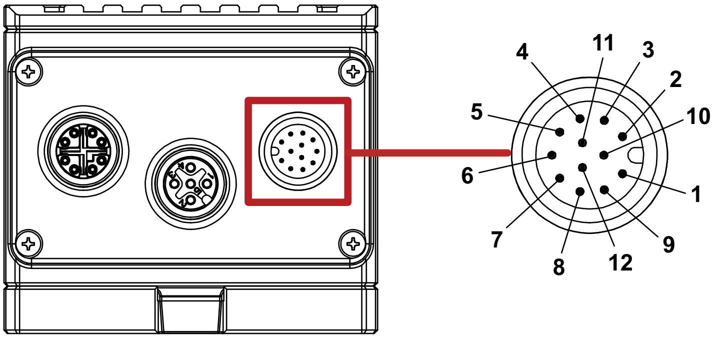
To connect the reader fully, you will need:

- A DIO (Parallel IO) cable, which includes connections for digital inputs, outputs, RS-232, and Power.
- An external light interconnect cable (optional – if external illumination will be used.)
- An X-Code Ethernet communications cable.

Key Point: Not all applications require all connections. The minimum required wiring is the X-Code Ethernet cable alone when using Power over Ethernet (PoE).

DIO (Parallel IO) Port Pins, Signals, and Flying Lead Colors

The Parallel IO Port connector is used for Digital Inputs (Trigger), Digital Outputs, RS-232, and Power. The following sections describe how to wire the Inputs, Outputs, and Power.

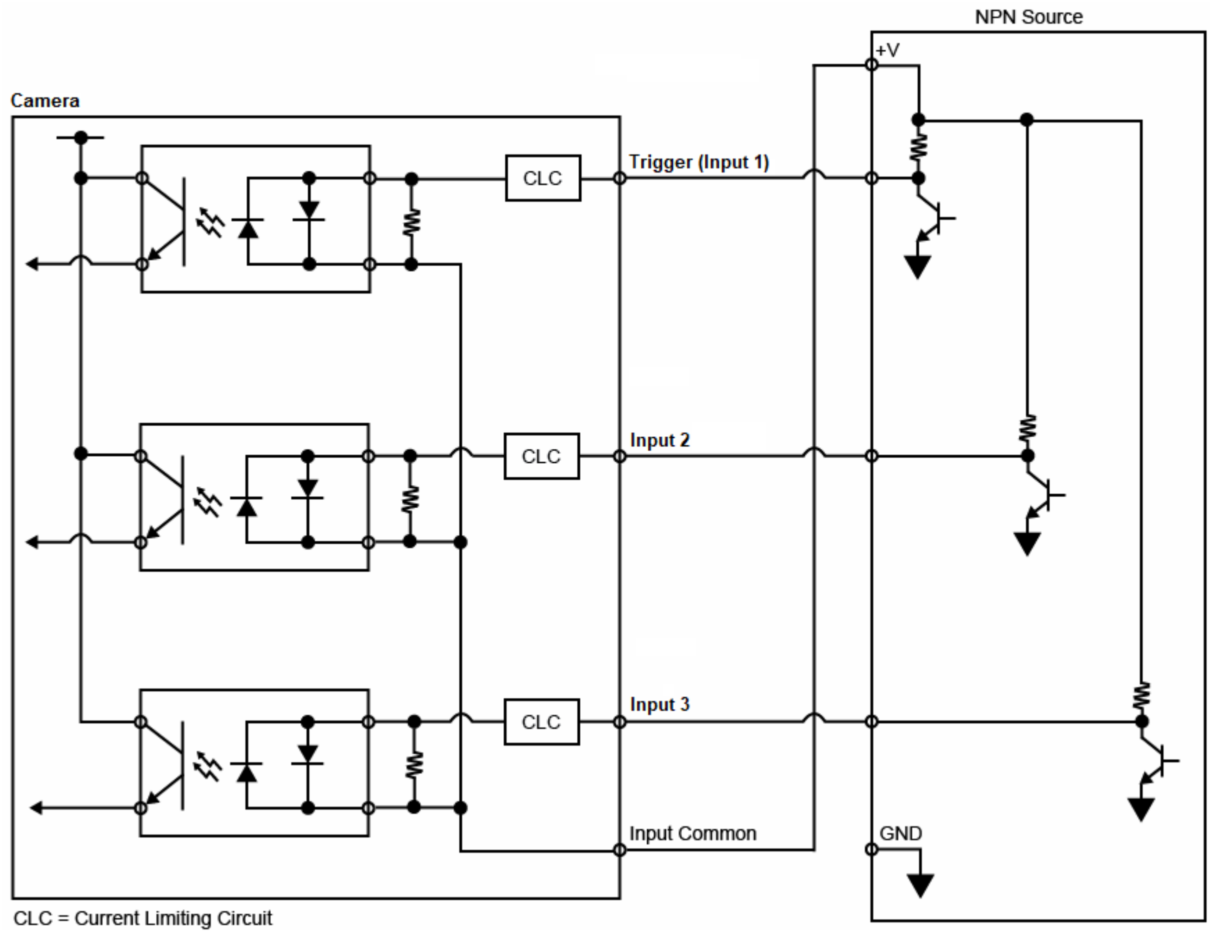


Pin	Name	Function	Flying Lead Color
1	Trigger (Input 1)	Trigger	WHITE
2	Power (+VIN)	24 Volts	BROWN
3	Input 3	General Purpose Input	GREEN
4	Input 2	General Purpose Input	YELLOW
5	Output 1	General Purpose Output	GRAY
6	Output 3	General Purpose Output	PINK
7	Ground (-VIN)	24V Reference (GND)	BLUE
8	Input Common	NPN or PNP Common for Input	RED
9	RS-232 (Host) RxD	Serial Command Input	BLACK
10	RS-232 (Host) TxD	Serial Data Output	VIOLET
11	Output 2	General Purpose Output	GRAY STRIPED
12	Output Common	NPN or PNP Common for Output	RED STRIPED

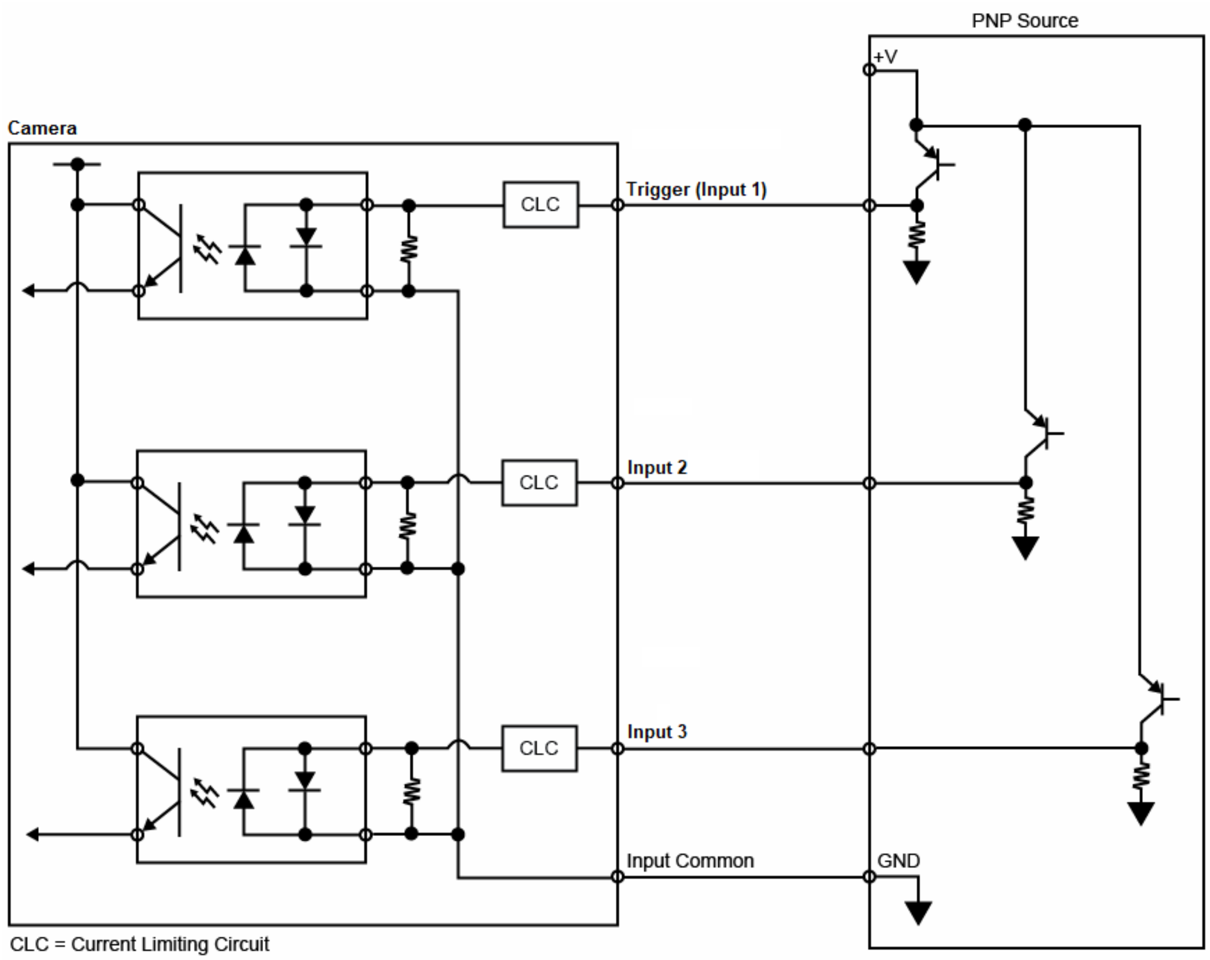
Digital Input Wiring

There are three digital inputs: Trigger (Input1), Input 2, and Input 3, as well as Input Common. The Trigger input is a high-speed, very-low-latency input for the fastest response from trigger to image acquisition. All inputs are wired the same. See the figures below for NPN and PNP Input wiring.

NPN Input


NPN Source
+V
Camera
CLC
Trigger (Input 1)
CLC
Input 2
CLC
Input 3
Input Common
GND
CLC = Current Limiting Circuit

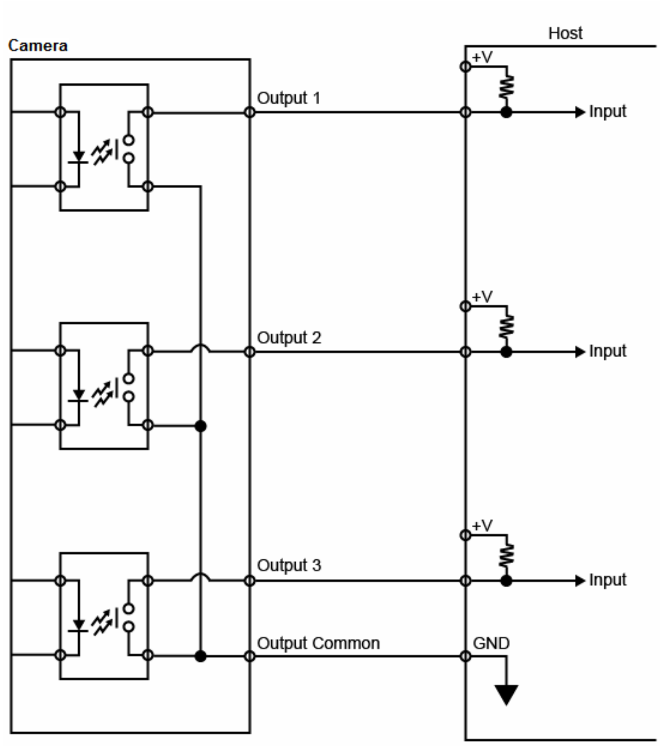
PNP Input



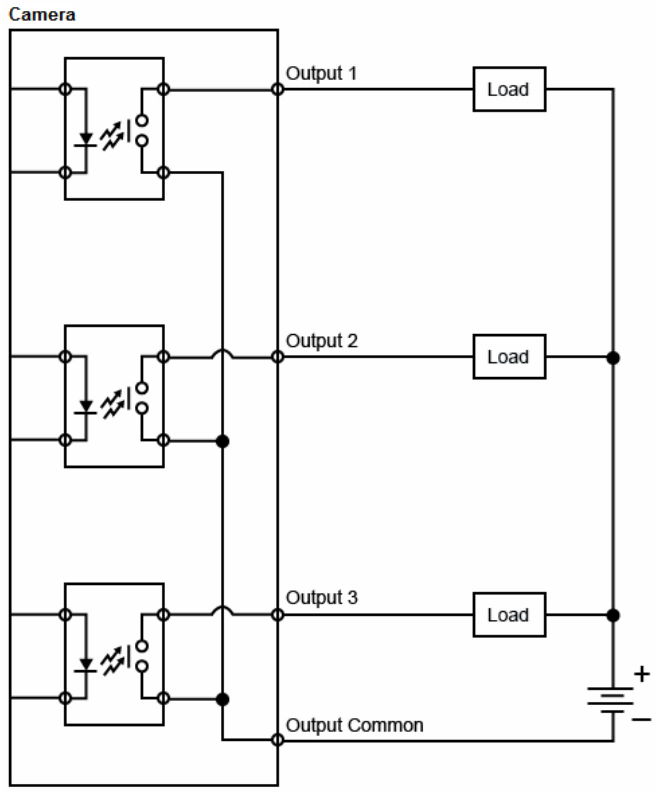
Digital Output Wiring

There are three digital outputs available for general use: Output 1, Output 2, and Output 3, as well as Output Common. See the figures below for NPN and PNP Output wiring.

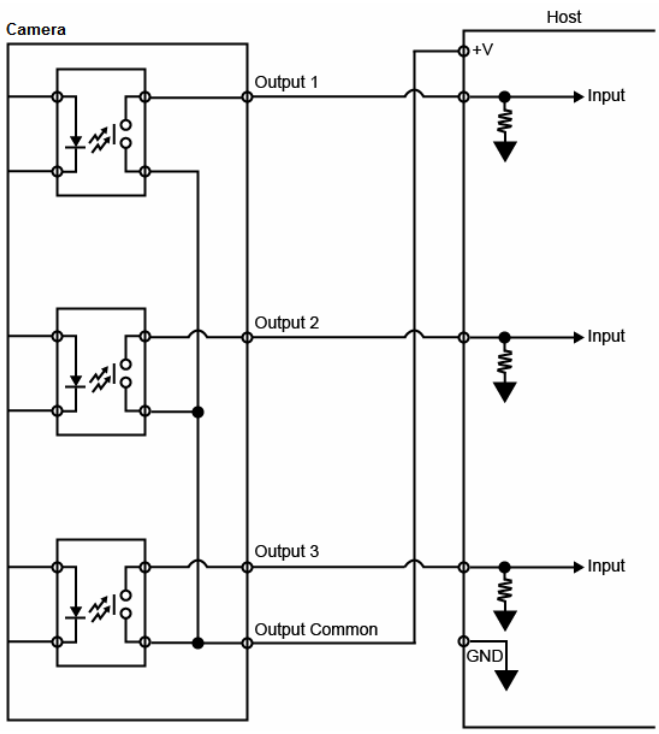
NPN Output for Host Input



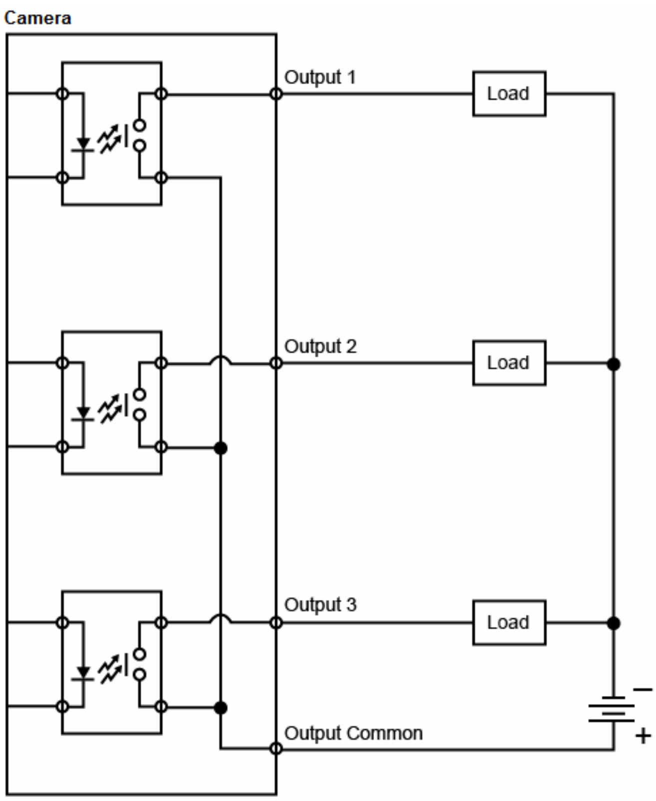
NPN Output for External Load



PNP Output for Host Input



PNP Output for External Load



Connect Power

● Power Options and Requirements

Power Options and Requirements

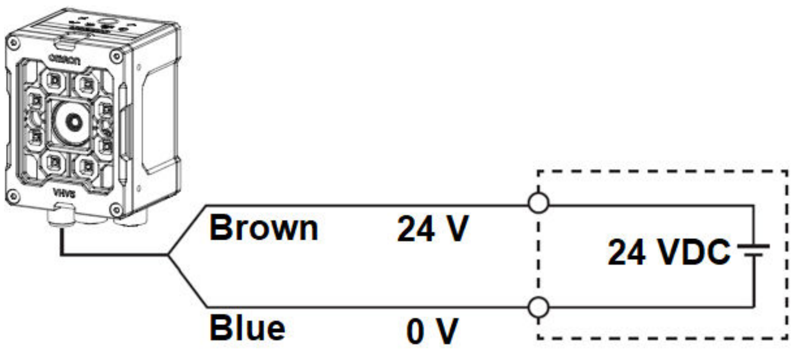
- 24 VDC +/- 10% through the DIO port connector
- Power over Ethernet

Note 1: If direct 24V and PoE are connected at the same time, the reader will automatically use direct 24V.

Note 2: To use the external light port, the unit must be powered from direct 24V.

Power Supply Voltage and Current Consumption	
Power Supply Voltage	Power over Ethernet (IEEE 802.3at) / 24 VDC +/– 10%
Current Consumption	PoE+ 50-57 VDC @ 0.6 A (Max.); Direct: 24 VDC @ 2.1 A (Max.); External Light Port Connector: 24 VDC @ 1.5 A (Max) (Internally Current-Limited)

● Power Wiring

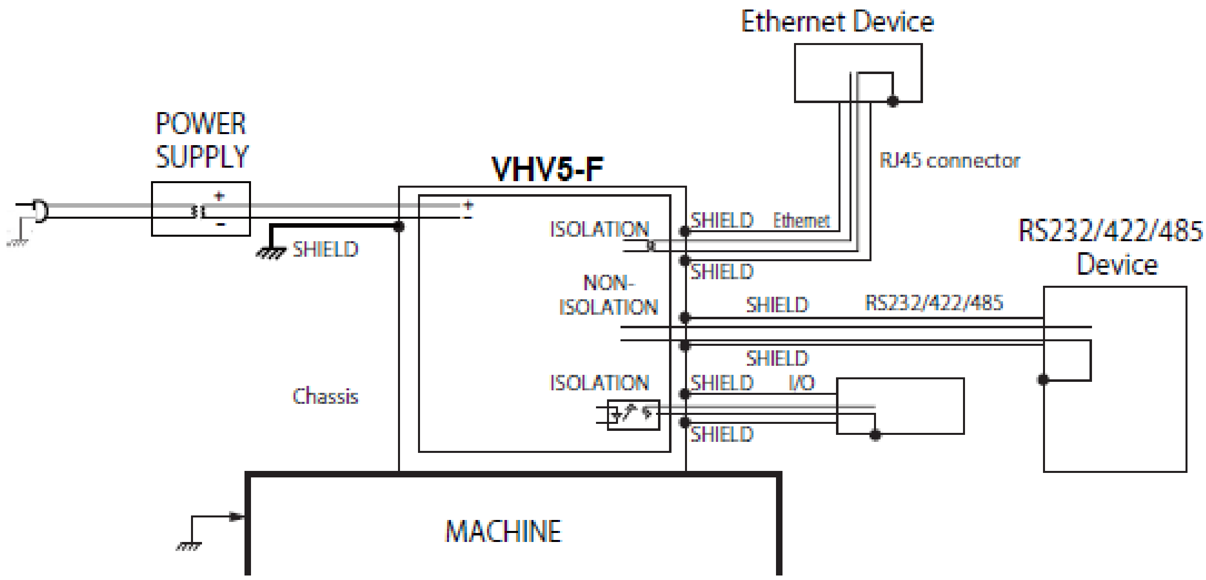


Pin	Name	Function	Flying Lead Color
2	Power (+VIN)	24 Volts	BROWN
7	Ground (–VIN)	24V Reference (GND)	BLUE

Proper Power and Grounding

● Ground and Shield Considerations

Proper grounding is necessary for operator safety, noise reduction, and the protection of equipment from voltage transients. Buildings, including any steelwork, all circuits, and all junction boxes must be grounded directly to an earth ground in compliance with local and national electrical codes.



An earth ground is provided through the cable shields and chassis of the reader. If the VHV5-F malfunctions due to influence of the environment by shield cables grounded, try any of the suggestions below.

- Disconnect the chassis and the shield cable of the power supply from the earth.
- Ground the shield cable of the power supply to –(0V). Ground any of one part of the shield cable, chassis, or RJ-45 connector of Ethernet cable to earth with D class grounding. Use a Class 2 power supply for the DC source.

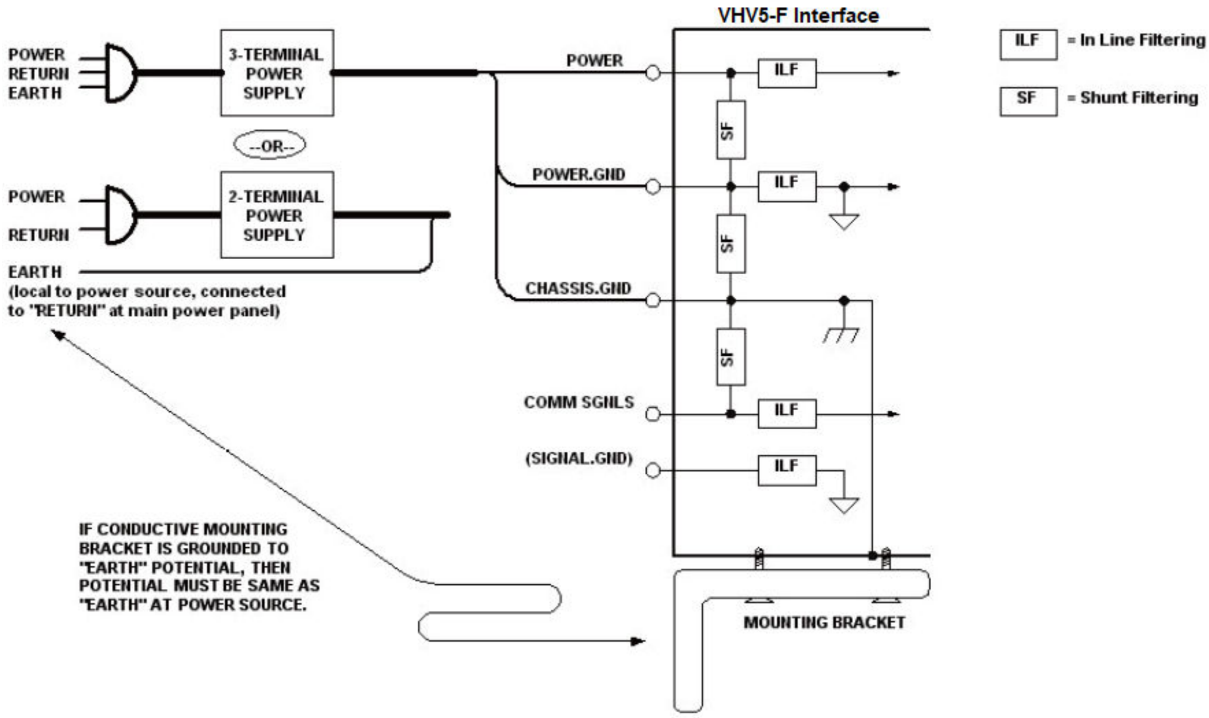
Note: In the case of this connection, must not ground the +(24V) of the power supply. If connected, the device will break down due to a short circuit.

● Ground Loops

Ground loops (signal degradation due to different ground potentials in communicating devices) can be eliminated or minimized by ensuring that both the host, imager, and their power supplies are connected to a common earth ground.

Note: If a malfunction occurred to your reader by noise, mount a noise filter close to the reader's power-supply terminals and ground the chassis of the filter.

● Expected Power and Ground Connections for Proper Operation



● Grounding Notes

- Ensure that mounting bracket "Earth" is at the same potential as power source "Earth".
- Supply "Return" and "Earth" ground must be stable, low-impedance reference points.
- "2-Terminal Power Supply" must still provide an "Earth" connection to the imager.
- "Signal Ground" can be used for communications and/or discrete signal ground reference. It must not be used as Power Ground or Earth Ground.

Connect External Light (Optional)

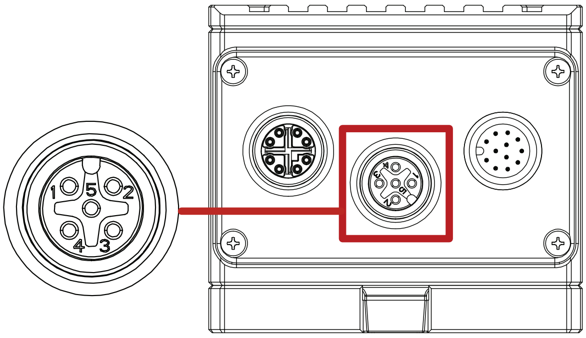
Note: The external light can only be used when the reader is powered via Direct 24V, not PoE.

● External Light Port

The third connector on the VHV5-F is used to drive an external light. The 5-pin female M12 provides 24V power, a Strobe Trigger output signal, and an optional Analog Intensity Control output signal. This five-pin assignment is compatible with many common machine vision light vendor's input connector requirements.

Precautions for Correct Use

The user must check the power and wiring specifications for their choice of external light and only connect the relevant signals. For example, pins 4 and 3 would be used to provide just a 24V strobe trigger signal output to an external strobe controller.



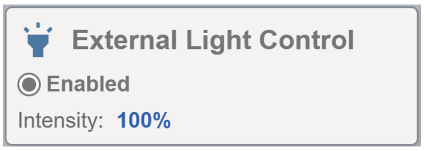
Pin	Signal	Description
1	+24 VDC	Provides up to 1.5 amps of current to light at 24V
2	Strobe Trig –	Strobe Trigger – (NPN referenced to DC Ground)
3	DC Ground	Ground
4	Strobe Trig +	Strobe Trigger + (PNP referenced to 24VDC Ground)
5	Analog Out	Selectable 0-10V analog output for intensity control

Examples:

- NERLITE Smart Series light with built-in strobe controller.
- Smart Vision lights with NanoDrive™ or Multi-Drive™ light control.

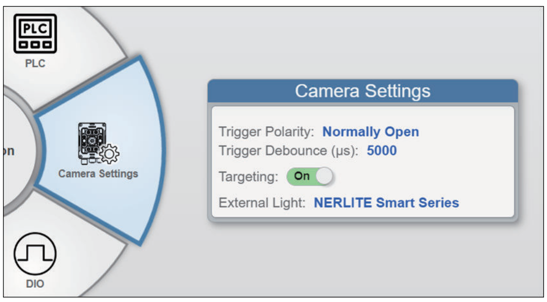
● External Light Enable

To use the External Light for a capture, it must be enabled in the Capture Settings dialog for that capture. A single capture cannot use both internal and external light at the same time. The Enable control acts like a radio button, turning off internal illumination. It is acceptable, however, to have captures that use internal light and others that use external light mixed in the same job.



● Intensity Control

Intensity Control is accomplished through a variable analog voltage output set on Pin 5. Each light vendor may have different voltage limits for intensity, so the user must select the proper vendor from the list in the Camera Settings dialog on the Device Page. This will limit the analog voltage output range that controls intensity to be compatible with that vendor's light. Pin 5 is set to 0V by default so this connector can be used to drive any external light that requires just power and strobe, or just strobe.



- **External Light Wiring Notes**

Note 1: Pin 2 is a sinking circuit (NPN). It provides a current-limited connection to ground when active and will float when not active. NPN requires an external 24VDC pullup for correct function.

Note 2: Pin 4 is a sourcing circuit (PNP). It provides a current-limited connection to 24VDC when active and will float when not active. PNP requires an external 24VDC pulldown for correct function.

Note 3: Both the PNP and NPN are non-isolated and reference to the same Power/GND as the M12 connector on the reader.

Note 4: NPN/PNP only function when the VHV5-F is connected to a 24VDC power supply (not PoE).

2-2-4 Set Up Network Connection between Host PC and Reader

Ethernet Communications

The VHV5-F uses a standard X-Code cable for 1000BASE-T communication and programming. The cable can also provide full power to the reader when used with a suitable PoE injector or PoE switch.

Ethernet communication requires that the reader and host be on the same network. The reader is shipped from the factory with a default IP address and Subnet.

The simplest method to connect is to set the Host PC to the same Subnet. Otherwise, you can use the Device Discovery Utility (DDU) to set the reader IP to be on the same network as the PC.

The IP address of the camera can also be updated from within the Device Page of WebLink if the PC and reader are already communicating. Please see section **6-1-3**.

Important: With PROFINET enabled on the VHV5-F and a PROFINET connection established between the reader and the PLC: if the membrane button, Omron Device Discovery Utility (DDU), or WebLink is used to assign the VHV5-F IP address, the camera will stop sending and receiving data on the PROFINET network. The user MUST power-cycle the VHV5-F to re-establish PROFINET communication and allow the user to connect to the WebLink user interface. If the VHV5-F IP address is assigned in the project of the PLC, the PLC-assigned IP address will be reassigned to the Device instead of the IP address that was set manually by either the membrane button, DDU, or WebLink.

Reader Factory Default IP Setting

Factory Default Settings	
IP Address	192.168.188.2
Subnet Mask	255.255.0.0
Gateway	Not set

Resetting IP Address to Default Using Membrane Control Button on the Reader

The IP address can be reset to factory default using the membrane switch on the back of the reader. Press the reader membrane button down and hold it. The lights will blink once after two seconds, and then will blink twice after five seconds. Release the membrane button after the double-blink. The IP address and subnet are now reset to factory default.

2-2-5 Guide to using the Device Discovery Utility (DDU) and Starting the WebLink Programming Interface

The Device Discovery Utility (DDU) is a program that runs on the PC. The DDU can be downloaded from the Omron Automation website. Search for "DDU".

The main purpose of the DDU is to discover and enumerate all of the Omron Fixed Mount Code Readers, Smart Cameras, and Handheld Readers that are attached to the network. Once the reader is discovered, the user can select any reader and perform a number of key camera maintenance functions.

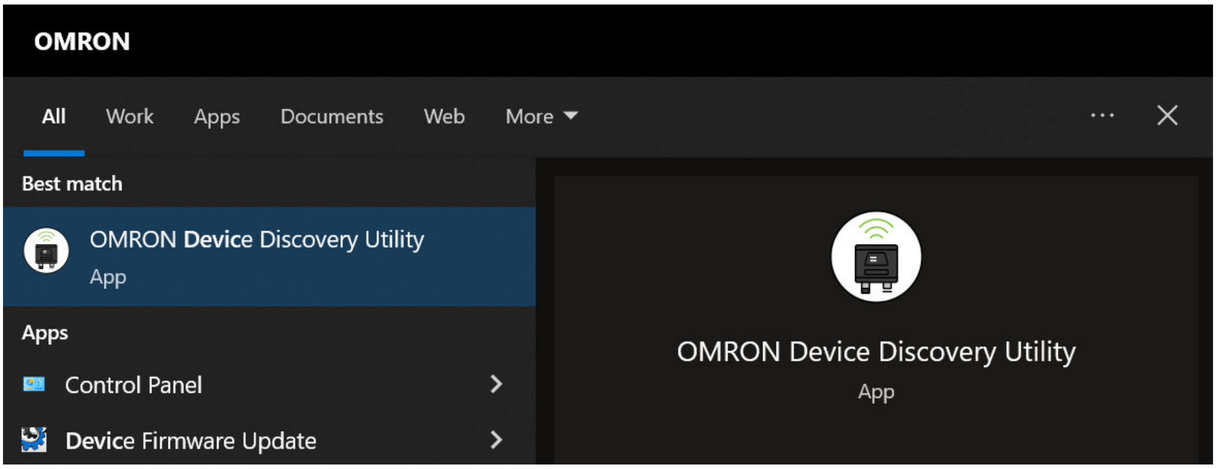
Note: DDU functions vary by the type of Omron reader or camera. The following is the list for the VHV5-F:

- Change Reader IP Address and Network Settings
- Change Reader Name
- Update Reader Firmware
- Switch Reader Firmware Version
- Update Reader Hardware Profile
- Install Reader Licenses

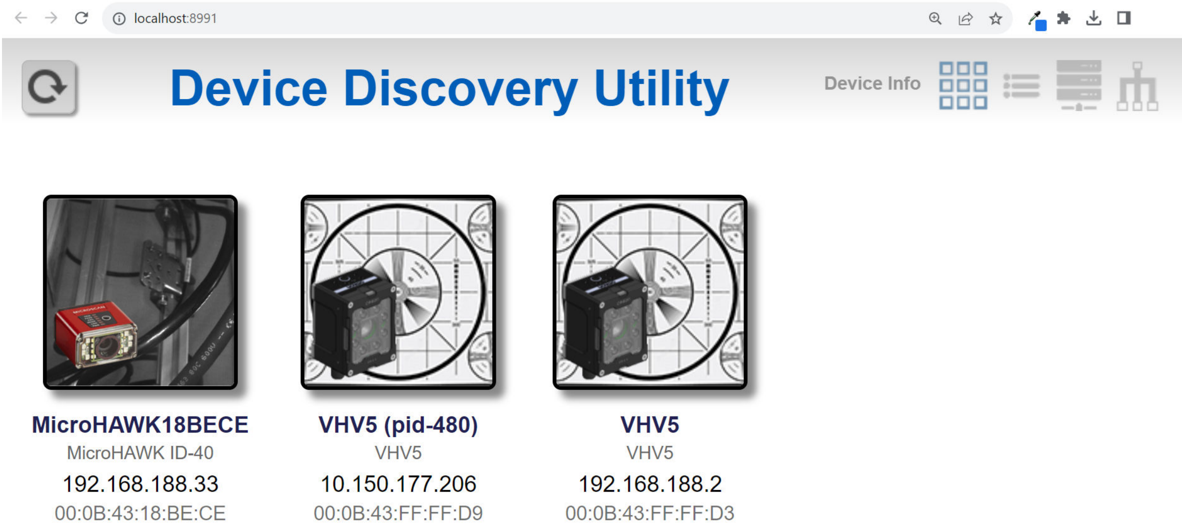
Each function is described in detail below.

Using the Device Discovery Utility (DDU) to Discover All Readers on the Network

Start the **Omron Device Discovery Utility** application on the PC.

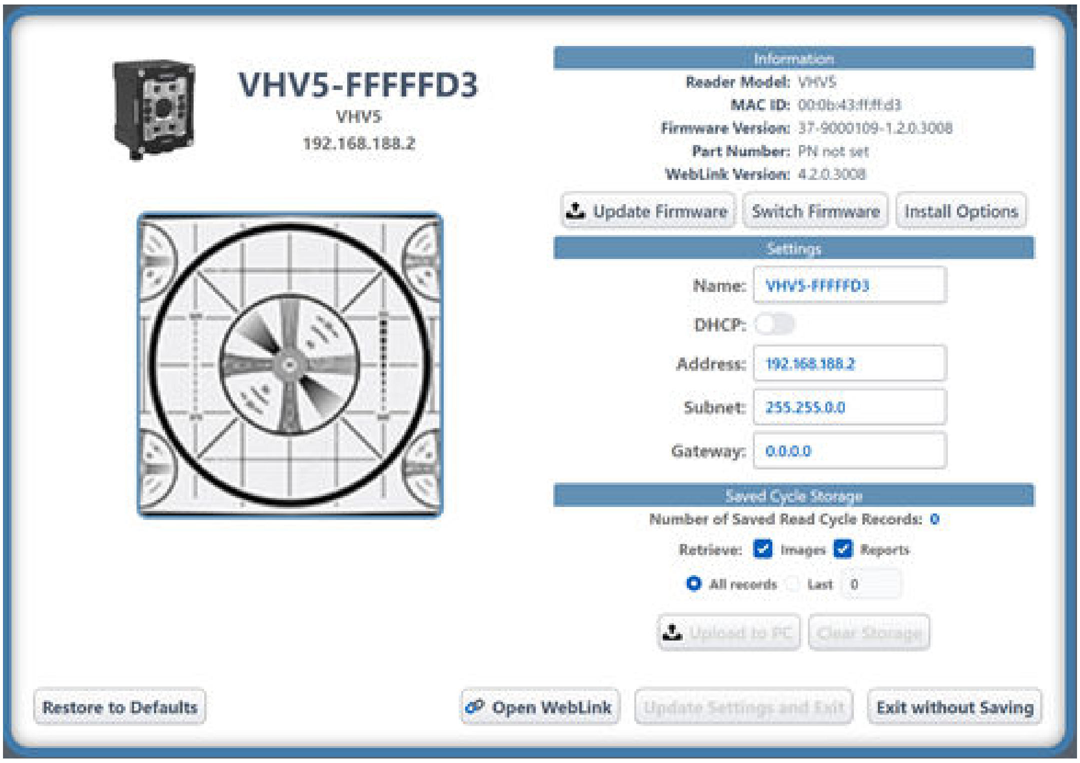


The DDU automatically discovers all readers that are reachable on the network, regardless of IP address and Subnet. Each reader on the network is displayed with its own icon and with basic information about the device.



Using the DDU to Change Reader IP Address and Network Settings

Click on the icon for the specific reader to see the current device settings.



All readers are shipped with the IP address set to the factory default of **192.168.188.2 (255.255.0.0)**.

To deploy multiple readers on a production floor, assign a unique IP address to each reader by typing the new IP address. Set Subnet appropriately. Ensure that any PC used to program the readers is also on that same Subnet.

Click the **Update Settings and Exit** button to update the reader. The reader will reboot and come up with new settings.

Using the DDU to Change Reader Name

The factory default name for each camera is **VHVF######**, where the **#**s are the last three octets of the reader's MAC ID. This guarantees a unique name for each reader. You can change the reader name by typing the new name and then clicking the **Update Settings and Exit** button.

Using the DDU to Update Firmware on the Reader

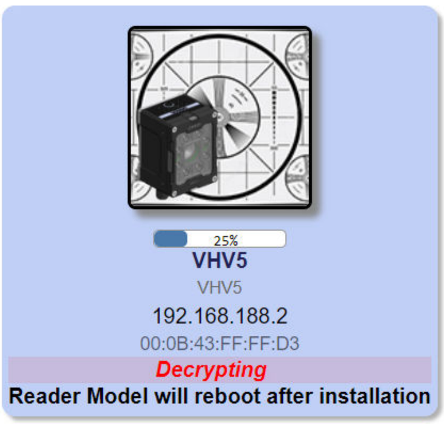
The DDU can also be used to update the reader's firmware.

Click the **Update Firmware** button. Navigate to the folder containing the latest software, and select it. The software name is the version number with the extension **.enc**.

Example: 37-9000109-1.2.0_3012_arm64_release.enc

The DDU displays update progress and reboots the reader when it is complete. The DDU automatically rediscovers the reader and re-displays it with current settings after the reboot.

IMPORTANT: POWER CYCLE THE UNIT AFTER CHANGING SOFTWARE VERSIONS. WHEN COMPLETE, REFRESH WEBLINK PAGE TO ENSURE A COMPLETE RELOAD OF THE UI.



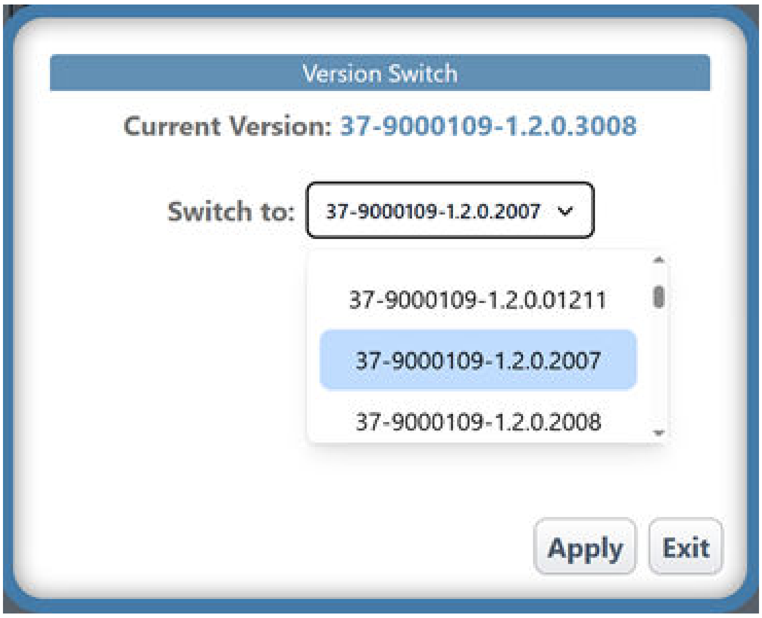
Note: The camera will load the new version and then reboot. It is good practice to power cycle the camera and then to refresh the browser once the camera comes back up to make sure the camera and UI are in sync.

Note on Jobs: When updating firmware, all current Jobs will be maintained in the Job Slots.

Using the DDU to Switch Firmware Versions on the Reader

The DDU can also be used to switch between firmware versions that have been loaded onto the reader. For example, if the camera is running V1.2, the user can choose to switch back to an older version.

Click the **Switch Firmware** button, select the version to switch to. Click apply.



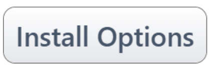
Note: The camera will load the new version and then reboot. It is good practice to power cycle the camera and then to refresh the browser once the camera comes back up to make sure the camera and UI are in sync.

Notes on Jobs:

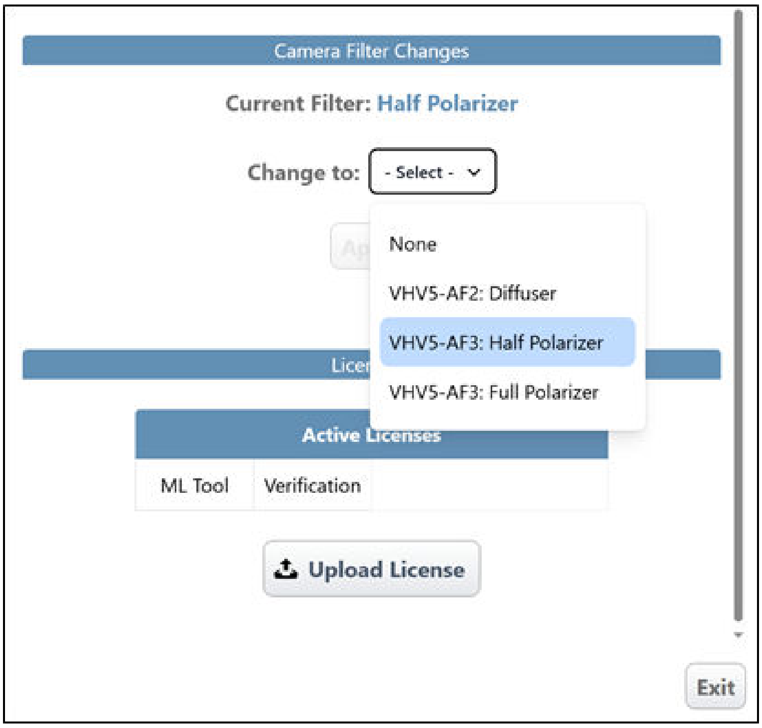
1. When switching firmware, it will reload the jobs into the job slots that were previously created under that version.
2. Prior to switching, the current set of jobs will be stored such that they will be available when you switch back.

Using the DDU to Update the Camera Device Profile (List of Installed Camera Accessories)

The DDU can also be used to update the camera device profile. The device profile changes when the user adds accessories to the camera such as the Polarizer, Half Polarizer, or Diffuser.



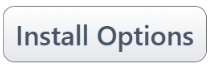
Click the **Install Options** button. Select the correct accessory that has been installed on the camera. Click Apply.



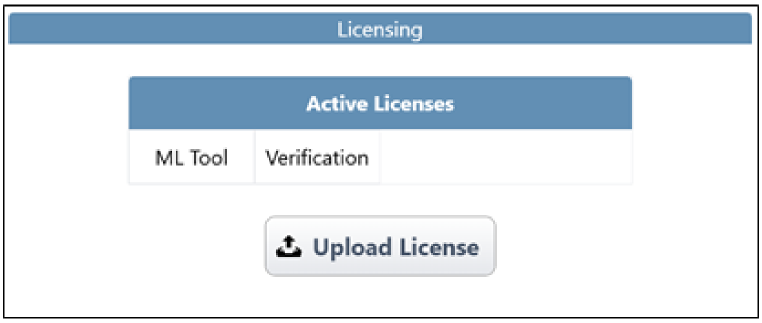
Once done, refresh the UI browser page. The new accessory will appear under the Device Description in the Device page or WebLink.

Using the DDU to Install Licenses

The DDU can also be used to add licenses to the camera to unlock features such as In-Line Verification.



Click the **Install Options** button. Click **Upload License**. Go to the directory location of the license that has been provided by Omron to load this feature onto the camera. Select the license file to install the license onto the camera.

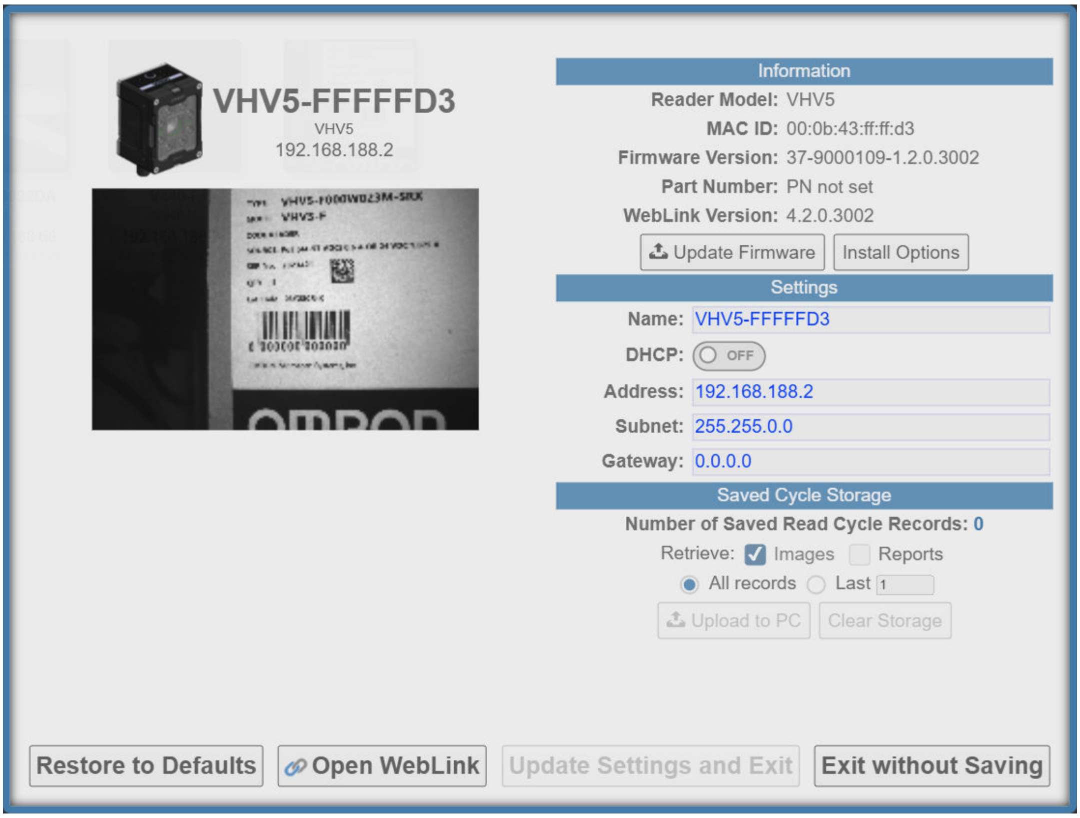


Once done, the license will appear under the **Active Licenses** heading.

2-2-6 Starting WebLink User Interface using the DDU or Browser

Using the DDU to Start WebLink on the Reader

Click the **Open WebLink** button to begin programming the reader.
See *4-1-2 WebLink PC System Requirements* on page 4-2.



Starting the WebLink User Interface using a Browser

The VHV5-F does not require user interface software to be installed on the PC to program the reader or to monitor it in Run mode. WebLink is a a web application that is hosted by the camera. This means there will never be any version mismatch issues between the user interface and the software that is running on the reader.

To access the WebLink user interface, open a browser and type the IP address of the reader in the address bar. The user interface will appear as a fully interactive web page.

3

Theory of Operation

3-1 Theory of Operation

Previous sections concerning application evaluation and reader model selection detail the initial steps required to choose the correct reader, ensuring a successful installation. A full understanding of the theory of operation for the reader is also essential to deploy it to its best advantage.

Theory of Operation describes:

- Device Settings and Communications
- Jobs (Read Cycle Types)
- The Read Cycle (Sequence of Steps)
- The Decode Tool (Operation and Qualification)
- The Verification Tool (Calibration, Operation, and Qualification)
- Processing Optimization

3-2 Device Settings and Communications

Settings for the reader are divided into two distinct types. First are the Device settings. These parameters normally remain fixed, based on the line or station with which the reader is integrated, and they primarily deal with communications. Second are the Job settings, which vary based on the requirements of each unique reading application.

3-2-1 Device Settings

Device settings are those that remain fixed no matter what reading application is being run. Device settings include the IP Address of the camera, RS-232 communication configuration, Socket communication configuration (UDP, TCP, Client and Server), Digital IO settings, EtherNet/IP settings, and PROFINET settings.

The understanding is that the reader will be deployed on a single production line and will communicate with the host by the same method for all jobs. It is logical for these settings remain fixed.

3-2-2 Communications Channels

The VHV5-F has five parallel and independent communications channels for receiving commands and sending out data. Commands can be entered through any of the ports and the reader will respond on that port. The read cycle result string and data is automatically sent through all enabled ports. These channels are:

- RS-232
- TCP/IP Server
- TCP/IP Client
- UDP Server
- UDP/IP Client
- EtherNet/IP and PROFINET

Key Point: All communications channels operate independently of one another. They can all be active at the same time. Settings made for TCP/IP, UDP, and the industrial protocols have no effect on each other. All of them simply share the same 1000BASE-T line.

The only exception is EtherNet/IP and PROFINET. Only one or the other protocol can be active.

3-3 Jobs

3-3-1 Jobs and Job Slots

Virtually every reading or reading/verification application is different. Applications can vary in the code types to be read, the number and position of the codes on the part, and the lighting, sensor, and focus settings required to image all of the codes.

WebLink allows the user to quickly and easily program the VHV5-F for each new application. These programs are called Jobs. Once a Job is created, it is stored on the camera in one of 32 memory Slots.

During production, Jobs are loaded by selecting the slot the Job is stored in. This can be done manually or programmatically. The file system allows Jobs to be deleted or even moved from one Slot to another.

Job archive files can be saved from the VHV5-F to the PC or loaded from the PC to the VHV5-F. This allows for Job backup, as well as for sharing Jobs between readers on the factory floor.

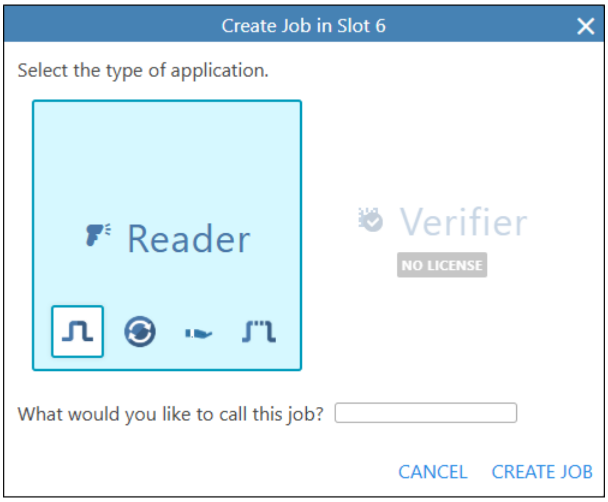
Key Point: Job changes on the VHV5-F are extremely fast. Job changes can be accomplished almost on a trigger to trigger basis.

Note: Slot 00 is reserved for a default Demo Job installed at the factory. It is set as the Boot job. All cameras will load and run this job when first powered up. This job cannot be deleted or changed. Modifications and be made to this job however, and then saved to another Slot. New Jobs can be created. Any Job can be set to the Boot Job which will then be loaded at power up rather than the default Demo Job.

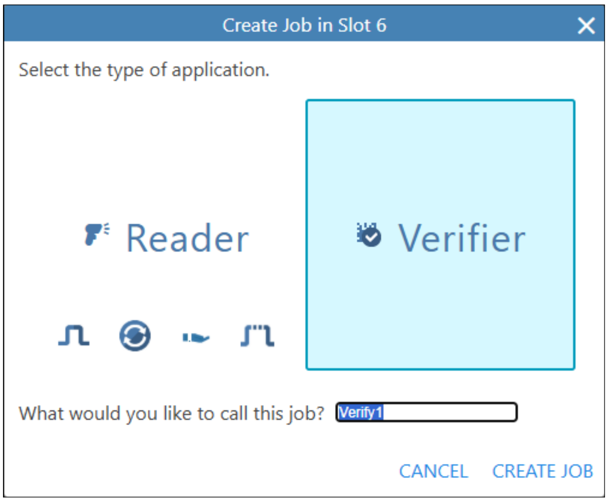
3-3-2 Job Types

There are four user selectable Job types that determine how a reader job will be triggered, acquire images, process, and send results. **The sequence the reader runs through from trigger to result is called the Read Cycle.** The four basic types are Triggered, Continuous, Presentation Mode

(Supermarket Mode), and Start Stop. When Creating a New Job in a Slot, the user selects the type of Job (or Read Cycle). This sets all the correct parameter defaults for that Job type.



If the VHV5-F has licensed In-Line Verification capability, the user will be presented with the choice of creating either a basic Reading Job or a Verification Job. The only Job Type for a Verification Job is **Triggered**, since the part needs to be positioned accurately in the field of view to provide the most consistent ISO/IEC Code Quality results.



Triggered

Triggered is the most common Read Cycle type. Here, the system receives a specific trigger indicating the part is in front of the reader. The trigger starts the Read Cycle. Within the read cycle, the reader acquires a fixed set of images and attempts to read within those images. The read cycle ends either when it has read, or when it runs out of images and still fails to decode. The next read cycle starts when a new trigger is received.

Continuous

For Continuous mode, the reader starts acquiring images automatically upon entering Run Mode and attempts to read within those images. The reader will continue indefinitely to acquire and process until a part enters the field of view and the codes on that part are read. **Only a successful read will end the read cycle.** At the end of the read cycle, the data is output, and then the next read cycle is started automatically, again waiting for a part to pass in front of the reader and be read.

Note: Continuous mode will read the same code over and over in this mode until the part is moved out of the field of view.

Presentation

Presentation mode is exactly the same as Continuous mode, except that once a code is read, the reader will wait a user-defined amount of time before starting the next read cycle. This is to prevent duplicate reads of the same part. This is the same principle as supermarket scanners.

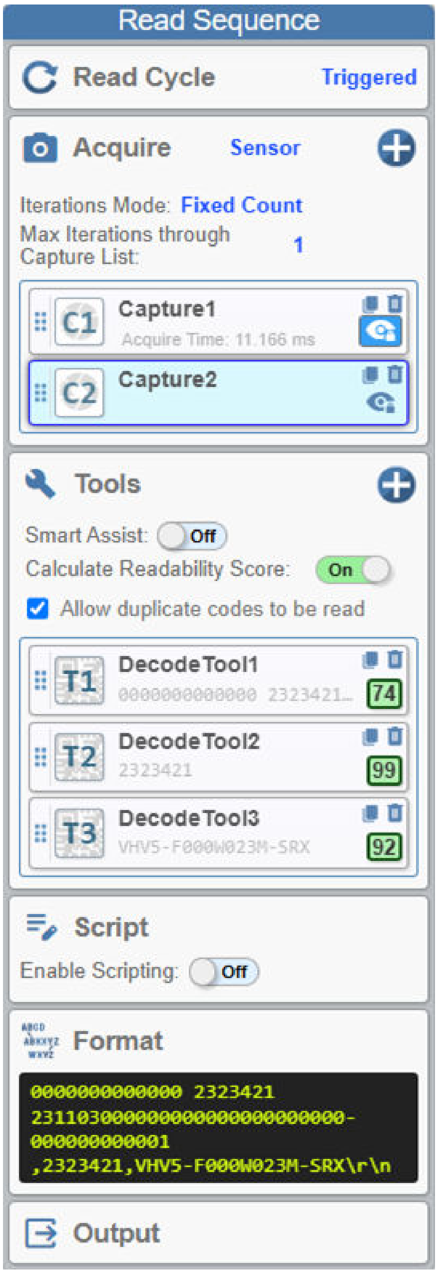
Start/Stop

Start/Stop is a combination of Triggered and Continuous. Like Triggered, the Read Cycle is started with a Trigger Signal. Like Continuous, within the read cycle, the reader acquires images continuously and attempts to decode while the trigger is held on. If it decodes successfully, it sends the data out immediately (or after the Stop signal, depending on user settings). The read cycle ends when the host sends the reader a Stop Trigger signal. It begins the next Read Cycle on the next Start Trigger.

3-4 Read Cycle Theory of Operation

3-4-1 The Read Cycle

The reader runs read cycles. Each read cycle is different based on the Job Type, but it generally starts with a trigger event, and ends with the read data transmitted out of the device to the host.



There are four Read Cycle, or Job types. Triggered, Continuous, Presentation Mode (sometimes called Supermarket Mode), and Start/Stop.

The sequence of steps within the Read Cycle is shown in the dialog and is described in the following sections.

3-4-2 Read Cycle Triggering

A Read Cycle is normally started by a physical trigger indicating that the part is in front of the camera. (Note, however for some Read Cycle modes such as “Continuous Read”, the trigger is an event, i.e. the completion of the prior Read Cycle.)

3-4-3 Image Acquisition

Once triggered, the reader acquires one or more Captures of the part while it is in front of the camera. Each capture can be set up with a unique combination of Exposure, Gain, Focus, and Lighting to ensure that all targeted codes can be read under all conditions in at least one of the images. As soon as the first capture is available, the Decode Tools are run.

3-4-4 Running the Decode Tools

Within the job, the user inserts one Decode Tool for each individual code that is meant to be read. That Decode Tool is programmed with a set of “Qualification” criteria that steers the Decode Tool to find one specific target code out of what could be many codes in the field of view. As each image becomes available, each Decode Tool will run in that image to try to find and read their “qualified” code. Once a Decode Tool has found its qualified code, it is marked as Passed and that Decode Tool shuts down. It will not run in any pending captures. Any Decode Tool that has not yet succeeded will continue to run in all available captures until it qualifies, or until there are no more captures for it to process, in which case the Decode Tool is marked as Failed.

The final processing step for each Decode Tool is the formation of a result string that is sent up to the read cycle to be included in the final read cycle output. The string normally just contains the decoded data string from the code, but the user can add other code specific data as well such as the X, Y and Theta coordinates of the code in the field of view, or a quality score for that code. The string for Decode Tools that have failed is generally “NOREAD”.

See the Decode Tool Theory of Operation section below.

3-4-5 Read Cycle End

The Read Cycle image processing phase ends once all Decode Tools have completed, and have passed their result back up.

If all Decode tools have succeeded early, all pending Captures in the Acquire step will be cancelled and the Read Sequence will move directly to the Format and Output stage.

3-4-6 Read Cycle Pass / Fail Determination

All Decode Tools within the job must Pass for the Read Cycle to Pass. If any of the Decode Tools Fail , the Read Cycle will Fail. The calculation for Decode Tool Pass/Fail is described in the *3-5 Decode Tool Theory of Operation* on page 3-11 below.

3-4-7 Scripting

The **Script** step runs next in the read sequence. Scripting gives the user programmatic access to virtually all Read Cycle and Decode Tool data in the system.

Using the LUA programming language as well as this data, the user is able to construct a custom output string or report that will be sent out at the end of the Read Sequence instead of the Formatted

Output string described in the next section. The custom output string is constructed within the **formatOutput(cycleData)** function.

A second LUA function, **postCycle(cycleData),** allows the user to set the states of the three digital outputs programmatically based on that same data.

LUA global variables are persistent across read cycles, so the user is able to accomplish many other advanced functions, such as complex trending analysis and reporting as well.

3-4-8 Data Output String Formatting

In the **Format** step in the Read Cycle, the formatted output string from each Decode Tool is passed to the Read Cycle Format Output step. Here, the final output string is constructed prior to being transmitted out as the final Read Cycle result.

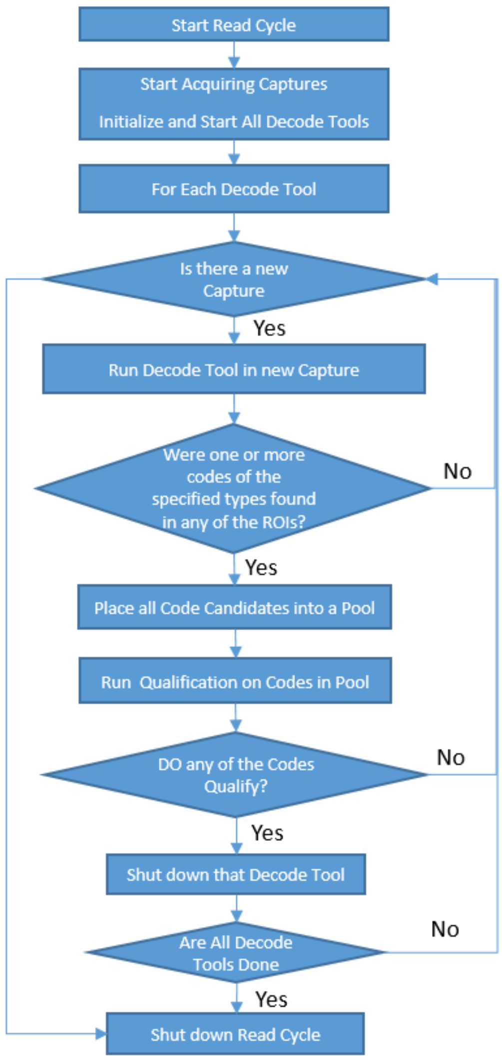
By default, each Decode Tool's string is simply appended to the final result string. The user also has the capability to add user-defined text, as well as Read Cycle-specific data such as the Trigger Time Stamp, or Read Cycle duration, into the final string.

Note: If the Script step is turned on, and if within the script the user generates an alternate output string using the **formatOutput()** function, the string from the Format step is overridden by the Script-based output string. The result of the **formatOutput()** function will be displayed in the Format dialog data view area as well.

3-4-9 Read Cycle Output Data Transmit

The read cycle ends with reporting. Here, the final formatted output string is sent to the WebLink results screen, as well as sent out all active data channels (RS-232, Socket, EtherNet/IP, PROFINET, etc.). The Digital Output signals indicating read cycle status such as Pass/ Fail are set at this time as well.

3-4-10 Read Cycle Flow Chart



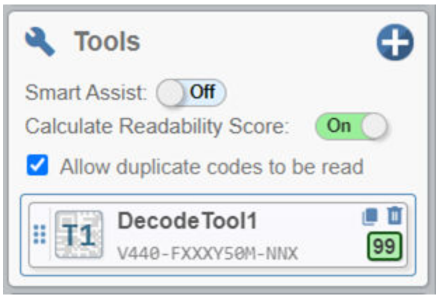
3-5 Decode Tool Theory of Operation

3-5-1 The Decode Tool

The Decode Tool is at the core of the reader. One Decode Tool is added to the Job for each code on the part that needs to be read.

The Decode Tool runs the X-Mode reading algorithm in each and every image presented to it. X-Mode searches each image for code candidates. Each candidate is passed to the decoding section of X-Mode to see if it can be read. If it does read, the Decode Tool goes on to perform matching and grading on that code.

Finally, the Decode Tool constructs a result string. This string generally contains the decoded data, but can also be formatted to contain an abundance of other data such as the position of the code in the field of view, the time it took the Decode Tool to run, or even a code quality grade report.



Note: The normal mode for the Decode Tool is one tool per code. The **LEARN CODES** button does exactly this, adding one tool for each code it finds in the image. This provides the greatest amount of control over each read. The Tool provides a secondary option called Multicode Mode. This option allows the user to set up a single tool to find 1 to n codes. See *7-7 Decode Tool Dialog Details* on page 7-49 for additional information.

3-5-2 Decode Tool List

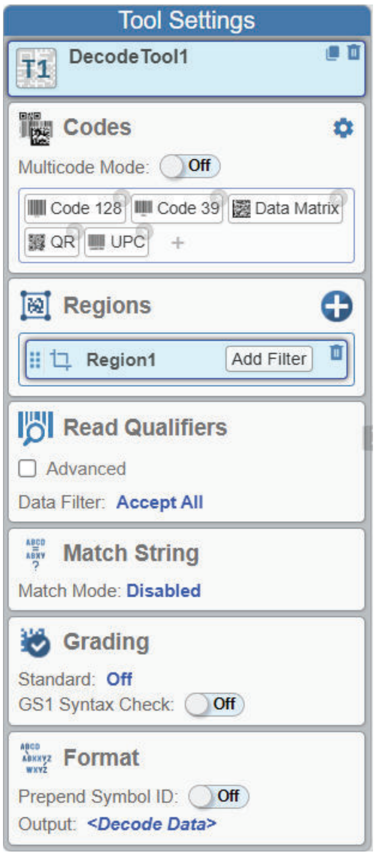
A Job can contain one Decode Tool or many, depending on the requirements of the reading application. Typically, one Decode Tool is inserted into the Decode Tool list for each code that is meant to be read. Tools are added via **LEARN CODES**, or by clicking the **+** icon. Clicking on each tool will open its parameter settings page.

3-5-3 Decode Tool Qualification

Clicking on a Decode Tool in the Tools list opens the Decode Tool settings dialog for that tool.

The Decode Tool Dialog is used to set up how the Decode Tool will run by setting up specific Qualification Criteria that are used to drive the tool to find and decode the exact code of interest.

For example, the Decode Tool can be programmed to find a QR Code that lies within a certain Region of Interest, and that starts with the letters “ABC”. The algorithm will sort through all code candidates it finds, and will only decode and output the one that “qualifies”. If no code is found that meets the qualification criteria, the Decode Tool will output a NOREAD message.



Qualification is nothing more than a set of tests or gates that each candidate code found by the decoding algorithm must get through to be considered the fully-qualified or "actual" code the tool was meant to find. The various gates are described below.

Code Found

Code Found is the first gate. This simply means that the algorithm has found a code that is of the correct type, and it is found within one of the regions or interest (ROIs) the user has set up.

Code types is set up in the Codes section of the dialog. It can be set to just one type like Data Matrix, or a list of types like Data Matrix or QR. If a code is found that is not one of these types, it is filtered out.

ROIs – Regions of Interest are used as implicit filters as well. The user can set ROIs only around the area of the image where the code is expected to be, eliminating any other codes in the image from consideration. Multiple Regions of Interest can be set up in case the code can be expected to be found in more that one position. For example, if the part can be in front of the camera in multiple orientations.

Code Read

Read Qualification is the second gate and is set up in the Read Qualifiers section of the dialog. Normally the Read Qualifier Data Filter is set up to accept any code that is found of the correct type within the ROIs the user has set up. It can be used as a much more powerful Logic Filter however when Advanced is selected.

Example 1: It can be used to make a more refined choice between multiple codes that are in a single ROI where one is the code of interest and the other is not.

For instance if there are two Data Matrix codes within a ROI, The qualification statement can be set to pick the code that is “The Data Matrix Code that Starts with the string “XYZ”. Now, if there is a Data Matrix code that starts with ABC, and another with XYZ, the algorithm will reject the candidate that starts with ABC if that is decoded first, and choose the code that starts with XYZ.

Example 2: As a second example, it can be set up to qualify on more than one code if both are acceptable. It would do this using Logic set up such as “If the Code is a Data Matrix Code and Starts with the string “ABC”, OR If the Code is a QR Code and Starts with “XYZ”. This would allow either of these codes to pass the Read Qualification Gate.

Match String

Match String is the final gate or filter. This is where the full contents of the code can be checked. For example, if there are two Data Matrix codes that start with ABC, but the user wants to assure that the one that reads ABC456 is read, they would set ABC456 in the match string list. If ABC123 is read first, the Match String gate would reject it, and the decoder would continue to provide candidates until ABC456 is presented and Match String passes.

Code Quality Validation (Grading)

Once a code has been fully qualified, the user has the optional capability to Validate the code quality using the ISO/IEC 15415, 15416, and 29158 grading standards.

This option, when used from within the Decode Tool, does not provide full ISO/IEC Verification capability. It provides Process Validation-level results only because there is no ISO/IEC image calibration available for the VHV5-F reader model. It is the responsibility of the user to set up the system to produce ideal imaging capable of giving meaningful code quality results.

Note: Calibration functionality is only available with a Verification License upgrade to the reader. Please see Chapter 8 for a full description of Code Quality Validation versus full ISO/IEC Code Quality Verification.

3-5-4 Decode Tool Pass / Fail Calculation

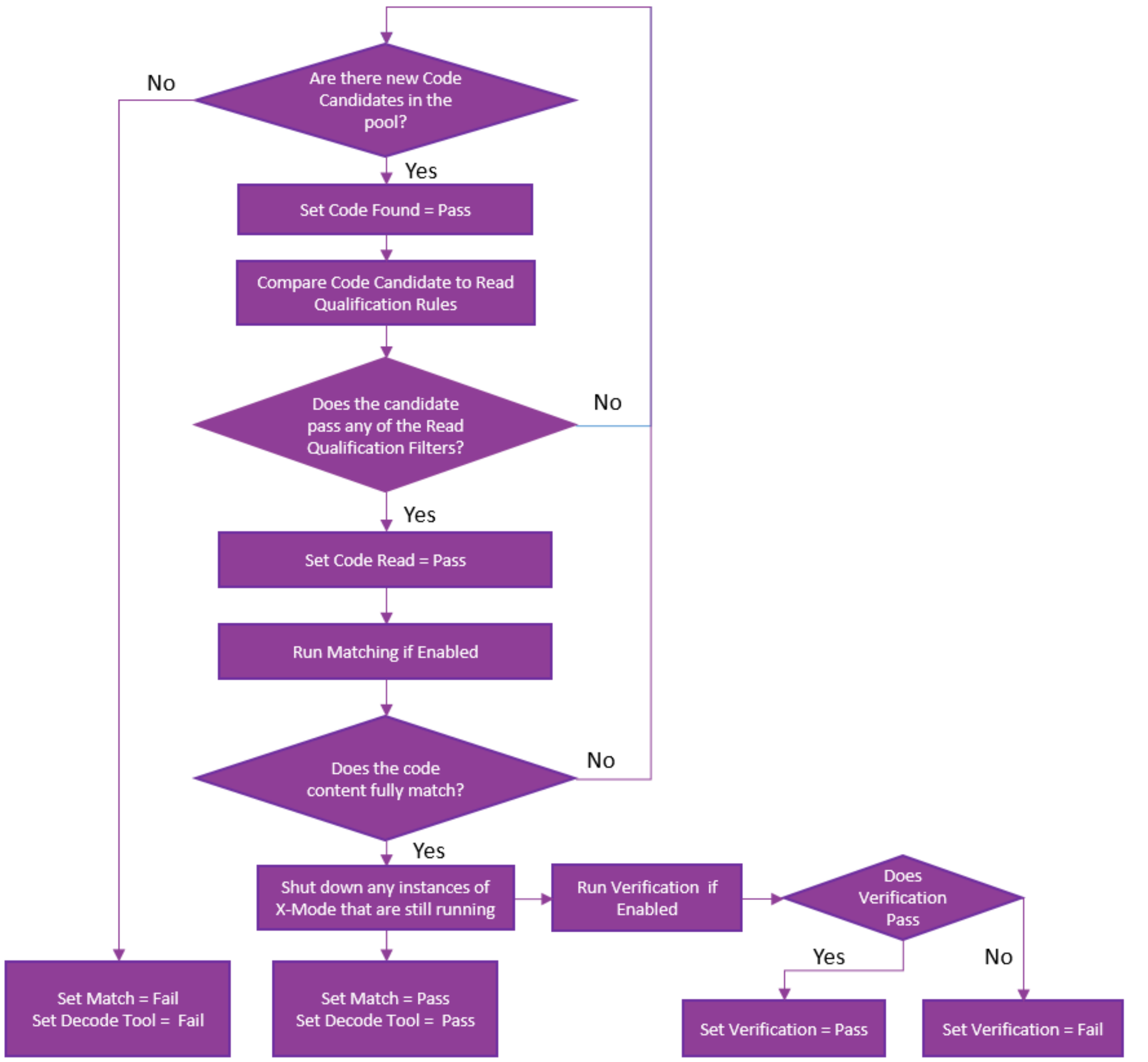
As indicated above, the Decode Tool runs code candidates through a series of qualification steps to ensure it finds exactly the right code the user is targeting to be read even though there may be many similar codes within the search area. If qualification criteria, or gates, are passed, the Decode Tool passes. Otherwise the Decode Tool fails. It is important to note that each of the individual qualification steps or gates (Code Found, Code Read, Match String, Code Quality) also have an associated Pass / Fail signal that can be transmitted to provide useful process information. For example, if the Decode Tool finds a code of the correct type within the ROI, but rather than starting with "ABC," as desired, it starts with "DEF". This would indicate to the host that parts are being mixed on the line.

Qualification is discussed more thoroughly in the Read Cycle Details section.

3-5-5 Decode Tool Data Formatting

Once the target code is found, each Decode tool has the capability to individually format its data output. The default output is the decoded data string. However, the user can insert custom text, as well as other code-specific data that has been computed, such as the position and angle of the code.

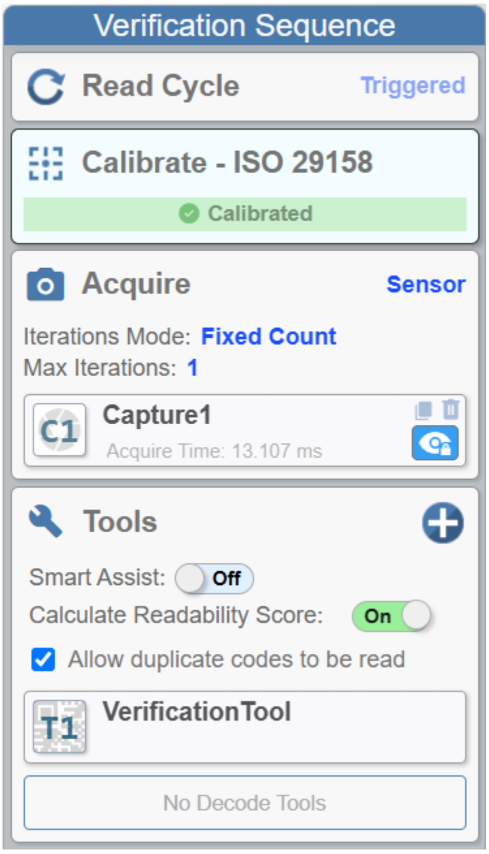
3-5-6 Decode Tool Read Qualification Flow Chart



3-6 Verification Tool Theory of Operation

3-6-1 The Verification Tool

When equipped with a Verification License, Job Creation gives the user the option to create an In-Line Verification Job as well. The default Verification Job has one Verification Tool in it by default as opposed to one Decode Tool.



The primary difference between a Verification Job and a Reading Job is that the Verification License allows the user to ISO Calibrate the image so that when grading is done, the system is able to produce grading results that conform to the ISO/IEC 15415, 15416, and 29158 standards when running the Verification Tool.

The Verification Tool itself runs exactly the same steps as a Decode Tool all the way down through reading and qualification. The difference is that the Verification Tool is only allowed to run on the one Calibrated image.

If there are multiple codes in the image that the user wants to ISO Verify, the user must turn on Multicode Mode. The Verification Tool will run ISO grading on the number of codes it is set up to find, and output individual results for each.

Please see **Chapter 8** for a full description of how to use the VHV5-F as an In-Line Verification System.

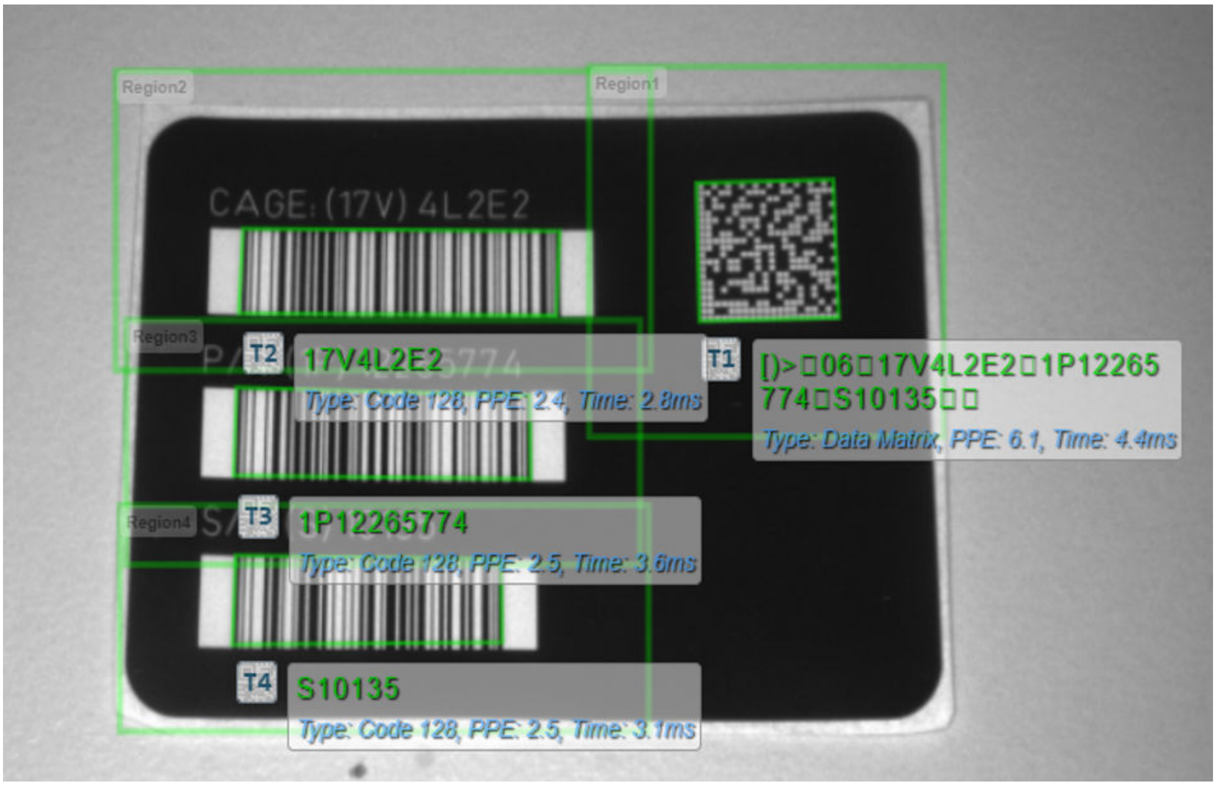
3-7 Read Cycle Processing Optimization

The reader has been designed for high resolution (2.3MP and a 5.0 MP sensors) and high speed. High resolution means more pixels to process. Processing more pixels means more time. The VHV5-F employs two mechanisms to minimize processing time. One: Regions of interest is under user control. Two: Pipelined Acquisition and Parallel Processing Operation and part of the system.

3-7-1 Regions of Interest

Default Region of Interest

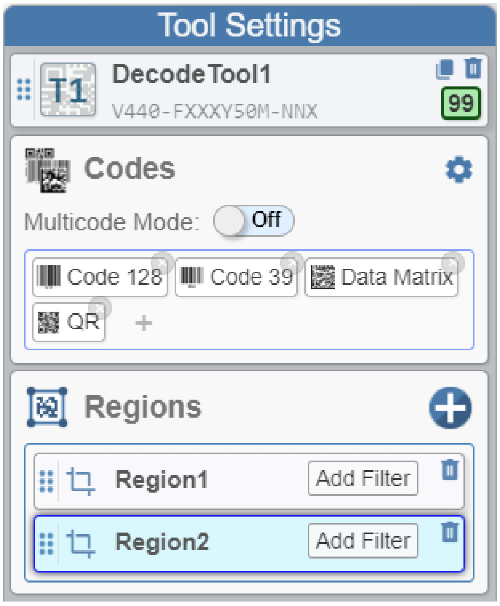
When a Decode Tool is inserted, it is created with a default ROI (Region of Interest) that the user is able to adjust for code position, size and expected positional uncertainty. Limiting the size of the Decode Tool read area reduces the number of pixels the system has to process thus decreasing overall read time. The ROIs also allow the user to target certain codes, and ignore other codes that may be in the image. The Learn Codes function automatically places and sizes the ROIs for the user. Users can adjust the ROIs.



Multiple Regions of Interest per Decode Tool

A single decode tool can have more than one ROI. For example if a code is in the corner of the part, and the part can be presented at any of four orientations, 4 separate ROIs can be set to cover each corner, again limiting the number of pixels the system has to process. The example below shows the

Decode Tool set up with two regions, the lower left and upper right to account for two orientations the part can be presented in.



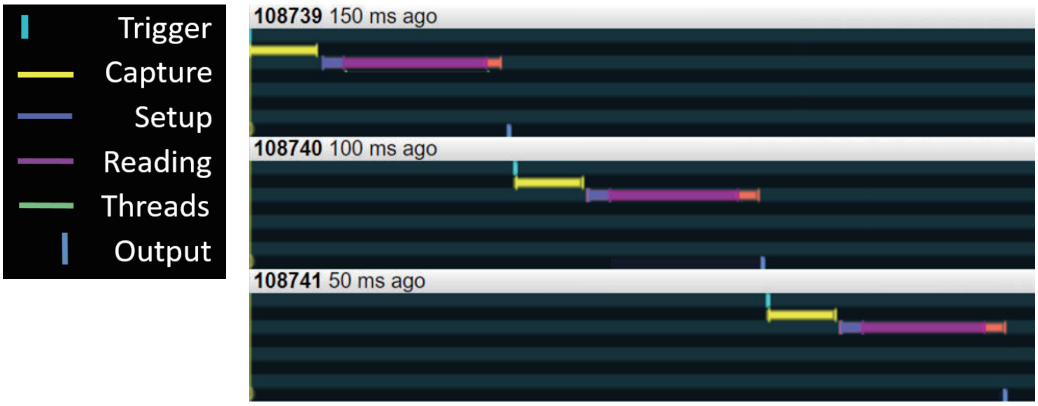
3-7-2 Pipelined Acquisition and Parallel Processing Operation

The VHV5-F is capable of both Pipelined Acquisition and Parallel Processing within the images enabling it to achieve nearly frame rates on well-tuned jobs. Frame rate processing means that the VHV5-F can run on the fastest production lines without affecting line throughput performance.

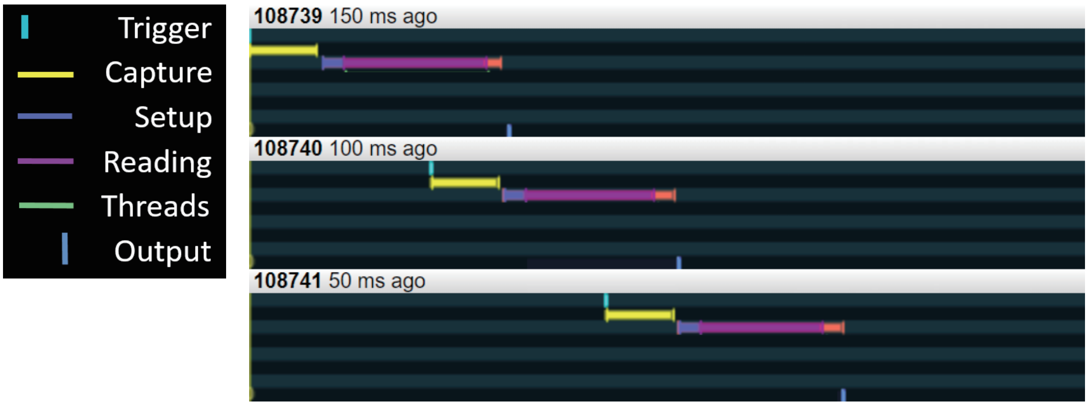
Pipelined Acquisition

The VHV5-F is capable of running multiple tasks at the same time. The two main tasks are image acquisiton and image processing. Pipelined Acquisition means that the reader can get a second trigger and begin acquiring images for the next read cycle while it is still processing the images from the first trigger. The effect an increase in read rate.

The following diagram from the Digital Softscope (Timing Profiler) within WebLink shows normal operation of a reader that follows a serial operation. Here a trigger is received, the image is acquired, then the image is processed and the data is output. The next trigger is sent once the output is received.

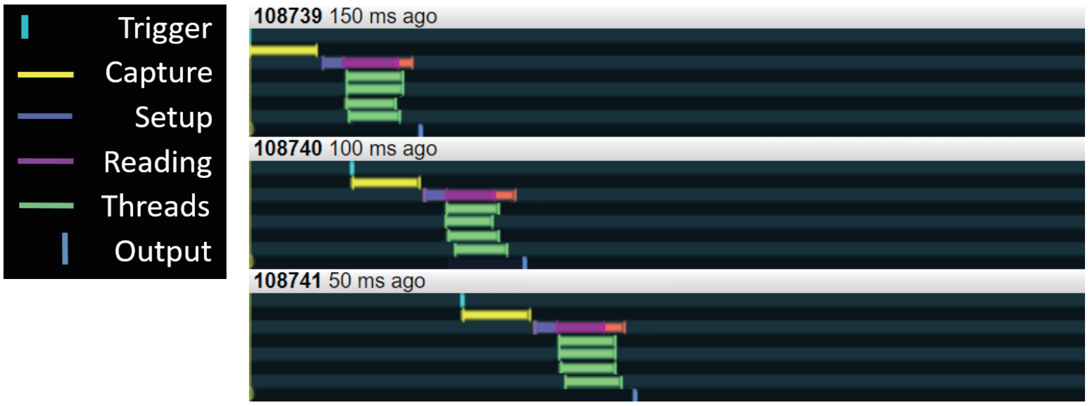


The next diagram shows the effect of Pipelined Acquisition. The trigger rate is increased so acquisition of next image occurs while previous one is still being processed. Rate is increased by the acquire time.



Parallel Processing

The VHV5-F is capable of using multiple cores simultaneously for image processing or reading. By efficiently breaking the processing task up amongst the cores the system can be triggered at an even higher rate. Depending on the image complexity and difficulty of reading, the system can approach operation at the frame rate of the reader.


Trigger
Capture
Setup
Reading
Threads
Output
108739 150 ms ago
108740 100 ms ago
108741 50 ms ago

4

Overview of WebLink 4.0 User Interface

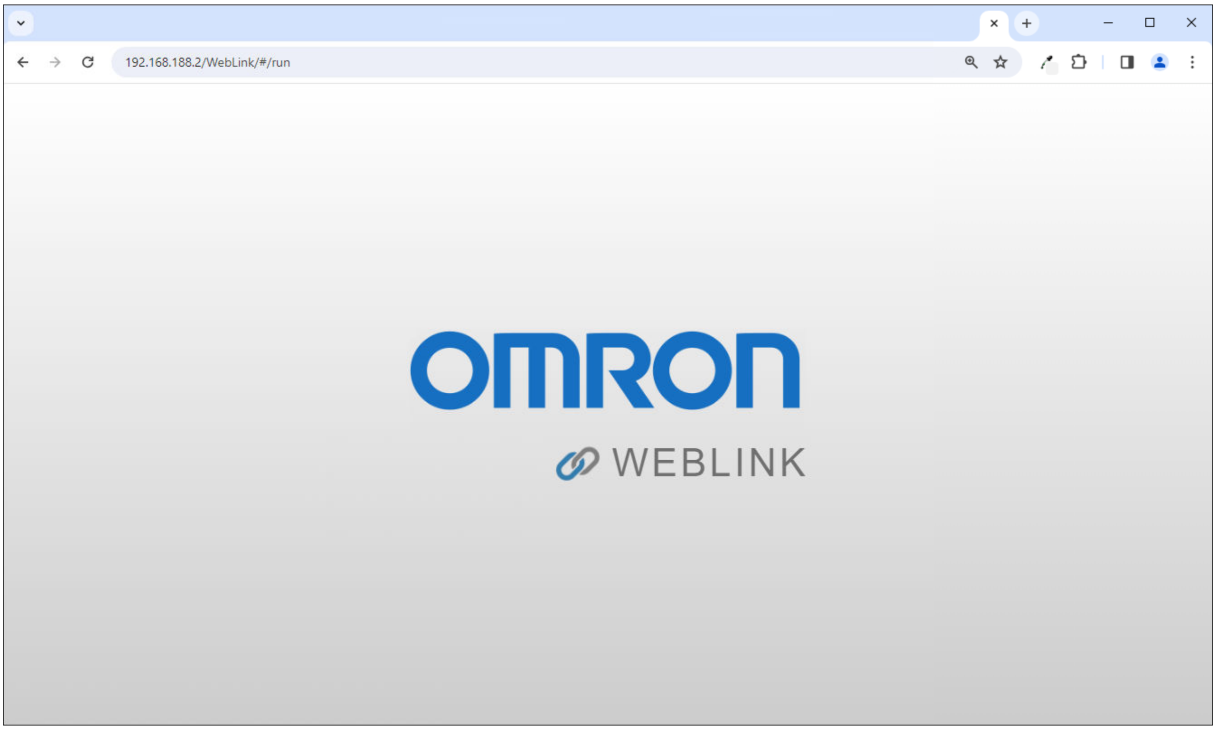
4-1 WebLink Overview and WebLink PC System Requirements

4-1-1 WebLink Overview

This section provides a quick high-level view of the VHV5-F WebLink programming interface as well as some of the main features in that interface. All elements of the user interface are described in detail in User Interface Details and Read Sequence Dialog.

WebLink is the main programming interface for the VHV5-F reader. It is a browser-based user interface hosted by the reader itself. **No PC install of software is required.**

To start WebLink, either use the DDU as described in System Configuration and Setup Flow, or simply type the IP address of the VHV5-F you wish to program in an approved browser on the programmer's PC.



4-1-2 WebLink PC System Requirements

Minimum System Requirements

- **Processor:** Intel Core i5 (10th gen or newer) or AMD Ryzen 5 (3000 series or newer)
- **RAM:** 8GB DDR4 (dual-channel configuration)
- **Graphics:** Integrated graphics (Intel UHD 630 or AMD Vega 8) or entry-level dedicated GPU with 2GB VRAM
- **Storage:** 256GB SSD (SATA SSD minimum, NVMe preferred)

- **Network:** Gigabit Ethernet port preferred
- **Operating System:** Windows 10 64-bit (version 1909 or newer) or Windows 11
  Display: 1080p monitor

Performance Assessment

To check if your PC meets the minimum requirements:

1. Windows System Assessment Tool (WinSAT):

- Open Windows Powershell as Administrator
- Run: **get-wmiobject -class win32_winsat**
- Check results. For this application, aim for scores of at least 6.0 in CPU, Memory, and Graphics categories.

```
Administrator: Windows Powe

PS C:\> get-wmiobject -class win32_winsat


__GENUS                  : 2
__CLASS                  : Win32_WinSAT
__SUPERCLASS             :
__DYNASTY                : Win32_WinSAT
__RELPATH                : Win32_WinSAT.TimeTaken="MostRecentAssessment"
__PROPERTY_COUNT         : 8
__DERIVATION             : {}
__SERVER                 : USOMCA3386
__NAMESPACE              : root\cimv2
__PATH                   : \\USOMCA3386\root\cimv2:Win32_WinSAT.TimeTaken="MostRecentAssessment"
CPUScore                 : 9.4
D3DScore                 : 9.9
DiskScore                : 8.7
GraphicsScore            : 8.1
MemoryScore              : 9.4
TimeTaken                : MostRecentAssessment
WinSATAssessmentState    : 1
WinSPRLevel              : 8.1
PSComputerName           : USOMCA3386


PS C:\>
```

Web Browser Recommendations

For optimal WebLink performance:

1. **Microsoft Edge (Chromium) -** Best choice for Windows integration, memory efficiency, and hardware acceleration support.
2. **Google Chrome -** Strong performance.

Edge is particularly recommended as it's optimized for Windows and typically provides the best hardware acceleration for image-intensive applications on Windows systems.

Browser Feature Requirements

WebLink requires certain features to be supported by the hosting browser. Support for these features is checked before WebLink loads, and if it is not available, an error message is displayed. The following features are required by WebLink and are checked at startup:

- Web Sockets
- HTML5 Canvas
- HTML5 Audio

4-1-3 Navigating WebLink

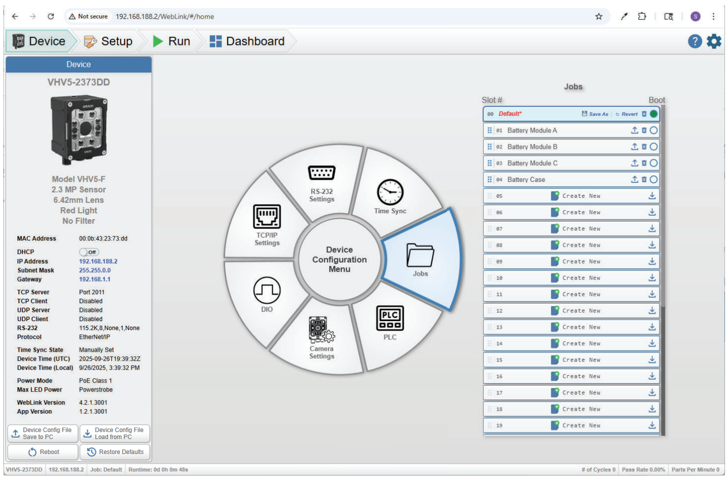
Mode Navigation

The WebLink user interface has four main views or modes that lead the user through the process of setting up the reader, programming it, and then deploying it on a line for reading applications. These are the **Device** view, the **Setup** view, the **Run** view, and the **Dashboard** view.

The chevrons at the top left of the UI are used to navigate between the different modes. Because the UI is actually running on the VHV5-F and being accessed by a browser, there is no need to upload or download jobs or settings between the UI and reader before changing from **Setup** mode to **Run** mode.

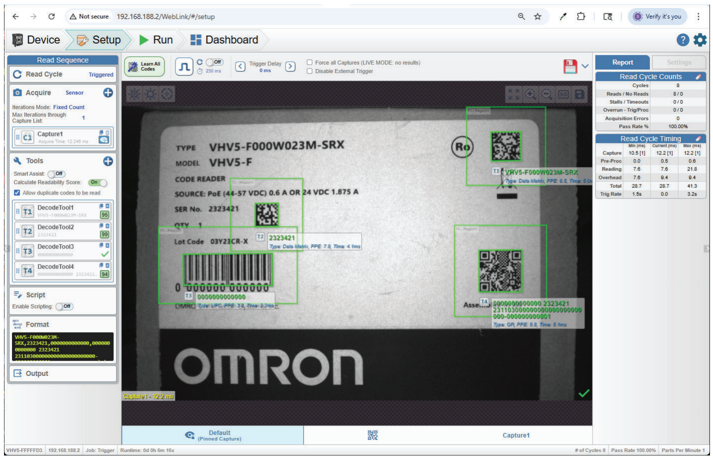
Device View

The **Device** view is used to set up VHV5-F hardware and communications channels to match the requirements of the line. These settings are persistent for all Jobs that are set up to run on that line. The **Device** view is also used as the file manager to create and manage reading **Jobs**.



Setup View

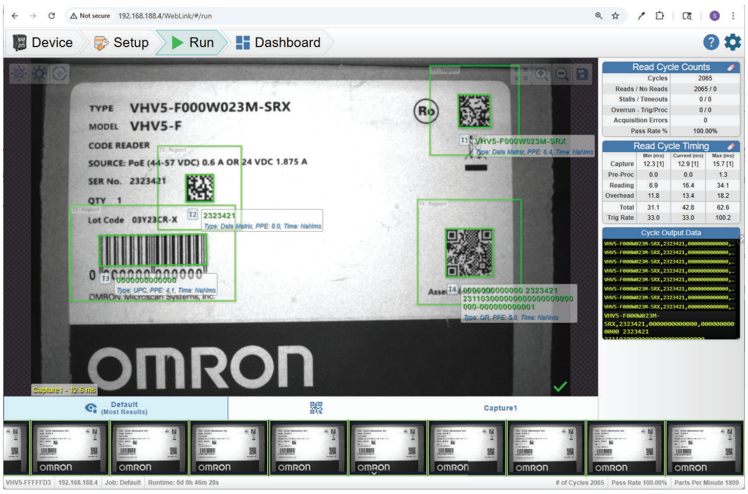
Once a Job is created or loaded in **Device** view, the **Setup** view allows the user to program, test, and tune the reading job before deploying it on the line. Job setup is aided by a number of high-level functions, such as Learn, that set up the Job automatically for the user.



Run View

The **Run** view is the main interface for real-time monitoring of the system as it is running on the line. It shows all images as well as counts, statistics, and read data for the production run.

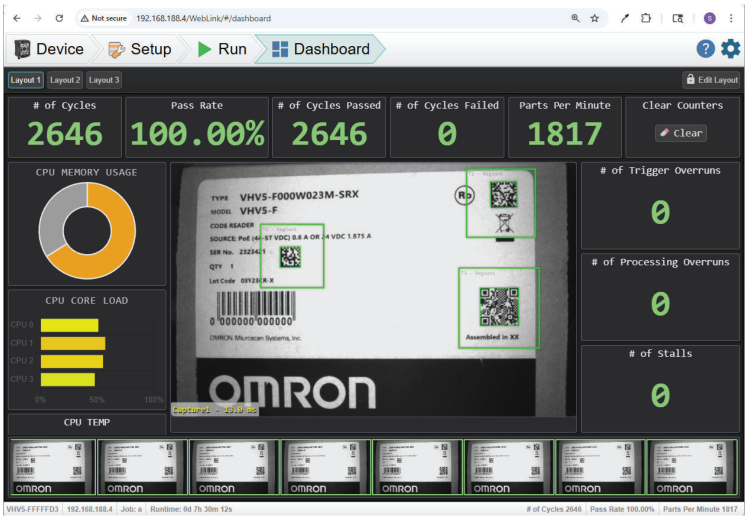
Note: The UI does not need to be connected when the system is in **Run** mode.



Dashboard View

The **Dashboard** view is a highly visual monitoring alternative to the Run view, showing images as well as key counts and statistics at a glance in an easy-to-view format.

Three different Dashboard layouts can be created to suit the needs of users off all levels of expertise.



5

Quick Start Guide for Programming the Reader

5-1 Basic Programming Flow

Chapter 1, ***Introduction***, discussed reader features, potential applications, and hardware accessories.

Chapter 2, ***System Configuration and Setup Flow***, guided the user through choosing a reader, unboxing it, getting it mounted and powered up, and then establishing a network connection to start the WebLink user interface.

Chapter 3, ***Theory of Operation***, provided a short tutorial on how the reader operates, allowing the user to take full advantage of the power and flexibility of the reader.

Chapter 4, ***Overview of WebLink 4.0 User Interface***, provided a quick map for navigating the different modes of the WebLink user interface from Setup to Runtime monitoring.

This chapter, ***Quick Start Guide for Programming the Reader***, walks the user through the six basic steps to program a standard code reading job. It begins with connecting to the device to access the user interface, creating a new job, programming and testing the job, and then deploying and monitoring the job as it runs on a production line.

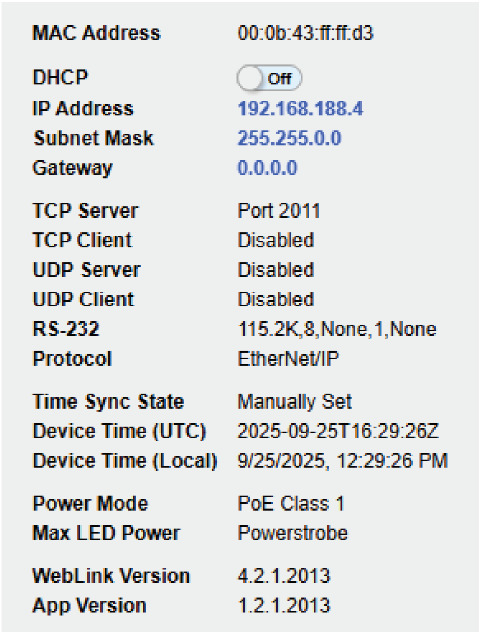
No.	Basic Programming Flow
1	Set Up Device Parameters on page 5-2
2	Create Job on page 5-3
3	Set Up Job on page 5-4
4	Configure Outputs on page 5-7
5	Test Job on page 5-9
6	Deploy Job on page 5-10

5-1-1 Example: Programming a Triggered Reading Job on a Production Line

1 **Set Up Device Parameters**

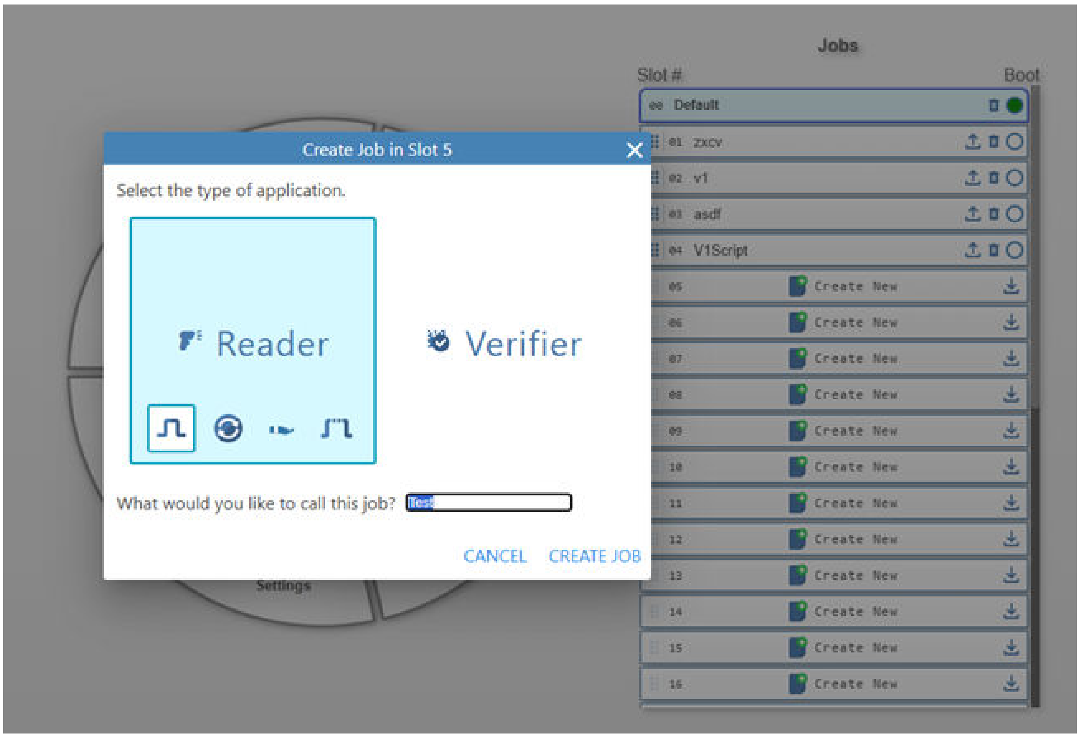
1) Connect to the reader by typing its IP address into your web browser's address bar.

2) Go to **Device** View and review current reader settings.



2 **Create Job**

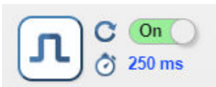
1) To create a job, select Jobs from the **Device Configuration** Menu.
2) Click on **Create New** in memory Slot 01 in the Jobs list. There are 32 possible slots to hold different reading jobs.
3) Choose a Job Type (in this case, select **Triggered**).
4) Give the job a name and click **Save**.
5) A new Triggered job is created and the user interface automatically switches to **Setup** view.



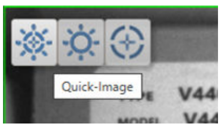
3 Set Up Job

1) While in **Setup** view, place the part to be read in front of the reader in the same position it will occupy while the line is running.

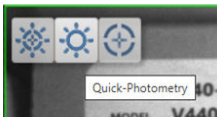
2) For triggered jobs, turn on virtual triggers at an interval of 250 ms. This will trigger the system without the line needing to be run. The read cycle will be run every 250 ms. If the line is running, the reader will respond to triggers coming in.



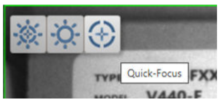
3) Click the **Quick-Image** button at the upper left of the image. This will automatically set the focus and exposure time to produce a good image to read codes.



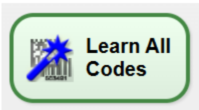
4) Alternatively, click the **Quick Photometry** button at the upper left of the image. Click in the image and drag around the area of the code to be read. The system will automatically set the sensor exposure time based on the immediate code area.



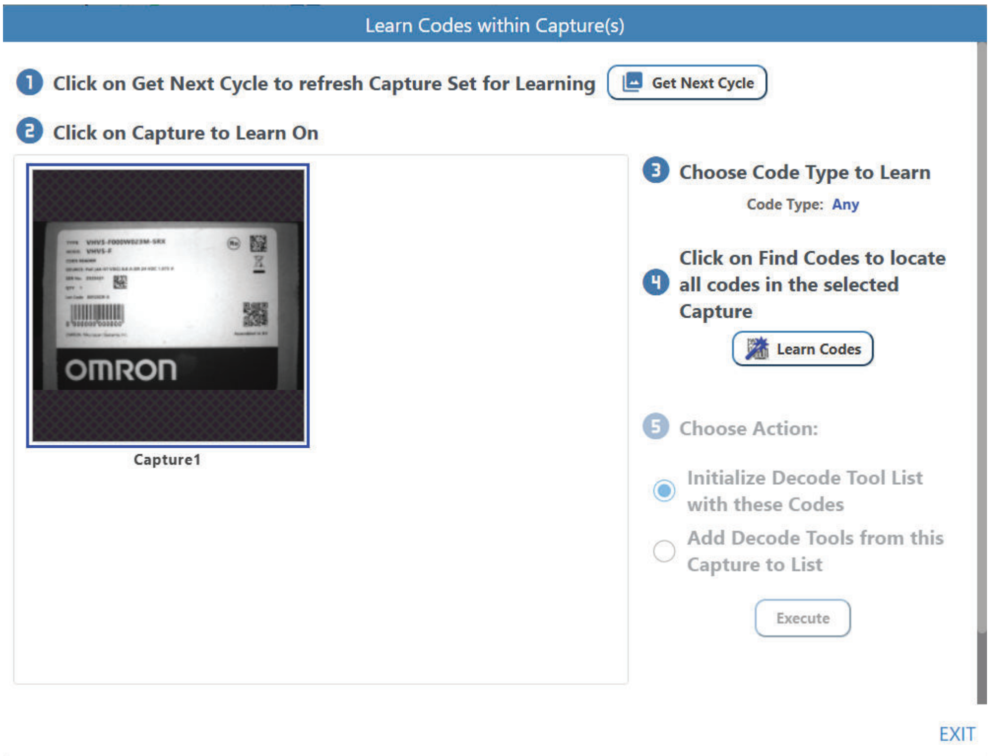
5) And, click the **Quick Focus** button at the upper left of the image. Click in the image and drag around the area of the code to be focused. The system will automatically set the best focus for the immediate code area.



6) Click the **Learn All Codes** button.



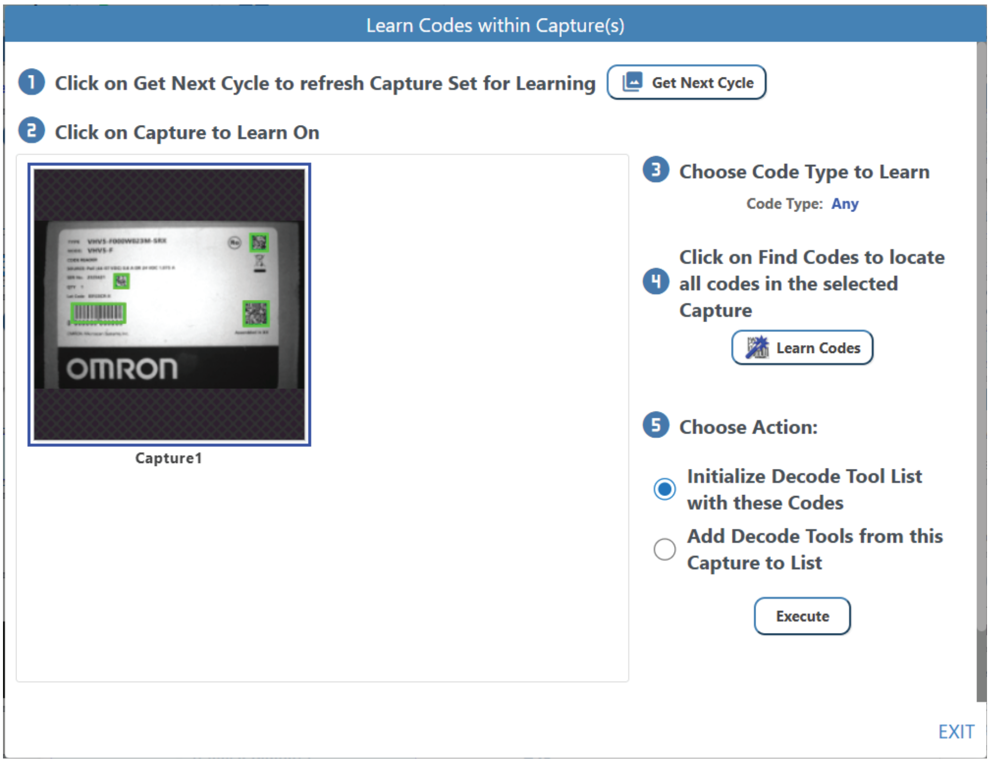
7) The system will display the following dialog box with the most recent image of the part in on the left side.



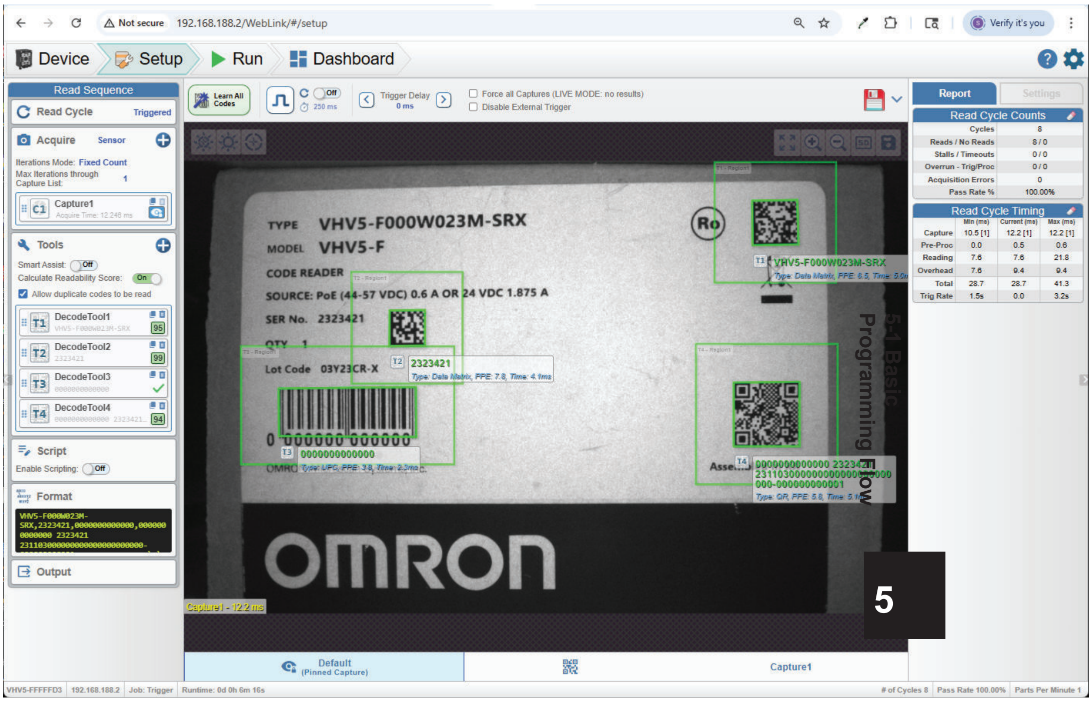
8) Change the values of Increase Search Region on each side of the code by X (pixels) and Y (pixels) to account for any positional uncertainty that is expected in the location of the part as the line is running.

9) Follow the steps from 1 to 4 to get the next image of the part and to locate all the codes in the image.

10) When prompted by step 5 becoming active, select **Initialize Decode Tools List with these Codes,** Click **Execute**, and then click **Exit**.



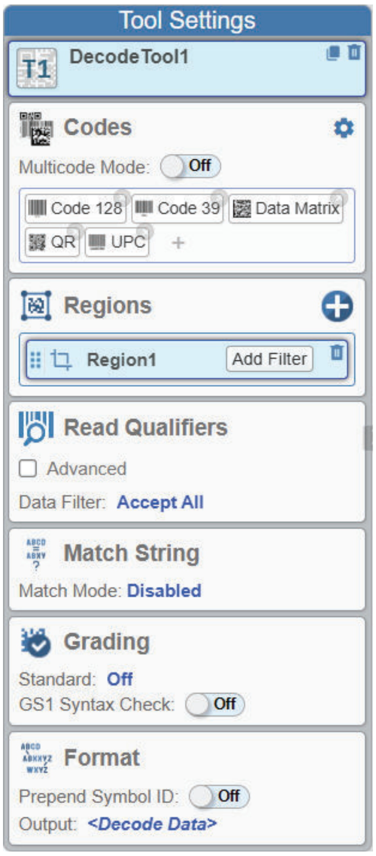
11) The system will automatically identify all codes of all types within the image and will create a Decode Tool with a region of interest for each one so they can be searched for and read individually within their own regions of interest. This accelerates code reading during run-time.

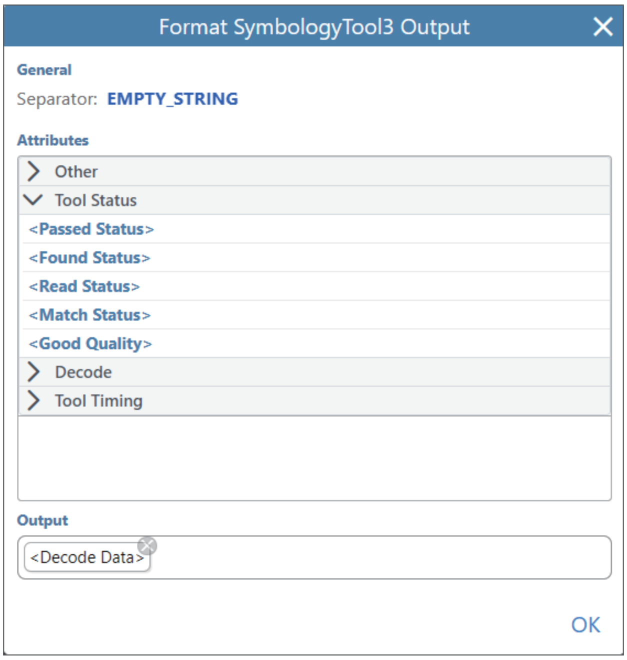


4 Configure Outputs

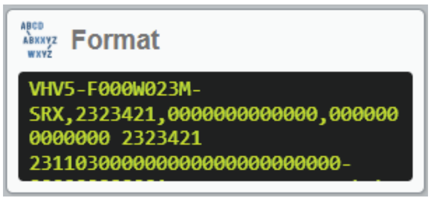
1) At the end of the Read Cycle, the system sends the resulting output as a string to the UI, as well as out the TCP port, RS-232 port, and through the Protocol assembly. Each Decode Tool generates a string result. By default it is just the decoded text of that Decode Tool. Other Decode Tool data, as well as user text, can be added to the string by clicking on **Decode Data** in the output section of the **Tool settings** dialog. It will bring up an editor for this purpose.

   Each Decode Tool generates a string result.

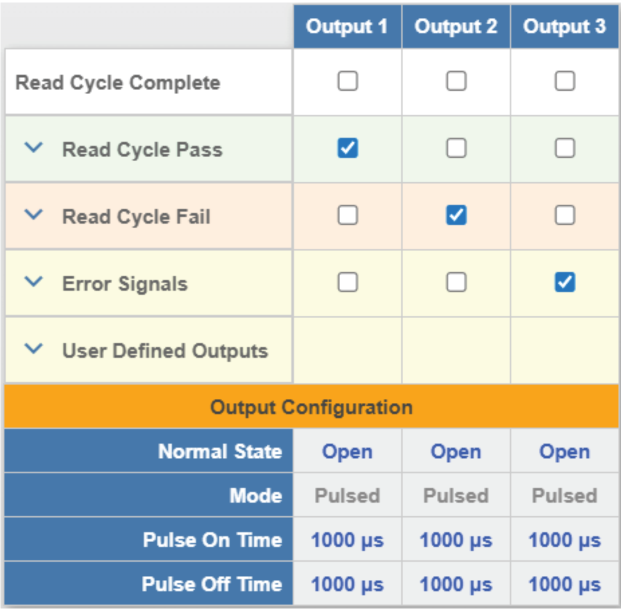




2) Next, the string from each Decode Tool is passed back to the Read Cycle Format Output step. The Format Step automatically appends all of the individual result strings from each Decode Tool into a final result output string. The order is the same as the Decode Tools in the list
3) The user can view the final output result in the **Format Output** box. Again, the user is able to add additional Read Cycle data to this string by clicking on the Format Output step in the Read Cycle and then working with that editor.



4) Digital Outputs for the Read Cycle are set up from the **Device** View. The default settings send a **Read Cycle Pass** on Output 1, **Read Cycle Fail** on Output 2 and any **Error** signal on Output 3.

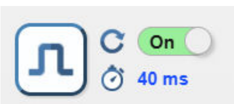


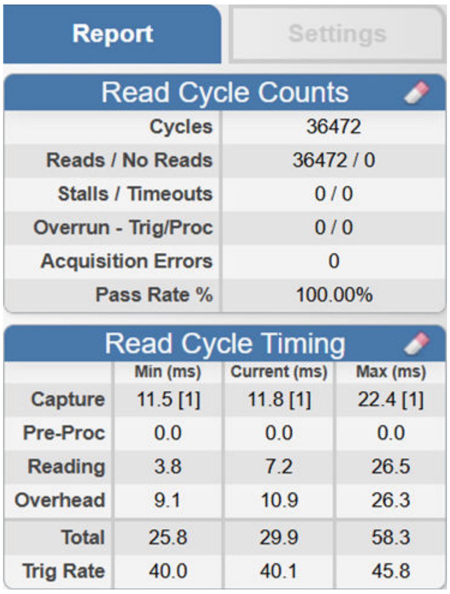
	Output 1	Output 2	Output 3
Read Cycle Complete	☐	☐	☐
Read Cycle Pass	☑	☐	☐
Read Cycle Fail	☐	☑	☐
Error Signals	☐	☐	☑
User Defined Outputs			
Output Configuration			
Normal State	Open	Open	Open
Mode	Pulsed	Pulsed	Pulsed
Pulse On Time	1000 µs	1000 µs	1000 µs
Pulse Off Time	1000 µs	1000 µs	1000 µs

5) PLC Protocol Outputs, whether EIO or PROFINET, are set into the standard Input Assembly that is common for both of them. (See **VHV5-F Communication Manual**.)

5 Test Job

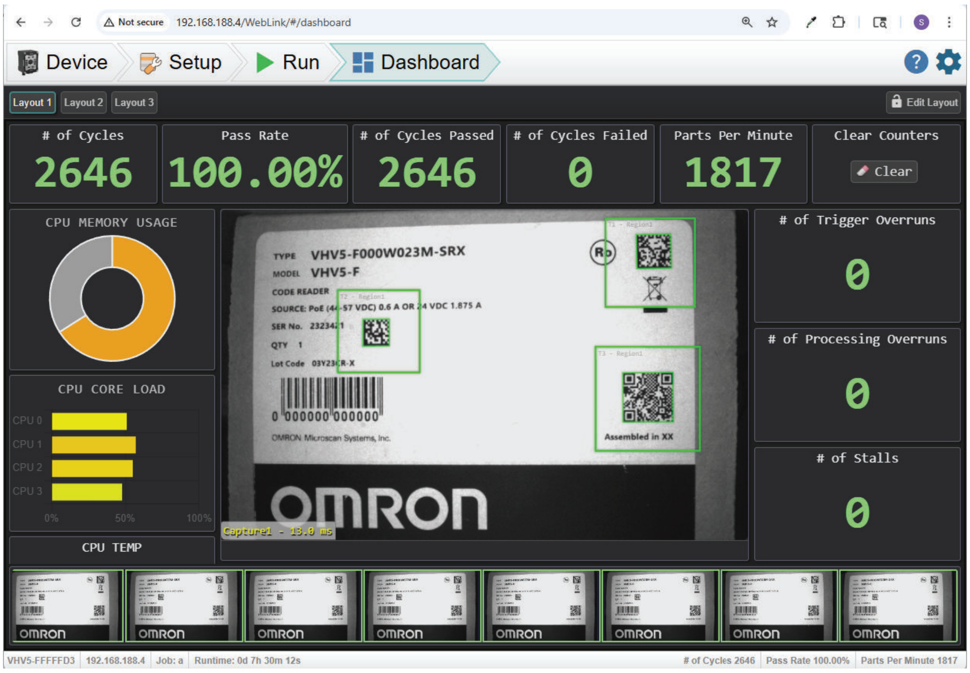
1) While in **Setup** view, test the job. With virtual or machine triggers running, the image constantly updates, showing the results of the read cycle.
2) The counts and statistics display shows pass / fail and timing for the read cycle. These values show the rate at which the reader can be run.
3) The Total time is the time from the trigger to when the read cycle results have been sent.
4) In the example below, it can be seen that the Total Read Cycle time varies between 25.8 and 58.3 msec.
5) You can confidently assume that a trigger rate of 50-60 msec can be sustained.
6) Faster rates can be sustained if the system is allowed to go into "pipeline" mode, where it is capturing the next image while the previous one is being processed.
7) Verify that this is the case by increasing the virtual trigger rate to 40 msec.





6 Deploy Job

1) Turn off the virtual trigger. Clear the read cycle counts and timing by clicking on the eraser icons.
2) The job is now waiting for actual triggers. There are multiple ways to trigger the reader from the running line. The following are the four trigger options that are active by default.
   - Virtual Trigger – Pulse generator in the user interface.
   - Serial Trigger – Via RS-232 or TCP-IP socket.
   - Industrial Protocol – PROFINET or EtherNet/IP.
   - Digital Trigger – High-speed trigger input on DIO port.
3) Enter Run mode by clicking the **Run** button. The system will now respond to actual triggers from the running line. Both the **Run** view and the **Dashboard** view are options for monitoring the production run.



6

User Interface Details

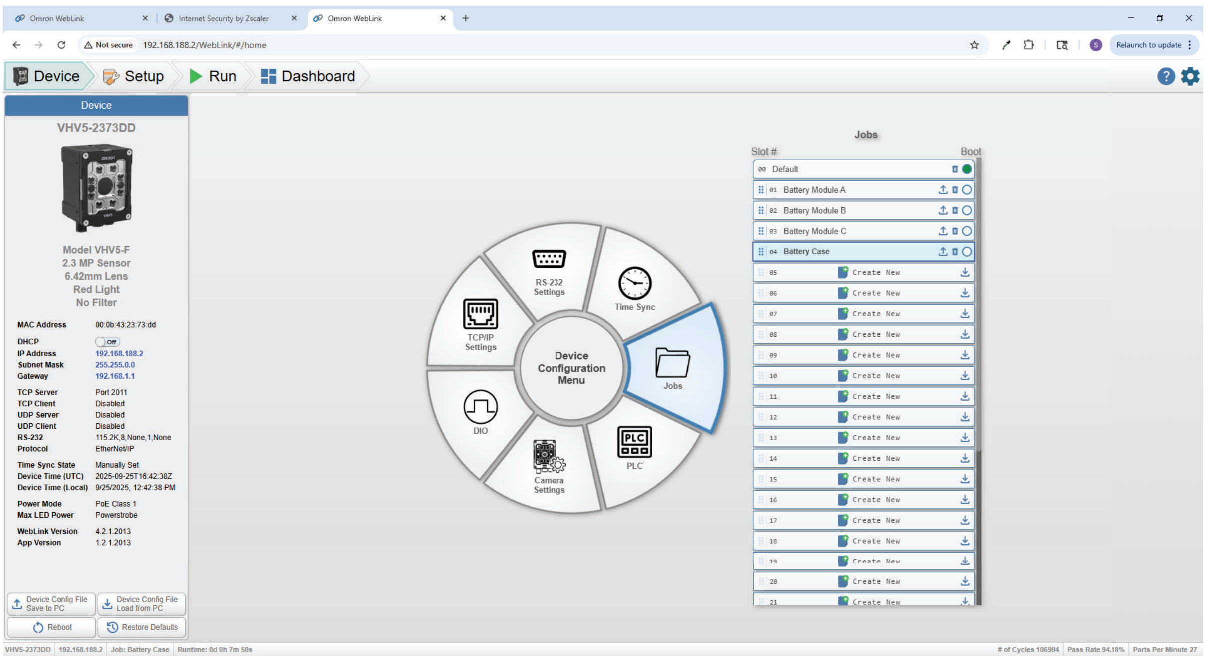
6-1 Device View

6-1-1 Overview

The **Device** view shows the current status and settings of the reader in the left-hand pane. The rotary menu in the middle is used to set up communication, industrial protocols, and other unique sensor and device settings. When menu items are selected, settings dialogs appear to the right of the menu wheel. If a parameter is changed, the user will be prompted to apply the settings.

The main control the user will access in the device view after the device has been set up is the Jobs menu. The Jobs dialog allows the user to Create, Save, and Load reading jobs.

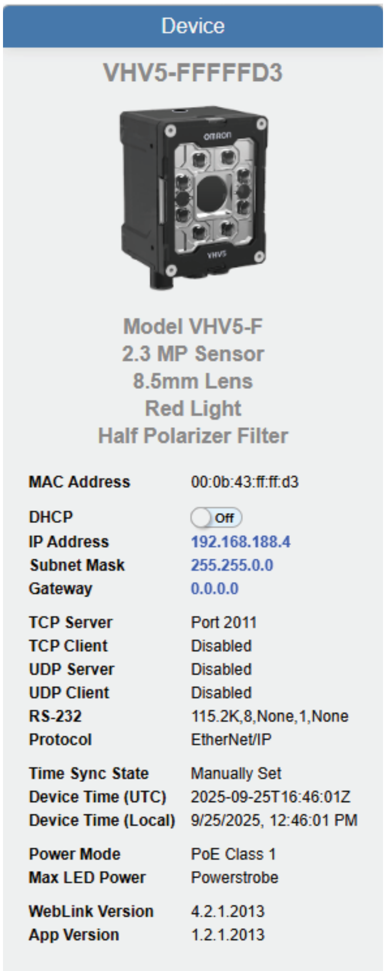
Key Point: Settings within the Device view, such as communications, Digital IO, and sensor settings apply to all reading jobs. The understanding is that the device (reader) will be deployed on a line and will communicate with the host by the same methods for all jobs, so it is logical for these setting re-main fixed.



6-1-2 State of the Reader when in Device View

- **Mode** = **Offline**. The Job is stopped. No read cycles are running.
- **Triggering –** Triggers are dropped in this mode.
- **Device Settings –** All device settings can be changed in this mode.
- **Job Change –** Jobs can be created, deleted, and changed in this mode.

6-1-3 Device Description Display



See details below for all elements displayed in the Device View as well as descriptions of how to set up the unit using the Device Configuration menu and dialogs.

Device Description and Status

The Device pane at the left side of the Device View is a summary showing the reader name, model details, communication settings, time and power settings, and the software versions currently loaded and running on the unit.

The information contains a combination of fixed data, such as the sensor and lens that are set at the factory; application settings such as RS-232 communications, which are changed through dialogs on the Device Page; and finally, settings such as the IP Address and Camera Name. The IP Address can be changed in WebLink. The Camera Name and IP Address can be changed in the Device Discovery Utility (DDU) as well.

● Fixed Settings

The following settings are factory-configured and not changeable by the user.

- Model Details – Shows the Sensor, Lens, and Light. These are set based on part number of the unit that was purchased.

- MAC Address – The MAC Address is unique for each device that is manufactured. The initial name of the device is based on the Model name and the MAC Address so that it will be guaranteed unique as well. For example, this device name is VHV5-F23742A. Whereas the MAC Address cannot be changed, the name can be changed with the DDU.

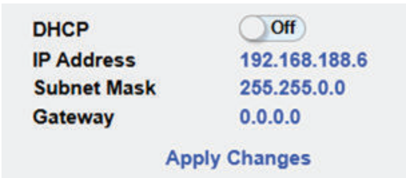
● Settings Controlled through the Device Configuration Menu Dialogs

The following communication parameters can be set directly from this page.

- TCP Server, TCP Client, RS-232, Industrial Protocols, Camera Time.
- Digital IO and various reader hardware settings such as Trigger polarity and debounce.

● Settings Controlled from the Device Pane

- **DHCP, IP Address, Subnet Mask, Gateway –** These IP settings can be changed directly in the Device Description pane. When the user makes any change, Apply Changes appears. The IP changes are immediate once the user clicks Apply. The user must retype the new IP Address into the browser to reconnect to the unit with WebLink.



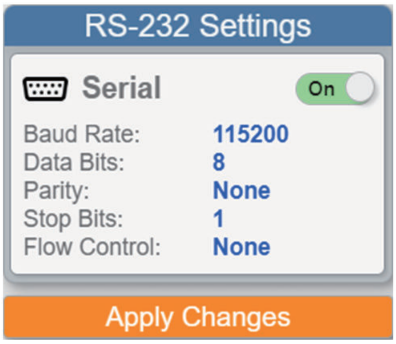
● Settings Made Using Device Discovery Utility (DDU)

- **Device Name –** By default the device name is set to “VHV5-F” + “MAC Address” of the reader. This guarantees a unique name out of the factory for each and every reader. The name can be changed using the DDU.
- **WebLink Version and App Version. –** This indicates the software versions that are loaded on the camera. Software updates can be performed using the DDU.
- **DHCP**, **IP Address**, **Subnet Mask**, **Gateway –** These IP settings can be changed through the Device Discovery Utility. Factory default for the unit is static IP address 192.168.188.2, 255.255.0.0, DHCP off.

6-1-4 Setting Up RS-232 Communications

RS-232 Settings Dialog

When enabled, the RS-232 channel can be used for both command input to the reader as well as for data output.



The default reader data output is the string constructed by the Format Output step in the Read Sequence. This is same string that is displayed in the UI, as well as the string that is sent over TCP/IP, and that is sent to the PLC.

RS-232 Settings

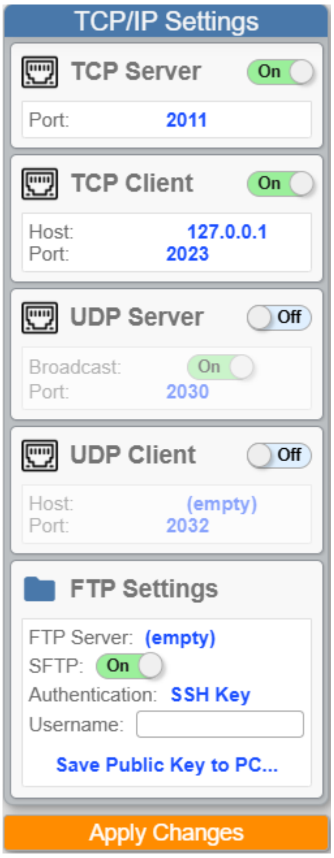
Item	Setting value [Job Default]	Description
Enabled	**[On]**, Off	The default setting of the Serial port is on. If this setting is changed, the reader must be rebooted for it to take effect.
Baud Rate	600, 1200, 2400, 4800, 9600, 19.2K, 38.4K, 57.6K, **[115.2k],** 230.4k	The rate at which the reader and host transfer data back and forth.
Data Bits	7, **[8]**	Seven or 8 bits comprising the data content
Parity	**[None]**, Even, Odd	An error detection routine in which one data bit per character is set to 1 or 0 so that the total number of bits in the data field is either even or odd.
Stop Bits	**[1]**, 2	One or two bits added to the end of each character to indicate the end of the character
Flow Control	**[None]**, Software (XOn/XOff), Hardware	Software flow control is a method of flow control used in RS-232 serial. It uses special codes, transmitted in-band, over the primary communications channel.

6-1-5 Setting Up TCP/IP Communications

TCP/IP Settings Dialog

The TCP/IP and FTP/SFTP settings dialog is used to set up reader-to-host communications, as well as to establish an FTP connection for saving Read Cycle images and reports.

TCP and UDP communication channels permit the establishment of connections with the reader on any port. The channels can be used for both command input to the reader as well as data output from the reader. The default reader output is the string constructed by the Format Output step in the Read Cycle. This is the same string that is displayed in the UI, as well as the string that is sent over RS-232, and that is sent to the PLC.



The reader can be set up as a TCP Server, TCP Client, UDP Server and UDP Client for maximum flexibility. The channels are not exclusive. Any combination of channels can be set up and will function simultaneously. Each channel operates in parallel with the others. Settings for one do not affect the others.

- **Default Settings**

By default, the reader operates as a TCP server, and communicates with the host (set up as a TCP client) over TCP/IP for both commands and data. If any setting is changed, the Apply Changes button appears. Settings are effective immediately after Apply.

- **TCP Server Implementation**

When the reader endpoint is configured as a TCP server, it is able to handle up to 10 simultaneous client connections. For TCP, the reader will refuse the connection when the limit has been reached.

- **TCP Client Implementation**

This allows the reader endpoint to be configured as a client that can then connect to a host server.

Note: The user must first set up and start an external TCP Server for the reader to be able to connect. The Host IP and Port are the IP and Port of the Server. The reader can only connect to one server at a time.

- **UDP Server Implementation**

When the reader endpoint is configured as a UDP Server, it is able to handle up to 10 simultaneous connections. For UDP, the reader will simply ignore the connection request due to the connectionless nature of the transport layer. By default, the UDP server will be in "Broadcast" mode, meaning it will send the V5 output data to all devices on its network or subnet. Any devices listening for UDP broadcast data on the same network as the VHV5-F can receive that data. Client UDP devices may send commands to the V5 by specifying its IP and the UDP Server port number (2030 by default). If the Broadcast mode is turned off, then the UDP Server will only communicate with devices that communicate with it first. For example, if a UDP client device were to send the “!TRIGGER” serial command, the VHV5-F would respond to that command by triggering an inspection and it would add the IP of that client to an internal list. All subsequent output data would then be sent to all clients in its list directly via UDP.

● UDP Client Implementation

This allows the reader endpoint to be configured as a UDP Client that can connect to a UDP Server running on the host. The reader can only send data out one UDP port. UDP is limited to UDP/IP in order to avoid broadcasting data on the network.

Note: The user must first set up and start an external UDP Server for the reader to be able to connect. The Host IP and Port are the IP and Port of the Server. The reader can only connect to one server at a time.

When in UDP Client mode, you must specify the IP address and port of the external UDP Server you wish to communicate with. All output will be sent directly to that IP and Port via UDP in a connectionless fashion. The VHV5-F will also listen for incoming commands from the specified IP and Port.

TCP/IP Settings

● TCP Server Settings

Item	Setting value [Job Default]	Description
Port	Any **[2011]**	Client devices connect to the reader using the reader’s IP and the Port number set in the dialog. There is no limitation on the port number for the reader, so can be set what is best for client.

● TCP Client Settings

Item	Setting value [Job Default]	Description
Host IP	Any	IP address of host running as TCP Server
Port	Any **[2023]**	The reader will connect to the host server using the IP of the host and Port defined by the host server.

● UDP Server Settings

Item	Setting value [Job Default]	Description
Broadcast	Off, **[On]**	If the Broadcast mode is turned on, the V5 data will be sent to all devices on its network or subnet. If the Broadcast mode is turned off, then the UDP Server will only communicate with devices that communicate with it first.

Item	Setting value [Job Default]	Description
Port	Any **[2030]**	Client UDP devices may send commands to the V5 by specifying its IP and the UDP Server port number (2030 by default). There is no limitation on the port number for the reader, so can be set what is best for client.

● UDP Client Settings

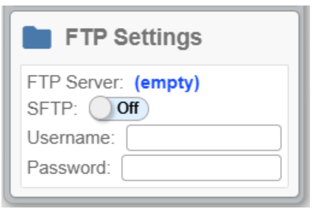
Item	Setting value [Job Default]	Description
Host IP	Any	IP address of host running as UDP Server
Port	Any **[2032]**	The reader will connect to the host server using the IP of the host and Port defined by the host server.

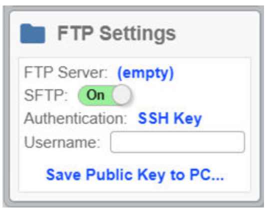
6-1-6 FTP and SFTP Settings Dialog

The TCP/IP and FTP/SFTP settings dialog is also used to set up a reader to remote FTP/SFTP Server connection for saving Read Cycle images and reports. The FTP/SFTP Server settings are global to all Jobs, and are therefore set up on the **Device** page under the **TCP/IP Settings** section of the wheel.

Once the Server connection is set up, the **Output** step in the job is used to program what files get saved, on what condition they are saved (e.g. Pass, Fail, etc.), and how they are named. The Output step is part of the Job, so these settings can be unique for each application.

The user can choose to transfer archived cycle reports to either an FTP or SFTP server at the end of a cycle. FTP (File Transfer Protocol) is the traditional, unencrypted method for transferring files, while SFTP (Secure File Transfer Protocol) encrypts the data during transfer, making it a more secure alternative. Note that FTP is faster than SFTP, so it is the preferred method when speed and not security is the goal.





FTP Server Mode

The following settings are required to connect and send data to a FTP server. The FTP server needs to be set up independently. The settings must match.

SFTP: Set to OFF.
FTP Server: The IP address of the server where cycle archive data will be written.
Username: The username of the FTP Server account you are logging into.
Password: The password of the FTP Server account you are logging into.

SFTP Server Mode

The following settings are required to connect and send data to a SFTP server. The SFTP server needs to be set up independently. The settings must match.

SFTP: Set to ON.
Username: The username of the FTP Server account you are logging into.
Authentication: When SFTP is enabled, an "Authentication" option is presented. The options for Authentication are Password or SSH Key.
Password: The user must enter a username and password in order to for the reader to login to the SFTP server. This option behaves the same as FTP, but is more secure.
SSH Key: This allows use of a public SSH key file for authentication, which is the most secure method. See next section for details.

SSH Key File Authentication

When SSH Key is selected, the VHV5-F automatically generates a private/public SSH key pair. On the VHV5-F, the **Private Key** file is used for authentication. But in order for that to work, the **Public Key** file must be retrieved from the VHV5-F and added to the list of authorized keys on the SFTP server.

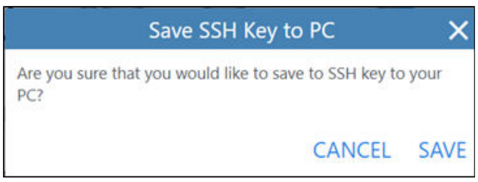
The following steps describe how to save a **Public Key** as well as an example of how to set up a typical SFPT Server to use the key.

Note: Consult your IT department in order to add the Public Key to the list of authorized keys on the specific SFTP server in use in the factory.

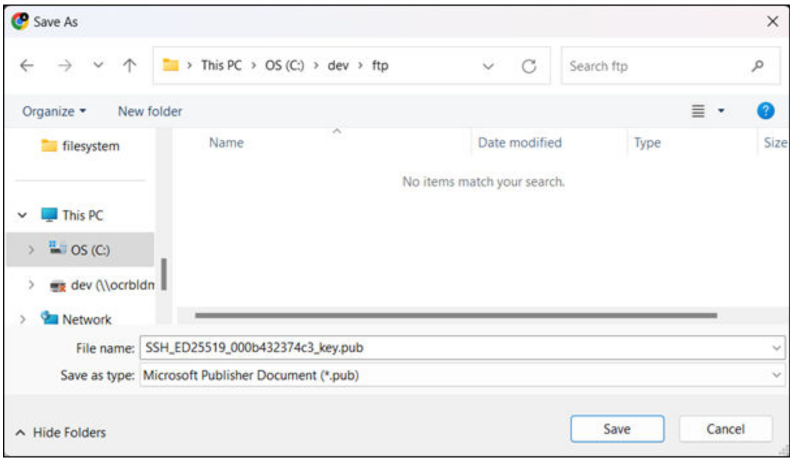
SSH Key File Authentication Steps

1 Extract a Public Key File and Save to PC

1) To extract the Public Key to share with the SFTP Server, click on the **Save Public Key to PC** option. The following dialog will come up:



2) Click **Save**. This brings up the **Save As** dialog to save the Public Key file to disk on the local PC hosting the Browser/User Interface. **Note:** The Public Key file name defaults to the name used on the camera. This name normally includes the Mac Address of the camera, which helps identify the individual camera if there are multiple cameras in use. It is recommended to keep the default name for this file.



2 Adding the Public Key to the SFTP Server (Example Only)

The following steps depend on the specific SFTP server that is being used. For illustrative purposes, as well as for test purposes, we will describe how to add the Public Key to the **OpenSSH** server in **WSL**.

1) **Open a CMD window "As Administrator" and install WSL.**
   a.) Type *wsl --install -d Ubuntu*
2) **Run WSL to get command prompt.**
3) **Install OpenSSH by issuing the following commands:**
   a.) *sudo apt update*
   b.) *sudo apt install openssh-server*
4) **Configure the Server for SFTP:**
   a.) *sudo nano /etc/ssh/sshd_config* (this opens the sshd_config file in a text editor)
   b.) Verify the following line is present in the file. Add it if not: *Subsystem sftp /usr/lib/openssh/sftp-server*
   c.) To allow password authentication, verify that the following line is present: *PasswordAuthentication yes*
5) **Start the Service**
   a.) *sudo service ssh start*
   b.) Enter the following if you want it to run every time you start WSL: *sudo service ssh enable*
   c.) To allow password authentication, verify the following line is present: *PasswordAuthentication yes*
   d.) Firewall: May need to add an exception for ***port 22*** to allow inbound connections.
6) Your SFTP server should be up and running now.

3 Configure SFTP Server to Allow Camera Authentication

1) Copy the public key you just uploaded from the camera to the */etc/ssh* folder in WSL.
2) Stop openssh service before making changes:
   a.) *sudo service ssh stop*
3) Add the public key to the 'authorized_keys' file in your home .ssh folder.
   a.) *cd ~/.ssh*
   b.) *sudo cat /etc/ssh/<public key file name> >> authorized_keys*

4) Start the service again:
   a.) *sudo service ssh start* (This will detect the changes to authorized_keys.)
5) **Take note of your username under WSL**. This is the username you will enter in the VHV5-F under the SFTP settings.
6) **Note:** If you do not have an .ssh folder in your home directory (~), you can add one. But you must be sure to set the correct permissions on that folder:
   a.) *cd ~*
   b.) *sudo mkdir .ssh*
   c.) *chmod 700 ./.ssh*
7) **Note:** If you had to add the .ssh folder, that means you also didn't have an 'authorized_keys' file. It is important that you have the correct permissions set on that file as well. Once it is created, do the following:
   a.) *cd ~/.ssh*
   b.) *chmod 600 authorized_keys*
8) **Once the public key file has been added to your server's list of authorized_keys and you have entered the same username on the VHV5-F as your user account in WSL, you should be able to authenticate from the VHV5-F**.

6-1-7 FTP Settings

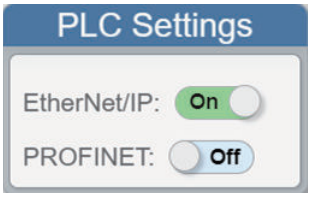
The FTP/SFTP settings dialog is used to set up reader-to-host communications, as well as to establish an FTP connection for saving Read Cycle images and reports to a Remote Server.

Item	Setting Value [Job Default]	Description
FTP Server	**[empty],** IP Address (x.x.x.x)	The IP Address of the Remote FTP or SFTP Server.
SFTP	**[On],** Off	On if using secure SFPT Server, Off if using standard FTP Server.
Username	**[blank],** user input	The Username for the FTP/SFPT Server account you are logging into.
Password	**[blank],** user input	The Password for the FTP/SFPT Server account you are logging into. Password becomes an option depending on the Authentication method chosen using next parameter.
Authentication	**[SSH Key],** Password	Option presented for SFTP Server. Authentication can be set to be either an SSH Key or Password.
Save Public Key to PC	**Function**	Save a Private Key to the Camera for SFPT, and opens dialog to save Public Key that should be added to authentication list on SFTP Server.

6-1-8 Enabling PLC Communications

PLC Settings Dialog

Either the EtherNet/IP or PROFINET protocol can be enabled at any one time. They cannot both be on. Both can be set to off.



There is no Apply button in this case. The setting auto-applies.

● Assemblies

Both EtherNet/IP and PROFINET use the same Output (PLC->Reader) and Input (Reader->PLC) Assemblies. The Output and Input Assemblies reflect Reader Control and Reader Status. The Input Assembly optionally provides the string constructed by the Format Output step in the Read Cycle to the PLC, or an Extended report.

See VHV5-F Communications documentation for details.

Output Assembly	Input Assembly
Read Cycle Control	Read Cycle Status
Reader Control	Reader Status
Job Control	Job Status
Command Control	Command Status
Output IO Control	Digital Input and Output Status
	Default and Extended Report

PLC Settings

PLC Settings

Item	Setting value [Job Default]	Description
EtherNet/IP	Off, **[On]**	Enable/Disable EtherNet/IP
PROFINET	**[Off]**, On	Enable/Disable PROFINET

6-1-9 Setting Camera Time

Camera Time Sync Dialog

The camera contains a high-resolution clock that needs to be synchronized to an external clock when powered up for the camera to be able to output “current” time information. This is because the camera does not have battery backup that keeps time when the unit is powered off.

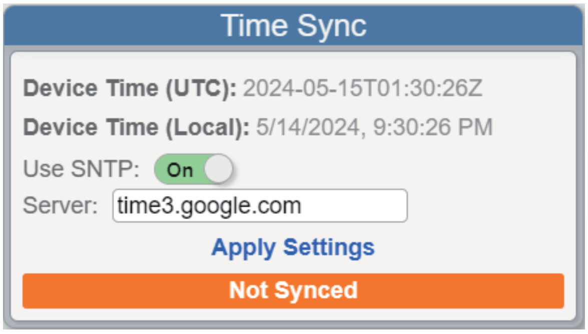
If the camera is not synced to an external clock, the camera clock will reference the base time that was set by the factory reflecting the time at which the camera was manufactured.

● Time Sync Options

The **Time Sync** dialog is used to synchronize the camera to an external clock. The external clock can be an SNTP (Simple Network Time Protocol) time server if the camera is directly plugged into a network that allows internet or intranet access to an SNTP server. If not connected to an SNTP server, time can be set manually using the time from the PC browser that is running WebLink.

● SNTP On

If set to **On**, the camera is set to connect to an SNTP server. As stated, SNTP requires that the camera be on a network that allows access to an SNTP source. The user should enter the IP address or URL representing a known SNTP server, and then click **Apply Settings**.



■ Synced

If successful, the camera clock is updated to UTC (Universal or Greenwich Mean Time) time, and a message is displayed at the bottom of the dialog indicating that the camera is synced. The current device time will be displayed at the top of the dialog in both UTC and Local formats. The camera clock is refreshed automatically every 30 minutes when set to use SNTP to keep it accurate.

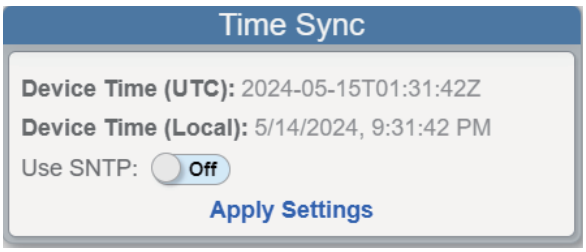
■ Not Synced

If the connection to the server is not successful, the message will be set to **Not Synced** and the camera clock will default to browser time if WebLink is running, or to the time set when the reader was manufactured if no browser is connected.

Key Point: For SNTP to work, the reader must be on a network that allows access to the internet to use the common SNTP servers, or to an intranet that has an SNTP server running. The reader cannot be synced if it is connected directly to the PC on a local-only network.

● SNTP Off

This is the default setting. If SNTP is set to **Off**, the reader will automatically sync to the time obtained from the browser when the reader is connected to WebLink. The Time Sync State reflects that the time is manually set.

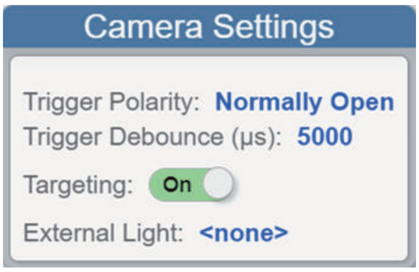


Item	Setting value [Job Default]	Description
Device Time	**N/A**	Displays the time from the camera clock. This will be default camera time if the camera has not been synced, or it will be the time from the source used to set it, either an SNTP server, or time from the browser being used to run WebLink Note: UTC time is used for Time Stamps and for File Names. UTC is Universal, or Greenwich Mean Time. Local time is there for display purposes.
Local Time	**N/A**	Displays Local Time based on the browser.
Use SNTP	**[Off]**, On	When set to Off, the camera time will be set to time from the browser if WebLink is connected and the user clicks Apply Settings. If On, the camera will attempt to get time from the SNTP server when the user clicks Apply Settings.
Apply Settings	**N/A**	Apply will initiate the camera sync operation.
Server	**[blank]**, known internet or intranet factory time server	**Time1.google.com** is one example of a common public SNTP server, but one that requires internet access to use. Consult your IT department for internal SNTP servers accessible on the factory network.
Sync Message	**Not Synced**, Synced	If Use SNTP is on, the message will display **Synced** if the clock is synced to an SNTP server. Otherwise it will display **Not Synced**. If SNPT is off, the message will display **Manually Set** upon obtaining time from the browser.

6-1-10 Setting Basic Camera Hardware Parameters

Camera Settings Dialog

This dialog is used to set basic camera hardware parameters related to Trigger, Targeting, and External Light control using the External Light Port connector.



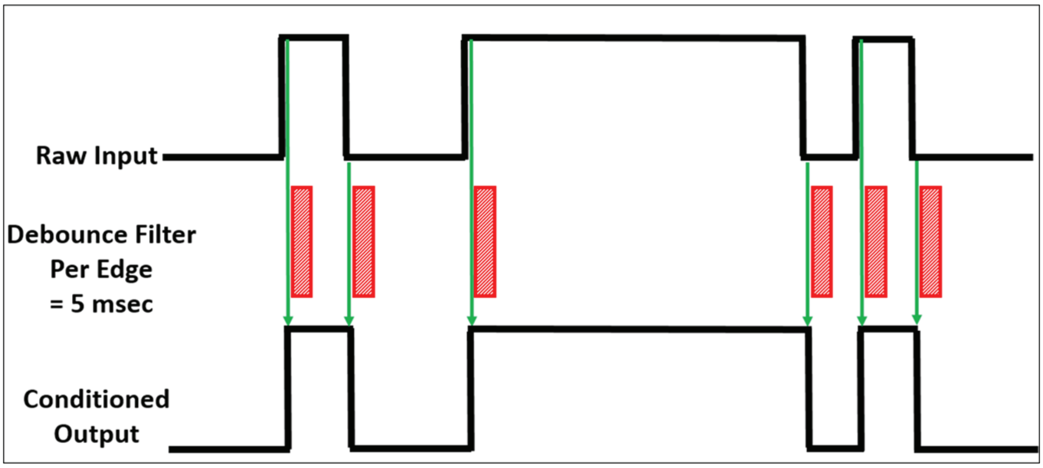
If settings are changed, the Apply Changes button appears. Settings are effective immediately after Apply is clicked.

Each item is explained in detail below.

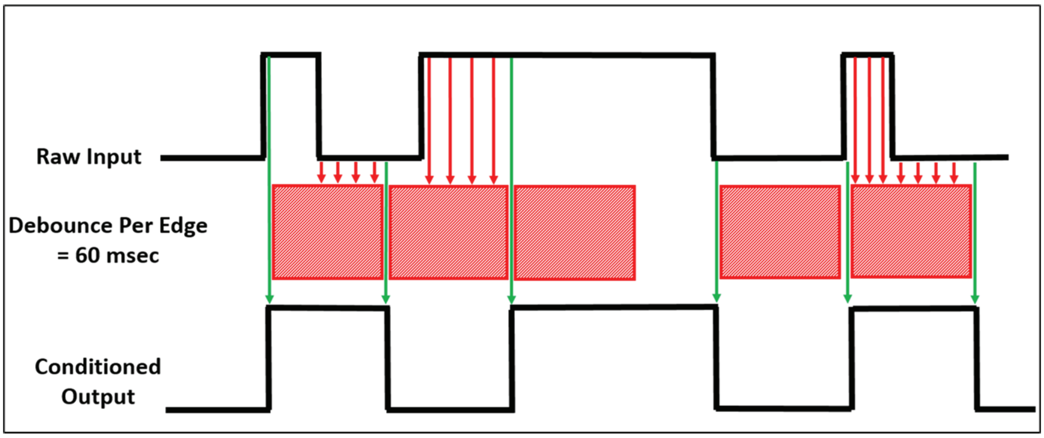
● Trigger Debounce

Trigger Debounce is a filter applied to both the rising and falling edge of a trigger. Trigger debounce time is used to ignore any bounce in the trigger signal that can occur because of electrical noise or problems with the trigger detecting the object.

Example 1: By default, the debounce time is set to 5 msec. As can be seen in the diagram below, this allows all of the low-to-high and high-to-low transitions to be passed though in a system with clean triggers.



Example 2: In the second example below, the debounce time is set to 60 msec. Any extra transitions in the trigger state that occur within this time will be filtered out. The debounce time starts right after the "Conditioned" low-to-high and high-to-low transition. If transitions occur within the debounce time, they are blocked. The line will be set to the state of the input at the time debounce is complete. Note how the final transition from high to low is held off by ~35 msec.



Note on Debounce Setting for Start/Stop Mode: For Start/Stop Mode, a rising edge starts the read cycle, and a falling edge stops the read cycle. If trigger transition occurs during the acquire time, the system can get out of sync. It is recommended to set the Debounce time to (20 msec + Exposure Time) for the 2.3 MP camera and (30 msec + Exposure Time) for the 5 MP camera to prevent this from happening.

Camera Settings

Item	Setting value [Job Default]	Description
Trigger Polarity	**[NormallyOpen]**, Normally Closed	Describes the normal state of trigger input. The reader triggered when the controlling system sets trigger to opposite state.

Item	Setting value [Job Default]	Description
Trigger Debounce (μs)	10-1,000,000 (1 sec) **[5000]**	Amount of time after receiving a trigger that the system will ignore new triggers. Allows the system to ignore trigger bounce which is common in some lower-cost, older technology hardware. Note that the debounce signal is applied to both the rising and falling edge of the trigger input line.
Targeting	Off, **[On]**	Enable/Disable green targeting lights on front of reader.
External Light	**[Inactive]**, NER Smart Series, **NPN and PNP Options**, SVL Nano or Multi-Drive Lights	Dictates what signals are active on the 5 pin 3rd connector for external lighting. Signals include Strobe Trigger Output, Power Output, and Analog Output (normally used for dimming control). • **Inactive – No output on 5 pins** • **NER Smart Series –** Power and appropriate strobe outputs for NER Smart Series. (No Dimming function). • **NPN Inverted Strobe Trigger Output –** Power and NPN Strobe Trigger, Active Low • **NPN Strobe Trigger Output –** Power and NPN Strobe Trigger, Active High • **PNP Inverted Strobe Trigger Output –** Power and PNP Strobe Trigger, Active Low, No Dimming • **PNP Strobe Trigger Output–** Power and PNP Strobe Trigger, Active High, No Dimming • **SVL Nano or Multi-Drive Lights –** Power, Strobe and Dimming analog voltage 0-10V.

6-1-11 Creating, Saving, and Managing Reader Jobs

Managing Jobs in the Job Slots Dialog

Jobs Menu: The user is able create a **Job** for each unique reading application that will run on the production line. For example reading a single UPC code on one vendor’s bottled of water vs. reading a UPC code and a QR code on another vendor’s bottled water.

In practice, the user will create a **Job** for each product, set it up and then test it. Once the job is complete, the user will store it on the camera in 1 of 32 **Job Slots**.

Note: The first slot 00 is reserved for a factory demo job that can be run at any time.

On power up, the reader will load and run the job marked as the **Boot Job**. Jobs can be changed at any time using the Jobs menu by selecting the slot containing the Job to be loaded. Jobs can be changed programmatically as well through RS-232, TCP/IP and using the PLC by issuing a command which references the Slot # for the job to be loaded.

Job Menu Controls

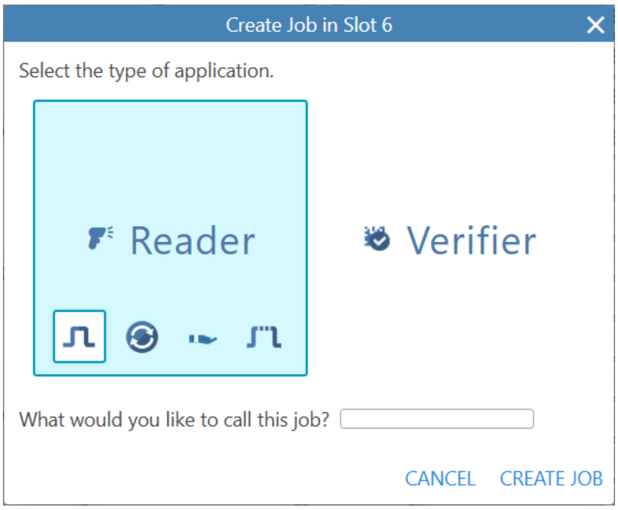
Directions for using the major Job menu functions are detailed below. The available functions are:

- Create New Job
- Save Job, Save As
- Revert Job
- Delete Job
- Change the Order of the Jobs in the Slots
- Set the Boot Job
- Archiving Jobs on the PC
  - Save Job from Slot # to PC
  - Load Job from PC into Slot #
  - View Job on the PC

● Create New Job

A new Job is created by clicking on Create New inside of an empty Job Slot.

The following dialog is displayed. The user is prompted to choose a specific Job Type (see Read Cycle Types) and then give the job a unique name.

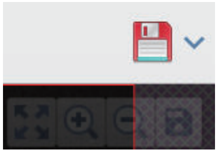


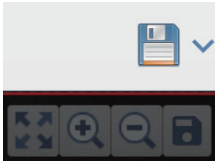
Once the user clicks **Create Job**, the user interface will automatically advance to the Setup View where they user will proceed to set up the actual application.

● Save Job, Save Job As

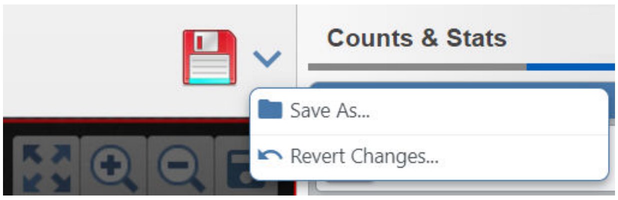
Once the job is complete, the user should save the job. There are two ways to save the job.

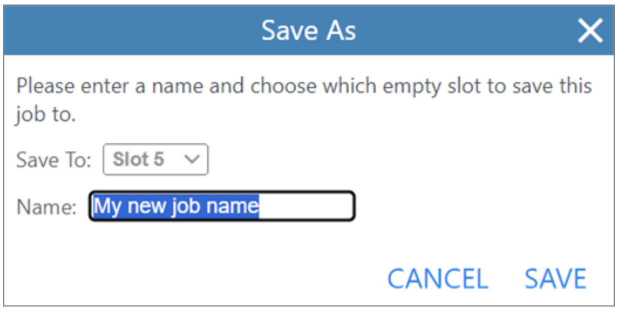
1. One method is to click on the **Save** Icon in the upper right corner of the image in Setup View. The icon will be red if there are pending changes. It will be blue once the job has been saved. The user also has the ability to save the job with another name to a different slot.

   The user also has the ability to do a **Save As** from this control by clicking the down arrow next to the disk icon. When the Save As drop down option is selected, the user is presented with a dialog to save the current job with a new name, as well as the slot a new slot in which to save it.

2. The second method is to go back to Device View. The currently selected job text will be red with an *, indicating that the job has changes not have not been saved. Click on the **Save** icon.

- **Revert Job**

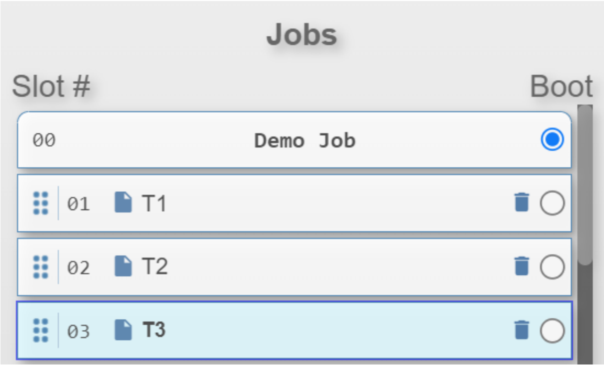
  Both methods also present the option to Revert Changes. By selecting this option, any changes made since the job was last saved will be reversed.

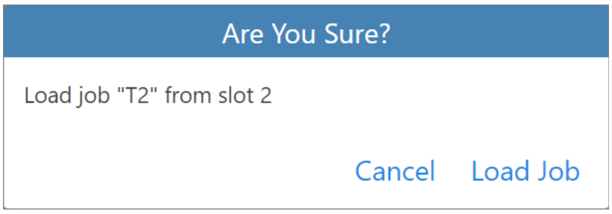
- **Delete Job**

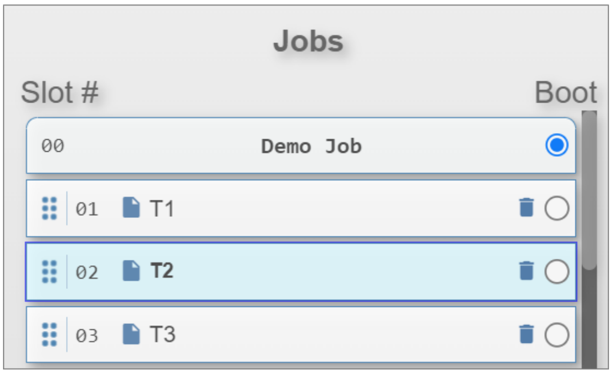
  Jobs can be deleted from Slots and from the camera by clicking on the Trash Can icon on the right side of the slot. That slot is now free for user to create and store another job into it.

- **Change Job**

  The current selected and loaded job is highlighted in light blue. The user can change jobs simply by clicking on a different slot with a Job stored in it. The user will be prompted if they are sure they want to change the job. The user selects Load Job. The Job change is almost instantaneous, and the newly selected job is now highlighted in light blue.



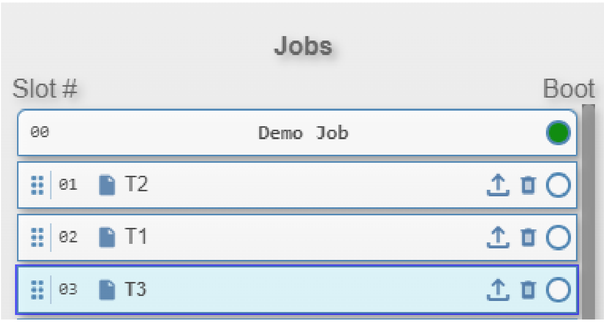


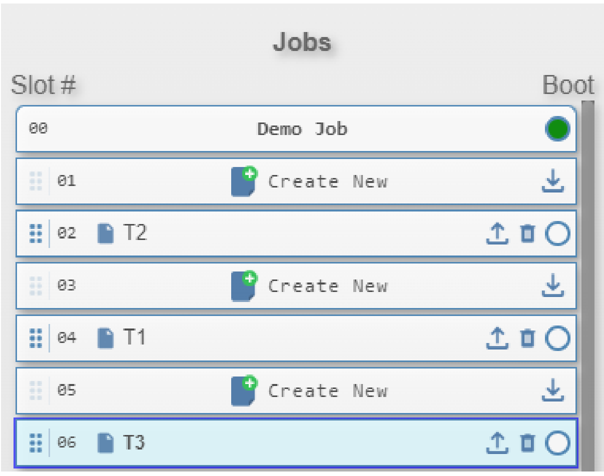


Key Point: Job Change can also be done programmatically from the PLC for from Serial or TCP/IP commands as the reader is running.

● Change the Order of the Jobs in the Slots

The user can rearrange the order of the job slots. This is done by clicking on the icon at the left side of the slot, and then dragging the job selection into a new location. The first example below shows a simple rearrangement. The second example shows shifting jobs down to allow for other jobs to be inserted between them.





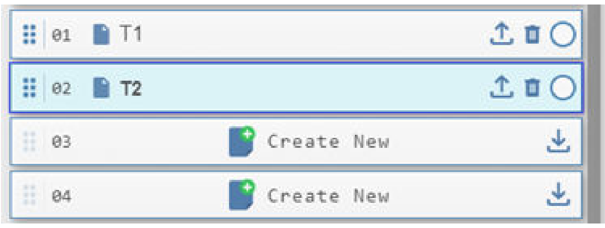
● Set the Boot Job

The boot job is the job that will be loaded when the camera is powered up. On power up, the job is loaded, and the reader is automatically put into Run Mode waiting for triggers.

The current Boot Job is indicated by the radio button to at the right side of the job slot. To change the Boot Job, click on the radio button for the Job/Slot that should be loaded and run at power up.

● Archiving Jobs using the PC

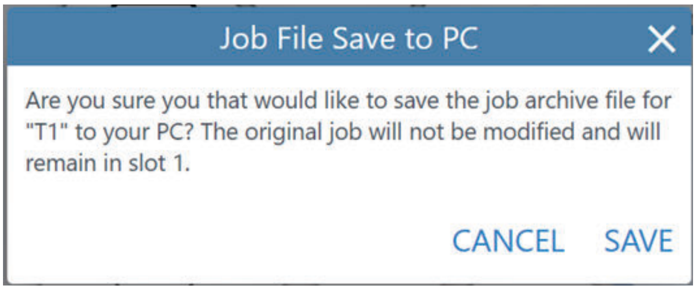
Job archive files can be saved from the reader to the PC, and inversely loaded from the PC into the device. As shown below in the Job Slots list, occupied slots have a button representing **Job File Save to PC**. This is an up arrow indicating that the job in that slot will be saved to the PC. Empty slots have a button representing **Job File Load from PC**. The icon is a down arrow indicating that job will be placed into that slot.



■ Job File Save to PC

Clicking on the **Job File Save to PC** button for an occupied job slot will prompt the user with a confirmation dialog. Clicking **Save** from within this dialog will transfer the job's archive file from the camera to the user's default download folder configured for their browser.

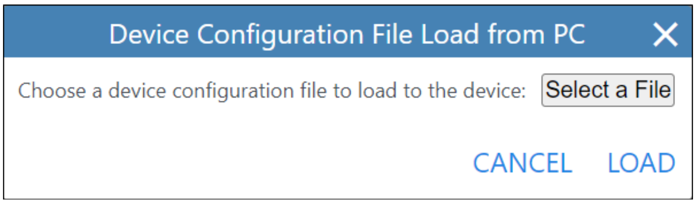
The naming format for the job is "Slot#_Job Name.job", where the Slot number is the slot it was uploaded from, and the Job Name is the name the operator gave the job. The file extension is automatically set as .job.



■ Job File Load from PC

Clicking on the **Job File Load from PC** button in an empty slot will prompt the user to Select a job archive file on the PC and then Load it into that slot.

Select a File will open a standard windows browser for the user the choose the job. The system will do basic error checking and confirm that the selected job file is a valid job archive, compatible with the device, and not using an existing job name. If the job is not compatible, the user is given the option to force the job to load anyway. Some settings may be modified or lost in this case.



■ Viewing Jobs on the PC

When jobs are saved to the Downloads directory on your PC, they follow the naming convention "Slot#_Job Name.job". This file, despite its ".job" extension, is actually a .zip archive. If you need to examine the contents of the job, you can simply rename the file extension from ".job" to ".zip". After renaming, you can extract the contents into a folder. Inside, you will find the actual job configuration in a file named "job.json". This .json file can be opened and viewed with any standard text editor. Additionally, if you need to compare this version of the job to another, you can use a file comparison tool like WinDiff to highlight any differences between the two versions.

6-1-12 Setting Up Digital Outputs

	Output 1	Output 2	Output 3
Read Cycle Complete	☑	☐	☐
Read Cycle Pass	☐	☑	☐
Read Cycle Fail	☐	☐	☑
Error Signals	☐	☐	☐
User Defined Ouputs			
Output Configuration			
Normal State	Open	Open	Open
Mode	Pulsed	Pulsed	Pulsed
Pulse On Time	1000 µs	1000 µs	1000 µs
Pulse Off Time	1000 µs	1000 µs	1000 µs

Using Digital Outputs to Signal Read Cycle Result Status

The reader has three digital outputs (Output 1 - 3) that can be used to provide detailed Read Cycle Pass/Fail information, as well as Reader Error information to an external host system.

● Digital Output Mode of Operation

The three Digital Outputs operate in Pulsed Mode. They will activate (turn on) at end of each Read Cycle to reflect the Read Cycle status. The outputs will be held on for a user to set Pulse On Time, and then will be held off for a user to set Pulse Off Time.

Key Point: The total Pulse On Time and Pulse Off Time will extend the length of the Read Cycle by that combined amount. Setting these values longer than necessary for the host to see the pulse can result in higher Read Cycle times than may be necessary. The default on and off pulse times are 1000 µs. This will add 2 msec to the Read Cycle time.

● Digital Output Normal State

The normal (not activated or off) state of each output can be set to Normally Open or Normally Closed.

● Digital Output Setting Logic

There are multiple check boxes under each Output that give the user a wide range control over how and why that Output will be set. One or more signals can be assigned to the same Output line.

If any of the selected states are true, the output line will be activated. **Example:** In the diagram above, both Overrun and General Error are selected under Output 3. If either of these errors occur, the Output will fire. The Output follows OR logic.

● Default Digital Output Settings

The default settings should be adequate for most applications. They provide a pulsed Pass, Fail, and Error signal at the end of each Read Cycle.

- Output 1 – Read Cycle Pass
- Output 2 – Read Cycle Fail
- Output 3 – Error Signals - Read Cycle Trigger and Processing Overrun Error, and General Reader Error.
- Operation
  - Normally Open
  - Pulsed Mode
  - Pulse On and Off Time – 1000 μs (1 msec)

● Alternate Digital Output Signaling Strategies

The default output setting indicates Read Cycle pass/fail, as well as any error that has occurred for each Read Cycle. The outputs can be configured differently than the default to give finer detail for each step in the read cycle as well as the exact error type. Clicking on the down arrows next to Pass Signals, Failed Signal, and Error opens up the Output dialog menu to show the detailed settings.

Positive Logic Example: This example shows, using Positive Logic, a deeper look into what passed or failed in the Read Cycle.

Output 1 is set to indicate that all the codes were found, meaning that a code of the correct type was found within the Decode Tool region of interest.

Output 2 indicates that not only were the codes found, but they passed the Read Qualification stage, which confirms that the code contained required data content. For example, a code was found that started with ABC.

Output 3 is set to indicate that not only were codes present, and passed Read Qualification, they passed the full String Matching test as well.

	Output 1	Output 2	Output 3
Read Cycle Complete	☐	☐	☐
^ Read Cycle Pass	☐	☐	☐
All Codes Present	☑	☐	☐
All Codes Read	☐	☑	☐
All Codes Match	☐	☐	☑
Good Quality Codes	☐	☐	☐
^ Read Cycle Fail	☐	☐	☐
Not All Codes Present	☐	☐	☐
Not All Codes Read	☐	☐	☐
Not All Codes Match	☐	☐	☐
Poor Quality Codes	☐	☐	☐

Negative Logic Example: This example shows, using Negative Logic, a deeper look into what passed or failed in the Read Cycle.

Output 1 is set to indicate that at least one of the target codes was not found.

Output 2 is set to indicate that at least one of the found codes failed the Read Qualification. For example, none of the codes found started with ABC.

Output 3 is set to indicate that at least one of the codes found and qualified ultimately failed String Matching.

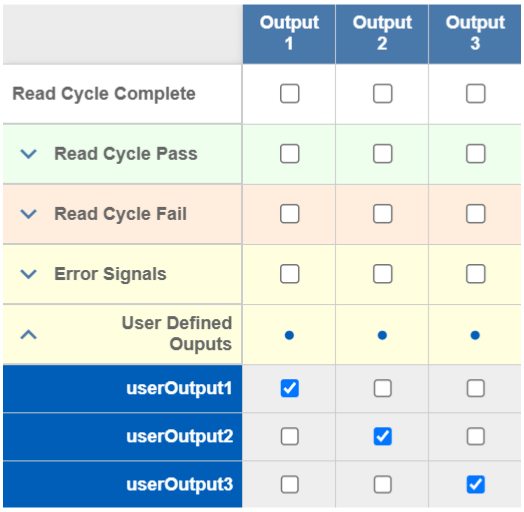
	Output 1	Output 2	Output 3
Read Cycle Complete	☐	☐	☐
^ Read Cycle Pass	☐	☐	☐
All Codes Present	☐	☐	☐
All Codes Read	☐	☐	☐
All Codes Match	☐	☐	☐
Good Quality Codes	☐	☐	☐
^ Read Cycle Fail	☐	☐	☐
Not All Codes Present	☑	☐	☐
Not All Codes Read	☐	☑	☐
Not All Codes Match	☐	☐	☑
Poor Quality Codes	☐	☐	☐

● User-Defined Outputs with Scripting

Scripting allows the user to set outputs based on custom logic. An example of this Logic could be setting an output if more than 3 codes in a row were unable to be read.

A second example when using Code Verification could be to set the outputs to control a stack light. Output 1 could be set on if the Code is Good Quality (Green Light), Output 2 if the code was fair quality (Yellow light), and Output 3 if the code quality is poor (Red Light).

To accomplish this, turn off checks under the standard logic section, expand User-Defined Outputs, and then select the Script-based user Output 1 to 3 to be connected to the physical Output 1 to 3.



A scripting example for Code Verification driving a stack light can be seen below. When the Script is run at the end of the Read Cycle, the post-Cycle function is used to set user Output 1 to 3 to true or false based on custom logic. These states are applied to the digital output signals.

```
-- This function is called at the end of a cycle
-- can set userOuputs here. No return value
function postCycle(cycleData)
    userOutput1 = false
    userOutput2 = false
    userOutput3 = false

    grade = cycleData.tools[1].symbologyResults[1].grading.iso15415.overall.grade

    if grade > 3 then
        userOutput2 = true
    else if grade > 1.5 then
            userOutput2 = true
        else
            userOutput3 = true
        end
    end
end
```

Digital Output Settings

● Digital Output Mode of Operation

Item	Setting value [Job Default]	Description
Normal State	**[Normally Open],** Normally Closed	
Mode	**[Pulsed]**	Pulsed Mode. Output will be set on, and then set off according to the Pulse On and Off time.

Item	Setting value [Job Default]	Description
Pulse On Time (μs)	1000 – 10,000,000 (10 sec) **[1000]**	Amount of time the Output Pulse is set to Active (On) state.
Pulse Off Time (μs)	1000 – 10,000,000 (10 sec) **[1000]**	Amount of time the Output Pulse is set to Off state.

● High-Level Output States

Item	Setting value [Job Default]	Description
Read Cycle Complete	**[Unchecked],** Checked	Read Cycle complete is Pulsed or Latched after Read Cycle Data has been transmitted.
Read Cycle Pass	Unchecked, **[Checked]**	Read Cycle Pass – This high level pass signal means the all codes were found, all codes were the correct type, and all were read and matched (i.e. contained the correct string content)
Read Cycle Fail	Unchecked, **[Checked]**	Read Cycle Fail – This high level fail signal means that either not all codes were code present, were not of the correct type, or did not read or match (did not contain the correct string content)
Error Signal	Unchecked,**[Checked]**	Error Signal – Indicates that at least one of the following errors occurred: Trigger Overrun, Processing Overrun, General Error (which includes Acquisition Error).

● Detailed (Positive Logic) Output States

Item	Setting value [Job Default]	Description
All Codes Present	**[Unchecked],** Checked	All Codes Present – Means that all Decode Tools in the job have found a code of the correct type in the designated search ROIs.
All Codes Read	**[Unchecked],** Checked	All Codes Read – Means that all Decode Tools in the job have found a code that contains the correct identifying data content. (Example: Starts with ABC)
All Codes Match	**[Unchecked],** Checked	All Codes Match – Means that all Decode Tools in the job have fully matched the required data content. (Example: Two codes are found that start with ABC, but full match indicates the target code is the one that ends with 123.) ***Key Point:*** The Match function will drive the reader to continue searching until it finds the full matching code if it exists. It will not stop decoding on the first code found that has been read. **Note:** If “All Codes Match” is selected in Output Dialog. The output will still turn on for the case where 1) The Decode Tool passes and 2) Matching is not enabled. Matching is assumed for that case. The Output will fire, and the All Codes Match will be set in the PLC Input Assembly as well.

Item	Setting value [Job Default]	Description
Good Quality Codes	**[Unchecked],** Checked	Good Quality Codes – Means that for all Decode tools where Verification is enabled, the codes all pass. Note: If the Decode Tools does not find the “qualified” code, it will not perform Verification.

● Detailed (Negative Logic) Output States

Item	Setting value [Job Default]	Description
Not All Codes Present	**[Unchecked],** Checked	Not All Codes Present – At least one Decode Tool has not found a code in its search area of the correct type.
Not All Codes Read	**[Unchecked],** Checked	Not All Codes Read – At least one Decode Tool has not found a code that has the correct identifying data content.
Not All Codes Match	**[Unchecked],** Checked	Not All Codes Match - At least one Decode Tool has not Matched.
Poor Quality Codes	**[Unchecked],** Checked	Poor Quality Codes – At least one Decode Tool is of poor quality and failed Verification.

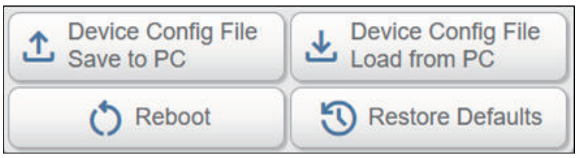
● Error Signals

Item	Setting value [Job Default]	Description
Overrun Error	Unchecked**, [Checked]**	Overrun Errors can be either Trigger or Processing Overrun Errors A Trigger Overrun indicates that a new trigger has been received before the last image was completed A Processing Overrun indicates that triggers are occurring a rate that is faster than the reader can process images. Once the reader runs out of image buffers, it issues the processing overrun signal.
General Error	Unchecked**, [Checked]**	General Error – This indicates and subsystem fault that has occurred with the camera such as a sensor or communication fault.

6-1-13 Device Configuration Save, Load, Restore, and Device Reboot

Buttons at the bottom of the Device Configuration summary are provided for Device Configuration management. The buttons allow the user to save and load specific configurations, and to restore the Device Configuration to factory defaults.

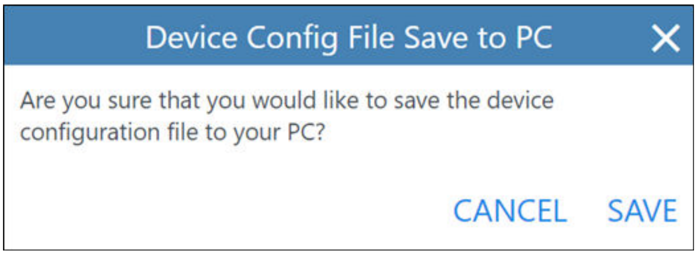
Note: Device Configuration files contain all the settings described in this chapter for RS-232, TCP/IP, DIO, Camera, and PLC settings. They do not include Jobs or Time Sync settings.



Save Device Configuration Settings to PC

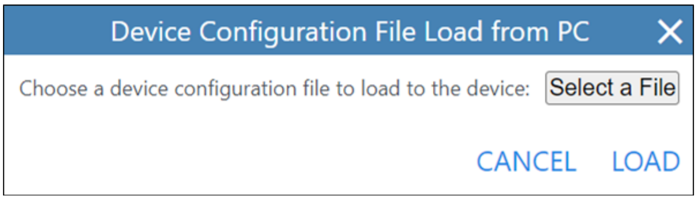
This control allows the user to save the current Device Configuration to the PC. This enables the user to store a backup, and to share the configuration with other cameras on the line.

Clicking the **Device Config File Save to PC** button will prompt the user with a confirmation dialog. Clicking **Save** from within this dialog will download the device config archive file to the user's default download folder configured for their browser. The user should move the config file from their Downloads folder into an appropriate backup location.



Load Device Configuration Settings from PC

Clicking the **Device Config File Load from PC** button will prompt the user to select a Device Configuration archive file on the PC using File Explorer, and will then load that config file onto the reader. The system will do basic error checking and confirm that the archive file is a valid config file, compatible with the device, before loading it.

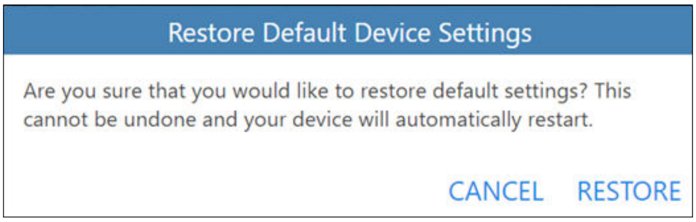


Restore Defaults

Restore Defaults is used to reset all the major Device Configuration settings back to Factory settings with some exceptions. Restore will not reset the Camera Name, Camera IP, or Subnet, nor does it restore the Time Sync Setting.

Finally, All Jobs will remain on the camera, but the Boot Job will be reset to the Demo Job in Slot 00.

Choosing **Restore Defaults** will launch a dialog to have the user confirm the restore request. Clicking **Restore** will restore the device defaults and then reboot the device. The user interface will automatically reconnect when this process is complete.



Reboot the Device

Choosing **Reboot** will launch a dialog to have the user confirm the reboot request. Clicking **reboot** will trigger a device reboot. The user interface will automatically reconnect when this process is complete.

Note: A reboot has the same effect as a power cycle. Everything is reset. The Boot Job will be loaded and started.

6-2 Setup View

6-2-1 Overview

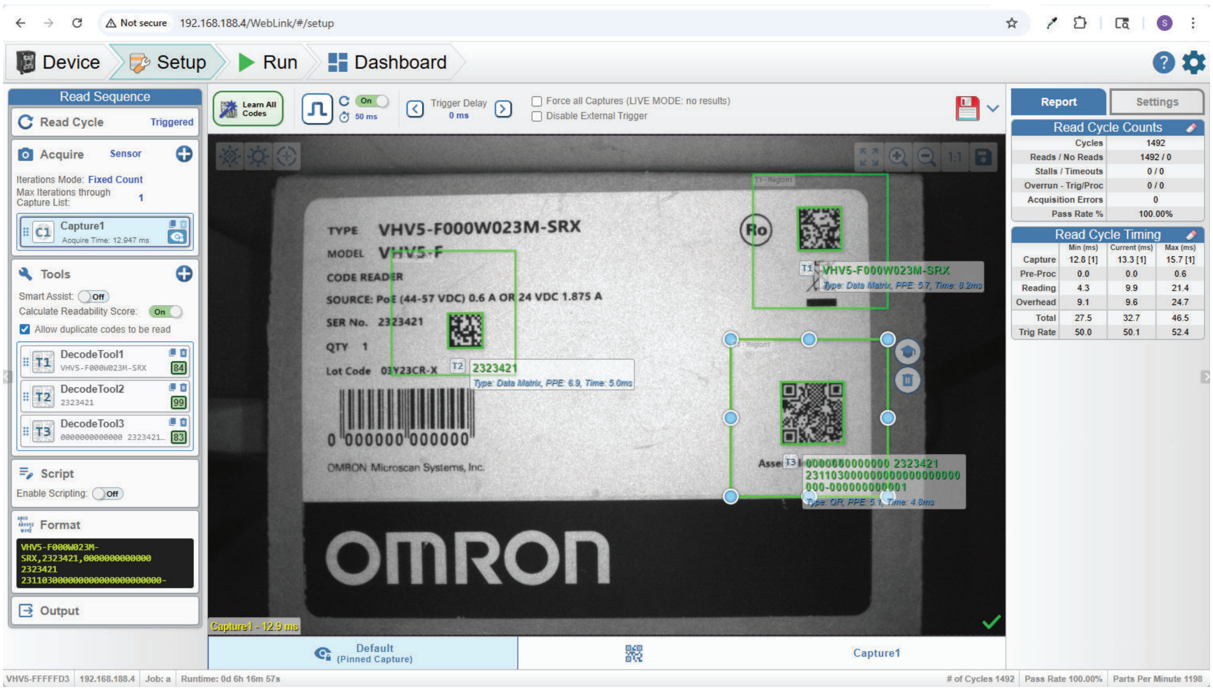
Once a job is created or loaded in Device view, the **Setup** view allows you to set all individual job parameters, and then to test and tune the job before going into Run mode.

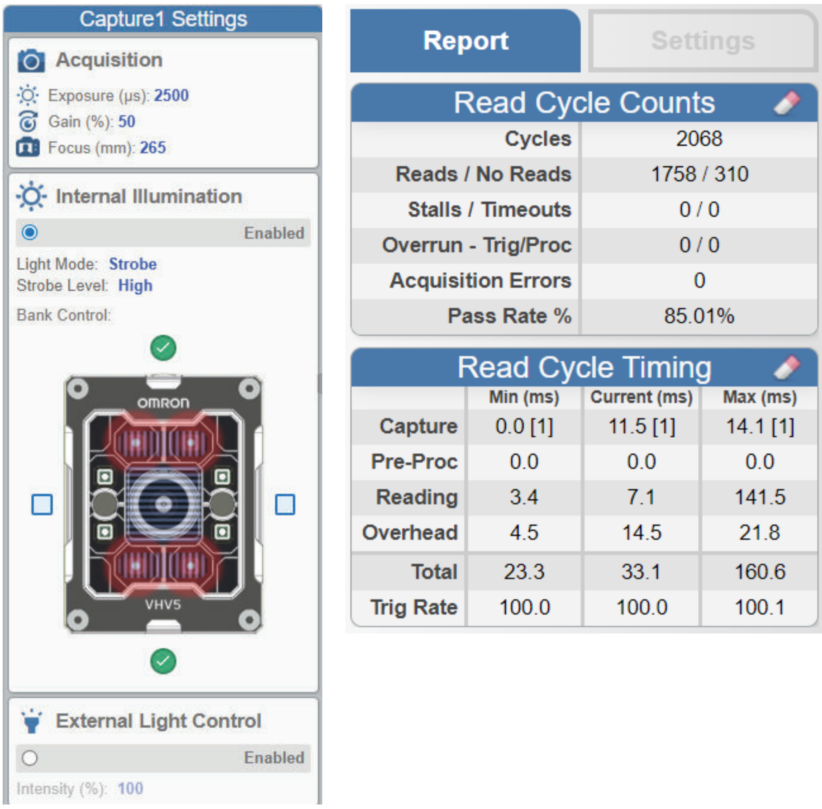
There is virtually no speed performance difference while operating in the Setup view vs. the Run view of the Dashboard. All testing, including with real triggers from a running line can be done in Setup view.

The panel on the left side of the user interface represents the read cycle of the job. During a read cycle the system will (automatically, or upon receiving a trigger,) acquire one or many captures. It will run the decode tools within all of those captures until each decode tool completes. Finally, the decoded data, and any system or read cycle data you have selected, is compiled into a formatted output string that is sent out the various communication channels.

The image in the center of the user interface allows you to see every read cycle.

The panel on the right side of the user interface will either show the parameters for the read cycle step that is selected in the left panel, or it will show the Counts and Timing Reports as the reading job is tested in Setup mode.





6-2-2 State of the Reader when in Setup View

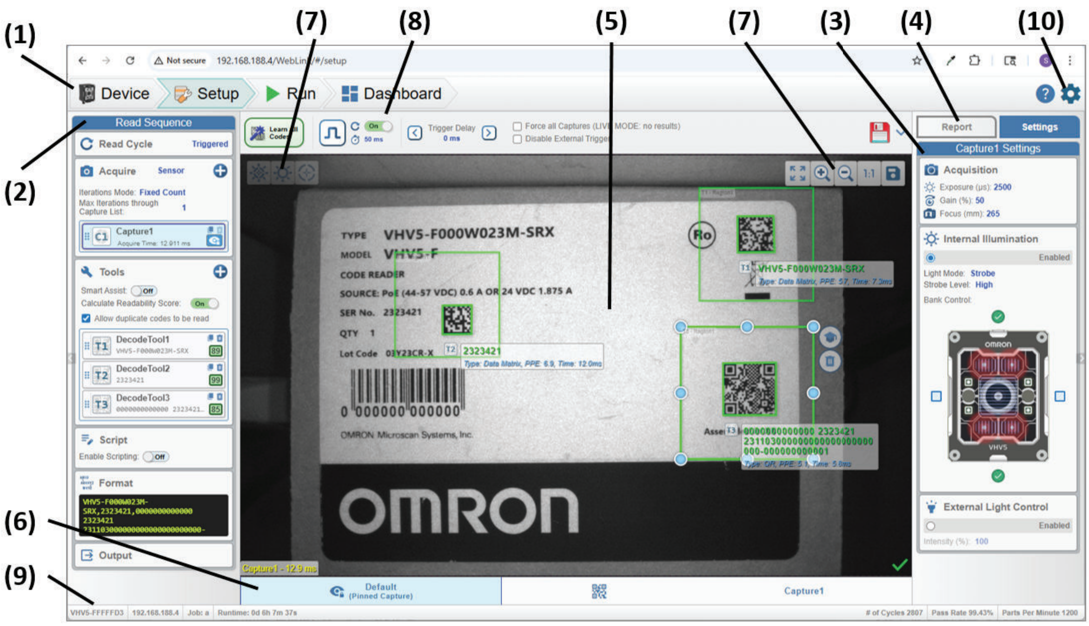
- **Mode –** Setup. A Job is loaded and running.
- **Setup Image Display –** The image is displayed by default at ½ resolution with an update rate of 15 frames per second. The user can click on the SD control in the top right of the image to toggle to full resolution. The button will change to HD, indicating full resolution. Here the user can see the details of each pixel. Clicking on the control again will toggle the image back to ½ scale, which enables maximum system performance.
- **Job Change –** A different Job cannot be loaded until the user goes back into Device View, or until a Job Load change command is received that first takes the system offline.
- **Triggering –** The reader is responding normally to all **virtual triggers** and **real triggers**. The operator can choose to ignore **real triggers** in this mode.
- **Read Cycle –** The **read cycle** engine is running normally. However, it will be interrupted for certain operations such as Quick Photometry and Quick Focus.
- **Parameter Change –** All **job parameters** can be changed while the read cycle is running. Effects of the parameter changes will be seen in the next cycle.
- **Outputs –** All outputs are functioning as they would in run mode. This includes RS-232, TCP/IP, PLC Communications and Digital IO.
- **High-Level Setup Functions –** The user has access to high-level setup functions that allow rapid programming of the job with minimal user input.
  - **Quick Photometry**, **Quick Focus**, and **Auto-Photometry/Focus** interrupt the read cycle, take over the reader, and perform the operation. The read cycle is stopped at this time, and does not respond to triggers. The reader will be set back to normal read cycle operation when complete.
  - **Learn** does not stop the read cycle. It takes the next image(s) from the read cycle and feeds them to a special X-Mode decoding instance which finds all codes in the image(s). For each found

code, Learn will insert a new decode tool into the job, replacing those already there. Similar to inline parameter changes, the job will continue running.

- **Optimize** does not stop the read cycle. It takes the next image(s) from the read cycle and feeds them to the Optimize routine running its own X-Mode decoding instance. Optimize will run in the background until complete. The operator can allow or disallow Optimize to set parameters in the current job. Similar to inline parameter changes, the job will continue running, but with newly optimized settings.

6-2-3 Main Components of the Setup UI

The following are the main components for the Setup View. The numbers correspond to the figure below. Each Element will be explained in subsequent sections.



1. Mode Navigation Chevrons – Located at the top left of the user interface. Used to move between Device, Setup, Run, and Dashboard Views.

2. Read Sequence Steps and High-Level Step Parameters – Sequence of Steps the reader runs for every read cycle. A limited set of global parameters affecting Acquire or Decode tools are set here.

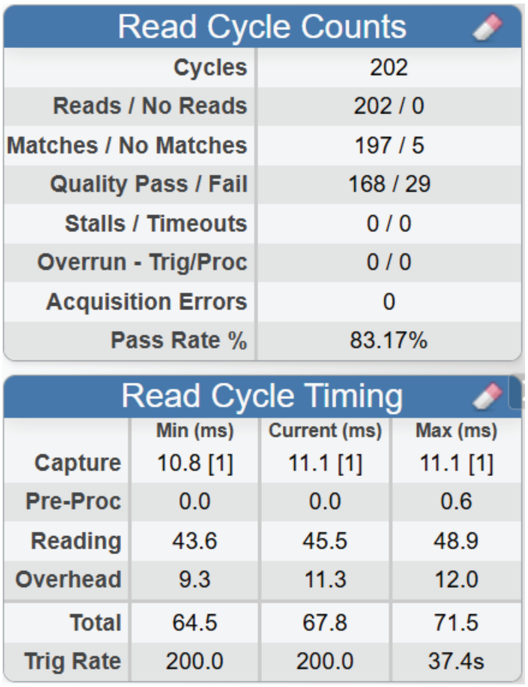
3. Detail Settings Dialogs for Steps – If the user clicks on a step in the Read Sequence such a Capture, or a Decode Tool, the tool will be highlighted in blue, and then the detailed settings dialog for that step will appear in the right hand pane under the Settings tab, allowing the user to view and change its parameters. See example in image above.

- For Decode Tools, the user can also click on the ROI (Region of Interest) in the image and the settings dialog will appear as well.
- If the user again clicks on the step in the Read Sequence, the step will un-highlight, and the Counts and Stats Read Cycle Report will reappear in the right hand pane.

4. Read Cycle Counts and Stats (Report) –

- The Report tab is shown by default when no step is selected.
- If the user clicks on a step, the Report tab automatically switches to the Settings tab.

- The user can see the Report again by clicking on it in the tab at the top.
- The read cycle report shows Read Cycle Pass/Fail counts in the upper section, and Read Cycle Timing in the lower section.
- The counts allow the user to follow the success or failure of the reading application.
- The Timing information allows the user to understand exactly how much time is required for the read sequence.



Read Cycle Counts	
Cycles	202
Reads / No Reads	202 / 0
Matches / No Matches	197 / 5
Quality Pass / Fail	168 / 29
Stalls / Timeouts	0 / 0
Overrun - Trig/Proc	0 / 0
Acquisition Errors	0
Pass Rate %	83.17%

Read Cycle Timing	Min (ms)	Current (ms)	Max (ms)
Capture	10.8 [1]	11.1 [1]	11.1 [1]
Pre-Proc	0.0	0.0	0.6
Reading	43.6	45.5	48.9
Overhead	9.3	11.3	12.0
Total	64.5	67.8	71.5
Trig Rate	200.0	200.0	37.4s

1) Read Cycle Counts

The upper counts section of the report allows the user to follow the success or failure of the reading application during a run.

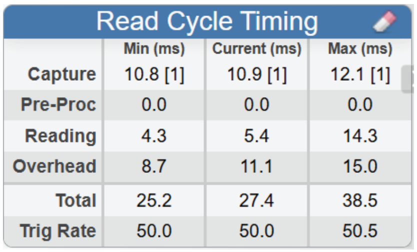
- The report shows how many cycles have been run. It shows the number of Reads / No Reads and Matches / No Matches as well as the Pass Rate percentage.
- For Warnings it shows Stalls or Timeouts, indicating that the system is running close to the maximum trigger rate.
- For Errors it shows Trigger or Processing Overruns, which indicate that the system is being triggered faster than it can take pictures or process. It also shows Acquisition Errors, which indicate errors in the digitizer that cause the acquisition to fail.

Item	Description
Cycles	The number of Read Cycles that have run since the job was loaded, or since the counts were reset with the eraser icon.
Reads / No Reads	The number of Reads vs. No Reads since counts were reset.
Matches / No Matches	The number of match string pass vs. match string fails since counts were reset. Note 1: Matches / No Matches will only be displayed if Match String is enabled for one of the Decode Tools in the Job. Note 2: Matches / No Matches will only increment if the code has first been Read.

Item	Description
Quality Pass / Fail	The number of code quality passes vs. fails since counts were reset. Quality includes both Verification Grading and GS1 Syntax Checking. If both are enabled, both must pass. Note 1:Quality Pass / Fail will only be displayed if Verification Grading or GS1 Syntax Checking is enabled for one of the Decode Tools in the Job. Note 2:Quality Pass / Fail will only increment if the code has first been read and matched if matching has been enabled. If it fails to Read or Match, then it the algorithm does not even try to grade.
Stalls	Stalls is a count of how many times the system has stalled since counts were reset. Stalls are a warning. The system will stall if it has completed the next read before finishing the prior read. The system automatically stalls, sending out the result from the latter read until it finishes with the first one. This is an indication that some codes may have more problems being read than others. Code quality should be checked, as well as job settings.
Timeouts	Timeouts is a count of how many Timeouts have occurred since counts were reset. Timeouts are a normal occurrence for codes that cannot be read. It happens when the code cannot be decoded within the Max Allotted Time Per Tool setup by the user. This is an indication that code quality may be insufficient, or that the job is not tuned well to read that code.
Trigger Overrun	Trigger Overrun is a count of how many times this error has occurred since counts were reset. Triggers Overruns are Errors – They indicate that triggers are being sent faster than the sensor can take picture and that the trigger rate must be slowed. Note that a Trigger Overrun indicates that the reader is now out of sync with the host since it did not actually receiver the trigger.
Processing Overrun	Processing Overrun is a count of how many times this error has occurred since counts were reset. Processing Overruns are Errors – They indicate that the reader is being triggered at a faster rate than the images can be processed. There is an image buffer pool that allows normal slowdowns and speed-ups, but if a Processing Overrun occurs, it means that the buffer pool is full. The trigger rate must be slowed, or the job must be tuned to run faster. Note that a Trigger Overrun indicates that the reader is now out of sync with the host since it did not actually receiver the trigger.
Acquisition Error	Acquisition Error is a count of how many times this error has occurred since counts were reset. Acquisition Errors indicate a failure in the digitizer causing the image not to be taken.
Pass Rate %	This is the percentage of Read Cycles that have passed. Note: For a Read Cycle to pass, it must not only Read, but also Match if matching is enabled, and pass quality check if Verification Grading or GS1 Syntax Checking are enabled. Overruns and Acquisition Errors also cause Read Cycle failures.

2) Read Cycle Timing

- The lower section of the report shows timing statistics for the current run. It shows the Minimum, Current, and Maximum time each of the key read cycle steps has available to execute. This data allows the user to see how fast a read cycle can actually run, as well as expected variation in that execution time. The data is also useful to detect which steps seem to be taking a long time, are not stable, or exhibit anomalies indicating that this step should be further tuned.



Read Cycle Timing

	Min (ms)	Current (ms)	Max (ms)
Capture	10.8 [1]	10.9 [1]	12.1 [1]
Pre-Proc	0.0	0.0	0.0
Reading	4.3	5.4	14.3
Overhead	8.7	11.1	15.0
Total	25.2	27.4	38.5
Trig Rate	50.0	50.0	50.5

Item	Description
Capture[#] (msec)	Capture is the total time spent acquiring all Captures that were required to complete the read cycle. The [#] number indicates how many of the Captures were actually required to read. If all codes were found in the first capture, the result would be something like 12[1]. If three of the Captures were required, this result would be closer to 36[3].
Pre-Proc (msec)	Pre-Proc is the time spent preprocessing the image using Filter Steps within the ROI. Image preprocessing is used to enhance the image prior to decode. If no ROI filters are enabled (such as scale or morphology) this time will be 0.
Reading (msec)	Reading is the total time spent in the X-Mode decoding routine.
Overhead (msec)	Overhead is an accumulation of all time spent in the read cycle performing necessary steps other than pre-proc and reading. Typically the bulk of this time is spent in the post-processing section preparing the report and sending out the data.
Total (msec)	Total is the total cycle time in msec calculated from when the Trigger was received for this read cycle to when the read cycle result sent out.
Trig(ger) Rate (msec)	The Trig(ger) Rate is the time in msec between the previous and current read cycle Trigger. For example, if the parts on the line are coming at ~600 PPM, this time would be ~100 msec.

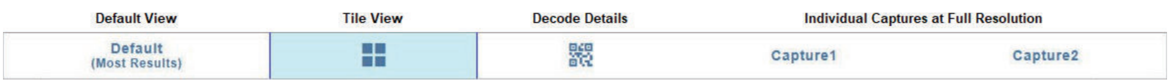
Note: Trigger rate (time between triggers) can be faster than the Total read cycle time because of pipelining. In pipeline mode the system is capable of acquiring the image for the current read while processing the previous read.

5. Image

The image from current read cycle is displayed in the center of the UI. The image will update at the end of every read cycle. Depending on which image view is selected different graphics will appear with Decode and Read Cycle Information. The image view is controlled by the Image View Tab control at the bottom of the image.

6. Image View Option Tabs

There are 4 main image view options. The Default view, the Tiled view, the Code Detail view (QR Icon), and the individual view of each unique capture set up in the job.

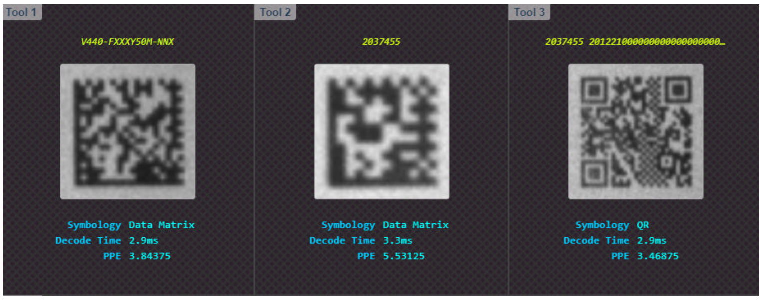


- **Default View –** The Default view shows the Capture in which the largest number of codes were decoded. (Note: Some codes may have been decoded in other images and will not be shown here. These can be seen in the other views described below.) The ROIs and Decode Graphics for each tool are shown. If the read cycle passes, the image is outlined in green and a green check appears at the lower right. If the read cycle fails, the outline is red and a red X appears at the lower right along with a message giving details of the failure.

- **Tile View –** This view appears if the Read Cycle has more than one Capture. This view is designed to show all the captures used for the cycle in a tiled format. The Capture number, and a graphic around and decodes is displayed. Note: A Capture will not be displayed in Tile View if it was not necessary to use that Capture to find a code. For example: If all codes were decoded in the first three Captures, then the 4th Capture will not be shown.

This view is very useful for tuning multiple Capture jobs. It allow the user to see what Capture were required to complete the Read Cycle. A Capture will not be performed if all Decode Tools have already succeeded. In the example below, two of the 3 codes were read in the first Capture. The final Decode Tool was able to read its code in the third Capture. The Read Cycle was satisfied, so ended without need to acquire the fourth image.

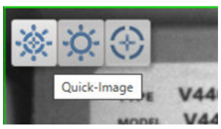
- **Decode Details –** This view will give a close up view of all codes from all Decode Tools in all Captures. It displays code contents at the top, as well as symbology type, Decode Time and PPE (Pixels Per Element) at the bottom.



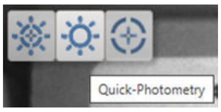
7. Image Controls

There are two sets of Image Controls. In the upper left of the image are the Quick Setup tools; Quick-Image, Quick-Photometry, Quick-Focus, and Autofocus/Photometry. (See Notes at end of section for more details on the operation of these Quick Setup Tools.) In the upper right of the image are the Zoom and Save Image tools. Scrolling is accomplished by right clicking and dragging on the image.

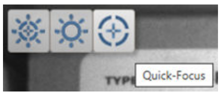
- **Quick Image** is a single click that automatically sets exposure time and the focus to ideal values for the center of the image. This is always a good first step to perform when starting with a new job or Capture.



- **Quick Photometry** gives the user more precise control over image brightness. The user is prompted to click at a certain spot in the image, or to drag around a section of the image for where to set ideal brightness. It automatically sets the exposure time so that the gray values at that specific area of the image go to a mid-range value of 128 Gray Scale.



- **Quick Focus** gives the user more precise control over focus. The user is prompted to click in the image, or to drag around a section of the image for where to set precise focus. This is useful often when there are objects of different heights in the image and the user needs to choose one over the other. It is also useful since the focus can change slightly from the center of the image to the outside corners. Often it is necessary to specifically click and focus on the code when it is on the outside edge of the image.



Note: Quick-Image, **Quick-Photometry**, and **Quick-Focus** interrupt the read cycle, take over the reader, and perform the operation. The Read Cycle is stopped at this time, and does not respond to triggers. The reader will be set back to normal Read Cycle operation when complete.

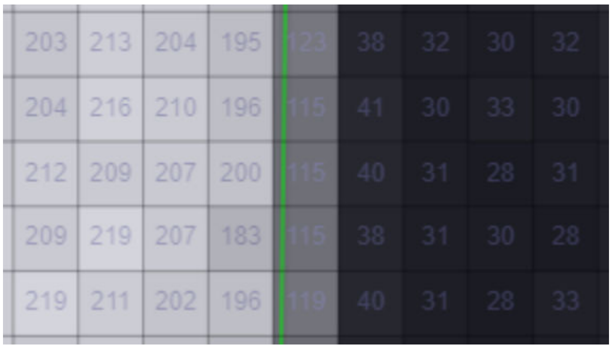
- **Auto-Focus/Photometry** is an additional control available if the Job Type is set to Continuous or Presentation. Activating this feature will cause the system to automatically call both Quick-Photometry and Quick-Focus after 5 seconds of NOREADS, creating a good image. This is a valuable out-of box-experience feature that will set up the proper imaging without any user interaction.

- **Image Zooming and Image Save Utilities:**

  - The left-hand **Zoom** button zooms the image to fit the extent of the screen.
  - The **+** and **–** zoom in and out.
  - Clicking on the **SD** icon will toggle the image display to full resolution. Clicking on the **HD** icon will set the screen back to normal resolution, which is ½ resolution.

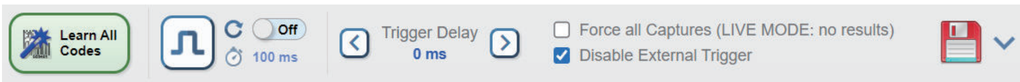
Note: If the user exits Setup Mode and then returns, it will automatically have gone back to ½ resolution

- The **Save** icon (blue disk) saves the current, actual image to the download directory as a full-resolution .png file.
- **Additional Screen Controls:**
  - The user can click on the image and then scroll in and out with the mouse wheel. Zooming in to the full extent shows the pixels with their numerical grey value.



  The image can be panned by right-clicking and dragging.
  - The Cursor Position and Grey Scale value of the pixel at those coordinates is shown at the bottom of the image display. This is useful for examining pixels and doing simple measurements of codes.

8. Setup View Utilities and Controls



- **Learn All Codes –** This function will learn all the codes in all the captures creating a unique Decode Tool for each. This function starts by bringing up a dialog that lets you capture the next set of images, determine how large the search ROIs should be set to based on known positional uncertainty of the part on the line, or the marks on the part. See the Learn All Codes section for additional details.

  Note: Learn does not stop read cycle. It will take next image(s) from the read cycle and feed them to a special X-Mode instance which finds all codes in the image(s). For each found code, Learn will insert a new Decode Tool into the job replacing those already there. Similar to inline parameter changes, the job will continue running.

- **Virtual Trigger Generator –** This function is available for Triggered Jobs only and allows the user to run the job without a physical trigger attached. The user can issue a single trigger by clicking on the square wave icon, or turn the generator on with the cycle icon to provide a stream of triggers at a set interval. The interval can be varied to test how fast the job can be run before putting it on the line.

- **Trigger Delay –** This function is for adjusting when the image is taken on a moving line. It inserts a delay between when the reader receives the trigger and when the picture is taken. This allows the user to programmatically slide the part back and forth to center it in the image without going onto the line to physically adjust the trigger position.

- **Force All Captures (Live Mode: No Results) –** This function will force the system to acquire and display all of the Captures the user has set up in the job. This allows the user to view all the Captures and see the effects of adjustments made to lighting and focus. The Captures can be viewed all together in the Tile View, or in the individual tabs for each Capture at the bottom of the screen.

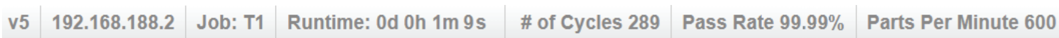
  Note: The system runs Read Cycles in this mode to get all the images for display, but it does not decode, send results, set digital outputs, or increment counts in the Read Cycle Count report. It does continue to increment the Cycle ID for each read cycle. If the user is monitoring Cycle ID, they will note that it jumps up in value when the data stream is turned back on.

- **Disable External Trigger –** VHV5-F jobs can be set up even on moving lines with active triggers. The physical trigger is active by default. Captures of all parts will occur when the trigger is received. If the user does not want the system to respond to physical triggers, but to Virtual triggers only, they must select Disable External Trigger.

- **Save Job –** Allows the user to save the job from the Setup view. The icon is when there are unsaved changes to the job. The icon is blue if job is the same. Clicking the icon saves the job. Clicking the down arrow allows the user to Save As the job with another name to another slot. It also allows the user to revert the job to its previous saved state.

9. Status Bar

The status bar at the bottom of the user interface is visible in all views.

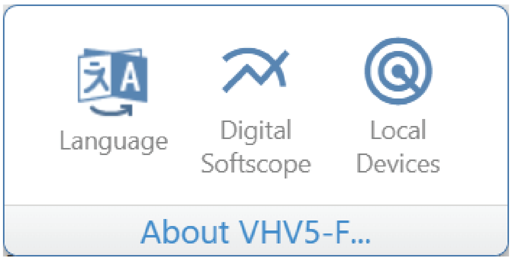


From left to right, it displays:
- Name of the camera
- IP Address of the camera
- Current loaded job name
- How long the job has been running,
- The total number of cycles (triggers) the reader has run,
- The Pass Rate,
- The run Rate in Parts per Minute (trigger rate)

10. Help and Advanced Settings

The **question mark icon** brings up this manual.

The gear icon brings up this dialog. From within this dialog, the user can change the language of the UI. They can access the Digital Softscope Tool for fine-tuning the timing of the application. They can also open a view to see all of the other local devices, VHV5-F cameras that are attached to the subnet, and then open WebLink on those alternate cameras.

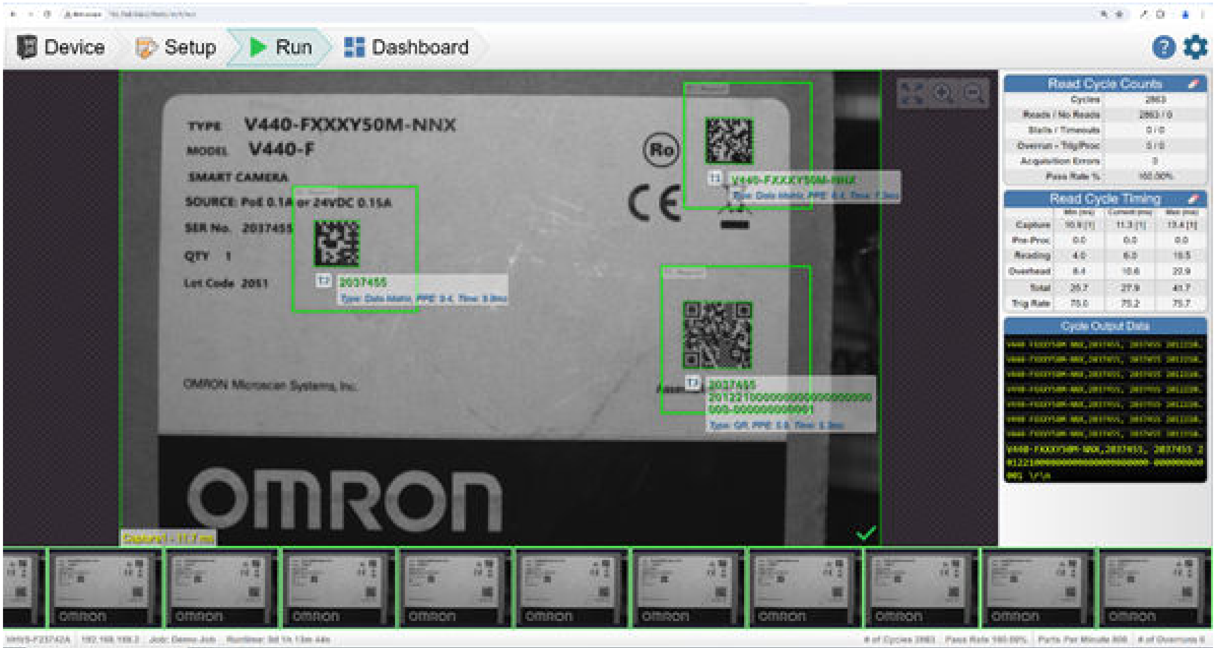


- The Digital Softscope is described in *6-5 Digital Softscope (Timing Profiler)* on page 6-49.
- The full set of selectable language options is shown below.
- The Local Devices dialog is shown below that.

6-3 Run View

6-3-1 Overview

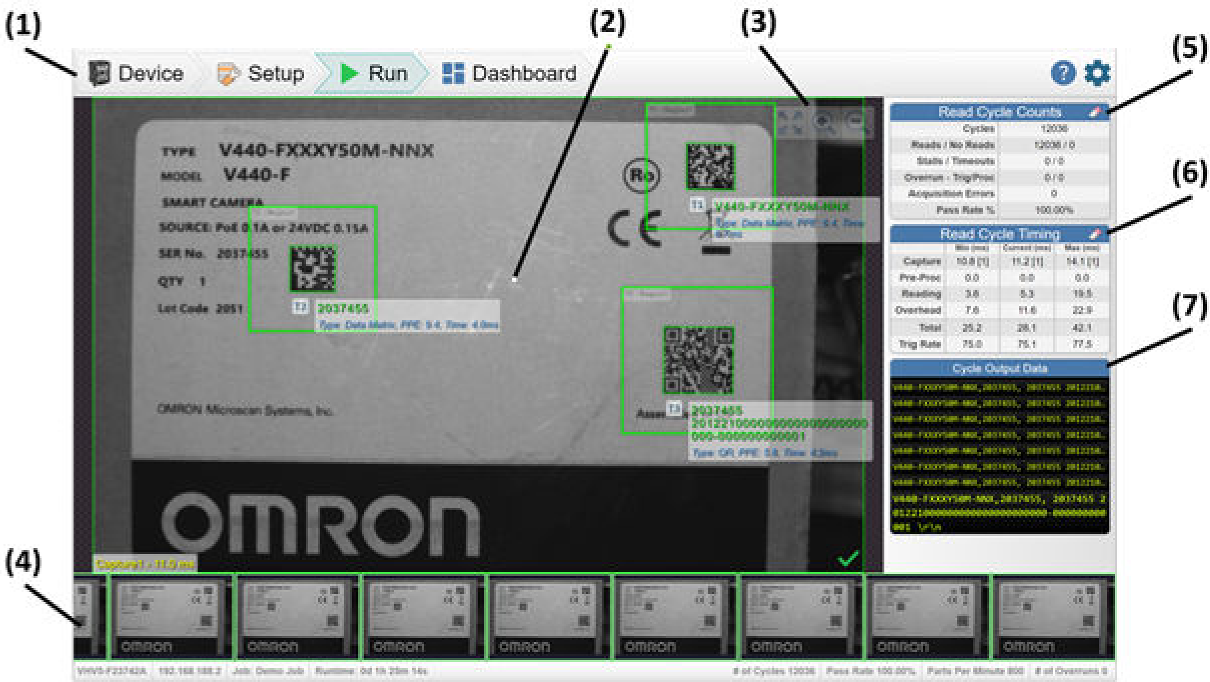
The **Run** view is the main way to monitor the system as it is running online. It shows an image for each trigger. It shows the counts and statistics for the entire production run. At the bottom of the screen it shows a filmstrip of the most recent read cycles.



6-3-2 State of the Reader when in Run View

- **Mode –** Run. A Job is loaded and running.
- **Runtime Image Display –** The image is displayed at ½ resolution and with an update rate of 15 frames per second.
- **Triggering and Outputs –** The read cycle engine is running, responding to all virtual or real triggers. All outputs are being set.
- **Job Change –** Job changes are allowed in this mode through command input, which first takes the system Offline.
- **High-Level Setup Functions –** Quick Photometry and Quick Focus operations can be performed in this mode. They can be initiated via serial or PLC commands. These operations will override the triggered read cycles and may cause the system to ignore triggers. More complex operations like Optimize are blocked during Run mode.

6-3-3 Main Components of the Run UI



1. **Mode Navigation Chevrons –** Located at the upper left of the UI. Used to move between Device, Setup, Run, and Dashboard Views.
2. **Main Image –** The image from current read cycle is displayed in the center of the UI. The image will update at the end of every read cycle. Depending on which image view is selected different graphics will appear with Decode and Read Cycle Information. The image view is controlled by the Image View Tab control at the bottom of the image.
3. **Image Zoom Utility –** Left-hand Zoom button Zooms the image to the extents of the screen. + and – Zoom in and out.

4. **Filmstrip –** Displays the last N cycles. Images are outlined in Green for Pass, and Red for Fail. If the user hovers over the image, that image is shown full size on the main screen.
5. **Read Cycle Counts –** The counts allow the user to follow the success or failure of the reading application.
   - The report shows how many cycles have been run. It shows how many Read/No Reads and Matches/No Matches and the Pass Rate%.
   - For Warnings it shows Stalls or Timeouts warning that the system is running close to max trigger rate.
   - For Errors it show Trigger or Processing Overruns which indicate system is being trigger faster than it can take pictures or process.

Read Cycle Counts	
Cycles	181
Reads / No Reads	181 / 0
Stalls / Timeouts	0 / 0
Overrun - Trig/Proc	0 / 0
Acquisition Errors	0
Pass Rate %	100.00%

6. **Read Cycle Timing –** The Timing information allows the user to understand exactly how much time is required for the read sequence.
   - The report shows the Min, Current, and Max time for the different steps in the cycle, Capture, Decode Tools, and Overhead (reporting). The report shows the total cycle time trigger to answer.
   - The Trig(ger) Rate is the time from Trigger to Trigger in msec.

Read Cycle Timing

	Min (ms)	Current (ms)	Max (ms)
Capture	10.8 [1]	11.7 [1]	18.4 [1]
Pre-Proc	0.0	0.0	0.0
Reading	1.4	5.0	21.8
Overhead	5.0	6.2	23.9
Total	18.7	23.0	47.9
Trig Rate	75.0	75.0	78.7

7. **Read Cycle Output Data –** Shows final result string from the Read Cycle.

Cycle Output Data

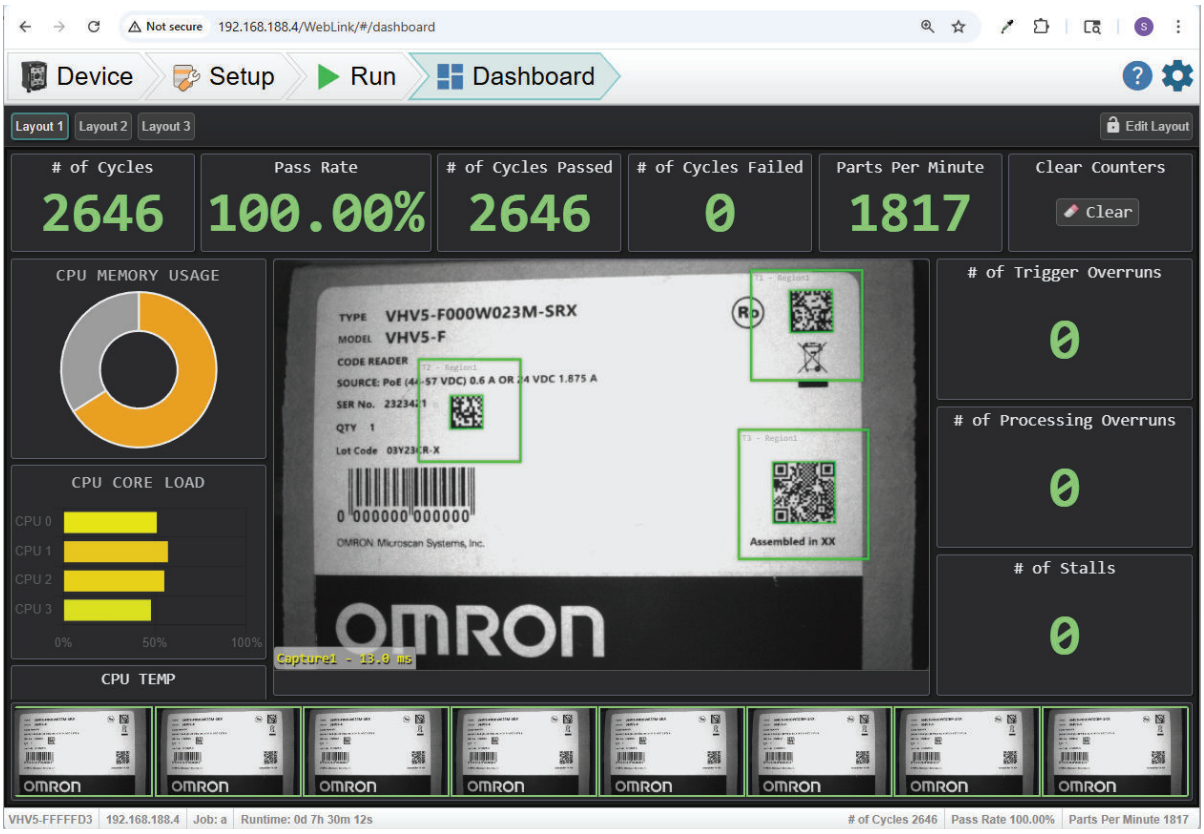
```
V440-FXXXY50M-NNX,2037455, 2037455 2012210…
V440-FXXXY50M-NNX,2037455, 2037455 2012210…
V440-FXXXY50M-NNX,2037455, 2037455 2012210…
V440-FXXXY50M-NNX,2037455, 2037455 2012210…
V440-FXXXY50M-NNX,2037455, 2037455 2012210…
V440-FXXXY50M-NNX,2037455, 2037455 2012210…
V440-FXXXY50M-NNX,2037455, 2037455 2012210…
V440-FXXXY50M-NNX,2037455, 2037455 2
0122100000000000000000000-000000000
001 \r\n
```

6-4 Dashboard

6-4-1 Overview

The **Dashboard** is a highly visual monitoring alternative to the Run view. It shows the image and film-strip as well as the key counts and statistics in an easy-to-view screen. The Dashboard view is fully configurable and can be tailored to show specific data.

The default Dashboard layout is set at the factory, but can be fully customized in the field. A total of three unique display layouts can be created and selected for use during runtime.

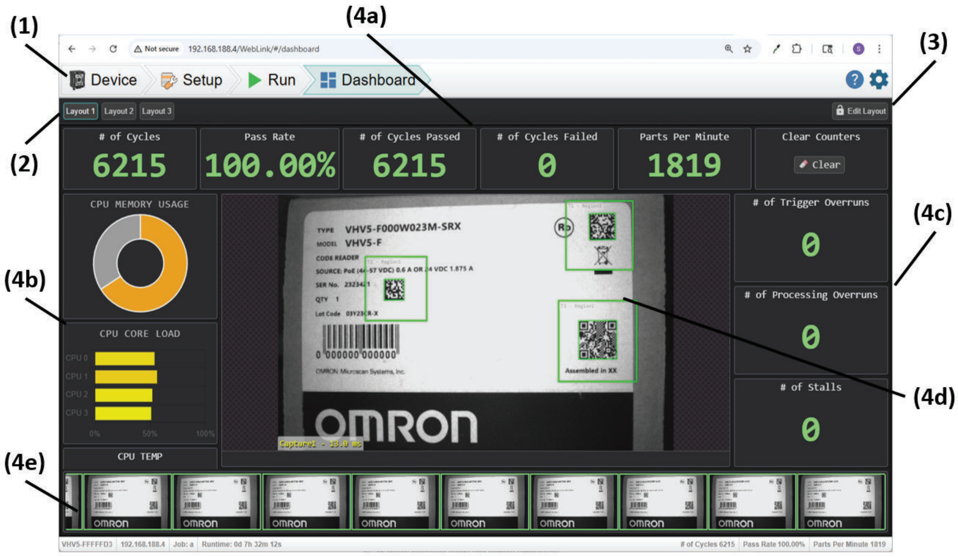


6-4-2 State of the Reader when in Dashboard View

- **Mode –** Run. A Job is loaded and running.
- **Dashboard Image Display –** The image is displayed at ½ resolution with an update rate of 15 frames per second.
- **Triggering and Outputs –** The read cycle engine is running, responding to all virtual or real triggers. All outputs are being set.
- **Job Change –** Job changes are allowed in this mode through command input, which first takes the system Offline.
- **High-Level Setup Functions –** Quick Photometry and Quick Focus operations can be performed in this mode. They can be initiated via serial or PLC commands. These operations will override the

triggered read cycles and may cause the system to ignore triggers. More complex operations like Optimize are blocked in Dashboard mode.

6-4-3 Overview of the Dashboard UI



The Layout Screen is divided into 5 main areas (4a-4e). Each section is populated with a set of dashboard "widgets" designed to show numeric data, graphical data, images or the filmstrip.

Each section can be completely customized. During Edit, the function of each widget can be changed. Widgets can be added and deleted. Widgets can be shifted to different locations within their section, or even dragged from one of the main areas to another.

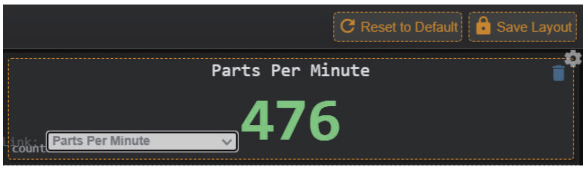
1. **Mode Navigation Chevrons –** Located at the top left of the user interface. Used to move between Device, Setup, Run and Dashboard Views.
2. **Alternate Dashboard Layouts 1-3 –** The User can create and choose from three alternate layouts of the Dashboard.
3. **Edit Layout Button –** Puts the Dashboard into Edit mode so the user can change the layout of display widgets in the dashboard. The user can:
   a) Shift the order of each result within one of the 5 main sections of the screen.
   b) Shift widgets between sections of the screen.
   c) Alter the values that are displayed by each widget.
   d) Add or delete widget from each section.
4. **Layout Areas 4a-4e –** By default these show:
   a) 4a shows high level run counts and stats.
   b) 4b shows processor usage and camera temperature.
   c) 4c shows warning and error counts.
   d) 4d shows the main image with graphics and read string results.
   e) 4e shows the filmstrip which displays the last N Read Cycles. Images are outlined in Green for Pass, and Red for Fail. If the user hovers over the image, that image is shown full size on the main screen.

6-4-4 Main Components of the Dashboard UI

Editing Dashboard Layout

The layout of the Dashboard can be customized by clicking on the Edit Layout button. The screen changes. Each display widget is outlined an orange dotted box, and a pull down menu appears allowing the user to change what value is displayed in that widget.

A trash can and a gear icon is located in the upper right of each major display section. These icons allow the user to delete or to add additional display widgets to each section.



Choosing Displayed Data

Choosing Displayed Data

The dropdown menu associated with each display widget allows the user to change the data that is displayed. This is the same data that is available in the reports as well as when formatting the final Read Cycle output string. The user clicks on the value that they want displayed.

Read Cycle Data
- Pass Rate
- # of Cycles
- # of Cycles Passed
- # of Cycles Failed
- Parts Per Minute

Decode Counts
- # of Reads
- # of No Reads
- # of Matches
- # of No Matches
- # of Good Quality
- # of Bad Quality

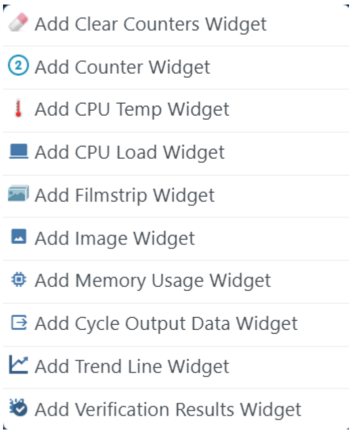
Decoder Tool Info
- Total Cycle Time
- Capture Time
- Setup Processing Time
- Pre-Processing Time
- Reading Time
- Overhead Time

Warning/Error Counts
- # of Trigger Overruns
- # of Processing Overruns
- # of Stalls
- # of Timeouts
- # of Errors
- # of Acquisition Errors

Adding Widgets

Adding Widgets

Clicking on the Gear brings up the following choices. Most of the widget choices are already part of the stand- ard display. The user will normally choose to add a new Counter Widget, or Trend Line Widget. After clicking on the choice, the user has the ability to choose what data is displayed in the widget.



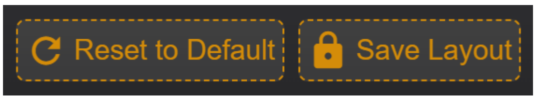
Note: Not all widgets, such as the Verification Results Widget, fit neatly in all layout areas (see layout areas 4a-4e in section 6-4-3). Some widgets are large and should be placed in the left, right, or large central section of the dashboard, rather than in the top or the bottom sections.

Arranging Widgets within the Dashboard

The widgets can be arranged or rearranged easily. The user simply clicks on a widget and drags is to any other location within the current display section, or over to another display section.

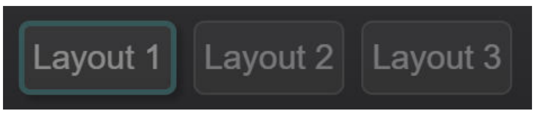
Saving or Resetting a Dashboard Layout

Once the user is satisfied with their dashboard layout, they can click on the Save Layout button. The layout may also be reset to the factory default layout.



Alternate Dashboard Layouts

The user can create up to three alternate dashboard layouts to fit the needs of different users such as Operator, Technician, and Engineer. By default, Layout 1 is displayed. Clicking on a different layout changes the display to that layout, and then clicking on Edit Layout allows that screen to be customized.



6-5 Digital Softscope (Timing Profiler)

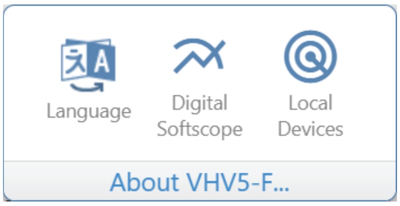
6-5-1 Digital Softscope (Timing Profiler)

WebLink for the VHV5-F offers a unique tool for Read Cycle optimization called the Digital Softscope. The Digital Softscope.is similar in concept to an oscilloscope. It is designed to show timing for all of the major events and processing that occur on the VHV5-F as it executes Read Cycles. This tool is useful to visualize and then to optimize the performance of the reader as it runs on a production line.

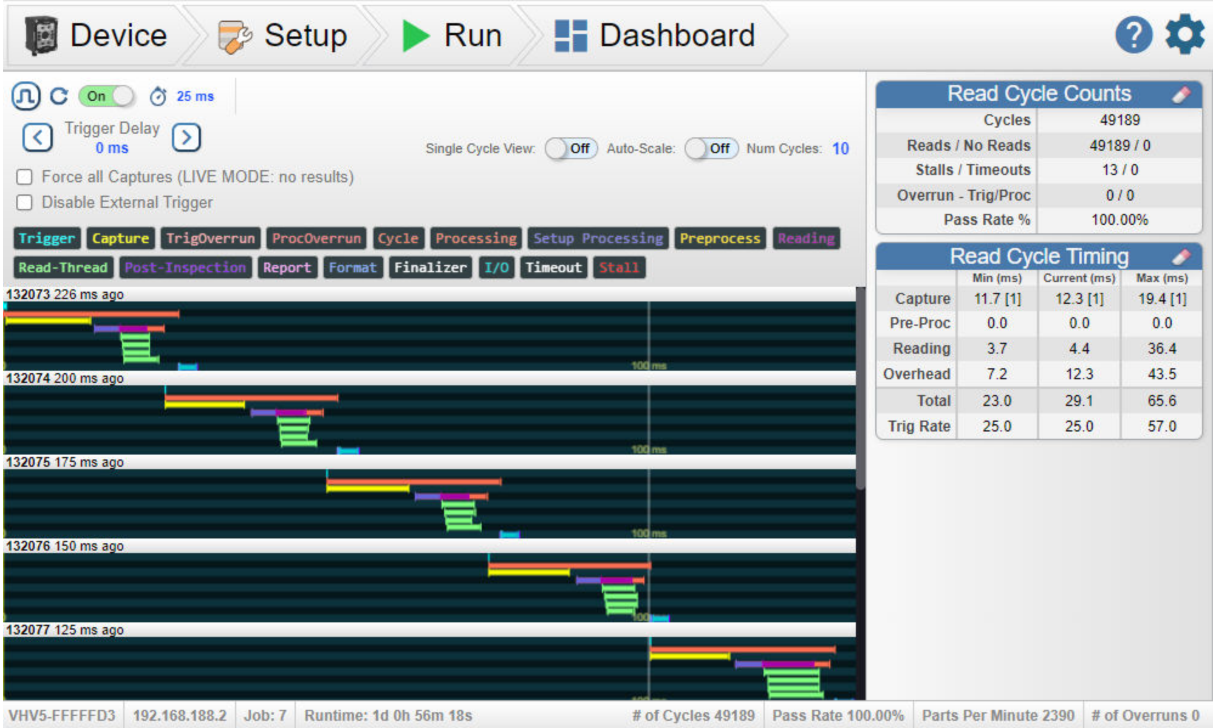
The line operator may not require this feature, but this is an extremely useful tool for system integrators or line technicians as they are bringing up high-performance systems, or as they are trying to troubleshoot runtime performance issues.

Key Point: No processing time is taken from the Read Cycle to gather or display the Digital Softscope data. The timing displayed is extremely accurate, and can help expose issues with the reader, as well as with the controlling PLCs or systems.

The Digital Softscope is accessed via the gear icon in the upper right corner of the user interface.

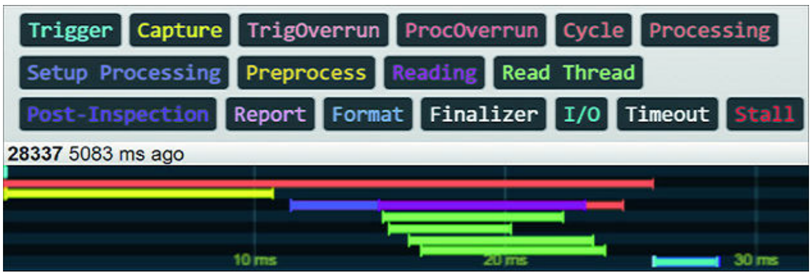


6-5-2 Digital Softscope Quick Start



As the system runs, the Digital Softscope gathers timing data on all significant events and processes and displays them in time based graph format. Each event and process is color coded per the chart below to allow the user to visualize the entire read cycle easily. Events such as Trigger show as blips, or short vertical lines. Processing is shown as horizontal bars, where the start, stop, and length of the bar denote the actual start, stop, and duration times.

Reading Example: The example below shows a single read cycle starting with a trigger, and ending with data being sent. The full duration is approximately 26 msec from trigger to answer.



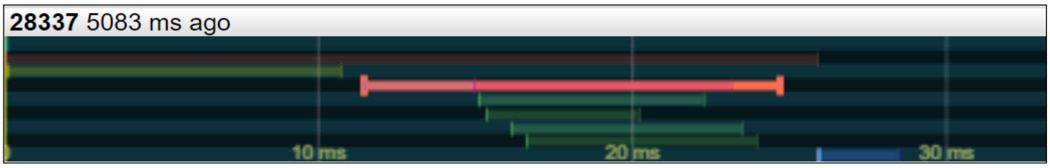
1. The Read Cycle starts with a Trigger event shown as a vertical light blue line.
2. Next, the system performs a Capture on an image shown as the yellow horizontal bar.
3. As soon as the image is available, read Processing begins.
4. Processing starts with Setup Processing, which prepares the X-Mode decoding algorithm to run.

   The next stage is Reading, where X-Mode is run on the image to look for the codes. Reading itself launches multiple instances of a `Read Thread`, which runs concurrently on the different cores to accelerate decoding.

5. Once the code or codes have been read, the final stage of `Processing` shuts down any `Read Thread` that is still running. The read cycle then moves on to the `Post-Inspection` stage.
6. During `Post-Inspection`, which is very short, the system compiles the data into a `Report`, proceeds to `Format` it, and, when Finalized (`Finalizer`), sends the report out through all enabled communication channels. The pass, fail, and error digital outputs are sent at this time too. `I/O` reflects the pulse on and off time of the outputs.

Key Point: Hovering the cursor over any of the event or process labels in the list above the graph will highlight that particular event or process, making it easy to see it in detail on the time plot.

For the example above, if the user hovers over `Processing`, the display changes to the figure below.



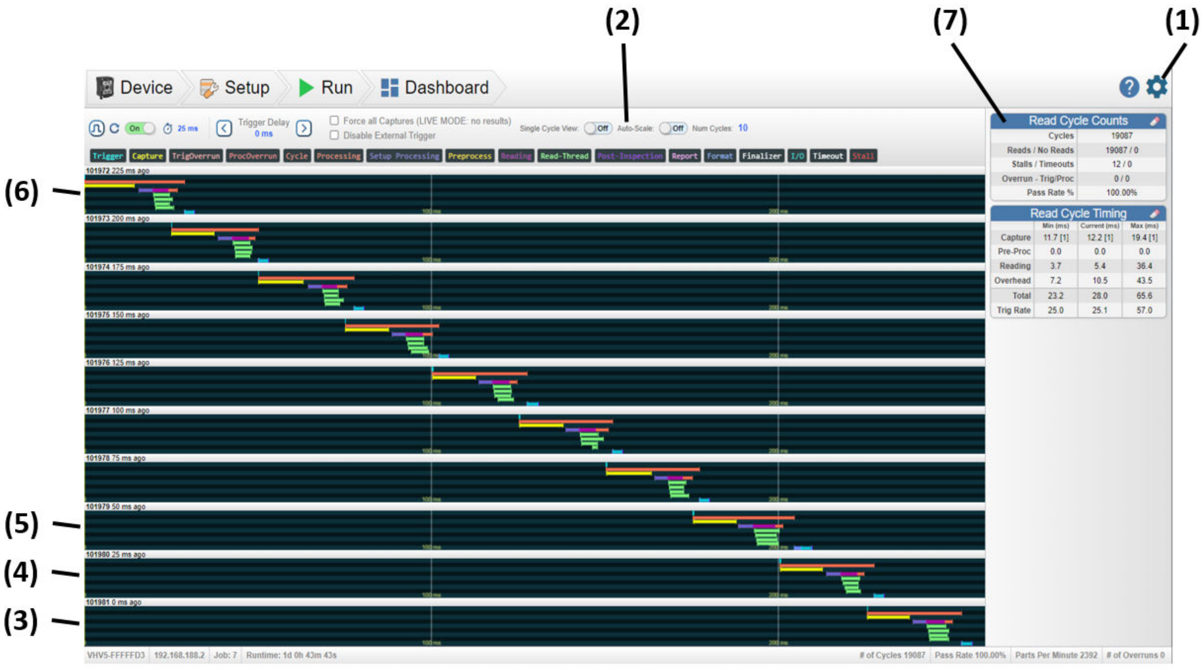
When looked at in comparison with the first figure, it is clear that `Processing` is a high level calling routine taking about 12 msec. Within processing, `Setup Processing` occurs, first taking about 3.5 msec, followed by `Reading`, which takes about 7 msec. The final `Processing` time (2 msec) is spent shutting down the instances of `Read Thread` and cleaning up prior to moving on to `Post-Inspection`.

This feature also provides a powerful tool to capture and see occasional rare error or warning events such as Trigger Overruns (`TrigOverrun`), Processing Overruns (`ProcOverrun`), and Stalls (`Stall`). These are errors or warnings which indicate the system is being triggered too fast. Errors will show up as Xs on the screen when you hover over the label. Stalls, which are warnings, will show up as a red line. The example below shows trigger overruns.

6-5-3 Multi-Cycle View

There are two main views for the Digital Softscope. The **Multi-Cycle View** shown here, and the Single Cycle View, which will be shown in the next section.

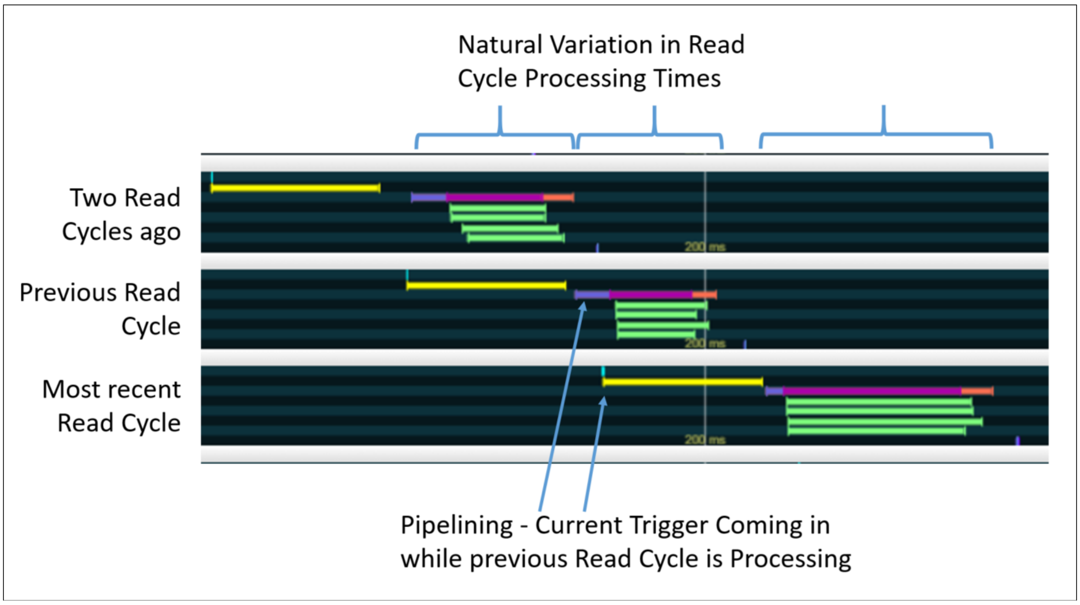
The Multi-Cycle View shows one read cycle per horizontal lane. Up to 12 back-to-back read cycles can be displayed in the time graph at the same time.



1. **Gear –** The Digital Softscope is accessed by selecting the Gear icon and then clicking on the Digital Softscope icon.
2. **Digital Softscope Controls**
   1) **Single Cycle View vs. Multi-Cycle View –** To choose between display above and display in next section.
   2) **Auto Scale –** When on, the time base is scaled to show at least one full read cycle. When turned off, the user can roll their mouse wheel in the graph area to shorten or lengthen the time scale for optimal viewing.

3) **Number Cycles –** The User can create and choose from three alternate layouts of the Dashboard.
4) **Trigger Delay –** Delays time between when trigger occurs and when the picture is taken. Used for aligning the part in the field of view without moving physical trigger.
5) **Trigger Generator Controls –** Used to simulate triggers allowing the user to determine before the system goes on line what the expected TACT time could be if all codes are similar to the one placed in front of the camera for testing.

3. Items **3** to **6** in the diagram above show the read cycle lanes. Read cycle lanes allow you to see how cycles overlap, as well as how previous read cycles affect the upcoming cycles.**3** shows the most recent read cycle.
4. Shows the previous read cycle.
5. Shows the read cycle before that.
6. Shows the oldest read cycle that fits on the screen depending on what Number of Cycles is set to.
   1) The most recent read cycle scope trace comes in at the bottom right. At each trigger, that trace is moved up and to the left.
   2) This view allows the user to see read cycles over time. It allows the user to see if they are in pipelining mode.
   3) It also allows the user to see Trigger Overruns, Processing Overruns, and Stalls.
   4) The image below shows an extremely well-optimized System capable, in this case, of running at 50 Reads Per Second, or 3,000 PPM.

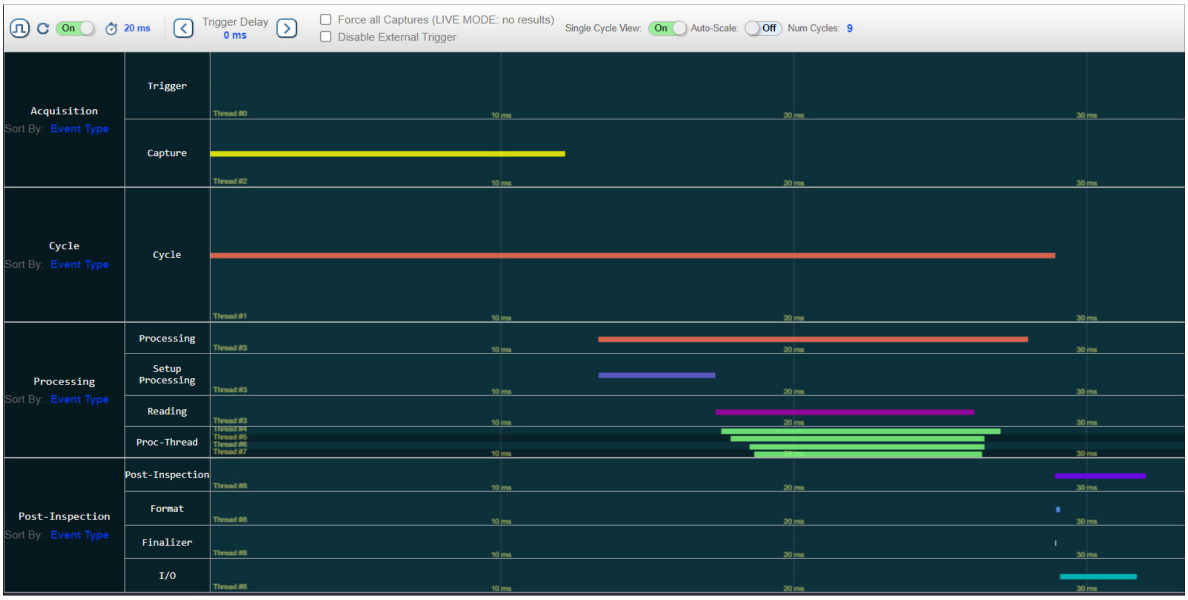


7. **Report –** This section shows the same report as the **Setup** and **Run** views.

6-5-4 Single Cycle View

The **Single Cycle View** only shows read cycle, but in much greater detail than the Multi-Cycle view. It does this by breaking all major events and processing threads up into their own lanes, giving the user a more an exact visualization of, and timing for each.

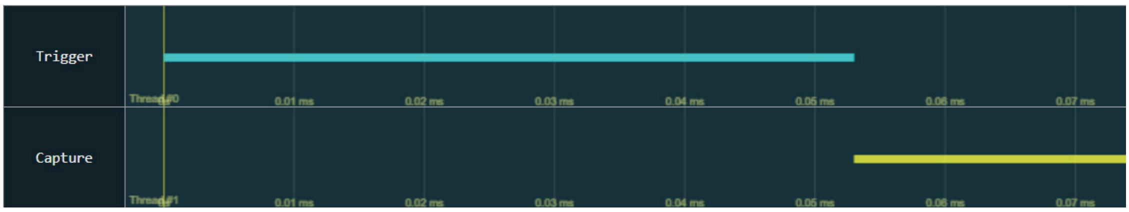
Note: The user can choose to sort by Event Type, which matches the Multi-Cycle View, or by Thread, which more clearly shows the order in which the process threads are created and run. The example below is sorted by Event Type.



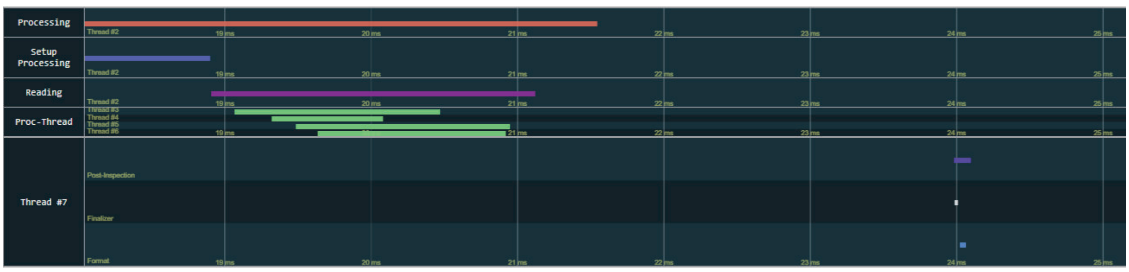
The second major benefit of this view is that the user can 1) turn off Auto Scale and then 2) Click on a signal and then use the mouse wheel to scroll down to an extremely small time base, essentially providing a "time zoom".

The user can also click on and then drag the whole time view left and right to see anywhere in the read cycle from trigger to answer.

Example 1: Here the user drags the view to the right to be able to see before start of the trigger. They then zoom with the mouse wheel to the point where it shows the actual trigger delay in microseconds before the capture starts.



Example 2: Here the user can see the end of the cycle in detail showing that the time between when processing ends and when the result is packaged and sent is approximately 2.5 msec.

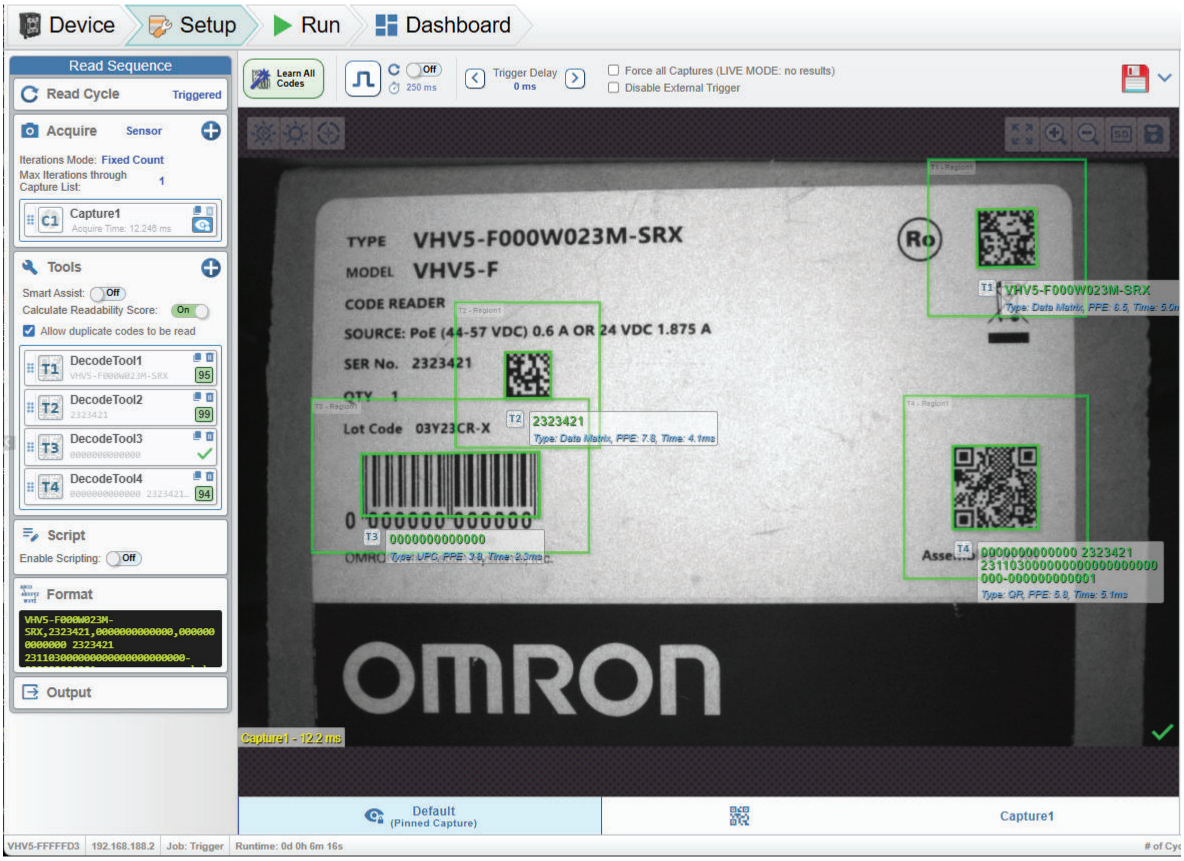


6-5-5 Digital Softscope Signals

Item	Description/Content
Trigger	Actual Trigger event that starts a read cycle.
Capture	Time for exposure and read out of each image, as well as any additional time necessary to set up capture such as sensor, focus and lighting changes.
TrigOverrun	Represented by an X. Occurs when a new trigger is sent while the system is still taking the current set of images. This error that indicates that results will no longer be synchronized with the triggers coming in.
ProcOverrun	Represented by an X. Occurs when images are being acquired faster than processing can keep up with them. If the image buffer is exhausted, new images will be thrown away. This error that indicates that results will no longer be synchronized with the triggers coming in.
Cycle	No Signal
Processing	Processing runs the following routines.
Setup Processing	Prepares the X-Mode Decoder to run.
Preprocess	Performs an image pre-processing set up for each ROI prior to running X-Mode Decoder.
Reading	Parent process for decoding that runs multiple instances of X-Mode in all of the ROIs.
Read Thread	Actual X-Mode decoder running on a region by region basis.
Post Inspection (Report, Format, Finalizer)	During Post Inspection, the report data is compiled, formatted and transmitted in the these three sub-steps.
I/O	Time reflecting both the Pulse On Time and then Pulse Off Time of the digital outputs. Outputs are set as last step in read cycle.
Timeout	Represented by an X. Occurs if Read Cycle is not complete before reaching the user-defined maximum allotted time for the cycle.
Stall	This line shows when current read cycle has to Stall, or wait, for the previous read cycle to be complete and send out its result before allowing the current one to send out its data. The Stall function assures that the order of results coming out of the reader follows the order of the triggers.

6-6 Advanced Functions and Operations

6-6-1 Learn All Codes



Learn All Codes simplifies the process of creating the Job by adding all necessary Decode Tools for the user. The Learn function searches in a Capture with Smart Assist to find all the codes that are present. Once done, Learn automatically adds a Decode Tool to the Tool list for each code found.

Learn also sets key parameters of the Decode Tool, such as the Code Type that is found, and creates a ROI (region of interest), used to search for the code during runtime. The ROI is set at the center of the learned code, and is sized with a margin around the code large enough to accommodate any positional uncertainty of the code as it runs. The size of the margin is a user parameter in the dialog.

Note: The Learn All Codes function is not enabled for Verification jobs that include the Verification Tool. In this case, the user must insert and set up all additional Decode Tools manually.

Operation

1. Set Up Capture or Captures
   1) Start by setting up the Capture (or Captures) to obtain a good image of the part and code.

2) If the job is being programmed on a moving line, set up the trigger so the part is centered in the image when triggered.

3) Click Learn All Codes.

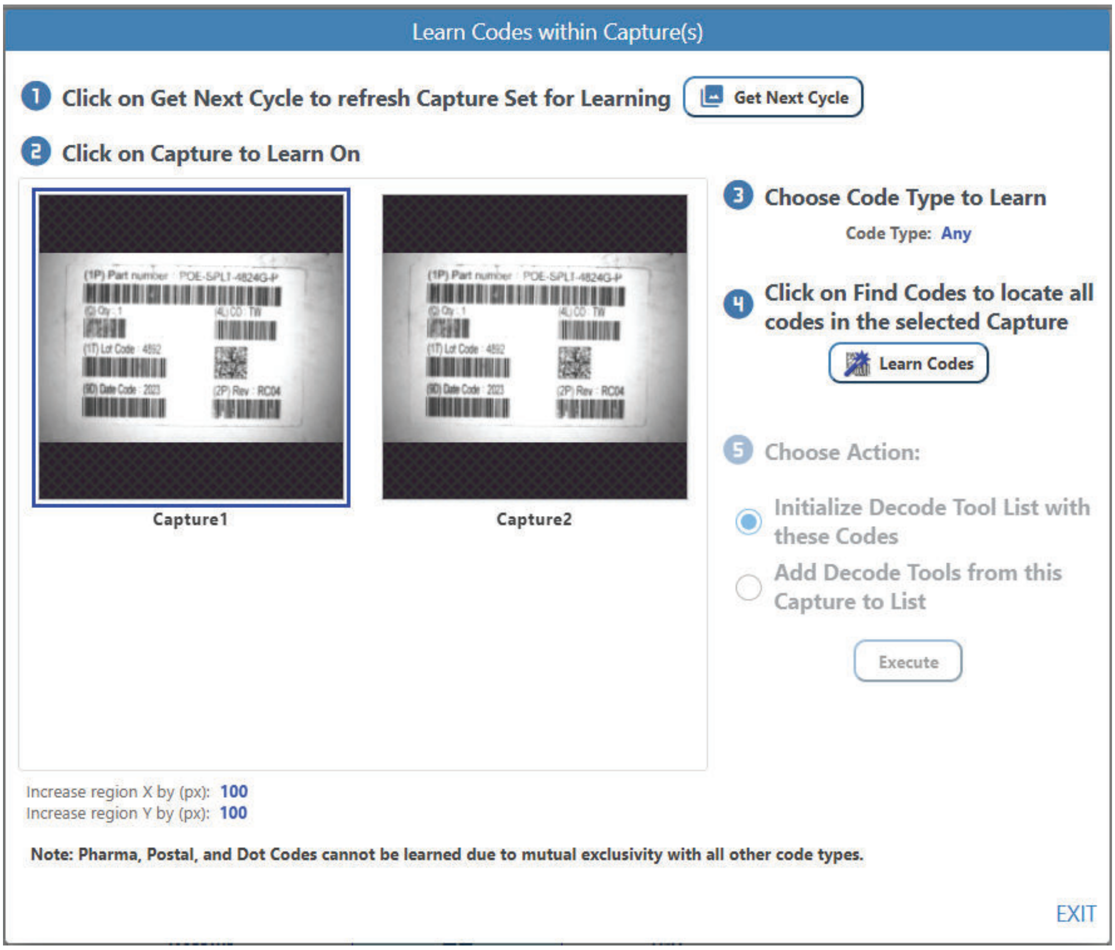
4) This will bring up the Learn Codes dialog shown below.

5) The dialog shows the 5-step Learn process.

6) The dialog also shows Captures from the most recent read cycle if the camera has already been triggered.

7) Capture 1 will be outlined in blue.

8) Follow the sequence of steps from 1 to 5 to learn the codes and update the job.

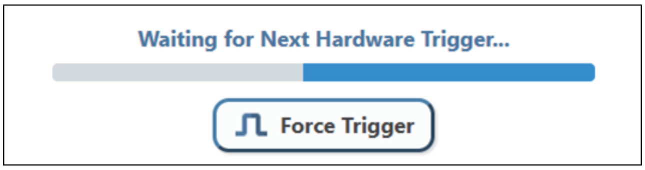


2. (Step 1) Get Next Cycle

1) If the Captures that are displayed are not high-quality, or they are not all displayed, the user should click on Get Next Cycle to acquire a full fresh set.

2) If the Job type is Continuous for Presentation, the system will acquire a new set of Captures immediately.

3) If the Read Cycle is triggered, and external triggers are enabled, the reader will wait for the next machine trigger to acquire a fresh set of images of the part as it goes by. A dialog is also shown to give the user the option to Force the Trigger.

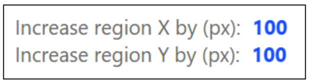


3. (Step 2) Click on Capture to Learn On
   1) The image will be outlined in blue.
4. (Step 3) Select Code Type to be Learned
   1) By default this is set to **Any**. Learn all Codes will find and learn all codes that are on the part.
   2) If you want the system only to learn one code type, or are trying to learn a large array of the same code type, such as Data Matrix, choose that code type first in the dropdown menu before proceeding to the next step.
      Note: It is also possible to re-enter Learn and choose another code type and add more Decode Tools. For example, the user can learn all the Data Matrix codes, and then add all the QR codes, and then add all the UPC codes. See step 5 for information about how to add codes to the list that has already Learned.
5. (Step 4) Learn Codes
   1) With a good Capture selected, the user should click on Learn Codes.
   2) The system Learns by running a full image X-Mode with Smart Assist turned on in that capture. Smart Assist assures that it finds all readable codes.

   3) This will locate all the codes in the image and outline them in green.

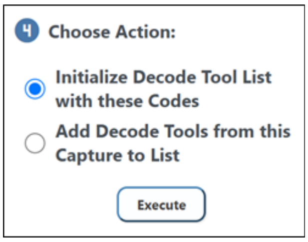
Capture1

6. (Step 5) Choose Action
   1) Set Decode Tool ROI Size. First, underneath the image area, use the controls to define the size of the ROI for each decode tool that will get added. Set the size to account for the amount of positional uncertainty expected in the part as it runs on the line. By default, the system will increase the size of the ROI by + and - 100 pixels on all sides of the part. If the part will not move much more in one direction, such as vertical, it is good to decrease the Y amount.



If the part will not move much during production, or will only move in the direction of the machine, it is good to decrease the size of both x and y. If you have a densely packed set of codes, such as an array, you should also decrease the size of the ROIs so they do not cover more than one part.

2) Choose the action. By default the codes found will be used to **Initialize the Decode Tool List with these Codes**, i.e. it will replace all Decode Tools in the current job with an entirely new set of Decode Tools, one for each code that it has just found.



3) If the user clicks on another image that contains codes that will only be seen there, the user can select **Add Decode Tools from this Capture to List** instead. This will append more Decode Tools to the job for finding and reading these other codes.

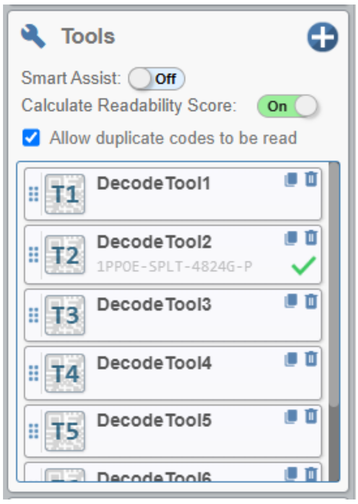
4) Make the selection and click **Execute** to complete it.

7. Click **Exit** to Complete the Process

1) Click **Exit** to close the Learn All Codes wizard.

2) View the new job structure on the left side of the screen under the Read Sequence.

3) The job will reflect all the added Decode Tools.

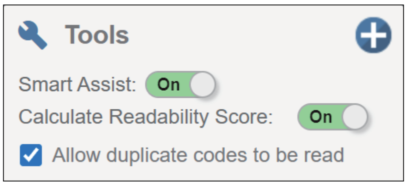


4) The user can trigger the job in Setup Mode and see the tools run.

5) The user can individually adjust the search ROIs for each tool.

6) The user can always add or delete additional Decode Tools from the job by clicking on the **+**icon or the trash can icon.

6-6-2 Smart Assist



Smart Assist and Optimize are designed to improve read rates for very difficult-to-read codes. Smart Assist is the simplest method to implement. It is the first step the user is advised to take when encountering difficulty in code reading. Smart Assist is enabled with a single-parameter setting in the Tools menu. Smart Assist turns on a specific set of Advanced Parameters in X-Mode that try more steps to read a code. The Advanced Parameters are shown below. The Smart Assist setting is global and applies to all Decode Tools in the job when turned on. (See note).

The key advantage of Smart Assist is that it automatically delivers all the functionality of the extremely complex and difficult-to-set-up Configuration Database models implemented by others.

When Smart Assist is on, it will automatically and intelligently apply a series of Advanced X-Mode Decoding and Image Preprocessing methods on an as-needed basis to assure successful decoding.

Smart Assist will do this for all Captures in the Read Cycle. The advantage here is that each capture can be set with different Exposure, Gain, Focus, and Light settings, which are already designed to give the algorithm the best chance to read the code by providing optimal images. Smart Assist along with each Capture becomes the equivalent of 24, then 48, then 72 … entries in the traditional Configuration Database.

Note: The Smart Assist setting is global. It turns on the defined set of Advanced Parameters for all Decode Tools within the Job. This can affect the Read Cycle time. If the reading problem is just with one code or a small set of codes, the user can use the gear icon in each tool and turn these same Smart Assist Advanced Parameters on and off individually. Smart Assist Advanced Parameters are described fully in the table below, and in section 7-7-4.

Operation

1. When Smart Assist is turned on, X-Mode will process normally until it encounters a difficulty.
2. At that time, X-Mode will begin to employ extended processing techniques such as Damaged Mode, Curved Mode etc. to try to decode within that image.
3. If it exhausts these techniques, X-Mode will begin to preprocess the images, changing contrast using Gain, size using Scale, and shape (or fill) of the code bars or cells using Morphology.
4. For each new enhanced image combination it will again try X-Mode normally, and then with the extended techniques.
5. Each additional processing operation is performed only when the previous steps fail to produce a decode.

The clear advantage of Smart Assist is that it is able to decode very low-quality or problematic codes simply by tuning a single parameter setting. There is no need for the user to become an expert on advanced parameter settings and complicated image preprocessing techniques.

The main disadvantage is that decode times can vary from very fast when no extraordinary processing is required, to quite slow when every available advanced technique and image preprocessing step must be used to finally decode. When cycle time is not an issue, Smart Assist is the best answer. If time is an issue, then setting Advanced Parameters individually, or running Optimize may be the better answer. Optimize is described in the next section.

Key Point: If decoding problems that require Smart Assist occur frequently , the user should first review the lens, lighting, and mounting to see if a much better class of images can be produced by altering the basic physical setup. Often, just changing the angle that the camera is mounted relative to the part face is all that may be required. See **Mounting the Camera** in the setup section.

The following table lists the Advanced Parameters and Image preprocessing operations Smart Assist uses.

Smart Assist Advanced Parameters	
Advanced Parameter	**Definition**
Damaged Mode	This function is useful for bad cell registration, or high optical distortion. Damaged mode assumes irregular cell placement, so it shifts the grid location for where it samples cell content to attempt to get a good read. This function has a low impact on the decode time.
Alignment Pattern Mode	If X-Mode has difficulty finding the four corners of the code, this instructs X-Mode to use the alignment patterns (internal Ls and clocks) to realign the cell sampling grids before decoding a Data Matrix. This is especially helpful for very large codes with multiple internal clock patterns because large codes can be more affected by optical distortion. The internal clock patterns are used to realign the sampling grid locally for each small group of cells. This function has a medium impact on the decode time.
Curved Mode	This enables curve detection for Data Matrix and QR Codes on bottles or cylinders. If enough curvature is detected, it will curve the grids accordingly, adjusting where it samples the cell centers. Note: This function works for smooth curves, such as when a code is wrapped around a bottle. If the code is more wrinkled, then Damaged Mode is a better solution. This function has a medium impact on the decode time.
ScaleUp	Scales up the image by 2x and then by 4x. This can help the algorithm to align the grid for where it samples the cells, as well as to give the algorithm a larger clear area for sampling the cell.
Scale Down	Scales down the image to ½, ¼ and then 1/16th if necessary for decoding. This helps by reducing the PPE down to the 5-5 cells that X-Mode is optimized for.
Apply Morphology	The system attempts to decode with the aid of various morphological operations such as Dilation, Erosion, Open, and Close.

6-6-3 Optimize

Optimize operates similarly to **Smart Assist** but with a more targeted approach. Smart Assist improves decoding for any code type or size that it encounters. Optimize, on the other hand, is trained on one specific code on the part. During the optimization phase, settings are tuned specifically to ensure that one specific code is read.

Smart Assist decode times can be long since there is no prior knowledge about the code that is being read. Optimize, on the other hand, will run much more efficiently since it has been trained specifically on one specific code.

The final difference is that Smart Assist is a global setting and is applied to all Decode Tools in the job. Optimize, on the other hand, is applied per Region of Interest (ROI) within a single Decode Tool. This allows for more granular control and optimization where each and every code can be tuned for optimal reading.

Optimization is initiated by clicking the **Train** hat in the top right corner of the ROI or image. Optimize begins by acquiring a set of 3-7 images of the codes from the running line. This ensures that Optimize accounts for the natural variation in the appearance of the code that occurs based on positional differences in the field of view, as well as variation in lighting across the field of view. The final Optimize solution is calculated based on the best answer for all images in the code set. Optimize calculates the following:

- Digital Gain
- Scale
- Morphological Filter
- Minimum Edge Strength (Necessary to detect the code.)
- Code Type
- Code Polarity
- Code Size

Gain, **Scale**, and **Morphological filters** are used to create the clearest possible image of the code.

Min Edge Strength, **Code Type**, **Code Polarity**, and **Code Size** are used to speed up the decode. They do this by ignoring all edges in the scene that are too weak to be part of the code, and ignoring all codes that are not the correct type, polarity, or size.

At the conclusion of Optimize, the operator is prompted to **Apply Optimization** or to **Cancel**. If the user selects Apply, all the parameters above will be set, and the Train Hat icon will be turned into an **Un-Optimize** icon (a Train Hat with a back arrow).

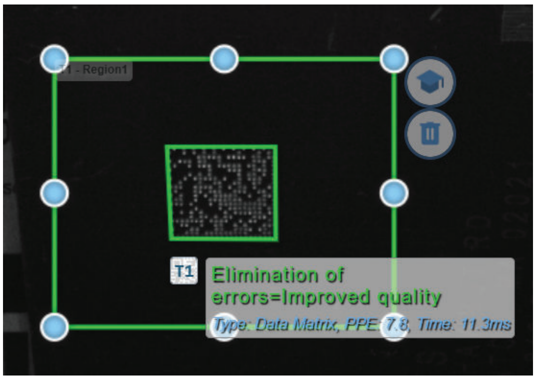
The next section is a step-by-step example demonstrating how to use Optimization.

Critical Note: The operator must click **Un-Optimize** to ensure that all optimization parameters, both seen and unseen, are reset to normal. Failure to do so can make the decode tools stop reading.

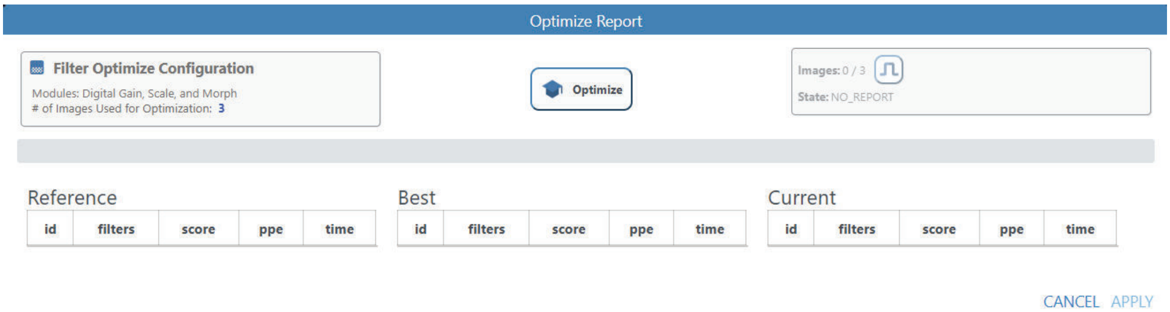
User Tip: Smart Assist and Optimize can be used together, providing the most robust approach. The image preprocessing from Optimize is applied first. If the code is not read, then the Advanced parameters (additional image preprocessing from Smart Assist) are applied next.

How to Run Optimize

1. Set up a ROI to limit the area the Decode Tool will run in.
2. Run the system to ensure that the ROI is large enough to account for the variation in code position as it is seen from trigger to trigger.
3. Click on the ROI, and then click on the Train Hat icon in the upper right.



4. This opens the Optimize Dialog.
5. Choose the Number (#) of images to be used for Optimization. **Key Point:** Optimize can be set up to run on 3 – 10 images. The optimization settings it chooses are the best settings for read success and low decode times based on an average of all images that are included. This naturally takes into account all the normal part-to-part marking differences, as well as differences in light return that are normally seen as the part moves around in the field of view.

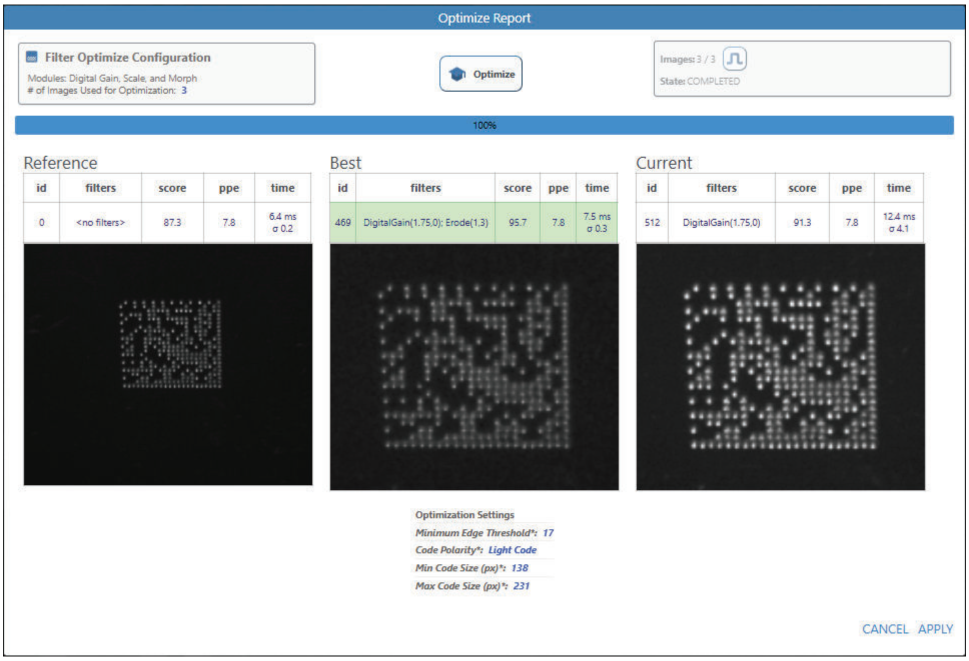


6. Click the Optimize button to begin.
7. The first step is for the system to collect the set of images to use for Optimize. If machine triggers are running, the system will automatically acquire the next # captures. If triggers are not on, the user can click the trigger button in the dialog to collect the necessary number of images.
   Note: If Continuous or Presentation mode are set, that number of parts needs to be moved in and out in front of the camera for Optimize to start. Optimize does not work with Start/Stop mode. The mode must be turned to Trigger first and then set back at the conclusion of Optimize.
8. Once all images are acquired, the Optimization sequence starts. The routine systematically goes though all combinations of the image and filter parameters. It compares the results from each and keeps track of the **Best** set.
9. **Best** for 1D codes is determined first by read success, and second by the shortest, most consistent Decode Time. Best for 2D codes is determined first by read success, second by the highest Readability Score, and third by the shortest, most consistent Decode Time.
   Note: The Readability Score for 1D codes is reported as 0.0 and is ignored. The Readability Score for 2D codes is reported as 0 to 99, with 99 being the best-formed code for reading.

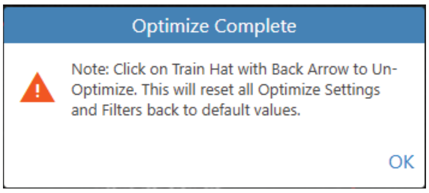
Note: The **Readability Score** for 1D codes is reported as **0.0** and is ignored. The Readability Score for 2D codes is reported as **0** to **99**, with 99 being the best-formed code for reading.

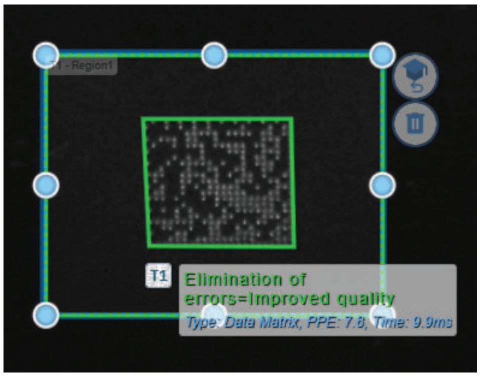
1) To start, Optimize first decodes with no image preprocessing and shows that image and Readability Score and Decode Time under Reference. This is the base performance case.
2) As it cycles through the various combinations of Gain, Scale and Morphology, it shows that image, score and time under **Current**.
3) It compares and then keeps track of the best parameter set, displaying it under Best.

10. Optimize progress is shown in the dialog.
    1) To start, Optimize first decodes the image set as-is, and displays the image, Readability Score, and Decode Time under the Reference heading. This is the base performance case.
    2) Optimize cycles through the various combinations of Gain, Scale, and Morphology. It shows each new image, score, and time under the **Current** heading.
    3) Optimize compares results and then keeps track of the best parameter set, displaying it under the **Best** heading.

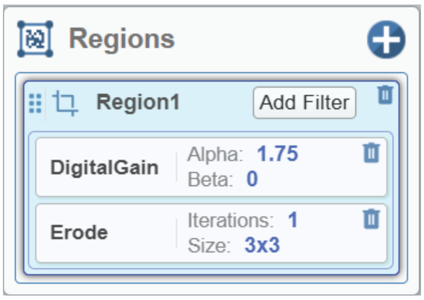


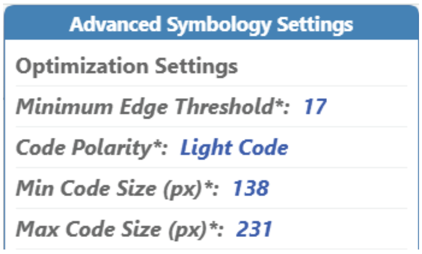
11. At the end of Optimize, Min Edge Strength, Code Polarity, and Min/Max Code Size are calculated and displayed below the Best heading.
12. The user can now click Cancel, or click Apply to accept the Optimize settings.
13. As part of Apply, a warning dialog is displayed. It is there to remind users to click on the Train Hat with back arrow if they want to Unoptimize the symbol. This operation will ensure that all parameters and filters are reset to default. Trying to undo all settings by hand can lead to no reads if one or more parameters are left set.





14. The results of Optimize can be seen in the Decode Tool. The Filters are shown in the Regions section, and the parameters are shown under the gear.





Final Notes:

1. The user can choose to set their own region **Image Preprocessing Filters** to create better images of the code. This capability is in the Decode Tool under the **Regions** section. See section 7-7-5.
2. Users can also set **Min Edge Strength**, **Code Type**, **Code Polarity**, **and Code Size** "by hand" to speed up the read. This capability is in the Decode Tool under gear dialog. See section 7-7-4.
3. Note that if the user sets either of these "by hand," the Train Hat icon will also change to allow a quick undo.

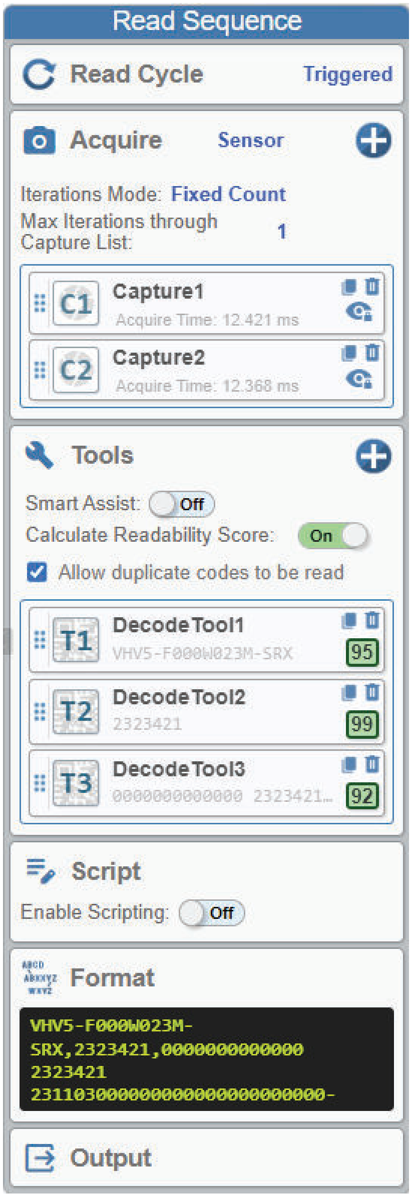
7

Read Sequence Dialog

7-1 Overview

The reader runs read cycles. The Read Cycle is based on the Job Type. There are four Read Cycles, or Job types: **Triggered**, **Continuous**, **Presentation Mode (Supermarket Mode)**, and **Start / Stop**. The Read Cycle runs through a sequence of steps, starting with a trigger event, and ending by transmitting data out of the device. See the Theory of Operation section for specific definitions of the cycle type, as well as how the Read Cycle operates.

The Read Sequence dialog shows the sequence of steps the reader executes as it runs each cycle. The main steps, or controlling functions, within the Read Sequence are:



Read Cycle Step – This step controls how the Read Cycle operates from Trigger to Answer.

Acquire Step – This step is used to insert and configure all the Captures that will be used during the Read Cycle. One or more captures can be set up with different Focus and Sensor settings to create different images. Captures 1-N are referred to as the **Capture List** in the next sections.

The Read Cycle Setting dialog described in the next section is used to fully configure the entire imaging sequence, including setting how many times to **Iterate** through the Capture List while attempting to read.

Tools Step – This step is used to insert, set up, and run one or more Decode Tools on the images acquired using the Capture List.

Script Step – This step allows the user to create custom data output strings using all the data calculated during the Read Cycle and from all Decode and Verification tools. This custom string will be transmitted out instead of the Format output string created in the next step. The Script Step also allows the user to set the 3 digital outputs based on programmatic results.

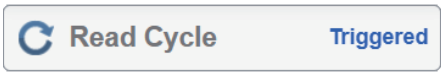
Format Output Step – This step manages the data coming back from all the decode tools, and is used to format the final reader output string.

Output Step – This final step allows the user to save Read Cycle images and reports to RAM on the camera for later retrieval, or to send them to an FTP site.

7-2 Read Cycle Step

7-2-1 Overview

Read Cycle is the first step in the Read Sequence. This step controls how the Read Cycle operates from Trigger to Answer.



The Read Cycle step exposes one parameter, the Read Cycle Type. This can be changed by the user during setup for testing purposes, but it is recommended that the job be created with the desired Read Cycle type when the user “Creates New Job”.

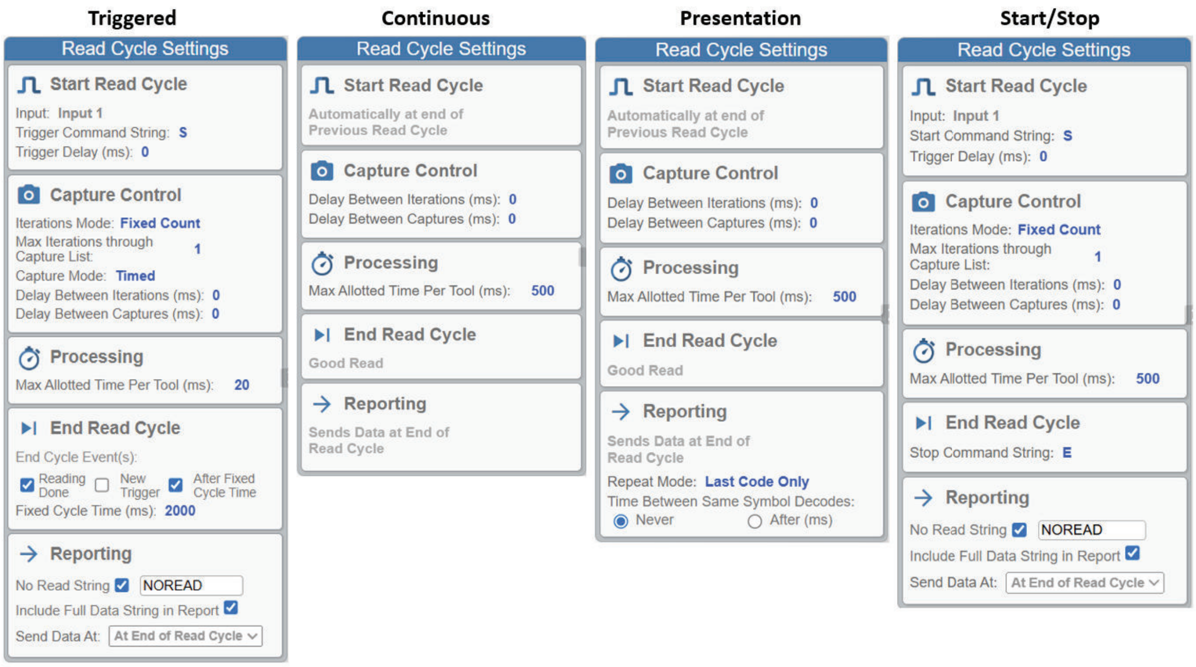
Clicking on the Read Cycle will highlight the step in light blue and will open up the specific Read Cycle Settings dialog in the right hand pane for that read cycle mode. The settings dialog allows the user to change parameters within the five read cycle control sections.

7-3 Read Cycle Settings Dialogs

7-3-1 Overview

When the user clicks on the Read Cycle step on the left side of the user interface, the Read Cycle Settings Dialog appears on the right allowing the user to tailor how the read cycle will run.

Below are the four variations of the Read Cycle Settings dialog for the four different read cycle types. The default settings can be used as-is for most applications.



Individual parameter settings for each read cycle type vary, but the Read Cycle control groupings are the same for all. The flow of the control sections from top to bottom parallel the flow of operation of the read cycle. They start at the top of the dialog with the event that Starts the Read Cycle, and conclude at the bottom with the event that Ends the Read Cycle and directions on how and when to report the read cycle data.

The control groups that parallel the flow of Read Cycle operation are:

1. **Start Read Cycle –** Parameters that control the trigger or method that starts the Read Cycle.
2. **Capture Control –** Parameters that control how images are captured within the read cycle. For read cycles that consist of multiple Captures, this section is where the timing between captures is set up.
3. **Processing –** The section allows the user to control the length of time each decode tool is allowed to run. Normally it is set to 500 msec, but if the user knows a good code will read within a shorter time, this parameter can be used to stop processing if the tool goes longer. This allows the user fine control over read cycle timing similar to the parameters in Capture Control.

4. **End Read Cycle –** Parameters in this section allow the user to set what event ends the read cycle. Normally it is when the reading is done, but other parameters exist and are explained in the sections below.
5. **Reporting –** Parameters in this section control how and when the data and results from the read cycle are reported.

Each Read Cycle type, and the control groups within the Read Cycle, are explained in detail in the sections below.

7-3-2 Triggered Read Cycle

Overview

The Triggered read cycle is the most common type of Read Cycle and offers the user the highest level of control. This first subsection below will demonstrate how the Default Triggered Read cycle job works. It will also show how to implement common modifications to the default job such as adding additional decode tools, or alternate image captures.

The subsection after that will go through the five groupings of the Read Cycle Parameter settings in detail. These again are **Start Read Cycle**, **Capture Control**, **Processing**, **End Read Cycle**, and **Reporting**.

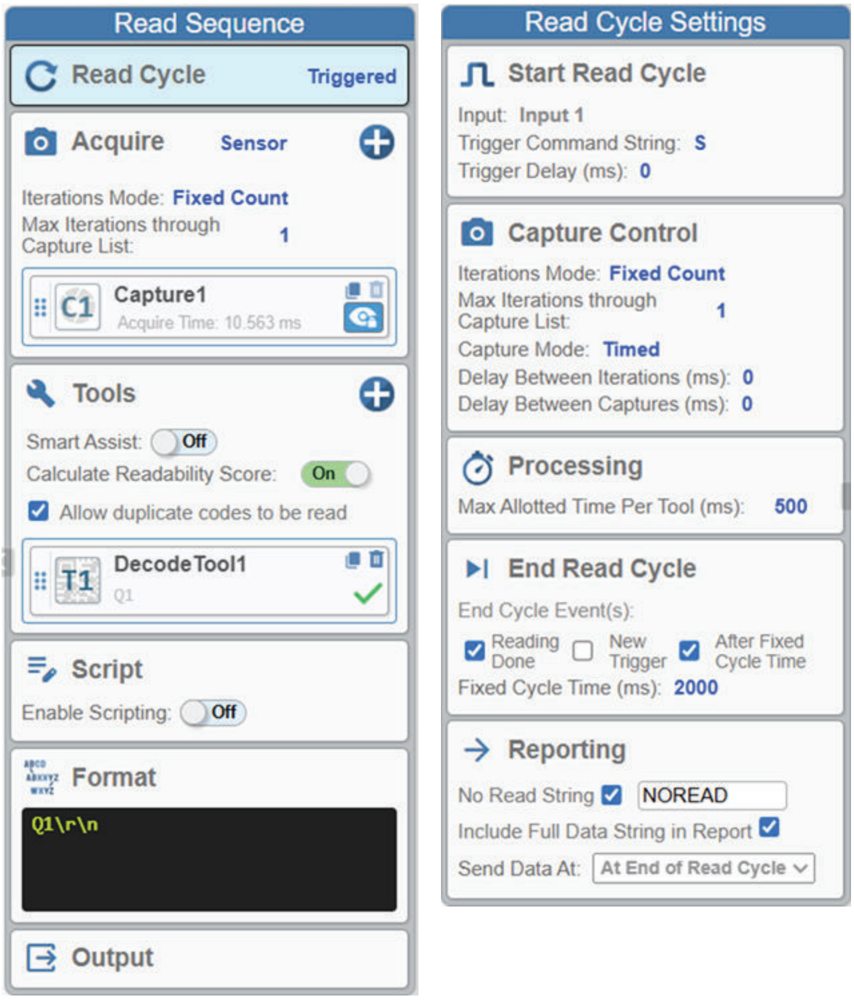
The major sections below those will describe the **Continuous**, **Presentation**, and **Start/Stop** read cycle types. The sections for these three other read cycle types should be read after reading and understanding this section for the Triggered read cycle since they share many of the same concepts and control parameters.

● Default Triggered Job

The Read Sequence for default Triggered Job appears as shown in the dialog on the left below. The Read Cycle is set to Triggered. Once triggered, the reader will Capture one image, and then run the one Decode Tool in that image, eventually producing a result.

The parameter settings that control how exactly how the Read Cycle runs from trigger to output are in the Read Cycle Settings dialog on the right. This dialog appears when the user clicks on Read Cycle in the Read Sequence dialog.

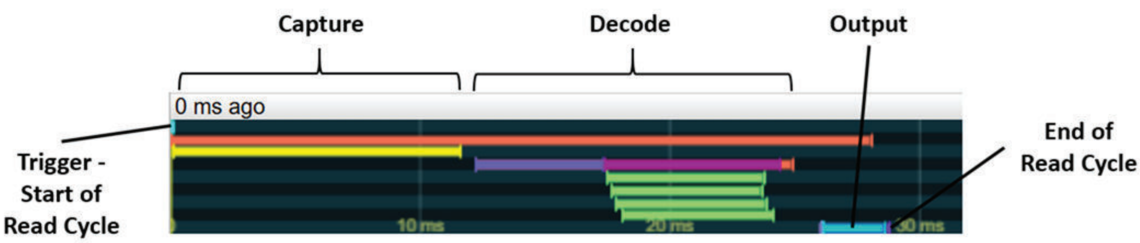
The read cycle operational flow groups are **Start Read Cycle**, **Capture Control**, **Processing**, **End Read Cycle**, and **Reporting**. From within these sections, the user can set the trigger, configure how the capture sequence proceeds, set a limit on the processing time for the Decode Tool, set up the event or events that end the read cycle, and then set up how the report is sent out.



Example 1: Default Trigger Job. Single Capture. Single Decode Tool.

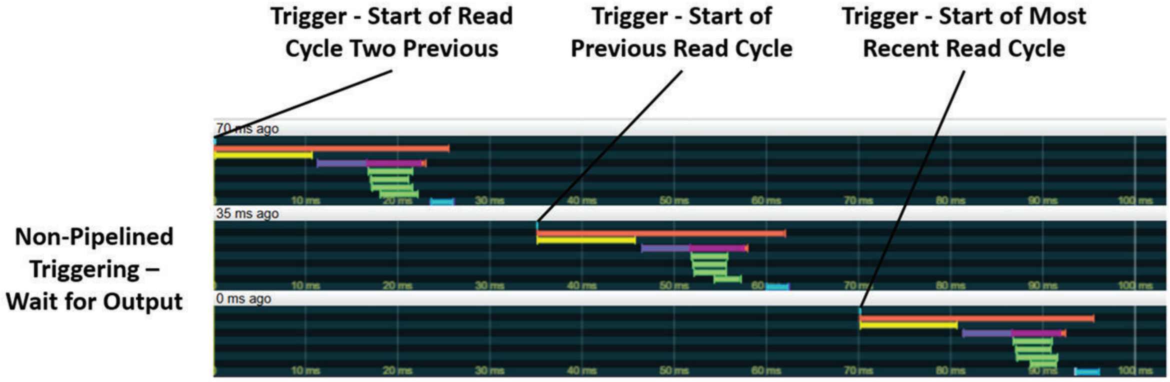
Below is a Digital Softscope trace showing how the default job runs once triggered.

The light blue vertical line on the left is the trigger. The yellow line represents the single Capture, and the Purple/Red/Green group of traces represent the Decode Tool as it is processed on the CPU's multiple cores. Once the decode is complete, the report is compiled and the output sent out. This ends the read cycle. The output trace is the darker blue line on the bottom right of the image. The entire Read Cycle Process, from Trigger to Answer, is indicated by the orange trace at the top.



Example 2: Default Triggered Job running continuously in Non-Pipelined Mode.

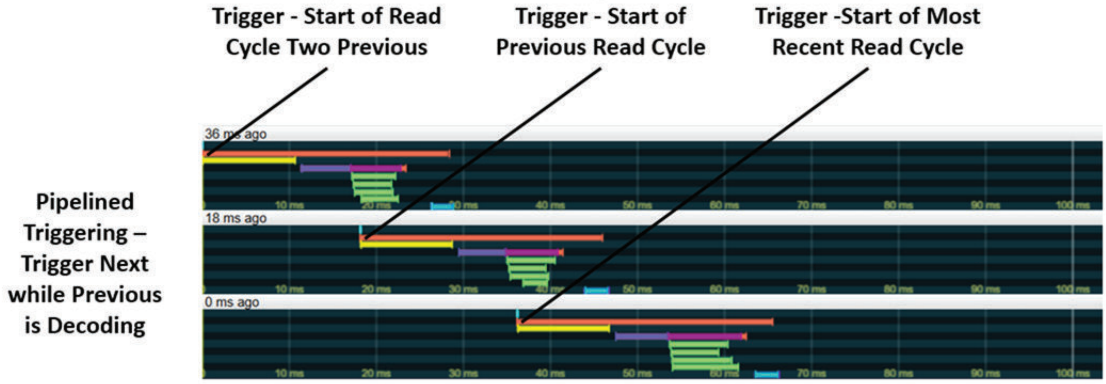
The example below shows the same job on a running line. Here we show the traces for three parts as they pass individually under the camera. Each part is triggered, takes an image and processes it. Here, enough time is allotted between triggers so that each Read Cycle completes and sends out its data before the next part is triggered. This is Non-Pipelined mode.



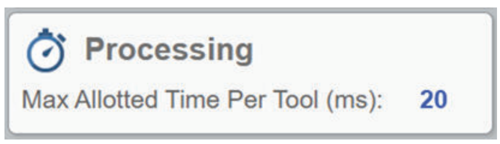
Example 3: Default Triggered Job running continuously on a line in Pipelined Mode.

The example shows the same job as above, but where the trigger rate is fast enough so that the trigger for the next part is received while the previous read is still being processed. Triggering in this way is called **Pipelined Mode**, and allows the system to reach its highest tact time. This works as long as the trigger for the next part is received after the image capture is complete for the previous part.

Note: The system enforces output synchronization so that the data will be sent out in the same order as the triggers. If a later read is done before a previous read, the system will stall until that prior read is done and its data is output.



It is a good idea when running in Pipelined mode to keep the Region of Interest tight around the code, and to set the **Max Allotted Time Per Tool** to a value just above the normal amount of time it typically takes to read the code. For example, if it is known that all codes read normally within 10-15 msec, then set the Max Allotted Time Per Tool to 20 msec.



● Common Modifications to the Default Triggered Job

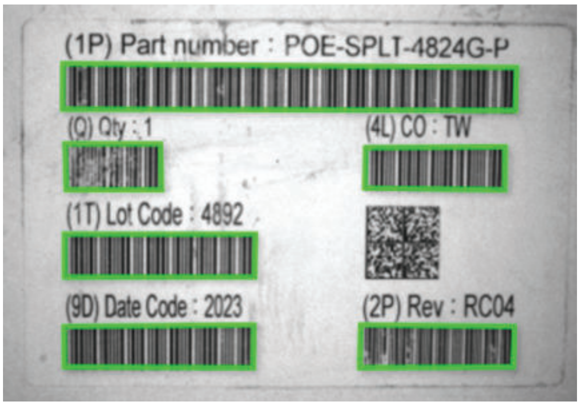
The following two examples show the most common ways the Default Triggered job is modified and used.

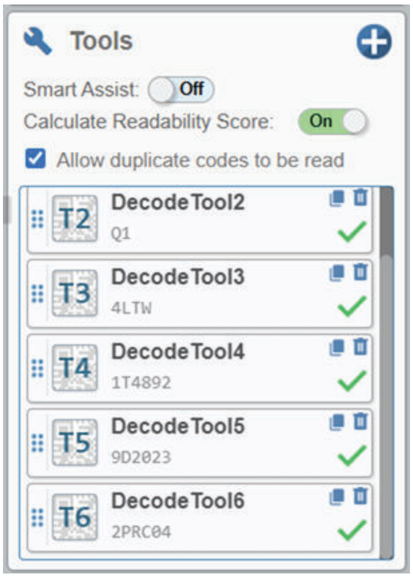
Example 1 shows the Default Job, but with additional Decode Tools added to read all the codes on a single part.

Example 2 shows the Default Job, but with additional Captures added to the Capture list. The different captures are configured with different Focus and/or Sensor settings, enabling the reader to obtain at least one good image of parts that may vary in height, brightness, or other characteristics.

Example 1: Default Triggered Job with Multiple Decode Tools

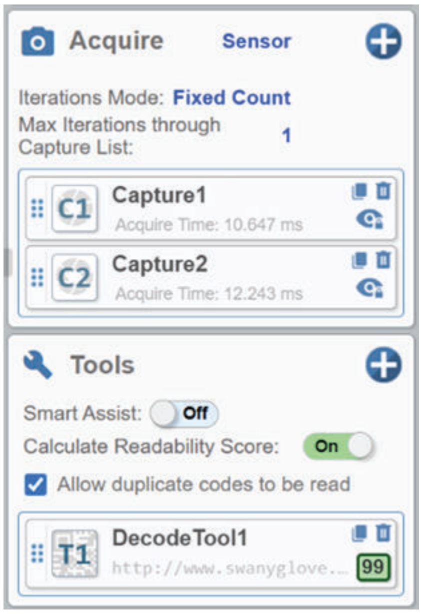
The job below is the same default triggered job with one Capture, but now containing six decode tools to read the six different codes arrayed on the part label.





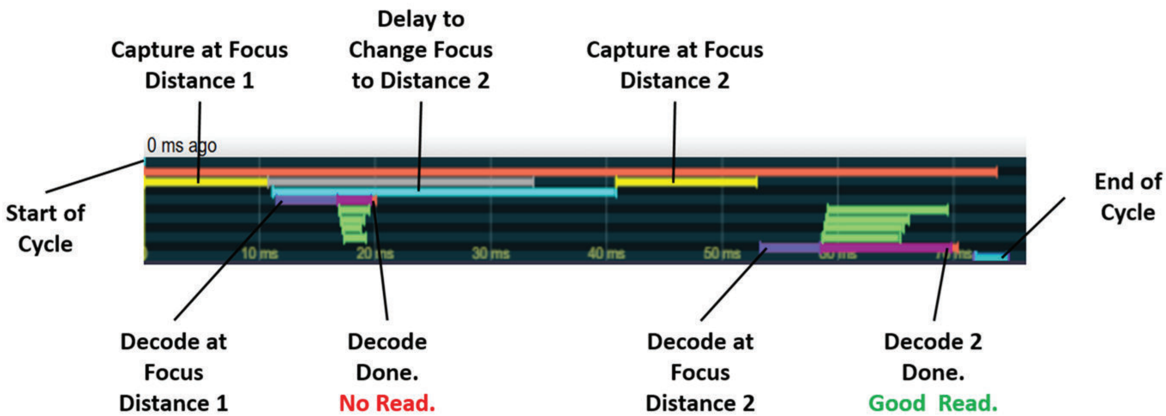
Note that there is still one capture. Four of the decode tools start immediately using the multiple cores. As those decodes complete, the fifth and sixth decode tools run at around the 22 msec mark.

Example 2: Default Triggered Job with Multiple Captures



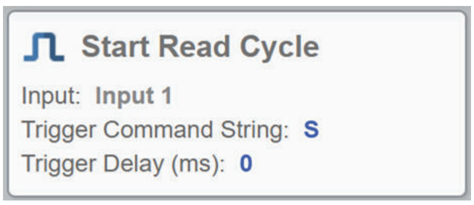
The job below is the same default triggered job with but with two Captures in the Capture List. Multiple Captures can be used for many reasons. A typical reason is to set up images with different Focus and/or Sensor settings to enable the reader to get good images of parts that vary in height or brightness.

The Capture at Focus 1 is the first yellow line on the left after the start of cycle. The decode tool is run in that image. At the same time as the decode tool is running, the system is commanding the liquid lens to move to the second focus distance. Changing focus on the 2.3 MP or 5 MP camera takes close to 30 msec. This is represented by the light blue line. Once the focus distance has been reached, the second capture is taken. This is the second yellow line. If the decode fails and is a No Read in the first capture, the reader will rerun the decode tool in the second image.



Start Read Cycle

This section allows the user to set up how the Triggered Read Cycle will be started. All triggered modes, digital inputs, serial trigger string, and PLC triggers are active at all times.



Physical Trigger – The cycle can be started with a physical trigger. By default, the physical trigger is Digital Input 1.

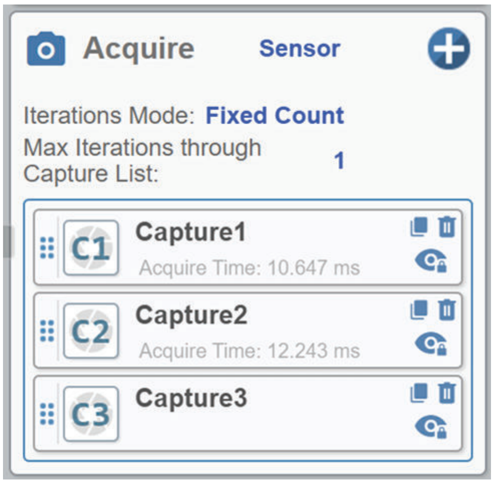
Start Command String – The cycle can also be started with a serial trigger sent through RS-232 or TCP/IP socket to the camera. The serial trigger string is a single character defined by the user.

PLC Trigger – The read cycle can always be started via PLC command if the Protocol is active.

Trigger Delay (msec) is used to hold off acquisition for a fixed time after the trigger is received. This allows the user to programmatically align the part in the field of view without having to go onto the line and change the physical trigger location.

Capture Control

There are two components to Capture Control. The first is the Acquire Step, and the second is Capture Control grouping of parameters accessed through the Read Cycle dialog.

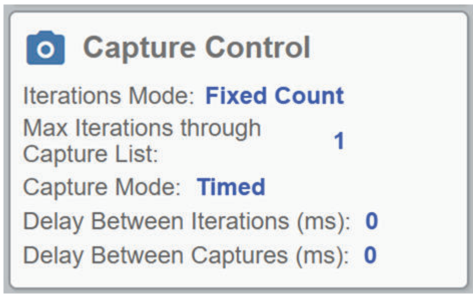


Acquire Step – All read cycles can be set up with one or more Captures.

The purpose of multiple captures is to acquire images with different settings, such as focus distance or exposure time, to be able to find and read codes under different conditions such as part height, or part color.

The full set of captures in the Acquire Step is called the Capture List.

Capture Control – The Capture Control in the Read Cycle dialog is used for extended control over the imaging sequence.



It can be set up to acquire the full **Capture List** once or many times during the Read Cycle. This is referred to as **Iterating through the Capture List**.

An example where iterating through the capture list multiple times would be useful is when the trigger occurs on the leading edge of a part, but where the code could be anywhere along the length of the part and multiple Captures or iterations through the capture list is necessary to image the entire area of the part to guarantee that the code is seen.

In summary, the Capture Control section gives the user detailed control over the image sequence, including how many times the Read Cycle will iterate through the Capture list set up in the Acquire step, as well as the time spacing between when all the images are acquired.

● Capture Control Parameters

The Capture Control parameters are described below. The parameters can be configured to create six different triggered read cycle modes, each designed for a specific use case.

The two tables below summarize the six modes. A rich set of examples detailing the operation, typical use case, and notes for each different **Read Cycle Mode** follows.

Iterations Mode – Iterations Mode can be set to Fixed (default), or Continuous.

- Fixed Count – When Iterations Mode set to Fixed Count, the Read Cycle will iterate through all the images in the Capture List up to the number of times defined by Max Iterations.

  When **Capture Mode** is set to **Timed**, the Timing or spacing between the captures is controlled by the Delay Between Iterations and Delay Between Captures settings.

  When **Capture Mode** is set to **Triggered**, the timing or spacing between the captures is controlled by an external trigger.

  The Timing between captures is also dictated by any Focus or Sensor settings changes between images. In Timed Mode, the delays are implemented automatically. In Triggered Mode, the controlling host needs to be aware of them and space the triggers accordingly.

- Continuous – When Iterations Mode is set to Continuous, this allows image capture to continue indefinitely until the code is read, or until and End of Read Cycle Event has occurs, such as a Cycle Timeout or a New Trigger.

  When **Capture Mode** is set to **Timed** and Delays are set to 0, the rate of image Capture is controlled by processing subsystem. The system captures each new image just as processing resources becoming available to run the Decode Tools in that image.

  When **Capture Mode** is set to **Timed** and **Delays are set > 0**, the rate of image Capture is still mainly controlled by processing subsystem, however the programmed delays will set the minimum amount of time that must occur between captures regardless of processing resource availability.

  When **Capture Mode** is set to **Triggered**, the timing or spacing between the captures is controlled by and external trigger. In this mode, if triggers occur faster than processing, images will be buffered and will be processed as CPU resources become available.

  As with Fixed Count, the Timing between captures in Continuous Mode is also dictated by any Focus or Sensor settings changes between images. In Timed Mode, the delays are implemented automatically. In Triggered Mode, the controlling host needs to be aware of them and space the triggers accordingly.

- **Note on Iterations Mode -** Fixed Count vs Continuous
  With Fixed Count, the user must set the number of Iterations for the System to run through the capture list, and the delays to match the amount of time the part will be passing under the camera. This requires calculation or trial and error.

  The advantage of Continuous mode is that the user does not have to set the number of iterations to match the coverage area. The Capture list will cycle continuously through until a code is read, or until and End of Read Cycle event is detected.

Max Iterations through Capture List – When Iterations Mode is set to Fixed Count, the user can program the maximum number of times the reader will cycle thought the Capture List in an attempt to find all the codes.

- **Iterations = 1 –** When Iterations is set to **1**, the system will acquire each image in the Capture List just one time in an attempt to decode. If the codes are not found within those images, the read cycle will fail.
- **Iterations > 1 –** When Iterations is set **above 1**, the system will acquire all images in the Capture List up to that many times to find and read all codes, or until it reaches the maximum number of iterations and quits.
- **Multiple Iterations Use Case –** A good application example for multiple iterations would be waiting for a part of unknown height to pass in front of a camera. Here, all captures can be set to different focus distances, and the system will cycle through these focus distances over and over while waiting for the part to pass by and the code to be read.

Delay Between Iterations (of the Capture List) – Delay Between Iterations (ms) specifies the delay before it will go back through the capture list to take the next set of pictures. The main purpose of this is to allow system processing to keep pace with the flood of images that would come in if this value was set to 0.

Delay Between Captures – This is similar to Delay between Iterations. Here, however, this sets a fixed delay between the actual captures in the list themselves. This again is used to set the rate at which pictures are taken so only the amount needed to see the part as it passes by the camera will be processed.

● Six Read Cycle Modes

There are six different Read Cycle modes. The two tables below summarize them. The operation, typical use cases, and notes for each mode are detailed after that in the examples for each Mode.

Iterations Mode = Fixed Count			
Mode Settings	**Mode 1**	**Mode 2**	**Mode 3**
	Iterations Mode = Fixed Count	Iterations Mode = Fixed Count	Iterations Mode = Fixed Count
	Max Iterations though Capture List = N	Max Iterations though Capture List = N	Max Iterations though Capture List = N
	Capture Mode = Timed	Capture Mode = Timed	Capture Mode = Triggered
Capture Timing	Delay between Iterations and/or Captures = 0	Delay between Iterations and/or Captures > 0	Delay between Iterations and Captures is dictated by the incoming trigger rate

Iterations Mode = Fixed Count			
Operation	The reader automatically acquires all images in the Capture List up to the Max Number of Iterations (N). **No Delay** will be inserted between the Captures. They will all be taken one after another. The exception is if the Focus or Sensor parameters are changed between Captures. If so, the system will insert the required delay to first change the settings prior to the next Capture.	The reader automatically acquires all images in the Capture List up to the Max Number of Iterations (N). **The user programmed delays** will be used to set the rate at which the system executes the Captures. If Focus or Sensor parameters are changing between captures, these will also affect the delay before the next Capture is taken.	The reader automatically acquires all images in the Capture List up to the Max Number of Iterations (N). **The incoming trigger rate** from the Host sets the rate at which the system executes the Captures. If Focus or Sensor parameters are changing between captures, these will also affect the delay before the next Capture is taken. (Trigger Timing needs to be spaced to account for this.)
End of Cycle	An End of Read Cycle Event will stop the system from Capturing.	An End of Read Cycle Event will stop the system from Capturing.	An End of Read Cycle Event will stop the system from Capturing.

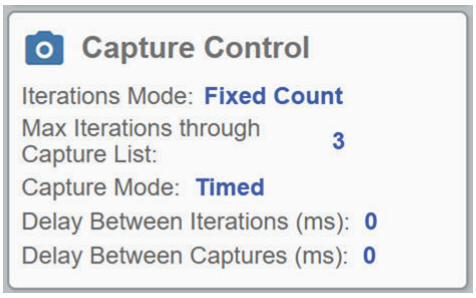
Iterations Mode = Continuous			
Mode Settings	**Mode 4**	**Mode 5**	**Mode 6**
	Iterations Mode = Continuous	Iterations Mode = Continuous	Iterations Mode = Continuous
	Capture Mode = Timed	Capture Mode = Timed	Capture Mode = Triggered
Capture Timing	Delay between Iterations and/or Captures = 0	Delay between Iterations and/or Captures > 0	Delay between Iterations and Captures is dictated by the incoming trigger rate

Iterations Mode = Continuous			
Operation	The reader will automatically acquire all images in the Capture List continuously up to an End of Read Cycle Event. The user does not have to specify a fixed number of Iterations. **Capture timing is self-regulated** based on the availability of Processing resources. The system takes the first image and starts processing it. While that image is being processed, the system will take the next picture and buffer it. It will be processed when system is done with prior image. Delays based on Focus or Sensor parameter changes between Captures are always adhered to.	The reader will automatically acquire all images in the Capture List continuously up to an End of Read Cycle Event. The user does not have to specify a fixed number of Iterations. **Capture timing is self-regulated** based on the availability of Processing resources. The system takes the first image and starts processing it. While that image is being processed, the system will take the next picture and buffer it. It will be processed when system is done with prior image. The difference from **Mode 4** is that if processing is fast, the system will always wait at least the minimum specified Delay between Iterations and Captures before acquiring the next image. Delays based on Focus or Sensor parameter changes between Captures are always adhered to.	The reader will automatically acquire all images in the Capture List continuously up to an End of Read Cycle Event. The user does not have to specify a fixed number of Iterations. The incoming trigger rate from the Host sets the rate at which the system executes the Captures. If Focus or Sensor parameters are changing between captures, these set a minimum required delay before the next Capture can be taken. (Trigger Timing needs to be spaced to account for this.)
End of Cycle	An End of Read Cycle Event will stop the system from Capturing.	An End of Read Cycle Event will stop the system from Capturing.	An End of Read Cycle Event will stop the system from Capturing.

Automatic Delay Set between Captures to Change Focus, Sensor Settings, or Light		
Parameter Change	**2.3 MP Sensor**	**5.0 MP Sensor**
Focus Change	42-50 msec	42-50 msec
Exposure or Sensor Gain Change	20 msec	0 msec
Light Bank Change	0 msec	0 msec
Light Power Change	157 msec	157 msec

- **Mode 1: Fixed Iterations Count = N, Timed Captures, No Delays between Captures**

Settings:
- Iterations Mode = Fixed Count
- Max Iterations through Capture List = N
- Capture Mode = Timed
- Delay Between Iterations = 0
- Delay Between Captures = 0
- Delays will be automatically inserted if Focus or Sensor Settings are changed between Captures



Operation:
In this mode, the system will cycle through the full Capture List up to N times (Max Iterations). All Captures and Iterations through the Capture List are taken back to back since there are no Delays set.

All Images are put in a buffer. Processing starts when the first image is acquired, and continues sequentially using all available images from the buffer until all the codes are read, or are not found in any of the images.

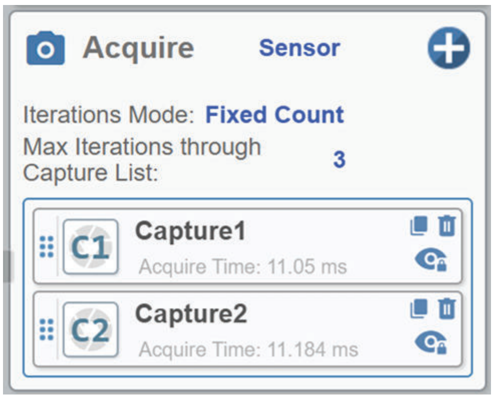
Use Case:
This mode useful to obtain a burst of images when the part is in place right at the trigger location.

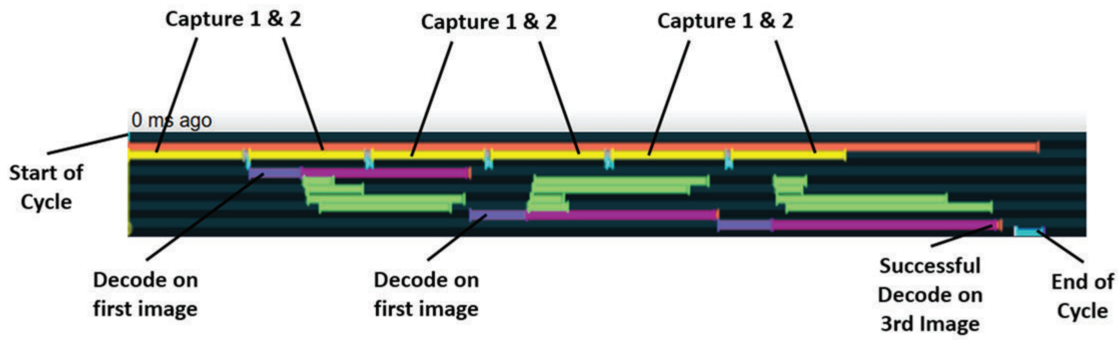
Notes:
If there are more than one capture in the Capture List, and they have different Focus or Sensor settings, system delays will be inserted automatically to allow time for these settings to update on the camera.

Example 1:
The example job below has 2 Captures, and is set up to do 3 Iterations through the Capture list. It is set up to find one code.

Note that because Delay between Captures and Iterations are set to 0, all images (yellow bars) are acquired back to back and put into a buffer. Processing (purple/green bars) starts on the first image and then cycles through each image from the buffer in turn.

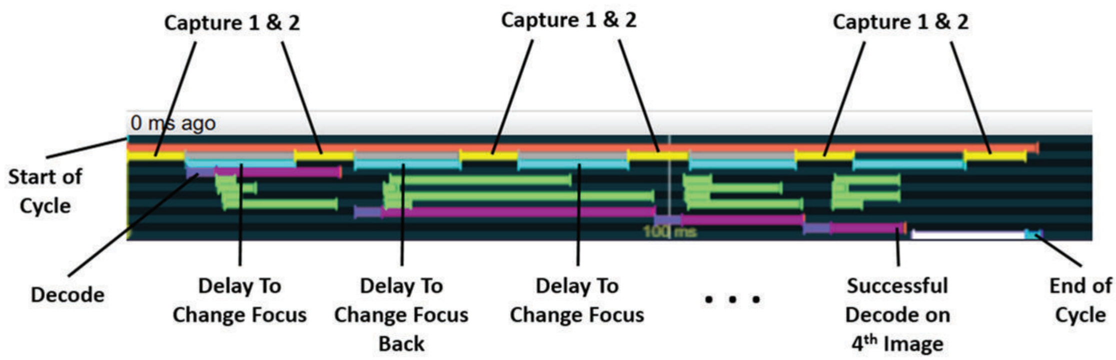
In this example, there are a total of 6 images (2 Captures x 3 Iterations), and the code is found and decoded in the 3rd image.





Example 2:

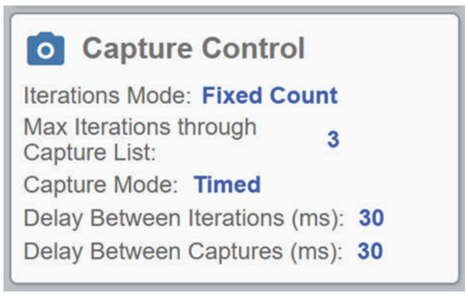
The example shows that if the Captures have different focus or sensor settings changes that require and internal system delays to implement, those delays will space out the captures even if Delay Between Iterations and Captures are set to 0.



● Mode 2: Fixed Count (N Iterations), Timed Captures, Programmed Delays between Captures

Settings:

- Iterations Mode = Fixed Count
- Max Iterations through Capture List = N
- Capture Mode = Timed
- Delay Between Iterations > 0
- Delay Between Captures > 0
- Additional Delays will be automatically inserted when Focus or Sensor Settings are changed between Captures



Operation:

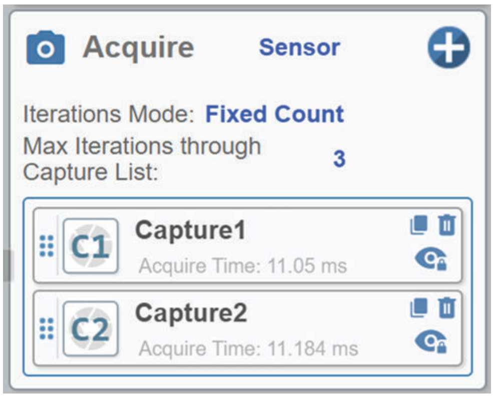
In this mode with Capture Mode set to timed and Delays set > 0, the system will cycle through the full Capture List N times (Max Iterations). Delays are set between the Captures in the list and between iterations of the list to space the imaging out.

All Captures and Iterations through the Capture List are taken based on either the initial trigger, or after the appropriate delay. Images are processed as they become available. If the processor is busy, the images are put in a buffer and will be processed sequentially as processing resources become available.

Use Case:
This mode useful to obtain a set of images that covers a long part where the code can be placed anywhere along its length. Timing and knowledge of the reader's field of view is used to compute the delays to space the image acquisition out over the entire part to obtain full coverage.

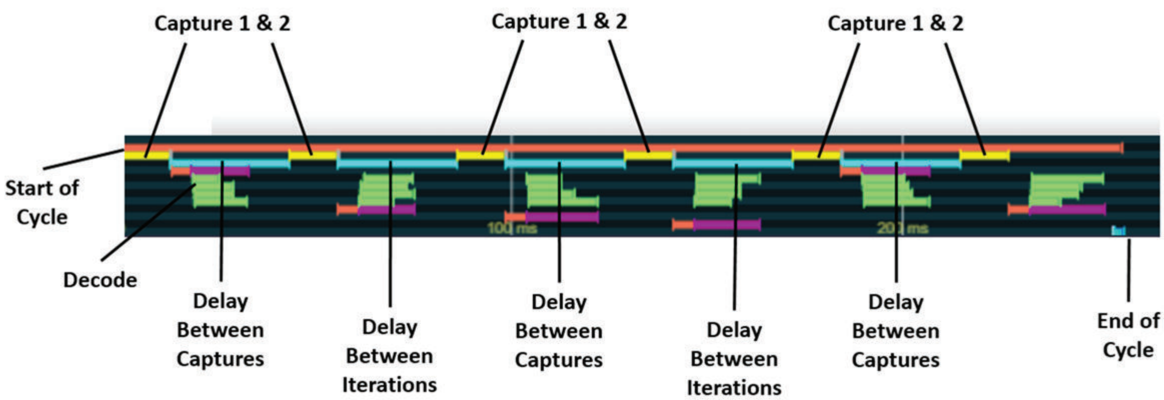
Notes:
If there are more than one capture in the Capture List, and they have different Focus or Sensor settings, system delays will be inserted automatically to allow time for these settings to update on the camera. Delays Between Captures and these system delays will overlap one another. However, Delays Between Iterations and these system delays will be additive.

Example 1:
The example job below has 2 Captures, and is set up to do 3 Iterations through the Capture list. It is set up to find one code. 6 total images are enough to see the entire area of the part as it passes in front of the camera over a period of time of 250 msec.

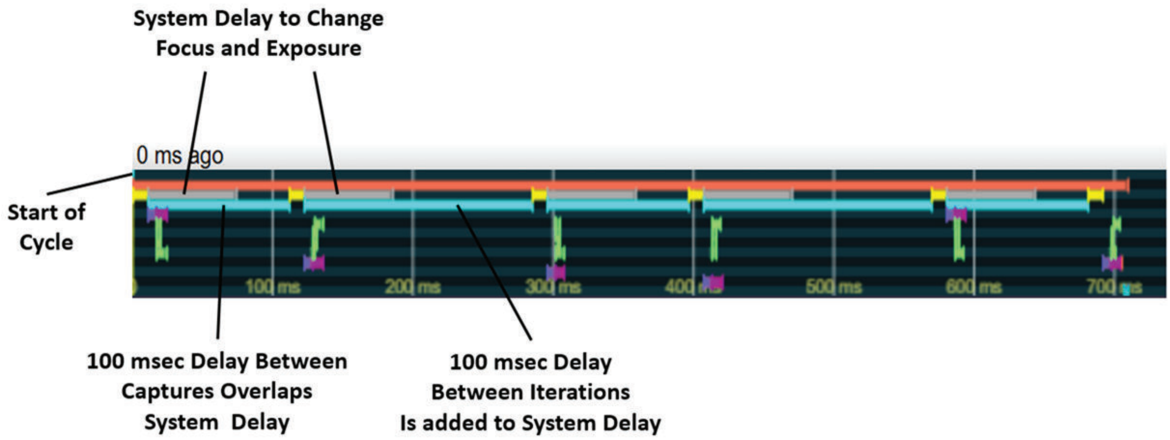


Note that because Delay between Captures and Iterations are set to 30 msec, the acquisition of all images (yellow bars) are spaced out by that amount. Processing (purple/green bars) starts on the first image and then cycles through each image as it becomes available live, or is taken from the buffer.

In this example, there are a total of 6 images (2 Captures x 3 Iterations). Here the code was found on the trailing edge of the part, and so decoded in the 6th image.



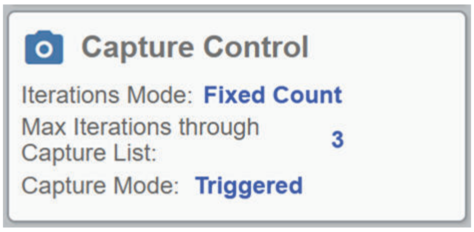
Example 2:
The example shows that if the Captures have different focus or sensor settings changes that require an internal system delay (grey lines) to implement, those delays occur coincident with the Delay Between Captures, but will add to the Delay Between Iterations.



● Mode 3: Fixed Count (N Iterations), Triggered Captures, Programmed Delays between Captures

Settings:

- Iterations Mode = Fixed Count
- Max Iterations through Capture List = N
- Capture Mode = Triggered
- Delays for Focus or Sensor Settings changes must be accounted for when setting trigger rate



Operation:

When Capture Mode is set to Triggered, all Captures and Iterations through the Capture List are based on an incoming stream of triggers, rather than internal reader timing delays.

This gives control of the image spacing to the host system. If the part is moving slower or faster, the host would know and would send triggers at the appropriate intervals.

Use Case:

This mode useful to obtain a set of images that covers a long part where the code can be placed anywhere along its length. Timed or strategically placed triggers are used to space the image acquisition out over the entire part to obtain full coverage.

Notes:

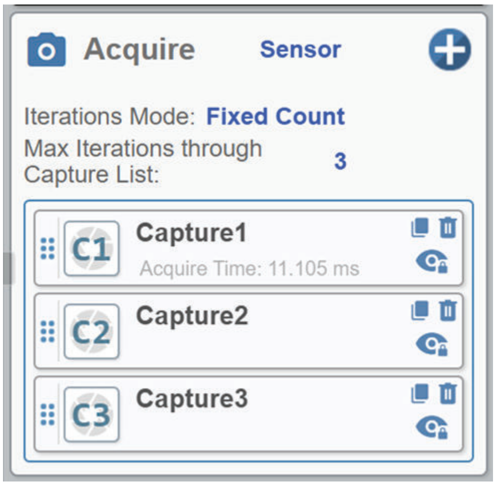
In this mode, regardless of whether or not all codes are found in the early images, the correct number of triggers must be sent. If 3 Captures and 3 iterations, 9 triggers must be received for read cycle to end.

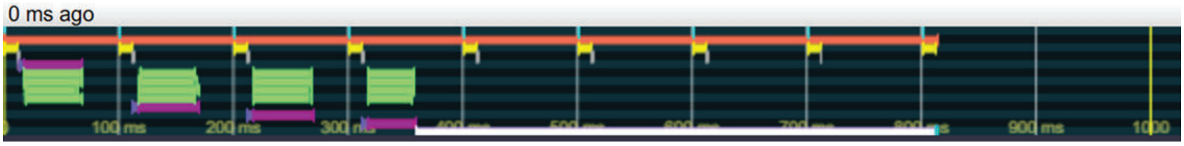
If Focus or Sensor changes are made between Captures, the Trigger spacing must be far enough apart in time to allow them to complete.

Example 1:
The example job below has 3 Captures, and is set up to do 3 Iterations through the Capture list. It is set up to find one code.

9 total triggers are sent to the reader at an interval of 100 msec. In this example, the code is found and read in the 4th image.

Note: The white line at the bottom. This indicates that although the code has been read, the reader needs to wait for all 9 triggers to come in before the Read Cycle will end.





● Mode 4: Continuous Iterations, Timed Captures, No Delays between Captures

Settings:
- Iterations Mode = Continuous until End of Read Cycle
- Capture Mode = Timed
- Delay Between Iterations = 0
- Delay Between Captures = 0
- Delays will be automatically inserted when Focus or Sensor Settings are changed between Captures

Operation:
In this mode, a trigger starts the cycle. The first image is acquired and processing begins on that image. While processing is occurring, the next image is acquired and put in a buffer. When processing is complete on the first image, processing begins on the buffered image, and then the next image is taken and put in the buffer. This continues until the code is read, or until an end cycle event occurs.

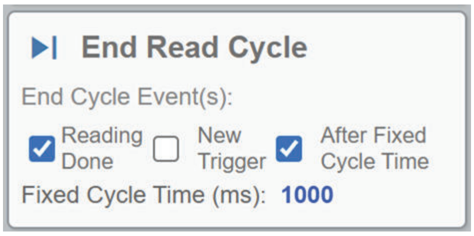
Setting Delays = 0 instructs the Reader to self-regulate the rate at which it captures images to match the rate at which it is able to process the images.

Use Case:
This mode useful when it is not clear when the part will arrive under the camera after the Trigger. The camera goes into a continuous read mode. Images are spaced out automatically to match the rate at which the reader is able to process the images, so captures are always the most current.

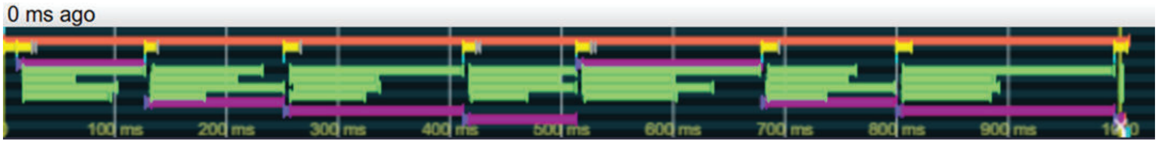
Notes:
The Read Cycle will end “After Fixed Cycle Time” of 2000 msec unless the user changes this or the other End Read Cycle event settings.

It is a good idea to limit the processing time per code as well to keep the system from betting bogged down in an overly complex scene where no actual code exists. See Example 2.

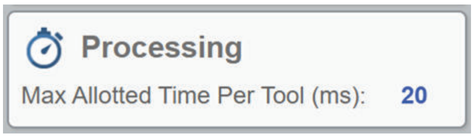
Example 1:
The example below shows the two yellow Capture traces in the top left which are captures taken right after the trigger. Processing starts on the first capture while the second capture is taken and then put in the buffer. When the first image is done being processed, processing is starts on the buffered image, and then the next image (3rd yellow line) is acquired. Note that the processing time (purple/green lines), which varies for each image, dictates the spacing between each capture.

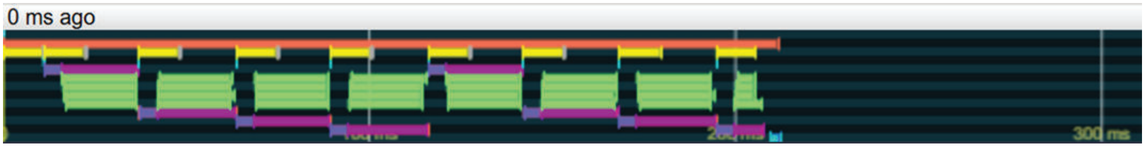


Note: No code was shown to the reader during this cycle so the full trace could be seen. The read cycle ended based on the 1000 msec Fixed Cycle Time setting.



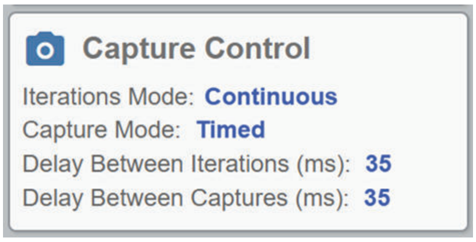
Example 2:
In this example, we show the effect of limiting Max Allotted Time for Processing to a low value that is just long enough to find a code if it is present. This example also shows a code passing in front of the camera and being read at the 200 msec mark ending the cycle.





● Mode 5: Continuous Iterations, Timed Captures, Programmed Delays between Captures

Settings:
- Iterations Mode = Continuous until End of Read Cycle
- Capture Mode = Timed
- Delay Between Iterations > 0
- Delay Between Captures > 0
- Additional Delays will be automatically inserted when Focus or Sensor Settings are changed between Captures



Operation:
Setting Delays > 0 is nearly the same as the previous mode, with two differences.

If the read time is shorter than the set delays, the reader will wait up to the full delay time before capturing the next image. This allows the user to set the pace of acquisition. If however the read times are longer than the delays, the reader will process the decode to completion and hold of capturing the next image.

The delays in effect set a minimum amount of time between the captures, but not a maximum.

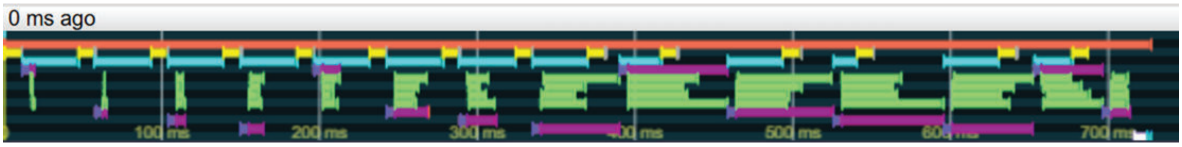
Use Case:
This mode useful to pace the system, attempting to read only at the necessary rate. This avoid excess flashes on the line amongst other things.

Notes:
As is the case in all the above example, System delays due to focus and/or sensor changes have precedence over the programmed delays. The system will not take the next capture until these are done regardless of the programmed settings.

Example: 1
Below the first reads are very fast since nothing is in the field of view. The delays are controlling the capture rate.

As the scene gets more complex, the decode time gets longer and at the 400 msec range, it can be seen that the processing along with the delays is gating the capture rate.

Here the code is read at the 700 msec mark.



● Mode 6: Continuous Iterations, Triggered Captures, Programmed Delays between Captures

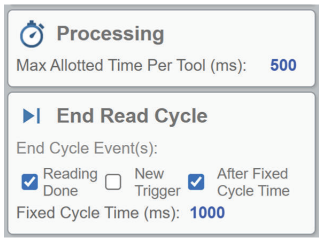
Settings:
- Iterations Mode = Continuous until End of Read Cycle
- Capture Mode = Triggered
- Required delays for Focus or Sensor Settings changes must be accounted for when setting trigger rate

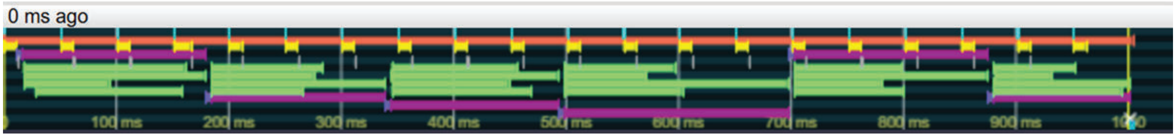
Operation:
This mode allows the user to provide triggers to drive the reader at a custom rate. At each trigger, the reader will take the next Capture in the List and Iteration sequence and buffer it. Decode Processing will proceed at whatever rate is set.

The advantage of this mode over Fixed Count, Continuous is that an exact number of triggers does not need to be received for the host and reader to stay in sync. In this mode, the reader will take all the images it can based on triggers, and process all it can up until the end of read cycle event.

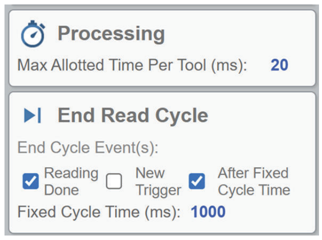
The two examples below show a poorly-set-up read cycle and a balanced setup. Note that we deliberately do present a code to the reader during these two cycles below so the user is able to see the entire read cycle from Start to Timeout.

Example 1: Non-Optimal Setup
Below is an example where triggers are set to come in at a 50 msec interval. The read cycle is programmed to end after 1 second if no code is found. Note that because the Max Allotted Time Per Tool is left at the default 500 msec, the reader is only able to process 5 of the images prior to the end of read cycle. This is not a balanced set-up and can be improved.

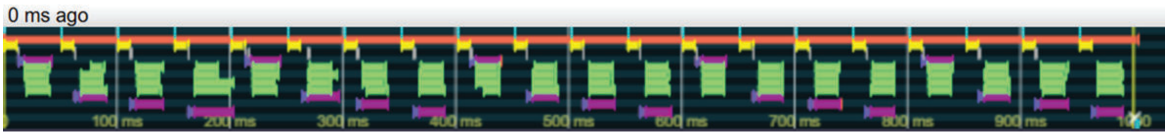




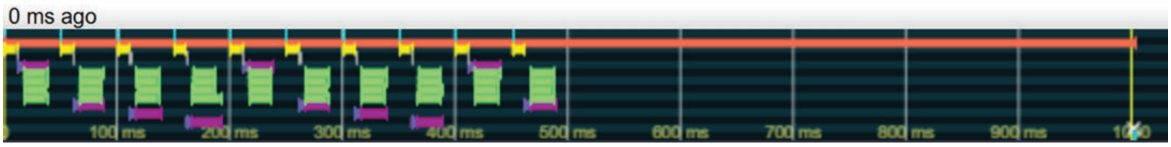
Example 2: Balanced Image Capture and Processing
This is a proper example that balances both the Capture and Processing Time. It is based on knowing that if the code is in the field of view, it can be read in 10-15 msec. This allows the user to set the Max Allotted Time Per Tool to 20 msec. Note that because of the Processing Timeout, each and every image is able to be processed.



Note: For figure 2a) there was no code on the part so the end of read cycle occurs at 1 second. For figure 2b) there was a code on the part and it was read in the 10th image.

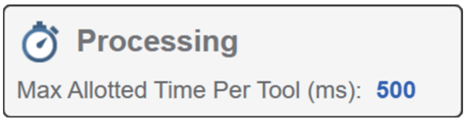


2a) No Code Found in Any Image



2b) Code is found and read in the 10th Image

Processing



Once the flow of Captured images start, decoding starts. This section gives the user control over X-Mode decode tool processing. The single parameter is:

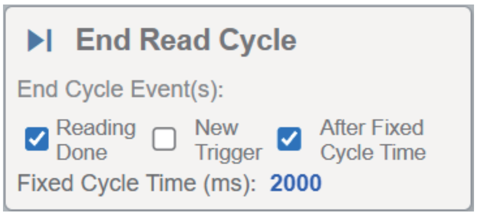
<u>Max Allotted Time Per Tool (msec)</u> – This parameter sets the maximum amount of time that any instance of the X-Mode decoder will be allowed to run. If X-Mode has not decoded within this amount of time, that X-Mode processing thread will be shut down. This parameter is useful for performance

optimization. A good example would be the case of looking at Captures set to different focus heights. If it is known that the target code can be read easily within 20 msec in a focused image, but takes up to 50 msec to fail in an unfocused image, the max time could be set to 25 msec so the system does not waste processing time.

Important Note: This parameter only fully limits the allotted time for the decode tool. For the verification tool, this parameter limits the time for finding the code with X-mode, but not the time to execute verification. The verification tool may take longer to execute than the Max Allotted Time Per Tool as the verification processing cannot be interrupted.

End Read Cycle

This section is used to determine when and for what reason the read cycle ends.



There are three main options. They can be chosen separately or in combination.

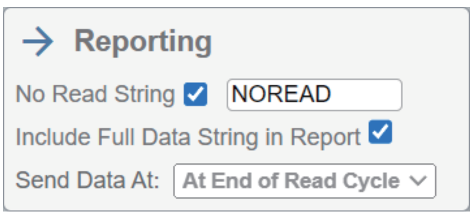
Reading Done – The read cycle will end when all X-Mode processing has completed. It is not required that all X-Modes have found a code, just that they have processed through the entire set of available Captures and conclude with either a Read or a No Read.

New Trigger – The read cycle will end if a new trigger comes in while the current read cycle is still active. The current read cycle will fail, passing on whatever partial result it has in the read cycle report. This mode is useful to prevent the line from falling behind the triggers that are coming in.

After Fixed Cycle Time/Fixed Cycle Time (msec) – These parameters set a fixed time after having received the trigger that the read cycle has to end. It can be used to stop the cycle early. If any processing is still running this will shut it down and the report will be sent. This parameter can also be used to extend the read cycle. If processing is done, but the PLC or other host expects the result at a fixed time after the trigger, this parameter will hold off, sending the data until the exact Fixed Cycle Time.

Reporting

This section is used to determine how the output string is composed, if it should be sent, and when to send it.



No Read String – If checked, the text from the No Read String text box will be used as the string content for any Decode Tools that have failed.

Include Full Data String in Report – By default, the final output string is transmitted out all TCP/IP and RS-232 ports that are enabled. When this option is unchecked, the string is not sent.

Note 1: This setting does not affect PLC-based communication. The output string is always set into the PLC Input Assembly.

Note 2: This setting also does not affect Digital Outputs. The outputs will always be set at the end of the Read Cycle, reflecting read cycle status.

Send Data At – This controls when the read data is sent.

- **At End of the Read Cycle –** This is the default behavior. The data string is sent at the end of the read cycle. The end of the read cycle is set when Reading is Done, or when a New Trigger is issued, or After Fixed Cycle Time.
- **As Data is Decoded –** This option is only relevant for the After Fixed Cycle Time option. If this is set, the reader will send the string data to the host immediately, but will not set Pass/Fail or End of Cycle digital outputs until the Fixed Cycle Time is complete. **Note:** This does not affect PLC communication. The PLC data is always set at the end of the read cycle.

7-3-3 Triggered Read Cycle Settings

Item	Setting value [Job Default]	Description
Start Read Cycle		
Input	**[Input 1 - Trigger]**	Digital Input 1 is the dedicated Trigger Input. The Start/Stop cycles starts when the Input is Activated.
Trigger Command String	Any String, **[S]**	Serial string used to Start the read cycle when commanded by RS-232 or Socket. Note: Non printable characters are not allowed, with the exception of space. Here, the user must type in an actual space with space bar. This will be displayed as <SP>.
Trigger Delay (msec)	**[0]-1000**	Trigger Delay (msec) is used to hold off acquisition for a fixed time after the trigger is received. This allows the user to programmatically align the part in the field of view without having to go onto the line and change the physical trigger location.
Capture Control		
Iterations Mode	**[Fixed Count],** Continuous	Controls whether the number of maximum iterations through capture list is capped at a fixed count defined by Max Iterations, or if iterations will proceed Continuously until Read is complete or an End Cycle Event has been received.

Item	Setting value [Job Default]	Description
Max Iterations Through the Capture List	**[1]-N**	When Iterations is set to one, the system will acquire each image in the Capture List just one time in an attempt to decode. If the codes are not found within those images, then read cycle will fail. When Iterations is set greater than one, the system will acquire all images in the Capture List over and over until all codes are found, or until reaching the maximum number of iterations.
Capture Mode	**[Timed]**, Triggered	Timed – Inserts “Delay Between Iterations” between each cycle through the Capture List. The main purpose of this is to allow system processing to keep pace with the flood of image that would come in if this value was set to 0. Triggered - When this mode is set to Triggered, the system will start the Read Cycle on the first trigger. Each subsequent Iteration through the capture list is started with a secondary trigger. It is a requirement in this mode that the number of triggers sent to the reader equals the number of Iterations, or the reader and controlling system will get out of sync.
Delay Between Iterations (msec)	0-10000 **[0]**	Delay inserted between running iterations of the full image Capture List to allow processing to keep up with image acquisition. No delay is inserted between individual Captures within the list. They run back to back.
Delay Between Captures (msec)	0-10000 **[0]**	Delay inserted between captures within the Capture List to allow processing to keep up with image acquisition.
Processing		
Processing – Max Allotted Time Per Tool (msec)	0-10,000 **[500]**	This parameter sets the maximum amount of time that any instance of the X-Mode decoder will be allowed to run. If X-Mode has not decoded within this amount of time, that X-Mode processing thread will be shut down. The verification tool may run longer than the Max Allotted Time.
End Read Cycle		
Reading Done	Unchecked, **[Checked]**	The read cycle will end when all X-Mode processing has completed. It is not required that all X-Modes have found a code, just that they have processed through the entire set of available Captures and conclude with either a Read or a No Read.
New Trigger	**[Unchecked],** Checked	The read cycle will end if a new trigger comes in while the current read cycle is still active. The current read cycle will fail, passing on whatever partial result it has in the read cycle report. This mode is useful to prevent the line from falling behind the triggers that are coming in.

Item	Setting value [Job Default]	Description
After Fixed Cycle Time	Unchecked, **[Checked]**	This parameter sets a fixed time after having received the trigger that the read cycle has to end. It can be used to stop the cycle early. If any processing is still running this will shut it down and the report will be sent. This parameter can also be used to extend the read cycle. If processing is done, but the PLC or other host expects the result at a fixed time after the trigger, this parameter will hold off sending the data until the exact Fixed Cycle Time
Fixed Cycle Time (msec)	0-60,000 **[2000]**	Fixed amount of time to end the Read Cycle and send the report data
Reporting		
No Read String	Unchecked,**[Checked]** and string to send **[NOREAD]**	Controls what is output for Decode Tools that fail to Read. By default the string is set to NOREAD.
Include Full Data String In Report	Unchecked, **[Checked]**	By default, the final output string is transmitted out all TCP/IP and RS-232 ports that are enabled When this option is unchecked, the string is not sent. Note1: This setting does not affect PLC based communication. The output string is always set into the PLC Input Assembly at the end of each Read Cycle. Note2: This setting also does not affect Digital Outputs. The digital outputs will always be set at the end of the Read Cycle to reflect the current read cycle status.
Send Data At	**[At End of Read Cycle]**, As Data is Decoded	Determines timing for sending out Format Output string from Read Cycle. Either it sends it out at the end of the cycle, or it sends it out as soon as all Decode Tools Qualify. **Note:** This does not affect PLC communication. The PLC data is always set at the end of the read cycle.

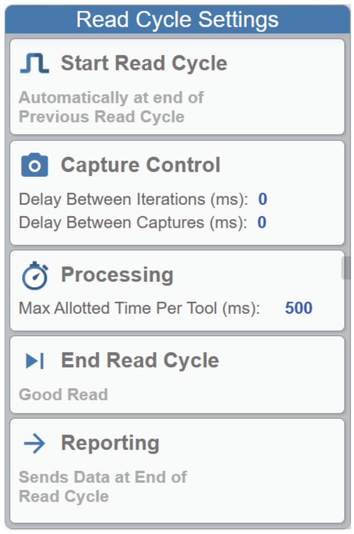
7-3-4 Continuous and Presentation Read Cycle Dialogs

Overview

● Continuous Mode

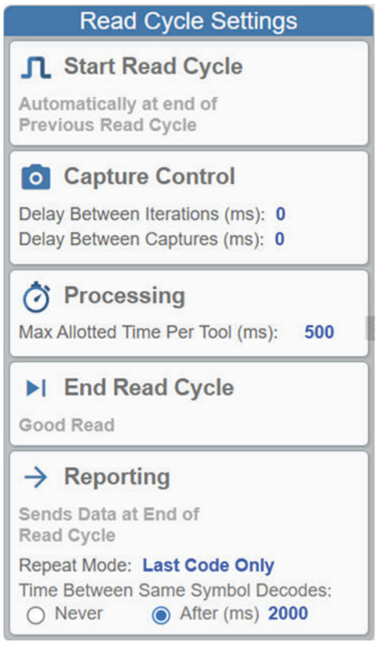
For Continuous mode, the reader starts acquiring images automatically upon entering Run Mode and attempts to read within those images. The reader will continue indefinitely to acquire and process until a part enters the field of view and the codes on that part are read. **Only a successful read will end the Continuous read cycle.** At the end of the Read Cycle, the read data is output, and then the next read cycle is started automatically, again waiting for a part to pass in front of the reader and be read.

Note: Continuous will read the same codes over and over in this mode until the part is moved out of the field of view.



● Presentation Mode

The Continuous and Presentation Mode read cycles are exactly the same except for one important difference: In Presentation mode, after Reporting, the cycle will pause for a set time before restarting the next read cycle. This is to keep the reader from outputting the string data for the same code multiple times. Presentation mode is sometimes called Supermarket mode. It works like retail scanners, where a delay is inserted after the decode to allow the part to move out of the field of view so the same product won't be scanned multiple times.



Start Read Cycle

Both modes start the first read cycle automatically when the job is loaded, and the restart the next read cycle after all Decode Tools have completed successfully. The read cycle will not end until it has Good Reads for all Decode Tools.

Capture Control

These two modes can work with one or multiple Captures in the Acquire Step. The full set of Captures are set up to be able to find the code in all situations, such as at different focus distances the part might be at, at different brightness levels, or even with different lighting.

For Continuous and Presentation Read Cycles, the Iteration Mode, described in detail for the Triggered Read Cycle, is set to Continuous by default. Fixed is not a user choice.

Delay between Iterations of the Capture List and Delay between Captures – Since Iteration Mode is Continuous, the reader will cycle through the full Capture List over and over **Continuously** until all codes are found.

By Default, when both delays are set to 0, the Continuous and Presentation modes self-regulate the image capture rate. The rate of image Capture is controlled by processing subsystem. The system captures each new image just as processing resources become available to run the Decode Tools in that image. See example 1.

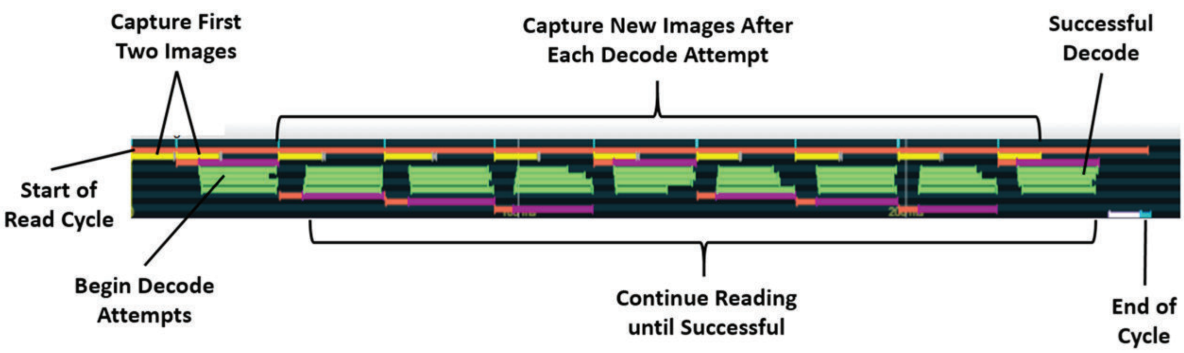
The user normally inserts one or both of these delays to set or slow the pace at which the system will acquire images. See example 2.

Example 1: Delay Between Iteration and Captures = 0

This is the pure self-regulating mode where images are captured when image processing resources become available to decode within it.

In this case, it can be seen that the system takes the first image (first yellow line), and then starts processing it. At the same time it is processing that first image, it takes the next capture (second yellow line) and puts it in a buffer. Once the system is done processing the first image, it takes it out of the buffer and begins processing it as it simultaneously acquires the next capture which it puts in the buffer.

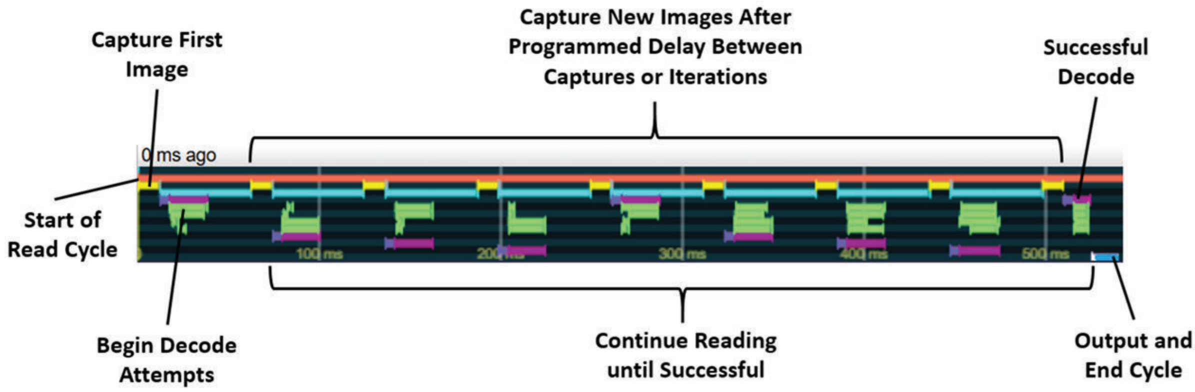
The DSS trace below shows that the spacing between captures is self-regulating based on the varying decode times. There is never more than one image being processed at a time, and never more than one image in the buffer pool waiting to be processed.



Example 2: Delay Between Iteration and Captures > 0

When Delays are > 0, the system operates almost the same as above. The exception is if the decodes are very fast, the system will wait to set Delay Time before taking the next image rather than capturing it immediately.

The DSS trace below shows that the spacing between captures is primarily regulated based on the delays since the decode times are shorter than the delays. However, if the Decode Times were longer than the delays, the system would wait for the decode to be done so there is never more than one image being processed at a time, and so that there is never more than one image in the buffer pool waiting to be processed.



Processing

Once the flow of Captured images start, decoding starts. This section gives the user control over X-Mode decode tool processing. The single parameter is:

Max Allotted Time Per Tool (msec) – This parameter sets the maximum amount of time that any instance of the X-Mode decoder will be allowed to run. If X-Mode has not decoded within this amount of time, that X-Mode processing thread will be shut down. This parameter is useful for performance optimization. A good example would be the case of looking at Captures set to different focus heights. If it is known that the target code can be read easily within 20 msec in a focused image, but takes up to 50 msec to fail in an unfocused image, the max time could be set by the user to 25 msec so the system does not waste processing time trying to decode within an image that does not have good focus.

End Read Cycle, Reporting, Repeat Reads, and Read Cycle Restart

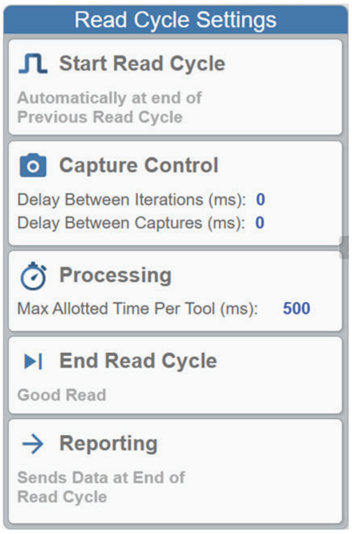
Continuous Mode is ideal for applications requiring constant and uninterrupted non-triggered code reading, providing robust and reliable performance in dynamic operational environments.

● Continuous Mode

1. In Continuous Mode, the Read Cycle ends on a **Good Read**, meaning that all Decode Tools have fully qualified.

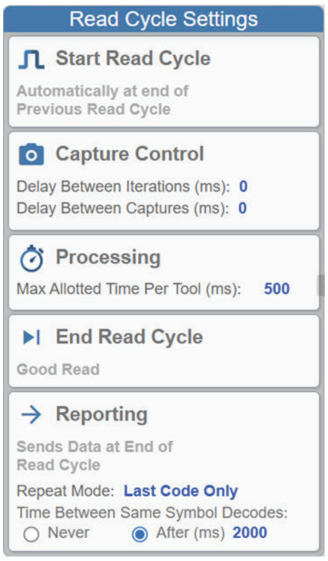
Note: A single Continuous Read Cycle will continue to run indefinitely until a part comes in front of the camera and there is a successful read.

2. The Report is sent out immediately at the end of the Read Cycle, and the next Read Cycle starts automatically.
3. If the same code or codes are still in the field of view, they will be read and output again.



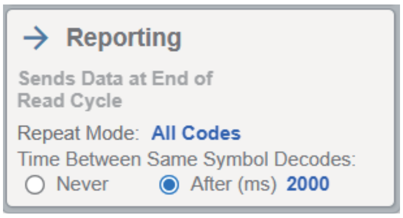
● Presentation Mode

Presentation Mode shares several characteristics with Continuous Mode but includes distinct features specifically designed to manage the repeat reading of the same codes more effectively.



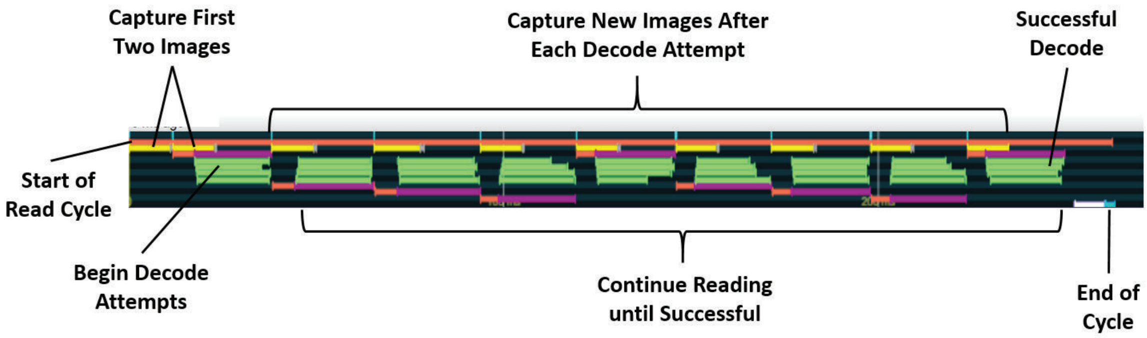
1. **Cycle Completion:** Similar to Continuous Mode, the Read Cycle in Presentation Mode concludes with a Good Read, indicating that all Decode Tools have successfully found, read and qualified their target barcode.
2. **Immediate Reporting and Cycle Continuation:** The output Reports is generated and sent out immediately at the end of each Read Cycle. Following this, the next Read Cycle starts automatically, ensuring a seamless flow of operations.

3. **Handling Repeat Reads:** The primary distinction between Continuous and Presentation Mode lies in their approach to managing repeat reads. Presentation Mode allows configuration settings that prevent the system from repeatedly reading the same code. This feature is particularly useful in environments where repeat reads can cause redundant information to be output.
4. **Configuring Repeat Read Behavior –** Two settings are used for preventing repeat reads of the same codes, either too soon, or at all.
   1) **Repeat Mode**: Users can select between **Last Code Only** and **All Codes**. **Last Code Only** applies repeat read logic solely to the most recently read code, whereas **All Codes** extends this logic to every code read since the start of the job.



   2) **Time Between Same Symbol Decodes**: This parameter can be set to **Never** or a specified number of milliseconds. If set to **Never**, the reader will ignore any code that matches a previously read code, continuously seeking a new, unique code. If a time interval is set (default is 2 seconds), the reader will not output the same code unless the specified duration has elapsed, allowing time-controlled repeat reads.

Example Continuous (Presentation) Read Cycle: A typical Continuous Read Cycle will look like the following using the Digital Soft Scope. Two images are acquired immediately to fill the Image Buffer Pool. (Two yellow traces at start of Cycle). Processing begins right after the first image is taken (purple and green traces). New images (subsequent yellow traces) are taken once processing has completed on the previous one. The Read Cycle ends and data is sent out when X-Mode is successful in finding and reading a code as the part finally passes in front of the camera (white and blue trace).



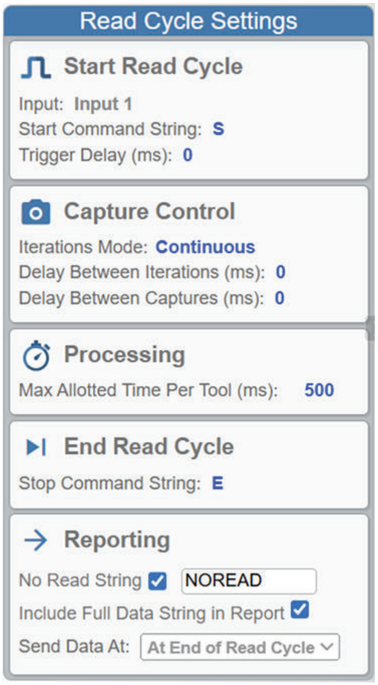
7-3-5 Continuous and Presentation Read Cycle Settings

Item	Setting value [Job Default]	Description
Start Read Cycle		

Item	Setting value [Job Default]	Description
Automatically at end of previous Read Cycle	Default. No other choice.	Continuous and Presentation Read Cycles start automatically when job is loaded, and restart automatically at the end of the read cycle.
Capture Control		
Delay Between Iterations (msec)	0-10,000 **[0]**	Delay inserted between running iterations of the full image Capture List to allow processing to keep up with image acquisition. No delay is inserted between individual Captures within the list. They run back to back.
Delay Between Captures (msec)	0-10000 **[0]**	Delay inserted between captures within the Capture List to allow processing to keep up with image acquisition.
Processing		
Max Allotted Time Per Tool (msec)	0-10,000 **[500]**	This parameter sets the maximum amount of time that any instance of the X-Mode decoder will be allowed to run. If X-Mode has not decoded within this amount of time, that X-Mode processing thread will be shut down. The verification tool may run longer than the Max Allotted Time.
End Read Cycle		
Good Read	Default. No other choice.	Continuous and Presentation Read Cycles will run indefinitely until they get a good read (all decode tools qualify)
Reporting		
Send Data at End of Read Cycle	Default. No other choice.	The report containing read string data, as well as setting of Digital Output and communication to PLC is done as last step at end of read cycle.
Repeat Mode (Presentation Cycle Only)	**[Last Code Only],** All Codes	Apply no-repeat read logic to just the previous code read, or to all codes that have been read since the job was started.
Time Between Same Symbol Decodes (msec)	**[Never],** After msec 0-1,000,000,000 msec **[2000] is default.**	**Presentation Mode Only** – Time delay before restarting next cycle to allow previous part to clear the field of view. This prevents duplicate reading of the same code. This value is set to Never by default. If the user chooses time, the default time is 2000 msec.

7-3-6 Start / Stop Mode Read Cycle Dialog

Start/Stop Mode is the final read cycle type. It is a combination of Triggered and Continuous mode. Please read these sections first for a more complete understanding.



As in Triggered mode, the Read Cycle is started with a Trigger Signal. As in Continuous mode, within the read cycle, by default the reader acquires images continuously and attempts to decode while the trigger is held on. If it decodes successfully, it sends the data out immediately (or after the Stop signal, depending on user settings). The read cycle ends when the host sends the reader a Stop Trigger signal. It begins the next Read Cycle on the next Start Trigger. The user may also set Iterations Mode to Fixed to limit how many times the reader cycles through the Capture List.

Warning: For Start/Stop mode, the user should set the Debounce Time under Camera Settings in the Device View to greater than (20 msec + Exposure Time) for the 2.3 MP camera, and greater than (30 msec + Exposure Time) for the 5 MP. Failure to do so can result in the Start/Stop signals getting out of sync.

Start Read Cycle

The read cycle starts when the trigger is activated or a Start Command String is received.

Capture Control and Processing

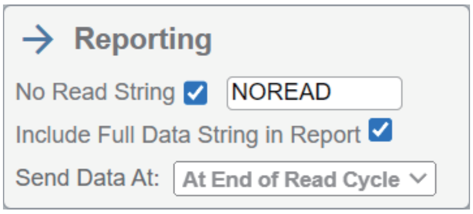
Once received, the read cycle behavior is exactly like continuous mode. It iterates through the Capture List over and over, running all Decode Tools in all Captures until it has a good read. As for the Triggered Read Cycle described above, a delay can be set between Captures and Iterations of the Capture list to pace the processing. The maximum time allowed for each X-Mode instance can be limited as well.

End Read Cycle

The cycle ends when the trigger is deactivated or when a Stop Command String is received. If any Decode Tools have not completed successfully (qualified) by this time, they are shut down and marked as no reads.

Reporting

This section determines how the output string is composed, if it should be sent, and when to send it.



No Read String – If checked, the text from the No Read String text box will be used as the string for any Decode Tools that have failed.

Include Full Data String in Report – By default, the final output string is transmitted out all TCP/IP and RS-232 ports that are enabled When this option is unchecked, the string is not sent.

Note 1: This setting does not affect PLC based communication. The output string is always set into the PLC Input Assembly at the end of each Read Cycle.

Note 2: This setting also does not affect Digital Outputs. The digital outputs will always be set at the end of the Read Cycle to reflect the current read cycle status.

Send Data At – This controls when the read data is sent.

- **At End of the Read Cycle** – This is the default behavior. The data string is sent at the end of the read cycle.
- **As Data is Decoded** – If this is set, the reader will send the string data to the host immediately, but will not set Pass/Fail or End of Cycle digital outputs until the Trigger is deactivated, or the Stop String is received. In Start/Stop mode the user may choose this option to tell the host that the cycle is complete, and they can issue the stop command sooner than expected. **Note:** This does not affect PLC communication. The PLC data is always set at the end of the read cycle.

7-3-7 Start/Stop Read Cycle Settings

Item	Setting value [Job Default]	Description
Start Read Cycle		
Input:	**[Input1 - Trigger]**	Digital Input 1 is the dedicated Trigger Input. The Start/Stop cycles starts when the Input is Activated.
Start Command String	Any String, **[S]**	Serial string used to Start the read cycle when commanded by RS-232 or Socket. Note: Non printable characters are not allowed, with the exception of space. Here, the user must type in an actual space with space bar. This will be displayed as <SP>.
Trigger Delay (msec)	[0]-1,000	Trigger Delay (msec) is used to hold off acquisition for a fixed time after the trigger is received. This allows the user to programmatically align the part in the field of view without having to go onto the line and change the physical trigger location.
Capture Control		

Item	Setting value [Job Default]	Description
Iterations Mode	**[Fixed Count],** Continuous	Controls whether the number of maximum iterations through capture list is capped at a fixed count defined by Max Iterations, or if iterations will proceed Continuously until Read is complete or an End Cycle Event has been received.
Delay Between Iterations (msec)	0-10,000 **[0]**	Delay inserted between running iterations of the full image Capture List to allow processing to keep up with image acquisition. No delay is inserted between individual Captures within the list. They run back to back.
Delay Between Captures (msec)	0-10000 **[0]**	Delay inserted between captures within the Capture List to allow processing to keep up with image acquisition.
Processing		
Processing – Max Allotted Time Per Tools (msec)	0-10,000 **[500]**	This parameter sets the maximum amount of time that any instance of the X-Mode decoder will be allowed to run. If X-Mode has not decoded within this amount of time, that X-Mode processing thread will be shut down. The verification tool may run longer than the Max Allotted Time.
End Read Cycle		
Stop Command String	Any String, **[E]**	Serial string used to stop the cycle when commanded by RS-232 or Socket. Note that falling edge of Input 1 Trigger will stop cycle if Trigger was used to start the cycle. Note 1: The end command must be different from the start command. Note 2: Non printable characters are not allowed, with the exception of space. Here, the user must type in an actual space with space bar. This will be displayed as <SP>.
Reporting		
No Read String	Unchecked,**[Checked]** and string to send **[NOREAD]**	Controls what is output for Decode Tools that fail to Read. By default the string is set to NOREAD.
Include Full Data String In Report	Unchecked, **[Checked]**	By default, the final output string is transmitted out all TCP/IP and RS-232 ports that are enabled When this option is unchecked, the string is not sent. Note 1: This setting does not affect PLC based communication. The output string is always set into the PLC Input Assembly at the end of each Read Cycle. Note 2: This setting also does not affect Digital Outputs. The digital outputs will always be set at the end of the Read Cycle to reflect the current read cycle status.
Send Data String	**[At End of Read Cycle]**, As Data is Decoded	Determines timing for sending out Format Output string from Read Cycle. Either it sends it when it receives the stop signal, or it sends it out as soon as all Decode Tools Qualify. **Note:** This does not affect PLC communication. The PLC data is always set at the end of the read cycle.

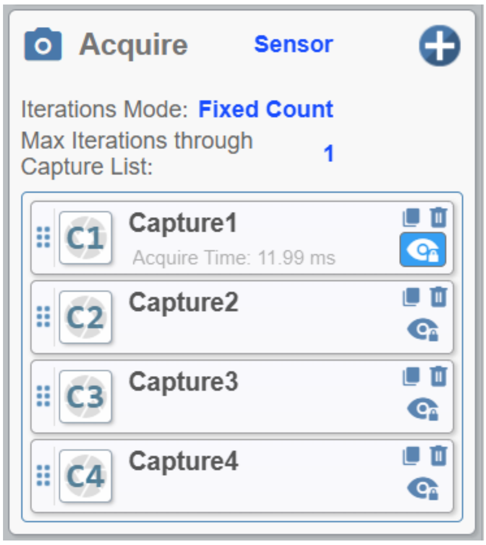
7-4 Acquire Step

7-4-1 Overview

The Acquire Step shows the Acquire source. By default, this is the Image Sensor on the Reader. The Acquire Step also shows a list of all of the individual images, or Captures, the user has set up to be able to find and read all of the codes.

During the Read Cycle, the system use as many of the Captures as necessary to get a successful read.

At the end of each Read Cycle, all Captures will display the amount of time they took to acquire, including the setup time required to change sensor parameters, autofocus distance, and lighting power prior to exposing the sensor.



The Acquire Step UI allows the user to add Multiple Captures into the list.

When the user clicks on a Capture, a parameter dialog opens up allowing the user to set the capture's Exposure, Gain, Focus, and Lighting.

Each Capture in the list can be set up with a unique combination of imaging parameters designed to ensure that all targeted codes can be read under all conditions by at least one of the Captures in the list. For example, if part heights may vary, each capture can be set up for a different focus distance.

In addition to Multiple Captures, the user can set the Read Cycle to iterate through the Capture list multiple times while it is waiting for the part to come into view.

7-4-2 Single and Multiple Captures in the Capture List

The main purpose of the Acquire Step is to set up one or more Captures to ensure that all codes can be read for the current application. Normally, a single Capture is sufficient, however there are situations where multiple Captures may be required or beneficial.

For Example: Codes at different distances requiring Captures with different focus values. Parts that are different colors or have different finishes, requiring Captures with different exposure times or using different lighting banks.

The + control and Trash Can icon are used to add/delete Captures into what is called the Capture List. Captures are shown as C1 – CN. When the user clicks on an individual Capture icon, the Capture Setting dialog appears on the right side of the UI allowing the user to uniquely configure that Capture.

7-4-3 Running Multiple Iterations through the Capture List

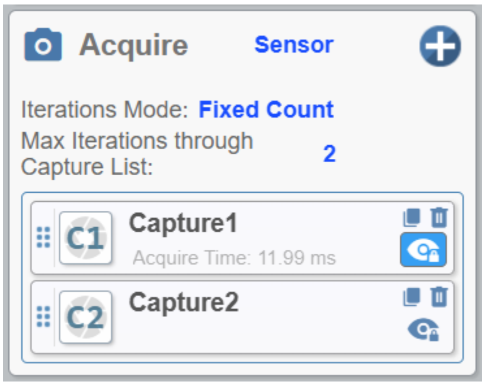
The final parameter in the Acquire Step is Iterations. This controls the maximum amount of times that the Read Cycle will acquire all the Captures in the list in an attempt to read. This value is normally set to one because the part will normally be right in front of the sensor when the read cycle is triggered. There are cases where the part may be moving across the field of view, or where the part may be rotating in the field of view and it necessary to repeat the Capture multiple times until the part is decoded.

Bottling Line Example: When codes are placed on round bottles and are moving across a large field of view, the code may or may not be visible depending on the angle. If the job is set up to iterate through the Capture List, the reader will keep taking images until it finds one where the code can be seen and read clearly. The image below shows the bottle entering from the left in the first iteration, and moving to the right where the code is finally able to be seen and read in the fourth iteration.

Key Point: The Tiled Image View allows the user to see all the images that are used to complete the Read Cycle.

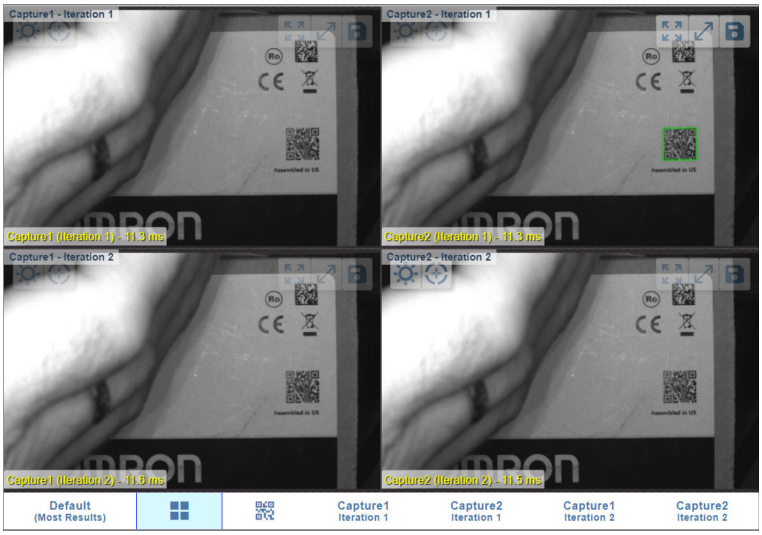
7-4-4 Multiple Captures and Multiple Iterations

The maximum number of Captures x the Maximum Number of Iterations cannot exceed 100. The Read Cycle will continue to take images until it is finally able to read all the target codes, or until a user set Time Out is reached. The image below shows a combination of the two concepts above.



- Two different captures are set up, one with a low exposure, and one with a high exposures, to be able to read two different colored parts.
- Iterations is set to two to allow the read cycle two chances at reading. The Tile view clearly shows what images are being acquired during the full read cycle.

Note: Captures in the Capture List are taken one after the other. Iterations though the Capture List can be spaced out in time using the **Delay Between Iterations (of the Capture List)** setting in the Read Cycle Dialog.



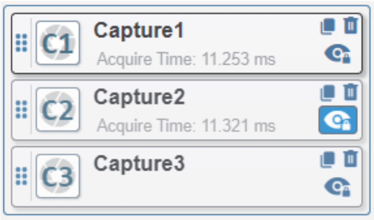
7-4-5 Working Efficiently with Multiple Captures (Pinning Captures)

In the normal operation of the Read Cycle, the reader will start by taking the first Capture and then trying to decode within that Capture. If all the codes are found in the first Capture, the read cycle will end without trying to use (or display) the other Captures.

This default processing can pose challenges during the setup phase, particularly when operators need to evaluate reading capability in multiple Captures that may not run normally.

Consider a scenario where an operator configures a job with three distinct Captures, each set at different focus distances to accommodate objects of varying heights.

Pinning Captures



To address this issue and enhance usability, operators have the option to "Pin" a specific Capture. This action prioritizes the pinned Capture to be used as the first capture of the Read Cycle.

By sequentially pinning and viewing Capture 1, then Capture 2, and finally Capture 3, operators can thoroughly test reading with each image during setup. This allows them to verify tool settings and the accuracy of the regions of interest, thus ensuring successful decoding within each Capture.

To pin a Capture, the operator clicks on the eye icon with a Lock symbol. Upon pinning, the icon changes to a dark blue color, indicating that the pinned Capture will lead in the Read Cycle. Unpinning is achieved by clicking the icon again, which reverts the cycle to its standard operation, starting with Capture.

Pinning will revert to Capture 1 whenever the Run mode or Dashboard mode are selected.

7-4-6 Acquire Step Settings

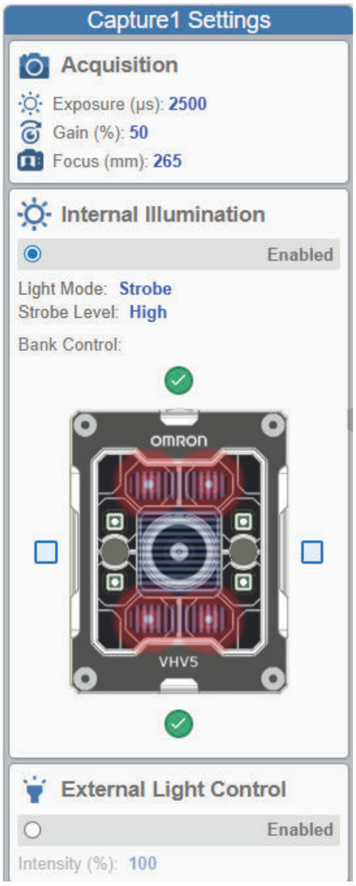
Item	Setting value [Job Default]	Description
Acquisition		
Input Channel Pull Down	**[Sensor]**	Sensor is the default channel for images when using the camera. File is the default channel when running emulator on the PC.
	**Add Capture**	Add a Capture to the bottom of the list. When this Capture is added, it inherits the same Capture Parameters as the Capture directly above it.
	**Duplicate and Delete Capture**	Duplicate the currently selected Capture and add it to the bottom of the list. When this Capture is added, it inherits the same Capture Parameters as the Capture it was duplicated from.
Iterations Mode	**[Fixed Count],** Continuous	Controls whether the number of maximum iterations through capture list is capped at a fixed count defined by Max Iterations, or if iterations will proceed Continuously until Read is complete or an End Cycle Event has been received.

Item	Setting value [Job Default]	Description
Max Iterations through Capture List	**[1] -** N	Max Iterations controls the maximum number of times the Read Cycle will run through the capture list in an attempt to read. If reading is successful, it will stop acquiring images. If reading is not successful, it will continue up and until it reaches the max allowed iterations. **Note: The maximum number of Iterations x Number of Captures cannot exceed 100.**
	**Capture Order Shifting**	The user can shift the order of the Captures in the list by clicking this icon and dragging the captures to the desired location. Capture numbering will stay ordered, but the parameters will shift along with the Capture.
Pinning a Capture 	**[Unlocked (not Pinned)]**, Pinned	The read cycle will always start with Capture 1 unless a different Capture is pinned. Pinning a Capture will cause the read cycle to start by taking that image and then trying to decode in it first.

7-5 Capture Settings Dialog

7-5-1 Overview

When the user clicks on the icon of a Capture in the Capture list, the Capture Settings dialog appears in the right side of the UI. The Capture Settings are used to set Exposure, Gain, Focus and Lighting to create a good lighting environment so that the codes on the part stand out in high contrast.



7-5-2 Capture Settings

Acquisition Settings

Exposure, Gain, and Focus can be set here by hand or can be set using the **Quick-Photometry**, and **Quick-Focus** tools in upper right of the image. These tools are recommended to acquire initial settings, and the UI can be used to adjust the values to suit the application better.

Enabling Internal Illumination or External Lighting

The lighting sections of the dialog control Internal Illumination and External Lighting. Either Internal Illumination or External Lighting can be used within a capture. They can't both be used at the same time. The Enable buttons act as radio buttons.

Internal Illumination Mode, Light Power, and Bank Control

The main control for Internal Illumination is Light Mode and Light Level. These are set to Strobe and High power level by default, and are a good starting choice for most applications. Constant light can be chosen rather than strobe if operators react negatively to having a strobe pulsing near their workspace.

Bank control is available for Internal Illumination. Each bank can be set on or off independently. This is especially useful when using the half-polarizer or when working with certain DPM marks.

The power level of the light can be adjusted in both Constant and Strobe modes from Low to High for Constant, and between Low and Ultra for Strobe.

External Light Control

External Light Control is accomplished through the External Light Port connector on the back of the reader. The connector supplies 24V and a Strobe Trigger to an external light. It can also supply and Intensity Control signal on Finally Pin 5 to vendors who support that option for controlling their lights.

7-5-3 Focus Details

In addition to the 2.3MP and 5.0MP sensor options, there are four lens options for the VHV5-F designed to provide maximum flexibility in mounting distances and fields of view. Each lens has a specific focus range and default focus distance as well.

Lens Name	Lens Focal Length (mm)	Focus Range (mm)	Default Focus Distance for Jobs
Wide	6.42	55-500	115
Medium	8.50	55-500	135
Narrow	12.50	100-1000	220
Long	20.00	100-2000	250

7-5-4 Light Power Limitations

Duty Cycle Limitations

Strobe lighting has been designed to provide maximum power to the lights without overheating the unit. To accomplish this, the system will automatically limit the duty cycle in the very extreme cases of long strobe times and extremely fast trigger rates. To do this, the system will not take the picture, and will instead return a Trigger Overrun error to the user indicating that he has to slow down triggers, or shorten the pulse time. If this last bit of light is needed, the user can accomplish this by applying a higher gain. For High power, the light must be off for 6x longer than it is pulsed. For Ultra, it must be off for 11x longer than the strobe is pulsed.

Example: For High Power strobe, exposure time = 1 msec the light, the unit must not trigger again for 6 msec. (6:1). In practice this is not an issue since at the high strobe power settings, the required strobe pulse time are generally less than 100 μsec.

Strobe Setting	Power Level	Duty Cycle Limitation
Low	0.65 W	None
Medium	2.0 W	None
High	12 W	6:1
Ultra	22 W	11:1

Constant Setting	Power Level	Duty Cycle Limitation
Low	0.65 W	None
High	2.0 W	None

Maximum Strobe Light Power Limitation Based on Camera Power Source

● 24V DC Power

When the camera is powered with 24V DC, there is no limit for Strobe Output Power. Strobe output can be set from Low (0.65 Watts) to Ultra (22 Watts).

The Power Mode and Max LED Power available is shown in the Device Status pane in the Device View.

Power Mode	Direct 24V
Max LED Power	Ultra

● PoE Power

When the camera is powered via PoE, a limit is imposed on the power available for the lighting. For Class 1 PoE, the Medium, High and Ultra strobe settings will all use 2 watts. For Class 2, High and Ultra will both use 6 watts.

Power Mode	PoE Class 1
Max LED Power	Med

Power Mode	PoE Class 2
Max LED Power	High

7-5-5 Image-to-Image Wait Time when Changing Parameters

Typically, the total time required to acquire an image includes just the Exposure Time plus the amount of time to read the image out of the sensor into camera memory.

Please note that additional overhead time is required before taking the picture if there are changes to sensor settings (Exposure, Gain), the autofocus lens focus distance, or to the light power level. These changes require time to be set up before the next image can be taken. For instance, autofocus takes 42-50 msec to change. The lens must be allowed to focus to the new distance before the new picture is taken.

The timing is all controlled internally, but when programming multiple Captures in a Capture List, it is important to keep this in mind and change as few things as possible from Capture to Capture, or keep similar settings in adjacent Captures.

Changing Light Power is the most expensive operation in terms of overhead time. It is better to choose one light setting (usually the brightest one that will be required), and then use Exposure and Gain to control brightness. This will save 137 msec on the 2.3 MP reader and 157 msec on the 5.0 MP reader.

The table below describes image-to-image wait time when changing parameters.

Parameter Change	2.3 MP Sensor (80 FPS)	5.0 MP Sensor (40 FPS)
Exposure Time (μsec)	16 – 300,000 μsec	16 – 300,000 μsec
Sensor Read Out Time	12.5 msec	25 msec
Exposure or Gain Change	20 msec	0 msec
Focus Change	42-50 msec	42-50 msec
Light Bank Change	0 msec	0 msec
Light Power Change	157 msec	157 msec

Capture Settings

Item	Setting Value [Job Default]	Description
Acquisition		
Exposure (μsec)	16-300,000 (0.3 sec) **Depends on base lens**	Exposure controls the brightness of image. Longer exposure times produce brighter images. Note that for fast moving applications, shorter exposure times are better to prevent blur. High brightness light, or higher gain values to compensate.
Gain (%)	0-100 **[50]**	Gain affect both brightness and contrast because it multiplies the signal strength. Note that at high values is also increases the effect of noise.
Focus (mm)	50-2000 **[Depends on base lens]**	Default Focus Distance and Range Vary based on lens. See table above.
Internal Illumination – Built in lights		
Enabled	**[Enabled],** Disabled	User can enable either built in lighting on the face of camera, or external lighting through the 3rd connector on bottom of camera. Both may not be used at the same time.
Light Mode	**[Strobe],** Constant	Light defaults to strobe to achieve brightest lighting for short exposure times. Constant can also be used if strobing is an issue for people on the line. Longer exposure times will be necessary.

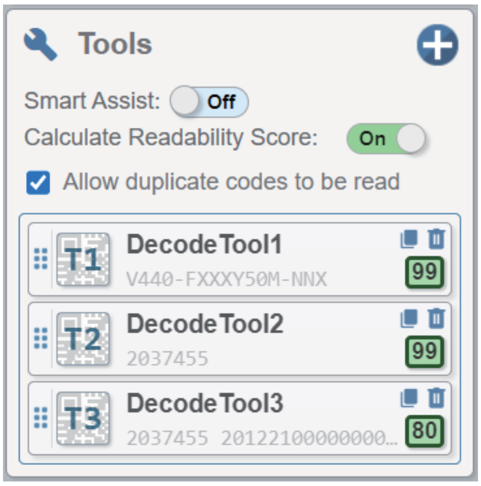
Item	Setting Value [Job Default]	Description
Strobe Level	Low, Medium, **[High],** Ultra	Four strobe power values. User should match light power with exposure and gain to get good image. High is default. Ultra may be needed for long range fast moving operations. See Light power to Duty Cycle note above.
Constant Level	Low, **[High]**	Two Constant power values. Match with exposure and gain to get good image. High is default.
Bank Control	**[Left, Right, Top, Bottom]**	Each bank can be enabled separately. User can pick best combination. All are on by default. Note the ½ Polarizer works with light pairs. Left/Right for non-polarized and Top/Bottom for polarized.
External Illumination – Lights controlled via External Light Port Connector		
Enabled	Enabled, **[Disabled]**	User can enable either external lighting through the External Light Port connector on bottom of camera, or lighting on face of camera. Both may not be used at the same time.
Intensity (%)	0 – **[100]**	Controls 5th pin analog voltage which is used as Intensity function on many major vendors lights.

7-6 Tool Step

7-6-1 Overview

The Tool Step contains the set of Decode Tools will run in all of the Captures. The maximum number of Decode Tools that can be added to a job is 400.

Each Decode Tool listed is responsible for reading one target code and will continue to run in all available images until that code is found. If the code is not found in any of the available images, that tool will be set to No Read.



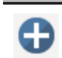
Controls in the Tool Step are used to Add, Duplicate, or Delete Decode Tools. Decode Tools are added to or deleted from the bottom of the list. Tools can be individually Deleted from within the middle of the list using the Trash Can icon, and they can be Duplicated from here as well. Duplicated Decode Tools are added to the bottom of the list.

The Tool Step is also used to set parameters such as Effort Level, Calculate Readability Score and Allow Duplicates. These three are global settings and apply to all Decode Tools in the Tool list.

At the end of each Read Cycle, all Decode Tools will display the Formatted Output string from that tool, a Pass/Fail Indication, the Readability Score if it is turned on, or the Verification Score if it is enabled.

Clicking on the icon T1 – TN will open the Decode Tool setting dialog for that particular Decode Tool, allowing the user to set up how that individual Decode Tool operates. See the next section for additional information.

7-6-2 Tool Step Settings

Item	Setting value [Job Default]	Description
	**Add Decode Tool Step**	Used to Add Decode Tools to the bottom of the Tool list. **Note: The maximum number of decode tools that can be added to a Job is 400.**
	**Duplicate and Delete Decode Tools**	Duplicate – Duplicates the currently selected Decode Tool, and adds it to the bottom of the list. The duplicated ROI will be offset from the original ROI so the user can easily select and move it. Delete – Deletes the selected Decode Tool from the list.

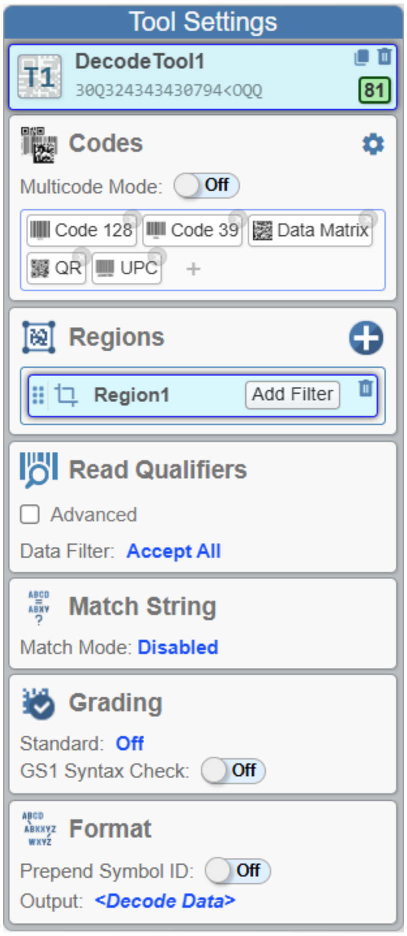
Item	Setting value [Job Default]	Description
	**Decode Tool Order Shifting**	The user can shift the order of the Decode Tools in the list by clicking this icon and dragging the Decode Tools to the desired location. Decode Tool numbering will stay ordered, but the parameters will shift along with the tool.
Smart Assist	**[Off]**, On	Smart Assist is off by default and uses standard X-Mode processing to decode without employing Advanced Decode Techniques or automatic Image Preprocessing. When Smart Assist is on, it is similar to Configuration Database Mode for reading very difficult codes. It automatically and intelligently applies Advanced Parameters, Scale, Gain, and Image Preprocessing to aid X-Mode processing.
Calculate Readability Score	Off, **[On]**	Enables calculation and display of the Readability Score for DM and QR 2D codes. The Readability Score is an indicator of code quality, or Readability varying from 1-99. **Note:** No score is currently calculated for other 2D code types. Values below 70 typically indicate that the user should check camera mounting, lighting and imaging parameters to improve the base image.
Allow duplicates codes to be read	Unchecked, **[Checked]**	Allows codes with the same string content to be read. If this is not set, the second code with duplicate string content will fail.

Note: Effort Level, Calculate Readability Score, and Allow Duplicates are Global Settings and apply to all Decode Tools in the list.

7-7 Decode Tool Dialog Details

7-7-1 Decode Tool Qualification

Clicking on any tool icon T1 – TN in the Tool Step opens the Decode Tool Settings dialog for that particular Decode Tool. The dialog is used to setup how the decoder will run, and is used to set the Qualification (Pass/Fail) criteria for the tool.



Setup includes:

- Choosing target Symbology types
- Defining ROIs (regions of interest) where the tool will run
- Defining any image pre-processing per ROI done prior to decode
- Setting Effort Mode to control Config DB and Advanced Parameters
- Setting Read Qualification, Match String, Grading and Output

When run, each Decode Tool executes in all Captures until the tool qualifies/passes, or until there are no more Captures to process and the tool is marked as No Read/Failed.

Qualification

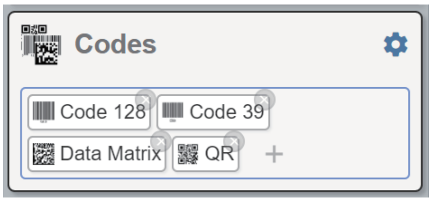
Each Decode Tool is set to find or qualify one specific code in the image. As potential candidate codes are read by X-Mode, they are subjected to series of stages, or gates to determine if they are the intended target code. If any gate fails, the Decode Tool will continue to run and supply more candidates until it runs out of Captures to process.

If a code Qualifies (passes all gates) the Decode Tool is set to Pass and X-Mode processing ceases. It will not continue to run even if there are Captures left that have not been processed.

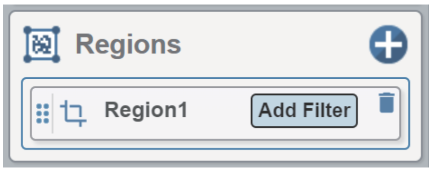
The Decode Tool will only pass if all Gates have passed (with the exception of Grading). Pass/Fail for the Decode Tool is set into an output result. An individual Pass/Fail result for each gate is stored as well that can be used for process control or other tracking purposes.

- **Gate 1 – Code is Present**

  Once a code is read by X-Mode that is one of the target symbology types and is in one of set ROIs, it is marked as found and sent on to the Read Qualification gate.



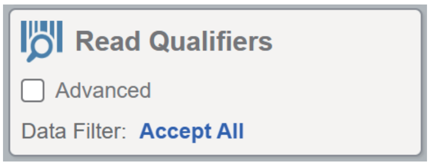
and



- **Gate 2 – Code is Read (Read Qualification)**

  Default – By default the Read Qualification stage is set to accept any code of the correct type that is "found" and declares it as read. Once read, the code is passed on to the final Matching and Verification qualification stages.

  Data Filter – Using the Data Filter, the user can limit the set of codes that can be qualified assuring only a code of a certain type will be read. For example, the Data Filter can be set so only codes that "Start With ABC" or "Contain XYZ" will qualify.

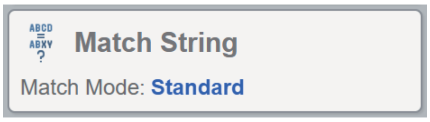


  Advanced – A secondary very powerful use of the Read Qualification stage is as a pre-filter. The Read Qualification section can be set up with a series of pre-filters to pass on only codes with a defined combination of Symbology type and data content. Multiple sets of these pre-filters can be set at one time and operate in an OR fashion. This gate qualifies any of the pre-filter combinations that are found, and then the code is passed on to the Code Matching stage.

  For example: Read Qualification can be set to accept a *Data Matrix that starts with ABC* **or** a *Code 128 that starts with XYZ*. The algorithm ignores all other codes that it finds and only passes the code that meets one of these very specific qualifications to the next stage. Once a code is found that satisfies one of these pre-filters, the code is marked as read. If no code is read that satisfies this gate, the Decode Tool will continue to run in all Captures until it does read, or until there are no more Captures to run in. In that case, the tool is marked as a No Read and fails.

● Gate 3 – Code Matches

The user can further define the required string content within the Match String stage using full or partial flexible string matching functions. This stage acts not only as a traditional Match String routine, but can also be used to perform a final test on the code that goes beyond Read Qualification or Match String alone.



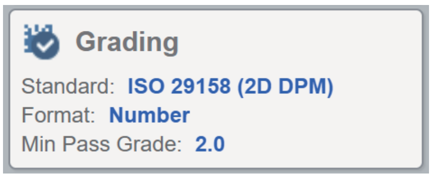
For Example: Gate 2 allows codes to be read that start with ABC or XYX indicating that the parts found are the correct type of parts. Match string however can be set to accept “only” ABC123, ABC234, or XYZ222, indicating that not only is the part the correct type, but is the correct exact model as well.

Individual Code Read Pass/Fail and Code Match Pass/Fail results can be sent to the controlling system informing it if the exact correct part is present, or if other similar parts of that type are mistakenly getting into the parts stream.

In summary, the decode tool performs standard read and match, and it allows for a two-stage matching process that allows the user to apply deeper logic, and communicate a richer output that would normally require scripting.

● Gate 4 – Code is Good Quality (ISO Verification/Validation)

When enabled, as a last step, the Decode Tool will check the quality of the code that has passed all of the previous qualification gates. It does this using standard ISO Verification algorithms. The user is able to set a Pass/Fail limit for Code Quality. Note, however, that this result will not affect the overall Decode Tool pass/fail result. Instead, the pass/fail result, score, or detailed verification report can simply be sent as data.



7-7-2 Decode Tool Settings

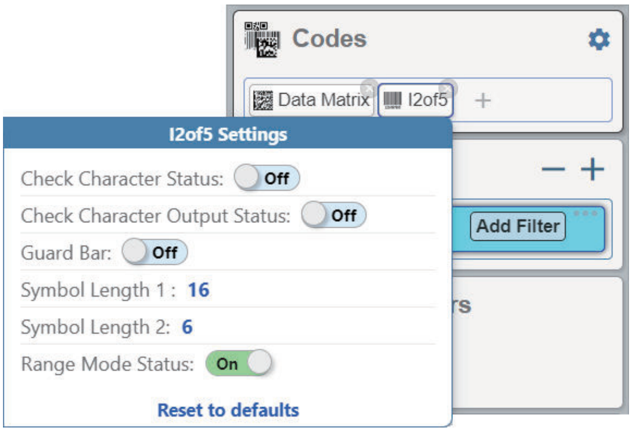
Item	Setting value [Job Default]	Description
Codes Setting Sprocket	Brings up code selection list.	Brings up dialog box for Advanced Decoding Parameters.
Codes Selector (+)	**[Data Matrix, QR Code, Code 128, Code 39],** All major types	Adds symbology types to the list the Decode Tool is set to read. Use the X in upper corner of code to delete a type from the list. **Note:** Pharmacode And DotCode are special symbology types. Only Pharmacode or only DotCode can be on in the tool.

Item	Setting value [Job Default]	Description
Multicode Mode	**[Off],** On	Turns on or off Multicode Mode. By default this is off and the Decode Tool is set to Find and Qualify just one single code. When Multicode Mode is turned on, a single Decode Tool can be set to find a set number of codes, or all codes within the field of view, or ROI. See section 7-7-16 for details on Multicode. The following sections will describe how the tool works when set to find a single particular code.
Regions	**[OneDefault Region]** -N Regions	Add or delete ROIs for the Decode Tool. Add with the **+** icon. Delete with the trash can icon next to the region.
Add Filter	**[No Filters],** Variable Filter Chain	See Creation of Image Preprocessing Filter Chain below.
Read Qualifiers – Advanced	Unchecked, **[Checked]**	Read Qualification will pass on any code that is found when this setting is unchecked. Read Qualification will pass on only those codes that are the correct symbology type and have the correct partial or full-string content.
Read Qualifiers – Data Filter	**[Accept All]**, Individualized Data Filter	(See Read Qualification below.)
Match String – Match Mode	**[Disabled]**,Standard	Turns on String Matching for the code that is both found and read by this Decode Tool. The Match or Mismatch output will affect the overall Pass/Fail status of this Decode Tool. (See Matching Function Below)
Grading Standard	**[Off]**,ISO 15416, ISO 15415, ISO 29158	Turns on applicable ISO Verification standard to perform grading for the code found by this Decode Tool. The numeric score (default) or letter grade will not be used to define whether or not the Decode Tool passes or fails. It is used to display the grades, or to output the grading report as data.
Output	**<Decode Data>,** Decode Tool Results	This section allows the user to completely format the string that is passed back to the Read Cycle for eventual output. The formatting tool described below allows the user to add a rich set of data into the output beyond just the decode string. For example, the X, Y, and Angle of the code can be added.

7-7-3 Setting Standard Decode Tool Parameters

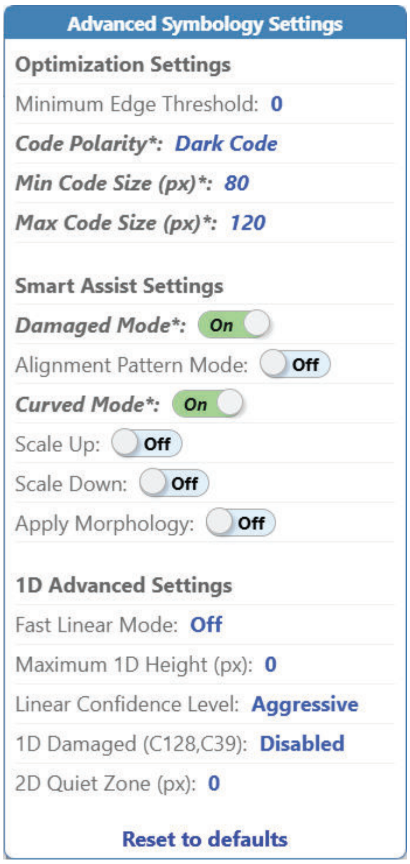
Each Symbology Tool has a set of parameters that control how it operates. Default settings are normally adequate and do not require user attention. If the Symbology is not working, or any of these parameters need to be set, the user should click on that Symbology in the Codes list. The Symbology Settings Dialog will appear, allowing the user to make changes.

See the **Symbologies** section for a full explanation of all settings for all code types.



7-7-4 Setting Advanced Decode Tool Parameters

When the user clicks on the Gear Icon, the following Advanced Parameters are available to be set individually for each Decode Tool. They apply to all Symbologies of that type that are enabled within the tool.



Optimization Settings

The Optimize function will set these automatically. The user can also set these "by hand". Whenever even one of these is set, the Train Hat will change to the Untrain Hat. Clicking Untrain will set these back to default.

The primary function of these parameters is to speed up X-Mode processing. Using these parameters, the operator can tell X-Mode to ignore low contrast edges in the image, ignore codes that are the wrong polarity, and ignore codes or other rectangular features in the image that are not roughly the correct size of the target code.

Optimization Settings	
Advanced Parameter	**Definition**
Minimum Edge Thresh-old (0 to 128)	This setting is used to improve search speed in images with an excessive amount of edges that have a lower contrast than the symbology. This setting will filter out edges with magnitude less than what is specified and only consider edges with sufficient contrast like those of the code. • The range is from **0** to **128**. • **1**corresponds to virtually no contrast. • **128** corresponds to a pure white background and pure black code. • The default setting is **0**. 0 instructs X-Mode to use internal threshold limit which is able to find codes with as little as 5% contrast. The user can experimentally set this to a much higher value. (64 is a good maxi-mum for black and white labels) Care must be taken with this setting, since setting the threshold too high can keep the decoder from finding and reading codes. **KEY POINT:** The **Optimize** routine sets this value to 60% of the gradient for the code that was optimized. If, after Optimization, codes are failing, this value should be reduced as a first step.
Code Polarity	This setting is used to improve search speed in images with an excessive number of edges or codes that have a different polarity than the symbology. If X-Mode finds that edge or code is the wrong polarity, it quits and moves onto the next code can-didate. **Any (default) –** Either light or dark codes. **Dark –** Dark codes on a light background. **Light –** Light codes on a dark background.
Min Code Size (px)	This setting is used to improve search speed in images with an excessive number of codes or other square or rectangular features. If, after a first pass to find the four corners, it does not meet a minimum size, X-Mode moves onto the next code can-didate. Setting can be any number of pixels: **The default is 0 –** 0 allows any code size to be found 80% of target code size is a good starting point for this setting.
Max Code Size (px)	This setting is used to improve search speed in images with an excessive number of codes or other square or rectangular features. If, after a first pass to find the four corners, it is larger than the maximum size, X-Mode moves onto the next code can-didate. Setting can be any number of pixels: **The default is 0 –** 0 allows any code size to be found. 120% of standard code size is a good starting point for this setting.

Smart Assist Advanced Parameters

The primary function of these parameters is to ensure that X-Mode is able to read successfully. Each of these functions requires additional processing time.

When **Smart Assist** is enabled, all six of the following **Advanced Parameters** are automatically set to **ON** in all Decode Tools. Each parameter directs X-Mode to expend extra effort, so the length and variance of Decode Times will increase.

If **Smart Assist** is off, the user can set these parameters individually "by hand" for any or all Decode Tools. Typically the user is able to determine the one or two parameters that have the most impact on readability. By setting just the relevant parameters, the Decode Time will be less and the variance in Decode Times will also be lower.

Smart Assist Advanced Parameters	
Advanced Parameter	**Definition**
Damaged Mode	This function is useful for bad cell registration, or high optical distortion. Damaged mode assumes irregular cell placement, so it shifts the grid location for where it samples cell content to attempt to get a good read. This function has a low impact on the decode time.
Alignment Pattern Mode	If X-Mode has difficulty finding the four corners of the code, this instructs X-Mode to use the alignment patterns (internal Ls and clocks) to realign the cell sampling grids before decoding a Data Matrix. This is especially helpful for very large codes with multiple internal clock patterns because large codes can be more affected by optical distortion. The internal clock patterns are used to realign the sampling grid locally for each small group of cells. This function has a medium impact on the decode time.
Curved Mode	This enables curve detection for Data Matrix and QR Codes on bottles or cylinders. If enough curvature is detected, it will curve the grids accordingly, adjusting where it samples the cell centers. Note: This function works for smooth curves, such as when a code is wrapped around a bottle. If the code is more wrinkled, then Damaged Mode is a better solution. This function has a medium impact on the decode time.
ScaleUp	Scales up the image by 2x and then by 4x. This can help the algorithm to align the grid for where it samples the cells, as well as to give the algorithm a larger clear area for sampling the cell.
Scale Down	Scales down the image to ½, ¼ and then 1/16th if necessary for decoding. This helps by reducing the PPE down to the 5-5 cells that X-Mode is optimized for.
Apply Morphology	The system attempts to decode with the aid of various morphological operations such as Dilation, Erosion, Open, and Close.

1D Advanced and 2D Quiet Zone Settings

1D Advanced Settings	
Advanced Parameter	**Definition**
Fast Linear Mode	**Off–**Advanced parameter is disabled. This feature prioritizes and improves the search and decode time for 1D symbols with a fixed orientation. **Fast Horizontal–**This enables the horizontal Fast Linear Mode. This will not decode vertical barcodes or 2D codes. **Fast Vertical–**This enables vertical Fast Linear Mode. This will not decode horizontal barcodes or 2D codes.
Maximum 1D Height (pixels)	This feature is used to eliminate invalid 1D Code candidates that may be found in visually "busy" images, such as those with lines of text surrounding the barcode. The user should measure the real barcode height in pixels and then round up by 10%. Any other feature in the scene, such as single or multiple lines of text, and even taller barcodes will be ignored. There is no limit on this height setting.
Linear Confidence Level	Linear Confidence Level is intended to prevent misreads. It applies to Code 128 and to Code 39. When it is set to a higher level, it requires more scan lines to decode the same result, making the read more certain. The default state is **Aggressive**. This requires only **1** scan line to decode. **Normal** requires **2** scan lines. The most secure state is **High**, which requires **3** scan lines to decode.
2D Quiet Zone (pixels)	Applies to the Quiet Zone size for 2D symbols. The user sets the size to the smallest quiet zone of the four sides in pixels. This allows X-Mode to eliminate some of the invalid code candidates that cause slow processing.There is no limit on this setting, and it should be set approximately to the distance from the code edge to the nearest non-code edge.

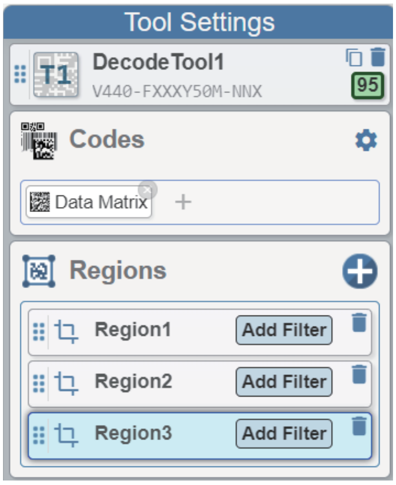
7-7-5 Decode Tool Dialog Regions (Regions of Interest)

Regions of Interest (ROIs)

Decode Tools can be set to run on the full image, or within a limited ROI (Region of Interest) in the image. ROIs reduce the amount of processing time required to run, and can be used to exclude non-target codes from consideration.

A single decode tool can also be set to run in multiple ROIs. For example, if the target code is printed at one corner of the part, and the part can be presented at any of four orientations, 4 separate ROIs can be added to cover each corner, again limiting the number of pixels the system has to process.

The example below shows the scenario with two ROIs in the lower left and upper right to account for two orientations the part can be presented in.



7-7-6 Working with Regions of Interest (ROIs)

As stated earlier, ROIs are mainly used to target and limit the image area in which the Decode Tool runs. Normally, a Decode Tool is configured with just one ROI, but it can be configured with multiple ROIs to target different areas of the image. The decoder will look for the target code in all of the ROIs. ROIs are also used to perform Image Preprocessing on the image prior to running the decoder. See section 7-7-5 – ROI Image Preprocessing Filters.

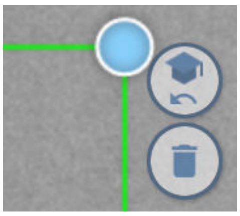
Regions of Interest are added to a Decode Tool using the **+** icon in the Regions area. They are deleted using the trash can icon.

ROIs appear on the screen as green boxes. The are labeled in the upper left hand corner showing the Decode Tool number and the Region number. The example below is T1-Region 1, signifying the first Decode Tool and the first Region.

When the user clicks on the Decode Tool in the Tool list, or clicks on the green box on the screen, the ROI becomes active with handles so the user can move it, resize it, delete it, and run Optimize. Optimize is explained in section 6-6-3.

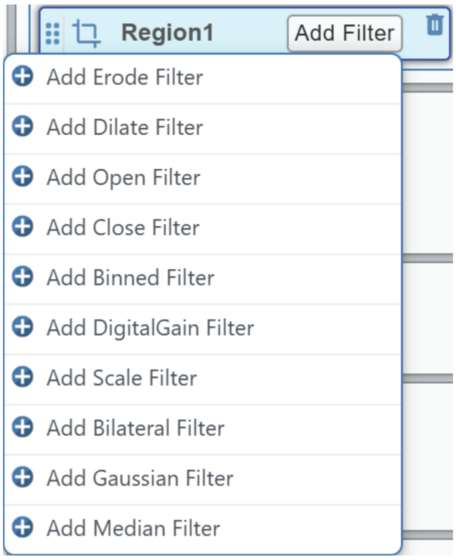
ROI Control

- **Move –** The ROI is moved by clicking anywhere inside the box and dragging it.
- **Resize –** The ROI is resized by clicking on any of the blue circle corner handles and dragging them.
- **Delete –** The trash can icon will delete the ROI.
- **Optimize –** The Train (hat) icon activates the Optimize function. Once Optimized (or once Minimum Edge Strength is set) the Train icon turns to the icon shown below.
- **Un-Optimize –** Clicking on the Train icon with the back arrow turns off Optimization for that ROI and/or sets Minimum Edge Strength back to default.



7-7-7 ROI Image Preprocessing Filters

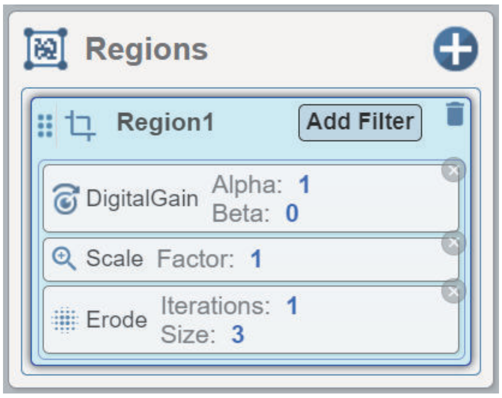
Each ROI can be set to run image preprocessing prior to executing X-Mode within that ROI. Image preprocessing is used to improve the image making it easier to X-Mode to find and read the code within it. The Add Filter button allows the user to a variety of filters into the ROI.



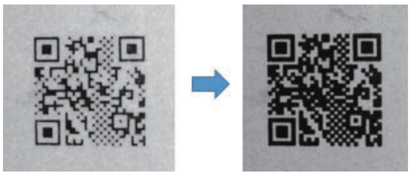
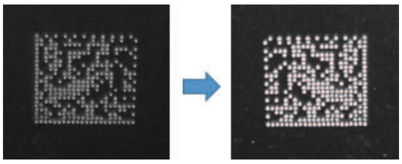
Multiple filters can be combined into filter chain as well. In the example below we use a normal ROI to first try to read the code, and if that does not work, the Decode Tool will try to decode using the ROI with the following filter chain to improve the image:

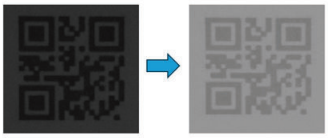
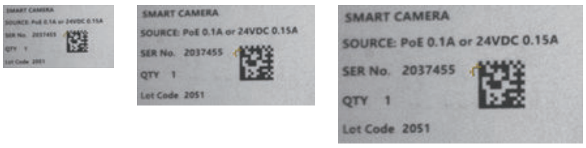
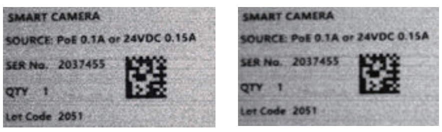
- Digital Gain is added to increase contrast
- Next the image is scaled up to improve the PPE of the code
- Finally the light cells are eroded (thinned out) to make them more closer to square cells

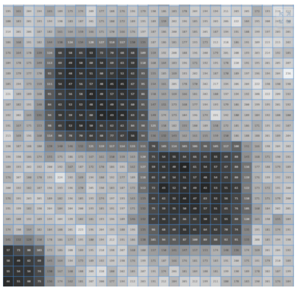
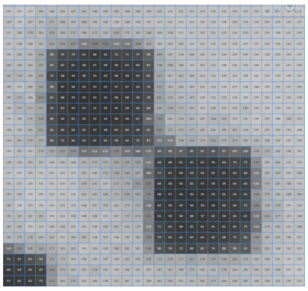
This chain turns the smaller original image in the center into the pre-processed image on the right.



7-7-8 Region Image Preprocessing Filter Settings

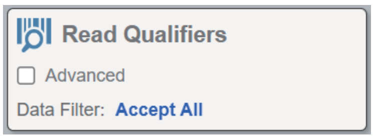
Item	Description/Content
Erode Filter	Erode Light (Dilate Dark) – Thins the light pixels and grows the dark pixels. This feature is useful for increasing the size of dark cells for a dark-on-light printed symbol. **Input Parameters:** • Iterations – Number of times to run the kernel. • Size – Size of the kernel (3 x 3, 5 x 5, 7 x 7). Larger kernels erode a wider area. 
Dilate Filter	Dilate Light (Erode Dark) – Grows the light pixels and thins the dark pixels. This feature is useful for increasing the size of the light cells for a light-on-dark direct part mark symbol. **Input Parameters:** • Iterations – Number of times to run the kernel. • Size – Size of the kernel (3 x 3, 5 x 5, 7 x 7). Larger kernels dilate a wider area. 
Binned Filter	**Binning –** Binning is a very fast operation that decimates the image in half for each iteration by averaging a 2x2 pixel area into 1 pixel for each iteration. This feature is useful when the PPE for codes is large, causing unnecessary processing time. For example, if a QR code PPE is 14 pixels, Binning with 2 iterations will bring the PPE down to 3.5. It will also reduce the number of pixels is the search region by the same amount. **Input Parameters:** • Iterations – Number of times to run binning. Each bin further reduces the size of the image to process.  Bin performs the operation once. If the user adds a second Bin filter, the image will be cut in half again.

Item	Description/Content
Digital Gain Filter	**Digital Gain –** Modify image brightness and contrast. This feature is useful to increase both the brightness and contrast of the image. For example, with an image with dark cells at **50** grey levels and light cells at **75**, the contrast difference between them is only **25**. When the Alpha (gain) is set to **2**, the contrast increases to **50** grey levels. **Input Parameters:** • Alpha (Gain) – Multiplier. 0-N. Alpha < 1 decreases the signal strength and contrast. Alpha > 1 increases. Gain has no upper limit and should be set empirically.  • Beta (Offset): Beta < 0 decreases the image brightness by Beta gray levels. Beta > 0 increases the image brightness Beta gray levels. Adjusting Beta (Offset) will affect the image brightness, but not change the contrast difference between light and dark. The image below shows the effect of Beta = 100. 
Scale Filter	**Scale –** Scales the input image up or down. Scale down reduces the number of pixels and may result in a faster decode. Scale up increases the number of pixels in a code and may increase the chances that the code cells can be correctly determined and the code decoded.  **Input Parameters:** • Scale– Multiplier Scale < 1.0 decreases size. Scale > 1.0 increases. Scale has no upper limit. However, if the PPE ends up greater than 10 pixels, the user should check to see if there are other issues with the code that go beyond the fact that it might be too small.
Median Filter	**Median Filter –** The median filter is a low-impact smoothing filter used to remove noise and edge artifacts.It is particularly effective for removing "salt-and-pepper" noise because the median is robust to outliers. **Input Parameters:** • Size– Size of the kernel (3 x 3, 5 x 5, 7 x 7). Larger kernels blur more. 

Item	Description/Content
Gaussian Filter	**Gaussian Filter –** The Gaussian smoothing operator is a 2D convolution operator that is used to "blur" images and remove detail and noise. In this sense it is similar to the median filter, but it uses a different kernel that represents the shape of a Gaussian ("bell-shaped") hump. It provides for wider smoothing than Median Filter while slightly preserving edges. **Input Parameters:** • Sigma X– Spread in the X direction. • Sigma Y – Spread in the Y direction. Values can range from 0.5 to N. A value of 0.5 to 1.0 is good for removing noise while preserving the code at 5 PPE. Higher values begin to blur the code itself. The sigma values control the spread of the Gaussian function. A larger sigma value will result in a wider spread. This means that more distant pixels will influence the blur.  
Bilateral Filter	**Bilateral Filter –** A bilateral filter is much like the Gaussian filter, but does a better job at removing noise while preserving edge definition. The Bilateral filter is often the best choice in code reading to remove background noise while preserving the integrity of the code. **Input Parameters:** • Diameter– Controls the size of the possible smoothing area. Values range from 1 to 9. Default is 5. Larger values will smooth more. • Sigma Mag– Controls the strength of the edge it will smooth. **1** will leave most edges and noise visible. **15** is a good default for most codes. Higher values like **25** to **40** are good for completely smoothing noise, while still keeping good edges on label-type parts. • Sigma Space– Leave at Default Value.  

7-7-9 Decode Tool Dialog Read Qualification

The function of Read Qualification was described above. This section deals with the specific settings of the Read Qualifiers section of the Decode Tool Dialog.

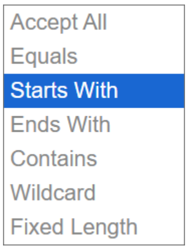


The default operation for the Read Qualifier is to accept any code that is “found”, qualify it as “Read”, and then pass it on to the “Match String” and “Grading” routines.

Using the **Data Filter** and **Advanced**, the user is able to limit, or to pre-filter, the set of codes that are qualified, assuring that only a certain type of code is read. For example, the Data Filter can be set so only codes that “Start With ABC” or “Contain XYZ” will qualify.

Data Filter

The Data Filter allows the user to limit or pre-filter the set of codes that are qualified as “Read” to a certain class of codes. It does this based on the content of the code of the string, or the length of the code. The list of Data Filters, or string functions, are the following and are self-documenting by virtue of their names, i.e. Equals, Starts With, Contains, etc.

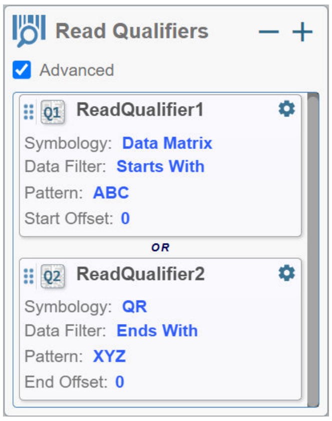


Advanced

When Advanced is checked, the user can set up multiple Read Qualifier cases with the **+/-** controls.

For each Qualifier case, the user can choose a specific Symbology for it to apply to, and they can choose a specific Data Filter that matches some expected portion of the code string data content.

In the example below, only Data Matrix codes that "Start with ABC", or QR Codes that "End with XYZ", will be qualified as “Read”. If a candidate code does not meet either of these two criteria, the system will continue on to consider the rest of the candidate list.



Read Qualifier Data Filters

● Starts With

Starts With is used to check the exact location of a substring within the decoded string.

Starts With is used in combination with an additional parameter called **Start Offset**. Start Offset is the exact character location within the string where the pattern is expected to start.

Starts With Example 1: For the string 123ABC456, if the user wants to check that the pattern 123 is exactly at the beginning of the string, they should say Starts With 123 at Start Offset 0. If the decoded string started with something other than 123, then the algorithm would conclude that this was not the code that the user was looking for, and continue to test other codes.

```
String: 123ABC456
Offset: 012345678
        ^
        123
```

Starts With Example 2: For the string 123ABC456, if the user wanted instead to check that the pattern ABC is there and in the correct location in the string, they should say Starts With ABC at Start Offset 3.

```
String: 123ABC456
Offset: 012345678
        ---^
        ---ABC
```

● Ends With

Ends With is similar to **Starts With** and used to check the exact location of a substring within the decoded string. In this case, however, it uses **End Offset**. This tells the match function to back up a certain number of spaces to do the string match.

Ends With Example 1: For the string 12ABC456, if the user wants to check for 456 using Ends With, they would say Ends With 456 with End Offset set to 0. The search has to back up 0 spaces to match the 456 pattern to the end of the string.

```
String: 123ABC456
Offset: 876543210
                ^
              456
```

Ends With Example 2: For the string 12ABC456, if the user wants to check for ABC using Ends With, they would say Ends With ABC with End Offset set to 3. This shifts the pattern back to the left to that offset and does a compare.

```
String: 123ABC456
Offset: 876543210
             ^---
           ABC---
```

● Contains

Contains is more flexible and is used to check that the substring exists somewhere within the decoded string. In this case Start Offset is used simply to narrow down an area of the string to check for the expected pattern.

Contains Example 1: For the string 123ABC456, if the user wants to check for ABC using Contains, they could say Contains ABC with Start Offset set to either 0, 1, 2, or 3. Contains starts searching at the Start Offset location and searches from there forward to the end of the string for ABC.

```
String: 123ABC456
Offset: 012345678
```

● Wildcard

Wildcard uses a **Wildcard Character (*)** and a **Placeholder Character (?)** for flexible matching where part of the match should be fixed, and where other characters are allowed to vary. The Wildcard character is a stand-in for any length of string. The Placeholder character is a stand-in for a single character.

Wild Card Example 1: For the string 12ABC456, if the user wants to check for ABC and be sure that it is preceded by three characters and followed by three characters, the user could set **???ABC???**.

If the length of the string before or after ABC is unknown, or the user does not care, the user could set ***ABC***.

If one end is known, such as the leading characters, and the other end is unknown, the user could set **???ABC***.

● Fixed Length

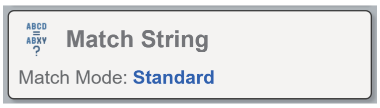
The **Fixed Length** filter sets the length that the string must be for the code to qualify as Read.

7-7-10 Read Qualification Settings

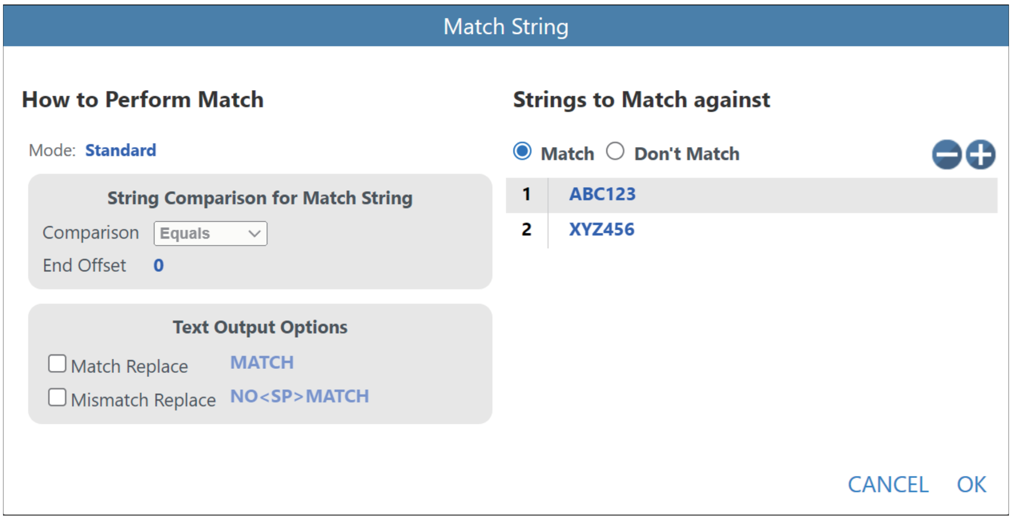
Item	Setting value [Job Default]	Description
Advanced	**[Unchecked],** Checked	Unchecked means that there are no special Read Qualification rules. The Decode Tool will **Accept-All** of the codes types that it has been set up to find and are the in ROIs.
+ / -	Addition and subtraction controls for rules.	Add or Delete a Qualifier Rule.
Symbology	**[All codes currently selected for this Decode Tool to read];** A subset of those codes	This setting allows the user to select a subset of all the codes. For example: The user can set it so that if it is a Data Matrix, the qualification logic will follow one path, and if a QR Code, the logic will follow a different path.
Data Filter	**[Accept All]**, See list below. Accept All Equals Starts With Ends With Contains Wildcard Fixed Length	Full set of common string comparison functions. Used to qualify on a code with specific string or substring content. See examples above.
Pattern	**[EMPTY_STRING]**, User Text	Examples: Starts with 123, 0 offset Ends with 456, 0 offset Contains ABC, 0 Offset Wildcard ???ABC*
Start Offset	**[0]** – String Length	0 means user is looking for this pattern starting at first character in the string
End Offset	**[0]** – String Length	0 means user is looking for this pattern starting at last character in the string minus the length of the comparison string
Wildcard Character	**[*]**	Allows matching to a pattern with unknown amount of characters somewhere in the string
Placeholder Character	**[?]**	Allows matching to a pattern with known set of characters at known location in the string. A **?** would be entered for each expected character.

7-7-11 Decode Tool Match String Dialog

If the code has passed Read Qualification, it is passed to Match String for partial for full string Match testing as the final qualification gate. The Match String function can be either Disabled or Standard. If the user clicks on Standard, the Match String Dialog opens up.



Match String Dialog



The left side of the dialog is used to set up **"How to Perform Match"**.

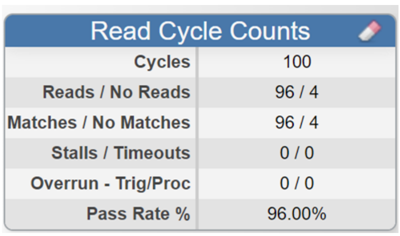
The **String Comparison for Match String** sections use the same exact String functions described above for Read Qualification.

The **Text Output Options** defines if the code string should replace by a MATCH of NO MATCH string. The user can substitute their own text in place of MATCH and NO MATCH.

The right side of the dialog is a list of the **Strings to Match Against**. The comparison is normally done as a Match, but the user can set it so that Don't Match is the result that should pass (i.e. the string should "not" be one of these).

Note 1: There may be multiple strings with very different content that are sent down from the Read Qualification stage. That is ok. All possible strings should be listed in this table and the Match Function will consider all of them.

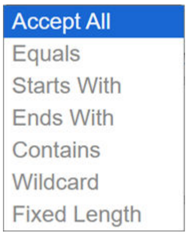
Note 2: Match / No Match counts will appear in the Read Cycle Counts report if Matching is enabled for one of the Decode Tools. If Match is not enabled, only Read / No Read will appear.



Read Cycle Counts	
Cycles	100
Reads / No Reads	96 / 4
Matches / No Matches	96 / 4
Stalls / Timeouts	0 / 0
Overrun - Trig/Proc	0 / 0
Pass Rate %	96.00%

7-7-12 Match String Settings

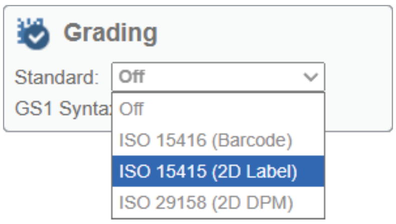
Item	Setting value [Job Default]	Description
Mode	**[Disabled]**, Standard	Off by default Standard is the only current option.

Item	Setting value [Job Default]	Description
Comparison	**[Accept All]** 	Full set of common string comparison functions. See examples above
Start Offset	**[0]** – String Length	0 means user is looking for this pattern starting at first character in the string
End Offset	**[0]** – String Length	0 means user is looking for this pattern starting at last character in the string minus the length of the comparison string
Wildcard Character	**[*]**	Allows matching to a pattern with unknown amount of characters somewhere in the string
Placeholder Character	**[?]**	Allows matching to a pattern with known set of characters at known location in the string
Match Replace	**[MATCH],** Any user text	If option is selected, the actual code string will be replaced by the Match Replace string in the output
Mismatch Replace	**[NO MATCH],** Any user text	If option is selected, the actual code string will be replaced by the Mismatch Replace string in the output
Match Option	**[Match],** Don't Match	Allows user to set Matching to pass on either Match or Mismatch
	Function	Add and Delete Sting from Match List
Match String List	User Input String List	List of all strings to Match (or Don't Match) against

7-7-13 Decode Tool Quality Score Grading

Overview

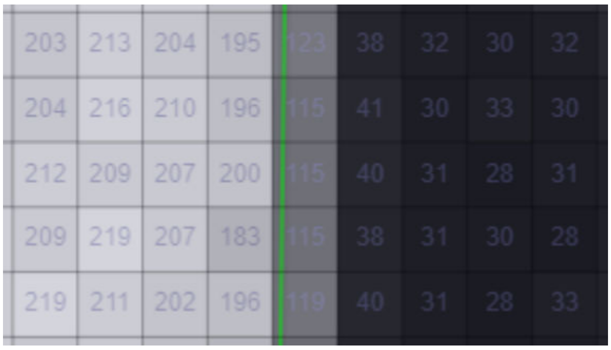
The Decode Tool provides an option to grade the final qualified target code against the three main ISO standards: 15416, 15415, and 29158. Only a code that makes it past all qualification gates will be graded.



Key Point: Calibration is not supported without a Verification license, so this tool can only be used for "print or process" validation and not full ISO Verification.

To achieve the best results for “validation” purposes, the user can approximate calibration for 15416 and 15415 by setting the Capture up on a black and white printed label on paper.

Adjust the Capture Exposure and Gain so that the dark cells are approximately 10-20 grey levels and the light background is approximately 210 grey levels. Note that you can zoom all the way in on an image and see the grey values for each pixel. The same is true for DPM. Set the Capture near these values.



Operation

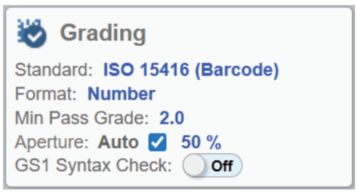
Within the Verification dialog, the user is able to select the ISO standard. The user can also set a Pass/Fail threshold for grading. If the grade, or code quality, is below this value, the Decode Tool will fail, which in turn will cause the Read Cycle to fail.

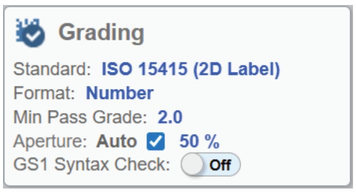
Normal use in reading applications is to set the Pass/Fail threshold to 0.0 so that Verification will not cause a read cycle failure, and instead will include the Verification Report in the output string, allowing the host to monitor print quality while reading.

There are three options for grading, selectable from the Grading dropdown list.

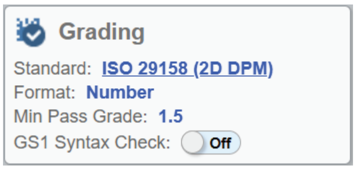
- **ISO 15416 –** is used for 1D Barcodes. Only UPC/EAN, Code 128, and Code 39 can be graded.
- **ISO 15415 –** is used for 2D Labels where strict grading is required. Only Data Matrix and QR Codes can be graded.
- **ISO 29158** is used for Direct Part Marks. It is also the best method for obtaining realistic grades from labels that reflect the actual reading capabilities of a normal code reader. Only Data Matrix and QR Codes can be graded.

- **ISO 15416, 15415 Grade Format –** ISO 15416 and 15415 provide a letter grade A - F, by default. The user can choose number format as an alternative. The numeric grade will vary from 4.0 – 0.0 but only displays in whole numbers.
- **ISO 15416, 15415 Aperture –** ISO 15416 and 15415 allow the user to set the Aperture as well. The aperture value range is 0-100% and is a percentage of the symbol cell size. 50% is the default.





- **ISO 29158 Grade Format –** Per the final standard, ISO 29158 provides a number grade by default. The numeric grade will vary from 4.0 – 0.0 and reporting down to the 1/10 place. The user can select Letter format as well. The system will output A-F, but does not show precision provided by the number format.
- **ISO 29158 Aperture –** There is no user setting for Aperture. ISO 29158 uses both a 50% and 80% aperture internally when it runs. The result it returns is the higher of the two scores.



7-7-14 Grading Settings

Item	Setting value [Job Default]	Description
Standard	**[Disabled]**, ISO15416, 15415, 29158	ISO 15416 is used for UPC/EAN, Code 128, and Code 39 barcodes. ISO 15415 is used for Data Matrix and QR Code Labels where strict grading is required. ISO 29158 is used for Data Matrix and QR Code DPM codes and is also the best method to obtain realistic grades from labels that match the reading capabilities of a normal code reader.
Format	**[Numeric]**, Strict Integer (15415 only), Letter	Numeric is default grading output for ISO 15415 ISO 15416, and ISO 29158. 4.0 - 0.0. This outputs the grade in decimal. For complete adherence to ISO 15415 reporting, the user should select Strict Integer. Letter converts 4.0 to 0.0 to A – F.
Min. Pass Grade	0.0 –4.0 **[2.0]** – for 15416 and 15415 **[1.5]** – for 29158	Pass/FailThreshold set by the user. The user is able to set a Pass/Fail threshold for grading. If the grade is below this value, the Decode Tool will fail, causing the Read Cycle to fail. Normal use in reading applications is to set the Pass/Fail threshold to 0.0 so that Verification will not cause a read cycle failure, and will instead include the Grading Report in the output string, allowing the host to monitor print quality while reading.
Aperture with Auto Enabled (Checked) (0 to 100% of the smallest code element)	0 - 100 **[50] -** for 15416 and 15415 **[N/A] -** for 29158	15416 and 15415 use 50% as default. 29158 uses 50% and 80% internally.
Aperture with Auto Disabled (Not Checked)	0 - 100 **[6] -** for 15416 and 15415 **[N/A] -** for 29158	Fixed aperture setting. With px displayed the aperture is measured in pixels. 0 will disable fixed aperture and enable Auto Aperture. 1 – 100 px (pixels)
GS1 Syntax Check	**[Off]**, On	Enables GS1 Syntax Checking

Grading Results Summary Display

When running in Setup Mode, the UI displays the Overall Grade for each Decode Tool within the step on the left side of the screen. The display will show either a letter grade or a numeric grade, depending on the setting.

If the user clicks on the overall grade, the detailed grading results are displayed. The set of tests performed by the three standards vary.

Reference Decode, which each have to pass to move on to the detailed tests, is shown at the top of the display. This is followed by the detailed test scores, and then the Overall score at the bottom. The Overall score is set as the minimum value of all the detailed tests.

Note: The current implementation of Verification on the VHV5-F is not calibrated. This means that the Contrast and Reflectance scores for ISO 15416 and 15415 depend on the user setting up a high-contrast black-and-white image to begin with as described in the Overview above. For ISO 29158, which requires both target calibration and part calibration, Minimum Reflectance is currently left out of the overall score calculation.

Grading Results Detail Display

ISO/IEC 15416

Verification Grades		
Overall	3.2	79
Decode	4.0	100
Edge Determination	4.0	100
Quiet Zone	4.0	100
Decodability	4.0	86
Defects	4.0	0
Minimum Edge Contrast	4.0	53
Minimum Reflectance	4.0	2
Modulation	3.2	62
Symbol Contrast	4.0	85

ISO/IEC 15415

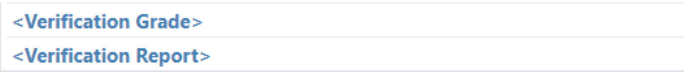
Verification Grades		
Overall	4.0	100
Decode	4.0	100
Axial Non-Uniformity	4.0	2
Contrast	4.0	72
Fixed Pattern Damage	4.0	100
Grid Non-Uniformity	4.0	11
Modulation	4.0	100
Reflectance Margin	4.0	100
Unused EC	4.0	83

ISO/IEC 29158

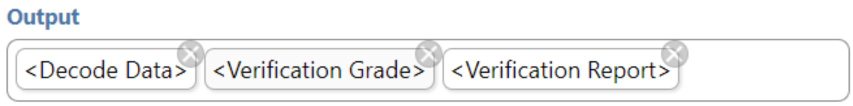
Verification Grades		
Overall	2.9	72
Reference Decode	4.0	100
Axial Non-Uniformity	4.0	2
Cell Contrast	4.0	55
Cell Modulation	2.9	72
Fixed Pattern Damage	3.8	95
Grid Non-Uniformity	4.0	19
Minimum Reflectance	4.0	100
Unused EC	4.0	100

Grading Results Output

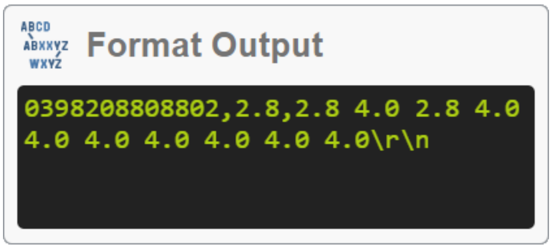
The summary Verification Grade and the full Verification Report can be added to the Output string that is created by each Decode Tool. This is done by clicking on the following items from the Output picker.



The output string format will resemble the following.



The actual output string will look like the following.



Verification Report

Following is the content and order of the output from each ISO report. The Overall Grade is the first piece of data in the report. Each result in the report is separated by a SPACE.

Order of Data in Report		
ISO 15416	**ISO 15415**	**ISO 29158**
Overall Grade	Overall Grade	Overall Grade
Reference Decode	Reference Decode	Reference Decode
Decodability	Axial Non-Uniformity	Axial Non-Uniformity
Defects	Contrast	Cell Contrast
Edge Determination	Fixed Pattern Damage	Cell Modulation
Minimum Edge Contrast	Grid Non-Uniformity	Fixed Pattern Damage
Min Reflectance	Modulation	Grid Non-Uniformity
Modulation	Reflectance Margin	Minimum Reflectance
Quiet Zone	Unused ECC	Unused ECC
Symbol Contrast		

ISO 15416 Tests (1D Barcodes)

- Overall Grade – Lowest of any of the subsequent tests
- Reference Decode – Test if the barcode decodes with ISO reference decoding algorithm
- Decodability - The proportion of the available margin before improperly decoding characters within the symbol. This measurement is based off the individual bar and space elements within a character and their deviations from thresholds used to identify characters.
- Defects (score) - Irregularities found within elements and the quiet zones measured in terms of element reflectance non-uniformity
- Edge Determination — Percentage value of minimum edge contrast. Edge Contrast is the difference between the bar reflectance and space reflectance of two adjacent elements.
- Min Edge Contrast — Percentage value of minimum edge contrast. Edge Contrast is the difference between the bar reflectance and space reflectance of two adjacent elements.

- Min Reflectance — Percentage value of reflectance of darkest bar.
- Modulation — The ratio of the minimum edge contrast to symbol contrast.
- Quiet Zone — Fails if there is a violation in the quiet zone region before the leading or trailing bar. The required quiet zones are symbology dependent and can be found in the symbology specifications.
- Symbol Contrast — Is the difference between the highest and the lowest reflectance values in a scan reflectance profile

ISO 15415 Tests (2D Labels)

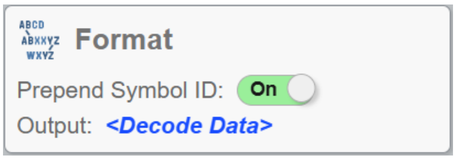
- Overall Grade - Lowest of any of the subsequent tests
- Reference Decode - Test if the 2D codes decodes with ISO reference decoding algorithm
- Axial Non-Uniformity - A measurement of the difference between the printed size of the rows and columns in a matrix.
- Contrast - The difference in percent of the maximum and minimum reflectivity in the inspection area.
- Fixed Pattern Damage - Measurement of non-uniformity in the quiet zone and in the locator and clock tracks
- Grid Non-Uniformity - This measurement is a delta of the difference of the measured grid in relation to the ideal grid formed from the four sides of the Data Matrix.
- Modulation - A measurement of the uniformity of the contrast of the dark areas and the light areas of the Data Matrix
- Reflectance Margin - Degree to which the cells are correctly distinguishable as black or white in comparison to the threshold.
- Unused Error Correction — The amount of error correction remaining after applying the reed Solomon error correcting algorithm and successfully decoding the symbol expressed as a percentage of the error correction contained within the symbol.

ISO 29158 Tests (2D DPM and General Labels)

- Overall Grade - Lowest of any of the subsequent tests
- Reference Decode - Test if the 2D codes decodes with ISO reference decoding algorithm
- Axial Non-Uniformity - A measurement of the difference between the printed size of the rows and columns in a matrix.
- Cell Contrast - The difference in percent of the center of the distribution of the light cells of the 2D Code versus the center of the distribution of the dark cells.
- Cell Modulation - A measurement of the uniformity of the contrast of the dark areas and the light areas of the Data Matrix
- Fixed Pattern Damage - Measurement of non-uniformity in the quiet zone and in the locator and clock tracks
- Grid Non-Uniformity - This measurement is a delta of the difference of the measured grid in relation to the ideal grid formed from the four sides of the Data Matrix.
- Minimum Reflectance – This measurement describes the brightness difference between the bright modules and the determined brightness of the bright modules in the calibration template.
- Unused Error Correction — The amount of error correction remaining after applying the reed Solomon error correcting algorithm and successfully decoding the symbol expressed as a percentage of the error correction contained within the symbol.

7-7-15 Decode Tool Output Formatting

Constructing the Decode Tool Output String



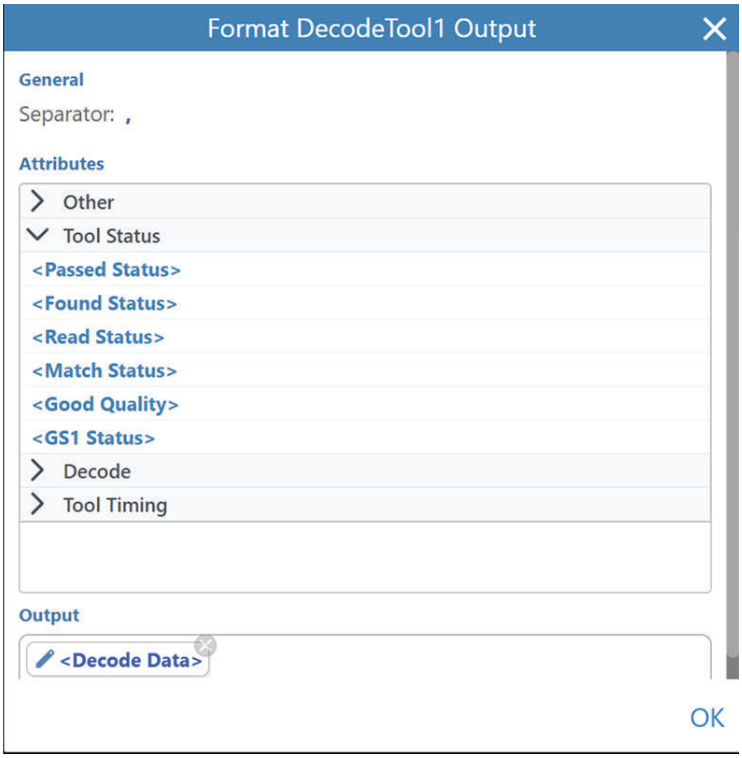
The last function in the Decode Tool is Output. Output is used to compose the data string that is sent out from the Decode Tool to the Read Sequence. Data strings from all Decode Tools are appended into the overall output string result that will be sent at the end of the Read Cycle to the host.

By default, the Output for each Decode Tool contains the <Decode Data> field. <Decode Data> is the string contents of the code that has just been read.

Users can choose to prepend the unique Symbology Identifier for each specific code type to the beginning of the string. **]d1** for example is the Symbol ID for the standard Data Matrix code. **]d2** is the Symbol ID for a GS1 Data Matrix Code.

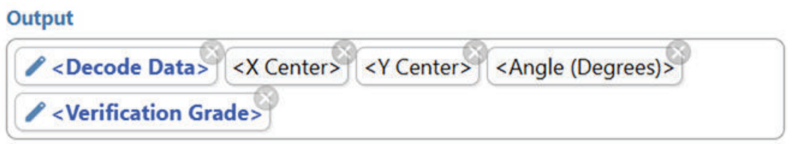
The Formatting Tool described below allows the user to further customize the decode tool output string by adding user text, additional attributes of the code itself such as its X,Y, and Angle, and performance metrics for the Decode Tool such as decode time.

1. Click on <Decode Data> to open up the output string editor. The current content fields of the string are listed in the Output area.

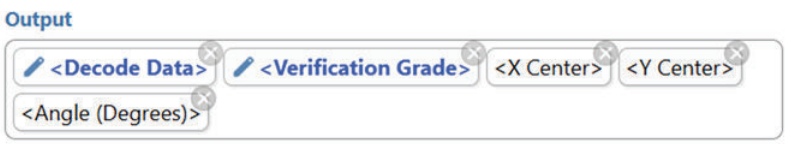


2. Append additional data to the string by clicking the desired attribute in the Other, Tool Status, Decode, or Tool Timing categories. That field will automatically appear at the end of the string in the Output area.
3. A user-defined separator is automatically inserted between each field as it is added.
   Note: There are three exceptions to this. No separator is inserted before or after <User Defined Text>, <SP>, or <TAB>. This allows the user the most control over creating a custom string.
4. The order of the fields in the string can be changed by dragging them to new locations in the field list.
5. Any data field, including <Decode Data>, can be deleted from the Decode Tool Output string by clicking on the X for that field.
6. Any data field that is a string will show up in blue. This means the user can click on it and Parse the string. See example 3.

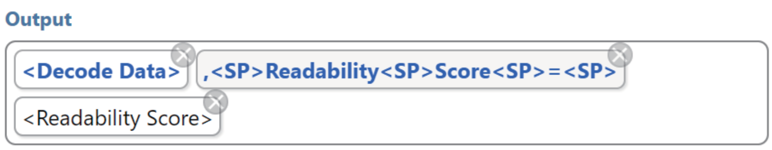
Example 1: This example shows what Output would contain if the user chose **Decode Data, X, Y, Angle, and Verification Grade** from the attributes lists.



Example 2: If the user wanted the Verification Grade second in the list instead, they would just click, drag, and drop it between <Decode Data> and <X Center>, producing the following:



Example 3: This example shows how the <User Defined Text> field is used. Clicking on that field allows the user to change the text. It was changed to “Readability Score" as shown below.



The output from the Decode Tool is now:

```
2037455, Readability Score = 83\r
\n
```

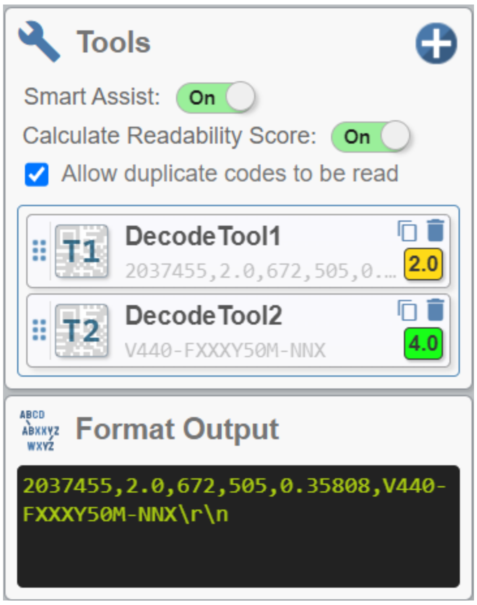
Example 4: This example shows how the string fields that show as blue in the Dialog can be clicked on and then be parsed so only a substring is sent out.

Parsing depends on the user setting a Start and End Index into the String. Index 0 is the first character, Index 1 is the second character, and so on.

Examples:

- Setting Start Index = 0 and End Index = -1 is the default. This will send out the entire string.
- Setting Start Index = 0 and End Index = 0 will send out just the first character.
- Setting Start Index = 0 and End Index = 5 will send out the first six characters (index 0,1,2,3,4,5)
- Setting Start Index = 2 and End Index = 7 will also send out six characters starting with the third character (**0,1**,**2,3,4,5,6,7**)

Key Point: All Decode Tool Data Strings are sent up to the Read Sequence where they are automatically appended into the final Read Cycle Output String. The custom string from each Decode Tool can be seen both in the Decode Tool in the Tools Step section, and as part of the final string in the Format Output section.



See the table below for all the data/attributes that can be added into the Decode Tool output string, including User-Defined Text.

Decode Tool Format Output Settings

Item	Setting Value [Job Default]	Description
Prepend Symbol ID	**[Off]**, On	When turned on, the system will prepend the unique Symbology Indentifier for each specific code type to the beginning of the string. **]d1** for example is the Symbol ID for the standard Data Matrix code. Note that for Multicode Mode, it will prepend the Symbol ID for each code that it finds.

Decode Tool Format Output Result Options

Item	Description/Content
Other (User Text and General Text Formatting)	
User Defined Text	String to be inserted by the user
<SP>	Space is inserted
<TAB>	Tab is inserted
Tool Status – Pass fail status of the Decode Tool	
Passed Status	Decode Tool Status. Code was found, read, and matched (if enabled). Passed = **TRUE**. Failed = **FALSE**
Found Status	Found means that a code was found that was one of the target symbology types selected by the user, and it was in one of the ROIs set up by the user. Passed = **TRUE**. Failed = **FALSE**
Read Status	Read means that a code was found, and then it passed the Read Qualification step. Passed = **TRUE**. Failed = **FALSE**
Match Status	Matched means that a code was found, passed the Read Qualification step, and finally that the full string content matched user set match string. Passed = **TRUE**. Failed = **FALSE**
Good Quality	Good Quality means that code qualified completely and passed.
Decode Data – Data generated by X-Mode specific to the code that was read.	
Symbology Type	Symbology Type. Data Matrix, Code 93, etc.
Decoded Data String	Actual string date contained in the code
Polarity	Dark on Light = **TRUE**. Light on Dark = **FALSE**
X1, Y1, X2, Y2, X3, Y3, X4, Y4 (pixels)	XY pixel coordinates of the four corners of the code corresponding the green rectangle drawn on the code. 1= Bottom Right, 2 = Bottom Left, 3 = Top Left, 4 = Top Right. Note that relationship stays relative to the angle of the code, not the code on the screen. Coordinate system reference: The upper left corner of the screen is considered 0,0 in pixel coordinates.
Readability Score	Outputs readability score 1-99 using quick test for code quality.
X Center Y Center (pixels)	X, Y coordinates of center of code. Corresponds to green rectangle drawn on the code. Coordinate system reference: The upper left corner of the screen is considered 0,0 in pixel coordinates.
Width, Height (pixels)	Width and Height of Code
Angle (Radians)	Angle of Code in Radians
Angle (Degrees)	Angle of Code in Degrees
Verification Grade	Letter or Number Grade depending on Format Setting A-F or 4.0 – 0.0
Verification Report	Output String with Letter or Number Grades for all verification tests. Overall Grade comes first, Reference Decode Second, and then all other tests as shown in the Verification Grade Display.
Verification Values	Output String with Calculated Value for all verification tests. Overall Grade values comes first, Reference Decode second, and then all other tests as shown in the Verification Grade Display. Values range from 0 to 100.

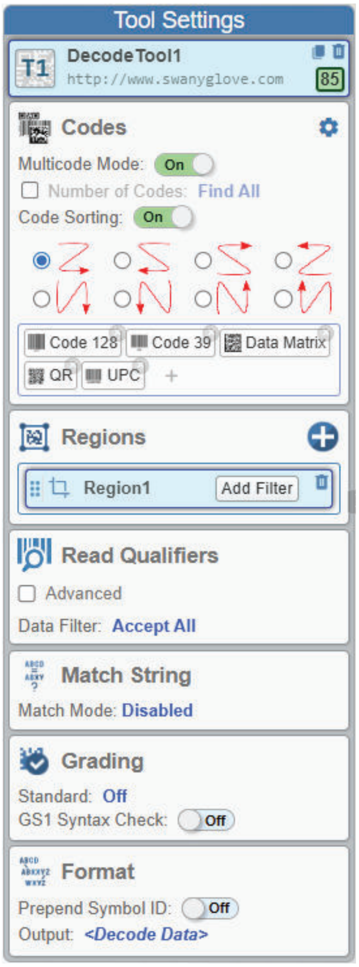
Item	Description/Content
Verification Summary	Verification Summary – Single string showing the relevant verification data required by many recording systems. Format: *<DPM (if ISO/IEC 29158)><overall_grade>/<aperture in mils>/<wave-length>/<angle>*
Verification Setup Notes	Contents of the custom setup field filled in by the user with any extra setup notes.
Verification is Calibrated	Is Calibrated = **TRUE**. Is not Calibrated = **FALSE**.
GS1 String	If GS1 Syntax Checking is turned on, it will output the decoded string along with showing the actual application identifiers in parentheses. For Example: 0100301162001165211000006628899417271031104119 46 will be output as (01)00301162001165(21)10000066288994(17)271031(10)411946.
Tool Timing	
Time Localize (µs)	Time spent searching for possible locations of the target code in the ROI or Field of View
X-Mode Decode Time (µs)	Time spent evaluating all possible locations to determine if they are in fact a code, and then additional time spent to do the decode.

7-7-16 MultiCode Mode

Multicode Mode

Multicode Mode Processing

Multicode Mode is a special mode of the Decode Tool that allows a single decode tool to read more than one code. It is an advanced feature designed to handle scenarios where multiple barcodes are present within a single field of view, and their positions or types are not consistent. This mode is particularly useful in applications such as bin picking or scanning packages on a conveyor belt.



When set to Multicode Mode, the Decode Tool will continue to run until the predetermined number of barcodes have been found, or until the Decode Tool quits, or times out.

For a barcode to be considered successfully decoded in Multi-code Mode, it will still need to pass all the normal Qualification Gates:

- It must be one of the predefined barcode types.
- It must fall within the designated Regions of Interest (ROI), if specified.
- It must satisfy the conditions set by the Read Qualifier.
- It must correspond with an entry in the Match String Database.
- When Grading and/or GS1 Syntax is enabled, all barcodes that qualify and match up to this point in processing will be graded and/or checked for proper GS1 syntax.

● Multicode Mode Output Format

Output data for all codes read in Multicode Mode are appended into a single data string.

The Output format for each code is the same. For instance, if the user has chosen to output <Decode Data>, <X Center>, <Y Center>, and <Angle>, then each decoded barcode will be appended to the string in this format, one after the other.

● Multicode Mode Output Order

Code Sorting – When Code Sorting is turned on, users can specify the order in which the barcode data is sorted in the string. The default setting is for code data to be reported from the top left to the bottom right of the field of view.

If Code Sorting is turned off, the output order will be unpredictable. It will be in the order in which X-Mode found the codes during the read cycle.

If **Advanced** is selected under **Read Qualifiers**, the output order will be the order of the multiple Read Qualifiers the user has set up with **ReadQualifier1** first, **ReadQualifier2** second, and so on.

7-8 Scripting Step

7-8-1 Overview

WebLink versions 1.2 and above support **Scripting**. Scripting allows the user to program custom functions that override the standard **Format Output Step**, as well as how the **Digital Outputs** are set at the end of the read cycle. Please see **Chapter 9 - Scripting** for details.

7-9 Read Sequence End

7-9-1 Overview

As described in the Read Cycle section, the Read Cycle completes differently for each type of Job.

Continuous Mode/Presentation Mode – Read Cycle Processing ends only when the Decode Tools all Qualify. Processing will continue indefinitely waiting for parts to appear in front of the camera and this occurs.

Start/Stop Mode – Read Cycle Processing ends only when the the Stop Command is received.

Triggered Mode – Ends once all Decode Tools have Qualified, or have been set to NOREAD after searching in all available Captures in the Capture List. Here, if all Decode tools have succeeded, all pending Captures will be cancelled.. If any of the Decode Tools have not yet succeeded, the read cycle will continue until those Decode Tools have processed all available images have either read or failed to read.

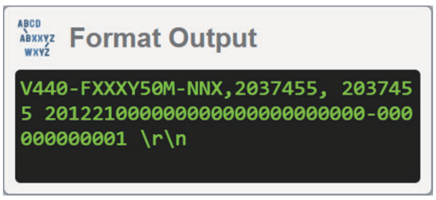
Once Read Cycle Processing ends the Read Sequence will move to the final two steps which are to format the output data, and then send the results through RS-232, TCP/IP and the Protocol Assembly. Finally, it will update the Digital outputs.

7-9-2 Read Sequence Data Format Output

Overview

In the next to last step in the Read Cycle, the formatted output string from each Decode Tool is passed to the Read Cycle Format Output step. Here, the final output string is constructed prior to being transmitted out as the final Read Cycle result.

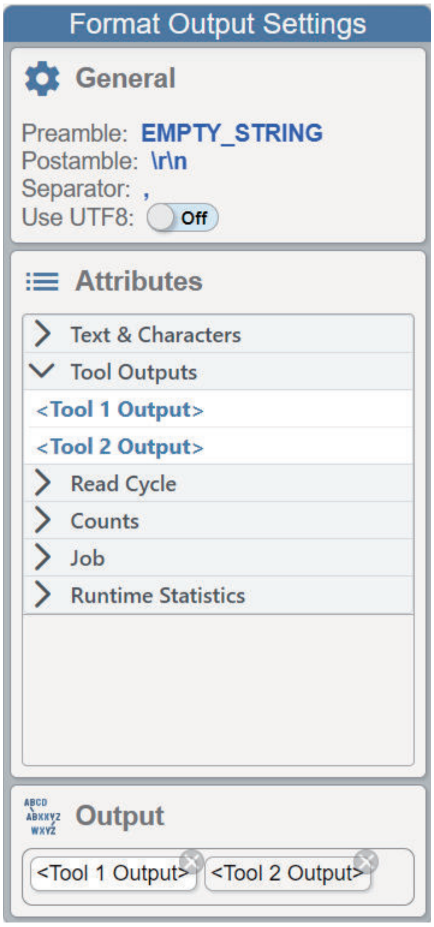
By default, each Decode Tool's string, <Tool Output> is appended into the final result string. The user also has the capability to add user defined text as well as Read Cycle specific data such as Read Time into the final string.



The Format Output Dialog described below allows the user to further customize the final result output string by adding User Text, detailed Pass/Fail data, Counts, Timing and performance metrics for the Read Cycle. Trigger and Result Time Stamps can be added as well.

Read Cycle Format Output Dialog

The user appends additional data to the string by clicking the desired attribute in the Tex t& Character, Tool Outputs, Read Cycle, Counts, Job, and Runtime Statistics categories. That field will automatically appear at the end of the string in the Output area.

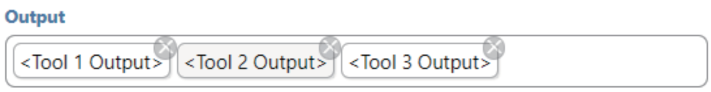


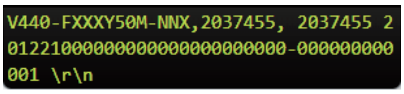
The user can set a predefined Preamble, Postamble and separator which will automatically inserted in the final result string.

The order of the fields in the string can be changed by dragging them to new locations in the field list.

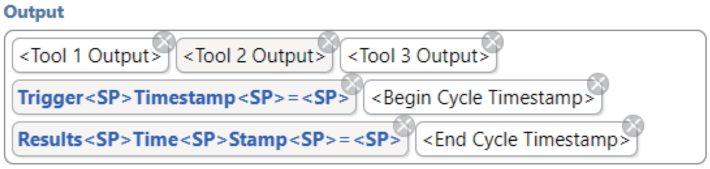
Finally, any piece of data, including <Tool Output>, can be deleted from the Output string by clicking the X for that field.

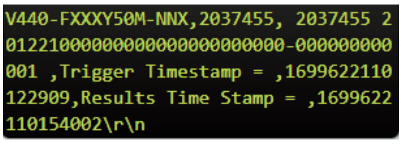
Example 1: This example shows what final Read Cycle Output would contain by default if the Job contained three Decode Tools.





Example 2: This formatting example shows custom text strings and timestamp data added for that read cycle.





7-9-3 Read Cycle Format Output Settings

Item	Description/Content
General string formatting and user-insertable text	
Preamble	String placed at beginning of result
Postamble	String placed at beginning of result
Separator	Separator placed between elements
Use UTF8:	Symbols such as those encoded with Japanese characters are in a Unicode format. The standard code reader specification states, however, that the reader has to output ANSI strings. The problem is that the ANSI format does not show the UNICODE characters in a recognizable form. This setting allows the user to switch between sending and displaying strings as either ANSI when off, or UTF8 when on, which allows the user to see Unicode character strings in their native form.
User-Defined Text and Characters	
User Defined Text	String to be inserted by the user
<SP>	Space is inserted
<TAB>	Tab is inserted
Tool Outputs	
Tool 1 Output	Final Formatted Output string from Decode Tool1
...	
Tool N Output	Final Formatted Output string from Decode Tool N, last in list
Read Cycle	
Passed	Read Cycle Passed = **True** Read Cycle Passed = **False**
All Present (Found)	All Codes Present = **True** Not All Codes Present = **False**
All Read	All Codes Read = **True** Not All Codes Read = **False**
All Match	All Codes Match = **True** Not All Codes Match = **False**
All Good Quality	All Codes Good Quality = **True** Not All Codes Good Quality = **False**
Number of Qualified Codes	This is the total number of codes read by all Decode Tools during this read cycle. This value is useful for Multicode Mode to know how many actual codes have been found by that one Multicode Tool.
Cycle ID	Number of Cycles since Camera Power Up/Reboot

Item	Description/Content
Begin Cycle Timestamp (μs)	Timestamp of when Trigger was received by the reader. The value is microseconds since Jan. 1, 1970.
End Cycle Timestamp (μs)	Timestamp of when the Result is sent by the reader. The value is microseconds since Jan. 1, 1970.
Trigger Overrun	Trigger Overrun has Occurred = **True** No Trigger Overrun Issues = **False**
Process Overrun	Process Overrun has Occurred = **True** No Process Overrun Issues = **False**
Duration (μs)	Entire time of the current read cycle
Capture Time (μs)	Time spent on all Captures required in the current read cycle
Preprocess Time (μs)	Time spent on all Image Preprocessing in the current read cycle
Read Time (μs)	Time spent on all Decode Tool X-Mode processing in the current read cycle
Overhead Time (μs)	Time spent on other processing in the cycle such as reporting
Counts – Summary Counts (Batch Counts)	
Total Read Cycles	Total number of Read Cycles run since counts last cleared
# Cycles Failed	Total number of Failed Read Cycles since counts last cleared
# Cycles Passed	Total number of Passed Read Cycles since counts last cleared
# Reads	Total number of Reads Cycles since counts last cleared
# No Reads	Total number of Failed No Read Cycles since counts last cleared
# Matches	Total number of Matches since counts last cleared
# No Matches	Total number of No Matches since counts last cleared
# Good Quality	Total number of Good Quality counts since last cleared
# Bad Quality	Total number of Bad Quality counts since last cleared
Pass Rate (%)	Pass Rate % = # Passed/Total Read Cycles
Job	
Job Name	Name of the current loaded Job
Job Slot	Slot where the currently loaded Job is stored
Runtime Statistics	
Part Per Minute (PPM)	Running average expressed in Parts Per Minute
Cycle Timeout (μs)	
Min, Current, Max Capture Time Duration (μs)	Statistics showing Minimum, Current, and Maximum Capture Times since counts last cleared. (Time spent acquiring images. If multiple captures were required, it would include the total time for all captures.)
Min, Current, Max Capture Time Count	Statistics showing Minimum, Current, and Maximum Capture Counts since counts last cleared. (Shows how many actual captures were required for decode.)
Min, Avg., Max, Current Processing Time (μs)	Statistics showing Minimum, Average, Maximum, and Current Processing Time since counts last cleared. (Time spent performing actual Read/ Decode during the Read Cycle.)
Min, Avg., Max, Current Overall Cycle Duration (μs)	Statistics showing Minimum, Average, Maximum, and Current Cycle Durations since counts last cleared. (Time from Read Cycle Trigger to Read Cycle End.)
Min, Avg., Max, Current Overhead Time (μs)	Statistics showing Minimum, Average, Maximum, and Current Overhead Time since counts last cleared. (Time spent during Read Cycle on all other tasks other than Capture, Image Preprocessing, and Decoding. This includes setting IO, reporting, etc.)

Item	Description/Content
Min, Current, Max, Avg. Time Between Cycles (μs)	Statistics showing Minimum, Current, Maximum, and Average Time Between Cycles since counts last cleared. (Time spent between end of processing previous cycle and processing current. Shows efficiency of the read cycle. This will go to near 0 when fully pipelined.)
Min, Current, Max, Avg. Trigger Rate (μs)	Statistics showing Minimum, Current, Maximum, and Average Trigger Rate since counts last cleared. (Time from Read Cycle Trigger to next Read Cycle Trigger.)
Min, Current, Max, Avg. Total Cycle Time (μs)	Statistics showing Minimum, Current, Maximum, and Average Total Cycle Time since counts last cleared. (Time from Read Cycle Trigger to Read Cycle End.)
Min, Current, Max, Avg. Idle Time (μs)	Statistics showing Minimum, Current, Maximum, and Average Idle Time since counts last cleared. (Time spent not processing, waiting for next trigger.)

7-9-4 Read Sequence Data Transmit

The read cycle ends with reporting, where the final formatted output string is sent to the WebLink results screen, and out all active data channels (RS-232, TCP/IP, Ethernet/IP, PROFINET, etc.).

Digital Output signals indicating read cycle status such as Cycle Complete, Cycle Passed, Cycle Failed, Error are set at this exact time as well.

Key Point: If Digital Outputs are set to pulse mode, that processing for the next cycle will not be able begin until the output has been held on and then off for the set pulse time. Attention must be paid not to set these times excessively long.

7-10 The Output Step

7-10-1 Overview

The last step executed in the Read Cycle is the Output Step.

The Output Step allows the operator to configure the system to save Images and/or Cycle Reports during Runtime for archiving or debugging purposes.

Save to RAM - Image and Report data can be saved to RAM. It can be retrieved using the DDU which will copy it out of RAM and save it to an organized set of folders on the PC.

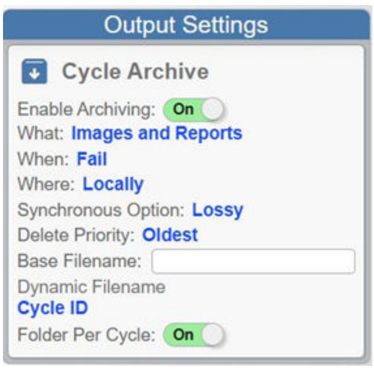
Save to FTP/SFTP Server - Image and Report data can also be saved to an FTP or SFP Server. Section 6-1-5 describes how to set up the VHV5-F reader to save to a Server. This section describes the different settings that allow you to save.

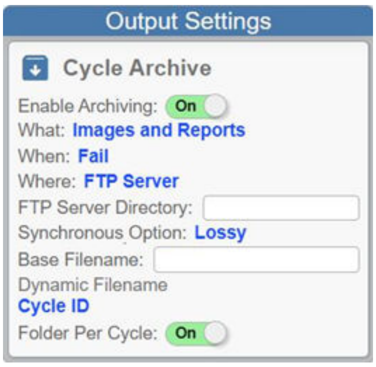
Note: Example Read Cycle Reports and guides for interpreting those reports are shown in **Appendix A**.

7-10-2 Output Dialog

Archiving must be enabled. It is off by default.

When Enabled, the user can configure the following parameters to determine what gets saved, under what condition it gets saved, and how the files are named. By default, when this section is enabled, files will be saved locally to RAM and can be retrieved using the DDU. The second option for where to save is to an FTP server.



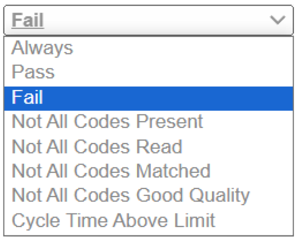


What to Save

What defines what to save. By default, both the Image and Cycle Report from a Read Cycle will be saved. The user can select Images or Cycle Reports only. The most common situation will be Images Only for the user to review problem decodes.

When, or under What Conditions, to Save

When defines what Read Cycle condition will cause the reader to save the Image and/or Cycle Report to RAM. By default, the condition to cause the save is a Read Cycle failure. The dropdown list gives the user much wide control over the condition for saving. The list is the same as what the operator is able to set for conditions to turn on the Digital Output.



Where to Save

"Where" defines where to save, either to RAM, or to an FTP Server. If FTP Server is selected, then the user is given an option to fill in for the **FTP Server Directory** name. The Directory should be pre-configured on the Server by the administrator.

File Control

The last three entries deal with file naming, as well as file management on the RAM.

● Delete Priority

Delete Priority deals with RAM file management. The camera RAM is used to save images and reports until the user requests the data to be uploaded to the PC. The size of the RAM allocated for storage is 500 MB. This will hold approximately 100 read cycles of data for the 5 MP camera, and more for the 2.3 MP. Once the RAM is full, newer reports will begin to overwrite the older ones.

The Delete Priority parameter is not shown for FTP/SFTP saving. Images stored to RAM and then sent to be saved over FTP are deleted immediately after the transfer is complete.

● Base and Dynamic File Name

The complete report file name consist of two strings concatenated together. The first is an optional static string called the **Base Filename**. This is defined by the operator and will remain fixed from cycle to cycle.

The second is a variable string called **Dynamic Filename**. The operator uses this field to select what will constitute the dynamic portion of the file name which will change from read cycle to read cycle thus creating a unique name for each cycle.

By default **Dynamic Filename** is set to the **Cycle ID**. The **Cycle ID** is a unique number. It is reset on camera power up and will continue to increment until the camera is shut down again. Any file saved with **Cycle ID** as part of the name will be different than all others for that interval.

The Dynamic portion can be set to the **Trigger Time Stamp**. The time stamp will always be unique if the camera is synced to a time server. If not, like Cycle ID, the time will be reset to factory time at power up.

Finally, it can be set to the actual **Decoded Output String**. Note that if the same code is being read over and over. This will not create a new unique file. The file will have the same name, and will be overwritten each time. In the same way, if the code fails to read and outputs "NOREAD", this will not be unique either. Each file will be named NOREAD and overwrite the previous.

● Folder Per Cycle

This option allows the user to choose the directory of the folder structure where the files will be saved. By default, this is set to Off. In this case, all files (both images and reports) from all read cycles will be saved into a single directory. This is ideal when, for example, trying to view all images at the same time using a File Explorer window.

When this option is set to Off, the results for each read cycle are saved to an individual folder or directory on the server under a main folder.

7-10-3 Output Step Settings

Item	Setting Value [Job Default]	Description
Enable Archiving	**[Off]**, On	Saving of Images and/or cycle reports.
What	**[Images and Reports]** Images Only Reports Only	Defines what should be saved for each Read Cycle.
When	Always Pass **[Fail]** Not All Codes Present Not All Codes Read Not All Codes Matched Not All Codes Good Quality Cycle Time Above Limit	Read Cycle result that prompts a report to be saved to RAM.

Item	Setting Value [Job Default]	Description
Delete Priority	**[Oldest],** Newest	Determines if system should overwrite the Oldest or Newest files in RAM when RAM becomes full when saving locally.
Base Filename	**[empty string]**, user text	User text which defines the first part of string representing the file name.
Dynamic Filename	None **Cycle ID** Time Stamp [Formatted Output]	Variable part of the string representing the file name. Note 1: Formatted Output can be the string created by Scripting. This allows user to give the file a custom-programmed file name. Note 2: The Time Stamp is based on the Time and Data inserted in the camera at time of manufacture, unless the Time is set in Device Page using Time Sync Dialog.
Folder Per Cycle	**[Off]**, On	This option allows the user to choose the directory of folder structure that the files will be saved under. By default, this is set to Off. In this case, all files (both images and reports) from all read cycles will be saved into a single directory. If On, the image and report from each read cycle will be stored together into a unique folder for that read cycle.

7-10-4 Image and Report Retrieval

Images and Reports are saved in RAM on the reader. The Omron Device Discovery Utility (DDU) is the tool to upload files for review on the PC.

Saved Cycle Storage

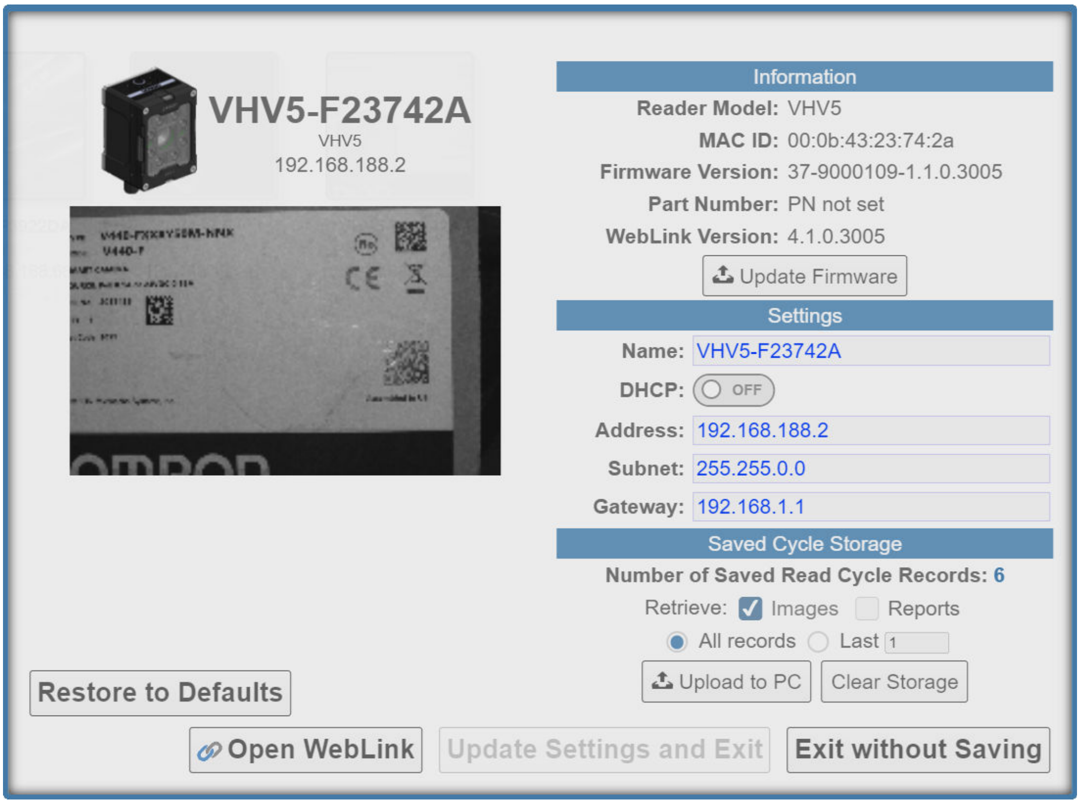
● Uploading Read Cycle Records to the PC

The DDU regularly checks the reader to determine if there are any Saved Read Cycle Records available for download from the camera to the PC. If records are present, their quantity is displayed.

Users should select whether they want to retrieve **Images**, **Reports**, or **both**.

Upon clicking the **Upload to PC** button, the records are compiled into a .zip file, transferred, and then saved in the PC's Downloads directory. After the transfer is complete, the records are automatically removed from the camera's RAM.

Additional controls allow the user to clear RAM storage. Users can also select how many of the records they would like to upload.



● File Naming Standard

■ Downloaded .zip Files

Downloaded files are .zip files containing all the data. The .zip file names have a fixed name format: **YearMonthDay_HourMinuteSecond_Camera- Name.zip**. See the example below.

Note: The Time and the Date for the .zip file are the based on the local time of the PC when the files were retrieved. This is the common convention. The same date and time stamp is seen under the Date Modified column.

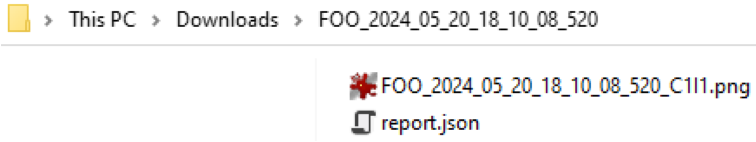
Name	Date modified	Type	Size
20240520_141015_VHV5-F23742A.zip	5/20/2024 2:10 PM	WinRAR ZIP archive	314 KB
20240520_140912_VHV5-F23742A.zip	5/20/2024 2:09 PM	WinRAR ZIP archive	1,708 KB
20240520_140738_VHV5-F23742A.zip	5/20/2024 2:07 PM	WinRAR ZIP archive	3,377 KB
20240520_140400_VHV5-F23742A.zip	5/20/2024 2:04 PM	WinRAR ZIP archive	569 KB

■ Contents of the .zip File

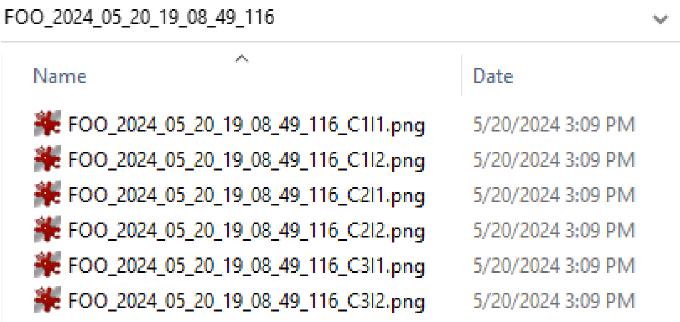
The.zip file includes one subfolder per cycle record. Each subfolder contains the image and/or report for that cycle. The folder and image and report names are generated by the camera reflecting the name defined by the user in the Output step.

Note: When the Timestamp is used as part of the file name, the Time and the Date are based on the UTC time of the camera when the read cycle was triggered.

The image name has an additional component that indicates which specific Capture is being referenced. The example below shows **C1|1**, which refers to Capture 1, Iteration 1.



An example with three Captures and 2 Iterations would look like the example below.



8

In-Line ISO/IEC Verifier

The following procedures are for VHV5-F readers that have a **Verification** license.

8-1 In-Line ISO/IEC Verification Overview

The VHV5-F, used for high-speed code reading, can also perform Code Quality Validation, fully-calibrated ISO/IEC Code Quality Verification, and GS1 Syntax Checking. The VHV5-F has the power to read and perform these additional functions directly on production lines (in-line) at rates up to 1,200 parts per minute.

8-1-1 Code Quality Validation vs. ISO/IEC Code Quality Verification

Code Quality Validation

Code Quality Validation (see **Decode Tool** section) is intended for process control. It can be used to provide real-time feedback on barcode print quality, allowing immediate adjustments to the printers or scanners just as problems begin to emerge. It uses ISO/IEC 15416, ISO/IEC 15415, and ISO/IEC 29158 algorithms to assess barcode quality, but does not mandate that the verifier be ISO/IEC-calibrated or that it employ ISO/IEC-specified lighting. The burden is placed on the user to determine how the verifier quality outputs map to the controllable facets of the production line printing or scanning processes. The Code Quality Validation feature is standard on all VHV5-F readers.

ISO/IEC Code Quality Verification

ISO/IEC code quality verification, the focus of this section, can also be used for process control, but its main purpose is to certify barcode quality against the ISO/IEC industry standards. This is a crucial step for manufacturers to demonstrate that their barcodes will be readable upon integration into customer supply chains. Full ISO/IEC-compliant verification requires that the verifier uses very specific mounting and illumination techniques, and that the system be calibrated using a controlled calibration card. One recommendation is the NIST calibration standard. Mounting and illumination is the focus of **section 8-2**. Calibration is the focus of **section 8-3**.

8-1-2 Verification Tool License Requirement

The **Verification Tool**, used for fully-calibrated ISO/IEC verification, is an advanced feature enabled via a **Verification License**. VHV5-F readers can be purchased with a Verification License preinstalled, or the license can be purchased at a later date and installed on any VHV5-F using the **Device Discovery Utility**. Note that the Verification License is unique for each reader, and is based on the reader's MAC address. The license comes at an additional cost.

8-1-3 ISO/IEC Verification Lighting and Calibration Requirements

There are three main ISO/IEC code verification standards, each targeted at a specific code type:

- ISO/IEC 15416:2016 – Used for 1D printed labels or high-contrast codes;
- ISO/IEC 15415:2011 – Used for 2D printed labels or high-contrast codes;
- ISO/IEC 29158:2020 – Used for 2D DPM codes, codes directly marked on the part using a variety of methods including laser etch, dot peen, ink jet, or engraving.

Each of the verification standards defines specific requirements for mounting the reader, for illuminating the codes, and for calibrating the system so it can accurately measure the key features that determine the readability or quality score of the barcode. The in-line verification system must be set up in accordance with the appropriate traceable ISO/IEC standard above to obtain certified results.

The table below provides a summary of the mounting, lighting, and calibration requirements for the three different standards. The sections following the table provide a detailed implementation guide.

ISO/IEC Standard	Reader Mounting Angle	Mounting Distance	Illumination	Required Calibration	Optional Calibration
ISO/IEC 15416:2016	90º (perpendicular to the code)	Achieves 6-8 pixels across a thin bar.	One-Directional (S) @ 45º Two-Directional (T) @ 45º Four-Directional (Q) @ 45º	Reflectance Calibration	Flat Field Correction
ISO/IEC 15415:2011	90º (perpendicular to the code)	Achieves 8-10 pixels across a single code cell.	Four-Directional (Q) @ 45º Four-Directional (Q) @ 30º Diffuse Coaxial (DOAL)	Reflectance Calibration	Flat Field Correction
ISO/IEC 29158:2020	90º (perpendicular to the code)	Achieves 8-10 pixels across a single code cell.	Four-Directional (Q) @ 30º Two-Directional (T) @ 30º One-Directional (S) @ 30º Diffuse Coaxial (DOAL) Diffuse Off-Axis (DOME)	Reflectance Calibration Part Calibration	N/A
	Tilted Coaxial Light (TCL) - Tilted relative to the code	Achieves 8-10 pixels across a single code cell.	Tilted Coaxial Light using built-in VHV5-F Illumination (TCL) Typically 60º (30º off 90) Do not exceed 45º.	Reflectance Calibration Part Calibration Perspective Correction	N/A

When the system is used for Code Validation rather than full ISO/IEC Code Verification, alternative configurations can be used that are simpler and less costly to set up.

The two suggested below allow full use of the internal camera lighting rather than relying on an external light source.

The options here are:
- Use TCL functionality with built-in VHV5-F illumination. (Reader mounted at angle to part).
- Use Polarizer filter with built-in VHV5-F illumination. (Reader mounted perpendicular to part).

Alternates for Code Validation	Reader Mounting Angle	Mounting Distance	Illumination	Required Calibration	Optional Calibration
Code Validation	Tilted relative to the part (20-30º off vertical) 90º (perpendicular to the code)	Achieves 8-10 pixels across a single code cell.	Tilted Coaxial Light using built-in VHV5-F Illumination (TCL) Built-in VHV5-F Illumination with Polarizer	Reflectance Calibration Part Calibration Perspective Correction when using TCL	Flat Field Correction

8-2 ISO/IEC Verification Mounting and Lighting

8-2-1 ISO/IEC 15416 / ISO/IEC 15415 (1D and 2D Labels) - Reader Mounting and Lighting Configurations

Reader Mounting

Mounting Angle - ISO/IEC 15416 and ISO/IEC 15415 specify that the reader be mounted perpendicular to the part plane at 90º so that the reader face and label face are parallel.

Mounting Distance - The mounting distance is determined by the camera optics, sensor resolution, and code size. The camera height should be set so that at an absolute minimum the thin bar of a 1D code is **~6 pixels wide (6 PPE)** so that one cell of a 2D matrix is **~8 pixels wide (8 PPE)**. Ideally, the camera and optics are chosen so the 1D code PPE is 8 pixels, and the 2D code PPE is 10 pixels.

Distance and Field of View to Determine Camera Model for Verification

Use the following tables to identify the Sensor/Lens combination that most closely matches the Verification application requirements. The tables below use the preferred PPE values for **Verification,** 8 pixels per thin bar (8 PPE) for 1D, and 10 pixels across a cell (10 PPE) for 2D. The wide lens is not recommended for verification applications.

Example: If the Code Type is 2D, and the Code Size 20 mils, the Medium Lens table below shows that a code up to 23.1 Mils can be verified at a distance of 150 mm, in a field of view of 113x71 mm.

- **2.3 MP Sensor Verification Tables**

2.3 MP - Medium Lens			
Minimum Element Size (Mils)			
Distance (mm)	Field of View (mm x mm)	1D Element (Mils)	2D Element (Mils)
100	79 x 49	13.0	16.2
150	113 x 71	18.5	23.1
200	147 x 92	24.1	30.1
250	181 x 113	29.6	37.0
300	215 x 134	35.2	44.0
350	248 x 155	40.7	50.9
400	282 x 176	46.3	57.9
450	316 x 198	51.9	64.8
500	350 x 219	57.4	71.8

2.3 MP - Narrow Lens			
Minimum Element Size (Mils)			
Distance (mm)	Field of View (mm x mm)	1D Element (Mils)	2D Element (Mils)
100	50 x 31	8.2	10.3
150	73 x 46	12.0	15.0
200	96 x 60	15.8	19.7
250	119 x 75	19.6	24.5
300	142 x 89	23.4	29.2
350	165 x 103	27.1	33.9
400	188 x 118	30.9	38.6
450	212 x 132	34.7	43.4
500	235 x 147	38.5	48.1
600	281 x 175	46.0	57.5
700	327 x 204	53.6	67.0
800	373 x 233	61.2	76.4
900	419 x 262	68.7	85.9
1000	465 x 291	76.3	95.3

2.3 MP - Long Lens			
Minimum Element Size (Mils)			
Distance (mm)	Field of View (mm x mm)	1D Element (Mils)	2D Element (Mils)
100	31 x 20	5.1	6.4
150	46 x 29	7.5	9.4
200	60 x 38	9.9	12.3
250	75 x 47	12.2	15.3
300	89 x 56	14.6	18.2
350	103 x 65	17.0	21.2
400	118 x 74	19.3	24.1
450	132 x 83	21.7	27.1
500	147 x 92	24.0	30.1
600	175 x 110	28.8	36.0
700	204 x 128	33.5	41.9
800	233 x 146	38.2	47.8
900	262 x 164	42.9	53.7
1000	291 x 182	47.7	59.6

● 5.0 MP Sensor Verification Tables

5.0 MP - Medium Lens			
Minimum Element Size (Mils)			
Distance (mm)	**Field of View (mm x mm)**	**1D Element (Mils)**	**2D Element (Mils)**
100	92 x 77	11.7	14.7
150	131 x 110	16.7	20.9
200	171 x 143	21.8	27.2
250	210 x 176	26.8	33.5
300	250 x 209	31.8	39.8
350	289 x 242	36.9	46.1
400	329 x 275	41.9	52.4
450	368 x 308	46.9	58.6
500	408 x 341	51.9	64.9

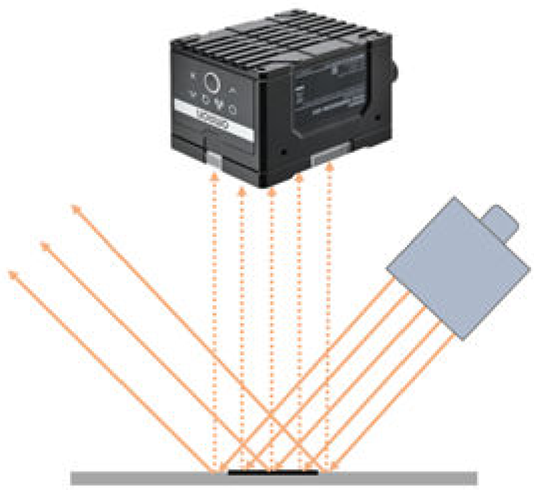
5.0 MP - Narrow Lens			
Minimum Element Size (Mils)			
Distance (mm)	**Field of View (mm x mm)**	**1D Element (Mils)**	**2D Element (Mils)**
100	58 x 49	7.5	9.3
150	85 x 71	10.9	13.6
200	112 x 94	14.3	17.9
250	139 x 116	17.7	22.1
300	166 x 139	21.1	26.4
350	193 x 161	24.5	30.7
400	219 x 184	28.0	35.0
450	246 x 206	31.4	39.2
500	273 x 229	34.8	43.5
600	327 x 273	41.6	52.0
700	380 x 318	48.5	60.6
800	434 x 363	55.3	69.1
900	488 x 408	62.1	77.7
1000	541 x 453	69.0	86.2

5.0 MP - Long Lens			
Minimum Element Size (Mils)			
Distance (mm)	Field of View (mm x mm)	1D Element (Mils)	2D Element (Mils)
100	37 x 31	4.7	5.8
150	53 x 45	6.8	8.5
200	70 x 59	8.9	11.2
250	87 x 73	11.1	13.8
300	104 x 87	13.2	16.5
350	120 x 101	15.3	19.2
400	137 x 115	17.5	21.8
450	154 x 129	19.6	24.5
500	171 x 143	21.7	27.2
600	204 x 171	26.0	32.5
700	238 x 199	30.3	37.9
800	271 x 227	34.6	43.2
900	305 x 255	38.8	48.5
1000	338 x 283	43.1	53.9

ISO/IEC 15416 Lighting

ISO/IEC 15416 specifies a reference lighting geometry with a single light source at 45º to the printed surface and with the camera perpendicular to the surface. This reference geometry is intended to minimize the effects of specular reflection (solid lines) and to maximize those of diffuse reflections (dotted lines) from the symbol into the camera.

The figure is meant to illustrate the principle of the optical arrangement and how it is designed to create a high-contrast image of the mark for measurement. It may or may not correspond with the final optical and lighting geometry deemed necessary to obtain even diffuse illumination over the entire area of the printed label. A practical setup may include an arrangement similar to the **45º Four-Directional Lighting** detailed in the section below for 2D label verification.



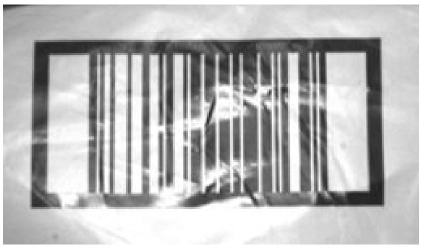
45º Directional Lighting

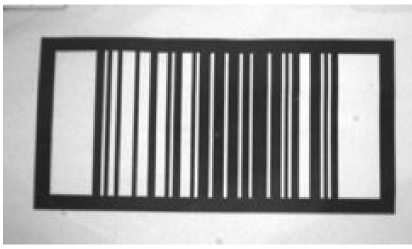
Note: Alternate optical geometries and components may be used, provided that their performance can be correlated with that of the reference optical arrangement defined in the ISO 15416 specification.

The user interface nomenclature for the 45º lighting options is:

- One-Directional (S) at 45º
- Two-Directional (T) at 45º
- Four-Directional (Q) at 45º

The image on the left below shows how a code can look with improper lighting. This code cannot be verified. The image on the right shows how using the correct lighting geometry described above is able to create a clear, high-contrast image of the code that can be used for verification.





Glossy Label, Poor Lighting **Glossy Label, 45º Lighting**

ISO/IEC 15415 Lighting

ISO/IEC 15415 specifies a reference lighting geometry using four directional light sources at 45º to the printed surface and with the camera perpendicular to the surface. This reference geometry is intended to minimize the effects of specular reflection (solid lines) and to maximize those of diffuse reflections (dotted lines) from the symbol into the camera.

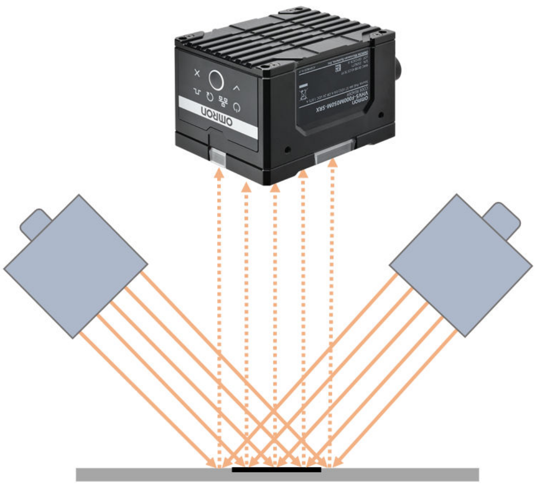
Four-Directional 45º Lights – This lighting is ideal for diffusely reflecting or semi-diffusely reflecting labels. This arrangement prevents glare off of the label surface from reflecting directly into the reader. Only the scattered light from the diffusely reflecting surface of the label makes it back to the reader.

The four-directional 45º lights are typically set up using a set of 4 bar lights mounted at the required angle to the part, and at a height above the part such that the center ray angle of the light hits the center of the code at the specified angle. See image to the right.

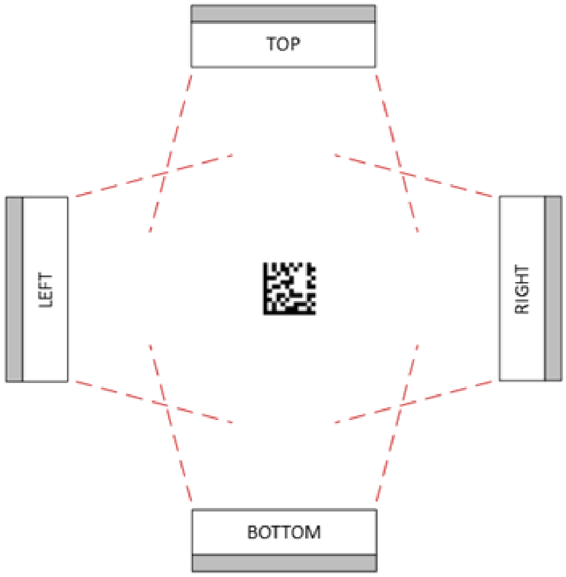
The user interface nomenclature for the 45º and 30º four-directional lighting is:

- Four-Directional (Q) at 45º
- Four-Directional (Q) at 30º

Note: Alternate optical geometries and compo-nents may be used, provided that their perform-ance can be correlated with that of the reference optical arrangement defined in the ISO 15415 specification. Alternate optical geometries in-clude 30º four-directional lighting and diffuse co-axial lighting.

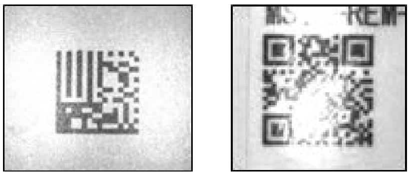


45º Four-Directional Lighting



Four-Directional Lighting Arrangement

The four images below demonstrate the benefit of using the four directional lighting geometry. The two images on the left are acquired using the built-in VHV5-F lighting. These images are poor and show glare off the label and a loss of contrast, which would be a problem for verification. The two images on the right are acquired with an external light, showing how it is able to create high-contrast, low-reflectance marks appropriate for code quality analysis.

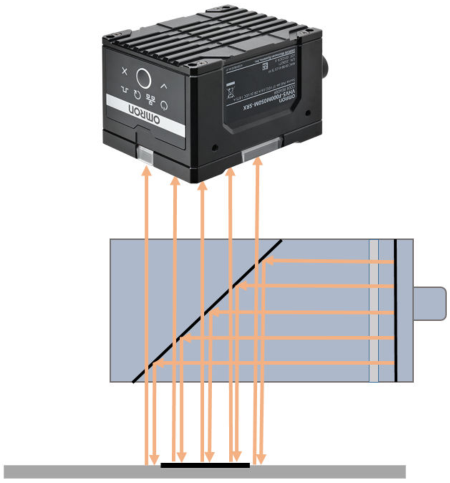


Diffuse Label using Built-In Light

Diffuse Label with 45º or 30º Four-Directional Lighting

Diffuse Coaxial Lighting – Diffuse Coaxial lighting, the last alternative, is used when labels are highly specular (shiny). This lighting configuration is more capable for reducing glare spots and producing a clear, high-contrast image of the code for analysis.

This setup typically uses a DOAL (Diffuse On-Axis Light) that is mounted between the camera and the part. The DOAL uses a beam splitter to direct light down to the code. Light reflects evenly off the label passing back up through the beam splitter to the reader.

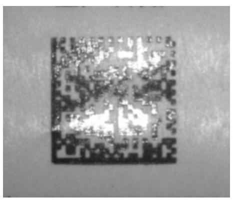


Diffuse Coaxial Lighting

The user interface nomenclature for Diffuse Coaxial lighting is:

- Perpendicular Coaxial (90º)

The two images below demonstrate the effectiveness of the DOAL on a label with a very glossy surface. The image on the left shows glare even with the 45º light. The image on the right using the Diffuse Coaxial Light eliminates the glare spots. The entire surface reflects the light evenly, creating a high-contrast image differentiated by the underlying light absorption of the label surface and the print.



Glossy Label, 45º Light

Glossy Label, Diffuse Coaxial

8-2-2 ISO/IEC 29158 (Direct Part Marks) - Reader Mounting and Lighting Configurations

Mounting

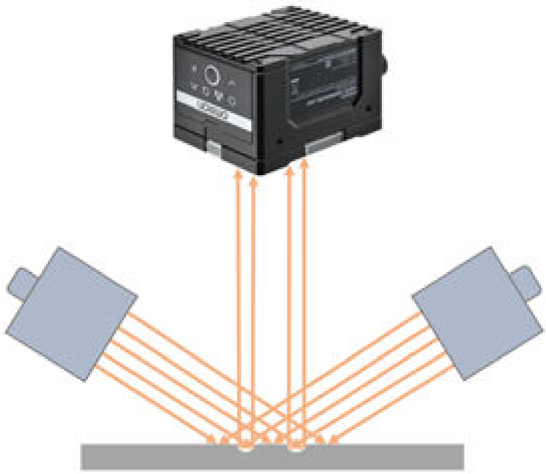
Mounting Angle - Traditionally, ISO/IEC 29158 specifies that the reader must be mounted perpendicular to the part plane at 90º so that the camera face and marked face of the part are parallel. An additional lighting option called **Tilted Coaxial Lighting (TCL)** allows the reader to be tilted relative to the part plane. This allows the internal lighting of the camera to be used for ISO/IEC verification. See the **TCL** section below.

Mounting Distance - The mounting distance is determined by the reader optics, sensor resolution, and code size. The height should be set so that the thin bar of a 1D code is **~6 pixels wide (6 PPE)**, or so that one cell of a 2D matrix is **~8 pixels wide (8 PPE)**. See **section 2-2-1** to determine the correct reader model and mounting distance to attain the required PPE.

ISO/IEC 29158 Lighting

ISO/IEC 29158 provides several lighting geometries designed to produce a clean image of a direct part mark code with no glare from the lighting. These include **30º Directional Light (1, 2, or 4 quadrants)**, **Diffuse Coaxial Light**, **Diffuse Off-Axis Light**, and **TCL**.

30º Directional Lighting for DPM – This lighting is ideal for direct part marks where the marking process changes the surface of the part. The flat reflective areas of the part shunt the light away from the camera and will appear black. Any surface with heavy texture (such as a laser mark), or contour (such as a dot peen mark), will reflect light back into the camera due to their angular roughness. Typically, codes will appear light on a dark background.



30º Directional Lighting

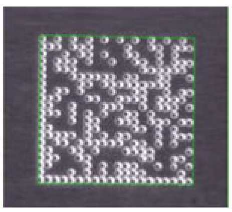
The 30º Directional Light is set up to use 1, 2, or 4 bar lights, each mounted at the required angle to the part, and at a height above the part such that the center ray angle of the light hits the center of the code at that 30º angle. See the image to the right. Quadrant control gives the user finer controls. For example, use of just two quadrants of the light can be used to eliminate machine striations from reflecting light back to the reader.

Note: A diagram of the Four-Directional Lighting Arrangement is shown in the ISO/IEC 15415 Lighting section.

The user interface nomenclature for the 30º quadrant light are:

- One-Directional (S) at 30º
- Two-Directional (T) at 30º
- Four-Directional (Q) at 30º

The images below demonstrate the effectiveness of the low-angle 30º four-direction light. Images 1 and 2 on the left show the dot peen and laser mark reflecting light back to the camera. Image 3 on the right is a reverse example where rough machine background reflects light back to the reader, and the smooth laser mark reflects the light away.



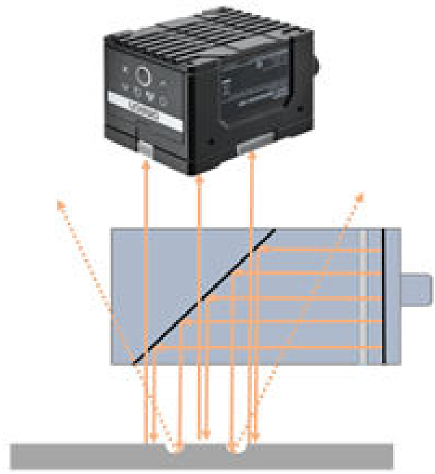
Dot Peen on Metal

Laser on Smooth Metal

Laser on Rough Metal

Diffuse Coaxial Lighting for DPM – Diffuse Coaxial Lighting produces an image that is the reverse of the low-angle light described above. Flat reflective areas of the part reflect light back to the reader and appear bright. Marks with heavy texture or contour reflect light away from the reader due to their angular roughness and appear dark. Under diffuse coaxial lighting, barcodes typically appear dark on a light background.

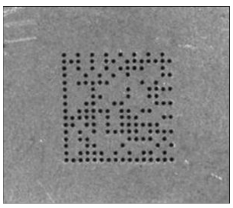
This setup normally uses a DOAL that is mounted between the reader and the part. The DOAL uses a beam splitter to direct light down to the code label. Light reflects evenly off the flat areas of the part back up through the beam splitter to the reader. Light from textured or contoured areas is reflected away from the reader depending on the degree of texture, or angle of contour.



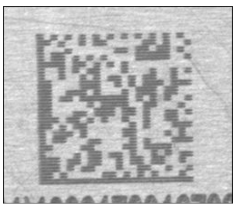
Diffuse Coaxial Lighting

The user interface nomenclature for Diffuse Coaxial Lighting is:
- Perpendicular Coaxial (90º)

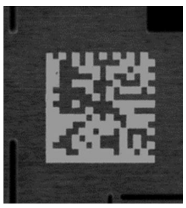
The images below demonstrate the effectiveness of Diffuse Coaxial Lighting. Images 1 and 2 on the left show the dot peen and laser mark reflecting light away from the reader. Image 3 on the right is a reverse example where the rough machined surface reflects light away from the reader, and the smooth laser mark reflects the light directly back.



Dot Peen on Metal

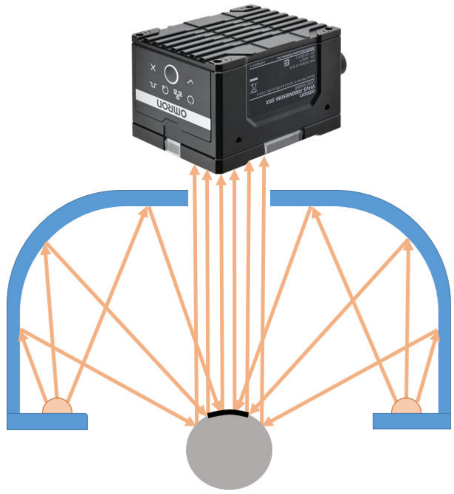


Laser on Smooth Metal



Laser on Rough Metal

Diffuse Off-Axis Lighting for DPM –
Diffuse Off-Axis Lighting is another option for direct part marks. This is used for parts with low angle contours such as a cylinder, and where the marking process is ink jet, laser, or dot peen, which either changes the surface absorption of the part, or creates a deep contour. The goal for this lighting is for any reflective surface with low angle contour to reflect light back to the reader and appear bright, for print marks to absorb the light, and for deep contours to reflect light away from the camera an appear dark.



Diffuse Off-Axis Lighting

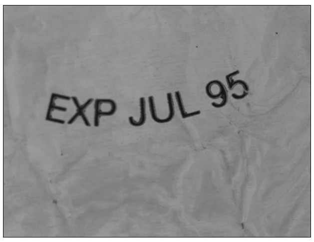
This setup typically uses a **Dome Light** that is mounted between the reader and the part. The interior of the dome acts as a light sphere so that light will hit the same spot on the part from many angles, eliminating all shadows from low angle contours. Dark-colored marks or sharp contoured areas absorb the light or reflect it away from the reader and appear dark.

The user interface nomenclature for Diffuse Off-Axis Lighting is:
- Diffuse Off-Axis (D)

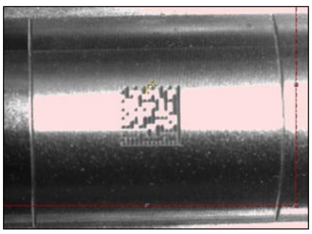
The four images below demonstrate the effectiveness of Diffuse Off-Axis (Dome) Lighting. The upper left image is wrinkled foil with printing on it. The lower left image is a laser mark on a cylinder. Both images show the result with a DOAL. The upper and lower images on the right show the same marks under Dome lighting that compensates for the large contour, allowing the codes to be seen clearly.

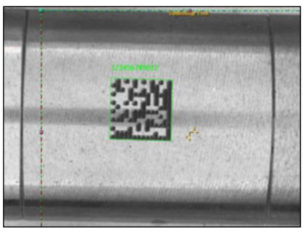
DOAL | **Dome Light**

Ink Jet on Foil



Laser on Metal Cylinder



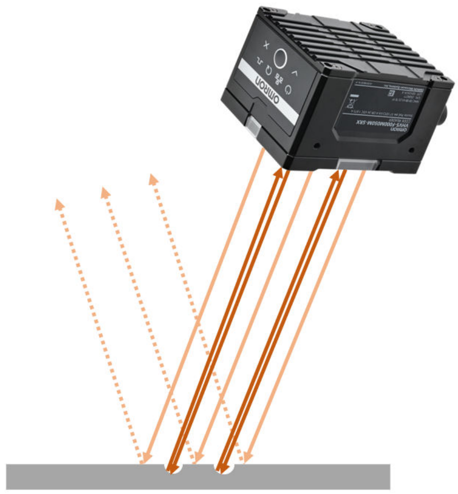


Tilted Coaxial Lighting (TCL) for DPM – Tilted Coaxial Lighting is a new, extremely practical option for verifying direct part marks. TCL allows the illumination that is built into modern code readers to be used for verification as well. This is a practical solution because this same lighting technique is what is used to read these marks on the factory floor.

With TCL, the reader, which is normally mounted at 90º for the other verification methods, is tilted off vertical until the part shows good contrast. 60º relative to that part face down to 45º is typical. In this configuration, the flat reflective areas of the part shunt the light away from the reader and will appear dark in the image. Heavily textured marks (such as laser marks), or marks with deep contours (such as dot peen marks), reflect light back into the reader due to their angle, and appear light on the dark background.

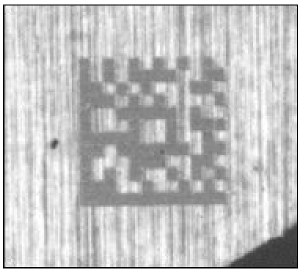
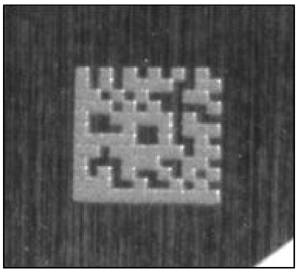
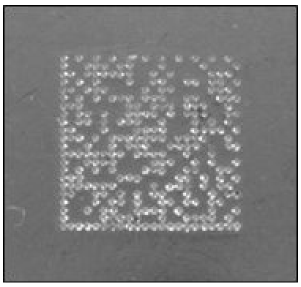
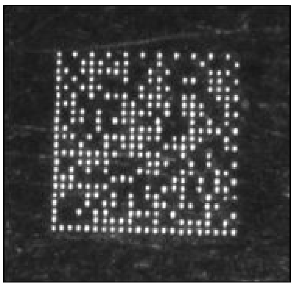
The user interface nomenclature for Tilted Coaxial Lighting is:

- TCL (CS)



Tilted Coaxial Lighting (TCL)

The four images below demonstrate the effectiveness of TCL. The two images on the left show the part when viewed with the 30º low-angle directional light. The two images on the right are under TCL, which can create a superior image of the mark, with higher contrast than the directional light or Diffuse Off-Axis (Dome) Light.

	30º Directional Light	**TCL Light**
Laser Mark		
Dot Peen		

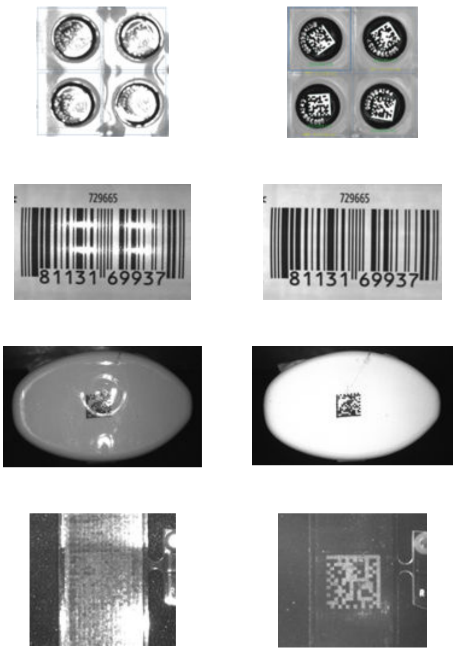
8-2-3 Alternate Mounting and Lighting Configuration for Code Validation

Polarized Lighting for Label and DPM – If the application is code validation used for process control rather than ISO code certification, then the **Polarizer** adds a simple and very powerful lighting option. In terms of simplicity, it uses the reader's built-in lighting with a Polarizer filter. This allows the reader to be mounted perpendicular to the part. The polarizer eliminates direct reflections off the part and produces a clear, high-contrast image of the code for analysis. This option works with labels as well as with many direct part marks.

This setup uses a polarizer mounted to the front face of the reader lights and lens. Polarized light is projected down to the part. Direct reflections off the part are blocked by a cross-polarizer in front of the lens. Only scattered light off the part and mark is seen by the reader. The images below show the applicability of the Polarizer method across a wide array of parts.

Polarized Light

Non-Polarized Light **Polarized Light**



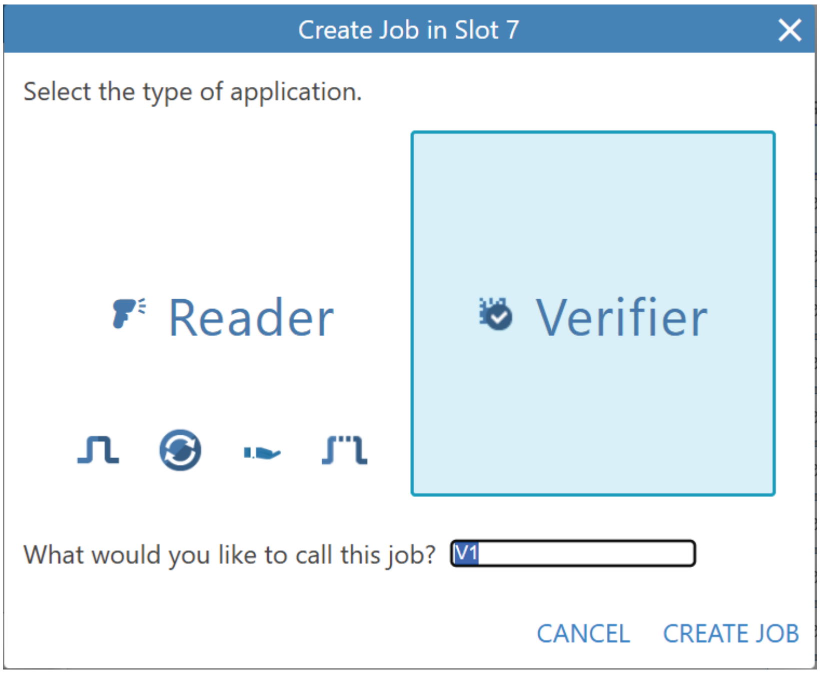
8-3 Setting Up a Verification Job

8-3-1 Creating a Verifier Job

With the Verification License installed in the camera, the **Device View** job creation dialog allows the user to create a standard **Reader Job** or a **Verifier Job**.

To create a Verifier Job, select Verifier, provide a name for the job, and click **CREATE JOB**. This will create the job with Verifier defaults, and then will direct the user interface into **Setup Mode**, where the user can complete programming.

By default, the system will create a job with ISO/IEC 29158 verification for Direct Part Marks enabled. Lighting is set to TCL to use the reader's internal lighting.



8-3-2 The Verification Job

The **Read Cycle** for a **Verifier Job** is shown on the right. Similar to a Reader Job, the Read Cycle in a Verifier Job begins with the acquisition of a single image in the **Acquire** step.

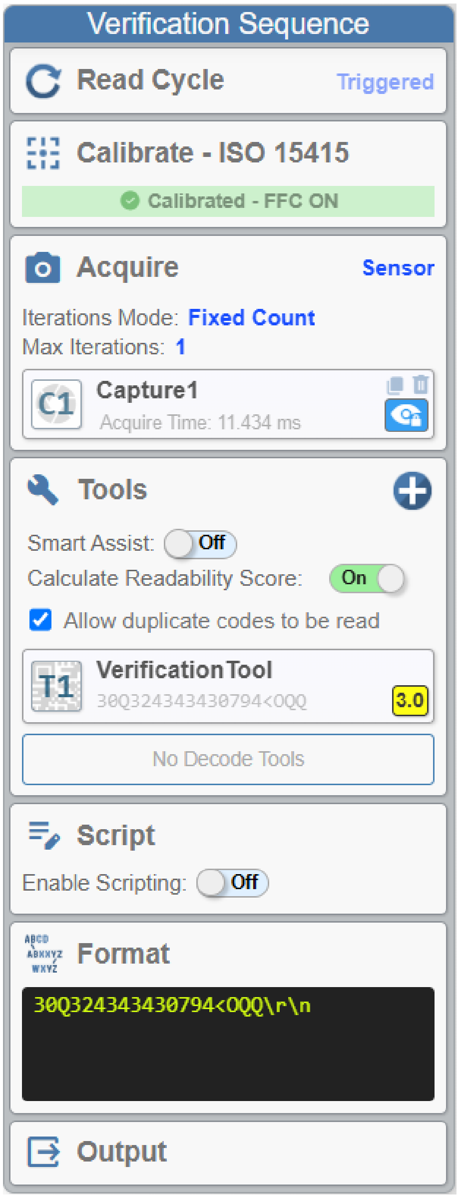
Note: This image, or capture, needs to be calibrated per ISO/IEC prior to running. Image Calibration is described in the following sections.

Once the calibrated image is acquired, a single **Verification Tool** is run in that calibrated capture. The Verifier Tool can be set up to read and verify just a single code, or it can be set up in **Multicode Mode** to read and verify multiple codes within the single calibrated capture. Note that the Verification Tool also provides the ability to perform **GS1 Syntax Checking** on the code, in addition to ISO/IEC code quality checking.

After the Verification Tool runs and provides grading results, the **Script** step runs. Scripting provides the user with extended capabilities for creating a custom output report as well as a means to set the digital outputs based on verification results.

Next, the **Format** step runs. It performs final formatting of the output string and then sends the result to the host.

Finally, the **Output** step runs, which can be used to save the image and report to the reader or to an FTP site.



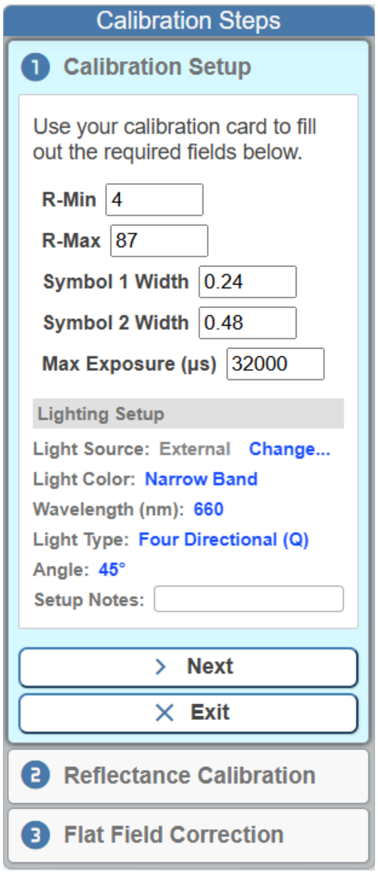
8-3-3 Summary of Calibration Requirements per ISO/IEC Standard

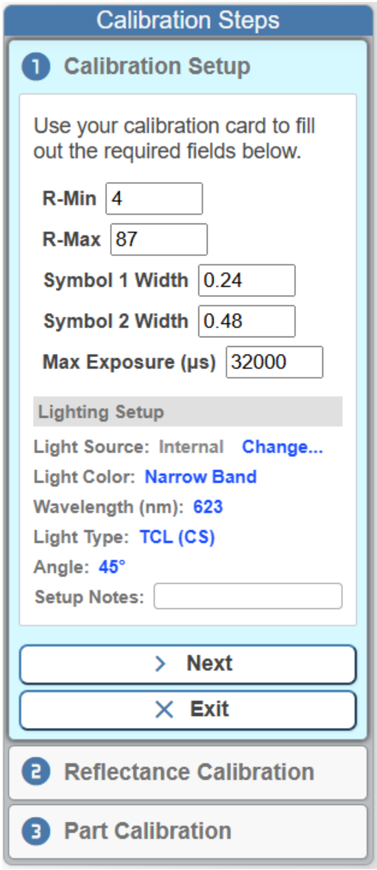
Each VHV5-F In-Line Verification Job must be calibrated to be considered ISO/IEC-compliant and capable of producing a certified output grade. An overview of the calibration steps required per the different ISO/IEC standards is shown below.

Sections **8-3-4** to **8-3-8** show how to calibrate the system using the WebLink **Calibration Wizard**.

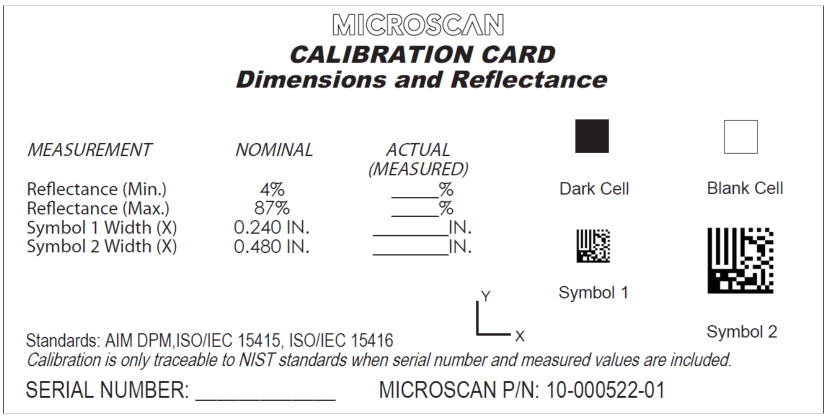
There are three steps required when calibrating, depending on the ISO/IEC standard used for verification. The steps vary slightly for ISO/IEC 15415 and 15416 versus ISO/IEC 29158.

ISO/IEC 15416 / ISO/IEC 15415	**ISO/IEC 29158**
1. Calibration Setup	1. Calibration Setup
2. Reflectance Calibration	2. Reflectance Calibration
3. Optional – Flat Field Correction	3. Part Calibration





All standards require the following calibration card. This card is purchased as an accessory.



Reflectance Calibration

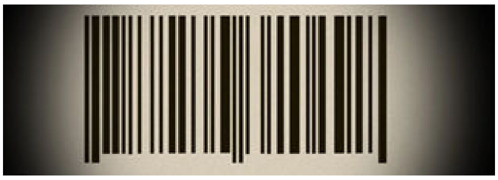
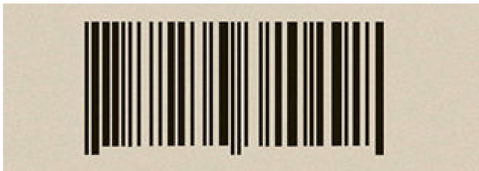
All three standards, ISO/IEC 15416, ISO/IEC 15416, and ISO/IEC 29158, require that **Reflectance Calibration** is performed with a calibration card available from Omron. Reflectance Calibration maps the reader's measurement of gray values to actual reflectance levels, establishing a conversion for the verification software to measure and output valid results for tests such as **Contrast**, **Modulation**, and **Reflectance Margin**.

Flat Field Correction

Flat Field Correction is an optional step for ISO/IEC 15415 and 15416. Flat Field Correction is used to correct brightness variations across the field of view caused by imperfect lighting. This allows calibration done at the center of the field of view to be valid at the corners of the image as well. This is not an issue for DPMs and ISO/IEC 29158, but can help improve label verification where codes are viewed across a web, or where long barcodes are being verified.

The image on the left is an example of an unbalanced field of view. The brightness and contrast at the center of the code are different from the outside edges. To the right is an example of that same code seen under the same lighting conditions, except with Flat Field Correction applied. The same level of contrast now exists across the entire field of view.

Flat Field Correction is performed using a blank diffuse white card (printing paper) placed in front of the camera at the part plane. When Flat Field Correction is complete, the image as seen on the left will now appear as the one seen on the right.

Part Calibration

ISO/IEC 29158 requires a secondary **Part Calibration** step. With the ISO/IEC 29158 standard, direct part marks are not required to have the same level of contrast as labels. The specification allows for the acceptable level of contrast or reflectance to be determined by a golden part that is shown to the system during the Part Calibration process.

To perform Part Calibration, a good part is placed in front of the reader and the user follows the steps in the **Calibration** user interface to calibrate on it.

Note: Part Calibration overrides the **Gain** and **Exposure** values set by **Reflectance Calibration**. Once Part Calibration is done, the job can only be used for ISO/IEC 29158 verification.

Perspective Correction for Tilted Coaxial Lighting (TCL)

ISO/IEC 29158 allows TCL as described in **section 8-2-2**. With TCL, the camera is set at an angle relative to the part plane to avoid direct reflection from the part. This induces perspective distortion in the shape of the code. It is no longer square, but keystone-shaped.

This distortion must be corrected by warping the code back to square for the ISO algorithms to evaluate it. The image transform to correct the distortion is calculated automatically from the four corners of the calibration symbol used during the reflectance calibration step. Therefore, it is very important that the calibration target be placed in the exact part plane during that step.

8-3-4 Start the Calibration Wizard

Before calibration, confirm that the Calibrate step identifies the desired verification standard. If the calibration standard is incorrect select the Verification step, go to Tool Settings, and set the desired verification standard. See **section 8-4**.

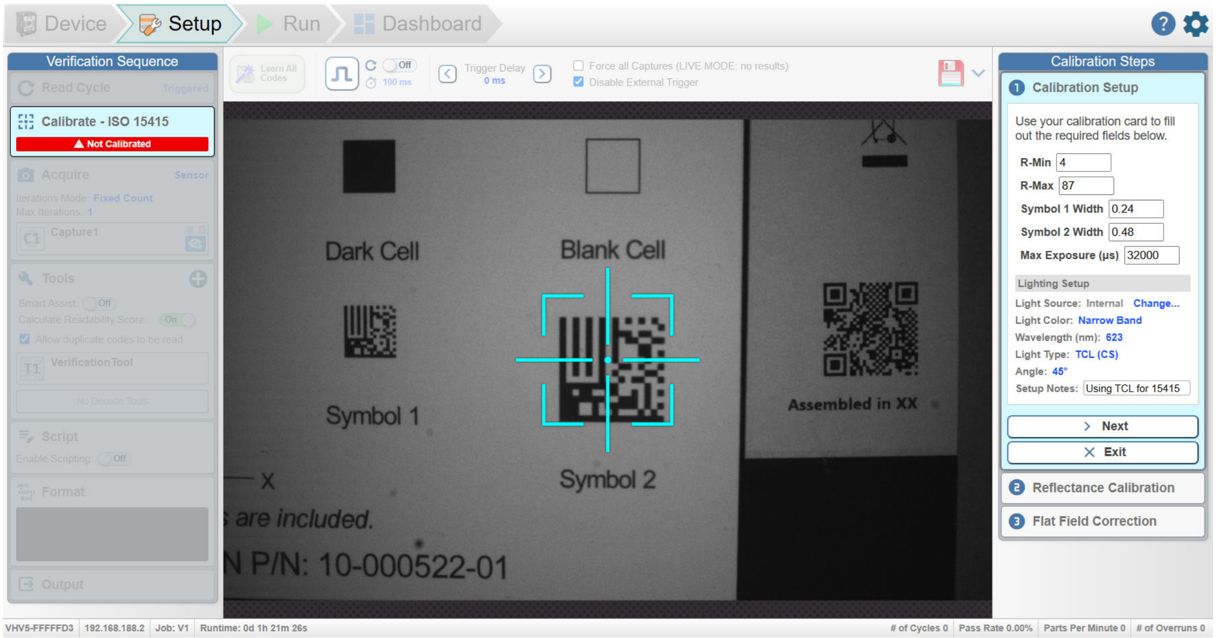
Calibration status is displayed as part of the Read Cycle. Calibration status has two states: **Not Calibrated** and **Calibrated**. The system starts off as uncalibrated for each new job. It must be calibrated for ISO Compliance. If it is not calibrated, it will run and produce grades, but the run status will be **Fail**. The calibration is saved as part of the job. If the user changes any of the acquisition parameters after calibration, such as gain, exposure, lighting, or the calibration standard, the system will go back to the uncalibrated state.

To calibrate or to recalibrate, click **Calibrate** in the Read Cycle step sequence. This will open the calibration user interface, or wizard, shown on the right side of the image below. The calibration user interface shows the series of steps to perform along with instructions for each step.

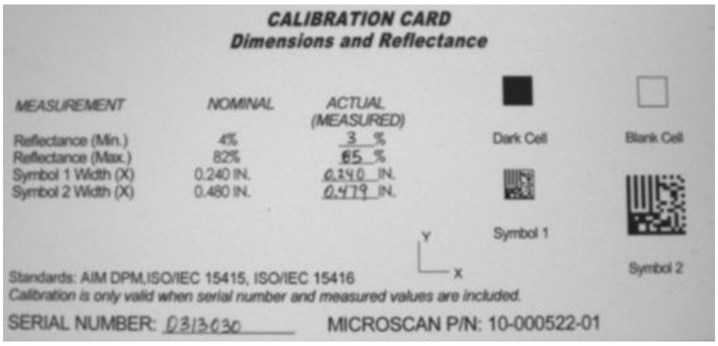
Align the Calibration Target in the Center of the Field of View

During calibration, the image display becomes a live video feed. Crosshairs are placed in the image to aid in positioning the calibration target in the center of the field of view in the part plane. Center on either the **Symbol 1** or **Symbol 2** that are printed on the calibration card. Choose the code that most completely fills the reticle. Usually this is the larger of the two symbols.

Note: The calibration card should be placed in the same exact plane as the part. You should perform an initial Quick Photometry and Quick Focus before initiating calibration to assure that the image is visible and in focus first.



Calibration Setup – Fill In the Data Fields



1. Go to **Step 1** in the Calibration interface.
   1) Enter the **R-Min**, **R-Max**, **Symbol 1 Width**, and **Symbol 2 Width** values found on the calibration card.
   2) You may also enter a **Max Exposure** value if you want to restrain the calibration routine from setting an Exposure value that is too high for your motion application. In this case, the system will prioritize Gain to get a good image.
2. Update the **Lighting Setup** section with details about your current lighting setup.
   1) **Light Source –** Set Light Source to **Internal** if you are using the built-in reader lighting, or **External** if you are using any type of external lighting.
   2) **Light Color –** If you are using the internal light of the reader, the light color will be set automatically for you. If you are using an external light, pick either **Narrow Band** if you are using a single-color LED such as red, or **White** if you are using an external white light.
   3) **Wavelength (nm) / Color Temp (K), or Custom (nm) –** Type in the nanometer wavelength of the light if you are using narrow band light. Type in light temperature in Kelvin if you are using a white light.

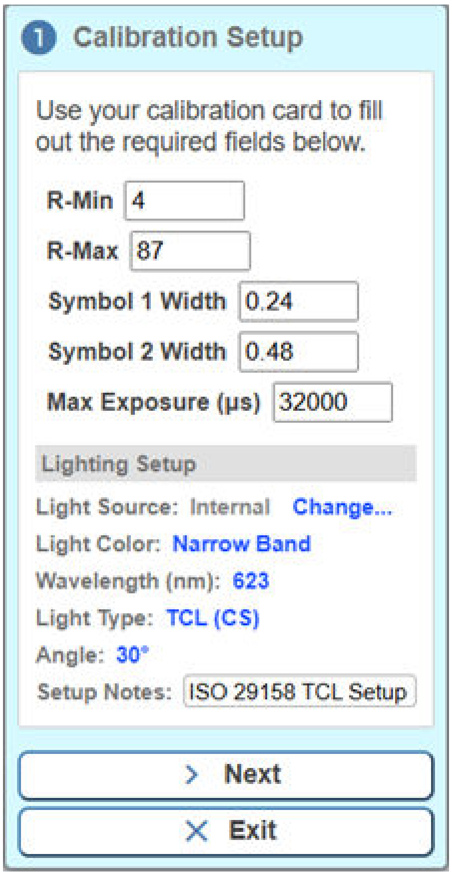
4) **Light Type –** For Light Type, there are six choices to cover the standard ISO lighting configurations. Choose the light type that best represents your lighting setup. For example, if you are using an external four-bar ring light, you would choose **Four Directional (Q)**. If you are using the internal lighting of the camera, you would select **TCL (CS)**.

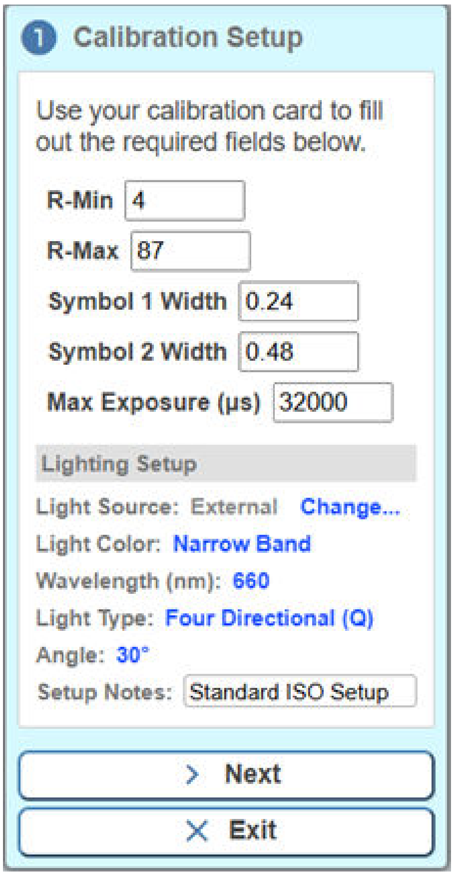
5) **Light Angle –** Type in the angle from the center ray of the light, or one of the light bars to the code. For ISO, this would normally be **30º** or **45º**.

6) **Setup Notes –** Finally, enter any Setup Notes to fully describe the imaging setup, especially if it is different from the ISO/IEC standards.

7) A typical ISO 29158 setup is shown below on the left, and a typical ISO 15415 4-Bar Ring Light setup is shown on the right.

3. Once all values are entered, click **Next** to proceed to **Reflectance Calibration**.

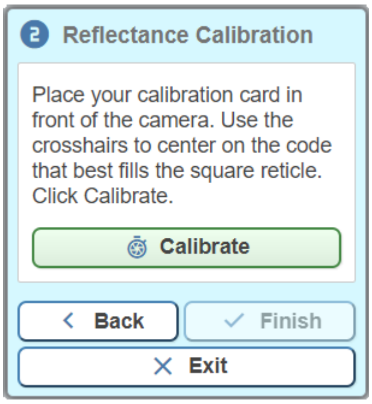




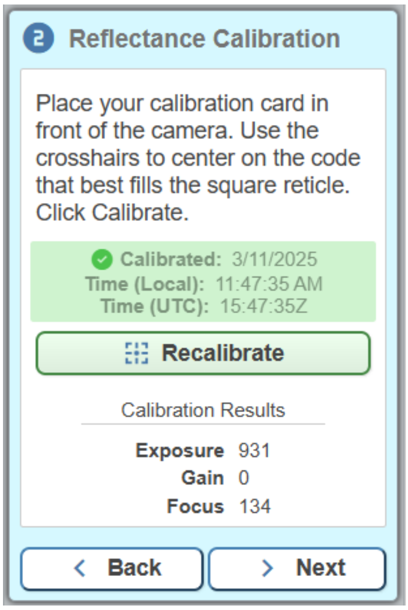
Item	Setting value [Job Default]	Description
R-Min (%)	**[4]**, Use Actual value printed on card.	The minimum reflectance value of the dark cells on the calibration card.
R-Max (%)	**[87]**, Use Actual value printed on card.	The maximum reflectance value of the light cells on the calibration card.
Symbol 1 Width (in.)	**[0.24],** Use Actual value printed on card.	Width of the small symbol on calibration card.
Symbol 2 Width (in.)	**[0.48],** Use Actual value printed on card.	Width of the small symbol on calibration card.
Max Exposure (μs)	**[32000]**,0-300,000	Controls the maximum exposure time that calibration is allowed to set for capture. This is used to keep exposure at a low value to eliminate blur for fast-moving applications.
Light Source	**[Internal],** External	By default, the system will use ISO 29158, and will select TCL (CS) which allow the use of the internal light of camera. The user can change this to match any of the standard lighting configurations detailed in section 8-2.
Light Color	**[Narrow Band],** White	Narrow band is for a single colored light such as Red or Blue. White is for using a broadband white light.
Wavelength (nm) / Color Temp (K)	**[(623nm)]**, Custom (nm), Custom (K)	If monochromatic, add the light wavelength in nanometers (nm). If White Light, type light Color Temp in Kelvin.
Light Type	**[TCL (CS)],** Perpendicular Coaxial (90º), One-Directional (S), Two-Directional (T), Four-Directional (Q), Diffuse Off-Axis (D)	Describes the lighting setup. Per ISO standards, it is either TCL for the internal lighting, a Coaxial DOAL light, a One, Two, or Four-directional low-angle light, or a Diffuse Off-Axis Dome light. See section **8-2-1** for how to choose lighting based on ISO standard and application.
Angle	**[45º],** 0º - 90º	The angle of the center of the light relative to the center of the code. Note the reference is 90º is when the camera is pointing straight down at part. If the light was horizontal, this would be 0º.
Setup Notes	Any	Field for text to fully describe the lighting setup. This field is normally used to describe setups that are outside of the norms set in the standards. This field is included in the Summary Output.

Perform Reflectance Calibration

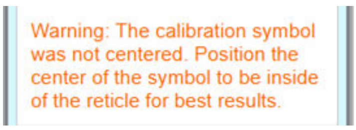
1. Verify that your calibration target is centered in the image as shown above, go to **Step 2** in the wizard, and then click the **Calibrate** button. The system will now attempt to perform Reflectance Calibration.



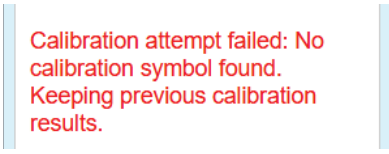
2. If Reflectance Calibration is successful, the following information will appear:
   1) The date and time of calibration;
   2) The **Exposure**, **Gain**, and **Focus** settings resulting from calibration;
   3) The **Next** button to move on to **Flat Field Correction** or to **Part Calibration** in the case of ISO/IEC 29158.



3. If the calibration was successful but the code was not centered within the reticle, the following warning will appear. It is not a critical warning, but if it is a simple matter to center the calibration symbol better, it is recommended that you do so.



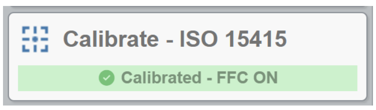
4. If calibration is unsuccessful, one of the following messages will appear. An example is shown below. In this case, the symbol on the Calibration card was not in the field of view. The fix is to reposition the card so the cal target is centered, and then recalibrate.



Note: If there was already an existing calibration, the unit will keep its current calibration.

Message	Suggested Action
System Error	Make sure that the values typed on the Calibration Card are entered correctly into the fields in Step 1 of the calibration wizard. If the problem persists, contact local support.
Gain and Exposure Adjustments Unable to Meet Calibration Requirements	This will most often occur when the user sets a very low max exposure time to avoid blur. This can result in a very high gain after Reflectance Calibration. If required gain is over 100, this error will appear. This error can be even more common during Part Calibration if Reflectance Calibration already has a very high gain. If the user then does a Part Calibration on a dark part that will boost the gain over 100, this error will also result. In both cases, the user will either need to increase what they are willing to accept for a maximum exposure time, set lights to Ultra, or use a brighter external light.
No Calibration Symbol Found	Ensure that one of the two Data Matrix symbols on the calibration card are seen and centered in the image.
Larger Symbol # 2 Required to Calibrate	This occurs when trying to calibrate on the smaller symbol, and it does not have enough pixels for calibration to complete. Slide the card over so the camera sees the larger symbol in the center of the field of view.
Not Enough Resolution to Calibrate	Same as above, but when the larger symbol does not have enough pixels for calibration to complete. At this point, the user must move the camera in, or go to a narrower lens to increase the code size.
QR Model 1 Symbols not Supported	This error can only occur during Part Calibration when the code is a Model 1 code. This is the original version of the QR code, and it is no longer meant to be used.

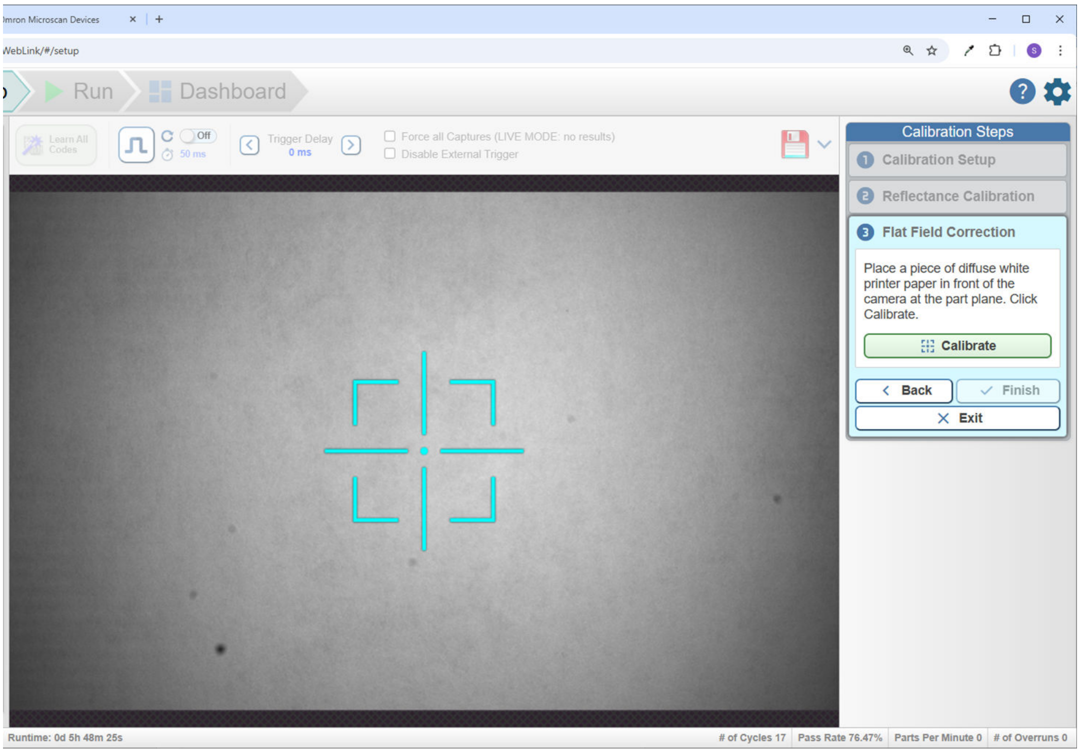
5. You can click the **Recalibrate** button if you want to run Reflectance Calibration again. Otherwise, click **Next** to move on to **Flat Field Correction** for ISO/IEC 15416 / ISO/IEC 15415 or **Part Calibration** in the case of ISO/IEC 29158.
6. Note that the calibration status has been updated on the Read Cycle with the status, the standard, and whether or not Flat Field Correction (FFC) is on.



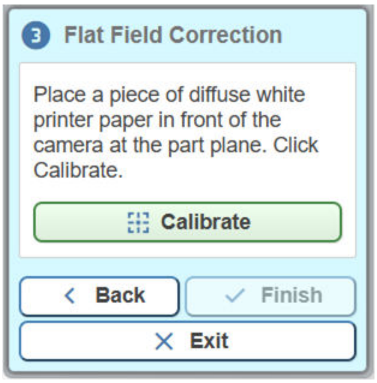
8-3-5 Performing Flat Field Correction for ISO/IEC 15416 / ISO/IEC 15415

If you are using ISO standards 15415 or 15416, the **Flat Field Correction** calibration step is available as an optional step. Flat Field Correction attempts to flatten the lighting creating uniform brightness across the entire image. This will improve consistency of verification results when the code is out of the center of the field of view, when verifying multiple codes in different areas of the field of view, and, in the case of long barcodes, when they cover the width of the field of view.

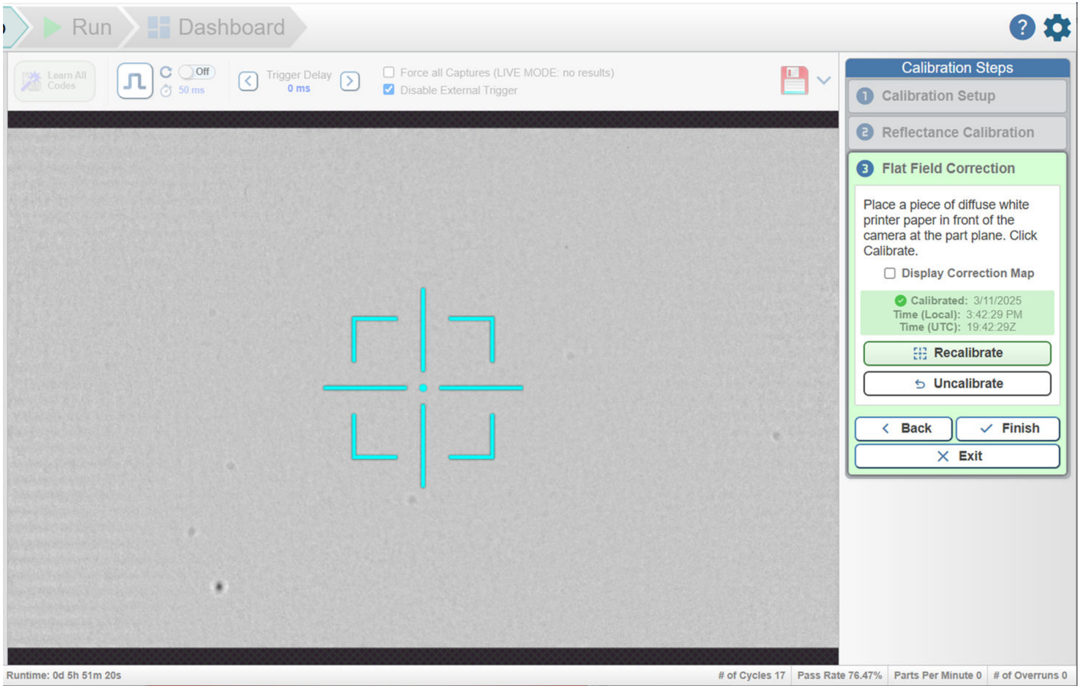
1. Start by placing a uniform diffuse white surface in front of the reader. This can be a piece of printer paper. It should be placed at the same position and orientation of the part plane, as was done for the Reflectance Calibration target. It should cover the entire field of view.



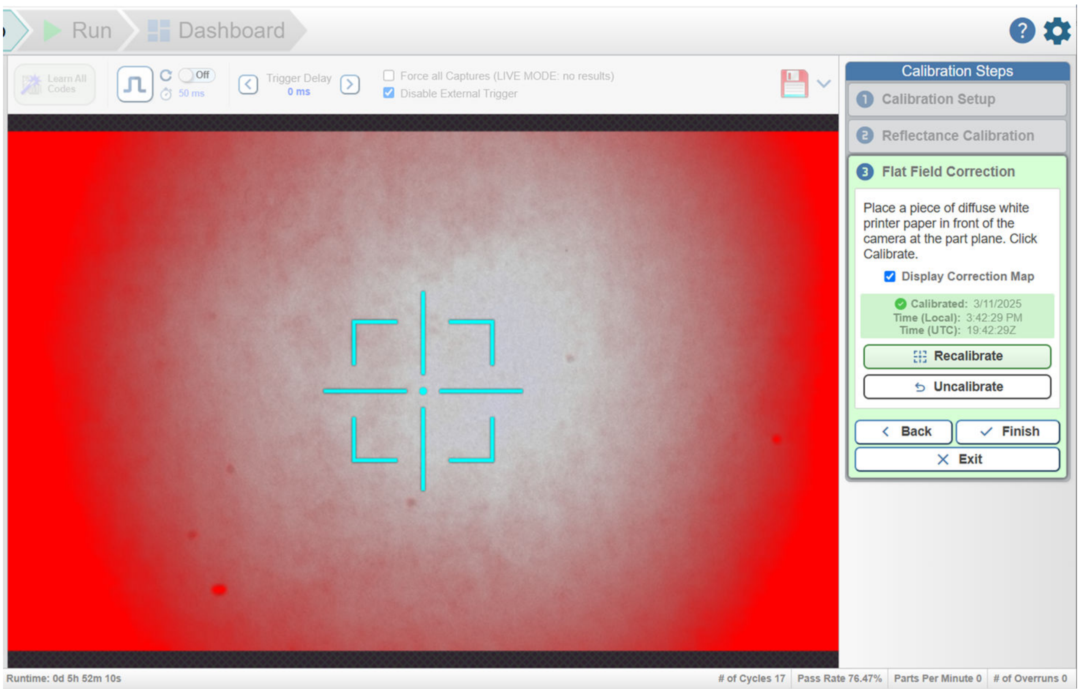
2. Click **Calibrate**. The system will attempt to calculate the **Flat Field Correction**.



3. If Flat Field Correction is successful, you will see:
   1) The green **Calibrated** message along with the time and date;
   2) The image on the screen as uniformly bright.



4. Clicking **Display Correction Map** will show the level of correction applied to flatten the image. Red indicates dark areas that were brightened. Blue indicates areas that were too bright and were darkened.



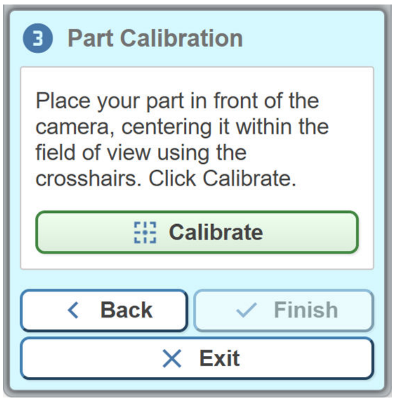
5. Once the Flat Field Correction has been calibrated, the full image will always render as the flat-field-corrected version in the **Setup**, **Run**, and **Dashboard** views.
6. Use the **Uncalibrate** button to clear the Flat Field Correction. You can also recalibrate.

8-3-6 Performing Part Calibration for ISO/IEC 29158

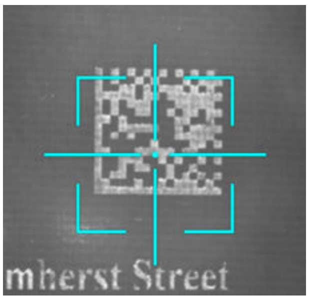
If you are performing ISO/IEC 29158, you will be required to perform Part Calibration as the third step. Part Calibration is performed after the Reflectance Calibration step. Part Calibration will compute new **Exposure** and **Gain** settings that produce a high-contrast image of the golden Direct Part Mark sample that is shown to the system during the Part Calibration process.

1. Select ISO/IEC 29158 as the Verification method. Click **Calibrate** in the Calibrate step. Input all data into the Calibration Setup dialog, and perform Reflectance Calibration on the card as shown in section 8-3-4.
2. For Part Calibration, place an example of your part with a "known good" version of the mark in front of the reader within the region of interest where it will be read, or centered in the reticle. Do not attempt to change exposure, gain, or lighting to make the part more visible. Part calibration will do this for you.

3. Go to **Step 3**, Part Calibration. Click the **Calibrate** button.



4. If successful, the image of the direct part mark should appear in high contrast.



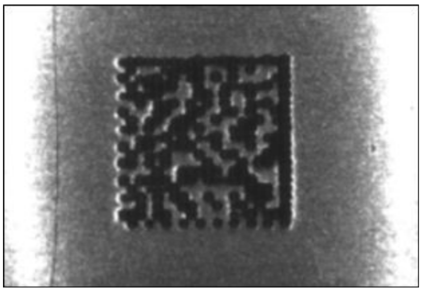
5. If the image does not appear similar to the one above, you will need to reevaluate your choice of lighting and choose a configuration that is capable of creating a good high-contrast image of the mark. See choices for DPM Lighting in **section 8-2-2**.

8-3-7 Calibrating TCL (Tilted Coaxial Lighting) for ISO/IEC 29158 DPM

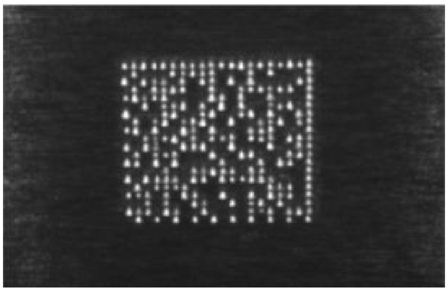
When performing ISO/IEC 29158 DPM verification, the **Tilted Coaxial Lighting (TCL)** option, which uses the internal lighting of the reader, is a powerful new option in the DPM standard. No external lighting is required. The internal light of the reader is used. This is both simpler and less expensive than traditional setups that require an external light

TCL works well because tilting the reader relative to the part to achieve high-contrast images of the mark is a well-known technique, and is used as a default for many DPM reading applications. See the example below. The image on the left is taken with the reader looking straight at the part. The image on the right is taken with the reader tilted at 30°.

Camera at 0°



Camera Tilted at 30°



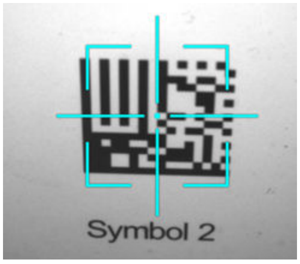
Tilting the reader would normally cause problems for verification since it changes the shape of the code. The above left image shows how the code is foreshortened in the Y axis and shows keystoning. This will create errors in verification measurements such as **Axial Non-Uniformity**. To compensate for this, the system computes an image transform during the Reflectance Calibration step. This transform is used to warp the image of the code back to square prior to running the verification algorithm.

This transform is computed automatically during the Reflectance Calibration step when the lighting type is set to **TCL (CS)**. The system uses the four corners from the symbol on the calibration card to compute the angle of the reader and then the transform required to put it back to square.

1. To use TCL, select **TCL (CS)** as the **Angle Type**.
2. Approximate the angle of your reader relative to the plane of the part and input that into the **Angle** field in the UI. The Angle will become part of the result string. To estimate the angle, use **90°**as the baseline for when the reader is looking straight down at the part. If you tilt the reader off vertical by 30° (which is typical), input the angle as 60° (90°- 30° = 60°) for the camera relative to the part plane.

3. Place the calibration card directly in the part plane at the exact position and angle the part will occupy.
4. Perform **Reflectance Calibration** using the largest of the two symbols to increase the accuracy of the computed transform.

   Note: You will notice the perspective distortion in the calibration target prior to this step.



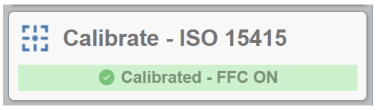
5. When calibration is complete, you will notice that the region of interest will render the code with the transform applied making the code appear square. The blue outline on the region indicates that the region is rendering the unwarped image.

Note: This is true for all filter outputs that can be seen when using the Decode Tool.

Key Point: Officially, TCL is only allowed per the ISO/IEC 29158 verification standard. However, TCL can also be used with the other standards if the application does not require full ISO/IEC Verification, but is able to use Validation level results instead. (See section **8-2-1** for a discussion of Verification versus Validation.) If the user chooses 15415 or 15416 along with TCL, it is allowed, but a Non-Compliant warning is shown under Calibration status. The user should annotate the custom setup, including light wavelength, in the **Setup Notes** field.

8-3-8 The Capture “Calibrated” State

Once you have performed all Calibration steps successfully, the **Capture** step will show you that it is now calibrated, listing both the standard, the status, and any additional information.



Summary of ISO/IEC 15416 and ISO/IEC 15415

These two standards only require Reflectance Calibration. Flat Field Correction is optional, but recommended.

When Calibration is performed, all of the settings from the Capture step will be saved. This includes **Gain**, **Exposure**, **Focus**, **FFC**, and **Lighting** settings. If any of these settings are changed, the capture will become uncalibrated.

Calibration is stored as part of the job. To reuse the calibration for other jobs that use the same label material and printing, use the Save As function to create a new job. Adjust the Regions of Interest to match the new application requirements and the system should be ready without having to recalibrate.

Summary of ISO/IEC 29158

Both **Reflectance Calibration** and **Part Calibration** are required here. Reflectance Calibration will choose an initial set of values for **Gain** and **Exposure**. **Part Calibration** will choose different values, however. The software keeps track of whether Reflectance Calibration and Part Calibration have ever been run. If they have, it is assumed that the calibration is good. The exceptions are the **Focus** and **Lighting** settings. Those are saved at the time of calibration, and if they change, the capture will be flagged as uncalibrated. Manually changing Exposure or Gain will not change the calibration state.

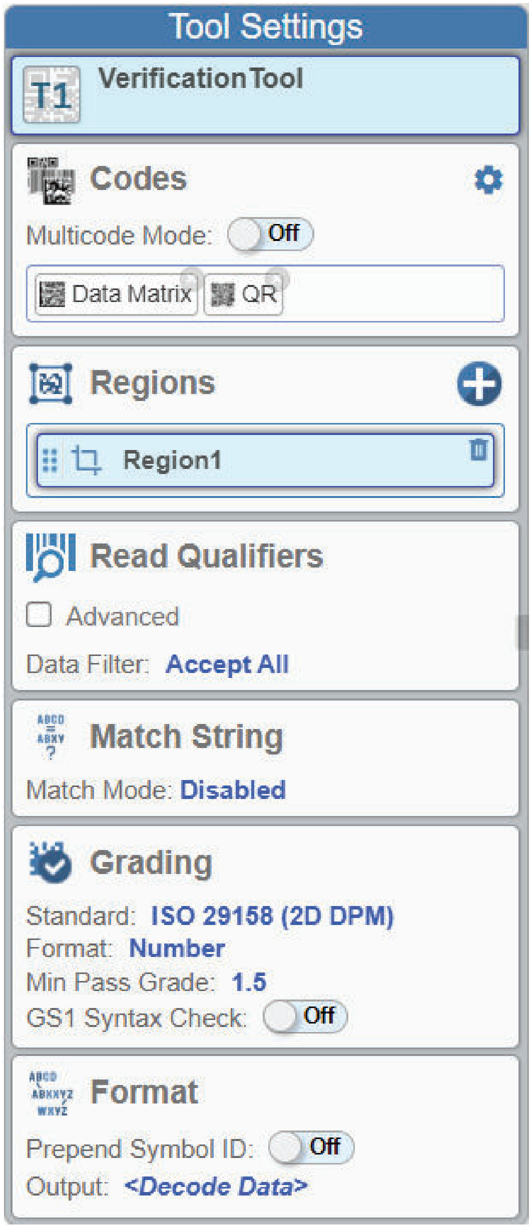
Calibration is stored as part of the job. To reuse the calibration for multiple Direct Part Marks presented in the same image plane, use the **Save As** function to create a new job. Adjust your Regions of Interest to match the new application. Go into the **Calibration Wizard** and advance to the Part Calibration step. Perform only this step and save the job. The system should be ready to go.

8-4 Verification Tool Dialog Details

The **Verification Tool** is the same as the Decode Tool, with some exceptions. Please see **Decode Tool Dialog Details** in **section 7-8** to review the individual parameters and settings in detail.

The main similarities and differences between the Verification Tool and the Decode Tool are the following:

1. The Verification Tool is only available when the VHV5-F has a Verification License;
2. Only one Verification Tool is allowed in the job;
3. The Verification Tool will only run in Capture 1;
4. The Verification Tool is able to run in a “calibrated” state and will produce certified ISO/IEC results;
5. Only those code types that are allowed under the ISO/IEC verification standards can be selected for Read and Verify within the Verification Tool;
6. The Verification Tool allows multiple codes to be verified at one time. This is done by enabling Multicode Mode and setting the number of codes appropriately;
7. Multiple regions can be set up manually for each code in the image to restrict the search area for each code;
8. No supplemental image preprocessing is allowed under ISO/IEC, so no filters other than Flat Field Correction can be applied within a region of interest;
9. Grading Defaults for a new job are shown to the right.
   1) **Standard:** ISO/IEC 29158 (DPM);
   2) **Format:** Number (decimal);
   3) **Min Pass Grade:** 1.5;
   4) **Aperture:** N/A - Internally calculated
   5) **GS1 Syntax Check:** Off



8-5 Grading Dialog Details

ISO/IEC 15416 Grading Settings		
Item	**Setting Values [Job Default]**	**Description**
Standard	ISO/IEC 15416	ISO 15416 is used for UPC/EAN, Code 128, Code 39, Code 93, Interleaved 2 of 5, and Codabar barcodes.
Format	**[Numeric]**, Letter	Numeric is the default grading output for ISO 15416. It outputs result in decimal with 0.1 resolution. Letter converts 4.0 - 0.0 to the letters A – F.
Min. Pass Grade	0.0 **–** 4.0, **[2.0]**	Pass/Fail Threshold set by the user. The user is able to set a Pass/Fail threshold for grading. If the grade is below this value, the Decode Tool will fail, which will also cause the Read Cycle to fail.
Aperture with Auto Enabled (Checked) (0 to 100% of the smallest code element)	0 – 100, **[50]**	15416 uses 50% as default
Aperture with Auto Disabled (Not Checked)	0 – 100, **[6]**	Fixed aperture setting. With **px** displayed the aperture is measured in pixels. With **mil** displayed the aperture is measured in Mils. 0 will disable fixed aperture and enable Auto Aperture. 1 – 100
GS1 Syntax Checking	**[Off]**, On	Enables GS1 Syntax Checking

ISO/IEC 15415 Grading Settings		
Item	**Setting Values [Job Default]**	**Description**
Standard	ISO/IEC 15415	ISO 15415 is used for Data Matrix, QR, and MicroQR Code labels where strict grading is required.
Format	**[Numeric]**, Strict Integer, Letter	Numeric is default grading output for ISO 15415. This choice outputs the alternate decimal grade for 15415. To select standard ISO grading, choose Strict Integer. Letter converts 4.0 - 0.0 to the letters A – F.
Min. Pass Grade	0.0 **–** 4.0, **[2.0]**	Pass/Fail Threshold set by the user. The user is able to set a Pass/Fail threshold for grading. If the grade is below this value, the Decode Tool will fail, which will also cause the Read Cycle to fail.
Aperture with Auto Enabled (Checked) (0 to 100% of the smallest code element)	0 – 100, **[50]**	15415 uses 50% as default.
Aperture with Auto Disabled (Not Checked)	0 – 100, **[6]**	Fixed aperture setting. With **px** displayed the aperture is measured in pixels. With **mil** displayed the aperture is measured in Mils. 0 will disable fixed aperture and enable Auto Aperture. 1 – 100
GS1 Syntax Checking	**[Off]**, On	Enables GS1 Syntax Checking

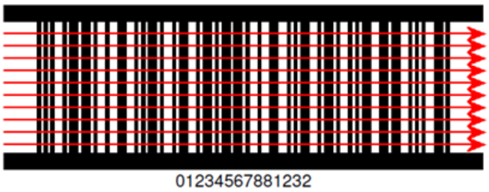
ISO/IEC 29158 Grading Settings		
Item	**Setting Values [Job Default]**	**Description**
Standard	ISO/IEC 29158	ISO 29158 is used for Data Matrix and QR Code DPM and is also the best method to obtain realistic grades from labels that match the reading capabilities of a normal code reader.
Format	**[Numeric]**, Letter	Numeric is the default grading output for ISO 29158. It outputs result in decimal with 0.1 resolution. Letter converts 4.0 - 0.0 the letters A – F.
Min. Pass Grade	0.0 **–** 4.0, **[1.5]**	Pass/Fail Threshold set by the user. The user is able to set a Pass/Fail threshold for grading. If the grade is below this value, the Decode Tool will fail, which will also cause the Read Cycle to fail.
GS1 Syntax Checking	**[Off]**, On	Enables GS1 Syntax Checking

8-6 Verification Reports

Each Verification standard measures and reports on key features of the code that reflect readability. The report data is available to see in the UI as well as to send in output strings to the host computer.

8-6-1 ISO/IEC 15416:2016 – 1D Printed Barcode Labels

ISO/IEC 15416 is used to verify the quality of 1D Barcode Labels. The results are based on measurement of 10 individual scan lines or scan reflectance profiles across the barcode. See image below.



Verification grade details can be seen in the Verification Grades dialog. Grades range from 4.0 for highest quality to 0.0 for lowest quality. Grades are in decimal format, and report with a resolution of 0.1. To the right of the grade is the **Value** that shows the internal measurement on a scale of 0-100.

This dialog shows the Overall grade for the code at the top of the dialog, followed by the average grade of all 10 scans lines for each of the lower level quality tests.

The Overall grade for the code is computed as the arithmetic mean of the 10 scan line grades, where each scan line grade is computed as the lowest grade of any parameter, or test, for that scan line.

Note: The ISO/IEC 15416 reports displays decimal grades with a resolution of 0.1.

ISO/IEC 15416:2016	Standards Grading (Value)	Description
Overall Grade	3.5 to 4.0 (A), 2.5 to 3.4 (B), 1.5 to 2.4 (C), 0.5 to 1.4 (D), Less than 0.5 (F)	Overall Grade and letter equivalent. Note that intermediate values are interpolated between 4.0 = 100 and 0.0 = 0.
Reference Decode	4.0 (100), 0.0 (0)	Reference Decode — Pass/Fail test. Checks that the barcode decodes with the ISO reference decoding algorithm.
Edge Determination	4.0 (100), 0.0 (0)	Edge Determination — Pass/Fail test. Checks that the edge gradients between all bars and spaces are above a defined threshold allowing edge to be detected.
Quiet Zone	4.0 (100), 0.0 (0)	Quiet Zone — Pass/Fail test . Fails if there is a violation in the quiet zone region outside the leading or trailing bar. The required quiet zones are symbology-dependent and can be found in the symbology specifications.
Decodability (%)	4.0 (≥62%), 3.0 (≥50%), 2.0 (≥37%), 1.0 (≥25%), 0.0 (<25%)	Decodability — Percentage value of the proportion of the available margin before improperly decoding characters within the symbol. This measurement is based on the individual bar and space elements within a character and their deviations from thresholds used to identify characters.
Defects (%)	4.0 (≤15%), 3.0 (≤20%), 2.0 (≤25%), 1.0 (≤30%), 0.0 (>30%)	Defects (score) — Percentage value of the irregularities found within elements and the quiet zones measured in terms of element reflectance non-uniformity.
Minimum Edge Contrast (%)	4.0 (≥15%), 0.0 (<15%)	Min Edge Contrast — Percentage value of minimum edge contrast. Edge Contrast is the difference between the bar reflectance and space reflectance of two adjacent elements.
Min Reflectance (%)	4.0 (Pass, ≤50% Rmax), 0.0 (Fail, >50% Rmax)	Min Reflectance — Percentage value of reflectance of darkest bar.
Modulation	4.0 (100), 3.0 (75), 2.0 (50), 1.0 (25), 0.0 (0)	Modulation — Unitless value between 0 and 100 of the ratio of the minimum edge contrast to the symbol contrast.
Symbol Contrast (%)	4.0 (≥70%), 3.0 (≥55%), 2.0 (≥40%), 1.0 (≥20%), 0.0 (<20%)	Symbol Contrast — Percentage value of the difference between the highest and the lowest reflectance values in a scan reflectance profile.

8-6-2 ISO/IEC 15415:2011 – 2D Printed Barcode Labels

ISO/IEC 15415 is used to verify the quality of 2D Code Labels. The verification results can be seen in the report UI listing the overall grade for the code at the top of the dialog, followed by the individual results.

Each result shows a grade from 4.0 for highest quality to 0.0 for lowest quality. This numeric grade is followed by the exact calculated internal measurement value on a scale of 0-100.

By default, one decimal place is used in the reported grade for a more detailed representation of symbol quality and matches the reporting format of the Omron LVS off-line verification systems. For full compliance with the ISO/IEC 15415:2011 standard, the reported grade must be truncated to a single digit integer value by changing the grading format option in the verification tool from “Number” to

" Strict Integer". As an example of a strict integer grade, any value from 2.1 to 2.9 will be reported as 2. Because of this, the grade can seem artificially low in comparison with the default number grade.

Report with Grading Format = Number

Verification Grades		
Overall	2.6	65
Reference Decode	4.0	100
Axial Non-Uniformity	4.0	0
Contrast	3.8	68
Fixed Pattern Damage	4.0	100
Grid Non-Uniformity	4.0	18
Modulation	2.6	65
Reflectance Margin	2.6	65
Unused EC	4.0	80

Report with Grading Format = Strict Integer

Verification Grades		
Overall	2	60
Reference Decode	4	100
Axial Non-Uniformity	4	1
Contrast	4	71
Fixed Pattern Damage	3	75
Grid Non-Uniformity	4	18
Modulation	2	60
Reflectance Margin	2	60
Unused EC	4	80

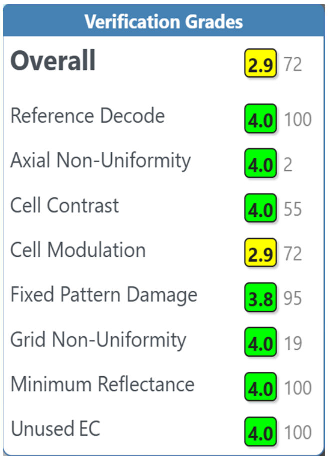
ISO/IEC 15415:2011	Standards Grading (Value)	Description
Overall Grade	4.0 (A), 3.0 (B), 2.0 (C), 1.0 (D), 0.0 (F)	Overall Grade — Lowest of any of the subsequent tests. Note that for values, 4.0 = 100, 3.0 = 75, 2.0 = 50, 1.0 = 25, and 0.0 = 0.
Reference Decode	4.0 (100), 0.0 (0)	Reference Decode — Pass/Fail test. Reflects if the 2D barcode decodes with the ISO reference decoding algorithm.
Axial Non-Uniformity (%)	4.0 (≤6%), 3.0 (≤8%), 2.0 (≤10%), 1.0 (≤12%), 0.0 (>12%)	Axial Non-Uniformity — Percentage measurement of the difference between the printed size of the rows and columns in a matrix.
Contrast (%)	4.0 (≥70%), 3.0 (≥55%), 2.0 (≥40%), 1.0 (≥20%), 0.0 (<20%)	Contrast — The percentage difference between the maximum and minimum reflectivity in the inspection area.
Fixed Pattern Damage	4.0 (100), 3.0 (75), 2.0 (50), 1.0 (25), 0.0 (0)	Fixed Pattern Damage — Unitless measurement of non-uniformity in the quiet zone and in the locator and clock tracks.
Grid Non-Uniformity (%)	4.0 (≤38%), 3.0 (≤50%), 2.0 (≤63%), 1.0 (≤75%), 0.0 (>75%)	Grid Non-Uniformity — Percentage measurement of the difference of the measured grid in relation to the ideal grid formed from the four sides of the 2D code.
Modulation	4.0 (100), 3.0 (75), 2.0 (50), 1.0 (25), 0.0 (0)	Modulation — Unitless measurement of the uniformity of the contrast of the dark areas and the light areas of the 2D code.
Reflectance Margin	4.0 (100), 3.0 (75), 2.0 (50), 1.0 (25), 0.0 (0)	Reflectance Margin — Unitless measurement of the degree to which the cells are correctly distinguishable as black or white in comparison to the global threshold.
Unused EC (%)	4.0 (≥62%), 3.0 (≥50%), 2.0 (≥37%), 1.0 (≥25), 0.0 (<25)	Unused Error Correction — The percentage of error correction remaining after applying the Reed Solomon error correcting algorithm and successfully decoding the symbol (expressed as a percentage of the error correction contained within the symbol).

8-6-3 ISO/IEC 29158:2020 – 2D Direct Part Marks

ISO/IEC 29158 is used to verify the quality of 2D Direct Part Marks including Data Matrix, QR Code, and Aztec. The verification results can be seen in the UI listing the overall score for the code at the top of the dialog, followed by the individual results.

Each result shows a grade from 4.0 for highest quality to 0.0 for lowest quality. This grade is followed by a value that shows the exact internal measurement as a percentage on a scale of 0-100.

Note: ISO/IEC 29158 reports decimal grades with a resolution of 0.1.

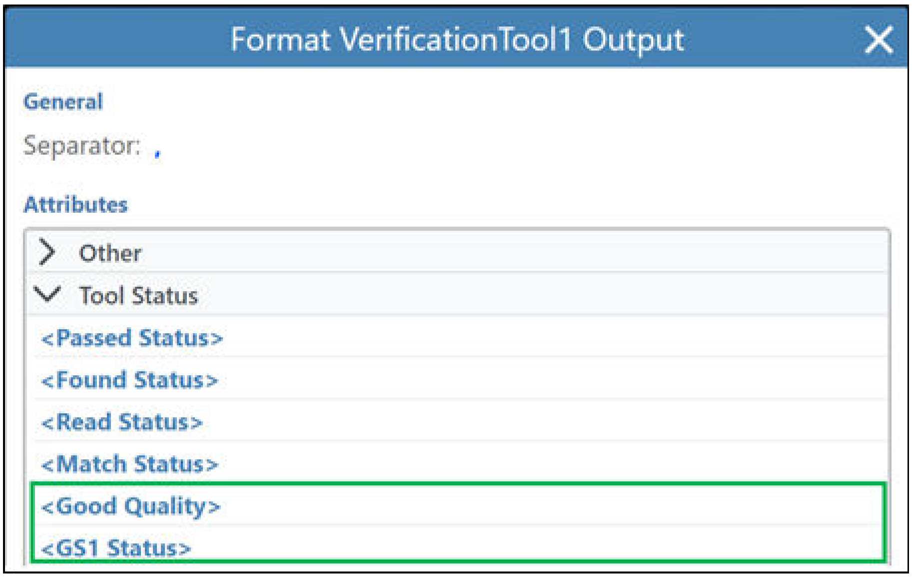


ISO/IEC 29158:2020	Standards Grading (Value)	Description
Overall Grade	3.5 to 4.0 (A), 2.5 to 3.4 (B), 1.5 to 2.4 (C), 0.5 to 1.4 (D), Less than 0.5 (F)	Overall Grade — Lowest of any of the subsequent tests. Note that intermediate values are interpolated between 4.0 = 100 and 0.0 = 0.
Reference Decode	4.0 (100), 0.0 (0)	Reference Decode — Pass/Fail test. Reflects if the 2D barcode decodes with ISO reference decoding algorithm.
Axial Non-Uniformity (%)	4.0 (<6%), 3.0 (<8%), 2.0 (<10%), 1.0 (<12%), 0.0 (≥14%)	Axial Non-Uniformity — Percentage measurement of the difference between the printed size of the rows and columns in a matrix.
Cell Contrast (%)	4.0 (>30%), 3.0 (>25%), 2.0 (>20%), 1.0 (>15%), 0.0 (≤10%)	Cell Contrast — The difference in percent of the center of the distribution of the light cells of the 2D code versus the center of the distribution of the dark cells.
Cell Modulation	4.0 (100), 3.0 (75), 2.0 (50), 1.0 (25), 0.0 (0)	Cell Modulation — Unitless measurement of the uniformity of the contrast of the dark areas and the light areas of the Data Matrix. Note: This measurement encompasses 15415 Modulation and Reflectance Margin.
Fixed Pattern Damage	Depends on code type. Example below is for Data Matrix. 4.0 (100), 3.0 (75), 2.0 (50), 1.0 (25), 0.0 (0)	Fixed Pattern Damage — Unitless measurement of non-uniformity in the quiet zone and in the locator and clock tracks.
Grid Non-Uniformity (%)	4.0 (<38%), 3.0 (<50%), 2.0 (<63%), 1.0 (<75%), 0.0 (≥88%)	Grid Non-Uniformity — Percentage measurement of the difference of the measured grid in relation to the ideal grid formed from the four sides of the 2D code.
Minimum Reflectance (%)	4.0 (≥20%), 3.5 (≥15%), 2.5 (≥10%), 1.5 (≥5%), 0.0 (0%)	Minimum Reflectance — Percentage measurement of the brightness difference between the bright modules and the determined brightness of the bright modules in the calibration template.
Unused EC (%)	4.0 (≥62%), 3.0 (≥50%), 2.0 (≥37%), 1.0 (≥25%), 0.0 (≥12.5%)	Unused Error Correction — The percent of error correction remaining after applying the Reed Solomon error correcting algorithm and successfully decoding the symbol (expressed as a percentage of the error correction contained within the symbol).

8-7 Verification Outputs Summary

Multiple verification result outputs are available for inclusion in the output string for setting the state of the digital outputs.

8-7-1 Status Outputs



Verification-Specific Status Outputs include:

- **Good Quality –** Code verified at or above the minimum passing grade;
- **GS1 Status –** Code passed the syntax verification test.

8-7-2 Decode Outputs

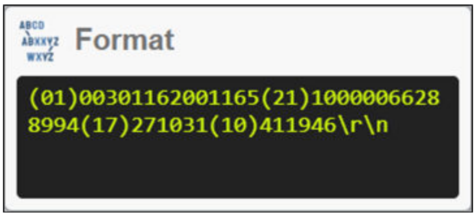
Decode Outputs include:

- **Verification Grade –** Overall verification grade for the code in either number (4.0-0.0) or letter format (A-F);
- **Verification Report –** Verification grades for all verification measurements in either the number or letter format;
- **Verification Values – Internal values** calculated by Verification (0-100) prior to being converted to a numeric or letter grade.;

- **Verification Setup Notes –** Contents of the custom setup field in step 1 of the calibration wizard that is filled in by the user with any extra notes describing the physical verification setup;
- **Verification is Calibrated –** True/False value indicating if Calibration Step has been completed. The tool will not run unless the system has been fully calibrated;
- **Verification Summary –** Single string showing the relevant verification data required by many recording systems. Example:
  Format: *<DPM (if ISO/IEC 29158)><overall_grade>/<aperture in mils>/<wavelength>/<angle>*

An example of the **Verification Summary** report string is shown below.

- **GS1 String –** When GS1 Syntax Checking is turned on, the system can output the string in GS1 format, the same as it is shown on the screen. The screen captures below show the on-screen graphics as well as the actual GS1 string that will be output.



9

Scripting

9-1 Overview

WebLink versions 1.2 and above support **Scripting**. Scripting allows the user to program custom functions that override the standard **Format Output Step**, as well as how the **Digital Outputs** are set at the end of the read cycle. Scripts are stored as part of the Job.

Scripting is a powerful capability allowing the user to control how the VHV5-F communicates out to the other equipment on the automation line through custom **Reports** and custom **Digital Outputs**. Scripting enables other complex operations as well, such as reporting on trends, since data collected within the script remains persistent from one read cycle to the next.

9-2 Lua Scripting Language

The scripting language is **Lua**. Lua is a general-purpose programming language that is particularly well-suited for tasks like scripting, allowing programmers to extend the functionality of existing software.

Lua is one of the main languages used for scripting on automation equipment. It has a straightforward and easy-to-learn syntax, making it accessible for both beginners and experienced programmers. It is a dynamically typed language, meaning that variable types are not explicitly declared and are checked at runtime. Lua automatically manages memory, freeing programmers from the burden of manual memory management. Finally, Lua supports multiple programming paradigms, including procedural, object-oriented, functional, and data-driven programming.

9-3 Script Step and Main Functions

The **Script** step runs just before the end of the read cycle prior to data output. There are two main functions the user can override. The first is **formatOutput()**, which allows the user to create a custom string output. The second is **postCycle()**, which allows the user to custom-set the digital outputs.

9-3-1 formatOutput() Function

Programming the formatOutput() Function

When enabled, **Scripting** allows the user to create an alternate string that will be sent out at the end of the read cycle on all enabled communication channels. The override function for this is **formatOutput()**. It allows complete replacement of the textual output data produced by the read cycle.

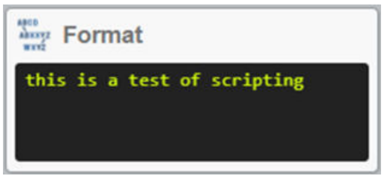
Nearly all of the data for each Decode Tool, as well as data for the Read Cycle itself (such as the Cycle Number) is contained in the **cycleData** report that is passed into the function. Each data element in the report is available within the Scripting environment to be used for logic and for creating the custom output string or report. The string returned by the formatOutput function replaces the string normally output by the job.

```

-- This function overrides the formatted output, return a string
function formatOutput(cycleData)
    return "this is a test of scripting"
end

```

This data string is displayed in the **UI Format** step, sent out over all enabled TCP/IP ports over RS-232, and set into the PLC input assembly at the end of the read cycle.



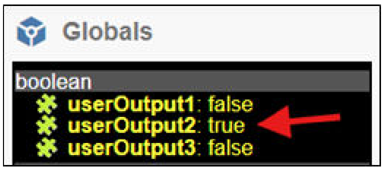
9-3-2 postCycle() Function

Programming the postCycle() Function

When enabled, **Scripting** allows the user to directly set the three digital outputs using the **postCycle** function. Again, all the data for each Decode Tool, as well as data for the read cycle itself (such as Verification Grade) is contained in the **cycleData** report, is available within the Scripting environment, and can be used to build the logic to set the outputs.

The postCycle() function sets the state of the outputs through use of the variables **userOutput1-3**. These variables activate the corresponding physical output at the end of the read cycle when set to true. No activation of the physical outputs will happen if the variable is set to false. The physical output will follow the device parameters for **Normal** state, **Pulse On Time**, and **Pulse Off Time**, defined in **6-1-12 Setting Up Digital Outputs**.

As the program runs, it is possible to see the states of **userOutput1-3** in the **Globals** output area of the Scripting user interface as shown below. Note that this area shows the variables used in the script and not the physical outputs.



An example of this logic could be setting an output if more than 3 codes in a row were unable to be read.

A second example shown below is how **ISO Code Verification** could be used to set the outputs to control a stack light. **Output 1** could be set to **on** if the code is **good quality (green light)**, **Output 2** if the code is **fair quality (yellow light)**, and **Output 3** if the code is **poor quality (red light)**.

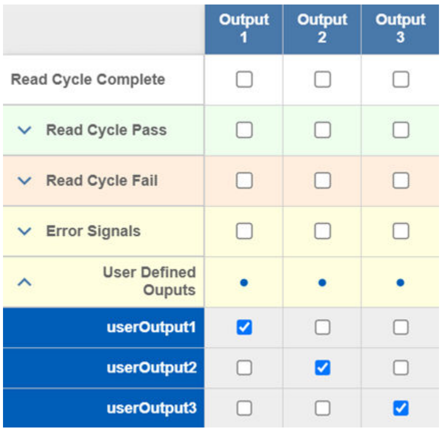
```

-- This function is called at the end of a cycle
-- can set userOuputs here. No return value
function postCycle(cycleData)
    userOutput1 = false
    userOutput2 = false
    userOutput3 = false

    if grade > 3 then
        userOutput1 = true
    else if grade > 1.5 then
        userOutput2 = true
        else
            userOutput3 = true
        end
    end
end
```

Configuring the Digital Outputs to Use User-Defined Outputs from Scripting

The Output configuration on the **Device Page** must be set to use the **User-Defined Outputs**. To accomplish this, turn off the checks under the standard logic section, expand User-Defined Outputs, and then select the Script-based **userOutput 1-3** to be connected to the physical Output 1 to 3.

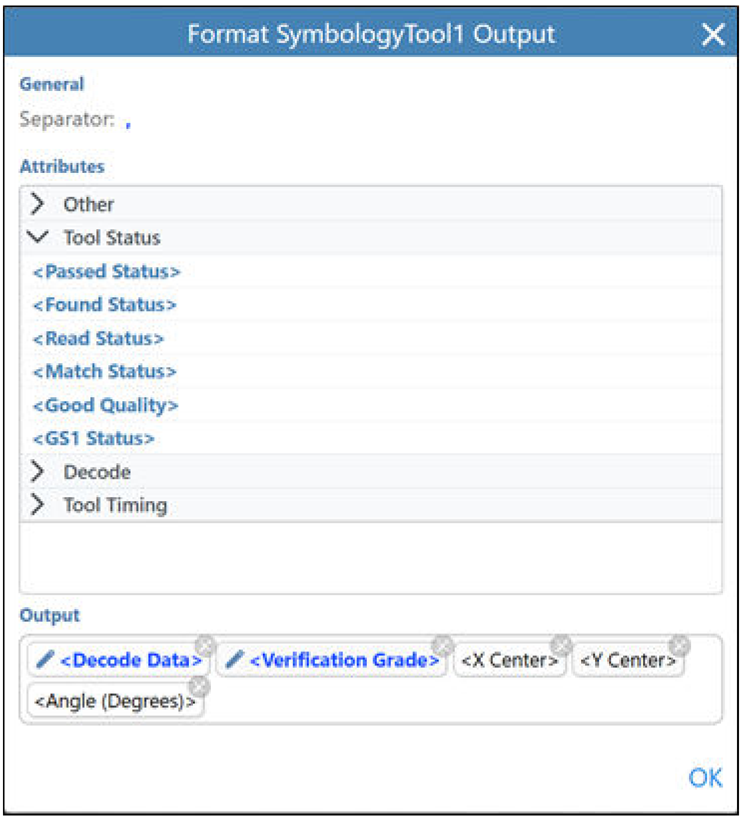


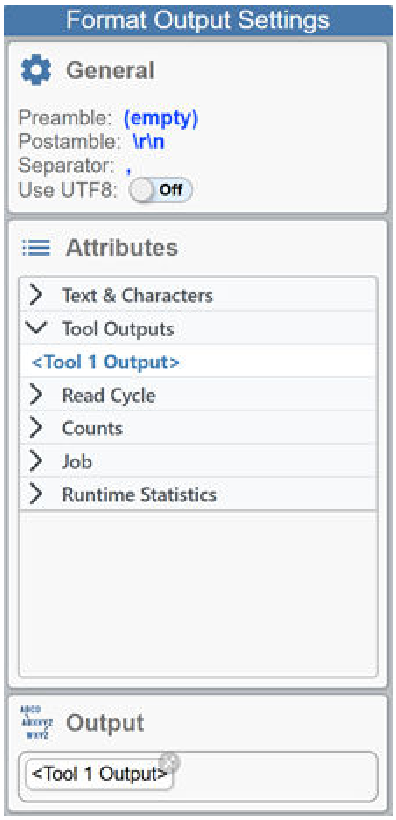
9-3-3 The cycleData Report (Symbology Tool and Read Cycle Data)

Symbology Tool and Read Cycle Format Data

WebLink generates a rich amount of data based on Decodes and Read Cycle performance. Access to Decode (Symbology) Tool and Read Cycle result data is fundamental to creating functional Scripts.

WebLink normally allows access to this data through the Decode Tool Format control (below left), as well as through the Read Cycle Format step (below right). Both allow extreme customization of the output string. Sections 7-7-15 and 7-8-3 describe each and every data field surfaced by these two controls.



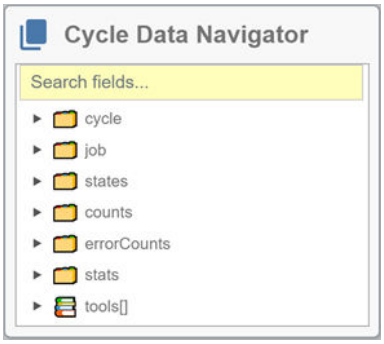


The cycleData Report

The majority of this same data is surfaced for use in Scripting through the **cycleData** report. The Cycle Data Navigator described in the next chapter provides quick and easy access to the programming variable names for this data. The user is able to use the control to find the data element, and then click on its name. When the user clicks on the name, the actual programmer's variable name is copied into the clipboard and can be pasted directly into the Lua script.

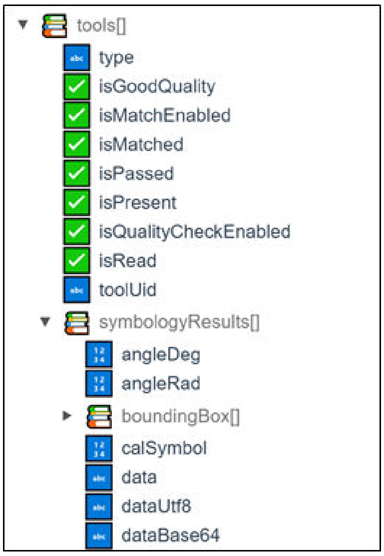
● Read Cycle Data

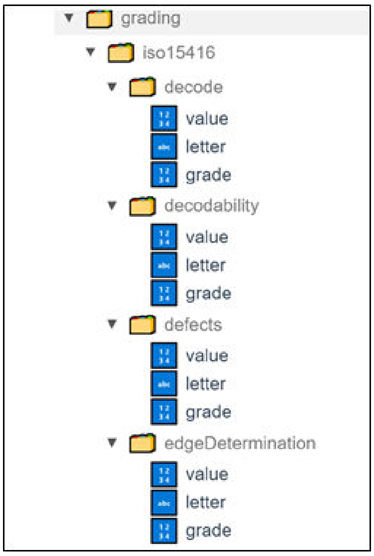
Cycle, states, counts, error counts, and stats are all subcategories of the available Read Cycle data. States, for example, surface Read Cycle pass/fail status, match status, code quality status, etc.



● Decode Tool Data

Tools[] is all the data from each and every Decode Tool within the Job. It is accessed as and array. Some data requires drilling down to the desired data variable. The example below on the right shows the expanded view when using the control to access Verification Grading data.





Note: Arrays are 1 based. The following example shows the variable names used to access the Readability Score in a job where there are two decode tools, Decode Tool 1 and Decode Tool 2.

```
-- This function overrides the formatted output, return a string
function formatOutput(cycleData)

    return "This is a test of scripting. Readability score for Decode Tool 1 = " ..
            cycleData.tools[1].symbologyResults[1].readability ..
            " Readability score for Decode Tool 1 = " ..
            cycleData.tools[2].symbologyResults[1].readability
end
```

This is the output of the formatOutput() function from the script example above.

Format

```
This is a test of scripting.
Readability score for Decode
Tool 1 = 93. Readability score
for Decode Tool 1 = 73.
```

9-4 WebLink Integrated Script Editing Environment

9-4-1 Integrated Code Editing Environment

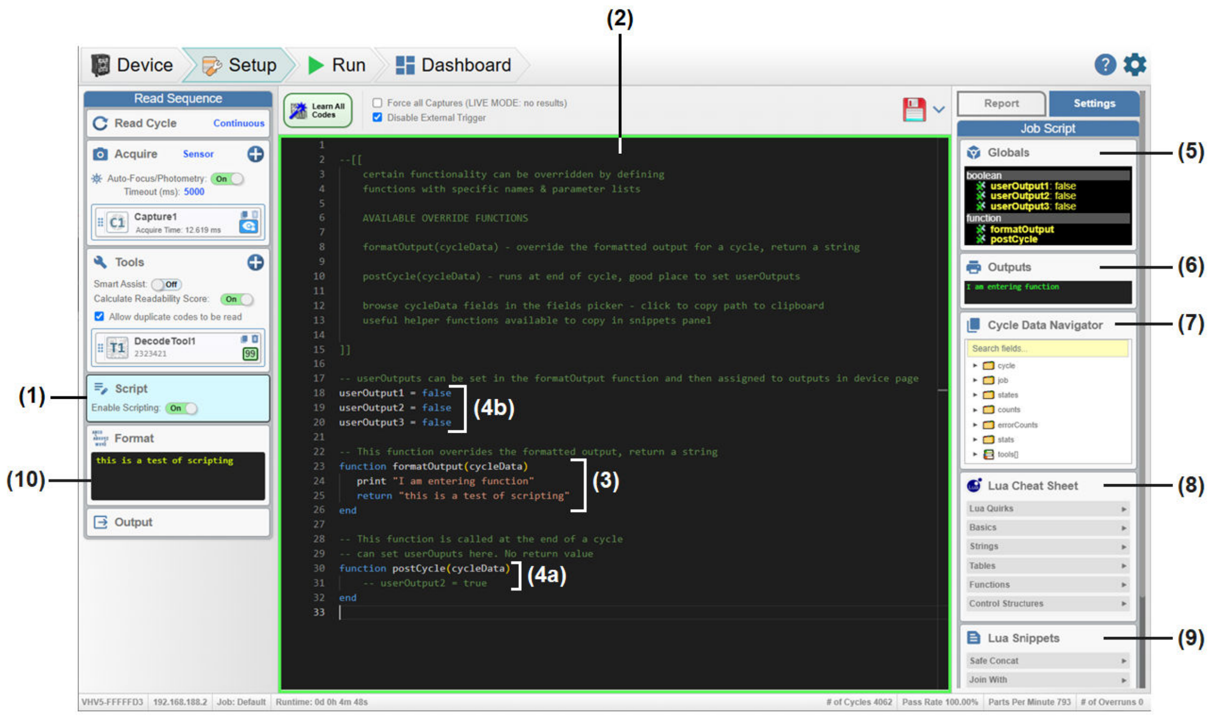
WebLink features an integrated script editing environment. The UI includes a modern editor with syntax checking and error highlighting functions. The UI also includes integrated debugging capabilities to view the value of Global Variable and see the Output of "debug" print statements.

To assist in programming, the editing environment provides the **Cycle Data Navigator**, a tree navigation control that allows the user to find and select any output data variable of the Decode Tool or Read Cycle, and to automatically copy and paste that variable name directly into the editor.

Finally, the UI features a **Lua Cheat Sheet** and **Lua Snippets**, to provide basic Lua help as well as access to advanced functions that can be copied and pasted into the script.

9-4-2 Script Editor Components

The following diagram shows the script editing environment that is seen when the **Script** step is selected and **Enable Scripting** is turned on.



1. **Script Step** – The Script Step runs at the end of the read cycle prior to the Format Output Step and prior to when the digital outputs are set. The script editing environment is displayed when this step is selected and **Enable Scripting** is turned on.

2. **Script Editor** – When scripting is enabled, the script editing environment takes over the screen. The center image display area is replaced with the script editor control. The right panel will show script related information.

   The editor does basic color coding based on the Lua syntax and handles detection of many syntax errors as you type. This is accomplished by running the Lua script first in the browser and capturing the error output. The editing area will show a green border if the syntax check passes, a red border if it fails.

   Syntax errors highlight the problem line, and the editor border will turn red.

   ```
   -- This function overrides the formatted output
   function formatO utput(cycleData)
       dumpTable(cycleData)
       return "this is a test of the scripting"
   end
   ```

   All edits happen live as you type, and the script is updated in the runtime the same way all parameters are altered in WebLink. Any changes to the script will occur in the next cycle. You can also edit the script while triggering the job.

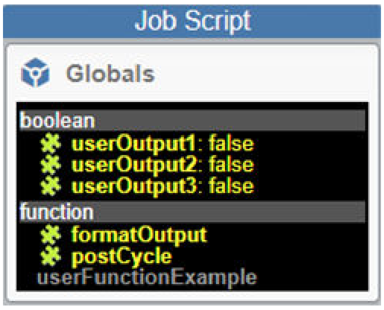
   Note 1: Continuous mode does not end the cycle until a code is found. For this reason, it is suggested that you first create a stable decode environment for continuous mode before you edit the script while running.

   Note 2: It is also possible to edit the script without it being run within the job. It is only when the Enable Scripting toggle is On that the script will take over.

3. **Formatted Output String Function**
   1) **formatOutput(cycleData)** is the script function that overrides the Format Step. User code is inserted here to create a custom data output string.
   2) This data string will be displayed in the UI, sent out over all enabled TCP/IP ports, over RS-232, and set into the PLC input assembly at the end of the Read Cycle.

4. **Digital Output Function**
   1) **postCycle(cycleData)** is the script function that sets the digital outputs. User code is inserted here to custom set the digital outputs.
   2) The function sets state of the outputs through use of the variables **userOutput1 – 3.** The variables are directly linked to the digital outputs. The state of the digital outputs is set at the end of the Read Cycle.

5. **Globals Watch Window** – Lists all Global Variables and their values, as well as user functions. There are several information blocks shown in the right panel. These panels are only visible if scripting is enabled. The **Globals** block shows the user defined functions and variables in the script.



For functions, in this example **formatOutput** and **postCycle** have been detected and appear in yellow to show that they are keywords. The **userFunctionExample** function was also detected, but it is grey because the runtime attaches no special meaning to it.

Also, the three **userOutput** global Booleans were detected. The value of these and any other global variables will updated and displayed at the end of each cycle.

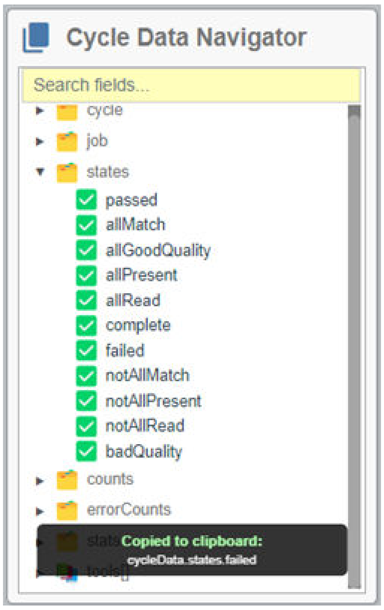
6. **Output** – The **Output** block shows the result of executing print() statements within the script. In this example, the formatOutput has a print statement whose text is shown here. This is a very useful debugging tool for use while developing scripts.

7. **Cycle Data Navigator** – Also available in the right panel is the **Cycle Data Navigator** block. This tree view picker control shows the various fields in the cycleData object. The fields within the cycleData object contain the key result data from all of the decode tools, verification tools, and from the read cycle.

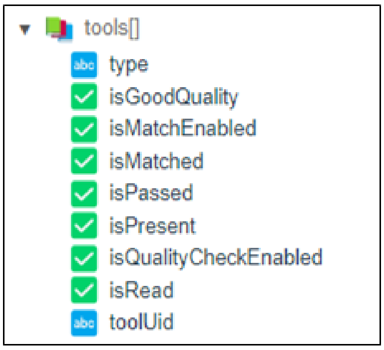
   This is the data that will be used to create the custom output string with formatOutput(). It is the data that will be used to determine the state to set the digital output with postCycle(). It is the data to use for any cycle-to-cycle logic.

   1) Clicking on a field will cause the full path to be copied to the clipboard, which can then be pasted into the editor.

      Note: The user must click on the string name itself for it to be automatically copied into the clipboard.

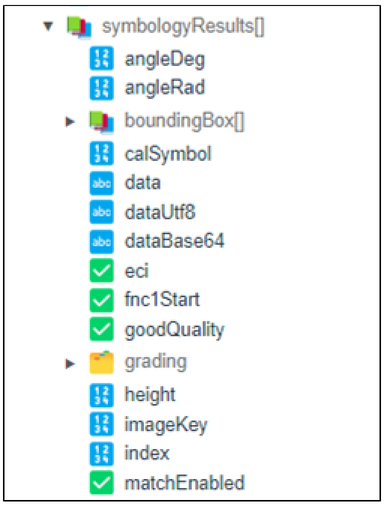


2) The Navigator permits drilling down to each individual tool result as well.

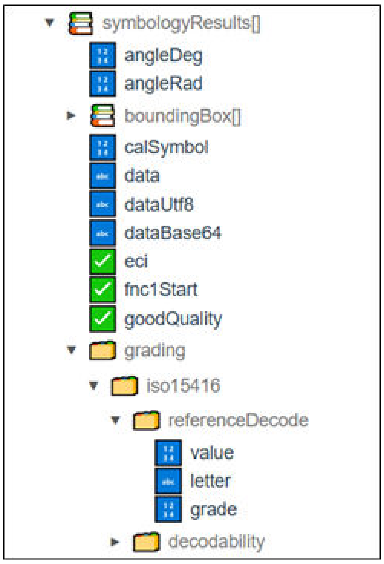


Note: Lua arrays begin at 1 and not 0 as is common in other programming languages.

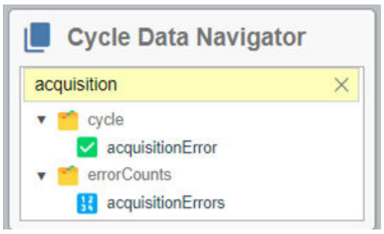
3) It is also possible to drill down to each symbology result. A normal symbology tool will have only one result, unless the multicode feature is enabled – in which case there will be a result per code found.



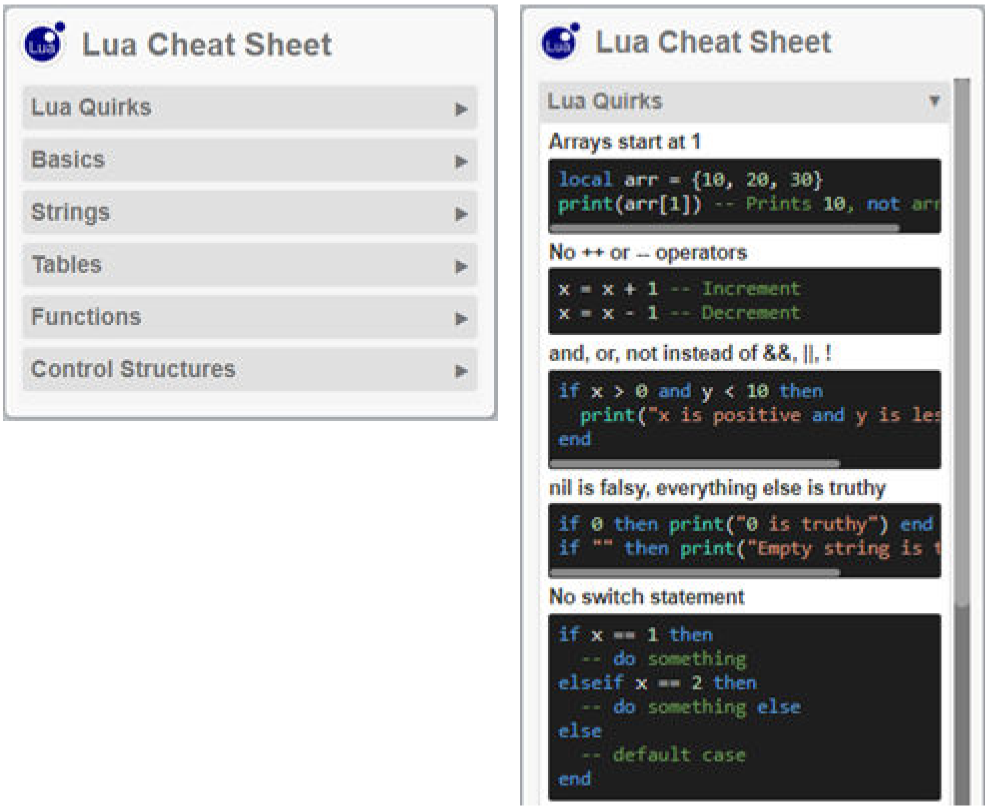
4) In the same way, it is possible to find all the outputs from the ISO Verification tools if they were enabled and run on a code. Search down to “grading”, and then select the ISO verification standard, the output value, and then finally the measurement value, letter grade, or numerical grade.



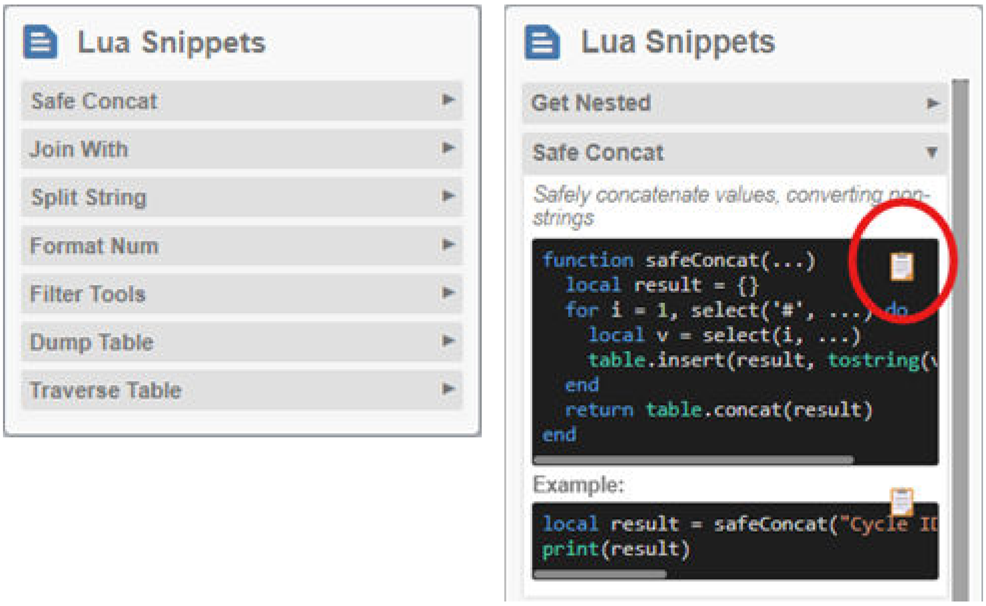
5) The search bar can be used to find individual fields by name. Type part of the name, and all the results will appear underneath.



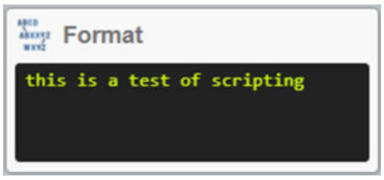
8. **Lua Cheat Sheet** – A “cheat sheet” is available with common tips and tricks for Lua programming. Individual sections can be opened to find information with examples.



9. **Lua Snippets** – A Lua Snippets control is also available with useful functions that can be pasted into the script. The selection of snippets is geared towards common scenarios when formatting or parsing text, or navigating a complex structure like the **cycleData** object returned in the Script. Sections can be opened to see the function code to copy as well as example usage. Click the button to copy the code to the clipboard.



10. **Format** – Shows the string from the script formatOutput(cycleData) function.



Note: This same data string is sent over all enabled TCP/IP ports, over RS-232, and set in the PLC input assembly at the end of the Read Cycle.

10

Serial Commands

The VHV5-F supports the serial commands described in this section.

10-1 Serial Command Syntax

Serial Command and Control

The reader TCP/IP, UDP, and RS-232 channels are normally used to output result data to a host. These same channels can be used to control the reader as well. This section lists the Serial Command set that can be used to control the reader.

The command set allows the host to Trigger the reader, to change the Mode of the reader, to set Key Job Parameters such as focus, lighting, and match string, and to call Quickset functions such as Quick Photometry and Quick Focus that actively set up imaging.

Serial Command Syntax

1. All Serial Commands start with an ! followed by the command name. All commands must be followed by a carriage return (CR).

   Example:
   !TRIGGER<CR>

2. Commands with arguments require a comma between each field.

   Example:
   !SETMATCHSTR,2,123456<CR>

Serial Command Response

1. All serial commands return an error code when complete. 0 = Success. All error codes are listed in the tables below. Note that some commands such as Quick Photometry and Quick Focus may take up to 5 seconds to complete.

   Example:
   !TRIGGER<CR>
   Expected Response: !TRIGGER=0

10-1-1 !TRIGGER

Description	Sends a soft trigger to the reader.	
Parameters	None	
Return Err Codes	0	Success

Operation: Triggers a Read Cycle if system is in Run or Setup mode.
Mode: System needs to be in Run mode or Setup mode to act on this command.

Example:
!TRIGGER<CR> – Triggers a Read Cycle.
Expected Response 1: !TRIGGER=0<CR><LF>
Expected Response 2: [Format Output]

10-1-2 !RUN

Description	Puts the reader into Run mode.	
Parameters	None	
Return Err Codes	0	Success

Operation: Puts the reader into Run mode and changes user interface to Run view.
Run Mode: Job Change is allowed in Run mode. Job Parameter changes are not allowed.

Example:
!RUN <CR> – Changes reader to Run mode.
Expected Response: !RUN=0<CR><LF>

10-1-3 !SETUP

Description	Puts the reader into Setup mode.	
Parameters	None	
Return Err Codes	0	Success

Operation: Puts the reader into Setup mode and changes user interface to Setup view.
Setup Mode: Job Change is not allowed in Setup mode. Job Parameter changes are allowed.

Example:
!SETUP<CR> – Changes reader to Setup mode.
Expected Response: !SETUP=0<CR><LF>

10-1-4 !OFFLINE

Description	Puts the reader into Offline mode. No triggers are accepted when offline.	
Parameters	None	
Return Err Codes	0	Success

Operation: Puts the reader in Offline mode and changes the user interface to Device view.
Offline Mode: Job is stopped and does not respond to triggers. Job Change is allowed in Offline mode. Job Parameter changes are not allowed.

Example:
!OFFLINE<CR> – Puts the reader in Offline mode.
Expected Response: !OFFLINE=0<CR><LF>

10-1-5 !SETEXPOSURE,<capture index>,<exposure value>

Description	Sets the specified capture to the specified exposure value.	
Parameters	<capture index>	1 based index of the capture you wish to modify.
	<exposure value>	Exposure setting you wish to set into the capture.
Return Err Codes	0	Success
	1	Error: No job is loaded.
	2	Error: Invalid capture index.
	3	Error: Exposure value was out of the valid range.
	101	Invalid command format. Must have at least 2 parameters.

Operation: Directly sets the Exposure Value of the selected Capture in the loaded job.

Example:
!SETEXPOSURE,1,64<CR> – Sets capture 1's exposure setting to 64.
Expected Response: !SETEXPOSURE=0<CR><LF>

10-1-6 !SETGAIN,<capture index>,<gain value>

Description	Sets the specified capture to the specified gain value.	
Parameters	<capture index>	1 based index of the capture you wish to modify.
	<gain value>	Gain value you wish to set into the capture.
Return Err Codes	0	Success
	1	Error: No job is loaded.
	2	Error: Invalid capture index.
	3	Error: Gain value was out of the valid range.
	101	Invalid command format. Must have at least 2 parameters.

Operation: Directly sets the Gain value of the selected Capture in the loaded job.

Examples:
!SETGAIN,1,50<CR> – Sets capture 1's gain setting to 50.
Expected Response: !SETGAIN=0<CR><LF>
!SETGAIN,1,101<CR> – Tries to set capture 1's gain setting to 101, but this is out of the valid range.
Expected Response: !SETGAIN=3<CR><LF>

10-1-7 !SETFOCUS,<capture index>,<focus value>

Description	Sets the specified Capture to the specified Focus value	
Parameters	<capture index>	1 based index of the capture you wish to modify.
	<focus value>	Focus value you wish to set into the capture.
Return Err Codes	0	Success
	1	Error: No job is loaded.
	2	Error: Invalid capture index.
	3	Error: Focus value was out of the valid range.
	101	Invalid command format. Must have at least 2 parameters.

Operation: Directly sets the Focus value of the selected Capture in the loaded job.

Example:
!SETFOCUS,1,150<CR> – Sets capture 1's Focus setting to 150.
Expected Response: !SETFOCUS=0<CR><LF>

10-1-8 !QUICKSET,<capture index>,<do focus>,<do photometry>,<roi left><roi top><roi width><roi height>

Description	Commands the reader to run either a Quick Focus, a Quick Photometry, or both. Optionally allows you to specify a region of interest (ROI) within the image in which to run the operations.

Parameters	<capture index>	1 based index of the capture on which you wish to run Quick Focus or Quick Photometry.
	<do focus>	Set to 1 if you wish to run the Quick Focus operation, 0 if not.
	<do photometry>	Set to 1 if you wish to run the Quick Photometry operation, 0 if not.
	<roi left>	Optional: Left-most pixel location of a region within the image in which you want to run the operation.
	<roi top>	Optional: Top-most pixel location of a region within the image in which you want to run the operation.
	<roi width>	Optional: Width of the region in which you want to run the operation.
	<roi height>	Optional: Height of the region in which you want to run the operation.
Return Err Codes	0	Success
	1	Error: No job is loaded.
	2	Error: Invalid capture index.
	3	Error: Invalid ROI parameters.
	99	Error: Unexpected error.
	101	Invalid command format. Must have at least 3 parameters.

Operation: Puts the system Offline. Runs Quick Photometry or Quick Focus on the selected Capture. Performs this operation within the specified region of interest (ROI). When done, the system is put back into the previous mode.

Note: This operation can take up to 5 seconds to complete and generate a response.

Examples:
!QUICKSET,1,1,0<CR> – Runs a Quick Focus operation on capture 1.
Expected Response: !QUICKSET=0<CR><LF>
!QUICKSET,2,0,1<CR> – Runs a Quick-Photometry operation on capture 2.
Expected Response: !QUICKSET=0<CR><LF>
!QUICKSET,1,1,1,400,500,400,200<CR> – Runs both a Quick Focus and Quick-Photometry operation on capture 1. These operations will be run within a region of the image starting at pixel 400,500, 400 pixels wide and 200 pixels tall.
Expected Response: !QUICKSET=0<CR><LF>

10-1-9 !JOBCHANGE,<job slot index>

Description	Changes the active job to the job in the specified slot.	
Parameters	<job slot index>	0 based index of the job slot to switch to.
Return Err Codes	0	Success
	2	Error: Unexpected Error
	3	Error: Job does not exist.
	8	Error: Invalid job file. Job could not be loaded because it is corrupt.
	12	Error: Invalid Job Slot specified. Slot was outside the valid range.
	101	Invalid command format. Must have at least 1 parameter.

Operation: Puts the system Offline if it is not already. Changes the Job to the one in the selected slot. When done, the system is put back into the previous mode.

Examples:
!JOBCHANGE,1<CR> – Change jobs to the job in slot 1.
Expected Response if there is a job in slot 1: !JOBCHANGE=0<CR><LF>
Expected Response if there is NO job in slot 1: !JOBCHANGE=3<CR><LF>
!JOBCHANGE,33<CR> – Trying to change to job slot 33, but there are only 32 slots on the VHV5-F.
Expected Response: !JOBCHANGE=12<CR><LF>

10-1-10 !SETMATCHSTR,<tool index>,<match string(s)>

Description	Sets the match string of the specified tool to the specified match string value.	
Parameters	<tool index>	1 based index of the tool with the match string you wish to modify. Set this to 0 if you wish to apply the match string to all tools.
	<match string(s)>	The list of match string values to set into the specified tool. This can be one string, or a comma separated list of strings. • If you omit the match string, then you are telling the tool that it should train the match string on the string found in the next decode. • If you wish to set a match string that contains a comma, it must be escaped using '\'. Otherwise, the comma will be treated as a parameter separator.
Return Err Codes	0	Success
	1	Error: Tool index is not valid.
	101	Invalid command format. Must have at least 2 parameters.

Operation: Sets the Match String for a specific Decode Tool.

Examples:
!SETMATCHSTR,2,123456<CR> – Sets tool 2’s match string to "123456".
Expected Result if tool 2 exists: !SETMATCHSTR=0<CR><LF>
Expected Result if tool 2 does NOT exist: !SETMATCHSTR=1<CR><LF>
!SETMATCHSTR,1,123\,456<CR> – Sets tool 1’s match string to “123,456”. Comma is escaped.
Expected Result: !SETMATCHSTR=0<CR><LF>
!SETMATCHSTR,0<CR> – Tells all tools to train their match string(s) on the next decode.
Expected Result: !SETMATCHSTR=0<CR><LF>
!SETMATCHSTR,3,1111,2222,3333<CR> – Sets tool 3’s match strings to "1111", "2222", and "3333".
Expected Result if tool 3 exists: !SETMATCHSTR=0<CR><LF>
Expected Result if tool 3 does NOT exist: !SETMATCHSTR=1<CR><LF>

10-1-11 !GETMATCHSTR,<tool index>

Description	Returns the match string(s) for the specified tool. Defaults to tool 0 if no index is specified.	
Parameters	<tool index>	Optional: 1 based index of the tool with the match string you wish to retrieve. If you leave off this parameter, then you will get the match string for tool 1.

Return Err Codes	0	Success
	1	Error: tool index is not valid.
	2	Error: specified tool is NOT a symbology tool and so has no match string.
	101	Invalid command format. Must have at least 2 parameters.

Operation: Returns the Match String for a specific Decode Tool.

Note: Command not applicable to EtherNet/IP or PROFINET.

Examples:

!GETMATCHSTR<CR> – Gets the match string from tool 1.

Expected Response (match string=123456): !GETMATCHSTR=0,123456

!GETMATCHSTR,2<CR> – Gets the match string from tool 2.

Expected Response if there is a tool 2: !GETMATCHSTR=0,123456

Expected Response if there is NOT a tool 2: !GETMATCHSTR=1

11

Symbologies

This main purpose of this section is to describe all of these low level parameter settings for each of the Code or Symbology Types so the user can set them intelligently.

11-1 Overview

Each Decode Tool is configured by the user to find and read one particular code in the image. The first thing the user must do is add all of the possible Code or Symbology Types it can be to the Codes list.

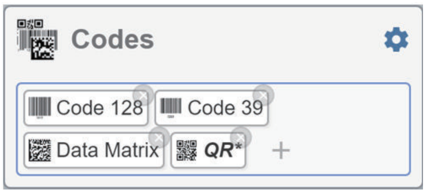
The second thing the user should do is set the specific parameters for that symbology type if required. As an example, for Code 39, the user may need to set "Fixed Symbol Length", so it is able to read the user's particular code.

The default settings for all code types are normally adequate to be able to read most codes with no change. However, there are cases when this is not true and alternate settings must be entered.

The main purpose of this chapter is to describe all of these low level parameter settings for each of the Code or Symbology Types so the user can set them intelligently.

11-1-1 Adding and Removing Codes from the List

Data Matrix, **QR Code**, **Code 128** and **Code 39** are enabled as default code types of the decoder algorithm will search for in any new job.

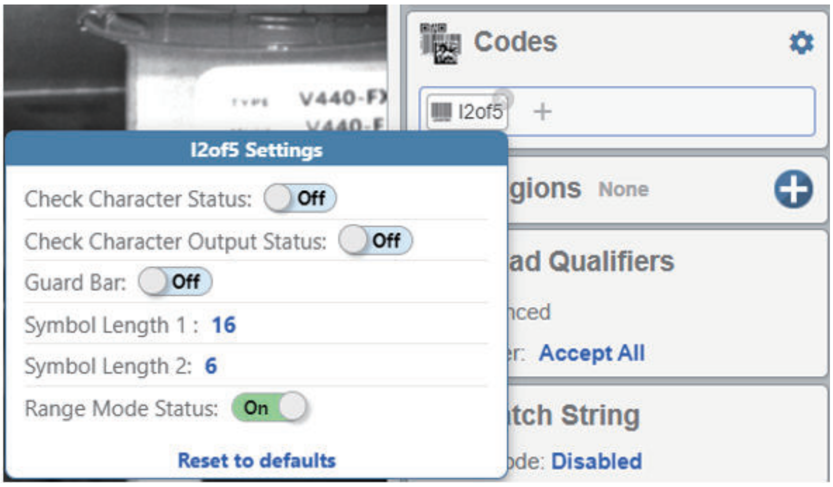


The user may add or remove Symbology types from the list of codes to be found. Code Types are added using the **+**. Code types are deleted from the list by clicking on the x in the top right corner of the code type. Adding the Code Type to the list automatically enables it. Removing it from the list automatically disables it.

11-1-2 Changing Symbology Parameters

To change the parameters for a particular Symbology Type, the user should click on that Code Type in the list. This brings up a dialog box showing current settings. The user can now modify the settings individually or restore the settings to back to default.

Note: The new settings only affect how this one Decode Tool will work. They are not global settings that affect all tools in the job.


Codes
I2of5
gions None
ad Qualifiers
nced
er: Accept All
tch String
ode: Disabled
I2of5 Settings
Check Character Status: Off
Check Character Output Status: Off
Guard Bar: Off
Symbol Length 1 : 16
Symbol Length 2: 6
Range Mode Status: On
Reset to defaults

11-2 Composite

When set to **Enabled** or **Required**, will decode the 2D composite component of a linear symbol. The linear symbol can be DataBar-14, DataBar Expanded, DataBar Limited, EAN-128, UPC-A, EAN-13, EAN-8, and UPC-E.

Usage:	Allows reading by both linear and 2D readers.
Default:	**Disabled**
Options:	**Disabled - when removed from the list** Enabled Required - when added to the list

11-2-1 Enabled

If **Composite** is set to **Enabled**, the reader will decode both the 2D composite and linear components. However, if the 2D composite component is not decoded, the linear data will be sent by itself at the end of the read cycle.

11-2-2 Required

If set to **Required**, the reader must decode both components, or a No-Read will occur.

11-2-3 Separator Status (Composite)

Usage:	Allows the user to distinguish between the main and **Supplemental** symbols.	
Definition:	Separates the linear and the composite component.	
Default:	**Disabled**	
Options:	Off = Disabled	On = Enabled

11-2-4 Separator Character (Composite)

Note: The Separator Character will be the same as the character defined in the **Multisymbol Separator** field.

Usage:	As required by the application.
Definition:	Allows the user to change the separator character from a comma to a new character.
Default:	**,** (comma)
Options:	Any ASCII character.

11-3 Aztec

Usage:	Used in document imaging, railway ticket validation, and some postal applications.
Definition:	A 2D matrix symbology built on a square grid with a square "bull's-eye" pattern at the center. **Aztec** can encode up to 3,832 numeric or 3,067 alphabetical characters, or 1,914 bytes of data. The level of Reed-Solomon error correction used with Aztec is configurable, from 5% to 95% of the total data region. The recommended error correction level is 23% of symbol capacity plus codewords.
Default:	**Disabled**
Options:	**Disabled - when removed from the list** Enabled - when added to the list There are no other settings for Aztec other than the automatic Enable/Disable.

11-4 Postal Symbologies

Important: Postal Symbologies must have a minimum pixels-per-element value of **4** to be decoded reliably by the reader.

The reader must be configured to specific read range, field of view, and camera parameters before decoding Postal Symbologies.

For optimal decode results, position the symbol as close to the center of the reader's field of view as possible.

11-4-1 Postal Symbology Type

Usage:	The following 1D **Postal Symbologies** are used in mail sortation, auditing, certified mail, registered mail, metered mail, and point-of-sale (POS) applications.
Definition:	Determines the postal symbology that will be decoded by the reader.
Default:	**Disabled**
Options:	**0 = Disabled** 1 = U.S. Post (POSTNET, PLANET, Intelligent Mail (USPS4CB)) 2 = Australia Post 3 = Japan Post 4 = Royal Mail 5 = Dutch Post (KIX) 6 = UPU

U.S. Post (POSTNET, PLANET, Intelligent Mail (USPS4CB))

When **U.S. Post** is enabled, the reader will only decode **POSTNET**, **PLANET**, and **Intelligent Mail (USPS4CB)** symbols.

Important: POSTNET Status, **PLANET Status**, and **Intelligent Mail (USPS4CB) Status** are enabled by default. However, if any of the three U.S. Post symbologies is set to **disabled** individually, symbols of that type will not be decoded by the reader even when U.S. Post is enabled.

For example, if **U.S. Post** is enabled but **POSTNET Status** is disabled, **POSTNET** symbols will not be decoded by the reader.

See **POSTNET Status**, **PLANET Status**, and **GS1 DataBar** for more detail about U.S. Post symbologies.

Australian Post

When **Australia Post** is enabled, the reader will only decode Australia Post symbols.

Japan Post

When **Japan Post** is enabled, the reader will only decode Japan Post symbols.

Royal Mail

When **Royal Mail** is enabled, the reader will only decode Royal Mail symbols.

Dutch Post (KIX)

When **Dutch Post (KIX)** is enabled, the reader will only decode Dutch Post (KIX) symbols.

UPU

When **UPU** is enabled, the reader will decode UPU symbols.

For example, if **Postal Symbology Type** is set to **UPU** and **POSTNET Status** is enabled, the reader will attempt to decode both UPU and POSTNET symbols.

11-4-2 POSTNET Status

Usage:	**POSTNET** is used by the United States Postal Service to direct mail. The ZIP Code or ZIP+4 Code is encoded in the symbol. Data is encoded in half-height and full-height bars, making POSTNET a "2-state" symbology. The delivery point (usually the last two digits of the address or post office box number) is also typically encoded in POSTNET symbols.
Definition:	If **U.S. Post** and **POSTNET Status** are both enabled, the reader will decode POSTNET symbols.
Default:	**Enabled**
Options:	Off = Disabled **On = Enabled**

11-4-3 PLANET Status

Usage:	**PLANET (Postal Alphanumeric Encoding Technique)** is a symbology used by the United States Postal Service to track and identify items during delivery. Each PLANET symbol is either 12 or 14 digits long, and encodes data in half-height and full-height bars, making PLANET a "2-state" symbology. The symbol always starts and ends with a full-height bar, or "guard rail", and each individual digit is represented by a set of five bars in which two of the bars are always short.
Definition:	If **U.S. Post** and **PLANET Status** are both enabled, the reader will decode PLANET symbols.
Default:	**Enabled**
Options:	Off = Disabled **On = Enabled**

11-4-4 USPS4CB Status

Usage: **USPS4CB**, also called **Intelligent Mail**, is used by the United States Postal Service to sort and track individual items as well as flats of mail. USPS4CB combines the capabilities of POSTNET and PLANET, and can encode 31 digits (65 bars). USPS4CB symbols are slightly longer than POSTNET symbols, and offer additional flexibility in choosing symbol height and width.

Data is encoded in four types of bars ("states"), each of which is identified by a name and a value. This type of postal symbol is known as "4-state". Each bar has a "tracker", or middle section, to which an "ascender" (top section) or "descender" (bottom section) may be added. The 4-state format allows the symbol to contain more information, and makes it easier to decode. 4-state symbols can also be printed easily in a variety of media, including dot matrix, inkjet, and laser.

Definition: If **U.S. Post** and **USPS4CB Status** are both enabled, the reader will decode USPS4CB symbols.

Default: **Enabled**

Options: Off = Disabled
On = Enabled

11-5 Code 39

Usage:	**Code 39** is considered the standard for non-retail 1D symbology.
Definition:	An alphanumeric symbology with unique start/stop code patterns, composed of 9 black and white elements per character, of which 3 are wide.
Default:	**Enabled**
Options:	Disabled - when removed from the list **Enabled - when added to the list**

11-5-1 Check Character Status (Code 39)

Default:	**Disabled**	
Options:	**Off = Disabled**	On = Enabled

11-5-2 Check Character Output Status (Code 39)

Usage:	**Check Character Output Status**, added to the symbol, provides additional data security.	
Definition:	When enabled, the check character is read and compared along with the symbol data. When disabled, symbol data is sent without the check character. **Note:** With **Check Character Output Status** and an **External** or **Serial** trigger option enabled, an invalid check character calculation will cause a No-Read message to be transmitted at the end of the read cycle.	
Default:	**Disabled**	
Options:	**Off = Disabled**	On = Enabled

11-5-3 Large Intercharacter Gap (Code 39)

Usage:	**Large Intercharacter Gap** is helpful for reading symbols that are printed out of specification.	
Definition:	When enabled, the reader can read symbols with gaps between symbol characters that exceed three times (3x) the narrow element width.	
Default:	**Disabled**	
Options:	**Off = Disabled**	On = Enabled

11-5-4 Fixed Symbol Length Status (Code 39)

Definition:	When enabled, the reader will check the symbol length against the symbol length field. If disabled, any length will be considered valid.	
Default:	**Disabled**	
Options:	**Off = Disabled**	On = Enabled

11-5-5 Fixed Symbol Length (Code 39)

Usage: **Fixed Symbol Length** helps prevent truncations and increases data integrity by ensuring that only one symbol length will be accepted.

Definition: Specifies the exact number of characters that the reader will recognize (this does not include start and stop and check characters). The reader ignores any symbology that does not match the specified length.

Default: **10**

Options: 1 to 64

11-5-6 Full ASCII Set (Code 39)

Usage: Must be enabled when reading characters outside the standard character set (0-9, A-Z, etc.)

The user must know in advance whether or not to use the **Full ASCII Set** option. Since **Full ASCII Set** requires two code words to encode one character, it is less efficient.

Definition: Standard Code 39 encodes 43 characters; zero through nine, capital "A" through capital "Z", minus symbol, plus symbol, forward slash, space, decimal point, dollar sign, and percent symbol. When **Full ASCII Set** is enabled, the reader can read the full ASCII character set, from 0 to 255.

Default: **Disabled**

Options: **Off = Disabled** On = Enabled

11-6 Codabar

Usage: Used in photo-finishing and library applications. Previously used in medical applications, but not typically used in newer medical applications.

Definition: Codabar is a 16-bit character set (0 through 9, and the characters **$**, **:**, /, **.**, **+**, and **–**) with start/stop codes and at least two distinctly different bar widths.

Default: **Disabled**

Options: **Disabled - when removed from the list**
Enabled - when added to the list

11-6-1 Start/Stop Match (Codabar)

Definition: When disabled, the reader will decode Codabar symbols whether or not the start and stop characters are the same.
When enabled, the reader will not decode Codabar symbols unless the start and stop characters are the same.

Default: **Enabled**

Options: Off = Disabled **On = Enabled**

11-6-2 Start/Stop Output (Codabar)

Definition: When disabled, the start and stop characters will not be present in the data output of the decoded symbol.
When enabled, the start and stop characters will be present in the data output of the decoded symbol.
Note: Because the start and stop characters are included as part of the data, the characters must be included as part of the length in a fixed length mode of operation.

Default: **Enabled**

Options: Off = Disabled **On = Enabled**

11-6-3 Large Intercharacter Gap (Codabar)

Definition: When disabled, the spaces between characters, or the "intercharacter gap", are ignored during the decode process.
Note: If the intercharacter space is large enough to be considered a margin, the symbol will not decode, regardless of this parameter's setting.

Default: **Disabled**

Options: **Off = Disabled** On = Enabled

11-6-4 Fixed Symbol Length Status (Codabar)

Definition: When disabled, the reader will accept any Codabar symbol provided it doesn't exceed the system's maximum capabilities.
When enabled, the reader will reject any Codabar symbol that doesn't match the fixed length.

Default: **Disabled**

Options: **Off = Disabled** On = Enabled

11-6-5 Fixed Symbol Length (Codabar)

Definition: This is the value against which all Codabar symbol lengths will be compared.

Default: **10**

Options: 1 to 64

11-6-6 Check Character Type (Codabar)

Definition: When disabled, the reader will not perform any character checking calculations on decoded Codabar symbols.
When set to **Mod 16**, the reader will perform a modulus 16 check character calculation on the symbol. If the symbol does not pass this calculation, it will not be decoded.
When set to **NW7**, The reader will perform an NW7 modulus 11 check character calculation on the symbol. If the symbol does not pass this calculation, it will not be decoded.
When set to **Both**, the reader will perform both the Mod 16 and NW7 modulus 11 check character calculations on the symbol. If the symbol does not pass either calculation, it will not be decoded.

Default: **NoCheck**

Options: **NoCheck** Mod 16 NW7 (Mod 11)
Mod 16 and NW7

11-6-7 Check Character Output (Codabar)

Definition: When this field is disabled and a check character calculation is enabled, the reader will strip the verified check character from the symbol data output. This condition must be accounted for if a fixed length is also being used.
When enabled, the reader will output the check character as part of the symbol data. This condition must be accounted for if a fixed length is also being used.

Default: **Disabled**

Options: **Off = Disabled** On = Enabled

11-7 Interleaved 2 of 5

Usage: I-2/5 has been popular because it is the most dense symbology for printing numeric characters less than 10 characters in length; however, Omron Microscan does not recommend this symbology for any new applications because of inherent problems such as truncation.

Definition: A dense, continuous, self-checking, numeric symbology. Characters are paired together so that each character has five elements, two wide and three narrow, representing numbers 0 through 9, with the bars representing the first character and the interleaved spaces representing the second character. (A check character is highly recommended).
Important: You must set Symbol Length in order to decode I-2/5 symbols, unless **Range Mode** is enabled.

Default: **Disabled**

Options: **Disabled - when removed from the list**
Enabled - when added to the list

11-7-1 Check Character Status (Interleaved 2 of 5)

Usage: This option is not typically used, but it can be enabled for additional security in applications where the host requires redundant check character verification.

Definition: An error correcting routine in which the check character is added.

Default: **Disabled**

Options: **Off = Disabled** On = Enabled

11-7-2 Check Output Status (Interleaved 2 of 5)

Definition: When enabled, a check character is sent along with the symbol data for added data security.

Default: **Disabled**

Options: **Off = Disabled** On = Enabled

11-7-3 Symbol Length #1 (Interleaved 2 of 5)

Usage: Useful in applications where I-2/5 symbols of a specific length are required.

Definition: The **Symbol Length # 1** field is one of two fields against which the decoded symbol is compared before accepting it as valid or rejecting it.

Default: **16**

Options: 0 to 64, even only (will be truncated to next lower even number if odd number is inserted)
Important: If **Range Mode** is disabled, the length of the symbol must match either **Symbol Length # 1** *or* **Symbol Length # 2** to be considered a valid symbol.
If **Range Mode** is enabled, **Symbol Length # 1** and **Symbol Length # 2** form a range into which the length of the symbol must fall to be considered valid.

11-7-4 Symbol Length #2 (Interleaved 2 of 5)

Usage:	Useful in applications where I-2/5 symbols of a specific length are required.
Definition:	The **Symbol Length # 2** field is one of two fields against which the decoded symbol is compared before accepting it as valid or rejecting it.
Default:	**6**
Options:	0 to 64, even only (will be truncated to next lower even number if odd number is inserted) **Important:** If **Range Mode** is disabled, the length of the symbol must match either **Symbol Length # 2** or **Symbol Length # 1** to be considered a valid symbol. If **Range Mode** is enabled, **Symbol Length # 2** and **Symbol Length # 1** form a range into which the length of the symbol must fall to be considered valid.

11-7-5 Guard Bar Status (Interleaved 2 of 5)

- **Note:** Whenever **Guard Bar** is enabled, the presence of guard bars (also called "bearer bars") is required for decoding to take place.

Usage:	Useful when I-2/5 multisymbols are enabled to prevent false data output. This typically occurs with highly tilted or skewed symbols.	
Definition:	A guard bar is a heavy bar, at least twice the width of the wide bar, surrounding the printed I-2/5 symbol and helping to prevent false reads.	
Default:	**Disabled**	
Options:	**Off = Disabled**	On = Enabled

11-7-6 Range Mode Status (Interleaved 2 of 5)

Usage:	Useful in applications where I-2/5 symbols of a specific length are required.	
Definition:	When **Range Mode** is disabled, the reader checks the value of the symbol length against the values set in **Symbol Length # 1** and **Symbol Length # 2**. If the symbol length does not match either of the preset values, then it is rejected as invalid. When **Range Mode** is enabled, **Symbol Length # 1** and **Symbol Length # 2** are combined to form a range of valid symbol lengths. Any symbol length that does not fall into this range is rejected as an invalid symbol. Either of the preset symbol length values in the **Symbol Length # 1** and **Symbol Length # 2** fields can form the start or end of the range.	
Default:	**Enabled**	
Options:	Off = Disabled	**On = Enabled**

11-8 UPC/EAN

Usage:	Used primarily in point-of-sale applications in the retail industry. It is commonly used with the readers in applications in combination with **Matchcode** when there is a need to verify that the right product is being placed in the right packaging.
Definition:	**UPC** (Universal Product Code) is a fixed length, numeric, continuous symbology. UPC can have two- or five-digit supplemental bar code data following the normal code. The UPC Version A (UPC, A) symbol is used to encode a 12 digit number. The first digit is the number system character, the next five are the manufacturer number, the next five are the product number, and the last digit is the checksum character. When enabled, the reader will read UPC Version A and UPC Version E only.
Default:	**Disabled**
Options:	**Disabled - when removed from the list** Enabled - when added to the list

11-8-1 EAN Status

Usage:	**EAN** is the European version of the UPC symbology and is used in European market applications. **Note: UPC** must be enabled for **EAN** to take effect.		
Definition:	EAN is a subset of UPC. Disabled – No EAN output Enabled - When enabled, the reader will read UPC Version A, UPC Version E, EAN 13, and EAN 8. It also appends a leading zero to UPC Version A symbol information and transmits 13 digits. If transmitting 13 digits when reading UPC Version A symbols is not desired, disable EAN. Enabled Suppress Leading 0 - Same as above. It will read the UPCs as EANs but will not add the leading 0. **Note:** The extra character identifies the country of origin.		
Default:	**Enabled**		
Options:	Disabled	**Enabled**	Enabled Suppress Leading 0

11-8-2 Supplemental Status (UPC/EAN)

Usage:	Reads **Supplementals** typically used in publications and documentation.		
Definition:	A supplemental is a 2 to 5 digit symbol appended to the main symbol. When set to **Enabled** or **Required**, the reader reads supplemental code data that has been appended to the standard UPC or EAN codes.		
Default:	**Disabled**		
Options:	**Disabled**	Enabled	Required

Disabled

UPC **Supplementals** will not be decoded.

Enabled

When enabled, the reader will try to decode a main and a supplemental.

Required

When set to **Required**, both the main and the supplemental symbols must be read.

For example, if **Supplementals** is set to **Required**, **Separator** is enabled, and an asterisk is defined as the UPC separator character. Then the data is displayed as:
MAIN * SUPPLEMENTAL.

- **Note:** Under no circumstances will the supplemental symbol data be sent without a main symbol.
- **Note:** If additional symbols—other than the main or supplemental—will be read in the same read cycle, **Number of Symbols** should be set accordingly.

11-8-3 Separator Status (UPC/EAN)

Usage:	Allows users to distinguish between the main and Action at Storage Full symbols.		
Definition:	A character can be inserted between the standard UPC or EAN symbology and the supplemental symbology when **Supplementals** is set to **Enabled** or **Required.**		
Default:	**Disabled**		
Options:	**Off = Disabled**	On = Enabled	

11-8-4 Separator Character (UPC/EAN)

Usage:	As required by the application.
Definition:	Allows the user to change the separator character from a comma to a new character.
Default:	**,** (**comma**)
Options:	Any ASCII character.

11-8-5 Supplemental Type (UPC/EAN)

Usage:	As required by symbology used in application.		
Definition:	Allows the user to select 2 character or 5 character supplements, or both.		
Default:	**Both**		
Options:	**Both**	2 characters only	5 characters only

Both

Either 2 character or 5 character supplementals will be considered valid.

2 Characters Only

Only two character supplementals will be considered valid.

5 Characters Only

Only five character supplementals will be considered valid.

11-8-6 Format UPC-E as UPC-A (UPC/EAN)

Definition:	When disabled, the reader will output the version E symbols in their encoded 6-character format. When enabled, the reader will format the symbol as either a 12-character UPC-A symbol or an EAN-13 symbol, depending on the state of the EAN status parameter. This formatting reverses the zero suppression that is used to generate the symbol in the UPC specification.	
Default:	**Disabled**	
Options:	**Off = Disabled**	On = Enabled

11-9 Code 128/EAN 128

Usage:	**Code 128** is a smaller symbology useful in applications with tight spots and high security needs.
Definition:	A very dense alphanumeric symbology. It encodes all 128 ASCII characters, it is continuous, has variable length, and uses multiple element widths measured edge to edge.
Default:	**Enabled**
Options:	Disabled - when removed from the list **Enabled - when added to the list**

11-9-1 Fixed Symbol Length Status (Code 128/EAN 128)

Definition:	When enabled, the reader will check the symbol length against the symbol length field. If disabled, any length will be considered a valid symbol.	
Default:	**Disabled**	
Options:	**Off = Disabled**	On = Enabled

11-9-2 Fixed Symbol Length (Code 128/EAN 128)

Usage:	**Fixed Symbol Length** helps prevent truncations and increases data integrity by ensuring that only one symbol length will be accepted.
Definition:	This specifies the exact number of characters that the reader will recognize (this does not include start, stop, and check characters). The reader ignores any symbol not having the specified length.
Default:	**10**
Options:	1 to 64

11-9-3 EAN 128 Status (Code 128/EAN 128)

Definition:	When this field is disabled, the reader will not check any Code 128 labels for conformance to EAN requirements, or perform any special formatting. When enabled, the reader can read symbols with or without a function 1 character in the first position. If a symbol has a function 1 character in the first position, it must conform to EAN format. Symbols that conform to EAN format will also be subject to the special output formatting options available in this command. If EAN status is required, the reader will only decode symbols that have a function 1 character in the first position and that conform to EAN format. All symbols read will be subject to the special output formatting options available in this command. **Note:** Code 128 status must be enabled for EAN status to be active.		
Default:	**Disabled**		
Options:	**Disabled**	Enabled	Required

11-9-4 Output Format (Code 128/EAN 128)

Definition:	In **Standard**, the reader will not apply special EAN output formatting options. In **Application**, the reader will apply the special EAN output formatting options to decoded EAN-conforming symbols.	
Default:	**Standard**	
Options:	**Standard**	Application

11-9-5 Application Record Separator Status (Code 128/EAN 128)

Definition: When enabled, an EAN separator will be inserted into the output between fields whenever an EAN-conforming symbol is decoded and EAN output formatting applies.

Default: **Disabled**

Options: **Off = Disabled** On = Enabled

11-9-6 Application Record Separator Character (Code 128/EAN 128)

Definition: This is an ASCII character that serves as an EAN separator in formatted EAN output.

Default: **, (Comma)**

Options: Any ASCII character (7 bit)

11-9-7 Application Record Brackets (Code 128/EAN 128)

Definition: If an EAN-conforming symbol is decoded and EAN formatting applies, this feature places bracket characters around the application identifiers in the formatted output.

Default: **Disabled**

Options: **Off = Disabled** On = Enabled

11-9-8 Application Record Padding (Code 128/EAN 128)

Definition: This feature causes the reader to pad variable-length application fields with leading zeroes. This is not done for the last field of a symbol.

Default: **Disabled**

Options: **Off = Disabled** On = Enabled

11-10 Code 93

Usage:	Sometimes used in clinical applications.
Definition:	Code 93 is a variable-length, continuous symbology employing four element widths. Each Code 93 character has nine modules that may be either black or white. Each character contains three bars and three spaces.
Default:	**Disabled**
Options:	**Disabled - when removed from the list** Enabled - when added to the list

11-10-1 Fixed Symbol Length Status (Code 93)

Definition:	When disabled, the reader will accept any Code 93 symbol provided is doesn't exceed the system's maximum capabilities. When enabled, the reader will reject any Code 93 symbol that doesn't match the fixed symbol length.	
Default:	**Disabled**	
Options:	**Off = Disabled**	On = Enabled

11-10-2 Fixed Symbol Length (Code 93)

Definition:	This is the symbol length value against which all Code 93 symbols will be compared.
Default:	**10**
Options:	1 to 64

11-11 PDF417

Usage:	Used in applications where a large amount of information (over 32 characters) needs to be encoded within a symbol, typically where the symbol is transported from one facility to another. For example, an automobile assembly line might use a single symbol with multiple fields of information that will be read at several stations along the way, without reference to a database.
Definition:	A two-dimensional, multi-row (3 to 90), continuous, variable length symbology that has high data capacity for storing up to 2,700 numeric characters, 1,800 printable ASCII characters, or 1,100 binary characters per symbol. Each symbol character consists of 4 bars and 4 spaces in a 17-module structure.
Default:	**Disabled**
Options:	**Disabled - when removed from the list** Enabled - when added to the list

Note: Sending **<a1>** will cause PDF417 data to be prefaced with information consisting of error correction level (ECC Level ***n***), number of rows (***n*** Rows), number of columns (***n*** Columns), number of informative code words (***n*** Info Code Words) and the number of data characters (***n*** Data Characters). This feature can be disabled by re-sending **<a1>.**

11-11-1 Fixed Symbol Length Status (PDF417)

Default:	**Disabled**	
Options:	**Off = Disabled**	On = Enabled

11-11-2 Fixed Symbol Length (PDF417)

Usage:	Used to increase data integrity by ensuring that only one symbol length will be accepted.
Definition:	When enabled, the PDF symbol must contain the same number of characters as the symbol length setting before it can be considered a good read. The reader will ignore any symbol not having the specified length.
Default:	**10**
Options:	1 to 2710

Note: Fixed Symbol Length Status must be enabled for **Fixed Symbol Length** to take effect.

11-12 Pharmacode

Warning: Pharmacode has no start/stop patterns and is not bi-directional. If you scan it from left-to-right, you get a different sequence of data than if you scan it right-to-left. It is also possible for Pharmacode to interpret other edges on the part (such as text) as a barcode. When deploying Pharmacode, the reader must be set up to see the code in the correct orientation, as well as with a tight region of interest so the reader only sees the actual Pharmacode symbol.

Usage: Used mostly with packaging for the pharmaceuticals industry.

Definition: Encodes up to five different numbers, each with its own color, which may be entered in decimal or "binary" format with a 1 represented by a thick bar and a 0 represented by a thin bar. Bar width is independent of height.
In decimal format, each part can be up to 999,999.
In binary format, each input can have up to 19 ones and zeros.
Important: When Pharmacode is enabled, other linear symbologies will not decode properly. Disable Pharmacode before reading other linear symbologies.

Default: **Disabled**

Options: **Disabled - when removed from the list**
Enabled - when added to the list

11-12-1 Fixed Symbol Length Status (Pharmacode)

Definition: When enabled, the reader will check the symbol length against the symbol length field. If disabled, any length will be considered valid.

Default: **Disabled**

Options: **Off = Disabled** On = Enabled

11-12-2 Fixed Symbol Length (Pharmacode)

Definition: Specifies the exact number of bars that must be present for the reader to recognize and decode the Pharmacode symbol.

Default: **5**

Options: 1 to 16

11-12-3 Minimum Number of Bars (Pharmacode)

Definition: Sets the minimum number of bars that a Pharmacode symbol must have to be considered valid.

Default: **2**

Options: 1 to 16

11-12-4 Bar Width Status (Pharmacode)

Definition: If set to **Mixed Narrow and Wide**, the reader will autodiscriminate between narrow bars and wide bars. If set to **All Narrow**, all bars will be considered as narrow bars. If set to **All Wide**, all bars will be considered as wide bars. If set to **Fixed Threshold**, it will use the fixed threshold value to determine whether the bars are narrow or wide. The **Bar Width Status** setting will be ignored when the reader is able to tell the difference between the narrow and the wide bars.

Default:	**Mixed Narrow and Wide**	
Options:	**Mixed Narrow and Wide** All Narrow All Wide Fixed Threshold	

11-12-5 Direction (Pharmacode)

Definition:	Specifies the direction in which a symbol can be read.	
Default:	**Forward**	
Options:	**Forward**	Reverse

11-12-6 Fixed Threshold Value (Pharmacode)

Definition:	Used when **Bar Width Status** is set to **Fixed Threshold**. Defines the minimum difference in pixels that will distinguish a narrow bar from a wide bar.
Default:	**10**
Options:	1 to 65535

11-12-7 Background Color (Pharmacode)

Definition:	Used when the color of bars is reversed. Sets the background color that a Pharmacode symbol must have to be considered valid.	
Default:	**White**	
Options:	Black	**White**

11-13 Data Matrix

Usage:	Very useful where information needs to be packed into a small area, and/or where symbols need to be applied directly to the substrate with laser etching, chemical etching, dot peen, or other methods.
Definition:	Data Matrix is a type of Matrix symbology and has historically had subsets ECC 000 - ECC 200. Each higher level refers to increased error correction capabilities culminating with ECC 200 which uses Reed Solomon error correction. ECC 000 – ECC 140 are considered defunct and are not supported by this product. ECC 200 symbols have an even number of rows and an even number of columns. Most of the symbols are square with sizes from 10x10 to 144x144. All ECC 200 symbols can be recognized by the upper right corner module being light (binary 0) instead of dark. Some standard Data Matrix symbols are rectangular, with sizes from 8x18 to 16x48. The recent DMRE (Data Matrix Rectangular Extension) change added a large number of alternate Rectangular code sizes. If the Data Matrix is a DMRE, the DMRE option should be enabled.
Default:	**Enabled**
Options:	Disabled - when removed from the list **Enabled - when added to the list**

11-13-1 DMRE Status

Usage:	The code type is useful where information needs to be packed into a narrow region, and/or where symbols need to be applied directly to the substrate with laser etching, chemical etching, dot peen, or other methods.
Definition:	DMRE is an ISO standard (ISO/IEC 21471) for Data Matrix codes with additional rectangular formats (aspect ratios) beyond what is supported by the standard Data Matrix standard (ISO16022). Status Enables or disables the DMRE symbology.
Default:	**Disabled**
Options:	**0 = Disabled** 1 = Enabled

11-14 QR Code and Micro QR Code

Usage: QR Codes are widely implemented in the automotive industry in Japan and throughout their worldwide supply chain.

Definition: QR Code is capable of handling numeric, alphanumeric, and byte data as well as kanji and kana characters. Up to 7,089 characters (numeric data) can be encoded using this symbol. Therefore, less space is required to encode the same amount of data in a QR Code symbol than in a conventional symbol, lowering the cost of labelling.
Three Position Detection Patterns in the symbol make omnidirectional, ultra-fast reading possible.
QR Code has error protection capability. Data can often be restored even if a part of the symbol has become dirty or damaged.

Default: **Enabled**

Options: Disabled - when removed from the list
Enabled - when added to the list

11-14-1 QR Model 1 Status

Definition: The original QR Code, a code capable of coding 1,167 numerals with its maximum version being 14 (73 x 73 modules).

Default: **Enabled**

Options: Off = Disabled **On = Enabled**

11-14-2 QR Model 2 Status

Definition: QR Code created by improving Model 1 so that this code can be read smoothly even if it is distorted in some way. QR Codes that are printed on a curved surface or whose reading images are distorted due to the reading angle can be read efficiently by referring to an alignment pattern embedded in them. This code can encode up to 7,089 numerals with its maximum version being 40 (177 x 177 modules).

Default: **Enabled**

Options: Off = Disabled **On = Enabled**

11-14-3 Micro QR Code Status

Usage: Used in various applications that require higher data density than that provided by standard QR Code. Some application examples are automotive inventory, vehicle ID, and mobile phone URL encoding.

Definition: **Micro QR Code** is a 2D matrix symbology that comes in 4 different symbol sizes, the largest capable of encoding 35 numeric characters.

Default: **Enabled**

Options: Off = Disabled **On = Enabled**

11-14-4 rMQR Status

Usage:	**Rectangular Micro QR Code** (**rMQR Code**) is designed as a rectangular variation of Micro QR Code and has the same parameters and applications as original QR and Micro QR Code. But rMQR Code is more suitable for rectangular areas and has a difference between width and height up to 19 in the 7 x 139 cell version. It can be used in 1D barcode applications. rMQR Code can replace Code 128 and Code 39 barcodes with more effective data encoding.
Definition:	**rMQR Code** is a 2D matrix symbology that comes in 32 different sizes, ranging from a minimum of 7 x 43 modules to a maximum of 17 x 139 modules.
Default:	**Enabled**
Options:	Off = Disabled **On = Enabled**

11-15 BC412

Usage:	Widely used in semiconductor manufacturing. Particularly useful where speed, accuracy, and ease of printing are required.
Definition:	BC412 (Binary Code 412), a proprietary IBM symbology since 1988, is an alphanumeric symbol with a set of 35 characters, each encoded by a set of 4 bars in 12 module positions. All bars have a single width; it is the presence (1) or absence (0) of bars in each of the twelve module positions that make BC412 binary. This symbology is also bi-directional and self-clocking, with a start character and a stop character.
Default:	**Disabled**
Options:	**Disabled - when removed from the list** Enabled - when added to the list

11-15-1 Check Character Output (BC412)

Usage:	**Check Character Output**, added to the symbol, provides additional security.	
Definition:	When enabled, the check character is read and compared along with the symbol data. When disabled, symbol data is sent without the check character.	
Default:	**Disabled**	
Options:	**Off = Disabled**	On = Enabled

11-15-2 Fixed Symbol Length Status (BC412)

Definition:	When enabled, the reader will check the symbol length against the symbol length field. If disabled, any length will be considered valid.	
Default:	**Disabled**	
Options:	**Off = Disabled**	On = Enabled

11-15-3 Fixed Symbol Length (BC412)

Definition:	When enabled, the check character is read and compared along with the symbol data. When disabled, symbol data is sent without the check character.
Default:	**10**
Options:	1 to 64

11-16 DataBar Expanded

Usage:	Used to encode primary and supplementary data in retail point-of-sale and other applications.
Definition:	DataBar Expanded is a variable length symbology that can encode supplementary information in addition to the 14-digit EAN item identification number and is capable of encoding up to 74 numeric or 41 alphabetic characters.
Default:	**Disabled**
Options:	**Disabled - when removed from the list** Enabled - when added to the list

11-16-1 Fixed Symbol Length Status (DataBar Expanded)

Definition:	When enabled, the reader will check the symbol length against the symbol length field, minus the embedded check character. If disabled, any length would be considered valid.	
Default:	**Disabled**	
Options:	**Off = Disabled**	On = Enabled

11-16-2 Fixed Symbol Length (DataBar Expanded)

Usage:	**Fixed Symbol Length** helps prevent truncations and increases data integrity by ensuring that only one symbol length will be accepted.
Definition:	Specifies the exact number of characters that the reader will recognize (this does not include start, stop, and check character characters). The reader ignores any symbol not having the specified length.
Default:	**14**
Options:	1 to 74

11-17 DataBar Limited

Usage:	DataBar Limited is designed to be read by laser and CCD readers. It is not recommended for omnidirectional slot scanners.
Definition:	Encodes a smaller 14-digit symbol (74 modules wide) that is not omnidirectional.
Default:	**Enabled** **Disabled**
Options:	**Disabled - when removed from the list** Enabled - when added to the list

11-18 DataBar-14

Usage:	Used in the grocery, retail, and prescription drug industries where 14-digit EAN item identification may be needed.
Definition:	DataBar-14 is a fixed symbol length symbology that encodes 14 digits, including a 1-digit indicator. DataBar-14 is 96 modules wide. It can be stacked in two rows, it can read omnidirectionally if printed in full height, or horizontally if height-truncated for small marking.
Default:	**Disabled**
Options:	**Disabled - when removed from the list** Enabled - when added to the list

11-19 Micro PDF (MicroPDF417)

Usage:	Used for labelling small items that need large data capacity.
Definition:	A variant of PDF417, a very efficient and compact stacked symbology that can encode up to 250 alphanumeric characters or 366 numeric characters per symbol.
Default:	**Disabled**
Options:	**Disabled - when removed from the list** Enabled - when added to the list

11-19-1 Fixed Symbol Length Status (MicroPDF417)

Default:	**Disabled**	
Options:	**Off = Disabled**	On = Enabled

11-19-2 Fixed Symbol Length (MicroPDF417)

Usage:	Used to increase data integrity by ensuring that only one symbol length will be accepted.
Definition:	When enabled, the MicroPDF417 symbol must contain the same number of characters as the symbol length setting before it can be considered a good read. The reader will ignore any symbol not having the specified length.
Default:	**10**
Options:	1 to 366

Note: Fixed Symbol Length Status must be enabled for **Fixed Symbol Length** to take effect.

11-20 DotCode

Important: When DotCode is enabled, no other symbologies will be decodable. You must disable DotCode to decode symbols of any other type.

Usage:	Used for labelling in packaging industry.
Default:	**Disabled**
Options:	**Disabled - when removed from the list** Enabled - when added to the list

11-20-1 Expected Rows and Expected Columns

Usage:	Advanced parameter that helps decode damaged Dot Codes. It benefits from knowing the number of rows and columns. If left set at 0, the DotCode algorithm will decode any size.
Default:	**0 (will decode any number of rows and any number of columns)**
Options:	0 to 124

11-20-2 Rotation Mode

Default:	**0 = No Rotation**
Options:	**0 = No Rotation** 1 = Low Rotation 2 = Omnidirectional

No Rotation

The reader will decode horizontal and vertical symbols (**+/–** approximately **3 degrees**).

Low Rotation

The reader will decode **+/–** approximately **10 degrees** from the horizontal or vertical symbols. It is slightly slower than the No Rotation option.

Omnidirectional

The reader supports **360 degree** decoding. It is significantly slower than the other two options.

12

Specifications

12

12-1 Code Reader Specifications

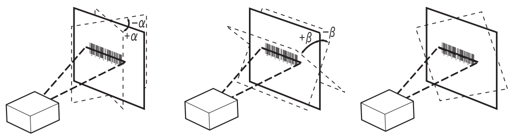
Item		VHV5-F□□□□023M-□□□	VHV5-F□□□□050M-□□□
Image Sensor	Resolution	2.3 MP - 1920 (H) x 1200 (V)	5.0 MP - 2472 (H) x 2048 (V)
	Pixel Size	3 µm	2.74 µm
	Color / Monochrome	Monochrome CMOS	
	Shutter	Global Shutter	
	Frames per Second	80 FPS	40 FPS
	Exposure	16 µs to 300,000 µs	50 µs to 300,000 µs (16 µs to 300,000 µs with strobe duration)
	Lens Selections	Focal Length: Wide = 6.42 mm, Medium = 8.5 mm, Narrow = 12.5 mm, Long = 20 mm	
	Focus	Liquid Lens Autofocus or Fixed Focus	
Symbologies[*1]	1D Symbologies	Code 39, Code 128, BC412, Interleaved 2 of 5, UPC/EAN, Codabar, Code 93, Pharmacode, PLANET, POSTNET, Japanese Post, Australian Post, Royal Mail, Intelligent Mail, KIX	
	2D Symbologies	Data Matrix (ECC 0-200), QR Code, Micro QR Code, Aztec Code, DotCode	
	Stacked Symbologies	PDF417, MicroPDF417, GS1 DataBar (Composite and Stacked)	
ISO Code Quality Checking	Data Matrix, QR Codes, 1D Symbologies	**Models without Verification License:** Code Quality Validation only using ISO 15416:2016, ISO 15415:2011, and ISO 29158:2020	
		Models with Verification License: Fully Calibrated ISO Code Quality Verification using ISO 15416:2016, ISO 15415:2011, and ISO 29158:2020	
Reading Performance[*2]	Number of Reading Digits	No upper limit (depends on bar width and reading distance)	
	Targeting Optics	Two green parallel LED spots	
	Illumination	8 high-power LEDs: White (6,500K) or Red (Wavelength: 625 nm)	
	Reading Distance / Field of View	Refer to Read Ranges section for details based on Lens and Sensor Type.	
	Pitch Angle (α)[*3]	±30°	
	Skew Angle (β)[*3]	±30°	
	Tilt Angle (γ)[*3]	±180°	
Trigger		External Trigger (Edge or Level), Serial Trigger (Ethernet, RS-232C), PLC	
Digital I/O Specifications	Input Signals	3 Inputs: IN1 (Trigger), IN2 (Unused), IN3 (Unused). Bi-directional, Optoisolated, 4.5-28V-rated (10 mA @ 28 VDC).	
	Output Signals	3 Fully Configurable Outputs: OUT1, OUT2, OUT3. Bi-directional, Optoisolated, 3-28V rated, (I_{CE} < 100 mA at 24 VDC, current limited by user).	
	External Strobe	24V, GND, Strobe+ (> 1.5kΩ, user-implemented), Strobe– (> 1.5kΩ, user implemented), Analog Intensity Control (0-10V). (Strobe Trigger can operate as NPN or PNP).	
Communication	Connectivity	RS-232C, Ethernet TCP/IP, EtherNet/IP™, PROFINET	
	Ethernet Specifications	1000BASE-T	
Image Logging	Image Logging Type	To RAM	
Indicator LEDs	Membrane Switch	PWR (Green), LINK (Amber), MODE/STATUS (Amber), TRIGGER (Amber), PASS (Green), FAIL (Red)	
	360° Indicators	PASS (Green), FAIL (Red)	
Power Supply Voltage		Power over Ethernet (IEEE 802.3at) / 24 VDC +/– 10%	
Current Consumption		PoE+ 50-57 VDC @ 0.6 A (Max.); Direct: 24 VDC @ 2.1 A (Max.); External Light Port Connector: 24 VDC @ 1.5 A (Max) (Internally Current-Limited)	
Environmental / Immunity	Ambient Temperature Range	Operating: 0 to 45° C; Storage: –25 to 65° C (with no icing or condensation)	
	Ambient Humidity Range	Operating and Storage: 25% to 85%	
	Ambient Atmosphere	No Corrosive Gases	
	Vibration Resistance	Oscillation Frequency: 10 to 150 Hz; Half Amplitude: 0.35 mm; Vibration Direction: X/Y/Z; Sweep Time: 8 Minutes/Count; Sweep Count: 10 Times	
	Shock Resistance	Impact Force: 150 m/s2, Test Direction: 6 Directions, 3 Times Each (Up / Down, Front / Behind, Left / Right)	
	Degree of Protection	IEC 60529 IP69K	
Weight	Main Body Only	Approx. 372 g	
	Packaged Weight	Approx. 505 g	

Item		VHV5-F□□□□023M-□□□	VHV5-F□□□□050M-□□□
Dimensions	**Main Body Dimensions**	57.5 mm (W) × 50.5 mm (D) × 75 mm (H) (89 mm height with connectors)	
	Packaging Dimensions	170 mm (W) × 117 mm (D) × 86 mm (H)	
Accessories		ReadMeFirst, CE Compliance Sheet	
Safety Standards		IEC/EN 62368-1, 2nd and 3rd Ed EN 62471 (LED Safety) UL 60950-1, 2nd Edition, 2019-05-09 (Information Technology Equipment - Safety - Part 1: General Requirements) CAN/CSA C22.2 No. 60950-1-07, 2nd Edition, 2014-10 (Information Technology Equipment - Safety - Part 1: General Requirements)*4	
Materials	**Case**	Aluminum, black anodized	
	Reading Window	Acrylic	
Software		WebLink	

*1. Symbologies are supported based on Omron’s read capability validation standard. Omron recommends that validation be performed for each application.

*2. Unless otherwise specified, reading performance is defined with center of field of view, angle R = ∞.

*3. Pitch angle Skew angle Tilt angle



*4. FCC = United States
UL = United States
CE = European Union
UKCA = Great Britain (England / Wales / Scotland)
RCM = Australia / New Zealand
KC = South Korea

12-2 Cable Specifications

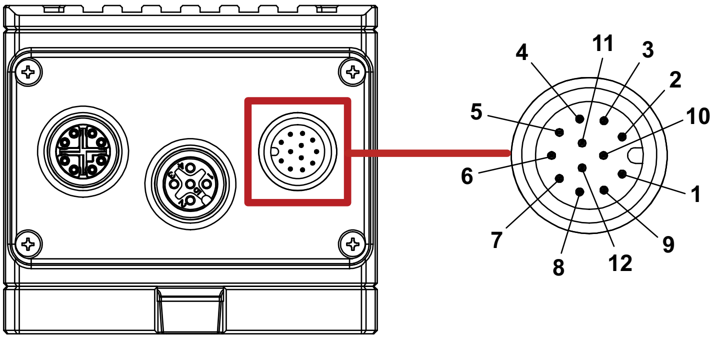
Item		61-9000134-0X	V430-W8□□-_M	V430-WQ-_M	V430-WR-_M
Cable Type		Robot cable			
Connector Type		Straight LD: Right Angle Down LU: Right Angle Up		Straight	
Category		Ethernet	I/O		I/O and RS-232
Size		AWG24			
Outer Diameter		7.37 mm	7.11 mm		
Min. Bending Radius		73.7 mm	53 mm		
Usage Environment	**Ambient Temperature Range**	Operating: 0 to 45°C Storage: -25 to 65°C (No Icing or Condensation)			
	Ambient Humidity Range	25 to 85% (Non-Condensing)			
	Ambient Atmosphere	No Corrosive Gases			
	Vibration Tolerance	Oscillation Frequency: 10 to 150Hz, Half Amplitude: 0.35 mm, Vibration Direction: X/Y/Z, Sweep Time: 8 minute/count, Sweep Count: 10 times			
	Shock Resistance	Impact Force: 150 m/s^2, Test Direction: 6 directions, three times each (up/down, front/back, left/right)			
Material		Connector Overmold: Thermoplastic Polyamide, Cable Jacket: Polyurethane			
Weight		61-9000134-01 (1M): 94g 61-9000134-02 (3M): 215g 61-9000134-03 (5M): 352g 61-9000134-04 (10M): 694g	V430-W8-3M: 259g V430-W8-5M: 422g V430-W8-10M: 829g V430-W8LD-3M: 253g V430-W8LU-3M: 253g	V430-WQ-1M: 109g V430-WQ-3M: 272g V430-WQ-5M: 351g	V430-WR-1M: 107g V430-WR-3M: 276g

Item		61-000184-01	61-000185-01
Cable Type		Static use cable	
Connector Type		Straight	
Category		Lighting	
Size		AWG22	
Outer Diameter		7.2 mm	6.6 mm
Min. Bending Radius		72 mm	66 mm
Usage Environment	**Ambient Temperature Range**	Operating: 0 to 45°C Storage: -25 to 65°C (No Icing or Condensation)	
	Ambient Humidity Range	25 to 85% (Non-Condensing)	
	Ambient Atmosphere	No Corrosive Gases	
	Vibration Tolerance	Oscillation Frequency: 10 to 150Hz, Half Amplitude: 0.35 mm, Vibration Direction: X/Y/Z, Sweep Time: 8 minute/count, Sweep Count: 10 times	
	Shock Resistance	Impact Force: 150 m/s^2, Test Direction: 6 directions, three times each (up/down, front/back, left/right)	
Material		Connector Overmold: Thermoplastic Polyurethane, Cable Jacket: PVC	
Weight		95 g	227 g

12-3 Electrical Specifications

12-3-1 DIO (Parallel IO) Port

The Parallel IO Port connector is used for Digital Inputs (Trigger), Digital Outputs, RS-232, and Power. M12 12-Pin Male.



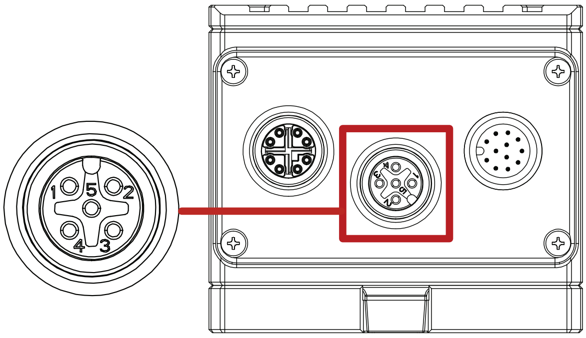
Pin	Name	Function	Flying Lead Color
1	Trigger (Input 1)	Trigger	WHITE
2	Power (+VIN)	24 Volts	BROWN
3	Input 3	Unused	GREEN
4	Input 2	Unused	YELLOW
5	Output 1	General Purpose Output	GRAY
6	Output 3	General Purpose Output	PINK
7	Ground (-VIN)	24V Reference (GND)	BLUE
8	Input Common	NPN or PNP Common for Input	RED
9	RS-232 (Host) RxD	Serial Command Input	BLACK
10	RS-232 (Host) TxD	Serial Data Output	VIOLET
11	Output 2	General Purpose Output	GRAY STRIPED
12	Output Common	NPN or PNP Common for Output	RED STRIPED

12-3-2 External Light Port

The third connector on the VHV5-F is used to drive an external light. The 5-pin female M12 provides 24V power, a Strobe Trigger output signal, and an optional Analog Intensity Control output signal. This five-pin assignment is compatible with many common machine vision light vendor's input connector requirements.

Precautions for Correct Use

The user must check the power and wiring specifications for their choice of external light and only connect the relevant signals. For example, pins 4 and 3 would be used to provide just a 24V strobe trigger signal output to an external strobe controller.



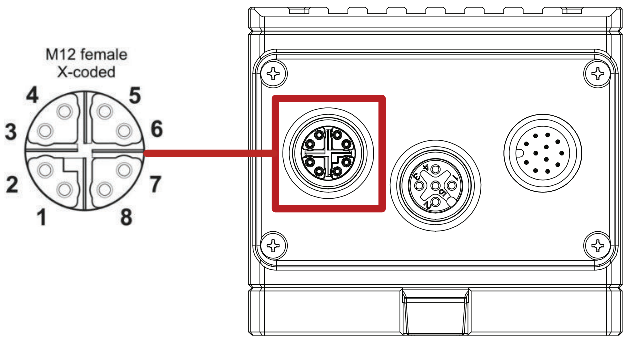
Pin	Signal	Description
1	+24 VDC	Provides up to 1.5 amps of current to light at 24V
2	Strobe Trig –	Strobe Trigger – (NPN referenced to DC Ground)
3	DC Ground	Ground
4	Strobe Trig +	Strobe Trigger + (PNP referenced to 24VDC Ground)
5	Analog Out	Selectable 0-10V analog output for intensity control

Examples:

- NERLITE Smart Series light with built-in strobe controller.
- Smart Vision lights with NanoDrive™ or Multi-Drive™ light control.

12-3-3 X-Code Ethernet Port

1000BASE-T X-Code Ethernet port. Female M12.



Pin	Description	Name
1	Bidirectional Data DA+	DA+
2	Bidirectional Data DA-	DA-
3	Bidirectional Data DB+	DB+
4	Bidirectional Data DB-	DB-
5	Bidirectional Data DD+	DD+
6	Bidirectional Data DD-	DD-
7	Bidirectional Data DC-	DC-
8	Bidirectional Data DC+	DC+

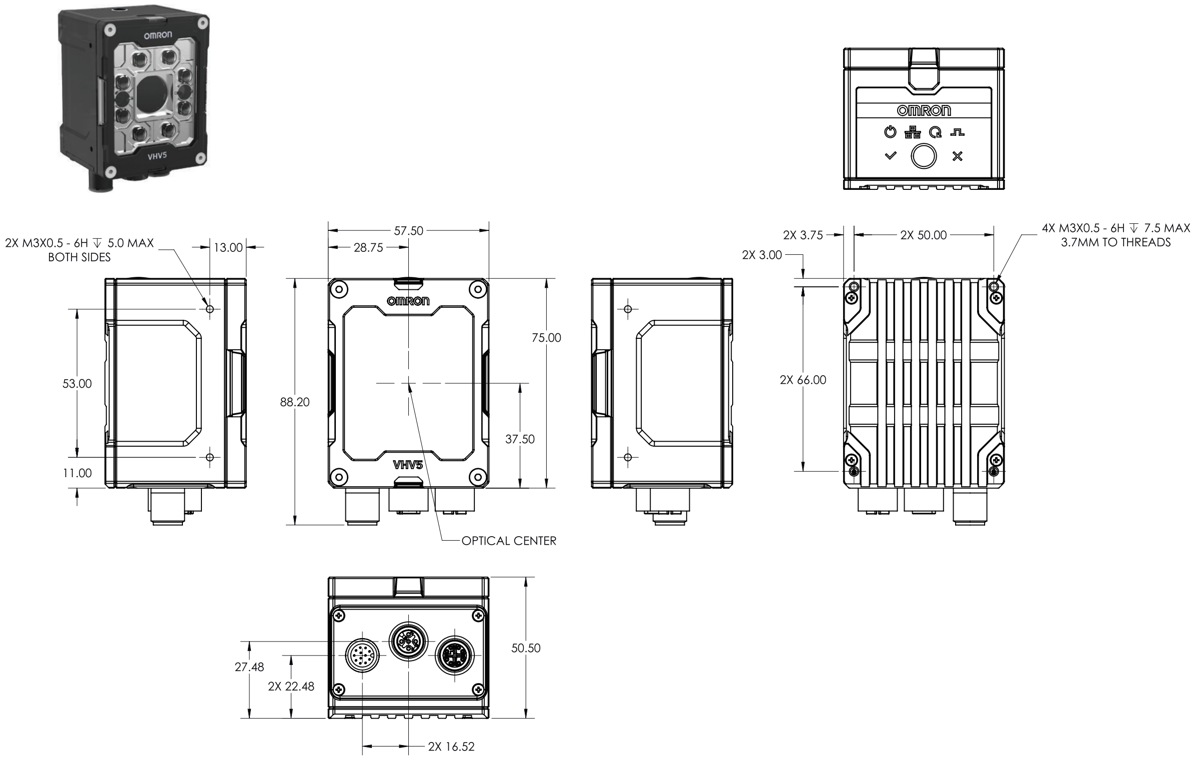
13

Code Reader and Accessory Drawings

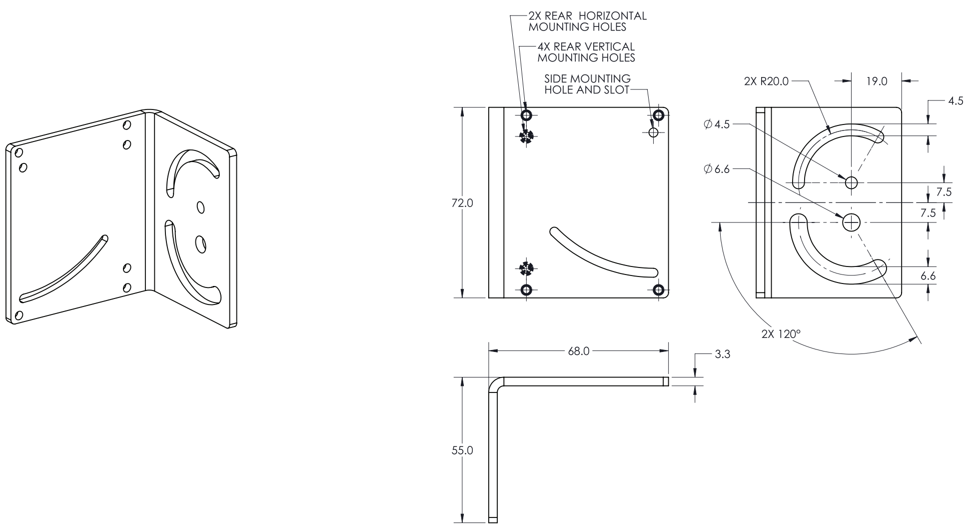
This section provides the code reader's physical dimensions and information about the cables and accessories that are currently available for the code reader.

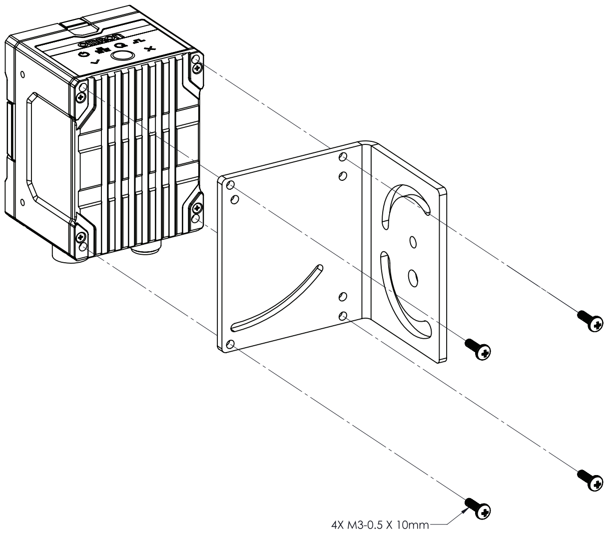
13-1 Dimensions

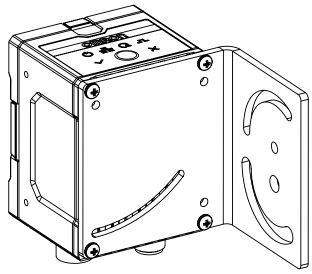
VHV5-F Autofocus Multicode Reader
(Unit: mm)



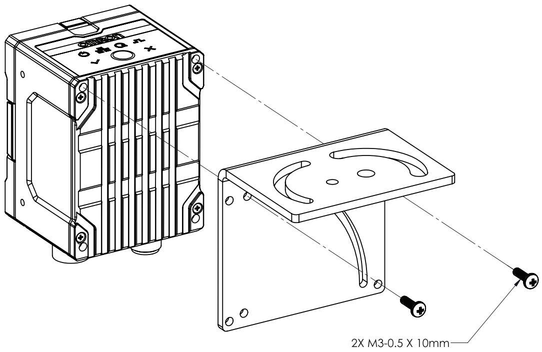
VHV5-F L-Bracket Adjustable Angle Mounting Kit
VHV5-AM0

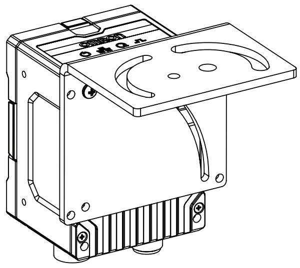






Assembled





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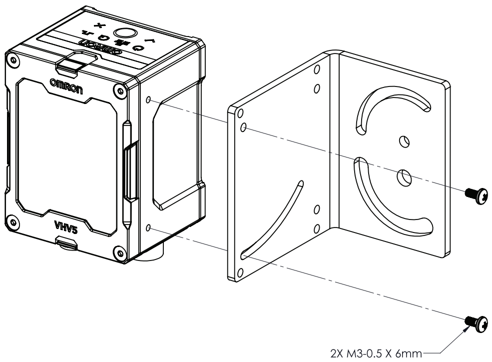
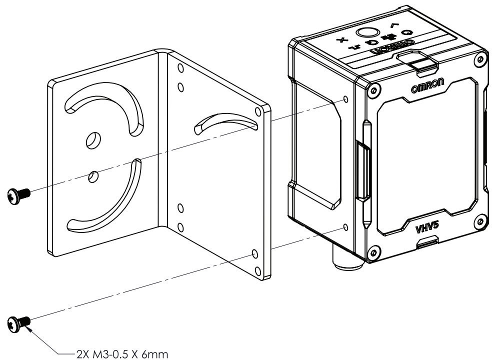
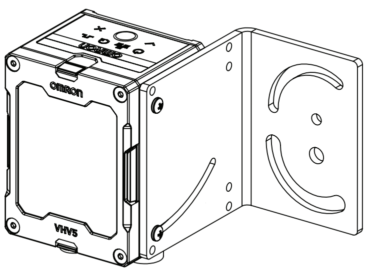
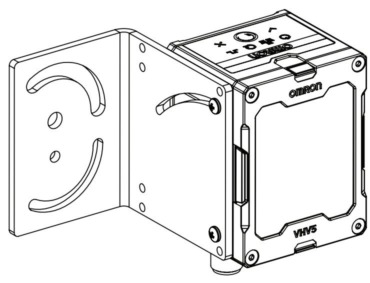






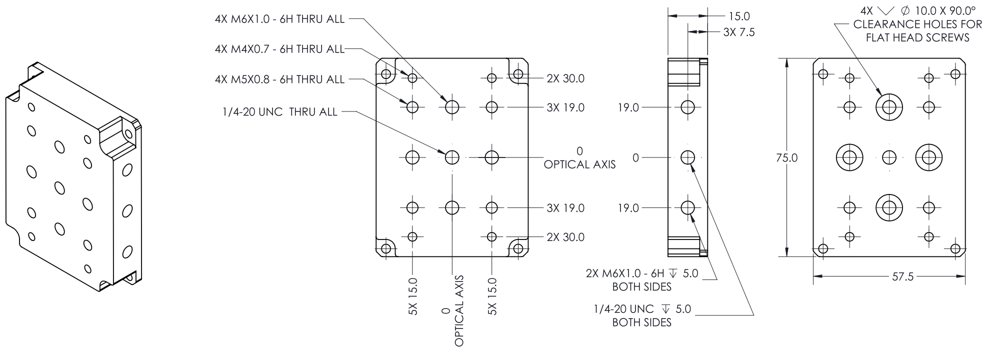


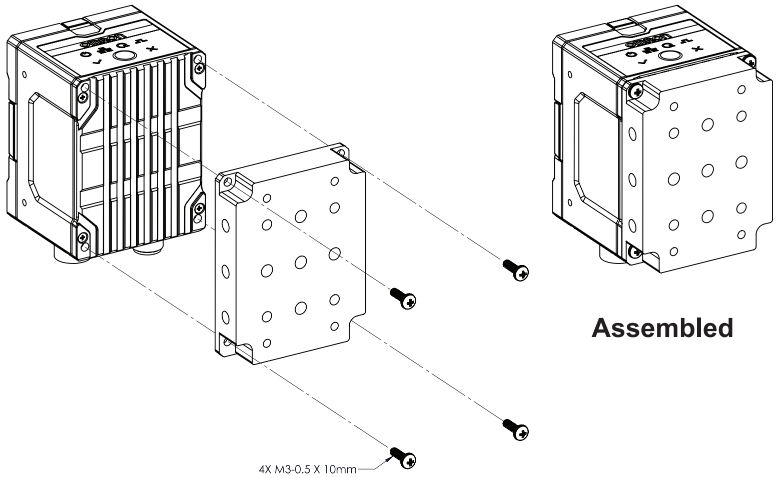
Assembled

Assembled

VHV5-F Universal Mounting Block and Heatsink

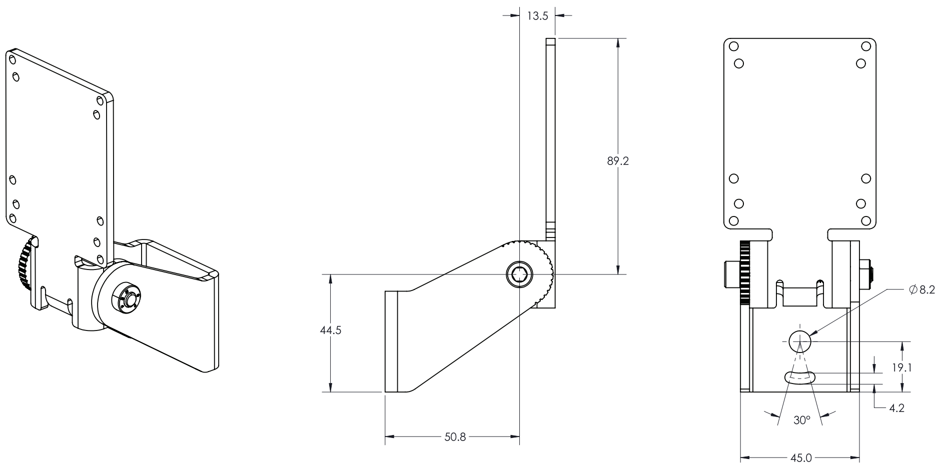
VHV5-AM1

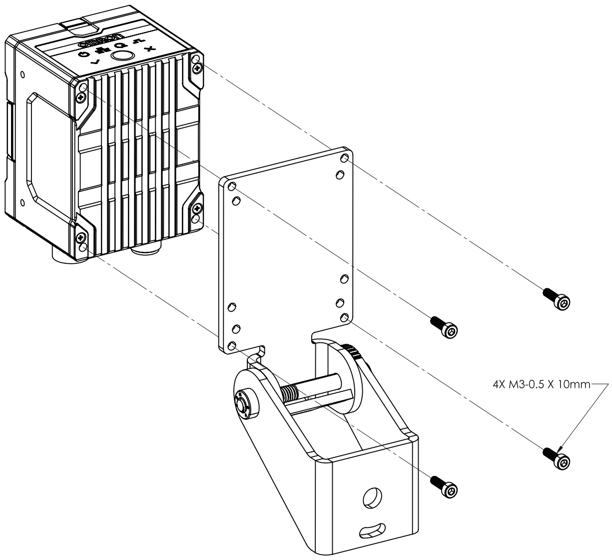


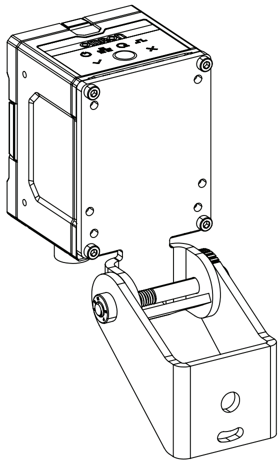


VHV5-F APG Pan and Tilt Camera Mount

VHV5-AM2







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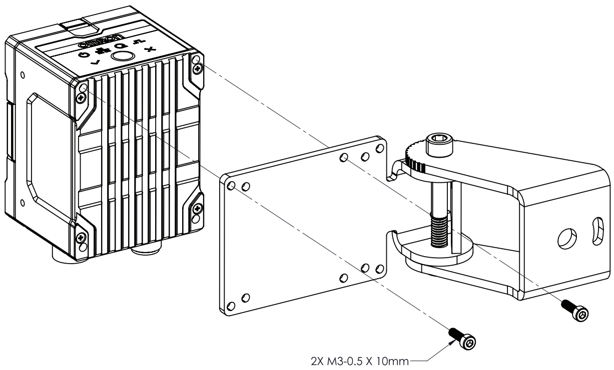

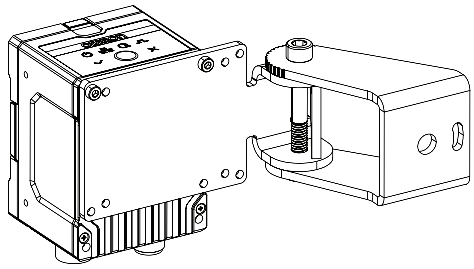

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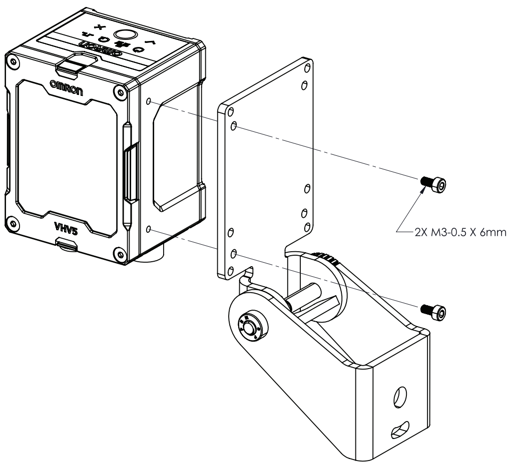
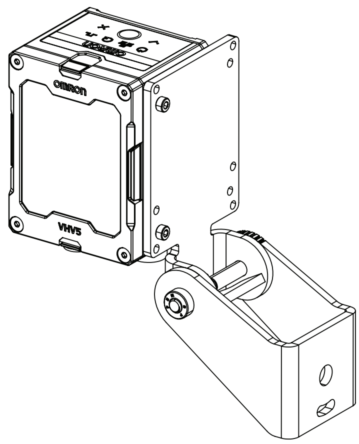
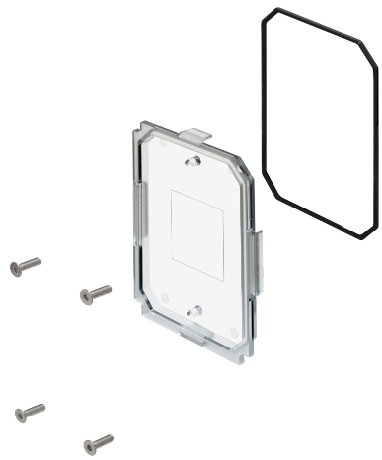




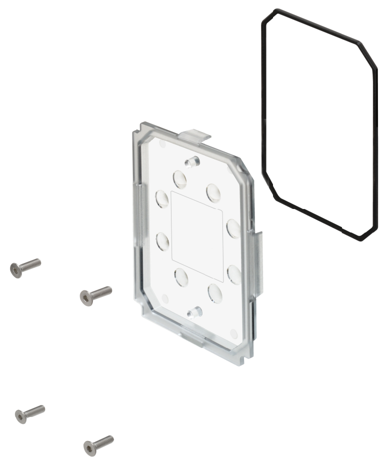
Assembled

VHV5-F Standard Window (for Wide and Medium Lens Models)
VHV5-AF0



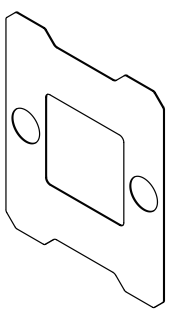
Torque: 4.8 in./lbs. (0.54 nm max.)

VHV5-F Lensed Window (for Narrow and Long Lens Models)
VHV5-AF1

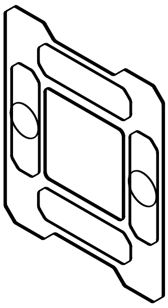


Torque: 4.8 in./lbs. (0.54 nm max.)

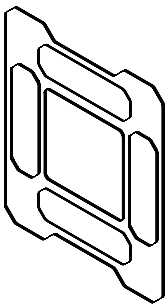
VHV5-F Diffuser Accessory
VHV5-AF2



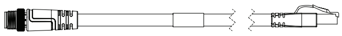
VHV5-F Polarizer Accessory
VHV5-AF3

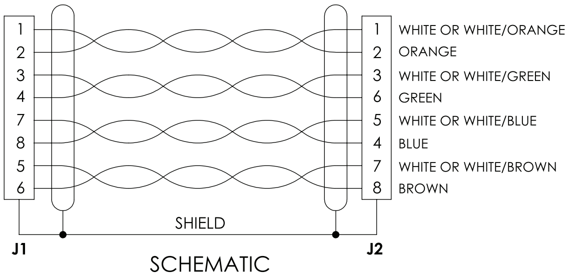


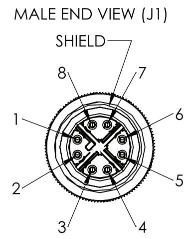
VHV5-F Half Polarizer Accessory
VHV5-AF4

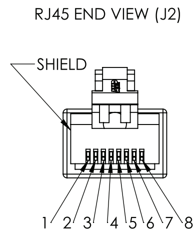


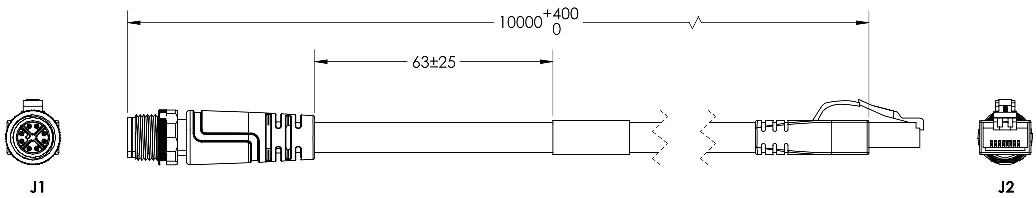
X-Code to RJ45 Ethernet Cable (High Flex, Straight, Black Jacket) – 1 Meter, 2 Meters, 5 Meters, 10 Meters
61-9000134-01
61-9000134-02
61-9000134-03
61-9000134-04



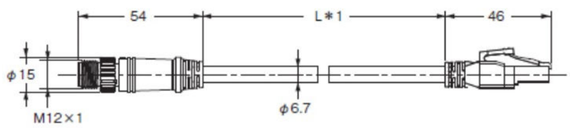






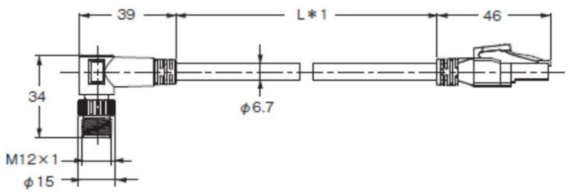


X-Code to RJ45 Ethernet Cable (High Flex, Straight, Black Jacket) – 2 Meters, 3 Meters, 5 Meters, 10 Meters, 20 Meters
FHV-VNB2 2M
FHV-VNB2 3M
FHV-VNB2 5M
FHV-VNB2 10M
FHV-VNB2 20M



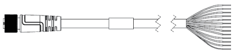
*1 – Overall cable length varies based on model number. Example: FHV-VNB2 2M is a 2 meter cable.

X-Code to RJ45 Ethernet Cable (High Flex, Right-Angle, Black Jacket) – 2 Meters, 3 Meters, 5 Meters, 10 Meters, 20 Meters
FHV-VNLB2 2M
FHV-VNLB2 3M
FHV-VNLB2 5M
FHV-VNLB2 10M
FHV-VNLB2 20M

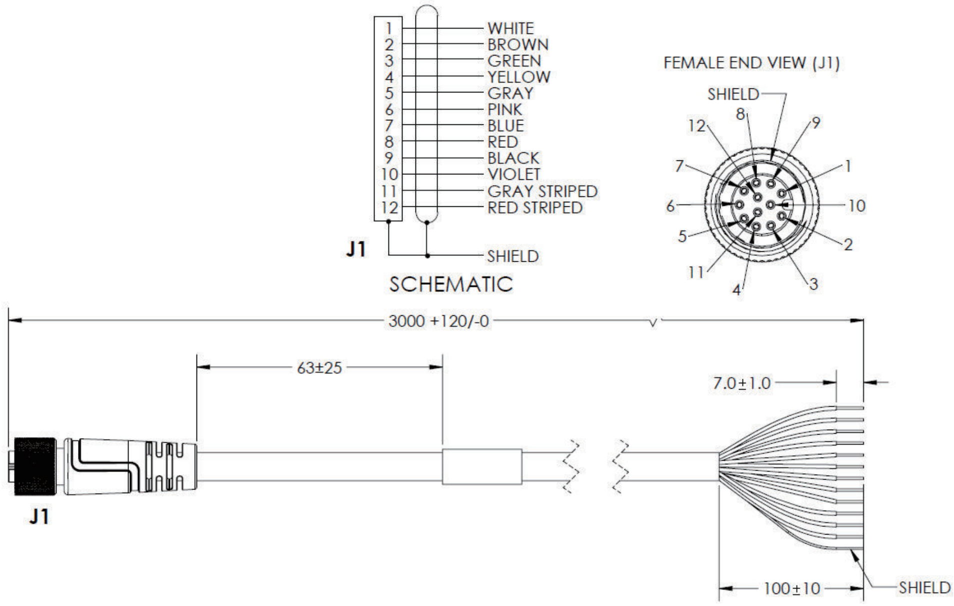


*1 – Overall cable length varies based on model number. Example: FHV-VNLB2 2M is a 2 meter cable.

M12 to Flying Leads Cable – Parallel IO (Power, DIO, RS-232) – 3 Meters, 5 Meters, 10 Meters
V430-W8-3M
V430-W8-5M
V430-W8-10M

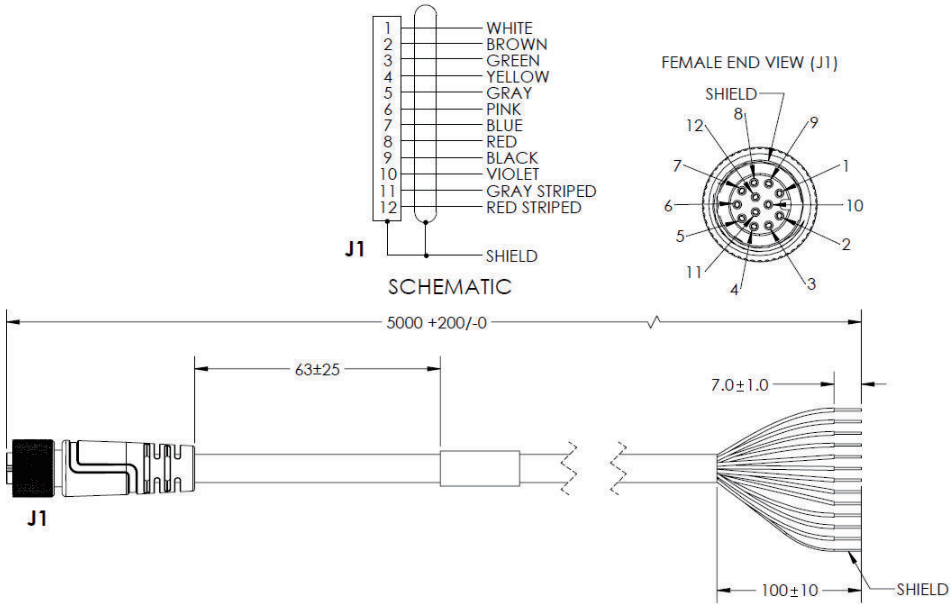


Pin	Name	Use
1	Trigger (Input 1)	Trigger
2	Power (+VIN)	24 Volts
3	Input 3	General Purpose Input
4	Input 2	General Purpose Input
5	Output 1	General Purpose Output
6	Output 3	General Purpose Output, Option-al Light Control
7	Ground (-VIN)	24V Reference (GND)
8	Input Common	NPN or PNP Common for Input
9	RS-232 (Host) RxD	Serial Command Input
10	RS-232 (Host) TxD	Serial Output Data
11	Output 2	General Purpose Output
12	Output Common	NPN or PNP Common for Output



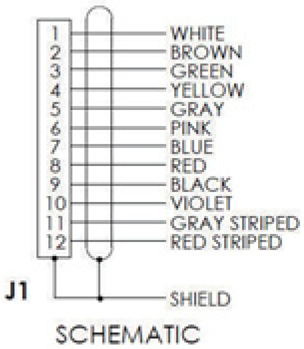
Pin	Name	Use
1	Trigger (Input 1)	Trigger
2	Power (+VIN)	24 Volts
3	Input 3	General Purpose Input
4	Input 2	General Purpose Input
5	Output 1	General Purpose Output
6	Output 3	General Purpose Output, Option-al Light Control
7	Ground (-VIN)	24V Reference (GND)
8	Input Common	NPN or PNP Common for Input

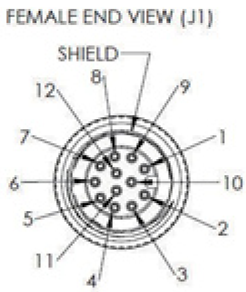
Pin	Name	Use
9	RS-232 (Host) RxD	Serial Command Input
10	RS-232 (Host) TxD	Serial Output Data
11	Output 2	General Purpose Output
12	Output Common	NPN or PNP Common for Output

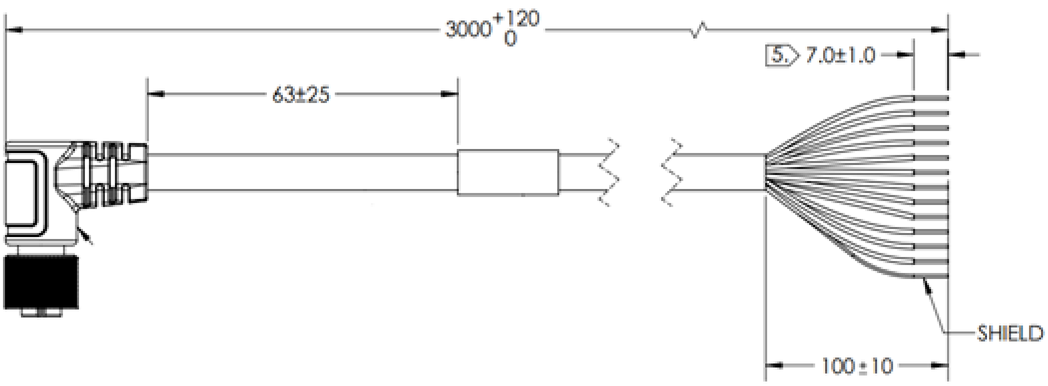


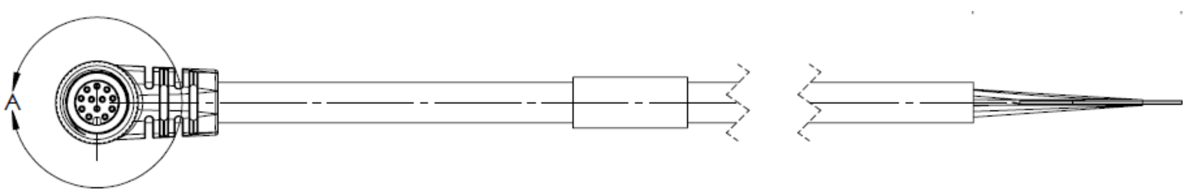
M12 to Flying Leads Cable – Parallel IO (Power, DIO, RS-232), Right Angle Back – 3 Meters V430-W8LD-3M

Pin	Name	Use
1	Trigger (Input 1)	Trigger
2	Power (+VIN)	24 Volts
3	Input 3	General Purpose Input
4	Input 2	General Purpose Input
5	Output 1	General Purpose Output
6	Output 3	General Purpose Output, Optional Light Control
7	Ground (-VIN)	24V Reference (GND)
8	Input Common	NPN or PNP Common for Input
9	RS-232 (Host) RxD	Serial Command Input
10	RS-232 (Host) TxD	Serial Output Data
11	Output 2	General Purpose Output
12	Output Common	NPN or PNP Common for Output



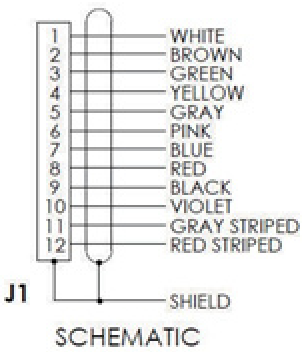


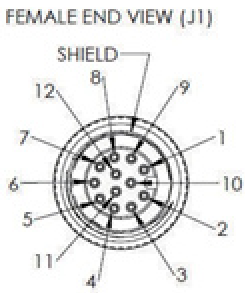


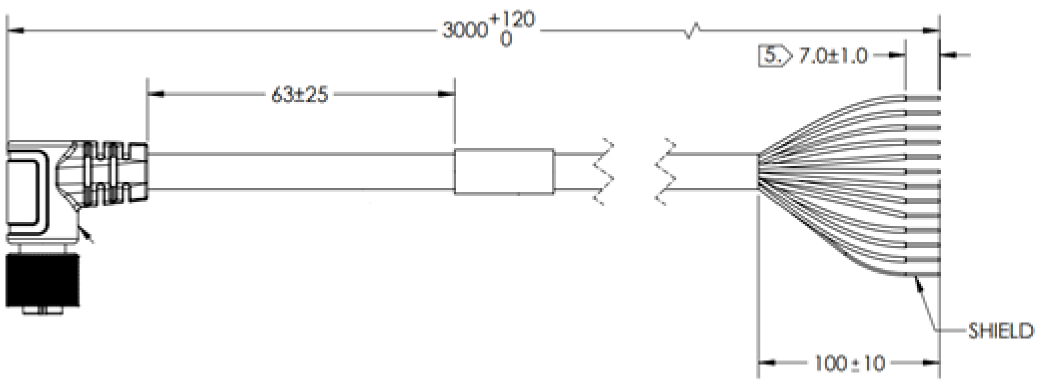


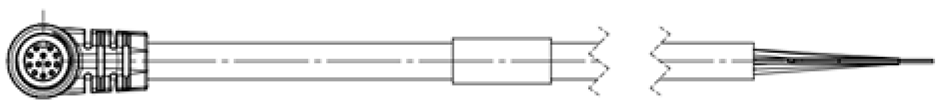
M12 to Flying Leads Cable – Parallel IO (Power, DIO, RS-232), Right Angle Front – 3 Meters V430-W8LU-3M

Pin	Name	Use
1	Trigger (Input 1)	Trigger
2	Power (+VIN)	24 Volts
3	Input 3	General Purpose Input
4	Input 2	General Purpose Input
5	Output 1	General Purpose Output
6	Output 3	General Purpose Output, Optional Light Control
7	Ground (-VIN)	24V Reference (GND)
8	Input Common	NPN or PNP Common for Input
9	RS-232 (Host) RxD	Serial Command Input
10	RS-232 (Host) TxD	Serial Output Data
11	Output 2	General Purpose Output
12	Output Common	NPN or PNP Common for Output





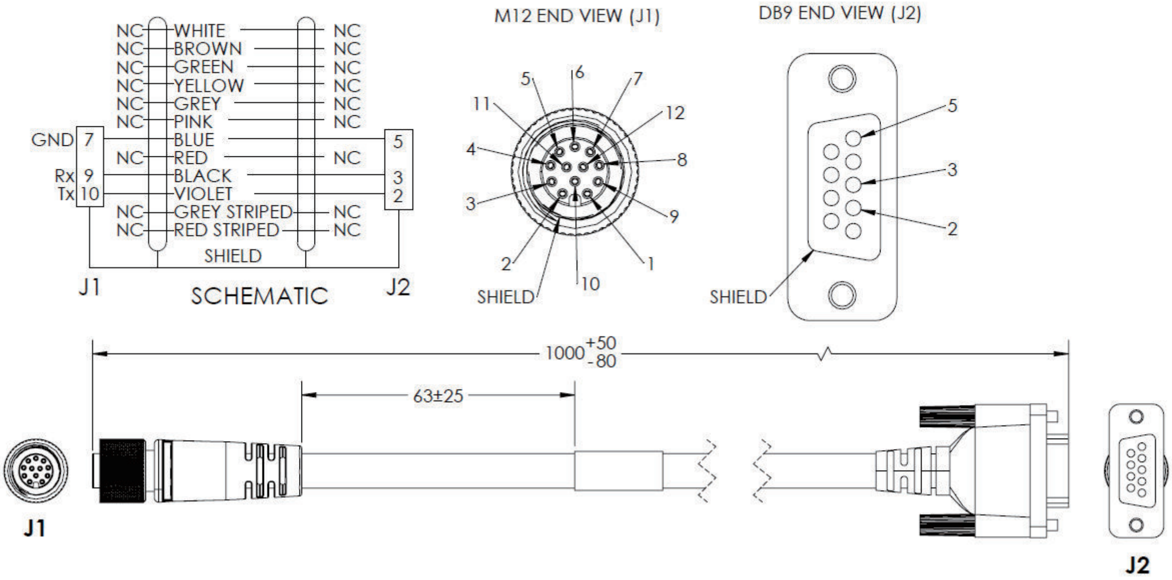


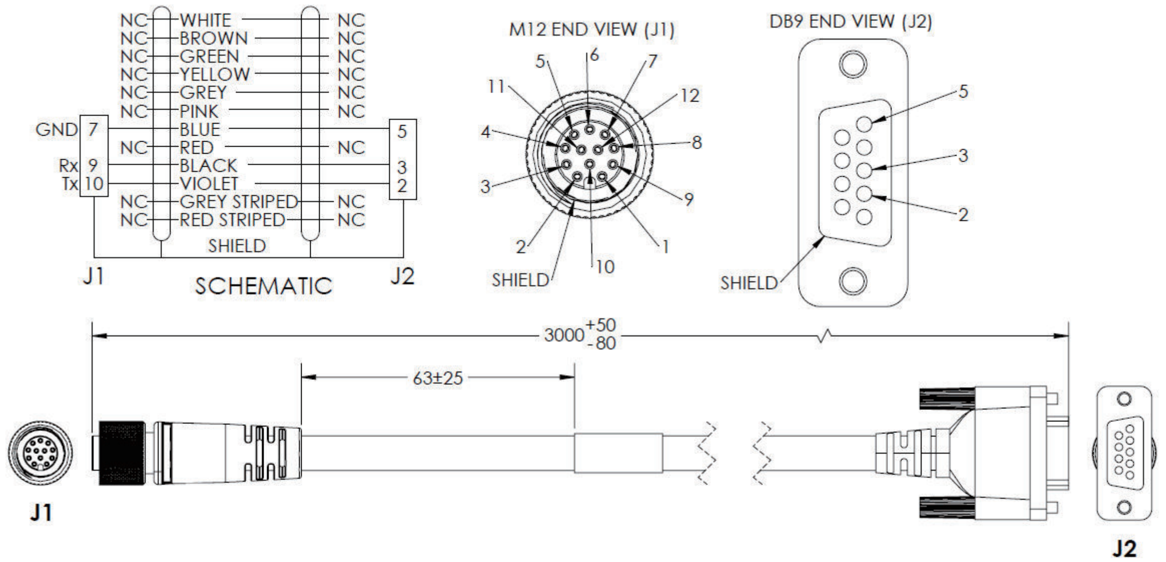


Reader M12 to RS-232 Breakout Cable – 1 Meter, 3 Meters

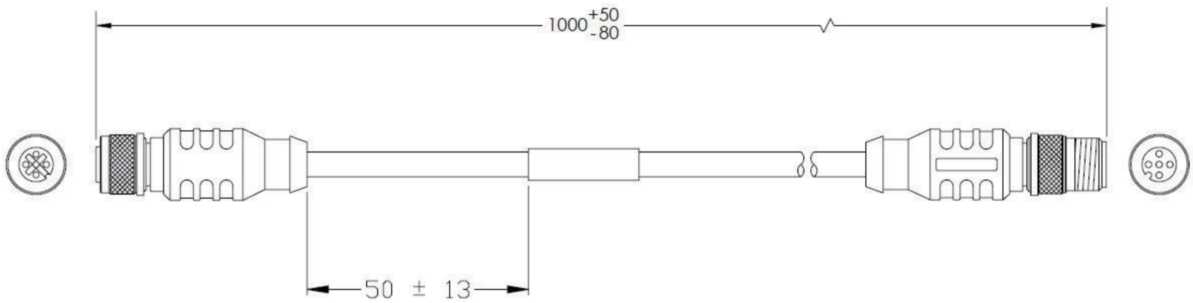
V430-WR-1M

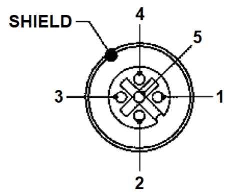
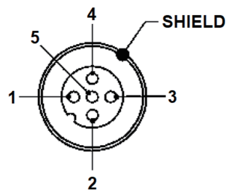
V430-WR-3M



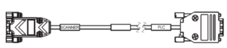


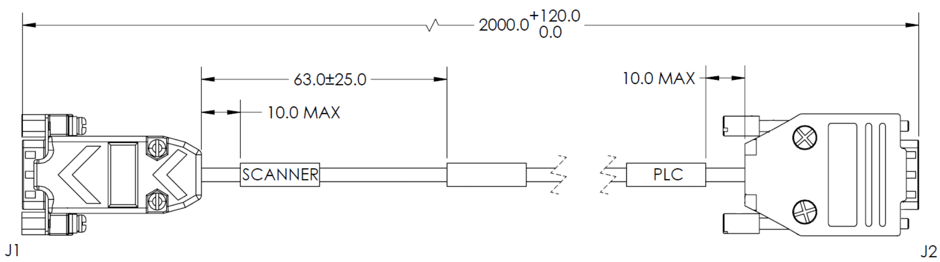
VHV5-F to External Light – 5 Pin M12 Plug to 5 Pin M12 Socket – 1 Meter
61-000184-01

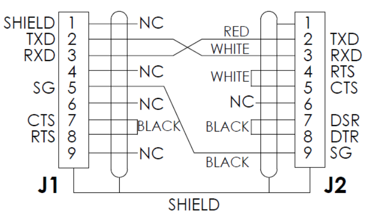


FEMALE END VIEW	MALE END VIEW
 1 = BROWN 2 = WHITE 3 = BLUE 4 = BLACK 5 = GRAY	 1 = BROWN 2 = WHITE 3 = BLUE 4 = BLACK 5 = GRAY

Cable, Adapter, Omron PLC – 2 Meters
V430-WPLC-2M

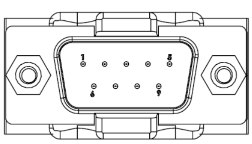




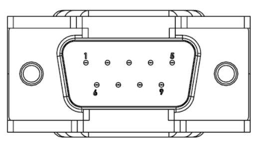


SCHEMATIC

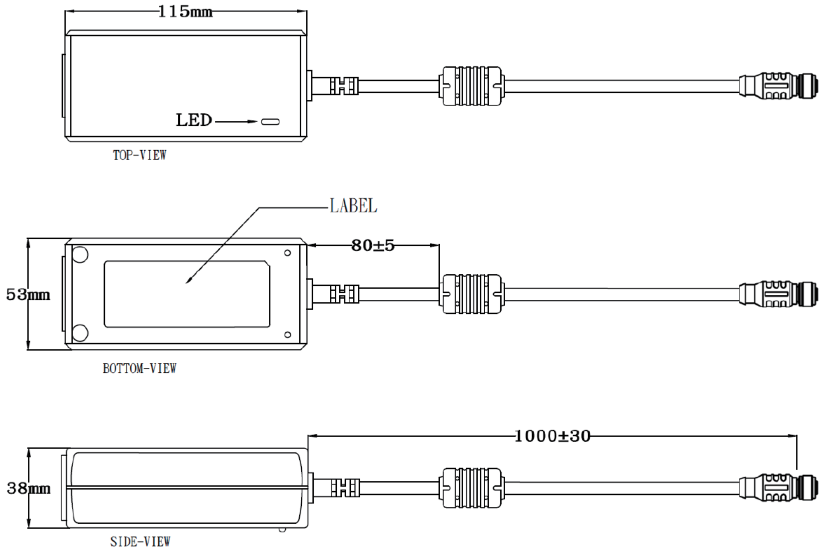
9 POS D-SUB PLUG (J1)

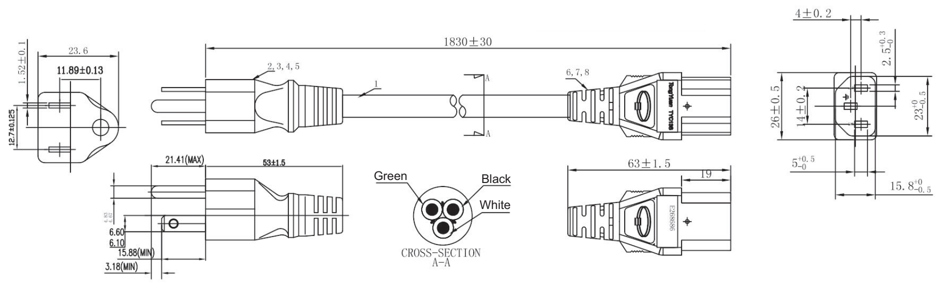


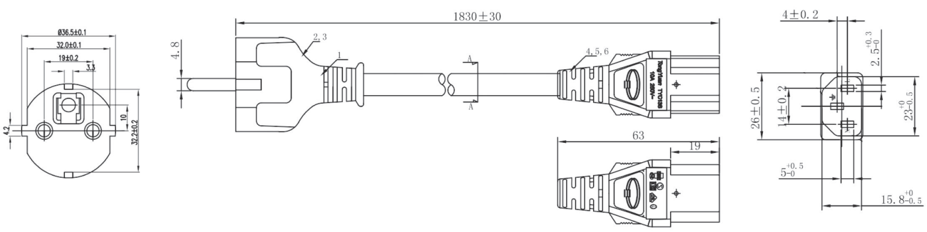
9 POS D-SUB PLUG (J2)



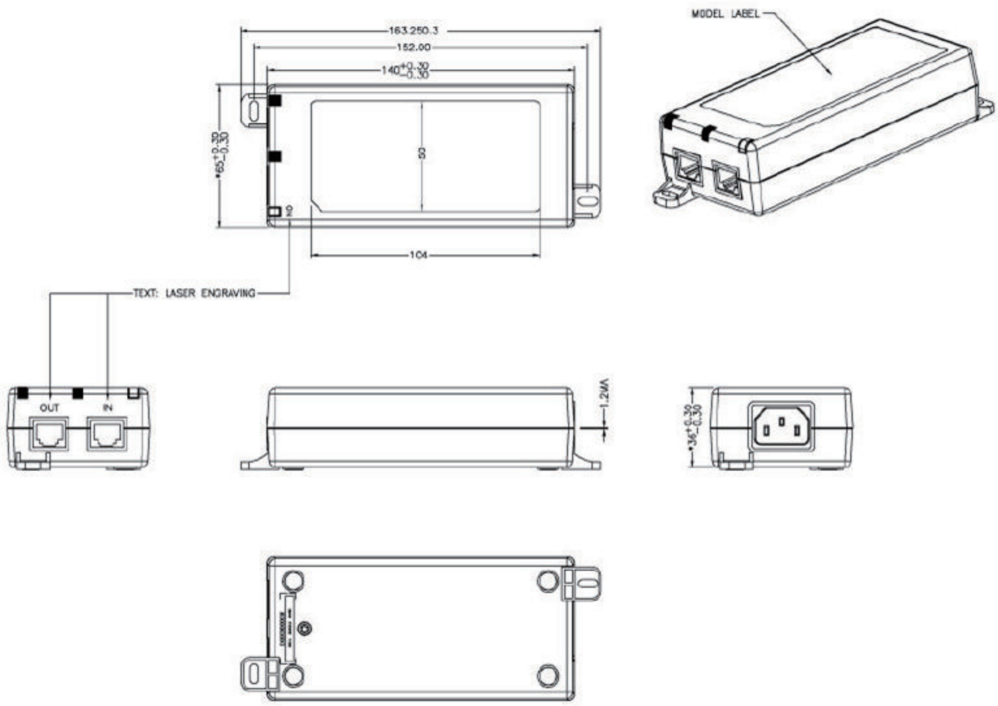
Power Supply, 100-240VAC, +24VDC, M12 12-Pin Socket – 1 Meter – U.S. / Euro Plug
97-000012-01



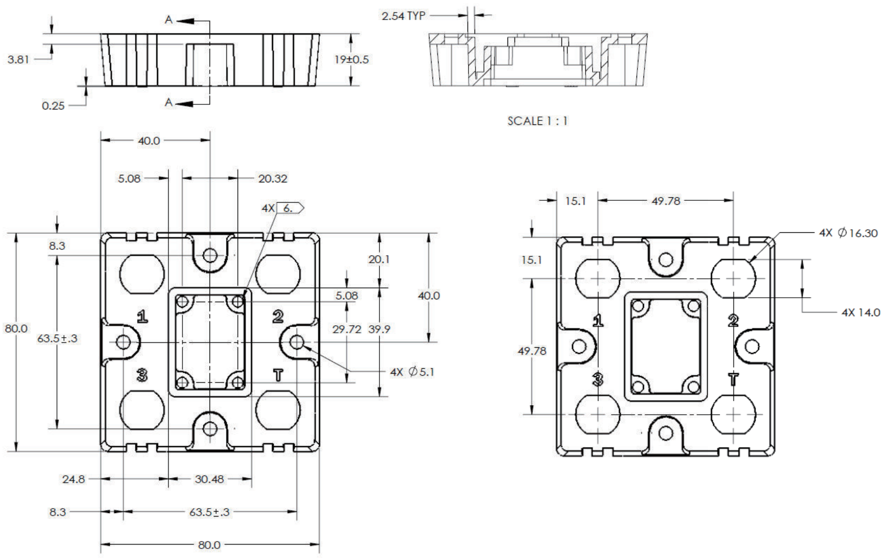




Single Port PoE Injector, 30W, IEEE802.3at Compliant, 2 x RJ45 Connector, 90 to 264VAC
98-9000311-01



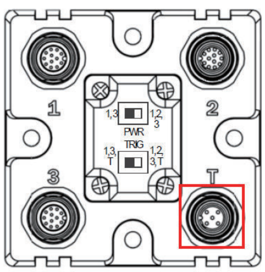
QX-1 Interconnect Module – Power, Trigger, Daisy Chain, Smart Light Control Breakout 98-000103-02



The QX-1's receptacles do not have explicit pin assignments. The QX-1 allows users to bus power and communications as required by the application.

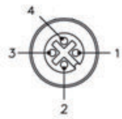
Connectors 1 and 3 are 12-pin plugs, and connector 2 is a 12-pin socket. All three connectors can be assigned to bus power and data as required by the application.

The two switches at the center of the device allow the user to route signals as needed.

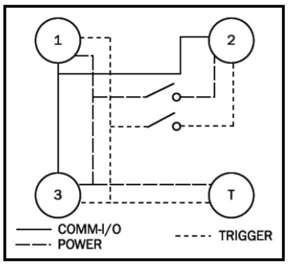


QX-1 Interface Device

Pin	Function
1	+24V
2	Trig/NM/Input 1 Common
3	Ground
4	Trigger



The diagram below (also shown on the base of the QX-1) illustrates how power, communications, I/O, and trigger signal can be routed through the QX-1 device depending on the needs of the application. The switches greatly increase signal routing flexibility.



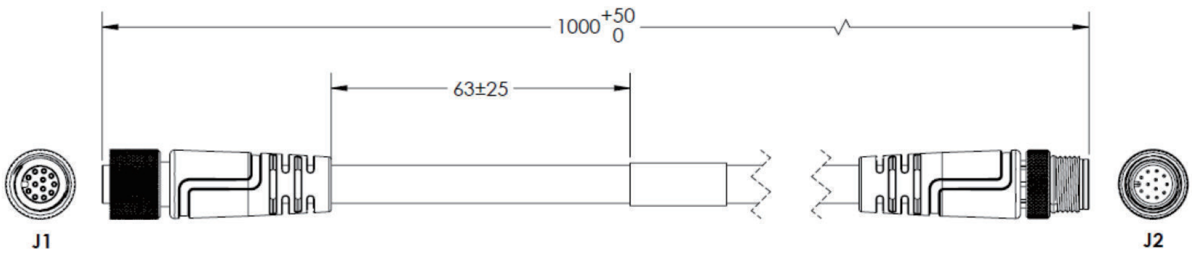
QX-1 Communications - I/O - Power - Trigger

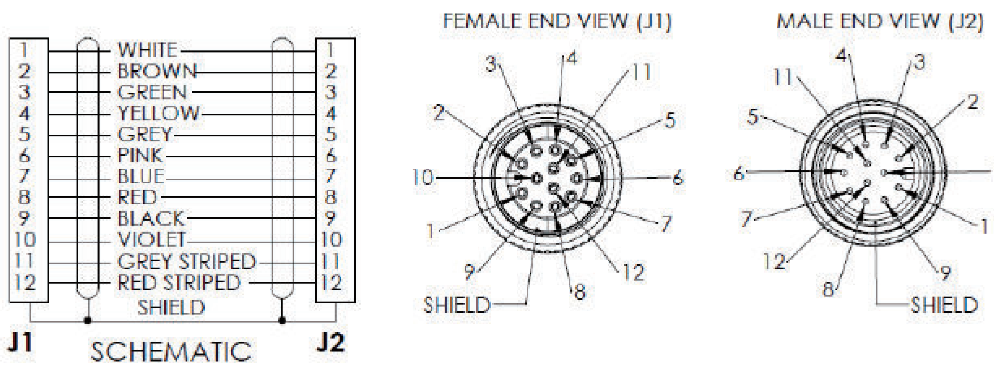
Reader to QX-1 Interconnect Cable – M12 Socket to M12 Plug – 1 Meter, 3 Meters, 5 Meters

V430-WQ-1M

V430-WQ-3M

V430-WQ-5M

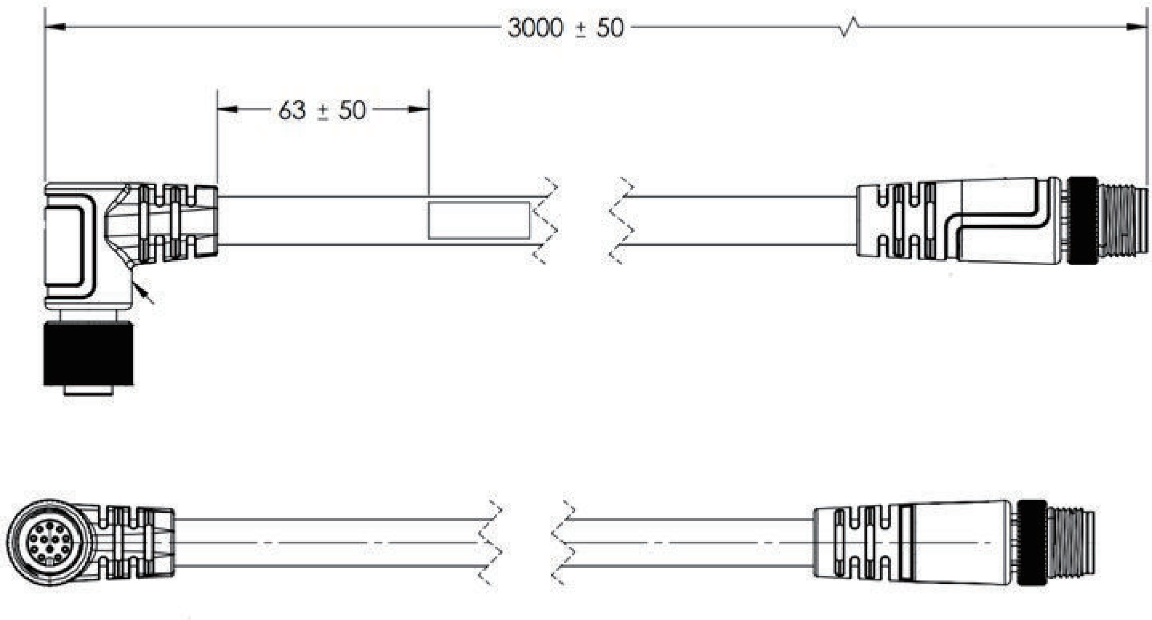


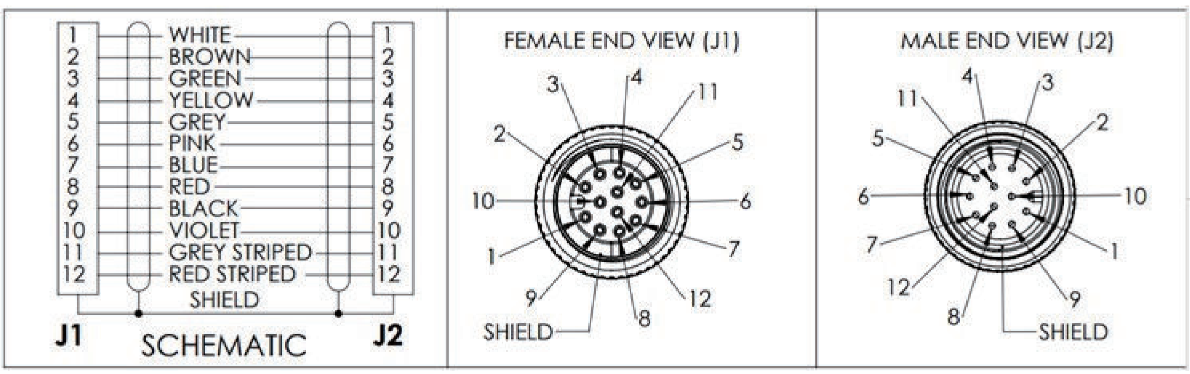


Reader to QX-1 Interconnect Cable – M12 Socket to M12 Plug – 1 Meter, 3 Meters (Right Angle to Back of Camera)

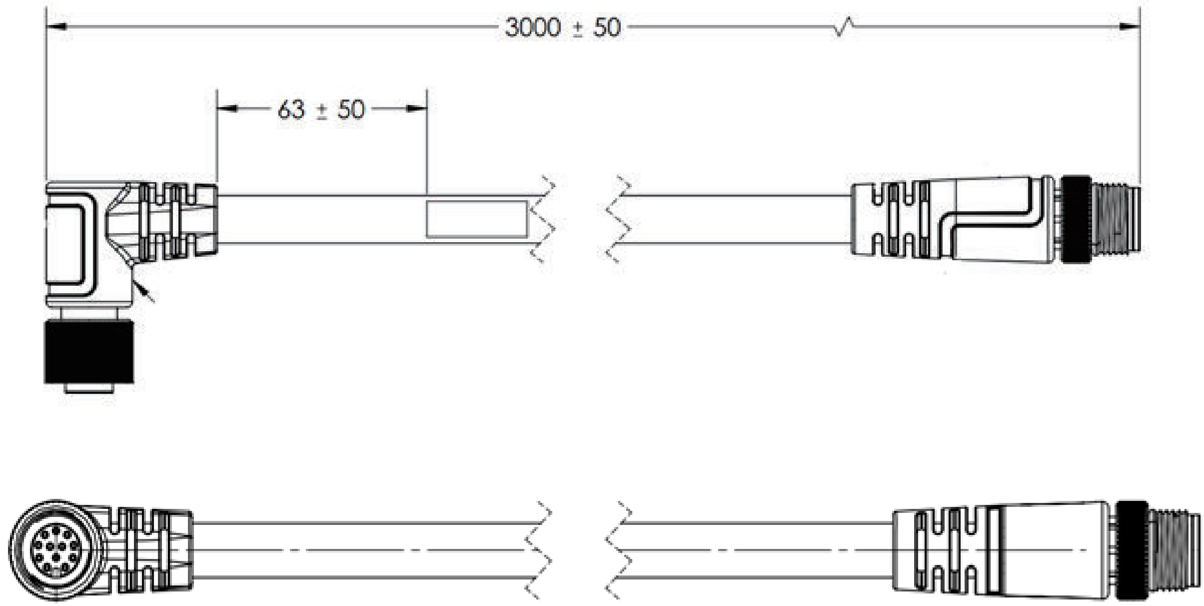
61-000162-03

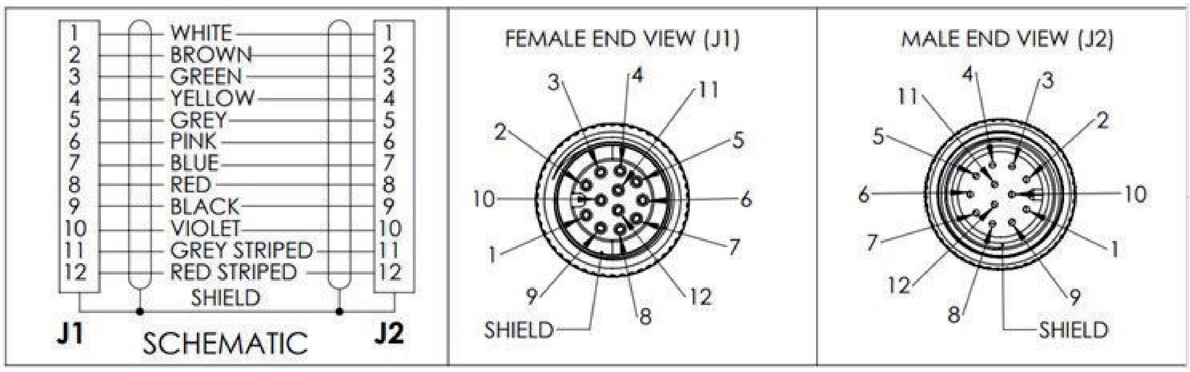
61-000148-03



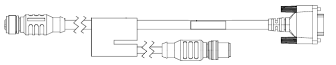


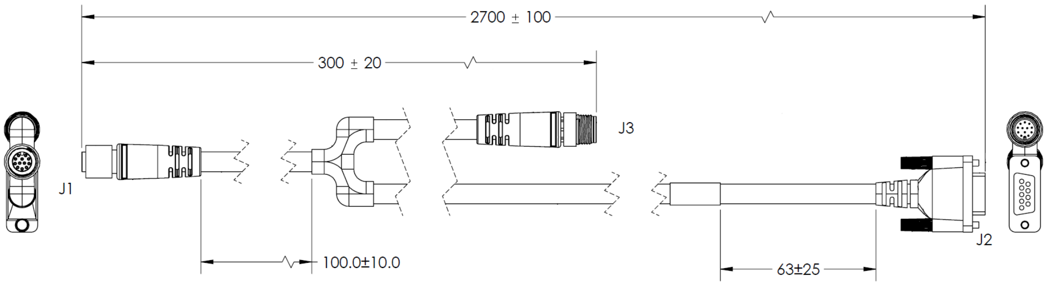
Right Angle Reader to QX-1 Interconnect Cable – M12 Socket to M12 Plug – 1 Meter, 3 Meters (Right Angle to Front of Camera)
61-000162-04
61-000148-04

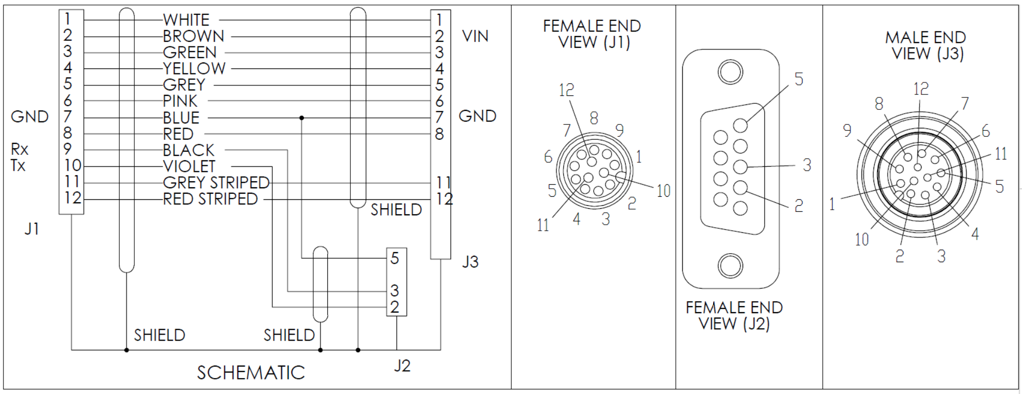




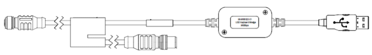
VHV5-F to QX-1 Interconnect Cables with RS-232 Breakout – 3 Meters, 5 Meters
V430-WQR-3M
V430-WQR-5M

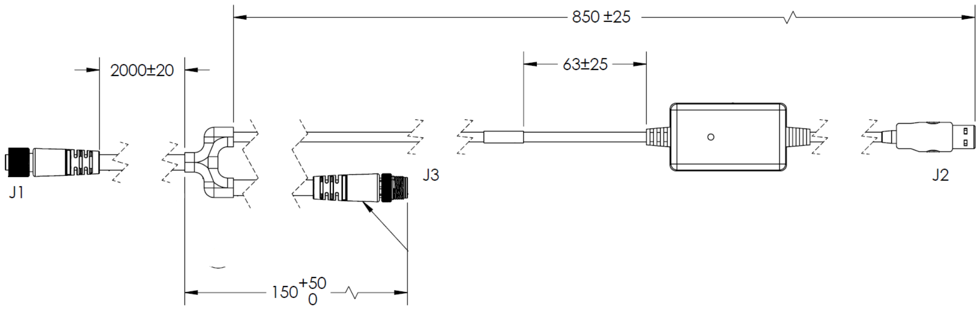


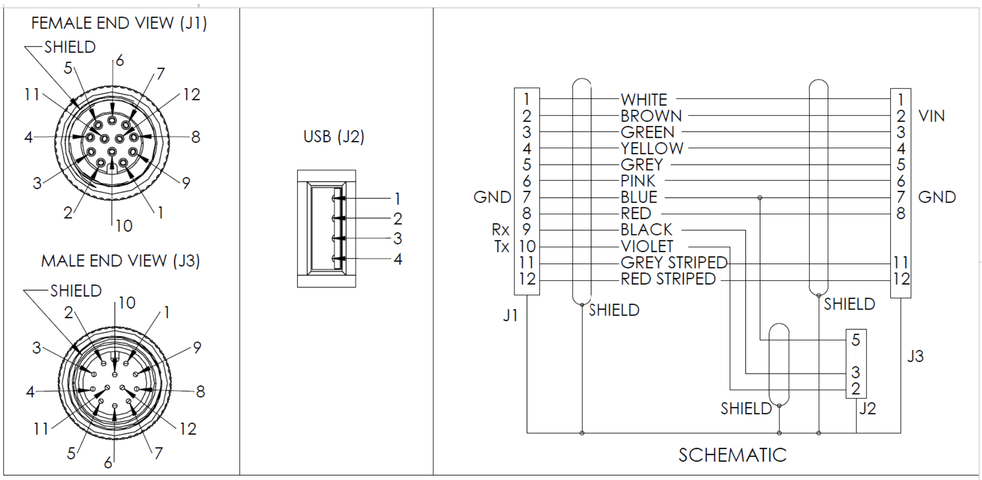




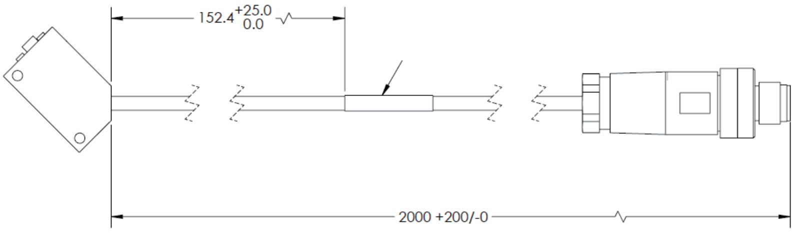
VHV5-F to QX-1 Interconnect Cables with USB Keyboard Wedge Breakout – 3 Meters V430-WQK-3M



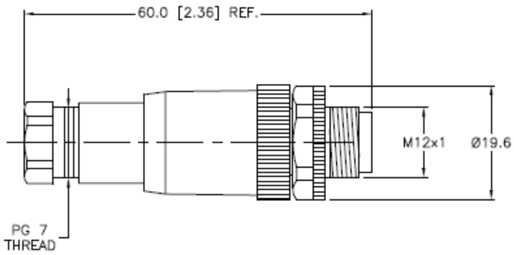




QX-1 Photo Sensor, M12 4-Pin Plug, NPN, Light ON / Dark ON – 2 Meters
99-9000016-01



QX-1 Field-Wireable M12 4-Pin Plug for Any Trigger Source or Photo Sensor – Screw Terminal Connector
98-9000239-01



13-2 Front Window Accessory Installation Guide

13-2-1 VHV5-AF0 Window Kit Removal and Installation

Removal:

Step 1: Disconnect power from the camera.

Step 2: Remove the four screws from the front bezel of the camera.

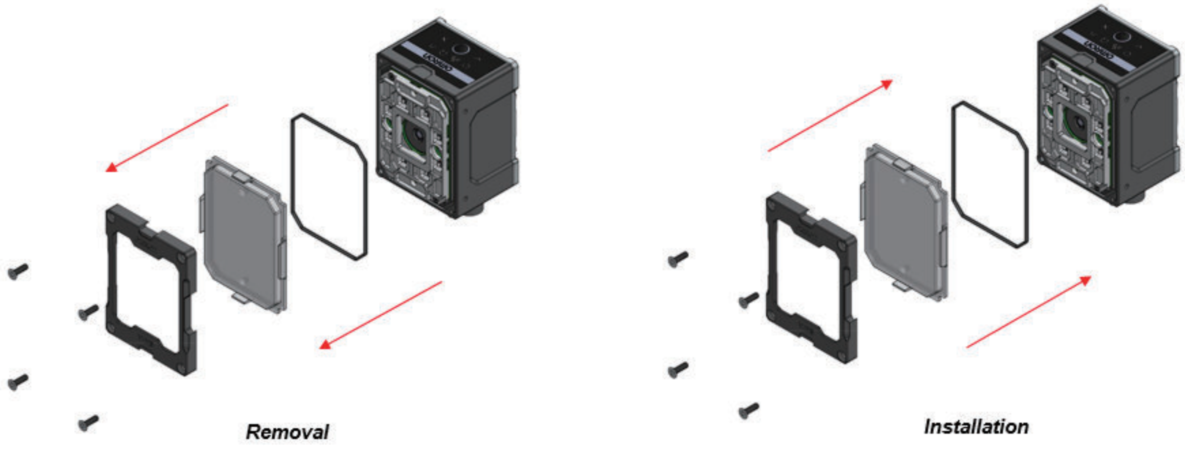
Step 3: Remove the front bezel, window and gasket.

Installation:

Step 1: Install the gasket onto the camera. Ensure that the gasket is properly seated in place.

Step 2: Install the window and bezel onto the camera.

Step 3: Secure the window in place using the screws provided. Do not over-tighten the screws. (4.8 in./lbs. (0.54 nm max.)



13-2-2 VHV5-AF1 Window with Optics Kit Removal and Installation

Removal:

Step 1: Disconnect power from the camera.

Step 2: Remove the four screws from the front bezel of the camera.

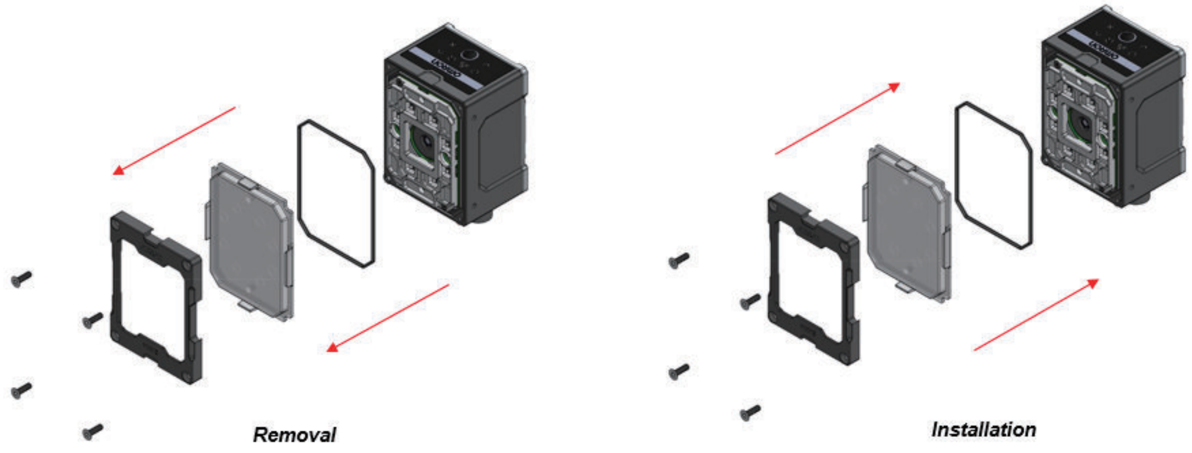
Step 3: Remove the front bezel, window and gasket.

Installation:

Step 1: Install the gasket onto the camera. Ensure that the gasket is properly seated in place.

Step 2: Install the window and bezel onto the camera.

Step 3: Secure the window in place using the screws provided. Do not over-tighten the screws. (4.8 in./lbs. (0.54 nm max.)



13-2-3 VHV5-AF2 Diffuser Kit Installation

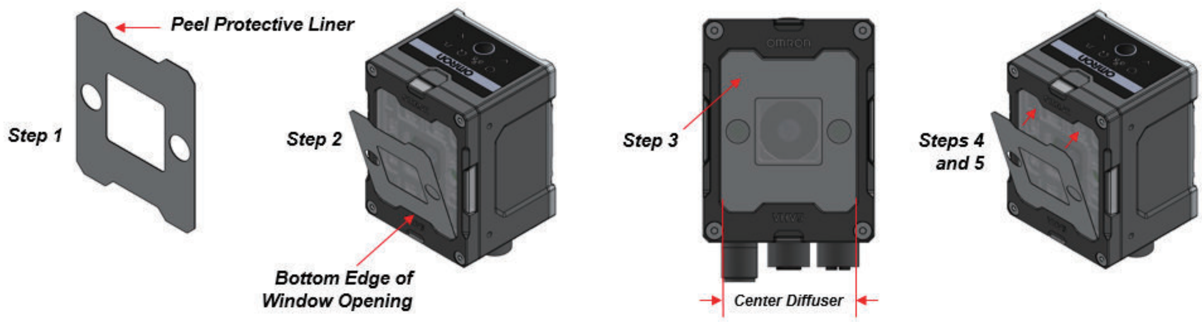
Step 1: Peel the protective liner from the adhesive on the diffuser.

Step 2: Rest the narrow edge of the diffuser on the bottom edge of the window opening at an angle as shown below.

Step 3: Center the diffuser left-to-right in the window opening.

Step 4: Affix the diffuser to the window.

Step 5: Run your finger over the surface of the diffuser using light pressure to complete the bond.



13-2-4 VHV5-AF3 Polarizer Kit Installation

Step 1: Peel the protective liner from the adhesive on the polarizer.

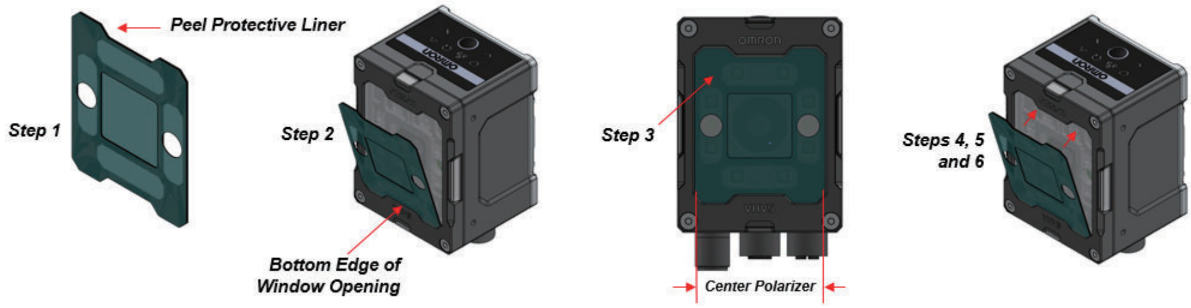
Step 2: Rest the narrow edge of the polarizer on the bottom edge of the window opening at an angle as shown below.

Step 3: Center the polarizer left-to-right in the window opening.

Step 4: Affix the polarizer to the window.

Step 5: Run your finger over the surface of the polarizer using light pressure to complete the bond.

Step 6: Peel the outer protective liner from the polarizer.



13-2-5 VHV5-AF4 Half-Polarizer Kit Installation

Step 1: Peel the protective liner from the adhesive on the polarizer.

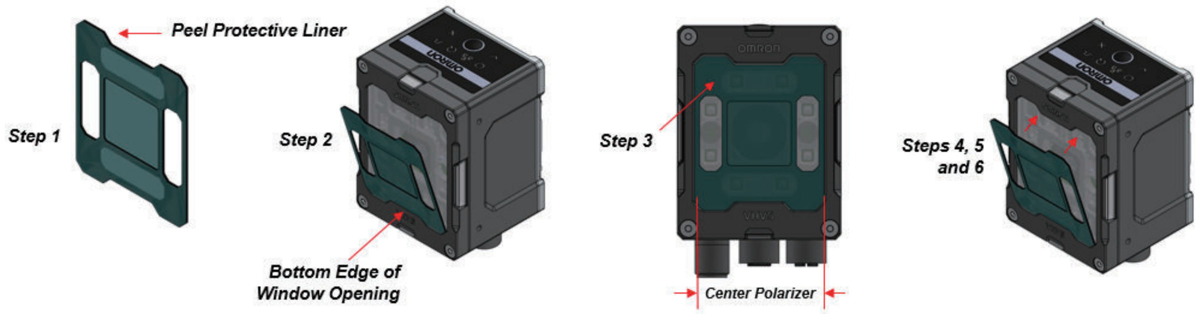
Step 2: Rest the narrow edge of the polarizer on the bottom edge of the window opening at an angle as shown below.

Step 3: Center the polarizer left-to-right in the window opening.

Step 4: Affix the polarizer to the window.

Step 5: Run your finger over the surface of the polarizer using light pressure to complete the bond.

Step 6: Peel the outer protective liner from the polarizer.



14

Troubleshooting

This section provides troubleshooting information, including suggestions about how to solve various code reader issues. It also answers some common questions about VHV5-F functionality.

14-1 Troubleshooting

Problem	Possible Causes	Possible Solutions
The code reader decodes the symbol, but does not transmit the symbol data to the host.	The code reader is not configured for the correct host type.	Use WebLink to set the appropriate host type.
	The PoE injector-to-host (device) cable is disconnected or loose.	Re-connect the cable.
The host displays decoded data incorrectly.	The code reader is not configured to work with the specific host.	Program the correct data output conditions (e.g., UPC-E to UPC-A conversion).

15

Service and Maintenance

15-1 Service

If you have difficulty using the equipment, contact your facility's technical or systems support. If there is a problem with the equipment, you can contact customer service at your regional Omron website.

When contacting support, please have the following information available:
- Serial number of the unit
- Model number or product name
- Software type and version number

Omron Microscan responds to calls by email, telephone, or fax within the time limits set forth in service agreements.

If your problem cannot be solved by support, you may need to return your equipment for servicing and will be given specific directions. Omron Microscan is not responsible for any damages incurred during shipment if the approved shipping container is not used. Shipping the units improperly can possibly void the warranty.

If you purchased your product from an Omron Microscan business partner, please contact that partner for support.

15-2 Maintenance

15-2-1 Known Harmful Ingredients

The following chemicals are known to damage the plastics on Omron Microscan products and should not come in contact with the device:

- Acetone
- Ammonia solutions
- Aqueous or alcoholic alkaline solutions
- Aromatic and chlorinated hydrocarbons
- Benzene
- Undiluted Bleach
- Carbolic acid
- Compounds of amines or ammonia
- Ethanolamine
- Ethers
- Ketones
- TB-lysoform
- Toluene
- Trichloroethylene

15-2-2 Tolerable Industrial Fluids and Chemicals

Not all fluid variants and brands have been tested.

The industrial fluids and chemicals listed below were evaluated and deemed tolerable for the housing of the VHV5-F. These industrial fluids and chemicals should not come in contact with the VHV5-F code reader window, which uses technology much like a digital camera. Marks, oil, or debris on the window will interfere with image captures. Leaving the following industrial fluids on the window will result in suboptimal decode performance. See *15-2-4 Cleaning the Code Reader* on page 15-4 for detailed cleaning instructions.

- Motor/Engine Oil
- Automatic Transmission Fluid (ATF)
- Continuously Variable Transmission (CVT) Fluid
- Industrial De-Greaser (Engine Brite Heavy Duty)
- Brake Fluid (DOT4)

If the code reader comes in frequent contact with the fluids and chemicals listed above, Omron Microscan recommends that you clean the outside of the code reader daily with the approved cleaning agent listed below.

15-2-3 Approved General Cleaning Agents

The following cleaning agents are approved for general cleaning of Omron Microscan products, including the VHV5-F.

- Isopropyl alcohol 70%

15-2-4 Cleaning the Code Reader

Routinely cleaning the exit window is required. A dirty window may affect scanning accuracy. Do not allow any abrasive material to touch the window.
To clean the code reader:

1. Dampen a soft cloth with one of the approved cleaning agents listed above or use pre-moistened wipes.

2. Gently wipe all surfaces, including the front, back, sides, top and bottom. Never apply liquid directly to the code reader. Be careful not to let liquid pool around the code reader window, trigger, cable connector or any other area on the device.

3. Be sure to clean the trigger and in between the trigger and the housing (use a cotton-tipped applicator to reach tight or inaccessible areas).

4. Do not spray water or other cleaning liquids directly into the exit window.

5. Wipe the code reader exit window with a lens tissue or other material suitable for cleaning optical material such as eyeglasses.

6. Immediately dry the code reader window after cleaning with a soft non-abrasive cloth to prevent streaking.

7. Allow the code reader to air dry before use.

8. Code reader connectors:
   1) Dip the cotton portion of a cotton-tipped applicator in isopropyl alcohol.
   2) Rub the cotton portion of the cotton-tipped applicator back-and-forth across the connector on the code reader at least 3 times. Do not leave any cotton residue on the connector.
   3) Use the cotton-tipped applicator dipped in alcohol to remove any grease and dirt near the connector area.
   4) Use a dry cotton tipped applicator and rub the cotton portion of the cotton-tipped applicator back-and-forth across the connectors at least 3 times. Do not leave any cotton residue on the connectors.

A

Appendices

A

A-1 Read Cycle Report Structure

A-1-1 Read Cycle Report Structure

A-1-1-1 Introduction

This appendix shows the format of the Read Cycle report. Read Cycle reports can be obtained using the Output Step and saving them via FTP, or by storing them locally on the camera and using the Omron Device Discovery Utility to upload them.

Appendix A-1-1-2 shows a typical Read Cycle Report for a Reading Job with Multiple Decode Tools.

Appendix A-1-1-3 shows a typical Read Cycle Report for a Verification Job with the Verification Tools set to verify Multiple codes.

Details for the data contained in the reports can be found in the referenced sections throughout the manual.

The reports are in JSON format.

A-1-1-2 Read Cycle Report Structure for Reading Jobs including Multiple Decode Tools


```
{
  "counts": {                // See Counts in Section 7-9-3 //
    "badQuality": 0,
    "cycles": 7,
    "failed": 0,
    "goodQuality": 0,
    "matches": 0,
    "noMatches": 0,
    "noReads": 0,
    "passRate": 1.0,
    "passed": 7,
    "reads": 7,
    "totalCycles": 7
  },
  "cycle": {                 // See Read Cycle in Section 7-9-3 //
    "acquisitionError": false,
    "captureTime": 28353,
    "cycleId": 11,
    "duration": 42177,
    "error": false,
    "generalError": false,
    "outData": "4550431091994,VHV5-AF0\r\n",
```

```
    "overheadTime": 7835,
    "overrun": false,
    "preProcessTime": 0,
    "processOverrun": false,
    "readTime": 5848,
    "triggerOverrun": false
  },
  "errorCounts": {            // See Read Cycle Counts in Section 6-2-3 //
    "aborts": 0,
    "acquisitionErrors": 0,
    "errors": 0,
    "overruns": 0,
    "processOverruns": 0,
    "stalls": 0,
    "timeouts": 0,
    "triggerOverruns": 0
  },
  "job": {
    "name": "Multicode",        // Loaded Job Name and Slot # from 7-9-3 //
    "slot": 5
  },
  "states": {                 // See Read Cycle states in Section 7-9-3 //
    "allGoodQuality": true,
    "allMatch": true,
    "allPresent": true,
    "allRead": true,
    "badQuality": false,
    "complete": true,
    "failed": false,
    "notAllMatch": false,
    "notAllPresent": false,
    "notAllRead": false,
    "passed": true
  },
  "stats": {                 // See Read Cycle stats in Section 7-9-3 //
    "captureTimeMaxCount": 1,
    "captureTimeMaxDurationUs": 28526,
    "captureTimeMinCount": 1,
    "captureTimeMinDurationUs": 27787,
    "currentCaptureCount": 1,
    "currentCaptureTimeUs": 28353,
    "cycleDurationUs": 42177,
    "idleTimeAverageUs": 47996765.85714286,
    "idleTimeMaxUs": 305582188,
    "idleTimeMinUs": 107130,
    "idleTimeUs": 170305,
    "numOfRealCaptures": 1,
```

```
  "overallCycleAverageDurationMs": 44095.28571428572,
  "overallCycleMaxDurationMs": 46945,
  "overallCycleMinDurationMs": 41850,
  "overheadTimeAverageUs": 7482.571428571428,
  "overheadTimeMaxUs": 8320,
  "overheadTimeMinUs": 6608,
  "overheadTimeUs": 7835,
  "partsPerMinute": 1.2489406010035393,
  "preProcessingTimeAverageUs": 0.0,
  "preProcessingTimeMaxUs": 0,
  "preProcessingTimeMinUs": 0,
  "preProcessingTimeUs": 0,
  "processingTimeAverageUs": 8245.714285714286,
  "processingTimeMaxUs": 10169,
  "processingTimeMinUs": 5848,
  "processingTimeUs": 5848,
  "readingTimeAverageUs": 8245.714285714286,
  "readingTimeMaxUs": 10169,
  "readingTimeMinUs": 5848,
  "readingTimeUs": 5848,
  "realCaptureTimeUs": 28353,
  "setupProcessingTimeAverageUs": 4693.714285714285,
  "setupProcessingTimeMaxUs": 4825,
  "setupProcessingTimeMinUs": 4600,
  "setupProcessingTimeUs": 4679,
  "timeBetweenCycleUs": 212341,
  "timeBetweenCyclesAverageUs": 48040715.428571425,
  "timeBetweenCyclesMaxUs": 305628984,
  "timeBetweenCyclesMinUs": 152980,
  "totalTimeAverageUs": 43949.57142857143,
  "totalTimeMaxUs": 46796,
  "totalTimeMinUs": 41713,
  "totalTimeUs": 42036,
  "triggerRateAverageUs": 48041144.571428575,
  "triggerRateMaxUs": 305628040,
  "triggerRateMinUs": 152029,
  "triggerRateUs": 212014
},
"tools": [                // One Group of Results Per Decode Tools  //
  {                     // See Decode Tool Outputs in Section 7-7 //
    "isGoodQuality": false,        // Decode tool 2             //
    "isMatchEnabled": false,
    "isMatched": false,
    "isPassed": true,
    "isPresent": true,
    "isQualityCheckEnabled": false,
    "isRead": true,
```

```
"numExpected": 1,
"numFound": 1,
"numQualified": 1,
"symbologyResults": [
  {
    "angleDeg": 176.72413718086415,
    "angleRad": 3.084418061552209,
    "boundingBox": [
      {
        "x": 911,
        "y": 671
      },
      {
        "x": 1489,
        "y": 706
      },
      {
        "x": 1478,
        "y": 910
      },
      {
        "x": 892,
        "y": 874
      }
    ],
    "calSymbol": 0,
    "data": "NDU1MDQzMTA5MTk5NA==",
    "dataBase64": "NDU1MDQzMTA5MTk5NA==",
    "dataUtf8": "4550431091994",
    "eci": false,
    "fnc1Start": false,
    "goodQuality": false,
    "grading": {
      "standard": "none"
    },
    "gs1Data": {
      "appIds": [],
      "enabled": false,
      "status": false,
      "stringBase64": "NDU1MDQzMTA5MTk5NA==",
      "stringUtf8": "4550431091994"
    },
    "height": 204,
    "imageKey": 11,
    "index": 0,
    "matchEnabled": false,
    "matched": false,
```

```
        "optimizeScore": 0,
        "outDataBase64": "NDU1MDQzMTA5MTk5NA==",
        "outDataUtf8": "4550431091994",
        "passed": true,
        "polarity": true,
        "ppe": 6.15625,
        "preProcessingTimeUs": 1677837501065359,
        "present": true,
        "processingTimeUs": 3076,
        "qualifierIndex": 0,
        "qualifierUid": "SymbologyQualifier2",
        "qualityEnabled": false,
        "read": true,
        "readability": 0,
        "region": {
          "height": 372,
          "width": 739,
          "xOffset": 830,
          "yOffset": 630
        },
        "regionUid": "Region2",
        "state": 2,
        "symbolId": {
          "id": "E",
          "modifier": "0",
          "string": "]E0"
        },
        "symbologyData": {
          "barCount": 30,
          "supplemental": 0,
          "version": "EAN-13"
        },
        "timeDecode": 3079,
        "timeLocalize": 1411,
        "toolSlot": 1,
        "toolUid": "SymbologyTool2",
        "ttr": 1677837501027258,
        "type": "UPC",
        "width": 579,
        "x": 1192,
        "y": 790
      }
    ],
    "toolUid": "SymbologyTool2",
    "type": "SymbologyTool"
  },
  {                          // Decode tool 1             //
```

```
"isGoodQuality": false,
"isMatchEnabled": false,
"isMatched": false,
"isPassed": true,
"isPresent": true,
"isQualityCheckEnabled": false,
"isRead": true,
"numExpected": 1,
"numFound": 1,
"numQualified": 1,
"symbologyResults": [
  {
    "angleDeg": 175.77960119068052,
    "angleRad": 3.0679327986199194,
    "boundingBox": [
      {
        "x": 728,
        "y": 544
      },
      {
        "x": 837,
        "y": 550
      },
      {
        "x": 827,
        "y": 658
      },
      {
        "x": 715,
        "y": 654
      }
    ],
    "calSymbol": 0,
    "data": "VkhWNS1BRjA=",
    "dataBase64": "VkhWNS1BRjA=",
    "dataUtf8": "VHV5-AF0",
    "eci": false,
    "fnc1Start": false,
    "goodQuality": false,
    "grading": {
      "standard": "none"
    },
    "gs1Data": {
      "appIds": [],
      "enabled": false,
      "status": false,
      "stringBase64": "VkhWNS1BRjA=",
```

```
  "stringUtf8": "VHV5-AF0"
},
"height": 108,
"imageKey": 11,
"index": 0,
"matchEnabled": false,
"matched": false,
"optimizeScore": 998399011,
"outDataBase64": "VkhWNS1BRjA=",
"outDataUtf8": "VHV5-AF0",
"passed": true,
"polarity": true,
"ppe": 7.8125,
"preProcessingTimeUs": 1677837501067275,
"present": true,
"processingTimeUs": 4999,
"qualifierIndex": 0,
"qualifierUid": "SymbologyQualifier1",
"qualityEnabled": false,
"read": true,
"readability": 93,
"region": {
  "height": 537,
  "width": 526,
  "xOffset": 582,
  "yOffset": 380
},
"regionUid": "Region1",
"state": 2,
"symbolId": {
  "id": "d",
  "modifier": "1",
  "string": "]d1"
},
"symbologyData": {
  "columns": 14,
  "damage": 0,
  "ecc": 200,
  "mirror": false,
  "readerConfig": false,
  "rows": 14,
  "uec": 0
},
"timeDecode": 5002,
"timeLocalize": 2010,
"toolSlot": 2,
"toolUid": "SymbologyTool1",
```

```
          "ttr": 1677837501027258,
          "type": "Datamatrix",
          "width": 109,
          "x": 776,
          "y": 601
        }
      ],
      "toolUid": "SymbologyTool1",
      "type": "SymbologyTool"
    }
  ],
  "version": "1.0"                // Report Format Version 1.0 //
}
```


A-1-1-3 Read Cycle Report Structure for Verification Job set to Multicode Mode


```
{
  "counts": {
    "badQuality": 13,
    "cycles": 13,
    "failed": 13,
    "goodQuality": 0,
    "matches": 0,
    "noMatches": 0,
    "noReads": 0,
    "passRate": 0.0,
    "passed": 0,
    "reads": 13,
    "totalCycles": 13
  },
  "cycle": {
    "acquisitionError": false,
    "captureTime": 24957,
    "cycleId": 31,
    "duration": 458284,
    "error": false,
    "generalError": false,
    "outData": "VHV5-AF0,4550431091994               240903000000000000003622612-30
0000000001                \r\n",
    "overheadTime": 9774,
    "overrun": false,
    "preProcessTime": 421701,
    "processOverrun": false,
    "readTime": 365063,
    "triggerOverrun": false
  },
```

```
"errorCounts": {
  "aborts": 9,
  "acquisitionErrors": 0,
  "errors": 0,
  "overruns": 0,
  "processOverruns": 0,
  "stalls": 0,
  "timeouts": 0,
  "triggerOverruns": 0
},
"job": {
  "name": "Verifier",
  "slot": 2
},
"states": {
  "allGoodQuality": false,
  "allMatch": true,
  "allPresent": true,
  "allRead": true,
  "badQuality": true,
  "complete": true,
  "failed": true,
  "notAllMatch": false,
  "notAllPresent": false,
  "notAllRead": false,
  "passed": false
},
"stats": {
  "captureTimeMaxCount": 1,
  "captureTimeMaxDurationUs": 28483,
  "captureTimeMinCount": 1,
  "captureTimeMinDurationUs": 23605,
  "currentCaptureCount": 1,
  "currentCaptureTimeUs": 24957,
  "cycleDurationUs": 458284,
  "idleTimeAverageUs": 50097142.23076923,
  "idleTimeMaxUs": 448337958,
  "idleTimeMinUs": 117370,
  "idleTimeUs": 117370,
  "numOfRealCaptures": 1,
  "overallCycleAverageDurationMs": 379321.46153846156,
  "overallCycleMaxDurationMs": 458284,
  "overallCycleMinDurationMs": 257152,
  "overheadTimeAverageUs": 9130.769230769232,
  "overheadTimeMaxUs": 9774,
  "overheadTimeMinUs": 7816,
  "overheadTimeUs": 9774,
```

```
  "partsPerMinute": 1.188676251250798,
  "preProcessingTimeAverageUs": 250290.3076923077,
  "preProcessingTimeMaxUs": 421701,
  "preProcessingTimeMinUs": 0,
  "preProcessingTimeUs": 421701,
  "processingTimeAverageUs": 345773.46153846156,
  "processingTimeMaxUs": 423406,
  "processingTimeMinUs": 223513,
  "processingTimeUs": 423406,
  "readingTimeAverageUs": 303159.76923076925,
  "readingTimeMaxUs": 365063,
  "readingTimeMinUs": 165518,
  "readingTimeUs": 365063,
  "realCaptureTimeUs": 24957,
  "setupProcessingTimeAverageUs": 5311.2307692307695,
  "setupProcessingTimeMaxUs": 6345,
  "setupProcessingTimeMinUs": 4864,
  "setupProcessingTimeUs": 5079,
  "timeBetweenCycleUs": 575507,
  "timeBetweenCyclesAverageUs": 50476317.615384616,
  "timeBetweenCyclesMaxUs": 448661249,
  "timeBetweenCyclesMinUs": 575507,
  "totalTimeAverageUs": 379175.3846153846,
  "totalTimeMaxUs": 458137,
  "totalTimeMinUs": 256995,
  "totalTimeUs": 458137,
  "triggerRateAverageUs": 9492459.222222222,
  "triggerRateMaxUs": 24054866,
  "triggerRateMinUs": 544044,
  "triggerRateUs": 544044
},
"tools": [
  {
    "isGoodQuality": false,
    "isMatchEnabled": false,
    "isMatched": false,
    "isPassed": false,
    "isPresent": true,
    "isQualityCheckEnabled": true,
    "isRead": true,
    "numExpected": 2,
    "numFound": 2,
    "numQualified": 2,
    "symbologyResults": [
      {
        "angleDeg": -179.74995627592037,
        "angleRad": -3.137228567330655,
```

```
"boundingBox": [
  {
    "x": 1333,
    "y": 803
  },
  {
    "x": 1448,
    "y": 803
  },
  {
    "x": 1449,
    "y": 918
  },
  {
    "x": 1334,
    "y": 918
  }
],
"calSymbol": 0,
"data": "VkhWNS1BRjA=",
"dataBase64": "VkhWNS1BRjA=",
"dataUtf8": "VHV5-AF0",
"eci": false,
"fnc1Start": false,
"goodQuality": true,
"grading": {
  "calPartDateTime": "",
  "calRefDateTime": "2026-01-16T10:35:45.058Z",
  "format": "grade",
  "grade": "3.0",
  "gradeReport": "3.0 4.0 4.0 4.0 3.0 4.0 3.8 3.8 4.0",
  "gradeString": "3.0/02/623/45CS",
  "isCalibrated": true,
  "iso15415": {
    "axialNonUniformity": {
      "grade": 4.0,
      "letter": "A",
      "value": 1
    },
    "contrast": {
      "grade": 4.0,
      "letter": "A",
      "value": 70
    },
    "decode": {
      "grade": 4.0,
      "letter": "A",
```

```
      "value": 100
    },
    "fixedPatternDamage": {
      "grade": 3.0,
      "letter": "B",
      "value": 75
    },
    "gridNonUniformity": {
      "grade": 4.0,
      "letter": "A",
      "value": 8
    },
    "modulation": {
      "grade": 3.799999952316284,
      "letter": "A",
      "value": 95
    },
    "overall": {
      "grade": 3.0,
      "letter": "B",
      "value": 75
    },
    "reflectanceMargin": {
      "grade": 3.799999952316284,
      "letter": "A",
      "value": 95
    },
    "revision": "2011",
    "unusedEC": {
      "grade": 4.0,
      "letter": "A",
      "value": 100
    }
  },
  "setupNotes": "",
  "standard": "iso15415",
  "valueReport": "75 100 1 70 75 8 95 95 100"
},
"gs1Data": {
  "appIds": [],
  "enabled": false,
  "status": false,
  "stringBase64": "VkhWNS1BRjA=",
  "stringUtf8": "VHV5-AF0"
},
"height": 115,
"imageKey": 1900,
```

```
"index": 0,
"matchEnabled": false,
"matched": false,
"optimizeScore": 999999051,
"outDataBase64": "VkhWNS1BRjA=",
"outDataUtf8": "VHV5-AF0",
"passed": true,
"polarity": true,
"ppe": 8.15625,
"preProcessingTimeUs": 421701,
"present": true,
"processingTimeUs": 363356,
"qualifierIndex": 0,
"qualifierUid": "SymbologyQualifier2",
"qualityEnabled": true,
"read": true,
"readability": 99,
"region": {
  "height": 1843,
  "width": 2224,
  "xOffset": 125,
  "yOffset": 102
},
"regionUid": "Region2",
"state": 2,
"symbolId": {
  "id": "d",
  "modifier": "1",
  "string": "]d1"
},
"symbologyData": {
  "columns": 14,
  "damage": 0,
  "ecc": 200,
  "mirror": false,
  "readerConfig": false,
  "rows": 14,
  "uec": 0
},
"timeDecode": 363359,
"timeLocalize": 1912,
"toolSlot": 1,
"toolUid": "VerificationTool2",
"ttr": 1677838156803280,
"type": "Datamatrix",
"width": 115,
"x": 1391,
```

```
          "y": 859
        },
        {
          "angleDeg": 179.85451809516385,
          "angleRad": 3.139053515348329,
          "boundingBox": [
            {
              "x": 997,
              "y": 945
            },
            {
              "x": 1234,
              "y": 945
            },
            {
              "x": 1234,
              "y": 1185
            },
            {
              "x": 995,
              "y": 1184
            }
          ],
          "calSymbol": 0,
          "data": "NDU1MDQzMTA5MTk5NCAgICAgICAgICAgICAgIDI0MDkwMzAwMDAwMDAwMDAwMDAw
MzYyMjYxMi0zMDAwMDAwMDAwMDEgICAgICAgICAgICAg",
          "dataBase64": "NDU1MDQzMTA5MTk5NCAgICAgICAgICAgICAgIDI0MDkwMzAwMDAwMDAwMD
AwMDAwMzYyMjYxMi0zMDAwMDAwMDAwMDEgICAgICAgICAgICAg",
          "dataUtf8": "4550431091994               240903000000000000003622612-3000
00000001                ",
          "eci": false,
          "fnc1Start": false,
          "goodQuality": false,
          "grading": {
            "calPartDateTime": "",
            "calRefDateTime": "2026-01-16T10:35:45.058Z",
            "format": "grade",
            "grade": "0.0",
            "gradeReport": "0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0",
            "gradeString": "0.0/00/623/45CS",
            "isCalibrated": true,
            "iso15415": {
              "axialNonUniformity": {
                "grade": 0.0,
                "letter": "F",
                "value": 0
              },
```

```
        "contrast": {
          "grade": 0.0,
          "letter": "F",
          "value": 0
        },
        "decode": {
          "grade": 0.0,
          "letter": "F",
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            "locator": [
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```

A-2 ASCII Table

A-2-1 ASCII Table

Dec	Hex	Mne	Ctrl
00	00	NUL	^@
01	01	SOH	^A
02	02	STX	^B
03	03	ETX	^C
04	04	EOT	^D
05	05	ENQ	^E
06	06	ACK	^F
07	07	BEL	^G
08	08	BS	^H
09	09	HT	^I
10	0A	LF	^J
11	0B	VT	^K
12	0C	FF	^L
13	0D	CR	^M
14	0E	SO	^N
15	0F	SI	^O
16	10	DLE	^P
17	11	DC1	^Q
18	12	DC2	^R
19	13	DC3	^S
20	14	DC4	^T
21	15	NAK	^U
22	16	SYN	^V
23	17	ETB	^W
24	18	CAN	^X
25	19	EM	^Y
26	1A	SUB	^Z
27	1B	ESC	^[
28	1C	FS	^\
29	1D	GS	^]
30	1E	RS	^^
31	1F	US	^_

Dec	Hex	Ch
32	20	SP
33	21	!
34	22	“
35	23	#
36	24	$
37	25	%
38	26	&
39	27	'
40	28	(
41	29	)
42	2A	*
43	2B	+
44	2C	,
45	2D	-
46	2E	.
47	2F	/
48	30	0
49	31	1
50	32	2
51	33	3
52	34	4
53	35	5
54	36	6
55	37	7
56	38	8
57	39	9
58	3A	:
59	3B	;
60	3C	<
61	3D	=
62	3E	>
63	3F	?

Dec	Hex	Ch
64	40	@
65	41	A
66	42	B
67	43	C
68	44	D
69	45	E
70	46	F
71	47	G
72	48	H
73	49	I
74	4A	J
75	4B	K
76	4C	L
77	4D	M
78	4E	N
79	4F	O
80	50	P
81	51	Q
82	52	R
83	53	S
84	54	T
85	55	U
86	56	V
87	57	W
88	58	X
89	59	Y
90	5A	Z
91	5B	[
92	5C	\
93	5D	]
94	5E	^
95	5F	_

Dec	Hex	Ch
96	60	`
97	61	a
98	62	b
99	63	c
100	64	d
101	65	e
102	66	f
103	67	g
104	68	h
105	69	i
106	6A	j
107	6B	k
108	6C	l
109	6D	m
110	6E	n
111	6F	o
112	70	p
113	71	q
114	72	r
115	73	s
116	74	t
117	75	u
118	76	v
119	77	w
120	78	x
121	79	y
122	7A	z
123	7B	{
124	7C	|
125	7D	}
126	7E	~
127	7F	D

A-3 Glossary of Terms

A-3-1 Glossary of Terms

Aberration — The failure of an optical lens to produce an exact point-to-point correspondence between the object and its resulting image. Various types are chromatic, spherical, coma, astigmatism and distortion.

Absorption — The loss of light of certain wavelengths as it passes through a material and is converted to heat or other forms of energy. (–)

Active Illumination — Lighting an area with a light source coordinated with the acquisition of an image. Strobed flash tubes and pulsed lasers are examples.

Ambient Light — Light which is present in the environment of the imaging front end of a vision system and generated from outside sources. This light, unless used for actual illumination, will be treated as background noise by the vision system.

Analog — A smooth, continuous voltage or current signal or function whose magnitude (value) is the information.

Analog-to-Digital Converter (A/D Converter or ADC) — A device that converts an analog voltage or current signal to a discrete series of digitally encoded numbers (signal) for computer processing.

Application-Specific Integrated Circuit (ASIC) — An integrated circuit that is customized for a particular kind of use, rather than general use. All vision system elements including firmware can be integrated into one ASIC.

Architecture — The hardware organization of a vision system designed for high speed image analysis.

Aspect Ratio — The ratio between the height and width of a sensor or display. Found by dividing the vertical number of pixels (height) by the horizontal number of pixels (width) leaving it in fractional format.

Automatic Gain Control (AGC) — Adjustment to signal strength that seeks to maintain a constant level regardless of the distance between a reader and symbol.

Auxiliary Port — RS-232 connection to an auxiliary terminal or device for remote viewing.

Blooming — A situation in which too many photons are being produced to be received by a pixel. The pixel overflows and causes the photons to go to adjacent pixels. Blooming is similar to overexposure in film photography, except that in digital imaging, the result is a number of vertical and/or horizontal streaks appearing from the light source in the picture.

Baud Rate — The number of discrete signal events per second; bits per second.

Capture — The act of acquiring and storing video images in an imager or host computer. Also, the image captured.

Charge-Coupled Device (CCD) — A semiconductor device with an array of light-sensitive elements that converts light images into electrical signals.

Check Character — A Modulus 43 or Modulus 10 character that is added to encoded symbol data for additional data integrity.

Complementary Metal Oxide Semiconductor (CMOS) — Like CCDs, CMOS imagers include an array of photo-sensitive diodes, one diode within each pixel. Unlike CCDs, however, each pixel in a CMOS imager has its own individual amplifier integrated inside.

Connector — A plug or socket on a device or cable providing in/out connectivity for various circuits and pins.

Concentrator — Intermediary device that relays data from imagers to a host and commands from the host to the imagers or other devices.
Counter — Memory space allocated to keep track of imager events.
Daisy Chain — Linkage of primary and secondary imagers allowing data to be relayed up to the host via auxiliary port connections.
Decode — A Good Read. The successful interpretation and output of the information encoded in a symbol.
Default — Restores ROM or flash settings, initializes serial commands and resets all counters.
Delimited — A delimited command or field is bracketed by predefined characters.
Decode Rate — The number of good reads per second achieved by an imager.
Dark Field Illumination — Lighting of objects, surfaces, or particles at very shallow or low angles, so that light does not directly enter a reader’s optical hardware.
Depth-of-Field — The in-focus range of an imaging system. Measured from the distance behind an object to the distance in front of the object with all objects appearing in focus.
Diffused Lighting — Scattered soft lighting from a wide variety of angles used to eliminate shadows and specular glints from profiled, highly reflective surfaces.
Digital-to-Analog Converter (DAC) — A VLSI circuit used to convert digitally processed images to analog for display on a monitor.
Digital Imaging — Conversion of an image into pixels by means of an Analog-to-Digital Converter where the level of each pixel can be stored digitally.
Digital Signal Processor (DSP) — A VLSI chip designed for ultra-high-speed arithmetic processing. Often embedded in a vision engine.
Discrete I/O — Inputs and outputs characterized by discrete signal transitions from one voltage level to another so that digital switching can occur.
Direct Memory Access (DMA) — A capability provided by some computer bus architectures that allows data to be sent directly to memory from an attached device.
Dynamic Range — The difference between the minimum and maximum thresholds of discernible images; the amount of usable signal.
Edge Enhancement — Image processing method to strengthen high-spatial frequencies in the image.
Embedded Memory — Onboard memory device such as EPROM or flash.
End of Read Cycle — The time or condition at which the imager stops expecting symbol information to decode.
Erasable Programmable Read-Only Memory (EPROM) — A memory chip that retains data when its power supply is turned off; “non-volatile memory”.
External Edge — Allows a read cycle to be initiated by a trigger signal from an object detector when it detects the appearance of an object (rising edge). The read cycle ends with a good read, a timeout, or a new trigger.
External Level — Allows a read cycle to be initiated by a trigger signal from an object detector. The read cycle ends when the object moves out of the detector’s range.
Falling Edge — A change of state (to inactive) associated with a level trigger.
Field-Programmable Gate Array (FPGA) — A semiconductor device containing programmable interconnects and logic components.
Fill Factor — Percentage of pixel area used for light collection.
Firmware — Software hard-coded in non-volatile memory (ROM), and closely tied to specific pieces of hardware.
Fixed Symbol Length — Increases data integrity by ensuring that only one symbol length will be accepted.

Focal Distance — In camera-based vision, the distance from the front of the camera to the object being viewed. (In optics, the distance from the lens to the focal plane.)
Focal Plane — Usually found at the image sensor, it is a plane perpendicular to the lens axis at the point of focus (–).
Focus — Any given point in an image at which light converges; the focal point.
Frame — The total area captured in an image sensor while the video signal is not blanked.
Frame Grabber — A device that interfaces with a camera and, on command, samples the video, converts the sample to a digital value and stores that in a computer's memory.
Front End System — The object, illumination, optics and imager blocks of a vision system. Includes all components useful to acquire a good image for subsequent processing.
Full Duplex — A communications system in which signals can travel simultaneously between devices.
Gain — The amount of energy applied to pixel gray scale values prior to output, expressed in dB; optimal signal strength.
Good Read — A decode. The successful scanning and decoding of the information encoded in a bar code symbol.
Gradient — The rate of change of pixel intensity (first derivative).
Gray Scale — Variations of values from white, through shades of gray, to black in a digitized image with black assigned the value of zero and white the value of one.
Half Duplex — A communications system in which signals can travel between devices in both directions, but not simultaneously.
Histogram — A graphical representation of the frequency of occurrence of each intensity or range of intensities (gray levels) of pixels in an image. The height represents the number of observations occurring in each interval.
Host — A computer, PLC, or other device that is used to execute commands and process data and discrete signals.
Image — Projection of an object or scene onto a plane (i.e. screen or image sensor).
Image Processing (IP) — Transformation of an input image into an output image with desired properties.
Image Resolution — The number of rows and columns of pixels in an image. A higher resolution means that more pixels are available per element of the symbol being read. Examples: 640 x 480 (VGA); 854 x 480 (WVGA); 1280 x 1024 (SXGA); 2048 x 1536 (QXGA).
Image Sensor — A device that converts a visual image to an electrical signal; a CCD or CMOS array.
Initialize — Implement serial configuration commands into the imager’s active memory.
Input — A channel or communications line. Decoded data or a discrete signal that is received by a device.
Integration — Exposure of pixels on a CMOS sensor.
Ladder Orientation — A linear symbol orientation in which the bars are parallel to the symbol’s direction of travel.
Light-Emitting Diode (LED) — A semiconductor device that emits light when conducting current.
Lens — A transparent piece of material with curved surfaces which either converge or diverge light rays.
Machine Vision — The automatic acquisition and analysis of images to obtain desired data for controlling a specific activity.
Multidrop — A communications protocol for networking two or more imagers or other devices with a concentrator (or controller) and characterized by the use of individual device addresses and the RS-485 standard.

Noise — The same as static in a phone line or “snow” in a television picture, noise is any unwanted electrical signal that interferes with the image being read and transferred by the imager.
Normally Closed — A discrete output state that is only active when open.
Normally Open — A discrete output state that is only active when closed.
Object Plane — An imaginary plane in the field of view, focused by an imager’s optical system at the corresponding image plane on the sensor.
Output — A channel or communications line. Data or discrete signals that are transmitted or displayed by a device.
Parity — An error detection routine in which one data bit in each character is set to 1 or 0 so that the total number of 1 bits in the data field is even or odd.
Picket Fence Orientation — A linear symbol orientation in which the bars are perpendicular to the symbol’s direction of travel.
Pitch — Rotation of a linear or 2D symbol around an axis parallel to the symbol length on the Substrate.
Pixel — An individual element in a digitized image array; “picture element”.
Port — Logical circuit for data entry and exit. (One or more ports may be included within a single connector.)
Processing Time — The time used by a vision system to receive, analyze and interpret image information. Often expressed in “parts per minute”.
Programmable Logic Controller (PLC) — An electronic device used in industrial automation environments such as factory assembly lines and automotive manufacturing facilities.
Progressive Scan — A non-interlaced scan that doubles the number of visible picture lines per field by displaying all picture lines at once.
Protocol — The rules for communication between devices, providing a means to control the orderly flow of information between linked devices.
Random Access Memory (RAM) — A data storage system used in computers, composed of integrated circuits that allow access to stored data in any sequence without movement of physical parts.
Read Cycle — A programmed period of time or condition during which a reader will accept symbol input.
Read-Only Memory (ROM) — A data storage medium used in computers and other electronics, primarily used to distribute Firmware.
Real-Time Processing — In machine vision, the ability of a system to perform a complete analysis and take action on one part before the next one arrives for inspection.
Region — Area of an image. Also called a region of interest for image processing operations.
Saturation — The degree to which a color is free of white. One of the three properties of color perception, along with hue and value.
Scattering — Redirection of light reflecting off a surface or through an object.
Skew — Rotation of a linear or 2D symbol around an axis parallel to the symbol height on the substrate.
Substrate — The surface upon which a linear or 2D symbol is printed, stamped, or etched.
Symbol Transitions — The transition of bars and spaces on a symbol, used to detect the presence of a symbol on an object.
Symbology — A symbol type, such as Code 39 or Code 128, with special rules to define the widths and positions of bars and spaces to represent specific numeric or alphanumeric information.
Tilt — Rotation of a linear or 2D symbol around an axis perpendicular to the substrate.
Trigger — A signal, transition, or character string that initiates a read cycle.

Very Large-Scale Integration (VLSI) — The creation of integrated circuits by combining thousands of transistor-based circuits on a single chip.
Watchdog Timer — A security device that detects system crashes and attempts to reset the imager.

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