Matrix 120™

PRODUCT REFERENCE GUIDE

Image Based Industrial Reader

⊕DATALOGIC

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PREFACE

ABOUT THIS MANUAL

This Product Reference Guide (PRG) is provided for users seeking advanced technical information, including connection, programming, maintenance and specifications. The Quick Reference Guide (QRG) and other publications associated with this product can be downloaded free of charge from the website listed on the back cover of this manual.

Manual Conventions

The following conventions are used in this document:

The symbols listed below are used in this manual to notify the reader of key issues or procedures that must be observed when using the reader:

NOTE: Notes contain information necessary for properly diagnosing, repairing and operating the reader.

CAUTION: This symbol advises you of actions that could damage equipment or property.

WARNING: This symbol advises you of actions that could result in harm or injury to the person performing the task.

TECHNICAL SUPPORT

Support Through the Website

Datalogic provides several services as well as technical support through its website. Log on to (www.datalogic.com).

For quick access, from the home page click on the search icon 🔍 , and type in the name of the product you're looking for. This allows you access to download Data Sheets, Manuals, Software & Utilities, and Drawings.

Hover over the Support & Service menu for access to Services and Technical Support.

Reseller Technical Support

An excellent source for technical assistance and information is an authorized Datalogic reseller. A reseller is acquainted with specific types of businesses, application software, and computer systems and can provide individualized assistance.

WARRANTY

Datalogic warrants that the Products shall be free from defects in materials and workmanship under normal and proper use during the Warranty Period. Products are sold on the basis of specifications applicable at the time of manufacture and Datalogic has no obligation to modify or update Products once sold. The Warranty Period shall be **two years** from the date of shipment by Datalogic, unless otherwise agreed in an applicable writing by Datalogic.

Datalogic will not be liable under the warranty if the Product has been exposed or subjected to any: (1) maintenance, repair, installation, handling, packaging, transportation, storage, operation or use that is improper or otherwise not in compliance with Datalogic's instruction; (2) Product alteration, modification or repair by anyone other than Datalogic or those specifically authorized by Datalogic; (3) accident, contamination, foreign object damage, abuse, neglect or negligence after shipment to Buyer; (4) damage caused by failure of a Datalogic-supplied product not under warranty or by any hardware or software not supplied by Datalogic; (5)any device on which the warranty void seal has been altered, tampered with, or is missing; (6) any defect or damage caused by natural or man-made disaster such as but not limited to fire, water damage, floods, other natural disasters, vandalism or abusive events that would cause internal and external component damage or destruction of the whole unit, consumable items; (7) use of counterfeit or replacement parts that are neither manufactured nor approved by Datalogic for use in Datalogic-manufactured Products; (8) any damage or malfunctioning caused by non-restoring action as for example firmware or software upgrades, software or hardware reconfigurations etc.; (9) loss of data; (10) any consumable or equivalent (e.g. cables, power supply, batteries, etc.); or (11) any device on which the serial number is missing or not recognizable.

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COMPLIANCE

GENERAL

For installation, use and maintenance it is not necessary to open the reader.

Only connect Ethernet and dataport connections to a network which has routing only within the plant or building and no routing outside the plant or building.

Power Supply

ATTENTION: READ THIS INFORMATION BEFORE INSTALLING THE PRODUCT

This product is intended to be installed by **Qualified Personnel** only.

This product is intended to be connected to a UL Listed Computer (LPS or "Class 2") which supplies power directly to the reader, or a UL Listed Direct Plug-in Power Unit marked LPS or "Class 2".

EMC Compliance

In order to meet the EMC requirements:

- connect reader chassis to the plant earth ground by means of a flat copper braid shorter than 100 mm;
- connect pin "Earth" of the CBX connection box to a good Earth Ground.

European Declaration of Conformity

Hereby, Datalogic S.r.l. declares that the full text of the European Declaration of Conformity is available at: www.datalogic.com. Select the link from the downloads section of the product page.

UKCA Declaration of Conformity

Hereby, Datalogic S.r.l. declares that the full text of the UKCA Declaration of Conformity is available at: www.datalogic.com. Select the link from the downloads section of the product page.

FCC Compliance

Modifications or changes to this equipment without the expressed written approval of Datalogic could void the authority to use the equipment.

This device complies with PART 15 of the FCC Rules. 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 which may cause undesired operation.

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/her own expense.

EAC Compliance

Customs Union:

The CU Conformity certification has been achieved; this allows the Product to bear the Eurasian Mark of conformity.

LED Safety

LED emission according to EN 62471.

Laser Safety

This product complies with 21 CFR 1040.10 except for conformance with IEC60825-1 Ed.3, as described in Laser Notice No. 56, dated May 8, 2019.

This product is classified as a Class 1M laser product according to IEC60825-1:2014.

Disconnect the power supply when opening the device during maintenance or installation to avoid exposure to hazardous laser light. The laser beam can be switched on or off through a software command.

> **WARNING: Use of controls or adjustments or performance of procedures other than those specified herein may result in exposure to hazardous visible laser light.**
> **LASER RADIATIONS DO NOT VIEW DIRECTLY WITH OPTICAL INSTRUMENTS CLASS 1M LASER PRODUCTS.**

IMPORTANT WARNINGS

Access to the internal parts of the product is allowed only to authorized personnel, duly qualified and trained with regards to risks of optical and electrical nature.

Datalogic declines any and all responsibility for work carried out on active parts by untrained or unauthorized personnel.

> **CAUTION: It is forbidden to change the intended use for which the product was designed and developed.**
> **Datalogic declines any and all responsibility for improper use of its product.**

> **CAUTION: It is the responsibility of the customer to install the product in proper safety condition!**

HANDLING

The Matrix 120 is designed to be used in an industrial environment and is built to withstand vibration and shock when correctly installed, however it is also a precision product and therefore before and during installation it must be handled correctly to avoid damage.

- avoid that the scanners hit one another causing damage. They should be handled separately.

- avoid that the readers are dropped (exceeding shock limits).

- do not fine tune the positioning by striking the reader or bracket.

NO
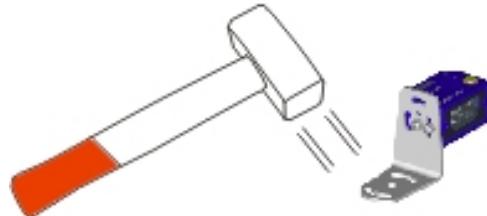
- do not weld the reader into position which can cause electrostatic, heat or reading window damage.

NO
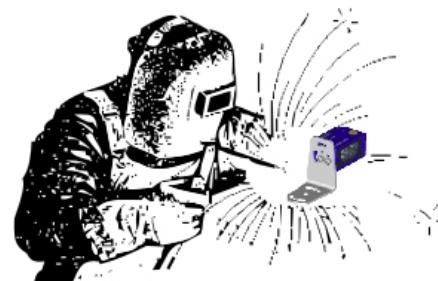
- do not spray paint near the reader which can cause reading window damage.

NO

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GENERAL VIEW

Matrix 120™
Serial + Ethernet Models
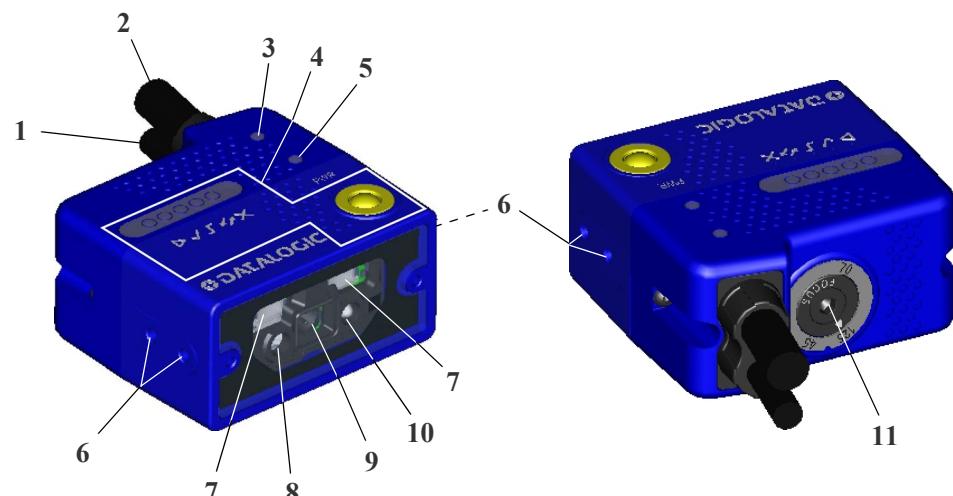
Figure A

1	Power - Serial Interface - I/O Cable w/Connector	7	Internal Illuminator
2	Ethernet Cable w/Connector	8	Aiming System Laser Source
3	Ethernet Connection LED	9	Lens
4	HMI X-PRESS Interface	10	Good Read LED (green)
5	Power On LED	11	Focus Adjustment Screw
6	Bracket Mounting Holes (4)		

Matrix 120™
Serial + USB Models
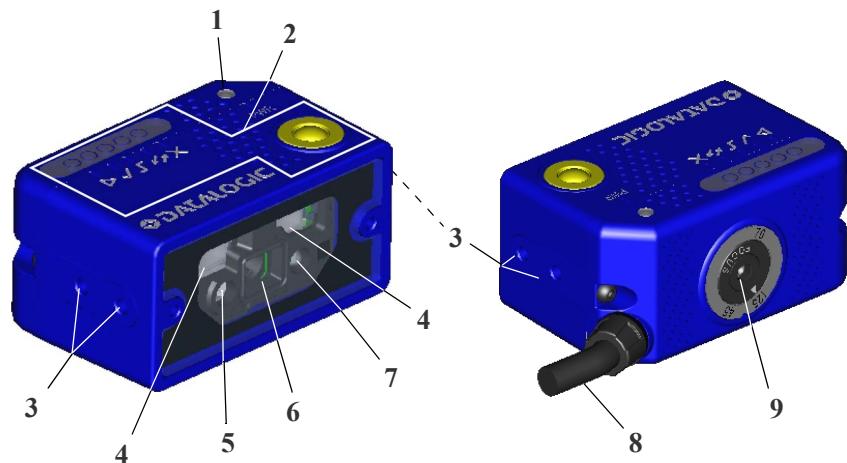
Figure B

1	Power On LED	**6**	Lens
2	HMI X-PRESS Interface	**7**	Good Read LED (green)
3	Bracket Mounting Holes (4)	**8**	Power - Serial Interface - I/O Cable w/Connector
4	Internal Illuminator	**9**	Focus Adjustment Screw
5	Aiming System Laser Source		

CHAPTER 1
RAPID CONFIGURATION

STEP 1 - CONNECT THE SYSTEM

The paragraphs in this step show a typical hardware setup depending on the Matrix 120 model and interface selection. Several other layouts are described in Typical Layouts, starting on page 61.

Ethernet Connections

To connect the system in an Ethernet point-to-point configuration, you need the hardware indicated in Figure 1. In this layout the data is transmitted to the Host from the Matrix 120 on-board Ethernet interface by using a **CAB-ETH-M0x** cable. There is no need to use a crossover adapter since Matrix 120 incorporates an autocross function.

Matrix 120 power and I/O device connections take place through the CBX connection box using the **CAB-1011** accessory cable.

When One Shot or Phase Mode Operating mode is used, the reader is activated by an External Trigger (photoelectric sensor) when the object enters its reading zone.

1 Ethernet Interface
2 Main Serial Interface (RS232 or RS422 Full-Duplex)
3 External Trigger (for One Shot or Phase Mode)
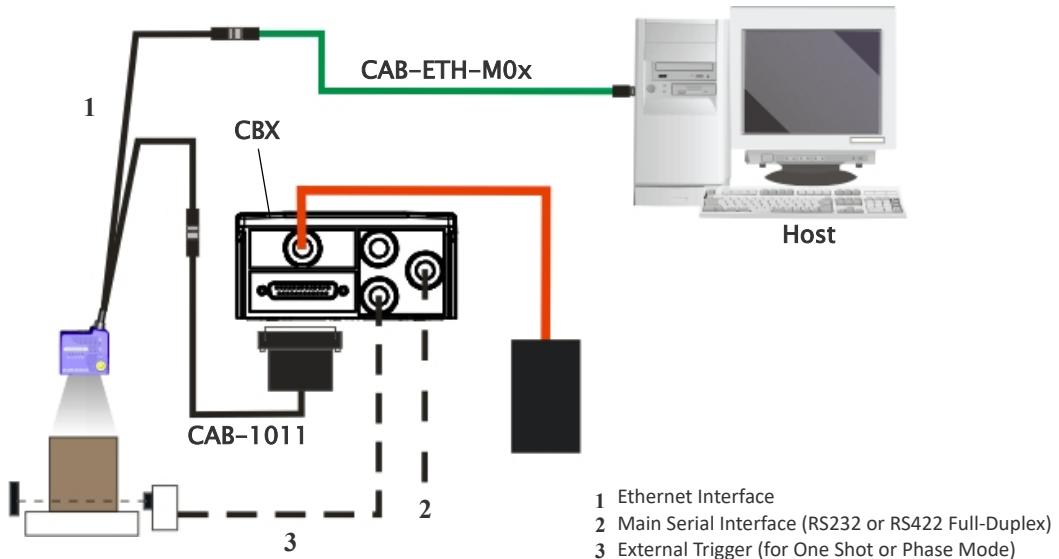
Figure 1. Ethernet Point-to-Point Layout

USB Connections

To connect the system in a USB point-to-point configuration, you need the hardware indicated in Figure 2. In this layout the data is transmitted to the Host from the Matrix 120 USB interface by using a **CAB-1021** accessory cable.

Host

CAB–1021
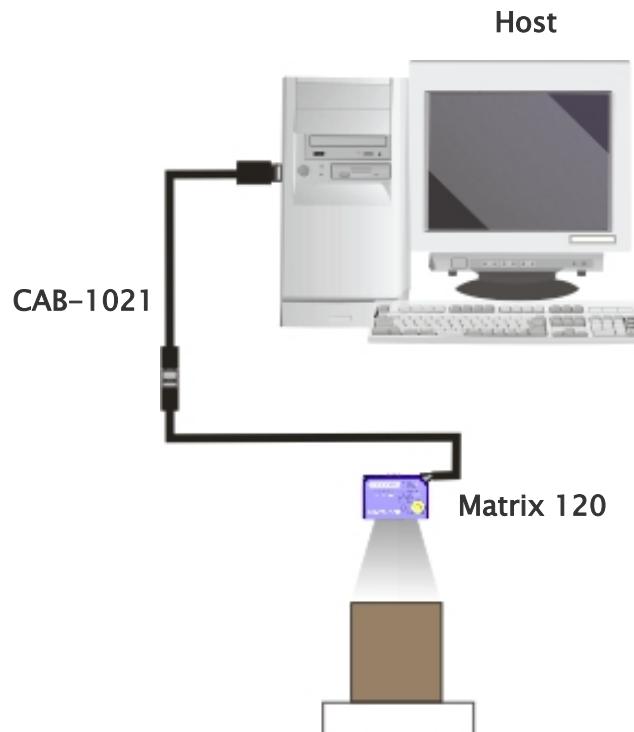
Matrix 120

Figure 2. USB Point–to–Point Layout

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Serial Connections

To connect the system in a Serial point-to-point configuration, you need the hardware indicated in Figure 3. In this layout the data is transmitted to the Host from the Matrix 120 main serial interface.

Matrix 120 power and I/O device connections take place through the CBX connection box using the **CAB-1011** accessory cable.

When One Shot or Phase Mode Operating mode is used, the reader is activated by an External Trigger (photoelectric sensor) when the object enters its reading zone.

1 Main Serial Interface (RS232 or RS422 Full-Duplex)
2 Optional Outputs
3 External Trigger (for One Shot or Phase Mode)
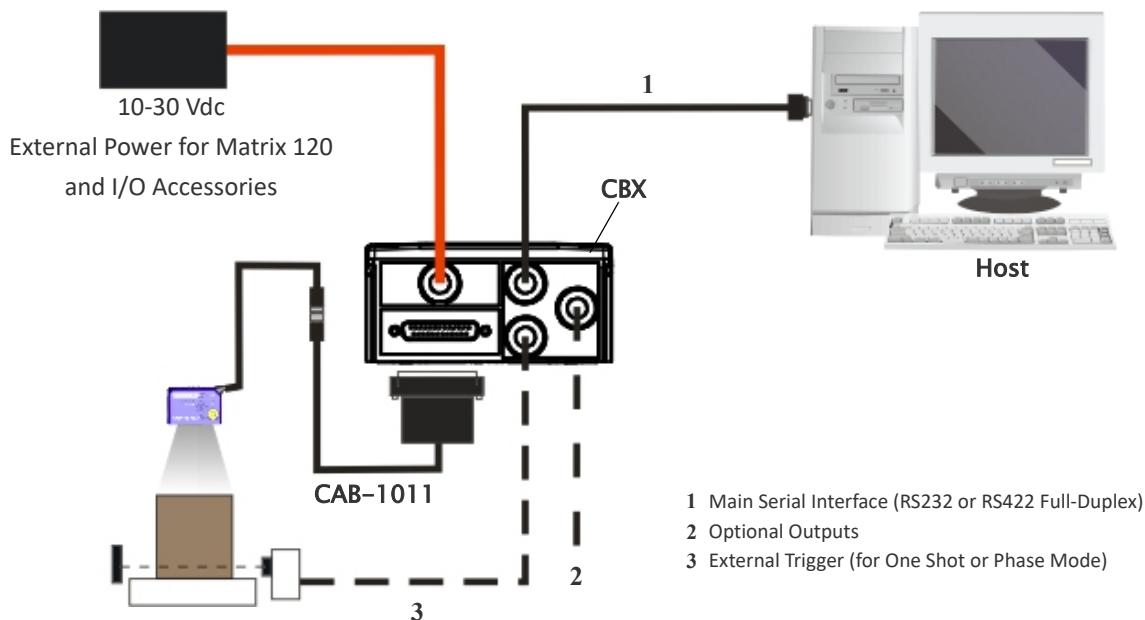
Figure 3. Serial Point-to-Point Layout

> **NOTE: For device configuration through DL.CODE, it is recommended to use either the Ethernet or USB interface (depending on your model). See USB Connection.**
> **It is not recommended to use the Main Serial interface for configuration unless the other interfaces are not available.**

CBX100/CBX500 Pinout for Matrix 120

The table below gives the pinout of the CBX100/CBX500 terminal block connectors. Use this pinout only when the Matrix 120 reader is connected to the CBX100/CBX500 by means of the CAB-1011 accessory cable:

CBX100/500 Terminal Block Connectors			
Input Power		**Outputs**	
Vdc	Power Supply Input Voltage +	+V	Power Source - Outputs
GND	Power Supply Input Voltage –	-V	Power Reference - Outputs
Earth	Protection Earth Ground	O1+	Output 1+
		O1-	Output 1-
Inputs		O2+	Output 2+
+V	Power Source - External Trigger	O2-	Output 2-
I1A	External Trigger A (polarity insensitive)	O3A	Output 3 (CBX500 only)
I1B	External Trigger B (polarity insensitive)		
-V	Power Reference - External Trigger	**Auxiliary Interface**	
+V	Power Source - Inputs	Matrix 120 has no Auxiliary Interface	
I1A	Input 2 A (polarity insensitive)		
I2B	Input 2 B (polarity insensitive)		
-V	Power Reference - Inputs	**ID-NET™**	
Shield		Matrix 120 has no ID-NET Interface	
Cable shield connected to chassis and 17-pin connector shell			
Main Interface			
RS232		**RS422 Full-Duplex**	
TX		TX+	
RX		[1]RX+	
-		[a]TX-	
-		RX-	
SGND		SGND	

1. Do not leave floating, see RS232 Interface for connection details

⚠ **CAUTION: Do not connect GND and SGND to different (external) ground references. GND and SGND are internally connected through filtering circuitry, which can be permanently damaged if subjected to voltage drops over 0.8 Vdc.**

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STEP 2 - MOUNT AND POSITION THE READER

1. To mount the Matrix 120, use the mounting brackets to obtain the most suitable position for the reader. The most common mounting configuration is shown in the figure below.
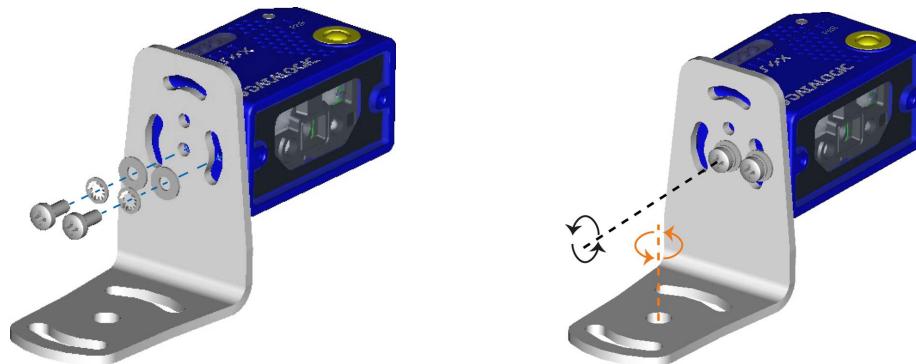
Figure 4. Positioning with Mounting Bracket

2. When mounting the Matrix 120, take into consideration these three ideal label position angles: **Pitch or Skew 10° to 20° and Tilt 0°**, although the reader can read a code at any tilt angle provided the code fits into the Field Of View (FOV).
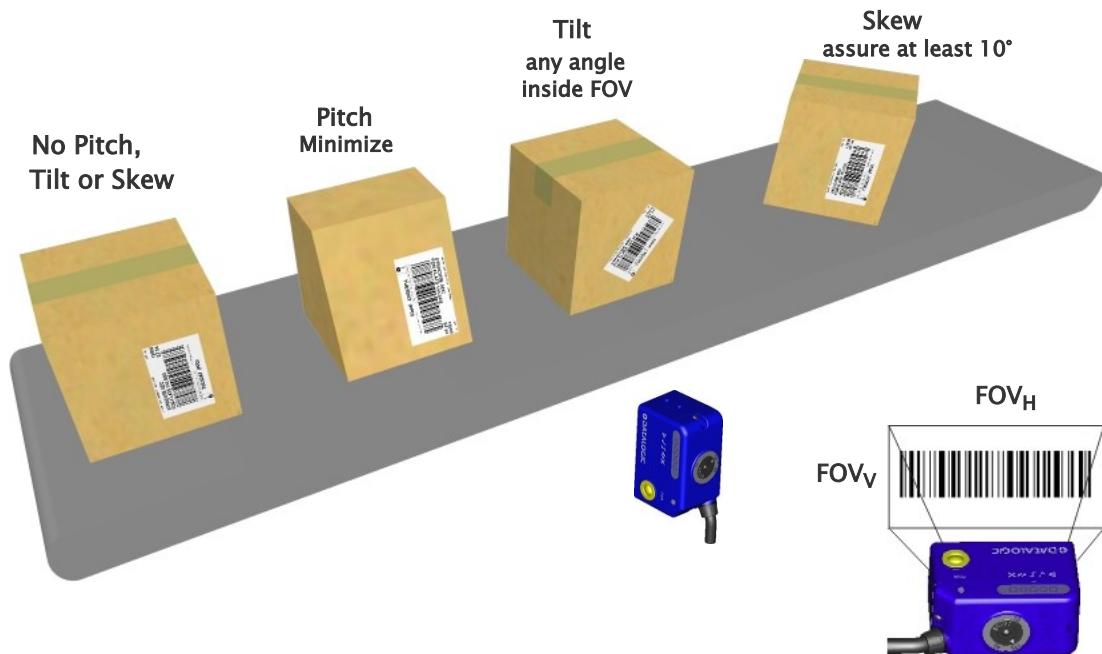
Figure 5. Pitch, Skew and Tilt References

3. Refer to the reading diagrams in Chapter 6, to determine the distance your reader should be positioned at.

> **NOTE: Rapid Configuration of the Matrix 120 reader can be made either through the X-PRESS™ interface (steps 3) which requires no PC connection, or by using the DL.CODE Configuration Program (steps 5-6). Select the procedure according to your needs.**

STEP 3 - X-PRESS CONFIGURATION

The Matrix 120 models are factory calibrated at three focus positions (**45, 70 and 125 mm for WVGA models; 45, 80 and 125 mm for MP models**). Using a 2.5 mm Hex key (Allen wrench), rotate the Focus Adjustment Screw at the back of the reader to one of these three positions for your application.

CAUTION: Do not rotate the Focus Adjustment Screw beyond the focus scale limits otherwise damage can occur to the focus mechanism.

Refer to the Reading Diagrams in Chapter 6, Reading Features, which show the reading ranges at the different focus positions for Code 128 (1D) and Data Matrix (2D) codes.

Focus/Aiming

Matrix 120 devices provide a built-in aiming system to aid reader positioning. The aiming system is accessed through the X-PRESS Interface.

1. Power the reader on. During the reader startup (reset or restart phase), all the LEDs blink for one second. On the connector side of the reader near the cable, the "POWER ON" LED (blue) indicates the reader is correctly powered.

2. Enter the Focus/Aim function by pressing and holding the X-PRESS push button until the Aim LED is on.

3. Release the button to enter the Aim function. The aiming system turns on see.

4. Place an **application specific code** in front of the reader at the reading distance indicated for your model as described above, centering it a few mm to the left of the aiming system indicator as shown below.
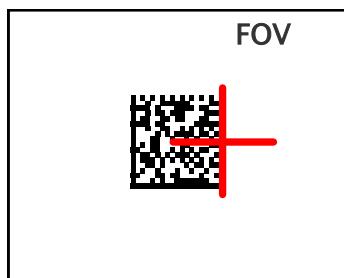
Figure 6. Aiming Function Using The Red Crosshairs

Figure 11. X-PRESS Interface: Aim Function

5. Exit the Aim function by pressing the X-PRESS push button once. The aiming system turns off.

Setup

1. Enter the Setup function by pressing and holding the X-PRESS push button until the Setup LED is on.

2. Release the button to enter the Setup function. The Setup LED will blink until the procedure is completed.
   The Setup procedure ends when the Image Acquisition parameters are successfully saved in the reader memory, the Setup LED will stop blinking and Matrix 120 emits 3 high pitched beeps.
   If the calibration cannot be reached after a timeout of about 5 (five) seconds, Matrix 120 will exit without saving the parameters to memory, the Setup LED will stop blinking and in this case Matrix 120 emits a long low pitched beep.

Figure 12. X-PRESS Interface:

Setup Function

Learn

1. Enter the Learn function by pressing and holding the X-PRESS push button until the Learn LED is on.

2. Release the button to enter the Learn function. The Learn LED will blink until the procedure is completed.
   The Learn procedure ends when the Image Processing and Decoding parameters are successfully saved in the reader memory, the Green Spot is activated, the Setup LED will stop blinking and Matrix 120 emits 3 high pitched beeps[1].
   If the autolearn cannot be reached after a timeout of about 3 (three) minutes, Matrix 120 will exit without saving the parameters to memory, the Learn LED will stop blinking and in this case Matrix 120 emits a long low pitched beep.

Figure 13. X-PRESS Interface:

Learn Function

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1. The Learn procedure will not recognize the following symbologies: Postal Codes, Pharmacode, MSI, Standard 2 of 5, Matrix 2 of 5

NOTE: The Grade A Barcode Test Chart cannot be used to set the Code 128 symbology (even though the reader successfully reads the code). Use the application specific code if you need to set this symbology.

NOTE: When using X-PRESS or the BM150 menu to perform Auto-Learn, only a <u>single code</u> can be configured (successive Learns will substitute the current code). To configure multiple codes, use the DL.CODE Auto-Learn procedure.

NOTE: You can always exit from any X-PRESS function at any time by pressing the X-PRESS push button once. After a short delay the procedure is canceled.

NOTE: If you have used this procedure to configure Matrix 120, go to Step 6 – Test Mode.

Reset Reader to Factory Default Environment (Optional)

If it ever becomes necessary to reset the reader's Environment parameters to their factory default values, you can perform this procedure by holding the X-PRESS push button pressed while powering up the reader. **You must keep the X-PRESS push button pressed until all LEDs blink simultaneously for about 3 seconds. Release and re-press the button during this LED blinking sequence**.

All the device Environment parameters are reset including the default IP Address. The Matrix 120 emits 3 high pitched beeps and after a few seconds enters run mode.

Any previously saved configurations on the device will remain in memory, but the Default configuration is set as the startup configuration.

NOTE: If you release the button while the LEDs are all on continuously (after the blinking phase), the reader will enter the Loader program sequence and the LEDs will begin to cycle through various patterns. Just cycle power to return to run mode.

STEP 4 - INSTALLING DL.CODE CONFIGURATION PROGRAM

NOTE: Refer to the DL.CODE User's Guide for correct use of the software.

CAUTION: DL.CODE does not currently support Windows Embedded (often used in industrial PCs and/or PLCs).

DL.CODE is a Datalogic reader configuration tool providing several important advantages:

- Intuitive Graphical User Interface for rapid configuration
- Defined configuration directly stored in the reader
- Discovery and IP address setting features to facilitate remote configuration
- Device Monitoring
- Device Driver Installation

To install DL.CODE:

1. On the PC that will be used for configuration, download the DL.CODE mini-DVD.zip file. Extract the files maintaining the folder structure and run the **start.hta** file to access the installation pop-up. Click on the **Install DL.CODE** link to run the installation program and follow the installation procedure.

NOTE: To configure Serial + USB model devices, check the appropriate Matrix USB Driver and/or RS232 Serial Port Driver installation boxes in the Welcome window of the DL.CODE Installer. In this case it is recommended to reboot the PC after DL.CODE installation.

NOTE: To perform a "silent" installation (without user input), see the DL.CODE User's Guide.

2. When the installation is complete the DL.CODE entry is created in the Start>Programs bar under "Datalogic" as well as a desktop icon. Double-click the desktop icon to run it.

Depending on your Matrix 120 model, you can connect to DL.CODE configuration environment through one of the following interfaces:

Model	Interface	Instructions
Matrix 120 xxx-x1x	Ethernet Configuration	STEP 4A
Matrix 120 xxx-x0x	USB Configuration	STEP 4B
All	Serial Configuration[1]	STEP 4C

1. All devices can be configured through their Main Serial port. However, through this interface, configuration is slower than the Ethernet or USB interfaces and presents some limitations. It is recommended to use the Serial interface for configuration **only** if the other interfaces are not available.

LOGIN

When you launch DL.Code for the first time, you must log in via one of the following options:

1. Log in

2. Sign Up

3. Offline access with an activation file

4. Start a 15-day trial

Figure 7 – Login Popup

NOTE: Login is mandatory. If you do not proceed with any of the provided options, DL.Code will shut down.
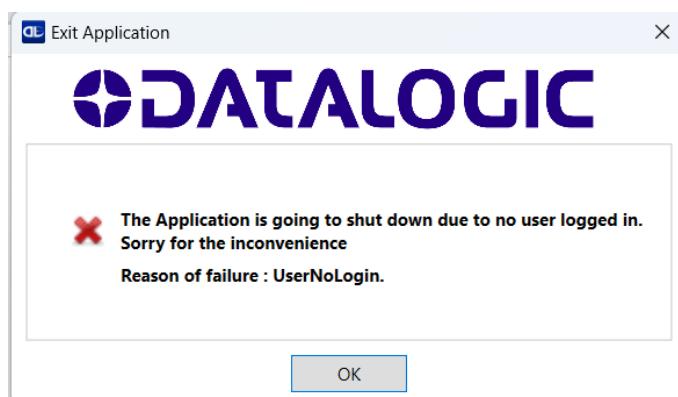
Figure 8 – Shut Down Message

Login and Signup

If you already have a Datalogic account, click the "Login" button and enter your email and password in the fields shown below to sign in.

If you do not have a Datalogic account, please click the "Sign up" button to create one. Fill in the fields to register in the form shown below.

Figure 9 – Sign up Form

Offline Login

If you are offline when you first launch DL.Code, follow the steps below.

1. Click the "Offline Login" button. The Popup will show you the Machine Id.

Figure 10 – Activation File Procedure

2. Contact the Technical Support and provide the Machine Id shown in your version of DL.CODE to obtain an activation file.

3. Once the Technical Support sends you the activation file, please load it using the "Load Activation File" button.

NOTE: The Machine Id shown in the picture above is for illustration purposes only. Refer to the Machine Id shown in your version of DL.Code.

Activation File Not Working

If your activation file does not work, the following window is displayed and DL.Code shuts down. Please contact Technical Support for help.
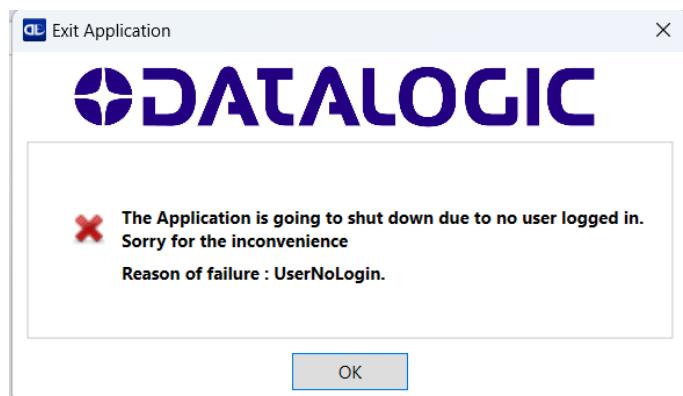
15-day Trial

If you wish to use DL.Code without logging in for a trial period, click the "Start trial" button. This will activate a 15-day trial.
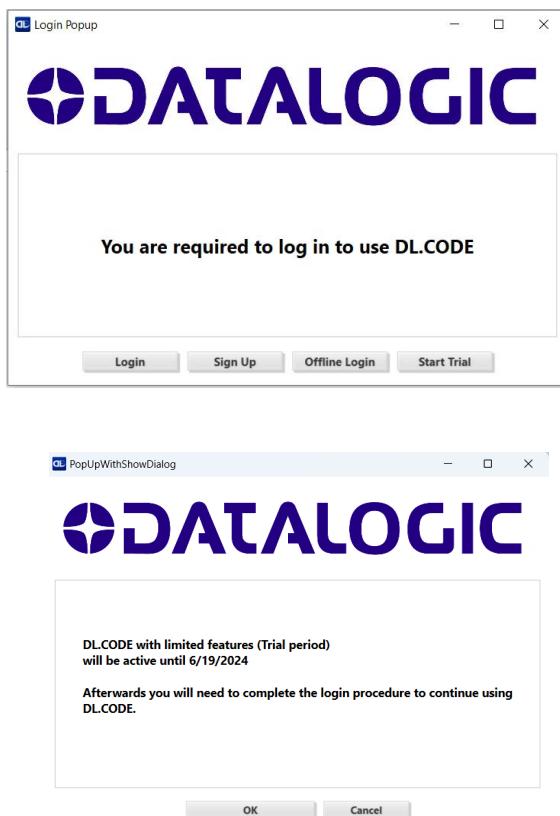
Figure 11 – 15-Day Trial

At any time during the trial period, you can decide to complete registration using the Online or Offline procedure.

At the end of the trial period, however, you are required to authenticate using one of the methods described before, otherwise DL.Code will shut down.

NOTE: The trial period is not extendable, and cannot be reused either with the same version or with future or past versions of DL.Code.
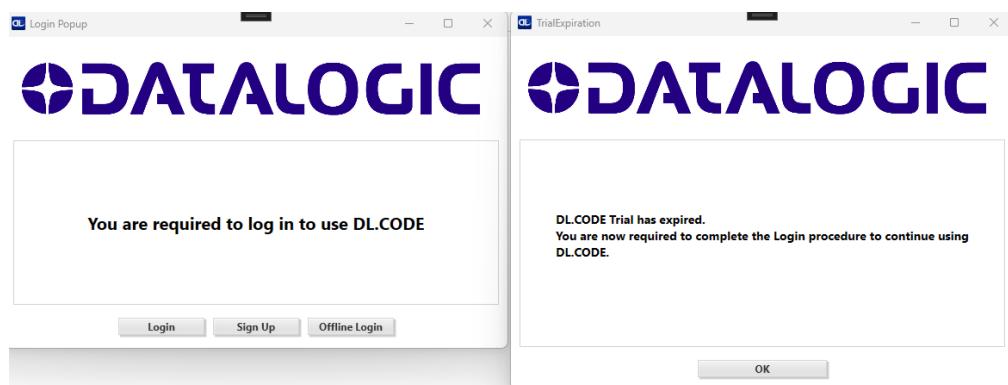
Figure 12 – End of Trial

Step 4A – Ethernet Device Discovery

The following configuration procedure assumes that a laptop computer running DL.CODE is connected to a factory default reader through the Ethernet port. See Step 1 - Connect the System.

The User Interface opens and displays a list of all the devices belonging to the Local Area Network. DL.CODE has a discovery feature to accomplish this task.
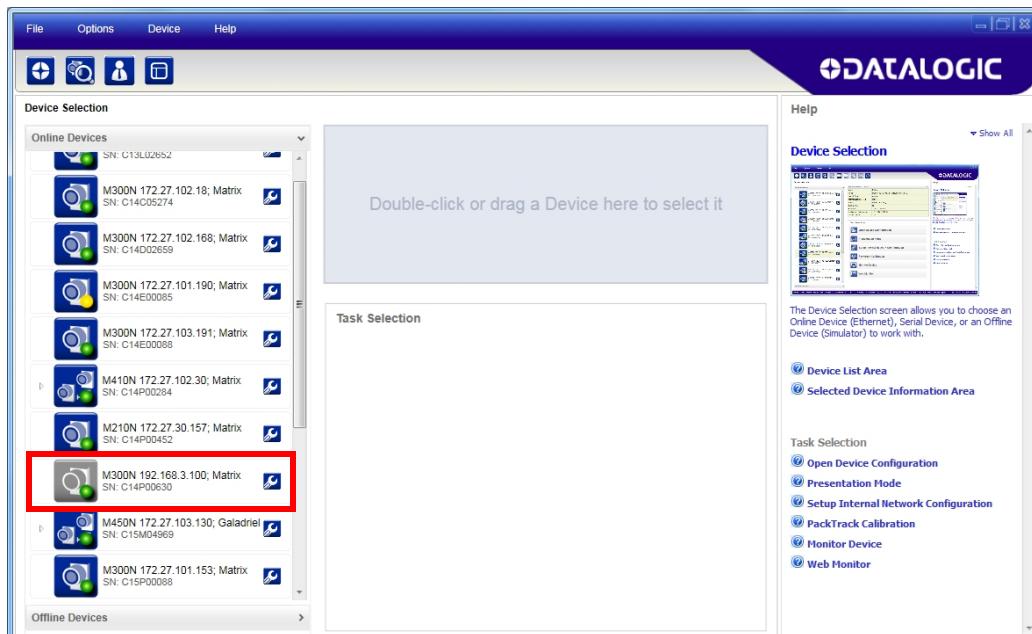
Figure 14. Device Discovery

The discovery feature will also show devices not belonging to the LAN and display them in gray (see Figure 14).

1. First the device must be added to the LAN by aligning its IP Address to the network. The network administrator should provide valid LAN address(es).

2. Find your device in the list by matching its serial number (SN) then click on the device wrench icon to open the Device Environment Configuration window.

3. Change the Ethernet Settings (IP Address, Subnet Mask, Gateway Address etc.) according to the network requirements.
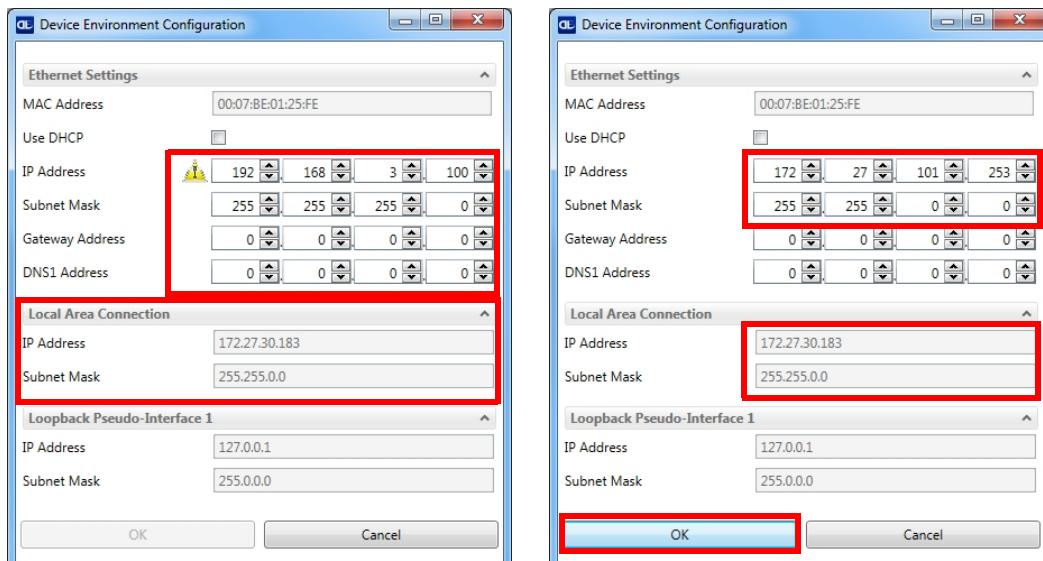
Figure 15. Device Environment Configuration Window

4. Click OK; the device will reappear in the list of Online Devices (in color) meaning it is now part of the LAN and can be configured. The new IP address will also be displayed.
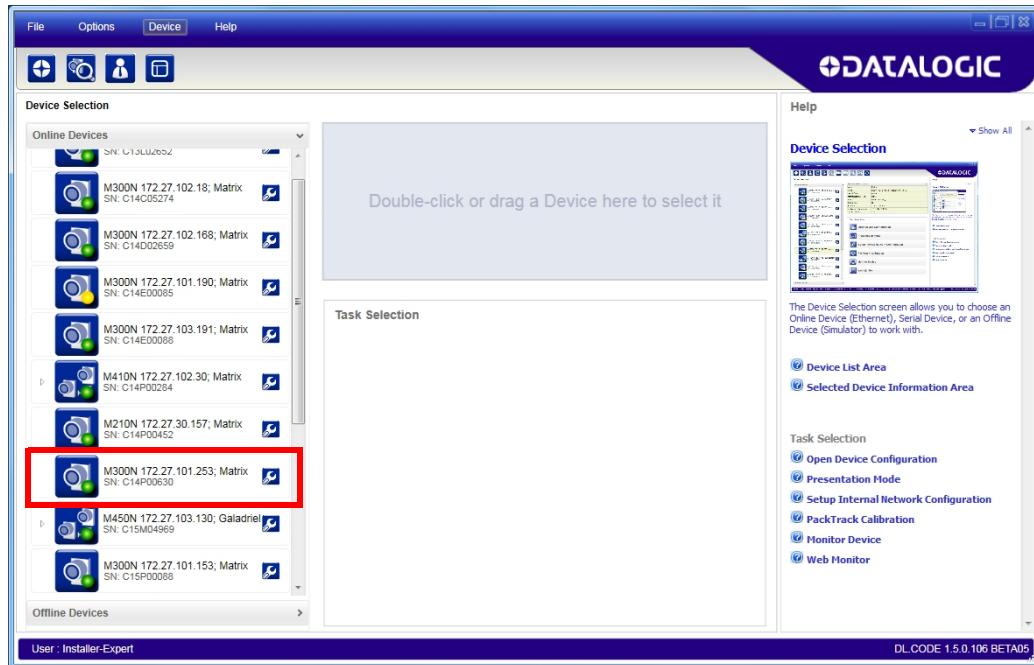
5. Double-click on or drag the device icon into the Selected Device Information Area. Details about the device will be displayed in this area.
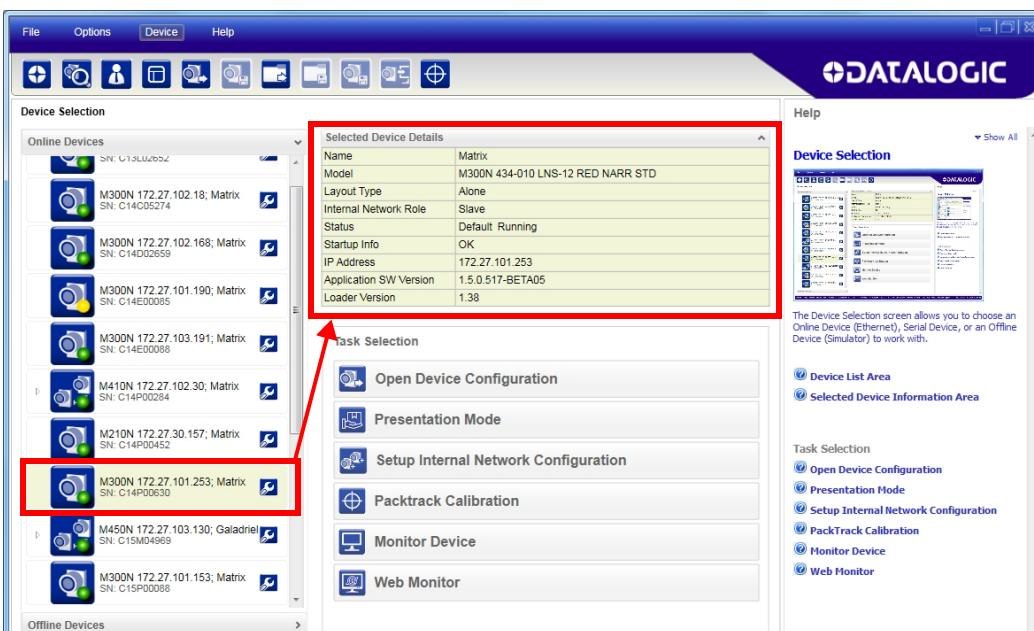
Figure 16. DL.CODE Opening Window

NOTE: After device discovery, configure your device through DL.CODE as described in Step 5 – Device Configuration.

Step 4B - USB Device Discovery

The following configuration procedure assumes that a laptop computer running DL.CODE is connected to a Matrix 120 factory default reader through the USB port (CAB-1021). See Step 1 - Connect the System.

1. After the reader is connected to the USB port and boots up successfully, from DL.CODE, click the Getting Started button to discover it. The unit will be shown in the network Online Devices list. **Matrix 120 devices connected through the USB interface will not be shown in the Serial Devices list**.

2. Find your device in the list by matching its serial number (SN). The USB driver creates a virtual Ethernet connection with an IP address that cannot be modified. In fact, it is easy to see the unit in the list because it is the one without a wrench icon (used for modifying the IP parameters).
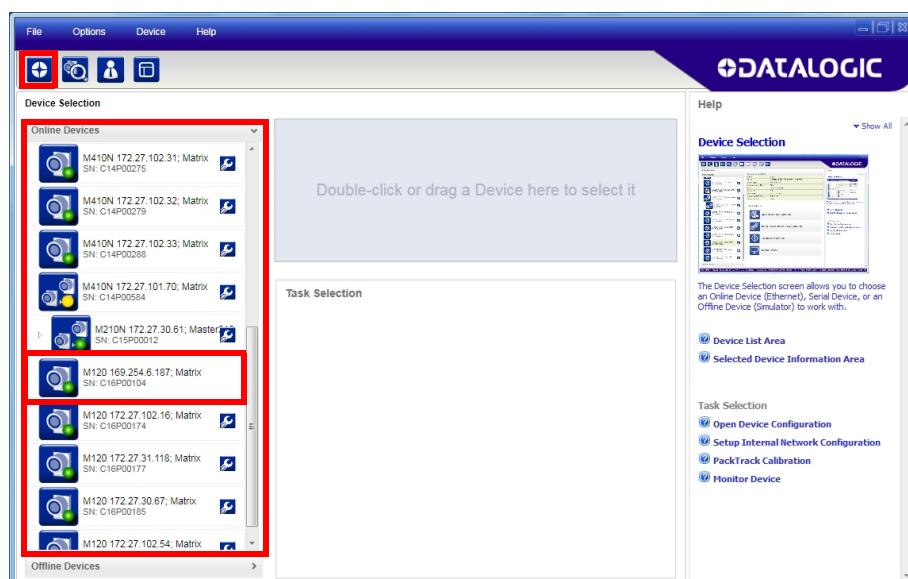
3. Double-click on or drag the device icon into the Selected Device Information Area. Details about the device will be displayed in this area.
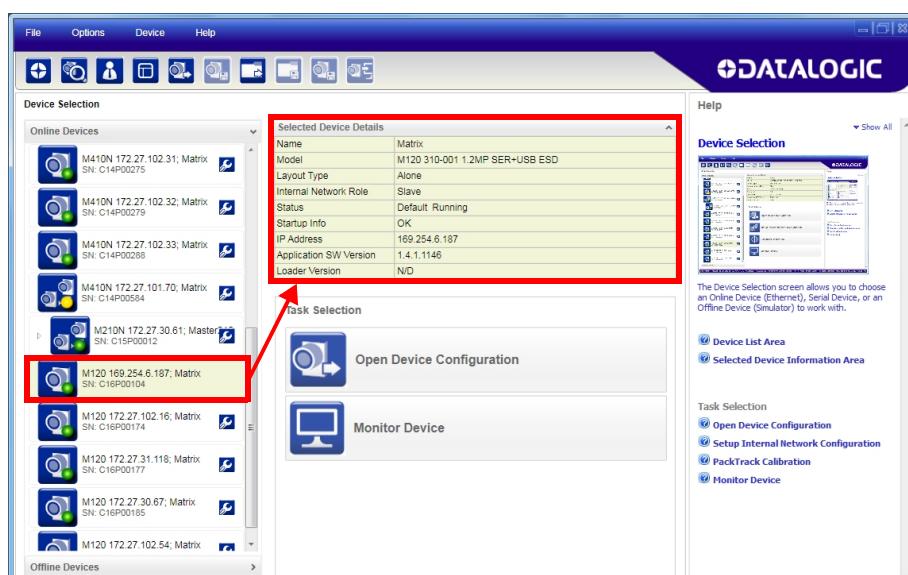
NOTE: After device discovery, configure your device through DL.CODE as described in Step 5 – Device Configuration.

Step 4C – Serial Device Discovery

Starting from DL.CODE 1.4.0, serial port communication is supported for device discovery and configuration. This allows dedicated serial communication models to be configured through DL.CODE.

> **NOTE: Although this feature allows all devices to be configured through their Serial Interface, be aware that transmission speeds and some DL.CODE features are limited when using this interface. It is always advised to use the Ethernet interface whenever possible.**

This feature is not enabled by default, so the first thing to do is to enable it through the UI Settings window.

1. From the main menu open the Options>UI Settings window.

2. Click on the Global Settings menu and scroll down to the Find Devices tab.

3. Check the **Enable Serial Device Discovery** box. Scroll down to see the following selections.

4. Select the Serial communication parameters according to your application. Default is **115200.**
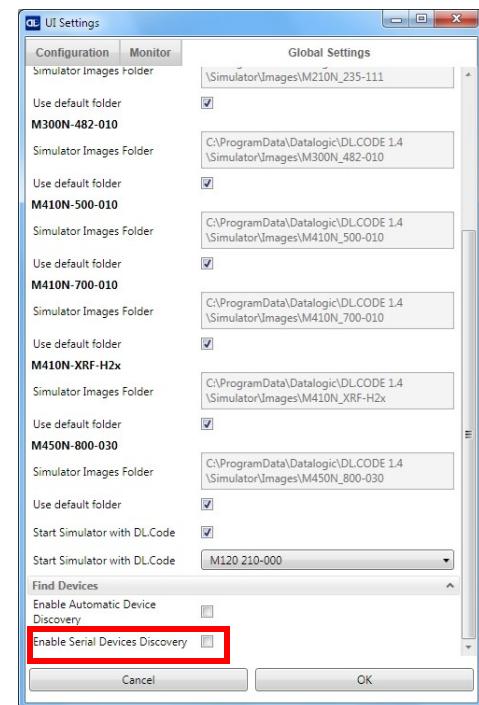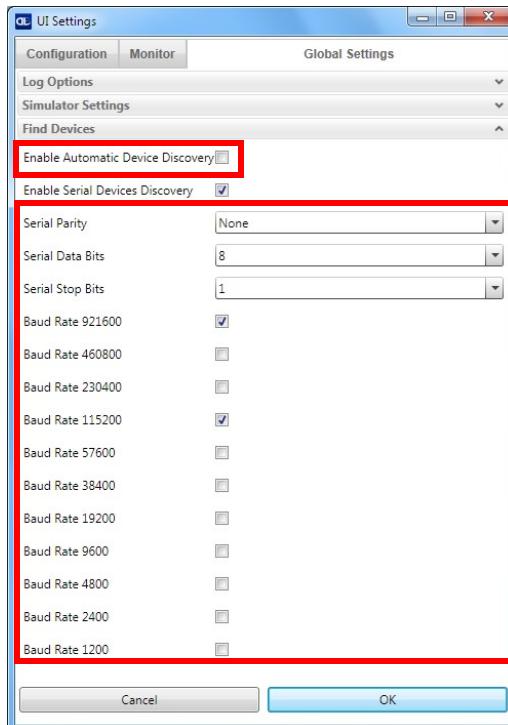
> **NOTE: If you're not sure of the Serial baud rate you can also check the Enable Automatic Device Discovery box which for serial devices will try communication at all baud rates, but only at No parity, 8 data bits;1 stop bit.**
> **Enabling this parameter can notably lengthen Discovery time, therefore in general it is better to disable it to increase Discovery efficiency.**

5. Click OK to return to DL.CODE and click on the Getting Started icon.

6. Open the Serial devices tab and double click on or drag the device icon into the Selected Device Information Area.
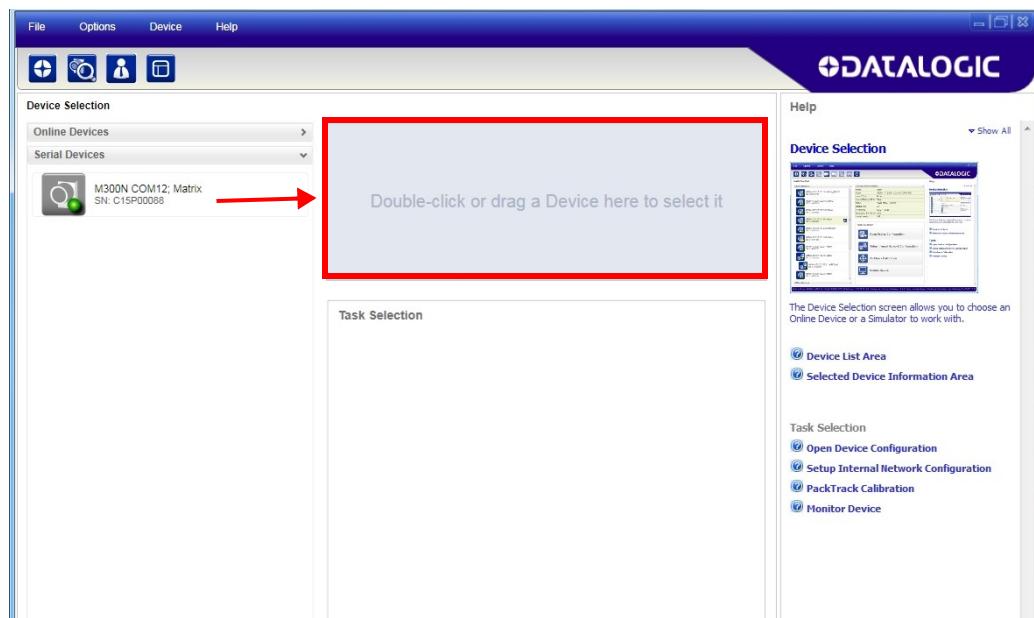
The device is now connected to the DL.CODE Configuration environment. Configure your device through DL.CODE as described in Step 5 - Device Configuration.
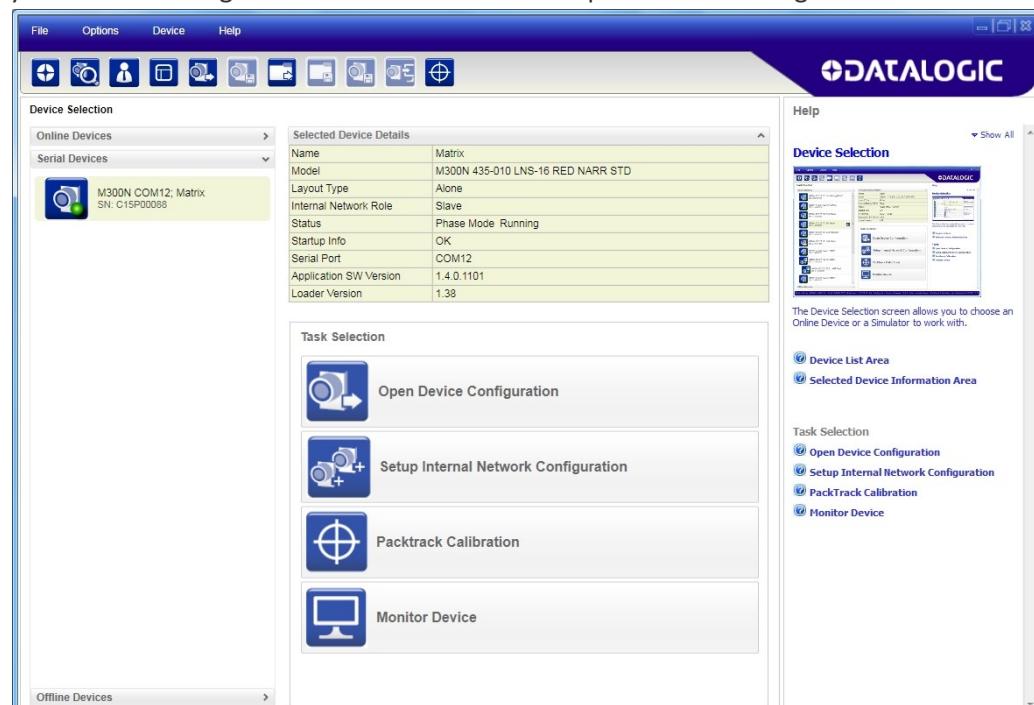
STEP 5 – DEVICE CONFIGURATION

Image and Code Settings

The image and Code Settings parameters are divided into two groups:

- Automatic Setup
- Manual Setup

Automatic Setup Automatic Setup uses up to two different algorithms for the automatic setting of optical, illumination and code parameters to achieve the most stable reading conditions.

Standard **Automatic Setup** (available on all products) can read one or more of the code symbologies from the table below. It can be set to include Image Filters if necessary.

Enabled 1D Codes	Enabled 2D Codes	Enabled Filters
CODE 128 EAN 128 CODE 39 CODE 93 CODABAR PDF417 MICRO PDF417 GS1 DATABAR GS1 DATABAR STACKED GS1 DATABAR LIMITED GS1 DATABAR EXPANDED GS1 DATABAR EXPANDED STACKED UPCEAN FAMILY EAN13 UPCEAN FAMILY EAN8 UPCEAN FAMILY UPCA UPCEAN FAMILY UPCE	DATAMATRIX ECC 200 QR MICRO QR AZTEC MAXICODE DOTCODE	ERODE 3x3, 5x5 and 7x7 DILATE 3x3, 5x5 and 7x7 SMOOTHING

NOTE: Refer to paragraph "Automatic Setup Configuration" on page 114 for more details on using the Automatic Setup.

Manual Setup provides access to the complete array of optical/illumination and code definition parameters that can be fine-tuned semi-automatically and manually to obtain the best results for applications of any complexity.

Automatic Setup	Manual Setup

NOTE: If your application requires multiple code symbologies, multiple image settings, Code Grading or other parameter settings for decoding, then use the Manual Setup.

NOTE: Refer to paragraph "Manual Setup Configuration" on page 116 for more details on using the Manual Setup.

Operating Mode Configuration Parameters

Reading Phase
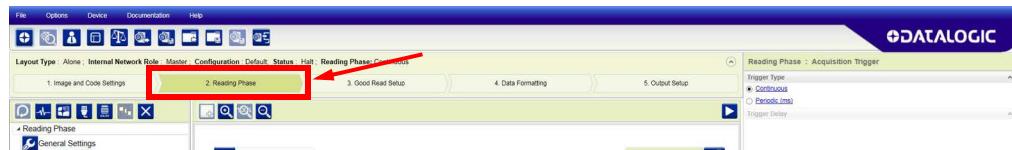
1. Select your application specific Operating Mode from the icons over the Configuration Parameters tree area: Continuous, One Shot, or Phase Mode.
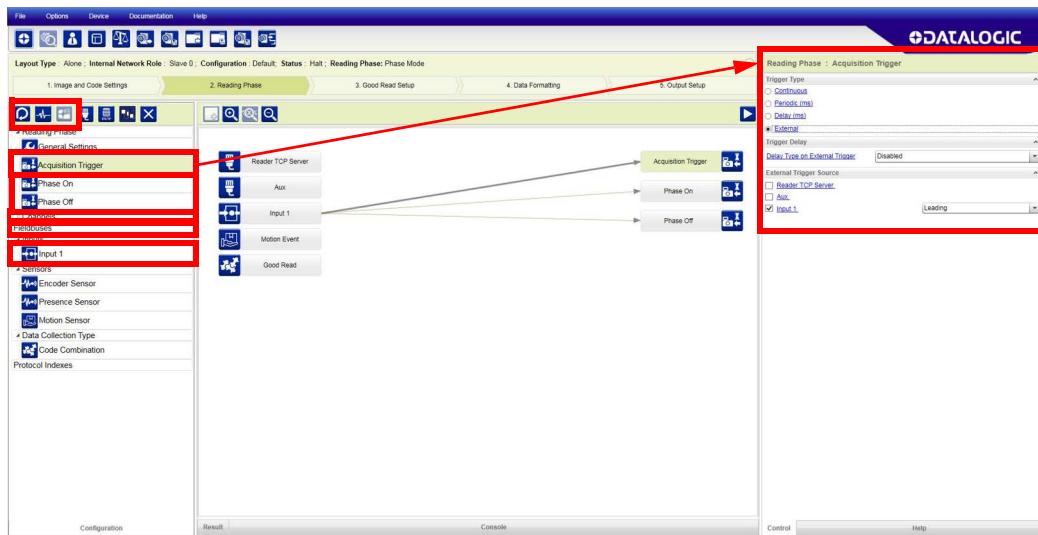
2. Configure the relative Operating Mode parameters from the Reading Phase parameters panel. Different groups will appear in the panel depending on the selected icons over the Configuration Parameters tree area.

> **CAUTION: If the same signal activates multiple events with the same edge, those events are fired in a random order.**
> **If the same channel activates multiple events with the same string, those events are fired in a random order.**
> **AVOID doing this action. The reader may not work properly, the result is not predictable!**

Good Read Setup

1. Select your specific data collection type from the icons over the Configuration Parameters tree area: Code Collection, Code Combination, Presentation or Match Code. Not all data collection types are available for all Operating Modes. Incompatible data collection types will be shown in gray and cannot be selected.
   The following example shows Code Combination. By default, the Expected Codes (when more than one code type is selected), are in logical AND, which means that all codes are required to be decoded to produce a Good Read condition.
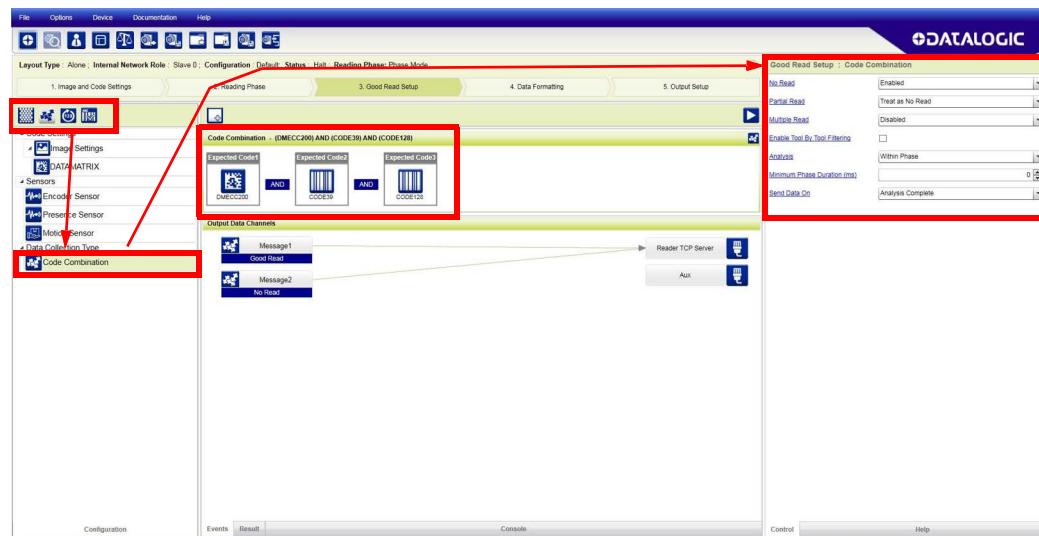
2. If a Good Read condition should be produced when any single code is decoded, independent of the others, then they need to be combined in logical XOR. To do this, drag the code icon(s) from their relative Expected Code box into the Expected Code box of the XOR combination you wish to create. Then delete the empty box by selecting it with the mouse (highlighted) and pressing the delete key on your keyboard.
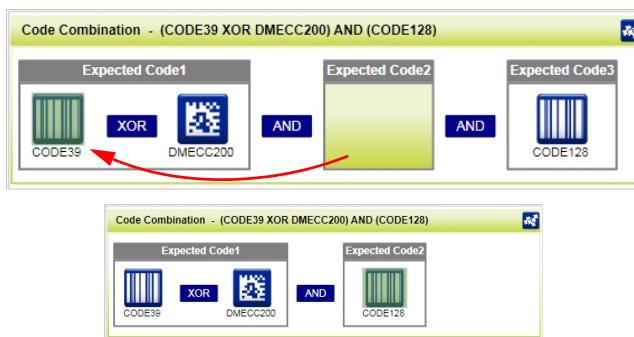
To create a logical AND condition from a logical XOR, create a new Expected Code box using the Add icon. Then drag the desired code icon from one box to the other.

Configuration Parameters

Data Formatting

1. Configure your application specific Data Formatting Message(s) from the Configuration Parameters tree area: Message 1, Message 2, etc.
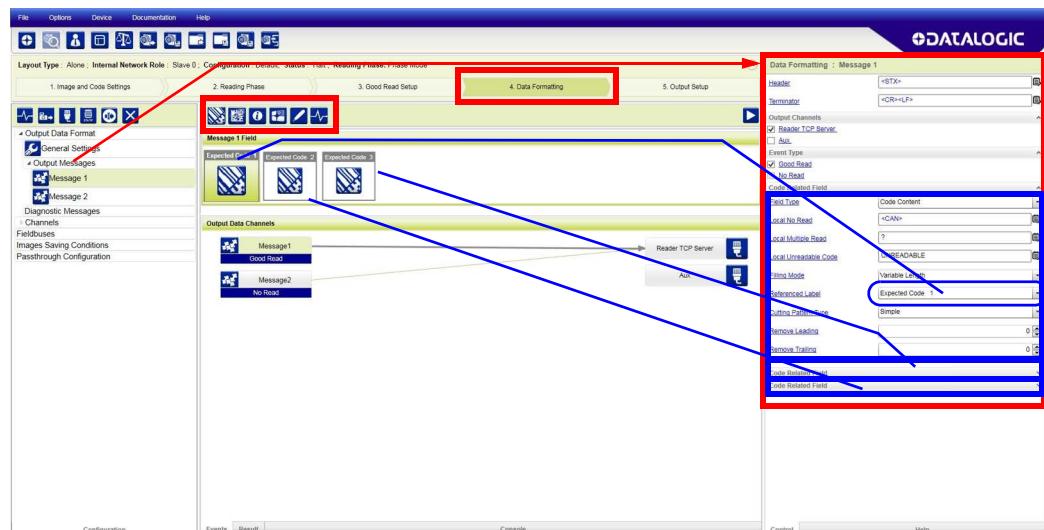
You can add fields to the output message by clicking on the icons above the Message Field area. They will be appended to the message. You can drag them to position them between other fields in the message so that the output message is ordered according to your application requirements.

Each field has its own relative configuration parameters in the parameters panel.

Output Setup

1. Configure your application specific Digital Output(s) and Green/Red Spots (if used) from the Configuration Parameters tree area: Output 1, Output 2, etc.
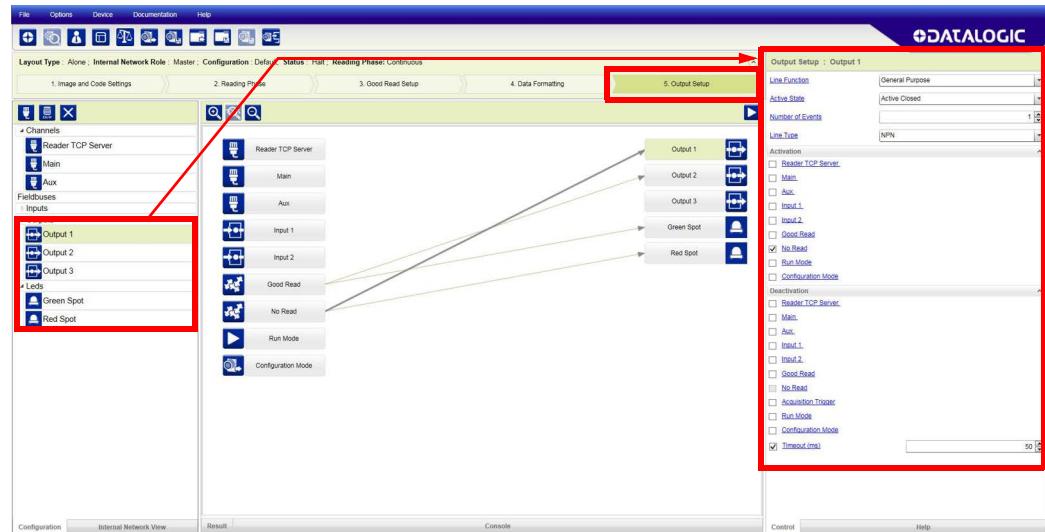
NOTE: Save the configuration from temporary memory to permanent memory, overwriting the previously saved configuration.

STEP 6 – TEST MODE

Use a code suitable to your application to test the reading performance of the system.

1. Enter the *Test* function by pressing and holding the X-PRESS push button until the Test LED is on.

2. Release the button to enter the *Test* function.
   Once entered, the Bar Graph on the five LEDs is activated and if the reader starts reading codes, the Bar-Graph shows the Good Read Rate.

Figure 17. X-PRESS Interface: Test Funcion

3. To exit the Test, press the X-PRESS push button once.

NOTE: By default, the Test exits automatically after three minutes.

The Bar Graph has the following meaning:
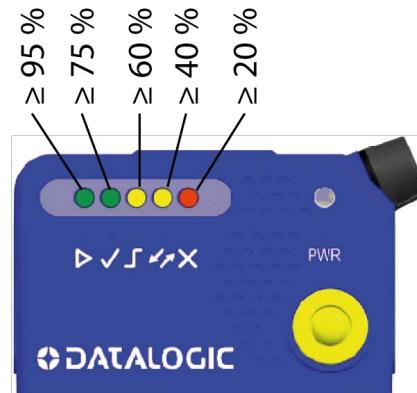
Figure 18. Test Function Bar Graph

In case of No Read condition, only the STATUS LED (red) is on and blinks.

ADVANCED READER CONFIGURATION

For further details on advanced product configuration, refer to the DL.CODE User's Guide available in the DL.CODE Help menu.

Host Mode Programming

The reader can also be partially configured from a host computer using the Host Mode programming procedure. See the Host Mode Programming Manual on the DL.CODE mini-DVD `.zip` file.

CHAPTER 2
INTRODUCTION

PRODUCT DESCRIPTION

The Matrix 120™ imager is the smallest ultra-compact industrial 2D imager range on the market to fit any integration space and the smallest compact 2D imager with embedded Ethernet connectivity.

Matrix 120 is available in different models, including a WVGA sensor for standard applications or a 1.2 MP sensor for high resolution bar codes.

Matrix 120 is characterized with the top industrial grade parts in its class (IP65 and 0-45 ºC / 32 – 133 ºF), with ESD safe models for applications in the electronic industry and features a glass-free reading window, suitable for the Food and Beverage environment.

As part of the full Matrix series, the Matrix 120 leads the market for customer ease of use because of DL.CODE™ configuration software, X-PRESS™ button and intuitive HMI.

The Matrix 120 is the entry level model of the best- in-class Matrix family of high performance industrial 2D imagers.

The Matrix 120 is the perfect solution when small dimension, simple integration and performance are the key drivers. This makes the Matrix 120 the ideal product for OEM customers: Chemical/Biomedical industry and Print & Apply applications. Additionally, this imager is perfect for entry level applications in the Factory Automation arena: Electronics, Packaging and Food/Beverage.

This technology intrinsically provides omni-directional reading.

Applications

- Electronics – Track and Trace PCB board manufacturing
- Factory Automation: Print & Apply – label verification
- Factory Automation: Food & Beverage – traceability
- OEM: Kiosks – ticketing machine
- Healthcare: Clinical Lab – vials identification
- Chemical and biomedical analysis machine
- Automotive: End-of-line tires inspection

⬦DATALOGIC

Highlights

- Ultra compact dimensions for easy integration
- WVGA and 1.2 MP models
- Smart user selectable focus for high application flexibility
- Embedded Ethernet connectivity
- Serial and USB options on the same model
- ESD versions for electronic applications
- DL.CODE software configurator for outstanding ease of setup
- X-PRESS, Datalogic's 'Green Spot' technology and intuitive HMI for top ease of use
- Top industrial grade: IP65; operating temperatures: 0-45 ºC / 32 – 133 ºF
- Sulfur Gas Protection according to DIN EN 60068-2-43

INDICATOR AND KEYPAD BUTTON
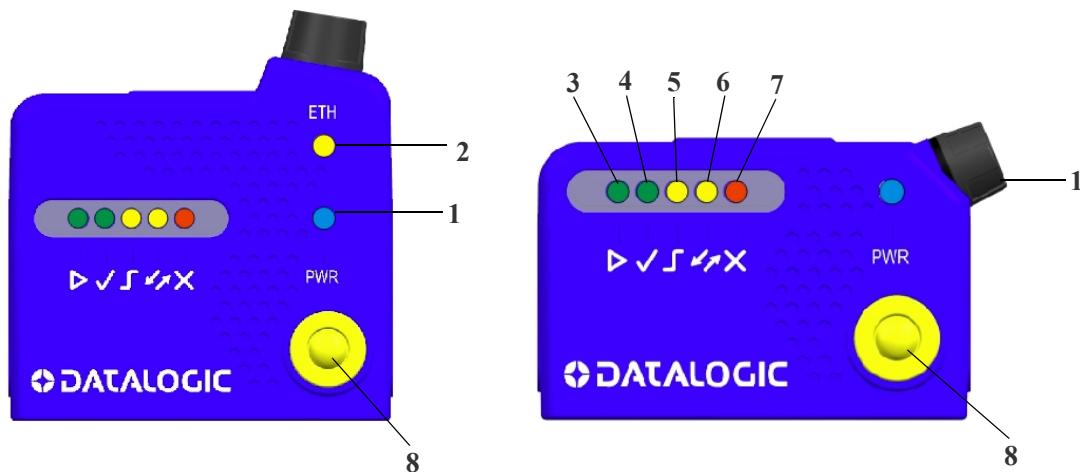
Figure 19. Indicators

The following LED indicators are located on the reader:

PWR	blue LED indicates that the reader is connected to the power supply (Figure 19, 1)
NET	yellow LED indicates connection to the on-board Ethernet network (Figure 19, 2)

In <u>normal operating mode</u> the colors and meaning of the five LEDs are illustrated in the following table:

READY	green LED indicates that the reader is ready to operate (Figure 19, 3)
GOOD	green LED confirms successful reading (Figure 19, 4)
TRIGGER	yellow LED indicates the status of the reading phase (Figure 19, 5)
COM	yellow LED indicates active communication on the main serial port * (Figure 19, 6)
STATUS	red LED indicates a NO READ result (Figure 19, 7)

* When connected to a Fieldbus network through the CBX500, the COM LED is always active, even in the absence of data transmission, because of polling activity on the Fieldbus network.

During the reader startup (reset or restart phase), these five LEDs blink for one second.

In <u>X-PRESS Configuration mode</u> the colors and meaning of these five LEDs are described in "X-PRESS Human Machine Interface" on page 29.

The keypad button (Figure 19, 8), is software programmable. By default it starts the X-PRESS interface for quick installation without using a PC (see Step 3 - X-PRESS Configuration).

X-PRESS HUMAN MACHINE INTERFACE

X-PRESS is the intuitive Human Machine Interface designed to improve ease of installation and maintenance.

Status information is clearly presented by means of the five colored LEDs, whereas the single push button gives immediate access to the following relevant functions:

	Test Mode with bar graph visualization to check static reading performance.	
⎍	Focus (Aim) turns on the laser indicator to aim the reader at the target. **The target should be placed a few mm to the left and centered vertically with respect to the aiming pattern (cross).**	
✓	Setup to self-optimize and auto-configure photometry parameters.	
▷	Learn to self-detect and auto-configure for reading an unknown barcode (by type and length). Only one symbology type can be saved using this method. Performing Autolearn on a second symbology will overwrite the first one.	

X-PRESS Functions

Quick access to the following functions is provided by an easy procedure using the push button:

1. **Press** the button (the Status LED will give a visual feedback).

2. **Hold** the button until the specific function LED is on (Test, Focus/Aim, Setup or Learn).

3. **Release** the button to enter the specific function.

Once button is pressed, the cycle of LEDs activation is as follows:

Release button
to Exit →

Release button
to enter Test Mode →

Release button
to enter Focus/Aim Mode →

Release button
to enter Setup Mode →

Release button
to enter Learn Mode →

Release button
to Exit → (cycle)
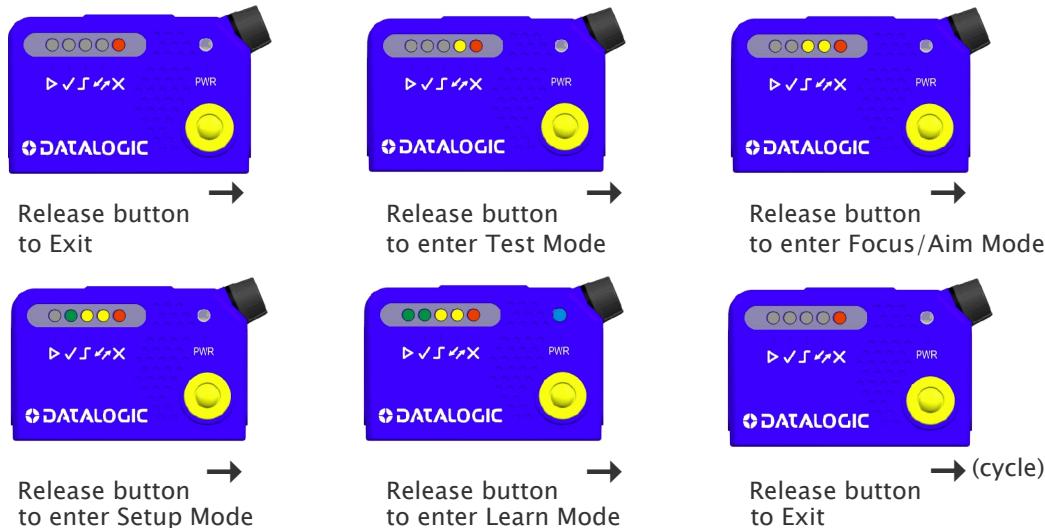
Test Mode

Once entered, the Bar Graph on the five LEDs is activated and if the imager starts reading codes, the Bar-Graph shows the Good Read Rate. The Bar Graph has the following meaning:
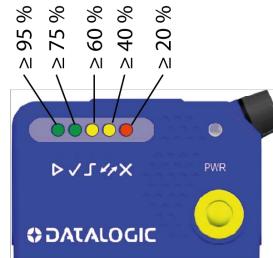
In case of a NO READ condition, only the Status LED (red) is on and blinks.

To exit the Test Mode, press the X-PRESS push button once.

> **NOTE: By default, the Test exits automatically after three minutes.**

Focus/Aim

This function causes the laser indicator to turn on. The laser aiming pattern is centered on the FOV vertically while it has a horizontal offset of a few mm to the right with respect to the FOV center. It can be used to position the imager on the code. The Aim LED blinks to indicate this state.

You can exit the Focus/Aim function at any time by pressing the X/PRESS push button once. After a short delay the laser indicator turns off.

Setup

Once entered, the imager automatically performs Image Acquisition parameter calibration for the specific code presented to it.The Setup LED will blink until the procedure is completed.

The Setup procedure ends when the Image Acquisition parameters are successfully saved in the reader memory, the Setup LED will stop blinking and Matrix 120 emits 3 high pitched beeps.

If the calibration cannot be reached after a timeout of about 5 (five) seconds, Matrix 120 will exit without saving the parameters to memory, the Setup LED will stop blinking and in this case Matrix 120 emits a long low pitched beep.

Learn

Once entered, the imager starts a procedure to automatically detect and recognize **a single code** which is presented to it. Successive Learns will substitute the current code.

The Learn LED will blink until the procedure is completed.

The Learn procedure ends when the Image Processing and Decoding parameters are successfully saved in the reader memory, the Green Spot is activated, the Learn LED will stop blinking and Matrix 120 emits 3 high pitched beeps.

If the autolearning cannot be reached after a timeout of about 3 (three) minutes, Matrix 120 will exit without saving the parameters to memory, the Learn LED will stop blinking and in this case Matrix 120 emits a long low pitched beep.

You can exit the Learn function at any time by pressing the X-PRESS push button once. After a short delay the Learn procedure is canceled.

Diagnostic Indication

The "STATUS" (red) and "READY" (green) LEDs blink simultaneously to signal the presence of an error. Diagnostic message transmission on interfaces can be enabled to provide details about specific error conditions. See the Diagnostic Error Conditions chart in the Diagnostic page of the DL.CODE Monitor.

	LED	STATUS
	Ready	Blink
	Good	
	Trigger	
	Com	
	Status	Blink

MODEL DESCRIPTION

Matrix 120 readers are described by their model number which indicates the characteristics listed in the diagram below. Not all combinations are available. For a complete list of combinations see the Models tab on the Product page of the website.

MATRIX 120 X1X-XXX

Sensor Size

2 = WVGA (752x480)
3 = 1.2 mega Pixels (1280x960)

Illuminator

1 = Standard Internal Illuminator

Lens

0 = Standard manual focus
1 = Wide Angle manual focus

Options

0 = Standard
1 = ESD Safe
5 = Polarizer
A = Digimarc® enabled

Interface

0 = Serial + USB
1 = Serial + Ethernet
5 = Serial + USB with short cable
6 = Serial + Ethernet with short cable

Code Reading Types

0 = 1D and 2D
1 = 1D only

AVAILABLE MODELS

Part Number	Description	Cable Length
937800000	MATRIX 120 210-000 WVGA SER+USB STD	1000 mm
937800001	MATRIX 120 210-010 WVGA SER+ETH STD	1000 mm
937800002	MATRIX 120 210-001 WVGA SER+USB ESD	1000 mm
937800003	MATRIX 120 210-011 WVGA SER+ETH ESD	1000 mm
937800004	MATRIX 120 310-001 1.2MP SER+USB ESD	1000 mm
937800005	MATRIX 120 310-011 1.2MP SER+ETH ESD	1000 mm
937800006	MATRIX 120 210-100 WVGA SER+USB 1D	1000 mm
937800007	MATRIX 120 210-110 WVGA SER+ETH 1D	1000 mm
937800008	MATRIX 120 311-000 1.2MP SER+USB WA	1000 mm
937800009	MATRIX 120 311-010 1.2MP SER+ETH WA	1000 mm
937800010	MATRIX 120 311-100 1.2MP SER+USB WA 1D	1000 mm
937800011	MATRIX 120 311-110 1.2MP SER+ETH WA 1D	1000 mm
937800014	MATRIX 120 311-005 1.2 SER+USB WA PLZR	1000 mm
937800015	MATRIX 120 311-015 1.2 SER+ETH WA PLRZ	1000 mm
937800040	MATRIX 120 311-205 SER+USB AGV	1000 mm
937800041	MATRIX 120 311-215 SER+ETH AGV	1000 mm
937800045	MATRIX 120 310-01A 1.2MP SER+ETH	1000 mm
937800052	MATRIX 120 210-050 WVGA SER+USB STD SC	100 mm
937800053	MATRIX 120 210-060 WVGA SER+ETH STD SC	100 mm
937800054	MATRIX 120 311-050 1.2MP SER+USB WA SC	100 mm
937800055	MATRIX 120 311-060 1.2MP SER+ETH WA SC	100 mm
937800056	MATRIX 120 311-055 1.2 SER+USB WA PLZ SC	100 mm
937800057	MATRIX 120 311-065 1.2 SER+ETH WA PLZ SC	100 mm

ACCESSORIES

The following accessories can be used with the Matrix 120 reader.

Accessory	Description	Order No.
Cables		
CAB-1011	M120 M12 Main To CBX (1M)	93A050099
CAB-1021	M120 M12 Main To USB (1M)	93A050100
CAB-1051	M120 M12 Main To USB + I/O (1M)	93A050108
CAB-1001	M120 M12-M12 Main Extension (1M)	93A050103
CAB-1002	M120 M12-M12 Main Extension (2M)	93A050104
CAB-1005	M120 M12-M12 Main Extension (5M)	93A050105
CAB-ETH-M01	M12-IP67 Ethernet Cable (1M)	93A051346
CAB-ETH-M03	M12-IP67 Ethernet Cable (3M)	93A051347
CAB-ETH-M05	M12-IP67 Ethernet Cable (5M)	93A051348
CBL-1534.02	Adapter Cable Ethernet M12 to female RJ45	93A050057
Connectivity		
CBX100	Compact Connection Box	93A301067
CBX500	Modular Connection Box	93A301068
Various Fieldbus Host Interface Modules are available		
Various Fieldbus Host Interface Modules and All-In-One Connection Box Kits are available		
BA100	DIN Rail Adapters	93ACC1821
BA200	Bosch and 80/20 Profile Adapters	93ACC1822
Various M12 Service Cable and Field Mount Connectors are available for Quick Link Series Connectors		
Power Supplies		
PG6002	AC/DC Power Supply Unit (US)	93ACC1718
PG6001	AC/DC Power Supply Unit (UK)	93ACC1719
PG6000	AC/DC Power Supply Unit (EU)	93ACC1720
Sensors		
MEP-593	Photocell Kit PNP (PH-1)	93ACC1791
MEP-543	Photocell Kit-NPN	93ACC1728
Other		
SW-DOCS-TEST CHART	DL.CODE Installation Mini DVD + Test Charts	93ACC0148

APPLICATION EXAMPLES

Document Handling

Matrix 120 is profitably used in the omnidirectional reading of 2D, stacked, linear and postal codes for example in automated document handling and mail processing systems (see Figure 20).

Figure 20. Address Coded in Data Matrix Symbology for Automated Mail Processing

Deformed or Overprinted Code Reading

Matrix 120 assures the reading of deformed and/or overprinted codes, even though damaged or printed on high reflective surfaces (see Figure 21, Figure 22, and Figure 23).

Figure 21. Unidose Flow-Pack with PDF417 Code

Figure 22. Overprinted Barcode Readable by Matrix 120 also Through the Envelope Window Film

Figure 23. Barcode Printed on Curved Surface Readable by Matrix 300N in spite of Image Optical Distortion

Ink-Jet Printing Technology
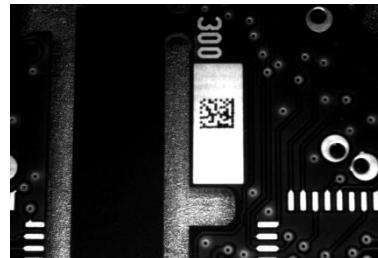
Figure 24. Dot Matrix Code Directly Marked on PCB Copper Pad by Using Ink-Jet Technology

Laser Marking/Etching Technology

Figure 25. Data Matrix Code Directly Marked on PCB Surface by Using Laser Etching Technology

> ⚠️ **CAUTION: Matrix 120 readers are not designed to be used in real-time Laser Marking applications (Mark & Read). They must be mounted far away from the Laser Marker to avoid burning the CMOS sensor.**

Short Distance Code Reading on Reflective and/or Colored Surface

Matrix Wide Angle Polarizer models provide advantages in particular applications which require codes to be read very short reading distances on reflective and/or colored surfaces like black plastic and have 0° Skew angles.

Digimarc Barcode

Content enhanced with Digimarc Barcode can be read with the following Matrix 120 model:

Part number	Description
937800045	Matrix 120 310-01A 1.2MP SER-ETH

Digimarc Barcode is a technology for product packaging and labeling that enables encoding a Global Trade Identification Number (GTIN) imperceptibly into artwork prior to printing. The GTIN carried by Digimarc Barcode is the same as a traditional GTIN typically found in a product's UPC/EAN barcode.

Digimarc Barcode is designed to be redundantly spread throughout an entire product package or printed material. This enables easy, reliable optical capture without interfering with design aesthetics.
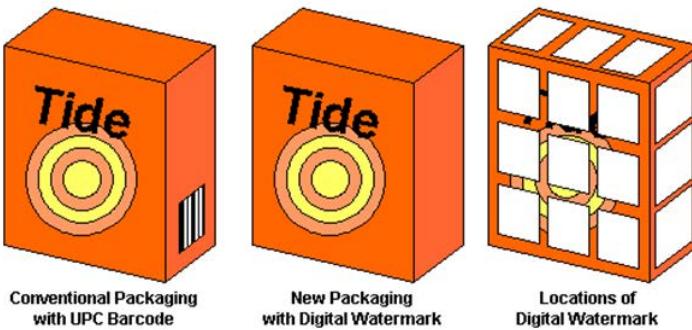
Figure 26. Digimarc Barcode distributed on all sides of the packaging

DWCODE™ is the name that GS1 US and GS1 Germany use to describe a Digimarc Barcode data carrier. A DWCODE includes the Global Trade Item Number (GTIN), i.e. a globally unique number used to identify trade items, products or services. This number is typically found in barcodes such as Universal Product Code (UPC) or European Article Number (EAN).

The process of incorporating a Digimarc Barcode data carrier into artwork is referred to as enhancement. Thanks to this process, Digimarc Barcode is imperceptible to the human eye but detectable to enabled camera-based scanners and mobile applications.

Figure 27. Enhancement process

For more information on the Digimarc® technology and application examples, download our Digimarc Technical Note from Datalogic website.

For quick access, from the home page click on the search icon, and type in "Digimarc". This allows you access to download Data Sheets, Manuals, and everything related to Digimarc Barcode.

CHAPTER 3
INSTALLATION

PACKAGE CONTENTS

Verify that the Matrix 120 reader and all the parts supplied with the equipment are present and intact when opening the packaging; the list of parts includes:

- Matrix 120 reader
- Quick Reference Guide
- Focus Lock Labels (5)
- Mounting Kit
  - Mounting Screws (5)
  - Washers (5+5)
  - Mounting Brackets (1)
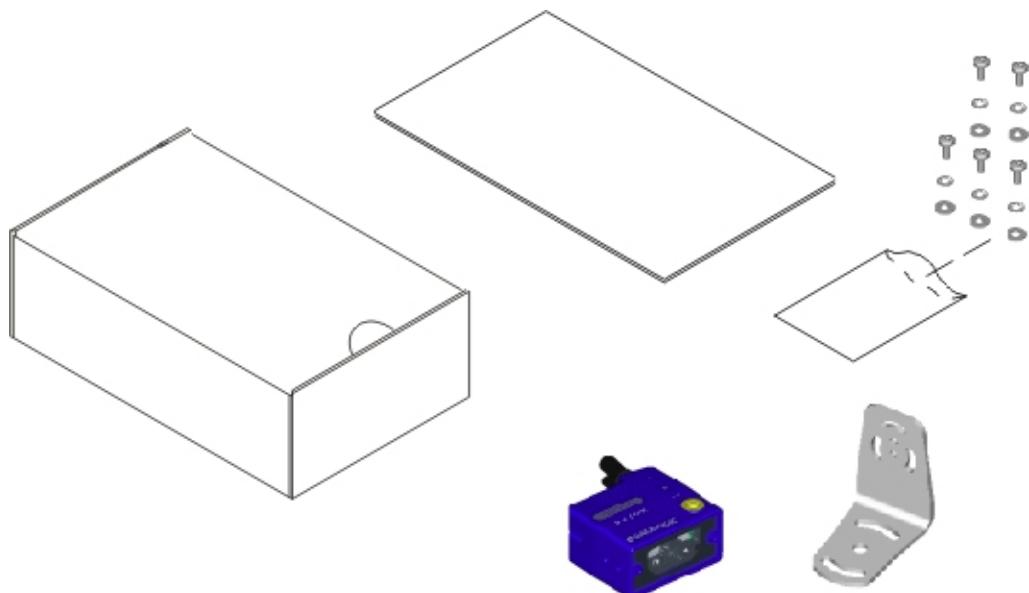
Figure 28. Package Contents

MECHANICAL DIMENSIONS

Matrix 120 can be installed to operate in different positions. The two screw holes (M4 x 5) on the body of the reader are for mechanical fixture (Figure 29).

The diagrams below give the overall dimensions of the reader and may be used for its installation.

Refer to page 43 for various mounting solutions and correct positioning, and Chapter 6, Reading Features for FOV vs. Reading Distance considerations.
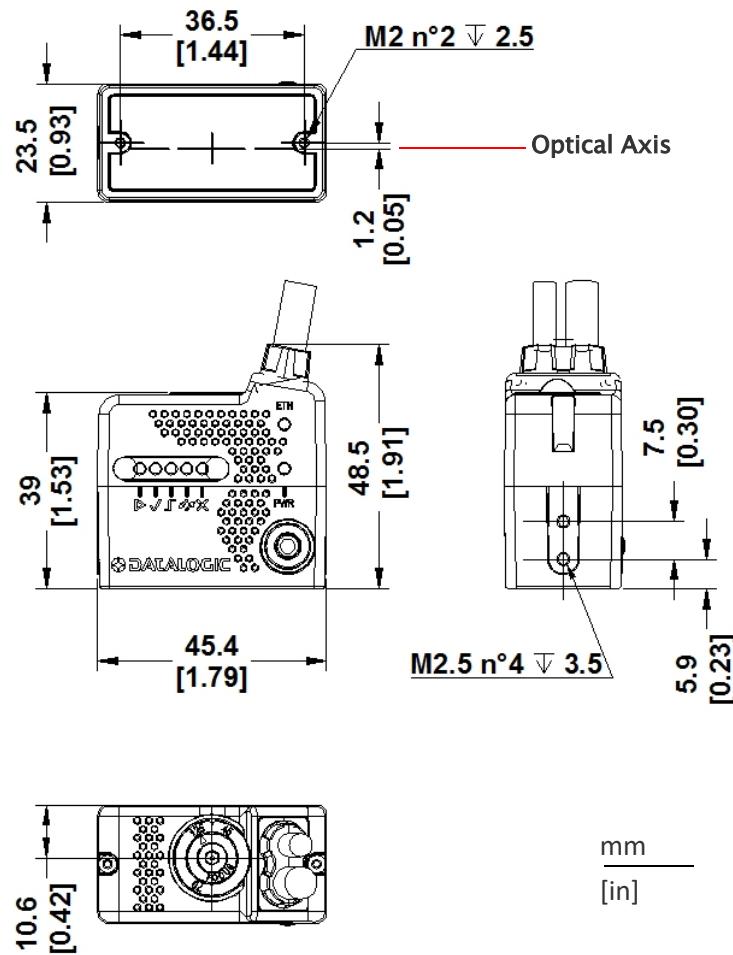
Figure 29. Overall Dimensions of Matrix 120 Ethernet Models

36.5
[1.44]

23.5
[0.93]

— Optical Axis

1.2
[0.05]

7.5
[0.30]

M2.5 n°4 ▽ 3.5

43.3
[1.70]

52.8
[2.08]

45.4
[1.79]

10.6
[0.42]

mm
[in]
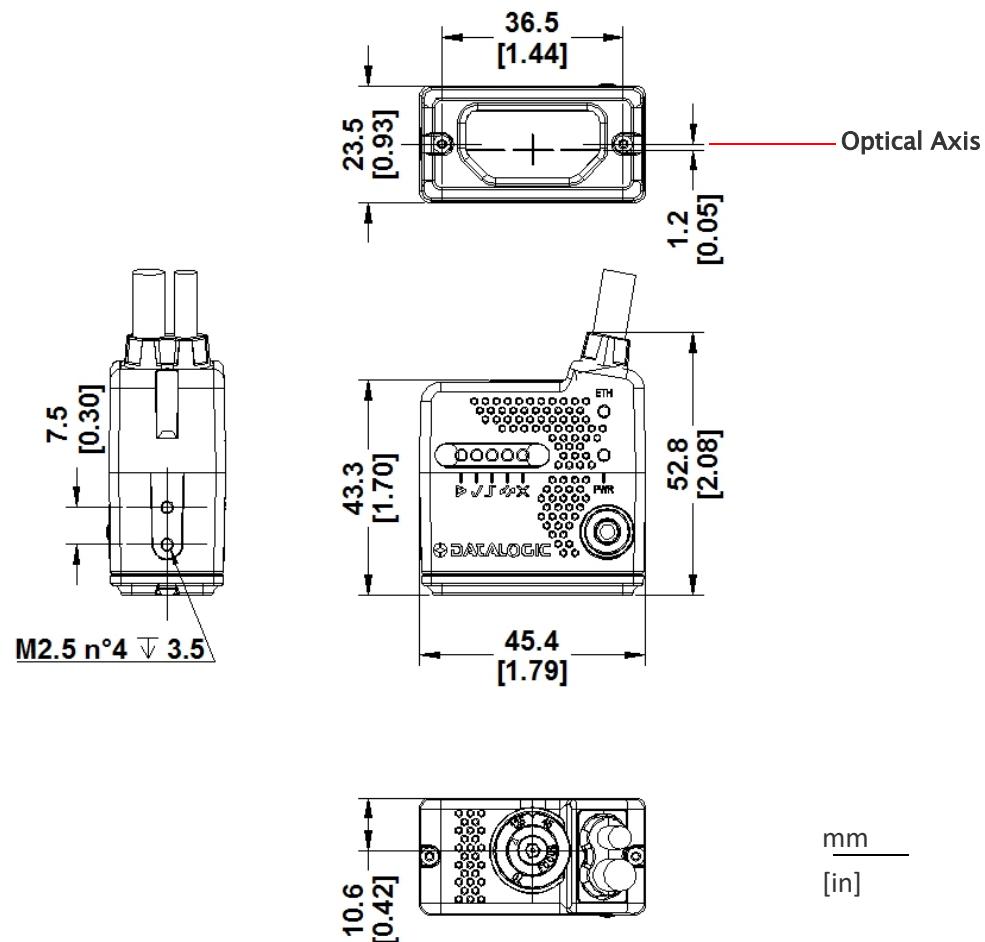
Figure 30. Overall Dimensions of Matrix 120 Ethernet Models with ESD Cover
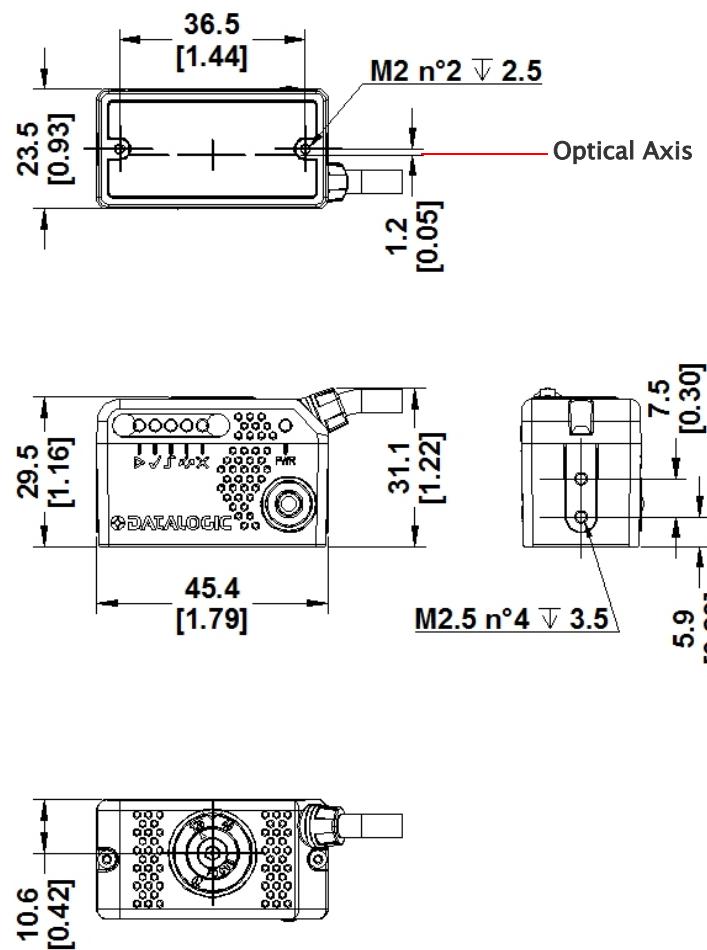
Figure 31. Overall Dimensions of Matrix 120 USB Models
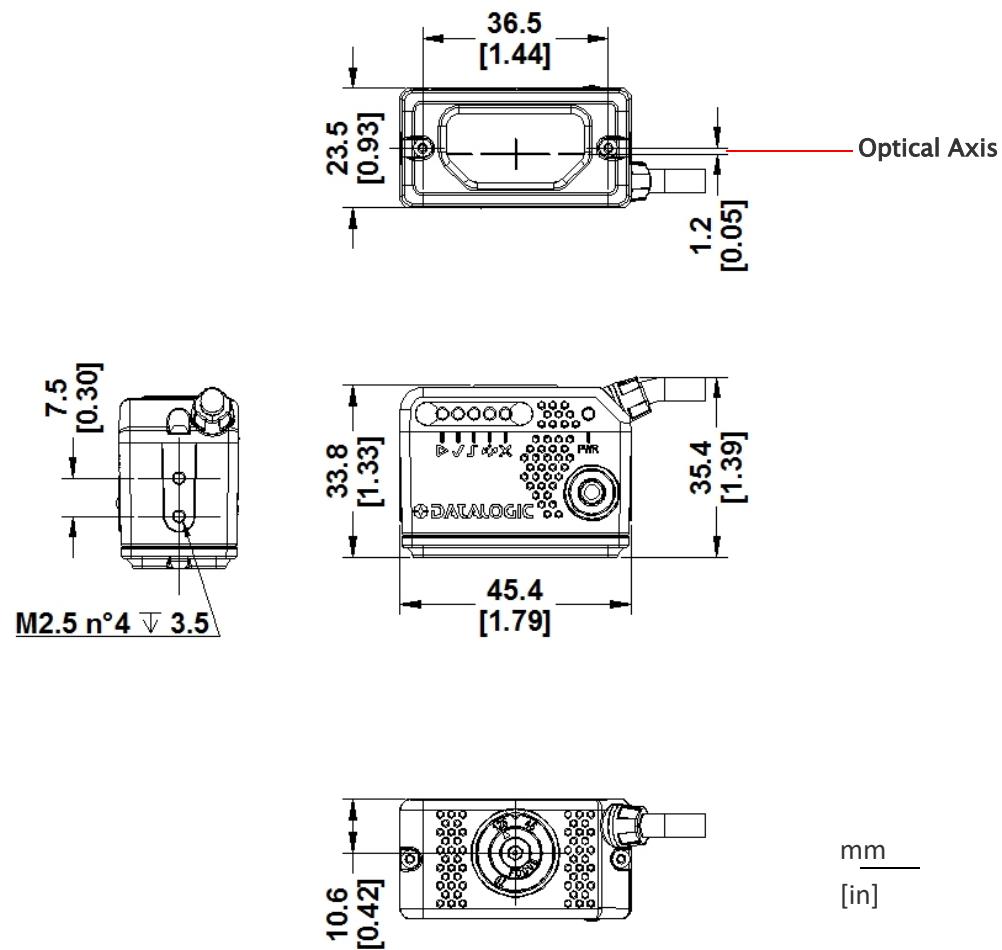
Figure 32. Overall Dimensions of Matrix 120 USB Models with ESD Cover
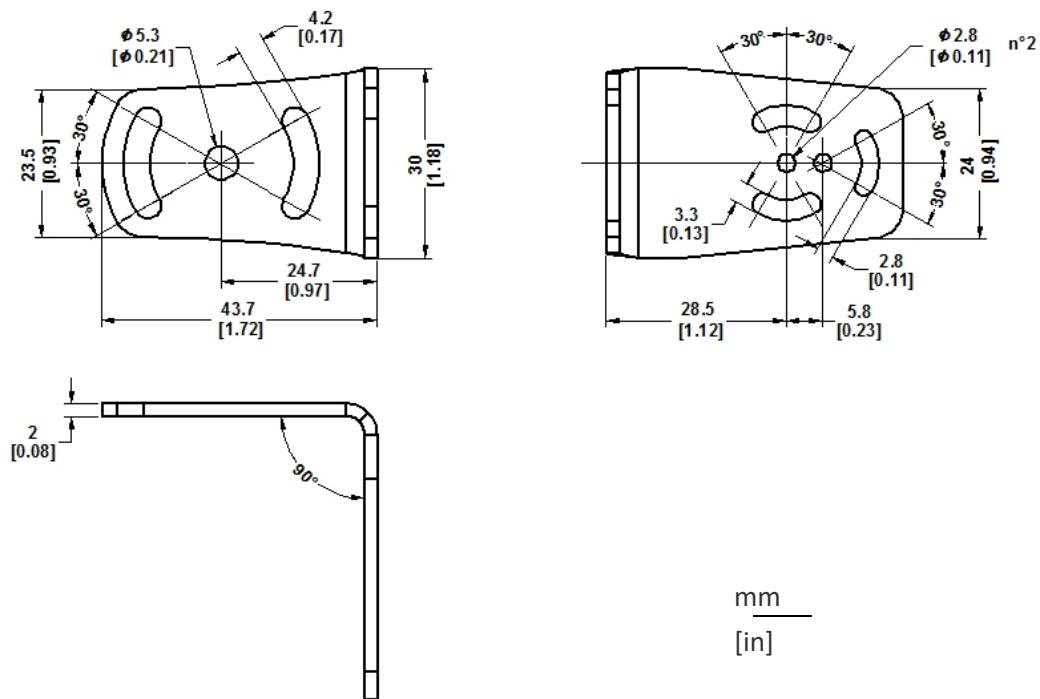
Figure 33. Mounting Bracket Overall Dimensions

MOUNTING AND POSITIONING MATRIX 120

Using the Matrix 120 mounting brackets you can obtain rotation on the various axes of the reader as shown in the following illustrations:
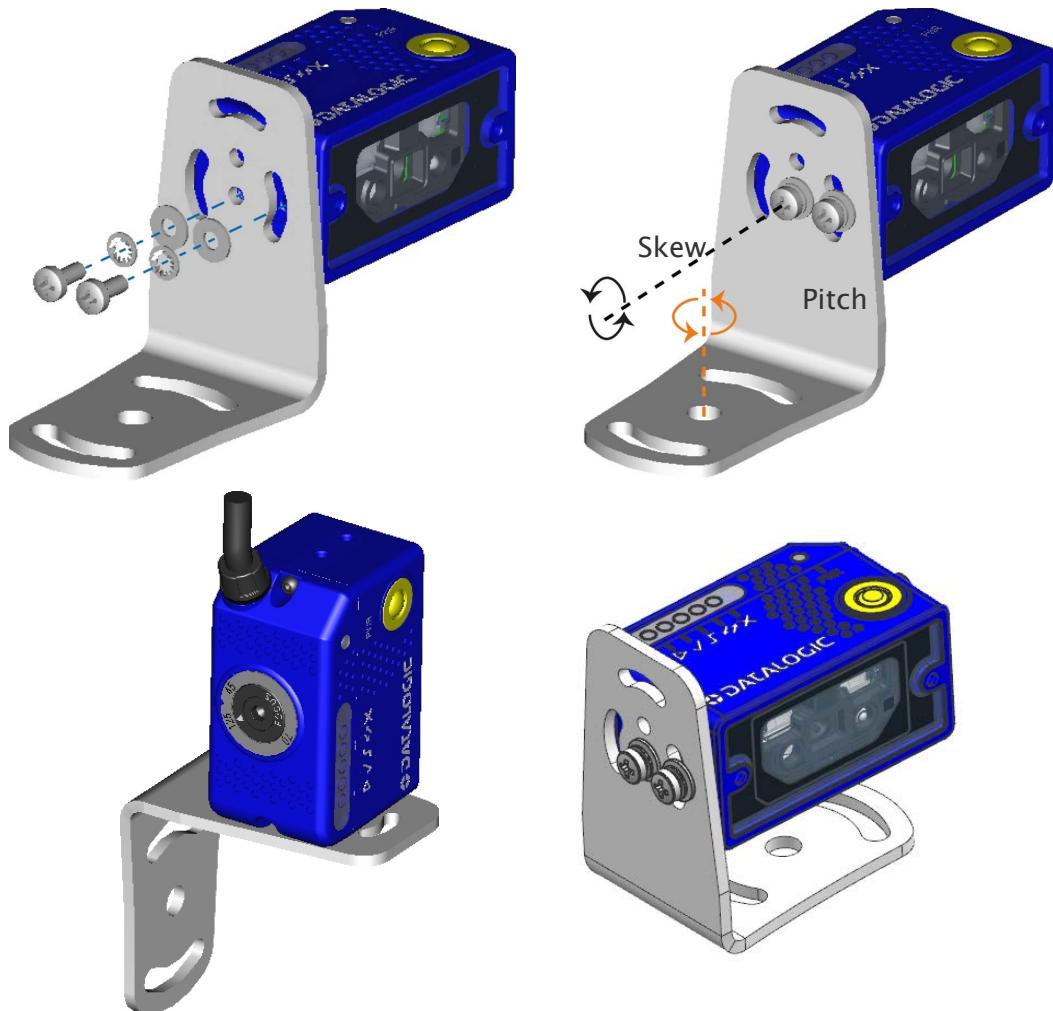
Figure 34. Bottom Mounting Positions for USB Models

Figure 35. Bottom Mounting Positions for Ethernet Models

Figure 36. Side Mounting Positions for USB Models
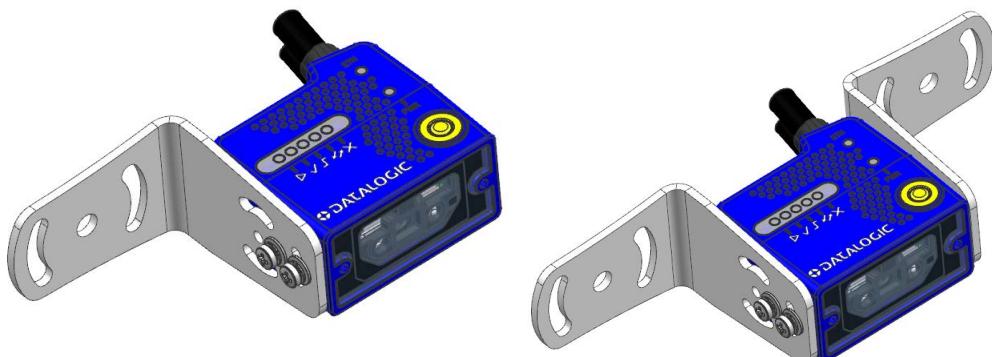
Figure 37. Side Mounting Positions for Ethernet Models

Matrix 120 is able to decode code labels at a variety of angles. However, significant angular distortion may degrade reading performance.

When mounting Matrix 120, take into consideration these **ideal** label position angles: **Pitch or Skew 10° to 20° and Tilt 0°**.

Note: Since Matrix 120 is omni-directional on the code plane, the Pitch and Skew angles have the same significance with respect to the code plane. However, in some advanced code reading applications performance can be improved by modifying the Skew angle.

The **Pitch, Skew and Tilt** angles are represented in Figure 38. Follow the suggestions below for the best orientation.

Position the reader in order to avoid the direct reflection of the light emitted by the Matrix 120 reader; it is advised to **assure at least 10°** for the Skew angle.
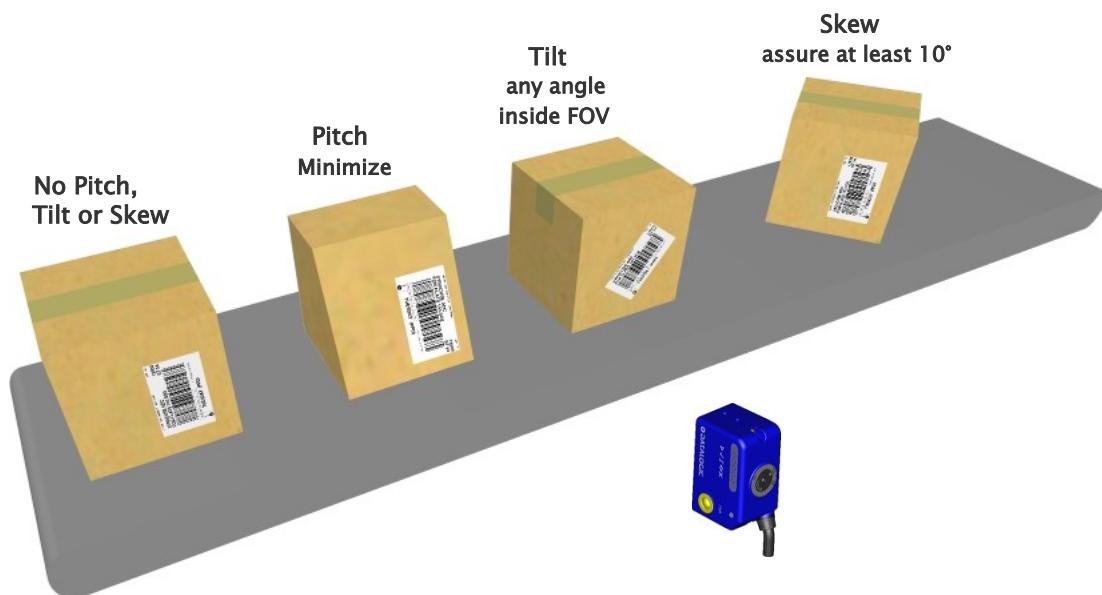
Figure 38. Code Reading Orientation

In some cases, such as low contrast or low illumination, it can be useful to use a **Pitch or Skew** angle = 0°.

The **Tilt** angle is also represented in Figure 39. Matrix 120 can read labels with any tilt angle. Keep in mind however, that since linear barcodes are rectangular, the reader should be aligned to fit them into the horizontal FOV.

Linear Barcode Reading

2D Code Reading

Figure 39. Tilt Angle Considerations

See Chapter 6, for FOV vs. Reading Distance considerations.

FOCUS LOCK LABEL (OPTIONAL)

There are five single-use focus lock labels included in the packaging that can be use to protect the focus position from being changed after the application has been completed.

These are adhesive labels that are designed to be applied over the focus screw as shown in the figure below.

⊙DATALOGIC

CHAPTER 4
CBX ELECTRICAL CONNECTIONS

All Matrix 120 models can be connected to a CBX connection box through the **CAB-1011** accessory cable. This accessory cable terminates in an M12 17-pin connector on the Matrix 120 side and in a 25-pin male D-sub connector on the CBX side.

> ⚠ **CAUTION: Do not use CAB-DSxx-S accessory cables with Matrix 120.**

We recommend making system connections through one of the CBX connection boxes since they offer the advantages of easy connection, easy device replacement, opto-isolated inputs (External Trigger and Input 2) and outputs (Outputs 1 and 2), and filtered reference signals.

> 📝 **NOTE: If you require direct wiring to the reader the connections are the same as shown in** Appendix A**.**

The table below gives the pinout of the CBX100/500 terminal block connectors. Use this pinout when the Matrix 120 reader is connected by means of the CBX100/500:

Group	Label	Description
Input Power	Vdc	Power Supply Input Voltage +
	GND	Power Supply Input Voltage -
	Earth	Protection Earth Ground
Inputs	+V	Power Source - External Trigger
	I1A	External Trigger A (polarity insensitive)
	I1B	External Trigger B (polarity insensitive)
	-V	Power Reference - External Trigger
	+V	Power Source - Inputs
	I2A	Input 2 A (polarity insensitive)
	I2B	Input 2 B (polarity insensitive)
	-V	Power Reference - Inputs
Outputs	+V	Power Source - Outputs
	-V	Power Reference - Outputs
	O1+	Output 1 + opto-isolated and polarity sensitive
	O1-	Output 1 - opto-isolated and polarity sensitive
	O2+	Output 2 + opto-isolated and polarity sensitive
	O2-	Output 2 - opto-isolated and polarity sensitive
Auxiliary Interface	Matrix 120 has not Auxiliary Interface	
ID-NET	Matrix 120 has no ID-NET Interface	
Main Interface		
RS232	TX	
	RX	
	-	
	-	
	SGND	
RS422 Full Duplex	TX+	
	*RX+	
	TX-	
	*RX-	
	SGND	

* Do not leave floating, see "RS422 Full Duplex Interface" on page 51 for connection details.

NOTE: To avoid electromagnetic interference when the reader is connected to a CBX connection box, verify the jumper positions in the CBX as indicated in its Installation Manual.

POWER SUPPLY

Power can be supplied to the reader through the CBX100/500 spring clamp terminal pins as shown in Figure 40:
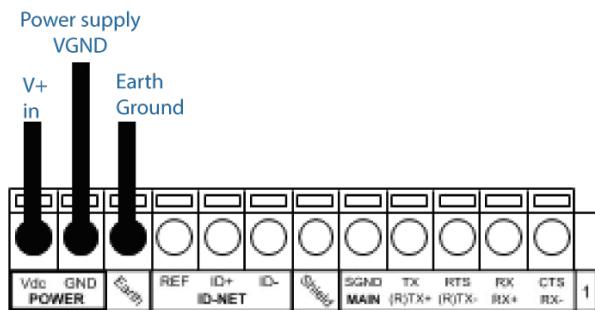
Figure 40. Power Supply Connections

The power must be between 10 and 30 Vdc only.

It is recommended to connect the device CHASSIS to earth ground (Earth) by setting the appropriate jumper in the CBX connection box. See the CBX Installation Manual for details.

MAIN SERIAL INTERFACE

CAUTION: Do not connect to the Main Interface spring clamp terminals if using Host Interface Modules (Fieldbus) with the CBX500.

The signals relative to the following serial interface types are available on the CBX spring clamp terminal blocks.

The main serial interface type and its parameters (baud rate, data bits, etc.) can be defined by the user via DL.CODE software. For more details refer to the Help On Line page of the Reading Phase step (Channels) in DL.CODE.

Details regarding the connections and use of the interfaces are given in the next paragraphs.

This interface can also be used for configuration through DL.CODE, see Step 4C - Serial Device Discovery.

RS232 Interface

The RS232 interface is generally used for Point-to-Point connections. When it is connected to the host computer it allows transmission of code data.

The following pins are used for RS232 interface connection:

CBX100/500	Description
TX	Transmit Data
RX	Receive Data
SGND	Signal Ground

It is always advisable to use shielded cables. The overall maximum cable length must be less than 15 m (49.2 ft).
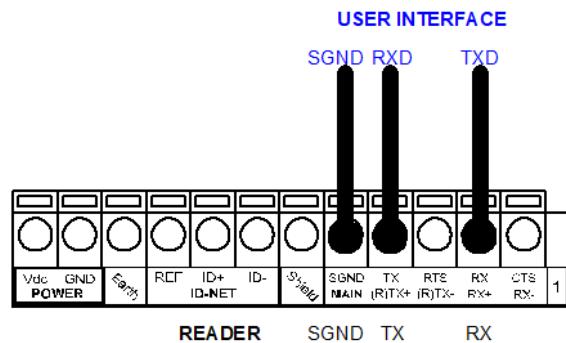
Figure 41. RS232 Main Interface Connections

RS422 Full Duplex Interface

The RS422 full-duplex (5 wires + shield) interface is used for non-polled communication protocols in point-to-point connections over longer distances (max 1200 m / 3940 ft) than those acceptable for RS232 communications or in electrically noisy environments.

The CBX pinout follows:

CBX100/500	Description
TX+	RS422 Transmit Data +
RX+	RS422 Receive Data +
TX-	RS422 Transmit Data -
RX-	RS422 Receive Data -
SGND	Signal Ground
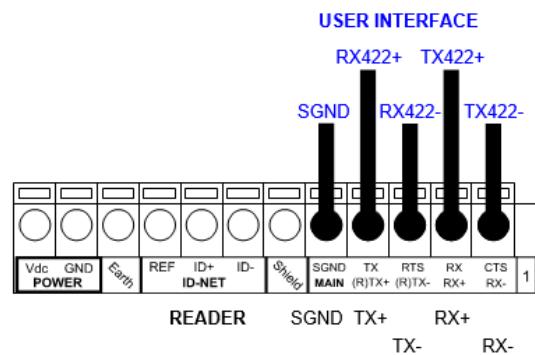
Figure 42. RS422 Full Duplex Connections

NOTE: For applications that do not use RS422 transmission to the reader (terminal block RX+ and RX- signals), do not leave these lines floating but connect them to SGND as shown below.
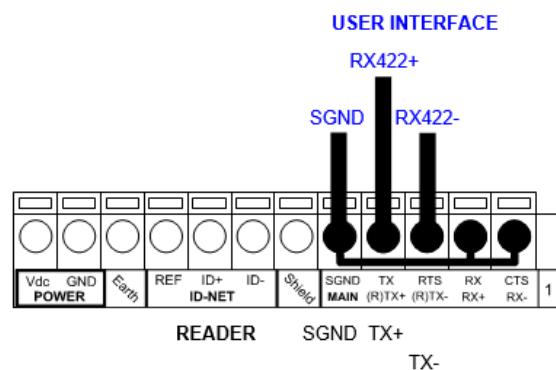
Figure 43. RS422 Full Duplex Connections Using Only TX Signals to Host

INPUTS

⚠️ **CAUTION: When Inputs 1 and 2 are connected through the CBX connection box, they become opto-isolated and polarity insensitive and acquire the electrical characteristics listed below. To function correctly, they require setting the Input <u>Line Type configuration parameters</u> to NPN for the respective input. The hardware connection to the CBX can be either NPN or PNP.**

There are two opto-isolated polarity insensitive inputs available when the reader is connected to the CBX: Input 1 (External Trigger) and Input 2, a generic input:

The External Trigger can be used in One Shot Mode or in Phase Mode. Its main functions are:
- acquisition trigger in One Shot Mode
- reading phase-ON/reading phase-OFF command in Phase Mode

The main functions of the general purpose Input 2 are:
- second external trigger in Phase Mode
- match code storage command when the Match Code option is enabled

The electrical features of both inputs are:

V_{AB} = 30 Vdc max.

I_{IN} = 12 mA (CAB-1011) + 12 mA (CBX) max.

The active state of these inputs are selected in software.

An anti-disturbance filter, by default, is implemented in software on both inputs. The value can be changed through the software parameter Debounce Filter. See the Help On Line page of the Reading Phase step (Inputs) in DL.CODE for further details on these parameters.

📝 **NOTE: Polarity insensitive inputs assure full functionality even if pins A and B are exchanged.**

The connections are indicated in the following diagrams:

CBX100/500	Description
+V	Power Source - External Trigger
I1A	External Trigger A (polarity insensitive)
I1B	External Trigger B (polarity insensitive)
-V	Power Reference - External Trigger

The yellow Trigger LED (Figure 19, 5) is on when the active state of the External Trigger corresponds to ON.

External Trigger Input Connections Using Matrix 120 Power

⚠️ **CAUTION: Power from the Vdc/GND spring clamps is available directly to the Input Device on the +V/-V spring clamps, and does not pass through the Power Switch (ON/OFF) inside the CBX. Disconnect the power supply when working inside the CBX.**
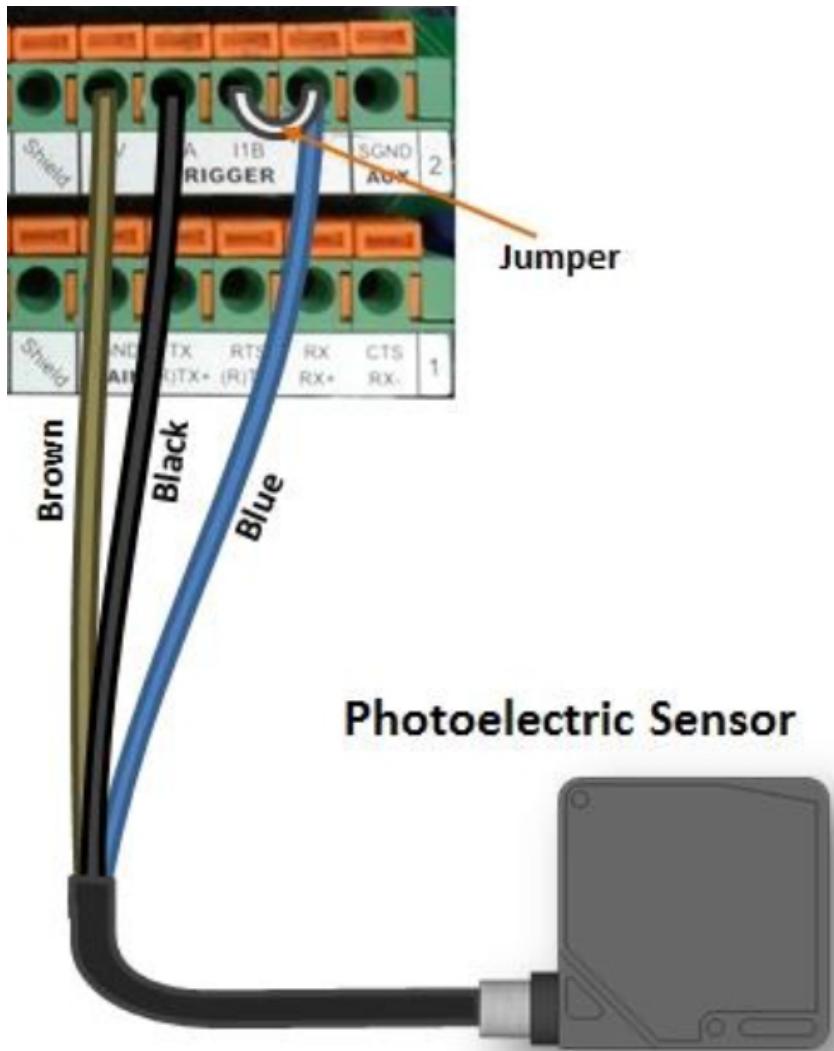
Figure 44. PNP External Trigger Using Matrix 120 Power
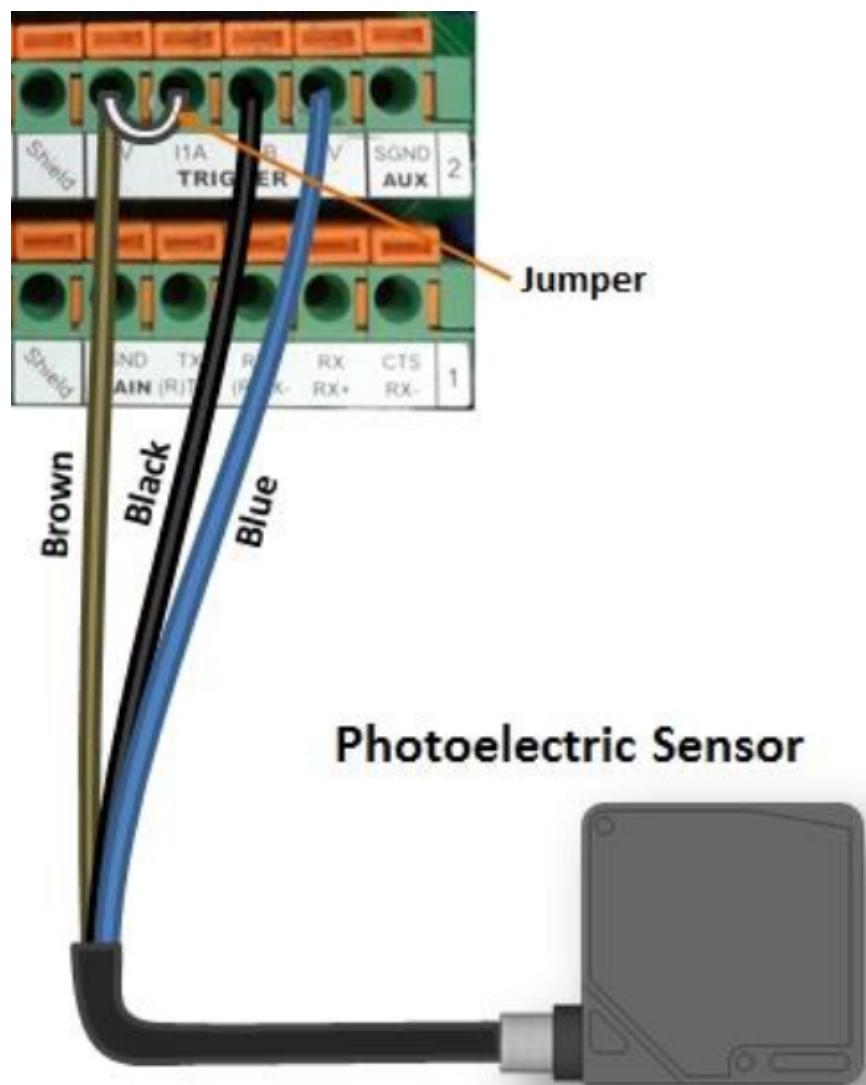
Figure 45. NPN External Trigger Using Matrix 120 Power

External Trigger Input Connections Using External Power
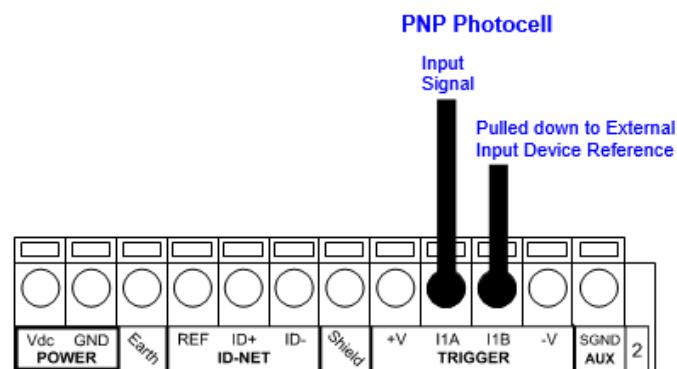
Figure 46. PNP External Trigger Using External Power
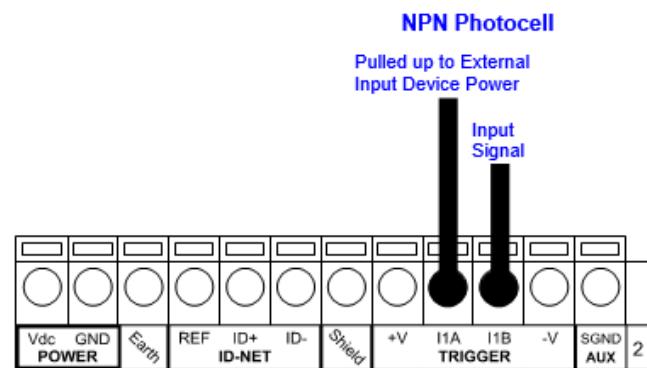
Figure 47. NPN External Trigger Using External Power

CBX100/500	Description
+V	Power Source – Inputs
I2A	Input 2 A (polarity insensitive)
I2B	Input 2 B (polarity insensitive)
–V	Power Reference – Inputs

Input 2 Connections Using Matrix 120 Power

⚠ **CAUTION: Power from the Vdc/GND spring clamps is available directly to the Input Device on the +V/–V spring clamps, and does not pass through the Power Switch (ON/OFF) inside the CBX. Disconnect the power supply when working inside the CBX.**
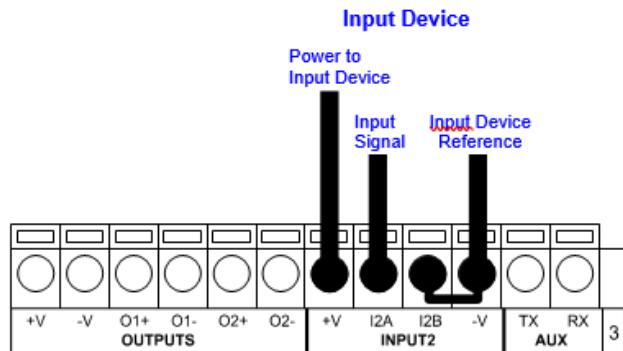
Figure 48. PNP Input 2 Using Matrix 120 Power
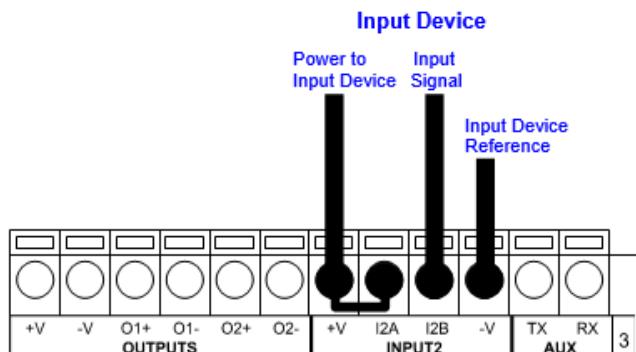
Figure 49. NPN Input 2 Using Matrix 120 Power

Input 2 Connections Using External Power
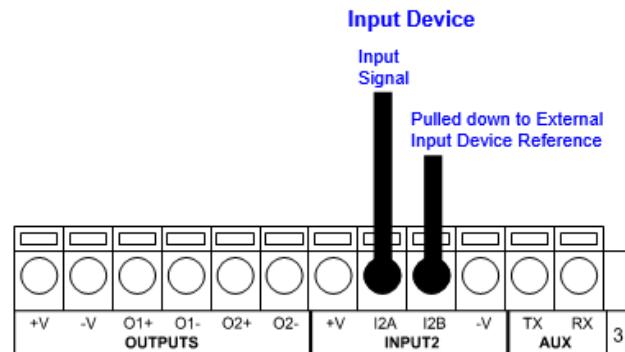
Figure 50. PNP Input 2 Using External Power
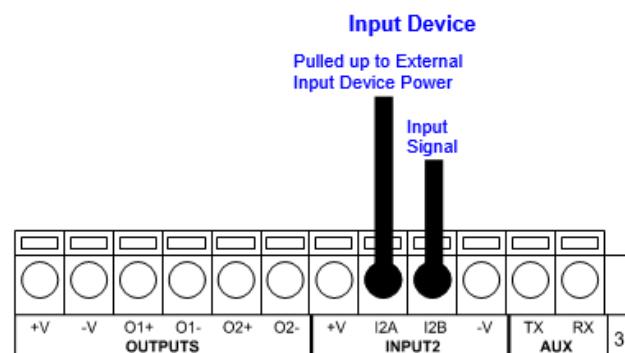
Figure 51. NPN Input 2 Using External Power

OUTPUTS

CAUTION: When Outputs 1 and 2 are connected through the CBX connection box, they become opto-isolated and polarity sensitive and acquire the electrical characteristics listed below. To function correctly, they require setting the Output Line Type configuration parameters to NPN for the respective output. The hardware connection to the CBX can be either NPN or PNP.

Three general purpose outputs are available and their meaning can be defined by the user. They are typically used either to signal the data collection result or to control an external lighting system.

CBX100/500	Description
+V	Power Source - Outputs
O1+	Output 1 + opto-isolated and polarity sensitive
O1-	Output 1 - opto-isolated and polarity sensitive
O2+	Output 2 + opto-isolated and polarity sensitive
O2-	Output 2 - opto-isolated and polarity sensitive
-V	Power Reference - Outputs

The electrical features of the outputs are the following:

Outputs 1 and 2
V_{CE} = 30 Vdc max.
I_{CE} = 40 mA continuous max.; 130 mA pulsed max.
$V_{CE\ saturation}$ = 1 Vdc max. @ 10 mA
P_D = 90 mW Max. @ 50 °C ambient temp.

By default, Output 1 is associated with the No Read event, which activates when the code(s) signaled by the external trigger are not decoded, and Output 2 is associated with the Good Read event, which activates when all the selected codes are correctly decoded.

The output signals are fully programmable being determined by the configured Activation/Deactivation events, Deactivation Timeout or a combination of the two. Refer to the DL.CODE parameters Help On Line for further details.

Output 1 and 2 Connections Using Matrix 120 Power

CAUTION: Power from the Vdc/GND spring clamps is available directly to the Output Device on the +V/–V spring clamps, and does not pass through the Power Switch (ON/OFF) inside the CBX. Disconnect the power supply when working inside the CBX.
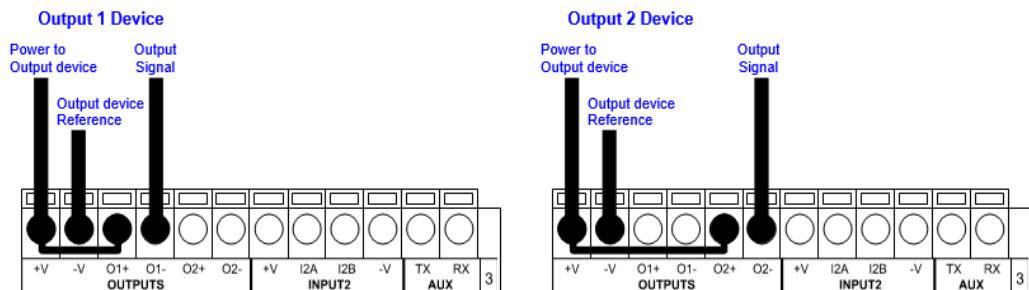

Figure 52. PNP/Open Emitter Output Using Matrix 120 Power
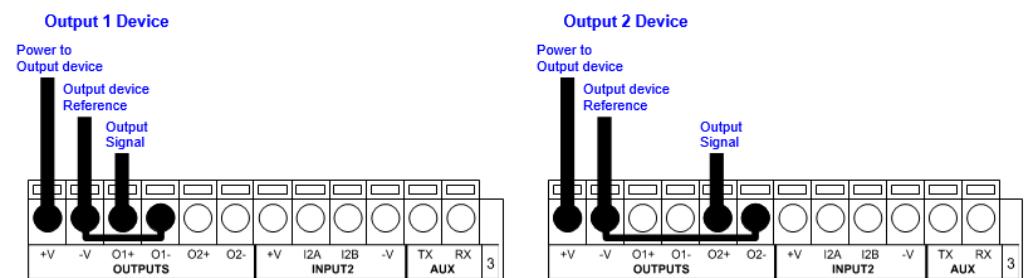
Figure 53. NPN/Open Collector Output Using Matrix 120 Power

Output 1 and 2 Connections Using External Power

CAUTION: If output devices are powered externally (separate from Matrix 120 power), it is always advised to maintain the same voltage levels used for the Matrix 120 device.
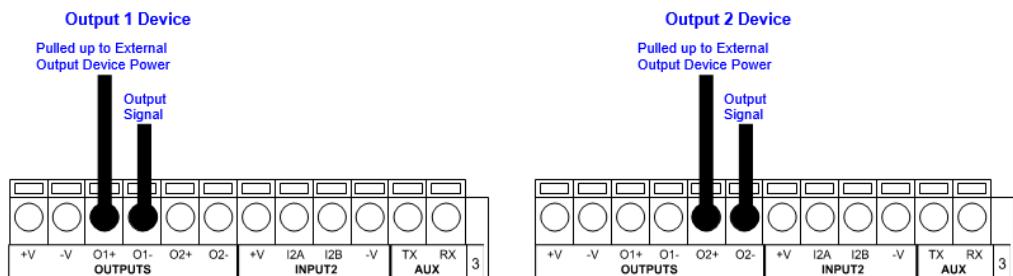
Figure 54. PNP/Open Emitter Output Using External Power
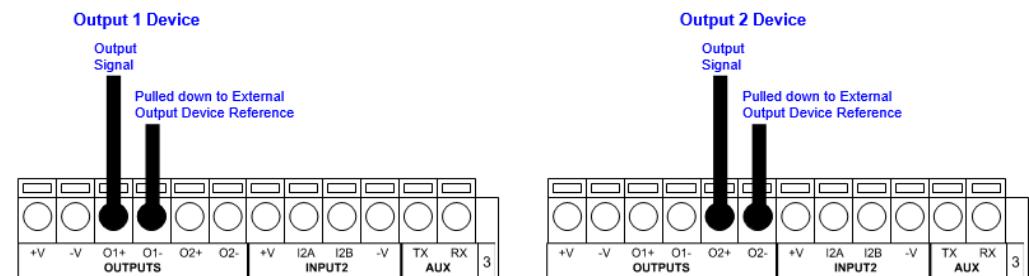
Figure 55. NPN/Open Collector Output Using External Power

ON-BOARD ETHERNET INTERFACE

For Ethernet models, the on-board Ethernet Interface can be used for TCP/IP communication with a remote or local host computer by connecting the reader to either a LAN or directly to a host PC. There is no need to use a crossover adapter since Matrix 120 incorporates an auto-cross function.

A **CAB-ETH-M0x** cable can be used to connect to a LAN.

On the Matrix 120 on-board Ethernet interface the following communication channels are available:

- TCP Client
- TCP Server
- UDP Channel
- FTP Client

The following Fieldbus protocols are also available over the on-board Ethernet interface:

- EtherNet/IP
- PROFINET IO
- Modbus TCP Client
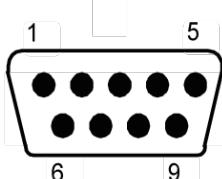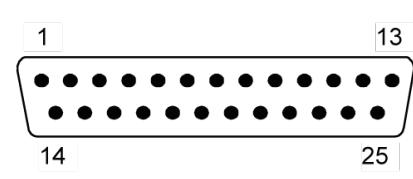
> **NOTE: Address class 169.254.x.x is reserved and cannot be used for PROFINET IO.**

For further details refer to the Help On Line page of the Reading Phase step (Channels) and (Fieldbuses) in DL.CODE.

USER INTERFACE - SERIAL HOST

The following table contains the pinout for standard RS232 PC Host interface. For other user interface types please refer to their own manual.

RS232 PC-side Connections			
9-pin male connector		25-pin male connector	
Pin	**Name**	**Pin**	**Name**
2	RX	3	RX
3	TX	2	TX
5	GND	7	GND

CHAPTER 5
TYPICAL LAYOUTS

The following typical layouts refer to system hardware configurations. However, they also require the correct setup of the software configuration parameters. Dotted lines in the figures refer to optional hardware configurations within the particular layout.

> ⚠ **CAUTION: Matrix 120 readers do not have Auxiliary Serial interfaces. Therefore, neither data monitoring nor device configuration ca be performed through this interface.**
> **Matrix 120 devices can be configured in DL.CODE through the Ethernet, Main Serial, or USB interfaces depending on the device model.**

ETHERNET CONNECTION

The Ethernet connection is possible in two different layouts.

In a Point-to-Point layout the reader is connected to a local host by using a **CAB-ETH-M0x** cable. There is no need to use a crossover adapter since Matrix 120 incorporates an autocross function.

1. Ethernet Interface
2. Auxiliary Serial Interface (Data Monitor)
3. External Trigger (for One Shot or Phase Mode)
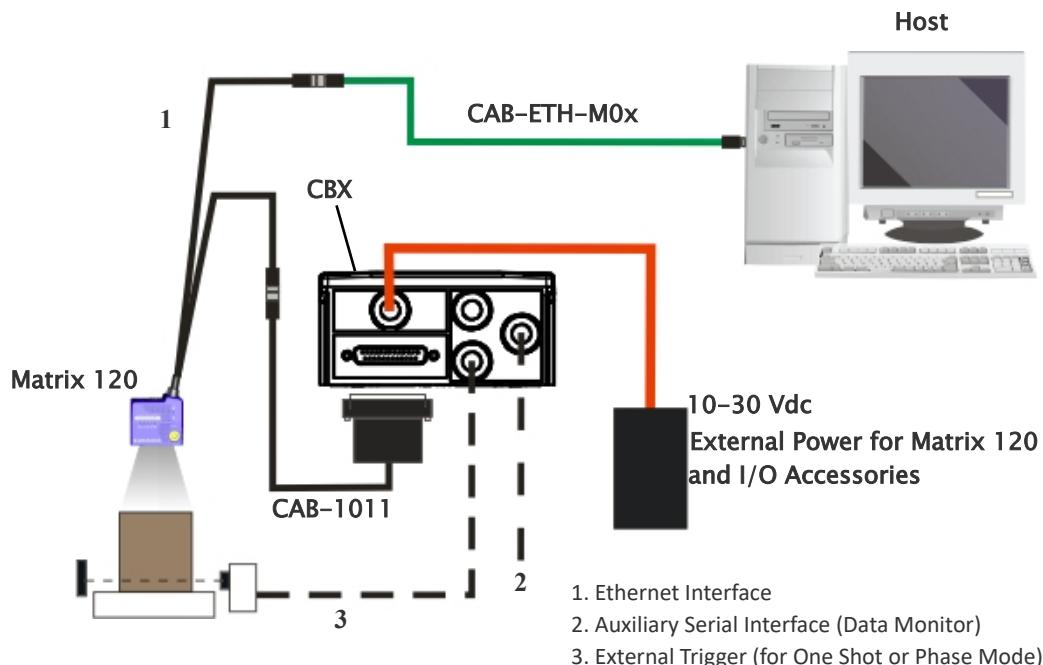
Figure 56. Ethernet Point-to-Point Layout

When using a Local Area Network (LAN), one or more Matrix 120 readers can be con-
nected to the network by using **CAB-ETH-M0x** cables:

1. Ethernet Interface
2. Main Serial Interface (Data Monitor)
3. External Trigger (for One Shot or Phase Mode)
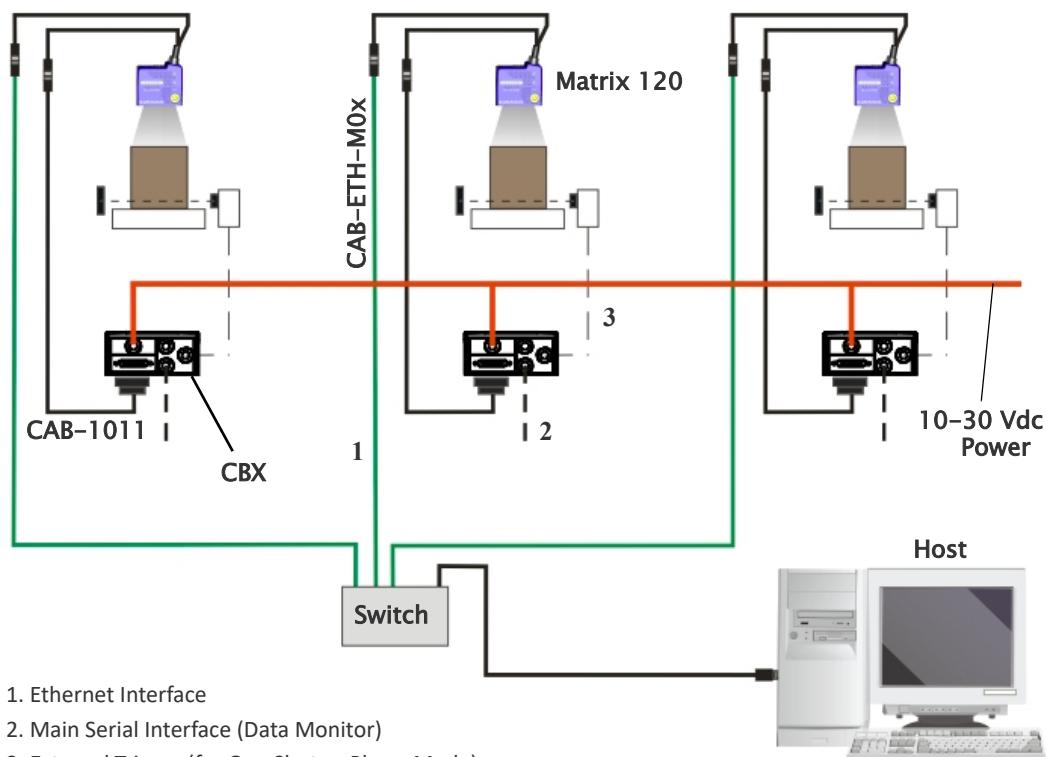
Figure 57. Ethernet Network Layout

SERIAL CONNECTION

In this layout the data is transmitted to the Host on the main serial interface. The Ethernet interface can be used for reader configuration by connecting a laptop computer running DL.CODE.

Data can be transmitted on the RS232 auxiliary interface independently from the main interface selection to monitor data.

When One Shot or Phase Mode operating mode is used, the reader can be activated by an External Trigger (for example a pulse from a photoelectric sensor) when the object enters its reading zone.

1. Main Serial Interface (RS232 or RS422 Full-Duplex)
2. Optional outputs
3. External Trigger (for One Shot or Phase Mode)
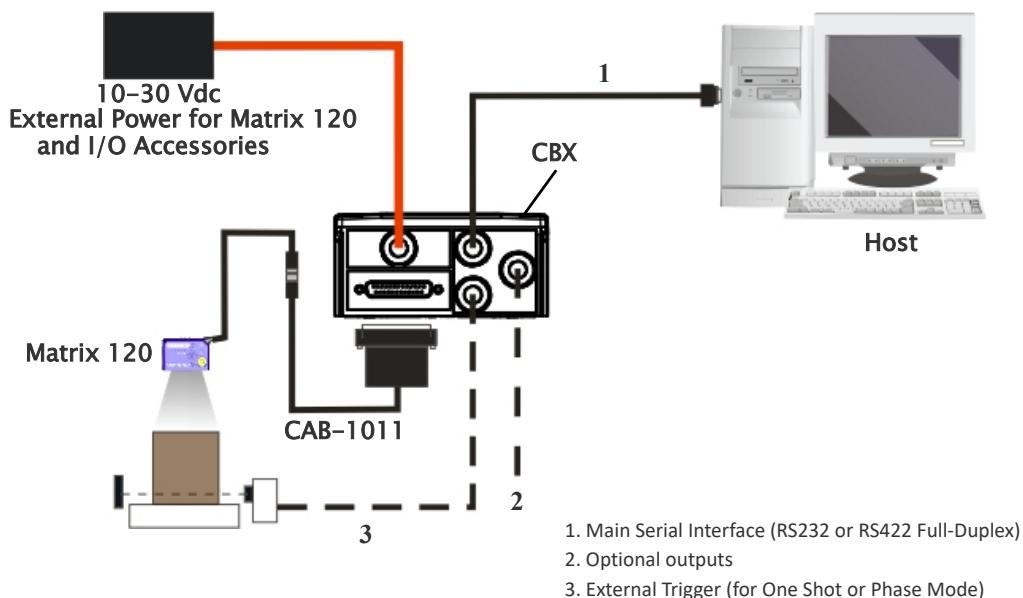
Figure 58. Serial Interface Point-to-Point Layout

All devices always support multiple output channels (i.e. for data monitoring).

FIELDBUS CONNECTION

⚠️ **CAUTION: Matrix 120 readers <u>do not have Auxiliary Serial interfaces</u>. Therefore, neither data monitoring nor device configuration ca be performed through this interface.**
Once the Matrix 120 device is configured in DL.CODE for HMS Fieldbus communication, the Main Serial channel is no longer available.
Therefore, it is recommended to make these configurations when connected to DL.CODE through either the Ethernet interface (using CAB-ETH-Mxx) or the USB interface (using CAB-1021).

In this layout a single reader functions as a Slave node on a Fieldbus network. The data is transmitted to the Host through an accessory Fieldbus interface board installed inside the CBX500 connection box (i.e. BM300 Profibus or BM400 DeviceNet).

Other I/O devices connected to the CBX can be controlled from the Filedbus Host through the Matrix reader.

When One Shot or Phase Mode operating mode is used, the reader can be activated by an External Trigger (photoelectric sensor) when the object enters its reading zone.

1. Fieldbus Interface (Profibus, DeviceNet, etc.)
2. Other I/O devices
3. External Trigger (for One Shot or Phase Mode)
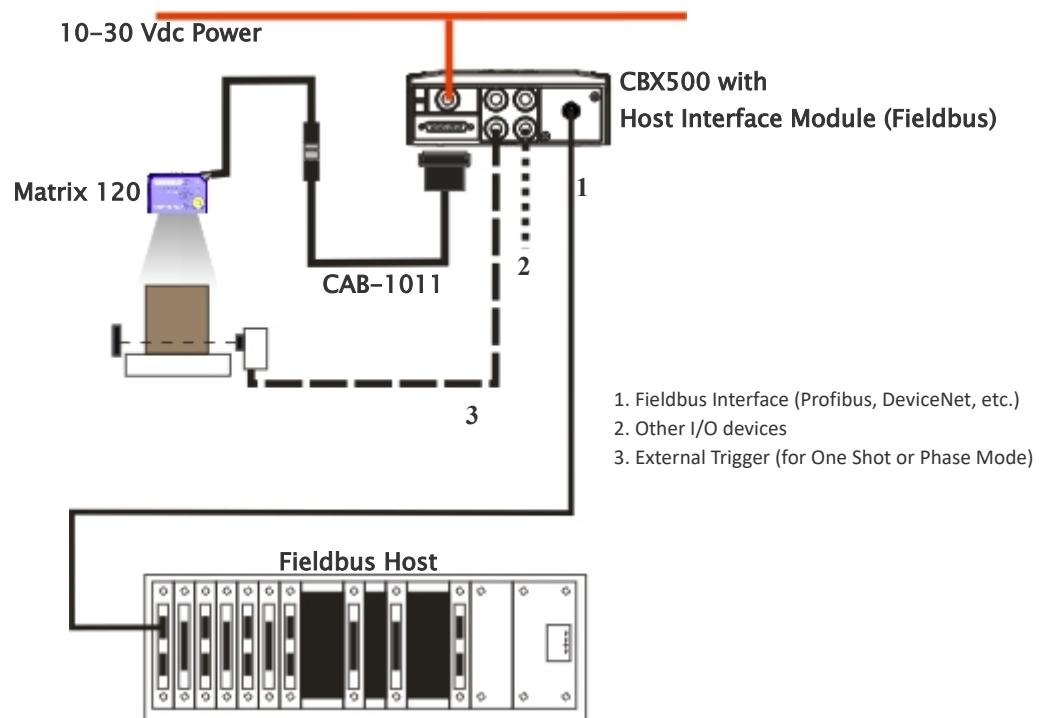
Figure 59. Fieldbus Interface Point-to-Point Layout

📝 **NOTE: Matrix 120 Ethernet models support Ethernet/IP, Modbus TCP and PROFINET-IO Fieldbus interfaces without the use of external Fieldbus modules. See Ethernet Connection.**

PASS-THROUGH

The pass-through layout allows each device to collect data from one or more pass-through input channels and send this data plus its own on one or more different output channels.

In this way independent devices can be connected together in combinations to create multi device networks. Many devices reading independently can send their messages through a common output channel which instead of being directed at a Host can be collected by another device on its pass-through input channel and sent to a Host on a different output channel.

1 Ethernet TCP/IP Server 1
2 Ethernet TCP/IP Server 2
3 Main Serial Interface (RS232 or RS422 Full-Duplex)
➡ Pass-through Input Channel
➡ Output Channel
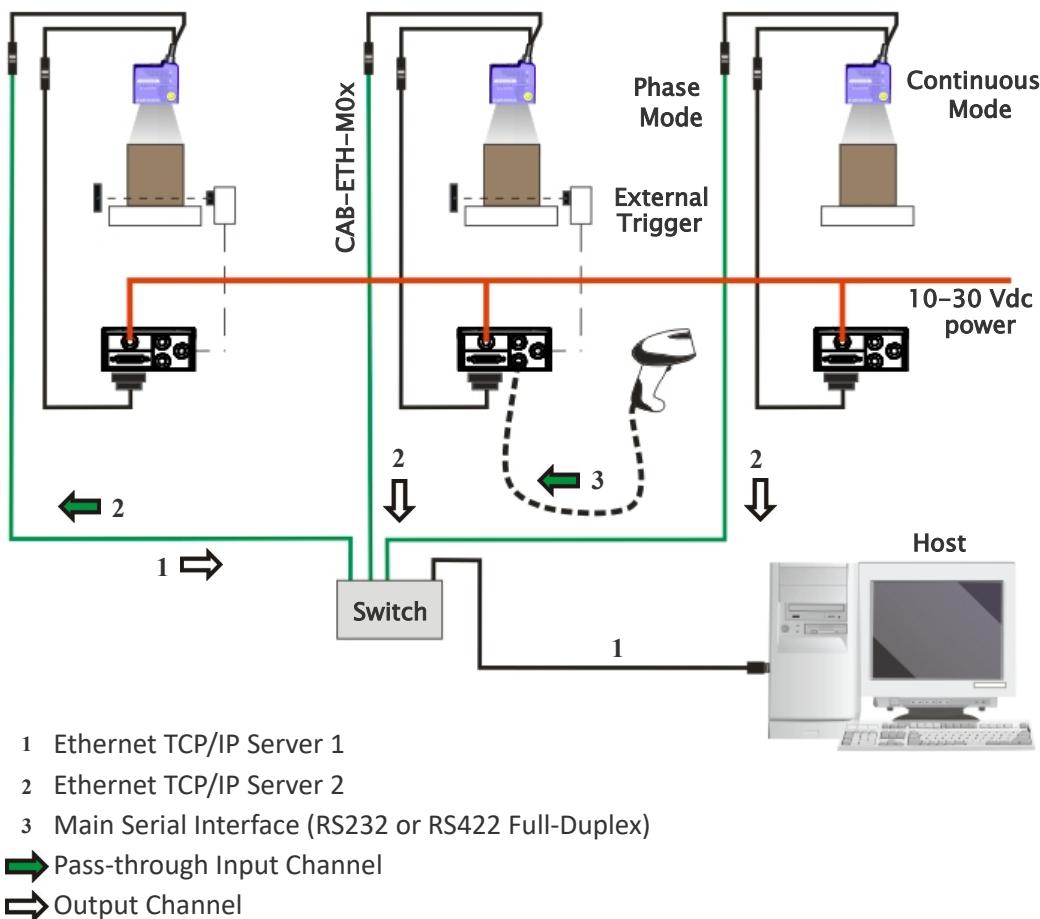
Figure 60. Pass-Through Layout

In a Pass-through layout each device supports multiple pass-through configurations to accept input from different devices on different channels (i.e. middle reader above). However, readers are not required to have a pass-through configuration if they don't need to receive data from an input channel (i.e. right reader above). The overall data collection device always has at least one pass-through configuration to collect the input data from the other devices and send it to the Host (i.e. left reader above).

All devices always support multiple output channels (i.e. for data monitoring).

In a Pass-through layout each device can have a different operating mode: Continuous, One Shot, Phase Mode, etc.

USB CONNECTION

For Matrix 120 xxx-x0x models, the USB connection is possible in different layouts.
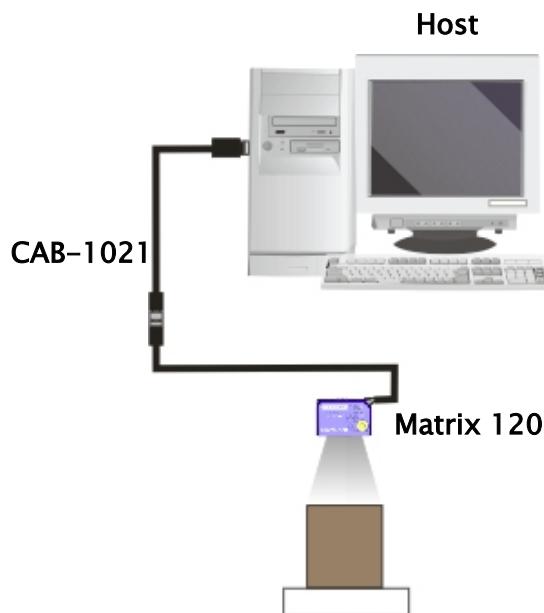
Figure 61. USB Point-to-Point Layout

NOTE: USB-HID (Keyboard Wedge) configurations can also be made through this interface. See "USB-HID (Keyboard Wedge) Configurations" on page 130**.**

One or more Matrix 120 USB models can be connected to a USB Hub. The HUB must be able to supply 500 mA to each port.
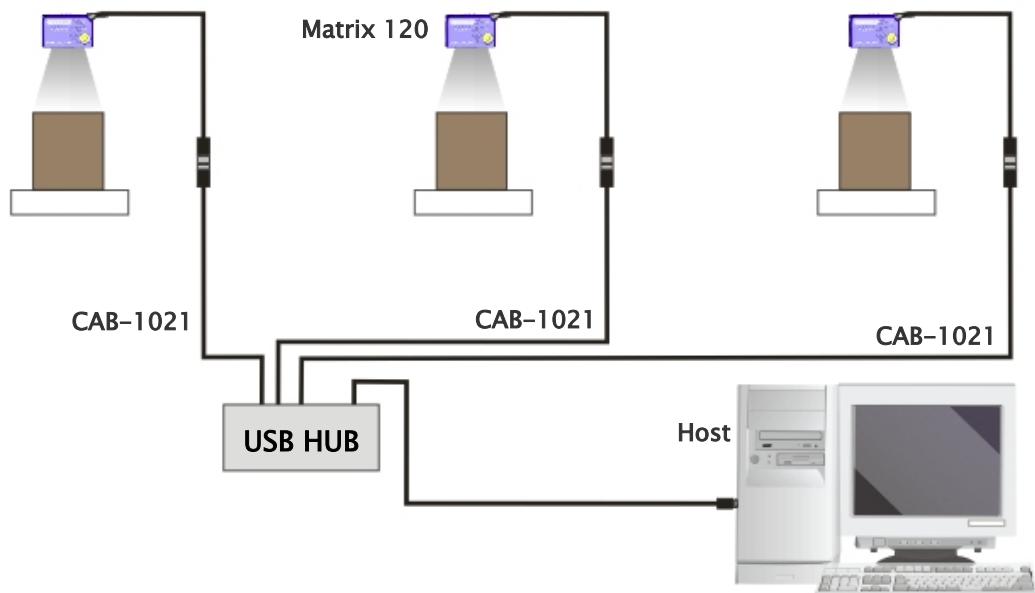
Figure 62. USB Layout to HUB

The CAB-1051 allows I/O devices to be connected to the reader when using the USB interface.
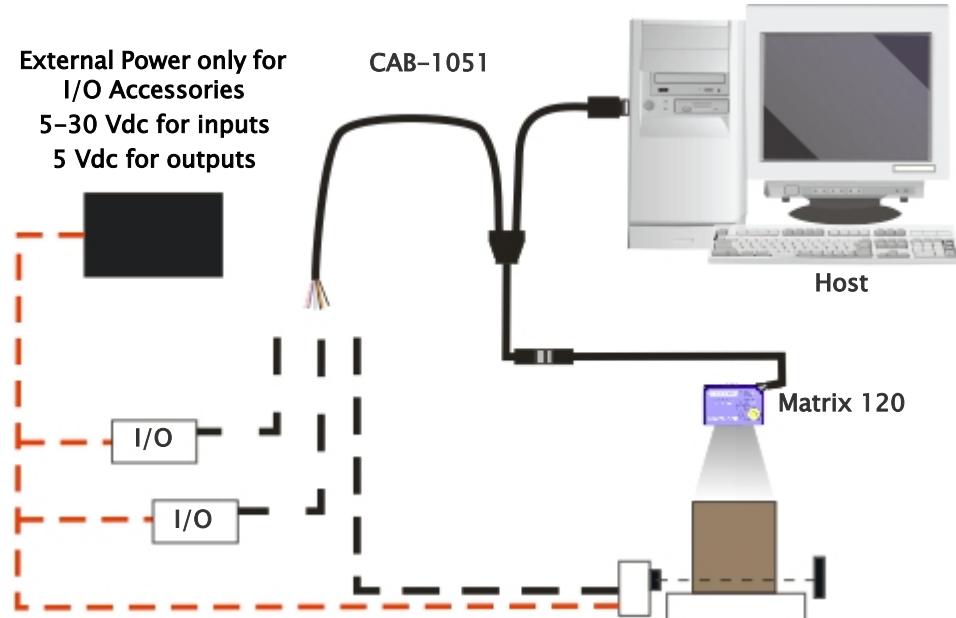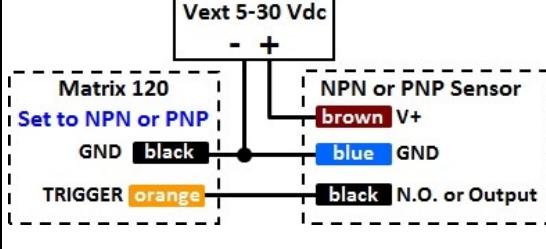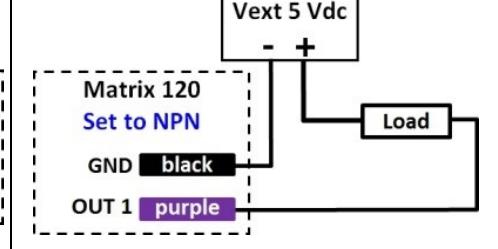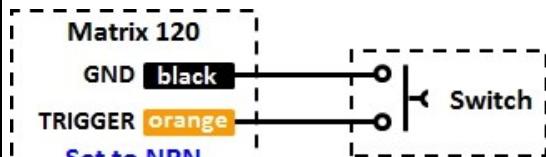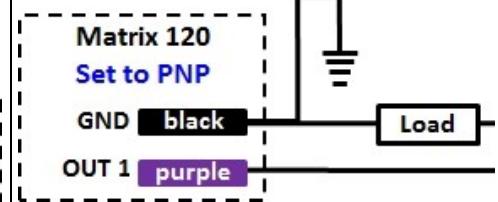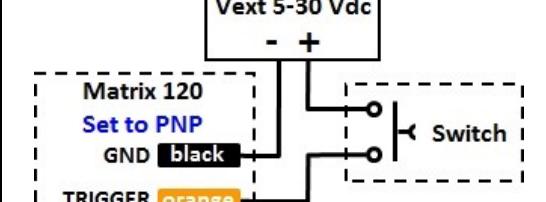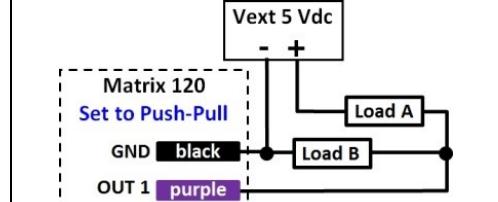
Figure 63. USB Point-to-Point Layout with I/O

The electrical connections between I/O devices and CAB-1051, together with the relative Matrix 120 Line Type parameter settings are shown below.

Inputs	Outputs
V_{ext} = 5-30 Vdc max I_{IN} = 3.5 mA max	V_{ext} = 5 Vdc max I_{CE} = 100 mA max
	 V_{out} = 3.3 Vdc max I_{out} = 50 mA max
CAB-1051 Input 1 (Trigger) = orange Input 2 = gray GND = black	CAB-1051 Output 1 = purple Output 2 = red/white GND = black

◆DATALOGIC

CHAPTER 6
READING FEATURES

FOV CALCULATION

Use the data in the following table to calculate the FOV for your application, referring to Figure 64 and the formula below.

Model	d_0	View Angle Horizontal	View Angle Vertical	View Angle Diagonal	Min Reading Distance mm
Matrix 120 210-xxx (WVGA)	8 mm	39°	26°	46°	25
Matrix 120 310-XXX (MP)	8 mm	41°	32°	49°	30
Matrix 120 311-xxx (MP+WA)	8 mm	52°	40°	63°	30

The viewing angle has a tolerance of ± 1° depending on the reading distance.

$$FOVx = 2 [(d + d0) \tan (ax/2)]$$

where:

FOV$_x$ = horizontal, vertical or diagonal FOV

α_x = horizontal, vertical or diagonal viewing angles.

d = reading distance (in mm) from window surface to code surface

d$_0$ = offset (in mm) from center of lens to external window surface
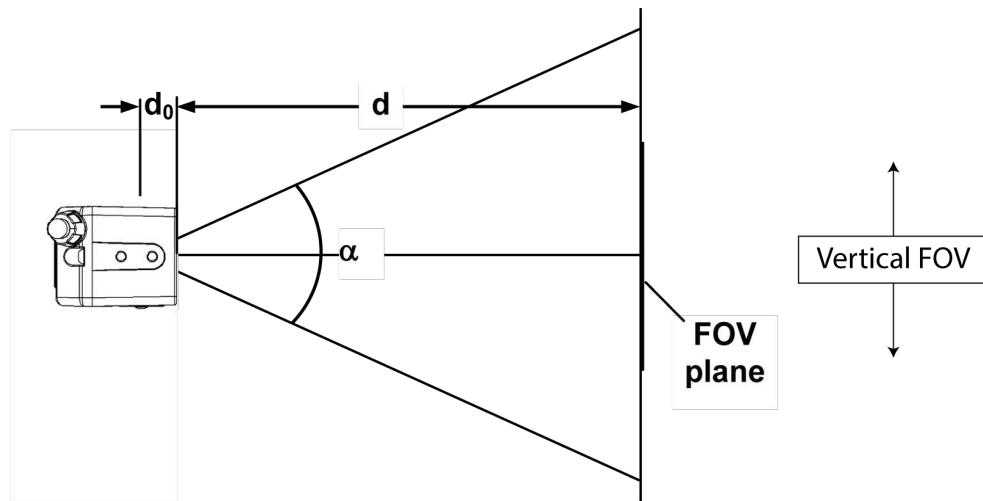
Figure 64. Reading Distance References

Example:

The FOV for a **Matrix 120 310-xxx** at a **reading distance of 100 mm** is:

FOV_H = 2 [(100 mm + 8 mm) * tan (41°/2)] $\cong$ **81 mm**
FOV_V = 2 [(100 mm + 8 mm) * tan (32°/2)] $\cong$ **62 mm**

GLOBAL FOV DIAGRAMS

NOTE: The following diagrams are given for typical performance at 25°C using high quality grade A symbols according to ISO/IEC 15416 (1D code) and ISO/IEC 15415 (2D code) print quality test specifications. Testing should be performed with actual application codes in order to maximize the application performance.

The following diagrams show the **maximum obtainable** Field of View for 1D and 2D codes using <u>Processing Mode = Advanced</u>. **Depending on the code resolution, symbology, and number of characters in the code, the Reading Area can be different from the FOV**.

See the Reading Diagrams, starting on page 76 for specific reading area examples.

Matrix 120 210–xxx WVGA Models
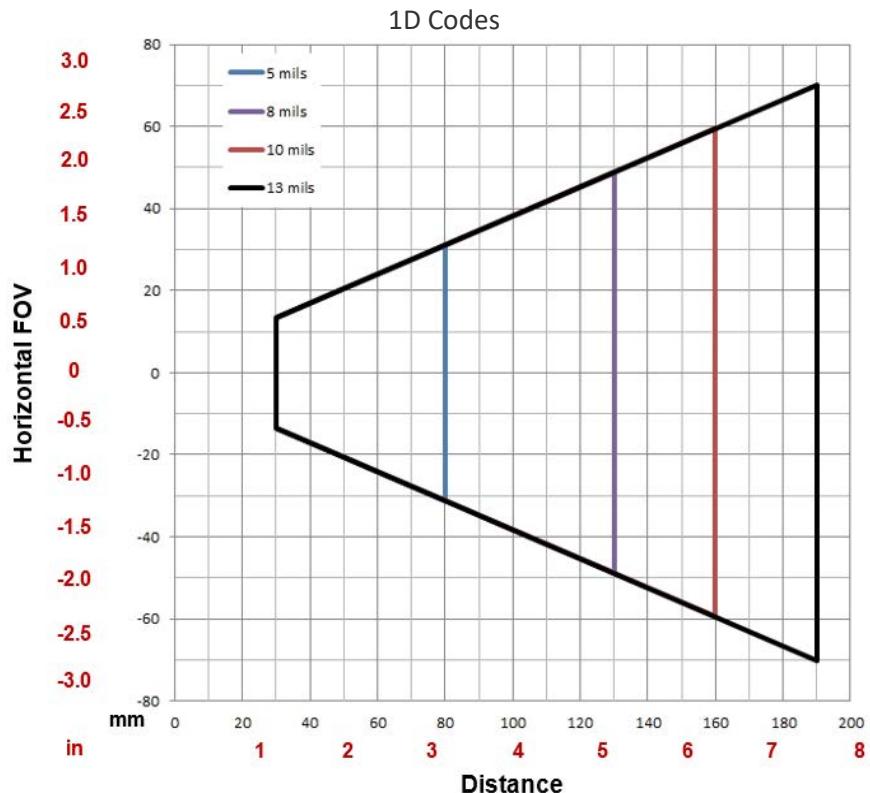
Figure 65. Global FOV 1D Code Diagram for WVGA Models
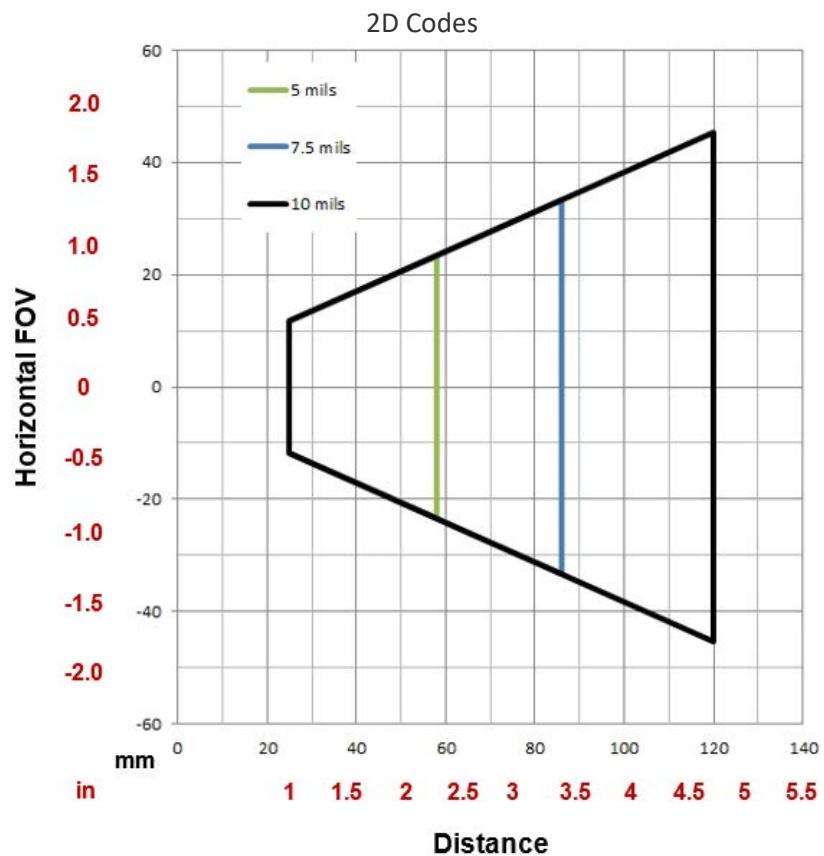
Figure 66. Global FOV 2D Code Diagram for WVGA Models

Matrix 120 310-xxx MP Models
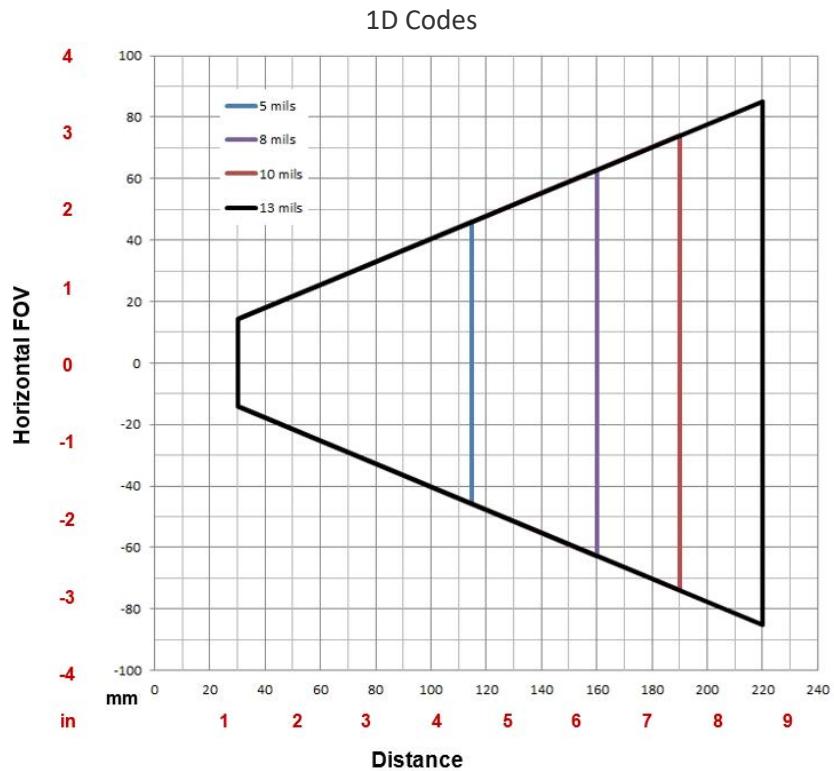
Figure 67. Global FOV 1D Code Diagram for MP Models
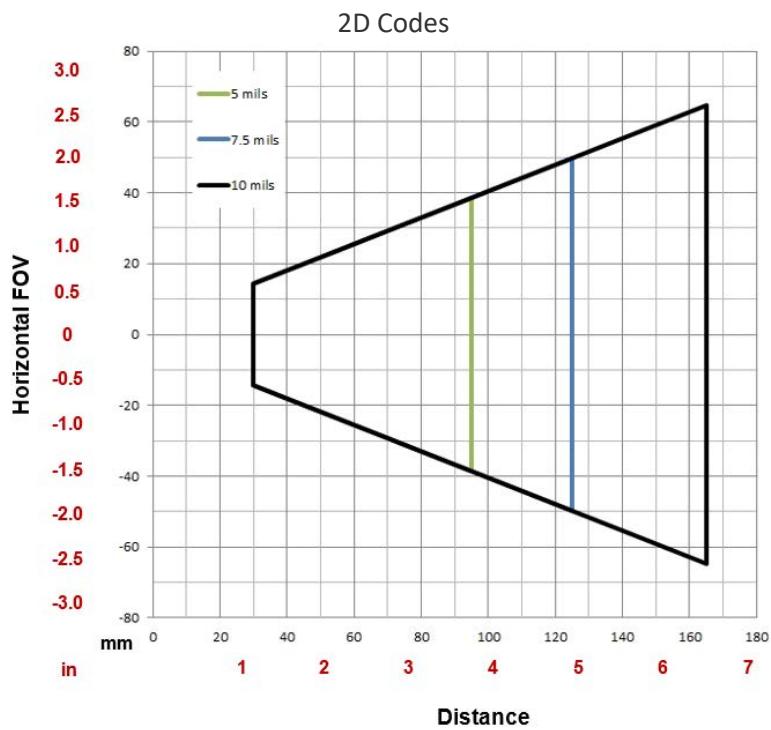
Figure 68. Global FOV 2D Code Diagram for MP Models

Matrix 120 311–xxx MP + WA Models
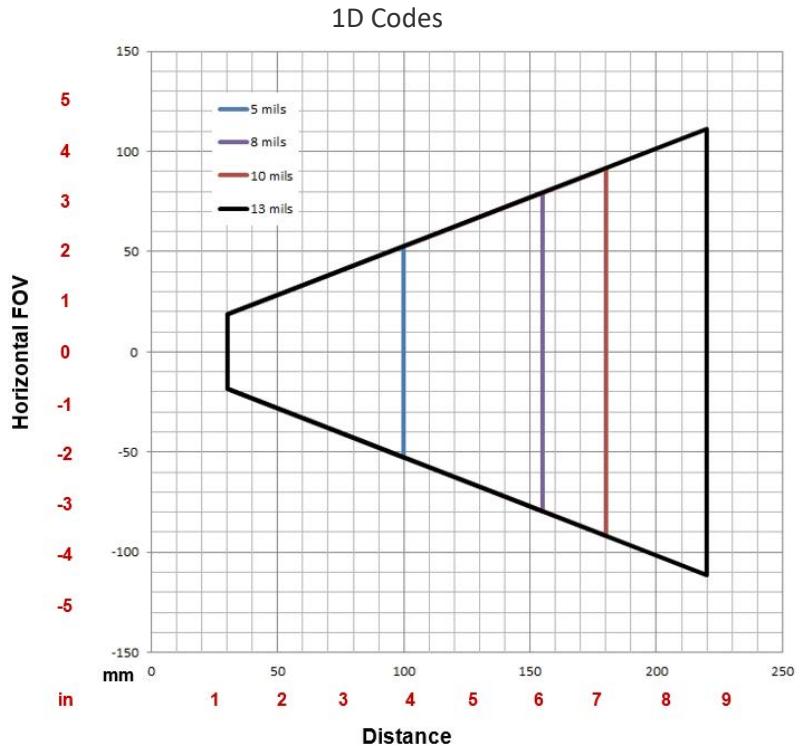
1D Codes

Figure 69. Global FOV 1D Code Diagram for MP Models
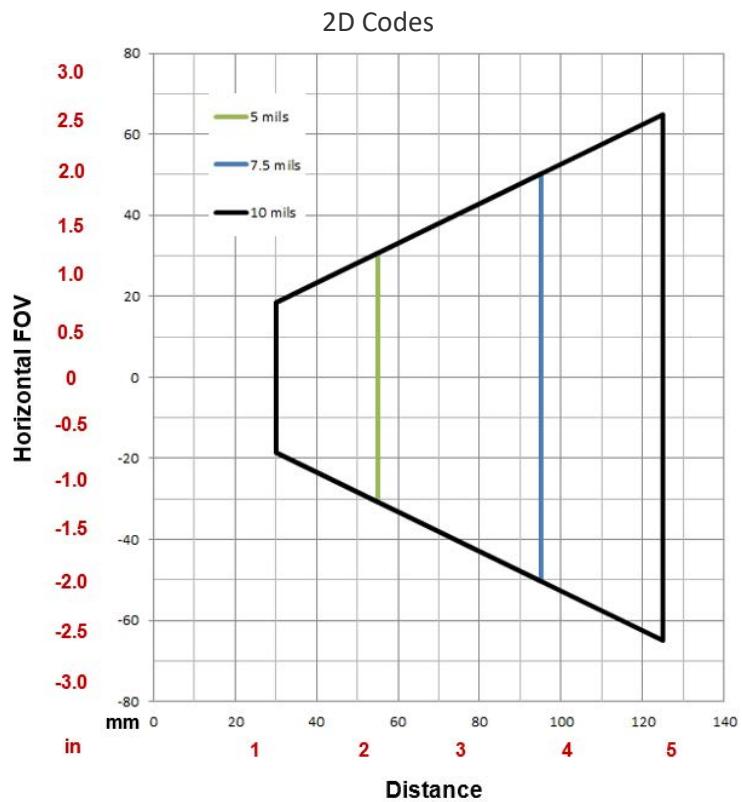
2D Codes

Figure 70. Global FOV 2D Code Diagram for MP Models

DATALOGIC

Matrix 120 310-xxA Models

Digimarc Barcode
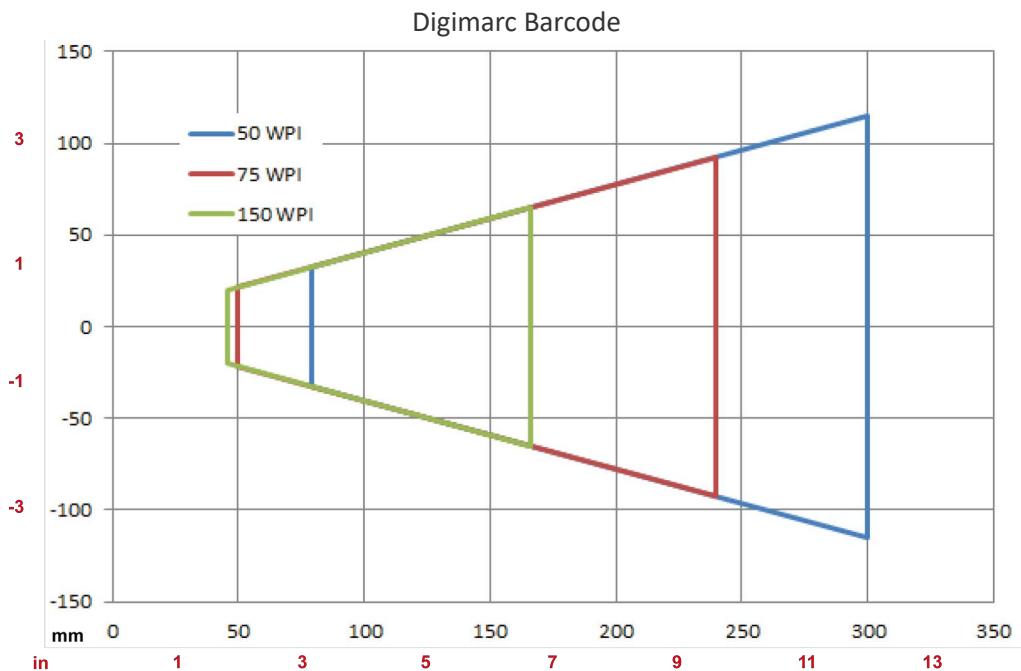
READING DIAGRAMS

- The following reading diagrams are to be considered as references and are given for typical performance at 25°C using high quality grade A symbols: Code 128 (1D code) and Data Matrix ECC 200 (2D code) from the Test Charts available in the SW-DOCS-TEST CHARTS accessory (93ACC0148).

- Testing should be performed with the actual Matrix 120 using application codes in order to evaluate whether maximizing application performance requires adjustments to the HW/SW configuration with respect to the Reference Conditions given under each diagram.

- The ratio of the Vertical FOV width with respect to the Horizontal FOV width in the diagrams depends on the models:

  - for WVGA it is about equal to 0.64; specifically 480/752. (e.e. FOVV. $\cong$ FOVH x 0.64);

  - for MP it is about equal to 0.75; specifically 960/1280. (e.e. FOVV. $\cong$ FOVH x 0.75).

- The reading distance ranges are measured from the reading window surface.

- Common software parameter settings:

  - reading all 1D code symbologies - Processing Mode=Standard;

  - reading 2D code symbologies - Processing Mode=Standard; Code Contrast=Low; Decoding Complexity=Medium.

- When defining a HW/SW configuration for the Matrix 120 for conditions different from those of the reference diagrams, it is suggested to keep in mind the following rules:

  - Changes in *Exposure Time* act directly proportional to the luminosity of the image and inversely proportional to the maximum code reading movement speed. Consequently, reducing the *Exposure Time* by half reduces the luminosity of the image by half but doubles the theoretical code reading movement speed.

  - Changes in *Gain* act directly proportional to the luminosity of the image. However, increasing the *Gain* value can reduce the quality of the acquired image.

- The max. theoretical Line Speed values for each diagram can be calculated using the formula in Chapter 6, Maximum Line Speed and Exposure Time Calculations.

Matrix 120 210-xxx 1D Codes (WVGA)

Matrix 120 210-xxx (WVGA)

Code 128 0.12 mm (5 mils)
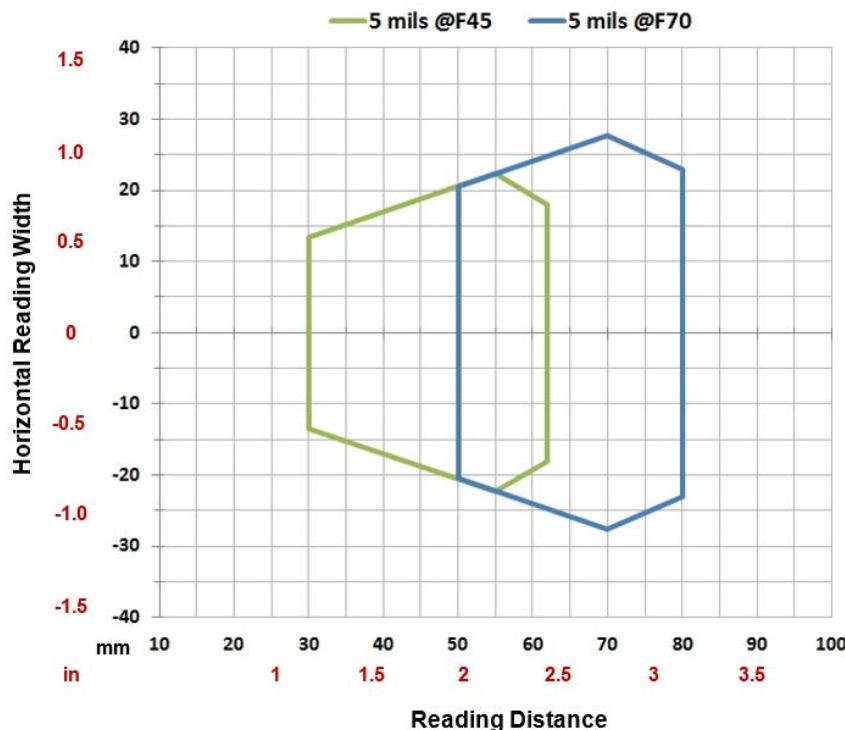
Conditions	
Hardware Settings	
Code Symbology	Code 128
Code Resolution	0.12 mm (5 mils)
Tilt Angle	0°
Skew Angle	15°
Focusing Distance (mm)	45 70
Software Parameters	
Exposure Time (µs)	400 500
Gain	10 15
Illuminator Lighting	Very High Power Strobed
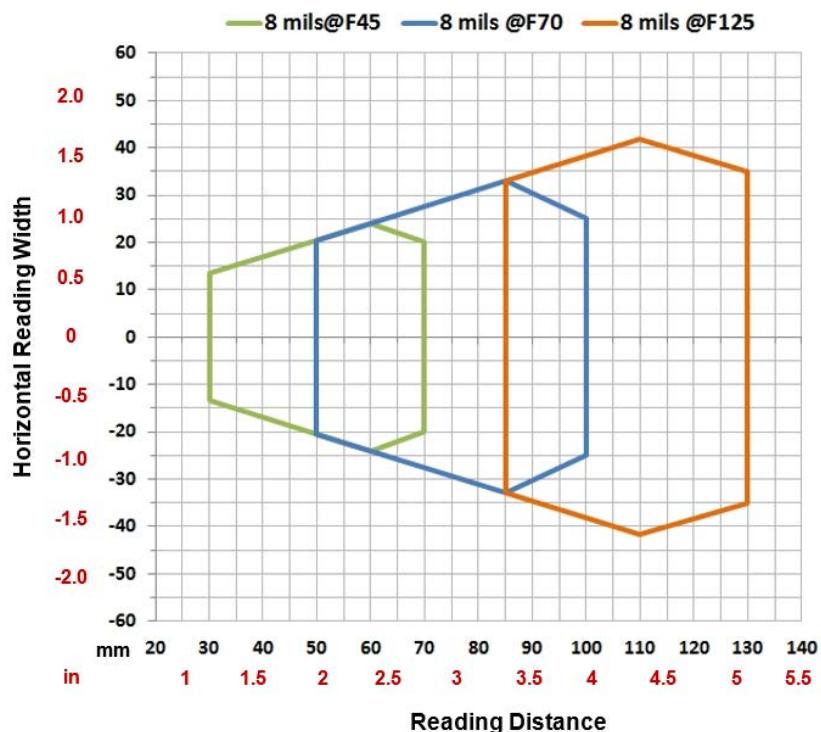
Code 128 0.20 mm (8 mils)

Conditions			
Hardware Settings			
Code Symbology	Code 128		
Code Resolution	0.20 mm (8 mils)		
Tilt Angle	0°		
Skew Angle	15°		
Focusing Distance (mm)	45	70	125
Software Parameters			
Exposure Time (µs)	400	500	600
Gain	15	20	30
Illuminator Lighting	Very High Power Strobed		
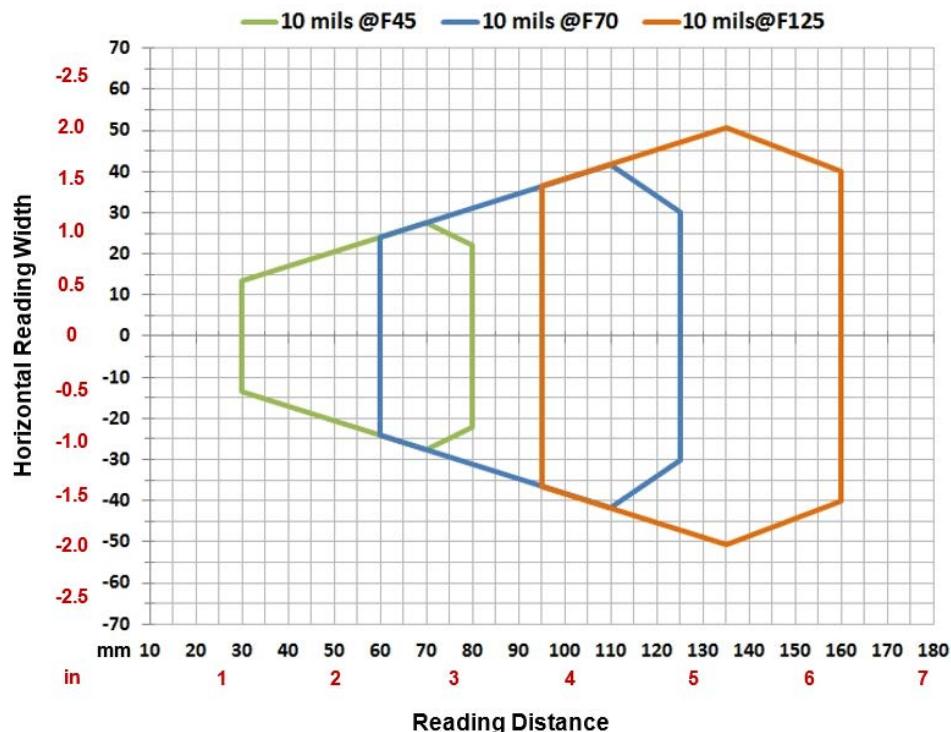
Code 128 0.25 mm (10 mils)

Conditions			
Hardware Settings			
Code Symbology	Code 128		
Code Resolution	0.25 mm (10 mils)		
Tilt Angle	0°		
Skew Angle	15°		
Focusing Distance (mm)	45	70	125
Software Parameters			
Exposure Time (µs)	500	700	800
Gain	10	20	32
Illuminator Lighting	Very High Power Strobed		
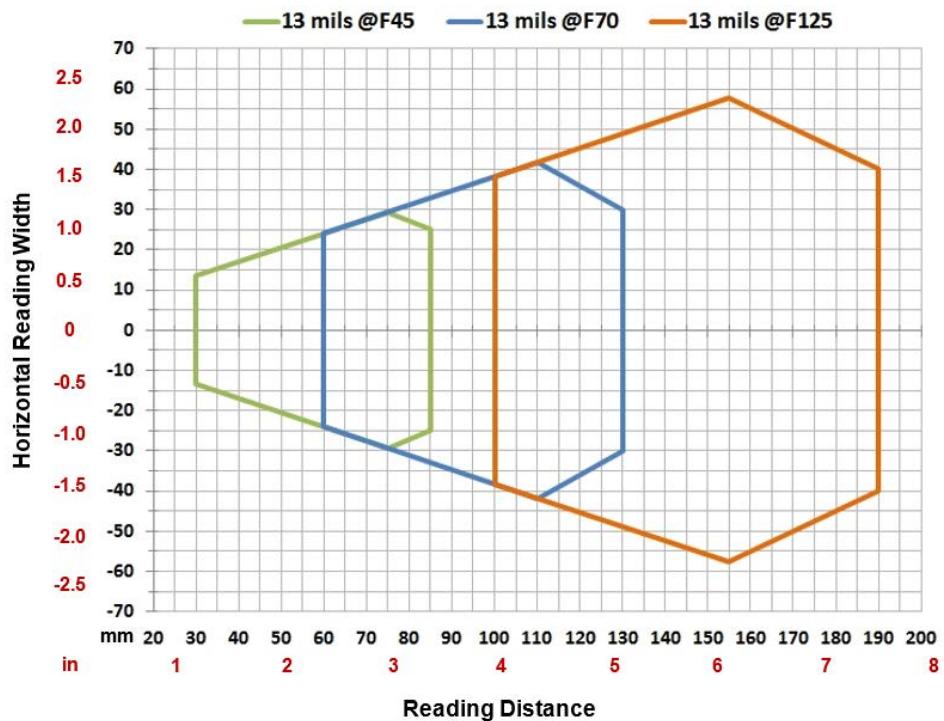
Code 128 0.33 mm (13 mils)

Conditions	
Hardware Settings	
Code Symbology	Code 128
Code Resolution	0.33 mm (13 mils)
Tilt Angle	0°
Skew Angle	15°
Focusing Distance (mm)	45 70 125
Software Parameters	
Exposure Time (µs)	400 600 800
Gain	10 20 32
Illuminator Lighting	Very High Power Strobed

Matrix 120 210-0xx 2D Codes WVGA

Vignetting

For Matrix 120 readers used in 2D code reading applications, due to the "fisheye" or "vignetting" effect of the lens, the reading area is limited to the central zone of the Vertical Field of View.
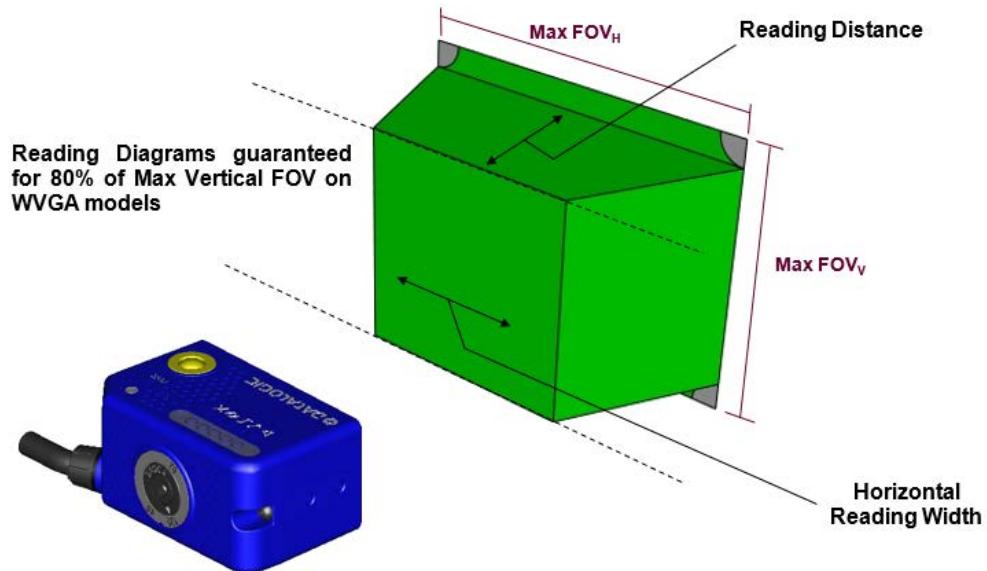
Figure 71. WVGA Model Vignetting Effect

Depending on the application, **Image Cropping** can be applied above and below the central zone of the vertical FOV, limiting image acquisition to the effective reading area and therefore increasing frame rate and reducing overall image processing time.

Matrix 120 210-xxx (WVGA)

Data Matrix 0.12 mm (5 mils)
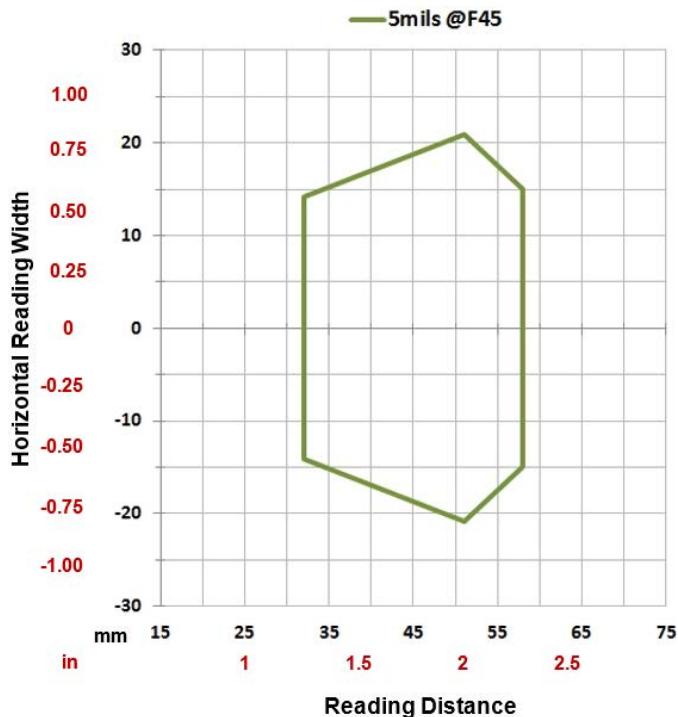
Conditions	
Hardware Settings	
Code Symbology	Data Matrix ECC 200
Code Resolution	0.12 mm (5 mils)
Tilt Angle	0°
Skew Angle	15°
Focusing Distance (mm)	45
Software Parameters	
Exposure Time (µs)	450
Gain	5
Illuminator Lighting	Very High Power Strobed
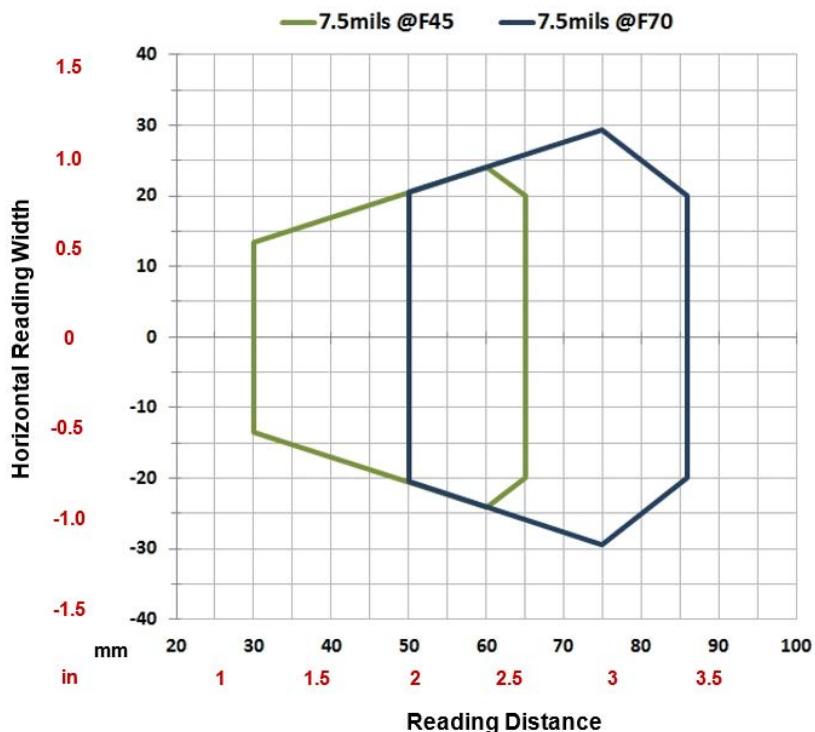
Data Matrix 0.19 mm (7.5 mils)

Conditions	
Hardware Settings	
Code Symbology	Data Matrix ECC 200
Code Resolution	0.19 mm (7.5 mils)
Tilt Angle	0°
Skew Angle	15°
Focusing Distance (mm)	45 70
Software Parameters	
Exposure Time (µs)	450 500
Gain	5 10
Illuminator Lighting	Very High Power Strobed

Matrix 120 210-xxx (WVGA)

Data Matrix 0.25 mm (10 mils)
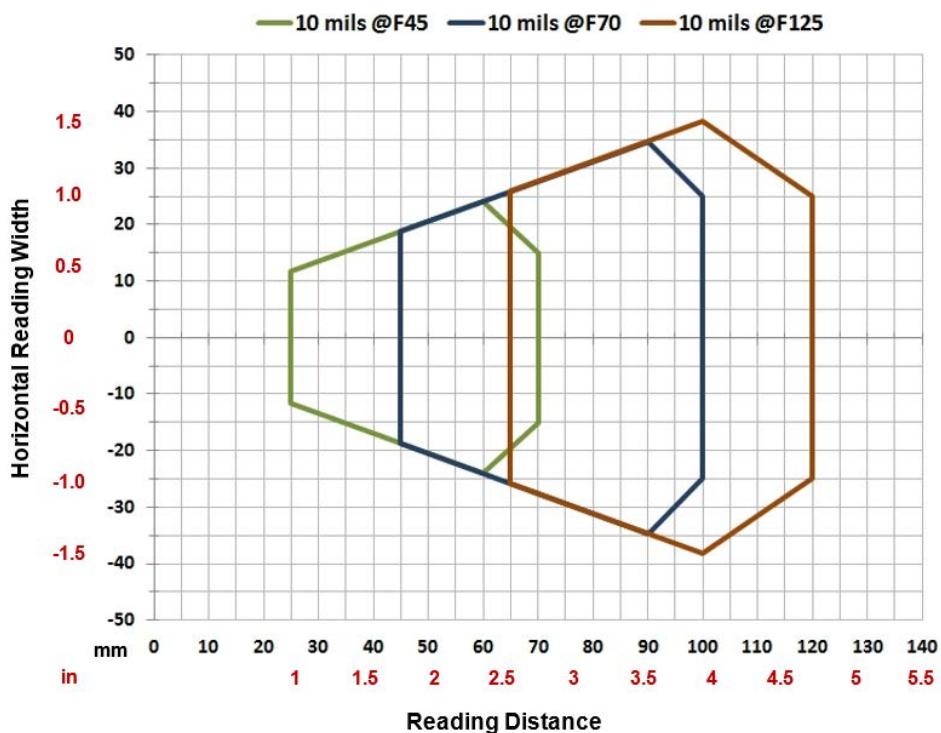
Conditions			
Hardware Settings			
Code Symbology	Data Matrix ECC 200		
Code Resolution	0.25 mm (10 mils)		
Tilt Angle	0°		
Skew Angle	15°		
Focusing Distance (mm)	45	70	125
Software Parameters			
Exposure Time (µs)	280	500	650
Gain	10	10	13
Illuminator Lighting	Very High Power Strobed		
Decoding Complexity	Very High		

Matrix 120 310-xxx 1D Codes (MP)

Matrix 120 310-xxx (MP)

Code 128 0.12 mm (5 mils)
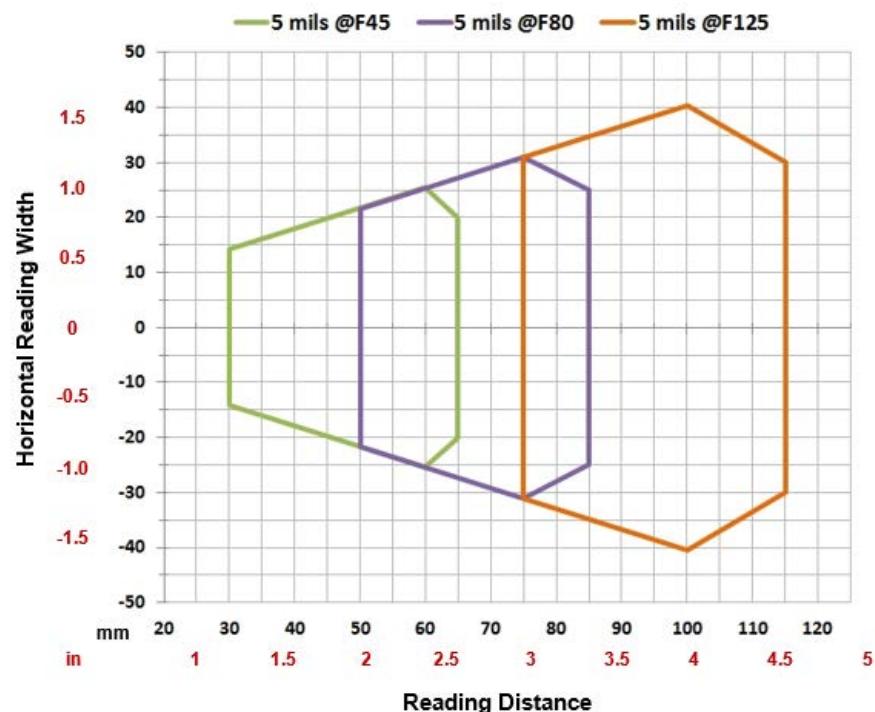
Conditions			
Hardware Settings			
Code Symbology	Code 128		
Code Resolution	0.12 mm (5 mils)		
Tilt Angle	0°		
Skew Angle	15°		
Focusing Distance (mm)	45	80	125
Software Parameters			
Exposure Time (μs)	300	350	500
Gain	10	15	20
Illuminator Lighting	Very High Power Strobed		
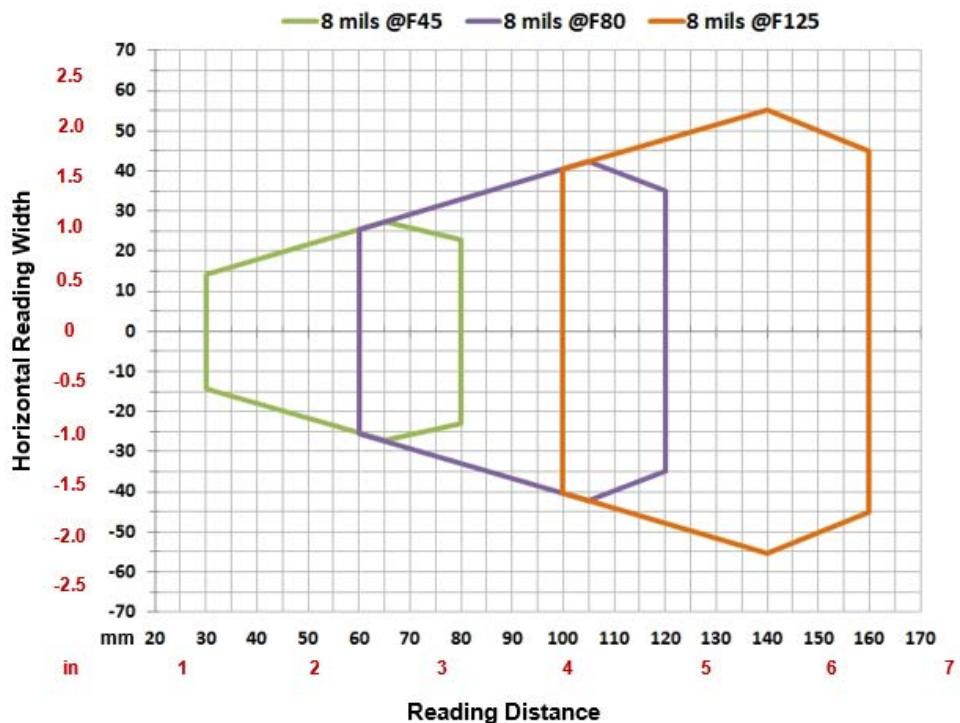
Code 128 0.20 mm (8 mils)

Conditions			
Hardware Settings			
Code Symbology	Code 128		
Code Resolution	0.20 mm (8 mils)		
Tilt Angle	0°		
Skew Angle	15°		
Focusing Distance (mm)	45	80	125
Software Parameters			
Exposure Time (µs)	300	500	700
Gain	15	20	25
Illuminator Lighting	Very High Power Strobed		
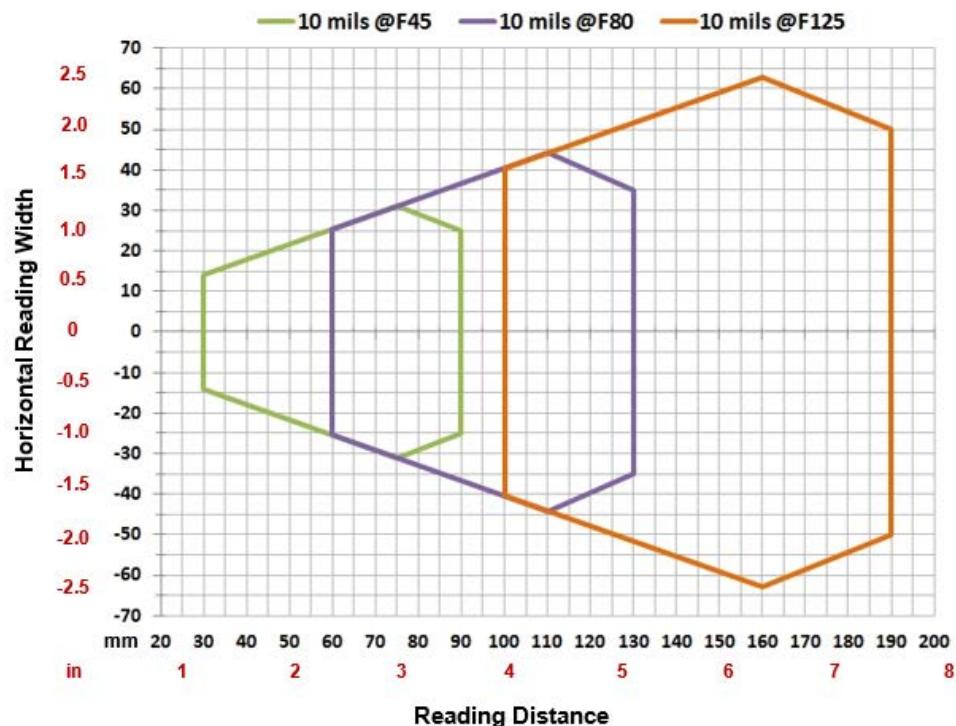
Code 128 0.25 mm (10 mils)

Conditions			
Hardware Settings			
Code Symbology	Code 128		
Code Resolution	0.25 mm (10 mils)		
Tilt Angle	0°		
Skew Angle	15°		
Focusing Distance (mm)	45	80	125
Software Parameters			
Exposure Time (µs)	300	400	500
Gain	10	15	25
Illuminator Lighting	Very High Power Strobed		

Code 128 0.33 mm (13 mils)

Conditions			
Hardware Settings			
Code Symbology	Code 128		
Code Resolution	0.33 mm (13 mils)		
Tilt Angle	0°		
Skew Angle	15°		
Focusing Distance (mm)	45	80	125
Software Parameters			
Exposure Time (µs)	400	600	700
Gain	15	20	32
Illuminator Lighting	Very High Power Strobed		

Matrix 120 310-0xx 2D Codes (MP)

Vignetting

For Matrix 120 readers used in 2D code reading applications, due to the "fisheye" or "vignetting" effect of the lens, the reading area is limited to the central zone of the Vertical Field of View.

Reading Diagrams guaranteed for 60% of Max Vertical FOV on MP models

Max FOV$_H$

Reading Distance

Max FOV$_V$

Horizontal Reading Width
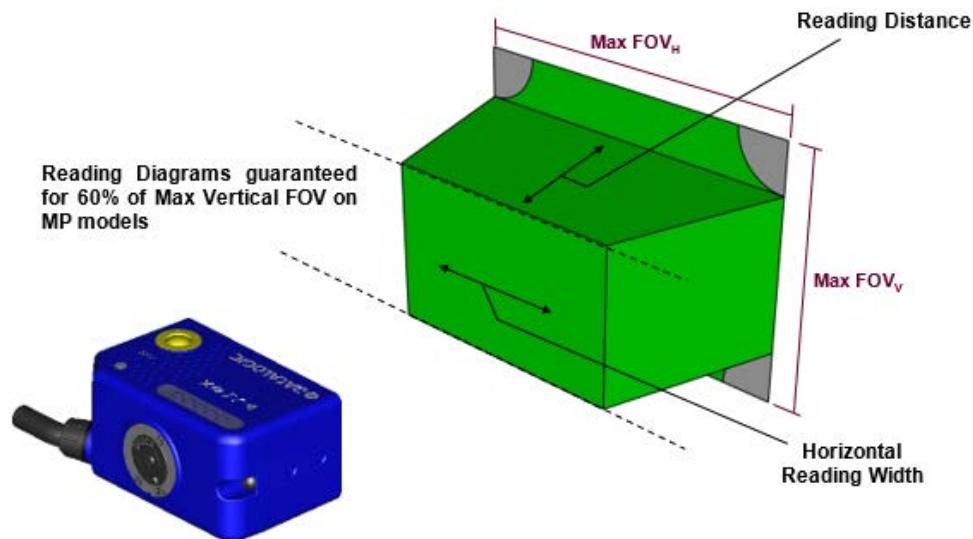
Figure 72. MP Model Vignetting Effect

Depending on the application, **Image Cropping** can be applied above and below the central zone of the vertical FOV, limiting image acquisition to the effective reading area and therefore increasing frame rate and reducing overall image processing time.

Matrix 120 310-xxx (MP)

Data Matrix 0.076 mm (3 mils)
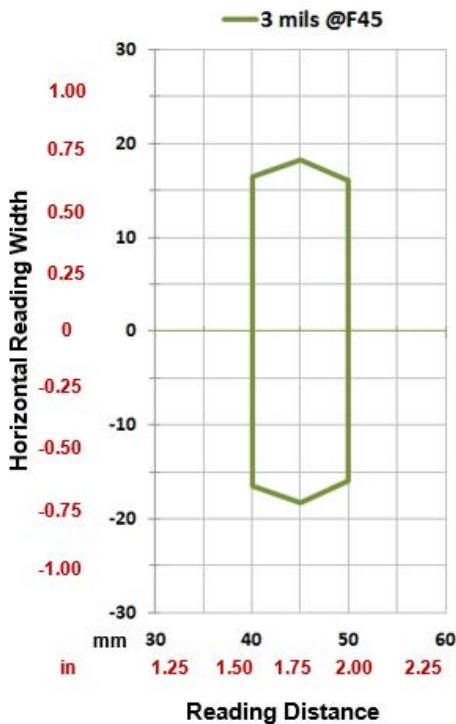
Conditions	
Hardware Settings	
Code Symbology	Data Matrix ECC 200
Code Resolution	0.076 mm (3 mils)
Tilt Angle	0°
Skew Angle	15°
Focusing Distance (mm)	45
Software Parameters	
Exposure Time (μs)	250
Gain	10
Illuminator Lighting	Very High Power Strobed

Data Matrix 0.13 mm (5 mils)
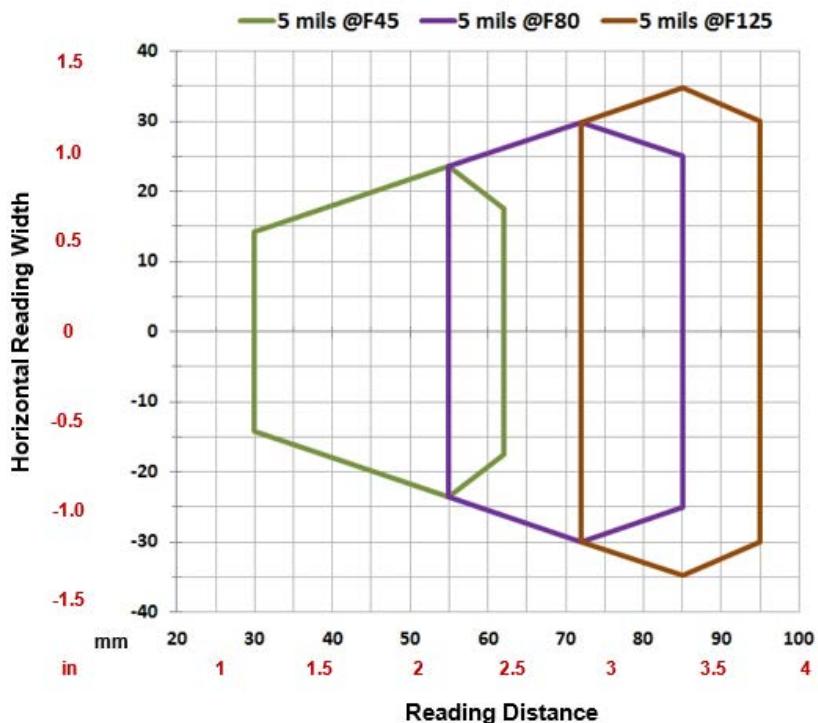
Conditions			
Hardware Settings			
Code Symbology	Data Matrix ECC 200		
Code Resolution	0.12 mm (5 mils)		
Tilt Angle	0°		
Skew Angle	15°		
Focusing Distance (mm)	45	80	125
Software Parameters			
Exposure Time (µs)	250	300	600
Gain	15	15	15
Illuminator Lighting	Very High Power Strobed		
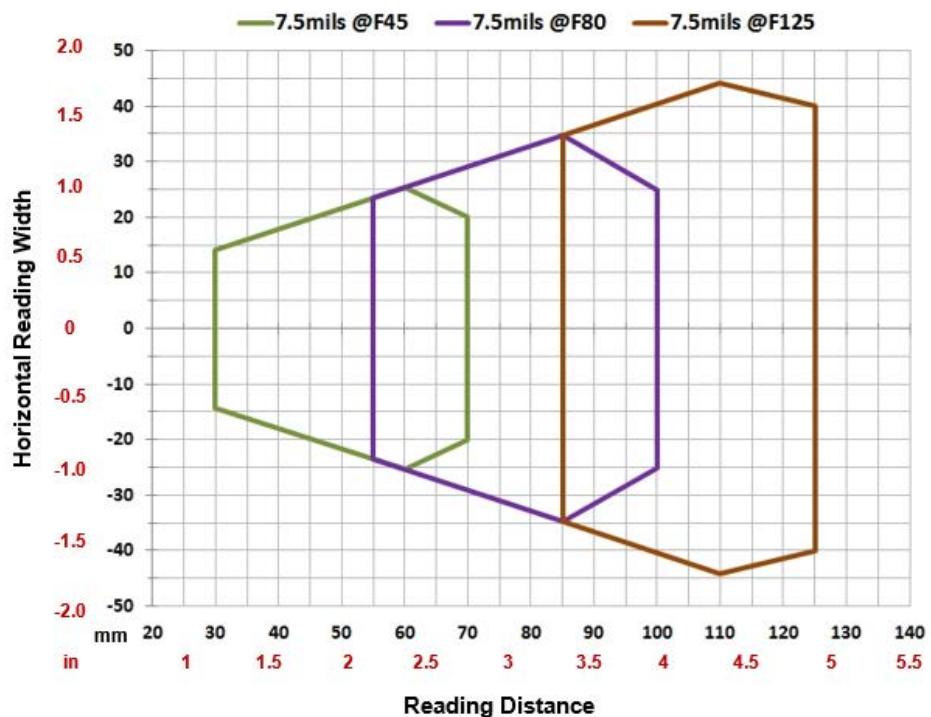
Data Matrix 0.19 mm (7.5 mils)

Conditions			
Hardware Settings			
Code Symbology	Data Matrix ECC 200		
Code Resolution	0.19 mm (7.5 mils)		
Tilt Angle	0°		
Skew Angle	15°		
Focusing Distance (mm)	45	80	125
Software Parameters			
Exposure Time (µs)	250	380	600
Gain	15	20	20
Illuminator Lighting	Very High Power Strobed		
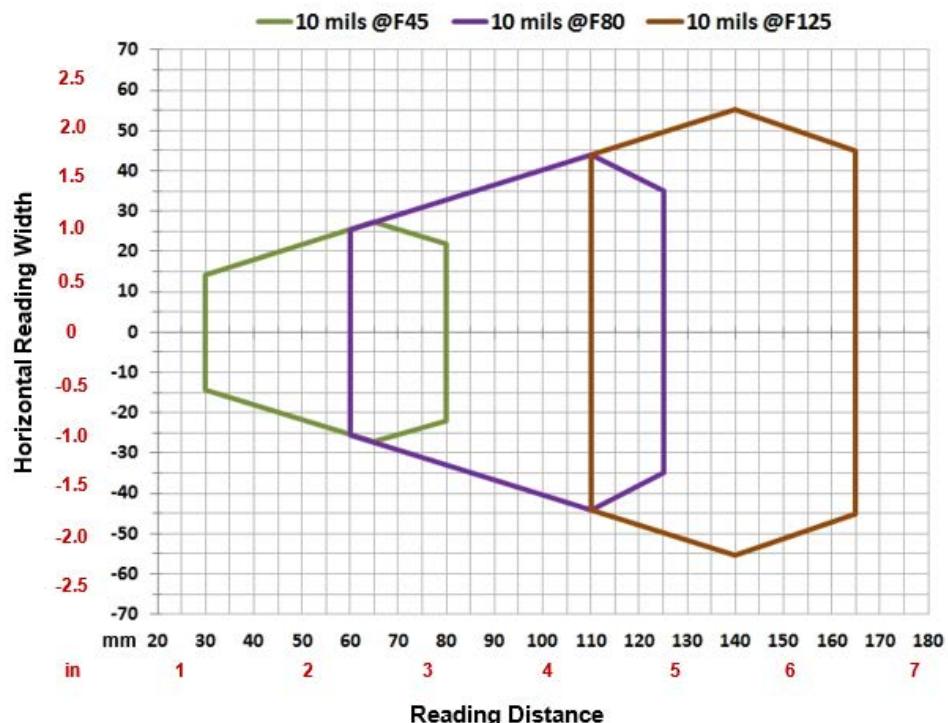
Data Matrix 0.25 mm (10 mils)

Conditions			
Hardware Settings			
Code Symbology	Data Matrix ECC 200		
Code Resolution	0.25 mm (10 mils)		
Tilt Angle	0°		
Skew Angle	15°		
Focusing Distance (mm)	45	80	125
Software Parameters			
Exposure Time (µs)	280	700	1000
Gain	15	20	32
Illuminator Lighting	Very High Power Strobed		

Matrix 120 311-xxx 1D Codes (MP+WA)

Matrix 120 311-xxx (MP+WA)

Code 128 0.10 mm (4 mils)
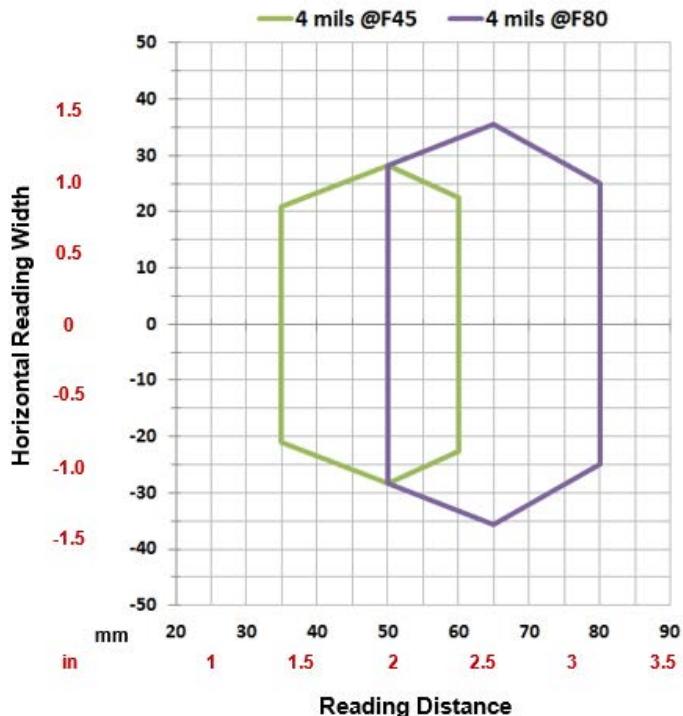
Conditions	
Hardware Settings	
Code Symbology	Code 128
Code Resolution	0.10 mm (4 mils)
Tilt Angle	0°
Skew Angle	15°
Focusing Distance (mm)	45 80
Software Parameters	
Exposure Time (µs)	250 300
Gain	10 15
Illuminator Lighting	Very High Power Strobed

Code 128 0.12 mm (5 mils)
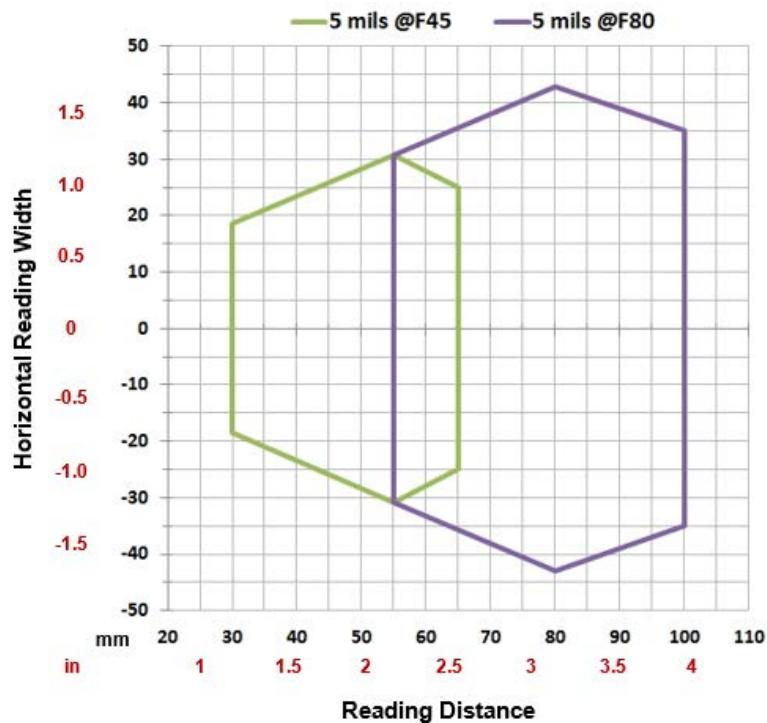
Conditions	
Hardware Settings	
Code Symbology	Code 128
Code Resolution	0.12 mm (5 mils)
Tilt Angle	0°
Skew Angle	15°
Focusing Distance (mm)	45　　　　　80
Software Parameters	
Exposure Time (µs)	250　　　　400
Gain	10　　　　　12
Illuminator Lighting	Very High Power Strobed
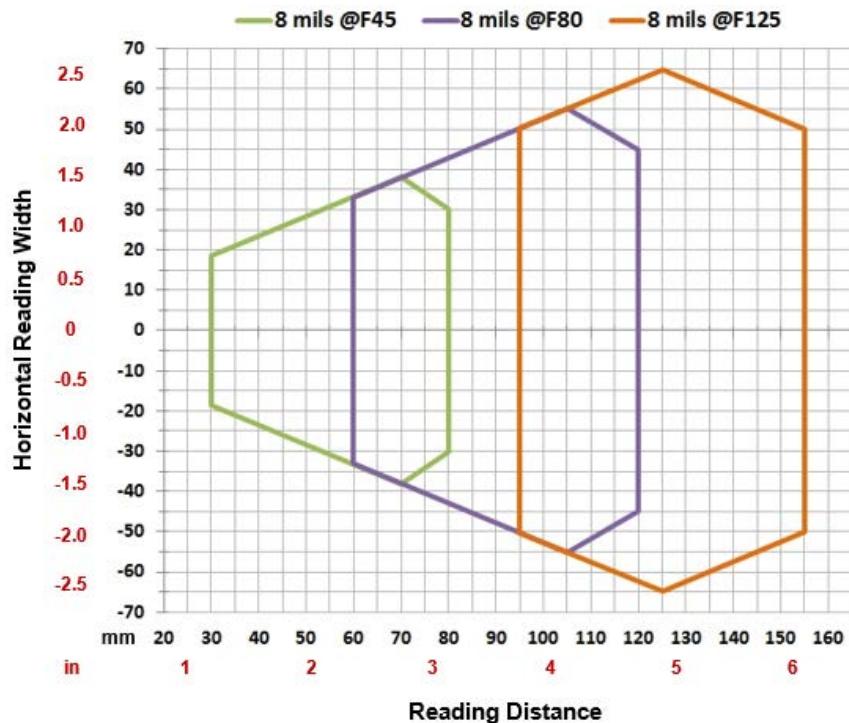
Code 128 0.20 mm (8 mils)

Conditions			
Hardware Settings			
Code Symbology	Code 128		
Code Resolution	0.20 mm (8 mils)		
Tilt Angle	0°		
Skew Angle	15°		
Focusing Distance (mm)	45	80	125
Software Parameters			
Exposure Time (µs)	300	400	600
Gain	10	20	25
Illuminator Lighting	Very High Power Strobed		

Code 128 0.25 mm (10 mils)

Conditions			
Hardware Settings			
Code Symbology	Code 128		
Code Resolution	0.25 mm (10 mils)		
Tilt Angle	0°		
Skew Angle	15°		
Focusing Distance (mm)	45	80	125
Software Parameters			
Exposure Time (µs)	400	600	700
Gain	10	20	25
Illuminator Lighting	Very High Power Strobed		

Code 128 0.33 mm (13 mils)

Conditions			
Hardware Settings			
Code Symbology	Code 128		
Code Resolution	0.33 mm (13 mils)		
Tilt Angle	0°		
Skew Angle	15°		
Focusing Distance (mm)	45	80	125
Software Parameters			
Exposure Time (µs)	400	600	700
Gain	10	20	25
Illuminator Lighting	Very High Power Strobed		

Matrix 120 311–0x0 2D Codes (MP+WA)

Vignetting

For Matrix 120 readers used in 2D code reading applications, due to the "fisheye" or "vignetting" effect of the lens, the reading area is limited to the central zone of the Vertical Field of View.
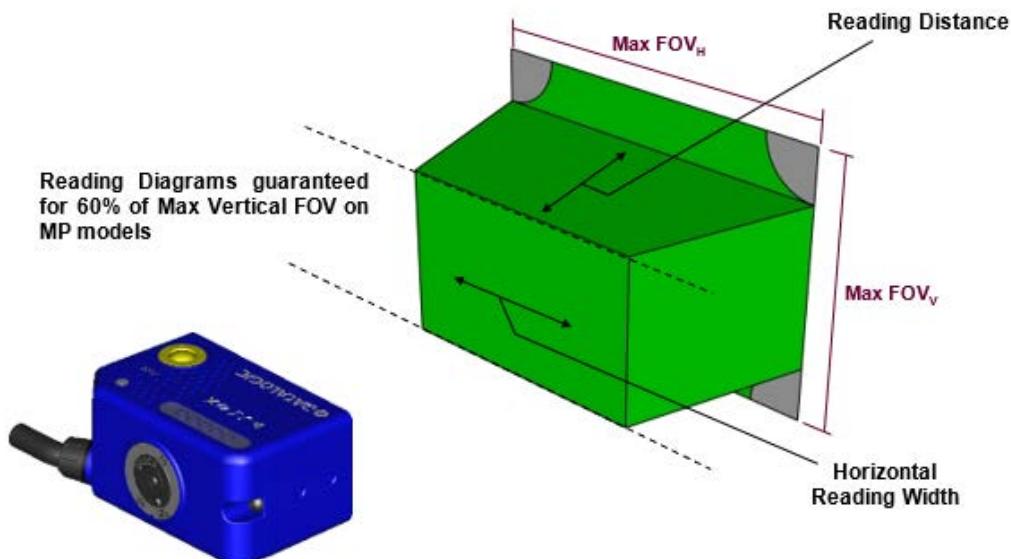
Figure 73. MP Model Vignetting Effect

Depending on the application, **Image Cropping** can be applied above and below the central zone of the vertical FOV, limiting image acquisition to the effective reading area and therefore increasing frame rate and reducing overall image processing time.

Matrix 120 311-xxx (MP+WA)

Data Matrix 0.13 mm (5 mils)

Conditions	
Hardware Settings	
Code Symbology	Data Matrix ECC 200
Code Resolution	0.12 mm (5 mils)
Tilt Angle	0°
Skew Angle	15°
Focusing Distance (mm)	45
Software Parameters	
Exposure Time (μs)	250
Gain	10
Illuminator Lighting	Very High Power Strobed

Data Matrix 0.19 mm (7.5 mils)

Conditions	
Hardware Settings	
Code Symbology	Data Matrix ECC 200
Code Resolution	0.19 mm (7.5 mils)
Tilt Angle	0°
Skew Angle	15°
Focusing Distance (mm)	45 80
Software Parameters	
Exposure Time (µs)	200 400
Gain	10 12
Illuminator Lighting	Very High Power Strobed
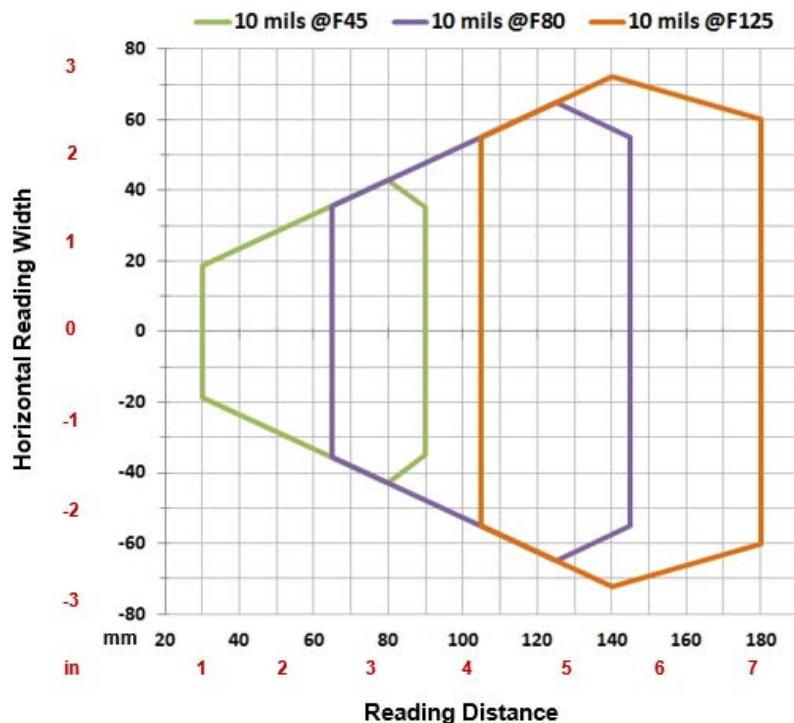
Data Matrix 0.25 mm (10 mils)

Conditions			
Hardware Settings			
Code Symbology	Data Matrix ECC 200		
Code Resolution	0.25 mm (10 mils)		
Tilt Angle	0°		
Skew Angle	15°		
Focusing Distance (mm)	45	80	125
Software Parameters			
Exposure Time (μs)	250	450	600
Gain	10	15	20
Illuminator Lighting	Very High Power Strobed		

Matrix 120 311-xx5 1D Codes (MP+WA+PLRZ)

Matrix 120 311-xxx (MP+WA+PLRZ)

Code 128 0.12 mm (5 mils)
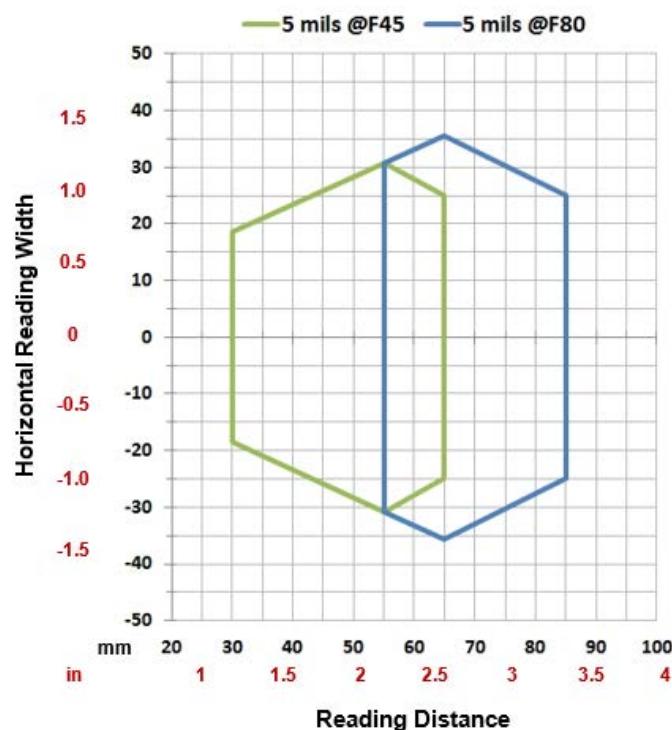
Conditions	
Hardware Settings	
Code Symbology	Code 128
Code Resolution	0.12 mm (5 mils)
Tilt Angle	0°
Skew Angle	0°
Focusing Distance (mm)	45 80
Software Parameters	
Exposure Time (µs)	600 800
Gain	25 32
Illuminator Lighting	Very High Power Strobed

Code 128 0.20 mm (8 mils)

*The vignetting effect described in Chapter 6, Vignetting applies to the F125 position for WA models.

Conditions			
Hardware Settings			
Code Symbology	Code 128		
Code Resolution	0.20 mm (8 mils)		
Tilt Angle	0°		
Skew Angle	0°		
Focusing Distance (mm)	45	80	125
Software Parameters			
Exposure Time (µs)	700	1000	1000
Gain	25	32	32
Illuminator Lighting	Very High Power Strobed		

Code 128 0.25 mm (10 mils)

*The vignetting effect described in Chapter 6, Vignetting applies to the F125 position for WA models.

Conditions			
Hardware Settings			
Code Symbology	Code 128		
Code Resolution	0.25 mm (10 mils)		
Tilt Angle	0°		
Skew Angle	0°		
Focusing Distance (mm)	45	80	125
Software Parameters			
Exposure Time (µs)	700	1000	1000
Gain	25	32	32
Illuminator Lighting	Very High Power Strobed		

Matrix 120 311–0x5 2D Codes (MP+WA+PLRZ)

Vignetting

For Matrix 120 readers used in 2D code reading applications, due to the "fisheye" or "vignetting" effect of the lens, the reading area is limited to the central zone of the Vertical Field of View.
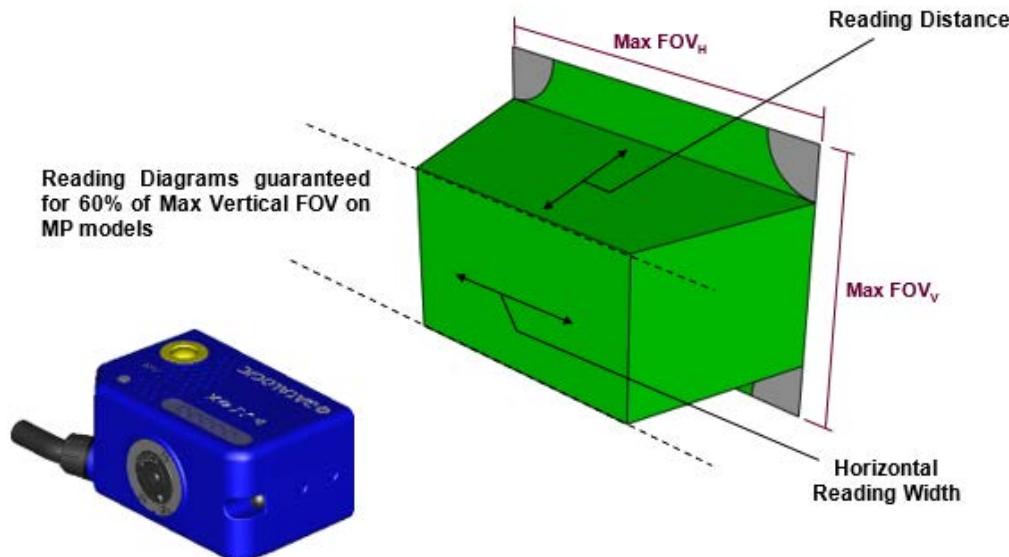

Figure 74. MP Model Vignetting Effect

Depending on the application, **Image Cropping** can be applied above and below the central zone of the vertical FOV, limiting image acquisition to the effective reading area and therefore increasing frame rate and reducing overall image processing time.

## Matrix 120 311-xxx (MP+WA+PLRZ)

Data Matrix 0.13 mm (5 mils)
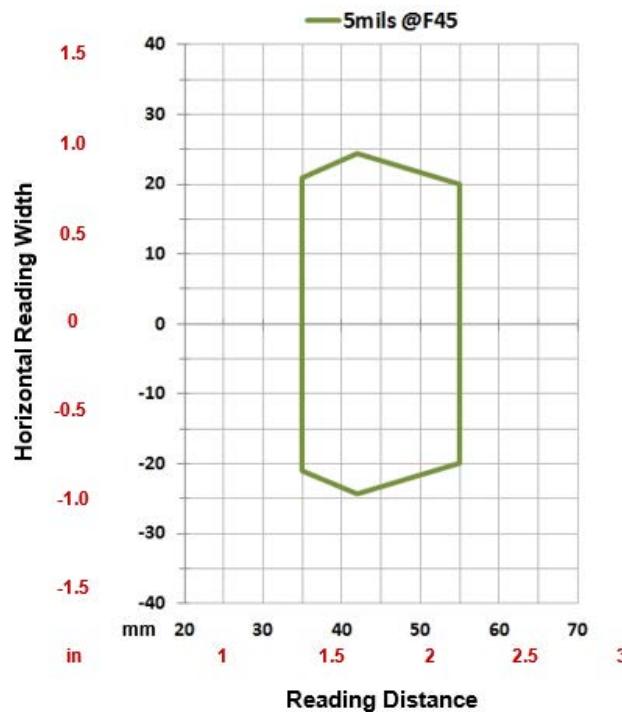
Conditions	
Hardware Settings	
Code Symbology	Data Matrix ECC 200
Code Resolution	0.12 mm (5 mils)
Tilt Angle	0°
Skew Angle	15°
Focusing Distance (mm)	45
Software Parameters	
Exposure Time (µs)	600
Gain	24
Illuminator Lighting	Very High Power Strobed

Data Matrix 0.19 mm (7.5 mils)

Conditions	
Hardware Settings	
Code Symbology	Data Matrix ECC 200
Code Resolution	0.19 mm (7.5 mils)
Tilt Angle	0°
Skew Angle	15°
Focusing Distance (mm)	45 80
Software Parameters	
Exposure Time (µs)	600 900
Gain	25 30
Illuminator Lighting	Very High Power Strobed

Data Matrix 0.25 mm (10 mils)

Conditions	
Hardware Settings	
Code Symbology	Data Matrix ECC 200
Code Resolution	0.25 mm (10 mils)
Tilt Angle	0°
Skew Angle	0°
Focusing Distance (mm)	45 80
Software Parameters	
Exposure Time (μs)	600 900
Gain	25 30
Illuminator Lighting	Very High Power Strobed

MAXIMUM LINE SPEED AND EXPOSURE TIME CALCULATIONS

The *Exposure Time* (or **Shutter**) parameter defines the time during which the image will be exposed to the reader sensor to be acquired. This parameter depends heavily on the environmental conditions (external lighting system, image contrast etc.).

In general, a longer time corresponds to a lighter image but is susceptible to blurring due to the code movement; a shorter exposure time corresponds to a darker image.

> **NOTE: The following considerations must be applied only when the internal lighting system and 2D codes are used. The Maximum line speed allowed for linear codes or postal code reading applications heavily depends on the direction of symbol movement. When the direction of movement is parallel to the elements of the code, the maximum speed is greater.**

Assuming:

- **X**: Code Resolution (mm)
- T_{exp}: Exposure Time (s)
- **LS**: Line Speed (mm/s)

The essential condition to avoid blurring effects between two adjacent elements in a dynamic reading application is:

$$LS * T_{exp} \leq X$$

The maximum (theoretical) line speed **LS** can be calculated as follows:

$$X / T_{exp\ (min)} = LS_{\ (max)}$$

$T_{exp\ (min)}$ is the minimum *Exposure Time* value obtainable for the specific application. It can be evaluated in static reading conditions and depends on the Matrix reader model selected for the application (internal lighting system, optical lens, reading distance) and on any external lighting system. It may also depend on code printing quality, and reader position.

Example

A Matrix 120 using:

Internal Lighting Mode = Very High Power Strobe

Exposure Time = 200 μs

Code Resolution (X) = 0.254 mm (10 mils)

has a maximum line speed of:

0.254 (mm) / 0.0002 (s) = 1270 mm/s

Likewise, $T_{exp\ (max)}$ is the maximum *Exposure Time* value that can be used without blurring for the given application line speed and code resolution. Therefore:

$$X / LS = T_{exp\ (max)}$$

$T_{exp\ (max)}$ and $LS_{(max)}$ are represented in the graph below as the curved line for **X** (code resolution). Values above the curve result in blurring. In practice, the application values are somewhere below the theoretical line (in the green area), due to environmental and other conditions.
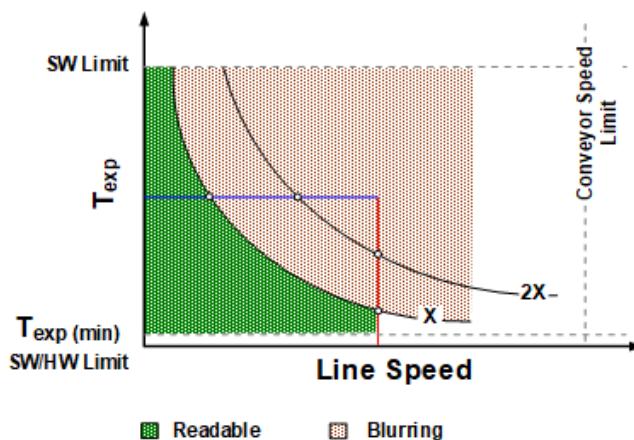
For example, the maximum target speed in the application is also affected by these conditions:

- **Code/Background Contrast**: maximum speed decreases when decreasing image contrast (poor quality codes, reflective transparent coverings, different supports and printing techniques).
- **Code Resolution**: maximum speed increases when decreasing code resolution, (i.e. **2X**). There is a decrement of overlapping effects between two adjacent elements.
- **Tilt Angle**: maximum speed decreases when increasing Tilt angle (from 0 to 45 degrees).

The *Internal Lighting* parameter allows setting the operating mode of the internal lighting system. The possible values are:

- *Disabled*: the built-in LED array is turned off all the time. This option can be useful if using an external lighting system;
- *-Power Strobed*: the built-in LED array is on only during the image exposure time. Different Power Strobed lighting levels can be set.

> **NOTE: To avoid LED array overheating, for Power Strobed settings, the program automatically limits the range of allowed values for the Exposure Time parameter. Therefore, after changes to Internal Lighting, recheck Exposure Time.**

CHAPTER 7
SOFTWARE CONFIGURATION

Software configuration of your Matrix 120 for static reading or simple code reading applications can be accomplished by the Rapid Configuration procedure using the X-PRESS HMI (which requires no external configuration program). This procedure is described in Chapter 1, Steps 3-4.

For the majority of applications however you will use DL.CODE, connecting to the reader through the on-board Ethernet interface. See Chapter 1, Steps 5-6.

DL.CODE SYSTEM REQUIREMENTS

> **CAUTION: DL.CODE does not currently support Windows Embedded (often used in industrial PCs and/or PLCs).**

To install and run DL.CODE you should have a Laptop or PC that meets or exceeds the following:
- 2.00 GHz or faster microprocessor
- Windows: 8, or 10
- 1 GB RAM
- 2 GB hard disk for 64-bit machines; 1 GB hard disk for 32-bit machines
- 100 Base-T Ethernet
- One 19" or larger monitor (optimized for 1280x1024 resolution)

READER CONFIGURATION

For an example of Matrix device configuration see the example in Chapter 1, Steps 5-6.

> **NOTE: Especially for lengthy configurations, it is always good practice to periodically save the configuration to permanent memory (Save on Device) to avoid losing the configuration in Temporary Memory. You must give a name to the new configuration or overwrite an existing one (except for Default which cannot be modified).**

When all the configuration parameters are set correctly and saved to the device, you can perform a Backup to File. See "Backup and Restore Through DL.CODE" on page 132.

> **NOTE: Datalogic guarantees that the reader's permanent memory can store at least 50 configurations without script formatting or with a script with less than 2048 characters. The actual number of configurations may be larger depending on the type of configuration and Matrix model.**
> **In addition to your application configuration(s), the Default configuration is always present on the reader and in fact it is not modifiable and cannot be deleted.**

Automatic Setup Configuration

To begin configuration, the reader must be correctly mounted so that its Field of View covers the application reading area.

1. From the Task Area select Open Device Configuration.

2. The Open Device Configuration window opens showing the list of currently saved configurations (jobs) saved on the device. For new devices, the only saved job is the Default configuration. Click OK. The device enters run mode and begins acquiring images.
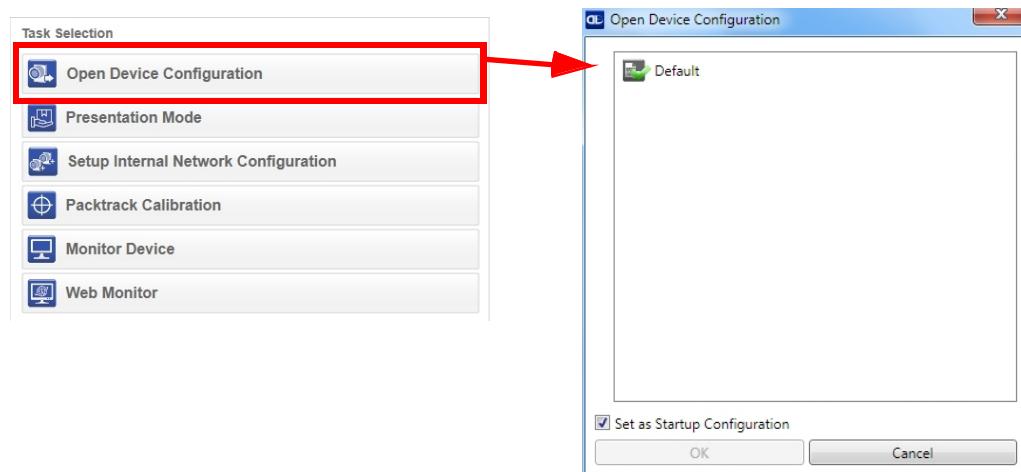
3. Place the application code in front of the reader at the correct application reading distance.

4. Click on the Pause button ⏸ to stop image acquisition.

  NOTE: Step 4, Clicking on the Pause button is optional.

5. Before proceeding with the Automatic Setup, you must set the focus first. Click on the Focus button. A green line alerts you when the procedure is complete.
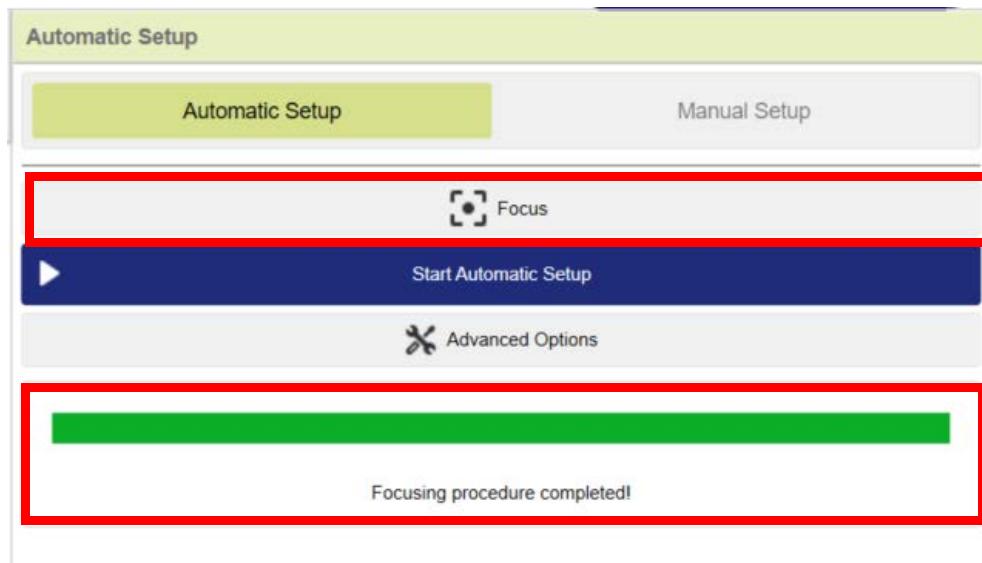
6. Now click on the **Start Automatic Setup** button.
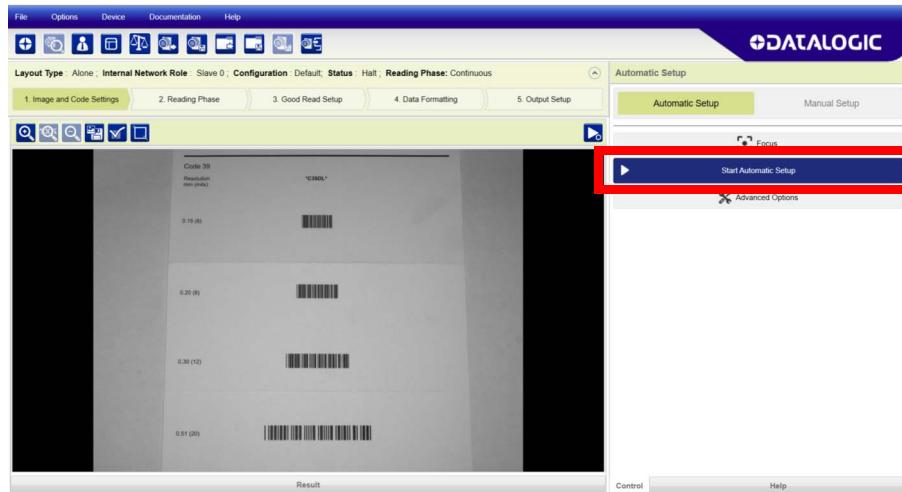
7. The following window is displayed and the reader begins acquiring images.
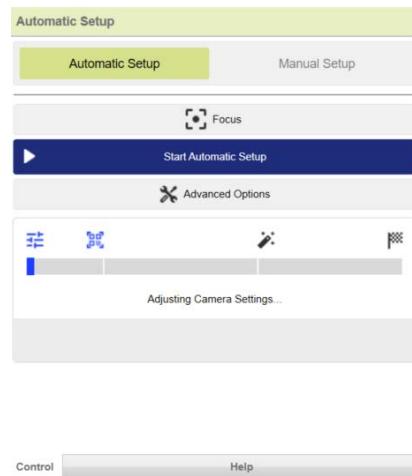
ICON	MEANING
≡	Initial photometric tuning
▦	Code Search
✨	Search Optimization
⚑	End of the Search

NOTE: Depending on the algorithm, certain phases may not be displayed.

8. At the end of the procedure the **Automatic Setup Completed!** message appears.
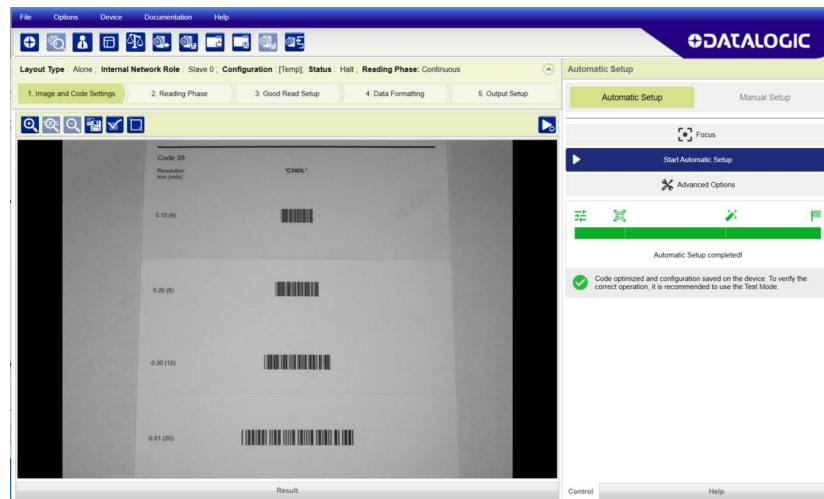
Your reader is now optimized for decoding. Continue with the Operating Mode configuration.

Error during Automatic Setup

If the Automatic Setup cannot find the code, the following message appears.

◆DATALOGIC
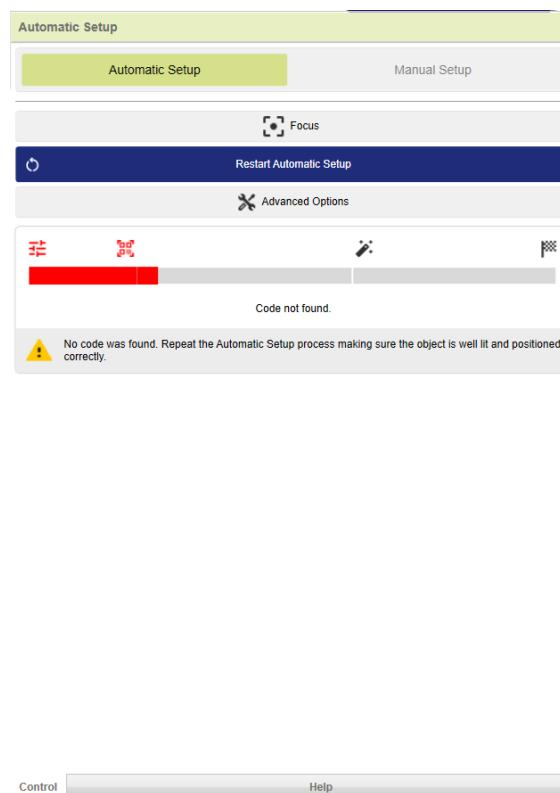
Advanced Options

If you need more configuration options, click the Advanced Options button. Depending on the connected device, different configuration labels are displayed.

> **NOTE: The GUI shown below for Advanced Options is valid for firmware later than 1.12.8 and later than DL.Code 1.13.2.**

Static vs Dynamic

The Advanced Options allows you to choose between Static and Dynamic Tuning. If your application involved moving codes, the Dynamic option must be selected to avoid a blurring effect on the image.

Static	Dynamic
Line Speed (mm/sec)	1000
Code Resolution (mm)	0.3
Reset	

> **NOTE: If you select the Dynamic option, two parameters must be set: Max Line Speed and Code Resolution.**

Manual Setup Configuration

If your application requires multiple code symbologies, multiple image settings or other parameter settings for decoding, use the Manual Setup.

1. Click on the Manual Setup button and press the Play icon ▶.

2. Place the **Grade A Barcode Test Chart** in the reading area. Once positioned, stop image acquisition by clicking on the Pause button ⏸.
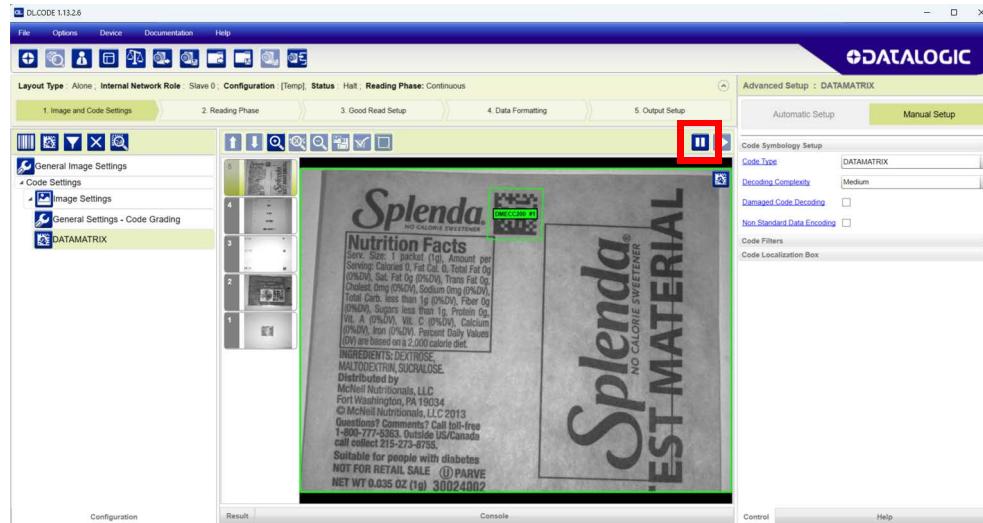
3. Click the Image Settings branch and then click the Image Auto-Setup button to automatically acquire the best exposure time and gain values.
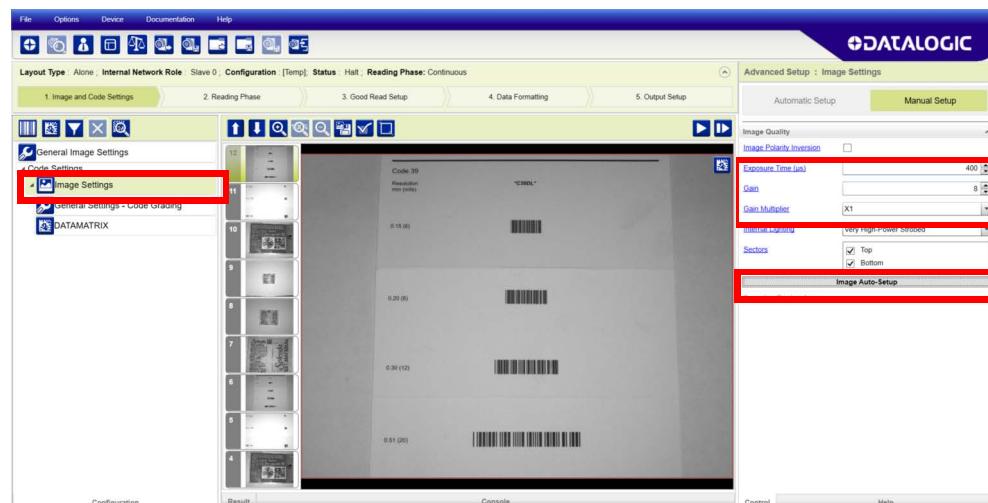
4. Select the Static or Dynamic Self-Tuning option; Start the Image Auto Setup and Apply to the Image Settings.
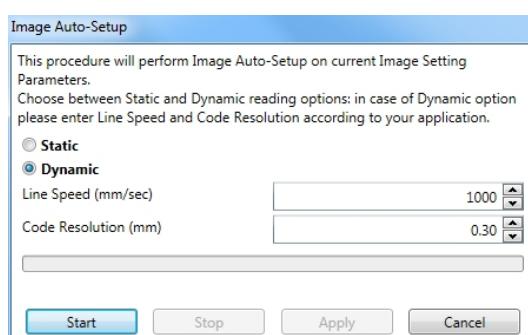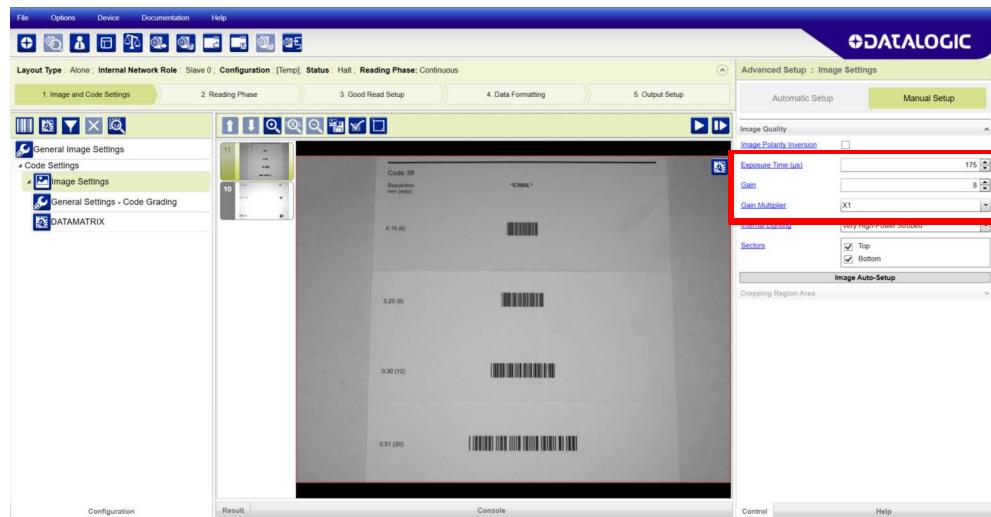
NOTE: For applications having multiple lighting or code reading conditions, up to 10 different.

Image Settings can be configured by adding them with the **icon.**

5. Now place **an application specific code** in front of the reader and **only** click the **Image Auto-Setup** button to register any changes in lighting or code surface contrast.

6. Click on the Datamatrix symbology under the Image Settings branch (enabled by default). If this symbology is among those in your application it will be shown in the image display with its code symbology name and a green box around it indicating it is decoded.
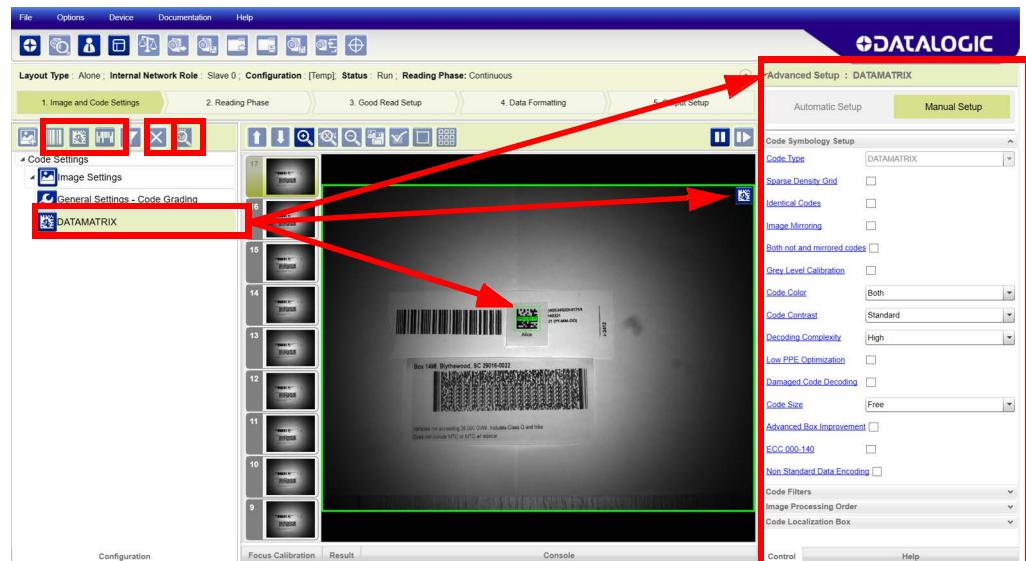
NOTE: The large green box for each symbol indicates the code localization area which by default is equal to the maximum FoV. It can be resized and moved by dragging its borders with the mouse. The code must be found within this area in order to be decoded.

7. Add your application specific codes to the Code Settings by selecting them from the icons over the Configuration Parameters tree area. If the Data Matrix symbology is not used, then delete it from the Code Settings with the Delete icon.

If you don't know the code type, you can use the Code Autolearn feature by clicking on the Autolearn icon.

> **NOTE: Refer to DL.Code User's Manual for more details about the Code Autolearn feature.**

8. For each symbology set the relative parameters according to your application.

MULTI IMAGE ACQUISITION SETTINGS

When <u>controlled</u> variable conditions occur in the application, Multiple *Image Acquisition Settings* can be defined to create a database of parameter groups that handle each specific application condition. This database of pre-defined settings improves system flexibility and readiness by being applied either automatically or selectively by an activation event.

For example, an application may have several <u>stable but different lighting conditions</u> which require different lighting options. One Image Acquisition Setting could enable and use an internal illuminator and another setting could enable and use an external lighting system.

This feature is available for all Operating Modes.

Image Settings are found in the DL.CODE **Manual Setup** step. Up to 10 different Image Settings can be configured by adding them with the Add icon.

For each Image Setting condition start **Image Auto-Setup**, select the Static or Dynamic Self-Tuning option; and Apply it.

> **NOTE: The Automatic Setup procedure can be used for each Image Setting that is added through the Manual Setup group, however only one code will be associated with each Image Setting.**

Automatic Image Settings Selection

If we don't know from one item to the next which reading condition will be presented, we will cycle through the pre-defined database of Image Settings (<u>one per acquisition</u>) in order to automatically capture the correctly lighted image over the course of several acquisitions. When the correct condition is matched, the result should be able to produce a Good Read.

When the **Image Settings Selection** is **Automatic** (default), then these Image Settings groups will be used cyclically.
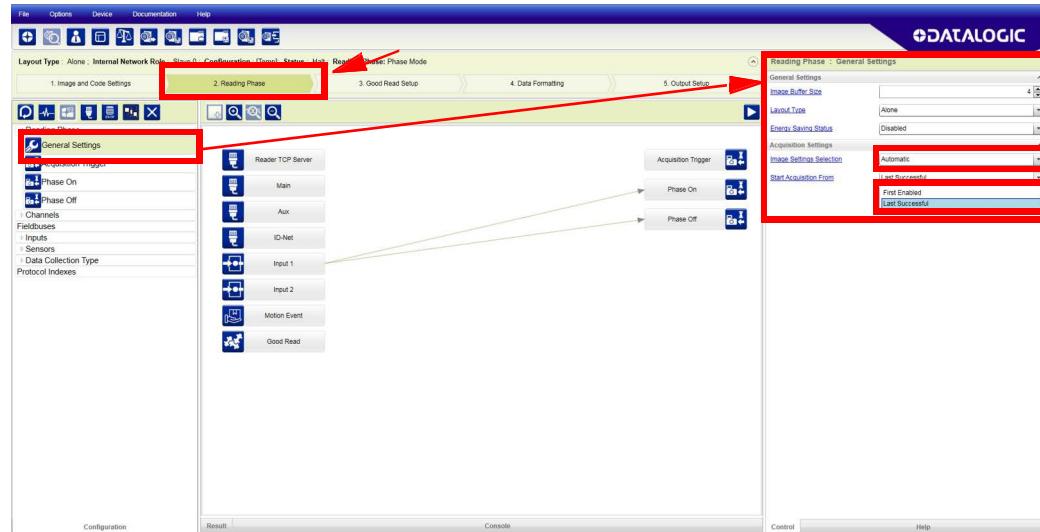
> **NOTE: Applications typically require more than one acquisition to obtain sufficient Good Read percentages. This means that for *N* acquisitions we will surely have captured the correct lighting condition but we will also have captured some acquisitions with the wrong lighting condition. A consequence then is that we cannot run these types of applications at the maximum speed because not all the acquisitions are useful to us. We must wait for a sufficient number of acquisitions that will guarantee a Good Read result.**

If items to be read having the same lighting conditions are grouped together, then we can improve the read rate through the **Start Acquisition From** parameter. By choosing the **Last Successful** value, we will start with the Image Setting that last produced a Good Read. For this group of items the last Image Setting used will be correct for the next item and so we start each cycle with the acquisition that will potentially produce a Good Read.

External Image Settings Selection

There are some applications where the lighting conditions are known before each item is read and therefore we can pre-select the correct Image Setting from an external source.

When the **Image Settings Selection** is **External**, Acquisition Sequences are created and by default each Image Setting has its own Acquisition Sequence.
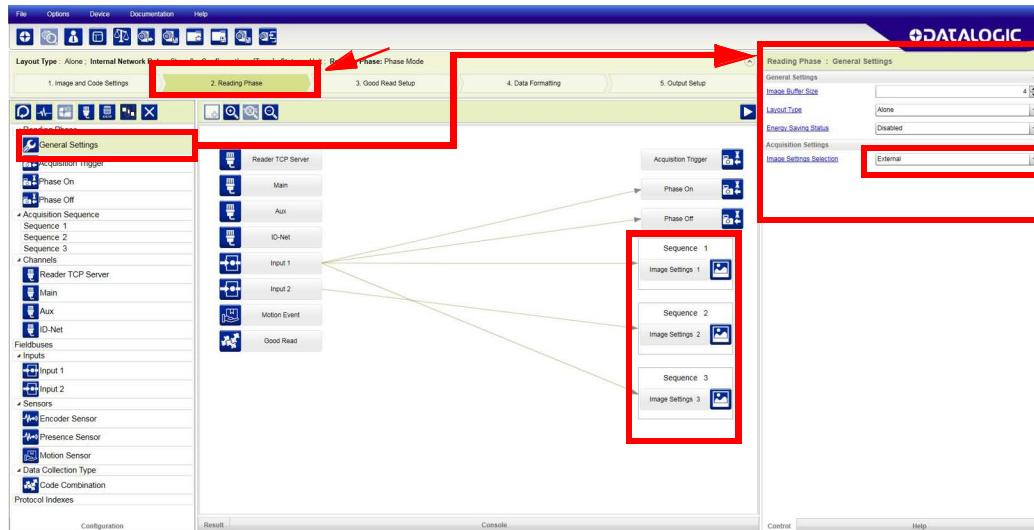
Each **Acquisition Sequence** can be activated exclusively by a single event, either through a string from an available communication channel or by a digital input.
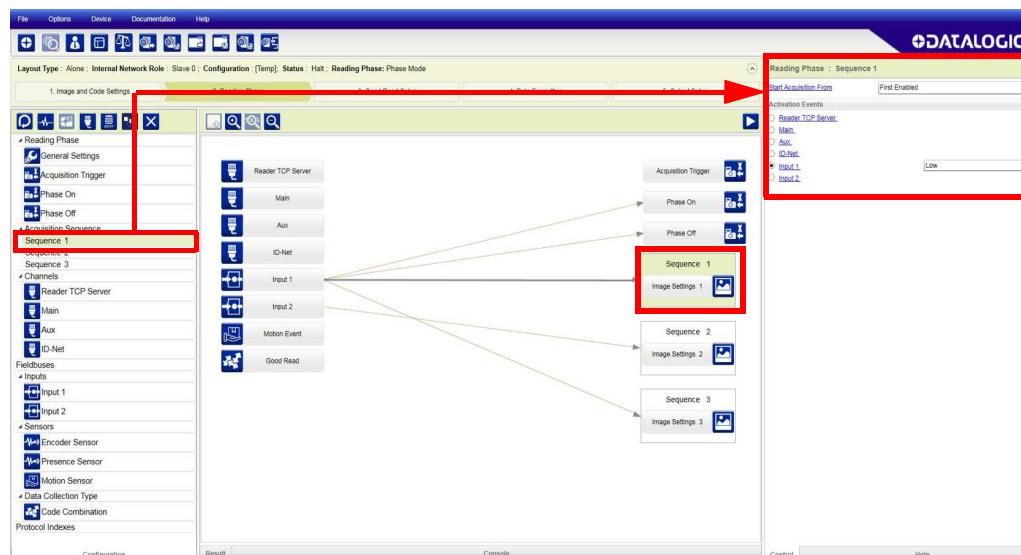
Alternatively, a hybrid configuration can be made where more than one **Image Setting** can be grouped into an Acquisition Sequence by dragging it into the desired Sequence box. Select the empty Sequence box and delete it with the delete key.
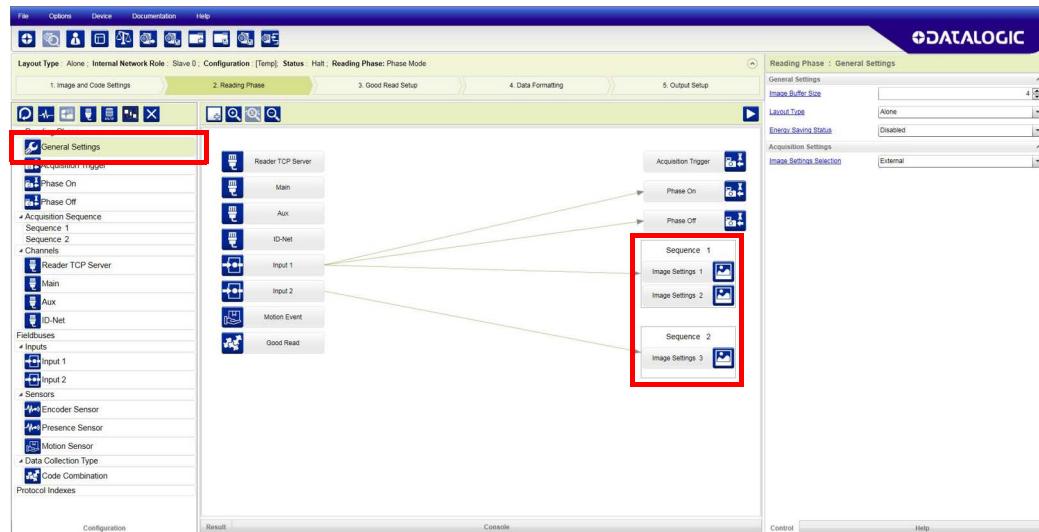
Each **Acquisition Sequence** can be activated exclusively by a single event, either through a string from an available communication channel or by a digital input.

In this case the **Start Acquisition From** parameter can improve the read rate for that Sequence. It has no meaning for a Sequence containing only one Image Setting.
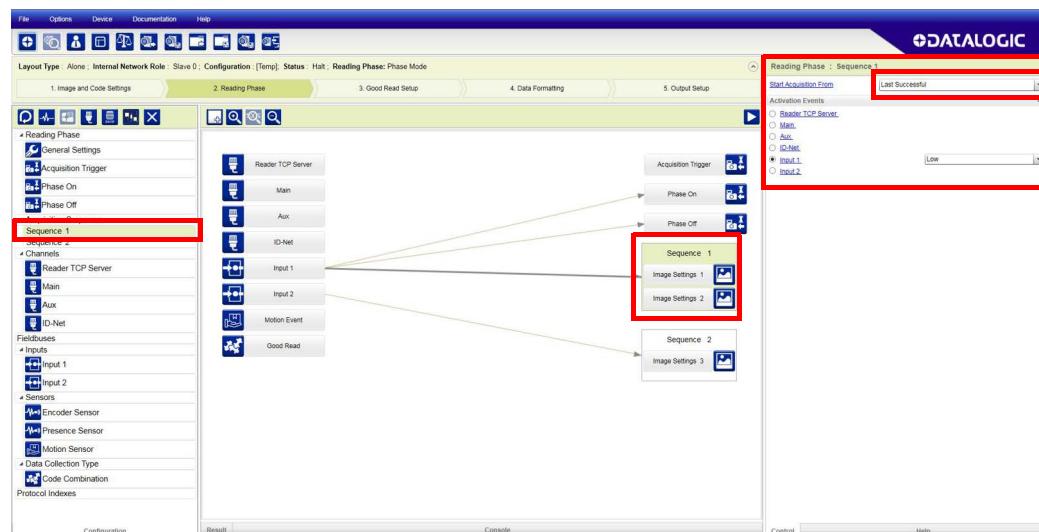
IMAGE CROPPING

In some applications, the Image Cropping feature in DL.CODE can help to increase decoding and result performance. Image cropping is performed from the Advanced Setup tab by clicking on the Add Cropping Region icon as shown below.

In Matrix 120 the frame rate is dependent on the number of rows and columns in the defined window. Image cropping allows reducing the Image processing area from the full FoV to a smaller area where codes are present. By excluding portions of the FoV, processing time is reduced.
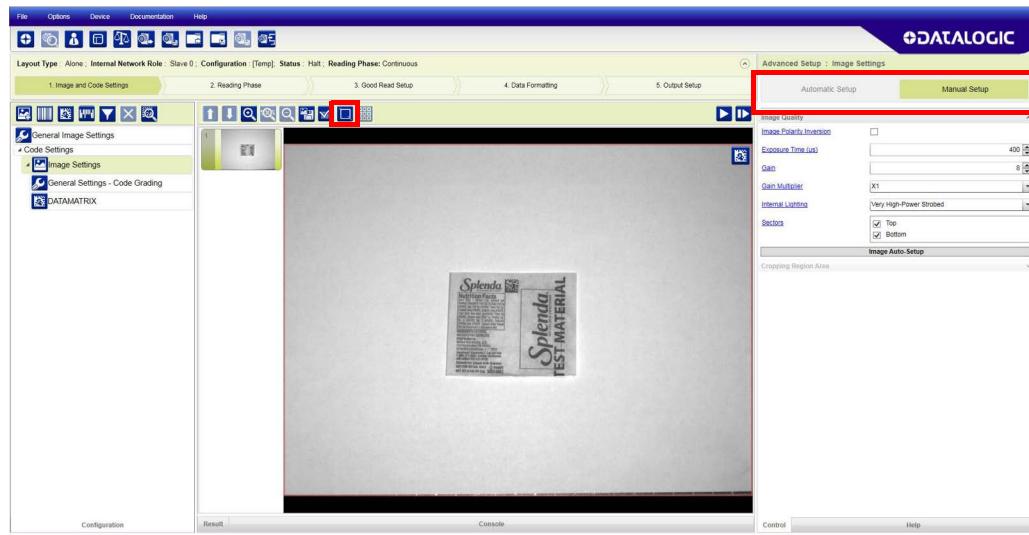
After clicking the Add Cropping Region icon, a blue border appears which by default is equal to the FoV.
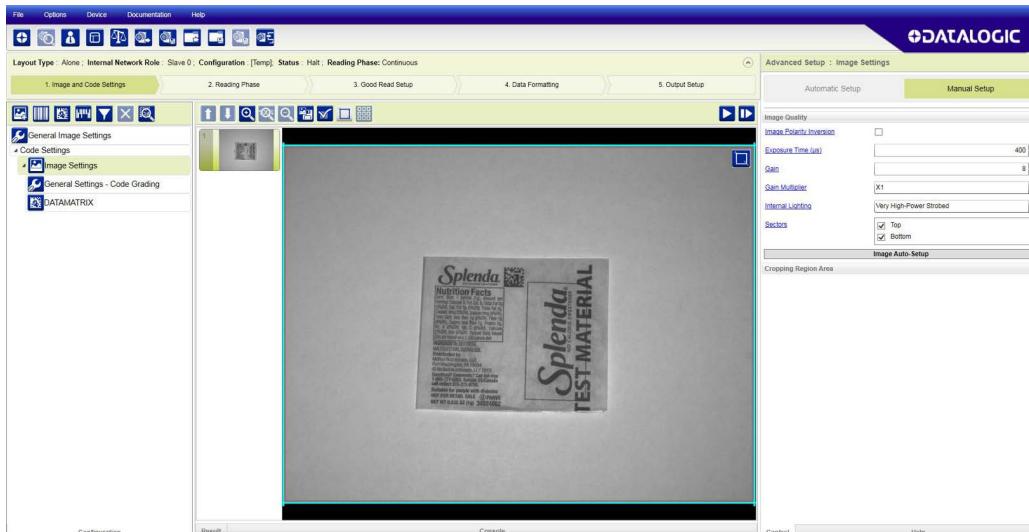
By dragging the edges with the mouse (resizing) you can crop the image to a specific location where codes are present. The numbers in the blue boxes refer to pixel references.

x,y coordinates of upper left corner of Cropping

number of pixels in vertical Cropping Region (Height)
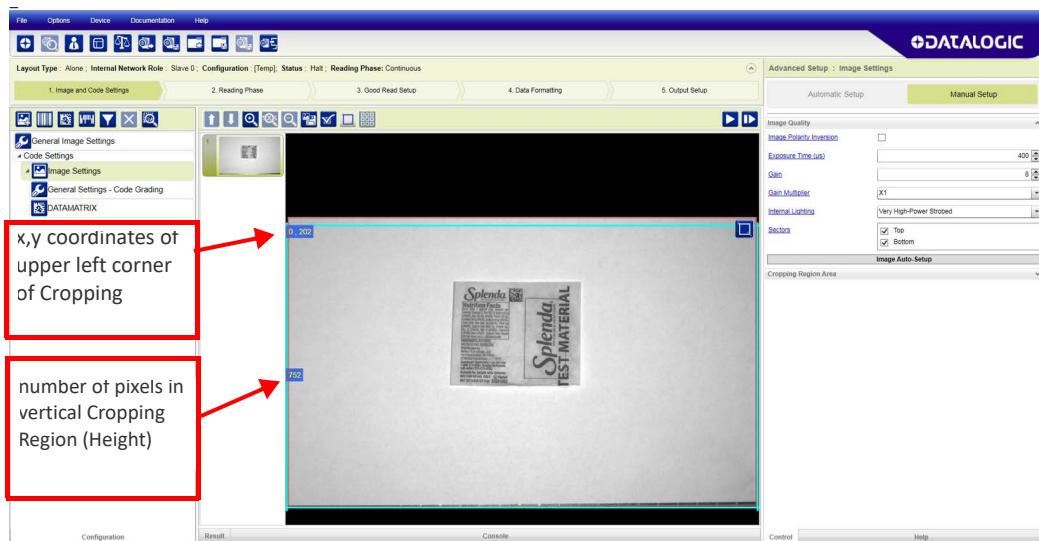
The cropped area can be moved by dragging the center.

You can also set the cropped image size and position through the Cropping Region Area group of parameters; size = **Width** and **Height**, position = **Left, Top** (x,y) coordinates.
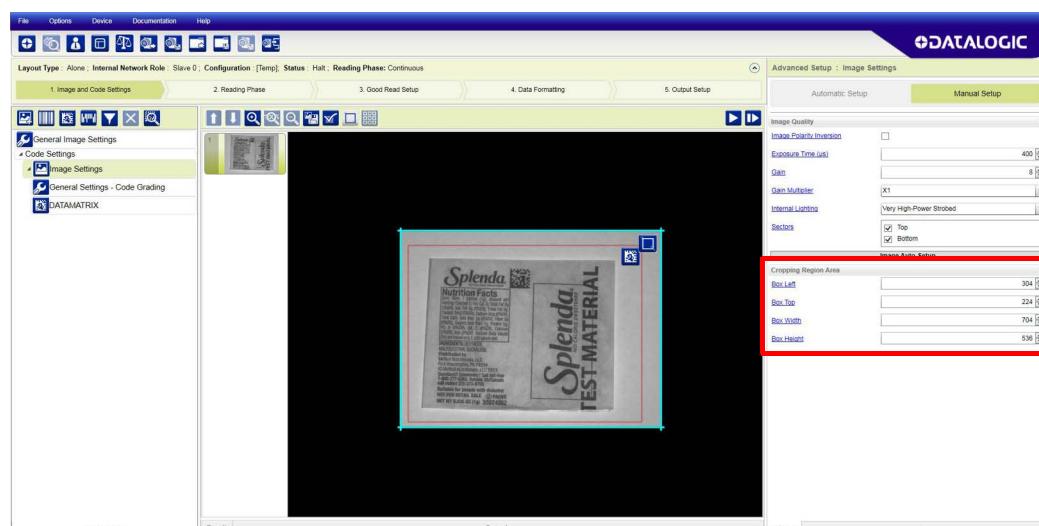
DIRECT PART MARKING APPLICATIONS

For **Data Matrix** family codes the ***Decoding Complexity*** parameter is available when Processing Mode is set to Standard and selects the decoding algorithm according to the printing/marking technique used to create the symbol and on the overall printing/ marking quality.

The possible selections progress from Low to Very High where Low can improve decoding time for good print/mark quality and/or relatively normal size codes. This is the default setting. Very High can improve the decode rate for low print/mark quality and/ or small size codes. This algorithm is much more aggressive but in general it may have longer decoding times than the lower complexity algorithms. **To minimize decoding time it is better to select the lowest value that still guarantees good decoding.**

Matrix 120 is indicated for DPM applications where the parts are marked by Laser Etching.

Various Image Filters are available to enhance Direct Part Marking applications. For more details see the DL.CODE User's Manual.

PASS-THROUGH CONFIGURATIONS

DL.CODE and Matrix 120 readers support pass-through multi device configurations.

The pass-through configuration allows individually working devices, to collect data from other devices and pass this data to a third device through a different communication channel.

The following screenshots show the pass-through configuration settings for the three devices in the example in .
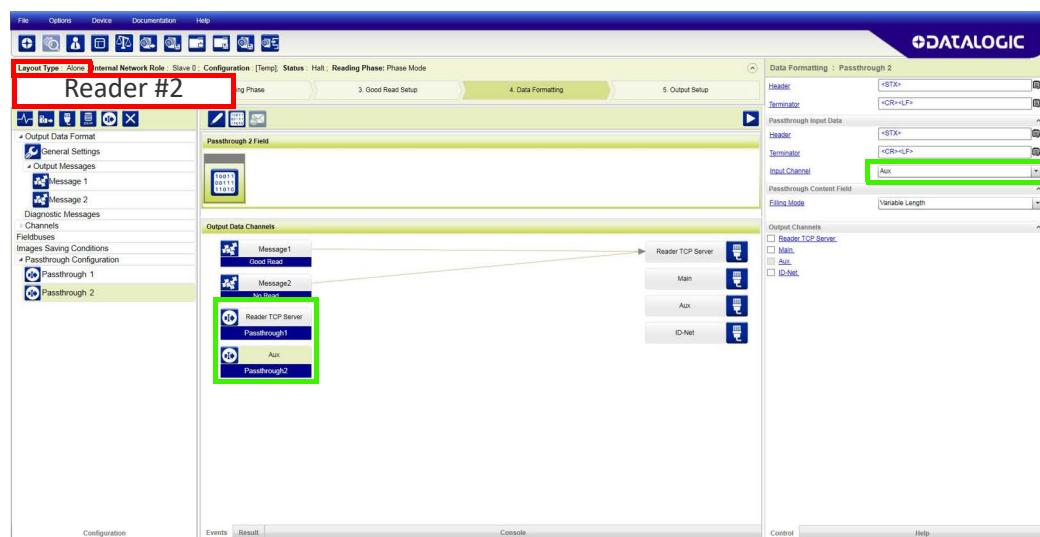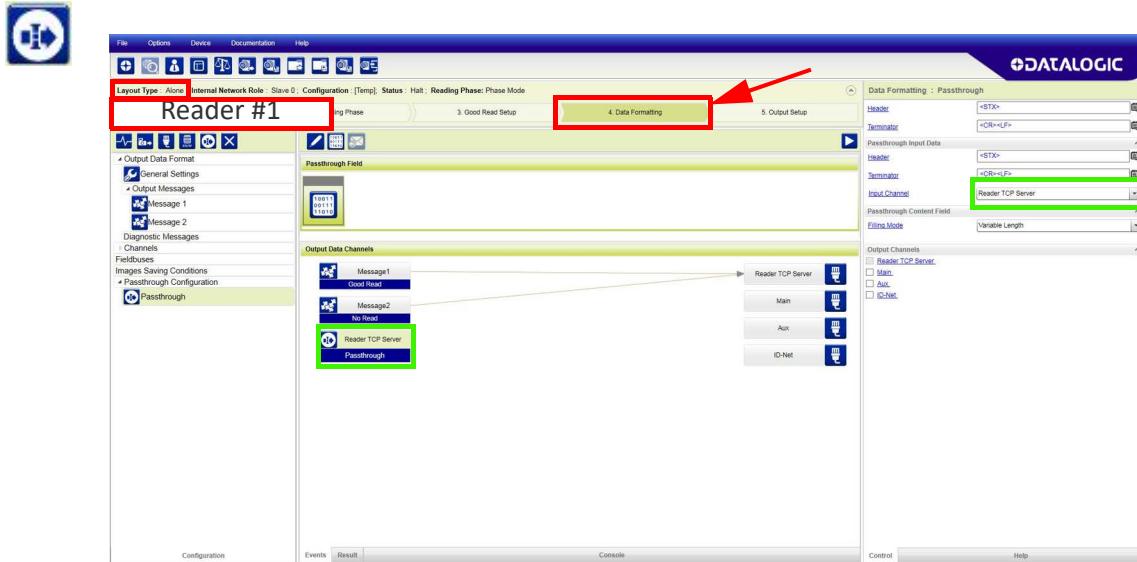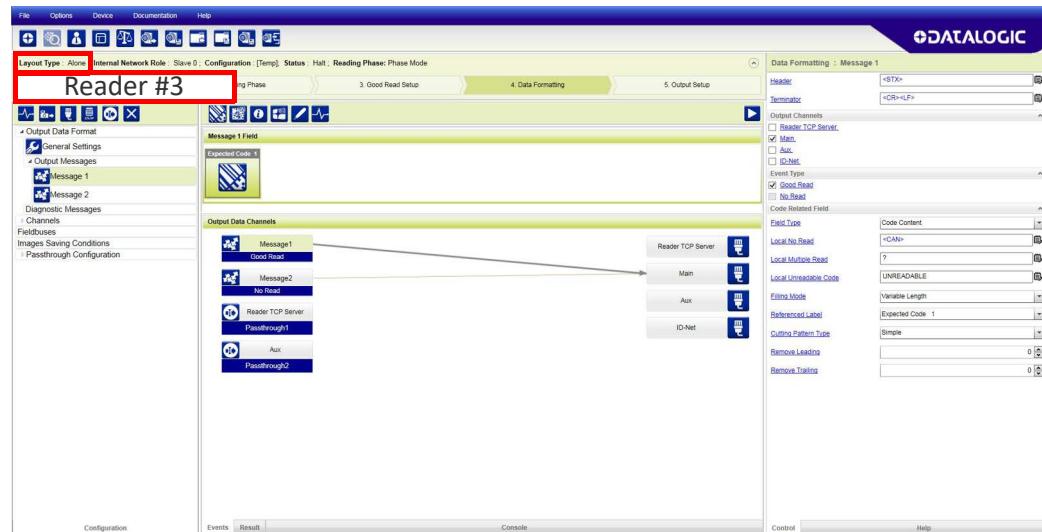
USB-HID (KEYBOARD WEDGE) CONFIGURATIONS

The Matrix 120 USB interface can be used as a USB-HID device (virtual keyboard) otherwise known as a keyboard wedge. In this configuration, code reading input form the Matrix 120 is sent directly to the application running on the PC as if it was typed from the PC keyboard. This is typically used in data entry programs.

To assure the input is correctly interpreted, the Matrix 120 reader must be aligned with your keyboard type. This is done through the Device>Settings>Settings>Maintenance Settings tab. Select your keyboard from the dropdown list.
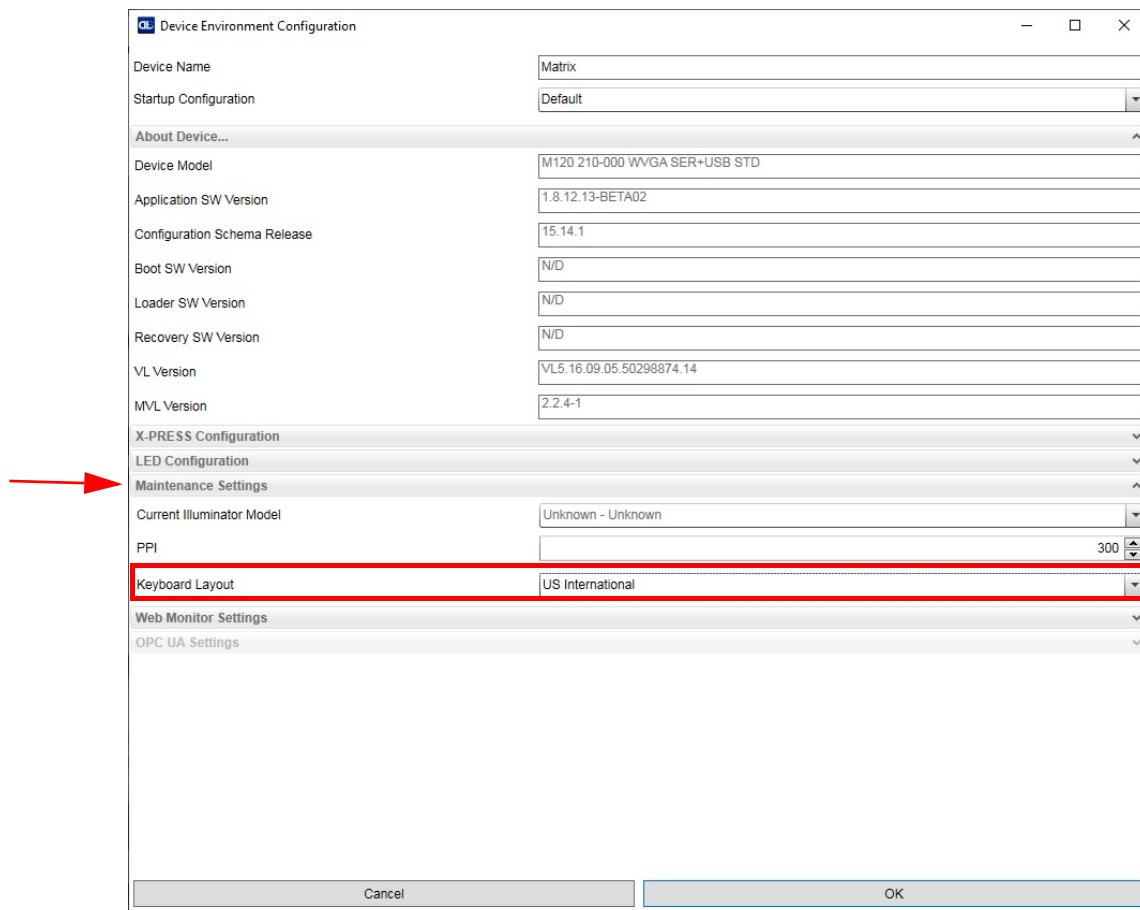
The USB-HID interface is a Matrix 120 Output only channel and is configured through the Data Formatting page.

You need to correctly set the Header and Terminator parameters depending on the requirements of the application running on the PC.

Typically, the Good Read message is transmitted, the No Read message is not transmitted, and Multiple Reads need to be correctly managed.
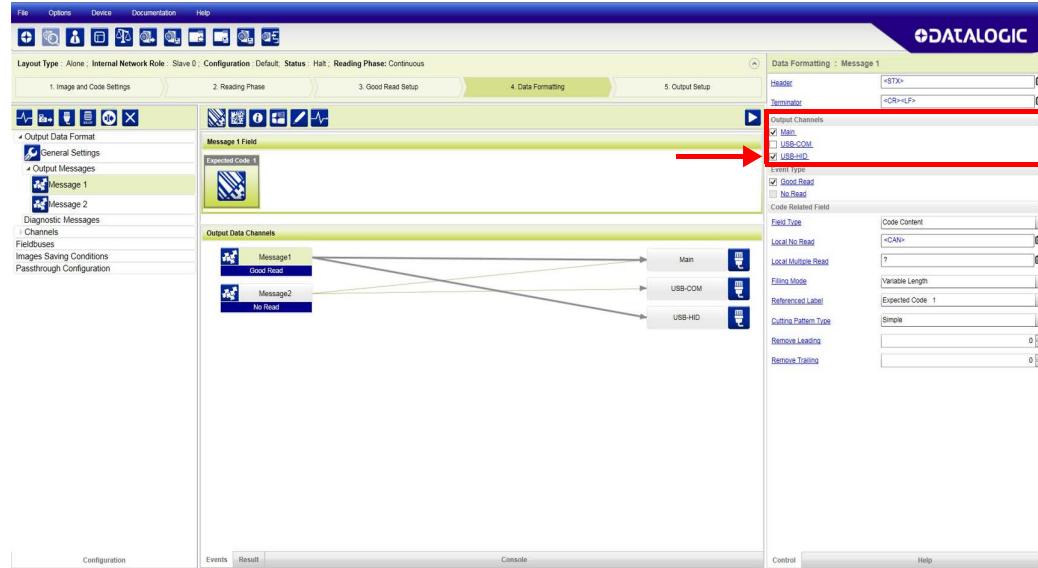
Data can be sent using different character encoding selections according to your application needs.
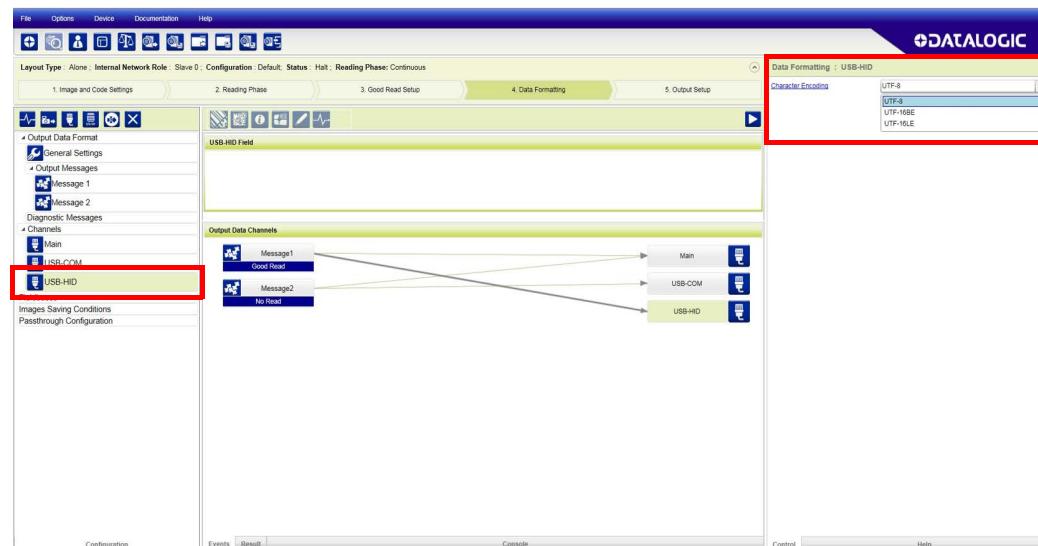
BACKUP AND RESTORE THROUGH DL.CODE

DL.CODE allows Backup and Restore to be performed to/from the configuration PC **only** via file.

DL.CODE provides complete backup and restore functions (Configuration and Environmental parameters) for Matrix 120 readers.

Backup and Restore functions provide parameters storage including <u>all configuration jobs present on the reader</u>.

> ⚠️ **CAUTION: It is strongly recommended to save all configurations to backup files.**

When performing Backup and Restore to/from file, device firmware can be included.
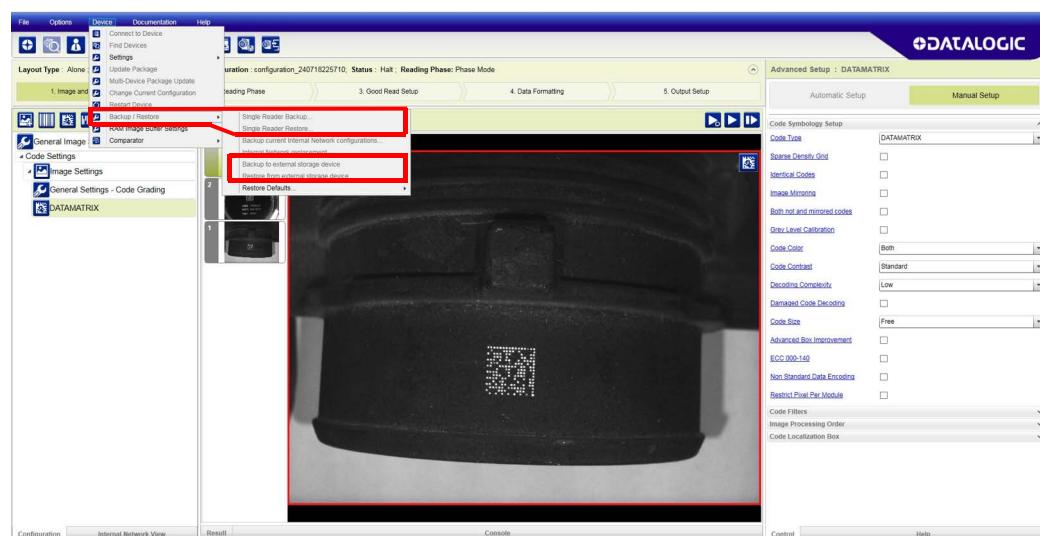
Backup

To perform a **Backup**:

1. From the DL.CODE Device menu, select **Single Reader Backup** (to file on PC).

You will be reminded that configuration in temporary memory will not be saved so you should save the configuration to the reader before performing Backup.

> Temporary configuration will be not included in the backup. Do you want to proceed?
>
> Yes   No
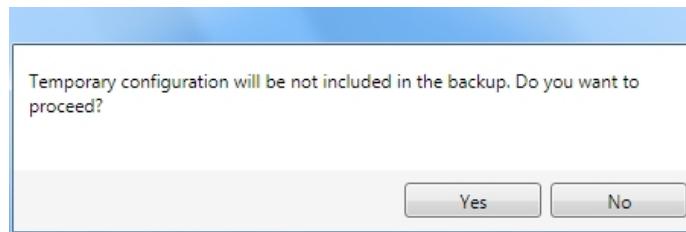
You will also be asked whether to include the firmware or not.

> **NOTE: Matrix 120 does NOT support the Firmware backup. Choose "NO" in the window below.**

> Backup
>
> Do you want to include firmware?
>
> Yes   No

> Device backup. Please wait....
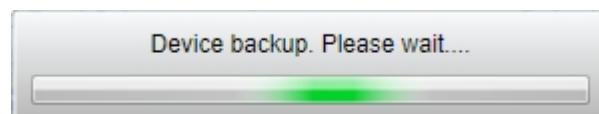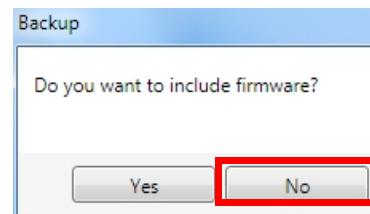
At the end of the backup, DL.CODE shows a message indicating successful completion.

> Attention
>
> Operation completed successfully!
>
> OK
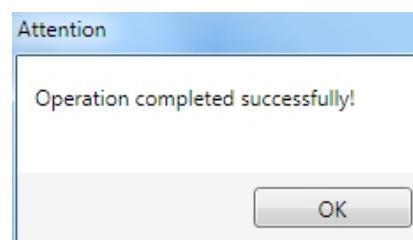
Restore

To perform a **Restore**:

1. From the DL.CODE Device menu, select **Single Reader Restore** (from file on PC).

Restore from external storage device. Please wait....

At the end of the restore, DL.CODE shows a message indicating successful completion.

Attention

Restore procedure completed successfully. The device will restart in order to apply changes!

OK
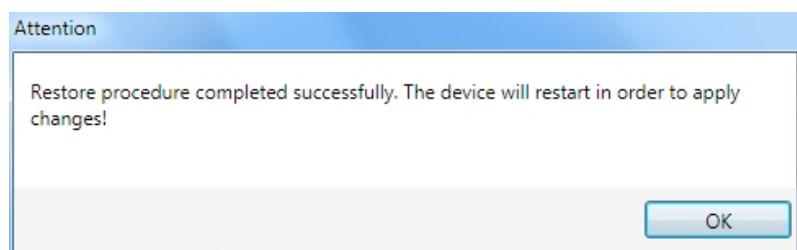
Replacement

CAUTION: The replacement device must be the exact same model as the device it is replacing.

The **Restore** function also provides easy and secure Single Device Replacement:

1. Remove the device to be replaced.

2. Connect the new device (make sure the new device has been previously set to factory default).

3. Run the Restore procedure by selecting either **Single Reader Restore** (from file on PC) (see: Restore procedure).

NOTE: In case of Backup or Restore operation failures, error messages will be displayed in the Monitor Diagnostic page.

RESTORE DEFAULTS

The device parameters are divided into two main classes, <u>Configuration</u> and <u>Environment</u>, which are affected differently by the Restore Defaults commands.

- The Configuration parameters are the ones set in the various steps of the configuration process and are specific to each application. When multiple configurations (jobs) are saved on a single device, these parameters can be different from one configuration to the next.

- Environment parameters regard the device Identity and Position in a Network (Ethernet, Fieldbus, etc.) and are not influenced by the Default (or any other) Configuration present in memory.

Restore Default Startup Configuration

The Default configuration is always present on the reader and in fact it is not modifiable and cannot be deleted. It can always be restored by simply selecting it from the Open from Device configuration list.
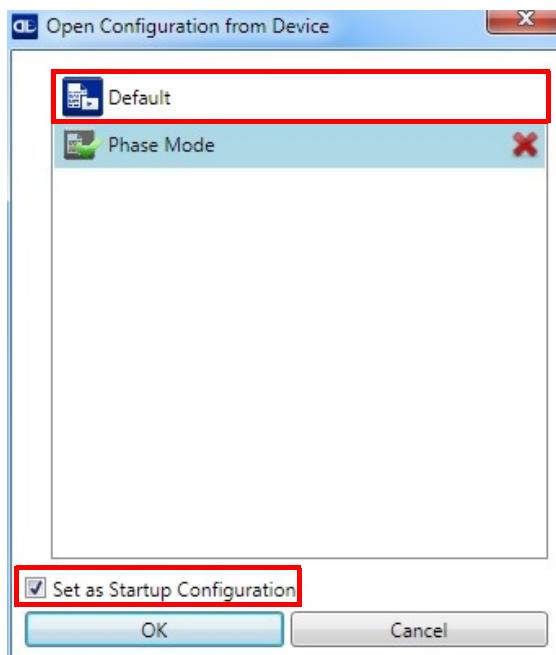
The same action can be performed from the Device menu >Backup/Restore > Restore Defaults > **Restore Default Startup Configuration**. The Default Configuration will be set to run at startup and the reader will be reset.
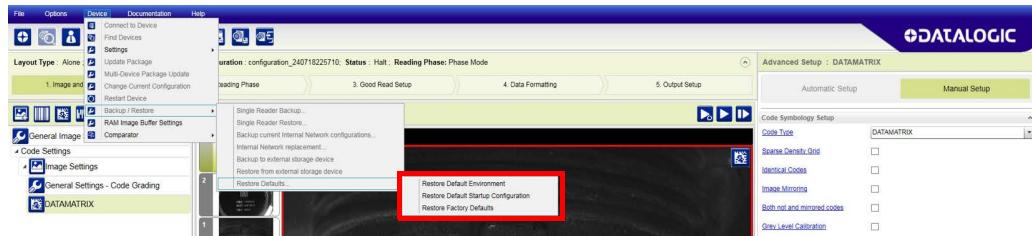
Any previously saved configurations on the device will remain in memory, but the Default configuration is set as the startup configuration.

Restore Default Environment

Restore Default Environment returns all Environment parameters to their factory default settings. The default IP address will be restored as well as all the parameters managed in the Device Environment Configuration window.
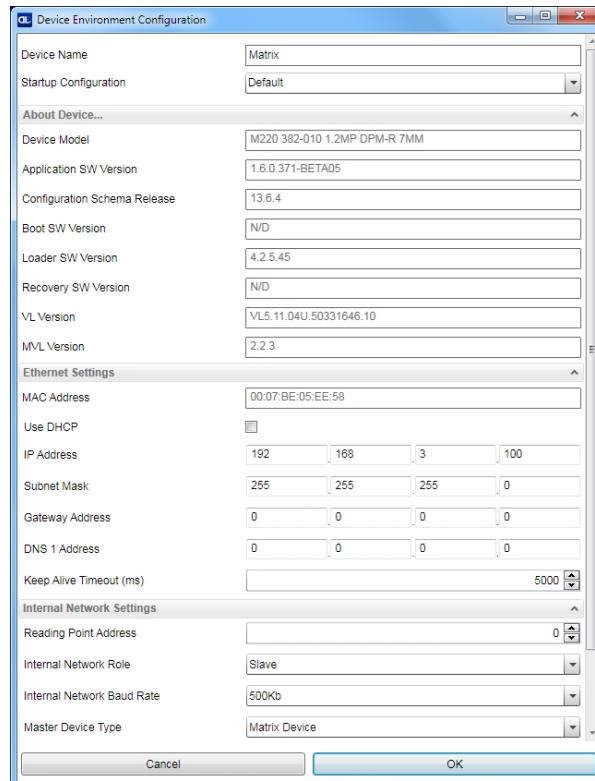
The Factory Default static IP address for all Matrix 120 model readers is:

IP Address = 192.168.3.100

Any previously saved configurations on the device will remain in memory, but the Default configuration is set as the startup configuration.

Restore Factory Defaults

In order to return a device to its absolute Factory default parameters (for example device replacement) it is necessary to use the **Restore Factory Defaults** command. You will be prompted to confirm.

All Environment parameters will be restored to Factory default values **and any existing configurations stored on the device will be erased**. The device will be reset and therefore start in run mode with the factory default configuration.

DIAGNOSTIC ALARMS

By using the **DL.CODE Monitor** functions from the File menu (or Monitor icon), you can get information about diagnostic alarms. Any alarms will show up as warning lights on the alarm panel.
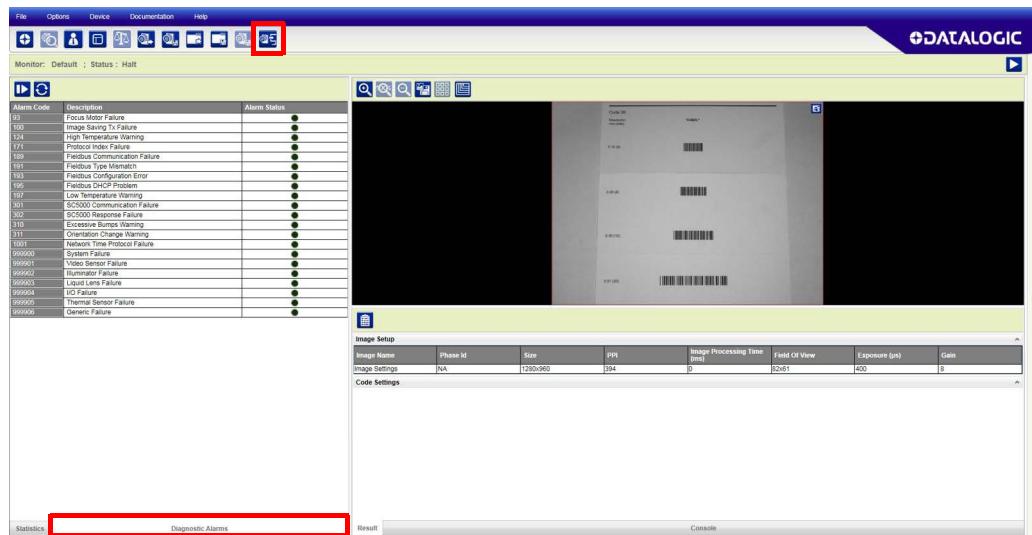
Figure 75. Diagnostic Alarms

For Matrix 120 readers some of these alarms are not relevant. The following table shows the relevant alarms:

Alarm Code	Description	Meaning
171	Protocol Index Failure	The expected Protocol Index is not received
189	Fieldbus Communication Failure	There is a communication error between the scanner and the Fieldbus module inside the CBX connection box or QLM Gateway
191	Fieldbus Type Mismatch	The Fieldbus module inside the CBX doesn't match the one saved in the scanner configuration memory
193	Fieldbus Configuration Error	A configuration error has occurred between the scanner and the Fieldbus module inside the CBX connection box
195	Fieldbus DHCP Problem	A communication problem has occurred between the DHCP server and the Fieldbus module inside the CBX connection box or QLM Gateway
999998	Camera Head Failure	The Matrix 120 Camera Head has failed

STATISTICS

Statistics on the reading performance can be viewed by enabling the Statistics panel from the **DL.CODE Monitor** item selected from the File menu (or Monitor icon).
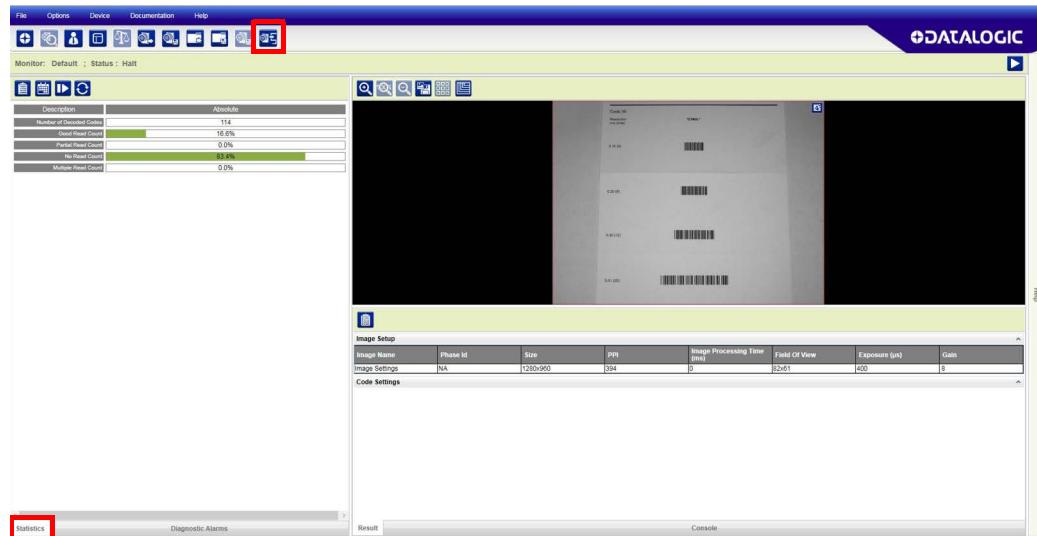
Figure 76. Reading Statistics

The enabled Statistical Counters can be selected from the Device>Settings>Configuration Settings menu.
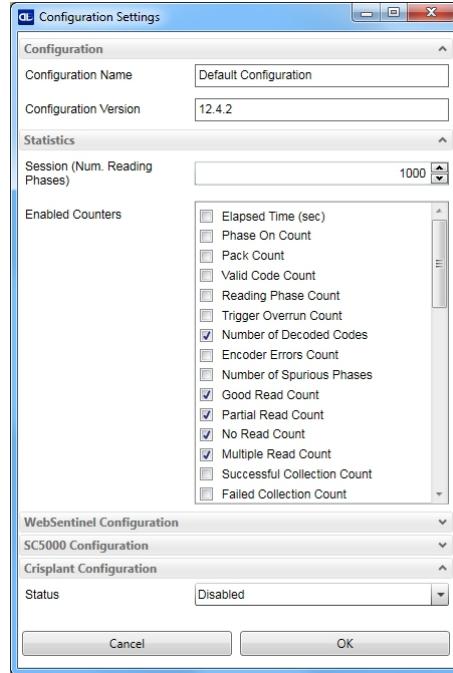
CHAPTER 8
MAINTENANCE

CLEANING

Clean the lens cover (see Figure A, 4) periodically for continued correct operation of the reader.

Dust, dirt, etc. on the lens cover may alter the reading performance.

Repeat the operation frequently in particularly dirty environments.

Use soft material and alcohol to clean the lens cover and avoid any abrasive substances.

CHAPTER 9
TROUBLESHOOTING

GENERAL GUIDELINES

- When wiring the device, pay careful attention to the signal name (acronym) on the CBX100/500 spring clamp connectors (Chapter 4,). If you are connecting directly to the Matrix 120 M12 17-pin connector, pay attention to the pin number of the signals (Appendix A).

- If you need information about a certain reader parameter you can refer to the DL.CODE help on line. Connect the device and click on the link to the parameter you're interested in.

- If you're unable to fix the problem and you're going to contact your local Datalogic office or Datalogic Partner or ARC, we suggest providing (if possible): Application Program version, Parameter Configuration file, Serial Number and Order Number of your reader. You can get most of this information while DL.CODE is connected to the reader.

Troubleshooting Guide	
Problem	**Suggestion**
DL.CODE Installation: Autorun or Start.hta doesn't run	Check Windows settings to see if Autorun is disabled. Associate the file type .hta with the Microsoft HTML Application host **mshta.exe** in Windows\System32.
Driver Installation Error: The ECM driver fails to install correctly.	Windows 7 requires that update KB3033929 be installed in order for the Matrix 120 ECM driver to work properly.
Power ON: the "POWER" LED is not lit.	Is power connected? If using a power adapter (like PG6000), is it connected to wall outlet? If using rail power, does rail have power? If using CBX, does it have power (check switch and LED)? Check if you are referring to the device / accessory cable or to the CBX spring clamp connectors. Measure Voltage either at pin **1** and pin **2** (for 17-pin connector) or at spring clamp **Vdc** and **GND** (for CBX).
One Shot or Phase Mode using the Input 1 (External Trigger) or Input 2: the "TRIGGER" LED is not blinking while the External Trigger is switching.	Check if you are referring to the 17-pin connector or to the CBX spring clamp connectors. Is the sensor connected to Input 1 or Input 2? Is power supplied to the photo sensor? For NPN configuration, is power supplied to one of the two I1 or I2 signals (A or B)? For PNP configuration, is one of the two I1 or I2 signals grounded (A or B)? Are the photo sensor LEDS (if any) working correctly? Is the sensor/reflector system aligned (if present)? On the Reading Phase step check the Input 1 or Input 2 *Debouncing Time* parameter setting. On the Reading Phase step check the settings for *Acquisition Trigger, Reading Phase-ON,* and *Reading Phase-OFF* parameters.
One Shot or Phase Mode using serial trigger source: the "TRIGGER" LED is not blinking.	On the Reading Phase step check the settings for *Acquisition Trigger, Reading Phase-ON,* and *Reading Phase-OFF* parameters. Are the COM port parameters (*Baud Rate, Parity, Data Bits, Stop Bits*) correctly assigned? On the Reading Phase step check the settings of *Acquisition Trigger String, Reading Phase-ON String,* and *Reading Phase-OFF String* parameters. Is the serial trigger source correctly connected?

Troubleshooting Guide	
Problem	**Suggestion**
Phase Mode: the "TRIGGER" LED is correctly blinking but no image is displayed in the DL.CODE window.	Is the Phase frequency lower than the maximum frame rate?
Continuous Mode: the "TRIGGER" LED is not blinking.	Verify the correct software configuration settings.
Any Operating Mode: the "TRIGGER" LED is correctly blinking but no result is transmitted by the reader at the end of the reading phase collection.	Check the Code Collection parameters on the Reading Phase step and the Data Formatting parameters on the Data Formatting step.
Image not clear:	Verify the Focus procedure and reading distance.
Reading: the reader always transmits the *No Read Message*	Run the Rapid Configuration procedure in Chapter 1, . Position the reader as described in "Mounting And Positioning Matrix 120" on page 43 and through DL.CODE: Tune the Acquisition Delay on Trigger if the moving code is out of the reader field of view; Set the Continuous Operating Mode if no external trigger source is available; Tune the Image Settings to improve the code image quality; Check the parameter settings in the Advanced Setup step: 2D Codes, 1D Codes, and Postal Codes; View the full resolution code image to check the printing or marking quality.
Serial Communication: reader is not transmitting anything to the host.	Is the serial cable wiring correct? If using CBX, be sure the RS422 termination switch is OFF. Are the host serial port settings the same as the reader serial port settings? In DL.CODE Device menu > Settings > Settings > LED Configuration, the COM LED Function can be configured to indicate Main Serial Port TX or Main Serial Port RX.
Serial Communication: data transferred to the host are incorrect, corrupted or incomplete.	Are the host serial port settings the same as the reader serial port settings? In the DL.CODE Data Formatting step check the settings of Header and Terminator String parameters. In the DL.CODE Data Formatting step, check the various Message Field parameter settings.

Troubleshooting Guide	
Problem	**Suggestion**
Configuration: cannot access environment parameters in DL.CODE (Device>Settings>Settings menu item is gray)	Are you using the Installer - Expert User level? If not, change it in the Options>Change User menu.
How do I obtain my reader Serial Number?	The reader Serial Number consists of 9 characters: one letter, 2 numbers, another letter followed by 5 numbers. The reader Serial Number is printed on a label that is affixed on the bottom case near the reading window. The Serial Number is also visible from the DL.CODE Device List Area.
How do I obtain my reader Order Number?	The reader Order Number consists of 9 numbers. The reader Order Number can be obtained by comparing the Device Model (in DL.CODE Device Menu > Settings > Settings > About Device) with the product models page on the Datalogic website.

APPENDIX A
TECHNICAL FEATURES

ELECTRICAL FEATURES	
Power	
Supply Voltage	5 to 30 Vdc (10 to 30 Vdc with CBX)
Consumption	0.4 - 0.1 A
Communication interfaces	
Main: RS232, RS422 Full-duplex	2400 to 115200 bit/s
USB	UBS 2.0 Hi-Speed
Ethernet (built-in) supported application protocols	10/100 Mbit/s TCP-IP, EtherNet/IP, Modbus TCP, PROFINET-IO
Fieldbus	CBX500 with HMS Host Interface Modules
Inputs	
Input 1 (External Trigger) and Input 2	Short circuit protected (opto-isolated and polarity insensitive when connected through CBX)
Max. Voltage	30 Vdc
Max. Input Currenct	3.5 mA (24 mA max. when connected through CBX)
Outputs [1]	
Output 1 and 2	NPN or PNP short circuit protected (opto-isolated and polarity sensitive when connected through CBX)
$V_{OUT\ high}$ (I_{LOAD} = 100 mA) Max.	28.3 Vdc (when using 30 Vdc power supply)
$V_{OUT\ low}$ (I_{LOAD} = 100 mA) Max.	1.7 Vdc
I_{LOAD} Max.	145 mA

1. when connected to the CBX connection boxes the electrical features for Output 1 and 2 become the following:
   Opto-isolated; V_{CE} = 30 Vdc max.; I_{CE} = 40 mA continuous max.; 130 mA pulsed max.;
   $V_{CE\ saturation}$ = 1 Vdc max. @ 10 mA; P_D = 90 mW Max. @ 50 °C ambient temp.

OPTICAL FEATURES

	WVGA	MP
Image Sensor	752x480	1280x960
Frame Rate	57 frames/sec.	36 frames/sec.
Focus Range[1] **Factory calibrated positions (mm)**	45 - 70 - 125	45 - 80 - 125
Image Sensor	CMOS sensor with Global Shutter	
Pitch	± 35°	
Tilt	0° - 360°(within vertical FOV)	
LED Safety	to EN 62471	

Laser Safety (Aiming source)
    Wavelength
    Max. Output Radiation
	IEC60825-1:2014, Class 1M
	645-660nm
	< 0,39mW	

Lighting System	Internal Illuminator	
Aiming System	Laser Indicator	

1. three factory calibrated positions; continuous focus range for fine tuning.

ENVIRONMENTAL FEATURES

Operating Temperature [1]	-0 to 45 °C (32 to 113 °F)
Storage Temperature	-20 to 70 °C (-4 to 158 °F)
Max. Humidity	90% non condensing
Vibration Resistance **EN 60068-2-6**	14 mm @ 2 to 10 Hz; 1.5 mm @ 13 to 55 Hz; 2 g @ 70 to 500 Hz; 2 hours on each axis
Bump Resistance **EN 60068-2-29**	30g; 6 ms; 5000 shocks on each axis
Shock Resistance **EN 60068-2-27**	30g; 11 ms; 3 shocks on each axis
Protection Class **EN 60529**	IP65
Sulfur Gas Test **DIN EN 60068-2-43**	Passed

1. high ambient temperature applications should use metal mounting bracket for heat dissipation.

PHYSICAL FEATURES

	Serial + USB	Serial + Ethernet
Dimensions Standard Model	45.4 x 31.1 x 23.5 mm (1.8 x 1.2 x 1 in.)	45.4 x 48.5 x 23.5 mm (1.8 x 1.9 x 1 in.)
Dimensions ESD Safe	45.4 x 35.4 x 23.5 mm (1.8 x 1.4 x 1 in.)	45.4 x 52.8 x 23.5 mm (1.8 x 2.1 x 1 in.)
Weight (with cable)	117 g. (4.1 oz.)	200 g. (7.1 oz.)
Cable Length	1000 mm[1]	
Material	Aluminum	
SER.+USB/ETH cable length	1000 ± 20 mm (39.4 ± 0.8 in)	

1. 100 mm for Matrix 120 x1x-x5x and Matrix 120 x1x-x6x models. Refer to "Available models" on page 33 for more details)

SOFTWARE FEATURES

Readable Code Symbologies

1D and Stacked	2D	Postal	Digimarc Barcode
PDF417 Standard and Micro PDF417 Code 128 (GS1-128) Code 39 (Standard and Full ASCII) Code 32 MSI Standard 2 of 5 Matrix 2 of 5 Interleaved 2 of 5 Codabar Code 93 Pharmacode EAN-8/13 - UPC-A/E (including Addon 2 and Addon 5) GS1 DataBar Family Composite Symbologies	Data Matrix ECC 200 (Standard, GS1 and Direct Marking) QR Code (Standard and Direct Marking) Micro QR Code MAXICODE Aztec Code	Australia Post Royal Mail 4 State Customer Kix Code Japan Post PLANET POSTNET POSTNET (+BB) Intelligent Mail Swedish Post	DWCODE™

Operating Mode	Continuous, One Shot, Phase Mode
Configuration Methods	X-PRESS Human Machine Interface DL.CODE Windows-based SW (Ethernet or Serial interface) Host Mode Programming sequences sent over Serial or Ethernet TCP interfaces
Parameter Storage	Permanent memory (Flash)

CODE QUALITY METRICS

Standard	Supported Symbologies
ISO/IEC 16022	Data Matrix ECC 200
ISO/IEC 18004	QR Code
AIM DPM	Data Matrix ECC 200, QR Code
ISO/IEC 15415	Data Matrix ECC 200, QR Code
ISO/IEC 15416	Code 128, Code 39, Interleaved 2 of 5, Codabar, Code 93, EAN-8-13, UPC-A/E

USER INTERFACE

LED Indicators	Power, Ready, Good; Trigger; Com, Status, (Ethernet Network); Good Read (Green Spot)
Keypad Button	Configurable via DL.CODE
Beeper	Configurable via DL.CODE

APPENDIX B
ALTERNATIVE CONNECTIONS

The connector pinouts and notes given in this appendix are for custom cabling applications.

POWER, COM AND I/O CONNECTOR

The Matrix 120 reader is equipped with an M12 17-pin male connector for connection to the power supply, serial interfaces and input/output signals. The details of the connector pins are indicated in the following table:
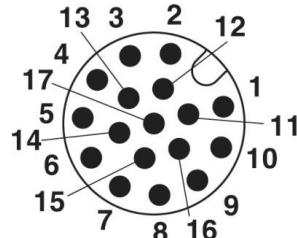
Figure 1. M12 17-pin male Power, COM and I/O Connector

POWER, COM AND I/O CONNECTOR PINOUT			
PIN	NAME	DESCRIPTION	
1	Vdc	Power supply input voltage +	
2	GND	Power supply input voltage -	
Connector case	CHASSIS	Connector case provides electrical connection to the chassis	
6	IN1	External Trigger (referenced to GND)	
5	Reserved	Reserved - do not connect	
13	IN2	Input 2 (referenced to GND)	
3	-		
9	O1	Output 1	(NPN or PNP short circuit protected and software programmable)
8	O2	Output 2	
16	-		
14	-		
4	-		
7	*USB+	USB data + (only for USB models)	
15	*USB-	USB data - (only for USB models)	

POWER, COM AND I/O CONNECTOR PINOUT				
PIN	NAME	DESCRIPTION		
			RS232	RS422 Full-Duplex
17	Main Interface (SW Selectable)	TX	TX+
11		RX	RX+ **
12		-	TX-
10		-	*RX-

* When using the USB interface without Datalogic accessory cables, EMC compliance requires the USB data and power signals originate from the same source (i.e.computer). Max USB cable length from M12 17-pin connector is 2 meters. **Incorrect disconnection can result in damage to the USB hub.**

** Do not leave floating, see "RS422 Full Duplex Interface" on page 51 for connection details.

In order to meet EMC requirements:

- connect the reader chassis to the plant earth ground by means of a flat copper braid shorter than 100 mm;
- connect your cable shield to the locking ring nut of the connector.

ON-BOARD ETHERNET CONNECTOR

A Standard M12 D-Coded female connector is provided for the on-board Ethernet connection. This interface is IEEE 802.3 10 BaseT and IEEE 802.3u 100 BaseTx compliant.
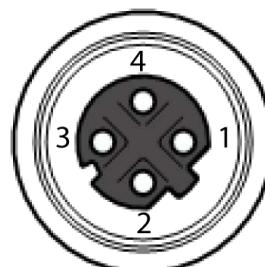
Figure 2. M12 D-Coded Female Ethernet Network Connector

ON-BOARD ETHERNET NETWORK CONNECTOR PINOUT		
PIN	NAME	DESCRIPTION
1	TX+	Transmitted data +
2	RX+	Received data +
3	TX-	Transmitted data -
4	RX-	Received data -

INPUTS

There are two non opto-isolated inputs available on the M12 17-pin connector of the reader: Input 1 (External Trigger) and Input 2, a generic input.

The electrical features of both inputs are:

INPUT	INPUT	$|V_{IN}|$ MIN.	V_{IN} MAX.	I_{IN} MAX.
NPN	OFF*	4 V	30 V	0 mA
	ON	0 V	2.5 V	0.3 mA
PNP	OFF*	0 V	2.5 V	0 mA
	ON	4 V	30 V	3.5 mA

* The OFF state is guaranteed even if the input is floating.

The relative pins on the M12 17-pin connector are:

INPUT PINOUT		
PIN	NAME	DESCRIPTION
6	IN1	External Trigger (referenced to GND)
13	IN2	Input 2 (referenced to GND)
2	GND	Power Supply input voltage –

NOTE: These inputs become opto-isolated when connected to the CAB-1011 accessory cable and acquire the electrical features described in "Inputs" on page 52**.**

OUTPUTS

Three general purpose **non opto-isolated** but short circuit protected outputs are available on the M12 17-pin connector.

⚠️ **CAUTION: If output devices are powered externally (separate from Matrix 120 power), it is always advised to maintain the same voltage levels used for the Matrix 120 device.**

The electrical features of the two outputs are the following:
Reverse-Polarity and Short-Circuit Protected
V_{OUT} (I_{LOAD} = -100 mA) max = 28.3 Vdc (when using 30 Vdc power supply)
V_{OUT} (I_{LOAD} = 100 mA) max = 1.7 Vdc
I_{LOAD} max = 145 mA

The pinout is the following:

OUTPUT PINOUT		
PIN	NAME	DESCRIPTION
9	O1	Configurable digital output 1
8	O2	Configurable digital output 2
2	GND	Ouptut reference signal

📝 **NOTE: These outputs become opto-isolated when connected to the CAB-1011 accessory cable and acquire the electrical features described in "Outputs" on page 58.**

The output signals are fully programmable being determined by the configured Activation/Deactivation events, Deactivation Timeout or a combination of the two. For further details refer to the Help On Line page for the Output Setup step in DL.CODE.
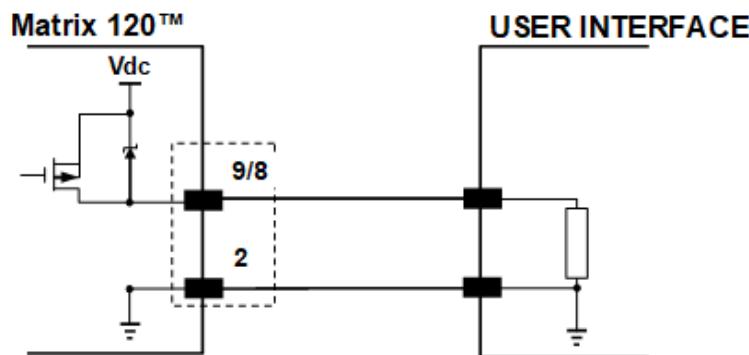

Figure 3. PNP Output Connection
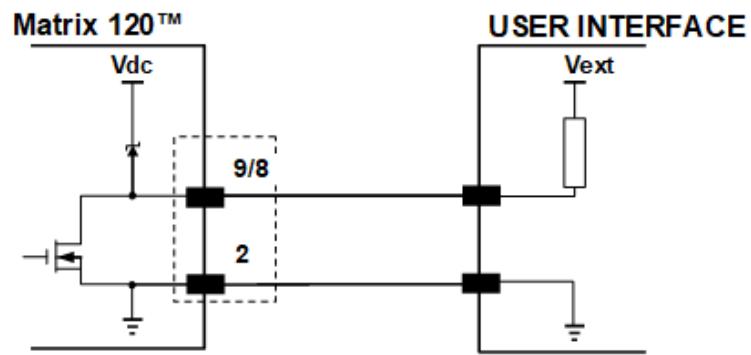
**Figure 4. NPN Output Connection**
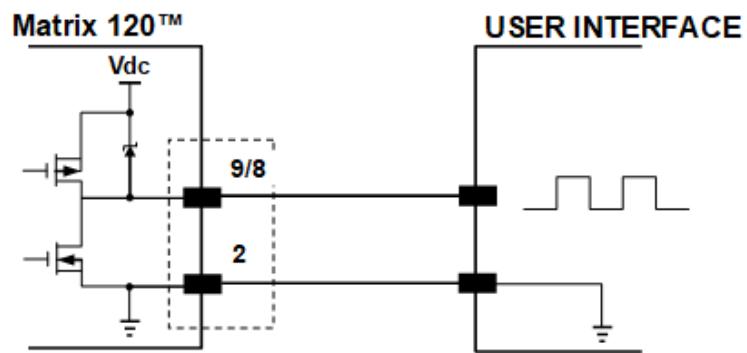
Figure 5. Push-Pull Output Connection

CAB-1011 CABLE FOR OPTO-ISOLATED I/O CONNECTIONS

The CAB-1011 accessory cable provides opto-isolated input/output signals between the Matrix 120 reader and the I/O devices.
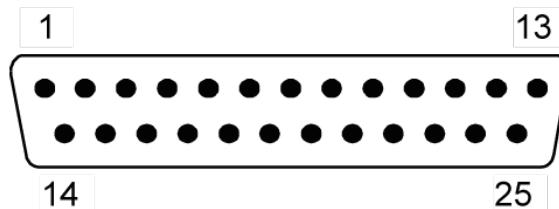
Figure 6. 25-pin D-Sub Male COM, I/O and Power Connector

OUTPUT PINOUT		
PIN	**NAME**	**DESCRIPTION**
1	CHASSIS	Cable shield connected to chassis
9, 13	Vdc	Power Supply Input Voltage +
7, 25	GND	Power Supply Input Voltage -
18	I1A	External Trigger (polarity insensitive)
19	I1B	External Trigger (polarity insensitive)
6	I2A	Input Signal 2 (polarity insensitive)
10	I2B	Input Signal 2 (polarity insensitive)
8	O1+	Configurable Digital Output 1 - positive pin
22	O1-	Configurable Digital Output 1 - negative pin
11	O2+	Configurable Digital Output 2 - positive pin
12	O2-	Configurable Digital Output 2 - negative pin
2	TX+	Transmitted data (+)
3	RX+	Received data (+)
4	TX-	Transmitted data (-) *(RS422 only)*
5	RX-	Received data (-) *(RS422 only)*
14, 16	-	Reserved
15, 17, 20 21, 23, 24	NC	Not Connected

CAB-1051 CABLE FOR USB INTERFACE WITH I/O CONNECTIONS

The CAB-1051 accessory cable allows the USB interface to be used with input/output signals between the Matrix 120 reader and the I/O devices. These signals are referenced to GND.

OUTPUT PINOUT		
PIN	**NAME**	**DESCRIPTION**
Pin	Name	Description
Orange	Input 1	External Trigger
Gray	Input 2	Input Signal 2
Purple	O1	Configurable Digital Output 1
Red/White	O2	Configurable Digital Output 2
Black	GND	Ground Reference
Black Thick	SHIELD	Cable Shield

⚠️ **CAUTION: If output devices are powered externally (separate from Matrix 120 power), it is always advised to maintain the same voltage levels used for the Matrix 120 device.**

USER INTERFACE – SERIAL HOST

RS232 PC-SIDE CONNECTIONS			
9-pin male connector		25-pin male connector	
Pin	**Name**	**Pin**	**Name**
2	RX	3	RX
3	TX	2	TX
5	GND	7	GND

How To Build A Simple Interface Test Cable: The following wiring diagram shows a simple test cable including power, external (push-button) trigger and PC RS232 COM port connections.
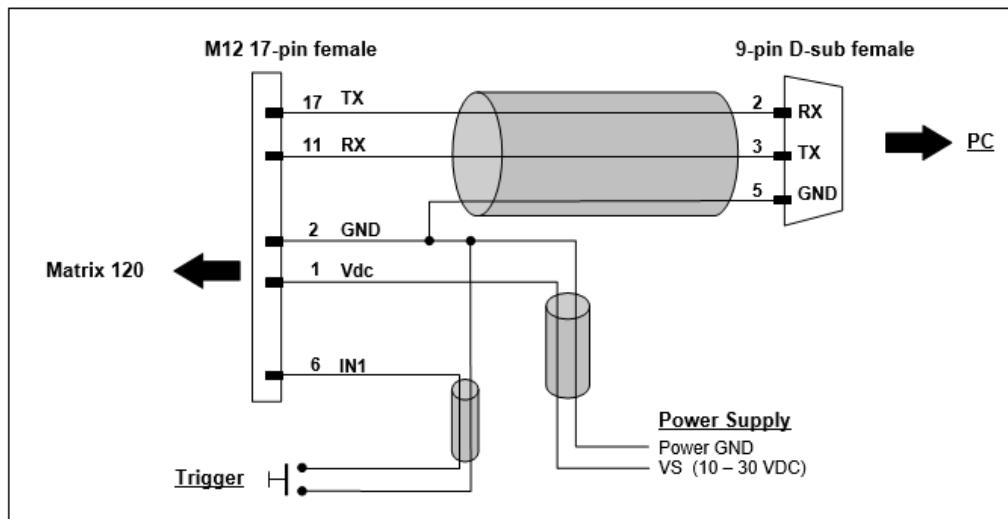
Figure 7. Test Cable for Matrix 120

GLOSSARY

AIM

(Association for Automatic Identification and Mobility): AIM Global is the international trade association representing automatic identification and mobility technology solution providers.

AIM DPM Quality Guideline

Standard applicable to the symbol quality assessment of direct part marking (DPM) performed in using two-dimensional bar code symbols. It defines modifications to the measurement and grading of several symbol quality parameters.

Barcodes (1D Codes)

A pattern of variable-width bars and spaces which represents numeric or alphanumeric data in machine-readable form. The general format of a barcode symbol consists of a leading margin, start character, data or message character, check character (if any), stop character, and trailing margin. Within this framework, each recognizable symbology uses its own unique format.

BIOS

Basic Input Output System. A collection of ROM-based code with a standard API used to interface with standard PC hardware.

Bit

Binary digit. One bit is the basic unit of binary information. Generally, eight consecutive bits compose one byte of data. The pattern of 0 and 1 values within the byte determines its meaning.

Bits per Second (bps)

Number of bits transmitted or received per second.

Bright Field Illumination

Lighting of surfaces at high (narrow) angles used to provide maximum reflection of the light to the reader's lens. This is effective on surfaces that absorb light or are not highly reflective and also on low contrast codes.

Byte

On an addressable boundary, eight adjacent binary digits (0 and 1) combined in a pattern to represent a specific character or numeric value. Bits are numbered from the

right, 0 through 7, with bit 0 the low-order bit. One byte in memory can be used to store one ASCII character.

Composite Symbologies

Consist of a linear component, which encodes the item's primary data, and an adjacent 2D composite component, which encodes supplementary data to the linear component.

Dark Field Illumination

Lighting of surfaces at wide angles used to avoid direct reflection of the light into the reader's lens. Typically this type of lighting is used in DPM solutions to enhance reflectance of the uneven surface do to the symbol marking technique. It is also used with very reflective surfaces.

Decode

To recognize a barcode symbology *(e.g.,* Codabar, Code 128, Code 3 of 9, UPC/EAN, etc.) and analyze the content of the barcode scanned.

Depth of Field

The difference between the minimum and the maximum distance of the object in the field of view that appears to be in focus.

Diffused Illumination

Distributed soft lighting from a wide variety of angles used to eliminate shadows and direct reflection effects from highly reflective surfaces.

Direct Part Mark (DPM)

A symbol marked on an object using specific techniques like dot peening, laser etching, chemical etching, etc.

EEPROM

Electrically Erasable Programmable Read-Only Memory. An on-board non-volatile memory chip.

Element

The basic unit of data encoding in a 1D or 2D symbol. A single bar, space, cell, dot.

Exposure Time

For digital cameras based on image sensors equipped with an electronic shutter, it defines the time during which the image will be exposed to the sensor to be acquired.

Flash

Non-volatile memory for storing application and configuration files.

Host

A computer that serves other terminals in a network, providing services such as net-work control, database access, special programs, supervisory programs, or program-ming languages.

Image Processing

Any form of information processing for which the input is an image and the output is for instance a set of features of the image.

Image Resolution

The number of rows and columns of pixels in an image. The total number of pixels of an image sensor.

Image Sensor

Device converting a visual image to an electric signal. It is usually an array of CCD (Charge Coupled Devices) or CMOS (Complementary Metal Oxide Semiconductor) pixel sensors.

IEC

(International Electrotechnical Commission): Global organization that publishes interna-tional standards for electrical, electronic, and other technologies.

IP Address

The terminal's network address. Networks use IP addresses to determine where to send data that is being transmitted over a network. An IP address is a 32-bit number referred to as a series of 8-bit numbers in decimal dot notation *(e.*g., 130.24.34.03). The highest 8-bit number you can use is 254.

ISO

(International Organization for Standardization): A network of the national standards institutes of several countries producing world-wide industrial and commercial stan-dards.

LED (Light Emitting Diode)

A low power electronic light source commonly used as an indicator light. It uses less power than an incandescent light bulb but more than a Liquid Crystal Display (LCD).

LED Illuminator

LED technology used as an extended lighting source in which extra optics added to the chip allow it to emit a complex radiated light pattern.

Matrix Symbologies (2D Codes)

An arrangement of regular polygon shaped cells where the center-to-center distance of adjacent elements is uniform. Matrix symbols may include recognition patterns which do not follow the same rules as the other elements within the symbol.

Multi–row (or Stacked) Symbologies

Symbologies where a long symbol is broken into sections and stacked one upon another similar to sentences in a paragraph.

RAM

Random Access Memory. Data in RAM can be accessed in random order, and quickly written and read.

Symbol Verification

The act of processing a code to determine whether or not it meets specific requirements.

Transmission Control Protocol/Internet Protocol (TCP/IP)

A suite of standard network protocols that were originally used in UNIX environments but are now used in many others. The TCP governs sequenced data; the IP governs packet forwarding. TCP/IP is the primary protocol that defines the Internet.

⊗ DATALOGIC

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