

Matrix 120™

Image Based Reader



Product Reference Guide

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Matrix 120™ Product Reference Guide
Original Instructions
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References

Reference Documentation

The documentation related to the Matrix 120 is listed below:

- This Product Reference Guide
- DL.CODE User's Manual
- DL.CODE Help Online
- Matrix Reading Methods, provided as supplementary documentation on the DL.CODE mini-DVD (downloaded .zip file or mini-DVD accessory)

Support Through The Website

Datalogic provides several services as well as technical support through its website. Log on to www.datalogic.com and click on the SUPPORT link which gives you access to:

- Downloads by selecting your product model from the drop-down list in the Search by Product field for specific Data Sheets, Manuals, Software & Utilities, and Drawings;
- Repair Program for On-Line Return Material Authorizations (RMAs) plus RepairCenter contact information;
- Customer Service containing details about Maintenance Agreements;
- Technical Support through email or phone.

Patents

See www.patents.datalogic.com for patent list.

This product is covered by one or more of the following patents:

Design patents: EP003042845; EP003074079

Utility patents: EP0996284B1; EP0999514B1; EP1014292B1; EP1128315B1; EP1172756B1; EP1396811B1; EP1413971B1; EP1804089B1; EP2315156B1; EP2517148B1; EP2649555B1; JP4435343B2; JP4571258B2; JP5192390B2; US6512218; US6616039; US6808114; US6877664; US6997385; US7053954; US7387246; US8058600; US8113430; US8368000; US8888003; US8915443; US9268982; US9430689; ZL200680050007.8.

Conventions



WARNING

This symbol alerts the user they are about to perform a dangerous action that could result in personal injury as well as damage to the device if not performed correctly. Examples involve exposure to dangerous levels of voltage or electrical shock hazards.



CAUTION

This symbol identifies a hazard or procedure that, if incorrectly performed, could cause equipment damage. It is also used to bring the user's attention to details that are considered IMPORTANT.



NOTE

This symbol draws attention to details or procedures that may be useful in improving, maintaining, or enhancing the performance of the hardware or software being discussed.

This manual uses the following conventions:

"User" refers to anyone using a Matrix 120 reader.

"Reader" refers to the Matrix 120 reader.

"You" refers to the System Administrator or Technical Support person using this manual to install, configure, operate, maintain or troubleshoot a Matrix 120 reader.



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.

CE Compliance

CE marking states the compliance of the product with essential requirements listed in the applicable European directive. Since the directives and applicable standards are subject to continuous updates, and since Datalogic promptly adopts these updates, therefore the EU declaration of conformity is a living document. The EU declaration of conformity is available for competent authorities and customers through Datalogic commercial reference contacts. Since April 20th, 2016 the main European directives applicable to Datalogic products require inclusion of an adequate analysis and assessment of the risk(s). This evaluation was carried out in relation to the applicable points of the standards listed in the Declaration of Conformity. Datalogic products are mainly designed for integration purposes into more complex systems. For this reason it is under the responsibility of the system integrator to do a new risk assessment regarding the final installation.

Warning

This is a Class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

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

All Matrix 120 readers contain one aiming Laser source used to position the reader.

This product conforms to the applicable requirements of IEC 60825-1 and complies with 21 CFR 1040.10 except for deviations pursuant to Laser Notice N° 50, date June 24, 2007. This product is classified as a Class 1M laser product according to IEC 60825-1 regulations.



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

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.



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.

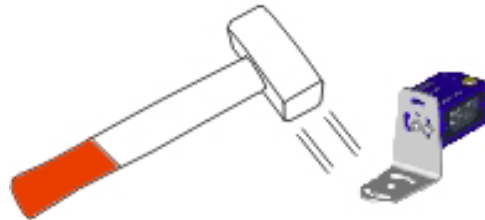


- avoid that the readers are dropped (exceeding shock limits).



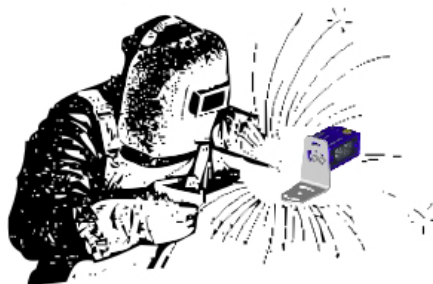
- do not fine tune the positioning by striking the reader or bracket.

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





General View

Matrix 120™ Serial + Ethernet Models

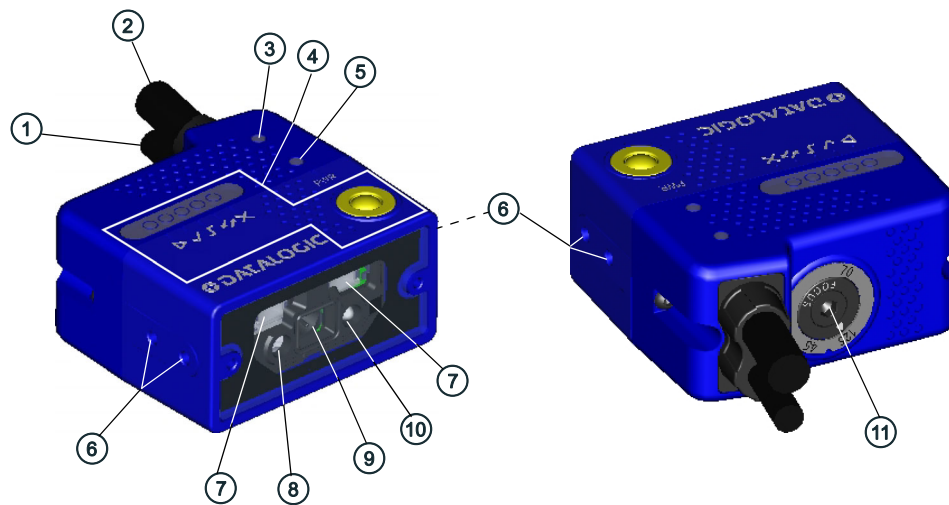


Figure A

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

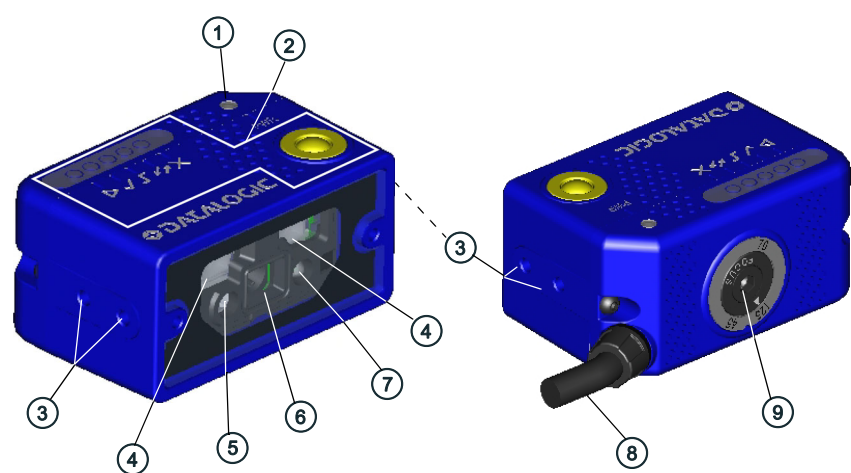


Figure B

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 Running H/F 1.

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.

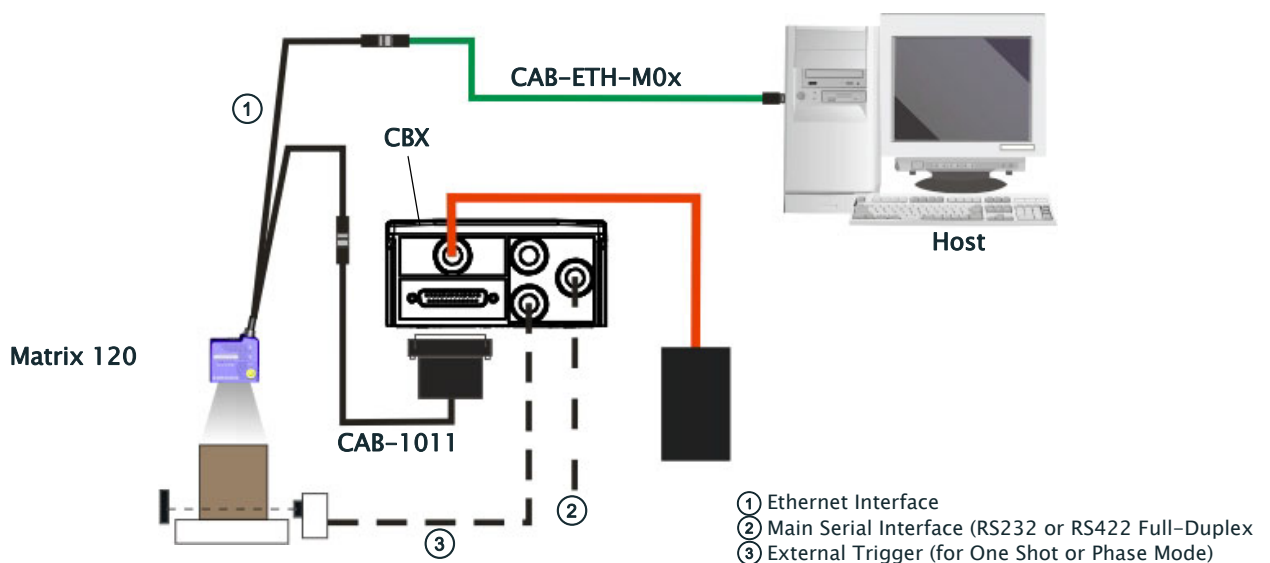


Figure 1 - Ethernet Point-to-Point Layout

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.

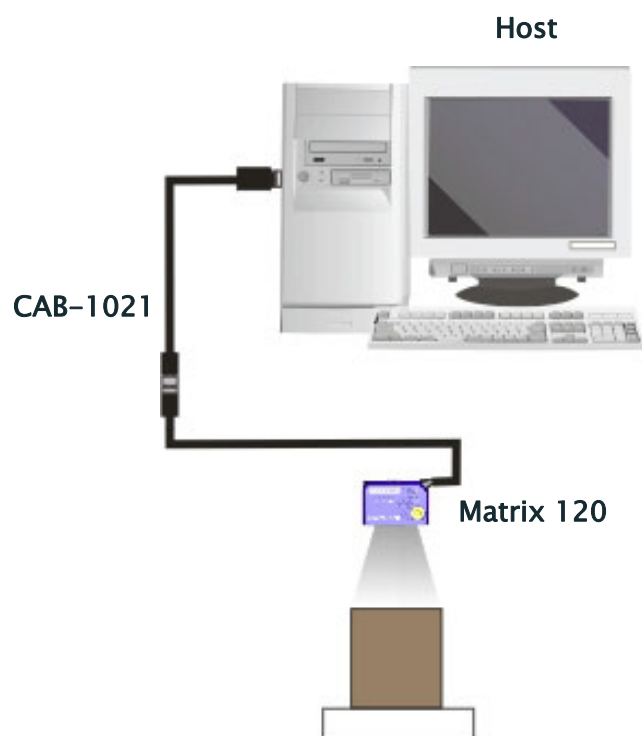


Figure 2 – USB Point-to-Point Layout

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.

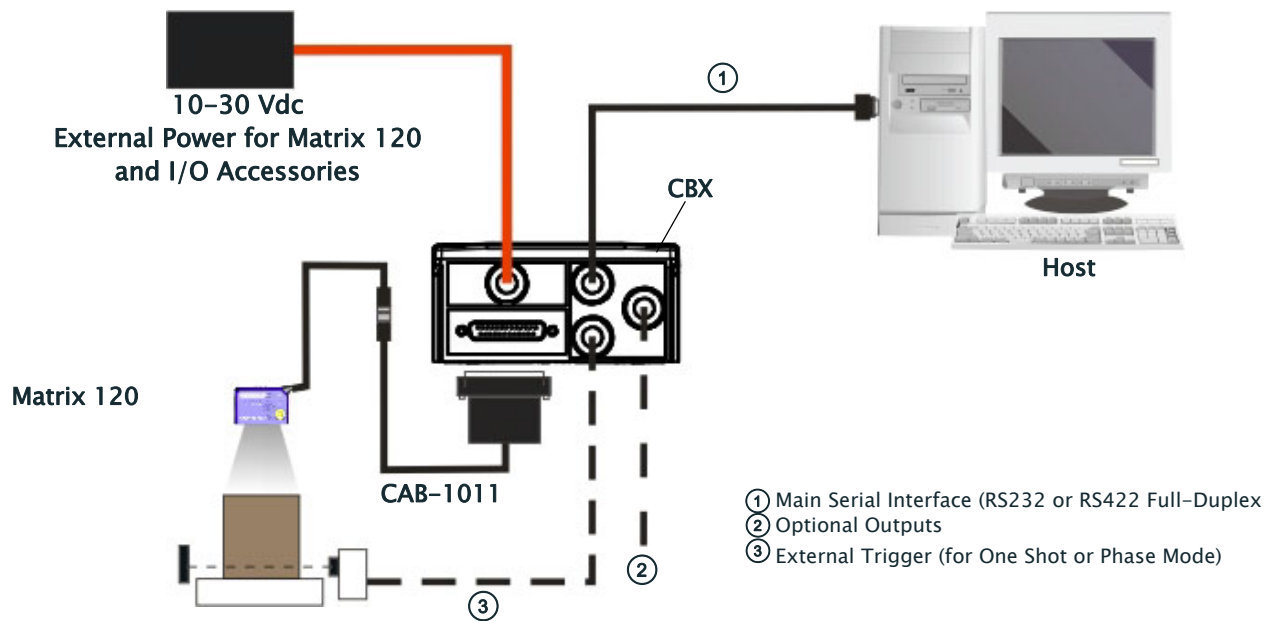


Figure 3 - Serial Point-to-Point Layout



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		aRX+	
-		aTX-	
-		RX-	
SGND		SGND	

a. 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.

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.

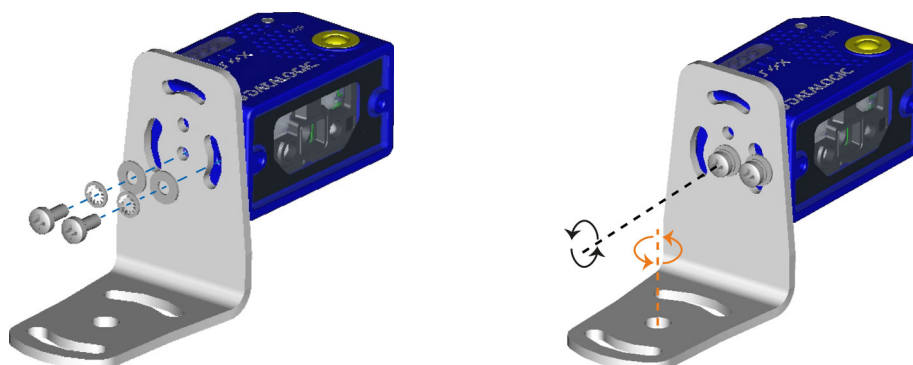


Figure 4 – Positioning with Mounting Bracket

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).

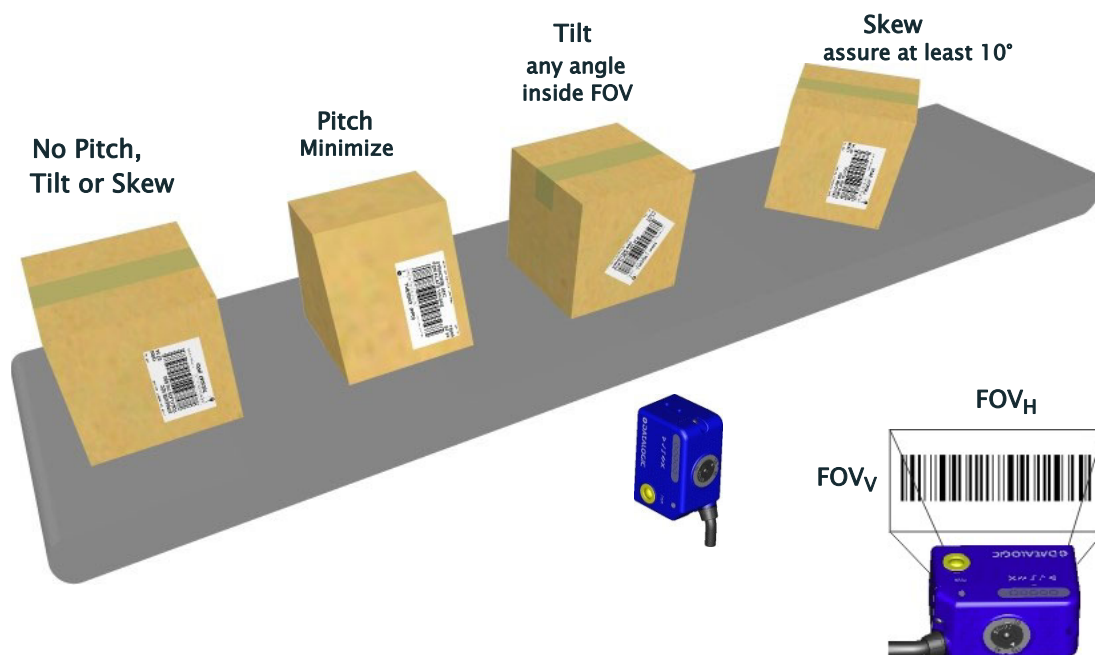


Figure 5 – Pitch, Skew and Tilt References

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.

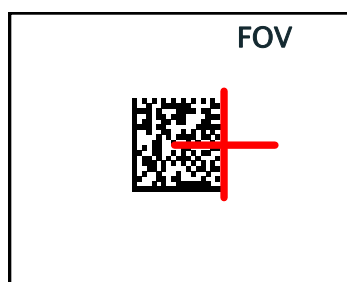


Figure 7 – Aiming Function Using The Red Crosshairs



Figure 8 – 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 8 – 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 beeps¹.

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 9 – X-PRESS Interface: Learn Function

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 single code 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.

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



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 (running Windows XP SP3, 7, 8, or 10), 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 ^a	STEP 4C

- a. 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.

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.

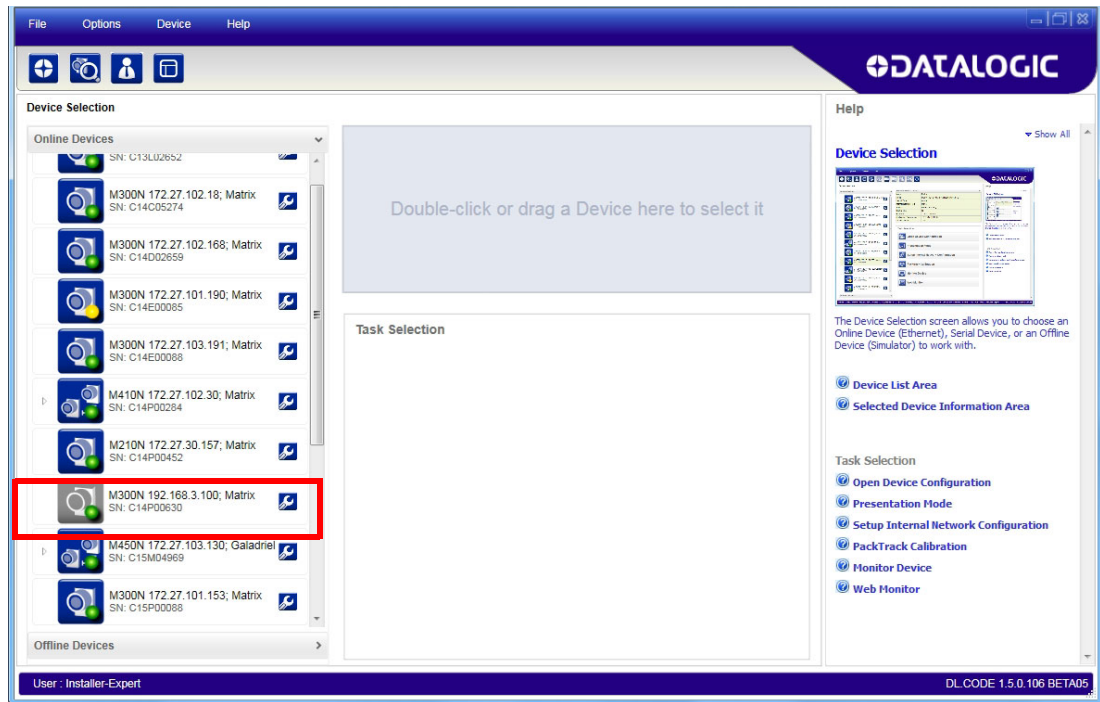


Figure 10 – Device Discovery

The discovery feature will also show devices not belonging to the LAN and display them in gray (see Figure 10 –).

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.



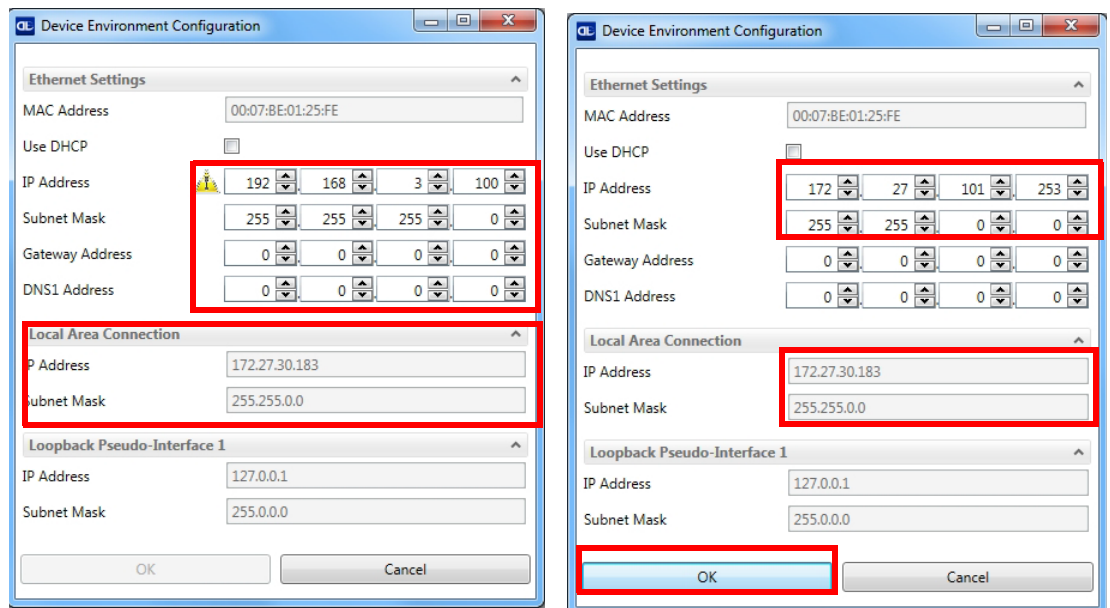
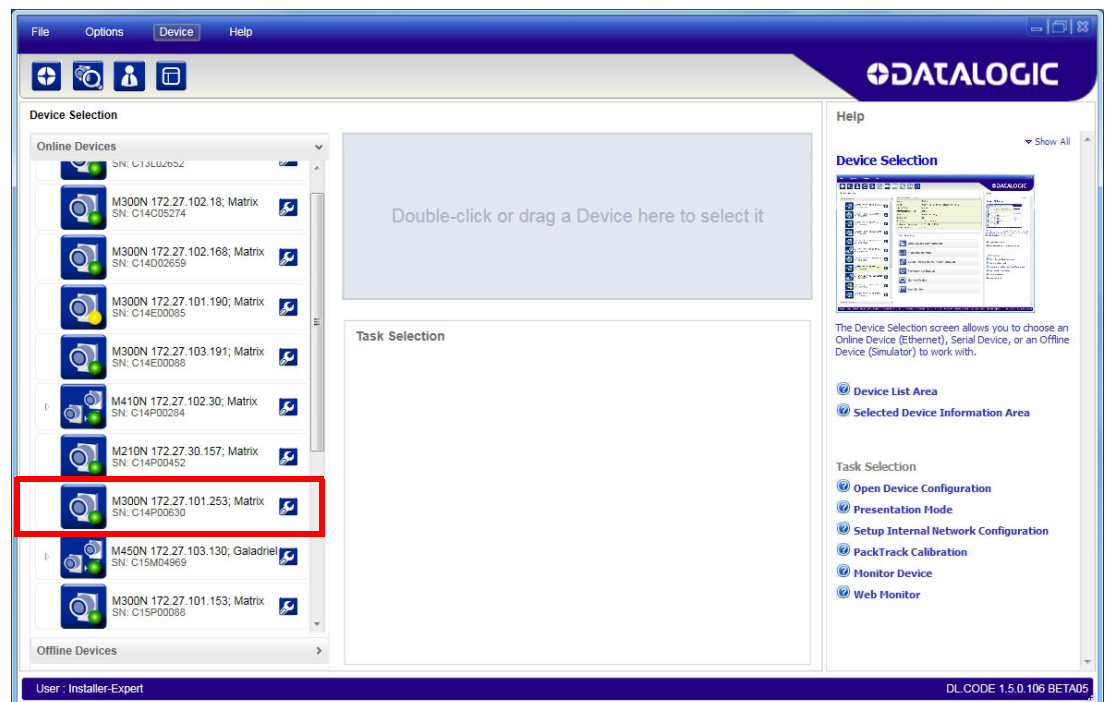


Figure 11 – Device Environment Configuration Window

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.



- Double-click on or drag the device icon into the Selected Device Information Area. Details about the device will be displayed in this area.

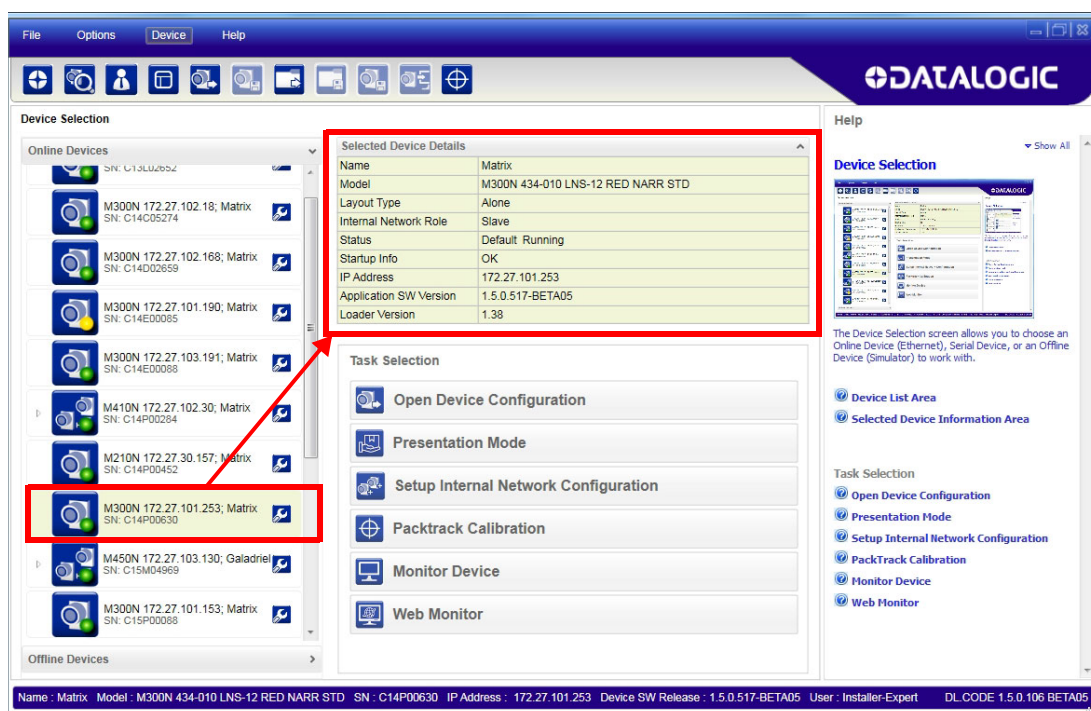


Figure 12 – DL.CODE Opening Window

**NOTE**

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

Step 4B - USB Device Discovery

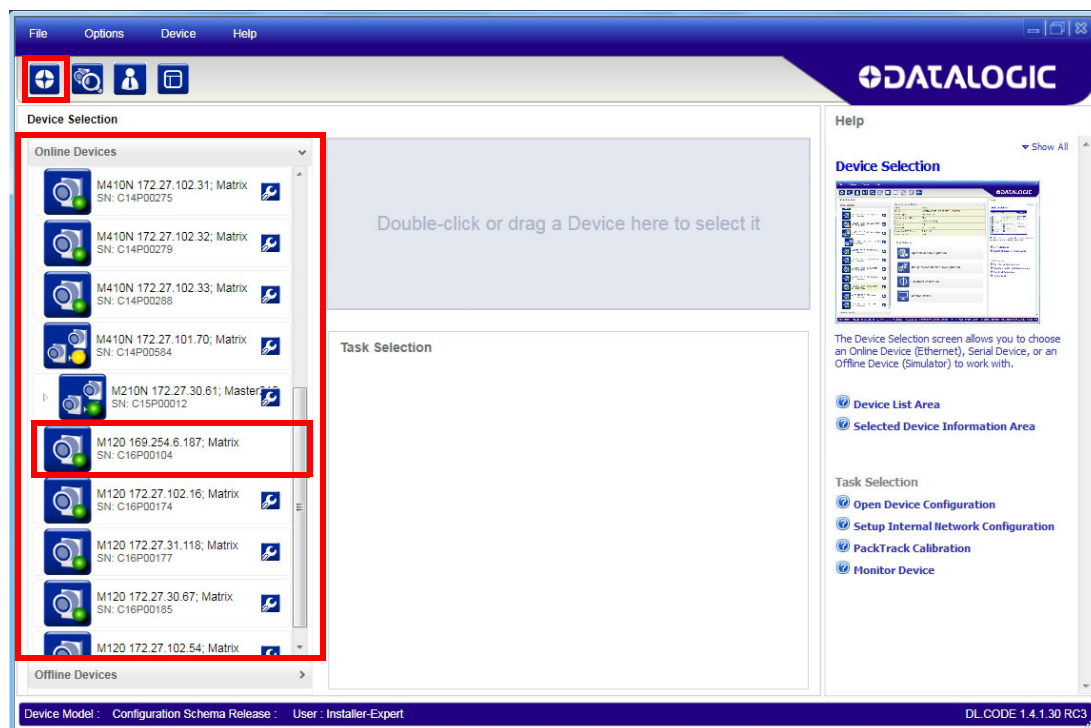


NOTE

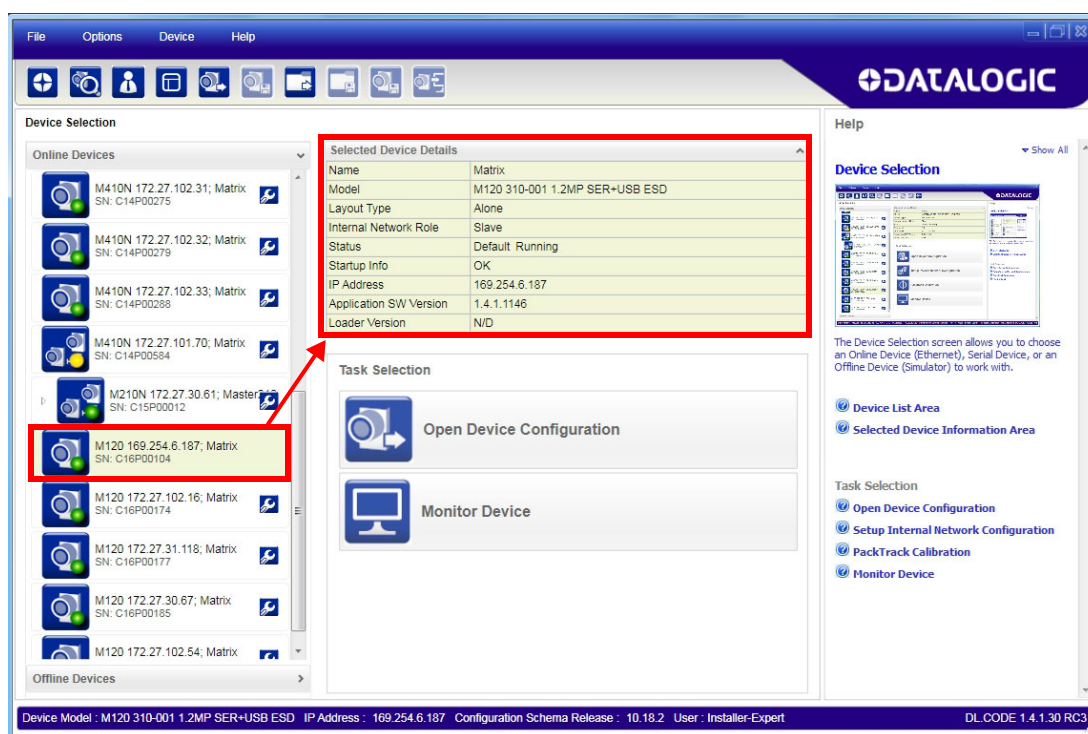
USB device discovery on a PC using Windows XP SP3 requires particular attention. See "Windows XP SP3 and Matrix 120 USB Interface" on page 150 for more information.

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).



- 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.

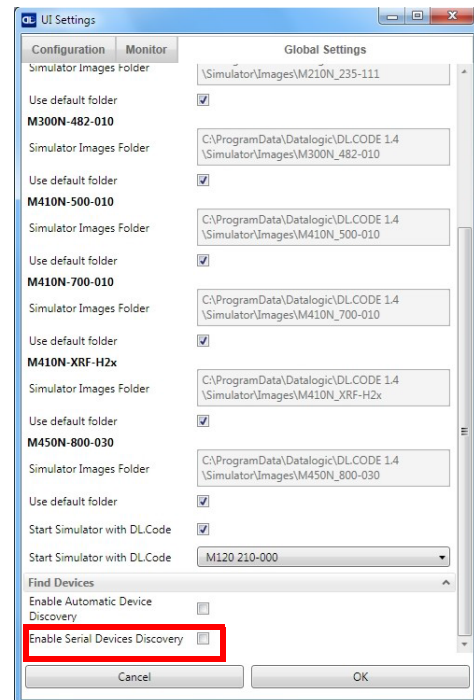
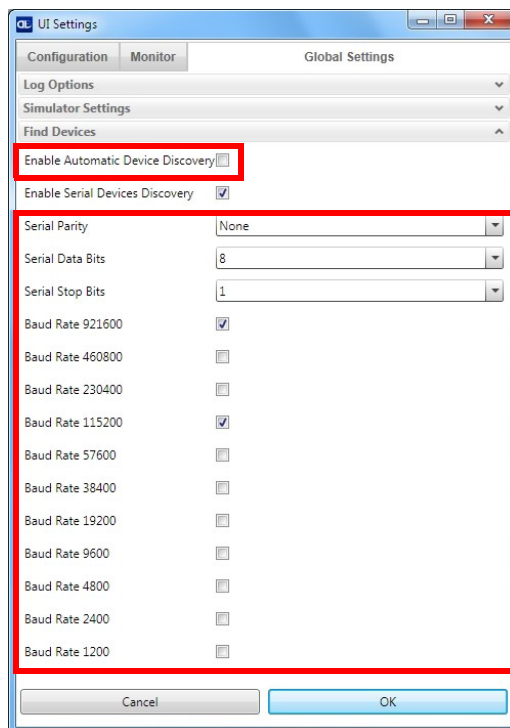


NOTE

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.

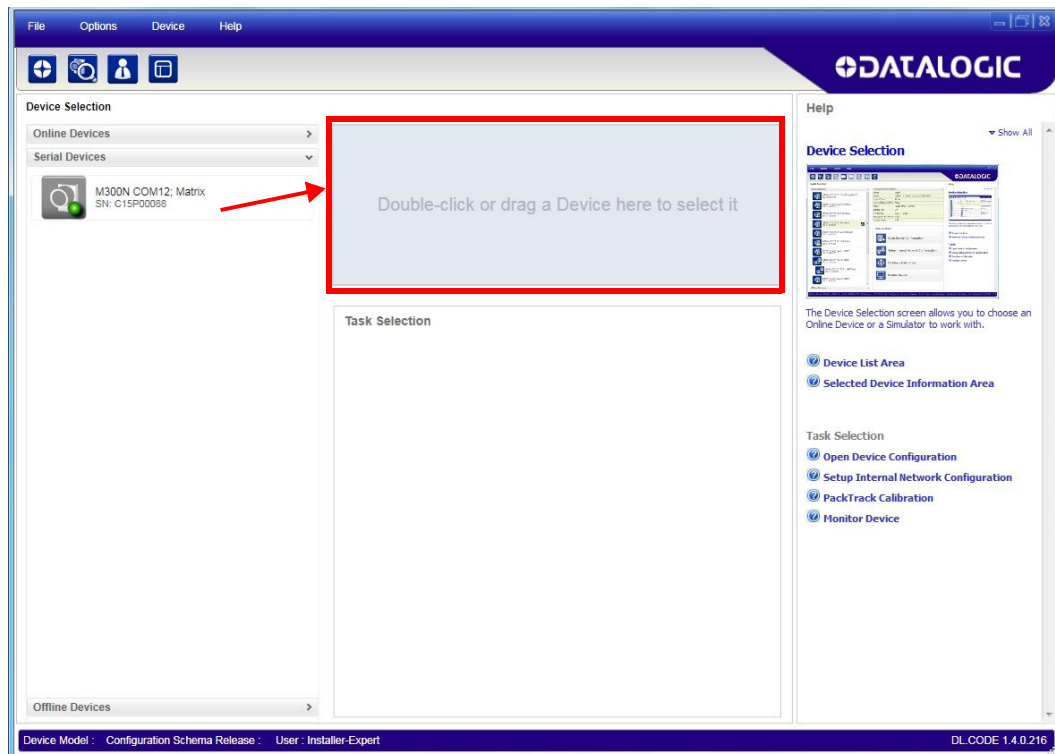


NOTE

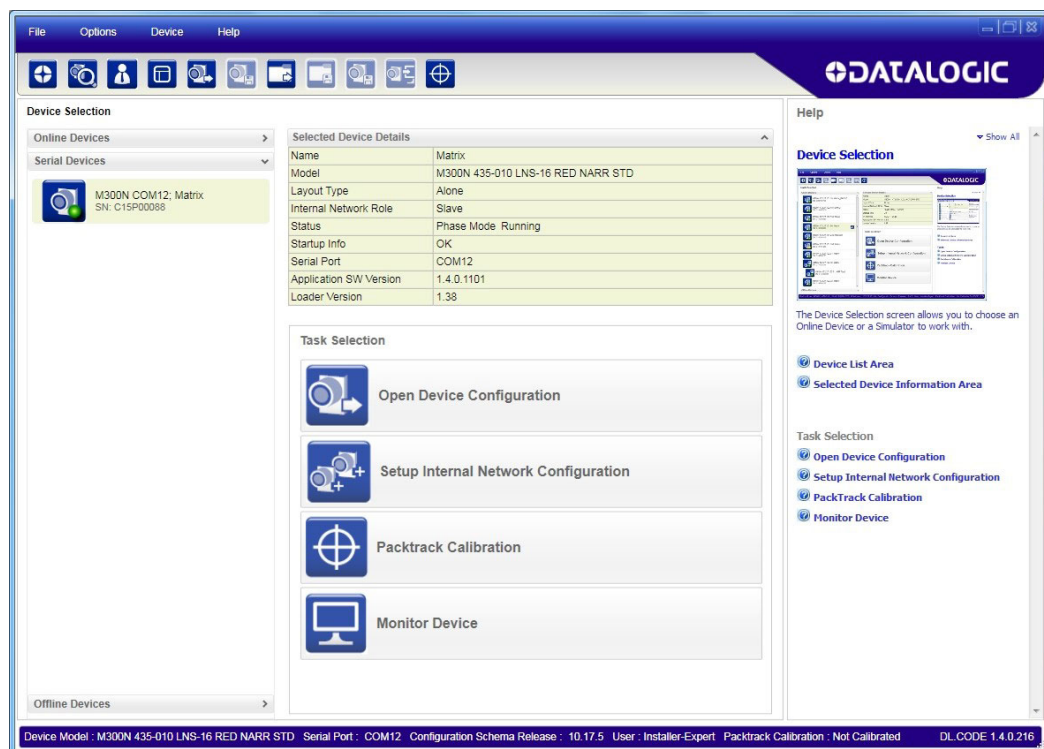
If you're not sure of the Serial baud rate you can also check the **Enable Automatic Device Discovery** box which for serial devices will try communication at all baud rates, but only at No parity, 8 data bits;1 stop bit.

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

Automatic or Advanced Setup

Automatic Setup provides an automatic procedure for setting: optical/illumination, reading distance (for software adjustable focus liquid lens models), and code definition parameters to obtain the most stable decoding conditions for a single code symbology based on the images presented to the reader. It can be set to include Image Filters if necessary. See the table below for codes and filters managed by Automatic Setup. Automatic Setup is especially useful for DPM applications.

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

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



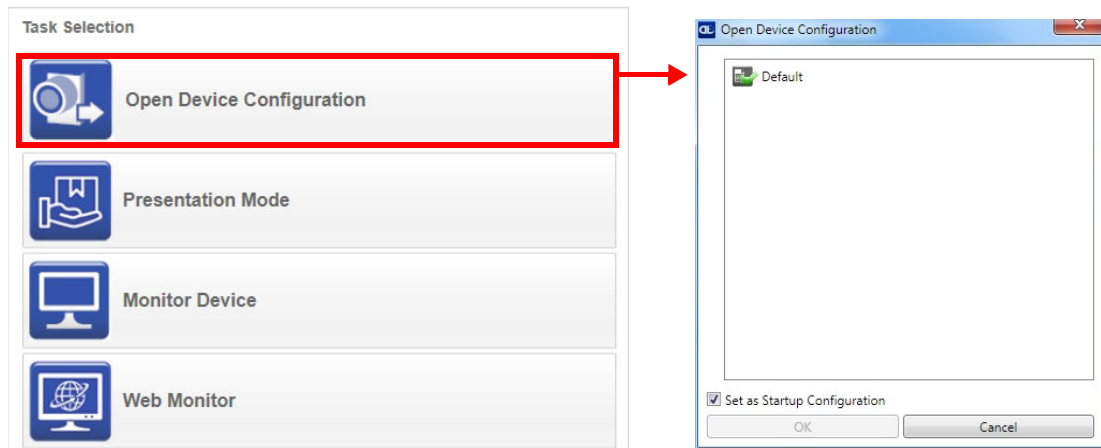
NOTE

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

Automatic Setup

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 an **application specific code** in front of the reader at the correct application reading distance.

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.



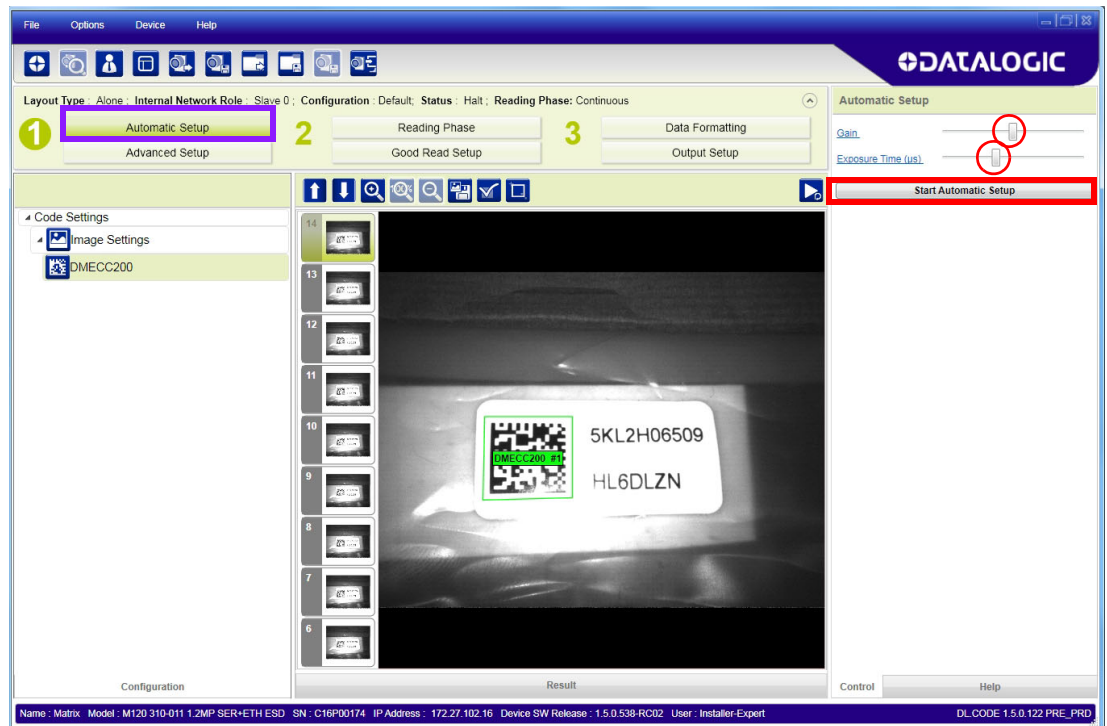
CAUTION

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 "[Reading Features](#)," starting on page 76 which show the reading ranges at the different focus positions for Code 128 (1D) and Data Matrix (2D) codes.



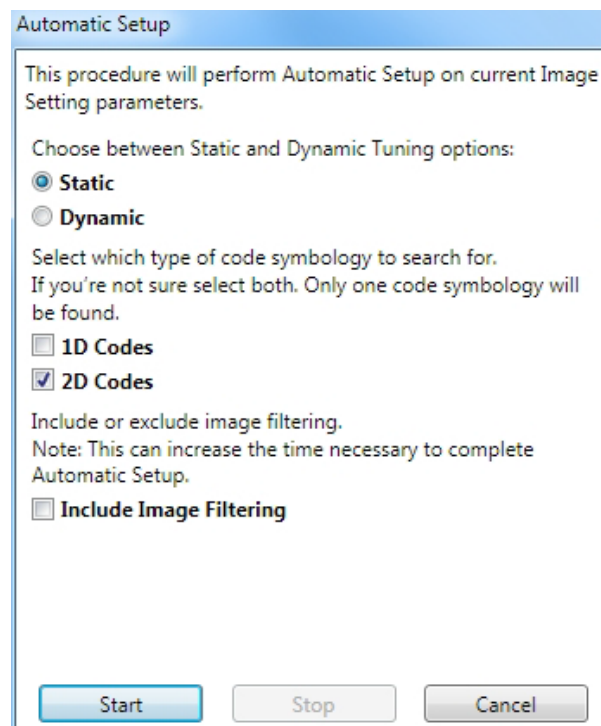
4. Once positioned, stop image acquisition by clicking on the Pause button.



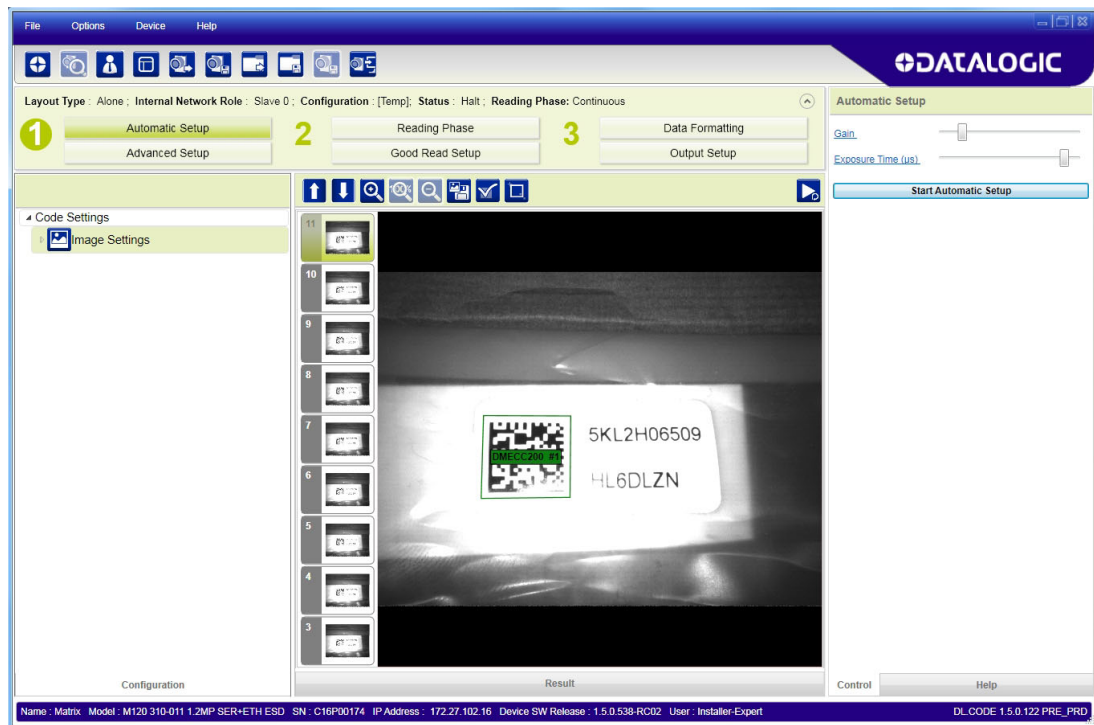
NOTE

If the image display area is too dark to see the images being captured, you can drag the Gain and Exposure Time sliders (circled in red in the figure above) to the right to increase visibility. This will not affect Automatic Setup.

- Click on the **Start Automatic Setup** button. The following window is displayed:



6. Select the correct reading conditions: Static or Dynamic Tuning, 1D or 2D code, Include Image Filtering (to find the best decoding condition).
7. Click Start to begin the procedure. The reader begins acquiring images. At the end of the procedure the **Status: Completed** message appears. You can Close the Automatic Setup window.

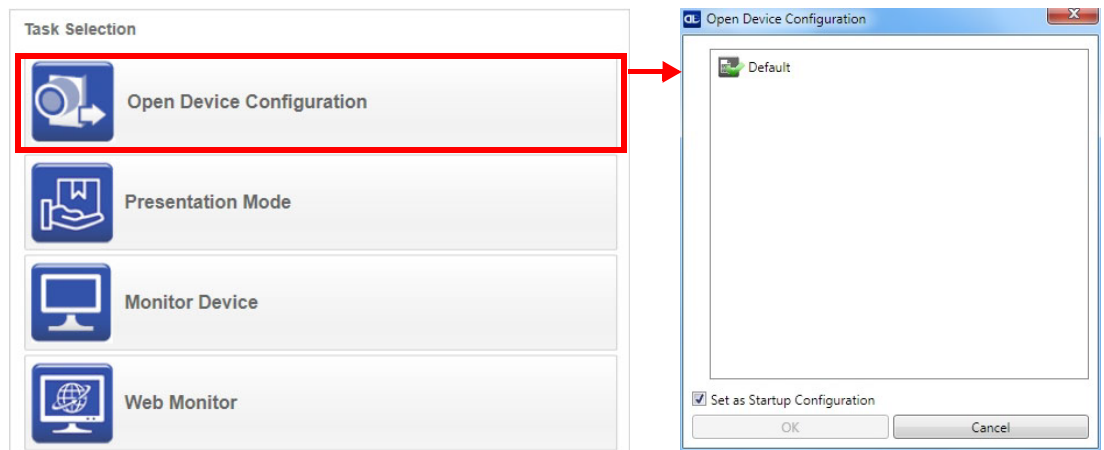


Your reader is now optimized for decoding. Continue with the Reading Phase configuration described on page 25.

Advanced Setup

To begin configuration, the reader must be correctly mounted at the correct reading distance for your application 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 an **application specific code** in front of the reader at the correct application reading distance.

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.



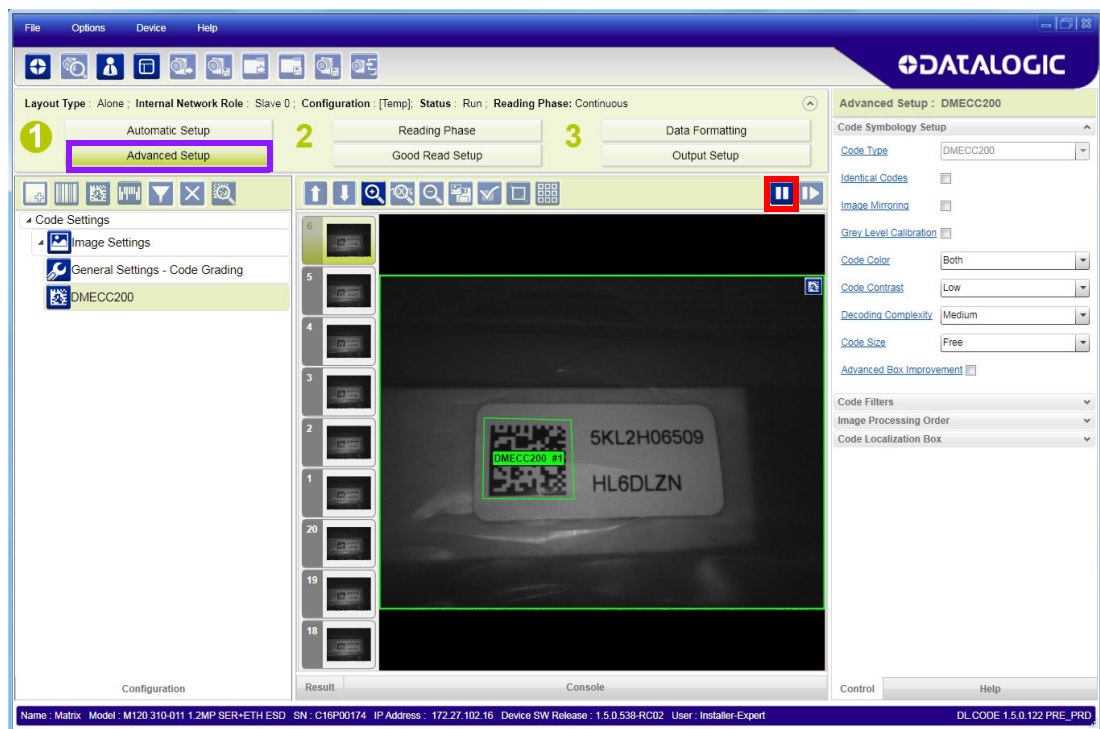
CAUTION

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

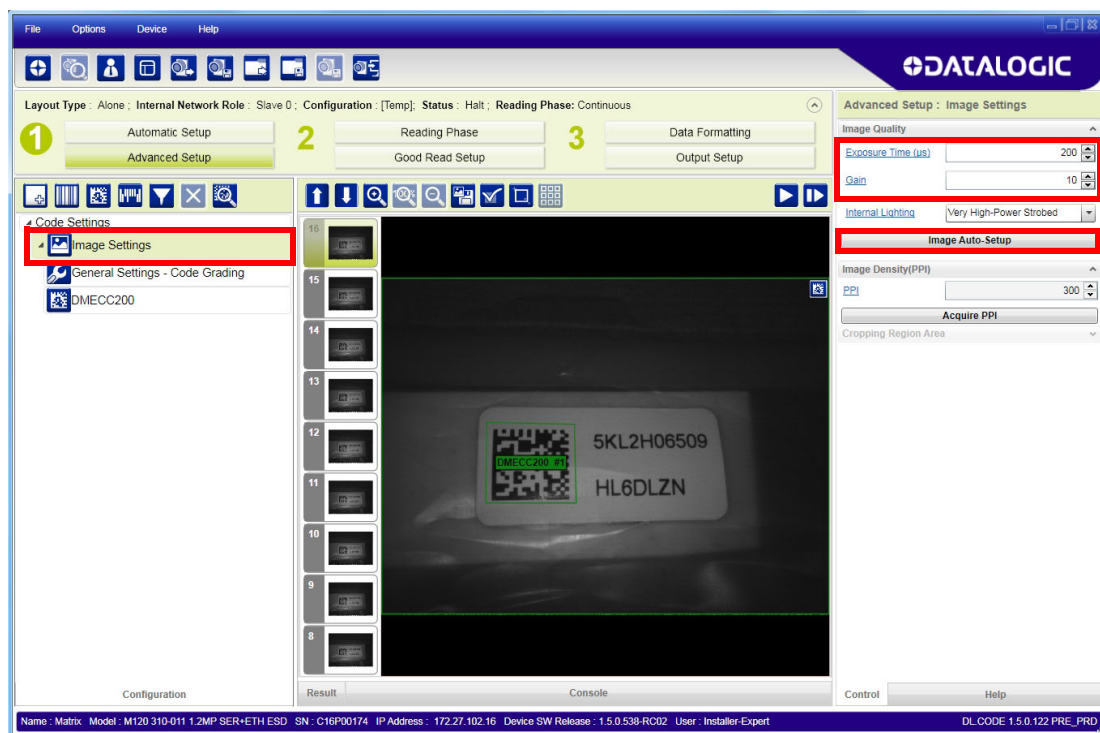
Refer to the Reading Diagrams in "[Reading Features](#)," starting on page 76 which show the reading ranges at the different focus positions for Code 128 (1D) and Data Matrix (2D) codes.



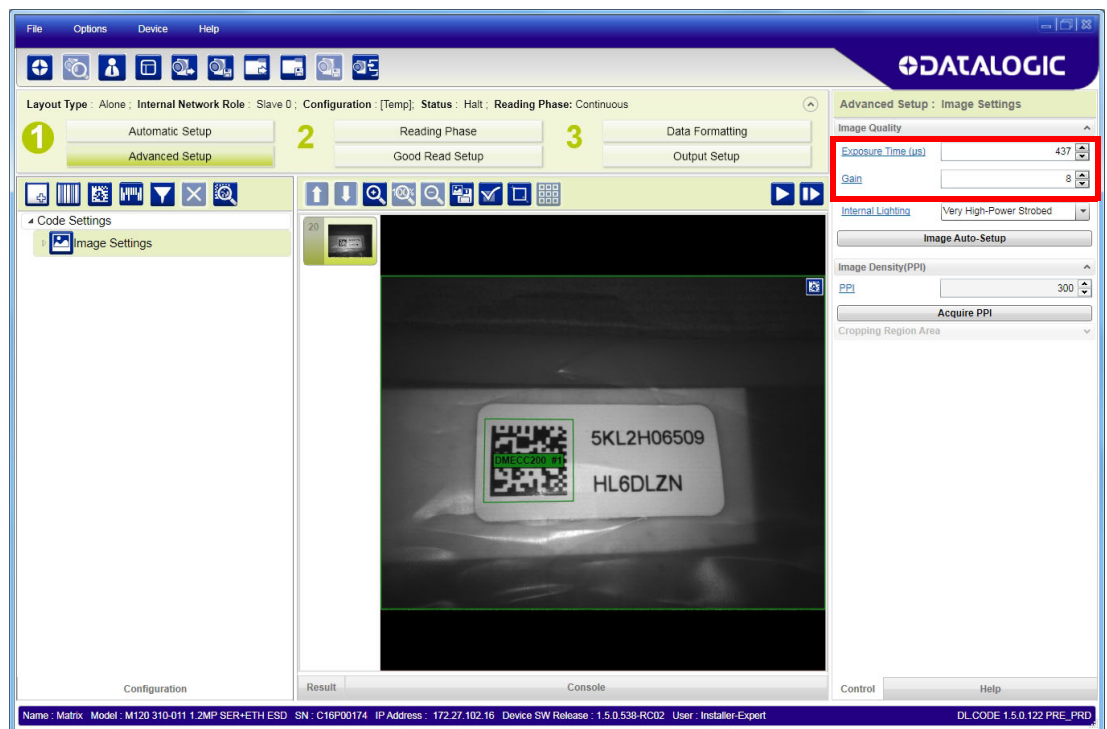
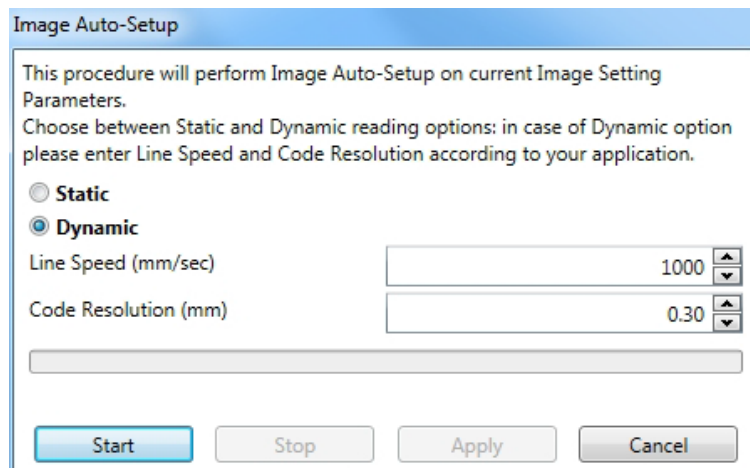
4. Once positioned, stop image acquisition by clicking on the Pause button.




5. Click the Image Settings branch and then click the Image Auto-Setup button to automatically acquire the best exposure time and gain values.



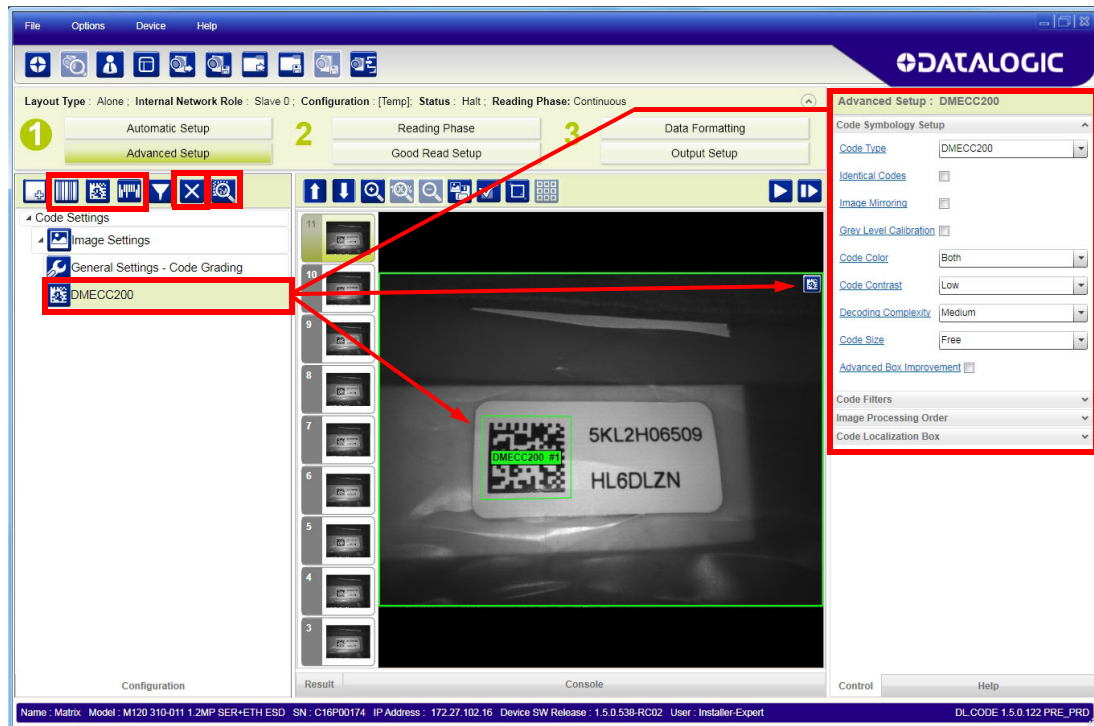
6. Select the Static or Dynamic Self-Tuning option; Start Autolearn and Apply to the Image Settings.



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.

- Click on the Data Matrix ECC 200 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 small 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.



- 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 Code Autolearn icon.¹ See the DL.CODE User's Manual for details.

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



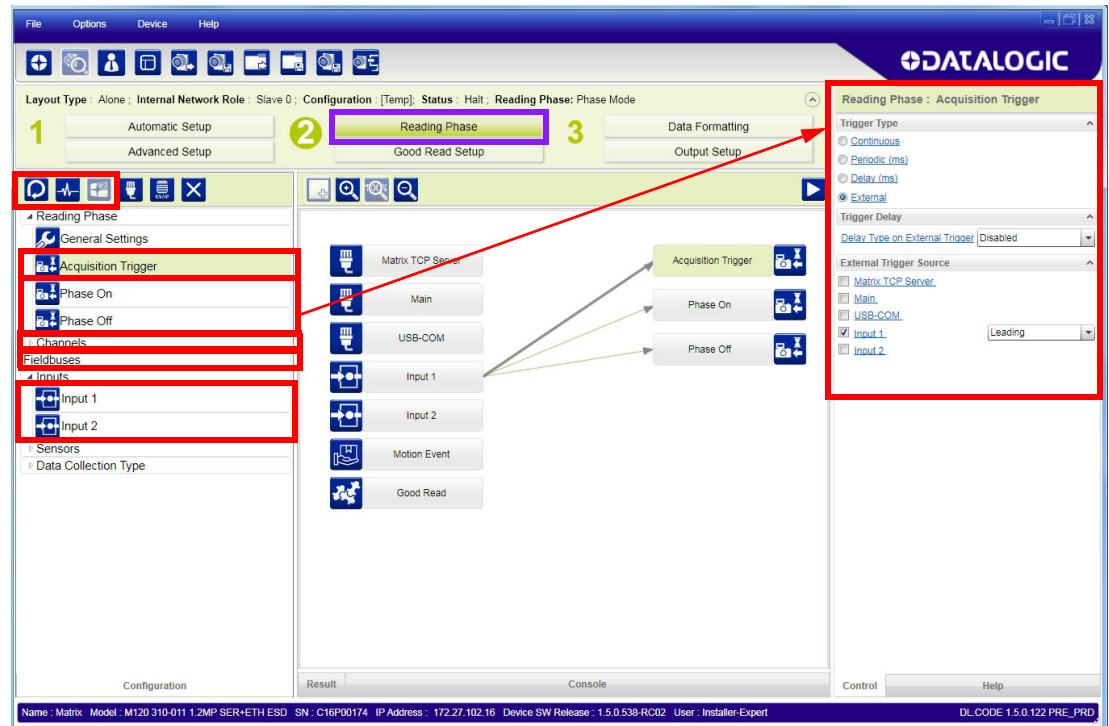
NOTE

Continue the configuration with the "Reading Phase" on page 25.

1. The Code Autolearn procedure will not recognize the following symbologies: Pharmacode, MSI, Standard 2 of 5, Matrix 2 of 5.

Reading Phase

1. Select your application specific Operating Mode from the icons over the Configuration Parameters tree area: Continuous, One Shot, or Phase Mode.

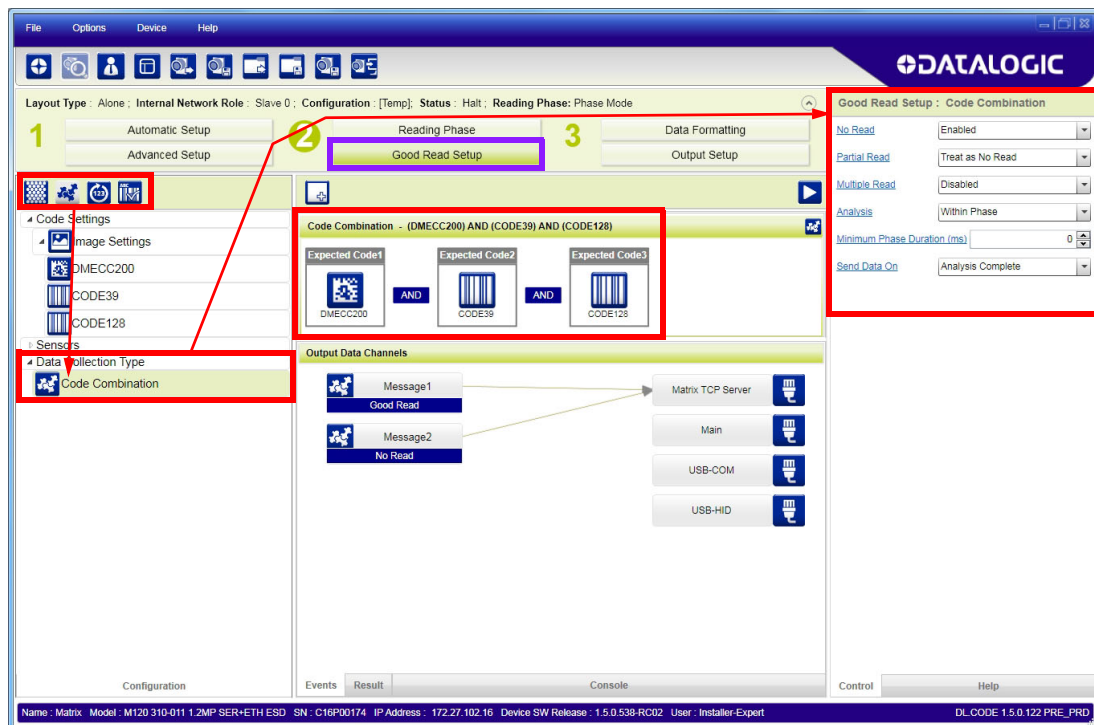


2. Configure the relative Operating Mode parameters from the Reading Phase parameters panel. Different groups will appear in the panel depending on the selected icons over the Configuration Parameters tree area.

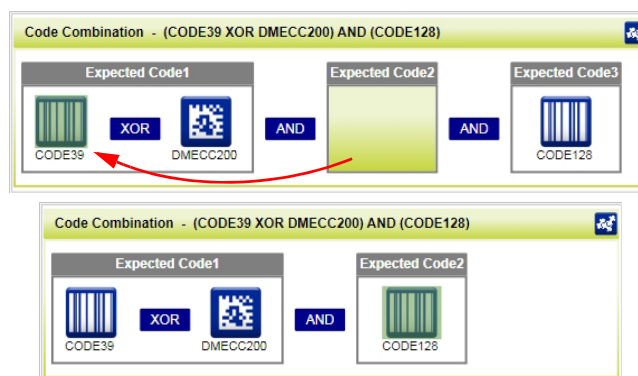
Good Read Setup

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.

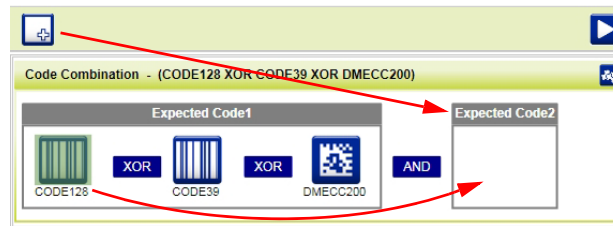


2. If a Good Read condition should be produced when any single code is decoded, independent of the others, then they need to be combined in logical XOR. To do this, drag the code icon(s) from their relative Expected Code box into the Expected Code box of the XOR combination you wish to create. Then delete the empty box by selecting it with the mouse (highlighted) and pressing the delete key on your keyboard.



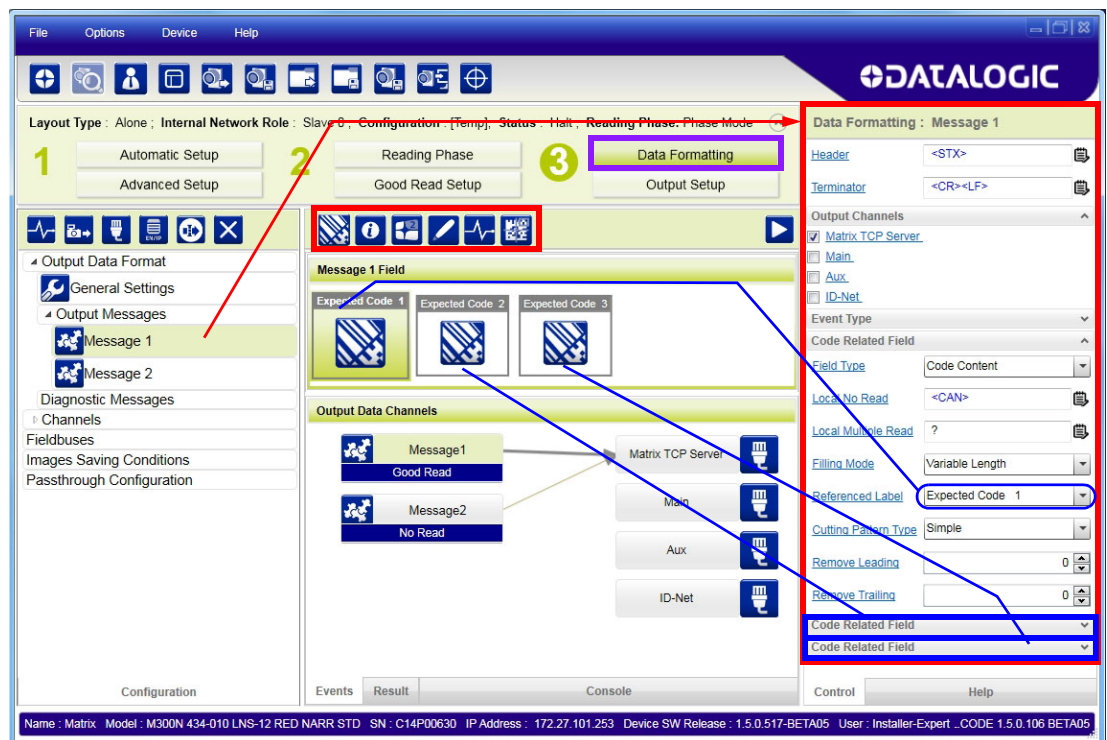


To create a logical AND condition from a logical XOR, create a new Expected Code box using the Add icon. Then drag the desired code icon from one box to the other.



Data Formatting

1. Configure your application specific Data Formatting Message(s) from the Configuration Parameters tree area: Message 1, Message 2, etc.

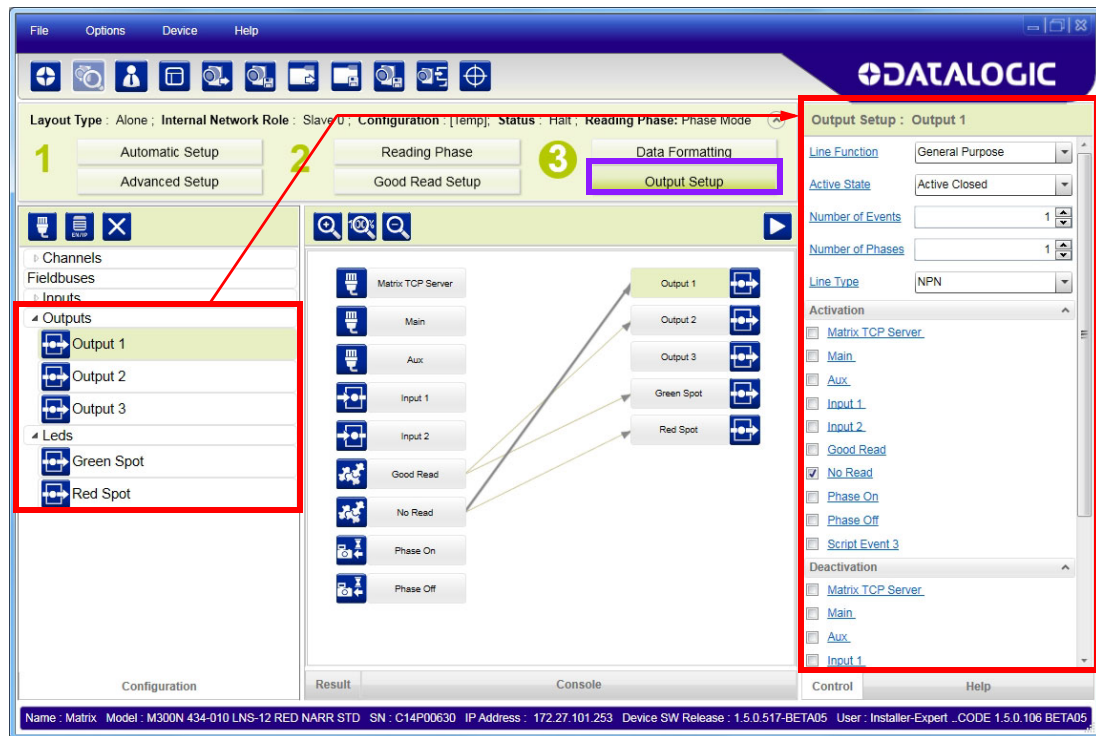


You can add fields to the output message by clicking on the icons above the Message Field area. They will be appended to the message. You can drag them to position them between other fields in the message so that the output message is ordered according to your application requirements.

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 13 – X-PRESS Interface: Test Function

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:

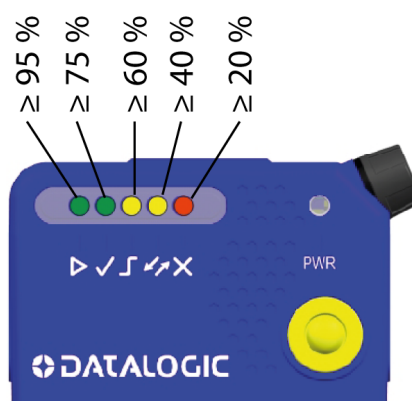


Figure 14 – Test Function Bar Graph

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 °C / 32 – 133 °F), 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

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 °C / 32 – 133 °F
- Sulfur Gas Protection according to DIN EN 60068–2–43

Indicator and Keypad Button

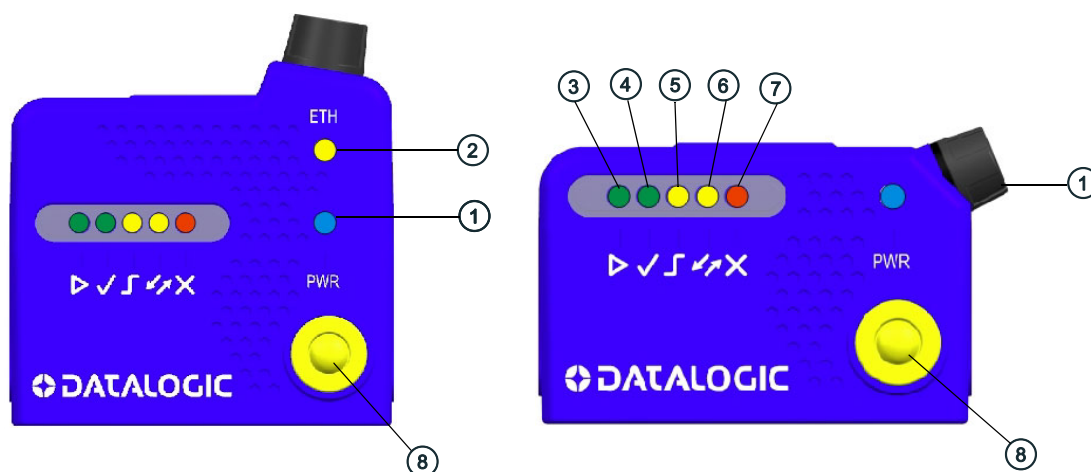


Figure 15 – Indicators

The following LED indicators are located on the reader:

PWR	blue LED indicates that the reader is connected to the power supply (Figure 15 –, 1)
NET	yellow LED indicates connection to the on-board Ethernet network (Figure 15 –, 2)

In normal operating mode 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 15 –, 3)
GOOD	green LED confirms successful reading (Figure 15 –, 4)
TRIGGER	yellow LED indicates the status of the reading phase (Figure 15 –, 5)
COM	yellow LED indicates active communication on the main serial port * (Figure 15 –, 6)
STATUS	red LED indicates a NO READ result (Figure 15 –, 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 X-PRESS Configuration mode the colors and meaning of these five LEDs are described in .

The keypad button (Figure 15 –, 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:

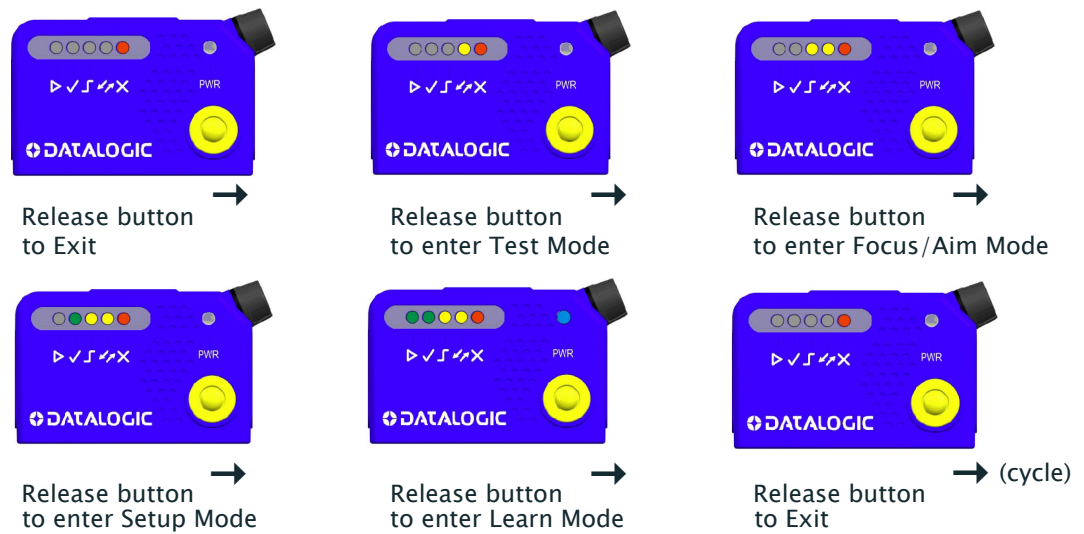
	Test Mode with bar graph visualization to check static reading performance.	
	Focus (Aim) turns on the laser indicator to aim the reader at the target. The target should be placed a few mm to the left and centered vertically with respect to the aiming pattern (cross).	
	Setup to self-optimize and auto-configure 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:

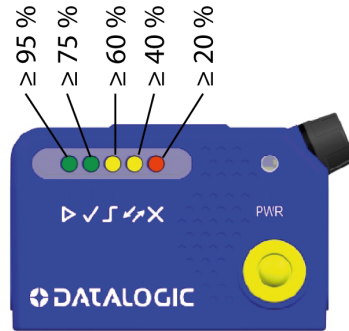
1. **Press** the button (the Status LED will give a visual feedback).
2. **Hold** the button until the specific function LED is on (Test, Focus/Aim, Setup or Learn).
3. **Release** the button to enter the specific function.

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



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.

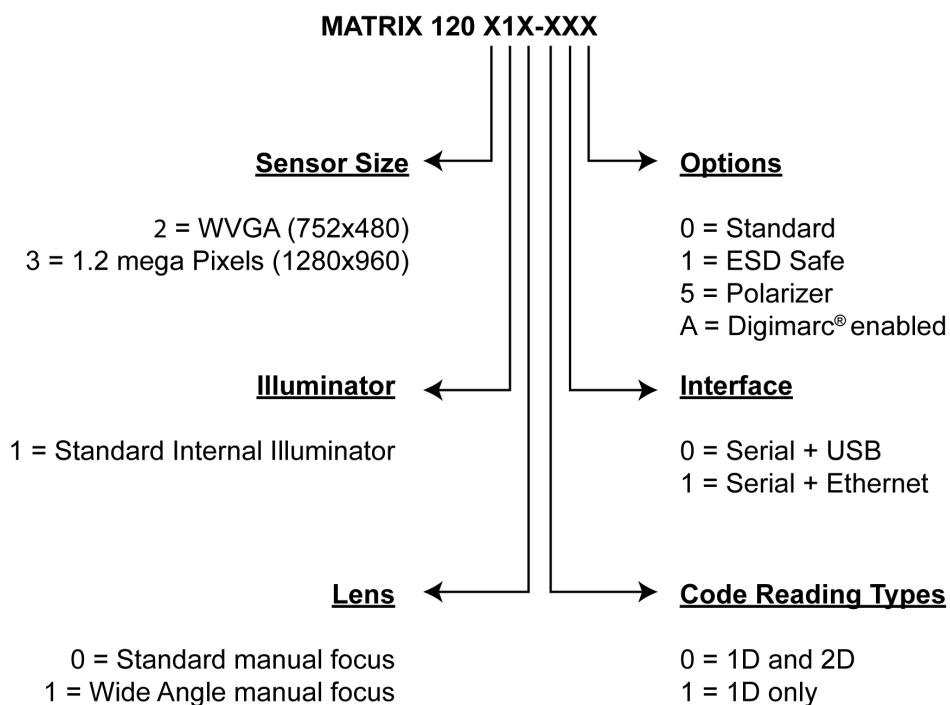
Diagnostic Indication

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.



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 16 –](#)).



Figure 16 – 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 17 –](#), [Figure 18 –](#), and [Figure 19 –](#)).

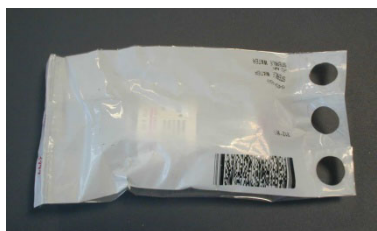


Figure 17 – Unidose Flow-Pack with PDF417 Code



Figure 18 – Overprinted Barcode Readable by Matrix 120 also Through the Envelope Window Film



Figure 19 – Barcode Printed on Curved Surface Readable by Matrix 300N in spite of Image Optical Distortion

Ink-Jet Printing Technology

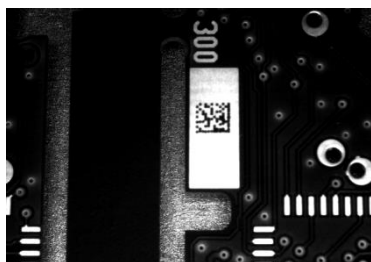


Figure 20 – Dot Matrix Code Directly Marked on PCB Copper Pad by Using Ink-Jet Technology

Laser Marking/Etching Technology



Figure 21 – 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.



WA Polarizer Model Reading Reflective Label



Standard Model Reading Reflective Label

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.

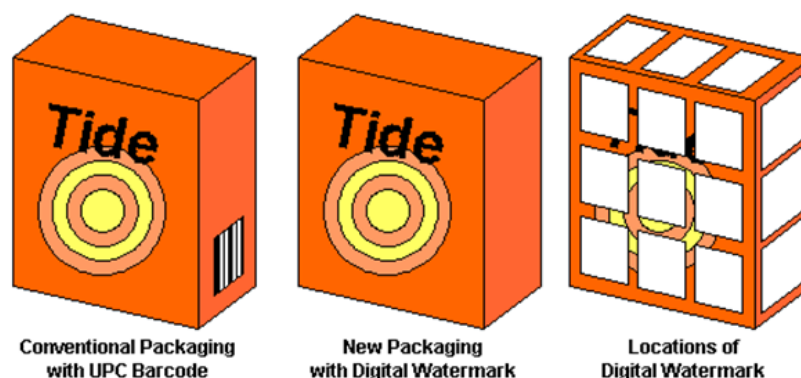


Figure 22 – Digimarc Barcode distributed on all sides of the packaging

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 23 – 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)

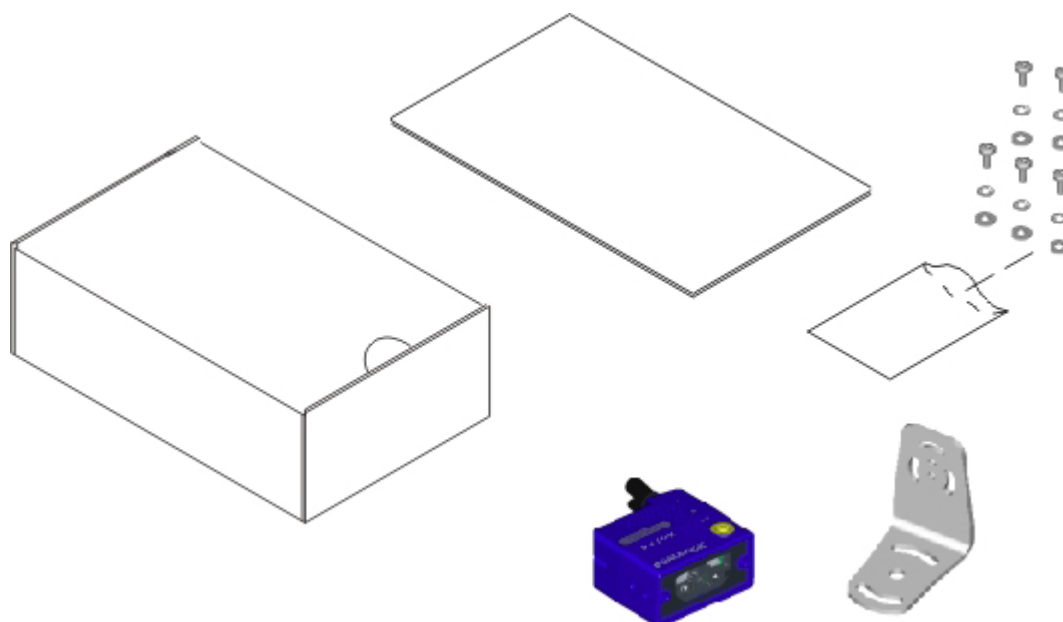


Figure 22 – Package Contents

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 23 -](#)).

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

Refer to page 50 for various mounting solutions and correct positioning, and [Chapter 6](#) for FOV vs. Reading Distance considerations.

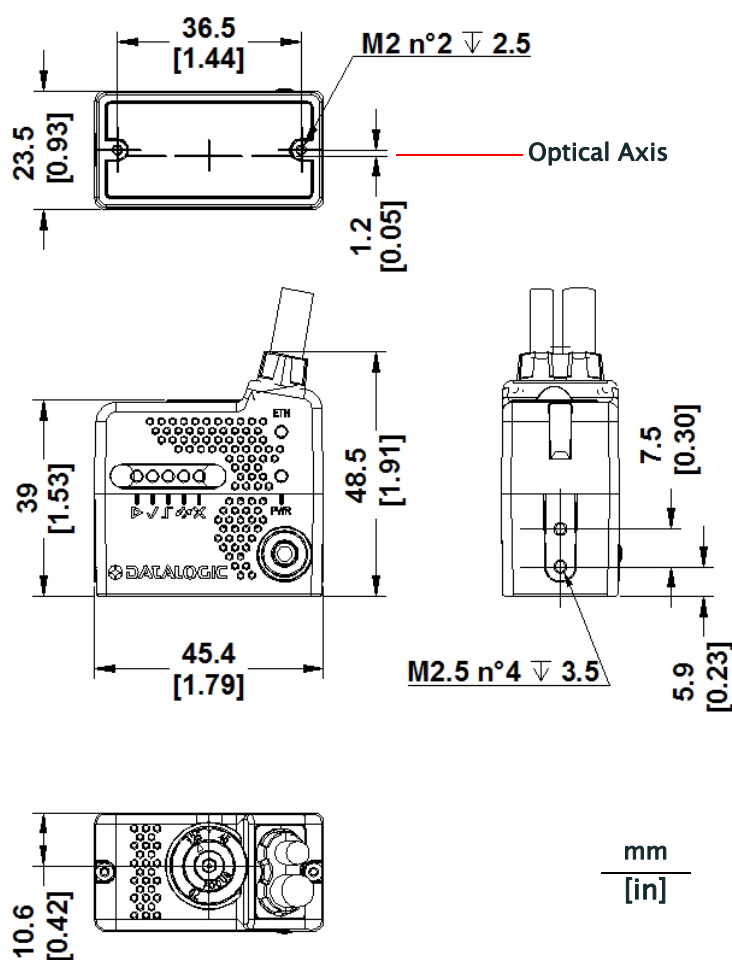


Figure 23 – Overall Dimensions of Matrix 120 Ethernet Models

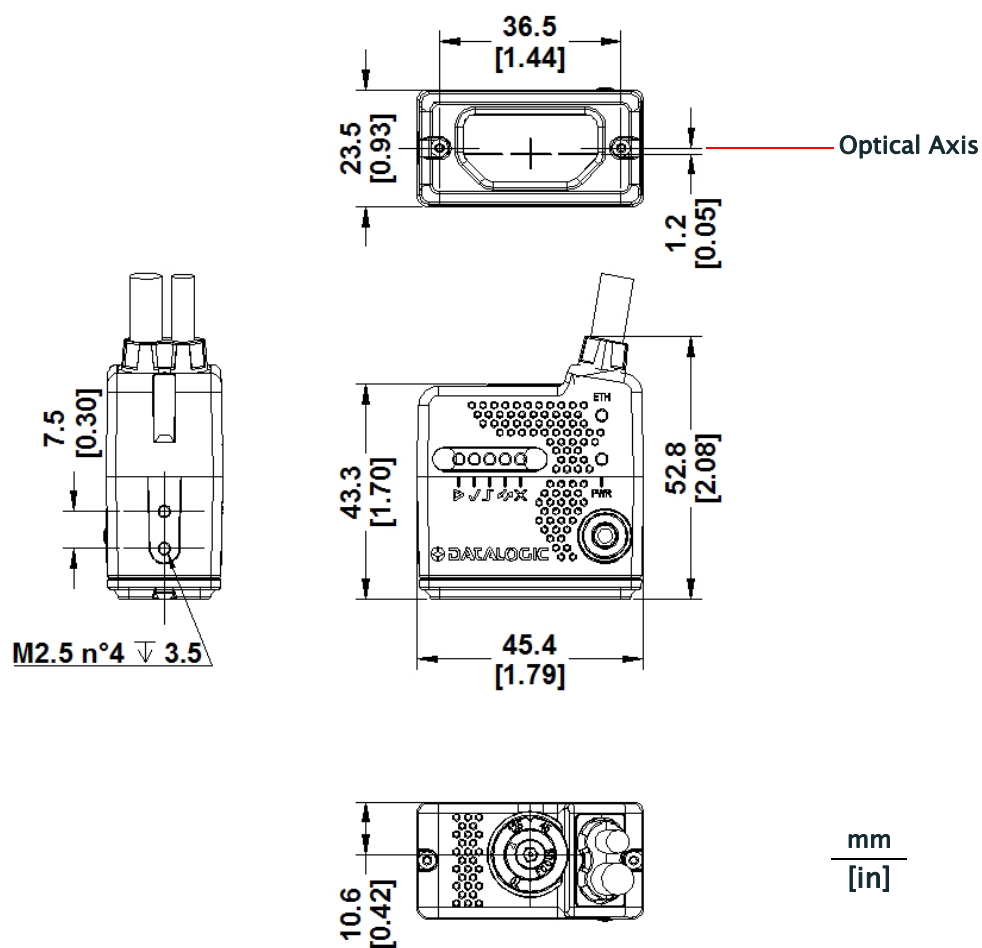


Figure 24 – Overall Dimensions of Matrix 120 Ethernet Models with ESD Cover

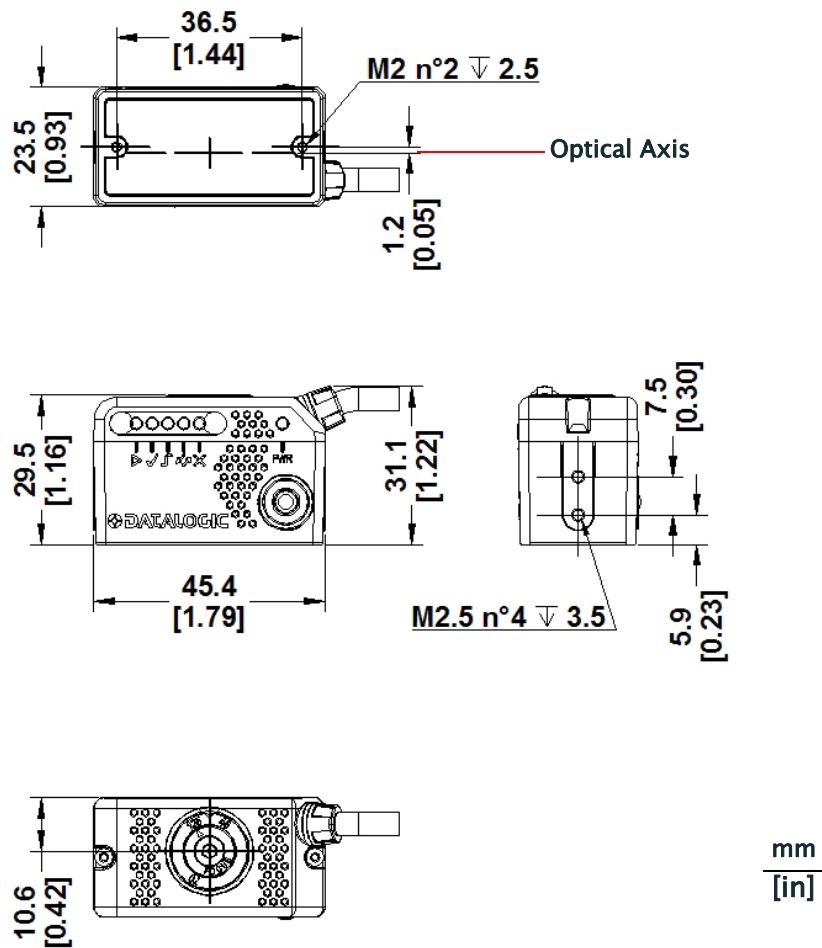


Figure 25 – Overall Dimensions of Matrix 120 USB Models

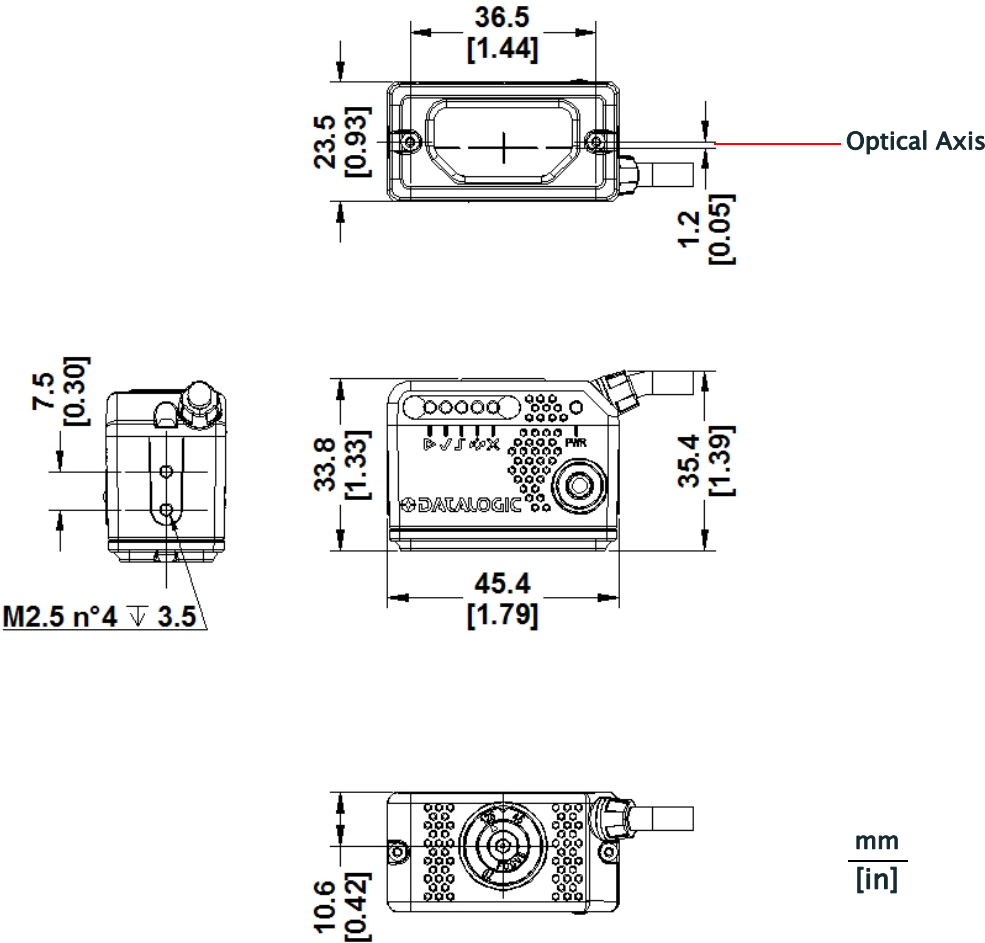


Figure 26 – Overall Dimensions of Matrix 120 USB Models with ESD Cover

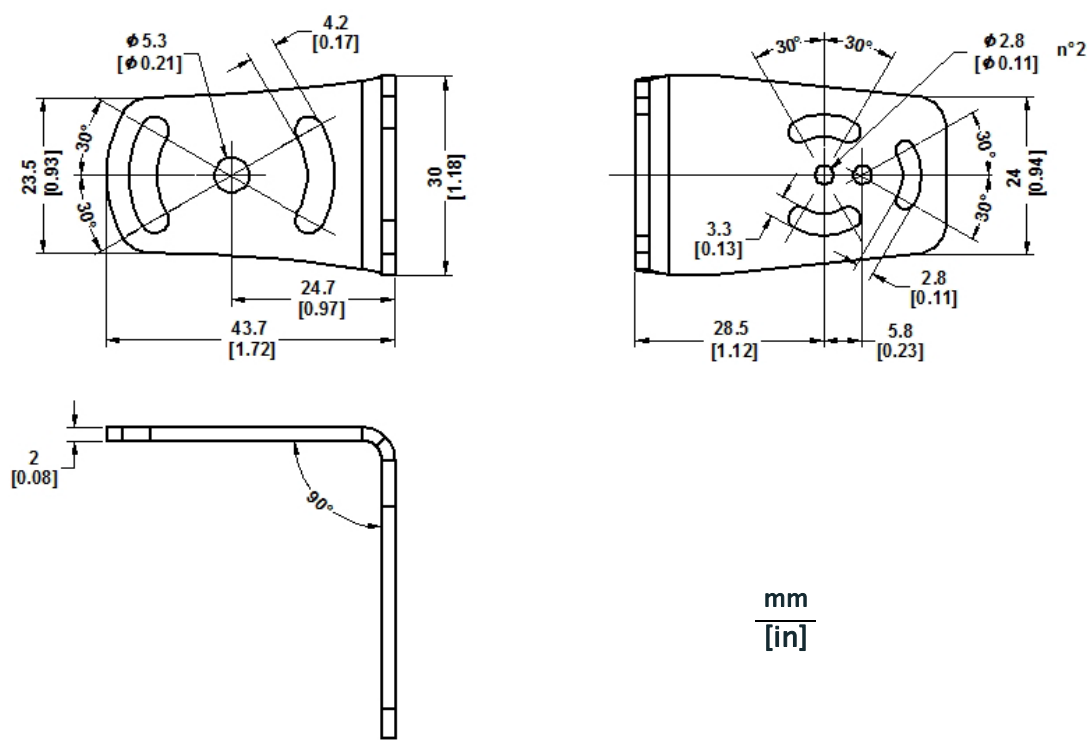


Figure 27 – Mounting Bracket Overall Dimensions

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:

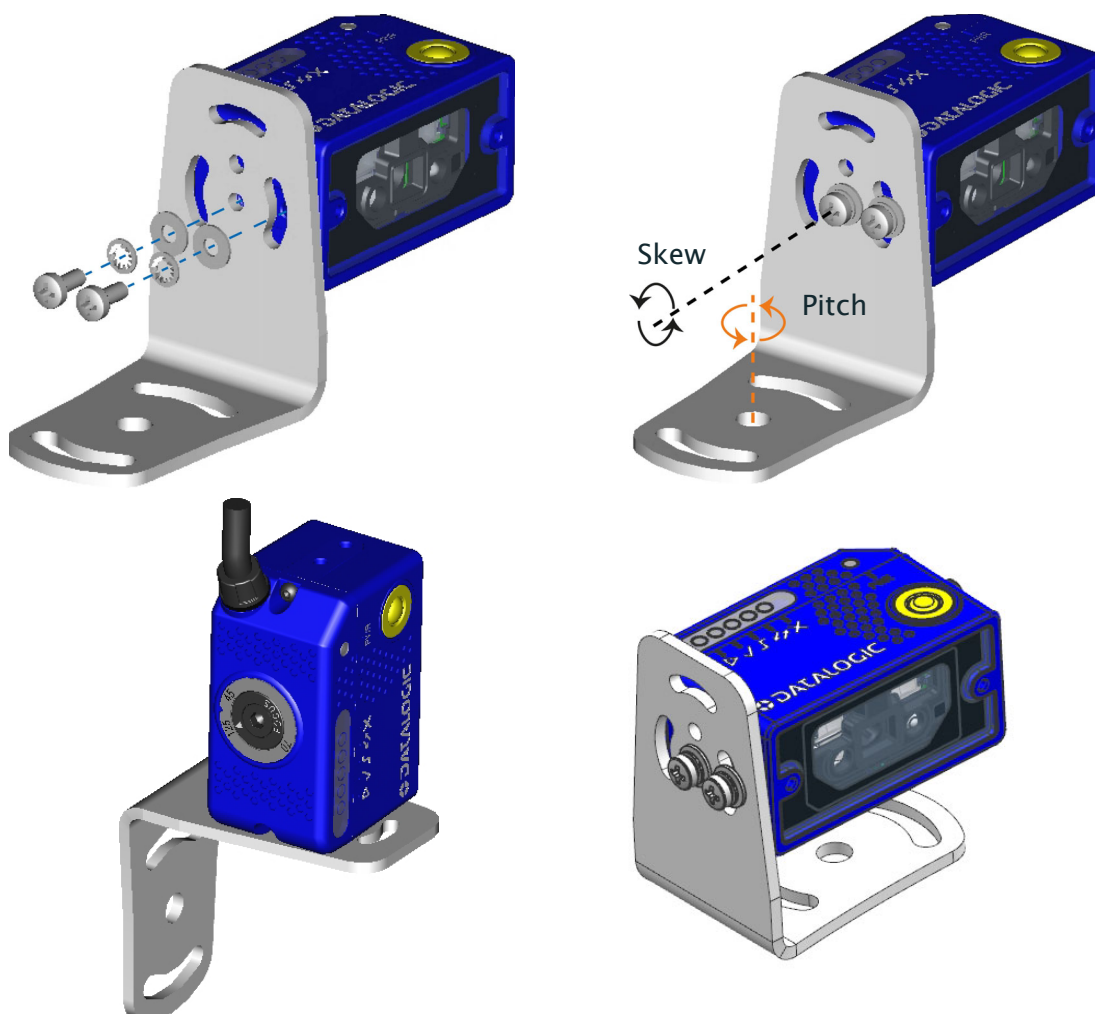


Figure 28 – Bottom Mounting Positions for USB Models

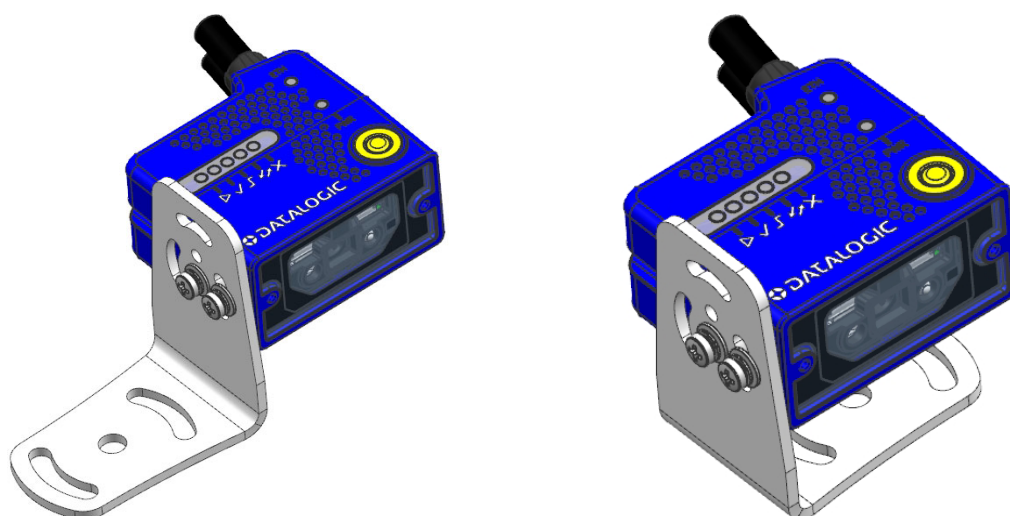


Figure 29 – Bottom Mounting Positions for Ethernet Models



Figure 30 – Side Mounting Positions for USB Models

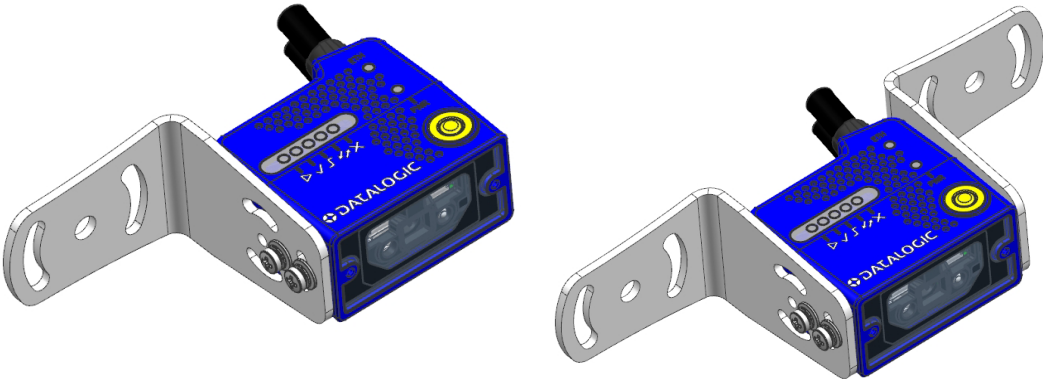


Figure 31 – Side Mounting Positions for Ethernet Models

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 32](#) -. 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.

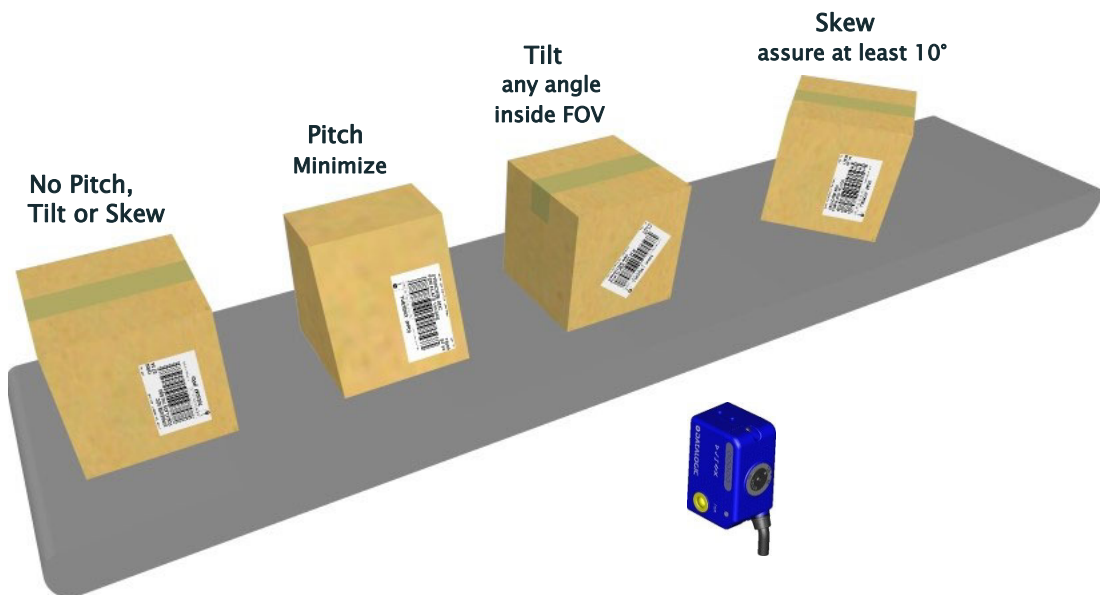


Figure 32 – Code Reading Orientation

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 33](#) -. 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.



Figure 33 – 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 used 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.





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

Group	Label	Description
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 ID-NET	Matrix 120 has not Auxiliary Interface	
	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 57 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 34 –:

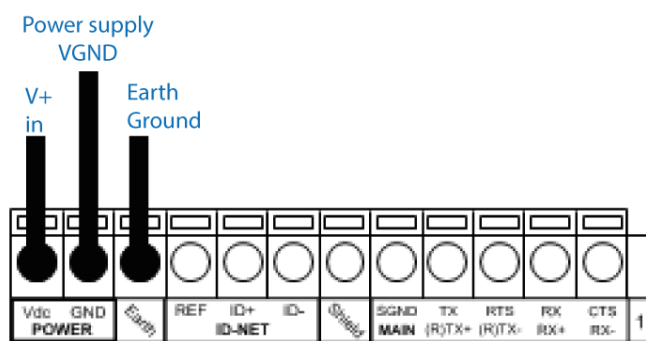


Figure 34 – Power Supply Connections

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).

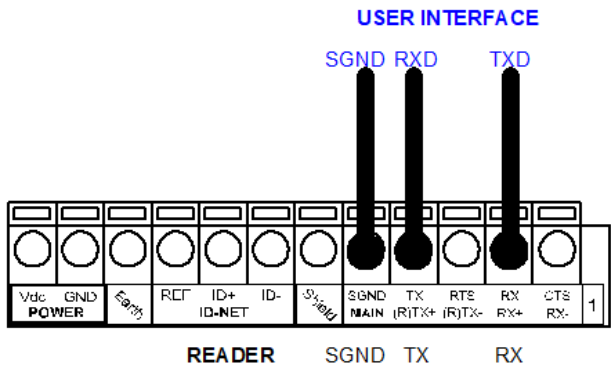


Figure 35 – RS232 Main Interface Connections

RS422 Full Duplex Interface

The RS422 full-duplex (5 wires + shield) interface is used for non-pollled 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

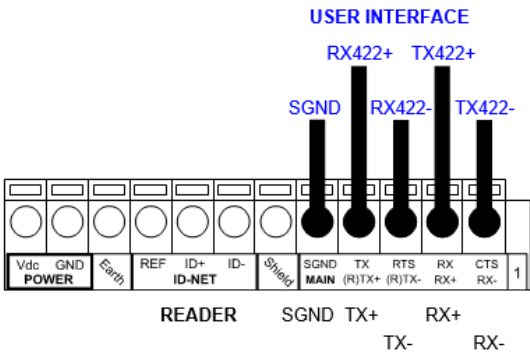


Figure 36 – RS422 Full Duplex Connections

**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.

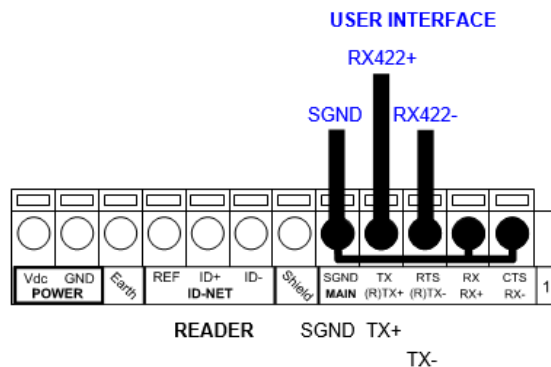


Figure 37 – RS422 Full Duplex Connections Using Only TX Signals to Host

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 [Line Type configuration parameters](#) 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:

$$V_{AB} = 30 \text{ Vdc max.}$$

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

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 15 –, 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.

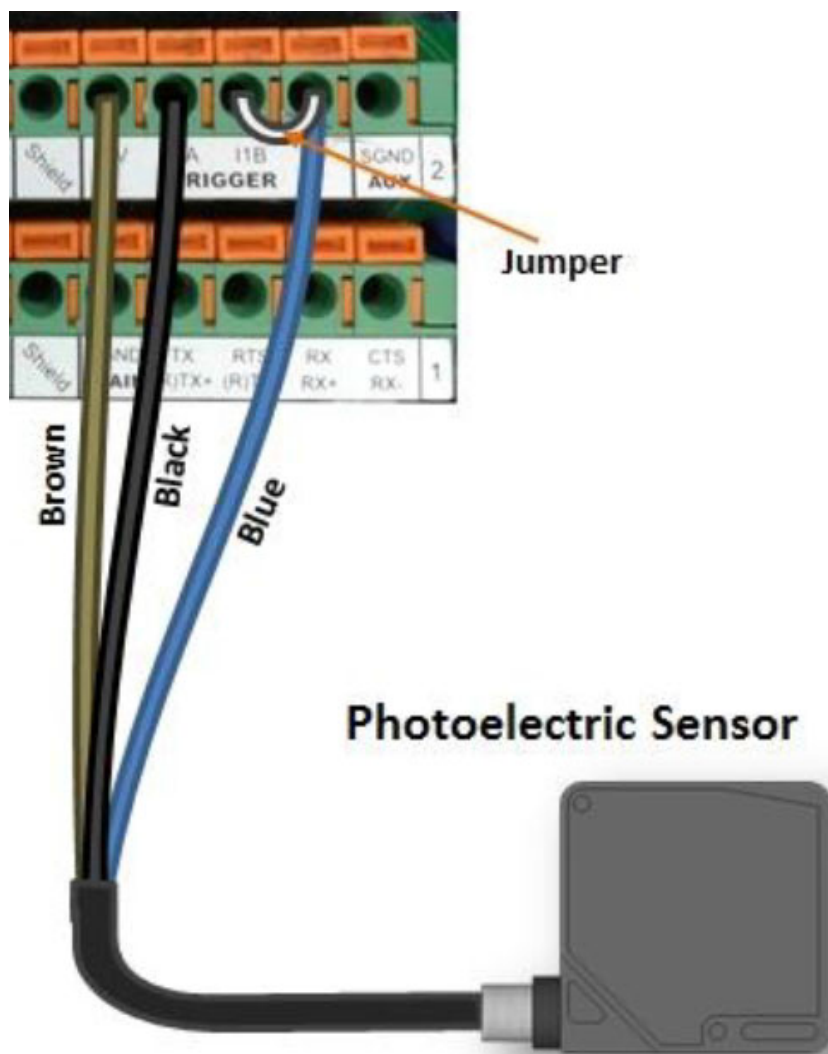


Figure 38 – PNP External Trigger Using Matrix 120 Power

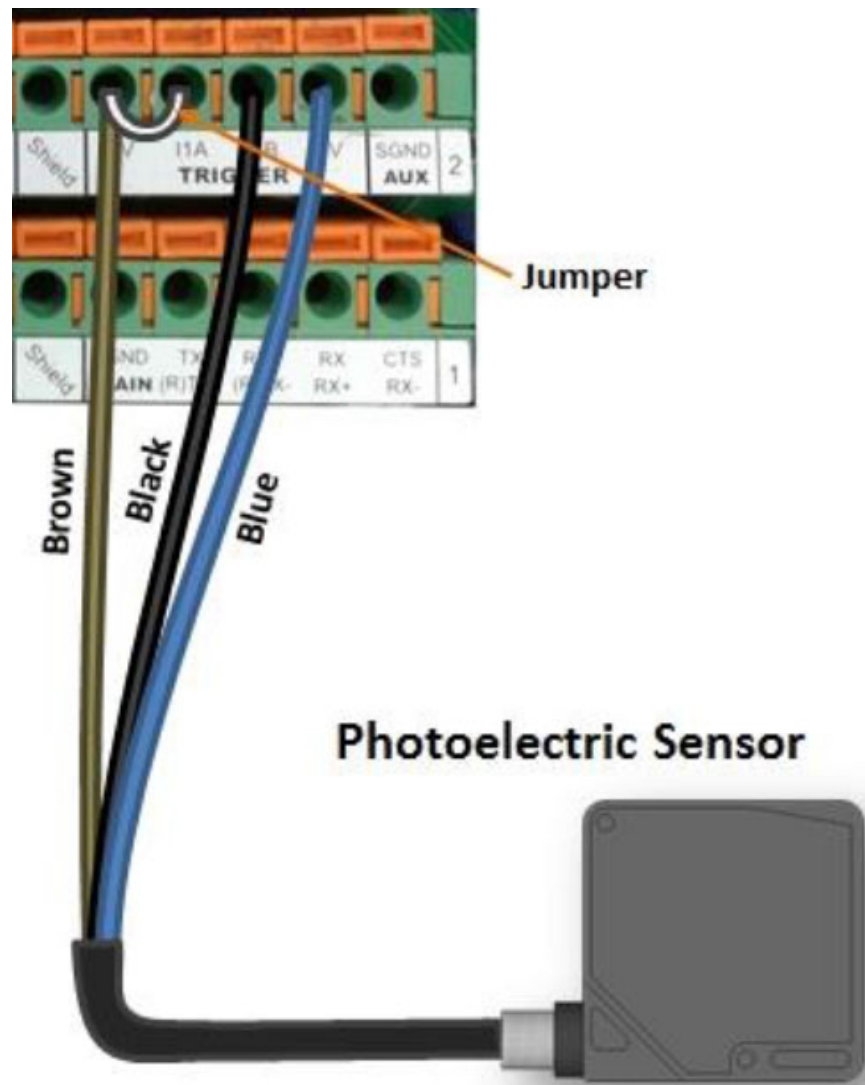


Figure 39 – NPN External Trigger Using Matrix 120 Power

External Trigger Input Connections Using External Power

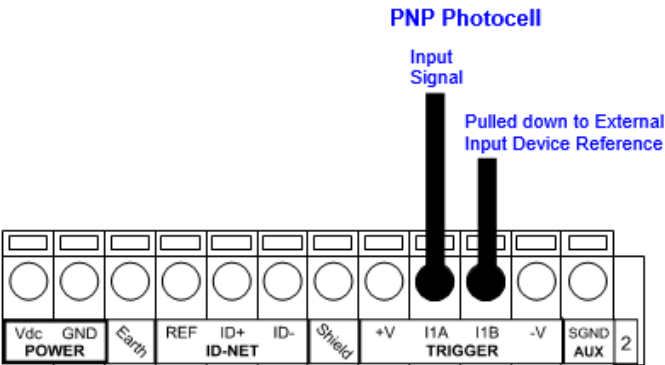


Figure 40 – PNP External Trigger Using External Power

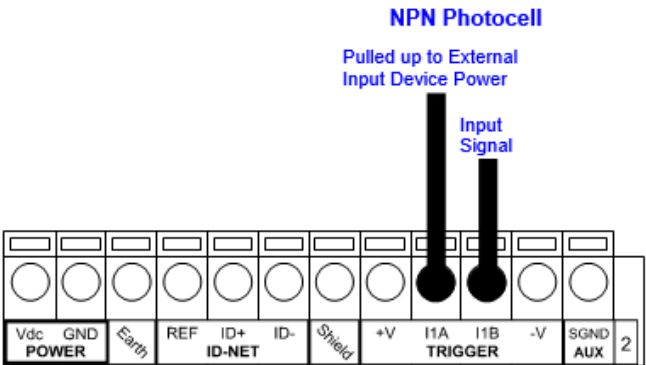


Figure 41 – NPN External Trigger Using External Power

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.

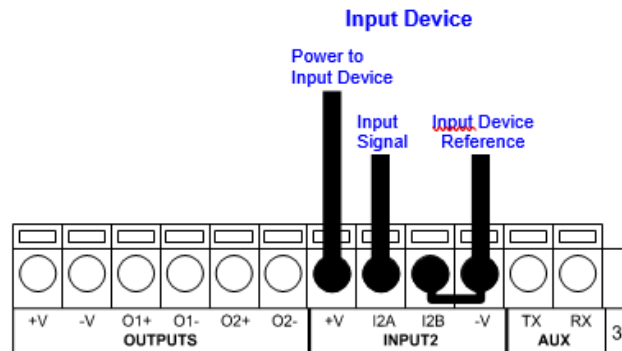


Figure 42 – PNP Input 2 Using Matrix 120 Power

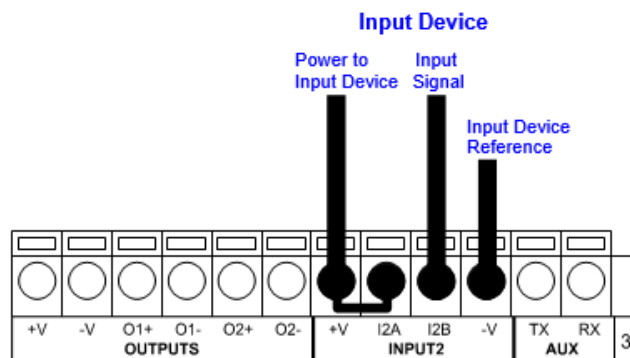


Figure 43 – NPN Input 2 Using Matrix 120 Power

Input 2 Connections Using External Power

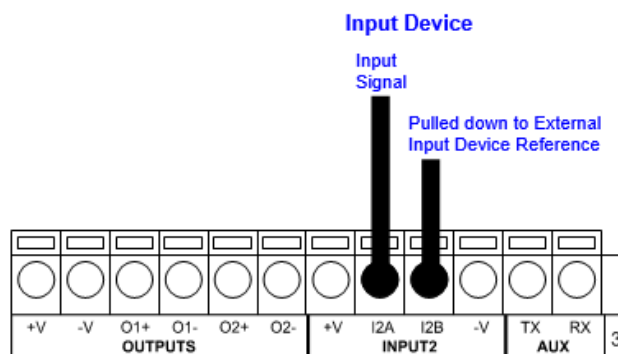


Figure 44 – PNP Input 2 Using External Power

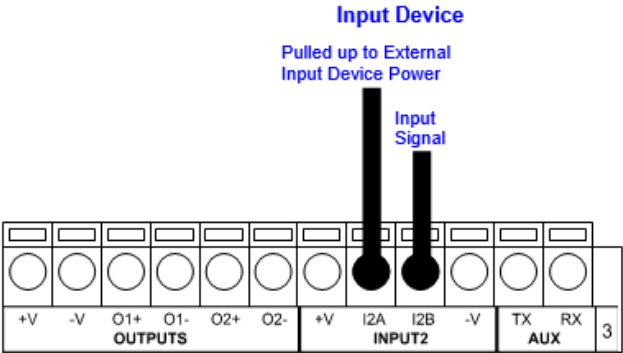


Figure 45 – NPN Input 2 Using External Power

Outputs



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

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.

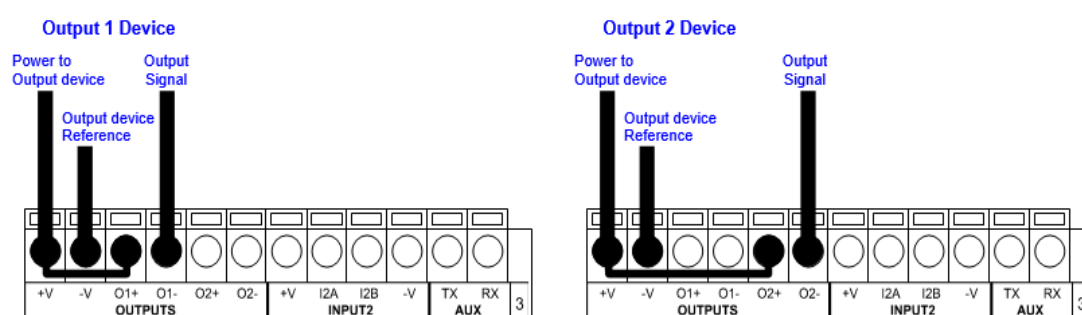


Figure 46 – PNP/Open Emitter Output Using Matrix 120 Power

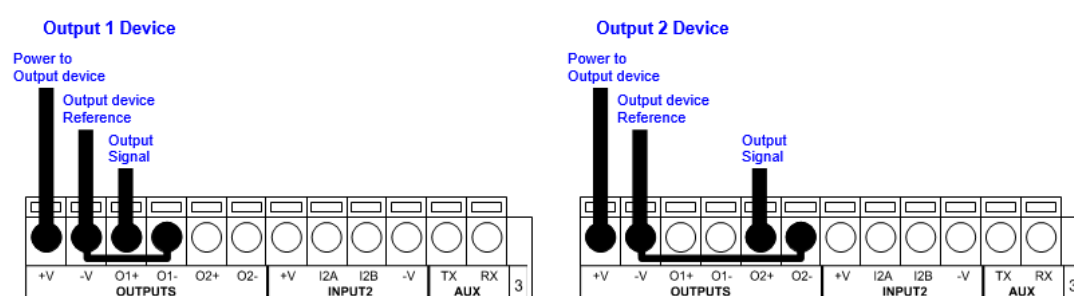


Figure 47 – NPN/Open Collector Output Using Matrix 120 Power

Output 1 and 2 Connections Using External Power



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.

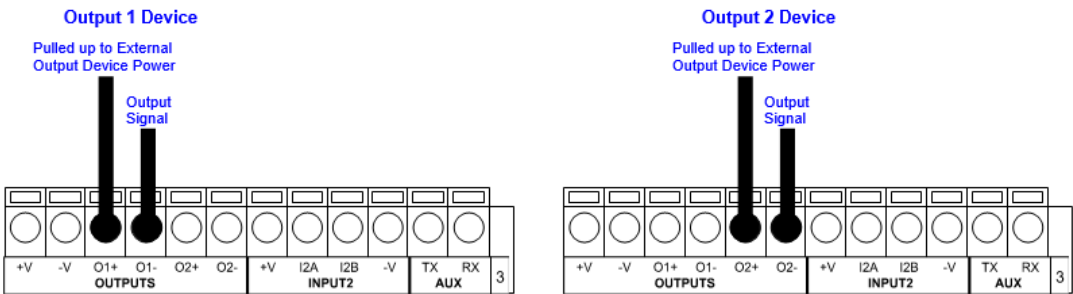


Figure 48 – PNP/Open Emitter Output Using External Power

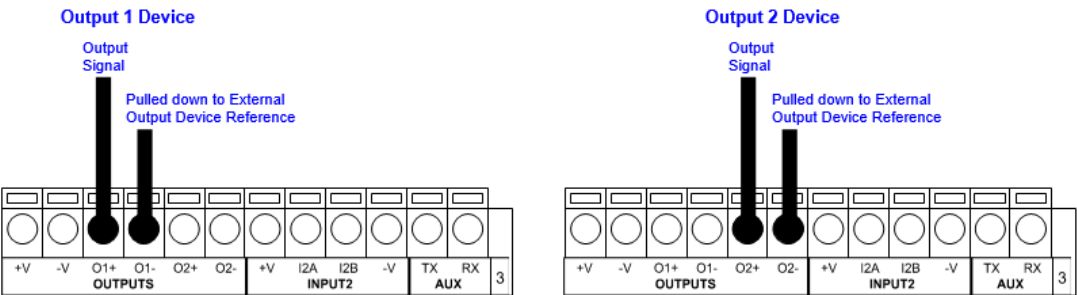


Figure 49 – NPN/Open Collector Output Using External Power

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

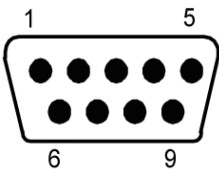
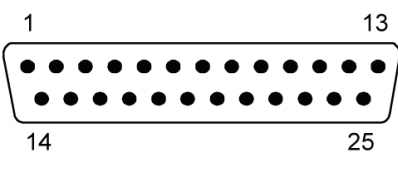
The following Fieldbus protocols are also available over the on-board Ethernet interface:

- EtherNet/IP
- PROFINET IO
- Modbus TCP Client

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			
 <p>9-pin male connector</p>		 <p>25-pin male connector</p>	
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 can 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.

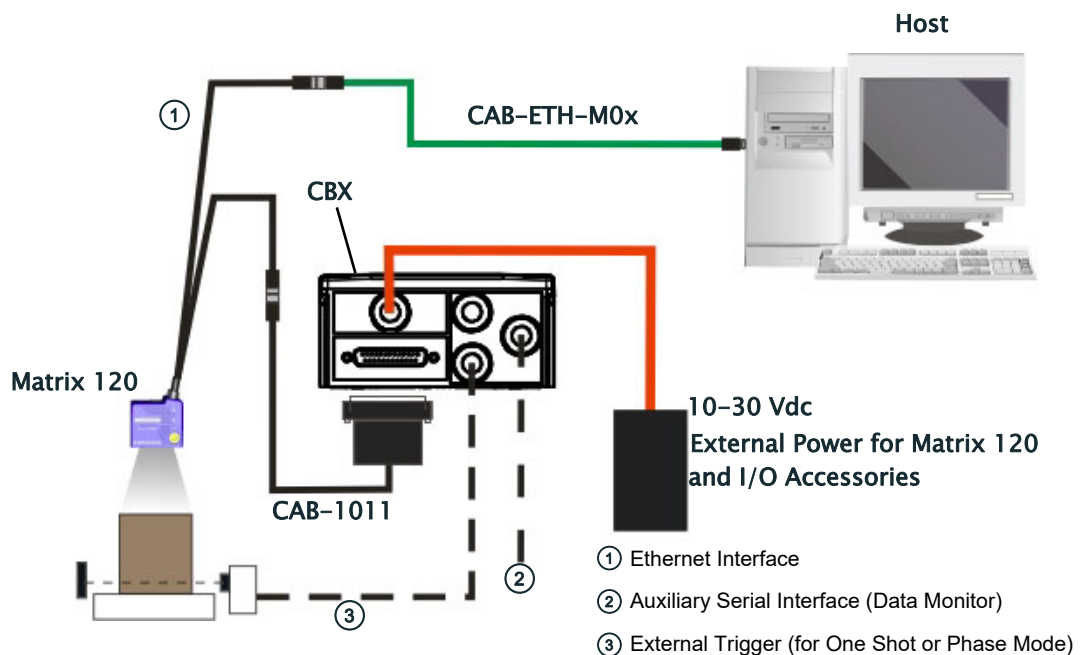


Figure 50 – Ethernet Point-to-Point Layout

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

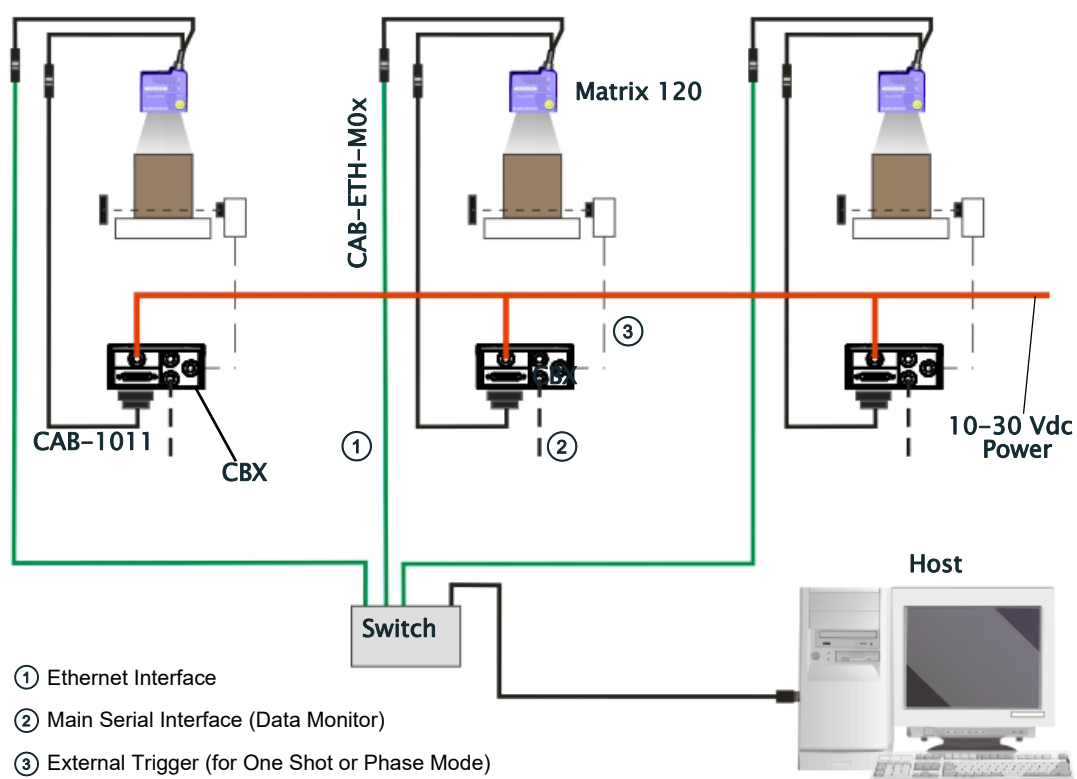


Figure 51 – Ethernet Network Layout

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.

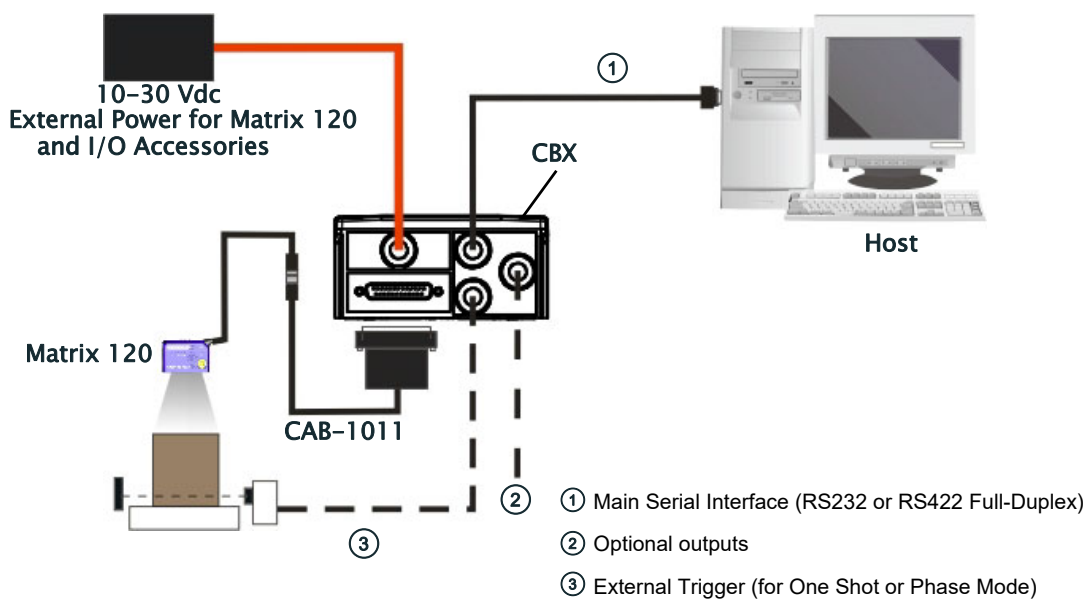


Figure 52 - Serial Interface Point-to-Point Layout

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

Fieldbus Connection



CAUTION

Matrix 120 readers do not have Auxiliary Serial interfaces. Therefore, neither data monitoring nor device configuration can 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 Fieldbus 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.

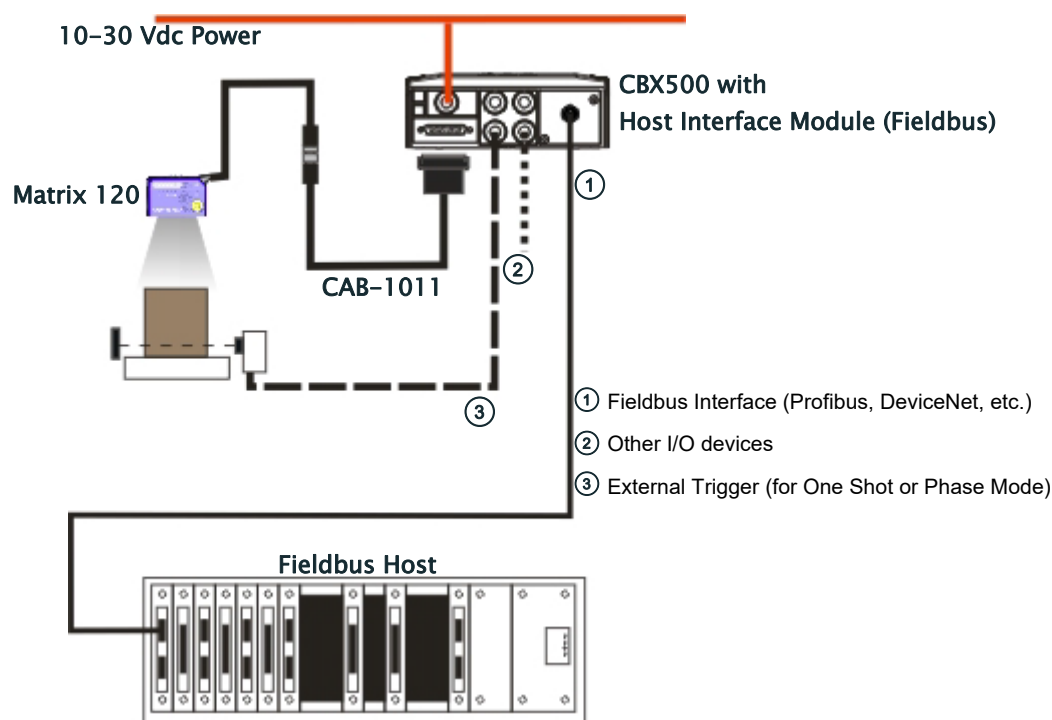


Figure 53 – Fieldbus Interface Point-to-Point Layout



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.

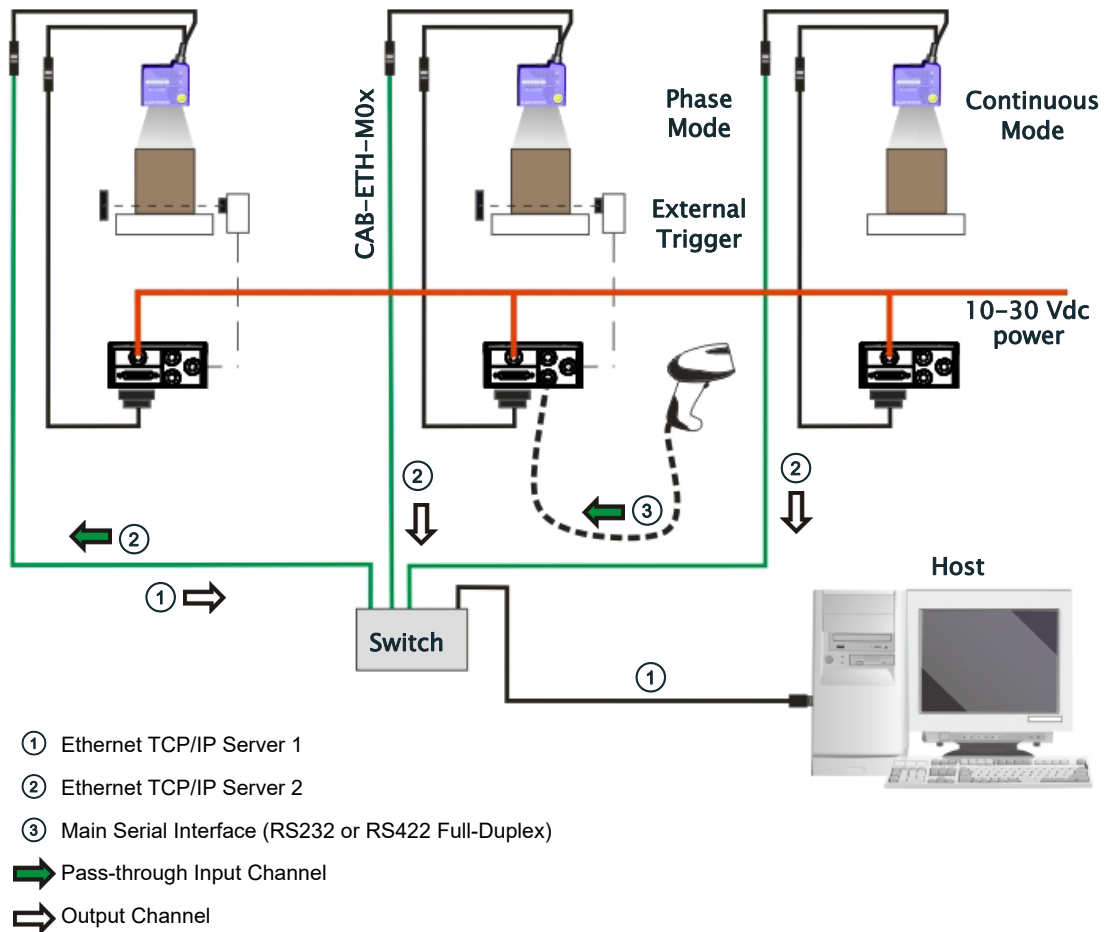


Figure 54 – Pass-Through Layout

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.

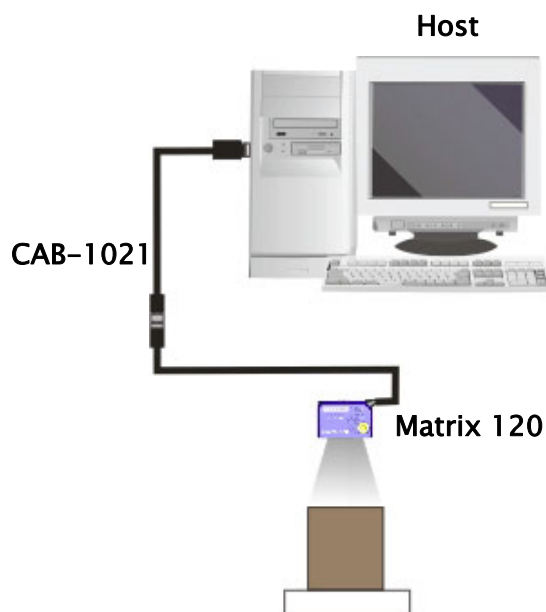


Figure 55 – USB Point-to-Point Layout



NOTE

USB-HID (Keyboard Wedge) configurations can also be made through this interface. See "USB-HID (Keyboard Wedge) Configurations" on page 139.

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.

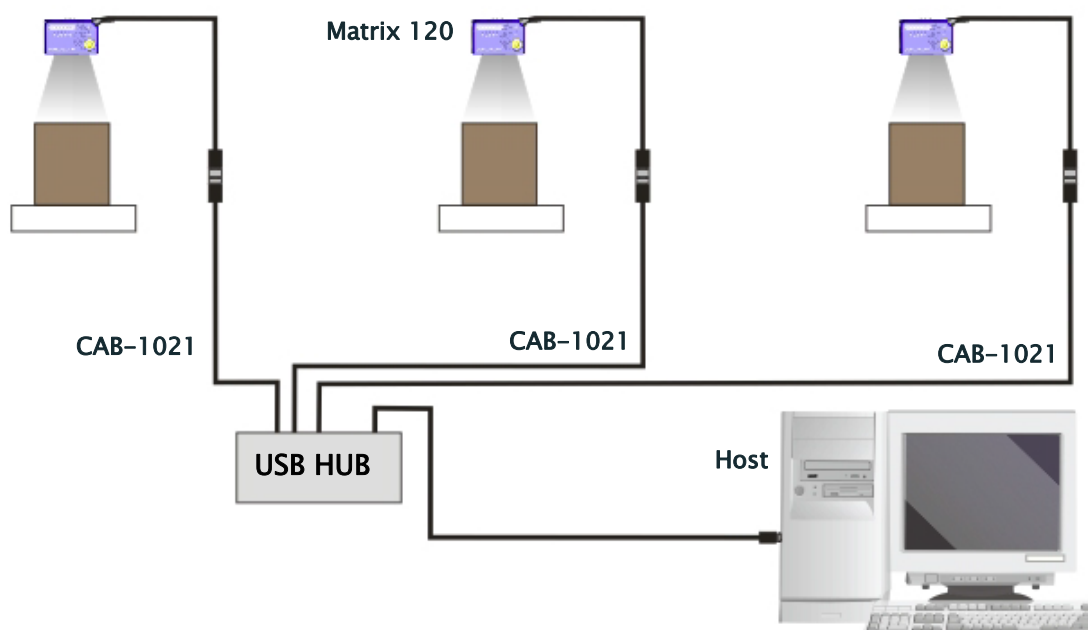


Figure 56 – USB Layout to HUB

The CAB-1051 allows I/O devices to be connected to the reader when using the USB interface.

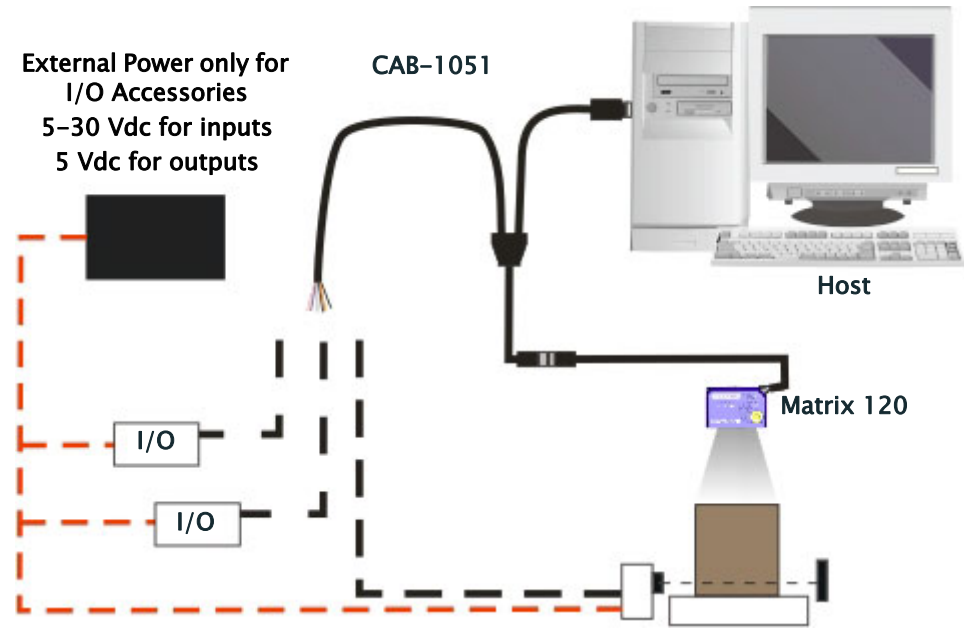
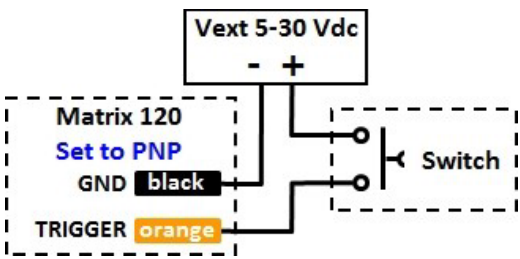
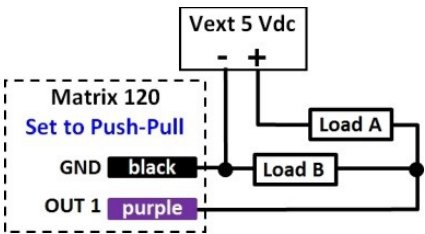


Figure 57 – USB Point-to-Point Layout with I/O

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
$V_{ext} = 5-30 \text{ Vdc max}$ $I_{IN} = 3.5 \text{ mA max}$	$V_{ext} = 5 \text{ Vdc max}$ $I_{CE} = 100 \text{ mA max}$
<div><div><div>Vext 5-30 Vdc</div><div><div>Matrix 120</div><div>Set to NPN or PNP</div><div>GND black</div><div>TRIGGER orange</div></div><div><div>NPN or PNP Sensor</div><div>brown V+</div><div>blue GND</div><div>black N.O. or Output</div></div></div></div>	<div><div><div>Vext 5 Vdc</div><div><div>Matrix 120</div><div>Set to NPN</div><div>GND black</div><div>OUT 1 purple</div></div><div>Load</div></div></div>
<div><div><div>Matrix 120</div><div>GND black</div><div>TRIGGER orange</div><div>Set to NPN</div></div><div>Switch</div></div>	<div><div><div>Matrix 120</div><div>Set to PNP</div><div>GND black</div><div>OUT 1 purple</div></div><div>Load</div></div> <div>$V_{out} = 3.3 \text{ Vdc max}$ $I_{out} = 50 \text{ mA max}$</div>

Inputs	Outputs
 <p>Vext 5-30 Vdc</p> <p>Matrix 120 Set to PNP GND black TRIGGER orange</p> <p>Switch</p>	 <p>Vext 5 Vdc</p> <p>Matrix 120 Set to Push-Pull GND black OUT 1 purple</p> <p>Load A Load B</p>
<p>CAB-1051</p> <p>Input 1 (Trigger) = orange</p> <p>Input 2 = gray</p> <p>GND = black</p>	<p>CAB-1051</p> <p>Output 1 = purple</p> <p>Output 2 = red/white</p> <p>GND = black</p>



Chapter 6

Reading Features

FOV Calculation

Use the data in the following table to calculate the FOV for your application, referring to [Figure 58](#) – 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 $\pm 1^\circ$ depending on the reading distance.

$$FOV_x = 2 [(d + d_0) \tan (\alpha_x/2)]$$

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

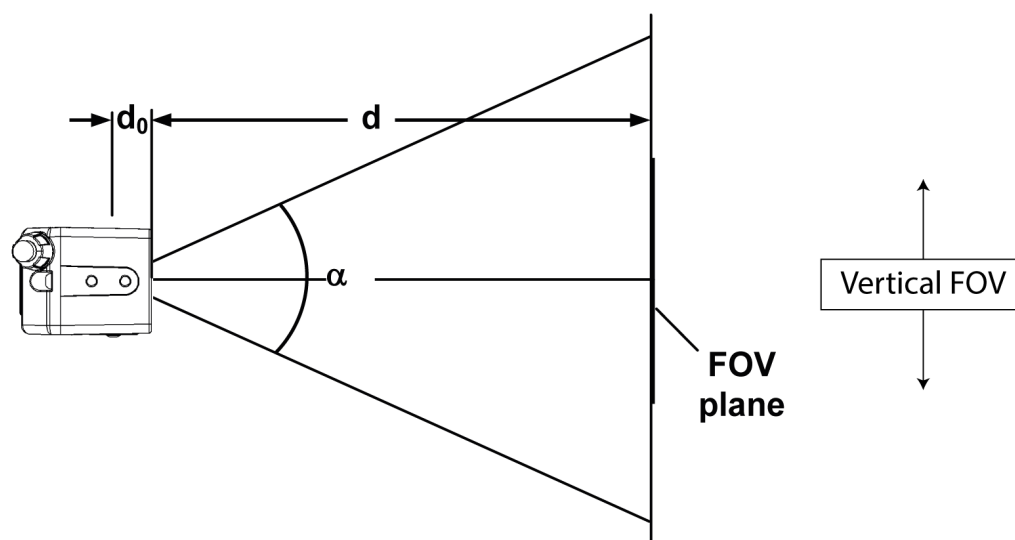


Figure 58 – Reading Distance References

Example:

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

$$\text{FOV}_H = 2 [(100 \text{ mm} + 8 \text{ mm}) * \tan (41^\circ/2)] \cong \mathbf{81 \text{ mm}}$$

$$\text{FOV}_V = 2 [(100 \text{ mm} + 8 \text{ mm}) * \tan (32^\circ/2)] \cong \mathbf{62 \text{ mm}}$$

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 Processing Mode = Advanced. 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 83 for specific reading area examples.

Matrix 120 210-xxx WVGA Models

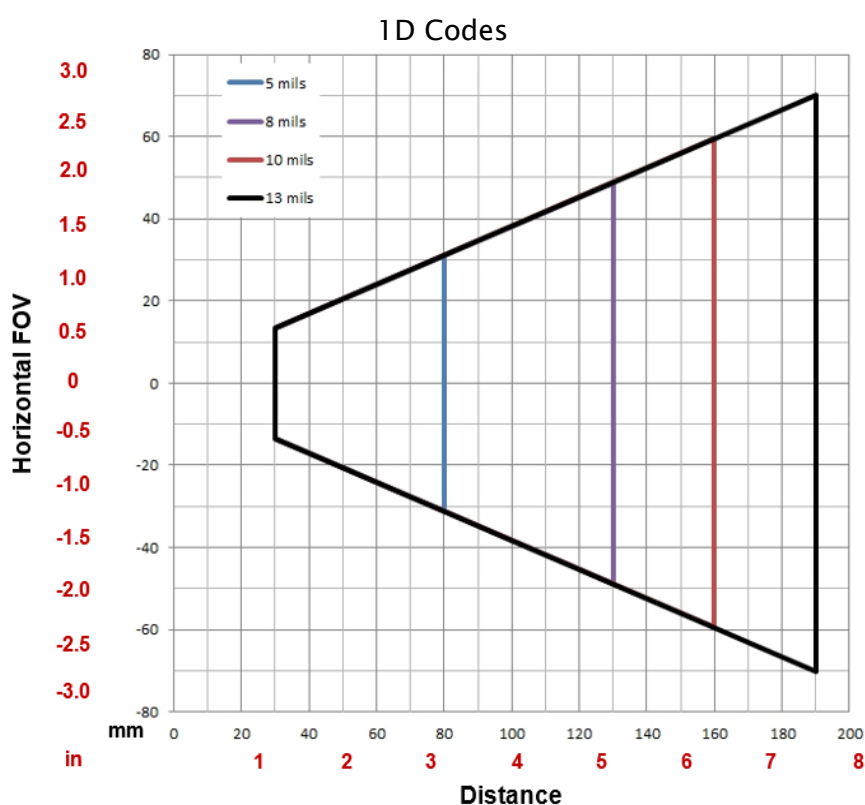


Figure 59 – Global FOV 1D Code Diagram for WVGA Models

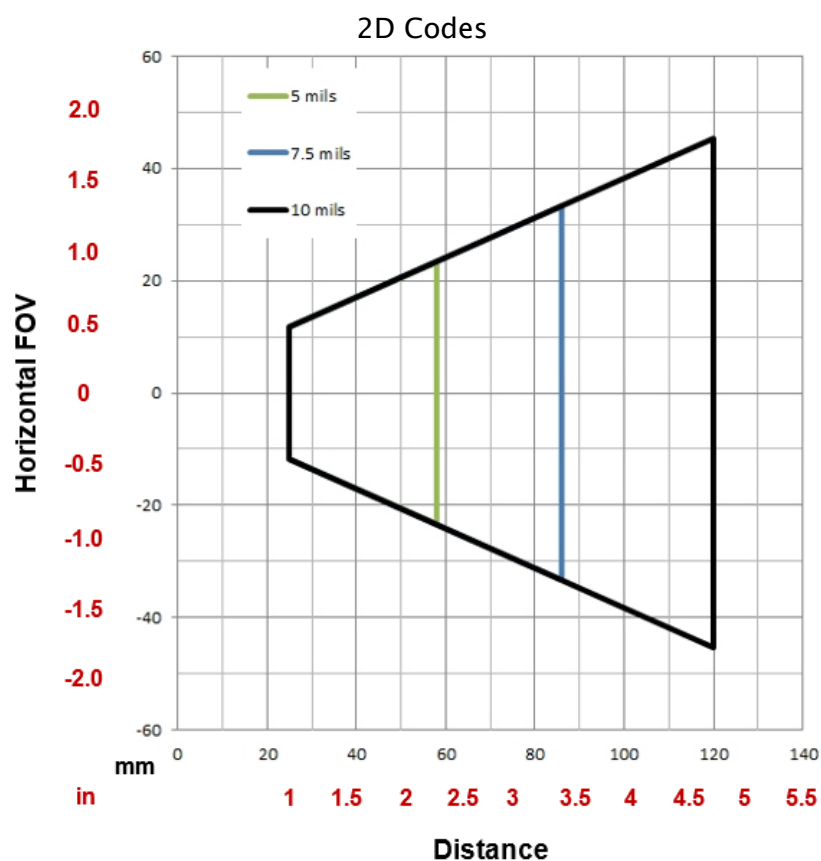


Figure 60 – Global FOV 2D Code Diagram for WVGA Models

Matrix 120 310-xxx MP Models

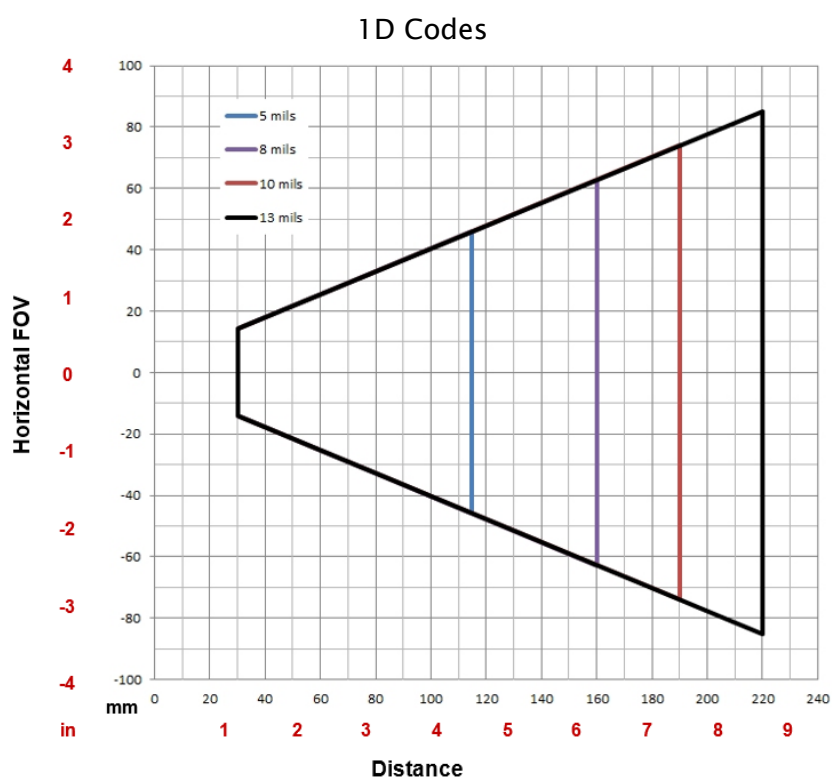


Figure 61 – Global FOV 1D Code Diagram for MP Models

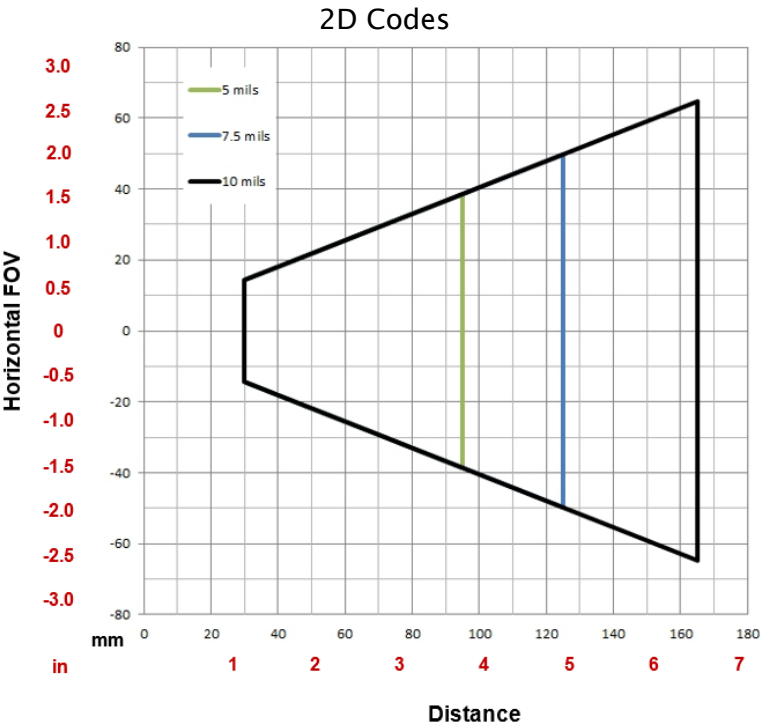


Figure 62 – Global FOV 2D Code Diagram for MP Models

Matrix 120 311-xxx MP + WA Models

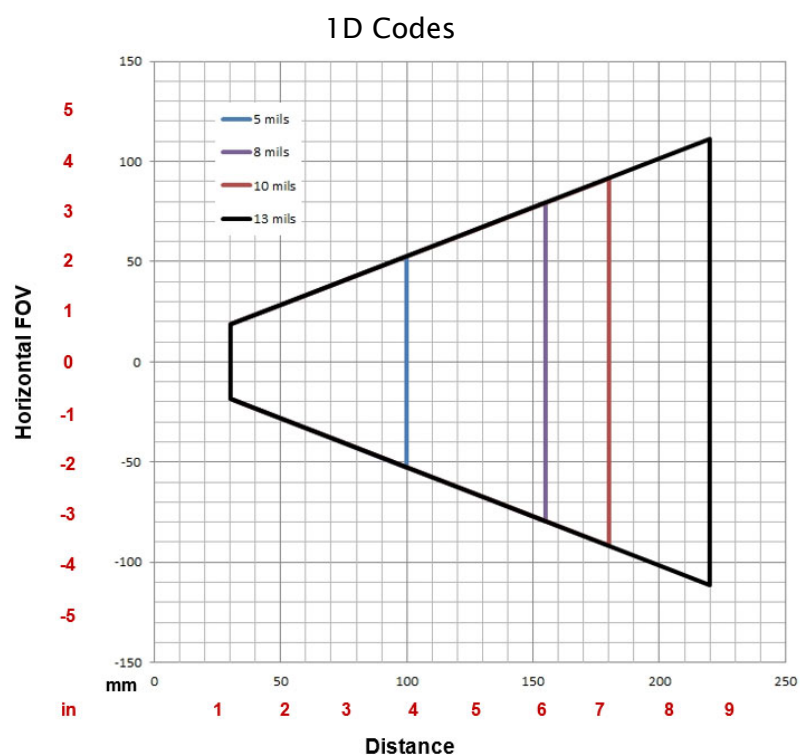


Figure 63 – Global FOV 1D Code Diagram for MP Models

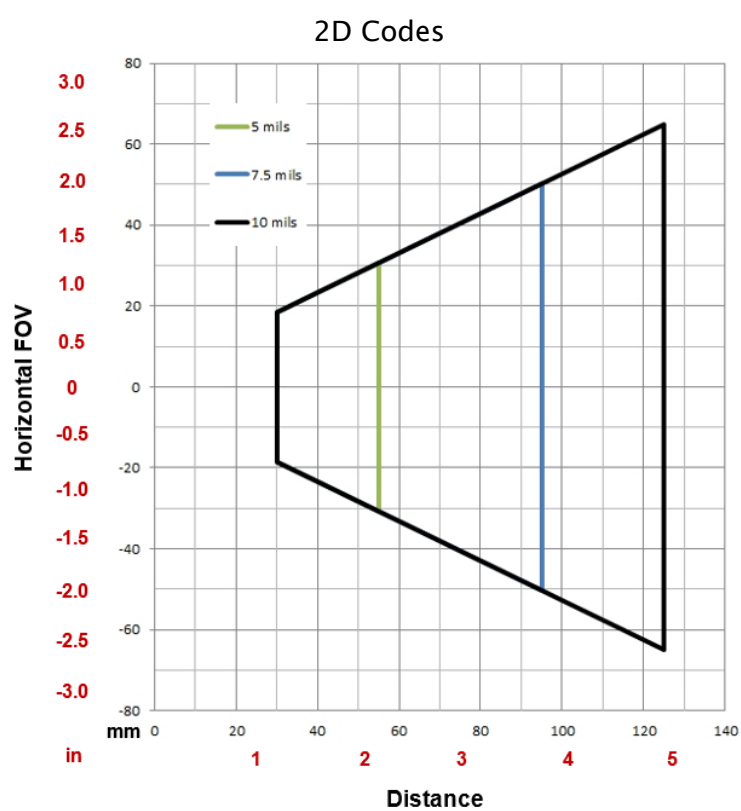
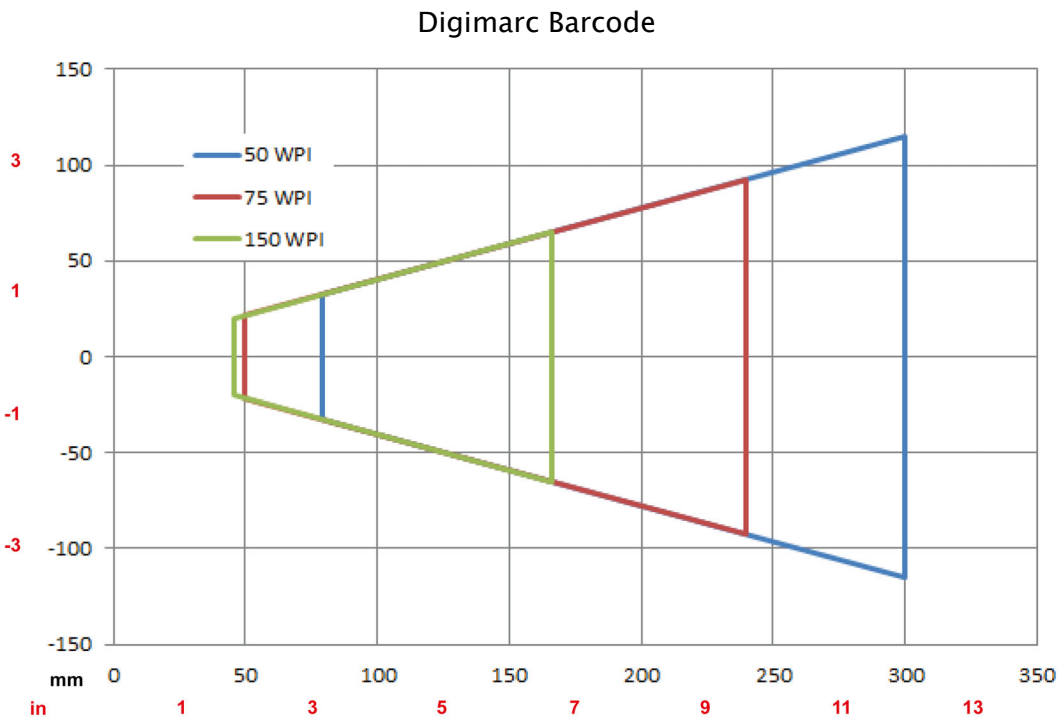


Figure 64 – Global FOV 2D Code Diagram for MP Models

Matrix 120 310-xxA Models



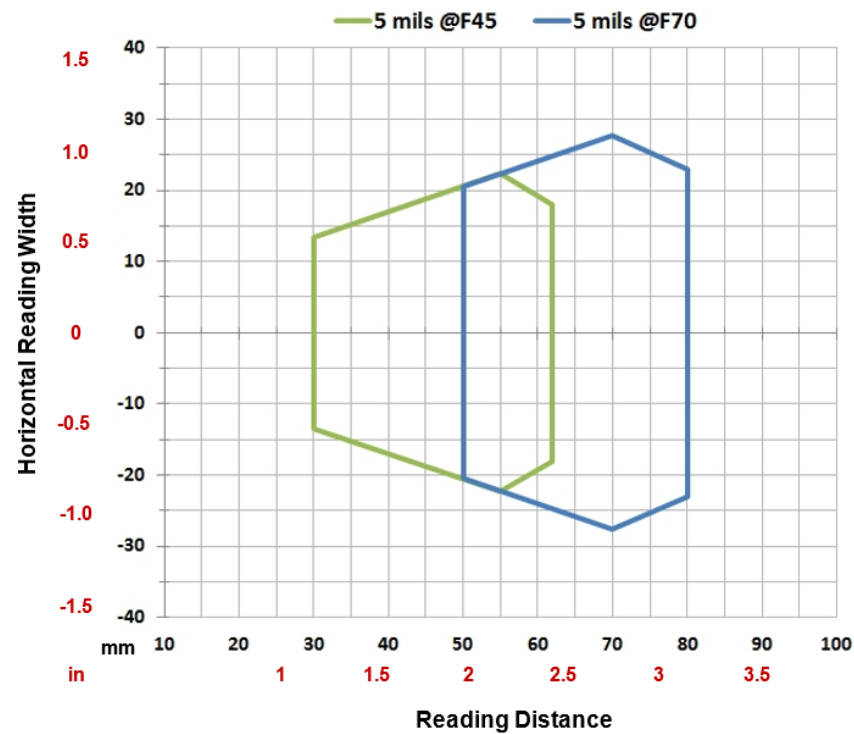
Reading Diagrams

- 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. $FOVV. \cong FOVH \times 0.64$);
 - for MP it is about equal to 0.75; specifically 960/1280. (e.e. $FOVV. \cong FOVH \times 0.75$).
- 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)

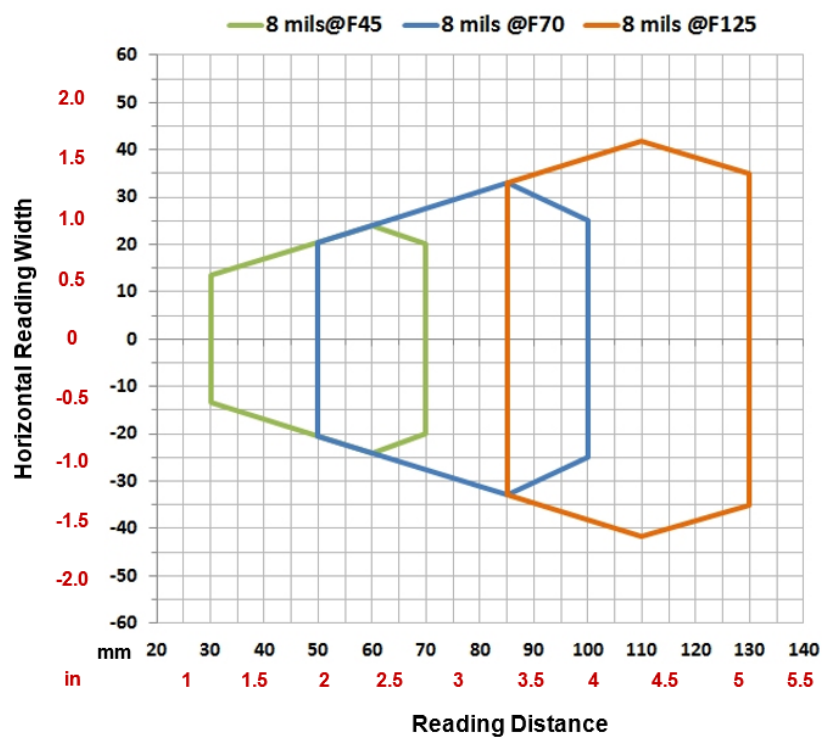
Code 128 0.12 mm (5 mils)



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	

Matrix 120 210-xxx (WVGA)

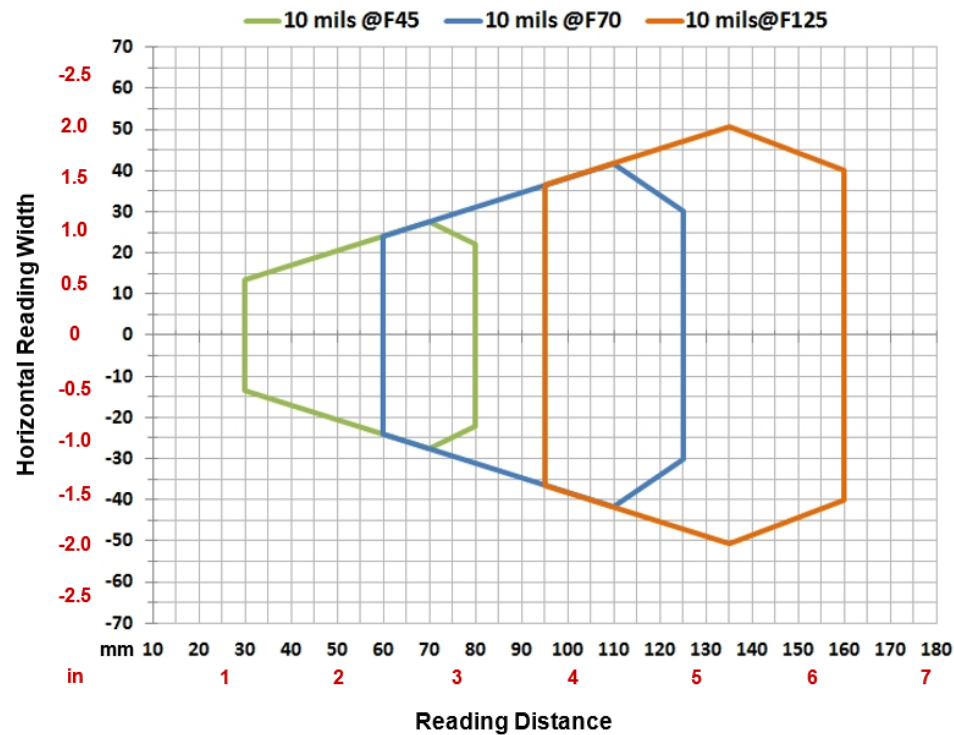
Code 128 0.20 mm (8 mils)



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		

Matrix 120 210-xxx (WVGA)

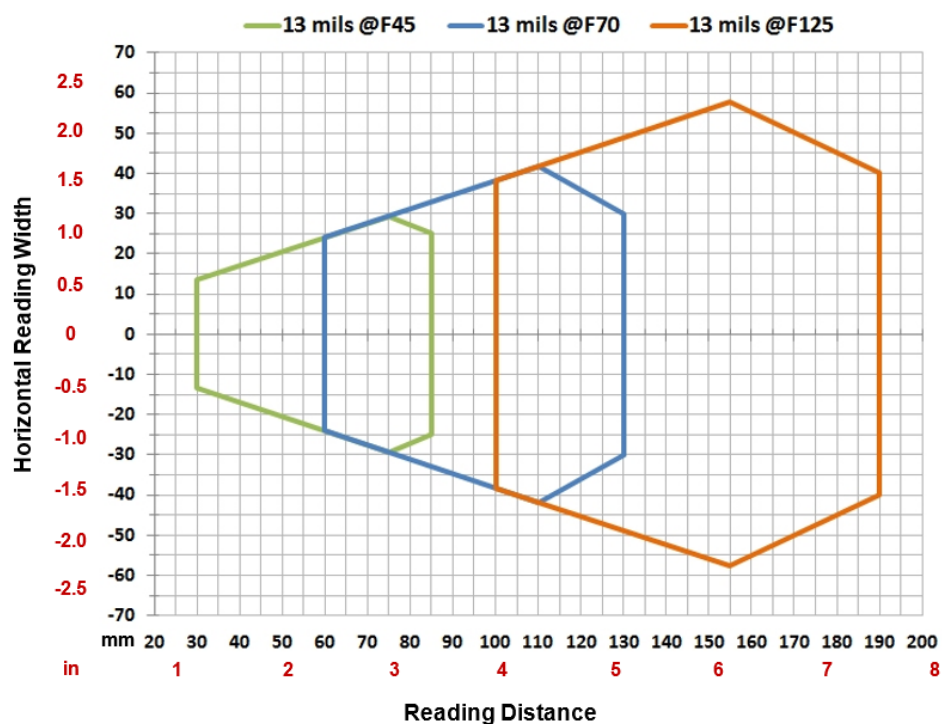
Code 128 0.25 mm (10 mils)



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		

Matrix 120 210-xxx (WVGA)

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.

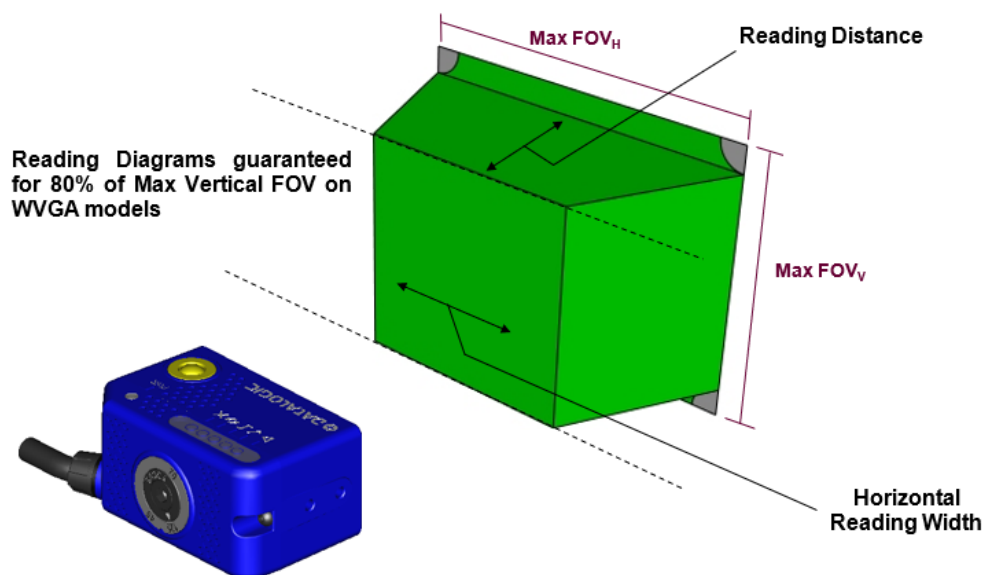
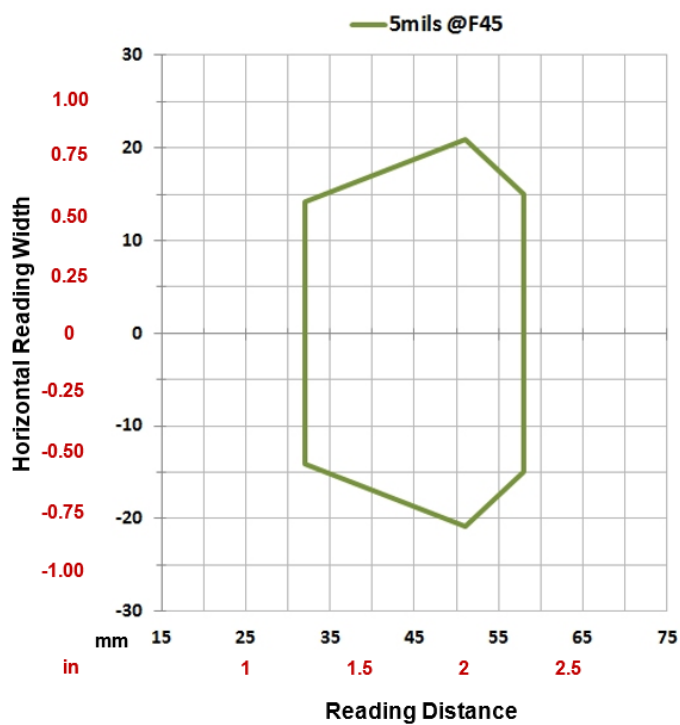


Figure 65 – WVGA Model Vignetting Effect

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)

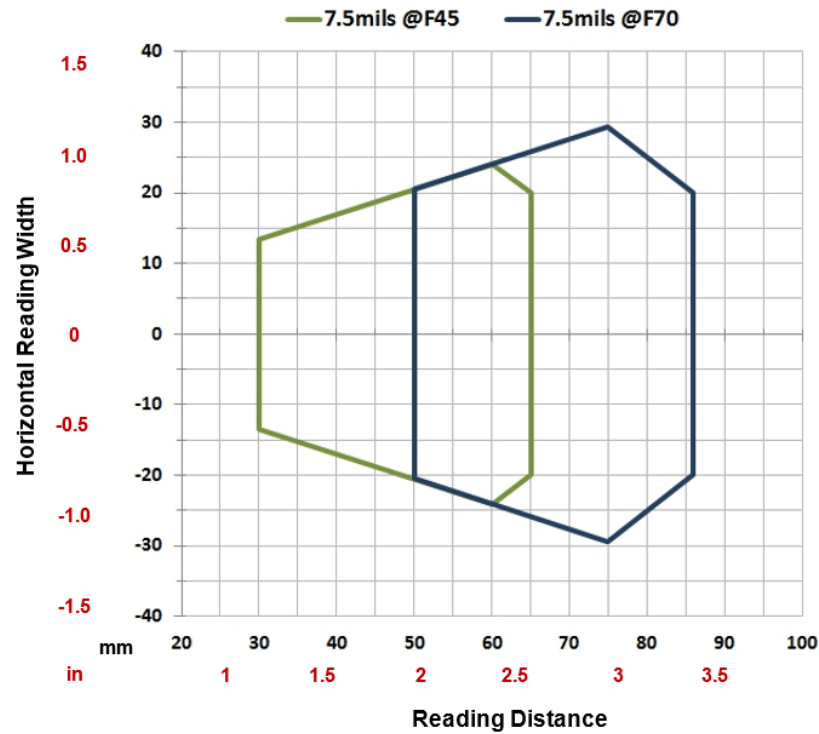
Data Matrix 0.12 mm (5 mils)



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

Matrix 120 210-xxx (WVGA)

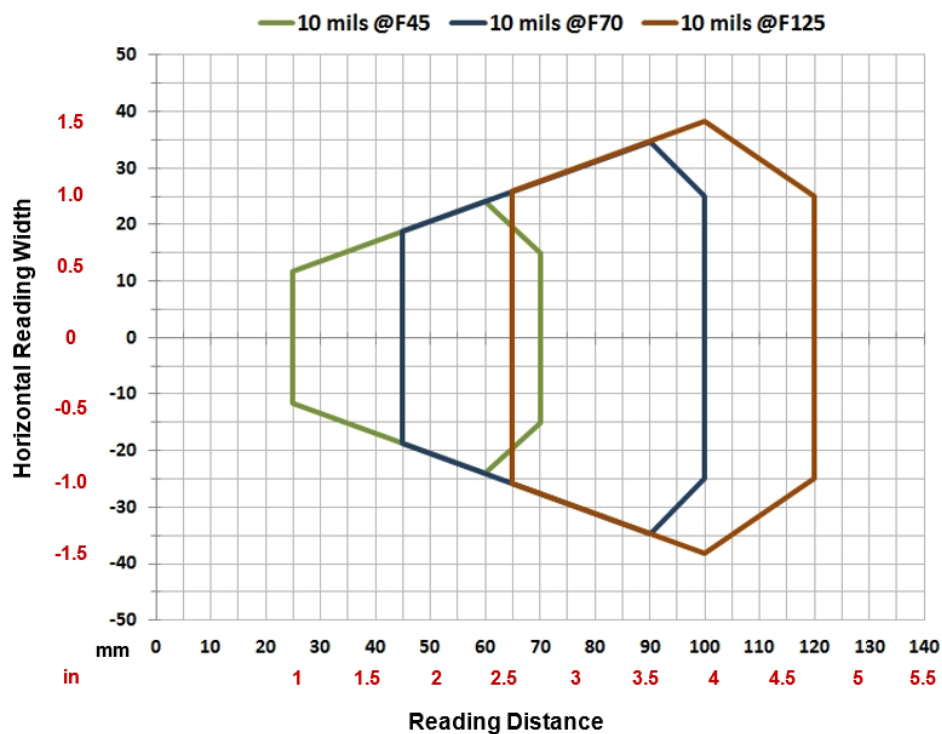
Data Matrix 0.19 mm (7.5 mils)



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)

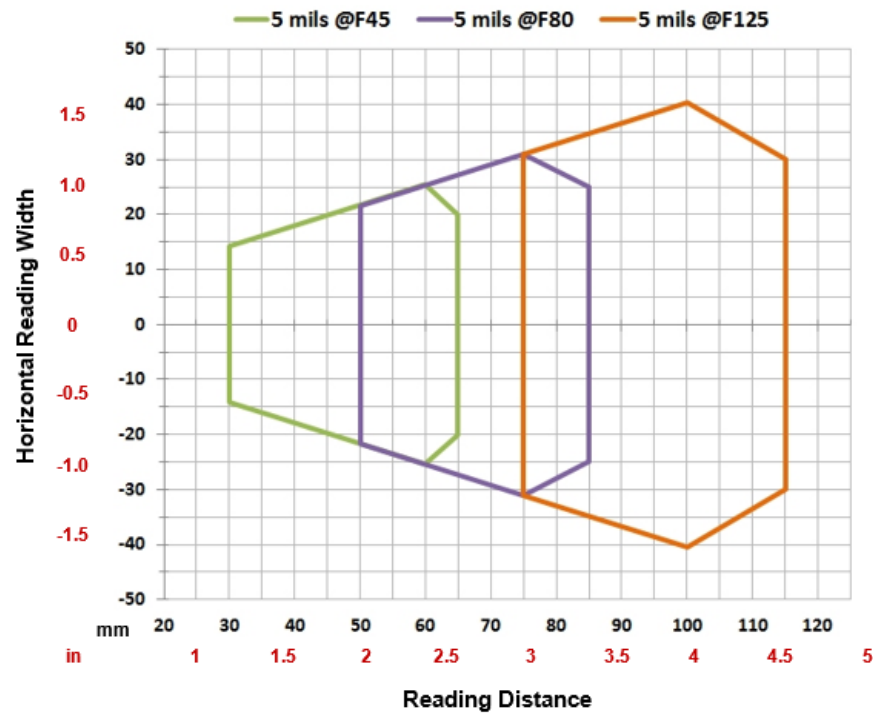


Conditions			
Hardware Settings			
Code Symbology	Data Matrix ECC 200		
Code Resolution	0.25 mm (10 mils)		
Tilt Angle	0°		
Skew Angle	15°		
Focusing Distance (mm)	45	70	125
Software Parameters			
Exposure Time (μs)	280	500	650
Gain	10	10	13
Illuminator Lighting	Very High Power Strobed		
Decoding Complexity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

Matrix 120 310-xxx 1D Codes (MP)

Matrix 120 310-xxx (MP)

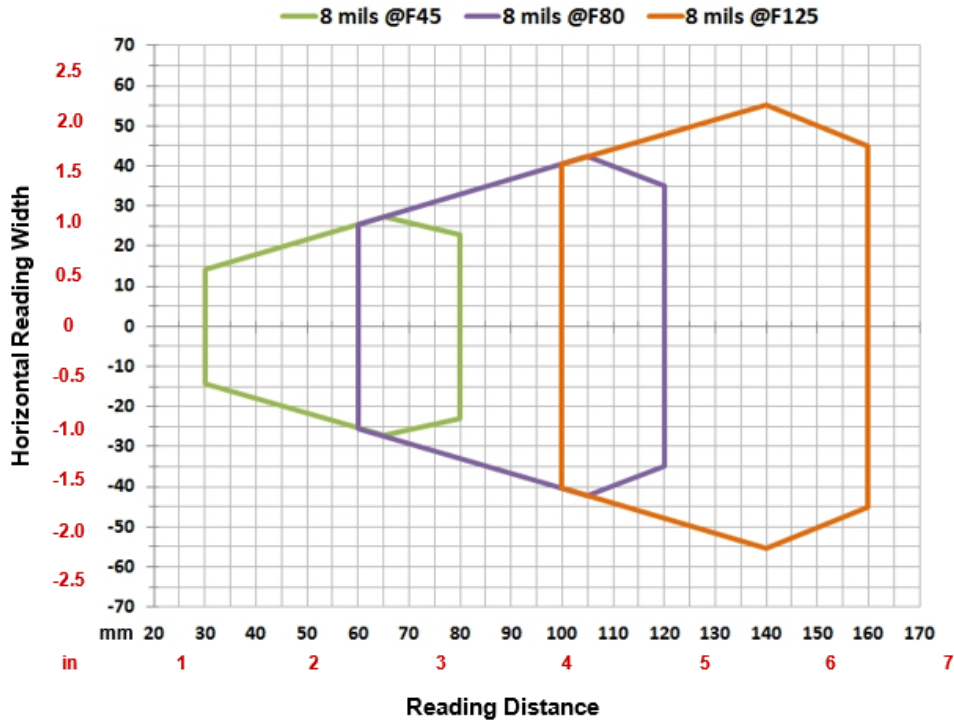
Code 128 0.12 mm (5 mils)



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		

Matrix 120 310-xxx (MP)

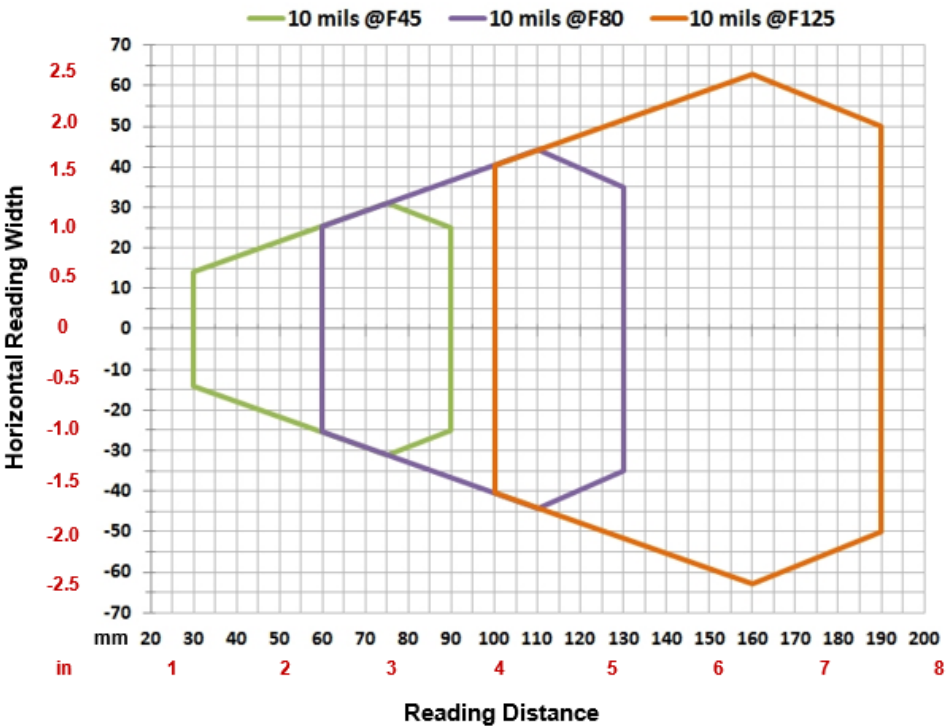
Code 128 0.20 mm (8 mils)



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		

Matrix 120 310-xxx (MP)

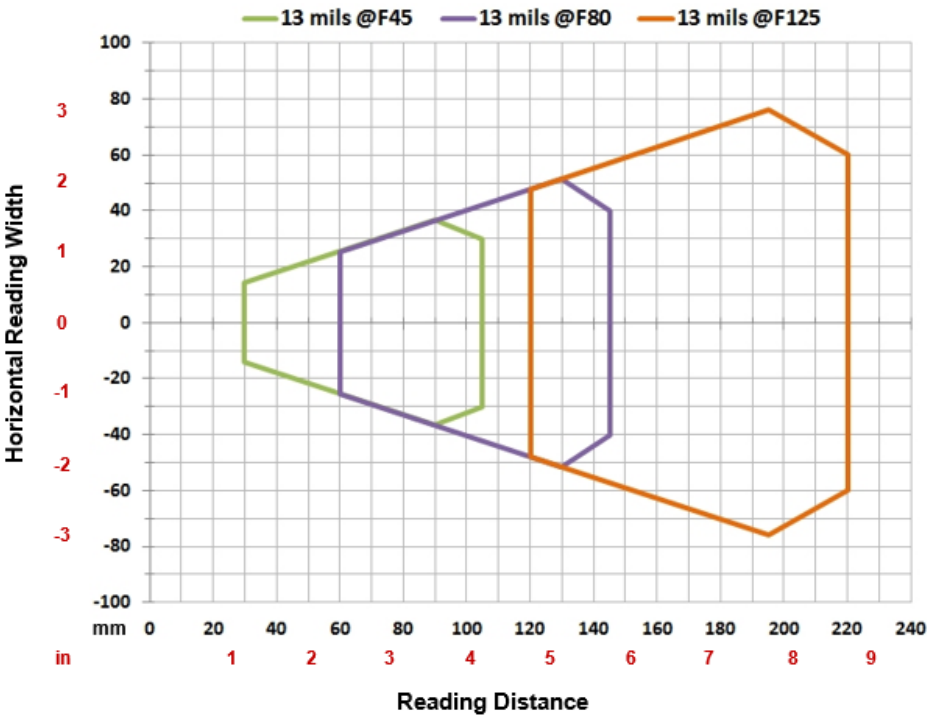
Code 128 0.25 mm (10 mils)



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		

Matrix 120 310-xxx (MP)

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.

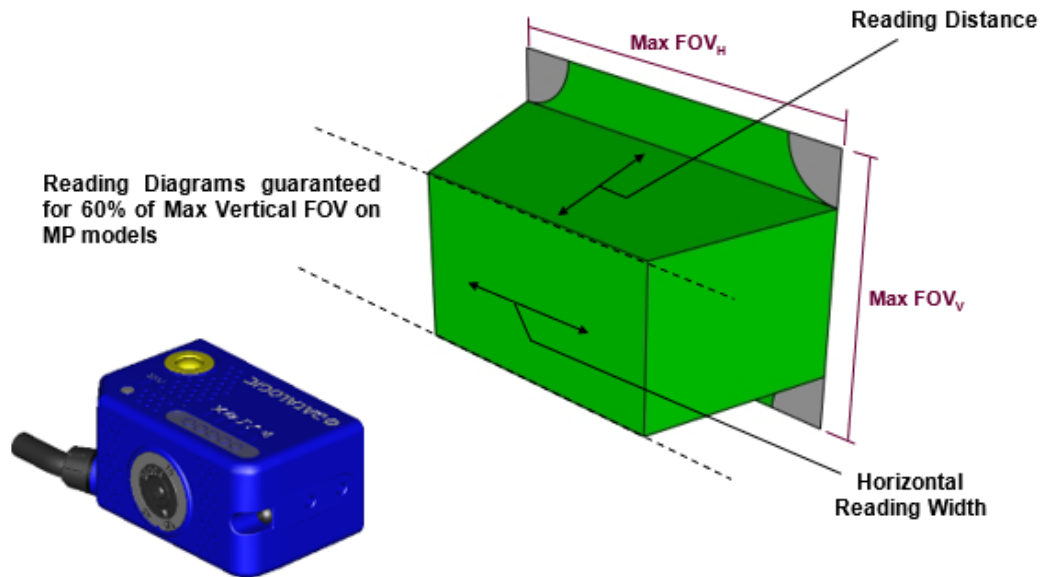
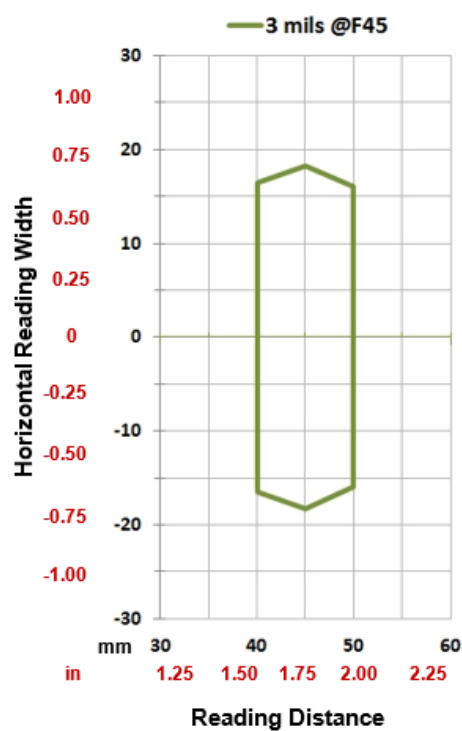


Figure 66 – MP Model Vignetting Effect

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)

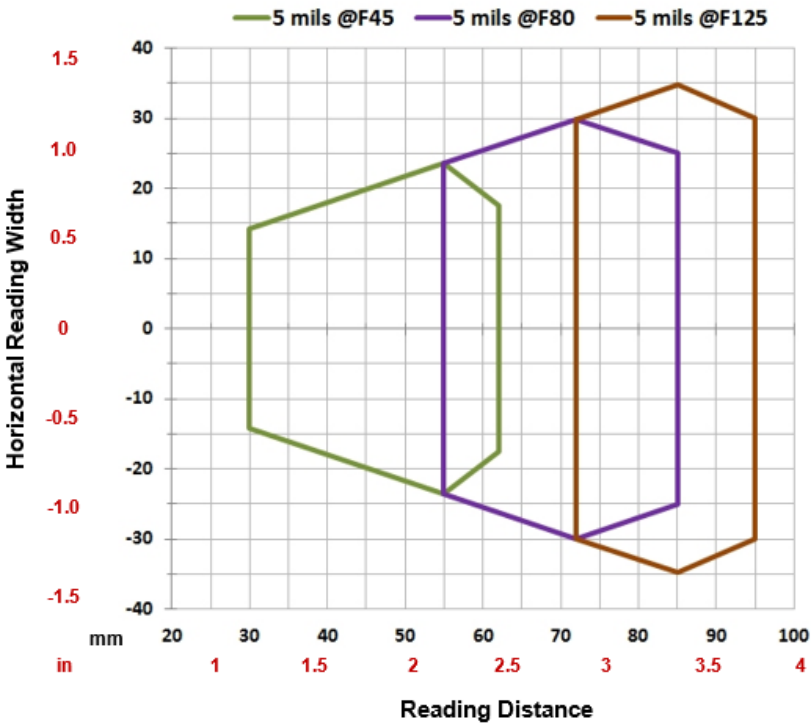
Data Matrix 0.076 mm (3 mils)



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

Matrix 120 310-xxx (MP)

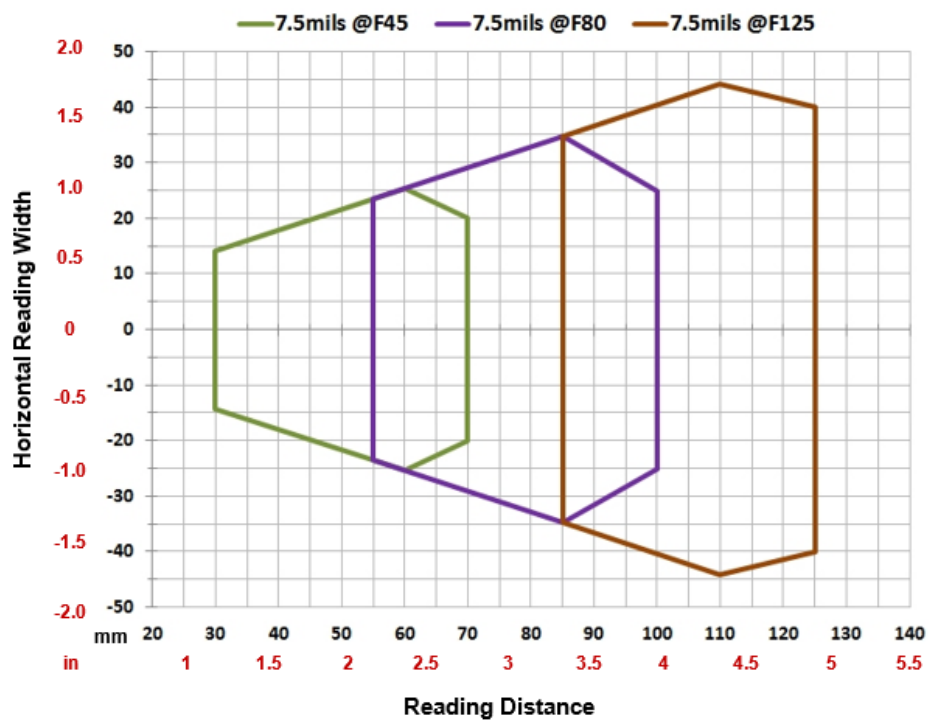
Data Matrix 0.13 mm (5 mils)



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		

Matrix 120 310-xxx (MP)

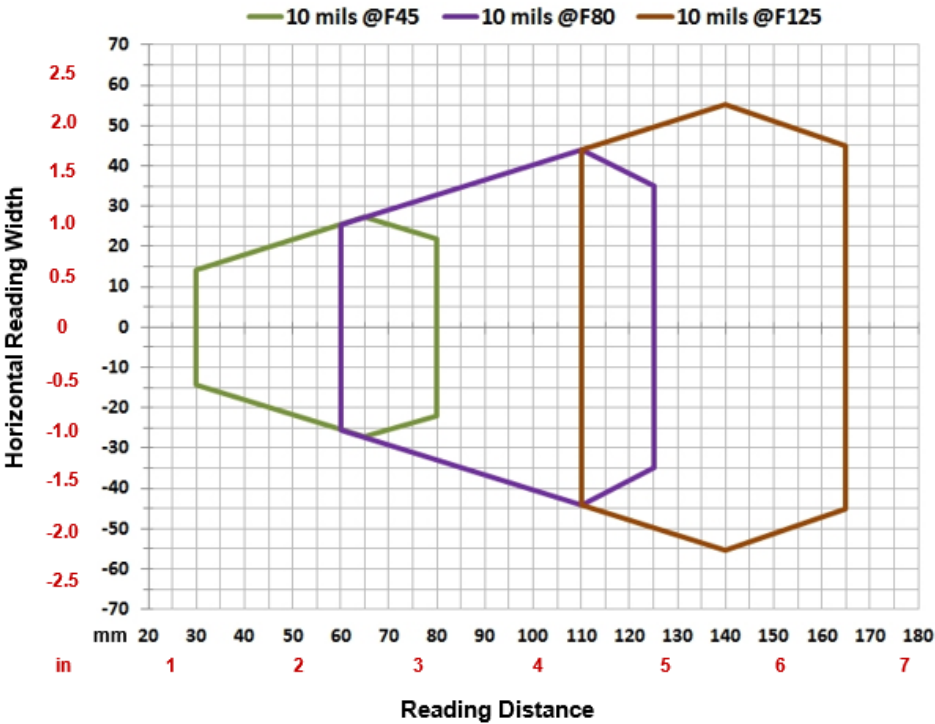
Data Matrix 0.19 mm (7.5 mils)



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		

Matrix 120 310-xxx (MP)

Data Matrix 0.25 mm (10 mils)

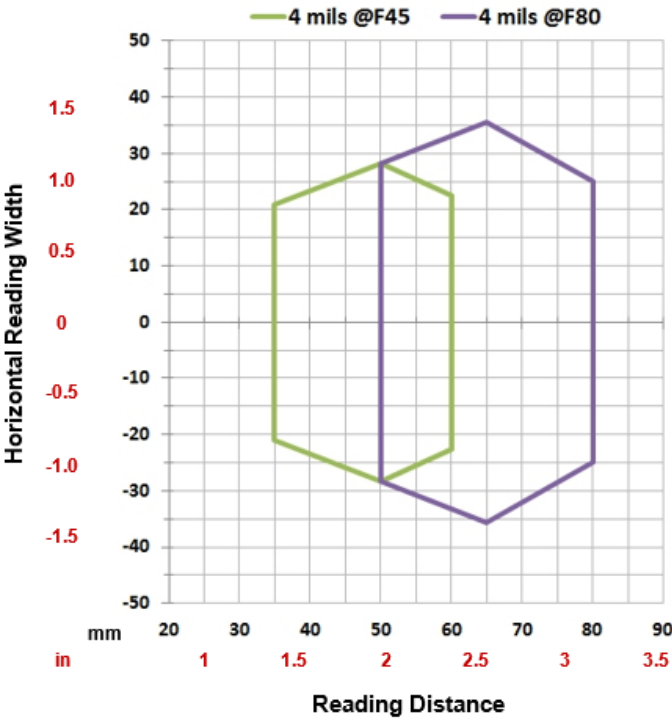


Conditions			
Hardware Settings			
Code Symbology	Data Matrix ECC 200		
Code Resolution	0.25 mm (10 mils)		
Tilt Angle	0°		
Skew Angle	15°		
Focusing Distance (mm)	45	80	125
Software Parameters			
Exposure Time (µs)	280	700	1000
Gain	15	20	32
Illuminator Lighting	Very High Power Strobed		

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

Matrix 120 311-xxx (MP+WA)

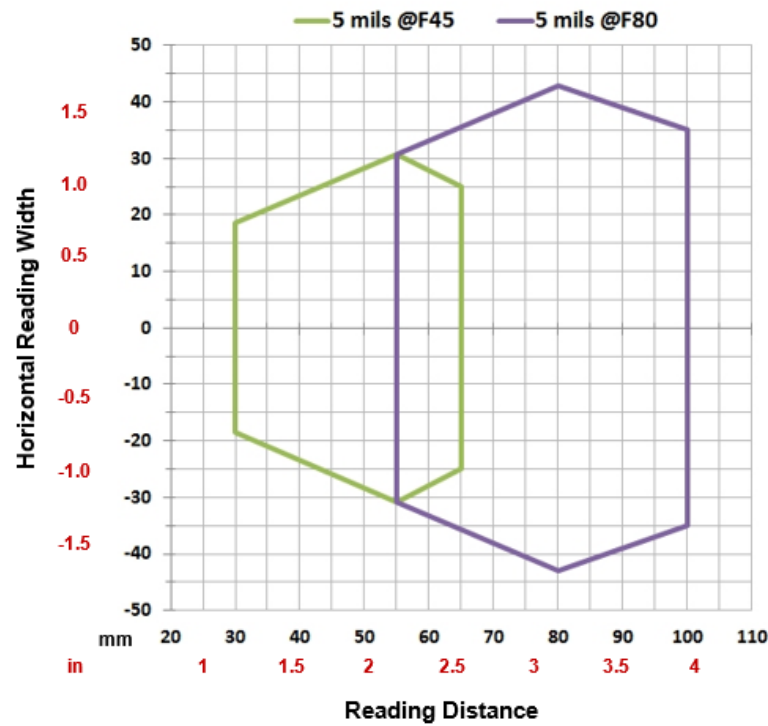
Code 128 0.10 mm (4 mils)



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	

Matrix 120 311-xxx (MP+WA)

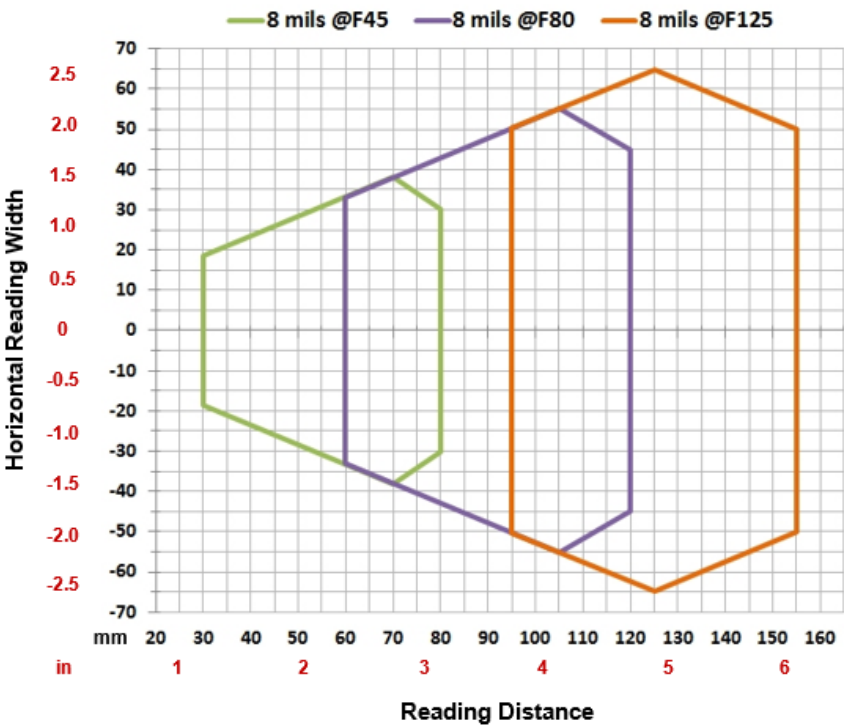
Code 128 0.12 mm (5 mils)



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	

Matrix 120 311-xxx (MP+WA)

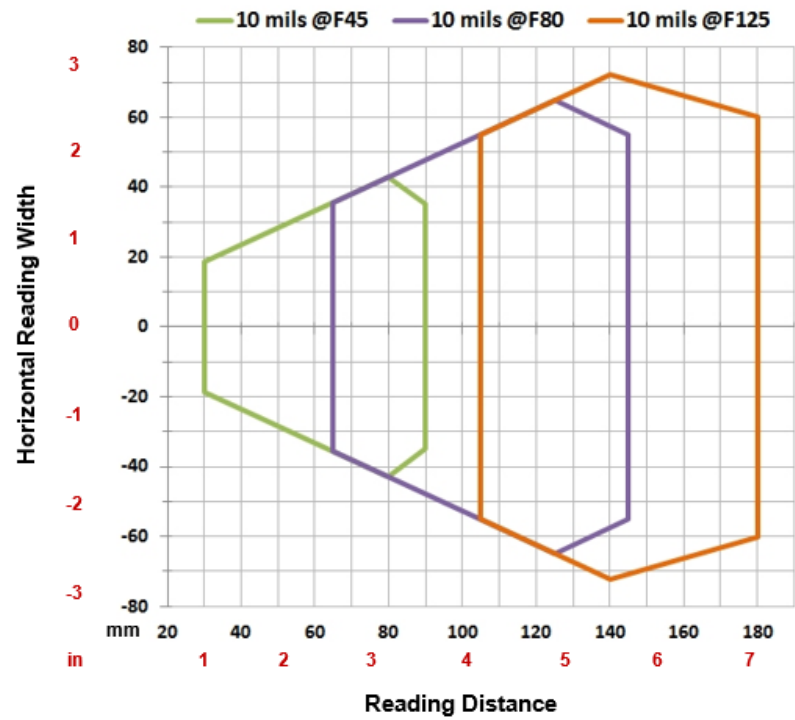
Code 128 0.20 mm (8 mils)



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		

Matrix 120 311-xxx (MP+WA)

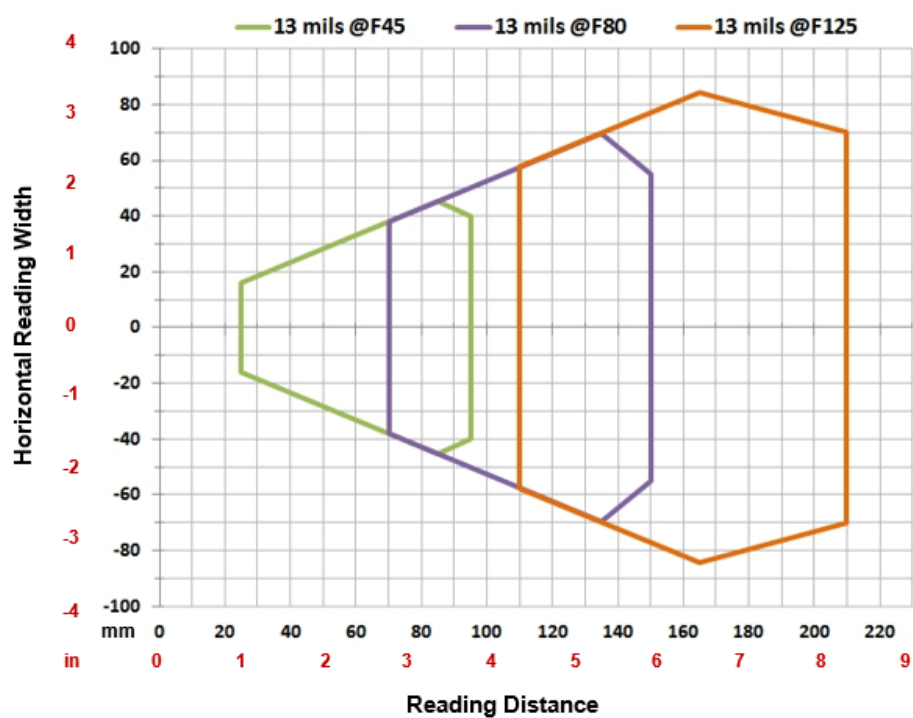
Code 128 0.25 mm (10 mils)



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		

Matrix 120 311-xxx (MP+WA)

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.

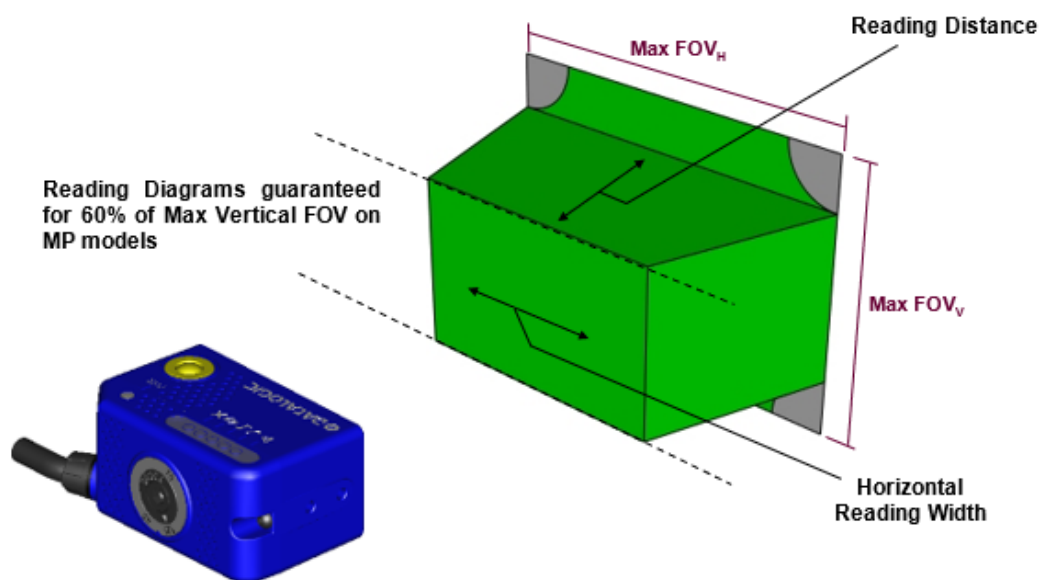
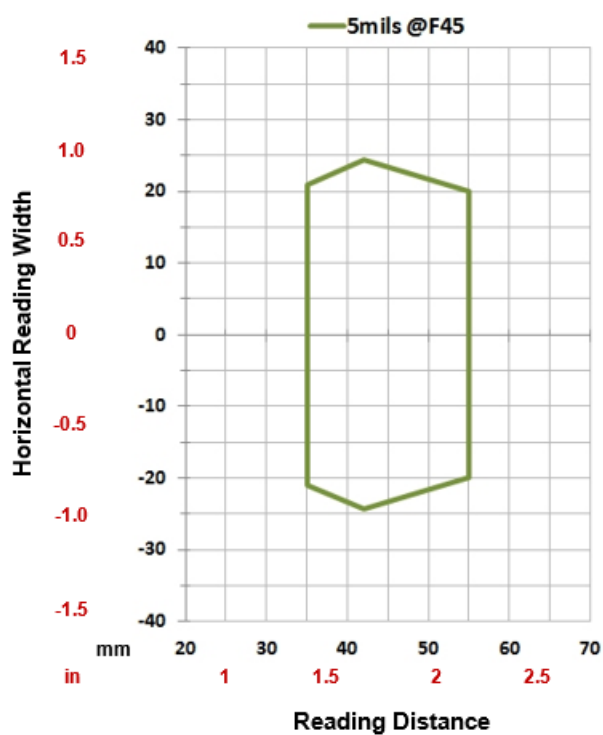


Figure 67 – MP Model Vignetting Effect

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)

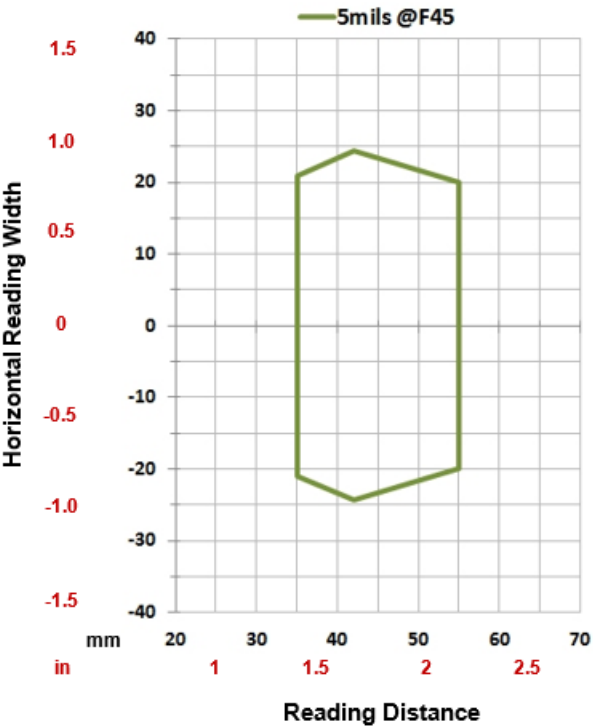
Data Matrix 0.13 mm (5 mils)



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

Matrix 120 311-xxx (MP+WA)

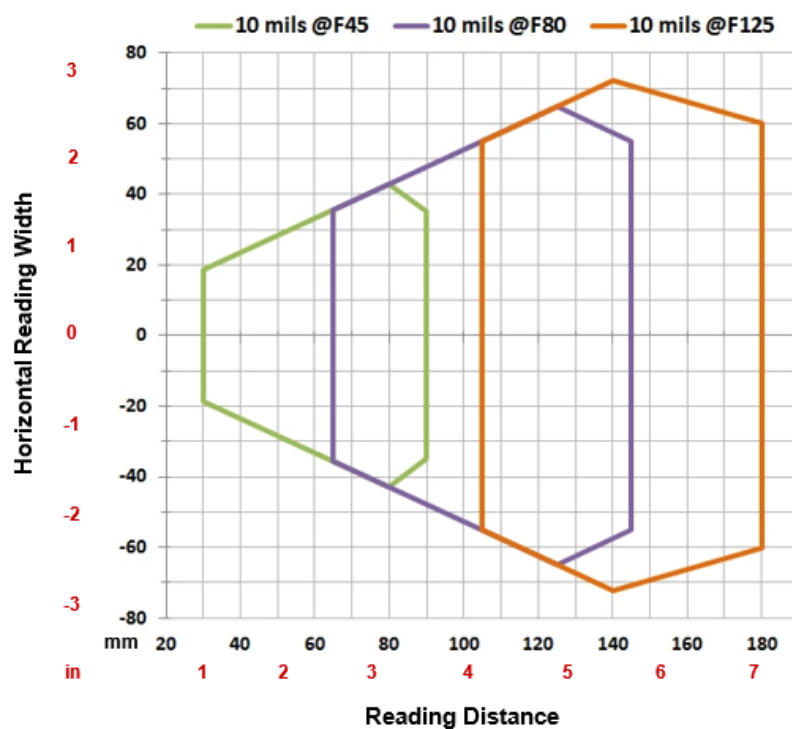
Data Matrix 0.19 mm (7.5 mils)



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	

Matrix 120 311-xxx (MP+WA)

Data Matrix 0.25 mm (10 mils)

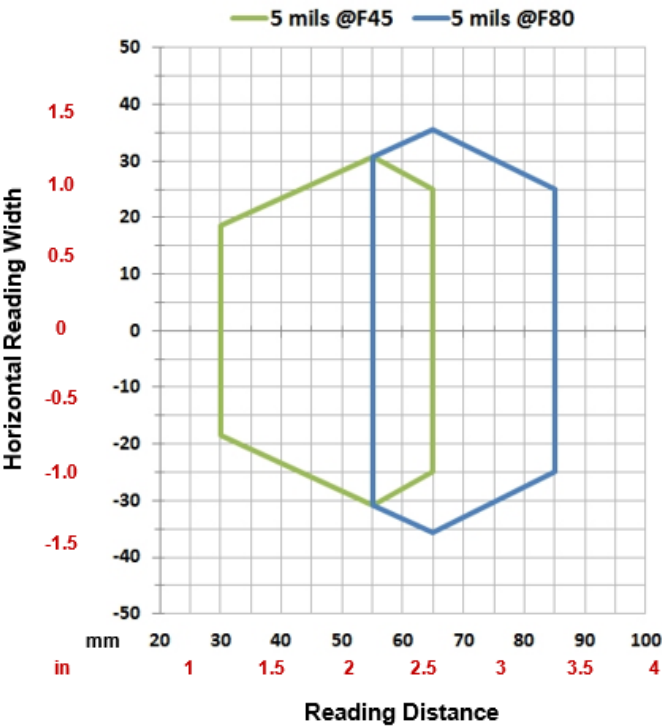


Conditions			
Hardware Settings			
Code Symbology	Data Matrix ECC 200		
Code Resolution	0.25 mm (10 mils)		
Tilt Angle	0°		
Skew Angle	15°		
Focusing Distance (mm)	45	80	125
Software Parameters			
Exposure Time (μs)	250	450	600
Gain	10	15	20
Illuminator Lighting	Very High Power Strobed		

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

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

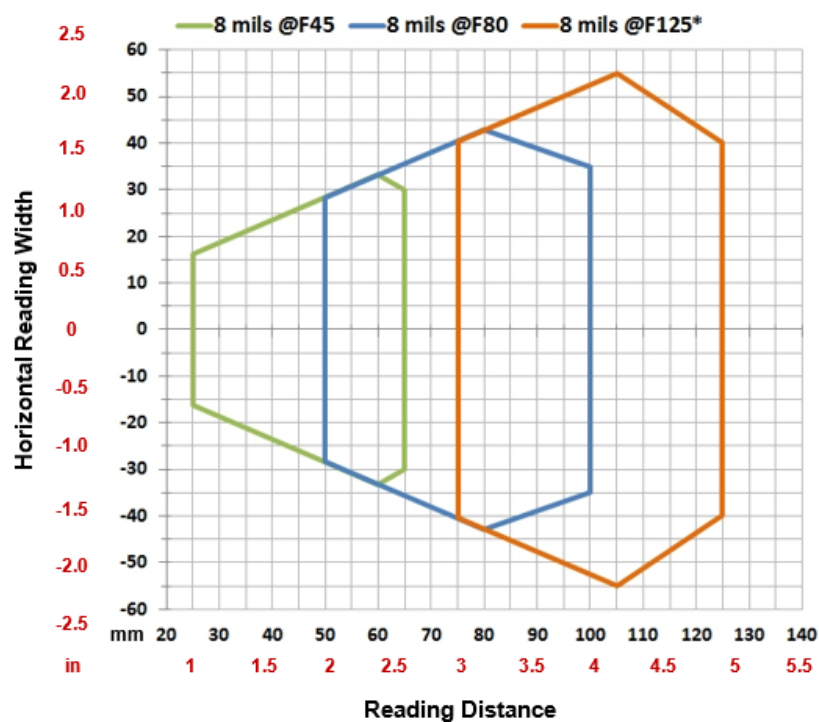
Code 128 0.12 mm (5 mils)



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	

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

Code 128 0.20 mm (8 mils)

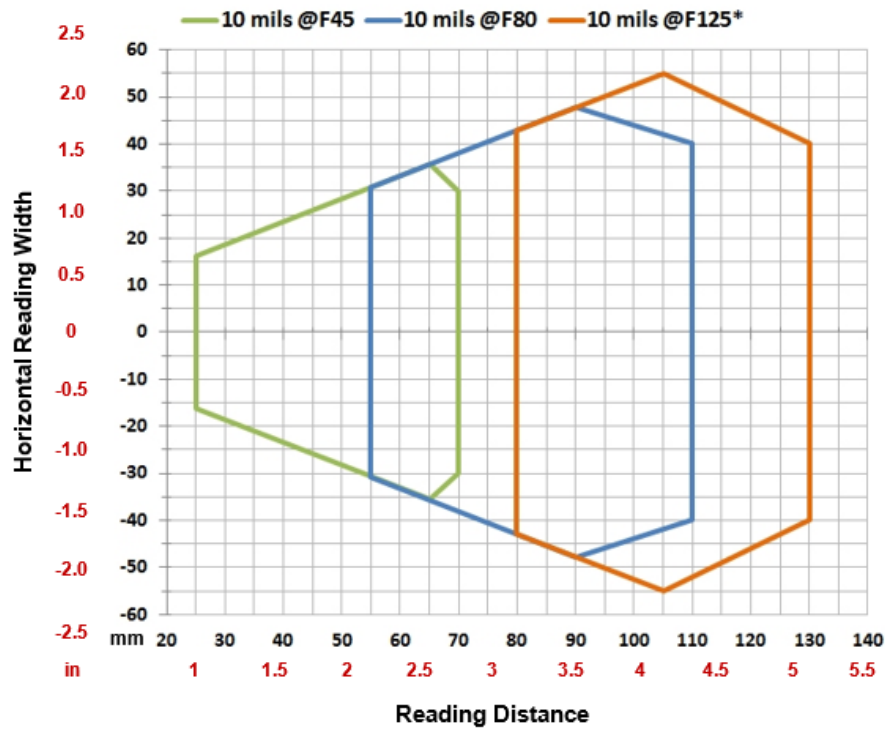


*The vignetting effect described in [Chapter 6, Vignetting](#) applies to the F125 position for WA models.

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		

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

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.

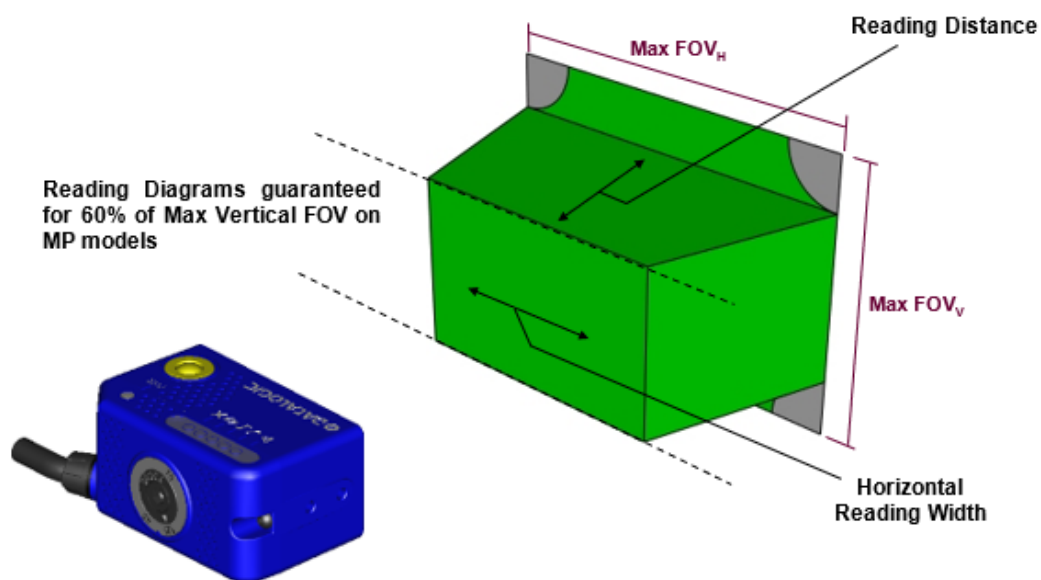
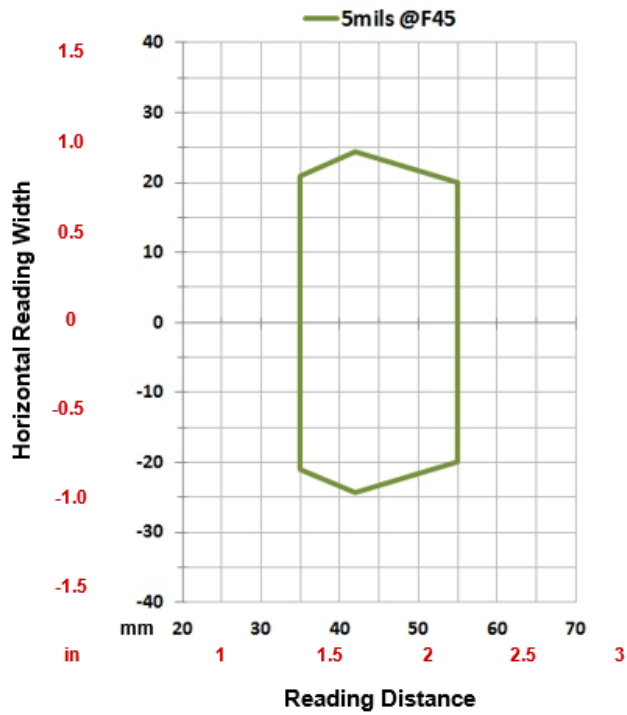


Figure 68 – MP Model Vignetting Effect

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)

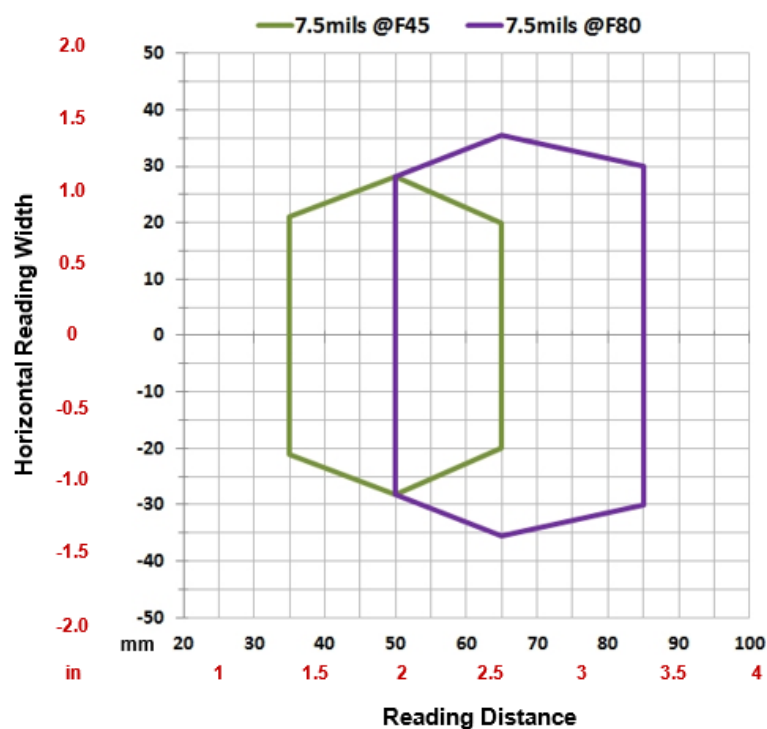
Data Matrix 0.13 mm (5 mils)



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

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

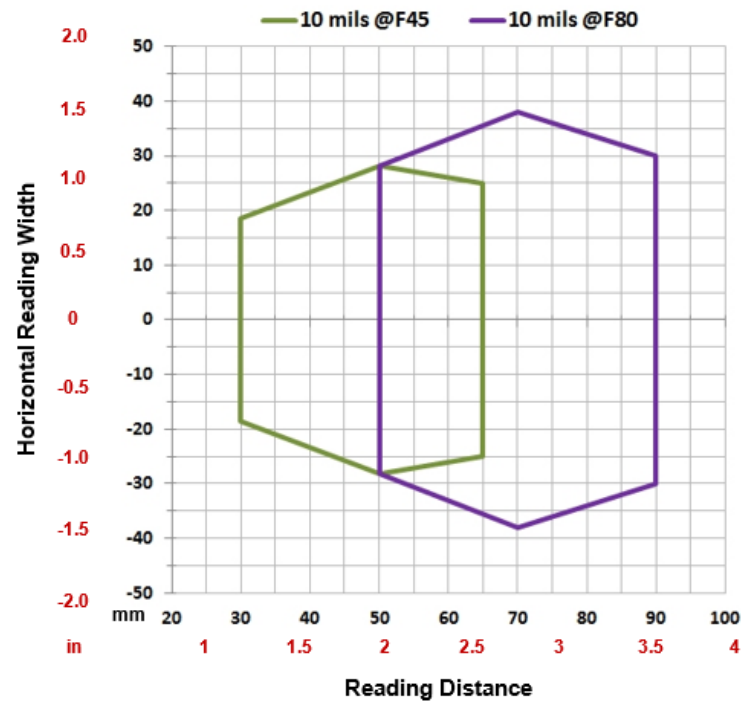
Data Matrix 0.19 mm (7.5 mils)



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

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

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)

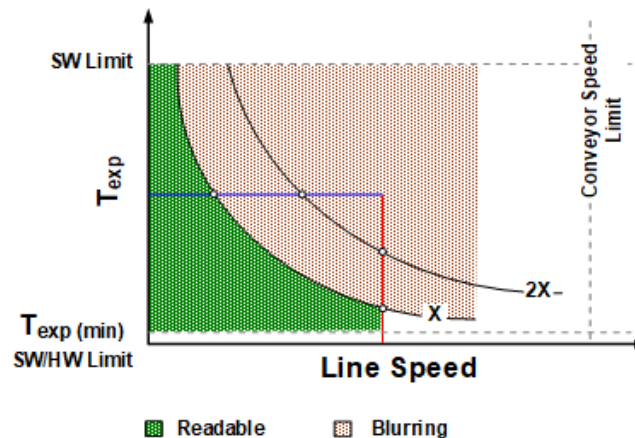
has a maximum line speed of:

$$0.254 \text{ (mm)} / 0.0002 \text{ (s)} = 1270 \text{ mm/s}$$

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

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

$T_{\text{exp (max)}}$ and $LS_{\text{(max)}}$ 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: XP SP3, 7, 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 and/or to an External storage device (BM100, etc.). See Backup and Restore Through DL.CODE.



NOTE

An improvement in the Matrix N Family readers allows them to contain several configurations or jobs in permanent memory.

This means that 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.

Auto-Calibration

DL.CODE provides the **Image Auto-Setup** tool to maximize the reading performance by tuning the acquisition parameters (photometry) automatically. By selecting the **Image Auto-Setup** tool from the Image Settings branch in the Advanced Setup step, the following window appears:

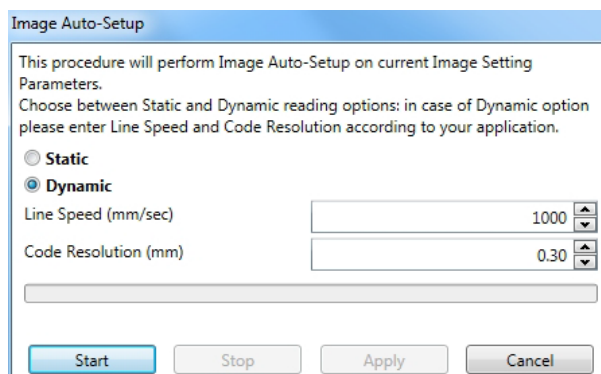


Figure 68 – Image Auto-Setup

Select the Static or Dynamic Self-Tuning option; Start Image Auto-Setup and Apply to the Image Settings. The Advanced Setup window works interactively so that you can see the results of the parameter setting changes as well as the decoding results (Results panel).

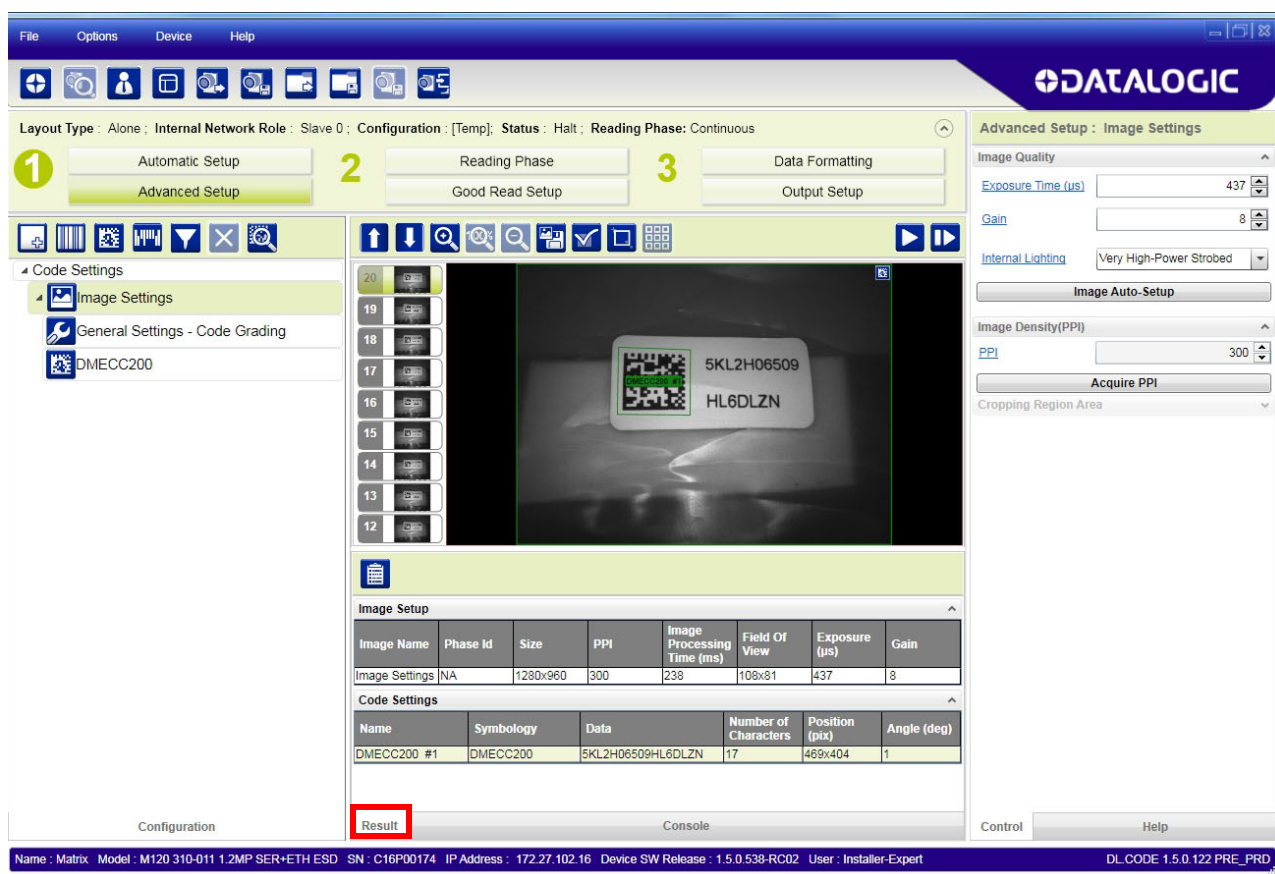


Figure 69 – Decoding Results OK

Manual Calibration

The following examples show some of the typical conditions occurring during the installation and how they can be tuned manually:

Under-exposure

To correct this result it is recommended to change the following parameters in their order of appearance:

1. increase the **Exposure Time**
2. increase the **Gain**



NOTE

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

High gain settings may produce a grainy image that may affect the decoding process.

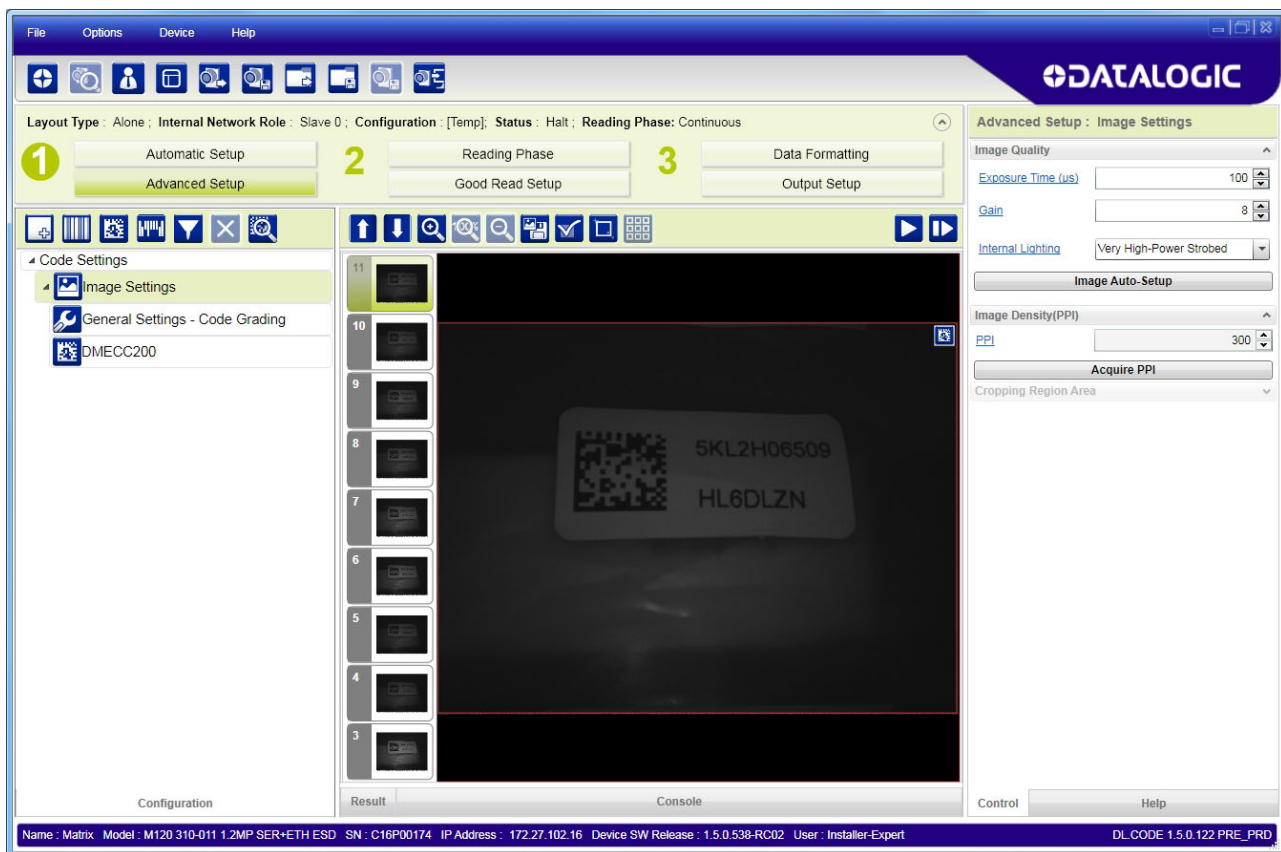


Figure 70 – Example Under Exposure: Too Dark

Over-exposure

To correct this result it is recommended to change the following parameters in their order of appearance:

1. decrease the **Gain**
2. decrease the **Exposure Time**



Figure 71 – Example Over Exposure: Too Light

Moving code out of the Field of View

To correct this result and have the code completely visible in FOV, it is possible to follow one or both the procedures listed below:

- reposition the reader
- use the **Delay on Trigger** and set the **Time** or **Space** values.

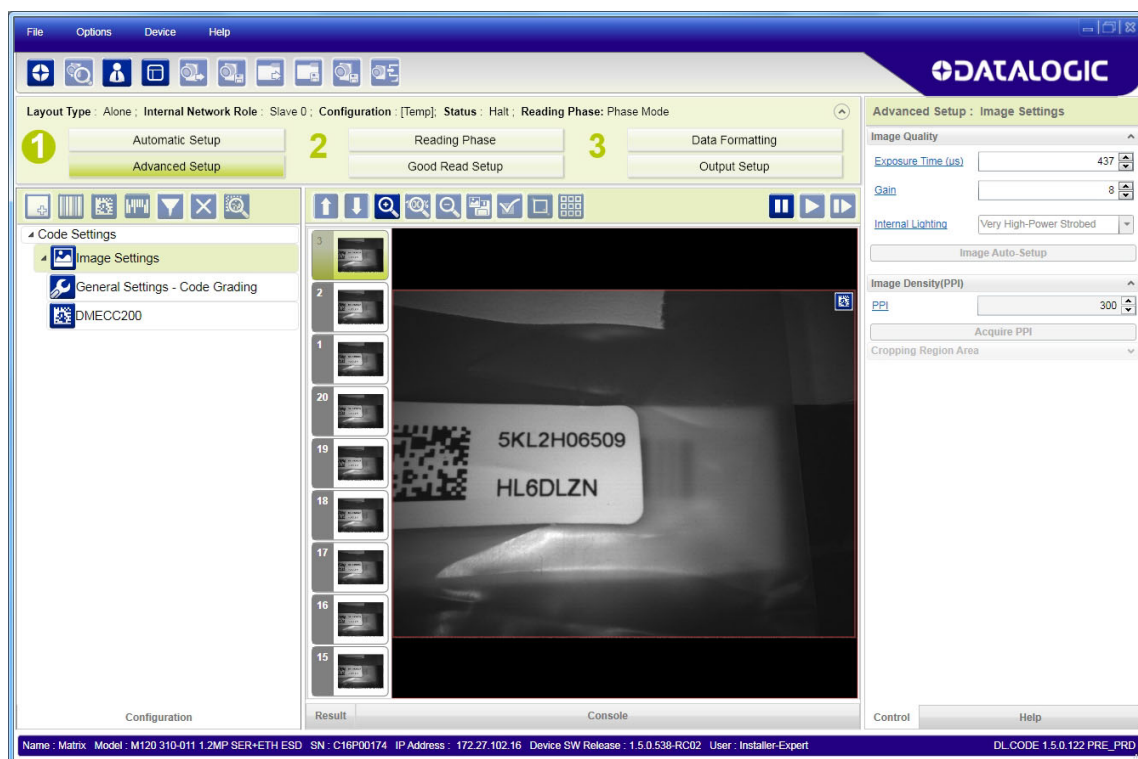


Figure 72 – Example Out of FOV

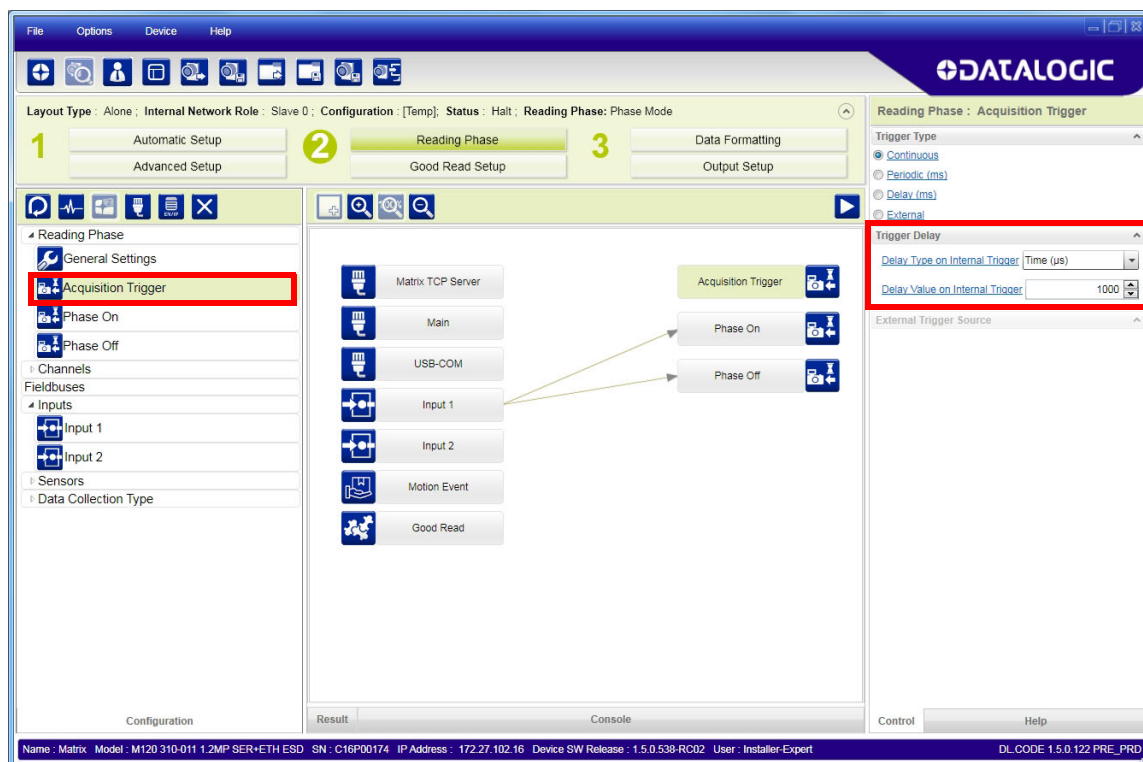


Figure 73 – Add Delay on Trigger to Correct Out of FOV

Multi Image Acquisition Settings

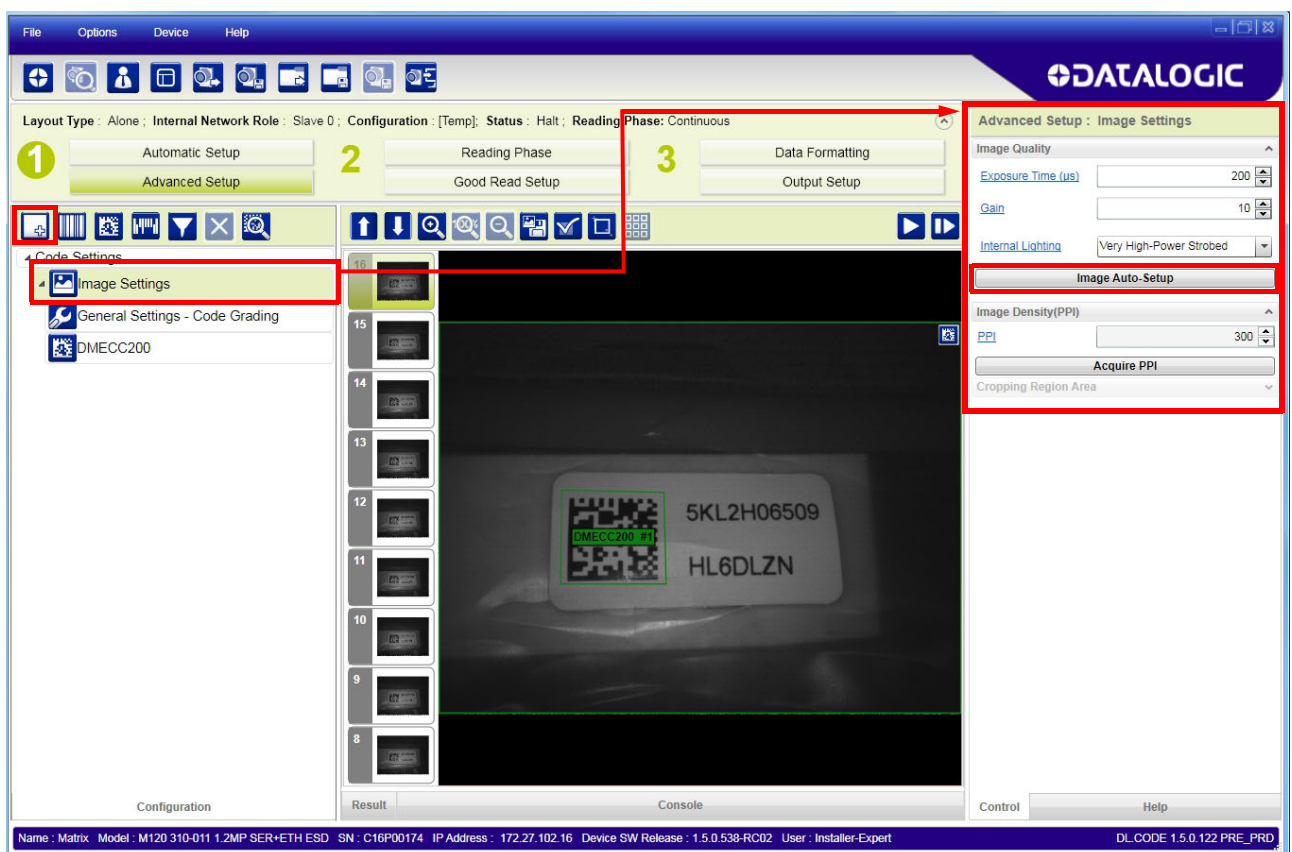
When controlled variable conditions occur in the application, Multiple *Image Acquisition Settings* can be defined to create a database of parameter groups that handle each specific application condition. This database of pre-defined settings improves system flexibility and readiness by being applied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

For example, an application may have several stable but different lighting conditions which require different lighting options.

This feature is available for all Operating Modes.



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

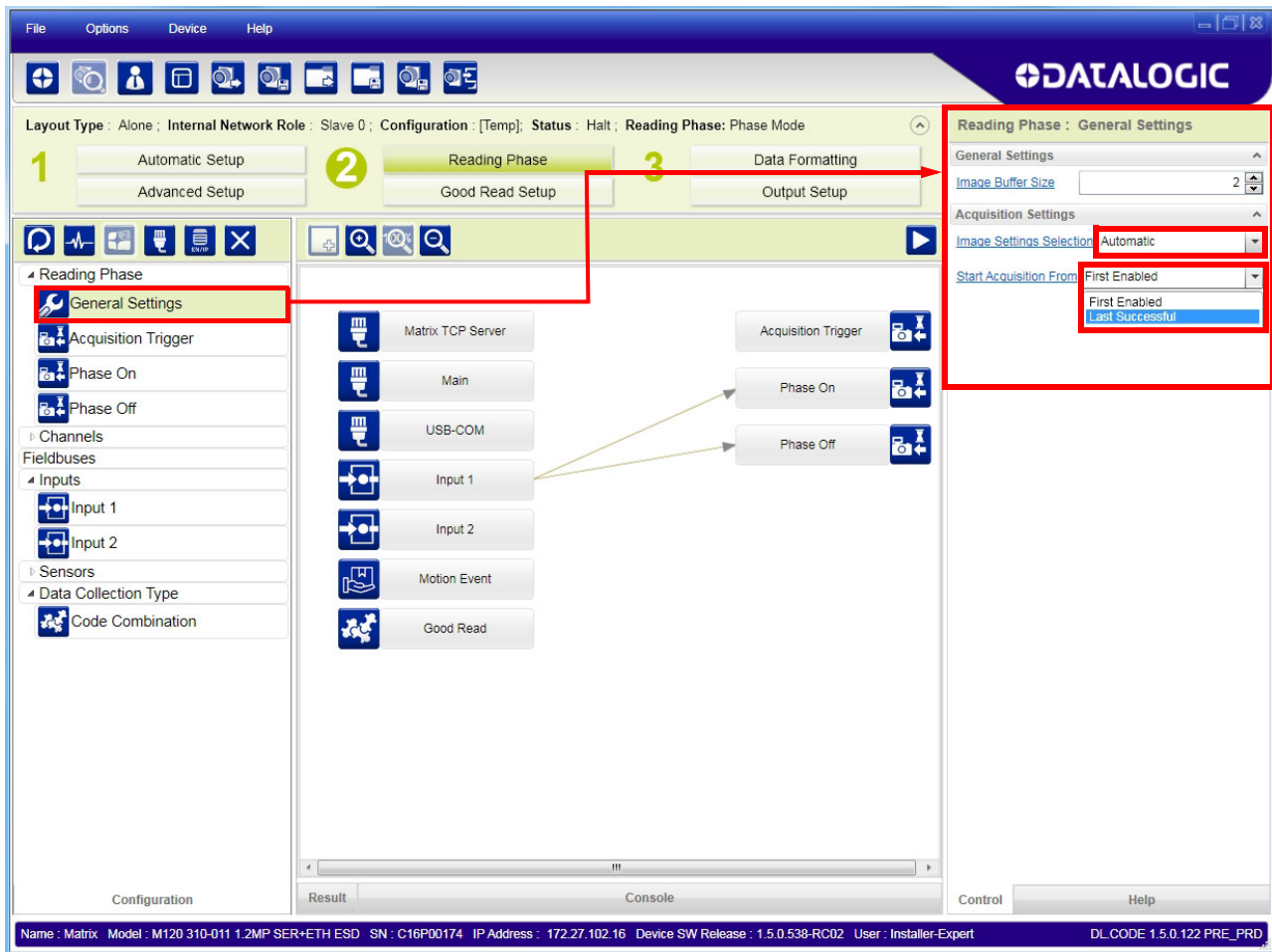


For each Image Setting condition start **Image Auto-Setup**, select the Static or Dynamic Self-Tuning option; and Apply it.

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 (one per acquisition) 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

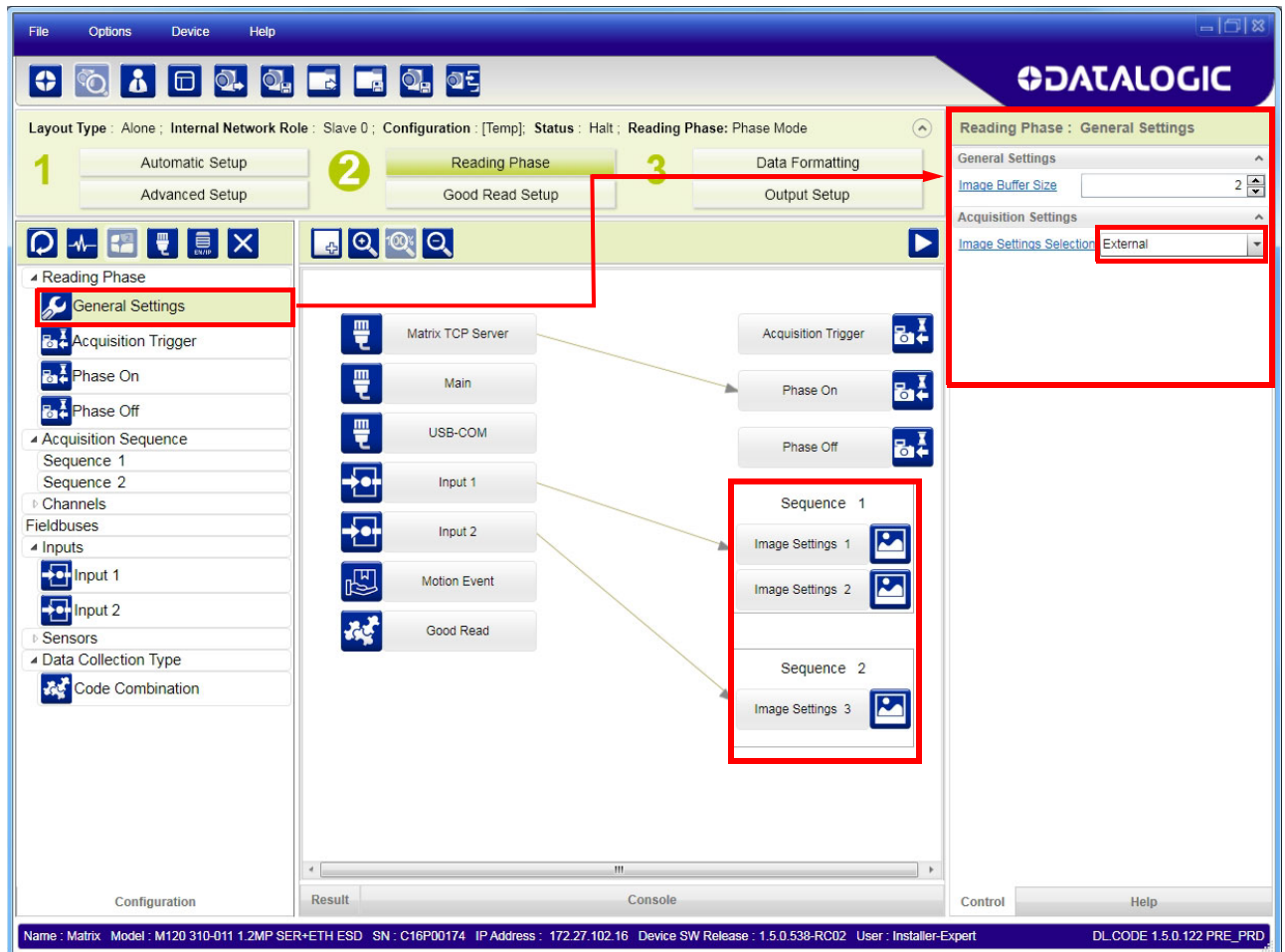
Applications typically require more than one acquisition to obtain sufficient Good Read percentages. This means that for N acquisitions we will surely have captured the correct lighting condition but we will also have captured some acquisitions with the wrong lighting condition. A consequence then is 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.

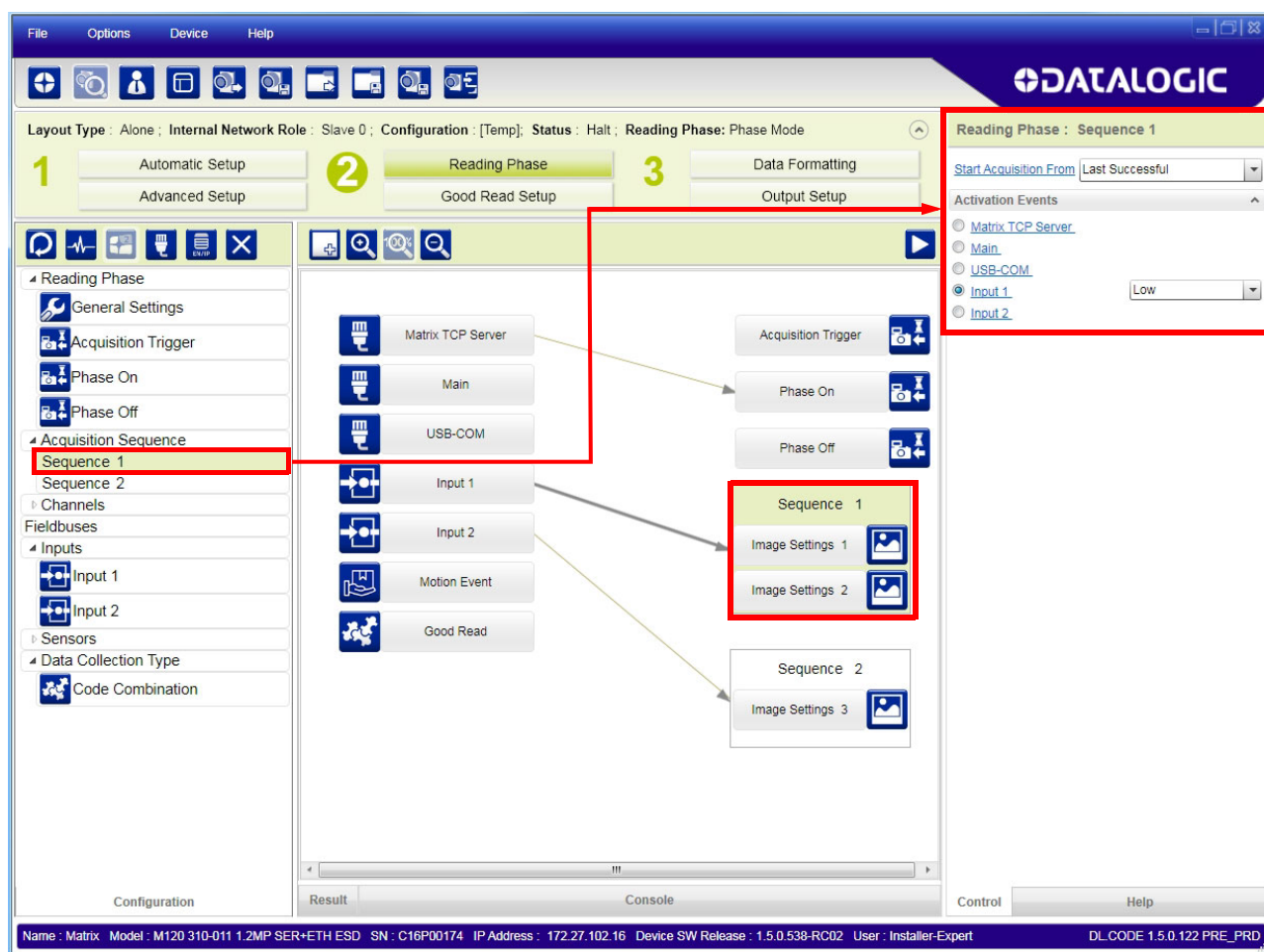
External Image Settings Selection

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.

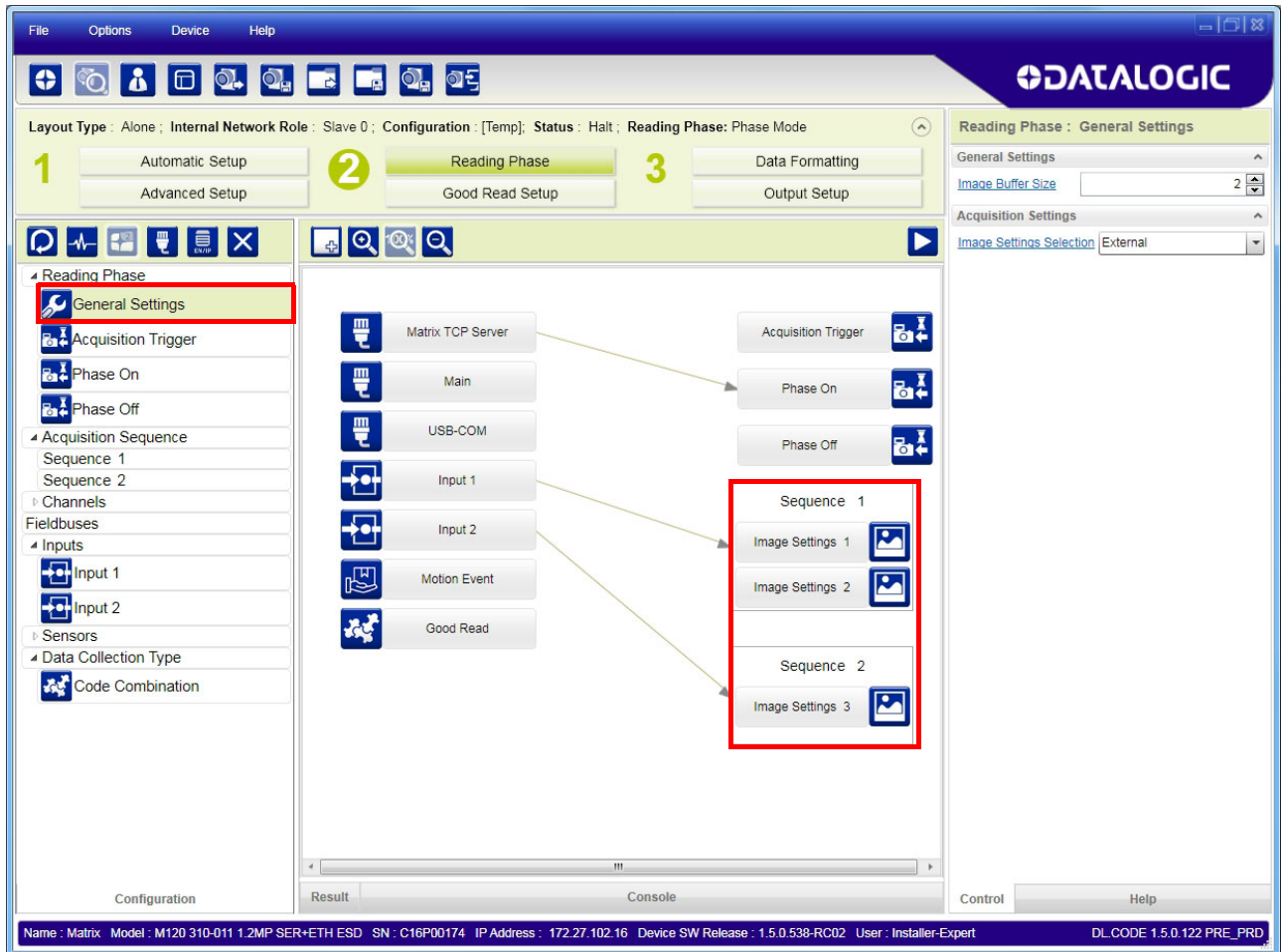
When the **Image Settings Selection** is **External**, Acquisition Sequences are created and by default each Image Setting has its own Acquisition Sequence.



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.

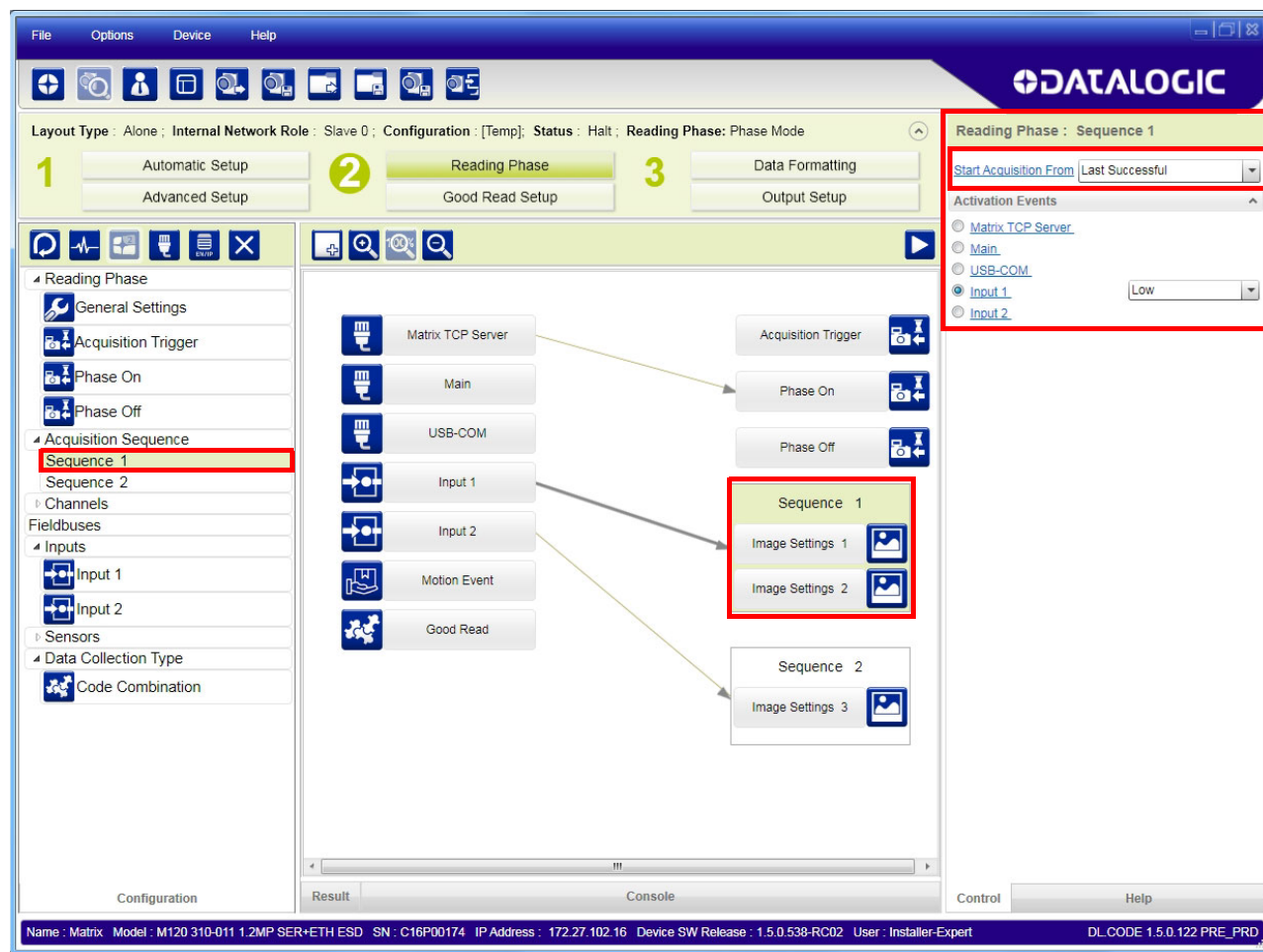


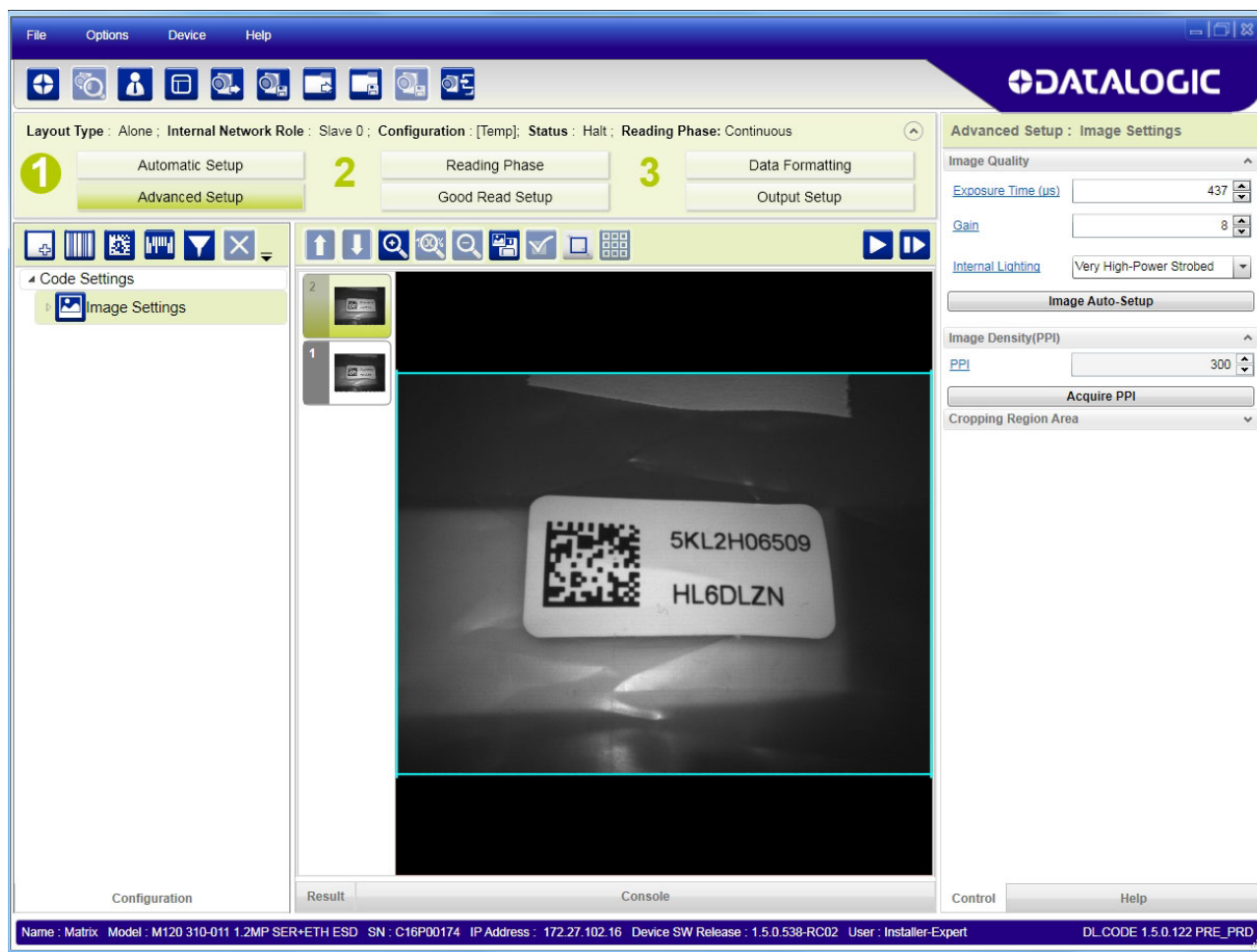
Image Cropping

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.

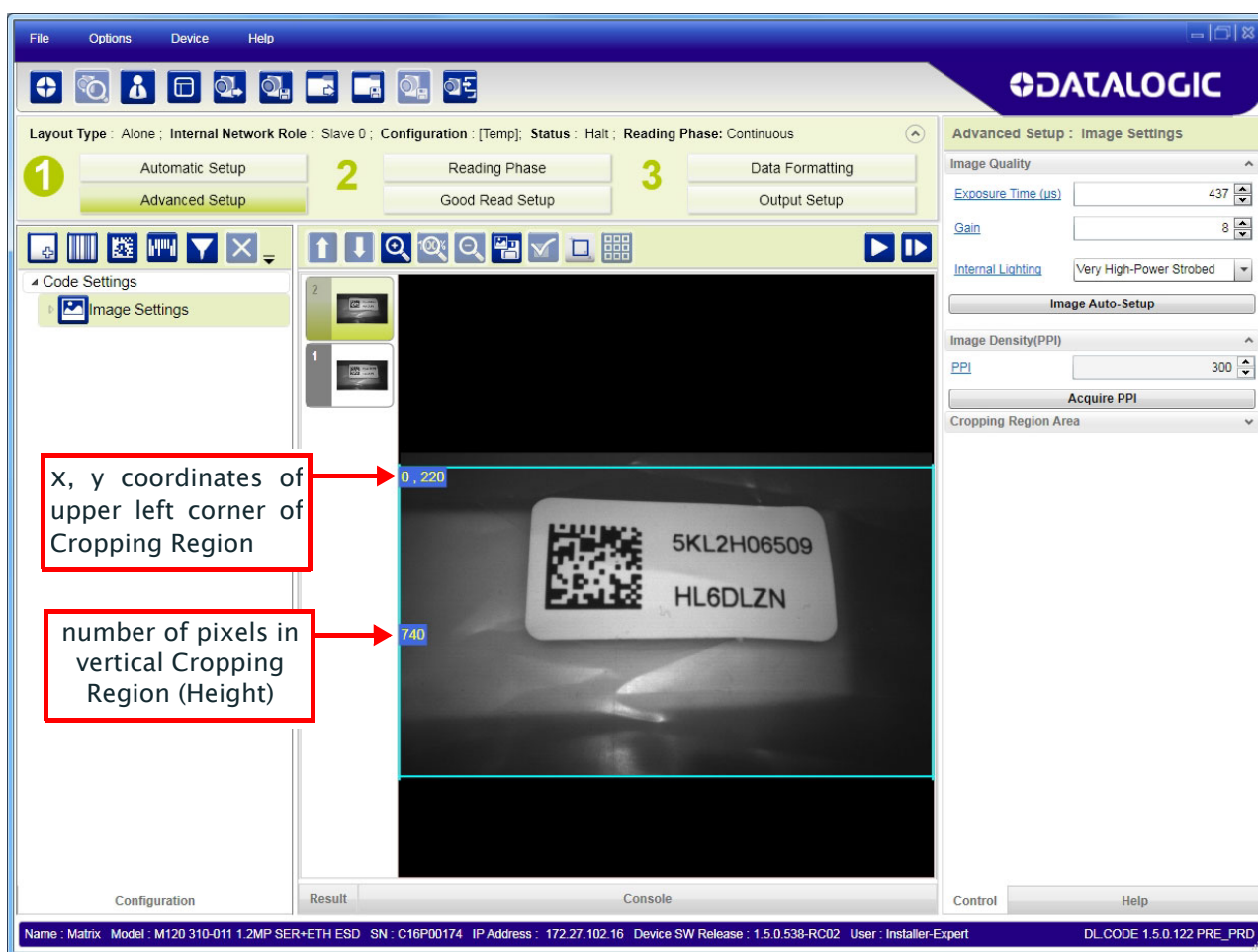
In Matrix 120 the frame rate is dependent on the number of rows and columns in the defined window. Image cropping allows reducing the Image processing area from the full FoV to a smaller area where codes are present. By excluding portions of the FoV, processing time is reduced.



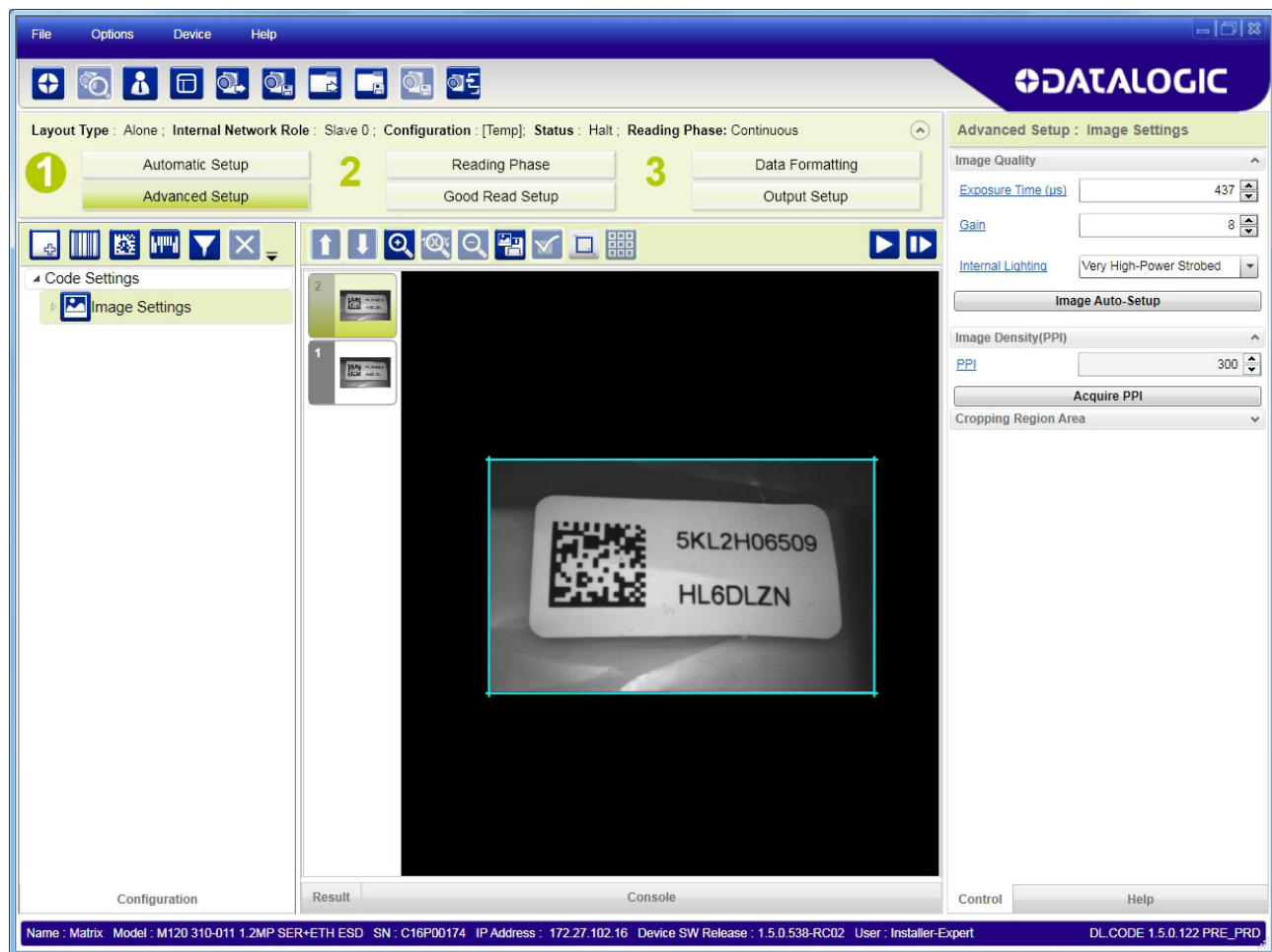
After clicking the Add Cropping Region icon, a blue border appears which by default is equal to the FoV.



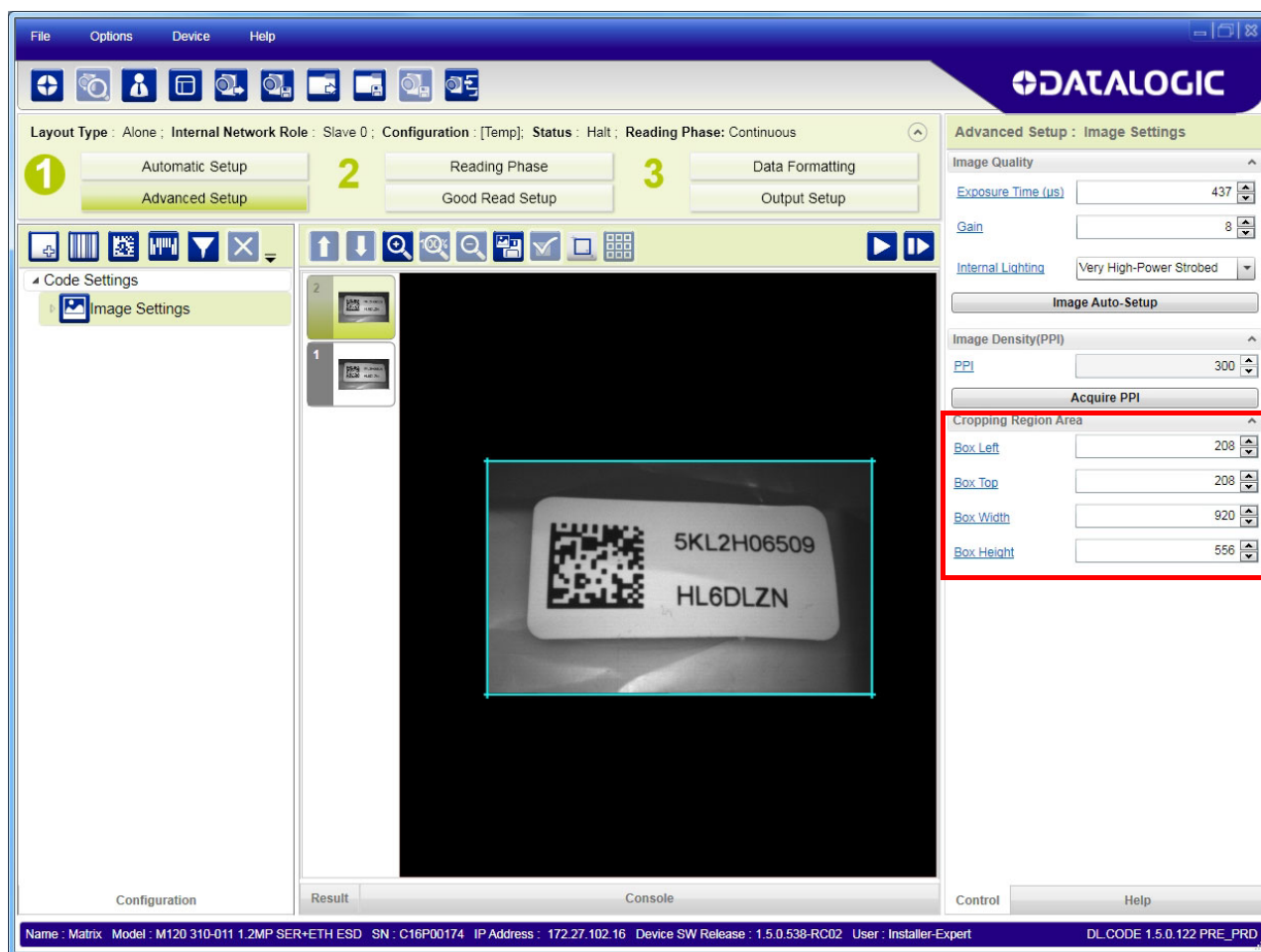
By dragging the edges with the mouse (resizing) you can crop the image to a specific location where codes are present. The numbers in the blue boxes refer to pixel references.



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.

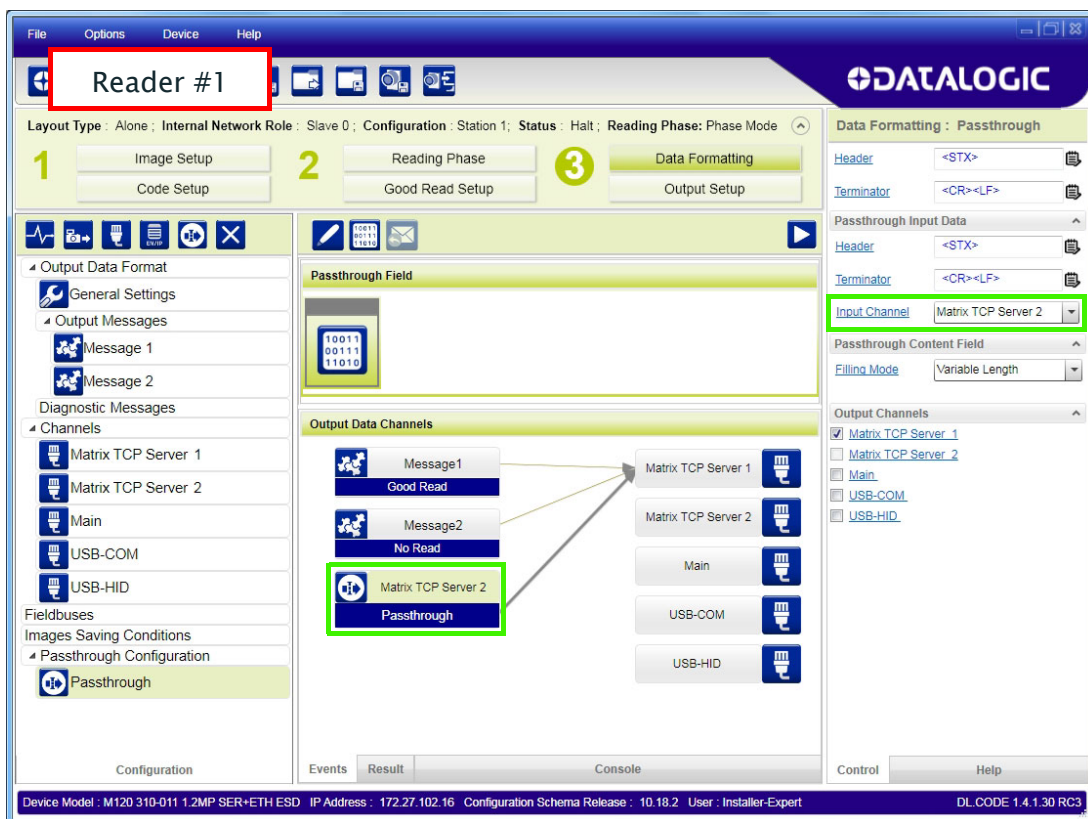
Various Image Filters are available to enhance Direct Part Marking applications. For more details see the DL.CODE User's Manual.

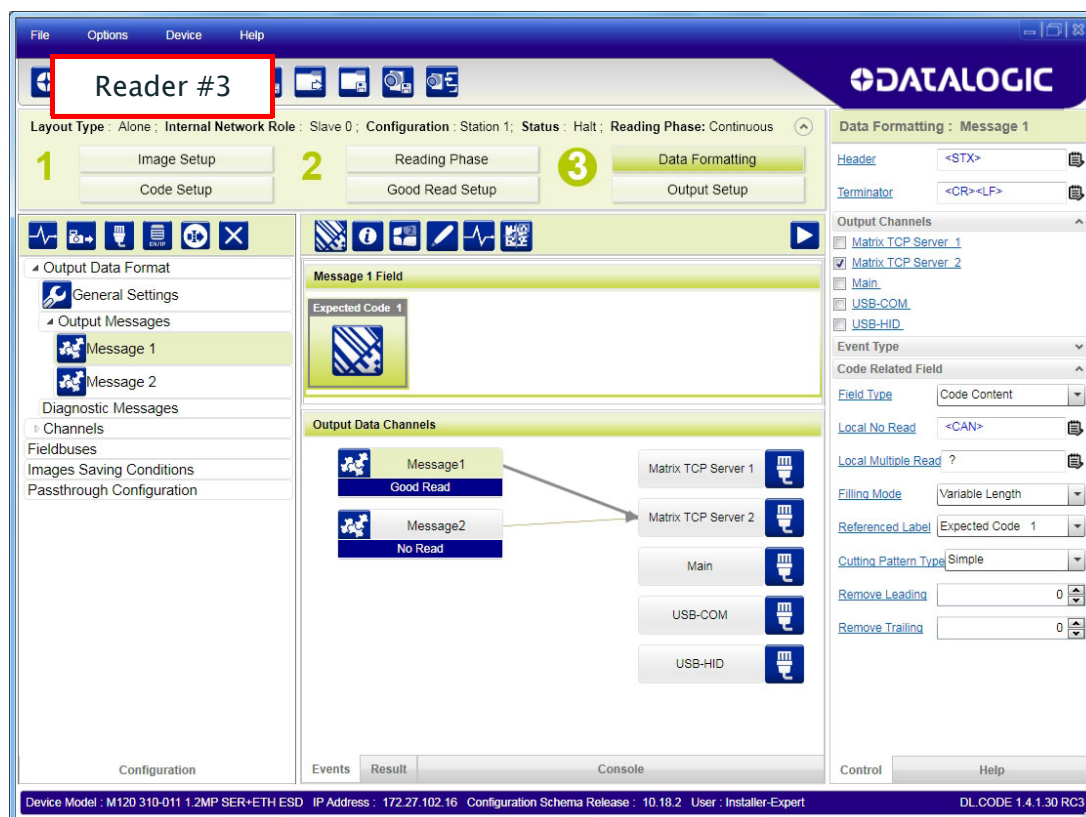
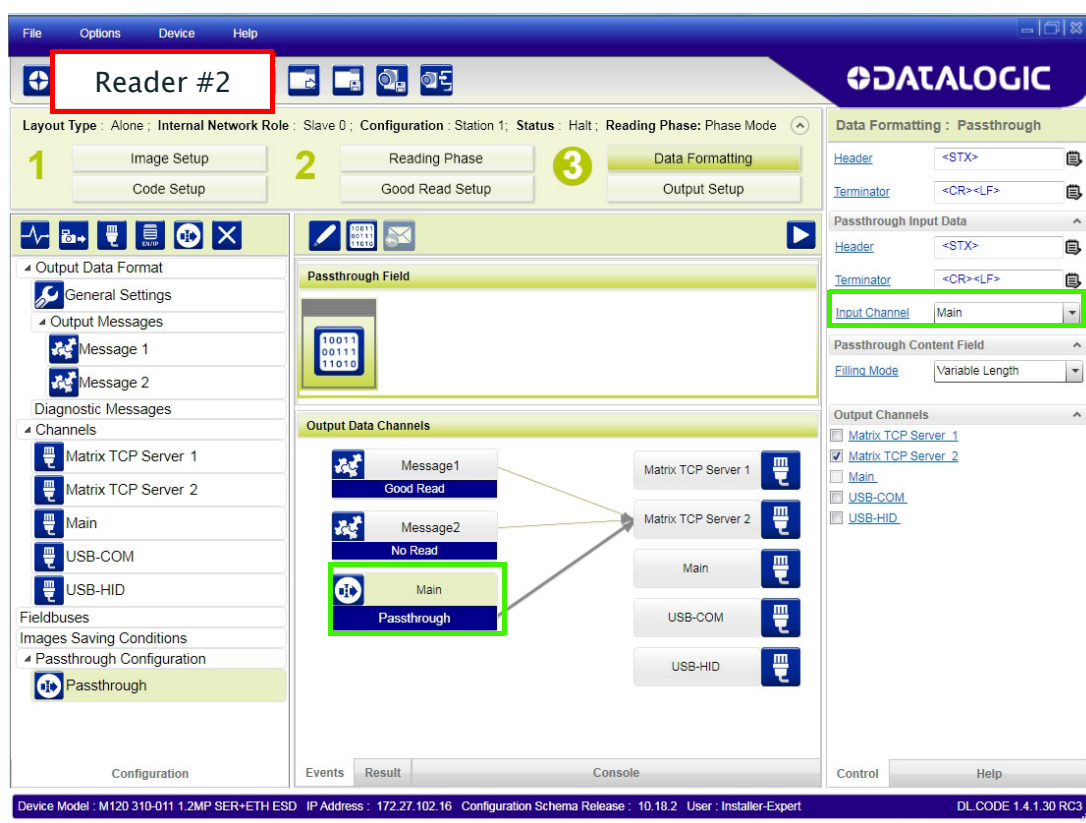
Pass-Through Configurations

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 "Pass-Through" on page 72.

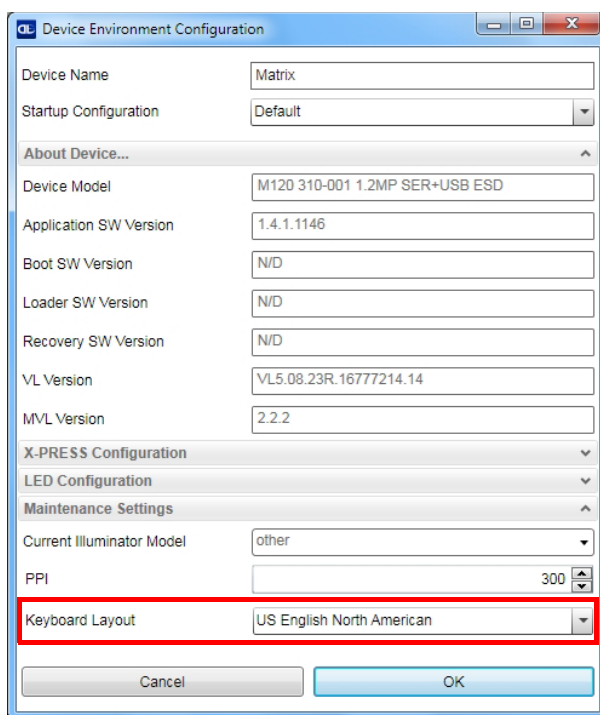




USB-HID (Keyboard Wedge) Configurations

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 from 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.

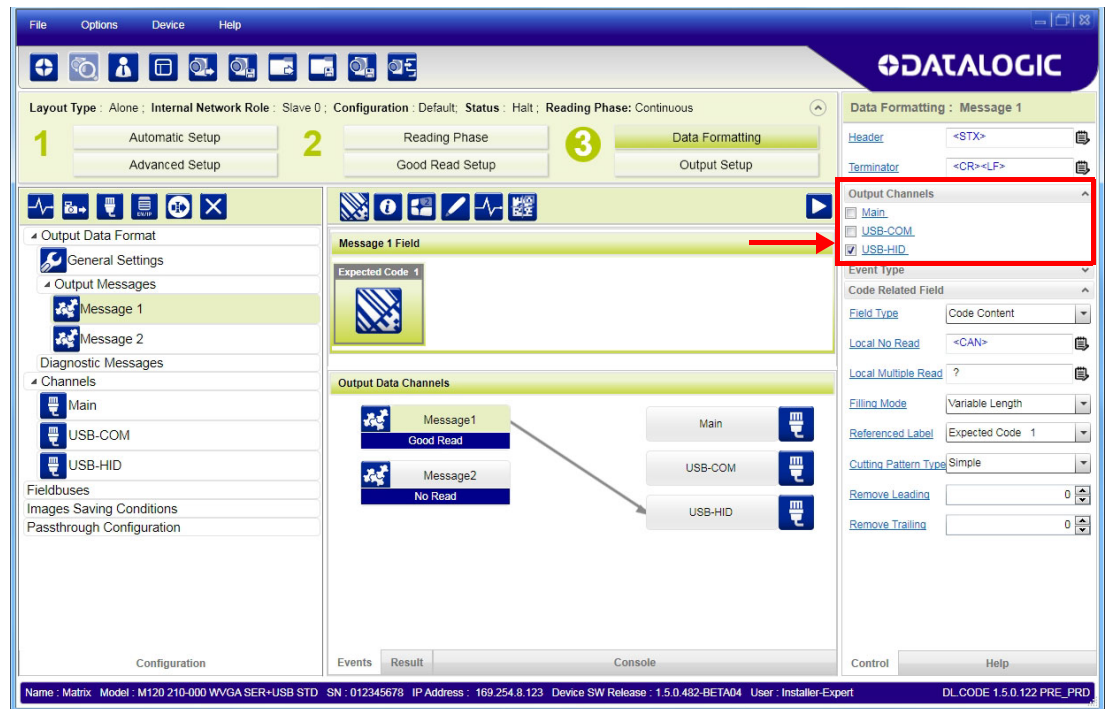
To assure the input is correctly interpreted, the Matrix 120 reader must be aligned with your keyboard type. This is done through the Device>Settings>Settings>Maintenance Settings tab. Select your keyboard from the dropdown list.



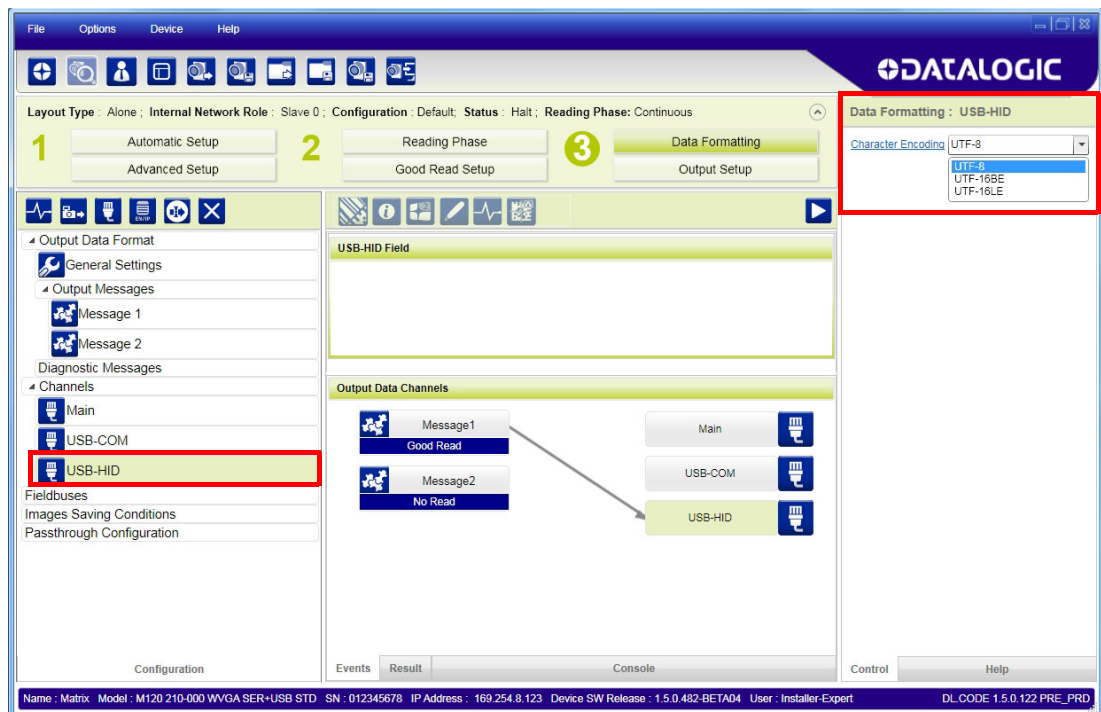
The USB-HID interface is a Matrix 120 Output only channel and is configured through the Data Formatting page.

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.

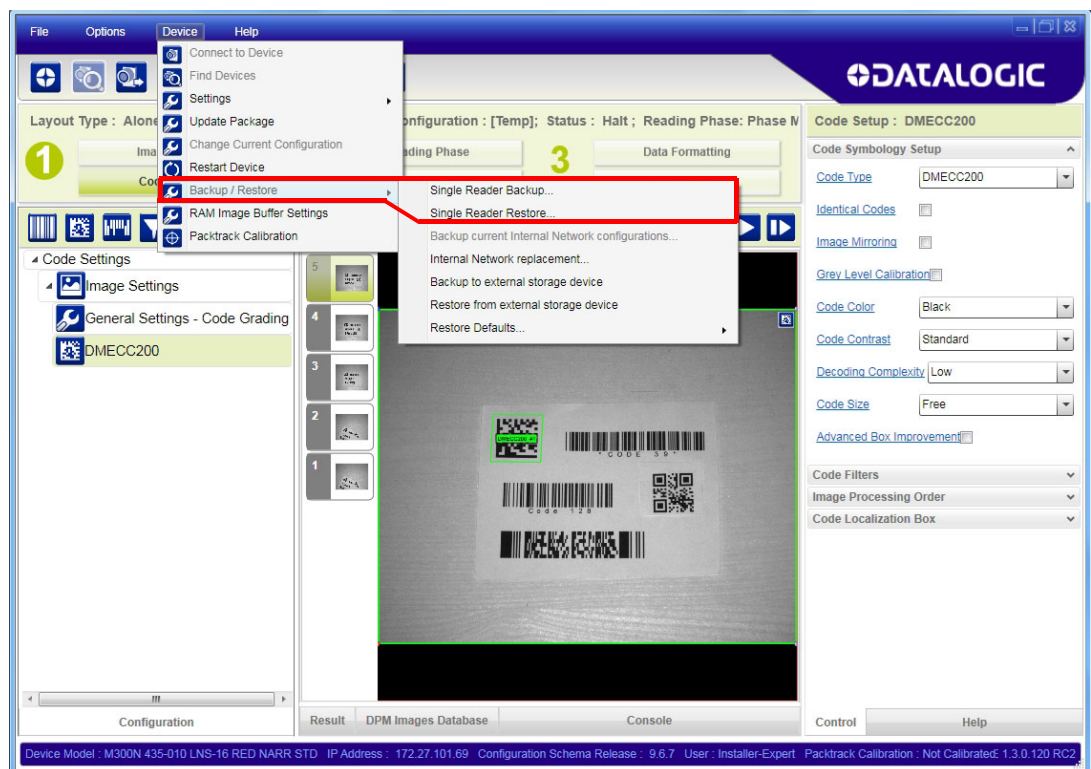
Backup and Restore functions provide parameters storage including all configuration jobs present on the reader.



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.

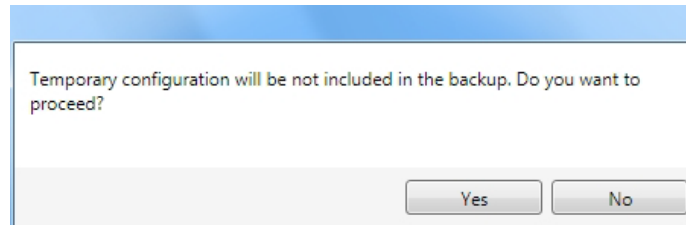


Backup

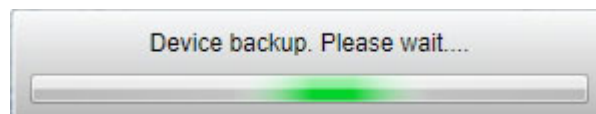
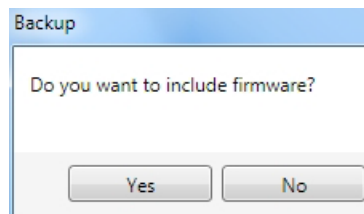
To perform a **Backup**:

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

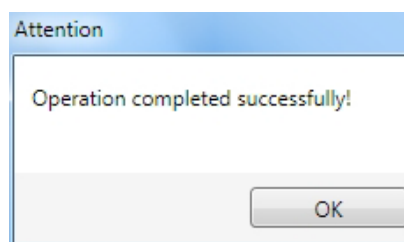
You will be reminded that configuration in temporary memory will not be saved so you should save the configuration to the reader before performing Backup.



You will also be asked whether to include the firmware or not.



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



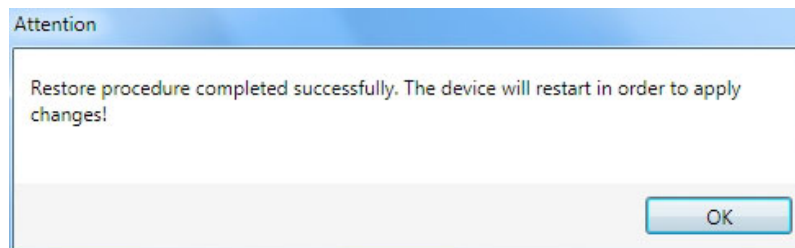
Restore

To perform a **Restore**:

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



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



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.

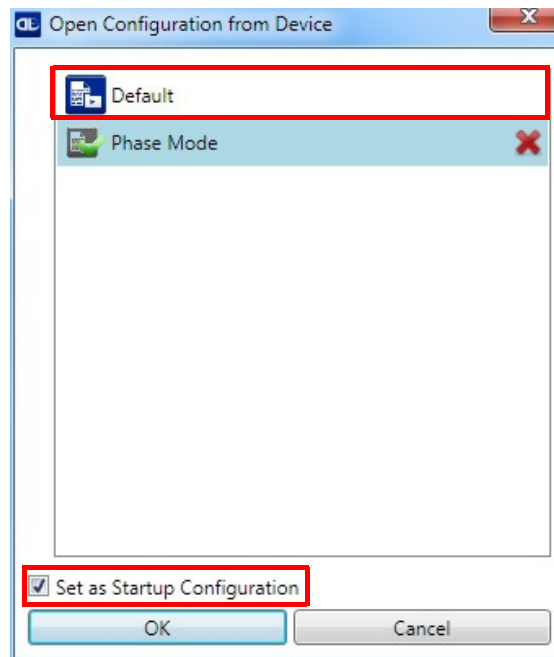
Restore Defaults

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

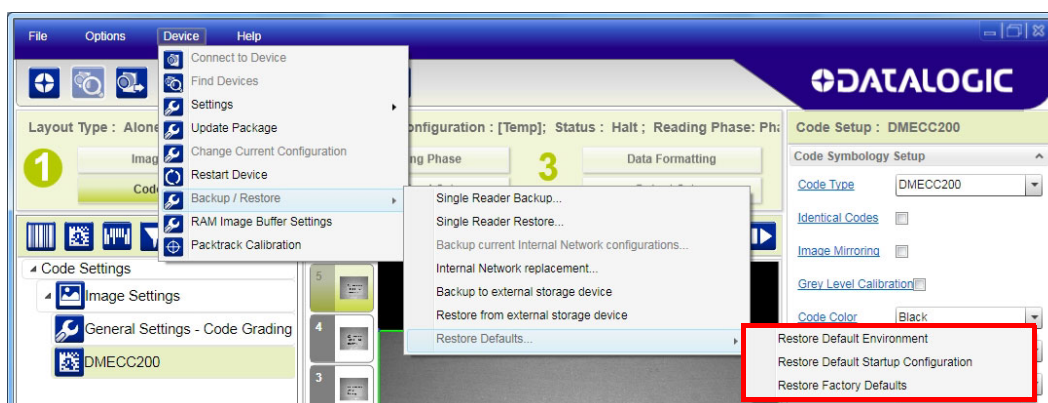
- The Configuration parameters are the ones set in the various steps of the configuration process and are specific to each application. When multiple configurations (jobs) are saved on a single device, these parameters can be different from one configuration to the next.
- Environment parameters regard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



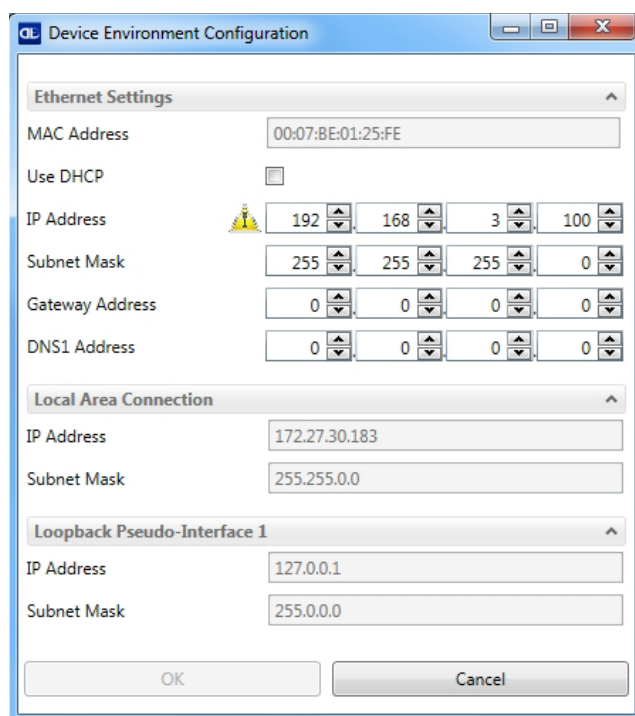
The same action can be performed from the Device menu > Backup/Restore > Restore Defaults > **Restore Default Startup Configuration**. The Default Configuration will be set to run at startup and the reader will be reset.



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 the state of the reader.

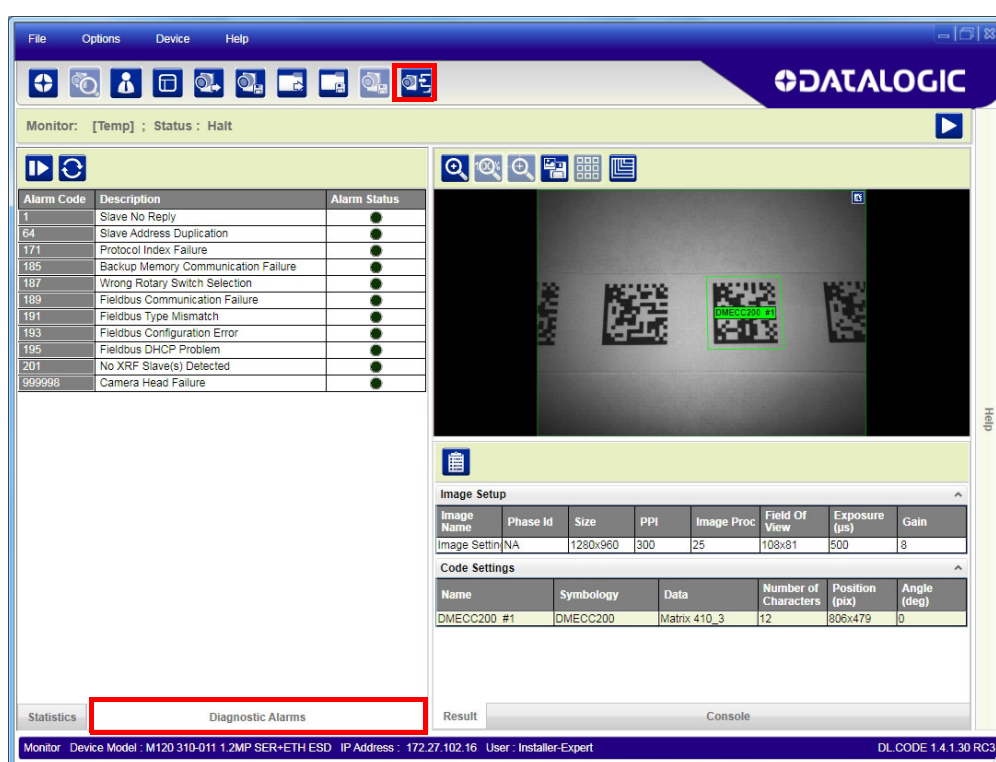


Figure 74 – Diagnostic Alarms

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).

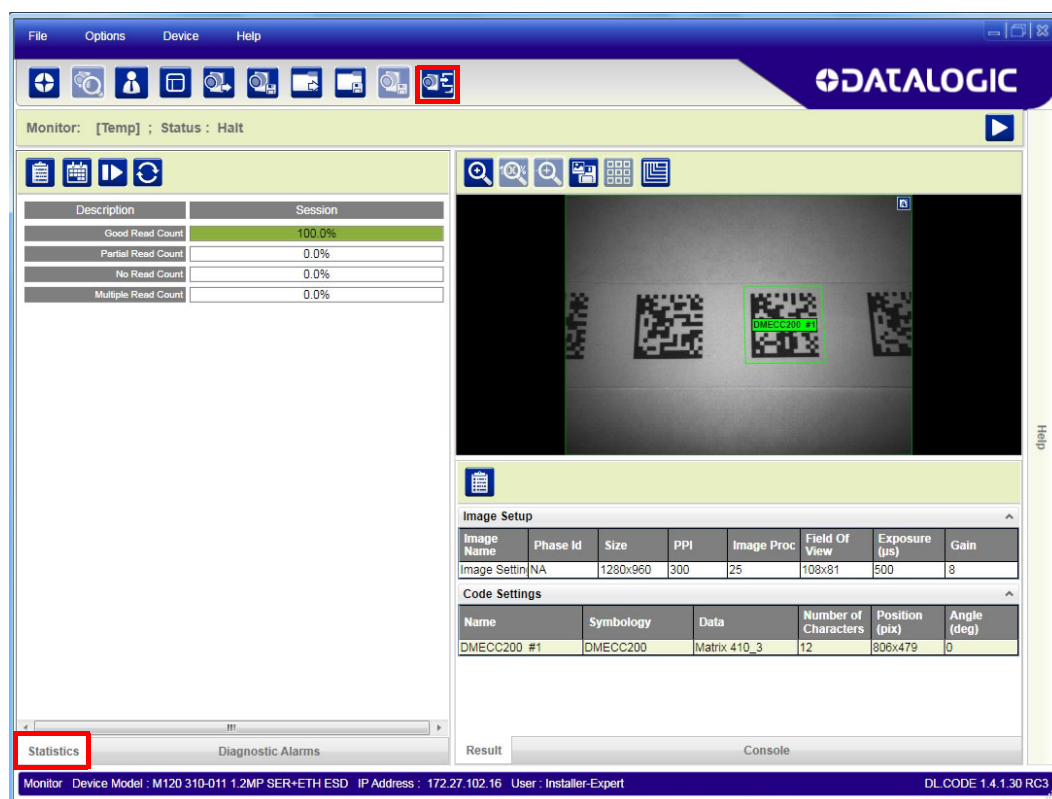
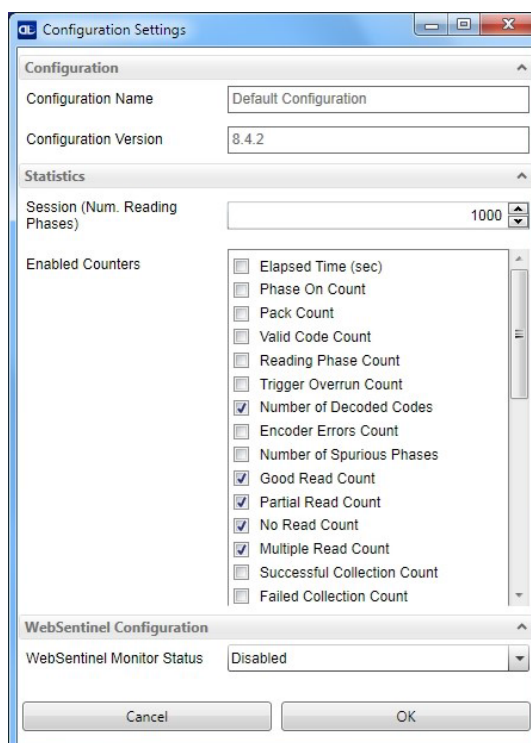


Figure 75 – Reading Statistics

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.

Windows XP SP3 and Matrix 120 USB Interface

There are some critical points to pay attention to when using DL.CODE for Matrix 120 configuration over the USB interface and the configuration PCs operating system is Windows XP.

- The USB drivers are **only** compatible with the most recent update of Service Pack 3 (SP3) for Window XP. Older versions of SP3 are not compatible with USB drivers. Connect to Windows Update and download the last available SP3 version before XP maintenance ended.
- On PCs running Windows XP SP3, only **one** USB device at a time can be connected to the LAN where DL.CODE performs discovery.
- First time USB device discovery on a PC using Windows XP SP3 requires being logged in as administrator in order to load the device drivers.
- Windows XP SP3 takes a longer time to establish connection (about 1 minute) before allowing USB device discovery.

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 <i>Debouncing Time</i> parameter setting. On the Reading Phase step check the settings for <i>Acquisition Trigger</i> , <i>Reading Phase-ON</i> , and <i>Reading Phase-OFF</i> 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 <i>Acquisition Trigger</i> , <i>Reading Phase-ON</i> , and <i>Reading Phase-OFF</i> parameters. Are the COM port parameters (<i>Baud Rate</i> , <i>Parity</i> , <i>Data Bits</i> , <i>Stop Bits</i>) correctly assigned? On the Reading Phase step check the settings of <i>Acquisition Trigger String</i> , <i>Reading Phase-ON String</i> , and <i>Reading Phase-OFF String</i> 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 <i>No Read Message</i>	Run the Rapid Configuration procedure in Chapter 1. Position the reader as described in 'Mounting And Positioning Matrix 120" on page 50 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?	<p>The reader Serial Number consists of 9 characters: one letter, 2 numbers, another letter followed by 5 numbers.</p> <p>The reader Serial Number is printed on a label that is affixed on the bottom case near the reading window.</p> <p>The Serial Number is also visible from the DL.CODE Device List Area.</p>
How do I obtain my reader Order Number?	<p>The reader Order Number consists of 9 numbers.</p> <p>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.</p>



Chapter 10

Technical Features

Electrical Features

Power	
Supply Voltage	5 to 30 Vdc (10 to 30 Vdc with CBX)
Consumption	0.4 to 0.1 A
Communication Interfaces	
Main: RS232, RS422 Full-duplex	2400 to 115200 bit/s
USB	USB 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 Current	3.5 mA (24 mA max when connected through CBX)
Outputs ^a	
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

- a. 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 Format	752x480	1280x960
Frame Rate	57 frames/sec.	36 frames/sec.
Focus Range ^a 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)	IEC60825-1 2007	
Lighting System	Internal Illuminator	
Aiming System	Laser Indicator	

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

Environmental Features

Operating Temperature ^a	-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

a. 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.)
Material	Aluminum	

Software Features

Readable Code Symbolologies			
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 Symbolologies	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 Windows-based SW (DL.CODE) via 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 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 A

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:

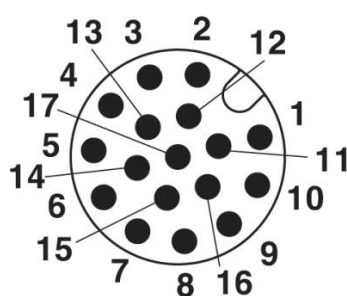


Figure 76 – M12 17-pin male Power, COM and I/O Connector

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 and cable shield	
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 1	

Power, Com and I/O Connector Pinout			
Pin	Name	Description	
16	-		
14	-		
4	-		
7	*USB+	USB data + (only for USB models)	
15	*USB-	USB data - (only for USB models)	
Pin	Name	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 57 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.

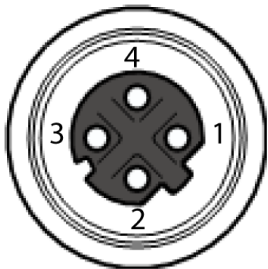


Figure 77 – M12 D-Coded Female Ethernet Network Connector

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	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 58.

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	Output 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 64.

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.

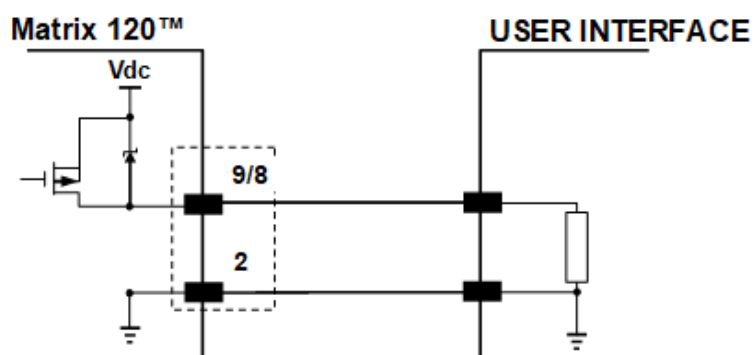


Figure 78 – PNP Output Connection

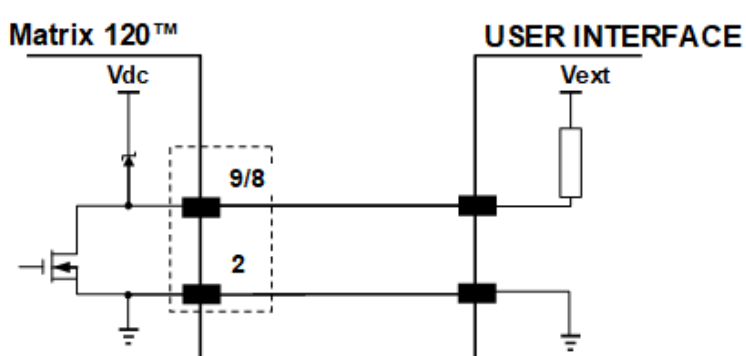


Figure 79 – NPN Output Connection

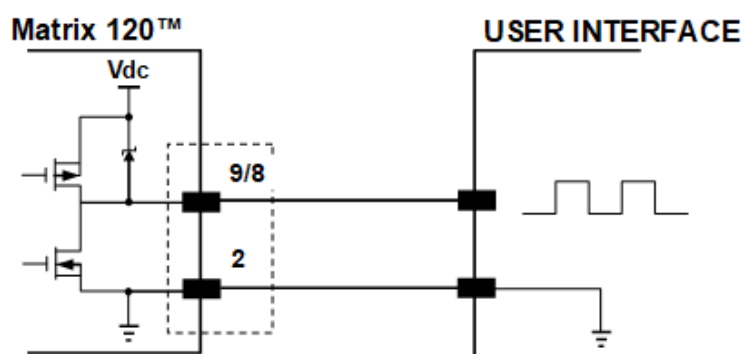


Figure 80 – Push-Pull Output Connection

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.

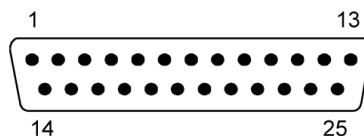


Figure 81 – 25-pin D-Sub Male COM, I/O and Power Connector

CAB-1011 Connector 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 (-) (<i>RS422 only</i>)
5	RX-	Received data (-) (<i>RS422 only</i>)
14, 16	-	Reserved
15, 17, 20	NC	Not Connected
21, 23, 24		

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.

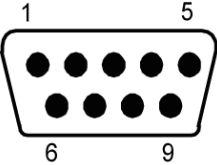
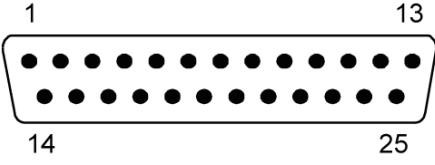
CAB-1051 Wires		
Pin	Name	Description
Orange	Input 1	External Trigger
Gray	Input 2	Input Signal 2
Purple	O1	Configurable Digital Output 1
Red/White	O2	Configurable Digital Output 2
Black	GND	Ground Reference
Black Thick	SHIELD	Cable Shield



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.

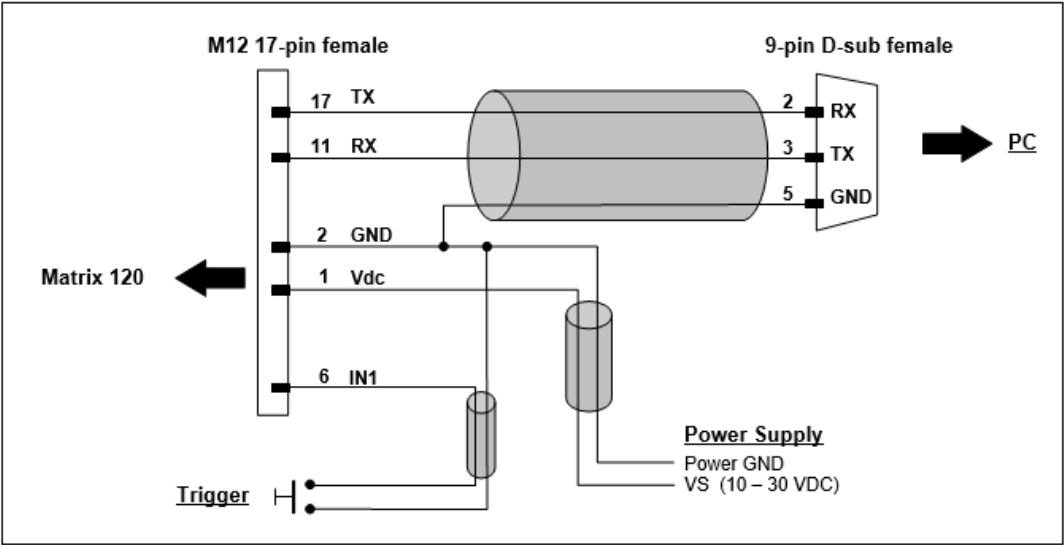


Figure 82 – Test Cable for Matrix 120



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 due 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 network control, database access, special programs, supervisory programs, or programming 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 international 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 standards.

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.

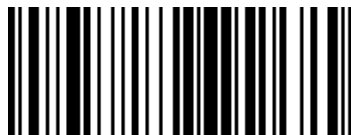
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