ABR 7000 Series Barcode Reader

Instruction Manual

Original Instructions
207634 Rev. A
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207634

Contents

1 Product Description

Imager-based barcode reader with superior decoding capability and a powerful array of lens and lighting options

- Powerful decoding capability to read even difficult 1D and 2D codes
- Superior ability to read DPM and low contrast codes
- Industrial IP67 metal housing for factory environments
- Autofocus or manual focus models available for ease of setup and configuration
- Quick configuration with push buttons or software interface
- Ethernet and serial communications for connection to the factory floor
- Powerful integrated LED lighting and easy focus adjustment in one package for maximum application flexibility
- Green "good read" and red "no read" feedback spotlights and beeper for easy monitoring
- Easy, multi-head system connection to multiply barcode reading power
- Embedded webserver interface for monitoring images and statistics over any network

WARNING: Not To Be Used for Personnel Protection

Never use this device as a sensing device for personnel protection. Doing so could lead to serious injury or death. This device does not include the self-checking redundant circuitry necessary to allow its use in personnel safety applications. A sensor failure or malfunction can cause either an energized or de-energized sensor output condition.

1.1 Models

Table 1: ABR 7000 Models

Model	Resolution	Lens	Lighting	Options	Communications	Codes
ABR7109-RSE2	1.3 MP (1280x1024 pixels)	9 mm, manual focus	Red	Standard	Serial/Ethernet	1D and 2D
ABR7109-MSE2		9 mm, manual focus	Multicolored DPM[2]			
ABR7112-RSE2		12 mm, manual focus	Red			
ABR7116-RSE2		16 mm, manual focus	Red			
ABR7106-RSE2		6 mm, manual focus	Red			
ABR7106-MSE2		6 mm, manual focus	Multicolored DPM[2]			
ABR71L9-RSE2		9 mm, Liquid Lens Autofocus	Red			
ABR71L9-MSE2		9 mm, Liquid Lens Autofocus	Multicolored DPM[2]			

1.2 Laser Description and Safety Information

The ABR 7000 internal illuminators contain two aiming Laser LEDs used to position the reader. 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.

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 2 laser product according to IEC 60825-1 regulations.

[2] Multicolored DPM models have red and blue lights for optimized reading of DPM codes.

CAUTION: Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure. Do not attempt to disassemble this sensor for repair. A defective unit must be returned to the manufacturer.

For Safe Laser Use - Class 2 Lasers

- Do not stare at the laser.
- Do not point the laser at a person's eye.
- Mount open laser beam paths either above or below eye level, where practical.
- Terminate the beam emitted by the laser product at the end of its useful path.

Reference IEC 60825-1:2007, Section 8.2.

CAUTION: Never stare directly into the sensor lens. Laser light can damage your eyes. Avoid placing any mirror-like object in the beam. Never use a mirror as a retroreflective target.

Class 2 Lasers

Class 2 lasers are lasers that emit visible radiation in the wavelength range from 400 nm to 700 nm, where eye protection is normally afforded by aversion responses, including the blink reflex. This reaction may be expected to provide adequate protection under reasonably foreseeable conditions of operation, including the use of optical instruments for intrabeam viewing.

Class 2 Laser Safety Notes

Low-power lasers are, by definition, incapable of causing eye injury within the duration of a blink (aversion response) of 0.25 seconds. They also must emit only visible wavelengths (400 to 700 nm). Therefore, an ocular hazard may exist only if individuals overcome their natural aversion to bright light and stare directly into the laser beam.

Laser wavelength: 630-680 nm **Output:** 1 mW **Pulse Duration:** variable

1.3 Features

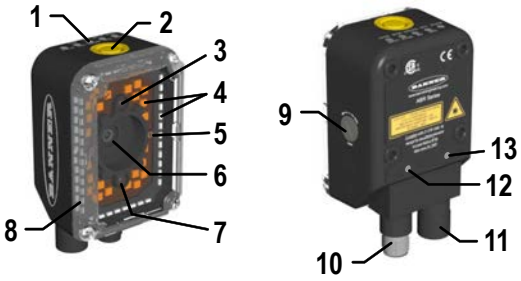


Figure 1. Models with Manual Adjustable Focus

1. Smart Teach Interface
2. Button
3. Good Read LED (green)
4. Internal Illuminator
5. Aiming System Laser Pointers
6. Lens
7. No Read LED (red)
8. Lens Cover
9. Focus Adjustment Screw
10. Power - Serial - I/O Connector
11. Ethernet Connector
12. Power ON LED
13. Ethernet Connection LED

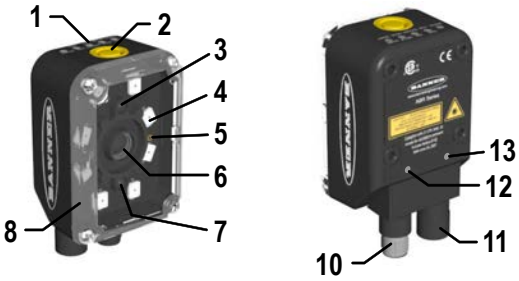


Figure 2. Models with Liquid Lens Autofocus

1.3.1 Indicators

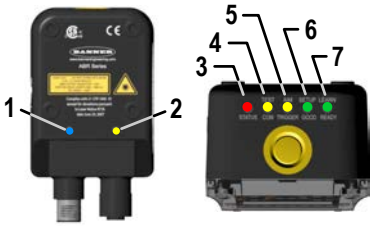


Figure 3. Indicators—Back and Top of Device

	Indicator	Color	Description
1	Power	Blue	Indicates that the reader is connected to the power supply
2	Ethernet Connection	Amber	Indicates connection to the Ethernet network
3	STATUS	Red	No read result
4	COM/Test	Amber	Active result output transmission on the Main serial port
5	TRIGGER/Aim	Amber	Reading in progress. Do not trigger a new reading attempt until the current attempt finishes
6	GOOD/Setup	Green	Reading successful
7	READY/Learn	Green	Ready

During the reader startup, all of the LEDs turn on for one second.

See *Smart Teach Interface* on page 36 for the colors and meanings of the five LEDs when the reader is in Smart Teach mode.

1.3.2 Diagnostic Indication

Figure 4. Diagnostic Indicators

The **Status** and **Ready** 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 Barcode Manager.

1.3.3 Button

Use the button for the Smart Teach interface for quick installation without using a PC. The button can be disabled or re-configured to perform additional functions from Barcode Manager.

See *Smart Teach Interface* on page 36.

2 Specifications and Requirements

2.1 Specifications—Reader

Supply Voltage
10 V dc to 30 V dc

Consumption
0.7 A to 0.2 A maximum

Communication Interface
Main RS232 or RS422 full duplex: 2400 bit/s to 115200 bit/s
Auxiliary - RS232: 2400 to 115200 bit/s
Ethernet[3]: 10/100 Mbit/s

Inputs
Input 1 (External Trigger) and Input 2 opto-isolated and polarity insensitive
Maximum voltage: 30 V dc
Maximum input current: 10 mA

Outputs
3 NPN/PNP/Push-Pull software selectable, reverse polarity and short circuit protected outputs available (2 Opto-isolated outputs instead if using TCNM-ACBB1, see *Outputs* on page 33 for specifications)
Maximum Current: 100 mA maximum
Output Saturation Voltage (in PNP or NPN mode): < 3 V at 100 mA
Maximum load device voltage drop (in NPN mode): 30 V

Indicators
Power LED
Ready, Good, Trigger, Com, Status LEDs
Ethernet Network LED
Green Spot LED

Other
Smart Teach Button (configurable via Barcode Manager), Beeper

Optical Features
Image Sensor: CMOS sensor with Global Shutter
Image Format: 1.3 M pixels SXGA (1280×1024) pixels
Frame Rate: 60 frames/sec.
Pitch: ±35°
Tilt: 0° to 360°
LED Safety: LED emission according to EN 62471
Laser Safey (pointers): IEC60825-1 2007
Lighting System: Internal Illuminator
Aiming System: Laser Pointers

Construction
Aluminum

Weight
About 238 grams (8.4 oz.)

Operating Conditions
Operating Temperature[4]: 0 °C to +50 °C (+32 °F to +122 °F)
Liquid Lens Autofocus models Operating Temperature[4]: 0 °C to +45 °C (+32 °F to +113 °F)
Storage Temperature: –20 °C to +70 °C (–4 °F to +158 °F)
90% maximum relative humidity (non-condensing)

Vibration Resistance EN 60068-2-6
14 mm at 2 to 10 Hz; 1.5 mm at 13 to 55 Hz; 2 a (a), 70 to 500 Hz; 2 hours on each axis

Shock Resistance EN 60068-2-27
30 g; 11 ms; 3 shocks on each axis

Bump Resistance EN 60068-2-29
30 g; 6 ms; 5000 shocks on each axis

Environmental Rating
IEC IP67[5]

Required Overcurrent Protection

WARNING: Electrical connections must be made by qualified personnel in accordance with local and national electrical codes and regulations.

Overcurrent protection is required to be provided by end product application per the supplied table.
Overcurrent protection may be provided with external fusing or via Current Limiting, Class 2 Power Supply.
Supply wiring leads < 24 AWG shall not be spliced.
For additional product support, go to *www.bannerengineering.com*.

Supply Wiring (AWG)	Required Overcurrent Protection (Amps)
20	5.0
22	3.0
24	2.0
26	1.0
28	0.8
30	0.5

Certifications

FCC Statement

Modifications or changes to this equipment without the expressed written approval of Banner Engineering 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 own expense.

3 The Ethernet interface supports application protocols: TCP/IP, EtherNet/IP, Modbus TCP
4 High ambient temperature applications should use metal mounting bracket for heat dissipation.
5 IEC IP67 when correctly connected to IP67 cables with seals.

2.2 Specifications—Software

Operating Mode
Continuous, One Shot, Phase Mode

Configuration Methods
Smart Teach Human Machine Interface
ABR 7000: Windows-based SW (Barcode Manager) via Ethernet Interface
Host Mode Programming sequences sent over Serial or Ethernet TCP interfaces

Parameter Storage
Permanent memory (Flash)

Barcode Types

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

2.3 PC Requirements—Barcode Manager

Administrative rights are required to install the Barcode Manager software.

Operating System
Microsoft® Windows® operating system version XP SP3, 7, 8, or 10[6]
Barcode Manager does not currently support Windows Embedded (often used in industrial PCs and/or PLCs)

System Type
32-bit or 64-bit

Hard Drive Space
2 GB hard disk for 64-bit machines; 1 GB hard disk for 32-bit machines

Memory (RAM)
1 GB RAM

Processor
2.00 GHz or faster microprocessor

Screen Resolution
One 19-inch or larger monitor, optimized for 1280×1024 resolution

Third-Party Software
Web Browser: Google Chrome, Mozilla Firefox, Microsoft Internet Explorer, Opera, etc.

Connection
100 Base-T Ethernet

2.4 Dimensions

All measurements are listed in millimeters [inches], unless noted otherwise.

[6] Microsoft and Windows are registered trademarks of Microsoft Corporation in the United States and/or other countries.

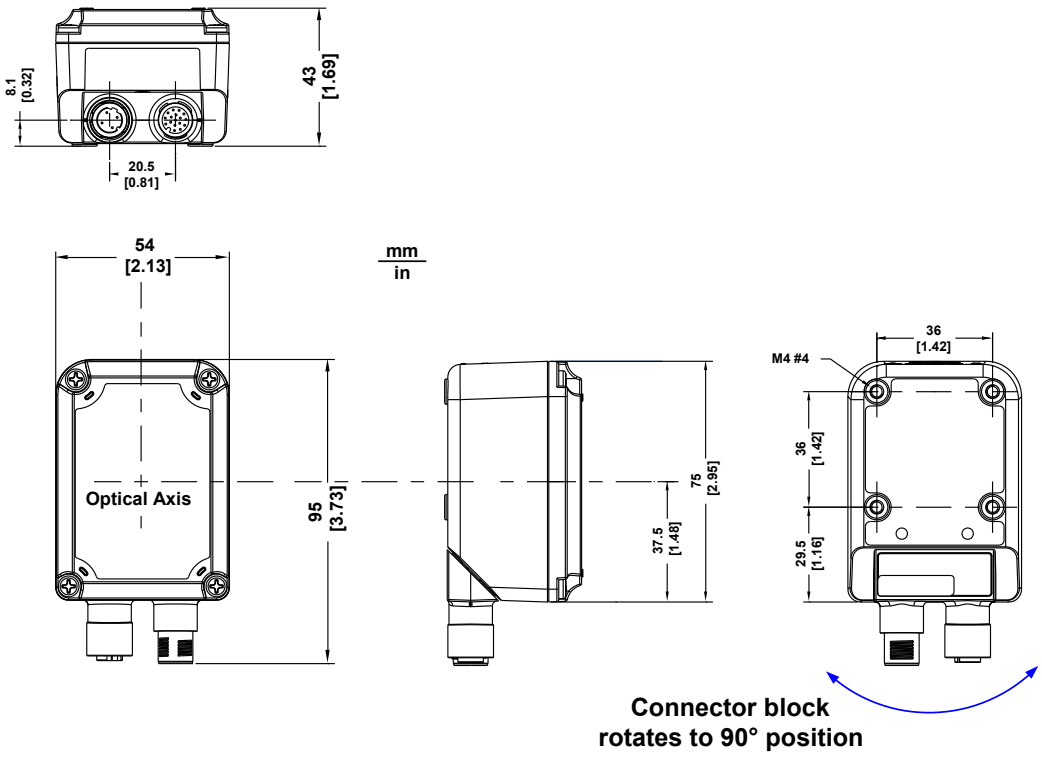


Figure 5. Overall Dimensions with Connector at 0°

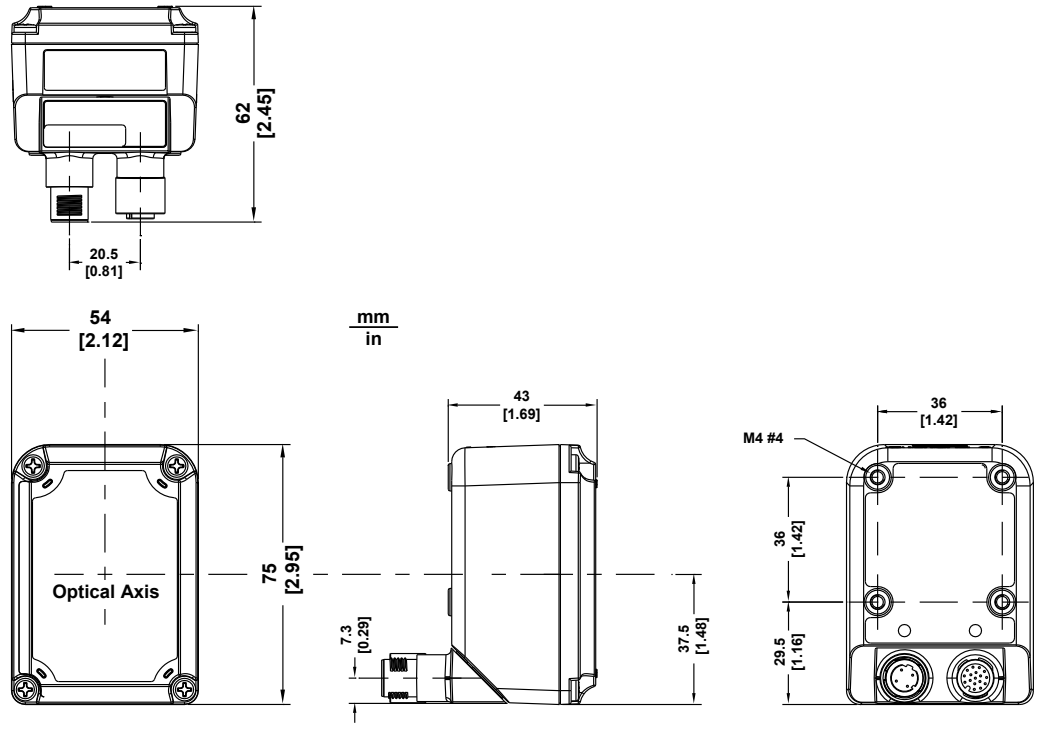


Figure 6. Overall Dimensions with Connector at 90°

3 Installation Instructions

3.1 Handling

Proper handling ensures that the ABR will function correctly.

The ABR is designed for use in an industrial environment. It is built to withstand vibration and shock when correctly installed. However, it is also a precision product and before and during installation it must be handled properly to avoid damage.

- Do not drop the device (exceeding shock limits)
- Do not fine tune the positioning by striking the device or the bracket
- Do not weld the device into position; this can cause electrostatic, heat, or reading window damage
- Do not spray paint near the reader; this can cause reading window damage

3.2 Mount the Reader

Note: Mount the device at a 10° to 15° angle from the target to avoid direct reflections.

1. Rotate the connector block to the desired angle.

Figure 7. Connector Block

2. If a bracket is needed, mount the device onto the bracket.
3. Select a reading distance.

   The ABR 7000 manual adjustable focus models and Liquid Lens Autofocus models are both factory focused to a precise reading distance.

   - If this distance is compatible with your application, or if you have a Liquid Lens Autofocus model, you can use the Smart Teach Interface to install the reader.
   - If this distance is not compatible with your application and you have a manual focus model, use the software setup procedure described in the Instruction Manual. See *Advanced Setup for Manual Adjustable Focus Models* on page 46.

   The following table shows the Horizontal Field of View size for these factory focused reading distances:

Lens	Factory Focused Reading Distance	Horizontal Field of View
6 mm	85 mm (3.3 in)	121 mm (4.8 in)
9 mm	180 mm (7.1 in)	145 mm (5.7 in)
9 mm Liquid Lens Autofocus	135 mm (5.3 in)[7]	109 mm (4.3 in)
12 mm	250 mm (9.8 in)	145 mm (5.7 in)
16 mm	320 mm (12.6 in)	132 mm (5.2 in)

4. Mount the device (or the device and the bracket) to the machine or equipment at the desired location. Do not tighten the mounting screws at this time.
5. Check the device alignment.
6. Tighten the mounting screws to secure the device (or the device and the bracket) in the aligned position.

[7] See *Aim and Autofocus the Reader—Liquid Lens Autofocus Models* on page 37to perform the autofocus to optimize the reader for other distances.

3.3 Position the Reader

The ABR is able to decode code labels at a variety of angles; however significant angular distortion may degrade reading performance.

When mounting the ABR, consider these ideal label position angles: Pitch or Skew 10° to 20° and Tilt 0°. The reader can read a code at any tilt angle provided the code fits into the Field Of View (FOV).

Note: Because the ABR 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 the following figure.

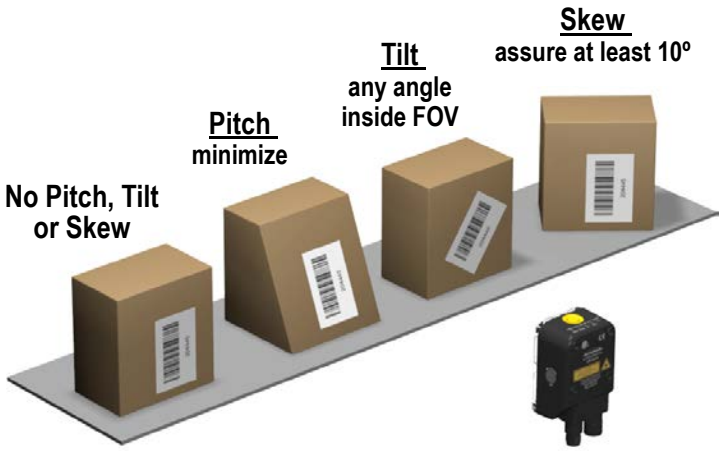


Figure 8. Code Reading Orientation—Pitch, Tilt, and Skew Angles

Use the follow the suggestions for the best orientation:

- Position the reader to avoid the direct reflection of the light emitted by the ABR reader. It is best to use at least 10° for the Skew angle
- Use a Pitch or Skew angle of 0° in some cases, such as low contrast or low illumination
- Align the reader to fit linear barcodes into the horizontal FOV for best performance (because linear barcodes are rectangular). The ABR can read labels with any tilt angle.

Figure 9. Code in FOV

Figure 10. Code Out of FOV Due to Tilt Angle

See *Reading Features* on page 81 for FOV vs. Reading Distance considerations.

3.4 Focus Lock Label—Optional

The Focus Lock Label is for ABR 7000 manual focus models only.

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.

3.5 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. Most examples show the optional, but recommended, TCNM-ACBB1 connection box (see *TCNM-ACBB1 Electrical Connections* on page 21).

Note: All software configurations are made through Barcode Manager which connects to the reader through the on-board Ethernet interface (recommended) or Serial interface.

Note: The Master/Slave Role is only significant for the Internal ID-NET Network. If your layout doesn't use the ID-NET network then the device's Role is not significant and can be ignored.

3.5.1 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 STP-M12D-4xx cable. There is no need to use a crossover adapter because ABR incorporates an autocross function.

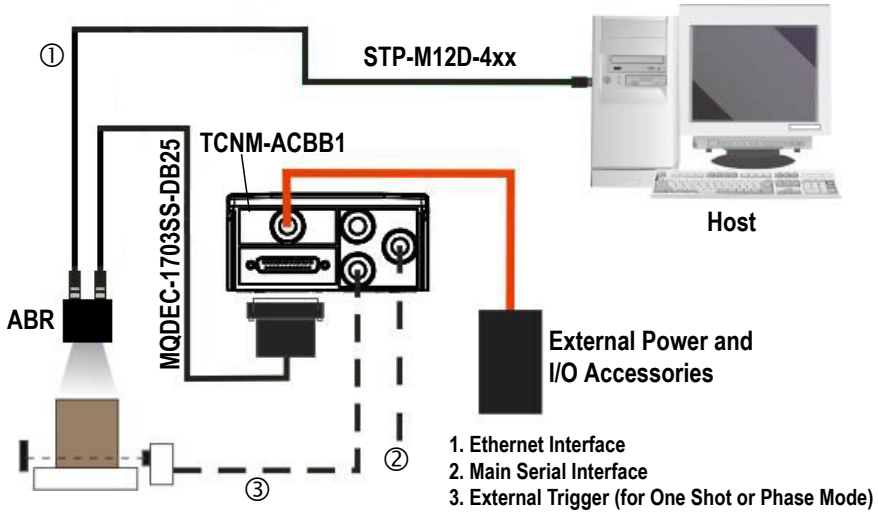


Figure 11. Ethernet Point-to-Point Layout

All devices always support multiple output channels (that is, for data monitoring).

When using a Local Area Network (LAN), one or more ABR readers can be connected to the network using STP-M12D-4xx cables.

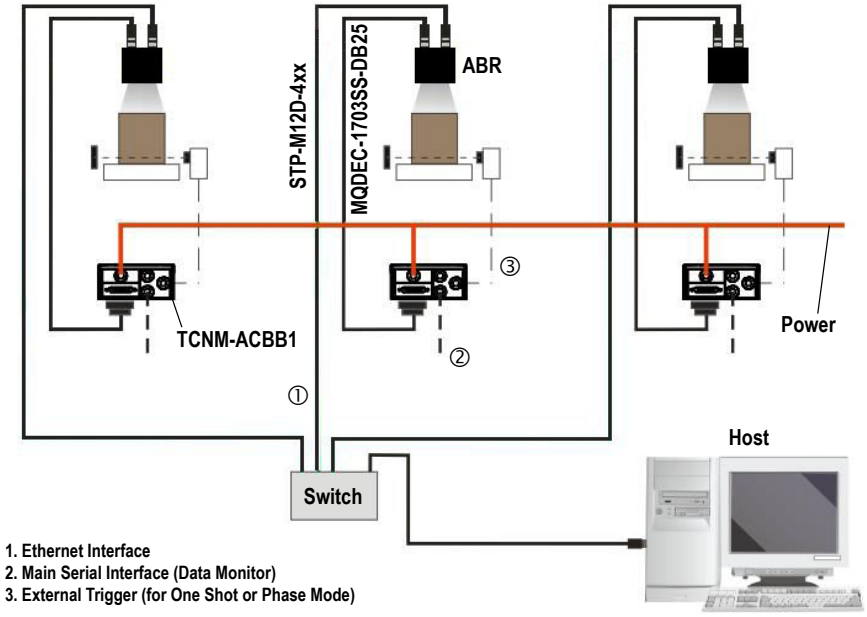


Figure 12. Ethernet Network Layout

3.5.2 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 Barcode Manager.

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 the reading zone.

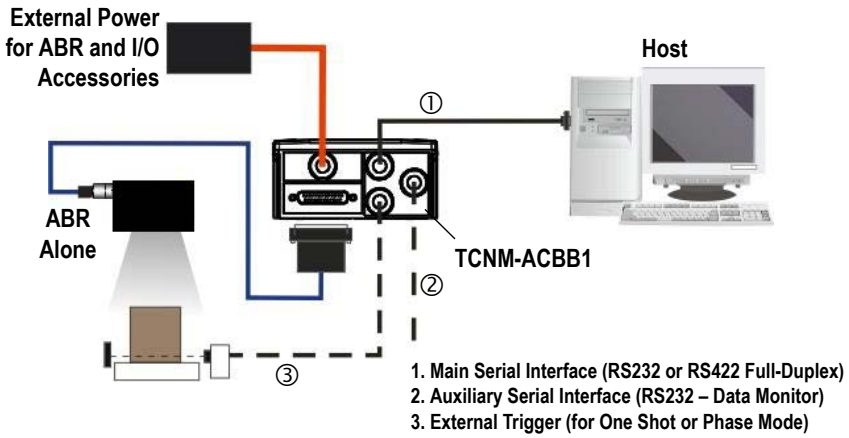


Figure 13. Serial Interface Point-to-Point Layout

All devices always support multiple output channels (that is, for data monitoring).

3.5.3 Pass-Through

The pass-through layout allows each device working alone, 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.

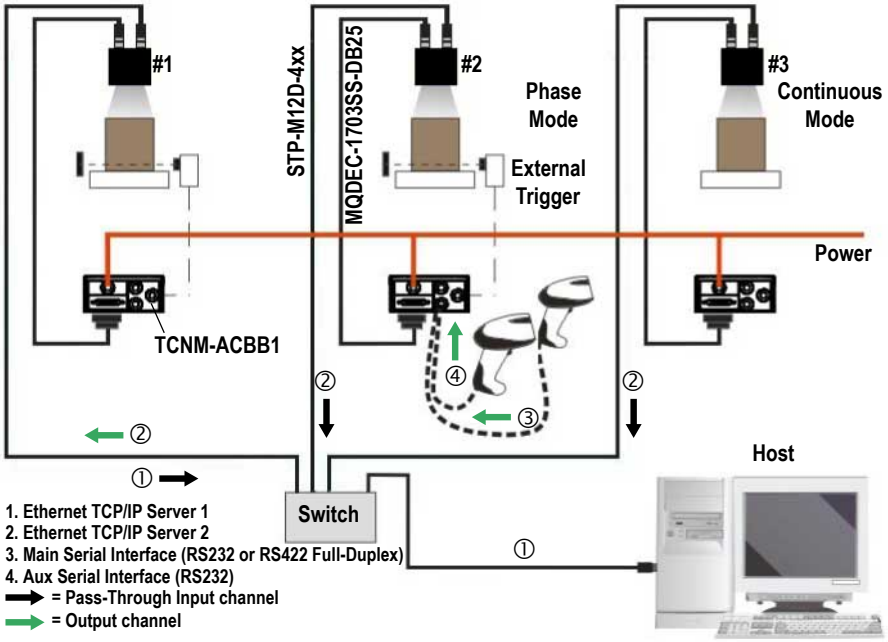


Figure 14. Pass-Through Layout

In a Pass-through layout each device supports multiple pass-through configurations to accept input from different devices on different channels (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 (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 (left reader, above).

All devices always support multiple output channels (that is, for data monitoring).

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

3.5.4 ID-NET Multidata Network (Pass-Through)

A special case of the pass-through layout allows each Slave device **working alone**, to collect data from one or more pass-through input channels and send this data plus its own on the ID-NET output channel to the Master.

The Slave readers are connected together using the ID-NET interface. Every Slave reader must have an ID-NET address in the range 1-31.

The Master collects the data from its pass-through ID-NET input channel and sends it to the Host on a different output channel.

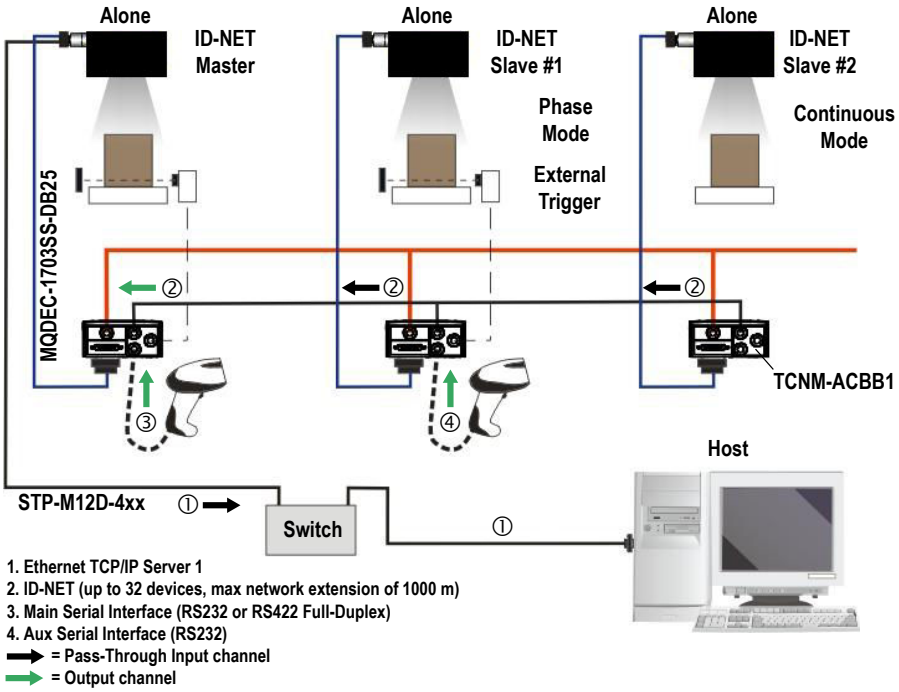


Figure 15. ID-NET Multidata Layout (Pass-Through)

In a Pass-through layout each device supports multiple pass-through configurations to accept input from different devices on different channels (Master reader, above). However, ID-NET Slave readers are not required to have a pass-through configuration if they do not need to receive data from an input channel (right reader, above). The ID-NET Master always has at least one pass-through configuration to collect the ID-NET Slaves data and send it to the Host.

Note: Slave devices cannot receive data from a pass-through ID-NET input channel and Master devices cannot send data on an ID-NET output channel.

All devices always support multiple output channels (that is, for data monitoring).

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

3.5.5 ID-NET Synchronized Network

When the device is working Synchronized, the ID-NET connection is used to collect data from several readers to build a multi-point or a multi-sided reading system; there can be one Master and up to 31 Slaves connected together.

The Slave readers are connected together using the ID-NET interface. Every slave reader must have an ID-NET address in the range 1-31.

The Master reader is also connected to the Host on one of its communication channels. In the following examples the RS232/RS422 main serial interface is used.

For a Master/Slave Synchronized layout the External Trigger signal is unique to the system; there is a single reading phase and a single message from the Master reader to the Host computer. **It is not necessary to bring the External Trigger signal to all the readers.**

In the Master/Slave Synchronized layout the Master operating mode can only be set to Phase Mode.

The Main and ID-NET interfaces are connected as shown in the following figures.

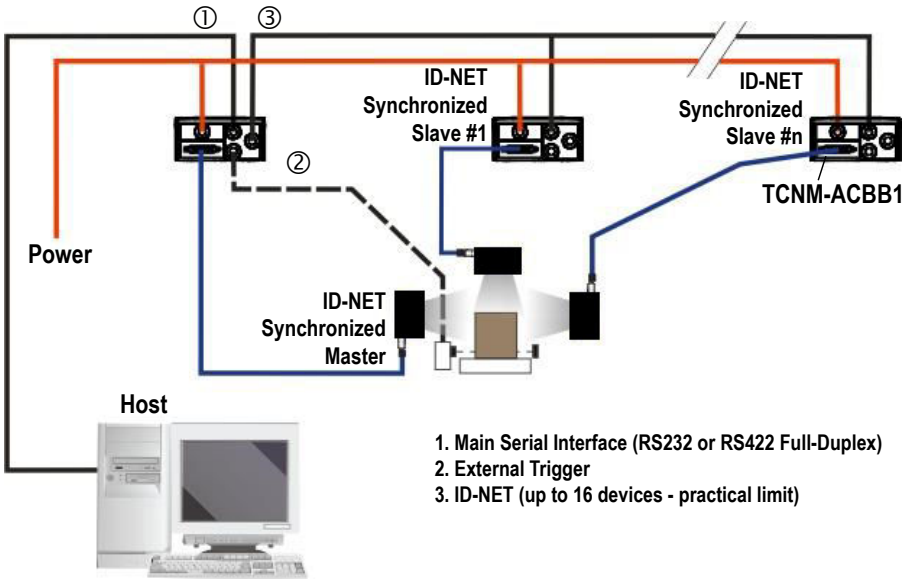


Figure 16. ID-NET Synchronized Layout

All devices always support multiple output channels (that is, for data monitoring).

The same configuration can be made to a Host using the on-board Ethernet interface to the Master. The TCP/IP Ethernet and ID-NET interfaces are connected as shown in the figure below.

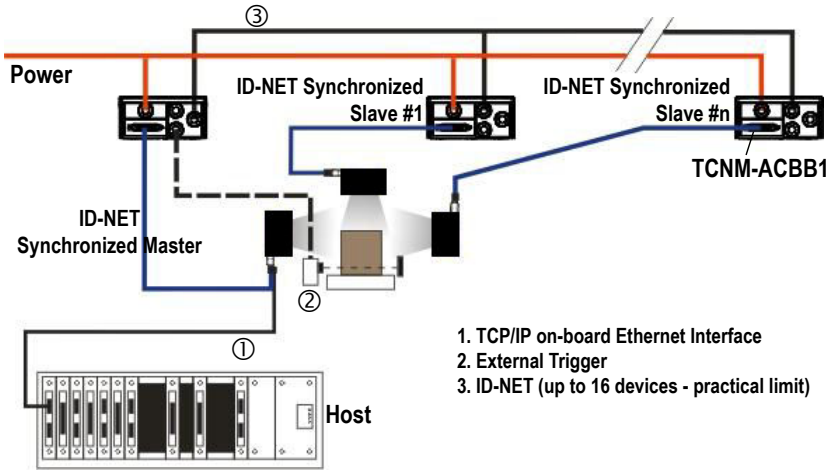


Figure 17. ID-NET Synchronized Layout with Master on-board TCP/IP Ethernet Interface to Host

3.6 Connector Descriptions

The connector pinouts and notes given in this section are for typical cabling applications.

3.6.1 Power, Communications, and I/O Connector

The ABR 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.

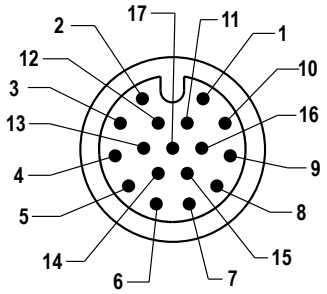


Figure 18. M12/Euro-style 17-pin male Communications, I/O, and Power Connector

Table 2: Power and I/O Pinouts for MQDC2S-17xx

Pin	Wire Color	Description	
1	Brown	Power Supply Input Voltage +	
2	Blue	Power Supply Input Voltage -	
3	White	Input Signal 2 B (polarity insensitive)	
4[8]	Green	Transmit Data of Auxiliary RS232	
5	Pink	External Trigger/Input 1 B (polarity insensitive)	
6	Yellow	External Trigger/Input 1 A (polarity insensitive)	
7	Black	ID-NET network +[9]	
8[8]	Gray	Configurable Digital Output 2 - positive pin NPN or PNP short circuit protected and software programmable	
9[8]	Red	Configurable Digital Output 1 - positive pin NPN or PNP short circuit protected and software programmable	
13	White/Green	Input Signal 2 A (polarity insensitive)	
14[8]	Brown/Green	Receive Data of Auxiliary RS232	
15	White/Yellow	ID-NET network -[9]	
16	Yellow/Brown	Output 3 NPN or PNP short circuit protected and software programmable	
Connector Case	n/a	Cable shield connected to chassis and 17-pin connector shell	
		RS232 Main Serial Interface	**RS422 FD Main Serial Interface**
10	Violet	-	RX-[10]
11	Gray/Pink	RX	RX+[10]
12	Red/Blue	-	TX-
17	White/Gray	TX	TX+

If using a TCNM-ACBB1 connection box, connect the reader using cable MQDEC-1703SS-DB25 and refer to for writing details.

Use Cat 5e or superior M12 D-code cables, such as STP-M12D-4xx.

To meet EMC requirements:

- Connect the reader chassis to the plant earth ground by means of a flat copper braid shorter than 100 mm

[8] Referenced to GND; Outputs become opto-isolated and polarity sensitive when connected through the TCNM-ACBB1 connection box. See *TCNM-ACBB1 Electrical Connections* on page 21 for connection details.
[9] See *ID-NET Network Termination* on page 25 for information on resister termination.
[10] If using RS422, do not leave floating. See *RS422 Full-Duplex Interface* on page 23 for connection details.

- Connect pin "Earth" of the TCNM-ACBB1 connection box to a good earth ground
- For direct connections, connect the cable shield to the locking ring nut of the connector

3.6.2 Inputs

There are two opto-isolated polarity insensitive inputs available on the M12 17-pin connector of the reader: Input 1 (External Trigger) and Input 2, a generic input. See *Inputs* on page 29 for more details.

The electrical features of both inputs are:

INPUT	| V AB | Minimum	$\| V_{AB} \|$ Maximum	I_{IN} Maximum
Open	0 V	2 V	0 mA
Closed	4.5 V	30 V	10 mA

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

Pin	Function
1	Power Supply input voltage +
2	Power Supply input voltage -
3	Input 2 B (polarity insensitive)
5	External Trigger B (polarity insensitive)
6	External Trigger A (polarity insensitive)
13	Input 2 A (polarity insensitive)

3.6.3 Outputs

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

The pinout is the following:

Pin	Function
9	Configurable digital output 1
8	Configurable digital output 2
16	Configurable digital output 3
2	Power Supply Input Voltage -

The electrical features of the three outputs are the following:

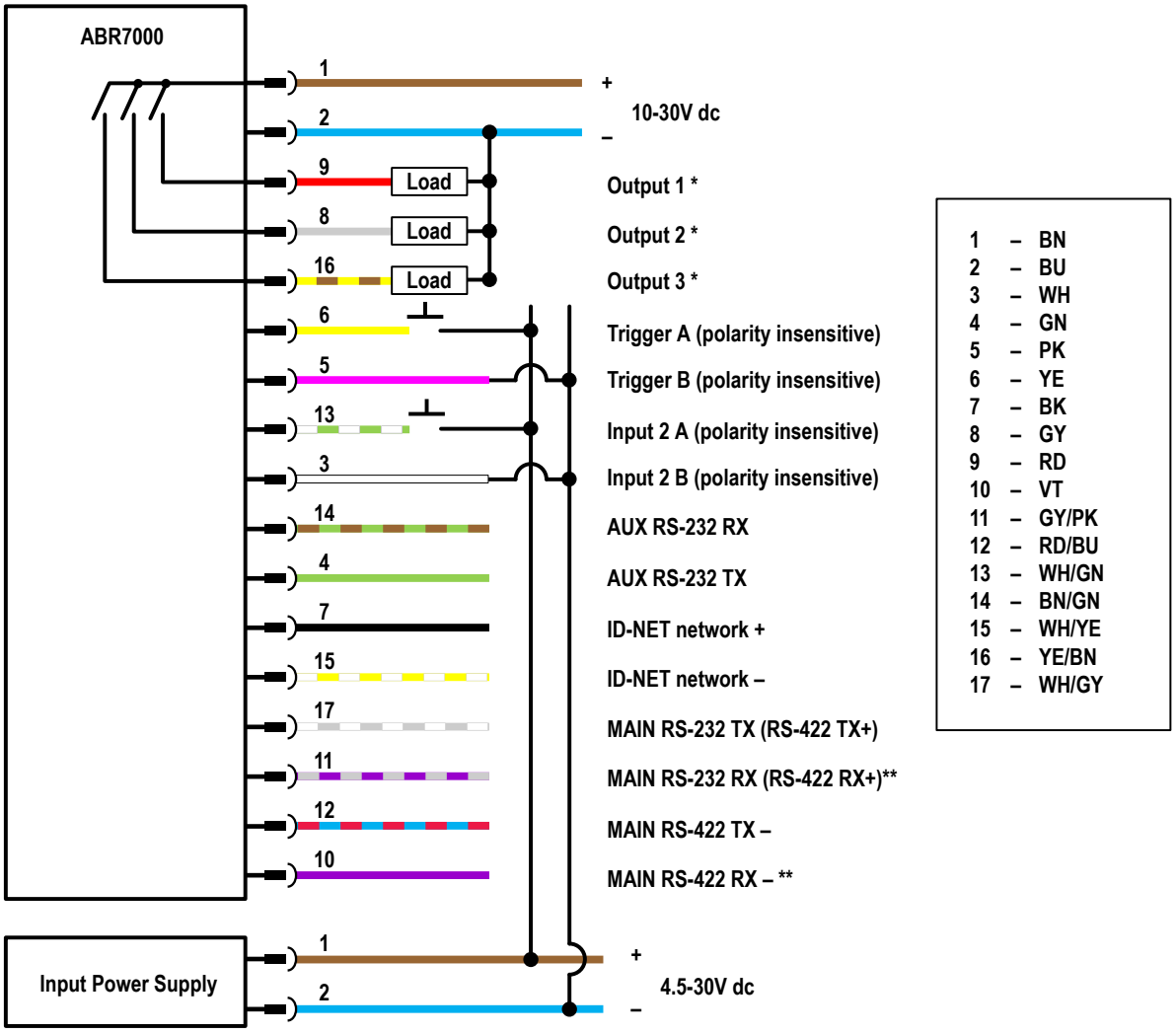
Outputs

3 NPN/PNP/Push-Pull software selectable, reverse polarity and short circuit protected outputs available (2 Opto-isolated outputs instead if using TCNM-ACBB1, see *Outputs* on page 33 for specifications)
Maximum Current: 100 mA maximum
Output Saturation Voltage (in PNP or NPN mode): < 3 V at 100 mA
Maximum load device voltage drop (in NPN mode): 30 V

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 Barcode Manager.

CAUTION: For NPN output connections, the external interface voltage (Vext) must not exceed the ABR power supply source voltage (Vdc) otherwise correct output functioning cannot be guaranteed.

3.6.4 Wiring

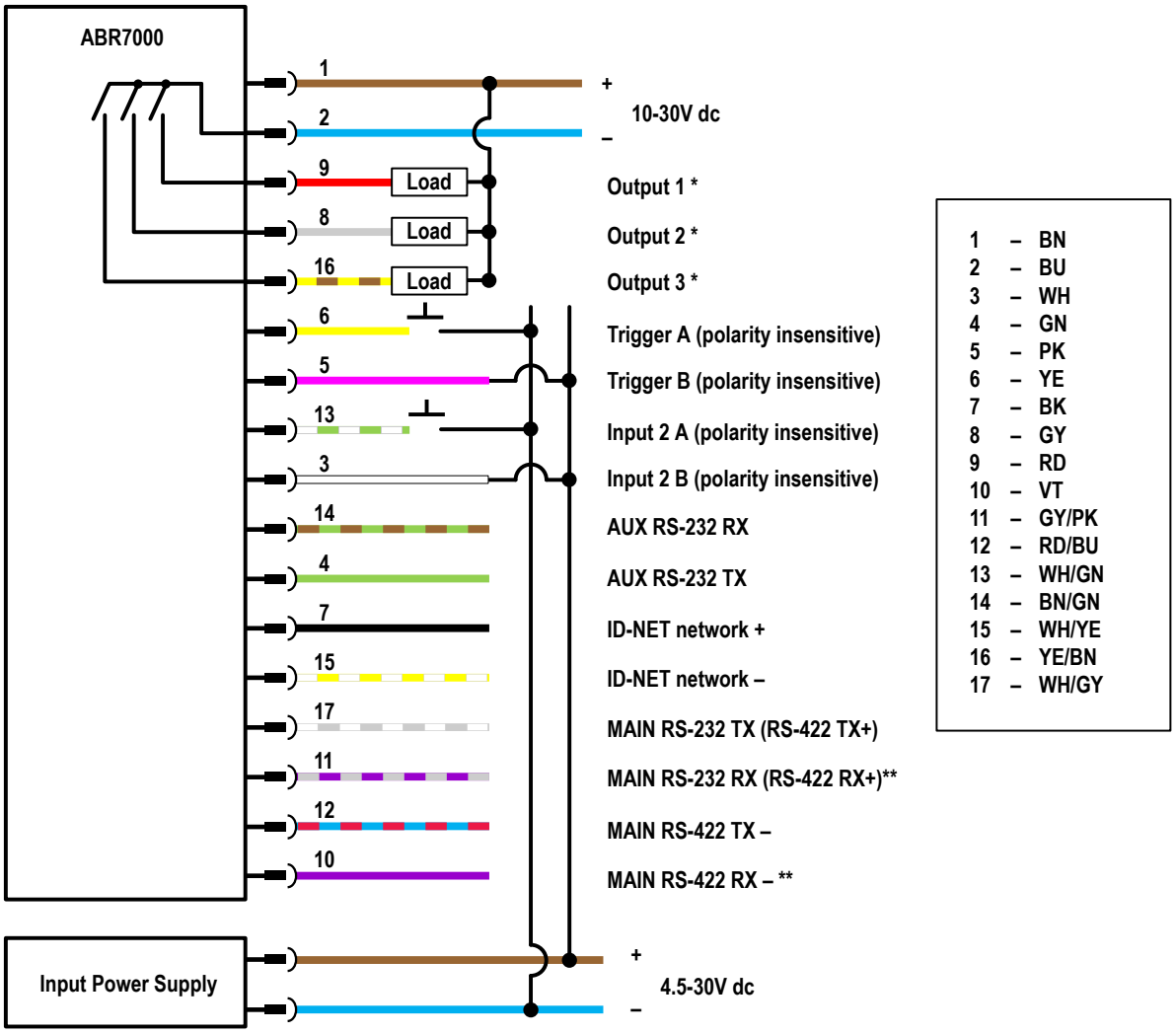


This is a typical example. Applications may vary.

* Output Line Type set to PNP in Barcode Manager

** If using RS-422, but not using RX+ and RX–, connect these two to –V dc or Ground

Figure 19. PNP Inputs and Outputs



This is a typical example. Applications may vary.

* Output Line Type set to NPN in Barcode Manager

** If using RS-422, but not using RX+ and RX–, connect these two to –V dc or Ground

Figure 20. NPN Inputs and Outputs

3.6.5 Ethernet Connector

A Standard M12 D-Coded female connector is provided for the Ethernet connection. This interface is IEEE 802.3 10 BaseT and IEEE 802.3u 100 BaseTx compliant.

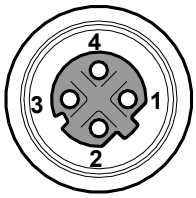


Figure 21. M12 D-Coded Female Ethernet Network Connector

Pin	Name	Function
1	TX +	Transmitted data (+)
2	RX +	Received data (+)
3	TX -	Transmitted data (-)
4	RX -	Received data (-)

3.6.6 Ethernet Interface

The 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 ABR incorporates an auto-cross function.

A STP-M12D-4xx can be used to connect to a LAN.

On the ABR Ethernet interface the following communication channels are available:

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

The following Industrial Ethernet protocols are also available over the Ethernet interface:

- EtherNet/IP
- Modbus TCP Client

3.7 TCNM-ACBB1 Electrical Connections

All ABR models can be connected to a TCNM-ACBB1 connection box through the MQDEC-1703SS-DB25 accessory cable. This cable terminates in an M12 17- pin connector on the ABR side and in a 25-pin male D-sub connector on the TCNM-ACBB1 side.

Make system connections through one of the TCNM-ACBB1 connection boxes because they offer the advantages of easy connection, easy device replacement, opto-isolated 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 this section with the exception of the digital Outputs. Direct wiring details are indicated in *Connector Descriptions* on page 16.

The table below gives the pinout of the TCNM-ACBB1 terminal block connectors. Use this pinout when the ABR is connected by means of the TCNM-ACBB1.

TCNM-ACBB1 Terminal Block Connectors	
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

TCNM-ACBB1 Terminal Block Connectors		
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		
TX	Auxiliary Interface TX	
RX	Auxiliary Interface RX	
SGND	Auxiliary Interface Reference	
Shield		
Shield	Network Cable Shield	
Main Interface		
	RS232	**RS422 Full-Duplex**
	TX	TX+
	RX	RX+[11]
	-	TX-
	-	RX-
	SGND	SGND

Important: 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 V dc.

Note: To avoid electromagnetic interference when the reader is connected to a TCNM-ACBB1 connection box, verify the jumper positions in the TCNM-ACBB1 as indicated in p/n 174477 *TCNM-ACBB1 Installation Manual*, available at *www.bannerengineering.com*.

3.7.1 Power Supply

Power can be supplied to the reader through the TCNM-ACBB1 spring clamp terminal pins.

The power must be between 10 V dc and 30 V dc only.

It is recommended to connect the device CHASSIS to earth ground (Earth) by setting the appropriate jumper in the TCNM-ACBB1 connection box. See p/n 174477 *TCNM-ACBB1 Installation Manual*, available at *www.bannerengineering.com*, for details.

3.7.2 Main Serial Interface

The signals relative to the following serial interface types are available on the TCNM-ACBB1 spring clamp terminal blocks.

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

Details regarding the connections and use of the interfaces are given in the following sections.

[11] Do not leave floating. See *RS422 Full-Duplex Interface* on page 23 for connection details.

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:

TCNM-ACBB1	Function
TX	Transmit Data
RX	Receive Data
SGND	Signal Ground

Shielded cables are recommended. The overall maximum cable length must be less than 15 m (49.2 ft).

RS422 Full-Duplex Interface

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

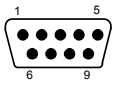
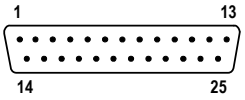
The TCNM-ACBB1 pinout follows:

TCNM-ACBB1	Function
TX+	RS422 Transmit Data +
RX+	RS422 Receive Data +
TX-	RS422 Transmit Data -
RX-	RS422 Receive Data -
SGND	Signal Ground

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.

3.7.3 User Interface—Serial Host

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

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

3.7.4 ID-NET Interface

TCNM-ACBB1	Function
Shield	Network Cable Shield
ID+	ID-NET network +
ID-	ID-NET network -
REF	Network Reference

ID-NET Cables

The following instructions refer to the figures in *ID-NET Network Termination* on page 25.

- The general cable type specifications are: CAT5 twisted pair + additional CAT5 twisted pair, shielded cable AWG 24 (or AWG 22) stranded flexible

  It is recommend to use DeviceNet cables (drop or trunk type) to the following reference standards:

  AN50325 – IEC 62026
  UL STYLE 2502 80°C 30V
- Cable Shield MUST be connected to earth ground ONLY at the Master
- NEVER use ID-NET cable shield as common reference
- The ID-NET max cable length depends on the baudrate used (see the Baudrate table, below)
- For Common Power Connections use only 2 wires (ID+ and ID-)
  - DC Voltage Power cable (Vdc – GND) should be handled as a signal cable (that is, do not put it together with AC cable)
  - Wire dimensioning must be checked in order to avoid voltage drops greater than 0.8 Volts
  - Cable should lie down as near as possible to the ID-NET cable (avoiding wide loops between them)
- Reader's chassis may be connected to earth
- Network inside the same building

Table 3: Baudrate

Baud Rate	125 kbps	250 kbps	500 kbps	1Mbps
Cable Length	1200 m	900 m	700 m	Application dependent; contact Banner Engineering for details.

Note: The default ID-NET baudrate is 500 kbps. Lower ID-NET baudrates allow longer cable lengths.

ID-NET Response Time

The following figure shows the response time of the ID-NET network. This time is defined as the period between the Trigger activation and the beginning of data transmission to the Host.

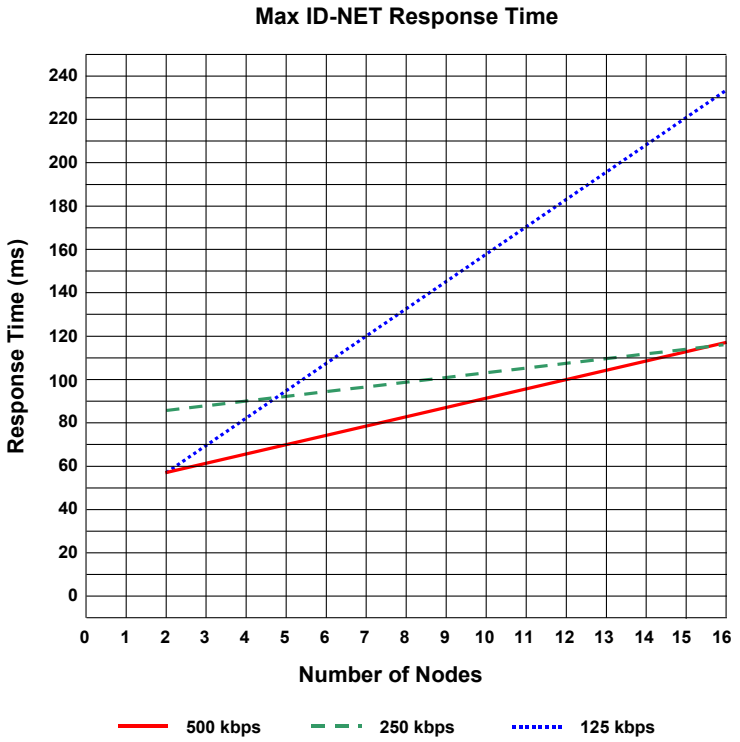


Figure 22. ID-NET Response Time

CONDITIONS

- ID-NET M/S Synchronized layout
- message length = 50 bytes per node

ID-NET Network Termination

The network must be properly terminated by a 120 Ohm resistor at the first and last reader of the network. This should be done by setting the ID-NET Termination Resistance Switch in the TCNM-ACBB1 to ON.

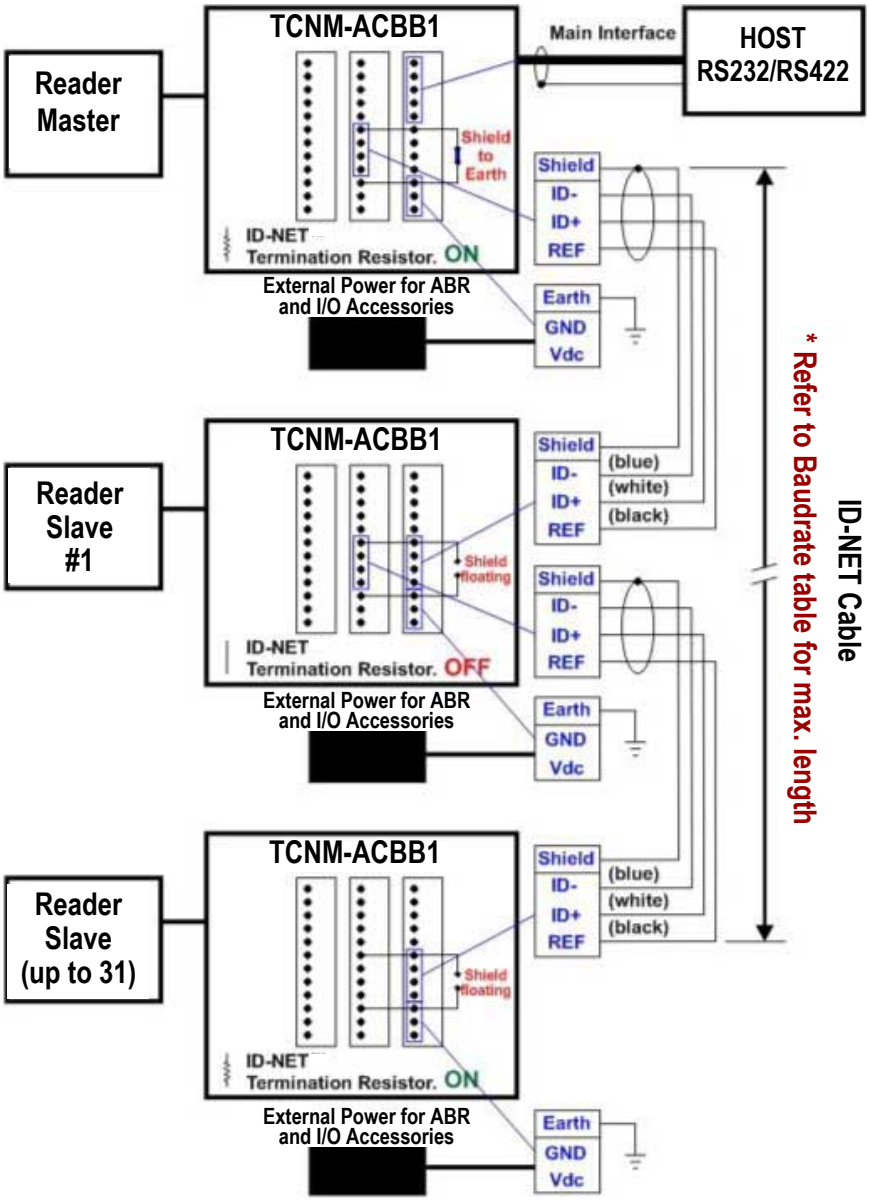


Figure 23. ID-NET Network Connections with Isolated Power Blocks

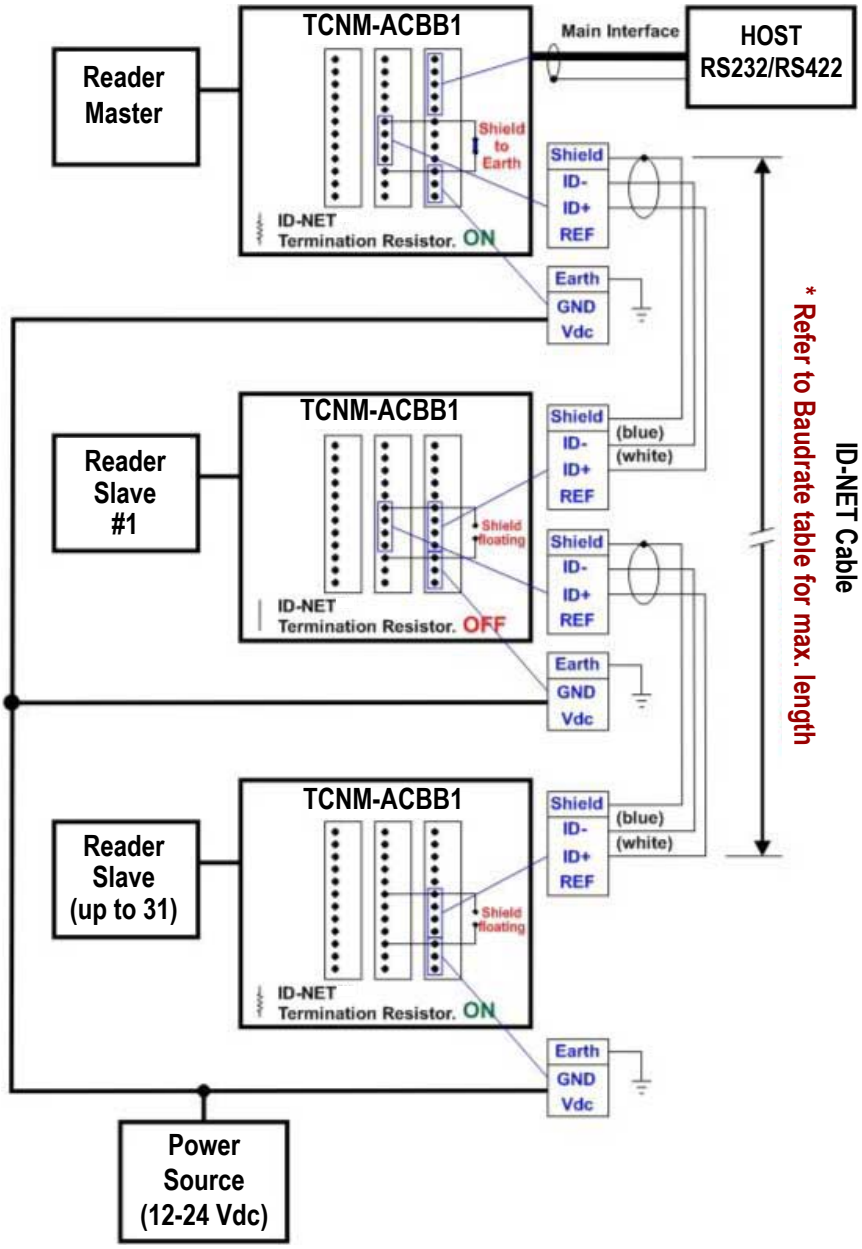


Figure 24. ID-NET Network Connections with Common Power Branch Network

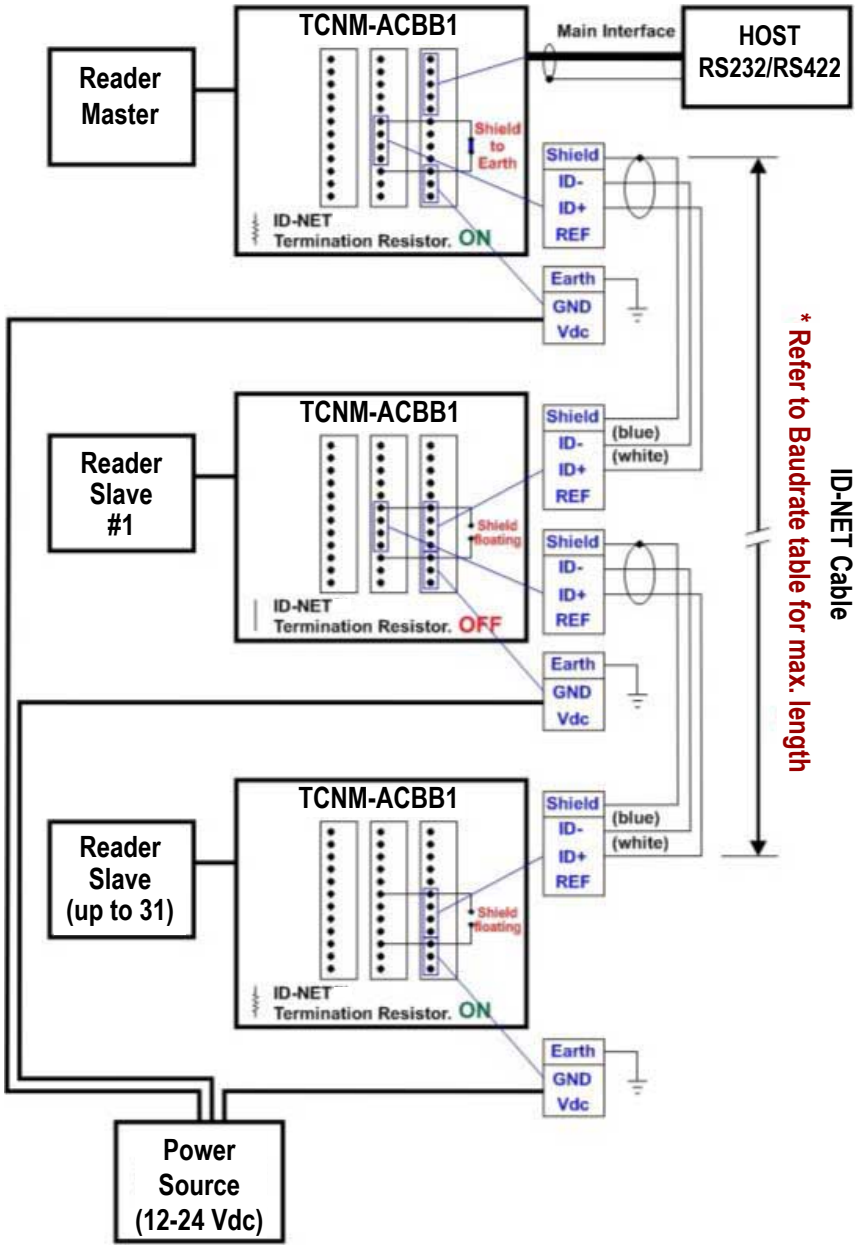


Figure 25. ID-NET Network Connections with Common Power Star Network

3.7.5 Auxiliary RS232 Interface

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

The parameters relative to the auxiliary interface (baud rate, data bits, etc.) can be defined through the Reading Phase step (Channels) in Barcode Manager.

The 9-pin female auxiliary interface connector inside the TCNM-ACBB1 is the preferred connector for temporary communication monitoring.

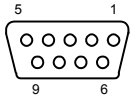


Figure 26. 9-pin female connector

If permanent system wiring is required, the following pins are used to connect the RS232 auxiliary interface:

TCNM-ACBB1	Function
RX	Auxiliary Interface Receive Data
TX	Auxiliary Interface Transmit Data
SGND	Auxiliary Interface Reference

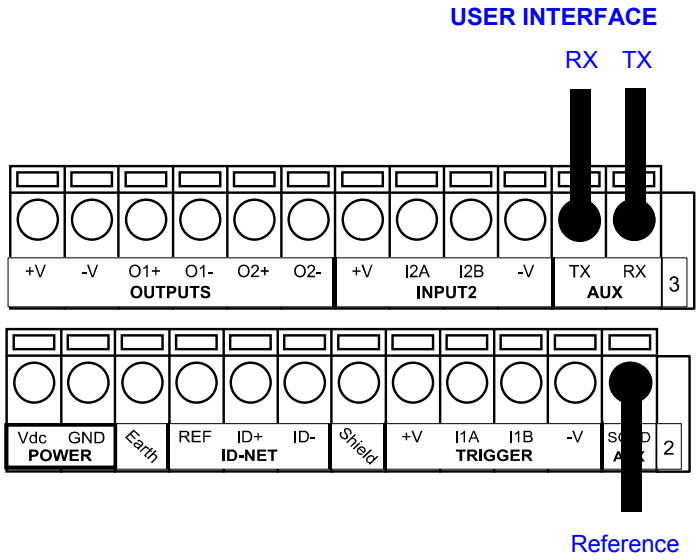


Figure 27. RS232 Auxiliary Interface Connections

Note: Do not connect the Auxiliary Interface to the TCNM-ACBB1 spring clamp connectors and the 9-pin connector simultaneously.

3.7.6 Inputs

There are two opto-isolated polarity insensitive inputs available on the reader: 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 V dc maximum
I_{IN} = 10 mA (reader) + 12 mA (TCNM-ACBB1) maximum

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 Barcode Manager for further details on these parameters.

These inputs are opto-isolated and can be driven by both NPN and PNP type commands.

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

The connections are indicated in the following diagrams:

TCNM-ACBB1	Function
+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 is on when the active state of the External Trigger corresponds to ON.

External Trigger Input Connections Using ABR 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 TCNM-ACBB1. Disconnect the power supply when working inside the TCNM-ACBB1.

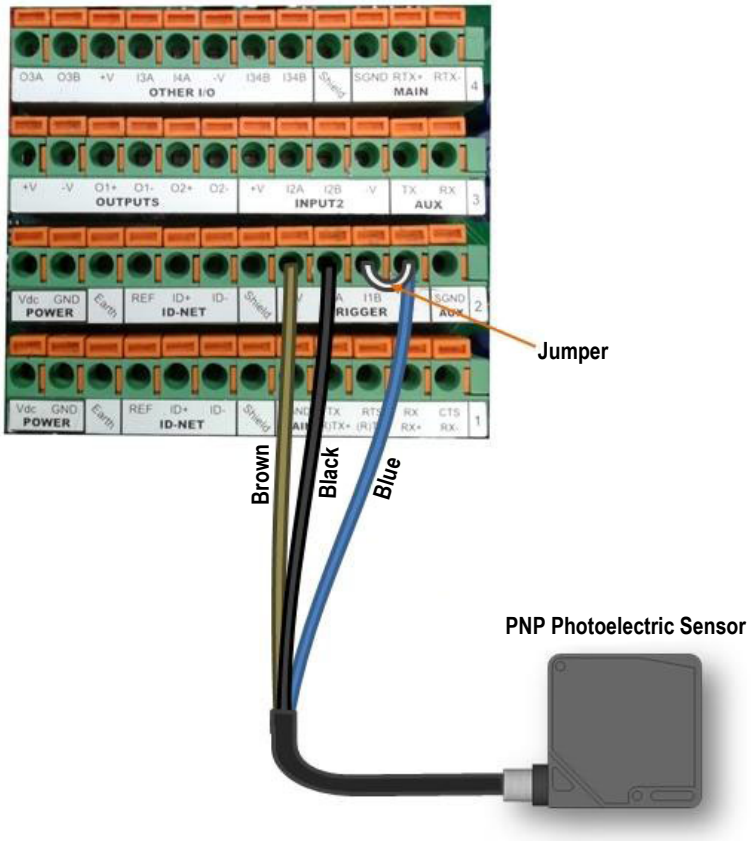


Figure 28. PNP External Trigger Using ABR Power

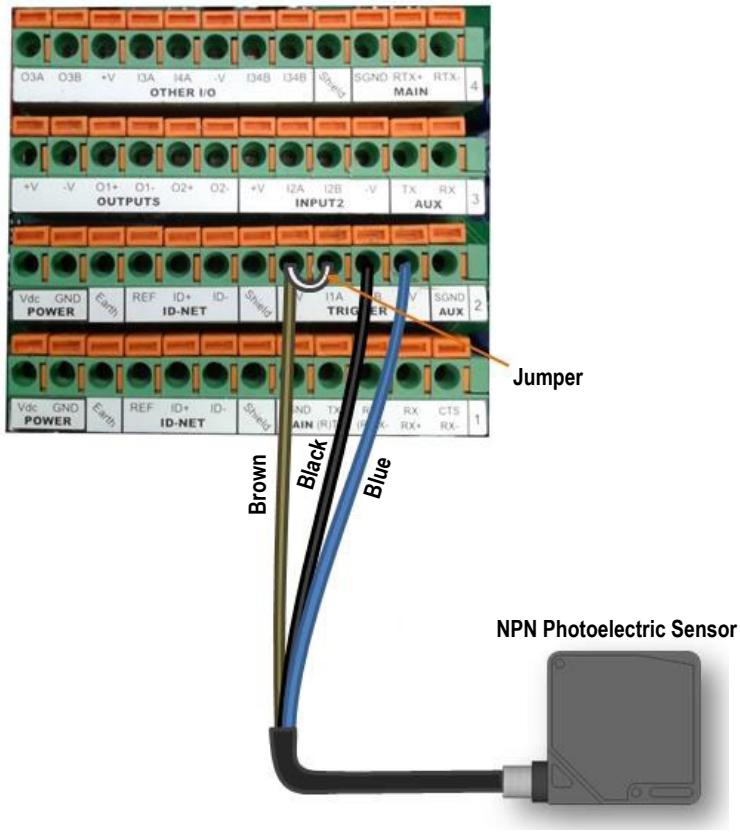


Figure 29. NPN External Trigger Using ABR Power

External Trigger Input Connections Using External Power

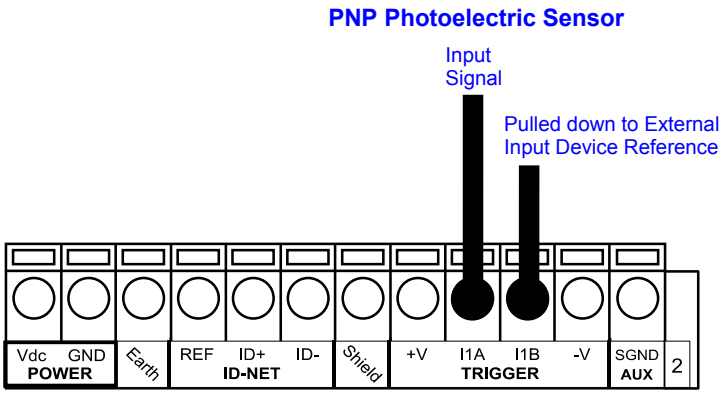


Figure 30. PNP External Trigger Using External Power

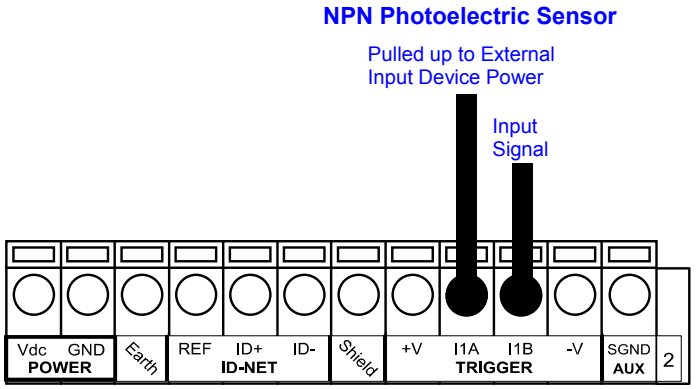


Figure 31. NPN External Trigger Using External Power

TCNM-ACBB1	Function
+V	Power Source - Inputs
I2A	Input 2 A (polarity insensitive)
I2B	Input 2 B (polarity insensitive)
-V	Power Reference - Inputs

Input 2 Connections Using ABR 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 TCNM-ACBB1. Disconnect the power supply when working inside the TCNM-ACBB1.

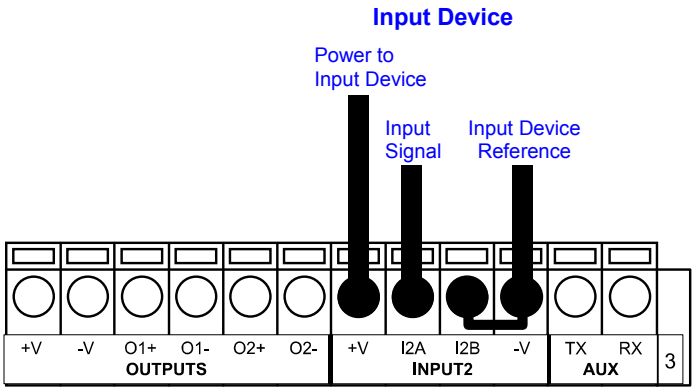


Figure 32. PNP Input 2 Using ABR Power

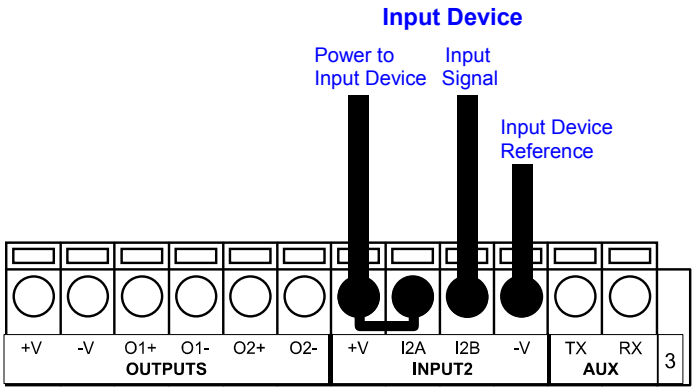


Figure 33. NPN Input 2 Using ABR Power

Input 2 Connections Using External Power

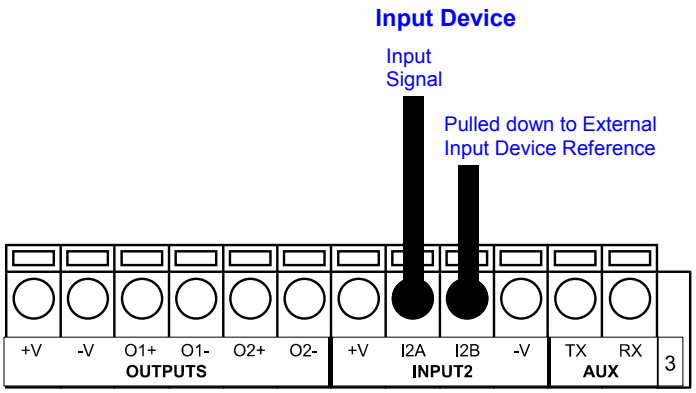


Figure 34. PNP Input 2 Using External Power

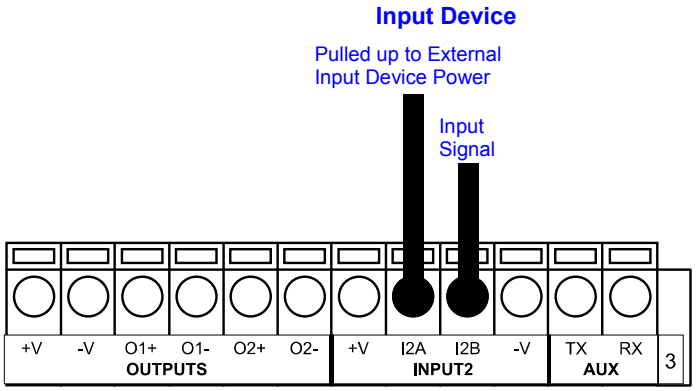


Figure 35. NPN Input 2 Using External Power

3.7.7 Outputs

CAUTION: When Outputs 1 and 2 are connected through the TCNM-ACBB1 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 TCNM-ACBB1 can be either NPN or PNP.

Two 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.

The third output of an ABR 7000 is not accessible when using a TCNM-ACBB1 connection box.

TCNM-ACBB1	Function
+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:

2 opto-isolated NPN or PNP, reverse polarity and short circuit protected outputs available
Maximum Current: 40 mA maximum continuous or 130 mA pulsed
Output Saturation Voltage (in PNP or NPN mode): < 1 V at 10 mA
Maximum load device voltage drop (in NPN mode): 30 V

Power Dissipation: 90mW maximum at 50 °C (122 °F) ambient temperature

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. 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 Barcode Manager parameters Help On Line for further details.

Output 1 and 2 Connections Using ABR 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 TCNM-ACBB1. Disconnect the power supply when working inside the TCNM-ACBB1.

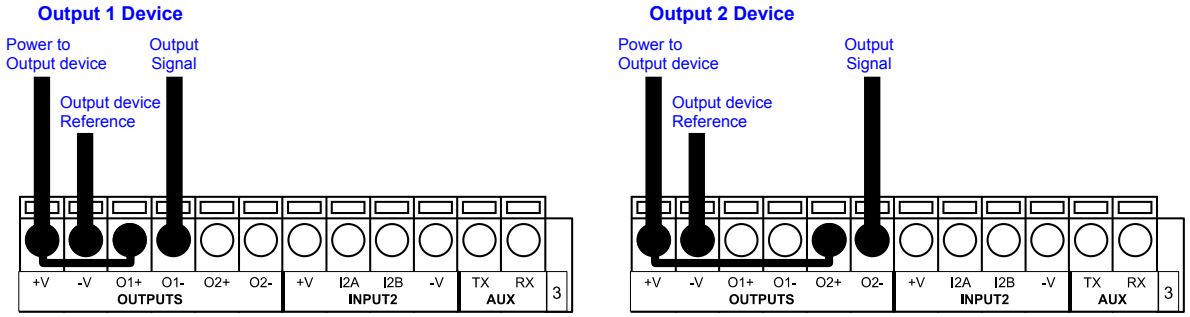


Figure 36. PNP/Open Emitter Output Using ABR Power

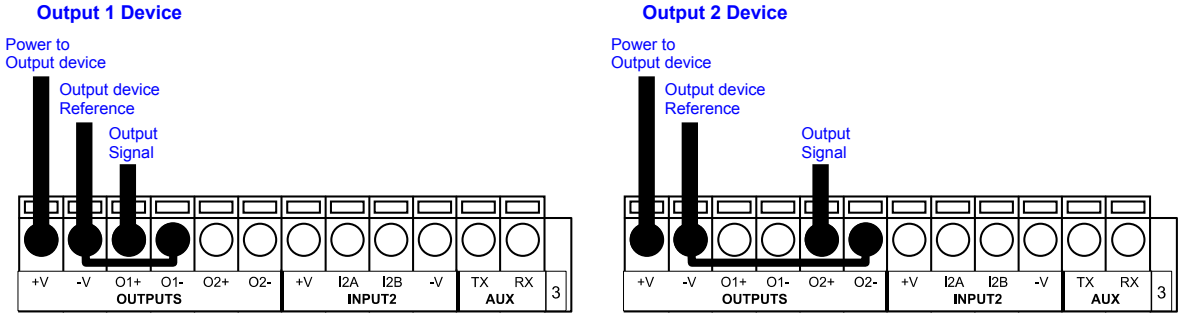


Figure 37. NPN/Open Collector Output Using ABR Power

Output 1 and 2 Connections Using External Power

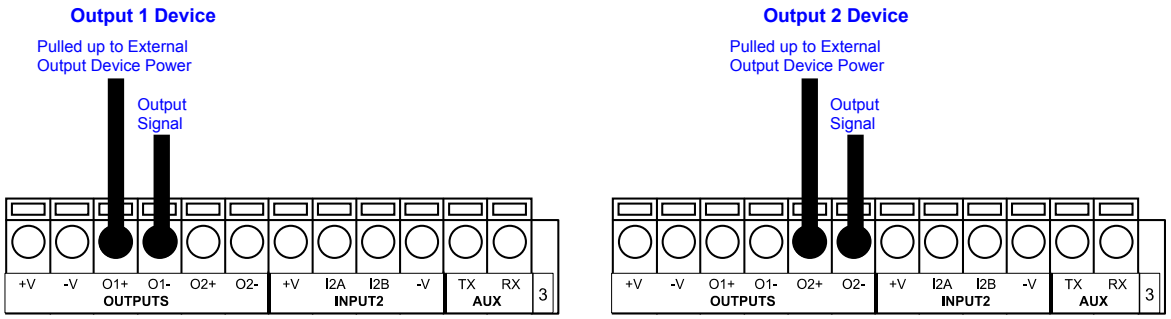


Figure 38. PNP/Open Emitter Output Using External Power

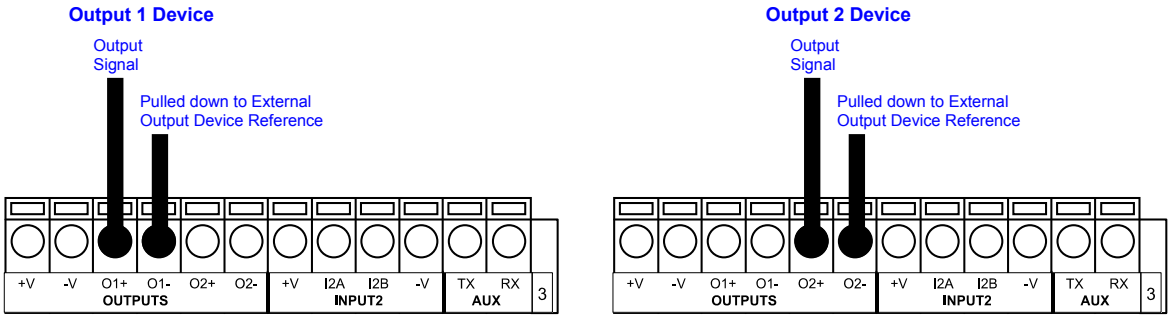


Figure 39. NPN/Open Collector Output Using External Power

Output 3 is not opto-isolated but can be assigned to the same events. By default it is not assigned to any event.

Note: For this output, set the Line Type configuration parameter according to the hardware connection to the TCNM-ACBB1: NPN, PNP or Push-Pull.

4 Smart Teach Interface

Smart Teach is designed to improve ease of installation and maintenance

Status information is clearly presented by means of the five colored LEDs. The single push button provides access to the following modes.

- **Test** includes bar graph visualization to check static reading performance
- **Aim/Autofocus** turns on the laser pointers to aid positioning and focusing
- **Setup** self-optimizes and auto-configures image brightness parameters
- **Learn** automatically detects and recognizes a single code which is presented to it. Successive Learns will substitute the current code. To configure multiple codes, use the Barcode Manager Auto-learn procedure

Quick access to the following modes is provided by using the push button:

1. Press the button. The **Status** LED gives visual feedback.
2. Hold the button until the specific mode LED is on (**Test**, **Aim/Autofocus**, **Setup**, or **Learn**).
3. Release the button to enter the specific mode.

After the button is pressed, the cycle of LED activation is as follows:

Release button to exit

Release button to enter **Test** mode

Release button to enter **Aim/Autofocus** mode

Release button to enter **Setup** mode

Release button to enter **Learn** mode

Release button to exit (cycle)

4.1 Test Mode

Test mode can be used to test the reading performance of the system. Use a code suitable for your application.

1. Enter the Test function by pressing and holding the Smart Teach 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 40. Smart Teach Interface: Test Function

The bar graph has the following meaning, referring to the actual percentage of good reads:

Figure 41. Test Function Bar Graph

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

3. To exit the test, press the Smart Teach button once.

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

4.2 Aim—Manual Focus Models

The Aim function turns on the built-in laser pointer aiming system to aid reader positioning. Because the laser pointers are centered on the FOV, use them to position the imager on the code. The Aim LED blinks to indicate this state.

1. Select a single code for your application and place at the correct reading distance for your application.

   See the *Global FOV Diagrams* on page 82 for reference.
2. Enter **Aim** mode by pressing and holding the Smart Teach button until the Aim LED is on.

Figure 42. Smart Teach Interface: Aim Mode

3. Release the button to enter **Aim** mode.
   The laser pointers turn on.
4. Position the code at the center of the Field of View (equidistant from the laser pointers).

Figure 43. Code Position

5. Once aligned, exit **Aim** mode by pressing the Smart Teach button once.
   After a short delay, **Aim** mode is cancelled and the laser pointers turn off.

4.3 Aim and Autofocus the Reader—Liquid Lens Autofocus Models

The Aim/Autofocus function turns on the built-in laser pointer aiming system to aid reader positioning. Because the laser pointers are centered on the FOV, use them to position the imager on the code. The Aim LED blinks to indicate this state. For Liquid Lens Autofocus models, the autofocus feature is incorporated into this function.

1. For best results, print the *PPI (Pixels Per Inch) Setup Chart* on page 120.

   Using this chart during Focus Autolearn typically results in a more accurate focus/reading distance, a more accurate PPI value and more accurate module size measurements of barcodes.
2. Place the PPI (Pixels Per Inch) Setup Chart in front of the reader at the correct reading distance for your application.

   See the Global FOV Diagrams in *Liquid Lens Autofocus Models 9 mm Lens* on page 83 for reference.
3. Enter Aim/Autofocus mode by pressing and holding the Smart Teach button until the Aim LED is on.

Figure 44. Smart Teach Interface: Aim/Autofocus Function

4. Release the button to enter the Aim function.
   The laser pointers turn on, and the Autofocus procedure begins. The Aim LED blinks until the procedure is complete.

5. **Within 3 seconds (before the reader flashes),** position the code closest to your application code size at the center of the Field of View (equidistant from the laser pointers). The code must not move during this procedure.

Figure 45. Code Position

The Autofocus procedure ends when the Reading Distance and PPI values are successfully saved in the reader memory, the Aim LED stops blinking and ABR 7000 emits three high pitched beeps.

If the Autofocus cannot be reached after a timeout of about 3 minutes, the ABR 7000 exits without saving the parameters to memory, the Aim LED stops blinking, and the ABR 7000 emits a long low pitched beep.

4.4 Setup

Once entered, the imager automatically performs the Image Acquisition parameter calibration for the specific code presented to it.

1. Enter **Setup** mode by pressing and holding the Smart Teach button until the **Setup** LED is on.

Figure 46. Smart Teach Interface: Setup Mode

2. Release the button to enter **Setup** mode.

   The **Setup** LED blinks until the procedure is completed. The **Setup** procedure ends when the Image Acquisition parameters are successfully saved in the reader memory, the **Setup** LED stops blinking, and the ABR emits three high pitched beeps.
3. If the calibration cannot be reached after a timeout of about 5 (five) seconds, ABR exits without saving the parameters to memory, the **Setup** LED stops blinking, and the ABR emits a long low pitched beep.

4.5 Learn

Once entered, the imager starts a procedure to automatically detect and recognize a single code[13] which is presented to it. Successive Learns will substitute the current code. To configure multiple codes, use the Barcode Manager Auto-learn procedure.

Exit **Learn** mode at any time by pressing the Smart Teach button once. After a short delay the Learn procedure is cancelled.

1. Enter **Learn** mode by pressing and holding the Smart Teach button until the **Learn** LED is on.

Figure 47. Smart Teach Interface: Learn Mode

2. Release the button to enter **Learn** mode.

   The **Learn** LED blinks until the procedure is complete. The Learn procedure ends when the Image Processing and Decoding parameters **for a single code** are successfully saved in the reader memory, the Green Spot is activated, the **Learn** LED stops blinking, and the ABR emits 3 high pitched beeps.

Note: The PPI (Pixels Per Inch) Setup 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: If you have used this procedure to configure the ABR, go to *Test Mode* on page 36.

[13] The Learn procedure does not recognize the following symbologies: Postal Codes, Pharmacode, MSI, Standard 2 of 5, or Matrix 2 of 5. Configure through Barcode Manager for these codes.

5 Getting Started

Power up the sensor, and verify that the power LED is on blue. Ethernet models only: verify that the Ethernet indicator is on amber to verify the Ethernet connection.

5.1 Install Barcode Manager

Administrative rights are required to install the Barcode Manager software.

Important: Install Barcode Manager on a Windows® XP, 7, 8, or 10[14] computer. Barcode Manager does not currently support Windows Embedded (often used in industrial PCs and/or PLCs).

1. Download the latest version of Barcode Manager from *www.bannerengineering.com*.
2. Navigate to and open the downloaded file.
3. Run `Barcode Manager_Setup.exe` to access the installation screen.
4. Follow the onscreen installation procedure.
   After the installation is complete, the Barcode Manager entry is created under **Start** > **Programs** > **Banner Engineering**. A desktop icon is also created.

5.2 Ethernet Device Discovery

The following configuration procedure assumes that a laptop computer running Barcode Manager is connected to a factory default reader through the Ethernet port.

The Barcode Manager user interface opens and displays a list of all the devices belonging to the Local Area Network (LAN).

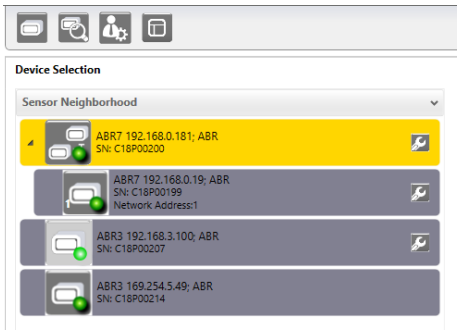


Figure 48. Device Discovery

The Barcode Manager discovery feature also shows devices not belonging to the LAN and displays them in light gray (see *Figure 48* on page 39).

The following is an example configuration for Windows® operating system version 7, 8, or 10.

[14] Microsoft and Windows are registered trademarks of Microsoft Corporation in the United States and/or other countries.

1. Confirm the network connections. Changing the Local Area Connection (LAN) properties of the programming computer to be compatible with the ABR device on the network may be required for connection.
   a) Click the **Start** button, then on the **Start** menu, click **Control Panel** or search for **Control Panel**.
   b) In **Control Panel**, click **Network and Internet**, then click **Network and Sharing Center**, and then click **Change adapter settings**.
   c) Right-click on the connection that you want to change, then click **Properties**.
   If you are prompted for an administrator password or confirmation, enter the password or provide confirmation.
   d) In the connection properties, click **Internet Protocol Version 4 (TCP/IPv4)**, and then click **Properties**.

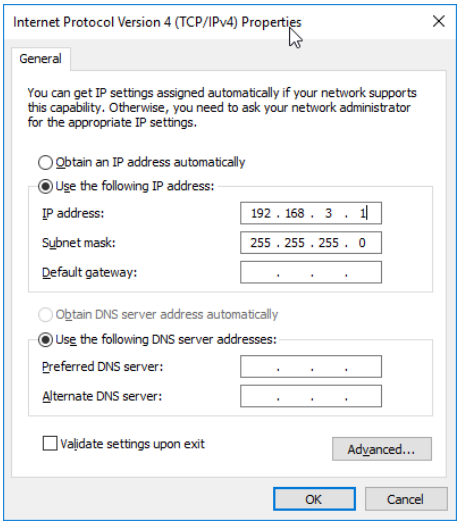


Figure 49. Local Area Connection Properties

   e) In the **Internet Protocol (TCP/IPv4) Properties**, select **Use the following IP address**.
   f) Make sure that the IP address is 192.168.3.1, and the subnet mask is 255.255.255.0.
   The IP address must be compatible with the default device address 192.168.3.100.
2. As an alternate method, change the IP address of the device.
   a) Add the device to the LAN by aligning its IP Address to the network. The network administrator should provide valid LAN address(es).
   b) Click the **device wrench** icon to open the **Device Environment Configuration** window.
   c) Change the Ethernet Settings (IP Address, Subnet Mask, Gateway Address, etc.) according to the network requirements.
   d) Click **OK**.
3. In Barcode Manager, click **Find Devices**.
   The device displays in **Sensor Neighborhood** with a dark gray icon, meaning it is now part of the LAN and can be configured. The new IP address also displays.
4. Double-click or drag the **device** icon into the **Selected Device Information Area**.
   Details about the device display in this area.

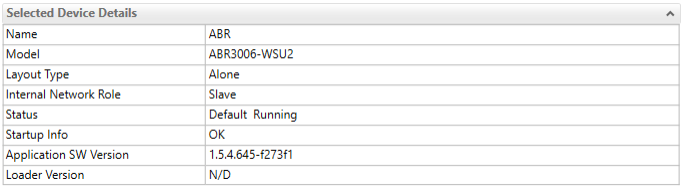


Figure 50. Device Selection—Selected Device Details

After device discovery, configure your device through Barcode Manager.

5.3 Serial Device Discovery

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

Serial Device Discovery is not enabled by default.

1. In Barcode Manager, from the main menu go to **Options** > **UI Settings** window.
2. Click on the **Global Settings** menu and scroll down to the **Find Devices** section.
3. Select **Enable Serial Device Discovery**.
   Additional options become available, including **Serial Parity**, **Serial Databits**, **Serial Stop Bits**, and **Baud Rates**.
4. Scroll down to see the options.
5. Select the Serial communication parameters according to your application.
   The default is 115200.

   Note: If you're not sure of the Serial baud rate, select **Enable Automatic Device Discovery** 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. In general it is better to disable it to increase discovery efficiency.
6. Click **OK** to return to Barcode Manager.
7. Click the **Getting Started** icon.
8. Open the **Serial Devices** tab.
9. Drag the **device** icon into the **Selected Device Information** area.
   The device is now connected to the Barcode Manager Configuration environment. Configure your device through Barcode Manager.

6 Device Configuration

6.1 Automatic 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.

Note: For Manual Adjustable Focus models go to *Advanced Setup for Manual Adjustable Focus Models* on page 46.

Automatic Setup provides an automatic procedure for setting optical/illumination 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	GS1 DataBar Stacked	Data Matrix ECC 200	Erode 3×3, 5×5 and 7×7
EAN 128	GS1 DataBar Limited	QR	Dilate 3×3, 5×5 and 7×7
Code 39	GS1 DataBar Expanded	Micro QR	Smoothing
Code 93	GS1 DataBar Expanded Stacked	Aztec	
Codabar	UPCEAN Family EAN13	MAXICODE	
PDF417	UPCEAN Family EAN8	DOTCODE	
MICRO PDF417	UPCEAN Family UPCA		
GS1 DataBar	UPCEAN Family UPCE		

1. Click **Open Device Configuration**. The **Open Device Configuration** window opens showing the list of configurations (jobs) currently saved on the device. For new devices, the only saved configuration is the Default configuration.
2. Click **OK**. The device enters continuous mode and begins acquiring images.
3. Place the application code in front of the reader at the correct application reading distance.
4. If needed, focus the reader on the code.
5. After the code is positioned, click **Pause** to stop image acquisition.

Note: If the image display area is too dark to see the images being captured, drag the Gain and Exposure Time sliders to the right to increase visibility. This will not affect Automatic Setup.

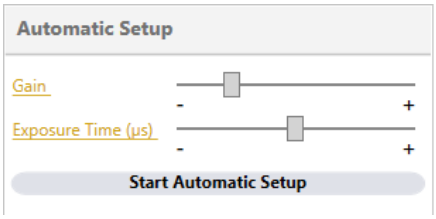


Figure 51. Gain and Exposure Time

6. Click **Start Automatic Setup**. The **Automatic Setup** window opens.

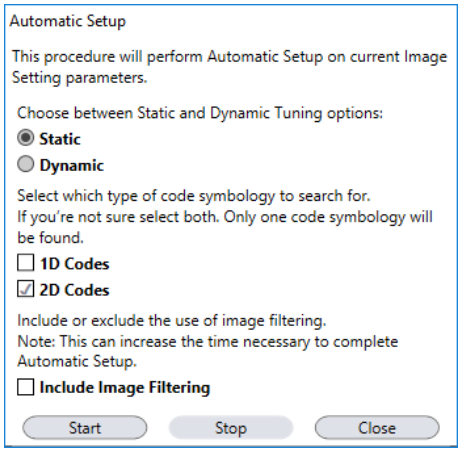


Figure 52. Automatic Setup

7. Select the correct reading conditions.
   - **Static** Tuning—No maximum limit on exposure time
   - **Dynamic** Tuning—Maximum allowable image exposure is automatically calculated using the parameters
   - **1D** code
   - **2D** code
   - **Include Image Filtering**—Select to find the best decoding condition.
8. Click **Start**.

   The reader begins acquiring images, adjusting the brightness and focus (for liquid lens autofocus models), and adjusting the decoding settings to find a barcode and optimize reading for the first code it finds. At the end of the procedure the Status: Completed message displays.
9. Close the **Automatic Setup** window.

   Your reader is now optimized for decoding. Continue setting up the reader for your application as desired. Typically, **Reading Phase** is configured next. See *Reading Phase* on page 50.

6.2 Advanced Setup for Liquid Lens Autofocus Models

Advanced Setup provides access to the complete array of optical/illumination and code definition parameters that can be fine-tuned semi-automatically and manually to obtain the best results for applications of any complexity. If your application requires multiple code symbologies, multiple image settings, Code Grading, or other parameter settings for decoding, use the 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.

Note: For manual adjustable focus models go to *Advanced Setup for Manual Adjustable Focus Models* on page 46.

1. From the **Task Area** select **Open Device Configuration**.
   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.
2. Click **OK**.
   The device enters run mode and begins acquiring images.
3. Click **Advanced Setup**.
4. Click the **Play** icon.
5. Place the PPI (Pixels per Inch) Setup Chart in the reading area.

6. After the chart is positioned, click **Pause** to stop image acquisition.

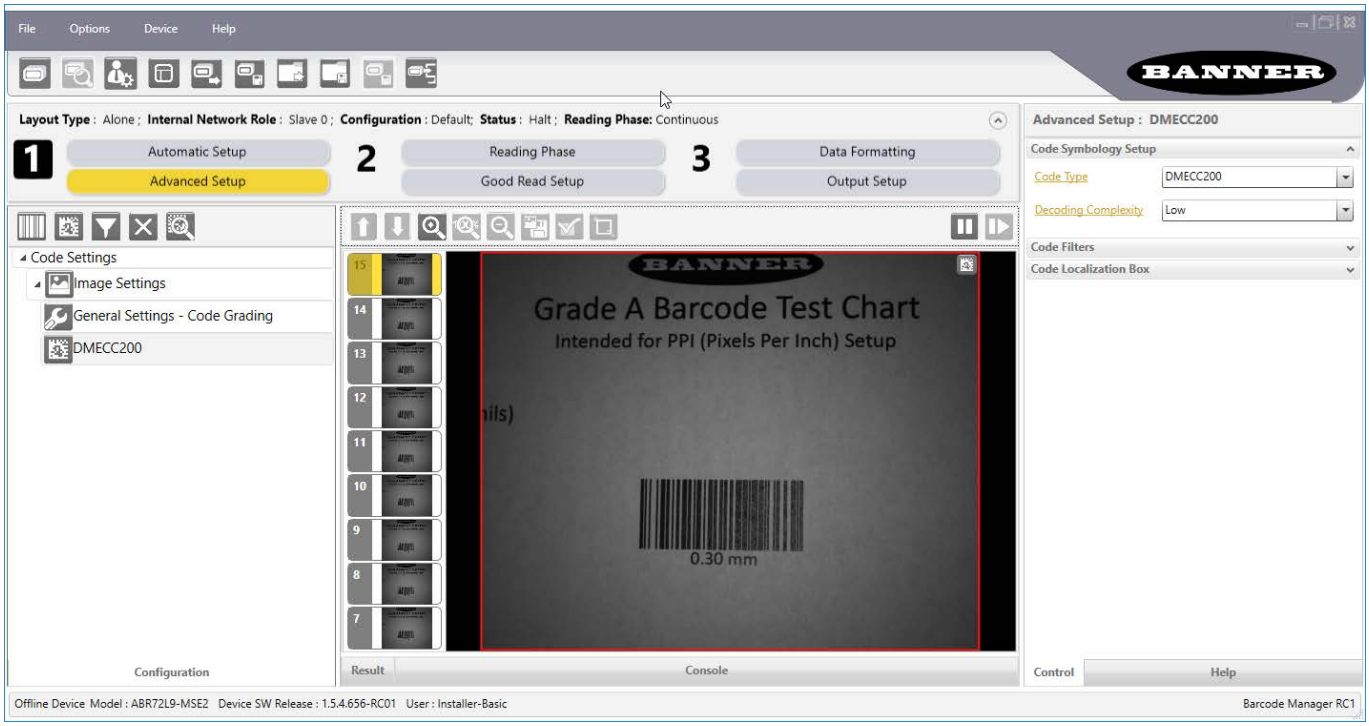


Figure 53. Chart Positioned

7. Click **Image Settings**.
8. Click **Image Auto-Setup** **Image Auto Setup** to automatically acquire the best exposure time and gain values.
9. Select the reading option.
   - **Static** reading—No maximum limit on exposure time
   - **Dynamic** reading—Maximum allowable image exposure is automatically calculated using the parameters

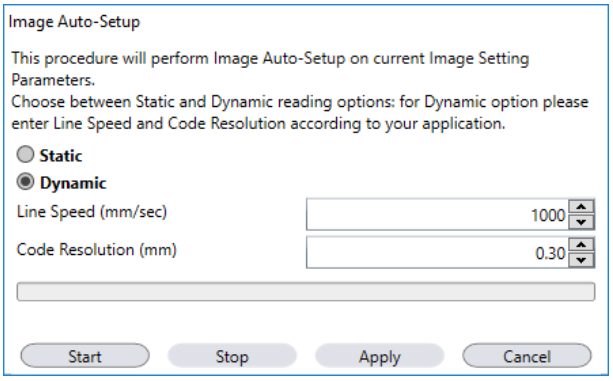


*Figure 54. **Image Auto-Setup** Window*

Note: For applications having multiple lighting or code reading conditions, up to 10 different Image Setups can be configured by adding them with the icon.

10. Click **Start**.
11. Click **Apply**.

12. Click Focus Autolearn **Focus Autolearn**.

Tip: You may have to click **Image Settings** again before you can click **Focus Autolearn.**

Note: The **Reading Distance** value is not significant until the Focus Autolearn procedure ends successfully.

The Calibrate dialog box opens allowing you to start the procedure.

13. Click **Start**.
    At the end of the calibration you can see the new Reading Distance and Image Density (PPI) values as well as the FOV dimensions.

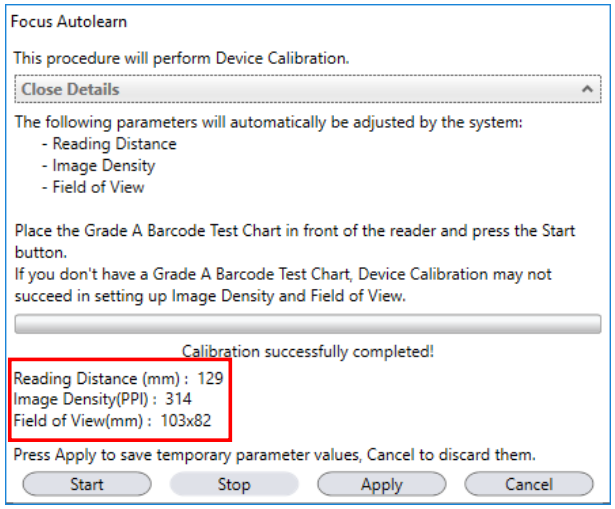


Figure 55. Reading Distance, Image Density, and FOV Dimensions

14. Click **Apply**.

Note: To enlarge the visual image of the code view, click the  zoom image icon, repositioning it on the code.

Note: At this point it is good practice to save the configuration from temporary memory to permanent memory, giving it a specific name.

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

16. Click 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.

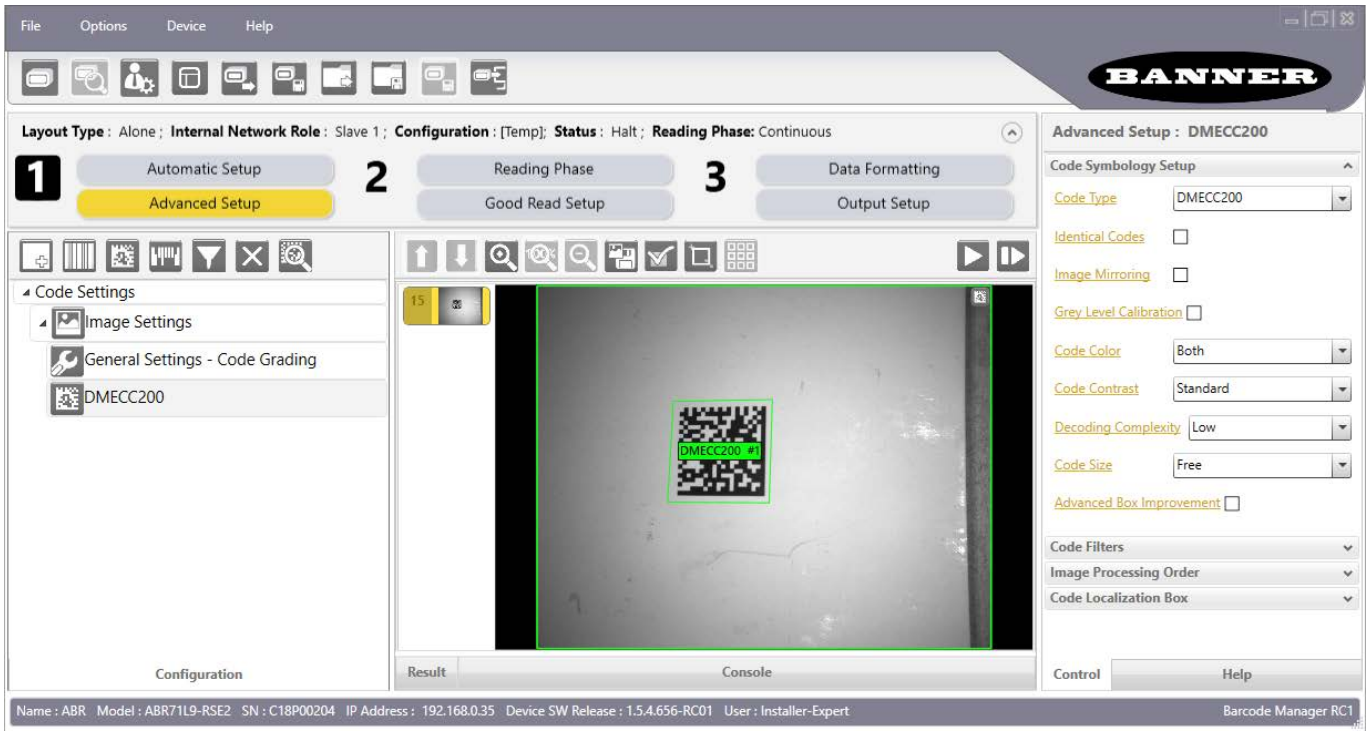


Figure 56. Decoded Data Matrix ECC 200

Note: The large green box for each symbol indicates the code localization area which by default is equal to the maximum FOV. Resize and move the box by dragging its borders with the mouse. The code must be found within this area in order to be decoded.

17. Add your application specific codes to the Code Settings by selecting them from the icons over the Configuration Parameters tree area.
18. If the Data Matrix symbology is not used, delete it from the Code Settings with the icon.
19. If you don't know the code type, use the Code Autolearn feature by clicking on the icon[15].
    See the Barcode Manager Instruction Manual (p/n 207635) for details.

Continue the configuration using *Reading Phase* on page 50.

6.3 Advanced Setup for Manual Adjustable Focus Models

Advanced Setup provides access to the complete array of optical/illumination and code definition parameters that can be fine-tuned semi-automatically and manually to obtain the best results for applications of any complexity. If your application requires multiple code symbologies, multiple image settings, Code Grading, or other parameter settings for decoding, use the Advanced Setup.

To begin configuration, correctly mount the reader so that its Field of View (FOV) covers the application reading area.

Note: For Liquid Lens Autofocus models go to *Advanced Setup for Liquid Lens Autofocus Models* on page 43.

1. From the **Task Area** select **Open Device Configuration**.
   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.
2. Click **OK**.
   The device enters run mode and begins acquiring images.

[15] The Code Autolearn procedure does not recognize the following symbologies: Pharmacode, MSI, Standard 2 of 5, Matrix 2 of 5.

3. Click **Advanced Setup**.
4. Click the **Play** icon.
5. Place the PPI (Pixels per Inch) Setup Chart in the reading area. See *PPI (Pixels Per Inch) Setup Chart* on page 120.
6. After the chart is positioned, click the **Pause** icon to stop image acquisition.

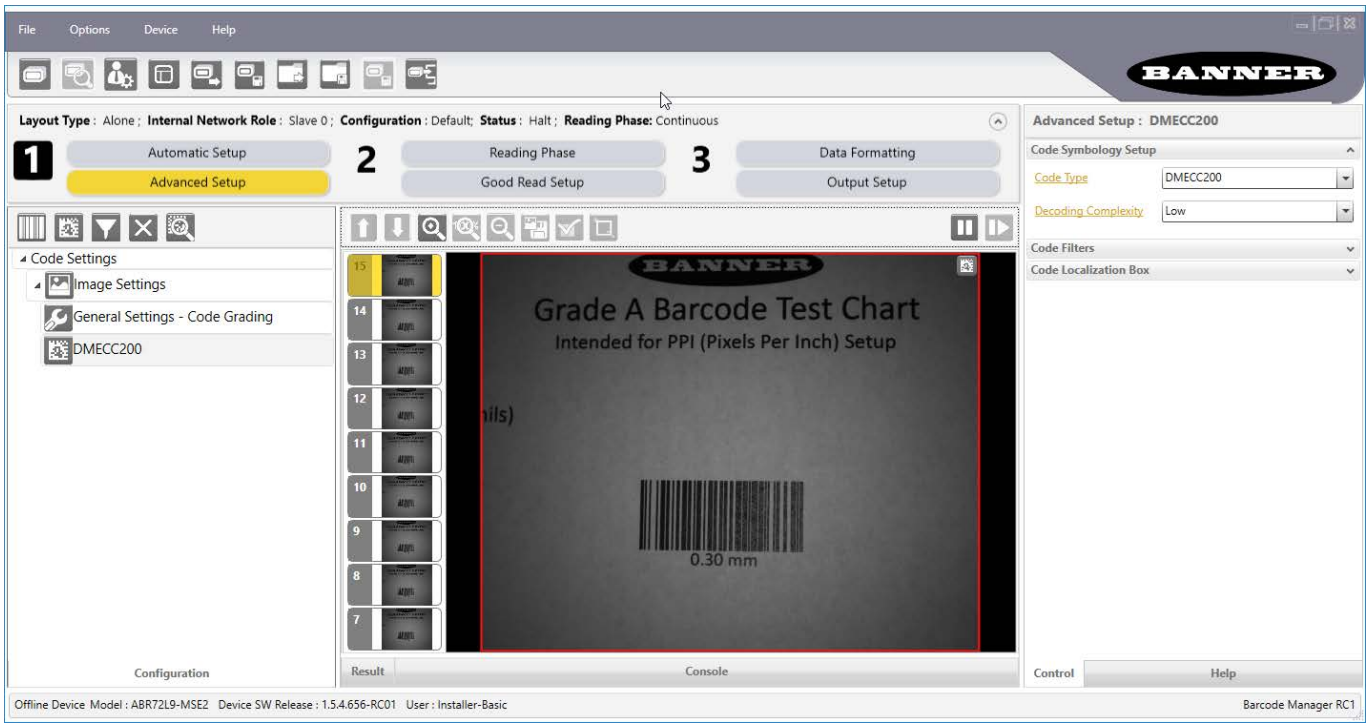


Figure 57. Chart Positioned

Note: If the image display area is too dark to see the images being captured, drag the Gain and Exposure Time sliders to the right to increase visibility. This will not affect Automatic Setup.

7. Click **Image Settings**.
8. Click **Image Auto-Setup** **Image Auto-Steup** to automatically acquire the best exposure time and gain values.
9. Select the reading option.
   - **Static** reading —No maximum limit on exposure time
   - **Dynamic** reading—Maximum allowable image exposure is automatically calculated using the parameters

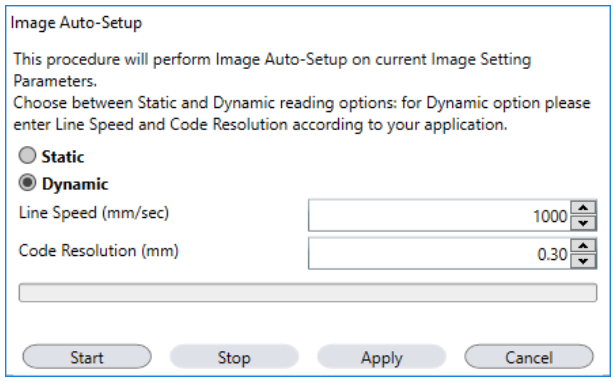


*Figure 58. **Image Auto-Setup** Window*

10. Click **Start**.
11. Click **Apply**.

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.

12. From the main menu open **Options** > **UI Settings** > **Configuration** tab.
13. Select **Focus Calibration** under **View Window** if it is not already selected.

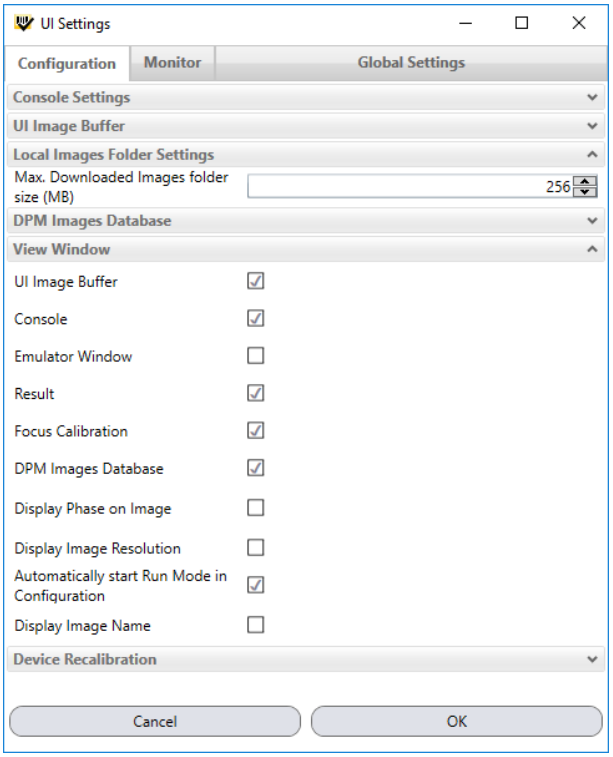


Figure 59. UI Settings

14. Click the **Focus Calibration** tab at the bottom of the window.

Note: This feature is only available for manual focus models.

The oscilloscope view is shown in the bottom panel and can be used for manual focus adjustment.

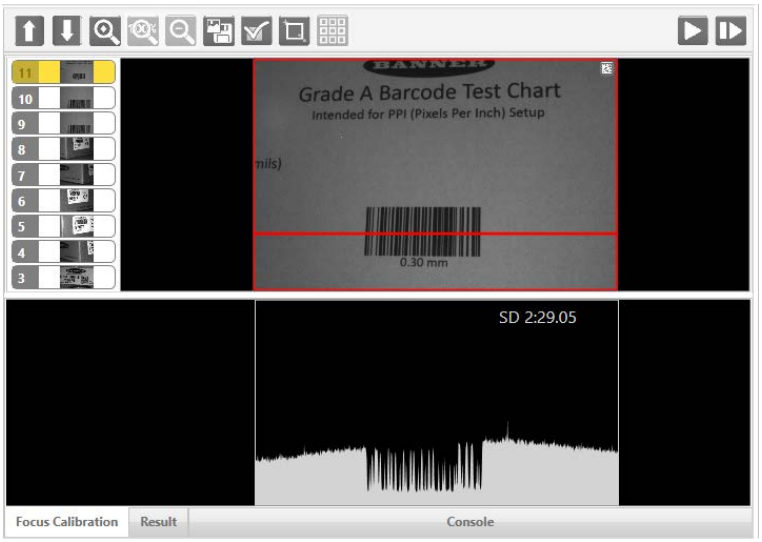


Figure 60. Oscilloscope View

The red line in the image panel above the oscilloscope must pass through the code. Click and drag the red line vertically to reposition it over the code.

Note: To enlarge the visual image of the code and the oscilloscope views, drag the Focus Calibration window up and click the **zoom image** icon repositioning it on the code.

While in run mode, manually adjust the focus until the bars relative to the code in the oscilloscope demonstrate their maximum length (focus).

You can also see the visual focus on the code view.

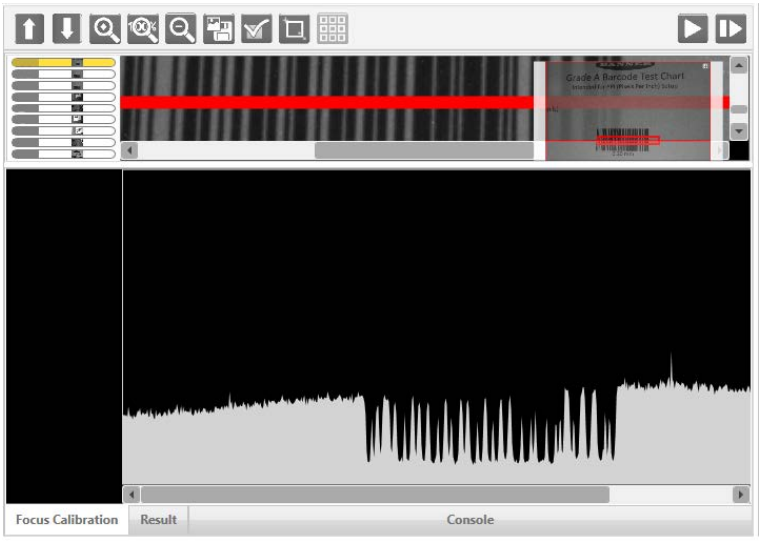


Figure 61. Code View and Oscilliscope View Zoomed In

When focused, click **Pause** to stop image acquisition.

15. Click Acquire PPI **Acquire PPI** to automatically set the Image Density so that the ABR functions correctly and to the fullest extent of its capabilities.

    This procedure is necessary to enable transmitting accurate barcode size estimates for barcodes at the same reading distance as the test card.

> **Note:** At this point it is good practice to save the configuration from temporary memory to permanent memory, giving it a specific name.

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

    Do not repeat Focus Calibration or PPI.

17. Click 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.

Figure 62. Decoded Image

> **Note:** The large green box for each symbol indicates the code localization area which by default is equal to the maximum FOV. Resize and move the box by dragging its borders with the mouse. The code must be found within this area in order to be decoded.

18. Add your application-specific codes to the Code Settings by selecting them from the icons over the Configuration Parameters tree area.
19. If the Data Matrix symbology is not used, delete it from the Code Settings with the icon.
20. If you don't know the code type, use the Code Autolearn feature by clicking on the icon[16].
    See the Barcode Manager Instruction Manual for details.
21. For each code symbology set the relative parameters according to your application.

Continue the configuration using *Reading Phase* on page 50.

6.4 Reading Phase

1. Click Reading Phase **Reading Phase**.

[16] The Code Autolearn procedure does not recognize the following symbologies: Pharmacode, MSI, Standard 2 of 5, Matrix 2 of 5.

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

   Continuous Mode and **Acquisition Trigger** are shown by default.
3. Configure the relative **Operating Mode** parameters from the **Reading Phase** parameters panel.
   Different groups appear in the panel depending on the selected icons over the **Configuration Parameters** tree area.

6.5 Good Read Setup

1. Click Good Read Setup **Good Read Setup**.
2. Select your specific data collection type from the icons over the Configuration Parameters tree area:
   - Code Collection
   - Code Combination
   - Code Presentation
   - Match Code

   Not all data collection types are available for all Operating Modes. Incompatible data collection types are 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.

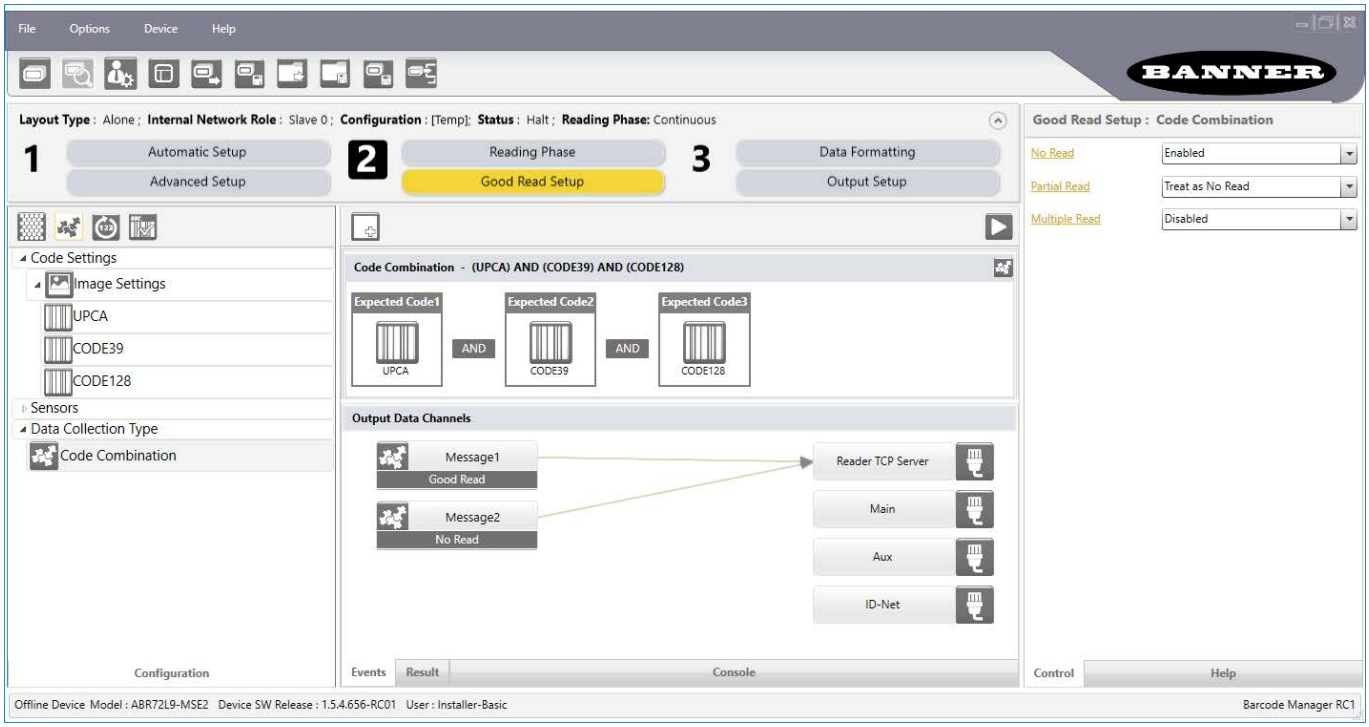


Figure 63. Good Read Setup: Code Combination

3. If a Good Read condition should be produced when any single code is decoded, independent from the others, combine them in logical XOR.
   a) Drag the code icon(s) from their relative Expected Code box into the Expected Code box of the XOR combination you wish to create.
   b) Delete the empty box by selecting it with the mouse (highlighted) and pressing **delete** on your keyboard.

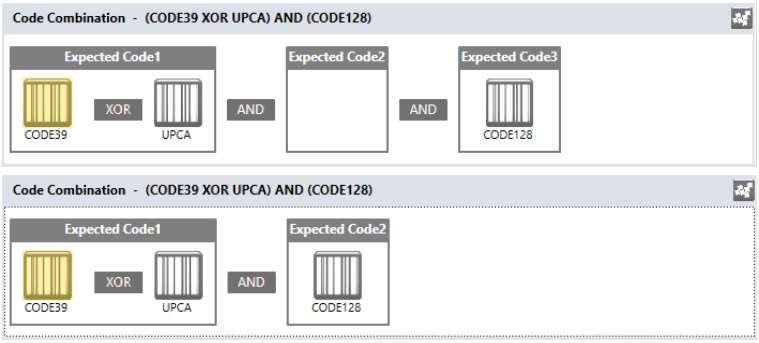


Figure 64. Code Combination

   c) To create a logical AND condition from a logical XOR, create a new Expected Code box using the icon.
   d) Drag the desired code icon from one box to the other.

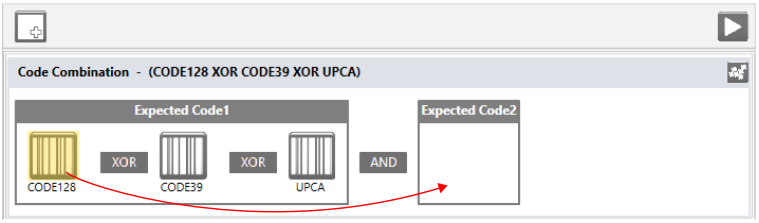


Figure 65. New Expected Code

6.6 Data Formatting

For details, see the Barcode Manager Instruction Manual, available at *www.bannerengineering.com*.

1. Click **Data Formatting**.

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

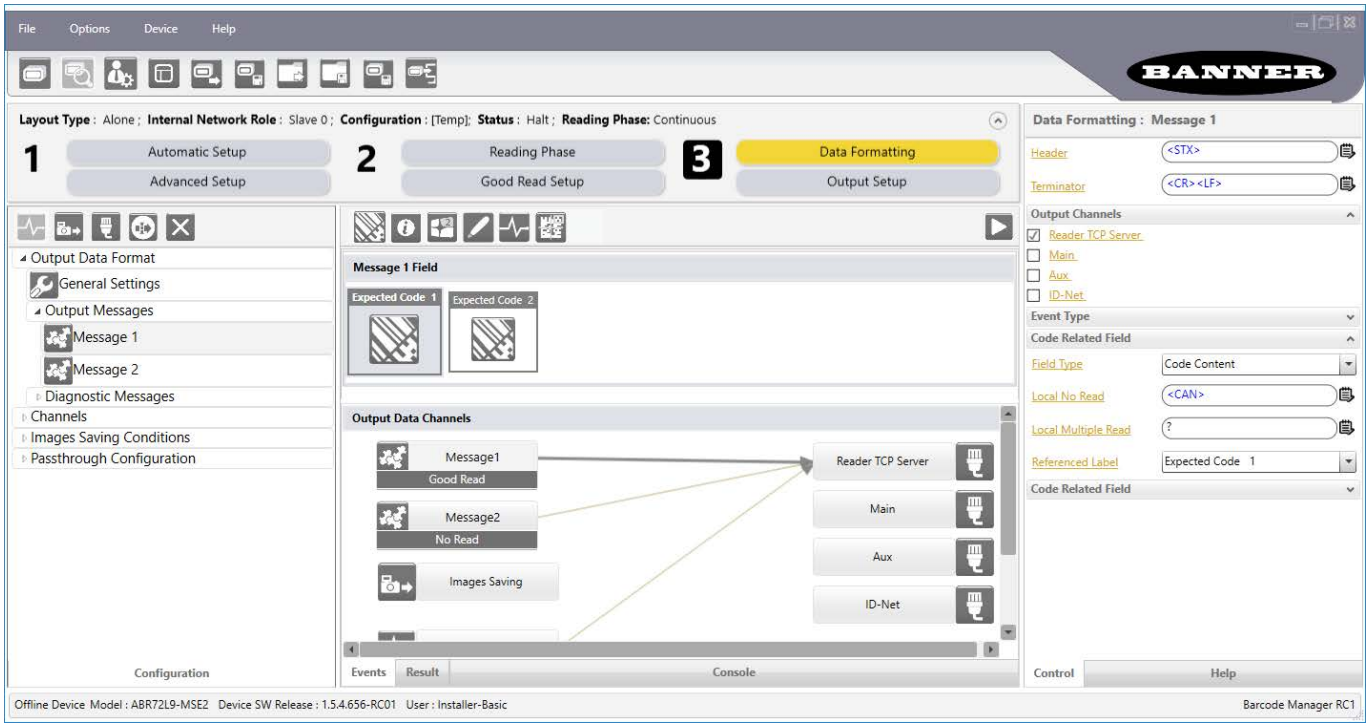


Figure 66. Data Formatting

3. Add fields to the output message by clicking on the icons above the Message Field area. The fields are appended to the message.
4. Drag the fields 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.

6.7 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.

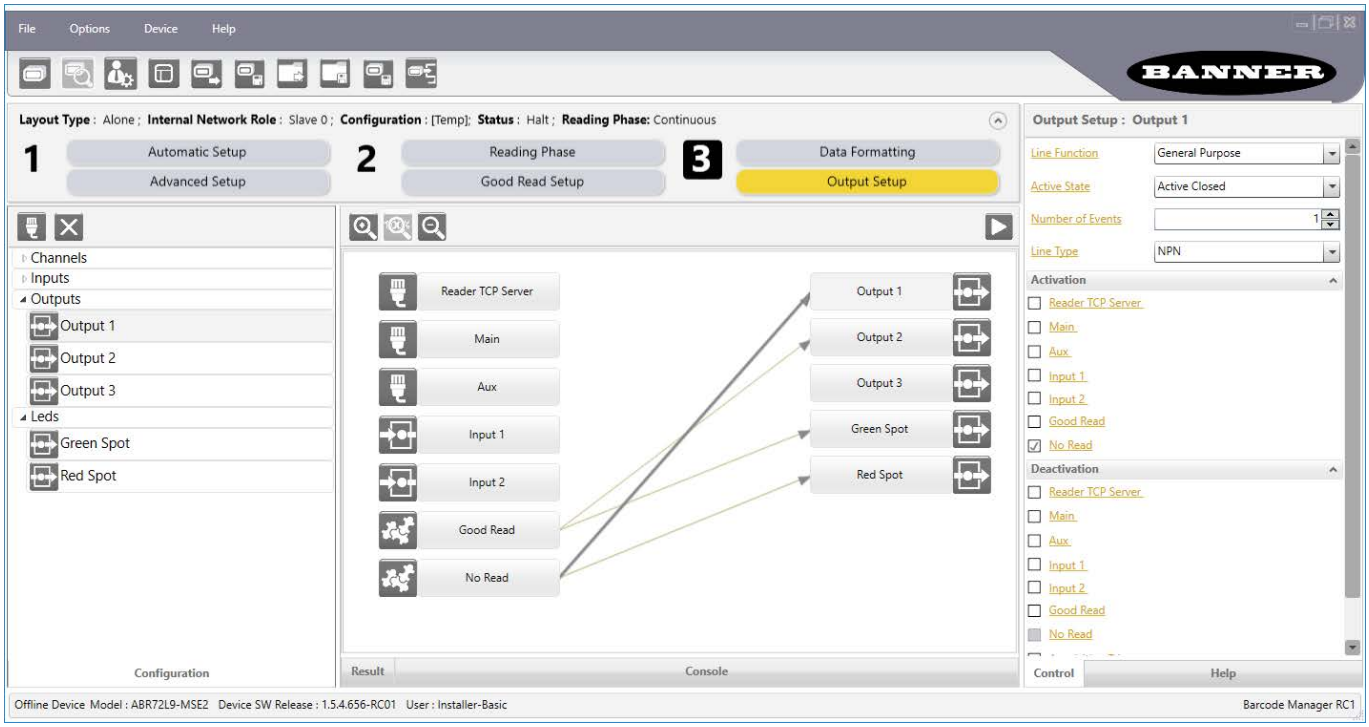


Figure 67. Output Setup

2. Save the configuration from temporary memory to permanent memory, overwriting the previously saved configuration.

6.8 Fine-Tuning Examples

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

6.8.1 Under-Exposure

To correct an under-exposure 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. Exposure time is also limited by the Internal Lighting mode parameter. Longer exposure times can be set if the power strobe level is lowered.

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

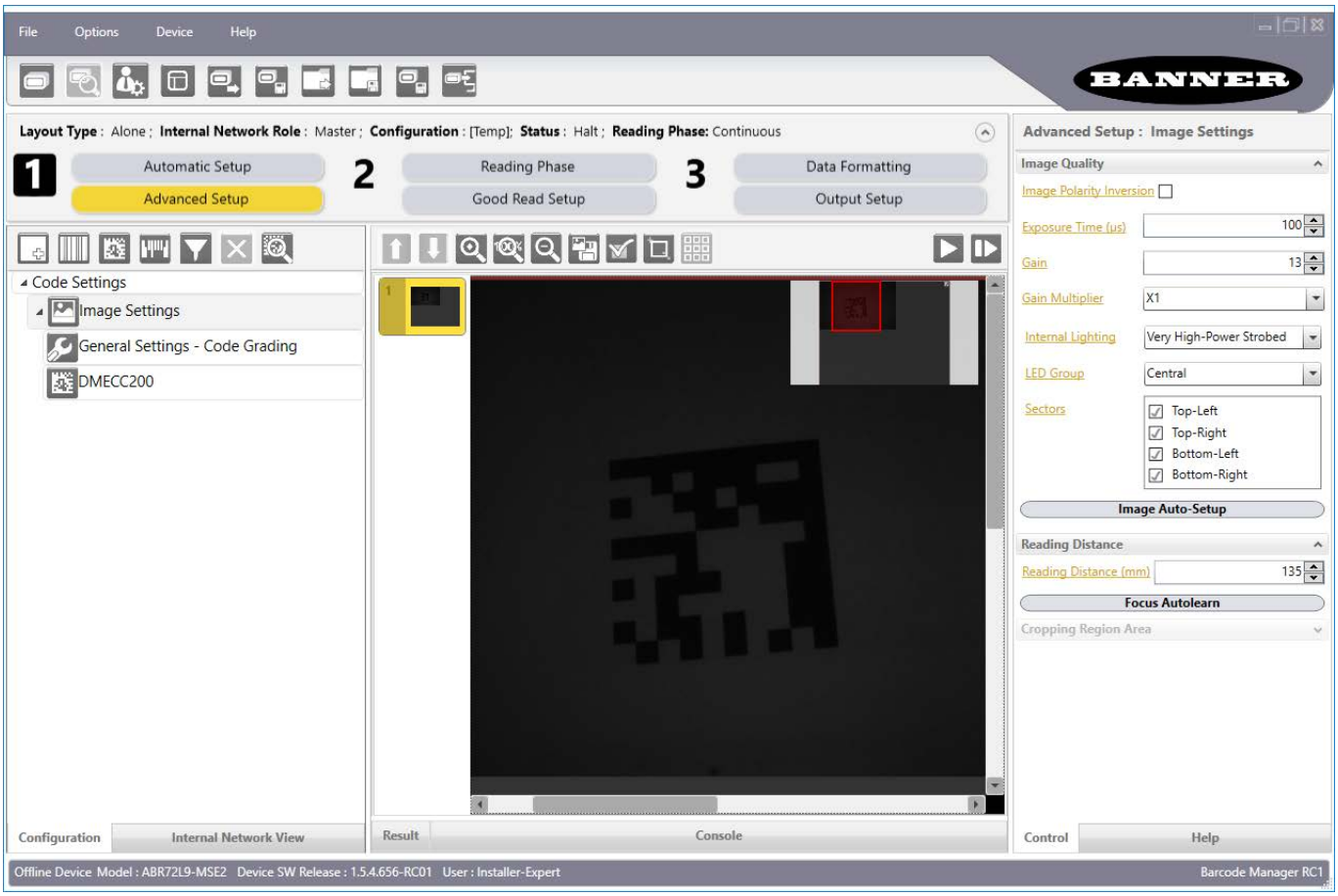


Figure 68. Example Under Exposure: Too Dark

6.8.2 Over-Exposure

To correct an over-exposure result, change the following parameters in order:

1. Decrease the Gain.
2. Decrease the Exposure Time.

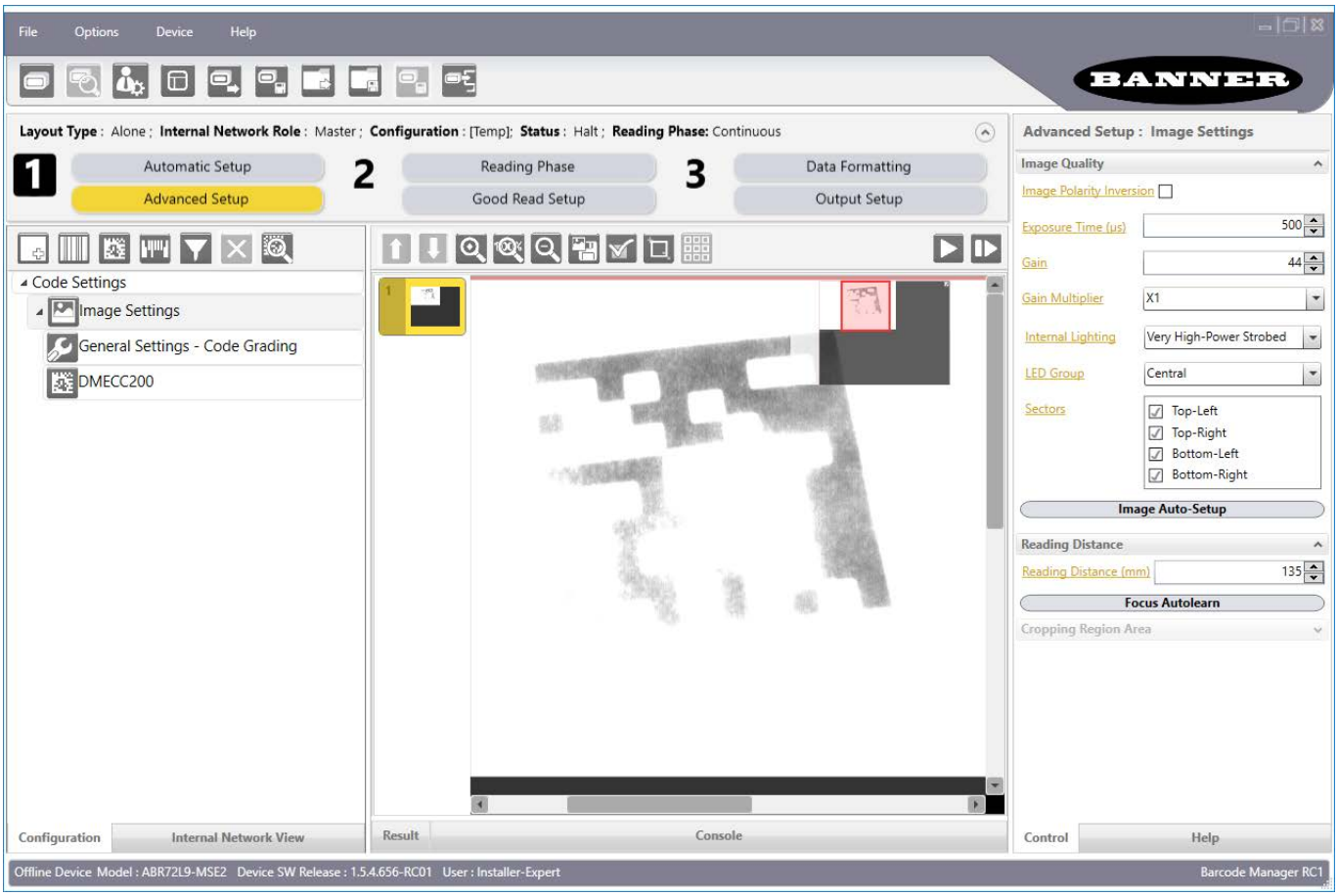


Figure 69. Example Over Exposure: Too Light

6.8.3 Code Moving Out of the FOV

To correct code moving out of the FOV and have the code completely visible in FOV, follow one or both of the following options:

- Reposition the reader
- Use the Delay on Trigger and set the Time or Space values

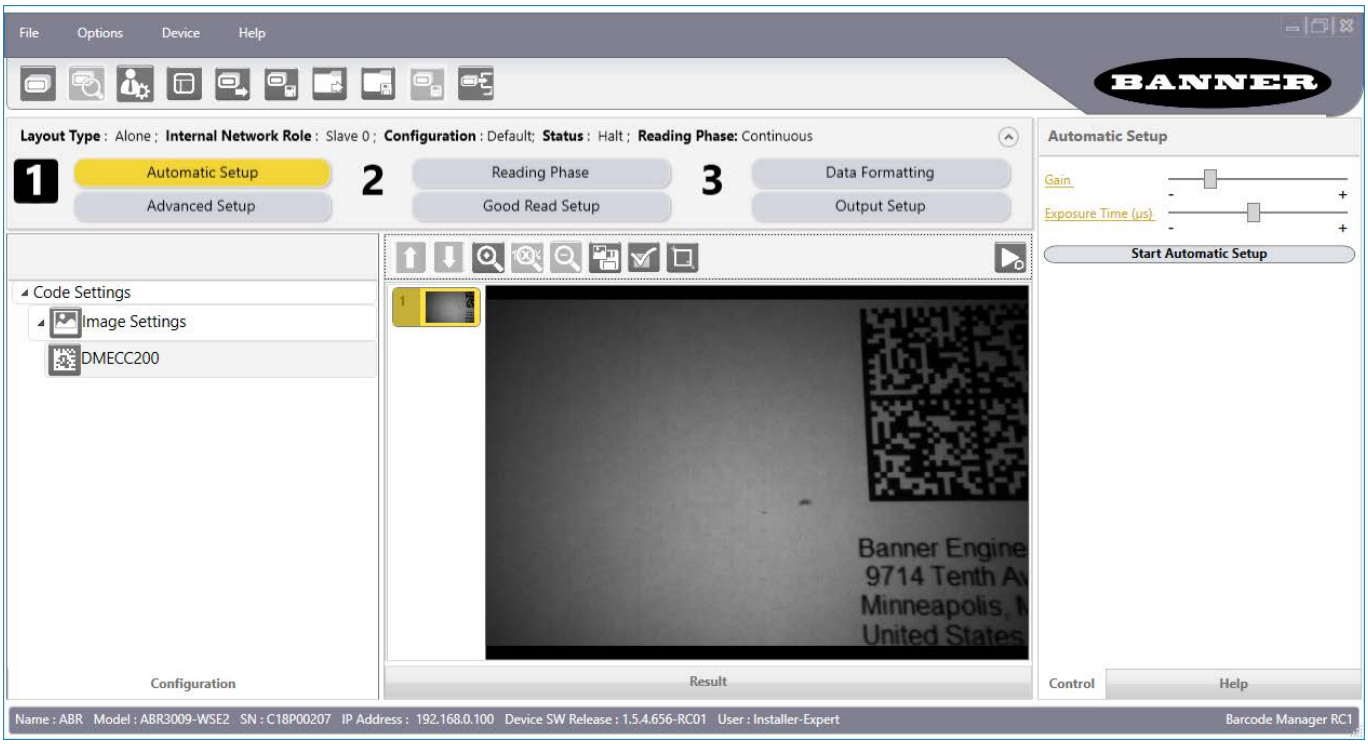


Figure 70. Example of Code out of the FOV

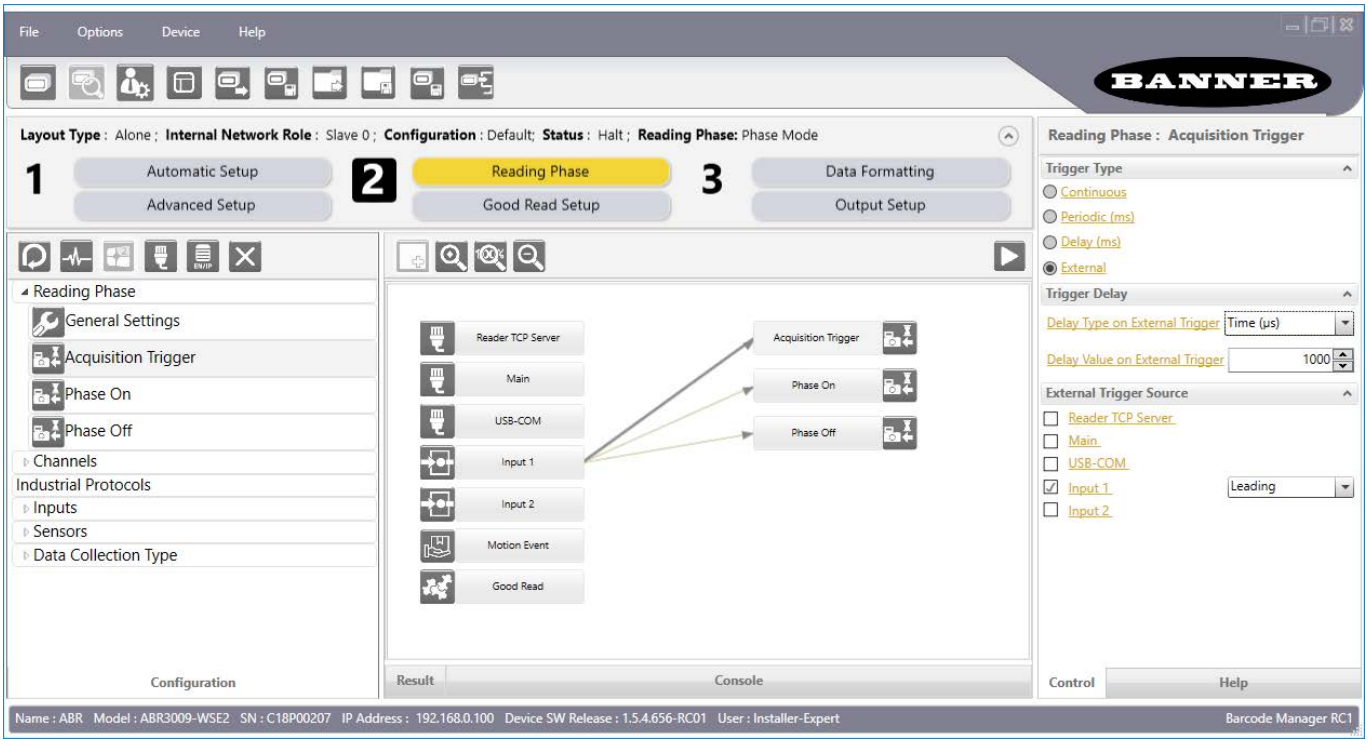


Figure 71. Add Delay on Trigger to Correct Out of FOV

7 Advanced Reader Configuration

For further details on advanced product configuration, refer to the Barcode Manager Instruction Manual available in the Barcode Manager Help menu.

7.1 Host Mode Programming

The reader can also be remotely configured from a host system using the Host Mode programming command language. See the Host Mode Programming Manual, available at *www.bannerengineering.com*.

8 Industrial Ethernet Overview

The ABR reader can be monitored and controlled using Industrial Ethernet protocols (EtherNet/IP or Modbus/TCP). On the monitoring side, the ABR makes the barcode data output string configured on the Data Formatting page available to a PLC or HMI along with eight user-defined output bits. These output bits can be configured to report the current status of the ABR, including Good Read, No Read, etc. or to report the status of an input bit.

Control of the ABR using Industrial Ethernet is possible using eight user-defined input bits. These can be configured as Reading Phase On, Reading Phase Off, Acquisition Trigger, or they can control an output bit.

Input command strings cannot be sent to the ABR using Industrial Ethernet, but trigger and Host Mode Programming commands can be sent to the TCP server channel by a socket connection.

8.1 Industrial Ethernet Setup in Barcode Manager

8.1.1 Set the Industrial Ethernet Protocol (EtherNet/IP, Modbus/TCP)

The Industrial Ethernet communication channel is disabled by default.

To enable this channel, use the following instructions.

1. From the **Reading Phase**, **Data Formatting**, or **Output Setup** pages, click **Add New Industrial Protocol**.

   Note: This option is available only for **Installer-Expert** users.

2. Select one of the choices:
   - EtherNet/IP
   - Modbus/TCP
3. After changing the settings, click **Play**, **Monitor**, or **Getting Started** to activate Industrial Communications with the new settings.

8.1.2 Industrial Ethernet Reading Phase Control

The Industrial Ethernet host controller can control the reading phase by assigning individual communication bits to reading phase parameters. These bits are received on the Industrial Ethernet channel as Input Bits.

To control the reading phase start and end using Industrial Protocol Input Bits, use the following instructions:

1. Go to **Reading Phase** > **Phase Mode** > **Phase On** and select an input bit from the Industrial Protocol Input Bit list. In this example, select Bit 2.

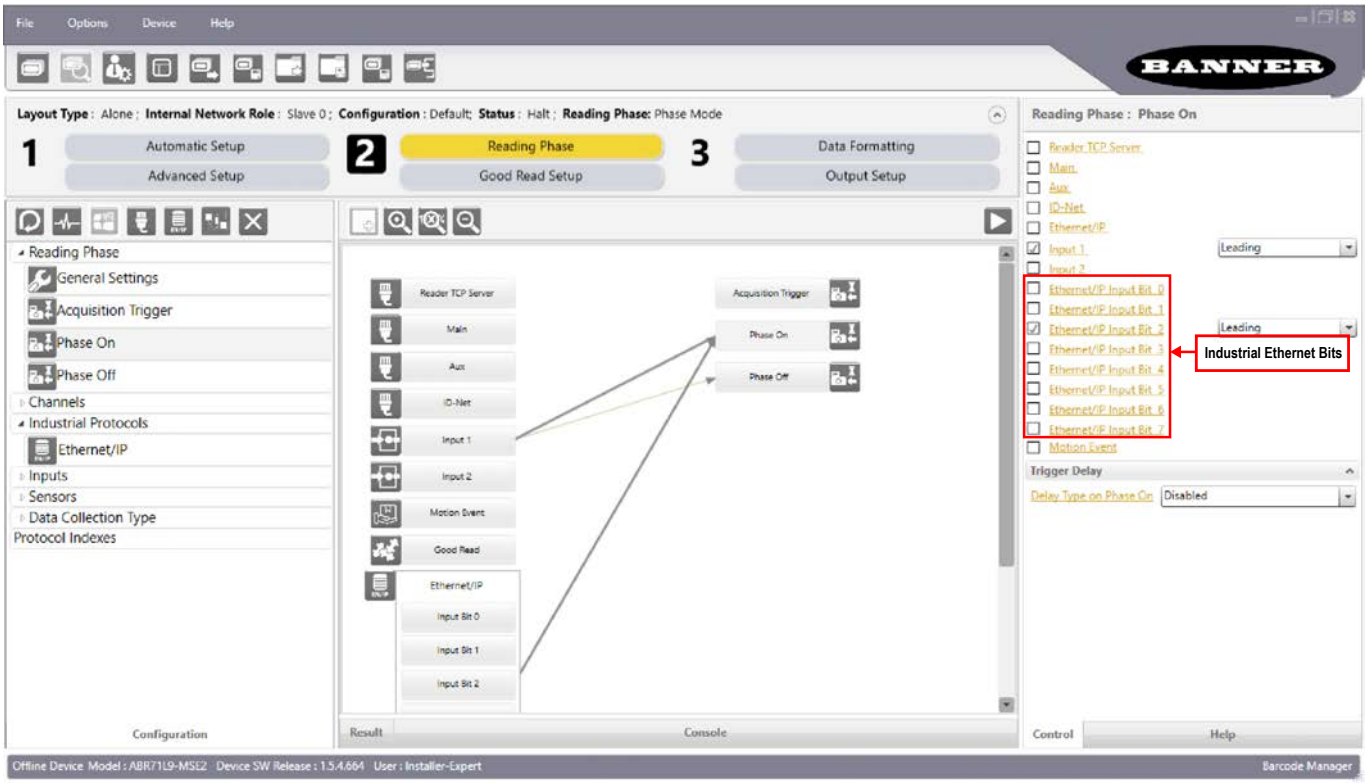


Figure 72. Industrial Ethernet Input Bits Configured for Phase On Control

2. Click **Phase Off**, and select the same bit used in step 1 from the Industrial Protocol Input Bit list.
3. Change selected bit polarity from **Leading** to **Trailing**.
   The reading phase will start when the input bit goes high, and end when the input bit goes low.

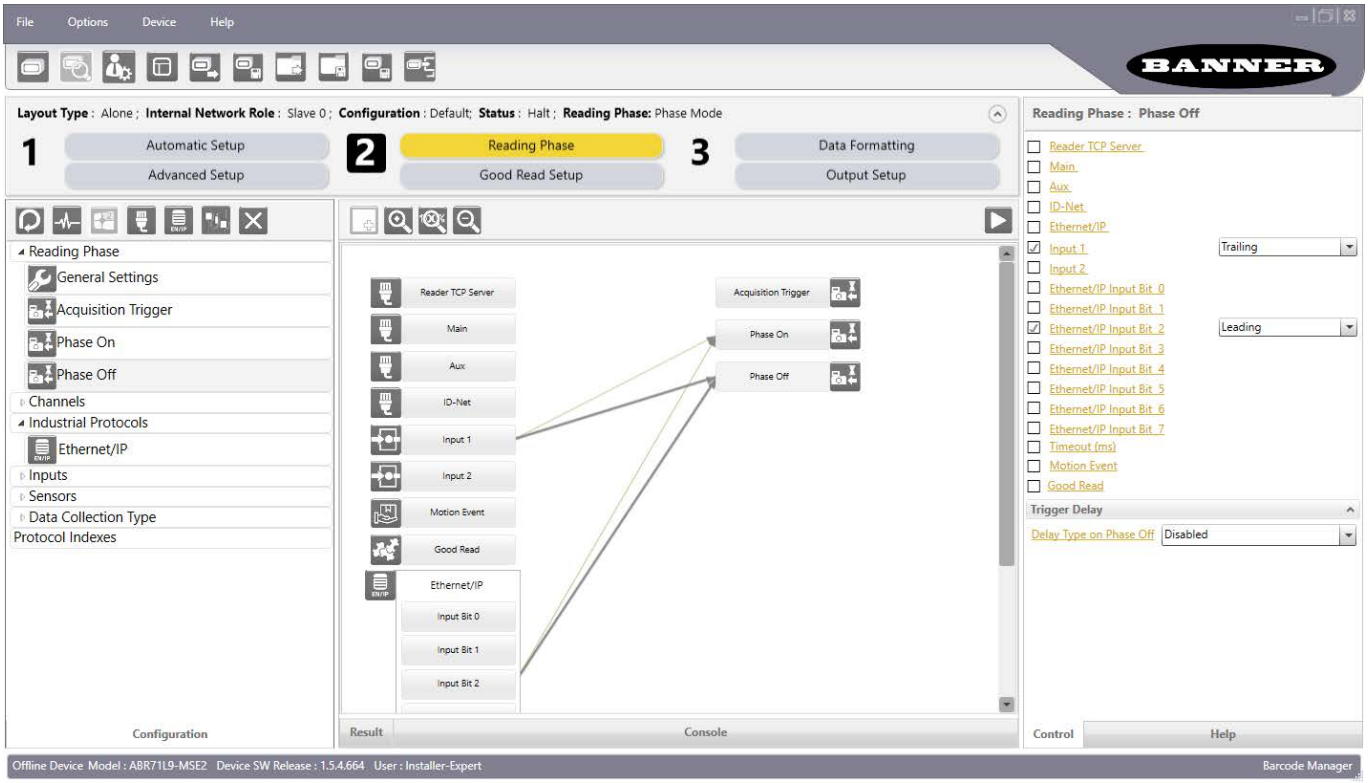


Figure 73. Industrial Ethernet Input Bits Configured for Phase Off Control

8.1.3 Industrial Ethernet Reading Phase Acquisition Control

To acquire individual images using an Industrial Protocol Input Bit, use the following instructions:

1. Go to **Reading Phase** > **Phase Mode** > **Acquisition Trigger** and select **Trigger Type** as **External**.
   The **External Trigger Source** list displays.
2. Select an Industrial Protocol Input Bit.

   In this example, select Bit 6.

   Because the selected bit polarity is set to **Leading**, the ABR will take an image each time the input bit goes high.

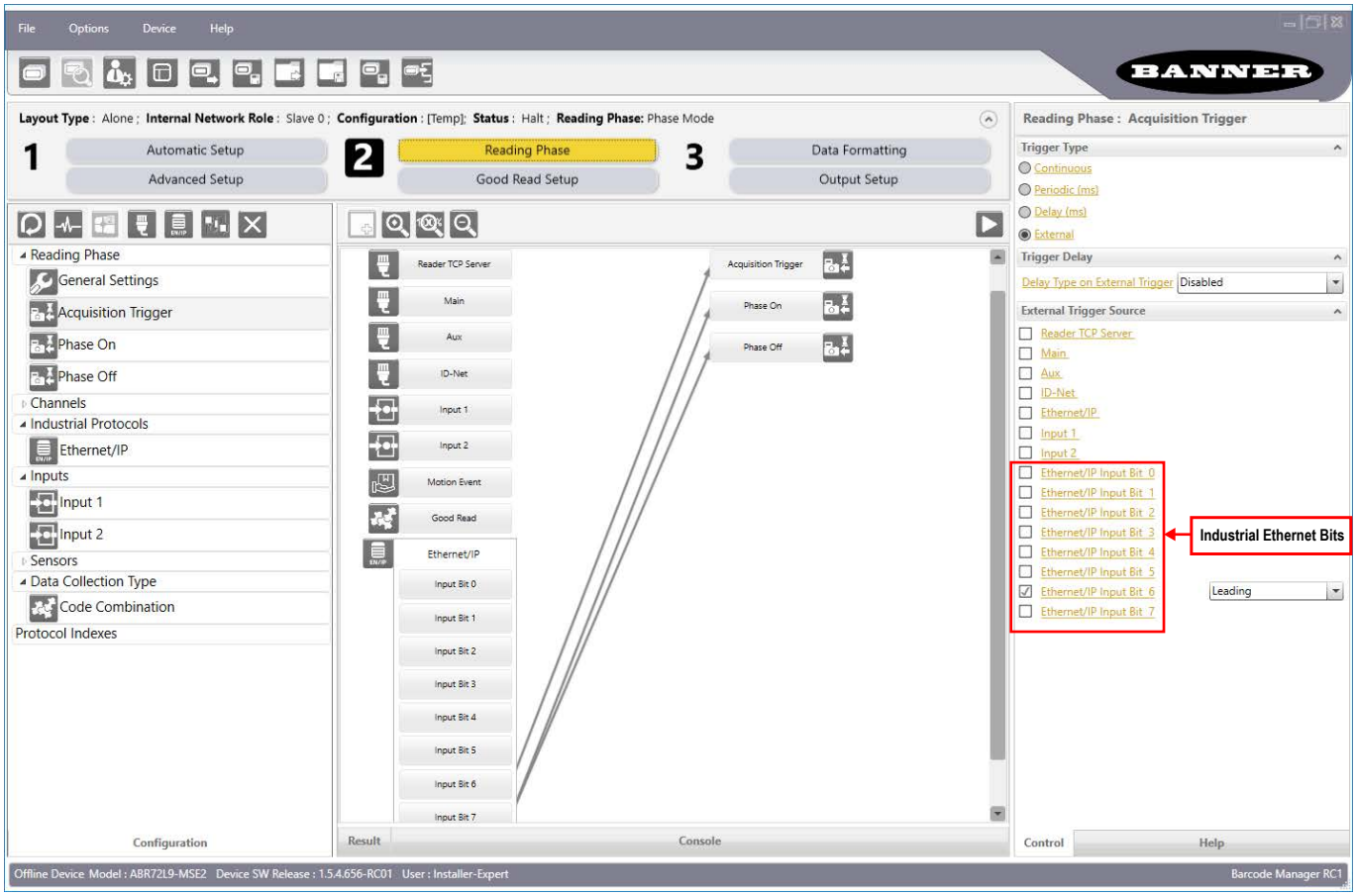


Figure 74. Industrial Ethernet Strings and Bits

8.1.4 Industrial Ethernet Digital Output Control

The Industrial Ethernet host controller can also drive the ABR reader's physical discrete outputs by assigning individual communication bits to the Digital Output Activation and Deactivation parameters. These bits are received by the ABR as Input Bits.

1. Go to **Output Setup** > **Output**.
2. Under **Activation**, select an input bit, leaving the polarity setting as **Leading**.

   In this example, select **Input Bit 0**.

3. Under **Deactivation**, select the same bit and set it to **Trailing**.
   When the host turns on the ABR Input Bit, the ABR turns on its physical discrete Output 1.

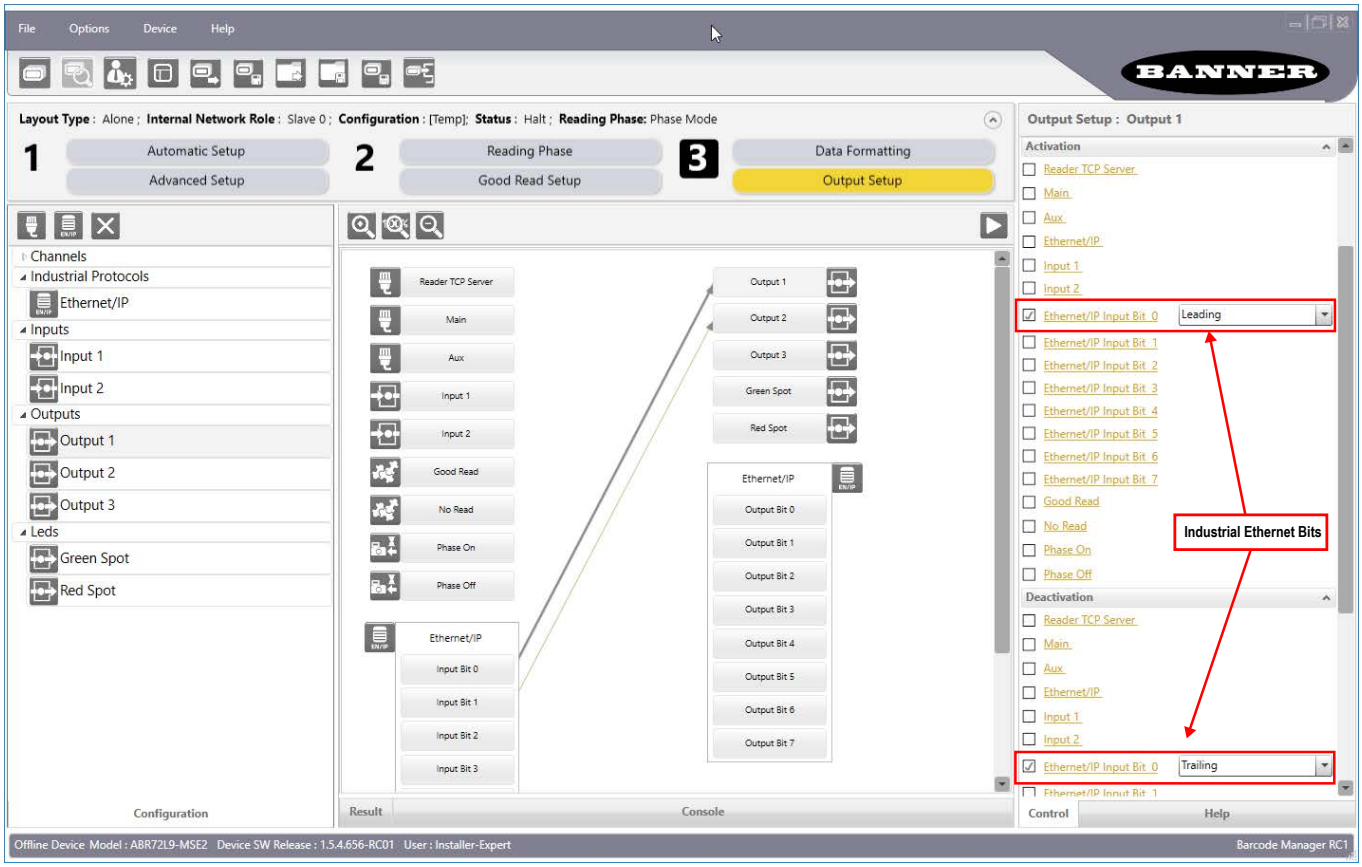


Figure 75. Industrial Ethernet Strings and Bits

8.1.5 Digital Input Echo to Industrial Ethernet

The Industrial Ethernet host controller can receive echoes of the Reading Phase and discrete digital Input signals from the ABR as Output bits.

1. Go to **Output Setup** and select an Industrial Protocol Output Bit.
   This example uses Output Bit 0.
2. Under Activation, select the discrete digital input to echo, leaving the bit polarity as **Leading**.

3. Under Deactivation, select the same input and set the polarity to **Trailing**.
   When physical Input 1 turns on, the Industrial Ethernet host controller will see the ABR Output Bit 0 turn on.

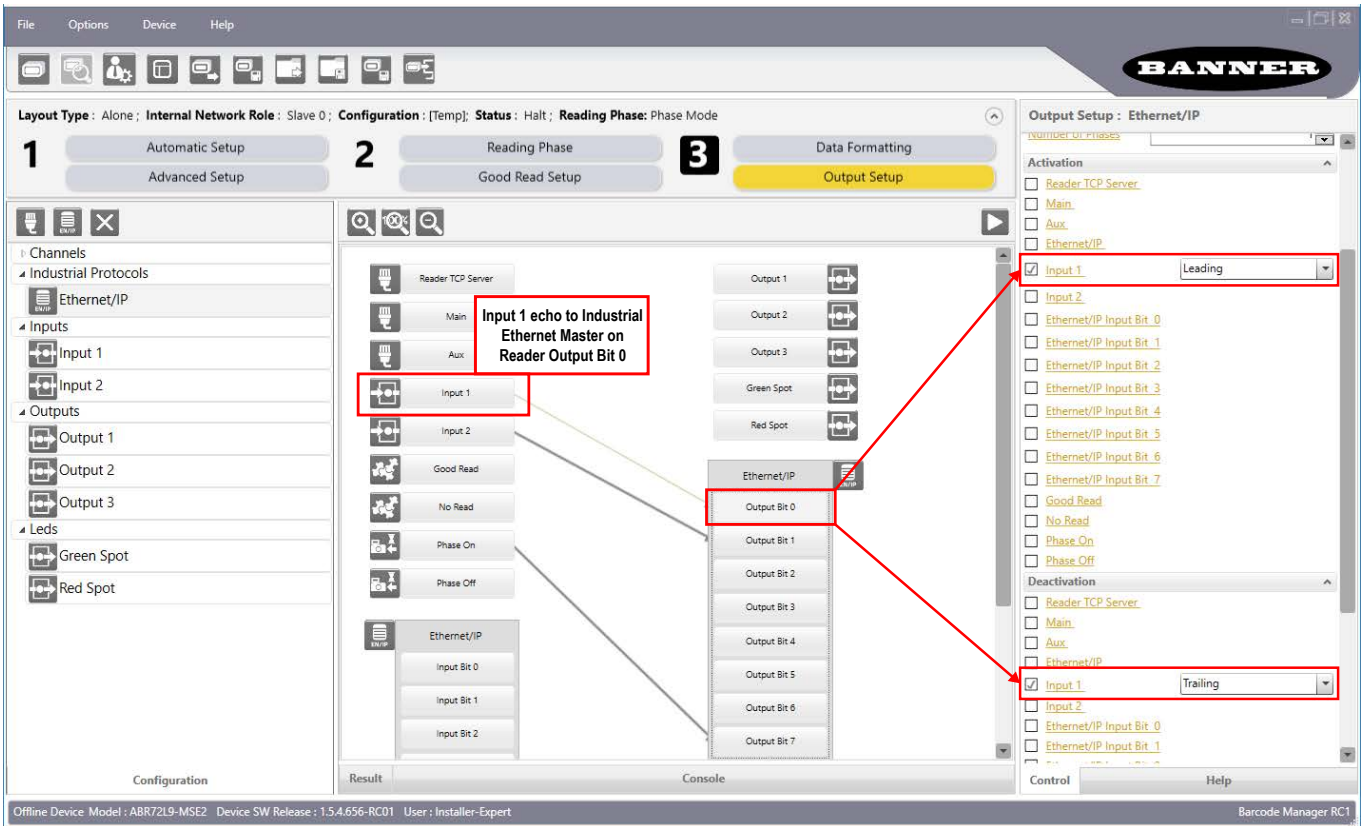


Figure 76. Digital Intput Echo to Industrial Ethernet

8.1.6 Transmitting Output Data Messages Using Industrial Ethernet

To send the result output data from the ABR to the Industrial Ethernet host controller, use the following steps:

1. Go to **Output Setup**.
   Should step 1 be Data Formatting rather than Output Setup?
2. Click on the Message you wish to send.

3. Click on the relevant Industrial Protocol.
   In this example, **Message 2** has been linked to the EtherNet/IP Industrial Protocol. The data from Message 2 will be sent, as an ASCII string, to the ABR Industrial Protocol output data registers. Arrows should be drawn automatically from the messages to the Industrial Ethernet channel in the diagram in the center of the screen.

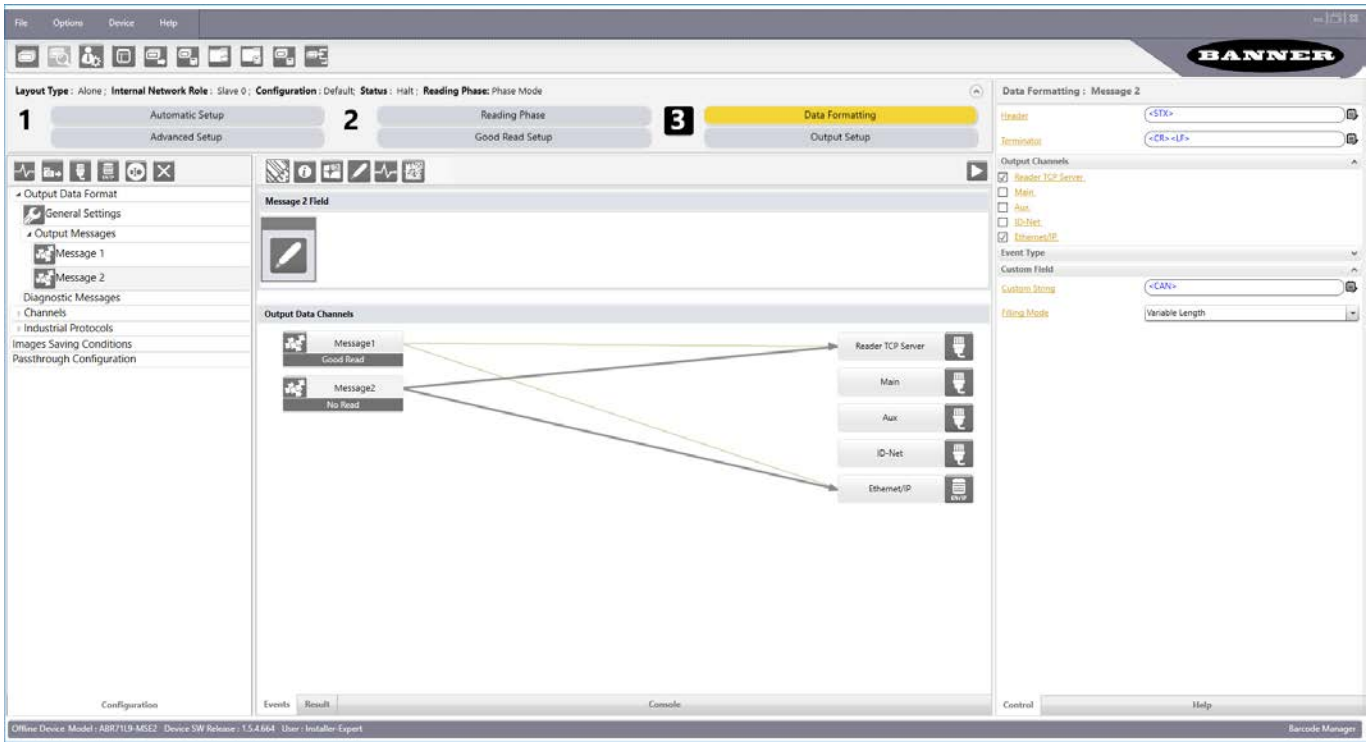


Figure 77. Data Formatting

8.2 EtherNet/IP

If you are using a PLC programmed by Rockwell Studio 5000 Logix Designer software version 20 or later, such as the ControlLogix or CompactLogix series, you should be able to skip to *ABR Series EDS File Installation in Studio 5000 Logix Designer Software* on page 68 and configure your PLC using the EDS and AOI files. Users of other controllers may have more need of *ABR Assembly Object Descriptions* on page 64 and *Configuring the ABR for Ethernet/IP in Barcode Manager* on page 67.

8.2.1 ABR Assembly Object Descriptions

The ABR reader is controlled via EtherNet /IP using assembly objects. From the point of view of a PLC, there is one input assembly and one output assembly

The Originator (client) of the EtherNet /IP connection is the PLC. The Target (AKA server) of the EtherNet /IP connection is the ABR reader. The direction of communication can be described as T > O or O > T (sometimes also shown as T2O or O2T). The following tables list the data contained in all of the ABR assembly instances.

Inputs to the Sensor (Outputs from the PLC)

PLC Assembly Instance 113 (0×71) - 3 Registers (Sensor Inputs/PLC Outputs) O > T

Data transfer direction: Originator (PLC) to Target (ABR). Assembly instance 113 is the data used to control the flow of result message strings from the ABR and pass 8 discrete input bits for control options such as triggering image acquisitions.

WORD#	WORD NAME	DATA TYPE
0	Last Item Sequence Number	8-bit integer
1	Output Bits	8-bit integer
2	Last Fragment Sequence Number	8-bit integer

Last Item Sequence Number

The Last Item Sequence Number is written with the Item Sequence Number by the Originator (PLC) to acknowledge the receipt of the Item Data. If fragmentation is used, this value is not written until the complete message is received.

Output Bits

The Output Bits attribute is a bitmap used to control the state of the eight discrete outputs to the ABR reader.

Last Fragment Sequence Number

The Last Fragment Sequence Number is written with the Fragment Sequence Number by the EtherNet /IP Originator (PLC) to acknowledge the receipt of an individual fragment. If fragmentation is not used, this value does not need to be written.

Outputs from the Sensor (Inputs to the PLC)

PLC Assembly Instance 100 (0×65) - 138 Registers (Sensor Outputs/PLC Inputs) T > O

Data transfer direction: Target (ABR) to Originator (PLC). Assembly instance 100 is the data sent back to the PLC to give the result of the last reading attempt, and the result message string if any.

WORD #	WORD NAME	DATA TYPE
0	Item Sequence Number	8-bit integer
1–2	Item Status	16-bit integer
3–4	Item Data Size	16-bit integer
5	Input Bits	8-bit integer
6	Failure Code	8-bit integer
7	Fragment Sequence Number	8-bit integer
8–9	Fragment Data Size	16-bit integer
10–137	Fragment Data	128 character string

Item Sequence Number

The Item Sequence Number is incremented by one on every new Item Data production. The Item Sequence Number is set to zero at power up. Once an Item Data packet is ready to transmit, the Item Sequence Number is set to one. This number does not increment again until the Originator (PLC) reports that it received the item by putting the matching Item Sequence Number into its Last Item Sequence Number register.

Item Status

The Item Status Code is the status of the last reading attempt and is always updated live regardless of whether the PLC has finished receiving all the fragments of the previous message. The following table shows the status codes and their meanings.

Item Status Code	Item Status Name
0×0000	Good Read
0×0001	Complete, No Read
0×0002	Partial Read
0×0003	Multiple Read
0×0004	Wrong Read

Item Data Size

The Item Data Size is the total size of the Item Data. If the Item Data Size is greater than 128 characters, fragmentation is used (see the fragmentation example in *Example of Message Transmissions in Action* on page 66).

Input Bits

The Input Bits attribute is a bitmap used to read the state of the 8 discrete inputs from the ABR reader.

Failure Code

The Failure Code is set when an error occurs with the reader. The following is a table of Failure Codes:

Failure Code	Name
0×01	Input Failure
0×02	Communications Failure
0×04	Reader Failure
0×08	Software Error
0×10	Remote Failure

Fragment Sequence Number

The Fragment Sequence Number is set to 1 on the first fragment of the latest Item Data transmission, when the Item Sequence Number increments up by 1. The Fragment Sequence Number is incremented by 1 on every new fragment. If fragmentation is not used, this value is fixed at 1. This value will only increment when the Last Fragment Sequence Number is set to match the current Fragment Sequence Number, to report that the PLC is ready for the next data. The value is only equal to 0 immediately after a power-up, before the first message is sent.

Fragment Data Size

The Fragment Data Size is the length of the data (in bytes) stored in the Fragment Data attribute. If fragmentation is used, this value equals 128 until the last fragment.

Fragment Data

This attribute stores the Fragment Data, which are the output messages from the ABR. If the Item Data Size is less than 128, this attribute stores the complete Item Data. If the Item Data Size is greater than 128, this attribute stores the individual fragments of data.

Example of Message Transmissions in Action

The following is an example of how a PLC receives two Items, one 100 bytes, and the next one 800 bytes, exactly as is done automatically in the I/O Data Add On Instruction (AOI) available on *www.bannerengineering.com*. The order is the same whether two reading attempts completed in quick succession before the PLC finished reading the first result, or whether they happened with a long period of time in between.

To ABR from PLC		To PLC from ABR					
Last Item Sequence Number	Last Fragment Sequence Number	Item Sequence Number	Fragment Sequence Number	Item Size	Fragment Size	Fragment Data Buffer	Description
0	0	0	0	0	0	NULL	Power Up
		1	1	100	100	[0–99]	ABR sends fragment 1 of item 1
1	0						PLC acknowledges item 1
		2	1	800	128	[0–127]	ABR sends fragment 1 of item 2
1	1						PLC acknowledges fragment 1

To ABR from PLC		To PLC from ABR					
Last Item Sequence Number	Last Fragment Sequence Number	Item Sequence Number	Fragment Sequence Number	Item Size	Fragment Size	Fragment Data Buffer	Description
		2	2	800	128	[128–255]	ABR sends fragment 2 of item 2
1	2						PLC acknowledges fragment 2
		2	3	800	128	[256–383]	ABR sends fragment 3 of item 2
1	3						PLC acknowledges fragment 3
		2	4	800	128	[384–511]	ABR sends fragment 4 of item 2
1	4						PLC acknowledges fragment 4
		2	5	800	128	[512–639]	ABR sends fragment 5 of item 2
1	5						PLC acknowledges fragment 5
		2	6	800	128	[640–767]	ABR sends fragment 6 of item 2
1	6						PLC acknowledges fragment 6
		2	7	800	32	[768–799]	ABR sends fragment 7 of item 2
2	0						PLC acknowledges item 2

Configuration Assembly Object

The ABR EtherNet/IP implementation does not support an assembly object Configuration instance. However, one is required for the creation of implicit Class 1 connections on a ControlLogix®[17] family PLC. Therefore, a configuration instance is defined as instance number 128 (0×80). Its size is zero.

Requested Packet Interval (RPI) Value

The ABR reader can operate with Requested Packet Intervals between 2 and 3200 milliseconds. The default set in the EDS file is 50 milliseconds. Setting this value faster than needed may hurt reading performance. If your message strings are over 128 bytes, it will take multiple packet intervals to transfer the message in 128 byte fragments. At the default 50 milliseconds setting, a 300 byte message string would take 100 milliseconds to 150 milliseconds to transfer completely.

8.2.2 Configuring the ABR for Ethernet/IP in Barcode Manager

After Ethernet/IP is added to a configuration's protocols (see *Industrial Ethernet Setup in Barcode Manager* on page 59) there is an option to configure settings specific to this protocol. Click **Ethernet/IP** in the left side Configuration panel, and select the desired option under **Keep Read Item** in the right side Control panel.

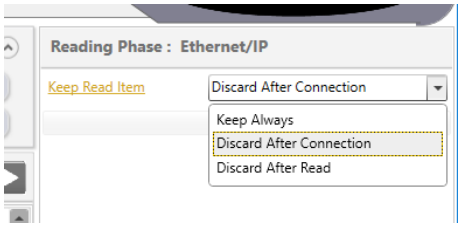


Figure 78. Keep Read Item

Keep Read Item allows managing the last code read and placed in the output buffer towards the EtherNet/IP host, in cases of re-connections to the network. The default setting will likely work for most applications. The options are:

- **Keep Always**—After the last code in the output buffer is read by the EtherNet/IP server manager (host), it remains in the output buffer.
- **Discard After Connection (default setting)**—After the last code in the output buffer is read by the EtherNet/IP server manager (host), it remains in the output buffer until the connection ends, then it is deleted. In this way it will not be re-read by the same host (or any host) in case of a re-connection.

[17] ControlLogix® is a trademark of Rockwell Automation, Inc.

- **Discard After Read**—After the last code in the output buffer is read by the EtherNet/IP server manager (host), it is deleted from the output buffer. In this way it will not be re-read by the same host (or any host) in case of a re-connection.

When there is more than one code in the output buffer, the EtherNet/IP protocol requires that each code read by the host be deleted and replaced by the next code in the output buffer.

8.2.3 ABR Series EDS File Installation in Studio 5000 Logix Designer Software

Use the **EDS Hardware Installation Tool** to register the Electronic Data Sheet (EDS) file.

Use the follow the steps, as well as *ABR Series Manual Installation in Studio 5000 Logix Designer Software* on page 73 to quickly and easily establish an implicit Class 1 connection between the ABR and a Rockwell Studio 5000 Logix Designer family PLC. Screenshots are from an example configuration with a ControlLogix 1756-L71 with a 1756-ENBT/A Ethernet module, using Studio 5000 Logix Designer version 30.

1. Download `Banner_ABR_1_1_08312018.eds` from *www.bannergineering.com*.
2. On the **Tools** menu, click **EDS Hardware Installation Tool**.
   The **Rockwell Automation's EDS Wizard** dialog displays.

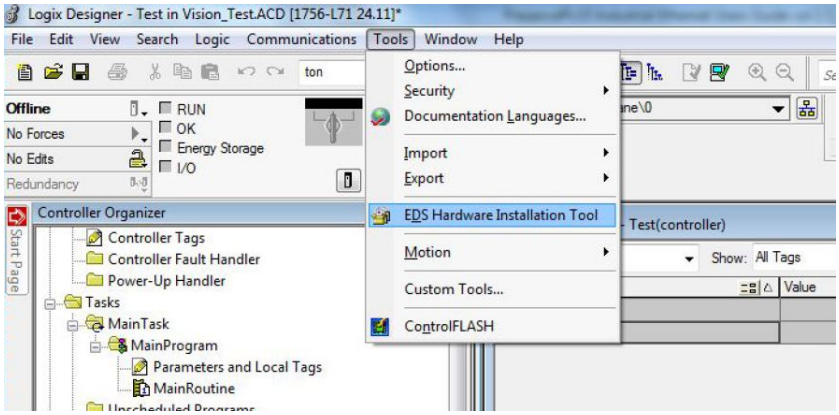


Figure 79. Tools—EDS Hardware Installation Tool

3. Click **Next**.
4. Select **Register an EDS file(s)**.

Figure 80. Rockwell Automation's EDS Wizard—Options

5. Browse to locate the EDS file and click **Next**.

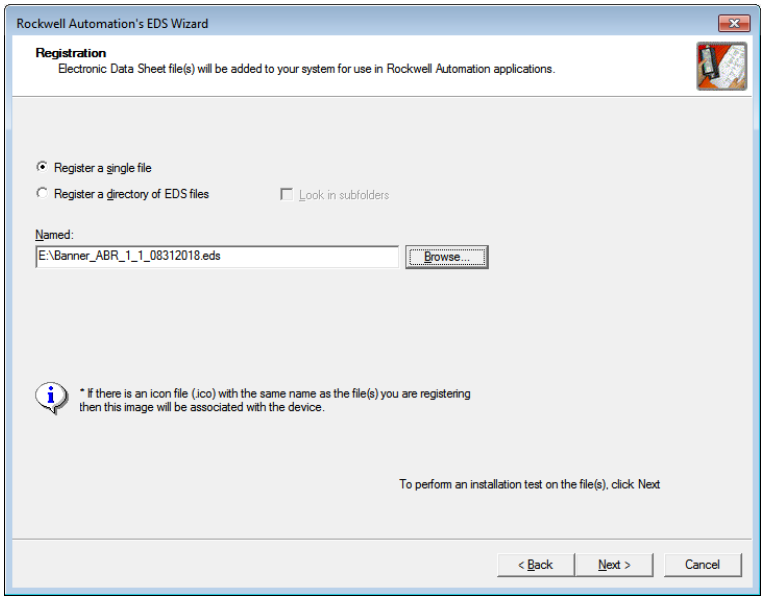


Figure 81. Select File to Register

6. Click **Next** to register the tested file.

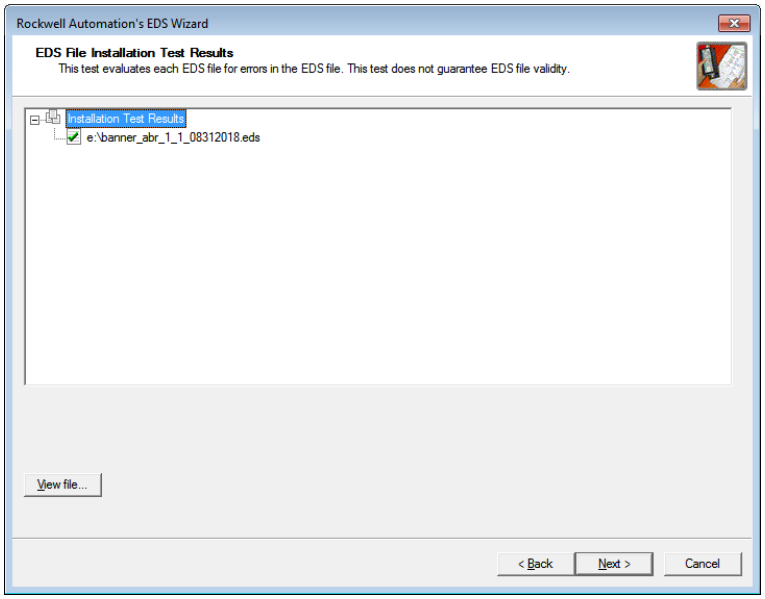


Figure 82. Register the Tested File

7. Click **Next** when you see the icon associated with the EDS file.

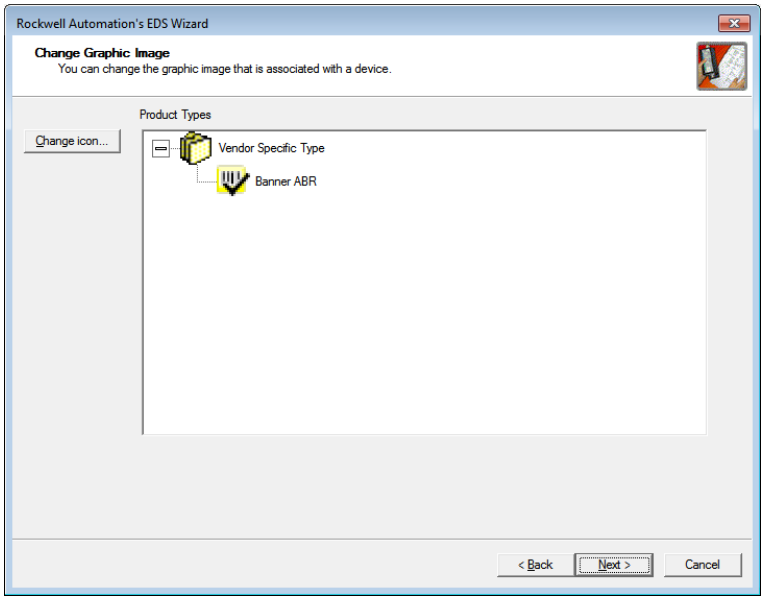


Figure 83. Rockwell Automation's EDS Wizard

8. Click **Next** to register the EDS file.

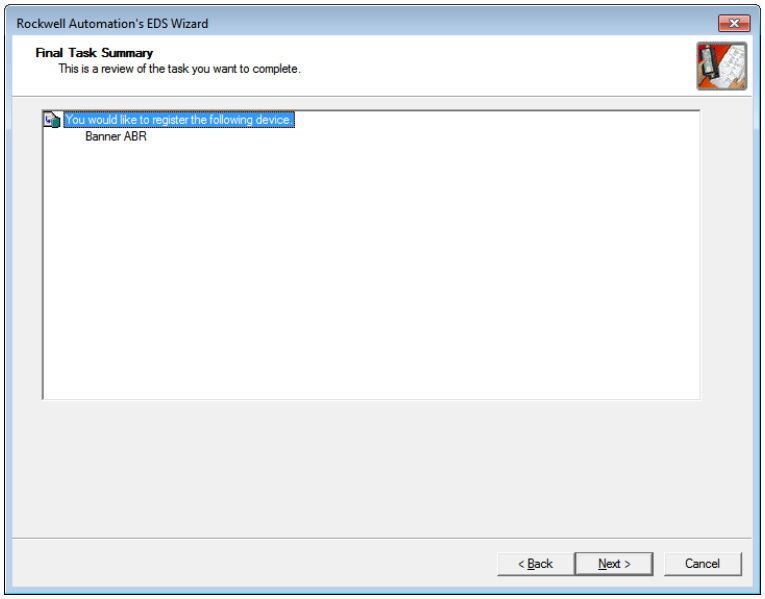


Figure 84. Register the EDS File

9. Click **Finish** to close the **EDS Wizard** .

10. Right-click on the PLC's Ethernet adapter and select **New Module...**

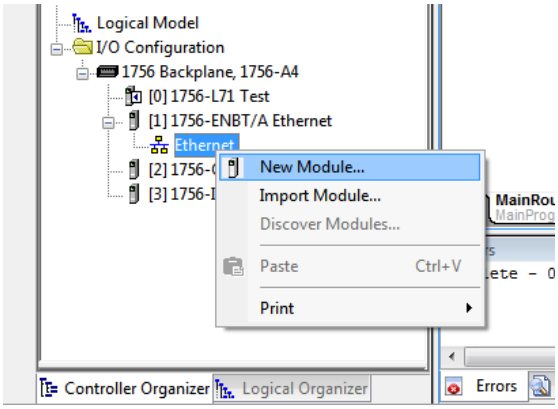


Figure 85. New Module

11. Locate the ABR from the catalog and click **Create**.

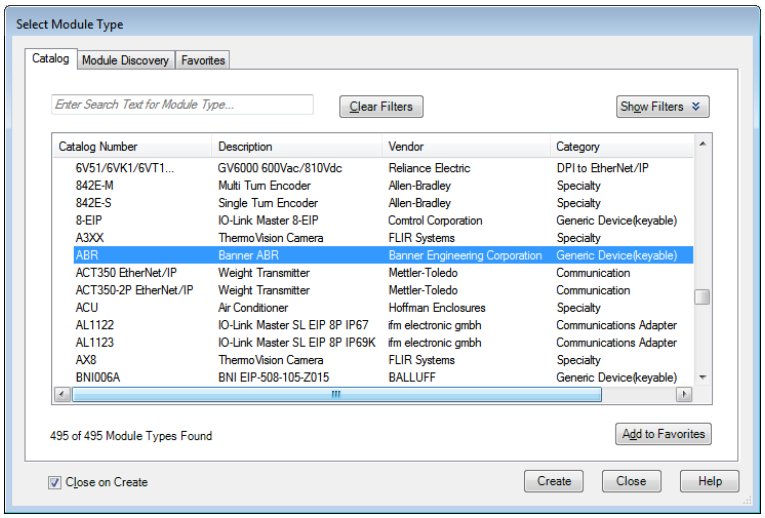


Figure 86. Select Module Type

12. Enter a name, description (optional), and IP address for the ABR.

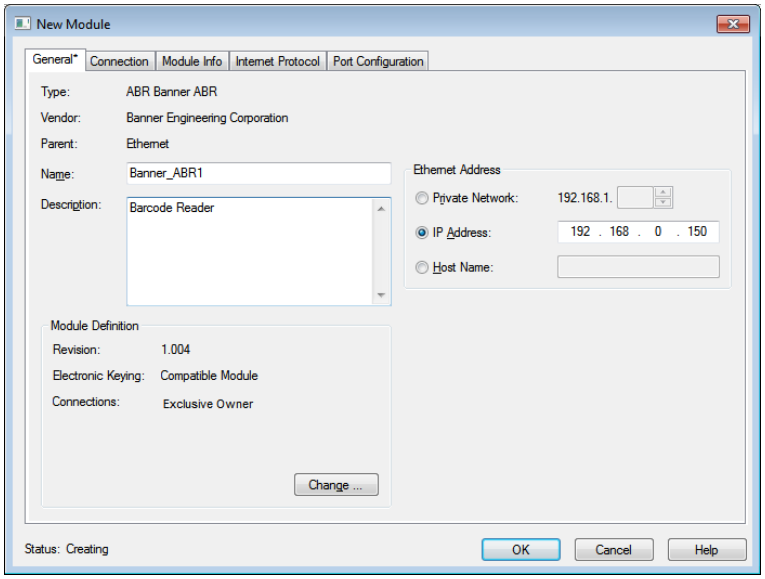


Figure 87. New Module

13. Set the desired **Request Packet Interval (RPI)** on the **Connection** tab.

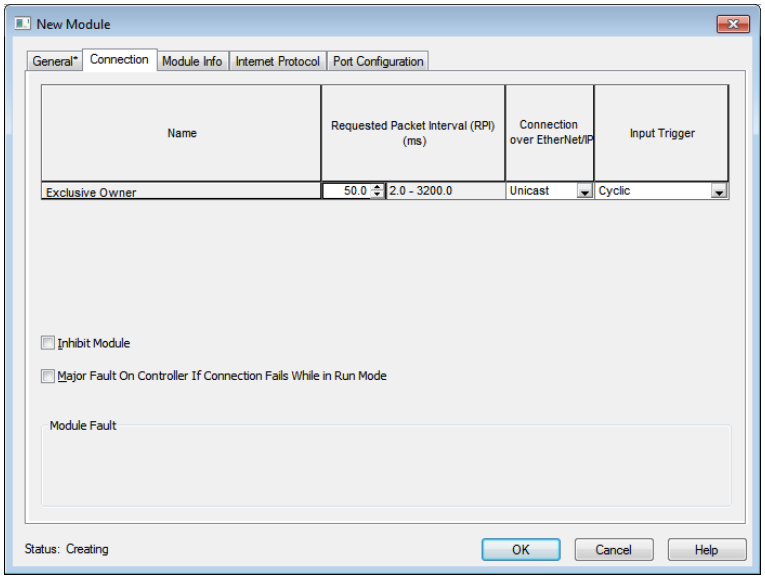


Figure 88. New Module—Connection Settings

8.2.4 ABR Series Manual Installation in Studio 5000 Logix Designer Software

If the EDS file installation in the previous section is not possible, follow the steps of this section. Otherwise skip this section.

1. Add a generic Ethernet module to the PLC's Ethernet card.
   a) Click **New Module**.

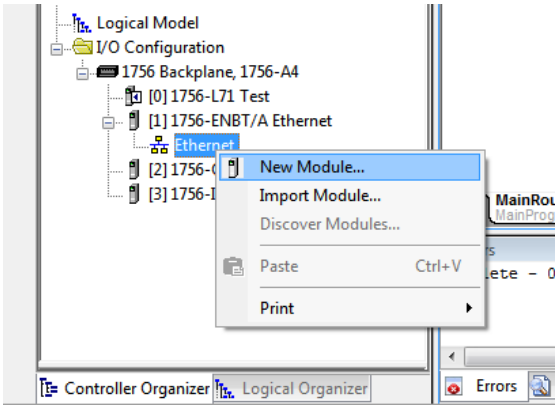


Figure 89. Add Ethernet Module

   b) Select **Generic Ethernet Module**.

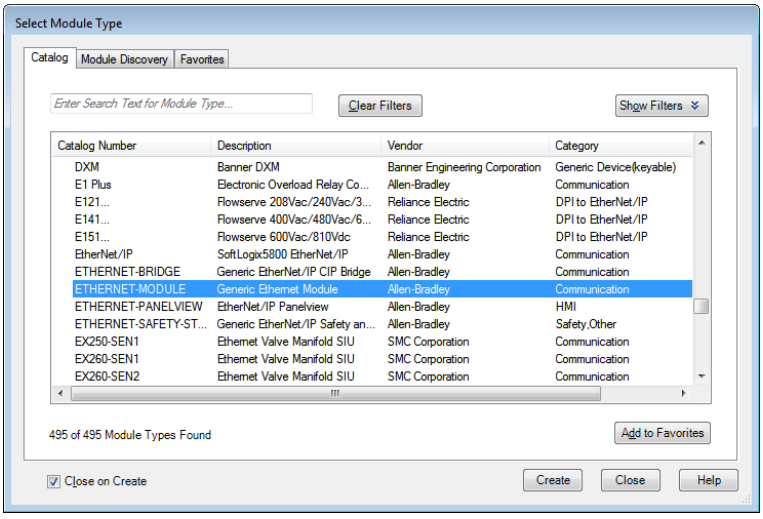


Figure 90. Select Module Type

2. Configure the Module Properties, including the **Name** and **IP Address** of your choice, and using the **Connection Parameters** and **Comm Format** shown.

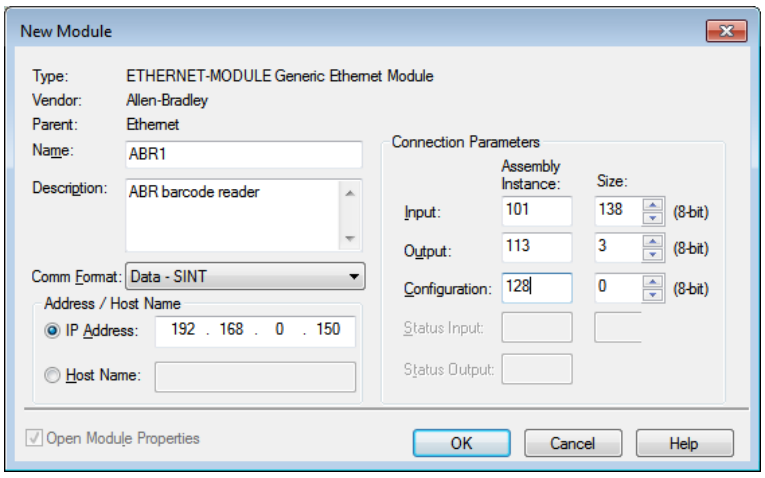


Figure 91. Module Properties

3. Click **OK**.
4. Set the desired **Request Packet Interval (RPI)** value and click **OK**.

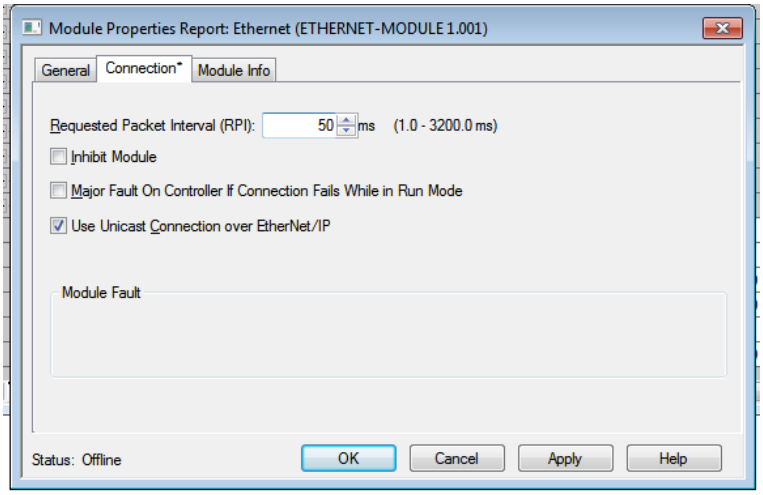


Figure 92. Module Properties Report: Ethernet

8.2.5 ABR Series AOI Installation in Logix Designer Software

1. Download the Add-On Instruction (AOI) file `Banner_ABR_AOI_IO_Data_1_0.L5X` from *www.bannerengineering.com*.
2. In the **Controller Organizer** window, right-click on the **Add-On Instruction** folder and select **Import Add-On Instruction**.

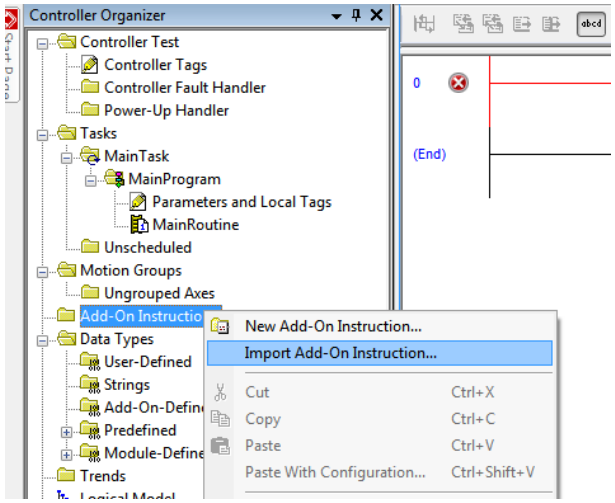


Figure 93. Import Add-On Instruction

3. Navigate to the correct file location, and select the AOI to be installed.

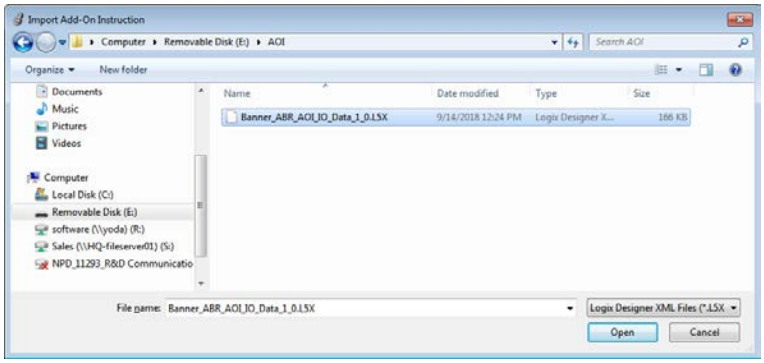


Figure 94. Select Add-On Instruction

4. Click **Open**.
   The **Import Configuration** window opens. The default selection creates all of the necessary items for the AOI.

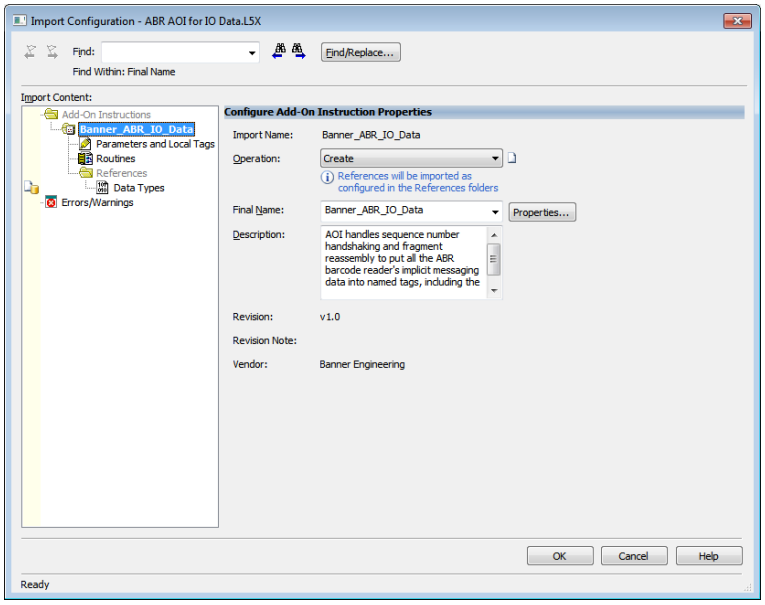


Figure 95. Import Configuration

5. Click **OK** to complete the import process.
   The AOI is added to the Controller Organizer window and looks similar to the following figure:

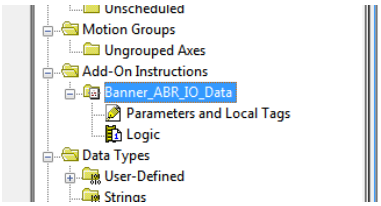


Figure 96. AOI Successfully Imported

6. Drag the AOI from the Controller Organizer to your ladder logic program to add the `Banner_ABR_AOI_IO_Data_1_0` AOI to the program.

Figure 97. New AOI Added to the Program

7. For each of the questions marks, create and link a new tag array.

   The AOI includes a new type of User Defined Tag (UDT), a custom array of tags meant specifically for this AOI.

   a) In the AOI, right-click on the question mark on the line labeled "Banner_ABR_IO_Data" and click **New Tag**. In this example, use the name "Banner_ABR1_AOI."

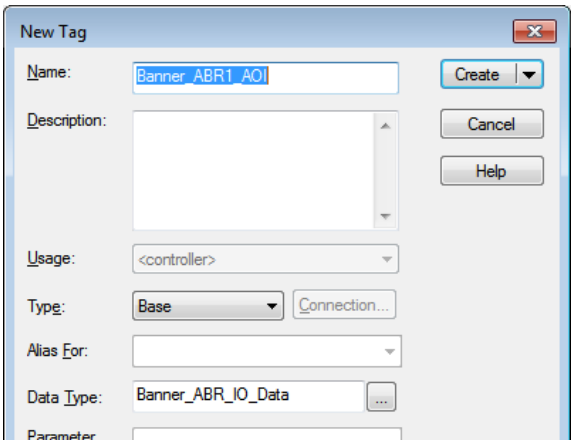


Figure 98. New Tag

   b) Click the question mark on the RawDataFromABR line.
   A list of tags displays.

   c) Select the appropriate tag. In this example, select Banner_ABR1:I.Data.

   This tag was created automatically when the new Ethernet Module was named (see *ABR Series EDS File Installation in Studio 5000 Logix Designer Software* on page 68 and *ABR Series Manual Installation in Studio 5000 Logix Designer Software* on page 73).

   d) Click the question mark on the RawDataToABR line.

   e) Select the appropriate tag. In this example, select Banner_ABR1:O.Data.

   f) In the AOI, right-click on the question mark on the line labeled "ABR_AOI_Tags" and click **New Tag**. In this example, use the name "Banner_ABR1_Tags."

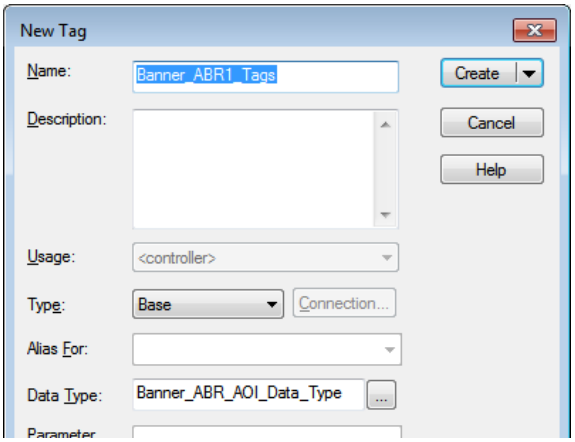


Figure 99. New Tag

   The AOI is ready to run.

8. Download the program to the PLC, run it, and put the PLC into Online mode to view live data.

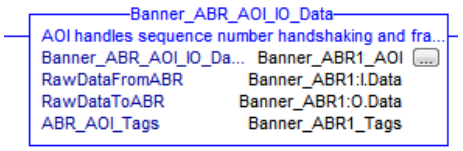


Figure 100. AOI Rung After All Tags are Assigned

9. Verify that the Banner ABR Ethernet Module is connected by making sure that there is not a yellow warning symbol over the module icon in the Controller Organizer. If there is no symbol, the ABR has a live connection to the PLC.

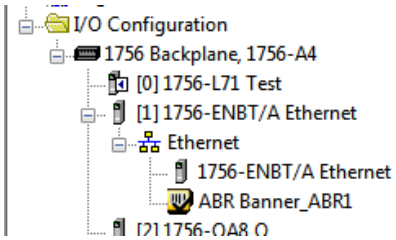


Figure 101. Icon—No Errors

10. Go to Controller tags and verify that the **LastItemSeqNum** tag is incrementing every time the reader sends a result message.
11. If the tag is not incrementing, and the module showed a good connection in step 10, make sure that the reader is in run mode or monitor mode. If it is, your AOI should be fully functional and receiving all the useful implicit messaging data from the ABR.

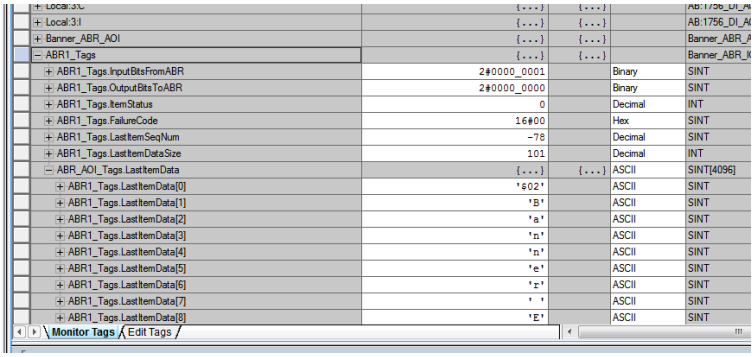


Figure 102. AOI Data Tags

8.2.6 AOI Data Description

The AOI's data, all contained in one User-Defined data type (UDT) tag array, contains the data tags described in the following sections.

InputBitsFromABR

The Input Bits tag is a bitmap used to read the state of the 8 discrete inputs from the ABR reader. These should update live to always show the latest result, even if the PLC is not caught up at transferring all the result messages.

OutputBitsToABR

The Output Bits attribute is a bitmap used to control the state of the 8 discrete outputs to the ABR reader. This can be used to trigger the reader by setting to 1 the bit ABR1_Tags.OutputBitsToABR.0, for example, as described in *Industrial Ethernet Reading Phase Control* on page 59.

ItemStatus

The Item Status Code is the status of the last reading attempt and is always updated live regardless of whether the PLC has finished receiving all the fragments of the previous message. The following table shows the status codes and their meanings.

Item Status Code	Item Status Name
0×0000	Good Read
0×0001	Complete, No Read
0×0002	Partial Read
0×0003	Multiple Read
0×0004	Wrong Read

FailureCode

The Failure Code is set when an error occurs with the reader. The following is a table of Failure Codes:

Failure Code	Name
0×01	Input Failure
0×02	Communications Failure
0×04	Reader Failure
0×08	Software Error
0×10	Remote Failure

LastItemSeqNumber

The Last Item Sequence Number is written with the Item Sequence Number by the Originator (PLC) to acknowledge the receipt of the Item Data. If fragmentation is used, this value is not written until the complete message is received.

LastItemDataSize

The Last Item Data Size is the total size of the Item Data that is currently contained as a valid message in the LastItemData array. This data is updated at the exact same time as when the LastItemSeqNumber increments, when a new item has been completely received, even if it took multiple packets to transfer in 128 byte fragments.

LastItemData

LastItemData is the 4096 byte array that contains the last full message transferred by the ABR to the PLC. This array is updated at the same time as LastItemDataSize and LastItemSeqNumber, after all fragments of the message have been re-assembled in the AOI. It might not always be the latest result message generated by the ABR if the PLC has fallen behind and the ABR is buffering multiple results waiting to finish sending them to the PLC. Only the bytes that fall within the size of the LastItemDataSize are overwritten, so there could also be old data left in the upper array addresses when a shorter message arrives than the previous message.

8.3 Modbus/TCP

The Modbus/TCP protocol provides device information using register and coil banks defined by the ABR.

This section defines the register and coil banks. By specification, Modbus/TCP uses TCP port 502. The ABR functions as a Modbus/TCP Client, so the host controller (usually a PLC) must act as a Server.

The following registers are used to send values back and forth from the barcode reader to the PLC. ABR series reader read-only output data messages are written to Holding Registers (40000) using Modbus function code 16 (Preset Multiple Registers). The ABR Input Bits are read every 50 milliseconds from the PLC as Inputs (10000) using Modbus function code 02 (Read Input Status). The state of the ABR Output Bits are written to the PLC on Coils (00000) using Modbus function code 05 (Write Single Coil).

Modbus Function Codes Used

- 02: Read Input Status
- 05: Force Single Coil
- 16: Preset Multiple Registers

Table 4: ABR Input Bits (10001–10008)

02: Read Input Status	
Register	**ABR Input Bit Position**
10001	Input Bit 0
10002	Input Bit 1
10003	Input Bit 2
10004	Input Bit 3
10005	Input Bit 4

02: Read Input Status	
Register	ABR Input Bit Position
10006	Input Bit 5
10007	Input Bit 6
10008	Input Bit 7

Table 5: ABR Output Bits (00001–00008)

05: Write Single Coil	
Register	ABR Output Bit Position
00001	Output Bit 0
00002	Output Bit 1
00003	Output Bit 2
00004	Output Bit 3
00005	Output Bit 4
00006	Output Bit 5
00007	Output Bit 6
00008	Output Bit 7

8.3.1 ABR Output Message Data

The ABR output messages are written to the 16-bit Holding Registers (40000).

The maximum message size is to 255 registers. This allows for up to 510 8-bit ASCII characters per message. If the message is longer than 510 characters only the first 510 characters are written, and the rest are discarded. The data is written in Big Endian format, with the first character of the message written to the upper byte, and the next character written to the lower byte of the first register. If the message is shorter than the number of registers being written, the ABR writes a 0 value to the extra bytes.

The following table shows the contents of the registers if 255 registers are being written, and the output message is: `[STX]123[ETX]`

Table 6: ABR Output Message Data (40001–40255)

16: Preset Multiple Registers		
Register	High Byte Contents (Bits 8-15)	Low Byte Contents (Bits 0-7)
40001	[STX]	1
40002	2	3
40003	[ETX]	[Null]
40004	[Null]	[Null]
40005	[Null]	[Null]
40006	[Null]	[Null]
...	...	...
40255	[Null]	[Null]

8.3.2 Configure the ABR for Modbus/TCP in Barcode Manager

After selecting Modbus/TCP on the Reading Phase, Data Formatting, or Output Setup pages (see *Industrial Ethernet Reading Phase Control* on page 59), the Control panel shows the following Modbus/TCP-specific settings:

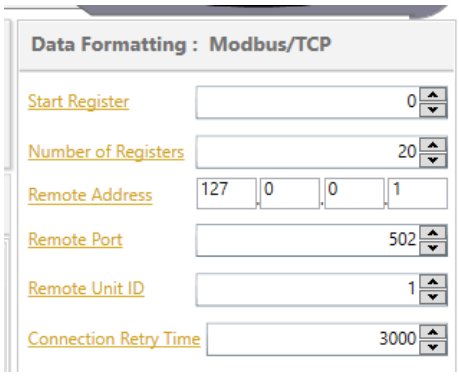


Figure 103. Modbus/TCP-Specific Settings and Their Default Values

Start Register

Defines the offset added to the **Starting Address** field of the Modbus/TCP message. If set to 5, the output messages are written from 40006 to 40025 instead of from 40001 to 40020.

Number of Registers

Defines the maximum number of registers according to the maximum length of the message to be transmitted. The size of the message transmitted is constant, thus, it must be big enough to contain the largest barcode information.

Remote Address

Defines the IP address of the server to which the client tries to connect.

Remote Port

Defines the port number of the server to which the client tries to connect. It must be different from the port numbers defined for other communications functions.

Remote Unit ID

Defines the unit identifier used with Modbus/TCP devices that are composites of several Modbus devices, for example on Modbus/TCP to Modbus RTU gateways. In these situations, the unit identifier tells the Slave Address of the device behind the gateway. By default, Modbus/TCP-capable devices usually ignore the unit identifier

Connection Retry Time

Defines a timeout (in milliseconds) for the Industrial Protocol Client before the client retries the connection between the client and the server. If the connection is not successful, further retries are attempted after this timeout expires. If set to 0 there is no retry attempt.

After changing settings, click **Play** , **Monitor** , or **Getting Started** to activate the Industrial Ethernet communications with the new settings.

9 Reading Features

9.1 FOV Calculation

Use the data in the following table to calculate the FOV for your application. Refer to *Figure 1* and the formula below.

Table 7: 7000 Models

Model	Lens Type	Offset Distance (d_0) (mm)	Horizontal Viewing Angle	Vertical Viewing Angle	Diagonal Viewing Angle	Min Reading Distance (mm)
ABR7106-xxE2	6 mm manual focus	7	66°	55°	80°	35
ABR71L9-xxE2	9 mm Liquid Lens Autofocus	14	40°	32°	50°	22
ABR7109-xxE2	9 mm manual focus	11	41°	34°	52°	70
ABR7112-xxE2	12 mm manual focus	4	32°	26°	40°	70
ABR7116-xxE2	16 mm manual focus	5	24°	19°	30°	80

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

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

where:

FOV_x = horizontal, vertical or diagonal field of view (FOV)
α_x = horizontal, vertical or diagonal viewing angles
d = reading distance (in mm) from window surface to code surface
d_0 = offset distance (in mm) from center of lens to external window surface

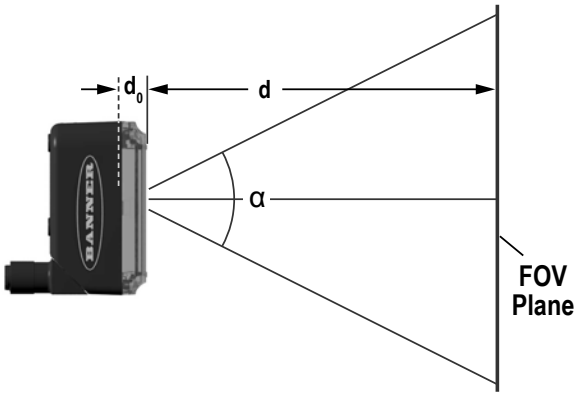


Figure 104. Reading Distance Reference

Examples

The FOV for a ABR71L9-RSE2 at a reading distance of 200 mm is:

$FOV_H = 2\ [(200\ mm + 14\ mm)\ \tan\ (40°/2)] \approx 156\ mm$

$FOV_V = 2\ [(200\ mm + 14\ mm)\ \tan\ (32°/2)] \approx 123\ mm$

9.2 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 reference Reading Diagrams for specific reading area examples.

9.2.1 Manual Focus Models 6 mm Lens

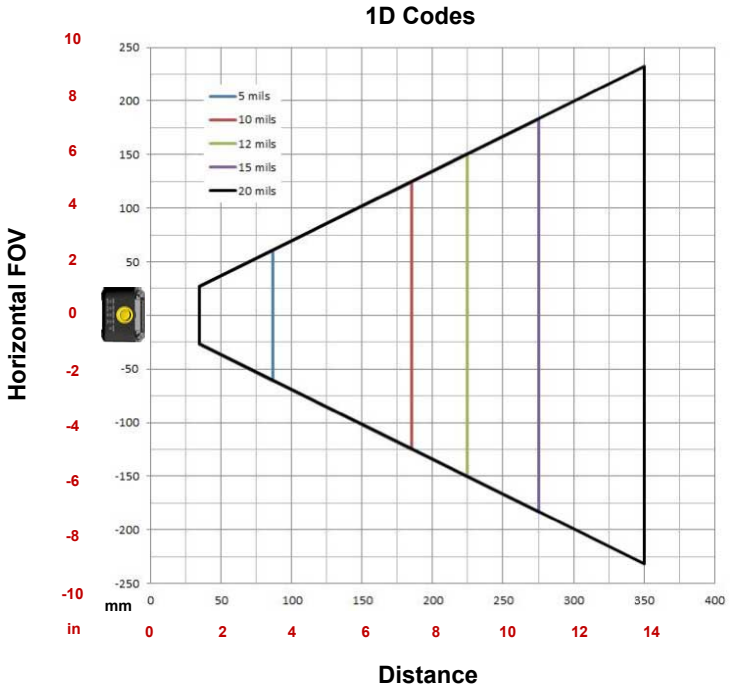


Figure 105. 1D Codes

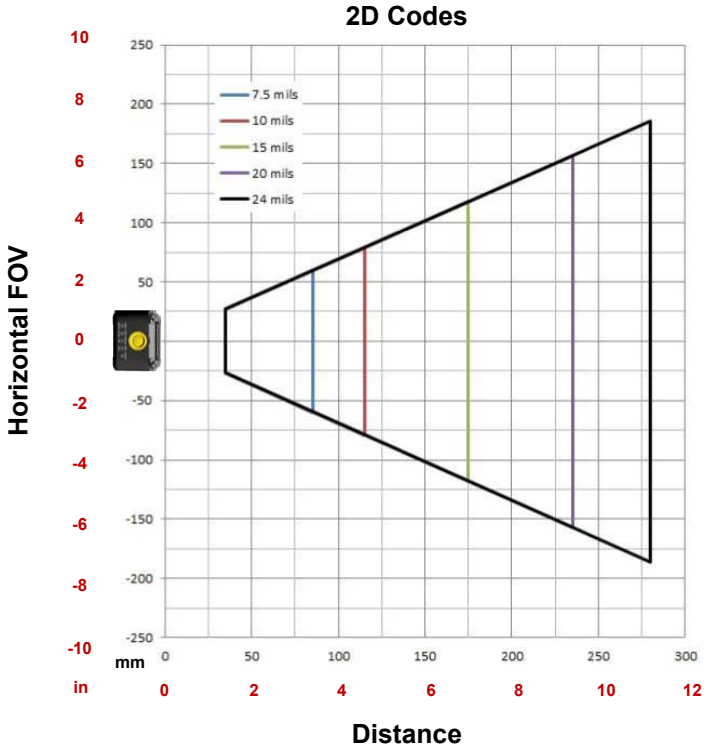


Figure 106. 2D Codes

9.2.2 Liquid Lens Autofocus Models 9 mm Lens

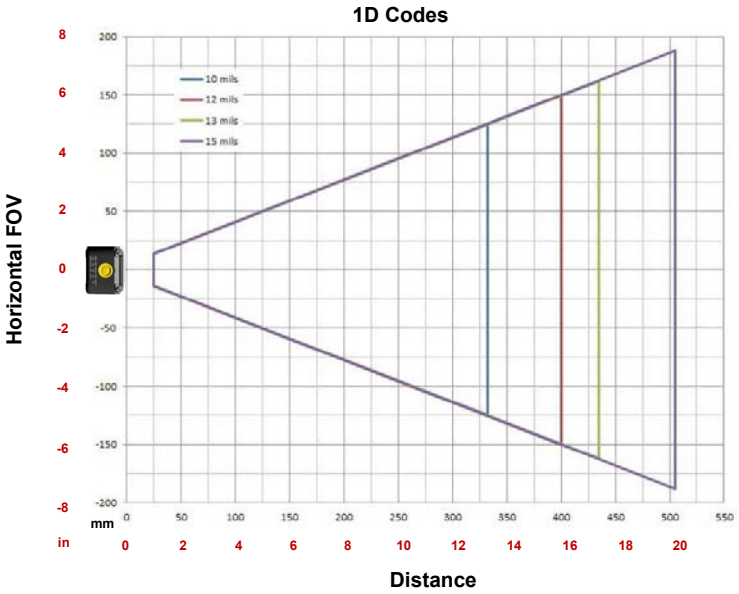


Figure 107. 1D Codes

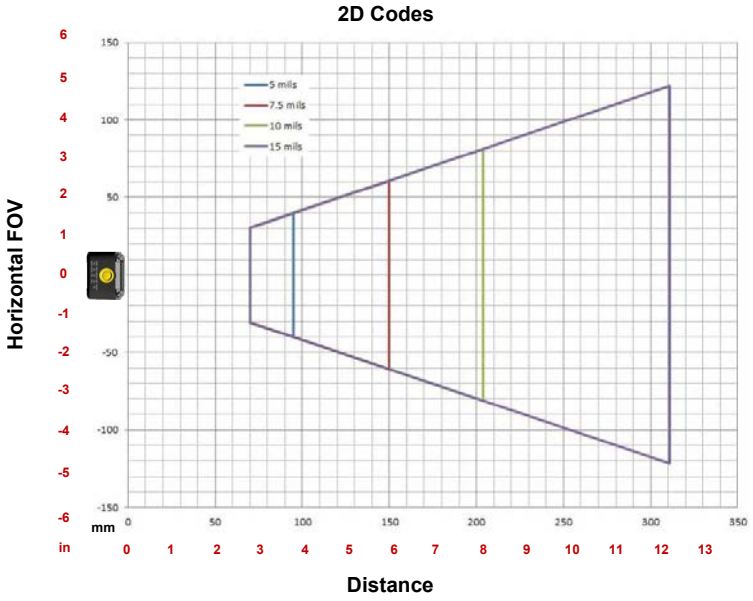


Figure 108. 2D Codes

9.2.3 Manual Focus Models 9 mm Lens

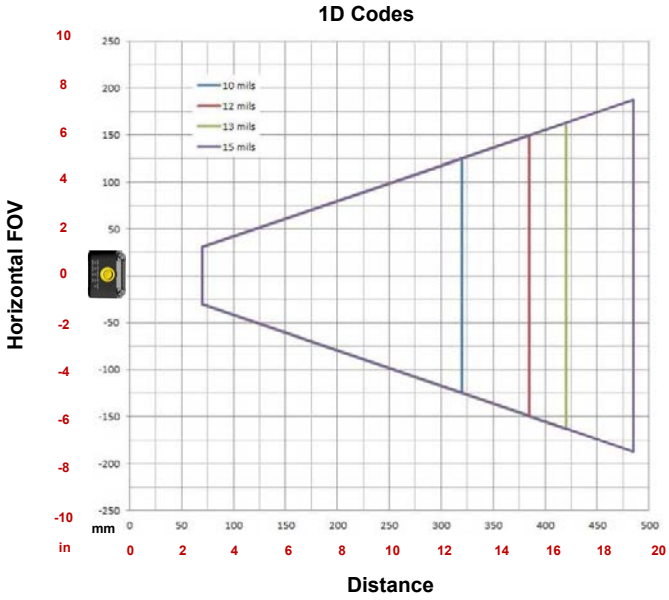


Figure 109. 1D Codes

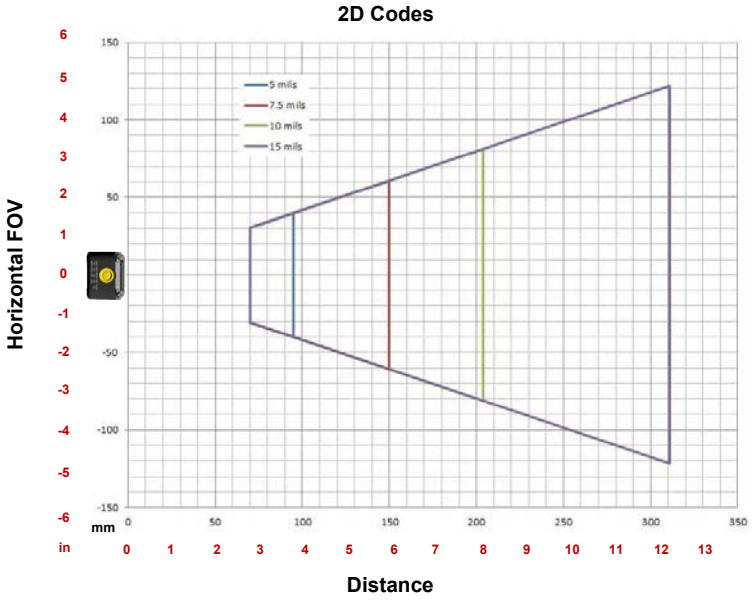


Figure 110. 2D Codes

9.2.4 Manual Focus Models 12 mm Lens

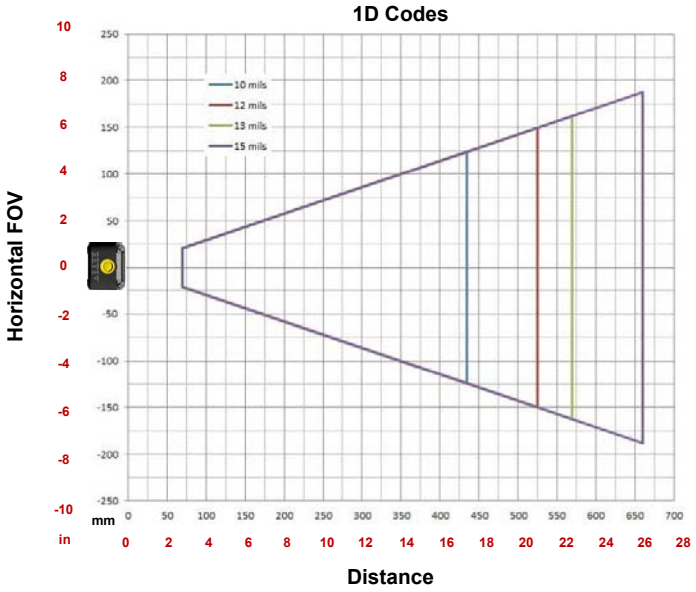


Figure 111. 1D Codes

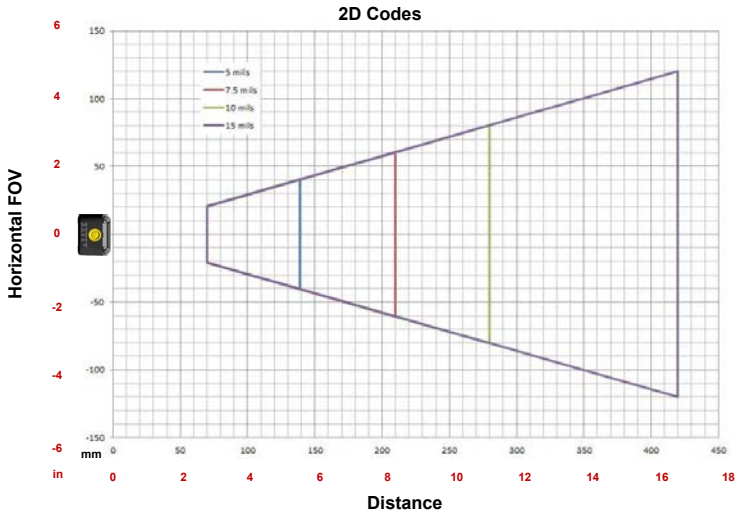


Figure 112. 2D Codes

9.2.5 Manual Focus Models 16 mm Lens

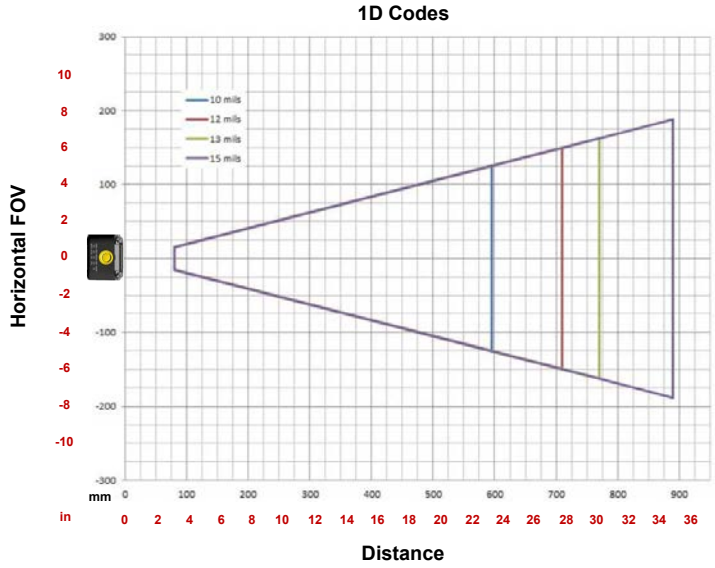


Figure 113. 1D Codes

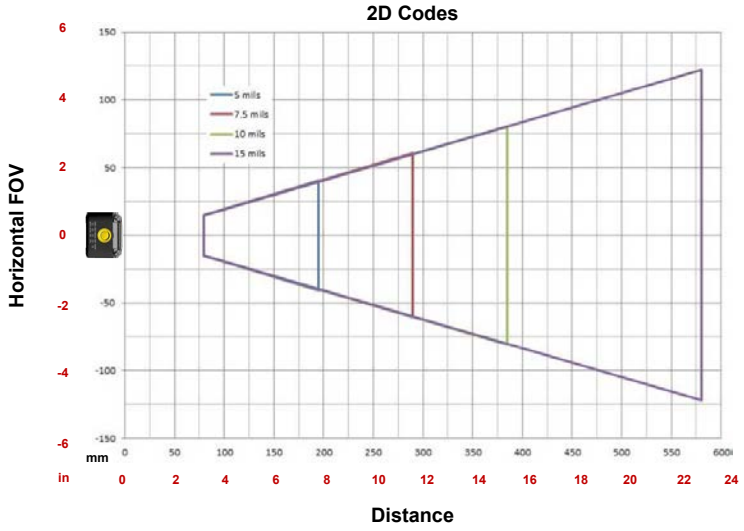


Figure 114. 2D Codes

9.3 Reading Diagrams

- The following reading diagrams are references and are provided for typical performance at 25 °C using high quality grade A symbols: Code 128 (1D code) and Data Matrix ECC 200 (2D code).
- Perform testing with the actual ABR using application codes to evaluate whether maximizing application performance requires adjustments to the hardware/software 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 model. For 7000 models, it is about equal to 0.8; specifically 1024/1280 (that is, $FOV_V \approx FOV_H \times 0.8$).
- The reading distance ranges are measured from the reading window surface.
- The maximum theoretical Line Speed values for each diagram can be calculated using the formula in *Maximum Line Speed and Exposure Calculations*.
- Common software parameter settings:
  - For all ABR 7000 6 mm models reading all code symbologies, and all 9 mm, 12 mm, and 16 mm models reading 1D code symbologies are: Processing Mode = Advanced Code Setting
  - For ABR 7000 9 mm, 12 mm, and 16 mm models reading 2D code symbologies: Processing Mode = Standard; Code Contrast = Low; Decoding Complexity = Very High
- When defining a hardware/software configuration for the ABR for conditions different from those of the reference diagrams, 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. Increasing the Gain value however, can reduce the quality of the acquired image.
  - At the center of the field of view, the lighting power of the red illuminator is about 1.5 times that of the Multicolored DPM illuminator.
  - For the DPM illuminator, the overall lighting power being considered is all Sectors ON from the Internal LED Group, unless specified otherwise.

9.3.1 ABR7106-xxE2 (6 mm models) 1D Codes

Code 128 0.12 mm (5 mils)

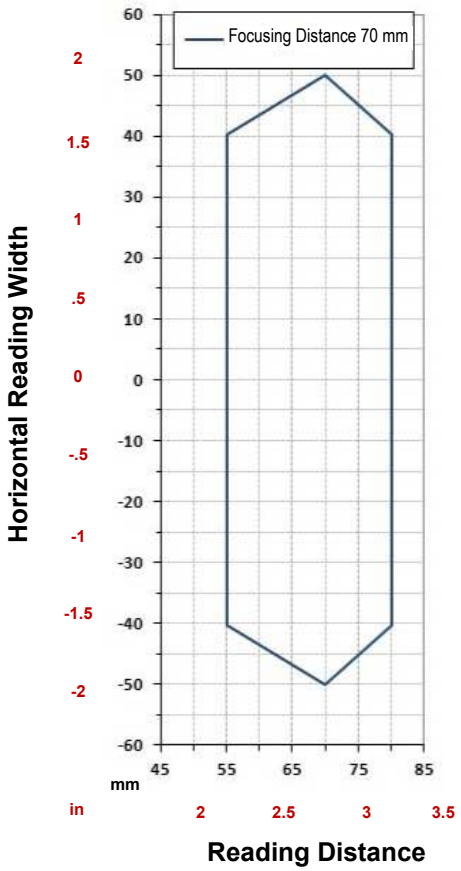


Figure 115. Code 128 0.12 mm (5 mils)

Hardware Settings	
Code Symbology	Code 128
Code Resolution	0.12 mm (5 mils)
Tilt Angle	0°
Skew Angle	15°
Focusing Distance (mm)	70

Software Parameters	
Internal Lighting	Very High Power Strobed
ABR7106-RSE2	
Exposure Time (µs)	90
Gain	5

Code 128 0.25 mm (10 mils)

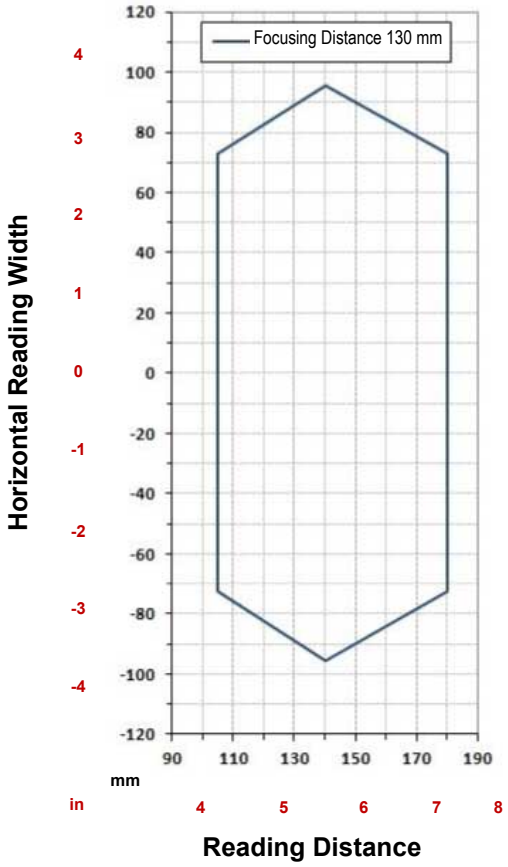


Figure 116. Code 128 0.25 mm (10 mils)

Hardware Settings	
Code Symbology	Code 128
Code Resolution	0.25 mm (10 mils)
Tilt Angle	0°
Skew Angle	15°
Focusing Distance (mm)	130

Software Parameters	
Internal Lighting	Very High Power Strobed
ABR7106-RSE2	
Exposure Time (µs)	80
Gain	20

Code 128 0.30 mm (12 mils)

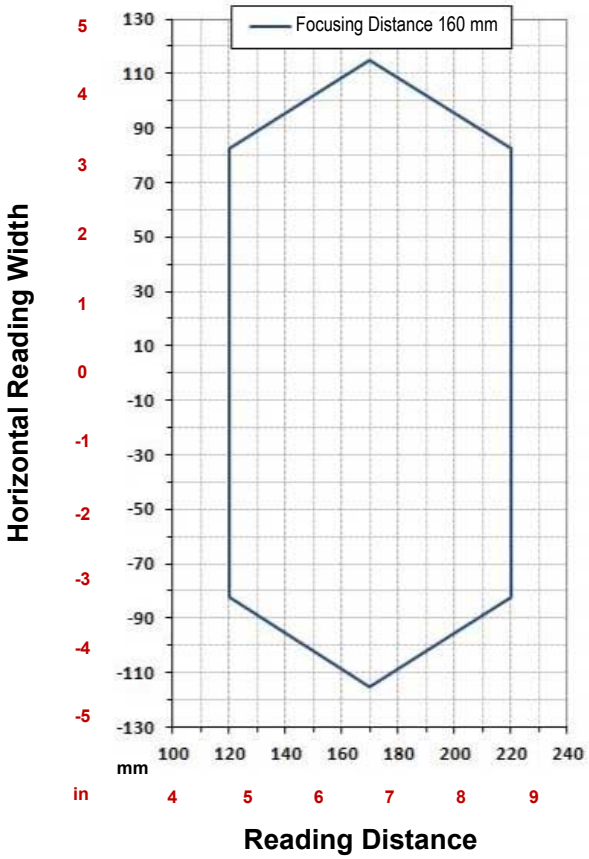


Figure 117. Code 128 0.30 mm (12 mils)

Hardware Settings	
Code Symbology	Code 128
Code Resolution	0.30 mm (12 mils)
Tilt Angle	0°
Skew Angle	15°
Focusing Distance (mm)	160

Software Parameters	
Internal Lighting	Very High Power Strobed
ABR7106-RSE2	
Exposure Time (µs)	100
Gain	20

Code 128 0.33 mm (13 mils)

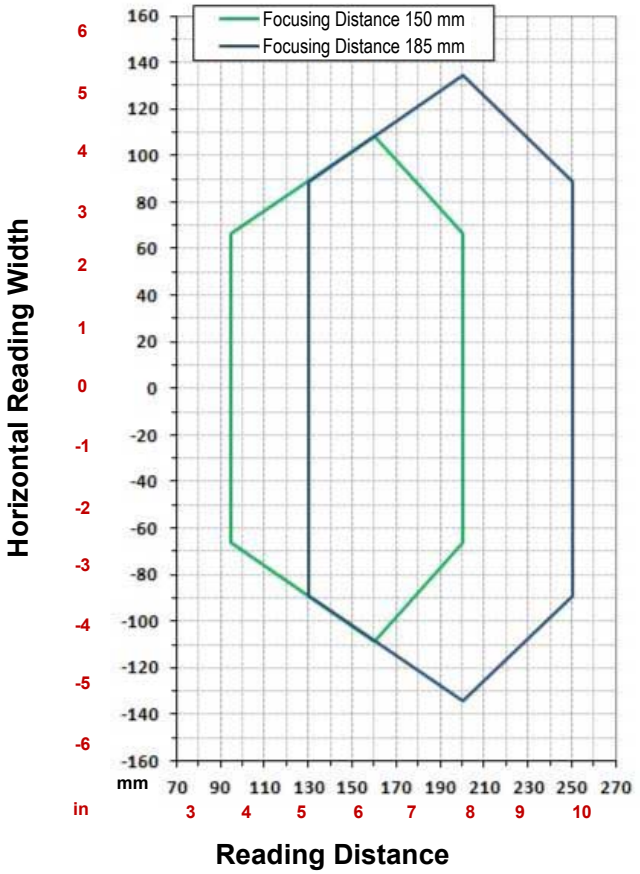


Figure 118. Code 128 0.33 mm (13 mils)

Hardware Settings		
Code Symbology	Code 128	
Code Resolution	0.33 mm (13 mils)	
Tilt Angle	0°	
Skew Angle	15°	
Focusing Distance (mm)	150	185

Software Parameters		
Internal Lighting	Very High Power Strobed	
ABR7106-RSE2		
Exposure Time (µs)	150	175
Gain	13	20

Code 128 0.38 mm (15 mils)

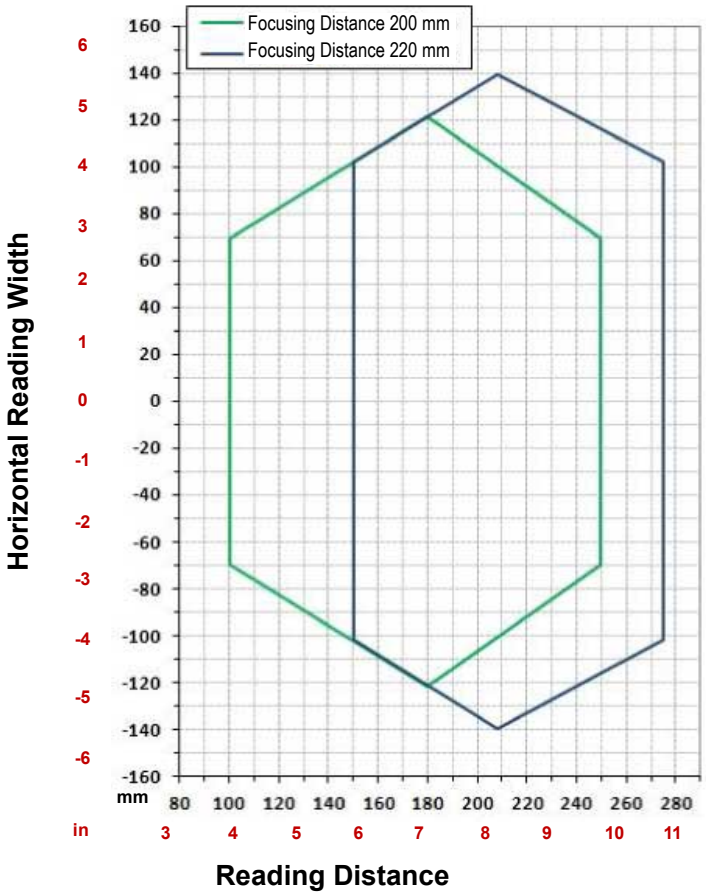


Figure 119. Code 128 0.38 mm (15 mils)

Hardware Settings		
Code Symbology	Code 128	
Code Resolution	0.38 mm (15 mils)	
Tilt Angle	0°	
Skew Angle	15°	
Focusing Distance (mm)	200	220

Software Parameters		
Internal Lighting	Very High Power Strobed	
ABR7106-RSE2		
Exposure Time (µs)	250	250
Gain	6	15

Code 128 0.50 mm (20 mils)

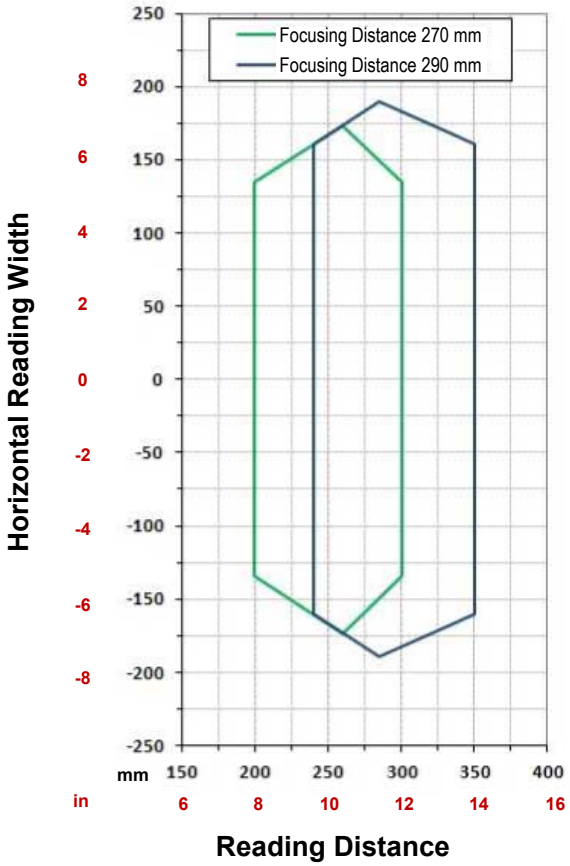


Figure 120. Code 128 0.50 mm (20 mils)

Hardware Settings		
Code Symbology	Code 128	
Code Resolution	0.50 mm (20 mils)	
Tilt Angle	0°	
Skew Angle	15°	
Focusing Distance (mm)	270	290

Software Parameters		
Internal Lighting	Very High Power Strobed	
ABR7106-RSE2		
Exposure Time (µs)	330	330
Gain	23	25

9.3.2 ABR7106-xxE2 (6 mm models) 2D Codes

Data Matrix 0.19 mm (7.5 mils)

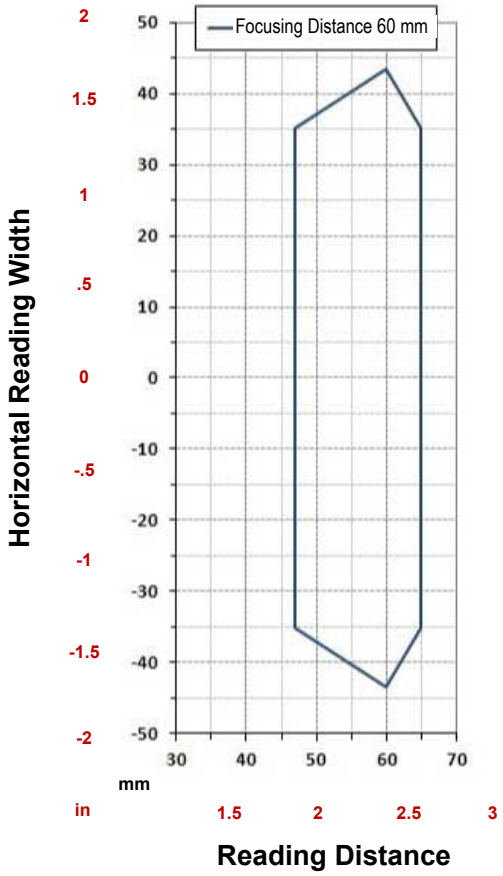


Figure 121. Focusing Distance—Data Matrix 0.19 mm (7.5 mils)

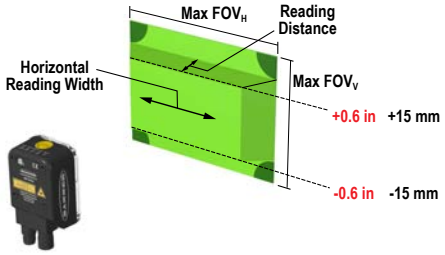


Figure 122. Effective Field of View for High Resolution Codes with 6mm Lens

Due to the "fisheye" effect of the 6 mm lens, the reading area for higher resolution codes is limited to the central zone of the Vertical Field of View.

For these applications, Image Cropping is recommended 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. See *Image Cropping* in the Barcode Manager Instruction Manual.

± 15 mm ≈ 550 pixels

1. Drag top of box to set x,y coordinates ≈ 0,236.
2. Drag bottom of box to set vertical window dimensions ≈ 550 pixels.

Hardware Settings	
Code Symbology	Data Matrix ECC 200
Code Resolution	0.19 mm (7.5 mils)
Tilt Angle	45°
Skew Angle	0°
Focusing Distance (mm)	60

Software Parameters	
Internal Lighting	Very High Power Strobed
ABR7106-MSE2	
LED Group	Peripheral
Exposure Time (µs)	380
Gain	23

Data Matrix 0.25 mm (10 mils)

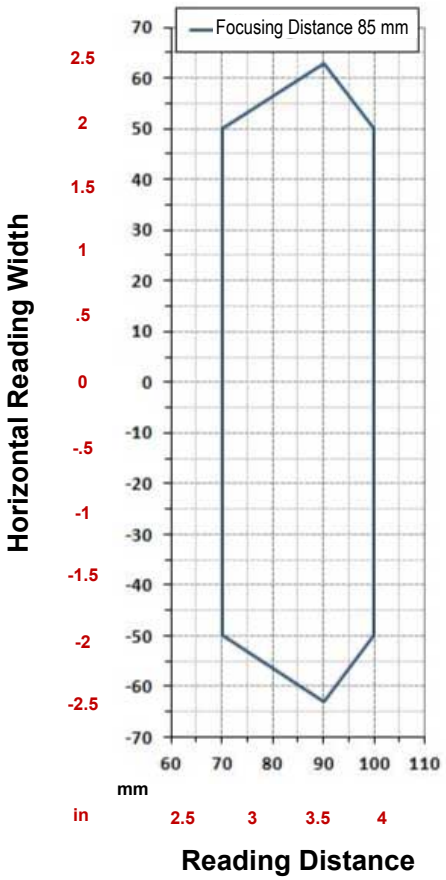


Figure 123. Focusing Distance—Data Matrix 0.25 mm (10 mils)

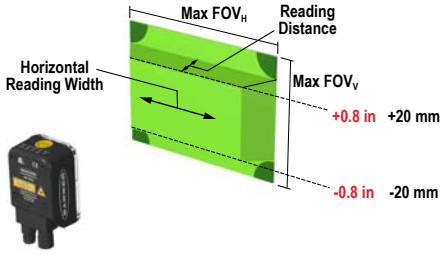


Figure 124. Effective Field of View for High Resolution Codes with 6mm Lens

Due to the "fisheye" effect of the 6 mm lens, the reading area for higher resolution codes is limited to the central zone of the Vertical Field of View.

For these applications, Image Cropping is recommended 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. See *Image Cropping* in the Barcode Manager Instruction Manual.

± 20 mm ≈ 512 pixels

1. Drag top of box to set x,y coordinates ≈ 0,255.
2. Drag bottom of box to set vertical window dimensions ≈ 512 pixels.

Hardware Settings	
Code Symbology	Data Matrix ECC 200
Code Resolution	0.25 mm (10 mils)
Tilt Angle	45°
Skew Angle	10°
Focusing Distance (mm)	85

Software Parameters	
Internal Lighting	Very High Power Strobed
ABR7106-RSE2	
Exposure Time (µs)	170
Gain	4
ABR7106-MSE2	
Exposure Time (µs)	170
Gain	6

Data Matrix 0.38 mm (15 mils)

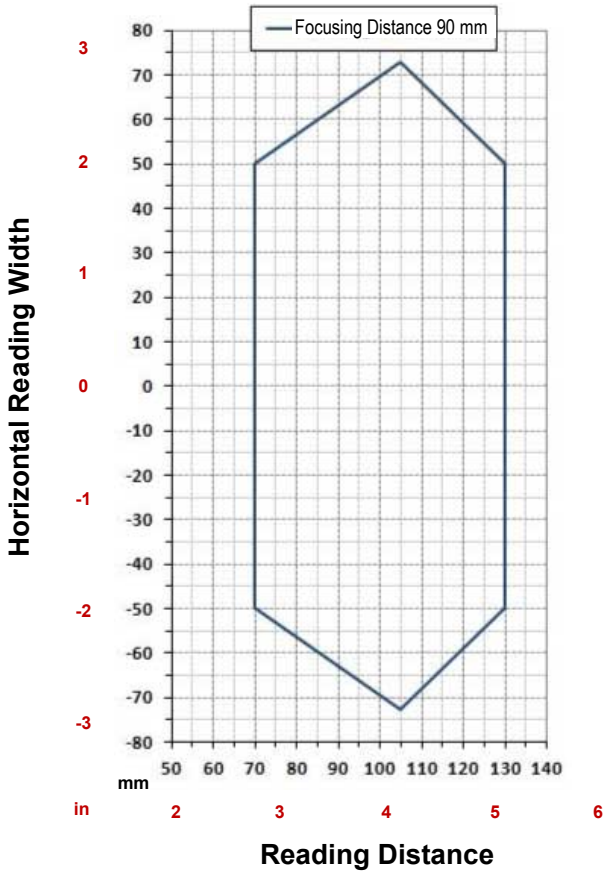


Figure 125. Focusing Distance—Data Matrix 0.38 mm (15 mils)

Hardware Settings	
Code Symbology	Data Matrix ECC 200
Code Resolution	0.38 mm (15 mils)
Tilt Angle	45°
Skew Angle	10°
Focusing Distance (mm)	90

Software Parameters	
Internal Lighting	Very High Power Strobed
ABR7106-RSE2	
Exposure Time (µs)	80
Gain	8
ABR7106-MSE2	
Exposure Time (µs)	80
Gain	12

9.3.3 ABR7109-xxE2 (9 mm models, manual focus) 1D Codes

Code 128 0.25 mm (10 mils)

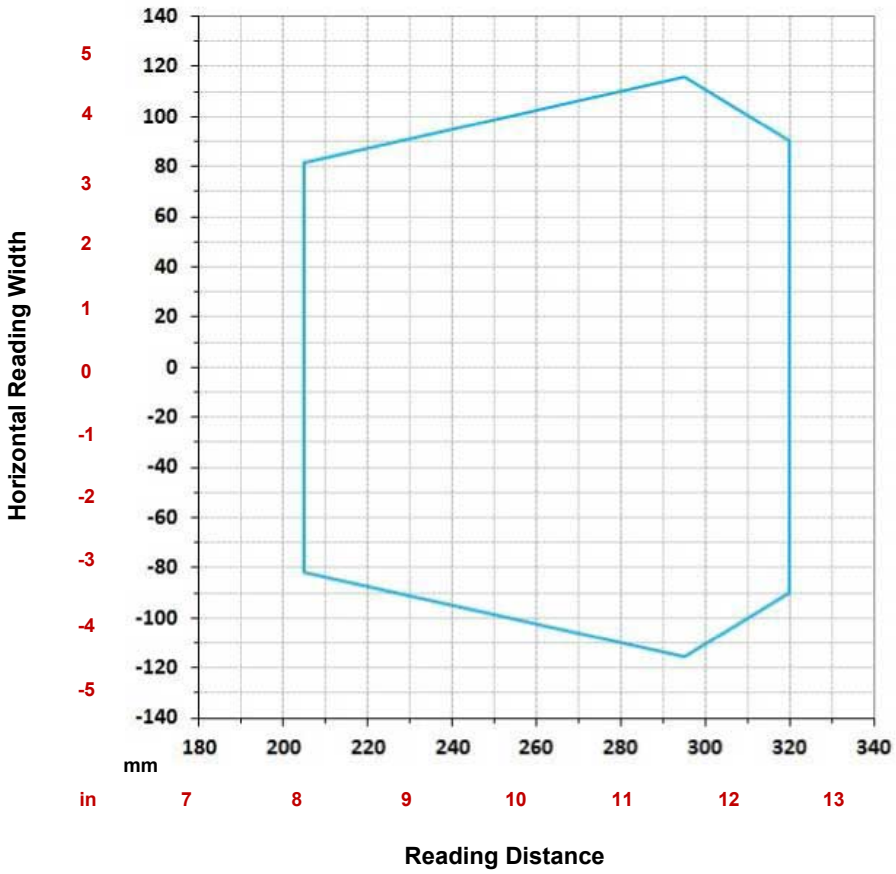


Figure 126. Code 128 0.25 mm (10 mils)

Hardware Settings	
Code Symbology	Code 128
Code Resolution	0.25 mm (10 mils)
Tilt Angle	45°
Skew Angle	15°
Focusing Distance (mm)	280

Software Parameters	
Internal Lighting	Very High Power Strobed
ABR7109-RSE2	
Exposure Time (µs)	166
Gain	11

Code 128 0.30 mm (12 mils)

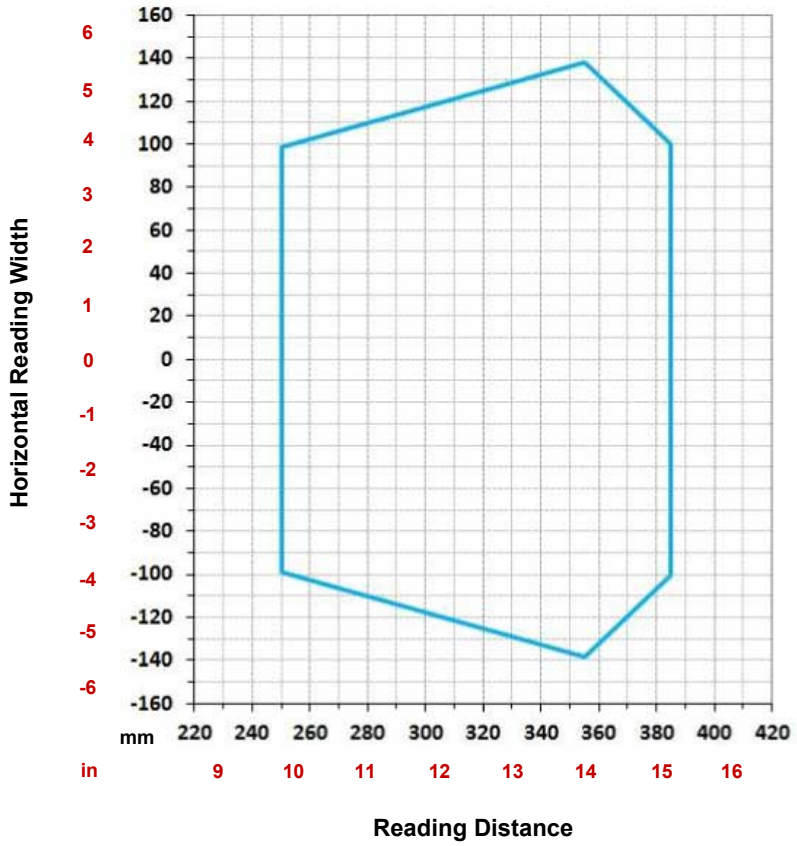


Figure 127. Code 128 0.30 mm (12 mils)

Hardware Settings	
Code Symbology	Code 128
Code Resolution	0.30 mm (12 mils)
Tilt Angle	45°
Skew Angle	15°
Focusing Distance (mm)	310

Software Parameters	
Internal Lighting	Very High Power Strobed
ABR7109-RSE2	
Exposure Time (µs)	200
Gain	14

Code 128 0.38 mm (15 mils)

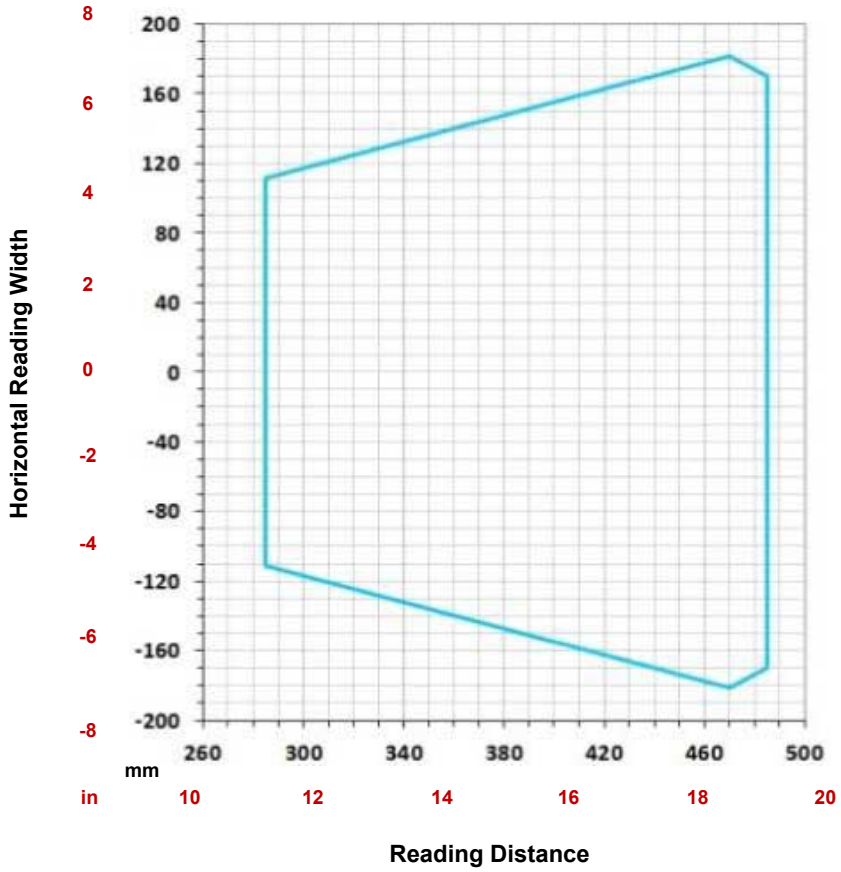


Figure 128. Code 128 0.38 mm (15 mils)

Hardware Settings	
Code Symbology	Code 128
Code Resolution	0.38 mm (15 mils)
Tilt Angle	45°
Skew Angle	15°
Focusing Distance (mm)	430

Software Parameters	
Internal Lighting	Very High Power Strobed
ABR7109-RSE2	
Exposure Time (µs)	305
Gain	20

9.3.4 ABR7109-xxE2 (9 mm models, manual focus) 2D Codes

Data Matrix 0.13 mm (5 mils)

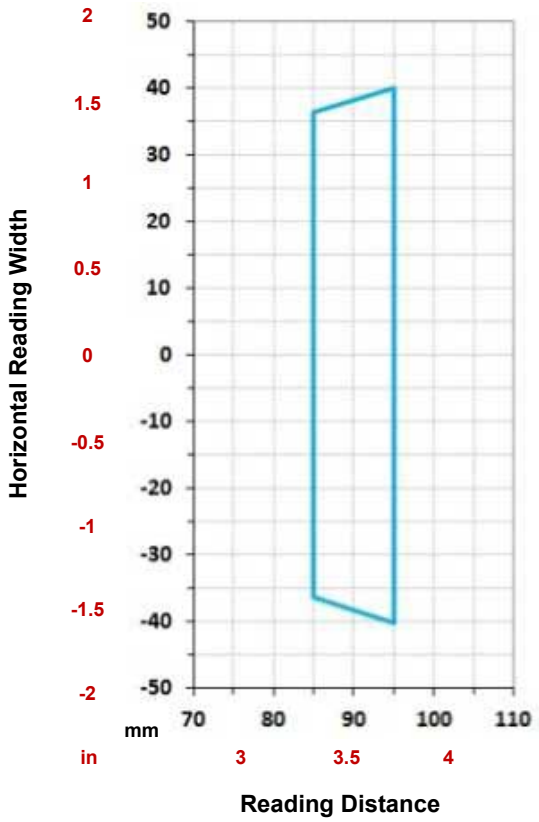


Figure 129. Data Matrix 0.13 mm (5 mils)

Hardware Settings	
Code Symbology	Data Matrix ECC 200
Code Resolution	0.13 mm (5 mils)
Tilt Angle	45°
Skew Angle	15°
Focusing Distance (mm)	91

Software Parameters	
Internal Lighting	Very High Power Strobed
ABR7109-RSE2	
Exposure Time (µs)	50
Gain	5

Data Matrix 0.19 mm (7.5 mils)

Figure 130. Data Matrix 0.19 mm (7.5 mils)

Hardware Settings	
Code Symbology	Data Matrix ECC 200
Code Resolution	0.19 mm (7.5 mils)
Tilt Angle	45°
Skew Angle	15°
Focusing Distance (mm)	135

Software Parameters	
Internal Lighting	Very High Power Strobed
ABR7109-RSE2	
Exposure Time (µs)	130
Gain	5

Data Matrix 0.25 mm (10 mils)

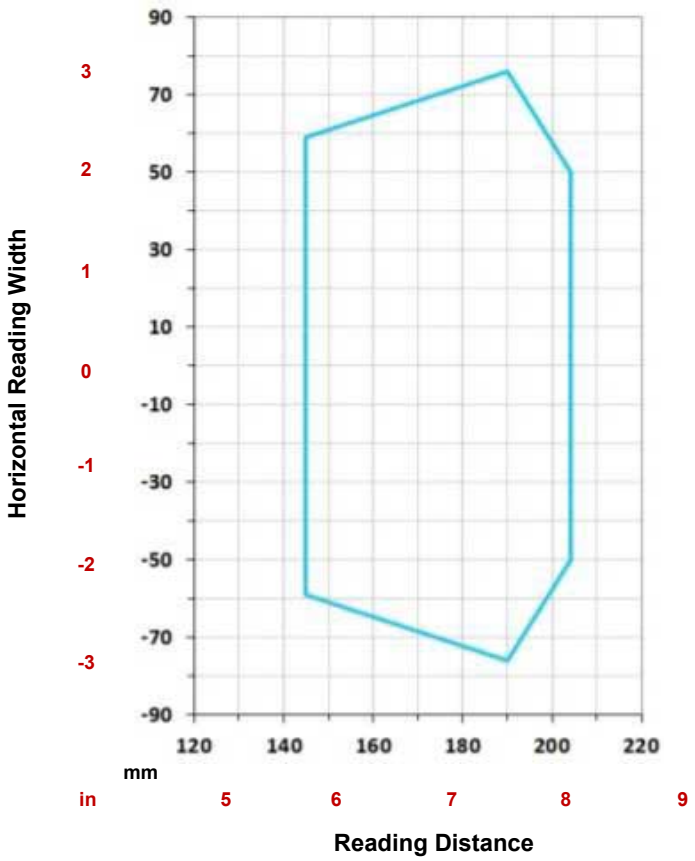


Figure 131. Data Matrix 0.25 mm (10 mils)

Hardware Settings	
Code Symbology	Data Matrix ECC 200
Code Resolution	0.25 mm (10 mils)
Tilt Angle	45°
Skew Angle	15°
Focusing Distance (mm)	180

Software Parameters	
Internal Lighting	Very High Power Strobed
ABR7109-RSE2	
Exposure Time (µs)	155
Gain	8
ABR7109-MSE2	
Exposure Time (µs)	310
Gain	8

9.3.5 ABR7112-RSE2 (12 mm models) 1D Codes

Code 128 0.25 mm (10 mils)

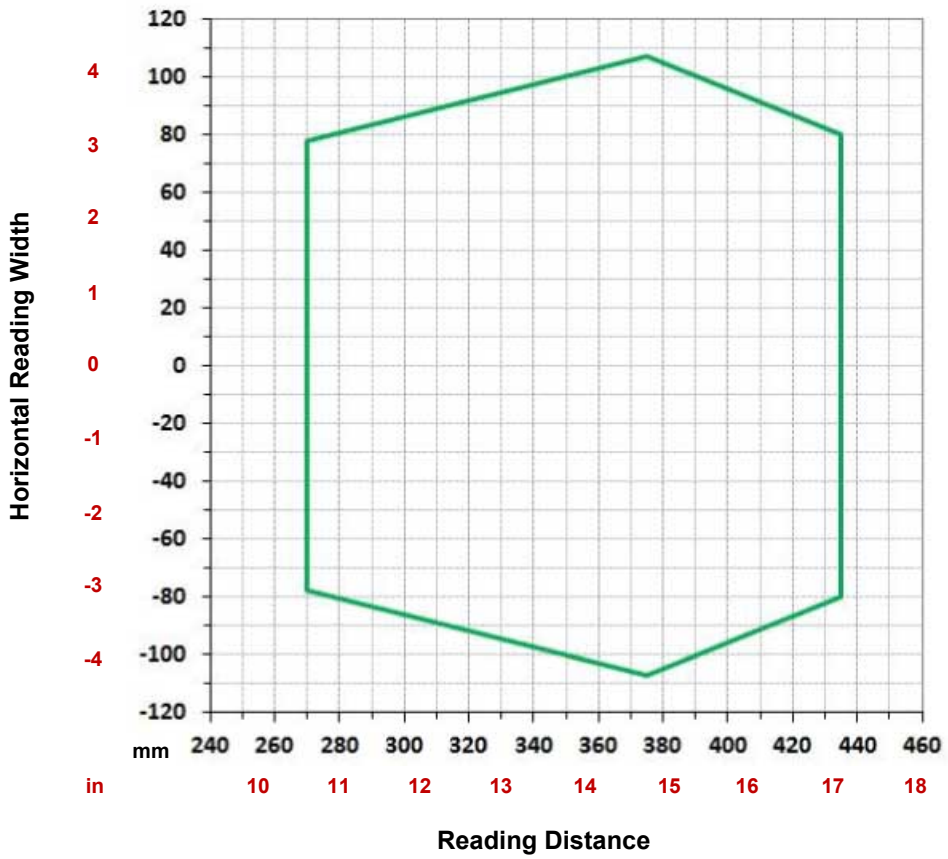


Figure 132. Code 128 0.25 mm (10 mils)

Hardware Settings	
Code Symbology	Code 128
Code Resolution	0.25 mm (10 mils)
Tilt Angle	45°
Skew Angle	15°
Focusing Distance (mm)	380

Software Parameters	
Internal Lighting	Very High Power Strobed
ABR7112-RSE2	
Exposure Time (µs)	210
Gain	10

Code 128 0.30 mm (12 mils)

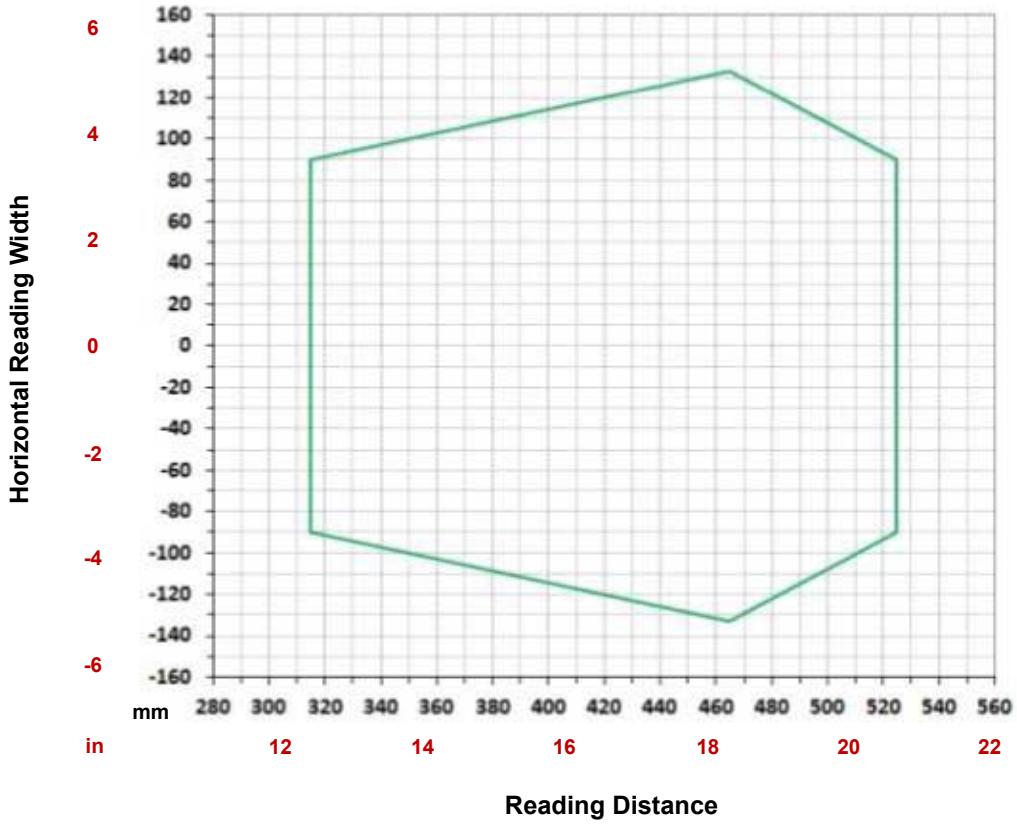


Figure 133. Code 128 0.30 mm (12 mils)

Hardware Settings	
Code Symbology	Code 128
Code Resolution	0.30 mm (12 mils)
Tilt Angle	45°
Skew Angle	15°
Focusing Distance (mm)	415

Software Parameters	
Internal Lighting	Very High Power Strobed
ABR7112-RSE2	
Exposure Time (µs)	250
Gain	9

Code 128 0.38 mm (15 mils)

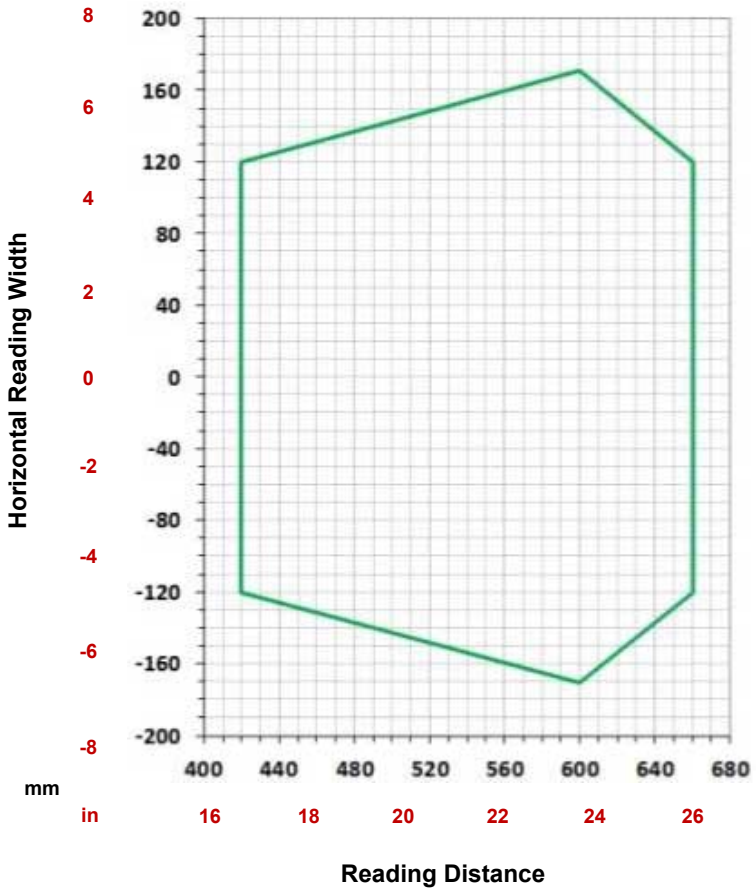


Figure 134. Code 128 0.38 mm (15 mils)

Hardware Settings	
Code Symbology	Code 128
Code Resolution	0.38 mm (15 mils)
Tilt Angle	45°
Skew Angle	15°
Focusing Distance (mm)	500

Software Parameters	
Internal Lighting	Very High Power Strobed
ABR7112-RSE2	
Exposure Time (µs)	250
Gain	12

Code 128 0.50 mm (20 mils)

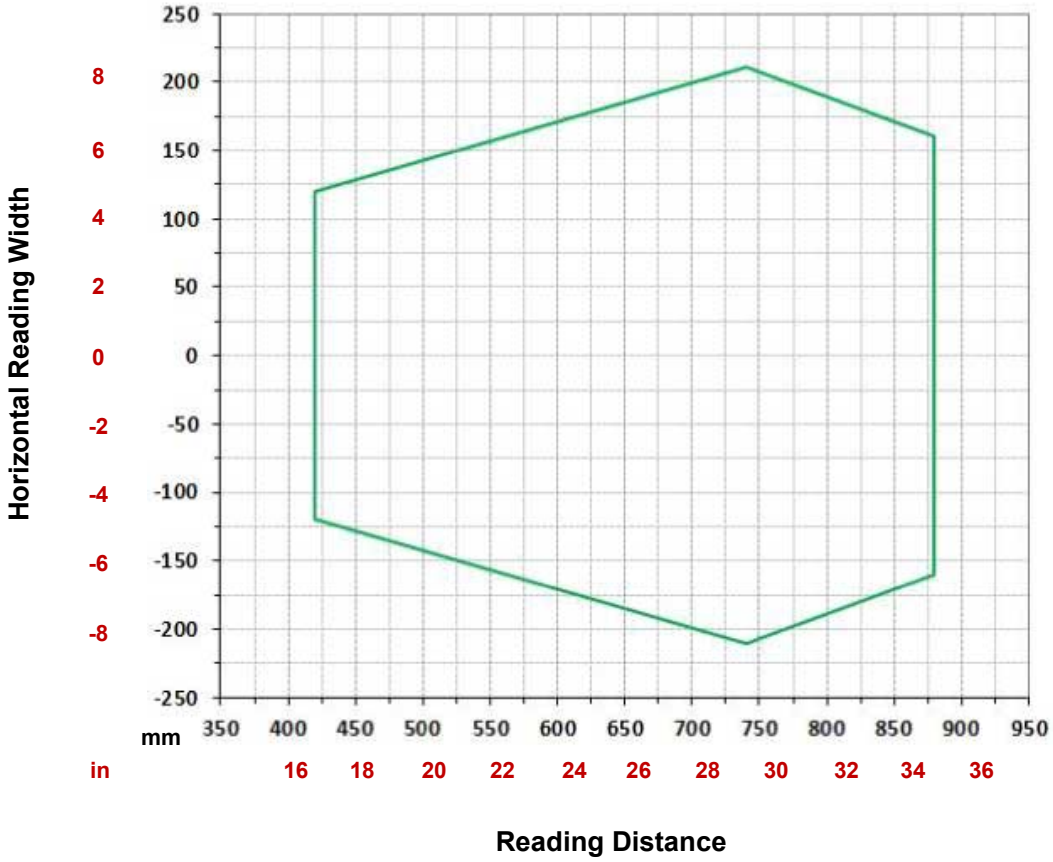


Figure 135. Code 128 0.50 mm (20 mils)

Hardware Settings	
Code Symbology	Code 128
Code Resolution	0.50 mm (20 mils)
Tilt Angle	45°
Skew Angle	15°
Focusing Distance (mm)	740

Software Parameters	
Internal Lighting	Very High Power Strobed
ABR7112-RSE2	
Exposure Time (µs)	330
Gain	17

9.3.6 ABR7112-RSE2 (12 mm models) 2D Codes

Data Matrix 0.13 mm (5 mils)

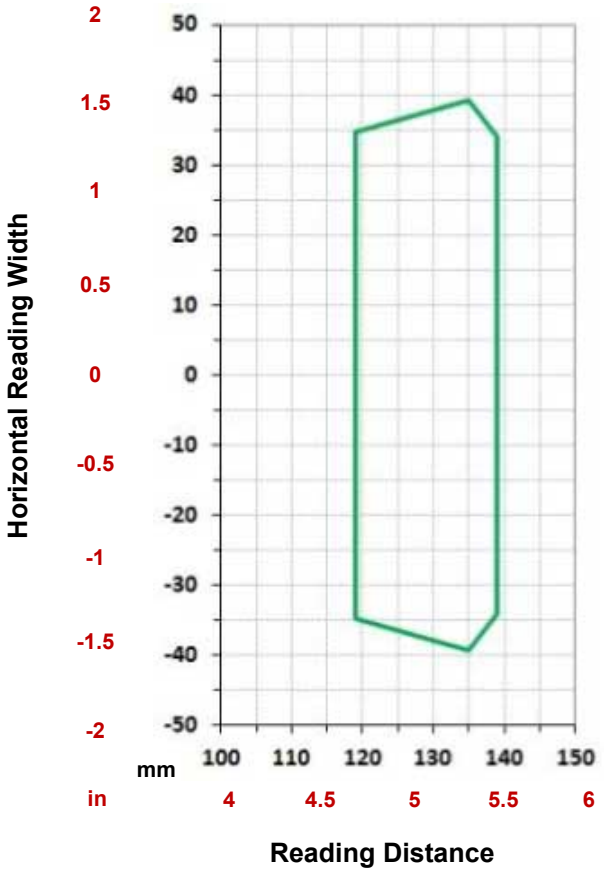


Figure 136. Data Matrix 0.13 mm (5 mils)

Hardware Settings	
Code Symbology	Data Matrix ECC 200
Code Resolution	0.13 mm (5 mils)
Tilt Angle	45°
Skew Angle	15°
Focusing Distance (mm)	133

Software Parameters	
Internal Lighting	Very High Power Strobed
ABR7112-RSE2	
Exposure Time (µs)	45
Gain	5

Data Matrix 0.19 mm (7.5 mils)

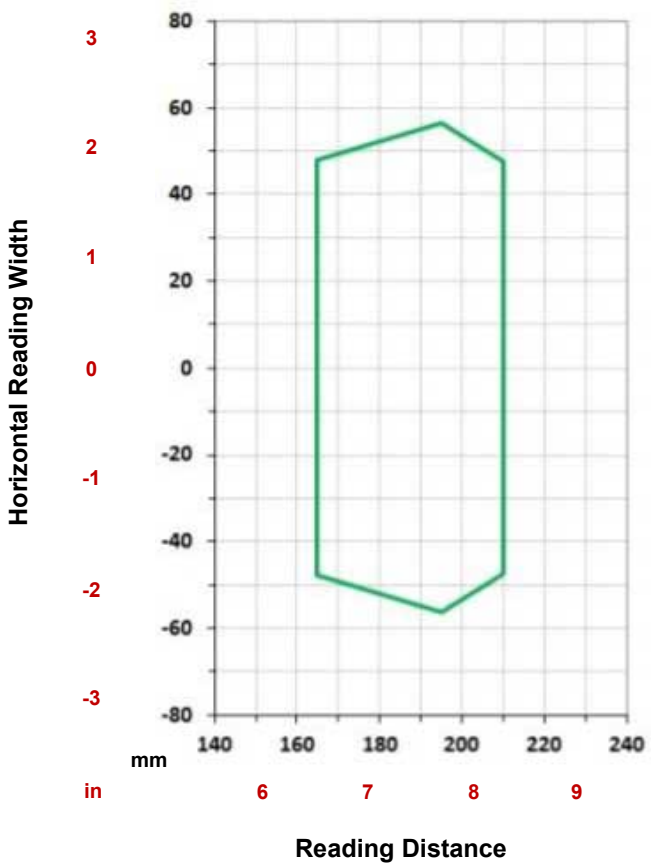


Figure 137. Data Matrix 0.19 mm (7.5 mils)

Hardware Settings	
Code Symbology	Data Matrix ECC 200
Code Resolution	0.19 mm (7.5 mils)
Tilt Angle	45°
Skew Angle	15°
Focusing Distance (mm)	195

Software Parameters	
Internal Lighting	Very High Power Strobed
ABR7112-RSE2	
Exposure Time (µs)	90
Gain	5

Data Matrix 0.25 mm (10 mils)

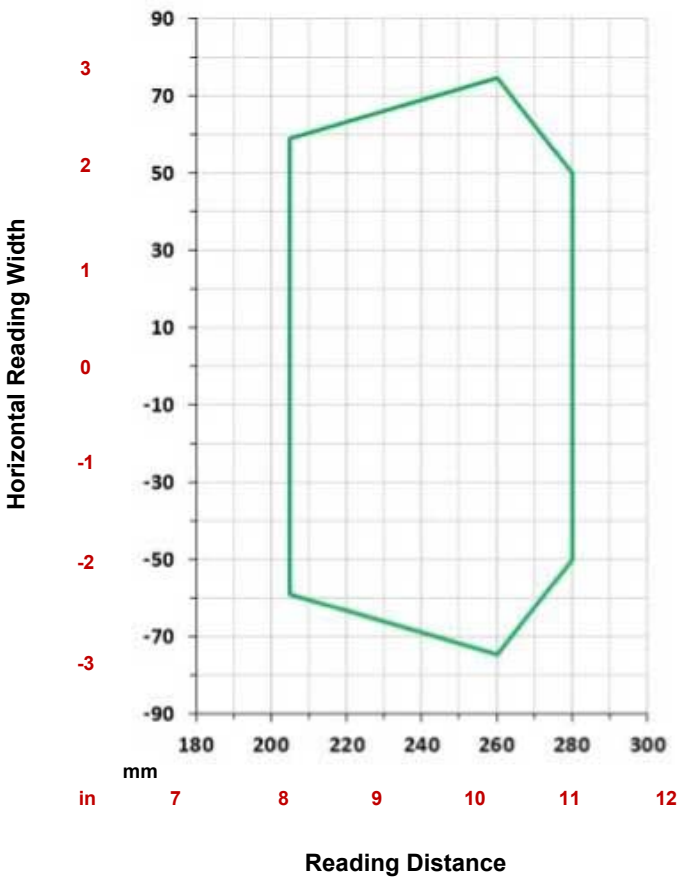


Figure 138. Data Matrix 0.25 mm (10 mils)

Hardware Settings	
Code Symbology	Data Matrix ECC 200
Code Resolution	0.25 mm (10 mils)
Tilt Angle	45°
Skew Angle	15°
Focusing Distance (mm)	250

Software Parameters	
Internal Lighting	Very High Power Strobed
ABR7112-RSE2	
Exposure Time (µs)	150
Gain	8

Data Matrix 0.38 mm (15 mils)

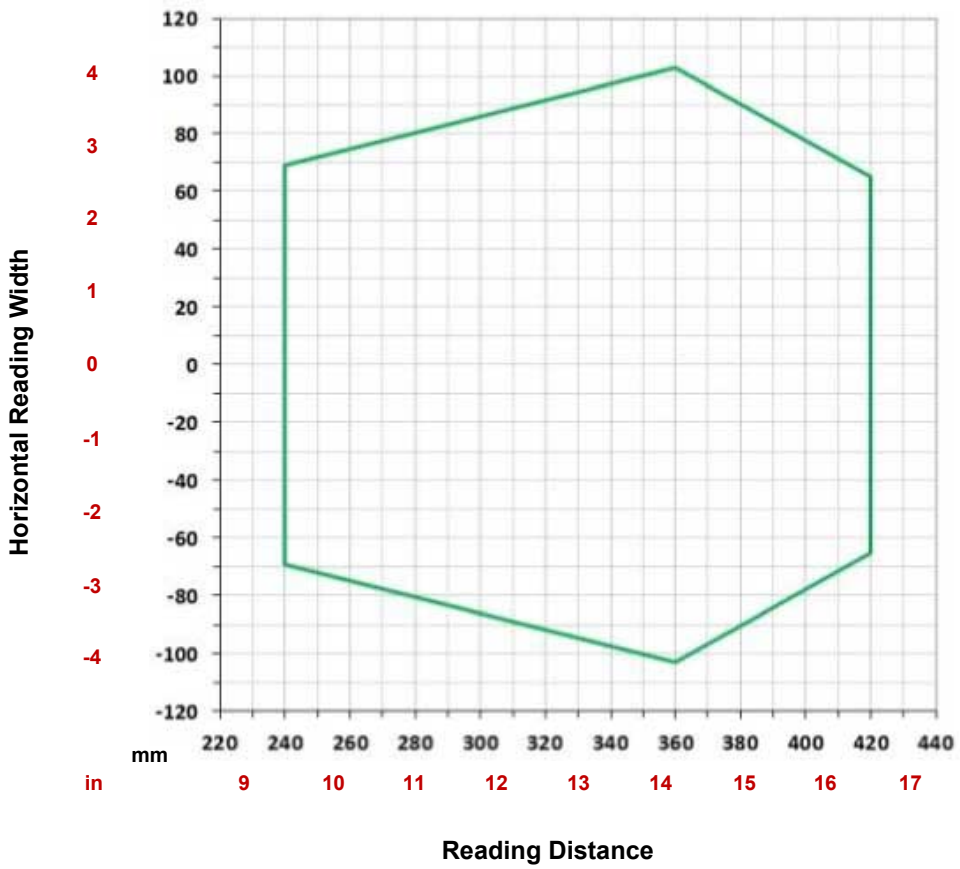


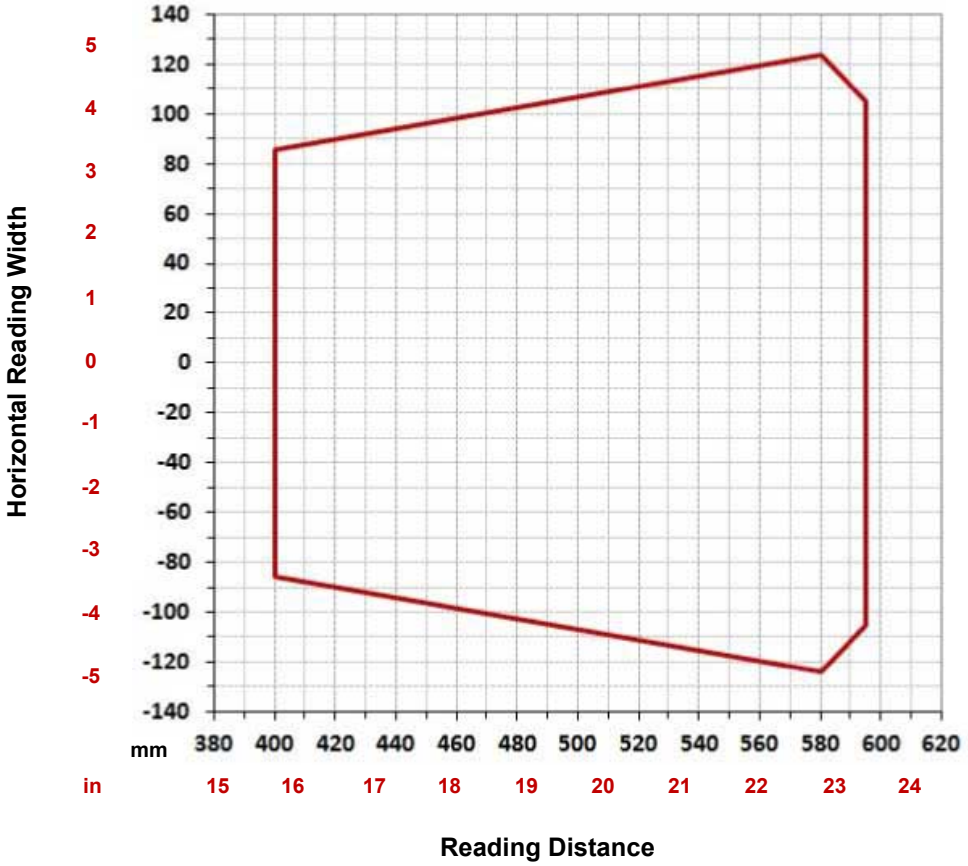
Figure 139. Data Matrix 0.38 mm (15 mils)

Hardware Settings	
Code Symbology	Data Matrix ECC 200
Code Resolution	0.38 mm (15 mils)
Tilt Angle	45°
Skew Angle	15°
Focusing Distance (mm)	355

Software Parameters	
Internal Lighting	Very High Power Strobed
ABR7112-RSE2	
Exposure Time (µs)	250
Gain	6

9.3.7 ABR7116-RSE2 (16 mm models) 1D Codes

Code 128 0.25 mm (10 mils)

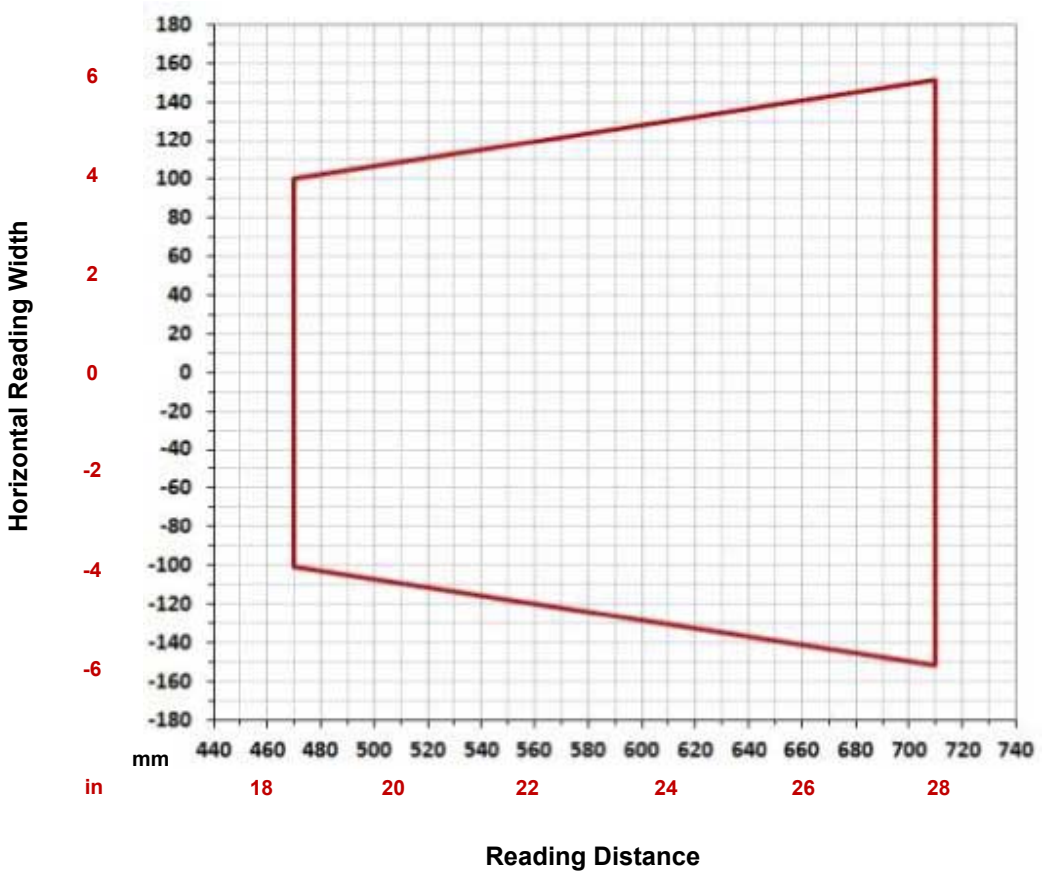


Hardware Settings	
Code Symbology	Code 128
Code Resolution	0.25 mm (10 mils)
Tilt Angle	45°
Skew Angle	15°
Focusing Distance (mm)	500

Software Parameters	
Internal Lighting	Very High Power Strobed
ABR7116-RSE2	
Exposure Time (µs)	250
Gain	16

Figure 140. Code 128 0.25 mm (10 mils)

Code 128 0.30 mm (12 mils)

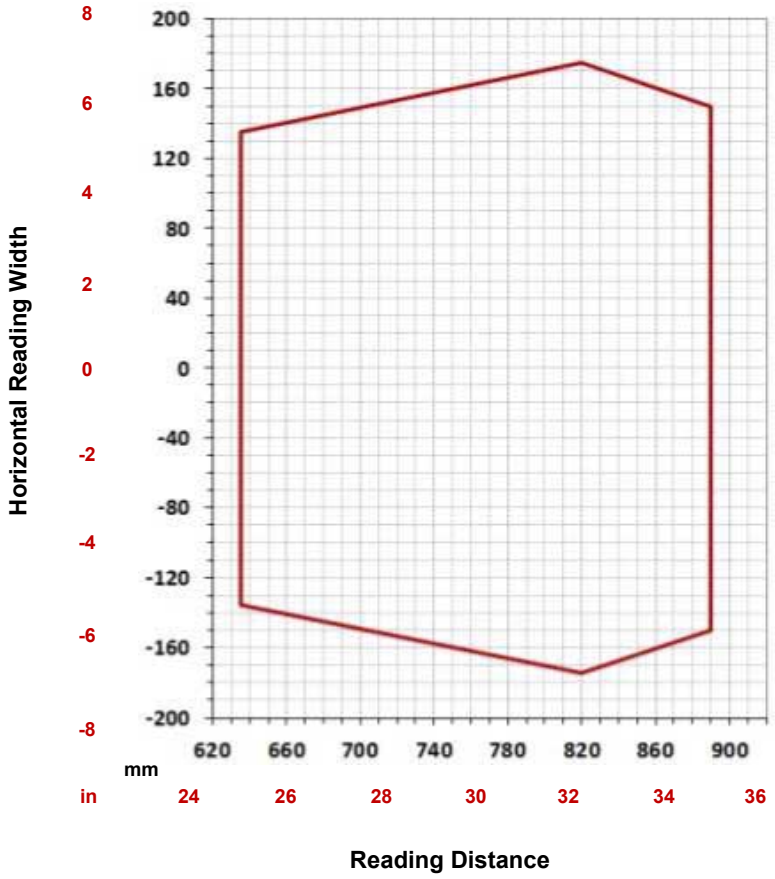


Hardware Settings	
Code Symbology	Code 128
Code Resolution	0.30 mm (12 mils)
Tilt Angle	45°
Skew Angle	15°
Focusing Distance (mm)	590

Software Parameters	
Internal Lighting	Very High Power Strobed
ABR7116-RSE2	
Exposure Time (µs)	300
Gain	19

Figure 141. Code 128 0.30 mm (12 mils)

Code 128 0.38 mm (15 mils)

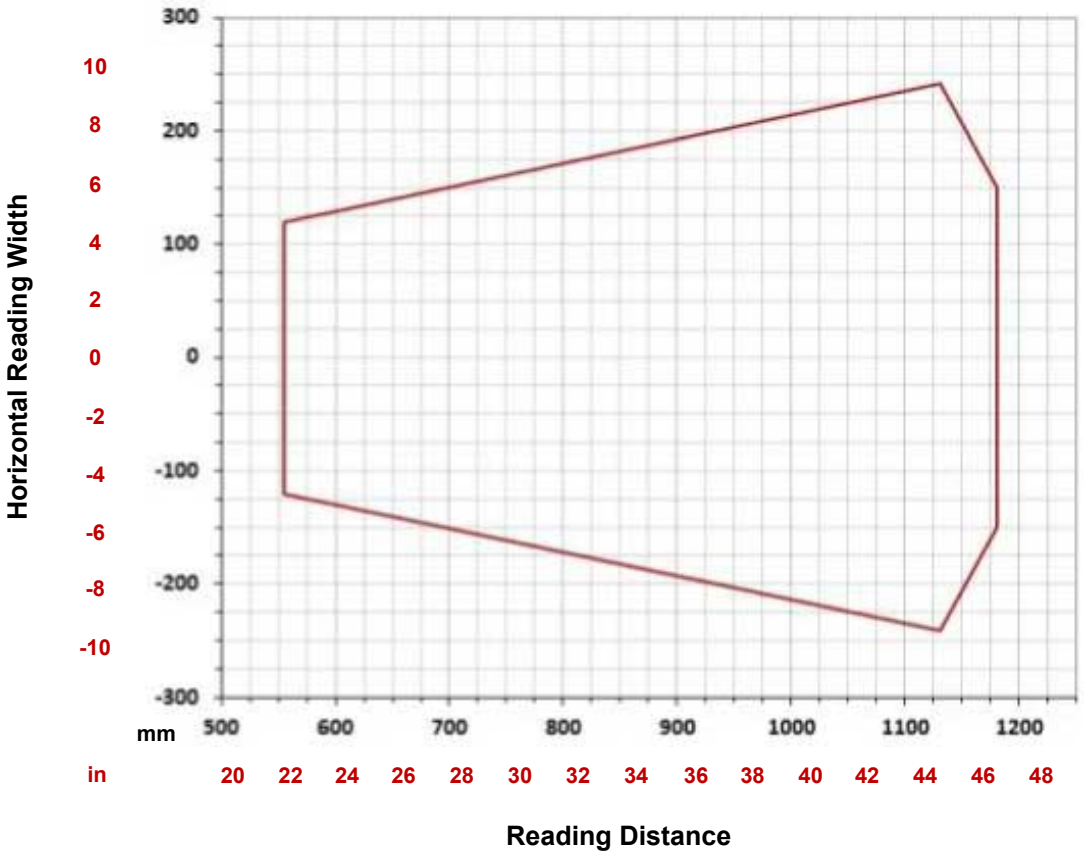


Hardware Settings	
Code Symbology	Code 128
Code Resolution	0.38 mm (15 mils)
Tilt Angle	45°
Skew Angle	15°
Focusing Distance (mm)	700

Software Parameters	
Internal Lighting	Very High Power Strobed
ABR7116-RSE2	
Exposure Time (µs)	500
Gain	24

Figure 142. Code 128 0.38 mm (15 mils)

Code 128 0.50 mm (20 mils)



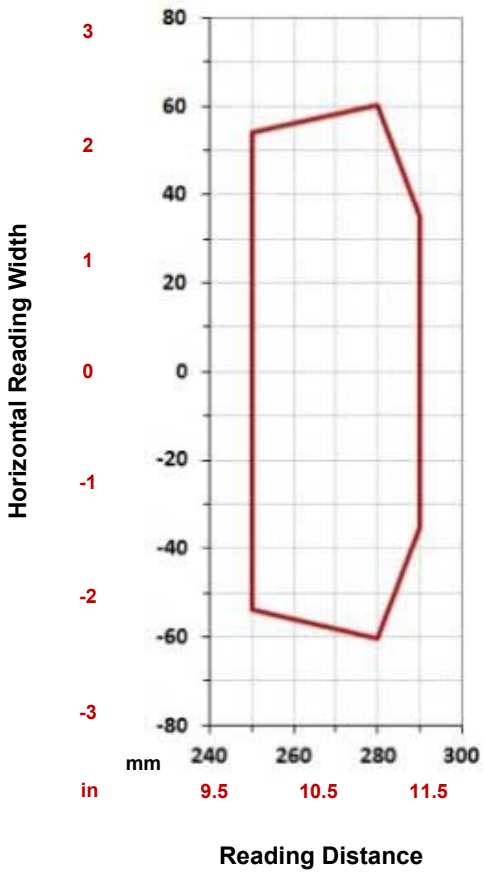
Hardware Settings	
Code Symbology	Code 128
Code Resolution	0.50 mm (20 mils)
Tilt Angle	45°
Skew Angle	15°
Focusing Distance (mm)	900

Software Parameters	
Internal Lighting	Very High Power Strobed
ABR7116-RSE2	
Exposure Time (µs)	500
Gain	19

Figure 143. Code 128 0.50 mm (20 mils)

9.3.8 ABR7116-RSE2 (16 mm models) 2D Codes

Data Matrix 0.19 mm (7.5 mils)

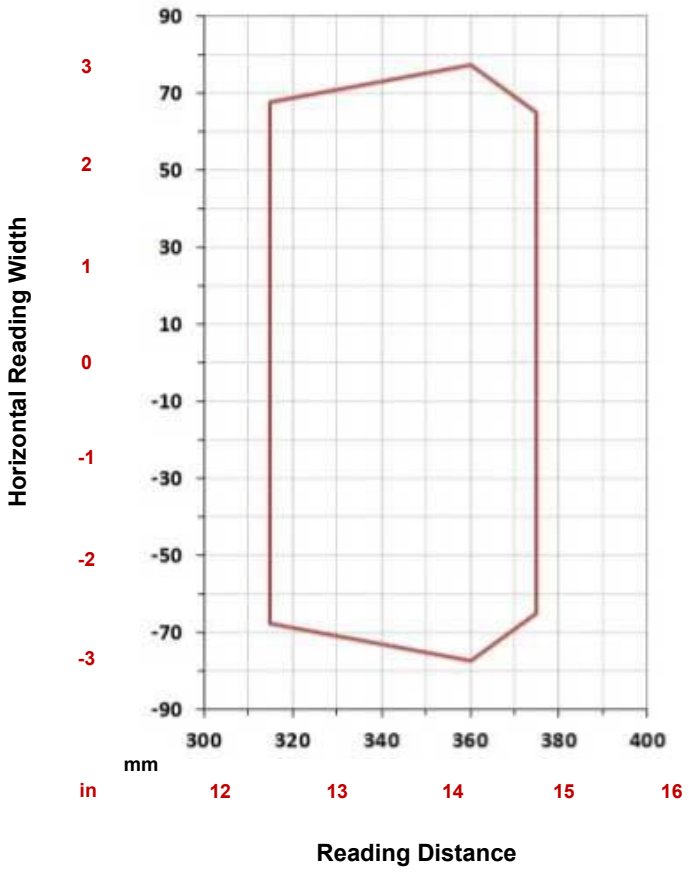


Hardware Settings	
Code Symbology	Data Matrix ECC 200
Code Resolution	0.19 mm (7.5 mils)
Tilt Angle	45°
Skew Angle	15°
Focusing Distance (mm)	275

Software Parameters	
Internal Lighting	Very High Power Strobed
ABR7116-RSE2	
Exposure Time (µs)	190
Gain	7

Figure 144. Data Matrix 0.19 mm (7.5 mils)

Data Matrix 0.25 mm (10 mils)

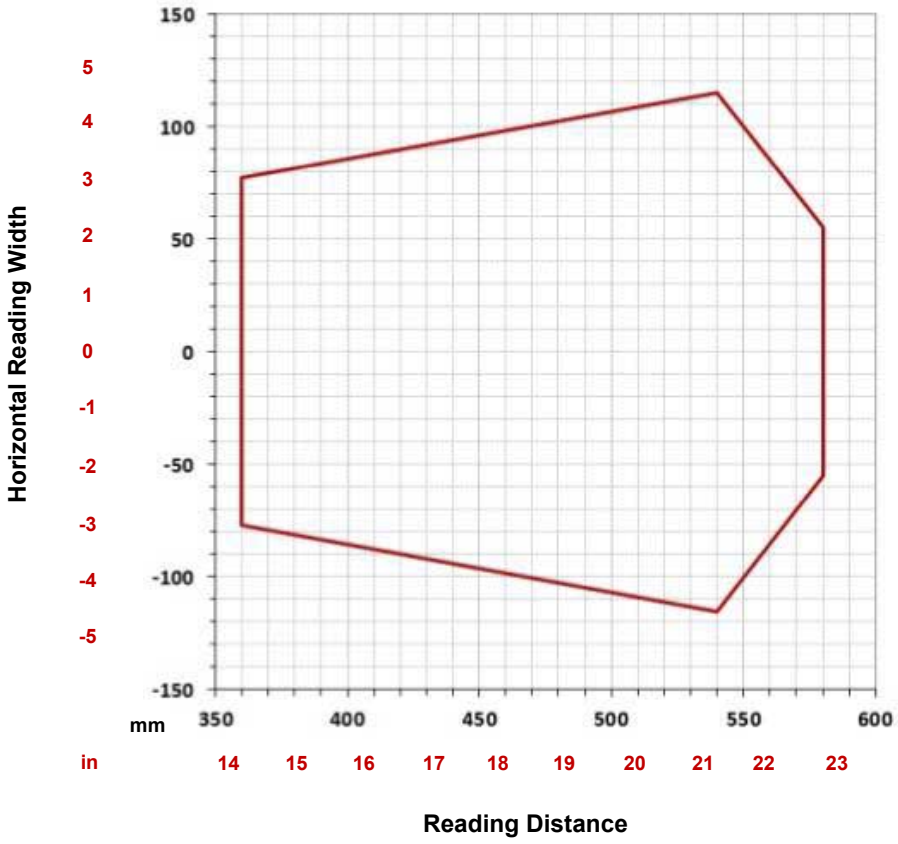


Hardware Settings	
Code Symbology	Data Matrix ECC 200
Code Resolution	0.25 mm (10 mils)
Tilt Angle	45°
Skew Angle	15°
Focusing Distance (mm)	340

Software Parameters	
Internal Lighting	Very High Power Strobed
ABR7116-RSE2	
Exposure Time (µs)	270
Gain	8

Figure 145. Data Matrix 0.25 mm (10 mils)

Data Matrix 0.38 mm (15 mils)



Hardware Settings	
Code Symbology	Data Matrix ECC 200
Code Resolution	0.38 mm (15 mils)
Tilt Angle	45°
Skew Angle	15°
Focusing Distance (mm)	495
Software Parameters	
Internal Lighting	Very High Power Strobed
ABR7116-RSE2	
Exposure Time (µs)	380
Gain	12

Figure 146. Data Matrix 0.38 mm (15 mils)

9.4 Maximum Line Speed and Exposure Calculations

When the **Dynamic** reading option is selected in the **Image Auto-Setup** or **Automatic Setup** window, the maximum allowable image exposure is automatically calculated according to the formula described in this section, using the parameters entered.

The Exposure Time (or Shutter) parameter defines the time during which the image will be exposed to the reader 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)

Conversion to Metric

- [Code Resolution in mils] x 0.0254 = Code Resolution in mm
- n/a
- [Line Speed in ft/min] x 5.08 = Line Speed in mm/s

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

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

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 ABR 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.

Examples

ABR 7000 using:

Internal Lighting Mode = Very High Power Strobe
Exposure Time (µs) = 100 µs
Code Resolution (X) = 0.254 mm (10 mils)

has a maximum line speed of: 0.254 (mm) / 0.0001 (s) = 2540 mm/s

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

$T_{exp\ (max)}$ and **$LS_{(max)}$** are represented in the graph below as the curved line for **X** (code resolution). Values above the curve result in blurring. In practice, the application values are somewhere below the theoretical line, (in the dark gray area), due to environmental and other conditions.

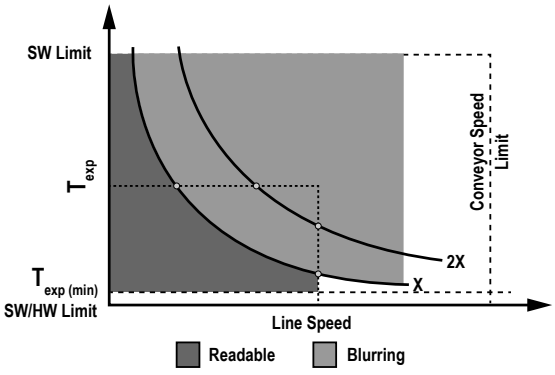


Figure 147. Maximum Line Speed and Exposure

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, (that is, **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.
- **Always ON**: The built-in LED array is turned on all the time at the lowest power level. This option is useful if the LED-array blinking disturbs the operator (Strobed operating mode).
- **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 the 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.

10 PPI (Pixels Per Inch) Setup Chart

Print and use the Setup Chart on the following page to aid in aiming and focusing the reader (7000 models), the Advanced Setup of the reader (7000 models), and the Learn procedure (3000 and 7000 models).

PPI (Pixels Per Inch) Setup Chart

Code 128

Resolution mm (mils)

0.30 (12)

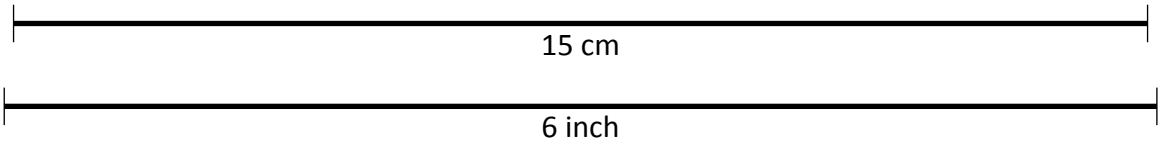
0.30 mm

0.50 (20)

0.50 mm

1.00 (40)

1 mm



15 cm

6 inch

Do not use these Barcodes for Smart Teach Autolearn

Do not scale this page

11 Application Examples

11.1 Document Handling

ABR is effective when used in the omnidirectional reading of 2D, stacked, linear, and postal codes. For example, in automated document handling and mail processing systems.

Figure 148. Address Coded in Data Matrix Symbology for Automated Mail Processing

11.2 Deformed or Overprinted Code Reading

ABR assures the reading of deformed and / or overprinted codes, even though damaged or printed on high reflective surfaces (see the following figures).

Figure 149. Packaging with PDF417 Code

Figure 150. Overprinted Barcode Readable by ABR Through the Envelope Window Film

Figure 151. Barcode Printed on Curved Surface Readable by ABR in spite of Image Optical Distortion

11.3 Direct Part Marking

ABR is also very powerful in reading low-contrast direct part marked codes (see the following figures).

Figure 152. Dot Matrix Code Directly Marked on Metal Surface by Using Dot Peening Technology

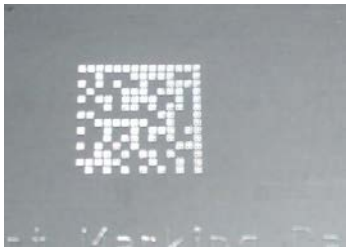


Figure 153. Dot Peening Marking on Metal Surface with Multi-dot per Code Element

Figure 154. Directly Marked Dot Matrix Code Characterized by Outstanding Separation Distance between Adjacent Code Elements

11.4 Ink-Jet Printing Technology

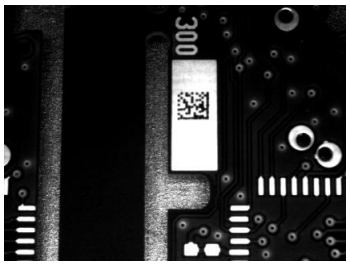


Figure 155. Dot Matrix Code Directly Marked on PCB Copper Pad by Using Ink-Jet Technology

11.5 Laser Marking/Etching Technology

Figure 156. Data Matrix Code Directly Marked on PCB Surface by Using Laser Etching Technology

CAUTION: ABR 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.

12 Troubleshooting

- When wiring the device, pay careful attention to the signal name (acronym) on the TCNM-ACBB1 spring clamp connectors (*TCNM-ACBB1 Electrical Connections* on page 21). If you are connecting directly to the ABR M12 17-pin connector pay attention to the pin number of the signals (*Connector Descriptions* on page 16).
- If you need information about a certain reader parameter, refer to the Barcode Manager online help. 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 Banner Engineering, provide (if possible): Application Program version, Parameter Configuration file, serial number and model number of your reader. Most of this information is available while Barcode Manager is connected to the reader.

Problem	Solution
Barcode Manager Installation: Autorun or Start.hta doesn't run	• Check the 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 (ABR 3000 models)	Windows 7 requires that update KB3033929 be installed for the ABR 3000 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 a wall outlet? • If using rail power, does the rail have power? • If using TCNM-ACBB1, does it have power (check switch and LED)? • Check if you are referring to the M12 17-pin connector or to the TCNM-ACBB1 spring clamp connectors. • Measure Voltage either at pin 1 and pin 2 (for 17-pin connector) or at spring clamp Vdc and GND (for TCNM-ACBB1).
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 device/accessory cable connector or to the TCNM-ACBB1 spring clamp connectors • Is the sensor connected to the Input 1 or Input 2? • Is power supplied to the photoelectric 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 photoelectric sensor LEDs (if any) working correctly? • Is the sensor/reflector system aligned (if present)? • On the Reading Phase step check the Input 1 or Input 2 Debouncing Time parameter setting • On the Reading Phase step check the settings for Acquisition Trigger, Reading Phase-ON, and Reading Phase-OFF parameters
One Shot or Phase Mode using serial trigger source: The **Trigger** LED is not blinking	• On the Reading Phase step check the settings for Acquisition Trigger, Reading Phase-ON, and Reading Phase-OFF parameters • Are the COM port parameters (Baud Rate, Parity, Data Bits, Stop Bits) correctly assigned? • On the Reading Phase step check the settings of Acquisition Trigger String, Reading Phase-ON String, and Reading Phase-OFF String parameters • Is the serial trigger source correctly connected?
Phase Mode: the **Trigger** LED is correctly blinking but no image is displayed in the Barcode Manager 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

Problem	Solution
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 • Verify the reading distance
Image focused but not decoded	Verify the Calibrate Image Density procedure
Reading: The reader always transmits the *No Read Message*	• See *Getting Started* on page 39 • Position the reader as described in *Position the Reader* on page 11 and through Barcode Manager: ◦ 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 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
Communication: Reader is not transmitting anything to the host	• Is the serial cable wiring correct? • If using TCNM-ACBB1, be sure the RS422 termination switch is OFF • Are the host serial port settings the same as the reader serial port settings? • In Barcode Manager **Device menu** > **Settings** > **Settings** > **LED Configuration**, the COM LED Function can be configured to indicate Main Serial Port TX or Main Serial Port RX
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 Barcode Manager Data Formatting step, check the settings of Header and Terminator String parameters • In the Barcode Manager Data Formatting step, check the various Message Field parameter settings
Configuration: Cannot access environment parameters in Barcode Manager (**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 find my reader serial number?	• The reader serial number consists of 9 characters: one letter, 2 numbers, another letter followed by 5 numbers • The reader serial number is printed on a label that is affixed on the bottom case near the reading window • The serial number is also visible from the Barcode Manager **Device List** Area

13 Lighting System Notes

ABR 7000 Models		Internal Illuminators	
Model	Lens Type	Number of LEDs	Color
ABR7106-RSE2	6 mm Manual Focus Lens	8	Red
ABR7106-MSE2		24/39	Red and Blue LEDs for bright/dark field lighting in DPM applications (software configurable sectors)
ABR71L9-RSE2	9 mm Liquid Lens Autofocus	8	Red
ABR71L9-MSE2		24/39	Red and Blue LEDs for bright/dark field lighting in DPM applications (software configurable sectors)
ABR7109-RSE2	9 mm Manual Focus Lens	8	Red
ABR7109-MSE2		24/39	Red and Blue LEDs for bright/dark field lighting in DPM applications (software configurable sectors)
ABR7112-RSE2	12 mm Manual Focus Lens	8	Red
ABR7116-RSE2	16 mm Manual Focus Lens	8	Red

13.1 Lighting Systems for Direct Part Marking

13.1.1 Lighting Systems for DPM Overview

ABR 7000 with red integrated illuminators are an optimum solution for all applications where codes are printed on paper and for most applications where direct part marking is obtained by ink jet or laser etching technology on flat non-reflective surfaces, without any evident machining flaws made by machine tools (that is, cutters or lathes).

When codes are marked on very reflective surfaces, the above illuminators can be used only if the reader's pitch or skew angle required to avoid direct reflection doesn't compromise code reading due to perspective distortion of which the code images are inevitably affected.

In other cases, where the above mentioned illuminators do not permit code image acquisition of sufficient quality for decoding, it is necessary to select a different lighting system for the ABR reader among those specifically designed for Direct Part Marking (DPM) code reading applications.

13.1.2 Internal DPM Illuminators

Use ABR 7000 models with red integrated illuminators for:

- Applications where codes are printed on paper
- Applications where direct part marking is obtained by ink jet or laser etching technology on flat non-reflective surfaces, without any evident machining flaws

ABR 7000 models with Multicolored DPM integrated illuminators provide:

- Bright Field illumination for DPM code marking on flat surfaces having evident machining flaws produced by machining tools
- Dark Field illumination for DPM laser etching or dot peening code marking on flat, highly reflective surfaces

13.1.3 Lighting Systems for DPM Selection Criteria

Lighting systems are designed for use in specific applications. The principle factors that determine selection of the most suitable lighting system for a code reading application are:

Code Printing or Marking Technique

Printing on paper or labels

Figure 157. Examples

Direct Marking with Ink Jet process

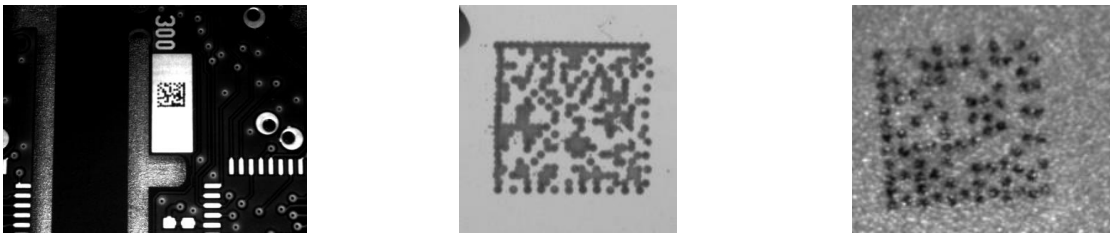


Figure 158. Examples

Direct Marking with Laser Etching process

Figure 159. Examples

Direct Marking with Dot Peening process

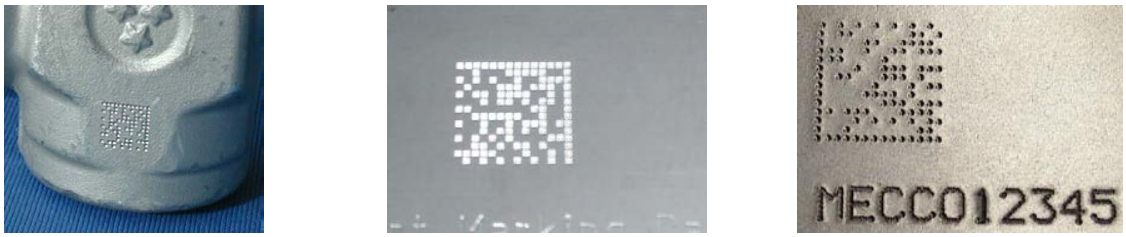


Figure 160. Examples

Shape of the code marking surface

Flat surface

Figure 161. Examples

Curved surface

Figure 162. Examples

Reflectivity of the code marking surface

Highly reflective surface

Figure 163. Examples

Opaque surface

Figure 164. Examples

Texture of the code marking surface

Smooth surface without any defects (such as scratches or streaks)

Figure 165. Examples

Surface with machining flaws produced by machining tools

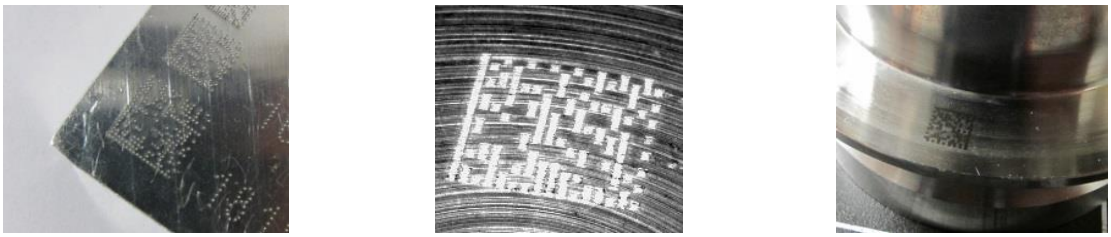


Figure 166. Examples

Rough surface typical of die-cast parts

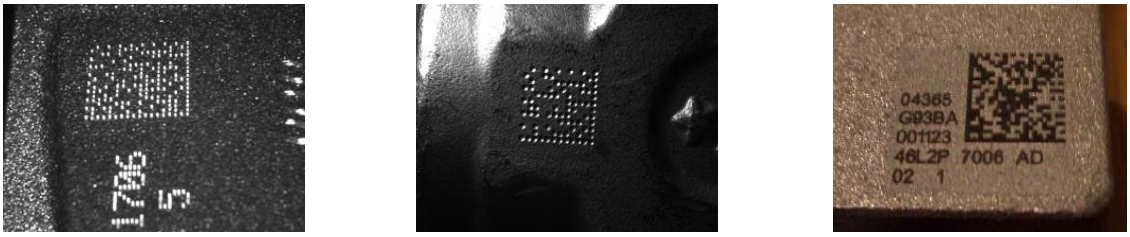


Figure 167. Examples

Colored codes and/or background

Figure 168. Examples

Typically, in DPM applications, the above mentioned factors are present in different combinations creating a vast number of cases. However, it is possible to subdivide the most common applications into macro-cases having characteristics that determine the choice of the most suitable lighting system to resolve the relative application, guaranteeing the best compromise between performance and cost.

13.2 ABR 7000 Recommended Illuminators

In the following table, macro-cases are listed, and for each of them, the most suitable ABR 7000 lighting systems used to resolve the application.

Application Characteristics	Red	Multicolored DPM Central	Multicolored DPM Peripheral
Printed codes on opaque paper or labels having a flat surface	✓	✓	OK
Laser Etching or Ink Jet code marking on an opaque, flat surface having no evident machining flaws	✓	✓	OK
Code marking on an opaque, rough surface	✓	OK	X
Code marking on a flat surface with evident machining flaws produced by machining tools	X	OK	✓
Laser Etching or Dot Peening code marking on a flat, highly reflective surface	X	X	✓
Code marking on a curved surface	X	X	OK
Red-printed code on white background	X	X	OK

Key:

✓—Suggested lighting system
OK—Compatible lighting system
X—Lighting system not recommended

Note: For correct use of the Multicolored DPM Peripheral illuminator, verify that the application working distance is within the lighting systems working distance. See the following table.

Table 8: Lighting System Working Distances

Reader Model	Lighting System	Working Distance
ABR71x9-RSE2	Red	20 to 550 mm
ABR71xx-MSE2	Multicolored DPM Central LED Group	20 to 250 mm
ABR71xx-MSE2	Multicolored DPM Peripheral LED Group	20 to 50 mm

Important: The minimum and maximum DPM application distance is limited by both the lighting system working distance and the reader focus distance.

For example the minimum application distance is limited by the reader minimum focus distance (25 mm for Liquid Lens Autofocus models). The maximum application distance is limited by the smaller of the illuminator maximum working distance or the lens maximum focus distance. See also *Global FOV Diagrams* on page 82.

13.2.1 Red Illuminator

The red illuminator is made up of eight LEDs which are all controlled simultaneously by the software application.

These are Bright Field general purpose illuminators used in the operating distance range from 20 mm to 550 mm. The reader focus distance further limits this range.

The red illuminator is an optimum solution for applications where codes are printed on paper and where Direct Part Marking (DPM) is obtained by ink jet or laser etching technology on flat non-reflective surfaces, without any evident machining flaws made by machine tools (that is, cutters or lathes). The reader's pitch or skew angle helps avoid direct reflection when codes are marked on very reflective surfaces.

Figure 169. LED Red Illuminator

13.2.2 Multicolored DPM Illuminator

This is both a Bright Field and a Dark Field illuminator.

The Multicolored DPM illuminator is made up of 63 LEDs divided into two groups of four sectors each which are independently controlled by the software application.

Four sectors of six LEDs each make up the internal group called Central LED Group and correspond to Bright Field illumination. The operating distance range is typically from 20 mm to 250 mm. The reader focus distance further limits this range.

The use of the Multicolored DPM Central LED Group is particularly effective in direct part mark applications (DPM), where linear machining flaws are present on the part surfaces. In fact, in these cases, an image of the code can be obtained having a very light background.

The other four sectors make up the external group called Peripheral LED Group and correspond to Dark Field illumination. Dark Field illumination is guaranteed by the 39 side-emitting blue LEDs divided as follows: a TOP sector of seven LEDs, a BOTTOM sector of eight LEDs and two sectors (LEFT and RIGHT) of twelve LEDs each.

Figure 170. 39/24 LED Multicolored DPM Illuminator

The Peripheral LED Group can be the correct solution for DPM applications with highly reflective surfaces. In these applications, by using a traditional bright field illuminator, the code can result unreadable. This is because in the acquired image some parts of the code are made invisible due to gray-level saturation generated by direct reflection of the illuminator LEDs.

To obtain optimum Dark Field illumination, it is necessary to work at close range, typically in the range from 20 mm to 50 mm. The reader focus distance further limits this range.

An orange filter is applied over the Central LED Group to avoid harmful blue light reflections off the Peripheral LED component packages.

The Peripheral LED Group can also be used as a Bright Field illuminator in the range from 50 mm to 100 mm.

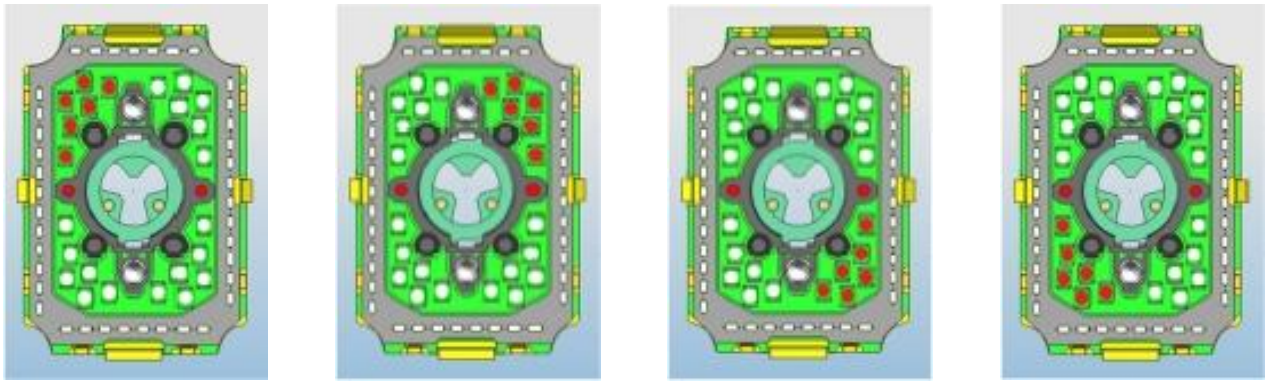


Figure 171. Central LED Group

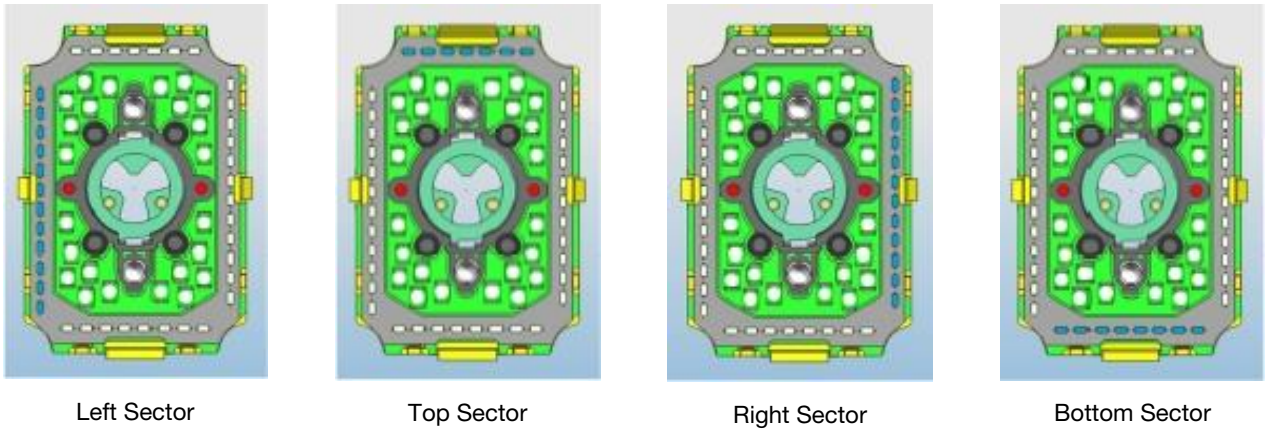


Figure 172. Peripheral LED Group

In the software, each single sector can be turned on, however it is NOT possible to simultaneously turn on sectors belonging to the separate LED Groups, Peripheral and Central. Even with this restriction, thirty different combinations of ON/OFF lighting configurations can be obtained.

By enabling multiple Image Settings, each having a different ON/OFF LED combination, it is possible to acquire different consecutive images, changing the activation of the eight LED sectors. This feature is particularly effective for reading codes printed/marked on reflective surfaces, by sequentially turning OFF the single LED sectors.

In the example below, two Data Matrix codes which have been etched onto a plastic reflective surface must be read.

With all four LED sectors enabled (Example A), the code is not readable due to the LED reflections on the code surface. By setting different Image Settings in which the Bottom-Right Sector is turned off (removed from the parameter combination – Example B) and Top-Left Sector is turned off (removed from the parameter combination – Example C), the code is illuminated by the other LED sectors without the reflections on the code surface.

Figure 173. Example A: Incorrect Illumination

Figure 174. Example B: Good Illumination on Left Code

Figure 175. Example C: Good Illumination on Right Code

Take into consideration that when using Multicolored DPM Central LED Group to illuminate surfaces where linear machining flaws are present, the well-lighted area depends on the direction of the machining flaws with respect to the illuminator's LED sectors, but independent of the reading distance.

This characteristic fixes the upper limit of the code dimensions compatible with the use of the Multicolored DPM. In reality, it is an actual limit of the usable part of the field of view. This limit must be taken into consideration during the feasibility analysis of the solution, including the eventual positioning variation of the codes with respect to the center of the reader's field of view.

The arrangement of the LED sectors allows obtaining a well-lighted area even when the direction of the machining flaws is changed.

Refer to the following images for the dimension of lighted area illuminated by the different LED groups.

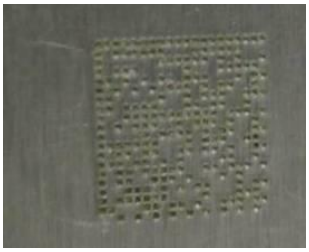
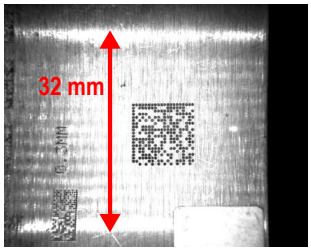


Figure 176. Color Photo of Code



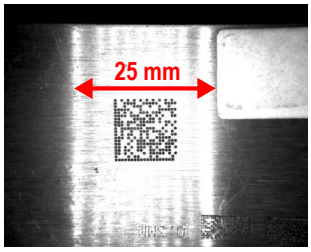


Figure 177. Multicolored DPM Peripheral LED Group

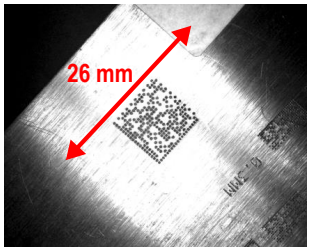


Figure 178. Multicolored DPM Central LED Group

13.2.3 ABR 7000 Applications

The following examples show the use of the illuminator models described in this manual.

Linear Machining Flaws

To better understand the advantages of using the Multicolored DPM in DPM applications where linear machining flaws are present on the part surfaces, see the example below. In the example, Data Matrix codes are marked using dot peening onto metal surfaces having evident machining flaws previously produced by machine tools.

Dot Peening on a Flat Surface with Vertical Streak-like Processing Flaws Produced by Machining Tools

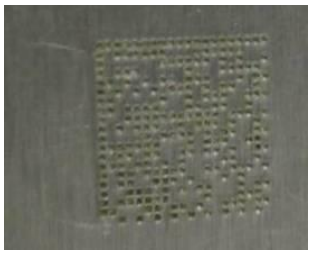


Figure 179. Color Photo of Code

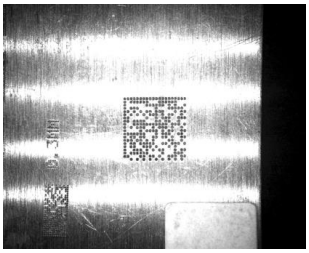


Figure 180. Red: Incorrect Illumination

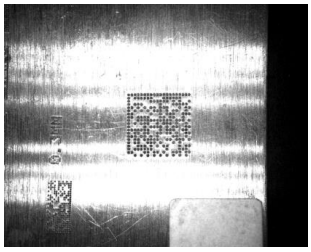


Figure 181. Multicolored DPM - Central Group: Incorrect Illumination

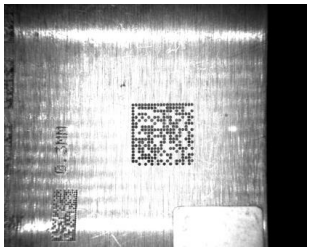


Figure 182. Multicolored DPM – Peripheral Group: Good Illumination

Highly Reflective Surfaces

This example shows the benefits obtained with Multicolored DPM on codes produced using dot peening on metal surfaces with high reflectance.

Dot Peening on a Flat Highly Reflective Surface

Figure 183. Color Photo of Code

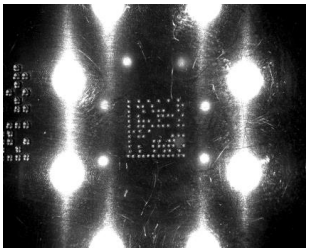


Figure 184. Red: Incorrect Illumination

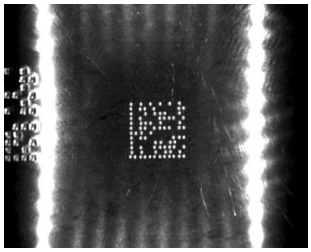


Figure 185. Multicolored DPM – Peripheral Group: Good Illumination

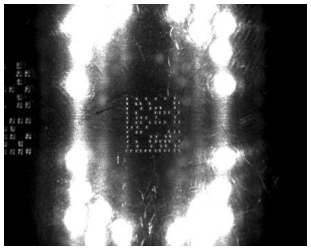


Figure 186. Multicolored DPM - Central Group: Incorrect Illumination

Laser Etching

The first example below shows the advantages obtained with Multicolored DPM and the **Multi Acquisition Setting** mode.

The second example shows codes produced using the laser etching process on metal surfaces that do not have evident machining flaws, however, these examples are characterized by reflectance dependent on the direction of illumination.

Laser Etching on PCB: Multicolored DPM with Multi Acquisition Settings

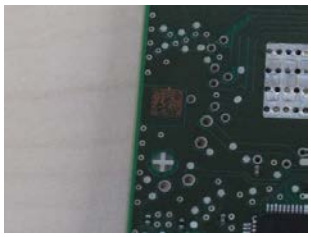


Figure 187. Color Photo of Code

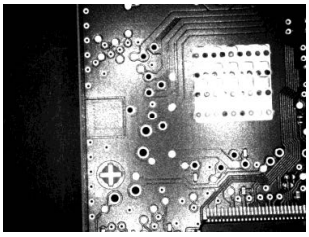


Figure 188. Red: Incorrect Illumination

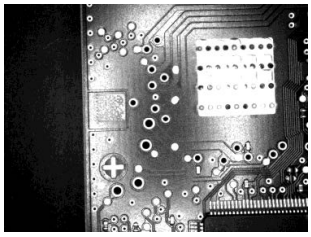


Figure 189. Multicolored DPM - Peripheral Group ALL Sectors On: Incorrect Illumination

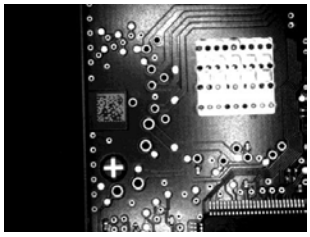


Figure 190. Multicolored DPM - Peripheral Group Right Sector Off: Good Illumination

Background with Anisotropic Reflectance

Figure 191. Color Photo of Code

Figure 192. Red: Incorrect Illumination

Figure 193. Multicolored DPM - Peripheral Group ALL Sectors On: Suboptimal Illumination

Figure 194. Multicolored DPM - Peripheral Group Top and Bottom Sectors On: Incorrect Illumination

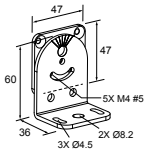
Figure 195. Multicolored DPM - Peripheral Group Left and Right Sectors ON: Good Illumination

14 Accessories

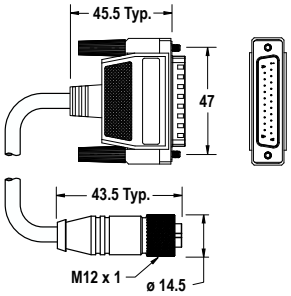
14.1 Brackets

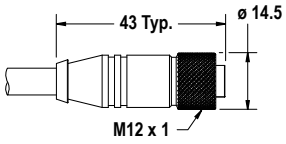
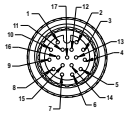
SMBABR7RA

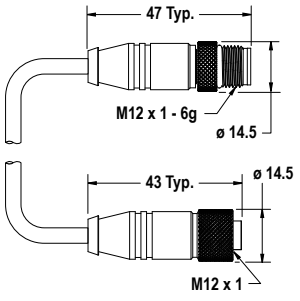
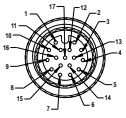
- Replacement right-angle bracket for ABR 7000 models
- Included with the product
- 3 mm cold rolled steel

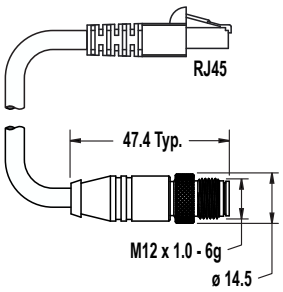
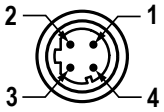


14.2 Cordsets

17-pin M12/Euro-style Female to DB25 Male Shielded			
Model	**Length**	**Style**	**Dimensions**
MQDEC-1703SS-DB25	0.91 m (3 ft)	Straight	

17-pin M12/Euro-style Female Shielded Quick Disconnect				
Model	**Length**	**Style**	**Dimensions**	**Pinout (Female)**
MQDC2S-1706	1.83 m (6 ft)	Straight		 1 = Brown 2 = Blue 3 = White 4 = Green 5 = Pink 6 = Yellow 7 = Black 8 = Gray 9 = Red 10 = Violet 11 = Gray/Pink 12 =Red/Blue 13 = White/ Green 14 = Brown/ Green 15 = White/ Yellow 16 = Yellow/ Brown 17 = White/ Gray
MQDC2S-1715	4.57 m (15 ft)			
MQDC2S-1730	9.14 m (30 ft)			

17-pin M12/Euro-style Extension Shielded Cable				
Model	Length	Style	Dimensions	Pinout (Female)
MQDEC-1706SS	1.83 m (6 ft)	Straight		 1 = Brown 2 = Blue 3 = White 4 = Green 5 = Pink 6 = Yellow 7 = Black 8 = Gray 9 = Red 10 = Violet 11 = Gray/Pink 12 =Red/Blue 13 = White/ Green 14 = Brown/ Green 15 = White/ Yellow 16 = Yellow/ Brown 17 = White/ Gray
MQDEC-1715SS	4.57 m (15 ft)			
MQDEC-1730SS	9.14 m (30 ft)			

4-pin M12/Euro-style D-code to RJ45 Shielded Ethernet				
Model	Length	Style	Dimensions	Pinout (Male)
STP-M12D-406	1.83 m (6 ft)	Straight		  1 = White/ Orange 2 = Orange 3 = White/ Blue 6 = Blue 1 = White/ Orange 2 = White/ Blue 3 = Orange 4 = Blue
STP-M12D-415	4.57 m (15 ft)			
STP-M12D-430	9.14 m (30 ft)			

14.3 Trigger Kit

Kit QS18LPTRIGKIT01 includes:

Qty.	Model	Description
1	QS18VP6LPQ5	QS18 polarized retroreflective sensor, 150 mm (6 in) PVC cable with a 4-pin M12/Euro-style quick disconnect, and nickel-plated brass coupling nut. Range: 3.5 m (12 ft)
1	MQDC-415	4.57 m (15 ft) cable with a 4-pin threaded M12/Euro-style straight connector
1	BRT-60X40C	Rectangular 60×40 mm retroreflective target. Reflectivity factor: 1.4
1	SMB18UR	Two-part universal rotating stainless steel bracket

14.4 Connection Boxes and Power Supply Boxes

TCNM-ACBB1

- Connection box
- For ABR 3000 and 7000 models

PSB4MK-24-06-Q0Q5

- Power supply box
- 0.6 A 24 V dc
- Requires AC cable SM30CC-306-WP
- Requires DC cable MQDMC-401

15 Product Support and Maintenance

15.1 Repairs

Contact Banner Engineering for troubleshooting of this device. **Do not attempt any repairs to this Banner device; it contains no field-replaceable parts or components.** If the device, device part, or device component is determined to be defective by a Banner Applications Engineer, they will advise you of Banner's RMA (Return Merchandise Authorization) procedure.

Important: If instructed to return the device, pack it with care. Damage that occurs in return shipping is not covered by warranty.

15.2 Maintenance

Maintenance tasks include keeping the hardware free of dust and dirt and updating the Barcode Manager software and sensor firmware as new versions become available.

15.2.1 Clean the Reader

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

Clean the lens cover periodically for continued correct operation of the reader.

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

Repeat the operation frequently in particularly dirty environments.

15.2.2 Update the Software and Firmware

The current version of Barcode Manager software and the sensor firmware is available for download from *www.bannerengineering.com*.

15.2.3 Update the Firmware

1. Make sure the device to be updated is selected and is shown in the status bar.

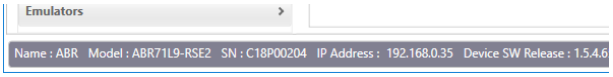


Figure 196. Status Bar

2. Go to **Device** > **Update Package**.

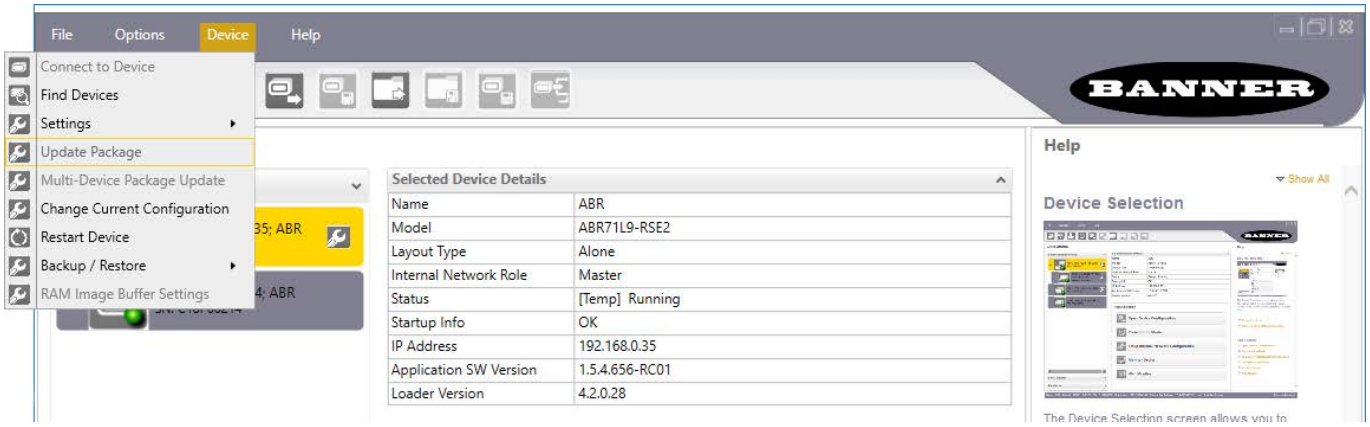


*Figure 197. **Update Package***

3. Select the firmware package file for your device family.

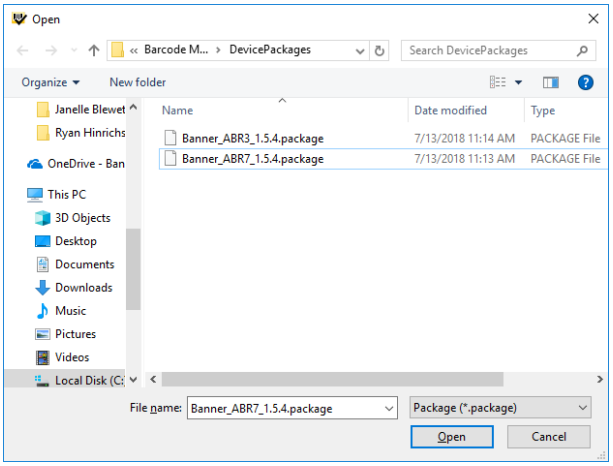


Figure 198. Select the Firmware File

   The **Device Package Update** window displays.
4. Click **Yes** to start the update.
   The **Device Restart Information** window displays.
5. Click **OK** to restart the device.
   The update finishes, the reader restarts, and Barcode Manager returns to the **Home/Device Selection** page.
6. If the reader is not listed in the **Device List Area**, click **Find Devices** to search for the reader.

15.3 Reset the Reader to the Factory Default Environment (Optional)

If it becomes necessary to reset the reader's environment parameters to the factory default values, use the Smart Teach button to perform the following procedure.

1. While powering up the reader, press and hold the Smart Teach button until all five Smart Teach LEDs flash simultaneously.
2. Release and immediately re-press the Smart Teach button one time.
   The reader beeps once as all 5 LEDs flash on simultaneously once more, and then turn off. After a few seconds the ABR enters run mode, and the internal illuminators start flashing. All of the reader's environment parameters are reset, including the IP address for Ethernet models (defaults to 192.168.3.100). Any previously saved configurations on the reader remain in memory, but the default configuration is set as the startup configuration.

Note: If you press and hold the Smart Teach button from power up until the point when the Smart Teach LEDs flash on and off for about 3 seconds, but you do not release within the 3 seconds or you release and re-press the button too slowly, the reader enters a manufacturer's software loading mode instead. The internal illuminators remain off as the Smart Teach LEDs cycle through various blinking patterns. Cycle power to return to Run mode or try again.

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15.5 Banner Engineering Corp. Limited Warranty

Banner Engineering Corp. warrants its products to be free from defects in material and workmanship for one year following the date of shipment. Banner Engineering Corp. will repair or replace, free of charge, any product of its manufacture which, at the time it is returned to the factory, is found to have been defective during the warranty period. This warranty does not cover damage or liability for misuse, abuse, or the improper application or installation of the Banner product.

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For patent information, see *www.bannerengineering.com/patents*.

16 Glossary

A

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 barcode symbols. It defines modifications to the measurement and grading of several symbol quality parameters.

B

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.

C

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.

D

Dark Field Illumination

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

Decode

To recognize a barcode symbology (for example, 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.

E

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.

F

Flash

Non-volatile memory for storing application and configuration files.

H

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.

I

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 (for example, 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.

L

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.

M

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.

R

RAM

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

S

Symbol Verification

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

T

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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