# ABR 7000 Series Barcode Reader

## Instruction Manual

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207634

ПРОМЭЛЕКТРОНИКА/ sales@prom-elec.com

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# 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 (1280×1024 pixels) | 9 mm, manual focus | Red | Standard | Serial/Ethernet | 1D and 2D |
| ABR7109-MSE2 | | 9 mm, manual focus | Multicolored DPM [3] | | | |
| 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 [3] | | | |
| ABR71L9-RSE2 | | 9 mm, Liquid Lens Autofocus | Red | | | |
| ABR71L9-MSE2 | | 9 mm, Liquid Lens Autofocus | Multicolored DPM [3] | | | |
| ABR71L9-WPE2 | | 9 mm, Liquid Lens Autofocus | White Polarized | | | |
| ABR72L9-RPE2 | 2 MP (1600×1200 pixels) | 9 mm, Liquid Lens Autofocus | Red Polarized | | | |
| ABR72L9-RDE2 | | 9 mm, Liquid Lens Autofocus | Red Diffused DPM [3] | | | |
| ABR72L16-WSE2 | | 16 mm, Liquid Lens Autofocus | White | | | |

[3] Multicolored DPM models have red bright field lights and blue low angle lights for optimized reading of Direct Park Marked (DPM) codes. Red Diffused DPM models have both groups of lights as well, but both are red and behind a diffuser.

| Model | Resolution | Lens | Lighting | Options | Communications | Codes |
|---|---|---|---|---|---|---|
| ABR72L16-RDE2 | | 16 mm, Liquid Lens Autofocus | Red Diffused DPM [3] | | | |

## 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.

**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.

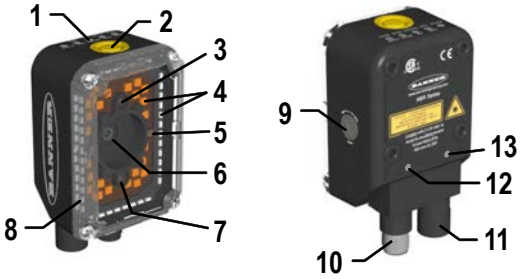
**Class 2 Laser Safety Notes**

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

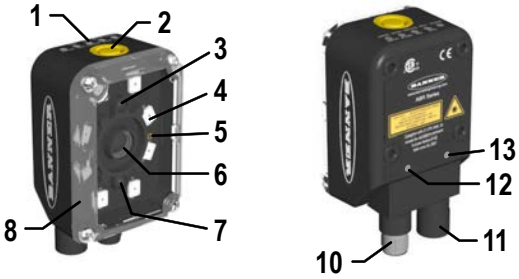
## 1.3 Features

*Figure 1. Models with Manual Adjustable Focus*



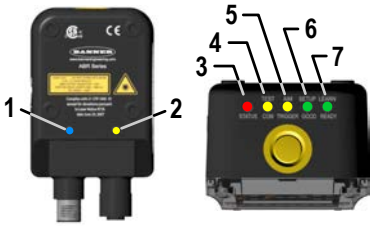

1. Smart Teach Interface
2. Button
3. Good Read LED (green)
4. Internal Illuminator
5. Aiming System Laser Pointers
6. Lens
7. No Read LED (red)
8. Lens Cover
9. Focus Adjustment Screw
10. Power - Serial - I/O Connector
11. Ethernet Connector
12. Power ON LED
13. Ethernet Connection LED

*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 p. 39 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 p. 39.

# 2 Specifications and Requirements

## 2.1 Specifications—Reader

**Supply Voltage**
10 V dc to 30 V dc

**Consumption**
0.7 A (at 10 V dc) to 0.2 A (at 30 V dc) maximum

**Communication Interface**
Main RS232 or RS422 full duplex: 2400 bit/s to 115200 bit/s
Auxiliary - RS232: 2400 to 115200 bit/s
Ethernet [4]: 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 p. 36 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

**Imager**
Image Sensor: CMOS sensor with Global Shutter
Image Format:

- 1.3 MP: SXGA (1280×1024) pixels
- 2.0 MP: 1600 × 1200 pixels

Frame Rate:

- 1.3 MP: 60 frames/second
- 2.0 MP: 45 frames/second

**Optical Features**
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, plastic window

**Weight**
About 238 grams (8.4 oz.)

**Operating Conditions**
Operating Temperature [5]: 0 °C to +50 °C (+32 °F to +122 °F)
Liquid Lens Autofocus models Operating Temperature [5]: 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 [6]

**Connections**
17-pin M12/Euro-style male connector for Power and I/O
4-pin D-code M12/Euro-style female connector for Ethernet connections

**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**

[4] The Ethernet interface is compatible with the following application protocols: TCP/IP, EtherNet/IP™, MODBUS® TCP, SLMP, PROFINET®. (The ABR is PROFINET compatible but not PROFINET certified.)
[5] High ambient temperature applications should use metal mounting bracket for heat dissipation.
[6] IEC IP67 when correctly connected to IP67 cables with seals.

### 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.

## 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<br>• Code 128 (GS1-128)<br>• Code 39 (Standard and Full ASCII)<br>• Code 32<br>• MSI<br>• Standard 2 of 5<br>• Matrix 2 of 5<br>• Plessey | • Interleaved 2 of 5<br>• Codabar<br>• Code 93<br>• Pharmacode<br>• EAN-8/13-UPC-A/E (including Addon 2 and Addon 5)<br>• GS1 DataBar Family<br>• Composite Symbologies | • Data Matrix ECC 200 (Standard, GS1 and Direct Marking)<br>• QR Code (Standard and Direct Marking)<br>• Micro QR Code<br>• MAXICODE<br>• Aztec Code<br>• Dotcode | • Australia Post<br>• Royal Mail 4 State Customer<br>• Kix Code<br>• Japan Post<br>• PLANET<br>• POSTNET<br>• POSTNET (+BB)<br>• Intelligent Mail<br>• 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 7, 8, or 10 [7]
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

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

## 2.4 Dimensions: 1.3 MP Models

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

*Figure 5. 1.3 MP Models: Overall Dimensions with Connector at 0°*

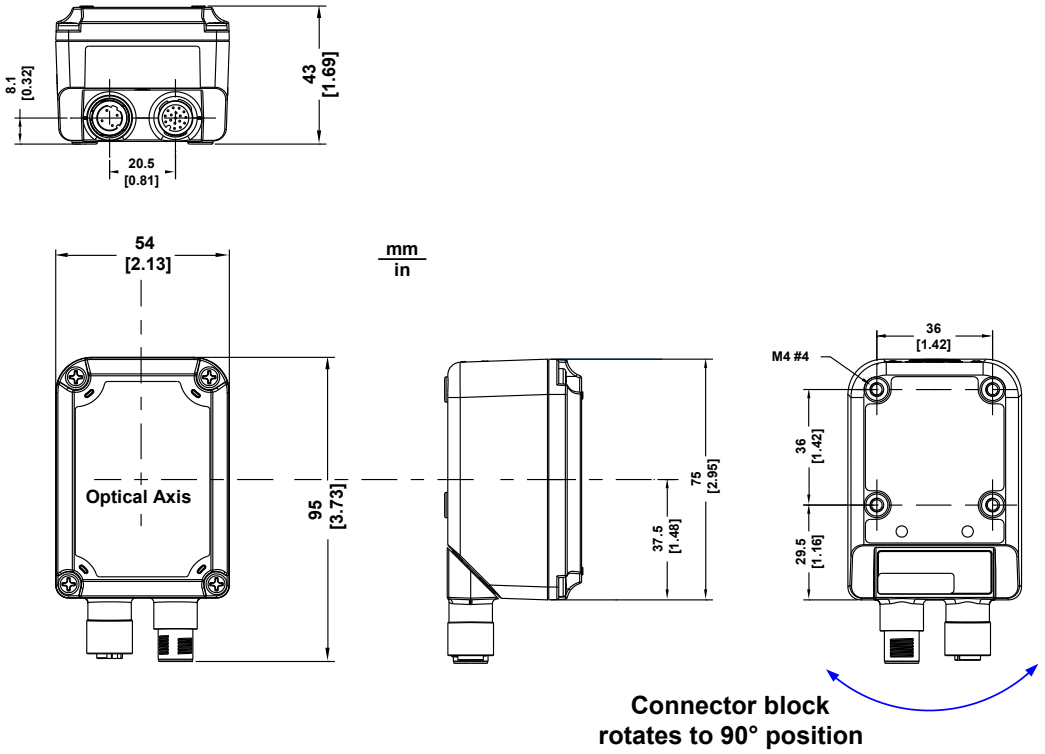
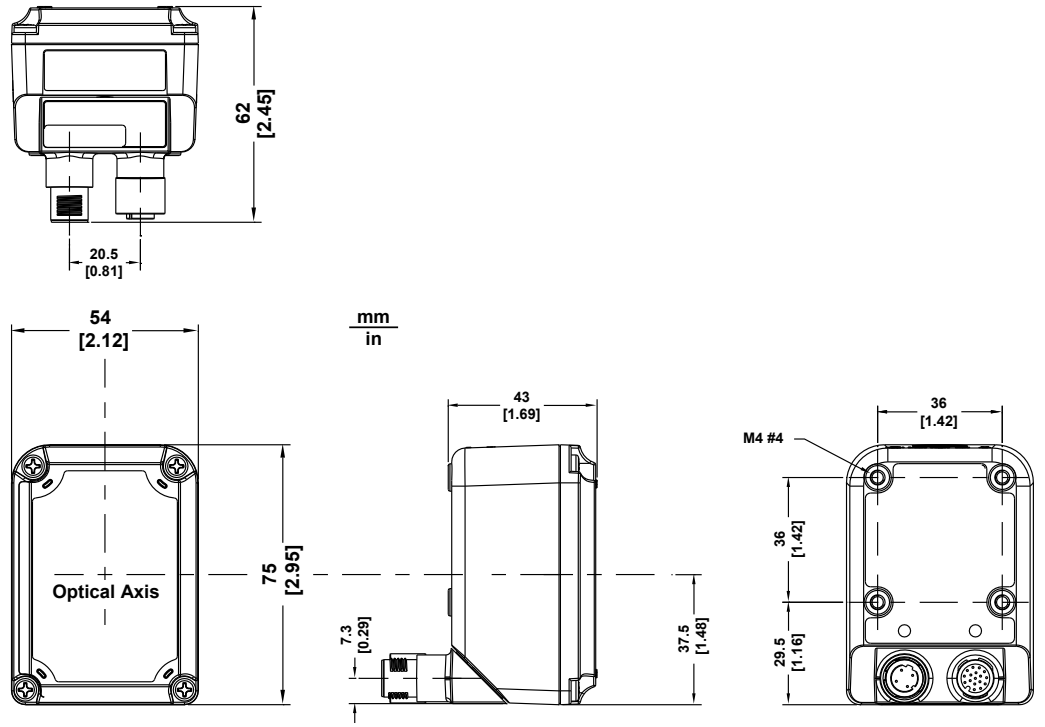



*Figure 6. 1.3 MP Models: Overall Dimensions with Connector at 90°*



## 2.5 Dimensions: 2 MP Models

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

### 2.5.1 Diffuse Models

*Figure 7. 2 MP Diffuse Models: Dimensions with Connector at 0°*

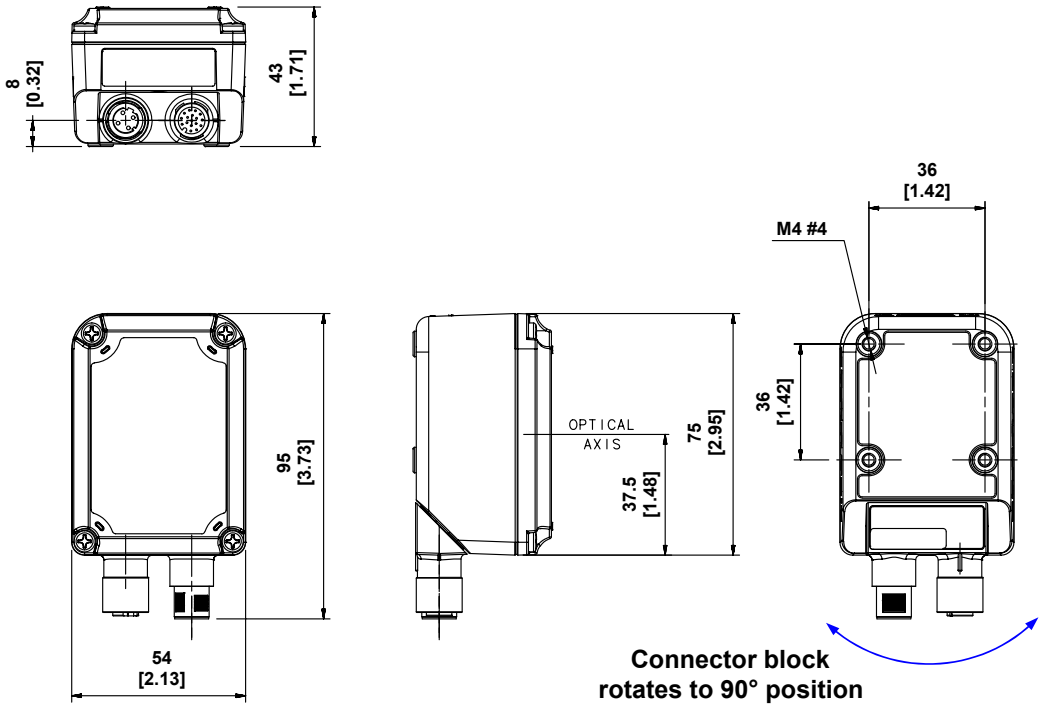
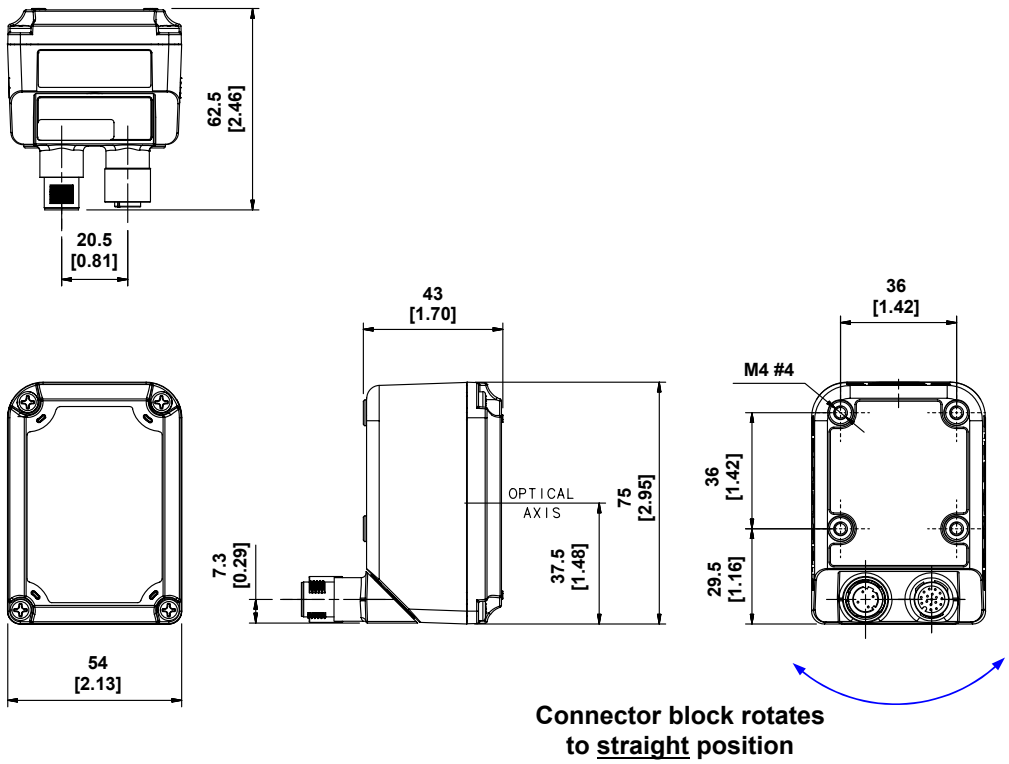


*Figure 8. 2 MP Diffuse Models: Dimensions with Connector at 90°*




## 2.5.2 Red Polarized and White Models

*Figure 9. 2 MP Red Polarized and White Models: Dimensions with Connector at 0°*

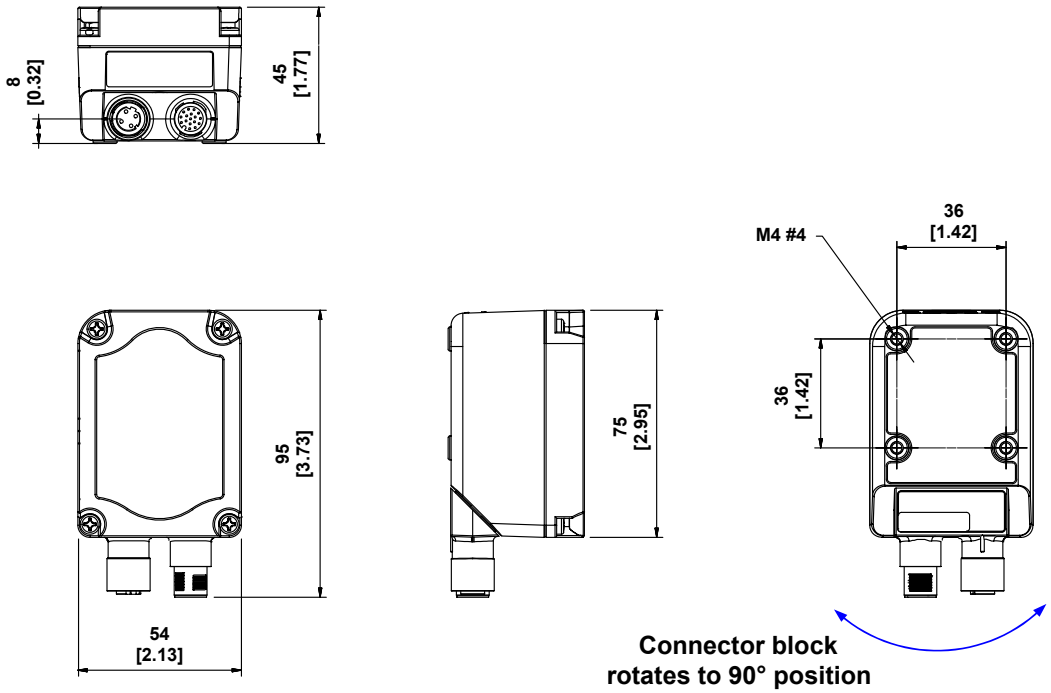
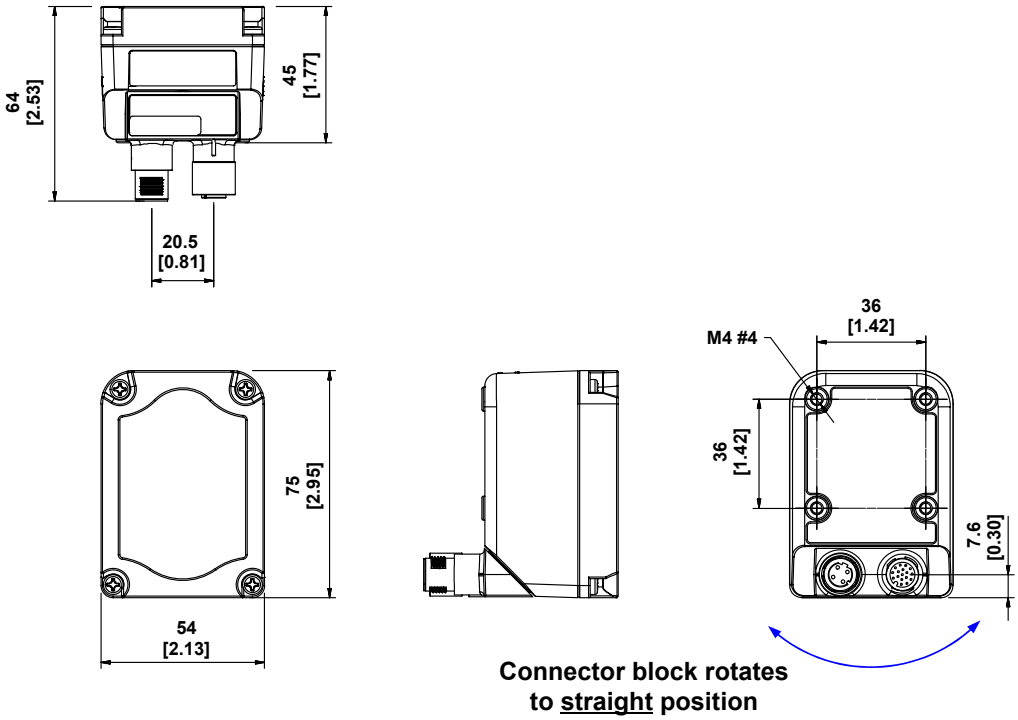


*Figure 10. 2 MP Red Polarized and White Models: Dimensions with Connector at 90°*



# 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 11. 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 p. 49.

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

| Lens | Resolution | Factory Focused Reading Distance | Horizontal Field of View |
|---|---|---|---|
| 6 mm | 1.3 MP | 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) [8] | 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) |
| 9 mm Liquid Lens Autofocus | 2 MP | 100 mm (3.9 in) [8] | 95 mm (3.7 in) |
| 16 mm Liquid Lens Autofocus | | 240 mm (9.4 in) [8] | 112 mm (4.4 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.

[8] See Aim and Autofocus the Reader—Liquid Lens Autofocus Models on p. 40to perform the autofocus to optimize the reader for other distances.

## 3.3 Position the Reader

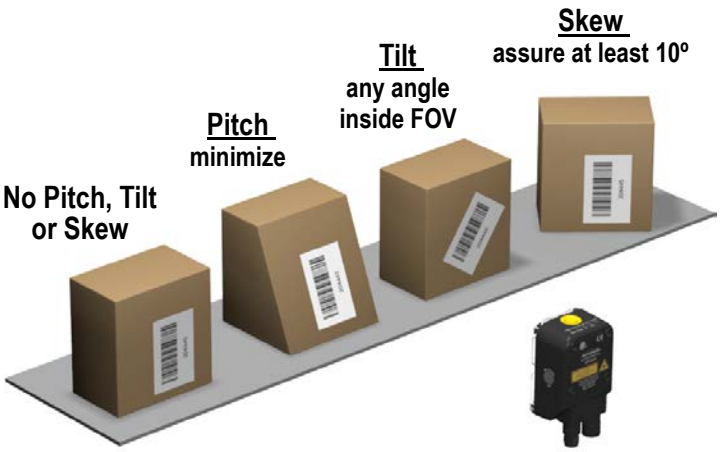
The ABR is able to decode code labels at a variety of angles; however significant angular distortion may degrade reading performance.

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 12. 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 13. Code in FOV*




*Figure 14. Code Out of FOV Due to Tilt Angle*




See Reading Features on p. 112 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 p. 25).

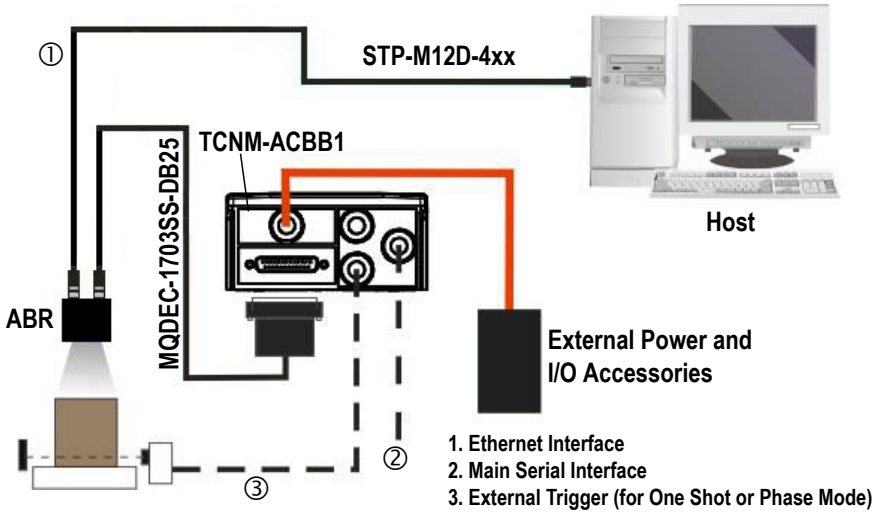
**Note:** All software configurations are made through Barcode Manager which connects to the reader through the on-board Ethernet interface (recommended) or Serial interface.

**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.

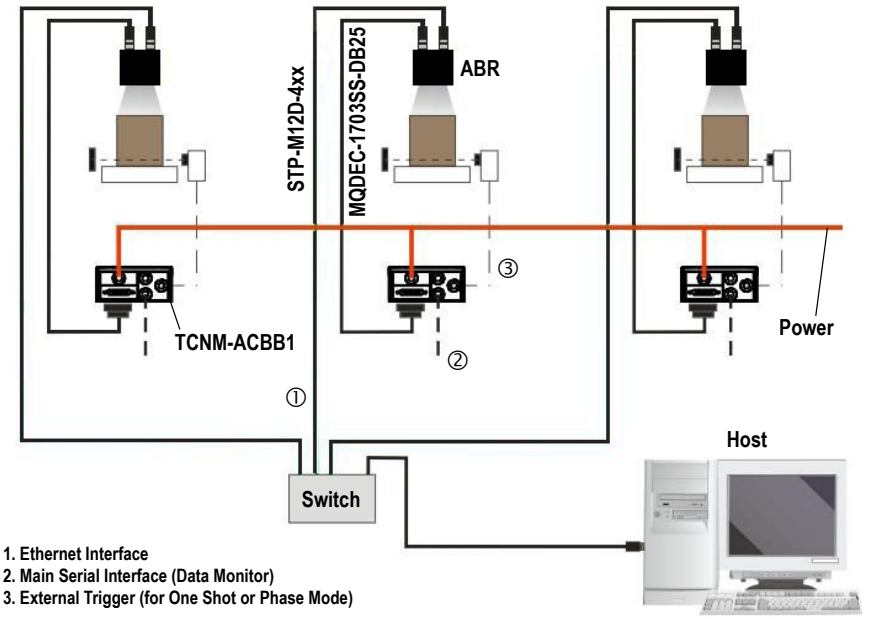
*Figure 15. Ethernet Point-to-Point Layout*




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 16. Ethernet Network Layout*



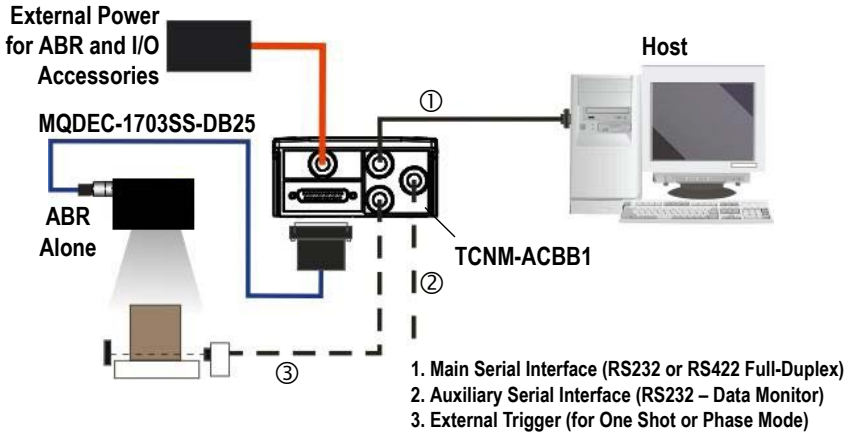

## 3.5.2 Serial Connection

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 17. Serial Interface Point-to-Point Layout*



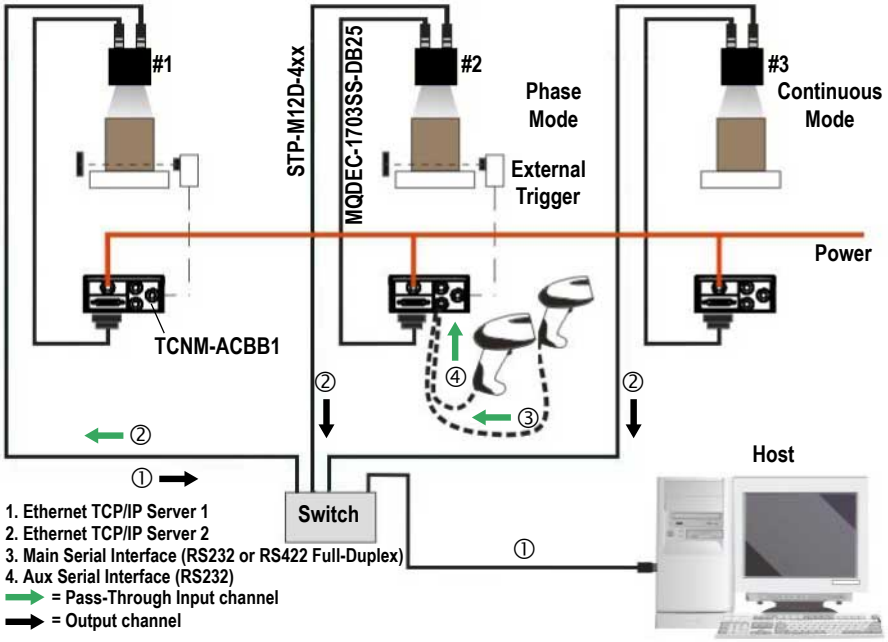

All devices always support multiple output channels (that is, for data monitoring).

## 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 18. 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.

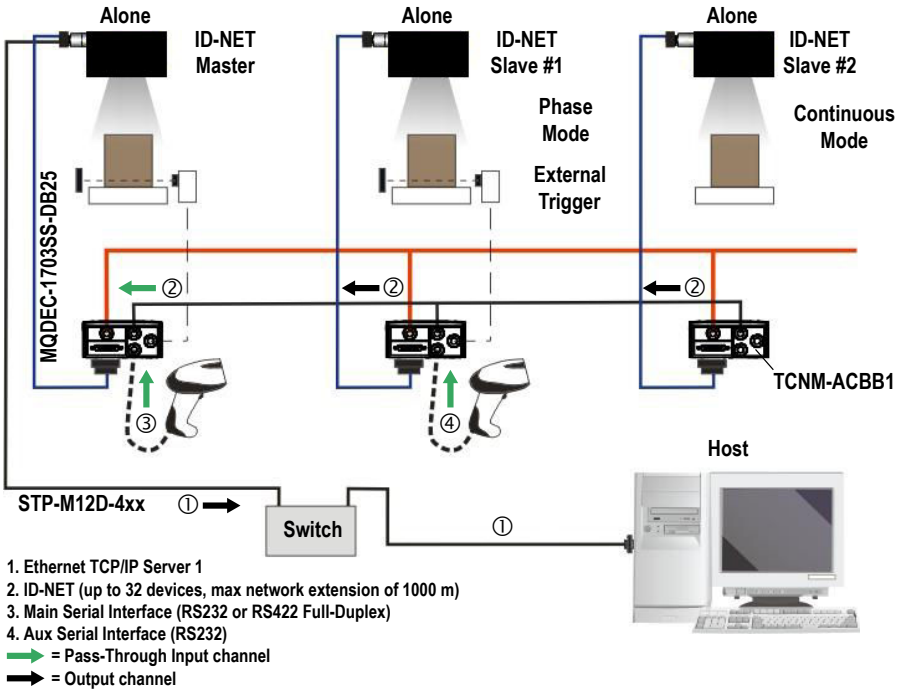
## 3.5.4 ID-NET Multidata Network (Pass-Through)

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 19. 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.

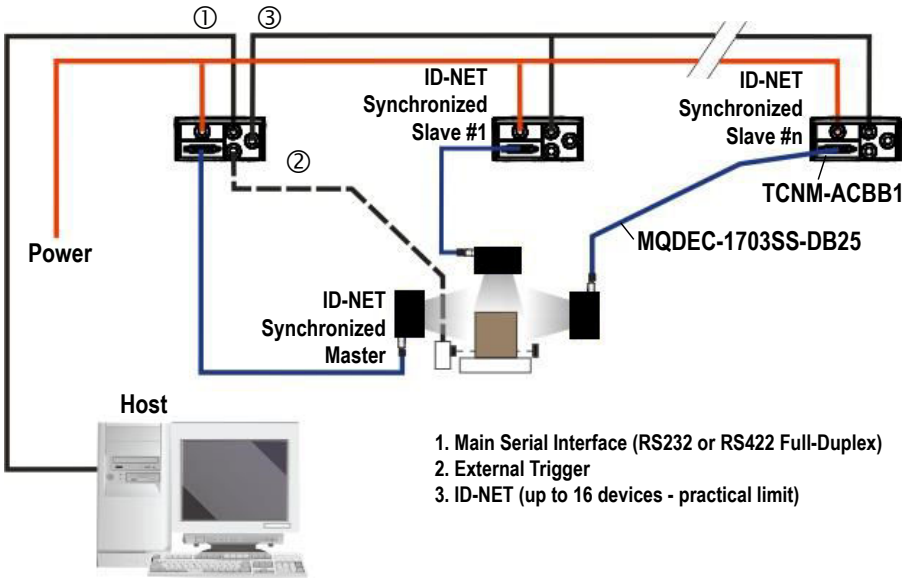
The Master reader is also connected to the Host on one of its communication channels. In the following examples the RS232/RS422 main serial interface is used.

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.

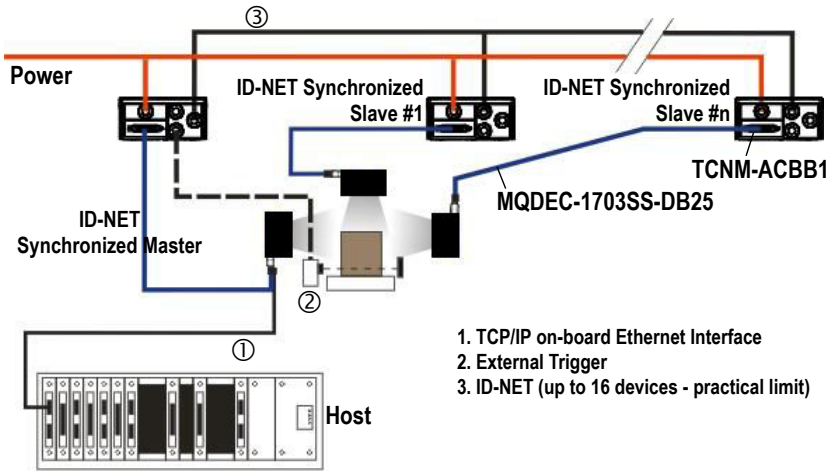
*Figure 20. ID-NET Synchronized Layout*




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 21. 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 22. M12/Euro-style 17-pin male Communications, I/O, and Power Connector*

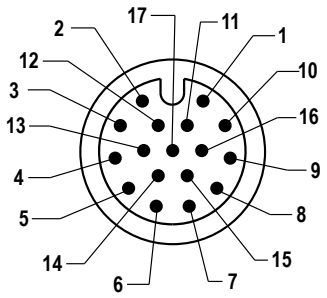



*Table 2: Power and I/O Pinouts for MQDC2S-17xx*

| Pin | Wire Color | Description | |
|---|---|---|---|
| 1 | Brown | Power Supply Input Voltage + (V dc) | |
| 2 | Blue | Power Supply Input Voltage - (GND) | |
| 3 | White | Input Signal 2 B (polarity insensitive) | |
| 4 [9] | 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 + [10] | |
| 8 [9] | Gray | Output 2<br>NPN or PNP short circuit protected and software programmable | |
| 9 [9] | Red | Output 1<br>NPN or PNP short circuit protected and software programmable | |
| 13 | White/Green | Input Signal 2 A (polarity insensitive) | |
| 14 [9] | Brown/Green | Receive Data of Auxiliary RS232 | |
| 15 | White/Yellow | ID-NET network - [10] | |
| 16 [9] | Yellow/Brown | Output 3<br>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 [9] | Violet | - | RX- [11] |
| 11 [9] | Gray/Pink | RX | RX+ [11] |
| 12 [9] | Red/Blue | - | TX- |
| 17 [9] | 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
- Connect pin "Earth" of the TCNM-ACBB1 connection box to a good earth ground

[9] Referenced to GND; any connected serial or I/O device must share a connection to GND. Outputs 1 and 2 become opto-isolated and polarity sensitive when connected through the TCNM-ACBB1 connection box. See TCNM-ACBB1 Electrical Connections on p. 25 for connection details.

[10] See ID-NET Network Termination on p. 29 for information on resister termination.

[11] If using RS422, do not leave floating. See RS422 Full-Duplex Interface on p. 27 for connection details.

- 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 p. 32 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**

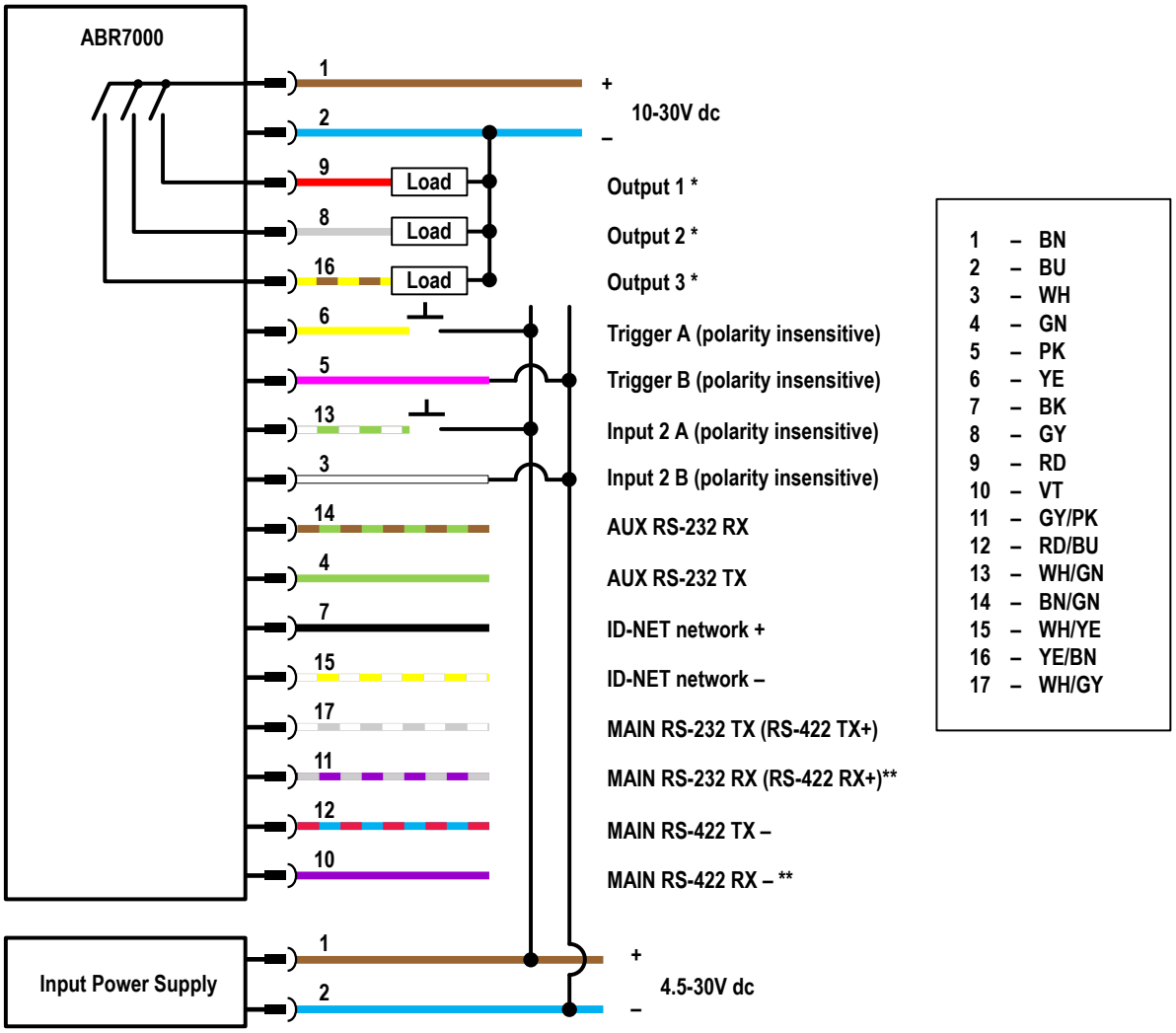
3 NPN/PNP/Push-Pull software selectable, reverse polarity and short circuit protected outputs available (2 Opto-isolated outputs instead if using TCNM-ACBB1, see for specifications)
Maximum Current: 100 mA maximum
Output Saturation Voltage (in PNP or NPN mode): < 3 V at 100 mA
Maximum load device voltage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

*Figure 23. PNP Inputs and Outputs*

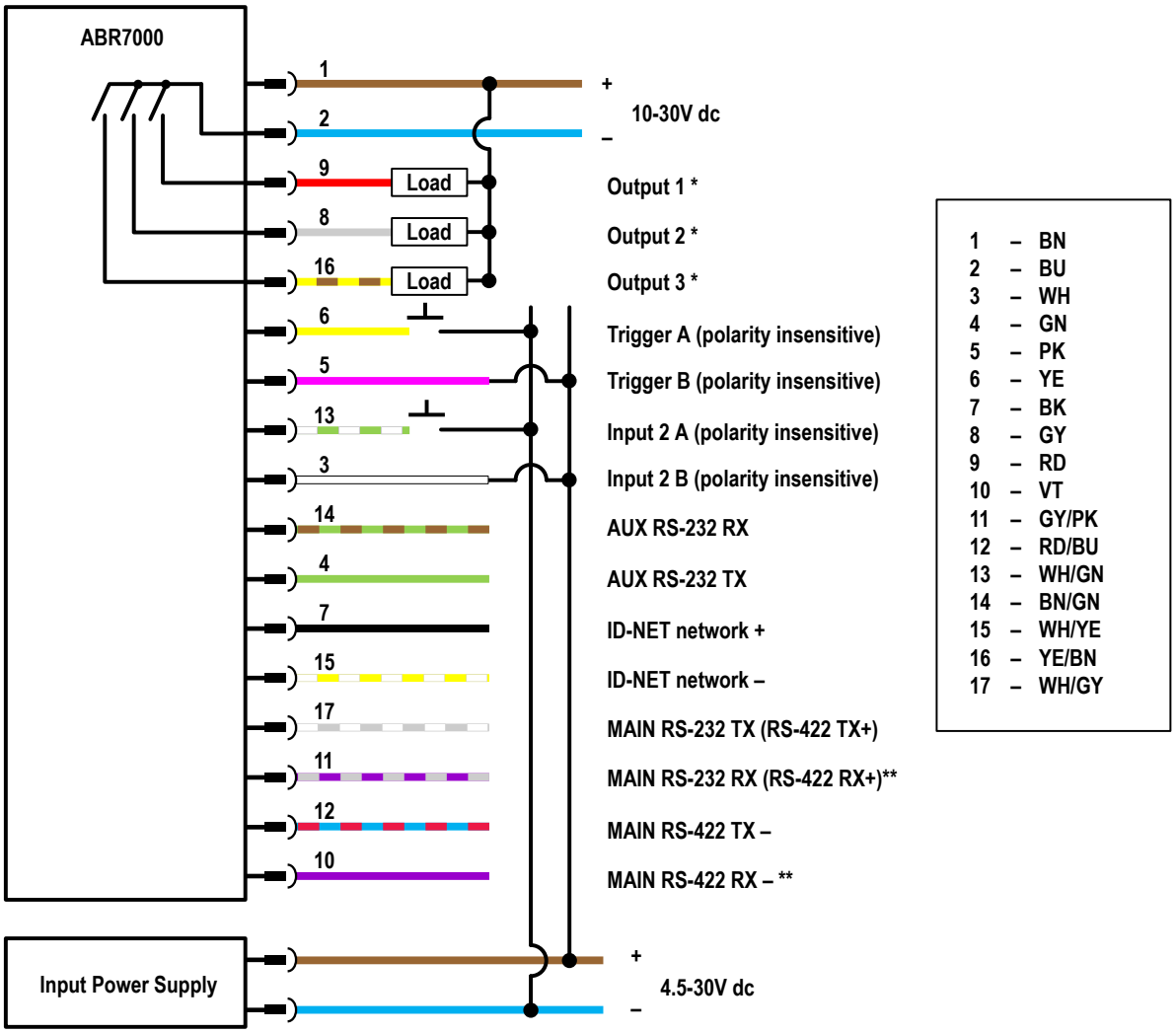



This is a typical example. Applications may vary.

* 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 24. NPN Inputs and Outputs*




**This is a typical example. Applications may vary.**

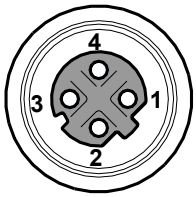
*** Output Line Type set to NPN in Barcode Manager**

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

## 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 25. 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 compatible over the Ethernet interface:

- EtherNet/IP™ [12]
- MODBUS® TCP Client [13]
- MODBUS® TCP Server [13]
- SLMP
- PROFINET® [14]

## 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 p. 20.

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) |

[12] EtherNet/IP™ is a trademark of ODVA, Inc.
[13] MODBUS® is a registered trademark of Schneider Electric USA, Inc.
[14] PROFINET® is a registered trademark of PROFIBUS Nutzerorganisation e.V.

| TCNM-ACBB1 Terminal Block Connectors | | |
|---|---|---|
| I2B | Input 2 B (polarity insensitive) | |
| -V | Power Reference – Inputs | |
| **Outputs** | | |
| +V | Power Source - Outputs | |
| -V | Power Reference - Outputs | |
| O1+ | Output 1 + opto-isolated and polarity sensitive | |
| O1- | Output 1 - opto-isolated and polarity sensitive | |
| O2+ | Output 2 + opto-isolated and polarity sensitive | |
| O2- | Output 2 - opto-isolated and polarity sensitive | |
| **Auxiliary Interface** | | |
| 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+ [15] |
| | - | 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.

[15] Do not leave floating. See RS422 Full-Duplex Interface on p. 27 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.

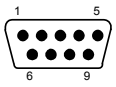
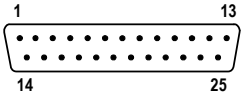
The TCNM-ACBB1 pinout follows:

| 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 p. 29.

- 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*

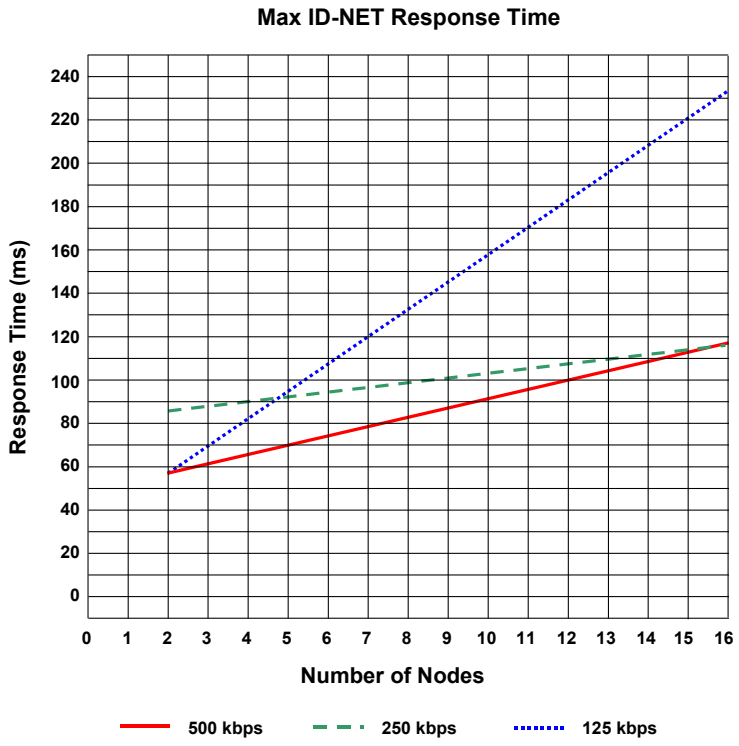
| Baud Rate | 125 kbps | 250 kbps | 500 kbps | 1Mbps |
|---|---|---|---|---|
| Cable Length | 1200 m | 900 m | 700 m | Application dependent; contact Banner Engineering for details. |

**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 26. 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 27. ID-NET Network Connections with Isolated Power Blocks*

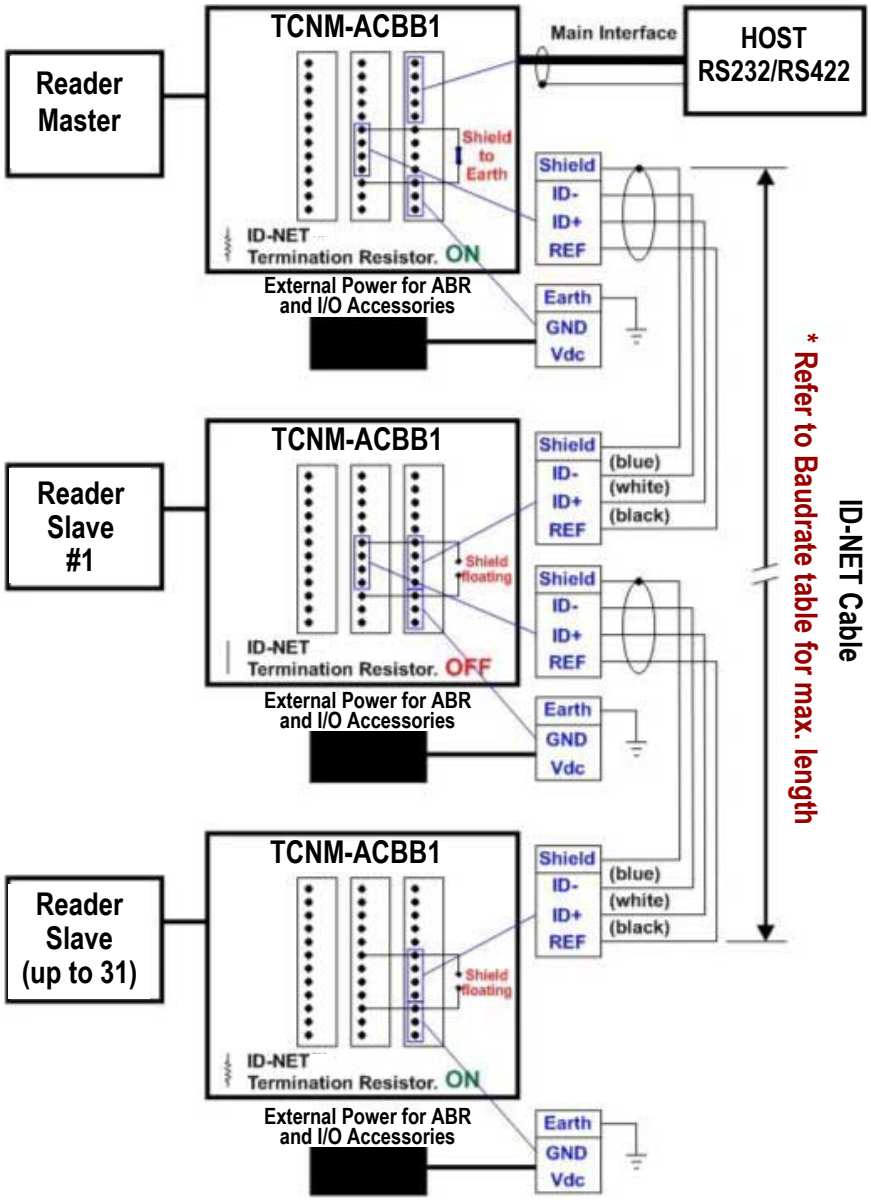


*Figure 28. ID-NET Network Connections with Common Power Branch Network*

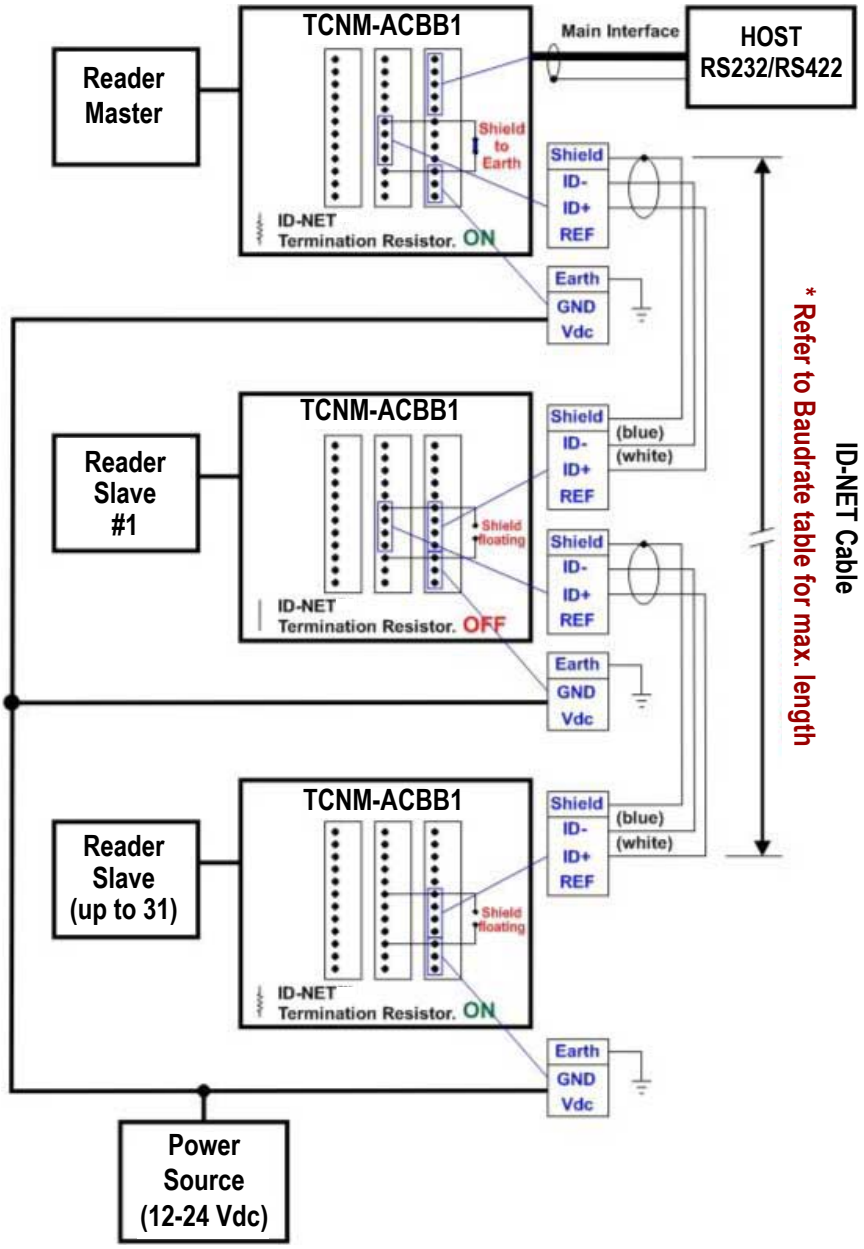
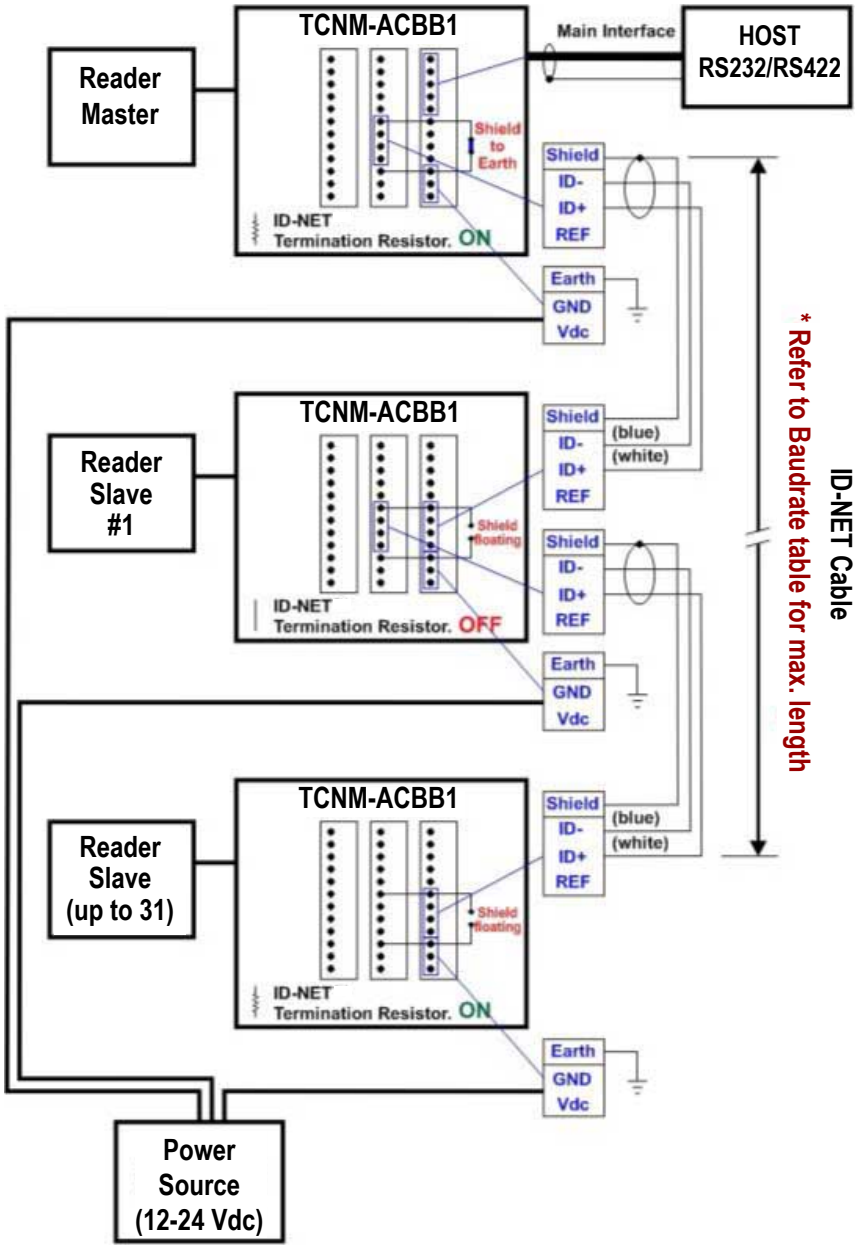


*Figure 29. ID-NET Network Connections with Common Power Star Network*



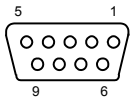

## 3.7.5 Auxiliary RS232 Interface

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.

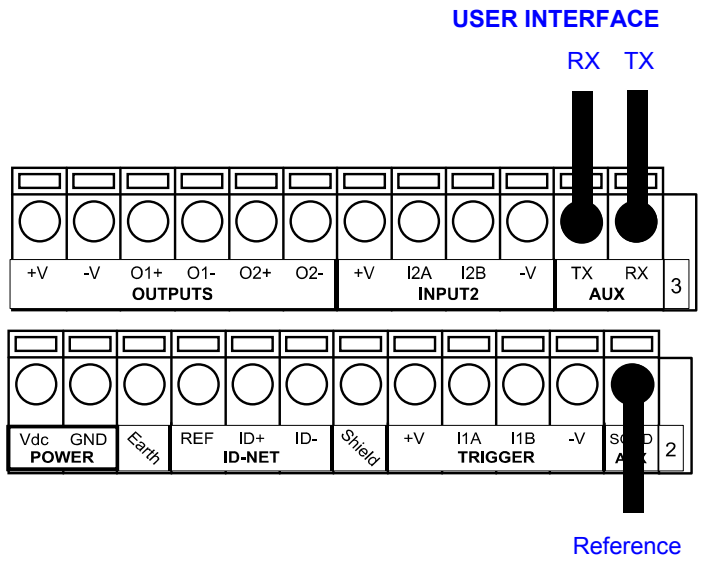
*Figure 30. 9-pin female connector*




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 31. 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 32. PNP External Trigger Using ABR Power*

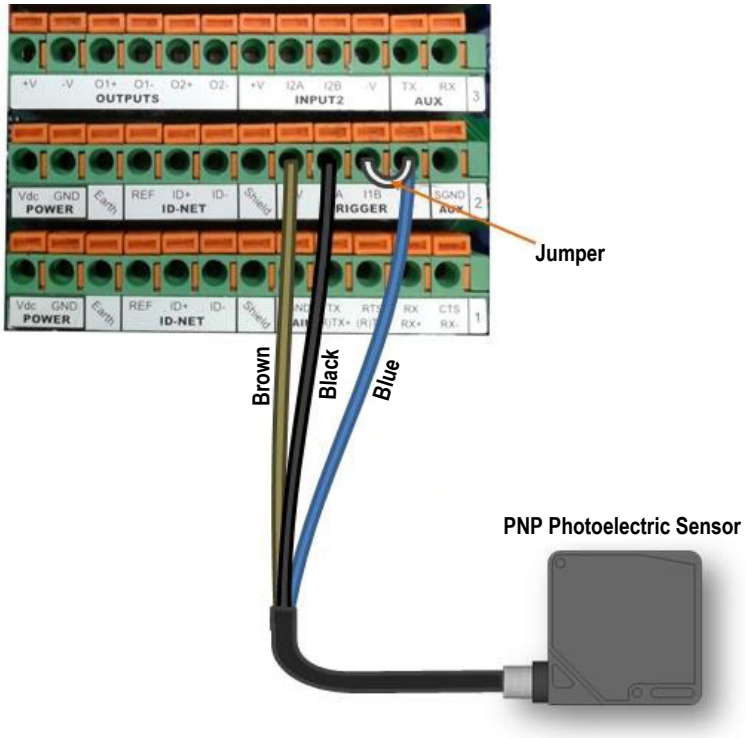
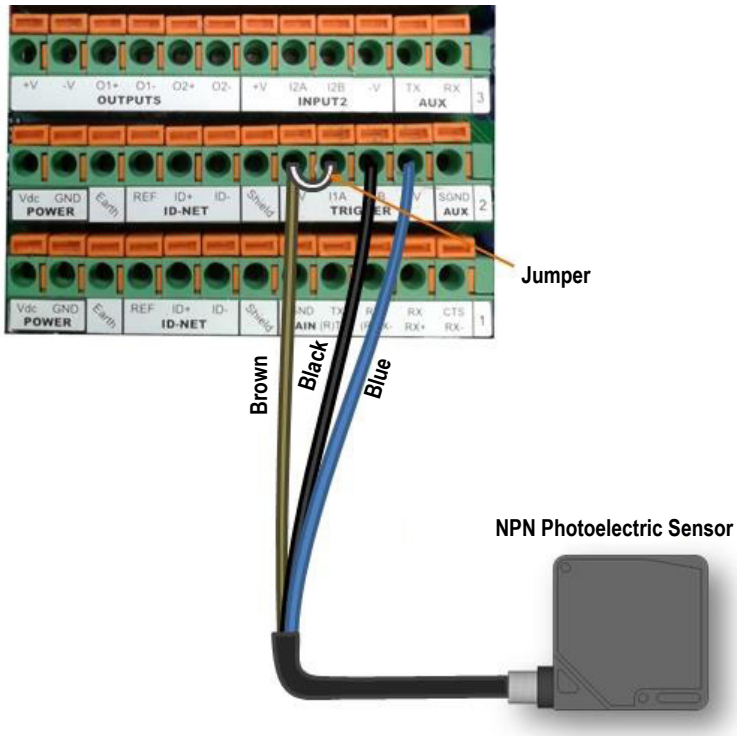


*Figure 33. NPN External Trigger Using ABR Power*




## External Trigger Input Connections Using External Power

*Figure 34. PNP External Trigger Using External Power*

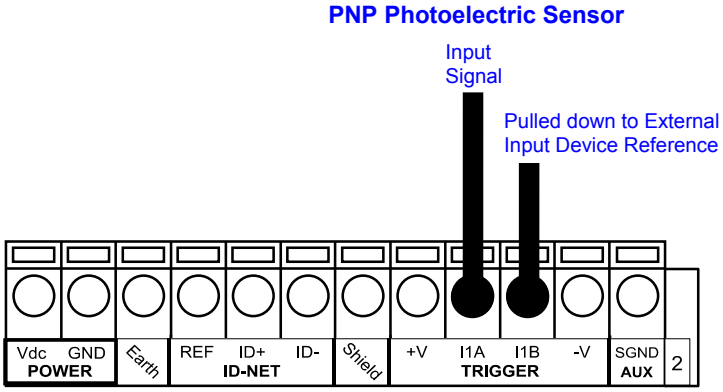
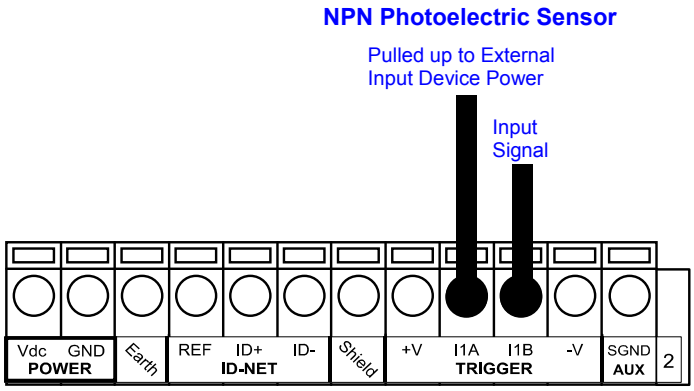


*Figure 35. NPN External Trigger Using External Power*




| 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 36. PNP Input 2 Using ABR Power*

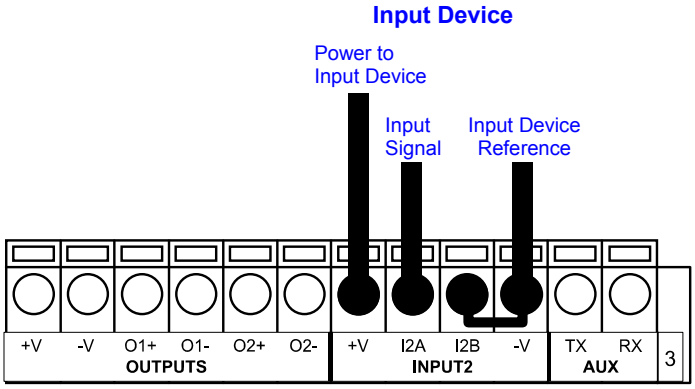
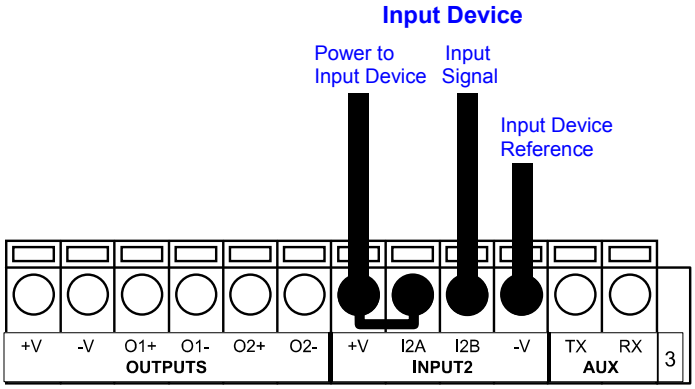



*Figure 37. NPN Input 2 Using ABR Power*



## Input 2 Connections Using External Power

*Figure 38. PNP Input 2 Using External Power*

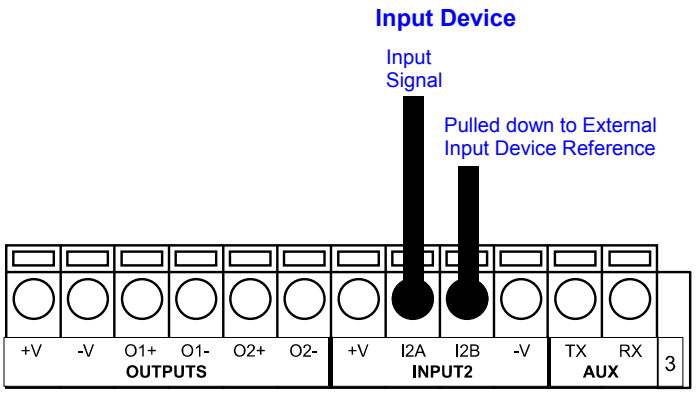
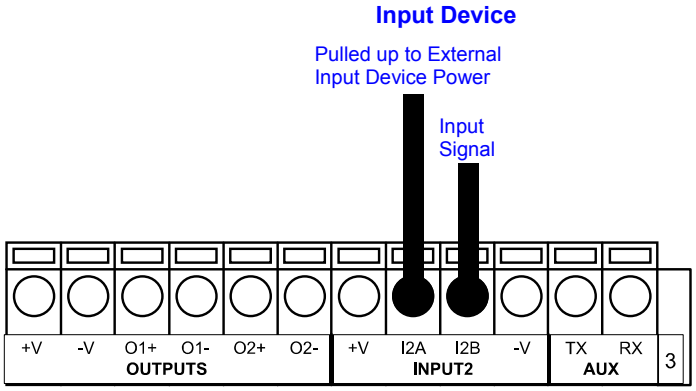



*Figure 39. NPN Input 2 Using External Power*




## 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 40. PNP/Open Emitter Output Using ABR Power*

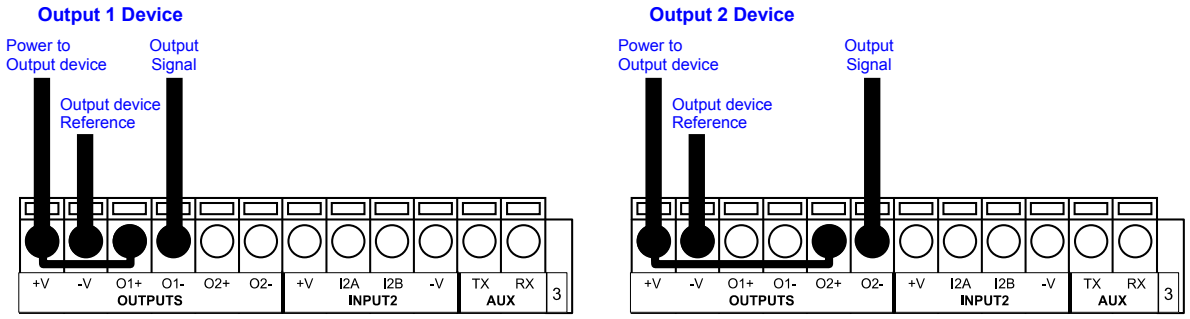
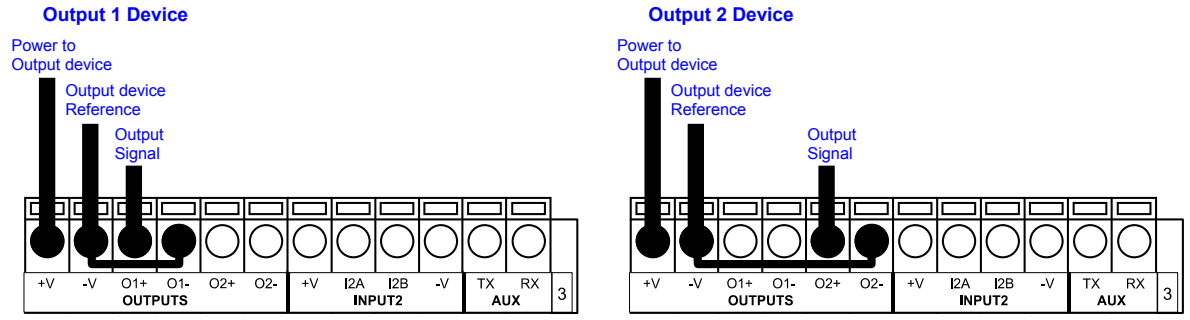



*Figure 41. NPN/Open Collector Output Using ABR Power*




## Output 1 and 2 Connections Using External Power

*Figure 42. PNP/Open Emitter Output Using External Power*

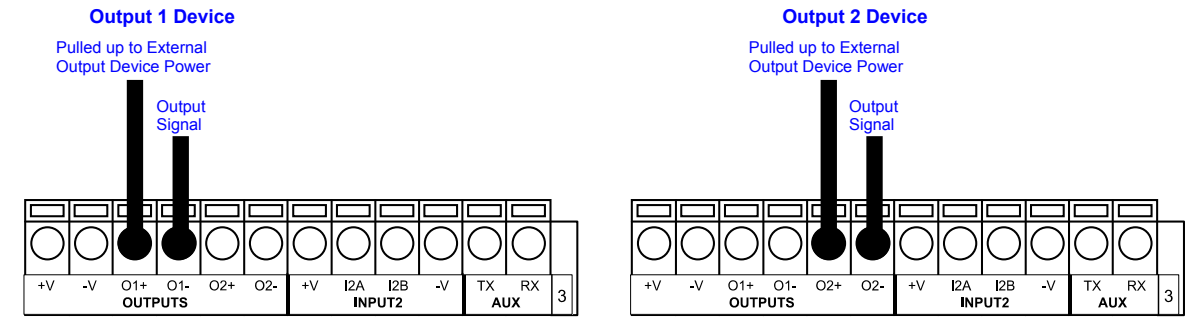
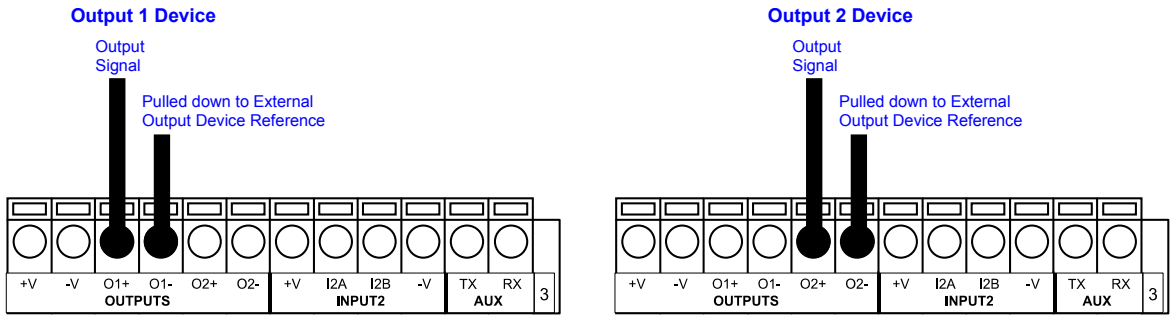


*Figure 43. NPN/Open Collector Output Using External Power*




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

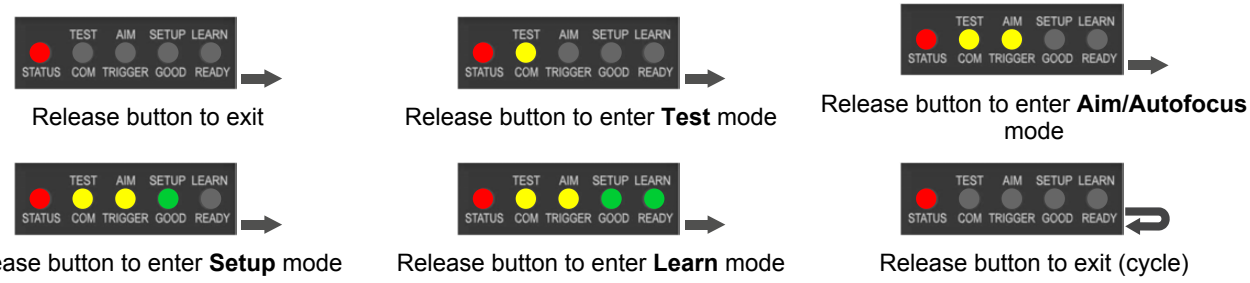
Status information is clearly presented by means of the five colored LEDs. The single push button provides access to the following modes.

- **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:




## 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 44. Smart Teach Interface: Test Function*




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

*Figure 45. 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 p. 113 for reference.
2. Enter **Aim** mode by pressing and holding the Smart Teach button until the Aim LED is on.

*Figure 46. 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 47. 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 p. 153.

   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 1.3 MP Models: Liquid Lens Autofocus Models 9 mm Lens on p. 115 for reference.
3. Enter Aim/Autofocus mode by pressing and holding the Smart Teach button until the Aim LED is on.

*Figure 48. 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 49. 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 50. 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.

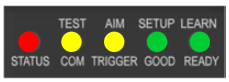
## 4.5 Learn

Once entered, the imager starts a procedure to automatically detect and recognize a single code [17] 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 51. 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 p. 39.

[17] The Learn procedure does not recognize the following symbologies: Postal Codes, Pharmacode, and MSI. 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® 7, 8, or 10 [18] computer. Barcode Manager does not currently support Windows Embedded (often used in industrial PCs and/or PLCs).

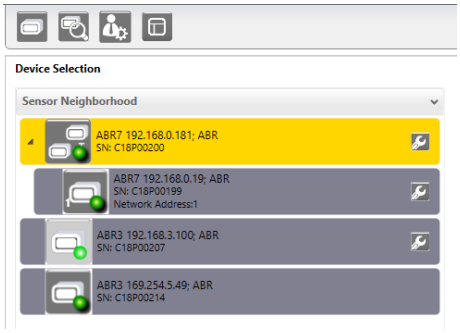
1. Download the latest version of Barcode Manager from www.bannerengineering.com.
2. Navigate to and open the downloaded file.
3. Run the downloaded file to access the installation screen.
4. Follow the onscreen installation procedure.
   After the installation is complete, the Barcode Manager entry 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 52. Device Discovery*



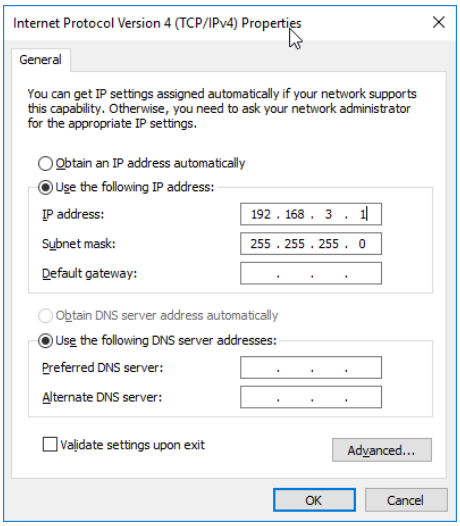

The Barcode Manager discovery feature also shows devices not belonging to the LAN and displays them in light gray (see Figure 52 on p. 42).

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

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**.

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

*Figure 53. 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 54. Device Selection—Selected Device Details*

| Selected Device Details | |
|---|---|
| Name | ABR |
| Model | ABR3006-WSU2 |
| Layout Type | Alone |
| Internal Network Role | Slave |
| Status | Default Running |
| Startup Info | OK |
| Application SW Version | 1.5.4.645-f273f1 |
| Loader Version | N/D |

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 p. 49.

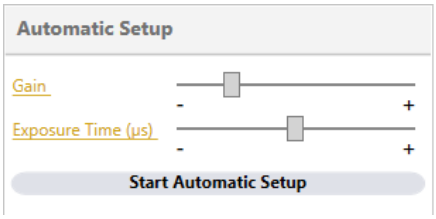
Automatic Setup provides an automatic procedure for setting optical/illumination and code definition parameters to obtain the most stable decoding conditions for a single code symbology based on the images presented to the reader. It can be set to include Image Filters if necessary. See the table below 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 Live Image Capture 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.

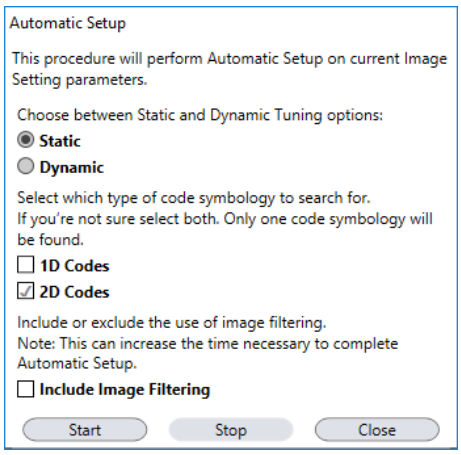
**Note:** If the image display area is too dark to see the images being captured, drag the Gain and Exposure Time sliders to the right to increase visibility. This will not affect Automatic Setup.

*Figure 55. Gain and Exposure Time*




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

*Figure 56. 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 p. 52.

## 6.2 Advanced Setup for Liquid Lens Autofocus Models

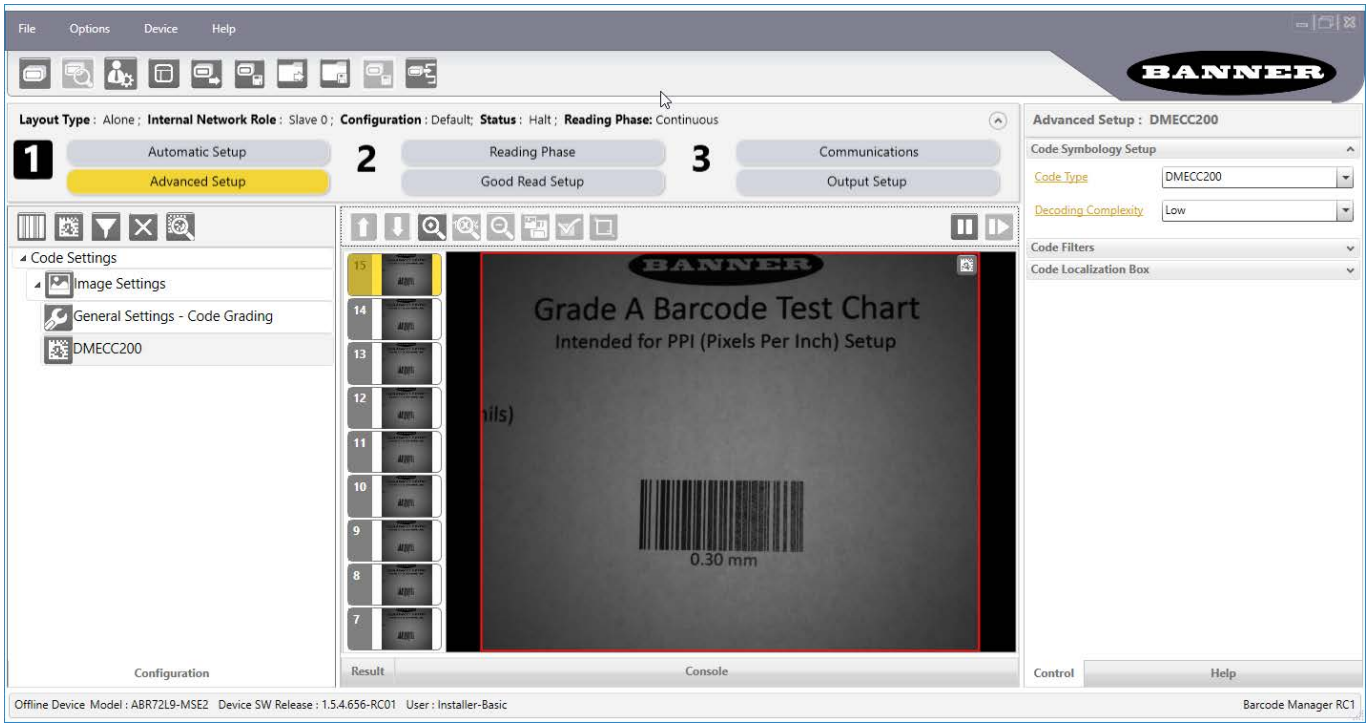
Advanced Setup provides access to the complete array of optical/illumination and code definition parameters that can be fine-tuned semi-automatically and manually to obtain the best results for applications of any complexity. If your application requires multiple code symbologies, multiple image settings, 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 p. 49.

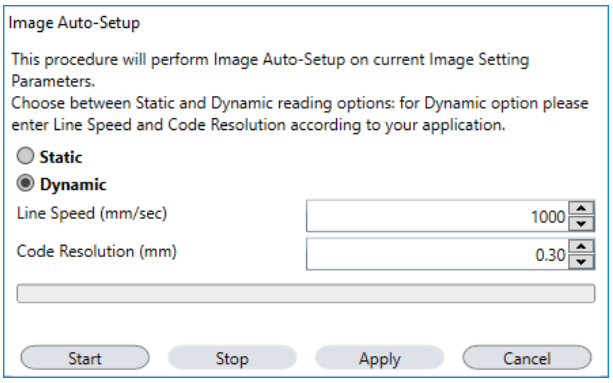
1. From the **Task Area** select **Open Device Configuration**.
   The **Open Device Configuration** window opens showing the list of currently saved configurations (jobs) saved on the device. For new devices, the only saved job is the Default configuration.
2. Click **OK**.
   The device enters run 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. (See PPI (Pixels Per Inch) Setup Chart on p. 153.)
6. After the chart is positioned, click **Pause** to stop image acquisition.

*Figure 57. 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 **Line Speed** and **Code Resolution** to avoid image blurring

*Figure 58. **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**.

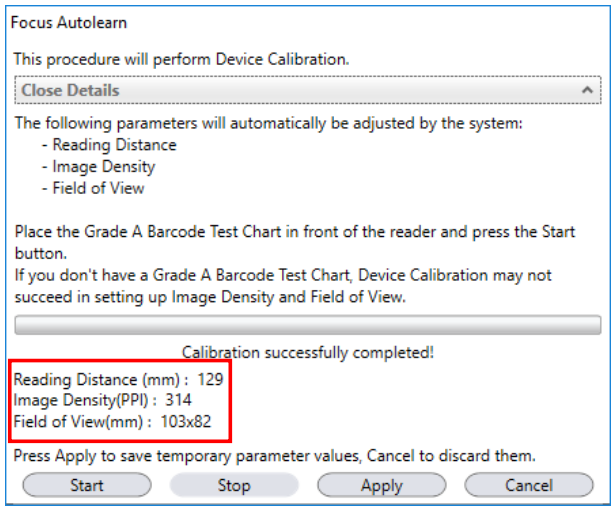
**Tip:** You may have to click **Image Settings** again before you can click **Focus Autolearn.**

**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 59. Reading Distance, Image Density, and FOV Dimensions*



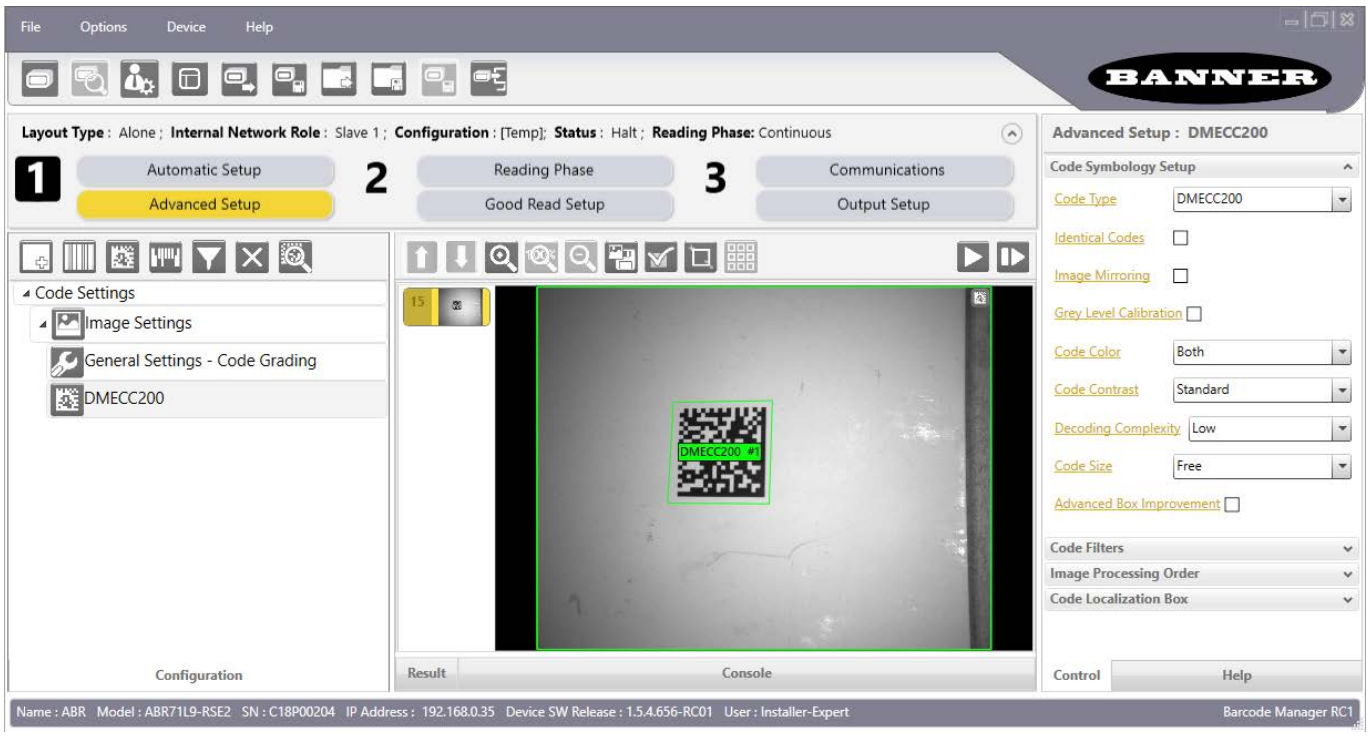

14. Click **Apply**.

> **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 60. 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 [19]. See the Barcode Manager Instruction Manual (p/n 207635) for details.

Continue the configuration using Reading Phase on p. 52.

## 6.3 Advanced Setup for Manual Adjustable Focus Models

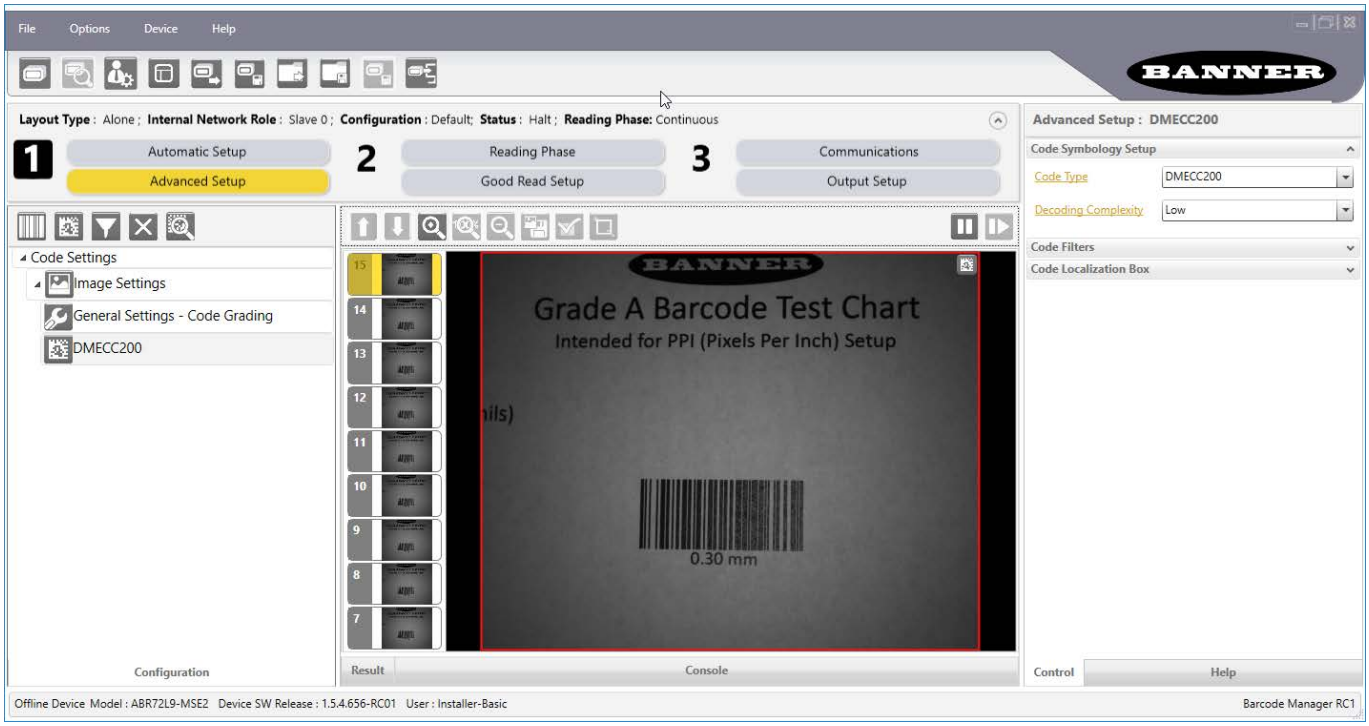
Advanced Setup provides access to the complete array of optical/illumination and code definition parameters that can be fine-tuned semi-automatically and manually to obtain the best results for applications of any complexity. If your application requires multiple code symbologies, multiple image settings, 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 p. 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. See PPI (Pixels Per Inch) Setup Chart on p. 153.
6. After the chart is positioned, click the **Pause** icon to stop image acquisition.

*Figure 61. Chart Positioned*

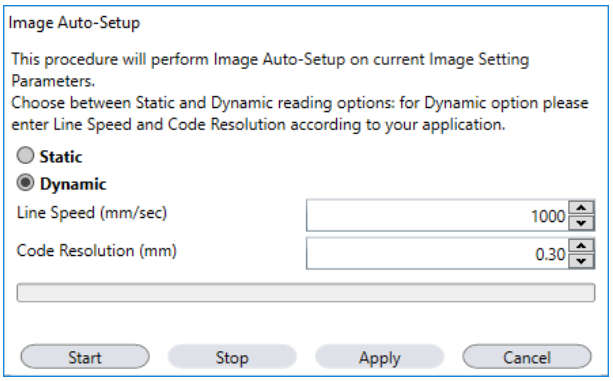



[19] The Code Autolearn procedure does not recognize the following symbologies: Pharmacode, MSI, Standard 2 of 5, Matrix 2 of 5.

**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 **Line Speed** and **Code Resolution** to avoid image blurring

*Figure 62. **Image Auto-Setup** Window*

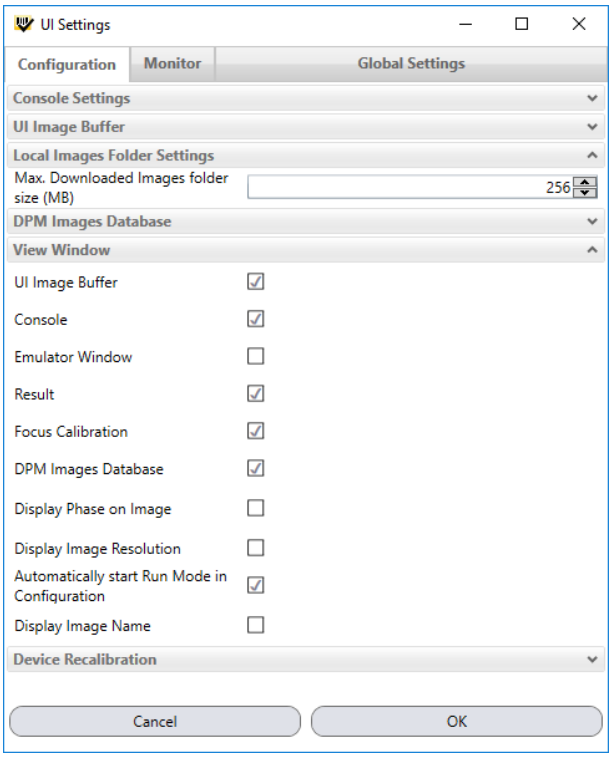



10. Click **Start**.
11. Click **Apply**.

**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 63. UI Settings*

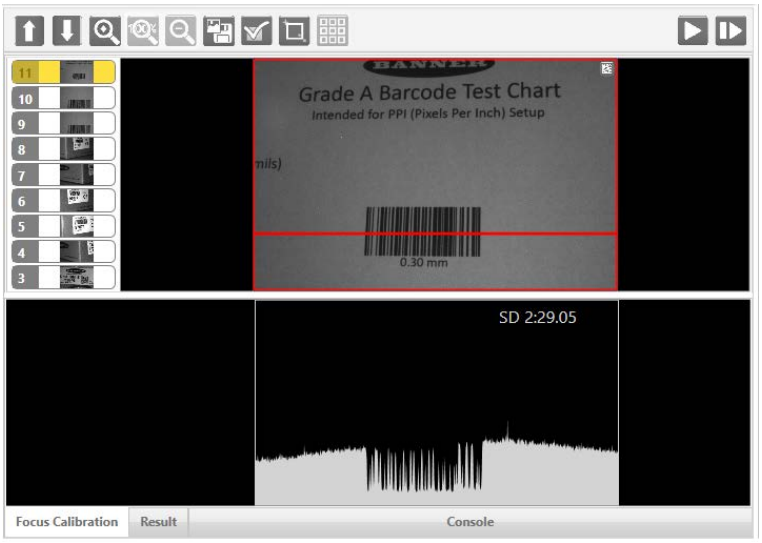


14. Click the **Focus Calibration** tab at the bottom of the window.

**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 64. Oscilloscope View*



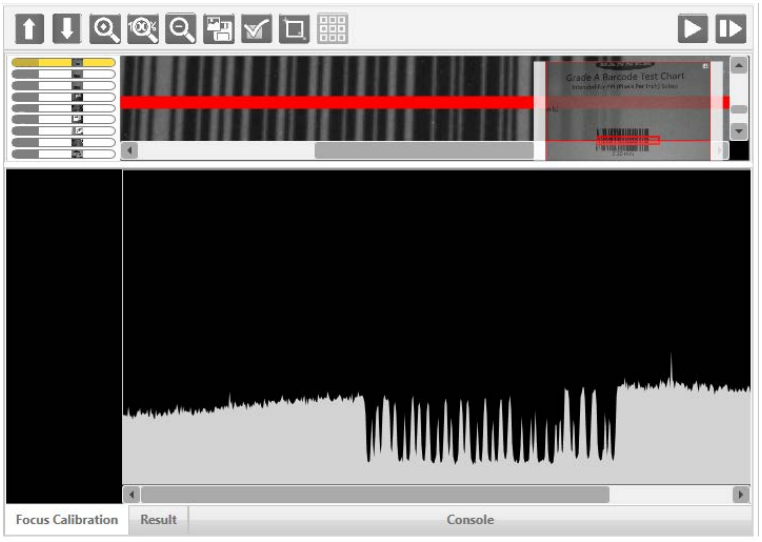

The red line in the image panel above the oscilloscope must pass through the code. Click and drag the red line vertically to reposition it over the code.

**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 65. 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 66. 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 [20].
    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 p. 52.

## 6.4 Reading Phase

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

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

**Continuous Mode** and **Acquisition Trigger** are shown by default.

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

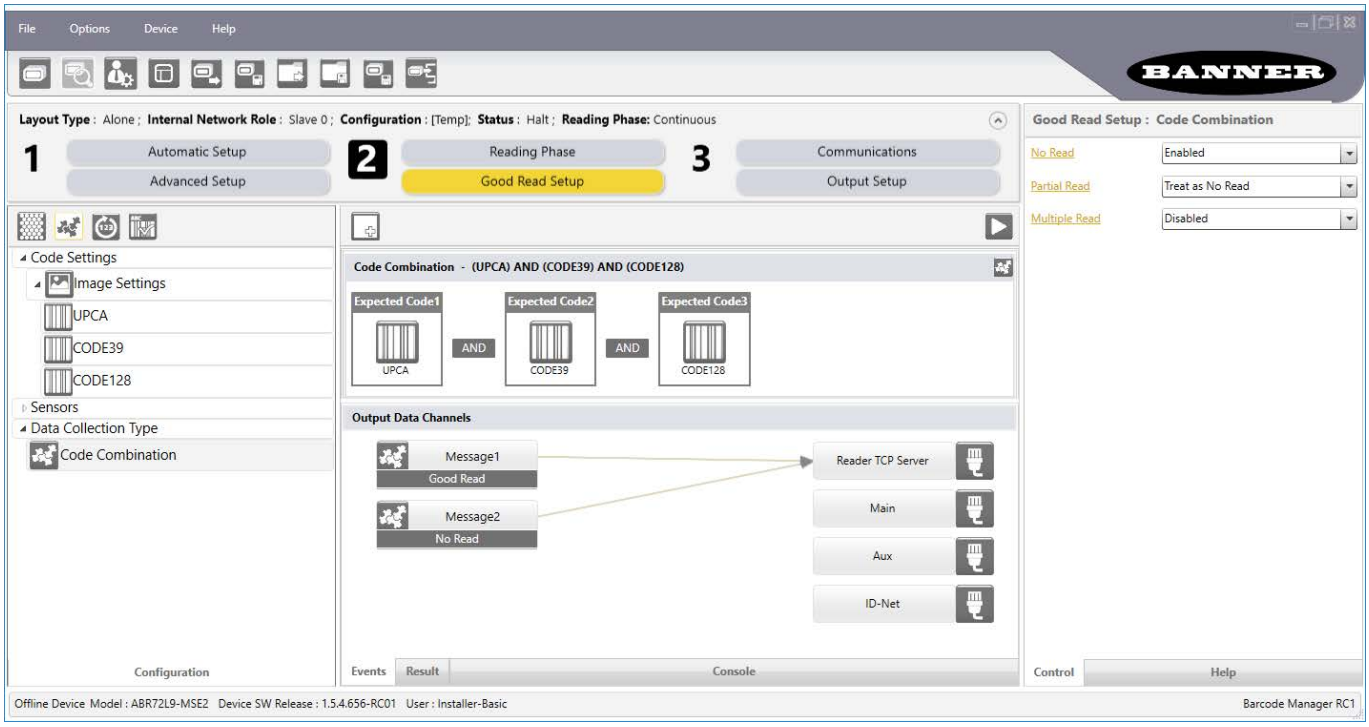
## 6.5 Good Read Setup

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.

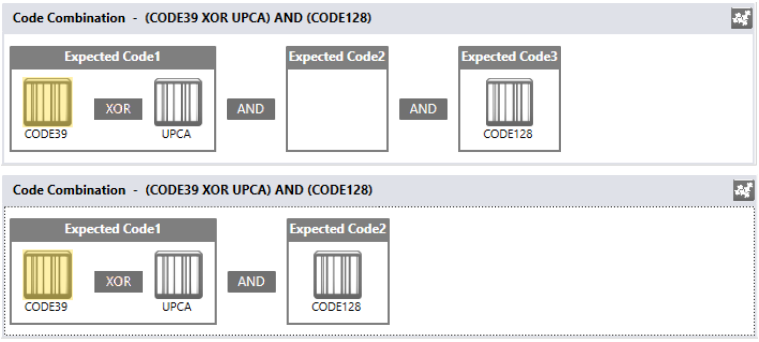
   The following example shows **Code Combination**. By default, the Expected Codes (when more than one code type is selected), are in logical AND, which means that all codes are required to be decoded to produce a Good Read condition.

*Figure 67. 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.

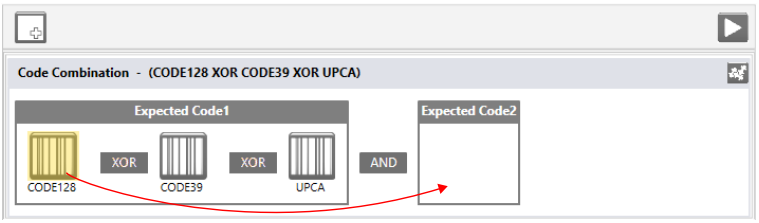
*Figure 68. Code Combination*




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 69. New Expected Code*

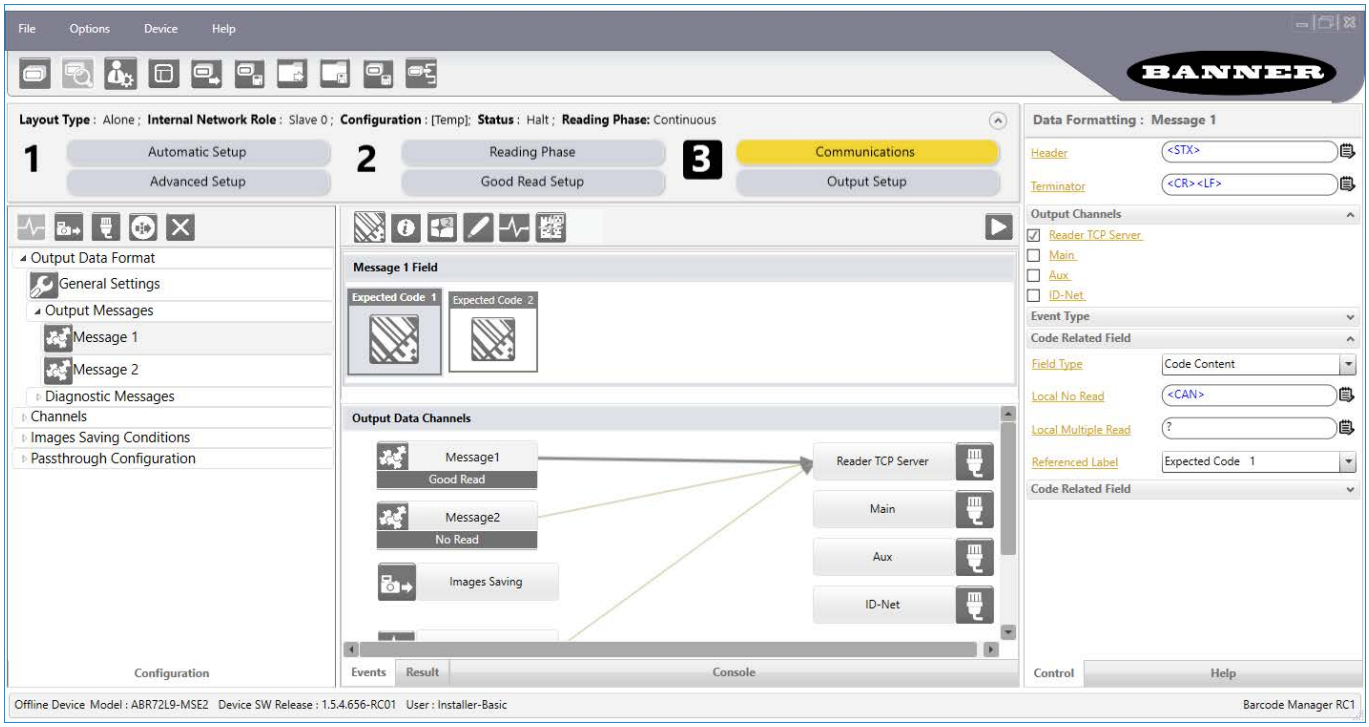



## 6.6 Communications

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

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

*Figure 70. Communications*




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

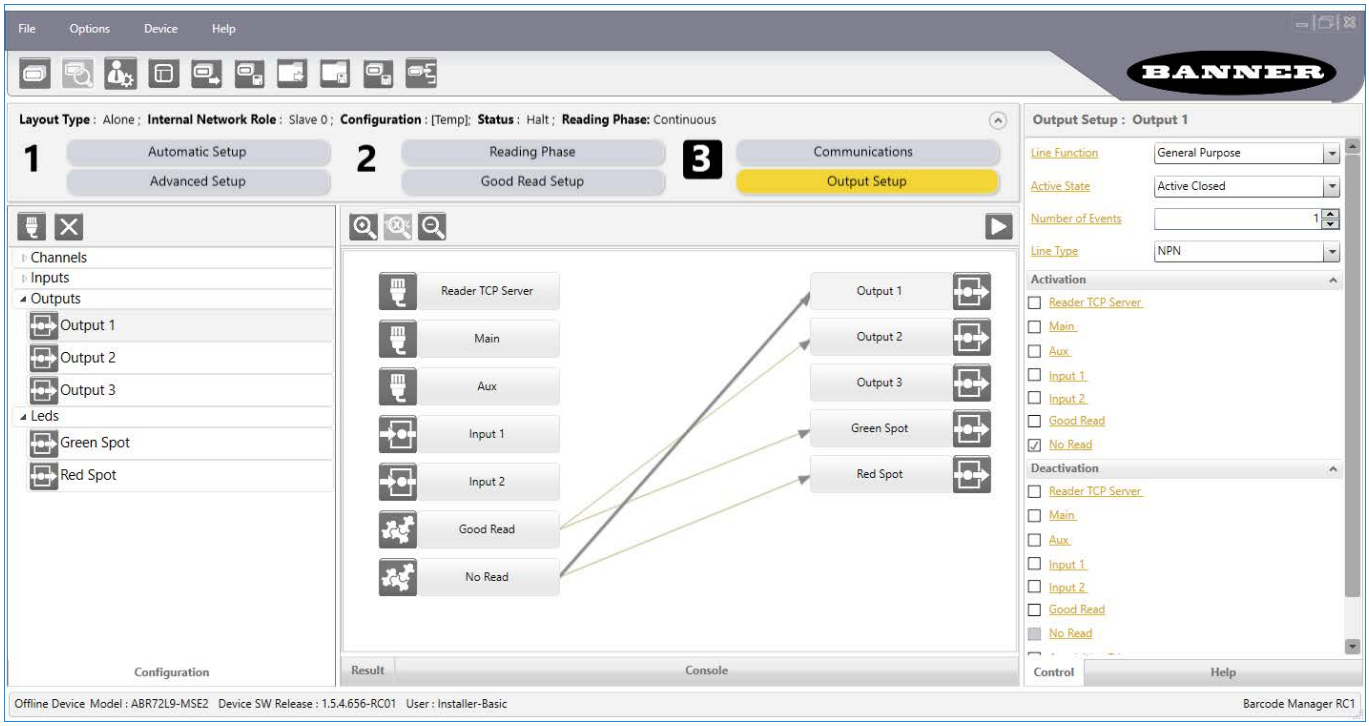
4. Drag the fields to position them between other fields in the message so that the output message is ordered according to your application requirements.

   Each field has its own relative configuration parameters in the Control 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 71. 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

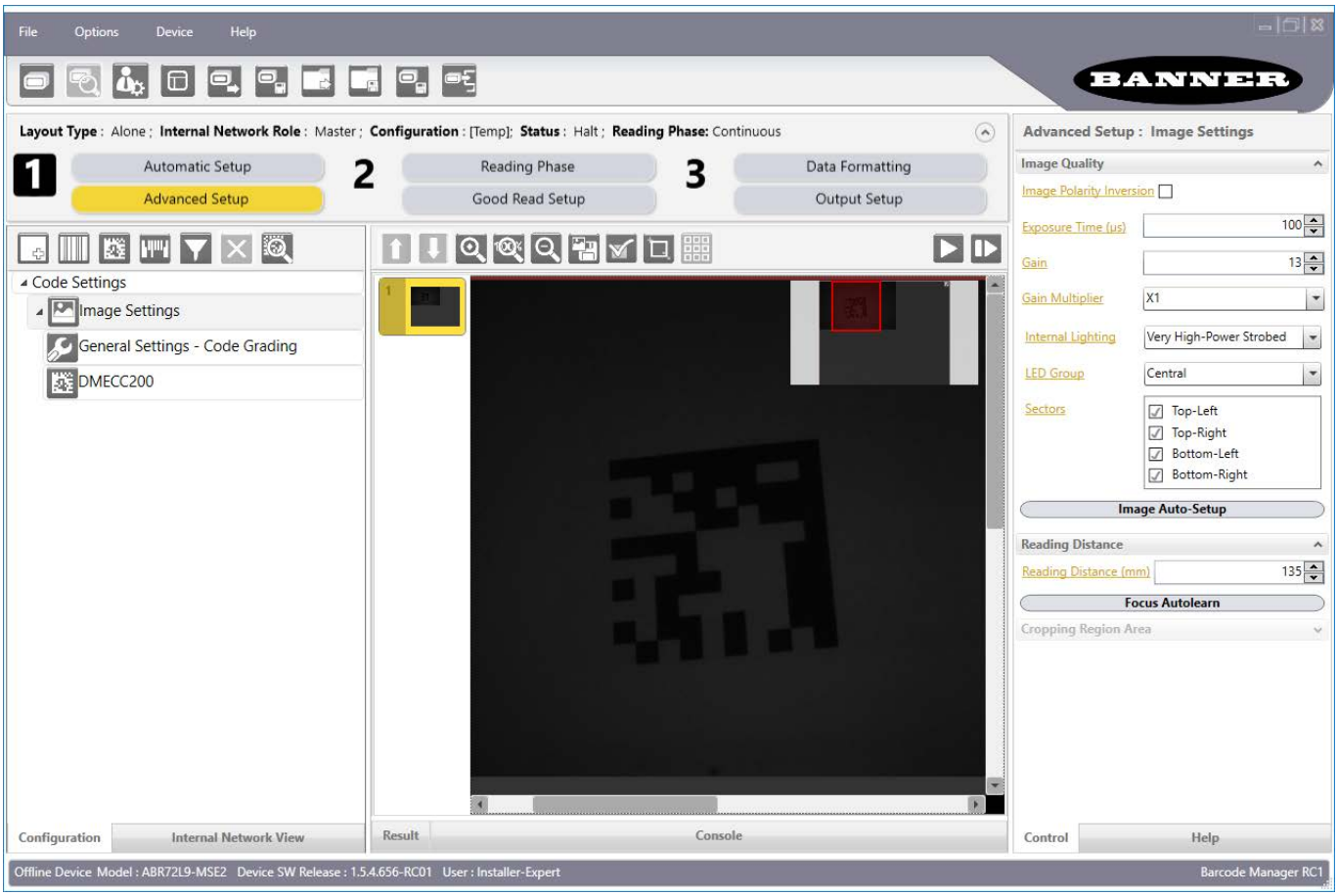
To correct an under-exposure result it is recommended to change the following parameters in their order of appearance:

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 72. Example Under Exposure: Too Dark*

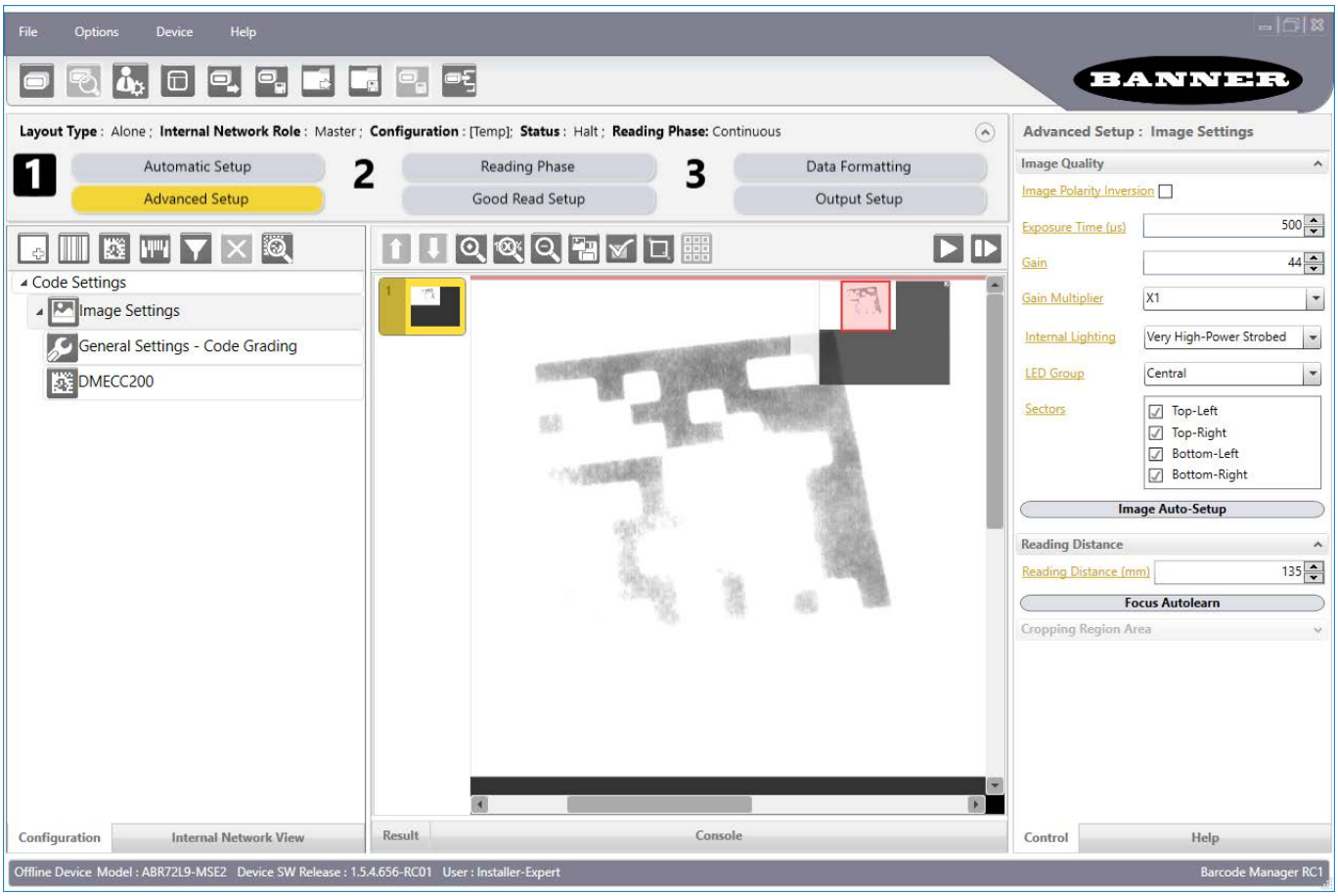



## 6.8.2 Over-Exposure

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

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

*Figure 73. 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 74. Example of Code out of the FOV*

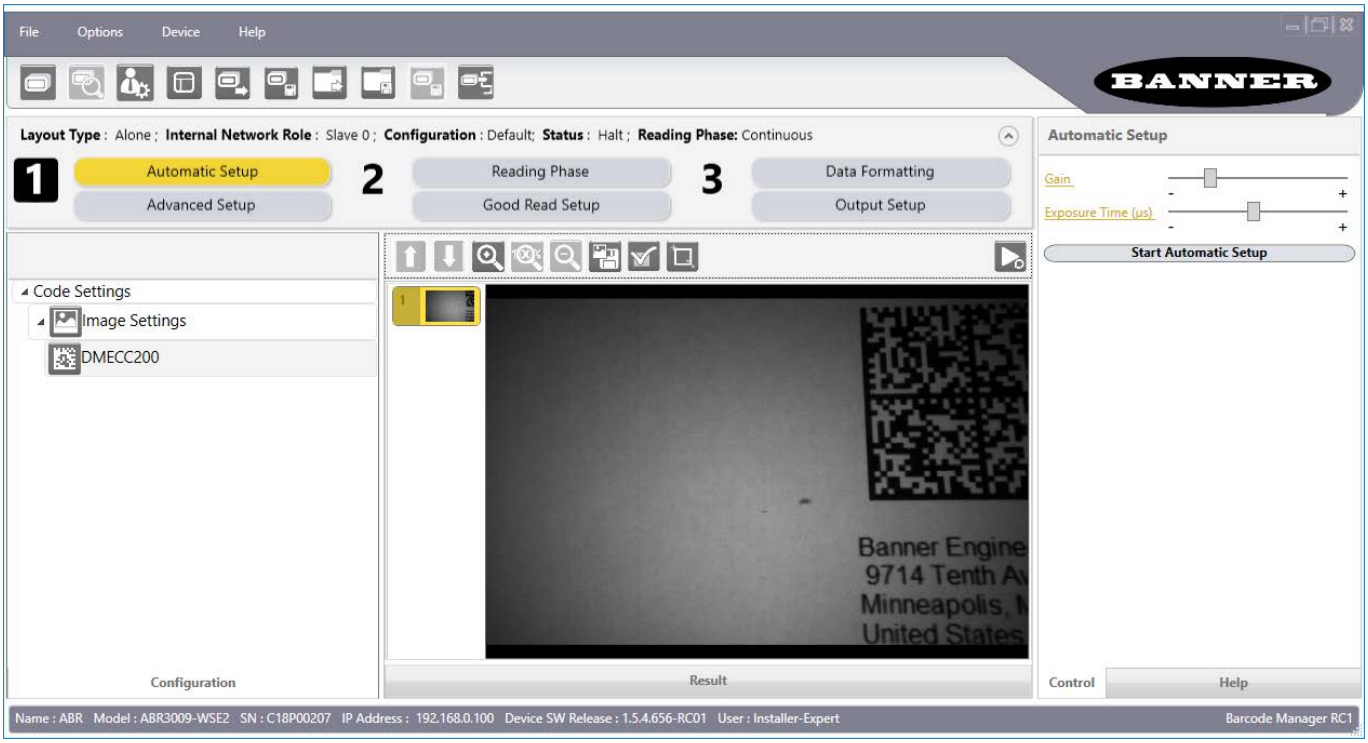
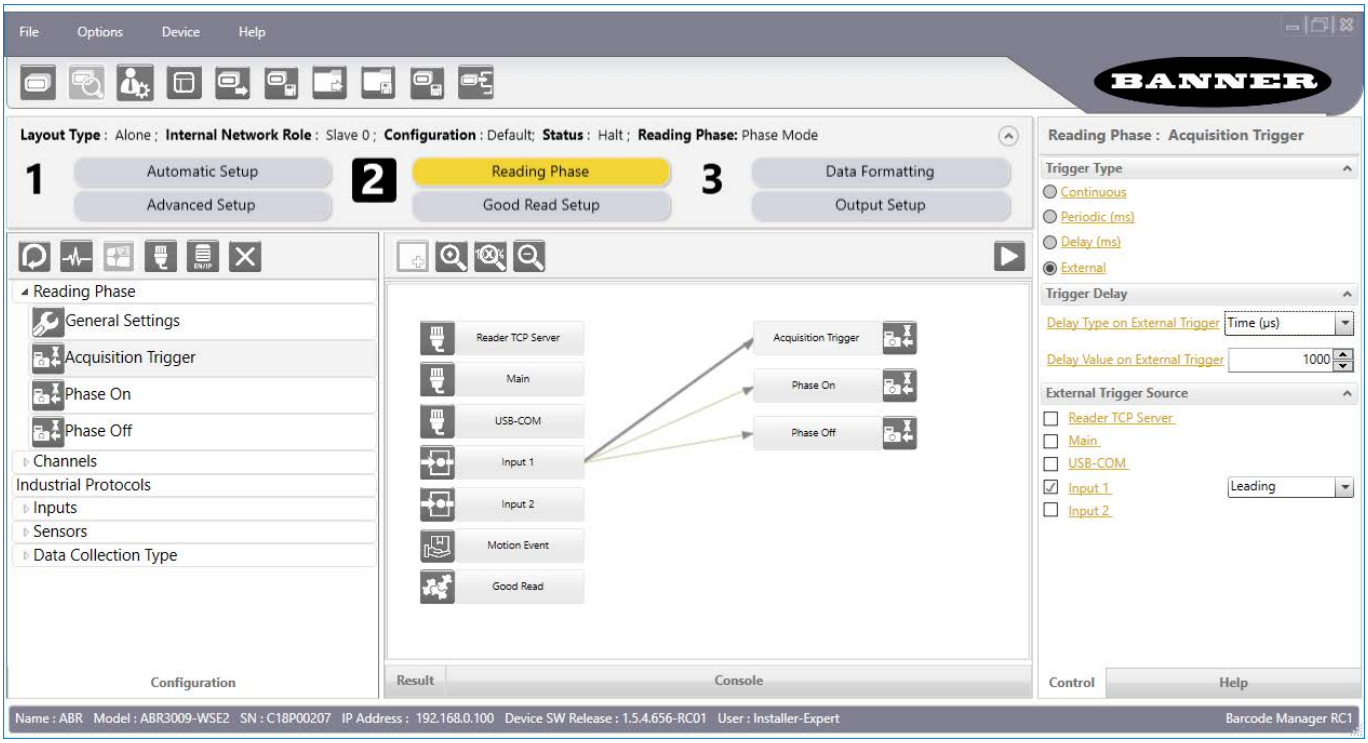



*Figure 75. Add Delay on Trigger to Correct Out of FOV*




## 6.8.4 DPM and Difficult 2D Code Reading

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

The possible selections progress from Low to Very High, where Low can improve decoding time for good print/mark quality and/or relatively normal size codes. This is the default setting. Very High can improve the decode rate for low print/mark quality and/or small size codes. This algorithm is much more aggressive but in general it may have longer decoding times

than the lower complexity algorithms. To minimize decoding time it is better to select the lowest value that still guarantees good decoding.

For QR codes the Decoding Method parameter allows the Dot Peen Decoding algorithm to be selected, which improves the decode rate for low quality Direct Part Mark codes and in general for Direct Part Mark codes with dot peening type module shapes.

# 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 information in the Barcode Manager Software Instruction Manual, available at www.bannerengineering.com.

# 8 Industrial Ethernet Overview

The ABR reader is compatible with and can be monitored and controlled using Industrial Ethernet protocols (EtherNet/IP™ [21], MODBUS® TCP [22], SLMP, or PROFINET® [23]). On the monitoring side, the ABR makes the barcode data output string configured on the Communications 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 Compatible Industrial Ethernet Protocol (EtherNet/IP™, MODBUS® TCP, SLMP, PROFINET®)

The Industrial Ethernet communication channel is disabled by default.

To enable this channel, use the following instructions.

1. From the **Reading Phase**, **Communications**, 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 Client
   - MODBUS TCP Server
   - SLMP
   - PROFINET [25]
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

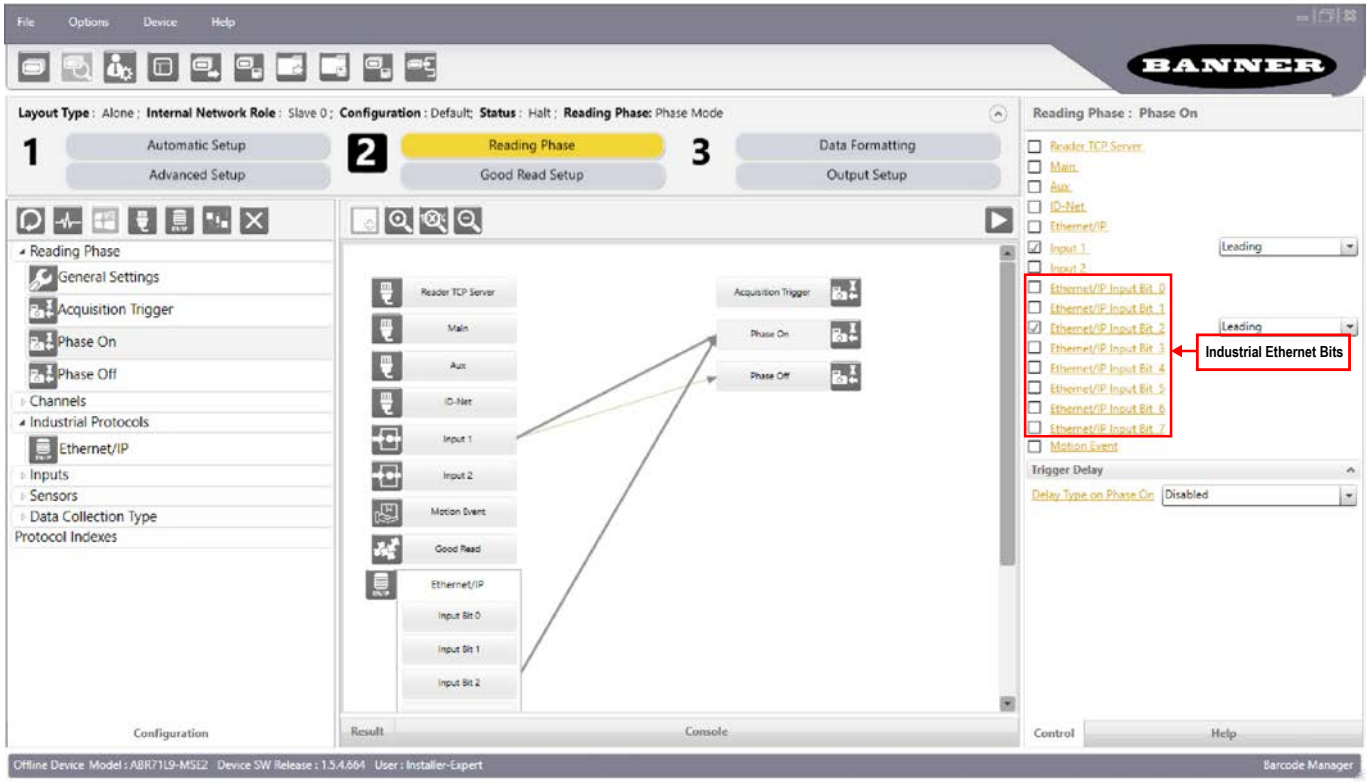
The Industrial Ethernet host controller can control the reading phase by assigning individual communication bits to reading phase parameters. These bits are received on the Industrial Ethernet channel as Input Bits.

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.

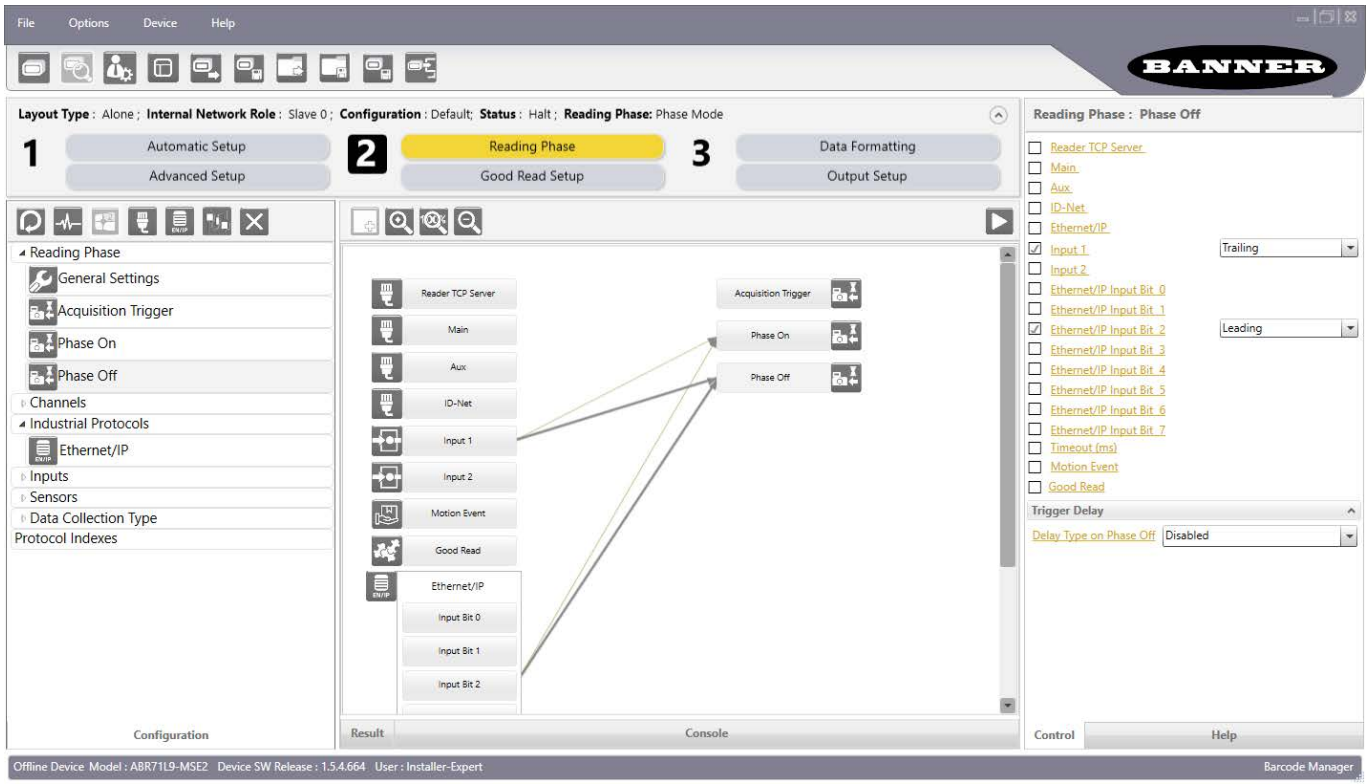
[21] EtherNet/IP™ is a trademark of ODVA, Inc.
[22] MODBUS® is a registered trademark of Schneider Electric USA, Inc.
[23] PROFINET® is a registered trademark of PROFIBUS Nutzerorganisation e.V.
[25] The ABR is PROFINET compatible but not PROFINET certified.

*Figure 76. 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 77. Industrial Ethernet Input Bits Configured for Phase Off Control*

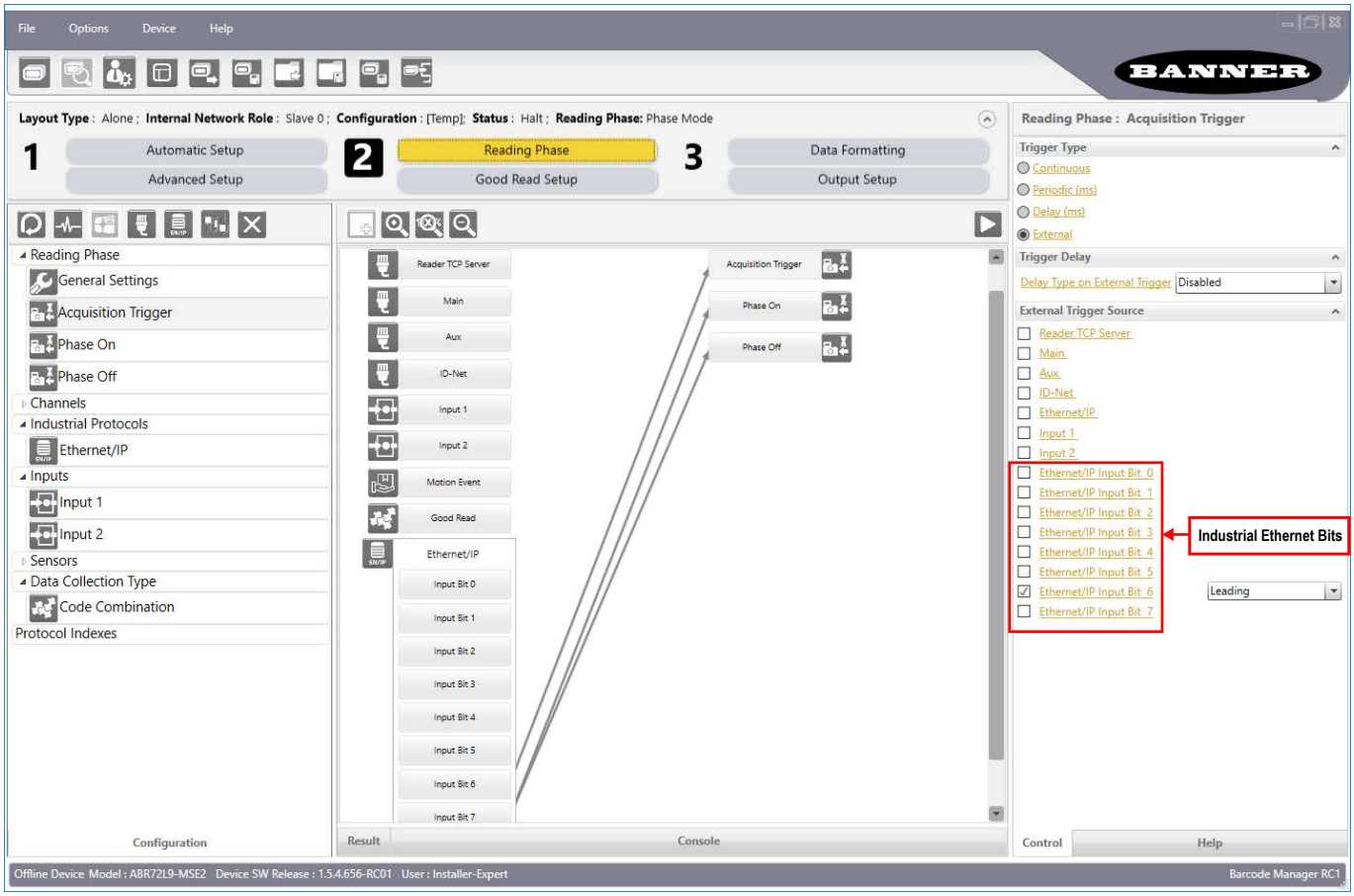


## 8.1.3 Industrial Ethernet Reading Phase Acquisition Control

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 78. Industrial Ethernet Strings and Bits*

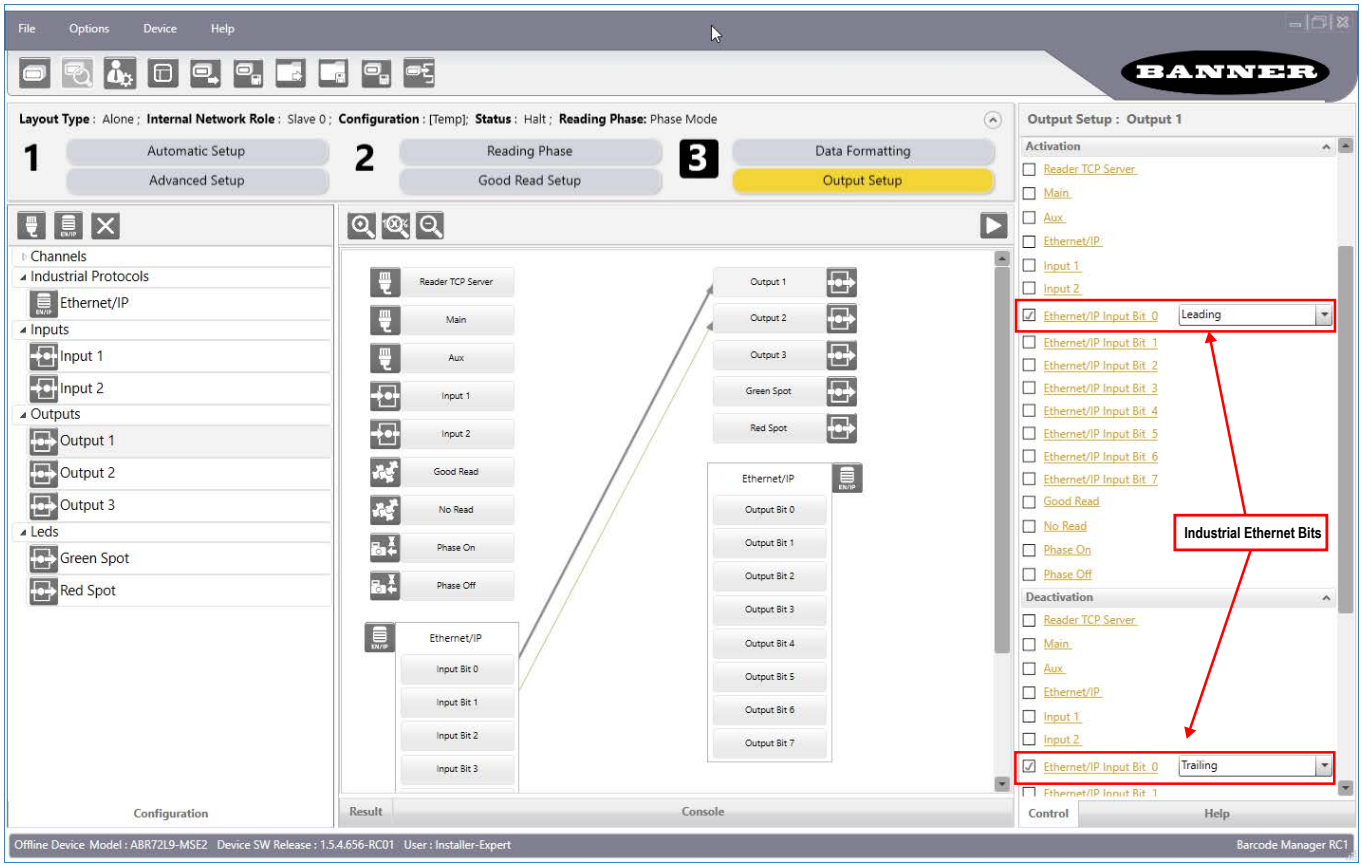



## 8.1.4 Industrial Ethernet Digital Output Control

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 79. Industrial Ethernet Strings and Bits*



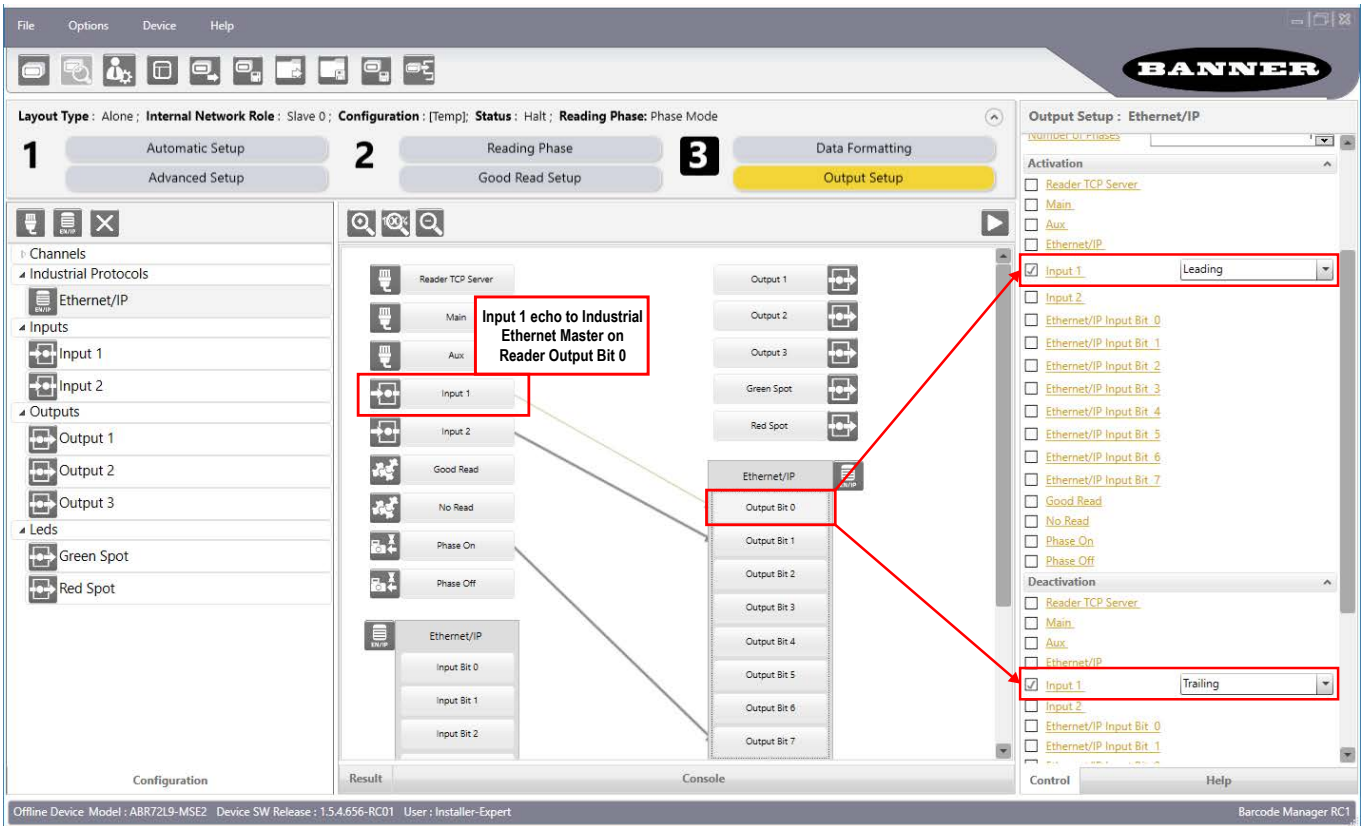

## 8.1.5 Digital Input Echo to Industrial Ethernet

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 80. Digital Input Echo to Industrial Ethernet*

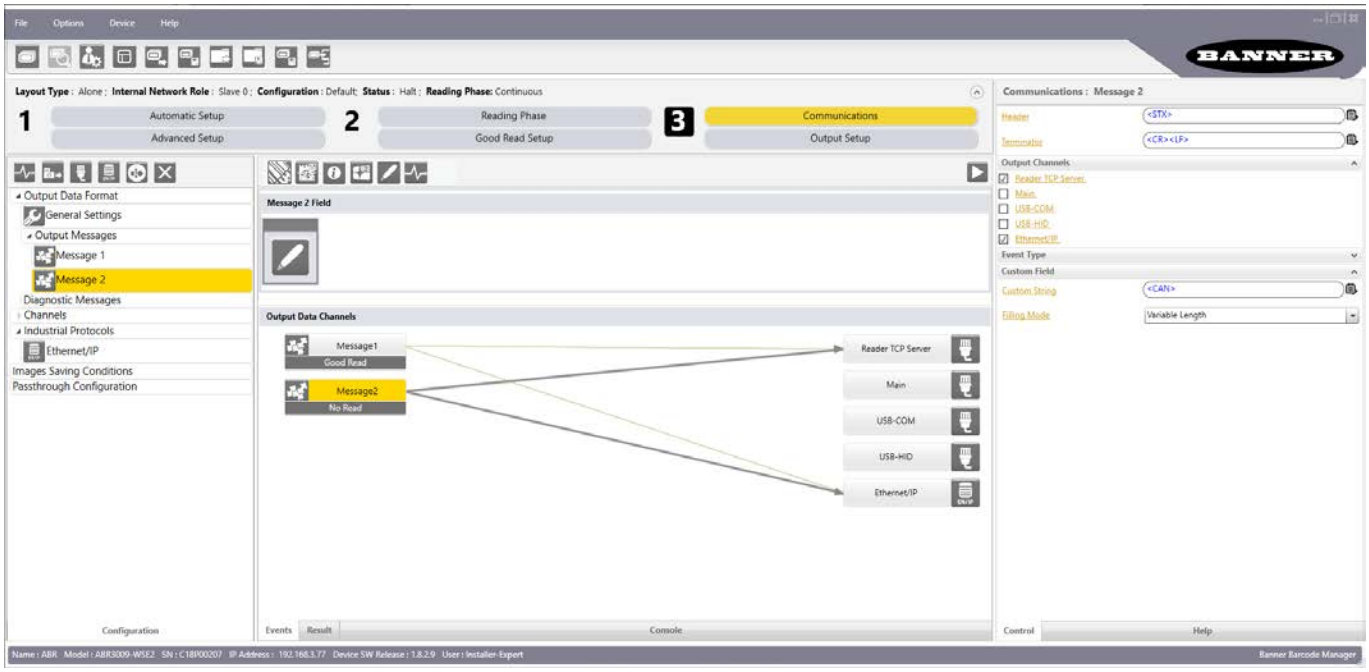



## 8.1.6 Transmitting Output Data Messages Using Industrial Ethernet

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

1. Go to **Communications**.
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 81. Communications*




## 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 p. 69 and configure your PLC using the EDS and AOI files. The AOI is recommended because when sending messages over EtherNet/IP, the ABR will send one message, and then wait to send any further data until the PLC sends back a handshake value. The AOI performs this handshaking automatically. Users of other controllers may have more need of ABR Assembly Object Descriptions on p. 66 and Configuring the ABR for Ethernet/IP in Barcode Manager on p. 69.

### 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 101 (0×65) - 138 Registers (Sensor Outputs/PLC Inputs) T > O

Data transfer direction: Target (ABR) to Originator (PLC). Assembly instance 101 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 p. 68).

### Input Bits

The Input Bits attribute is a bitmap used to read the state of the 8 discrete inputs from the ABR reader. These Input Bits are shown as Output Bits in Barcode Manager, and can be configured on the Output Setup page.

### 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 |
| | | 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 |

| 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 | 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® [26] family PLC. Therefore, a configuration instance is defined as instance number 128 (0×80). Its size is zero.

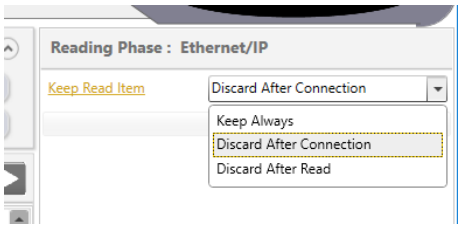
### Requested Packet Interval (RPI) Value

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 p. 61) 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 82. 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.
- **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

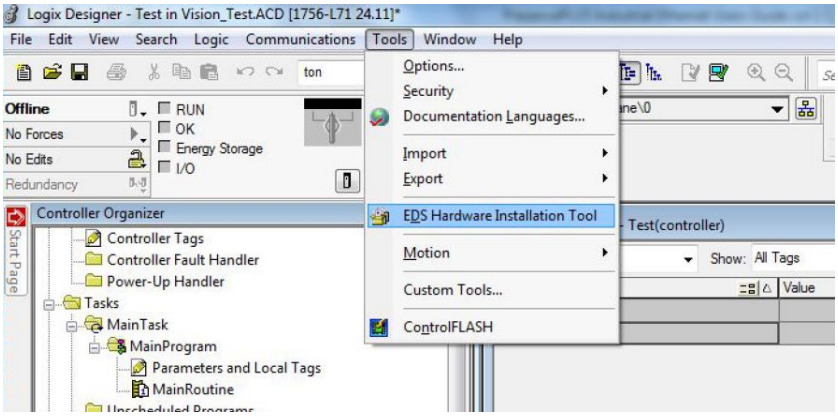
Use the following the steps to quickly and easily establish an implicit Class 1 connection between the ABR and a Rockwell Studio 5000 Logix Designer family PLC.

The 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. Note that ABR Series Manual Installation in Studio 5000 Logix Designer Software on p. 73 may be used instead.

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.

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

*Figure 83. Tools—EDS Hardware Installation Tool*



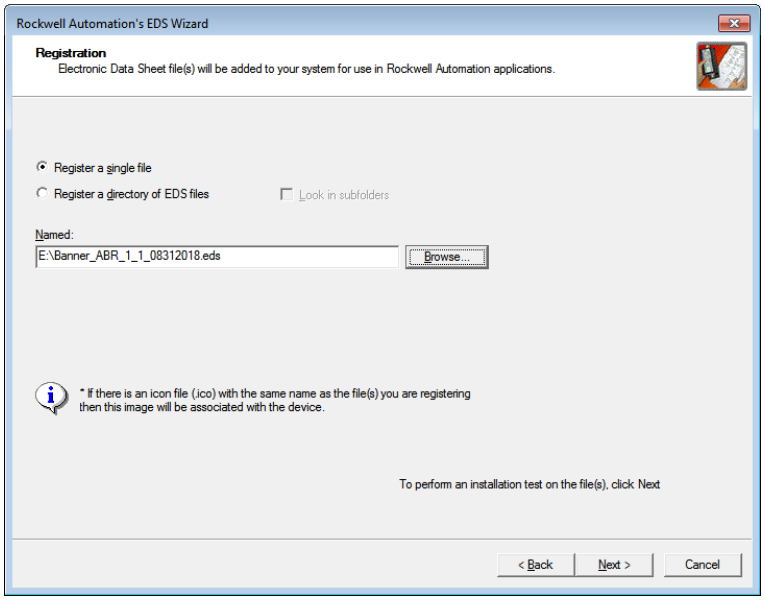

3. Click **Next**.
4. Select **Register an EDS file(s)**.

*Figure 84. Rockwell Automation's EDS Wizard—Options*



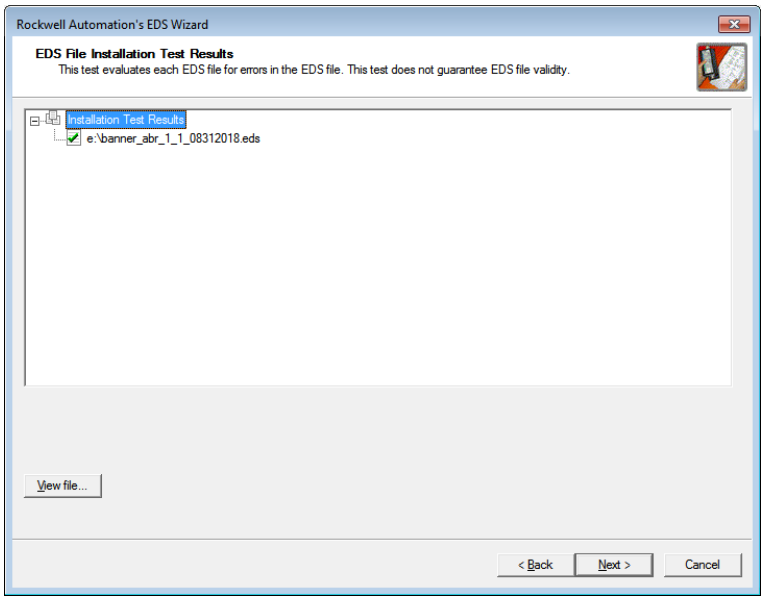

5. Browse to locate the EDS file and click **Next**.

*Figure 85. Select File to Register*



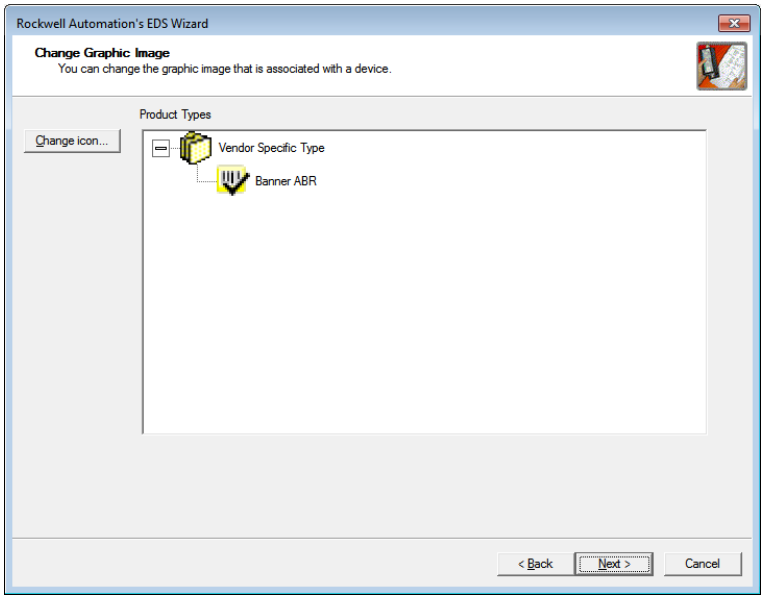
6. Click **Next** to register the tested file.

*Figure 86. Register the Tested File*



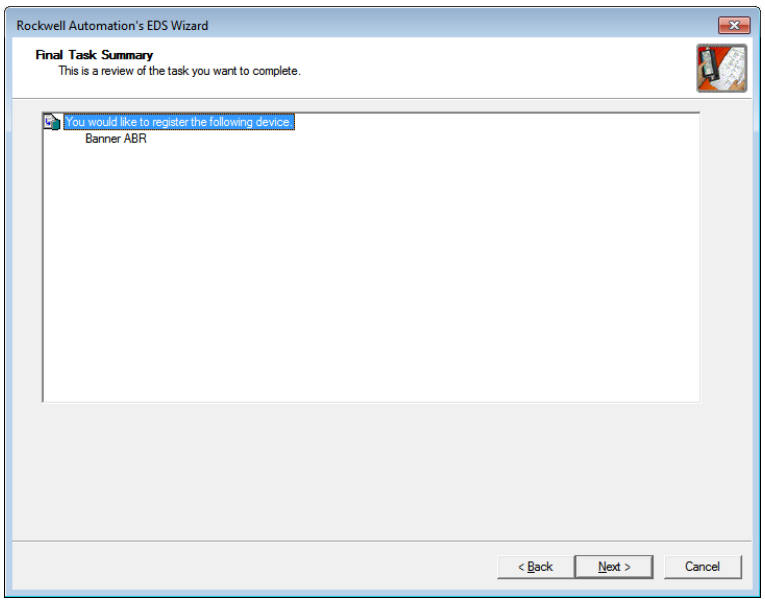

7. Click **Next** when you see the icon associated with the EDS file.

*Figure 87. Rockwell Automation's EDS Wizard*



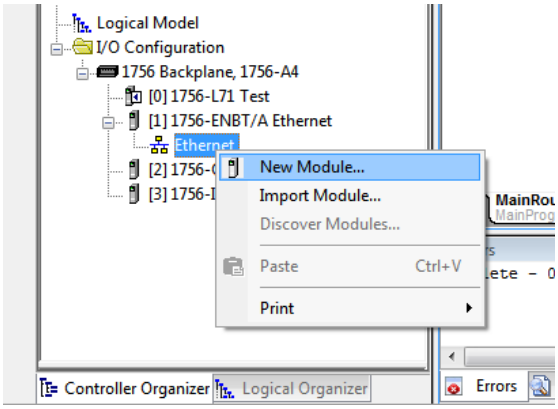

8. Click **Next** to register the EDS file.

*Figure 88. Register the EDS File*



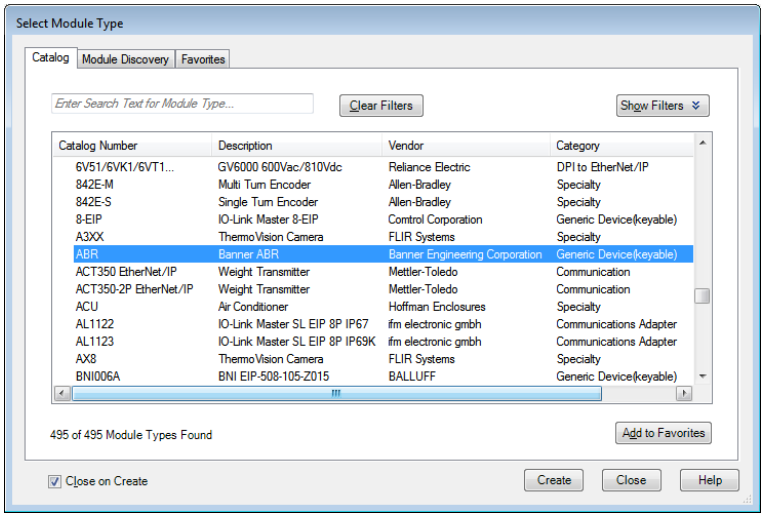

9. Click **Finish** to close the **EDS Wizard** .
10. Right-click on the PLC's Ethernet adapter and select **New Module...**

*Figure 89. New Module*



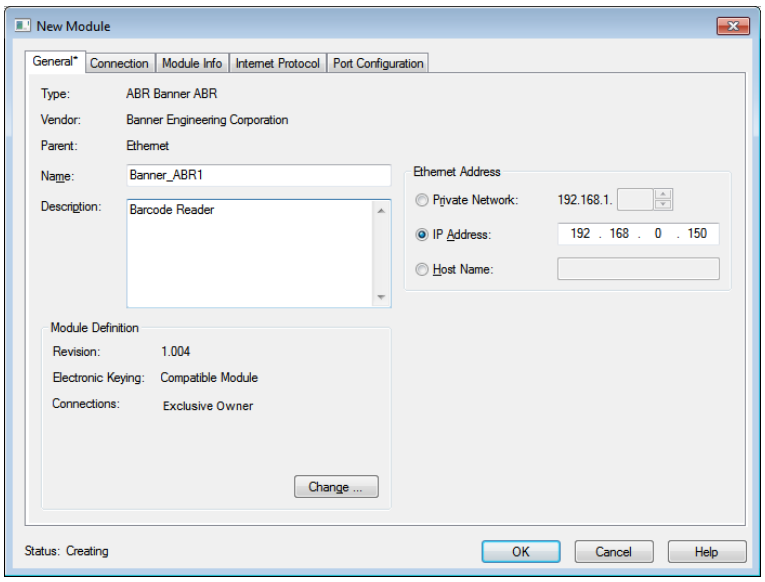

11. Locate the ABR from the catalog and click **Create**.

*Figure 90. Select Module Type*



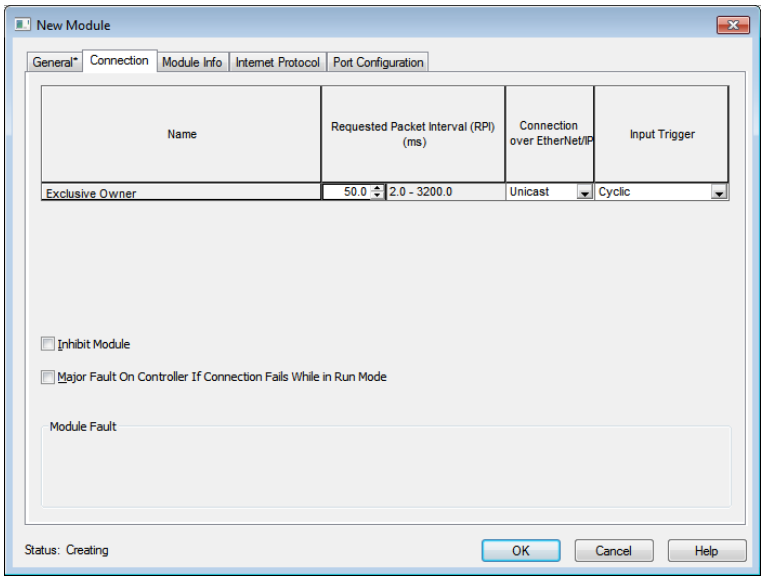

12. Enter a name, description (optional), and IP address for the ABR.

*Figure 91. New Module*




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

*Figure 92. New Module—Connection Settings*

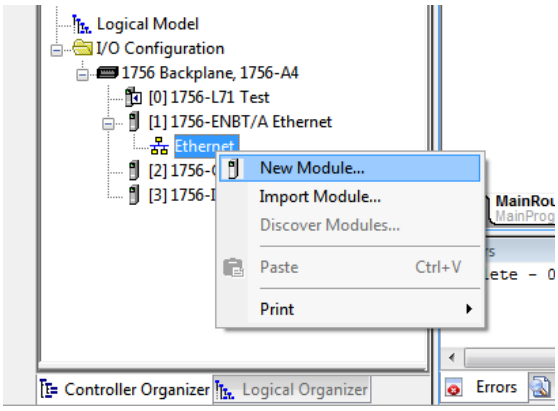



## 8.2.4 ABR Series Manual Installation in Studio 5000 Logix Designer Software

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

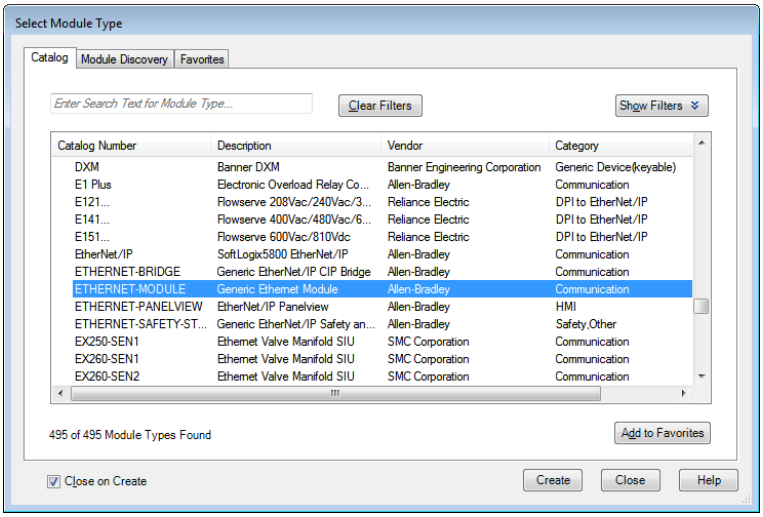
1. Add a generic Ethernet module to the PLC's Ethernet card.
   a) Click **New Module**.

*Figure 93. Add Ethernet Module*



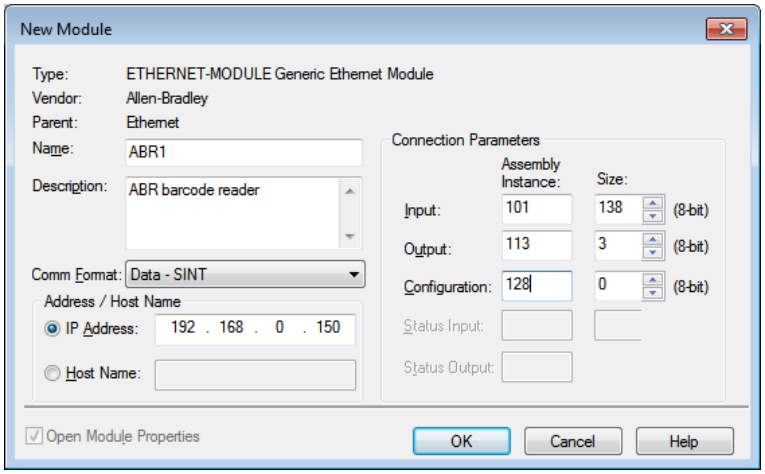

b) Select **Generic Ethernet Module**.

*Figure 94. Select Module Type*



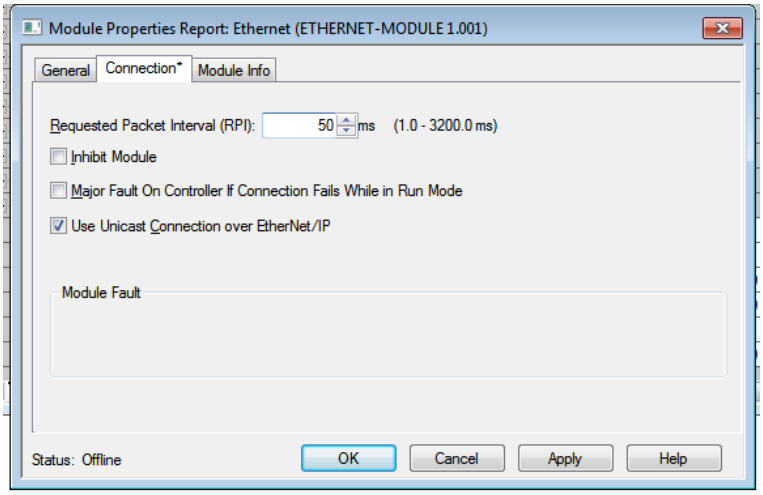

2. Configure the Module Properties, including the **Name** and **IP Address** of your choice, and using the **Connection Parameters** and **Comm Format** shown.

*Figure 95. Module Properties*




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

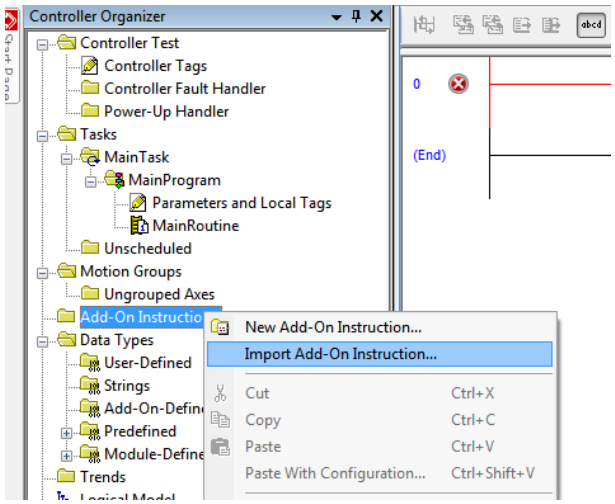
*Figure 96. Module Properties Report: Ethernet*




## 8.2.5 ABR Series AOI Installation in Logix Designer Software

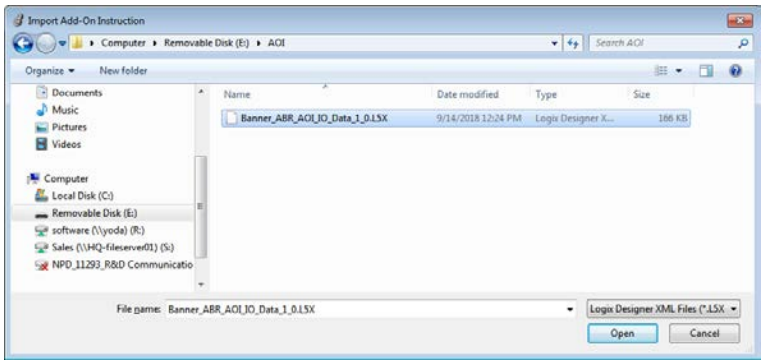
1. Download the Add-On Instruction (AOI) file `Banner_ABR_AOI_IO_Data_2_0.L5X` from www.bannerengineering.com.
2. In the **Controller Organizer** window, right-click on the **Add-On Instruction** folder and select **Import Add-On Instruction**.

*Figure 97. Import Add-On Instruction*



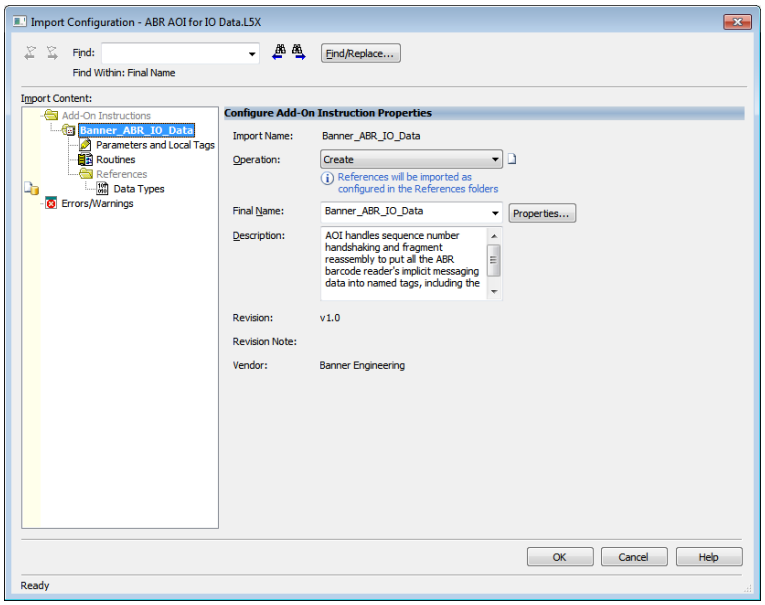

3. Navigate to the correct file location, and select the AOI to be installed.

*Figure 98. Select Add-On Instruction*



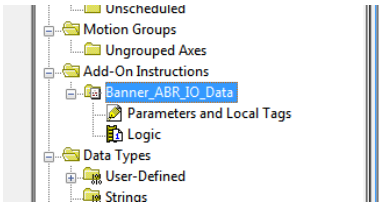

4. Click **Open**.
   The **Import Configuration** window opens. The default selection creates all of the necessary items for the AOI.

*Figure 99. 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 100. AOI Successfully Imported*



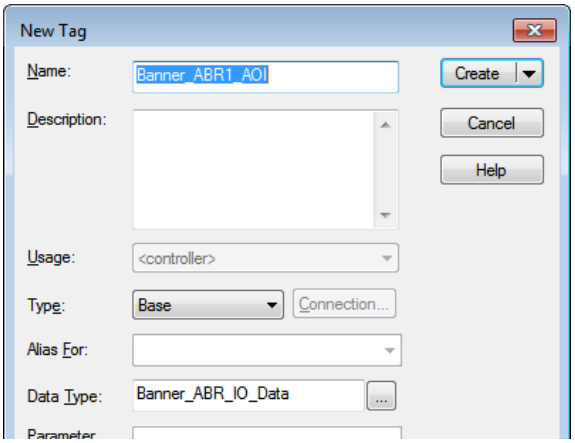

6. Drag the AOI from the Controller Organizer to your ladder logic program to add the `Banner_ABR_AOI_IO_Data` AOI to the program.

*Figure 101. New AOI Added to the Program*



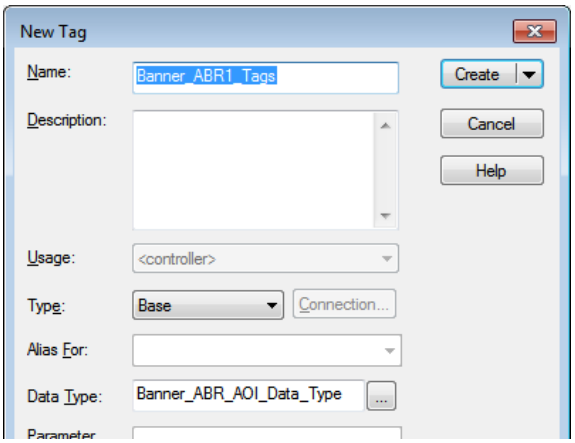

7. For each of the questions marks, create and link a new tag array.
   The AOI includes a new type of User Defined Tag (UDT), a custom array of tags meant specifically for this AOI.
   a) In the AOI, right-click on the question mark on the line labeled "Banner_ABR_IO_Data" and click **New Tag**. In this example, use the name "Banner_ABR1_AOI."

*Figure 102. 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 p. 69 and ABR Series Manual Installation in Studio 5000 Logix Designer Software on p. 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."

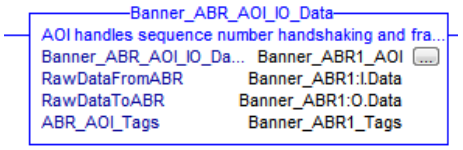
*Figure 103. New Tag*




The AOI is ready to run.

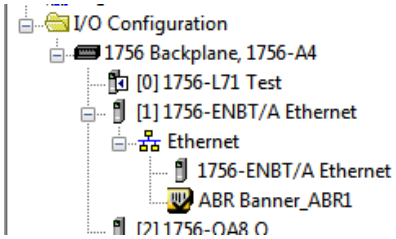
8. Download the program to the PLC, run it, and put the PLC into Online mode to view live data.

*Figure 104. AOI Rung After All Tags are Assigned*



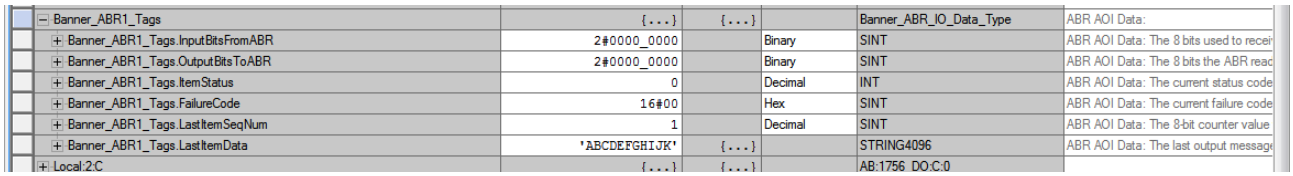

9. Verify that the Banner ABR Ethernet Module is connected by making sure that there is not a yellow warning symbol over the module icon in the Controller Organizer. If there is no symbol, the ABR has a live connection to the PLC.

*Figure 105. 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 106. AOI Data Tags*



| | | | | | |
|---|---|---|---|---|---|
| Banner_ABR1_Tags | {...} | {...} | | Banner_ABR_IO_Data_Type | ABR AOI Data: |
| Banner_ABR1_Tags.InputBitsFromABR | 2#0000_0000 | | Binary | SINT | ABR AOI Data: The 8 bits used to recei |
| Banner_ABR1_Tags.OutputBitsToABR | 2#0000_0000 | | Binary | SINT | ABR AOI Data: The 8 bits the ABR reac |
| Banner_ABR1_Tags.ItemStatus | 0 | | Decimal | INT | ABR AOI Data: The current status code |
| Banner_ABR1_Tags.FailureCode | 16#00 | | Hex | SINT | ABR AOI Data: The current failure code |
| Banner_ABR1_Tags.LastItemSeqNum | 1 | | Decimal | SINT | ABR AOI Data: The 8-bit counter value |
| Banner_ABR1_Tags.LastItemData | 'ABCDEFGHIJK' | {...} | | STRING4096 | ABR AOI Data: The last output messag |
| Local:2:C | {...} | {...} | | AB:1756_DO:C:0 | |

## 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 p. 61.

### 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.

### LastItemData

LastItemData is the 4096 byte String tag that contains the last full message transferred by the ABR to the PLC. This tag's data and length are updated at the same time as 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 last message 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® [27] 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. Select in Barcode Manager whether the ABR will function as a MODBUS TCP Client (also known as a MODBUS Master), or as a MODBUS TCP Server (also known as a MODBUS Slave).

*MODBUS Function Codes Used*

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

## 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]`

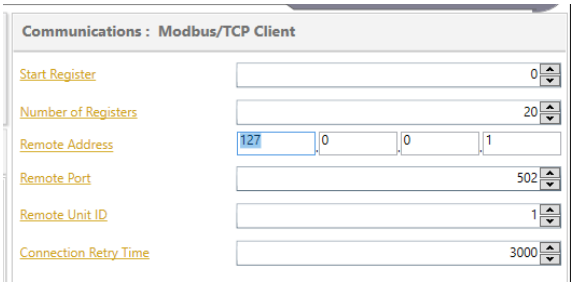
*Table 4: ABR Output Message Data (40001–40255)*

| **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 Client in Barcode Manager

After selecting **MODBUS TCP Client** on the **Reading Phase**, **Communications**, or **Output Setup** pages (see Industrial Ethernet Reading Phase Control on p. 61), the Control panel shows the following MODBUS TCP Client-specific settings:

*Figure 107. MODBUS TCP Client-specific Settings and Their Default Values*




[27] MODBUS® is a registered trademark of Schneider Electric USA, Inc.

**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.

In MODBUS TCP Client mode, the ABR reads the Input Bits every 50 milliseconds from the PLC (or other MODBUS TCP server) 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). The following tables show the address locations of the input and output bits.

*Table 5: 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 |
| 10006 | Input Bit 5 |
| 10007 | Input Bit 6 |
| 10008 | Input Bit 7 |

*Table 6: ABR Output Bits (00001–00008)*

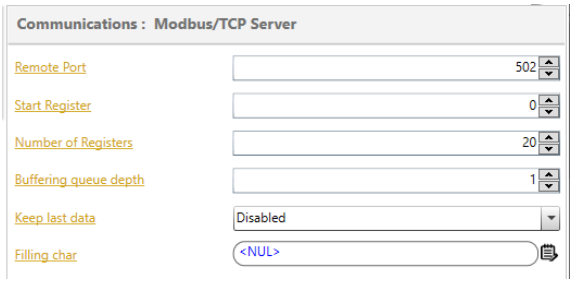
| **05: Write Single Coil** | |
|---|---|
| **Register** | **ABR Output Bit Position** |
| 00001 | Output Bit 0 |
| 00002 | Output Bit 1 |
| 00003 | Output Bit 2 |
| 00004 | Output Bit 3 |
| 00005 | Output Bit 4 |
| 00006 | Output Bit 5 |

| 05: Write Single Coil | |
|---|---|
| **Register** | **ABR Output Bit Position** |
| 00007 | Output Bit 6 |
| 00008 | Output Bit 7 |

## 8.3.3 Configure the ABR for MODBUS® TCP Server in Barcode Manager

After selecting MODBUS TCP Server on the **Reading Phase**, **Communications**, or **Output Setup** pages (see Industrial Ethernet Reading Phase Control on p. 61), the Control panel shows the following MODBUS TCP Server-specific settings:

*Figure 108. MODBUS TCP Server-Specific Settings and Their Default Values*




**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 Server Channels.

**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.

**Buffering Queue Depth**

It defines the size of the circular queue used by MODBUS to store codes generated by the ABR reader but not yet read by the PLC.

**Keep Last Data**

When enabled, the last code generated by the ABR reader is always sent to the PLC, even if the PLC has already read it.

**Filling Char**

Define padding characters used to fill in registers where no new data is present.

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

In MODBUS TCP Server mode, the PLC (or other MODBUS TCP Client) reads the ABR Output Bits as Inputs (10000) using MODBUS function code 02 (Read Input Status). The PLC writes to the ABR Input Bits on Coils (00000) using MODBUS function code 05 (Write Single Coil). The following tables show the address locations of the input and output bits.

*Table 7: ABR Input Bits (00001–00008)*

| 05: Write Single Coil | |
|---|---|
| **Register** | **ABR Input Bit Position** |
| 00001 | Input Bit 0 |
| 00002 | Input Bit 1 |
| 00003 | Input Bit 2 |
| 00004 | Input Bit 3 |

| 05: Write Single Coil | |
|---|---|
| **Register** | **ABR Input Bit Position** |
| 00005 | Input Bit 4 |
| 00006 | Input Bit 5 |
| 00007 | Input Bit 6 |
| 00008 | Input Bit 7 |

*Table 8: ABR Output Bits (10001–10008)*

| 02: Read Input Status | |
|---|---|
| **Register** | **ABR Output Bit Position** |
| 10001 | Output Bit 0 |
| 10002 | Output Bit 1 |
| 10003 | Output Bit 2 |
| 10004 | Output Bit 3 |
| 10005 | Output Bit 4 |
| 10006 | Output Bit 5 |
| 10007 | Output Bit 6 |
| 10008 | Output Bit 7 |

## 8.4 SLMP

According to the CC-Link website, "SLMP, or Seamless Message Protocol, is a feature of the CC-Link IE Field network that allows users to vertically integrate field devices with controllers to information systems, and seamlessly connect field systems to information systems".

In this section, the SLMP configuration of the ABR 7000 is shown. Despite some little differences, from here on SLMP and MC PROTOCOL words are used interchangeably. In Figure 109 on p. 82 and Table 9 on p. 83 is shown the actual system configuration (Mitsubishi CPU and additional modules), and device connections. GX Works 2 Version 1.577B has been used for configuration and programming purposes. The workstation and the PLC communicate over USB connection.

*Figure 109. System Configuration*

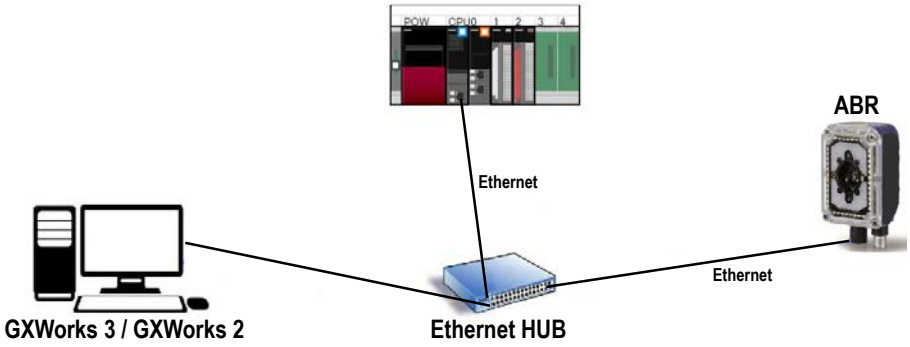



*Figure 110. CPU and Additional Modules Configuration*

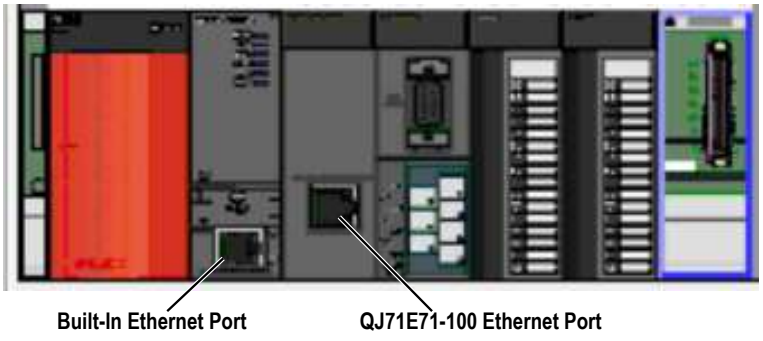


*Table 9: CPU and Additional Modules*

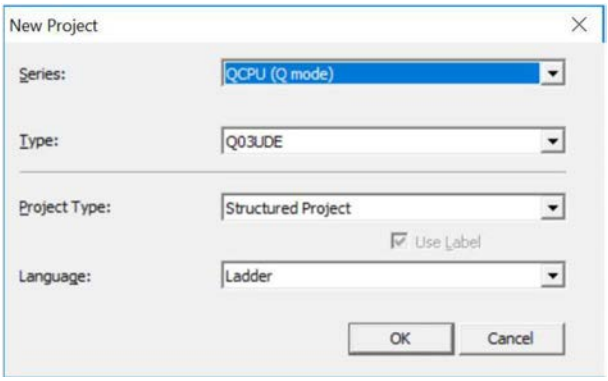
| Base Slot | Model Name | I/O Address | IP Address |
|---|---|---|---|
| CPU | Q03UDECPU | - | 192.168.3.39 |
| 0–0 | QJ71E71-100 | 0000 | 192.168.3.101 |
| 0–1 | QJ71C24N | 0020 | |
| 0–2 | QX40 | 0040 | |
| 0–3 | QY40P | 0050 | |
| 0–4 | - | 0060 | |

Because two network cards are present, Built-In Ethernet and QJ71E71-100, there are two methods to connect a device using SLMP protocol. Both methods are covered in the following sections.

## 8.4.1 SLMP Configuration: Built-In Ethernet Port

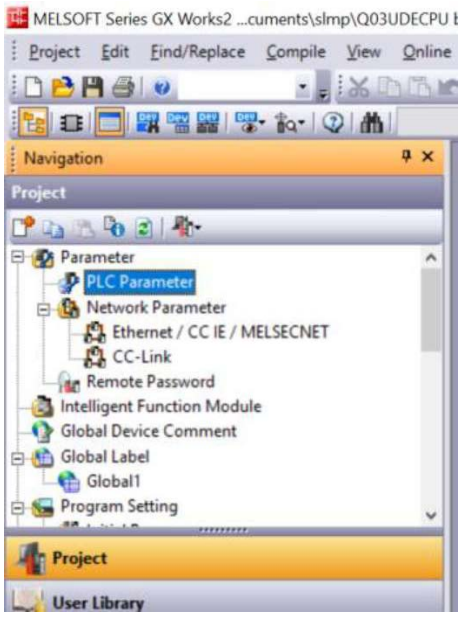
SLMP protocol on a built-in Ethernet port is possible starting from a new project or from an existing project.

*Figure 111. New Project Window*




1. Double-click **PLC Parameter**.

*Figure 112. Existing Project Navigation*




The **Q Parameter Setting** screen displays.

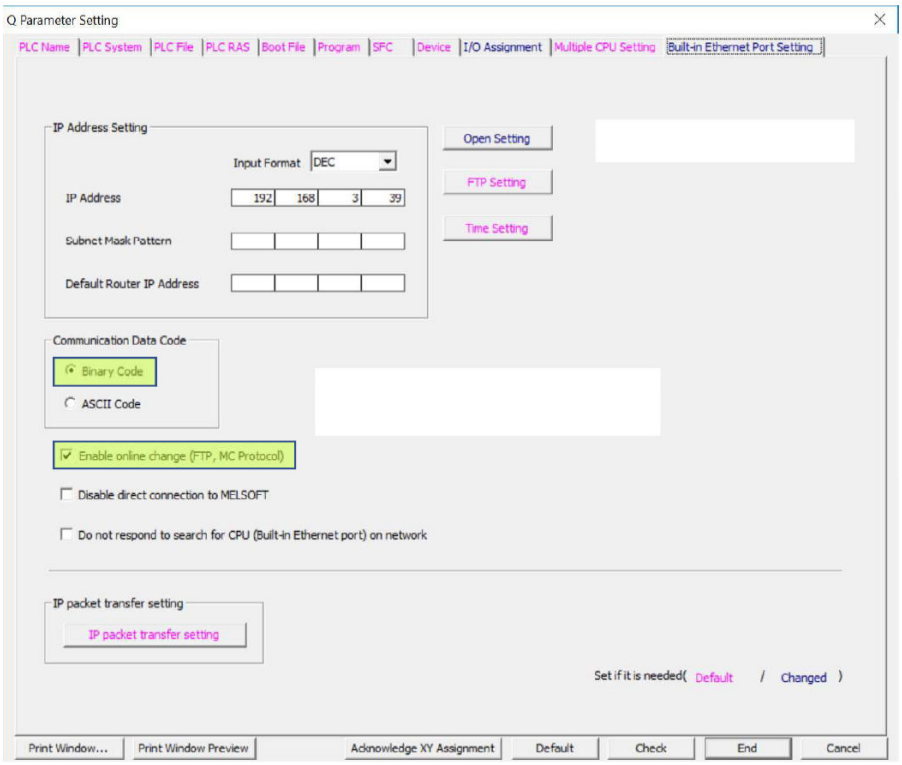
*Figure 113. **Q Parameter Setting** Screen*




2. From the **Q Parameter Setting** screen, click the **Built-In Ethernet Port Setting** tab.

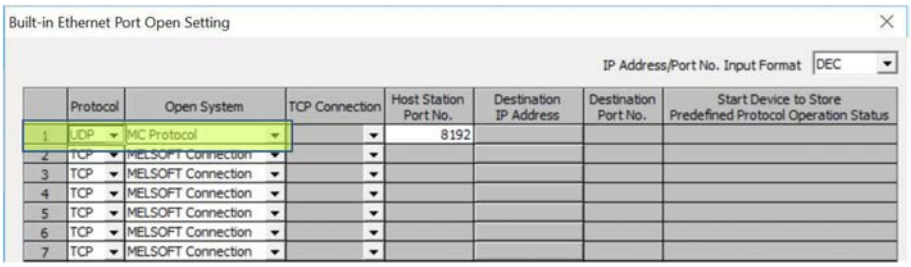
   From this tab, you can configure parameters such as the CPU network address and communication data code (binary/ASCII). It is also possible to allow an external device to modify process memory areas while CPU is running.
3. Select the **Binary Code** option and the **Enabled online change (FTP, MC Protocl)** checkbox, highlighted in the following figure.

*Figure 114. **Q Parameter Setting** Screen: **Built-In Ethernet Port Setting** Tab*




4. Click **Open Setting** next to the ID Address Setting.
   The **Built-In Ethernet Port Open Setting** screen opens.

*Figure 115. **Built-In Ethernet Port Setting** Screen*




5. From the **Built-In Ethernet Port Setting** screen, enable the SLMP (MC Protocol) and set up the UDP port.

   Choose any port number except those shown in Figure 115 on p. 84. The port number set here and the port number of the ABR must match.

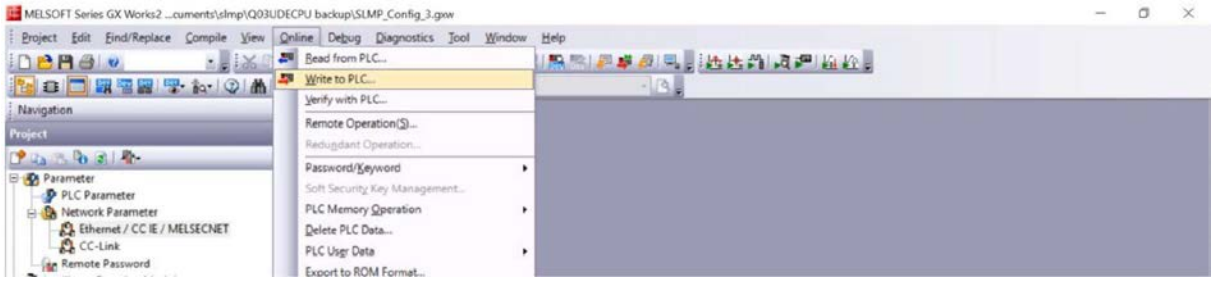
   The Host Station Port Number must be within the range of 1025 to 4999 or 5010 to 65534 (Dec).

6. Confirm the operation by clicking **End** on both the **Built-In Ethernet Port Open Setting** and **Q Parameter Setting** screens.
7. After the parameters are set, rebuild the entire project and download it to the PLC.

*Figure 116. Compilation Menu*



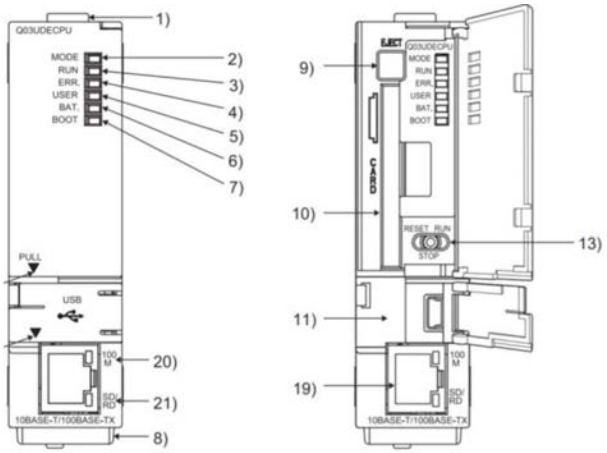

*Figure 117. Project Download*




8. Reset the hardware after the changes.

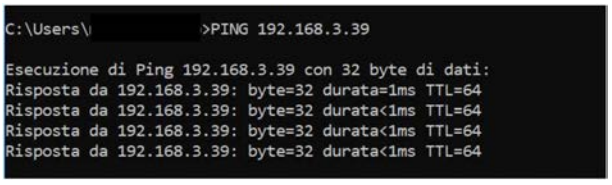
   This is required and can be done through switch 13, shown in the following figure.

*Figure 118. CPU Drawing*




9. After the hardware reset, execute a PING command to make sure of PLC reachability over the network.

*Figure 119. Device PING*



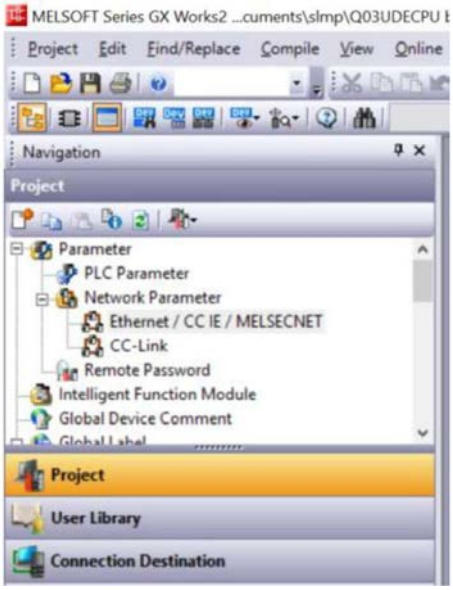

SLMP configuration of Built-In Ethernet port is complete.

Skip the next section if QJ71E71-100 Ethernet Module is not present or it is not necessary to configure SLMP on it.

## 8.4.2 SLMP Configuration: QJ71E71-100 Ethernet Module

1. Open the module configuration by expanding **Network Parameter** in the left column and double-clicking **Ethernet / CC IE / MELSECNET** .

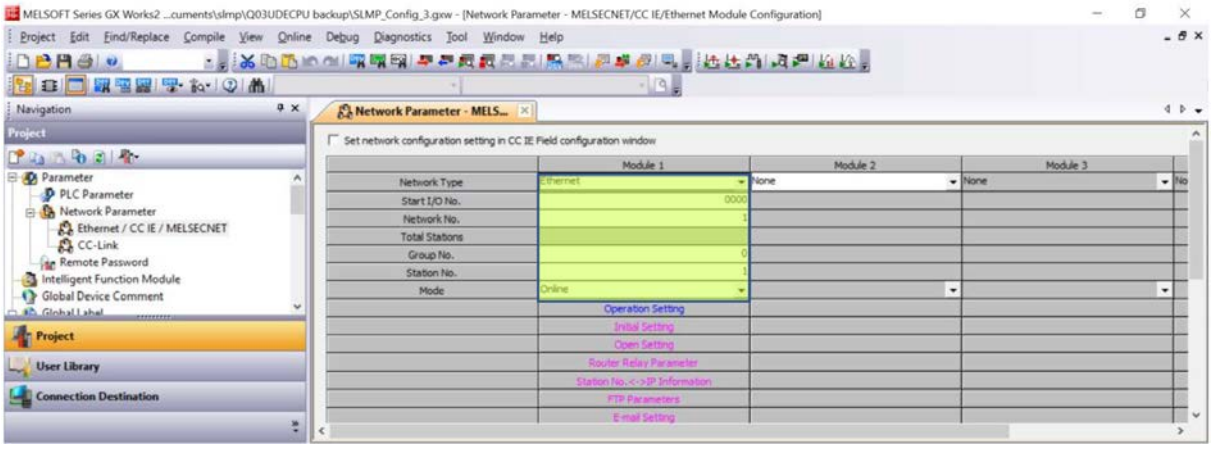
*Figure 120. Project Navigation*




The **Network Parameter** tab opens.

2. Enter the highlighted parameter in the **Module 1** column; see the following figure.

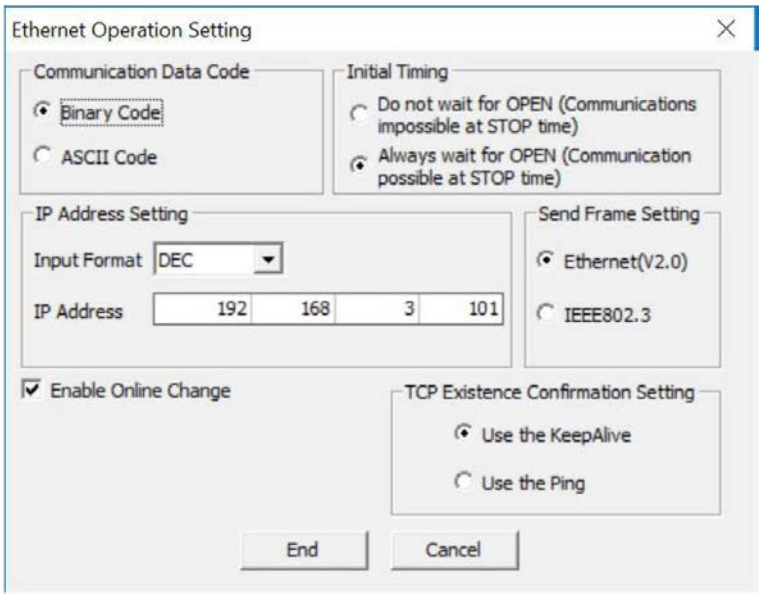
*Figure 121. Project Navigation*




3. Click **Operation Setting**.
   The **Ethernet Operation Setting** window displays.
4. Insert the same parameters as shown in the following figure.

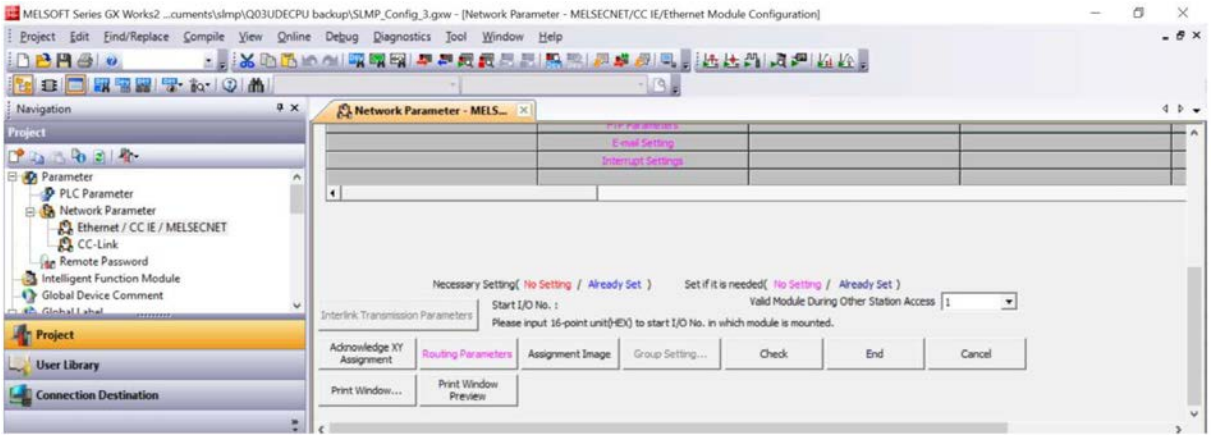
   A different IP address can be chosen.

*Figure 122. QJ71E71-100 Ethernet Operation Setting*




5. Click **End** to confirm the settings.
6. Click **End** at the bottom of the **Network Parameter** tab to save the settings.

*Figure 123. Parameter Saving*

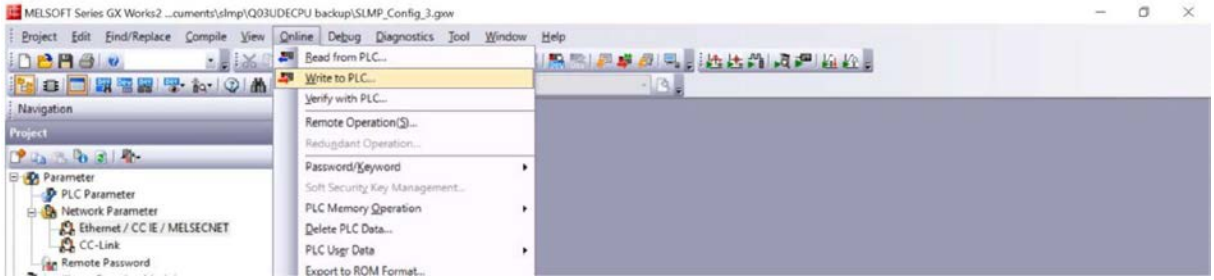



7. After the parameters are set, rebuild the entire project and download it to the PLC.

*Figure 124. Compilation Menu*

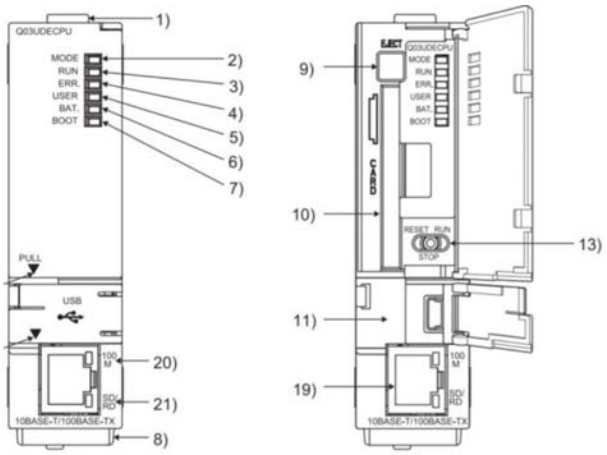



*Figure 125. Project Download*



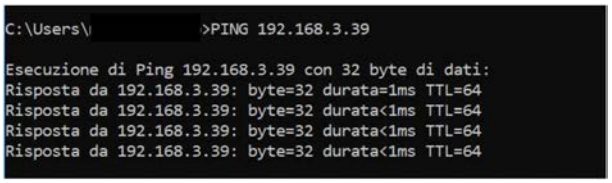
8. Reset the hardware after the changes.
   This is required and can be done through switch 13, shown in the following figure.

*Figure 126. CPU Drawing*



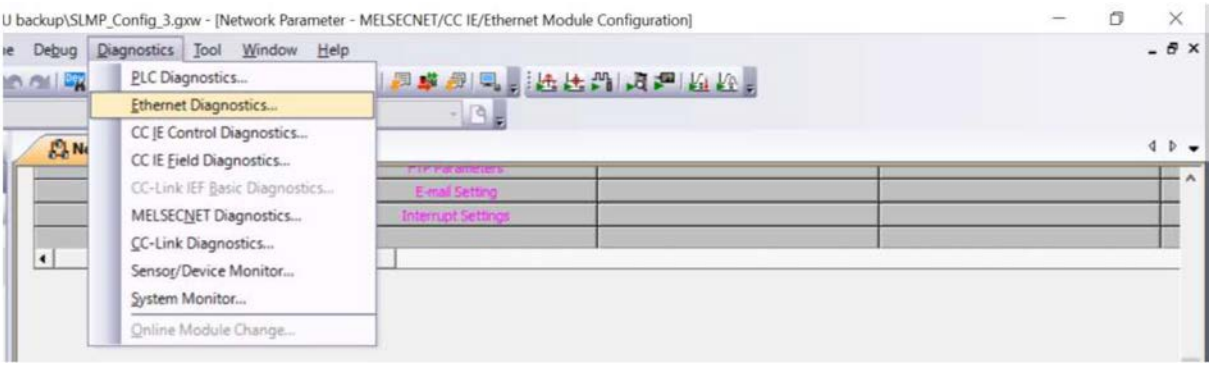

9. After the hardware reset, execute a PING command to make sure of QJ71E71-100 reachability over the network.

*Figure 127. Device PING*



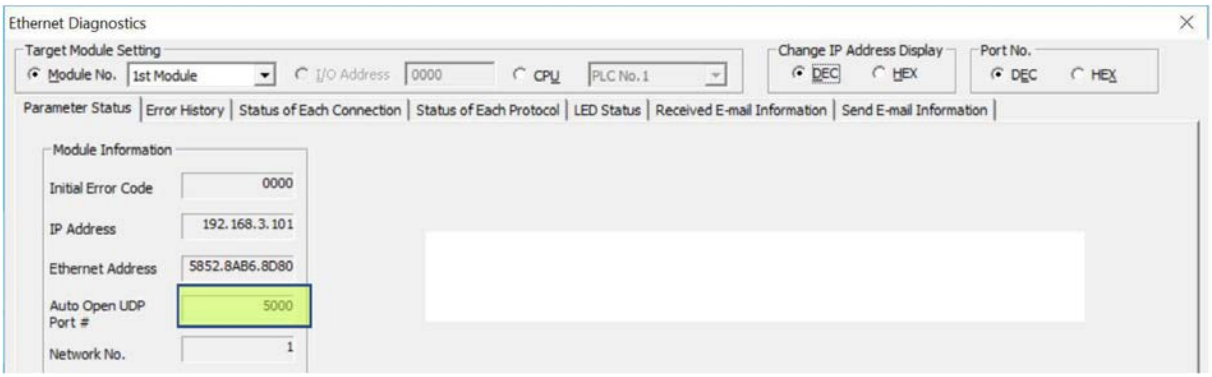

10. Verify the port number.
    Notice that no UDP port number setting has been made so far. The reason why this setting is not necessary is that the QJ71E71-100 Ethernet module has a listening UDP socket already open on port 5000 (Decimal), and on that port, the PLC responds to SLMP messages.
    a) Navigate to **Diagnostics** > **Ethernet Diagnostics**.

*Figure 128. Diagnostic Menu*




    b) Observe the Auto Open UDP Port #.
    This number must be set in the ABR configuration in the Barcode Manager software.

*Figure 129. PLC Ethernet Diagnostics*



The QJ71E71-100 Ethernet Module configuration is complete.

## 8.4.3 General Considerations

Note that **Enabled Online Change** must be enabled whatever PLC network card you choose, built-in or QJ71E71-100 Ethernet module, to allow a SLMP device to modify (write) PLC memory while control program is running.

## 8.4.4 ABR SLMP Configuration

Use the following steps to configure the ABR to enable SLMP Communication.

Refer to the Barcode Manager Manual for general settings. It is possible to modify an existing configuration or create a new one. Before starting, change the user to Installer Expert by navigating to **Options** > **Change User** > **Installer Expert**.

1. Enable the SLMP Protocol to allow communication. From the **Reading Phase** page, click **Add New Industrial Protocol** and select **SLMP**.

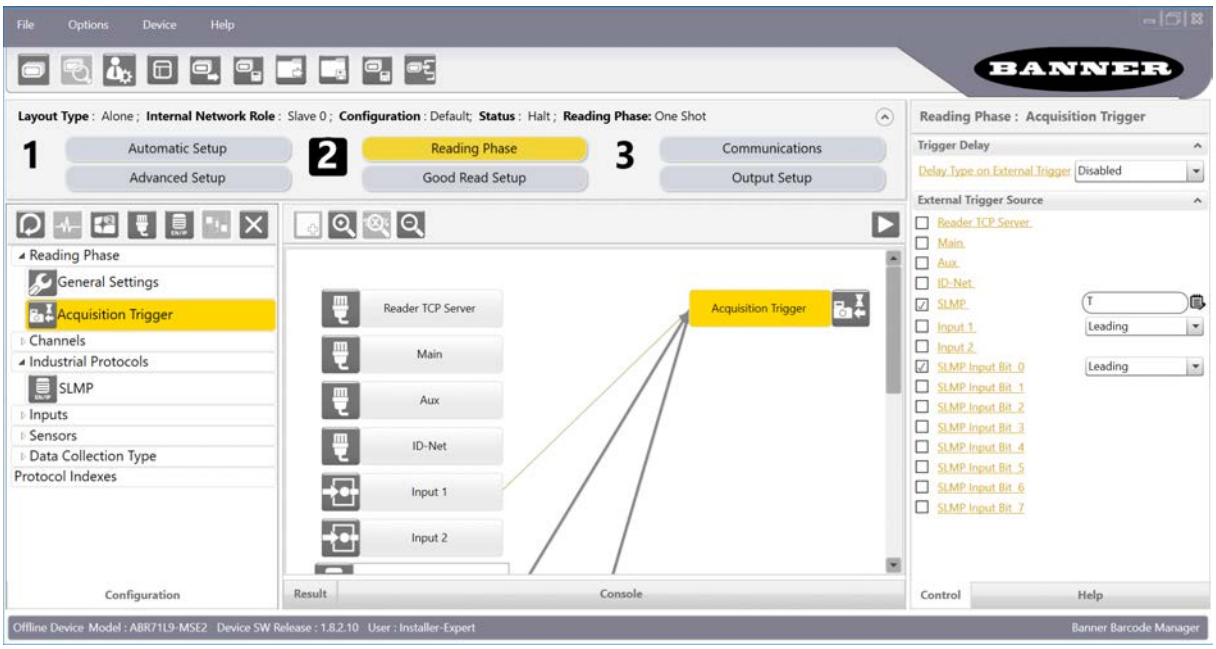
*Figure 130. Enable SLMP*




2. In the **Reading Phase: SLMP** pane, set the desired ABR Network parameters.
   - For Built-In Ethernet connection, choose the **Remote Port** from an admissible interval (see SLMP Configuration: Built-In Ethernet Port on p. 83)
   - For QJ71E71-100 Ethernet module connection, the **Remote Port** must be set to 5000
   - The **Remote Address** must match the PLC network card address
3. Set the PLC memory allocation:
   - **Number of Input Devices** and **Number of Output Devices** are the input and output exchange area width
   - **Input Offset** and **Output Offset** are the starting address of exchange areas in D memory of Q03UDE
4. Select **One Shot Mode**.
5. Select the Acquisition Trigger Source by selecting the following checkboxes:
   - **SLMP**
   - **SLMP Input Bit 0**

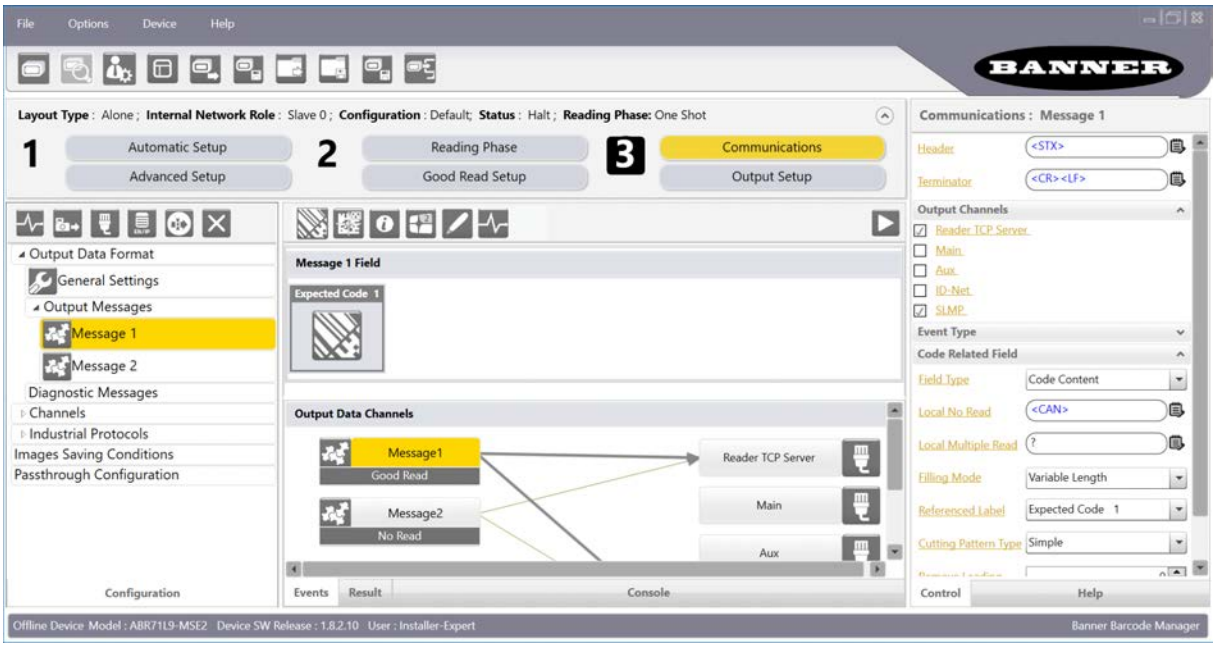
   For trigger control only by SLMP, clear the **Input 1** checkbox.

*Figure 131. Acquisition Trigger Setting: One Shot Mode Settings Shown*




6. Click **Communications**.
7. Redirect the reading message to SLMP for both read and no read results.
   a) From the Configuration Parameters tree area, select **Message 1**.
   b) On the Output Channels pane, select **SLMP**.
   c) From the Configuration Parameters tree area, select **Message 2**.
   d) On the Output Channels pane, select **SLMP**.

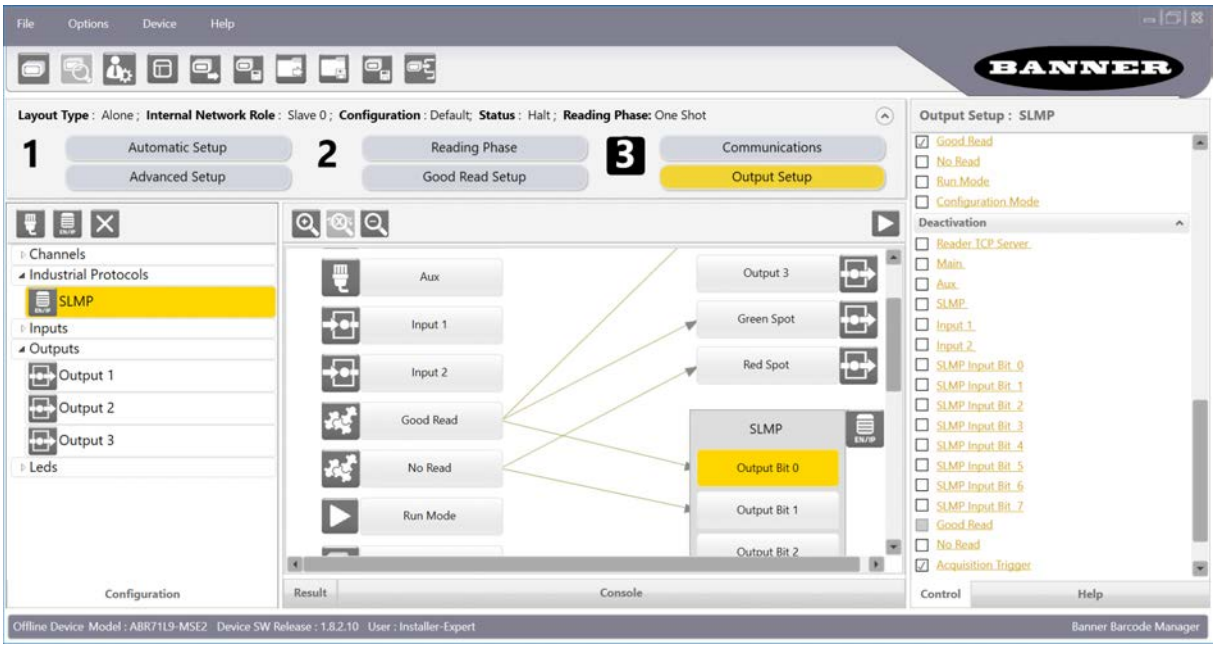
*Figure 132. ABR Output Data Setting*




8. Go to **Output Setup** > **Industrial Protocols** > **SLMP**.
9. Redirect the status output to SLMP and choose the activation and deactivation policy for both read and no read result.
   a) Click **Output Bit 0** in the center pane.
   b) On the Activation pane, select **Good Read**.
   c) On the Deactivation pane, select **Acquisition Trigger**.
   d) Click **Output Bit 1** in the center pane.

e) On the Activation pane, select **No Read**.
f) On the Deactivation pane, select **Acquisition Trigger**.

*Figure 133. ABR Control Output Setting: Output Bit 0 Shown*




10. After the settings are complete, save the configuration on the ABR.
The above configuration leads to following memory mapping:

*Table 10: Resulting Output Configuration*

| ABR -> PLC | Byte 1 | Byte 2 |
|---|---|---|
| D228 | Reserved | Digital I/O |
| D229 | Data | Data |
| … | Data | Data |
| D259 | Data | Data |

*Figure 134. Resulting Output Configuration*

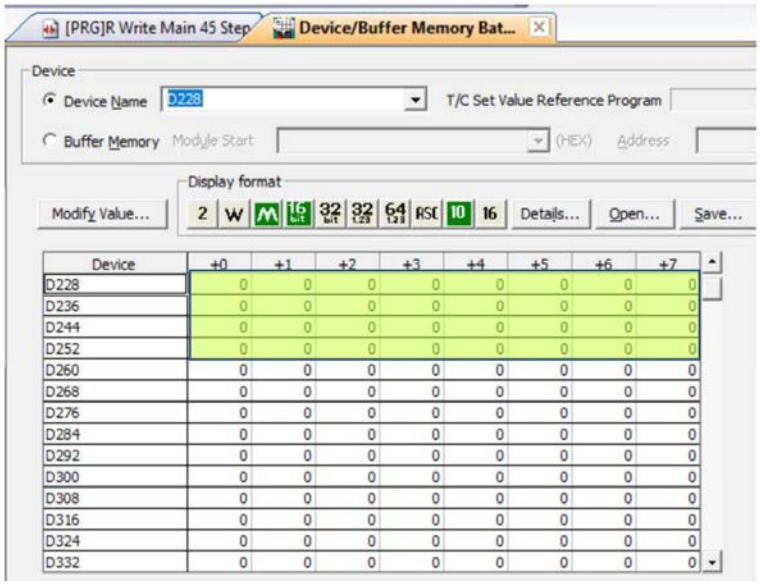
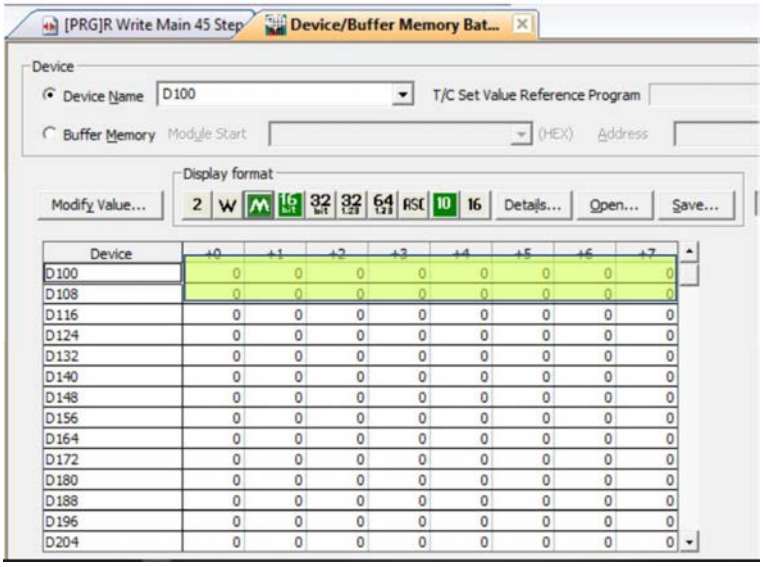


*Table 11: Resulting Input Configuration*

| PLC-ABR | Byte 1 | Byte 2 |
|---|---|---|
| D100 | Reserved | Digital I/O |
| D101 | Data | Data |
| … | Data | Data |
| D115 | Data | Data |

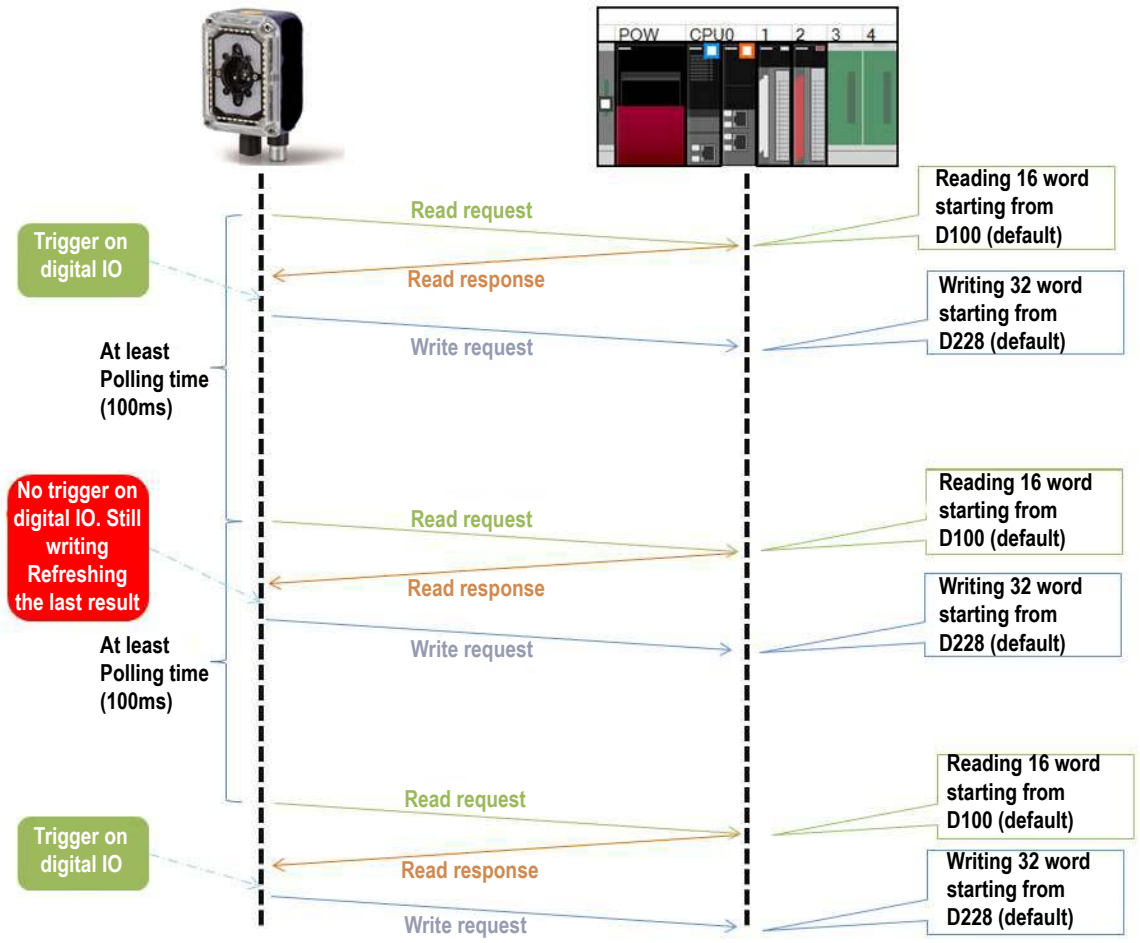
*Figure 135. Resulting Input Configuration*




## 8.4.5 PLC-ABR Communication Sequence

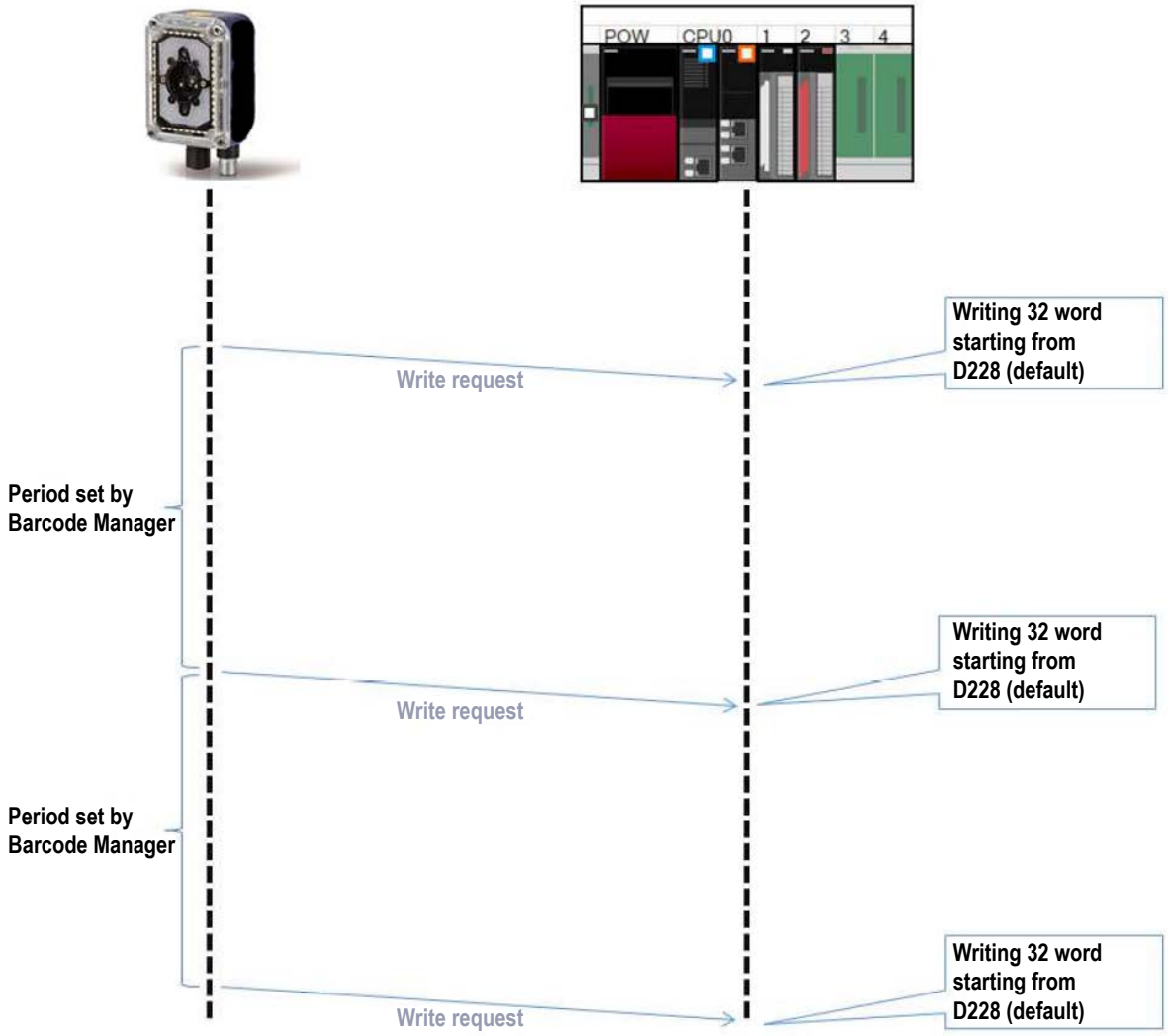
The following shows the communication flow and signal timing for both triggered and continuous acquisition mode. Note that the preceding configuration leads to triggered acquisition mode.

*Figure 136. Triggered Communication Sequence*




The interval between two read requests is at least equal to the polling time set in Barcode Manager.
Alternatively, it is possible to set ABR in continuous triggering mode. In this mode any trigger command is needed.

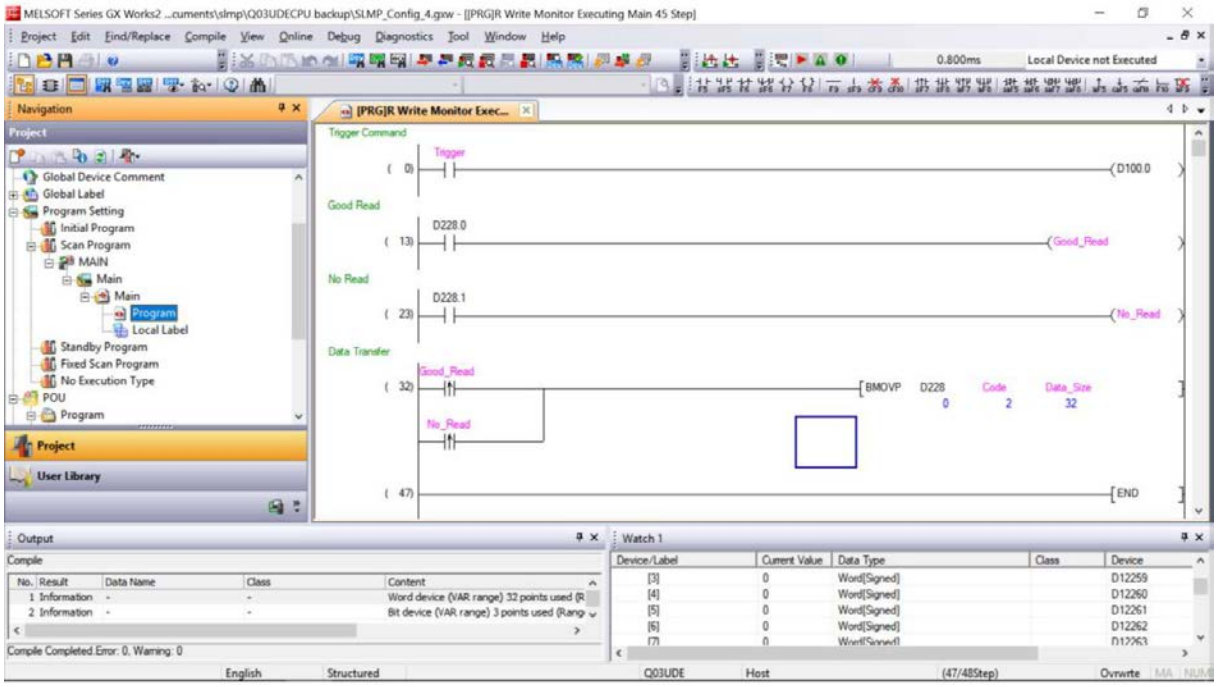
*Figure 137. Periodic Communication Sequence*



## 8.4.6 GX Works 2 Sample Program

The following figure shows a sample ladder program for implementing triggered acquisition.

*Figure 138. Sample Ladder Program*




## 8.4.7 Connection of Multiple Devices

Whichever type of PLC network card is used, each device needs a unique IP address chosen in the same subnet. Input and output offsets must be chosen to avoid overlaps. For simplicity, input and output area size (Number of Input Devices and Number of Output Devices) are 50 words wide.

### Ethernet Module Example

In this example, the devices are connected to QJ71E71-100 Ethernet module, and the IP address specified is 192.168.3.101. Table 12 on p. 95 shows a possible configuration in Barcode Manager. Note that 192.168.3.101 must not be assigned to any ABR device to avoid IP conflict.

*Table 12:*

| | Device IP | Remote Address | Remote Port | Number of Input Devices | Input Offset | Number of Output Devices | Output Offset |
|---|---|---|---|---|---|---|---|
| Device 1 | 192.168.3.1 | 192.168.3.101 | 5000 | 50 | 100 | 50 | 150 |
| Device 2 | 192.168.3.2 | 192.168.3.101 | 5000 | 50 | 200 | 50 | 250 |
| … | | | | | | | |
| Device n | 192.168.3.n | 192.168.3.101 | 5000 | 50 | 100×n | 50 | 100×n+50 |

### Built-In Ethernet Module Example

In this example, the devices are connected to a built-in Ethernet module, the IP address specified is 192.168.3.39, and the host port station is chosen in an allowable interval. Table 13 on p. 96 shows a possible configuration in Barcode Manager. Note that 192.168.3.39 must not be assigned to any ABR device to avoid IP conflict.

*Table 13:*

| | Device IP | Remote Address | Remote Port | Number of Input Devices | Input Offset | Number of Output Devices | Output Offset |
|---|---|---|---|---|---|---|---|
| Device 1 | 192.168.3.1 | 192.168.3.39 | any | 50 | 100 | 50 | 150 |
| Device 2 | 192.168.3.2 | 192.168.3.39 | any | 50 | 200 | 50 | 250 |
| … | | | | | | | |
| Device n | 192.168.3.n | 192.168.3.39 | any | 50 | 100×n | 50 | 100×n+50 |

## 8.5 PROFINET® Compatible

PROFINET® [31] is a data communication protocol for industrial automation and processes. PROFINET IO defines how controllers (IO controllers) and peripheral devices (IO devices) exchange data in real time.

The ABR 7000 supports PROFINET IO. The data communication protocol is TCP/IP; the data transmission medium is copper wire; the PROFINET conformance class is CC-A. [32]

**Note:** In this document, outputs from the ABR device are referred to as "inputs" to the controller (PLC). Outputs from the controller (PLC) are referred to as "inputs" to the ABR device.

The ABR is PROFINET compatible but not PROFINET certified.

**Note:** The GSD file is available for download at http://www.bannerengineering.com.

### 8.5.1 General Station Description (GSD) File

The General Station Description (GSD) file contains module information, such as:

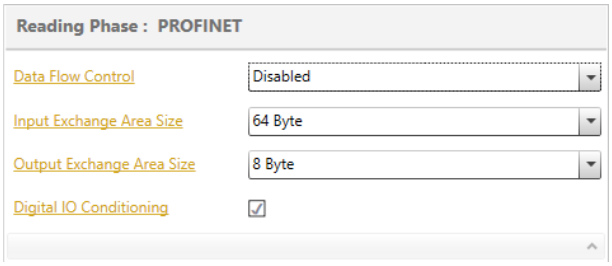
- Configuration data
- Data information (pass count, inspection status, etc.)
- Diagnostics

### 8.5.2 Configure the ABR

After PROFINET is added to a configuration's protocols (see Set the Compatible Industrial Ethernet Protocol (EtherNet/IP, MODBUS TCP, SLMP, PROFINET) on p. 61), there is an option to configure settings specific to this protocol.

1. Click **PROFINET** in the left side Configuration panel.
   The right side **Control** panel displays the PROFINET settings.
2. Use the default settings, unless the output strings sent by the ABR need to be longer than 63 characters.

*Figure 139. PROFINET Settings in the Barcode Manager Software*




**Data Flow Control**

When Enabled, communication requires handshaking control, but can use multiple 64 byte fragments to transmit larger messages. The default is Disabled.

[31] PROFINET® is a registered trademark of PROFIBUS Nutzerorganisation e.V.
[32] CC-A ensures that the device has the minimum properties regarding functionality and interoperability.

**Input Exchange Area Size**

The maximum amount of data the PLC can get from the ABR in one cycle. Because this setting must match the GSD file used, the default setting is recommended. The default is 64 Byte.

**Output Exchange Area Size**

The maximum amount of data the ABR can get from the PLC in one cycle. Because this setting must match the GSD file used, the default setting is recommended. The default is 8 Byte.

**Digital IO Conditioning**

When this checkbox is selected, the ABR is capable of exchanging 8 bits of both input and output data to be used for control such as reading phase triggers and output pulses. This data appears in the first byte of the input and output data, so the output data message string will start in the second byte when checked. The checkbox is selected by default.

## 8.5.3 Configuration Instructions

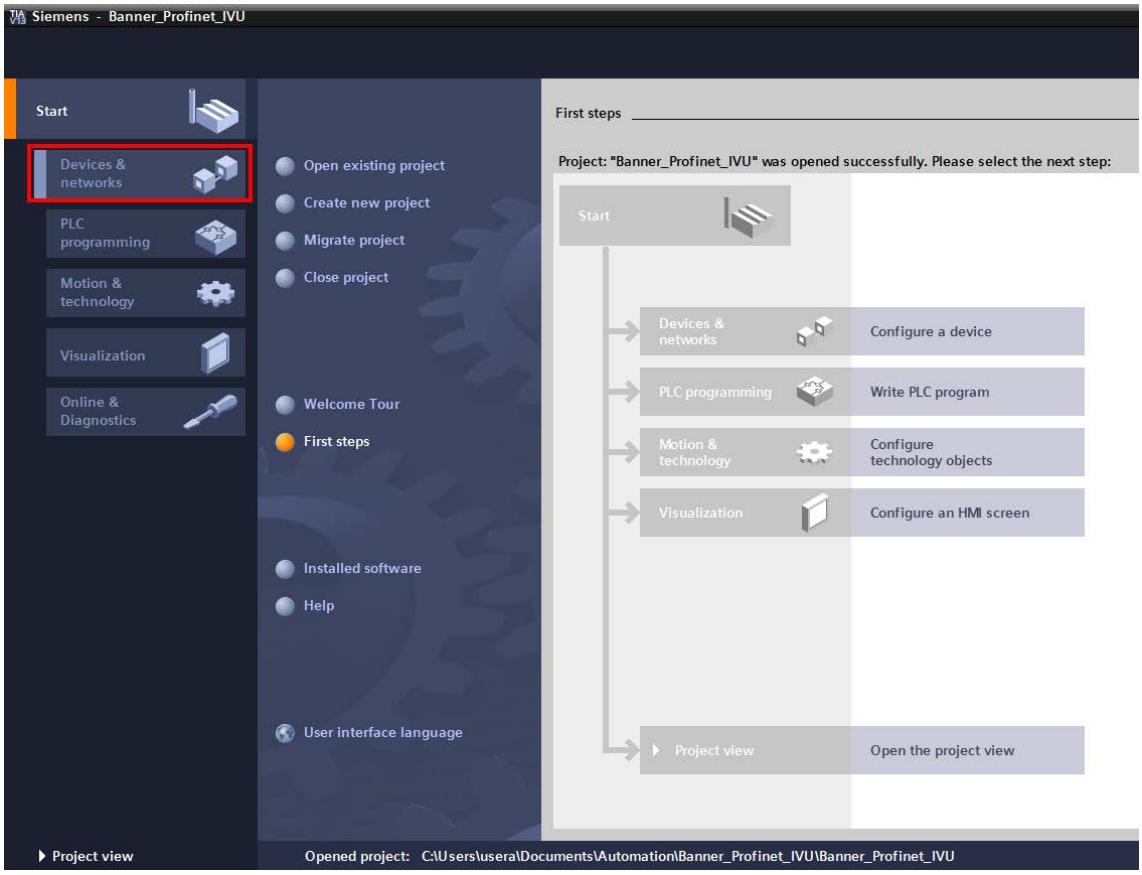
# Using Siemens TIA Portal (v15) Software

## Installing the GSD File

Use these instructions to install the GSD file in the Siemens TIA Portal (v15) software. Use these instructions as a basis for installing the GSD file in another controller (PLC).

1. Start the Siemens TIA Portal (v15) software.
2. Click **Open existing project**.
3. Select a project and open it.
4. Click **Devices & networks** after the project has been uploaded.

*Figure 140. Devices and Networks*




5. Click **Configure networks**.

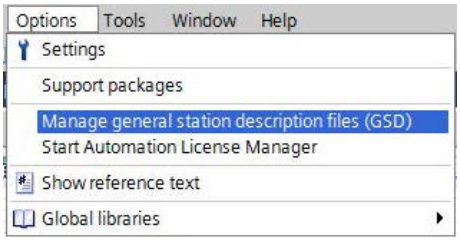
*Figure 141. Configure Networks*




**Network view** displays.

6. Click **Options** and select **Manage general station description file (GSD)**.

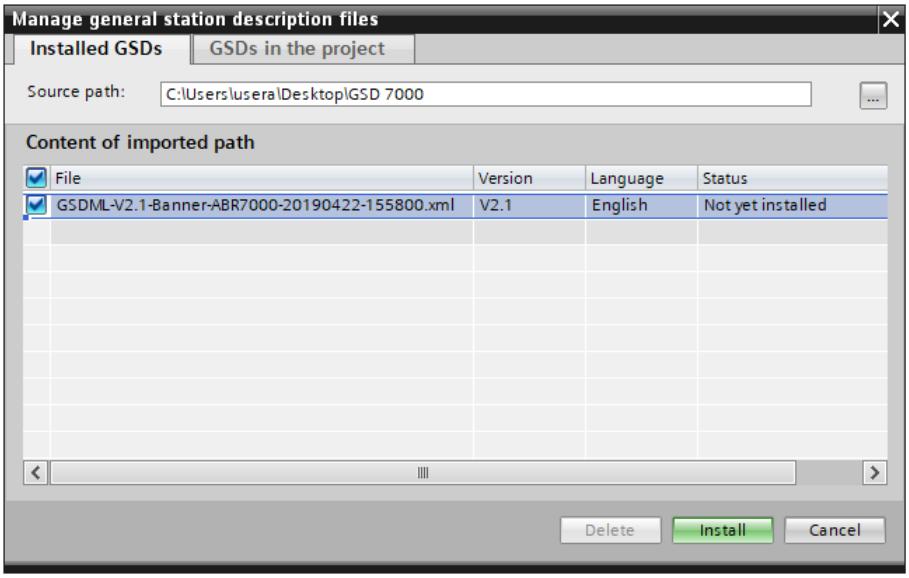
*Figure 142. Options—Install the GSD*




The **Install general station description file** window opens.

7. Click the browse button **(...)** to the right of the **Source path** field.

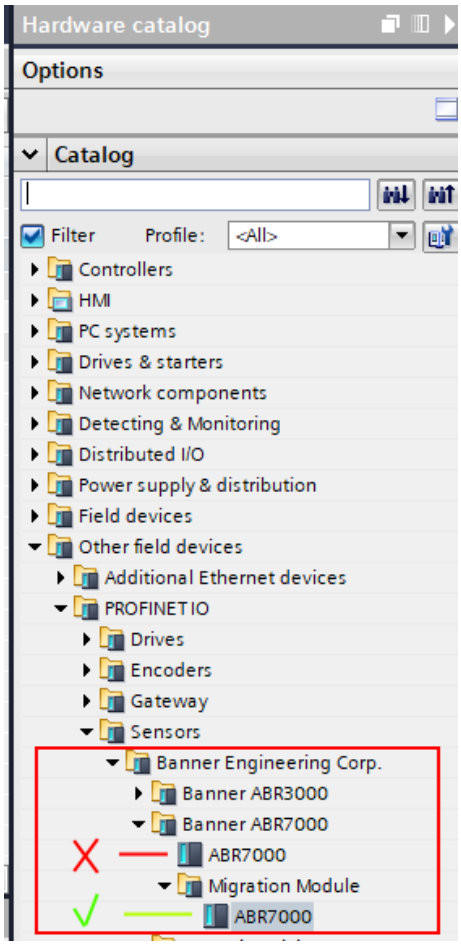
*Figure 143. Manage GSD Files*




8. Navigate to the location the ABR GSD file was downloaded to.

9. Select the ABR GSD file.
10. Click **Install**.

*Figure 144. Hardware Catalog*




11. Click **Close** when the install finishes.
12. Click **Devices & networks**.
    The system installs the ABR GSD file and places it in the **Hardware catalog**. In the above example, the ABR GSD file is located under **Other field devices** > **PROFINET IO** > **Sensors** > **Banner Engineering Corp.** > **Banner ABR7000** > **Migration Module** > **ABR7000**.

**Note:** The ABR 7000 appears twice in the Hardware catalog. The second instance, under Migration Module, is recommended for most modern PLCs.

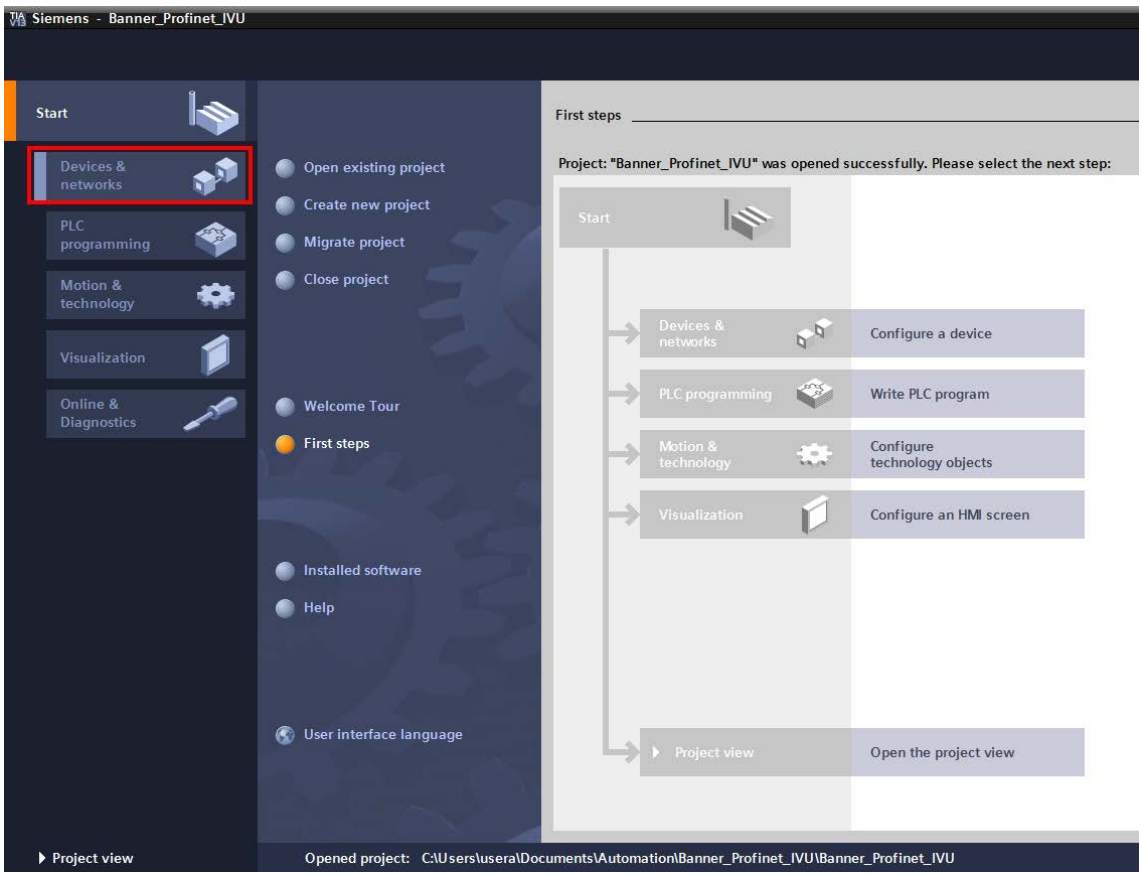
**Note:** If the ABR GSD file does not install properly, save the log and contact Banner.

## Adding a Device to a Project

Use these instructions to add a ABR device to a Siemens TIA Portal (v15) project, and to configure the device. Use these instructions as a basis for adding a ABR device to another controller (PLC).

1. Start the Siemens TIA Portal (v15) software.
2. Click **Open existing project**.
3. Select a project and open it.
4. Click **Devices & networks** after the project has been uploaded.

*Figure 145. Devices and Networks*




5. Click **Configure networks**.

*Figure 146. Configure Networks*

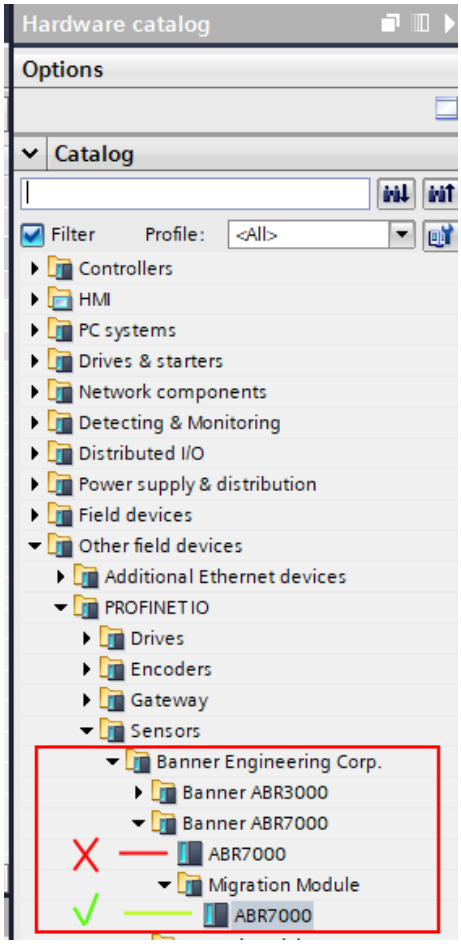



**Network view** displays.

**Note:** For Step 6 through Step 10, **Network view** must be open.

6. Locate the ABR in the **Hardware catalog**.

*Figure 147. Hardware Catalog*




In the above example, the ABR device is located under **Other field devices** > **PROFINET IO** > **Sensors** > **Banner Engineering Corp** > **Banner ABR7000** > **Migration Module** > **ABR7000**.

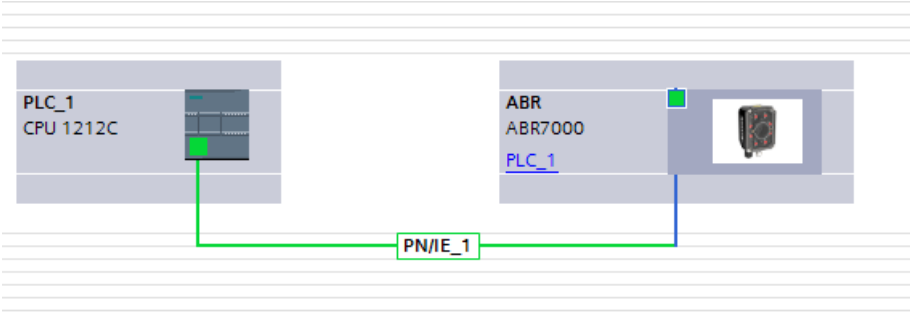
**Note:** The ABR 7000 appears twice in the Hardware catalog. The second instance, under Migration Module, is recommended for most modern PLCs.

7. Select the device and add it to the configuration.

| Selection Option | Description |
|---|---|
| **Drag** | Drag the ABR from the **Hardware catalog** directly into the configuration. |
| **Double-click** | Double-click on the ABR and add it to the configuration. |

8. Click the green square on the ABR icon. Drag the pointer to the green square on the PLC_1 icon to connect the device to the controller (PLC).

*Figure 148. Drag to Connect*




The connection is made.

9. Double-click the ABR icon to open the **Device** window.
10. Select the desired modules or submodules from the **Hardware catalog** and drag them onto the **Device overview** tab on the **Device view** tab.

    If the PROFINET settings in Barcode Manager are left at default, then these modules do not need to be configured; the default settings will match.

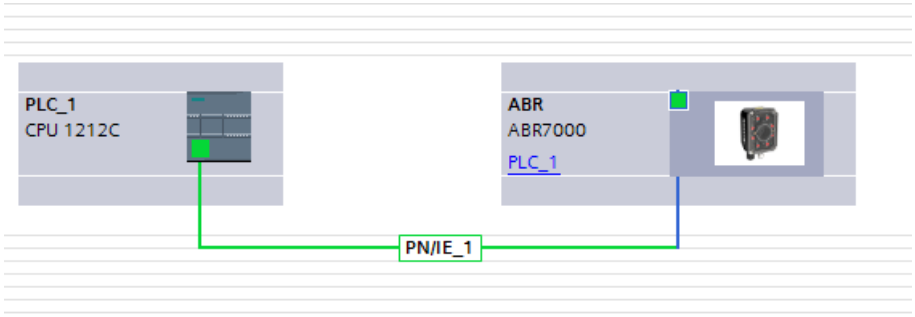
    The ABR device is configured.

## Changing the Device IP Address

Use these instructions to change the IP address of the ABR device, using the Siemens TIA Portal (v15) software. Use these instructions as a basis if you are using another controller (PLC).

1. Start the Siemens TIA Portal (v15) software.
2. Click **Open existing project**.
3. Select a project an open it.
4. Click **Devices & networks** after the project has been uploaded to go to **Network view**.

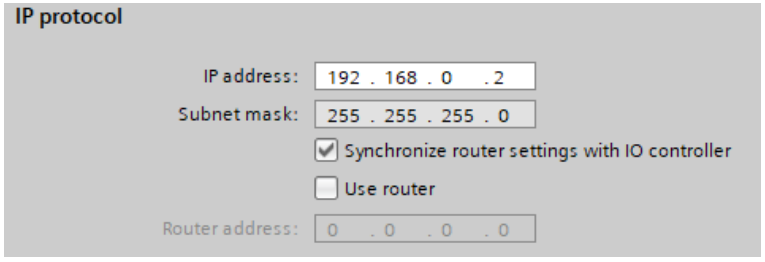
*Figure 149. Network View*




**Network View** displays.

5. Double-click on the ABR icon to open the **Device view**.
6. Click on the ABR icon in the graphic area of the **Device view** to open the **Module properties** window. The module can now be configured.
7. Click **Properties**.
8. Click **General**.
9. Select **PROFINET interface**.
   The project sets the IP address of the device.
10. Enter the IP address.

*Figure 150. Set IP Address*




11. Right-click on the device icon and select **Online & diagnostics**.

*Figure 151. Select Online & Diagnostics*

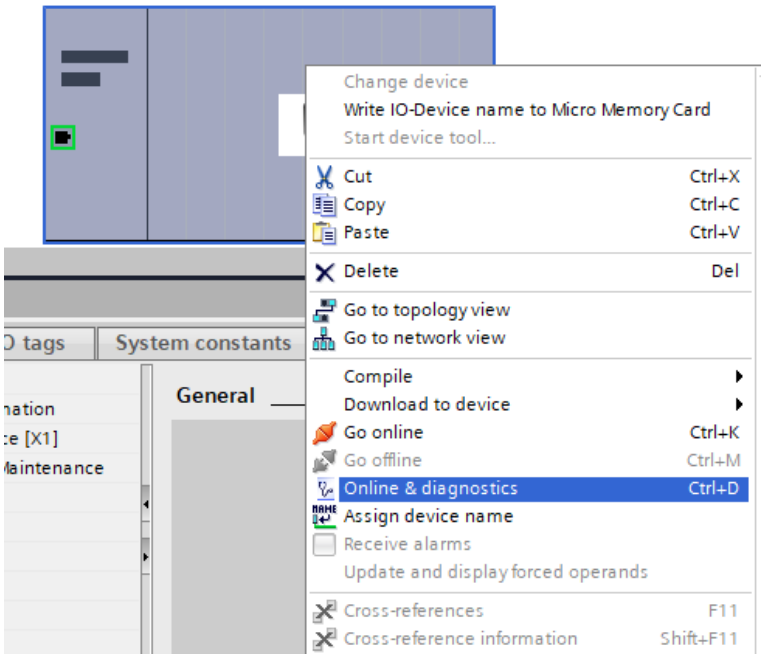
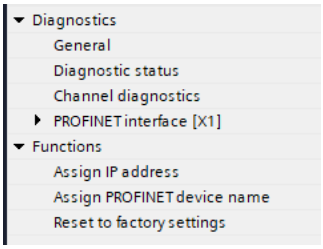


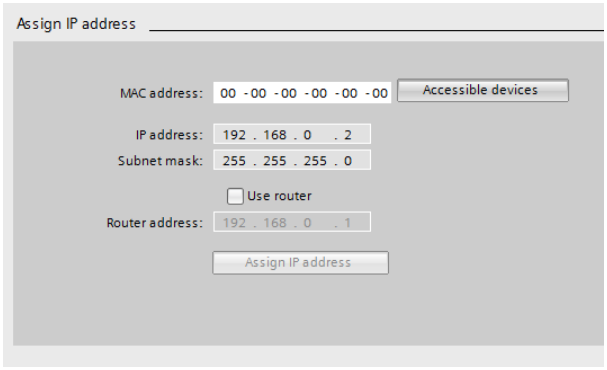

*Figure 152. Online & Diagnostics*




The **Online & diagnostics** window displays.

12. Select **Assign IP address** under **Functions**.
13. Click **Accessible devices**.

*Figure 153. Assign IP Address—Accessible Devices*

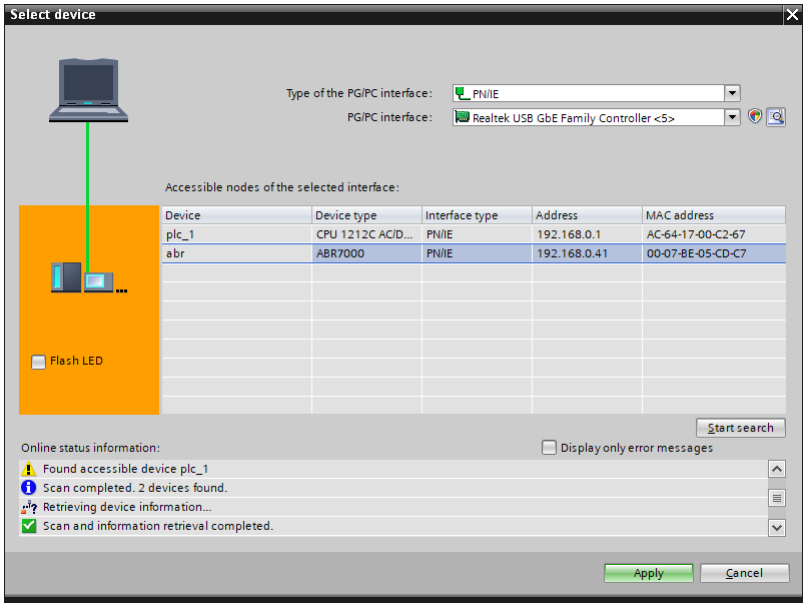



The **Select device** window searches the network for available devices.

14. Determine the device to be adjusted via the MAC address and select it.

    Use the Barcode Manager software to verify the MAC address: **Getting Started** > **Sensor Neighborhood**.
15. Click **Apply**.

*Figure 154. Select the Device and Apply Changes*




The IP address for the device is updated.

16. Click **Assign IP address** to complete the step.

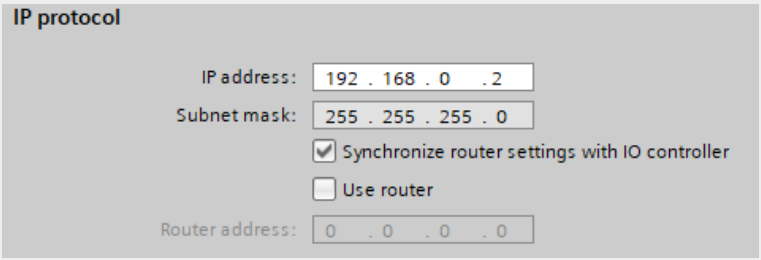
    This step is completed for every device.

**Note:** PROFINET devices commonly lack an IP address on startup (IP address = all zeros). However, ABR devices require an IP address to connect to Barcode Manager to set the device configuration.

By default, each Banner device shipped from the factory is assigned the IP address 192.168.3.100. The default address can be changed using Barcode Manager.

Immediately after the PROFINET protocol has been enabled in the Banner device, but before the PLC discovers and connects to the Banner device, the Banner device will retain its IP address. After the PLC discovers and connects to the Banner device, the behavior of the IP address depends on the state of the PLC.

*Figure 155. Siemens TIA Portal (v15): IP Protocol Options*




The PLC assigns the Banner device IP address, but only after the program has been loaded into the PLC and is running.

If the Banner device is restarted after it was discovered and configured by the PLC, the Banner device has an IP address of 0.0.0.0 until the PLC discovers it and assigns it the specified address again.

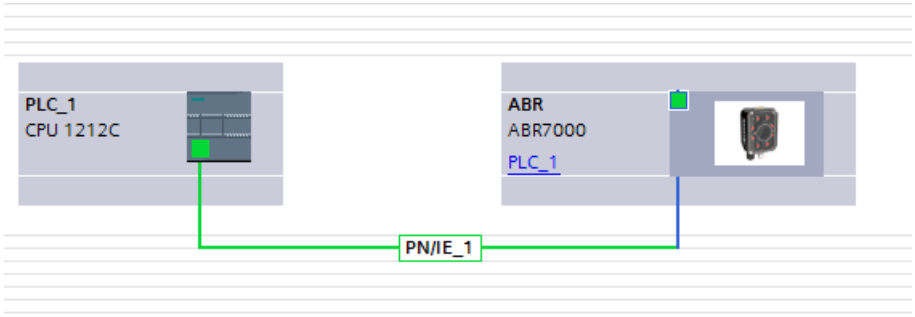
When the Banner device has no IP address assigned, it is still possible to assign an IP address to the Banner device using Barcode Manager. However, if this address is different than what is specified in the PLC, the Banner device reverts to the address specified in the PLC when the PLC becomes active again.

## Changing the Device Name

Use these instructions to change the name of the ABR device, using the Siemens TIA Portal (v15) software. Use these instructions as a basis if you are using another controller (PLC).

1. Open a project and click on **Devices & networks** to go to the **Network view**.

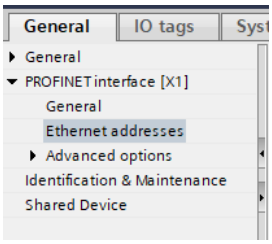
*Figure 156. Network View*




**Network view** displays.

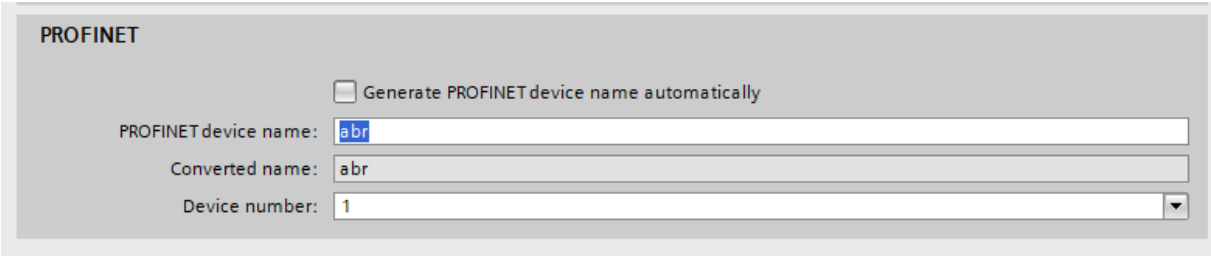
2. Double-click on the ABR icon to open **Device view**.
3. Click on the ABR icon in the graphic area of **Device view** to open the **Module properties** window.
4. Click **General**.
5. Select **PROFINET interface [X1]** > **Ethernet addresses**.

*Figure 157. Ethernet Addresses*




6. Deselect **Generate PROFINET device name automatically**.

*Figure 158. PROFINET Device Name*




7. Enter a unique name in the **PROFINET device name** field.

   This must match the ABR Device Name configured in the Barcode Manager software, which is ABR by default. This can be changed in the Barcode Manager software under **Device** > **Settings** > **Settings**.
8. Enter a unique device number in the **Device number** field.

**Note:** Each device number is used only once.

9. Right-click on the device icon and select **Online & diagnostics**.

*Figure 159. Select Online & Diagnostics*

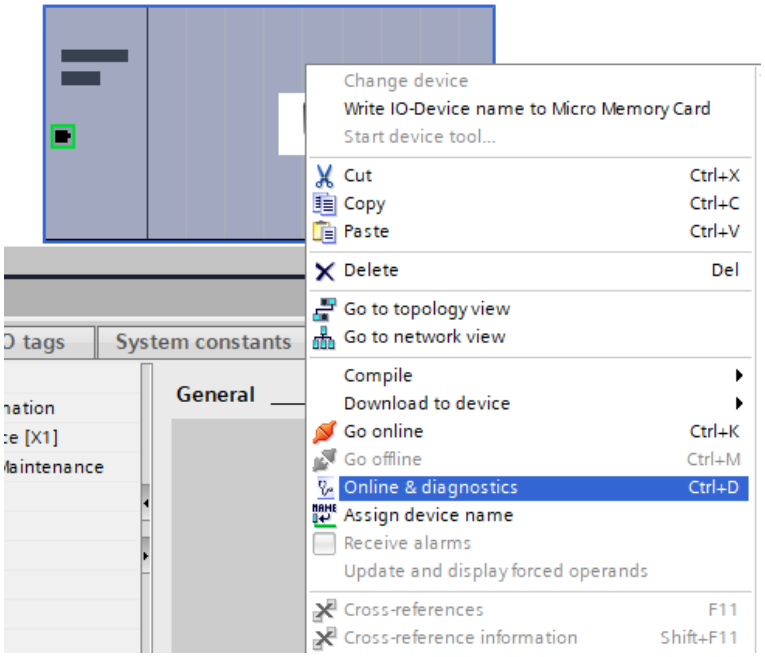
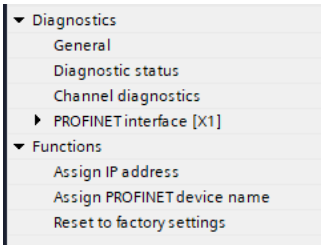


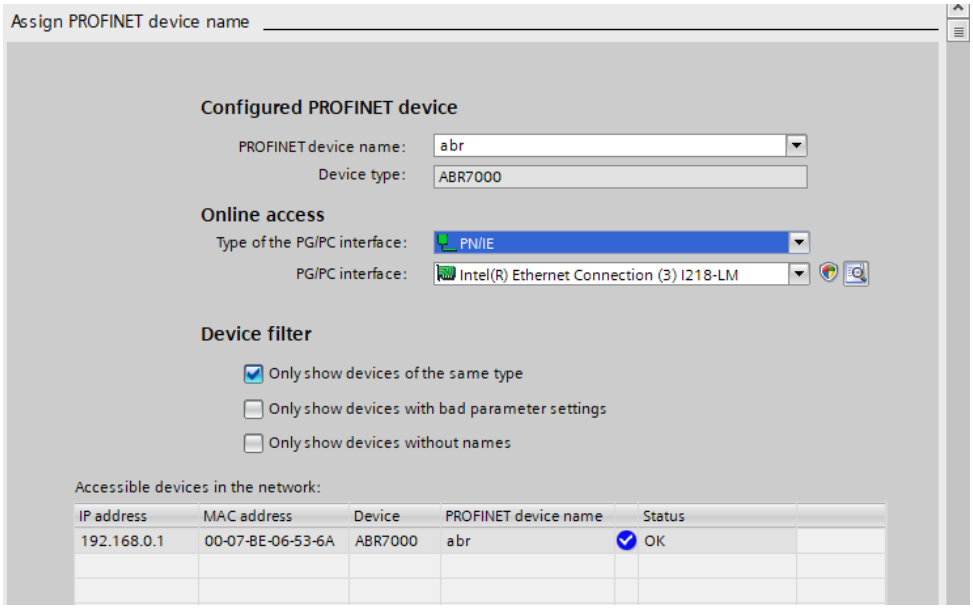

*Figure 160. Online & Diagnostics*




The **Online & diagnostics** window displays.

10. Select **Assign PROFINET device name** under **Functions**.
    The **Assign PROFINET device name** window displays. The devices in the network are discovered.
11. Select the device that will have a name assigned to it.
12. Click **Assign name** to start the process.
    The name is assigned.

*Figure 161. Assign Name*



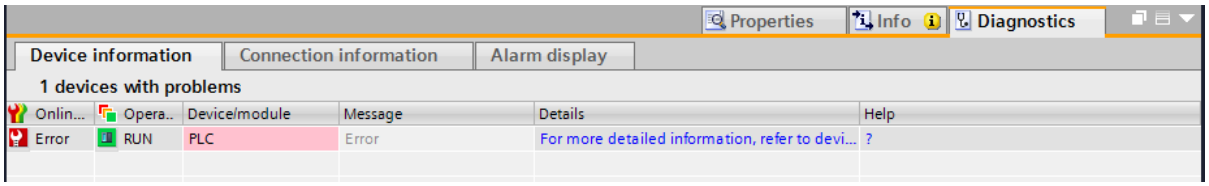
The project can be downloaded to the PLC to test the connection and check for errors.

## 8.5.4 Diagnosing Errors

The Siemens TIA Portal (v15) software includes numerous diagnostic tools. When a computer is connected to the controller (PLC), diagnostic information is available. The controller (PLC) generates a message that displays in the **Diagnostics** window. A flashing red light on the CPU module of the controller (PLC) indicates an error.

1. Click on the text in the **Details** column to request detailed information about the device that caused the error.

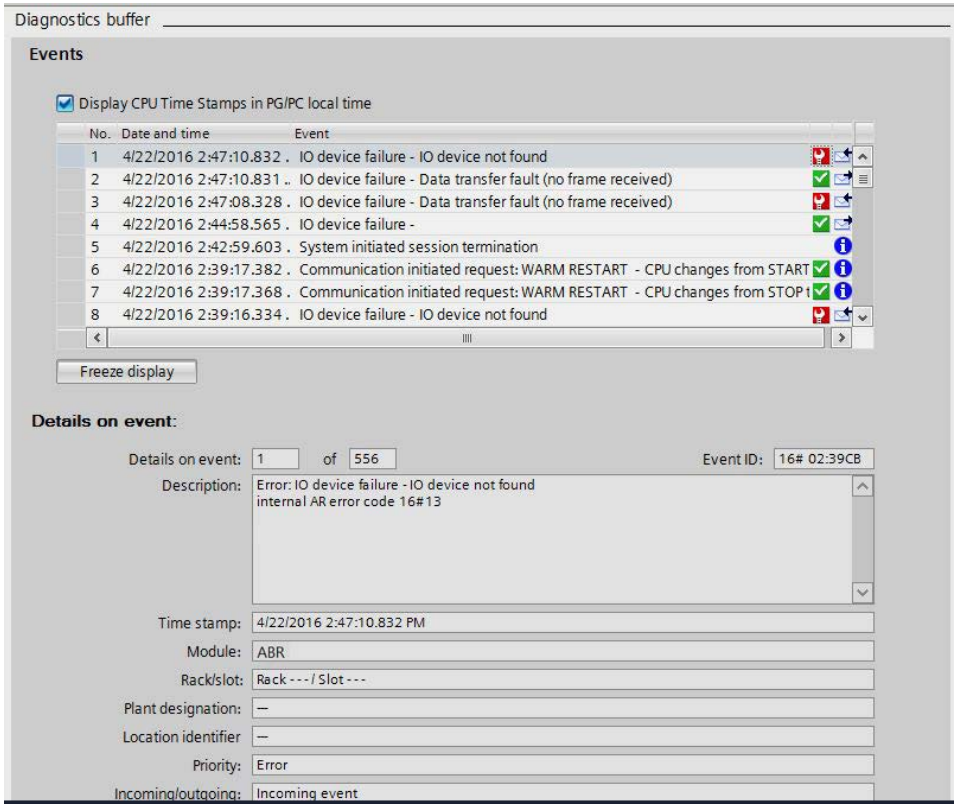
*Figure 162. Diagnostics*




All system and device messages are displayed in the **Diagnostics buffer** window under **Events** and **Details on event**.

2. Select a message in the table, **Display CPU Time Stamps in PG/PC local time**.

*Figure 163. Diagnostics Buffer*




The respective information displays in the **Description** field under **Details on event**.

3. Read the message to learn about the error and resolve it. When the error is resolved, the icon that corresponds to the displayed message is green.

## 8.5.5 PROFINET® Data Map

The addresses used in the PLC for ABR data will vary, but the order of the data will not. Use this example to learn how to find the ABR data in the PLC.

1. Open **Device & Networks**.
2. Select the desired ABR.

3. Select the **Device View** tab.

The **Device Overview** tab shows how the ABR is mapped to the local memory of the PLC. In the example shown, the input data is stored in I68 through I131. This is a total of 64 bytes worth of data. It may be necessary to change the size of slots 1 and 2. Make sure these match the ABR PROFINET settings in Barcode Manager.

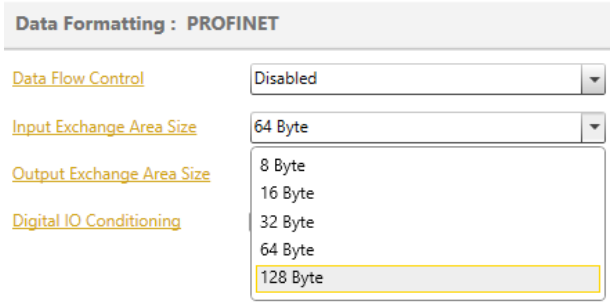
*Figure 164. ABR addresses in PLC memory, with default sizes*

| Module | Rack | Slot | I address | Q address |
|---|---|---|---|---|
| ABR | 0 | 0 | | |
| Interface | 0 | 0 X1 | | |
| 8 Byte Output_1 | 0 | 1 | | 64...71 |
| 64 Byte Input_1 | 0 | 2 | 68...131 | |

**WARNING:** If using an S7-300 PLC, such as model number CPU315-2 PN/DP, you may need to change the I and Q addresses to different values than the default values to make sure they are valid memory locations. The I and Q area is only 128 bytes by default. See Banner tech note *S7-300 and the ABR* for more details.

The following is an example of when to change the default settings: If you want to read a 70-character long barcode and transmit the whole contents to the PLC. To do this, change the Input Exchange Area Size to the maximum, which is 128 bytes. In this case, if the default size of 64 bytes is used, the last few characters of a code this size are ignored.

*Figure 165. Increasing the size of the data (optional)*




If 128 bytes is not enough data, try using Data Flow Control to send the data in fragments. Contact Banner for more information.

The first byte of the input data and the first byte of the output data are used for the discrete Industrial Protocol bits. Industrial Protocol bits are user-defined to perform functions like triggers and pass/fail outputs. Using default data size settings and the PLC addresses shown in Figure 164 on p. 108, the PLC data map looks like this:

| PLC byte address | PLC bit | ABR Function |
|---|---|---|
| Q64 | Q64.0 | PROFINET Output Bit 0 |
| | Q64.1 | PROFINET Output Bit 1 |
| | Q64.2 | PROFINET Output Bit 2 |
| | Q64.3 | PROFINET Output Bit 3 |
| | Q64.4 | PROFINET Output Bit 4 |
| | Q64.5 | PROFINET Output Bit 5 |
| | Q64.6 | PROFINET Output Bit 6 |
| | Q64.7 | PROFINET Output Bit 7 |
| Q65-Q71 | | Data Flow Control (optional) |
| I68 [33] | I68.0 | PROFINET Input Bit 0 |
| | I68.1 | PROFINET Input Bit 1 |
| | I68.2 | PROFINET Input Bit 2 |
| | I68.3 | PROFINET Input Bit 3 |

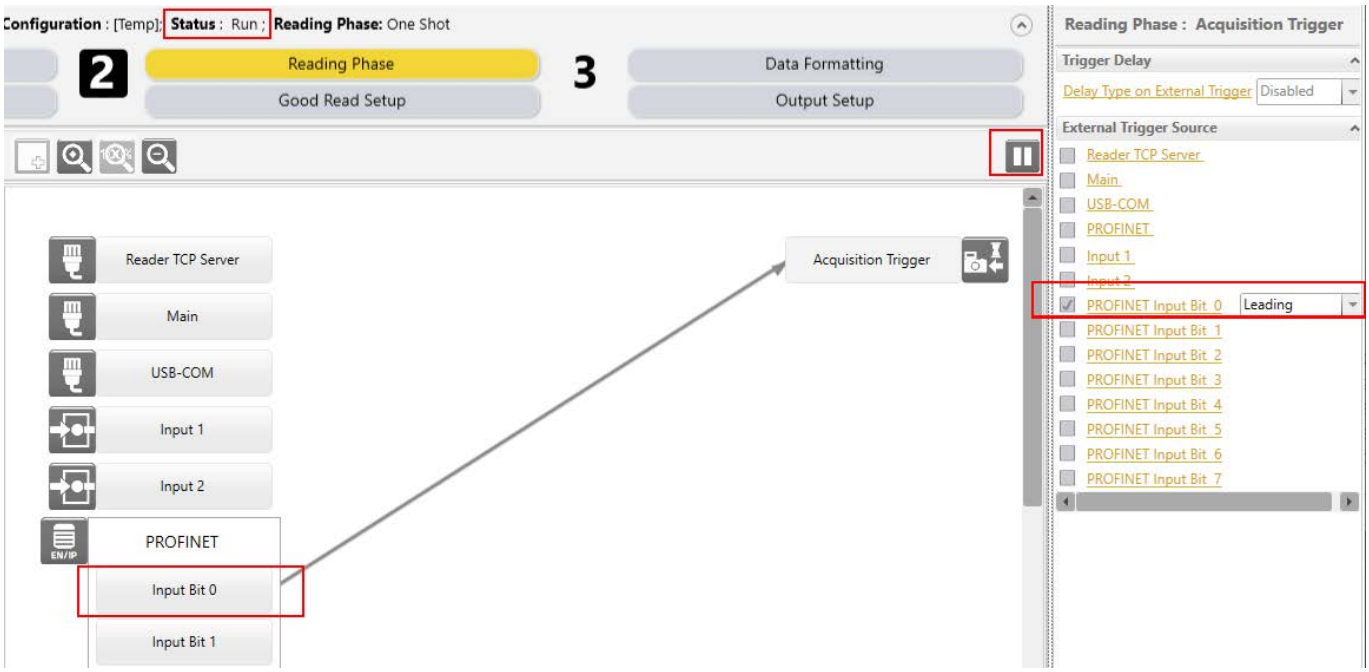
[33] If the Digital IO Conditioning setting in Barcode Manager PROFINET settings is disabled, then the input and output bits are not used, and barcode data messages moves up a byte to start at I68.

| PLC byte address | PLC bit | ABR Function |
|---|---|---|
| | I68.4 | PROFINET Input Bit 4 |
| | I68.5 | PROFINET Input Bit 5 |
| | I68.6 | PROFINET Input Bit 6 |
| | I68.7 | PROFINET Input Bit 7 |
| I69-I131 [33] | | Barcode Data Messages |

The following shows how the input bits are used:

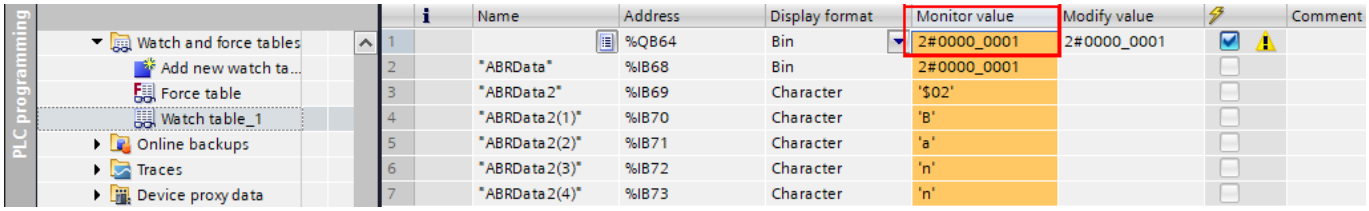
1. Set the One Shot Mode Acquisition Trigger to Bit 0 = Leading.
2. Make sure the ABR is in Run mode.

*Figure 166. ABR Trigger Setup*




3. Open a Watch table in TIA Portal.
4. Set Q64.0 to 1 to trigger the ABR.

*Figure 167. Toggling Trigger Bit*




For detailed information, see Industrial Ethernet Reading Phase Control on p. 61.

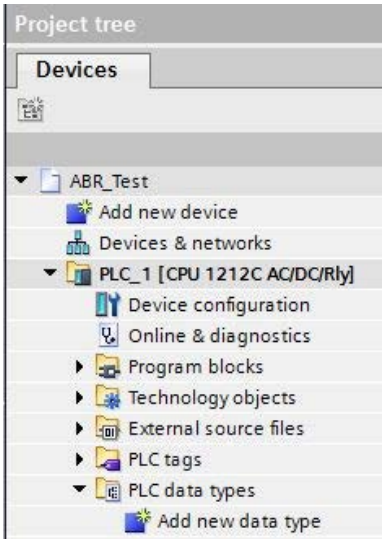
## 8.5.6 Monitoring ABR Barcode Data as a String

This example shows how to convert barcode data to a readable string of text. It assumes that the input size is 64 bytes, IO Conditioning is unchecked, and Data Flow Control is Disabled.

The ABR mapping in the PLC is as in Figure 164 on p. 108.

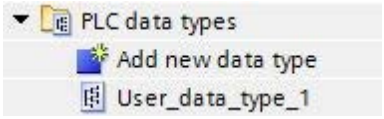
1. Create a custom PLC data type.
   a) On the **Project Tree**, under **Devices**, double-click **Add new data type**.

*Figure 168. Add New PLC Data Type*



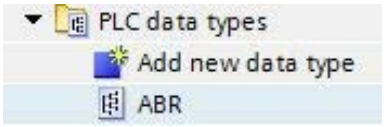

A generic "User data type" is created.

*Figure 169. User Data Type*



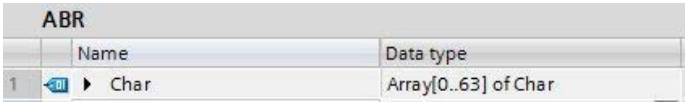

b) Rename the "User data type" as desired.
In this example, the name is set to `ABR`.

*Figure 170. Rename User Data Type*



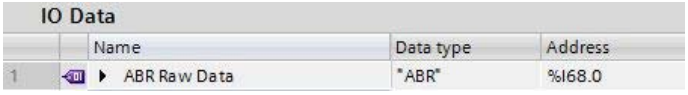

2. Double-click on **ABR**.
The configuration window opens.
3. Create an array of 64 characters.

*Figure 171. 64 Character Array*



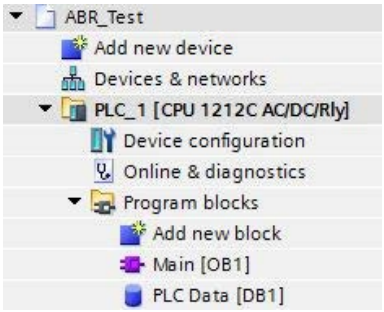

4. Next create a new PLC tag.
5. Add this tag to a new or existing table.

*Figure 172. PLC Data Tag in a Table*



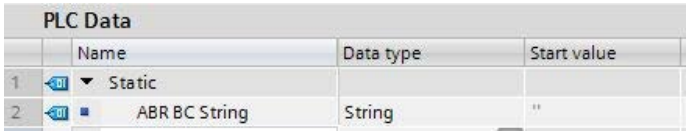

6. Create a data block that will be used to store a string.
In this example, the PLC Data was created.

*Figure 173. PLC Data*



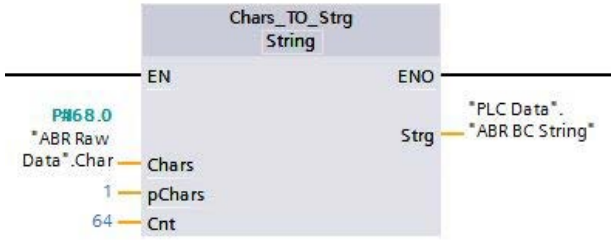
7. Add a string type tag to the data block.

*Figure 174. Data Type = String*




8. Add a Chars to Strg command; this will convert the raw data into a string.

*Figure 175. Chars_TO_Strng*




- Chars has the raw data tag created linked to it.
- pChars tells the block the first raw data element it should start at. The example shows to start at element 1. In the normal setup the first byte stores communications information which should be ignored.
- Cnt is the maximum value of the data being sent. Sixty-four bytes of data in this example.
- Strg is linked to the tag in the data block.

The conversion of raw data to string is complete at this point.

# 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 14: 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 |
| ABR72L9-xxE2 | 9 mm Liquid Lens Autofocus | 18 | 45° | 34° | 54° | 30° |
| 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 |
| ABR72L16-xxE2 | 16 mm Liquid Lens Autofocus | 14 | 25° | 19° | 31° | 50° |

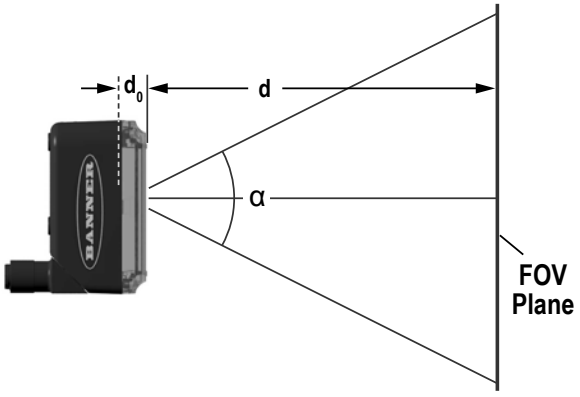
The viewing angle has a tolerance of ±1° depending on the reading distance.

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

where:

$FOV_x$ = horizontal, vertical or diagonal field of view (FOV)
$\alpha_x$ = 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 176. Reading Distance Reference*




### Examples

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

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

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

## 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 1.3 MP Models: Manual Focus Models 6 mm Lens

*Figure 177. 1D Codes*

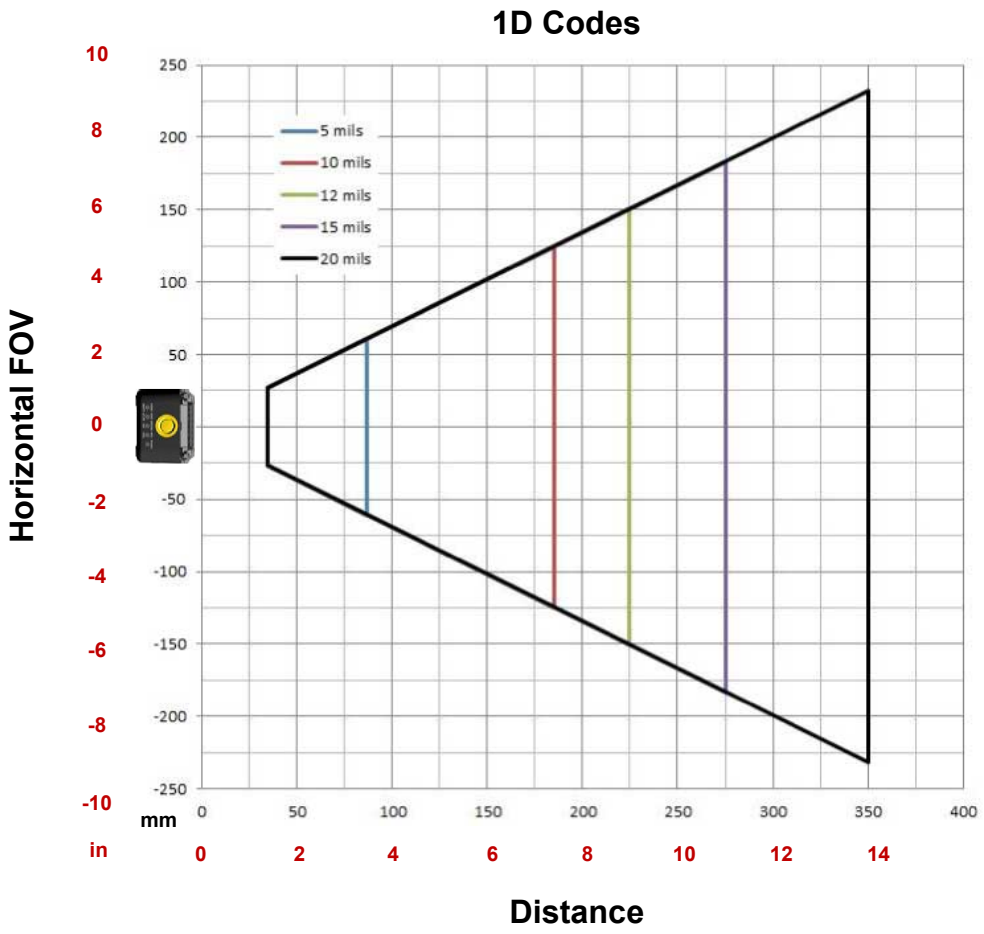
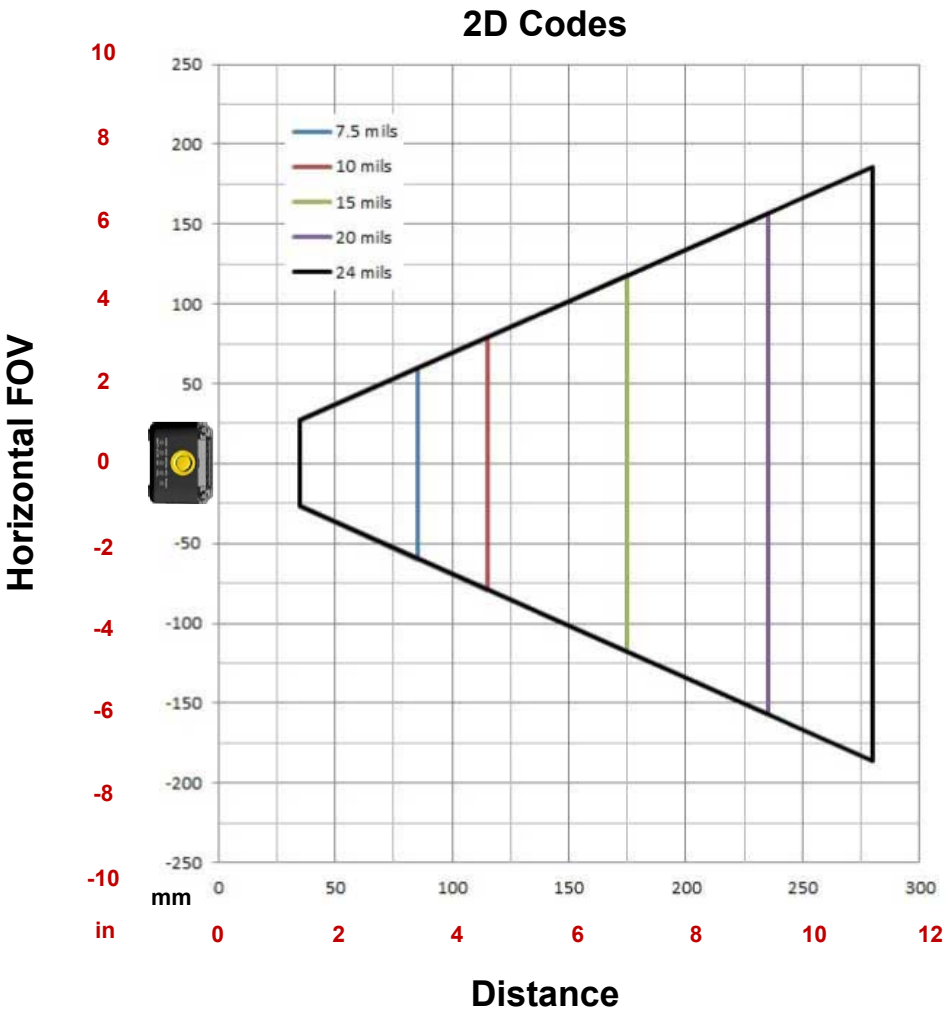


*Figure 178. 2D Codes*



# 9.2.2 1.3 MP Models: Liquid Lens Autofocus Models 9 mm Lens

*Figure 179. 1D Codes*

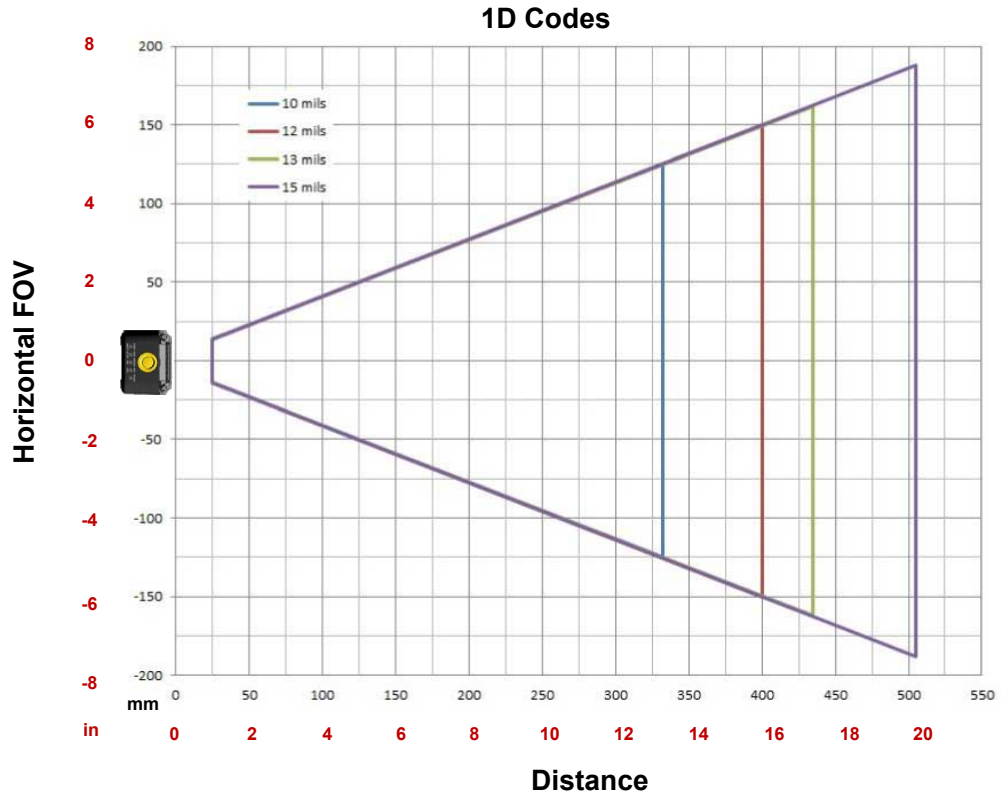
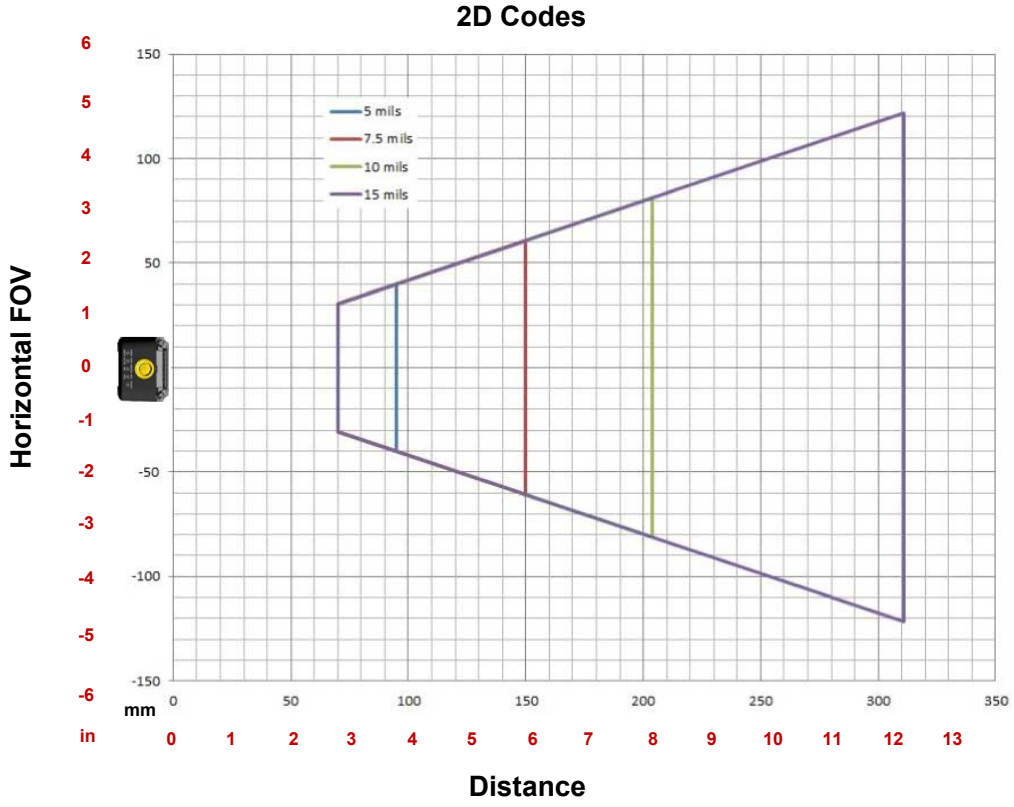



*Figure 180. 2D Codes*



## 9.2.3 1.3 MP Models: Manual Focus Models 9 mm Lens

*Figure 181. 1D Codes*

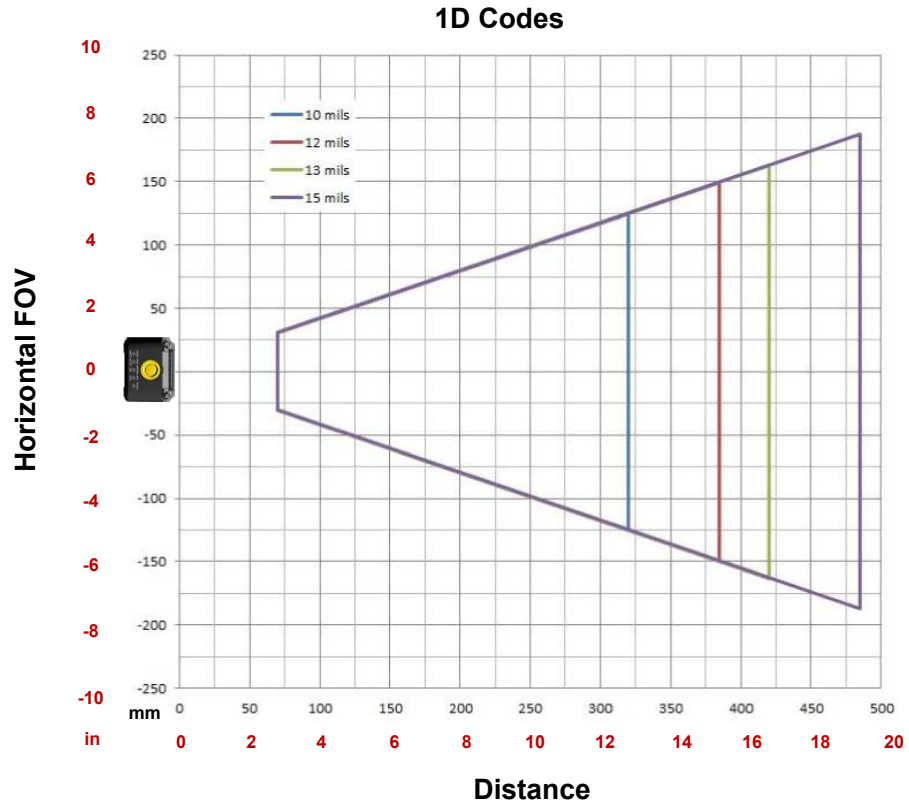
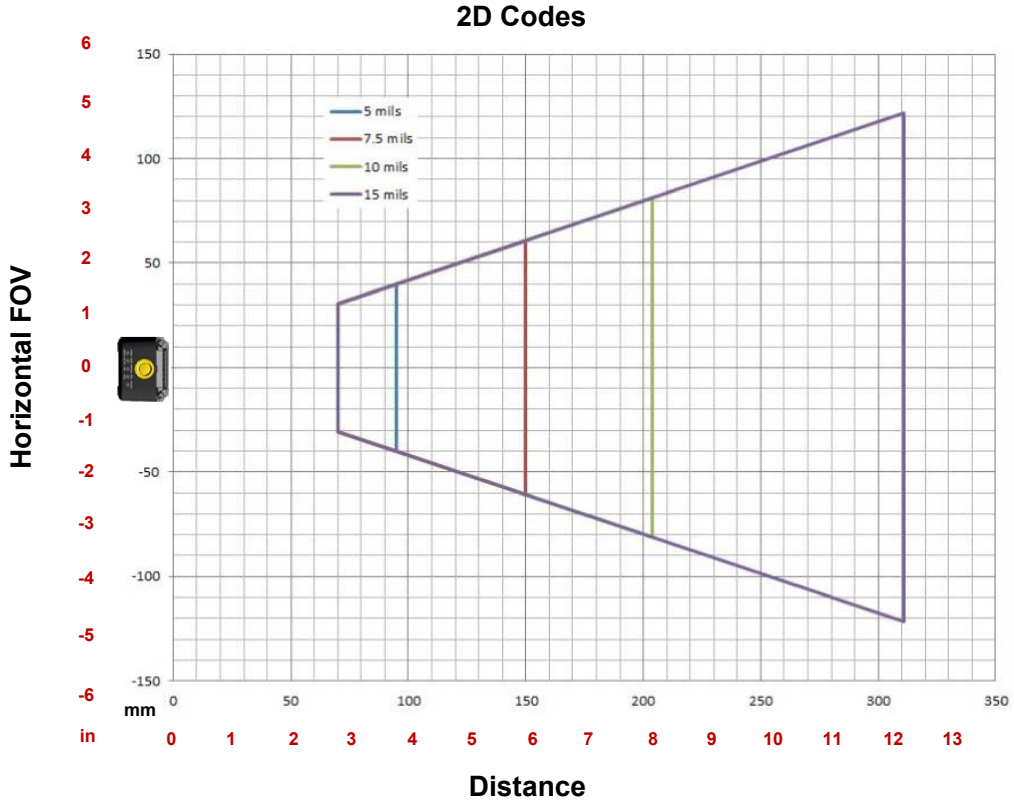



*Figure 182. 2D Codes*



## 9.2.4 2 MP Models: Liquid Lens Autofocus Models, 9 mm Lens

*Figure 183. 9 mm Global FOV Diagram*

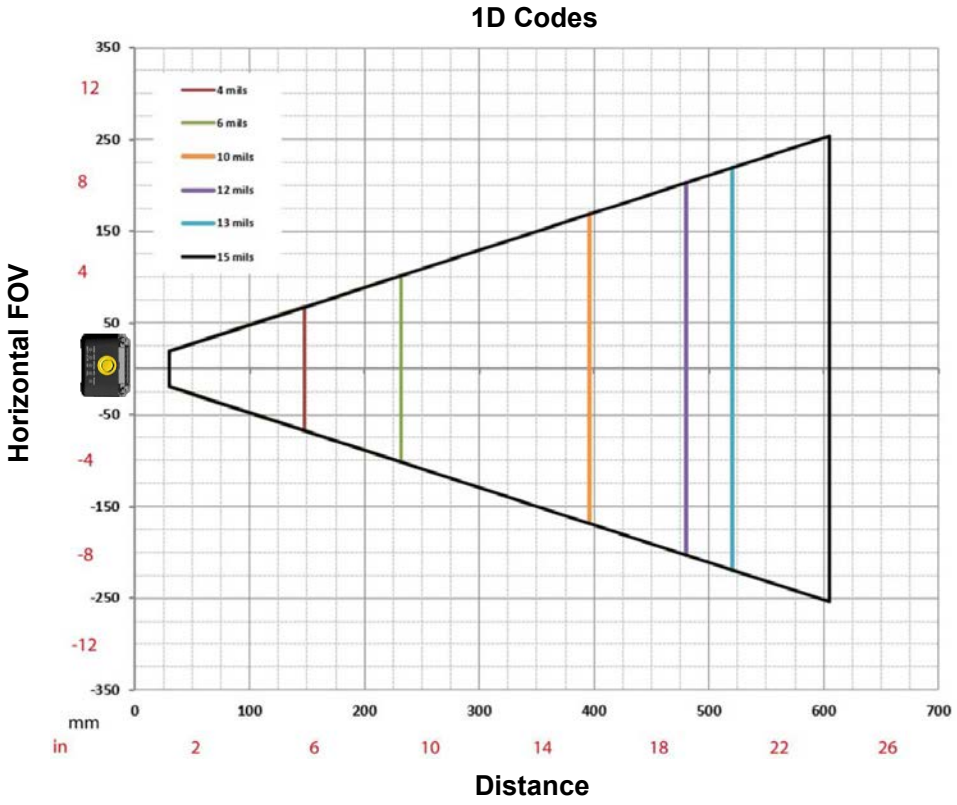
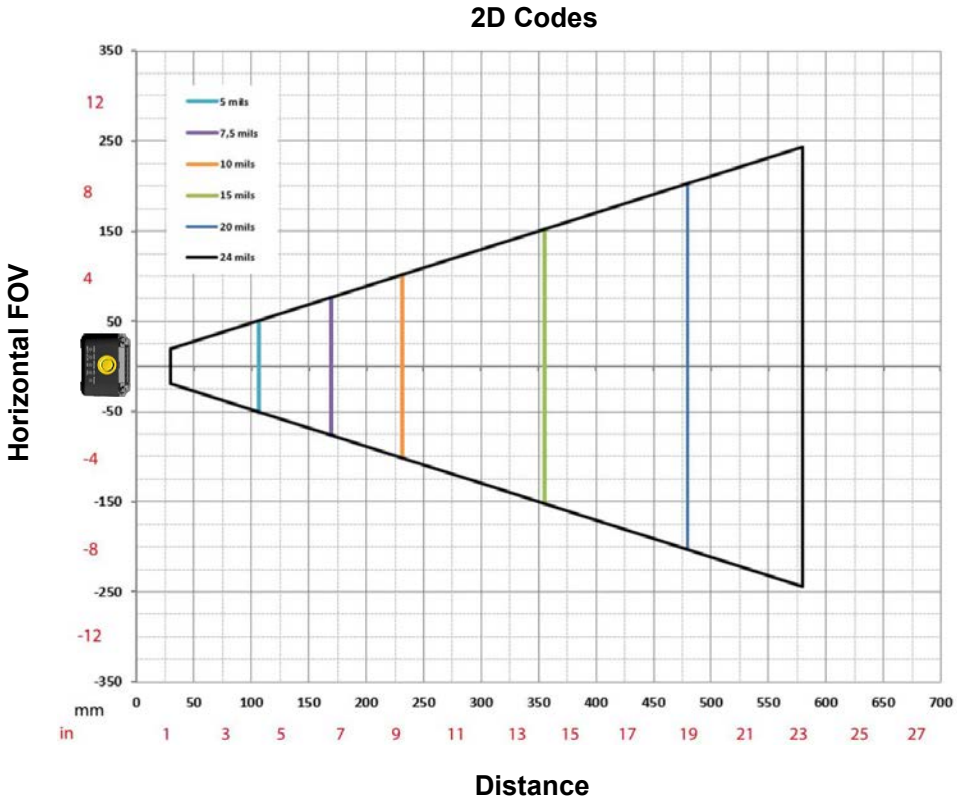



*Figure 184. 9 mm Global FOV Diagram*



## 9.2.5 1.3 MP Models: Manual Focus Models 12 mm Lens

*Figure 185. 1D Codes*

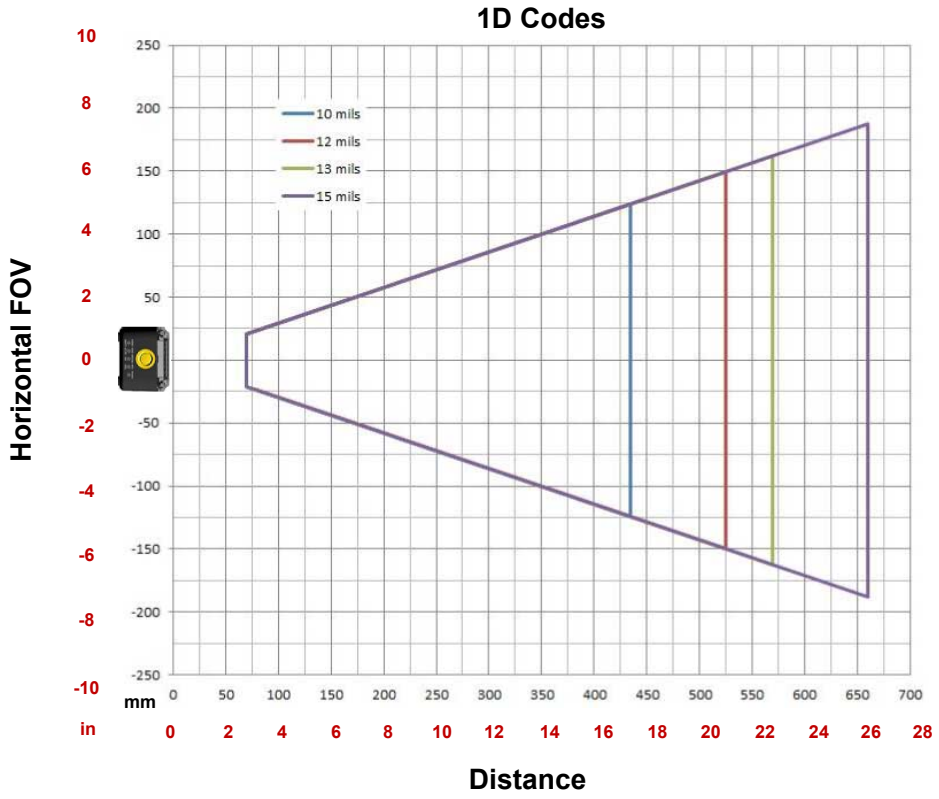
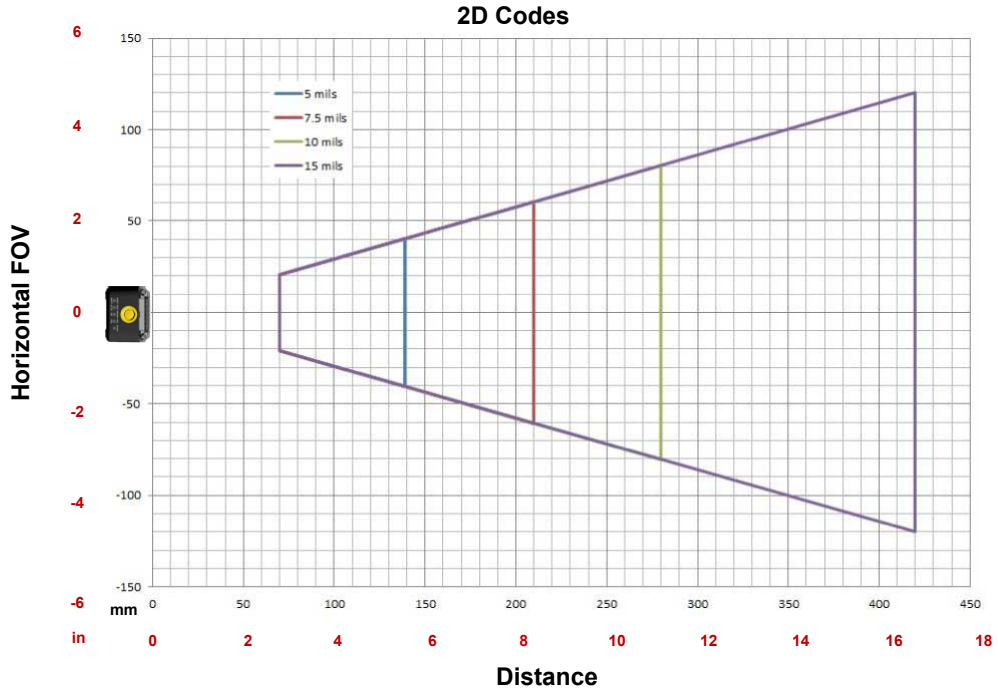



*Figure 186. 2D Codes*



## 9.2.6 1.3 MP Models: Manual Focus Models 16 mm Lens

*Figure 187. 1D Codes*

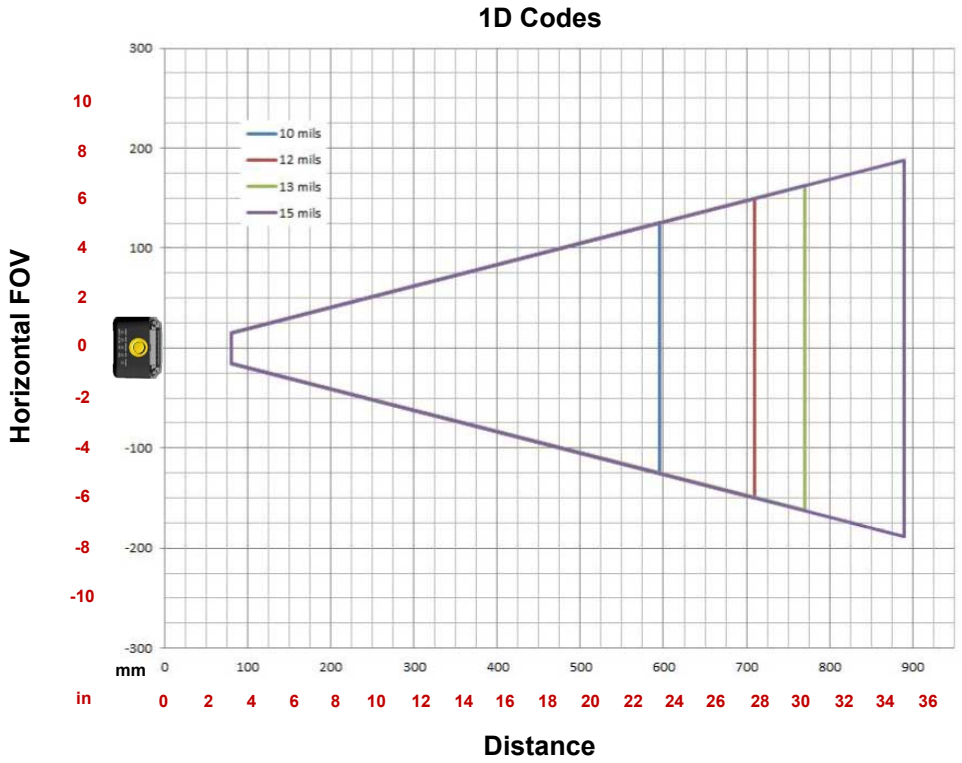
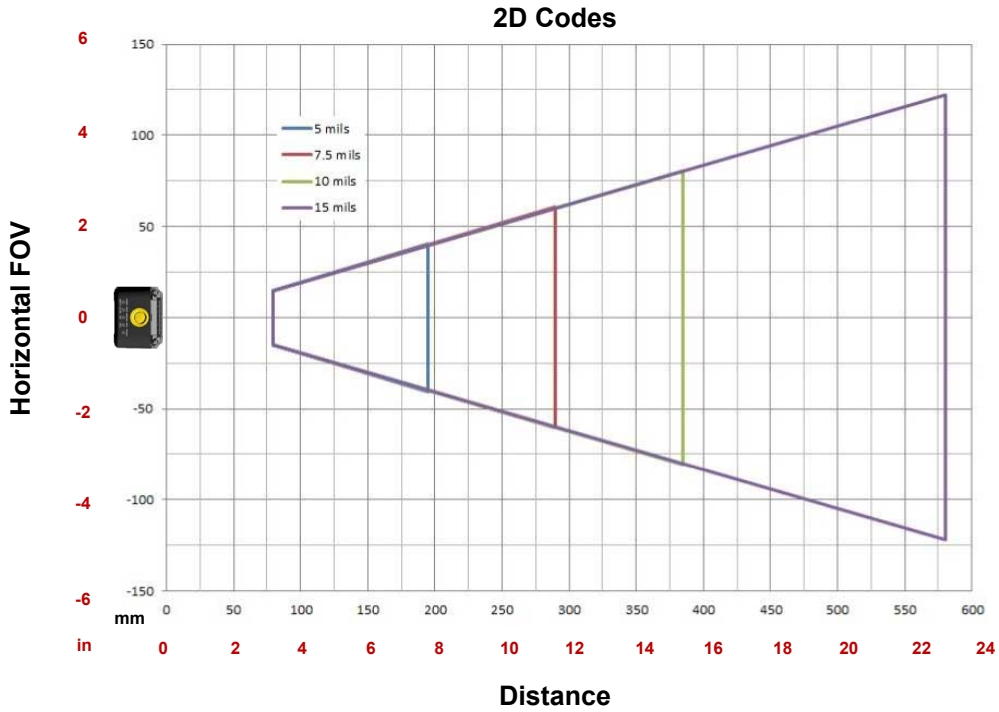



*Figure 188. 2D Codes*



## 9.2.7 2 MP Models: Liquid Lens Autofocus Models, 16 mm Lens

*Figure 189. 16 mm Global FOV Diagram*

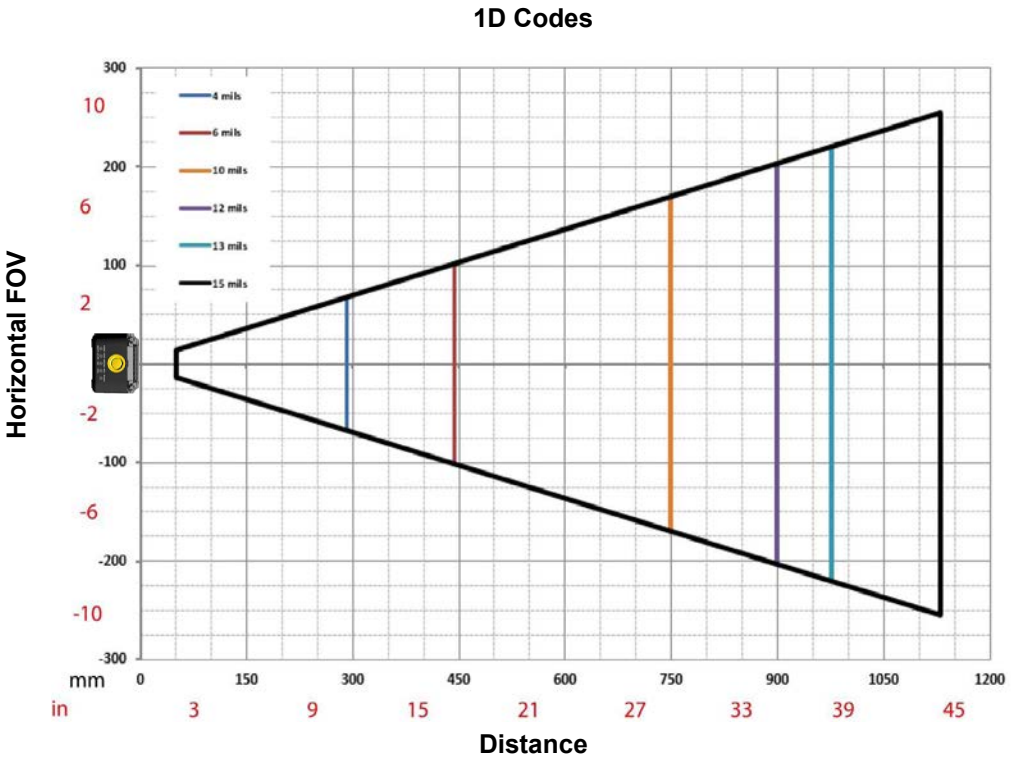
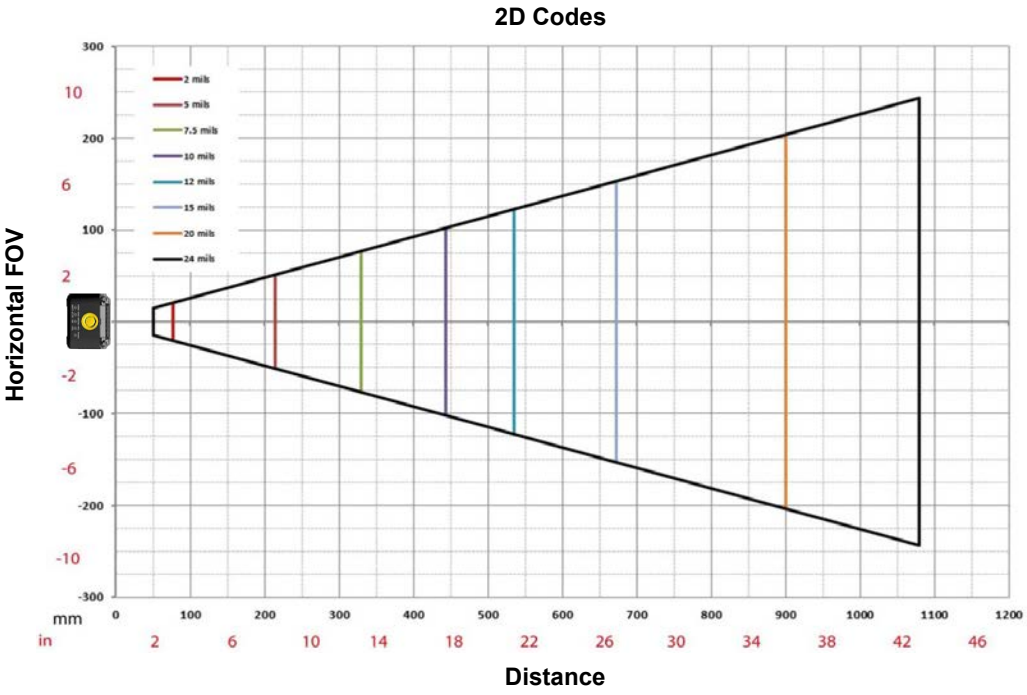



*Figure 190. 16 mm Global FOV Diagram*




## 9.3 Reading Diagrams

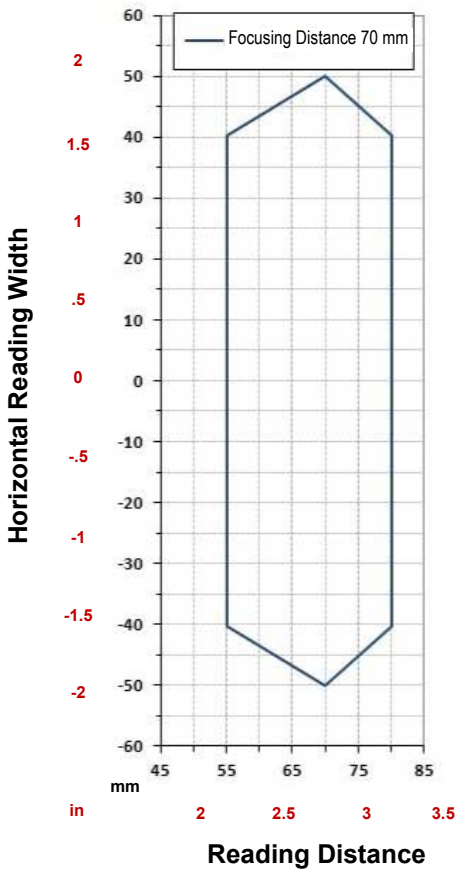
- The following reading diagrams are references and are provided for typical performance at 25 °C using high quality grade A symbols: Code 128 (1D code) and Data Matrix ECC 200 (2D code).

- 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 191. Code 128 0.12 mm (5 mils)*

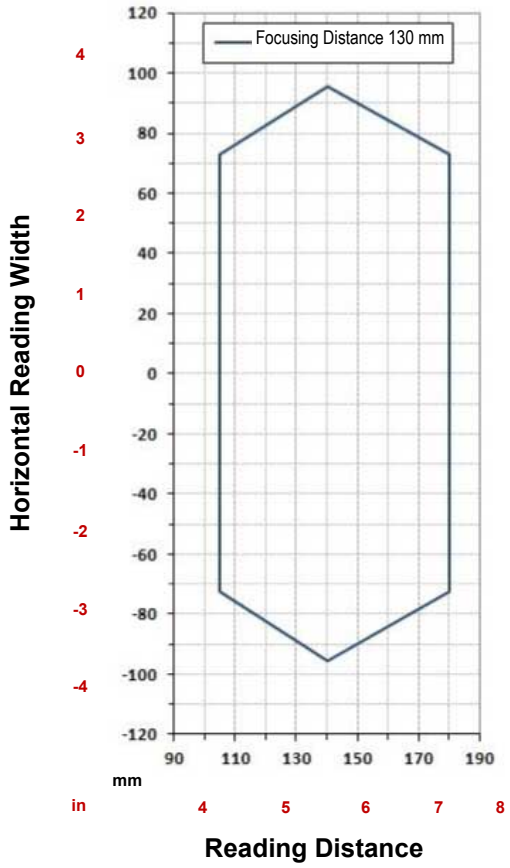


| Hardware Settings | |
|---|---|
| Code Symbology | Code 128 |
| Code Resolution | 0.12 mm (5 mils) |
| Tilt Angle | 0° |
| Skew Angle | 15° |
| Focusing Distance (mm) | 70 |

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

## Code 128 0.25 mm (10 mils)

*Figure 192. Code 128 0.25 mm (10 mils)*



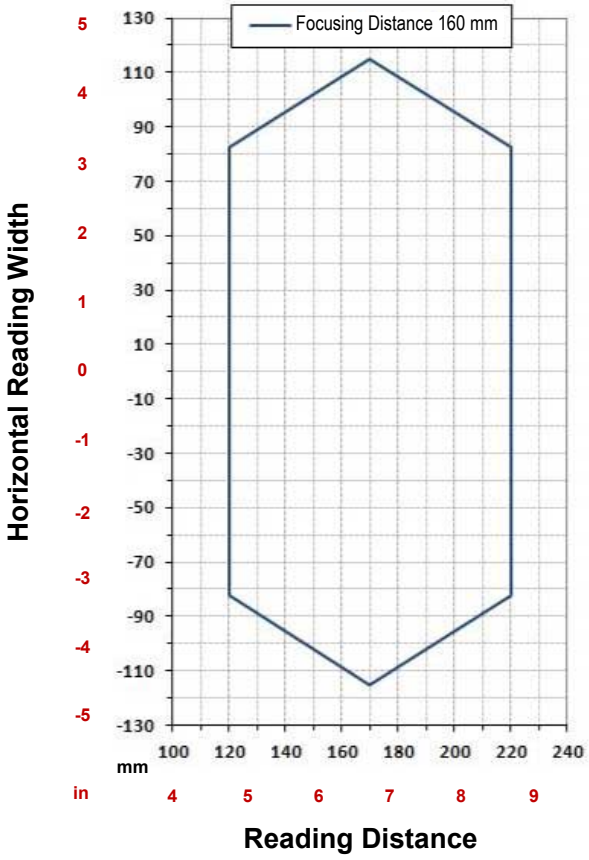

| Hardware Settings | |
|---|---|
| Code Symbology | Code 128 |
| Code Resolution | 0.25 mm (10 mils) |
| Tilt Angle | 0° |
| Skew Angle | 15° |

| Hardware Settings | |
|---|---|
| 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 193. Code 128 0.30 mm (12 mils)*



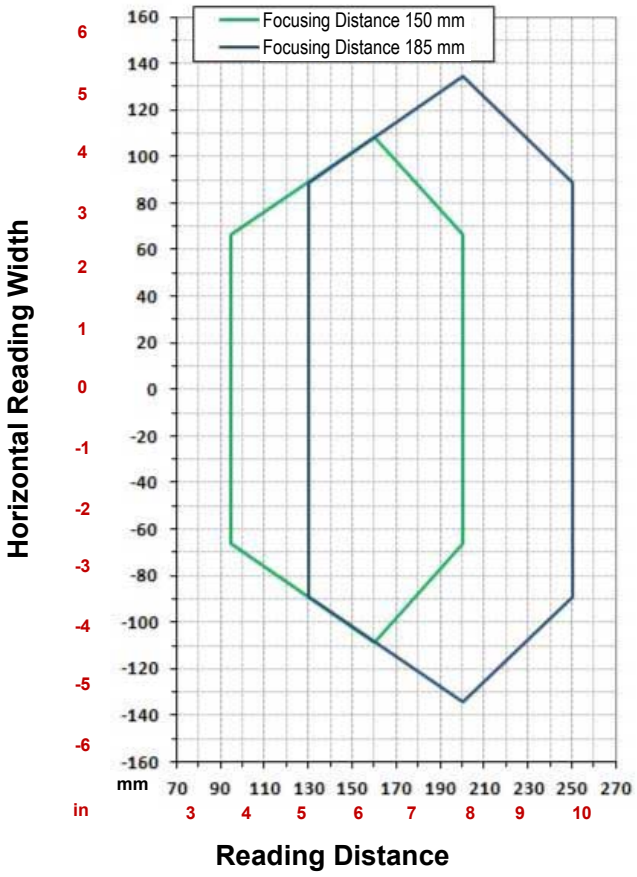

| Hardware Settings | |
|---|---|
| Code Symbology | Code 128 |
| Code Resolution | 0.30 mm (12 mils) |
| Tilt Angle | 0° |
| Skew Angle | 15° |
| Focusing Distance (mm) | 160 |

| Software Parameters | |
|---|---|
| Internal Lighting | Very High Power Strobed |
| **ABR7106-RSE2** | |

| Software Parameters | |
|---|---|
| Exposure Time (µs) | 100 |
| Gain | 20 |

## Code 128 0.33 mm (13 mils)

*Figure 194. Code 128 0.33 mm (13 mils)*

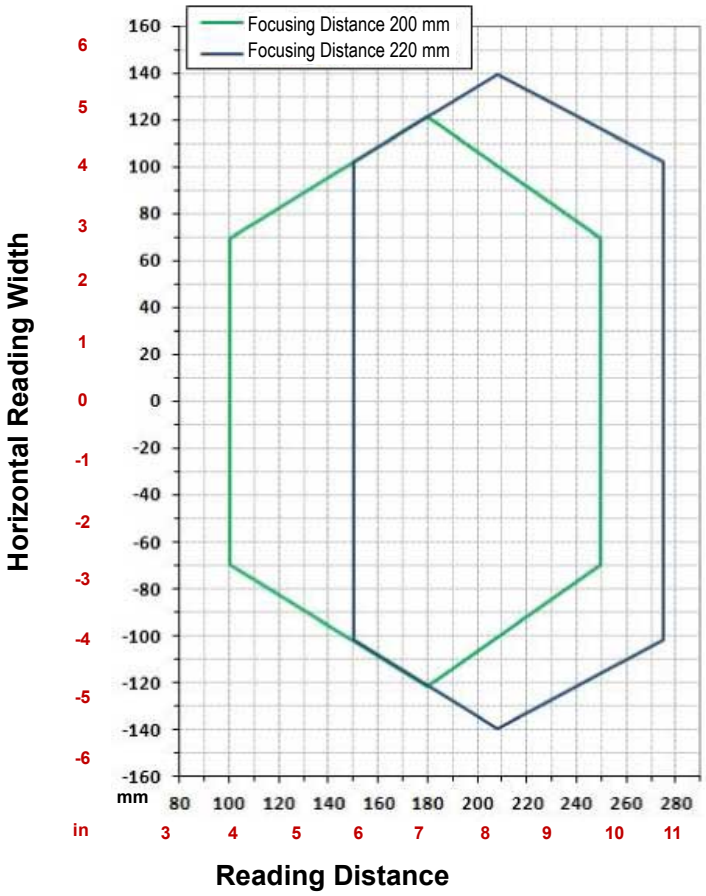



| Hardware Settings | | |
|---|---|---|
| Code Symbology | Code 128 | |
| Code Resolution | 0.33 mm (13 mils) | |
| Tilt Angle | 0° | |
| Skew Angle | 15° | |
| Focusing Distance (mm) | 150 | 185 |

| 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 195. Code 128 0.38 mm (15 mils)*

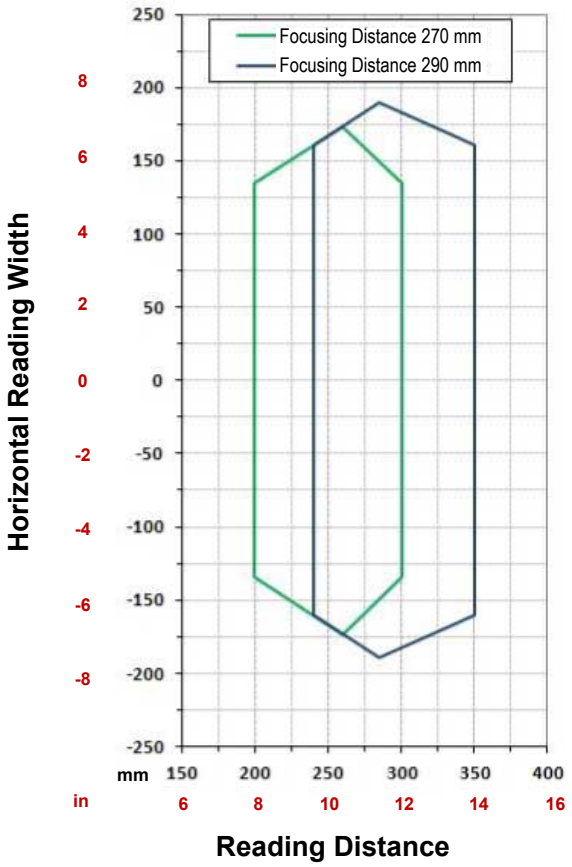



| Hardware Settings | | |
|---|---|---|
| Code Symbology | Code 128 | |
| Code Resolution | 0.38 mm (15 mils) | |
| Tilt Angle | 0° | |
| Skew Angle | 15° | |
| Focusing Distance (mm) | 200 | 220 |

| 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 196. 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 197. Focusing Distance—Data Matrix 0.19 mm (7.5 mils)*

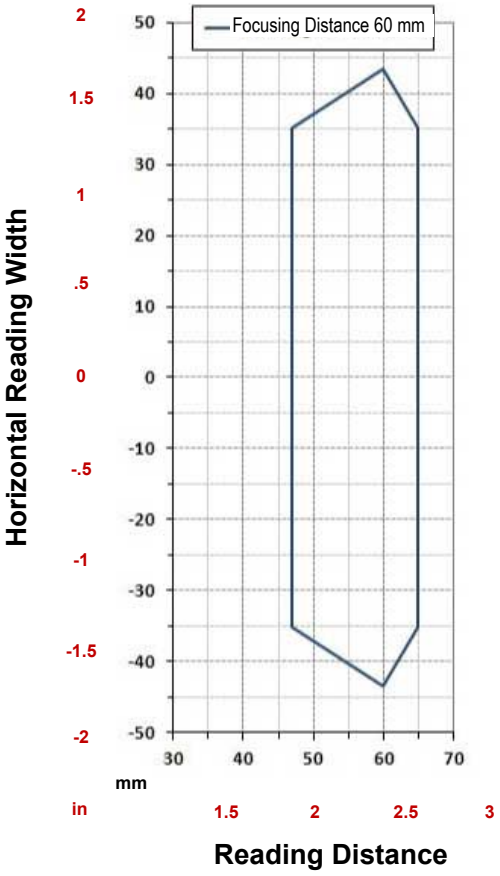
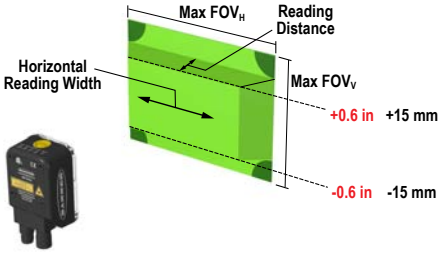



*Figure 198. Effective Field of View for High Resolution Codes with 6mm Lens*




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 199. Focusing Distance—Data Matrix 0.25 mm (10 mils)*

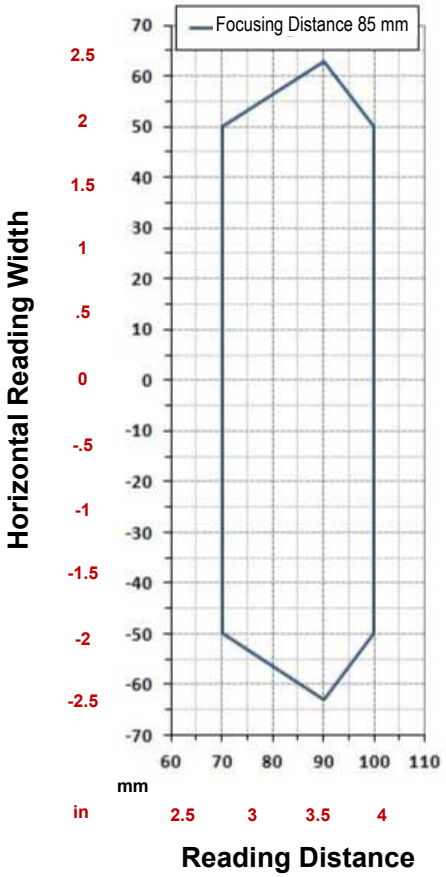
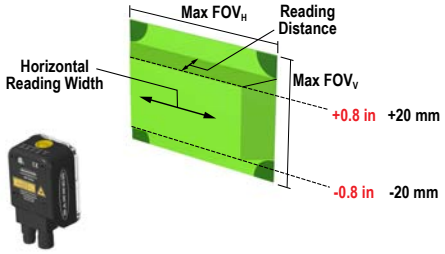



*Figure 200. Effective Field of View for High Resolution Codes with 6mm Lens*




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

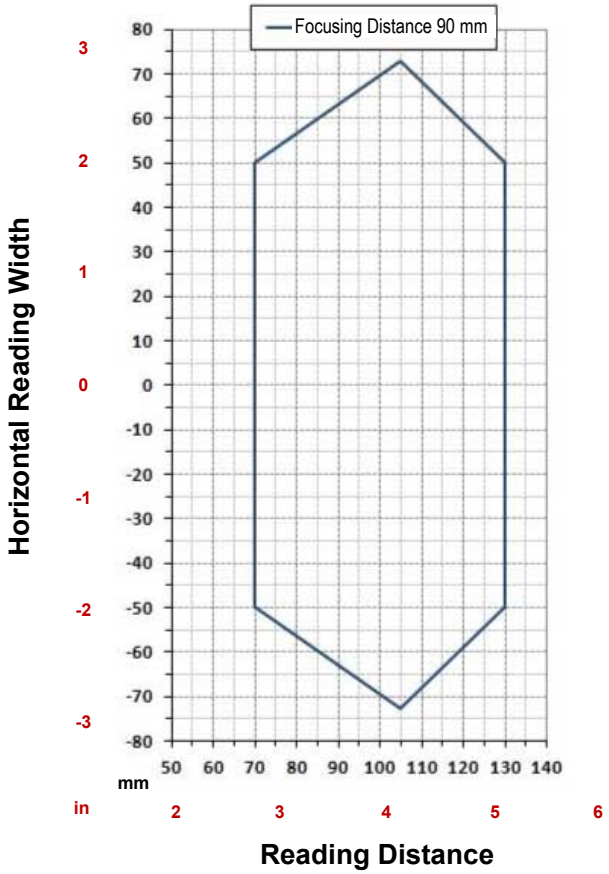
1. Drag top of box to set x,y coordinates ≈ 0,255.
2. Drag bottom of box to set vertical window dimensions ≈ 512 pixels.

| **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 201. Focusing Distance—Data Matrix 0.38 mm (15 mils)*



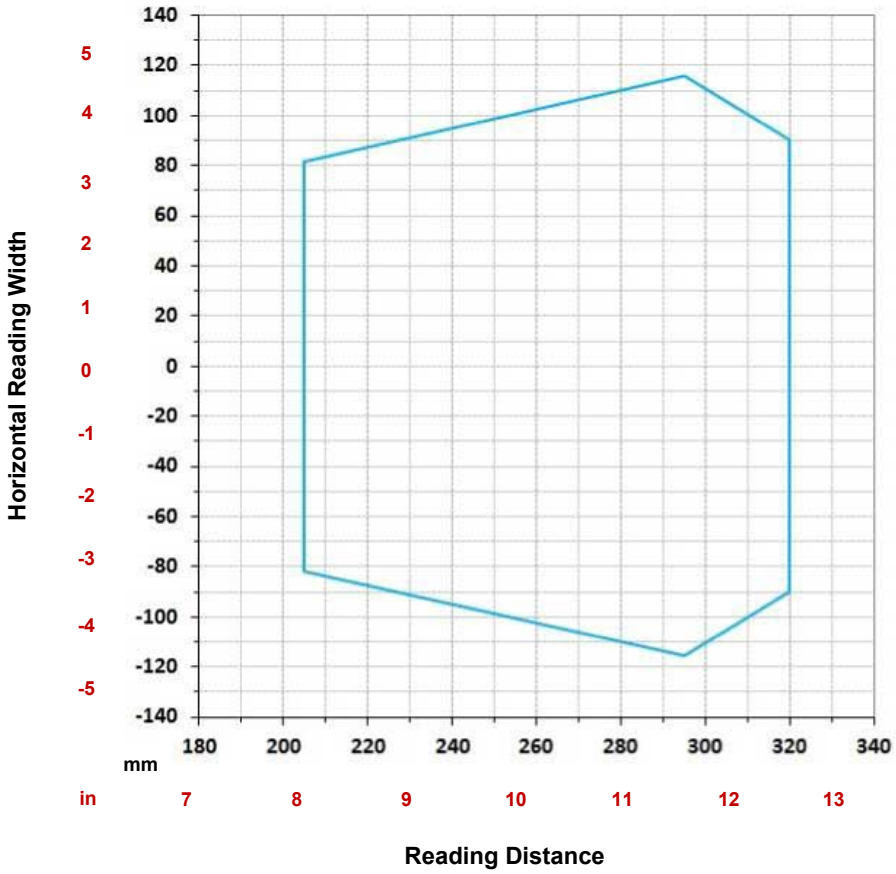

| Hardware Settings | |
|---|---|
| Code Symbology | Data Matrix ECC 200 |
| Code Resolution | 0.38 mm (15 mils) |
| Tilt Angle | 45° |
| Skew Angle | 10° |
| Focusing Distance (mm) | 90 |

| 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 202. Code 128 0.25 mm (10 mils)*

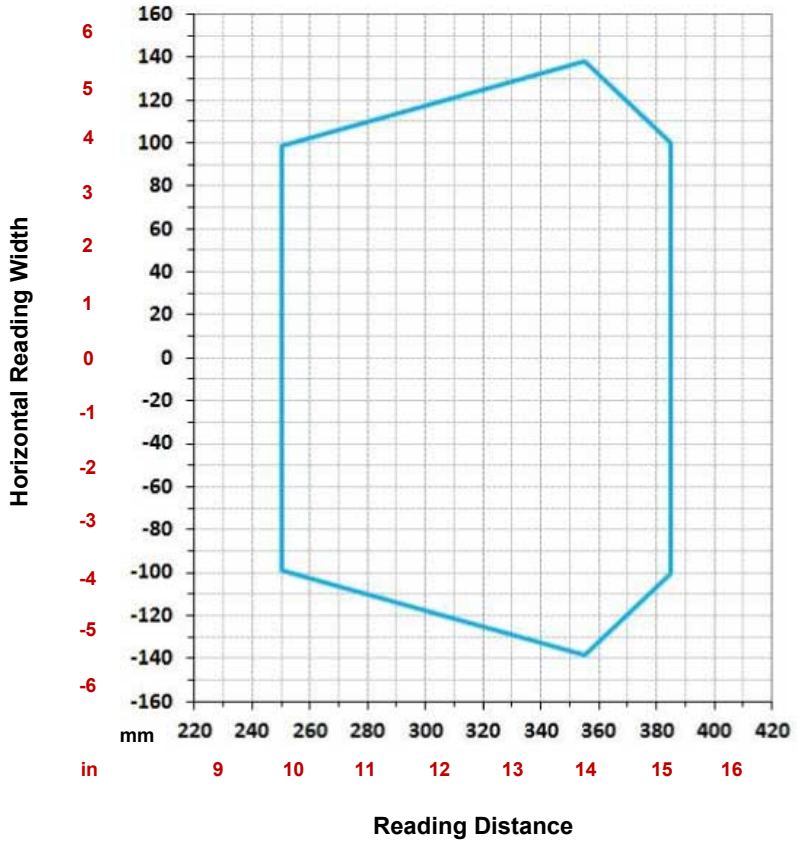



| Hardware Settings | |
|---|---|
| Code Symbology | Code 128 |
| Code Resolution | 0.25 mm (10 mils) |
| Tilt Angle | 45° |
| Skew Angle | 15° |
| Focusing Distance (mm) | 280 |

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

## Code 128 0.30 mm (12 mils)

*Figure 203. Code 128 0.30 mm (12 mils)*

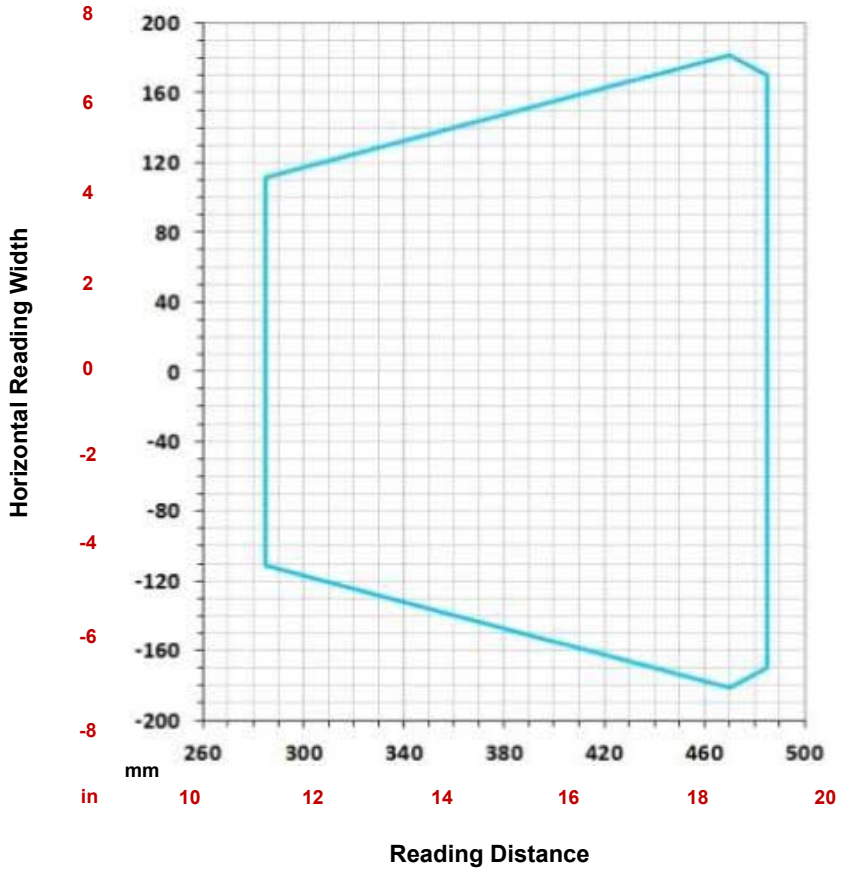



| Hardware Settings | |
|---|---|
| Code Symbology | Code 128 |
| Code Resolution | 0.30 mm (12 mils) |
| Tilt Angle | 45° |
| Skew Angle | 15° |
| Focusing Distance (mm) | 310 |

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

## Code 128 0.38 mm (15 mils)

*Figure 204. Code 128 0.38 mm (15 mils)*



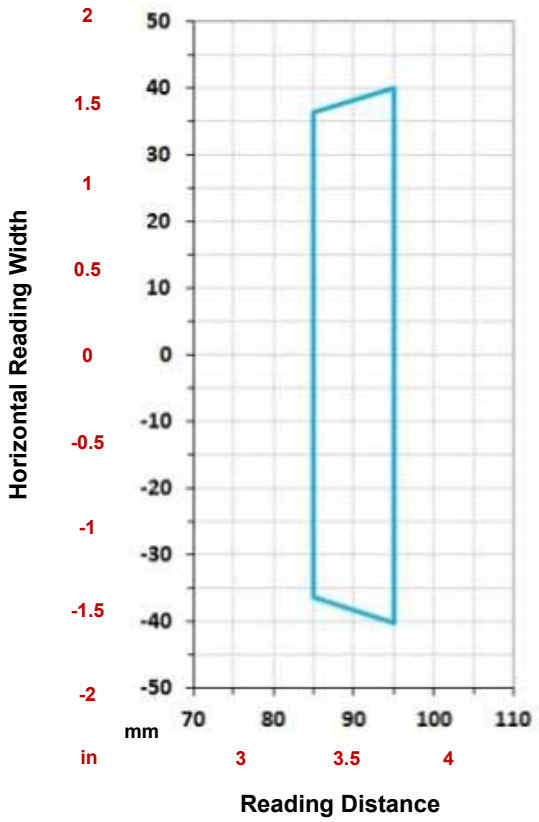

| Hardware Settings | |
|---|---|
| Code Symbology | Code 128 |
| Code Resolution | 0.38 mm (15 mils) |
| Tilt Angle | 45° |
| Skew Angle | 15° |
| Focusing Distance (mm) | 430 |

| 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 205. 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 206. Data Matrix 0.19 mm (7.5 mils)*

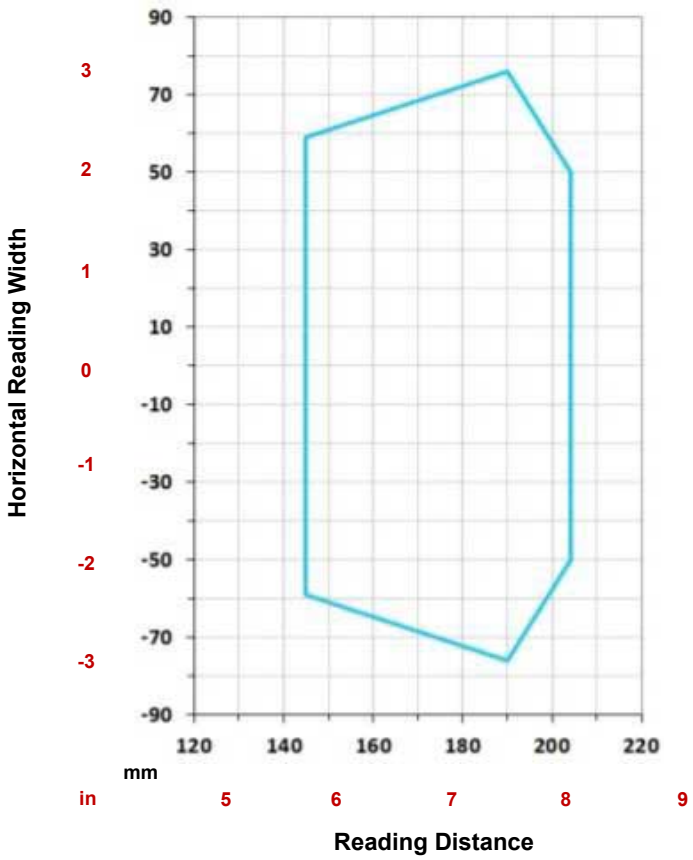



| Hardware Settings | |
|---|---|
| Code Symbology | Data Matrix ECC 200 |
| Code Resolution | 0.19 mm (7.5 mils) |
| Tilt Angle | 45° |
| Skew Angle | 15° |
| Focusing Distance (mm) | 135 |

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

## Data Matrix 0.25 mm (10 mils)

*Figure 207. Data Matrix 0.25 mm (10 mils)*



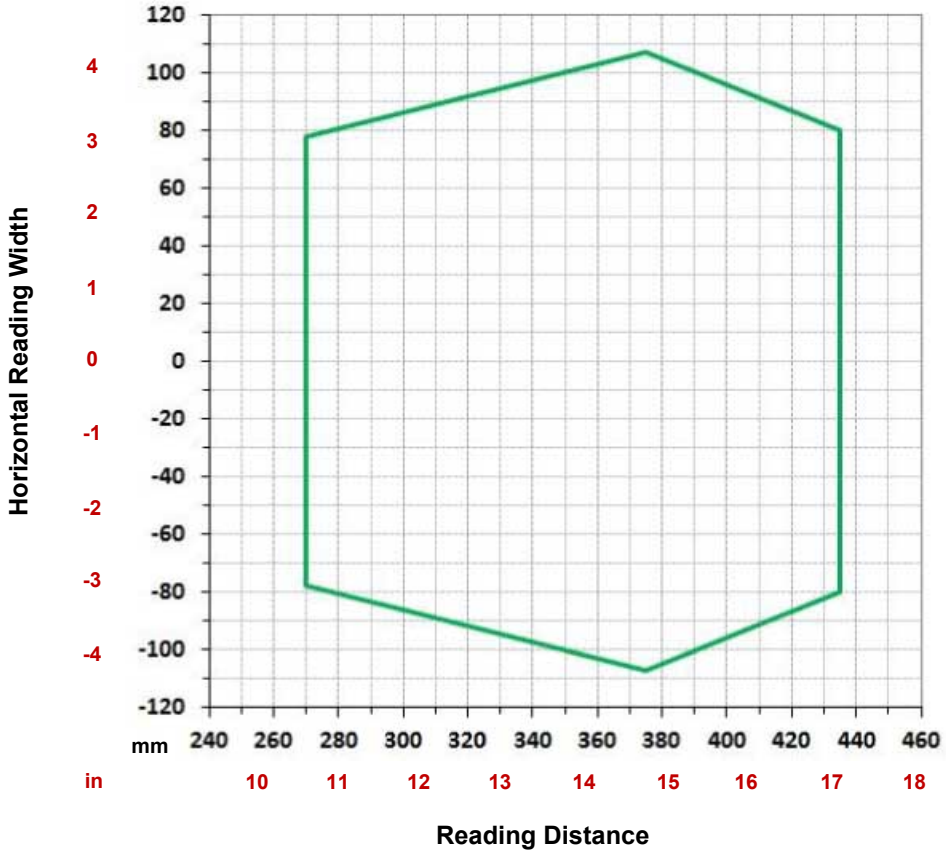

| Hardware Settings | |
|---|---|
| Code Symbology | Data Matrix ECC 200 |
| Code Resolution | 0.25 mm (10 mils) |
| Tilt Angle | 45° |
| Skew Angle | 15° |
| Focusing Distance (mm) | 180 |

| 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 208. Code 128 0.25 mm (10 mils)*

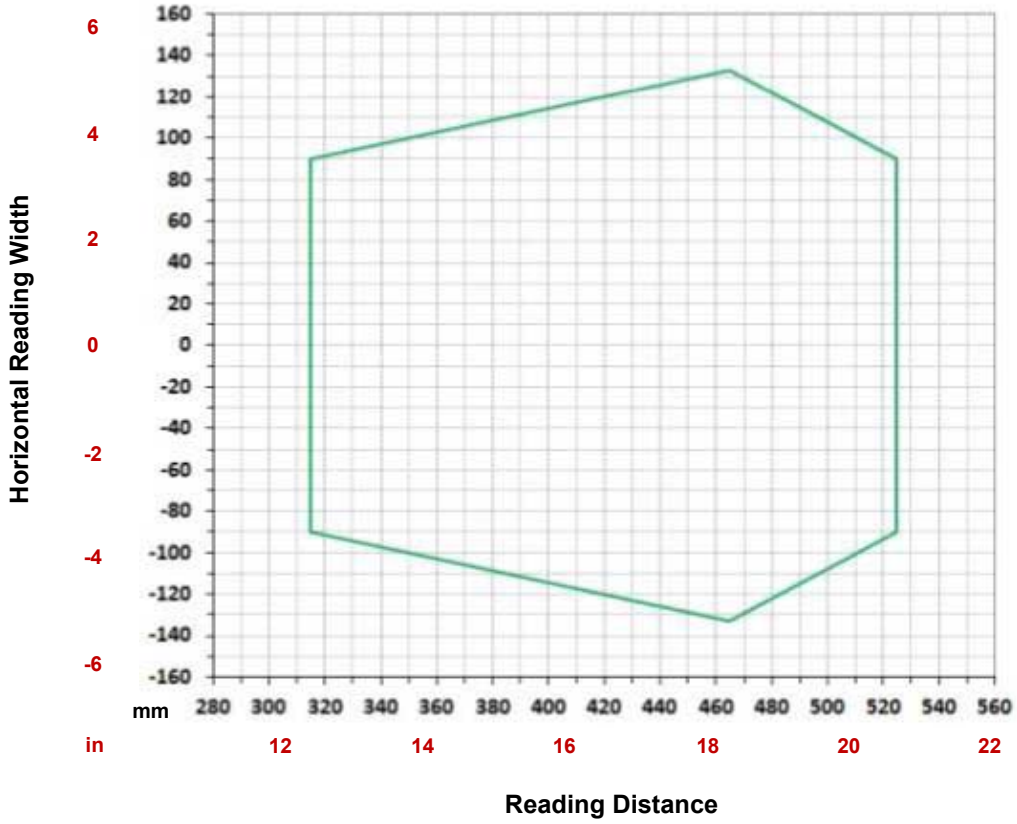



| Hardware Settings | |
|---|---|
| Code Symbology | Code 128 |
| Code Resolution | 0.25 mm (10 mils) |
| Tilt Angle | 45° |
| Skew Angle | 15° |
| Focusing Distance (mm) | 380 |

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

## Code 128 0.30 mm (12 mils)

*Figure 209. Code 128 0.30 mm (12 mils)*

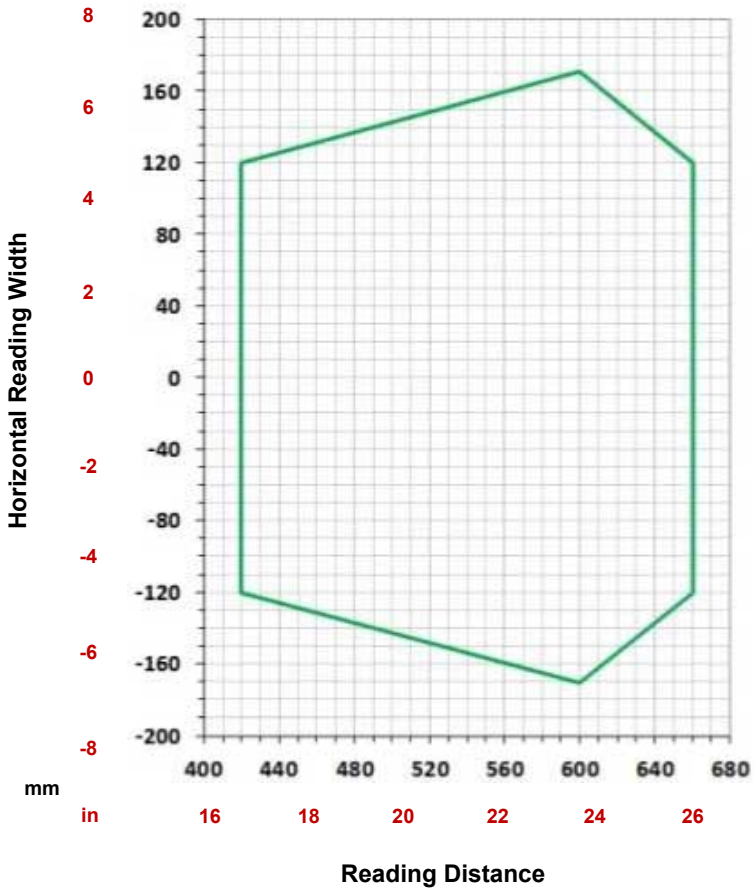



| Hardware Settings | |
|---|---|
| Code Symbology | Code 128 |
| Code Resolution | 0.30 mm (12 mils) |
| Tilt Angle | 45° |
| Skew Angle | 15° |
| Focusing Distance (mm) | 415 |

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

## Code 128 0.38 mm (15 mils)

*Figure 210. Code 128 0.38 mm (15 mils)*

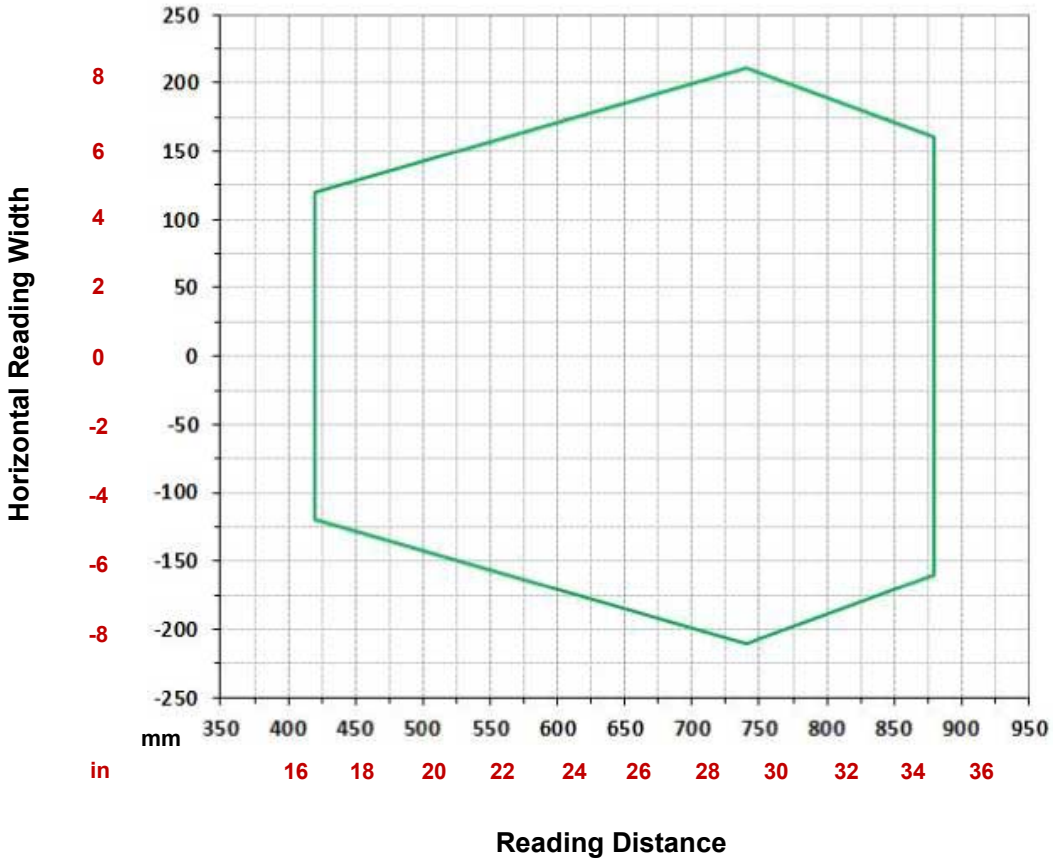



| Hardware Settings | |
|---|---|
| Code Symbology | Code 128 |
| Code Resolution | 0.38 mm (15 mils) |
| Tilt Angle | 45° |
| Skew Angle | 15° |
| Focusing Distance (mm) | 500 |

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

## Code 128 0.50 mm (20 mils)

*Figure 211. Code 128 0.50 mm (20 mils)*



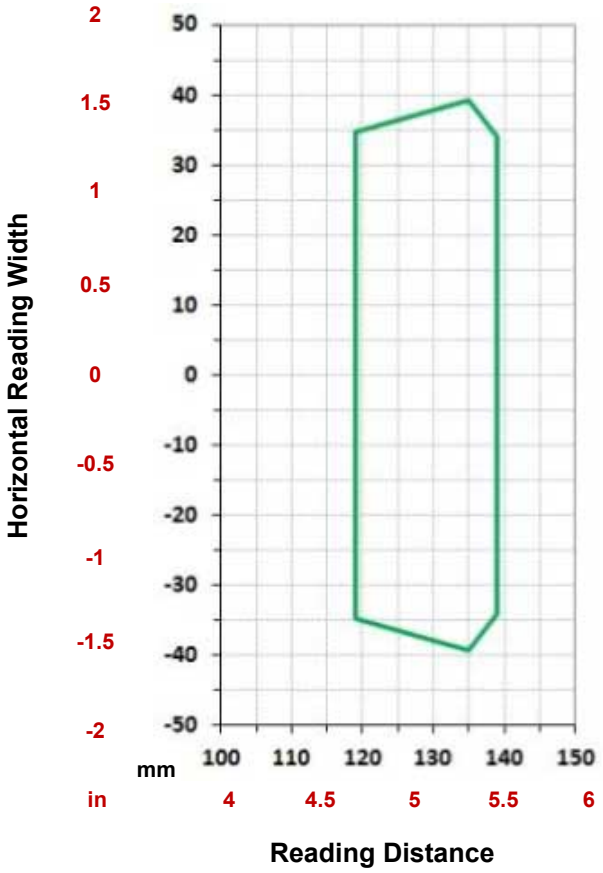

| Hardware Settings | |
|---|---|
| Code Symbology | Code 128 |
| Code Resolution | 0.50 mm (20 mils) |
| Tilt Angle | 45° |
| Skew Angle | 15° |
| Focusing Distance (mm) | 740 |

| 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 212. Data Matrix 0.13 mm (5 mils)*

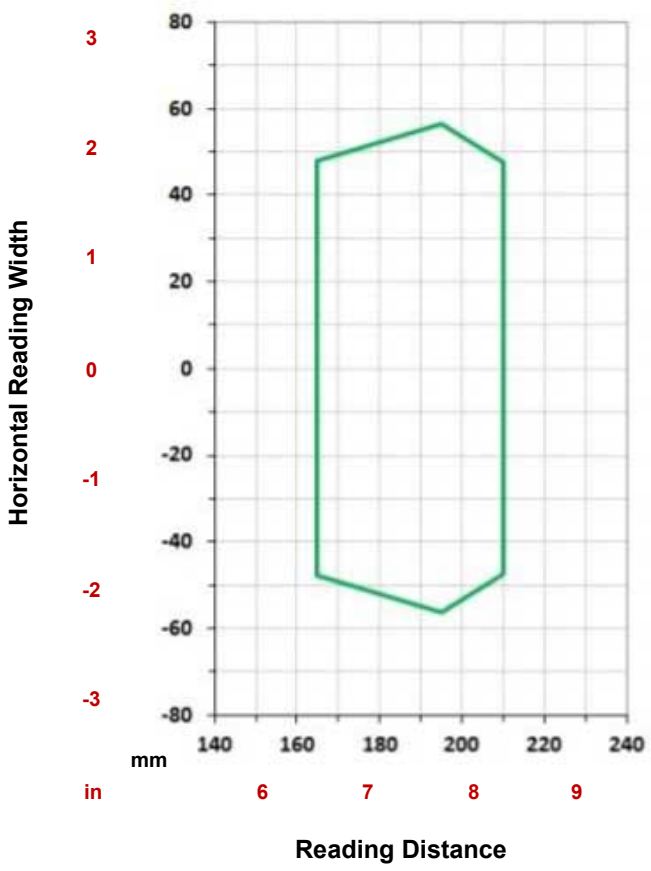



| Hardware Settings | |
|---|---|
| Code Symbology | Data Matrix ECC 200 |
| Code Resolution | 0.13 mm (5 mils) |
| Tilt Angle | 45° |
| Skew Angle | 15° |
| Focusing Distance (mm) | 133 |

| 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 213. Data Matrix 0.19 mm (7.5 mils)*

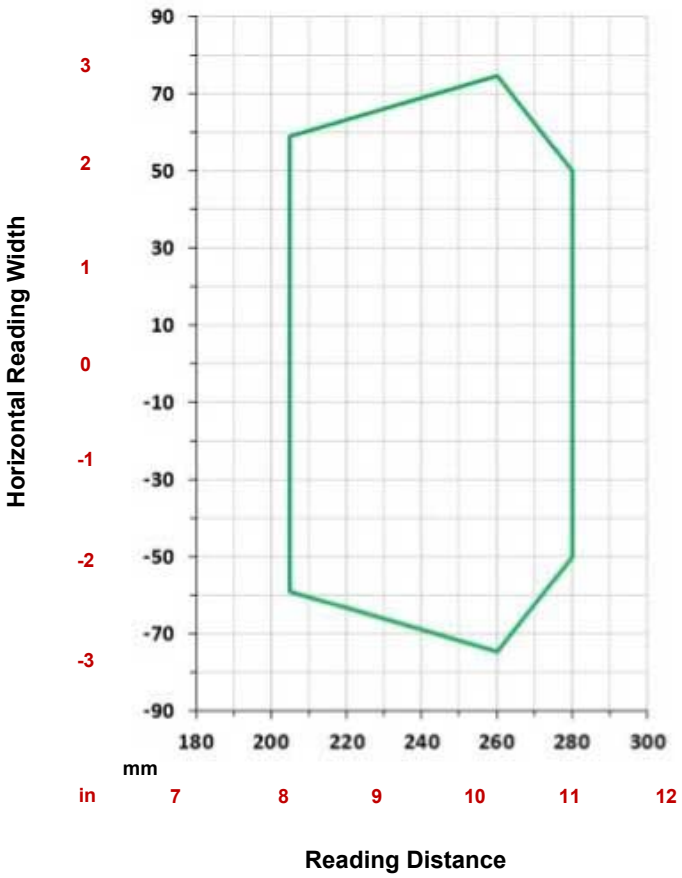



| Hardware Settings | |
|---|---|
| Code Symbology | Data Matrix ECC 200 |
| Code Resolution | 0.19 mm (7.5 mils) |
| Tilt Angle | 45° |
| Skew Angle | 15° |
| Focusing Distance (mm) | 195 |

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

## Data Matrix 0.25 mm (10 mils)

*Figure 214. Data Matrix 0.25 mm (10 mils)*

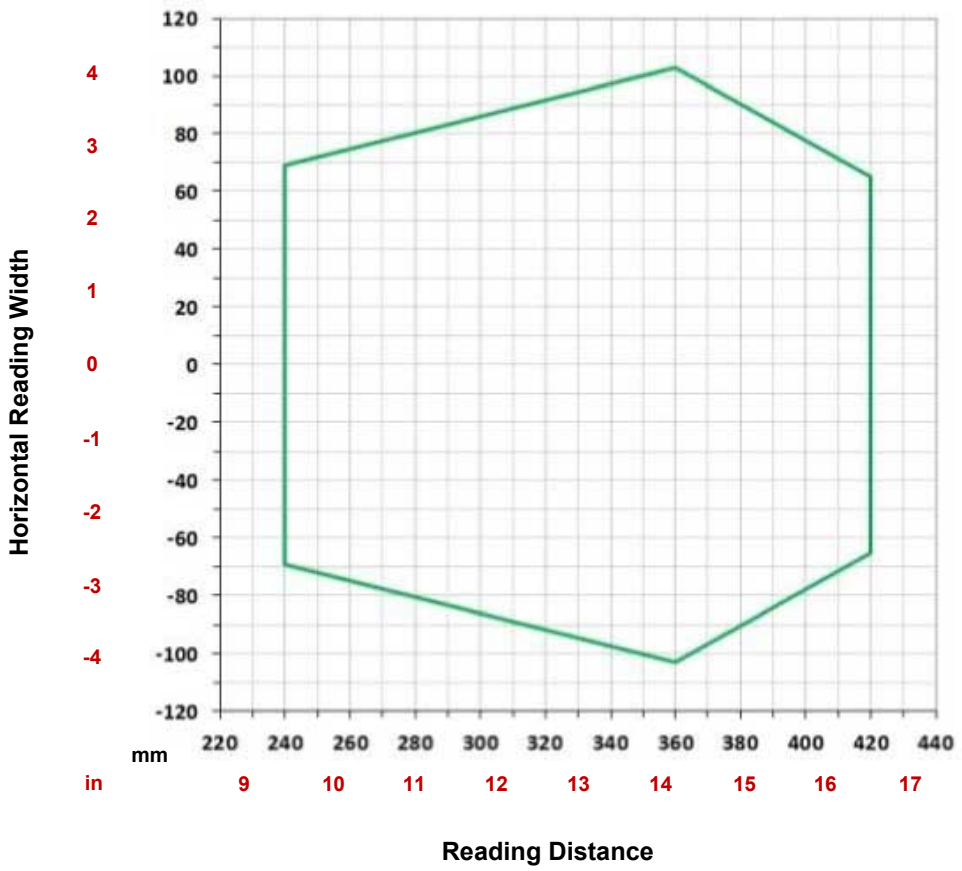



| Hardware Settings | |
|---|---|
| Code Symbology | Data Matrix ECC 200 |
| Code Resolution | 0.25 mm (10 mils) |
| Tilt Angle | 45° |
| Skew Angle | 15° |
| Focusing Distance (mm) | 250 |

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

## Data Matrix 0.38 mm (15 mils)

*Figure 215. Data Matrix 0.38 mm (15 mils)*



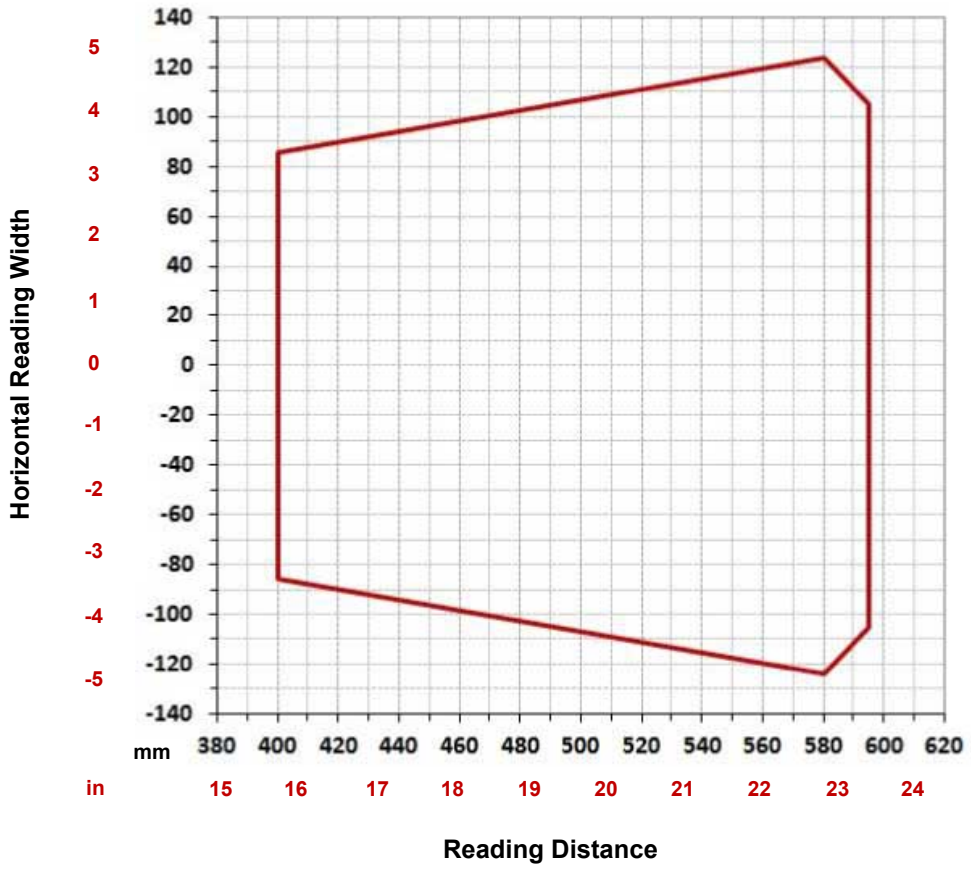

| Hardware Settings | |
|---|---|
| Code Symbology | Data Matrix ECC 200 |
| Code Resolution | 0.38 mm (15 mils) |
| Tilt Angle | 45° |
| Skew Angle | 15° |
| Focusing Distance (mm) | 355 |

| 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)

*Figure 216. Code 128 0.25 mm (10 mils)*

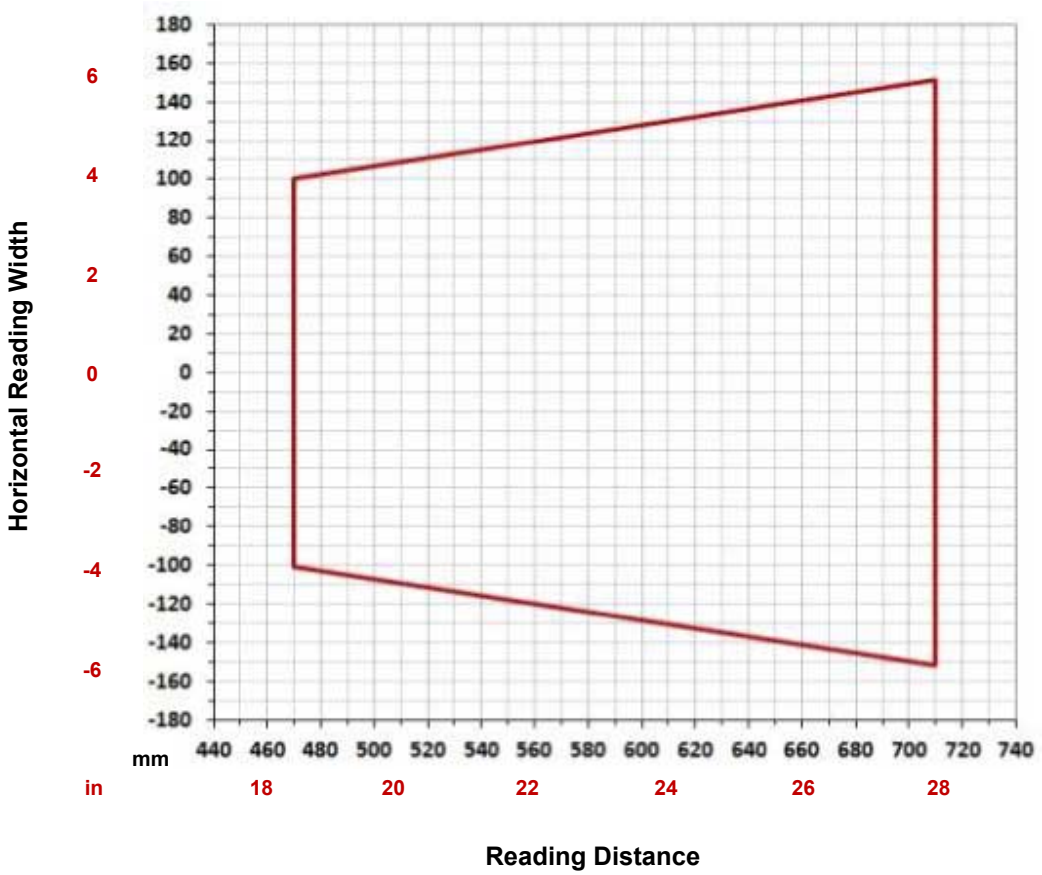



| Hardware Settings | |
|---|---|
| Code Symbology | Code 128 |
| Code Resolution | 0.25 mm (10 mils) |
| Tilt Angle | 45° |
| Skew Angle | 15° |
| Focusing Distance (mm) | 500 |

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

## Code 128 0.30 mm (12 mils)

*Figure 217. Code 128 0.30 mm (12 mils)*

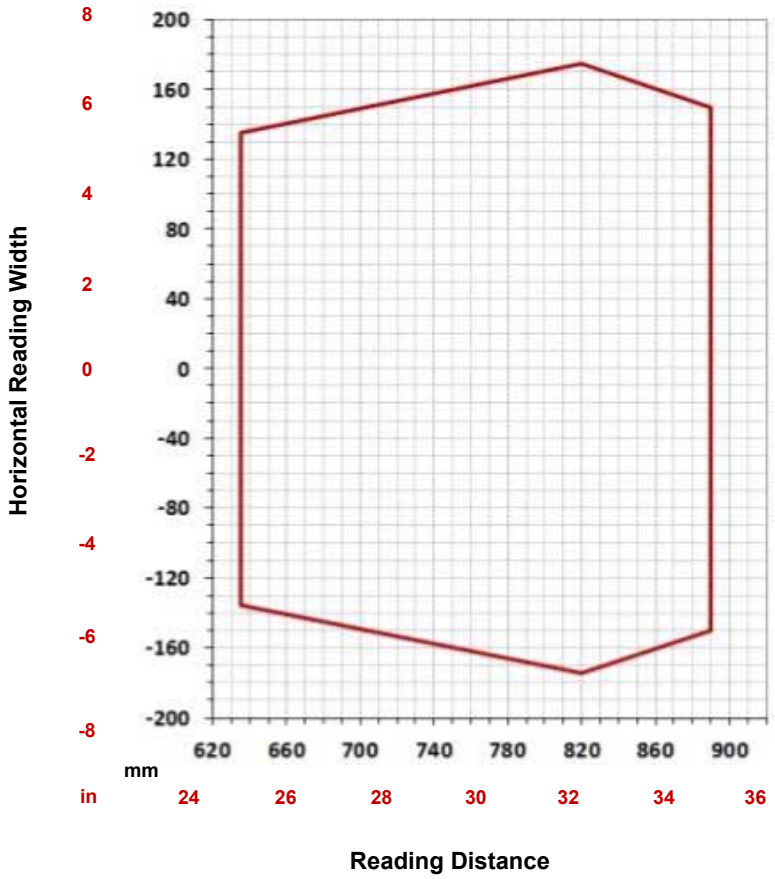



| Hardware Settings | |
|---|---|
| Code Symbology | Code 128 |
| Code Resolution | 0.30 mm (12 mils) |
| Tilt Angle | 45° |
| Skew Angle | 15° |
| Focusing Distance (mm) | 590 |

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

## Code 128 0.38 mm (15 mils)

*Figure 218. Code 128 0.38 mm (15 mils)*

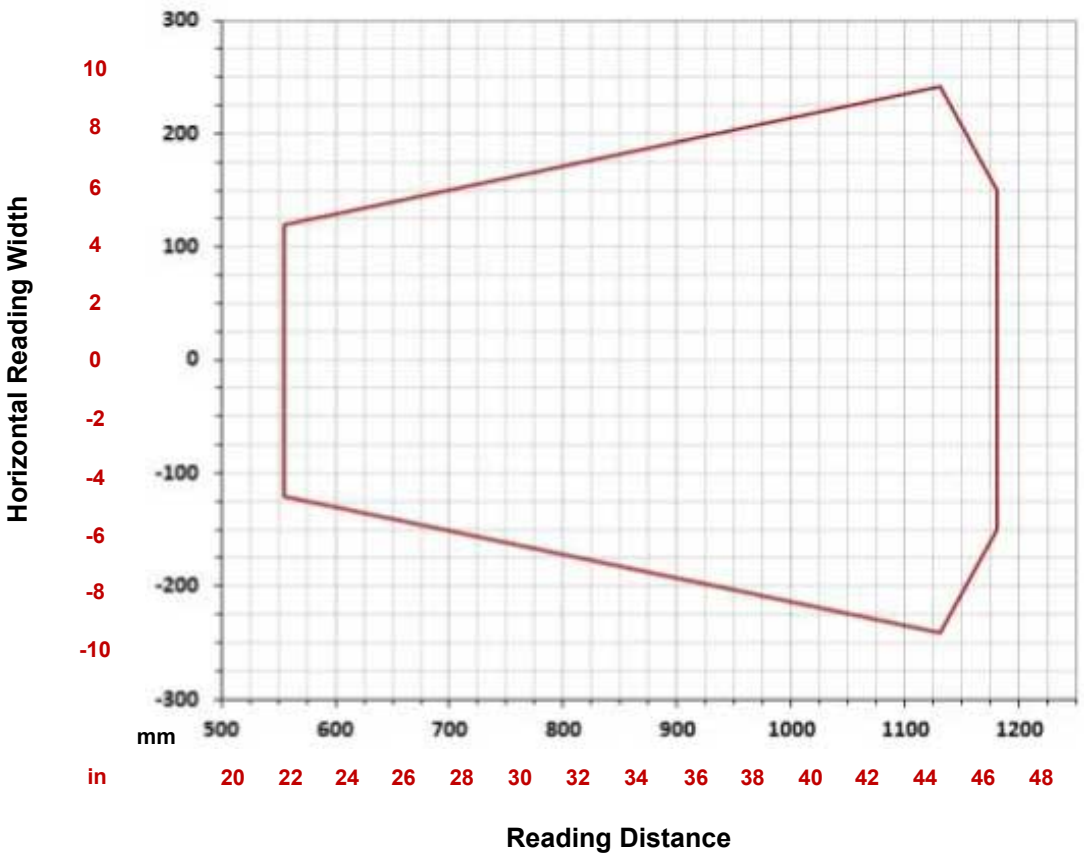



| Hardware Settings | |
|---|---|
| Code Symbology | Code 128 |
| Code Resolution | 0.38 mm (15 mils) |
| Tilt Angle | 45° |
| Skew Angle | 15° |
| Focusing Distance (mm) | 700 |

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

## Code 128 0.50 mm (20 mils)

*Figure 219. Code 128 0.50 mm (20 mils)*



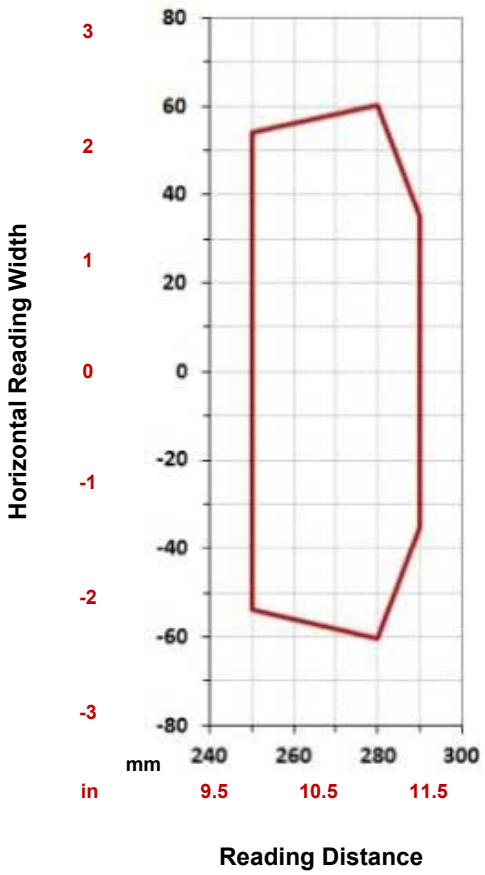

| Hardware Settings | |
|---|---|
| Code Symbology | Code 128 |
| Code Resolution | 0.50 mm (20 mils) |
| Tilt Angle | 45° |
| Skew Angle | 15° |
| Focusing Distance (mm) | 900 |

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

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

## Data Matrix 0.19 mm (7.5 mils)

*Figure 220. Data Matrix 0.19 mm (7.5 mils)*

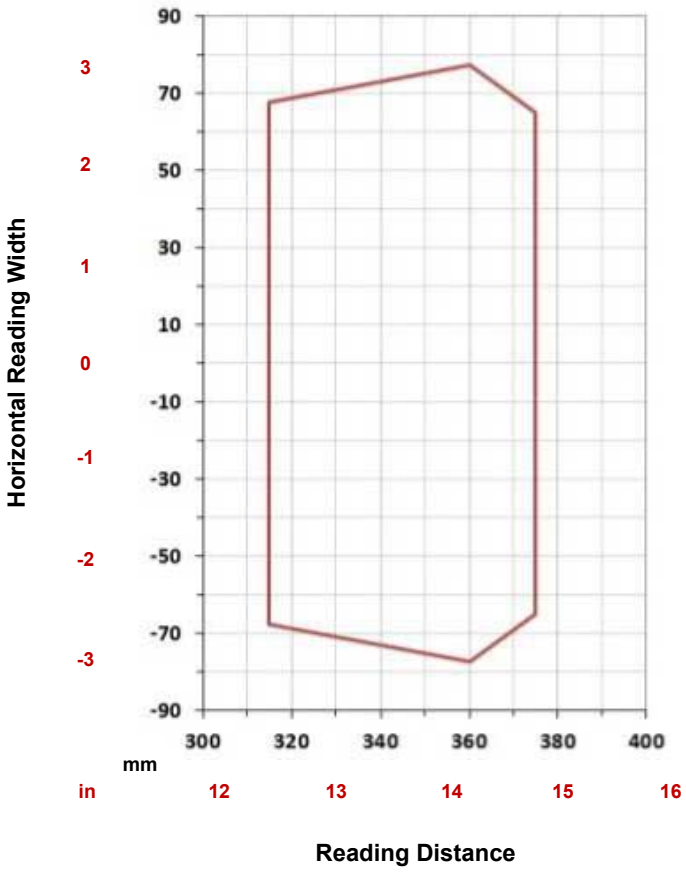



| Hardware Settings | |
|---|---|
| Code Symbology | Data Matrix ECC 200 |
| Code Resolution | 0.19 mm (7.5 mils) |
| Tilt Angle | 45° |
| Skew Angle | 15° |
| Focusing Distance (mm) | 275 |

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

## Data Matrix 0.25 mm (10 mils)

*Figure 221. Data Matrix 0.25 mm (10 mils)*

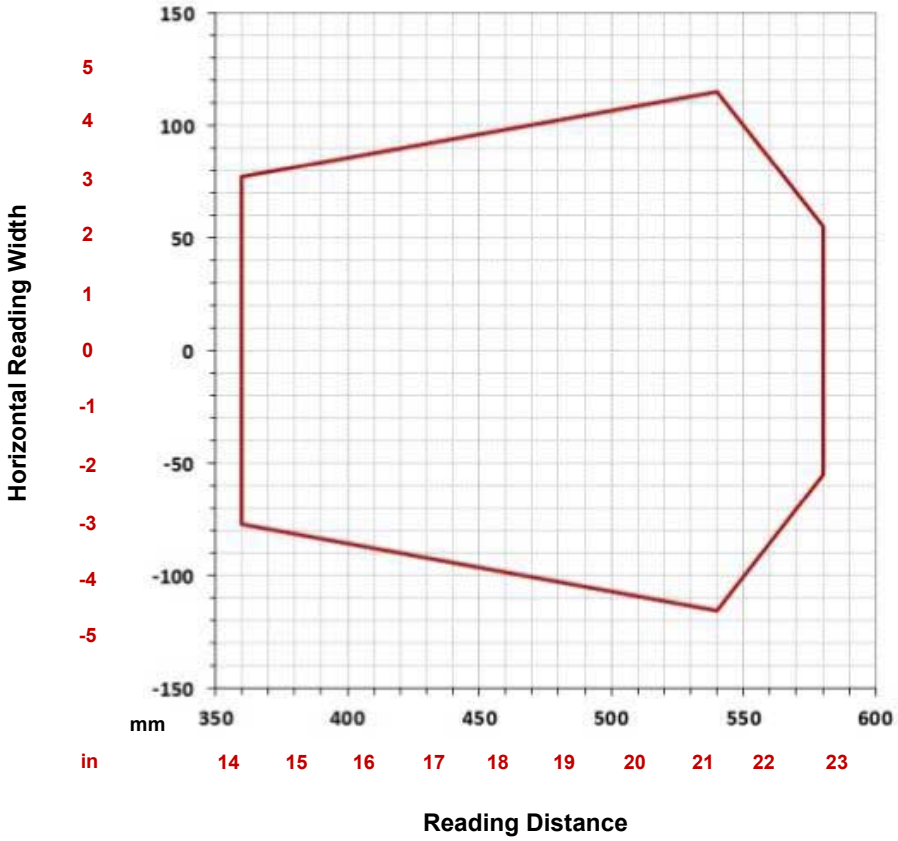



| Hardware Settings | |
|---|---|
| Code Symbology | Data Matrix ECC 200 |
| Code Resolution | 0.25 mm (10 mils) |
| Tilt Angle | 45° |
| Skew Angle | 15° |
| Focusing Distance (mm) | 340 |

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

### Data Matrix 0.38 mm (15 mils)

*Figure 222. 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 |

## 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 might not apply for linear codes or postal code reading applications. 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:

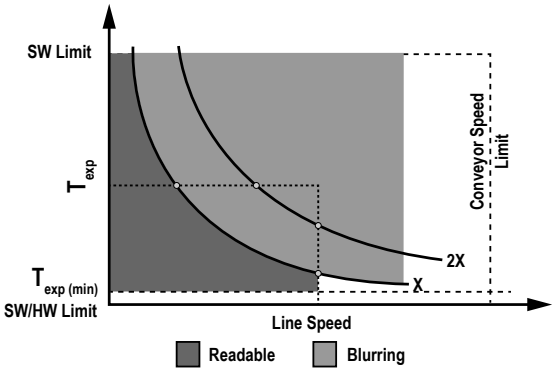
Internal Lighting Mode = Very High Power Strobe
Exposure Time (µs) = 100 µs
Code Resolution (X) = 0.254 mm (10 mils)

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 223. 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 (ABR 7000 liquid lens autofocus models), or in the Acquire PPI (Pixels Per Inch) procedure in the Advanced Setup of the reader (ABR3 000 and ABR 7000 manual focus models). Using this chart when running the AutoSetup procedure or the Focus Autolearn procedure on a liquid lens autofocus model typically results in a more accurate focus/reading distance. This in turn results in a better image and a more accurate PPI value. On any model, using this chart to accurately configure the PPI value allows the ABR to provide accurate module size measurements of barcodes for a given distance.

# PPI (Pixels Per Inch) Setup Chart

## Code 128

Resolution mm (mils)

0.30 (12)



0.30 mm

0.50 (20)

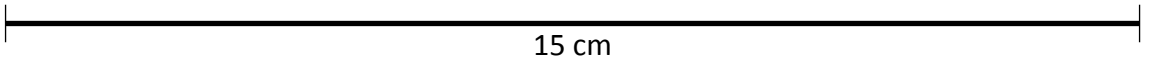


0.50 mm

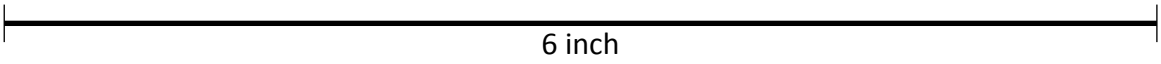
1.00 (40)



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 224. 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 225. Packaging with PDF417 Code*



*Figure 226. Overprinted Barcode Readable by ABR Through the Envelope Window Film*



*Figure 227. 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 228. Dot Matrix Code Directly Marked on Metal Surface by Using Dot Peening Technology*



*Figure 229. Dot Peening Marking on Metal Surface with Multi-dot per Code Element*

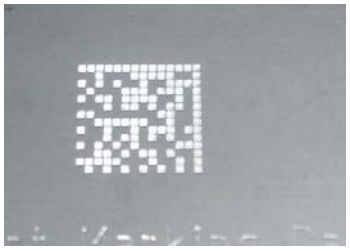
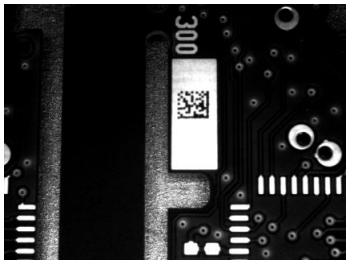


*Figure 230. Directly Marked Dot Matrix Code Characterized by Outstanding Separation Distance between Adjacent Code Elements*



## 11.4 Ink-Jet Printing Technology

*Figure 231. Dot Matrix Code Directly Marked on PCB Copper Pad by Using Ink-Jet Technology*




## 11.5 Laser Marking/Etching Technology

*Figure 232. 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 p. 25). If you are connecting directly to the ABR M12 17-pin connector pay attention to the pin number of the signals (Connector Descriptions on p. 20).
- 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<br>• 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?<br>• If using a power adapter (like PG6000), is it connected to a wall outlet?<br>• If using rail power, does the rail have power?<br>• If using TCNM-ACBB1, does it have power (check switch and LED)?<br>• Check if you are referring to the M12 17-pin connector or to the TCNM-ACBB1 spring clamp connectors.<br>• 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<br>• Is the sensor connected to the Input 1 or Input 2?<br>• Is power supplied to the photoelectric sensor?<br>• For NPN configuration, is power supplied to one of the two I1 or I2 signals (A or B)?<br>• For PNP configuration, is one of the two I1 or I2 signals grounded (A or B)?<br>• Are the photoelectric sensor LEDs (if any) working correctly?<br>• Is the sensor/reflector system aligned (if present)?<br>• On the Reading Phase step check the Input 1 or Input 2 Debouncing Time parameter setting<br>• 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<br>• Are the COM port parameters (Baud Rate, Parity, Data Bits, Stop Bits) correctly assigned?<br>• On the Reading Phase step check the settings of Acquisition Trigger String, Reading Phase-ON String, and Reading Phase-OFF String parameters<br>• 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 Communications parameters on the Communications step. |
| Image not clear | • Verify the Focus procedure<br>• 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 p. 42<br>• Position the reader as described in Position the Reader on p. 15 and through Barcode Manager:<br>◦ Tune the Acquisition Delay on Trigger, if the moving code is out of the reader field of view<br>◦ Set the Continuous Operating Mode if no external source is available<br>◦ Tune the Image Settings to improve the code image quality<br>◦ Check the parameter settings in the Advanced Setup step: 2D Codes, 1D Codes, and Postal Codes<br>◦ 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?<br>• If using TCNM-ACBB1, be sure the RS422 termination switch is OFF<br>• Are the host serial port settings the same as the reader serial port settings?<br>• 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?<br>• In the Barcode Manager Communications step, check the settings of Header and Terminator String parameters<br>• In the Barcode Manager Communications 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<br>• The reader serial number is printed on a label that is affixed on the bottom case near the reading window<br>• 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** |
| **1.3 MP Models** | | | |
| 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-WPE2 | | 8 | White Polarized |
| 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 |
| **2 MP Models** | | | |
| ABR72L9-RPE2 | 9 mm Liquid Lens Autofocus | 10 | Red Polarized |
| ABR72L9-RDE2 | | 24/26 | Red Diffused with central/peripheral software configurable sectors for DPM applications |
| ABR72L16-WSE2 | 16 mm Liquid Lens Autofocus | 10 | White |
| ABR72L16-RDE2 | | 24/26 | Red Diffused with central/peripheral software configurable sectors for DPM applications |

## 13.1 ABR 7000 Illuminators

### 13.1.1 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 | Standard Red | Standard White | Diffused DPM | Multicolored DPM Central | Multicolored DPM Peripheral | Polarized |
|---|---|---|---|---|---|---|
| Printed codes on opaque paper or labels having a flat surface | ✓ | ✓ | OK | ✓ | OK | OK |
| Laser Etching or Ink Jet code marking on an opaque, flat surface having no evident machining flaws | ✓ | ✓ | OK | ✓ | OK | OK |
| Code marking on an opaque, rough surface | ✓ | OK | OK | OK | X | OK |
| Code marking on a flat surface with evident machining flaws produced by machining tools | X | X | ✓ | OK | ✓ | OK |

| Application Characteristics | Standard Red | Standard White | Diffused DPM | Multicolored DPM Central | Multicolored DPM Peripheral | Polarized |
|---|---|---|---|---|---|---|
| Laser Etching or Dot Peening code marking on a flat, highly reflective surface | X | X | X | X | ✓ | ✓ |
| Red-printed code on white background | X | ✓ | X | X | OK | X |
| Mixed color codes/background | x | ✓ | X | X | X | X |

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.

## 13.1.2 Illuminator Working Distances

*Table 15: Lighting System Working Distances*

| Reader Model | Lighting System | Working Distance |
|---|---|---|
| ABR71x9-RSE2 | Red | 20 mm to 550 mm |
| ABR71xx-MSE2 | Multicolored DPM Central LED Group | 20 mm to 250 mm |
| ABR71xx-MSE2 | Multicolored DPM Peripheral LED Group | 20 mm to 50 mm |
| ABR7xxx-xPE2 | Polarized | 20 mm to 350 mm |
| ABR72L9-RDE2 | Red Diffused, both LED Groups | 20 mm to 350 mm |
| ABR72L16-RDE2 | Red Diffused, both LED Groups | 40 mm to 450 mm |
| ABR72L16-WSE2 | White | 40 mm to 1200 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 p. 113.

## 13.1.3 Color Contrast Considerations

ABR 7000 models are available with red, blue and white lighting to help resolve applications that have colored codes and/or colored backgrounds.

Choose between colors to maximize the contrast between the code and its background. In general, a code illuminated with a light of the same color becomes brighter, on the other hand when illuminated with an opposite color it appears darker (see Figure 233 on p. 162). Consequently, during the image acquisition the lighting system changes the chromatic rendering of the target according to the color of the illuminator, modifying the contrast between target and background. See the following examples.

*Figure 233. Chromatic Circle Chart*

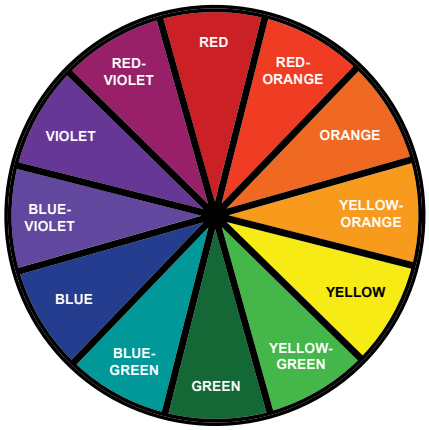



*Figure 234. Color Photo of Codes*

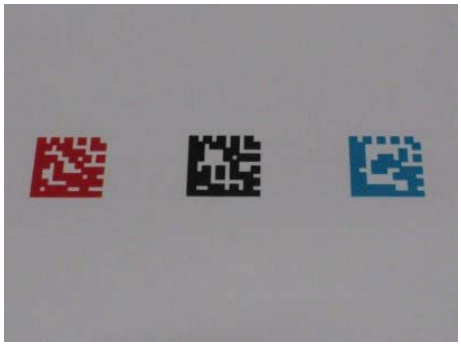
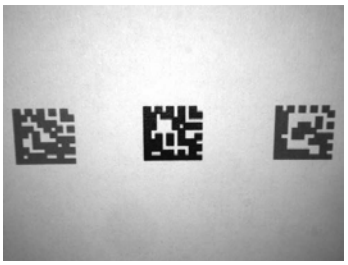


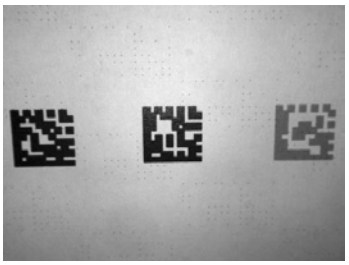
*Figure 235. Codes Under Different Illuminators*

**White Light**



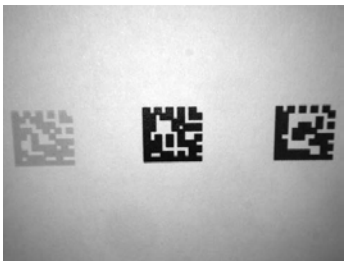
Good contrast on all codes

**Blue Light**



Red code (left) has good contrast. Blue code (right has low contrast).

**Red Light**



Red code (left) has very low contrast. Blue code (right has good contrast).

| Models | Standard | MLT-DPM | DIF/MLT-DMP |
|---|---|---|---|
| **Illumination Color** | **White** | **Blue** | **Red** |
| Mixed color codes/background | ✓ | X | X |
| Red-printed code on light background<br>White-printed code on red background | OK | ✓ | X |

| Models | Standard | MLT-DPM | DIF/MLT-DMP |
|---|---|---|---|
| **Illumination Color** | **White** | **Blue** | **Red** |
| Red-printed code on dark background<br>Black-printed code on red background | OK | X | ✓ |
| Red-printed code on dark background<br>Black-printed code on red background | OK | X | ✓ |
| Blue-printed code on dark background<br>Black-printed code on blue background | OK | ✓ | X |

Key:

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

## 13.1.4 Standard Illuminators

These illuminators are made up of eight LEDs for 1.3 MP models and ten LEDs for 2 MP models. These are bright field, general purpose illuminators. The LEDs have different lenses depending on the imager lens of each model.

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 236. Red Illuminator*



The white illuminator is suitable for applications with colored codes and/or colored backgrounds (for example, a red code on a white background) or with mixed color codes (for example, a blue/red code on a white background).

*Figure 237. White Illuminator*



With the standard or polarized illuminators on 2MP models, the following combinations of lighting configurations can be obtained.

*Figure 238. Lighting Configurations*



All ON | Even Alternate Chain | Odd Alternate Chain

## 13.1.5 Polarized Illuminators

Polarized illuminators have a built-in polarizing filter. This is the ideal solution to reduce hot spots on reflective surface applications, such as:

- DPM on reflective metal surfaces
- DPM on non-metal reflecting surfaces
- DPM on electronic circuit boards
- Glossy labels
- Labels under plastic films

*Figure 239. 1.3 MP Model with 8-LED Polarized Illuminator*

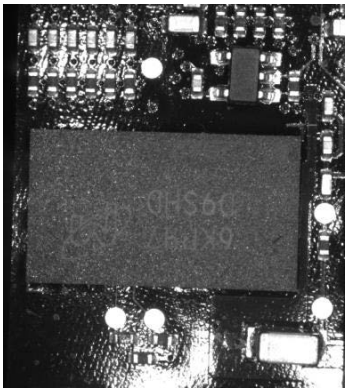
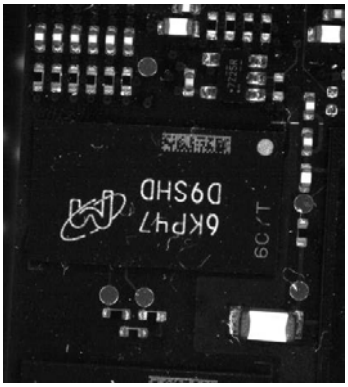


*Figure 240. 2 MP Model with 10-LED Polarized Illuminator*

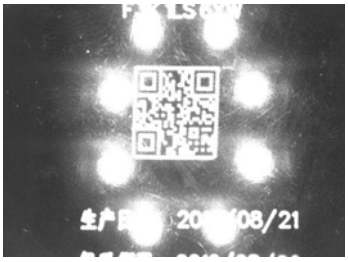
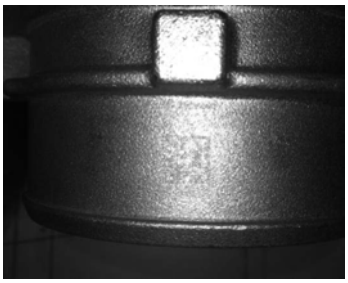
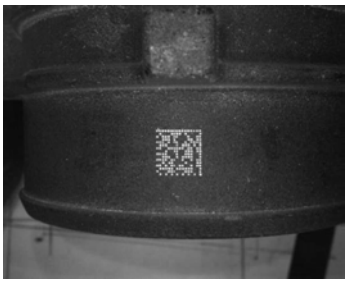
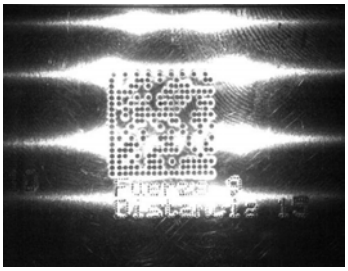
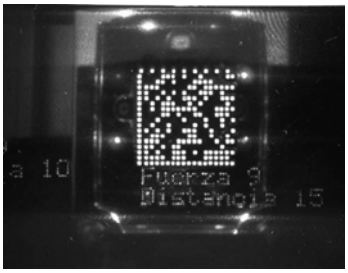
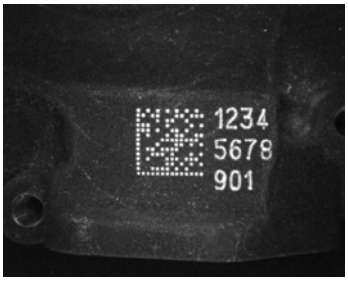


By removing LED reflection, an ABR 7000 with polarized illuminators features significant mounting flexibility, because it can be mounted 90° to the target surface. This in turn avoids code distortion and allows more reliable code grading. The following examples show the difference between codes read with and without polarizing filters:

## DMP: Data Matrix on Electronic Components

| Non-Polarized | Polarized |
|---|---|
|  |  |

## DMP: Data Matrix and QR Codes on Metal Surfaces

| Non-Polarized | Polarized |
|---|---|
|  |  |
|  |  |
|  |  |
|  |  |

### Barcode on Glossy Surface

| Non-Polarized | Polarized |
|---|---|
|  |  |

## 13.1.6 Multicolored DPM Illuminator

This is both a Bright Field and a Dark Field illuminator available for 1.3 MP models.

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 241. 39/24 LED Multicolored DPM Illuminators*



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. This group is similar to the Diffused DPM Illuminator Peripheral LED Group but differs by the light intensity (lower in the MLT-DPM) and wavelength emitted by the LEDs.

*Figure 242. Central LED Group*



Top-Left Sector



Top-Right Sector



Bottom-Right Sector



Bottom-Left Sector

*Figure 243. Peripheral LED Group*



Left Sector



Top Sector



Right Sector



Bottom Sector

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 244. Example A: Incorrect Illumination*



*Figure 245. Example B: Good Illumination on Left Code*



*Figure 246. 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 247. Color Photo of Code*

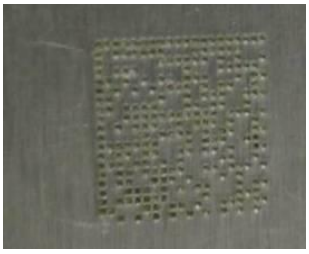


*Figure 248. Multicolored DPM Peripheral LED Group*

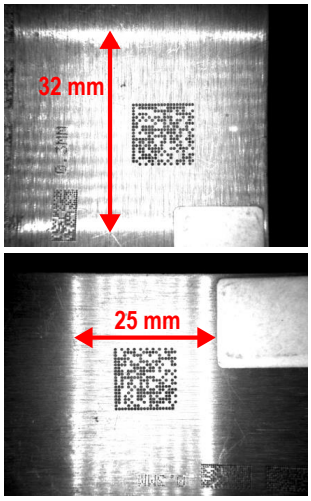
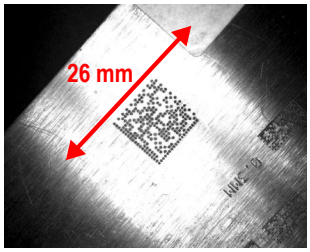



*Figure 249. Multicolored DPM Central LED Group*




## 13.1.7 Diffused DPM Illuminator

This illuminator is made up of 50 LEDs divided into two groups of four sectors each, independently controlled by the software application. Four sectors make up the internal group called Central LED Group. The other four sectors make up the external group called Peripheral LED Group.

*Figure 250. 26/24-LED Diffused DPM Illuminator*



The following ON/OFF lighting configurations can be set.

*Figure 251. Central LED Group*



Top-Left Sector | Top-Right Sector | Bottom-Right Sector | Bottom-Left Sector

*Figure 252. Peripheral LED Group*



Left Sector | Top Sector | Right Sector | Bottom Sector

Using 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. Despite 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, different consecutive images can be acquired, 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, a Data Matrix code etched onto a PCB (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. With different image settings in which the Right sector is turned off (removed from the parameter combination—Example B), the code is illuminated by the other LED sectors without the reflections on the code surface.

*Figure 253. Example A: Incorrect Illumination*

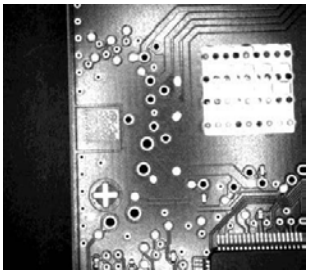
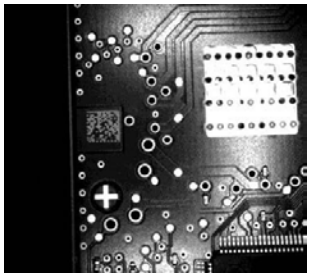


*Figure 254. Example B: Good Illumination*



The use of the Diffused DPM Illuminator is effective in direct part marking applications (DPM), where linear machining flaws are present on the part surfaces. In these cases, an image of the code can be obtained having a very light background. In addition, the high number of LEDs and the diffuser increase background uniformity because the dark bands that are generated by the spacing between adjacent LEDs are minimized.

Remember that when using a Diffused DPM Illuminator to illuminate surfaces with linear machining flaws, the well-lighted area depends on the direction of the machining flaws with respect to the illuminator's LED sectors, irrespective of the reading distance.

This characteristic fixes the upper limit of the code dimensions compatible with the use of this illuminator. In reality, it is an actual limit of the usable part of the field of view. Therefore, this limit must be taken into account 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 255. Photo of Code*

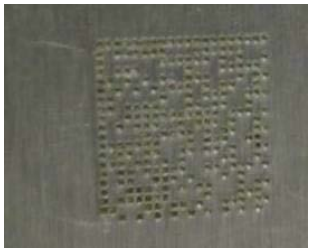


*Figure 256. Peripheral LED Group*

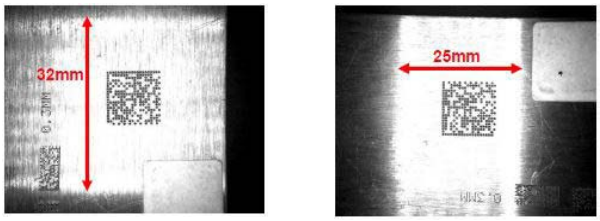
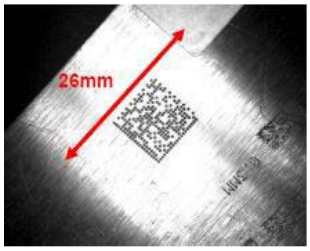



*Figure 257. Central LED Group*




## 13.2 Lighting Systems for Direct Part Marking

### 13.2.1 Lighting Systems for DPM Selection Criteria

In cases where standard illuminators do not permit code image acquisition of sufficient quality for decoding, it is necessary to select a different lighting system, such as those designed for Direct Part Marking (DPM) code reading 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

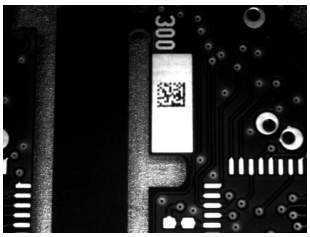
*Figure 258. Examples*

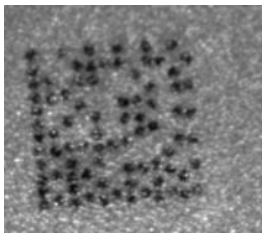





Direct Marking with Ink Jet process

*Figure 259. Examples*

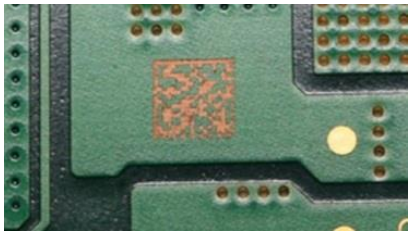


Direct Marking with Laser Etching process

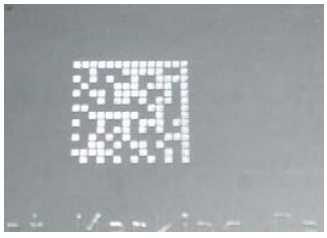
*Figure 260. Examples*



Direct Marking with Dot Peening process

*Figure 261. Examples*


**Shape of the code marking surface**

Flat surface

*Figure 262. Examples*



Curved surface

*Figure 263. Examples*



**Reflectivity of the code marking surface**

Highly reflective surface

*Figure 264. Examples*



Opaque surface

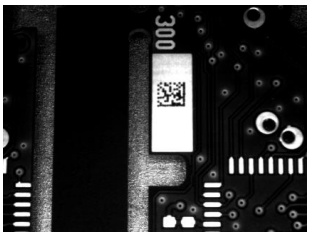
*Figure 265. Examples*



**Texture of the code marking surface**

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

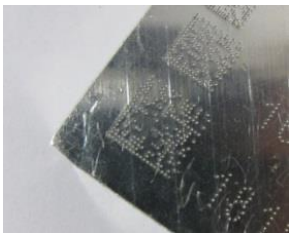
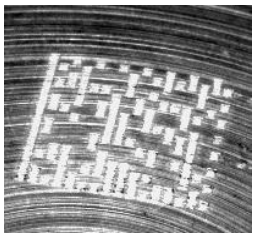
*Figure 266. Examples*





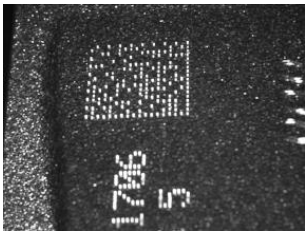
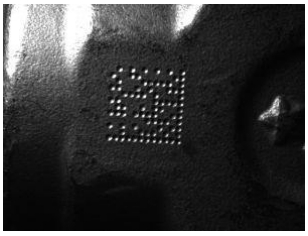
Surface with machining flaws produced by machining tools

*Figure 267. Examples*


Rough surface typical of die-cast parts

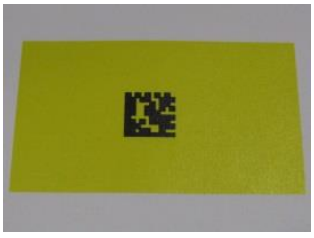
*Figure 268. Examples*

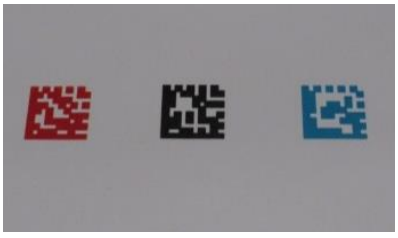





**Colored codes and/or background**

*Figure 269. Examples*



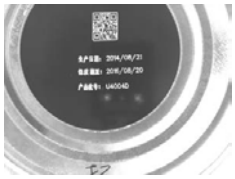
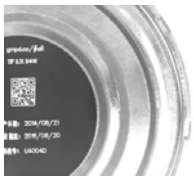


Typically, in DPM applications, the above mentioned factors are present in different combinations creating a vast number of cases. However, it is possible to subdivide the most common applications into macro-cases having characteristics that determine the choice of the most suitable lighting system to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

## 13.2.2 Code Positioning Considerations

The following images have been captured by ABR 7000 readers to demonstrate positioning and contrast considerations for DPM applications.

Because the various internal illuminators on the ABR models are located above or below the sensor, the light emitted from them can cause glare in the respective area of the image. If this glare covers the code, the reader will not be able to see it and therefore cannot decode it (see the first image in the table below).

| Application Characteristics | Non Polarized | Polarized | Diffused |
|---|---|---|---|
| Reading a Data Matrix code etched on a metal surface (can lid)<br>Code at FoV center | <br>No read | <br>OK | <br>OK |
| Reading a Data Matrix code etched on a metal surface (can lid)<br>Code at FoV top | <br>OK | <br>OK | <br>OK |
| Reading a Data Matrix code etched on a metal surface (can lid)<br>Code at FoV bottom | <br>OK | <br>OK | <br>OK |
| Reading a Data Matrix code etched on a metal surface (can lid)<br>Code at FoV right | <br>OK | <br>OK | <br>OK |
| Reading a Data Matrix code etched on a metal surface (can lid)<br>Code at FoV left | <br>OK | <br>OK | <br>OK |

## 13.2.3 ABR 7000 DPM 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 270. Color Photo of Code*

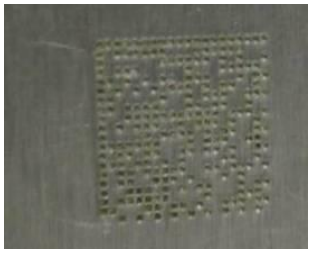


*Figure 271. Red: Incorrect Illumination*

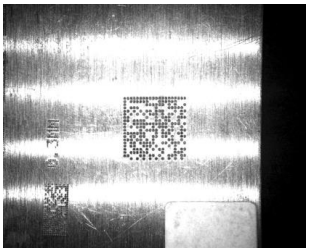


*Figure 272. Multicolored DPM - Central Group: Incorrect Illumination*

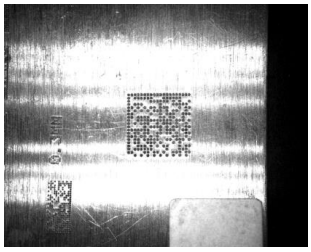
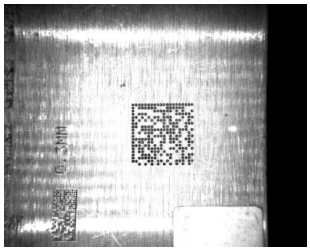


*Figure 273. Multicolored DPM – Peripheral Group: Good Illumination*



## 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 274. Color Photo of Code*



*Figure 275. Red: Incorrect Illumination*

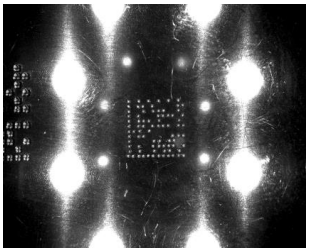


*Figure 276. Multicolored DPM – Peripheral Group: Good Illumination*

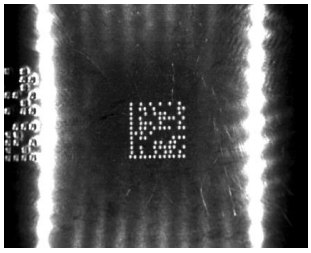


*Figure 277. Multicolored DPM - Central Group: Incorrect Illumination*



## 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 278. Color Photo of Code*

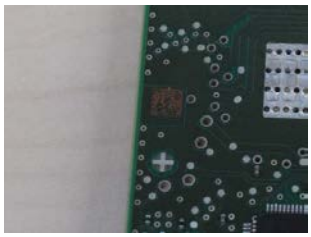


*Figure 279. Red: Incorrect Illumination*

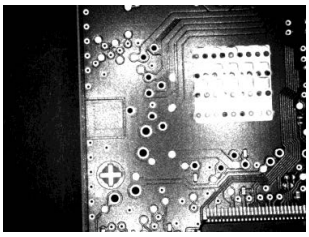


*Figure 280. Multicolored DPM - Peripheral Group ALL Sectors On: Incorrect Illumination*

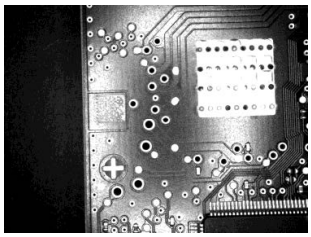
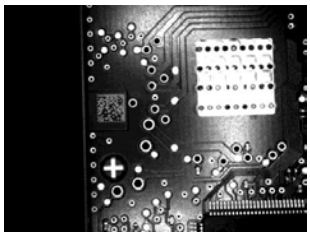


*Figure 281. Multicolored DPM - Peripheral Group Right Sector Off: Good Illumination*



## Background with Anisotropic Reflectance

*Figure 282. Color Photo of Code*




*Figure 283. Red: Incorrect Illumination*



*Figure 284. Multicolored DPM - Peripheral Group ALL Sectors On: Suboptimal Illumination*




*Figure 285. Multicolored DPM - Peripheral Group Top and Bottom Sectors On: Incorrect Illumination*



*Figure 286. Multicolored DPM - Peripheral Group Left and Right Sectors ON: Good Illumination*

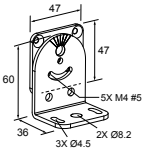


# 14 Accessories

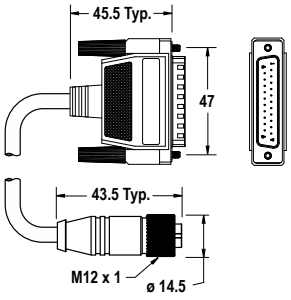
## 14.1 Brackets

**SMBABR7RA**

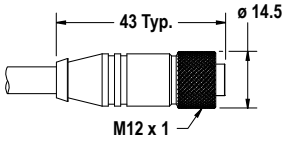
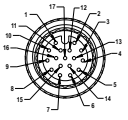
- Replacement right-angle bracket for ABR 7000 models
- Included with the product
- 3 mm cold rolled steel

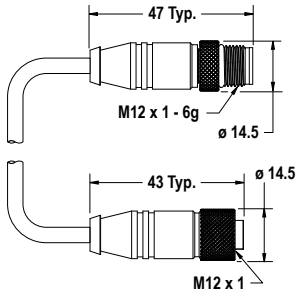
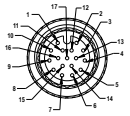


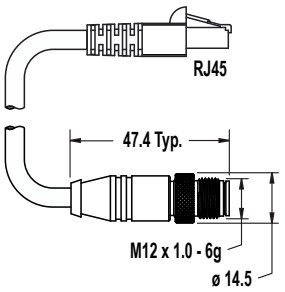
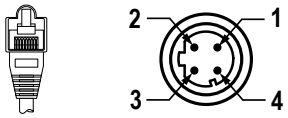

## 14.2 Cordsets

| 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<br>2 = Blue<br>3 = White<br>4 = Green<br>5 = Pink<br>6 = Yellow<br>7 = Black<br>8 = Gray<br>9 = Red<br>10 = Violet<br>11 = Gray/Pink<br>12 =Red/Blue<br>13 = White/ Green<br>14 = Brown/ Green<br>15 = White/ Yellow<br>16 = Yellow/ Brown<br>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 |  | <br>1 = Brown<br>2 = Blue<br>3 = White<br>4 = Green<br>5 = Pink<br>6 = Yellow<br>7 = Black<br>8 = Gray<br>9 = Red<br>10 = Violet<br>11 = Gray/Pink<br>12 =Red/Blue<br>13 = White/ Green<br>14 = Brown/ Green<br>15 = White/ Yellow<br>16 = Yellow/ Brown<br>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 |  | <br>1 = White/ Orange<br>2 = Orange<br>3 = White/ Blue<br>6 = Blue<br>1 = White/ Orange<br>2 = White/ Blue<br>3 = Orange<br>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 Additional Accessories

**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



**TCNM-ACMK-100**

- Backup memory module
- Plugs into TCNM-ACBB1
- Requires TCNM-ACBB1 and ABR 7000



# 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.

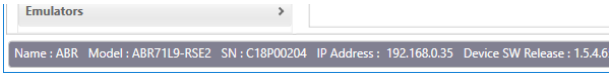
### 15.2.2 Update the Software and Firmware

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

### 15.2.3 Update the Firmware

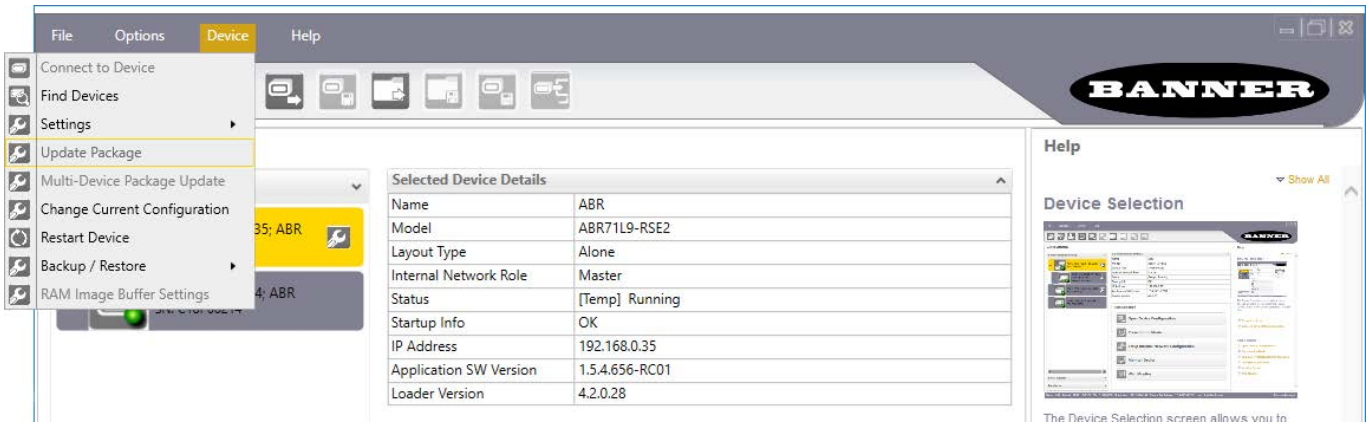
1. Make sure the device to be updated is selected and is shown in the status bar.

*Figure 287. Status Bar*



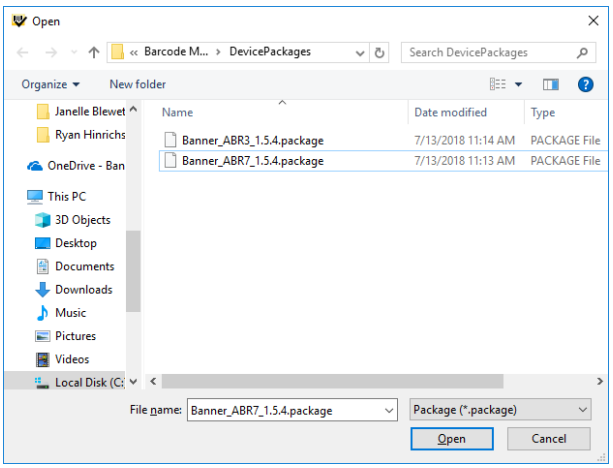

2. Go to **Device** > **Update Package**.

*Figure 288. **Update Package***




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

*Figure 289. 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.

## 15.4 Contact Us

Banner Engineering Corp. headquarters is located at:

9714 Tenth Avenue North
Minneapolis, MN 55441, USA
Phone: + 1 888 373 6767

For worldwide locations and local representatives, visit www.bannerengineering.com.

# 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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