ICC

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PicoPort Level 1 Technical Support Guide

This guide details the steps and concepts required to perform Level 1 technical support with a customer having network communication issues with an OEM device incorporating the PicoPort.

The support technician should follow each of the steps below, in order, checking each checkbox until the issue is resolved. If the issue is not resolved after following all steps and checking all checkboxes, the issue may be escalated to ICC.
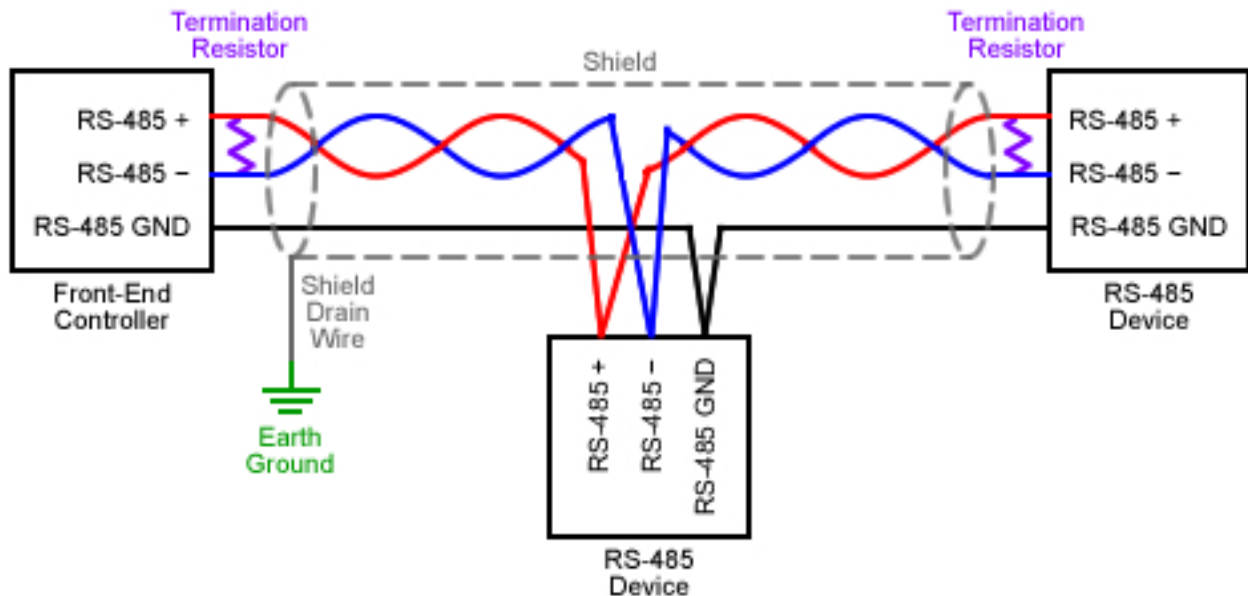
This support guide must be completed with the customer in its entirety prior to escalating an issue to ICC.

1. Power

1.1. *Power Supply*

☐ Confirm the device is powered correctly using an appropriate power supply. Please follow the appropriate OEM instructions.

2. RS-485 Wiring

Typical RS-485 Daisy-Chain Network Wiring

2.1. *Network Topology*

☐ Confirm that all RS-485 devices are wired in a daisy-chain topology.

☐ Confirm that the RS-485 cabling does not exceed 4,000ft (~1200m). If the RS-485 network requires a distance greater than this limit, confirm that RS-485 repeaters are used to divide the network into segments, where each segment does not exceed 4,000ft (~1200m).

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2.2. *Cabling*

☐ Confirm that the cable used for the RS-485 network is a twisted-pair cable and that the twisted pair wires are used for the RS-485 data signals.

Helpful Tips

- Recommended cable characteristics
  - o 1 twisted-pair for RS-485 data signals plus 1 conductor (or twisted-pair) for RS-485 ground.
  - o Wire gauge of 24 AWG to 16 AWG.
  - o Characteristic impedance of 100Ω to 140Ω.
  - o Capacitance (wire to wire) of less than 30pF/ft (~100pF/m).
  - o Capacitance (wire to shield) of less than 60pF/ft (~200pF/m).

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2.3. *RS-485 Signals*

☐ Confirm all devices share a common RS-485 ground reference (zero volt reference).

☐ Confirm the device's RS-485 + signal is connected to the network's RS-485 + wire and the device's RS-485 − signal is connected to the network's RS-485 − wire.

☐ Try swapping the + and − wires. If this doesn't resolve the issue, return the + and − wires back to their original connections. This action does not cause damage to RS-485 devices.

☐ If a shielded cable is used, confirm the shield drain wire is connected to earth ground at one end only, at a single location, typically on or near the front-end controller. Also confirm that the shield is daisy-chained at each device and is continuous across the entire cable run.

Helpful Tips

- RS-485 requires 3 signals: +, −, and ground. A 4th signal for cable shielding may optionally be used, however this is not the same as, and should not be confused with, RS-485 ground.

- RS-485 uses differential signaling. The + and − signals are always the inverse of one another. Both + and − signals can be thought of as "send" signals and the ground as the "return". For example, if the RS-485 + signal is 5V with respect to ground (HIGH), the RS-485 − signal will be 0V with respect to ground (LOW).

- Some vendors use labeling such as A and B for their RS-485 + and − signals. Polarity for A and B is not consistent among vendors, so it is sometimes required to connect A to B and B to A instead of A to A and B to B, as would be expected.

- RS-485 ground may also be referred to as common-mode reference, signal ground (SG), reference (REF), or common (COM). This provides the zero volt reference between devices for the RS-485 + and − data signals.

- The recommended method of connecting RS-485 ground signals together is to use a dedicated wire in the RS-485 cable. If a dedicated wire is not available, the cable shield can be used as the RS-485 ground wire. In this circumstance, the shield drain wire should be connected to each device's RS-485 ground instead of being connected to earth ground at one end and daisy-chained at each device.

- Some RS-485 devices do not provide an RS-485 ground terminal. These devices may have a floating (isolated) RS-485 ground, use the power supply ground as RS-485 ground, or use earth ground as RS-485 ground. When wiring to devices that use earth ground as RS-485 ground, a local earth ground connection for each device should be used instead of a dedicated wire in the RS-485 cable to prevent ground loops.

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2.4. *End-of-Line Termination Resistors*

☐ Confirm that termination resistors are only applied at each end of the RS-485 network and match the characteristic impedance of the cable (typically 120 ohms).

☐ Try removing any termination resistors on the network. If this doesn't resolve the issue, keep all termination resistors removed from the network until the issue is resolved. Only after the issue is resolved should termination resistors be reinstalled.

Helpful Tips

- Some devices include built-in termination resistors, enabled by dip switches or jumpers.

- Termination resistors may not be necessary for networks with short cabling and low baud rates. The following table can be used as a guideline.

Baud Rate	Maximum Length Without Termination
9600 and below	Termination not required
19,200	2,800ft (850m)
38,400	1,400ft (425m)
57,600	940ft (285m)
76,800	700ft (210m)
115,200	470ft (140m)

In general, the following equation can be used to determine if termination may be unnecessary:

$$L < \frac{0.66C}{12B}$$

Where **L** is the cable length, **C** is the speed of light (approximately 984,000,000ft/s or 300,000,000m/s), and **B** is the baud rate. Note that this equation assumes bits are sampled in the middle of each bit time, 3 round trips are required for reflections to dampen out, and a worst-case propagation velocity of 66% the speed of light.

- Applying termination resistors to an RS-485 network without appropriate idle biasing may cause some devices to be unable to communicate on the network. When the bus is idle (i.e. no devices are transmitting), the differential voltage between the RS-485 + and − signals must be at least 200mV. Idle biasing is typically performed by connecting a resistor between the RS-485 + signal and 5V and connecting a resistor between the RS-485 − signal and ground. The resistor value used depends on, and limits, the number of devices connected to the network.

- ICC recommends only using termination resistors when necessary, dictated by the length of the cabling and baud rate used (refer to the table above). Many technicians install termination out of convention, without assessing whether it is necessary, and typically do so without making considerations for idle biasing. This can actually cause more communication issues than without using termination, since the termination applies an additional, and often unnecessary, load to the RS-485 bus.

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3. Device Configuration Settings

3.1. *How to Configure Device Settings (Only Applicable if NPU Software is Used)*

3.1.1. Required Items

- Windows PC

- USB Cable

- Network Parameter Utility (NPU) Software (Provided by the OEM)

- OEM Device

- Power Supply (only required if OEM device cannot be powered via USB)

3.1.2. Steps

- Download and extract the NPU software

- Open the NPU software

- Connect a USB cable between the PC and device

- Apply power to the device (only required if OEM device cannot be powered via USB)

- The NPU will automatically connect to the device and show its current network settings

- Configure network settings for your network

- Click the "Submit" button

3.2. *Network Communication Settings*

- ☐ Confirm that all of the following settings match on all devices connected to the network.

  - ☐ Baud Rate

  - ☐ Parity

  - ☐ Number of Stop Bits

3.3. *Device Addressing*

- ☐ Confirm that the following settings for the device are unique on the network (i.e. no other device uses the same values).

  - ☐ Address (also called MAC Address in BACnet MS/TP)

  - ☐ Device Instance (BACnet MS/TP only, also called Device Instance Number, Device Object Instance Number, Device ID, Device Object ID, or Device Object Identifier)

  - ☐ Device Name (BACnet MS/TP only, also called Device Object Name)

- ☐ Try changing the device's address to a different, unused address. If this doesn't resolve the issue, restore the device's address back to its original setting.

- ☐ Confirm that the front-end controller (master/client device) is configured to target the device's address (device instance for BACnet MS/TP).

- ☐ BACnet MS/TP only: Confirm that the Max Master setting on all devices is higher or equal to the highest MAC address on the network. If there is any doubt, this setting should be set to 127, which is the highest possible value.

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Helpful Tips

- Device settings can be configured using the Network Parameter Utility (NPU) software via USB or via the OEM's own method. If the NPU is not used, please consult the appropriate OEM instructions for how to configure device settings.

- Many devices require a reset or power cycle after changing configuration settings for the settings to take effect.

- The Network Parameter Utility (NPU) will automatically reset the PicoPort so that configuration settings take effect immediately after clicking the "Submit" button.

- BACnet MS/TP uses two levels of device addressing for each device, a MAC address and a device instance.

  The MAC address is the low-level address, used on the MS/TP (Master-Slave/Token Passing) layer in order to arbitrate communications on the bus (i.e. which device may transmit at any given time). Every BACnet MS/TP device on the RS-485 bus must be configured with a unique MAC address to prevent communication errors. If a device is configured with the same MAC address as the front-end controller, this can effectively "take down" a BACnet MS/TP network, causing the front-end controller to be unable to communicate to any devices.

  The device instance is the high-level address, used on the BACnet layer, and is used to target a BACnet device. The device instance should be unique on the entire BACnet network, but may not necessarily cause communication errors, as some BACnet clients are able to detect and handle duplicate device instances on the network when discovering devices.