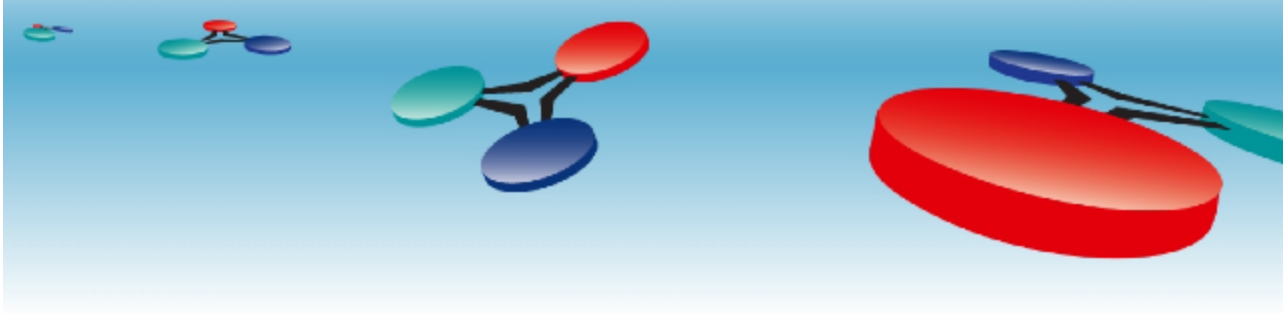




User's Guide

BAS-o-matic BACnet MS/TP Option

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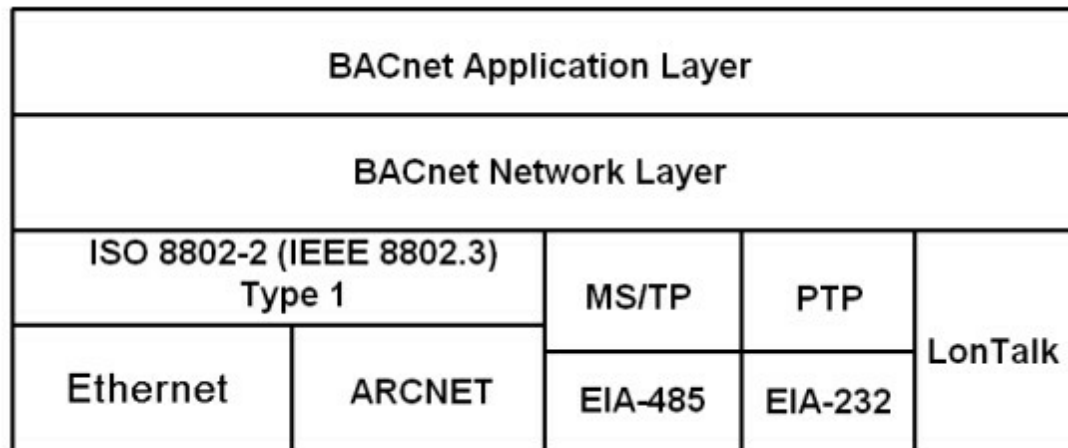
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MS/TP overview

MS/TP overview

The BACnet standard defines the following architecture:



MS/TP is one of the data links supported by the BACnet standard. MS/TP is a master/slave token-passing protocol which uses standard serial ports on microcontrollers and EIA-485 transceivers. This network offers the lowest possible hardware cost for BACnet integration and is used by many companies for their device level network.

Token Passing

Token passing is a well known networking access control mechanism. MS/TP uses this "token passing" system to control access to the network. A master node may initiate the transmission of a data frame only when it holds the token. Both master and slave nodes may transmit data frames in response to requests from master nodes. After the master node with the token sends a number of frames (defined by the Nmax_info_frames setting) the node then passes the token to the next master node.

Token frames are not acknowledged.

MS/TP Frame

An MS/TP frame contains; **Frame Type**, **Destination Address**, **Source Address**, **Length**, **Header CRC**, **BACnet Data**, and **Data CRC**.

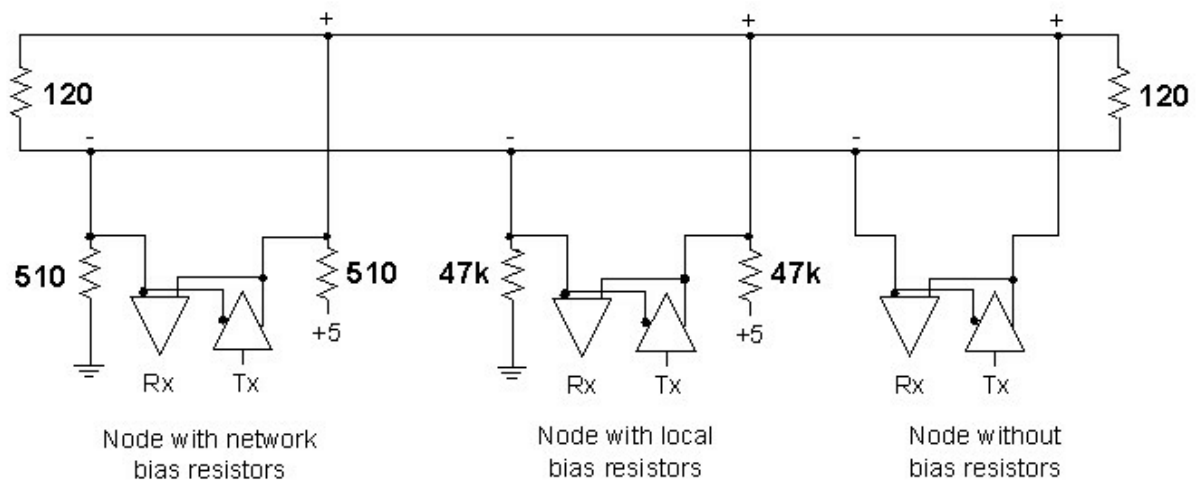
When the frame type is "00", this indicates that the frame is a token. Another typical message would be a Frame type "05" which indicates a frame called "Bacnet Data Expecting Reply". This communicates between 0 and 501 octets of BACnet data to the Destination address. The reply would be returned immediately to the originating master node.

MS/TP physical layer

MS/TP physical layer

The BACnet MS/TP specification describes the following physical characteristics:

- An MS/TP EIA-485 network uses shielded, twisted-pair cable.
- The maximum number of nodes per segment is 32.
- The polarity of the connection must be consistent (all + connections tie together and all - connections connect together).
- No T connections are allowed.
- 120 ohm termination resistors are needed at each end of a segment.
- Allowable baud rates are: 76800, 38400, 19200, and 9600. (9600 MUST be supported, others are optional)
- The shield shall be grounded at one end only to prevent ground currents
- Each MS/TP segment needs network bias resistors (3 types described in standard)



U+4 Hardware Details

U+4 Hardware Details

It has been found that a Windows Operating System can not consistently respond to the critical timing specified by the BACnet MS/TP specification. Our U+4 device contains a microprocessor that handles these time critical issues.

An overview of this device is:

- USB to RS485 interface
- High speed co-processor handles time critical data and solves Windows real time response issues
- Both DB9 and screw terminals
- Professional electrical construction in a rugged metal housing
- Data and Power indication
- USB powered (no external power)



Power

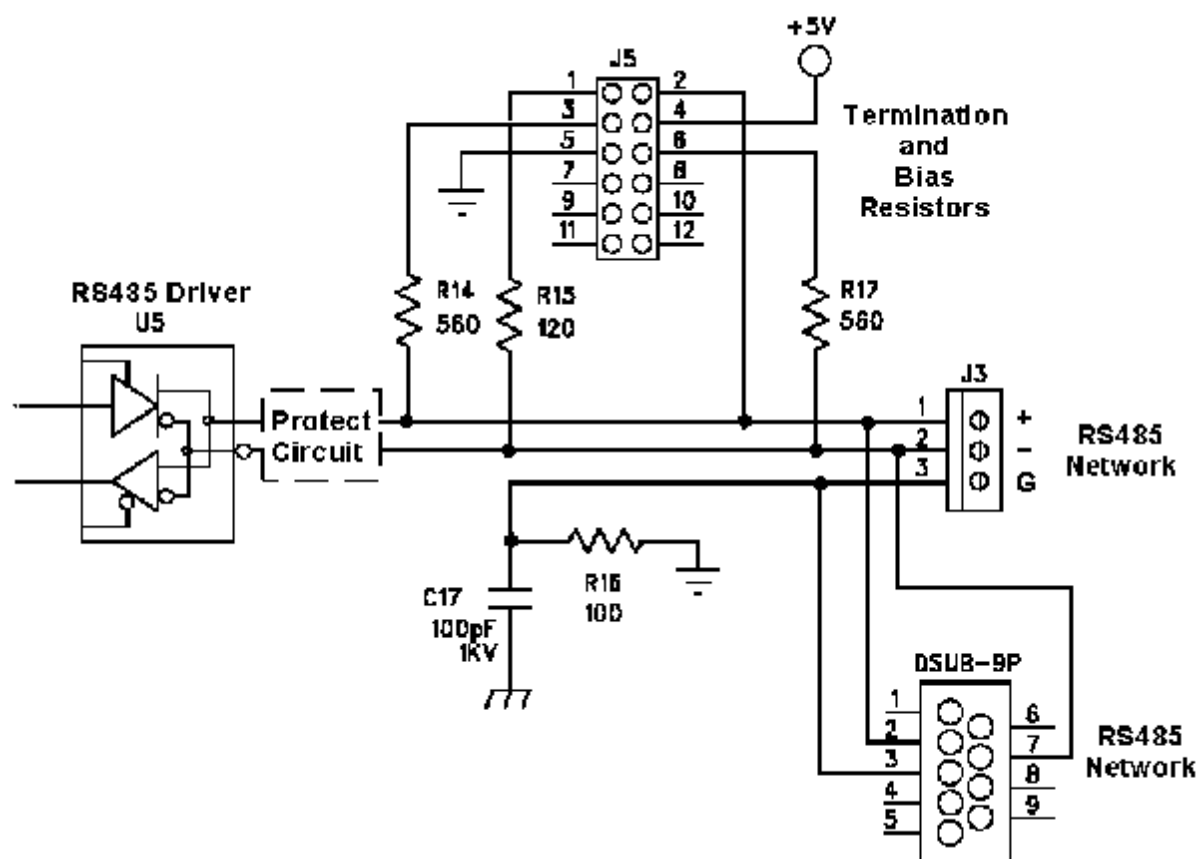
The U+4 is powered by the USB port and does not require a separate power supply. Proper power will be indicated by the Power LED indicator being on.

Data

The Data LED will indicate any read or write operation within the unit (activity on the network)

RS485 connection

The back panel of the U+4 has two connectors. The three conductor screw terminal allows connection of the RS485 network using industrial connectors, and the 9 pin D is merely in parallel with these connections offering an alternative connection. Please refer to the following schematic:



Termination and Bias settings

Inside the U+4 unit is a header called J5 which lets you set termination or bias resistors into the network circuit. When jumpers are in positions 1-2, 3-4, 5-6 then these resistors are in the circuit. NOTE: These are not in the circuit when delivered from the factory.

U+4 Software Driver Setup

U+4 Software Driver Setup

QUICK HELP: To get your U+4 device working, you need to 1) install the software driver, 2) connect the device to your computers USB port, and 3) point Windows to the drivers location (default = C:\Program Files\Cimetrics\BAS-o-matic\Plugins\MSTPDriver) (default for 64 bit systems = C:\Program Files (x86)\Cimetrics\BAS-o-matic\Plugins\MSTPDriver)

Windows XP

1) Driver Installation : The U+4 software driver is installed by the standard BAS-o-matic installation program. If you have doubts about this driver being installed, you can go to **Start | Control Panel | Network Connections** and see if you now have one more "**Local Area Connection x**" (where x is one more than you normally have on your machine). NOTE: The U+4 hardware device must be connected for this to be displayed.

If you need to reinstall this driver,

- a) Go to **Start | Control Panel | Add or Remove programs | BAS-o-matic | Change** to start this program again.
- b) Select **Fieldbus interface | MS/TP driver** and start the load process again.

Windows Vista

1) Driver Installation : The U+4 software driver is installed by the standard BAS-o-matic installation program. If you have doubts about this driver being installed, you can go to **Start | Right click on Network | Properties | Manage Network Connections** and see if you now have one more "**Local Area Connection x**" (where x is one more than you normally have on your machine). NOTE: The U+4 hardware device must be connected for this to be displayed.

If you need to reinstall this driver,

- a) Go to **Start | Control Panel | Programs and Features | right click on BAS-o-matic | Choose Change** to start this program again.
- b) Select **Fieldbus interface | MS/TP driver** and start the load process again.

Windows 7

1) Driver Installation : The U+4 software driver is installed by the standard BAS-o-matic installation program. If you have doubts about this driver being installed, you can go to **Start | Control Panel | Network and Internet | Network and Sharing Center | Change Adapter Settings** and see if you now have one more "**Local Area Connection x**" (where x is one more than you normally have on your machine). NOTE: The U+4 hardware device must be connected for this to be displayed.

If you need to reinstall this driver,

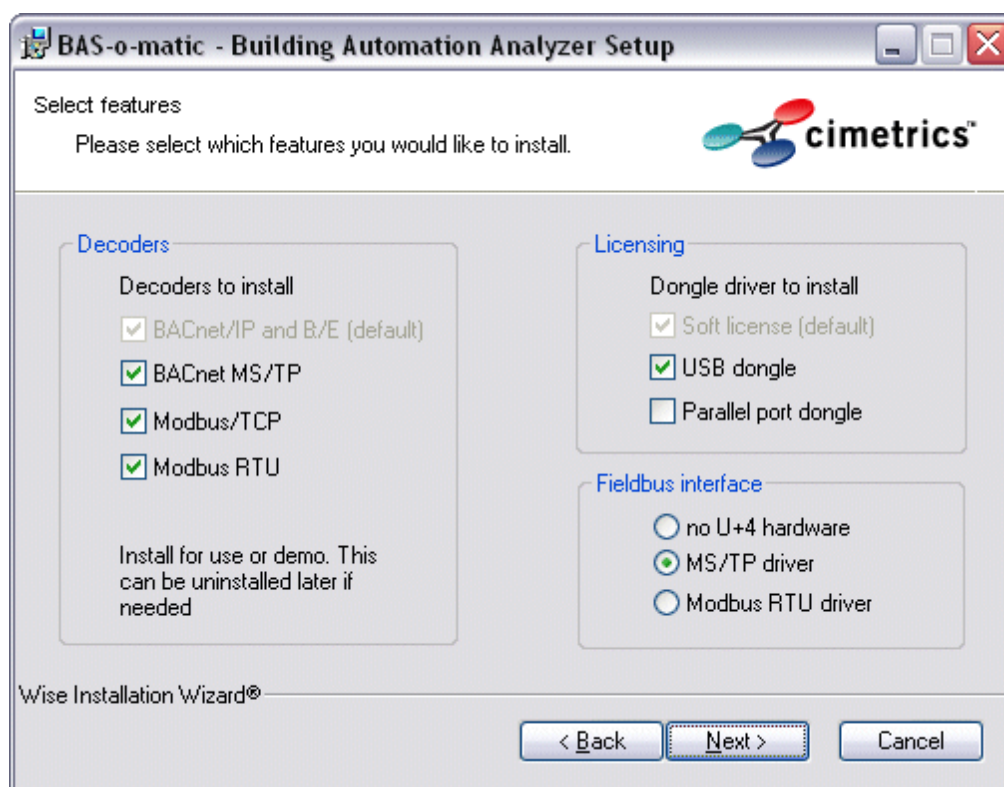
- a) Go to **Go to Start | Control Panel | Programs | Programs and Features | right click on BAS-o-matic | Choose Change** to start this program again.
- b) Select **Fieldbus interface | MS/TP driver** and start the load process again.

Windows 8

1) Driver Installation : The U+4 software driver is installed by the standard BAS-o-matic installation program. If you have doubts about this driver being installed, you can go to **Start | Right click on Network | Properties | Manage Network Connections** and see if you now have one more "**Local Area Connection x**" (where x is one more than you normally have on your machine). NOTE: The U+4 hardware device must be connected for this to be displayed.

If you need to reinstall this driver,

- a) Go to **Start | Control Panel | Programs and Features | right click on BAS-o-matic | Choose Change** to start this program again.
- b) Select **Fieldbus interface | MS/TP driver** and start the load process again.



2) Connect the device - Connect the U+4 to the USB port. Windows will display that a USB device has been found and will ask you to manually select a driver.

3) Find the driver file - Select the location of the driver file (default = C:\Program Files\Cimetrics\BAS-o-matic\Plugins\MSTPDriver)
(default for 64 bit systems = C:\Program Files (x86)\Cimetrics\BAS-o-matic\Plugins\MSTPDriver)

U+4 Driver Settings + Filters

U+4 Driver Settings + Filters

Changing Driver Settings

View device status under **Start | Control Panel | Network Connections**. To change settings, right click on the U+4 icon and select **Properties**.

You can also change status in Settings menu. Under **Options** tab select Automation Protocols. Choose BACnet-MS/TP and click Configure.

On the Local Area Connection screen, right click, and select **Properties**.

If you have a Cimetrics BACstac: The BAS-o-matic program does NOT use the Cimetrics BACstac, but if you have this installed for another program, please unselect this protocol now.

Click on **advanced | Drivers** then you can change the following option settings:

- **MS/TP MAC address:** A hex value between 0 and 254. This is the unique address needed to identify each device on the MS/TP network.
- **Max Masters:** This is the maximum number of master controllers on the network. One should make this number as close as possible to the actual number of master devices so time is not spent trying to discover masters that do not exist.
- **Max Info Frames:** This is the maximum number of frames that this device can send before it must pass the token to the next device. Default = 5
- **Baud rate:** All devices on the network must be set to the same baud rate. BACnet MS/TP baud rates are 76800, 38400, 19200, and

9600. Some manufacturers have implemented other baud rates, so the U+4 device can also be set to: 115200, 28800, 14400, 4800, and 2400).

- **Mode:** There are four modes:

1) All - pass ALL BACnet MS/TP data to BAS-o-matic.

2) All BACnet data - only pass MS/TP frames with BACnet NPDU's to BAS-o-matic

3) Directed BACnet data - pass all MS/TP frames with BACnet NPDU's that are addressed to this specific Node Address (+ Broadcast messages) to BAS-o-matic

4) Directed BACnet NPDU only - pass only directed BACnet or Broadcast NPDU packets.

When you are finished, close the advanced drivers window.

If you have a Cimetrics BACstac: Reselect the BACstac protocol and a screen will pop up which says "BACstac has been started".

When finished, close all Control Panel windows and go back to using the BAS-o-matic program.

Display details - MS/TP

Display details - MS/TP

The BAS-o-matic display shows three views: 1) a line by line listing of captured packets 2) decoded packets based on the cursor highlight of view #1 and 3) raw data in hex notation based on the cursor highlight in view #1. An example of a decoded packet is explained below (Read Property in this example):



MS/TP Frame

- **Silence timer** - This indicates the time of silence on the wire when the beginning of this packet was received. This timer is defined in 9.5.2 "Variables" of the standard. It is used by Receive Frame Finite State Machine, described in 9.5.4. This value might be useful for debugging networks which often drop tokens or generate duplicated tokens.

- **Status** - The internal status associated with received packet (returned by U+4 firmware).

Possible values:

0x00 **OK** - a valid packet with BACnet data destined for this node 0x80 Not for us - a valid packet, either without BACnet data (that is: a control packet), or a packet destined to another node

0x81 **timeout** - frame was not received due to timeout

0x83 **bad header CRC**

0x84 **Frame too long**

0x85 **Bad data CRC**

- **Direction** - Corresponds to the direction of the packet in respect to the machine the program is installed on (In = the device is receiving, Out = the device is sending out, Pass through = packet going across the wire, Broadcast = packet that is addressed to everybody)

- **Direction** - Corresponds to the direction of the packet in respect to the machine the program is installed on (In = the device is receiving, Out = the device is sending out, Pass through = packet going across the wire, Broadcast = packet that is addressed to everybody)
- **Time / Delta Time** - The time that this packet was generated and delta is the difference of time between the last packet and the current packet.
- **Frame Size** - This shows the **complete** size of the frame in hexadecimal.

IMPORTANT NOTE ABOUT FRAME SIZE: The BAS-o-matic software includes 25 bytes of SNAP header (inserted by the U+4 device), and Silence Timer+status, but excluding preamble. Therefore, the actual size of the MS/TP frame on the wire (including the header, but not including preamble) is the "Frame size" value minus 25.

- **Frame Number** - This is the sequential number of the frame.

MS/TP Header

This is the header, as defined in 9.3 "MS/TP Frame Format", but excluding the preamble, which is stripped off by the driver, because it is the same for all frames.

- **Type** - This is the type of the MS/TP frame, as defined in 9.3.1 - 9.3.8 of the BACnet standard.

Possible values are:

- (0) = **Token**
- (1) = **Poll For Master**
- (2) = **Reply For Poll For Master**
- (3) = **Test_Request**
- (4) = **Test_Response**
- (5) = **BACnet Data Expecting Reply**
- (6) = **BACnet Data Not Expecting Reply**
- (7) = **Reply Postponed**

- **dstAddress** - The MS/TP address where the packet is being sent to (one octet). A Destination Address of 255 ('FF') denotes broadcast. Addresses 0 to 127 are valid for both master and slave nodes. Addresses 128 to 254 are valid only for slave nodes.

- **srcAddress** - The MS/TP address where the packet came from (one octet).

- **Length** - The length of the BACnet data. This is zero if no data is present. (2 bytes)

- **Header CRC** - The CRC of the header data (1 byte)

BACnet data

- **Data CRC** - The CRC of the BACnet data, if data is present (2 bytes)

BACnet Network Header

- **BACnet Protocol Version** - Indicates the version of the BACnet protocol. This value is currently '1'.

- **Priority** - Specifies the priority of the message. This is a numeric value used by BACnet routers to determine any possible deviations from a first-in-first-out approach. There are four different priorities that can be used and they are **Life safety message** , **Critical Equipment Message** , **Urgent Message** , and **Normal message** .

- **Data Expecting Reply** - This is a Boolean parameter that indicates whether (TRUE) or not (FALSE) a reply service is expected for the service being used.

BACnet APDU Fixed Part - BACnet Application Layer

- **Service Request** - This relates to the type of service requested

- **Unsegmented Request** - This parameter indicates whether or not the service request is entirely, or only partially, contained in the present Protocol Data Unit. If the request is present in its entirety, the value of the 'segmented-message' parameter shall be FALSE. If the present PDU contains only a segmented of the request, this parameter shall be TRUE.

- **Max. Segments Accepted** - This parameter is required for certain services but is not required for others. When present, this parameter specifies the maximum number of segments that the device will accept. This parameter is included in the request so that the responding device may determine how to convey its response.

- **Max. APDU Size Accepted** - This parameter is required for certain services but is not required for others. When present, this shows the maximum size of a single APDU (Application Protocol Data Unit) that can be accepted by the device. This parameter is included in the request so that the responding device may determine how to convey its response.

- **Invoke ID** - This is the Identification number of the request generated. This value has to be an integer in the range of 0-255 and is assigned by the service requester only. This ID will be unique for all outstanding confirmed request APDUs generated by the device. The acknowledgments to this request should also have the same Invoke ID.

- **Service Choice** - This shows the kind of BACnet Service such as "I-Am" or "ReadProperty".

- **Property Identifier** - This shows the property of the target BACnet object.

BACnet APDU Variable Part - BACnet Application Layer

This corresponds to the second part of the Application layer and is the variable part. Specific information concerning BACnet services will be listed here.

- **Object Identifier** - This shows the instance number of the target device and the BACnet object.

- **Property Identifier** - This shows the property of the target BACnet Object.

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More information

More information

Go to **HELP | Contents & Index** for information about program functions.

Go to **HELP | BACnet** for all BACnet specific information.

Links to MS/TP Resources

Links to MS/TP Resources

Here are some other resources where you can learn more about relevant issues.

NOTE: Check the main help file for MS/T for General Networking links.

MS/TP Information

[BACnet MS/TP working group](#) - MS/TP and PTP Maintenance and Enhancement.

[BACnet MS/TP FAQ](#) - In this article, H. Michael Newman, Manager of Cornell University's Utilities Department Computer Section and Chairman of ASHRAE's BACnet committee since its inception in 1987, answers some of the most frequently asked questions about the BACnet standard, ANSI/ASHRAE 135-1995.

[MS/TP communication bus technical bulletin](#) - This document describes the specifications, device limits, and rules of the MS/TP communications bus. This document also describes how to wire and terminate devices, and troubleshoot device communication on the MS/TP bus.

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