Rockwell Automation

**DeviceNet will not function correctly if design rules are not followed.
Even a Network previously thought to be functioning correctly may begin
to exhibit abnormal or anomalous operation due to incorrect system design.
The following are tips to help locate and correct these abnormalities.**

For specific DeviceNet system installation information.
Please refer the "DeviceNet Planning and Installation Manual".

Manuals can be ordered via the Internet at **http://www.theautomationbookstore.com/**

ATTENTION

**Verify that all devices on the network have been certified by ODVA and
carry the DeviceNet Conformance check on their name plate.**

Termination Resistors:

A termination resistor equal to 121 Ohms 1% , 1/4W must be attached at each end of the
Trunk cable. The resistors must be connected across the Blue & White wires of the
DeviceNet cable.

Resistor connection can be verified by disconnecting DeviceNet power and measuring
the resistance across the Can_H & Can_L lines (Blue & White Wire). This can be
measured with an Ohm meter. The reading should be *approximately 60 Ohms.*

<u>**Very Important:**</u> The DeviceNet network will not operate correctly without terminating
resistors. Termination resistors can be ordered from your local Allen-Bradley Distributor
using the *part number 1485A-C2*.

Network Grounding:

The DeviceNet cable must by grounded at only one location. This should be done closest to the center of the network. Connect the network Shield and Drain wire to an earth ground using #8 AWG wire up to a maximum 3m (10Ft) in length.Also connect the V-conductor (Black Wire) of the network trunk cable and the DC ground of the power supply to this ground connection.

Power Supply Discussion:

DeviceNet requires 24VDC. Use a power supply rated 24VDC (+/- 1%). Make sure the power supply has it's own current limit protection. Provide fuse protection for each segment of the cable system. DeviceNet requires a power supply to have a rise time of less then 250mS to within 5% of its rated output voltage. The power supply must be sized correctly to provide each device with its required power.

1. The thin wire trunk line can only handle 3 amps and the thick wire trunk line can physically handle 8 amps. However, in North America the current is limited to 4 amps. Multiple power supplies can be installed on a DeviceNet network, but no section of cable should have more current flowing than the appropriate rating. An important note is that when putting multiple power supplies on a network; break the Red V+ wire between the power supplies. This effectively isolates the power supplies from each other.

2. Common mode voltage can sometimes be an issue on DeviceNet networks which have trunk lines that are extra long and/or have devices on them, drawing large currents at longer distances. If the voltage on the Black V- wire ever gets more than 4.65 volts different from one point of the network to another, then communication problems could occur. On an existing network, if the voltage between the Red V+ wire and the Black V- wire ever gets below 15 volts, then common mode voltage could be adversely affecting network communications. Adding an additional power supply or moving an existing power supply closer to the heavier current loads will normally cure common mode voltage problems.

Important: It is recommended that the DeviceNet power supply should be used to power the DeviceNet network only. When multiple power supplies are required, verify that the V+ connection is broken between the supplies. Please refer to the " DeviceNet Planning and Installation Manual " for more specific installation procedures.

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Verify Network Voltages

It needs to be understood that DeviceNet is actually a three wire Differential Voltage network communication is accomplished by switching the CAN-H (White wire) and CAN-L (Blue wire) signals relative to the V- line (Black Wire). The CAN-H swings between 2.5 VDC (Recessive State) and 4.0 VDC (Dominant State) while the CAN-L swings between 1.5 VDC (Dominant State) and 2.5 VDC (Recessive State)

Without a network master connected to the DeviceNet, the CAN-H and CAN-L lines should read between 2.5 VDC and 3.0 VDC relative to V- and the voltages should be identical. (Recessive State). Measure these voltages right at the SDN scanner. Use a voltmeter in DC mode.

With a network master connected **and polling the network,** the CAN-H to V- voltage will be around +3.2 VDC. The CAN-L to V- voltage will be around 2.4 VDC. The reason these values appear a little different than the ranges shown on the scope trace, is that the signals are switching, which slightly affects the DC value being read by the VOM.

If Can-H to V- and Can_L to V- are too low; less than 2.5 V dc and 2.0 V dc respectively the issue is probably a bad transceiver or bad wiring. To find a bad transceiver remove one node at a time measuring Can-H and Can-L to V- each time a device is removed.

To check a transceiver (rough test) with everything removed from a device use an ohm meter to measure resistance between V+ and Can-H V+ and Can-L V- and Can-H V- and Can-L. These impedances should all be greater than 1 M ohm.

Examine the System Design of the Installation

- ❑ Walk the network if possible to determine the actual layout. (Make a sketch of the network)
- ❑ Check number of nodes
- ❑ Check cumulative drop length
- ❑ Check individual drop lengths
- ❑ Check branched drop length
- ❑ Check total trunk length, including long drop near the ends
- ❑ Check the termination location and measure the terminators
- ❑ Check the power supply cable length and gauge
- ❑ Check for one, and only one, earth ground of the V- and shield
- ❑ Break the combination shield/V- connection to frame ground and verify >1.0 Mohm to frame ground
- ❑ Check for one and only one V- to shield connection
- ❑ Break the shield/V- connection at the power supply and verify >1.0 Mohm shield to V- with 24VDC off
- ❑ Check for shorts of CAN- and/or CAN+ to shield or V- verify with an OHM meter
- ❑ Check the length and gauge of the earth ground connection
- ❑ Check total power load and its distribution points

Check the Power

- ❑ Check trunk and drop current limits
- ❑ Check type (size and length) of cable bringing power into the trunk
- ❑ Measure the 24V supply at the middle and ends of the network
- ❑ Consider spot checking the power for noise with an oscilloscope

It is recommended but not required that the 24 VDC Network Power for DeviceNet should be used for the DeviceNet network only to aid in eliminating noise issues.

Check the Wiring

- ❑ Check lead dress in junction boxes
- ❑ Check that connectors are screwed together tightly
- ❑ Check that glands are screwed tightly
- ❑ Check for foreign material (electrical tape, RTV, etc.) in glands
- ❑ Check that nodes are not touching extremely hot or cold surfaces
- ❑ Check that cables are kept a few inches away from power wiring
- ❑ Check that cables are not draped on electric motors, relays, contactors or solenoids
- ❑ Check that cables are not constrained so as to place excessive tension on connectors
- ❑ Wiggle connectors to provoke intermittent failures

❑ **Check the Scanner Configuration**

- ❑ Verify the scanlist
- ❑ Baud Rate
- ❑ Node Address
- ❑ Series/Revision of the 1747/1771-SDN scanner

Refer to Knowbase for documents on factory defaulting DeviceNet Scanners

Check the Nodes

- ❑ Cycle power to the 24V supply, this will reset the scanner to initialize the network
- ❑ Examine the scanner display codes to identify problem nodes.
(Reference the SDN manual for a description of these codes)

At problem nodes

Blinking GREEN means the node is not being allocated by the scanner
- ❑ Check that the node is in the scan list
- ❑ Check that the scanner is not bus off
- ❑ Check if connection is timing out

Blinking RED means no communication
- ❑ Check for missing power on all nodes
- ❑ Check if all other nodes are disconnected
- ❑ Check node baud rate (Bad baud rate does not always cause buss off)
- ❑ Check scanner, if a code 91 is displayed then the communications connection with the node has timed out. ***Recycle 24V supply and then reset scanner.***

If scanner goes bus off again, The problem is some combination of

- Defective node
- Node baud rate
- Bad topology
- Bad connections
- Bad scanner
- Bad power
- Bad grounding
- Bad electrical noise

A Solid RED light at power-up means two nodes have the same address.
A Solid RED after allocation means bus off Check baud rate.

If the problems persist:

- Replace T-Tap
- Check topology
- Check power for noise with oscilloscope or power disturbance analyzer

Finally if the problem remains after all else has been tried replace the node.
(Be sure to set the node address and baud rate on the replacement node, if applicable)

Points to Remember

- Pressing the reset button on the scanner does not reset the network
- Cycling the rack power does not reset the network
- When using a DeviceLink a bus off (solid RED) condition can only be cleared by cycling the 24V power
- Cycling power on the network will cause the scanner to go bus off
- DeviceNet 9000 bus off (solid RED) condition can be cleared by cycling the 24V power or by pressing the program button for several seconds
- Extreme care must be given to the task of setting initial addresses and baud rates because one incorrect node address or incorrect baud rate will cause other nodes to appear to be bad (solid RED).
- If the scanner is bus off (code 91), nodes will not re-allocate (flashing GREEN or RED) even if they are functioning correctly
- RSNetworx for DeviceNet and a 1770-KFD/1784-PCD can be used to identify the functioning nodes on the network.
- If a node goes bus off (solid RED for DeviceLink), and is replaced and still goes bus off, the problem is not the node but rather the setting of the address or baud rate or a network wide problem related to topology, grounding, electrical noise or an intermittent node

MORE TROUBLESHOOTING TIPS

- Try to distinguish, as soon as possible, a device problem from a media problem.
- Try to reduce the system to the smallest size, which still exhibits the problem. This can be done by removing nodes, drops, taps, or lengths of trunk can do this.
- Use substitution where possible to rule things out, but be careful!

Actual Field Case:

Product A works with Product B and not with Product C.
We conclude that the problem is with Product C -- WRONG!!
The problem was with product A., Product C was operating correctly, But just happened to be Susceptible to the fault in the product A.

Always remember <u>do not</u> assume too much!

If you suspect a media problem, inspection is always a good first step.
Verify lengths, topology, and proper termination (*VERY IMPORTANT*).

Always. Always, ALWAYS!!........... Check all Connections.

Opens or shorts may be the biggest problem. On an idle bus (without traffic) voltages can indicate problems. CAN_L and CAN_H should be about 2.5 to 3.0 volts relative to V-. If there is traffic, CAN_L will be a little lower, CAN_H a little higher.

Use an OHM meter to check resistance between CAN_H and CAN_L when idle. This should be about 60 ohms (two 120 ohm terminators in parallel). This value may be as low as 50 ohms if there are many nodes attached. Make sure all wires are well attached to the right places. The V+ level, relative to V-, should always be between 11 to 25 volts.

One common problem people run across is incorrect setting of baud rates and node addresses. Always verify the nodes address and baud rate before installing it on a network. And try not to change a nodes baud rate while on the network. Do all baud changes on a point-to-point only connection.

Ground Loops

Before trying this make sure the shield is grounded in only one place.

Use the oscilloscope to determine if there are ground loops in your system. You should NOT see 60 Hz or Harmonics in your signal. Assuming you use DC coupling on the oscilloscope you should see....

 2.8 VDC offset on both Can_High & Can_Low NO Sinusoidal signal; ie 60 Hz components.

DeviceNet Cable (Color Codes and Signals)

BLACK	Common	-- COM
BLUE--	Signal Low	-- CAN_L
Uninsulated	Shield	-- SHIELD
WHITE	Signal High	-- CAN_H
RED	Power Supply	-- VDC+
GREEN	Chassis Ground	-- EARTH GROUND

DeviceNet QD Connectors

Examining the connector with the keyway pointing down. Number the pins starting at the pin right most to the keyway (1) and continue counter clockwise until you reach pin (5).

PIN 1	SHIELD	GREEN (or Bare wire)
PIN 2	VDC+	RED
PIN 3	COM	BLACK
PIN 4	CAN_HIGH	WHITE
PIN 5	CAN_LOW	BLUE
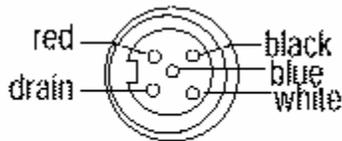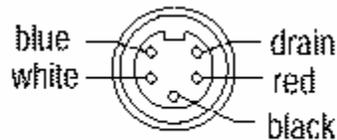
Micro QD Cable   **Mini QD Cable**

10-Pin Linear Plug (1787-PLUG10R)
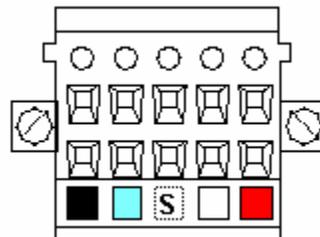
Black * Blue * Shield * White * Red
Recommended for daisy-chain network connections

DeviceNet Flat Media

Flat media connectors are available in Micro/Mini Quick Disconnect and Open Style. Flat Media helps speed up network installation as well eliminating wiring mistakes.
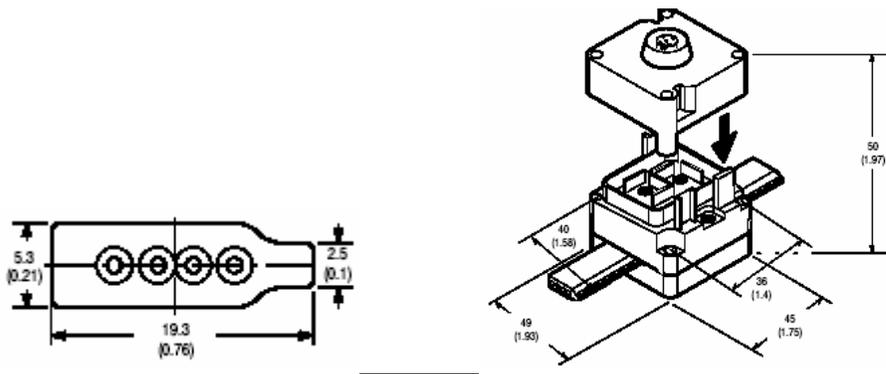
DeviceNet Scanner Status / Error Codes

The bicolor (GREEN/RED) module status indicator displays device status. It indicates whether the device has power and is functioning properly.

```
Indicator is                      Then                      Take this action
-----------------|------------------------------------------|----------------------|
Off              | There is no power applied to the device.  | Apply power.
                 |                                           |
Green            | The device is operating in normal condition.| Do nothing.
                 |                                           |
Flashing Green   | The device needs configuring.             | Configure the device.
                 |                                           |
Flashing Red     | There is an invalid configuration.        | Verify dip switch
                 |                                           | settings.
                 |                                           | Check configuration
                 |                                           | setup.
                 |                                           |
Red              | The device has an unrecoverable fault.    | Replace the module.
-----------------|------------------------------------------|----------------------|
```

The network status indicator is a bicolor (GREEN/RED) LED. The following table provides troubleshooting information about communication links.

```
Indicator is          Then                Which Indicates      Take this action
-------------|----------------------------|-------------------|----------------------|
Off          | The device has no power or  |  The channel is   |Power-up the scanner,
             | the channel is disabled for |   disabled for    |provide network power
             | communication due to bus off|    DeviceNet      |to channel, and make
             | condition, loss of network  |   communication   |sure channel is
             | power, or has been          |                   |enabled in both the
             | intentionally disabled.     |                   |scanner configuration
             |                             |                   |table and module command
             |                             |                   |word.
-------------|----------------------------|-------------------|----------------------|
Flashing     |The two-digit numeric display|  The channel is   |Configure scan list
Green        |for the channel indicates an |  enabled but no   |table for channel
             |error code that provides more| communication is  |to add devices
             |information about the        |    occurring      |
             |condition of the channel     |                   |
-------------|----------------------------|-------------------|----------------------|
Solid Green  |  There's normal operation   |All slave devices in|
             |                             |the scan list table |
             |                             |are communicating   |    Do Nothing
             |                             |normally with the   |
             |                             |scanner             |
-------------|----------------------------|-------------------|----------------------|
```

```
-------------|---------------------------|-------------------|----------------------|
Solid Red    |The communications channel |The scanner may be |Reset module. If      |
             |has failed.The two digit   |defective.         |failures continue,    |
             |numeric display for the    |                   |replace module.       |
             |channel displays an error  |                   |                      |
             |code that provides more    |                   |                      |
             |information about the      |                   |                      |
             |condition of the channel   |                   |                      |
-------------|---------------------------|-------------------|----------------------|
Flashing Red |The two-digit numeric display|At least one of the |Examine the failed   |
             |for the channel display an |slave devices in the|device and check the |
             |error code that provides more|scanner's scan list|scan list table       |
             |information about the      |table has failed to|for accuracy.         |
             |condition of the channel.  |communicate with the|                     |
             |                           |scanner.The network |                      |
             |                           |has faulted.       |                      |
-------------|---------------------------|-------------------|----------------------|
```

Your 1747/1771-SDN Scanner Module has a node address/status indicator that uses numeric
displays to indicate diagnostic information about your module. The display flashes at
approximately 1 second intervals, depending on network traffic. The following table
summarizes the meanings of the numeric codes.

```
 Numeric Code            Description                    Take this action
---------------|---------------------------------------|-----------------------------|
Network Address|Normal operation. The numeric display  |        Do nothing           |
   Displays    |matches the scanner's node address on the|                           |
   0 - 63      |DeviceNet network                      |                             |
---------------|---------------------------------------|-----------------------------|
               |Scanner failed Duplicate Node Address  |Change the scanner channel   |
     70        |check                                  |address to another available |
               |                                       |one. The node address you    |
               |                                       |selected is already in use on|
               |                                       |that channel.                |
---------------|---------------------------------------|-----------------------------|
               |Illegal data in scan list table        |Reconfigure scan list table  |
     71        |(node number alternately flashes).     |and remove any illegal data. |
               |                                       |                             |
---------------|---------------------------------------|-----------------------------|
               |Slave device stopped communicating     |Inspect the field devices and|
     72        |(node number alternately flashes).     |verify connections.          |
               |                                       |                             |
---------------|---------------------------------------|-----------------------------|
               |Device's identity information does not  |Verify that the correct device|
     73        |match electronic key in scan list table|is at this node number.      |
               |entry (node number alternately flashes).|Make sure that the device at |
               |                                       |the flashing node address    |
               |                                       |matches the desired electronic|
               |                                       |key (vendor, product code,   |
               |                                       |product type).               |
---------------|---------------------------------------|-----------------------------|
```

74	Data overrun on port detected.	Modify your configuration and check for invalid data. Check network communication traffic.
75	No network traffic at all has been detected.	Verify connections.
76	No direct network traffic for scanner detected.	None. The scanner hears other network communication.
77	Data size expected by the device does not match scan list entry (node number alternately flashes).	Reconfigure your module for the correct transmit and receive data sizes.
78	Slave device in scan list table does not exist (node number alternately flashes).	Add the device to the network, or delete the scan list entry for that device.
79	Scanners duplicate node check was not acknowledged or module failed to transmit a message.	Make sure that your module is connected to a valid network. Check for disconnected cables. Verify baud rate.
80	Scanner is in IDLE mode.	Enable RUN bit in SDN module command register. Put PLC/SLC in RUN mode.
81	Scanner is in FAULT mode.	Check ladder program for fault bits being set in SDN.
82	Error detected in sequence of fragmented I/O messages from device (node number alternately flashes).	Check scan list table entry for slave device to make sure that input and output data lengths are correct. Check slave device configuration.
83	Slave device is returning error responses when scanner attempts to communicate with it (node number alternately flashes).	Check accuracy of scan list table entry. Check slave device configuration. Slave device may be in another master's scan list. Reboot slave device.
84	Scanner is initializing the DeviceNet channel.	None. This code clears itself once scanner attempts to initialize all slave devices on the channel.

85	Data size larger than 255 bytes OR a run time data size error received.	Configure the device for a smaller data size. OR the slave has a variable connection size which AB scanners do not support.
86	Device is producing zero length data (idle state) while channel is in Run Mode.	Check device configuration and slave node status.
88	Shared inputs error also appears at power-up and reset, the module displays all 14 segments of the node address and status display LEDs.	Check connection of master to slave that is configured for shared inputs - it may be powered down or disconnected.
89	This is an ADR error. The Device does not support the Auto-Device Recovery or is not configured properly.	Check configuration or disable the ADR function for this device.
90	User has disabled communication port	Reconfigure your module. Check Module Command Register.
91	Bus-off condition detected on comm port. Scanner is detecting communication errors	Check DeviceNet connections and physical media integrity.Check system for failed slave devices or other possible sources of network interference.
92	No network power detected on comm port.	Provide network power. Make sure that scanner drop cable is providing network power to scanner comm port.
95	Application FLASH update in progress.	None. Do not disconnect the module while application FLASH is in progress. You will lose any existing data in the scanner's memory.
97	Scanner halted by user command.	Check ladder program for cause of fault bits.
98	Unrecoverable firmware failure.	Service or replace your module
99	Unrecoverable hardware failure.	Service or replace your module.

```
---------------|----------------------------------------|----------------------------|
               |                                        |                            |
    E2         | RAM Test Failure                       | Return/Replace module      |
               |                                        |                            |
-------------------------------------------------------------------------------------|
               |                                        |                            |
    E4         | Lost Power During FLASH Upgrade        | Return/Replace module      |
               |                                        |                            |
-------------------------------------------------------------------------------------|
               |                                        |                            |
    E5         | No Boot or Main Code                   | Return/Replace module      |
               |                                        |                            |
-------------------------------------------------------------------------------------|
               |                                        |                            |
    E9         | The 1747-SDN scanner has been flushed  | Cycle Power on SDN to recover
               | From the command register.             |                            |
               |                                        |                            |
-------------------------------------------------------------------------------------|
```

80%-90% of all network problems stem from miswiring, loose connections, opens or shorts during the wiring installation phase.

Rockwell Automation now offers the....
MediaChecker

Product Features

- Tests your installed network cable for **Shorts**
- Tests your installed network cable for **Opens**
- Displays distance to cable short
- Displays distance to cable open
- Determines if there are **split pairs** in twisted cables
- Identifies **miswiring** at connector end
- Displays conductors that are miswired
- Measures overall network cable **length**
- Measures network **termination** value (resistance)
- Multi **language** support

Supported Networks

- DeviceNet - Thick, Thin & KwikLink Flat Media
- ControlNet- RG6 Coax cable, DS3/4 cable (Tap)
- Ehternet- STP, UTP
- Data Highway +
- Remote I/O

To order your own MediaChecker
contact your local Rockwell Automation / Allen-Bradley
distributor or sales office and request
Catalog Number 1788-MCHKR