DeviceNet Troubleshooting Tips

How To Find Common DeviceNet Problems Fast With The DeviceNet Detective

How To Detect Opens & shorts in network wiring, faulty connectors or cable

Use the BUS DIAGNOSTIC menu to check power supply and CAN signal levels:

- You should see 24V DC (DeviceNet spec calls for 11-25V range) on the Power line
- You should see **CAN_H mean** ~3Vdc (rarely less than 2.5V)
- **CAN_L mean** should be ~2.1Vdc if the Network is active (rarely more than 2.5V).
- You should see the following RANGES:
- **CAN_H range**: ~2.2-3.8Vdc
- **CAN_L range**: ~1.4-2.8Vdc
- CAN_H should **never** be lower than CAN_L. If this condition occurs, you will see a warning that says "CAN wire twist!" and you should look for a direct physical cause.
- Typically if the *lowest value of CAN_L to the highest value of CAN_H* is more than 3 volts, this indicates a problem, either physically or with high bus traffic.

Use LED's to find out which nodes are OK

- The LEDs found on DeviceNet nodes are an excellent diagnostic tool for checking the health / status of your nodes.
- The "LED Color Codes" menu on the DeviceNet Detective REFERENCE menu helps you interpret the exact meaning of each LED state.

Create a "Live List" to see Which Nodes Are Communicating

- Scan the network using "Device Diagnostic" menu. This will give you a list of each properly connected node and its attributes.
- This will verify that all stations are connected, that MACID's are correct, and nodes are capable of communicating to the master.
- Look for "missing" nodes. This indicates physical connection or power problems for that node.

Power Distribution Problems

According to the DeviceNet specification, the network should supply 11Vdc minimum and 25Vdc maximum at each device. Likewise, devices should work properly with 11-25Vdc according to spec.

- To check that your network distributes power properly, plug in your Detective at various points along the trunk line (and drops) to ensure that, at each point, the voltage is within an acceptable range.
- We recommend building in a 'safety margin' – don't design your network so that Devices are close to the limits all the time.
- Remember that devices will consume more power when outputs are on, causing larger voltage drops at those times.
- In the "DETECTIVE SETTINGS" menu, set a supply alarm voltage below which you want warning. Plug the Detective in at locations far from the power supply and leave the detective running as your process runs over time. If the network voltage falls below this level at any time, this low voltage event will appear on the PROBLEM LIST.
- Note that "THIN" cable, which has a higher DC resistance, will have greater voltage drop across distance.

Common Mode Voltage

Intermittent problems can result out of Common Mode Voltage problems (V- potential is greater then CAN_H/L). In order to eliminate Common Mode Voltage as a problem in your system, connect the Detective at the following points in your Network:

- The two furthest ends (Terminator Position)
- At the DeviceNet Master(s)

- At each power supply

If you check the Supply Voltage on each point, the maximum difference between any two points should be >6 V.
If the difference is greater then 6 Volt, you will see measurements for CAN_H/L to be different then the expected 2V for CAN_L and 3V for CAN_H. Voltages can be going <0V or >4.8V. Even CAN errors might be shown at the nodes with the highest Common Mode Voltage.

In order to solve this problem you want to investigate to move the power supply more to the center of your network or add additional power supplies.

Notes on Multiple Power Supplies

You can design your network using one or more power supplies on the network to ensure that:

- The voltage drop in the cable between a power supply and each station it supplies does not exceed 5Vdc
- The current does not exceed the cable/connector ratings
- See to it that the power supply common ground voltage level does not vary by more than 5V between any two points in the network
- Once again, use the BUS DIAGNOSTIC menu to monitor network voltage at various points across the network.

Network Grounding

- Physically connect DC power supply ground wire and the shield together to earth ground at the location of the power supply.
- If you use multiple power supplies, connect this ground only at the power supply closest to the middle of the network
- Make sure that all nodes on the network connect to the shield, the signal and power lines

Application Note – DeviceNet Trouble Shooting

How to Detect Ground Loops

- Break the shield at a few points along the trunk line and insert a DC current meter
- If you detect current flow, the shield is connected to DC ground in more than one place, resulting in a ground loop.

Network Termination & Signal Wires

- DeviceNet requires two terminators, which should be installed at each end of the trunk line.
- The Detective does not specifically detect terminators, but you can detect them indirectly. CAN_H / CAN_L voltage swings which are greater or less than 3 volts are a good indication that you are missing terminators.
- If your network is not terminated, the CAN voltage ranges will be greater than 3 volts in some places on the network and less at others (standing waves on the line).
- Check the ranges and mean CAN_L (blue) and CAN_H (white) signals
- **CAN_H range**: ~2.2-3.8Vdc
- **CAN_L range**: ~1.4-2.8Vdc

Do You Have A Topology Problem?

- Drop Lines too long: If the total amount of drops exceeds the permitted length, you may see variations on CAN signal amplitude throughout the network.
- Trunk line too long: This will cause "transmission line problems" in which reflections in the network cause faulty reception of messages. You may see this as CAN frame errors.

Intermittent Problems: Look for patterns

- Do some nodes communicate properly while others do not? What differences are there between the functioning nodes and the others? (Proximity to the power supply, to the termination resistors, to the master scanner.)
- Faulty devices (are all of your Devices conformance tested by ODVA?)

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Application Note – DeviceNet Trouble Shooting

How to Detect Electrical Interference:

- The most common symptom of EMI/RFI problems are CAN FRAME ERRORS which you can find both in the MESSAGE TRAFFIC and PROBLEM LIST menus.
- You will see bursts of CAN frame errors, sometimes connected with specific nodes.
- Do intermittent problems occur when other, non-related equipment is in use?
- Use the PROBLEM LIST to track these problems over time, and correlate events with other equipment in your facility, i.e. EMI/RFI from a Variable Frequency Drive that changes state.

Duplicate Node Addresses (MACID's)

- If two of your nodes have the same address, the Detective will identify this problem when you SCAN the network. Using the information provided, identify which node you need to change the address for.

Wrong Baud Rates

- The network cannot communicate properly if some nodes have the wrong baud rate. The Detective will indicate that you have multiple baud rates on the network, but will not be able to resolve the problem beyond that point.
- The master should stay online and give an error code that indicates wrong baud rates.

Excessive Message Traffic

- An important indication is the "% BUS LOAD" field.
- 0% means that the network is idle.
- 10-90% indicates normal network operation, depending on the configuration of each device and the nature of your process.

Loads over 90% indicate problems. High bus loads can indicate any of the following:

- Some nodes are having difficulty making connections with other nodes and have to re-transmit repeatedly to get messages through. Check termination, bus length, topology, physical

connections, grounding.

- Defective nodes can "chatter" and put garbage on the network.
- Nodes supplied with corrupt or noisy power may chatter.
- Change Of State (COS) devices may be excessively busy with rapidly changing data and cause high % bus load.
- Large quantities of explicit messages (configuration and diagnostic data) being sent can cause high % bus load.
- Note that the DeviceNet Detective adds traffic of its own. Use the MESSAGE DELAY in the DETECTIVE SETTINGS menu to slow down this traffic if it is excessive while the Detective is scanning the network. Small numbers = fast scanning, large numbers (100ms or more) = slow scanning.

CAN ERROR RATE

- Use this field to see when the network is in a condition of creating constant CAN errors and when it is not. Cross-reference this to the PROBLEM LIST and MESSAGE TRAFFIC menu for a total picture of the problem.

TOTAL CAN ERRORS

- You may have a large accumulated number of CAN errors if you have been connecting and disconnecting nodes. However, if you are still accumulating CAN errors while nodes are connected normally, this indicates physical media, EMI/RFI or topology problems. This could also indicate faulty nodes.

MESSAGE TRAFFIC menu

- You should not normally see much Group 1 traffic on most nodes, unless you have Change of State devices on your network. You should see lots of Group 3 traffic from the master and group 2 traffic from slaves. You should only see Group 4 traffic if there is lots of configuration and diagnostic data being exchanged.

Application Note – DeviceNet Trouble Shooting

Valuable Data from the Scan List

- The Device Diagnostic menu gives detailed data on each node. If you suspect faulty nodes, check the firmware revision number with the manufacturer.

Limitation of the Problem List menu

- The PROBLEM LIST indicates nodes that have come on and off line, bursts of CAN errors, and blatant physical media problems such as shorts. It also indicates if network voltage has gone below the alarm threshold.
- The problem list will only log the 20 most recent network "events." It is not normally necessary to have a longer list than this because the 20 you have are a great place to start.
- If you have an overload of problems on this list, it indicates an immediate problem that needs to be solved right away, and that the network is not operable.

Changing MACID and BAUDRATE using the Detective

- Software settable devices can be changed with the Detective TASK WIZARDS menu. Note that you cannot use this menu when the bus is "live." The devices must be offline.

Master / Scanner Error Codes

- The Error Codes on a PLC scanner (i.e. SLC500) can be interpreted using this menu. These error codes are extremely useful in identifying specific configuration problems and states.

Detective Settings

- The Detective normally finds the lowest available MACID on the network and "eavesdrops" using this node number. If the number that was last used is available when connected, the Detective will stay with that number. You can change the Detective MACID if you wish, however.
- The Detective does not appear in the Master's scan list; it is neither a master nor a slave.

- You can change the SUPPLY ALARM setting to any value that helps you identify intermittent problems.
- "Secure" vs. "Insecure" scan mode: "Secure" prevents you from taking the network down by changing MACID or BAUDRATE while the bus is on.
- "Message Delay" inserts delays into the transmission of CAN messages from the Detective to slow down diagnostic traffic. This number should be greater than 50 or 100 ms in large, busy networks, but on small networks can be dialed down to the single digits. Too low of a setting can take down the network.