Bulletin No.: PIT5698C
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Preliminary Information

PIT5698C LIN Bus Diagnostic Information

Models

Brand:	Model:	Model Years:	VIN:		Engine:	Transmissions:
			from	to		
All	All	2013 - 2023	All	All	All	All

Involved Region or Country	North America
Condition	As more smart motors, switches, and sensors are being used there are more Local Interconnect Network (LIN) buses on vehicles. Because of this, some questions have raised regarding diagnosis of a LIN bus circuit. This document is intended to help better understand LIN buses and provide some diagnostics tips. Note: As always, follow normal SI diagnostics.

Correction:

LIN Bus Information

- The LIN bus consists of a single wire and is used to exchange information between one master control module (example ECM, BCM, etc.) and one or more smart device(s) such as switches, sensors, motors, etc.

- The LIN bus is relatively simple and it exchanges data at a slower rate than other GMLAN buses.

- LIN buses are not wired to the DLC, thus the scan tool does not communicate directly on a LIN bus. The scan tool will communicate with the master controller of the LIN bus, which is wired to the DLC (High, Low, Chassis, etc), in order to command outputs or read parameters from the smart device(s).

- If serial data communication is lost between any of the LIN devices on the LIN bus network, the master control module will set a no communication code against the non-communicating LIN device.

- Each component on a LIN network (master and any smart devices) will send out their own reference voltage which is 1 volt less than system voltage (throughout this document we will refer to this as "approximately 12 volts") and then toggle that reference voltage low when communicating, as shown below. Knowing that each device sends out its own reference voltage can be very useful when performing diagnostics. In some cases, this reference voltage is even present after the ignition is off and the vehicle has completely powered down, this is because many smart devices are only powered by a hot at all times circuit.

- Because the LIN bus voltage ranges between approximately 12 to 1 volt it is very important we have proper battery voltage while performing diagnostics. It is recommended to install the GR8 or equivalent battery tender on the vehicle while diagnosing a LIN bus, or false reading may be read.

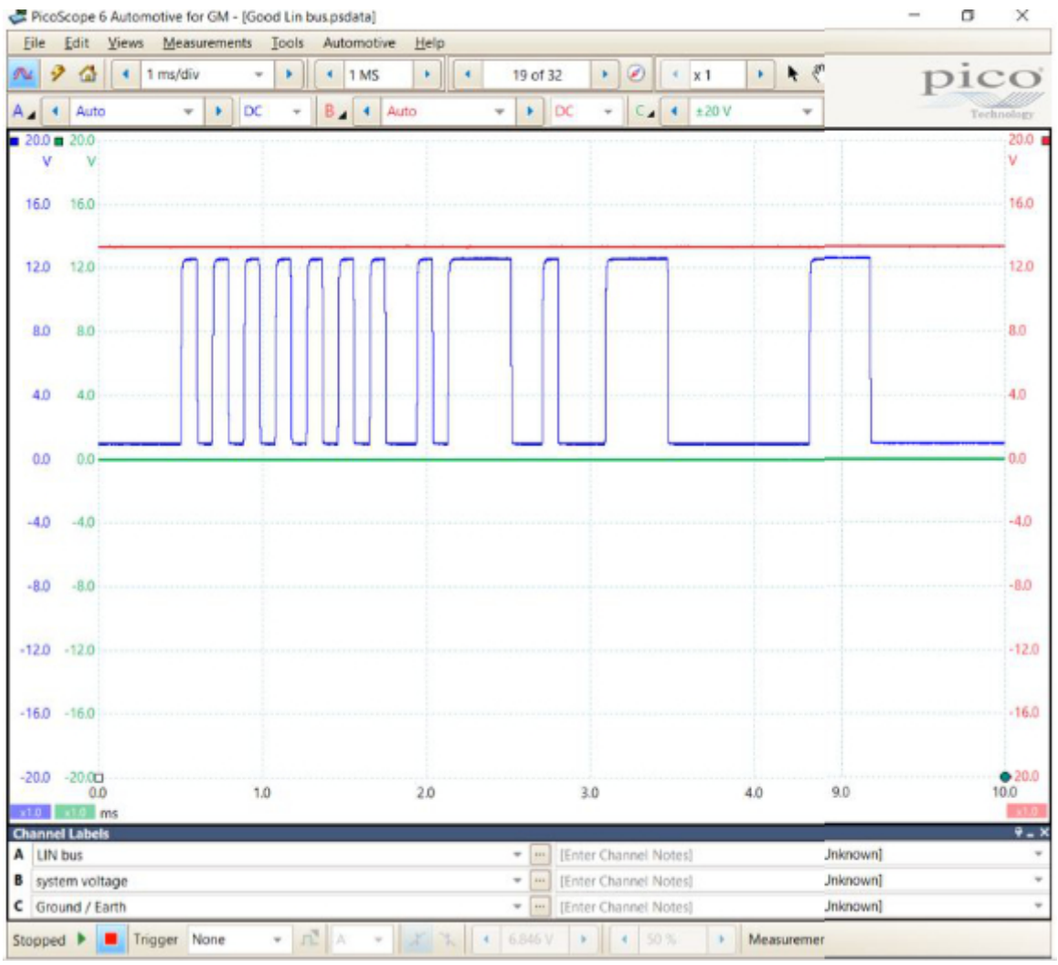
- When a LIN bus is at rest/not communicating it will read a steady voltage of approximately 12 volts.

- When monitoring a properly operating LIN bus with the Fluke 87 meter set to "peak" min/max (1 ms record), the reference voltage readings will be approximately 12 volts max and 1 volt min. If the meter is not set to the "peak" min/max setting, it will not capture the true min/max readings and typically read between 7 - 9 volts.

- In most cases, when the ignition is turned on, the master controller will wake up the smart device(s) via the LIN bus. If the smart device does not wake up, the master controller will set a DTC for that device and will continue to

try and wake up the smart device. This can be seen by the toggling voltage on the LIN bus.

- In some cases the smart device will wake up the master controller, an example of this is the driver's door ajar switch. The door ajar switch is hard-wired to the driver's window motor. The driver's window motor has a LIN bus to the BCM. When the driver's door is opened, the ajar switch closes, thus signaling to the driver's window motor to send a LIN message to the BCM. This wakes up the BCM and it communicates to the vehicle that the driver's door is open and the BCM will turn on the dome lights and start waking up the other modules.



For the example shown above three scope traces were used:

Red - System voltage
Blue - LIN Bus Voltage (properly operating LIN Bus)
Green - Ground

Note: The LIN Bus voltage never goes to fully system voltage or to ground. A properly operating LIN Bus voltage should be approximately 1 volt less than system voltage and 1 volt above ground, as shown.

Diagnostic Tip Information

Below are some diagnostic tips for the LIN bus circuit, in addition, the LIN bus schematic seen below will be used as an example in some of the tips. The following is not a flow chart, and as always, follow normal SI diagnostics.

- It is recommended to install the GR8 or equivalent battery tender on the vehicle while diagnosing a LIN bus or false readings may be obtained. Unlike other GMLAN buses which work at much lower voltages (example 0 to 5 or 1.5/2.5/3.5 volts) the LIN bus operates in a range from 1 to 12 volts, and having proper battery voltage is critical to get proper readings.

- Inspect for any DTC's.

- If a LIN bus has more than one smart device, check to see if the other devices are working. Using the example below, if the customer's complaint was that the rear wiper was not operating, check to see if the rear power windows operate. This can help to start narrowing down the area of concern.

- The LIN bus is a single wire and many faults are basic failures, such as, opens, high resistance, shorts to ground/power, poor terminal drag, connectors not fully seated. Using the proper terminal test probes inspect for these type of failures.

- Testing/monitoring the reference voltage of the LIN bus can help determine what type of failure to inspect for.

- Inspect for the reference voltage coming from the master controller: With the master controller connected, disconnect the smart device(s) and turn on the ignition. At the smart device(s), inspect for the toggling reference voltage coming from the master module of the LIN bus. Remember, if using a Fluke 87 meter set to "peak"

min/max (1 ms record), the voltages will be approximately 12 volts max and 1 volt min. If the voltage is fully system voltage and not toggling, it could indicate a short to power. If the voltage is not present, it could indicate an open or short to ground.

Note: Certain types of shorts on a LIN bus circuit can cause the module to shut down and stop outputting its reference 12 volts until the fault is no longer present and the ignition/power is cycled or DTC's are cleared.

- Inspect for the reference voltage from the smart device(s): With the smart device in question plugged in, disconnect the master controller and all other smart device(s) on the same LIN bus. At the master controller, inspect for the reference voltage coming from the smart device, which will be a steady 12 volts (approximately). There are a few things to keep in mind when testing the reference voltage from the slave devices:

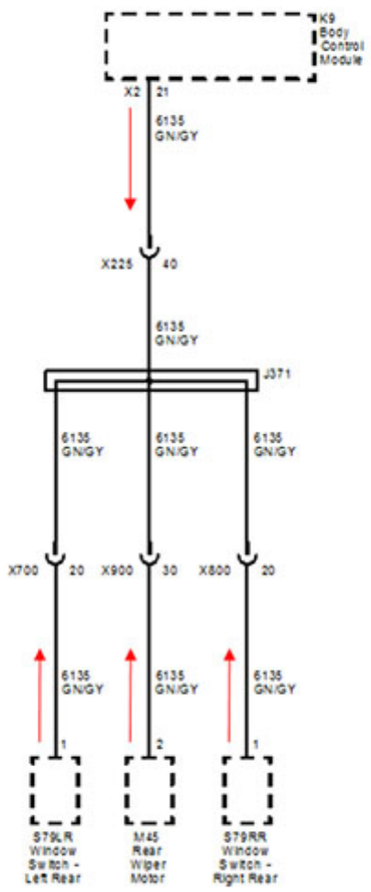
1. Most slave devices have a hot at all times feed and no switched ignition inputs. In these cases, the ignition does not need to be turned on to test for the reference voltage. Always check the wiring diagram for the smart device to determine if it has power at all times or if it has a switched ignition. If it has a switched ignition feed, when the master controller is unplugged the smart device may not be powered on. In these cases, the smart device will need to have power applied to the switched ignition input before testing.

2. When testing the LIN bus reference voltage from a smart device, which has a switched ignition, some devices will only output their steady 12 volts (approximately) for a few seconds and then it will drop to 0 volts. This is because the testing is done with the master controller disconnected and when the smart device does not establish communication from the master controller it will shut down its LIN bus reference voltage.

3. If there is more than one smart device, such as the example below, keep in mind that each smart device is sending out its own reference voltage. In these cases, the other smart devices will need to be disconnected along with the master controller before checking the reference voltage from that smart device in question.

If no voltage is found coming from the smart device, it could indicate poor terminal tension at the LIN bus terminal, the smart device was not powered on (missing power or ground), issue with the smart device itself, etc.

If the voltage is present check to make sure the correct part number smart device is installed. In many cases, the smart device part numbers change from year to year but they look similar.



Additional SI Keywords

U1343 U1345 U1346 U1347 U1348 U1349 U135D U135E U1501 U1502 U1505 U1509 U150E U150F U1510 U1511 U1512 U1513 U1514 U1515 U1516 U1517 U1518 U1519 U151A U151B U151C U151F U1520 U1521 U1522 U1523 U1524 U1525 U1526 U1528 U152A U152B U152C U152D U1531 U1530 U1532 U1534 U1538 U153A U1540 U1548 U1549 U154A U154B U1550 U1551 U1555 U1556 U1558 U1559 U155D U156D U15E1 U15F0 U15F1 U15F3 U2010 U2011 U2012 U2013 U2022 U2023 U250D

Version History

Version	4
Modified	07/23/2019 - Created on 07/23/2020 - Updated to add the 2021 models 07/21/2021 - Update model year and correction section 9/28/2022 - Updated to add the 2013 and 2023 model years

GENERAL MOTORS