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Controller Area Network (CAN)

GMLAN Overview

GMLAN is the General Motors variation of the CAN Bus. Although it is CAN based, there are enough proprietary features and functions to make this a unique protocol. GMLAN was introduced on the following models (only the first year of use is listed):

- 2003 – ION
- 2004 – Rendezvous, CTS, XLR, SRX, Malibu (new, not Classic)
- 2005 – LaCrosse, Rendezvous, Rainier, STS, Cobalt, Corvette, Equinox, SSR, some Trailblazer & Envoy, G6, GTO, Grand Prix, Saturn L-Series, VUE

Note: *Earlier Cadillac Catera & Saturn 3.0L V6 (Opel) applications used 2-wire CAN, generally connecting the PCM, EBCM, and TCM. On these applications, CAN was not ported to the DLC, but rather was converted to KW2000 for Scan Tool communications through Pin 7. These applications often had a Class 2 circuit to DLC Pin 2, but only for body systems communication. This early use of CAN was limited, and should not be confused with the Generic version of CAN or GMLAN. The following GMLAN articles do not apply to these limited applications.*

Multiple Protocol Vehicles

Many applications use more than one protocol for the operation of the wide variety of electronic control systems. Check the wiring diagrams to determine how a module in question is communicating. If a module is connected to more than one network, it's possible that the module is being used as a gateway to translate between protocols.

GMLAN Speeds

CAN terminology isn't very consistent, so when you hear speed or polarity terms, be sure you know what they are referring to. For example, a vehicle may have high and low speed GMLAN, but when the repair information refers to GMLAN High and GMLAN Low, they are referring to voltage polarity on the high speed GMLAN network. GMLAN High is the positive half of high speed GMLAN to DLC Pin 6. GMLAN Low is the negative half of high speed GMLAN to DLC Pin 14.

GMLAN supports up 3 different speed networks on the same vehicle. Using this standard allows Domestic vehicles to be produced using a much more flexible topology of modules and components. However, General Motors does not use standardized 'CAN A' (low-speed), 'CAN B' (mid-speed), and 'CAN C' (high-speed) labels.

Low-Speed – The low speed GMLAN protocol conforms to the ISO 11898 standard, and is used for transmitting and receiving within simple systems that only require 100-200 ms response times (i.e. power door locks). This is a single wire network that typically communicates at 33 kbps using a 0-5 Volt toggling signal. This circuit connects to the DLC at Pin 1.

Mid-Speed – The mid-speed GMLAN protocol is not currently used on any applications. If it is used in the future, it will very likely be used in entertainment and comfort systems. This is a single wire network that typically communicates at 95 kbps, and may be used for some entertainment and comfort systems in the future.

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GMLAN Speeds – Continued

High-Speed – The High speed GMLAN protocol conforms to the ISO 11519 standard, and is used wherever data needs to be sent and received nearly real-time. This includes ABS and traction control systems, and drive by wire applications. This network communicates at an astonishing 1 mbps (1000 kbps)!

The high-speed network (GMLAN High) uses 2 circuits (Bus + and Bus -) instead of the single circuit used on GMLAN Low. These circuits form a twisted pair, used to shield circuit from RF interference, since CAN is very sensitive to interference. These circuits are connected to the DLC at Pins 6 & 14.

Gateway Modules

GMLAN allows for 3 overlapping CAN Buses, but there are no vehicles in production that use all 3. The data on GMLAN High and GMLAN Low can be shared through a 'Gateway' module. A gateway is any module that includes functionality that allows it to translate between 2 or more different protocols.

For a Scan Tool to talk to these networks through the DLC, a special signal buffer must be used. The 'CANdi' module (a vehicle interface module) is used for the Tech 2 or the Vetronix Mastertech to be able to 'talk' CAN. Other Scan Tools have CAN interface modules and software as well. All CAN modules really slow down the data, but as new generations of CAN enabled Scan Tools are developed they are able to take advantage of the full speed of the data stream. If your Scan Tool can talk to a CAN vehicle without a specific interface box (like the CANdi module), then your tool was manufactured as 'CAN enabled'.

CAN Splice Packs

Like GM Class 2 networks, many High Speed GMLAN networks have centralized splice packs with removable combs. This helps you isolate the modules on the network for testing or programming. When you see a Splice Pack in a wiring diagram, check for a location or a connector view to see if it's a removable comb.

CAN Faults

GMLAN doesn't seem to be having the same high failure rates as Class 2. This is because most GMLAN variations use 2 wires for redundancy, and the protocol is less susceptible to having failed modules pull the circuits to ground (a very common Class 2 issue). However, all of the same connection issues are present for GMLAN:

- Loose connections & backed out connector terminals module and inline
- Harness rub-through on harnesses (especially under seats)
- Intermittent module operation due to loose grounds
- Partial shorts or opens due to green 'goo' that seems to grow in GM connectors

ATG TIP!
If GMLAN High (+) shorts to ground, or GMLAN Low (-) shorts to power, you won't be able to clear BCM codes until you disconnect the battery for a time to 'unlock' the module. No other modules seem to be affected like this. Codes can be cleared normally after GMLAN High (+) shorts to power or GMLAN Low (-) shorts to ground.

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Termination Resistors & Bias

High speed GMLAN uses two 120 Ohm termination resistors placed between GMLAN+ and GMLAN- circuits. One is usually located inside the PCM. The other is sometimes located inside another module, like the ABS module, but is most often a stand-alone resistor taped into the harness. The network can operate with one open resistor, but the signal will be less stable, and communication errors may occur.

To test the termination resistors, simply place the Ohmmeter leads across DLC terminals 6 & 14 with the key OFF.

- The Ohmmeter should read 60 Ohms if both resistors are OK (they are in parallel, so the total resistance is *less than* either resistor by itself).
- So if your Ohmmeter reads 120 Ohms, you have one open resistor.
- If your Ohmmeter reads infinity Ohms, you may have 2 open resistors, but it's much more likely that you don't have a good connection at the DLC.
- If your Ohmmeter reads 0 Ohms, the GMLAN +/- circuits are shorted together.

GMLAN Bias Voltage
The GMLAN circuits, like other manufacturer's CAN circuits, are biased to 2.5 Volts, with the Bus+ leg toggling from 2.5 Volts up to 3.5 Volts, and the Bus- leg toggling from 2.5 Volts down to 1.5 Volts.

GMLAN 'Wake-Up'

Class 2 networks have a Power Mode Master (PMM) that wakes the modules up when needed. This prevents battery rundown when they're not needed. GMLAN networks have a very different strategy involving a dedicated 12-Volt circuit connected to all GMLAN high modules.

When the ignition switch is in positions 'I' or 'II', the GMLAN equivalent of a PMM (usually the BCM) closes a switch and sends 12 Volts to the other modules telling them to wake up and get to work. In some cases, the BCM may also control a dedicated relay to tell other modules it's time to 'talk'. Look in the Wake Up Circuit wiring diagram to see if there is a Communications Enable Relay, and what modules it controls.

GMLAN Generic Usage

Although many manufacturers are using CAN for all or part of the vehicle networking needs, the EPA has implemented a plan to evolve the current OBD II protocols into a highly defined CAN protocol. This Generic conversion was completed in 2008 models, but some 2008 models still don't use the Enhanced version (GMLAN). The PCM starts talking in CAN Generic when the Scan Tool sends the proper request.

Expected CAN Activity

High Speed:
2.34 Volts average on GMLAN Low, and 2.66 Volts average on GMLAN High. The average difference between GMLAN Low and GMLAN High is 375 mV.

Low Speed
2.5 Volt average at 1-2 kHz, depending on the number of modules on the network and various accessory states.

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High Speed GMLAN Lab Scope Tests

The Lab Scope can be used to verify that the CAN circuits have activity with the Key ON, Engine OFF or running. Channel 1 (top trace) shows GMLAN High (+) from DLC Pin 6. Channel 2 (bottom trace) shows GMLAN Low (-) from DLC Pin 14.

You should back probe the connector or a DLC breakout box to avoid pin damage, and to allow simultaneously test with a Scan Tool connected. Better yet, use a DLC breakout box.

Note: *The CAN circuits are 'talking' whether the Scan Tool is connected or not, so there are no special test conditions. These circuits should show activity whenever the key is ON.*

The GMLAN (+) and GMLAN (-) circuits are opposite in polarity, so the traces should look exactly opposite. The only real difference in the signals is that they toggle in opposite directions from the baseline voltage (2.5 Volts).

These are very complex signals, and can cycle as fast as 100 kHz (100,000 cycles per second!). There is no way to know exactly what the signal should look like because the variations mean something to the sending and receiving modules.

Both the high (Pin 6) and low (Pin 14) circuits have a 2.5-Volt baseline. The Pin 6 trace shows the signal ring from 2.5 to 3.5 Volts to 'talk', and the Pin 14 trace shows an exact mirror image of the signal (dropping from 2.5 to 1.5 Volts to talk).

The second example shows the same signals, but at a faster time setting. At this sampling speed the signal doesn't look very clean. This example was included just to show that this waveform texture is normal at this setting (the screen is only 1/5th of a millisecond!).
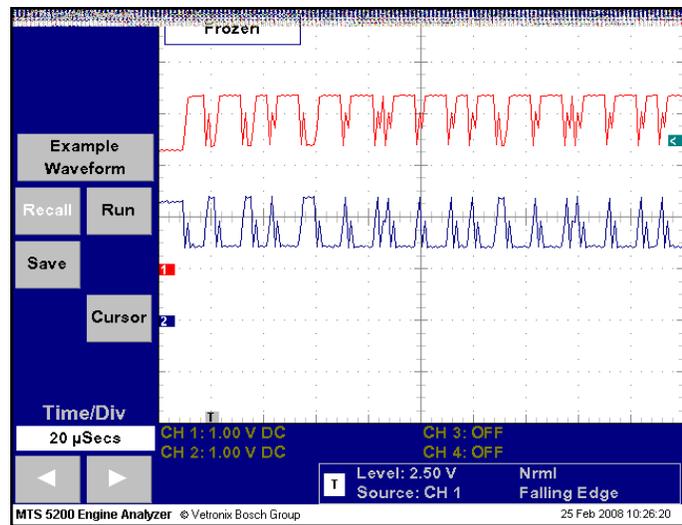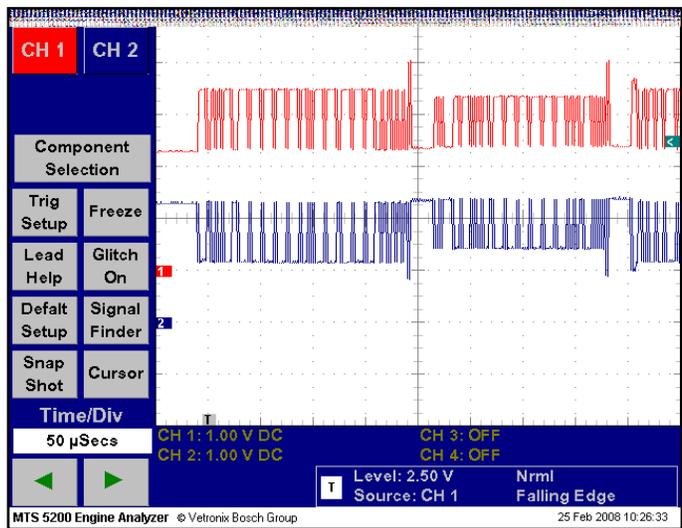
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High Speed GMLAN Lab Scope Tests – Continued

The capture below shows GMLAN activity with a Tech 2 connected, but turned OFF. The signals are cycling beyond the 0-1 Volt range up or down from the bias, but still somewhat normal. The bias, however, is not normal for high speed CAN systems. High speed CAN (including GMLAN), normally uses a 2.5 Volt bias. That's the case here too, until the Tech 2 was connected. Even though the Scan Tool is OFF, the bias is pulled down to 2 Volts. This doesn't occur on all applications, but you should be aware that it may be normal.

ATS EScope GMLAN Waveforms – Tech 2 Connected but OFF
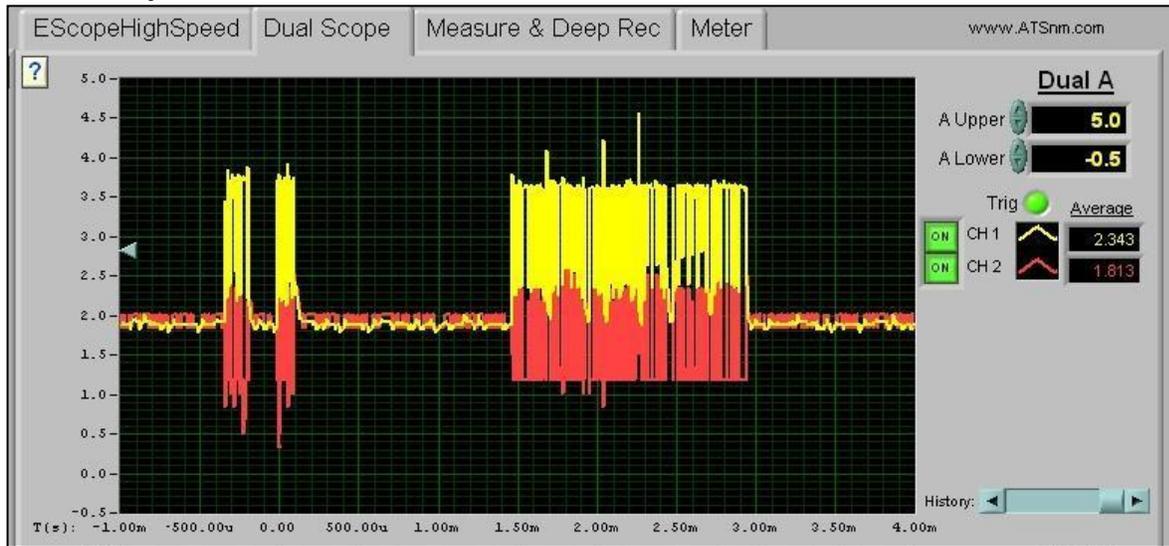
The next capture shows the GMLAN activity with the Scan Tool communicating with the CAN modules. Note that the bias is now closer to 3.5 Volts. You won't see these results for other manufacturers, so it's important to know that it is normal for *some* GM applications.

ATS EScope GMLAN Waveforms – Tech 2 Connected & Talking