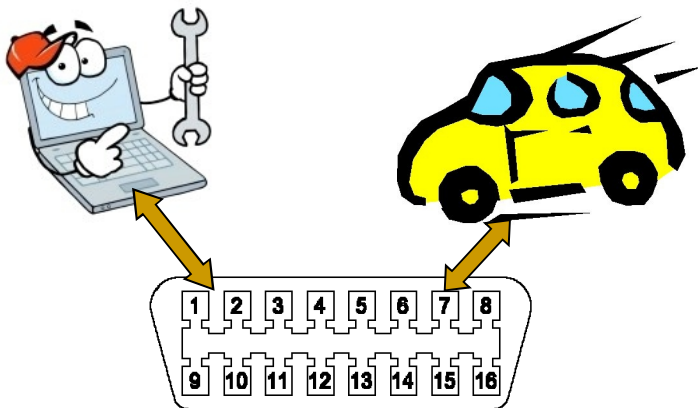


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# Vehicle CAN-bus Scan Tool Development

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Abhishek Bhat  
July 1<sup>st</sup> 2011



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# Content

- **Introduction of the speaker**
- Vehicle Diagnostic Systems
- Development of the Scan Tool
- Example of operation

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# Introduction

- Educational Background
    - University of Michigan, Ann Arbor
      - Masters in Mechanical Engineering
    - University of Pune, India
      - Bachelors in Mechanical Engineering
  
  - Professional Experience
    - MBtech NA LLC
      - Simulation Engineer at Chrysler Group LLC
      - Hardware in Loop Test Engineer at Daimler Trucks NA
    - Mercedes Benz India Pvt. Ltd
      - Diagnostics and Rectification Engineer on Assembly Line
  
  - Personal Projects
    - Development of CAN based Scan Tools
    - Voice Activated vehicle control via mobile interface
    - Augmented Vision display over the windscreen
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# Introduction to Vehicle Diagnostic Systems

- On-Board Diagnostics, or OBD, in an automotive context, is a generic term referring to a vehicle's self-diagnostic and reporting capability.<sup>1</sup>
- The current OBD-II specification was made mandatory for all cars sold in the United States since 1996.
- The OBD-II standard specifies the type of diagnostic connector (J1962 connector) and its pin out, the electrical signaling protocols available, and the messaging format.
- As a result of this standardization, a single device can query the on-board computer(s) in any vehicle – The Off Board Diagnostic Scan Tool

References: 1 – Wikipedia

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# J1962 Connector

- Manufacturers had the freedom to choose the necessary protocol
  - Pin Diagram of OBD 2 Connector <sup>1</sup>

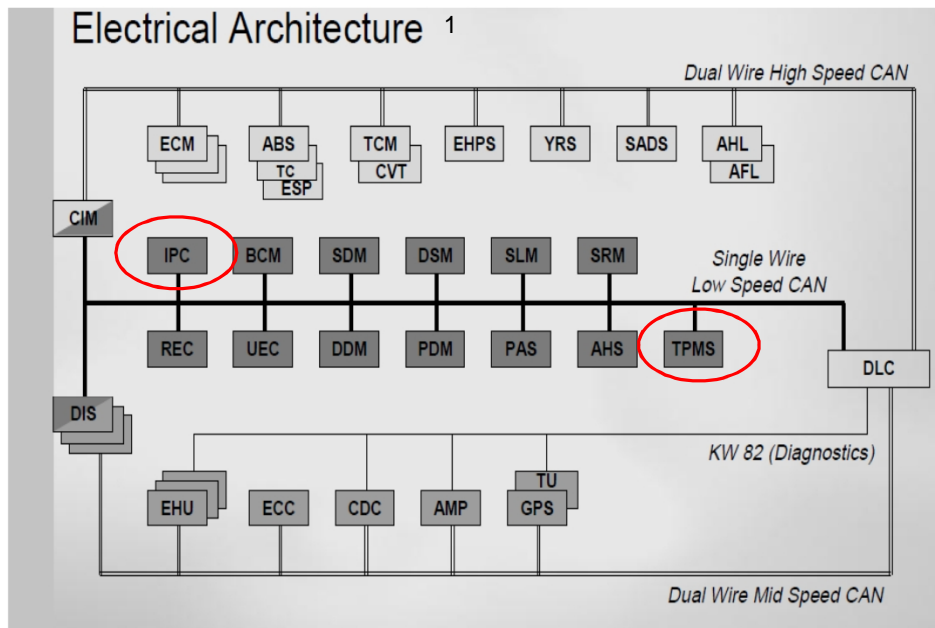
1. Manufacturer discretion. GM: J2411 GMLAN/SWC/Single-Wire CAN.	9. -
2. Bus positive Line of SAE-J1850 PWM and SAE-1850 VPW	10. Bus negative Line of SAE-J1850 PWM only (not SAE-1850 VPW)
3. Ford DCL(+) Argentina, Brazil (pre OBD-II) 1997-2000, USA, Europe, etc. Chrysler CCD Bus(+)	11. Ford DCL(-) Argentina, Brazil (pre OBD-II) 1997-2000, USA, Europe, etc. Chrysler CCD Bus(-)
4. Chassis ground	12. -
5. Signal ground	13. -
6. CAN high (ISO 15765-4 and SAE-J2284)	14. CAN low (ISO 15765-4 and SAE-J2284)
7. K line of ISO 9141-2 and ISO 14230-4	15. L line of ISO 9141-2 and ISO 14230-4
8. -	16. Battery voltage

J1962 Connector



References: 1 – Wikipedia

# GMLAN Vehicle Architecture



- GM SWCAN works on a 29 bit identifier
- The data transmission rate is 33.33 kBaud
- On the OBD diagnostic port, the SWCAN can be accessed on pin 1 of the J1962 connector

References: 1 – Dr. Thomas ITDC-PE Electronics, VehicleDiagnostics.ppt, 25-Sep-02

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# System Components



- Wireless scan tool
  - Works for all OBD-2 protocols
  - Based on ELM 327 chip <sup>1</sup>

- Modified J1962 cable <sup>2</sup>
  - Modified to connect the Pin 1 (SWCAN) to the ELM chip.



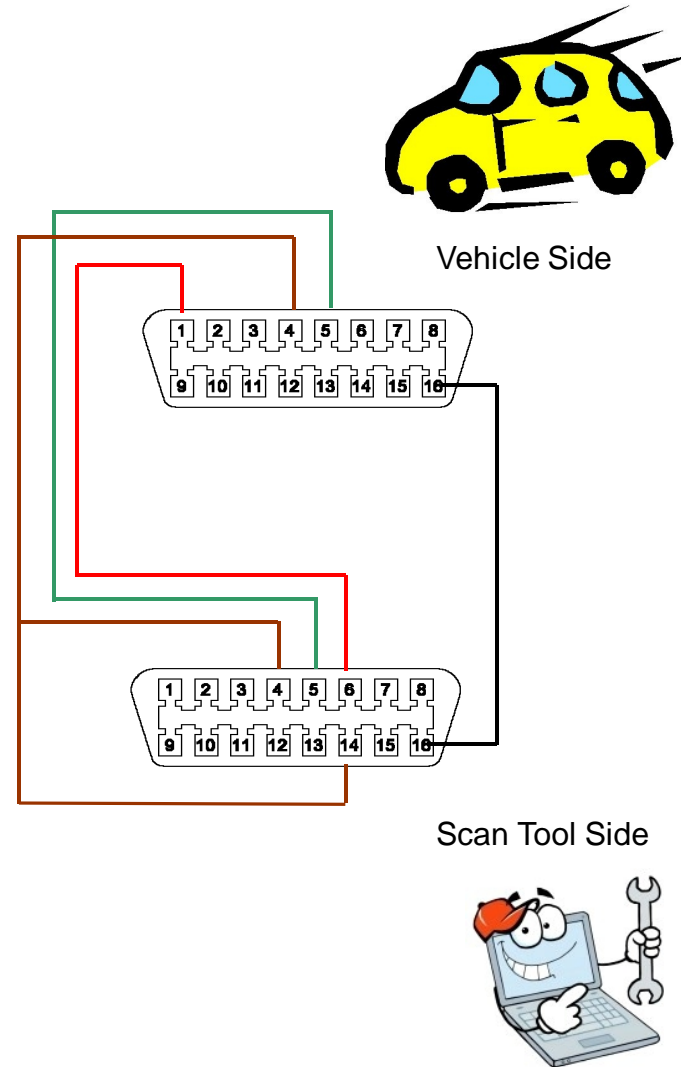
- Computer interface
  - Uses Hyperterminal for Serial Communication

References: 1 – [www.elmelectronics.com/DSheets/ELM327DS.pdf](http://www.elmelectronics.com/DSheets/ELM327DS.pdf)

2 – [www.obd2cables.com](http://www.obd2cables.com)

# Wiring Modification

Vehicle End	Scantool End	Comments
MALE	FEMALE	
1	6	GMLAN to CAN_HIGH
4	4,14	CAN_LOW is tied to the chassis ground. Short pins 4 and 14 on the scan tool side. This is because the SWCAN works on 0 to 5 V range while dual wire CAN works on 1.5V to 3.5 V.
5	5	Signal Ground
16	16	+ve Battery voltage
		** IMPORTANT : Thus the Pin 14 on vehicle is not connected to the scantool. DON'T short the pin 4 and 14 on the vehicle side!



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# Scan Tool Initialization

- Start HyperTerminal to initiate the serial communication with the scantool.
  - Set the COM Port Settings as (115200,8,N,1,none)
  - This will initiate the communication of the laptop with the scantool
- Configure the scan tool to start accessing the CAN bus :
  - AT PP 2c SV 41 (*receive and transmit 29 bit header can messages on ISO 15765-4*)
  - AT PP 2d SV 0F (*set baud rate divisor accordingly to support 33.3kbps*)
  - AT PP 2c ON (*enable the Protocol*)
  - AT PP 2D ON (*enable baud rate setting*)
  - ATZ (*reset the ELM327 for changes to take effect*)
  - ATSP B (*manually set protocol to USER1 - user-defined*)
  - ATH1 (*display headers*)
  - AT CAF 0 (*turn on CAN auto-formatting*)
- Now that the scantool has been configured correctly, the required CAN messages can be accessed
- Vehicle Tested on : 2010 Chevrolet Impala

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# Example 1 : Vehicle Odometer Reading

- Setting scan tool
  - Set filter for specific CAN message
    - AT CF 10 04 E0 60
  - Set the mask for the CAN message
    - AT CM 1F FF FF FF – (Ensures exact message is filtered)
  - Start scanning the CAN bus for the message to be transmitted on the bus
    - AT MA
  
- Response – (in SI Unit - kilometer)
  - The response message is received at every kilometer counter
    - Received Message: 10 04 E0 60 00 01 63 80 00
  - Conversion Formula: (0 -31 bit ) / 64 in km
    - (&h00016380 => 91008)/ 64 = 1422 km

# Example 2 : Tire Pressure Values

- Setting scan tool
  - Set filter for specific CAN message
    - AT CF 10 00 A0 B0
  - Set the mask for the CAN message
    - AT CM 1F FF FF FF – (Ensures exact message is filtered)
  - Start scanning the CAN bus for the message to be transmitted on the bus
    - AT MA
  
- Response – (in SI units - kPa)
  - The response message is received every mile
    - Received Message 10 0 A0 B0 24 24 39 39 3A 38 02 FF
  - Conversion Formula :
    - Pressure FL - Byte 3 \*4 = (&h39 =>57)\*4 = 228 kPa
    - Pressure FR - Byte 4 \*4 = (&h39 =>57)\*4 = 228 kPa
    - Pressure RR - Byte 5 \*4 = (&h3A =>58)\*4 = 232 kPa
    - Pressure RL - Byte 6 \*4 = (&h38 =>56)\*4 = 224 kPa

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*Thank you!*

*Questions and Queries?*

# In car Testing





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# Limitations of Generic Scan Tools

- GM Single Wire CAN-bus (SWCAN) is not federally mandated to be made available via generic scan tool
- GM Specific scantool ( eg. Scan XL) is expensive and doesn't give access to the data except read out on the screen.
- In order to access the TPMS (tire pressure) and Instrument Cluster (odometer reading), standard scan tool needs to be modified to access the low speed canbus (SWCAN)