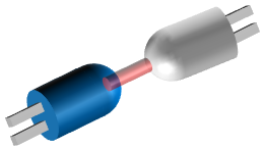
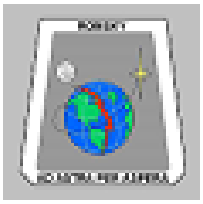


Speed Detect 1 Beam User's Manual

V1.0.0

11 January 2016



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Revision History

Version	Date	Name	Description
1.0.0	11 JAN 2016	P. Romsky	Initial Release

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List of Equations

This document has no equations at this time

1 Overview

The Speed Detect 1 Beam is a suite of hardware, firmware and software components that can be used in O-Gauge model trains to determine the scale speed of the train, the number of cars, and the number of axels on the train. This document provides details on how to install software on a Personal Computer (PC), build railway Detectors, and how to operate the Graphical User Interface (GUI). Section 5 contains a Parts List for all of the major components needed to set-up Speed Detect 1 Beam.

1.1 Electro-Static Discharge

This section provides information on Electro-Static Discharge concerns.

WARNING

Handle the Parallax BOE Prototype Board (Adapter) and
the IR LEDs (Detector) only at a Static Free workstation

The components used on the Adapter and Detector are susceptible to Electro-Static Discharge (ESD) and can be damaged by simple handling. Mild static energy (even seemingly undetectable) can damage these components. The BS2 microcontroller (chip) on the Adapter is a CMOS device and is especially susceptible to ESD damage. Static electricity discharge through the Detector can damage the BOE Adapter if the two are connected. If a Static Free workstation is not available, periodically touch ground to bleed off static electricity when handling. A low cost Static Free workstation can be made from an ESD wrist strap and small conductive mat (available from Digi-Key www.digikey.com) that is tied to a good earth ground.

2 Setup

This section provides details on the setup of the Speed Detect 1 Beam GUI and the Parallax Board Of Education (BOE) Prototyping Board (Adapter). The following sections include: Install Software, Connect the Adapter, and Configure the COM Port.

2.1 Install Software

This section provides instructions on installing the software required for Speed Detect 1 Beam.

2.1.1 Download the Speed Detect 1 Beam Distribution Software Kit

The Speed Detect 1 Beam software is available for free from the following website:

http://www.paul.romsky.com/index_model_trains.htm

Download this .zip archive (compressed folder) to a Personal Computer (PC) and unzip its contents in order to install the distribution software kit.

2.1.2 Install Speed Detect 1 Beam GUI

After downloading and unzipping (uncompressing) the distribution software kit, traverse to …/**cvidistkit.Speed_Detect_1_Beam/Volume** and double click on **setup.exe**

Press the **Next** button at each prompt, and answer '**Yes'** to any questions until the software is installed.

After the software installation is complete, you must **reboot** your Personal Computer (PC). You will be prompted when to do so.

After rebooting, **Speed Detect 1 Beam** should be found in your **Windows Start** menu under **All Programs.**

2.1.3 Install Parallax USB to Serial Driver

Perform the following to install the Parallax USB to Serial Driver on a Personal Computer (PC):

1. Plug the USB Cable into the Parallax BOE Prototyping Board (Adapter).
2. Plug the other end of the USB Cable into a USB port on the PC.
3. Wait for the pop-up message on the PC that your device is ready to use.

4. See Section 2.2.1 to connect the Power Supply to the Adapter.
5. Set the Adapter board **Power** Switch **On** (1 Position).

2.1.4 Install the Adapter Firmware on the BS2

Insure that Sections 2.1.1 through 2.1.3 above have been completed before performing this step.

Depending on your PC, the Speed Detect 1 Beam software will be installed in one of the two following locations:

C:\Program Files\Speed_Detect_1_Beam

or

C:\Program Files (x86) Speed_Detect_1_Beam

Traverse to the appropriate directory and double click on **Speed_Detect_1_Beam_BS2_Download.exe**

This will launch the BS2 installer GUI. Press **Download** in the GUI to install the BS2 program (firmware) on the Adapter. This should take only about 5 seconds to complete.

The B2S will store this firmware in on-board non-volatile memory which will retain the program even after power is removed from the Adapter, therefore, this installation needs to be done only once (or only when updates to the Firmware are required).

NOTICE

The BS2 (which is on the Adapter) has internal on-board non-volatile memory (similar to that found in USB Memory Sticks) that can be programmed for about 10,000 times before it "wears-out". **DO NOT** install the firmware every time you use the Adapter - do so only when needed. Even if updates were provided once a week (which is not likely) the BS2 non-volatile memory will accept new updates for over 200 years before it wears-out. Once programmed, the BS2 should retain this memory for at least 20 years before it "fades". Therefore, re-programming the memory (with the same firmware) once every few years is a sound habit to develop to insure the memory stays "fresh".

2.2 Connect the Adapter

This section provides instructions on connecting the Adapter (Parallax BOE Prototyping Board) to the Detector and to the Personal Computer (PC). The Adapter, with USB Cable and Power Supply is shown in Figure 1.

Figure 1 – Parallax BOE Prototyping Board (Adapter)

2.2.1 Connect the 9VDC Power Supply to Adapter

Perform the following to connect power to the Adapter.

1. Insure that the Adapter board **Power** Switch **Off** (0 Position) at this time.
2. Plug the **Ring/Tip** end of the **9VDC Power Supply** cable into the Power Jack on the Adapter.
3. Plug the **Power Supply** into a **mains** power receptacle.
4. Keep the Adapter board **Power** Switch **Off** (0 Position) at this time.

2.2.2 Connect Adapter to PC

Perform the following to connect the Parallax BOE Prototyping Board (Adapter) to the PC:

1. Connect the **USB Cable** from the Adapter to an unused **USB Port** on the PC.
2. Insure that the USB connector is properly connected and **fully seated** into the USB Port.

2.2.3 Connect Adapter to Detector

See Section 2 for details on making an Infra-Red (IR) Detector in order to complete this step.

WARNING

Never plug a wire into any "VIN" point on the Adapter. This will damage the relatively expensive BS2 chip or the Detector's LEDs. It is highly recommended that black electrical tape be placed over **all** VIN points on the Adapter to prevent inadvertent connections to that damaging voltage (see Figure 2)

Perform the following to connect the desired Detector to the Parallax BOE Prototyping Board (Adapter):

1. Insure that the Adapter board **Power** Switch is **Off** (0 Position)

2. Connect the Detector Black wire to a VSS point on the Adapter
3. Connect the Detector Red wire to a VDD point on the Adapter
4. Connect the Detector White wire to a P15 point on the Adapter
5. Connect the Detector Green wire to a P14 point on the Adapter (wire is for future use)
5. Set the Adapter board **Power** Switch to **On** (1 Position)

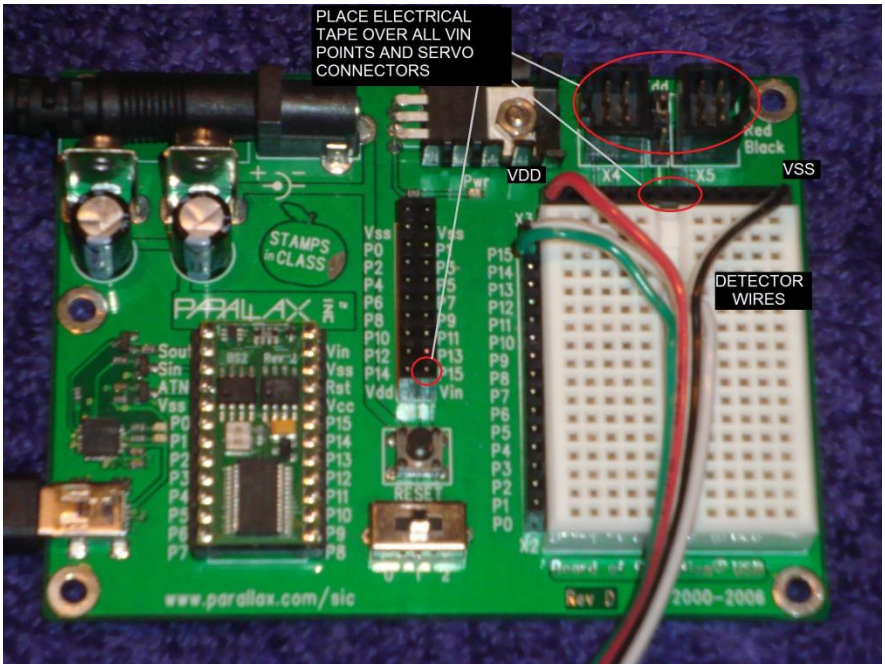

Figure 2 – Detector Wire Connections to Adapter

2.3 Configure the COM Port

This section provides instructions to determine which COM Port the USB Driver selected during installation.

2.3.1 Determine COM Port

Use the PC Control Panel, Device Manager and see which COM Port appears and disappears when the Adapter is inserted and removed from the USB Port. Make a note of this COM Port number, it will be used in Section 4.1.2.

3 Detectors

This section provides details on building the various Detectors for use with the Speed Detect 1 Beam GUI and Adapter. The following sections include: Cross Track Detector, and Through Rail Detector.

3.1 Cross Track Detector

The Cross Track detector can be used to measure speed and count cars (including the locomotive). This detector uses a simple trestle with vertical up-rights on either side of the track. A IR Source LED and IR Detector LED pair are mounted in the up-rights (one on each side). When a locomotive or car breaks the beam, the Adapter measures the time of this break and sends information to the GUI via the USB cable. The GUI then processes this data and displays the result. An example of a Cross Track Detector is shown in Figure 3 below. This adapter has the LEDs at the perfect height for most trains that are expected to pass through it. One option would be to offset the LEDs; that is, install one LED lower on one

side and the other LED higher on the other. This will give a vertically diagonal beam that should detect most any locomotive/car.

Details on building a Cross Track detector can be found in the installation directory (see Section 2.1.4) in the file: Speed_Detect_1_Beam.pdf

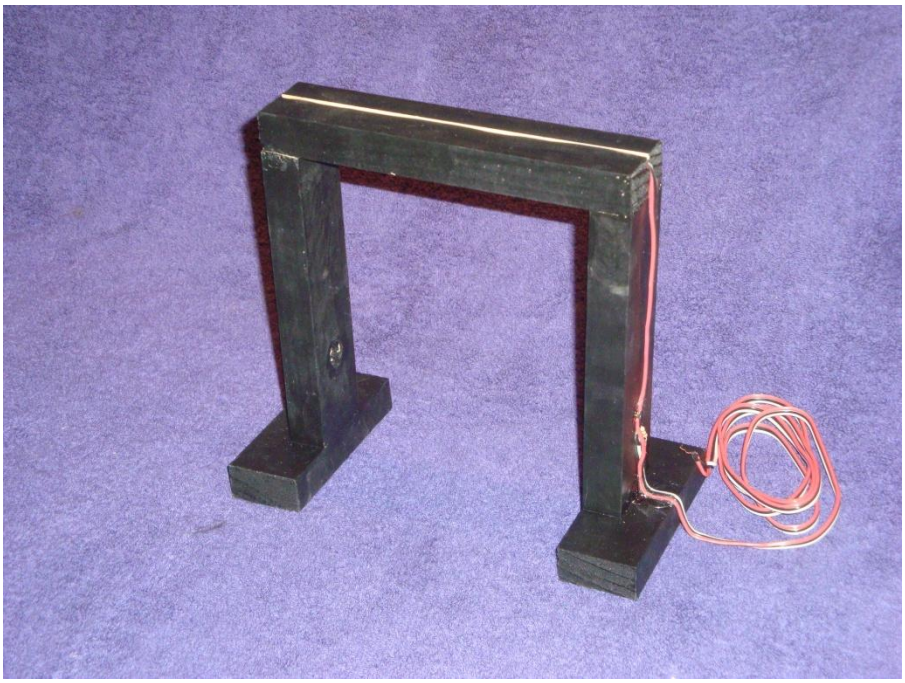

Figure 3 – Cross Track Detector

3.2 Through Rail Detector

The Through Rail detector can be used to measure speed and count axels (including the locomotive). This detector uses a simple IR Source LED and IR Detector LED pair that are mounted in the track (on the inner and outer side of one of the outer rails) – a hole is drilled through the rail so that a Wheel Flange breaks the beam as it passes. When a locomotive or car wheel breaks the beam, the Adapter measures the time of this break and sends information to the GUI via the USB cable. The GUI then processes this data and displays the result. An example of a Through Rail Detector is shown in Figure 4 below.

Details on building a Through Rail detector can be found in the installation directory (see Section 2.1.4) in the file: Speed_Detect_1_Beam.pdf

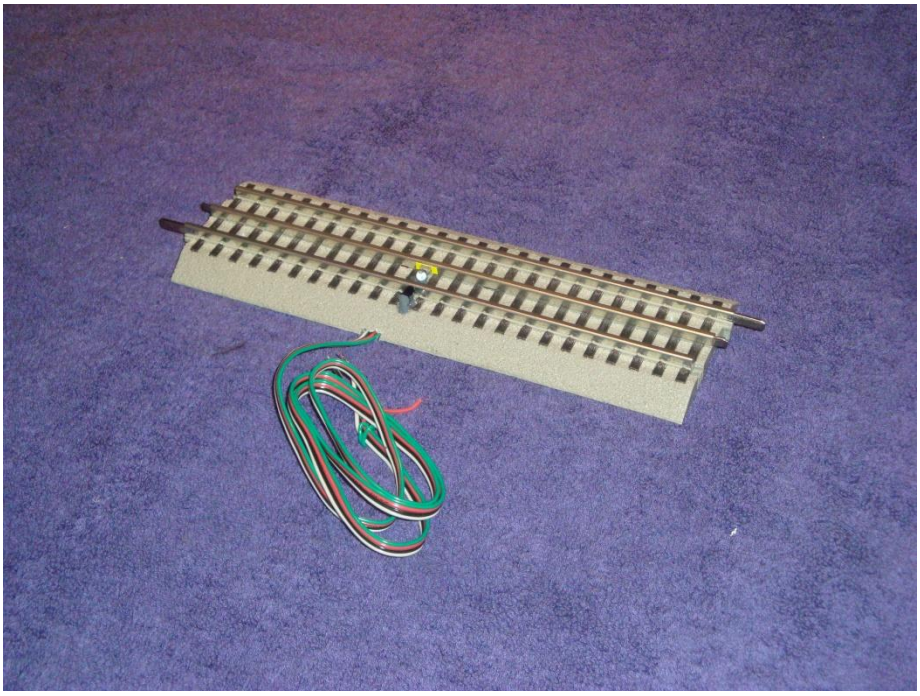

Figure 4 – Through Rail Detector

4 Operation

This section details the operation of the Speed Detect 1 Beam Detectors, Adapter, and Software.

4.1 The Speed Detect 1 Beam GUI

This section provides instructions to operate the Speed Detect 1 Beam Graphical user Interface (GUI).

Note: The Adapter will not update to any changes to the following fields until the **Set** button is pressed (see Section 4.1.13).

4.1.1 Launching the GUI

From the Windows Start Menu, select: **Start -> All Programs -> Speed Detect 1 Beam.**

The GUI should display (see Figure 5).

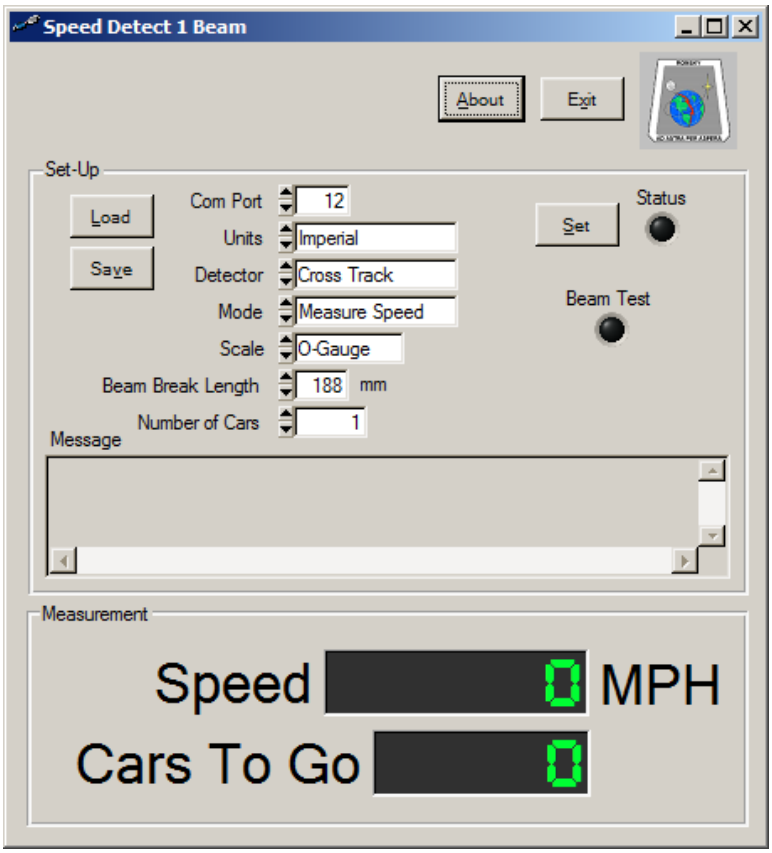

Figure 5 – Speed Detect 1 Beam GUI Main Screen

4.1.2 Select Com Port

Enter the COM Port number that was determined in Section 2.3 in the **Com Port** field.

4.1.3 Select Units

Select either **Imperial** (US) or **Metric** in the **Units** field.

Imperial will display speed in Miles per Hour (MPH), Metric will display speed in Kilometers per Hour (Km/h)

4.1.4 Select Detector

Select which detector is connected to the Adapter (**Cross Track** or **Through Rail**) in the **Detector** field.

See Section 3 for details on the various Detectors that may be used.

The **Undercarriage Reflect** Detector is not yet supported – do not select this Detector.

4.1.5 Measure Speed

To measure the speed of the train, select **Measure Speed** in the **Mode** field.

4.1.6 Count Cars

To count train cars (including the locomotive), the **Detector** field must be set to **Cross Track** and a Cross Track detector must be used.

Then select **Count Cars** in the **Mode** field.

4.1.7 Count Axels

To count train axels, the **Detector** field must be set to **Through Rail** and a Through Rail detector must be used.

Then select **Count Axels** in the **Mode** field.

4.1.8 Beam Test

To test the Detector's IR Beam, select **Beam Test** in the **Mode** field.

In Beam Test Mode, the Beam State LED on the GUI will go Green when the beam is unbroken, and will go Yellow when the beam is broken.

This is helpful to confirm that the IR LEDs in the Detector are working and are properly aligned, and may be used to determine Beam Break Lengths of Wheels, Locomotives, and Cars (see Section 4.1.10).

4.1.9 Select Scale

Currently, only O-Gauge can be selected in the **Scale** field.

4.1.10 Enter Beam Break Length

The Beam Break Length is always entered in millimeters (mm) regardless of which units are selected in the **Units** field.

If a Cross Track Detector is used, enter the length of the leading car/locomotive. Measure the length from where the beam will be broken (a typical locomotive is about 300 mm).

If a Through Rail Detector is used, enter the length that the leading car/locomotive lead wheel will travel to break the beam (typically 8 mm).

The Beam Break Length can be determined by entering Beam Test Mode (see Section 4.1.8), then sliding the desired locomotive/car along the rail until the beam just breaks (the Beam Test LED in the GUI goes Yellow). Then mark that wheel's tangent spot on the rail (where the wheel touches the rail). Then, slide the locomotive/car further along the track until the beam is just no longer broken (the Beam Test LED in the GUI goes Green). Again, mark this spot (from the same wheel) on the rail. With a metric ruler (or metric micrometer), measure the distance of the two marks on the rail (in mm). This is Beam Break Length.

4.1.11 Enter Number of Cars

If a Cross Track detector is used, the Number of Cars field will be displayed. Enter the number of cars in the train (including locomotive) in the **Number of Cars** field. This is required because each car in the train has a different length from the leading car (usually the locomotive) and the Speed Detect 1 Beam GUI needs to skip past the trailing cars before making its next measurement (the lead car/locomotive). If 1 is entered and the train consists of more than a locomotive alone, the speed reading will be inaccurate.

4.1.12 Enter Number of Axels

If a Through Rail detector is used, the Number of Axels field will be displayed. Enter the number of axels in the train (including locomotive) in the **Number of Axels** field. This is required because each locomotive/car in the train may have a different wheel diameters and the Speed Detect 1 Beam GUI needs to skip past the remaining wheels before making its next measurement (the lead car/locomotive). If 1 is entered and the train has various size wheels, the speed reading will be inaccurate.

4.1.13 Configure the Adapter to Latest Settings

After all settings are made in the desired fields, press the **Set** button to send the settings to the Adapter.

Note: Set **must** be pressed before the new settings take place; this allows you set up the GUI as needed and to set the Adapter only when ready.

4.1.14 Save Settings

Press the **Save** button to save your current settings for future use. These settings will be automatically loaded the next time the GUI is launched.

4.1.15 Load Settings

To load previously saved settings, press the **Load** button. This will replace all the fields in the GUI with the saved fields.

4.1.16 About

To display version information of the GUI, press the **About** button.

4.1.17 Exit

To exit the GUI, press the **Exit** button. Note: It may take a few seconds for the GUI to respond to the Exit button as the GUI completes its last function.

5 Parts List

The parts required to use the Speed Detect 1 Beam hardware, software, and firmware is shown in Table 1. The prices (cost) shown are in US Dollars (USD) at the time this document was created. Prices and availability may vary.

Table 1 – Parts List

Item	Ref Desg	Supplier	Part Number	Qty	U/M	Cost	Description
1	DK1	Paul Romsky	SD1B_V1_0_0	1	EA	0.00	Software, Speed Detect 1 Beam, Distribution Kit, Version 1.0.0, Contains GUI, BOE Firmware, and Documentation. Free (No Charge)
2	A1	Digi-Key	32900-ND	1	EA	79.89	Kit, Prototype, Board of Education (BOE), with BS2 Microcontroller and USB Cable (Mfr: Parallax)
3	PS1	Digi-Key	750-00008-ND	1	EA	9.99	Power Supply, 9VDC 1A Output, Input 120V/240V, Plug: Positive Tip (fits item 2 Input Power Jack). Part number shown is for US/Canada only, other countries may require a different Power Supply for the mains power receptacle used
4	A2	Trains On Tracks	6-12014	1	EA	4.95	Track, Model Train, O-Gauge, Straight, With Roadbed, 10 Inch, FasTrack (Mfr: Lionel) Item is Optional: Required only if building a Through Rail Detector
5	CR1/ CR2	Radio Shack	276-0142	1	EA	3.99	Kit, IR LED Pair, Wavelength 850nm, T 3/4 Package, Source LED 100mA at 1.8V, Detector LED 1mA at 1.2V Vbr=60V
6	R1	Radio Shack	2711321	1	EA	0.30	Resistor, 1K, 0.25W, 5% Tolerance, Axial, Carbon. $1.49 for Pack of 5, price is for 1 from Pack
7	R2	Radio Shack	2711311	1	EA	0.30	Resistor, 100K, 0.25W, 5%

							Tolerance, Axial, Carbon. $1.49 for Pack of 5, price is for 1 from Pack
8	W1	Radio Shack	<Ask Dealer>	3	FT	2.80	Cable, Flat, 4 Conductor, 26 or 28 AWG, Solid, Cu, (Black, Red, White, Green). $13.99 per 15 Foot Roll, price is for 3 Feet off Roll
9	-	Radio Shack	6400002	1	FT	0.50	Solder, Thin, 60/40, Rosin Core. $8.49 per Roll, price is for approx 1 Foot from Roll
10	-	<Internet>	3M DP110	5	ML	1.85	Epoxy, 2 Part, Grey, Scotch Weld (Mfr: 3M Part: S-20884). $18.45 per 50 mL Tube, price is for approx 5 mL from Tube. Locktite 5 Minute 2-Part Epoxy may be substituted (available at most hardware stores)

Units of Measure (U/M)
AR = As Required
EA = Each
FT = Foot
ML = milli-Liter (mL)
OZ = Ounce (Weight)
PK = Pack
RL = Roll
TB = Tube

6 Acronyms

This section lists all acronyms listed in this document. Additional acronyms and definitions that do not appear in this document may also be included due to their related scope of this document.

A/D	See ADC
AC	Alternating Current
A/C	Air Conditioner (in a vehicle accessory context)
A/C	See AC (in an electrical context)
ADC	Analog to Digital Converter
ALDL	Assembly Line Diagnostics Link (a GM diagnostic protocol developed before ODB-I)
C	Temperature in Degrees Celsius: C = (F – 32) * (9 / 5)
CEL	Check Engine Lamp (or Light)
CL	Closed Loop
COM	Communications (a Serial Port on a PC)
D/A	See DAC
DAC	Digital to Analog Converter
DC	Direct Current
D/C	See DC
DMALDL	Diagnostic Mode ALDL
DMFACT	Diagnostic Mode Factory
DMDIAG	Diagnostic Mode Diagnostic Lamp
EGR	Exhaust Gas Re-circulator
ESD	Electro-Static Discharge
F	Temperature in Degrees Fahrenheit: F = (C * (5 / 7)) + 32
GM	General Motors
GUI	Graphical User Interface
I/O	Input/Output (also IO)
IAC	
ID	Identifier
IR	Infra-Red
K	Kilo ($1x10^{3}$)
Km/h	Kilometers per Hour (1 Km/h = 0.621371 MPH)
LED	Light Emitting Diode
LORPMHY	Low RPM High
LSb	Least Significant Bit
LSB	Least Significant Byte
m	Milli ($1x10^{-3}$)
M	Mega ($1x10^{6}$)
MAT	Manifold Air Temperature
MAP	Manifold Air Pressure
MAF	Mass Air Flow
MCU	Microcontroller Controller Unit
MPH	Miles Per Hour (1 MPH = 1.60934xx Km/h)
MSb	Most Significant Bit

MSB	Most Significant Byte
n	Nano ($1x10^{-9}$). More properly: the lower case Greek letter nu (ŋ)
O2	Oxygen
OBD-I	On Board Diagnostics Level 1
PC	Personal Computer
PROM	Programmable Read Only Memory
QTY	Quantity (or Qty)
RPM	Revolutions Per Minute
Ref Desg	Reference Deignator
s	Seconds
SLRL	
T	Tera ($1x10^{9}$)
TCC	
TPS	Throttle Position Sensor
u	Micro ($1x10^{-6}$). More properly: the lower case Greek letter mu (µ)
U/M	Unit of Measure
USB	Universal Serial Bus
USD	United States Dollars
V	Volts
VAC	Volts AC
VDC	Volts DC

7 Index

No Index is provided at this time.

End of Document