Powertrain Control Solutions, LLC

Xtended Fuel Controller

INSTRUCTION MANUAL
VERSION 1.1

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1. XFC INTRODUCTION

Engines modified to increase power have altered air/fuel ratio values. The stock engine control module will make incorrect adjustments based on these air/fuel ratio values. The Xtended Fuel Controller (XFC) is a solution for optimum fuel control on modified engines. To account for the modified air/fuel ratio values the XFC controls the sensor signals to the stock engine control module. *The XFC corrects these signals by comparing the input signals to a table, then sending the altered signals to the stock engine controller*. Tables can be changed allowing the XFC to be customized in the field to specific applications.

When injectors are changed or a turbo is added, this changes the operating parameters of the engine. The XFC manipulates the MAF/MAP signal to enable the engine control module to operate with the modified operating conditions of the engine. Replacing the narrowband oxygen sensor in the exhaust with a wideband oxygen sensor allows superior control over the air/fuel ratio.

The throttle response signals change with a modified engine. The XFC alters the throttle signals so that the stock engine control module can control the engine.

The XFC can control a 25-amp fuel pump if additional pressure is required to meet the fuel demands of a modified engine with a stock deadhead fuel system.

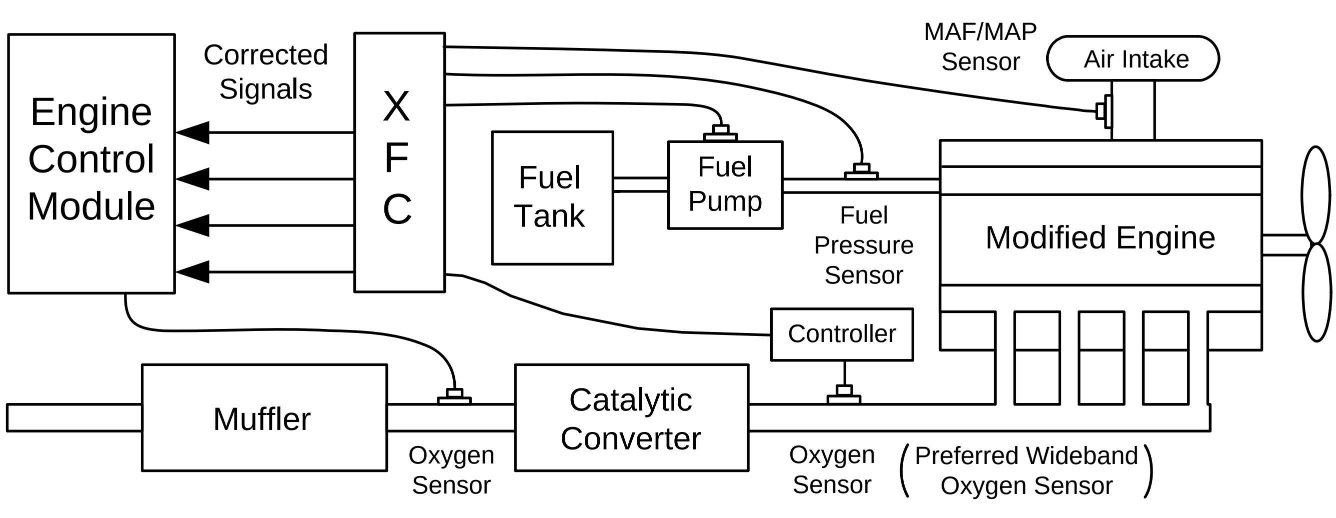
XFC can provide either open or closed loop fuel pressure control for deadhead systems. Dead head systems with a fuel pressure sensor in closed loop have better fuel pressure control. Open loop fuel pressure control without a fuel pressure sensor can also be done.

The XFC has a software monitor display showing all inputs and outputs of the XFC, speed, fuel pressure, RPM, throttle position, MAF and air/fuel ratio. This gives an overall view of how engine performance is affected when making tuning adjustments. This data can be recorded for later analysis with the XFC data viewer or Microsoft Excel®. The XFC software offers a strong set of capabilities and datalogging viewing options. Data files use the file extension .flg which is associated with XFC software. This does not prevent users from opening the same file in Excel®.

The XFC has a RS-232 serial port and CAN 2.0b. The CAN 2.0b communicates with other electronic control modules and RS-232 is used to program the XFC with a computer. The XFC comes with a harness containing the CAN 2.0b connectors. We an offer inexpensive USB to RS-232 serial port adapter.

Programmable inputs and outputs allow the XFC to be customized to just about any application in the field. Different setting can be stored in the computer and quickly uploaded into the XFC.

XFC Installed



2. XFC FEATURES

2.1 XFC Software

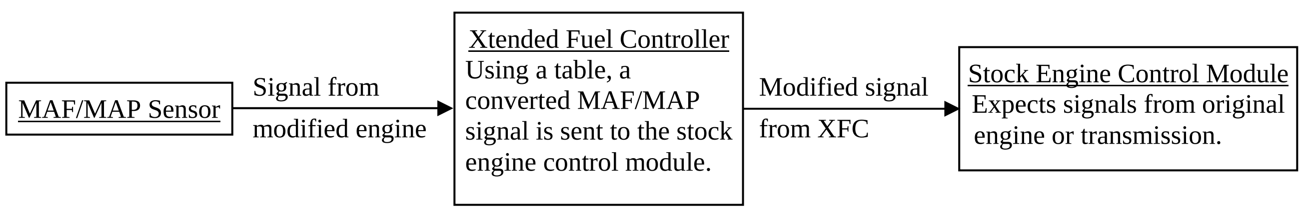
The XFC software provides an intuitive and familiar windows style interface. User preferences are accommodated by a concurrent menu and explorer style of navigation. Real time tuning gives the user immediate control over XFC parameters. A monitor screen and background data logging assist in speeding up the tuning process. A version of our Datalog Viewer software is included with the XFC for data analysis. Also the datalog files can be exported for programs such as Microsoft Excel® for data analysis. Programmable trigger levels, diagnostics, fully definable sensor calibrations, selectable breakpoints and programmable units allow for complete flexibility in the engine tuning environment. The XFC can be upgraded in the field with the latest version of software. Compatibility with Windows® operating systems ensures usability on almost any computer.

2.2 MAF/MAP Control

The MAF/MAP signals are used to determine load on the engine. When injectors are changed or a turbo is added, this changes the operating parameters of the engine. The XFC manipulates the MAF/MAP signal to enable the engine control module (ECM) to operate with the different operating conditions of the modified engine. The XFC converts the Mass Air Flow (MAF) and Manifold Absolute Pressure (MAP) signals so that the ECM can control the modified engine. The XFC works with either analog or frequency MAF.

MAF/MAP signals are compared to values in a table. The results are converted to a signal that is sent to the stock engine control module. MAF conversion table can use a percentage change, voltage change, or frequency change to create the output MAF signal. The MAP conversion table can use a percentage change, voltage change or a pressure value to create the output MAP signal.

Diagram For MAF/MAP Signal Conversion

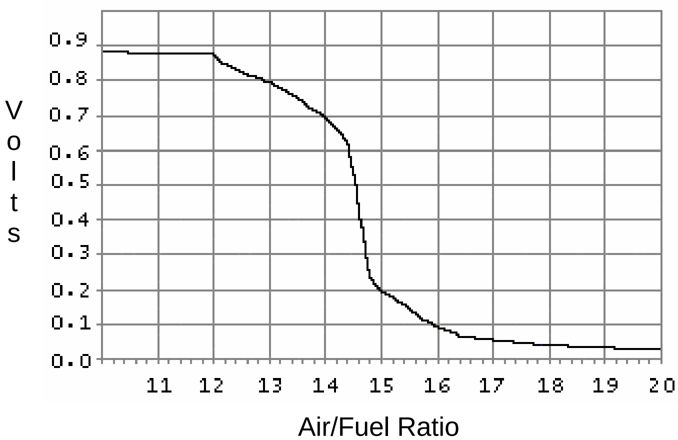


Also input analog (0 – 5v) signals can be converted to a frequency based output signal, or a frequency based input signal can be converted to a analog (0 – 5v) signal. The installer has the option of changing sensors when using the XFC without having to consider the stock engine control module.

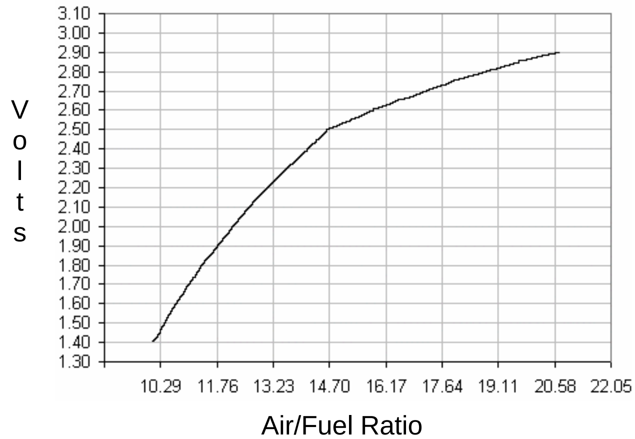
2.3 Air/Fuel Ratio Control

The type of oxygen sensor in the exhaust determines the performance of XFC in controlling the air/fuel ratio. The O_2 narrowband sensor has a 0 – 1.2v output. The O_2 wideband sensor has a 0 – 5v output. The wideband sensor has a greater sensitivity to oxygen. For best performance replace the narrowband sensor with a wideband sensor and controller. The XFC will convert the wideband signal to a narrowband signal for the engine control module. We offer an inexpensive O_2 wideband sensor and controller.

Typical
Narrowband Oxygen Sensor Output Voltage

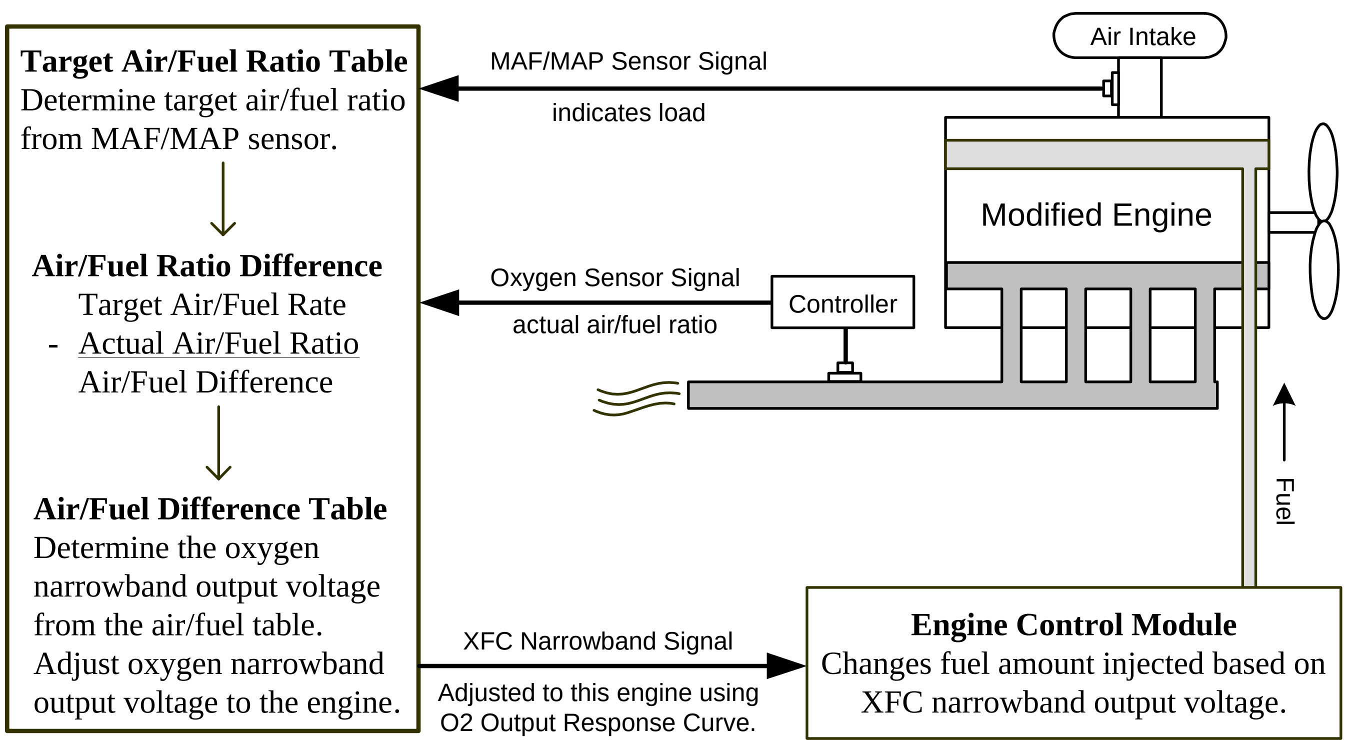


Typical
Wideband Oxygen Sensor Output Voltage



The XFC uses the MAF/MAP sensor to determine the target air/fuel ratio from a table. The target air/fuel ratio is subtracted from the actual air/fuel ratio provided by the exhaust oxygen sensor. The result is the air/fuel ratio difference. The XFC uses the air/fuel ratio difference in a table to provide a narrowband output voltage to the engine control module. The narrowband output voltage curve can be modified to match different engines.

Diagram For Closed Loop Air/Fuel Ratio

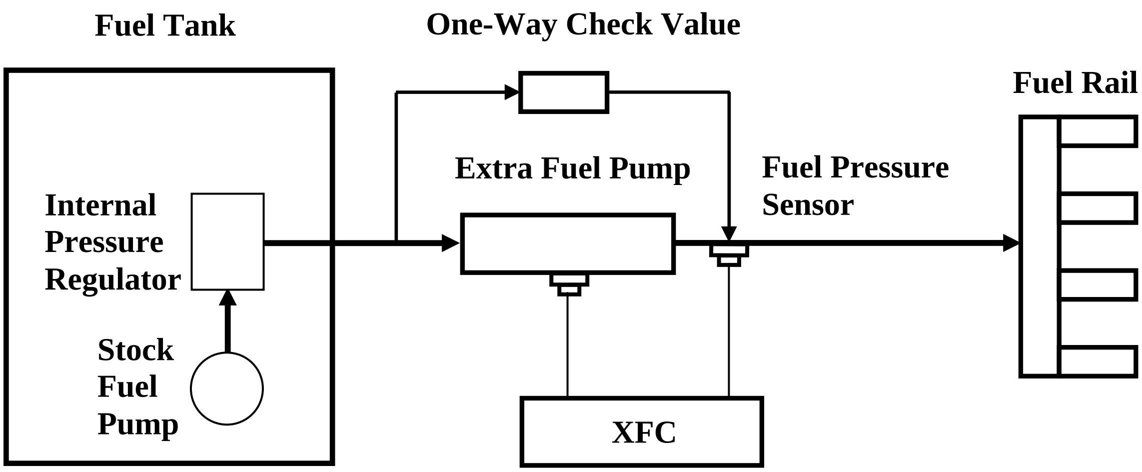


2.4 Fuel Pressure Control

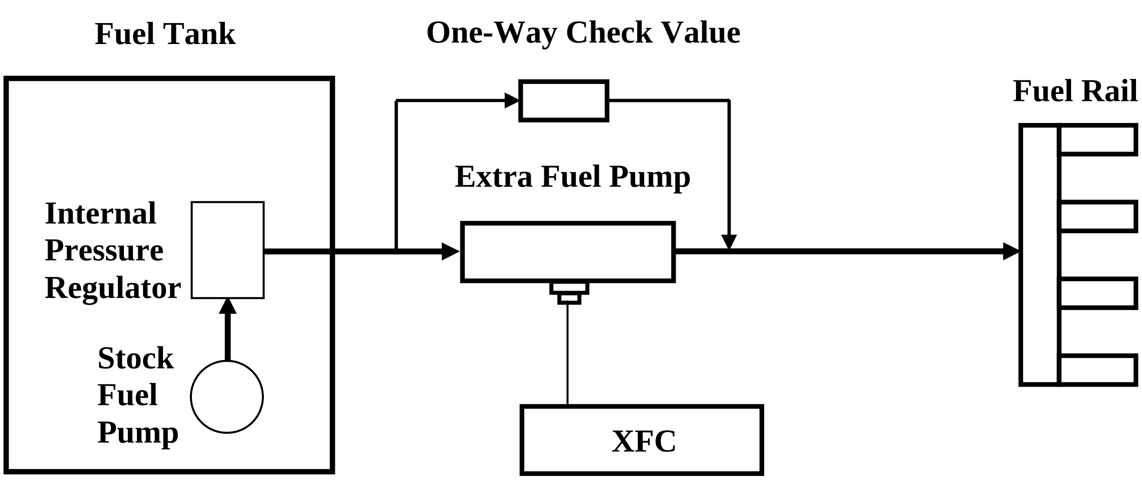
If the stock deadhead fuel system is unable to meet the fuel requirements of the modified engine, the XFC can control an additional fuel pump in series with the stock fuel pump. The XFC has two methods of control. Dead head fuel systems can use either open loop or closed loop (PID) control. The closed loop (PID) dead head system uses a fuel pressure sensor that provides fuel pressure feedback. The dead head closed loop system eliminates the risk of changes in fuel pump performance due to variables like temperature, battery voltage and pre-pump performance.

The XFC can control the additional fuel pump in open loop deadhead mode by using the MAF/MAP signal to determine load. But with a stock dead system it is recommended that the XFC be used in closed loop (PID) mode with an additional fuel pump and fuel pressure sensor for optimal fuel pressure control. We offer fuel system components like a one-way check valve, extra fuel pump and fuel pressure sensor for the conversion of the fuel system.

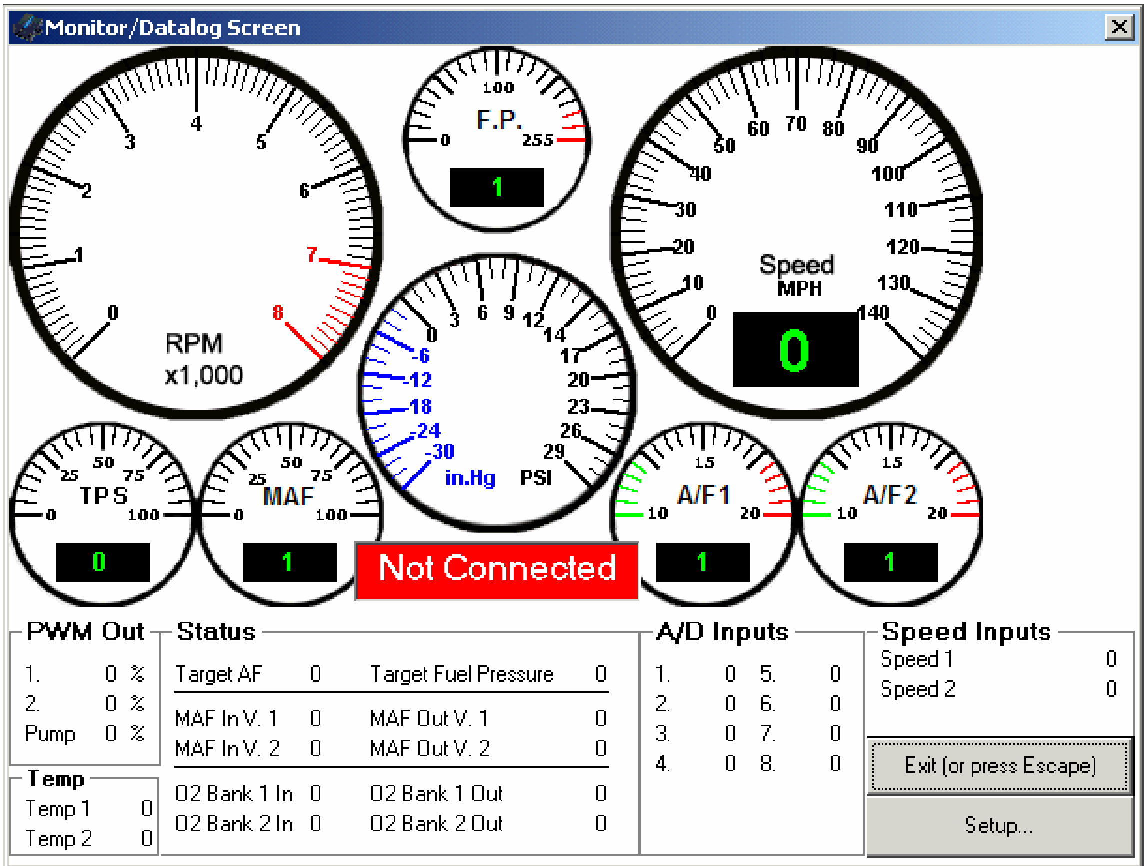
Dead Head Fuel Pump Control
Closed loop control with Fuel Pressure Sensor.



Dead Head Fuel Pump Control
Open loop control without Fuel Pressure Sensor.



2.5 Monitor Display



The XFC has a monitor display showing all inputs/outputs to the XFC; speed, fuel pressure, RPM, throttle position, MAF and air/fuel ratio. This gives an overall view of engine performance when making tuning adjustments. This data can be recorded for later analysis with the XFC data viewer or Microsoft Excel®. The XFC software offers a much stronger set of capabilities and datalogging viewing options; however many users may wish to use other tools or analysis methods which do not fall within the scope of the XFC software. Data files use the file extension .flg which is associated with XFC software. This does not prevent users from opening the same file in Excel®.

If the XFC is not connected to the computer a red bar with the words "Not Connected" will appear on the monitor display.

2.6 Datalogging

Datalogging is one of the most powerful features offered by the XFC. It allows a user to record engine behavior. The extra analog and digital inputs offered by the XFC allow the XFC to be used as a general datalogging device for any other vehicle functions you may wish to record.

2.6.1 Begin A Datalog

1.) XFC power must be on and the XFC must be communicating/online with the computer.
2.) Click on the datalog folder. Double click the Start/Log button.
3.) A window will appear with the option to "start logging." Click this button. When prompted, choose file name and location for your datalog. As with calibration files, choose a descriptive name including time, date, and/or application for the datalog. After choosing a name, click save.
4.) The computer will now begin datalogging. Engine parameters may be viewed through the monitor display while datalogging.
5.) When the datalog is completed, click "Stop Logging" button. This will complete the datalogging session and save the datalog file to the location specified.

2.6.2 View A Datalog

1.) Datalogs may be viewed with the Datalog Viewer software, Microsoft Excel or any other program that can handle the tab delimited values contained in the datalog. The Datalog Viewer software offers a much stronger set of capabilities and datalogging viewing options; however we understand that many users may wish to use other tools or analysis methods which do not fall within the scope of the XFC software. The datalog files use the file extension .flg which is associated with the Datalog Viewer Software; however this does not prevent users from opening the same file in Microsoft Excel.
2.) To use the Datalog Viewer software, go to the datalog pull down/explorer folder. Double click the view button. If you know the location of the datalog file, you may also open this file directly, which will automatically start the Datalog Viewer software.
3.) If the Datalog Viewer software is not being opened with a file, a blank screen will appear. Click the "load" button or go to File-> Open. Choose the file location and name and click open or hit enter.
4.) Initially, your datalog will appear in graph view. To begin viewing the data, click in the boxes next to the datafields you wish to see near the top of the screen. You may view this data in a tabular view by clicking the table view button on the icon menu.
5.) Several zooming options are available by right clicking your mouse button. You may zoom in by clicking on a beginning time and an ending time for your graph selection. You may also choose to view all the data, zoom to a percentage, or zoom to a particular time period.
6.) Please refer to the hotkeys list for a complete listing of key options for navigating the datalog menu.
7.) You may load another datalog or continue tuning at any time.

2.7 Flash Upgrade Procedure

The XFC has the powerful ability to be upgraded in the field. This ensures that future features and capabilities will be available to all users.

To perform a flash upgrade, do the following:

1.) The XFC power must be on and the XFC must be communicating and online with your computer.
2.) To begin a flash upgrade, select Communications -> flash upgrade from the explorer menu or Communications -> flash upgrade -> flash upgrade XFC from the toolbar. Once this form opens, no other forms will be available. This is done to protect the XFC. At this form, the firmware major and minor revision will be displayed. The hardware revision will also be displayed.
3.) To begin flashing the transmission controller, click the "Open Flash File to Begin" button. This will open a file selection menu. Only *.rom files can be opened and the correct file must be chosen for a proper upgrade. If you are unsure about which rom file you should use, contact technical support first. When using newer software with an older controller (or vice versa), the unit may not communicate or properly find the com port until it is flash upgraded. You may need to manually select the com port. Once the correct file has been selected, click open in the current menu.
4.) A warning message will appear with a warning not to turn the power off until the upgrade is complete. Follow these instructions explicitly. Heed this warning! Click the yes button if you are prepared to flash the unit.
5.) The initial flash upgrade screen will display a progress bar and provide some information about the flash procedure. Once complete, the last line of text will read "Flash upgrade complete!"
6.) If you experience a box that appears saying "error writing to unit please check connection and try again." You will need to turn the unit off and on again, check all your connections and start over with these directions. Your unit will not begin to function properly again until a successful flash has been completed.

2.8 Communications

The XFC has RS-232 and CAN 2.0b onboard. RS-232 (Serial Communication) has been provided for communication with your computer. We have gone to great lengths to ensure reliable communication between your PC and the XFC. CAN 2.0b (Controller Area Network) is a noise tolerant automotive communication network.

Some USB to RS-232 serial port adaptors can be marginal. We offer an inexpensive USB to serial port cable and drivers for use with computers that lack a serial port.

2.9 Diagnostic Trouble Codes

The XFC offers basic diagnostic trouble codes for all analog inputs, battery voltage and XFC temperature. These diagnostic measures have been provided to alert the user of potential problems and prevent premature failure of the XFC. A diagnostic trouble code failure occurs in the following conditions:

1.) An analog input value is above the high failure value or below the low failure value as programmed in each analog input.
2.) Battery voltage exceeds 25 volts.
3.) Unit temperature exceeds 120°C (248°F) or falls below -30°C (-22°F).

A simple failure flag will appear when datalogging and when viewing the monitor display. To view the details of the failure or clear the failure value;

1.) Click the Communications folder. Double the Diagnostic Trouble Codes button.
2.) A screen of possible diagnostic trouble codes is displayed. These failures should be taken seriously and investigated (especially the XFC overtemp and battery overvoltage warnings). To ignore these values could lead to failure of the engine or XFC.
3.) Click the Clear button to clear these values after investigating and solving the problem.

2.10 Password Protection

The XFC offers password protection to help installers avoid warranty, intellectual property and customer issues. Once the password has been set, the calibration stored on the unit may only be retrieved by people who know said password. Any user may completely overwrite this information with a different calibration but that user would need to start tuning from nothing.

If a password is lost, it can be retrieved by technical support staff using a permission key issued by the software. This password has a high level of encryption and an person (s) wishing to receive a new password must have all of the information from the original purchaser and pass a verbal test to receive a calibration.

2.11 Hotkeys List

Use these keys to move quickly around the XFC program.

Hotkeys For XFC	
FUNCTION	KEYS
Monitor Setup	CTRL-K
Monitor Screen	CTRL-M
Retrieve calibration file from unit	CTR_R
Create new calibration file	CTRL-N
Open new calibration file	CTRL-O
Save calibration file	CTRL-S
Save calibration file as	CTRL-A
Cut	CTRL-X
Copy	XTRL-C
Paste	CTRL-V
Redo	CTRL-Y
Undo	CTRL-Z
Go Online	CTRL-G
Go Offline	CTRL-H
Toggle dockable explorer view	CTRL-E
Cascade Windows	CTRL-F7
Tile Windows	CTRL-F8
Help for Current windows	F1
Percent add/subtract to selected data	CTRL-P
Linearize selected data	CTRL-L
Increase by 1 to selected data	CTRL +
Decrease by 1 to selected data	CTRL -
Increase/Decrease Selection	CTRL_i
Set Selection to	CTRL_J
Forward ten cells	Up Arrow
Back ten cells	Down Arrow
Forward one cell	Right Arrow
Back one cell	Left Arrow

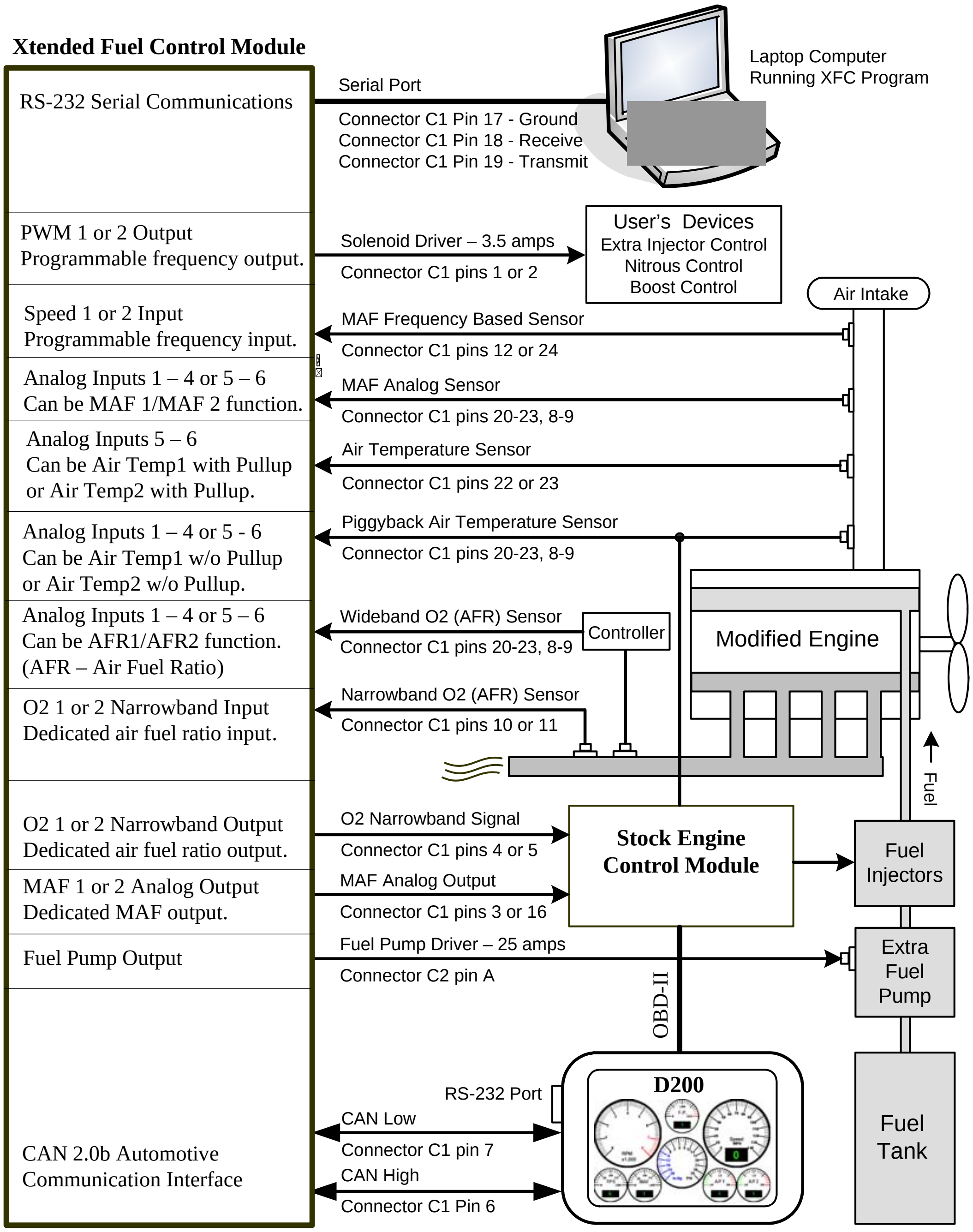
3. XFC INPUTS/OUTPUTS

INPUTS	Connectors C1 & C2	MICROCOMPUTER
Input Disabled; Fuel Pressure Input; TPS; MAP; MAF 1; MAF 2; AFR1; AFR2; Air Temp1 Input w/o Pullup enabled; Air Temp2 Input w/o Pullup enabled *A MAF analog input can have a MAF PWM frequency output.*	C1 Pin 21 C1 Pin 20 C1 Pin 8 C1 Pin 9	Analog 1 - Analog 2 - Analog 3 - Analog 4 - Programmable Inputs
Input Disabled; Fuel Pressure Input; AFR1; AFR2; MAP; MAF 1; MAF 2; TPS; Air Temp1 Input w/Pullup enabled; Air Temp2 Input w/Pullup enabled; Air Temp1 Input w/o Pullup enabled; Air Temp2 Input w/o Pullup enabled *A MAF analog input can have a MAF PWM frequency output.*	C1 Pin 22 C1 Pin 23	Analog 5 - Analog 6 - Programmable Inputs
VSS; Frequency Based MAF 1; Input RPM; Frequency Based MAF 2 *A MAF frequency input can have a MAF analog output.*	C1 Pin 12 C1 Pin 24	Speed 1 - Speed 2 - Programmable Inputs
O_2 Sensor 1 Narrow Band 0 – 1.2v	C1 Pin 10	O_2 1 Input
O_2 Sensor 2 Narrow Band 0 – 1.2v	C1 Pin 11	O_2 2 Input

OUTPUTS

OUTPUTS	Connectors C1 & C2	MICROCOMPUTER
Windows Settings (Switch above or between RPM) 2D 1 x 16 Table (Boost) 2D 16 x 16 Table (MAF MAP AFR1 AFR2 Temp 1 Temp 2 TPS) *A MAF analog input can have a MAF PWM frequency output.*	C1 Pin 1 C1 Pin 2	PWM 1 - PWM 2 - Programmable Outputs
Fuel Pump Driver (25 amp)	C2 Pin 1A	Fuel Pump Output
MAF 1 (0 – 5v) *A MAF frequency input can have a MAF analog output.*	C1 Pin 16	MAF 1 Analog Output
MAF 2 (0 – 5v) *A MAF frequency input can have a MAF analog output.*	C1 Pin 3	MAF 2 Analog Output
O_2 Sensor 1 Narrow Band (0 – 1.2v)	C1 Pin 4	O_2 1 Output
O_2 Sensor 2 Narrow Band (0 – 1.2v)	C1 Pin 5	O_2 2 Output
CAN 2.0b Standard Automotive Communication Protocol Communications Between XFC & Other Control Devices	C1 Pin 6 C1 Pin 7	CAN High CAN Low
RS-232 Serial Communications Communications Between XFC & PC Laptop Computer	C1 Pin 17 C1 Pin 18 C1 Pin 19	Ground Receive Transmit

4. EXAMPLE OF CONNECTIONS TO XFC



D200 - Touch Screen Dash Logger Connected to XFC & Stock Engine Control Module

The D200 is a stand alone fully programmable monitoring, datalogging and analysis system capable of working with most OBD-II engines built after 1996. Through ODB-II, the D200 offers real-time display of parameters hidden by the engine's stock powertrain management system.

The D200 can display information from a Lambda meter, aftermarket ECU, stock ECU, transmission controller, fuel controller, MAP sensor, throttle position sensor, vehicle speed and more.

4.1 Sensors

A Short description of the different sensors types the XFC can handle are listed below.

Fuel Pressure Sensor ----------	A sensor in the fuel line produces a voltage output that varies with the pressure of the fuel pump.
TPS Sensor --------------------- (Throttle Position Sensor)	A sensor that measures throttle position. A variable resistor is connected to the throttle shaft. When the shaft is moved a signal of varying voltage is created. Voltage increases when the throttle is opened up. This signal and the MAF/MAP signal are used by the engine control module to determine engine load.
MAP Sensor ------------------- (Manifold Absolute Pressure)	A sensor that measures air pressure in an engine. A resistor in the intake manifold changes resistance due to pressure. Lower the engine vacuum, the higher the MAP voltage. Higher MAP voltage indicates greater load.
MAF Sensor ------------------- (Mass AirFlow)	A sensor that measures airflow into an engine. One type of MAF sensor is the bypass hot-wire sensor. It has a portion of air into the engine flow across a hot wire. The amount of air affects the wire resistance. To maintain the same wire temperature the engine control module has to increase/decrease current through the wire. This current change is how airflow into an engine is monitored. Another type of MAF sensor measures the turbulence around a tube in the air flow into an engine.
AFR Sensor -------------------- (Air Fuel Ratio)	A sensor that measures oxygen in the engine exhaust. The sensor generates two chemical reactions to produce a signal. Oxygen in the exhaust reacts with material in the sensor producing a voltage. In a different part of the sensor, oxygen in the air reacts to the same material, producing a voltage. These two voltages when compared result in the airfuel ratio output signal.

4.2 Analog Inputs

Analog inputs have been designed with universal application in mind. Through this adds complexity to the XFC, it allows the XFC to be installed in virtually any application. Analog inputs 1 - 4 have been designed to be piggybacked with any sensor from an engine controller or directly measure most sensors except for temperature sensors or other resistance based two wire sensors. Analog inputs 5 - 6 have been designed to be piggybacked with any sensor from an engine controller or directly measure most sensors.

Input Disabled – No input to XFC.

Fuel Pressure Input – Signal from fuel pressure sensor, used to control extra fuel pump.

TPS – Throttle Position Sensor, signal from a device measuring relative travel of throttle plate.

MAP – Manifold Absolute Pressure, signal from a device that measures absolute pressure (or vacuum) of the intake charge for an engine. This signal can be interpreted as engine load.

MAF1 – Mass AirFlow 1 – One of two inputs from sensors that measure airflow into the engine based on air mass. This signal can be interpreted as engine load.

MAF2 – Mass AirFlow 2 – One of two inputs from sensors that measure airflow into the engine based on air mass. This signal can be interpreted as engine load.

AFR1 – Air Fuel Ratio 1 – One of two inputs from sensors that measures oxygen in the exhaust. This signal can be interpreted as air fuel ratio.

AFR2 – Air Fuel Ratio 1 – One of two inputs from sensors that measures oxygen in the exhaust. This signal can be interpreted as air fuel ratio.

Air Temp1 Input w/o Pullup enabled – One of two inputs that measures air temperature. Input does not have a pull-up resistor. Used to piggy-back connections to an air temperature sensor.

Air Temp2 Input w/o Pullup enabled – One of two inputs that measures air temperature. Input does not have a pull-up resistor. Used to piggy-back connections to an air temperature sensor.

Air Temp1 Input w/Pullup enabled – One of two inputs that measures air temperature. Input does have a pull-up resistor. Used for stand alone connections to an air temperature sensor.

Air Temp2 Input w/Pullup enabled – One of two inputs that measures air temperature. Input does have a pull-up resistor. Used for stand alone connections to an air temperature sensor.

4.3 Speed Inputs

The XFC has two frequency inputs, Speed 1 and Speed 2. They have four functions.

VSS – Vehicle Speed Sensor – Input measures driveshaft speed by counting teeth passing by on a wheel. This count can be calculated to determine vehicle speed if the final drive ratio, gear ratios, and tire size are known.

Input RPM – Counts the number of spark events to determine engine rpm.

Frequency Based MAF 1 – Frequency Based Mass AirFlow 1 – One of two inputs measuring airflow into an engine using a frequency based signal. This signal can be interpreted as engine load.

Frequency Based MAF 2 – Frequency Based Mass AirFlow 2 – One of two inputs measuring airflow into an engine using a frequency based signal. This signal can be interpreted as engine load.

To accommodate a wide range of speed sensor applications, speed input trigger levels and filter values are programmable. Trigger level and filtering programmability helps eliminate false triggering in a noisy environment or no triggering with a low speed or weak signal. Through these parameters can be difficult to understand and deal with, it allows the XFC to accommodate nearly all available sensors.

Trigger Level: Trigger levels are provided for each speed input. This value is provided because different sensors provide different signals. Setting a Trigger value too low may cause the speed input to be triggered by electrical noise in your vehicle. This is most readily observed by excessive triggering, false triggering and/or a datelog graph that show little consistency. Setting a Trigger value too high may cause the speed input to remain untriggered by the sensor input. This is most readily observed by no triggering and/or a datalog graph that shows no change.

Filter Values: Filter values are provided to eliminate noise and change the cutoff requency of the filter. Increasing the filter value is lowering the cutoff frequency on this lowpass filter. This has an effect on the ability of the XFC to display a high frequency input. For an engine RPM input (low frequency) set the filter somewhere between 30 and 60. For a vehicle speed input (high frequency) set the filter somewhere between 2 to 10. Setting a filter value too high may cause a speed input to stop reading at high speed/RPM.

Glitch Values: Glitch filter values are provided as added logic to ensure proper speed input values. The glitch filter works by checking the speed input trigger signal to see how long it has remained at or above the trigger level. The trigger level has to stay high for a particular time period before being detected as a valid edge. A higher glitch filter setting is longer edge detection time period. We recommend a glitch filter setting of 3 (maximum).

These values only need to be adjusted in cases where speed inputs are not working properly. An example is a speedometer that is reading erratically or will only start working at an above normal mph. Trigger values can be adjusted such that the corresponding speed inputs reads correctly at low speed/RPM. Trigger values can be lowered if speed inputs are not triggering at or only at high speeds. Filter values can be raised if experiencing significant speed input scatter. If you are having problems making adjustments, call us or visit our website.

4.4 Oxygen Narrowband Inputs

The XFC has two narrowband (0 - 1.2v) O_2 dedicated inputs. Used to determine air fuel ratio. The output can be skewed to control the stock engine control module.

5. OUTPUTS

5.1 PWM Outputs

Pulse width modulated (PWM) outputs control solenoids based on duty cycle. There are three PWM outputs. PWM 1 and PWM 2 are programmable outputs with current capacity of 3.5 amps. These two PWM outputs can be used to provide boost, nitrous, and extra injector control or other generic functions. The third PWM is a dedicated output that controls an extra fuel pump. The current capacity of this fuel pump driver is 25 amps. The PWM outputs may also be used to convert a MAF analog signal to a MAF frequency signal.

5.2 Analog Outputs

There are two wideband (0 – 5v) MAF outputs. These signals indicate engine load. These two wideband MAF outputs can convert a MAF frequency signal to a MAF analog signal.

The two narrowband (0 – 1.2v) O_2 outputs indicate air fuel ratio.

5.3 Communication

The XFC has been designed with RS-232 serial communication and CAN 2.0b onboard. RS-232 has been provided for communication with your computer. Through less convenient than USB, serial communication still offers the best reliability and capability in a noisy automotive environment.

CAN 2.0B has been provided for communication with other electronic controllers. CAN 2.0b is a noise tolerant automotive communication network (Controller Area Network), which is the preferred modern automotive communication standard. If there is no RS-232 serial port on the computer, a USB to serial port adapter must be installed with driver before trying to communicate with the XFC.

6. INSTALLATION

6.1 Installer Capabilities

The installer should know how to use a computer and how to setup a serial port for the XFC program. To get the maximum performance out of the XFC, tuning the engine should be done under load on a dynamometer using diagnostic equipment. Good performance can be achieved without dynamometer or diagnostic equipment by an experienced tuner.

6.2 XFC Location

The XFC is designed for a high temperature, caustic and humid environment. Though the XFC can easily live in such an environment, an installation location inside is preferable. Please keep the XFC away from extreme heat sources, ignition wires or any obvious water sources.

6.3 Wiring XFC

Refer to wiring diagrams for your engine to determine the signal wire on each sensor. Be careful to avoid moving parts and hot parts when routing the signal wires. The method used to tap into these sensors will depend on your experience and preference in connectors. For permanent installation, please remember that no wire should be exposed to the elements. If possible splice into the exiting harness or wire in a Y-harness. Always remember to use heat shrink on any exposed wire joints or unsealed connections.

Wire +12v switched power (Power turns on when key is turned to ignition position.) to the XFC. Power source should be protected with a 25-amp fuse.
Wire ground connection to a clean ground terminal. (Preferably on transmission or engine).
Wire sensors to XFC.
Connect XFC harness sensor output wires to engine control module.

Double check installation of all connectors, splices and routing of the harness for any potential fitment problems, hot spots or unprotected/exposed wires or connectors.

6.4 Computer and XFC Connection

- Turn key to ignition position.
- Connect your PC to the XFC and start the XFC program.
- The program will automatically determine if the XFC is online or offline.
- If the computer is unable to detect the XFC confirm that the serial port is active, and that the USB to serial port adapter is properly installed and functioning.
    - Have only one XFC program running. If more than one XFC program is running, this may cause a conflict.
    - Check to see if other programs are using the same serial port.
    - Close all other programs.
    - Click on the XFC Setup menu button of the XFC program at the top of the screen.
    - Select Communications where the serial port can be scanned and manually configured.
    - If you are unable to manually configure the port and the port is both active and operating properly, please contact us or refer to the web forum.
- Installation is complete, and the XFC ready to be tuned to this engine.

6.5 Communications

The XFC has RS-232 and CAN 2.0b onboard. RS-232 (Serial Communication) has been provided for communication with your computer. We has gone to great lengths to ensure reliable communication between your PC and the XFC. CAN 2.0b is a noise tolerant automotive communication network (Controller Area Network).

Some USB to serial port cables can be marginal. We offer an inexpensive USB to serial port cable and driver for use with computers that lack a serial port.

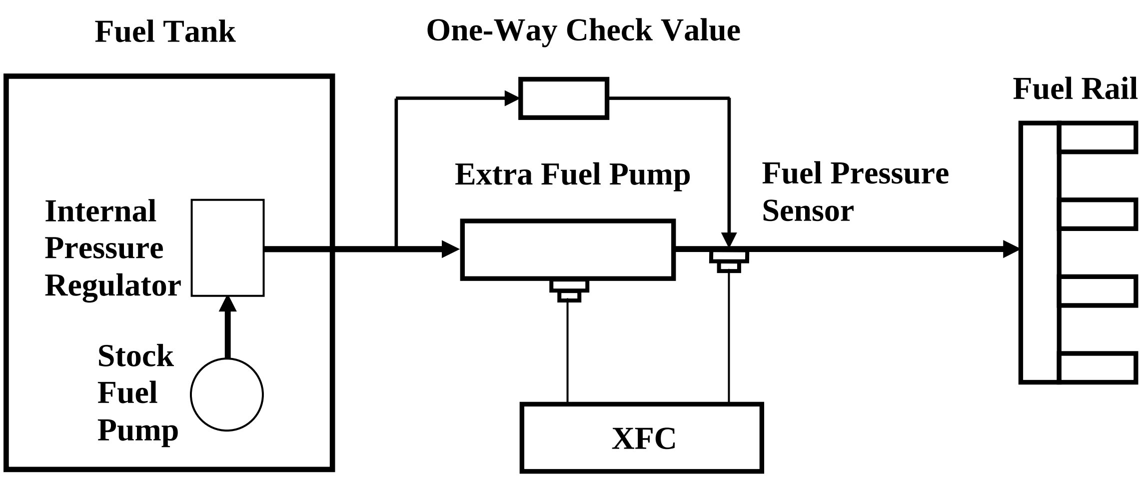
6.6 Extra Fuel Pump

If the stock deadhead fuel system is unable to meet fuel requirements for the modified engine, the XFC can control an additional fuel pump in series with the stock fuel pump. The XFC has two methods of control. Dead head fuel systems can use either open loop or closed loop (PID) control. The closed loop (PID) dead head system uses a fuel pressure sensor that provides fuel pressure feedback. The dead head closed loop system can support higher fuel pressure and eliminates the risk of changes in fuel pump performance due to variables like temperature, battery voltage and pre-pump performance.

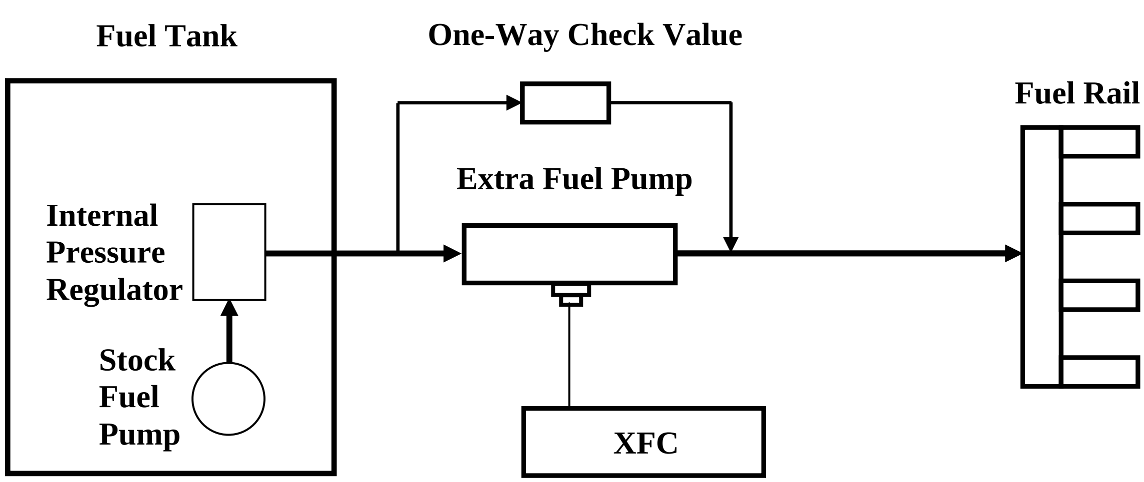
See the diagram below to see how to install an extra fuel pump. *The most important consideration is determining the type of stock fuel system; return fuel system or dead head system.* Do not use the XFC to control return fuel systems.

The XFC can control the additional fuel pump in open loop mode by using the MAF/MAP signal to determine load. But with a stock dead system it is recommended that the XFC be used in closed loop (PID) mode with an additional fuel pump and fuel pressure sensor for optimal fuel pressure control. We offer fuel system components like a one-way check valve, extra fuel pump and fuel pressure sensor for the conversion of the fuel system.

Dead Head Fuel Pump Control
Control is closed loop with Fuel Pressure Sensor.



Dead Head Fuel Pump Control
Open loop control without Fuel Pressure Sensor.

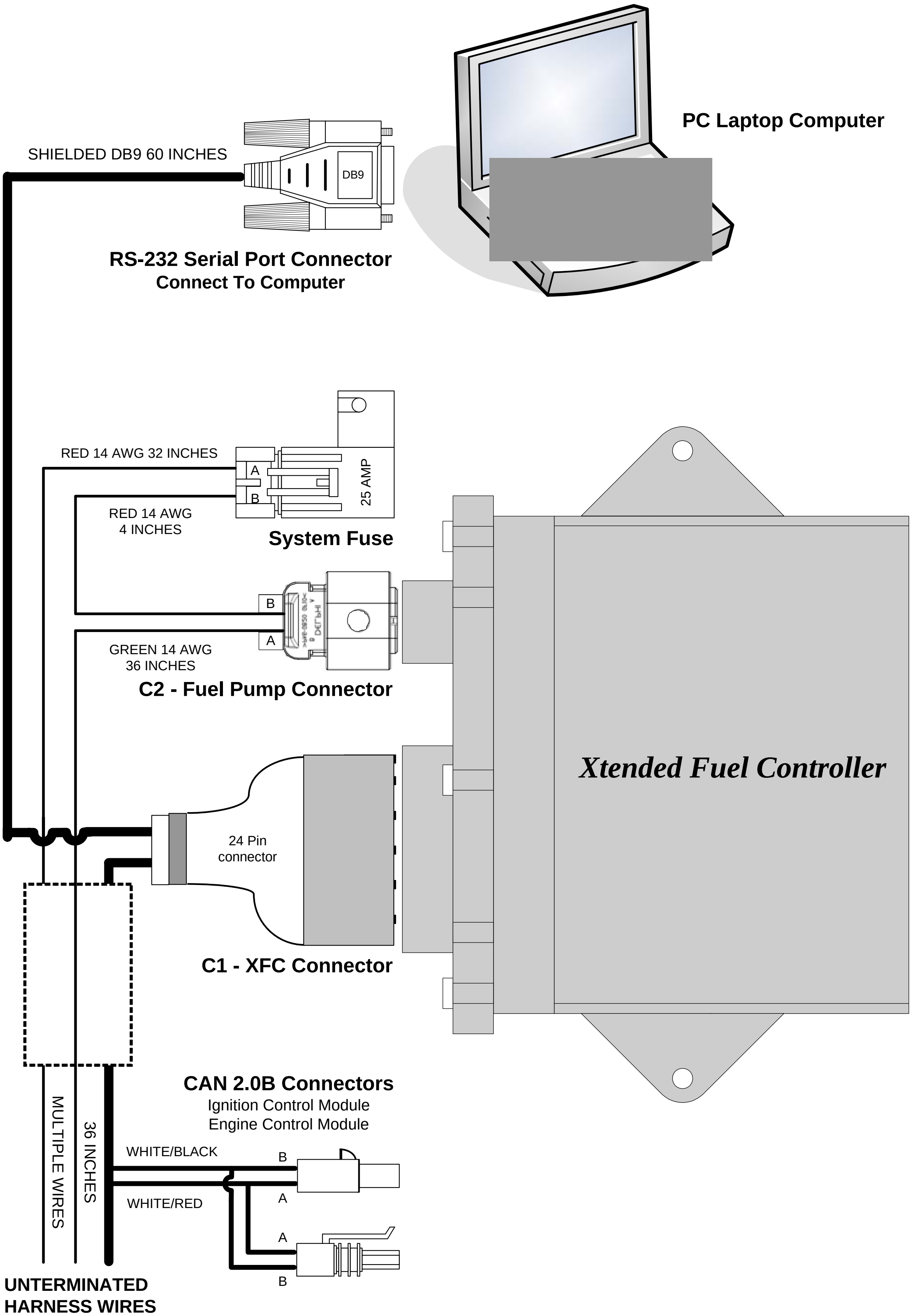


6.7 File Management

When the computer connects with the XFC, the program asks to go to the XFC. If yes, the computer will be loaded with settings from the XFC and goes online with the XFC.
If changes are made at this time, those changes will be immediately reflected in the XFC.
You may select offline mode or simply work without a XFC connected to the computer.

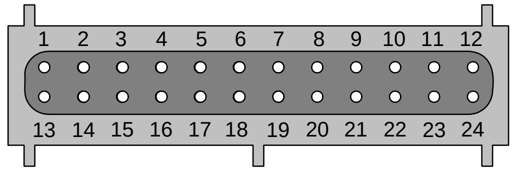
When offline or unconnected, changes can be made to any program on the computer. Open calibrations by choosing the Calibration icon on the toolbar or by choosing File>Open calibration file. Save these files with any file name and in any directory. Use a descriptive name like 1993-Firebird-350Ramjet-4L65E-1-13-04.XFC if you are a reseller/tuner or perhaps just 1-13-04.XFC if you use the XFC on a single engine. Remember that when offline, changes must be saved to be reflected in that file.

7. XFC WIRE HARNESS



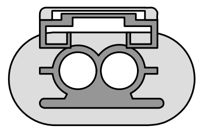
7.1 C1 – XFC Main Connector

Wire Side Of Connector



7.2 C2 – Fuel Pump Connector

Wire Side Of Connector

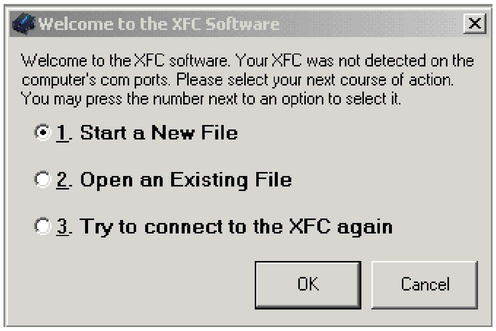


7.3 XFC Harness Unterminated Wires

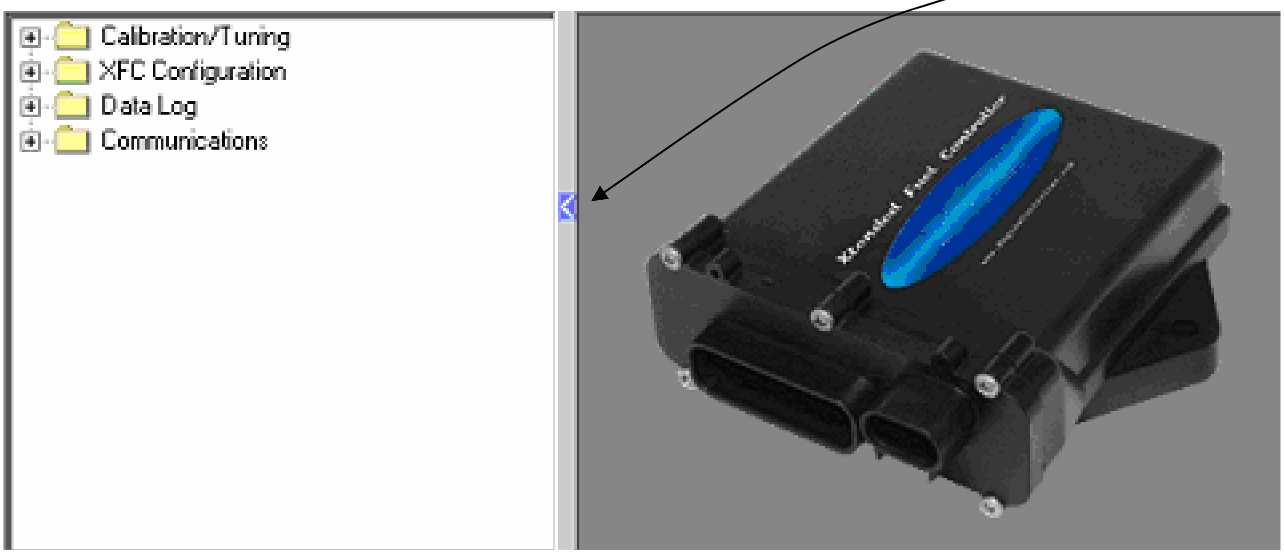
AWG	C1 PIN	WIRE COLOR	FUNCTION	HARNESS FUNCTION	CUSTOMER NOTES
20	1	VIOLET.BLACK	PWM 1 OUTPUT	PROGRAMMABLE OUTPUTS 1	
20	2	VIOLET/RED	PWM 2 OUTPUT	PROGRAMMABLE OUTPUTS 1	
20	3	PINK/LT.BLUE	MAF 2 OUTPUT	MAF 2 OUTPUT ANALOG(0-5V)	
20	4	PINK/BLACK	OXYGEN 1 OUTPUT	OXYGEN 1 OUTPUT	
20	5	PINK/RED	OXYGEN 2 OUTPUT	OXYGEN 2 OUTPUT	
20	6	WHITE/RED	CAN HIGH	COMMUNICATION CABLE	
20	7	WHITE/BLACK	CAN LOW	COMMUNICATION CABLE	
20	8	GRAY/BLACK	ANALOG 3 INPUT	PROGRAMMABLE INPUTS 1	
20	9	GRAY/RED	ANALOG 4 INPUT	PROGRAMMABLE INPUTS 1	
20	10	GRAY/LT.GREEN	OXYGEN SENSOR 1 INPUT	OXYGEN SENSOR 1 INPUT	
20	11	GRAY/LT.BLUE	OXYGEN SENSOR 2 INPUT	OXYGEN SENSOR 2 INPUT	
20	12	ORANGE/BLACK	SPEED 1 INPUT	PROGRAMMABLE INPUTS 3	
20	13	BLACK	GROUND	BATTERY CONNECTION	
20	14	BLACK/WHITE	SENSOR/AD GROUND	SENSOR OR REF GROUND	
20	15	RED/WHITE	REF VOLTS (+5V OUT)	SENSOR OR REF VOLTS	
20	16	PINK/LT.GREEN	MAF 1 OUTPUT	MAF 1 OUTPUT ANALOG(0-5V)	
24	17	BLUE	RS-232 GROUND	COMMUNICATIONS CABLE	
24	18	RED	RS-232 RECEIVE	COMMUNICATIONS CABLE	
24	19	BROWN	RS-232 TRANSMIT	COMMUNICATIONS CABLE	
20	20	GRAY/WHITE	ANALOG 2 INPUT	PROGRAMMABLE INPUTS 1	
20	21	GRAY/PINK	ANALOG 1 INPUT	PROGRAMMABLE INPUTS 1	
20	22	GRAY/ORANGE	ANALOG 5 INPUT	PROGRAMMABLE INPUTS 2	
20	23	GRAY/YELLOW	ANALOG 6 INPUT	PROGRAMMABLE INPUTS 2	
20	24	ORANGE/RED	SPEED 2 INPUT	PROGRAMMABLE INPUTS 3	
AWG	**C2 PIN**	**WIRE COLOR**	**FUNCTION**	**HARNESS FUNCTION**	
14	A	DARK GREEN	FUEL PUMP OUTPUT	FUEL PUMP +12V DRIVER	
14	B	RED	POWER FROM A SWITCH	SWITCHED POWER	

8. INSTALL COMPUTER PROGRAM

Put the CD into the CD player
The program will open automatically.
Follow directions to finish installation of program.
On startup this screen appears when the program is unable to communicate with the XFC.



Assuming this is the first time using the program, click on "OK".
Notice the blue arrow on the gray bar in the middle of the display.
Clicking on the bar will expand the right portion of the display to the far left.
Click again to have the folders reappear.



Calibration/Tuning contains tables to change signals for the engine control module.
Users will be making most of their on-going tuning adjustments in this section.

XFC Configuration configures inputs/outputs to the tables.
This section is initially used when the XFC is installed to set-up the inputs and outputs.
After installing the XFC, this section is not generally used in normal operation.

DataLog views and stores data generated by the XFC.

Communications sets up the communications between the XFC and a computer, programs the XFC with new files, and has a monitor display to observe all the inputs and outputs.

9. XFC CONFIGURATION

This section is where tables and graphs are configured, inputs and outputs are programmed, PWM parameters are set, and the oxygen (air/fuel ratio) response is customized for an engine.

After installing the XFC, the inputs and outputs must be assigned.

See the diagram below to get an overall general view of the inputs and outputs of an installation.

First determine the type of sensors that are connected to the XFC.

Is the load sensor MAF or MAP?

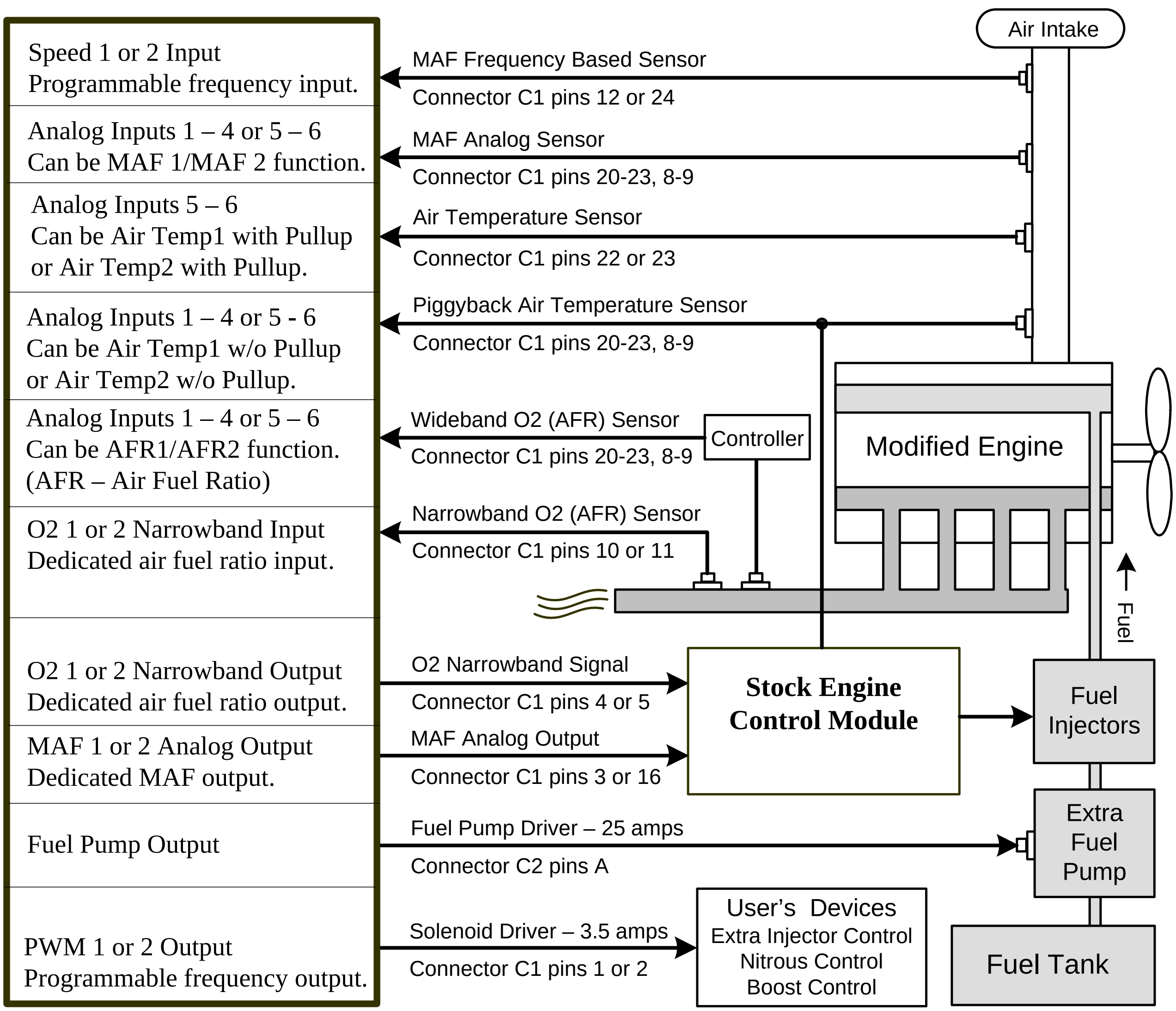
Is the sensor frequency or analog based?

If frequency, is the sensor Karmon Vortex or GM?

Is the O_2 sensor wideband or narrowband?

If an extra fuel pump has been added, what is the frequency of the fuel pump?

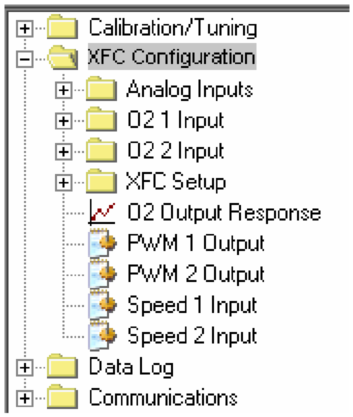
Is the air temperature sensor connected to the XFC and stock engine module, or is it connected only to the XFC? Only some inputs can accept directly an air temperature sensor. Other inputs require a pull-up resistor for an air temperature sensor.



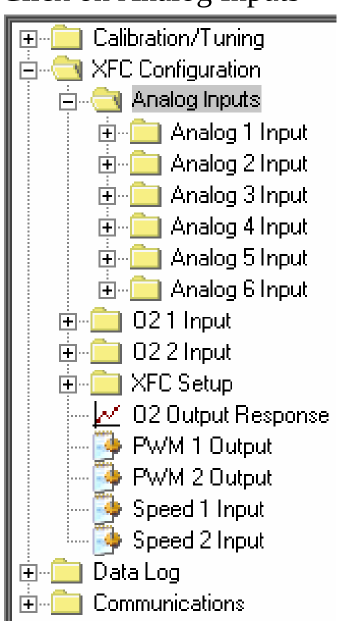
9.1 Setting Analog Input Functions

The inputs and outputs are in the XFC Configuration section. In the XFC Configuration section sensors are assigned in Analog Inputs. Once the assignments and adjustments are done there is seldom a need to use this section.

Start the XFC program.
Start A New File.
Click on XFC Configuration



Click on Analog Inputs



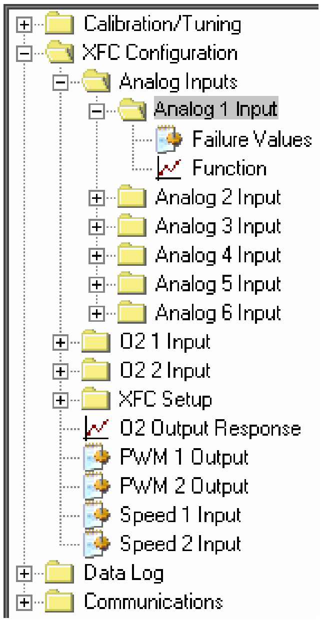
There are six analog inputs that can be assigned different sensors.
The inputs have the following functions:

- Fuel Pressure Sensor
- Air Temperature Sensor with or without pullup resistor.
- Air Fuel Ratio Sensor – AFR Sensor
- Mass Air Flow Sensor – MAF Sensor
- Throttle Position Sensor – TPS Sensor
- Manifold Absolute Pressure Sensor – MAP Sensor

These six analog inputs are separated into two groups.
Analog 1 thru Analog 4 lack pull-up resistors for air temperature sensors.
Analog 5 thru Analog 6 have pull-up resistors for air temperature sensors.
This is only difference between the two groups.

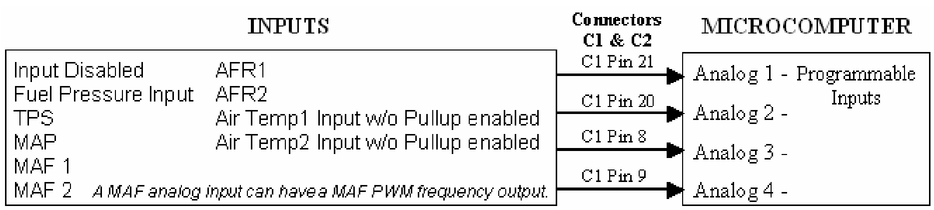
9.2 Analog 1 Thru 4 Inputs

Click on Analog 1 Input



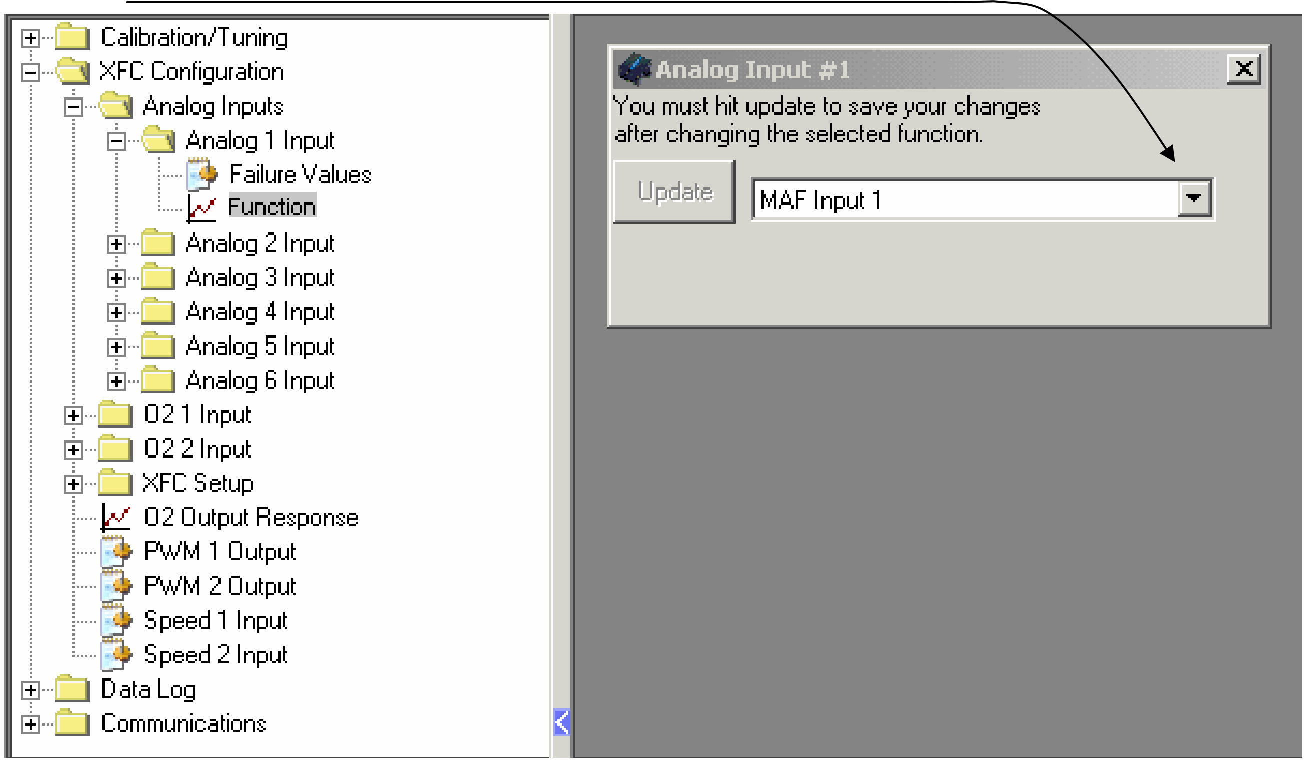
The inputs have the following functions:

Fuel Pressure Sensor
Air Temperature Sensor without pullup resistor.
Air Temperature Sensor without pullup resistor.
Mass Air Flow Sensor - MAF Sensor
Throttle Position Sensor – TPS Sensor
Manifold Absolute Pressure Sensor – MAP Sensor



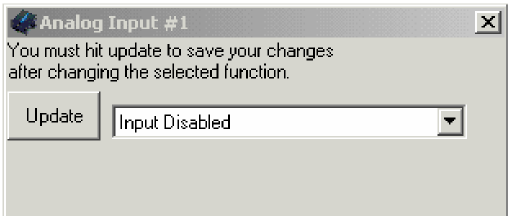
Double click on Function

Click the down arrow in the display to see a list of functions and their setting.

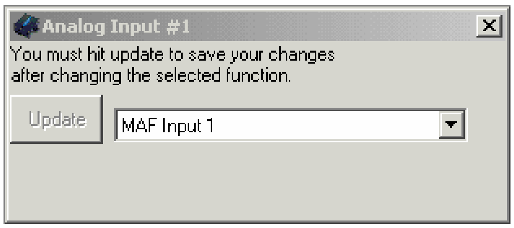


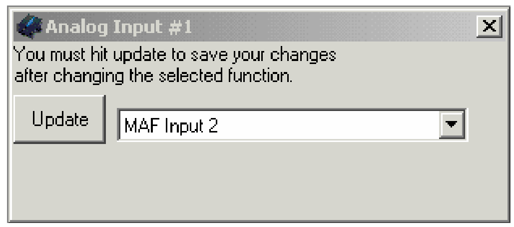
9.2.1 Mass Air Flow (MAF) Input

The XFC has two function assignments for Mass Air Flow (MAF) sensors that measure airflow into an engine. Most MAF sensors have a hot wire cooled by a portion of the airflow into the engine. The amount of air affects the wire resistance. To keep the same wire temperature the engine control module has to increase/decrease current through the wire. This current change is how airflow into an engine is monitored.



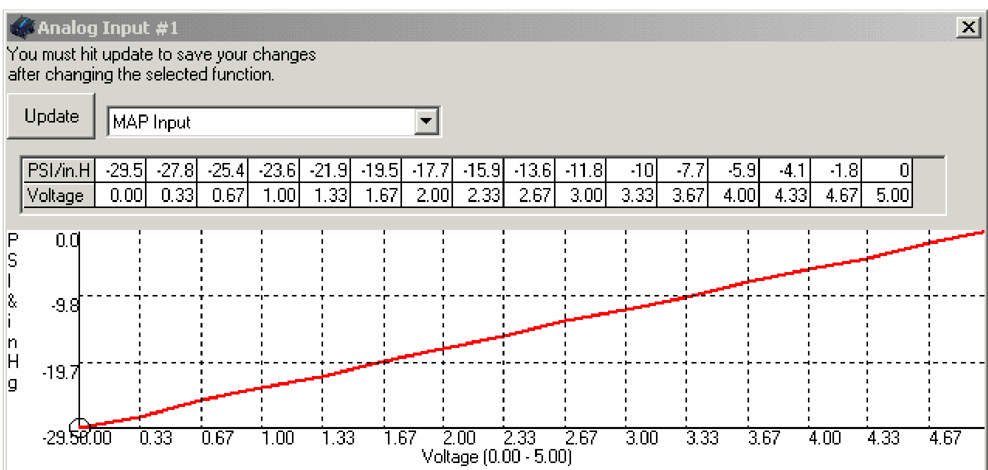
All inputs are initially disabled.





9.2.2 Manifold Absolute Pressure (MAP) Input

The XFC has one function for a Manifold Absolute Pressure (MAP) sensor that measures air flow into an engine. A resistor in the intake manifold changes resistance due to pressure. The lower the engine vacuum, the higher the MAP voltage. Higher MAP voltage indicates greater load.

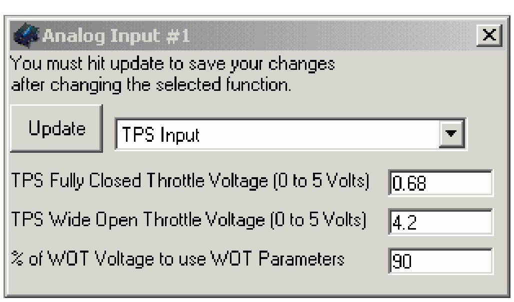


Changing any value in the two data rows affects how the XFC interprets the input from the sensor.

To quickly linearize data, hold down and move the left mouse button between two points. Then press “CTRL” & “L”.

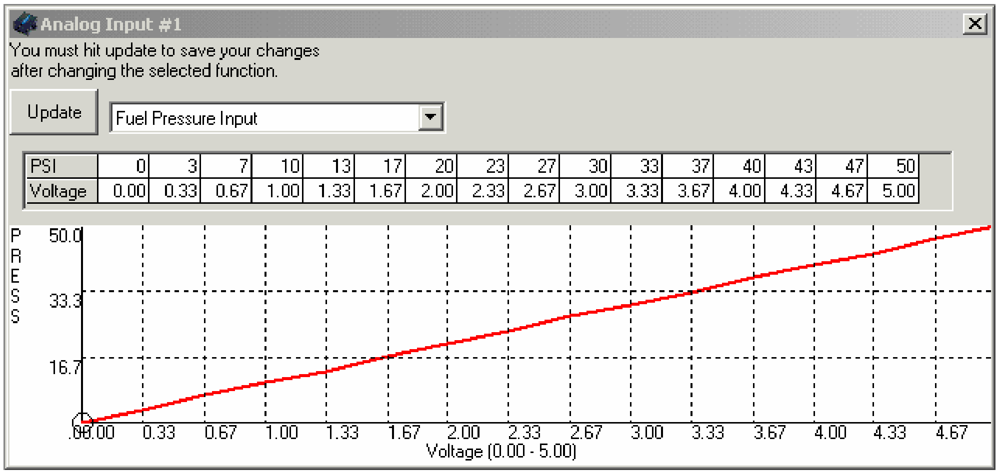
9.2.3 Throttle Position System (TPS) Input

The XFC has one function for the Throttle Position System (TPS) sensor that measures throttle position. A variable resistor is connected to the throttle shaft. When the shaft is moved a signal of varying voltage is created. Voltage increases when the throttle is opened up. This signal and the MAF/MAP signal are used by the engine control module to determine engine output power.



9.2.4 Fuel Pressure Input

The XFC has one function for fuel pressure sensor voltage.



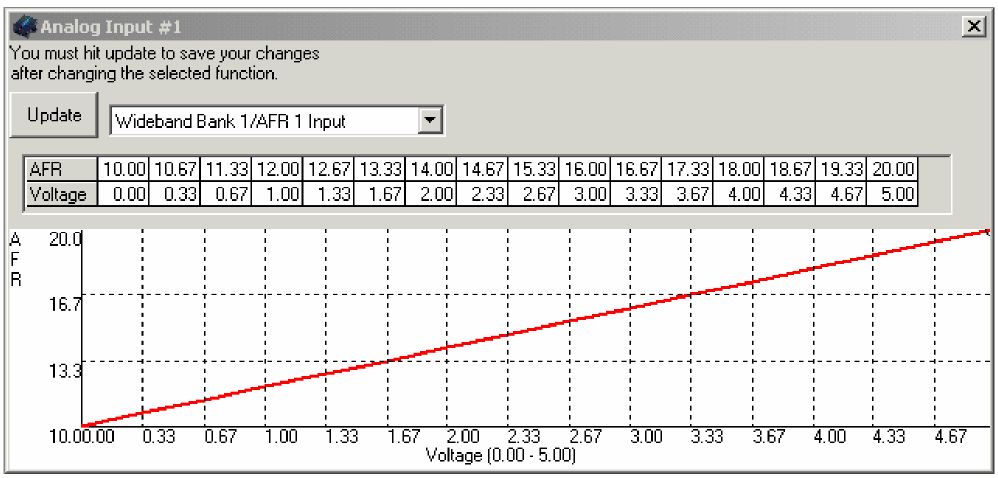
PSI	0	3	7	10	13	17	20	23	27	30	33	37	40	43	47	50
Voltage	0.00	0.33	0.67	1.00	1.33	1.67	2.00	2.33	2.67	3.00	3.33	3.67	4.00	4.33	4.67	5.00

Changing any value in the two data rows affects how the XFC interprets the input from the sensor.

To quickly linearize data, hold down and move the left mouse button between two points. Then press “CTRL” & “L”.

9.2.5 Air Fuel Ratio (AFR) Input

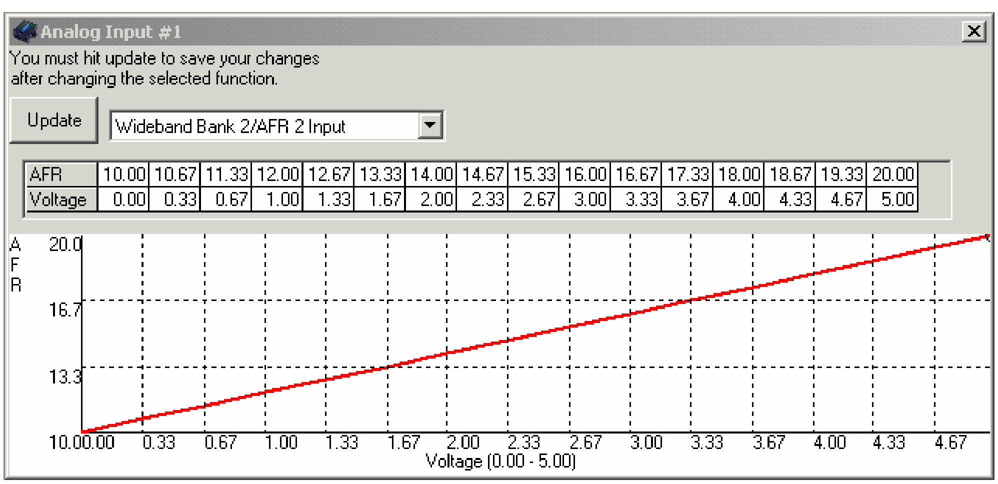
The XFC has two wideband functions for the Air Fuel Ratio (AFR) sensor that measures oxygen in the engine exhaust. The wideband oxygen sensors are used with a controller to give a broader range of output signal (0 – 5vdc) rather than the stock narrowband output signal (0 – 1.2v).



AFR	10.00	10.67	11.33	12.00	12.67	13.33	14.00	14.67	15.33	16.00	16.67	17.33	18.00	18.67	19.33	20.00
Voltage	0.00	0.33	0.67	1.00	1.33	1.67	2.00	2.33	2.67	3.00	3.33	3.67	4.00	4.33	4.67	5.00

Changing any value in the two data rows affects how the XFC interprets the input from the sensor.

To quickly linearize data, hold down and move the left mouse button between two points. Then press “CTRL” & “L”.



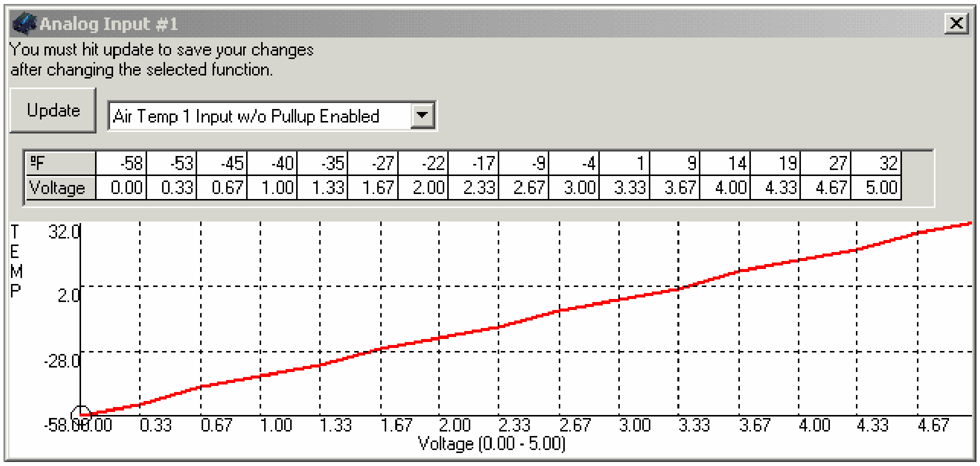
AFR	10.00	10.67	11.33	12.00	12.67	13.33	14.00	14.67	15.33	16.00	16.67	17.33	18.00	18.67	19.33	20.00
Voltage	0.00	0.33	0.67	1.00	1.33	1.67	2.00	2.33	2.67	3.00	3.33	3.67	4.00	4.33	4.67	5.00

Changing any value in the two data rows affects how the XFC interprets the input from the sensor.

To quickly linearize data, hold down and move the left mouse button between two points. Then press “CTRL” & “L”.

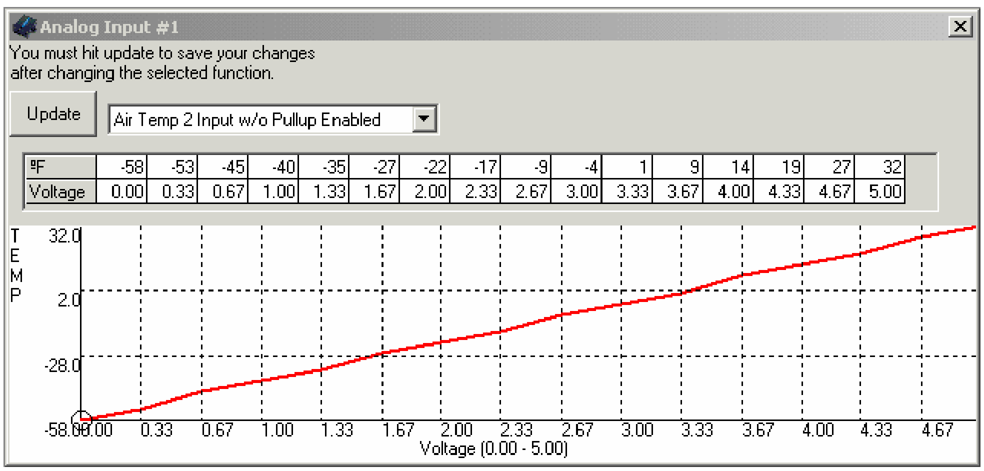
9.2.6 Air Temp w/o Pullup Enabled

The XFC has two functions for the air temperature sensor that measures temperature of the air into the engine. These two input functions do not have a pull-up resistor. They are normally used by connecting to a air temperature sensor that is also connected to the engine control module.



Changing any value in the two data rows affects how the XFC interprets the input from the sensor.

To quickly linearize data, hold down and move the left mouse button between two points. Then press “CTRL” & “L”.



Changing any value in the two data rows affects how the XFC interprets the input from the sensor.

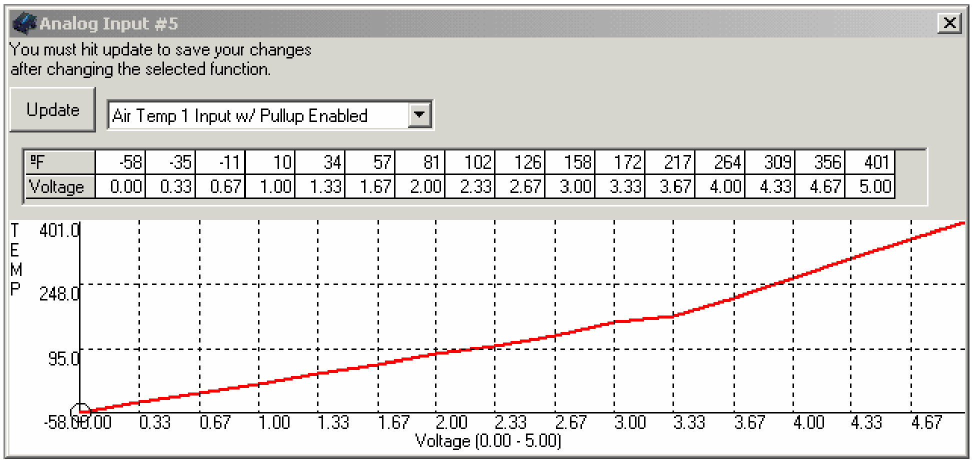
To quickly linearize data, hold down and move the left mouse button between two points. Then press “CTRL” & “L”.

The XFC has two functions for the air temperature sensor that measures temperature of the air into the engine. These two input functions do not have a pull-up resistor. They are normally used by connecting to a air temperature sensor that is also connected to the engine control module.

9.3 Analog 5 Thru 6 Inputs

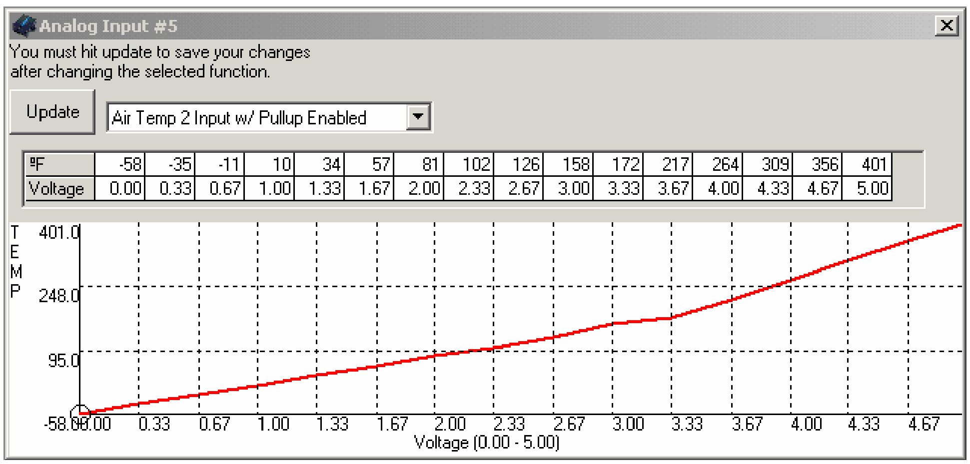
Analog 5 thru 6 has the same functions as analog 1 thru 4 plus two more functions.

These two functions have programmable pull-up resistors for air temperature sensors.



Changing any value in the two data rows affects how the XFC interprets the input from the sensor.

To quickly linearize data, hold down and move the left mouse button between two points. Then press "CTRL" & "L".



Changing any value in the two data rows affects how the XFC interprets the input from the sensor.

To quickly linearize data, hold down and move the left mouse button between two points. Then press "CTRL" & "L".

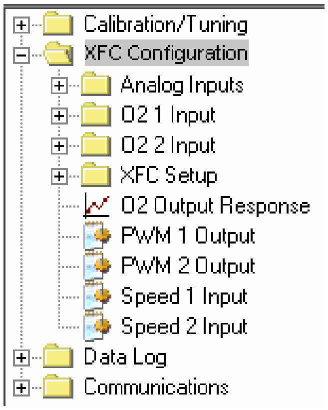
.

The XFC has two functions for the air temperature sensor that measures temperature of the air into the engine. These two input functions on Analog 5 and 6 do have a pull-up resistor. They can be connected directly to an air temperature sensor.

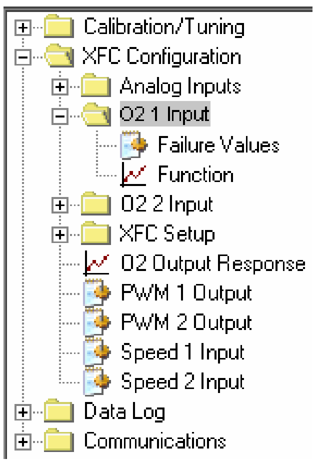
9.4 O_2 1 & 2 Inputs

O_2 1 Input and O_2 2 Input adjust the air/fuel ratio.
Adjustments are the same for both O_2 1 Input and O_2 2 Input.
Only failure values and input response curves can be changed.

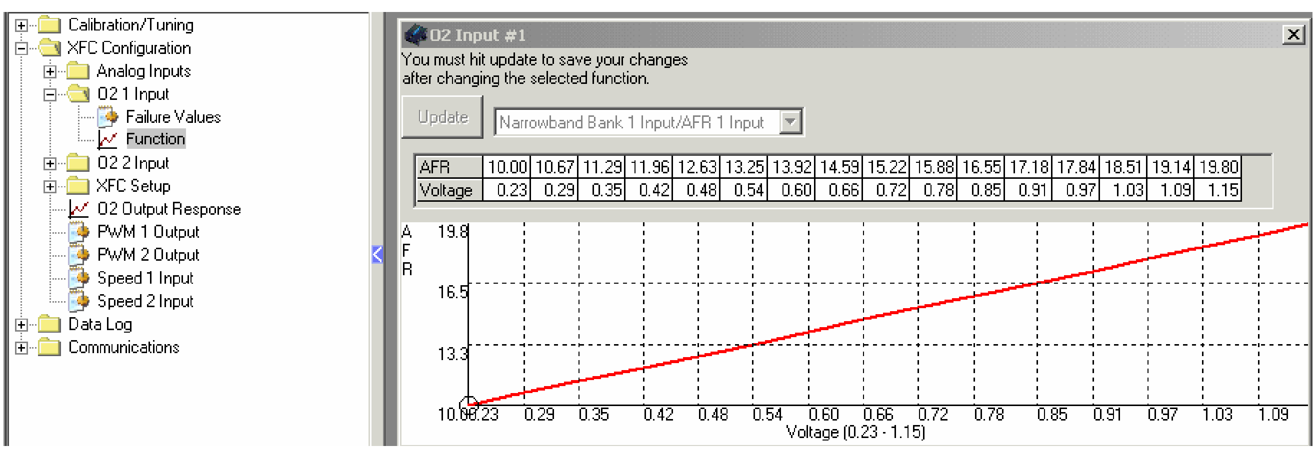
Click on XFC Configuration



Click on O_2 1 Input.



Double click on Function.



Changing any value in the two data rows affects how the XFC interprets the input from the sensor.

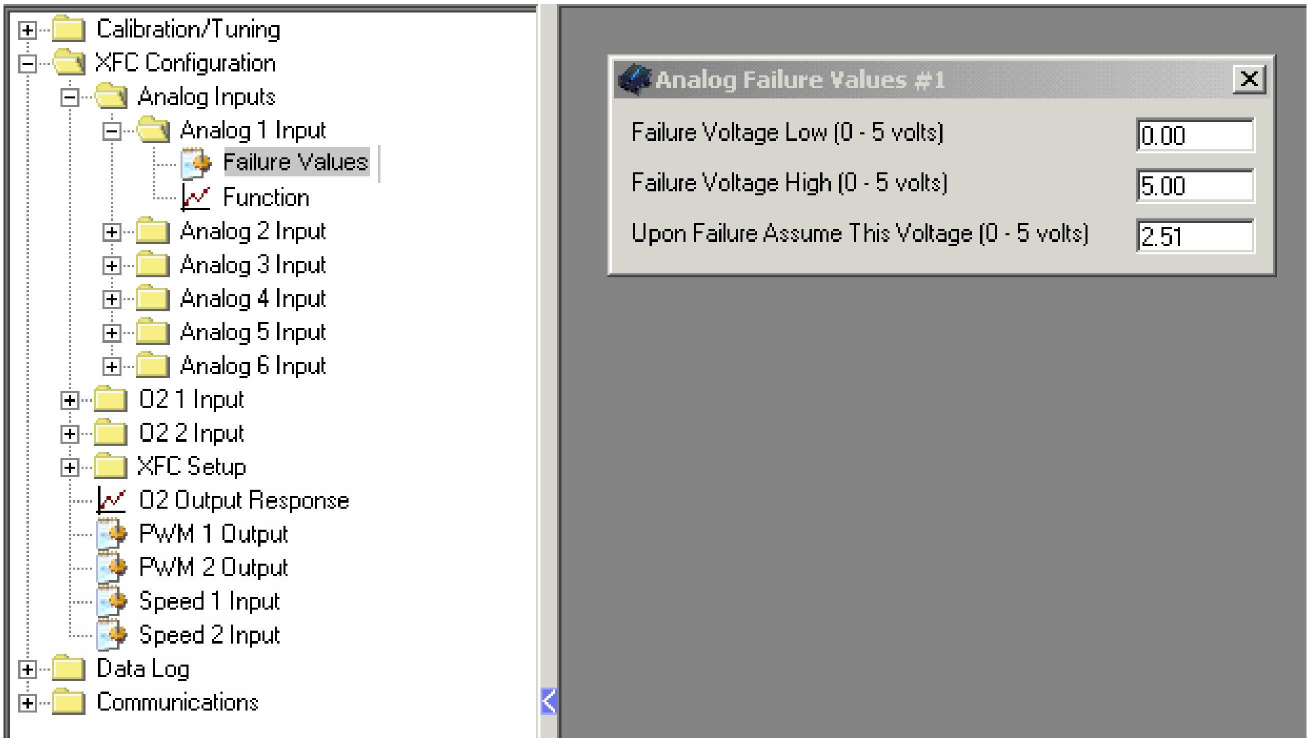
To quickly linearize data, hold down and move the left mouse button between two points.
Then press “CTRL” & “L”.

9.5 Setting Analog Failure Values

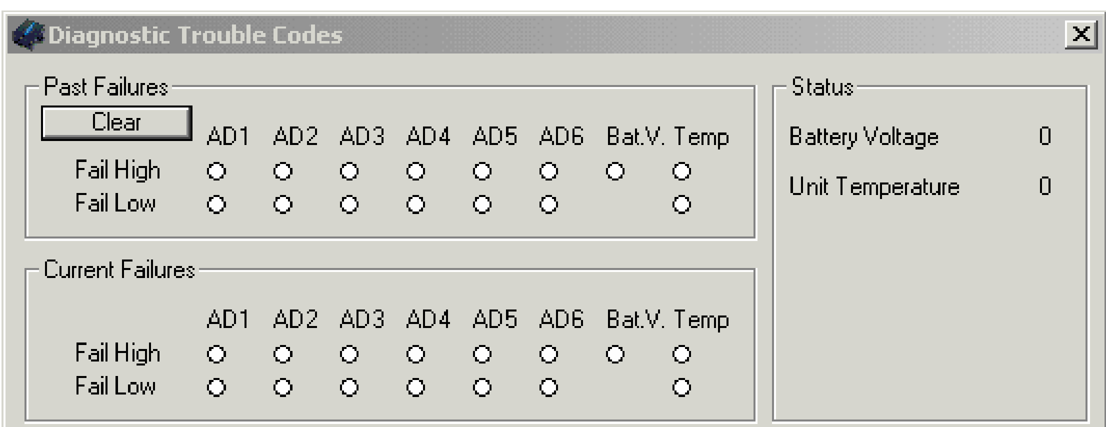
Failure Values are voltages that define failure of the input.
Failed inputs can be set to a predetermined voltage.

Be careful when setting failure voltages. If values for failure voltages are in the operating range of a sensor this will trigger the XFC to take action when sensor values are equal to failure voltages. Most of the time failure value voltages do not need to be changed.

Double click on Failure Values.

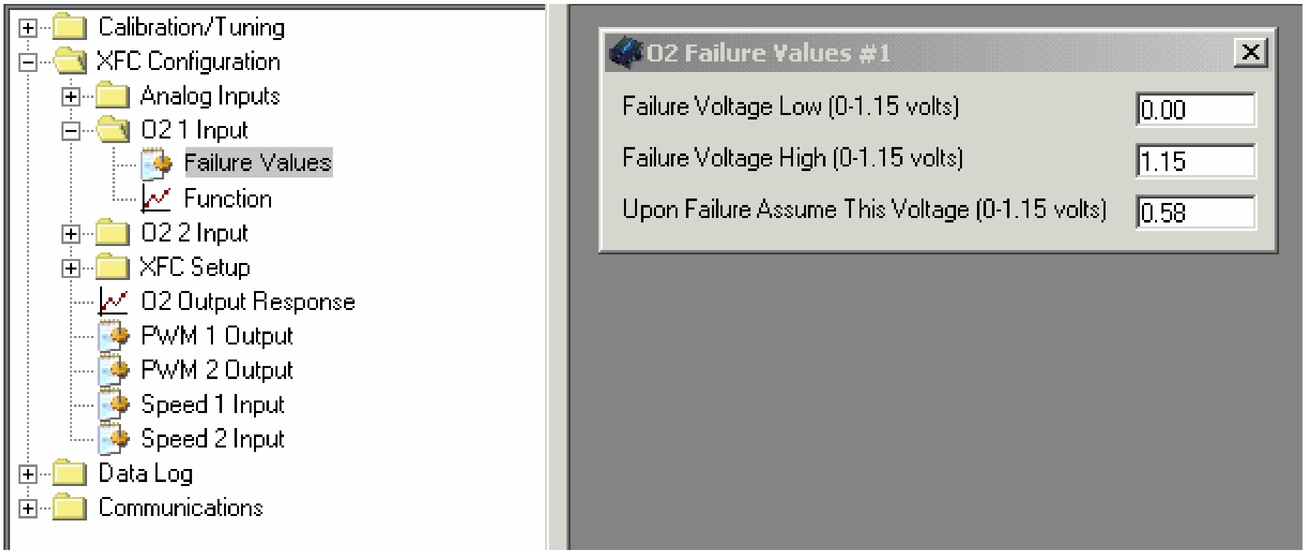


Read the display and enter values.
Analog input failures are recorded at Communications>Diagnostic Trouble Codes.



Diagnostic trouble codes provide failure determination for several parameters. The monitor screen will indicate an analog failure and the main window will flash red when an overtemp condition occurs. The fail low analog value is triggered when voltage of an analog input goes below the programmed analog failure value for that input. The fail high analog value is triggered when voltage of an analog input goes above the programmed analog failure value for that input. The fail high battery voltage is 25 volts. Above this voltage, the unit will cease to function. Fail high temperature is 248°F or 120ºC. The fail low temperature is -22ºF or -30ºC. Above or below this temperature range, the unit shuts down to protect the electronics.

Double click on Failure Values.

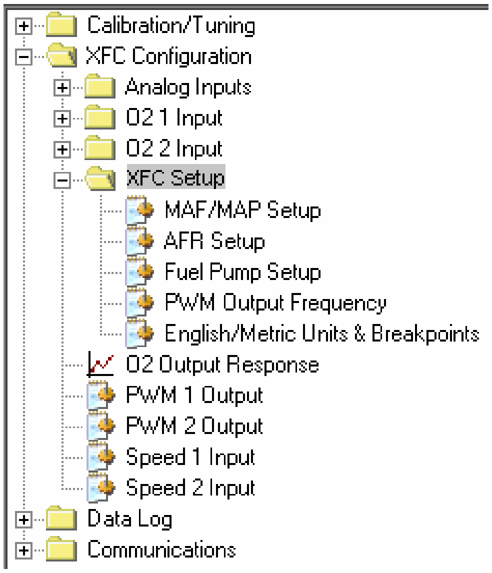


Be careful when setting failure voltages. If values for failure voltages are in the operating range of a sensor this will trigger the XFC to take action when sensor values are equal to failure voltages. Most of the time failure value voltages do not need to be changed.

9.6 XFC Setup

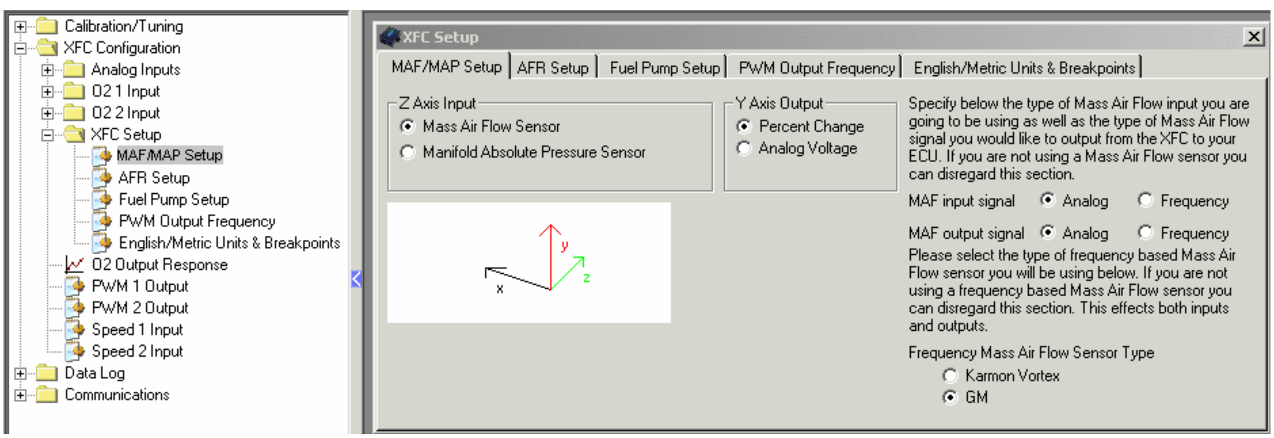
Click on XFC Setup.

This is where the tables and graphs are configured, PWM output frequency determined, table/graph breakpoints set and English or Metric units chosen.



9.6.1 MAF/MAP Setup

Double click on MAF/MAP Setup.



Make a selection in the Z Axis input to chose a type of table/graph.

MAF/MAP table or graph can be: Engine RPM vs Mass Air Flow Sensor (Percent Change)
Engine RPM vs Mass Air Flow Sensor (Analog Voltage)
Engine RPM vs Manifold Absolute Pressure Sensor (Percent Change)
Engine RPM vs Manifold Absolute Pressure Sensor (Analog Voltage)
Engine RPM vs Manifold Absolute Pressure Sensor (Pressure)

Percent Change - Changes are made by percentage increase or decrease of table value.
Analog Voltage - Changes are made by entering a different voltage.
Pressure - Changes are made by entering a different pressure.

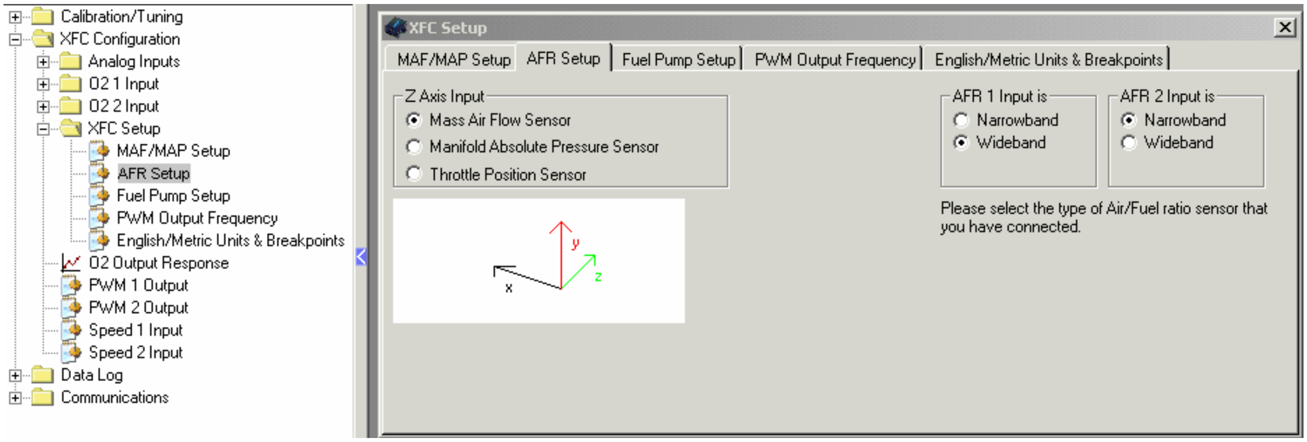
When a mass airflow sensor is used, the table/graph displays if its analog or frequency.
MAF analog input can be converted to a MAF frequency output.
MAF frequency input can be converted to a MAF analog output.

If a frequency mass airflow sensor is used, chose between a Karmon Vortex or GM type sensor.

See Analog Inputs section to set a MAF/MAP analog input.
See Speed Inputs section to set a MAF frequency input.

9.6.2 AFR Setup

Double click on AFR Setup.



Make a selection in the Z Axis input to chose a type of table/graph.

Air/Fuel Ratio table or graph can be: Engine RPM vs Mass Air Flow Sensor (Frequency or Analog)
Engine RPM vs Manifold Absolute Pressure Sensor
Engine RPM vs Throttle Position Sensor.

When a mass air flow sensor is used, the table/graph displays if its analog or frequency.

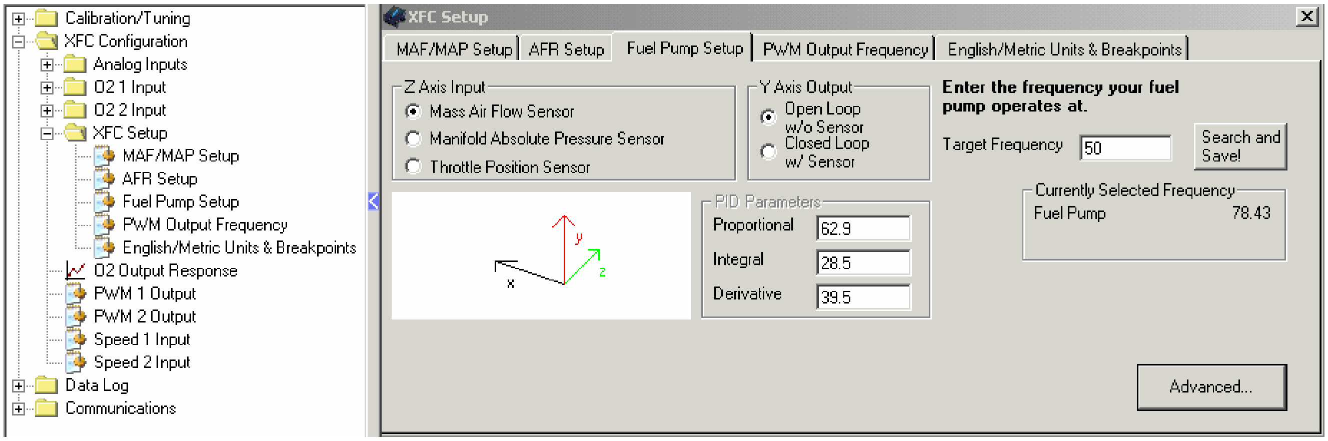
AFR 1 Input and AFR 2 inputs are setup in XFC Configuration>Analog Inputs.

The Narrowband/Wideband settings are for analog input functions AFR1 and AFR2 for O_2 exhaust sensors. Narrowband sensors have an output voltage range of 0 – 1.2vdc. Wideband sensors have an output voltage range of 0 – 5vdc. The XFC has two dedicated narrowband sensor inputs in addition to using AFR1 or AFR2 as narrowband sensor inputs. Wideband sensors with their controllers have a wider signal range but cost more than a narrowband sensor.

See Analog Inputs section to set a MAF/MAP analog input.
See Speed Inputs section to set a MAF frequency input.

9.6.3 Fuel Pressure Setup

Double click on Fuel Pump Setup.



Important: Read the section in the manual on adding an extra fuel pump.
Make a selection in the Z Axis input to chose a type of table/graph.

Fuel Pressure table or graph can be: Engine RPM vs Mass Air Flow Sensor (Frequency or Analog)
Engine RPM vs Manifold Absolute Pressure Sensor
Engine RPM vs Throttle Position Sensor

When a mass air flow sensor is used, the table/graph displays if its analog or frequency.
The mass air flow type sensor; frequency or analog, is set in XFC Configuration>XFC Setup>MAF/MAP Setup.

Target Frequency is where the drive frequency of the pump is entered. Once the pump frequency is entered, click the Search and Save button.
Advanced button just shows another way to set the pump frequency.

PID Parameters are used when a fuel pressure sensor is added to control an extra fuel pump.

Proportional adjustment value is proportional to the error of the signal.

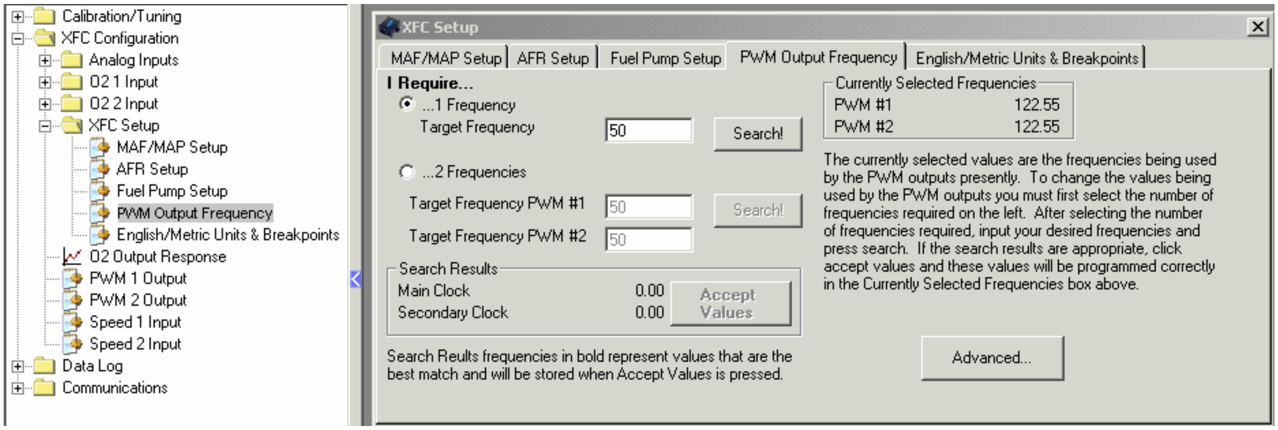
Integral adjustment value is proportional to the amount of time the error is present.
Used to eliminate offset.

Derivative adjustment value is proportional to the rate of change of error.
Used to avoid overshoot

See Analog Inputs section to set a MAF/MAP analog input.
See Speed Inputs section to set a MAF frequency input.

9.6.4 PWM Output Frequency

Double click on PWM Output Frequency.



The frequency of the two PWM outputs are set here.
There are two frequencies, the main frequency and another frequency based on the main frequency.
Both PWM outputs use one of these two frequencies.

Be aware that changing a frequency could affect both PWM outputs.

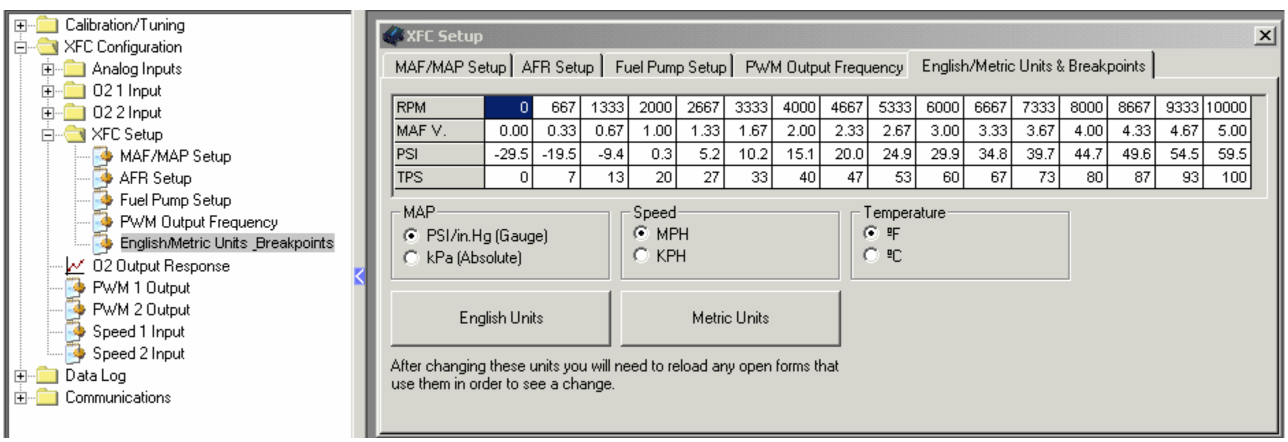
Advanced button shows a different way of setting frequencies.

But generally only the main (1 Frequency Target) frequency needs to be set.

Enter a frequency then click Search button.
If the result is close enough, then click Accept Values button.

9.6.5 English/Metric & Breakpoints

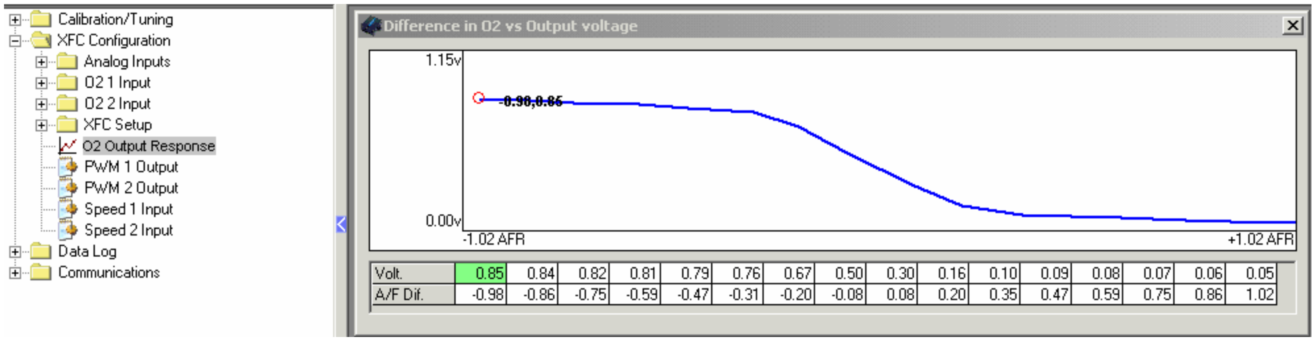
Double click on English/Metric & Breakpoints.



English or metric units of measure are set here.
The rows of data are breakpoints for the different tables or graphs.

9.7 O_2 Output Response

Double click on O_2 Output Response.

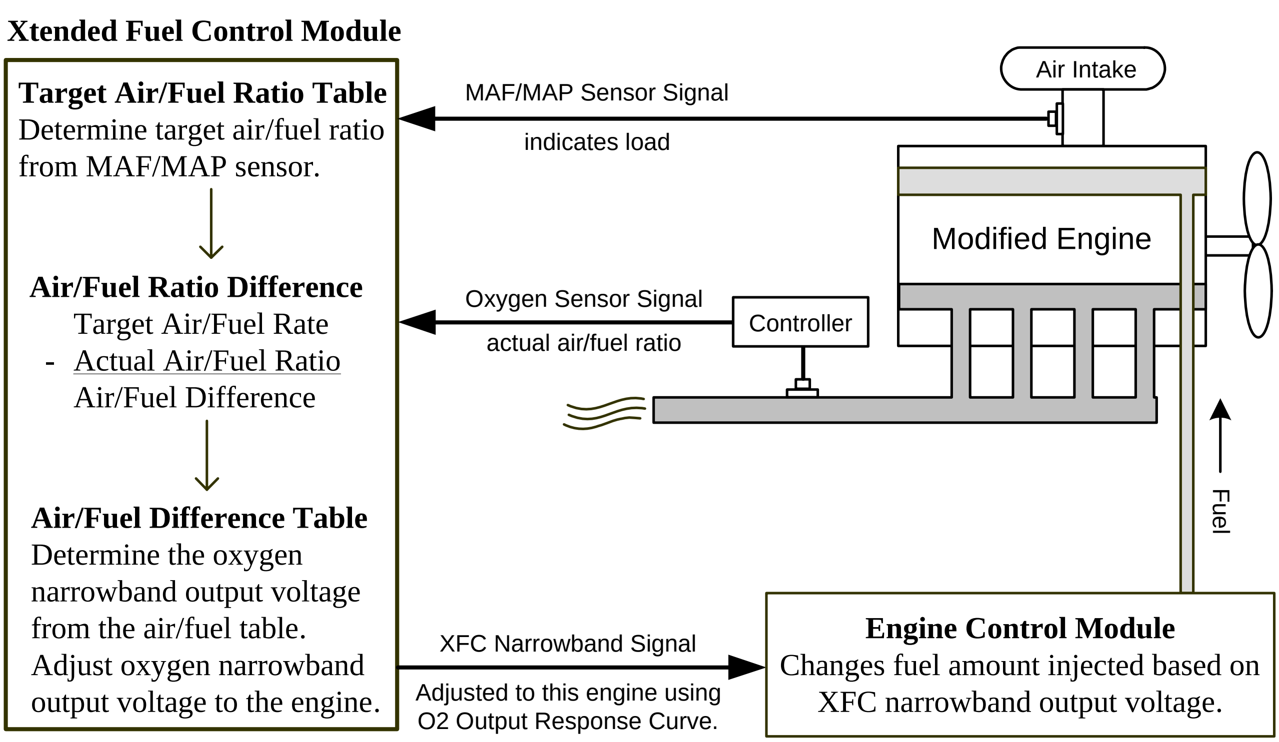


Volt.	0.85	0.84	0.82	0.81	0.79	0.76	0.67	0.50	0.30	0.16	0.10	0.09	0.08	0.07	0.06	0.05
A/F Dif.	-0.98	-0.86	-0.75	-0.59	-0.47	-0.31	-0.20	-0.08	0.08	0.20	0.35	0.47	0.59	0.75	0.86	1.02

This display determines the response of the narrowband oxygen output to the engine control module. The response is based on the difference between the Air/Fuel Ratio Table and the actual air/fuel ratio. The response curve is adjusted to each engine.

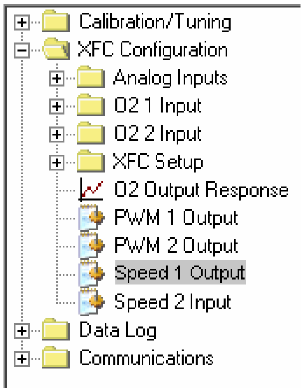
The XFC uses the MAF/MAP sensor to determine the target air/fuel ratio from a table. The target air/fuel ratio is subtracted from the actual air/fuel ratio provided by the exhaust oxygen sensor. The result is the air/fuel ratio difference. The XFC uses the air/fuel ratio difference in a table to provide a narrowband output voltage to the engine control module. The narrowband output voltage curve can be modified for different engines.

Diagram For Closed Loop Air/Fuel Ratio Control

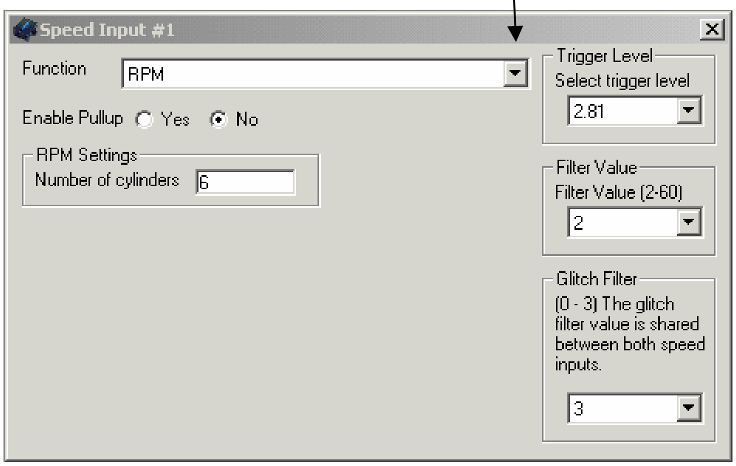


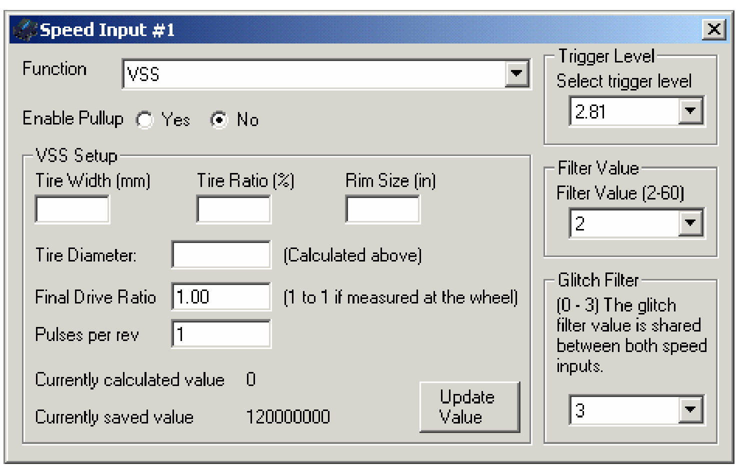
9.8 Speed 1 & 2 Inputs

Click on Speed 1 Input.



Speed 1 and 2 inputs have the same functions.
These two speed inputs can have their signals filtered.
Click the down arrow to see other functions for the speed inputs.

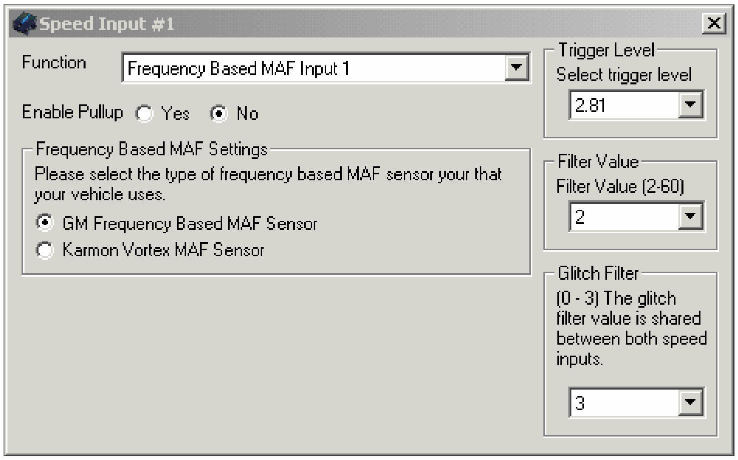


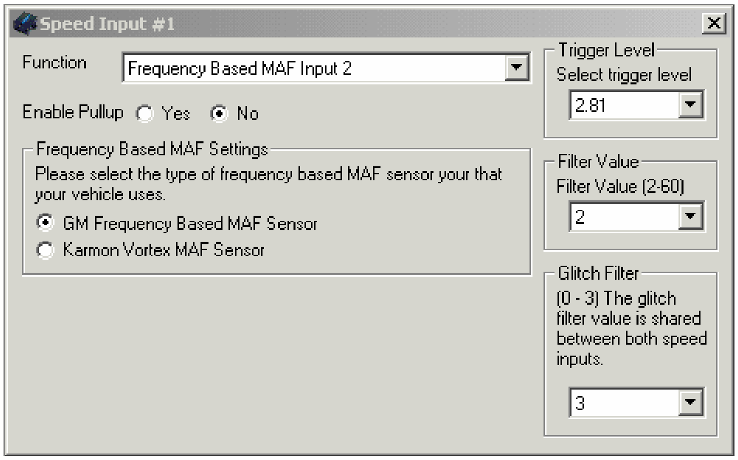


Trigger Level:
The value at which a signal will be considered valid. For example, a speed sensor that goes to 2.5 volts will never be considered valid if the trigger level setting is above 2.5 volts. A trigger level that is set too low can suffer from excessive noise and cause false triggering. 0.94 volts is a good place to start.

Filter Values:
This is a low-pass filter (meaning that only low frequency values are allowed to pass through this filter). A higher value will filter more and is appropriate for lower frequency inputs like engine rpm. A lower value will filter less and is appropriate for higher frequency inputs like wheel speed. 2 is a good starting point for a wheel speed or vehicle speed input. 60 is a good starting point for an engine rpm input.

Glitch filter:
Filters momentary spikes in speed readings. The higher the number, the stronger the filtering. Usually this should be left at 3 unless otherwise instructed.





Trigger Level:
The value at which a signal will be considered valid. For example, a speed sensor that goes to 2.5 volts will never be considered valid if the trigger level setting is above 2.5 volts. A trigger level that is set too low can suffer from excessive noise and cause false triggering. 0.94 volts is a good place to start.

Filter Values:
This is a low-pass filter (meaning that only low frequency values are allowed to pass through this filter). A higher value will filter more and is appropriate for lower frequency inputs like engine rpm. A lower value will filter less and is appropriate for higher frequency inputs like wheel speed. 2 is a good starting point for a wheel speed or vehicle speed input. 60 is a good starting point for an engine rpm input.

Glitch filter:
Filters momentary spikes in speed readings. The higher the number, the stronger the filtering. Usually this should be left at 3 unless otherwise instructed.

10. XFC CALIBRATION/TUNING

Click on Calibration/Tuning.

Screen background is blue when the XFC is online to the computer.

Screen background is gray when the XFC is offline to the computer.

The five tables in the Calibration/Tuning section are the center of the XFC.

The tables are based on engine rpm vs. an input.

To adjust the output signals, table entries are changed.

The initial setup revolves around the XFC Configuration of inputs and outputs for the tables.

Once the inputs/outputs are configured, no more adjustment is generally done.

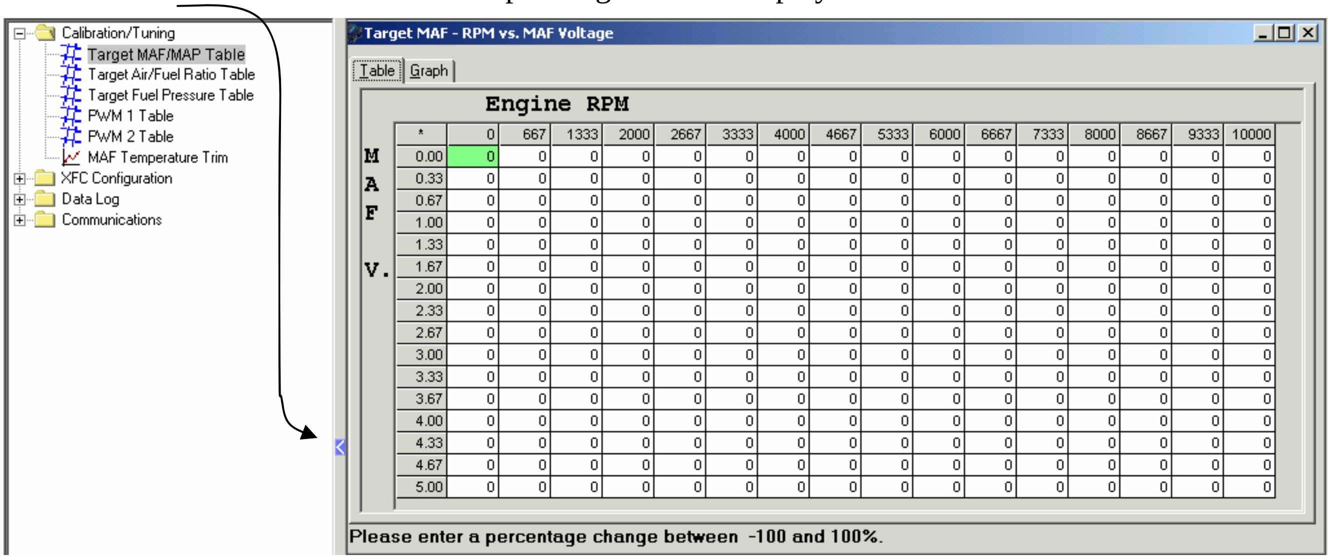
Installation and configuration of inputs/outputs should be done before using tables/graphs.

10.1 MAF/MAP Table

The MAF/MAP table is used to modify the signal from a MAF/MAP sensor. Typically this is done to prepare the signal for a stock engine control module.

Double click on MAF/MAP Table.

If desired click the blue arrow to expand right side of display.



*	0	667	1333	2000	2667	3333	4000	4667	5333	6000	6667	7333	8000	8667	9333	10000
0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.67	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.67	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2.33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2.67	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3.33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3.67	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4.33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4.67	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

A MAF/MAP Table is displayed.

This table consists of engine rpm vs input MAF sensor voltage, using a percentage change in the table.

For a different MAF/MAP table go to XFC Configuration>XFC Setup>MAF/MAP Setup.

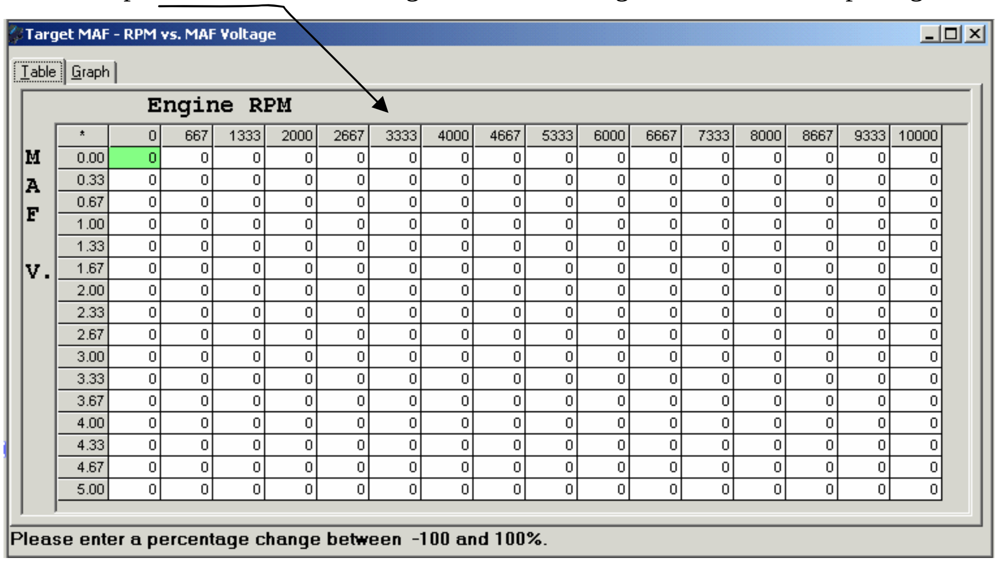
Change/save settings.

Return/click to Target MAF/MAP Table for a different table.

MAF/MAP table can be: Engine RPM vs Mass Air Flow Sensor (Percent Change)
Engine RPM vs Mass Air Flow Sensor (Analog Voltage)
Engine RPM vs Manifold Absolute Pressure Sensor (Percent Change)
Engine RPM vs Manifold Absolute Pressure Sensor (Analog Voltage)
Engine RPM vs Manifold Absolute Pressure Sensor (Pressure)

Percent Change - Default values are used. Enter a percent of increase/decrease for adjustment at a given rpm.
Analog Voltage - Default values are used. Enter a different voltage for adjustment at a given rpm.
Pressure - Default values are used. Enter a different pressure for adjustment at a given rpm.

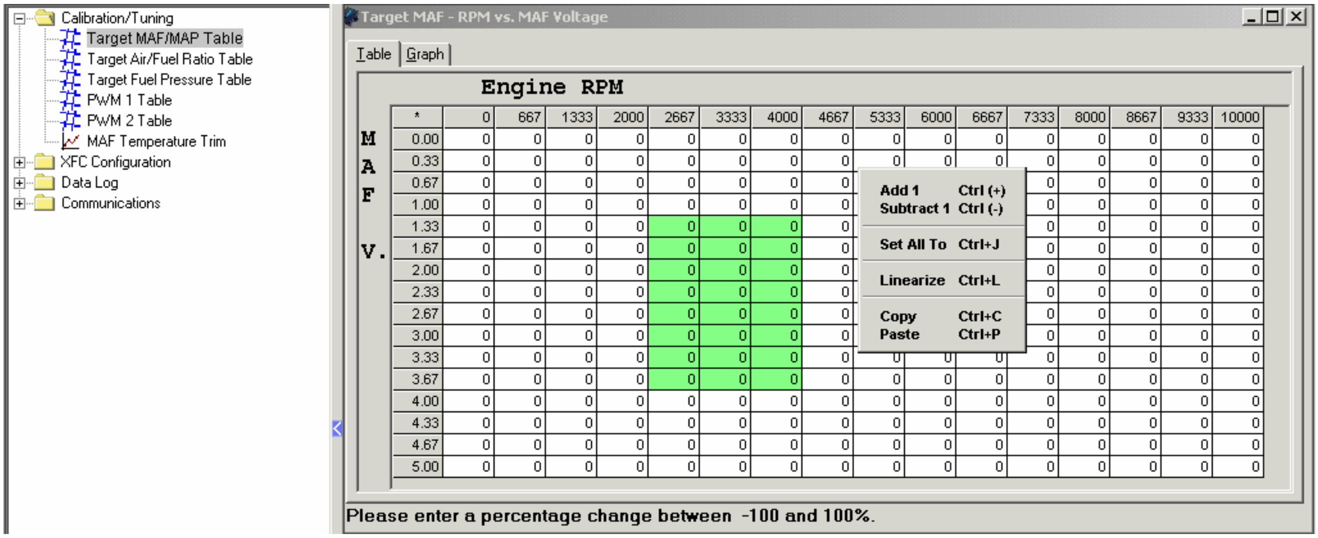
Table/Graph columns can be changed at XFC Configuration>XFC Setup>English/Metric Units & Breakpoints.



*	0	667	1333	2000	2667	3333	4000	4667	5333	6000	6667	7333	8000	8667	9333	10000
0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.67	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.67	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2.33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2.67	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3.33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3.67	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4.33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4.67	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

10.1.2 Large Table Changes

To make large table changes use the left mouse button to highlight a section of the table.
Right click the table.

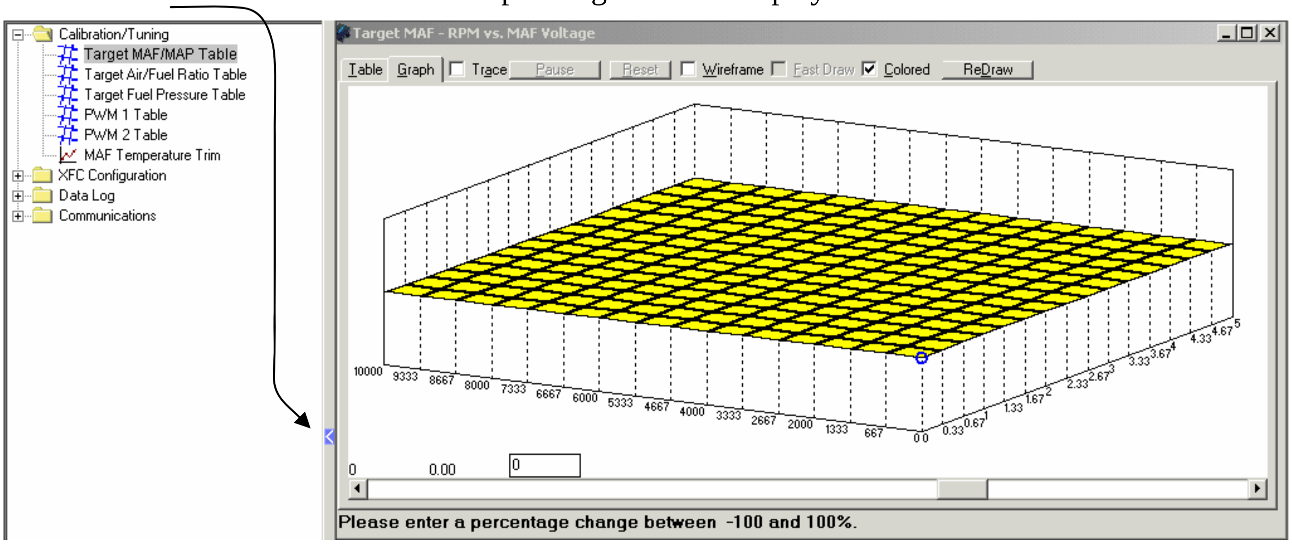


A pop-up display appears.
The highlighted area will change based on what function is clicked in the pop-up display.
"Add 1" and "Subtract 1" are not always a value of 1, it can represent 1% of a value.
When Linearize is selected, values linearly increase/decrease between beginning and ending values.
Any change in the table is immediately reflected in the graph.

10.2 MAF/MAP Graph

Click the Graph tab.

If desired click the blue arrow to expand right side of display.



The MAF/MAP Graph is displayed.

Moving the scroll bar rotates the graph for a better view.

The Trace box is checked to provide a trace on the screen when the engine is running.

This graph consists of engine rpm vs input MAF sensor voltage, using percentage change in the graph.

For a different MAF/MAP graph go to XFC Configuration>XFC Setup>MAF/MAP Setup.

Change/save settings.

Return/click to Target MAF/MAP Graph for a different graph.

MAF/MAP graph can be: Engine RPM vs Mass Air Flow Sensor (Percent Change)
Engine RPM vs Mass Air Flow Sensor (Analog Voltage)
Engine RPM vs Manifold Absolute Pressure Sensor (Percent Change)
Engine RPM vs Manifold Absolute Pressure Sensor (Analog Voltage)
Engine RPM vs Manifold Absolute Pressure Sensor (Pressure)

Percent Change - Default values are used. Enter a percent of increase/decrease for adjustment at a given rpm.
Analog Voltage - Default values are used. Enter a different voltage for adjustment at a given rpm.
Pressure - Default values are used. Enter a different pressure for adjustment at a given rpm.

The box with numbers is where value changes are entered.

Click on the appropriate place in the graph.

Then enter a value in the box.

Then hit the “Enter” key.

Values are immediately updated in the graph and table.

The number next to the box is input MAF/MAP voltage.

The number at the end is engine rpm.

Graph Setting

For a fast computer: Trace ON, Color ON.

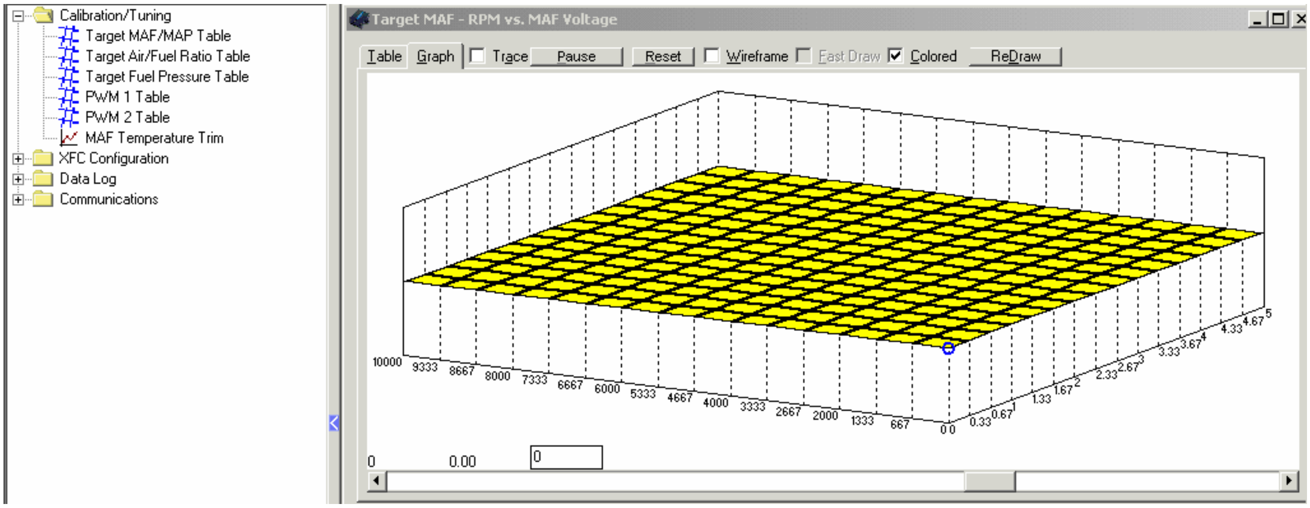
For a medium speed computer: nothing on.

For a slow computer: Wire Frame ON.

For a very slow computer: Wire Frame ON, Fast Draw ON, Periodic Redraw may be required.

10.2.1 Trace

When the XFC connected and in online mode with the XFC program real time activity can be recorded in graph section. This is useful when trying to tune out the rough edges of a calibration. Start the trace by clicking on the trace button and the trace ball will begin leaving a trail of where it has been on the graph. The trace is paused by clicking the Pause button. To resume the trace, click the Record button. The trace is reset by clicking on the Reset button.



If an engine has an area that needs additional tuning, an ideal recording method would be as follows:

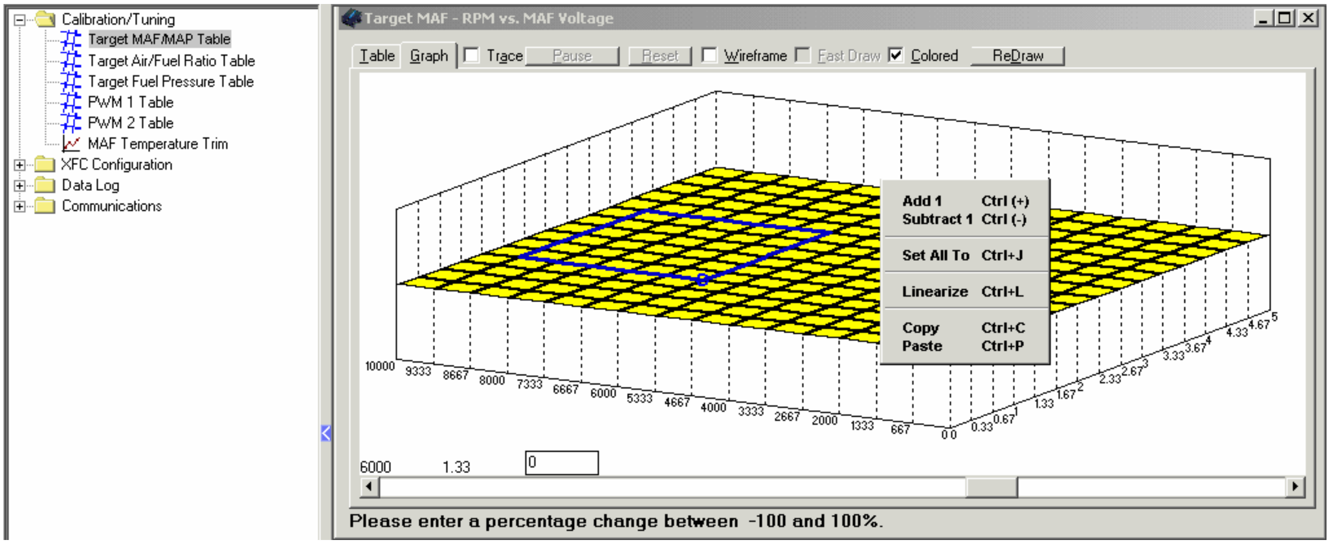
1.) Start a trace from the display or press A on the keyboard, reset a running grace by simply pressing the Reset button next to the trace or pressing R on the keyboard.
2.) Bring the vehicle to the conditions where it appeared to require tuning. Repeat these conditions several times in a row.
3.) Once having recreated the issue several times press the Pause button or press P on the keyboard. There is now a brief recording of where the engine was operating during the trace. This should help tune out the problem.

Please note the longer the trace runs, the more resources will be required of the computer. Ideally run a brief trace when a problem area is discovered and pause once the area has been recorded.

Remember – If testing this on the street always have someone else in the vehicle operating the computer. The driver should *NEVER* operate a computer while operating a vehicle.

10.2.2 Large Graph Changes

To make large table changes use the left mouse button to highlight a section of the graph.
Right click the graph.



A pop-up display appears.
The highlighted area will change based on what function is clicked in the pop-up display.

"Add 1" and "Subtract 1" are not always a value of 1, it can represent 1% of a value.

When Linearize is selected, values linearly increase/decrease between beginning and ending values.

Any change in the graph is immediately reflected in the table.

10.3 MAF/MAP Setup

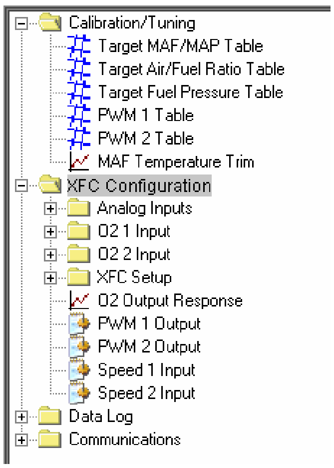
MAF/MAP tables and graphs are determined in MAF/MAP Setup.
To change a MAF/MAP table or graph go to XFC Configuration>XFC Setup>MAF/MAP Setup.

MAF/MAP table or graph can be:
- Engine RPM vs Mass Air Flow Sensor (Percent Change)
- Engine RPM vs Mass Air Flow Sensor (Analog Voltage)
- Engine RPM vs Manifold Absolute Pressure Sensor (Percent Change)
- Engine RPM vs Manifold Absolute Pressure Sensor (Analog Voltage)
- Engine RPM vs Manifold Absolute Pressure Sensor (Pressure)

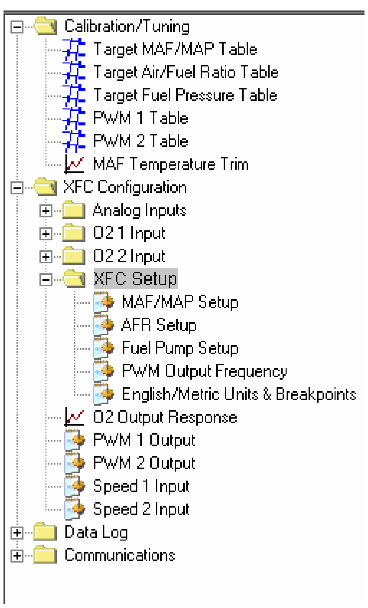
Percent Change - Default values are used. Enter a percent of increase/decrease for adjustment at a given rpm.
Analog Voltage - Default values are used. Enter a different voltage for adjustment at a given rpm.
Pressure - Default values are used. Enter a different pressure for adjustment at a given rpm.

Below is an example of how to get to MAF/MAP Setup.

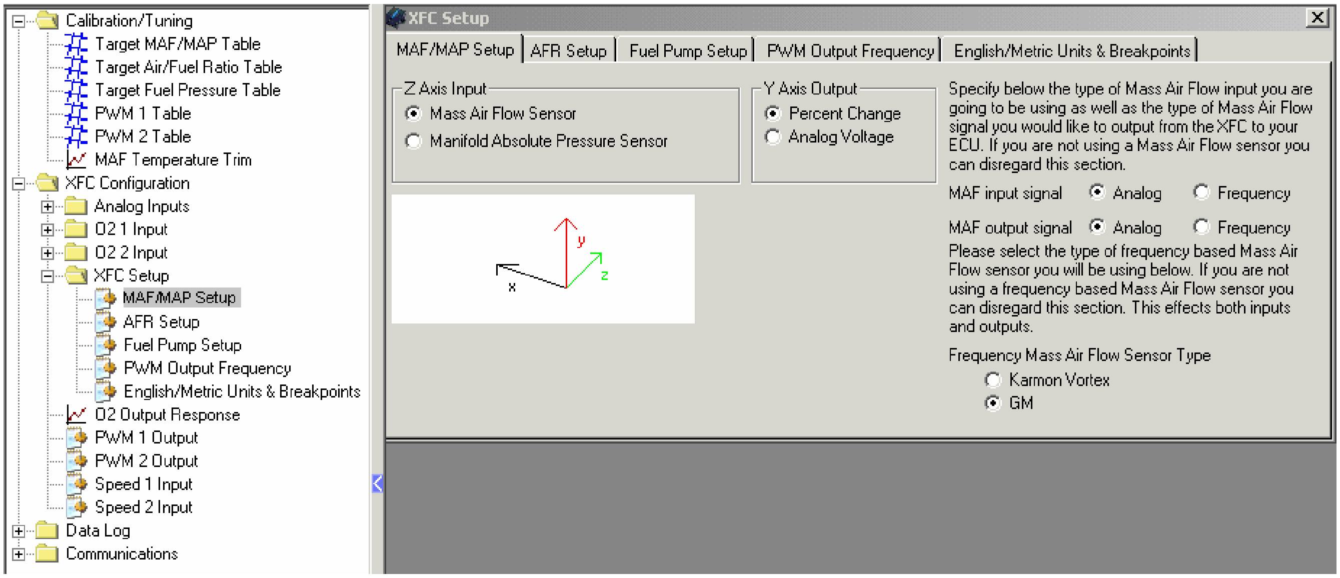
Click on XFC Configuration.



Click on XFC Setup to get to MAF/MAP Setup.



Double click on MAF/MAP Setup.



Make a selection in the Z Axis input to chose a type of table/graph.

MAF/MAP table or graph can be: Engine RPM vs Mass Air Flow Sensor (Percent Change)
Engine RPM vs Mass Air Flow Sensor (Analog Voltage)
Engine RPM vs Manifold Absolute Pressure Sensor (Percent Change)
Engine RPM vs Manifold Absolute Pressure Sensor (Analog Voltage)
Engine RPM vs Manifold Absolute Pressure Sensor (Pressure)

Percent Change - Changes are made by percentage increase or decrease of table value.
Analog Voltage - Changes are made by entering a different voltage.
Pressure - Changes are made by entering a different pressure.

If a frequency mass air flow sensor is used, chose between a Kamon Vortex or GM type sensor.
When a mass air flow sensor is used, the table/graph will display if the sensor is analog or frequency.

MAF analog input can be converted to a MAF frequency output.
MAF frequency input can be converted to a MAF analog output.

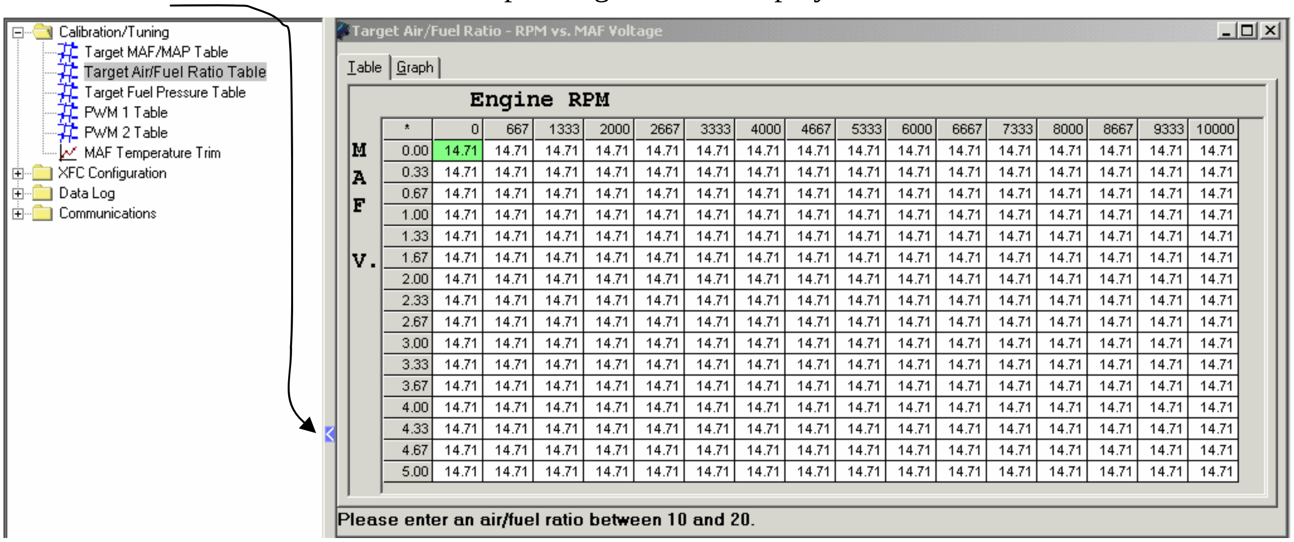
See Analog Inputs section to set a MAF/MAP analog input.
See Speed Inputs section to set a MAF frequency input.

10.4 Air/Fuel Ratio Table

The Air/Fuel Ratio table is used to create an air/fuel ratio value for a given engine rpm from a MAF/MAP/Throttle sensor. This provides a desired air/fuel ratio to compare against an actual air fuel ratio value to make fuel adjustments to the engine..

Double click on Air/Fuel Ratio Table.

If desired click the blue arrow to expand right side of display.



*	0	667	1333	2000	2667	3333	4000	4667	5333	6000	6667	7333	8000	8667	9333	10000
0.00	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71
0.33	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71
0.67	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71
1.00	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71
1.33	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71
1.67	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71
2.00	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71
2.33	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71
2.67	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71
3.00	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71
3.33	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71
3.67	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71
4.00	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71
4.33	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71
4.67	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71
5.00	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71

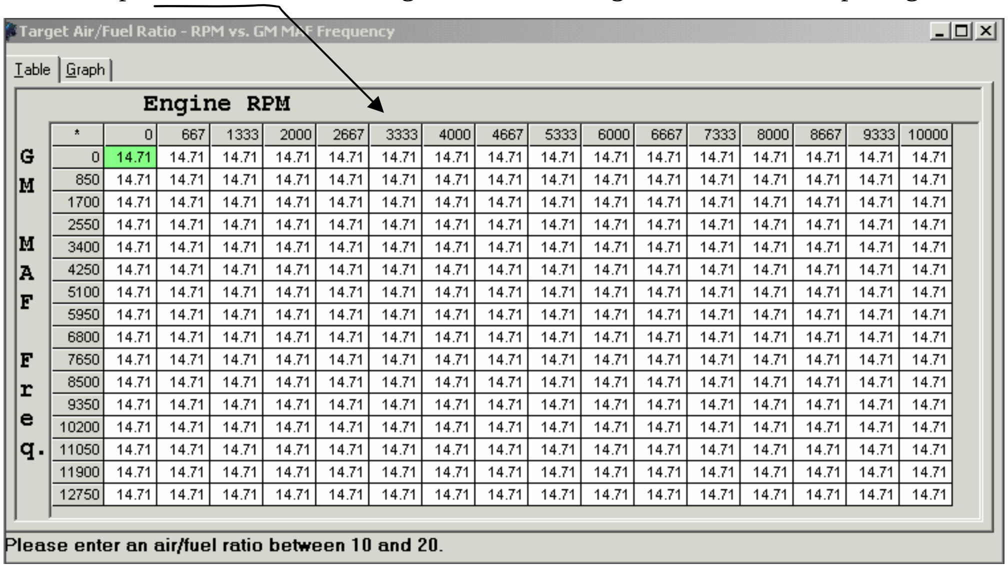
The Air/Fuel Ratio Table is displayed.
This table consists of engine rpm vs input MAF sensor voltage.
The table can consist of engine rpm vs MAF voltage, MAP voltage or throttle position.

For a different Air/Fuel Ratio Table go to XFC Configuration>XFC Setup>AFR Setup.
Change/save settings.
Return/click to Target Air/Fuel Ratio Table for a different table.

Air/Fuel Ratio table can be: Engine RPM vs Mass Air Flow Sensor (Frequency or Analog)
Engine RPM vs Manifold Absolute Pressure Sensor
Engine RPM vs Throttle Position Sensor

When a mass air flow sensor is used, the table/graph will display if the sensor is analog or frequency.
The mass air flow type sensor; frequency or analog, is set in XFC Configuration>XFC Setup>MAF/MAP Setup.

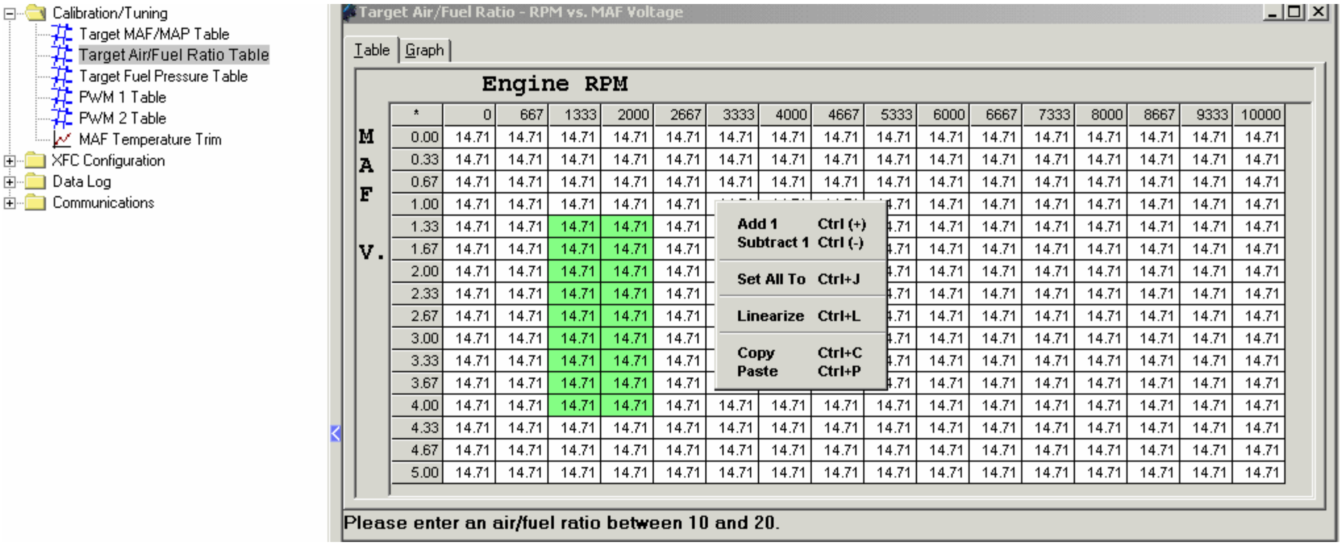
Table/Graph columns can be changed at XFC Configuration>XFC Setup>English/Metric Units & Breakpoints.



*	0	667	1333	2000	2667	3333	4000	4667	5333	6000	6667	7333	8000	8667	9333	10000
0	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71
850	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71
1700	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71
2550	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71
3400	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71
4250	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71
5100	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71
5950	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71
6800	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71
7650	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71
8500	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71
9350	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71
10200	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71
11050	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71
11900	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71
12750	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71	14.71

10.4.1 Large Table Changes

To make large table changes use the left mouse button to highlight a section of the table.
Right click the table.



A pop-up display appears.
The highlighted area will change based on what function is clicked in the pop-up display.

"Add 1" and "Subtract 1" are not always a value of 1, it can represent 1% of a value.

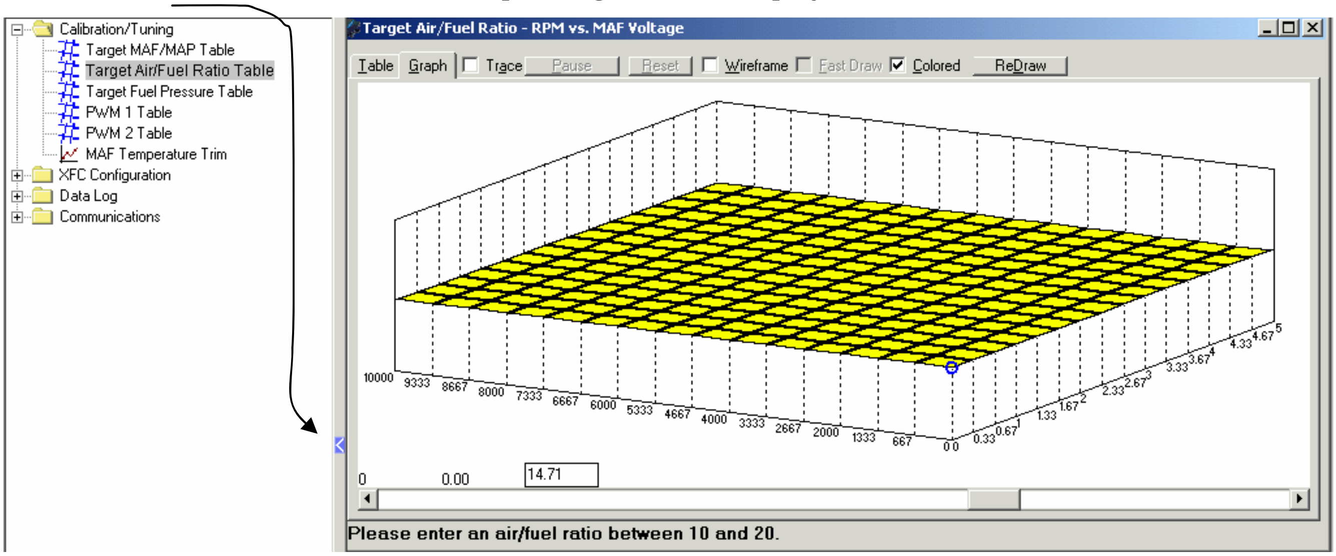
When Linearize is selected, values linearly increase/decrease between beginning and ending values.

Any change in the table is immediately reflected in the graph.

10.5 Air/Fuel Ratio Graph

Click on the Graph tab.

If desired click the blue arrow to expand right side of display.



The Air/Fuel Ratio Graph is displayed.
Moving the scroll bar rotates the graph for a better view.
The Trace box is checked to provide a trace on the screen when the engine is running.
This graph consists of engine rpm vs input MAF sensor voltage.
The graph can consist of engine rpm vs MAF voltage, MAP voltage, or throttle position.

For a different Air/Fuel Ratio Graph go to XFC Configuration>XFC Setup>AFR Setup.
Change/save settings.
Return/click to Target Air/Fuel Ratio Table for a different table.

Air/Fuel Ratio graph can be: Engine RPM vs Mass Air Flow Sensor (Frequency or Analog)
Engine RPM vs Manifold Absolute Pressure Sensor
Engine RPM vs Throttle Position Sensor

When a mass air flow sensor is used, the graph displays if its analog or frequency.
The mass air flow type sensor; frequency or analog, is set in XFC Configuration>XFC Setup>MAF/MAP Setup.The box with numbers is where value changes are entered.

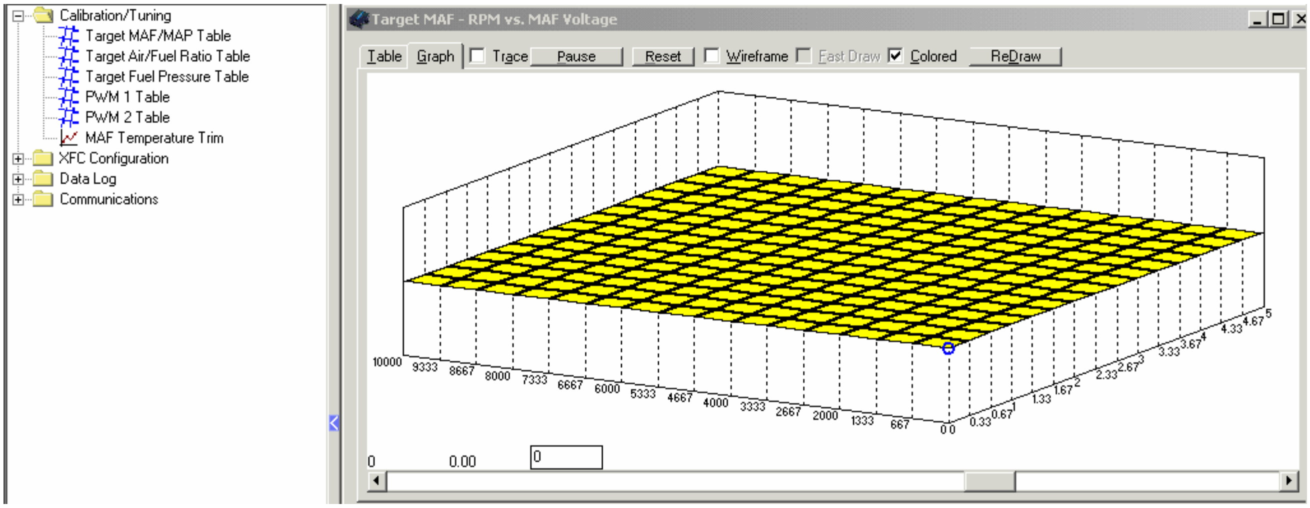
Click on the appropriate place in the graph.
Then enter a value in the box.
Then hit “Enter” key.
Values are immediately updated in the graph and table.

The number next to the box is input MAF voltage, MAP voltage, or throttle position.
The number at the end is engine rpm.

Graph Setting
For a fast computer: Trace ON, Color ON.
For a medium speed computer: nothing on.
For a slow computer: Wire Frame ON.
For a very slow computer: Wire Frame ON, Fast Draw ON, Periodic Redraw may be required.

10.5.1 Trace

When the XFC connected and in online mode with the XFC program real time activity can be recorded in graph section. This is useful when trying to tune out the rough edges of a calibration. Start the trace by clicking on the trace button and the trace ball will begin leaving a trail of where it has been on the graph. The trace is paused by clicking the Pause button. To resume the trace, click the Record button. The trace is reset by clicking on the Reset button.



If an engine has an area that needs additional tuning, an ideal recording method would be as follows:

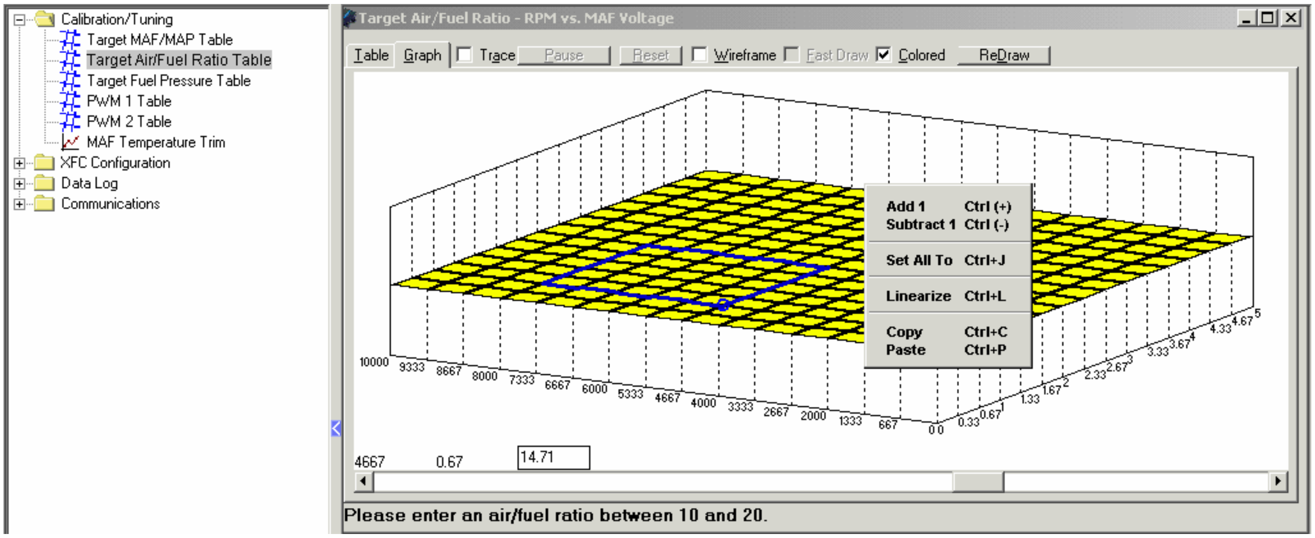
1.) Start a trace from the display or press A on the keyboard, reset a running grace by simply pressing the Reset button next to the trace or pressing R on the keyboard.
2.) Bring the vehicle to the conditions where it appeared to require tuning. Repeat these conditions several times in a row.
3.) Once having recreated the issue several times press the Pause button or press P on the keyboard. There is now a brief recording of where the engine was operating during the trace. This should help tune out the problem.

Please note the longer the trace runs, the more resources will be required of the computer. Ideally run a brief trace when a problem area is discovered and pause once the area has been recorded.

Remember – If testing this on the street always have someone else in the vehicle operating the computer. The driver should *NEVER* operate a computer while operating a vehicle.

10.5.2 Large Graph Changes

Use the left mouse button to highlight a section of the graph.
Right click the graph.



A pop-up display appears.

The highlighted area will change based on what function is clicked in the pop-up display.

“Add 1” and “Subtract 1” are not always a value of 1, it can represent 1% of a value.

When Linearize is selected, values linearly increase/decrease between beginning and ending values.

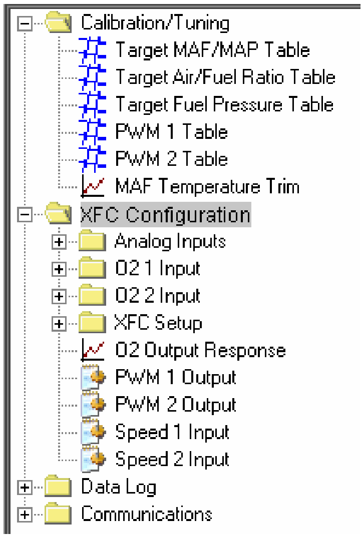
Any change in the graph is immediately reflected in the table.

10.6 Air/Fuel Ratio Setup

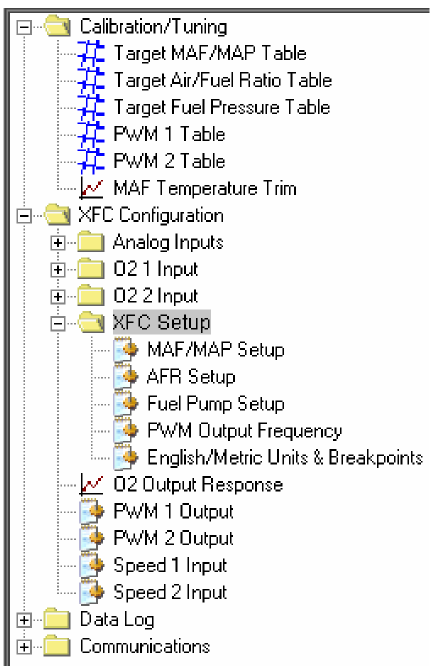
Air/Fuel Ratio tables and graphs are determined in AFR Setup.
To change a Air/Fuel Ratio table or graph go to XFC Configuration>XFC Setup>AFR Setup.

AFR/Fuel Ratio table or graph can be: Engine RPM vs Mass Air Flow Sensor (Percent Change)
Engine RPM vs Manifold Absolute Pressure Sensor
Engine RPM vs Throttle Position Sensor.

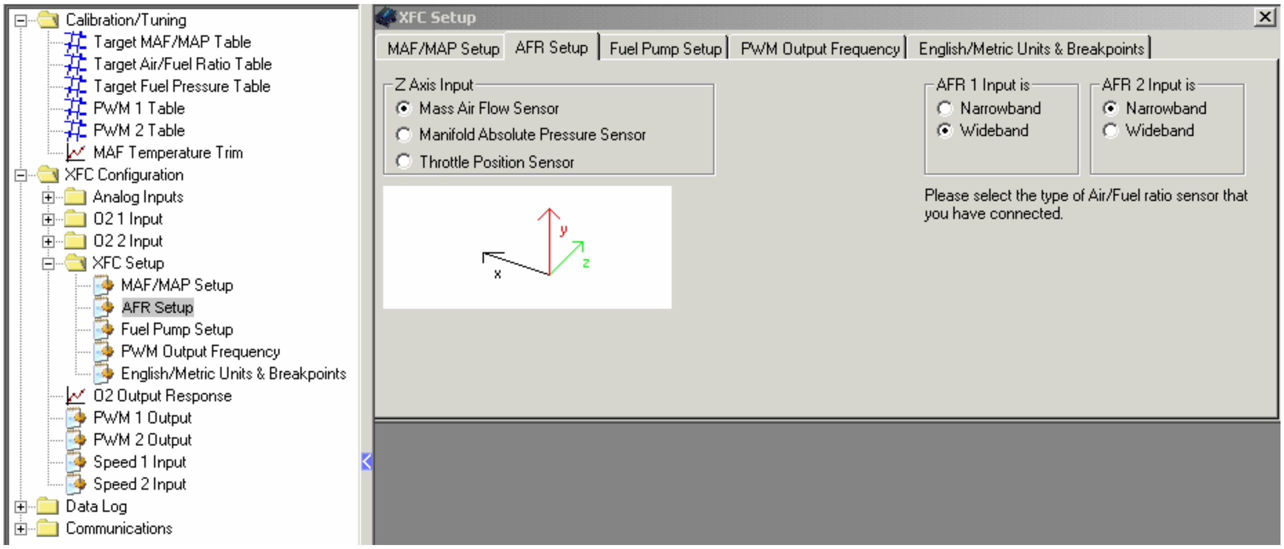
Below is an example of how to get to MAF/MAP Setup.
Click on XFC Configuration to get to XFC Setup.



Click on XFC Setup to get to AFR Setup.



Double click on AFR Setup.



Make a selection in the Z Axis input to chose a type of table/graph.

Air/Fuel Ratio table or graph can be: Engine RPM vs Mass Air Flow Sensor
Engine RPM vs Manifold Absolute Pressure Sensor
Engine RPM vs Throttle Position Sensor.

When a mass air flow sensor is used, the table/graph will display if the sensor is analog or frequency.

AFR 1 Input and AFR 2 inputs are setup in XFC Configuration>Analog Inputs.

The Narrowband/Wideband settings are for analog input functions AFR1 and AFR2 for O_2 exhaust sensors. Narrowband sensors have an output voltage range of 0 – 1.2vdc. Wideband sensors have an output voltage range of 0 – 5vdc. The XFC has two dedicated narrowband sensor inputs in addition to using AFR1 or AFR2 as narrowband sensor inputs. Wideband sensors with their controllers have a wider signal range but cost more than a narrowband sensor.

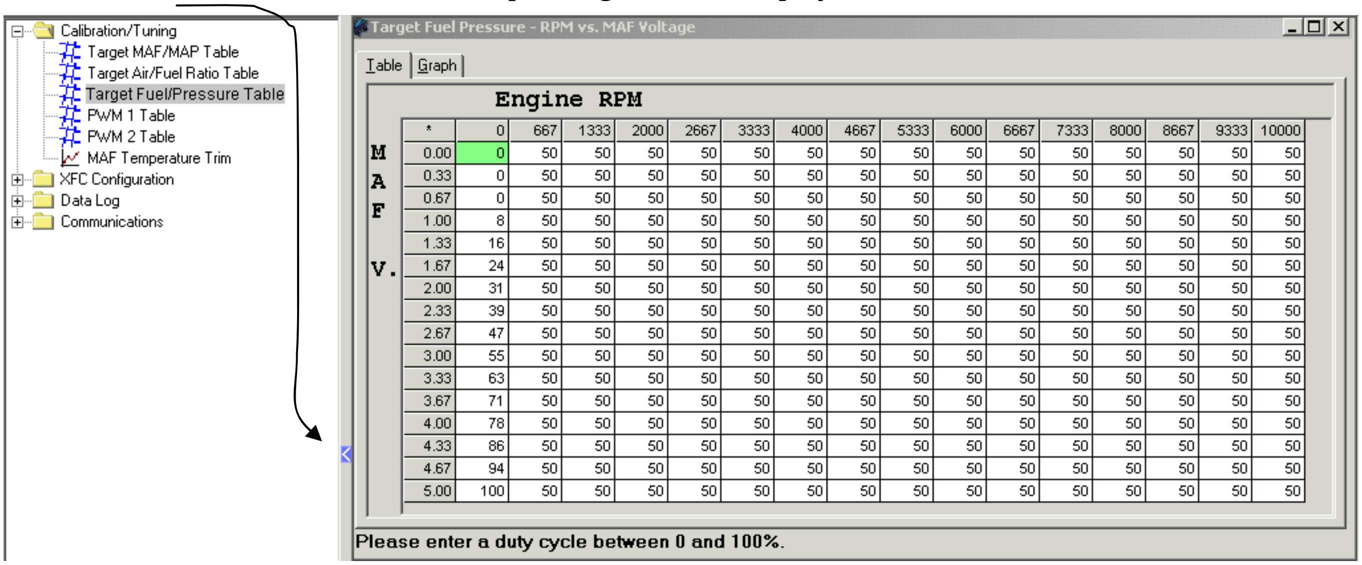
See Analog Inputs section to set a MAF/MAP analog input.
See Speed Inputs section to set a MAF frequency input.

10.7 Fuel Pressure Table

The MAF/MAP table is used to modify the signal from a MAF/MAP sensor. Typically this is done to prepare the signal for a stock engine control module.

Double click on Fuel Pressure Table.

If desired click the blue arrow to expand right side of display.



*	0	667	1333	2000	2667	3333	4000	4667	5333	6000	6667	7333	8000	8667	9333	10000
0.00	0	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
0.33	0	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
0.67	0	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
1.00	8	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
1.33	16	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
1.67	24	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
2.00	31	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
2.33	39	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
2.67	47	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
3.00	55	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
3.33	63	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
3.67	71	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
4.00	78	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
4.33	86	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
4.67	94	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
5.00	100	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50

The Fuel Pressure Table is displayed.

This table consists of engine rpm vs input MAF sensor voltage.

The table can consist of engine rpm vs MAF voltage, MAP voltage or throttle position.

For a different Fuel Pressure Table go to XFC Configuration>XFC Setup>Fuel Pump Setup

Change/save settings.

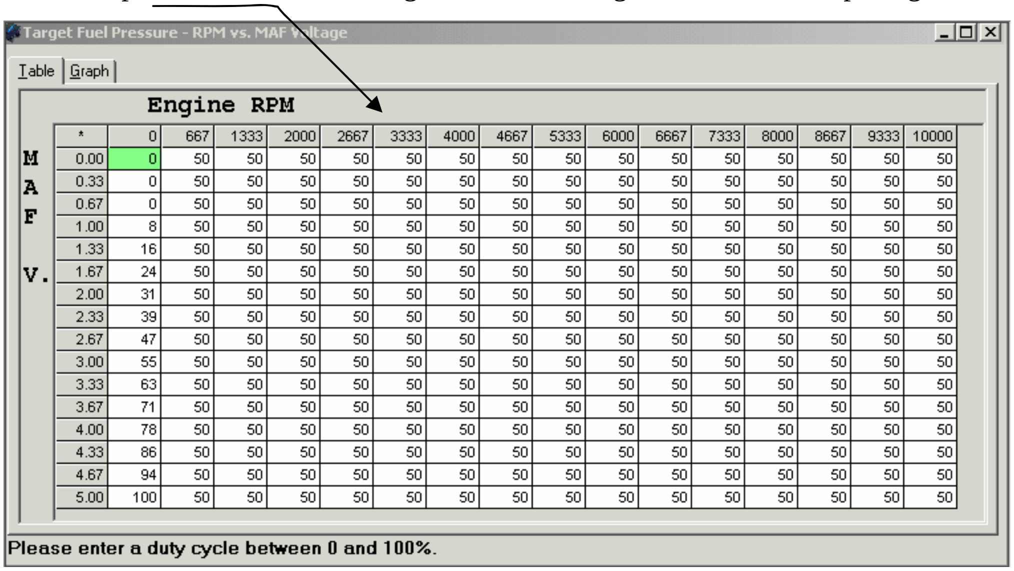
Return/click to Fuel Pressure Table for a different table.

Air/Fuel Ratio table can be: Engine RPM vs Mass Air Flow Sensor (Frequency or Analog)
Engine RPM vs Manifold Absolute Pressure Sensor
Engine RPM vs Throttle Position Sensor

When a mass air flow sensor is used, the table/graph will display if the sensor is analog or frequency.

The mass air flow type sensor; frequency or analog, is set in XFC Configuration>XFC Setup>MAF/MAP Setup.

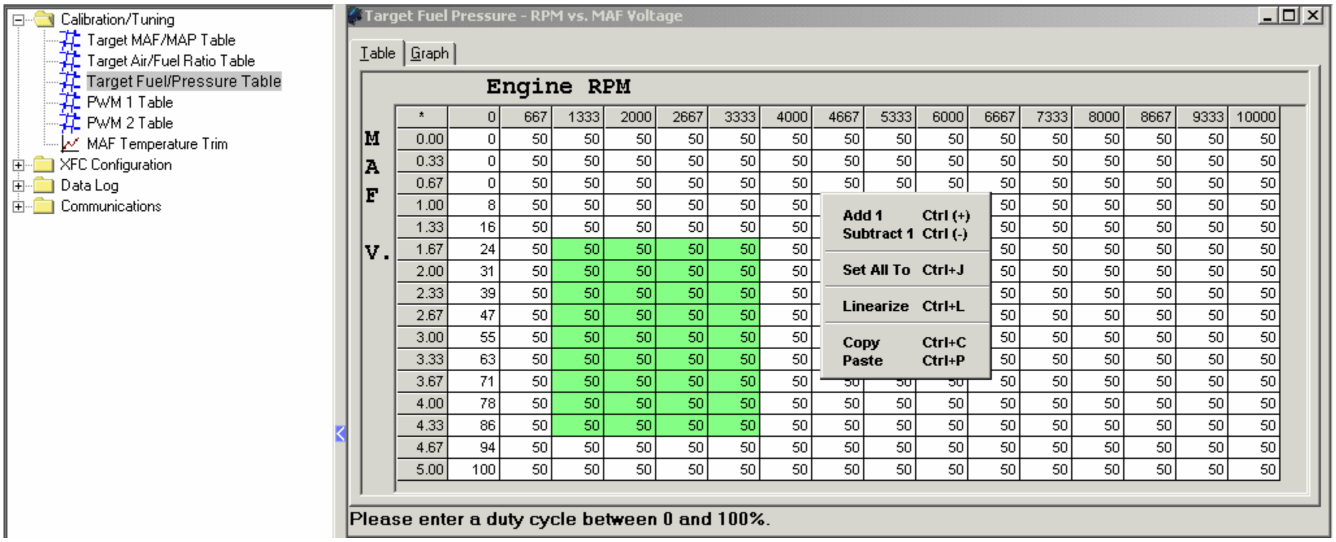
Table/Graph columns can be changed at XFC Configuration>XFC Setup>English/Metric Units & Breakpoints.



*	0	667	1333	2000	2667	3333	4000	4667	5333	6000	6667	7333	8000	8667	9333	10000
0.00	0	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
0.33	0	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
0.67	0	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
1.00	8	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
1.33	16	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
1.67	24	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
2.00	31	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
2.33	39	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
2.67	47	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
3.00	55	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
3.33	63	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
3.67	71	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
4.00	78	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
4.33	86	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
4.67	94	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
5.00	100	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50

10.7.1 Large Table Changes

To make large table changes use the left mouse button to highlight a section of the table.
Right click the table.



A pop-up display appears.
The highlighted area will change based on what function is clicked in the pop-up display.

"Add 1" and "Subtract 1" are not always a value of 1, it can represent 1% of a value.

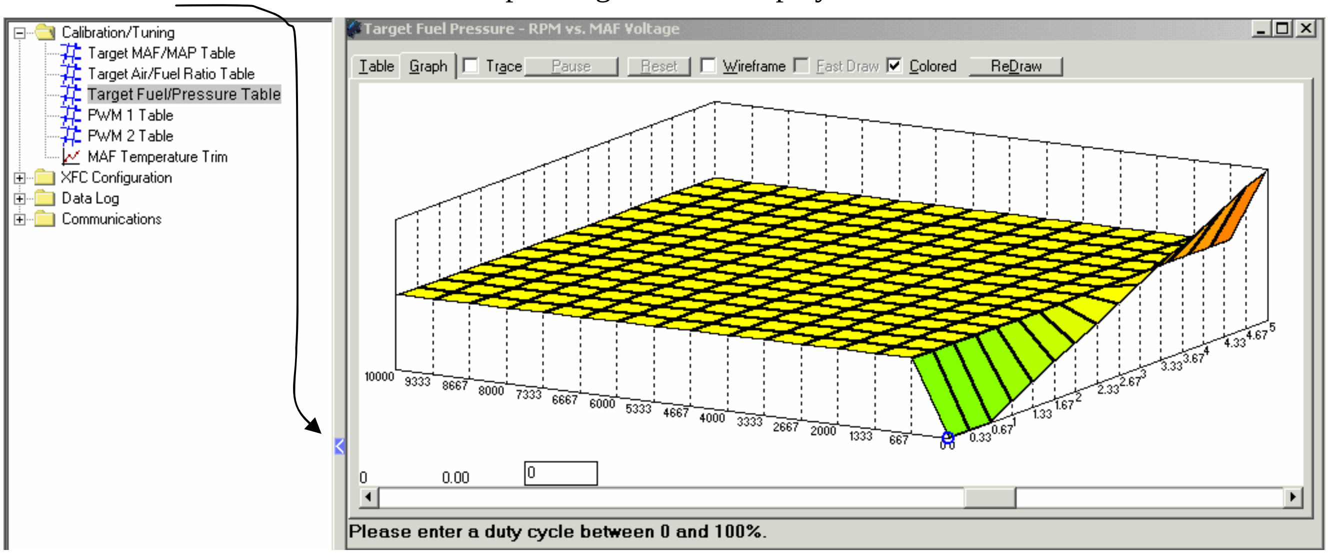
When Linearize is selected, values linearly increase/decrease between beginning and ending values.

Any change in the table is immediately reflected in the graph.

10.8 Fuel Pressure Graph

Click on the Graph tab.

If desired click the blue arrow to expand right side of display.



The Fuel Pressure Graph is displayed.
Moving the scroll bar rotates the graph for a better view.
The Trace box is checked to provide a trace on the screen when the engine is running.
This graph consists of engine rpm vs input MAF sensor voltage.
The graph can consist of engine rpm vs MAF voltage, MAP voltage, or throttle position.

For a different fuel pressure graph go to XFC Configuration>XFC Setup>Fuel Pump Setup

Change/save settings.

Return/click to Fuel Pressure Table for a different graph.

Fuel Pressure Graph can be: Engine RPM vs Mass Air Flow Sensor (Frequency or Analog)
Engine RPM vs Manifold Absolute Pressure Sensor
Engine RPM vs Throttle Position Sensor

When a mass air flow sensor is used, the table/graph will display if the sensor is analog or frequency.
The mass air flow type sensor; frequency or analog, is set in XFC Configuration>XFC Setup>MAF/MAP Setup.
The box with numbers is where value changes are entered.

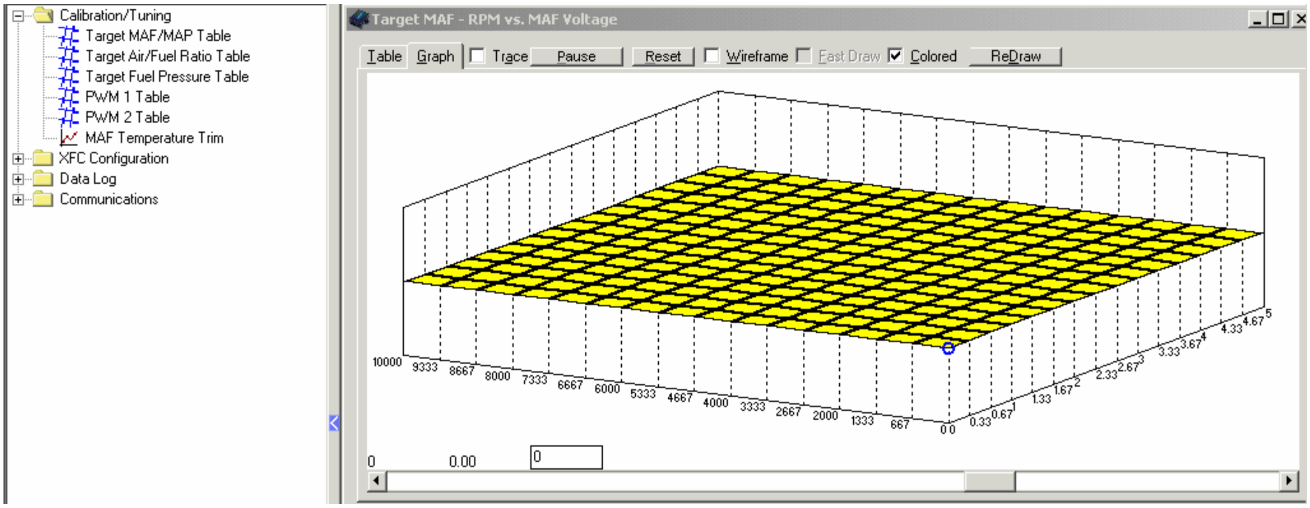
Click on the appropriate place in the graph.
Then enter a value in the box.
Then hit “Enter” key.
Values are immediately updated in the graph and table.

The number next to the box is input MAF voltage, MAP voltage, or throttle position.
The number at the end is engine rpm.

Graph Setting
For a fast computer: Trace ON, Color ON.
For a medium speed computer: nothing on.
For a slow computer: Wire Frame ON.
For a very slow computer: Wire Frame ON, Fast Draw ON, Periodic Redraw may be required.

10.8.1 Trace

When the XFC connected and in online mode with the XFC program real time activity can be recorded in graph section. This is useful when trying to tune out the rough edges of a calibration. Start the trace by clicking on the trace button and the trace ball will begin leaving a trail of where it has been on the graph. The trace is paused by clicking the Pause button. To resume the trace, click the Record button. The trace is reset by clicking on the Reset button.



If an engine has an area that needs additional tuning, an ideal recording method would be as follows:

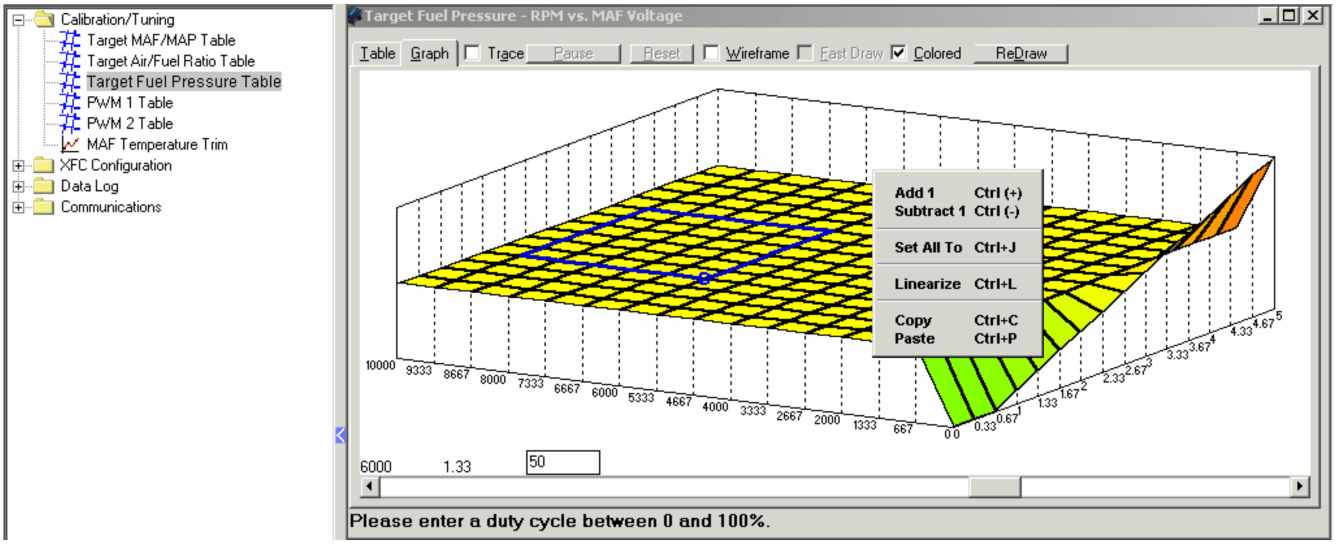
1.) Start a trace from the display or press A on the keyboard, reset a running grace by simply pressing the Reset button next to the trace or pressing R on the keyboard.
2.) Bring the vehicle to the conditions where it appeared to require tuning. Repeat these conditions several times in a row.
3.) Once having recreated the issue several times press the Pause button or press P on the keyboard. There is now a brief recording of where the engine was operating during the trace. This should help tune out the problem.

Please note the longer the trace runs, the more resources will be required of the computer. Ideally run a brief trace when a problem area is discovered and pause once the area has been recorded.

Remember **–** If testing this on the street always have someone else in the vehicle operating the computer. The driver should *NEVER* operate a computer while operating a vehicle.

10.8.2 Large Graph Changes

Use the left mouse button to highlight a section of the graph.
Right click the graph.



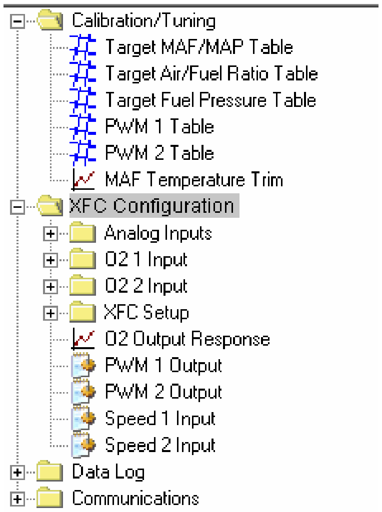
A pop-up display appears.
The highlighted area will change based on what function is clicked in the pop-up display.
"Add 1" and "Subtract 1" are not always a value of 1, it can represent 1% of a value.
When Linearize is selected, values linearly increase/decrease between beginning and ending values.
Any change in the graph is immediately reflected in the table.

10.9 Fuel Pump Setup

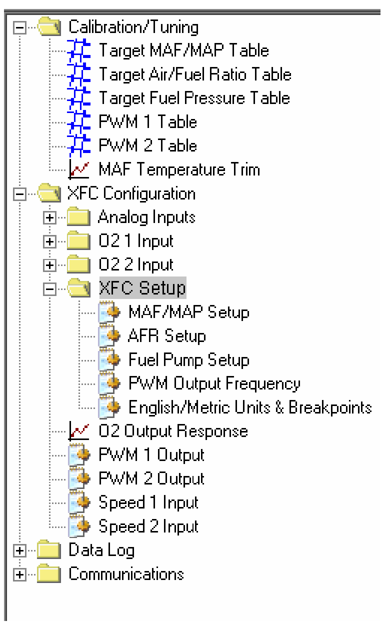
Fuel Pressure tables and graphs are determined in Fuel Pump Setup.
To change a Fuel Pressure table or graph go to XFC Configuration>XFC Setup> Fuel Pump Setup.

Fuel Pressure table or graph can be: Engine RPM vs Mass Air Flow Sensor (Percent Change)
Engine RPM vs Manifold Absolute Pressure Sensor
Engine RPM vs Throttle Position Sensor.

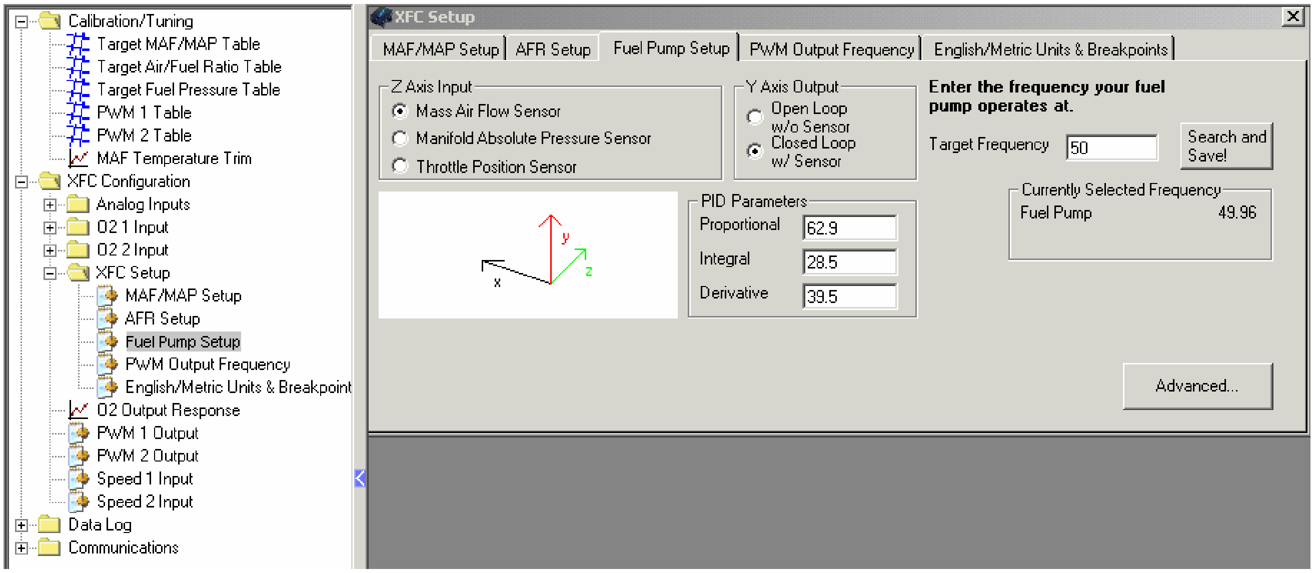
Below is an example of how to get to MAF/MAP Setup.
Click on XFC Configuration.



Click on XFC Setup.



Double click on Fuel Pump Setup.



Important: Read the section in the manual on adding an extra fuel pump.

Make a selection in the Z Axis input to chose a type of table/graph.

Fuel Pressure table or graph can be: Engine RPM vs Mass Air Flow Sensor (Frequency or Analog)
Engine RPM vs Manifold Absolute Pressure Sensor
Engine RPM vs Throttle Position Sensor

When a mass air flow sensor is used, the table/graph will display if the sensor is analog or frequency. The mass air flow type sensor; frequency or analog, is set in XFC Configuration>XFC Setup>MAF/MAP Setup.

Target Frequency is where the drive frequency of the pump is entered. Once the pump frequency is entered, click the Search and Save button.

Advanced button just shows another way to set the pump frequency.

PID Parameters are used when a fuel pressure sensor is added to control an extra fuel pump.

Proportional adjustment value is proportional to the error of the signal.

Integral adjustment value is proportional to the amount of time the error is present.
Used to eliminate offset.

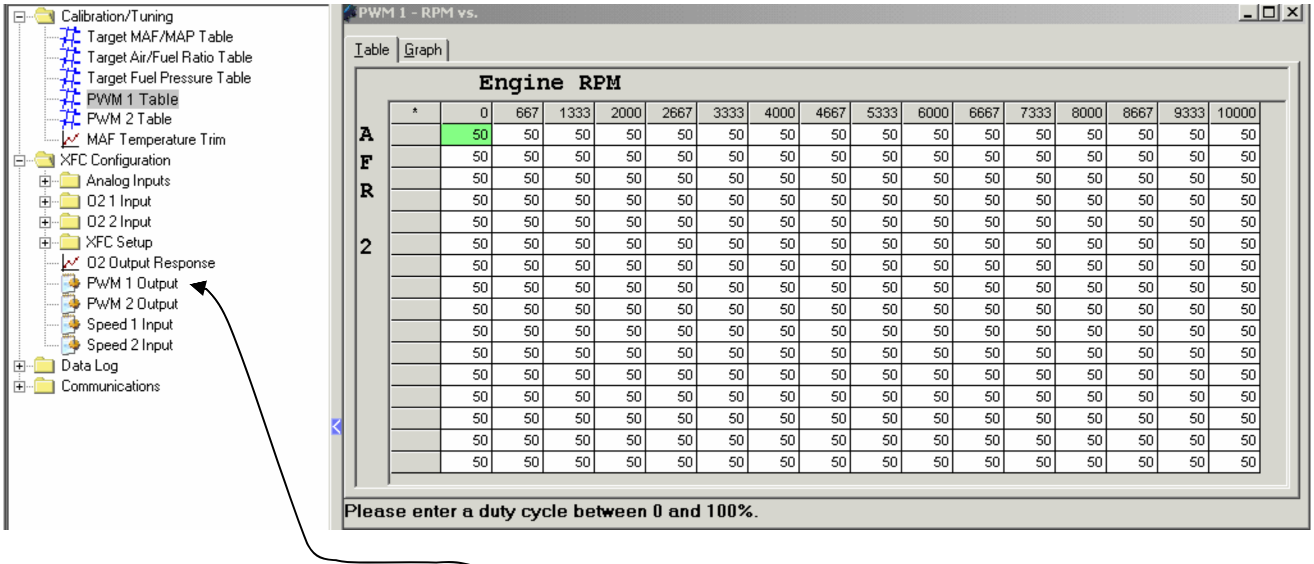
Derivative adjustment value is proportional to the rate of change of error.
Used to avoid overshoot

See Analog Inputs section to set a MAF/MAP analog input.
See Speed Inputs section to set a MAF frequency input.

10.10 PWM 1 & 2 Tables

PWM 1 & 2 Tables are similar. Explanation is given only for PWM 1 Table.

Double click on PWM 1 Table.

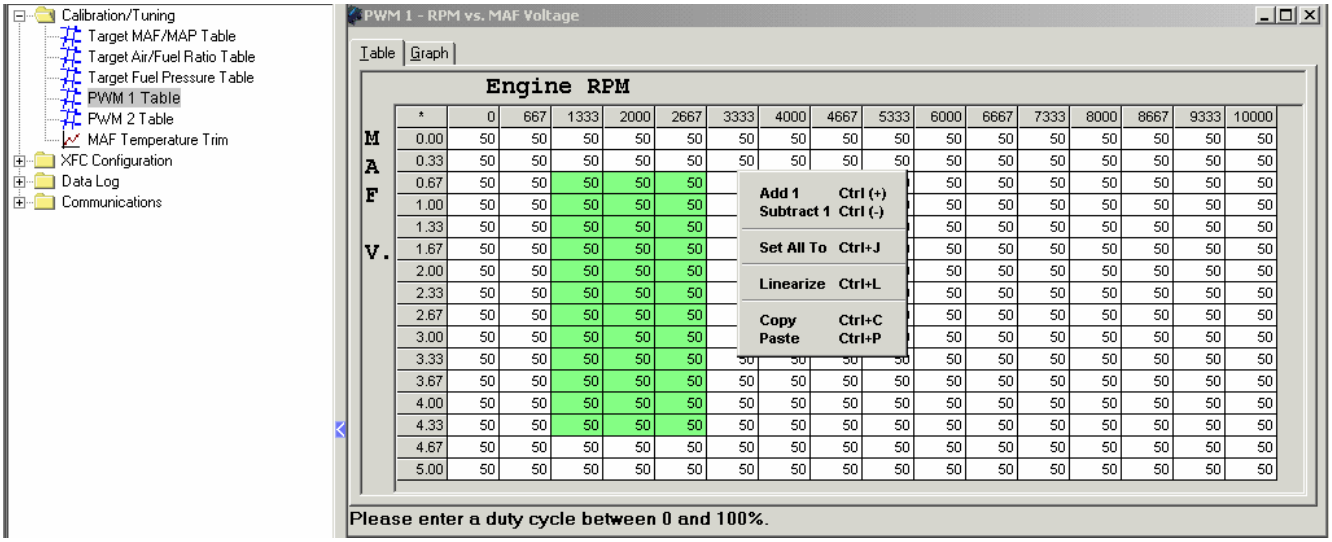


*	0	667	1333	2000	2667	3333	4000	4667	5333	6000	6667	7333	8000	8667	9333	10000
	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50

The PWM 1 Table is displayed.
Change the table by changing the PWM 1 Output.
This table consists of engine rpm vs input MAF sensor voltage.
PWM Table entries are done by entering changes in the table.
The PWM 1 Table controls the PWM 1 Output frequency and current.
Current rating is 3.5 amps ac/dc.
Duty cycle or time on for the PWM output is listed in the table for each rpm.
.

10.10.1 Large Table Changes

To make large table changes use the left mouse button to highlight a section of the table.
Right click the table.

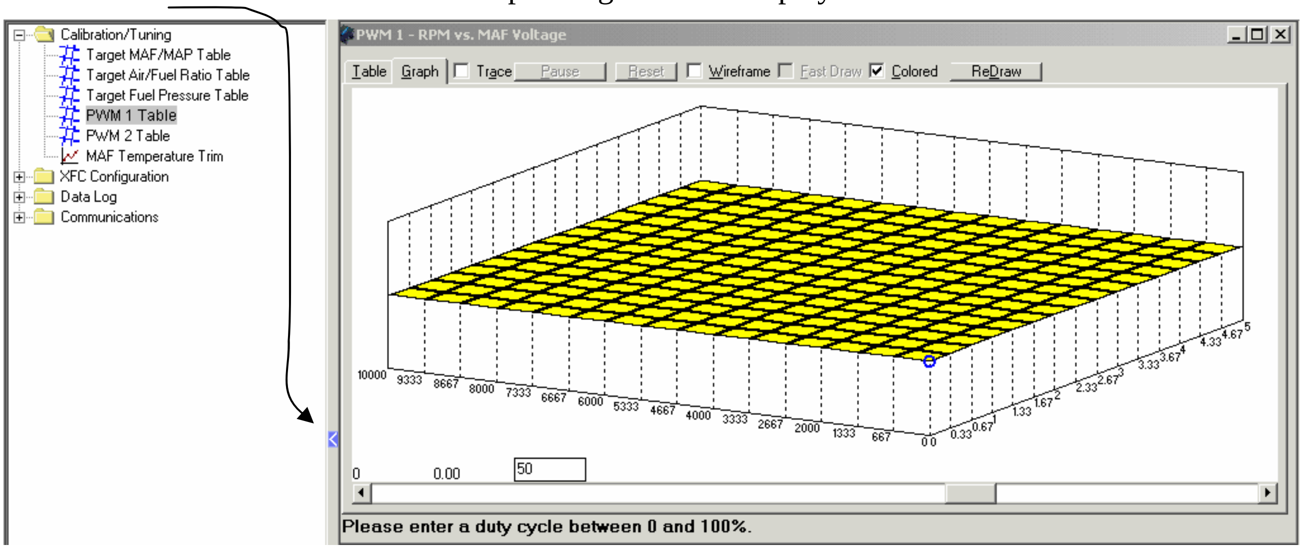


A pop-up display appears.
The highlighted area will change based on what function is clicked in the pop-up display.
"Add 1" and "Subtract 1" are not always a value of 1, it can represent 1% of a value.
When Linearize is selected, values linearly increase/decrease between beginning and ending values.
Any change in the table is immediately reflected in the graph.

10.11 PWM 1 Graph

Click on the Graph tab.

If desired click the blue arrow to expand right side of display.



The PWM 1 Graph is displayed.
Moving the scroll bar rotates the graph for a better view.
The Trace box is checked to provide a trace on the screen when the engine is running.
This graph consists of engine rpm vs input MAF sensor voltage.
The graph can consist of engine rpm vs various types of inputs.
Graph entry type is determined in XFC Configuration>PWM 1 Output.

PWM 1 Graph entries are done by entering changes in the graph.

The box with numbers is where value changes are entered.

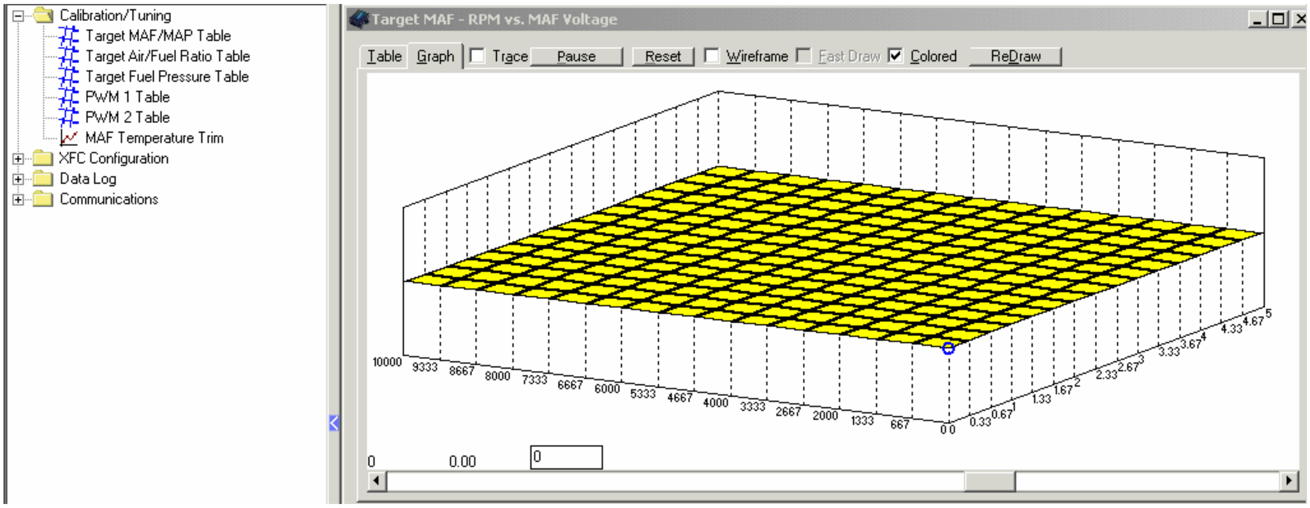
Click on the appropriate place in the graph.
Then enter a value in the box.
Then hit "Enter" key.
Values are immediately updated in the graph and table.

The number next to the box is input MAF voltage, MAP voltage, or throttle position.
The number at the end is engine rpm.

Graph Setting
For a fast computer: Trace ON, Color ON.
For a medium speed computer: nothing on.
For a slow computer: Wire Frame ON.
For a very slow computer: Wire Frame ON, Fast Draw ON, Periodic Redraw may be required.

10.11.1 Trace

When the XFC connected and in online mode with the XFC program real time activity can be recorded in graph section. This is useful when trying to tune out the rough edges of a calibration. Start the trace by clicking on the trace button and the trace ball will begin leaving a trail of where it has been on the graph. The trace is paused by clicking the Pause button. To resume the trace, click the Record button. The trace is reset by clicking on the Reset button.



If an engine has an area that needs additional tuning, an ideal recording method would be as follows:

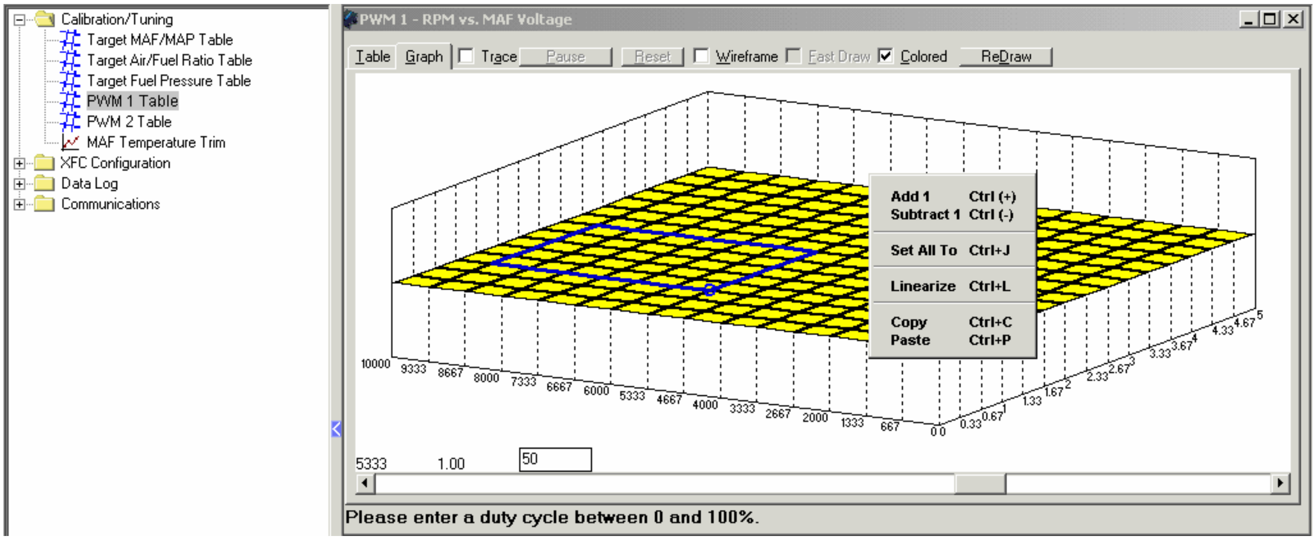
1.) Start a trace from the display or press A on the keyboard, reset a running grace by simply pressing the Reset button next to the trace or pressing R on the keyboard.
2.) Bring the vehicle to the conditions where it appeared to require tuning. Repeat these conditions several times in a row.
3.) Once having recreated the issue several times press the Pause button or press P on the keyboard. There is now a brief recording of where the engine was operating during the trace. This should help tune out the problem.

Please note the longer the trace runs, the more resources will be required of the computer. Ideally run a brief trace when a problem area is discovered and pause once the area has been recorded.

Remember – If testing this on the street always have someone else in the vehicle operating the computer. The driver should *NEVER* operate a computer while operating a vehicle.

10.11.2 Large Graph Changes

Use the left mouse button to highlight a section of the graph.
Right click the graph.



A pop-up display appears.
The highlighted area will change based on what function is clicked in the pop-up display.

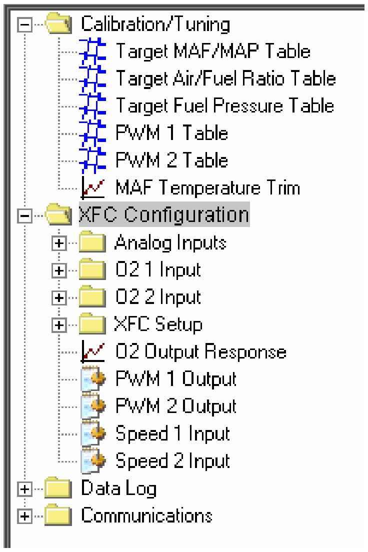
"Add 1" and "Subtract 1" are not always a value of 1, it can represent 1% of a value.

When Linearize is selected, values linearly increase/decrease between beginning and ending values.

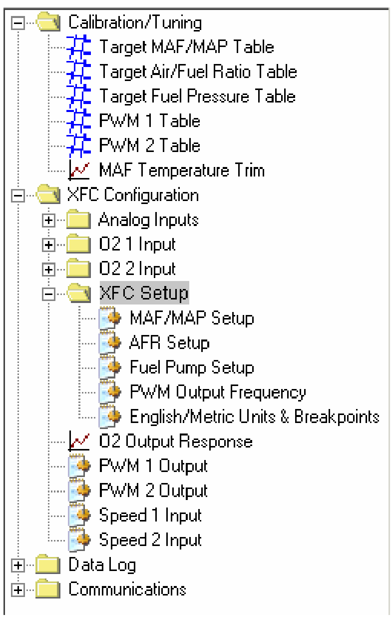
Any change in the graph is immediately reflected in the table.

10.12 PWM Output Frequency

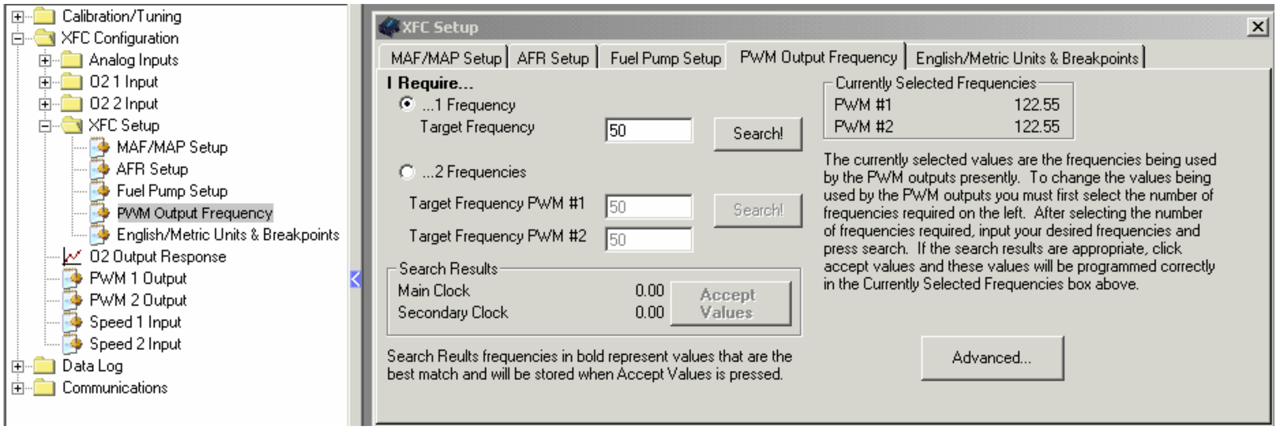
Click on XFC Configuration to get to XFC Setup.



Click on XFC Setup to get to PWM Output Setup.



Double click on PWM Output Frequency.



The frequency of the two PWM outputs are set here.
There are two frequencies, the main frequency and another frequency based on the main frequency.
Both PWM outputs use one of these two frequencies.

Be aware that changing a frequency could affect both PWM outputs.

Advanced button shows a different way of setting frequencies.

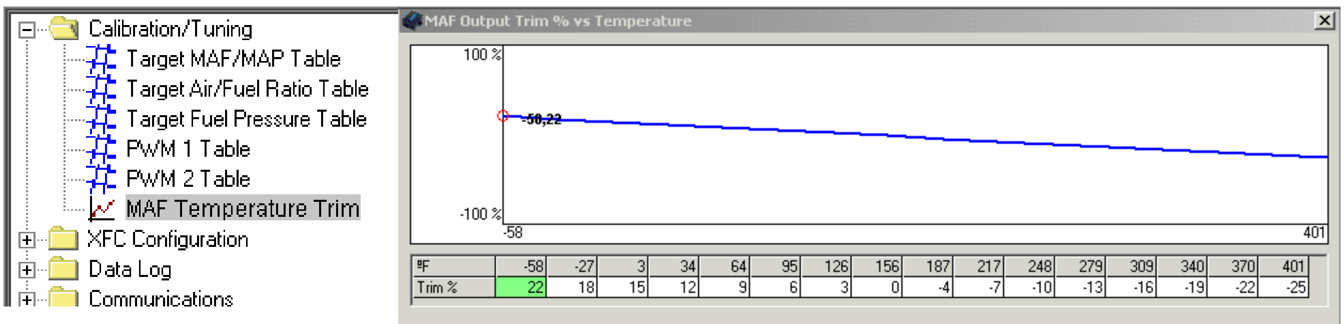
But generally only the main (1 Frequency Target) frequency needs to be set.

Enter a frequency then click Search button.
If the result is close enough, then click Accept Values button.

10.13 MAF Temperature Trim

Click on Calibration/Tuning.

Double click on MAF Temperature Trim



The MAF output is trimmed for temperature in this display.

Changing any value in the two data rows affects how the XFC interprets the input from the sensor.
To quickly linearize data, hold down and move the left mouse button between two points.
Then press “CTRL” & “L”.

Trim adjustment is done by percentage.
To change from Fahrenheit to Centigrade, go to XFC Configuration>XFC Setup>English/Metric Units & Breakpoints.

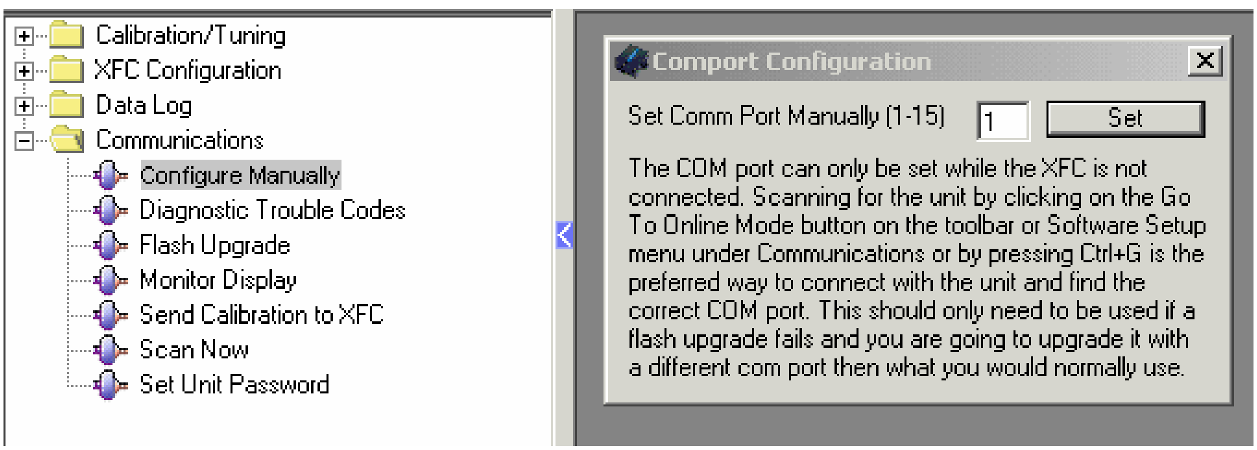
11. XFC/COMPUTER COMMUNICATIONS

Communications folder is used to setup communications between the XFC and computer.
Port configuration, alarm codes, XFC flash upgrades, operating engine monitor screen, and passwords are done from this screen.

Click on Communications.

11.1 Configure Manually

Double click on Configure Manually.

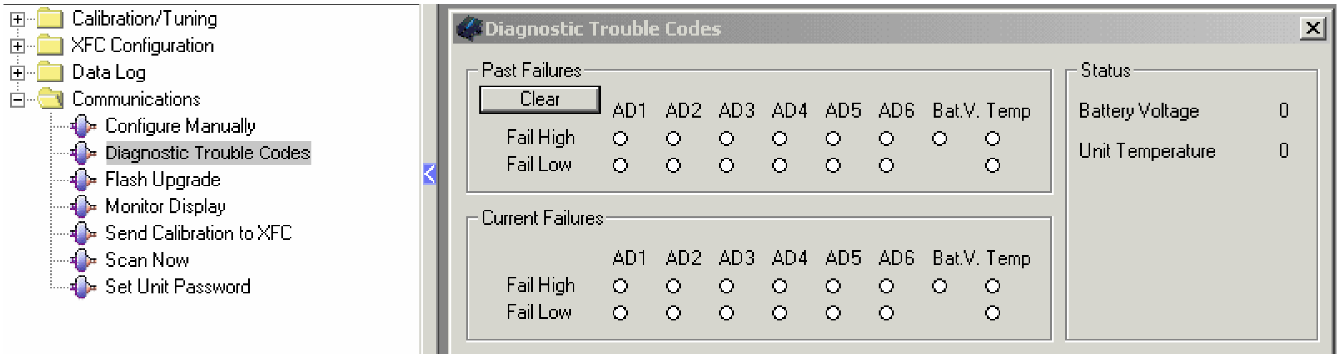


Manually configuring a com port for use with the XFC software is a task for advanced users only. Generally if the XFC software is unable to communicate with the XFC, the reason has nothing to do with com port selection. For this reason, use the manual com port setting as a last resort to a communication problem. Please do not try to use this feature if you do not fully understand what a com port is and which com port you wish to set.

The only time that a com port should need to be manually set is during a flash upgrade procedure. It is possible to have software newer than the firmware in a XFC such that the XFC will no longer go online with the XFC. In this case, the com port should be determined from your computer hardware settings and programmed under Communications >Flash Upgrade>Configure Manually.

11.2 Diagnostic Trouble Codes

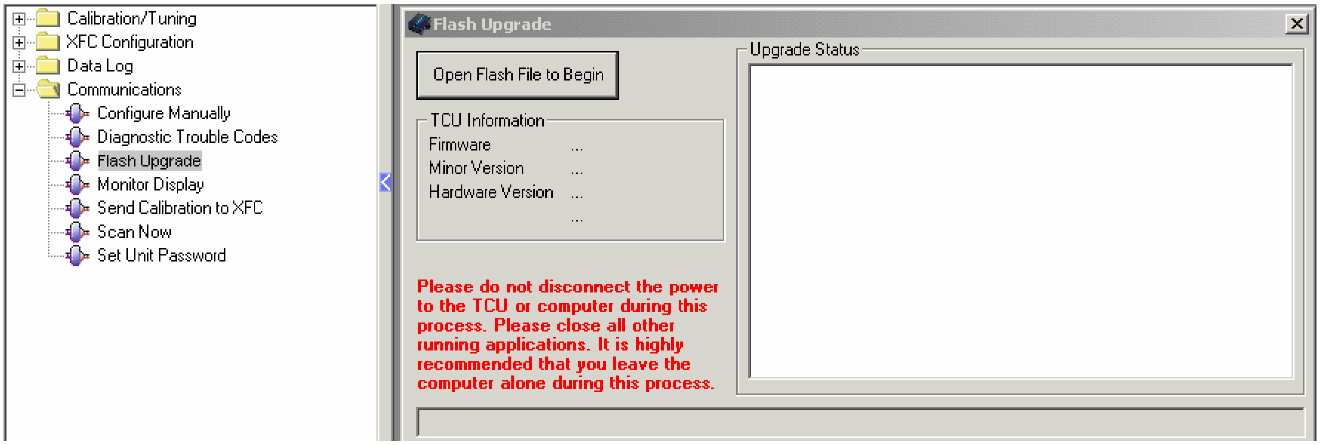
Double click on Diagnostic Trouble Codes.



Diagnostic trouble codes provide failure determination for several parameters. The monitor screen will indicate an analog failure and the main window will flash red when an overtemp condition occurs. The fail low analog value is triggered when voltage of an analog input goes below the programmed analog failure value for that input. The fail high analog value is triggered when voltage of an analog input goes above the programmed analog failure value for that input. The fail high battery voltage is 25 volts. Above this voltage, the unit will cease to function. Fail high temperature is 248°F or 120ºC. The fail low temperature is -22º F or -30ºC. Above or below this temperature range, the unit shuts down to protect the electronics.

11.3 Flash Upgrade

Double click on Flash Upgrade



The flash upgrade procedure should not be used unless well understood. The flash upgrade procedure is not intended to change a calibration file or to tune the XFC. Flash upgrade procedure is only used for firmware upgrades. Firmware upgrades directly modify the code in control systems of the XFC. The ability to flash upgrade the firmware allows the XFC to be upgraded in the field so that new features can be added and possible problems can be remedied.

The XFC power must be on and the XFC must be communicating and online with the computer. Save files calibration files already in the unit prior to upgrading! To begin a flash upgrade, select flash upgrade from the explorer menu or flash upgrade then flash upgrade XFC from the toolbar. Once this form opens, no other forms will be available. This is done to protect the XFC. At this form, the firmware major and minor revision will be displayed. The hardware revision will also be displayed. To begin flashing the XFC, click the "Open Flash File to Begin" button. This will open a file selection menu. Only *.rom files can be opened and the correct file must be chosen for a proper upgrade. If you are unsure about which rom file you should use, contact technical support first. When using newer software with an older controller (or vice versa), the unit may not communicate or properly find the com port until it is flash upgraded. Once the correct file has been selected, click open in the current menu. A warning message will appear with a warning not to turn the power off until the upgrade is complete. *Heed this warning!* Follow these instructions explicitly. Once the instructions are understood, click yes.

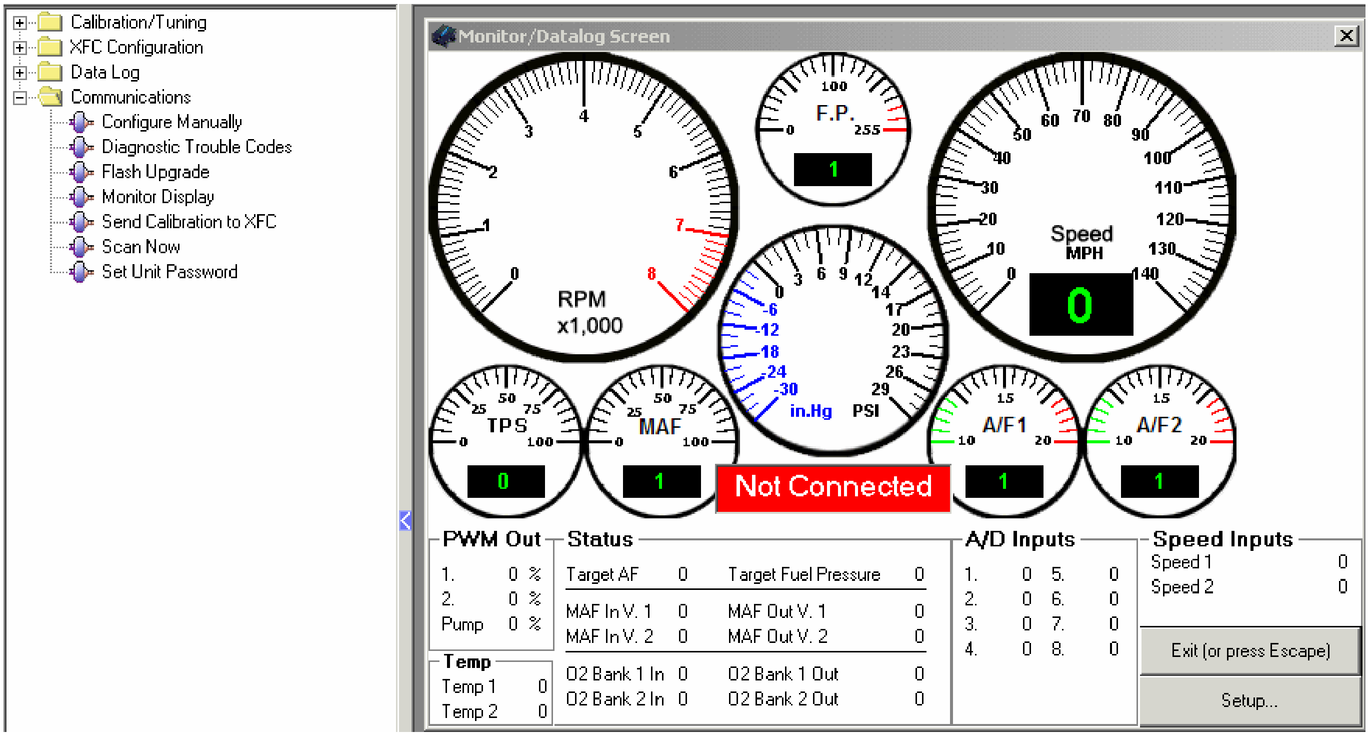
The flash upgrade procedure will now begin and a taskbar will show upgrade progress. Once completed, a message will appear notifying the user that a calibration must be programmed into the unit before continuing. Click ok. Select a new calibration file. If the calibration file requires a change before being programmed into the unit, a message will appear and you will be able to save the new file. This happens because some versions of firmware are only compatible with some calibrations. Once the flash upgrade procedure is complete, the unit should be turned off and turned back on again.

If a box appears saying “Error writing to unit please check connection and try again.” turn unit off and on again, check all connections and start over with these direction. Unit will not begin to function properly again until a successful flash has been completed.

11.4 Monitor Display

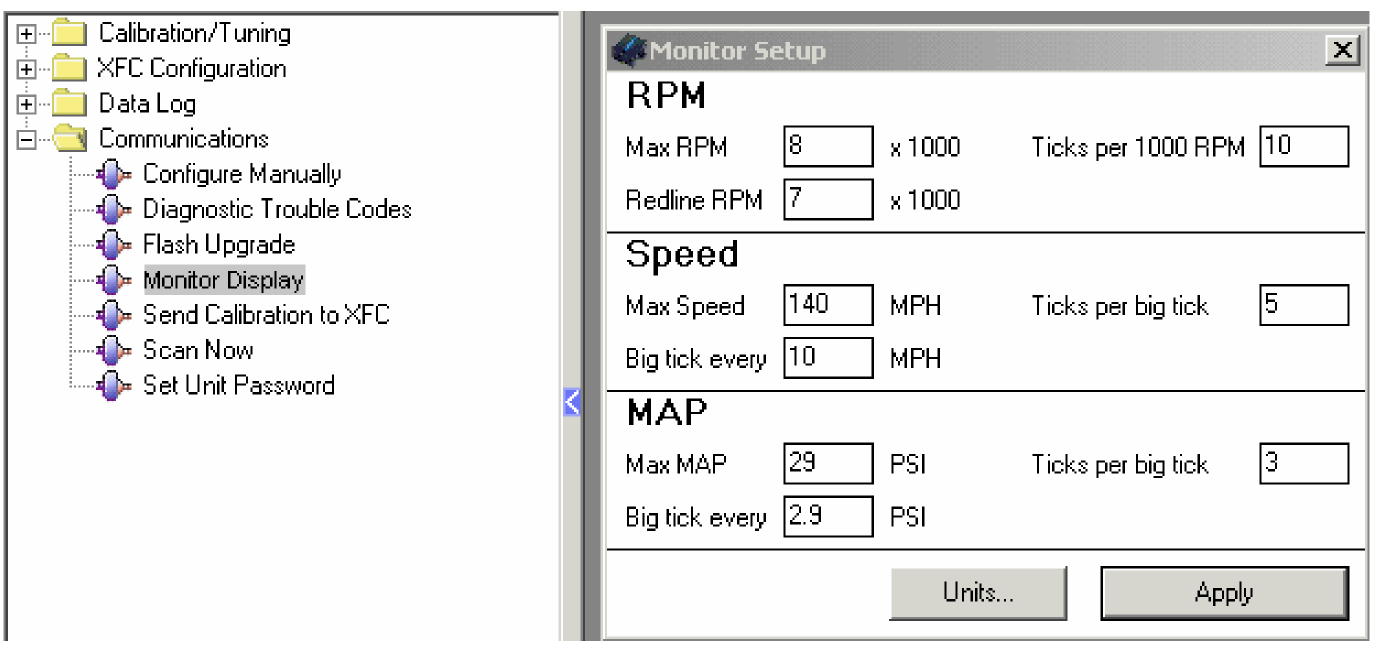
Double click on Monitor Display.

If the XFC is not connected to the computer a red bar with the words “Not Connected” appears on the monitor display.

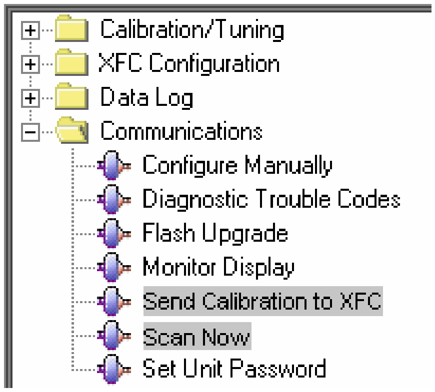


The monitor display shows all inputs/outputs to the XFC, speed, fuel pressure, RPM, throttle position, MAF and air/fuel ratio. This gives an overall view of how engine performance when making tuning adjustments.

Press Setup to configure the gauges.



The next two displays need to be connected to the XFC to work.

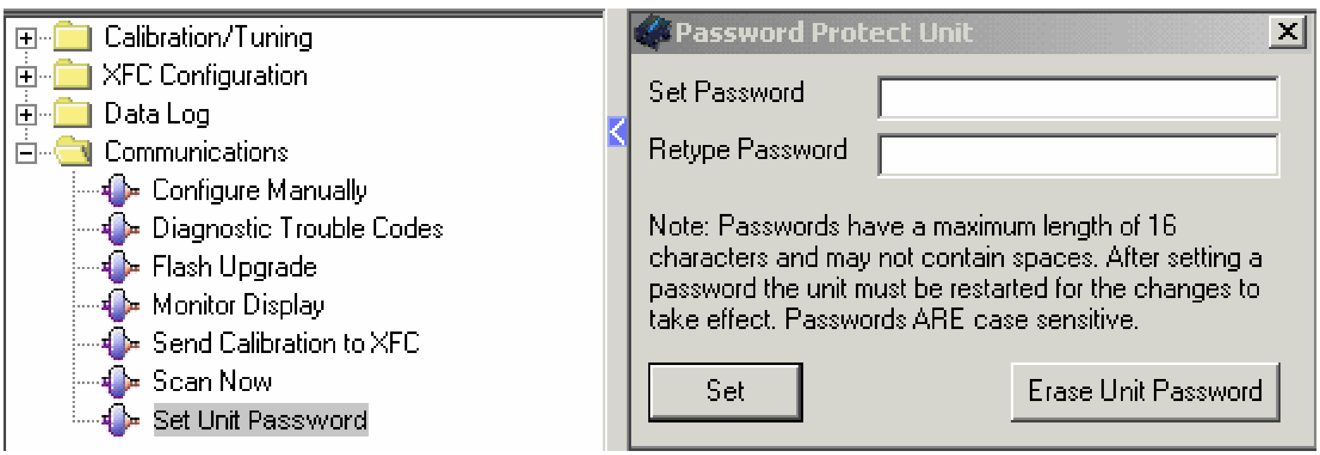


Send Calibration to XFC enters data into the XFC.

Scan Now has the computer look to see if the XFC is connected.

11.5 Set Unit Password

Double click on Set Unit Password.



The XFC offers password protection to help installers avoid warranty, intellectual property and customer issues. Once the password has been set, the calibration stored on the unit may only be retrieved by people who know said password. Any user may completely overwrite this information with a different calibration but that user would need to start tuning from nothing.

If a password is lost, it can be retrieved by technical support staff using a permission key issued by the software. This password has a high level of encryption and an person (s) wishing to receive a new password must have all of the information from the original purchaser and pass a verbal test to receive a calibration.

12. GLOSSARY OF TERMS

Absolute Pressure: Atmospheric (barometric) pressure plus the gauge reading.

Ampere (amp): A unit of measure for the flow of electrical current in a circuit.

Analog: Data which is represented by continuous variation.

Atmospheric Pressure: The force exerted on everything around us by the weight of air. At sea level, atmospheric pressure is 14.7 psi (pounds per square inch), or in the metric system, 101.3 kPa (kilopascals) or 1 bar.

Boost: When intake manifold pressure is greater than atmospheric pressure due to turbo or supercharging.

Duty Cycle: In reference to an electrical signal, often an electronically controlled solenoid. It is the amount of time (expressed as a percentage) that current flows through the solenoid.

The percentage of time that a pulse width modulated output is turned on. A duty cycle of 100% indicates a fully turned-on modulation output.

ECM: Engine Control Module. An electronic control module used to process several inputs for the control of several outputs relating to the engine.

Fuse: A device consisting of a piece of wire with a low melting point, inserted in a circuit. It will melt and open the circuit when the system is overloaded.

Ground: In this manual, ground primarily refers to electrical ground. A connection to the negative side of vehicle battery. A connection to engine ground or transmission ground should also form a connection to the negative side of vehicle battery.

Load: The amount of work that and engine must provide at a given instant. Load is measured by using a TPS, MAP or MAF sensor.

Manifold Absolute Pressure (MAP) Sensor: A device that measures the absolute pressure (or vacuum) of the intake charge for an engine. This signal can be interpreted as engine load.

Mass Airflow (MAF) Sensor: A device that measures the airflow into the engine based on air mass. The signal can be interpreted as engine load.

Pressure: A measurable force that is exerted on an area and expressed as kilopascals (kPa), pounds per square inch (psi) or bar.

Power: In this manual, power primarily refers to a 12 volt source. Also a connection to the positive side of vehicle battery or a switched 12 volt source.

Pulse Width Modulated (PWM): An electronic signal that continuously cycles the ON and OFF time of a device (such as a solenoid) while varying the amount of ON time.

Pulse Width Modulated (PWM) Solenoid: A computer-controlled solenoid that turns on and off at a variable rate.

Resistance: The electrical property of a circuit that tends to prevent or reduce the flow of current. Resistance is measured in ohms. A resistor is a device installed in an electrical circuit to permit a predetermined current to flow with a given applied voltage.

Solenoid: An electromagnetic device containing a coil winding and a movable core. As current is sent through the winding, the core is moved. When applied to hydraulic oil circuits, pressure can be controlled electrically. In this manual, solenoid primarily refers to electronically controlled solenoids. Solenoids may be PWM or digitally controlled (on/off). PWM solenoids typically regulate pressure while digital solenoids typically regulate flow.

Switch: A device used to open, close, or redirect the current in an electrical circuit.

Thermistor: A special resistor used to measure temperature. It decreases its resistance with increases in temperature.

Throttle Position Sensor (TPS): A sensor that measures the relative travel of the throttle plate.

Vehicle Speed Sensor (VSS) A device that measures driveshaft speed by counting the number of teeth passing by on a nearby wheel. This count can be calculated to determine vehicle speed if the final drive ratio and gear ratios are known.

XFC Xtended Fuel Controller. An electronic control module that allows a stock engine control module to be used with a modified engine.

13. TERMS AND CONDITIONS

13.1 Definitions

"Products" means the products in the then-current Product List. A product may include both hardware and software components. Our company may add to, delete from, or otherwise modify the Products on the product list at any time.

"Customer" means an end user of a Product.

"Limited Warranty Statement" means the then current warranty from our company to our Customers.

13.2 Ordering and Payment

1. ORDERS. Orders shall be in writing and be subject to acceptance by our company. The terms and conditions of each order shall be as provided by this Agreement, and the provisions of either party's of purchase order, acknowledgement or other business forms will not apply to any order notwithstanding the other party's acknowledgment or acceptance of such form.

2. SHIPMENT. Shipment will be F.O.B. our company's specified warehouse ("Delivery Point"), freight collect, at which time title (excluding any software components of Products) and risk of loss will pass to Customer. All freight, insurance and other shipping expenses from Delivery Point, as well as any expenses related to Customer's special packing requests, will be borne by Customer unless otherwise agreed to in writing by our company.

3. PAYMENT. Subject to compliance with our company's credit requirements, payments on orders will be due and payable in full thirty (30) days from the invoice date. If Customer is in default of its payment obligations, our company shall give written notice of such default to Customer. Upon receipt of such default notice. Customer shall have fifteen (15) days notice period, Customer shall pay monthly service charges of 2% per month for any past due amounts. Customer shall have ninety (90) days from receipt of such default notice to cure. If Customer fails to cure within the (90) days notice period, Customer's unpaid balance shall be referred to a collection agency. Our company may in its sole discretion change Customer's credit terms and/or require C.O.D./prepayment for any shipments.

4. FUNDS. ALL payment for Products and Services by Customer and by Customer's customers shall be made in **U.S. Funds** via check or other mutually agreed upon electronic payment methods. Local currency prices may vary between time of order and time of payment based on fluctuations in the currency exchange rate.

5. TAXATION. The payment obligations stated in section are exclusive of any federal, state, municipal or other governmental taxes, duties, excise taxes or tariffs now or hereafter imposed on the sale of the Products. Any such taxes applied will be added to and itemized on our company's invoices when they are rendered.

13.3 Warranty

1. EXPRESS DISCLAIMER. OUR COMPANY MAKES NO WARRANTIES OR REPRESENTATIONS AS TO THE Products, EXCEPT AS SET FORTH BELOW. ALL IMPLIED WARRANTIES AND CONDITONS, INCLUDING BUT NOT LIMITED TO IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND NON-INFRINGEMENT, ARE HEREBY DISCLAIMED.

2. LIMITATION OF LIABILITY. THE LIABILITY OF OUR COMPANY AND ITS SUPPLIERS ARISING OUT OF OR RELATING TO THIS MANUAL OR THE SUPPLY OF Products HEREUNDER, SHALL BE LIMITED TO THE ACTUAL AMOUNTS PAID BY CUSTOMER TO OUR COMPANY FOR THE Products GIVING RISE TO SUCH DAMAGES, AND SHALL IN NO EVENT INCLUDE LOSS OF PROFITS, COST OF PROCURING SUBSTITUTE GOODS OR SERVICES, OR ANY INCIDENTAL, INDIRECT OR CONSEQUENTIAL DAMAGES OF ANY KIND, EVEN IF OUR COMPANY OR ITS SUPPLIER IS AWARE OF THE POSSIBILITY OF SUCH DAMAGES.

3. LIMITED WARRANYT STATEMENT. Our company warrants all merchandise against defects in factory workmanship and materials for a period of 12 months after purchase. This warranty applies to the first retail purchaser and covers only those products exposed to normal use or service. Provisions of this warranty shall not apply to our company product used for a purpose for which it is not designed, or which has been altered in any way that would be detrimental to the performance or life of the product, or misapplication, misuse, negligence or accident. On any part or product found to be defective after examination by our company, our company will only repair or replace the merchandise through the original selling dealer or on a direct basis. Our company assumes no responsibility for diagnosis, removal and/or installation labor, loss of vehicle use, loss of time, inconvenience or any other consequential expenses. The warranties herein are in lieu of any other expressed or implied warranties, including any implied warranty of merchantability or fitness, and any other obligation on the part of our company, or selling dealers.

14. SPECIFICATIONS

General
- 25 MHZ Microcontroller
- One year Warranty (Parts and Labor)
- Factory Tested and Burned In
- Sealed Enclosure (5.7"x5.4"x1.9") .6lbs
- Sealed Connectors
- Wiring Harnesses Machine Crimped & Tested
- In-Field Flash Upgradable
- High EMI Immunity
- Closed Loop (PID) Fuel Pump Control
- Real Time Tuning & Datalogging

Operating Conditions
- Temperature Range –30° to 85°C
- Operating Voltage 8 to 27 volts
- Operating Current (Controller Only) 250ma
- Reverse Battery/Transient Voltage Protection
- Maximum Operating Current 25A
- (Required Amperage Dependant on Fuel Pump)

Inputs

Oxygen Sensors
- 2 Standard O_2 Inputs (0-1.2v)
- 2 Wide Band O_2 Inputs (0-5v)
- Wideband Inputs Programmable As Temperature Inputs
- 16 Point User Definable Sensor Calibration

Frequency
- Programmable Triggering With Filtering
- Vehicle Speed
- Engine RPM
- Frequency MAF

Fuel Pressure
- Analog Input (0-5v)
- 16 Point User Definable Sensor

Manifold Pressure (MAP)
- Analog (0-5v)
- 16 Point User Definable Sensor Calibration

Mass Airflow (MAF)
- 2 MAF Inputs (0-5v) - Frequency Or Analog
- 16 Point User Definable Sensor Calibration

Outputs

Oxygen Sensors
- 2 Standard O_2 Outputs (0-1.2v)
- Signal Skew For Each O_2 Output
- Skew Based On 16x16 Point 3D Lookup Table

Mass Airflow (MAF)
- 2 MAF Outputs (0-5v)
- Signal Skew For Each MAF Input
- Skew Based On 16x16 Point 3D Lookup Table

PWM Outputs
- 2 Programmable PWM Outputs
- Skew Based On 16x16 Point 3D Lookup Table

Fuel Pump
- High Power Driver (25amps continuous)
- Closed Loop Feedback From Fuel Pressure Input

Communication
- RS-232
- CAN 2.0b

