MFG Valve Operation & Diagnostics

Applicable to: Spark Ignited PSI 40L and 53L

MFG Valve Overview

The 40L and 53L engines are equipped with Mass Flow Gas valves (“”MFG”). This valve replaces the traditional EPR and mixer fuel systems found on smaller engines. The MFG contains a brushless motor that controls the movement of a throttle shaft within the MFG. Fuel flow is controlled by changing the position of the throttle shaft, allowing accurate and consistent fuel mass flow rates.

After fuel flow is controlled by the MFG, the controlled gaseous supply flow is directed to the fuel-air mixer where it is mixed with air to produce a combustible fuel-air mix. The fuel-air mixture is then compressed via the turbocharger and cooled via the CAC.

The flow of the fuel-air mixture is controlled by separate throttles (one per bank) which are located downstream of the MFG, fuel mixer, and Turbo/CAC. You can see this as a visual representation on the last page of this document as image 1.

Basic Information

- One MFG is installed per engine bank (1 Primary side & 1 Secondary side)
- The MFG is directional, there is an arrow cast into the housing indicating flow direction
- Communicates with the ECM via CAN
- MFG contains 3 pressure sensors and temperature sensor
    - *Upstream Absolute Pressure Sensor*
    - *Downstream Absolute Pressure Sensor*
    - *Delta Pressure Sensor*

Fuel Requirements

See PSI publication 56100051 “MFG Fuel System Setup Guidelines” for detailed requirements and information.

- Minimum 3” NPT regulator with at least 5psi at the regulator inlet
- 20 to 30 inches of water column (inH2O) at the MFG inlet while engine is at full operating load
- Piping between regulator outlet and the lockoff inlets should be at least 3” NPT

Important Diagnostic Variables

Anytime you are running, commissioning, or diagnosing an MFG equipped engine, PSI recommends using 4G Display and our custom PSI HD plot file template. This plot file template will allow you to record many variables in 4G Display which may be useful in diagnostics. The PSI HD plot file template can be downloaded from the PSI cloud based support portal or by reaching out to PSI technical support at www.psiengines.com/service in the support section.

Continue to the next page to review specific important variables to monitor in 4G Display.

Important Diagnostic Variables

Description	Variable Name	Units	Notes
MFG Delta Pressure	MFG_DPPress	PSI	Delta Pressure between upstream and downstream MFG Pressure - Ideal >0.5
MFG Downstream Pressure	MFG_DSPress	PSI	Pressure downstream of MFG Throttle Blade (time-averaged reading)
MFG Upstream Pressure	MFG_USPress	PSI	Pressure upstream of MFG Throttle Blade (time-averaged reading)
MFG Throttle Command Percent	MFG_TPS_cmd_pct	%	*See notes below*
MFG Throttle Actual Percent	MFG_TPS_act_pct	%	*See notes below*

The maximum MFG Throttle Actual Percent (MFG_TPS_act_pct) is limited by the calibration in the engine ECM. Early engines may have the maximum MFG TPS % set to 89% whereas the latest calibrations are set to 75% maximum MFG TPS %.

Pressure Measurement Units: The MFG reports data in PSI (pounds per square inch). The upstream and downstream pressure sensors report in PSIA (pounds per square inch absolute), which includes the atmospheric pressure. 4G Display shows MFG Pressure as PSIA.

Adjusting for Atmospheric Pressure: Since the sensors use PSIA, adjustments need to be made to account for the atmospheric pressure to ensure that the pressure supplied to the engine is correct (20-30 IWC). This corrected pressure is what we refer to as gauge pressure, in this case, measured in IWC (inches of water column).

Correct Pressure Range for Engines: The engine requires a fuel pressure in the range of 20-30 IWC (gauge pressure). This is roughly equivalent to 1 PSI (since 1 PSI = 27 IWC).

The upstream and downstream numbers in 4G Display will stay in the 14-15 psi range at sea level even when making large pressure changes.

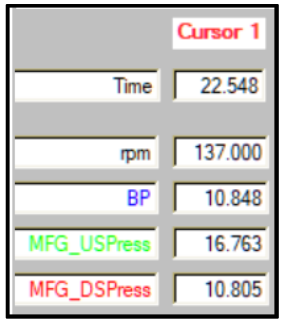
An easy method to convert MFG inlet pressure is below

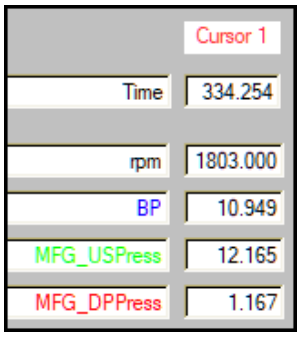
(**MFG Upstream Pressure** – **Barometric Pressure**) X **27** = **MFG Inlet Fuel Pressure in Inches of Water Column**

Example Calculations

Excessive Fuel Pressure
MFG_USPress = 16.76
BP = 10.8
(16.76 - 10.8) X 27 = 158.49 inWC

Correct Fuel Pressure
MFG_USPress = 12.16
BP = 10.9
(12.16 – 10.9) X 27 = 34.02 inWC



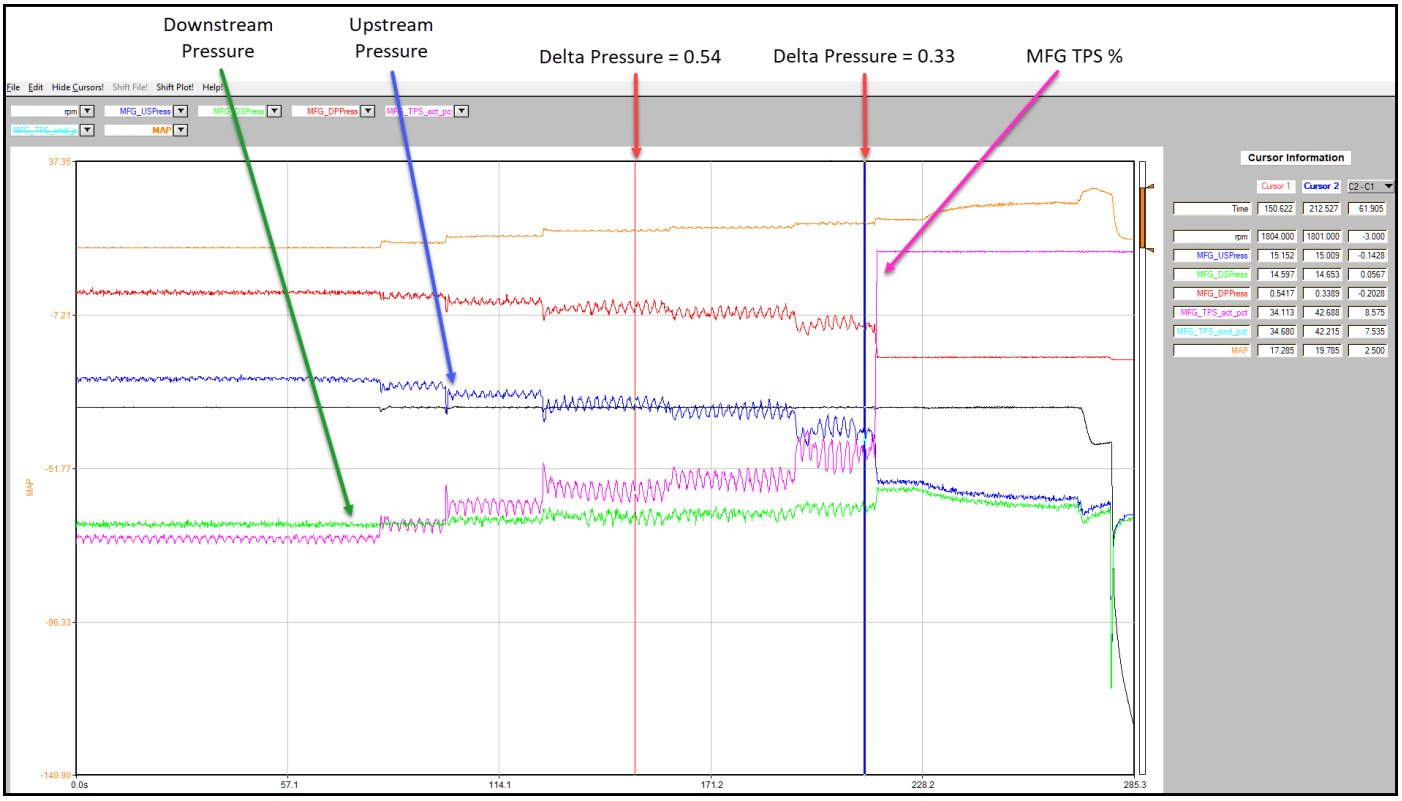


Diagnostic Tips

Fuel Delivery Issues (Volume or Pressure)

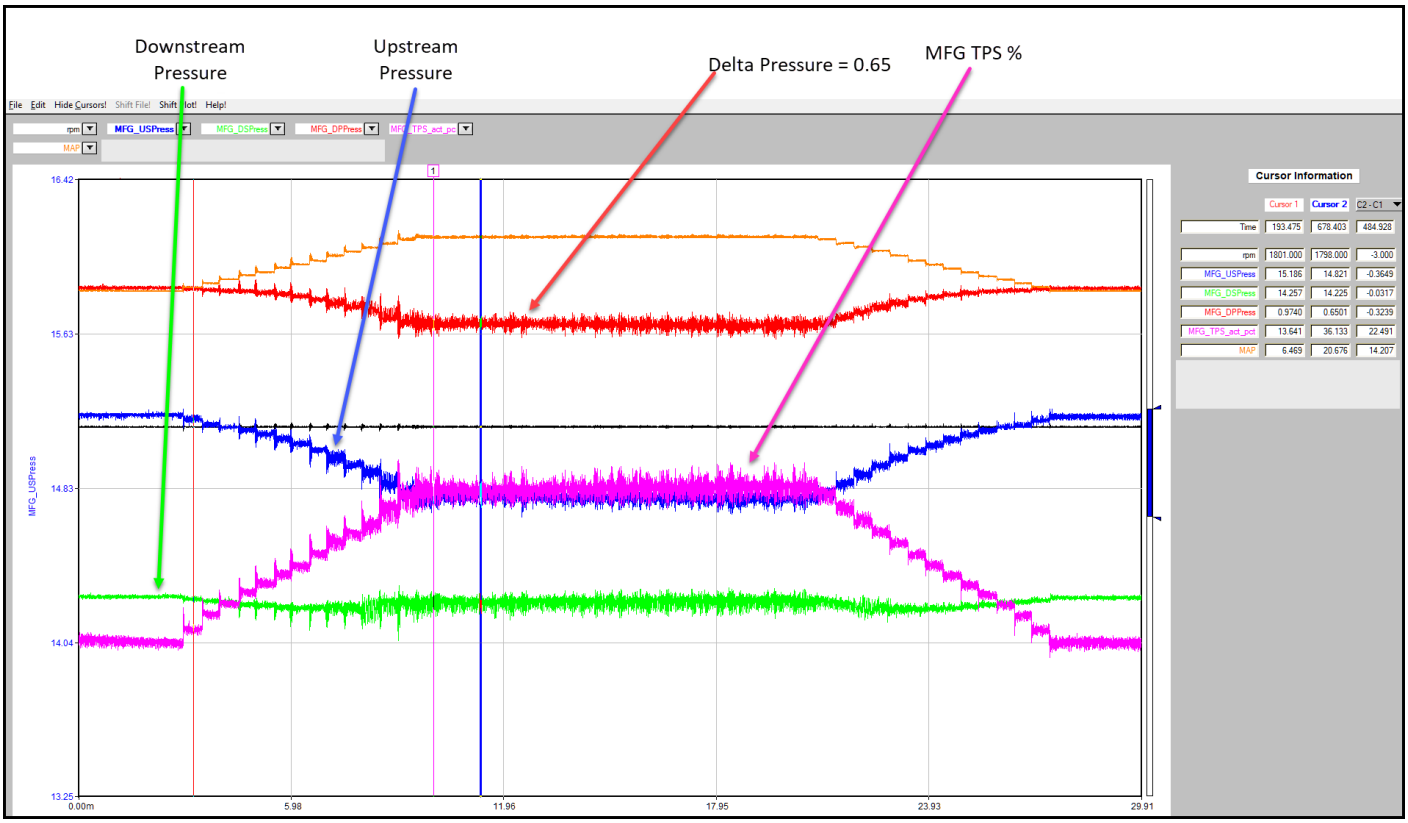
Monitor the MFG_DPPress (MFG differential pressure across the device) and MFG_TPS_act_pct (MFG actual throttle position). An ideal differential pressure reading on a plot file is a above 0.5 (rule of thumb). If the delta pressure goes below 0.25, throttle position could spike to the maximum value allowed in the calibration (either 89% or 75%). When looking at the plot file you can see the MFG TPS % (**Pink Line**) has a clear step change high and then a saturation/flatline. This indicates the fuel flow is not adequate and the system is losing control.

Notice how as engine load increases, the upstream pressure decreases (**Blue Line**). The delta pressure eventually drops below 0.5psi and the MFG throttle percentage (**Pink Line**) increases to the max position. This is an example of low fuel volume and pressure being delivered to the regulator and subsequently the MFG.



Compare the prior plot file data to the example shown below, which is a good test run to full load.

1. Delta Pressure never drops below 0.50
2. MFG TPS is steady at 36% during full load



Additional Information on Pressure Conversion

The simple chart below shows an estimated conversion of inches of water column (IWC) to PSIA, which is what is displayed in 4G Display.

If barometric pressure is 14.7 psi

Fuel pressure 20 IWC → 15.4 psi
Fuel pressure 30 IWC → 15.8 psi
Fuel pressure 40 IWC → 16.2 psi

If barometric pressure is 12 psi

Fuel pressure 20 IWC → 12.7 psi
Fuel pressure 30 IWC → 13.1 psi
Fuel pressure 40 IWC → 13.5 psi

System Diagram

1) Upstream gaseous fuel supply
2) Mass Flow Gas Valve (MFG)
3) Engine and related engine components
4) Engine Control Module (ECM)

IMAGE 1