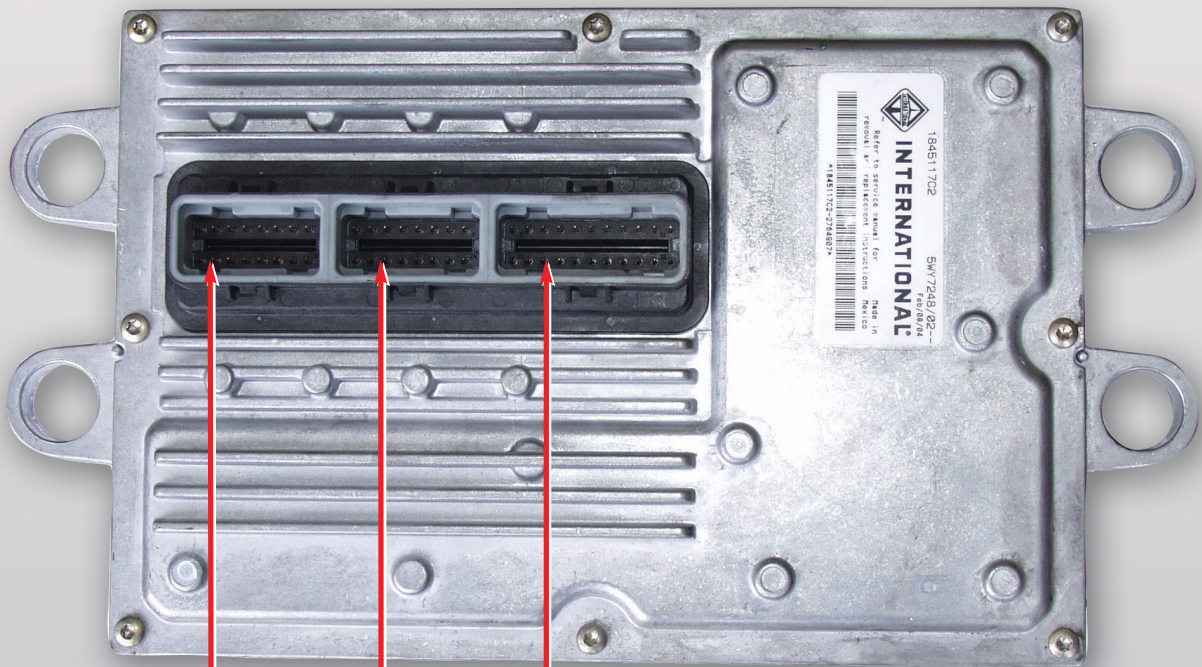


Technician FLCM Guide for the 6.0L Power Stroke Engine

Description

Operation

General Diagnostics



C1388C (X3) Connector: Power, Ground, Relay Control and Communications

C1388B (X2) Connector: Injector Control, Cyl. 2,3,5,8

C1388A (X1) Connector: Injector Control, Cyl. 1,4,6,7

FICM DESCRIPTION AND BASIC OPERATION

A drawing of the FICM (Fuel Injection Control Module) subsystem is shown in Figure 1.

The FICM drives the fuel injector solenoids based on fuel and timing commands (via *CAN2 link) from the PCM. It uses engine speed and position signals (*CKPO, *CMPO) to determine when the injectors need to be activated.

The ignition switch provides *KEYPWR to the FICM. Once this signal is detected by the FICM, the *MPR output of the FICM will engage the FICM relay. This in turn provides the *FICM PWR and *FICM Logic PWR voltages to the FICM.

The FICM provides a feedback signal to the PCM indicating when the FICM is providing control signals to the injector (fueling) (via CAN2 link and *FICMM signal).

The FICM will cycle through the injector outputs when the key is placed in the ON position. This is called pre-cycle and the time of pre-cycle varies with engine temperature. The pre-cycle is done as a self test of the injector circuits.

****See Glossary for detailed definition or explanation.***

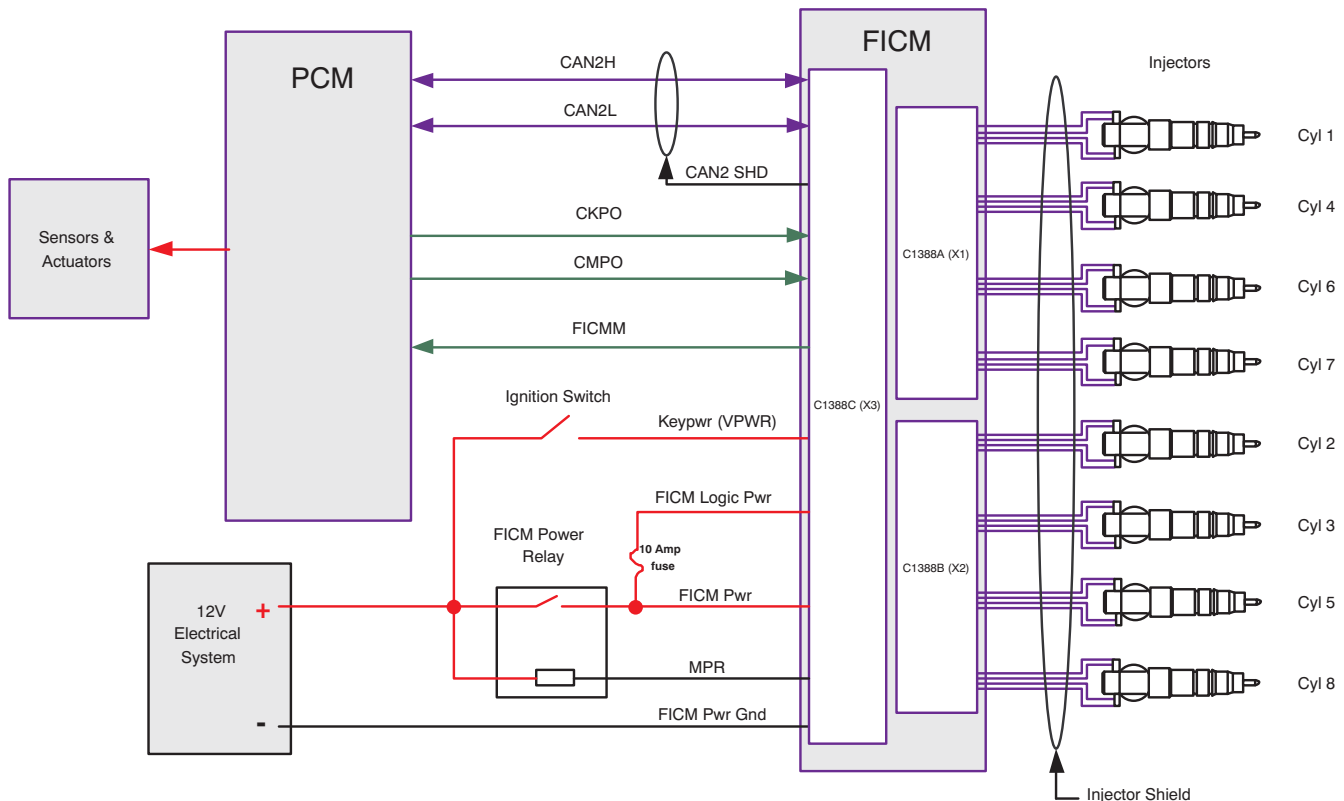


Figure 1

FICM DESCRIPTION AND BASIC OPERATION (CONT'D)

The internal structure of the FICM is shown in Figure 2. The FICM internally generates 48V used to drive the injector solenoids.

See Figure 3 for diagram of output configuration. Each individual injector is controlled with four driver outputs from the FICM. There are high and low side drivers for the open and close coil of each injector.

On 2004.25+ (1845117C2 FICMs), the low side driver is actually shared among 4 injectors. This means an injector short to ground on the low side could produce four different cylinder error codes. On 2003.25 (1837127C4 FICMs) there are individual low side drivers for each injector. This means a low side failure would result in a single injector error code. **Note:** International FICM part numbers are located on a label on the connector side of the module.

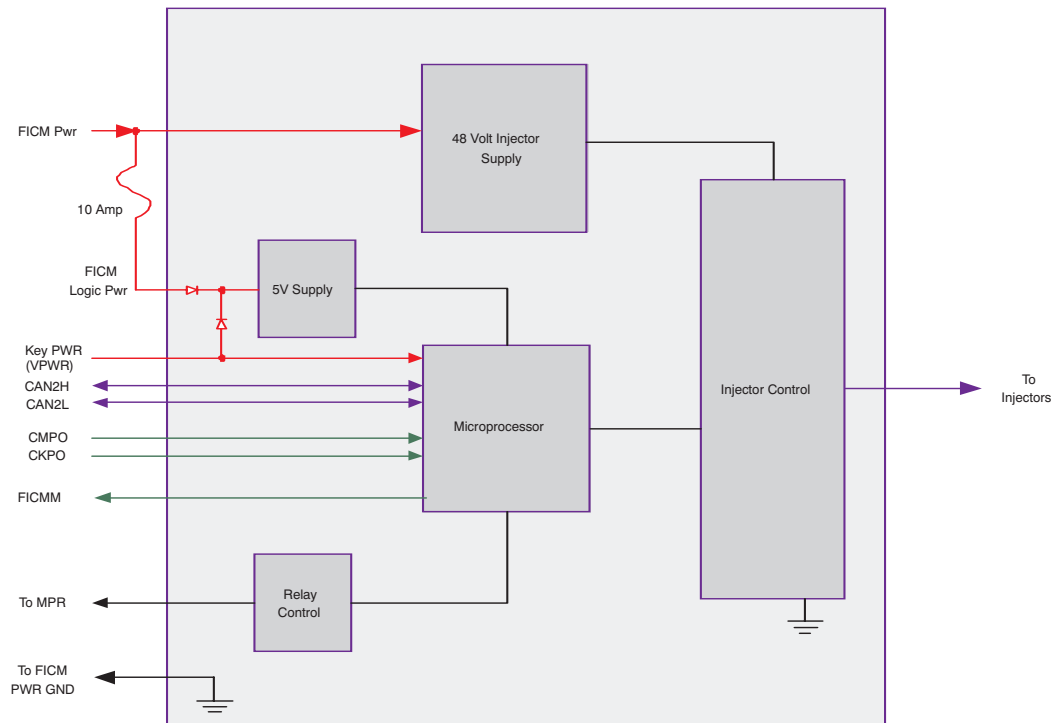


Figure 2

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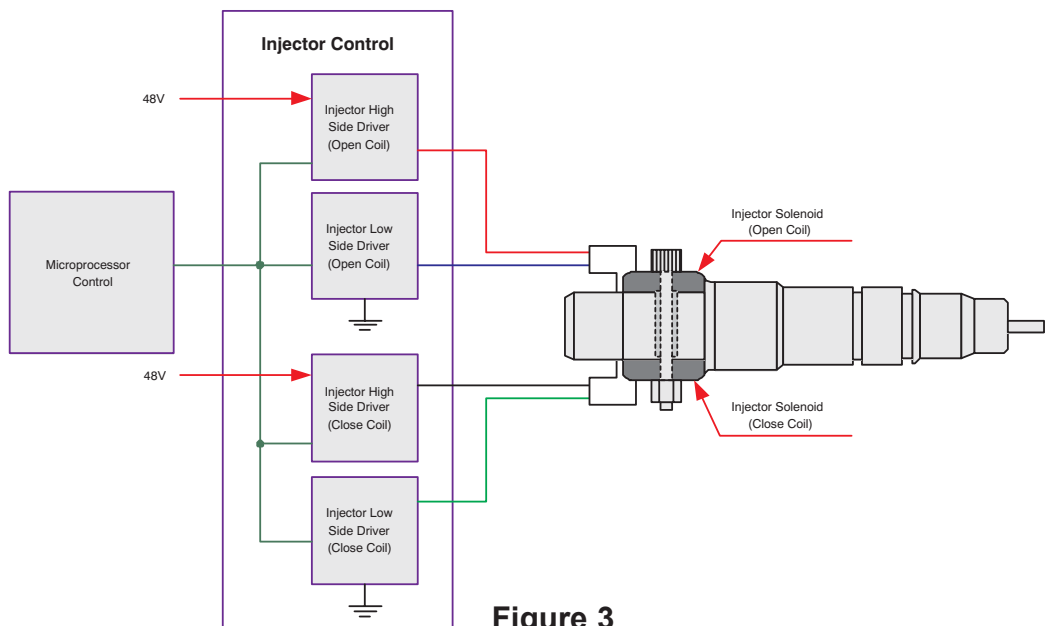


Figure 3

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FICM DESCRIPTION AND BASIC OPERATION (CONT'D)

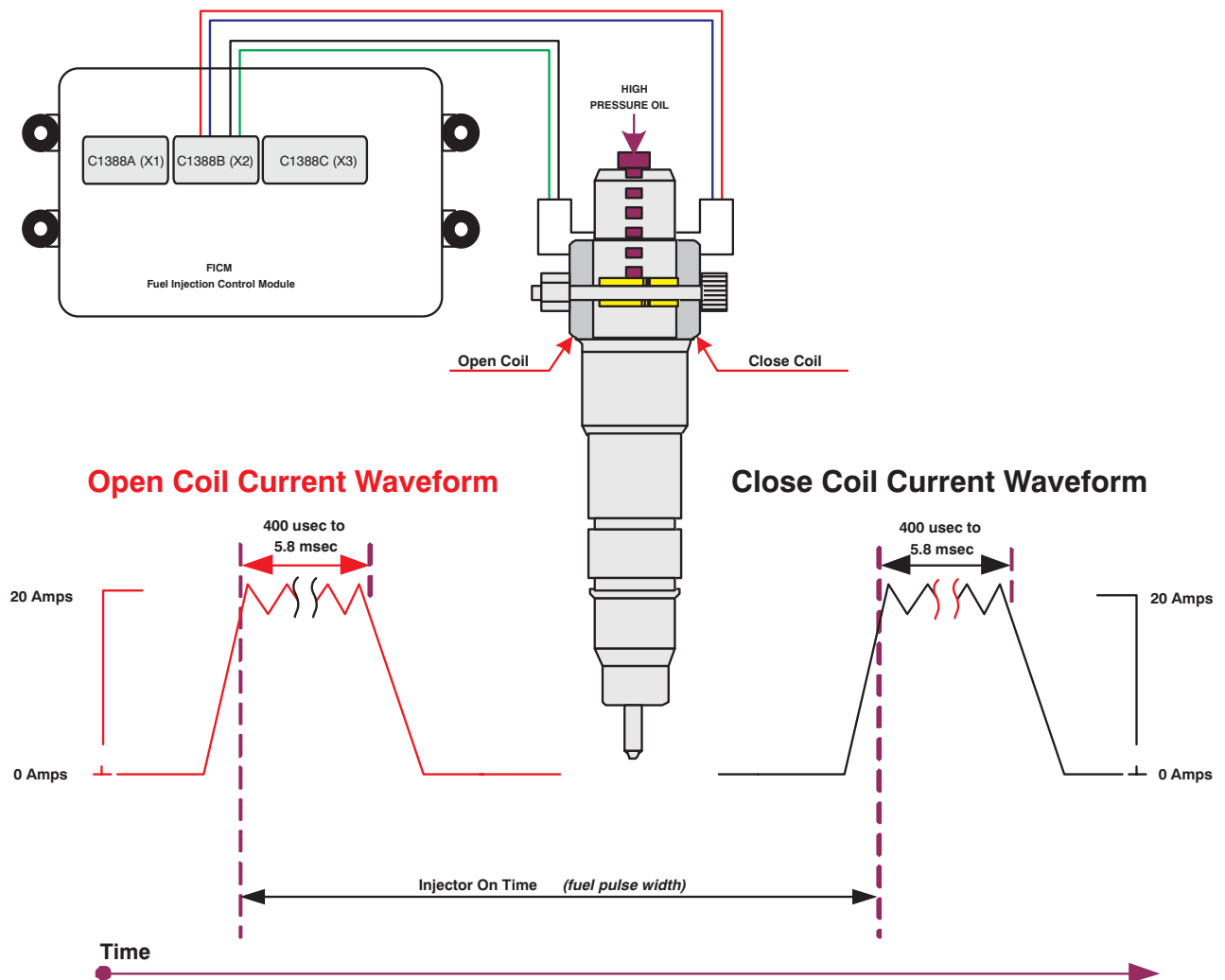
To drive the fuel injector, the FICM produces two control signals for each injector.

The open coil is driven (via a 20A pulse) to open the injector. This shifts the spool valve in the injector to the open state. Once this has taken place, high pressure oil is directed on top of the injector intensifier piston. In result, fuel is being delivered through the nozzle of the injector.

Once the desired fuel has been delivered, as calculated by the PCM/FICM, the close coil is driven (via a 20A pulse) to close the injector. This stops the distribution of high pressure oil to the top of the intensifier piston thus stopping the delivery of fuel.

The net time between pulses is equivalent to the fuel pulse width (FuelPW) used to provide fueling.

The coil on time is currently calibrated from "400us to 5.8ms". The 5.8ms is for cold starts. As the engine warms up the duration decreases and settles around 800us depending on the amount of fuel being commanded.



NOTE: WAVEFORMS ARE FOR REFERENCE ONLY.

Figure 4

FICM DESCRIPTION AND BASIC OPERATION (CONT'D)

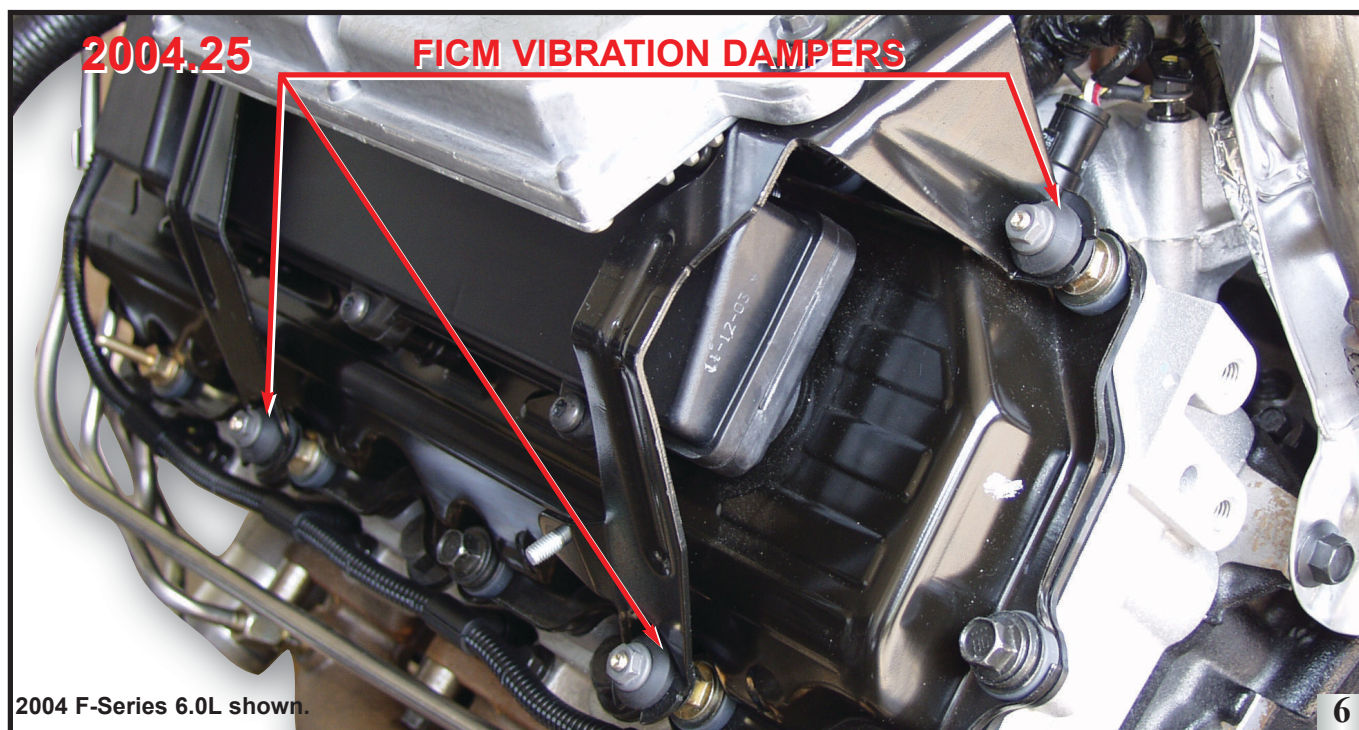
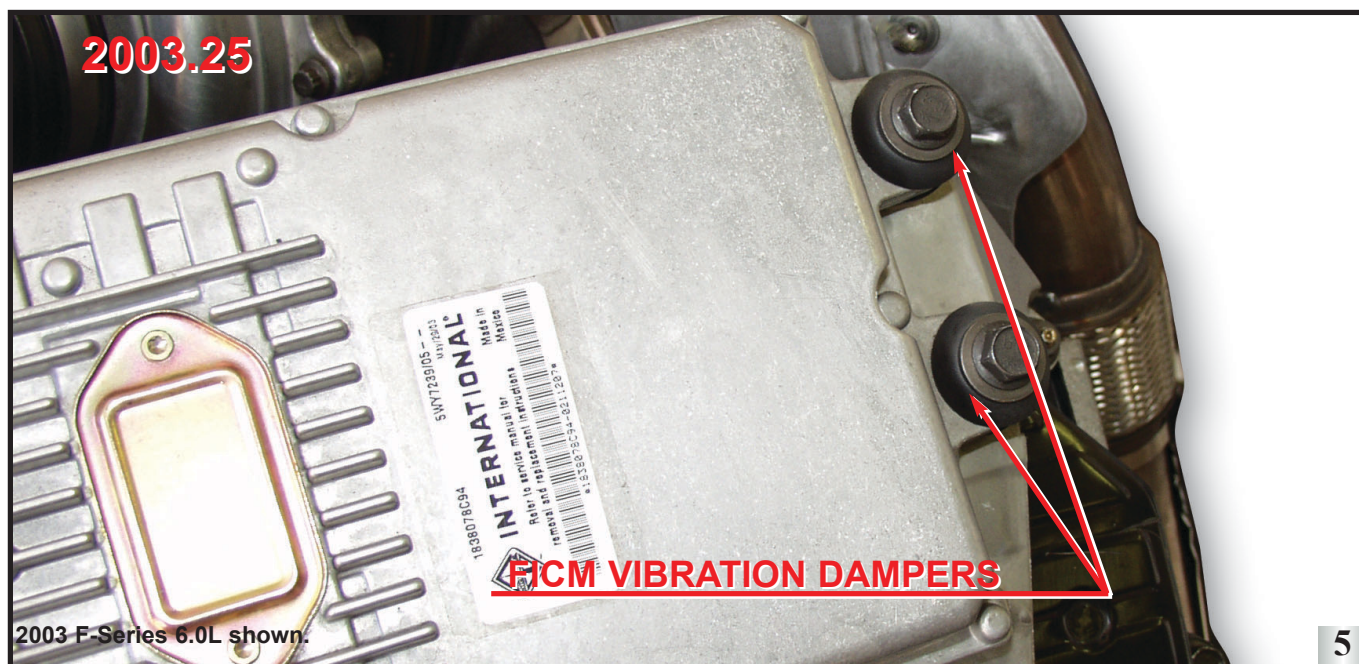
The FICM is isolated from the engine with vibration dampers. The dampers reduce the amount of engine vibration induced into the module and protects the internal electronics.

NOTE: It is very important for the long term reliability of the FICM that the isolators be reinstalled after any service work is performed.

On 2003.25 6.0L engines, the dampers were mounted directly to the FICM.

On 2004.25 6.0L engines, the dampers were moved to base of the bracket supporting the FICM.

Econoline chasis have the FICM mounted in the engine compartment near the brake booster. The FICM is mounted with vibration dampers and they should be replaced upon completion of any service.



DIAGNOSTICS

NOTE: Make sure the WDS is at the latest release level and that the vehicle is updated to the latest calibration. Calibration concerns, powertrain component faults and FICM malfunctions may produce similar driveability concerns. The FICM is often mis-diagnosed and needlessly replaced.

NOTE: The most common symptoms of a failed FICM are: NO START or CONSTANT MISFIRE AT ALL ENGINE TEMPERATURES. Symptoms other than these are not likely to be caused by the FICM module.

NOTE: Replacement FICMs do not contain software. They must be programmed prior to use.

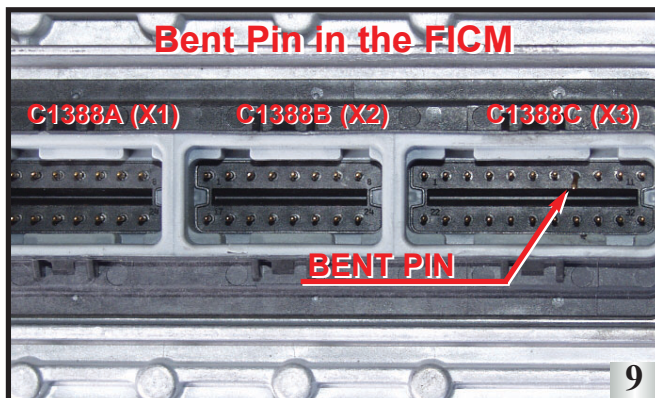
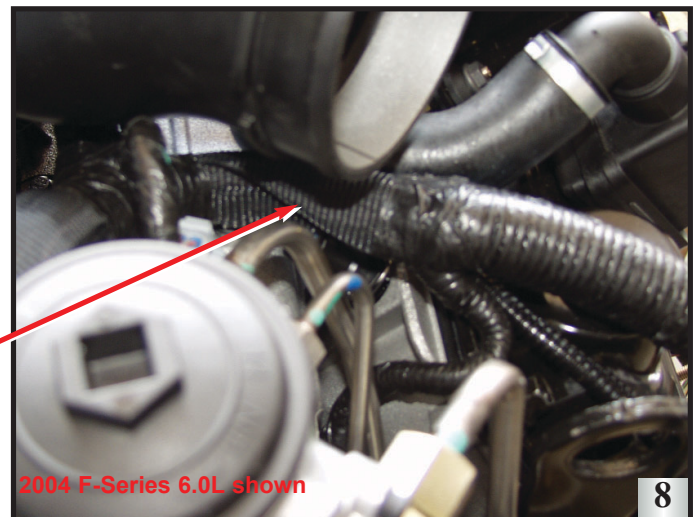
Wiring Checks

- Check for FICM wiring harness chafing. Moving the wiring harness can be done to check the integrity of connections at the FICM and injectors. Fuel injector circuit wiggle test can be used only with engine running (KOER) due to the fact the FICM determines injector circuit faults by monitoring low or high injector current. Wiring harness chafes can often be difficult to locate. If any wiring chafes are noted, repair as necessary and re-evaluate vehicle.

Some common chafe locations are:

- Upper left valve cover or valve cover stud, near the FICM.
- Idler pulley under the thermostat (wiring routed around power steering pump).
- Left front valve cover hold down bolts/studs.
- Exhaust Pressure (EP) sensor bracket at thermostat housing.
- Right valve cover at glow plug control module (GPCM).
- Accelerator Pedal pivot point under dash.
- PCM harness at battery box.
- CKP wiring near A/C compressor and belt tensioner.
- 12A581 Harness circuit 1044 (WH/YE) near connector C1443 (Left rear corner of engine compartment).
- Front left of intake manifold near breather tube and air inlet duct.
- Closely inspect wiring related to injector DTC's.
- Inspect terminals for backed out and bent pins.

For additional information refer to the latest Technical Service Bulletins or Special Service Messages.



Caution: Moving the wiring during service can temporarily remove the fault and make a FICM replacement appear to have fixed the fault.

Careful attention should be made when inspecting the wiring harness and connectors for loose or damaged pins.

DIAGNOSTICS CONTINUED

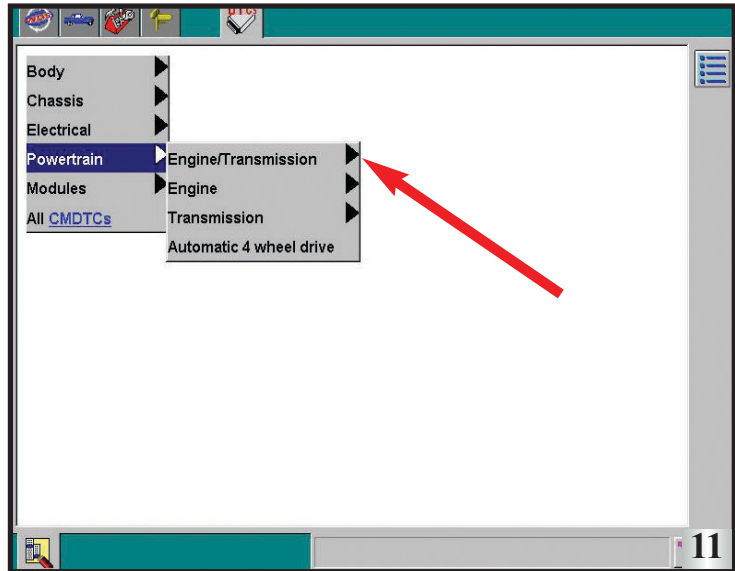
FICM FAULT DETECTION

Fault Detection

- The FICM circuit fault detection is unique from other Ford circuits. The FICM measures current to determine if an injector coil is open or shorted.
- Open coils produce low current which sets the injector circuit low codes (ie. P0261, P0264, ... , P0282).
- Shorted coils (side shorts) or short to grounds produce high current which sets the injector circuit high codes (ie. P0262, P0265, ..., P0283).

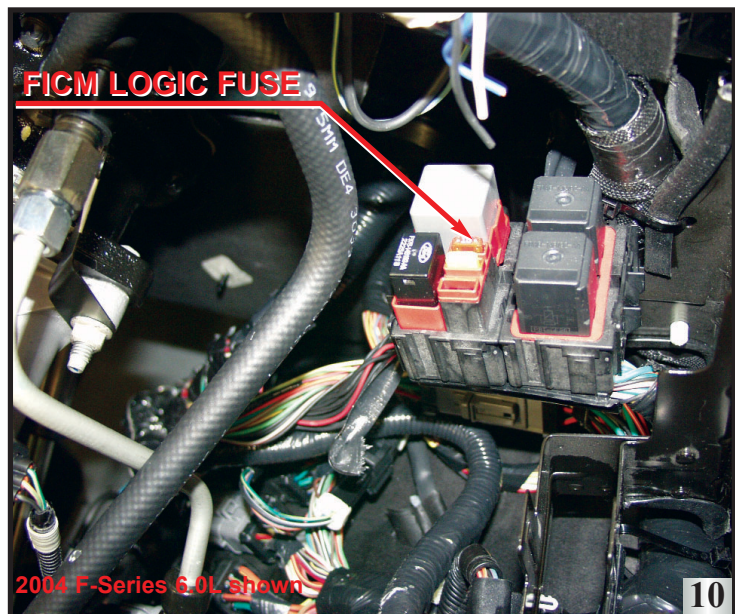
Diagnostic Trouble Code Retrieval

- Technicians must retrieve codes from the PCM as well as the TCM. The power monitor DTCs reside within the TCM (Note: P2252 and P0148) and may be the only diagnostic tool to lead the technician to the cause of the drivability issue.
- The PCM controller and TCM controller are within the same enclosure on the 6.0L. Having two controllers PCM and TCM is relatively new.
- When extracting DTC's via the WDS, it is important that you not only retrieve the Engine DTC's but also the Transmission DTC's. This can be completed in one step by selecting POWERTRAIN - ENGINE/TRANSMISSION rather than ENGINE and TRANSMISSION individually.
- It is important that transmission codes are retrieved from both automatic and manual transmission applications.
- NOTE: This step is unique to the 6.0L Diesel engine vs. the 7.3L Diesel engine.



FICM Logic Power

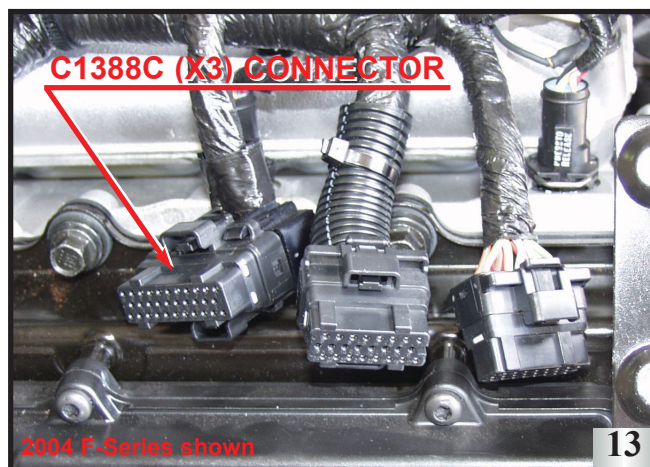
- If there is no FICM logic power to the FICM, the injectors will still buzz once the key is cycled but the engine will not start. There will be no other symptoms related to the no start condition.
- With the WDS, select DATALOGGER PID FICM LPWR. This PID will show how much voltage is being supplied to the FICM. If less than eight volts, check for short/open or low battery.
- If no voltage is being supplied, check logic fuse located in the relay center box. This box is mounted on the driver's side toward the cowl.
- No voltage could also be caused by the FICM logic circuit through the C1282 (12-PIN) connector.



DIAGNOSTICS CONTINUED

FICM PID and Wiring Relationship

- The FICM voltage PIDs are heavily filtered and therefore will respond slowly to a wiggle test for intermittent connection.
- The FICM voltage PIDs are displayed in half volt (0.5v) resolution.
- The FICM logic power circuit runs from the FICM (connector C1388C (X3), pin 8), goes through the C1282 (12 pin) connector, pin 6 and intersects to the FICM Power Circuit. Included in the FICM logic power circuit is a 10 amp fuse.
- The FICM's key power circuit runs from the FICM (connector C1388C(X3), pin7), goes through the C1282 (12 pin) connector, pin 9 and makes connection with the ignition switch, where it receives its power.
- The FICM power circuit runs from the FICM (connector C1388C(X3), pins 4,23,24,25), goes through the C1282 (12 pin) connector, pin 12 and connects at the FICM power relay.
- The FIVE FICM ground pins (1, 2, 3, 22, 26) are all tied together inside the FICM. Hence, no independent affect on a PID.



FICM POWER IDENTIFICATION

PID	FICM LPWR	FICM VPWR	FICM MPWR
Definition	FICM Logic Power	FICM Vehicle Power (Key Power)	FICM Main Internal Injector Power
Voltage input pin(s) at C1388C	8	7	NA - (Internal to FICM) pins 4,23,24,25 must have VBAT to create this power
Expected PID voltage	VBAT Range	VBAT Range	48V range

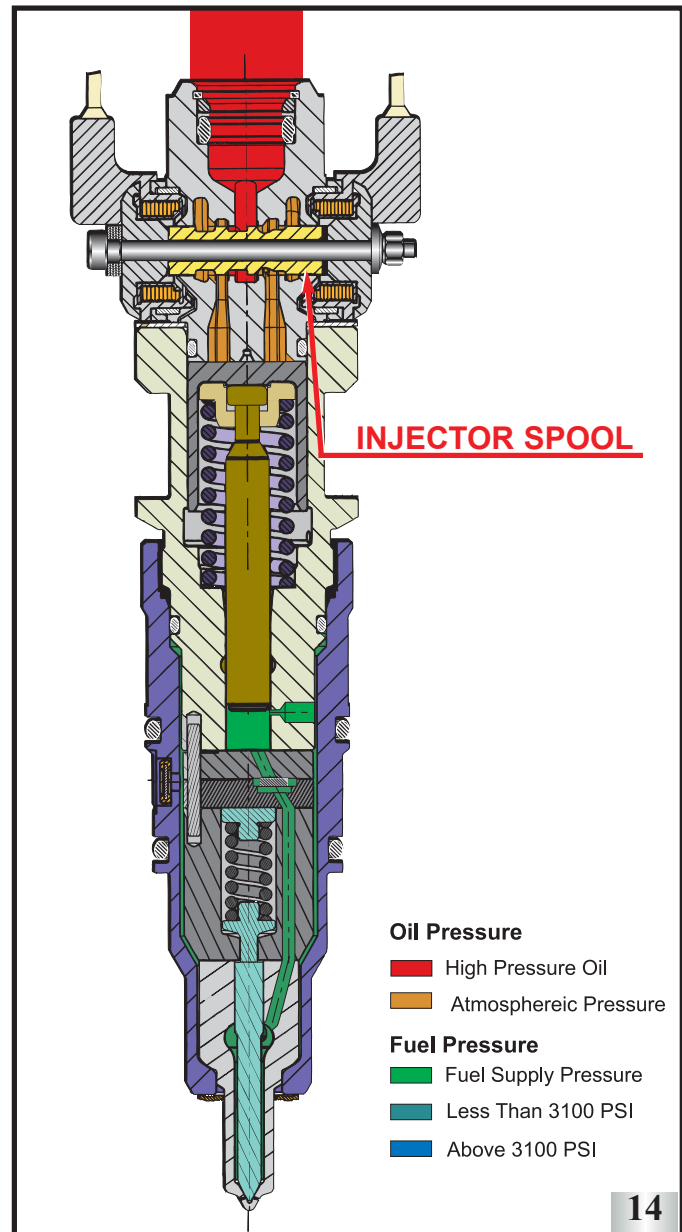
DIAGNOSTICS CONTINUED

Engine Maintenance

- If an engine has been the victim of poor/lack of maintenance, performance and operation quality will suffer. Components that are highly susceptible to poor maintenance are the fuel injectors.
- Poorly maintained oil and poor fuel quality (Low lubricity or unclean) can permanently damage multiple injectors within a short time period. This can lead a technician to believe that the FICM has malfunctioned when it actually is working as intended.
- One way to investigate questionable maintenance with damaged injectors is through the use of the injector electrical test (buzz/click test).
- A damaged or poorly maintained injector may be quieter or have an intermittent buzz/click. The buzz/click may sound abnormal when engine oil temperature is cold (ambient temperature) and return closer to normal as the engine temperature rises.
- The reason for the change in sound results from the build-up of oil sludge on the ends of the spool valve in the upper portion of the injector.
- This type of failure is not a defect in the product but rather a result of a poorly performed maintenance schedule.

Bio-Diesel Fuel

- Higher than specified amounts of Bio-diesel fuel has been found to cause multiple injector failures. These multiple failures can tend to make a technician believe that the FICM is malfunctioning.
- In these cases, the FICM is working as intended, but movement of the spool in the upper portion of the injector is limited due to sludge build-up on the ends of the spool.
- This type of failure is not a defect in the product but rather a result of an unauthorized amount of Bio-diesel fuel being used.



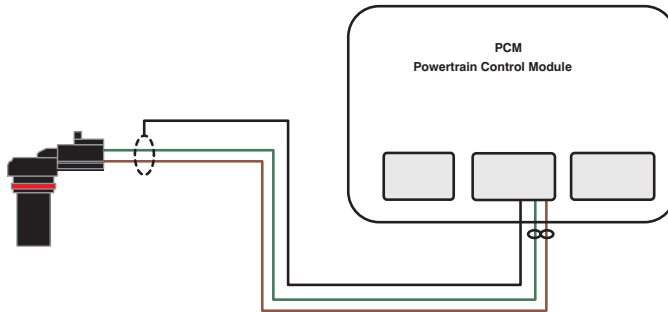
DIAGNOSTICS CONTINUED

SYNC

SYNC is achieved when the PCM receives a signal from the Crankshaft sensor (CKP) indicating the sensor is working and the correct signal has been identified by the PCM. If the Crankshaft sensor is working improperly, the PCM cannot calculate engine speed or cylinder position, preventing fuel delivery.

Diagnosing SYNC:

- Using the WDS, select the SYNC PID. This PID will be viewed as a YES or NO on the top of the data screen. KOER, SYNC should always read YES.
- SYNC is totally derived from the CKP sensor. It is possible to have no CMP sensor signal and still have SYNC (YES) and an RPM signal.
- NO SYNC and no RPM signal, typically is a faulty CKP sensor/circuit problem.



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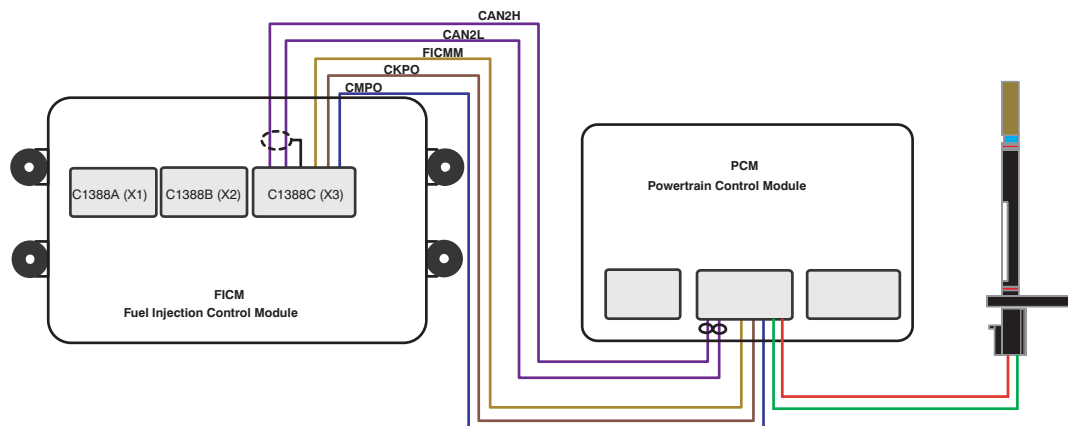
FICM SYNC

The FICM uses CMPO (Camshaft Position Sensor Output) and CKPO (Crankshaft Position Sensor Output) signals, which are sent by the PCM, to calculate FICM SYNC. FICM SYNC is calculated by the FICM and is the correlation between the camshaft pin and the crankshaft triggers. Once FICM SYNC is achieved, the FICM uses engine speed, MFDES (Mass Fuel Desired), EOT, and ICP to calculate fuel timing, pulse width, and pilot injection usage. If the CMPO and CKPO signals are not properly timed, FICM Sync may not occur.

Diagnosing FICM SYNC:

Note: Always diagnose any SYNC issues before diagnosing FICM SYNC issues.

- Using the WDS, select the FICM SYNC PID. This PID will be viewed as a YES or NO on the top of the data screen. KOER, FICM SYNC should always read YES.
- If there is no FICM SYNC while cranking the engine, then the problem is limited to the circuit illustrated below. The FICM SYNC circuit relays information from the PCM to the FICM.
- **Engine Wiring Harness:** FICM SYNC occurs through two circuits between the FICM and PCM. Verify engine wiring harness circuits CMPO and CKPO. If one of these two circuits has a short/open, FICM SYNC will not occur.
- **PCM:** If the PCM is not working properly, FICM SYNC may not occur.
- **FICM:** If the FICM is not working properly, FICM SYNC may not occur.
- **CMP** If the CMP signal is corrupt (electrical or mechanical), FICM SYNC may not occur.



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FAULT CODE DIAGNOSTICS

P0261	Cylinder 1 Injector Circuit Low		FICM has detected an open injector circuit. Injector circuit open or defective coil.
P0264	Cylinder 2 Injector Circuit Low		
P0267	Cylinder 3 Injector Circuit Low		
P0270	Cylinder 4 Injector Circuit Low		
P0273	Cylinder 5 Injector Circuit Low		
P0276	Cylinder 6 Injector Circuit Low		
P0279	Cylinder 7 Injector Circuit Low		
P0282	Cylinder 8 Injector Circuit Low		
P0262	Cylinder 1 Injector Circuit High		FICM has detected a short in an injector circuit to ground. Injector circuit short to ground, defective coil.
P0265	Cylinder 2 Injector Circuit High		
P0268	Cylinder 3 Injector Circuit High		
P0271	Cylinder 4 Injector Circuit High		
P0274	Cylinder 5 Injector Circuit High		
P0277	Cylinder 6 Injector Circuit High		
P0280	Cylinder 7 Injector Circuit High		
P0283	Cylinder 8 Injector Circuit High		
P0263	Cylinder 1 Contribution/Balance		When maximum/minimum pulse width adder is exceeded a fault is set. Cylinder weak due to mechanical problem or injectors are not contributing necessary volume of fuel.
P0266	Cylinder 2 Contribution/Balance		
P0269	Cylinder 3 Contribution/Balance		
P0272	Cylinder 4 Contribution/Balance		
P0275	Cylinder 5 Contribution/Balance		
P0278	Cylinder 6 Contribution/Balance		
P0281	Cylinder 7 Contribution/Balance		
P0284	Cylinder 8 Contribution/Balance		
P2614	Camshaft Position Output Circuit/Open		Check CMP+/- or CKP+/- and CKPO or CMPO circuits.
P2617	Crankshaft Position Output Circuit/Open		
P0611	Fuel Injection Control Module Performance		FICM memory fault will set if a RAM or ROM fault exists. Loss of FICM Power. Other internal FICM failure.
P1378	Fuel Injection Control Module System Voltage Low		FICM detects logic power low, less than 7 volts. Low batteries, loose connections/ resistance in circuit, defective relay.
P1379	Fuel Injection Control Module System Voltage High		FICM detects excessive voltage, greater than 16 volts. Charging system fault.
P0148	Fuel Delivery Error		*Power Monitor Activated
P2552	FICMM Circuit - Throttle/Fuel Inhibit Circuit		
U0105	Lost Communication With FICM		Check CAN2H/CAN2L circuits, PCM, or FICM issue.
U0306	Software incapatability with FICM		Reprograming of PCM and FICM may be necessary.

This information is not intended to replace the PC/ED and should be used as a reference.

**See Glossary for detailed definition or explanation.*

PROGRAMMING

The FICM contains a “flash memory” which can be reprogrammed. Included in the memory is the calibration or strategy which drives the injectors.

To program the FICM, a WDS tool downloads the new program information to the PCM which serves as a gateway to the FICM. The PCM transfers the program to the FICM.

NOTE: Replacement FICMs do not contain software. They must be programmed prior to use.

If there is no pre-cycle with the new module, it could be an indication that the module is not programmed. Loss of power or CAN2 communication can also cause this condition. Check for DTCs to confirm power or communication loss.

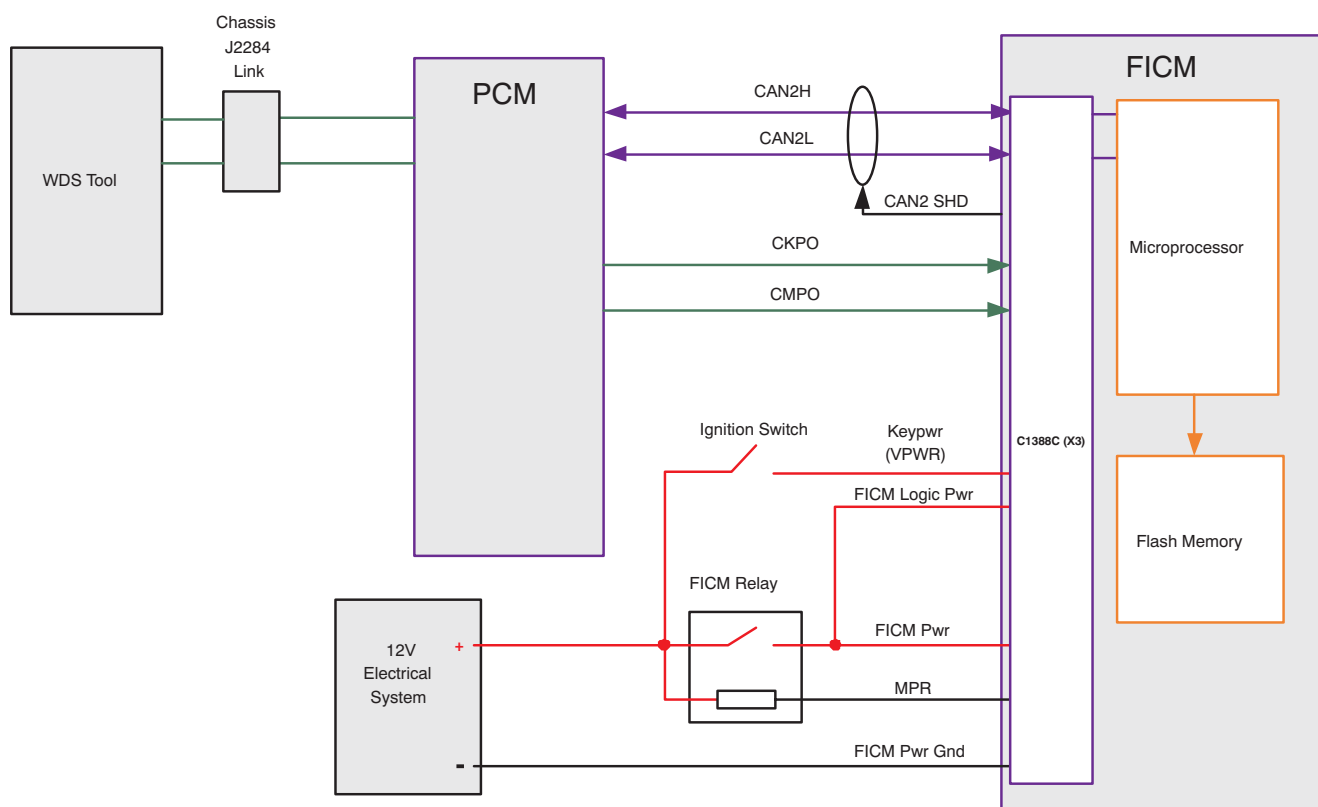


Figure 5

GLOSSARY

CAN2 Link- Dedicated CAN (Controller Area Network) communications data link between the PCM and FICM. CAN2 link is a network where modules can communicate using “bits” of information. These “bits” are transmitted at speeds of thousands per second.

CKP- Crankshaft Position Sensor.

CKPO- Buffered Crankshaft speed/position sensor output signal from PCM to FICM.

CMP- Camshaft Position Sensor.

CMPO- Buffered Camshaft sensor position output signal from PCM to FICM.

FICM- Fuel Injection Control Module.

FICM Logic Power- FICM power input used to supply logic circuitry.

FICM MPWR- Power created by the DC/DC converter sent out to drive the injectors.

FICM Power- FICM power input used to supply internal DC/DC converter.

FICMM- FICM power monitor output.

FICM SYNC- FICM SYNC is calculated by the FICM and is the correlation between the camshaft pin and the crankshaft triggers.

Key PWR(Power)- Battery voltage that is received, via the ignition switch when the key is placed in the ON position.

MPR- FICM Main power relay control output from FICM.

SYNC- SYNC is achieved when the PCM receives a signal from the crankshaft sensor and camshaft sensor indicating they are working and in time.

Power Monitor- Power Monitor is used to insure that the modules in the system do not start fueling and create power greater than demand. In the Power Monitor System one module serves as a watchdog for another module. The FICM sends out a signal which is monitored by the TCM (which is packaged in the PCM). If something wrong is detected, the two CMPO and CKPO outputs going to the FICM can be turned off by the PCM/TCM thus disabling fueling of the FICM.

VPWR- Vehicle (battery) power.

