V2 | N2 2020

Ford Tech Tips

Technical Knowledge for Ford Service Professionals

FORD PARTS

Throttle Body and Throttle Pedal Diagnostics

Condition: 2005 Ford Freestyle with a 3.0L engine surge while driving

Unlike some other drive-by-wire systems, modern Ford models have one extra signal that the engine controller uses to monitor the driver's intent. Originating from the throttle pedal, three signal inputs are monitored for rationality.

The engine controller (PCM) will provide: two reference voltage circuits (5V) and two signal return circuits (ground). If one of the ground connections is damaged or if one of the reference voltages is disturbed/disconnected/shorted at any potentiometer, the remaining potentiometers will function. The PCM is constantly monitoring the throttle pedal; if any of the above is "not rational," then a fault is stored within that controller. Be aware that a network fault or component fault codes may occur within other network controllers.

This statement also holds true that if a potentiometer has an internal problem, the faults will be shared between the "accepting" controllers within that network.

The PCM will still function in a limited capability and allow the driver to move the vehicle. Warning lamps will illuminate, limited torque is noticed and depending on the severity, the transmission will enter limp mode.

The throttle body operates via PCM by the inputs received from the throttle pedal signals. If the signals are rational, the throttle body operates normally.

The throttle body has an electric motor that opens or closes the throttle blade depending on driver input and the PCM programming. The PCM will maintain the required and optimum

Tools used
Ford IDS
Screen capturing software
90-amp floating power supply
Access to relevant schematics and TSBs
Notepaper, pen and highlighting marker

RPM depending on the pre-programmed factors such throttle demand, engine load, MAF, coolant temperature, vehicle speed etc., including various inputs such as steering pressure and AC demands.

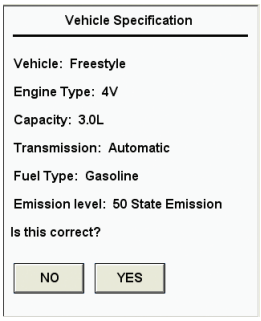
The throttle body also signals its current position (from closed to open or vice versa) via output voltage from its built-in potentiometers. Those potentiometers are attached to the throttle blade shaft. Rationality of the output is also monitored by the PCM.

Despite this model's age, the majority of the factors and tests are applicable for current models. This particular vehicle suffered from unwanted surging while driving, and a quick road test confirmed the driver's complaint. An in-shop test confirmed the complaint as well, but not as evident compared to the road test.

Start here and keep all records

As with any diagnostic analysis, keeping records is proof of the vehicle's condition when it arrives with a complaint. When looking at the complete scan of the vehicle, there will likely be more instances of unknown or unrelated faults recorded in multiple controllers that may or may not have any relevance to the customer's complaint.

This particular vehicle had multiple faults recorded within multiple controllers that would appear to indicate a malfunctioning controller and CAN messaging interference between the engine and transmission management system.



Initial Screen

The best advice is to follow the initial complaint and to keep it simple. The starting point will be identifying of the model and capturing all recorded faults. Test the "battery," clean the connections and make sure a clean and stable power supply is attached while testing. The battery was questionable, but the power supply maintained the correct voltage and enough current to complete all the tests. The questionable battery was replaced due to its age and that it was a factory original.

Within this frame (all CMDTCs), clicking each control module in blue will access the respected controllers fault. Once the faults are captured and recorded, look for the Freeze Frame data and save the image(s). Freeze Frame data may hint as to why the faults were recorded and a direction toward a successful repair.

For the sake of clarity, only the faults are displayed rather than five images.

PCM
P061B-FF Internal Control Module Torque Calculation Performance
P1000-FF Check of all systems is not complete since last memory clear
P2106-FF Throttle Actuator Control System - Forced Limited Power

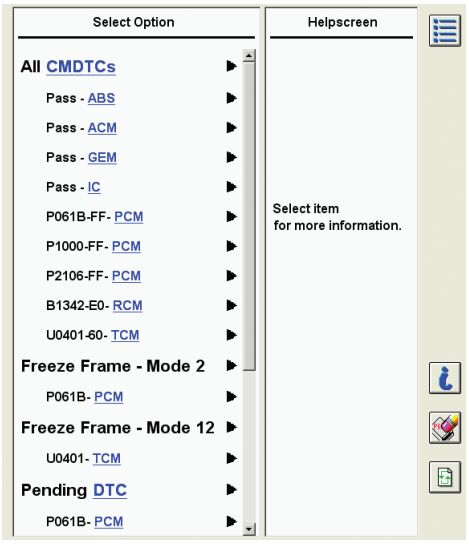
RCM
B1342-EO ECU internal fault - Internal microprocessor failure

TCM
U0401-60 Invalid or Missing CAN Data From The PCM

Capture the Freeze Frame data before deleting the recorded faults first.

The Freeze Frame data may suggest what happened when the fault was set. The following Freeze Frame image indicates nothing out of the ordinary and appears the fault(s) had been during a cold startup.

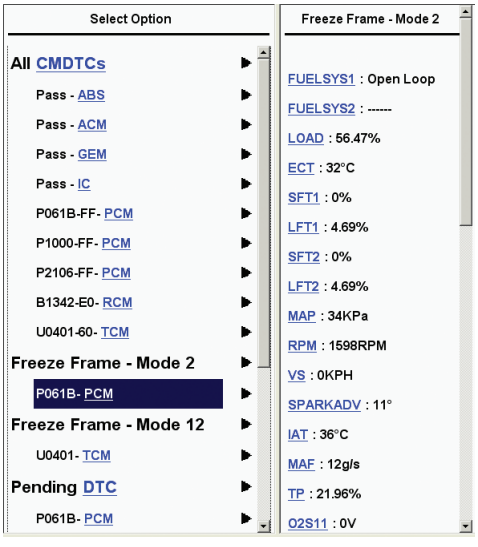
Moving the slider on the right side of the screen and reading the data capture didn't offer any clues to the initial complaint. Once the faults and Freeze Frame are captured, delete all the faults following the IDS instructions.



All CMDTCs

Pay attention to the primary complaint: P061B-FF and P2106-FF.

These particular faults point toward control module or throttle pedal/throttle body performance. The IDS can measure the voltage and throttle angles of both the throttle pedal and throttle body.



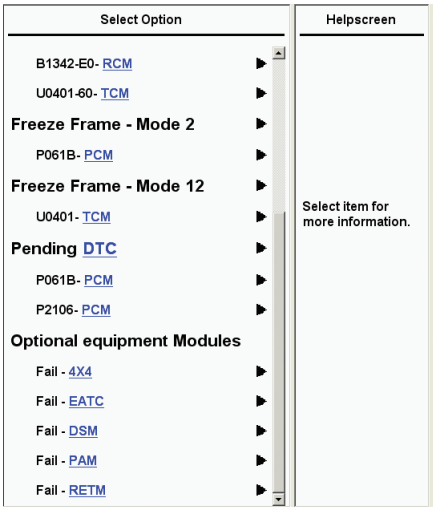
Freeze Frame

The majority of readers will likely understand how a throttle pedal or throttle body works, but has anyone asked what the relationship is between the driver intent and the IDS?

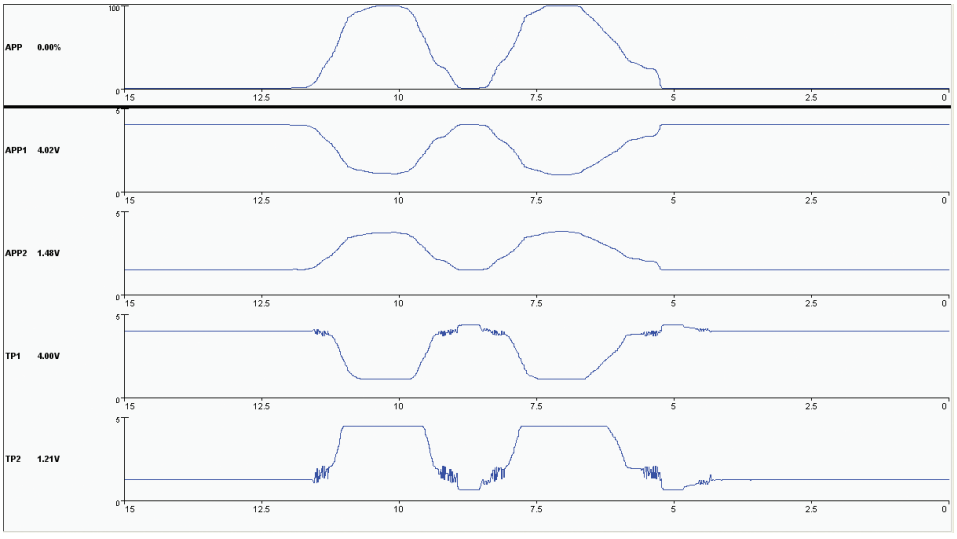
In simple terms

The IDS software and VCM will connect via LAN to the laptop. The IDS will confirm the correct internal software of the VCM. The operator will request a connection with the vehicle and identify it with a make, model, year and its VIN.

Normally, the operator will request "ALL CMDTCs" and the IDS will "ping" all controllers that are active on the network, and display the recorded faults. If a controller is not listed within the request,



Optional Equipment



Throttle Testing

either those controllers are not installed or not communicating. Accordingly, pay attention to the list and know what's installed.

As an example, some models may or may not have modules such as 4x4 or PAM installed (4-wheel-drive or Parking Aid Module).

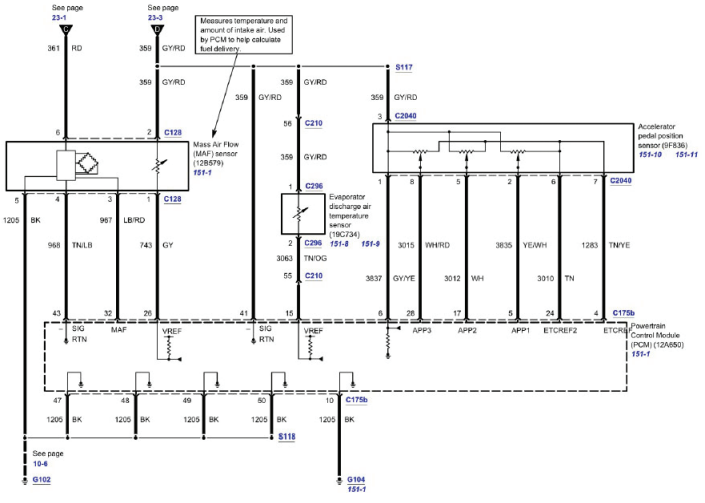
During the diagnosis, all data is requested by the IDS software via LAN connection in a digital form. The IDS software will request the operator's intent with IDS, access a controller PID and receive the digital data. That digital data is converted and displayed on the screen that is read in a form that we can understand.

If more than one PID is requested, each is requested, converted and displayed on the screen. The next PID is requested, converted and displayed on the following line. If five PIDs are requested, that same request is repeated five times in five separate lines on the screen. That process repeats itself and redraws the data at every request. The data will remain active until the operator stops the request.

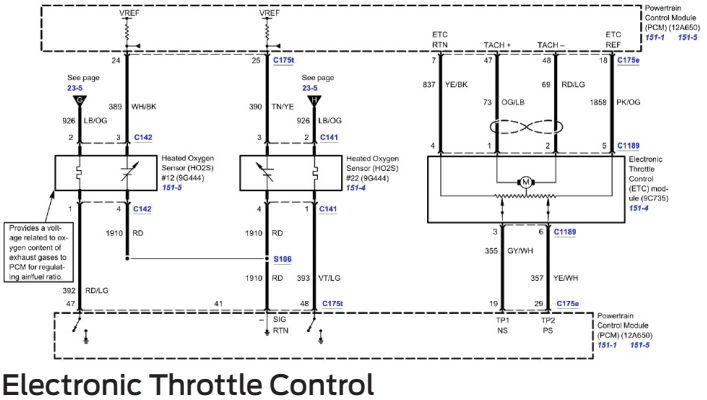
The data displayed will redraw itself relative to the speed of the laptop processor.

Again, when requesting data, it is normally converted from digital values to a recognized value we can understand. Those converted values are also processed within the IDS software to be graphed in most cases. It is the graphing that becomes a desirable visual aid when measuring and testing within the IDS platform.

Now that the process is understood, let's have a look at the data that the IDS displays when viewing the



Accelerator Circuit



Electronic Throttle Control

throttle pedal and throttle body simultaneously.

While preparations are made, it is a good idea to access the PCM connections (schematics) for the throttle pedal and throttle body. We chose to monitor the data collected as APP in percentage:

APP1 with APP2 in voltage and TP1 with TP2 in voltage. With the IDS running with KOEO, two slow throttle applications [off to WOT to off (x2)] pointed to the customer's complaint of throttle surging.

The test was repeated several times and can be accomplished with an oscilloscope, but the IDS with VCM has an advantage in this case. Notice the interference at TP1 and TP2.

If an oscilloscope is used, follow the schematic(s) as an aid. If using IDS, the schematics also offer a clear overview of the interconnection between the throttle pedal, throttle body and PCM.

Side note 1

It was quite interesting when someone decided to offer and request to install a used throttle body. This used version was not the same because the original had two small coolant hoses attached. The correct version has a "cold weather" package to eliminate throttle body freezing.

Side note 2

Now imagine someone taking the time to source the used part, return the wrong version, and hopefully return with the correct replacement. One needs to question the time the vehicle spent in the service bay, running back and forth, cleaning and testing the used part again. In this case, the local dealer offered the correct version and part number, which would have been a much more efficient purchase.

With the correct throttle body installed, the IDS was used again to measure the difference and follow up if any possible faults that may have returned.

The difference between the wrong replacement part and the right one verifies the surging will not be evident during the road test. Remember that there were other controller faults recorded from the beginning of this exercise.

After a few key cycles and another road test, none of the earlier faults returned. It is highly probable that a defective battery, which cannot provide sufficient current on cranking, will also cause other network controllers to set faults as described earlier.

Explanation in simple terms

The engine starter is undeniably the greatest draw on the electrical system, either cold or hot. If there is insufficient voltage and insufficient current, one or more controllers will suffer the consequences. These consequences will be one or more controllers recording faults attributed to an internal defect or several communication error(s).

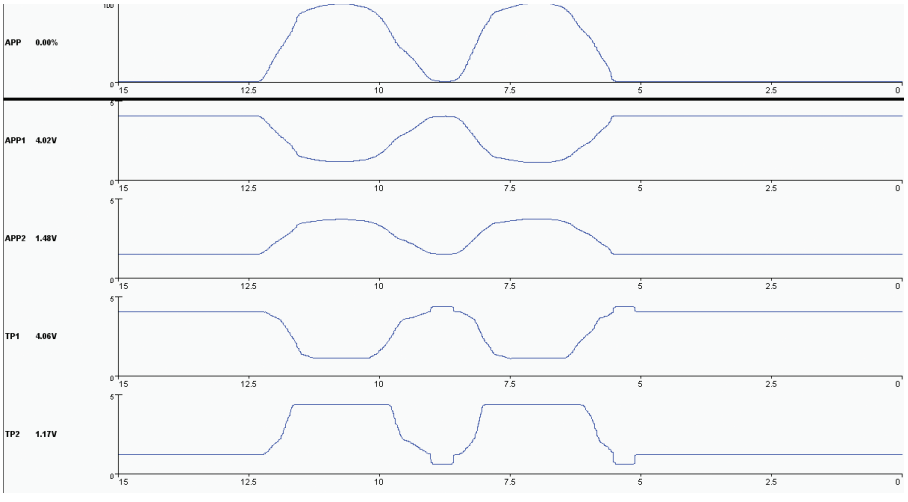
After the throttle body and battery was replaced:

RCM B1342-EO ECU internal fault and

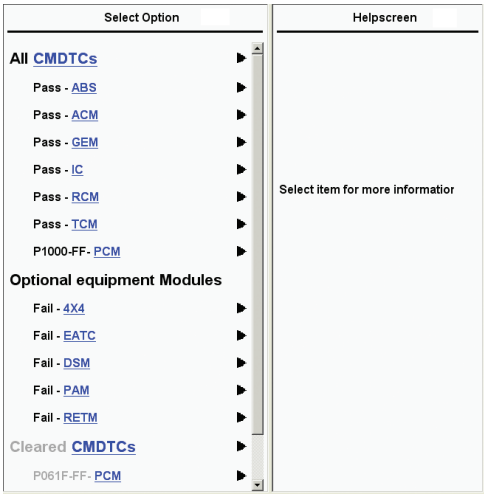
TCM U0401-60 Invalid or Missing CAN Data did not return.

Generation II

Torque based electronic throttle control basics: Benefits
No throttle cable required
Responsive powertrain and improvements to shift quality
Cruise control actuators are not required
Idle air control is not required
Airflow range at any altitude
Increased torque and precise shift points



New Throttle Body



Final Scan

It's a hardware and software strategy delivering engine torque output via throttle angle.

Based on driver intent, torque-based electronic throttle uses a throttle pedal position sensor.

Gen II is a drive-by-wire system eliminating the idle air control system.

Torque-based systems adjust the automatic transmission programs dynamically.

Dynamic adjustments deliver performance via throttle angle while calculating desired wheel torque during transmission shift points.

- APP throttle percentage is a positive slope (0-100 percent)
- APP1 is a negative voltage slope (5-0V)
- APP2 is a positive voltage slope (0-5V)
- APP3 is a positive voltage slope (0-5V)
- TP1 is a negative voltage slope (0-5V)
- TP2 is a positive voltage slope (5-0V)

The signal from the throttle pedal is converted in degrees by the PCM. The software calculates the degrees to counts as the input to a torque-based strategy. The reason there are three separate position signals is to ensure the PCM receives the correct input, even if one of the signals fails. The term "rationality" means that if one signal is incorrect compared to the remaining two, the PCM will calculate where the signal should be.

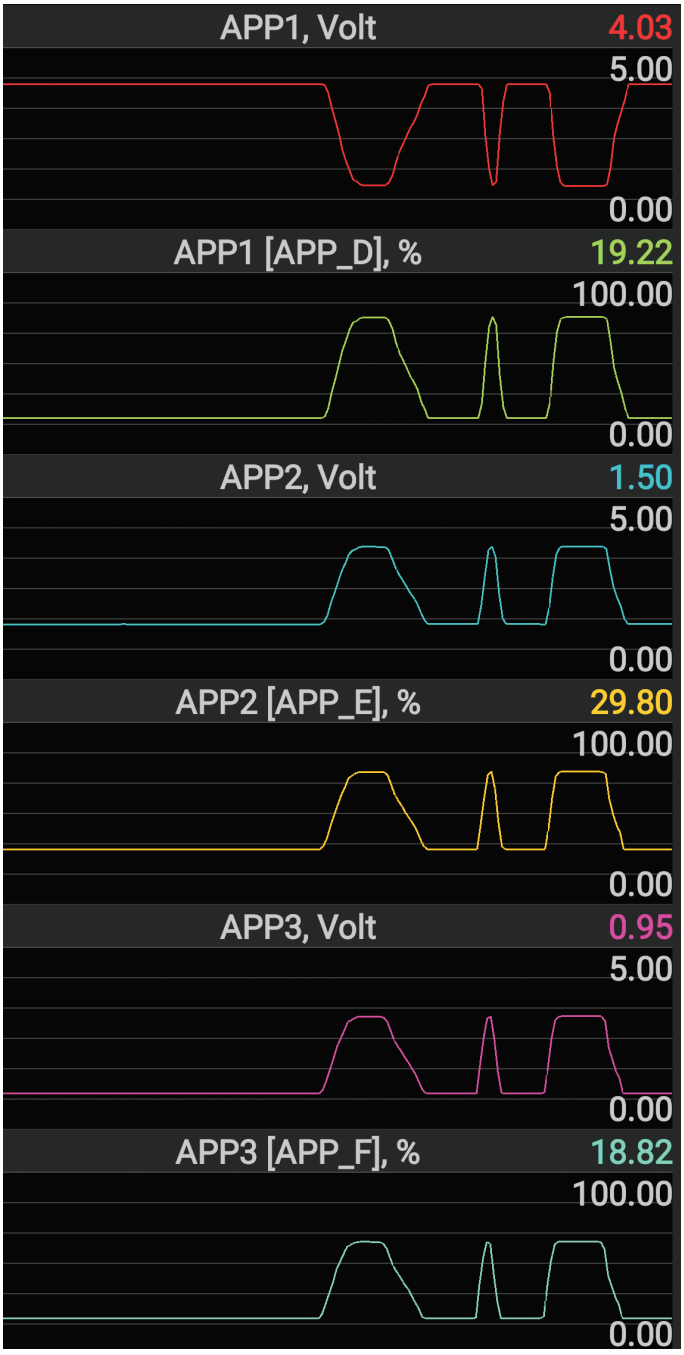
GEN II throttle bodies use two springs. One is used to close the throttle, while the other is within the plunger to offer a default angle when no battery voltage is applied as an aid to "limp home" mode.

Guide and setup for cleaning or replacing throttle bodies

- Clean the throttle body. If the mounting seal is damaged, replace it.
- Begin by turning off all electrical components (e.g., radio, headlamps, AC/heater system).
- Clear all faults and clear the PCM adaptive memory (PCM Reset).
- Set the ignition switch to the run position and wait until all the instrument warning lamps are off. Repair any unwanted warning lamps before proceeding.
- The PCM will sweep the throttle body blade to learn the new positions.
- Start the engine and allow it to idle for 10 minutes.
- Wait until the ECT reaches full operating temperature.

- Idle should drop as the ECT warms. Monitor the ECT with IDS.
- Continue idling for an additional five minutes.
- The PCM will adjust/learn the idle program.
- Drive the vehicle at various road speeds.
- The PCM learns its transmission shift points.
- Recheck for any recorded faults.

Is there another way to measure a throttle pedal? >



Alternative Test

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