Vehicle Prepping: Replacing The Control Module Of Your Car

Do you have enough money set aside to pay for hundreds to thousands of dollars in vehicle computer repair and diagnostics?

Have you been watching the news and feel that either a terrorist group or a foreign country is right on the brink of launching an EMP strike right here in the United States?

Even without the usual concerns you take into account as a prepper, just a few computer chips can make it impossible for you to use your survival vehicle, nor to get to work and meet other vital transportation needs.

Replacing the PCM or Powertrain Control Module in your vehicle brings you one step closer to having reliable transportation regardless of what is going on in the world around you.

What is the PCM?

In most vehicles, the Powertrain Control Module is the key computer that controls just about every aspect of your vehicle's performance. Its presence is designed to improve gas mileage and also make it easier for mechanics to detect oncoming system or part failure as well as find problems faster when they occur.

As with any other computer, however, they can be a serious headache to consumers because:

- When they break down or produce false readings that prevent an otherwise functional car from operating.

Replacing the computer can be very expensive and is usually beyond the ability of the vehicle owner. It also often requires a manufacturer licensed repair shop to reset the new computer so that it works correctly.

- The PCM and other computer systems in the car are all susceptible to EMP strikes.
- In more modern vehicles, the computers may be hacked by outsiders that can literally cause your vehicle to stop cold in traffic or accelerate to a dangerous level in order to cause a crash.
- RFID chips equipped with GPS locators or wireless internet access elsewhere in the vehicle can make it easy for hackers, stalkers, and others to locate your vehicle. In some modern vehicles, these chips which may not reside in the actual PCM can cause your vehicle to become inoperable.

The Basic Parts of the PCM

The ECU or Engine Control Unit

It controls the air to fuel ratio, idle speed, and ignition timing. Together with these functions, the ECU or related computers may also control firing order and valve timing.

In some vehicles, the ECU may also control ABS braking, skid control, traction monitoring, and cruise control. The ECU may also have some control over steering in newer vehicles with automated crash avoidance technologies.

The TCU or Transmission Control Unit

It's mainly used in vehicles with automatic transmissions. This part of the PCM receives information from sensors that reveal the vehicle's speed, the throttle position, and

traction control monitoring. From this data, it determines which gear is best to use.

It also controls how the transmission shifts from one gear to the next. The TCU is also heavily involved in improving mileage.

The BCM or Body Control Module

This module is usually dedicated to other accessories found in the vehicle. Automatic seat belts, electronic lock doors, sun roof, anti-theft systems, the radio, electronic windows, and internal lights will all be controlled by this module. Some vehicles may have this module integrated with the ECU, while it is a separate computer in others.

Video first seen on DanielJaegerFilms.

In order to function, the PCM must send and receive information about what is going on in other parts of the vehicle. Much like your brain, the PCM has “sensors” that detect certain conditions and then relay the information directly back to the PCM, or to another module that reports back to the PCM.

As an analogy, your eyes detect the presence of a very narrow band of frequencies within the light spectrum. That information is sent via the optic nerve to your brain where it is interpreted so that you can “see”.

Once the PCM receives information from the sensors, it compares it to information organized in a table or database. If the value is outside the range set in the database, then the PCM “interprets” that something is wrong. If the data is inside the range, then it determines there are no problems in that part of the engine. Depending on the findings, the PCM will send one set of directions or another to other computer modules, that, in turn, control how the actual working parts

of your vehicle perform.

As an extremely simplified example, a sensor located inside the cylinder might report when the spark plug has fired, as well as the estimated power of that spark. The PCM or an associated module should have already initiated the process which takes fuel from the gas tank, turns it into a mist, combines it with air, and then injects it into the cylinder.

As the explosion occurs inside the cylinder, another sensor might keep track of the heat delivered by the explosion, if there are leaks in the piston rings, and when the piston reaches its lowest point in the cylinder.

While all this information is coming in and being compared, the PCM will be dedicating some of its resources to repeating the same process in the next cylinder set in the firing order. If a fault occurs, other resources within the PCM will be used to let the driver know there is a problem by activating one or more lights on the dashboard.

That’s a lot of work for one tiny computer, isn’t it? While you can expect the sensors attached to the PCM to fail more often than the computer itself, they can cause it to send out wrong instructions, or, worse yet, cause the PCM to shut your vehicle down entirely. In the scenario listed above, here are some problems that can occur.

These problems can occur regardless of whether an EMP strikes. In addition, if an EMP occurs, damage to the computer chips or those found in the sensors can also generate false readings or no readings at all. Either way, your vehicle may not run, or be ruined because the computer will give directions that can cause the engine to seize up and fail.

- If the plug is fouled or does not fire, that will be transmitted to the PCM. An error code will be generated that will cause the check engine light on your dashboard to light up.

- If the sensors itself is failing and transmits that the plug is misfiring, it will also cause the PCM to generate a system fault.
- If an EMP strike affects this or some other sensor that, in turn, damages part of the PCM, it may cause the cylinders to fire out of order. It may also reduce coolant flow (modern automobile computers send less coolant through a newly started or cold engine so that it heats up faster), which can cause the engine to overheat and seize up. If you think about all the things that can cause an engine to seize up or fail, chances are you will find at least on sensor that leads back to the PCM. Each of these sensors can very easily cause the engine to seize up via the PCM or other computers attached to it.

Perhaps off topic, but I am inclined to disagree with the view that a motor vehicle that is not running during an EMP and has the battery out should survive the blast. Others claim it is impossible for the computer to cause the engine or transmission to seize up and fail completely.

Remember, an EMP pulse can propagate without the benefit of a physical medium such as a wire or other direct connection. If your vehicle is near a power line or anything else that can conduct electricity, the computer can be ruined by the EMP. The safe distance from the power line will depend on the magnitude of the EMP and the capacity of the conducting medium.

In essence, the stronger the EMP, the further away your vehicle will have to be from transmission sources to remain safe. Do some research on wireless power transmission, a technology envisioned by Tesla and on the verge of changing how we receive electricity from centralized sources.

What Does the PCM Do in Your Specific Vehicle?

Depending on the age, make, and model of your vehicle, the PCM may do relatively little, or it may replace important parts that were once mainstays in motor vehicles. As a general rule of thumb, the newer your vehicle is, the more integrated the PCM will be.

For example, almost all vehicles on the market right now still have camshafts (these determine when valves open and close). It is entirely possible, however, to see camshaft free vehicles widely available to consumers in the next 5 – 10 years. Instead of a camshaft (which you can fix or replace as needed), these newer vehicles use hydraulic pumps that are, in turn, controlled by the engine control unit (aka ECU).

Before you decide to remove the PCM, look at the shop manual that should be available through the manufacturer. This book should tell you exactly what the PCM does in your vehicle, all the other computers it connects to, and the sensors involved in the chain of information.

If you are in the market for a new or used vehicle that you might want to retrofit to get rid of the computers, it will help to have a look at the manufacturer's shop manual. As you read through the shop manual, flow charts including the following information:

- The name of each sensor, the module it reports to, and what it reports.
- Other information that is reported to the same module from other sensors.
- Where the module reports next in the chain. Keep following this chain until it goes directly back to one of the major parts of the PCM. Also note any side chains

that may report to another module elsewhere in the system.

- Continue following each line of the flow chart until you reach an actual component that does tangible work in the vehicle. For example, you will know you have completed the trail when you hit something that instructs a motor to turn, a valve to open, or a hydraulic pump to work.
- If there are RFID (Radio Frequency Identification) chips or other ties not entirely related directly to engine performance, this is how you will find them.

Once you have made a complete chart of the sensors and modules within the vehicle, it will be easier to see how they all connect to each other. Bypassing one sensors may, in fact, entail bypassing several others so that the vehicle runs properly. If the PCM is highly integrated into the transmission and braking systems, you may have to do the entire overhaul at one time.

Alternatively, you may want to consult some open source vehicle retrofitting sites to see if there are workaround micro controllers that transmit information to the PCM even though the sensors and other parts no longer exist.

Make sure that your vehicle is safe to operate during the time period when one part of the PCM is present, but another is not. Fortunately, if your main concern is getting rid of automated remote shutoff RFIDs or other devices that can be used to control your vehicle remotely, bypassing them may not impact the overall functionality and safety of the vehicle.

Common Systems and Replacement Options

The Air to Fuel Ratio

If your vehicle has fuel injectors, then the air to fuel mixture will be controlled by some kind of computer. The only thing you can do, based on older technology, is to replace the fuel injectors with a carburetor.

If there is not enough space between the top of the engine and the hood, you may need to cut a hole in the hood to accommodate the added height of the carburetor.

Idle Speed

If you replace the fuel injector system, the carburetor will also control the idle speed. Unlike fuel injector systems, you will have full, easy control of the idle speed when using a carburetor. If the idle is too fast or too slow, just turn the idle adjustment screw.

In modern vehicles with PCMs, you cannot adjust the idle speed at all, and will have to take the vehicle to a mechanic that has the kind of computers onhand that can communicate with the PCM and make the necessary adjustments.

Ignition Timing

At the simplest, modern electronic ignition systems use sensors to monitor a magnet spinning on the distributor shaft. Transistors and other solid state devices (which you will recall are highly sensitive to EMPs) initiate high current flow through a coil, which then causes the spark plug to emit a spark. This whole process is controlled by the PCM or a related module.

You would need to install a mechanical based distributor in place of the electronic ignition system and then adjust the timing manually as needed. A mechanical distributor basically

has a “cap and rotor” assembly on top of the distributor. The rotor has a piece of metal in the middle that accepts current from the distributor, and a small metal bit of metal on the outer edge. The cap has one metal bit for each spark plug that will be activated by the distributor.

As the rotor spins, the two pieces of metal meet and electricity from the distributor passes through the rotor, into the cap, down the spark plug wire, and into the spark plug. Once the metal on the rotor passes the metal point on the cap, no power is available for that spark plug until the metal on the rotor spins back into position.

Along with the distributor, you would also need to add a vacuum advance to the ignition system.

Firing Order

On a mechanical distributor system, the firing order is determined by the position of a gear which drives the distributor. This gear, in turn, is driven by the camshaft.

In order to avoid backfires or other symptoms of misfiring, the cables that connect the distributor to the spark plugs must be in the right order. If you do not have a repair manual that indicates the cylinder designations for each point on the distributor cap, and the firing order, you will have to find them manually.

Video first seen on HOWSTUFFINMYCARWORKS.

Valve Timing

Modern camshaft systems use the ECU to control how much the exhaust and intake valves open as well as when they do so in the timing sequence.

Changing this system to remove the computer control will depend largely on how the camshaft is constructed and how the camshaft lobe is designed. Since different manufacturers use different methods for arriving at variable valve timing systems, you will need to look at the system for your car and take it from there.

ABS Braking

Basically, anti-lock braking systems use a sensor that detects when the wheel stops spinning, yet the vehicle itself keeps moving forward. Because locked wheels prevent steering, the first priority is to get the wheels turning again so that traction can be restored. Since most people slam the brakes when they feel the vehicle skid, they make the situation worse.

ABS systems automatically release the brakes and then re-apply them so that there is a balance between braking and traction control. You should be able to remove the sensors, and also the control module that connects to the pump that provides power assist while braking.

Just remember that you may need to do some additional work to restore full control between the brake pedal and the master cylinder.

Automatic Transmission Gear Switching

Even though you may remove the ECU, some parts of the TCU may still be looking for input from the ECU. As a result, you may also need to make some changes to the transmission so that it can run without input from a computer module. First, you can completely change the automatic transmission out for a manual one. This can be a difficult task, especially if you cannot find a compatible transmission.

Building one from the ground up would take access to metal working equipment, plus the experience required to build a fairly complicated system. Since you may also want to eliminate as many motors as possible in the vehicle, switching to a manual transmission may prove to be the best option.

Your other option may be to install an older style cable that controls the transmission directly based on the position of the gas pedal.

Essentially, the transmission has a throttle valve that connects to the gas paddle via a cable. When you press on the gas, more pressure is exerted on the throttle valve. This, in turn, initiates changes in the hydraulic system within the transmission to engage or disengage different gears.

Electronic Windows

Have you ever shut the engine of your vehicle, and then realized that you needed to open or close the window?

If so, then you can readily understand what the rest of your vehicle will feel like when some part of the PCM is damaged or destroyed by an EMP. Without question, electronic windows are as dangerous as they are problematic to preppers that want a safe, reliable vehicle.

In order to change electronic windows for manual ones, you will need to find and install a window crank system that will fit inside the door compartment of your vehicle.

If the window system is deeply integrated into an anti-theft device which integrates with the PCM, you may have to disabled any number of sensors and auxiliary control modules so that the vehicle will start up and run properly.

Electronic Doors

You will more than likely need to change the lock on the door as well as install a manual lock system. This includes an internal door latch that will allow you to open the door from the inside.

Considering how dangerous electronic doors are if you happen to get locked inside, making this change should be a top priority even if you aren't concerned about EMP proofing at this time. As with electronic windows, you may have to disable parts of the PCM or the BCM in order to get the vehicle to operate.

Steering System

Since most modern vehicles don't have crash avoidance systems, the computer integration may be at about the same level as in the braking system. You may need to do without power steering, mainly because this is yet another motor that can be damaged by an EMP.

Are you going to let another year go by without doing something to EMP proof your car? In all probability, this will be the year I begin the process of rebuilding and retrofitting a more modern vehicle to one that will be EMP proof.

Please comment in the section below on this topic so that we can all be encouraged to be better and more confident preppers in the arena of transportation!

*This article has been written by **Carmela Tyrell** for Survivopedia.*

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