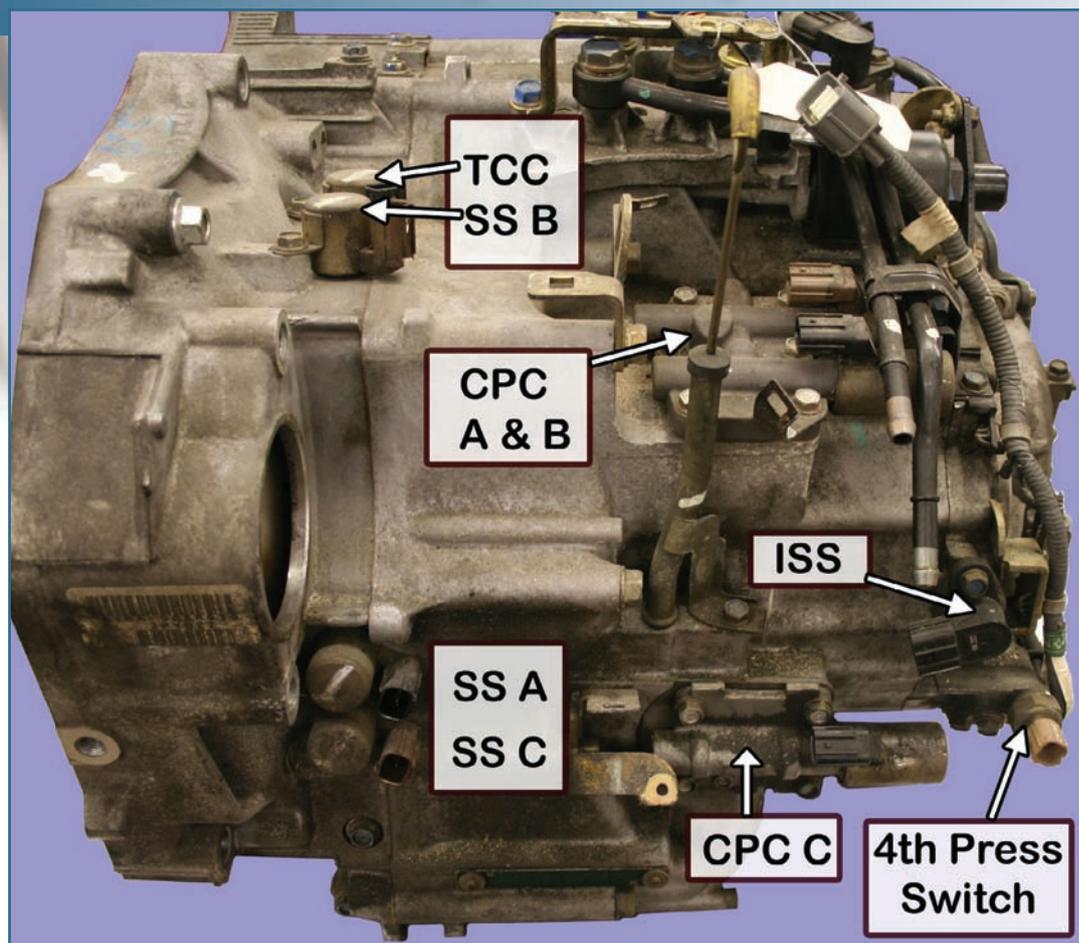


Honda 5-Speed Clutch Pressure Control (CPC)



by Sean Boyle



Call it unique, eccentric or unconventional, but Honda has always had their own way of designing powertrains. Their transmissions are no different. For example, instead of planetary gearsets, they use constant-mesh, helical-cut gears, similar to a manual transmission, to obtain different gear ratios (Figure 1). Also, instead of pressure control via a solenoid, they pull the reaction directly from the torque converter stator shaft to work on the pressure regulator valve.

The Honda transmission is by far the simplest transmission to understand regarding powerflow, but by the same token, it's one of the most complicated transmissions to understand regarding hydraulics... that is, until you learn the concept.

In the past, Honda transaxles used simple shift valves that fed pressure to an applying clutch, and directed release pressure through some form of orifice control valve. In fact, Honda 4-speeds still use this simple form of shift

control.

With this design, the valving is responsible for controlling the overlap between the applying clutch and the releasing clutch (Figure 2). Proper clutch overlap is essential, because if you release a clutch too quickly, it'll cause a flare; if you release it too slowly, it'll cause a bindup.

During a typical shift, the releasing clutch must maintain fluid pressure long enough for the applying clutch to start to take hold. This intended overlap

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Honda 5-Speed Clutch Pressure Control (CPC)

would cause a short bind, to pull the engine speed down to the necessary RPM for a typical, smooth upshift.

This concept isn't unique to Honda transmissions; in fact, most transmissions require this form of hydraulic timing. One way manufacturers get around the overlap issue is to use sprags or roller clutches, which benefit shift quality by allowing a clutch to apply without timing the release of the previous clutch. Even though sprags or rollers do allow for smoother upshifts and downshifts, Honda transmissions typically only have one sprag (low), or in some cases none at all. This means practically every upshift and downshift must be timed precisely to ensure the smoothest shift possible.

No doubt, the typical 4-speed Honda transaxle works well and is relatively reliable. But it all comes down to shift quality, or shift *feel*. Honda transaxles tend not only to work like a manual transmission, but also to shift like one. Shifts are firm and noticeable, and that's not necessarily acceptable among customers wanting an automatic transmission-equipped vehicle, especially since these transmissions are used in the Acura line, which competes with high-end luxury vehicles. It all comes down to shift quality, so the new era of Honda transmissions must control the shifts with greater accuracy. This is where the Clutch Pressure Control (CPC) circuit comes into play (Figure 3).

The CPC circuit is nothing new with Honda. The purpose of the CPC valve is to manipulate line pressure into a usable pressure for applying or releasing a clutch. Along with accumulators, the CPC circuits have direct influence over shift feel.

Early Honda transmissions had a throttle valve that would alter CPC pressure. This eventually evolved into electronic control of the CPC valve through a solenoid. Finally, the modern CPC circuits evolved into a system where multiple solenoids control the apply *and* release of the various clutches. This article will focus on the CPC circuits found in a typical 5-speed Honda/Acura transmission, such as the BYBA.

At the heart of the CPC circuits are the CPC solenoids (Figure 4). These



Figure 1

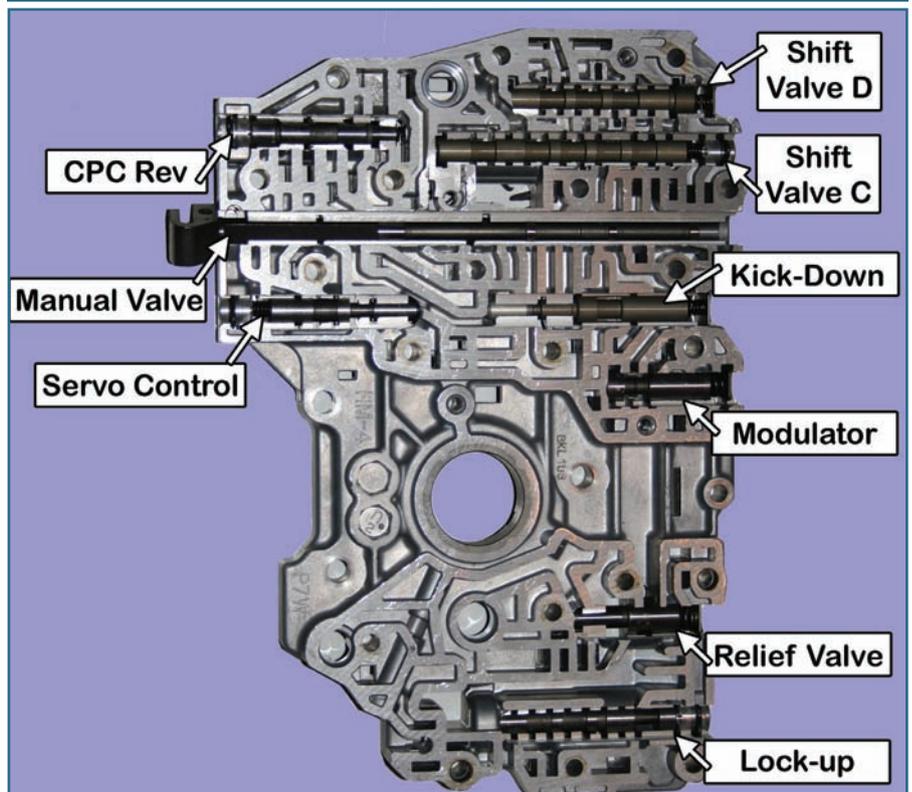


Figure 2

linear solenoids (as Honda would call them) are pulse width modulated (PWM) to physically control the position of their corresponding hydraulic spool valves. Unlike many traditional solenoids that modify oil pressure to move a valve, these solenoids press directly against the valve, and rely on a spring to return the valve to the

rest position. The spool valves reduce modulator (solenoid feed) pressure to a CPC signal pressure that moves a CPC valve in the valve body.

There are actually three CPC solenoids in the late model 5-speed transmission, but for the most part, only CPC A and B are responsible for clutch apply and release. CPC C is primarily

It all comes down to shift quality, so the new era of Honda transmissions must control the shifts with greater accuracy. This is where the Clutch Pressure Control (CPC) circuit comes into play.

used for torque converter clutch control. The CPC solenoids are mounted externally, and are conveniently located on top of the transmission.

The PCM pulses the CPC solenoids at 244 Hz (Figure 5). The typical duty cycle can vary between 40% – 50% when the solenoids are energized in 2nd and 4th gears. When the solenoids are de-energized, the PCM still modulates the solenoids between 10% – 25%.

During a shift, the duty cycle signals increase or decrease in unison to achieve the desired shift feel. This is all controlled by the PCM, which toggles power to modulate the solenoids.

The ground connection for the solenoids is located at the rear of the transmission, above the pressure switches.

When changing CPC solenoids, be careful to avoid getting debris into the transmission (Figure 6). Since the solenoids are mounted on top of the transmission, grit and grime tends to collect around them.

Pay attention to the feed pipes, which fit between the CPC solenoid and the transmission case; three feed

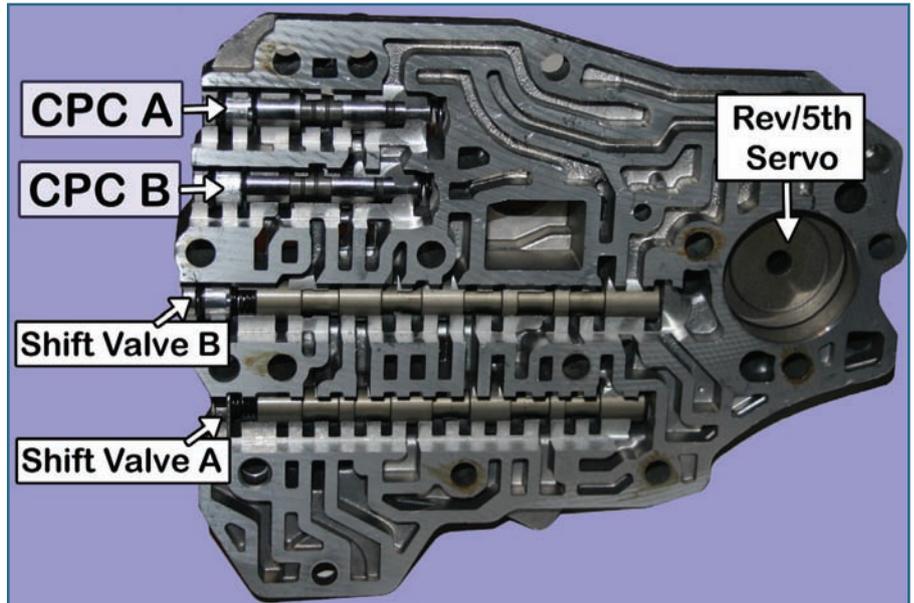


Figure 3

	CPC Circuit A			CPC Circuit B		
	Electrical	Hydraulic	Clutch	Electrical	Hydraulic	Clutch
1 st	OFF	Min	N/A	OFF	Max	N/A
1 st - 2 nd	PWM	Min to Max	2 nd	PWM	Max to Min	N/A
2 nd	ON	Max	N/A*	ON	Min	N/A
2 nd - 3 rd	PWM	Max to Min	2 nd	PWM	Min to Max	3 rd
3 rd	OFF	Min	N/A*	OFF	Max	N/A*
3 rd - 4 th	PWM	Min to Max	4 th	PWM	Max to Min	3 rd
4 th	ON	Max	N/A*	ON	Min	N/A*
4 th - 5 th	PWM	Max to Min	4 th	PWM	Min to Max	5 th
5 th	OFF	Min	N/A*	OFF	Max	N/A*

* The shift valves direct line pressure to the clutches once they are in gear.

pipes are about 0.710" long and have a cup-type filter pressed into each tube. In addition, there's a longer 1.565" feed pipe that fits between the case and a vent section of the CPC solenoid body.

Even though the CPC solenoids have steel spool valves and are fed filtered ATF, the return springs are very soft, which makes them susceptible to sticking, especially after an overhaul.



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CPC solenoid A is a normally-trapping solenoid, which means hydraulic pressure doesn't pass through the solenoid when it's de-energized.

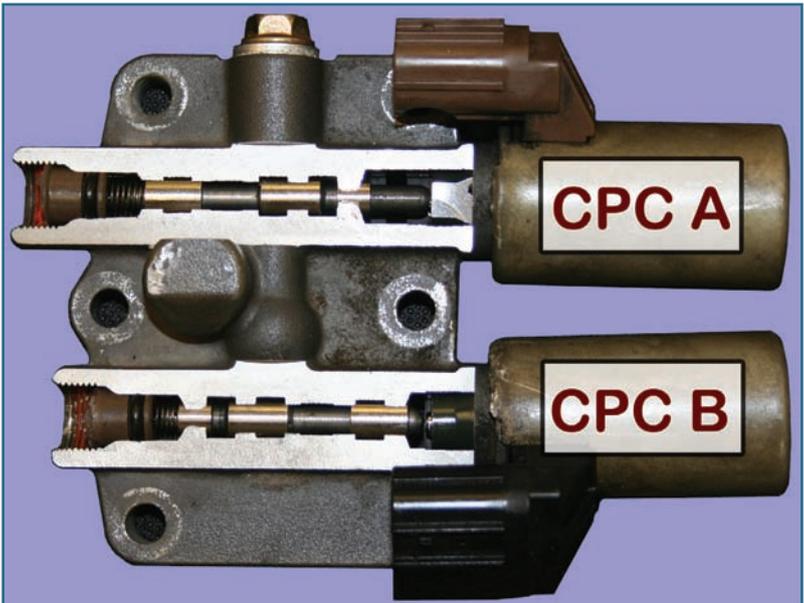


Figure 4

CPC solenoids A and B control their corresponding CPC valves located in the valve body. Each CPC valve either regulates line pressure and directs it to apply clutches, or they regulate clutch pressure release from the clutches that are disengaging.

CPC solenoid A is a normally-trapping solenoid, which means hydraulic pressure *doesn't* pass through the solenoid when it's de-energized. CPC solenoid B is a normally-passing solenoid, which means hydraulic pressure passes through the solenoid when it's de-energized.

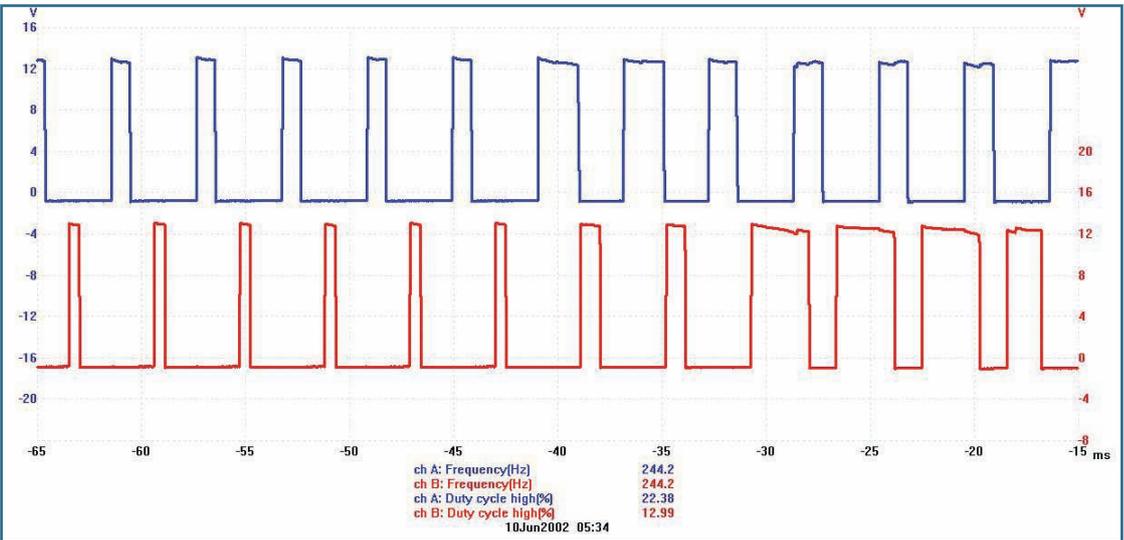


Figure 5

The strategy of the PCM involves modulating both solenoids either on or off together (Figure 7). For example, in first gear both CPC solenoids are off, which allows CPC A to generate minimum or no signal pressure and CPC B to generate maximum signal pressure. When the PCM commands a shift from first to second, both solenoids modulate on, which causes the CPC A to move from minimum to maximum pressure, and CPC B to move from maximum to minimum pressure.

During the shifts, CPC pressures are directed to the actual clutch elements through the action of the shift solenoids and shift valves. It basically comes down to this: During the shifts, CPC pressure is in complete control of

applying and releasing clutch pressures. Then, after the shift, the shift valves direct line pressure to the necessary clutches. If a transmission holds all of its gears, but only exhibits issues during the shift, such as a flare or bind, the CPC circuit could likely be the culprit. (ins newxt cht)

Gear	Sol A	Sol B	Sol C
P, R, N	OFF	ON	OFF
1st	ON	ON	ON
1st to 2nd	ON	ON	ON
2nd	ON	ON	OFF
2nd to 3rd	OFF	ON	OFF
3rd	OFF	ON	ON
3rd to 4th	OFF	OFF	ON
4th	OFF	OFF	OFF
4th to 5th	ON	OFF	OFF
5th	ON	OFF	ON



Figure 6

The strategy of the PCM involves modulating both solenoids either on or off together

Here's an example of a typical shift from second to third. While reviewing the CPC chart for 2nd gear, notice that both CPC A and B are energized. The solenoids are preparing for either an upshift into 3rd or a downshift into 1st.

The CPC A circuit controls pressure to the 2nd and 4th clutches and the CPC B circuit controls pressure to the 3rd and 5th clutches. The manual valve applies line pressure to the first clutch when the transmission is in a drive range, and since the 5-speeds use a low sprag, it can remain applied.

While in second gear (Figure 8) with both solenoids energized, maxi-

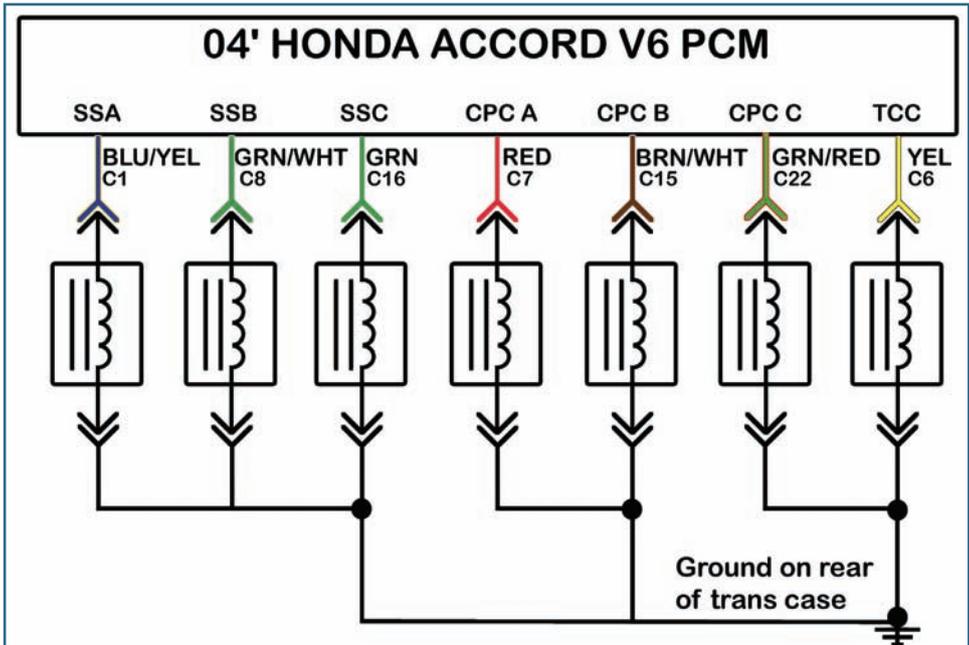


Figure 7

mum CPC A pressure and minimum CPC B pressure stop at shift valve A. Line pressure from the manual valve is directed through shift valve C, to shift valve A, then finally to shift valve B before reaching the 2nd gear accumulator and clutch.

Notice solenoids A, B and C act on their corresponding shift valves. There are actually two other shift valves in this transmission — as well as many other valves — but to keep things simple, the schematics only show what's needed for a shift.

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Once the conditions are right for a shift from 2nd to 3rd, (Figure 9) the PCM first turns shift solenoid A off. This shuttles shift valve A and directs 2nd clutch pressure to the CPC A circuit, which was waiting with maximum CPC pressure. Now CPC A can regulate the release of the 2nd clutch.

Also during the 2-3 shift, the CPC B circuit is directed to the 3rd clutch, pressure switch and accumulator. At this point, the CPC B circuit is in complete control of the 3rd clutch apply. The PCM will pulse the CPC B solenoid off to increase 3rd clutch pressure at the desired rate.

During the shift, the PCM monitors engine speed, mainshaft speed, and secondary shaft speed to determine the quality of the shift. The PCM can adapt and change how the CPC solenoids react during a shift. Unfortunately, unlike many other manufacturers, Honda doesn't provide adaptive values on their diagnostic scan tool, but they have many shift related DTCs.

Once the shift is complete, the PCM energizes shift solenoid C, which shuttles shift valve C and directs line pressure to the 3rd clutch, accumulator and pressure switch.

While in third gear, both CPC solenoids are off, which means the CPC A circuit has minimum pressure and the CPC B circuit has maximum pressure, both prepared for the next upshift or downshift (Figure 10).

The PCM monitors the solenoid circuits continuously for proper electrical operation, such as open or short circuits in the solenoids or pressure switches. It monitors the vehicle, mainshaft and secondary shaft speeds to determine if the shifts are smooth and to make sure the clutches are holding. The following is a chart of DTCs for shift-related failures:

DTC	Description	Possible failure
P0731-P0735	Problem with clutch or related hydraulic circuit	Drain and inspect fluid to determine possibility of clutch failure. Honda suggests draining the fluid through a paint strainer to catch contamination. Check pressure on related clutch.
P0746	CPC solenoid valve A stuck OFF	Mechanically stuck valve or solenoid. Honda suggests checking operation by activating the solenoid and observing its movement.
P0747	CPC solenoid valve A stuck ON	Mechanically stuck valve or solenoid. Honda suggests checking operation by activating the solenoid and observing its movement.
P0751	Shift solenoid A stuck OFF	Mechanically stuck valve or solenoid. Actuate solenoid and listen for click.
P0752	Shift solenoid A stuck ON	Mechanically stuck valve or solenoid. Actuate solenoid and listen for click.
P0756	Shift solenoid B stuck OFF	Mechanically stuck valve or solenoid. Actuate solenoid and listen for click.
P0757	Shift solenoid B stuck ON	Mechanically stuck valve or solenoid. Actuate solenoid and listen for click.
P0761	Shift solenoid C stuck OFF	Mechanically stuck valve or solenoid. Actuate solenoid and listen for click.
P0762	Shift solenoid C stuck ON	Mechanically stuck valve or solenoid. Actuate solenoid and listen for click.
P0776	CPC solenoid valve B stuck OFF	Mechanically stuck valve or solenoid. Honda suggests checking the operation by activating the solenoid and observing its movement.
P0777	CPC solenoid valve B stuck ON	Mechanically stuck valve or solenoid. Honda suggests checking the operation by activating the solenoid and observing its movement.
P0780	Problem with shift control system	Check to make sure solenoid connectors didn't get mixed up. Possible shift valve D stuck. Sets when PCM detects a downshift to 2 nd instead of an upshift from 3 rd to 4 th .
P0962	Problem with CPC solenoid valve A circuit	PCM detects low current, most likely from excessive resistance in the circuit or solenoid.
P0963	Problem with CPC solenoid valve A circuit	PCM detects high current, most likely from low resistance in the circuit or solenoid.
P0966	Problem with CPC solenoid valve B circuit	PCM detects low current, most likely from excessive resistance in the circuit or solenoid.
P0967	Problem with CPC solenoid valve B circuit	PCM detects high current, most likely from low resistance in the circuit or solenoid.
P0970	Problem with CPC solenoid valve C circuit	PCM detects low current, most likely from excessive resistance in the circuit or solenoid.
P0971	Problem with CPC solenoid valve C circuit	PCM detects high current, most likely from low resistance in the circuit or solenoid.
P0973	Shift valve A solenoid circuit open	PCM internal driver circuit detects an open in the solenoid circuit. Solenoids are high-side switched.
P0974	Shift valve A solenoid circuit shorted	PCM internal driver circuit detects a short in the solenoid circuit. Solenoids are high-side switched.
P0976	Shift valve B solenoid circuit open	PCM internal driver circuit detects an open in the solenoid circuit. Solenoids are high-side switched.
P0977	Shift valve B solenoid circuit shorted	PCM internal driver circuit detects a short in the solenoid circuit. Solenoids are high-side switched.
P0979	Shift valve C solenoid circuit open	PCM internal driver circuit detects an open in the solenoid circuit. Solenoids are high-side switched.
P0980	Shift valve C solenoid circuit shorted	PCM internal driver circuit detects a short in the solenoid circuit. Solenoids are high-side switched.

While in second gear (Figure 8) with both solenoids energized, maximum CPC A pressure and minimum CPC B pressure stop at shift valve A.

Understanding the relationship of the CPC solenoids is invaluable when diagnosing shift issues with Honda transmissions. Think of the symptoms that a failed CPC solenoid or valve could cause, assuming, of course, that there's no DTC and the transmission isn't in failsafe. The following chart summarizes

Honda 5-Speed 2nd Gear

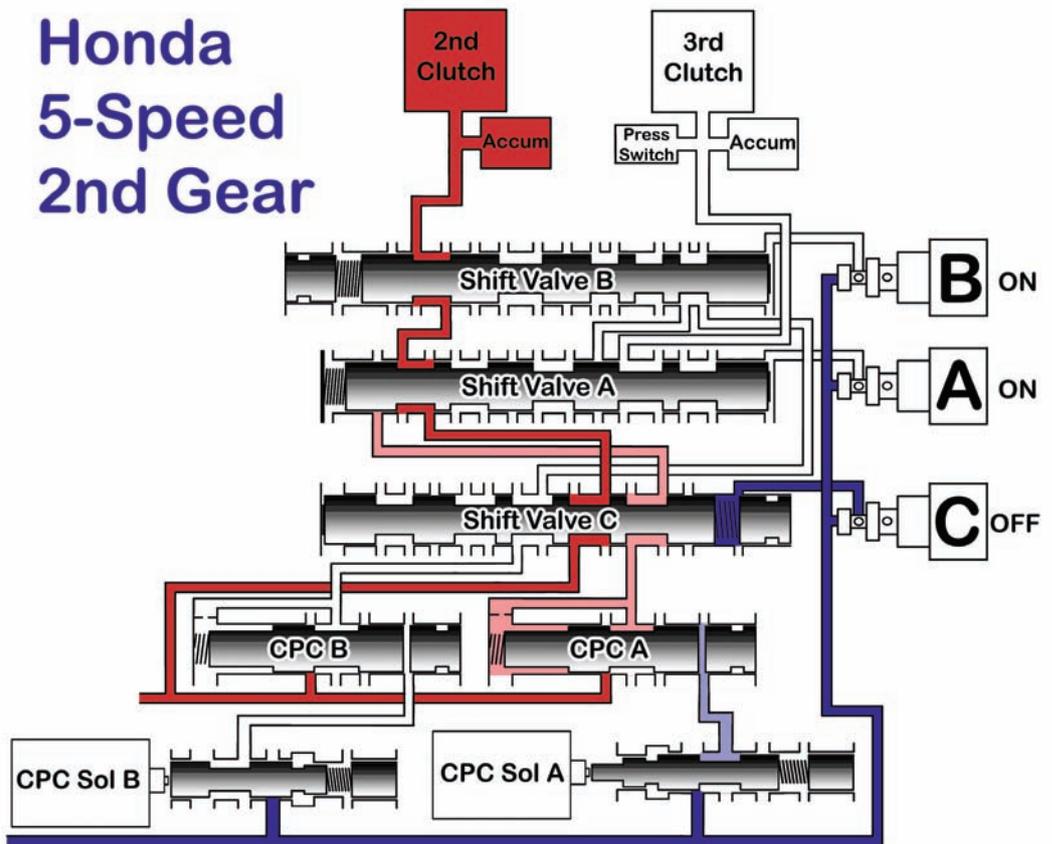


Figure 8



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what might happen if there is an issue with one of the CPC circuits: (see chart to the right).

If these failures were *total or complete* failures, a DTC would more than likely set. But if the valves or the solenoid armature had intermittent failures, the problem might slip through detection criteria for the DTC.

As an experiment, I purposely failed the CPC circuits on a test vehicle (2002 Acura MDX); a DTC set immediately for a plugged CPC A circuit and the transmission went into failsafe. The CPC B circuit was a different story; a DTC never set, but the vehicle reacted with every symptom listed in the chart for CPC B pressure always low. With enough driving, the DTC was sure to set, but remember: this was a complete failure of the CPC circuit. Intermittent failures could cause the same symptoms while the PCM would attempt to adapt to the erratic operation.

Honda transmissions are out there by the millions, so it's time to embrace these units with open arms. Although the reliability and quality of the Honda product is second to none, the advances they've made to improve shift quality have also left them susceptible to increased failures. With a solid understanding of the system, many of the shift issues make sense and come down to the basic electrical/hydraulic relationship.

One last note regarding the ever-so-popular Honda 5-speed: Honda recently increased their warranty on the following models to 7 years, 9 months, or 109,000 miles, whichever comes first.

- 1999-2002 3.2TL
- 2003 TL (except Type S) up to VIN 19UUA5...3A019556
- 2003 TL (Type S) up to VIN 19UUA5...3A019061
- All 2001-2002 3.2 CL
- 2003 3.2 CL up to VIN 19UYA42...3A005203
- All 1999-2001 Odyssey
- All 2000-2001 Accord
- All 2000-2001 Prelude

Other than the noted vehicles, 2005-and-earlier Hondas have a 3-year, 36,000-mile warranty, and 2006-to-current Hondas have a 5-year, 60,000-mile warranty.

Failure	Possible Components	Transmission Symptom
CPC A pressure always high	<ul style="list-style-type: none"> • CPC valve stuck in max pressure • CPC solenoid always energized • CPC solenoid valve stuck on hydraulically 	2 nd gear start * Harsh/bind 2-3, 3-4, 4-5 Harsh/bind 5-4, 4-3, 3-2
CPC A pressure always low	<ul style="list-style-type: none"> • CPC valve stuck in min pressure • CPC solenoid always de-energized • CPC solenoid valve stuck off hydraulically 	Harsh 1-2 Flare on 2-3, 3-4, 4-5 Flare on 5-4, 4-3, 3-2
CPC B pressure always high	<ul style="list-style-type: none"> • CPC valve stuck in max pressure • CPC solenoid always de-energized • CPC solenoid valve stuck on hydraulically 	Harsh/bind 2-3, 3-4, 4-5 Harsh/bind 5-4, 4-3, 3-2
CPC B pressure always low	<ul style="list-style-type: none"> • CPC valve stuck in min pressure • CPC solenoid always energized • CPC solenoid valve stuck off hydraulically 	Flare on 2-3, 3-4, 4-5 Flare on 5-4, 4-3, 3-2

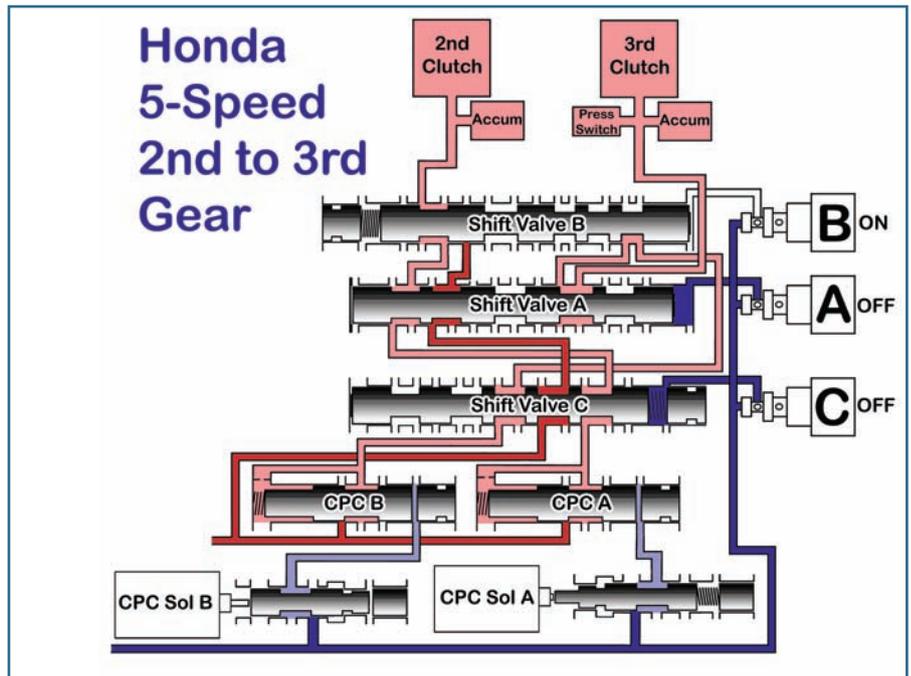


Figure 9

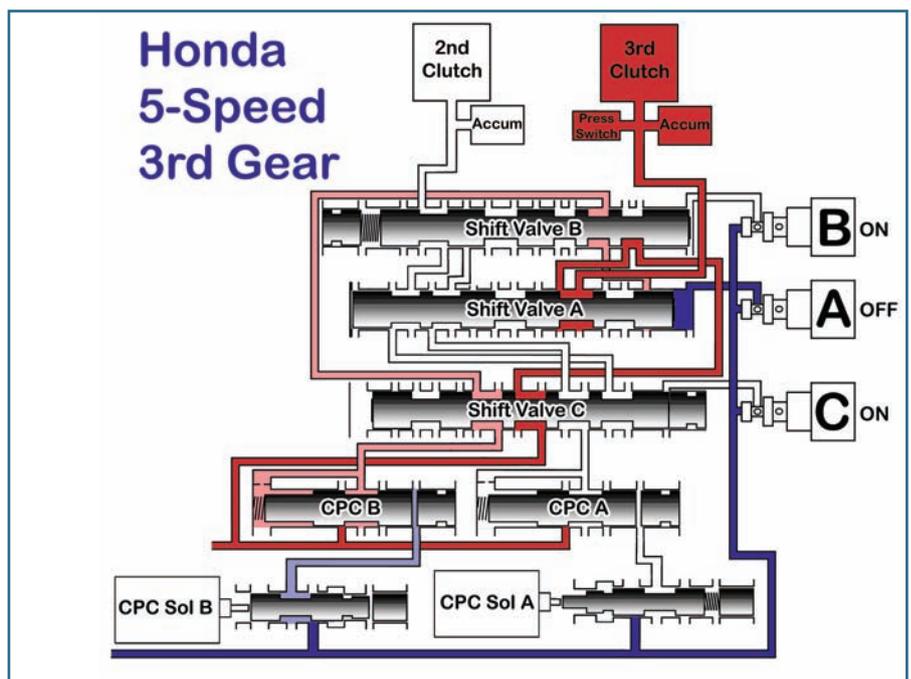


Figure 10

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Ford Motor Company Announces Expanded Call Center Service to Include Placing Orders

Ford Motor Company has launched an expanded Ford Powertrain Sales Call Center located in Dearborn, Michigan. Now, independent installers will be able to order Ford and Motorcraft® New and Remanufactured engines and transmissions through the Call Center. “We’re excited about the opportunity to provide a one-stop-shopping solution to our powertrain installers,” said Jeff Lombardi, FCSD Powertrain Product Marketing Manager. “With one call, our customers will get competitive price quotes and unparalleled product support from a factory-trained Call Center agent,” Lombardi said.

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