Ford Bypass Circuits

By Gregg Nader

Typical lock-up torque converters have two oil circuits to keep the converter charged with oil and to control release/apply of the torque converter clutch. Some Ford torque converters are different, having an additional third oil circuit in the torque converter.

In most conventional non lock-up torque converters, oil is fed to the rear half of the torque converter (converter impeller) and then flows through the front half of the converter (converter turbine) and exits. The direction of the oil flow never changes.

In a typical lock-up torque converter, the direction of oil flow into and out of the torque converter changes direction to control release/apply of the torque converter clutch. From the moment the engine is started, oil is fed between the torque converter front cover and the lock-up piston. This keeps the TCC piston pushed away from the front cover and in the TCC released position. Oil then flows through the rear half of the converter and exits. *Figure 1* shows a typical torque converter in TCC released mode.

To apply the torque converter clutch the TCC apply/switch valve changes position and the direction of oil flow through the converter is reversed. Fluid under pressure in the impeller and turbine area (TCC apply pressure) pushes the TCC piston into the front cover engaging the converter clutch. TCC does not fully apply until the oil that was between the front cover and the lock-up piston (TCC release oil) is allowed to exhaust.

The rate of TCC engagement is affected by two factors. How much apply pressure is pushing the TCC piston towards the cover, and orifices that control how fast the release oil exhausts. Apply pressure and release oil exhaust rate can be varied, so lock-up has three stages: full release, controlled modulated apply and full apply. *Figure 2* shows a typical torque converter in TCC applied mode.

Ford CD4E, AXOD/E, AX4N, AODE/4R70W and G4/F4EAT transmissions use three oil circuits to keep the converter charged with oil and to control the release/apply of the torque converter clutch. Oil flows into the rear of the torque converter (converter impeller CI), then flows through the converter turbine (CT) and exits. Oil flow in the CI and CT

Figure 1

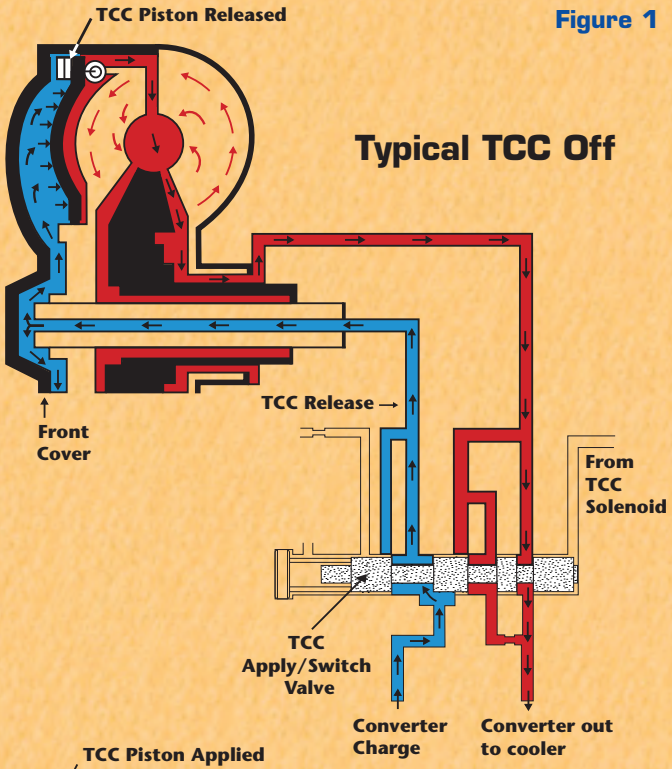
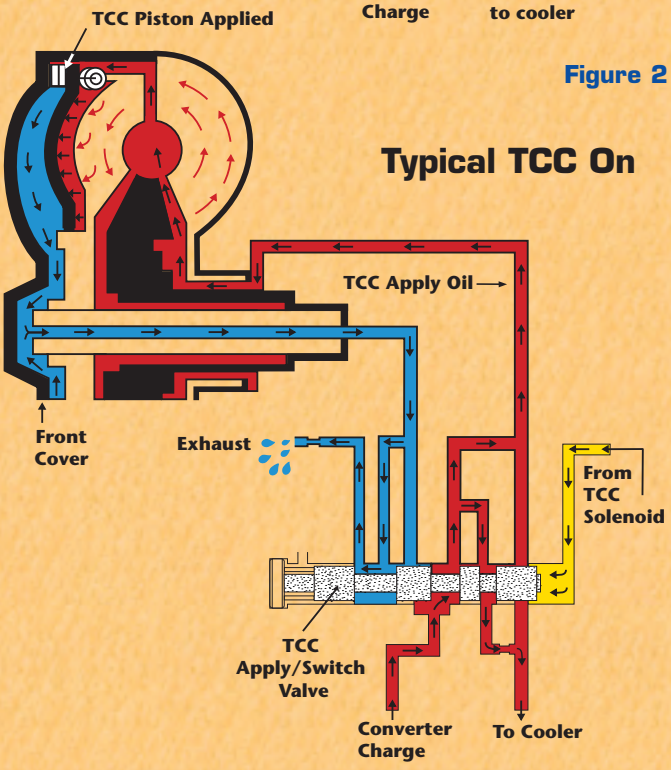


Figure 2



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circuits is the same as a non lock-up converter, the direction of oil flow through these circuits never changes. The 3rd oil circuit is called Converter Bypass or CBY and controls apply/release of the converter clutch.

From the moment the engine is first started, oil is fed into the converter through both CI (converter impeller) and the CBY bypass oil circuits. Oil exits the converter through the CT (converter turbine) oil circuit. Bypass oil flows between the torque converter front cover and the lock-up piston. This keeps the TCC piston pushed away from the front cover in the TCC released position. *Figure 3* shows a typical Ford bypass torque converter in the TCC released mode.

To apply the torque converter clutch, the PCM controls the TCC solenoid to change the position of the bypass valve and reduces CBY pressure. As the bypass valve moves, it restricts oil into the bypass circuit and remaining oil pressure between the front cover and TCC piston is allowed to exhaust. CBY oil pressure can be varied so lock-up has three stages, full release, controlled modulated apply and full apply. *Figure 4* shows a typical Ford bypass converter in the TCC applied mode.

Figure 3

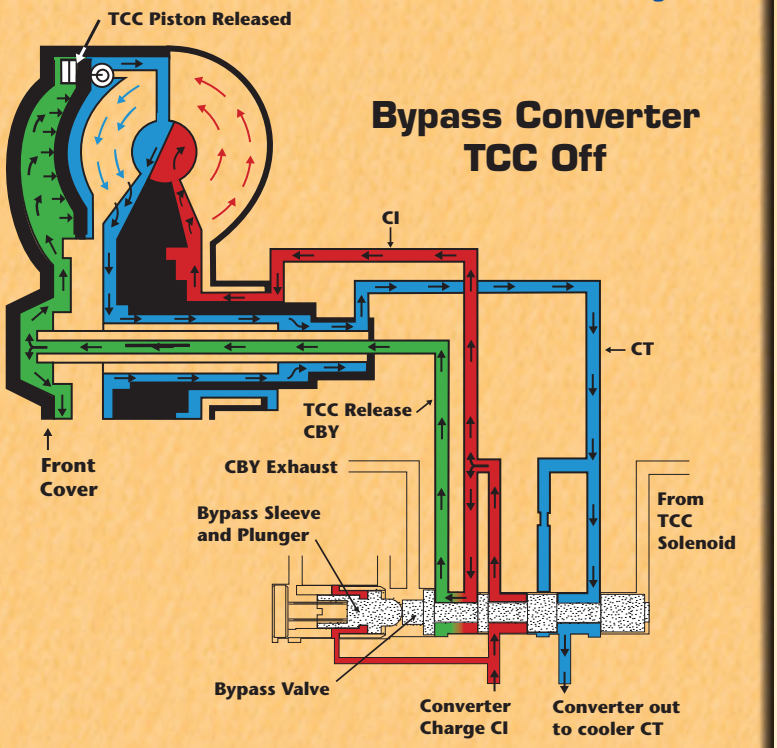
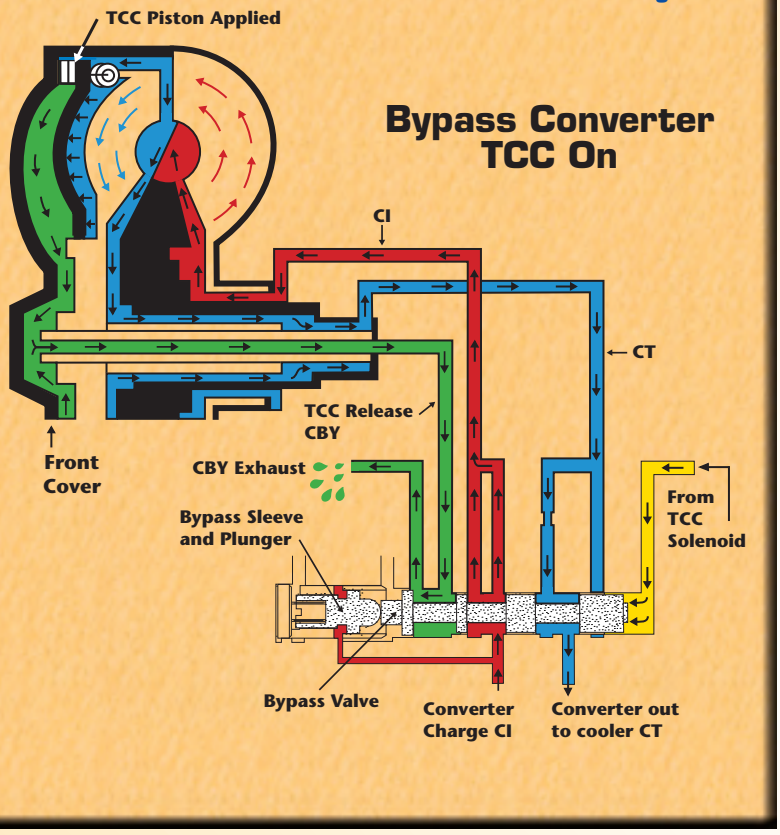


Figure 4



Problems with Bypass Circuits:

Low converter pressure (CT) is the equivalent of low TCC apply pressure and results in TCC slip. Low converter pressure can be caused by a reduced volume of oil being fed to the converter due to problems in the valve body, pump, torque converter as well as external electronic controls.

Valve body bore wear at the bypass sleeve/plunger, bypass valve, and converter regulator valves result in lower overall CT/TCC apply pressure and limits the bypass valves ability to control CBY bypass oil.

High CT pressure from a stuck converter regulator valve or high line pressure can crack a TCC piston and result in a TCC slip code.

Valve body pressure regulator bore wear as well as trouble codes, FMEM (PCM failure mode) can also result in lower converter pressure. Low pump volume or high line pressure causes the pressure regulator valve to restrict converter charge (CI).