What's With All the Checkballs?

by Randall Schroeder
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The aftermarket offers many different types of kits and modifications that'll take care of most performance needs, based on hours of research and development.

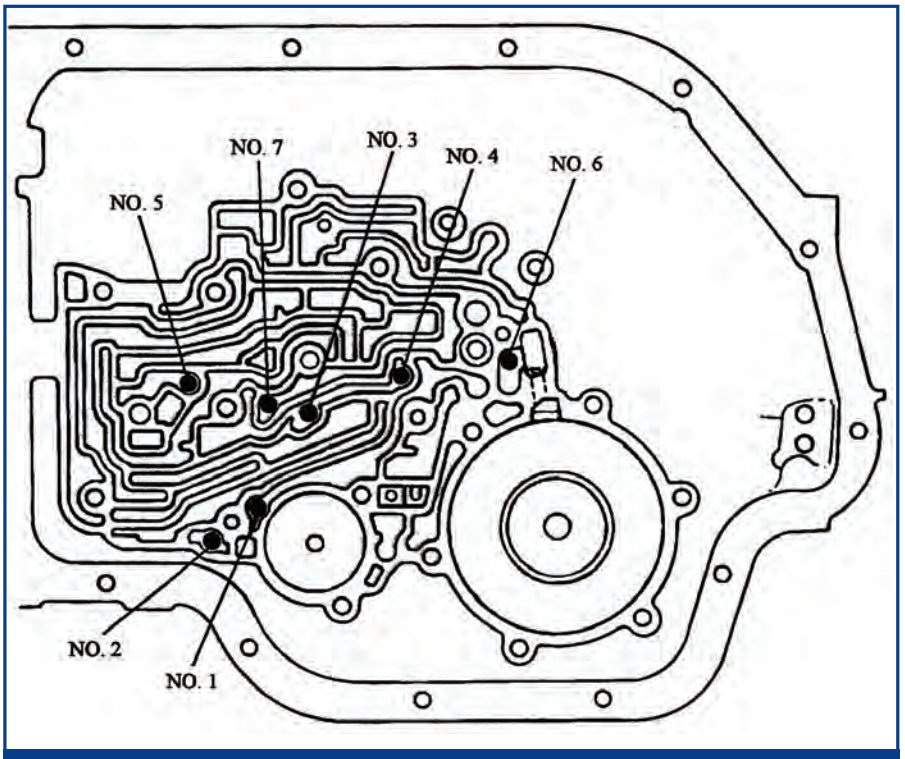

Figure 1

Performance has always held an allure for auto enthusiasts and is the "driving" influence for many doctors (mechanics) in shops today. But with all the new technology reaching the automotive market, there's a fine line between what worked in the past and what works today.

Today's vehicle performance novice will often think, "If I feel the shift, it must be a good shift." Some folks might call this the "feel of power." But here again, what worked before may not work or be reliable today.

Electronics have created a whole new area of performance complications, corrections, and causes that face today's doctors in their operating rooms (shops). In this edition of Doctor, Doctor, we're going to look at checkballs and their functions. Checkballs will have one of three functions:

Timing the apply pressure transfer to a circuit.

Timing the release pressure from a circuit.

Redirecting or switching fluid flow.

Functions 1 and 2 are very similar as they each slow pressure and the flow of oil. Function 3 is different, as it redirects channeled oil, splitting between two or more circuits.

Let's take a look at some real world situations. For this article, we'll be comparing the TH400 of old with today's 4L80E.

Years ago, technicians discovered they could make shifts more aggressive by leaving out certain checkballs. You can do this in many different units, but unless you're doing the rest of the modifications that go along with leaving that checkball out, other parts may break. Remember, the feel of power doesn't necessarily mean the feel of durability; in some instances it means "You play, you pay."

The aftermarket offers many different types of kits and modifications that'll take care of most performance needs. These kits are based on hours of research and development. In other words, the manufacturers worked with a clear understanding of the unit, along with a bit of trial and error, to come up with kits that work.

So let's look at what we've learned about the effects of leaving in, or taking out, checkballs. This is just one aspect of rebuilding and understanding performance units. Clutch material, metal compounds used for driving and driven components, clearances, axle ratios, tire sizes, engine torque, horsepower, etc., are all part of the total package.

Rarely is there one simple modification that will cure all performance issues. Everything can and will affect other areas. Think of it as a corollary

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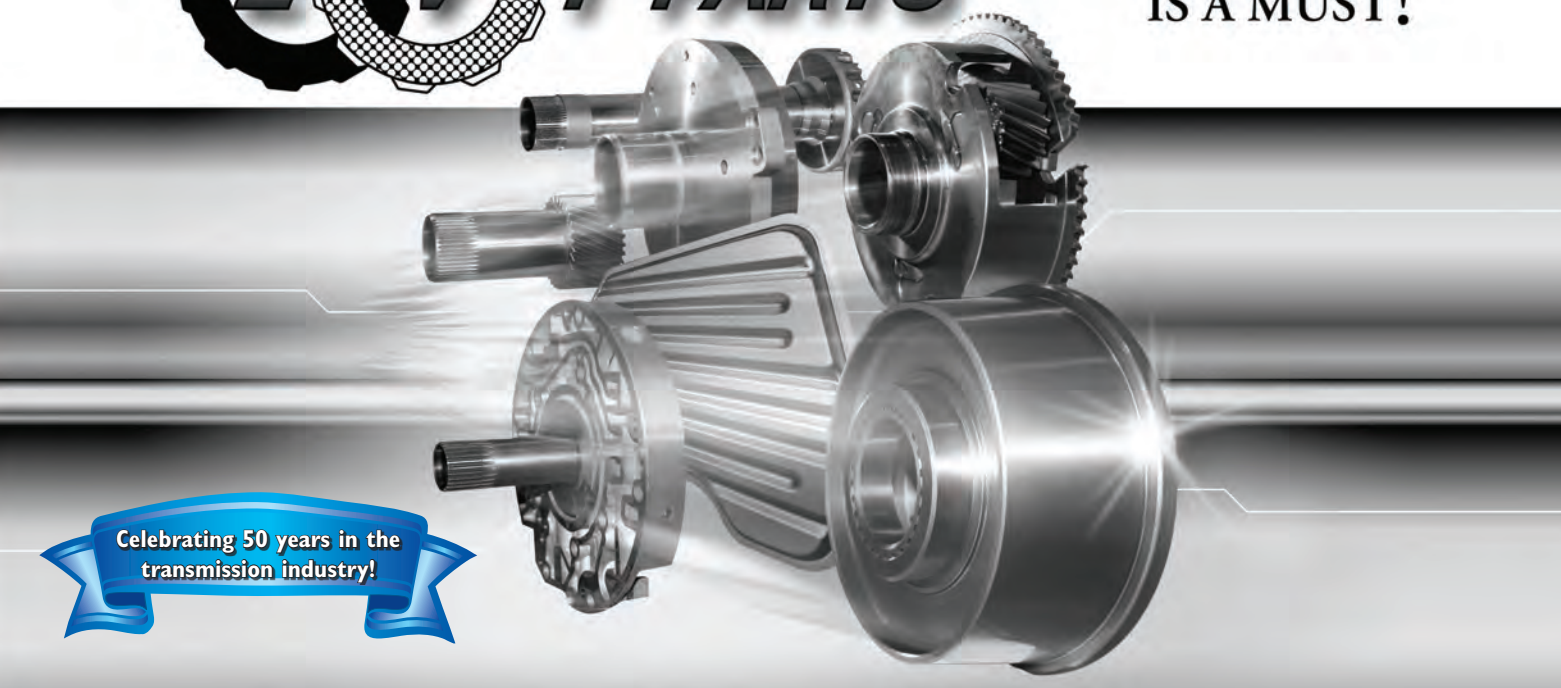

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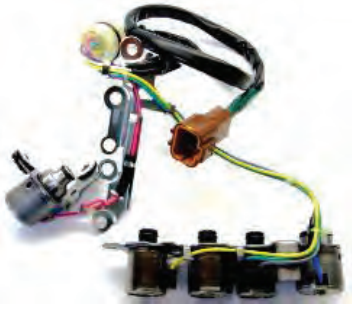

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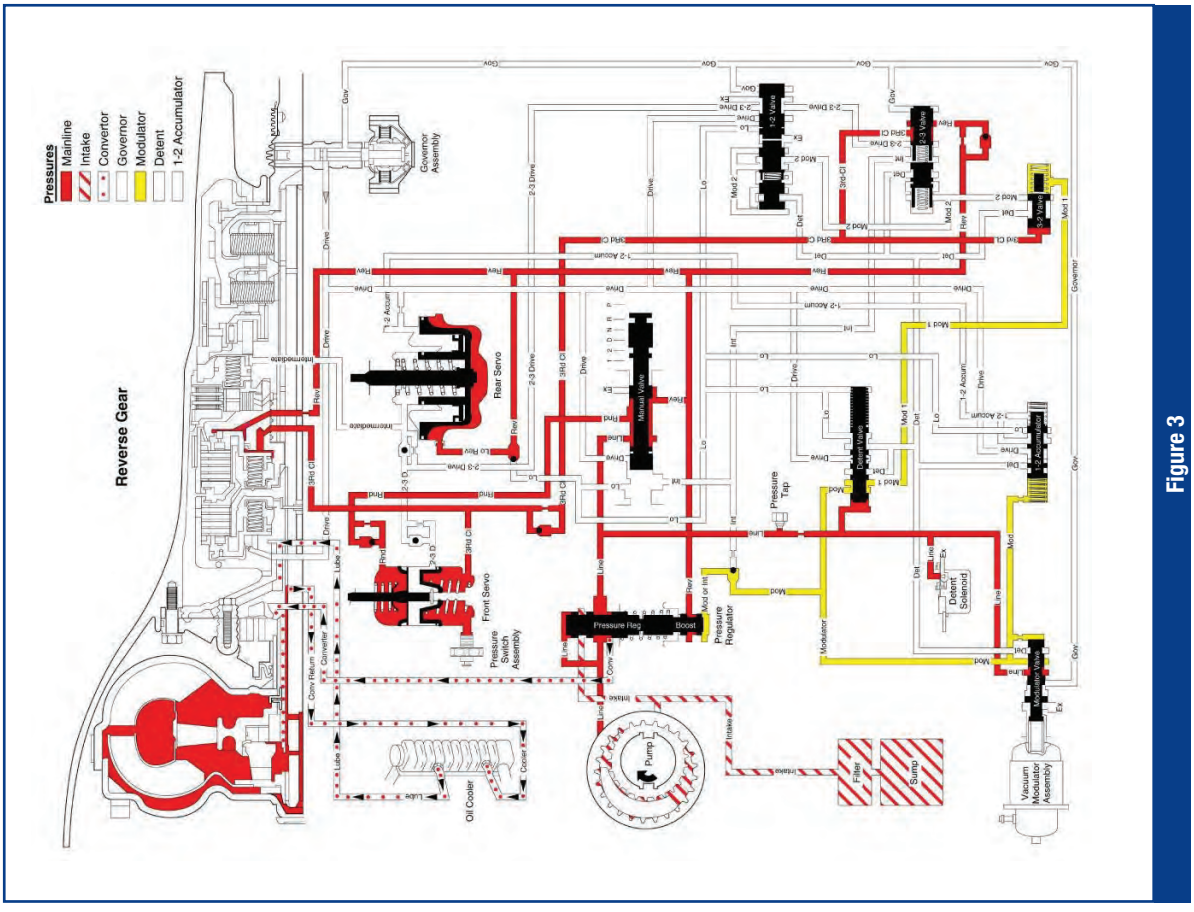

Figure 3

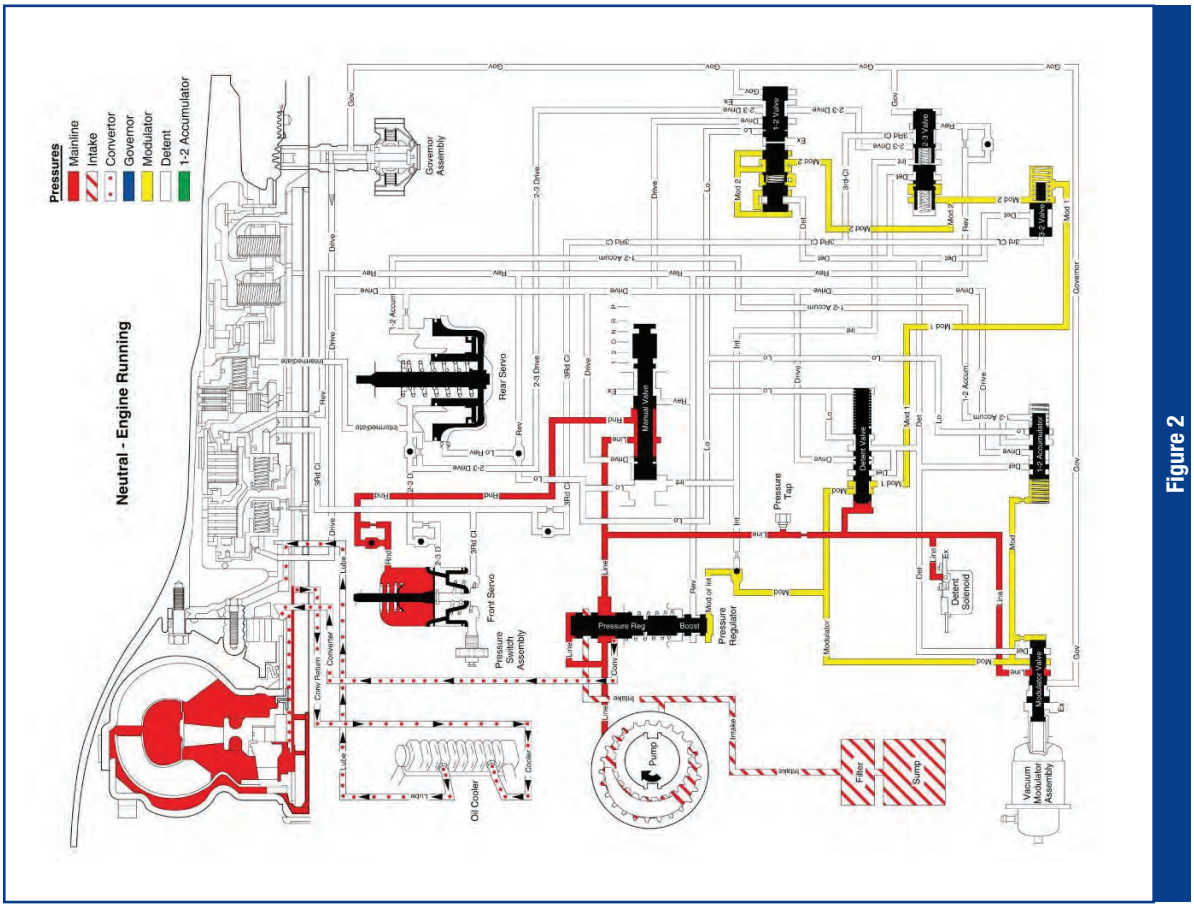

Figure 2

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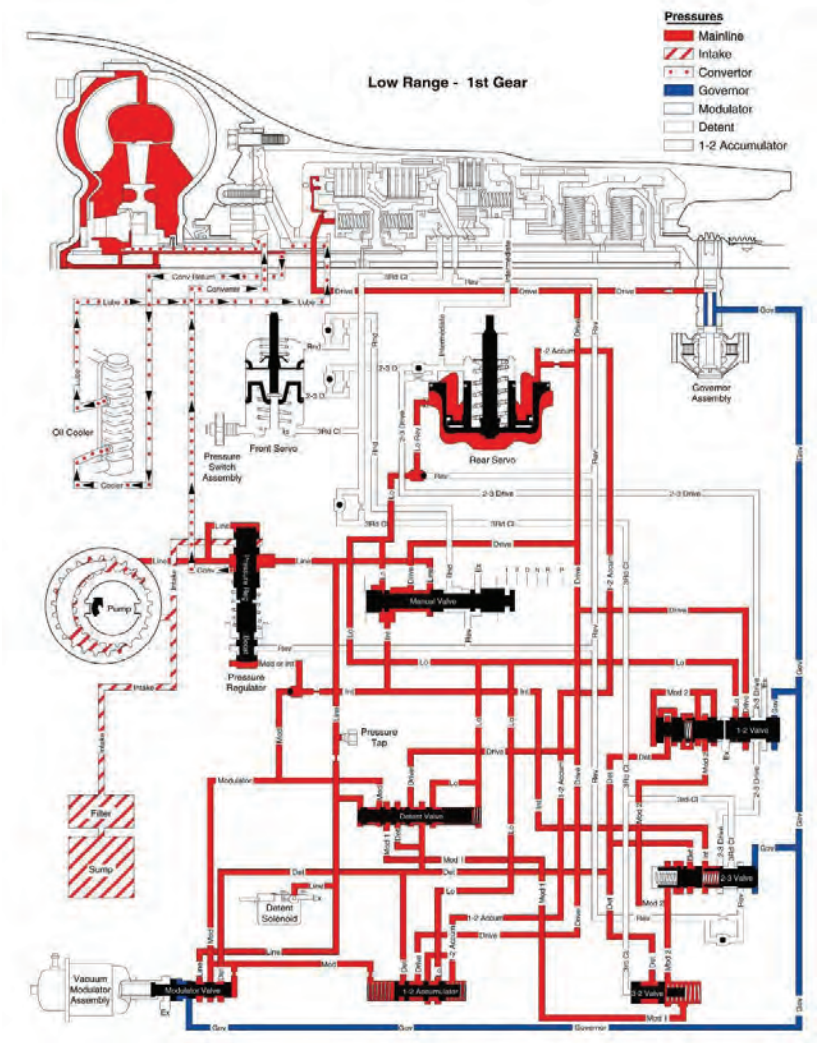

Figure 4

to Newton's 3rd Law of Motion: in this case, for every action, there will be an equal or greater reaction.

A Look at the TH400

The turbo 400 is often used in early racing applications. Through trial and error, we've learned that two of the six or seven checkballs used (depending on the year of the unit) must be installed for this transmission to work (figure 1).

These critical checkballs are shuttling checkballs. The checkballs used for clutch apply and accumulator supply can be left out, but the shuttling/blocker checkballs that control two circuits must be installed because of pressure redirection.

Here's a list of the TH400 checkballs and the circuits they control:

1 —Direct Clutch; nonfunctional after 1975.

2 —Intermediate Servo; manual second apply; not 100% required.

3 —3-2 Direct Clutch; slows oil feed from the accumulator on a 3-2 shift (brake band apply accumulation); not 100% required.

4 —1-2 Intermediate Clutch; directs oil flow to intermediate accumulator and clutch; not 100% required.

5 —Intermediate/Modulator; shuttle ball, directs modulator or manual 2 oil to the pressure regulator valve; required.

6 —Low/Reverse Band; shuttle ball, redirects oil from manual valve for reverse and manual low; required.

The first three speeds of the 4L80E operate very much like the TH400; the major differences are the addition of overdrive and a coast clutch for engine braking.

7 —Reverse Band; used in later units to slow servo apply; not 100% required.

So, on the 7-checkball design, the TH400 unit will provide aggressive shifts with five of the checkballs removed. On the TH400 with only six checkballs, you can remove four safely.

Keep in mind, removing a few checkballs isn't the total package for building a race unit. These checkballs just aren't 100% required. They've been put in place to maintain a smooth shift.

Knowing the type and system of the checkballs and which checkball does what, you can fine tune shift qualities by leaving out one checkball or drilling a circuit feed orifice next to the checkball to allow faster oil transfer to the circuits.

But if you were to remove checkball 5 (figure 2), you wouldn't get any modulator oil to the PR boost valve; it would leak past the manual valve. If you left out checkball 6, you'd have no oil fed to the direct clutch, as this is a shuttle between reverse (figure 3) or manual 1 (figure 4) and 3rd gear oil. These two checkballs must be installed for this unit to work.

Early 4L80E

The first three speeds of the 4L80E operate very much like the TH400; the major differences come with the addition of overdrive and a coast clutch for engine braking. This gives the checkballs new functions.

And this is also where old school thinking can create a costly mistake when leaving out one or more checkball. With the addition of computer controls and adaptive monitoring, the control module has the ability to raise and lower pressures during each shift.

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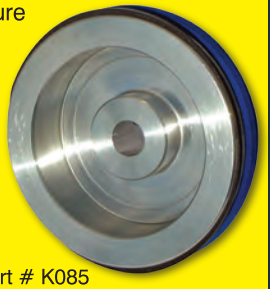

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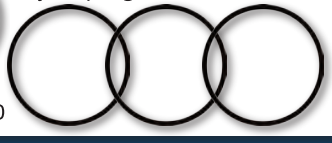

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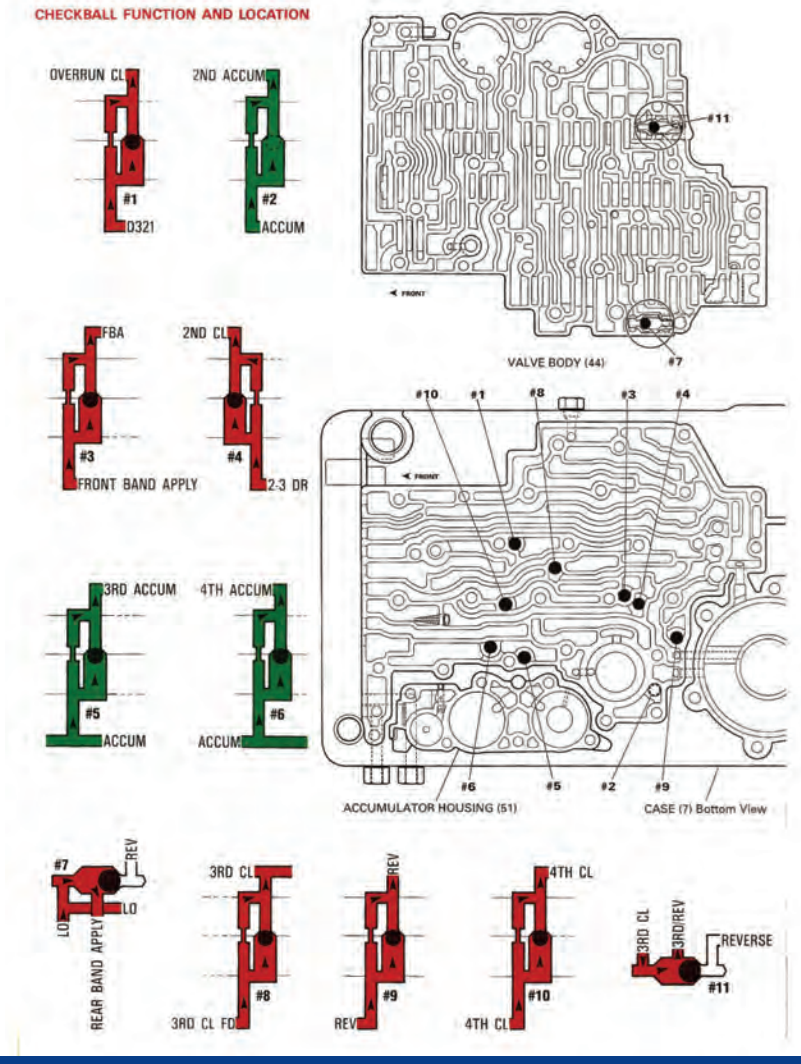

Figure 5

The electronic module continually monitors how fast or slow a shift occurs and adjusts pressure accordingly.

So in simple terms, if a shift were to happen too fast, the module would command pressures low, causing clutches or a band to fail. Remember, the aftermarket performance kits required many hours of research and development to create performance products that work. These kits have been tested and retested to make sure your unit will live with all the modifications.

Understanding what the checkballs control will help if you were considering removing a checkball or drilling a hole to create faster fluid flow. Let's look at the 4L80's 11 checkballs (figure 5) and see what they help control:

1—Overrun Clutch; slows oil feed to the overrun clutch to control apply feel; also allows faster exhaust of the overrun clutch during release; not 100% required.

2—2nd Accumulator (figure 6); not used on all models. Helps control the apply/fill rate of the accumulator by assisting the spring pressure. This checkball is needed to create the pressure difference between minimum line and maximum line pressure for accumulator compression control.

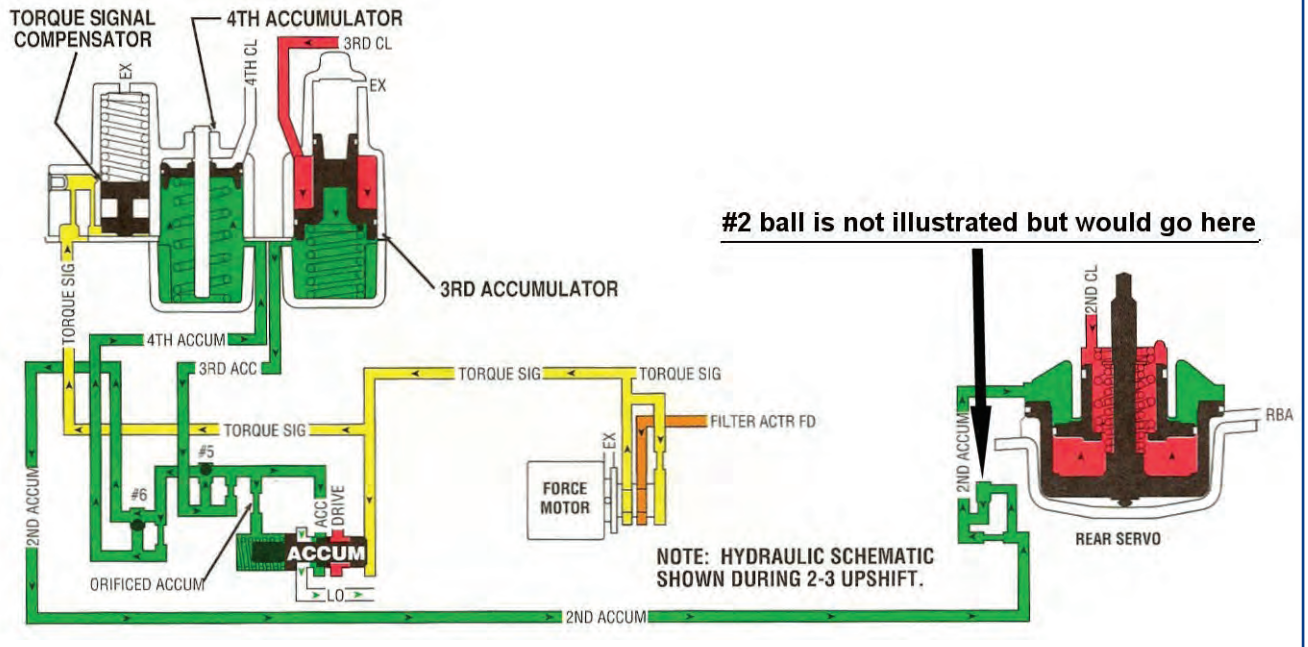

Figure 6

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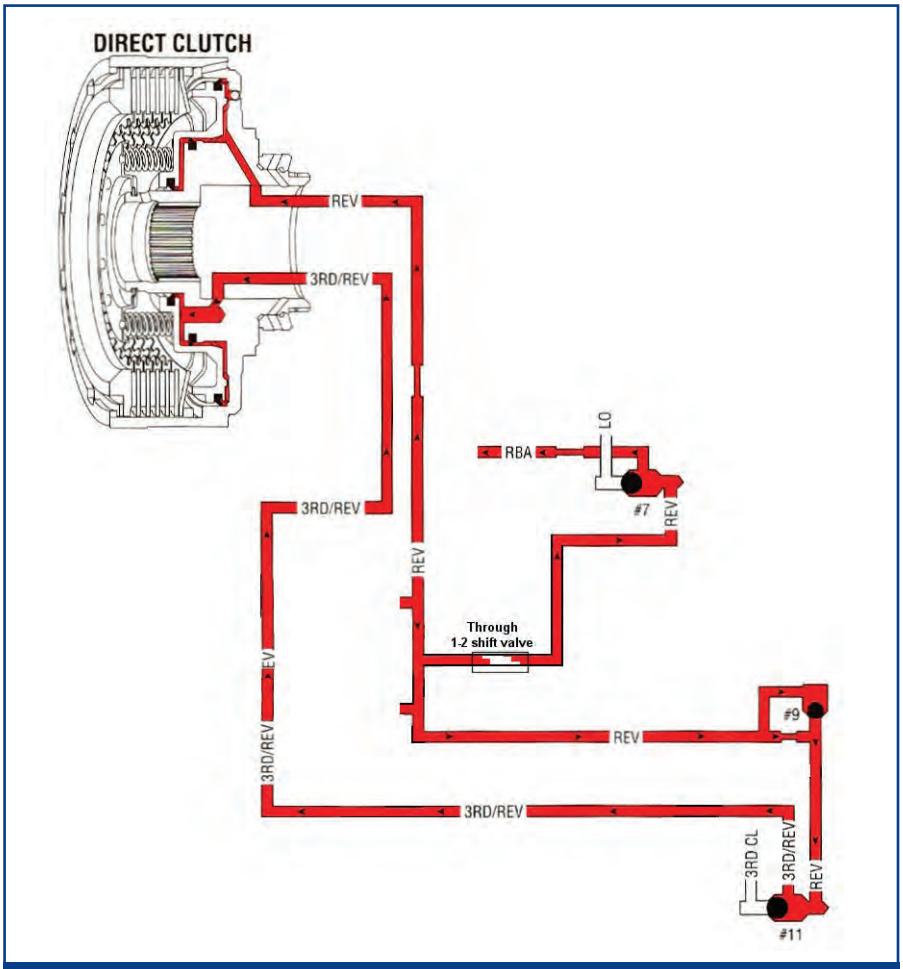


Figure 7

3—Front Band Apply control slows oil feed to the front band (2nd gear engine brake band) to control apply feel; also allows faster exhaust of the front band during release; not 100% required.

4—2nd Clutch Feed; slows oil feed to the 2nd clutch to control apply feel; also allows faster exhaust of the 2nd clutch during release; not 100% required.

5—3rd Clutch Accumulator; helps control the apply/fill rate of the accumulator by assisting the spring rate. This checkball is needed to create the pressure difference between minimum line and maximum line pressure for accumulator compression control.

6—4th Clutch Accumulator; helps control the apply/fill rate of the accumulator by assisting spring pressure. This checkball is needed to create the pressure difference between minimum line and maximum line pressure for accumulator compression control.

7—Low/Reverse Band; shuttle ball; redirects oil from manual valve for reverse and manual low band control; required.

8—3rd (Direct) Clutch; slows oil feed to the 3rd clutch to control apply feel; also allows faster exhaust of the 3rd clutch during release; not 100% required.

9—Reverse feed (direct clutch drum); slows oil feed to the reverse/direct clutch to control apply feel; also allows faster exhaust of the reverse/direct clutch during release; not 100% required.

Note: The direct clutch drum has two separate oil charge circuits: one for 3rd/4th gear, and both for reverse oil charge. Checkball 8 controls oil feed between the top edge of the piston and the middle seal (figure 7). Checkball 9 controls oil feed between the middle seal of the piston and the bottom seal.

10—4th Clutch Feed for Overdrive; slows oil feed to the 4th clutch to control apply feel; also allows faster exhaust of the 4th clutch during release; not 100% required.

11—3rd and Reverse (Direct Clutch); shuttle ball; redirects oil from the manual valve for drive 3rd/4th gear and reverse; required.

Even though some of the checkballs aren't 100% required, remember that with electronic controls, if a clutch applies too fast, the electronics could lower apply rate pressure which can cause a component to fail.

When faced with an OD Ratio code that won't go away, it's sometimes — not always! — useful to leave out the #10 apply rate checkball (figure 8). This allows the OD clutch to fill faster, preventing the transitional apply/slip code from recurring.

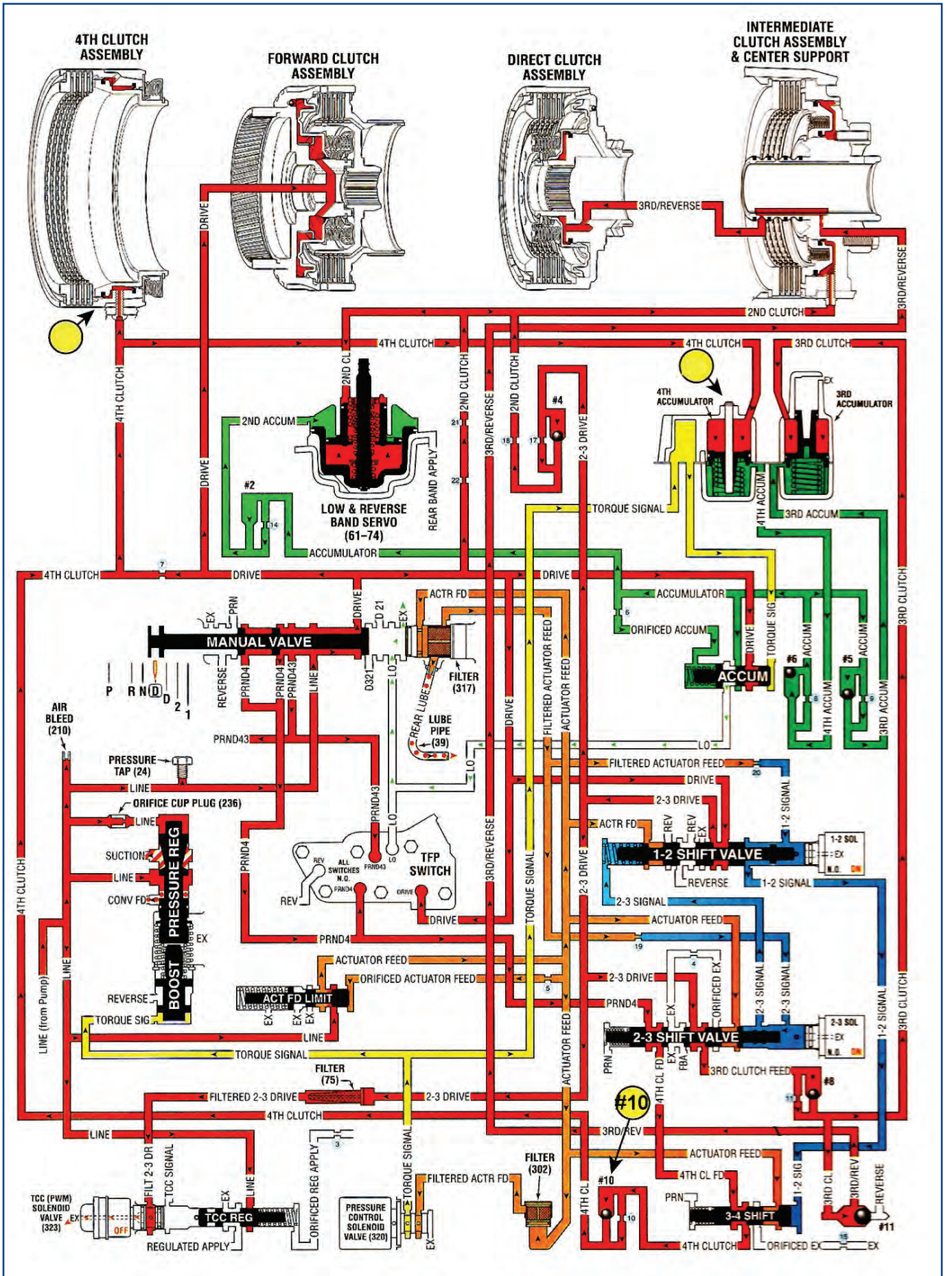
Understand the functions of each of these checkballs can make your job easier when problems show up in the "operating room." Remember, the same old modifications you've been familiar with for years may not always provide the same old results when working on these newer systems.

On early units that have pressure controlled by either a vacuum modulator or a TV cable, you can leave the checkballs out to modify pressures. But on electronic units, leaving out a checkball should never be part of a normal rebuild practice; it can be useful when you're faced with a shift ratio code.

Only modify or remove a checkball if you're dealing with a specific shift problem, and always refer to schematics that provide you with a clear understanding of what each checkball does.

Until next time, keep those transmissions in working shape!

The Doctor


4TH CLUTCH ASSEMBLY
FORWARD CLUTCH ASSEMBLY
DIRECT CLUTCH ASSEMBLY
INTERMEDIATE CLUTCH ASSEMBLY & CENTER SUPPORT
3RD/REVERSE
2ND CLUTCH
4TH CLUTCH
3RD CLUTCH
4TH ACCUMULATOR
3RD ACCUMULATOR
2ND ACCUM
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ACTUATOR FEED
FILTERED ACTUATOR FEED
1-2 SHIFT VALVE
1-2 SOL
1-2 SIGNAL
2-3 SHIFT VALVE
2-3 SOL
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PRESSURE CONTROL SOLENOID VALVE (320)
LINE (from Pump)
#10
#11

Figure 8