

Focus on the 4F27E



by Lance Wiggins

one more time

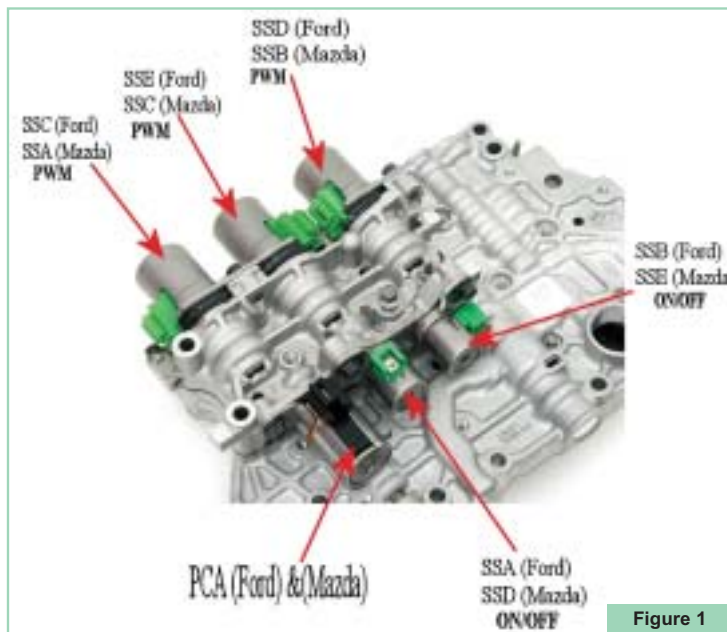


Figure 1

Once again, it's time to *PLAY BALL!* Yes, baseball is in the air and recently my friend Tony and I had the opportunity to join the Los Angeles Dodgers for their opening day of spring training. WOW! What a cool way to spend a day off. I mean, let's face it, sometimes getting out of the shop for anything is cool... but this was special.

There was one thing we talked about on the way to the stadium: work. Even on a day off, most of us can't help but talk about work.

So there we were, on the way to the stadium, and me yapping about how transmissions work and how they're changing and how we diagnose them, and... well, you get the picture. And then he mentions something he'd noticed on his car: a late model Ford Focus, with a 4F27E transmission. The problem — and its solution — turned into a pretty interesting case study. So, in this issue of *Let's Play Ball!* we're going to "Focus" on the 4F27E one more time.

The 4F27E transmission has been around for a few years now and most of you have experience with this Mazda-built transmission. One of the most misunderstood characteristics of this unit is the shift pattern and solenoid sequence. The 4F27E uses three PWM (Pulse Width Modulated) solenoids and two On/Off solenoids (figure 1).

While both manufacturers use the same unit, Mazda and Ford each have different names for the solenoids. Ford solenoids A and B (on Mazda, solenoids D and E) are On/Off solenoids; they operate the 3-4 shift valve and the TCC control valve. Ford solenoids D, E, and C (on Mazda, solenoids B, C and A) are PWM (Pulse Width Modulated) solenoids, used solely to regulate the oil from the solenoids to the clutches.

SOLENOID OPERATION CHART – TORQUE CONVERTER DISENGAGED

Gearshift Selector Position	PCM Commanded Gear	Shift Solenoid A (ON/OFF)*	Shift Solenoid B (ON/OFF)*	Shift Solenoid C (PWM)†	Shift Solenoid D (PWM)†	Shift Solenoid E (PWM)†
P/N	P/N	ON	OFF	OFF	OFF	OFF
R	R	OFF	OFF	OFF	OFF	ON
D	1	OFF	OFF	OFF	ON	ON
	1(M)	ON	ON	OFF	OFF	ON
	2	OFF	OFF	OFF	OFF	ON
	3	OFF	OFF	OFF	OFF	OFF
4	ON	OFF	ON	OFF	OFF	

* With an ON/OFF solenoid, OFF = No Hydraulic Flow.
† With a PWM solenoid, OFF = Full Hydraulic Flow.

SOLENOID OPERATION CHART – TORQUE CONVERTER ENGAGED

Gearshift Selector Position	PCM Commanded "D" Gear	Shift Solenoid A (ON/OFF)*	Shift Solenoid B (ON/OFF)*	Shift Solenoid C (PWM)†	Shift Solenoid D (PWM)†	Shift Solenoid E (PWM)†
D	3	OFF	ON	ON	OFF	OFF
	4	ON	ON	ON	OFF	OFF

* With an ON/OFF solenoid, OFF = No Hydraulic Flow.
† With a PWM solenoid, OFF = Full Hydraulic Flow.

Figure 2

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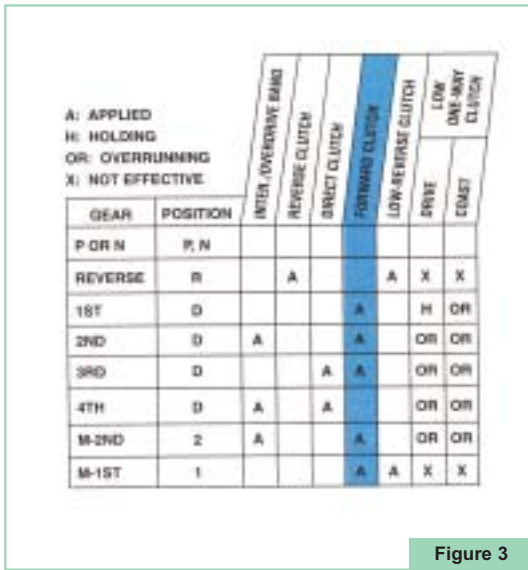


Figure 3

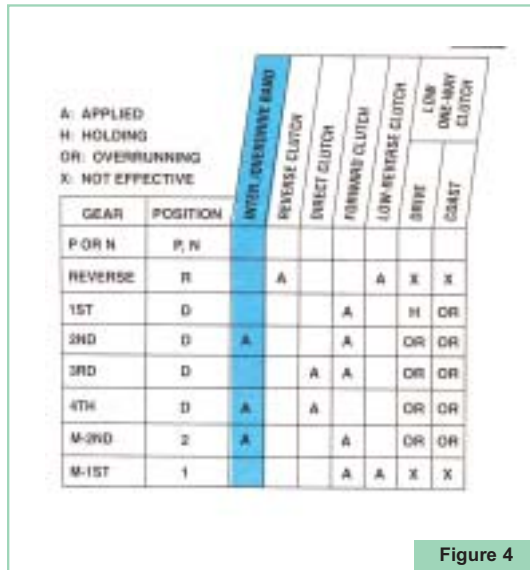


Figure 4

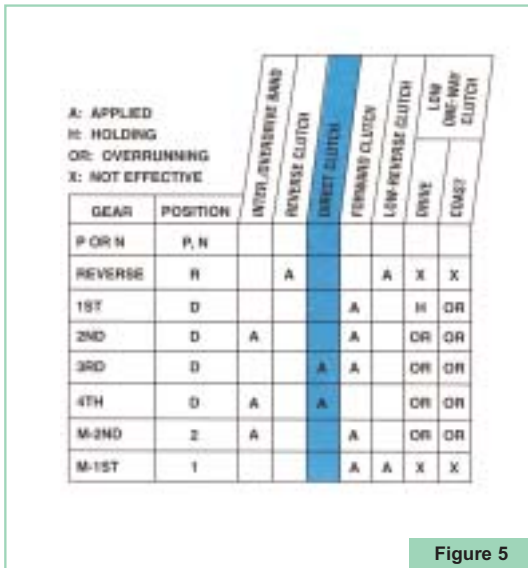


Figure 5

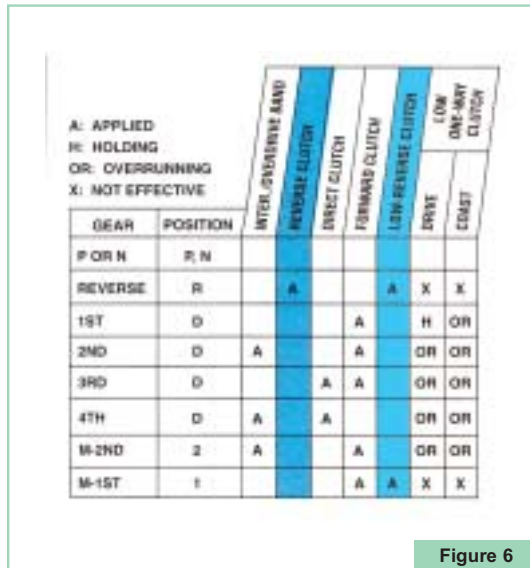


Figure 6

Diagnosing the 4F27E is pretty easy, once you understand how the transmission operates. The clutch and band application chart makes this a simple procedure.

You should monitor these solenoids through your scan tool; you may get a percentage or a varying voltage as a reading. A reading of 25% equates to 25% open; that is, the amount of flow being allowed through the solenoid. 75% equates to 75% open (flow), and so on. Use the solenoid chart (figure 2) to determine the proper solenoid operation order for both Ford and Mazda.

Diagnosing the 4F27E is pretty easy, once you understand how the transmission operates. The clutch and band application chart makes this a simple procedure. The forward clutch is applied for 1st through 3rd gears, and

released in 4th (O/D) gear (figure 3). The 2-4 band is applied in 2nd and 4th gears (figure 4). The direct clutch is applied for 3rd and 4th (figure 5). The reverse clutch is only applied for reverse, and the low/reverse clutch applies for reverse and manual low (figure 6).

Which brings us to my buddy's car. Most of the time it worked fine, but every now and then, he thought he noticed the transmission was slipping going into 4th gear. So I asked him about 2nd gear; he claimed that was okay. And he reiterated that the condition was intermittent. That in itself was



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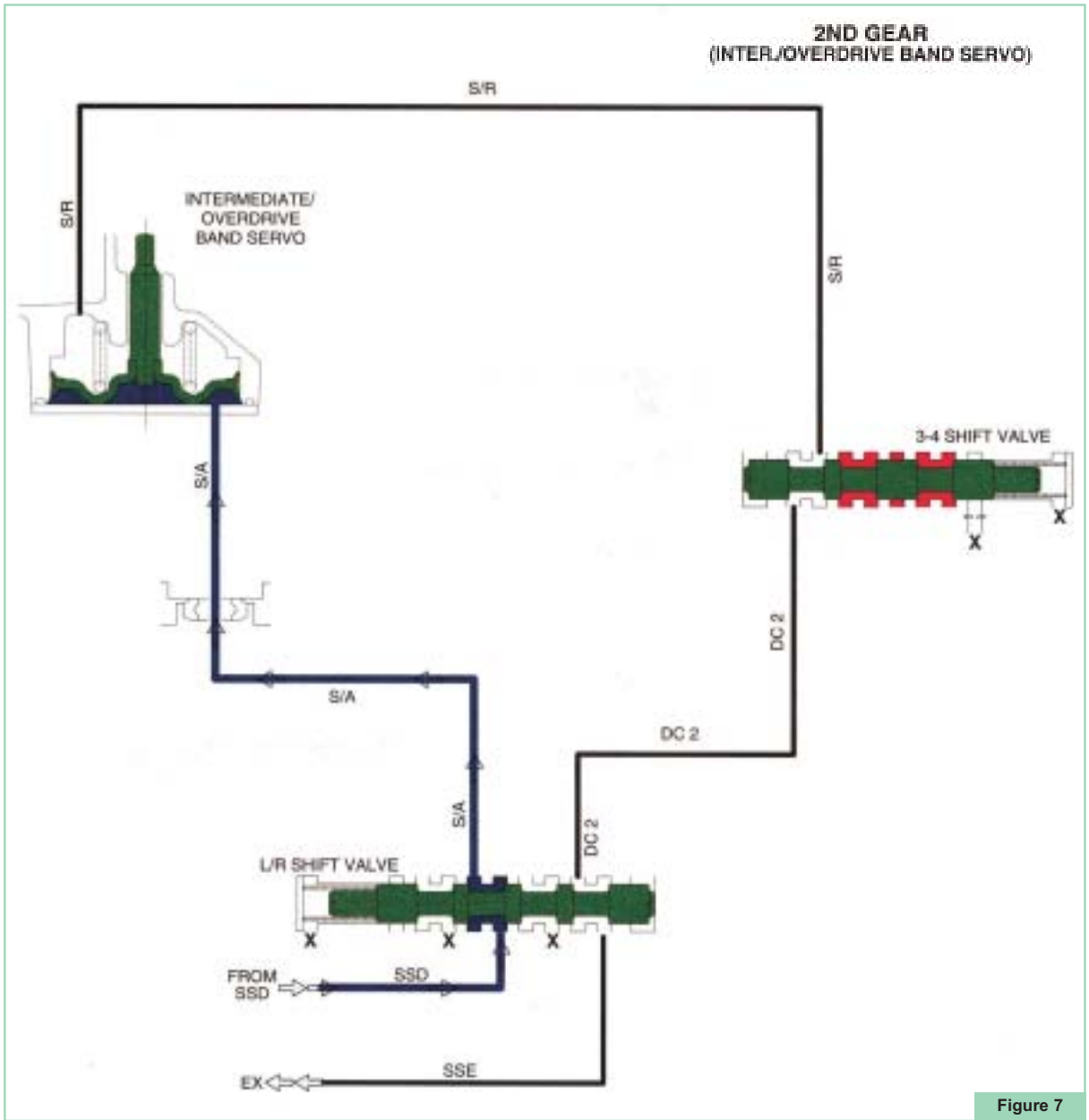


Figure 7

troubling, but here's what we did to diagnose, identify and repair the problem:

All of the 4F27E manuals show only one pressure tap — the mainline tap — but we know there are more. Just above the TR (Transmission Range) sensor, there's an allen-head plug for the direct clutch. Remember, the direct clutch is applied in 3rd and 4th gears.

Pressure is applied to the release side of the 2-4 servo in 3rd gear, and is released in 4th gear. But wait... *I did*

say that direct oil was applied to the release side of the 2-4 servo and that the direct clutch is used in third and fourth gear, didn't I? Well, if that's the case, how does the direct clutch stay on, if the oil is released from the 2-4 servo in 4th gear?

Here's how: The oil is directed to the release side of the 2-4 servo in 3rd gear by PWM solenoid E in Fords (solenoid C in Mazdas), forcing the oil to the clutch through the 3-4 shift valve (figure 7). In 4th gear, the oil is still

directed to the 3-4 shift valve by PWM solenoid E in Fords (solenoid C in Mazdas), but now the 3-4 shift valve is stroked by the Ford SSA (Mazda SSD) solenoid (figure 8).

Part of diagnosing this 4F27E involved taping into the release side of the servo. This allowed us to answer two questions:

1. Is there enough pressure to apply the clutch?
2. Did the valve move?



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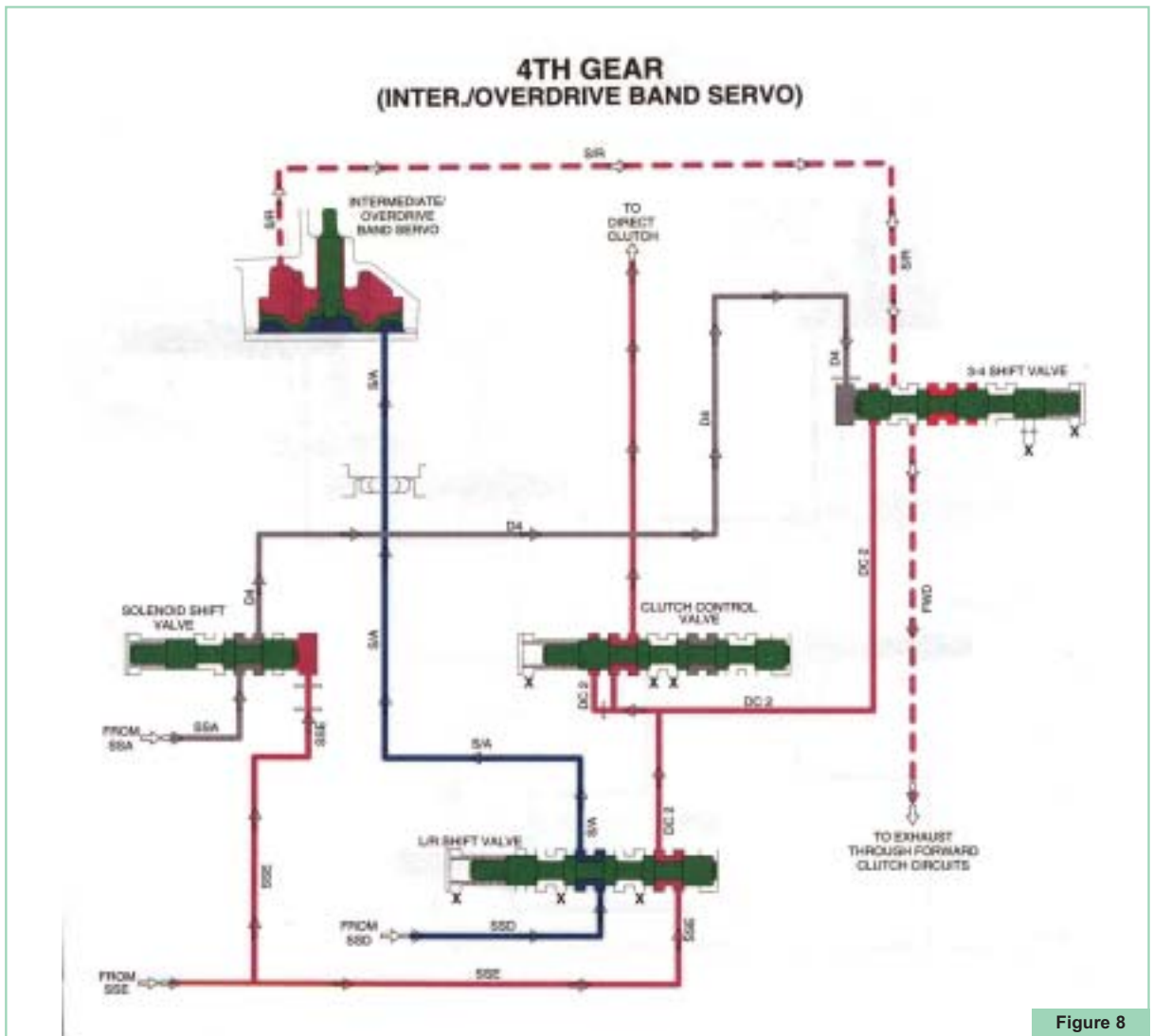


Figure 8

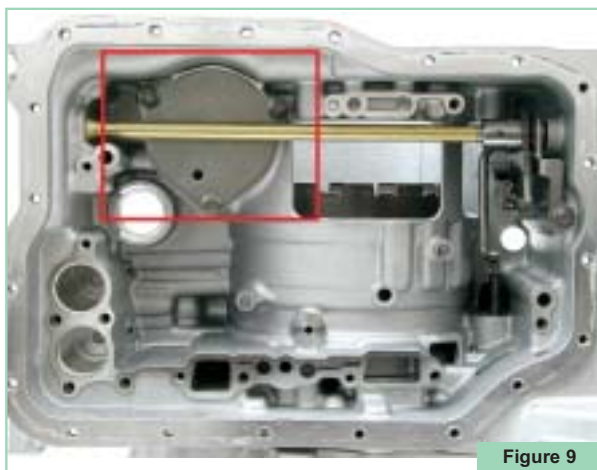


Figure 9



Figure 10

We ended up with two separate results: First, when the transmission was working well; second, when it didn't work properly. When the transmission was working well the pressure at the tap in 3rd gear was 120 PSI. In 4th it dropped to 0 PSI.

The second time we tested the transmission, the condition occurred. Pressure in 3rd gear was still 120 PSI. But when the computer commanded 4th gear, the pressure went from 120 PSI to 45 PSI... and then to 0 PSI. So here's what we discovered:

1. The commands to the transmission were correct.
2. The valve did stroke.
3. The unit worked well sometimes and not other times.
4. When the transmission was acting up, the pressure was different, almost like the valve was sticking.

But *why* would it work intermittently? It turned out that my buddy had taken the car to a local shop when the problem first appeared. So I talked to the technician who worked on it; he told me he replaced the valve body, and everything air-checked okay.

From here we needed to check the mechanical components of the transmission. We removed the valve body, which gave us access to the servo cover (figure 9). The servo looked good while it was in the unit, but we needed to remove it from the transmission... and BAM! Home Run! The servo pin was severed from the base (figure 10). We replaced the servo pin, and the problem hasn't recurred since.

By understanding how the unit worked, and following a logical diagnostic procedure, we were able to work our way right to the failure. What potentially could have been a difficult, time-consuming problem went from a strikeout in the making to a home run hit! Is it any wonder we always strive to understand the rules before we try to play the game? Not to me: I know the guys I'm talking to and I know why they're playing... to be the best!

...and *That's the Game!*



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