Auto transmission tuning tutorial

 joecar

Many thanks to joecar for this info.

I don't have a tutorial written, but some basic steps that could be included for daily driver usage (feel free to add, delete, modify, correct, increase knowledge):

a. Increase shift pressures 5-10%.
b. Decrease shift times to around 0.3s.
c. Decrease torque reduction at each shift by 5-10%.
d. Adjust the upshift and downshift curves, BUT always keep the upshift curve higher than the downshift curve (i.e. at each TPS value, keep the upshift speed greater than the downshift speed); "hysteresis" prevents gear hunting.

Go for a drive, logging various trans pids
(vss, rpm, tps, map/maf, torque, tft, pcs, gear, shift times, shift errors, various tstates).

Check "feel" of each shift (harsh, firm, soft, sloppy);
harsh or sloppy is no good;
if it's too firm:
if line pressure pid shows high pressure at lower throttle positions,
then reduce pressure for that shift, otherwise increase torque reduction;
if it's too soft:
if line pressure pid shows low pressure at higher throttle positions,
then increase pressure for that shift, otherwise decrease torque reduction;
If you break tire traction, how severe is it...?
(little chirp at medium throttle is okay, big spin loose is not okay)...?
You want firm positive shift, not harsh super firm jerking shift.
Torque reduction curves have a big effect on shift feel.

Are shifts occurring in the specified shift times...?
Compare this with time taken for shift initiation to rpm drop; does it match...?
If shifts are slower, then pressure may be too low (or trans worn out);
If shifts are faster, then pressure may be too high;
watchout:

PCM may try to adapt by altering pressure;
if pressure goes too low, clutches/band slip and burn;
if pressure goes too high, pump wears out prematurely;
You want shifts to be fairly reasonably quick, not overly quick, and not long drawn out.

Does it shift too early or too late...?
if too early, increase shift MPH;
if too late decrease shift MPH;
you may like it to hold longer thru each gear
(reduces fuel economy, increase gearset wear);
you may like it to sequence thru gears quickly
(increases fuel economy, reduce gearset wear);

Is WOT shift at the RPM you want...?
Adjust WOT RPM and test it out;
it may shift at a higher RPM, so watch out that it doesn't hit rev limiter.

Edit: WOT shift occurs as soon as both WOT MPH and WOT RPM are met.

The ideas behind all of this:
1. slow sloppy shifts allow clutches and band to slip during the shift, causing wear and heat.
2. quick harsh hard shifts fatigue the hard parts, the driveline, the axle, and wears the tires and engine mounts.
3. high line pressure wears the pump prematurely;
4. excessive line pressure may damage the accumulator pistons and clutch/band servo pistons (and may blow the snap rings out of the ends of the clutch packs), and may crack the case.
5. quick firm shifts reduce the amount of time the clutch/band slips during the shift
(the releasing component ramps down (slips during this), the applying component ramps up (slips during this);
reducing the time taken for this reduces slip which in turn reduces heat and wear).
6. overheated atf causes friction material to go bad and o-rings to go hard (and leak),
and overheated atf loses its properties/qualities.
7. nice quick crisp shifts make the car feel like a "performance" car;
the conservative factory feel makes the car feel like a slow lumbering land yacht, and wears clutches/bands earlier; although in recent years the factory increased line pressure slightly and uses torque reduction to make the shift sloppy (which protects entire drivetrain).

As with anything good (or bad), don't overdo it; don't overdo it; don't overdo it.

Drag racing requires different characteristics, a stall converter, a shift kit, some reinforced hard parts, a bigger axle, bigger U-joints; of course, everyone already knows this.

If you drag race and/or run a stall converter, it is a really good idea to install an atf cooler.

Strip or street, you will do well to use synthetic atf, and to flush the converter (using return line method) when installing the synth atf.

Edit: Do not alter the PCS table; this table tells the PCM what pressures the PCS produces as a function of current and temp.
If for some reason you adjusted the screw in the back of the PCS, you will need to adjust this table, but this is difficult.
It's best not to alter either the PCS table nor the PCS screw, unless there's a very good reason.

TCC apply/release:
The TCC Apply and Release curves show a large step to 256 MPH at around 80% TPS; this is to have the TCC released above 80% throttle to prevent the TCC friction surface from burning out (there's only one surface); too much torque will overcome the TCC and make it slip.

WOT MPH and WOT RPM upshift:
Keep in mind that WOT upshift requires that both WOT MPH and WOT RPM be met; set the WOT RPM to what you want to shift at (maybe subtract 200 RPM from it), calculate the MPH this corresponds to, and subtract say 10 MPH from this, and set this as the WOT MPH; this allows the MPH condition to be met first, and then the RPM condition triggers upshift; log data and fine tune.

Line pressure and PCS pressure:
The PCS controls "Torque Signal" pressure which acts on the end of the Boost Valve which, via spring, assists the Pressure Regulator valve; so while PCS pressure may range up to 95 psi, line pressure may range up to 250 psi (varies with different model of 4L60E and with shift kit); so if you have a shift kit installed, use Scan Tool Bi-Dir mode to command PCS current and observe line pressure tap using pressure gauge (remember as PCS current goes down, PCS pressure goes up); this gives you an idea of how line pressure ranges, and you can modify the Shift Pressure tables accordingly.

Quote:

> Originally Posted by **Redline Motorsports**
> *It makes sense to set the MPH first to a MPH that you know you will hit for sure and then set the RPM for the actual shift point. Do I understand that correctly?*

Yes, that's correct; log a test run (at the strip, no doubt) and fine tune the WOT RPM points in each gear (not going to get to 4th).

Quote:

> Originally Posted by **Redline Motorsports**
> *I would like to know a bit more as to which TM tables can get tweaked to firm up the shifts just a bit*

Briefly, tweak the following:

a. shift pressures: increase tables D0701, D0702, D0703 by no more than 10%-25% above stock;
if you increase further, pump has to work harder and wear life is reduced;

b. desired shift times: reduce tables D1108, D1109, D1110 to around 0.2s-0.3s;

c. torque reduction: reduce tables D0801, D0802, D0803;
keep reducing these until you start getting tire chirp at 60-80% throttle (take your pick)
on 1-2 and 2-3 shifts (if you can); if you reduce TR any further, then drivetrain will suffer (and rear end becomes uncontrollable  ... if you reduce TR all the way to 0%, each shift will be **brutal**...  ).

You may want to make the above changes less pronounced at low TPS, and more pronounced at high TPS.

Log and verify the following:
1. PCS (psi) is not high at light throttle nor low at heavy throttle;
2. Last Shift Time (s) matches the tables;
3. TFT is staying below 190°F;

Not doing c. will make a. seem to not have effect.

If after a. and c. shift is not firming up, you need to monitor line pressure using gauge attached to tap on side of case, do Scan Tool Bi-Directional PCS test and compare gauge readings with spec (50-230 psi); if appreciably below this, trans. has pressure leak, and clutches/band will slip if significant torque is applied.

Cheers,
Joe


If you have installed a shiftkit, you should 0 out shift times. This will disable transmission adaptive learning. I would 0 torque management, also. (See following caution)

I would caution about removing TM altogether since it can be hard on the drivetrain (would require stronger parts in the trans. and on back).

If the trans. is fairly stock, I would reduce TM/TR some amount, but not all the way.

If trans. is built up, and driver doesn't mind the feel, then there's quite a few people who have zeroed out TM/TR with no problem.

Something that was brought to my attention by a fellow EFILive user...

When in SD mode, log the pid GM.TRQENG "Delivered Engine Torque" and make sure it looks sensible:
a. it should never go negative,
b. it should follow TPS, MAP, MAF in terms of engine output

(i.e. GM.TRQENG should look sane wrt to what engine is doing).

If it fails a. or b. above, then this is an indication that the airflow calculations are incorrect (I'm not sure exactly how the torque is calculated from airflow).

The problem is that the PCM may now be commanding in-gear line pressure too low allowing slipage which leads to failure very quickly.

So pay attention to this.