

Injector Driver

Theory of Operation

Refer to the schematic.

This circuit was designed to work with the 1227747 ECM, but will most likely work with most other ECMs as well. It drives low impedance (around 2 ohm) injectors. It might work with high impedance injectors, but I have not tested it.

This circuit is used to drive the other two injectors in a four injector throttle body. The ECM already drives two of them, this drives the other two. It uses one of the injector drive lines as the trigger signal.

Pin 1 of connector J1 is one of the injector drive signals out of the ECM. If you examine this signal using a scope, you will notice that it briefly drops from battery voltage (12V-14V) to around 1V-2V. It stays there for a few milliseconds, and then pops back up to about 1V-2V below the battery voltage for the rest of the time that the injector is to be driven. This is controlled by the LM1949 in the ECM.

U2 is configured as a comparator that drives its output low whenever the signal from the injector is more than one diode drop (about 0.6V) below battery voltage. Diode D2 and resistor R8 set the threshold for the comparator to be constantly about .6V below the battery voltage, so this will work even when the voltage drops during cranking. R6 and R4 provide hysteresis to prevent oscillation as the voltage at pin 3 of the op-amp passes the voltage threshold at pin 2. If you want to use both of the injector drive signals from the ECM, and drive one additional injector from each, rather than driving both from one signal, you could replicate this circuit using the other op-amp in the package. You would not need to replicate the diode (D2) and resistor (R8) though. Just tie the two (-) terminals together and replicate R4, R6, and D3.

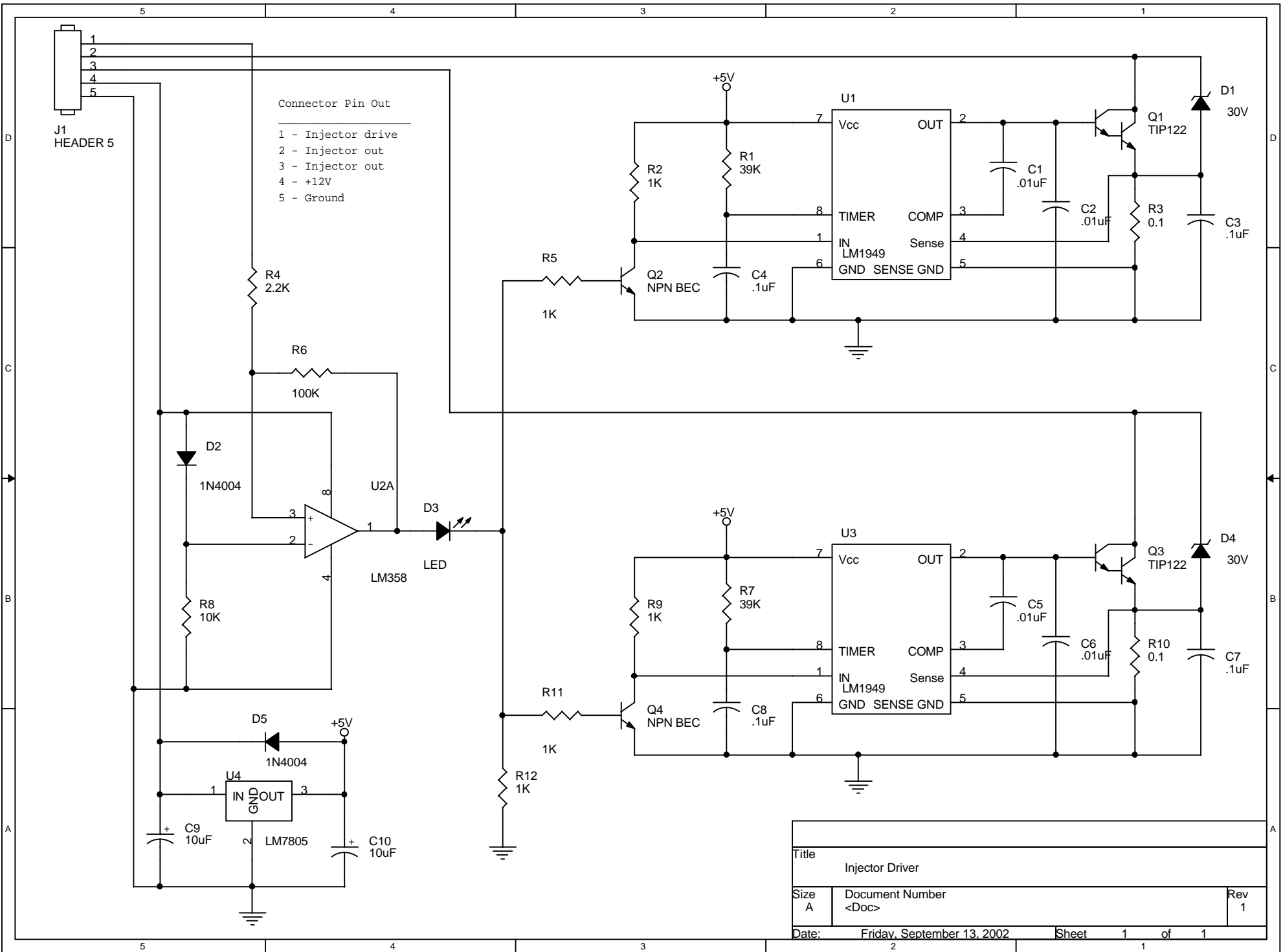
Diode D3 (LED) is there to drop the voltage output, and is only needed if the op-amp used does not drop to less than about .5V. Many op-amps will only drive their low output to about 1V above ground, and without a voltage drop, Q2 and Q4 might not turn off reliably. Q2 and Q4 invert the signal from the op-amp, and limit the voltage swing to +5V to protect the input on the LM1949.

The LM1949 is an injector driver chip. When you drive the input (pin 1) high, it drives its output (pin 2) high to turn on the attached transistor (Q1 and Q3). When the current through the sense resistor (R3 and R10) builds up to a set voltage, the output drive is reduced, thus reducing the current that flows through the injector. This allows the use of a cheaper transistor, and reduces heat build-up in and extends the life of the injector. For more information, read through the LM1949 data sheet.

The big transistors (Q1 and Q3) need to have heat sinks to keep them from getting too hot. Also, D1 and D4 are required, and need to be fairly high wattage zeners. These diodes limit the flyback voltage from the injector coil, and protect the transistors. Without these diodes, you will toast your transistors. The sense resistors (R3 and R10) need to be about 2W devices. You could probably get by with 1W resistors, but at high pulse widths, they could get pretty hot.

If you would like a visual indication of what is happening using an LED, tie a 1K resistor from +12V to the anode of an LED, and the cathode of that LED to pin 1 of U2. The LED should then turn on each time the injector turns on.

That's about it.



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Injector Driver

Bill Of Materials

Item	Quantity	Reference	Part	Vendor	
1	4	C1,C2,C5,C6	.01uF	Digi-Key	PCC103BNCT-ND
2	2	C3,C7	.1uF	Digi-Key	PCC103BNCT-ND
3	2	C8,C4	.1uF	Digi-Key	PCC1840CT-ND
4	2	C10,C9	10uF	Digi-Key	P5157-ND
5	2	D1,D4	30V	Digi-Key	1N5363BMSCT-ND
6	2	D5,D2	1N4004	Digi-Key	1N4004MSCT-ND
7	1	D3	LED	Digi-Key	160-1136-ND
8	1	J1	HEADER 5	Digi-Key	WM4503-ND
9	2	Q1,Q3	TIP122	Digi-Key	TIP122FS-ND
10	2	Q4,Q2	NPN BEC	Digi-Key	MMBT3904DICT-ND
11	2	R1,R7	39K	Digi-Key	P39.2KCCT-ND
12	5	R2,R5,R9,R11,R12	1K	Digi-Key	P1.0KACT-ND
13	2	R10,R3	0.1	Digi-Key	12FR100-ND
14	1	R4	2.2K	Digi-Key	P2.2KACT-ND
15	1	R6	100K	Digi-Key	P100KACT-ND
16	1	R8	10K	Digi-Key	P10KACT-ND
17	2	U1,U3	LM1949	Digi-Key	LM1949N-ND
18	1	U2	LM358	Digi-Key	296-1014-1-ND
19	1	U4	LM7805	Digi-Key	LM340T-5.0-ND