Notes:

Jumpers labeled JP3, JP4, JP5 and JP6 are crossover wires, nothing more. This was done to ease single sided PCB Prototype testing.

J2 is the TE Connectivity Automotive Grade water resistant connector. The 35 positions will allow for modifications to the board for additional inputs/outputs as this design only uses 27 positions. My samples to test have arrived, http://www.te.com Part #'s:
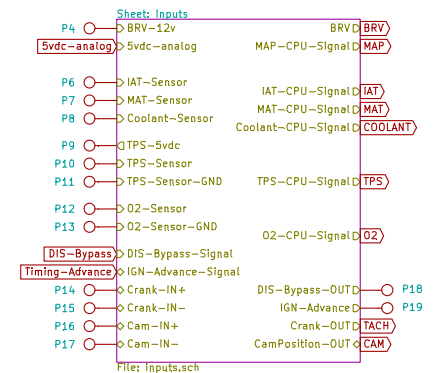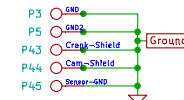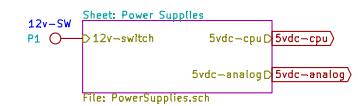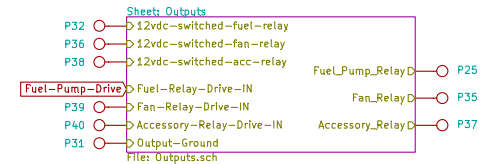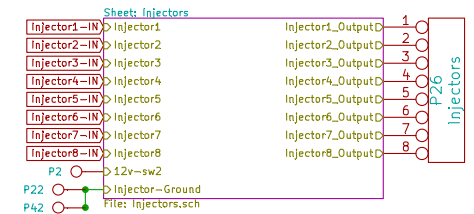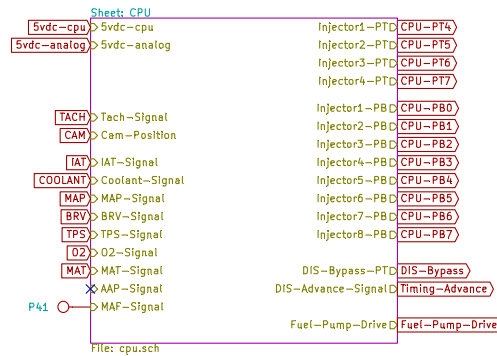
1-776163-2 Right Angle 35 Position Header (Natural Color)
OR
1-776231-2 Vertical 35 Position Header (Natural Color)
1-776231-2 Vertical 35 Position Header (Natural Color)
776164-2 35 Position AMP SEAL Plug Assembly (Natural Color)

Make sure that the PCB grounds do not touch the inside of the case and isolate the TO-220 voltage regulators from the end panels of the case with mica insulators and use plastic screws.

5vdc-cpu = VDD

5vdc-analog = VCC

INJ-GND and INJ-GND2 are isolated to only be used by the Injector FETs

Sheet: CPU

5vdc-cpu ▷ 5vdc-cpu	Injector1-PTD ▷ CPU-PT4
5vdc-analog ▷ 5vdc-analog	Injector2-PTD ▷ CPU-PT5
	Injector3-PTD ▷ CPU-PT6
	Injector4-PTD ▷ CPU-PT7
TACH ▷ Tach-Signal	Injector1-PBD ▷ CPU-PB0
CAM ▷ Cam-Position	Injector2-PBD ▷ CPU-PB1
IAT ▷ IAT-Signal	Injector3-PBD ▷ CPU-PB2
COOLANT ▷ Coolant-Signal	Injector4-PBD ▷ CPU-PB3
MAP ▷ MAP-Signal	Injector5-PBD ▷ CPU-PB4
BRV ▷ BRV-Signal	Injector6-PBD ▷ CPU-PB5
TPS ▷ TPS-Signal	Injector7-PBD ▷ CPU-PB6
O2 ▷ O2-Signal	Injector8-PBD ▷ CPU-PB7
MAT ▷ MAT-Signal	DIS-Bypass-PTD ▷ DIS-Bypass
✗ AAP-Signal	DIS-Advance-SignalD ▷ Timing-Advance
P41 ▷ MAF-Signal	Fuel-Pump-Drive ▷ Fuel-Pump-Drive

File: cpu.sch

Sheet: Injectors

Injector1-IN ▷ Injector1	Injector1_OutputD
Injector2-IN ▷ Injector2	Injector2_OutputD
Injector3-IN ▷ Injector3	Injector3_OutputD
Injector4-IN ▷ Injector4	Injector4_OutputD
Injector5-IN ▷ Injector5	Injector5_OutputD
Injector6-IN ▷ Injector6	Injector6_OutputD
Injector7-IN ▷ Injector7	Injector7_OutputD
Injector8-IN ▷ Injector8	Injector8_OutputD
P2 ○ ▷ 12v-sw2	
P22 ○ ▷ Injector-Ground	
P42 ○	

P26 Injectors — 1 2 3 4 5 6 7 8

File: Injectors.sch

Sheet: Outputs

P32 ○ ▷ 12vdc-switched-fuel-relay	
P36 ○ ▷ 12vdc-switched-fan-relay	
P38 ○ ▷ 12vdc-switched-acc-relay	Fuel_Pump_RelayD ○ P25
Fuel-Pump-Drive ▷ Fuel-Relay-Drive-IN	
P39 ○ ▷ Fan-Relay-Drive-IN	Fan_RelayD ○ P35
P40 ○ ▷ Accessory-Relay-Drive-IN	Accessory_RelayD ○ P37
P31 ○ ▷ Output-Ground	

File: Outputs.sch

Sheet: Power Supplies

12v-SW P1 ○ ▷ 12v-switch	5vdc-cpuD ▷ 5vdc-cpu
	5vdc-analogD ▷ 5vdc-analog

File: PowerSupplies.sch

P3 ○ GND
P5 ○ GND
P43 ○ Crank-Shield — Ground
P44 ○ Cam-Shield
P45 ○ Sensor-GND

For 6/8 cylinder using Port T with current code, run jumper wires from:
P20 pin 1 to P21 pin 1 = Bank 1
P20 pin 2 to P21 pin 2 = Bank 2
P20 pin 3 to P21 pin 3 = Bank 3
P20 pin 4 to P21 pin 4 = Bank 4

P21 Pin 1 has a trace to P34 Pin 2 on the PCB
P21 Pin 2 has a trace to P34 Pin 4 on the PCB
P21 Pin 3 has a trace to P34 Pin 5 on the PCB
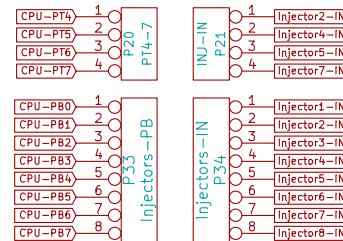P21 Pin 4 has a trace to P34 Pin 7 on the PCB

AND DO THE FOLLOWING

For 6/8 cylinder using Port T with current code jumper from:
(can be tie-bar shorting jumper if you installed a 0.100" pin header for P34)
P34 pin 1 to P34 pin 2
P34 pin 3 to P34 pin 4
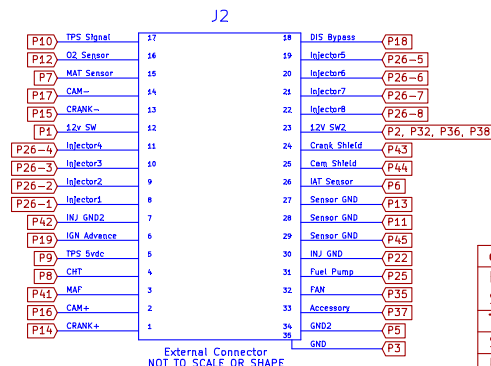P34 pin 5 to P34 pin 6
P34 pin 7 to P34 pin 8

To use Port B with future XGATE code, run jumper wires from:
P33 to P34 pin for pin and do not connect anything to P21.
ie:
P33 pin 1 to P34 pin 1
P33 pin 2 to P34 pin 2
P33 pin 3 to P34 pin 3
P33 pin 4 to P34 pin 4
P33 pin 5 to P34 pin 5
P33 pin 6 to P34 pin 6
P33 pin 7 to P34 pin 7
P33 pin 8 to P34 pin 8

P20 PT4-7		P21 INJ-IN
CPU-PT4 — 1		1 — Injector2-IN
CPU-PT5 — 2		2 — Injector5-IN
CPU-PT6 — 3		3 — Injector5-IN
CPU-PT7 — 4		4 — Injector7-IN

P33 Injectors-PB		P34 Injectors-IN
CPU-PB0 — 1		1 — Injector1-IN
CPU-PB1 — 2		2 — Injector2-IN
CPU-PB2 — 3		3 — Injector3-IN
CPU-PB3 — 4		4 — Injector4-IN
CPU-PB4 — 5		5 — Injector5-IN
CPU-PB5 — 6		6 — Injector6-IN
CPU-PB6 — 7		7 — Injector7-IN
CPU-PB7 — 8		8 — Injector8-IN

P21 and P34 allow for selection to use either Port T (4 cpu outputs MAXIMUM:current code) or Port B (8 cpu outputs:future XGATE code)

Sheet: Inputs

P4 ○ ▷ BRV-12v	BRVD ▷ BRV
5vdc-analog ▷ 5vdc-analog	MAP-CPU-SignalD ▷ MAP
P6 ○ ▷ IAT-Sensor	IAT-CPU-SignalD ▷ IAT
P7 ○ ▷ MAT-Sensor	MAT-CPU-SignalD ▷ MAT
P8 ○ ▷ Coolant-Sensor	Coolant-CPU-SignalD ▷ COOLANT
P9 ○ ▷ TPS-5vdc	
P10 ○ ▷ TPS-Sensor	
P11 ○ ▷ TPS-Sensor-GND	TPS-CPU-SignalD ▷ TPS
P12 ○ ▷ O2-Sensor	
P13 ○ ▷ O2-Sensor-GND	O2-CPU-SignalD ▷ O2
DIS-Bypass ▷ DIS-Bypass-Signal	
Timing-Advance ▷ IGN-Advance-Signal	
P14 ○ ▷ Crank-IN+	DIS-Bypass-OUTD ○ P18
P15 ○ ▷ Crank-IN-	IGN-AdvanceD ○ P19
P16 ○ ▷ Cam-IN+	Crank-OUTD ▷ TACH
P17 ○ ▷ Cam-IN-	CamPosition-OUTD ▷ CAM

File: inputs.sch

J2

P10	TPS Signal	17	18	DIS Bypass	P18
P12	O2 Sensor	16	19	Injector5	P26-5
P7	MAT Sensor	15	20	Injector6	P26-6
P17	CAM-	14	21	Injector7	P26-7
P15	CRANK-	13	22	Injector8	P26-8
P1	12v SW	12	23	12v SW2	P2, P32, P36, P38
P26-4	Injector4	11	24	Crank Shield	P43
P26-3	Injector3	10	25	Cam Shield	P44
P26-2	Injector2	9	26	IAT Sensor	P6
P26-1	Injector1	8	27	Sensor GND	P13
P42	INJ GND2	7	28	Sensor GND	P11
P19	IGN Advance	6	29	Sensor GND	P45
P9	TPS 5vdc	5	30	INJ GND	P22
P8	CHT	4	31	Fuel Pump	P25
P41	MAP	3	32	FAN	P35
P16	CAM+	2	33	Accessory	P37
P14	CRANK+	1	34	GND2	P5
			35	GND	P3

External Connector
NOT TO SCALE OR SHAPE

diyefi.org
File: Jaguar.sch
Sheet: /
Title: Jaguar PCB for FreeEMS

Size: A4	Date: 6 feb 2012	Rev: A.2
KiCad E.D.A. eeschema (2011-12-28 BZR 3254)-stable		Id: 1/7

CPU Power
5vdc-cpu VDD

Sheet: ft232
RX → RX
TX → TX
VDD → 5vdc-ft232rl
GND
File: ft232.sch

PP1 and PP2 allow us access to the Port P0-7 pins on the CPU so that we can test these outputs in the future.

C47 10v Tantalum
C2 X7R Ceramic
C47 10uF
C2 0.22uF

C4 and C44 X7R Ceramic
C4 0.22uF
C44 0.22uF

PP4-7
PP2

U1
MC9S12XDP512

PP0-3
PP1

/SS1_PWM3_KWP3_PP3
SCK1_PWM2_KWP2_PP2
MOSI1_PWM1_KWP1_PP1
MISO1_PWM0_KWP0_PP0
PK3
PK2
PK1
PK0
Tach-Signal — IOC0_PT0
Cam-Position — IOC1_PT1
DIS-Advance-Signal — IOC2_PT2
DIS-Bypass-PT — IOC3_PT3
VDD1
VSS1
Injector1-PT — IOC3_PT4
Injector2-PT — IOC5_PT5
Injector3-PT — IOC6_PT6
Injector4-PT — IOC7_PT7
PK5
PK4
TXD2_KWJ1_PJ1
RXD2_KWJ0_PJ0
BKGD — MODC_BKGD
Injector1-PB — PB0
Injector2-PB — PB1
Injector3-PB — PB2
Injector4-PB — PB3
Injector5-PB — PB4

C1 X7R Ceramic
C1 0.22uF

VRH — 5vdc-analog
VDDA
PAD15_AN15
PAD07_AN07 — MAT-Signal
PAD14_AN14
PAD06_AN06 — BRV-Signal
PAD13_AN13
PAD05_AN05 — AAP-Signal
PAD12_AN12
PAD04_AN04 — MAP-Signal
PAD11_AN11
PAD03_AN03 — IO2-Signal
PAD10_AN10 — MAF-Signal
PAD02_AN02 — TPS-Signal
PAD09_AN09
PAD01_AN01 — Coolant-Signal
PAD08_AN08
PAS00_AN00 — IAT-Signal
VSS2
VDD2
PA7 — Fuel-Pump-Drive
PA6
PA5
PA4
PA3
PA2
PA1
PA0

C5 X7R Ceramic
C5 0.22uF

Check Engine Light
LED D1
5vdc-analog
R7 1k
R8 10k
R78 1k
VCC

Load/Run:
Open = Run
Closed = Load
Load/Run
Load1

PP4_KWP4_PWM4_MISO2
PP5_KWP5_PWM5_MOSI2
PP6_KWP6_PWM6_/SS2
PP7_KWP7_PWM7_SCK2
PK7
VDDX
VSSX
PM0_RXCAN0
PM1_TXCAN0
PM2_RXCAN1_RXCAN0_MISO0
PM3_TXCAN1_TXCAN0_/SS0
PM4_RXCAN2_TXCAN0_TXCAN4_MOS
PM5_TXCAN2_TXCAN0_TXCAN4)SCK0
PJ7_KWJ7_TXCAN4_SCL0_TXCAN0
VREGEN
PS7_/SS0
PS6_SCK0
PS5_MOSI0
PS4_MISO0
PS3_TXD1
PS2_RXD1
PS1_TXD0
PS0_RXD0
PM6_RXCAN3_RXCAN4_RXD3
PM7_TXCAN3_TXCAN4_TXD3
VSSA
VRL

PB5
PB6
PB7
TXD5_/SS2_KWH7_PH7
RXD5_SCK2_KWH6_PH6
TXD4_MOSI2_KWH5_PH5
RXD4_MISO2_KWH4_PH4
XCLK_PE7
MODB_PE6
MODA_PE5
ECLK_PE4
VSSR1
/RESET
VDDPLL
XFC
VSSPLL
EXTAL
XTAL
TEST
SS1_KWH3_PH3
SCK1_KWH2_PH2
MOSI1_KWH1_PH1
MISO1_KWH0_PH0
PE3
PE2
/IRQ_PE1
/XIRQ_PE0

Injector6-PB
Injector7-PB
Injector8-PB

XCLK
MODB
MODA
RESET
VDDPLL
XFC
VSSPLL
EXTAL
XTAL

R1 10k
R2 10k
R3 10k
C3 0.22uF
C48 10v Tantalum
C3 X7R Ceramic
C48 10uF
VDD

BDM Connector
R4 10k
R5 10k
P27
BDM
BKGD
RESET
C6 0.1uF
VDD

PLL Circuit
VSSPLL — CPU Pin 46
C8 0.22uF
VDDPLL — CPU Pin 43
C7 6.8nF
R6 3.3k
C9 680pF
XFC — CPU Pin 44

Crystal Circuit
EXTAL
X1 16MHz
XTAL
R62 1M or 10M
R62 1M
C10 12pF
C11 12pF

Jumpers JP3 and JP4 are crossover wires to allow routing on the PCB.
If you redesign the board remove these before trying to place the
components on the PCB as you my not need them.

FT232RL

Pin	Signal
4	VCCIO
20	VCC
16	USBDM
15	USBDP
8	NC
19	_RESET
24	NC
27	OSCI
28	OSCO
17	3V3OUT

Signal	Pin
TXD	1
RXD	5
_RTS	3
_CTS	11
_DTR	2
_DCR	9
_DCD	10
_RI	6
CBUS0	23
CBUS1	22
CBUS2	13
CBUS3	14
CBUS4	12

U7

AGND 25 GND 7 GND 18 GND 21 TEST 26

5v-USB
C39 0.1uF
C40 4.7uF
USB-GND

R79 22
Vbus

J1 USB
Shield_4 5
Vbus 1
D- 2
D+ 3
GND 4
Shield_2 6
D- D+

5v-USB
R55 2.4k

C41 0.1uF

USB-GND

USB-B Mini Connector
J2 USB
Vbus 1
D- 2
D+ 3
GND 4
5

JP4 JUMPER 1 2
JP3 JUMPER 1 2

LED D33
R57 470
5v-USB

LED D34
R58 470

5v-USB
R56 2.4k
VDD 5vdc-ft232rl
R60 10k

U8 PS2911-1-F3-A
A 1 C RX 4
K 2 E GND 3

5v-USB
R59 10k
VDD
R61 2.4k

U9 PS2911-1-F3-A
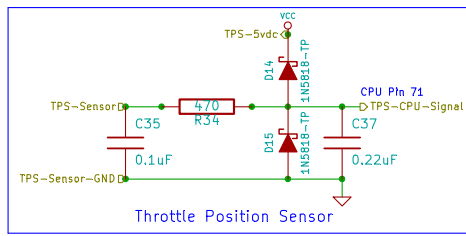C 4 A 1
E 3 K 2
USB-GND TX

For GM DIS and Ford EDIS leave Crank-IN~ and Cam-IN~ totally disconnected.

For Ford EDIS do not connect Cam-IN+ to anything either.
R16, R17, C25, R10, R12 and D5 are not needed for the EDIS system.

R20 and 23 are only to be used with VR inputs, do not
populate these components for GM DIS or Ford EDIS systems.
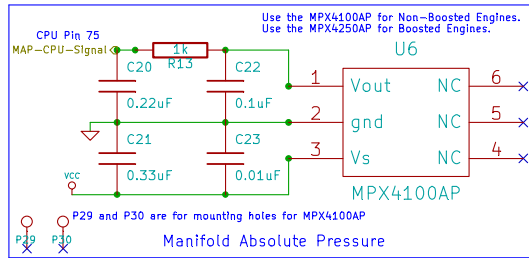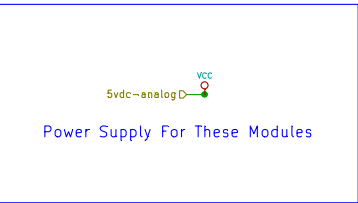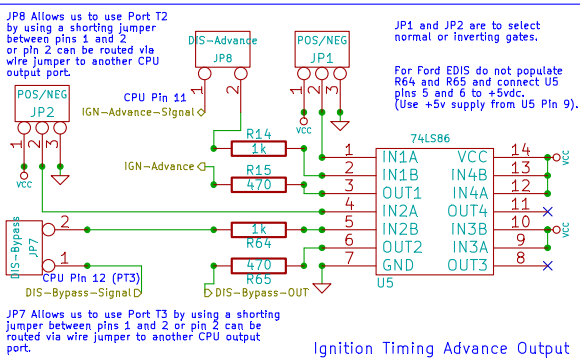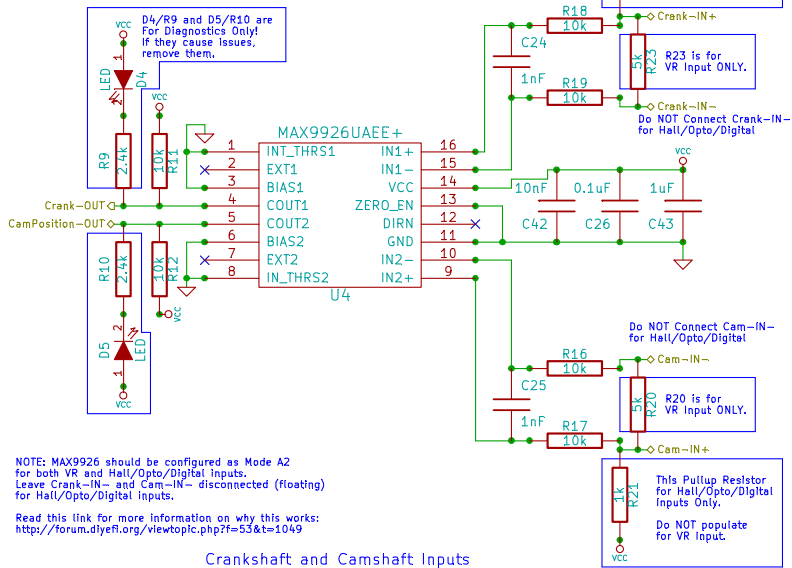
R24, R25 and R31 (2.49k) can be replaced if using sensors other than
GM temperature sensors; for FORD Sensors: use 27.4k 0.1% Metal Film
resistors; for MOPAR Sensors: use 9.1k 0.1% Metal Film resistors or
use 2.43k 0.1% Metal Film resistors (best for most cases). Be sure to
use FreeTherm to adjust the values in the FreeEMS code for the best
accuracy irregardless of which value resistors you use!

D4/R9 and D5/R10 are
For Diagnostics Only!
If they cause issues,
remove them.

This Pullup Resistor
for Hall/Opto/Digital
Inputs Only.

Do NOT populate
for VR Input.

R22 1k

R18 10k
C24
1nF
R19 10k

Crank-IN+

R23 is for
VR Input ONLY.
5k

Crank-IN~

Do NOT Connect Crank-IN~
for Hall/Opto/Digital

MAX9926UAEE+

1 INT_THRS1   IN1+ 16
2 EXT1   IN1- 15
3 BIAS1   VCC   14
4 COUT1   ZERO_EN 13
5 COUT2   DIRN 12
6 BIAS2   GND   11
7 EXT2   IN2- 10
8 IN_THRS2   IN2+ 9
U4

LED D4
R9 2.4k
R11 10k
Crank-OUT
CamPosition-OUT
D5 LED
R10 2.4k
R12 10k

C42 10nF   C26 0.1uF   C43 1uF

NOTE: MAX9926 should be configured as Mode A2
for both VR and Hall/Opto/Digital inputs.
Leave Crank-IN~ and Cam-IN~ disconnected (floating)
for Hall/Opto/Digital inputs.

Read this link for more information on why this works:
http://forum.diyefi.org/viewtopic.php?f=53&t=1049

Do NOT Connect Cam-IN~
for Hall/Opto/Digital

R16 10k
C25
1nF
R17 10k

Cam-IN~

R20 is for
VR Input ONLY.
5k

Cam-IN+

This Pullup Resistor
for Hall/Opto/Digital
Inputs Only.
R21 1k

Do NOT populate
for VR Input.

Crankshaft and Camshaft Inputs

JP8 Allows us to use Port T2
by using a shorting jumper
between pins 1 and 2
or pin 2 can be routed via
wire jumper to another CPU
output port.

JP1 and JP2 are to select
normal or inverting gates.

For Ford EDIS do not populate
R64 and R65 and connect U5
pins 5 and 6 to +5vdc.
(Use +5v supply from U5 Pin 9).

DIS-Advance JP8
POS/NEG JP1
POS/NEG JP2

CPU Pin 11
IGN-Advance-Signal
R14 1k
R15 470
IGN-Advance

74LS86
1 IN1A   VCC 14
2 IN1B   IN4B 13
3 OUT1   IN4A 12
4 IN2A   OUT4 11
5 IN2B   IN3B 10
6 OUT2   IN3A 9
7 GND   OUT3 8
U5

R64 1k
R65 470
DIS-Bypass-Signal
CPU Pin 12 (PT3)
DIS-Bypass JP7
DIS-Bypass-OUT

JP7 Allows us to use Port T3 by using a shorting
jumper between pins 1 and 2 or pin 2 can be
routed via wire jumper to another CPU output
port.

Ignition Timing Advance Output

5vdc-analog VCC

Power Supply For These Modules

Manifold Air Temperature
VCC
R24 2.49k
MAT-SensorD
C28 0.1uF
R26 470
D8 1N5818-TP
D9 1N5818-TP
CPU Pin 81
MAT-CPU-Signal
C30 1uF

Intake Air Temperature
VCC
R25 2.49k
IAT-SensorD
C29 0.1uF
R27 470
D10 1N5818-TP
D11 1N5818-TP
C31 1uF
This jumper allows us to
jump over Vcc on the PCB
JUMPER JP5
CPU Pin 67
IAT-CPU-Signal

Coolant Temperature
VCC
R31 2.49k
Coolant-SensorD
C33 0.1uF
R32 470
Ground
D12 1N5818-TP
D13 1N5818-TP
C36 1uF
This jumper allows us to
jump over Vcc on the PCB
JUMPER JP6
CPU Pin 69
Coolant-CPU-Signal

Throttle Position Sensor
TPS-5vdc
TPS-SensorD
R34 470
D14 1N5818-TP
D15 1N5818-TP
CPU Pin 71
TPS-CPU-Signal
C35 0.1uF
C37 0.22uF
TPS-Sensor-GND

Exhaust Oxygen Sensor
VCC
O2-SensorD
R33 470
D16 1N5818-TP
D17 1N5818-TP
CPU Pin 73
O2-CPU-Signal
C34 0.1uF
C38 0.22uF
O2-Sensor-GND

Battery Reference Voltage
BRV-12vD
R29 3.9k
R30 1k
C32 0.1uF
R28 470
D6 1N5818-TP
D7 1N5818-TP
CPU Pin 79
BRV
C27 0.22uF

Manifold Absolute Pressure
Use the MPX4100AP for Non-Boosted Engines.
Use the MPX4250AP for Boosted Engines.
CPU Pin 75
MAP-CPU-Signal
C20 R13 1k C22
0.22uF   0.1uF
C21 C23
0.33uF   0.01uF
U6
1 Vout   NC 6
2 gnd   NC 5
3 Vs   NC 4
MPX4100AP

P29 and P30 are for mounting holes for MPX4100AP
P29 P30

diyefi.org
File: inputs.sch
Sheet: /Inputs/
Title: Jaguar PCB for FreeEMS
Size: A4   Date: 6 feb 2012   Rev: A.2
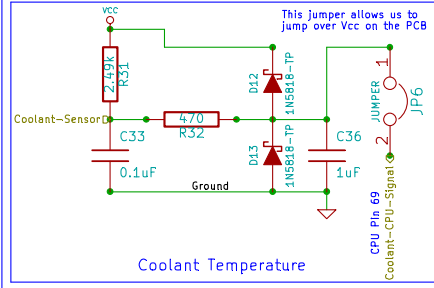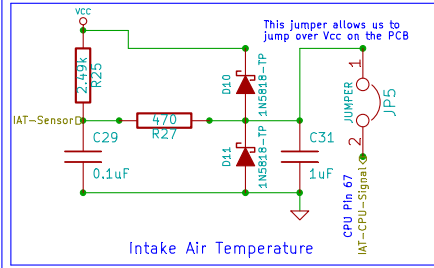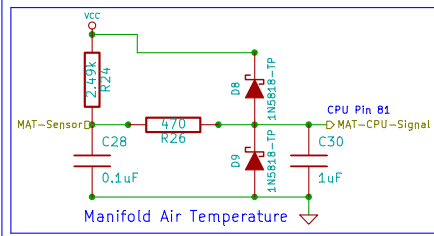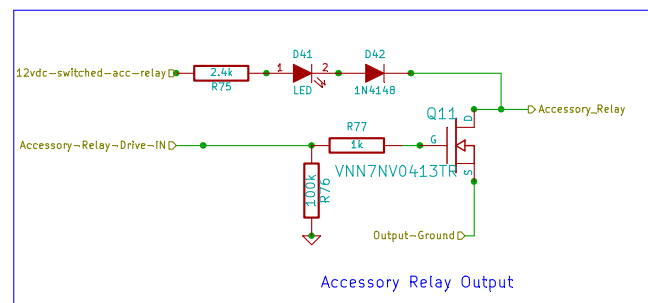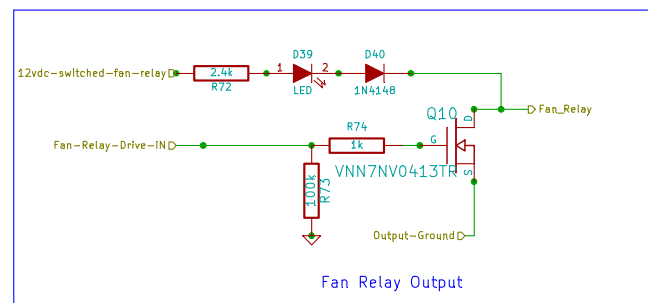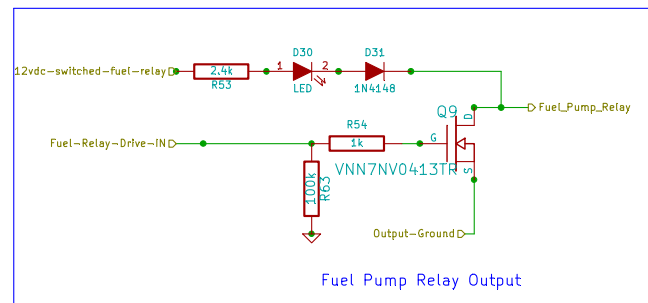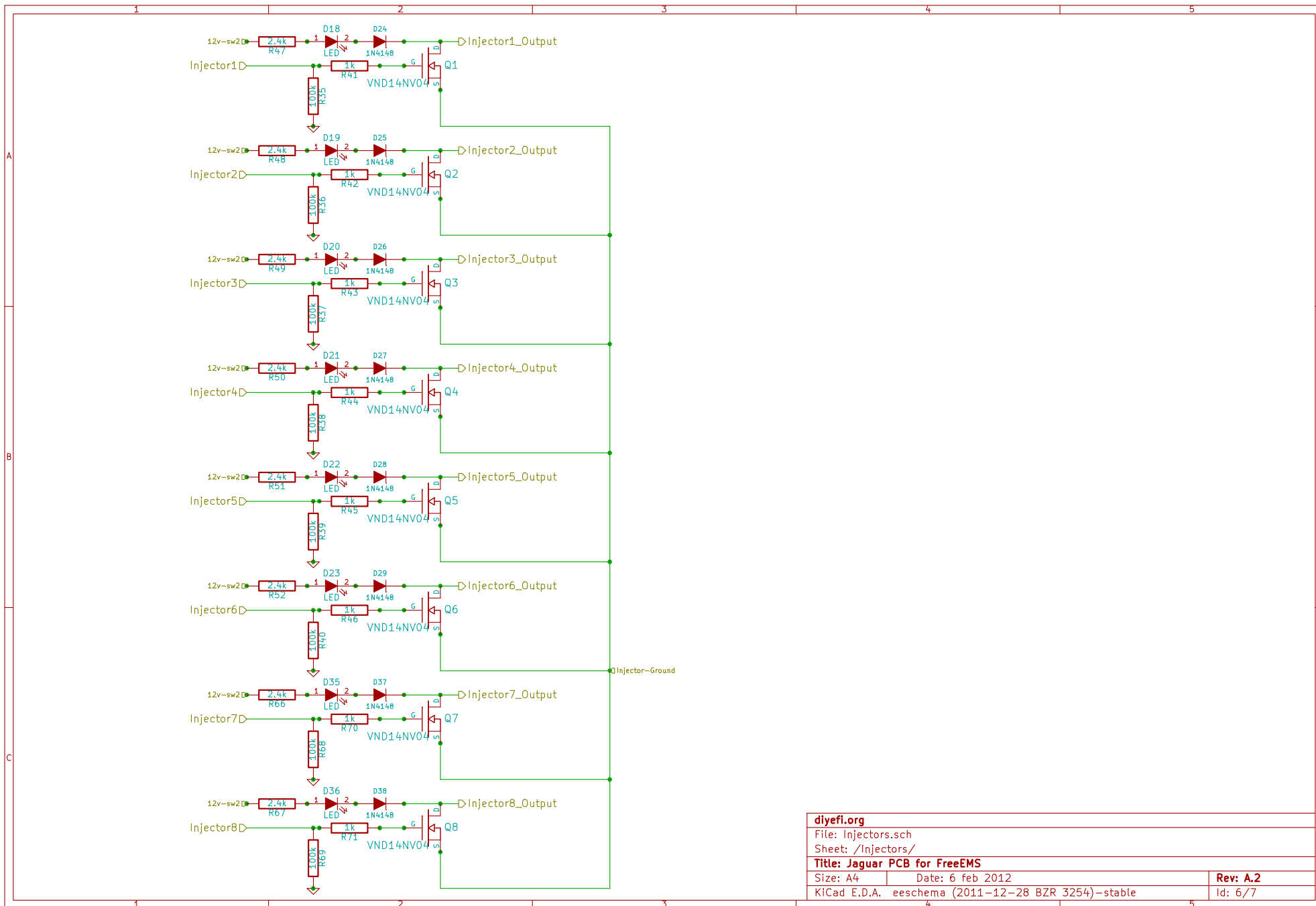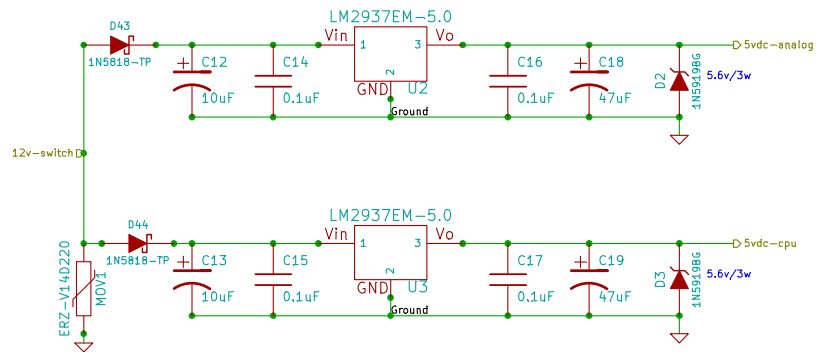KiCad E.D.A. eeschema (2011-12-28 BZR 3254)-stable   Id: 4/7

Fuel Pump Relay Output

12vdc—switched—fuel—relay

R53 2.4k

D30 LED 1 2

D31 1N4148

Fuel_Pump_Relay

Q9

Fuel—Relay—Drive—IN

R54 1k

G D S

R63 100k

VNN7NV0413TR

Output—Ground

Fan Relay Output

12vdc—switched—fan—relay

R72 2.4k

D39 LED 1 2

D40 1N4148

Fan_Relay

Q10

Fan—Relay—Drive—IN

R74 1k

G D S

R73 100k

VNN7NV0413TR

Output—Ground

Accessory Relay Output

12vdc—switched—acc—relay

R75 2.4k

D41 LED 1 2

D42 1N4148

Accessory_Relay

Q11

Accessory—Relay—Drive—IN

R77 1k

G D S

R76 100k

VNN7NV0413TR

Output—Ground

12v-sw2 · R47 2.4k · D18 LED · D24 1N4148 · Injector1_Output
Injector1 · R41 1k · Q1 VND14NV04
R35 100k

12v-sw2 · R48 2.4k · D19 LED · D25 1N4148 · Injector2_Output
Injector2 · R42 1k · Q2 VND14NV04
R36 100k

12v-sw2 · R49 2.4k · D20 LED · D26 1N4148 · Injector3_Output
Injector3 · R43 1k · Q3 VND14NV04
R37 100k

12v-sw2 · R50 2.4k · D21 LED · D27 1N4148 · Injector4_Output
Injector4 · R44 1k · Q4 VND14NV04
R38 100k

12v-sw2 · R51 2.4k · D22 LED · D28 1N4148 · Injector5_Output
Injector5 · R45 1k · Q5 VND14NV04
R39 100k

12v-sw2 · R52 2.4k · D23 LED · D29 1N4148 · Injector6_Output
Injector6 · R46 1k · Q6 VND14NV04
R40 100k

Injector-Ground

12v-sw2 · R66 2.4k · D35 LED · D37 1N4148 · Injector7_Output
Injector7 · R70 1k · Q7 VND14NV04
R68 100k

12v-sw2 · R67 2.4k · D36 LED · D38 1N4148 · Injector8_Output
Injector8 · R71 1k · Q8 VND14NV04
R69 100k

LM2937EM-5.0

D43
1N5818-TP

Vin | 1 | 3 | Vo

+ C12
10uF

C14
0.1uF

GND | 2 | U2
Ground

C16
0.1uF

+ C18
47uF

D2
1N5919BG

5.6v/3w

▷ 5vdc-analog

12v-switch ▷

ERZ-V14D220
MOV1

LM2937EM-5.0

D44
1N5818-TP

Vin | 1 | 3 | Vo

+ C13
10uF

C15
0.1uF

GND | 2 | U3
Ground

C17
0.1uF

+ C19
47uF

D3
1N5919BG

5.6v/3w

▷ 5vdc-cpu

C14, C15, C16 and C17 are 50v X7R Ceramic capacitors.

C12 and C13 are 35v Tantalum capacitors.
C18 and C19 are 10v Tantalum capacitors.