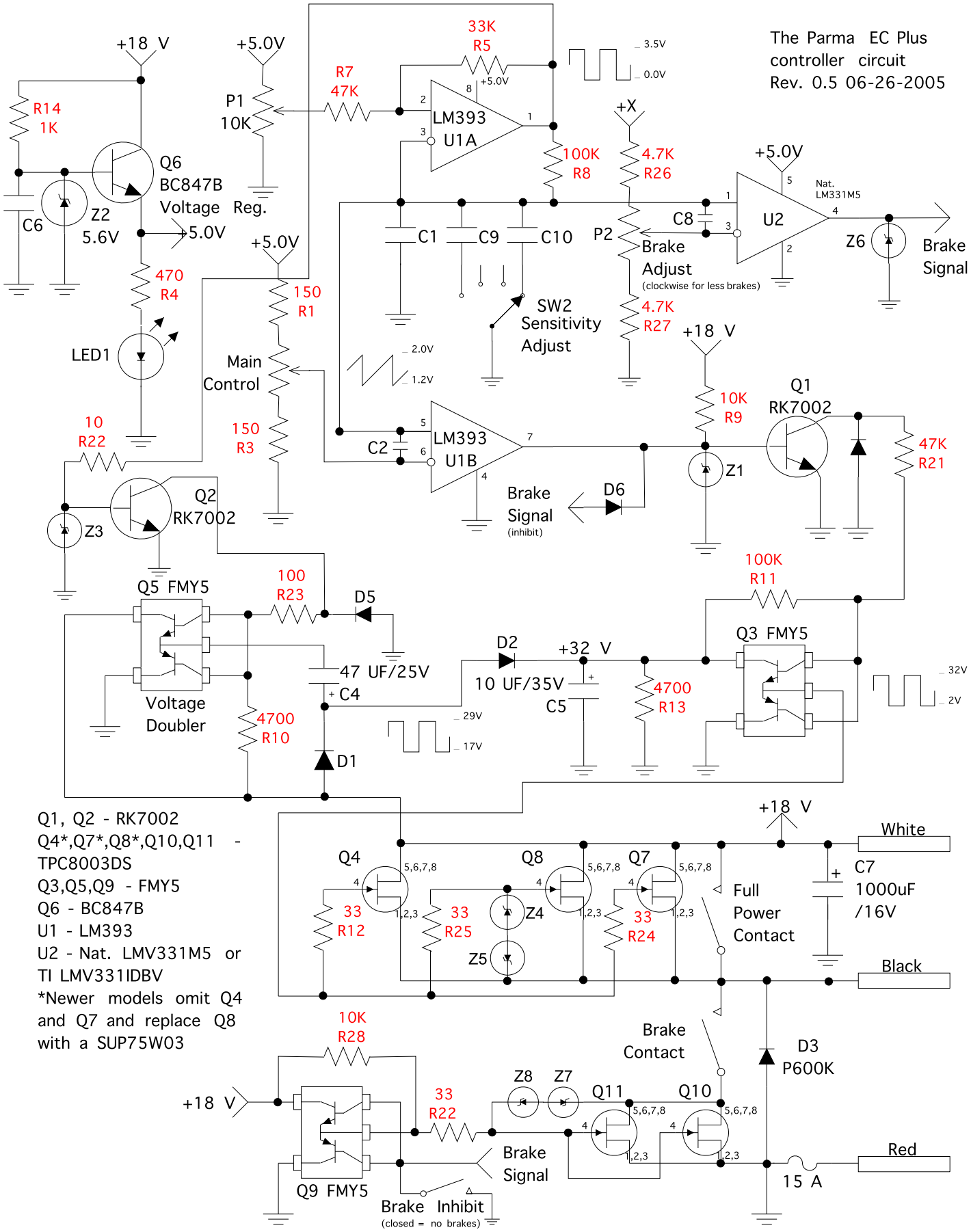
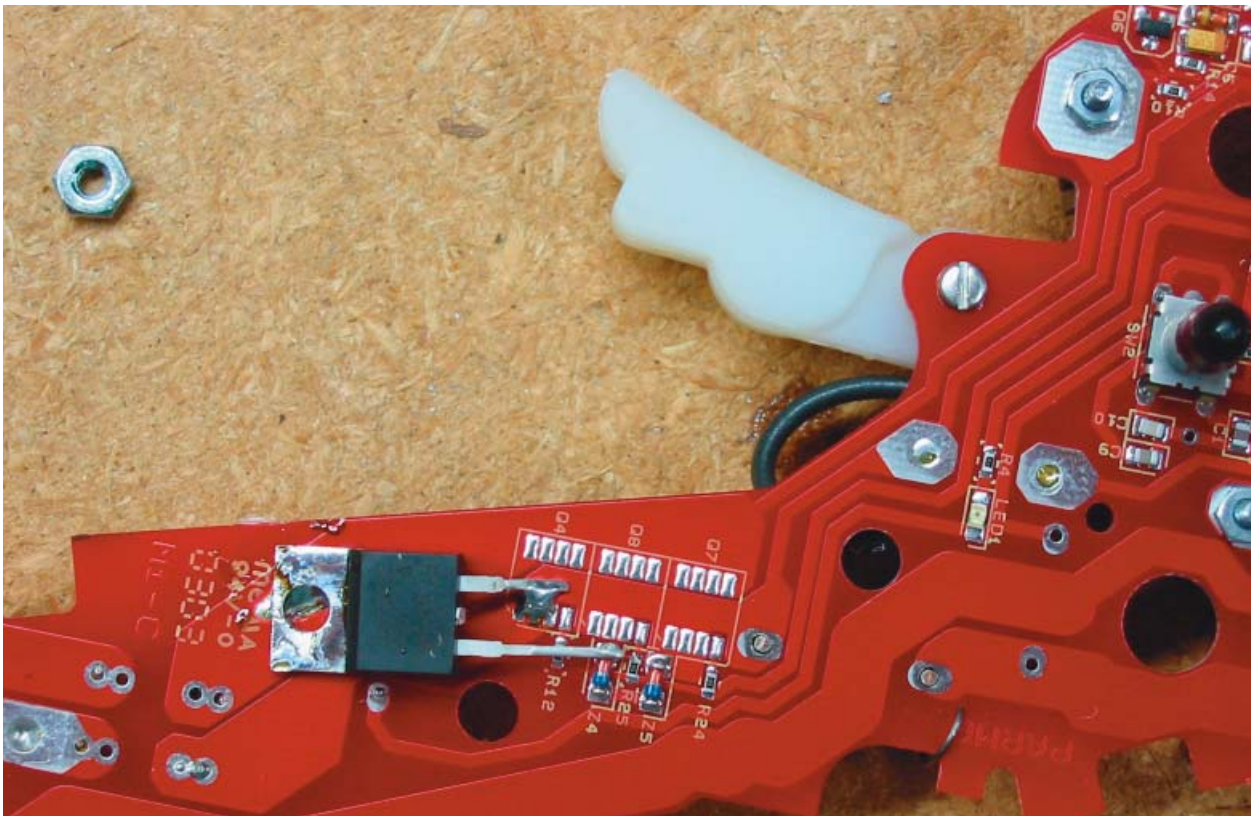

The Parma EC Plus controller circuit
Rev. 0.5 06-26-2005
+18 V
+5.0V
33K
R5
R7
47K
P1
10K
R14
1K
Q6
BC847B
Voltage Reg.
C6
Z2
5.6V
+5.0V
LM393
U1A
100K
R8
+X
4.7K
R26
+5.0V
Nat.
LM331M5
U2
C8
C1
C9
C10
P2
Brake
Adjust
(clockwise for less brakes)
Z6
Brake
Signal
470
R4
150
R1
SW2
Sensitivity
Adjust
4.7K
R27
LED1
Main
Control
+18 V
10K
R9
Q1
RK7002
10
R22
150
R3
C2
LM393
U1B
Z1
47K
R21
Brake
Signal
(inhibit)
D6
Q2
RK7002
Z3
Q5 FMY5
100
R23
D5
100K
R11
Q3 FMY5
D2
+32 V
47 UF/25V
C4
10 UF/35V
C5
4700
R13
Voltage
Doubler
4700
R10
D1
Q1, Q2 - RK7002
Q4*,Q7*,Q8*,Q10,Q11 - TPC8003DS
Q3,Q5,Q9 - FMY5
Q6 - BC847B
U1 - LM393
U2 - Nat. LMV331M5 or TI LMV331IDBV
*Newer models omit Q4 and Q7 and replace Q8 with a SUP75W03
+18 V
White
Q4
Q8
Q7
33
R12
33
R25
Z4
Z5
33
R24
Full
Power
Contact
C7
1000uF
/16V
Black
10K
R28
Brake
Contact
D3
P600K
+18 V
33
R22
Z8
Z7
Q11
Q10
Brake
Signal
Q9 FMY5
Brake Inhibit
(closed = no brakes)
Red
15 A

The Parma EC Plus controller circuit:

Notes:
1) It uses three tiny power FETs for switching the "on" power. The claim to fame of these devices is that they have the lowest on resistance of any off-the-shelf semiconductor. They go down to 7 milliOhms each. And three are used in parallel. Each of these three ultra-tiny FETs is rated at 13 amps! This controller could theoretically drive 39 amps! ...without the need for any heat sink!

1a) Newer versions of the Parma electronic controller use a different power transistor. Instead of three TPC8003DS power FETs in parallel, the newer version uses a single SUP75N03 which is rated at 75 amps. If you have the older configuration, upgrading is really pretty easy for someone with mid-level soldering skills. You can see the new device installed here:



You can see where three surface mount FETs (Q4, Q8 and Q7) used to populate the board. Now a single SUP75N03 resides there.

The drain is connected to the tab so soldering the tab to the positive voltage (white wire) makes one connection. The gate is soldered to the diode (Z4) and the source is soldered to the output (black wire).

You can get the part for $3.60 and upgrade your old Parma controller. See it here:
http://www.mouser.com/index.cfm?handler=displayproduct&lstdispproductid=307487&e_categoryid=277&e_pcodeid=78101

2) The full power stop shorts the white and black wires for full voltage with no diode or transistor voltage drops.

3) It uses two of the TPC8003DS type FETs for braking. Braking is only enabled when the control is in the full off position (and brake switch has to be turned on). The amount of braking (duty cycle 0% to 100%) is controlled by a tiny potentiometer on the controller. An adjustment tool is provided with the controller.

4) The controller employs a voltage doubler circuit to obtain the necessary VGS voltage (about 4 volts) for completely switching on the driving FETs.

5) The sensitivity adjustment is a three position switch which switches capacitors for controlling the time constant of the ramp generating circuit used to ultimately create PWM square waves. Each position changes the slope and frequency of the ramp voltage. Personally, I don't see how this would change anything except the frequency of the output PWM square waves. I suspect that the duty cycle will not be changed. This adjustment has dubious value in my opinion.

6) There appears to be two minor but definite screw ups. Two capacitors on the circuit board are rated at 16 volts. This is a problem given that HO slot cars commonly employ 18 volts. Except for this (and the questionable #5 item); the Parma controller design cuts no corners. Overall, they did an awesome job. Perhaps these controllers were really designed for 12 volt slot cars.

Anyway, the two problematic capacitors are
C7 1000 uF/16V
C6 1 uF/16V

You can replace C7 with a 470 uF/35 V capacitor found at Radio Shack.
C6 is a very small tantalum surface mount capacitor that I believe is 1 uF. A 35 volt replacement, AVX TAJB105M035R, can be found here:
http://www.mouser.com/Search/ProductDetail.aspx?qs=XbmmIB%252bc7ehn9yf726s%2fuw%3d%3d
(updated 01-14-2008 GTW).

By the way, if you look in the upper right corner of the picture, you will see a butterscotch-colored rectangular-shaped capacitor. That is the C6 which often fails.

7) Not all components could be determined. Some of these tiny surface mount devices bear few identifying numbers. I tried my best. Perhaps you can help identify more.

8) The +18 Volt signal is based on the assumption that the controller is operating on 18 volts. Your usage may be different.

9) Many parts are available from Mouser Electronics:
http://www.mouser.com
I found the comparator at DigiKey:
http://www.digikey.com/

U1 is an LM393:
http://www.national.com/ds.cgi/LM/LM193.pdf
U2 is a National LMV331:
http://www.national.com/ds.cgi/LM/LMV331.pdf
or a TI LMV331IDBV:
http://focus.ti.com/docs/prod/folders/print/lmv331.html
Q1, Q2 - RK7002:
http://www.rohm.co.uk/downloads/Standard%20Transistors.pdf
Q4,Q7,Q8,Q10,Q11 are TPC8003 devices:
http://www.semicon.toshiba.co.jp/td/en/Transistors/Power_MOSFETs/en_20030307_TPC8003_datasheet.pdf
Q3, Q5 and Q9 FMY5 transistor arrays:
http://www.rohm.com/products/databook/tr/pdf/fmy5.pdf
Q6 - BC847B:
http://www.rohm.com/products/databook/tr/pdf/bc847b.pdf