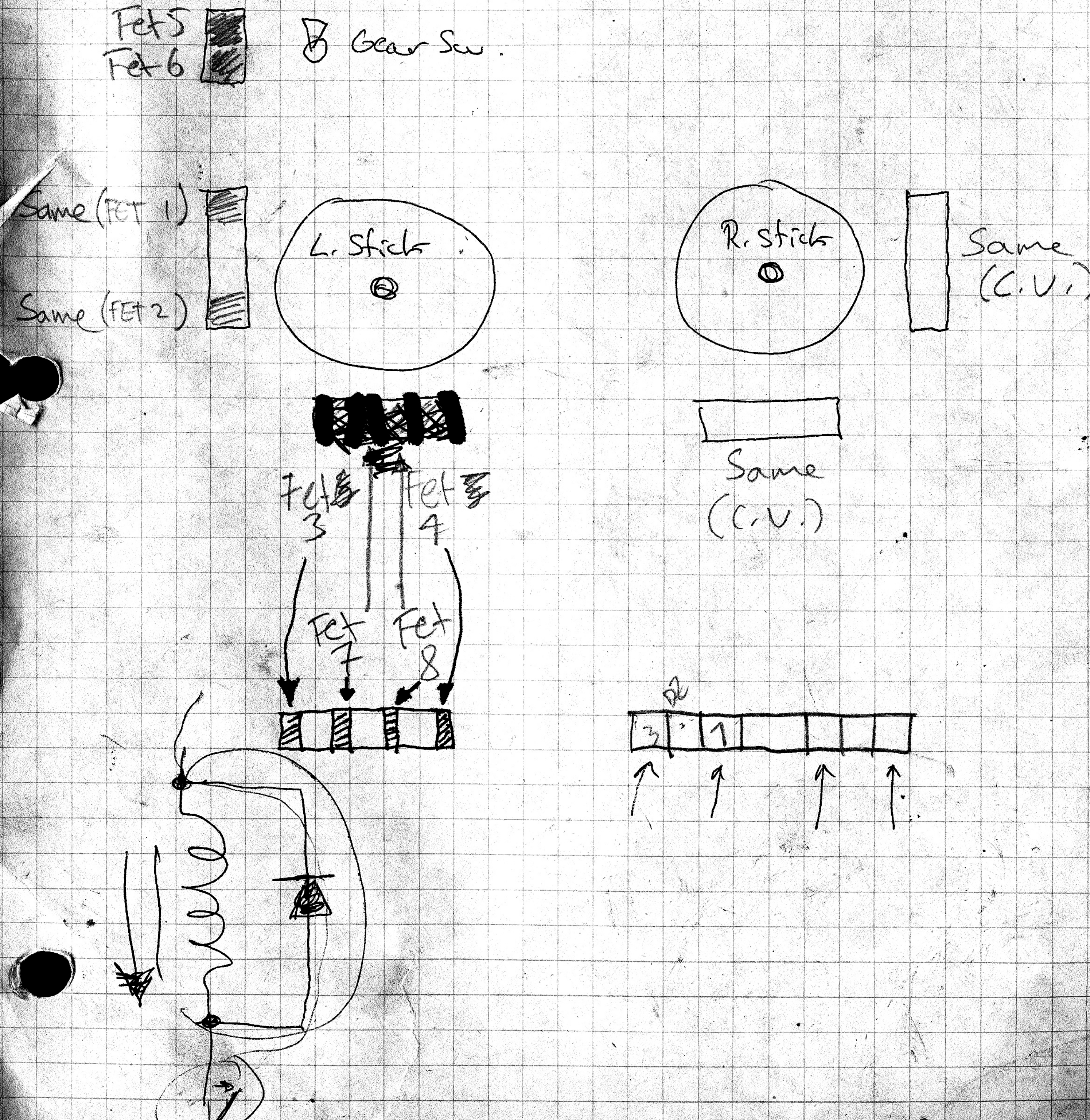
Amsterdam Machines

Bombloader 2
Ignitor (V1) 11
Inchworm 24
Little Arm 29
Running Machine 32
Screw Machine 41
V1 48

Bomb Loader
Channel Assignments



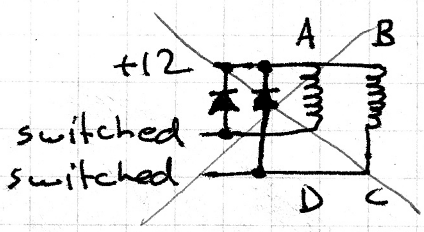
Bomb Loader Update
March 1997
Ralf B.

- ~~relays now use 12V coils, so that one bank of FETs can be used for both relays and pegasus values~~ see below
- 2nd 10 pin mil connector for new prop control lines
- remote start and stop disabled to free up channels for prop

10 pin connector pin:	Description:	box wire:	external wire:
A	+ 12 V. In	red/wh	
B	+ 12 V out	purple	purple
C	FET 3	lt.blue/wh	lt.grey/wh
D	4	violet/wh	dk.grey/wh
E	5	green/wh	green/wh
F	6	black/wh	black/wh
G	N/C		
H	N/C		
J	FET 7	blue/wh	blue/wh
K	8	orange/wh	red/wh

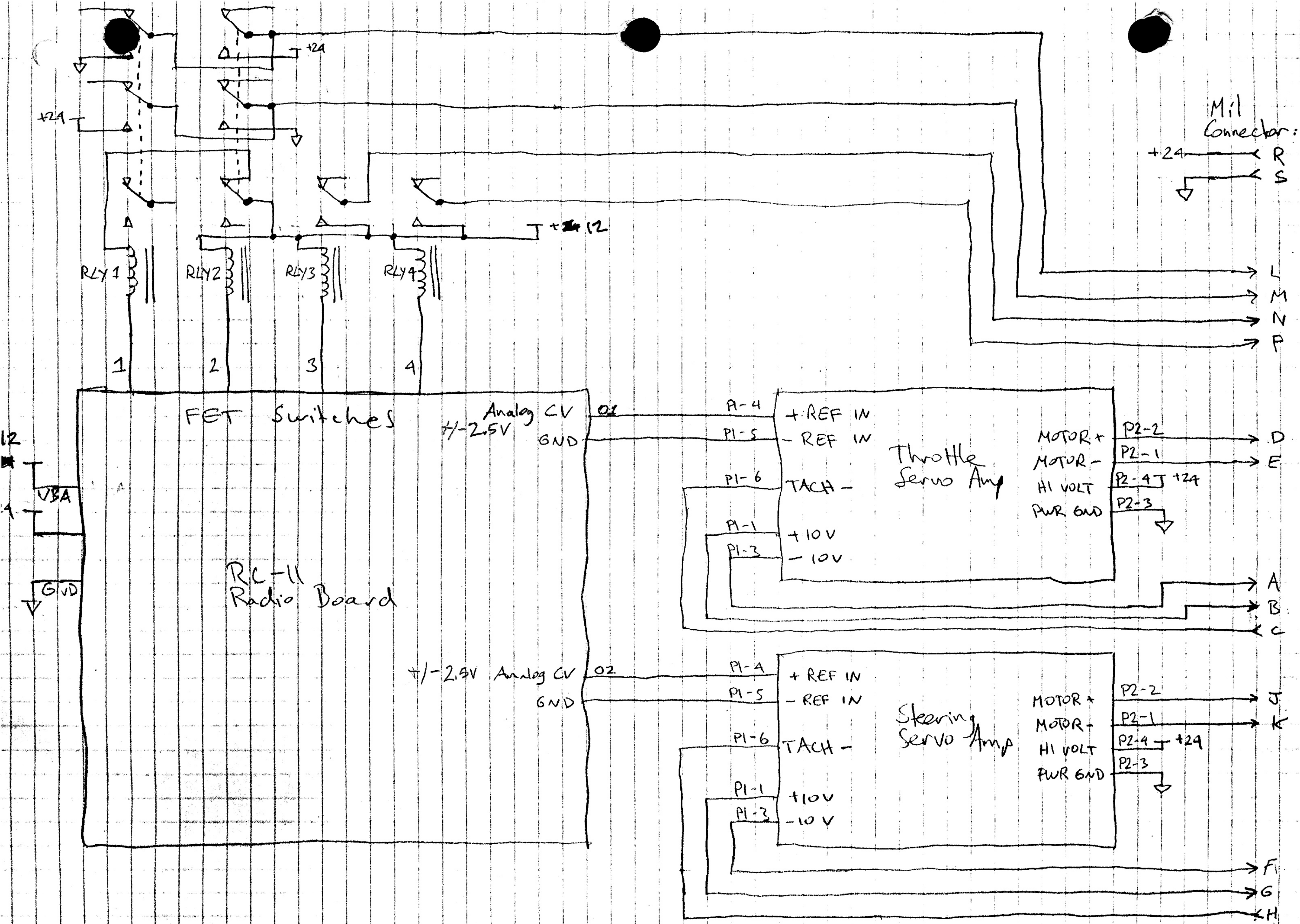
Pegasus value connectors:

A - Black
B - Blue
C - Green
D - Brown



not correct

Sept. '97: FETs 1 and 2 now drive high-current relays with 24V coils. The clamping diodes on the Fogarty board have been removed to drive both 12 and 24 VDC loads from the FET banks.



Bomb Loader Cart Controller, Nov. '95

Bomb Loader Cart Controller
November 1995

This controller is like the one developed for the car hunt. One of Mike Fogarty's radio boards controls two high-current servo amplifiers, giving two proportional, closed-loop channels. Three additional channels are used to switch relays.

Mil connector pinouts:

A: Throttle, +10V ref	**E**: Throttle, -Motor	**J**: Steer, + Motor	**N**: Relay 3
B: ", -10V ref	**F**: Steer, +10V ref	**K**: ", -Motor	**P**: Relay 4
C: ", pot wiper	**G**: ", -10V ref	**L**: Arm Lift	**R**: +24 VDC
D: ", + Motor	**H**: ", pot wiper	**M**: Arm Lift	**S**: Ground

Servomotor mil connector pinouts:

A: motor
B: motor
C: +10V ref
D: pot wiper
E: -10V ref

Servo amplifier switch settings:

1: off	2: off	3: on	4: on	5: off
6: on	7: off	8: on	9: off	10: off

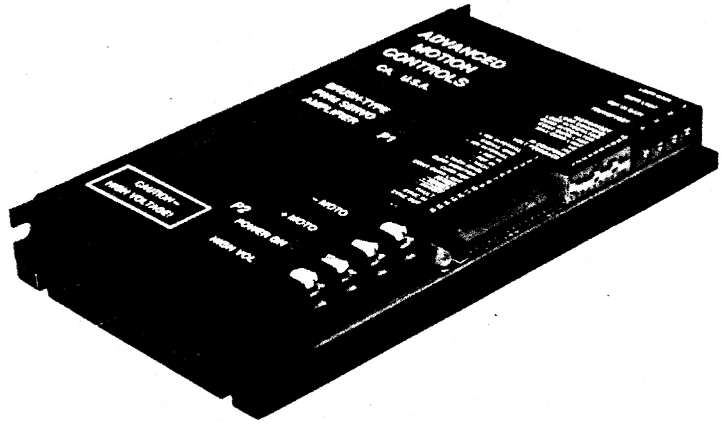
Joystick assignments:

Right stick, L-R: Steer L-R (proportional)
Right stick, U-D: Drive Fwd-Back (proportional)
Left stick, L-R: ~~Full right turns on relay 4~~ ~~= start engine~~ big hand hydro cylinders
Left stick, U-D: Full travel up raises arm, down lowers. (Uses relays 1 and 2 to apply opposite polarity to actuator)
Gear switch: ~~Turns on relay 3~~ = ~~kill engine. Up is engine~~ on.

big hand ~~L-R~~ ~~cylinder~~
gate open-close

* ~~On-off switch on dash will override this~~
~~i.e. if the dashboard switch is ON you~~
~~can't stop the engine remotely.~~

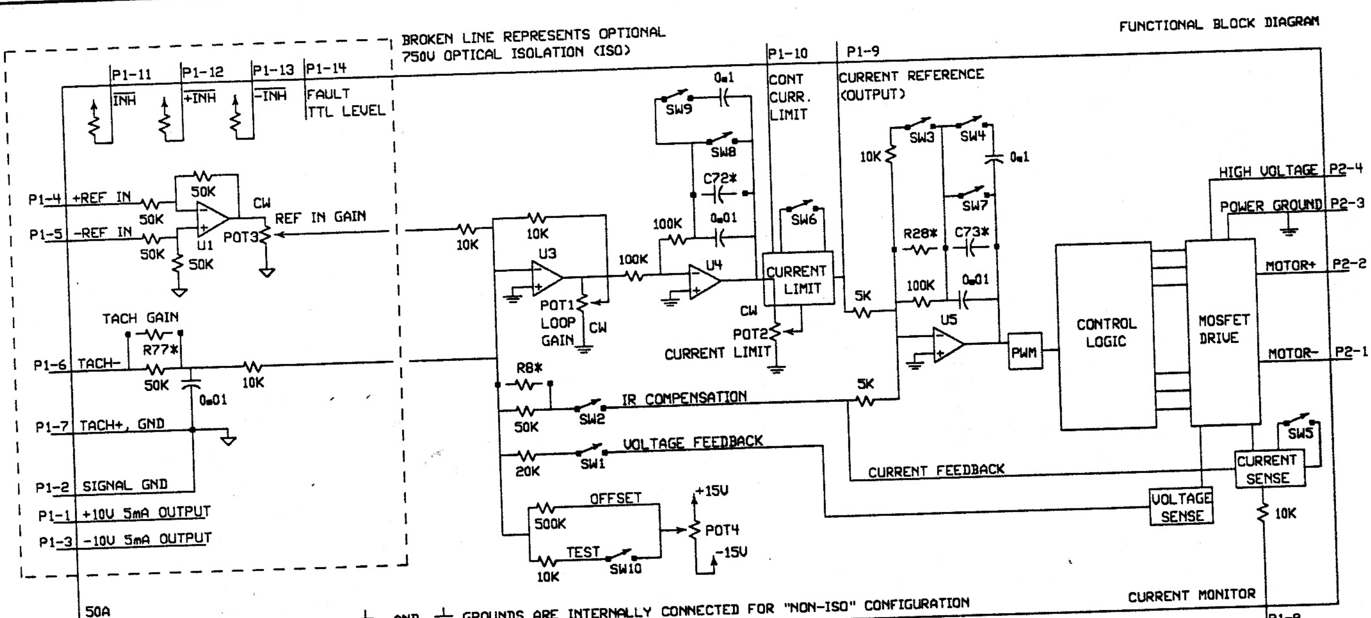
SERIES 50A PWM SERVO AMPLIFIERS
Models: 30A8, 25A20, 50A8, 50A20



FEATURES:

* Surface-mount technology
* Small size, low cost, ease of use
* Optional input signal isolation for off-the-rectified 120 VAC line operation
* DIP switch selectable: current, voltage, velocity, IR compensation, position loop control
  Four quadrant regenerative operation

DESCRIPTION: 50A Series PWM servo amplifiers are designed to drive brush type DC motors. Single red/green LED indicates operating status. All models are fully protected against over-voltage, over-current, over-heating and short-circuits across motor, ground and power leads. All models interface with digital controllers or can be used as a stand-alone drive. They require only a single unregulated DC power supply. Loop gain, current limit, input gain and offset can be adjusted using 15-turn potentiometers. The offset adjusting potentiometer can also be used as an on-board input signal for testing purposes when SW10 (DIP switch) is "On".



MODE SELECTION TABLE

	SW1	SW2	SW3	SW4	SW5	SW6	SW7	SW8	SW9	SW10
CURRENT MODE	OFF	OFF	ON	OFF	X	X	OFF	ON	OFF	X
VOLTAGE MODE	ON	OFF	ON	OFF	X	X	OFF	OFF	OFF	X
IR COMPENSATION	ON	ON	ON	OFF	X	X	OFF	OFF	OFF	X
TACHOMETER MODE	OFF	OFF	ON	OFF	X	X	OFF	OFF	OFF	X

X - DON'T CARE
SW7 SHOULD BE OFF FOR MOST APPLICATIONS
* OPTIONAL USER INSTALLED THROUGH HOLE COMPONENT

LED GREEN - NORMAL OPERATION, LED RED - FAULT
RECOMMENDED SETTING FOR CURRENT MODE - POT1 FULLY CCW, POT3 FULLY CW

SW3 - REDUCES CURRENT LOOP GAIN, WHEN ON
SW4 - INCREASES THE VALUE OF CURRENT INTEGRATOR CAPACITOR, WHEN ON
SW5 - REDUCES BOTH PEAK AND CONTINUOUS CURRENT LIMIT BY 50%, WHEN OFF
SW6 - REDUCES CONTINUOUS CURRENT LIMIT BY 50%, WHEN ON
SW9 - INCREASES THE VALUE OF THE INTEGRATOR CAPACITOR, WHEN ON
SW10 - FUNCTION OF POT4 - TEST INPUT, WHEN ON, OFFSET ADJUSTMENT, WHEN OFF

ADVANCED MOTION CONTROLS
3211 Corte Malpaso Unit 407, Camarillo, CA 93012 Tel: (805) 389-1935, Fax: (805) 389-1165

POWER STAGE SPECIFICATIONS	MODELS			
	30A8	25A20	50A8	50A20
DC SUPPLY VOLTAGE	20-80V	30-200V	20-80V	30-20[illegible]
PEAK CURRENT (2 sec. max., internally limited)	±30A	±25A	±50A	±50
MAX. CONT. CURRENT (internally limited)	±15A	±12.5A	±25A	±25A
MINIMUM LOAD INDUCTANCE*	200uH	250uH	200uH	250uH
SWITCHING FREQUENCY	33kHZ			
HEATSINK (BASE) TEMPERATURE RANGE	-25° to +65°C, shuts off if above +65°C			
POWER DISSIPATION AT CONT. CURRENT	30W	55W	50W	100W
OVER-VOLTAGE SHUT-DOWN (self reset)	86V	200V	86V	200V
BANDWIDTH	2.5kHz			

OUTPUT SPECIFICATIONS		
LOW VOLTAGE POWER SUPPLIES: (for customer use) +10V P1- 1 -10V P1- 3	5mA, short circuit protected	
CURRENT MONITOR: P1- 8	1V=4A, when SW5=On; 1V=2A, when SW5=Off	1V=8A, when SW5=On; 1V=4A, when SW5=Off
CURRENT REFERENCE: P1- 9	7.5V = maximum peak current	
FAULT:P1-14	TTL	

INPUT SPECIFICATIONS		
-$\overline{\text{INHIBIT}}$: +$\overline{\text{INHIBIT}}$: $\overline{\text{INHIBIT}}$:	P1-13 P1-12 P1-11	TTL, internal pull-up resistor, pull to ground to inhibit amplifier
TACHOMETER:	P1-6	Maximum ±60V analog, 60K input resistance
INPUT:	P1-4,5	Differential analog input, max. ±15V, 50K input resistance

MECHANICAL SPECIFICATIONS	
POWER CONNECTOR	Screw terminals
SIGNAL CONNECTOR	Molex connector
SIZE (inches)	4.23 x 7.35 x 1.00
WEIGHT	1.5 lb.

* "Pancake" and "basket-wound" motors require external inductors

PIN FUNCTIONS

CONNECTOR	PIN	NAME	DESCRIPTION / NOTES	I/O
P1	1	+10V INTERNAL	Provides regulated voltages of +/-10V @ 5mA for customer use. Short circuit protected	O
	2	SIGNAL GND		
	3	-10V INTERNAL		
	4	+REF IN	Differential pre-amp	I
	5	-REF IN		
	6	-TACH	Tachometer	I
	7	+TACH (GND)		
	8	CURRENT MONITOR	This signal is proportional to the actual current in the motor leads. Scaling is 4A/V (2A/V when SW5=Off) for 30A8 and 25A20; and 8A/V (4A/V when SW5=Off) for 50A8 and 50A20	O
	9	CURRENT REF	Command signal to the internal current-loop. The maximum peak current rating of the amplifier always equals 7.5V at this pin (see section "D")	O
	10	CONTINUOUS CURRENT LIMIT	Can be used to reduce the factory-preset maximum continuous current limit (see section "D")	I
	11	$\overline{\text{INHIBIT}}$	Inhibit. It turns off all mosfets of the "H" bridge drive when pulled to ground	I
	12	+$\overline{\text{INHIBIT}}$	Inhibits the motor for "+" direction only. This function can be useful to drive the motor off from a "limit switch"	I
	13	-$\overline{\text{INHIBIT}}$	Inhibits the motor for "-" direction only. This function can be useful to drive the motor off from a "limit switch"	I
	14	FAULT (red LED)	TTL compatible output. It becomes high if output short-circuit, over-voltage, over-heating, inhibit, and during "power-on reset". Fault condition indicated by red LED	O
	15	SYNCH IN	Used for synchronizing the switching frequency of several amplifier modules. Consult factory for this option. Not applicable for "ISO" option. In the "ISO" option pin 16 is connected to power ground and can be used as ground with P1- 8,9	N/A
	16	SYNCH OUT		

SWITCH FUNCTIONS

SWITCH	FUNCTION DESCRIPTION	SETTING	
		ON	OFF
1	Internal voltage feedback	On	Off
2	Internal current feedback for IR compensation	On	Off
3	Current loop gain	Decrease	Increase
4	Current loop integration	Increase	Decrease
5	Current scaling (when "Off", increases sensitivity of current sense thus reducing both peak and continuous current limit by 50% (see section "D")		Half-current
6	Can be used to reduce factory-preset maximum continuous current limit (see section "D")		
7	It is recommended to leave SW7 in "Off" position	Shorts out the current loop integrator capacitor	Off
8	This capacitor normally ensures "error-free" operation by reducing the error-signal (output of summing amplifier) to zero	Shorts out the outer velocity / voltage loop integrator capacitor	Off
9	Adjusts the value of the integrator capacitor. It is recommended to leave SW9 in "Off" position for most applications	Increase	Decrease
10	Offset / test. Sensitivity of the "offset" pot. Used as an on-board reference signal in test mode	Increase	Decrease

POTENTIOMETER FUNCTIONS

POTENTIOMETER	DESCRIPTION	TURNING CW
Pot 1	Loop gain adjustment in voltage & velocity modes. Voltage to current scaling factor adjustment in current mode	Increases loop gain
Pot 2	Current limit. It adjusts both continuous and peak current limit by maintaining their ratio	Increases current limit
Pot 3	Reference gain. It adjusts the ratio between input signal and output variables (voltage, current, velocity)	Increases reference input gain
Pot 4	Offset / test. Used to adjust any imbalance in the input signal or in the amplifier. When SW10 (DIP switch) is "On", the sensitivity of this pot is greatly increased thus it can be used as an on-board signal source for testing purposes	N/A

8. CAUTIONARY NOTES

DO NOT REVERSE THE POWER SUPPLY LEADS !!!!!

USE SUFFICIENT POWER SUPPLY CAPACITANCE !!!!

Insufficient power supply capacitance problem occurs particularly with high inductance motors. During braking much of the stored mechanical energy is fed back into the power supply and charges its output capacitor to a higher voltage. If the charge reaches the amplifier's over-voltage shutdown point, output current and braking will cease. At that time energy stored in the motor inductance continues to flow through diodes in the amplifier to further charge the power supply capacitor. The voltage rise depends upon the power supply capacitance, motor speed, and inductance.

A 2mH motor at 20 amperes can charge 2000uF up to 30V.

An appropriate capacitance is typically 2000uF/A maximum output current for a 50V supply.

DO NOT SPIN THE MOTOR WITHOUT POWER !!!!!

The motor acts as a generator and will charge up the power supply capacitors through the amplifier. Too high a speed may cause over-voltage breakdown in the power MOSfets. Note that an amplifier having an internal power converter that operates from the high voltage supply will become operative.

DO NOT SHORT THE MOTOR AT A HIGH SPEED !!!!!

When the motor is shorted, its own generated voltage may produce a current flow as high as 10 times the amplifier peak current. The short itself should not damage the amplifier but may damage the motor. If the connection arcs or opens while the motor is spinning rapidly, this high current flows back into the amplifier (due to stored energy in the motor inductance) and may damage the amplifier.

ELECTRICAL CHARACTERISTICS — continued (T_C = 25°C unless otherwise noted.)

Characteristic		Symbol	Min	Typ	Max	Unit
ON CHARACTERISTICS (1)						
DC Current Gain (I_C = 0.5 Adc, V_{CE} = 5 Vdc) (I_C = 4 Adc, V_{CE} = 5 Vdc)		h_{FE}	50 200	100 400	— —	—
Collector-Emitter Saturation Voltage (I_C = 4 Adc, I_B = 0.2 Adc) (I_C = 8 Adc, I_B = 0.4 Adc) (I_C = 4 Adc, I_B = 0.2 Adc, T_C = 100°C)		$V_{CE(sat)}$	 — — —	 — — —	 2 3 2.2	Vdc
Base-Emitter Saturation Voltage (I_C = 4 Adc, I_B = 0.2 Adc) (I_C = 8 Adc, I_B = 0.4 Adc) (I_C = 4 Adc, I_B = 0.2 Adc, T_C = 100°C)		$V_{BE(sat)}$	 — — —	 — — —	 2.5 3.5 2.4	Vdc
Diode Forward Voltage (2) (I_F = 5 Adc)		V_f	—	—	2.5	Vdc
SWITCHING CHARACTERISTICS						
Typical Resistive Load (Table 1)						
Delay Time	(V_{CC} = 250 Vdc, $I_{C(pk)}$ = 6 A I_{B1} = I_{B2} = 0.25 A, t_p = 25 μs, Duty Cycle ≤ 1%)	t_d	—	0.04	—	μs
Rise Time		t_r	—	0.5	—	μs
Storage Time		t_s	—	8	—	μs
Fall Time		t_f	—	2	—	μs
Inductive Load, Clamped (Table 1)						
Voltage Storage Time	($I_{C(pk)}$ = 6 A, $V_{CE(pk)}$ = 250 Vdc I_{B1} = 0.06 A, $V_{BE(off)}$ = 5 Vdc	t_{sv}	—	4	—	μs
Crossover Time		t_c	—	2	—	μs

(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle = 2%.
(2) The internal Collector-to-Emitter diode can eliminate the need for an external diode to clamp inductive loads. Tests have shown that the Forward Recovery Voltage (V_f) of this diode is comparable to that of typical fast recovery rectifiers.

TYPICAL CHARACTERISTICS

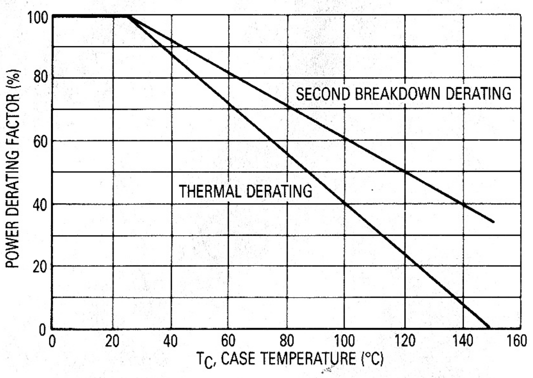


Figure 1. Power Derating

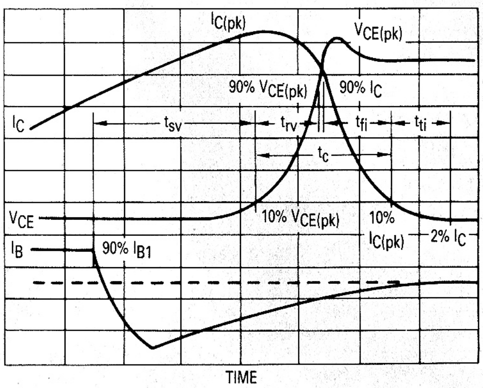


Figure 2. Inductive Switching Measurements

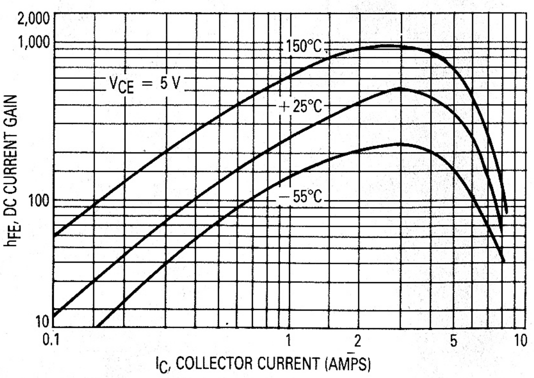


Figure 3. DC Current Gain

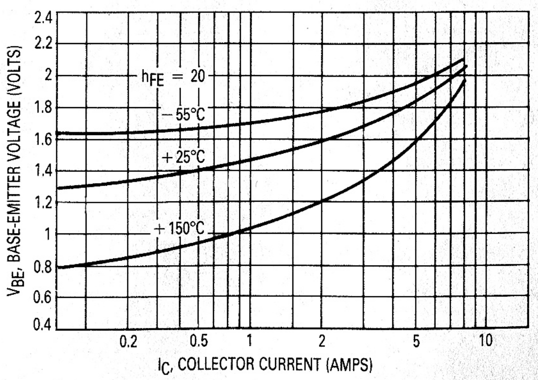
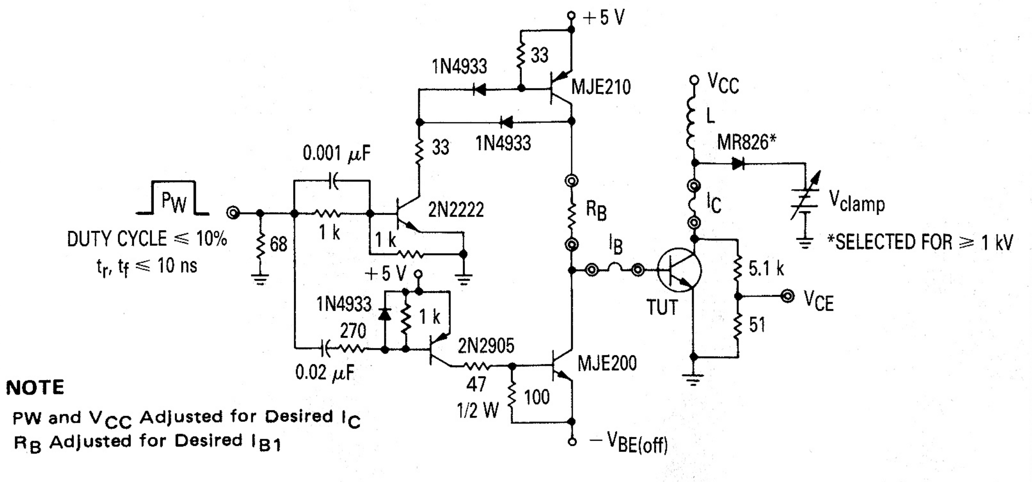


Figure 4. Base-Emitter Voltage

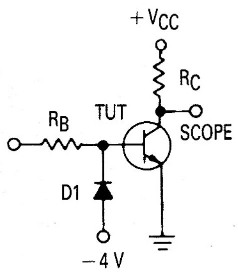
Table 1. Test Conditions for Dynamic Performance

	Reverse Bias Safe Operating Area and Inductive Switching	Resistive Switching

Test Circuits



NOTE
PW and V_{CC} Adjusted for Desired I_C
R_B Adjusted for Desired I_{B1}



Circuit Values

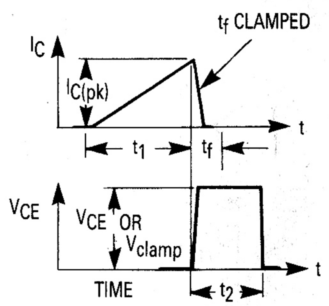
COIL DATA:
FERROXCUBE CORE #6656
FULL BOBBIN (~16 TURNS) #16

GAP FOR 200 μH/20 A
L_{coil} = 200 μH

V_{CC} = 30 V
$V_{CE(pk)}$ = 250 Vdc
$I_{C(pk)}$ = 6 A

Resistive Switching: V_{CC} = 250 V
D1 = 1N5820 OR EQUIV.

Test Waveforms



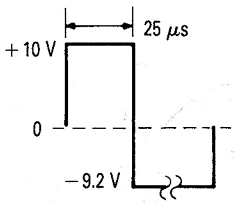
Output Waveforms

t_1 ADJUSTED TO OBTAIN I_C

$$t_1 \approx \frac{L_{coil}\,(I_{C_{pk}})}{V_{CC}}$$

$$t_2 \approx \frac{L_{coil}\,(I_{C_{pk}})}{V_{clamp}}$$

TEST EQUIPMENT
SCOPE — TEKTRONIX
475 OR EQUIVALENT



t_r, t_f < 10 ns
DUTY CYCLE = 1%
R_B AND R_C ADJUSTED FOR DESIRED I_B AND I_C

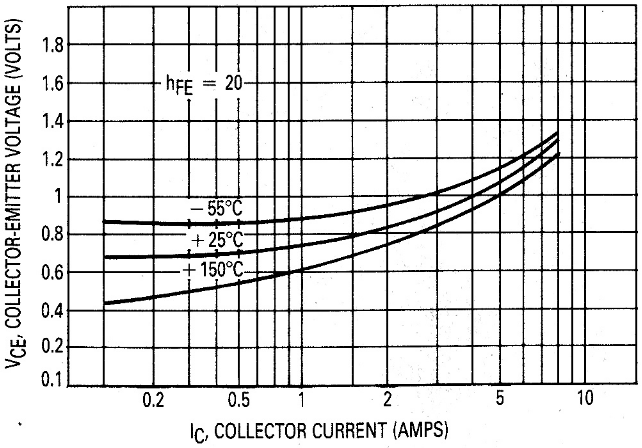
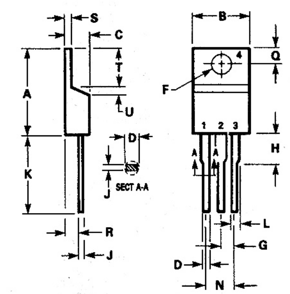


Figure 5. Collector Saturation Voltage

OUTLINE DIMENSIONS



DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	14.48	15.75	0.570	0.620
B	9.65	10.29	0.380	0.405
C	4.06	4.82	0.160	0.190
D	0.64	0.89	0.025	0.035
F	3.61	3.73	0.142	0.147
G	2.41	2.67	0.095	0.105
H	2.79	3.93	0.110	0.155
J	0.36	0.56	0.014	0.022
K	12.70	14.27	0.500	0.562
L	1.14	1.39	0.045	0.055
N	4.83	5.33	0.190	0.210
Q	2.54	3.04	0.100	0.120
R	2.04	2.79	0.080	0.110
S	1.14	1.39	0.045	0.055
T	5.97	6.48	0.235	0.255
U	0.00	1.27	0.000	0.050
V	1.14	—	0.045	—
Z	—	2.03	—	0.080

NOTES:
1. DIMENSION H APPLIES TO ALL LEADS.
2. DIMENSION L APPLIES TO LEADS 1 AND 3.
3. DIMENSION Z DEFINES A ZONE WHERE ALL BODY AND LEAD IRREGULARITIES ARE ALLOWED.
4. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
5. CONTROLLING DIMENSION: INCH.

STYLE 1:
PIN 1. BASE
2. COLLECTOR
3. EMITTER
4. COLLECTOR

CASE 221A-02
TO-220AB

SAFE OPERATING AREA INFORMATION

FORWARD BIAS

There are two limitations on the power handling ability of a transistor: average junction temperature and second breakdown. Safe operating area curves indicate $I_C - V_{CE}$ limits of the transistor that must be observed for reliable operation; i.e., the transistor must not be subjected to greater dissipation than the curves indicate.

The data of Figure 6 is based on $T_C = 25°C$; $T_{J(pk)}$ is variable depending on power level. Second breakdown pulse limits are valid for duty cycles to 10% but must be derated when $T_C \geqslant 25°C$. Second breakdown limitations do not derate the same as thermal limitations. Allowable current at the voltages shown on Figure 6 may be found at any case temperature by using the appropriate curve on Figure 1.

REVERSE BIAS

For inductive loads, high voltage and high current must be sustained simultaneously during turn-off, in most cases, with the base to emitter junction reverse biased. Under these conditions the collector voltage must be held to a safe level at or below a specific value of collector current. This can be accomplished by several means such as active clamping, RC snubbing, load line shaping, etc. The safe level for these devices is specified as Reverse Bias Safe Operating Area and represents the voltage-current condition allowable during reverse biased turn-off. This rating is verified under clamped conditions so that the device is never subjected to an avalanche mode. Figure 7 gives the complete RBSOA characteristics.

The Safe Operating Area figures shown in Figures 6 and 7 are specified ratings for these devices under the test conditions shown.

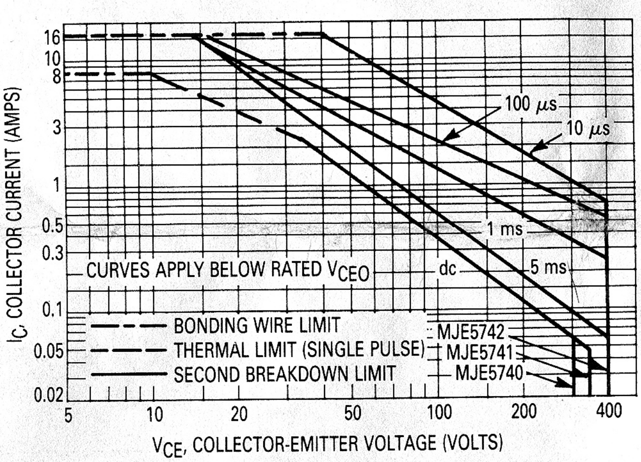


Figure 6. Forward Bias Safe Operating Area

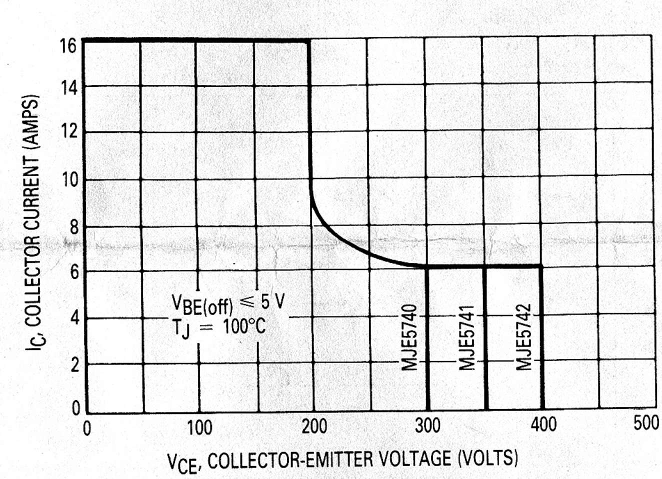


Figure 7. Reverse Bias Safe Operating Area

RESISTIVE SWITCHING PERFORMANCE

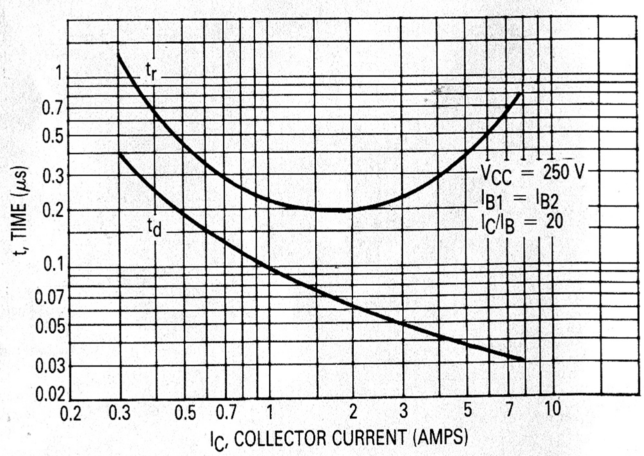


Figure 8. Turn-On Time

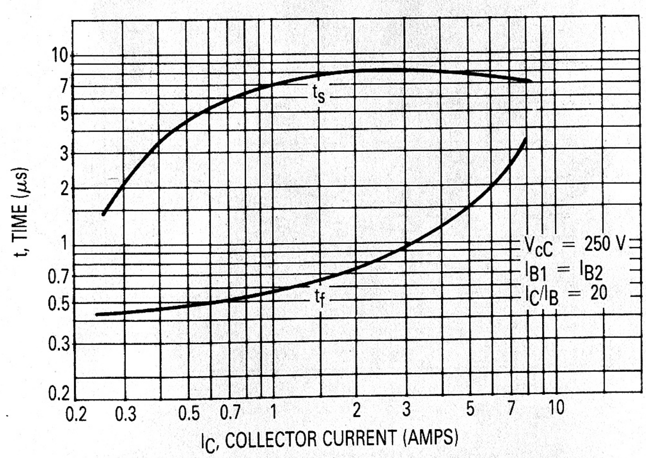


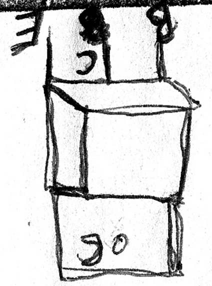
Figure 9. Turn-Off Time

Literature Distribution Centers:

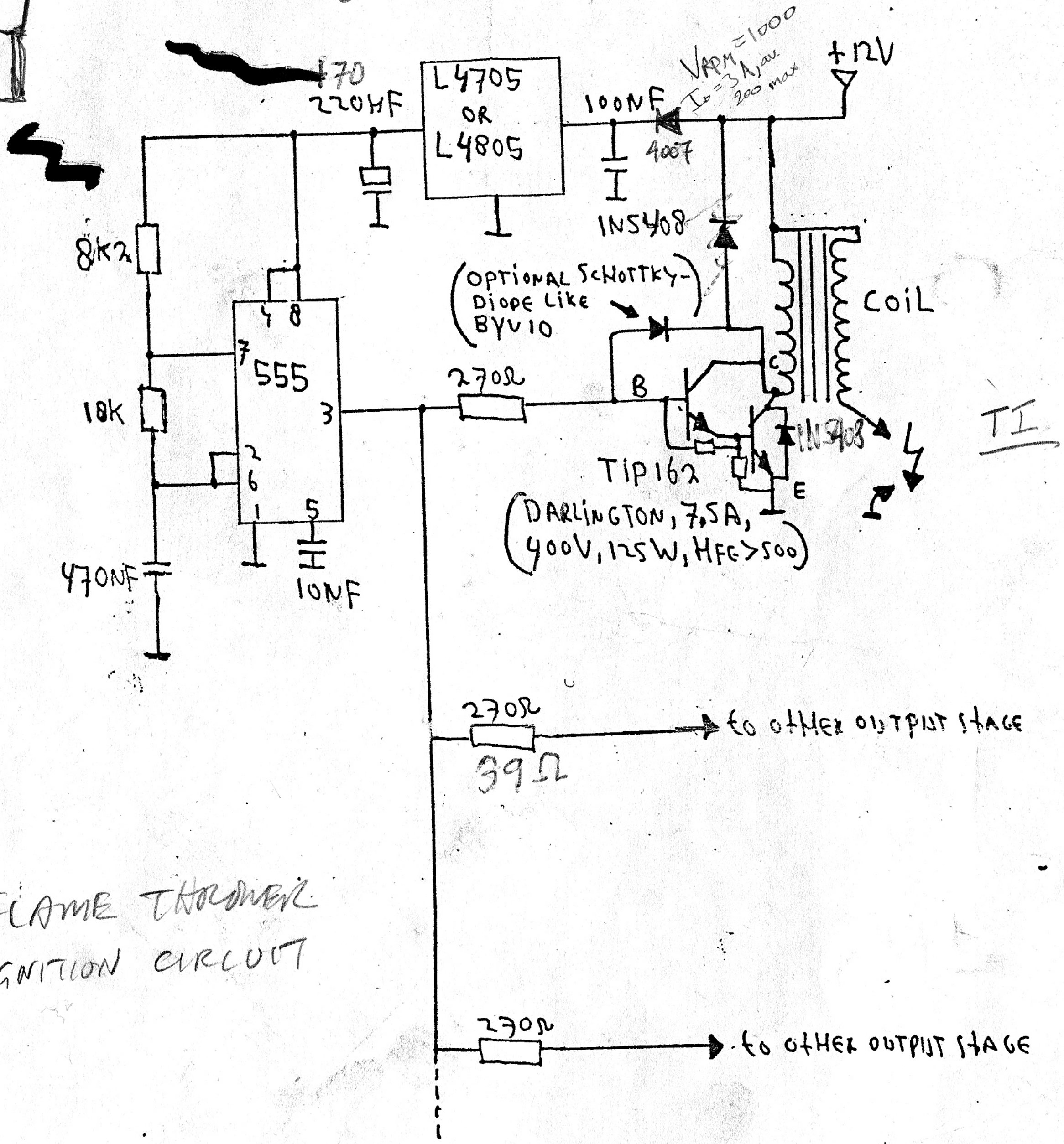
USA: Motorola Literature Distribution; P.O. Box 20912; Phoenix, Arizona 85036.
EUROPE: Motorola Ltd.; European Literature Center; 88 Tanners Drive, Blakelands Milton Keynes, MK145BP, England.
ASIA PACIFIC: Motorola Semiconductors H.K. Ltd.; P.O. Box 80300; Cheung Sha Wan Post Office; Kowloon Hong Kong.

MOTOROLA

12975-1 PRINTED IN USA 4-87 IMPERIAL LITHO C47578 15,000 DS-3378R1



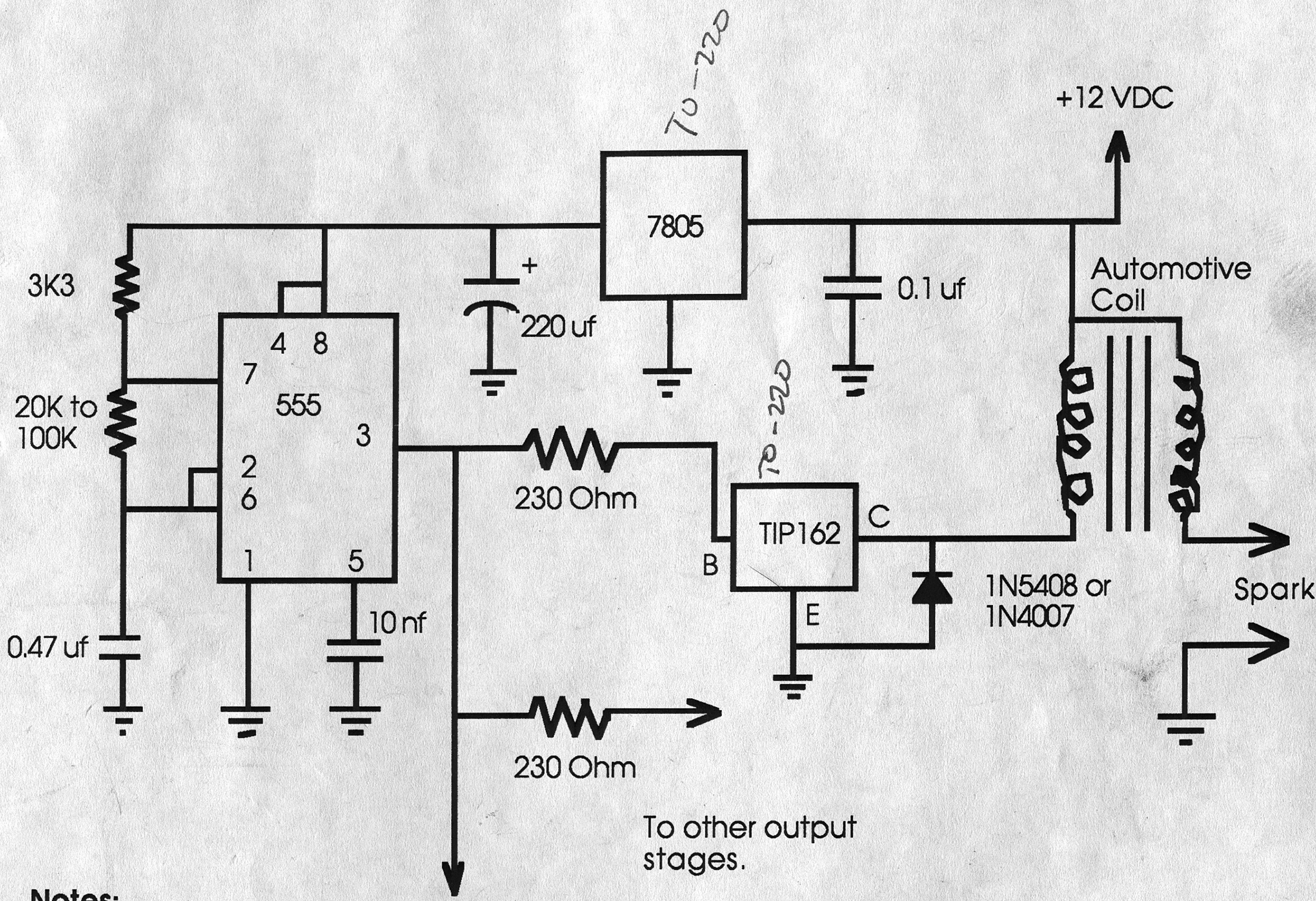
47K



FLAME THROWER
IGNITION CIRCUIT

Electronic Ignition Circuit
Survival Research Laboratories

Revision Feb. 1992 by Ralf



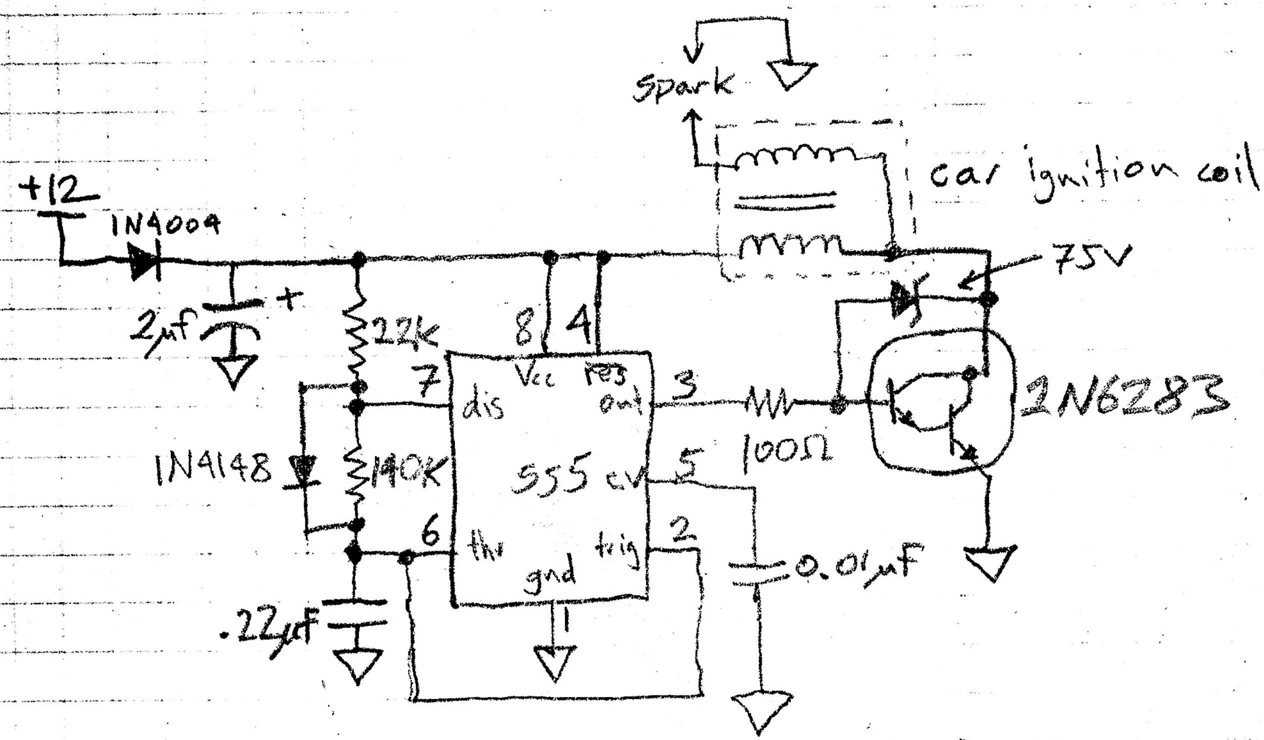
Notes:

1. The letter "u" in capacitor values denotes micro.
2. The TIP162 is a Darlington transistor package, and provides good results when driven by any 50% square wavefrom 14 to 150 Hz.

Apr. 92: 2 of these circuits now in V1, one of which drives 2 output stages.

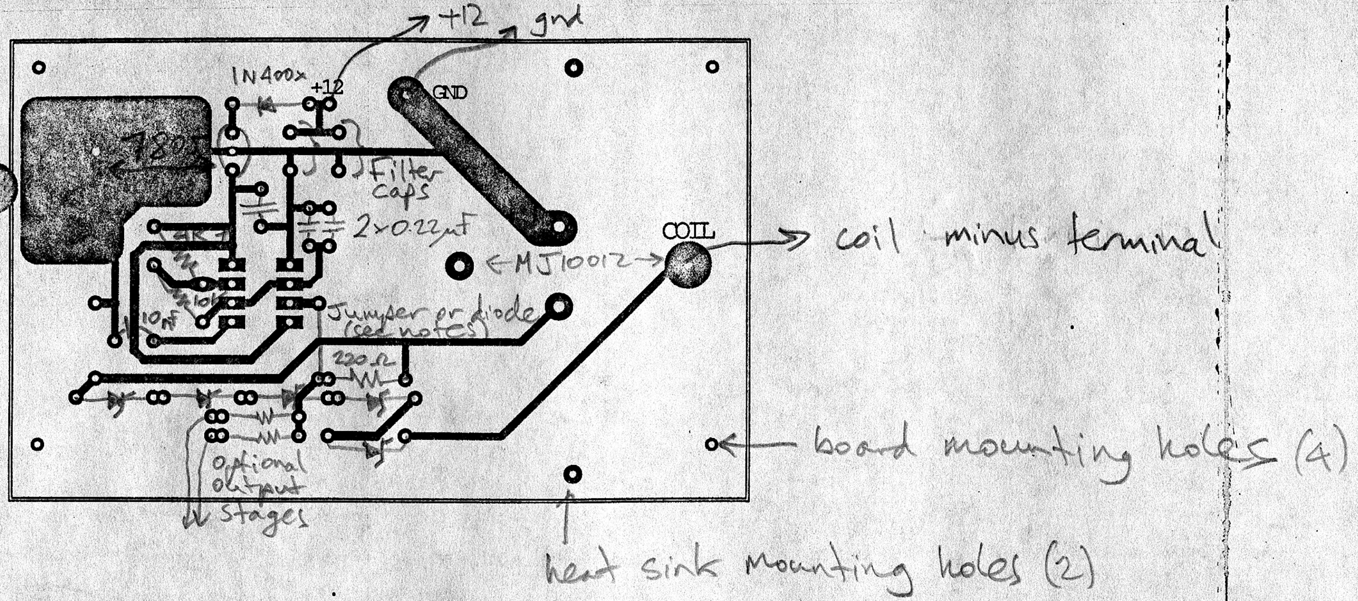
Apr. 94: Newer version of this circuit available under Ignitor section.

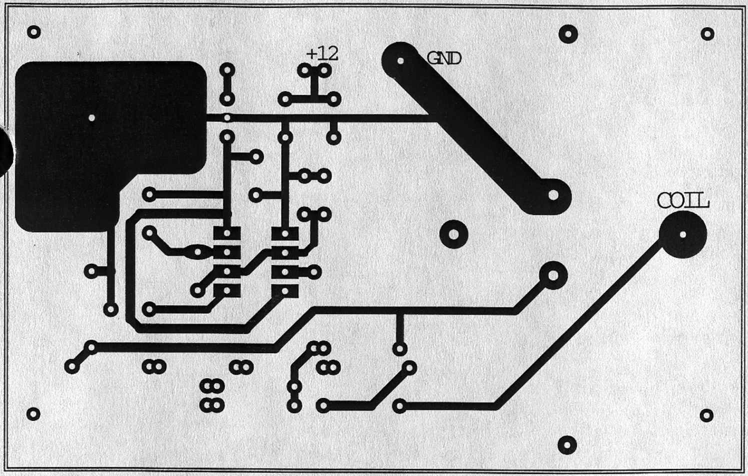
4 of these have been built to make use of some Darlington transistors we got free. The low breakdown voltage (75V) means they'll only make a quarter inch or so of spark. Note the diode to give a low (~20%) duty cycle, and a lower sparking frequency than the V1-type ignitor. The printed circuit board layout file is "Small TO-3 ignitor".



Ralf B.
March 1996

Parts Placement




+12
GND
COIL

MOTOROLA SEMICONDUCTORS

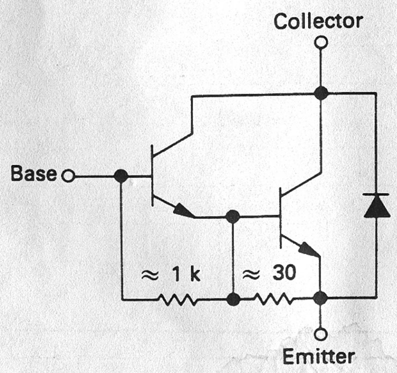
P.O. BOX 20912 • PHOENIX, ARIZONA 85036

MJ10012
MJH10012

NPN SILICON POWER DARLINGTON TRANSISTOR

The MJ10012 and MJH10012 are high-voltage, high-current darlington transistors designed for automotive ignition, switching regulator and motor control applications.

- Collector-Emitter Sustaining Voltage — $V_{CEO(sus)}$ = 400 Vdc (Min)
- 175 Watts Capability at 50 Volts
- Automotive Functional Tests

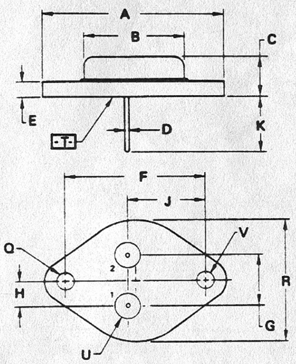


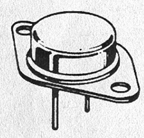
10 AMPERE

POWER TRANSISTORS
DARLINGTON NPN SILICON

400 VOLTS
175 AND 118 WATTS

MJ10012





STYLE 1
PIN 1. BASE
2. EMITTER
CASE COLLECTOR

NOTES:
1. DIMENSIONS Q AND V ARE DATUMS.
2. -T- IS SEATING PLANE AND DATUM.
3. POSITIONAL TOLERANCE FOR MOUNTING HOLE Q:

⌖	ϕ.13 (0.005) Ⓜ	T	V Ⓜ

FOR LEADS:

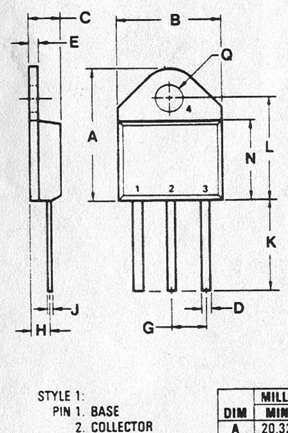
⌖	ϕ.13 (0.005) Ⓜ T	V Ⓜ	Q Ⓜ

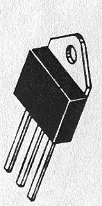
4. DIMENSIONS AND TOLERANCES PER ANSI Y14.5, 1973.

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	–	39.37	–	1.550
B	–	21.08	–	0.830
C	6.35	7.62	0.250	0.300
D	0.97	1.09	0.038	0.043
E	1.40	1.78	0.055	0.070
F	30.15 BSC		1.187 BSC	
G	10.92 BSC		0.430 BSC	
H	5.46 BSC		0.215 BSC	
J	16.89 BSC		0.665 BSC	
K	11.18	12.19	0.440	0.480
Q	3.81	4.19	0.151	0.165
R	–	26.67	–	1.050
U	4.83	5.33	0.190	0.210
V	3.81	4.19	0.151	0.165

CASE 1-05
TO-204AA
(Formerly TO-3)

MJH10012





STYLE 1:
PIN 1. BASE
2. COLLECTOR
3. EMITTER
4. COLLECTOR

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	20.32	21.08	0.800	0.830
B	15.49	15.90	0.610	0.626
C	4.19	5.08	0.165	0.200
D	1.02	1.65	0.040	0.065
E	1.35	1.65	0.053	0.065
G	5.21	5.72	0.205	0.225
H	2.41	3.20	0.095	0.126
J	0.38	0.64	0.015	0.025
K	12.70	15.49	0.500	0.610
L	15.88	16.51	0.625	0.650
N	12.19	12.70	0.480	0.500
Q	4.04	4.22	0.159	0.166

CASE 340-01
TO-218AC

MAXIMUM RATINGS

Rating	Symbol	MJ10012	MJH10012	Unit
Collector-Emitter Voltage	$V_{CEO(sus)}$	400		Vdc
Collector-Emitter Voltage (R_{BE} = 27 Ω)	V_{CER}	550		Vdc
Collector-Base Voltage	V_{CBO}	600		Vdc
Emitter-Base Voltage	V_{EBO}	8.0		Vdc
Collector Current — Continuous — Peak (1)	I_C	10 15		Adc
Base Current	I_B	2.0		Adc
Total Power Dissipation @ T_C = 25°C @ T_C = 100°C Derate above 25°C	P_D	 175 100 1.0	 118 47.5 1.05	 Watts Watts W/°C
Operating and Storage Junction Temperature Range	T_J, T_{stg}	−65 to +200	−55 to +150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max		Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	1.0	0.95	°C/W
Maximum Lead Temperature for Soldering Purposes: 1/8″ from Case for 5 Seconds	T_L	275		°C

(1) Pulse Test: Pulse Width = 5.0 ms, Duty Cycle ≤ 10%.

ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS (1)					
Collector-Emitter Sustaining Voltage (Figure 1) (I_C = 200 mAdc, I_B = 0, V_{clamp} = Rated V_{CEO})	$V_{CEO(sus)}$	400	–	–	Vdc
Collector-Emitter Sustaining Voltage (Figure 1) (I_C = 200 mAdc, R_{BE} = 27 Ohms, V_{clamp} = Rated V_{CER})	$V_{CER(sus)}$	425	–	–	Vdc
Collector Cutoff Current (Rated V_{CER}, R_{BE} = 27 Ohms)	I_{CER}	–	–	1.0	mAdc
Collector Cutoff Current (Rated V_{CBO}, I_E = 0)	I_{CBO}	–	–	1.0	mAdc
Emitter Cutoff Current (V_{EB} = 6.0 Vdc, I_C = 0)	I_{EBO}	–	–	40	mAdc
ON CHARACTERISTICS (1)					
DC Current Gain (I_C = 3.0 Adc, V_{CE} = 6.0 Vdc) (I_C = 6.0 Adc, V_{CE} = 6.0 Vdc) (I_C = 10 Adc, V_{CE} = 6.0 Vdc)	h_{FE}	 300 100 20	 550 350 150	 – 2000 –	–
Collector-Emitter Saturation Voltage (I_C = 3.0 Adc, I_B = 0.6 Adc) (I_C = 6.0 Adc, I_B = 0.6 Adc) (I_C = 10 Adc, I_B = 2.0 Adc)	$V_{CE(sat)}$	 – – –	 – – –	 1.5 2.0 2.5	Vdc
Base-Emitter Saturation Voltage (I_C = 6.0 Adc, I_B = 0.6 Adc) (I_C = 10 Adc, I_B = 2.0 Adc)	$V_{BE(sat)}$	 – –	 – –	 2.5 3.0	Vdc
Base-Emitter On Voltage (I_C = 10 Adc, V_{CE} = 6.0 Vdc)	$V_{BE(on)}$	–	–	2.8	Vdc
Diode Forward Voltage (I_F = 10 Adc)	V_f	–	2.0	3.5	Vdc
DYNAMIC CHARACTERISTICS					
Output Capacitance (V_{CB} = 10 Vdc, I_E = 0, f_{test} = 100 kHz)	C_{ob}	–	165	350	pF
SWITCHING CHARACTERISTICS					
Storage Time (V_{CC} = 12 Vdc, I_C = 6.0 Adc, I_{B1} = I_{B2} = 0.3 Adc) Figure 2	t_s	–	7.5	15	μs
Fall Time (V_{CC} = 12 Vdc, I_C = 6.0 Adc, I_{B1} = I_{B2} = 0.3 Adc) Figure 2	t_f	–	5.2	15	μs
FUNCTIONAL TESTS					
Second Breakdown Collector Current with Base-Forward Biased	$I_{S/B}$	See Figure 10			–
Pulsed Energy Test (See Figure 12)	$\frac{I_C^2 L}{2}$	–	–	180	mJ

(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle = 2%.

FIGURE 1 – SUSTAINING VOLTAGE TEST CIRCUIT

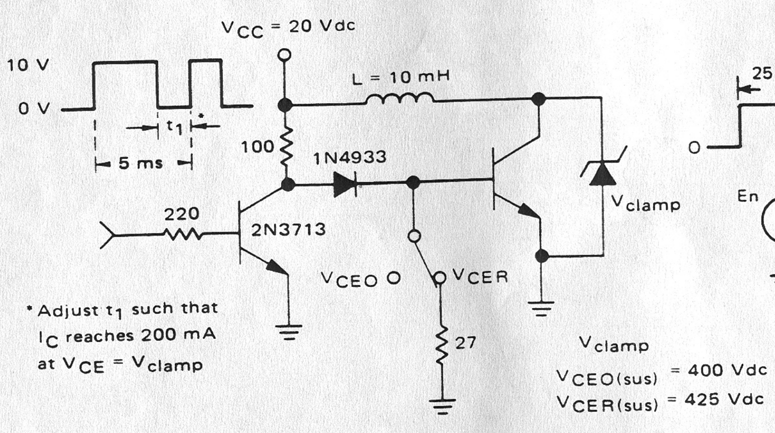


FIGURE 2 – SWITCHING TIMES TEST CIRCUIT

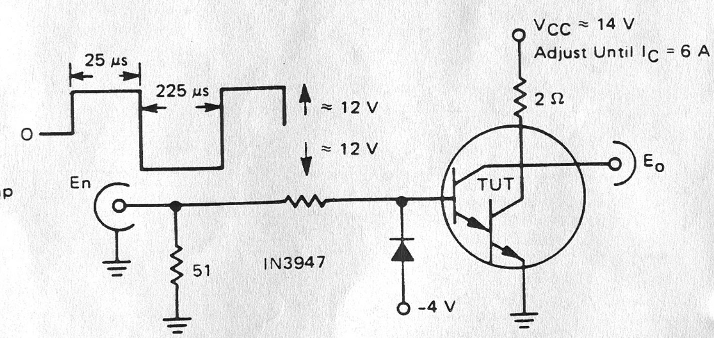


FIGURE 3 — DC CURRENT GAIN

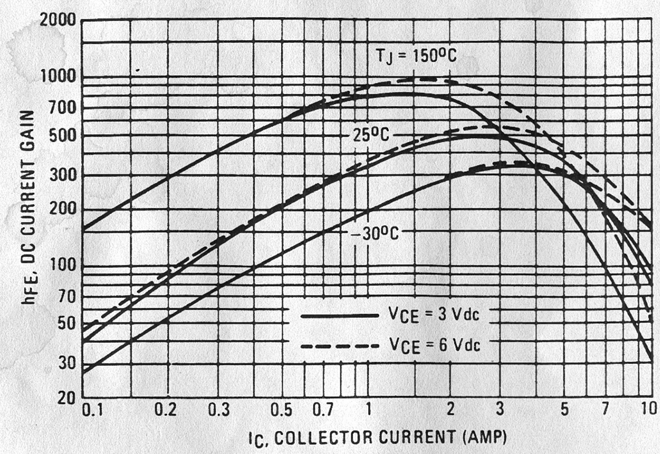


FIGURE 4 — COLLECTOR-SATURATION REGION

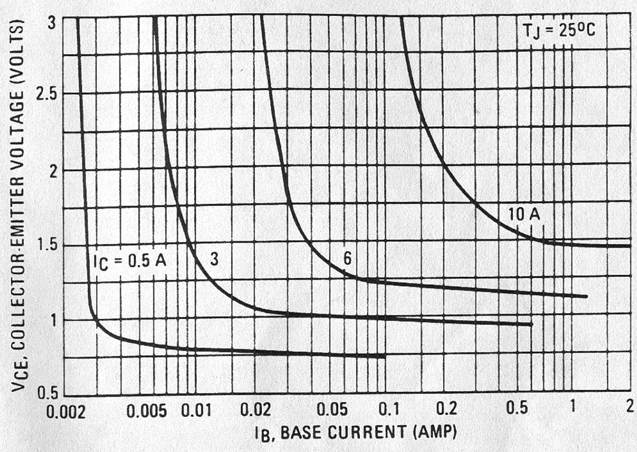


FIGURE 5 — COLLECTOR-EMITTER SATURATION VOLTAGE

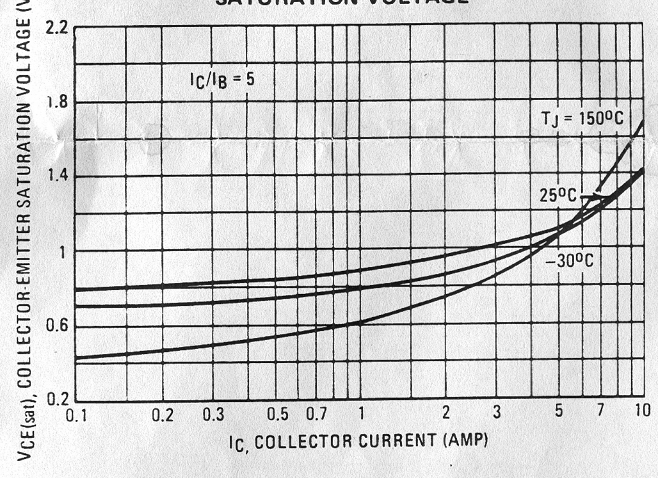


FIGURE 6 — BASE-EMITTER VOLTAGE

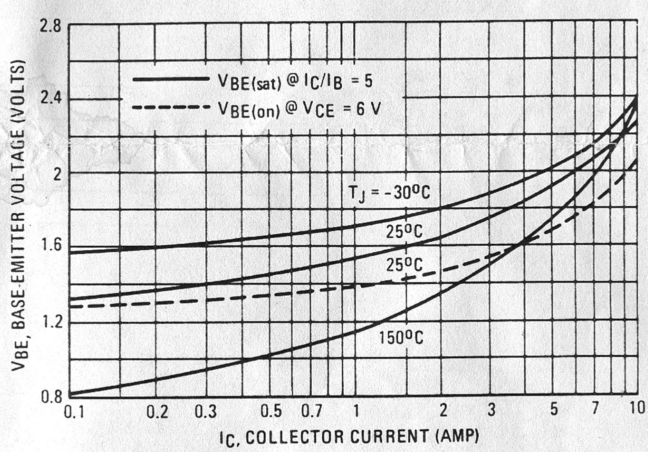


FIGURE 7 — TURN-OFF SWITCHING TIME

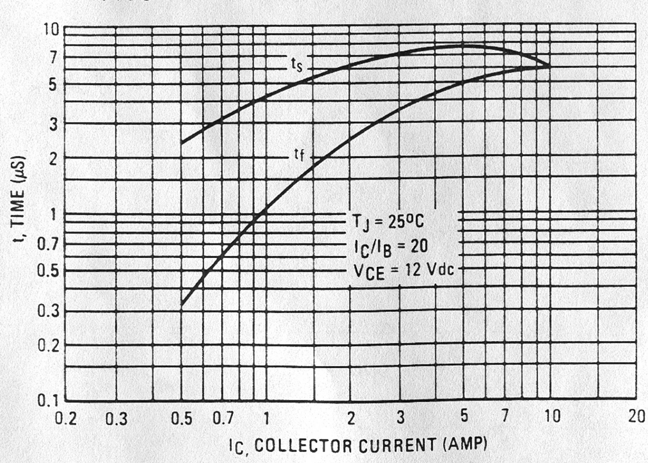


FIGURE 8 — COLLECTOR CUTOFF REGION

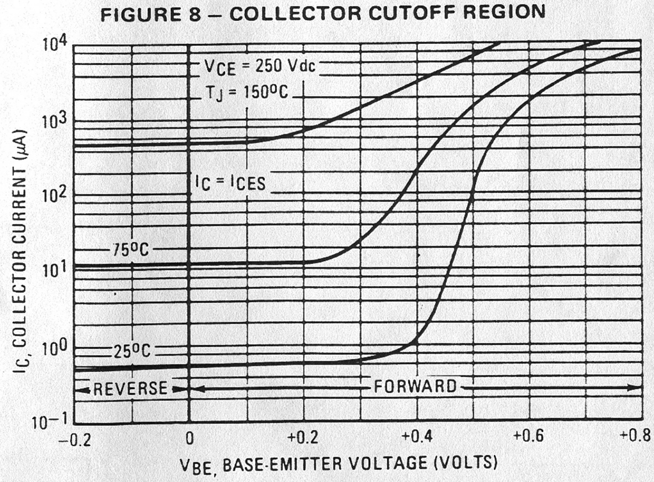


FIGURE 9 — THERMAL RESPONSE

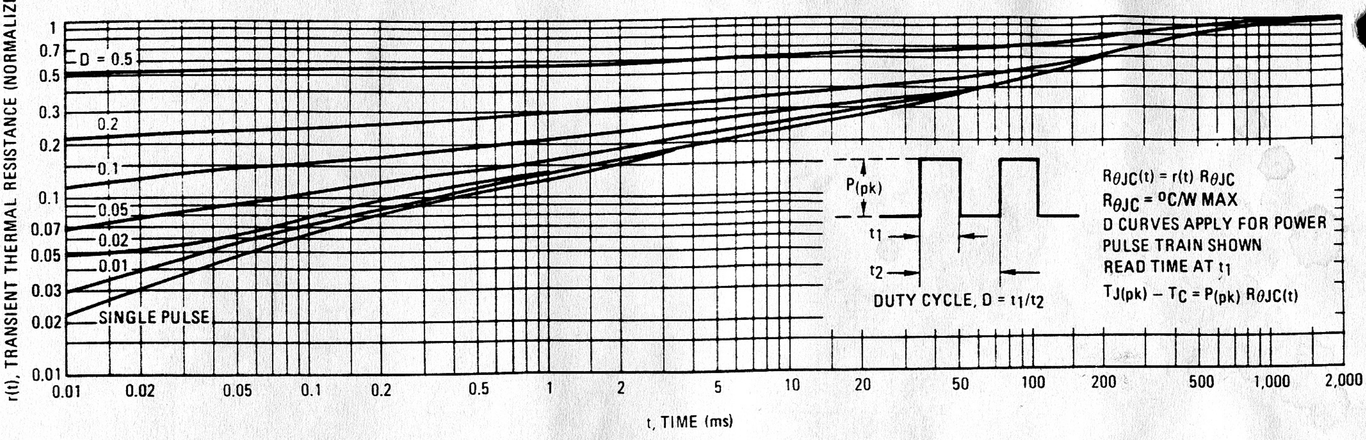
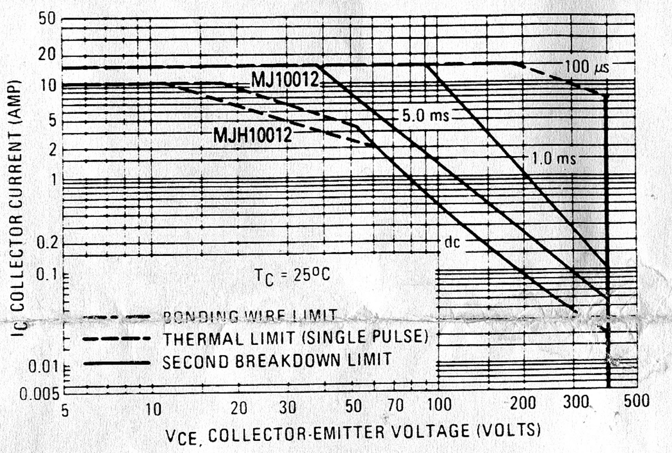


FIGURE 10 — FORWARD BIAS SAFE OPERATING AREA



There are two limitations on the power handling ability of a transistor: average junction temperature and second breakdown. Safe operating area curves indicate I_C-V_{CE} limits of the transistor that must be observed for reliable operation; i.e., the transistor must not be subjected to greater dissipation than the curves indicate.

The data of Figure 10 is based on $T_C = 25^oC$; $T_{J(pk)}$ is variable depending on power level. Second breakdown pulse limits are valid for duty cycles to 10% but must be derated when $T_C \geqslant 25^oC$. Second breakdown limitations do not derate the same as thermal limitations. Allowable current at the voltages shown on Figure 10 may be found at any case temperature by using the appropriate curve on Figure 11.

$T_{J(pk)}$ may be calculated from the data in Figure 11. At high case temperatures, thermal limitations will reduce the power that can be handled to values less than the limitations imposed by second breakdown.

FIGURE 11 — POWER DERATING

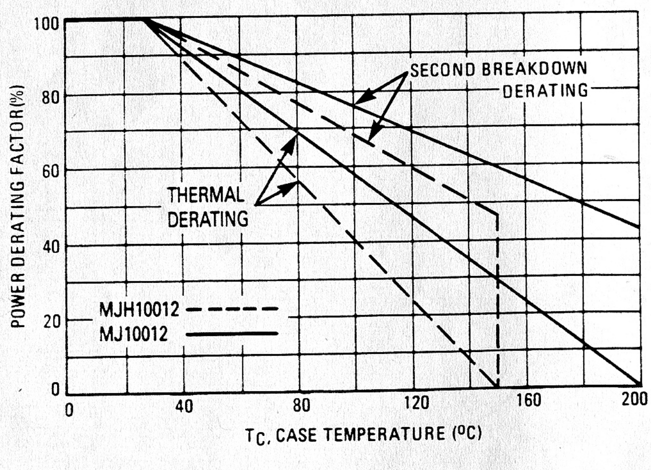
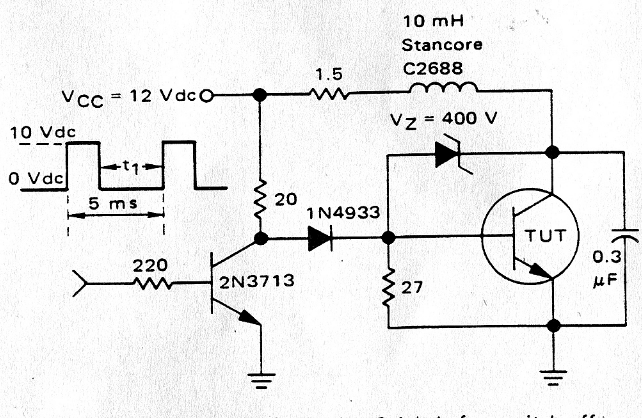


FIGURE 12 — USAGE TEST CIRCUIT



t_1 to be selected such that I_C reaches 6 Adc before switch-off.

NOTE:

"Usage Test," Figure 12 specifies energy handling capabilities in an automotive ignition circuit.

MOTOROLA Semiconductor Products Inc.

BOX 20912 • PHOENIX, ARIZONA 85036 • A SUBSIDIARY OF MOTOROLA INC.

DS3318R2

Order this data sheet
by MJE5740/D

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

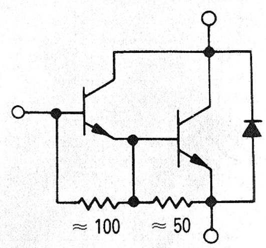
MJE5740
MJE5741
MJE5742

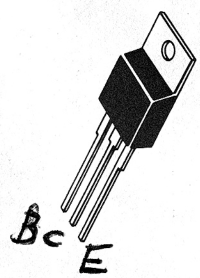
NPN Silicon Power Darlington Transistors

POWER DARLINGTON TRANSISTORS
8 AMPERES
300, 350, 400 VOLTS
80 WATTS

The MJE5740, 41, 42 darlington transistors are designed for high-voltage power switching in inductive circuits. They are particularly suited for operation in applications such as:

- Small Engine Ignition
- Switching Regulators
- Inverters
- Solenoid and Relay Drivers
- Motor Controls





CASE 221A-02
TO-220AB

MAXIMUM RATINGS

Rating	Symbol	MJE5740	MJE5741	MJE5742	Unit
Collector-Emitter Voltage	$V_{CEO(sus)}$	300	350	400	Vdc
Collector-Emitter Voltage	V_{CEV}	600	700	800	Vdc
Emitter Base Voltage	V_{EB}		8		Vdc
Collector Current — Continuous — Peak (1)	I_C I_{CM}		8 16		Adc
Base Current — Continuous — Peak (1)	I_B I_{BM}		2.5 5		Adc
Total Power Dissipation @ $T_A = 25°C$ Derate above 25°C	P_D		2 16		Watts mW/°C
Total Power Dissipation @ $T_C = 25°C$ Derate above 25°C	P_D		80 640		Watts mW/°C
Operating and Storage Junction Temperature Range	T_J, T_{stg}		−65 to +150		°C

(1) Pulse Test: Pulse Width = 5 ms, Duty Cycle = 10%.

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	1.56	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	62.5	°C/W
Maximum Lead Temperature for Soldering Purposes: 1/8″ from Case for 5 Seconds	T_L	275	°C

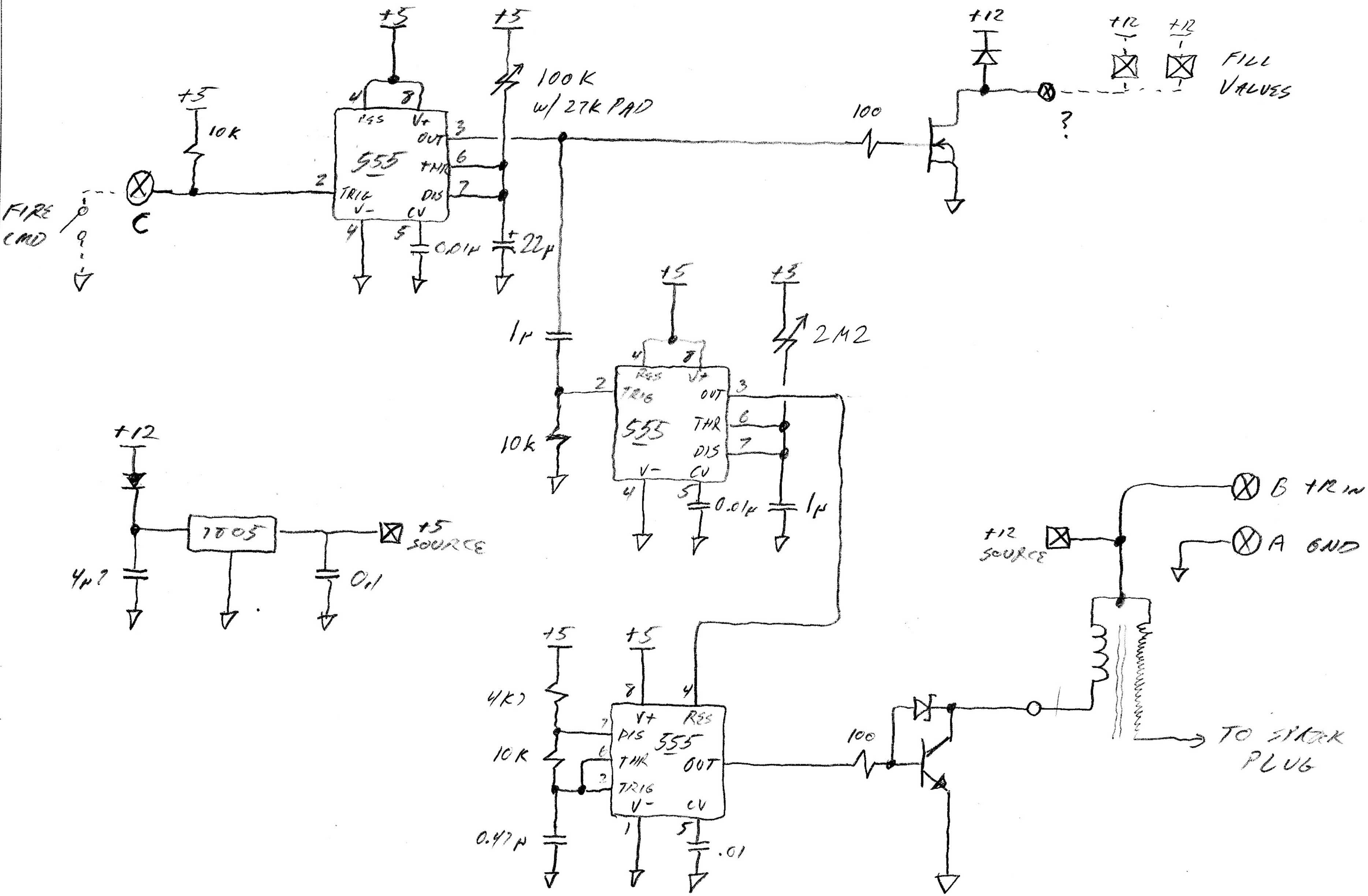
ELECTRICAL CHARACTERISTICS ($T_C = 25°C$ unless otherwise noted.)

Characteristic		Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS (2)						
Collector-Emitter Sustaining Voltage ($I_C = 50$ mA, $I_B = 0$)	MJE5740 MJE5741 MJE5742	$V_{CEO(sus)}$	300 350 400	— — —	— — —	Vdc
Collector Cutoff Current (V_{CEV} = Rated Value, $V_{BE(off)}$ = 1.5 Vdc) (V_{CEV} = Rated Value, $V_{BE(off)}$ = 1.5 Vdc, $T_C = 100°C$)		I_{CEV}	— —	— —	1 5	mAdc
Emitter Cutoff Current (V_{EB} = 8 Vdc, $I_C = 0$)		I_{EBO}	—	—	75	mAdc
SECOND BREAKDOWN						
Second Breakdown Collector Current with Base Forward Biased		$I_{S/b}$	See Figure 6			
Clamped Inductive SOA with Base Reverse Biased		RBSOA	See Figure 7			

(2) Pulse Test: Pulse Width = 300 μs, Duty Cycle = 2%.

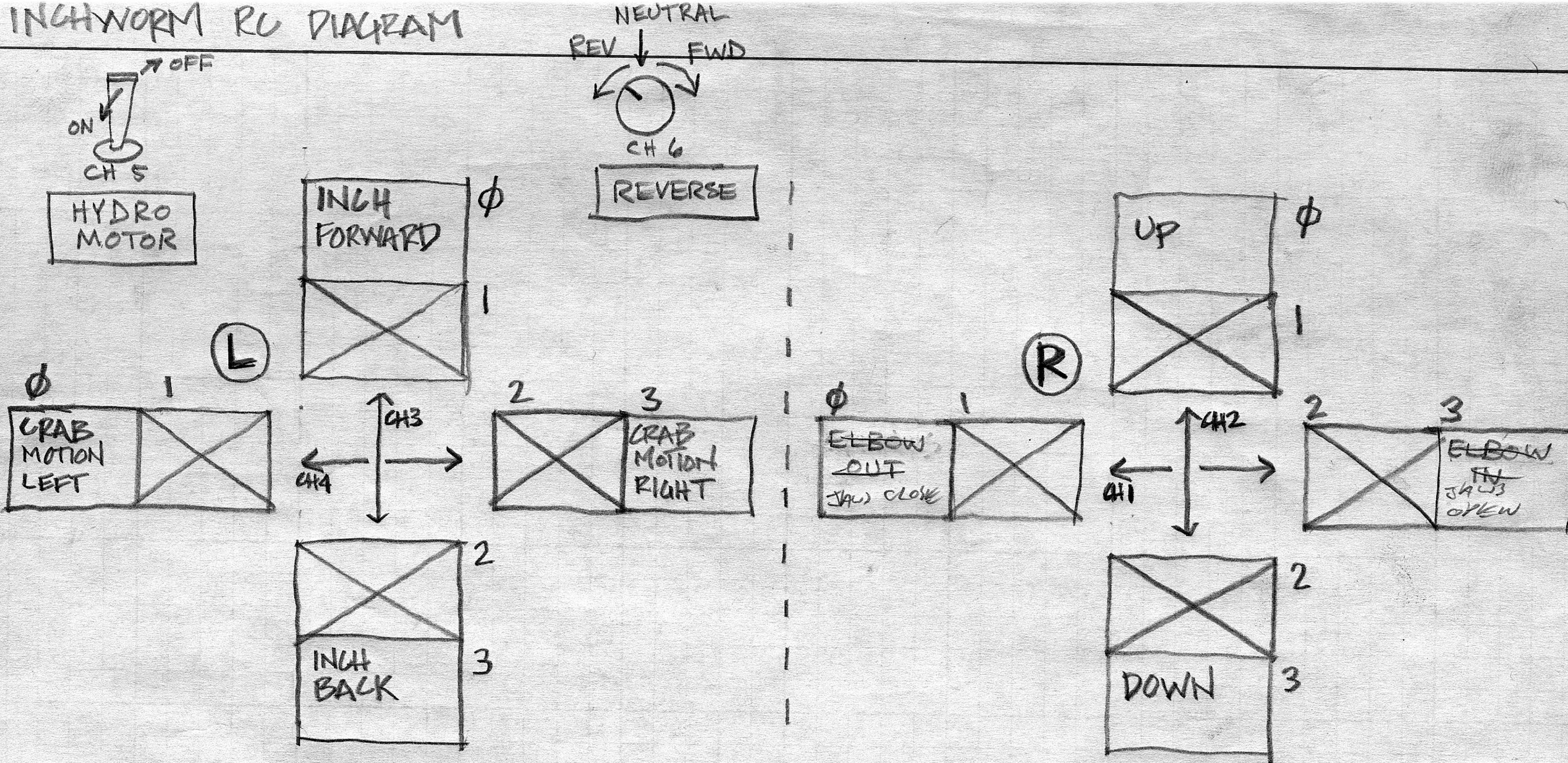
(continued)

MOTOROLA



+5
10K
FIRE CMD
C
RES
V+
OUT
555
THR
TRIG
DIS
V-
CV
0.01μ
22μ
100K
w/ 27K PAD
100
+12
FILL VALVES
?
1μ
2M2
10k
+12
7805
+5 SOURCE
4μ?
0.1
4K7
0.47μ
.01
B +12 in
A GND
+12 SOURCE
TO SPARK PLUG

INCHWORM RC DIAGRAM



AUG 27 1992

Mod 10/16/92
G. Homsy

INCHWORM RELAY DIAGRAM

COMMAND	JOY POS	RELAY LEFT
FORWARD RED	CH6 3 (inverted)	C22
HYDRO MOTOR ORG	CH5 3	A22
REVERSE RED (X2)	CH6 Ø	C19
INCH FORWARD	CH3 Ø	A15
INCH BACK	CH3 3	A18
CRAB RIGHT BLUE	CH4 3	C18

RELAY RIGHT	JOY POS	COMMAND	
C11	CH2 Ø	UP BLACK STRIPE	
A11	CH1 Ø	~~ELBOW~~ OUT YEL	JAWS CLOSE ORG/BLK
A14	CH1 3	~~ELBOW~~ ~~IN~~ YEL/BK	JAWS OPEN ORG
C14	CH2 3	DOWN BLACK	
C15	CH4 Ø	CRAB LEFT BLUE STRIPE	
OR GATE BOARD		DUMP RELAY MAGENTA STRIPE	

FUTABA RECIEVER

AUG 27 1992

Clay

Mod 10/16/92
G. Homsy

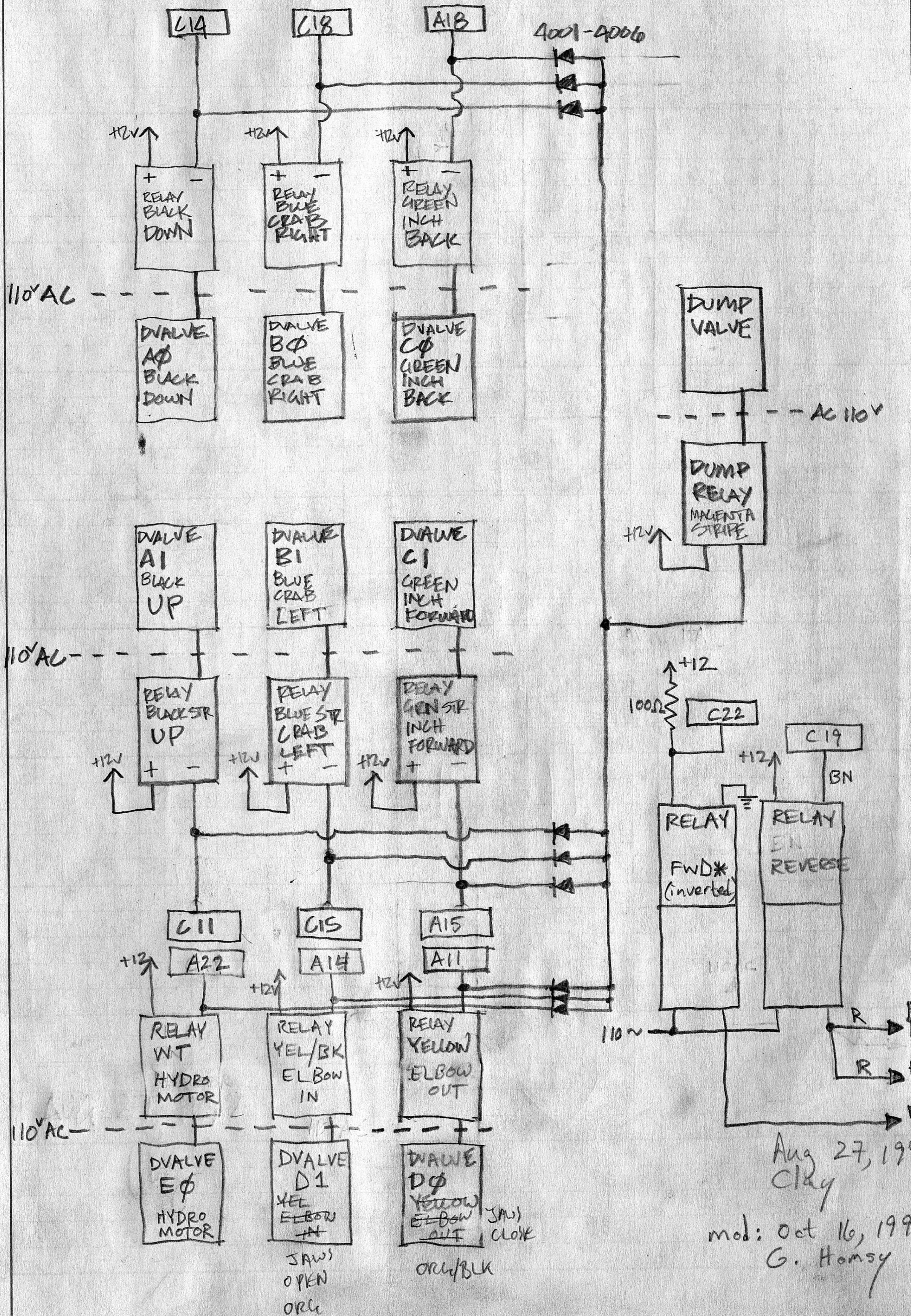
INCHWORM HYDROLIC VALVES (DIRECTIONALS)

DIRECTIONAL VALVES

	A	B	C	D	E
	BLACK	BLUE	GREEN	YELLOW	ORANGE
WIRE CONTROL/ HYDROLIC TUBES	BLACK DOWN	BLUE CRAB RIGHT	GREEN INCH BACK	YELLOW ELBOW OUT	ORG JAWS OPEN ~~HYDRO MOTOR~~
CONTROL BOX HERE	BLACK STRIPE UP	BLUE STRIPE CRAB LEFT	GREEN STRIPE INCH FORWARD	Y/BK ELBOW IN	ORG/BK JAWS CLOSE ~~NOT USED~~

(CENTER OF MACHINE HERE)

INCHWORM DUMP VALVE WIRING



Aug 27, 1992
Clay

mod: Oct 16, 1992
G. Homsy

ED #0 - NO TAPE
ED #1 - 1 TAPE
HITE #2 -
2 PIECES OF TAPE

SPECIAL INSTRUCTIONS

LITTLE ARM

R/C CONNECTOR 1 OF 2

RD - RED
PR - PURPLE
BK - BLACK

1. RED #1 BK ~~F~~ G
RD ~~G~~ H
WH ~~H~~ J

POWER BK/WH ~~POWER~~ T ~~S~~ ½
RD/WH V

2. WHITE #0 PR/WH A
RD/WH B
BK/WH C

WHITE #1 PR/WH D
RED/WH E
BK/WH F

3.
WHITE #2 PR/WH K
RD/WH L
BK/WH M

SPECIAL INSTRUCTIONS

LITTLE ARM

R/C CONNECTOR PAGE 2 OF 2

1. RED #Ø BK ~~G~~ N
RD P
WH R

2.

3.

Din 10 pin mil:

A	A 24
B	C 24
C	A 22
D	C 22
E	A 20
F	C 20
G	C 18
H	A 18
J	C 16
K	A 16

19 pin mil:

A	A 12
B	A 11
C	C 11
D	A 10
E	A 9
F	C 9
G	A 8
H	A 7
J	C 7
K	A 6
L	A 5
M	C 5
N	A 4
P	A 3
R	C 3

NO S
NO U

T to white wire
V to black wire

Little Arm
Harness Pinouts
3/97

(A) clip black
to orage exposed wire

* 1 is shortest
5 is longest

1
A pin K
B pin J
C pin K
D pin J

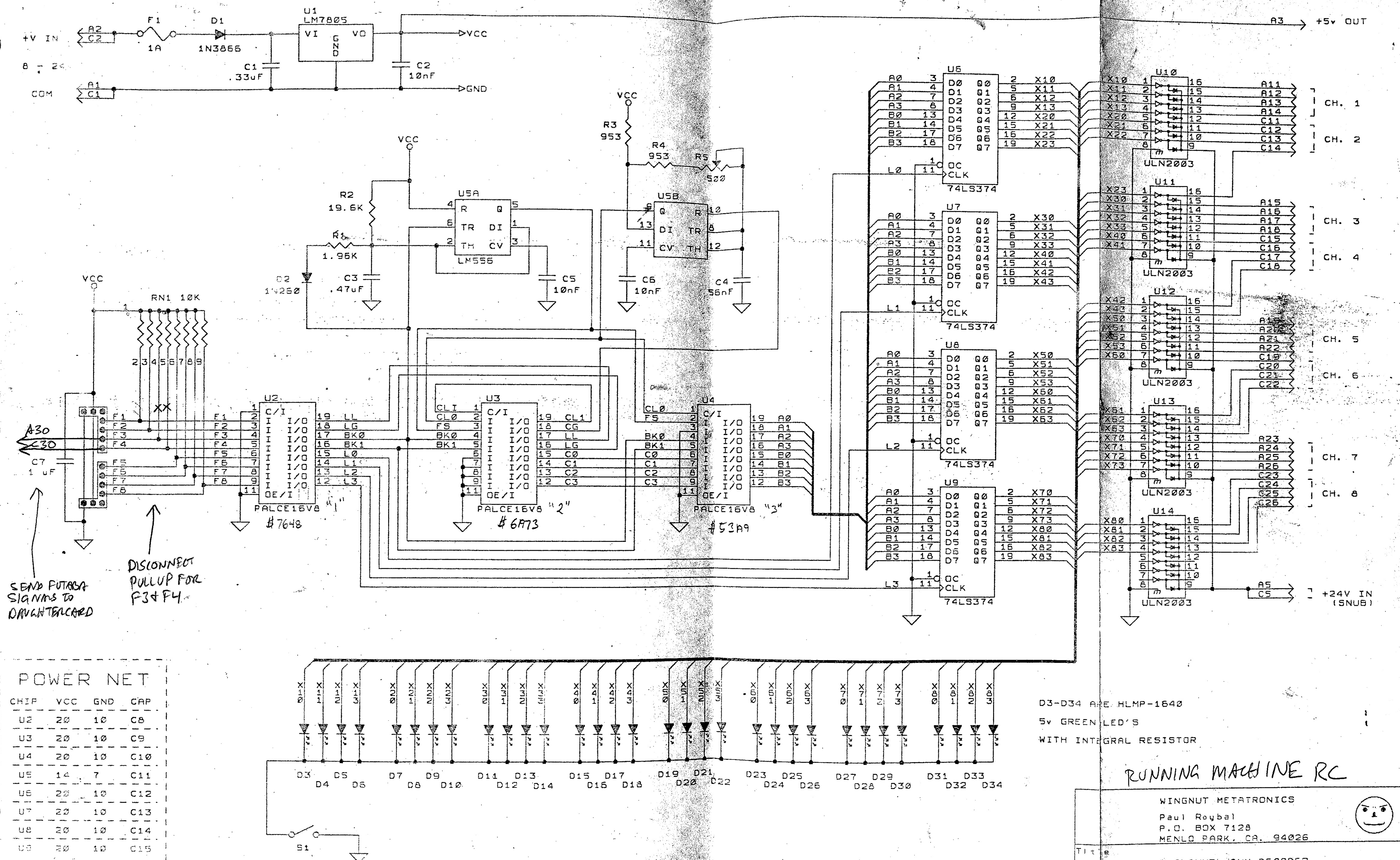
2
A pin ~~G~~ H
B pin ~~F~~ G
C pin ~~G~~ H
D pin ~~F~~ G

3
A pin F
B pin E
C pin F
D pin E

4
A pin D
B pin C
C pin D
D pin C

5
~~A~~A pin B
B — pin A
~~C~~C pin B
D — pin A

Little Arm
Harness
March 97



POWER NET

CHIP	VCC	GND	CAP
U2	20	10	C8
U3	20	10	C9
U4	20	10	C10
U5	14	7	C11
U6	20	10	C12
U7	20	10	C13
U8	20	10	C14
U9	20	10	C15

C8 - C15 = .1 uF

RUNNING MACHINE RC

WINGNUT METATRONICS
Paul Roybal
P.O. BOX 7128
MENLO PARK, CA. 94026

Title: 8 CHANNEL PWM DECODER

Size	Document Number	REV
B	SRL-PR-001-03 SCH	0

Date: October 24, 1990 Sheet 1 of 1

Running Machine Futata Transmitter
Mil Connector Pinouts

A +V
B Gnd
C Right Stick - L/R pot wiper
D " cct board
E Right Stick - U/D pot wiper
F " cct board
G Left Stick - U/D pot wiper
H " cct board
J Left Stick - L/R pot wiper
K " cct board
L Gear Switch (switch to gnd)
M Gear Swict cut board lead

Jumper these pins to restore normal operation

This connector allows use of external potentiometers.

Jan. 97
Ralf B.

Running machine 11 pin mil connector:

A	Steering ~~Feedback~~ pot	~~Or~~ Red	Gnd	
B	"	~~Green~~ Green	+12	
C	"	~~Gray~~ ~~Black~~	Black	
D	"	Shield	Green	pot
E			Red	
F			Shield	
G				
H				
J				
K	+12 V from battery			
L	Battery gnd.			

5-15-95 M. FOGARTY

VALVE 2		CONTROL BOX CONN PIN
D		E
C	Stick. R →	F
B	TR	D
A	TR	D

Red - A
Green - B
White - C
Black - D

Running machine control box:

19 pin mil connector:

A	Value 1	D & B	← connected at 5 pin (
B		A	
C		C	
D	Value 2	D & B	A+B
E		A	D
F		C	
G	Value 3	D & B	
H		A	
J		C	
K	Value 4	D & B	
L		A	
M		C	
N	Value 5	D & B	
P		A	
R		C	
S			
T			
U			
V			

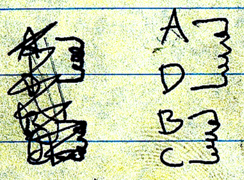
Running machine values:

6 pin mil connector (male):

connector (male)

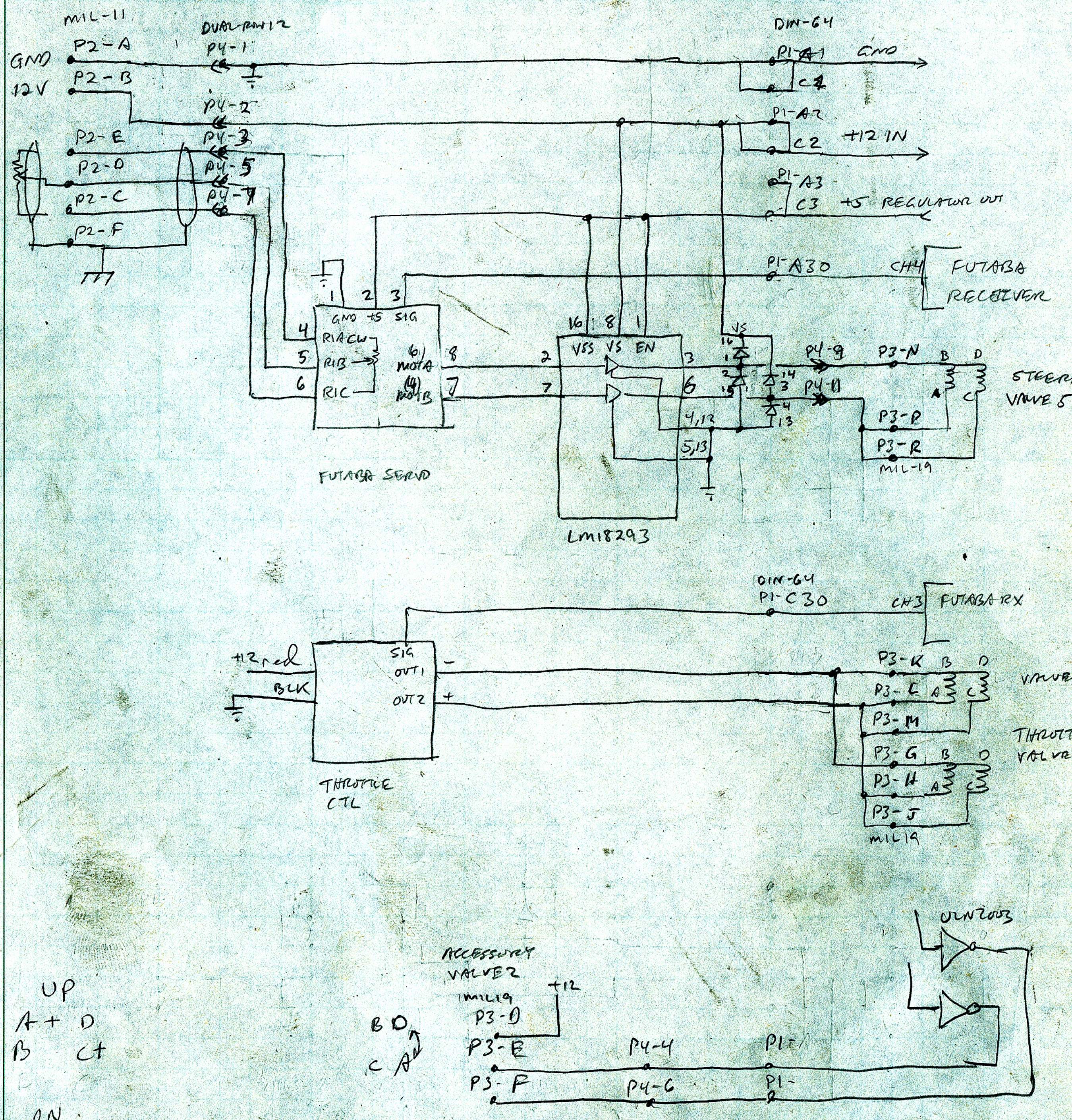
A - A
B - B
C - C
D - D

valve labels



P1 - 64-PIN EUROCARD MALE
P2 - 11 PIN MIL POWER + FEEDBACK
P3 - 19 PIN MIL VALVE CTL
P4 - 12 PIN DUALRON

PR-03 DECODER BOARD



UP
A + D
B C+

DN
A D+
B+ C

National Semiconductor

LM18293 Four Channel Push-Pull Driver

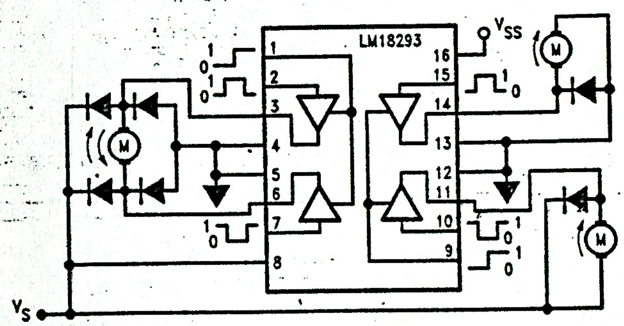
General Description

The LM18293 is designed to drive DC loads up to one amp. Typical applications include driving such inductive loads as solenoids, relays and stepper motors along with driving switching power transistors and use as a buffer for low level logic signals. The four inputs accept standard TTL and DTL levels for ease of interfacing. Two enable pins are provided that also accept the standard TTL and DTL levels. Each enable controls 2 channels and when an enable pin is disabled (tied low), the corresponding outputs are forced to the TRI-STATE® condition. If the enable pins are not connected (i.e., floating), the circuit will function as if it has been enabled. Separate pins are provided for the main power supply (pin 8), and the logic supply (pin 16). This allows a lower voltage to be used to bias up the logic resulting in reduced power dissipation. The chip is packaged in a specially designed 16 pin power DIP. The 4 center pins of this package are tied together and form the die paddle inside the package. This provides much better heat sinking capability than most other DIP packages available. The device is capable of operating at voltages up to 36 volts.

Features

- 1A output current capability per channel
- Pin for pin replacement for L293B
- Special 16 pin power DIP package
- 36 volt operation
- Internal thermal overload protection
- Logical "0" input voltage up to 1.5 volts results in high noise immunity

Typical Connection



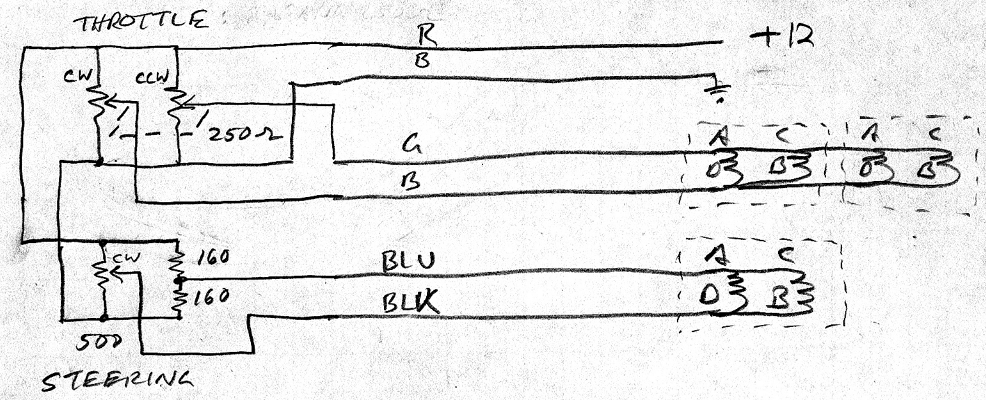
TL/H/8706–1

FIGURE 1. Application circuit showing bidirectional and on/off control of a single DC motor using two outputs and unidirectional on/off function of two DC motors using a single output each.

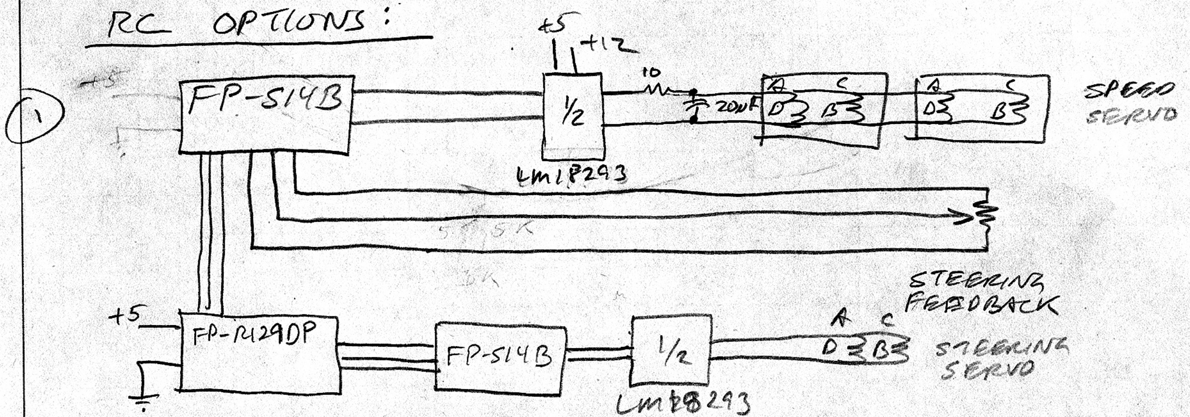
Order Number LM18293N
NS Package Number N16A

RC OPTIONS

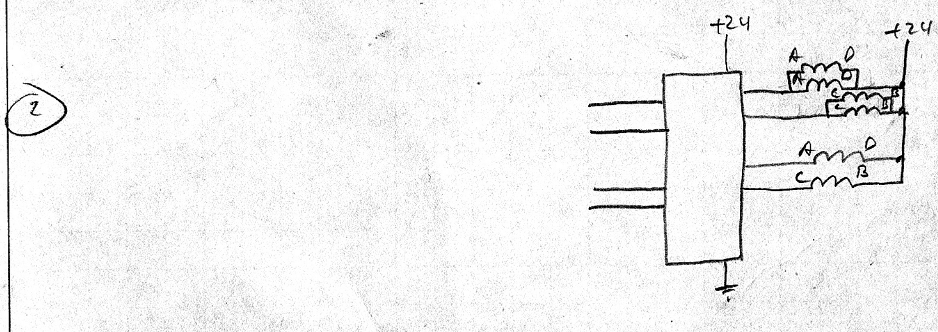
MANUAL CONTROLLER:



RC OPTIONS:



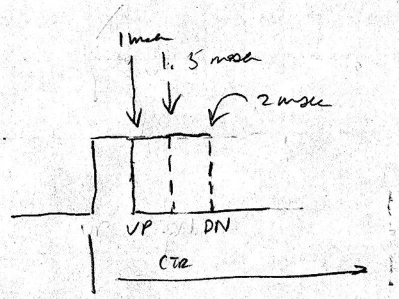
with '293 QUAD HALF BRIDGE DRIVER CHIP



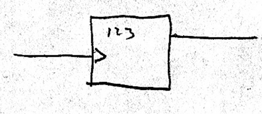
WITH ULN2003

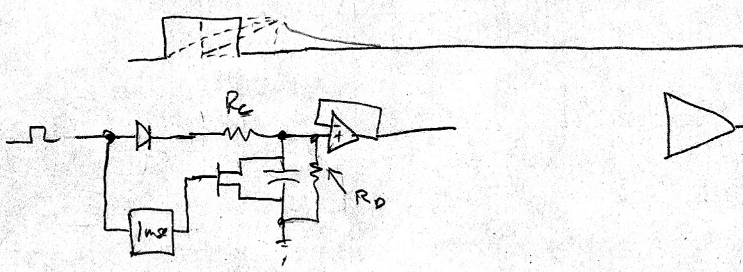
14 m sec

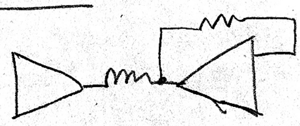
BAL6686
BA 6688 L



1.5 msec







BAL 6686

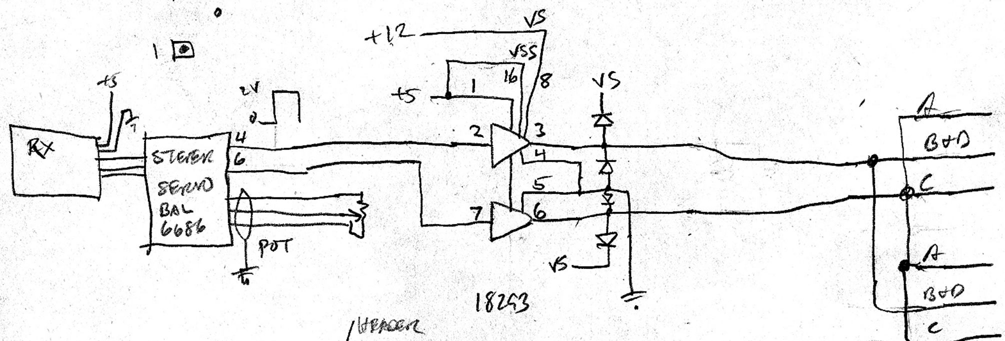
V+

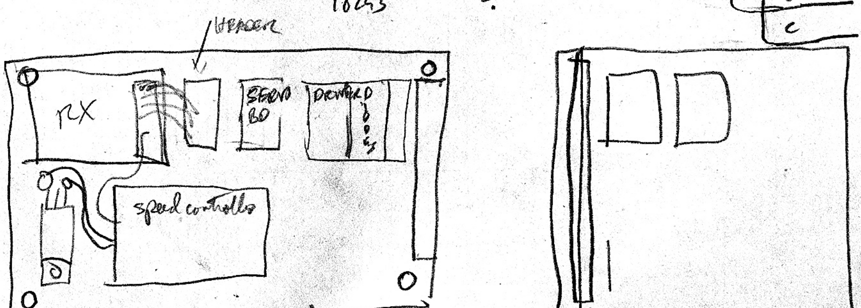
— STICK DOWN PWM

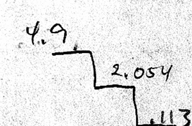
— STICK UP PWM

1

.386 - .224 = .162 V







Screw Machine Update
April 2005
Ralf Burgert

The screw machine now has a Making Things board ("Stepper Block" module) as its controller.

Inputs:
I0 - Futaba Channel 1
I1 - Futaba Channel 2

Outputs :
Q1 - clutch 2
Q2 - clutch 1
Q3 - clutch 4
Q4 - clutch 3

The board decodes the Futaba position and implements the following:

	Turn on Q:
Stick Up	1,4
Stick Down	2,3
Stick Right	1,2
Stick Left	3,4
Stick Up+Right	1
Stick Up+Left	4
Stick Down+Right	2
Stick Down+Left	3

So that with the output wiring given, the clutches are driven as below:

	Clutch:
Stick Up	2,3
Stick Down	1,4
Stick Right	1,2
Stick Left	3,4
Stick Up+Right	2
Stick Up+Left	3
Stick Down+Right	1
Stick Down+Left	4

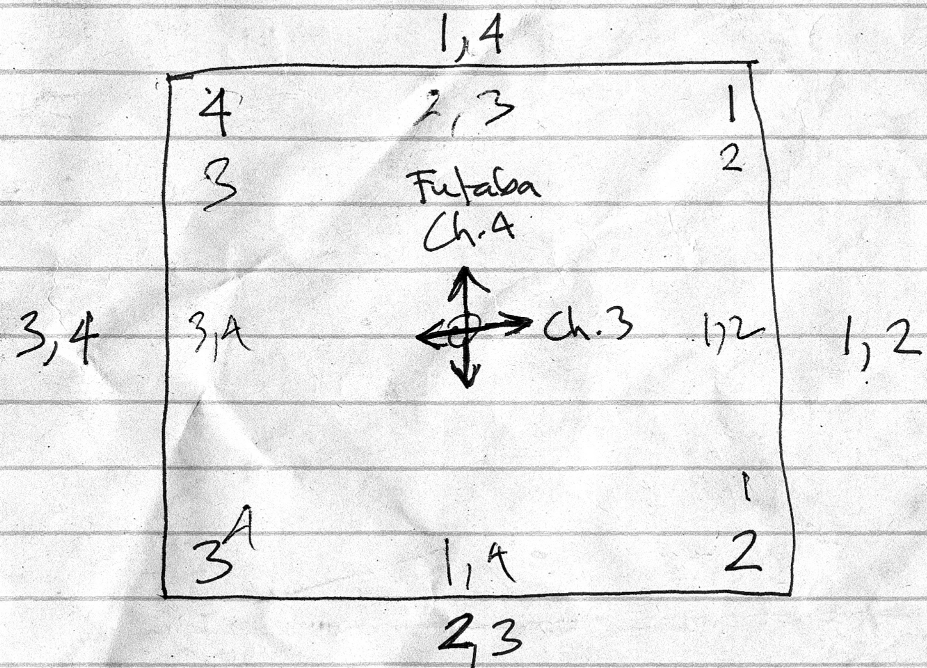
Note that this is different than the mapping in previous versions.

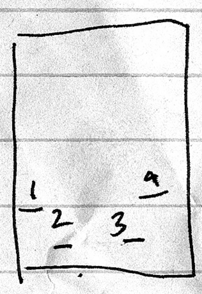
Clutch 3 is currently completely worn and needs to be replaced.

Engine power switch is intermittent and needs to be replaced.

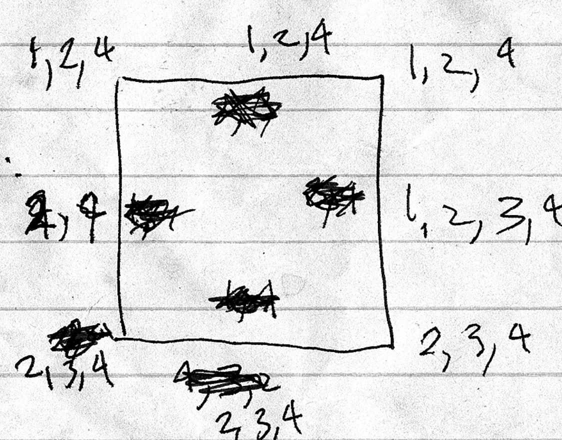
Screw Machine Control Mapping

Clutch numbers:

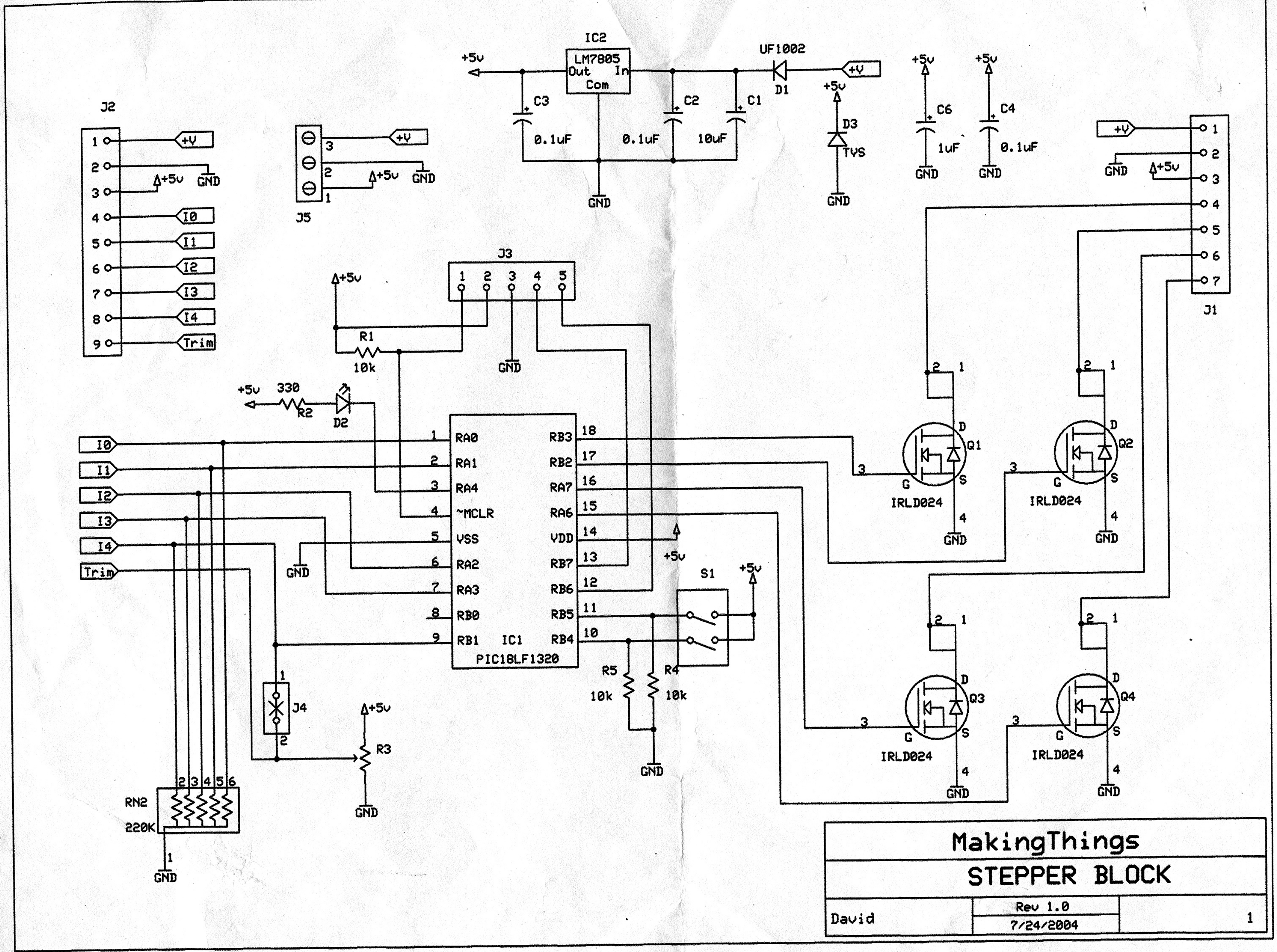




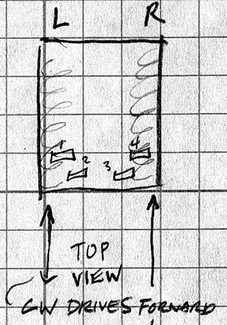
Current:



- Ch. 1, 2 to drive 2 FETs each
- Ch. 5 to drive 1 FETs
- 70% full joystick travel to turn on, no less.



C:\mt\pcb\block_stepper_01.sch - Sheet1



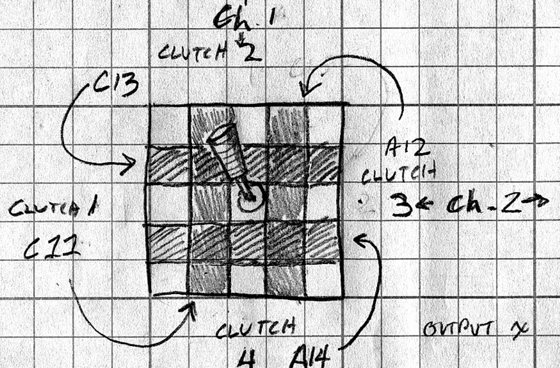
CLUTCH	SCREW	DIRECTION
1	L	CW, FORW
2	R	CW, BACKW
3	L	CCW, BACKW
4	R	CCW, FORW

BEHAVIOR	CLUTCH(ES)
RUSH LEFT	3,4
RUSH RIGHT	1,2
FORWARD	1,4
BACKWARD	2,3
TURN F CW	1
TURN F CCW	4
TURN B CW	2
TURN B CCW	3

VIBRO-HARDEN EVERYTHING

ILLEGAL COMBINATIONS

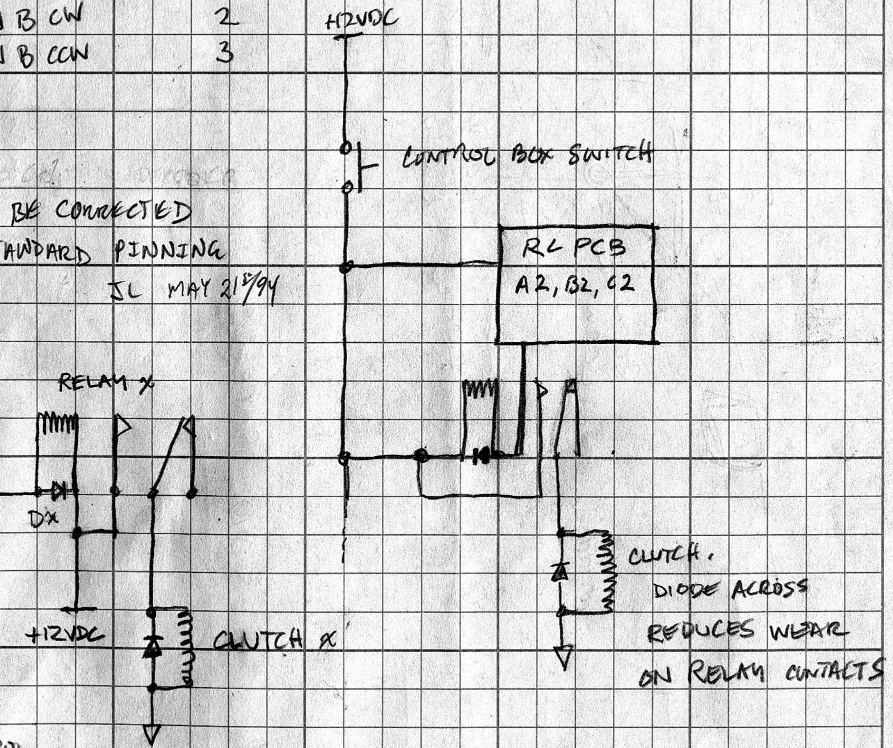
1 & 3
2 & 4



RIGHT JOYSTICK

CLUTCH	PIN ON RC PCB (EURO)
1	~~C 11~~
2	~~C 13~~
3	~~A 12~~
4	~~A 14~~

MUST BE CORRECTED TO STANDARD PINNING
JL MAY 21st/94



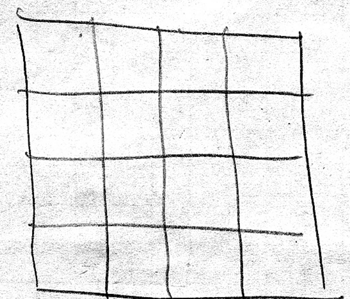
CLUTCH CONTROL SCHEMATIC

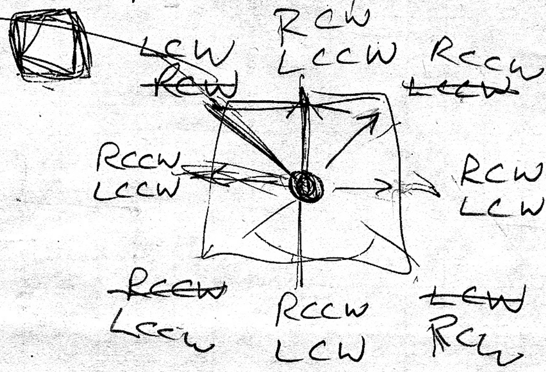
NOTE! THIS DESIGN USES THE RALF BURGERT RC PRINTED CIRCUIT BOARDS. THESE BOARDS HAVE ULN2003 SINKING OUTPUTS TO DRIVE RELAYS THAT MUST HAVE CLAMPING DIODES.

* IMPORTANT: GREG USED GERMANIUM DIODES TO "OR" THE JOYSTICK QUADRANTS TOGETHOR

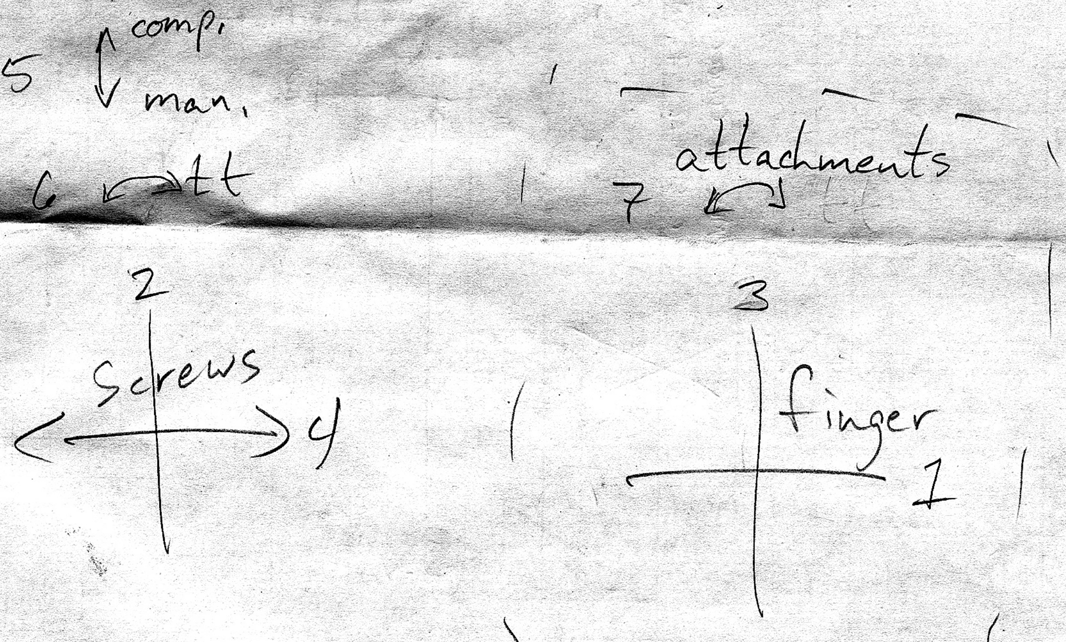
SCREW MACHINE CONTROL CIRCUIT	
M. FOGARTY	5/1/94

Radio board supplementary ckts





isolate coils for screws



2 ⇔ 3 in mode II

Screw Machine Update
February 1996

The screw machine's radio board was replaced in Phoenix. The joystick quadrants on the current board are not diode-OR'd together. Doing this made the machine prone to running away if the trim control on the transmitter was accidentally moved.

Screw Logic

$$RCW = U\bar{L}\bar{R} + R\bar{U}$$

$$LCW = UL + R\bar{U}\bar{D} + D\bar{L}\bar{R}$$

$$RCCW = UR + L\bar{U}\bar{D} + D\bar{L}\bar{R}$$

$$LCCW = U\bar{L}\bar{R} + L\bar{U}$$

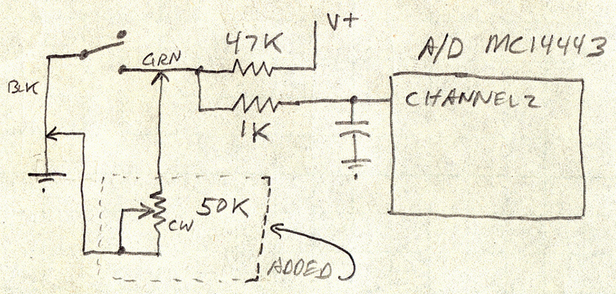
March '97 V-1 Update:

- Ch. 5 relay (top left of box) connected and working. For props, water injection, etc.

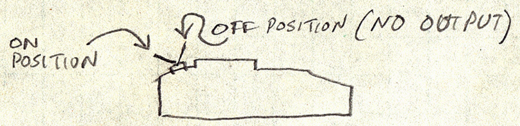
- the second terminal from the left, of the terminal block on the side of the moto-truck motor (under cover) sets the motor speed. Pulling this terminal to ground places a resistance in series with the motor power. The purple wire in the control box can be used for this, but is currently disconnected. Ideally it would be pulled low momentarily when the motor is run, to avoid stalling the motor. Stalling the motor (without the resistor in series) for any length of time will melt the power cables.

- Trimpot added: reduces & adjusts "GEAR" switch open voltage. This allows use of channel 5 on Roybal decoder board.

- NOTE: THIS SIMPLE MOD ALLOWS SELECTION OF ONE (STICK DOWN) OUTPUT ON CHAN. 5.

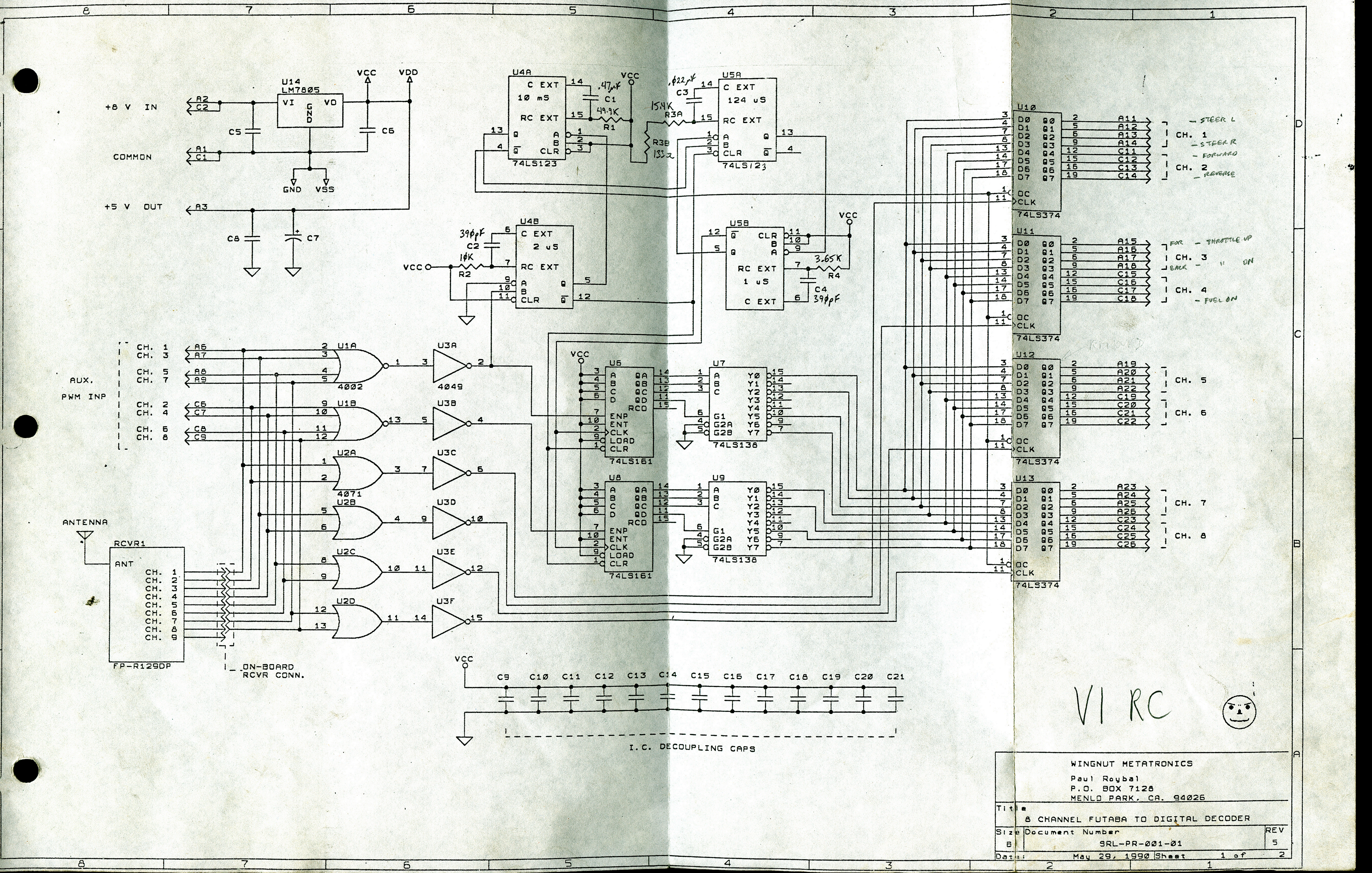


THE TRIMPOT IS TOP PANEL ACCESSIBLE, NEXT TO CH. 5 GEAR SWITCH.



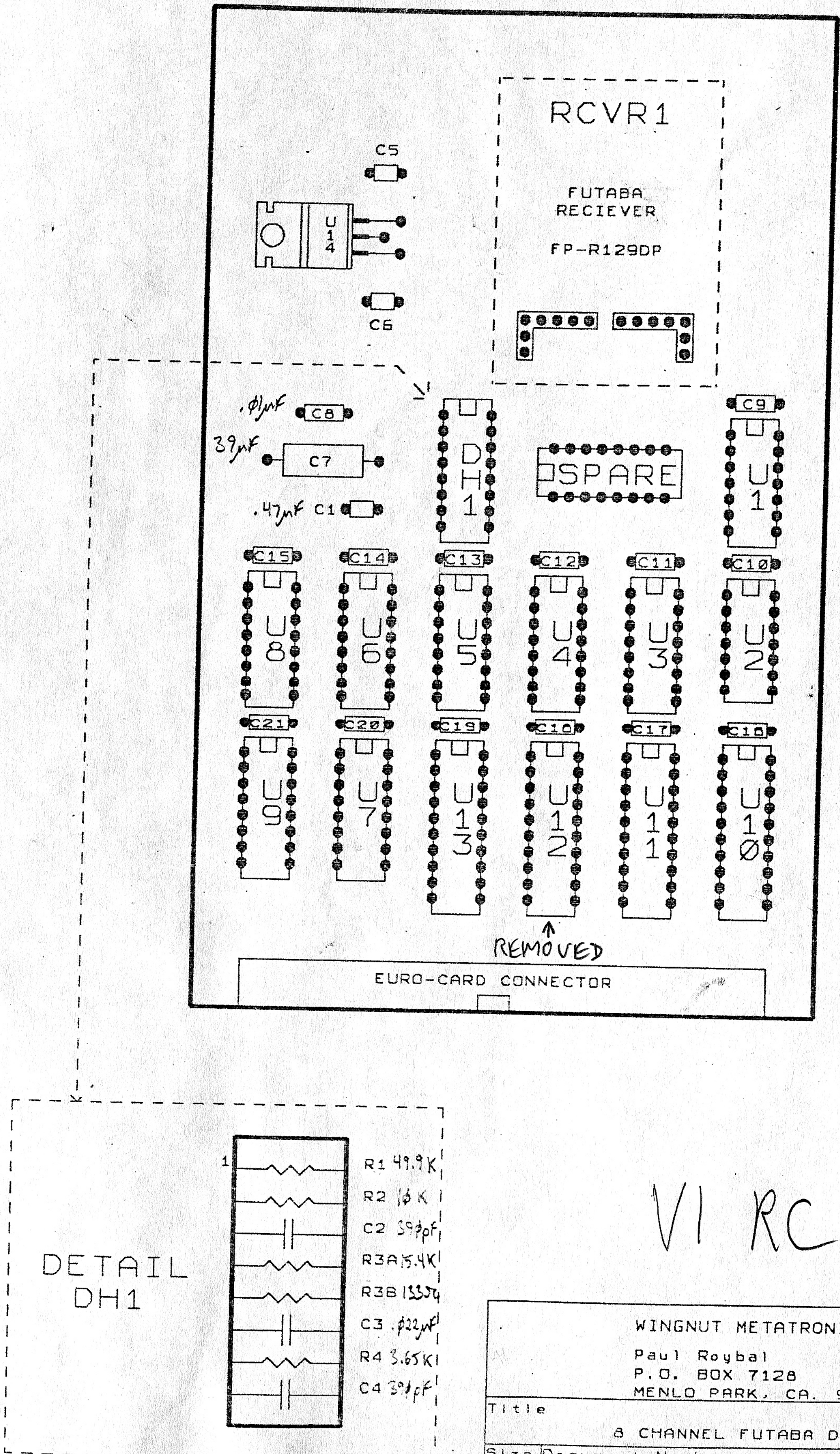
March '97 trimpot update:

The new transmitter has a 25K pot. It's located in the D/R switch mounting hole.



WINGNUT METATRONICS
Paul Roybal
P.O. BOX 7128
MENLO PARK, CA. 94026
Title
8 CHANNEL FUTABA TO DIGITAL DECODER
Size B
Document Number SRL-PR-001-01
REV 5
Date: May 29, 1990 Sheet 1 of 2
VI RC
+8 V IN
COMMON
+5 V OUT
U14 LM7805
AUX. PWM INP
ANTENNA
RCVR1
FP-R129DP
ON-BOARD RCVR CONN.
I.C. DECOUPLING CAPS
U4A 74LS123
U5A 74LS123
U4B
U5B
U1A 4002
U2A 4071
U3A 4049
U6 74LS161
U8 74LS161
U7 74LS138
U9 74LS138
U10 74LS374
U11 74LS374
U12 74LS374
U13 74LS374
CH. 1
CH. 2
CH. 3
CH. 4
CH. 5
CH. 6
CH. 7
CH. 8
STEER L
STEER R
FORWARD
REVERSE
THROTTLE UP
FUEL ON

GENERAL PARTS LAYOUT



VI RC

WINGNUT METATRONICS Paul Roybal P.O. BOX 7128 MENLO PARK, CA. 94026		
Title 8 CHANNEL FUTABA DECODER		
Size A	Document Number SRL-PR-001-01 LAY	REV 0
Date: October 27, 1990	Sheet 2 of 2	

8 CHANNEL FUTABA TO DIGITAL DECODER
SRL-PR-001-01
Bill Of Materials

May 29, 1990

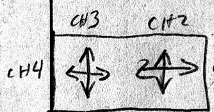
Revised: May 29, 1990
Revision: 5
19:53:10

Item	Quantity	Reference	Part
1	1	C1	0.47 uF POLY
2	2	C2,C4	390pF MICA
3	1	C3	22 nF POLY
4	1	C5	0.33 uF CER
5	2	C6,C8	0.01 uF CER
6	1	C7	39 uF 10V ELECT
7	13	C9,C10,C11,C12,C13,C14, C15,C16,C17,C18,C19,C20, C21	0.1 uF CER
8	1	R1	49.9 K 1% 1/8 W
9	1	R2	10.0 K 1% 1/8 W
10	1	R3A	15.4 K 1% 1/8 W
11	1	R3B	133 OHM 1% 1/8 W
12	1	R4	3.65 K 1% 1/8 W
13	1	RCVR1	FP-R129DP (FUTABA RECIEVER)
14	1	U1	4002
15	1	U2	4071
16	1	U3	4049
17	1	U4, U5	74LS123
19	2	U6,U8	74LS161
20	2	U7,U9	74LS138
21	4	U10,U11,U12,U13	74LS374
22	1	U14	LM7805

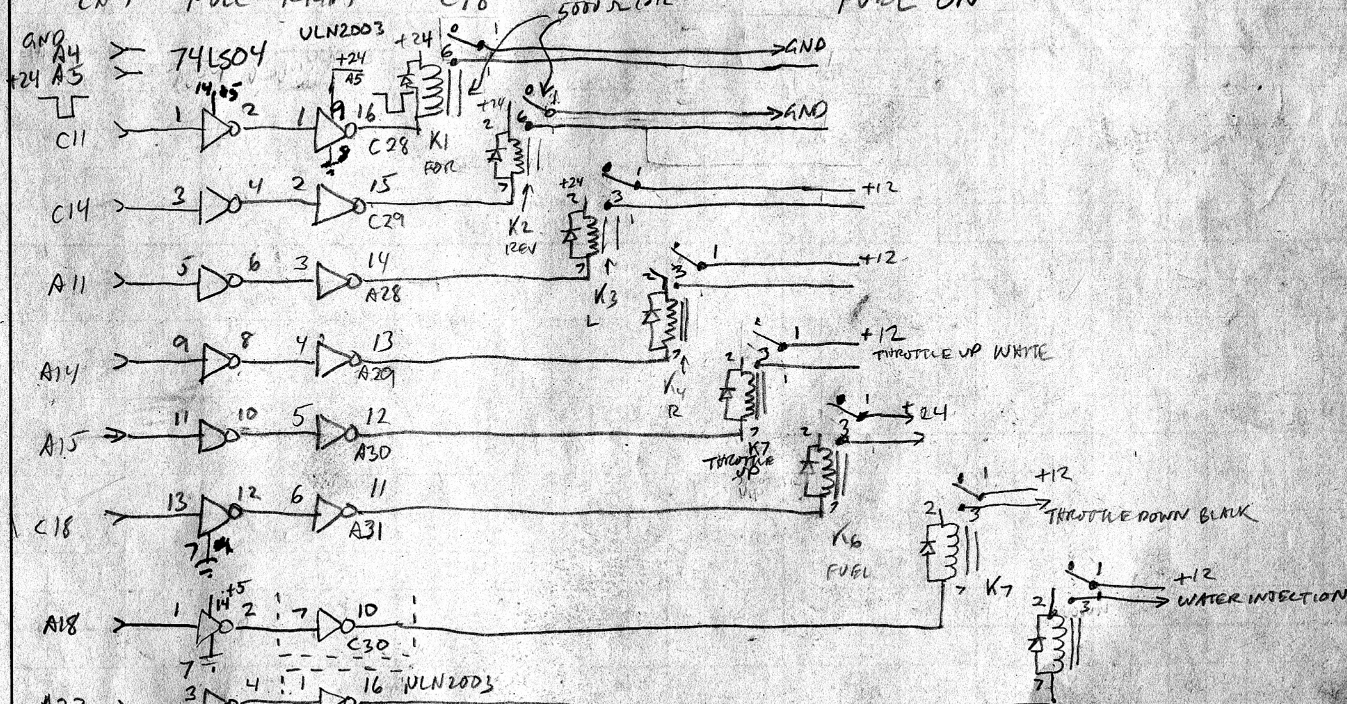
V1 RC RECEIVER

DRIVE REQ:

	CLOSURE TO:	I (Amps)	V	Contacts (current)	NOTES
FORWARD	GND	1.7	12V	5	
Reverse	GND	1.7	12V	5	
Left	12V	3	12V	5	STARTER RELAY
Right	12V	3	12V	5	" "
Throttle up	12V	3	12V	5	
Fuel Clutch	12V	1	12V	5	
Throttle DOWN	12V	3	12V		



CHANNEL	POSITION	TTL PIN	D.C. OUT PIN	FUNCTION
CH2	FULL FORWARD	C11	C28	DRIVE { FORWARD
CH2	FULL REVERSE	C14	C29	DRIVE { REVERSE
CH5	ON	A22		
CH1	FULL LEFT	A11	A28	STEER { LEFT
CH1	FULL RIGHT	A14	A29	STEER { RIGHT
CH3	FULL BACK	A18	C30	THROTTLE DOWN
CH3	FULL FORWARD	A15	A30	THROTTLE UP
CH4	FULL RIGHT	C18	A31	FUEL ON



TRANSMITTER NOTES -

1. FAILSAFE THROTTLE ("F/S") ON

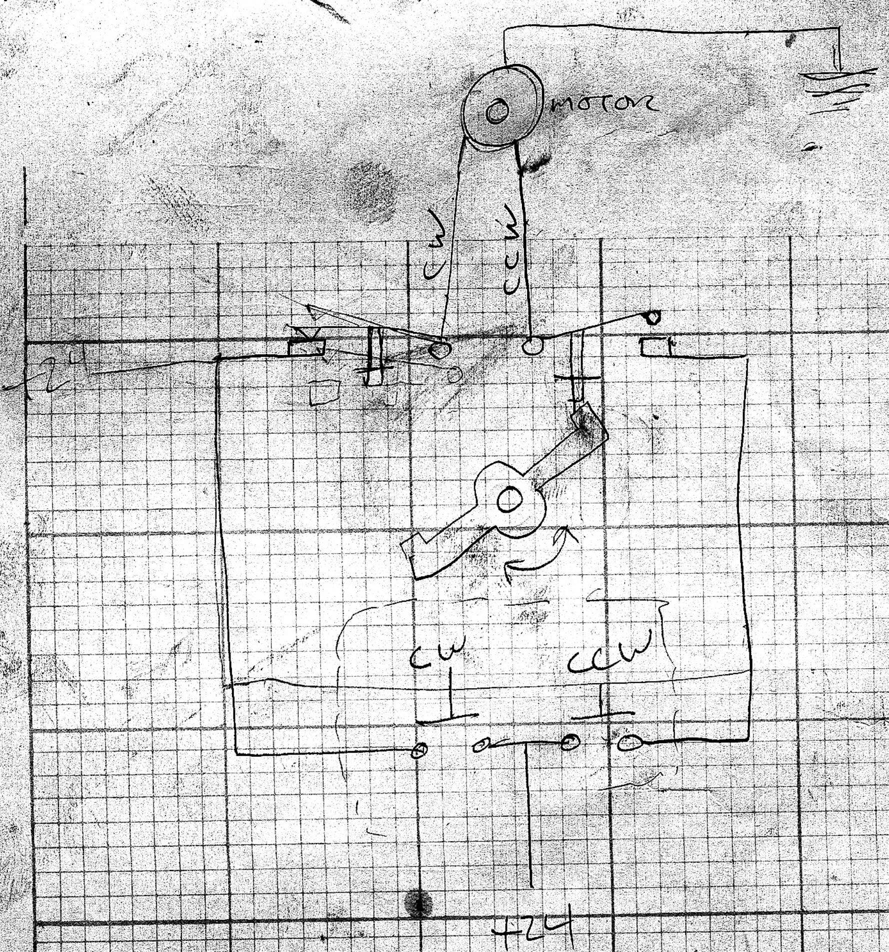
K1-K7: 24V 80mA DPDT RELAY, 5A contacts

T.S.: 1 2 3 4 5 6 | 7 8 9 10 11 12

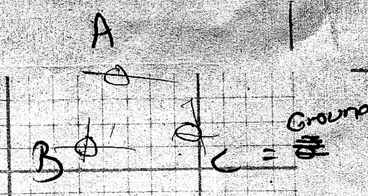
GND 12 24 GND 12 110 | K1

TRANSMITTER NOTES:

1. FAILSAFE THROTTLE ("F/S") ON
2. CH 5 SWITCH MOD FOR WATER



+24
MOTOR
CW
CCW
CW
CCW
+24



A
B
C =
Ground