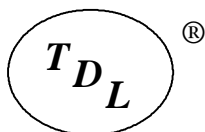


USER GUIDE

6-Channel Volume Controller with IR Remote Control Model 465

First version August 2006



... since 1957

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MODEL 465 – OPERATION

Plug the supplied 24 VAC wall transformer into any convenient outlet and connect the cable power plug to the power-in connector on the rear panel. To turn on the 465, just flip the POWER ON switch to its up position. The red power-on indicator will light.

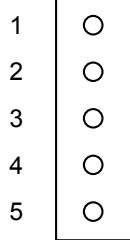
IMPORTANT: The model 465 uses an AC wall transformer. A 24 VDC wall power supply will not work correctly.

You will find both balanced XLR input and output connectors and unbalanced RCA input and output connectors on the rear panel. All of these connectors are active all the time so you may use them in any combination depending on your signal sources and power amplifiers. That is, if all your signal sources and power amplifier inputs are balanced, just use the XLR connectors. However, you may also use an unbalanced input and corresponding balanced output (or *vice versa*) if this scheme fits your system.

The MASTER VOLUME control may be set by turning the knob or by using the remote control. Just point the remote control at the little round window on the left side of the front panel and press **volume up** or **volume down**. The yellow LED (IR detect) will flash and the master volume knob will move one step up or down. Each channel has its own volume control in case you need this feature to balance the sound levels. This may be needed if your power amplifiers have different gains or if your speakers have different sensitivities. Each channel volume control can also be disabled individually if you prefer. Remove the top cover and follow the diagram on the next page. (This diagram is also included on the underside of the top cover plate.)

A mute function for all six channels is provided using the remote control, just press the **mute** button. The mute function is a toggle, that is, one press turns it on (the green LED will light) and the next press turns it off (the green LED will go off).

There is no remote control function to turn the 465 on and off because, in truth, it would have to **always** be on for the remote control on/off to be recognized! In the interest of electrical power conservation, you will have to use the power switch.



TO DISABLE THE CHANNEL VOLUME CONTROL FOR ANY OF THE SIX CHANNELS, FIND THE THREE WIRES COMING FROM THE CONTROL TO BE DISABLED. FOLLOW THESE WIRES TO THE 3-PIN CONNECTOR ON THE CIRCUIT BOARD AND DISCONNECT IT BY PULLING UP ON THE NYLON CONNECTOR SHELL. (THE CONNECTOR IS PLUGED INTO PINS 3, 4 AND 5.)

UNPLUG THE JUMPER FROM PINS 1 AND 2 AND PLACE IT ON PINS 3 AND 4.

TO RESTORE CHANNEL VOLUME CONTROL JUST "UNDO" THE ABOVE STEPS.

MODEL 465 – CIRCUIT DESCRIPTION

Please refer to the Block Diagram on the next page and to the circuit diagrams in Figures 1, 2 and 3.

Although the remote control unit and the microprocessor that decodes its output signals are digital, the volume control is totally analog. The direct current (DC) control voltage which is varied by turning the Master Volume control knob or by stepping the motor controls the volume in all six channels simultaneously.

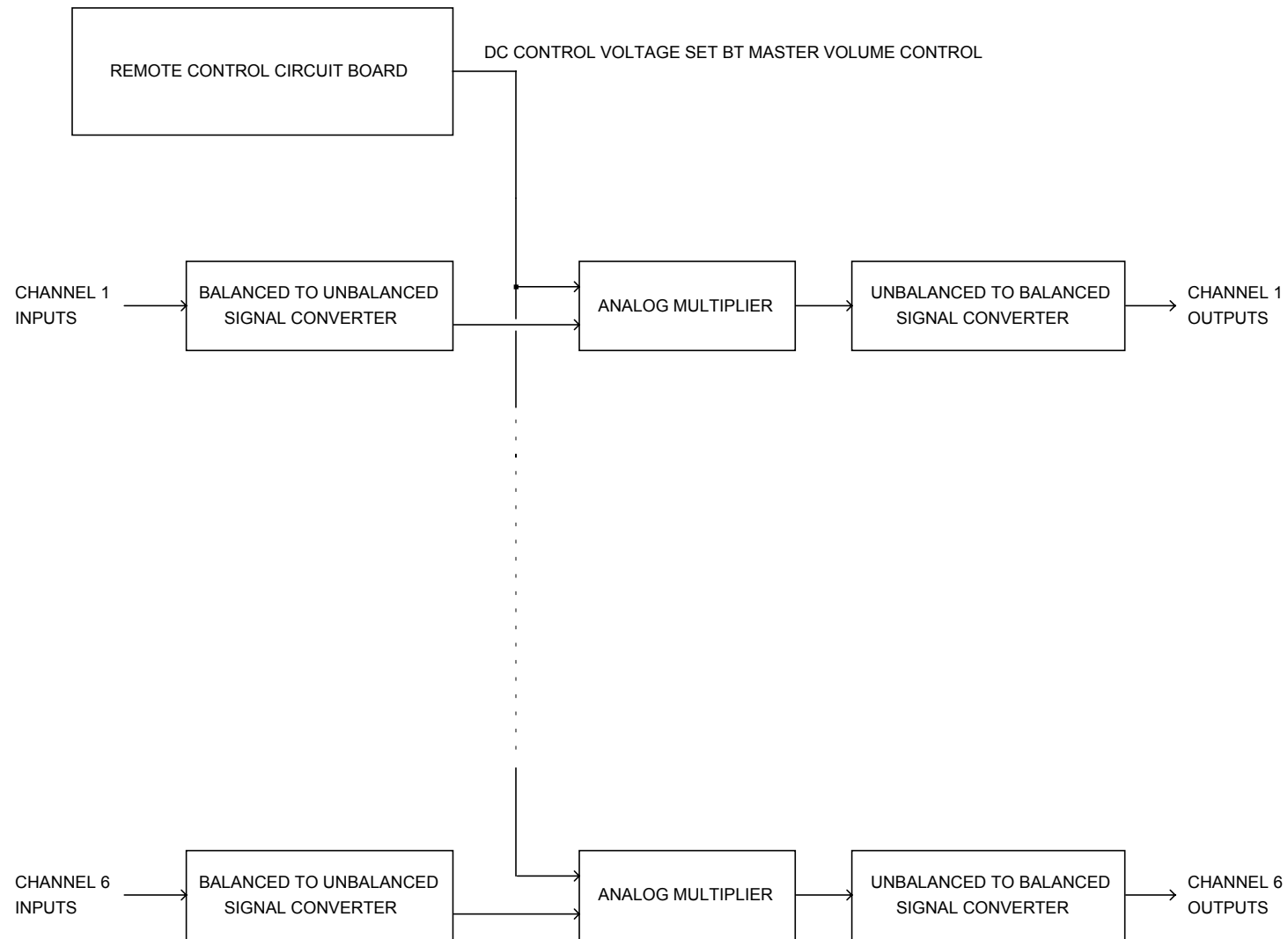
This voltage, which varies from (nearly) zero to +10 volts, is used to control the output signal level from six analog multipliers, U2 in Figure 2. The output signal voltage is:

$$V_o = (X * Y) / 10$$

where X is the audio signal level and Y is the DC control voltage. Thus as Y is varied from zero to 10, V_o varies from (nearly) zero to unity.

U1 in Figure 2 is a unity gain instrumentation amplifier that converts the balanced input to an unbalanced signal for the multiplier. U3 provides unity gain and a high input impedance to keep from loading the (optional) channel volume control. Finally, U4 converts the unbalanced signal back to a balanced output, also with unity gain.

The power supply is shown in Figure 3. U1, an LM675T power opamp, and its associated circuit effectively “splits” the DC voltage from the bridge rectifier (BR1) and filter capacitors C1 and C2 into ± 17 volts for the voltage regulators U2 through U5. Using two +12 volt regulators (U2 and U3) insures good isolation between the analog and digital parts of the circuit (so you don’t hear stepper motor noise in the audio).



Model 465 Simplified block diagram

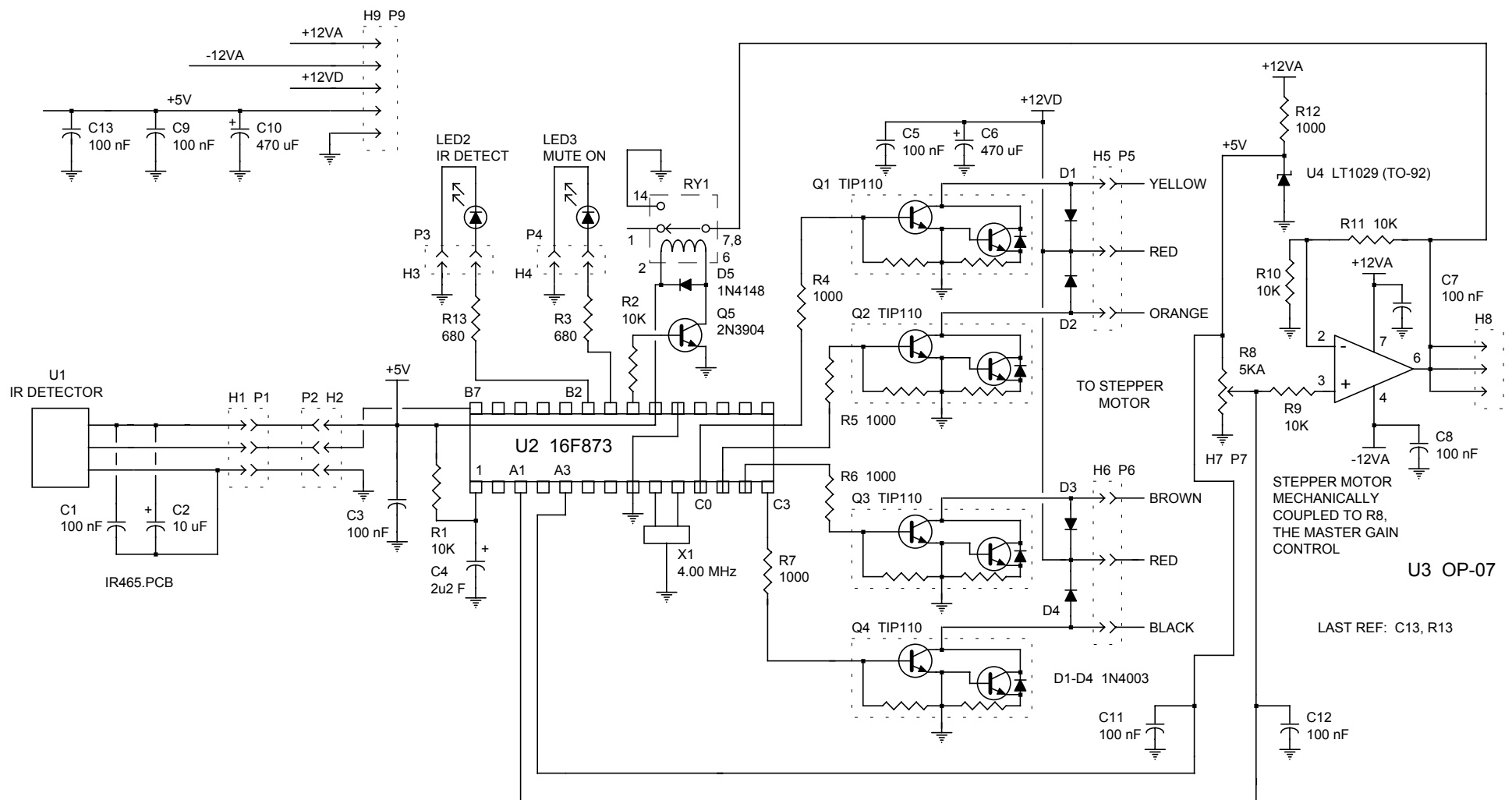


Fig. 1 -- IR remote control of stepper motor and control voltage generator
Circuit boards IR465.PCB and REMOT465.PCB

Bypass capacitors are per board, not per channel.

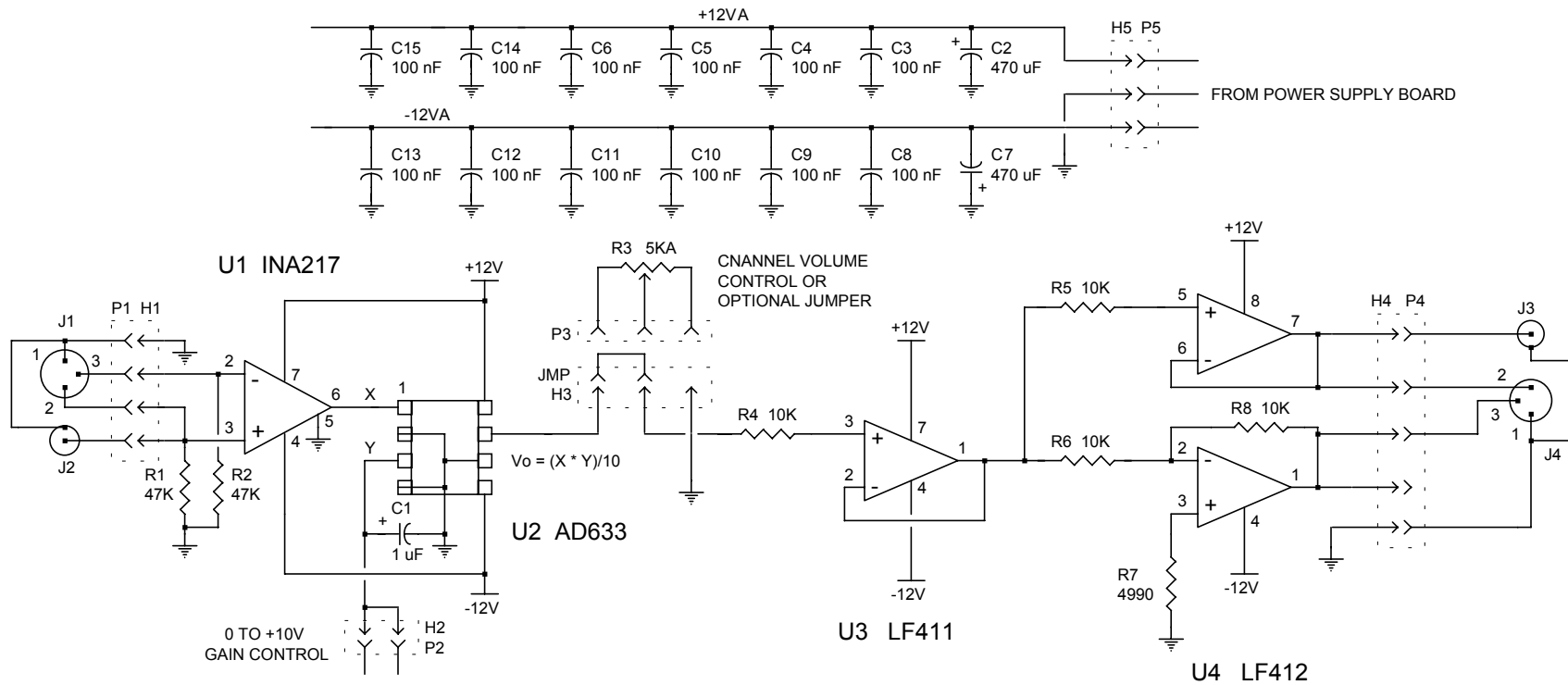


Fig. 2 -- One channel of the model 465 volume controller
Each MAIN465.PCB contains three channels

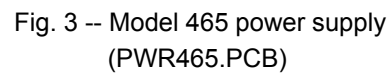
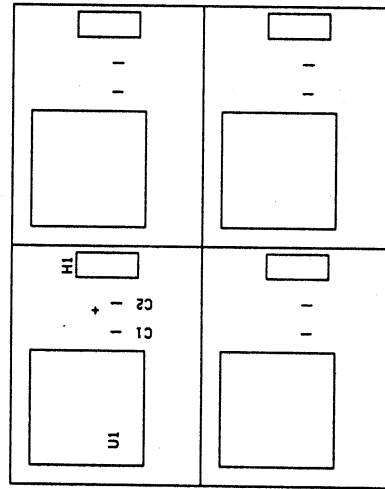
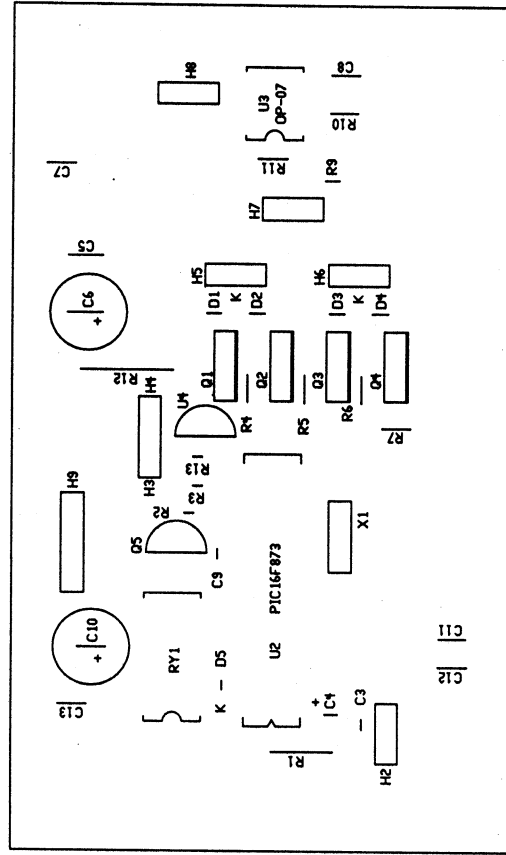


Fig. 3 -- Model 465 power supply
(PWR465.PCB)



IR Detector Parts Placement



REMOT465 Parts Placement

Fig. 4 -- Parts Placement

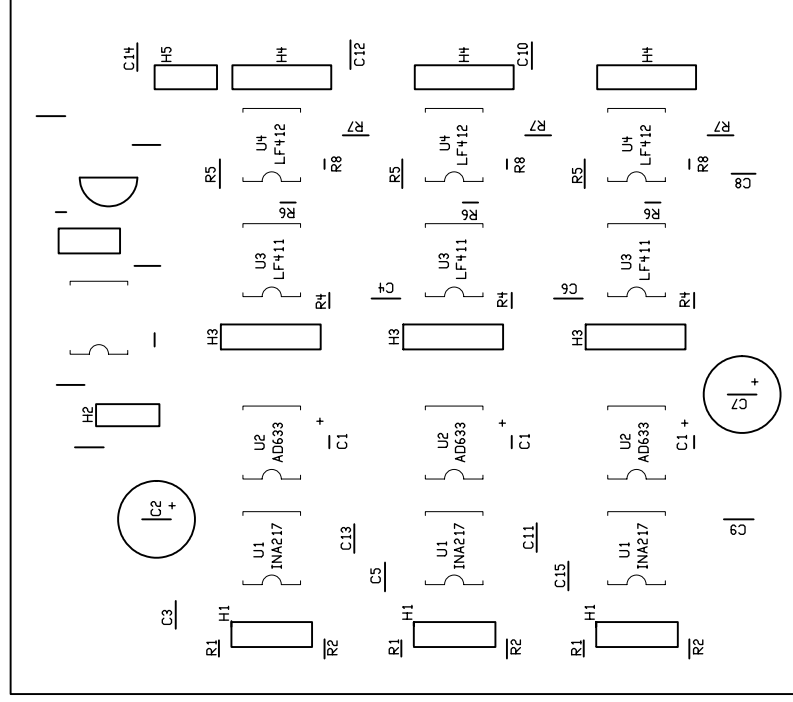


Fig. 5 -- MAIN465.PCB Parts Placement

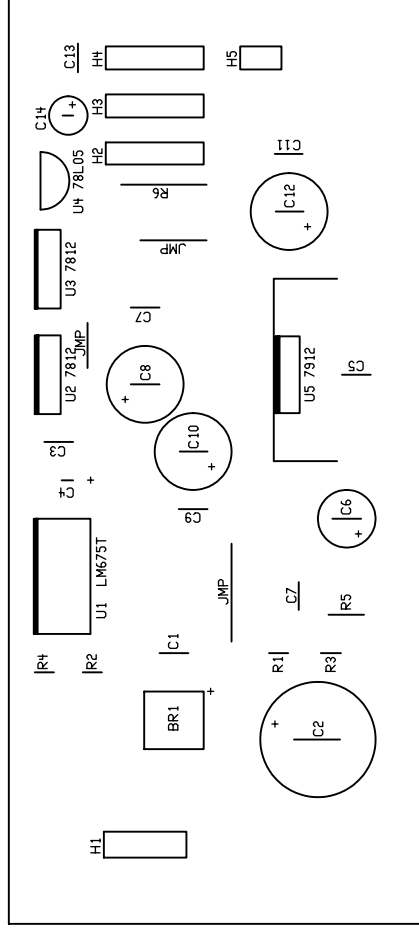


Fig. 6 -- PWR465.PCB Parts Placement

6-CHANNEL VOLUME CONTROL
with IR Remote Control
Model 465
Parts List

MAIN465.PCB (2 BOARDS ARE USED)

REFERENCE	VALUE	DESCRIPTION	MANUFACTURER	
R1, R2	47K	1%, 1/4 w, metal film	(Times six)	
R4, R5, R6, R7, R8	10K	1%, 1/4 w, metal film	(Times six)	
C1	1 uF	25 V, tantalum electrolytic	(Times six)	
C2, C7	470 uF	25 V, radial electrolytic	(Times two)	
C3, C4, C5, C6, C8, C9, C10, C11, C12, C13, C14, C15	100 nF	5%, 50 V, polyester film	(Times two)	
U1	INA217AIP	Instrumentation amplifier, 8-pin DIP	(Times six)	DigiKey
U2	AD633AN	Analog multiplier, 8-pin DIP	(Times six)	DigiKey
U3	LF411CN	Opamp, 8-pin DIP	(Times six)	Jameco
U4	LF412CN	Dual opamp, 8-pin DIP	(Times six)	Jameco
H1		4-pin male header	Molex WM4002	(Times six)
H2		2-pin male header	Molex WM4000	(Times two)
H3		3-pin male header	Molex WM4001	(Times six)
H4		5-pin male header	Molex WM4003	(Times six)
H5		3-pin male header	Molex WM4001	(Times two)
P1		4-pin terminal shell	Molex WM2013	(Times six)
P2		2-pin terminal shell	Molex WM2011	(Times two)
P3		3-pin terminal shell	Molex WM2012	(Times six)
P4		5-pin terminal shell	Molex WM2014	(Times six)
H5		3-pin terminal shell	Molex WM2012	(Times two)
		82 terminal pins	Molex WM1114	

(2) Circuit board, MAIN465.PCB
(8) 4-40 x 5/8" machine screws
(8) 4-40 hex nuts
(8) 4-40 hex spacers, nylon, 3/8" length

IR465.PCB (IR Detector)

C1	10 uF	25 V, tantalum electrolytic	
C2	100 nF	50 V, polyester film	
U1	IR detector module, 33 kHz pulse rate		Sharp GPIU581Y or equal

H1	3-pin male header	Molex WM4001
P1	3-pin terminal shell 3 terminal pins	Molex WM2012 Molex WM1114
	Circuit board, IR465.PCB IR filter (4) 4-40 x 1/4" machine screws (2) 4-40 hex spacers, nylon, 1/2" length	Edmund Scientific NT43-952

REMOT465.PCB (Remote Control)

R1, R2, R9, R10, R11	10K	1%, 1/4 w, metal film	
R3, R13	680	1%, 1/4 w, metal film	
R4, R5, R6, R7	1000	1%, 1/4 w, metal film	
R8	5000	Audio taper pot	Mouser (Alpha) 31VJ305
R12	1000	1%, 1/2 w, metal film	
C3, C5, C7, C8, C9, C11, C12, C13	100 nF	50 V, polyester film	
C4	2u2	25 V, dipped tantalum electrolytic	
C6, C10	470 uF	25 V, radial electrolytic	
D1 - D4	1N4003	Silicon diode	
D5	1N4148	Silicon diode	
U2	PIC16F873	Microprocessor programmed with FIRM465 software	
U3	OP-07CP	Opamp, 8-pin DIP	
U4	LT1029	+5 V reference, TO-92	
Q1 - Q4	TIP110	NPN Darlington transistor, TO-220	
Q5	2N3904	Silicon NPN transistor, TO-92	
RY1		SPDT relay	Potter & Brumfield JWD-172-155 or equal
X1	4.00 MHz	Ceramic resonator	
H2, H5, H6, H7, H8	3-pin male header	Molex WM4001	
H3, H4	2-pin male header	Molex WM4000	
H9	5-pin male header	Molex WM4003	
P2, P5, P6, P7, P8	3-pin terminal shell	Molex WM2012	
P3, P4	2-pin terminal shell	Molex WM2011	
P5	5-pin terminal shell	Molex WM2014	
	24 terminal pins	Molex WM1114	

Circuit board, REMOT465.PCB

- (1) 28-pin DIP socket for U2
- (4) 4-40 x 5/8" machine screws
- (4) 4-40 hex spacers, nylon, 3/8" length
- (4) 4-40 hex nuts

PWR465.PCB (Voltage Regulators)

R1, R3	22K1	1%, 1/4 w, metal film	
R2	1000	1%, 1/4 w, metal film	
R4	15K	1%, 1/4 w, metal film	
R5	1 ohm	5%, 1/2 w, carbon film	
R6	604	1%, 1/4 w, metal film	
C1, C3, C5, C7, C9, C11, C13	100 nF	5%, 50 V, polyester film	
C2	2200 uF	50 V, radial electrolytic	
C4	47 uF	50 V, radial electrolytic	
C6	100 uF	50 V, radial electrolytic	
C8, C10, C12, C14	220 uF	50 V, radial electrolytic	
C15	220 nF	5%, 50 V, polyester film	
BR1		Silicon diode bridge, 100 PIV, 1 A	
U1	LM675T	Power opamp, TO-220/5	Jameco 120926
U2, U3	7812A	+12 V regulator, TO-220	Mouser L7812CP
U4	78L05A	+5 V low-power regulator, TO-92	Jameco 51182
U5	7912A	-12 V regulator, TO-220	Mouser L7912CP
H1	4-pin male header		Molex WM4002
H2, H3, H4	5-pin male header		Molex WM4003
H5	2-pin male header		Molex WM4000
P1	4-pin terminal shell		Molex WM2013
P2, P3, P4	5-pin terminal shell		Molex WM2014
P5	2-pin terminal shell		Molex WM2011
	21 terminal pins		Molex WM1114
	Circuit board, PWR465.PCB		
	(4) 4-40 x 5/8" machine screws		
	(4) 4-40 hex spacers, nylon, 3/8" length		
	(4) 4-40 hex nuts		
	Heat sink for U1, U2 and U3	1/8" alum angle, 1.5 x 1.5 x 3.5	
	Heat sink for U5	Jameco 42622	

ENCLOSURE MOUNTED PARTS

	Rack mount enclosure, 3.5 x 7 x 19 inches	Sescom model 2RU7
	Front panel	Metalphoto of Cincinnati, PN m465frnt
	Rear panel	Metalphoto of Cincinnati, PN m465back
	Stepper motor, unipolar, 12 VDC, 20 ohms, 7.5 degree steps	Minebea PM55L-048 or equal
	Subassembly for stepper motor and Master Volume control	TDL SM465
	5K, audio taper pot channel vol control	Mouser (Alpha) 31VJ305 (Times six)
	Knob for Channel Volume control	Jameco (Eagle 45KN032) (Times six)
	Knob for Master Volume control	Jameco (Eagle 45KN033)
LED1	LED, red, panel mount (power on)	Lumex (DigiKey 67-1147)
LED2	LED, yellow, panel mount (IR detect)	Lumex (DigiKey 67-1149)
LED3	LED, green, panel mount (mute on)	Lumex (DigiKey 67-1148)
F1	Fuse holder, panel mount, 5 mm with 1A fuse	Littlefuse (Mouser 576-03455LS1H)
J1, J3	Connector, female RCA, panel mount, black	Kobiconn (Mouser 161-1052) (Times six)
J2	XLR connector, panel mount female	Parts Express 090-349 (Times six)
J4	XLR connector, panel mount, male	Parts Express 090-348 (Times six)
J13	Power in connector, 2.5 mm male, insulated	Mouser 163-4303
S1	Toggle switch, SPST, 5A	
	Misc. hardware, teflon insulated wire, and shrink tubing	

OTHER SYSTEM COMPONENTS

Std. TV remote control unit with batteries	Tele Commander, TC101
Wall AC transformer, 24 VAC @ 400 mA	Various manufacturers