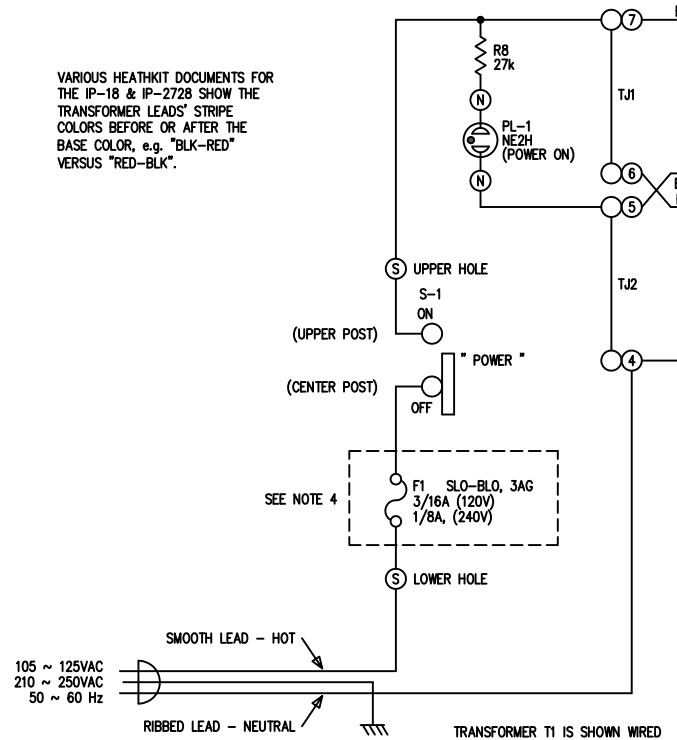


SEMICONDUCTOR REPLACEMENT TABLE

HEATHKIT PART NUMBER	GENERIC PART NUMBERS			LIMITED SPECIFICATIONS
	FIRST	SECOND	THIRD	
57-65	1N4002	1N4004		SILICON DIODE, 100PIV, 1A
56-45 (VR-20)	1N5932A			20V ZENER DIODE, 1.5W
56-26	1N191	NTE109	1N5711	GERMANIUM DIODE, 90PIV, 500mA
417-140	2N4304	2N4416		N-CHANNEL JFET
417-109	2N3566			NPN TRANSISTOR, 30V, 200mA, TO-105
417-215/417-162	2N3055	2N305	MHT9210	NPN TRANSISTOR, 100V, 15A, 115W, TO-3
417-118	2N3393	2N3416		NPN TRANSISTOR, 25V, 0.5A, 0.625W, TO-92

'FIRST' & 'SECOND' PART NUMBERS ARE HEATHKIT'S RECOMMENDATIONS, 'THIRD' PART NUMBER SHOULD WORK WHERE TWO 417 SERIES HEATHKIT PART NUMBERS ARE SHOWN FOR A PART, THE FIRST NUMBER IS THE BEST CHOICE

VARIOUS HEATHKIT DOCUMENTS FOR THE IP-18 & IP-2728 SHOW THE TRANSFORMER LEADS STRIPE COLORS BEFORE OR AFTER THE BASE COLOR, e.g. "BLK-RED" VERSUS "RED-BLK".

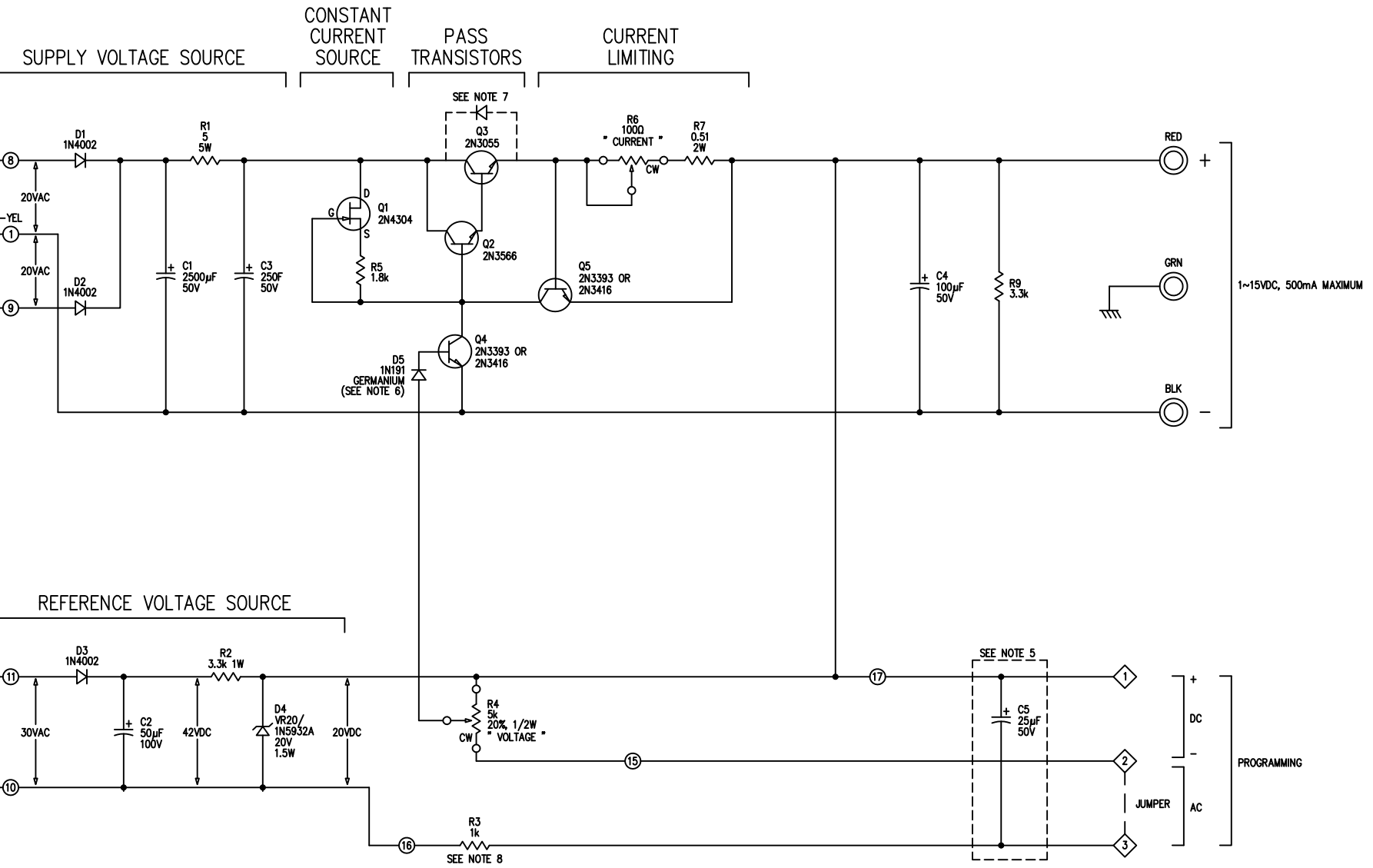


TRANSFORMER T1 IS SHOWN WIRED FOR 120VAC POWER. VOLTAGE SELECTION IS MADE WITH BARE WIRE JUMPERS ON THE CIRCUIT BOARD, IN HOLES ADJACENT TO THE NUMBERED TRANSFORMER WIRING HOLES. FOR 240VAC POWER, REMOVE JUMPERS T1 & T2, AND INSTALL A JUMPER BETWEEN THE HOLES ADJACENT TO NUMBERED HOLES 5 & 6.

CURRENT LIMITING/CONSTANT CURRENT MODE NOTES:

NORMALLY, THE "CURRENT" CONTROL R6 SHOULD BE SET FULLY CLOCKWISE. IF IT IS DESIRED TO HAVE THE POWER SUPPLY LIMIT THE MAXIMUM OUTPUT CURRENT, i.e. "CURRENT LIMITING" OR "CONSTANT CURRENT" MODE, FOLLOW THE PROCEDURE BELOW:

- SET "VOLTAGE" CONTROL R4 AND "CURRENT" CONTROL R6 FULLY COUNTERCLOCKWISE, AND DISCONNECT ANY LOAD FROM THE OUTPUT TERMINALS.
- WITH A VOLTMETER CONNECTED TO THE OUTPUT TERMINALS, TURN THE "VOLTAGE" CONTROL R4 UNTIL THE METER READS THE DESIRED VOLTAGE.
- CONNECT THE DESIRED LOAD TO THE OUTPUT TERMINALS, WHILE KEEPING THE VOLTMETER CONNECTED.
- ADJUST "CURRENT" CONTROL R6 CLOCKWISE UNTIL THE METER AGAIN SHOWS THE DESIRED VOLTAGE.
- IF THE LOAD INCREASES (IF ITS RESISTANCE DECREASES SO THAT THE POWER SUPPLY WOULD OTHERWISE NEED TO INCREASE OUTPUT CURRENT), THE SUPPLY WILL AUTOMATICALLY REDUCE THE OUTPUT VOLTAGE TO KEEP THE OUTPUT CURRENT CONSTANT AT THE ORIGINALLY SET VALUE. NOTE THAT THE SUPPLY DOES NOT INCREASE OUTPUT VOLTAGE ABOVE THE PRESET VOLTAGE VALUE IF THE LOAD RESISTANCE INCREASES TO MORE THAN ITS ORIGINAL VALUE.



NOTES:

- 1) RESISTORS ARE 1/2W, 10% UNLESS MARKED DIFFERENTLY. RESISTANCES GIVEN WITHOUT A "K" OR "M" SUFFIX ARE IN OHMS.
- 2) NUMBERS IN DIAMOND OUTLINES ARE THE "PROGRAMMING" TERMINALS ON THE REAR OF THE POWER SUPPLY.
- 3) ROUND TERMINALS WITH MARKINGS INSIDE LARGE CIRCLES ARE FOR NUMBERED HOLES ON THE CIRCUIT BOARD; SOME REVISIONS OF THE BOARD'S SILK SCREEN MIGHT NOT INCLUDE THE HOLE NUMBERING; HOWEVER THE ASSEMBLY INSTRUCTIONS AND DIAGRAMS REFERENCE THEM BY THOSE NUMBERS.
- 4) THE IP-18 AND THE IP-2728 ARE ALMOST EXACTLY THE SAME POWER SUPPLY, WITH THE EARLIER IP-18 HAVING THE SO-CALLED "NEW LOOK" STYLING AND PAINT COLOR SCHEME, WHILE THE LATER IP-2728 HAD THE "POST NEW LOOK" STYLING AND PAINT COLORS. THE IP-18 KIT DID NOT INCLUDE A LINE FUSE; THIS WAS ADDED WITH THE IP-2728 VERSION. THE CIRCUIT BOARD WAS NOT REVISED, SO THE FUSE 'F1' WAS ADDED IN-LINE WITH THE WIRING BETWEEN THE CIRCUIT BOARD'S LOWER HOLE MARKED 'S' AND THE CENTER POST OF THE POWER SWITCH 'S1'. A FUSE MAY BE ADDED TO AN IP-18 BY CUTTING THE WIRE BETWEEN THE LOWER 'S' HOLE AND THE CENTER POST OF 'S1', AND CONNECTING THE CUT WIRE ENDS TO EITHER SIDE OF A SUITABLE FUSE (THE IP-2728 DID NOT USE A FUSE HOLDER, RATHER THE STRIPPED WIRE ENDS WERE SIMPLY SOLDERED TO THE METAL CAPS OF THE 3AG FUSE, WITH AN INSULATING SLEEVE COVERING THE FUSE AND ITS CAP CONNECTIONS).
- 5) THE IP-18, AND EARLIER PRODUCTION VERSIONS OF THE IP-2728, DID NOT INCLUDE CAPACITOR 'C5', WHICH WAS SIMPLY SOLDERED BETWEEN 'PROGRAMMING' TERMINALS 1 & 3 WITH THE CAPACITOR'S (+) END ORIENTED TO TERMINAL 1.
- 6) FOR D6, 1N191 DIRECT REPLACEMENT IS NTE109. POSSIBLE ALTERNATE PARTS (UNPROVEN) ARE 1N5711, 1N34A.
- 7) IT HAS BEEN REPORTED THAT A HEATHKIT SERVICE BULLETIN RECOMMENDED ADDING A 1N4002 DIODE ACROSS TRANSISTOR 'Q3', WITH THE DIODE'S CATHODE CONNECTED TO THE TRANSISTOR'S COLLECTOR AND THE DIODE'S ANODE CONNECTED TO THE TRANSISTOR'S EMITTER; THIS MODIFICATION CAN HELP PREVENT DAMAGE TO 'Q3' IF AN EXTERNAL VOLTAGE SOURCE, WHOSE VOLTAGE IS GREATER THAN 15V, IS CONNECTED TO THE POWER SUPPLY'S OUTPUT TERMINALS.
- 8) RESISTOR R3 IS NOT ON THE CIRCUIT BOARD, RATHER ONE END OF IT TERMINATES AT NUMBERED HOLE 16 WHILE THE OTHER END TERMINATES AT REAR PANEL TERMINAL 3.
- 9) THIS SCHEMATIC WAS DRAWN, USING AUTOCAD, AS A MEANS TO GET A LEGIBLE SCHEMATIC FOR THE HEATHKIT IP-18 AND IP-2728. AN EFFORT HAS BEEN MADE TO SIZE AND SCALE COMPONENTS AND TEXT FOR THE LARGEST AND BEST VISIBILITY AND LEGIBILITY WHILE STILL FITTING ON A NORMAL 11 X 17" SHEET OF PAPER. ALL COMPONENT VALUES AND DESIGNATIONS, TERMINALS, WIRE COLORS, AND PRINTED CIRCUIT BOARD HOLES ARE SHOWN AS VERIFIED BY EXAMINATION OF A BUILT AND WORKING IP-2728 POWER SUPPLY.
- 10) THE COPYRIGHT HOLDER HEREBY GIVES PERMISSION TO FREELY DISTRIBUTE THIS DOCUMENT, AS LONG AS NO ALTERATIONS ARE MADE AND CREDIT IS GIVEN, ALONG WITH THE COPYRIGHT NOTICE.

REMOTE PROGRAMMING:

- 1) FOR DC PROGRAMMING, REMOVE THE JUMPER THAT IS NORMALLY BETWEEN THE TWO REAR PANEL TERMINAL BOARD'S "AC" POSITIONS; THIS DISCONNECTS THE INTERNAL REFERENCE VOLTAGE FROM THE POWER SUPPLY'S REGULATOR CIRCUIT. CONNECT THE EXTERNAL DC VOLTAGE SOURCE TO THE TERMINAL BOARD'S "DC" POSITIONS, OBSERVING THE + & - POLARITY. SET THE "VOLTAGE" AND "CURRENT" CONTROLS FULLY CLOCKWISE, AND THE POWER SUPPLY OUTPUT WILL NOW FOLLOW THE EXTERNAL DC PROGRAMMING VOLTAGE, UP TO THE MAXIMUM VOLTAGE LIMIT OF ABOUT 15VDC. THE "VOLTAGE" CONTROL CAN BE TURNED COUNTERCLOCKWISE AS MAY BE REQUIRED TO REDUCE THE SUPPLY'S OUTPUT VOLTAGE TO A VALUE LESS THAN THE APPLIED DC PROGRAMMING VOLTAGE. THE "CURRENT" CONTROL MAY BE SET LOWER IF LIMITED CURRENT OPERATION IS DESIRED.
- 2) FOR AC PROGRAMMING, REMOVE THE JUMPER THAT IS NORMALLY BETWEEN THE TWO REAR PANEL TERMINAL BOARD'S "AC" POSITIONS; THIS DISCONNECTS THE INTERNAL REFERENCE VOLTAGE FROM THE POWER SUPPLY'S REGULATOR CIRCUIT. CONNECT THE EXTERNAL AC PROGRAMMING VOLTAGE SOURCE TO THESE SAME TWO "AC" TERMINAL POSITIONS. THE AC SIGNAL SOURCE MUST HAVE A LOW IMPEDANCE, SUCH AS THE SECONDARY OF A POWER TRANSFORMER; A HIGHER IMPEDANCE SOURCE PROBABLY WILL NOT WORK WELL. THE POWER SUPPLY'S "VOLTAGE" CONTROL WILL SET THE AVERAGE DC VOLTAGE OF THE RESULTING PULSATING DC OUTPUT VOLTAGE, WHICH WILL FOLLOW THE AC PROGRAMMING SIGNAL'S PROFILE AND RATE OF CHANGE/FREQUENCY; NOTE THAT HIGHER FREQUENCY AC PROGRAMMING IS NOT PRACTICAL, AND THAT WHILE THE AC SIGNAL MAY GO POSITIVE AND NEGATIVE, THE SUPPLY'S OUTPUT CAN ONLY BE POSITIVE, SO THE "VOLTAGE" CONTROL'S SETTING MUST BE HIGH ENOUGH THAT IT CANCELS OUT THE NEGATIVE VOLTAGE EXCURSION OF THE AC SIGNAL.

HEATHKIT  
DC POWER SUPPLY IP-18/IP-2728  
SCHEMATIC DIAGRAM