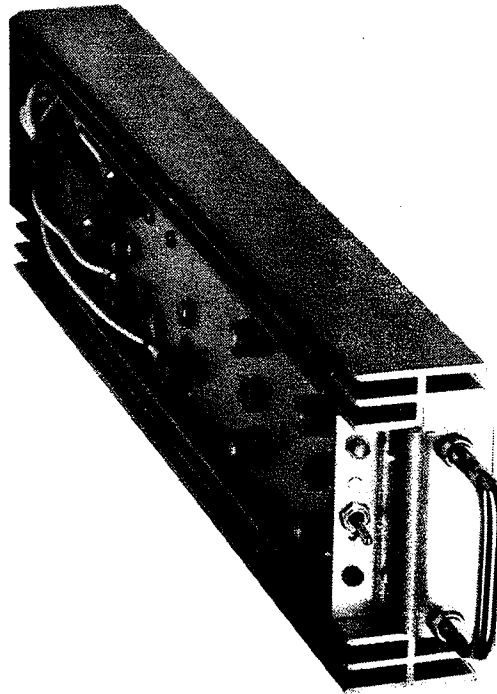


SERVICE INSTRUCTION

NAS13
RECTIFIER/REGULATOR MODULE



NAUTICAL ELECTRONIC LABORATORIES LIMITED

RR1 TANTALLON, HACKETT'S COVE

HALIFAX COUNTY, NOVA SCOTIA, CANADA

80J 3J0



NAS13 RECTIFIER/REGULATOR DIFFERENCE DATA SHEET
(Indicator Lamp Change)

INTRODUCTION

NAS13A rectifier/regulator modules utilize a light emitting diode instead of an incandescent lamp as their indicating lamp.

INTERCHANGEABILITY

The NAS13A and NAS13 (all variations) rectifier/regulator modules are functionally identical and they are fully interchangeable.

DIFFERENCES

The following changes to the NAS13 rectifier/regulator module appendix are required to support the NAS13A variation.

At table 1-2 - wiring list

Delete:

A1-B	DS1-1	26	White	22
------	-------	----	-------	----

Add:

A1-B	TT-1	26	White	22	
TT-1	XDS1 Anode	RAP09	Resistor	1000 Ohms	R2
XDS1 Cathode	Ground	-	Black	22	

At table 1-3 - Reference Designation Index

Delete:

DS1	Lamp, Incandescent, Amber, 18V, 0.026A	BAP08	300-1-HM631	55292
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Add:

DS1	Diode, Light Emitting, Amber	QK14	5082-4592	50434
R2	Resistor, Film, 1000 ohms, 2% 1/2W	RAP09	RL20S102G	36002
XDS1	Socket, LED	QK25	PS-200-B	15513

At table 1-4 - Quantities Per Unit Index

Delete:

BAP08	Lamp, Incandescent, Amber, 18V, 0.026A	300-1-HM631	55292	1
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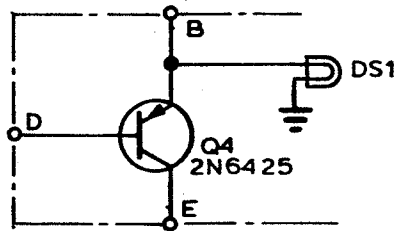
Add:

QK14	Diode, Light Emitting, Amber	5082-4592	50434	1
QK25	Socket, LED	PS-200-B	15513	1
RAP09	Resistor, Film, 1000 ohms, 2% 1/2W	RL20S102G	36002	1

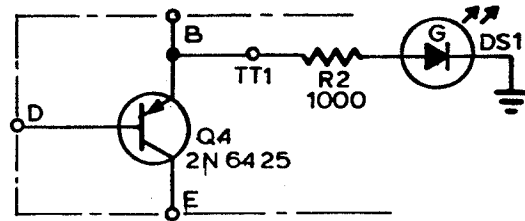
NAS13 RECTIFIER/REGULATOR DIFFERENCE DATA SHEET
(Indicator Lamp Change)

At figure 2 - Electrical Schematic

Change circuit for DS1 as shown in figure 1 of this difference data sheet.



NAS13

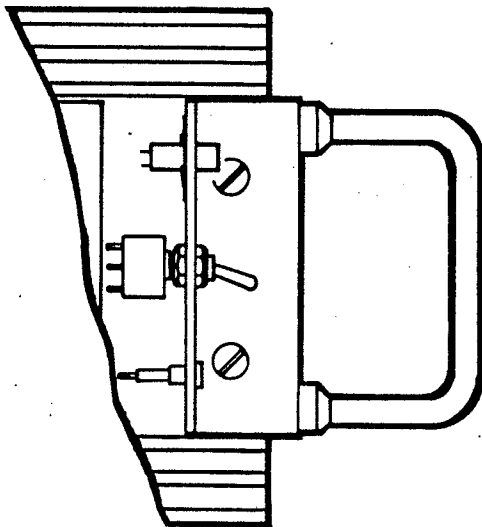


NAS13A

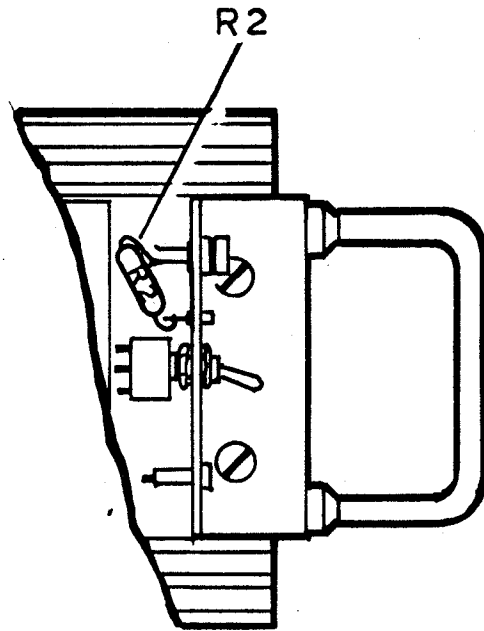
Figure 1 NAS13/NAS13A Electrical Schematic Differences

At figure 4 - Assembly Detail

Add resistor R1 to assembly detail as shown in figure 2 of this difference data sheet.



NAS13



NAS13A

Figure 2 NAS13/NAS13A Assembly Detail Differences

NAS13
RECTIFIER/REGULATOR MODULE

LIST OF EFFECTIVE PAGES

The list of effective pages lists the status of all pages in this manual. Pages of the original issue are identified by a zero in the Change No. column. Pages subsequently changed are identified by the date of the change number. On a changed page, the text affected by the latest change is indicated by a vertical bar in the margin opposite the changed material.

Original 15 June 1982

Total number of printed sides in this manual is 12 as listed below:

PAGE	CHANGE No.	DATE	PAGE	CHANGE No.	DATE
Title	0	01 June 1982	7	0	01 June 1982
Effective (Page 1)	0	01 June 1982	8	-	Blank
1	0	01 June 1982	9	0	01 June 1982
2	0	01 June 1982	10	-	Blank
3	0	01 June 1982	11	0	01 June 1982
4	0	01 June 1982	12	-	Blank
5	0	01 June 1982	13	0	01 June 1982
6	0	01 June 1982	14	-	Blank



NAS13
RECTIFIER/REGULATOR MODULE

INTRODUCTION

1. The following information on the NAS13 rectifier/regulator module is provided to allow a competent technician to troubleshoot and repair a defective module using tools and test equipment normally available at an AM radio station workshop. An alternative to these procedures is to utilize Nautel's module exchange/repair service facilities.

1.1 Bench testing procedures are provided which enable fault isolation to be carried out with the module removed from its associated transmitter. This allows the transmitter to operate normally when the defective modulator is replaced by a spare; or at a reduced output level if no spare module is available, while the module is being repaired.

1.2 Parts lists, wiring lists, electrical schematic diagrams and mechanical layout drawings for the NAS13 rectifier/regulator module are included in this appendix.

MECHANICAL CONFIGURATION

2. Mechanical configuration of the NAS13 rectifier/regulator module is shown in figures 3 and 4.

THEORY

3. The function of the NAS13 rectifier/regulator module, as its name implies, is twofold:

- (a) Rectification of the nominal three phase, 55 volt phase-to-phase ac input by a three-phase bridge to provide a nominal -79 volts dc.
- (b) Regulation of the output voltage against a high input ac voltage and/or surges on the ac input.

3.1 Rectification is achieved by the full wave bridge consisting of rectifiers CR1, CR2 and CR3 on one side and thyristors Q1, Q2 and Q3 on the other side of the bridge network. Fuses F1, F2 and F3 protect the rectifier bridge components against excessive load current. The outputs on P1-1, thru P1-4 are normally joined externally to the module to a choke which, in turn, feeds the storage capacitors of the NASM1 modulator module.

3.2 Regulation is achieved by gating thyristors Q1 thru Q3 off when the output voltage exceeds a preset value. Control voltages for the gates of Q1 thru Q3 are generated on printed circuit board A1 of the rectifier/regulator. This regulator circuit operates off a +15 volt dc regulated power supply which is fed to the circuit via a 1/2-amp fuse F4, an 85°C manually reset thermal switch and rectifier/regulator on/off switch S1. When +15 volts is applied to assembly A1, A1Q3 is immediately turned on which, in turn, switches on A1Q4, and allows a single phase, full wave rectified current to flow via R1, A1Q4 and CR4 to the output on P1-1. This limits the inrush current to the associated modulator's storage capacitors, and in normal operation allows the magnitude of the voltage on P1-1 to increase slowly. While the magnitude of the negative voltage is low (between zero and -50 volts) A1Q2 is turned on via the resistive network R6, R7, R9 and R10. At a nominal -55 volts A1Q2 will turn off as the voltage on its base becomes less than +0.5 volts. This allows A1Q1, which was clamped off via A1Q2, to be turned on via the resistive network R4, R5, R6 and R7. Q4, which has been held off by A1R3, will then turn on and apply a gating voltage to thyristors Q1 thru Q3 via diodes A1CR1, A1CR2 and A1CR3. This gating voltage will remain on the thyristors until such time as the magnitude

NAS13
RECTIFIER/REGULATOR MODULE

of the voltage on P1-1 becomes large enough to reduce the voltage on the base of A1Q1 below its turn-on threshold. The thyristors will remain off to allow the output voltage to drop in level to where A1Q1 is again turned on, thus providing regulation of the output voltage to a preset level determined by the setting of variable resistor A1R4. Adjustment of this regulation voltage may be made over a nominal range of -70 to -75 volts dc.

3.3 Whenever Q4 is off and +15 volts is applied via S1, DS1 will be turned on. DS1 provides an indication that the regulator is active; it does not indicate whether or not the module is functional.

FUNCTIONAL TEST

4. Functional testing of the rectifier/regulator module is part of the overall transmitter calibration procedure (see section 5 of the transmitter manual). Should a faulty rectifier/regulator be indicated by these tests, it should be removed from the transmitter for fault isolation and repair.

BENCH TESTING

5. Bench testing of the NAS13 rectifier/regulator module is done by checking individual circuit functions independently as the normal input voltages and output load present in the transmitter are not likely to be available for bench testing. Test the module using the following procedures:

- (a) Connect NAS13 rectifier/regulator module to test setup as shown in figure 1. (Switch S1 should be off).
- (b) Apply lead labelled (B) to P1-1.
- (c) Adjust zero to -75 volt power supply to -40 volts. Apply lead labelled (A) to P1-7.
- (d) Check input current is zero.
- (e) Switch S1 on. Check input current goes to 260 ± 20 mA, and DS1 is on.
- (f) Change lead (B) to P1-4. Ground base of A1Q2 at junction of R9 and R10. Check input current goes to 400 ± 40 mA and DS1 is off. Remove ground at base of A1Q2.
- (g) Change lead (A) to P1-9 and lead (B) to P1-2. Check input current is zero.
- (h) Ground base of A1Q2. Check input current goes to 400 ± 40 mA. Remove ground at base of A1Q2.
- (i) Change lead (A) to P1-11 and lead (B) to P1-3. Check input current is zero.
- (j) Ground base of A1Q2. Check input current goes to 400 ± 40 mA. Remove ground at base of A1Q2.
- (k) Change lead (A) to P1-7 and disconnect lead (B). Check DS1 is on.

NAS13
RECTIFIER/REGULATOR MODULE

- (l) Increase magnitude of zero to -75 volt power supply output until DS1 turns off. Check voltage is 53 ± 3 volts.
- (m) Continue to increase negative voltage input to -72.5. Adjust A1R4 until DS1 just turns on.
- (n) Disconnect NAS13 rectifier/regulator module from test setup. Using multimeter (ohms), check operation of rectifiers CR1, CR2, CR3 and CR4.

REPAIR

6. Due to the nature of the high power and high current devices used in the NAS13 rectifier/regulator module, special precautions must be taken when making repairs to these modules.

6.1 FUSE REPLACEMENT: Fuses F1, F2 and F3 are special fast-acting 40 amp fuses designed to protect semiconductor devices. A special protective plexiglass cover is mounted over fuses F1, F3 and thyristors Q1, Q2, Q3. This cover is designed to prevent accidental shorting of the 55 volt, high current, ac supply to these devices and to provide mechanical protection for cathode and gate terminals of the thyristors. It is essential to ensure this plexiglass cover is in place before attempting to insert one of these modules into a transmitter cabinet.

6.1.2 When replacing a fuse, loosen nuts holding the fuse in place, swing the fuse clear of the mounting bolt and remove. Insert new fuse ensuring the fuse terminals are between a flat washer and a solder lug, or between two flat washers. Tighten securing nuts firmly to ensure the lock washer is functioning.

6.2 REPAIR OF ASSEMBLY A1: To replace a component on printed circuit board assembly A1, remove two nuts holding the board in place. The board may then be raised and folded back on its leads to allow removal and replacement of any component. When remounting the board in position, care must be taken to prevent pinching of leads that run between the board and main chassis.

6.3 REPLACEMENT OF THYRISTORS Q1, Q2 OR Q3: Cathode and gate terminals of these devices require special precautions when handling in order to prevent cracking the header seal of these terminals. Do not attempt to remove these components until leads have been carefully unsoldered. When mounting the new device, to ensure good terminal contact is made via mica insulating washers without damaging washers. Hold body of the device from turning with spin-tight tool while tightening the retaining nut to a torque of from 25 to 30 inch-pounds. After device is securely mounted, reconnect cathode and gate terminals taking care not to place any excessive mechanical stress on them.

6.4 REPLACEMENT OF COMPONENTS ON THE RECTIFIER PLATE ASSEMBLY: thyristors Q1 thru Q3 may be replaced without removing this assembly (see above). However, to replace CR1 thru CR4, S2 and Q4, it is necessary to remove this assembly from the main chassis. To prevent damage to other components on the assembly, unsolder all leads and header terminals of Q1 thru Q3 and CR1 thru CR4 before removing the assembly. Use appropriate care not to place mechanical stresses on these terminals.

NAS13
RECTIFIER/REGULATOR MODULE

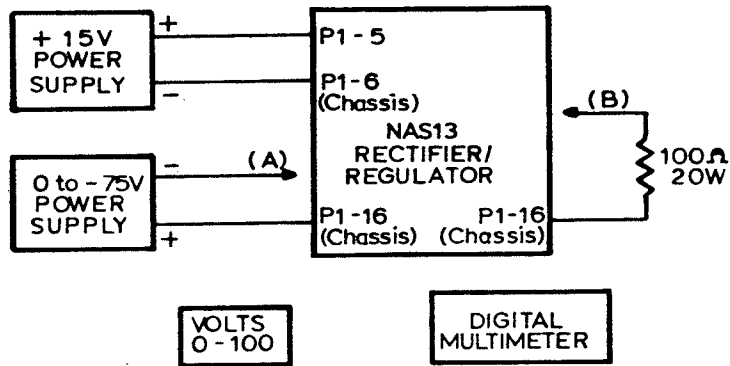


Figure 1 - Test Setup

Table 1 - Test Equipment

NOMENCLATURE	PART, MODEL, OR TYPE NUMBER (EQUIVALENTS MAY BE USED)
Digital Multimeter	3 1/2 digit, ac and dc volts, ohms and amps, $\pm 0.5\%$ accuracy. Beckman 3010
15 Vdc Power Supply	15 Volts 1 Amp
Variable dc Power Supply	0-100 Volts 1/2 Amp
Resistor	100 ohms, 20 Watts

NAS13
RECTIFIER/REGULATOR MODULE

Table 2 - Wiring List NAS13 Rectifier Regulator Module

SOURCE	DESTINATION	CODE	SIZE	FUNCTION
P1-1	CR4-Anode	1 White	14	
P1-2	Q1-Anode	2 White	14	
P1-3	Q2-Anode	3 White	14	
P1-4	Q3-Anode	4 White	14	
P1-5	F4-1	5 Red	22	
P1-6	A1-C	6 Black	22	
-	-	7 Not Used		
-	-	8 Not Used		
-	-	9 Not Used		
-	-	10 Not Used		
-	-	11 Not Used		
-	-	12 Not Used		
F1-2	CR3-Anode	13 White	14	
F3-2	CR2-Anode	14 White	14	
-	-	15 Not Used		
F2-2	CR1-Anode	16 White	14	
S1-2	A1-A	17 Red	22	
A1-B	Q4-Emitter	18 White	22	
A1-D	Q4-Base	19 White	22	
A1-E	Q4-Collector	20 White	22	
A1-H	Q2-Gate	21 White	22	
A1-J	Q3-Gate	22 White	22	
A1-K	CR4-Anode	23 White	22	
A1-L	R1-2	24 White	22	
A1-TP1	TP1	25 White	22	
A1-B	DS1-1	26 White	22	
F4-2	S2-1	27 Red	22	
S2-2	S1-1	28 Red	22	
P1-13	Ground	- Black	14	Jumper
P1-14	Ground	- Black	14	Jumper
P1-15	Ground	- Black	14	Jumper
P1-16	Ground	- Black	14	Jumper
P1-7	F1-1	- White	16	Jumper
P1-8	F1-1	- White	16	Jumper
P1-9	F2-1	- White	16	Jumper
P1-10	F2-1	- White	16	Jumper
P1-11	F3-1	- White	16	Jumper
P1-12	F3-1	- White	16	Jumper
F1-2	Q3-Cathode	- -	16	Jumper
F3-2	Q2 Cathode	- -	16	Jumper
F2-2	Q1-Cathode	- White	16	Jumper
CR3-Anode	R1-1	- -	22	Jumper
A1-F	Q1-Gate	- -	22	Jumper

NAS13
RECTIFIER/REGULATOR MODULE

Table 3 NAS13 Rectifier/Regulator Module Reference Designation Index

REF DES	NAME OF PART AND DESCRIPTION	NAUTEL'S PART NO.	JAN, MIL OR MFR PART NO.	(OEM) MFR CODE
-	Rectifier/Regulator Module	NAS13	139-5000	37338
A1	Regulator PCB	139-5006	139-5006	37338
A1C1	Capacitor, Ceramic, 0.01uF 10%, 100V	CCG04	CKR05BX103KL	56289
A1C2	Capacitor, Ceramic, 0.22uF 10%, 50V	CCG08	CKR06BX224KL	56289
A1C3	Capacitor, Ceramic, 0.1uF 10%, 100V	CCG07	CKR06BX104KL	56289
A1C4	Capacitor, Ceramic, 0.1uF 10%, 100V	CCG07	CKR06BX104KL	56289
A1CR1	Diode	QK35	1N4246	12969
A1CR2	Diode	QK35	1N4246	12969
A1CR3	Diode	QK35	1N4246	12969
A1Q1	Transistor, NPN	QA35	2N930	04713
A1Q2	Transistor, NPN	QAP06	2N2222	04713
A1Q3	Transistor, PNP	QB11	2N5416	04713
A1Q4	Thyristor	QB15	2N2326	04713
A1R01	Resistor, Film, 560 ohms, 2% 1/2W	RAP08	RL20S561G	36002
A1R02	Resistor, Film, 560 ohms, 2% 1/2W	RAP08	RL20S561G	36002
A1R03	Resistor, Film, 33K ohms, 2% 1/2W	RAP15	RL20S333G	36002
A1R04	Resistor, Variable, 10K ohms, 1/2W	RW27	63X103T000	02111
A1R05	Resistor, Film, 47K ohms, 2% 1/2W	RD15	RL20S473G	36002
A1R06	Resistor, Film, 100K ohms, 2% 1/2W	RAP17	RL20S104G	36002
A1R07	Resistor, Film, 150K ohms, 2% 1/2W	RD21	RL20S154G	36002
A1R08	Resistor, Film, 10K ohms, 2% 1/2W	RAP13	RL20S103G	36002
A1R09	Resistor, Film, 330K ohms, 2% 1/2W	RAP19	RL20S334G	36002
A1R10	Resistor, Film, 470K ohms, 2% 1/2W	RD27	RL20S474G	36002
A1R11	Resistor, Film, 10K ohms, 2% 1/2W	RAP13	RL20S103G	36002
A1R12	Resistor, Film, 1000 ohms, 2% 1/2W	RAP09	RL20S102G	36002
C1	Capacitor, Tantalum, 1.0uF 50V	CCP24	CSR13G105KM	56289
C2	Capacitor, Tantalum, 1.0uF 50V	CCP24	CSR13G105KM	56289
C3	Capacitor, Tantalum, 1.0uF 50V	CCP24	CSR13G105KM	56289
CR1	Diode	QK17	1N1187A	04713
CR2	Diode	QK17	1N1187A	04713
CR3	Diode	QK17	1N1187A	04713
CR4	Diode	QK17	1N1187A	04713
DS1	Lamp, Incandescent, Amber 18V, 0.026A	BAP08	300-1-HM631	55292
F1	Fuse, 40 Amp, 130V	FC04	ANN40	71400
F2	Fuse, 40 Amp, 130V	FC04	ANN40	71400
F3	Fuse, 40 Amp, 130V	FC04	ANN40	71400
F4	Fuse, 1/2 Amp, Slow Blow	FB13	MDL-250V-1/2A	71400
L1	Toroid, Coated	LX16	11-660B	33062
P1	Connector, Plug, 16-pin	JO10	P3-5416-SB	13150
Q1	Thyristor, Power	QB14	MCR64-5	04713
Q2	Thyristor, Power	QB14	MCR64-5	04713
Q3	Thyristor, Power	QB14	MCR64-5	04713
Q4	Transistor, PNP	QB10	2N6425 <i>2N6213</i>	04713
R1	Resistor, Wirewound, 47 ohms, 5%, 15W	RS24	HLM15-47 Ohms-5%	35005
S1	Switch, Toggle, 1PST	SA26	MSTE-106D	15605
S2	Thermostat 80°C	SC17	2455RN-87	14604
TP1	Jack, Tip, Violet	JO20	450-4355-1-0317	71279
XF4	Fuse Block, 1-pole	FA26	357001	75915

NAS13
RECTIFIER/REGULATOR MODULE

Table 4 NAS13 Rectifier/Regulator Module Quantities Per Unit Index

NAUTEL'S PART NO.	NAME OF PART AND DESCRIPTION	JAN, MIL OR MFR PART NO.	(OEM) MFR CODE	TOTAL IDENT PARTS
NAS13	Rectifier/Regulator Module	139-5000	37338	REF
139-5006	Regulator PCB	139-5006	37338	1
BAP08	Lamp, Incandescent, Amber 18V, 0.026A	300-1-HM631	55292	1
CCG04	Capacitor, Ceramic, 0.01uF 10%, 100V	CKR05BX103KL	56289	1
CCG07	Capacitor, Ceramic, 0.1uF 10%, 100V	CKR06BX104KL	56289	2
CCG08	Capacitor, Ceramic, 0.22uF 10%, 50V	CKR06BX224KL	56289	1
CCP24	Capacitor, Tantalum, 1.0uF 50V	CSR13G105KM	56289	3
FA26	Fuse Block, 1-pole	357001	75915	1
FB13	Fuse, 1/2 Amp, Slow Blow	MDL-250V-1/2A	71400	1
FC04	Fuse, 40 Amp, 130V	ANN40	71400	3
J010	Connector, Plug, 16-pin	P3-5416-SB	13150	1
J020	Jack, Tip, Violet	450-4355-1-0317	71279	1
LX16	Toroid, Coated	11-660B	33062	1
QA35	Transistor, NPN	2N930	04713	1
QAP06	Transistor, NPN <i>CN 2863</i>	2N2222	04713	1
QB10	Transistor, PNP	2N6425 <i>2N 2863</i>	04713	1
QB11	Transistor, PNP	2N5416	04713	1
QB14	Thyristor, Power	MCR64-5	04713	3
QB15	Thyristor	2N2326	04713	1
QK17	Diode	1N1187A	04713	4
QK35	Diode	1N4246	12969	3
RAP08	Resistor, Film, 560 ohms, 2% 1/2W	RL20S561G	36002	2
RAP09	Resistor, Film, 1000 ohms, 2% 1/2W	RL20S102G	36002	1
RAP13	Resistor, Film, 10K ohms, 2% 1/2W	RL20S103G	36002	2
RAP15	Resistor, Film, 33K ohms, 2% 1/2W	RL20S333G	36002	1
RAP17	Resistor, Film, 100K ohms, 2% 1/2W	RL20S104G	36002	1
RAP19	Resistor, Film, 330K ohms, 2% 1/2W	RL20S334G	36002	1
RD15	Resistor, Film, 47K ohms, 2% 1/2W	RL20S473G	36002	1
RD21	Resistor, Film, 150K ohms, 2% 1/2W	RL20S154G	36002	1
RD27	Resistor, Film, 470K ohms, 2% 1/2W	RL20S474G	36002	1
RS24	Resistor, Wirewound, 47 ohms, 5%, 15W	HLM15-47 Ohms-5%	35005	1
RW27	Resistor, Variable, 10K ohms, 1/2W	63X103T000	02111	1
SA26	Switch, Toggle, 1PST	MSTE-106D	15605	1
SC17	Thermostat 80°C	2455RN-87	14604	1



NAS13
RECTIFIER/REGULATOR MODULE

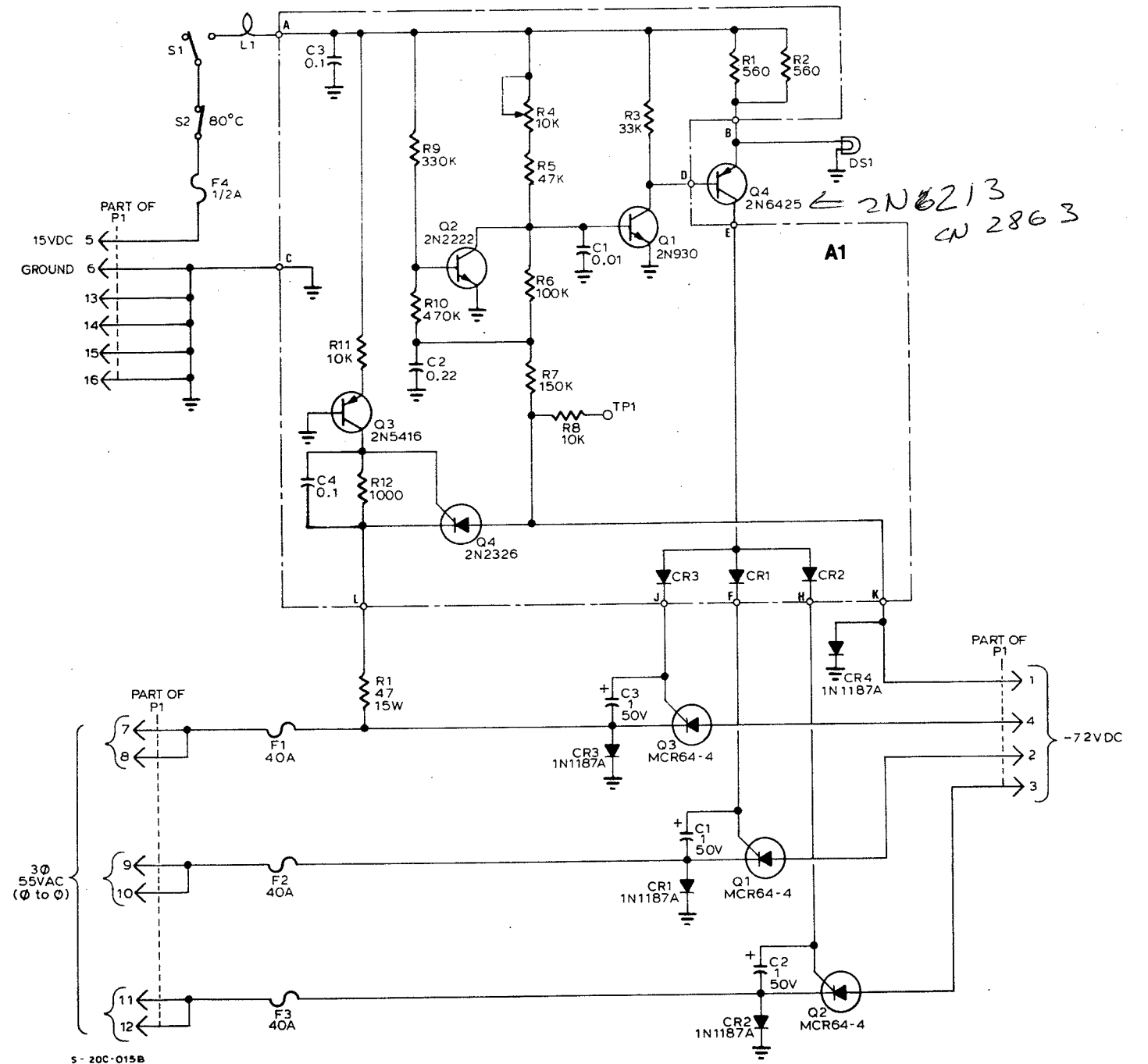
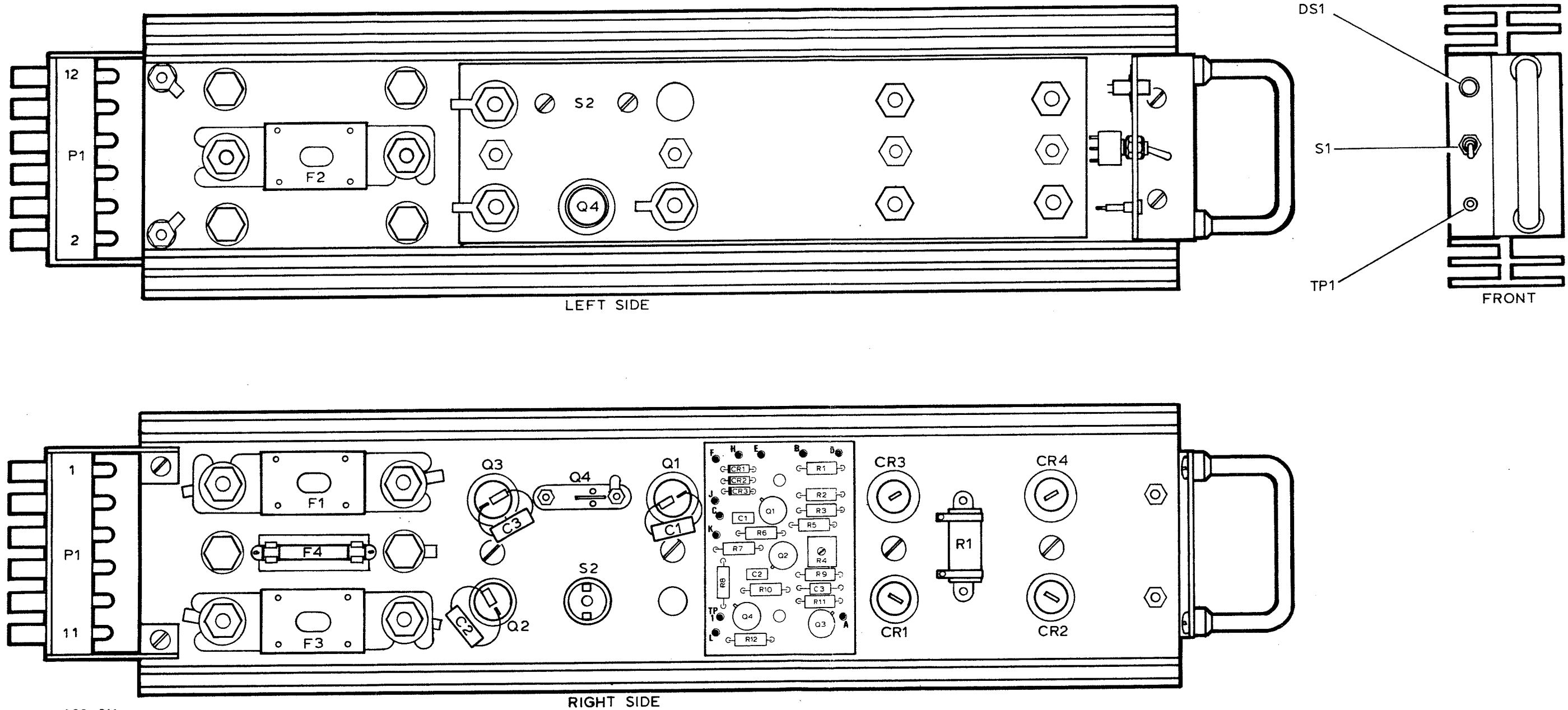


Figure 2 Electrical Schematic - NAS13 Rectifier/Regulator Module

NAS13
RECTIFIER/REGULATOR MODULE



M - 20C - 011

Figure 3 NAS13 Rectifier/Regulator Module

NAS13
RECTIFIER/REGULATOR MODULE

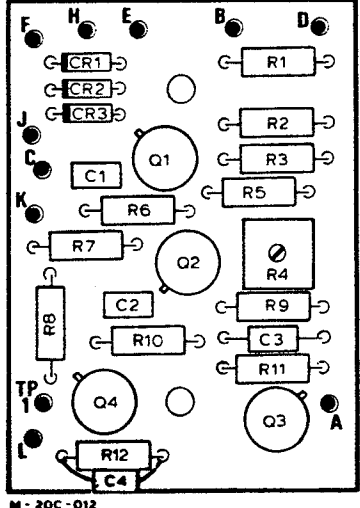


Figure 4 NAS13 Rectifier/Regulator PCB
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01 April 1983