INSTRUCTION BOOK

POWER SUPPLY

TYPE 251 MODEL 3

NORTHERN RADIO COMPANY

Incorporated

pace-setters

in quality

communication

equipment

STANDARD WARRANTY

All items of equipment and material used in this unit are guaranteed against defects in material, workmanship, or manufacture for a period of one year from date of shipment.

Under the terms of this Warranty, all items which fail within the period defined will be replaced or repaired F.O.B. point of manufacture without cost to purchaser. Prior approval of the company shall be obtained before returning any equipment. If upon examination of the defective item the company can show that failure was not due to any defective workmanship, material or manufacture, the company will bill the purchaser for the cost of replacement or repair.

Instruction Book
Power Supply

Type 251 Model 3

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2-21-63 ns

1. GENERAL

Purpose:

The Northern Radio Power Supply (plug-in), Type 251 Model 3, is used as a source of operating power for transistorized equipments, such as the Northern Radio Type 211 Keyers, Type 212 Converters, and Type 234 Diversity Combiners.

The Type 251 Power Supply is normally used in locations requiring only small numbers of units, such as the Type 244 Model 1 Shelf for two (2) Type 211 Keyers and the Type 246 Model 1 Shelf for three (3) Type 212 Converters, with loads totaling up to approximately 200 milliamperes.

Description:

The Power Supply, Type 251 Model 3, is a solid state supply employing a high gain transistor and a zener reference diode in its regulating circuit. The Type 251 Model 3, Power Supply, is 1-1/2" high x 3-5/8" wide x 7" long, equipped with a plug and locking devices for mounting on the back of appropriate shelves, such as the Type 244 Model 1, Dual Frequency Shift Tone Keyer Shelf and Type 246 Model 1, Triple Frequency Shift Tone Converter Shelf. This Power Supply incorporates a transformer so that there is no connection between the AC input and DC output. Further, all electrical connections are floating with respect to chassis so that any grounding arrangements desired may be used.

The use of solid state devices throughout this unit results in a device which is more compact, more reliable, and far more efficient than has been previously possible. Internal heat in the unit is somewhat dependent upon the characteristics of the load connected to the unit. Proper stabilization circuitry and adequate heat sinks have been provided to assure continuous operation without fear that excessive temperature rises will occur due to unit dissipation.

Technical Data:

A. C. Input:	115/230 VAC, 50/60 cycles ± 10%
D. C. Output:	14 volts DC ± 1-1/2 volts
Maximum Output:	200 milliamperes DC.
Special Features:	Plug-In Construction. Fits on appropriate shelves, such as the Northern Radio Type 244 Dual Frequency Shift Tone Keyer Shelf, and Type 246 Triple Frequency Shift Tone Converter Shelf.

2. DESCRIPTION OF OPERATION

(Refer to Block Diagram, NRC Dwg. No. A-251-3-02)

Block Diagram Analysis:

The Northern Radio Company Type 251 Model 3, Power Supply, may be considered to consist of four basic circuit sections:

1. Input Transformer
2. DC Source
3. Voltage Reference
4. Series Regulator

AC Power is transformer coupled to the full wave rectifier. The rectifier and filter capacitor then serve as a source of DC current for both the voltage reference and the load.

The series regulator consists of a single power transistor arranged as a variable impedance. The value of which, depends on the difference between the output voltage and the reference voltage.

Circuit Theory:

Power input transformer T1 provides isolation of the Power Supply from AC line, and applies alternating current at a suitable voltage to the full wave rectifier CR1, CR2.

The output of the rectifier circuit is smoothed in input capacitor C1 and applied directly to the voltage reference circuit R2, CR3 and to the series regulator circuit R1, Q1.

The reference voltage developes across CR3 is applied directly to the base of Q1. The impedance of Q1 then varies in such a way as to tend to maintain the output voltage constant at -14 volts DC.

Final filtering is provided by output capacitor C2.

3. INSTALLATION INSTRUCTIONS

Mechanical:

The Power Supply mounts horizontally on the mounting shelf and locks in position with two screws located on the front panel.

Electrical:

Before the power line is connected, it should be confirmed that the AC line voltage is 115 volts AC ± 10%, 50/60 cps.

No adjustments are required on the unit.

4. MAINTENANCE

Since the Power Supply incorporates long life reliable solid state devices, and since very little heat is generated in the unit, maintenance requirements are minimized.

In the event of malfunction, the Supply should be removed to the test bench and tested for compliance with the specification. If the performance is not as specified, the procedure of Section 5, Trouble Shooting Information, should be followed to locate the defective component.

In the infrequent instances when it is necessary to remove and replace components on the etched circuit board, it is desirable that a small soldering iron with limited heat storage be used.

5. TROUBLE SHOOTING INFORMATION

If the Power Supply fails to function properly, the following procedure will be helpful in locating the defective component.

Procedure:

1. Adjust the AC input voltage to 115 volts AC and the load to 100 ohms.

2. Measure the voltage across C2.

   REQUIREMENT: 12.5 to 15.5 volts DC

   If the requirement is not met, proceed to Step 3.

3. Measure the voltage across C1.

   REQUIREMENT: 26.0 to 36.0 volts DC

   If the requirement is met, proceed to Step 4.
   If the requirement is not met, proceed to Step 5.

4. Measure the voltage across CR3.

   REQUIREMENT: 13.3 to 14.7 volts DC

   If the requirement is not met, while the requirement of Step 3 is met, proceed to Step 6.
   If the requirement is met and if the voltage across C2 is not within the requirements of Step 2, disconnect, test and replace Q1, C2 or R1, as necessary, in that order.

5. Remove Q1 and again measure the voltage across C1.

   REQUIREMENT: 26.0 to 36.0 volts DC

   If the requirement is met, proceed to Step 6.
   If the requirement is not met, proceed to Step 7.

6. With Q1 removed, measure the voltage across CR3.

   REQUIREMENT: 13.3 to 14.7 volts DC

   If the requirement is met, disconnect, test and replace Q1, C1 or R1, as necessary, in that order.
   If the requirement is not met, while the requirement of Step 5 is met, disconnect, test and replace CR3 or R2, as necessary, in that order.

Procedure: (cont'd)

7. Measure the AC voltage across T1, pins 3 and 5.

REQUIREMENT: 45.0 to 55.0 volts rms AC.

If the requirement is met, while the requirement of Step 5 is not met, disconnect, test and replace C1, CR1 or CR2, as necessary, in that order.
If the requirement is not met, proceed to Step 8.

8. Disconnect the wires from T1, terminals 3 and 5, and again measure the AC voltage across T1 terminals 3 and 5.

REQUIREMENT: 45.0 to 55.0 volts rms AC

If the requirement is met, while the requirement of Step 5 is not met, disconnect, test and replace C1, CR1 or CR2, as necessary, in that order.
If the requirement is not met, replace T1.

9. Replace Q1. Replace the wires on T1, terminals 3 and 5.

TABLE OF CIRCUIT VOLTAGES

The following are tvpical volt ges measured at the points indicated. Measurements are made with 115 volts AC line voltage and with a 100 ohm load.

SYMBOL	EMITTER	BASE	COLLECTOR
Q1	-14.0	-14.3	-27.0

Veb = 0.30

Voltage across T1 Secondary Pins 3 - 5	51 V AC
Voltage across C1	31.2 V. DC
Voltage across CR3	14.0 V. DC
Voltage Output	14.0 V. DC

6. ELECTRICAL PARTS LIST

Symbol	Function	Description	Mfr.	Part No.
C1	Input capacitor	250 mfd 50 volt electrolytic capacitor	CDC	BR-250-50
C2	Output capacitor	100 mfd 25 volt electrolytic capacitor	CDC	BR-100-25
CR1	Power rectifier	Silicon rectifier 200 volt peak inverse, 0.75 amp @ 50°C	ANY	1N538
CR2	Power rectifier	Silicon rectifier 200 volt peak inverse, 0.75 amp @ 50°C	ANY	1N538
CR3	Voltage reference diode	Silicon diode 14.0 volts ± 5%	ANY ANY	MZ623-9B or 1M14ZS5
P1	"Plug-in" connector	8 pin male connector	AMP	26-4101-8P
Q1	Voltage regulator transistor	Power transistor, 80 volts, 3 amps, high gain germanium PNP	ANY	2N618
R1	Current limiter collector resistor	27 ohms ± 5% 6.5 watts wirewound resistor	ANY	RW67V270
R2	Voltage regulator control base series resistor	1.5K ohms ± 10% 1 watt composition resistor	ANY	RC32GF152K
T1	Power transformer	Primary: 117/234 volts, 47 cps minimum Secondary: 23-0-23 volts @ 0.2 amps Hermetically sealed per MIL-T-27A	NRC	1324
TB1	Input option strapping board	4 lug terminal board	NRC	A-251-3-12
XQ1	Q1 socket	Power transistor socket	CIN	14T24324

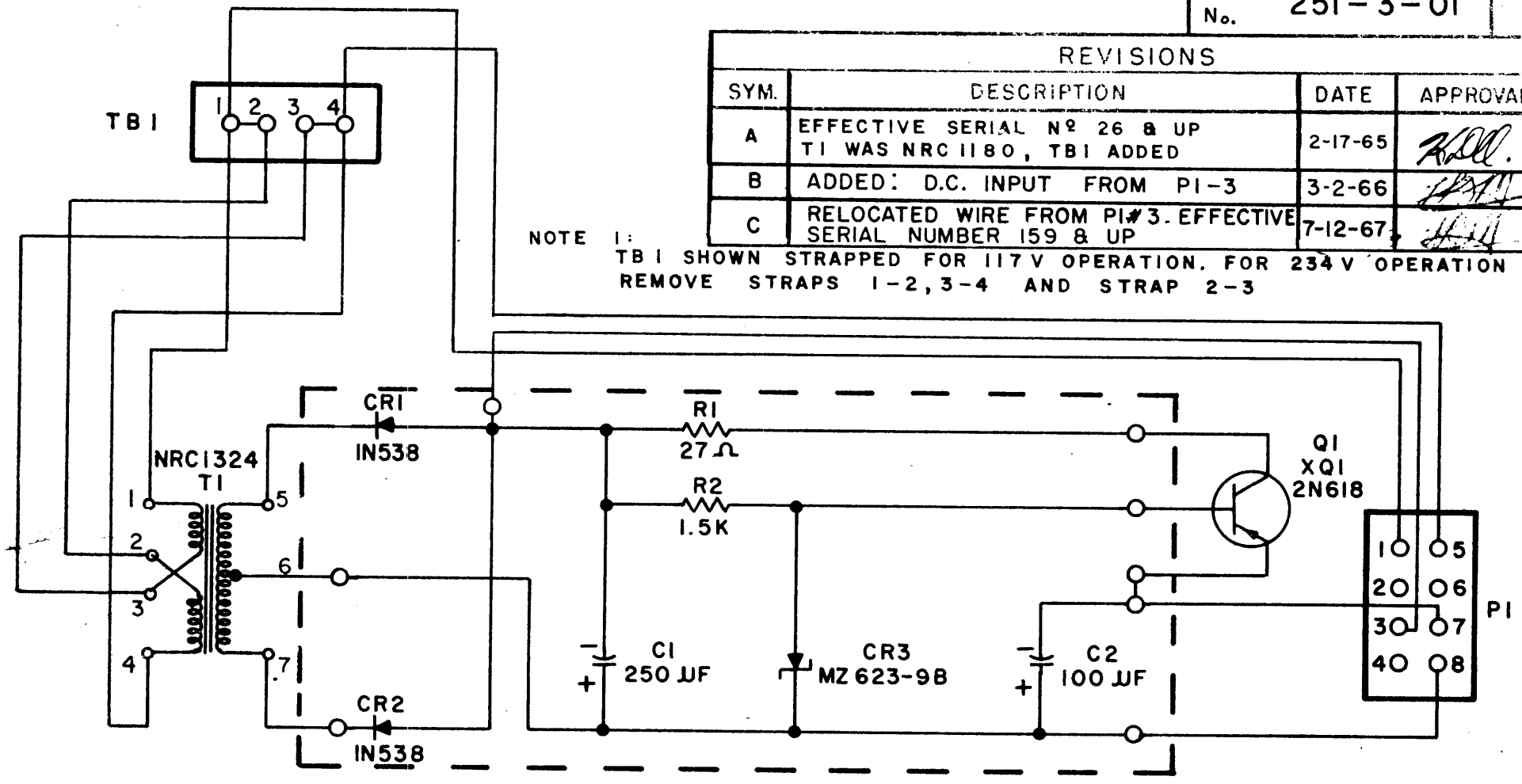
MANUFACTURERS' DESIGNATION

MFR. CODE NO.	FEDERAL CODE NO.	NAME
AMP	02660	American Phenolic Corporation
CDC	14655	Cornell-Dubilier Electric Corporation
CIN	71785	Cinch Manufacturing Corporation
NRC	88183	Northern Radio Company, Incorporated

DWG. No.	REV.
251-3-01	

REVISIONS			
SYM.	DESCRIPTION	DATE	APPROVAL
A	EFFECTIVE SERIAL Nº 26 & UP T1 WAS NRC 1180, TB1 ADDED	2-17-65	KDD.
B	ADDED: D.C. INPUT FROM P1-3	3-2-66	
C	RELOCATED WIRE FROM P1#3. EFFECTIVE SERIAL NUMBER 159 & UP	7-12-67	

NOTE 1:
TB 1 SHOWN STRAPPED FOR 117 V OPERATION. FOR 234 V OPERATION REMOVE STRAPS 1-2, 3-4 AND STRAP 2-3



ETCHED CIRCUIT BOARD
SUB-ASSEMBLY NRC1210

UNLESS OTHERWISE SPECIFIED	DRAFTSMAN	DATE	NAME:
DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS ± 1/32 DECIMALS ± .005 ANGLES	A. W.	2-18-63	SCHEMATIC POWER SUPPLY TYPE 251 MOD. 3
MATERIAL:	CHECKER RT	2-18-63	
FINISH:	ENGINEER		
	APPROVAL KDD	2-18-63	

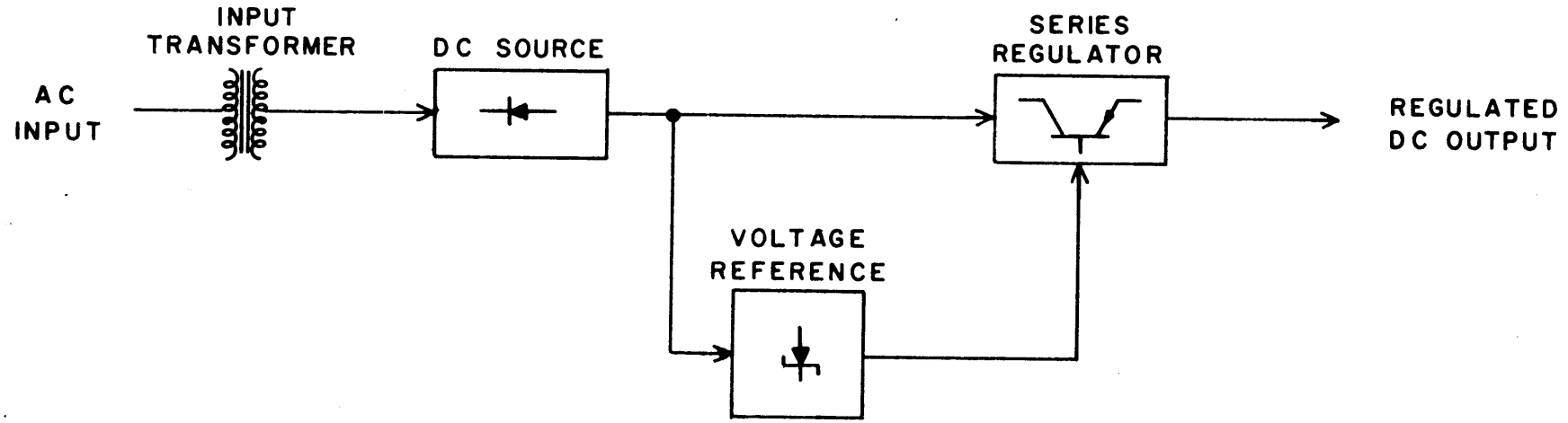
NORTHERN RADIO COMPANY
INCORPORATED
143-147 WEST 22ND ST. N.Y. 11
NEW YORK

DWG. No. 251-3-01

SCALE: NONE | SHEET 1 OF 1 | DWG. SIZE A

DWG. N.	251-3-02	REV.

REVISIONS			
SYM.	DESCRIPTION	DATE	APPROVAL



UNLESS OTHERWISE SPECIFIED	DRAFTSMAN	DATE	NAME:
DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS ± 1/64 DECIMALS ± .005 ANGLES	A. W.	2-18-63	BLOCK DIAGRAM POWER SUPPLY TYPE 251 MOD. 3
MATERIAL:	CHECKER J B.	2-18-63	
FINISH:	ENGINEER		
	APPROVAL K D D	2-18-63	

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NEW YORK

DWG. No. 251-3-02

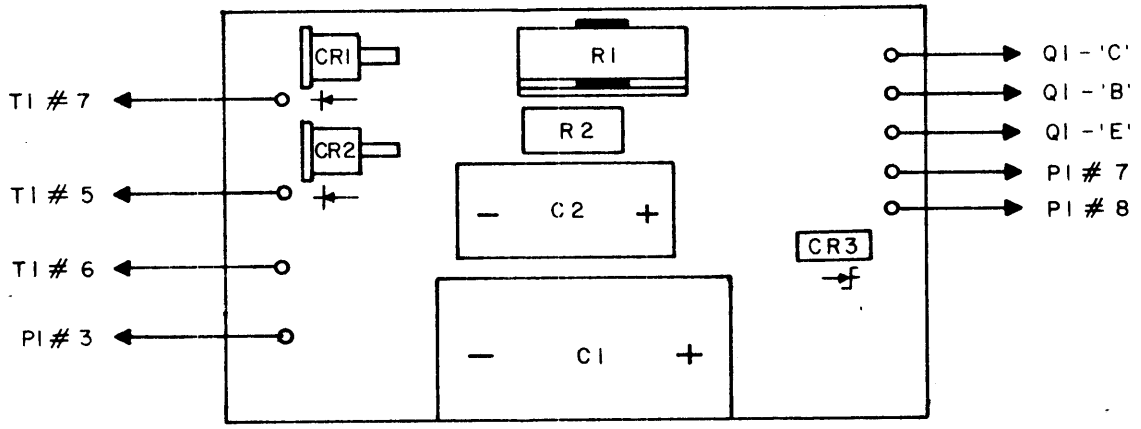
SCALE: NONE | SHEET 1 OF 1 | DWG. SIZE A

DWG. No.	251-3-03	REV.

REVISIONS			
SYM.	DESCRIPTION	DATE	APPROVAL
A	TI-7 WAS 3, TI-6 WAS 4.	12-19-66	
B	CONNECTION TO PI#3 ADDED. EFFECTIVE SERIAL NUMBER 159 & UP	7-12-67	

CIRCUIT BOARD SUB-ASSEMBLY

NRC – 1210



'B' – BASE

'C' – COLLECTOR

'E' – EMITTER

UNLESS OTHERWISE SPECIFIED	DRAFTSMAN	DATE	NAME:
DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS ± 1/64 DECIMALS ± .005 ANGLES	A. W.	2-15-63	LAYOUT, COMPONENT POWER SUPPLY TYPE 251 MOD.3
MATERIAL:	CHECKER RZ	2-18-63	
	ENGINEER		
FINISH:	APPROVAL KDD.	2-18-63	

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DWG. No. 251-3-03

SCALE: NONE | SHEET 1 OF 1 | DWG. SIZE A