NORTHERN RADIO COMPANY
Incorporated
143-149 WEST 22nd ST., NEW YORK, N. Y. 10011

pace-setters

in quality

communication

equipment

In Canada: Northern Radio Mfg. Co., Ltd., 1950 Bank St., Billings Bridge, Ottawa, Ontario.

TABLE OF CONTENTS

1. GENERAL

Purpose:

The Northern Radio Loop Current Control, Type 238 Model 1, is used as a current "normalizer" in DC teleprinter signal loops, to automatically maintain loop current at the optimum value despite changes in loop resistance or loop supply voltage.

Teleprinter "Equipment" or "Subscriber" loop extensions ordinarily require manually adjusted current normalizing facilities for the purpose of adjusting the total loop resistance, including the wireline in any equipment connected thereto, to a standard value. Any variation in the resistance of the wireline, or any change in the equipment installed in the loop, ordinarily require that the normalizing resistance be changed. Extensions which are capable of being switched require extra attention to assure that all such extensions maintain uniform resistance. Thus, such circuits not only require facilities for metering and manually adjusting circuit characteristics, but also require a number of expensive "man-hours" of installation and maintenance effort to effect the required adjustments.

Use of the Type 238 Model 1, Loop Current Control, eliminates this necessity for manual adjustment of the resistance of such printer loop extension. Initial cost of installations including the Northern Radio Loop Current Control, Type 238 Model 1, will ordinarily be approximately the same as installations including facilities for manual adjustments. Initial savings will result from the elimination of the adjustment procedure before placing such circuits into operation. The "maintenance-free" characteristics of the Loop Current Control will effect savings in maintenance costs thereafter. In many cases it will be practicable to install the Loop Current Control device in "common" portions of the circuit involved and thus effect considerable savings in initial investments.

The Loop Current Control, Type 238 Model 1, is designed for use in loops requiring a nominal 60 milliamperes operating current, while the Model 2 is designed for a nominal 20 milliampere circuit. Both models incorporate a calibration control to allow reasonable variations from these design values.

Description:

The Northern Radio Loop Current Control, Type 238 Model 1, is a completely electronic solid state device contained in a 1-1/4" wide x 3" high x 4-1/4" deep housing. It is a "two-terminal" device intended to be placed in series with a DC current loop. It is a "constant current" device which will maintain the loop current at a predetermined value (within the designed limits of the device) regardless of changes in the resistance of other parts of the loop circuits, or of the supply voltage connected to the loop.

Description: (cont'd)

The Loop Current Control, Type 238 Model 1, requires no source of operating power other than the normal loop current passing through it. Thus, it is a completely "floating" device which may be connected anywhere in the loop. Two or more such devices may be connected in series within the same loop whenever the limits of variation of resistance or supply voltage exceed the design limits of one such device.

This device, requiring no supplemental power supply to perform its functions, is a new development made possible through the use of solid state devices. It is a reliable, long-life, maintenance-free device that will result in more efficient operation of printer loops. Internal heat is determined by the amount of regulation required, being maximum when the device is required to present the appearance of maximum resistance. Proper mechanical design is employed to assure adequate heat sink characteristics, and proper stablizing circuits assure that the device will function properly under any anticipated ambient temperature conditions to be encountered. A number of these devices may be mounted in close proximity without undue worries as to any possible ill effects due to elevated temperatures resulting from such assembly.

Principle of Operation:

Referring to Block Diagram A-238-1-03, the Loop Current Control, Type 238 Model 1, is connected in series with the printer loop. The loop current passes through a "Non-Linear Bridge" which balances at the rated normal current but delivers an "error" voltage for any other current value. The "error" voltage is fed to an "Error Amplifier" and the output of the "Error Amplifier" controls a "Current Regulator" circuit which effectively changes in internal resistance in the direction required to return the loop current to the normal value.

Technical Data:

Input Impedance:	Variable. Automatically changes as necessary to maintain "constant current" in the circuit to which connected. Maximum and minimum limit of operation are specified by allowable voltage drops across the terminals of the device.
Voltage Limits:	Maximum - 90 volts Minimum - 10 volts
Operating Currents:	Model 1: 60 milliamperes (adjustable 55-75 milliamperes) Model 2: 20 milliamperes (adjustable 10-30 milliamperes)
Controls:	A current calibrating adjustment is provided within the device. No operating controls are required.
Power Requirements:	None, other than the normal loop current passing through the device.

Technical Data: (cont'd)

Dimensions:	1-1/4" wide x 3" high x 4-1/4" deep. For rack mounting a number of these units, a shelf assembly is available accommodating nine (9) units in a panel height of 3-1/2".
Weight:	Approximately 1/2 lb.
Special Features:	"Plug-In" construction. Polarized to assure current flow in proper direction. With supplemental equipment, may be used on "polar" as well as "neutral" DC circuits.
	Up to nine (9) Type 238 Model 1, Loop Current Controls, may be mounted on a Type 242 Model 1 Shelf for 60 mA operation.
	Up to nine (9) Type 238 Model 2, Loop Current Controls, may be mounted on a Type 242 Model 1 or 2 Shelf for 20 mA operation.

2. DESCRIPTION OF OPERATION

(Refer to Block Diagram NRC Dwg. No. A-238-1-03 and Schematic Diagram NRC Dwg. No. B-238-1-01)

The "Non-Linear Bridge" consists of Zener Diode CR1 and Resistors (R1 + R2), R3 and R4. R1 is made adjustable to determine the bridge current which produces balance.

Transistors Q1 and Q2 constitute the "Error Amplifier" which controls the "Current Regulator" Transistor Q3.

3. INSTALLATION

Mechanical:

The Type 238 Loop Current Control will normally be used as one of a group of such controls mounted on a shelf, such as the Northern Radio Type 242 Model 1, Loop Current Control Shelf, which is wired to accommodate up to nine (9) controls.

Prior to installation, each new control should be thoroughly inspected for mechanical damage due to rough handling during shipment. If there is no sign of mechanical defect, the control should be installed by inserting into the proper space in the shelf (observing polarized plug and socket) until the plug on the back of the Control engages with the socket of the shelf and the "bullet-catches" on the shelf engage with the locking springs inside the Control. The "bullet-catches" and springs assure that the Control will remain securely fastened on the shelf until intentionally removed. Removal is accomplished by pulling forward on the handle of the Control and rocking up and down slightly until the catches disengage.

Electrical:

Since the Type 238 Control is a plug-in unit, its electrical connections are completed to the shelf when it is placed into operating position. It is only necessary to be assured that the proper circuit connections are made to the shelf. CAUTION: Proper polarity must be observed in making connections to the shelf so that the relative polarities of voltage on the block terminals will be as indicated on Drawings B-242-1-01 and B-238-1-01. Also the maximum voltage drop across the Controls must be limited to 90 volts. Therefore, if the Loop Current Supply Voltage exceeds 90 volts, a suitable fixed resistance should be used to absorb the excess voltage.

Electrical: (cont'd)

The required minimum series resistance may be calculated as follows:

$$R_{min} = (E_{supply}-90)/I_{loop\ amperes}$$

For example, for a 120 volt supply and 0.06 ampere Loop Current adjustment, a minimum resistance of 500 ohms is required.

The maximum resistance which could be in the circuit under these operating conditions would be approximately 1800 ohms.

If it is known that the external circuit resistance including wire line resistance and equipment resistance permanently associated with the control will always equal or exceed the minimum resistance required, then no supplemental resistor is necessary.

4. OPERATING INSTRUCTIONS

The Type 238 Loop Current Controls are adjusted for proper operation at the nominal operating currents before shipment and require no adjustment unless other values of current within their adjustable range are required. Screwdriver adjustment of R1 may be accomplished through the hole in the front of the cover of the Control whenever such adjustment is required.

5. MAINTENANCE

Since the Control employs long-life reliable semi-conductor elements and since adequate heat stabilization is employed in the design, it is anticipated that maintenance requirements will be minimized. In the event of malfunction, it is recommended that the Control be removed from the shelf and testing accomplished at the test bench.

In the infrequent instances when it is necessary to remove and replace components on the printed board, it is highly desirable that an appropriate small soldering iron with limited heat storage be employed.

6. ELECTRICAL PARTS LIST

Symbol	Function	Description	Mfr.	Part No.
CR1	Q1 bias control diode	5 volt zener diode	ANY	1N750A
CR2	Q3 bias diode	High conductance silicon diode	TXI PSC	G130 or PS592 Conf A
P1	"Plug-In" connector	2 prong connector	HBJ	P302AB
Q1	1st error amplifier	High gain general purpose germanium transistor, 250 milliamperes maximum 200 milliwatts dissipation, PNP type	MOT	2N652A
Q2	2nd error amplifier	High gain general purpose germanium transistor, 250 milliamperes maximum 200 milliwatts dissipation, PNP type	MOT	2N652A
Q3	Current regulator	High voltage, high gain, high current power transistor, germanium, PNP type	MOT	2N618
R1	Current calibrating control	100 ohm subminiature potentiometer 0.25 watt power rating	ALB	RH101M
R2	Q1 base series resistor	47 ohms ± 10% 1/2 watt composition resistor	ALB	EB 4701
R3	Q2 base series resistor	150 ohms ± 10% 1/2 watt composition resistor	ALB	EB 1511
R4	Q2 base shunt resistor	220 ohms ± 10% 1/2 watt composition resistor	ALB	EB 2211
R5	Regulator compensating resistor	150K ohms ± 10% 1/2 watt composition resistor	ALB	EB 1541
R6	Q1-Q2 emitter resistor	1.5K ohms ± 10% 1/2 watt composition resistor	ALB	EB 1521
R7	Q3 base series resistor	680 ohms ± 10% 1/2 watt composition resistor	ALB	EB 6811

Symbol	Function	Description	Mfr.	Part No.
R8	Q3 bias resistor	1750 ohms ± 10% 10 watts wirewound resistor	TRU WLE	FR10/1750 or 10F1750
XQ3	Q3 socket	Power transistor socket	CIN	14T24324

7. ELECTRICAL PARTS LIST

Symbol	Function	Description	Mfr.	Part No.
CR1	Q1 bias control diode	5 volt zener diode	ANY	1N750A
CR2	Q3 bias diode	High conductance silicon diode	TXI PSC	G130 PS592 Conf A
P1	"Plug-in" connector	2 prong connector	HBJ	P302AB
Q1	1st error amplifier	High gain general purpose germanium transistor, 250 mA maximum 200 mw dissipation, PNP type	MOT	2N652A
Q2	2nd error amplifier	High gain general purpose germanium transistor, 250 mA maximum 200 mw dissipation, PNP type	MOT	2N652A
Q3	Current regulator	High voltage, high gain, high current power transistor, germanium PNP type	MOT	2N618
R1	Current calibrating control	1000 ohms subminiture potentiometer 0.25 watt power rating	ALB BOU	RH102M 275-1-102
R2	Q1 base series resistor	68 ohms ± 10% 1/2 watt composition resistor	ALB	EB 6801
R3	Q2 base series resistor	680 ohms ± 10% 1/2 watt composition resistor	ALB	EB 6811
R4	Q2 base shunt resistor	1.5K ohms ± 10% 1/2 watt composition resistor	ALB	EB 1521
R5	Regulator compensating resistor	470K ohms ± 10% 1/2 watt composition resistor	ALB	EB 4741
R6	Q1-Q2 emitter resistor	680 ohms ± 10% 1/2 watt composition resistor	ALB	EB 6811
R7	Q3 base series resistor	1K ohm ± 10% 1/2 watt composition resistor	ALB	EB 1021

Symbol	Function	Description	Mfr.	Part No.
R8	Q3 bias resistor	12K ohms ± 10% 10 watt wirewound resistor	TRU WLE	FR10/12000 or 10F12000
XQ3	Q3 socket	Power transistor socket	CIN	14T24324

Symbol	Function	Description	Mfr.	Part No.
E1	Connection strip	18 terminal barrier strip	HBJ KUL	18-140-3/4W-E or 600-18-3/4ST-SI
E2	Connection strip	10 terminal barrier strip	HBJ KUL	10-140-3/4W-E or 600-10-3/4ST-SI
J1	Receptacle for Loop Current Control, Type 238	2 prong female receptacle	HBJ	S302AB
J2	Receptacle for Loop Current Control, Type 238	2 prong female receptacle	HBJ	S302AB
J3	Receptacle for Loop Current Control, Type 238	2 prong female receptacle	HBJ	S302AB
J4	Receptacle for Loop Current Control, Type 238	2 prong female receptacle	HBJ	S302AB
J5	Receptacle for Loop Current Control, Type 238	2 prong female receptacle	HBJ	S302AB
J6	Receptacle for Loop Current Control, Type 238	2 prong female receptacle	HBJ	S302AB
J7	Receptacle for Loop Current Control, Type 238	2 prong female receptacle	HBJ	S302AB
J8	Receptacle for Loop Current Control, Type 238	2 prong female receptacle	HBJ	S302AB
J9	Receptacle for Loop Current Control, Type 238	2 prong female receptacle	HBJ	S302AB
R1	Current limiting resistor	600 ohms 5 watt wirewound resistor, lug terminals	TRU WLE OHM	FR5/600 or 5F600 or Brown Devil

Symbol	Function	Description	Mfr.	Part No.
R2	Current limiting resistor	600 ohms 5 watt wirewound resistor, lug terminals	TRU WLE OHM	FR5/600 or 5F600 or Brown Devil
R3	Current limiting resistor	600 ohms 5 watt wirewound resistor, lug terminals	TRU WLE OHM	FR5/600 or 5F600 or Brown Devil
R4	Current limiting resistor	600 ohms 5 watt wirewound resistor, lug terminals	TRU WLE OHM	FR5/600 or 5F600 or Brown Devil
R5	Current limiting resistor	600 ohms 5 watt wirewound resistor, lug terminals	TRU WLE OHM	FR5/600 or 5F600 or Brown Devil
R6	Current limiting resistor	600 ohms 5 watt wirewound resistor, lug terminals	TRU WLE OHM	FR5/600 or 5F600 or Brown Devil
R7	Current limiting resistor	600 ohms 5 watt wirewound resistor, lug terminals	TRU WLE OHM	FR5/600 or 5F600 or Brown Devil
R8	Current limiting resistor	600 ohms 5 watt wirewound resistor, lug terminals	TRU WLE OHM	FR5/600 or 5F600 or Brown Devil
R9	Current limiting resistor	600 ohms 5 watt wirewound resistor, lug terminals	TRU WLE OHM	FR5/600 or 5F600 or Brown Devil

Symbol	Function	Description	Mfr.	Part No.
E1	Connection strip	18 terminal barrier strip	HBJ KUL	18-140-3/4W-E 600-18-3/4ST-SI
E2	Connection strip	10 terminal barrier strip	HBJ KUL	10-140-3/4W-E 600-10-3/4ST-SI
J1	Receptacle for Loop Current Control	2 prong female receptacle	HBJ	S302AB
J2	Receptacle for Loop Current Control	2 prong female receptacle	HBJ	S302AB
J3	Receptacle for Loop Current Control	2 prong female receptacle	HBJ	S302AB
J4	Receptacle for Loop Current Control	2 prong female receptacle	HBJ	S302AB
J5	Receptacle for Loop Current Control	2 prong female receptacle	HBJ	S302AB
J6	Receptacle for Loop Current Control	2 prong female receptacle	HBJ	S302AB
J7	Receptacle for Loop Current Control	2 prong female receptacle	HBJ	S302AB
J8	Receptacle for Loop Current Control	2 prong female receptacle	HBJ	S302AB
J9	Receptacle for Loop Current Control	2 prong female receptacle	HBJ	S302AB
R1	Current limiting resistor	2400 ohms 6.5 watt wirewound resistor	ANY	RW67V242

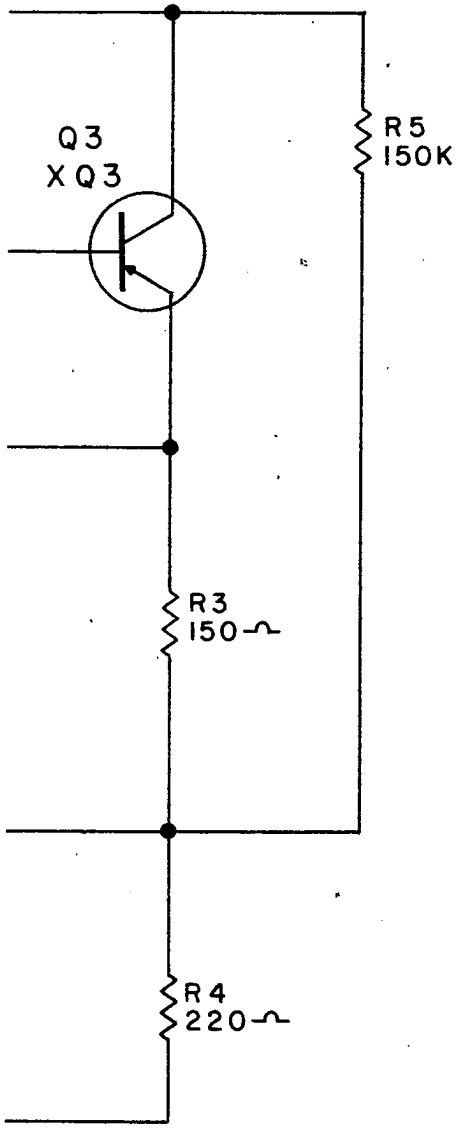
Symbol	Function	Description	Mfr.	Part No.
R2	Current limiting resistor	2400 ohms 6.5 watt wirewound resistor	ANY	RW67V242
R3	Current limiting resistor	2400 ohms 6.5 watt wirewound resistor	ANY	RW67V242
R4	Current limiting resistor	2400 ohms 6.5 watt wirewound resistor	ANY	RW67V242
R5	Current limiting resistor	2400 ohms 6.5 watt wirewound resistor	ANY	RW67V242
R6	Current limiting resistor	2400 ohms 6.5 watt wirewound resistor	ANY	RW67V242
R7	Current limiting resistor	2400 ohms 6.5 watt wirewound resistor	ANY	RW67V242
R8	Current limiting resistor	2400 ohms 6.5 watt wirewound resistor	ANY	RW67V242
R9	Current limiting resistor	2400 ohms 6.5 watt wirewound resistor	ANY	RW67V242

MANUFACTURERS' DESIGNATIONS

MFR. CODE NO.	FEDERAL CODE NO.	NAME
ALB	01121	Allen-Bradley Company
CIN	71785	Cinch Manufacturing Corporation
HBJ	75173	Howard B. Jones, Division Cinch Manufacturing Corporation
KUL	75382	Kulka Electric Corporation
MOT	04713	Motorola Semiconductor Products, Incorporated
OHM	44655	Ohmite Manufacturing Company
PSC	01281	Pacific Semi-Conductors, Incorporated
TRU	94310	Tru-Ohm Products
TXI	01295	Texas Instruments, Incorporated
WLE	63743	Ward Leonard Electric Company

REV.	DWG. No.
	238-1-01

REVISIONS			
SYM.	DESCRIPTION	DATE	APPROVAL
A	R8 WAS 1.5K	7-29-59	ga
B	R2 WAS 68Ω	8-17-61	GDH
C	CR1 WAS PS6468	7-14-66	



	DRAFTSMAN	DATE
	R.L.F.	5-7-59
	CHECKER	
	ENGINEER J.S.H.	
	APPROVAL GDH	5/7/59

NAME:

SCHEMATIC

LOOP CURRENT CONTROL

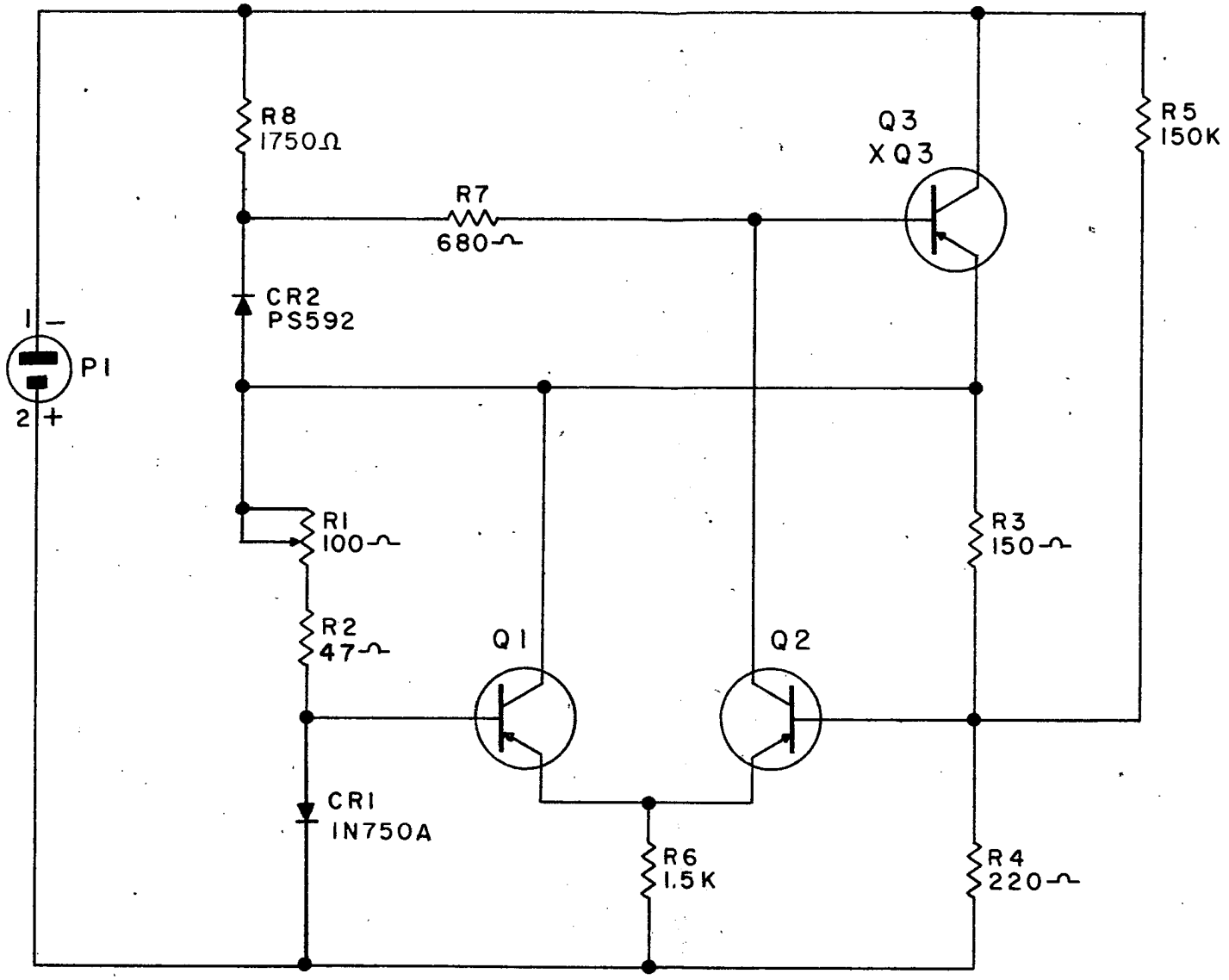
TYPE 238 MODEL 1

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

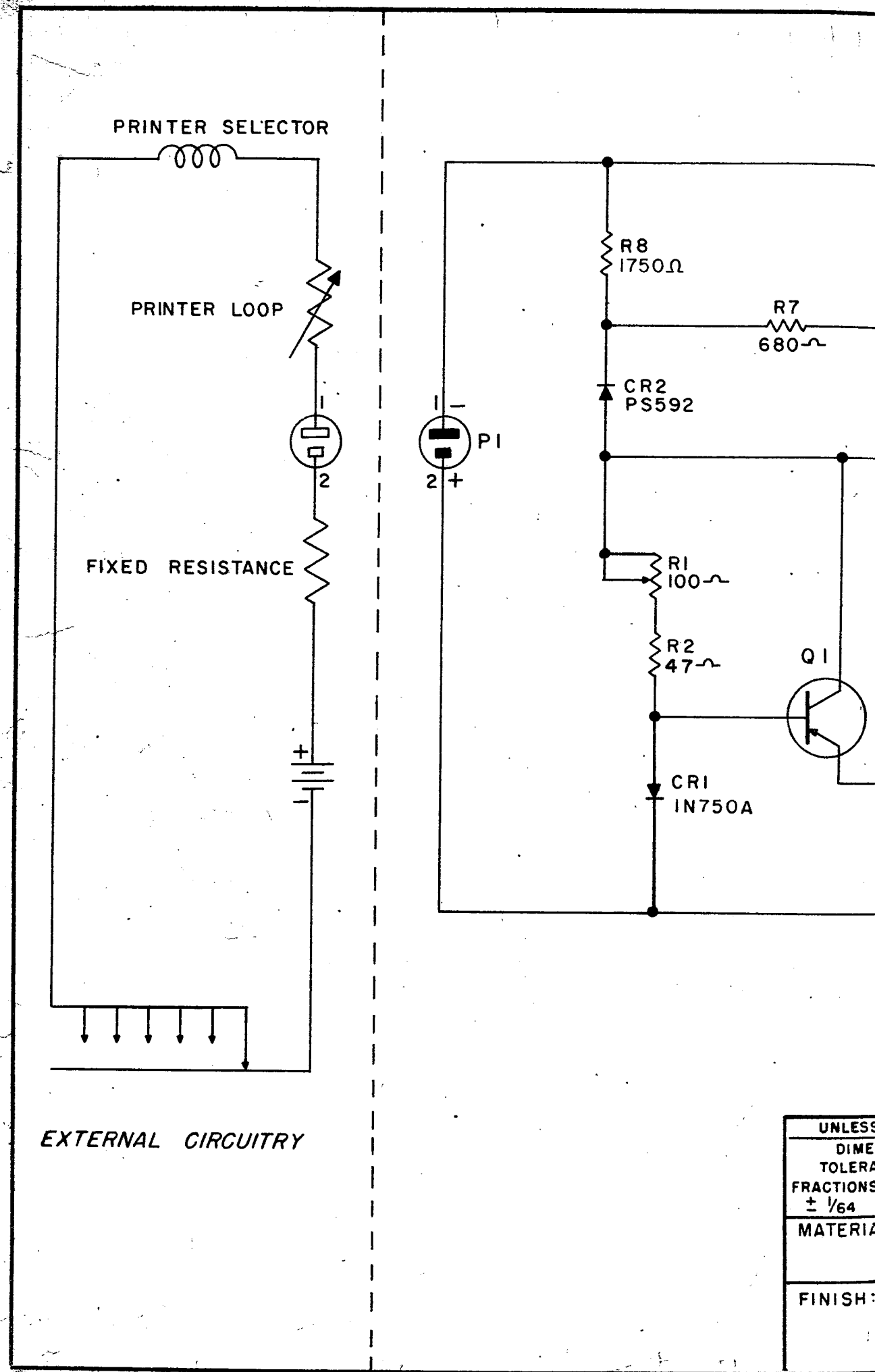
NORTHERN RADIO COMPANY
INCORPORATED
143-147 WEST 22ND ST. N.Y. 11
NEW YORK

DWG. No. 238-1-01

DWG. No.	REV.
238-1-01	



UNLESS OTHERWISE SPECIFIED	DRAFTSMAN	DATE	NAME:
DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS ± 1/64 DECIMALS ± .005 ANGLES	R.L.F.	5-7-59	
MATERIAL:	CHECKER		LOOP
	ENGINEER J.S.H.		TYP
FINISH:	APPROVAL JH	5/7/59	SCALE:


PRINTER SELECTOR
PRINTER LOOP
1
2
FIXED RESISTANCE
+
−
EXTERNAL CIRCUITRY
R8
1750Ω
R7
680
CR2
PS592
1 −
P1
2 +
R1
100
R2
47
Q1
CR1
IN750A
UNLESS
DIME
TOLERA
FRACTIONS
± 1/64
MATERIA
FINISH

REVISIONS			
SYM.	DESCRIPTION	DATE	APPROVAL
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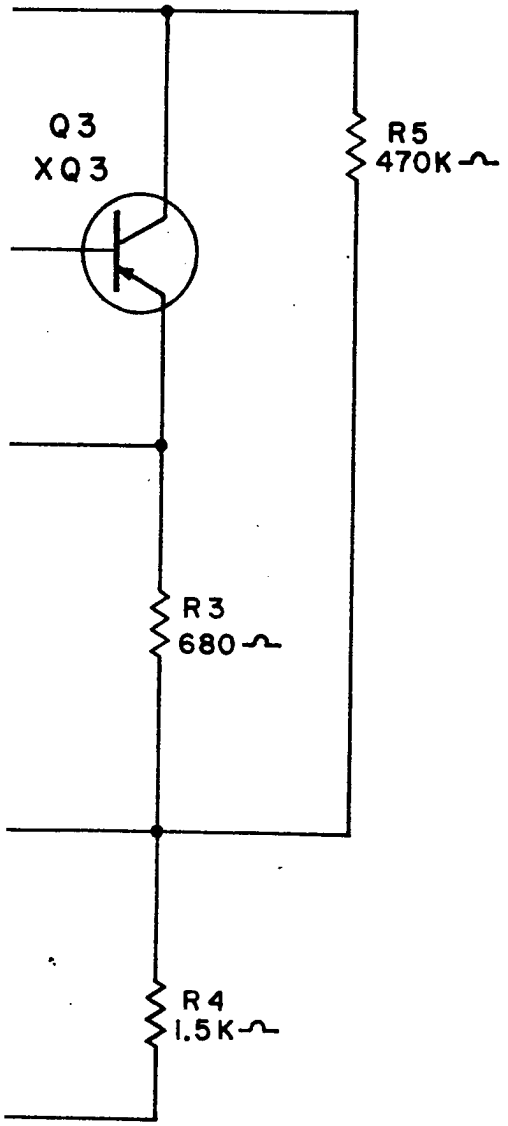
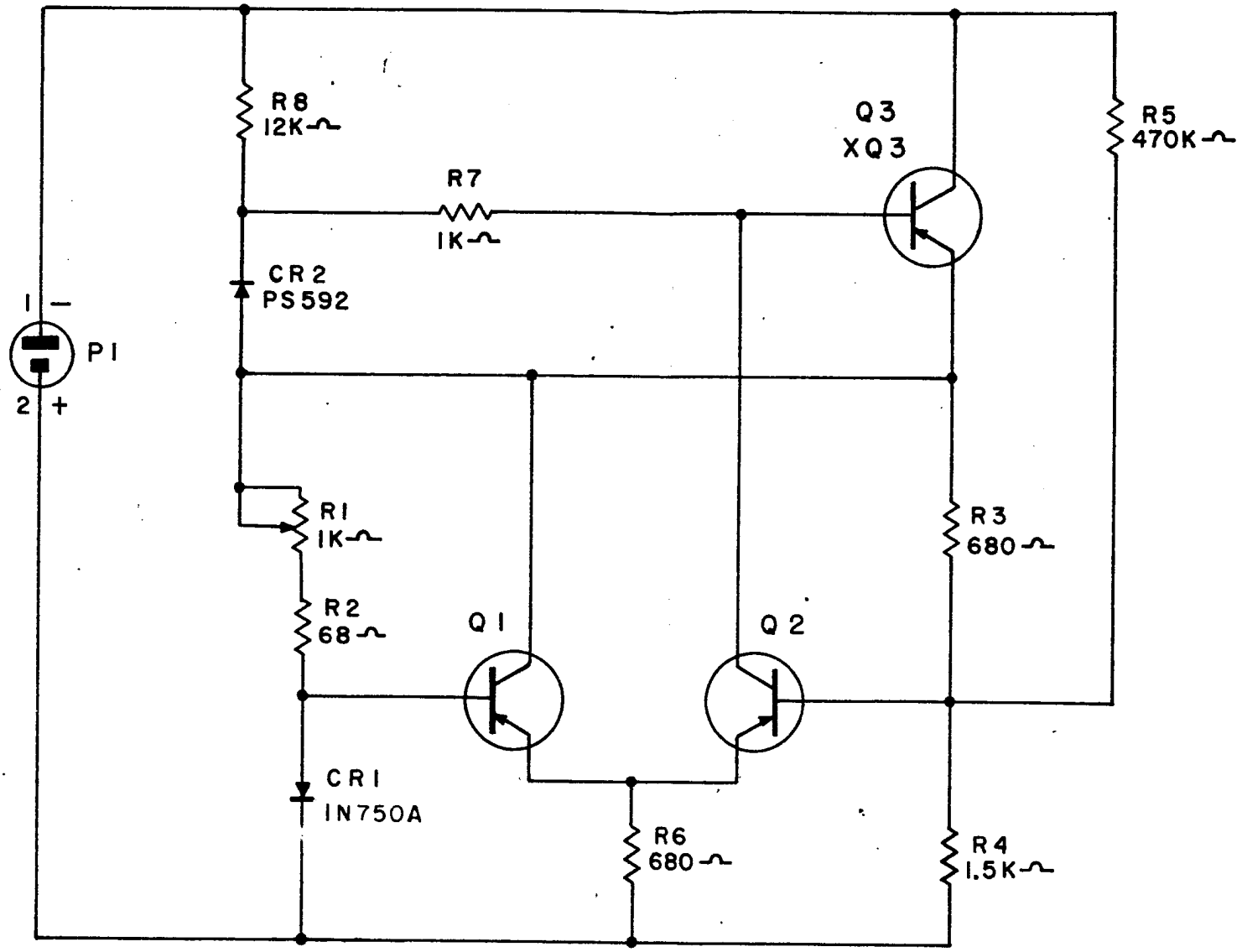
B	CR1 WAS IN705 OR PS 6468	7-14-66	

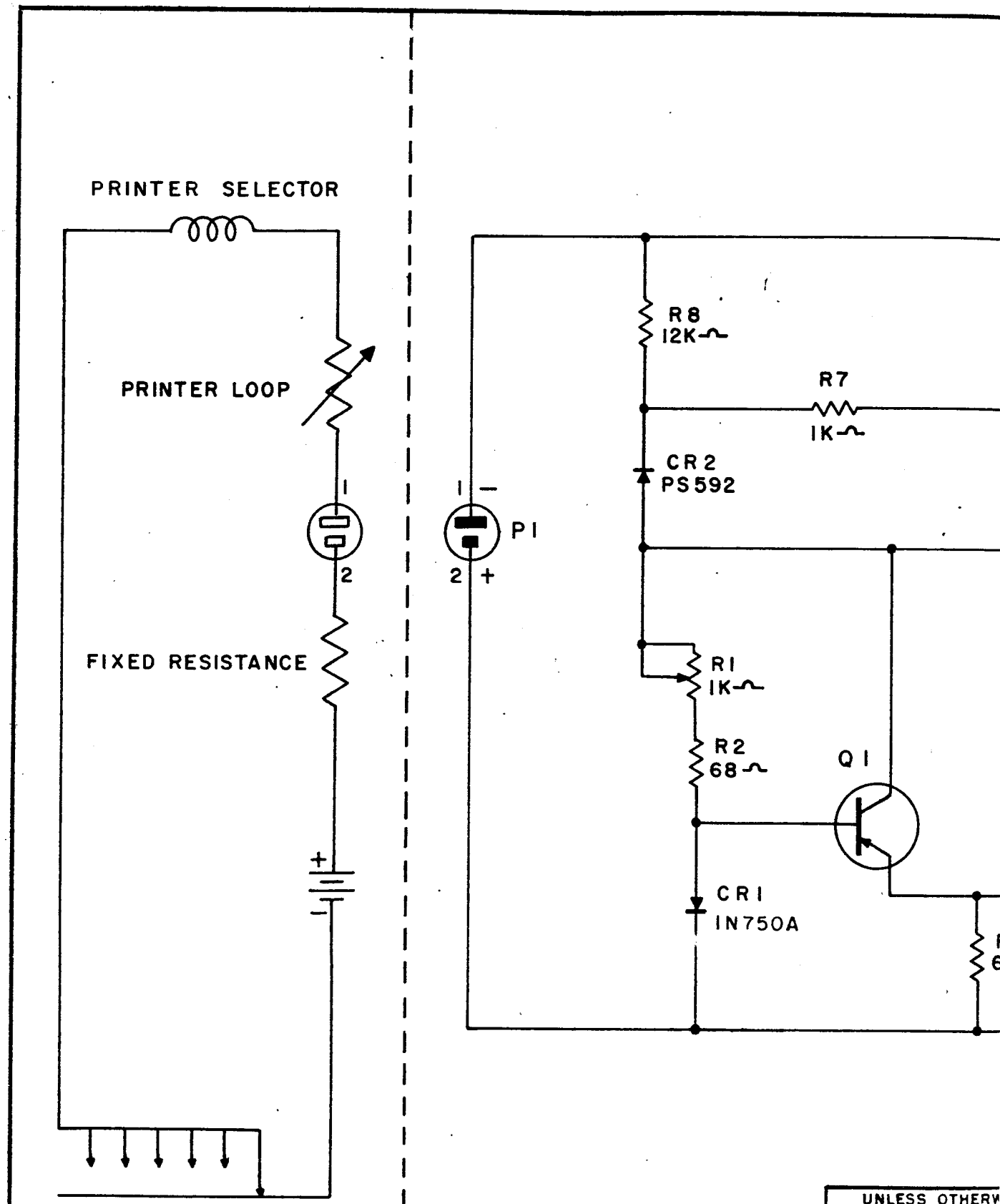


DRAFTSMAN: J. G.	DATE: 8-28-59	NAME: SCHEMATIC	NORTHERN RADIO COMPANY INCORPORATED
CHECKER		LOOP CURRENT CONTROL	143-147 WEST 22ND ST. N.Y. 11 NEW YORK
ENGINEER		TYPE 238 MOD. 2	DWG. No. 238-2-01
APPROVAL: GH	2/9/61	SCALE: NONE / SH. 1 OF 1	DWG. SIZE B

DWG. No.	REV.



UNLESS OTHERWISE SPECIFIED	DRAFTSMAN	DATE	NAME:
DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS ± 1/64 DECIMALS ± .005 ANGLES	J. G.	8-28-59	
MATERIAL:	CHECKER		LO
	ENGINEER		
FINISH:	APPROVAL	2/9/61	SCALE:



UNLESS OTHERW
DIMENSIONS A
TOLERANCES O
FRACTIONS ± 1/64 DECI ± .0
MATERIAL:
FINISH:

DWG. No.	238-1-02	REV.

REVISIONS			
SYM.	DESCRIPTION	DATE	APPROVAL
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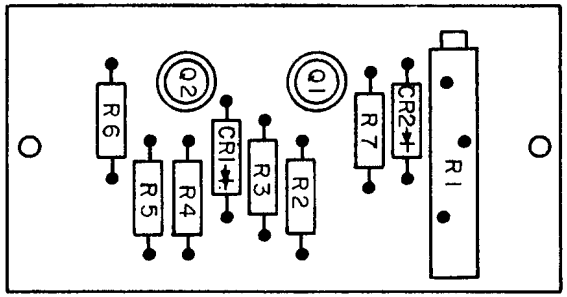


UNLESS OTHERWISE SPECIFIED	DRAFTSMAN	DATE	NAME:
DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS ± 1/64 DECIMALS ± .005 ANGLES	R.L.F.	8-4-59	LAYOUT, COMPONENT
MATERIAL:	CHECKER		LOOP CURRENT CONTROL
FINISH:	ENGINEER		TYPE 238 MOD. 1 & 2
	APPROVAL		

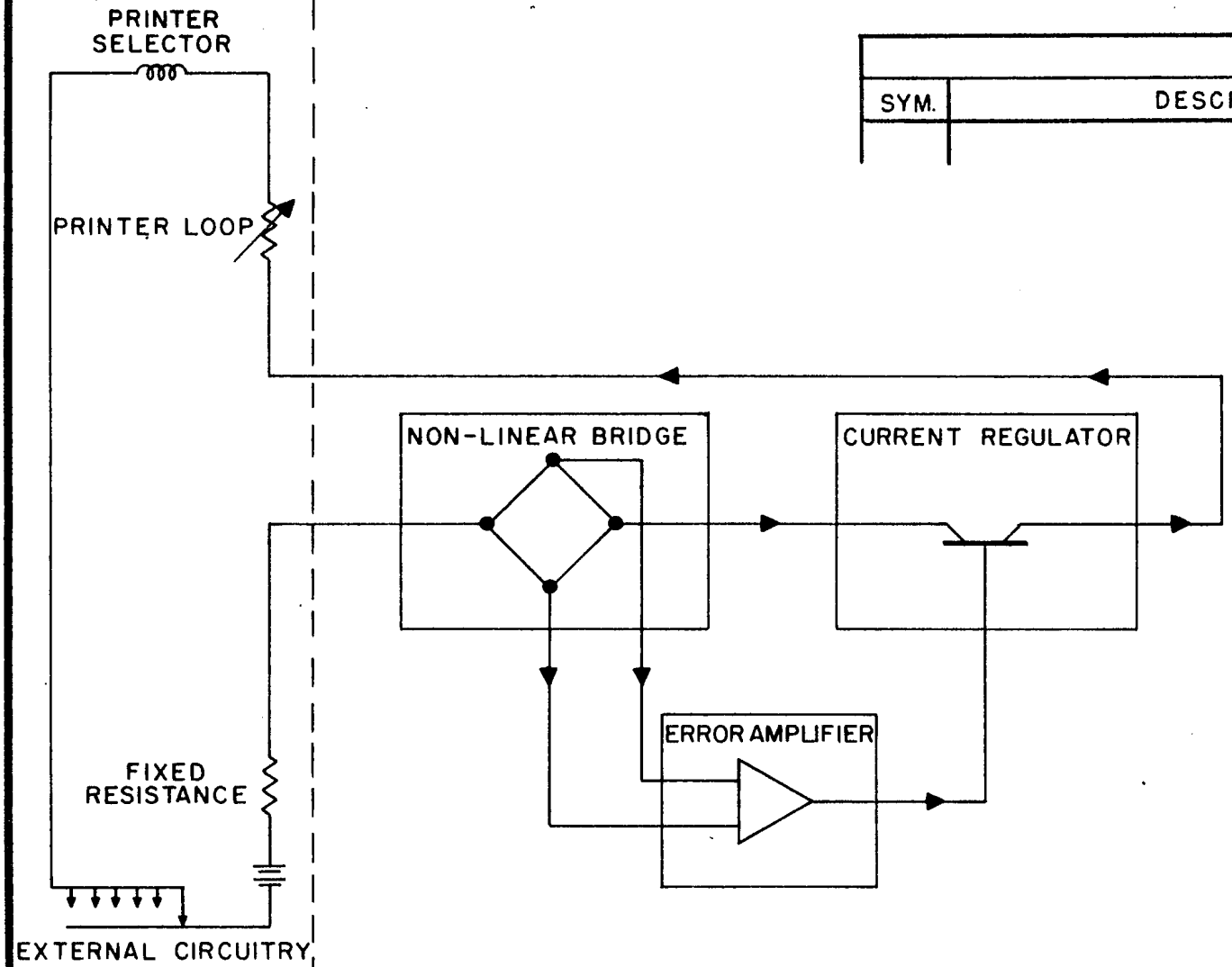
NORTHERN RADIO COMPANY
INCORPORATED
143-147 WEST 22ND ST. N.Y. 11
NEW YORK

DWG. No. 238-1-02

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

DWG. No.	238-1-03	REV.

REVISIONS			
SYM.	DESCRIPTION	DATE	APPROVAL



UNLESS OTHERWISE SPECIFIED	DRAFTSMAN	DATE	NAME:
DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS ± 1/64 DECIMALS ± .005 ANGLES	R.L.F.	8-28-59	FUNCTIONAL BLOCK DIGRAM LOOP CURRENT CONTROL TYPE 238 MOD. 1&2
MATERIAL:	CHECKER		
FINISH:	ENGINEER		
	APPROVAL	8/28/59	

SCALE: NONE	SHEET 1 OF 1	DWG. SIZE A

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

DWG. No. 238-1-03

REVISIONS			
SYM.	DESCRIPTION	DATE	APPROVAL
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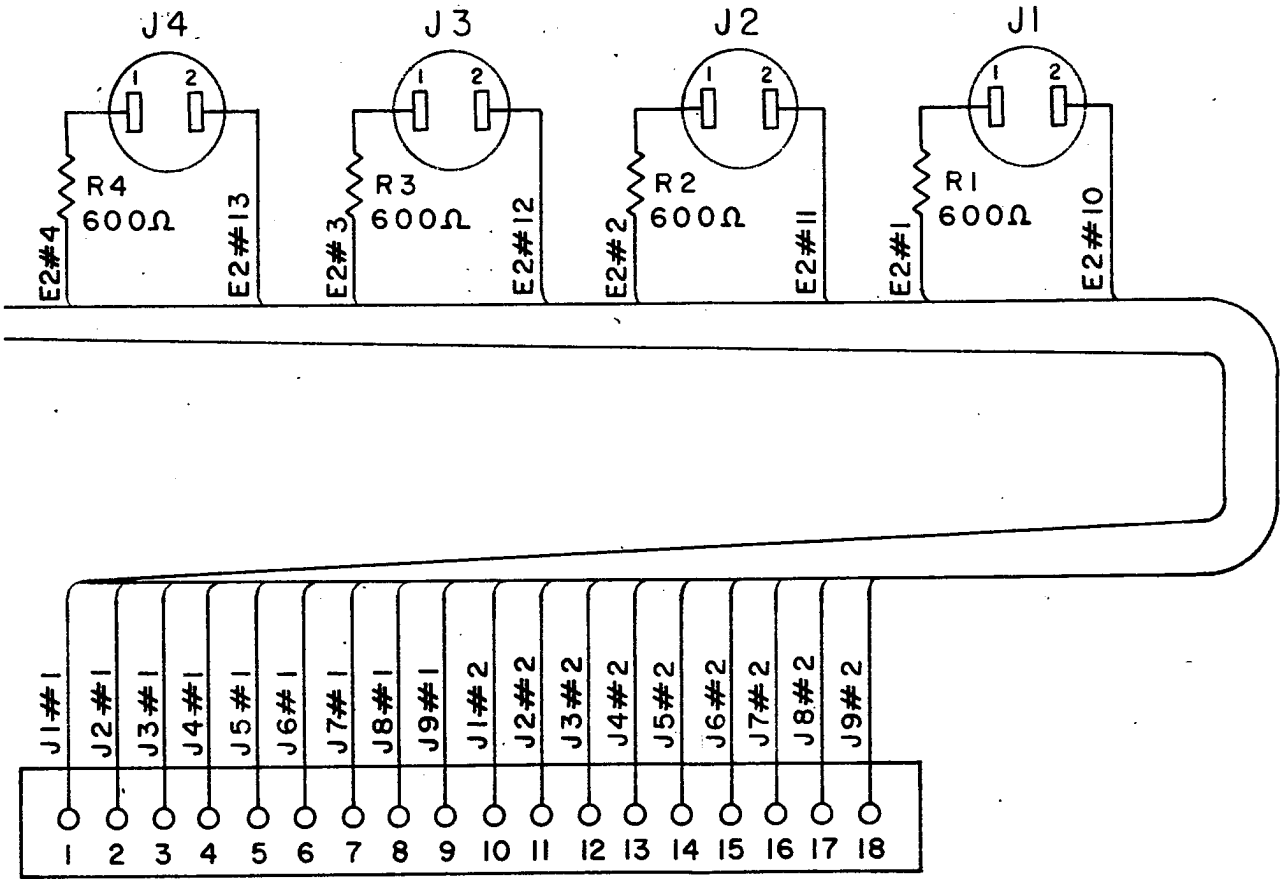
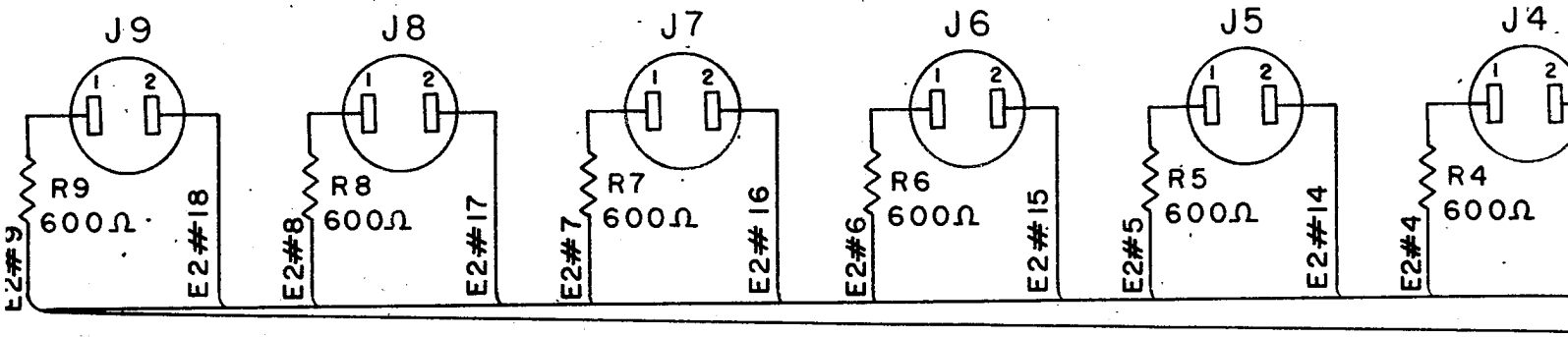
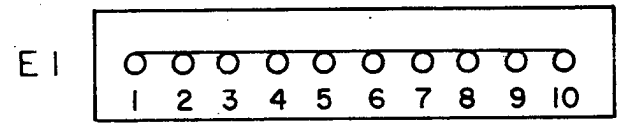


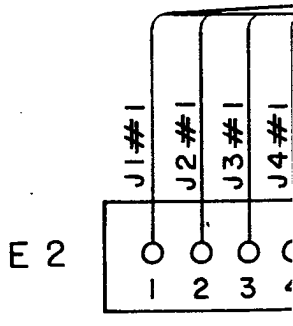
DRAFTSMAN: J. G.	DATE: 10-20-59	NAME: SCHEMATIC LOOP CURRENT CONTROL SHELF TYPE 242 MOD. 1	NORTHERN RADIO COMPANY INCORPORATED 143-147 WEST 22ND ST. N.Y. 11 NEW YORK
CHECKER: J.G.	10-20-59		
ENGINEER:			DWG. No. 242-1-01
APPROVAL:	10/20/59	SCALE: NONE / SH. 1 OF 1	DWG. SIZE B

REV.





TO TELETYPEWRITER LOOP CIRCUITS
(COMMON SIDE)



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LOOP
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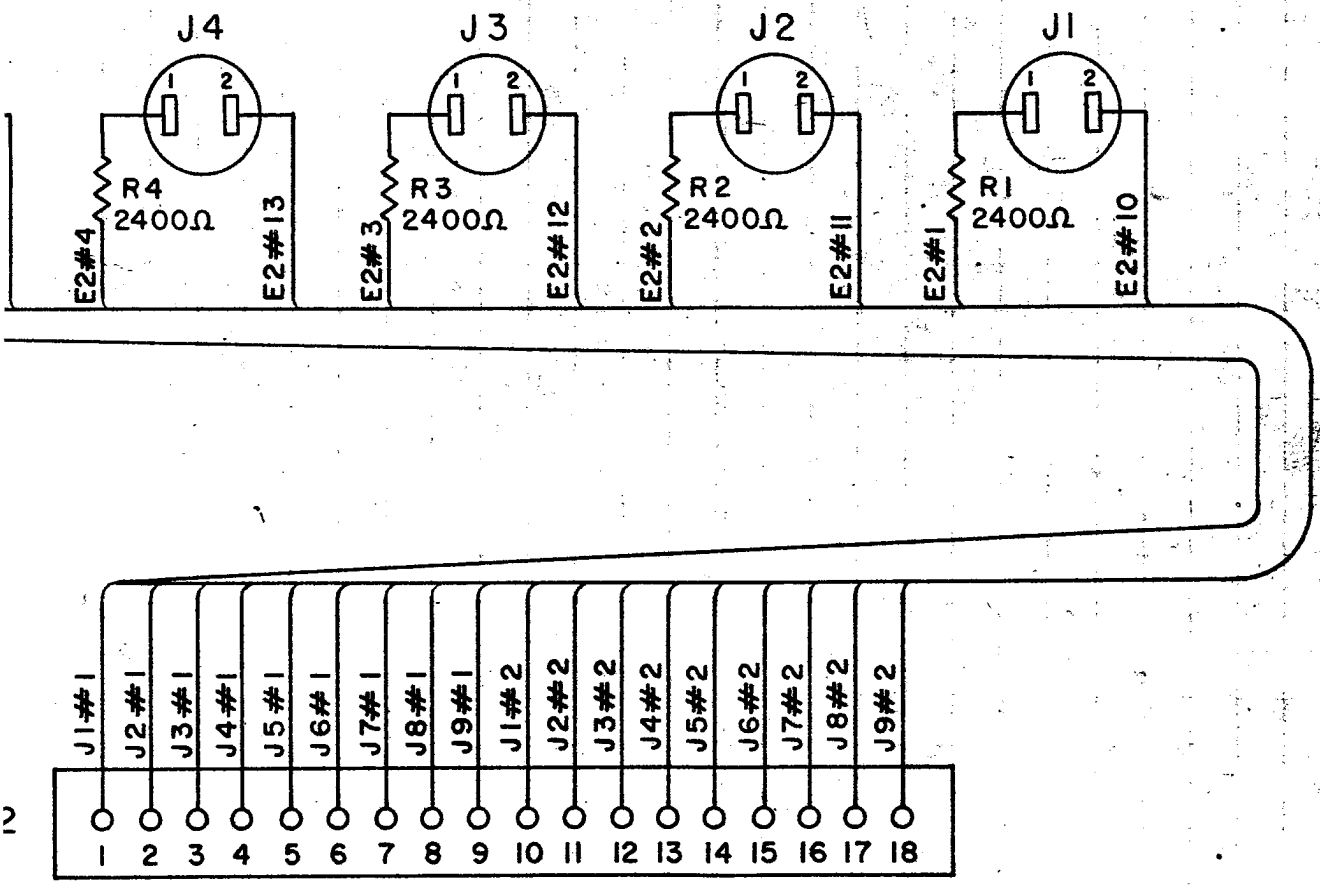
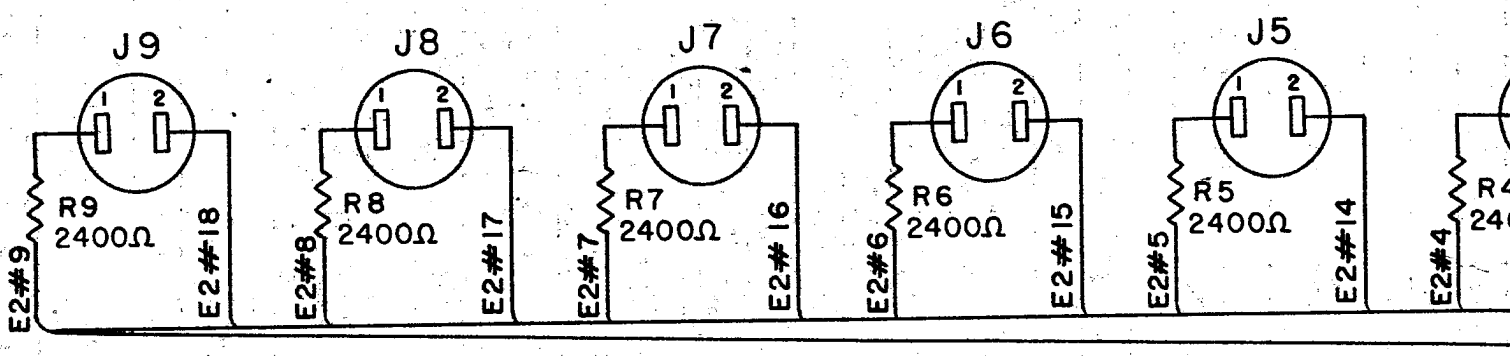
UNLESS OTHERWISE SPECIFIED	DRAFTSMAN
DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS ± 1/64 DECIMALS ± .005 ANGLES	J. G.
MATERIAL:	CHECKER
FINISH:	ENGINEER
	APPROVAL

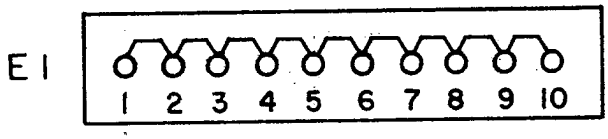
REV.	DWG. No.	REVISIONS			
		SYM.	DESCRIPTION	DATE	APPROVAL



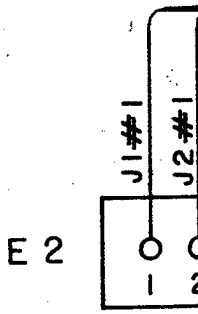
DRAFTSMAN S. S.	DATE 6-19-64	NAME: SCHEMATIC	NORTHERN RADIO COMPANY INCORPORATED	
CHECKER RF	6-19-64	LOOP CURRENT CONTROL SHELF	143-147 WEST 22ND ST. N.Y. 11 NEW YORK	
ENGINEER		TYPE 242 MOD. 2	DWG. No. 242-2-01	
APPROVAL RDD	6-22-64	SCALE: NONE	SH. 1 OF 1	DWG. SIZE B

REV.





TO TELETYPEWRITER LOOP CIRCUITS
(COMMON SIDE)



└T.O

UNLESS OTHERWISE SPECIFIED	DRAFT
DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS ± 1/64 DECIMALS ± .005 ANGLES	S.
MATERIAL:	CHEC
	ENGI
FINISH:	APPR