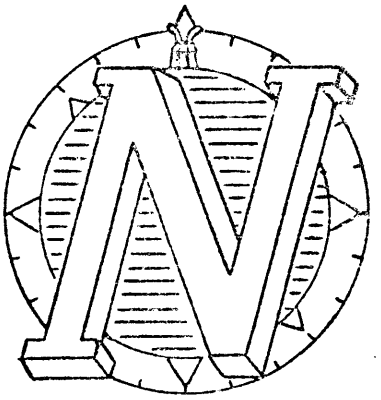
INSTRUCTION BOOK

FREQUENCY SHIFT DIVERSITY

CONVERTER

TYPE 174 MODEL 3 & 3A



NORTHERN RADIO

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SEPTEMBER 17, 1973

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.

24 JANUARY 1973

NORTHERN RADIO FREQUENCY SHIFT DIVERSITY CONVERTER

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Section I GENERAL

1-1. PURPOSE

The Northern Radio Frequency Shift Diversity Converter, Type 174 Model 3 or 3A, is used to demodulate the frequency shifted audio output signal from one or two radio receivers into DC pulses suitable for operating printers or feeding information into data processing terminals. By means of plug-in frequency determining networks, wide or narrow shift signals, located at any reasonable part of the audio spectrum, may be accommodated.

1-2. DESCRIPTION

The Northern Radio Frequency Shift Diversity Converter, Type 174 Model 3 or 3A, is a fully transistorized two-channel diversity unit, for use with single receiver frequency diversity systems, or with two receiver space diversity systems.

The Model 3 Frequency Shift Converter is for narrow band Space diversity or Frequency diversity operation and Model 3A is for Space diversity wide band operation. Either model is available with discriminator assemblies for both Mark and Space frequencies fixed, or with the Mark frequency fixed and the Space frequency tunable. Optional operating features, available at extra cost, on either model include the following.

Mark-Hold:	This feature holds the Converter output in a Mark condition whenever the incoming tone signal disappears.
Low Level Keying:	This feature modifies the differentiating network to permit monitoring low level DC (e.g., ±6 VDC) Keying Systems.
High Level Polar Printer Driver:	This feature provides a High Level Polar Output to drive a Polar Printer and incorporates a self-contained Polar Power Supply.
Low Level Polar Printer Driver:	This feature provides a low level Polar Output (±6 volts, ±1 volt DC) per MIL-STD-188( ).
Mark Frequency 1000 Hz Discriminator:	This feature provides a discriminator with a fixed Mark frequency of 1000 Hz and tunable Space frequency.

The optional features are factory installed when included in the Purchase Order.

The audio tones of each channel are separately limited and demodulated before combining takes place. Combining action is controlled in such a manner that the signal channel which receives the stronger signal at its input terminals contributes the larger percentage of the combined output. The combined output signal is then low pass filtered and amplified to drive an "Electronic Relay". The output terminals of the Electronic Relay are electrically isolated from the chassis and from the other circuit "common" connections, and may be used as "dry contacts" to control an externally powered circuit, or may be connected to an internal source of DC power to provide nominal 60 or 20 milliampere signals to the external circuits.

1-3. TECHNICAL CHARACTERISTICS

Input Impedance:	600 ohms unbalanced
Input Level:	-50 to +10 VU
Input Frequencies: (Frequency Diversity)	425 to 3315 cps channels at ±42.5 cps shift, or 300 to 3300 cps channels at ±30 cps shift. Other frequencies and shift available for special application.
(Space Diversity)	Center frequencies and shifts adjustable to meet operating requirements. Normally centered on 2550 cps for 850 cps shift.
Output:	1. "Dry contact" keying of externally powered circuits up to 100 milliamperes and 260 volts open circuit. 2. Internally powered 60 or 20 milliamperes (nominal) keying to 2000 ohm loads (floating). Neutral or polar output.
Limiter Recovery Time:	Negligible for a 40 VU differential between Mark and Space frequencies.
Maximum Channel Keying Speeds:	50 dot cycles to 1200 dot cycles, consistent with bandwidth of networks in use.
Monitoring Facilities:	Cathode Ray Tube monitoring of keying and tuning. Input Level Indicator Meters (Two) Output Current Indicator Meter Input Level Jacks Output Current Jack Output Test Points on Plug-in Modules
Controls:	Primary Power Switch Input Monitor Switch Channel Switch Sense Switch Tuning (Space Diversity) Keying Speed Switch Output Current Control CRT Controls (Focus and Intensity)
Power Requirements:	115/230 ±10% volts AC, 47/440 cps, 15 watts, approximately.
Mounting:	Standard relay rack.
Dimensions:	19" wide x 3-1/2" high x 14" deep, approximately
Weight:	Approximately 16 pounds

Section II INSTALLATION

2-1. MECHANICAL INSTALLATION

Before installing the Converter it should be inspected to assure that all plug-in units are properly installed and firmly seated in their appropriate sockets. Plug-in cards are identified by an "EB" number etched on the back side of the card and should be seated in sockets bearing corresponding identification information. The component side of each card must be toward the front panel of the Converter chassis. Locking devices associated with subassemblies should be firmly seated in the locked position.

Refer to the Schematic Diagram C-174-3-01 and Wiring Diagrams D-174-3-02 and D-174-3A-02. Determine whether the primary power to which the unit will be connected corresponds with the internal wiring of the Converter, and make any necessary strapping connections as detailed in the next paragraph.

NOTE

Converters are normally factory wired for operation on 115 volts AC.

After the unit has been inspected and any necessary adjustments made, it may be installed in a standard cabinet or rack at a height convenient for observation of the Monitor and Meter on the unit.

2-2. ELECTRICAL INSTALLATION

The Converter is normally wired for operation from 115 volt, 50/60 (or 400) cps primary supply unless otherwise specified on order.

The wiring option for 115 or 230 volt operation is accomplished at Terminal Board TB1 on the underside of the Converter chassis. A protective insulating cover installed above this board protects against possible accidental contact with the AC terminals, and must be removed for inspection or wiring change.

Two separate straps are installed, one between Terminals 1 and 2 and a second between Terminals 3 and 4, for 115 volt operation.

One strap is installed between Terminals 2 and 3 for 230 volt operation.

Before connecting an output load to the Converter, the "Output Current" control must be checked to assure that it is in its extreme counter clockwise position. After the Converter is turned on and receiving a Mark signal, the Output Current may be adjusted to the proper value.

The Printer Driver output is "floating" with respect to the chassis so that either side of the load may be grounded. The Printer Driver section of this book should be reviewed before connecting a grounded load to the Converter.

2-3. SPACE DIVERSITY INSTALLATION

For Space Diversity operation, one receiver is connected to Channel 1 input (Terminals 1 and 2 of E1) and the other receiver is connected to Channel 2 input (Terminals 3 and 4 of E1). The receiver outputs should be 600 ohms inpedance, and if unbalanced, the grounded sides of the receiver outputs should be connected to Terminals 2 and 4 respectively. Twisted pairs, preferrably shielded, should be used for connecting between the receivers and the Converters. When the output circuits of the receivers are ungrounded, it is usually desirable to ground Terminals 2 and 4 of E1 to the Converter chassis and/or the Converter electrical "common" circuitry.

The electrical "common" of the Converter circuitry is not internally grounded to the Converter chassis but appears at Terminal 5 of E1 and Terminal 4 of E2. Chassis ground is connected to Terminal 6 of E1 and Terminal 5 of E2. Normally, it is preferrable to tie the Converter circuitry to ground by means of a strap between the appropriate terminals of either E1 or E2.

2-4. FREQUENCY DIVERSITY INSTALLATION

When the Converter is to be used for frequency diversity operation, one receiver output is connected to both channels.

Special discriminator networks, tuned to the desired frequencies, are available for frequency diversity operation.

These discriminator networks are, of course, narrow band networks in accordance with the standard 170 hertz spaced channels utilizing center frequencies of 425 to 2975 hertz or the CCITT standard 120 hertz spaced channels utilizing center frequencies of 420 to 3180 hertz.

Several converters may be operated from a single voice frequency channel as long as the individual discriminator networks in the converters are all on different frequencies so that there is no interference between their respective passbands. When the converters are operated in this manner, the single voice frequency line is connected to both channel inputs of all the converters in use.

When narrow band fixed frequency discriminator networks are used, the tuning of the converter channels is completely determined by the networks and the "tuning" siwtch located on the converter front panel is rendered ineffective, so that it cannot interfere with the discriminator circuit.

Section III OPERATION

3-1. PREPARATION FOR USE

Before applying AC power to the Converter, check to assure that the Output Current control is in minimum output (extreme counter-clockwise) position, and that the signal input and output lines are properly connected. Set the Converter controls as follows.

a) Output Current - Minimum Output
b) Sense Switch - +
c) Keying Switch - Slow
d) Diversity Switch - Channel 1
e) Monitor Switch - Channel 1
f) Power Switch - On

3-2. INITIAL ADJUSTMENTS

For Frequency Diversity operation, the following tune-up procedures should be followed.

a) Receiver should be tuned for maximum deflection of S Meter for desired signal.

b) Audio output level of Receiver should be adjusted for full scale reading of Converter Meter (Ø dBm).

c) The CRT pattern should correspond to one of the monitor patterns shown on Drawing No. A-174-2-20.

d) Steady Mark signal should be requested from the transmitting station.

e) The CRT monitor pattern should correspond to the steady Mark pattern. Receiver tuning should be rechecked for maximum pattern deflection to right of scope center.

f) The output current may now be checked and the output current control may be adjusted to the proper operating value (normally 60 mA).

g) Channel 2 tuning and level should be checked by throwing the Monitor switch to the Channel 2 position and the Channel 2 Receiver should be adjusted for proper indications as to signal level and tuning.

h) The transmitting station should now be requested to send a "test tape".

i) The Tuning Control should now be adjusted for best pattern on the Monitor scope.

j) Receiver tuning should be slightly readjusted for equal Mark and Space flag lengths, if necessary.

k) Turn on motor power to the Printer and observe that proper printing is obtained when the "Diversity" siwtch is in any position.

l) Set "Diversity" switch to "Diversity" and commence normal traffic.

3-3. DETAILED OPERATION

The detailed operation of the Frequency Shift Diversity Converter is divided into separate paragraphs covering the plug-in assemblies comprising the unit. The overall signal flow is illustrated in the Schematic Diagram C-174-3-01 and Block Diagram A-174-3-04.

3-4. BANDPASS FILTERS

Bandpass filters are contained in the "plug-in" Frequency Determining Networks whenever necessary.

3-5. AUTOMATIC GAIN CONTROL AMPLIFIER (SA174201A)

The Automatic Gain Control (AGC) Amplifier serves two functions. By "compressing" the signal, it acts as part of the limiter chain, and it produces a control signal which is utilized in the Diversity Control functions.

The AGC Amplifier consists of a "variolosser" amplifier (including Transistors Q101 to Q104 inclusive) and a signal rectifier and filter section (including Transistors Q105 and Q106). The rectified and filtered signal developed at the amplifier output is fed back to the variolosser where any increase in control current causes an increase in the signal attenuation through the variolosser, with the result that the output signal from the AGC amplifier is "compressed" in relation to the input signal.

3-6. LIMITER AMPLIFIER (SA174202A)

Transistors Q201 and Q203 comprise a push-pull "limiter" amplifier which accepts the signal from the AGC amplifier and delivers a signal which is of essentially constant amplitude for all input signals exceeding a level of approximately -50 dBm. The collector circuits of Q201 and Q202 are directly connected to the inputs of the Discriminator circuits where further limiting takes place.

3-7. DISCRIMINATOR CIRCUITS (SA174203A)

Transistors Q301 to Q306 inclusive are used to drive the Discriminator Tank, including L1 to L4 inclusive, and associated capacitors and resistors. Q301 and Q302 drive the Mark (high frequency) tank while Q303 and Q304 drive the Space (low frequency) tank. The amplitude of signal developed by the Mark tank circuit is controlled by variable resistor R301, while the amplitude of the Space tank is controlled by the variable resistor R302. The absolute amplitude of both signals may be reduced simultaneously by the application of a control signal (from the Diversity Control SA174204A) to the junction of Resistors R307, R308 and R309. The function of the control signal is to reduce the bias voltage applied to the bases of "current sink" transistors Q305 and Q306 and thus reduce the drive power applied to the tank circuits. Diodes CR301 to CR304 inclusive, rectify the signal voltage developed across the Mark and Space tanks with the Mark signal developing positive voltage and the Space signal developing negative voltage.

The SA174203A Network is normally used for "Space Diversity" operation where the outputs of two different radio receivers feed the two channel inputs of the Converter. Provision is made for accommodating frequency shift signals with different amounts of shift in the following manner. The Mark Tank in the SA174203A is permanently tuned to a frequency of 2975 cps, while the Space Tank circuit is tunable from the front panel of the Converter ("Tuning" Control). The basic Space Tank circuit is tuned to a frequency of 1775 cps and this circuit may be retuned to other frequencies by adjustment of the tuning control switch. Approximate Space resonant frequencies, commencing with the "Tuning" switch, in its most counter clockwise position, are as follows.

Switch Position	Space Frequency	For Shift of
1	2825 cps	150 cps (±75 cps)
2	2775 cps	200 cps (±100 cps)
3	2675 cps	300 cps (±150 cps)
4	2575 cps	400 cps (±200 cps)
5	2375 cps	600 cps (±300 cps)
6	2125 cps	850 cps (±425 cps)
7	1775 cps	1200 cps (±600 cps)

In operation, the radio receiver is always tuned to place the Mark frequency at 2975 cps. The Converter "Tuning" Control is then tuned to resonate the Space frequency. Normally, the Converter will function without errors if the Space Tuning is within one position of the correct adjustment.

3-8. MARK FREQUENCY 1000 HZ DISCRIMINATOR (SA174203A-S)

The Discriminator SA174203A-S is tuned for a fixed Mark frequency of 1000 Hz and an adjustable Space frequency as shown below.

Switch Position	Space Frequency	For Total Shift of
1	1300 Hz	300 Hz (±50 Hz)
2	1400 Hz	400 Hz (±50 Hz
3	1500 Hz	500 Hz (±50 Hz)
4	1600 Hz	600 Hz (±50 Hz)
5	1700 Hz	700 Hz (±50 Hz)
6	1850 Hz	850 Hz (±75 Hz)
7	2000 Hz	1000 Hz (±75 Hz)

The operation of the Discriminator SA174203A-S (Schematic Diagram C-SA174-2-0103A-S) is the same as explained for the SA174203A Discriminator in the preceeding paragraph.

3-9. SPACE DIVERSITY WIDE BAND OPERATION (SA174203A-WB3)

For Space Diversity wideband operation the Type 174 Model 3A Converter utilizes a Discriminator Network different from the one used in the Model 3 Converter, and the Tuning Switch (S6) on the Converter front panel has been changed to accommodate the new network.

Functionally, this new combination provides for two tuning bandwidths, with the channel center frequency fixed at the same frequency for either bandwidth, as opposed to the tuning arrangement of the Model 3 Converter where the Mark frequency is fixed and the Space frequency is varied to suit the required bandwidth.

The SA174203A-WB3 Discriminator Network normally supplied with this Converter is tuned for a center frequency of 2550 hertz and the Mark and Space frequencies are as shown below.

Switch Position	Space Frequency	Mark Frequency	For Shift of
1	2337.5 Hz	2762.5 Hz	425 Hz (+212.5 Hz)
2	2125 Hz	2975 Hz	850 Hz (±425 Hz)

Networks for other center frequencies or shifts may be obtained on special order.

For "narrow band", "Space diversity" or "Frequency diversity" operation, the functioning of the Type 174 Model 3 and 3A Converters is identical. For these modes of operation, the Discriminator tuning is entirely determined by the Network components and the "Tuning" switch is automatically disconnected from the circuitry when fixed frequency narrow band networks are used.

3-10. COMBINER CIRCUITS AND DIVERSITY CONTROL (SA174204A)

The rectified discriminator outputs from the two channels are fed to the bases of transistors Q401 and Q402. These transistors, functioning as emitter followers, are used to minimize loading of the tank circuits by the rectification function. The emitters of Q401 and Q402 connect to a low pass RC filter (C401 to C404 inclusive and R403, R404 and R407). The filter output is connected to emitter followers Q406 and Q407 and the output of Q407 is connected to the Automatic Threshold Control Unit SA174209A.

If the channel switch is connected in the "Channel 1" position, the output of Channel 2, Discriminator is disconnected, or if it is in the "Channel 2" position, the output of Channel 1 is disconnected. When the switch is in the "Diversity" position, both channels are connected and contribute to the signal output as described below.

Diversity combining takes place in the following manner. If Channel 1 has a stronger Mark signal than Channel 2, the stronger positive output of Channel 1 will raise the cathodes of the Discriminator (SA174203A) diodes CR301 and CR302 (in Channel 2) positive, reverse biasing the diodes and cutting off current flow from Channel 2 as long as Channel 1 has the stronger signal. As Channel 2 is cut off, the Channel 1 positive output is applied to the base of transistor Q401 in the Diversity Control.

Likewise, if Channel 1 has a stronger Space signal than Channel 2, the stronger negative output of Channel 1 applied to the anodes of the discriminator diodes CR303 and CR304 (in Channel 2) reverse biases the diodes and cuts off current flow from Channel 2 as long as Channel 1 has the stronger signal. As Channel 2 is cut off, the Channel 1 negative output is applied to the base of transistor Q402 in the Diversity Control.

The Automatic Diversity Control has the following effect. It further decreases the limiter output of the channel with the weaker signal, thus assisting the combiner in selecting the stronger signals. The limiter output is controlled in the following way. The DC control voltages developed by the two AGC Amplifiers are applied to the bases of a differential amplifier Q403-Q404, and the two collectors of the Differential Amplifiers control the base potentials applied to the Discriminator current sink transistors Q305-Q306 in Channel 1 and the corresponding units in Channel 2. The connections are such that a stronger signal in Channel 2 reduces the base potentials of Q305-Q306 in Channel 1 and thus reduces the signal output from the discriminator of Channel 1. Similarly, a stronger signal in Channel 1 reduces the discriminator output from Channel 2.

3-11. DC AMPLIFIER (SA174205A)

The Discriminator output signal (which passes through the Automatic Threshold Control unit) is applied to the base of Q501, which is part of a differential amplifier including Q502 as the other amplifier and Q503 as a current sink. The base of Q501 receives a "reference voltage" from the Automatic Threshold Control unit which assures that the signal as seen at the differential amplifier input is a symmetrical polar signal, thus minimizing output signal distortion due to slight mistuning of the radio receiver. The output signal from the collectors of Q501 and Q502 is applied to the bases of another differential amplifier, Q504-Q505, and the output of this stage is a square wave signal suitable for driving low level "logic" circuitry or a "plug-in" Printer Relay.

Capacitor C3 on the "keying" switch (S3) of the front panel is provided to produce additional low pass filtering of the discriminator output signal for low speed keying (approximately 75 baud or less) and is effective when the "keying" switch on the Converter front panel is in the "Slow" position.

3-12. PRINTER DRIVER (SA174206A)

The plug-in Printer Driver includes a power transformer, rectifiers, and filter for self-contained loop current supply.

DC Isolation between the output of the DC Amplifier (SA174205A) and the Printer Driver output is obtained through use of a keyed oscillator (transistor Q603) operating at approximately 50 kilocycles. Transistor Q601 and Q602 control the oscillator, keying it "ON" for a Mark signal and "OFF" for a Space signal. Transformer T602 serves as the inductance for the oscillator circuit and as the decoupling transformer feeding rectifier CR606. The rectified oscillator signal is filtered by C605 and applied to the base of a "Darlington Amplifier Circuit" consisting of transistor Q604 and Q605. These transistors present a low impedance current path when the oscillator is "ON" and a very high impedance current path when the oscillator is "OFF". Diode CR608 protects the transistors against damage due to improper connection of an external battery.

Circuit connections through the main connector (P601) to the Output Terminal Strip (E2) on the rear of the Converter allow choice of external or internal loop battery. When the "internal" battery is to be used, the load is connected between Terminals 1 and 2 of Terminal Strip E2 (pins 7 and 14 of P601). When an external battery is to be used, the loop (including the external battery) is connected between terminals 1 and 3 of Terminal Strip E2 (pins 6 and 7 of P601), with the positive side of the loop connected to Terminal 1 (pin 7 of P601). Either side of the external loop may be grounded, (but not both) or the loop may be left "floating" if desired.

Normally, it is desirable that one side of the loop be grounded either locally or at the far end of the loop. Whenever the loop is a metallic circuit with no ground at the far end, it is suggested that Terminal No. 3 of Terminal Strip E2 be grounded. Assuming that the Converter chassis is grounded through its rack mounting, this may be accomplished by connecting a "strap" between Terminals 3 and 5 of Terminal Strip E2.

CAUTION

Before connecting an external loop to the Converter or applying AC power, double check to assure that any external battery is properly connected to the loop (including polarity consideration) and that such battery is of suitable voltage (normally 120 volts maximum for 20 or 60 milliampere circuits); that any grounds are proper; and that the loop current adjusting control on the front panel of the Converter is at its MAXIMUM COUNTER-CLOCKWISE position. After power is applied, the current control may be advanced to produce proper output current, as observable on the panel mounted meter.

NOTE

A polar Output Driver is available as an option in place of the Printer Driver, if polar operation is required.

3-13. HIGH LEVEL, POLAR, PRINTER DRIVER (SA174210)

The optional High Level, Polar, Printer Driver SA174210 is used in place of the Printer Driver, SA174206A when polar output is desired.

Referring to the Schematic Diagram C-SA174-2-0110, the plug-in High Level, Polar, Printer Driver includes a power transformer, rectifiers and filter for a self-contained polar battery.

DC isolation between the output of the DC Amplifier (SA174205A) and the Polar Printer Driver is obtained through the use of a keyed oscillator operating at approximately 50 KHz. Transistor Q603 serves as the oscillator and transistors Q601 and Q602 control the oscillator, keying it ON for a Mark signal and OFF for a Space signal.

In normal keying, a Mark signal is represented by a positive voltage at Pin 11 of connector P601. Transistor Q601 is reverse biased and is cut off. Transistor Q602 is forward biased by the negative supply voltage on Pin 12 of the Connector P601 and saturates permitting transistor Q603 to oscillate. Transformer T602 serves an an inductor for the oscillator circuit and as a decoupling transformer. The AC voltage appearing across the secondary of T602 is rectified by diode CR606 and filtered by capacitor C605. This voltage biases transistor Q605 to saturation. When this condition exists, Q607 is forward biased and Q604 is reverse biased. With Q607 forward biased, there is a low impedance path for the minus 60V Loop Battery to Pin 7, of P601. With Q604 "cut-off", the positive Loop Battery loop is an open circuit.

For a Space condition in normal keying, a negative voltage is present at Pin 11 of P601. This condition forward biases Q601, cutting off Q602 and oscillator Q603. With no AC signal across the secondary of T602, transistor Q605 is cut off. Under these conditions Q604 is forward biased from the positive Battery Loop. Transistor Q607 is also cut-off and the current limiting resistor R612 is inserted in the negative Battery Loop. Q604 and Q606 are connected in the conventional Darlington configuration, so that when Q604 is forward biased, Q606 presents a low impedance to the plus 60V Loop Battery.

Resistors R610 and R611 serve to limit the current flow through Q606 and Q607 and to protect the transistors against voltage surges which occur during the Mark-Space transitions as a result of the inductive reactance of a normal teleprinter load.

3-14. LOW LEVEL POLAR PRINTER OUTPUT OPTION

When a Low Level (+6 volt +1 volt DC) POlar Printer Output per MIL-STD-188( ) is required, the Converter is equipped with a Printer Driver (Polar High Level) Subassembly SA174210, which has been modified to produce a low level polar signal meeting the requirements of MIL-STD-188( ).

Technically, the modification consists of the addition of a series current limiting resistor in the output circuit with the final output shunted by a bridge rectifier-Zener diode combination which limits the output voltage to ±6 volts ±1 volt for loads not exceeding 10 mA, and limits short circuit current to approximately 15 mA. A shunting capacitor is also provided to "shape" the output wave and minimize high frequency output components.

The Schematic Diagram A-9-1052 identifies the components and circuit changes in the input circuit of the SA174210 Subassembly. The component Layout A-9-1053 shows the positioning of the components on the small printed circuit board used in the modification.

3-15. MONITOR CIRCUIT (SA174307A)

The tuned circuit outputs from the discriminator are amplified by Transistor Q701 and Q702. Q701 amplifies the Space signal while Q702 amplifies the Mark signal. The monitor selects the channel to be monitored. The output signals from the collectors of Q701 and Q702 drive the horizontal deflection plates of the monitor cathode ray tube.

The vertical sweep signal is obtained by differentiating the output signal from the DC chain and amplifying the resultant signal with Transistor Q703.

The resultant oscilloscope pattern thus produced is as follows. When Mark frequency is present, a horizontal trace is produced on the right side of the Cathode Ray Tube, while the output of Q703 causes an upward sweep on the tube.

When Space frequency is present, the horizontal trace appears on the left side of the tube and Q703 causes a downward sweep.

In addition, the SA174307A may be used to monitor Low Level DC Keying Systems (e.g. +6 VDC) by changing R725 in the differentiating network from 100,000 ohms to 33,000 ohms.

Front panel controls are provided for adjustment of Cathode Ray Tube "Intensity" and "Focus".

3-16. MAIN POWER SUPPLY (SA174308)

There are three separate power supplies for a complete Converter equipped with a Printer Driver.

The Main Supply, Schematic Diagram B-SA-174-3-0108, includes positive and negative 14 volts regulated supplies for operation of all circuits except the Monitor and Printer Relay circuits.

The Monitor Power Supply, Schematic Diagram C-SA-174-3-0107A, includes an AC filament supply and the necessary DC high voltage supply for the cathode ray tube and high voltage for the amplifier transistors used in the Monitor.

The Printer Driver Power Supply, Schematic Diagram B-SA-174-2-0106A, includes DC loop current supply as required for Neutral operation. The optional Polar Driver, Schematic Diagram C-SA-174-2-0110, also includes necessary DC loop current supply.

All Power Supply transformers are arranged for operation from 115 or 230 volts AC sources and one common strapping function provided on the main chassis accomplishes the wiring change for the entire unit when the voltage requirement is changed.

3-17. AUTOMATIC THRESHOLD CONTROL UNIT (SA174209A)

The Automatic Threshold Control Unit receives the Mark and Space signals from Q407 of the Diversity Control. These signals are applied to the base of transistors Q901 and Q902 in the Threshold Control, and develops a "reference" voltage which is the average of the two applied voltages. This "reference" voltage and the signal voltage are applied to the DC Amplifier (SA174205A).

3-18. MARK-HOLD FEATURE

In some applications of the Type 174 Converters, it is desirable to have a "Mark-Hold" feature, to hold the Converter output signal in Mark condition, whenever the incoming tone signal disappears.

This factory installed option consists of an etched circuit board (EB218) with components and a 2.5K ohm potentiometer. The etched circuit board is mounted on the underside of the main chassis and the potentiometer is mounted on the rear of the main chassis between terminal block E1 and the Test Jacks.

The circuit of the "Mark-Hold" feature is shown on Drawing No. B-9-0368 and the Component Layout on Drawing A-9-0456. Functioning is as follows. AGC voltages developed by the amplifiers for the two channels of the Converter are applied to the bases of transistors Q1001 and Q1002, and compared with the THRESHOLD voltage applied to the base of Transistor Q1003. If either (or both) of the channels is developing an AGC voltage greater than the THRESHOLD voltage, then transistor Q1003 is "cut-off" and transistors Q1004 and Q1005 also are cut-off. In this case, the Converter circuitry functions in its normal manner.

If neigher AGC voltage is equal to the THRESHOLD voltage, then Q1003, Q1004 and Q1005 are conducting and, through the connection from the junction of resistor R1006 and R1007 to Pin 11 of Scoket J6, the "Mark-Hold" circuitry forces the output of the converter to a Mark condition.

The THRESHOLD adjustment can be set to allow a dynamic signal level variation of approximately 40 dBm (from +10 dBm to -30 dBm) for operation of the Converter while still assuring that the output will be held in Mark condition for no signal input. It should be noted that this dynamic range is the range of the signal which is instantaneously stronger. That is to say, if either channel is at -30 dBm or greater, the Converter will function properly.

Section IV MAINTENANCE

4-1. GENERAL

Maintenance of the Type 174 Model 3 and 3A Frequency Shift Converter consists of inspecting the unit, replacing components, adjusting when necessary, and testing the converter for satisfactory operation.

4-2. TOOLS AND TEST EQUIPMENT

The tools and test equipment recommended for maintenance and/or troubleshooting the Type 174 Model 3 and 3A Frequency Shift Diversity Converter are listed in Table 4-1.

Table 4-1 Tools and Test Equipment

Item	Type
Long nose pliers	5"
Diagonal cutters	5"
Screwdriver	3/32" straight end blade
Soldapullt	Vacuum solder remover
Soldering iron	Pencil type, 35 watts
Solder	Multicore 60/40, 0.078 dia (71 mm).
Variable Attenuator	600 ohms, 0-58 dB, Daven Type T-332G or equivalent, three required.
VU Meter	Northern Radio Type 254 Model 1 or equivalent.
Vacuum Tube Voltmeter	Simpson Model 303 or equivalent.
Oscilloscope	Dumont Type 304H or equivalent.
Teletype Printer	Teletype Corporation Model 28 or equivalent.
Frequency Counter	Berkeley Type 554F or equivalent (EPUT Meter).
Transmitter Distributor	Teletype Corporation Model 14 or equivalent.
Keyer (Transmitter)	Northern Radio Type 153 Model 3 or equivalent.
Oscillator	Hewlett-Packard Type HP200A or equivalent.

4-3. MARK-HOLD ADJUSTMENT

In the event any components of the Mark-Hold circuitry required replacement, the adjustment of the threshold control, R1008 on the Schematic Drawing B-9-0368, must be checked by performing the following steps.

a) Terminate Channel 2 input with a 600 ohm resistor.

b) Throw Diversity Switch to CHANNEL 1 portion.

c) Apply a keyed tone signal to Channel 1 input at -40 dBm level.

d) Observe output signal (preferably with an Oscilloscope) while adjusting the THRESHOLD control from full clockwise position in a counter-clockwise direction until keying just stops. Output should then rest in Mark condition.

e) Increase input signal level until clean keying is observed. This should occur at approximately -35 dBm.

f) Apply normal signals to both channel input terminals and restore Diversity switch to DIVERSITY position.

g) Converter is now ready to handle traffic.

4-4. TROUBLESHOOTING

In the event of malfunction of the Frequency Shift Diversity Converter, it is suggested the unit be removed to the test bench and the procedure below followed.

1. Inspect the unit for damage to components, facings, etc.

2. With power switched OFF, connect the unit in the circuit of Northern Radio Drawing No. B-6-1316.

3. Turn the "output current" variable resistor to the maximum counter-clockwise position.

4. Arrange the Keyer to transmit at the marking frequency and adjust the Keyer's output level to zero dBm.

5. Apply power to the unit.

6. Operate the Meter Switch to the "Current" position. The meter should indicate approximately 20 mA.

7. Turn the "output current" variable resistor clockwise until the meter reads 60 mA.

8. Measure the resistance from E2-1 to E2-4 and from E2-2 to E2-4.

   Requirement: The resistance should read at least 1 megohm.

9. Operate the Diversity Switch to the DIVERSITY position. Observe CH 1 meter.

   Requirement: The meter should indicate full scale. If the requirement is not met, adjust the variable resistor R123 of the Channel 1 AGC Amplifier as necessary.

10. Observe CH 2 meter.

    Requirement: The meter should indicate full scale. If the requirement is not met, adjust the variable resistor R123 of the Channel 2 AGC Amplifier as necessary.

11. Operate the Diversity Switch to the DIVERSITY position and the Tuning Dial to Step 6. With keyed signals applied, observe the signal patterns on the Monitor Tube with the Monitor Switch operated alternately to the "CH 1" and "CH 2" positions.

    Requirement: The pattern for both channels should be equal in size emaniting from center 3/8" to ±1/16" length. If the requirement is not met, turn the variable resistor of the AGC Amplifier of the channel which has the larger pattern clockwise slightly to make them equal.

12. Reduce signal level into Channel 1 by 4 dB. (Use ATT. A).

    Requirement: The flag pattern associated with Channel 1 should diasppear and the flag pattern associated with Channel 2 should become slightly larger.

13. Reduce signal level into Channel 2 by 8 dB. (Use ATT. B).

    Requirement: The flag pattern associated with Channel 2 should disappear and the flag pattern associated with Channel 1 should increase slightly.

14. Reduce signal level from Channel 1 by a further 4 dB.

    Requirement: The flag pattern associated with each channel should be equal in size emanating from center of screen 3/8" ±1/16" length.

15. Set ATT. A and ATT. B back to zero dB again.

16. Operate both the Diversity Switch and the Monitor Switch to the CH 1 position. With VTVM connected to the Pin 1 of the Socket J3-1 (Space Tank) and to the Pin 13 of the Scoket J3-1 (Mark Tank), observe the voltage on the VTVM.

    Requirement: The amplitude of both Mark and Space signals should be 7.1 volts RMS ±0.2.

17. Operate both the Diversity Switch and the Monitor Switch to the CH 2 position. With VTVM connected to the Pin 1 of the Socket J3-2 and to the Pin 13 of the Socket J3-2, observe the voltage on the VTVM.

    Requirement: The amplitudes of both Mark and Space signals should be 7.1 volts RMS ±0.2.
    If the requirement is not met, adjust the Mark and Space amplitude control variable resistors R301 and R302 in the Channel Discriminator as required.

18. Dotter ON. Operate the CH 1 attenuator to the 50 dB position and the Diversity Switch to DIVERSITY position. No flag pattern will show on the Monitor Tube in CH 1 and clean flag pattern will show in CH 2. Return attenuator to zero dB.

    Operate the attenuator of CH 2 to 50 dB. No flag pattern will show on the Monitor Tube in CH 2 and flag pattern will show in CH 1. Return attenuator to zero dB.

19. Connect scope probe to the Terminal E of the Socket EB-160. Operate the SLOW-FAST switch and observe the waveform on the Oscilloscope.

    Requirement: The waveform, when the switch is operated to SLOW, should be more rounded than when the switch is operated to FAST.

20. Operate SENSE SWITCH to the (+) position. Observe reversals across 2K ohm load and adjust R914 in the Automatic Threshold for zero distortion.

    Requirement: The printer should print correctly.

21. Operate the SENSE SWITCH to the (-) position.

    Requirement: The printer should not print correctly.

22. With SENSE SWITCH operated to the (+) position, vary signal from Ø to -50 dB on each channel separately and simultaneously.

    Requirement: The printer should print correctly throughout.

23. Replace the Northern Radio Type 153 Model 3 Keyer with an Oscillator.

24. Operate the TUNING SWITCH to the Step 1 position. Adjust the Oscillator to transmit 2825 Hz at Ø dBm level.

25. Operate both the DIVERSITY and the MONITOR switch to the CH 1 and CH 2 alternately. Observe the signal on the monitor tube.

    Requirement: A horizontal line should appear on the Monitor Tube. The line associated with each channel should be equal in length 3/8" ±1/16".

26. Operate the TUNING SWITCH to the Step 2 position. Adjust the Oscillator to transmit 2775 Hz at Ø dBm level. Repeat Step 25.

27. Operate the TUNING SWITCH to the Step 3 position. Adjust the Oscillator to transmit 2675 Hz at Ø dBm level. Repeat Step 25.

28. Operate the TUNING SWITCH to the Step 4 position. Adjust the Oscillator to transmit 2575 Hz at Ø dBm level. Repeat Step 25.

29. Operate the TUNING SWITCH to the Step 5 position. Adjust the Oscillator to transmit 2375 Hz at Ø dBm level. Repeat Step 25.

30. Operate the TUNING SWITCH to the Step 7 position. Adjust the Oscillator to transmit 1775 Hz at Ø dBm level. Repeat Step 25.

Section V ELECTRICAL PARTS LIST

5-1. FREQUENCY SHIFT DIVERSITY CONVERTER

Symbol	Description	Mfr.	Part No.
C1,C2	0.002 mfd, 1000 WV ceramic capacitor	CEN	DD202
C3	0.47 mfd ±20%, 25 volt ceramic capacitor	SPR	5C11
E1	6 terminal screw type and solder lugs	KUL	600-6-Y-SI
E2	5 terminal screw type and solder lugs	KUL	600-5-Y-SI
F1,F2	1/2 amp Slo-Blo fuse	LFU	313.500
I1	Bayonet base lamp, Neon	GEC ANY	NE51 or B1A
J1-1,J1-2, J2-1,J2-2, J4,J5,J9,J10	18 terminal printed circuit connector	AMP	225-21831-101
J3-1,J3-2	24 prong female connector with floating bushing	AMP	57-20240
J6,J7	14 prong female connector with floating bushing	AMP	57-20140
J8	8 prong female connector with floating bushing	AMP	26-4201-8S
J11,J12	3 conductor microphone jack	SWC	S112B
J13	2 conductor phone jack, tip continuation circuit, insulated sleeve	SWC	N112A
J14	Tip jack, Red	ANY	MS16108-2
J15	Tip jack, Black	ANY	MS16108-3
J16	Tip jack, White	ANY	MS16108-1
M1,M2	0-100 microammeter	INI	Model 1122HL100DCUA
M3	100-0-100 microammeter	INI	Model 1122HC200DCUA
P1	3 pin AC receptacle	SWC	AC3G
R1	5000 ohms 25 watt Model H with 1/8" screwdriver slot	OHM	0162
R2	12 ohms ±10% 2 watts composition resistor	ANY	RC42GF120K
R3	10K ohms ±10% 1/4 watt composition resistor	ANY	RC07GF103K
R4,R5	4.7K ohms ±10% 1/4 watt composition resistor	ANY	RC07GF472K
S1,S3,S4,S5	DPDT toggle switch	CHC	8363K7
S2	6 circuit, 2 to 3 position shorting rotary switch	MAL	3163J
S6	2 circuit, 11 position non-shorting rotary switch, 1/2" shaft (for Model 3)	CEN	2513
	4 circuit, 2-6 position non-shorting rotary switch, 3/8" shaft (for Model 3A)	CEN	PA2011

Symbol	Description	Mfr.	Part No.
XF1,XF2	Panel mounting finger type knob fuseholder for 3AG fuse	LFU	342001
XI1	Pilot light assembly with clear lens and internal resistor	DLA	26408-1137
Z1	Line Cord Assembly	NRC	1363

5-2. AGC AMPLIFIER, SA174201A

Symbol	Description	Mfr.	Part No.
C101	100 mfd ±20%, 10 volt tantalum capacitor, insulated sleeve	TXI	SCM107GP010D4
C102	150 mfd ±20%, 15 volt tantalum capacitor, insulated sleeve	TXI	SCM157HP015D4
C103,C104	0.22 mfd ±20%, 25 volt ceramic capacitor	SPR	5C9
C105	4.7 mfd ±20%, 15 volt tantalum capacitor, insulated sleeve	TXI	SCM475BP015D4
C106	0.47 mfd ±20%, 25 volt ceramic capacitor	SPR	5C11
CR101,CR102, CR103,CR104	80 volt germanium diode	ANY	1N100
CR105,CR106, CR107,CR108	50 volt 100 mA silicon diode	ANY ANY	1N659 or 1N914
Q101,Q102, Q103,Q104, Q105	PNP silicon transistor	MOT	2N3251
Q106	NPN silicon transistor	MOT	2N2501
R101,R120, R124	1K ohm ±10% 1/4 watt composition resistor	ANY	RC07GF102K
R102,R103,R113, R118,R122	10K ohm ±10% 1/4 watt composition resistor	ANY	RC07GF103K
R104,R105, R114	100 ohm ±10% 1/4 watt composition resistor	ANY	RC07GF101K
R106,R109. R119	6.8K ohms ±10% 1/4 watt composition resistor	ANY	RC07GF682K
R107	220 ohms ±10% 1/4 watt composition resistor	ANY	RC07GF221K
R108	22K ohms ±10% 1/4 watt composition resistor	ANY	RC07GF223K
R110,R117 R121	4.7K ohms ±10% 1/4 watt composition resistor	ANY	RC07GF472K
R111,R112, R115,R116	150 ohms ±10% 1/4 watt composition resistor	ANY	RC07GF151K
R123	2.5K ohms potentiometer	ALB	RH252M
T101,T102, T103,T104	1500 ohms center tapped/10K ohms center tapped miniature transformer	NRC UTC	1329 DO-T25

5-3. LIMITER UNIT, SA174202A

Symbol	Description	Mfr.	Part No.
C201,C202	100 mfd ±20% 10 volts tantalum capacitor, insulated sleeve	TXI	SCM107GP010D4
C203	0.001 mfd 600 volts ceramic capacitor	CEN	ID102
C204	0.01 mfd ±20% 25 volt ceramic capacitor	AEO	TP89-103RM
CR201,202, 203,204,205, 206,207,208	50 volts 100 mA silicon diode	ANY ANY	1N659 or 1N914
J201	Test probe receptacle, Brown	API	3-582118-1
J202	Test probe receptacle, Red	API	3-582118-2
Q201,202,203	PNP silicon transistor	MOT	2N3251
R201	6.8K ohms ±10% 1/4 watt composition resistor	ANY	RC07GF682K
R202	10K ohms ±10% 1/4 watt composition resistor	ANY	RC07GF103K
R203,204, 209,210	1K ohm ±10%, 1/4 watt composition resistor	ANY	RC07GF102K
R205,206, 211,212	2.2K ohms ±10% 1/4 watt composition	ANY	RC07GF222K
R207	1K ohm potentiometer	ALB	RH102M
R208	3.3K ohms ±10% 1/4 watt composition resistor	ANY	RC07GF332K

5-4. DISCRIMINATOR, SA174203A

Symbol	Description	Mfr.	Part No.
CR301,302, 303,304	50 volt 100 mA silicon diode	ANY ANY	1N659 or 1N914
FL301	2550 cps bandpass filter	NRC	1326
FL302	Tuned circuit for frequency diversity operation	NRC	1327A
P301	Male connector - 24 pin	AMP	57-10240
Q301,302, 303,304,305, 306	NPN silicon transistor	MOT	2N2501
R301,302	1K ohm ±20% 1/4 watt rectangular potentiometer	ALB	RH102M
R303,304, 307,308	4.7K ohms ±10% 1/4 watt composition resistor	ANY	RC07GF472K
R305,306	330 ohms ±10% 1/4 watt composition resistor	ANY	RC07GF331K
R309	10K ohm ±10% 1/4 watt composition	ANY	RC07GF103K
R310,311, 312,313	100 ohms ±10% 1/4 watt composition resistor	ANY	RC07GF101K

5-5. DISCRIMINATOR, SA174203A-S

Symbol	Description	Mfr.	Part No.
CR301,302, 303,304	50 volt 100 mA silicon diode	ANY ANY	1N659 or 1N914
FL301	2550 cps bandpass filter	NRC	1326
FL302	Tuned circuit	NRC	2039
P301	Male connector - 24 pin	AMP	57-10240
Q301,302,303, 304,305,306	NPN silicon transistor	MOT	2N2501
R301,302	1K ohm ±20% 1/4 watt rectangular potentiometer	ALB	RH102M
R303,304, 307,308	4.7K ohms ±10% 1/4 watt composition resistor	ANY	RC07GF472K
R305,306	330 ohms ±10% 1/4 watt composition resistor	ANY	RC07GF331K
R309	10K ohm ±10% 1/4 watt composition resistor	ANY	RC07GF103K
R310,311, 312,313	100 ohms ±10% 1/4 watt composition resistor	ANY	RC07GF101K

5-6. DISCRIMINATOR SA174203A-WB3

Symbol	Description	Mfr.	Part No.
CR301,302, 303,304	50 volt 100 mA silicon diode	ANY ANY	1N650 or 1N914
FL301	2550 cps bandpass filter	NRC	1326A
FL302	Tuned circuit	NRC	1500
P301	Male connector - 24 pin	AMP	57-10240
Q301,302,303, 304,305,306	NPN silicon transistor	MOT	2N2501
R301,302	1K ohm ±20% 1/4 watt rectangular potentiometer	ALB	RH102M
R303,304, 307,308	4.7K ohms ±10% 1/4 watt composition resistor	ANY	RC07GF472K
R305,306	330 ohms ±10% 1/4 watt composition resistor	ANY	RC07GF331K
R309	10K ohms ±10% 1/4 watt composition resistor	ANY	RC07GF103K
R310,311, 312,313	100 ohms ±10% 1/4 watt composition resistor	ANY	RC07GF101K

5-7. FIXED FREQUENCY DISCRIMINATOR TYPE SA174203A-(*)

Symbol	Description	Mfr.	Part No.
CR301,302, 303,304	50 volt 100 mA silicon diode	ANY ANY	1N659 or 1N914

*Type SA174203A-4, High Freq. 807.5 Hz, Low Freq. 722.5 Hz.

Carrier Frequency: 765 ±42.5 Hz.

FL301	765 Hz bandpass filter	NRC	697
FL302	Tuned circuit for 765 ±42.5 Hz operation	NRC	1480

*Type SA174203A-5, High Freq. 977.5 Hz, Low Freq. 892.5 Hz.

Carrier Frequency: 935 ±42.5 Hz

FL301	935 cps bandpass filter	NRC	698
FL302	Tuned circuit for 935 ±42.5 Hz operation	NRC	1481

*Type SA174203A-7, High Freq. 1317.5 Hz, Low Freq. 1232.5 Hz.

Carrier Frequency: 1275 ±42.5 Hz

FL301	1275 Hz bandpass filter	NRC	700
FL302	Tuned circuit for 1275 ±42.5 Hz operation	NRC	1483

*Type SA174203A-8, High Freq. 1487.5 Hz, Low Freq. 1402.5 Hz.

Carrier Frequency: 1445 ±42.5 Hz

FL301	1445 Hz bandpass filter	NRC	701
FL302	Tuned circuit for 1445 ±42.5 Hz operation	NRC	1484

*Type SA174203A-56, High Freq. 1275 Hz, Low Freq. 1105 Hz.

Carrier Frequency: 1190 ±85 Hz

FL301	1190 Hz bandpass filter	NRC	781
FL302	Tuned circuit for 1190 ±85 Hz operation	NRC	1618

*Type SA174203A-72, High Freq. 2295 Hz, Low Freq. 2125 Hz.

Carrier Frequency: 2210 ±85 Hz.

FL301	2210 Hz bandpass filter	NRC	784
FL302	Tuned circuit for 2210 ±85 Hz operation	NRC	1619

P301	Male connector - 24 pin	AMP	57-10240
Q301,302,303, 304,305,306	NPN silicon transistor	MOT	2N2501
R301,302	1K ohm ±20% 1/4 watt rectangular potentiometer	ALB	RH102M

Symbol	Description	Mfr.	Part No.
R303,304, 307,308	4.7K ohms ±10%, 1/4 watt composition resistor	ANY	RC07GF472K
R305,306	330 ohms ±10%, 1/4 watt composition resistor	ANY	RC07GF331K
R309	10K ohms ±10%, 1/4 watt composition resistor	ANY	RC07GF103K
R310 thru 313	100 ohms ±10%, 1/4 watt composition resistor	ANY	RC07GF101K

5-8. DIVERSITY CONTROL, SA174204A

Symbol	Description	Mfr.	Part No.
C401	0.047 mfd ±20% 25 volts ceramic capacitor	SPR	3C15
C402,403,404	0.47 mfd ±20% 25 volts ceramic capacitor	SPR	5C11
C405,406	10 mfd ±20% 20 volts tantalum capacitor, insulated sleeve	TXI	SCM106BP020D4
CR401,402	50 volts 100 mA silicon diode	ANY ANY	1N659 or 1N914
J401	Test probe receptacle, Brown	API	3-582118-1
J402	Test probe receptacle, Red	API	3-582118-2
J403	Test probe receptacle, Orange	API	3-582118-3
Q401,406	NPN silicon transistor	MOT	2N2501
Q402,403,404, 405,407	PNP silicon transistor	MOT	2N3251
R401,402,405, 406,412	10K ohms ±10% 1/4 watt composition resistor	ANY	RC07GF103K
R403,404	1.5K ohms ±10% 1/4 watt composition resistor	ANY	RC07GF152K
R407,413, 414,421	6.8K ohms ±10% 1/4 watt composition resistor	ANY	RC07GF682K
R408	4.7K ohms ±10% 1/4 watt composition resistor	ANY	RC07GF472K
R409,410,411, 418,419,423	2.2K ohms ±10% 1/4 watt composition resistor	ANY	RC07GF222K
R415,416,417, 420	220 ohms ±10% 1/4 watt composition resistor	ANY	RC07GF221K
R422	3.3K ohms ±10% 1/4 watt composition resistor	ANY	RC07GF332K

5-9. DC AMPLIFIER, SA174205A

Symbol	Description	Mfr.	Part No.
C501	0.01 mfd ±20% 25 volts ceramic capacitor	AEO	TP89-103RM
C502,503	0.47 mfd ±20% 25 volts ceramic capacitor	SPR	5C11
J501	Test probe receptacle, Brown	API	3-582118-1
J502	Test probe receptacle, Red	API	3-582118-2
J503	Test probe receptacle, Orange	API	3-582118-3
J504	Test probe receptacle, Yellow	API	3-582118-4
Q501,502,503	PNP silicon transistor	MOT	2N3251
Q504,505	NPN silicon transistor	MOT	2N2501
R501	100 ohms ±10% 1/4 watt composition resistor	ANY	RC07GF101K
R502	10K ohms ±10% 1/4 watt composition resistor	ANY	RC07GF103K
R503,508,509, 511,512,513, 510	4.7K ohms ±10% 1/4 watt composition resistor	ANY	RC07GF472K
R504,505	2.2K ohms ±10% 1/4 watt composition resistor	ANY	RC07GF222K
R506	3.3K ohms ±10% 1/4 watt composition resistor	ANY	RC07GF332K
R507	220 ohms ±10% 1/4 watt composition resistor	ANY	RC07GF221K

5-10. PRINTER DRIVER, SA174206A

Symbol	Description	Mfr.	Part No.
C601,602	150 mfd 150 volt electrolytic capacitor	CDC	BR150-150
C603	0.01 mfd 50 volt ceramic disc capacitor	SPR	TG-S10
C604	680 mmf ±10% 500 volts ceramic capacitor	CEN	ID681
C605	0.1 mfd ±20% 200 volt paper capacitor heremetically sealed	ASC FDE	MQCP-2-1 or MFC-104K
C606	0.05 mfd 500 volt ceramic disc capacitor	CEN	ID503
CR601 thru CR605, 607,608	225 volts 400 mA silicon diode	ANY	1N645
CR606	General purpose germanium diode	SYL	1N34AS
P601	14 pin male connector	AMP	57-10140
Q601,602,603	High gain general purpose germanium transistor, 250 milliamperes, PNP type	MOT	2N652A
Q604,605	NPN silicon high voltage transistor	NRC	1340
R601	100 ohms ±5% 6.5 watt wirewound resistor or 100 ohms ±5% 5 watt wirewound resistor	ANY WLE	RW67V101 or 5XM

Symbol	Description	Mfr.	Part No.
R602	220K ohms ±10% 1/4 watt composition resistor	ANY	RC07GF224K
R603	22K ohms ±10% 1/4 watt composition resistor	ANY	RC07GF223K
R604,605	10K ohms ±10% 1/4 watt composition resistor	ANY	RC07GF103K
R606	33K ohms ±10% 1/4 watt composition resistor	ANY	RC07GF333K
R607	3.3K ohms ±10% 1/4 watt composition resistor	ANY	RC07GF332K
R608	680 ohms ±10% 1/4 watt composition resistor	ANY	RC07GF681K
R609	1K ohm ±10% 1/4 watt composition resistor	ANY	RC07GF102K
R610	470 ohms ±10% 1/4 watt composition resistor	ANY	RC07GF471K
T601	Power transformer Primary: 117/234 volts Secondary: 92 volts, CT 100 mA	NRC	1328
T602	500 ohms CT/600 ohms 500 milliwatt miniature transformer	NRC	1357

5-11. AUTO THRESHOLD, SA174209A

Symbol	Description	Mfr.	Part No.
C901,902,903	100 mfd ±20% 10 volt tantalum capacitor insulated sleeve	TXI	SCM107GP010D4
CR901,902	225 volt 400 mA silicon diode	ANY	1N645
J901	Test probe receptacle, Brown	API	3-582118-1
J902	Test probe receptacle, Red	API	3-582118-2
Q901,904,905	PNP silicon transistor	MOT	2N3251
Q902,903,906	NPN silicon transistor	MOT	2N2501
R901 thru 904, 907,908,917	3.3K ohms ±10% 1/4 watt composition resistor	ANY	RC07GF332K
R905,906	15K ohms ±10% 1/4 watt composition resistor	ANY	RC07GF153K
R909	22K ohms ±10% 1/4 watt composition resistor	ANY	RC07GF223K
R910,911	6.8K ohms ±10% 1/4 watt composition resistor	ANY	RC07GF682K
R912,913	1.5K ohms ±10% 1/4 watt composition resistor	ANY	RC07GF152K

Symbol	Description	Mfr.	Part No.
R914	2.5K ohm potentiometer	ALB	RH252M
R915,916	10K ohms ±10% 1/4 watt composition resistor	ANY	RC07GF103K
R918	2.2K ohms ±10% 1/4 watt composition resistor	ANY	RC07GF222K

5-12. HIGH LEVEL, POLAR, PRINTER DRIVER, SA-174210.

Symbol	Description	Mfr.	Part No.
C601,602	250 mfd 150 volt electrolytic capacitor	SPR	39D257F150HP4
C603	0.01 mfd 50 volt ceramic disc capacitor	SPR	TG-S10
C604	680 pfd ±10% 500 volt ceramic capacitor	CEN	ID681
C605	0.1 mfd ±10% 200 volt mylar capacitor	FDE	MFC-104K
CR601 thru 605, 607,608	225 volts 400 mA silicon diode	ANY	1N645
CR606	General purpose germanium diode	SYL	1N34AS
P601	14 pin male connector	AMP	57-10140
Q601,602,603	Germanium transistor, 250 mA PNP	MOT	2N652A
Q604 thru 607	Silicon transistor, 250 volt NPN	NRC	1340
R601	220K ohms ±10% 1/4 watt composition resistor	ANY	RC07GF224K
R602	22K ohms ±10% 1/4 watt composition resistor	ANY	RC07GF223K
R603,604	10K ohms ±10% 1/4 watt composition resistor	ANY	RC07GF103K
R605	33K ohms ±10% 1/4 watt composition resistor	ANY	RC07GF333K
R606	680 ohms ±10% 1/4 watt composition resistor	ANY	RC07GF681K
R607	3.3K ohms ±10% 1/4 watt composition resistor	ANY	RC07GF332K
R608,612	47K ohms ±10% 1 watt composition resistor	ANY	RC32GF473K
R609,613	15K ohms ±10% 1/4 watt composition resistor	ANY	RC07GF153K
R610,611	220 ohms ±5% 6.5 watt wirewound resistor	ANY	RW67V221
T601	Power Transformer Primary: 117/234 volts Secondary: 92 volts CT, 100 mA	NRC	1328
T602	Wnd #1: 50 turns CT Wnd #2: 25 turns	NRC	1908

5-13. LOW LEVEL (±6 volts ±1 volt DC) POLAR OUTPUT MODIFICATION OF SA174210 HIGH LEVEL POLAR PRINTER DRIVER

Symbol	Description	Mfr.	Part No.
C1	0.68 mfd +80 -20% 50 volt ceramic capacitor	SPR	7C023684D85000E
CR1	Rectifier assembly, Bridge, 50V rms minimum 100 mA minimum	MOT	MDA-920A-2
CR2	4.7 volts ±5% Zener diode, 400 mw	ANY	1N750A
R1	4.7K ohms ±10% 2 watt composition resistor	ANY	RC42GF472K

5-14. MONITOR, SA174307A

Symbol	Description	Mfr.	Part No.
C701	0.1 mfd ±10% 600 WVDC mylar capacitor	FDE ASC	MFF-104K or MQCP-6-1
C702A C702B	2 x 0.1 mfd ±10% 1000 volt bathtub capacitor (C702A and C702B in one case)	SAN	5010.2X1RT
C703,704	4 mfd 250 volt electrolytic capacitor	AEO	PRS 1550
C705,706	0.01 mfd GMV 600 volt ceramic disc capacitor, 11/16" dia.	SOL	CD20X-103Z
CR701,702,703	1500 volt 100 mA silicon diode	MOT	1N3283
CR704,705	225 volt 400 mA silicon diode	ANY	1N645
P701	Male connector - 14 pin	AMP	57-10140
Q701,702,703	NPN silicon high voltage transistor	NRC	1340
R701,702,709	100 ohms ±10% 1/4 watt composition resistor	ANY	RC07GF101K
R703,704,730	2.2 megohms ±10% 1 watt composition resistor	ANY	RC32GF225K
R705	100K ohms ±10% 2 watt potentiometer	ANY	JA1N056P104UA
R706	150K ohms ±10% 1/4 watt composition resistor	ANY	RC07GF154K
R707	500K ohms ±10% 2 watt potentiometer	ANY	JA1N056P504UA
R708	1.5 megohms ±10% 1 watt composition resistor	ANY	RC32GF155K
R710,712,719, 726	1 megohm ±10% 1/4 watt composition resistor	ANY	RC07GF105K
R711	4.7K ohms ±10% 1/4 watt composition resistor	ANY	RC07GF472K
R713,723,*725, 731	100K ohms ±10% 1/4 watt composition resistor	ANY	RC07GF104K
	*For low-level DC Keying Systems (e.g., ±6 VDC) R725 is:		
	33K ohms ±10% 1/4 watt composition resistor	ANY	RC07GF333K

Symbol	Description	Mfr.	Part No.
R714,724	22K ohms ±10% 1/4 watt composition resistor	ANY	RC07GF223K
R715,722,728	68K ohms ±10% 1/4 watt composition resistor	ANY	RC07GF683K
R716,720	330K ohms ±10% 1/4 watt composition resistor	ANY	RC07GF334K
R717, 721	2.5K ohms ±20% 1/4 watt rectangular potentiometer	ALB ALB	RH252M or RP252M.
R718	1K ohm ±10% 1/4 watt composition resistor	ANY	RC07GF102K
R727	47K ohms ±10% 1/4 watt composition resistor	ANY	RC07GF473K
R729	10K ohms ±10% 1/4 watt composition resistor	ANY	RC07GF103K
T701	Power Transformer Primary: 115/230 volts Sec. #1: 6.3 volts AC, 0.6 amp Sec. #2: 375 volts tapped at 150 volts, 10 mA	NRC	1322
V701	Cathode Ray Tube, 1"	RCA	1EP1
X701	11 pin socket, 3 tabs	EFJ	124-311-100

5-15. MAIN POWER SUPPLY, SA174308

Symbol	Description	Mfr.	Part No.
C801 thru C806	Electrolytic capacitor 150 mfd, 50 volts DC	CDC	BR150-50
CR801,802, 804,805	225 volts, 400 mA, silicon diode	ANY	1N645
CR803,806	15 volts ±5% 1 watt Zener diode	ANY	1N3024B
P801	Male connector 8 pin	AMP	26-4101-8P
Q801	NPN silicon transistor	MOT	2N2501
Q802,804	PNP germanium power transistor	ANY ANY	2N618 or 2N1011
Q803	PNP silicon transistor	MOT	2N3251
R801,802, 805,806	3.3K ohms ±10% 1/4 watt composition resistor	ANY	RC07GF332K
R803,807	330 ohms ±10% 1/4 watt composition resistor	ANY	RC07GF331K
R804,808	33 ohms ±10% 1/4 watt composition resistor	ANY	RC07GF330K
T801	Power Transformer Primary: 117/234 volts Secondary: 48 volts, CT, 200 mA	NRC	1324
XQ802,804	Power transistor socket	CIN	14T24324

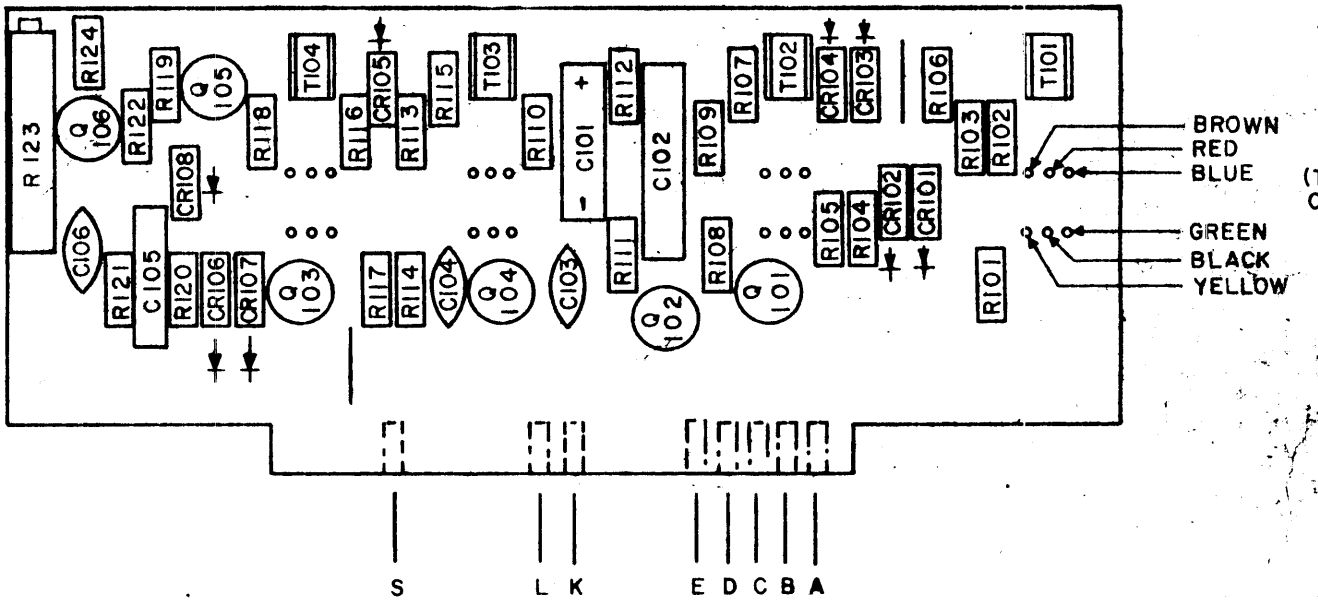
5-16. MANUFACTURERS' DESIGNATIONS

Mfr. Code	Fed Code	Name
AEO	00656	Aerovox Corporation
ALB	01121	Allen-Bradley Company
AMP	02660	Amphenol Corp.
API	00779	Amp, Incorporated
ASC	82376	Astron Corporation
CDC	14655	Cornell-Dubilier Electronics
CEN	71590	Globe-Union Inc., Centralab Div.
CHC	15605	Cutler-Hammer, Incorporated
CIN	71785	Cinch Mfg. Corporation & Howard B. Jones Div.
EFJ	74970	E.F. Johmson Company
FDE	27735	F-Dyne Electronic Company
GEC	24446	General Electric Company
INI	81030	International Instruments Inc.
KUL	75382	Kulka Electric Corporation
LFU	75915	Littelfuse, Incorporated
MAL	37942	P.R. Mallory & Company, Inc.
MOT	04713	Motorola Semiconductor Prods, Inc.
NRC	88183	Northern Radio, R.F. Communications Div. Harris-Intertype Corp.
OHM	44655	Ohmite Manufacturing Company
RCA	86684	Radio Corporation of America
SAN	00853	Sangamo Electric Company
SOL	96296	Solar Mfg. Corporation
SPR	56289	Sprague Electric Company
SWC	82389	Switchcraft Incorporated
SYL	82219	Sylvania Electric Prods. Inc.
TXI	01295	Texas Instruments, Inc.
UTC	80223	United Transformer Company
WLE	63743	Ward Leonard Electric Company

DWG. N. SA-174-2-0201 REV. A

REVISIONS			
SYM.	DESCRIPTION	DATE	APPROVAL

ETCHED CIRCUIT BOARD
(EB 166A)



(TYPICAL COLOR CODE ON T101-T104)

UNLESS OTHERWISE SPECIFIED	DRAFTSMAN	DATE	NAME:
DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS ± 1/64 DECIMALS ± .005 ANGLES	G. P.	4-21-65	COMPONENT LAYOUT A.G.C. AMPLIFIER SA 174201A
MATERIAL:	CHECKER	4-22-65	
FINISH:	ENGINEER		
	APPROVAL	4/29/65	

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

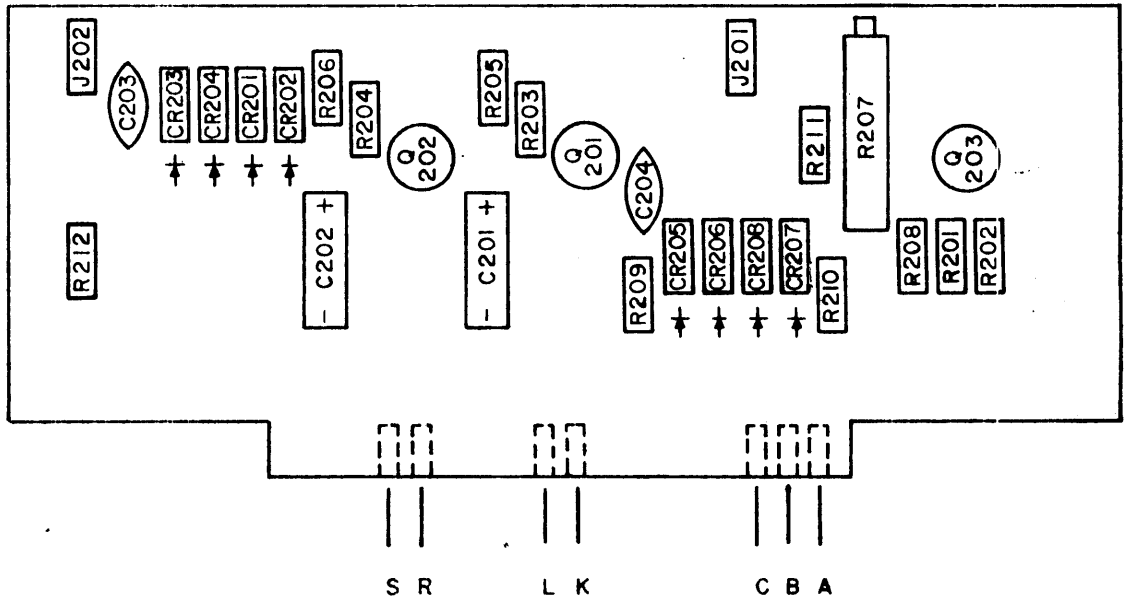
DWG. No. SA-174-2-0201A

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

DWG. N. SA-174-2-0202A

REVISIONS			
SYM.	DESCRIPTION	DATE	APPROVAL

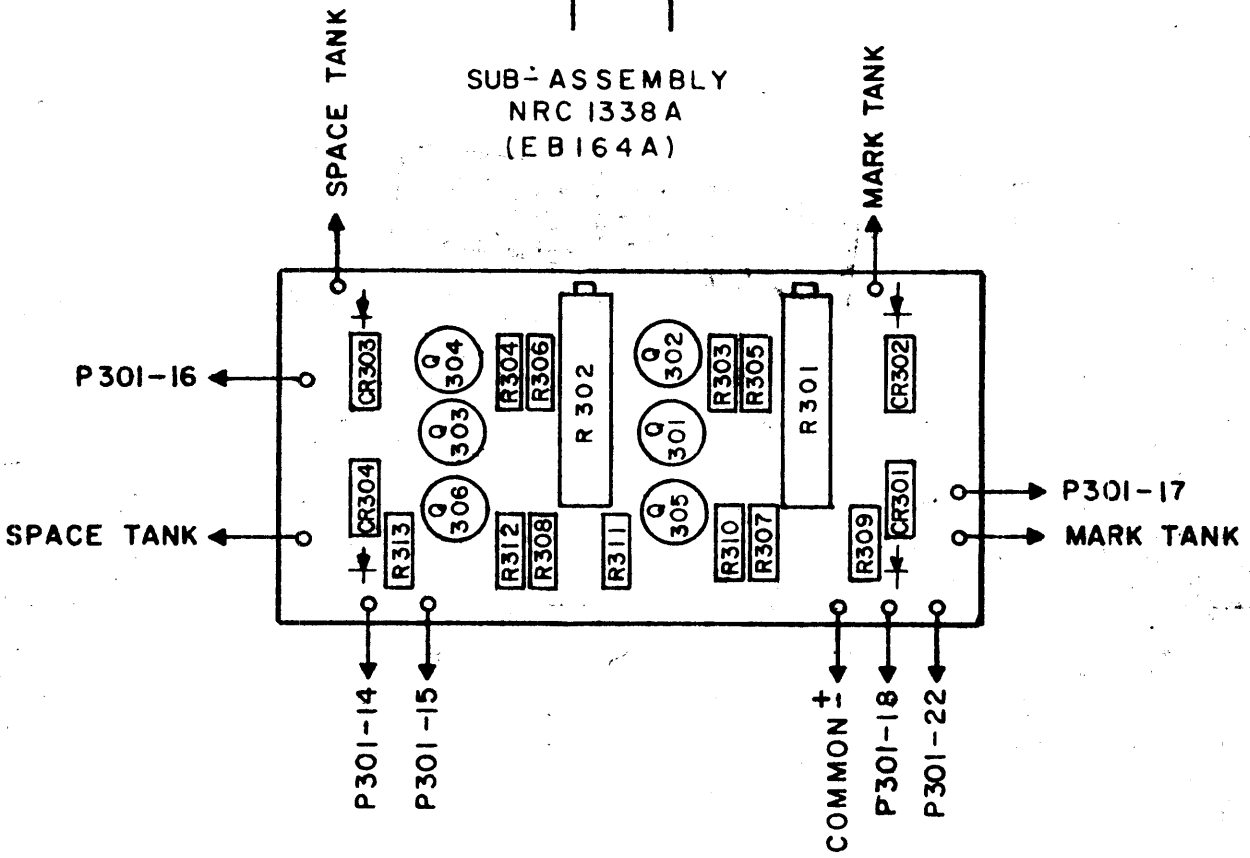
ETCHED CIRCUIT BOARD
(EB 158 A)



UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS ± 1/64 DECIMALS ± .005 ANGLES MATERIAL: FINISH:	DRAFTSMAN G P	DATE 4-16-65	NAME: COMPONENT LAYOUT LIMITER SA 174202A	NORTHERN RADIO COMPANY INCORPORATED 143-147 WEST 22ND ST. N.Y. 11 NEW YORK DWG. N. SA-174-2-0202A
	CHECKER	4-22-65		
	ENGINEER			
	APPROVAL 4/23/65		SCALE: NONE	SH. 1 OF 1 DWG. SIZE A

DWG. N. SA 174-2 0203 A REV.

REVISIONS			
SYM.	DESCRIPTION	DATE	APPROVAL



UNLESS OTHERWISE SPECIFIED	DRAFTSMAN	DATE	NAME:
DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS ± 1/64 DECIMALS ± .005 ANGLES	G P	2-25-65	COMPONENT LAYOUT DISCRIMINATOR SA174203A
MATERIAL:	CHECKER	4-28-65	
	ENGINEER		
FINISH:	APPROVAL	4/28/65	

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

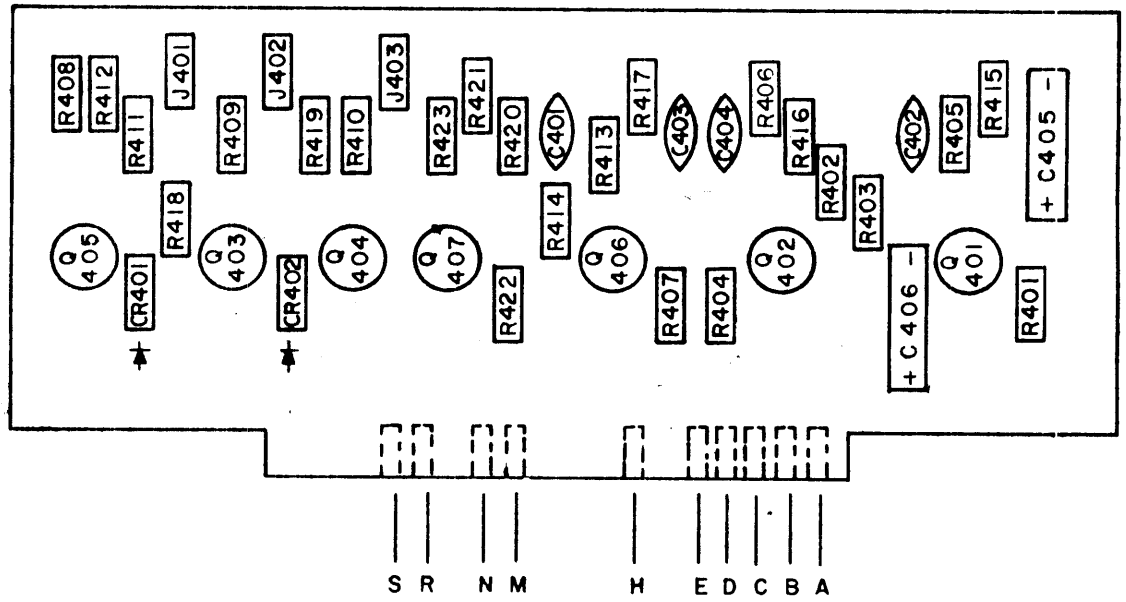
DWG. No. SA-174-2-0203 A

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

DWG. N.	REV.

REVISIONS			
SYM.	DESCRIPTION	DATE	APPROVAL

ETCHED CIRCUIT BOARD
(EB 161A)



UNLESS OTHERWISE SPECIFIED	DRAFTSMAN	DATE	NAME:
DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS ± 1/64 DECIMALS ± .005 ANGLES	G P	4-21-65	COMPONENT LAYOUT DIVERSITY CONTROL SA 174204A
MATERIAL:	CHECKER EP	4-22-65	
FINISH:	ENGINEER		
	APPROVAL JPH	9/29/65	

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

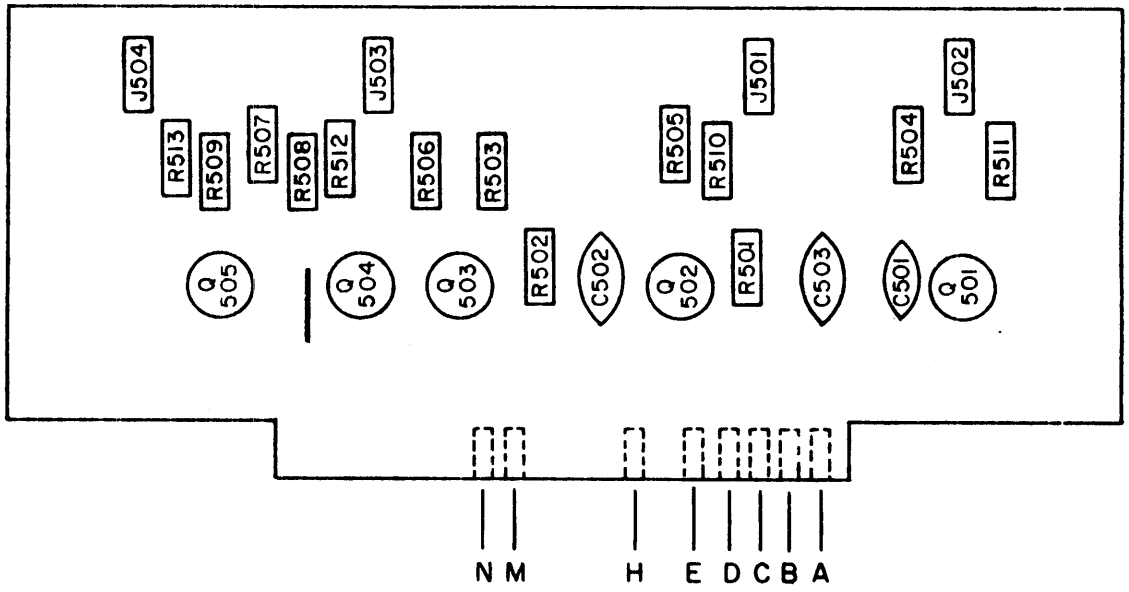
DWG. No. SA-174-2-0204A

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

DWG. N.	REV.
SA-174-2-0205A	

REVISIONS			
SYM.	DESCRIPTION	DATE	APPROVAL

ETCHED CIRCUIT BOARD
(EB 160A)



UNLESS OTHERWISE SPECIFIED	DRAFTSMAN	DATE	NAME:
DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS ± 1/64 DECIMALS ± .005 ANGLES	S. S.	4-15-65	COMPONENT LAYOUT DC AMPLIFIER SA 174205A
MATERIAL:	CHECKER	4-22-65	
FINISH:	ENGINEER		
	APPROVAL	4/29/65	SCALE: NONE SHEET: 1 OF 1

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

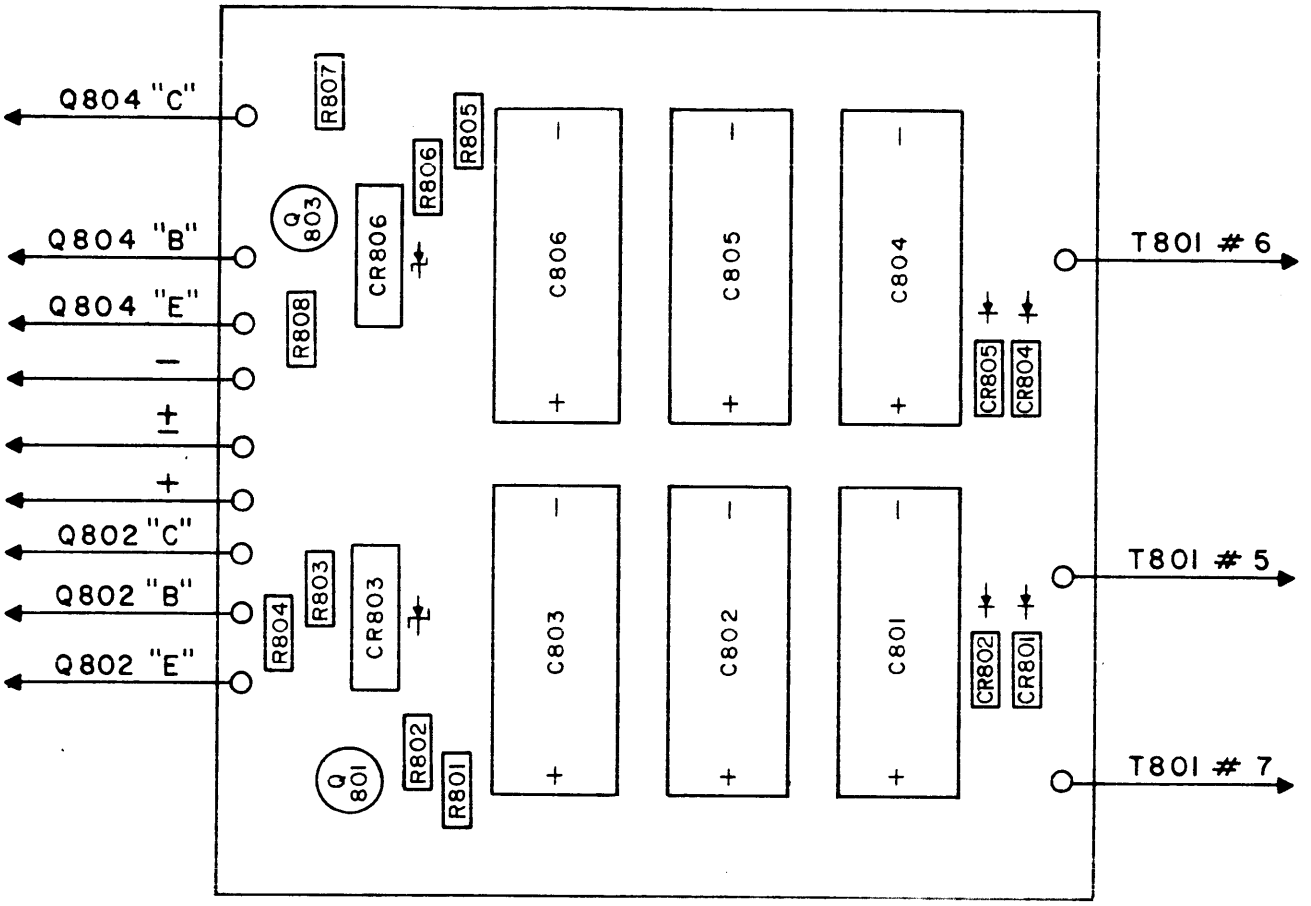
DWG. N. SA-174-2-0205A

DWG. SIZE A

DWG. No. SA-174-2-0208	REV.

REVISIONS			
SYM.	DESCRIPTION	DATE	APPROVAL

SUB-ASSEMBLY NRC 1341
(EB 157)

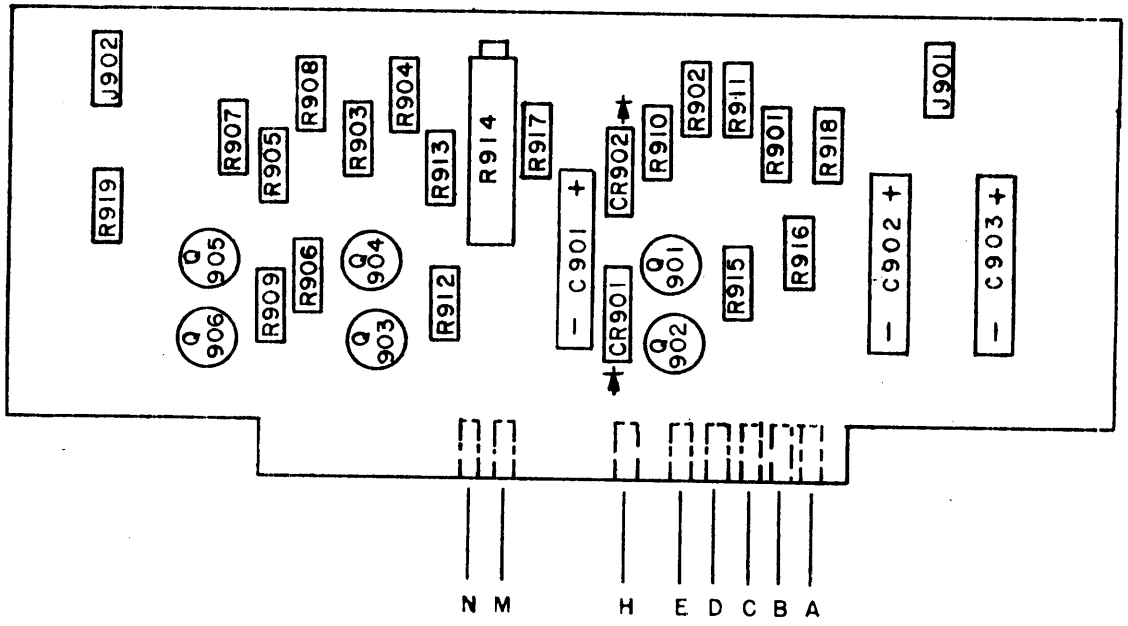


UNLESS OTHERWISE SPECIFIED	DRAFTSMAN	DATE	NAME:	NORTHERN RADIO CO. INCORPORATED
DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS DECIMALS ANGLES ± 1/64 ± .005	S. S.	10-23-64	COMPONENT LAYOUT MAIN POWER SUPPLY SA 174208	143-147 WEST 22ND ST. N.Y.11, NEW YORK
MATERIAL:	CHECKER	11-12-64		
FINISH:	ENGINEER			
	APPROVAL	11/12/64	SCALE: NONE SHEET: 1 OF 1	DWG. No. SA-174-2-0208 DWG. SIZE A

DWG. N.	REV.

REVISIONS			
SYM.	DESCRIPTION	DATE	APPROVAL

ETCHED CIRCUIT BOARD
(EB 159A)



UNLESS OTHERWISE SPECIFIED	DRAFTSMAN	DATE	NAME:
DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS ± 1/64 DECIMALS ± .005 ANGLES	G P	4-19-65	COMPONENT LAYOUT AUTO THRESHOLD SA 174209A
MATERIAL:	CHECKER RF	4-22-65	
FINISH:	ENGINEER		
	APPROVAL GPH	4/29/65	

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

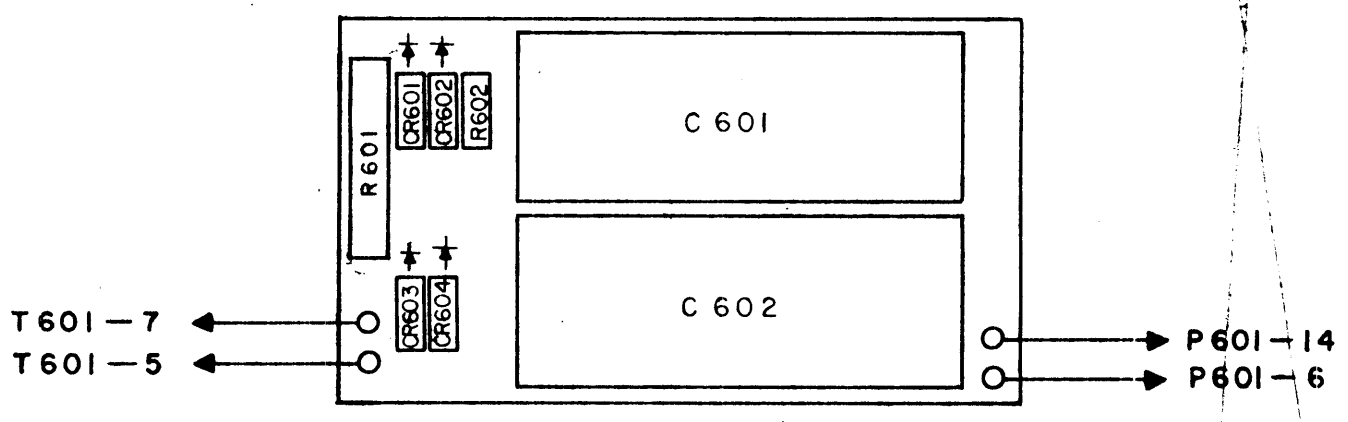
DWG. No. SA-174-2-0209A

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

DWG. N. SA-174-2-0306A	REV.

REVISIONS			
SYM.	DESCRIPTION	DATE	APPROVAL

SUB – ASSEMBLY
NRC1337A
(EB167A)

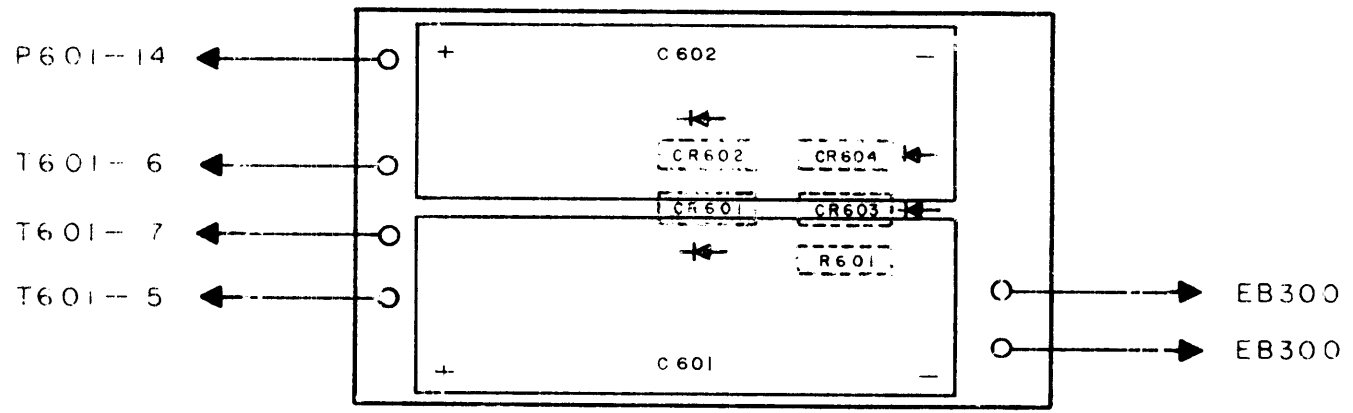


UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS ± 1/64 DECIMALS ± .005 ANGLES	DRAFTSMAN GP	DATE 5-7-65	NAME: COMPONENT LAYOUT PRINTER DRIVER SA174206A	NORTHERN RADIO COMPANY INCORPORATED 143-147 WEST 22ND ST. N.Y. 11 NEW YORK
MATERIAL:	CHECKER	5-7-65		DWG. N. SA-174-2-0306A
FINISH:	ENGINEER		SCALE: NONE SH 1 OF 1	DWG. SIZE A
	APPROVAL	5/7/65		

DWG. N.	SA 174-2-0310	REV.

REVISIONS			
SYM.	DESCRIPTION	DATE	APPROVAL

CIRCUIT BOARD SUB-ASSEMBLY NRC 2015
(CONSISTS OF ETCHED BOARD WITH COMPONENTS)
EB 300 (ETCHED BOARD ONLY)



UNLESS OTHERWISE SPECIFIED	DRAFTSMAN	DATE	NAME:
DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS ± 1/64 DECIMALS ± .005 ANGLES	CHEN	4-22-70	COMPONENT LAYOUT SUB-ASSEMBLY NRC 2015 PRINTER DRIVER (POLAR HIGH LEVEL) SA 174210
MATERIAL:	CHECKER	4-22-70	
FINISH:	ENGINEER		
	APPROVAL		

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

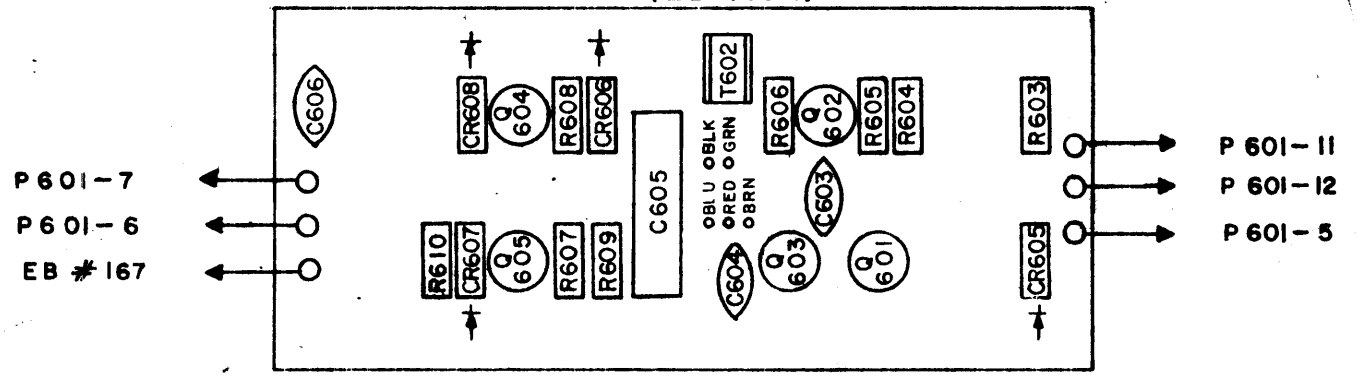
DWG. No. SA-174-2-0310

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

DWG. No.	REV.
SA-174-2-0-06A	

REVISIONS			
SYM.	DESCRIPTION	DATE	APPROVAL

SUB-ASSEMBLY NRC1347A
(EB 168A)



UNLESS OTHERWISE SPECIFIED	DRAFTSMAN	DATE	NAME:
DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS ± 1/64 DECIMALS ± .005 ANGLES	S. S.	5-7-65	COMPONENT LAYOUT PRINTER DRIVER SA 174206A
MATERIAL:	CHECKER	5-7-65	
FINISH:	ENGINEER		
	APPROVAL	5/7/65	

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

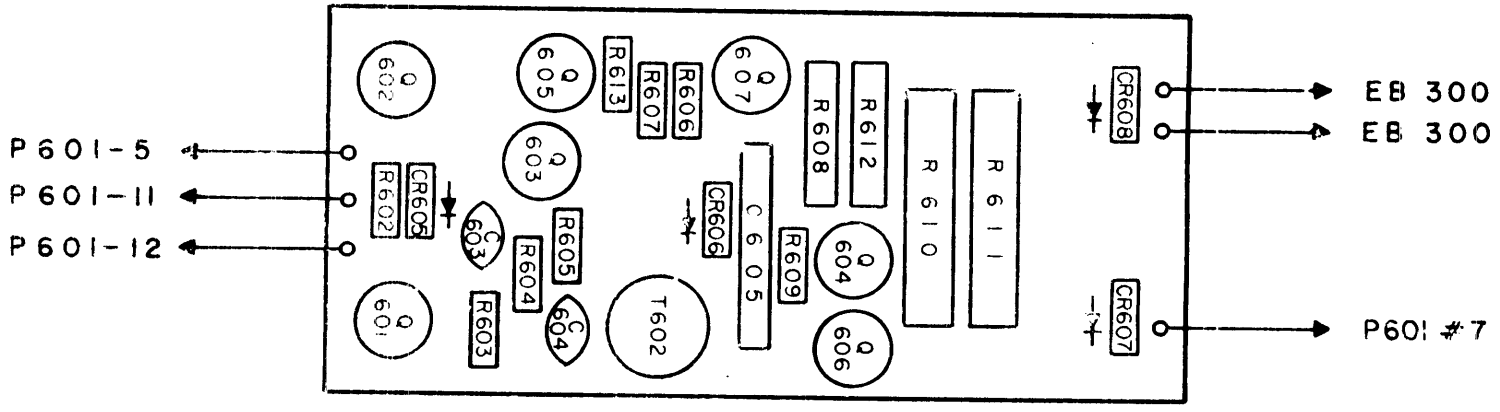
NORTHERN RADIO COMPANY
INCORPORATED
143-147 WEST 22ND ST. N.Y. 11
NEW YORK

DWG. No. SA-174-2-0406A

DWG No. SA174-2-0410	REV.

REVISIONS			
SYM.	DESCRIPTION	DATE	APPROVAL

CIRCUIT BOARD SUB-ASSEMBLY NRC 2016
(CONSISTS OF ETCHED BOARD WITH COMPONENTS)
EB #301 (ETCHED BOARD ONLY)



UNLESS OTHERWISE SPECIFIED	DRAFTSMAN	DATE	NAME:
DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS ± 1/64 DECIMALS ± .005 ANGLES	CHEN	4-22-70	COMPONENT LAYOUT SUB-ASSEMBLY NRC 2016 PRINTER DRIVER (POLAR HIGH LEVEL) SA 174210
MATERIAL:	CHECKER	4-13-70	
FINISH:	ENGINEER		
	APPROVAL		
	SCALE: NONE	SH 1 OF 1	DWG. SIZE A

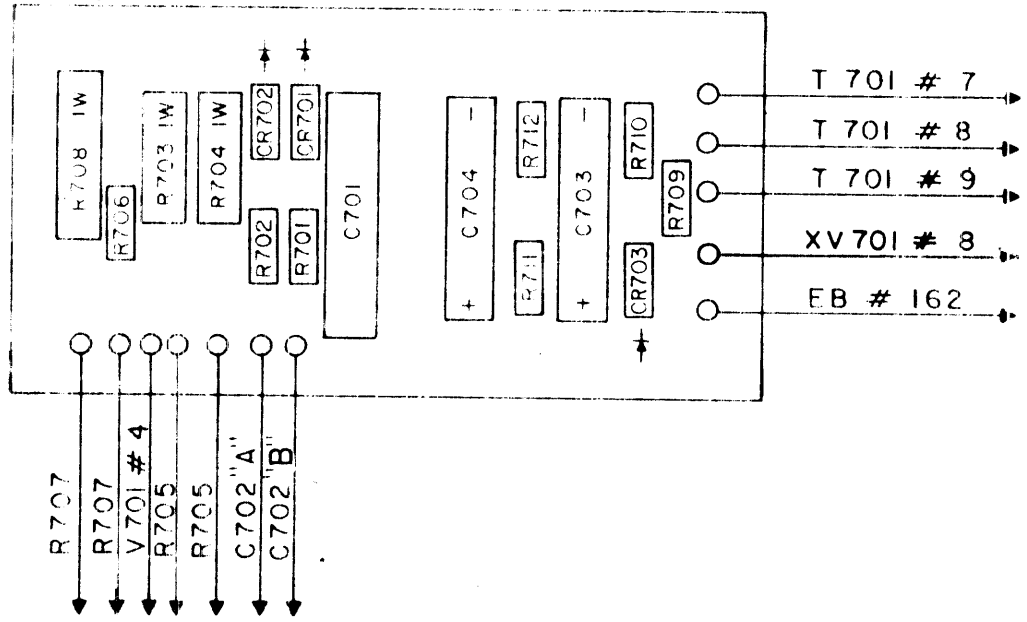
NORTHERN RADIO COMPANY
INCORPORATED
143-147 WEST 22ND ST. N.Y. 11
NEW YORK

DWG. No. SA174-2-0410

DWG. No. SA-174-3-0307A	REV.

REVISIONS			
SYM.	DESCRIPTION	DATE	APPROVAL

SUB-ASSEMBLY NRC 1621
(EB 163A)



UNLESS OTHERWISE SPECIFIED	DRAFTSMAN	DATE	NAME:
DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS ± 1/64 DECIMALS ± .005 ANGLES	J. B	8-29-67	COMPONENT LAYOUT (POWER SUPPLY) MONITOR SA174307A
MATERIAL:	CHECKER		
FINISH:	ENGINEER		
	APPROVAL		

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

DWG. No. SA-174-3-0307A

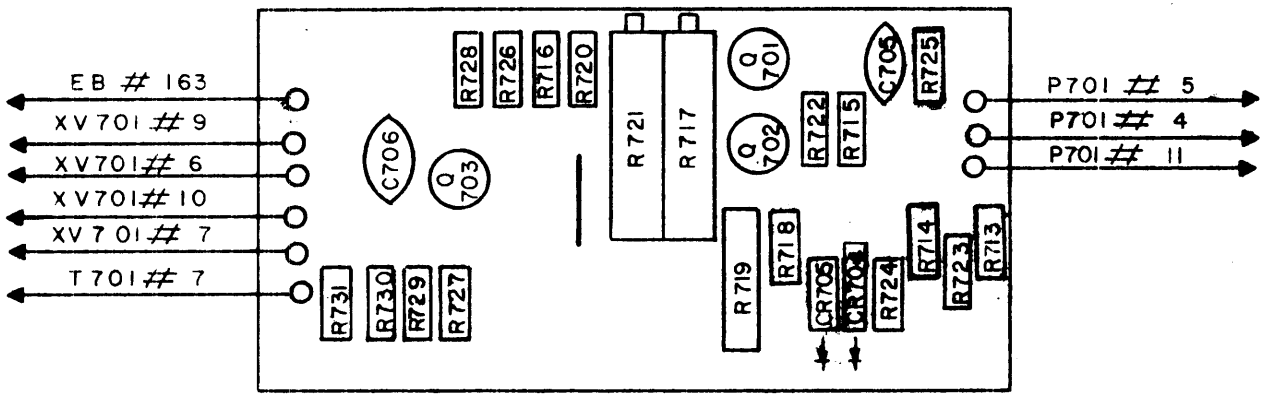
SCALE: NONE | SH. 1 OF 1 | DWG. SIZE A

DWG.	REV.
N .SA-174-3-0407A	

REVISIONS			
SYM.	DESCRIPTION	DATE	APPROVAL

SUB – ASSEMBLY NR C1620

(E B 162 A)



UNLESS OTHERWISE SPECIFIED	DRAFTSMAN	DATE	NAME:
DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS ± 1/64 DECIMALS ± .005 ANGLES	J.L.G	8-29-67	COMPONENT LAYOUT (AMPLIFIER) MONITOR SA174307A
MATERIAL:	CHECKER	9-15-67	
FINISH:	ENGINEER		
	APPROVAL		

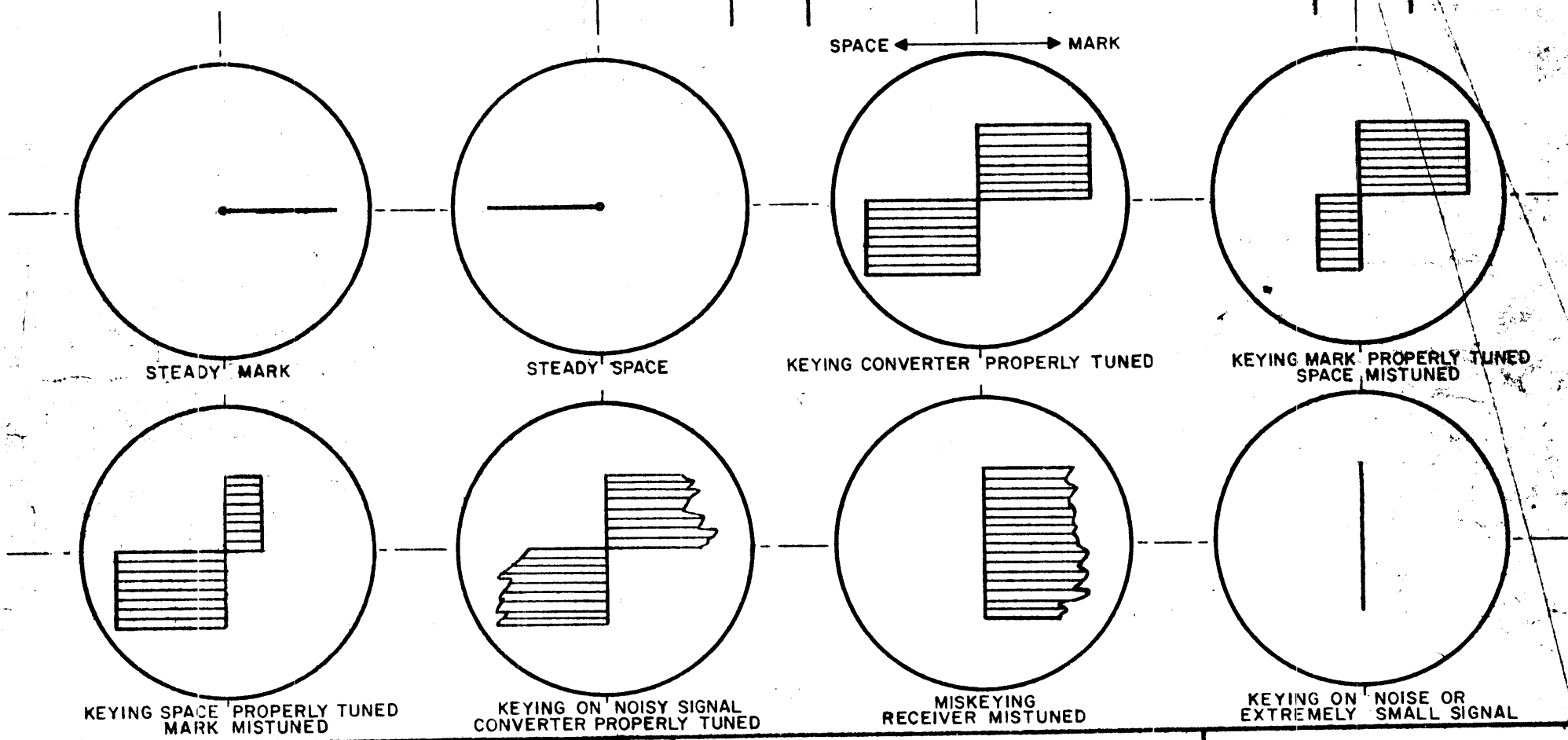
NORTHERN RADIO COMPANY INCORPORATED
143-147 WEST 22ND ST. N.Y. 11 NEW YORK

DWG. N. SA-174-3-0407A

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

DWG. N. 174-2-0 REV.

REVISIONS			
SYM.	DESCRIPTION	DATE	APPROVAL



UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
FRACTIONS ± 1/64 DECIMALS ± .005 ANGLES

MATERIAL:

FINISH:

	DRAFTSMAN	DATE
	S. S.	11-17-64
CHECKER	RJF	11-17-64
ENGINEER		
APPROVAL	JPH	11/17/64

NAME:

TUNING PATTERNS

F. S. DIVERSITY CONVERTER

TYPE 174 MOD. 2

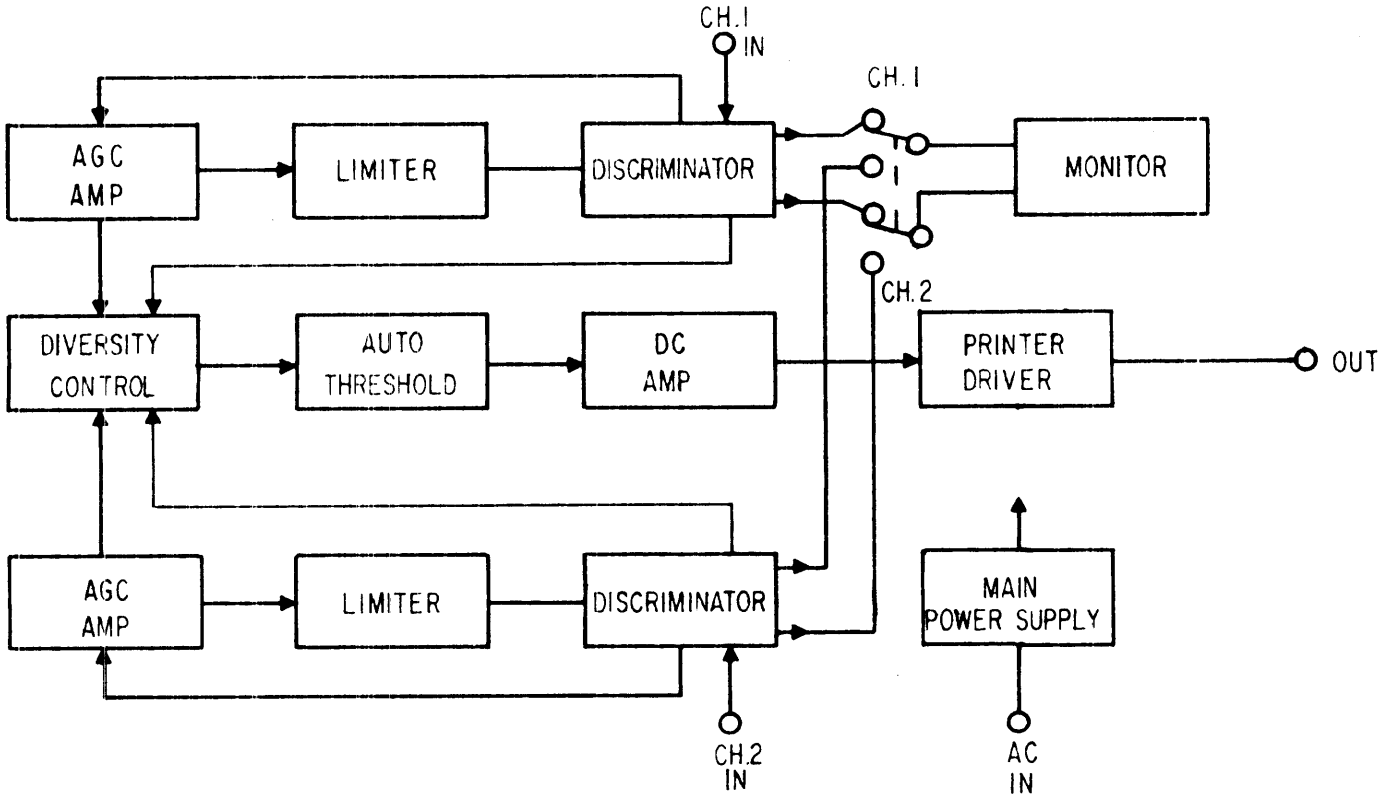
SCALE: NONE SHEET: 1 OF 1 DWG. SIZE A

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

DWG. No. 174-2-20

DWG. No.	174-3-	REV.

REVISIONS			
SYM.	DESCRIPTION	DATE	APPROVAL



UNLESS OTHERWISE SPECIFIED	DRAFTSMAN	DATE	NAME:
DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS ± 1/64 DECIMALS ± .005 ANGLES	H. B.	1-19-67	BLOCK DIAGRAM FREQUENCY SHIFT DIVERSITY CONVERTER TYPE 174 MOD. 3
MATERIAL:	CHECKER	1-19-67	
FINISH:	ENGINEER		
	APPROVAL		

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

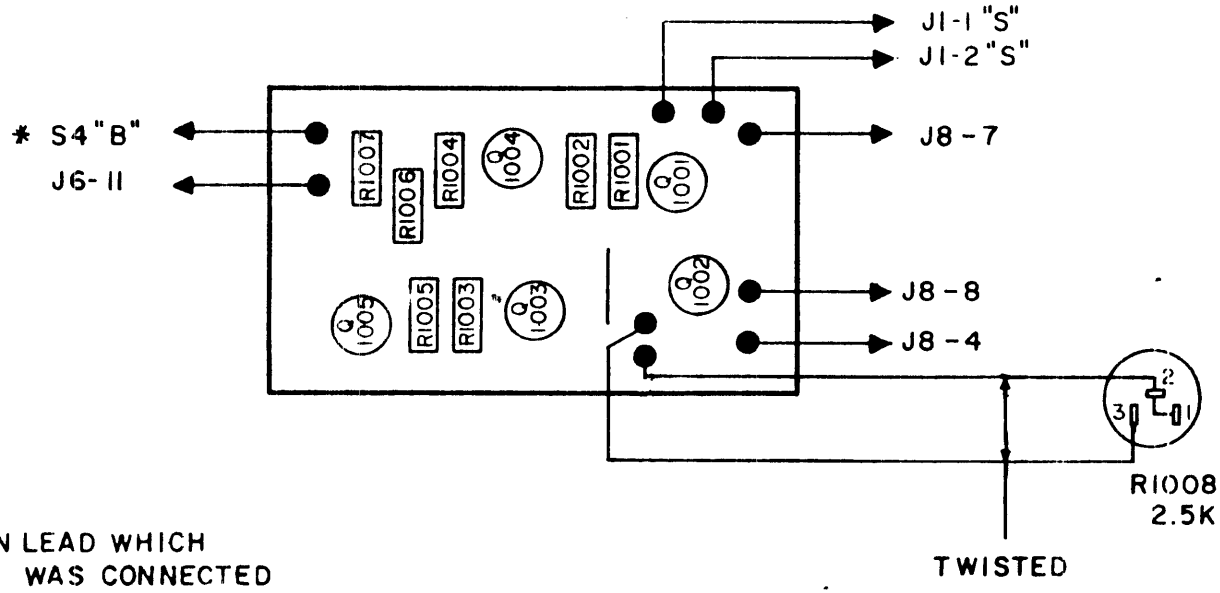
NORTHERN RADIO COMPANY
INCORPORATED
143-147 WEST 22ND ST. N.Y. 11
NEW YORK

DWG. No. 174-3-04

DWG. N.	REV.

REVISIONS			
SYM.	DESCRIPTION	DATE	APPROVAL

SUB-ASSEMBLY NRC 1642
EB 218



NOTE:
*- GREY-GREEN LEAD WHICH ORIGINALLY WAS CONNECTED TO J6-11

UNLESS OTHERWISE SPECIFIED	DRAFTSMAN	DATE	NAME:
DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS ± 1/64 DECIMALS ± .005 ANGLES	J. B.	10-26-67	LAYOUT COMPONENT "MARK-HOLD" FOR F.S. DIVERSITY CONVERTER TYPE 174 MODELS 2,3&3A NRC 1642
MATERIAL:	CHECKER	10-27-67	
FINISH:	ENGINEER		
	APPROVAL		

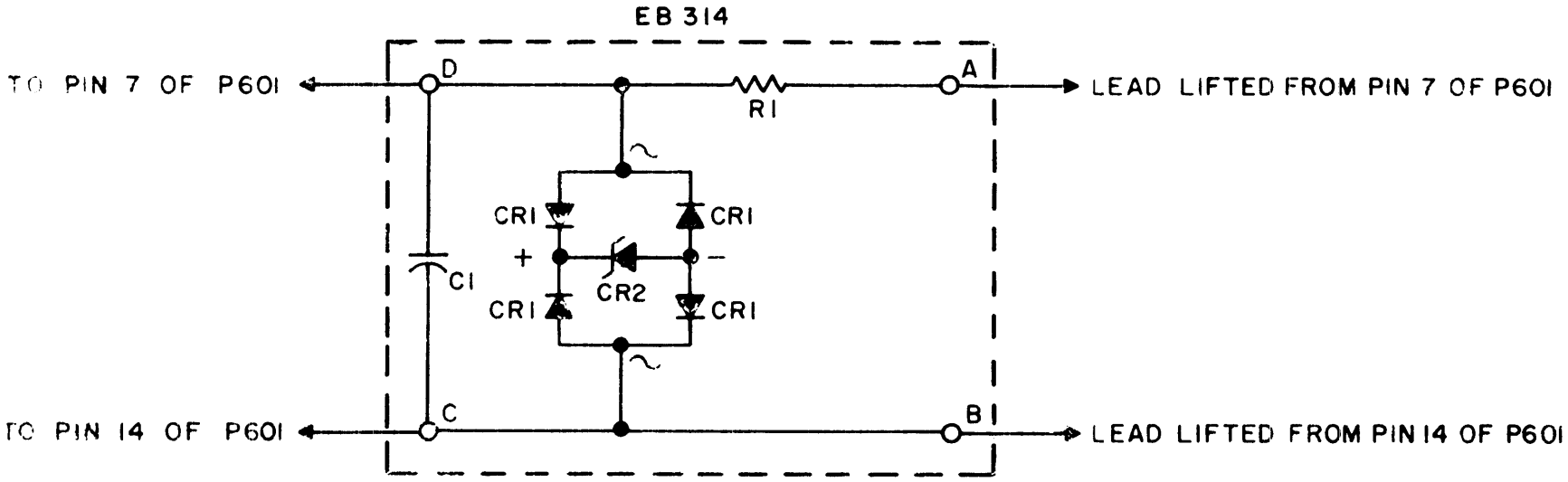
NORTHERN RADIO COMPANY
INCORPORATED
[redacted]

DWG. No. 9-0456

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

DWG. No. 9-10	REV.

REVISIONS			
SYM.	DESCRIPTION	DATE	APPROVAL



UNLESS OTHERWISE SPECIFIED	DRAFTSMAN	DATE
DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS ± 1/64 DECIMALS ± .005 ANGLES	D A L	9/22/70
MATERIAL:	CHECKER	9 23 70
	ENGINEER	
FINISH:	APPROVAL	

NAME:

SCHEMATIC
LOW LEVEL OUTPUT MODIFICATION TO SA174210 PRINTER DRIVER
NRC 2077

NORTHERN RADIO COMPANY
INCORPORATED

[redacted]

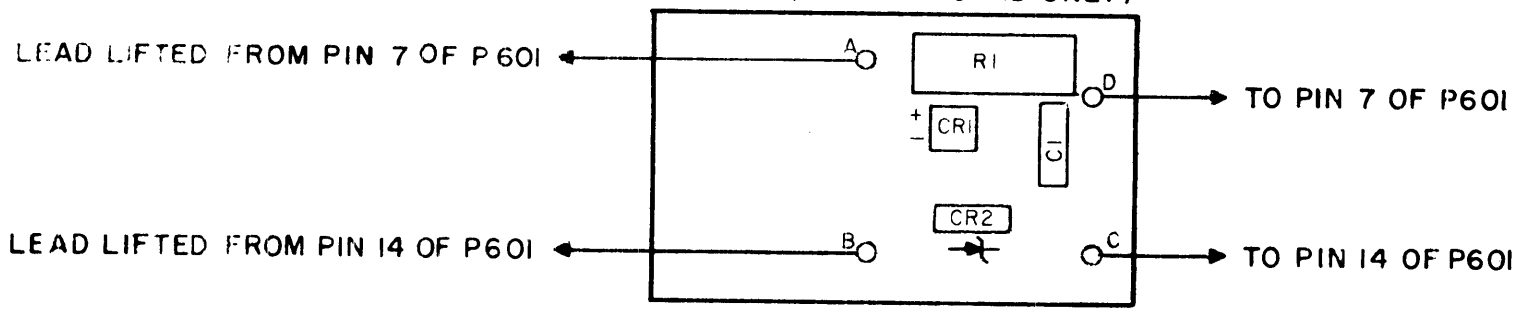
DWG. N. 9-1052

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

DWG. No.	REV.

REVISIONS			
SYM.	DESCRIPTION	DATE	APPROVAL

CIRCUIT BOARD SUB-ASSEMBLY NRC 2077
(CONSISTS OF ETCHED BOARD WITH COMPONENTS)
EB 314 (ETCHED BOARD ONLY)



UNLESS OTHERWISE SPECIFIED	DRAFTSMAN	DATE
DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS ± 1/64 DECIMALS ± .005 ANGLES	D A L	9/22/70
MATERIAL:	CHECKER	9-23-70
	ENGINEER	
FINISH:	APPROVAL	

NAME:
LAYOUT, COMPONENTS
SUB-ASSEMBLY NRC 2077
LOW LEVEL OUTPUT
MODIFICATION TO SA174210
PRINTER DRIVER
NRC 2077

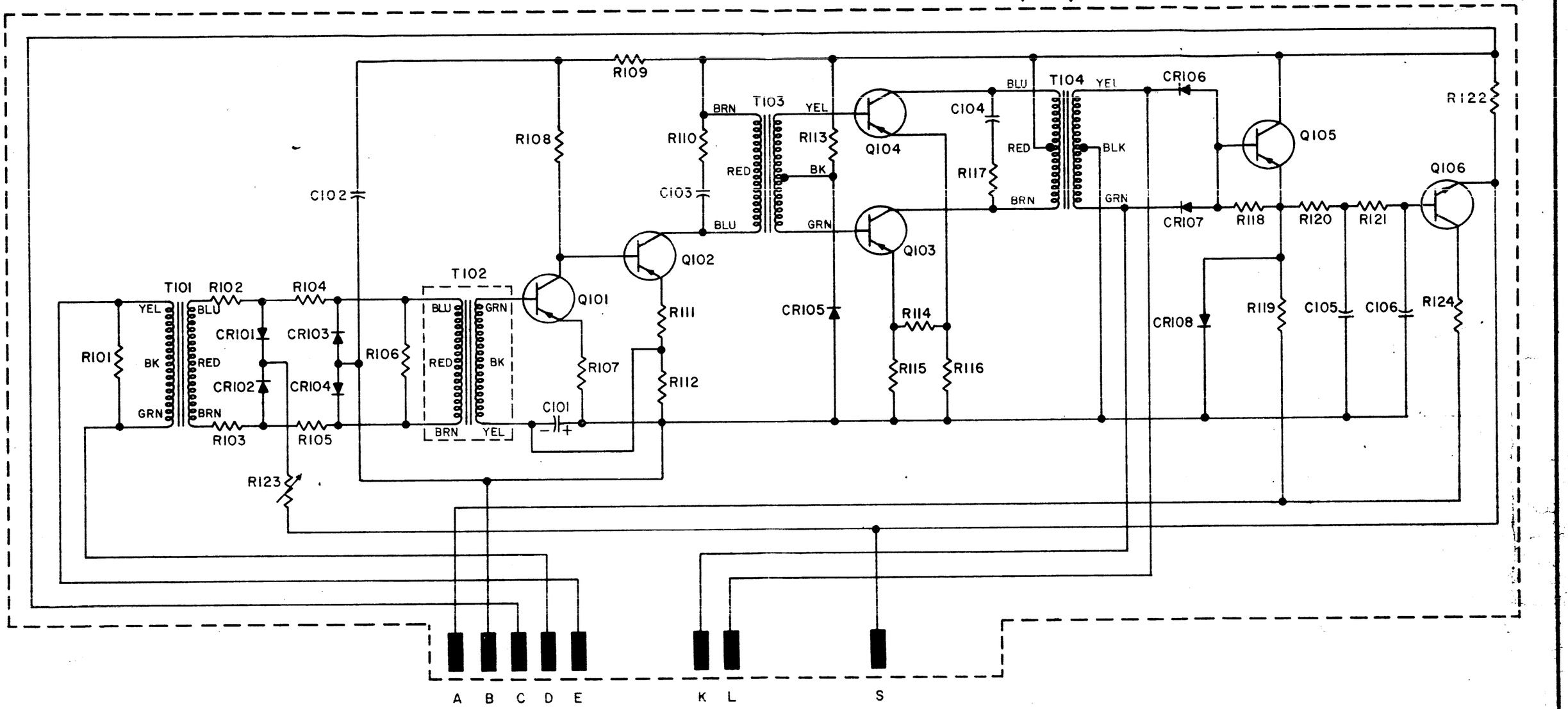
NORTHERN RADIO COMPANY
INCORPORATED
[redacted]

DWG. No. 9-1053

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

ETCHED CIRCUIT BOARD (EB166A)

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



UNLESS OTHERWISE SPECIFIED	DRAFTSMAN	DATE	NAME:
DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS ± 1/64 DECIMALS ± .005 ANGLES	G P	3-5-65	SCHEMATIC AGC AMPLIFIER SA 174201A
MATERIAL:	CHECKER	#28-65	
FINISH:	ENGINEER		
	APPROVAL	4/30/65	

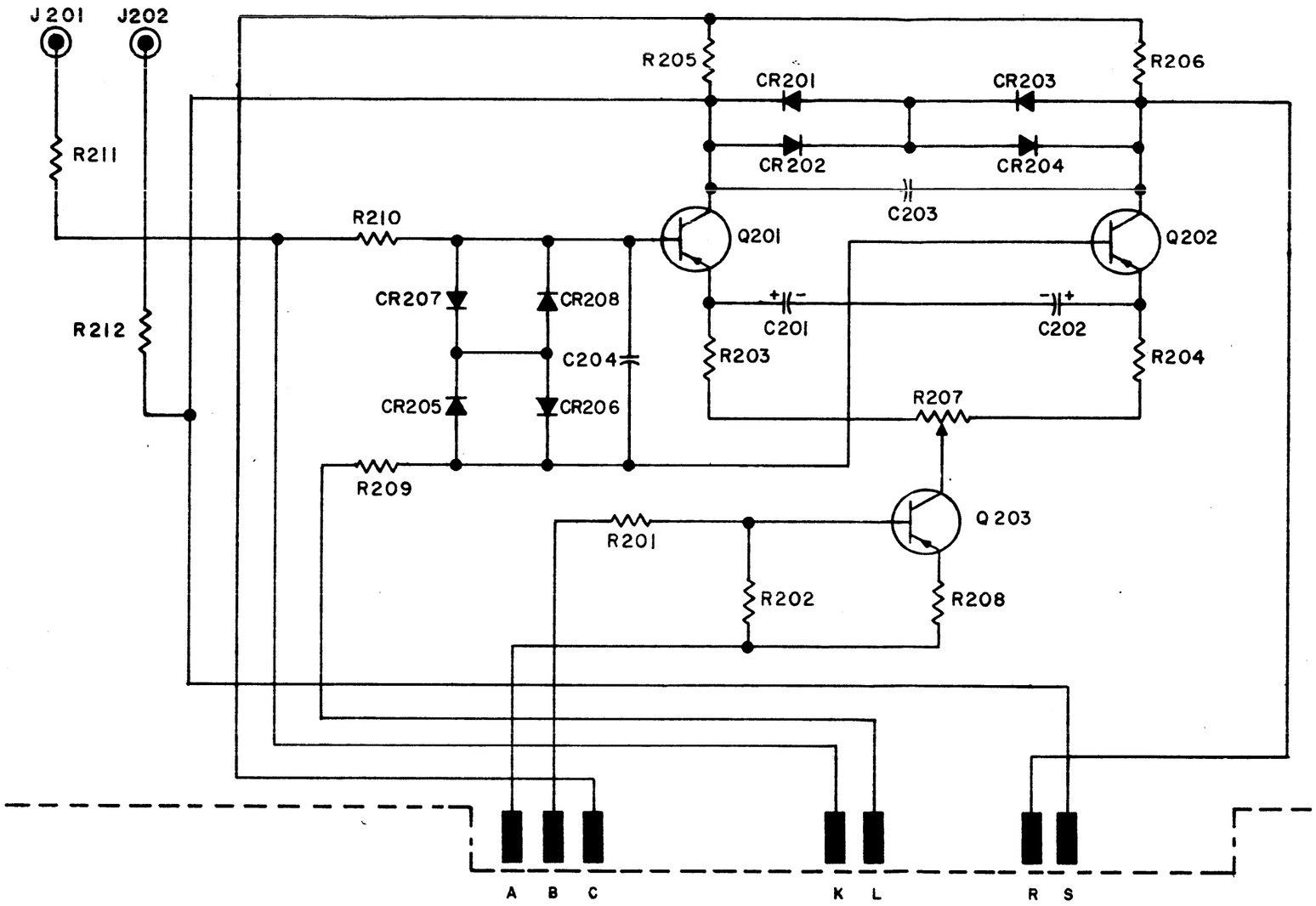
NORTHERN RADIO COMPANY
INCORPORATED

DWG. No. SA-174-2-0101A

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

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

ETCHED CIRCUIT BOARD (EB158A)



UNLESS OTHERWISE SPECIFIED	DRAFTSMAN	DATE	NAME:
DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS ± 1/64 DECIMALS ± .005 ANGLES	G. P	4-16-65	SCHEMATIC LIMITER SA174202A
MATERIAL:	CHECKER	4-26-65	
FINISH:	ENGINEER		
	APPROVAL	4/30/65	
	SCALE: NONE	SHEET 1 OF 1	

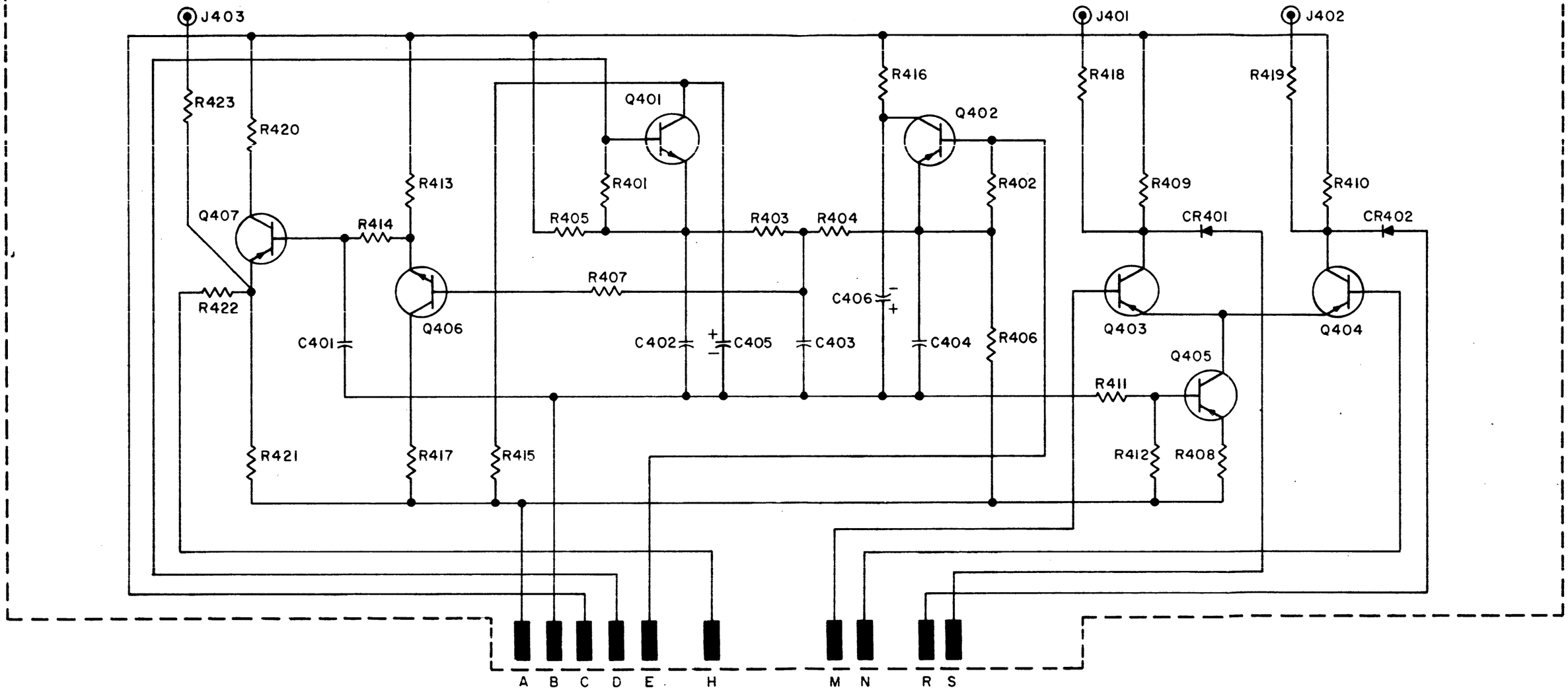
NORTHERN RADIO COMPANY
INCORPORATED
525 W. HIBISCUS BLVD.
MELBOURNE FLA.

DWG. NO. SA-174-2-010
DWG. SIZE B

REVISIONS			
SYM.	DESCRIPTION	DATE	APPROVAL

REV.
DWG. No.

ETCHED CIRCUIT BOARD (EB161A)



UNLESS OTHERWISE SPECIFIED	DRAFTSMAN	DATE	NAME:
DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS ± 1/64 DECIMALS ± .005 ANGLES	S. S.	2-25-65	SCHEMATIC DIVERSITY CONTROL SA174204A
MATERIAL:	CHECKER R.T.	2-25-65	
FINISH:	ENGINEER		
	APPROVAL JPH	4/30/65	

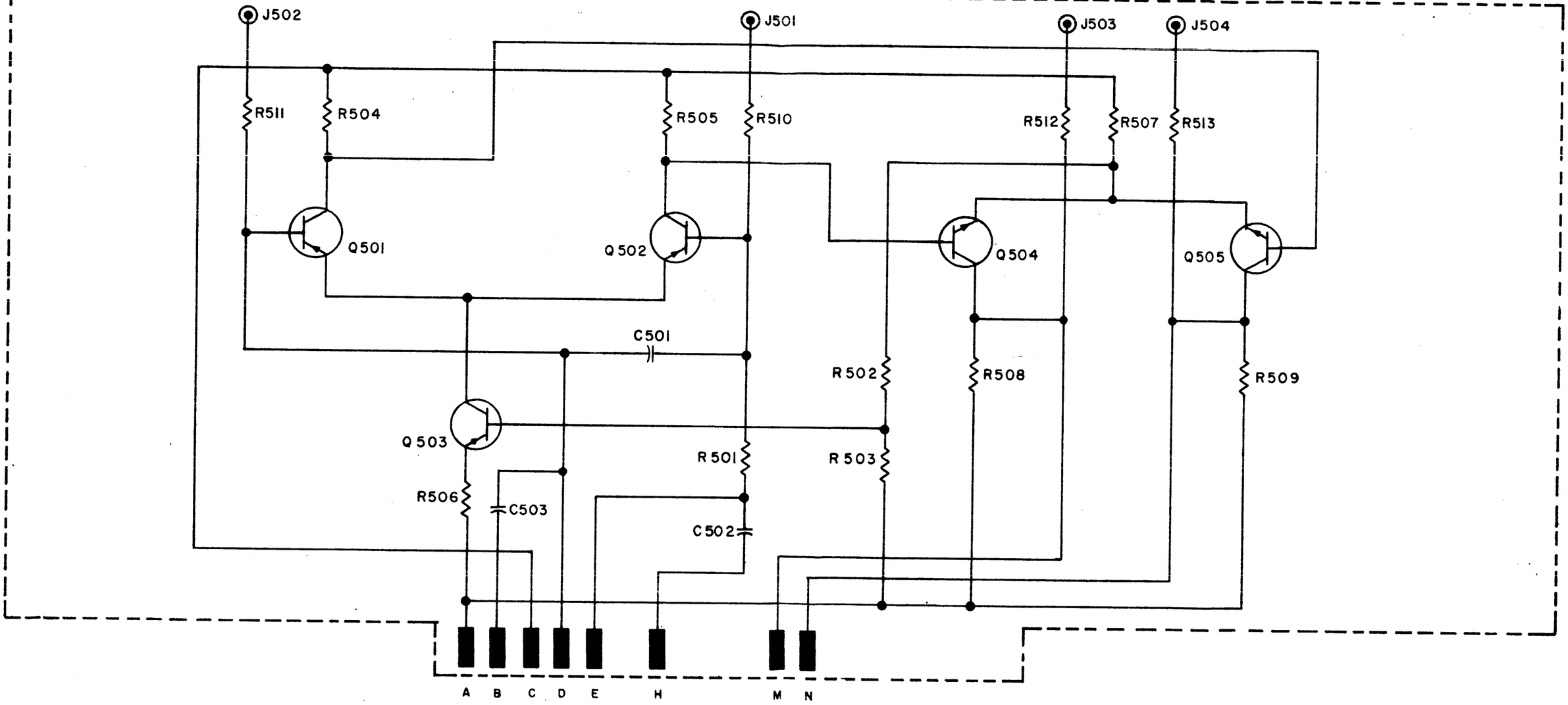
SCALE: NONE | SHEET: 1 OF 1 | DWG SIZE B

NORTHERN RADIO COMPANY
INCORPORATED
325 W HUNTINGTON BLVD.
BELLMORE, L.I., N.Y.

DWG. No. SA-174-2-0104A

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

ETCHED CIRCUIT BOARD (EB160A)



UNLESS OTHERWISE SPECIFIED	DRAFTSMAN	DATE	NAME:
DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS ± 1/64 DECIMALS ± .005 ANGLES	S. S.	2-26-65	SCHEMATIC D.C. AMPLIFIER SA174205A
MATERIAL:	CHECKER	4-26-65	
FINISH:	ENGINEER		
	APPROVAL	9/30/65	

NORTHERN RADIO COMPANY
INCORPORATED
325 W. HIBISCUS BLVD.
MELBOURNE FLA.

DWG. No. SA-174-2-0105A

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

REVISIONS			
SYM.	DESCRIPTION	DATE	APPROVAL

SUB-ASSEMBLY NRC1337A

NRC1328
T601

A.C. IN
A.C. IN
A.C. IN
A.C. IN

P601
1 8
2 9
3 10
4 11
5 12
6 13
7 14

CR601
CR603
CR604
CR602
R601
C601
C602
R602

SUB - ASSEMBLY NRC1347A

R603
Q601
CR605
C603
R604
R605
Q602
R606
Q603
C604
T602
BRN.
BLK.
RED.
BLU.
GRN.
CR606
C605
R607
R608
Q604
CR608
Q605
R609
CR607
C606
R610

SUB-ASSEMBLY NRC1347A

5K 25W

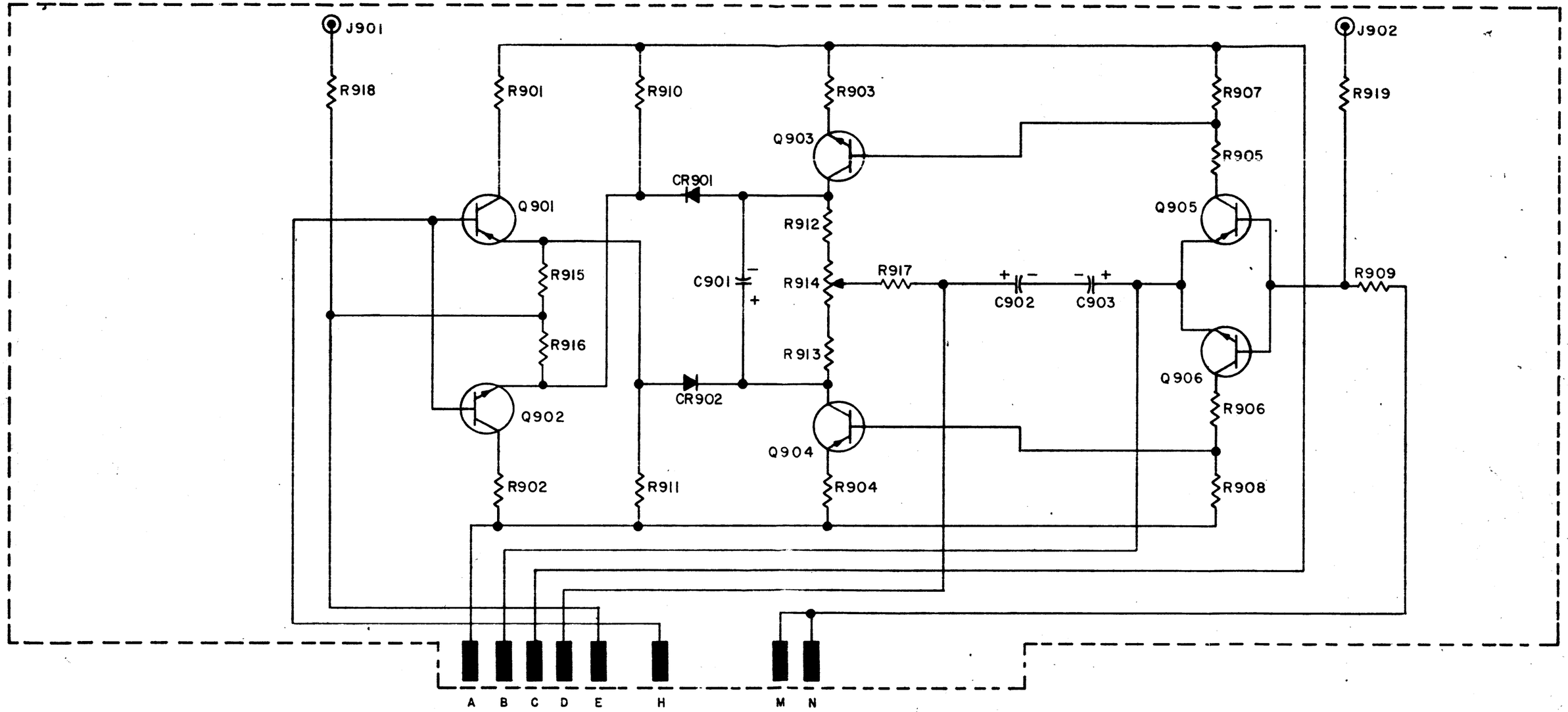
UNLESS OTHERWISE SPECIFIED	DRAFTSMAN	DATE	NAME:
DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS ± 1/64 DECIMALS ± .005 ANGLES	S. S.	5-10-65	SCHEMATIC PRINTER DRIVER SA174206A
MATERIAL:	CHECKER R.A.	5-10-65	
FINISH:	ENGINEER		
	APPROVAL	5/10/65	SCALE: NONE SHEET: 1 OF 1

NORTHERN RADIO COMPANY
INCORPORATED
325 N. HIBISCUS BLVD.
MELBOURNE FLA.

DWG. No. SA-174-2-0106A
DWG. SIZE B

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

ETCHED CIRCUIT BOARD (EB159A)



UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS ± 1/64 DECIMALS ± .005 ANGLES	DRAFTSMAN S. S.	DATE 2-25-65	NAME: SCHEMATIC AUTO THRESHOLD SA 174209A
MATERIAL:	CHECKER RF	4-28-65	
FINISH:	ENGINEER		
	APPROVAL [illegible]	4/30/65	SCALE: NONE SHEET 1 OF 1 DWG. SIZE B

NORTHERN RADIO COMPANY INCORPORATED

[redacted]

DWG. N. SA-174-2-0109A

REV	NO.	REVISIONS SYM	DESCRIPTION	NOTE	APPROVAL

SUB-ASSEMBLY NRC 2015
E.B. 300

NRC 1328
T601

RED
BLK
BRN

P601

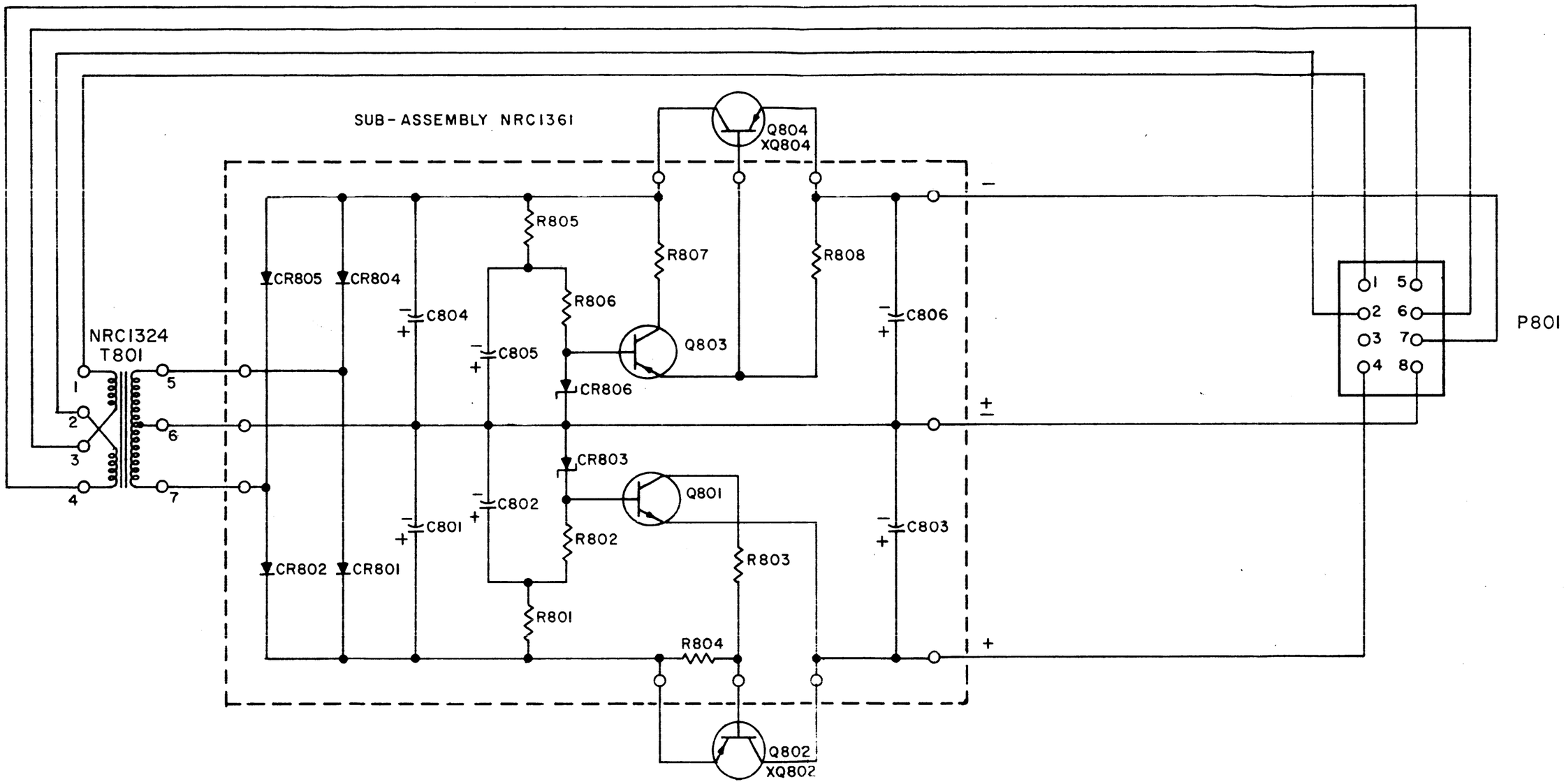
SUB-ASSEMBLY NRC 2016
E.B. 301

NOTE
1. BASIC COLOR IS WHITE ON ALL WIRES

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS ± 1/64 DECIMALS ± .005 ANGLES	DRAFTSMAN HGS	DATE 20APR70	NAME: WIRING DIAGRAM PRINTER LOGIC (POLAR HIGH LEVEL) SA174210
MATERIAL:	CHECKER JPF	4-23-70	
FINISH:	ENGINEER		
	APPROVAL		SCALE: NONE SH 1 OF 1

SA 174-2-0210

REVISIONS			
SYM.	DESCRIPTION	DATE	APPROVAL

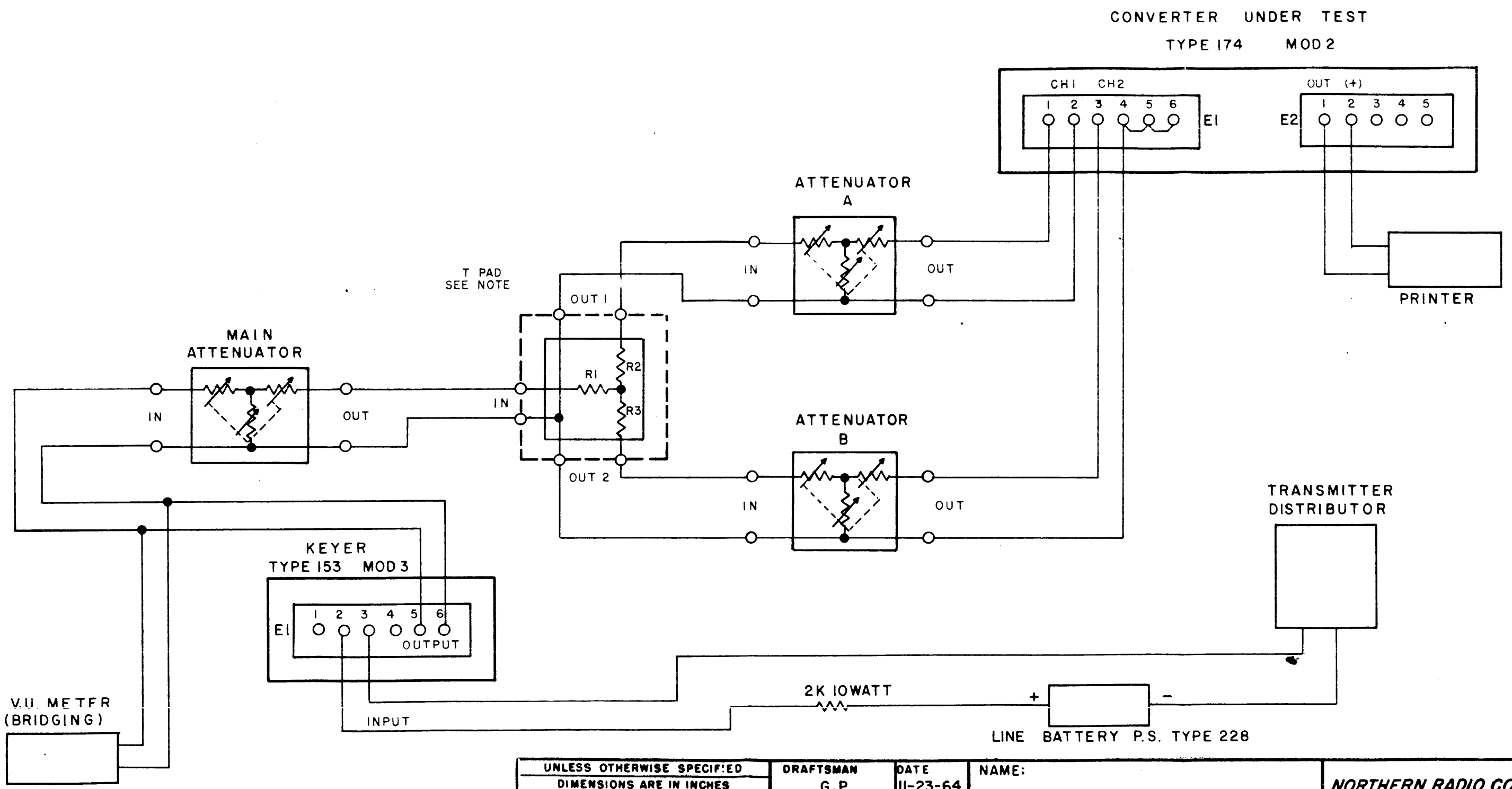


UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS ± 1/64 DECIMALS ± .005 ANGLES	DRAFTSMAN S. S.	DATE 5-10-65	NAME: SCHEMATIC MAIN POWER SUPPLY SA174308
MATERIAL:	CHECKER	5-10-65	
FINISH:	ENGINEER		
	APPROVAL	5/10/65	SCALE: NONE SHEET 1 OF 1

NORTHERN RADIO COMPANY
INCORPORATED
[illegible]

DWG. N. SA-174-3-0108
DWG. SIZE B

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



NOTE:

1. T PAD RESISTORS R1, R2 & R3 ARE 200 OHMS ±5% 1/4 WATT.

UNLESS OTHERWISE SPECIFIED	DRAFTSMAN	DATE	NAME:	NORTHERN RADIO COMPANY
DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS ± 1/64 DECIMALS ± .005 ANGLES	G.P.	11-23-64	TEST CIRCUIT	INCORPORATED 143-147 WEST 22ND ST. N.Y. 11 NEW YORK
MATERIAL:	CHECKER R.G.	12-3-64	F.S DIVERSITY CONVERTER	
FINISH:	ENGINEER		TYPE 174 MOD 2	DWG. N. 6-1316
	APPROVAL	12-3-64	SCALE: NONE SH 1 OF 1	DWG. SIZE B

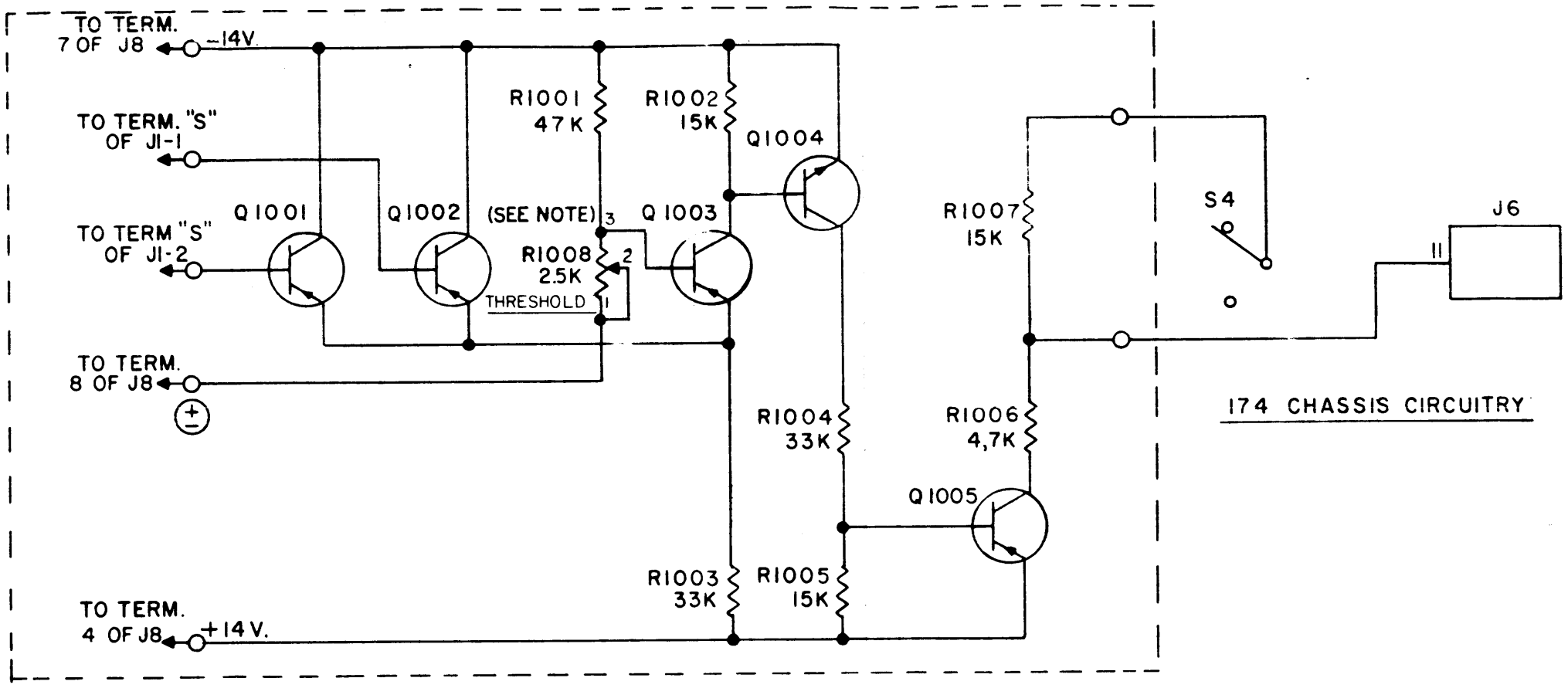
REVISIONS			
SYM.	DESCRIPTION	DATE	APPROVAL
A	COMPONENT DESIGNATIONS REVISED. ADDITIONAL INFORMATION ADDED.	10-27-67	

DWG. NO.

REV.

SUB-ASSEMBLY NRC 1642

EB 218



NOTE: 1=Q1, Q2, Q3 AND Q5 ARE PNP SILICON TRANSISTORS, MOT. TYPE 2N3251 OR SIMILAR. Q4 IS AN NPN SILICON TRANSISTOR, MOTOROLA TYPE 2N2501 OR SIMILAR.

2= R1008 IS NOT LOCATED ON ETCHED CIRCUIT BOARD.

UNLESS OTHERWISE SPECIF'ED DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS ± 1/64 DECIMALS ± .005 ANGLES	DRAFTSMAN A.W.	DATE 2-6-67	NAME: "MARK - HOLD" CIRCUIT ADDITION TO NORTHERN RADIO F.S. DIVERSITY CONVERTERS TYPE 174 - MODELS 2,3, &3A
MATERIAL:	CHECKER	2-6-67	
FINISH:	ENGINEER		
	APPROVAL	2/6/67	SCALE: NONE SH. 1 OF 1 DWG. SIZE B

NORTHERN RADIO COMPANY INCORPORATED

DWG. No. 9-0368

SUB- ASSEMBLY NRC 1338A (EB 164

P301

1 130
2 140
3 150
4 160
5 170
6 180
7 190
8 200
9 210
10 220
11 230
12 240

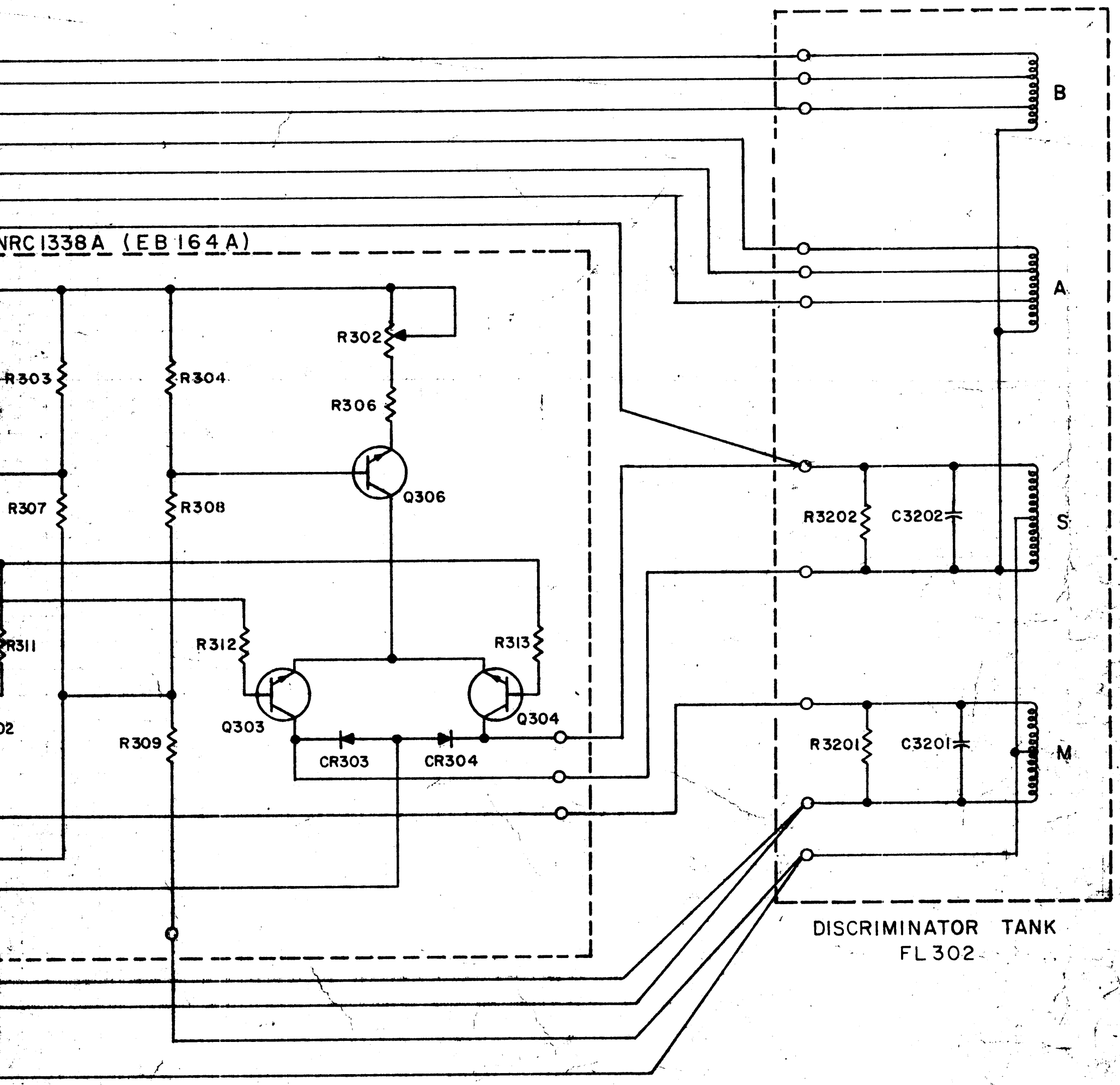
R301
R303
R305
Q305
R307
R310
R311
Q301
Q302
CR301
CR302
R309

BAND PASS FILTER
FL 301

1
2
3
4

UNLESS OTH
DIMENSIO
TOLERANCE
FRACTIONS
± V64
MATERIAL:
FINISH:

REVISIONS			
SYM.	DESCRIPTION	DATE	APPROVAL
A	REDRAWN	5-7-65	GPH
B	ADDED: PIN NUMBERS TO FL 301	7-15-66	
C	"TUNABLE" ADDED TO TITLE BOX	1-16-68	



UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS ± 1/64 DECIMALS ± .005 ANGLES	DRAFTSMAN G P	DATE 5-7-65	NAME: SCHEMATIC TUNABLE DISCRIMINATOR
MATERIAL:	CHECKER	5-7-65	NORTHERN RADIO COMPANY INCORPORATED 143-147 WEST 22ND ST. N.Y. 11, NEW YORK
FINISH:	ENGINEER		DWG. NO. SA-174203
	APPROVAL GPH	5/10/65	SCALE: NONE SHT. 1 OF 1 SIZE C

SUB- ASSEMBLY NRC1338A (EB164A

P301

1 130
2 140
3 150
4 160
5 170
6 180
7 190
8 200
9 210
10 220
11 230
12 240

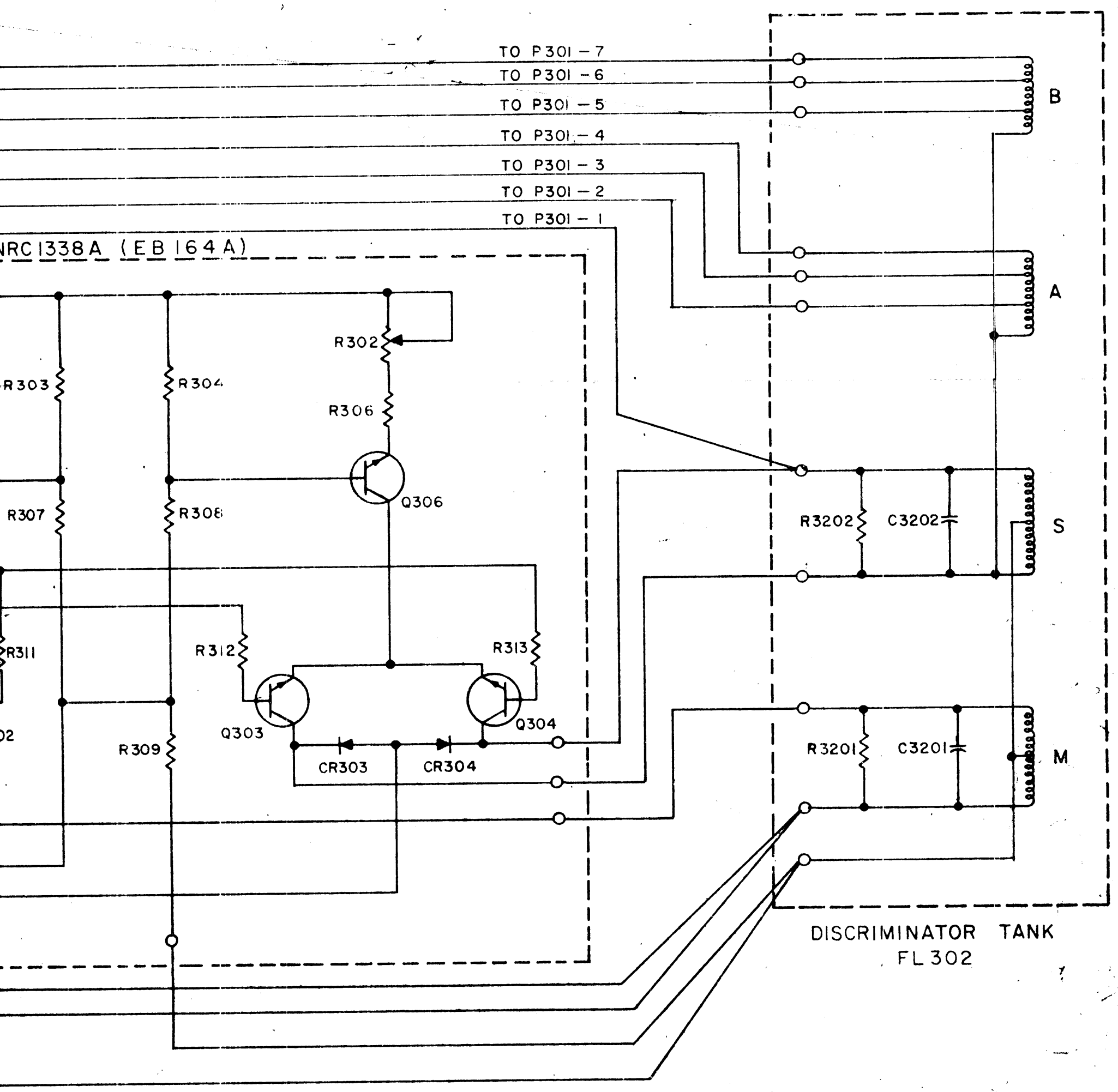
R301
R303
R304
R305
Q305
R307
R308
R310
R311
R312
Q301
Q302
R309
CR301
CR302

BAND PASS FILTER
FL 301

1
2
3
4

UNLESS OTHERWI
DIMENSIONS AR
TOLERANCES ON
FRACTIONS DECIM
± 1/64 ± .00
MATERIAL:
FINISH:

REVISIONS			
SYM.	DESCRIPTION	DATE	APPROVAL



REV.

DWG. No.

UNLESS OTHERWISE SPECIFIED	DRAFTSMAN	DATE	NAME:
DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS ± 1/64 DECIMALS ± .005 ANGLES	D.A.L.	6-29-70	SCHEMATIC TUNABLE DISCRIMINATOR
MATERIAL:	CHECKER	6-30-70	
FINISH:	ENGINEER	6/30/70	SA 174203A-S
	APPROVAL	6/30/70	

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

DWG. No. SA 174-2-0103A-S

SCALE: NONE | SHEET 1 OF 1 | SIZE C

SUB- ASSEMBLY NRC 1338A (EB 164A)

P301

1	13		
2	14		
3	15		
4	16		
5	17		
6	18		
7	19		
8	20		
9	21		
10	22		
11	23		
12	24		

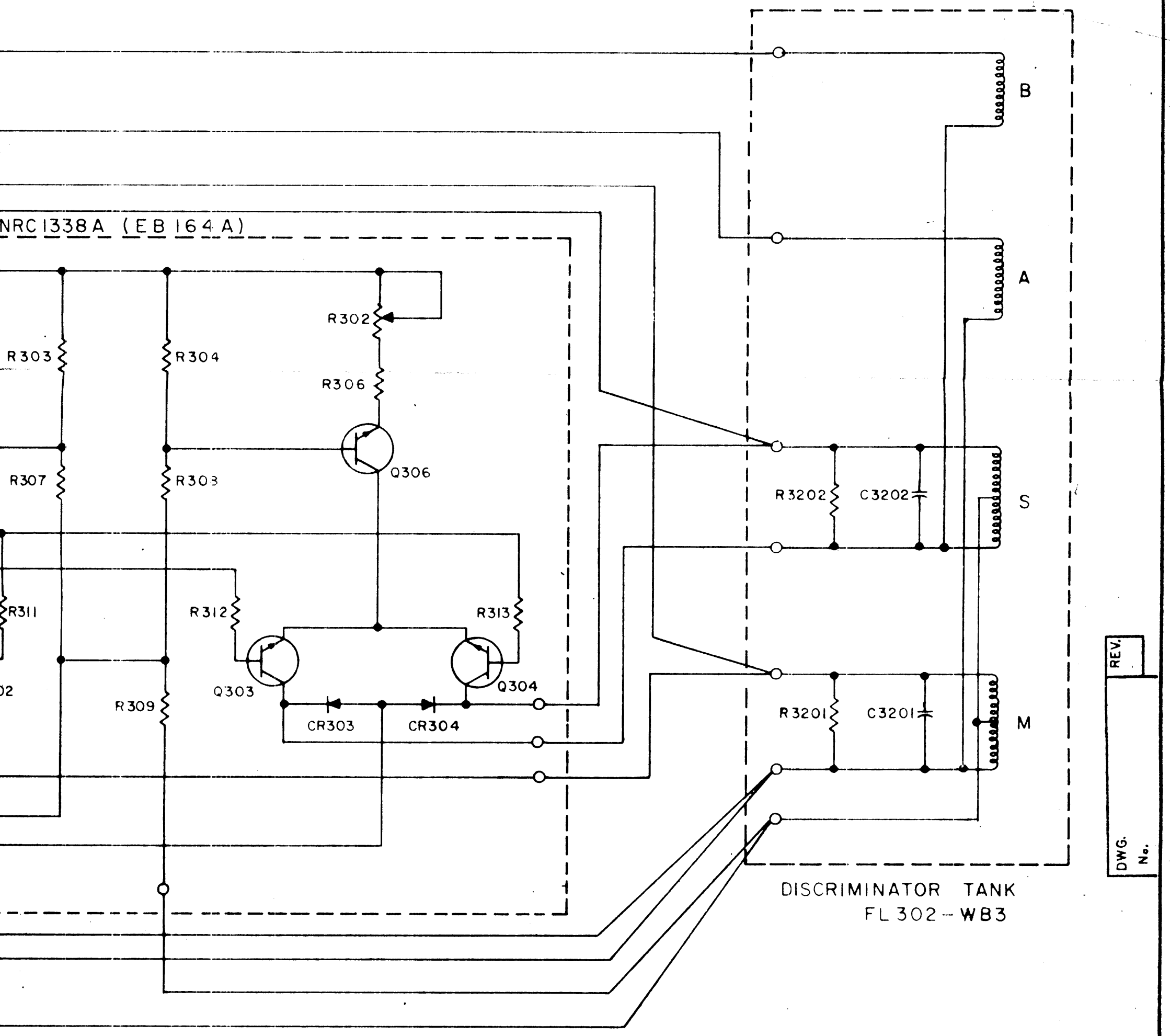
R301
R303
R304
R305
Q305
R307
R308
R310
R311
R312
Q301
Q302
Q30
R309
CR301
CR302

BAND PASS FILTER
FL 301

1
2
3
4

UNLESS OTHERWIS
DIMENSIONS ARE
TOLERANCES ON
FRACTIONS ± 1/64
DECIMAL ± .005
MATERIAL:
FINISH:

REVISIONS			
SYM.	DESCRIPTION	DATE	APPROVAL
A	ADDED: PIN NUMBERS TO FL 301	7-15-66	



UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS ± 1/64 DECIMALS ± .005 ANGLES	DRAFTSMAN G P	DATE 5-7-65	NAME: SCHEMATIC DISCRIMINATOR SA 174203A-WB3
MATERIAL:	CHECKER		
FINISH:	ENGINEER		
	APPROVAL		
	SCALE: NONE	SH 1 OF 1	DWG SIZE C

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

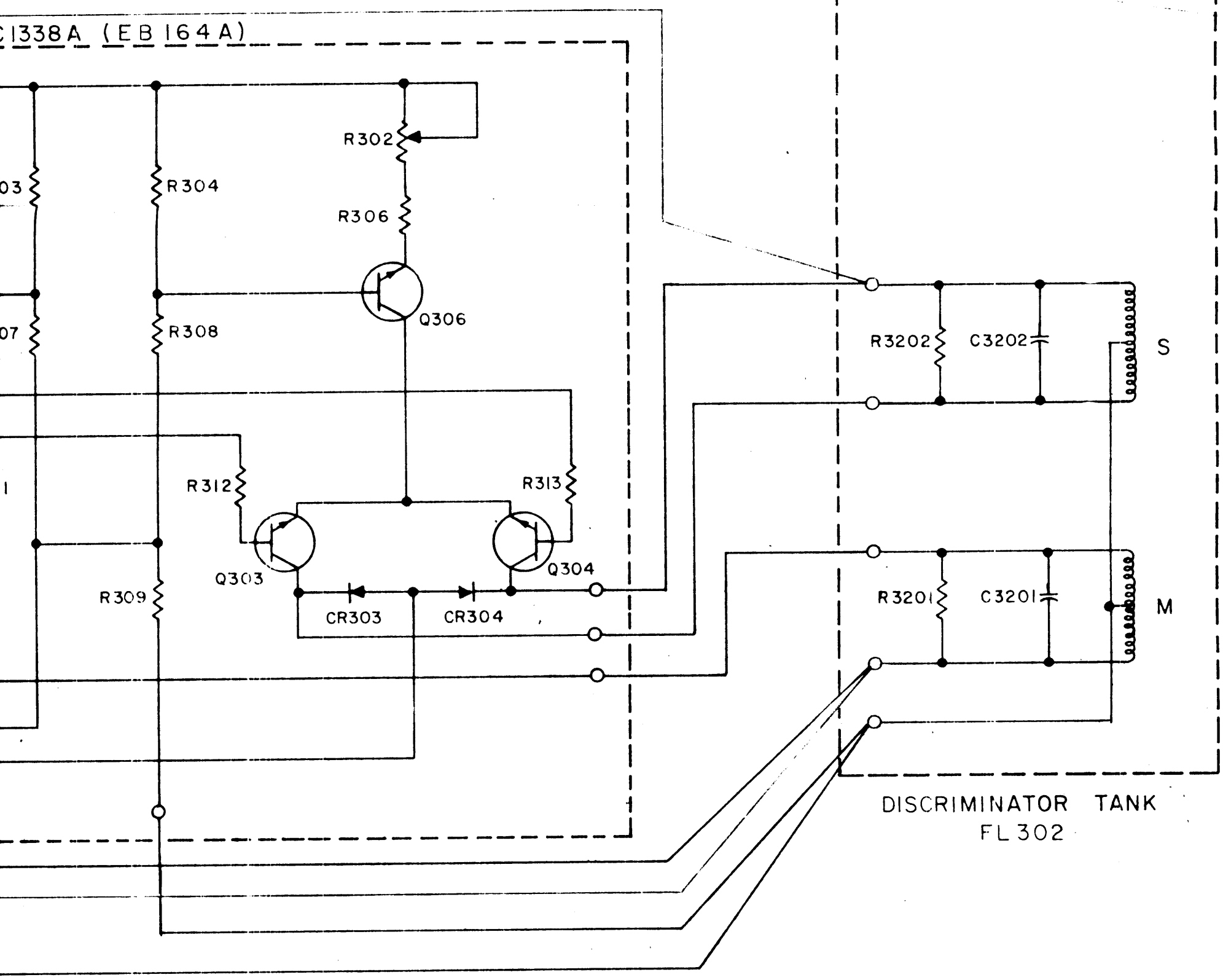
DWG. No. SA-174 2-0103A-WB3

SUB- ASSEMBLY NRC 1338A (EB 164A)

UNLESS OTHERWIS
DIMENSIONS ARE
TOLERANCES ON
FRACTIONS ± 1/64
DECIMAL ± .005
MATERIAL:
FINISH:

REVISIONS			
SYM.	DESCRIPTION	DATE	APPROVAL
A	DRAWING WAS C9-0304	1-10-68	

C1338A (EB164A)



UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS ± 1/64 DECIMALS ± .005 ANGLES	DRAFTSMAN J. B.	DATE 6-14-66	NAME: SCHEMATIC FIXED FREQUENCY DISCRIMINATOR FOR SA 174203A-1,-2, ETC	NORTHERN RADIO COMPANY INCORPORATED 143-147 WEST 22ND ST. N.Y. 11 NEW YORK
MATERIAL:	CHECKER			DWG. No. SA-1,-2-0403A
FINISH:	ENGINEER			
	APPROVAL		SCALE: NONE SH 1 OF 1	DWG. SIZE C

SUB-ASSEMBLY NRC 2015
EB 300

NRC 1328
T601

A.C. IN.
A.C. IN.
A.C. IN.
A.C. IN.

P601

CR603
CR601
CR602
CR604
C601
C602
R601

SUB- ASSEMBLY NRC 2016
EB 301

R602
R603
R604
R605
Q601
Q602
Q603
CR605
C603
C604

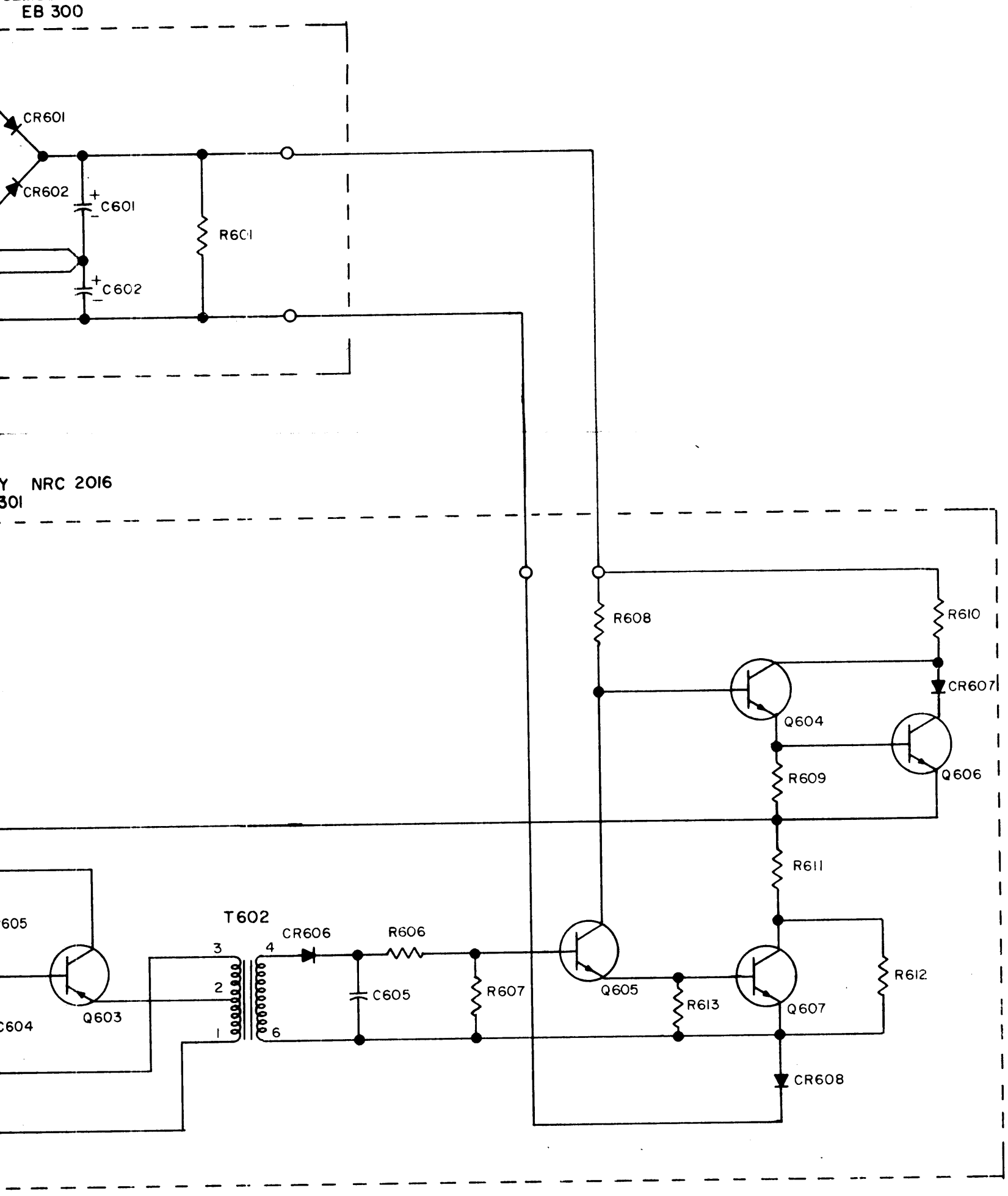
T602

UNLESS OTHERWISE S
DIMENSIONS ARE IN I
TOLERANCES ON
FRACTIONS ± 1/64 DECIMALS ± .005
MATERIAL:
FINISH:

REVISIONS			
SYM.	DESCRIPTION	DATE	APPROV.

SEMBLY NRC 2015
EB 300

Y NRC 2016
301



REV.

DWG. N.

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS ± 1/64 DECIMALS ± .005 ANGLES	DRAFTSMAN HGS	DATE 13 APR 70	NAME: SCHEMATIC PRINTER DRIVER (POLAR HIGH LEVEL) SA 174210
MATERIAL:	CHECKER RF	4-23-70	
FINISH:	ENGINEER		
	APPROVAL		

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

DWG. No. SA 174-2-0110

SCALE: NONE | SH. 1 OF 1 | DWG. SIZE C

E1

CH 1 INPUT

1

2

E

D

AGC AMPLIFIER

J1-1

K

L

S

K

L

LIMITER

J2-1

R

S

15

14

20

21

11

12

13

DISCRIMINATOR

1

J3-1

18

17

16

CH. 2 DIV.

CH. 1

S2

CH. 1 INPUT 0-100

M1

CH. 2 INPUT 0-100

M2

M

J4

D

E

S

R

DIVERSITY CONTROL

H

N

J1-2

AGC AMPLIFIER

J2-2

LIMITER

J3-2

DISCRIMINATOR

CH.2 INPUT

3

4

E1

115V

LINE CORD ASSEMBLY NRC 1363

ADAPTER PLUG

LINE

UNLES

DIM

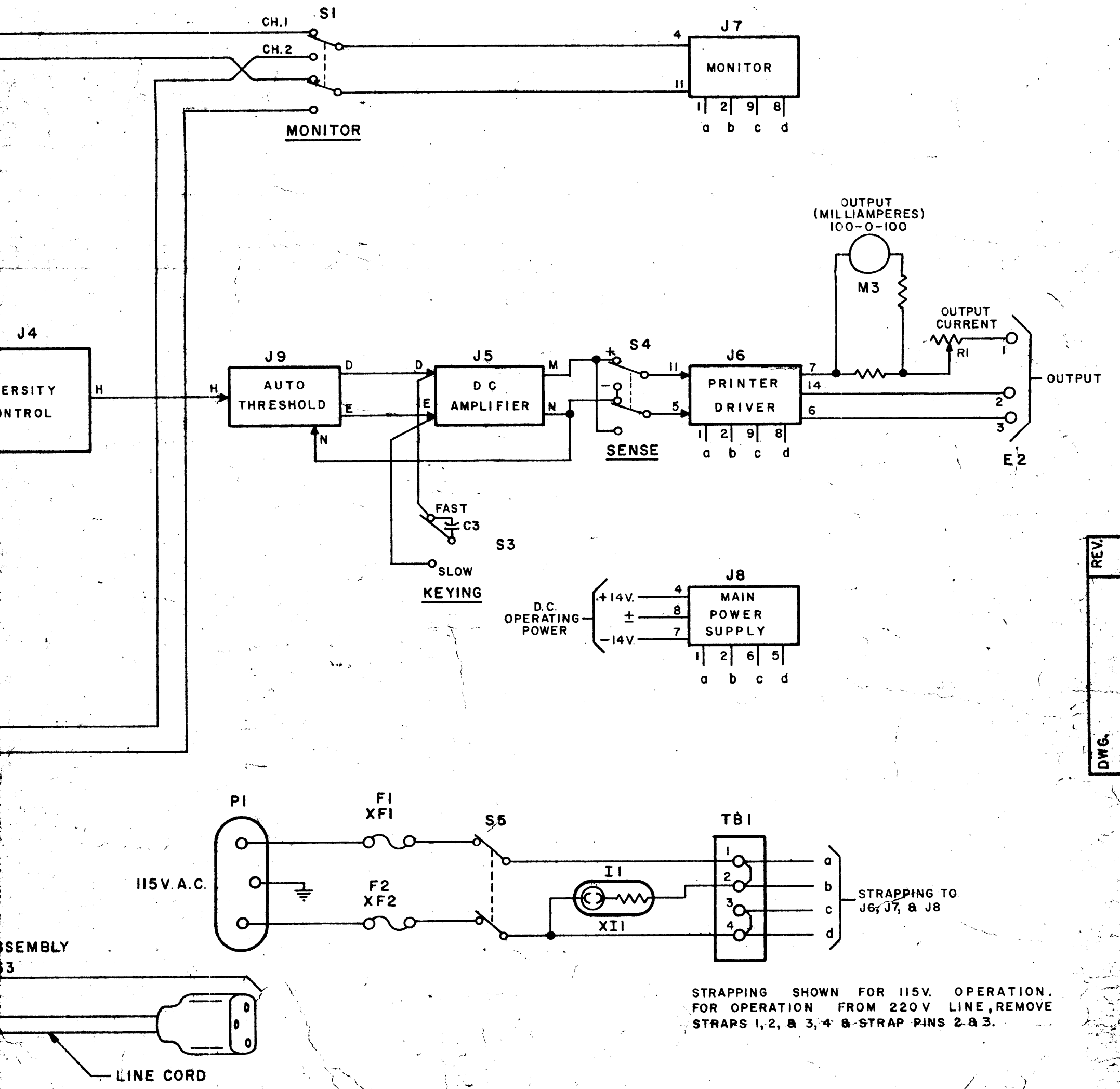
TOLER

FRACTION

MATERI

FINISH

REVISIONS			
SYM.	DESCRIPTION	DATE	APPROVAL
A	S3 CIRCUIT REVISED, C3 ADDED	7-31-67	
B	WIRES REVERSED ON DC AMPL. J5-D & E	5-2-69	



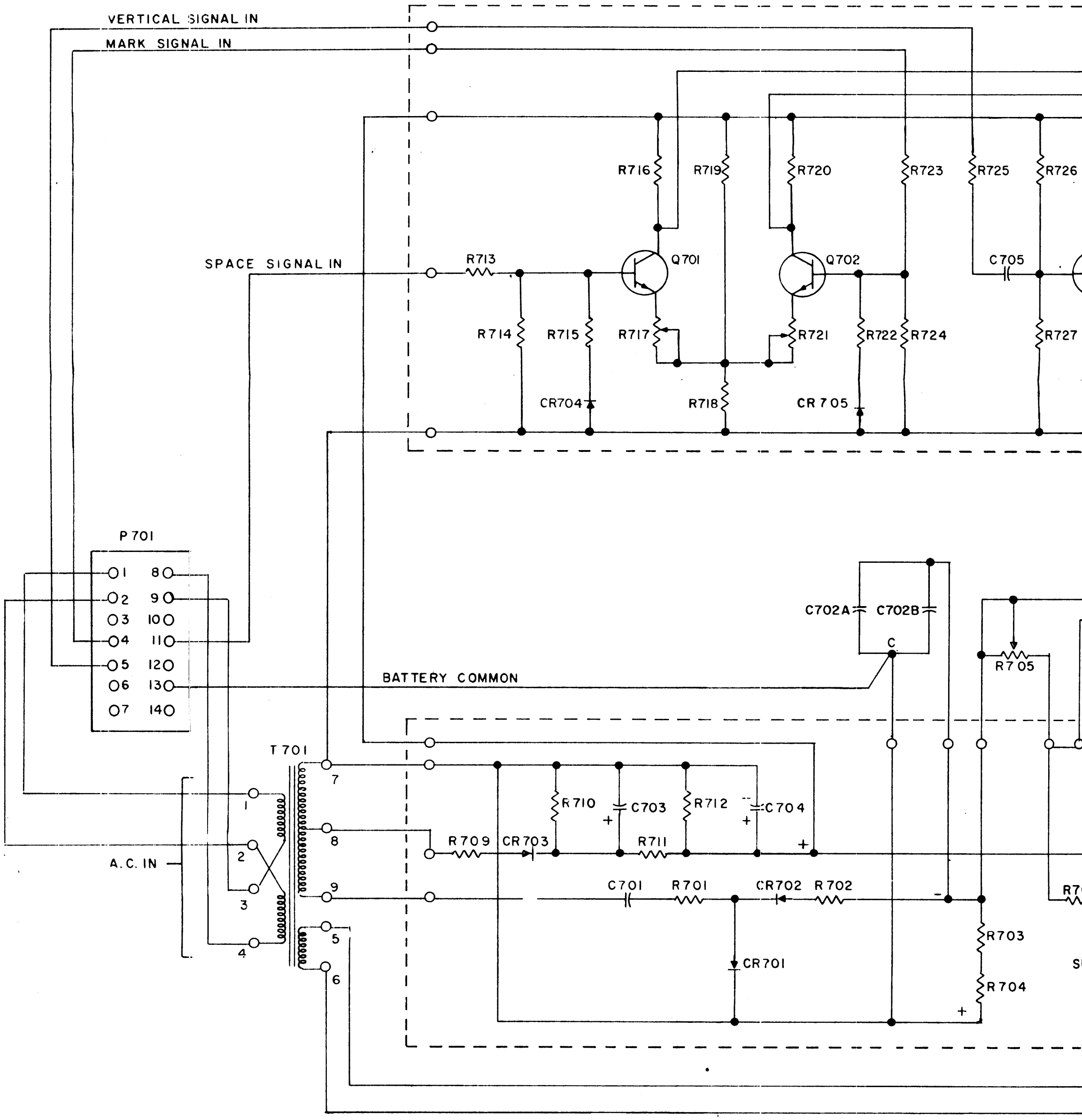
STRAPPING SHOWN FOR 115V. OPERATION.
FOR OPERATION FROM 220V LINE, REMOVE
STRAPS 1, 2, & 3, 4 & STRAP PINS 2 & 3.

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS ± 1/64 DECIMALS ± .005 ANGLES MATERIAL: FINISH:	DRAFTSMAN G P	DATE 5-26-65	NAME: SCHEMATIC FREQUENCY SHIFT DIVERSITY CONVERTER TYPE 174 MOD 3
	CHECKER	5-26-65	
	ENGINEER		
	APPROVAL	5/27/65	SCALE: NONE SH. 1 OF 1 SIZE B

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

DWG. No. 174-3-01

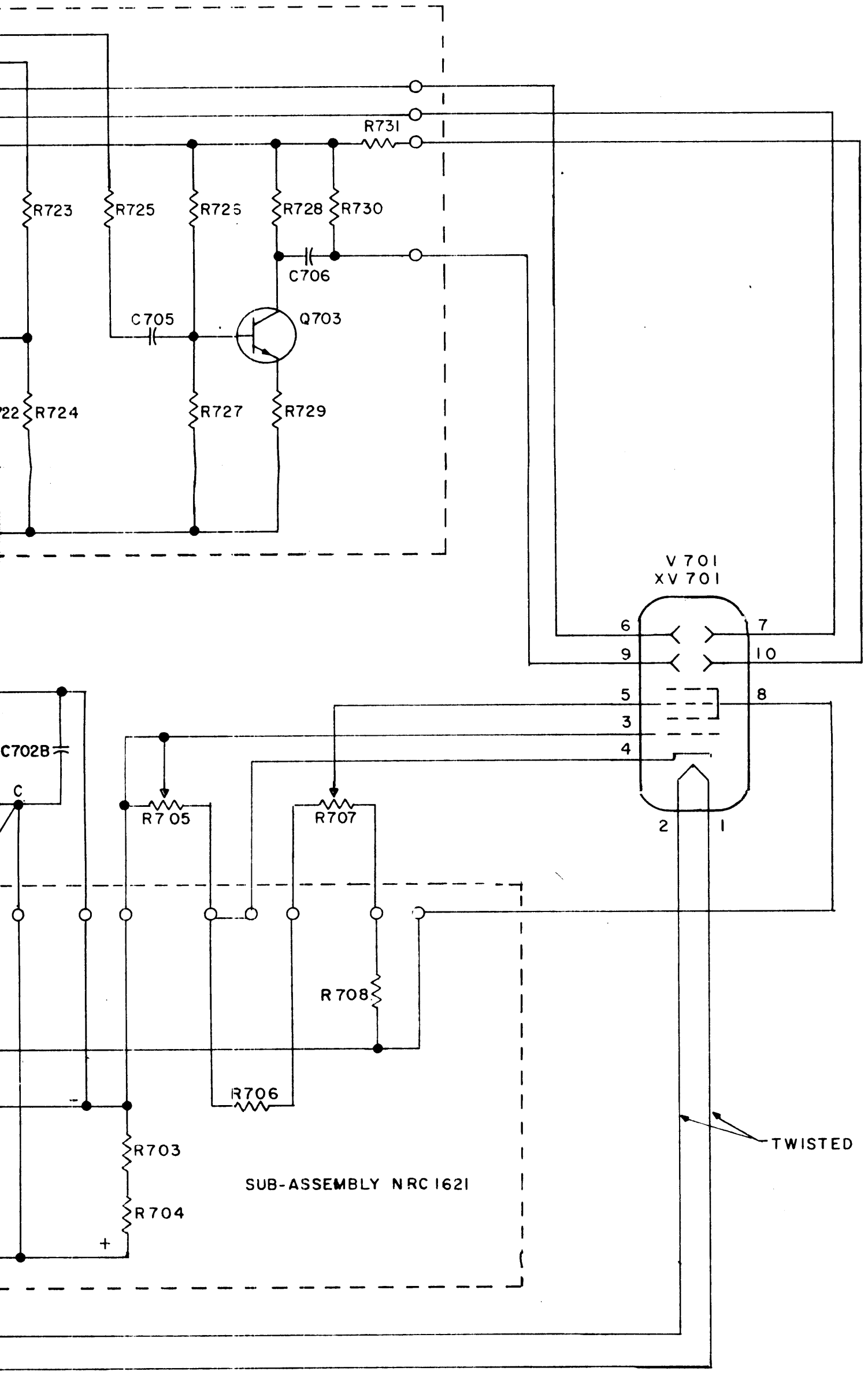
SUB-ASSEMBLY NRC 1620



UNLESS OTHERWIS
DIMENSIONS ARI
TOLERANCES ON
FRACTIONS ± 1/64 DECIMA ± .005
MATERIAL:
FINISH:

REVISIONS			
SYM.	DESCRIPTION	DATE	APPROVAL
A	TERMS. 2&9 OF P701 WERE CONN. TO 3&2 OF T701 RESPECTIVELY	10-12-67	

ASSEMBLY NRC 1620



REV.

DWG. No.

UNLESS OTHERWISE SPECIFIED	DRAFTSMAN	DATE	NAME:
DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS ± 1/64 DECIMALS ± .005 ANGLES	L.D	8-30-67	SCHEMATIC MONITOR SA 174307A
MATERIAL:	CHECKER	8-31-67	
FINISH:	ENGINEER		
	APPROVAL		

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

DWG. No. SA-174-3-0107A

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