

SERVICE MANUAL

ASTRO 102 BX TRANSCEIVER



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To the Service Technician:

The ASTRO-102BX is a modern, top-of-the-line, sophisticated Amateur Band Transceiver utilizing state-of-the-art techniques and design. The features that today's Hams want are built into the unit, not marketed as "add on" accessories at extra cost -- dual PTO's, Passband Tuning, Full or Semi Break-in, VOX, CW Sidetone, RIT, Notch Filter, and more.

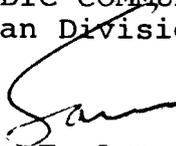
Whenever performance measured up to required standards, integrated circuit technology was used in the design; where special functions were required, or desired performance could not otherwise be obtained, carefully designed discrete component circuits were included, rather than accept compromised performance.

Every care has been taken to provide long, trouble-free life, but the requirements of extra operating features, high performance design, and compact packaging demanded by today's Hams results in a unit necessitating a high degree of skill on the part of you, the Service Technician. To assist you, this manual has been painstakingly prepared. Take the time to thumb through it; read and study the Theory of Operation section and the Servicing Hints section; it will be time well spent, even for the most highly qualified and experienced personnel.

It is you, the Service Technician, that will ultimately determine how well or how poorly the radio will work, and therefore how satisfied or dissatisfied our customers will be, in the long run. If you have a suggestion or a problem, write or call our service department. We'll listen, and help you all we can.

Sincerely,

CUBIC COMMUNICATIONS, INC.
Swan Division


Sam F. Arn, K6TSD
President

SFA/lb



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General Information

The Swan ASTRO 102BX is a 160M through 10M SSB amateur transceiver that features dual PTO's and frequency counter for split frequency operation with digital frequency readout. Frequency selection is the only tuning necessary when operating into a matched antenna with a VSWR of 1.7:1 or less.

Standard features include: Full break-in or semi-break-in CW operation; narrow band crystal CW filter; two position CW transmit pulse shaping; VOX; noise blanker; SSB transmit speech processor; true RF and IF gain controls; peak reading wattmeter with FWD, REF, and ALC positions; variable AGC decay; passband tuning; and audio notch filter. The basic single conversion design has been proven in thousands of the popular Swan transceivers. Mechanical and electrical designs are exceptional, for years of trouble-free operation, even in a rugged mobile environment.

The unit is designed for fixed and mobile use with minimum interconnections. For fixed station operation an auxiliary speaker/power supply, model PSU-6, provides 13.6 V DC from 115/230 V AC. A matching antenna tuner, model ST2A, is also available.

The transmitter may be used for RTTY or Slow Scan TV, but operation in these modes requires additional forced air cooling. See the operator's annual for precautions to be observed when operating in these modes. The ASTRO 102BX includes automatic gain control (AGC) in the receive mode, and automatic level control (ALC) in the transmit mode. CW sidetone is also provided.

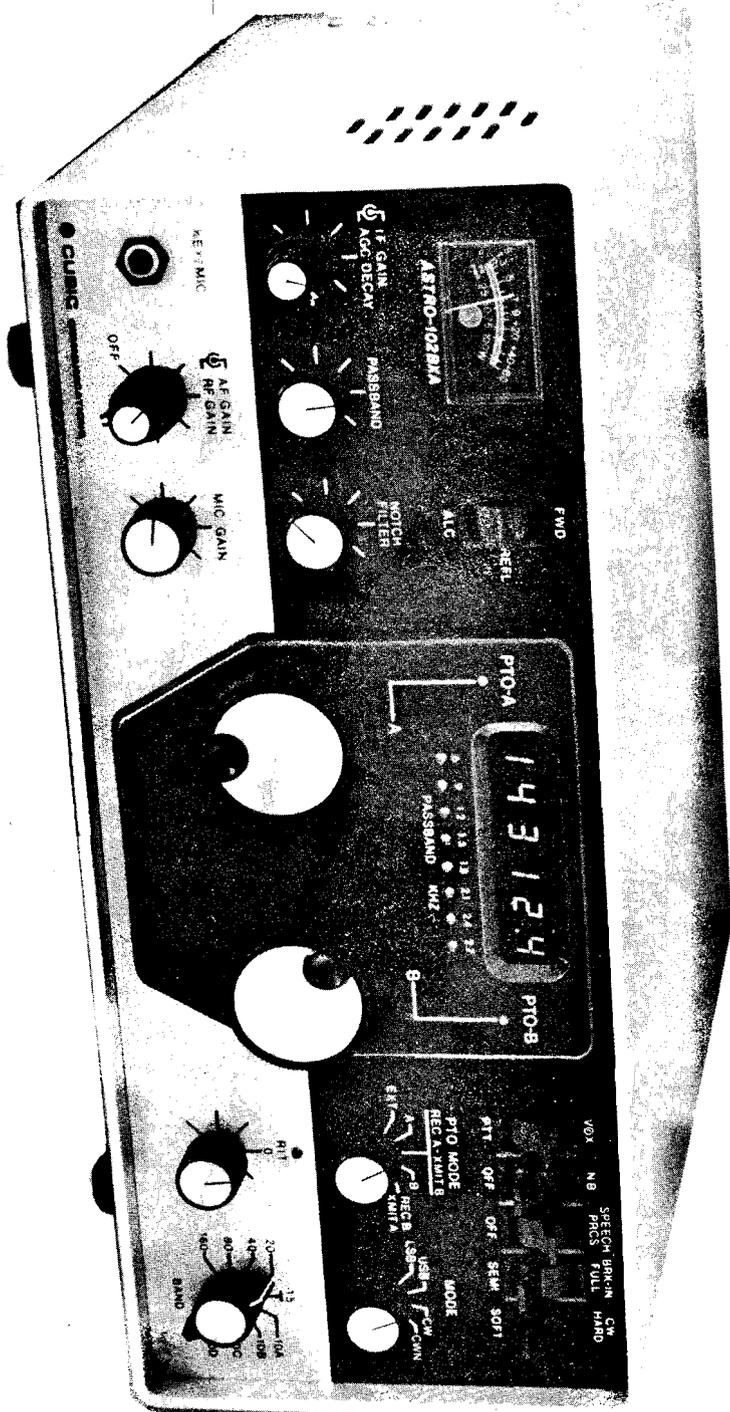


FIGURE 5-1



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Specifications

General

Frequency Coverage*

160M.....	1.8-2.0 MHz
80M.....	3.5-4.0 MHz
40M.....	7.0-7.5 MHz
20M.....	14.0-14.5 MHz
15M.....	21.0-21.5 MHz
10M.....	28.0-28.5 MHz
	28.5-29.0 MHz
	29.0-29.5 MHz
	29.5-29.999 MHz

*Approximately 50 to 100 kHz overrange provided on each band.

Frequency Control: Dual PTO with 6-digit frequency counter and RIT control.

PTO Modes of Operation: A only; Receive A-Transmit B; B only; Receive B-Transmit A; External LO.

Modes of Operation: SSB with selectable sideband. CW with automatic 800 Hz offset on transmit and full or semi-breakin.

Power Input Requirements: 12-14 V DC negative ground only. No damage up to 15 VDC. 20 amperes peak current.

Electromagnetic Interference:

Transmit: Five element low pass filter on each band.

Receive: Five element lowpass filter plus three pole bandpass filter on each band.

Dimensions: 6.375" H x 14.25" W x 13.25" D
16.2 cm x 36.2 cm x 33.7 cm
Weight: 23.5 pounds (10.6 kg)

Rear Panel:

Power connector:

Pin 1	13.6 V DC
2	Ground
3	Ground (used for accessories)
4	13.6 V DC
5	Ground
6	13.6 V DC fused to 3 amps (used for accessories)

Antenna connector: UHF (SO-239)

External speaker/phones: Phone jack

External relay: RCA jack



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Key: RCA jack
EXT. Modulation: RCA jack
Fuse: 3 amp fast blow
Ext. L.O.: RCA jack

Receiver

Circuit Design: Single conversion to 9.00165 MHz IF using double balanced mixer. Exceptional immunity to overload and cross modulation.

Receiver Sensitivity: 10 dB S+N/N typical at 0.35 uV

Image Rejection: Better than 60 dB

Receiver Selectivity: SSB and CW--2.4 kHz bandwidth, two 8-pole crystal filters with shape factor 1.4; 6 dB to 100 dB
CWN--300 Hz bandwidth. IF crystal filter in series with one 8 pole SSB filter

Passband Tuning: SSB and CW eight pole cutoff continuously variable high pass or low pass. LED readout shows equivalent audio passband.
CWN--IF crystal filter continuously tunable over 300 to 3000 Hz with passband control

Dynamic Range: AGC greater than 100 dB; third order intercept +15 dBm

Audio Output Power: Greater than 3 watts into 4 ohms.

Meter: S-units from 1 to 9; 20, 40 and 60 dB over S-9

Transmitter

Circuit Design: Excellent harmonic and TVI suppression. ALC limits SSB peak power and CW power to 100 watts output.

Power Input: 235 watts PEP input at 13.6 V DC input

Power Output: 100 watts PEP into 50 ohm non-reactive load at 13.6 V DC

Unwanted Sideband Rejection: >60 dB down at 1000 Hz audio note

Harmonic Output: >45 dB below peak power level

Carrier Suppression: >50 dB below peak power level



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Spurious Output: > 55 dB below peak power level

Transmit Control: PTT and VOX standard
(for SSB)

CW Transmit: Full or semi-breakin with sidetone standard. Automatic 800 Hz offset on transmit frequency.

Microphone Input: 47 k Ω input impedance

Audio Response: 300 to 3000 Hz \pm 6 dB

Meter: In receive mode, reads S units and dB over S-9; in transmit mode, reads peak power selected by meter switch; Forward power 100 watts full scale, reflected power 10 watts full scale, or reads ALC.

Cooling: Large capacity heat sink fins supplied. For SSTV, RTTY, and semi-continuous transmit, forced air cooling such as a small "muffin" fan on heat sink fins is required.

VSWR Shutdown: Full power up to VSWR = 1.7:1

Approximate limit ratio as follows:

<u>VSWR</u>	<u>Percent Power</u>
1.7:1	100%
2.0:1	80%
3.0:1	60%
Open or short	25% (equivalent voltage)



Receiver Theory

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NOTE: Component designations used in the "Theory" sections of this manual are the shortened numbers as they appear on the schematic diagrams. To determine complete component designation, the board/location number must be added after the letter or letters. See the "Note" in the first portion of the "Parts" section of this manual.

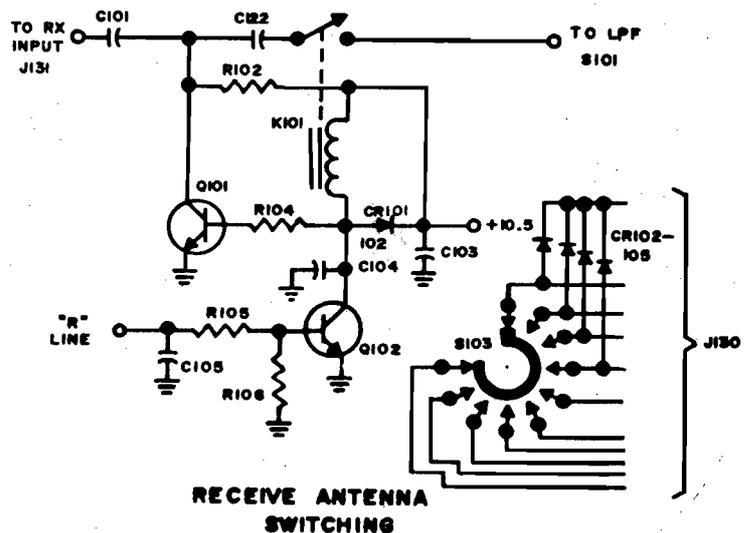
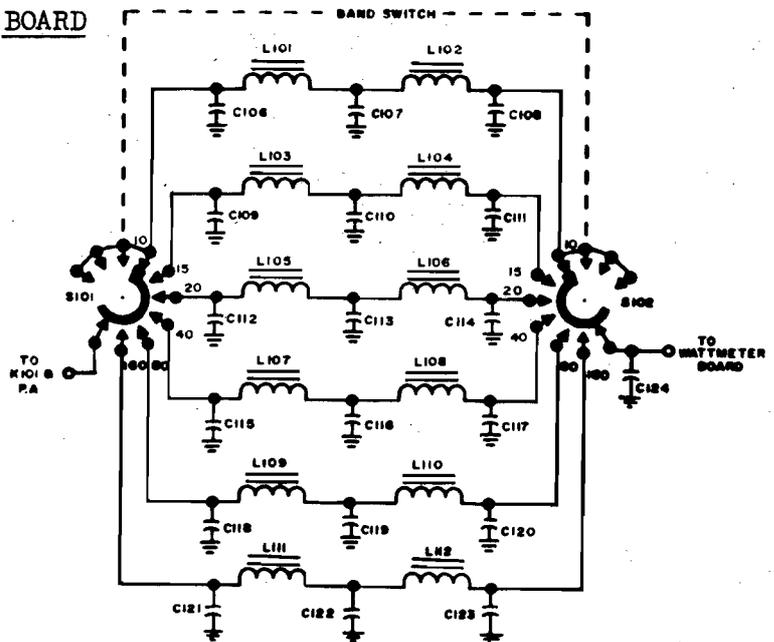
Schematic diagrams contained in the "Theory" sections of this manual are simplified to help in the understanding of the operation of the circuit; they may not always, therefore, be sufficient for troubleshooting purposes. When servicing the equipment, it is urged that the technician use only the schematic diagrams included in the "Servicing Data" portion of this manual.

BANDSWITCH AND LOW PASS FILTER BOARD

The received signal from the antenna connector is passed through one of six low pass filters, which are also used in the transmit condition. Each is composed of two inductors and three capacitors, yielding a five pole filter for each band (160 through 10 meters). Note that the same filter is used for all segments of the 10 meter band.

The filters are selected by S101 and S102, sections of the BAND switch. From S101, the signal is passed to relay K101, through C122, and through C101. From there it is routed to the input of the preselector board.

Receiver antenna switching is accomplished by K101, which is activated by Q102. When the receive ("R") line is high, as it is in the receive condition Q102 is biased to saturation, energizing K101 and connecting C122 to the output of the selected low pass filter. Since the collector of Q102 is low when it is thus saturated, Q101 is in a non-conducting condition and has no effect. However, when the "R" line is low, as





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as it is in the transmit condition, Q102 is cut off, and its collector voltage is high. This biases Q101 on, providing a path to ground for any transmit signal coupled across the open contacts of K101 due to stray capacity. In this manner, the input of the receiver is protected during transmission periods.

S103, a part of the BAND switch, is used to provide a voltage to each of ten control lines, depending upon its position. There are separate control lines for the 160, 80, 40, 20, 15, 10A, 10B, 10C and 10D positions, and an additional line, which, through CR102 through CR105, is high for any of the 10 meter positions of the BAND switch. These control lines are used in other sections of the transceiver.

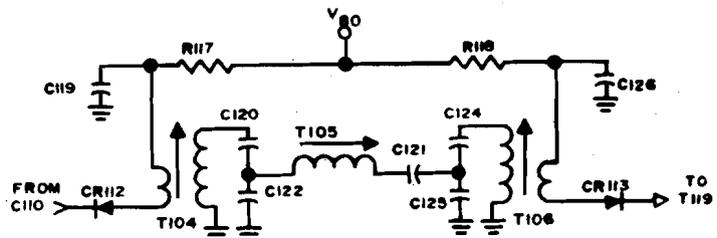
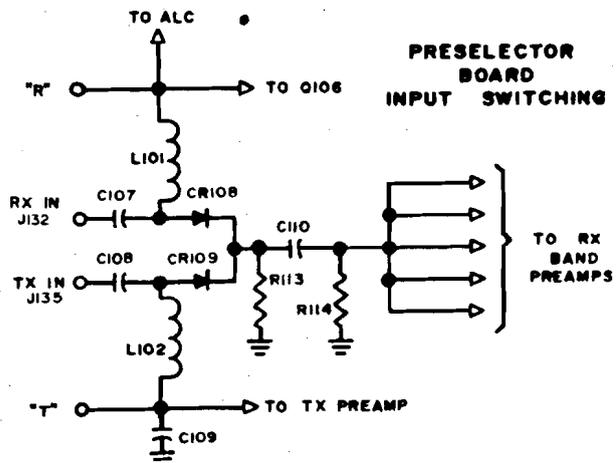
PRESELECTOR

In the receive condition, the transmit ("T") line is low. Thus, CR109 in the input circuitry of the preselector is reverse biased, and the TX IN jack is effectively open circuited. L102 is an RF choke to prevent signal from being bypassed to ground through C109 on the "T" line.

On the other hand, the "R" line is high in the receive condition, and is connected through RF choke L101 to CR108, which it biases to an "on" condition. R113 provides a ground return and the voltage drop across it reverse biases the "off" diode. C110 is a DC blocking capacitor, and passes the signal on to the input of the preselector band filters. R114 acts as a DC return for the switching currents for the filter selection circuits, and provides reverse bias to the "off" diodes.

There are six band filters in the preselector (only one is used for all four segments of the 10 meter band). These filters are selected by the BAND switch, utilizing the voltages on the control lines from S103, as mentioned earlier. For discussion purposes, only the 80 meter filter will be considered.

The voltage from the 80 meter control line is coupled through isolating resistor R117, the primary of T104, and CR112 to the output of the input switching circuit previously discussed, where it is provided with a ground return path through R114. C119 provides a ground for the signal at one end of the primary of T104. The signal is then passed through diode switch CR112 to T104, while the voltage drop across R114 reverse biases the corresponding diode switches in the other filters.



80 M BAND FILTER

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The secondary of T104 is resonated by the C120-C122 series combination, and they act as an impedance transformation voltage divider. T105 and C121 form a series resonant circuit, and its output is coupled to C124-C125, which again transforms the impedance of the signal path, and also resonates with output transformer T106. The combination of the two parallel resonant circuits and one series resonant circuit forms a bandpass filter of excellent characteristics. Output switching is provided by R118, in conjunction with CR113, in a manner identical to the input switching scheme.

The output of the preselector filters is coupled to the preamplifier stage, Q101, via autotransformer T119 and coupling capacitor C163. R127 provides a DC path to ground for the switching diode, and provides reverse bias for the "off" diodes in the other filters, while C159 effectively grounds the bottom of T119 for the signal.

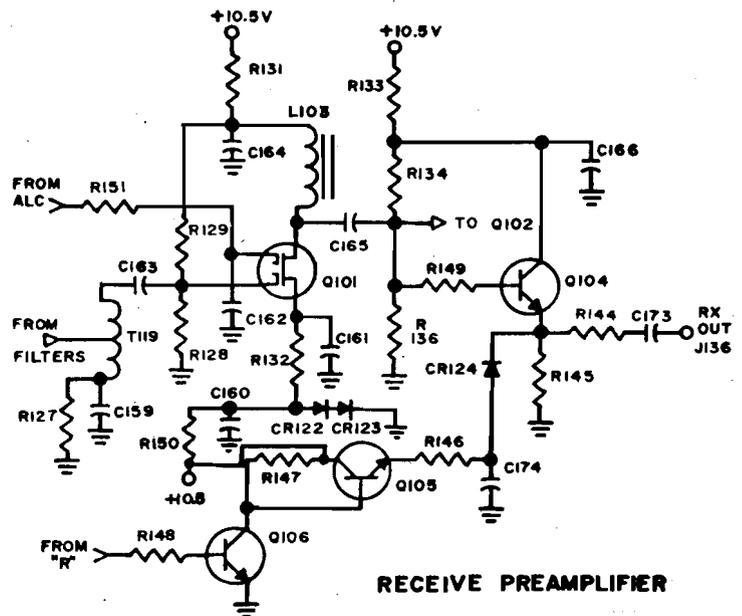
Bias for Q101 is provided both by the source circuitry and the R128-R129 combination. So far as gate two is concerned, the bias is determined by the source network as well as whatever is applied to it via the ALC line. CR122 and CR123, biased in the forward direction by the voltage applied by R150, provide a fixed drop of approximately 1.4 volts, while additional bias is supplied by the drop across source resistor R132. C160 and C161 are both bypasses.

Signal from the drain of Q101 is taken via C165, after being developed across load L103. R131 and C164 form a decoupling network for the supply line. Signal from the drain of Q101 is taken via C165, after being developed across load L103. R131 and C164 form a decoupling network for the supply line.

In the receive condition, the "R" line is high, causing Q106 to saturate, thus lowering the voltage on the base of Q105, causing it to cease conduction. Diode switch CR124 is then reverse biased by the voltage drop across R145, allowing Q104 to operate in a normal manner. Bias for Q104 is derived by R134 and R136, while R149 serves to prevent instability. Output of the preselector is taken from the emitter of Q104 via R144 and C173 and coupled to the receiver input of the exciter board.

EXCITER BOARD--FIRST MIXER

After passing through the preselector and being amplified by the preamplifier, the received signal is connected to mixer Z101 via C102, a blocking capacitor. Local oscillator signal, brought to the exciter board through J105, is coupled via blocking capacitor C164 to the base of amplifier Q114. Bias for Q114 is developed in a conventional manner via the R167-R168 voltage divider. The emitter resistor of Q114 is divided into two parts,



RECEIVE PREAMPLIFIER



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opening its source-to-drain path, thus opening the signal path. Otherwise, a ground is applied to the gate via R113, keeping Q104 in an "on" condition. C111 and R113 serve to lengthen the pulse at the gate of Q104 to ensure positive blanking.

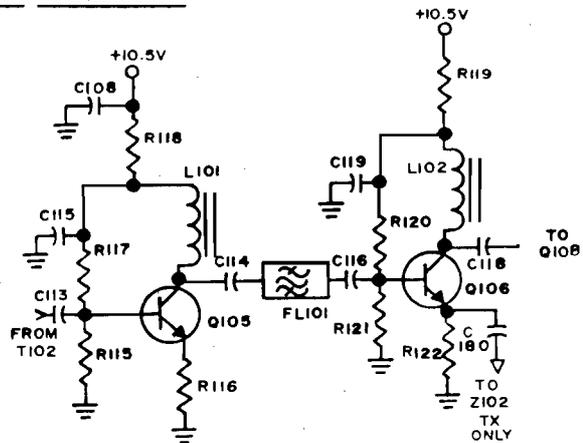
FILTER BUFFER, FILTER, AND POST FILTER AMPLIFIER

From T102, the signal is coupled to filter buffer amplifier Q105 via blocking capacitor C113. Bias is developed by R115 and R117, while emitter resistor R116 is unbypassed, providing degeneration. Output is taken across collector load L101 and coupled through blocking capacitor C114 to the first I.F. filter, FL101. R118, C108, and C115 are a decoupling network.

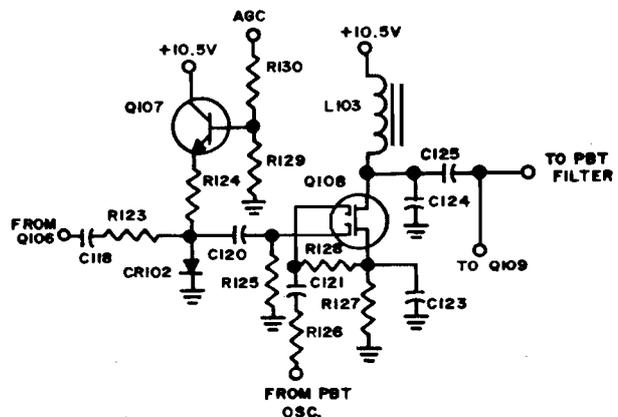
From filter FL101, the signal is coupled through C116 to the base of post filter amplifier Q106, which is biased by R120 and R121. In the transmit condition, Q106 acts as an emitter follower (discussed in detail in the Transmit section of this manual), while in the receive condition, the output is taken from the collector after being developed across load L102. C118 is a blocking capacitor. Note that the use of inductive loads and unbypassed emitters in the stages preceding the AGC attenuator ensure good strong signal handling capability.

AGC ATTENUATOR

From Q106, the received I.F. signal is coupled through C118 and R123 to AGC attenuator PIN diode CR102, and thence via C120 to gate one of pass band tuning first mixer, Q108. AGC voltage, when required, is applied to the base of AGC driver Q107 via voltage divider R129-R130. Current is then supplied to the PIN diode via R124, causing it to conduct to a degree determined by the AGC voltage; it acts, in conjunction with R123, as a variable voltage divider, similar in effect to a conventional volume control, and thus provides the AGC action required. Up to about 50 dB of attenuation is available at this point.



FILTER BUFFER, FILTER, AND
POST FILTER AMPLIFIER



I.F. AGC ATTENUATOR AND
PBT MIXER



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PASSBAND TUNING

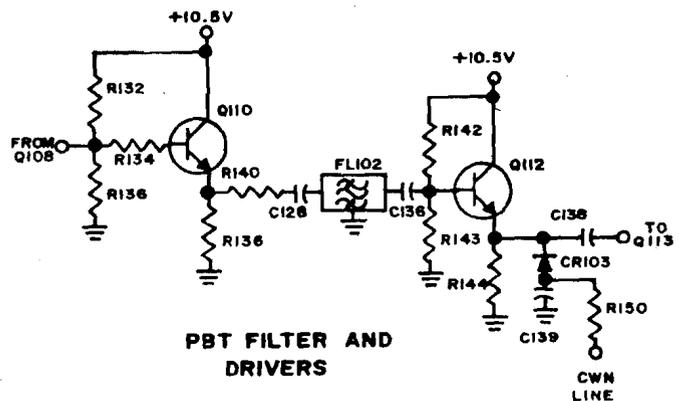
Q108, a dual-gate MOSFET, acts as a subtractive mixer, with the first I.F. signal applied to gate one, and the passband tuning oscillator signal applied to gate two. Bias for gate one is developed across R127, while connecting gate two to the source via R128 makes it operate without bias. Output of Q108, now at the pass band tuning I.F. of 13.8 MHz, is taken from its drain. L103 and C124 form a parallel resonant drain load. C125 is a coupling capacitor, routing the signal to the SSB filter via Q110 and to the CW narrow filter via Q109.

Q110, conventionally biased, acts as an emitter follower to drive the SSB filter, FL102. After passing through the filter, the signal is coupled to Q112 via C136. Q112 is also an emitter follower, with its output developed across R144 and bias developed by the R142-R143 combination. C138 is a blocking capacitor.

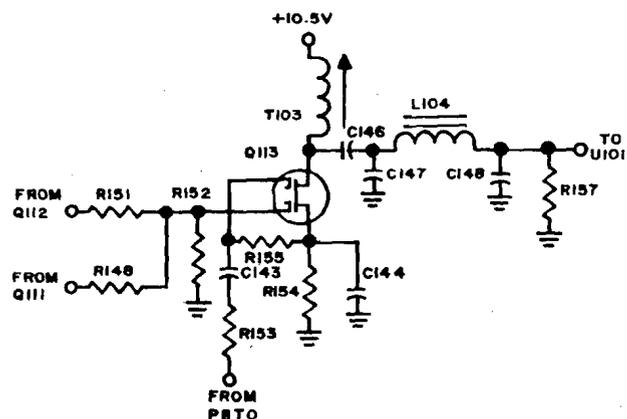
When operating in the CW narrow mode, voltage is applied to the CWN line through R150 to diode switch CR103. This voltage reverse biases the base-emitter junction of Q112, causing it to cease to conduct, and thus breaking the signal path. Also, C139 shorts the signal path through CR103.

Signal from the CWN filter amplifier Q111 (covered later) and from the SSB filter are coupled to gate one of the second PBT mixer Q113. R148 and R151 are isolation resistors, and R152 is the gate return resistance for Q113, which is also a subtractive mixer. Oscillator energy is coupled to gate two of Q113 in the same manner as it was to the first PBT mixer, and the bias arrangement is also the same. Output is taken via C146, now back at the first I.F. frequency of 9 MHz. C147 serves the dual function of resonating with T103 and serving as the first element in a low pass filter composed of C147, L104 and C148, which filters out unwanted mixer products. R157 terminates the filter in its required load.

PBT oscillator Q123 is a conventional Colpitts crystal controlled oscillator, with C203 and C204 providing the feedback capacitive divider. R214 and R215 form the bias network, while R127 is the emitter resistance. T106



PBT FILTER AND DRIVERS



2nd PBT MIXER

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and C205 form a parallel resonant collector load. The frequency of the oscillator is adjusted by the application of a voltage from the PASSBAND tuning control on the front panel through isolation resistor R213, to varicap CR110. The range of adjustment is set by trimmer C206, while C207 is a bypass.

Because the same frequency oscillator signal is applied to both PBT mixers, any signal going into the first PBT mixer will leave the second on precisely the same frequency. This is why the PASSBAND tuning control only affects the relative position of the passband and has no effect on the frequency of the signal tuned in.

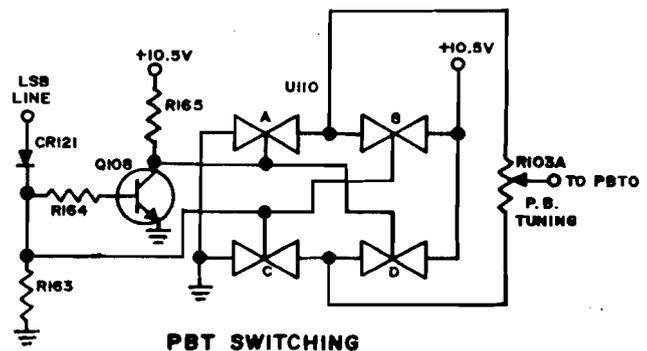
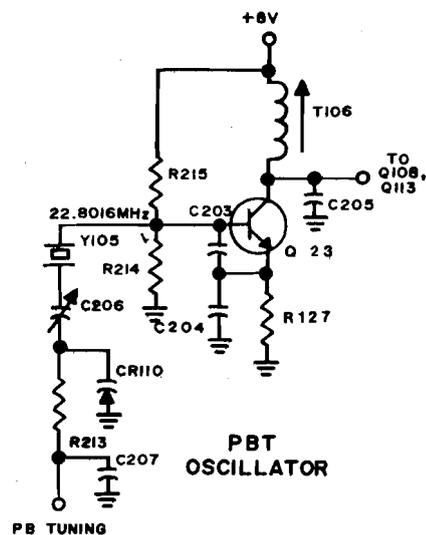
The direction of tuning of the passband oscillator must be one way for USB/CW

operation, and the opposite direction for LSB operation for the effect at audio to remain the same. When in the LSB mode, a positive voltage is applied through CR121 on the audio board to the base of Q108, through limiting resistor R164. Simultaneously, it is also used to turn sections B and C of switch U110 on. Section B of U110 applies +10.5 volts to the upper end of the PASSBAND tuning control R103A, while section C grounds the other end. Since Q108 is saturated, its collector is low, and this voltage, applied to sections A and D of U110, turns them off. When in the USB or CW modes, however, the LSB line is low, and thus sections A and D of U110 are on, while sections B and C are off. This action reverses the voltage applied to the tuning control.

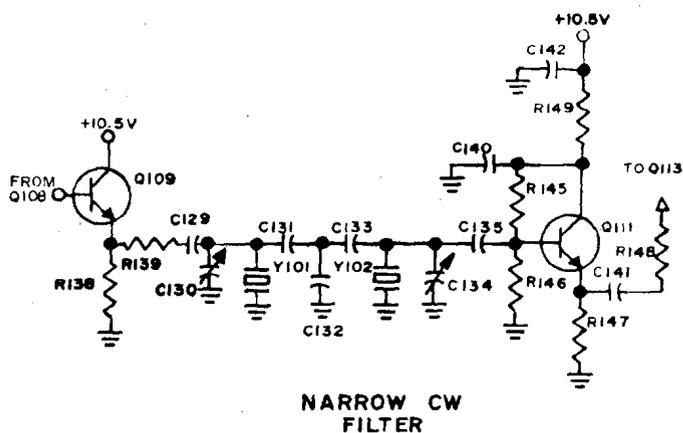
Operation of the PASSBAND tuning indicator will be covered in the "Ancillary Circuits" section of this manual.

CWN FILTER

Signal at the second I.F. of 13.8 MHz, from the first passband tuning mixer (Q108), is also coupled to the base of Q109. Bias is received from the same network that supplies Q110, the filter driver. Q109 acts as an emitter follower driver for the CW narrow filter, and the required filter termination impedance is provided by R138 and R139, while C129 is a blocking capacitor. The CW narrow filter is composed of Y101 and Y102, with C131 and C133 acting as coupling capacitors and C130 and C134 providing adjustments

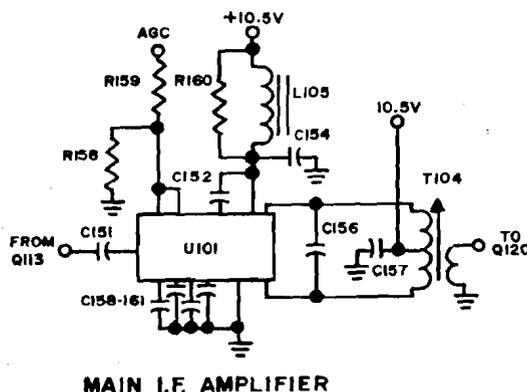


to properly align the filter response. C135 acts as an output coupling capacitor, and carries the signal to the base of Q111. Power for Q111 is taken from the CWN line, and bias is provided by R145 and R146. Output is taken across emitter resistor R147 and coupled to the second passband tuning mixer Q113 through C141 and R148.



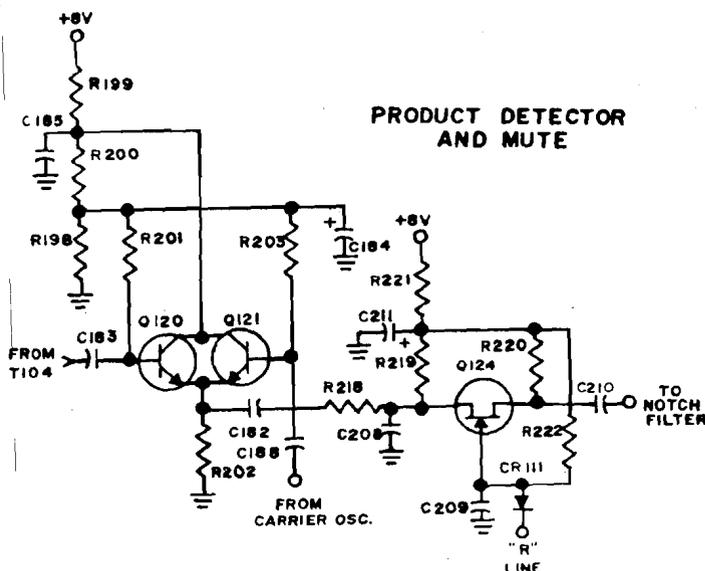
MAIN I.F. AMPLIFIER

The signal from Q113, now again at the 9 MHz I.F., is coupled through C151 to the main I.F. amplifier, U101. This integrated circuit is composed of two amplifier sections, with the output of the first section developed across the R160-L105 load combination. C154 resonates with L105, while R160 broadens the response by "swamping" the tuned circuit. C152 couples the output thus developed from the first amplifier section of U101 to the second section of the same IC. Output of the second section is coupled to push-pull T104, which is resonated by C156. C157 is a bypass. The output of T104 is coupled to the product detector, Q120. AGC control is applied through voltage divider R158-R159. Overall gain of U101 is up to 70 dB.



PRODUCT DETECTOR/AUDIO MUTE

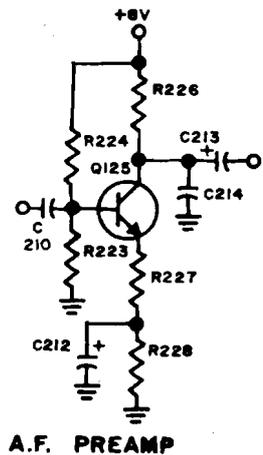
Carrier oscillator energy is coupled via C186 to the base of Q121, which forms an emitter-coupled pair with Q120. Bias is developed by R200 and R198, acting as a voltage divider, and R201 and R203 serve as isolating resistors, while C184 is a bypass. Q120 and Q121 act as a mixer, combining the I.F. input from T104 and the carrier oscillator signals to recover the audio frequency of the incoming signal. Output is coupled via C182 to an RC network composed of R218 and C208,



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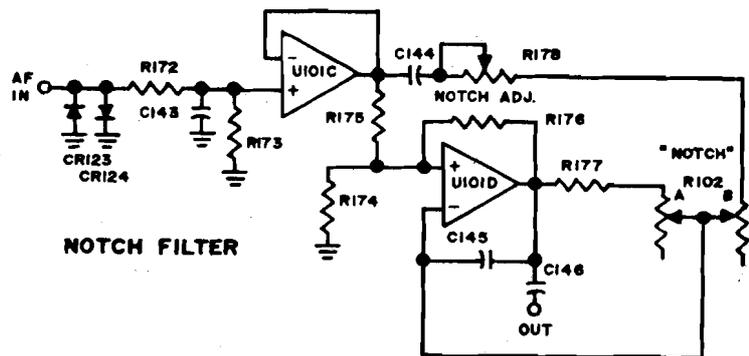
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which filters out any undesired mixer products. Q124, in series with the signal path, acts as a switch to cut off the receiver output AF when in the transmit condition. In that instance, the "R" line would be low, grounding the gate of Q124 and causing it to act as an open circuit. R219 and R220 provide bias voltage for the source and gate. Output of the AF mute gate is then coupled via C210 to the base of AF amplifier Q125, which provides additional gain. Bias is conventional, while the emitter resistance is only partially bypassed to set the gain (see the "Servicing Hints" section of this manual for a discussion of feedback amplifiers such as this). Output is taken via C213, while C214 provides a degree of high frequency rolloff for more pleasing audio response.



NOTCH FILTER

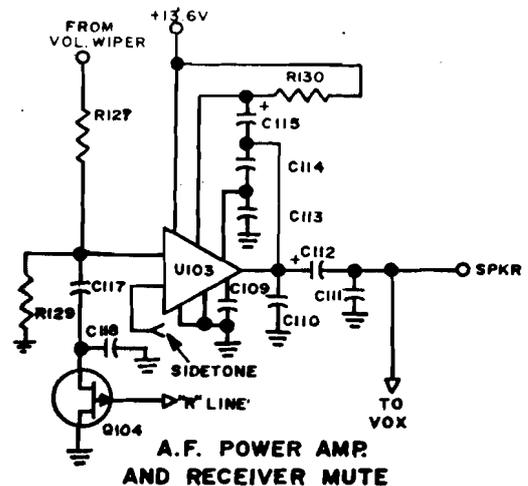
Audio from Q125 is applied to CR123 and CR124, which act as a limiter, effectively clipping off any peaks exceeding approximately ± 0.7 volt. The R172-C143 combination filters the output of the clipper and shapes the audio response. U101C is connected as a voltage follower, providing drive for active filter U101D that is the same amplitude and phase as its input, but of a lower driving impedance.



C144 and R178, with R120A on the front panel, form the series leg of a Wein bridge, while C145, R177 and R102B (also on the front panel) form the shunt leg of the same Wein bridge. This bridge is inserted in the inverting feedback loop to form a notch when combined with the normal audio frequency applied to the non-inverting input of amplifier U101D. R176 and R174 form a positive feedback path to raise the "Q" of the circuit.

AUDIO POWER AMPLIFIER/RECEIVER MUTE

Audio from the output of the notch filter is applied to the high side of the front panel volume control, and its wiper is returned, through R127, to the input of audio power amplifier U103. R129 acts in conjunction with R127 as a voltage divider. Receiver mute switch Q104 is connected between this input and ground, through isolating capacitor C117. When in the receive condition, a voltage on the "R" line holds Q104 in the "open" condition, allowing the signal to be amplified by U103; when in the transmit condition, the "R" line is grounded, turning Q104 "on" and shunting the signal to gr-



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ound. C118 and R127 shape the audio response.

When in the transmit condition, and when sending CW, the sidetone audio signal is applied to the other input of U103; thus, the operator is able to monitor his own sending.

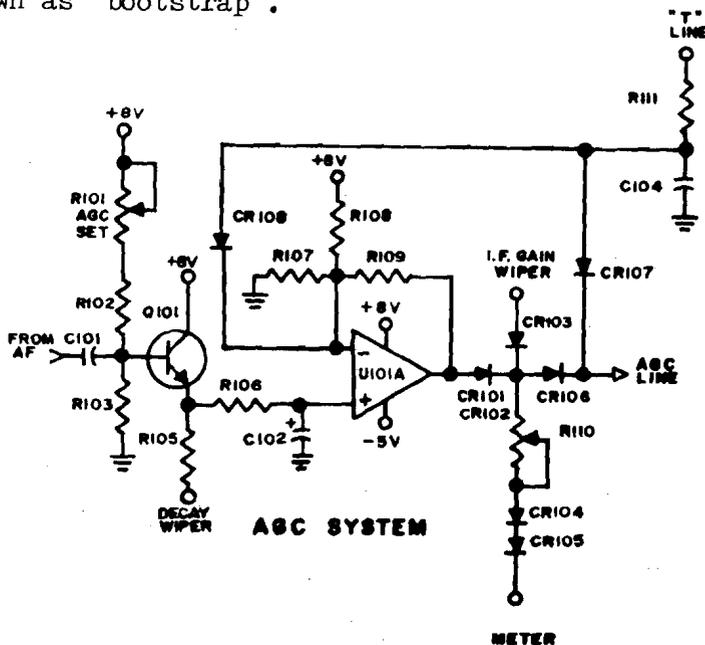
C113 and C114 form an audio shaping network for more pleasing response, and C112 couples the output to the speaker. C110 and C111 are RF bypasses. C109 bypasses certain internal circuitry of U103, while R130 and C115 provide a type of feedback path known as "bootstrap".

AUTOMATIC GAIN CONTROL

The audio frequency signal is coupled to the base of Q101 via C101. Bias is set by R101, R102 and R103, with R101 serving as the AGC threshold adjustment. When the audio peaks are of sufficient amplitude, Q101 conducts, which causes a current to flow through R105 and the DECAY control, a variable resistance to ground. The voltage drop across this combination charges capacitor C102, with series resistor R106 controlling the charging time, and thereby the attack time. When the AF signal disappears, C102 discharges through R106 and the R105-DECAY control combination, thus the setting of the control varies the decay time of the AGC.

The voltage across C102 is applied to the non-inverting input of amplifier U101A. Provided the output of U101A is greater than any reverse bias to CR101 supplied through CR103 by the I.F. GAIN control, the output of U101A is applied to the AGC line through CR106, and to the S meter through calibration control R110 and voltage dropping diodes CR104 and CR105. R107, R108 and R109 establish a reference level and the gain of U101A.

When in the transmit condition, the "T" line goes high, and applies a voltage through CR108 to the inverting input of U101A, causing its output to go low and remain there so long as the "T" line remains high, thus disabling the amplifier. This ensures that the S meter is disabled in transmit. This same voltage is applied, through CR107, to the AGC line to force maximum attenuation of the AGC PIN diode in the IF amplifier chain, and to cut off the I.F. integrated circuit amplifier, U101, on the exciter board. This ensures that no signal is present in the AGC loop during transmit and full gain is available when switched back to receive.





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Transmitter Theory

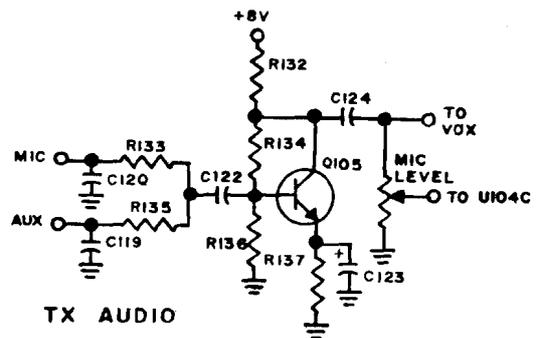
Microphone Preamplifier.....	4-1
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MICROPHONE PREAMPLIFIER

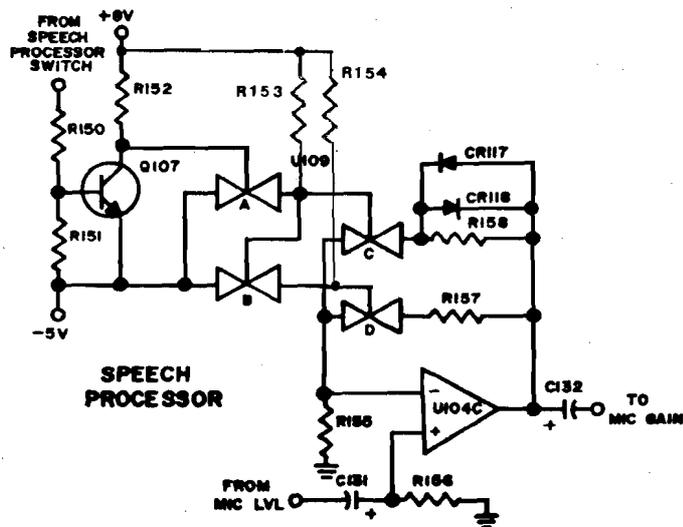
The audio signal from the microphone or external input jack is coupled through R133 or R135, respectively, to blocking capacitor C122 and thence to the base of microphone preamplifier Q103. C119 and C120 are RF bypasses, while bias is developed from the collector by voltage divider R134-R136. This provides feedback to keep the gain of the stage fixed. The emitter circuit is standard, composed of resistor R137 and bypass capacitor C123. Output is coupled via C124 to the VOX circuit and to the internal microphone level control.



SPEECH PROCESSOR

When the operator desires to use the built-in speech processor, a voltage is applied, through voltage divider R150-R151, that biases Q107 into conduction thus lowering its collector voltage and turning section A of switch U109 off. This in turn activates sections B and C of that switching IC. The former turns section D off, opening the feedback path for U104C composed of R157, and the latter completes the alternative feedback path composed of R158, CR117 and CR118.

U104C, in this case, operates as a compressor. When signal peaks at the output of the amplifier exceed the barrier potential of CR117 and CR118 (+ 0.7 volt) these peaks are fed back to the inverting input of that amplifier, thus reducing its gain. When speech processor operation is not desired, R157 is utilized as the feedback path, converting U104C into an ordinary fixed-gain amplifier stage.



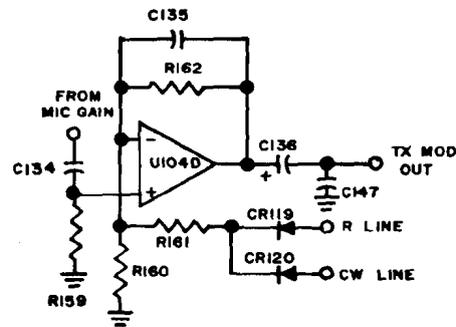
MODULATION AMPLIFIER

U104D is a fixed-gain amplifier, immediately following the front panel MIC GAIN control. Feedback is provided by the R162-C135 parallel combination, with C135 providing additional feedback at the higher audio frequencies thus reducing gain of the stage in that range, and providing a more pleasant



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normal sound to the transmitted voice signal. The output is taken via C136, with C147 providing bypassing for RF energy. When operating in the CW mode, or in the receive condition, the amplifier is disabled by voltages applied through CR120 or CR119, respectively, and through R161, to the inverting input of the amplifier, causing its output to go to its lowest limit and remain there so long as these voltages are present, preventing it from amplifying the transmit audio signal.

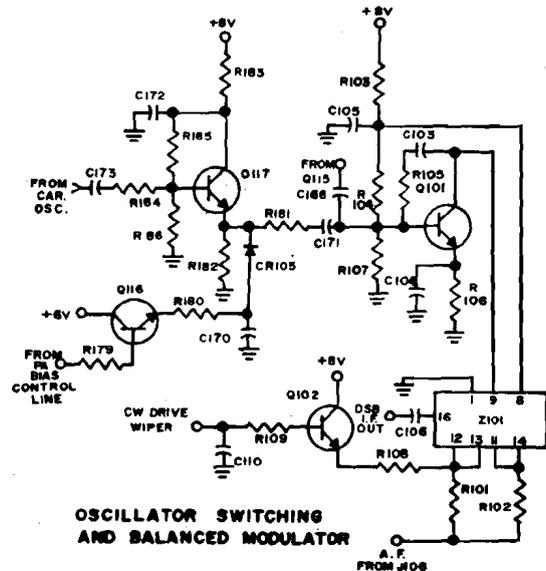


MODULATION AMPLIFIER

BALANCED MODULATOR

Z101, on the exciter board, used as the first mixer in the receive condition, is used as the balanced modulator in the transmit condition. Audio from the modulation amplifier is applied to Z101 through R101 and R102. Meanwhile, the P.A. bias line, which goes low for transmit, cuts off Q116, removing the voltage applied through R180 and CR105 from the emitter of Q117 which allows it to operate as a normal amplifier. This voltage, present in the receive condition, reverse biases the base-emitter junction of Q117, disabling it when it is not needed.

Carrier oscillator energy is coupled through C173 and R184 to the base of Q117, where it is amplified. Output is taken from the emitter, through R181 and C171, and applied to the base of Q101. (In the receive condition, local oscillator energy is coupled through Q115 to the base of Q101, but this path is interrupted in the transmit condition). Q101 is a feedback amplifier, with its gain determined by the ratio of feedback resistor R105 to the input series resistor, R181. Bias and emitter circuits are conventional, and output is taken from the collector of Q101 through a winding internal to Z101. The DSB suppressed-carrier output is taken through C106. (For internal circuitry of Z101, see the Servicing Hints section of this manual.)



OSCILLATOR SWITCHING
AND BALANCED MODULATOR

FIRST I.F./NOISE BLANKER GATE

The DSBSC output of Z101 is coupled to the first I.F. amplifier, Q103, via C106. R111 and R112 form the bias network, while emitter resistor R110 is unbypassed, providing some degenerative feedback. Output is developed across a parallel-tuned resonant circuit composed of the primary of T101 and C109. R114 and C107 form a decoupling network, while the latter also places the upper end of the primary of T101 at AC ground.

The secondary of T101 presents a signal at low impedance which is coupled through noise blanker gate Q104 to the primary of T102, where it is stepped back up. C112 resonates the secondary of T102. In the transmit condition, the noise blanker gate is held in the on condition at all times.

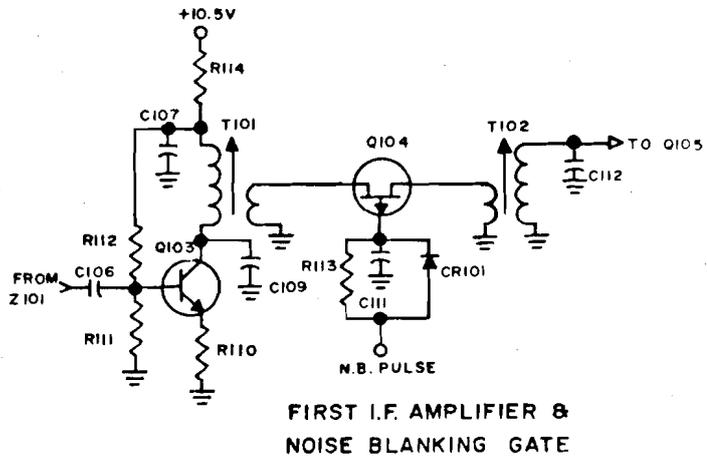
FILTER BUFFER AND FILTER

From T102, the signal is coupled to the filter buffer amplifier, Q105, via blocking capacitor C113. Bias is developed by R115 and R117, while emitter resistor R116 is unbypassed. Output is taken across collector load L101 and coupled through blocking capacitor C114 to the first IF filter, FL101. R118, C108 and C115 are a decoupling network.

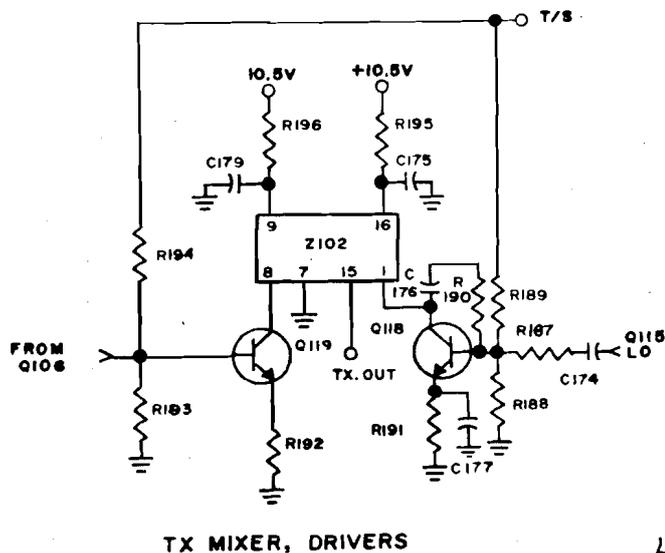
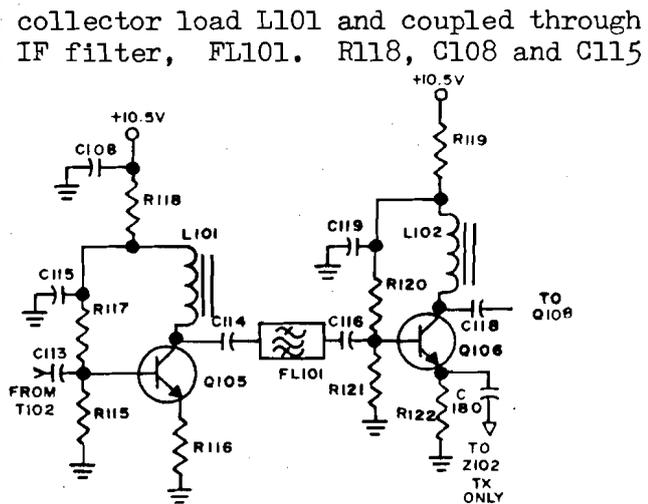
From filter FL101, the signal is coupled through C116 to the base of post filter amplifier Q106, which is biased by voltage divider R120 and R121. In the transmit condition Q106 acts as an emitter follower, with its output coupled via C180 and R197 to the transmit mixer driver, Q119.

TRANSMIT MIXER

As mentioned above, the signal from the post filter amplifier, Q106, which is now a single sideband, suppressed carrier signal at the IF frequency of 9 MHz, is coupled to transmit mixer driver Q119. This stage has conventional bias, an unbypassed emitter, and its output taken from the collector through a winding of Z102. This winding is decoupled by R196 and C179. Bias supply comes from the T/S line from the control circuitry,



FIRST I.F. AMPLIFIER & NOISE BLANKING GATE



TX MIXER, DRIVERS



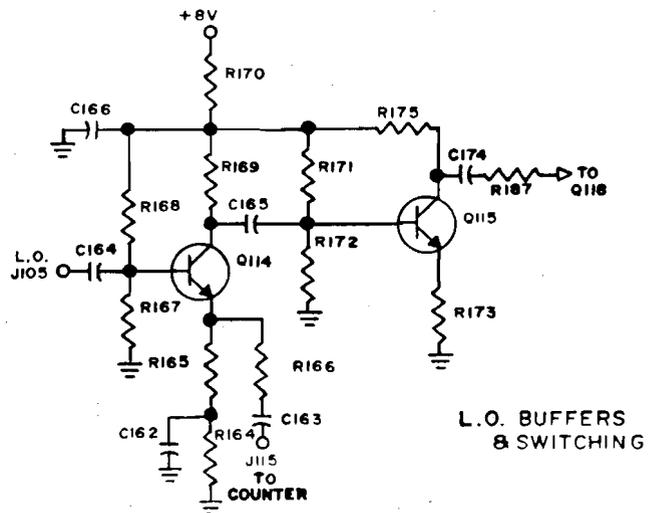
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which will be covered later.

Local oscillator energy is coupled to the base of the other driver, Q-118. The gain of this stage is determined by the ratio of feedback resistor R190 to input resistor R187; C174 and C176 are merely DC blocking capacitors. The emitter of the stage is bypassed conventionally. Output is taken from the collector through a winding of the transmit mixer, Z102, a doubly balanced mixer assembly identical to that used for A101.

L.O. drive is connected to Z102 through an amplifier/buffer network contained on the exciter board also. Signal from the local oscillator board is applied to buffer Q114 via C164. Output is taken from the R165 portion of the emitter resistance, and coupled through R166 and C163 to the counter board, to provide the signal for the front panel digital dial, while the remainder of the emitter resistance, R164, is bypassed by C162.

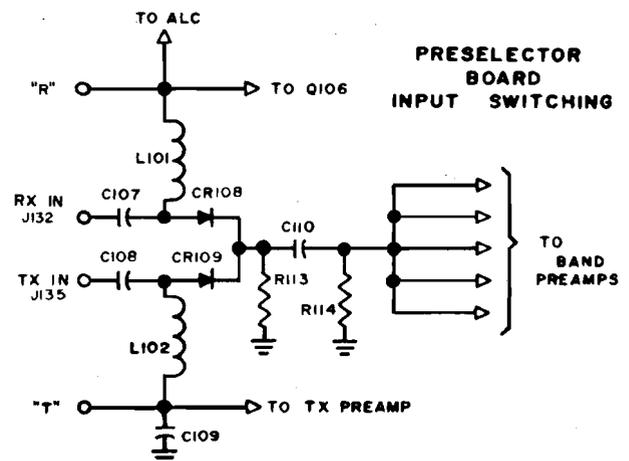
Signal is also taken from the collector of Q114, coupled through C165, and applied to the base of Q115. The emitter resistor of this stage is unbypassed, creating some degree of degenerative feedback, and the output is taken via C174 and R187 to the mixer driver, Q118.



L.O. BUFFERS & SWITCHING

PRESELECTOR--INPUT SWITCHING

Output from transmit mixer Z102 which is now at the desired operating frequency, is coupled to the same preselector board used in the receive portion of the transceiver. It is coupled via C108 and C110 to the input of the band preamplifier filters when the "T" line is high, biasing switch CR109 on through L102 and R113. Since the "R" line is low under transmit conditions, the voltage dropped across R113 reverse biases receive switch CR108, disconnecting the receiver input from the preselector.



PRESELECTOR--BANDPASS FILTERS

Since operation of all of the individual band filters is identical, only one, the 80 meter version, is discussed here. These filters are selected by the BAND switch on the front panel of the transceiver, utilizing the control lines from S103 on the Bandswitch/Low Pass Filter board.



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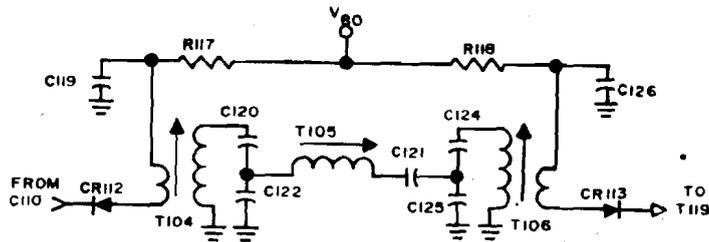
The voltage from the 80 meter control line is coupled through isolating resistor R-117, the primary of T104, and CR112 to the output of the switching circuitry discussed in the previous section, where it is provided with a ground return path through R-114. C119 provides a ground for the signal at one end of the primary of T104. The signal is then passed through diode switch CR112 to T104, while the voltage drop across R114 reverse biases the corresponding diode switches in the other filters.

The secondary of T104 is resonated by the C120-C122 series combination, and they also act as an impedance transformation voltage divider. T105 and C121 form a series resonant circuit, and its output is coupled to C124-C125, which again transforms the impedance of the signal line, and also resonates with output transformer T106. The combination of the two parallel resonant circuits and one series resonant circuit forms a bandpass filter of excellent characteristics. Output switching is provided by R118, in conjunction with CR113, in a manner identical to the input switching scheme.

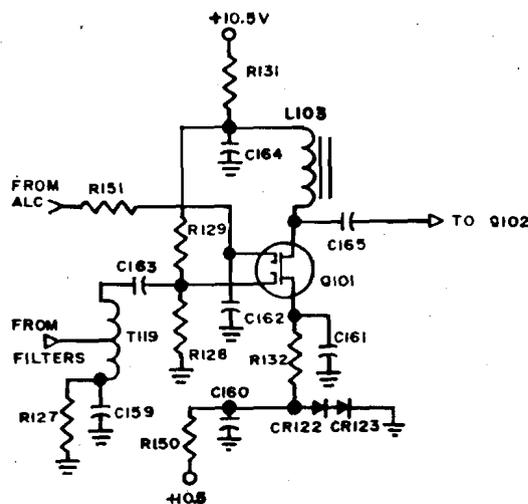
The output of the preselector filters is coupled to the preamplifier stage, Q101, via autotransformer T119 and coupling capacitor C163. R127 provides a DC path to ground for the switching diode, while C159 effectively grounds the bottom of T119 for the signal.

Bias for Q101 is provided by both the source circuitry and the R128-R129 combination. So far as gate two is concerned, the bias is determined by the source network and what ALC is applied to it from the ALC circuitry, to be discussed later. CR122 and CR123, biased in the forward direction by the voltage applied to R150, provide a fixed drop of approximately 1.4 volts, while additional bias is supplied by the drop across source resistor R132. C160 and C161 are both bypasses.

Output, via C165, is taken from Q101 and applied to transmit preamplifier Q102, which is a conventionally biased emitter follower stage. This in turn is coupled via C170 to frequency-equalizing network R138-C171, and then to the base of feedback amplifier Q103. Gain of this stage is determined by



80 M BAND FILTER





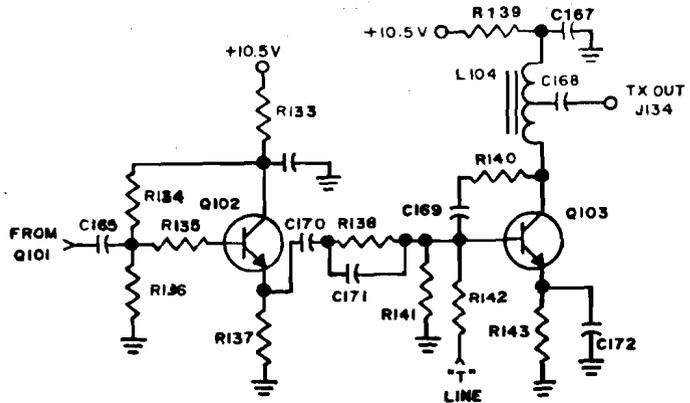
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the ratio of R140 to the impedance of the R138-C171 combination. Bias is applied only in the transmit condition, from the "T" line, via voltage divider R141-R142. The emitter circuit is composed of R143 bypassed by C172.

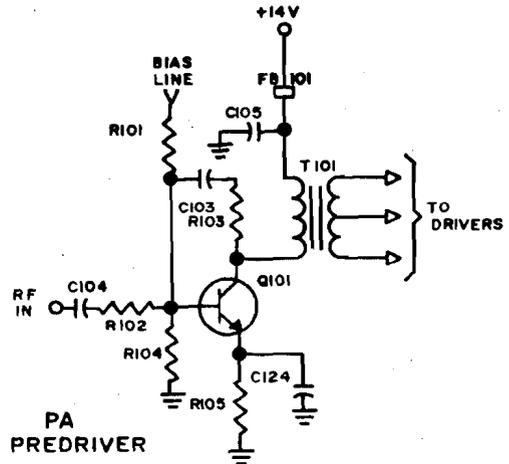
Output is taken from a tap on autotransformer L104 and coupled through C168, providing a low impedance signal that can be coupled through a coaxial cable to the power amplifier board with minimum loss. C167 and R139 form a supply line decoupling network.



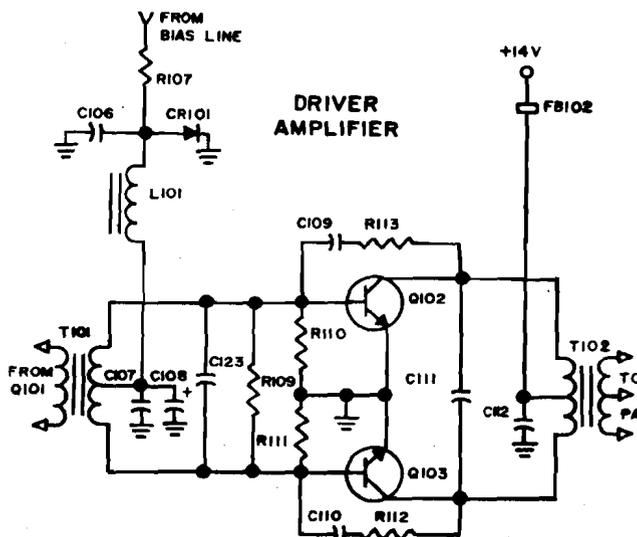
TRANSMIT PREAMP

POWER AMPLIFIER

From the preselector, the transmit signal is applied to PA predriver Q101 on the power amplifier board via coupling capacitor C104. Since Q101 is a feedback stage, its gain is set by the ratio of feedback resistor R103 to input resistor R102, while bias is taken from the PA bias line via voltage divider R101-R104. The emitter circuit is conventional, and the output is taken via T101, which provides a push-pull signal for the following driver stages. C105 and ferrite bead FB101 provide decoupling for the collector supply line.



PA PREDRIVER



DRIVER AMPLIFIER

The driver amplifiers, fed by transformer T101, are supplied bias via the center tap of that transformer and RF choke L101. R107 and CR101 form a forward-biased diode regulator circuit to control the amount of bias supplied. C106, C107 and C108 are bypasses.

The C123, R109, R110 and R111 network assures the correct load impedance on the secondary of T101. The R113-C109

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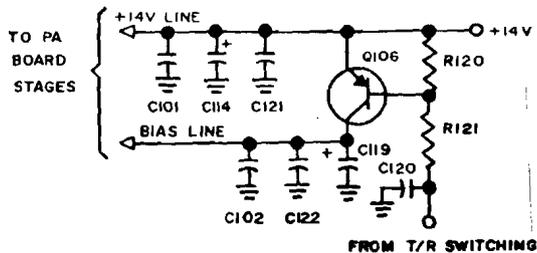
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and R112-C110 networks provide feedback for the stages. C111 helps to provide proper frequency response at the primary of the interstage transformer, T102, while C112 and FB102 provide required decoupling of the supply line.

Power amplifier stages Q104 and Q105 both are also driven in push-pull, from the secondary of transformer T102. Bias is supplied in a manner similar to that of the driver stages, and again, a network composed of C115, R115, R116, R117 and R118 assure proper termination impedance for the secondary of T102. Feedback networks are provided for these stages also, and output appears across the secondary of T103. C118 and RFC L103 provide supply decoupling.

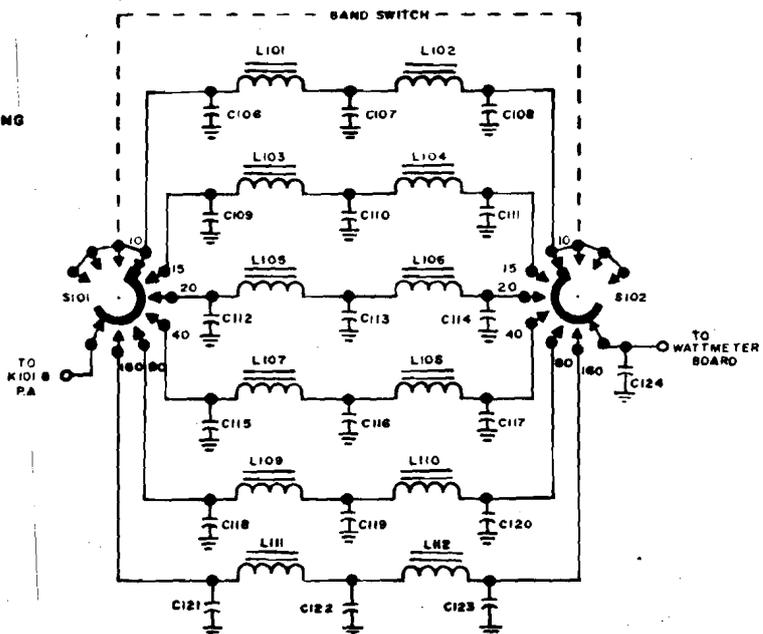
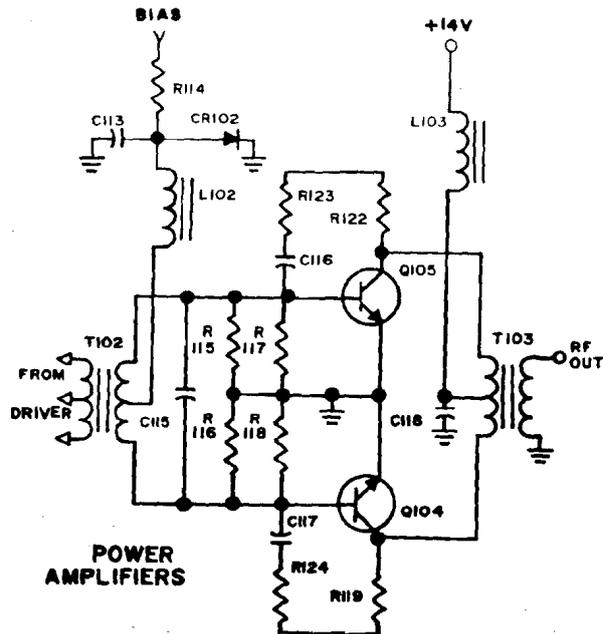
The bias line for the PA board is controlled by Q106. Normally, the base of this device is held at the +14 volt supply potential through R120, thus cutting it off. When, however, the transmit mode is activated, the T/R switching circuits ground the lower end of R121, thus lowering the voltage on the base of Q106 and allowing it to saturate. This energizes the bias line and all circuits supplied from it.

Capacitors C102, C122 and C119 on the bias line, and C101, C114 and C121 on the +14 volt supply line assure good bypassing at all frequencies from audio to radio.



PA BOARD BIAS

The output from the power amplifier is coupled to switch S101 on the bandswitch/low pass filter board, and thence through the appropriate low pass filter for the band selected, and out through S102 to the wattmeter/SWR board (covered later). Each of the low pass filters on this board is a five pole type, designed to greatly attenuate out-of-band harmonics and spurious outputs.





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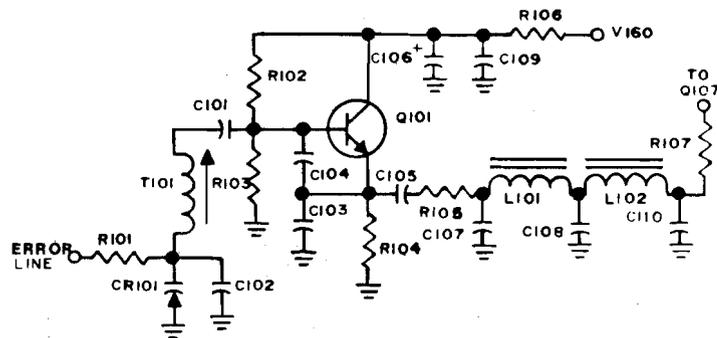
Oscillator Theory

Band Voltage Controlled Oscillators.....	5-1
Permeability Tuned Oscillators (PTOs).....	5-3
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Local Oscillator Mixer.....	5-5
Carrier Oscillator.....	5-7
CW Sidetone Oscillator.....	5-7
-5 Volt Oscillator/Regulator.....	5-8

BAND VOLTAGE CONTROLLED OSCILLATORS

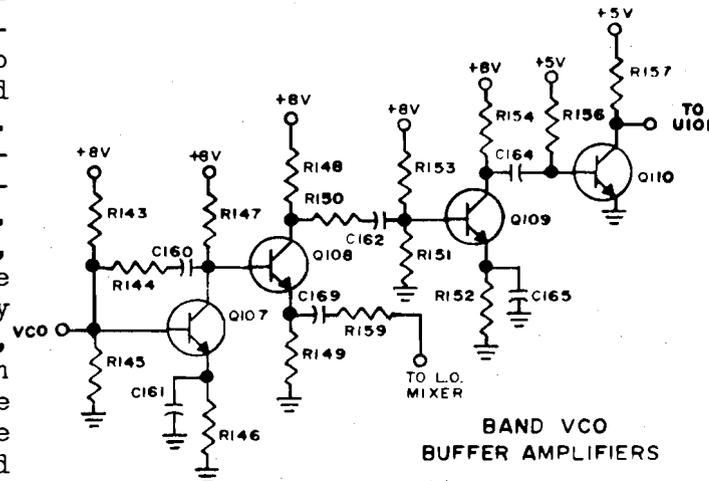
Each of the six bands has its own voltage controlled oscillator (VCO) that operates at a frequency 14.5 MHz higher than the low edge of the band itself. Each of these VCOs is the same as the other, with the exception of the values of the frequency sensitive components, so only one will be discussed here, that for the 160 meter band.

The oscillator circuit is derived from the basic Colpitts oscillator, with C103 and C104 providing the tapped capacitance for feedback. T101 and the parallel combination of varicap CR101 and C102 provide the tuned circuit. Voltage applied by the error line through isolation resistor R101 tunes the varicap. C101 is a blocking capacitor, and bias is developed by voltage divider R102-R103. Output is taken through blocking capacitor C105 and series resistor R105, and is filtered by a low pass filter composed of inductors L101 and L102, with C107, C108, and C110.



BAND VCO

The output of the filter is coupled through series resistor R107 to a line common with the other five oscillators, and to the base of summing amplifier Q107. R144 and C160 provide a feedback path from collector to base of this stage, so the gain of Q107 is determined by the ratio of R144 to R107. (See the "Servicing Hints" section of this manual for a discussion of feedback amplifiers). Bias for Q107 is conventional, as is the emitter circuitry. The collector of Q107 is directly coupled to the base of Q108, making them into a high-gain compound pair. Output to the L.O. mixer is taken from the emitter of Q108 through C169 and R159, while an additional output is taken from the collector through R150 and C162, and applied to the base of amplifier Q109. This stage then drives level translator Q110 through C164, and bias is applied through dropping resistor R156. The output of Q110, now a square wave at a TTL-compatible level, is directly coupled to the prescaler of the band phase locked loop. (See the "Servicing Hints" section for a discussion of the PLL.)



BAND VCO
BUFFER AMPLIFIERS



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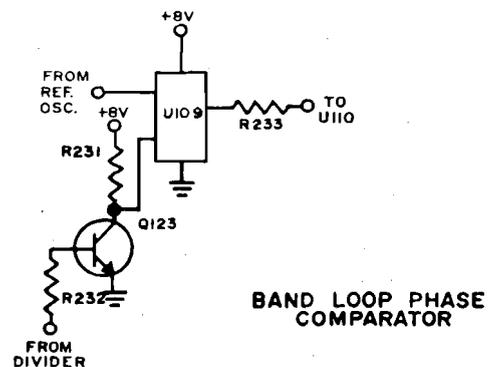
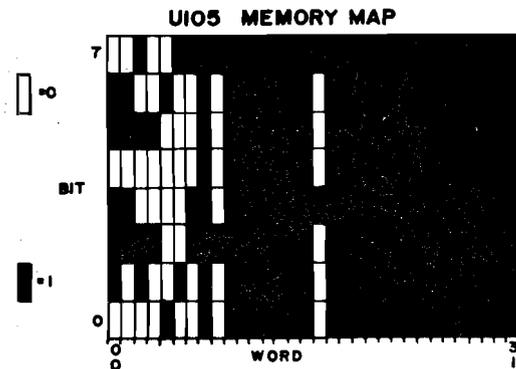
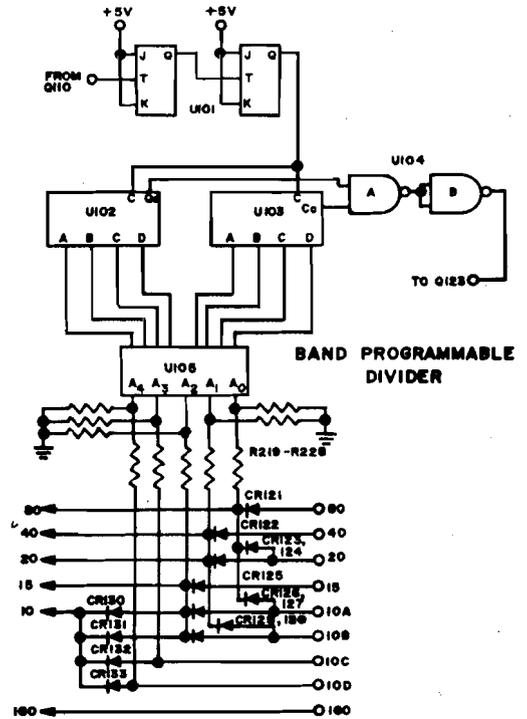
U101, a dual J-K flip flop, is used as a divide-by-four prescaler for the divider chain. Its output is coupled to the clock inputs of U102 and U103 in parallel. The outputs of U102 and U103 are gated through U104A to produce an output pulse when the counter has completed its counting cycle; this pulse is then inverted through U104B, and used to drive the phase detector driver, Q123.

Programming of counters U102 and U103 is accomplished by the diode matrix composed of CR121 through CR129, and memory U105. For 160 meter operation, all five input lines to U105 are low, or binary 00000; for 80 meters, the coding is 00001; for 40, 00010; for 20, 00011; for 15, 00100; for 10A, 00101; for 10B, 00110; for 10C, 01000; and for 10D, 10000. Band program memory U105 decodes these addresses into the bit combinations necessary to set the required division ratios into counters U102 and U103, as shown in the accompanying memory map of U105.

Additional diodes (CR130 through CR133) are connected to the 10 meter control lines which provide a common 10 meter bus, regardless of which segment of the band is selected by the BAND switch, and is used to energize the 10 meter VCO and 10 meter L.O. filter.

The output of the programmable divider is coupled through R232 to the base of driver Q123. Its output is coupled to the phase comparator, U109. The other input to the phase comparator is the 125 kHz signal from U101B, the loop reference oscillator and divider. Y101 controls the frequency of the oscillator at 2 MHz, with C246 providing a means of adjusting the calibration.

Output of the phase comparator, U109, is coupled through R233 to the inputs of two amplifier stages, U110A and U110B. Capacitor and resistor combinations C248-R233 and R239-C249 form the loop filter. For 160 through 15 meter operation, U110A is used as the error amplifier, with its output driving the varicaps in those band oscillators; for the 10 meter band, U101B, with higher gain, is used to drive the varicap of that band's oscillator. More gain is required be-





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cause the higher divider numbers also reduce the loop gain.

In this manner, the band VCOs are constrained to oscillate on precise multiples of the crystal controlled reference frequency of 125 kHz. The exact multiple is the total division performed on the VCO frequency, including that of the prescaler.

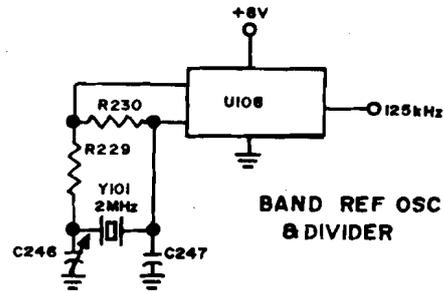
PERMEABILITY TUNED OSCILLATORS

There are two identical permeability tuned oscillators in the ASTRO 102BX. Only one is described here.

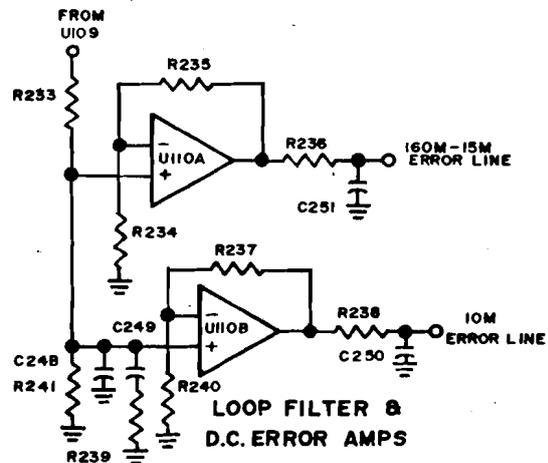
The permeability tuned oscillator is the primary means of varying the frequency of the transceiver. It is a Colpitts circuit, and the tuned frequency is determined by L601 in parallel with the appropriate capacitors, CR601, C603, C604, C605 and C606. The frequency tuned is 5.0 to 5.5 MHz, and this combination of capacitors is chosen to provide temperature compensation for low drift, and must be replaced with exactly the same types to maintain this stability, if replacement becomes necessary.

R606 provides a DC return for the gate bias of Q601, which is developed by R609. Feedback to sustain oscillation is achieved by the C609-C610 divider combination. The drain is decoupled to ground by R610 and C611, while the output is taken from the source to drive FET buffer Q602.

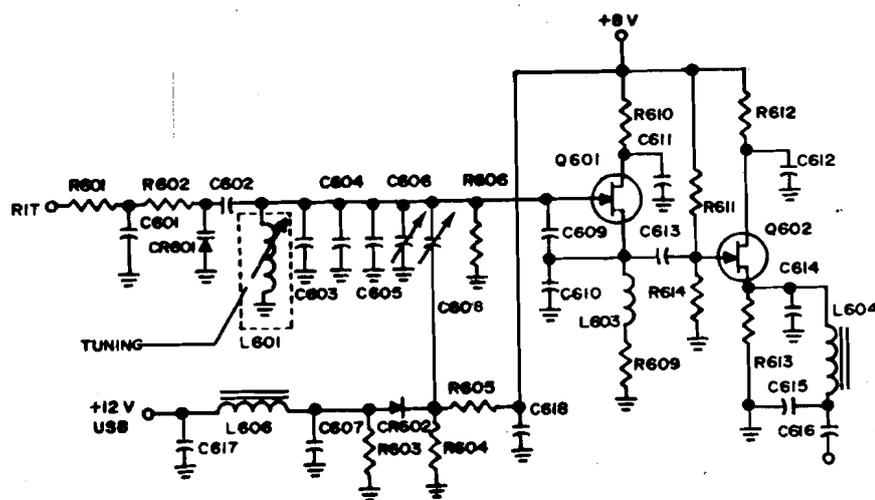
The bias generated by source resistor R613 of Q602, whose value is set by the desired output impedance, is greater than is desirable for this FET; hence, a positive voltage to offset this is developed



BAND REF OSC & DIVIDER



LOOP FILTER & D.C. ERROR AMPS



PERMEABILITY TUNED OSCILLATOR

by the R611-R614 combination. Output is taken via low pass filter C614-L604-C615 to assure good spectral purity.

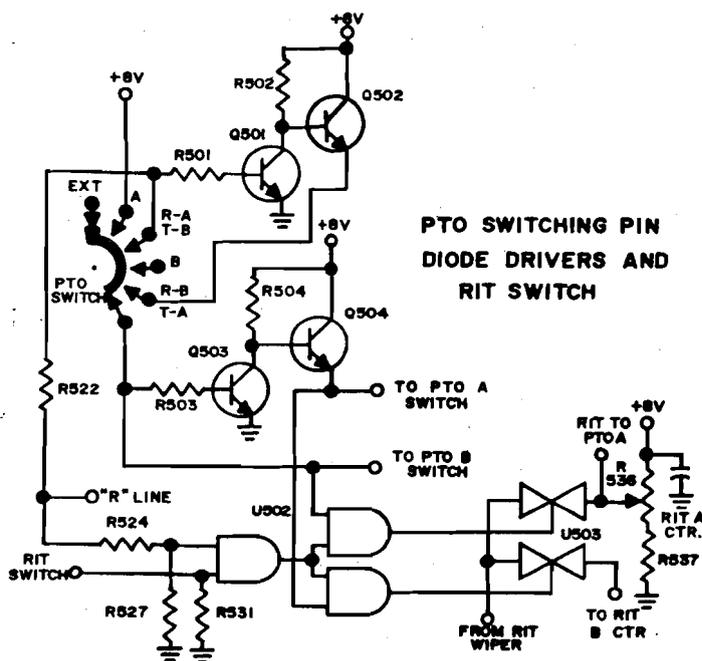
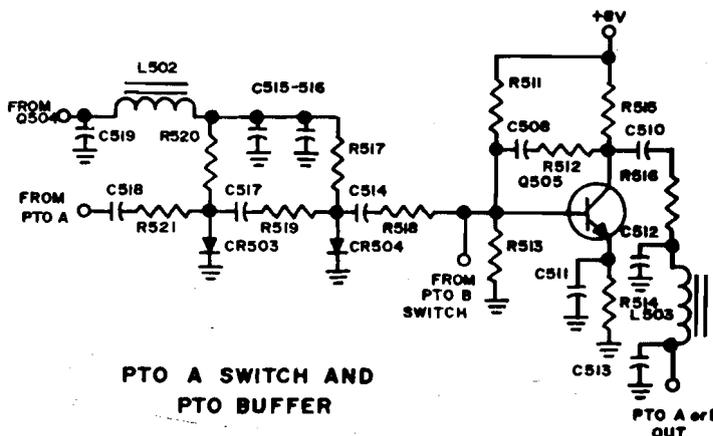
When operating in the USB mode, the required frequency shift is set by C608, which is switched in parallel with the tuned circuit by CR602.

When RIT is used, the required shift is obtained by varactor diode CR601, connected in parallel with the tuned circuit by blocking capacitor C602. The DC tuning voltage for this varactor is applied through the R601-R602 combination, and is decoupled by C601. C606 is a calibration control.

PTO SWITCHING

The switches are used for the PTO outputs; only one will be described here, as both are identical and the description of one will apply equally to both.

A control voltage, the generation of which will be discussed later, is applied to decoupling RF choke L502 from Q504. C519, C515 and C516 are bypass capacitors. This voltage is applied to PIN diode attenuators CR503 and CR504 through isolating resistors R520 and R517, causing the diodes to present a low resistance to ground. Since the signal from the PTO passes through R521 and R519 (as well as blocking capacitors C518 and C517, it is dropped by these two resistors, with essentially none passing through to the base of the buffer, Q505. Thus, when this control voltage is removed, the PTO output is allowed to pass to the buffer. Q505 is a summing amplifier, with its gain determined by the ratio of R512 to R518 (and others, when the other section is in use). Bias and emitter circuitry are conventional, and output is taken from the collector through low pass filter C512-L503-C513 to assure that no harmonics or spurs are passed on to



the mixer. In the off condition, the switch provides greater than 100 dB of attenuation to the unwanted PTO output.

The control signal for the PTO switching circuitry is derived from the front panel PTO switch. In the PTO A position, +8 volts is applied to the PTO B switching circuitry directly through the switch contacts, thus disabling PTO B. It is also applied to the base of Q503, causing it to saturate; since Q504 is direct coupled to its collector, the latter is then turned off and no voltage appears on the PTO A control line, allowing its signal to pass and appear at the output.

In the PTO B position, no voltage is applied to the PTO B line, allowing it to function, and Q504 is turned on, allowing voltage to appear on the PTO A control line, disabling PTO A.

For split operation, "R" line voltage is used (through the PTO switch on the front panel) to drive the PTO B control line and the Q503-Q504 combination. Thus, which PTO is turned on depends upon whether the "R" line is high or low (receiver on or off). For reverse split operation Q501 and Q502 provide an inverted "R" line voltage (+ for transmit, 0 for receive) which is used instead.

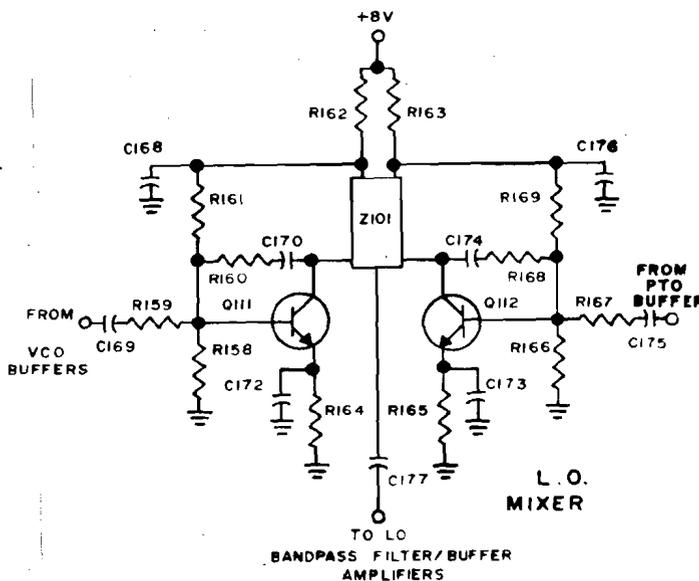
When the RIT switch on the front panel is on, and the transceiver is in the receive condition ("R" line high), AND gate U502A is on, and its output is high. This high is coupled to one input of U502B and U502C. The other inputs of each of these AND gates is connected to the PTO A and PTO B control lines, respectively. Thus, when the PTO B control line is high (and the PTO A line is low), analog switch U503A is turned on and the voltage from the RIT control wiper is applied to the RIT input of PTO A. R536 and R537 provide center adjustment for the RIT circuitry in the PTO.

When the PTO A control line is high, the remaining section of the AND gate is on, turning on U503B, and supplying the RIT control voltage to PTO B. A center adjustment similar to that for the A PTO is included in the circuit although not shown in the diagram, for simplicity.

LOCAL OSCILLATOR MIXER

Output from the band synthesizer (VCO buffer) is applied to mixer driver Q111 through blocking capacitor C169. Q111 is a feedback amplifier whose gain depends on the ratio of R160 to R159, and its output is applied to one input of the L.O. mixer Z101, which is a doubly-balanced mixer identical to others used in this transceiver. Also, the output of the selected PTO is applied to Q112 through blocking capacitor C175. This stage too, is a feedback amplifier, with its gain determined by R167 and R168. Its output is similarly coupled to Z101.

Output of Z101 is at the operating frequency plus 9 MHz, and





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is processed through one of six bandpass filter-amplifier combinations. Since all six are identical in operation, only the 160 meter version will be discussed here.

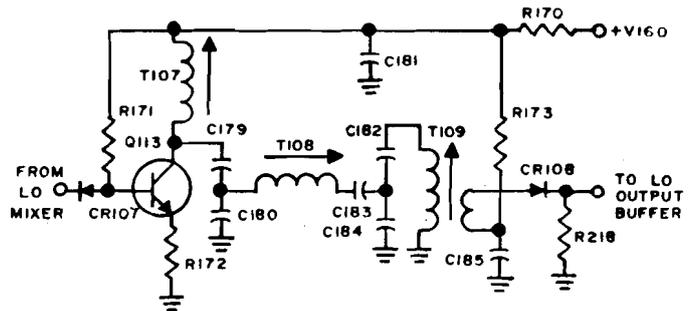
Collector and switching power comes from the 160 meter control line. R171 supplies bias for amplifier Q113, and also biases switch CR107 on; the voltage drop across its ground return resistor (not shown in the simplified diagram) reverse biases similar diode switches in the other bandpass filter circuits.

Q113 operates without an emitter bypass capacitor, and is therefore a bit degenerative; its collector is composed of a parallel resonant circuit formed by T107 and the C179-C180 combination. Output is taken from the low impedance tap between these two capacitors, and coupled through series resonant circuit T108-C183, then stepped back up to higher impedance by the output parallel resonant circuit T109-C182-C184. Output switching is via CR108, biased on through R173, the secondary of T109, and R218. C185 is a bypass for the signal. Again, the voltage drop across R218 reverse biases the output switching diodes in the other filters.

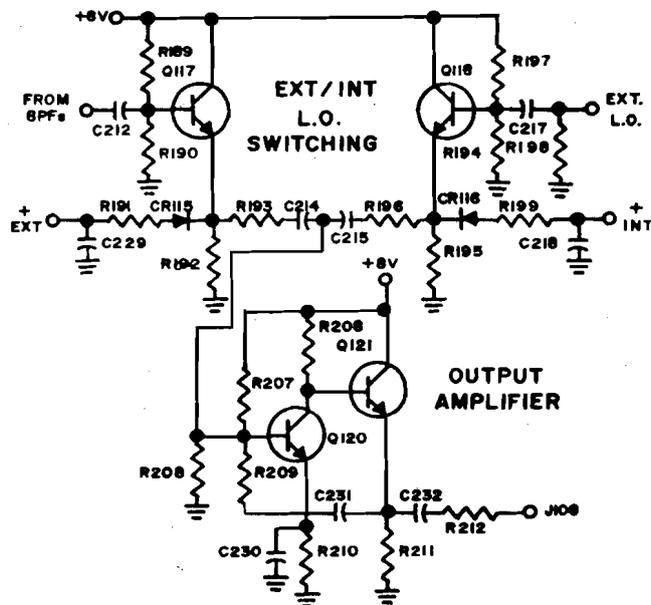
When the PTO switch on the front panel is in the EXTERNAL position, a voltage is applied through R191 to CR115, and thence to the emitter of L.O. buffer Q117. This reverse biases this stage's base-emitter junction, preventing internally-generated L.O. energy from being passed on. At the same time the voltage drop across R195 reverse biases CR116 (since the INT line is low) and Q118 acts as a buffer for externally supplied L.O. signal, and it is passed on through R196 and C215 to the L.O. output amplifier, Q120.

When the PTO switch is in any other than the EXT position, the INT and EXT voltages are reversed, and internally generated L.O. signal is passed on to Q120.

Q120 and Q121 are directly coupled, and amplify the L.O. signal selected by the switching circuit. The emitter of Q120 is wired conventionally, while R206 and R207 are the bias divider. Feedback from the emitter of Q121



LO BANDPASS FILTER/BUFFER



to the base of Q120 is provided by the R209-C231 network. Output is taken from the emitter of Q121 through C232 and R212, and routed to the exciter board.

CARRIER OSCILLATOR

Since the ASTRO 102BX utilizes only one crystal filter, the carrier oscillator frequency must be shifted appropriately when selecting USB, LSB or CW modes, so that the signal will fall within the pass band of the filter. Only one oscillator is used, with a crystal switching scheme used to select the proper crystal, depending upon the mode selected.

Q122 is the oscillator, with bias provided by R206 and R207. Feedback is provided by C188 and C-189. R205 is the emitter resistor. The collector load is comprised of T105 and C187, which form a parallel resonant circuit. R204 and C-190 form a decoupling network.

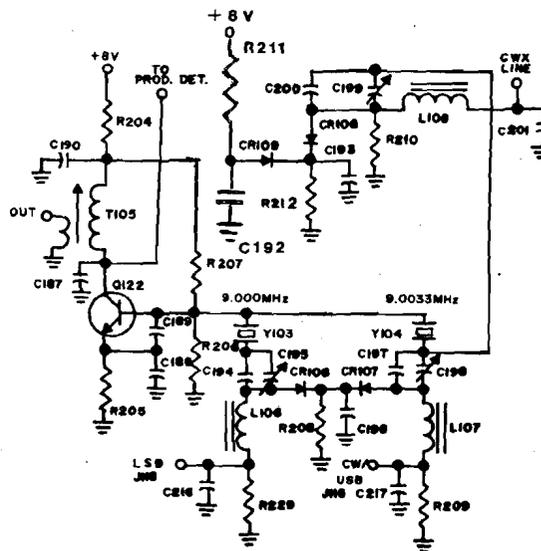
In the LSB mode, a + voltage is applied through L106 which forward biases diode CR106, with R208 serving as a ground return. In this manner, C196 effectively grounds the lower end of C194 and C195, placing Y103 into the circuit between Q122's base and ground; the oscillator then operates at Y103's frequency, as trimmed by C195.

At the same time, the voltage drop across R208 reverse biases CR107, preventing Y104 from having any effect on the oscillator frequency. In the USB or CW receive modes, the + voltage is applied via L107 to CR107, forward biasing it in the same manner as CR106 in the LSB mode. CR106 is now reverse biased, and Y104 controls the frequency of oscillation. The exact frequency is set by C198.

When transmitting in the CW mode, an offset is desired to place the signal into the passband of the IF filter. In the ASTRO 102BX, this offset is approximately 800 Hz from the receive condition, and is provided by "pulling" the frequency of Y104. In transmit, the CWX line is high, forward biasing CR108 and reverse biasing CR109. C199 and C200 now affect the frequency of Y104, and C199 is adjusted during alignment to provide the desired frequency offset.

CW SIDETONE OSCILLATOR

When operating in the CW mode, a sidetone is provided in the transmitter's loudspeaker so that the operator may monitor his own sending. This signal is generated by CW sidetone oscillator U101B. The frequency of the sidetone is determined by the positive feedback path for U101B, that is, C-106, C105, and R118. The gain of the stage is determined by the inverting



CARRIER OSCILLATOR



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feedback path, R121, CR125, CR111 and R120; with the diodes providing a leveling action for the oscillator output. The output is applied to sidetone level control R124, and thence to the audio frequency power amplifier via coupling capacitor C108.

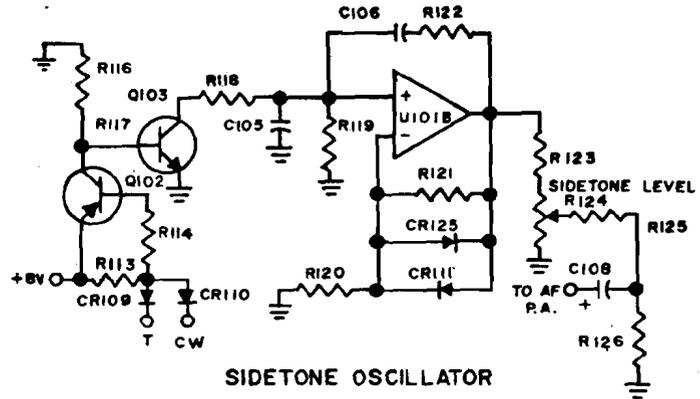
Keying of the sidetone oscillator is accomplished by Q102 and Q103. When in the CW mode, CR110 is reverse biased, but the base of Q102 is held low by the "T" line, maintaining Q102 in a conducting state. When the key is closed, the "T" line goes high, allowing the base of Q102 to rise, and cutting off conduction in R116 in the collector circuit

Thus, when the key is closed, and the MODE switch is in the CW position the base of Q103 is low due to the fact that Q102 is not conducting, and it does not conduct. This allows U101B to oscillate. When the key is opened, the "T" line goes low, CR109 conducts, and the base of Q102 is grounded. It thus conducts, creating a voltage drop across R116, and biases Q103 on. This prevents U101B from oscillating.

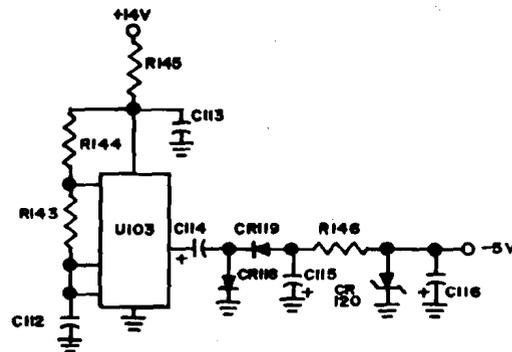
-5 VOLT OSCILLATOR/REGULATOR

The negative five volts DC required by various portions of the transceiver circuitry is provided by oscillator U-103, a timer IC connected in the astable mode. The frequency of oscillation is set by the R143, R144 and C112 combination. Output is taken through capacitor C114, and applied to a voltage doubler composed of CR118 and CR119. C114 and C115 are an integral part of the doubler circuit, charging alternately on different half-cycles of the oscillator output. Their individual voltages add during discharge, providing the required voltage doubler action.

The negative voltage thus generated is regulated by the combination of dropping resistor R146 and zener diode CR120, in a conventional zener regulator circuit. Output is filtered by C116.



SIDETONE OSCILLATOR



-5V OSCILLATOR AND REGULATOR



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Ancillary Circuits

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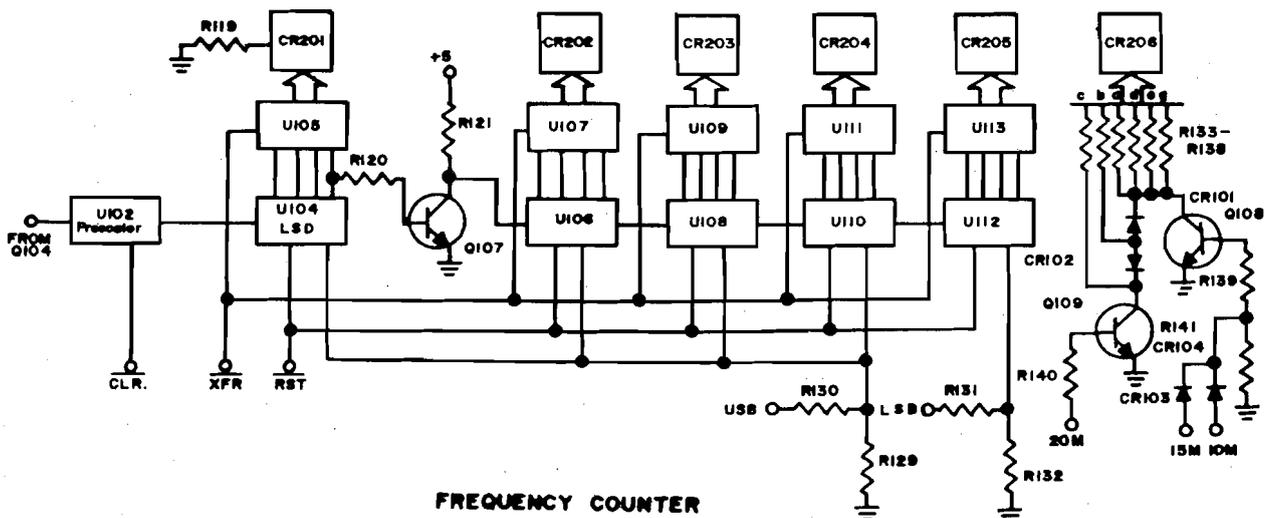
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FREQUENCY COUNTER

The ASTRO 102BX uses an accurate, crystal controlled time base and a frequency counter to provide the operator with a digital display of the transceiver's operating frequency. This counter measures the local oscillator frequency, corrects for the fact that this is 9 MHz above that which the transceiver is receiving or transmitting, and displays the results.

The incoming local oscillator signal, taken from the emitter of Q114 on the exciter board, is amplified and processed by the counter input amplifier. R102, R103 and R104 form an attenuator network, used to reduce any spurious signals generated in the counter, preventing them from being coupled back into the receiver circuitry. The overall design of the counter includes extensive planning to prevent "counter birdies"--an unfortunate phenomenon in all digital dial radios. This includes the solid shielding box and cover that the counter is enclosed in, feedthrough capacitors on leads penetrating this shield, high isolation amplifiers, input attenuator, etc. The results are that the unavoidable spurs are reduced to insignificant levels. The technician is cautioned to exercise particular care in maintaining the integrity of this shielding.

C104 couples the signal to the base of the first of two devices connected as a compound pair, Q101 and Q102. Bias for Q101 is provided by conventional voltage divider R105-R106, and the drop across its emitter resistor, R107, provides bias for Q102. The emitter resistance of Q102 is divided into two parts, R108 and R109, with the latter bypassed by C105. This arrangement compensates for the inherent 6 dB-per-octave rolloff in transistor gain, thus levelling its response over the range desired. Output from Q102 is taken via the collector, coupled through C106 and R113, and applied to the base of Q103. This stage is conventional in all respects, with R114





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and R110 forming the bias network and R111, bypassed by C109, the emitter circuit. The output of Q103, now gain-levelled and amplified, is applied to the base of Q104 through C108. Since the desired output of this stage is a square wave suitable for driving the counter prescaler, and linearity is no longer of importance, R117 suffices to provide bias for Q104. The collector is directly coupled to the input of the prescaler.

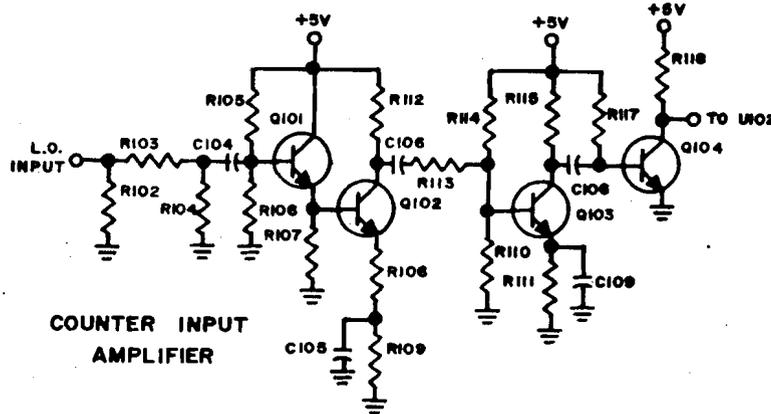
U102, a divide-by-ten counter, reduces the frequency of the incoming signal from the input range of approximately 10.8 to 39

MHz (9 MHz above the transceiver operating frequency) to 1.08 to 3.9 MHz for the input of the counter proper. It is cleared at the end of each count cycle by the negative-going pulse on the clr line. This line provides the necessary gate function to drive the counter proper.

The counter chain is conventional, with two exceptions; the output of the prescaler is still too high for reliable operation of the CMOS devices, particularly complex devices such as counters, on a 5 volt supply; hence, in this decade, a low-power Schottky device is used. This counter, the least significant figure decade (100 Hz on the display), counts using the conventional BCD code, and its four output lines drive U105, a combined storage latch, decoder, and seven-segment display driver. When the end of the count cycle is reached, the xfr line is brought momentarily low causing the latches in U105 to accept the data being fed to it by U104, and to store it until updated at the end of the next counting cycle. This data is then decoded, and the proper segments of the display, CR201, are activated, displaying the count. CR201 is a common anode type of display, so grounding the input pins for the appropriate segments will cause them to light. Current is limited to the correct value (15 mA) by internal circuitry of U105. R119 is used to provide a path to ground for the decimal point of CR201, and to limit its current, so that it is lighted at all times the radio is on.

The second somewhat unusual feature of the counter is that the output of the LSD decade is not taken from the counter "carry" output, for the pulse presented here is much too narrow for the following, CMOS decade. Instead, output is taken from the Q_D terminal, through current limiting resistor R120, and applied to the base of Q107. The collector, with pull up resistor R121, is connected to the input of the next decade counter, U106. The pulse thus obtained is much wider than that presented at the "carry" output, and is inverted to the correct polarity.

The subsequent decades of the counter are all of the CMOS family--U106, U108, U110 and U112. Each has a "carry" output which is used to drive directly the "up count" input of the subsequent decade. Each has four BCD coded data output lines which are connected to the latch/decoder/driver IC corresponding to that decade, i.e., U107, U109, U111 and U113. Each of





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these in turn operates the appropriate display indicators. The latches are all strobed once per count cycle to update the display, in the same manner as described for U105.

In order to read the incoming frequency correctly, to the nearest 100 Hz, the counter would have to be gated "on" for 10 milliseconds; however, since we use a prescaler with a divide-by-ten ratio, we must extend the count cycle time to 100ms. This is accomplished by the clr line of U102, the prescaler. It operates, and passes on its output pulses, only when that line is high; thus, for the time it is low, the counters stop, but store their present count while the latches are strobed, thus passing that count to them (and the displays), and then are preset by the rst line, ready to start the next count cycle.

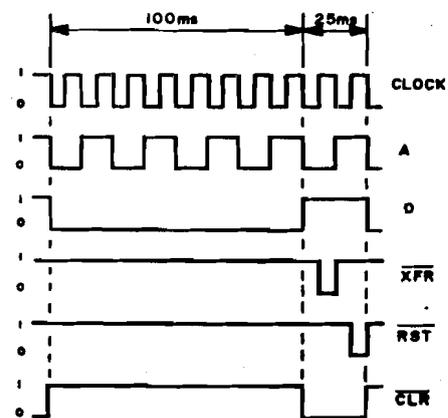
Unfortunately, it takes a finite time to (a) stop the counting, (b) transfer the count to the latches, (c) clear the counters and (d) start the next count cycle. This is accomplished, as shown in the accompanying counter timing chart, during the 25 ms immediately following the counting portion of the counting cycle. This overall cycle translates to a rate of eight updates of the display per second.

For a laboratory-style frequency counter each decade would be reset to zero (BCD 0000) at the end of each complete count cycle; but here, we have to account for the fact that the frequency being counted is 9 MHz above the operating frequency, and for the fact that we have different offsets (carrier oscillator frequencies) for USB and LSB operation. This makes it necessary to preset the counters to a number different than zero in order to compensate. When operating in the USB mode, the number to which the counters must be preset are (MSD to LSD) 09967; in the LSB mode, it is 10000. This is accomplished by hard-wiring the USB and LSB lines to the appropriate load inputs of the counter chips, and using the rst line to drive the "load" control pins. Then, when the active counting portion of the count cycle begins again, each counter advances through zero (overflow) to a value appropriate for the transceiver operating frequency, and this value is displayed. Any carry from the MSD counter is discarded and ignored.

Another way of stating the matter is that the counters are preset to the above numbers, which correspond to a number that is 9,000.0 (or 9,003.3) subtracted from the overflow value of the counter chain, i.e., 10000.0. This is, in fact, a negative number, although the counter does not recognize it as such---in this way, the counter subtracts the carrier oscillator frequency from the L.O. frequency, as is required for a correct display.

It is not necessary for the 10 MHz digit to be arrived at by a counter, and to do so would add unnecessary complexity to the circuit. Instead, it is hard-wired such that, when the BAND switch is on the 160 through 40 meter positions, it is extinguished; when it is in the 20 meter position, Q109 is saturated and segments B and C of the display are grounded through appropriate current limiting resistors, and the numeral "1" is therefore displayed; and in the 10 and 15 meter positions of the BAND switch, Q108 is saturated, grounding the current limiting resistors for segments A, B, D, E and G, thus displaying the numeral "2".

COUNTER TIMING CHART

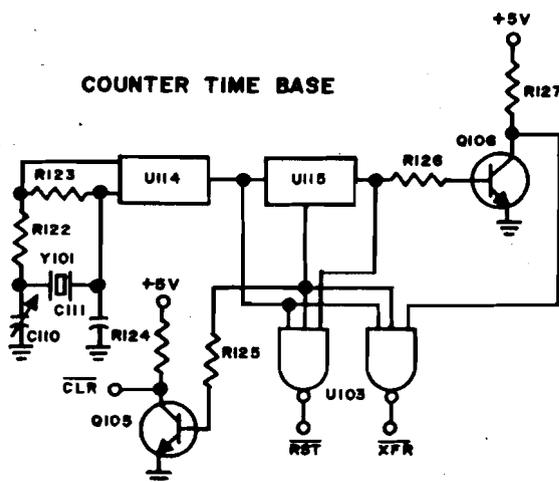


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The necessary control signals for the counter (clr, rst, and xfr), are generated by the time base/control circuitry. Crystal Y101, operating at a frequency of 1.31072 MHz, provides the stability necessary for accurate frequency measurement. C110 permits it to be adjusted to precisely the correct frequency. U114 contains the oscillator circuitry, as well as a divider with a factor of 2^{14} , or 16,384. The output of the counter is the square wave signal labelled "clock" on the timing chart. U115 is a decade counter, with outputs taken at the clock-divided-by-two (A) terminal, and the clock-divided-by-ten (D) terminal. The waveforms are shown in proper relationship in the timing diagram. The D output, inverted by Q105, is used as the clr signal; gate U103A generates the rst signal, and gate U103B generates the xfr signal.

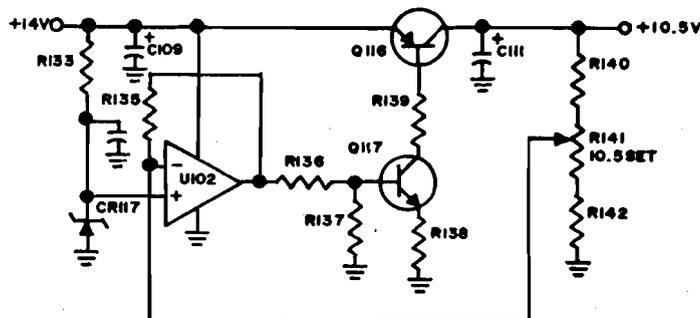
COUNTER TIME BASE



10.5 VOLT REGULATOR

A regulated 10.5 volts is required by many of the circuits in the transceiver. It is provided by the circuit comprised of Q116, Q117 and U102. The raw +14 volts is applied to the emitter of PNP series transistor Q116.

The output of Q116, its collector, is sampled by the R140-R141-R142 voltage divider, with R141 serving as the "+10.5 set" control, and its wiper is connected to the inverting input of U102. A reference derived from zener diode CR117 through dropping resistor R133 is applied to the operational amplifier's non-inverting input. The output of this stage, a DC voltage, is applied to Q117 and determines the degree to which it is allowed to conduct, and thence its collector voltage. Its collector, in turn, drives the base of Q116 in such a manner as to control its degree of conduction, and thence to maintain its output voltage at the required level.



+10.5V REGULATOR

WATTMETER/SWR DETECTOR

The wattmeter board circuitry takes a sample of the current in the antenna line via transformer T101, and a sample of the voltage signal appearing on the antenna line at the output of the transformer via the capacitive voltage divider composed of C101, C102 and trimmer C103, the latter of which allows precise alignment. These signals are combined in such a manner that CR101 produces a rectified output voltage proportional to the magnitude of

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any signal reflected from the antenna due to mismatch, etc., while CR102 provides a voltage proportional to the power sent to the antenna. These signals are smoothed by the C104-R103-C106 and C105-R104-C107 combinations. These signals are then used in the ALC, SWR, and wattmeter circuitry to provide front panel indications and protective functions for the transmitter power amplifier.

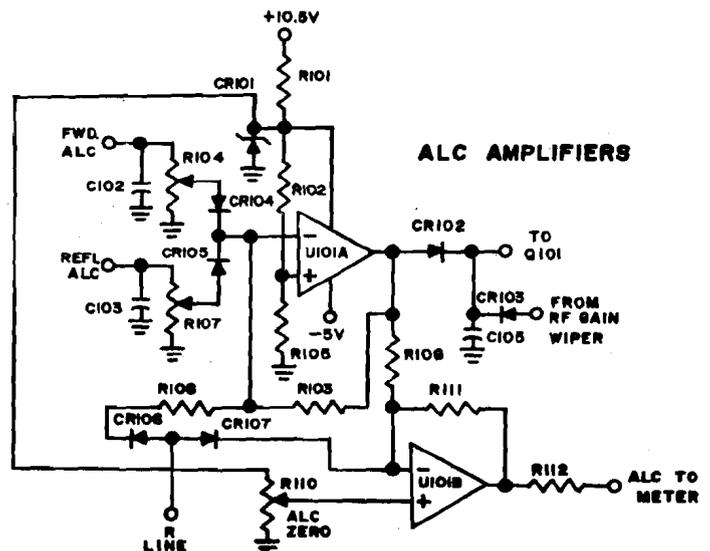
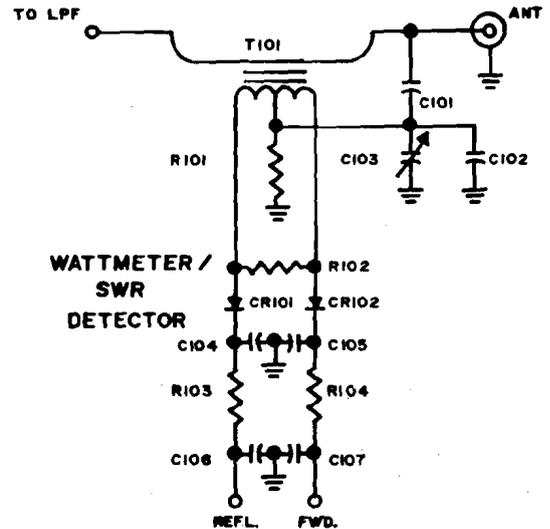
AUTOMATIC LEVEL CONTROL

The FWD and REFL signals from the wattmeter board are coupled to the pre-selector board where they are adjusted by R104 and R107 respectively. C102 and C103 bypass the lines as they come into the board. CR104 and CR105 act as an "or" gate, allowing the largest of the two signals to pass to the inverting input of ALC amplifier U101A. Feedback for this amplifier is via R103, while R102 and R105 establish a bias at the non-inverting input which sets the quiescent operating point of the output of this stage. R101 and CR101 provide a regulated voltage for this bias network and for U101, as well as for the ALC ZERO adjustment.

If the REFLECTED ALC signal should exceed a given amount, or if the FWD ALC signal should exceed that produced at the maximum safe output of the PA, CR105 or CR104 will conduct, causing the output of U101A to go more negative.

This output will be passed through CR102, and on to Q101 in the pre-selector, where it is used to reduce the gain of the stage, and thus the output of the transmitter. Manual RF GAIN control is accomplished by inserting a voltage to Q101 via CR103 to the ALC line when in the receive condition. The "R" line, through CR106 and R108, biases the inverting input of U101A in such a manner as to disable it in receive.

The output of U101A is also coupled via R106 to the inverting input of U101B. The ratio of feedback resistor R111 to input resistor R106 determines the gain of the stage, and the output is coupled through limiting resistor R112 to the meter switch, where it may be selected by the operator to give a front panel ALC indication if he so desires. R110, connected to the non-inverting input of U101B, provides a zero set calibration control for the meter reading. When in the receive condition, U101B is also disabled by the "R" line, through CR107, in the same manner as U101A.





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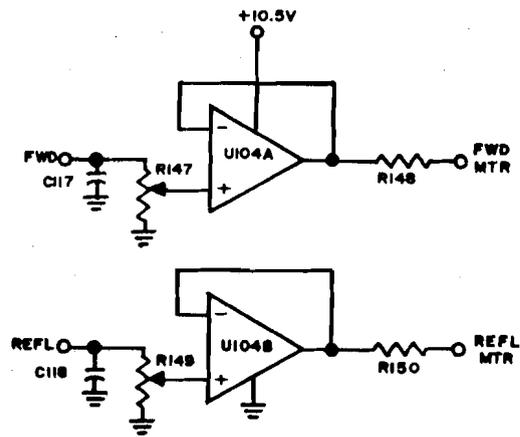
FWD and REFL signals from the watt-meter board are also applied to SWR meter drivers U104A and U104B through calibration potentiometers R147 and R149, respectively. These are unity-gain amplifiers, used only to prevent the meter from loading the wattmeter board output. The operator may select either the FWD or REFL power to be read on the calibrated meter by means of the front panel METER switch. R148 and R150 are current limiting resistors.

VOX CIRCUIT

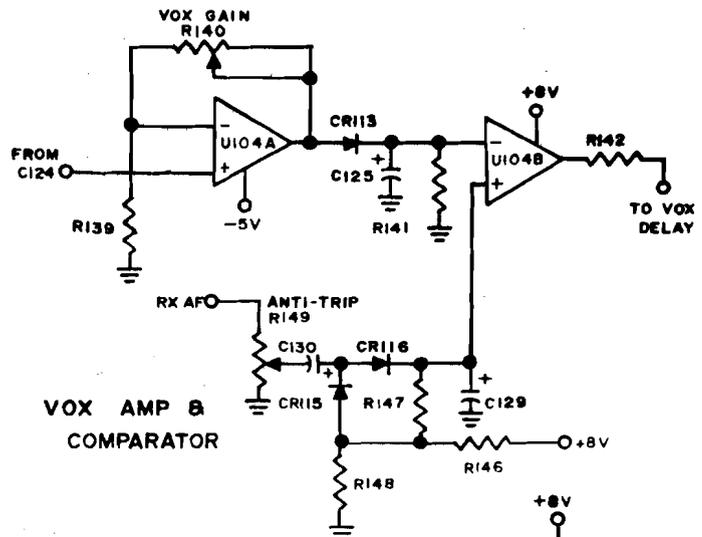
When VOX operation is selected by the operator, microphone AF is supplied from the preamplifier to U104A, where it is further amplified. The amount of this amplification is controlled by the VOX gain control, R140. The output of this stage is rectified by CR113, and smoothed by C125, and applied to the inverting input of comparator U104B.

A sample of the received AF, from the speaker line, is applied to the anti-trip control, R149, and then through C130 to CR115 and CR116, which form a voltage doubler rectifier. C129 smooths this DC signal, and it is coupled to the non-inverting input of the comparator. A DC bias, to set the comparator's threshold, is added to the rectified anti-trip signal by the R146-R148-network. The comparator's output will depend upon which of the two input signals are the larger; should the VOX signal be the largest, the output will go low; if the anti-trip signal is larger, it will be prevented from doing so.

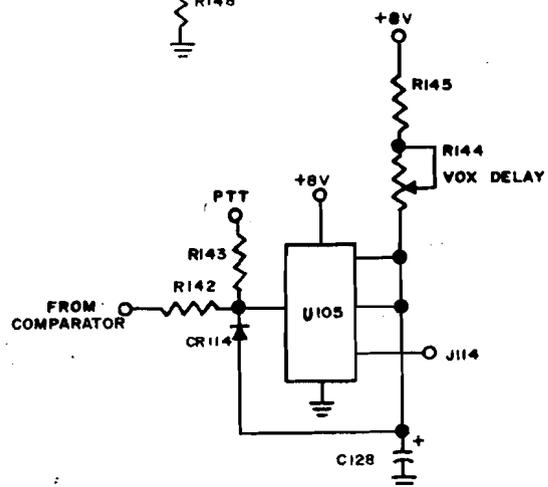
The output of the comparator is coupled through R142 to the trigger input of timer U105, causing it to activate and its output to go high. This high state is continued for the duration of the low on the input (diode CR114 prevents C128 from charging during the duration of the low voltage at its cathode) plus the time it takes for C128 to charge through R144 and R145 to 2/3 of the supply voltage after the low



SWR METER DRIVERS



VOX AMP & COMPARATOR



VOX DELAY



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on the input of the timer has ceased. The amount of time it takes for C128 to charge is determined by the setting of R144, thus the amount of delay is controllable. Should VOX not be desired, the VOX/PTT switch connects a + voltage to the timer input via R143 when in the PTT position

KEYING CONTROL

When in the CW mode of operation, the CW line is high, and it, through R101 biases Q101 on, effectively reducing its collector voltage and cutting off Q102. This makes the collector voltage of Q102 rise, and CR102 conducts in turn, biasing Q103 to an on condition. Thus its collector, the key line, is at a low value, its normal, un-keyed condition.

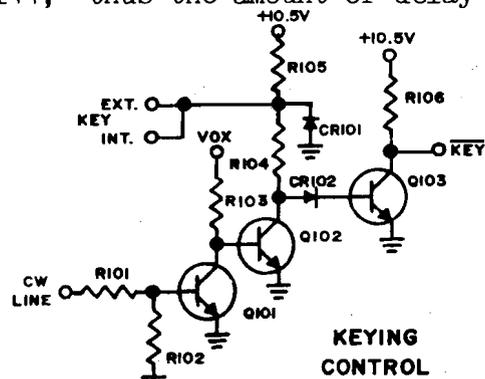
Should either the EXT KEY or the KEY contacts be closed, the junction of R104 and R105 in the collector circuit of Q102 is grounded, removing the voltage to CR102 and the base of Q103 causing the collector voltage to Q103 (and the key line) to rise.

In the USB or LSB modes, the CW line is low, and Q101 does not conduct. PTT operation is then exactly as described above for CW, but if VOX is selected, the VOX circuit provides a voltage to R103 which causes Q102 to saturate, again removing voltage from CR102, and so Q103 ceases to conduct and the key line rises.

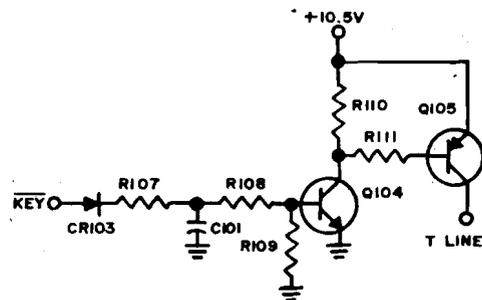
The key line, when high, causes CR103 to conduct through R107 and R108 biasing Q104 on. The combination of R107 and C101 control the rise characteristics of the keying waveform, while the falling characteristics are controlled by the discharge of C101 through R108 and the parallel combination of the base-emitter junction of Q104 and R109. When Q104 conducts, its collector goes low, lowering the base potential of PNP transistor Q105, and it saturates, energizing the "T" line.

When the "T" line and key line are both high, CR105 and CR106 are reverse biased, allowing Q108 to conduct, and charge C105 through R121. This time constant determines how fast the "T/S" line is allowed to rise to full voltage. The "T/S" line supplies bias to the drivers for the transmit mixer, Z102 on the exciter board, thus permitting generation of the transmitter signal.

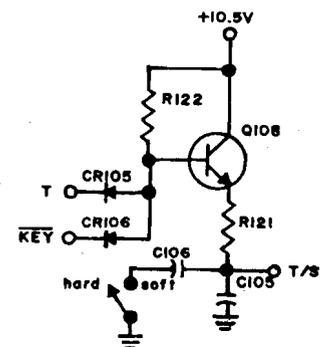
For lower speed CW operation, it is desirable to have a slower ("softer") attack and decay time on the CW note, so the operator may switch C106 in parallel with C105, thus increasing the time constant. High speed CW is more easily copied when it has a fast ("hard") attack time, so C106 is then switched out of the circuit, at the operator's option.



KEYING CONTROL



"T" LINE CONTROL



CW SHAPING

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Also, when the key line is high, C102 and biasing Q106 on through R112 and R114. This lowers the base voltage of Q107, causing it to cease to conduct, and bringing the "R" line to ground potential. When the key line goes low, C102 discharges through R112 and the R113-R114 and Q106 base-emitter junction parallel combination, delaying the turn off of Q106 and thus the return of the "R" line to a high value. This is to assure that there is a delay between the deenergizing of the "T" line and the reenergizing of the "R" line, so that certain switching functions can be accomplished without affecting either receive or transmit function.

When semi-breakin is selected the CW timer holds the base of Q106 high for a brief time, preventing return to the receive condition between characters. When full breakin is selected, this feature is disabled.

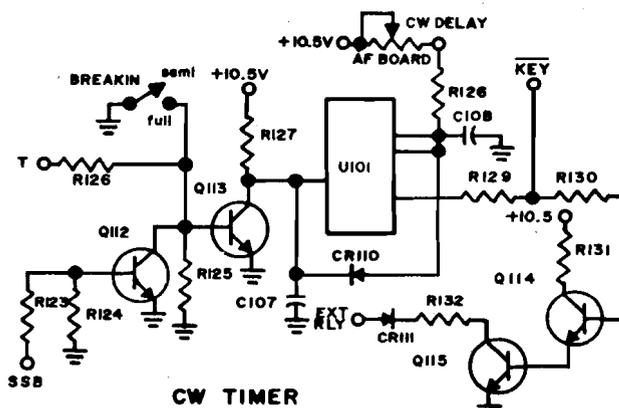
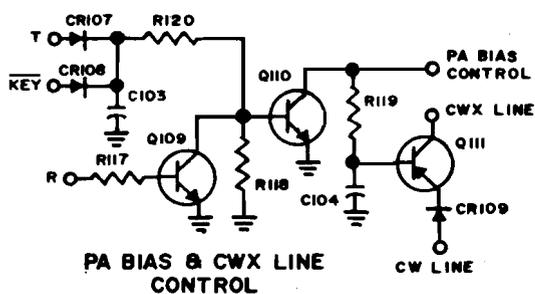
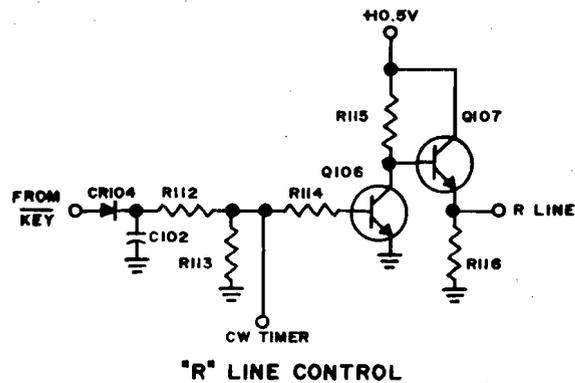
When either the "T" line or the key line is high, voltage is applied to Q110, making it conduct. This brings the PA BIAS control line low, and turns on the bias to the power amplifier stages. Also, the base of Q111 goes low, allowing it to conduct. Q111 then conducts from the CW line through CR109, to the CWX line, energizing it.

Should, however, the "R" line be high, voltage is applied through R117 to the base of Q109, causing it to saturate, and grounding the base of Q110, thus nullifying the effect of the "T" and key lines outlined above. Thus, there can be no output from the transmitter until the antenna switching circuitry has returned to the receive condition. This is an "interlock" function, which prevents damage to the receiver front end in the event of a control malfunction.

CW TIMER

When the BREAKIN switch is in the SEMI position, energization of the "T" line applies a voltage to the base of Q113, causing it to saturate and the voltage at the input of timer U101 to go low. So long as this condition pertains, capacitor C108 is prevented from charging through R128 and the CW DELAY control by diode CR110. When the input is low, or until C108 is

CR104 is allowed to conduct, charging C102 and biasing Q106 on through R112 and R114. This lowers the base voltage of Q107, causing it to cease to conduct, and bringing the "R" line to ground potential.





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charged to 2/3 of the supply voltage after the input has returned high, the output of U101 is high. When this condition prevails, Q114 is turned on through R129 and R130. This in turn saturates Q115, which keys an external relay (such as for a linear amplifier, etc.) through protective diode CR111 and resistor R132.

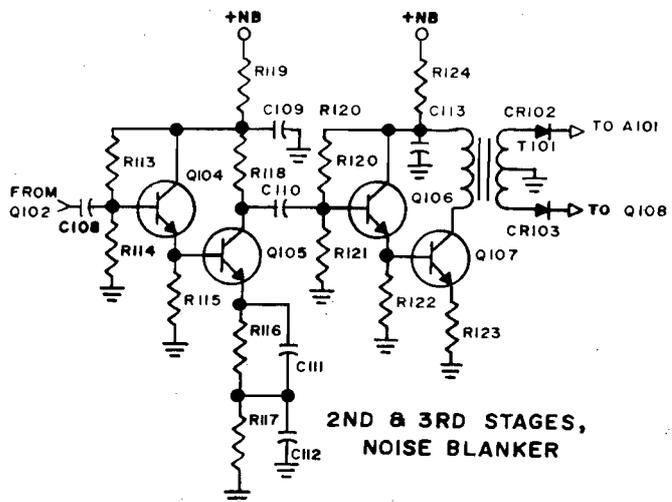
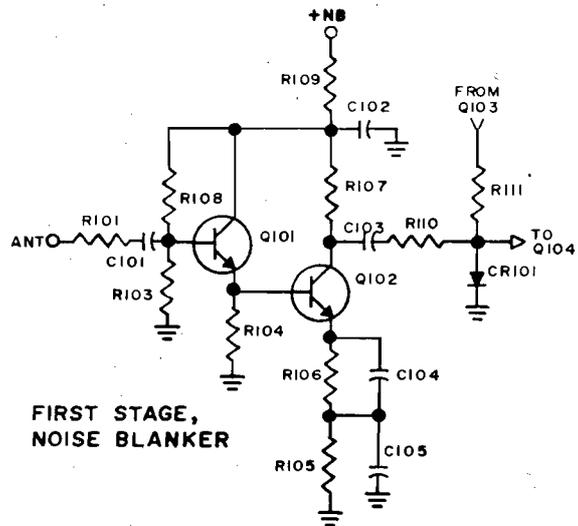
Should FULL breakin be selected by the operator, the base of Q113 is grounded and the control input of the timer is never allowed to go low. Keying is then controlled by the key line, connected to the junction of R129 and R130. When the transmitter is keyed, this line goes high, and Q114 and Q115 are again saturated, grounding the external relay line. Note that few external amplifiers are capable of operating at full breakin, due to the slowness of the switching of the various relays, etc. Only those amplifiers especially built, or modified, for QSK operation should be used when full breakin is desired.

NOISE BLANKER

The noise blanker signal input is taken directly from the receiver antenna input, and is coupled through isolation resistor-capacitor combination R101-C101 to the base of compound stage Q101 and Q102. Bias for that pair is derived from R108 and R103, with supply decoupling provided by R109 and C102.

Frequency compensation is accomplished by R106-C104 and R105-C105 networks. Output is taken through C103, R110, and C108 to the base of the second compound stage. That stage, Q104 and Q105, operates in the same manner as the first one. In turn, this output is taken to yet a third compound stage, Q106 and Q107. This pair utilizes a conventional emitter network and untuned transformer T101 in its output. Note that the entire circuit is broadbanded--no selectivity is built in, so that noise pulses, no matter what frequency, will be accepted. The use of three compound stage amplifiers in cascade realizes a very high gain, for good sensitivity to the noise pulses.

The upper half of the secondary of T101 drives detector CR102, and after filtering by the C115-C116-R126 network, the resultant DC signal is applied to operational amplifier U101. The gain of this device is set by the ratio of R128 to R129 and its input threshold point is determined by voltage divider R127 and R129 on the non-inverting input. The DC output of A101 is applied through



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current limiting resistor R112 to the base of Q103. Q103 supplies a current to PIN diode CR101 which serves as a variable attenuator, thus supplying AGC to the noise blanker receiver. The R125, R126, C115 and C116 network integrates all incoming signals to drive U101 and generate AGC to prevent strong signals (SSB, AM, or CW) from generating cross modulation in the blanking gate.

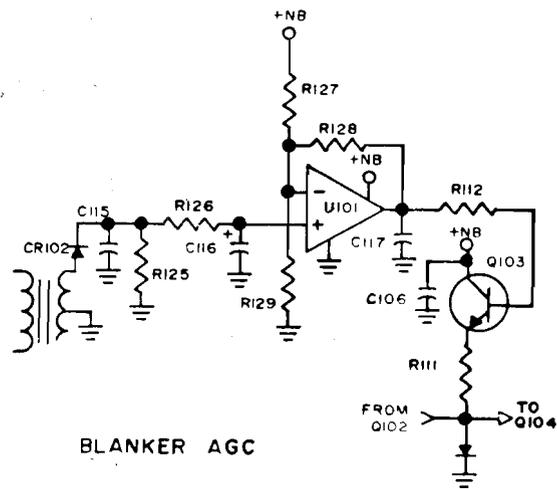
The bottom half of T101 drives detector CR103, which supplies a DC pulse to the base of Q108 when a noise pulse is received. When Q108 is thus turned on, it in turn causes PNP transistor Q109 to conduct, creating a blanking pulse across its load resistor, R134, which is coupled to the noise blanker gate in the I.F. circuit on the exciter board.

PASSBAND TUNING INDICATOR

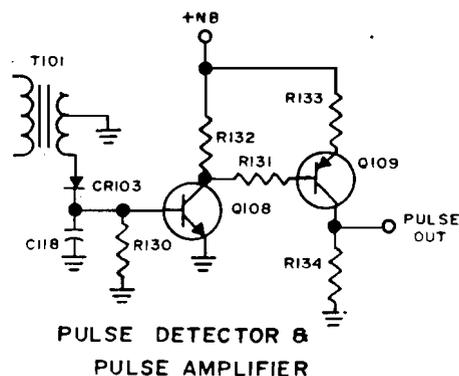
A separate section of the front-panel PASSBAND tuning control, R103B, is used to develop a signal used to drive the series of LEDs that indicate the status of the tuning of the passband circuit. R166 is used in series with it to provide a range calibration adjustment, and the output, bypassed by C138, is coupled to the analog input of analog-to-digital converter IC U106, on the audio board.

U106 is capable of free-standing operation, but to operate in such a manner, it must be provided with an R-C combination that sets the frequency of operation of the internal clock oscillator on the chip. R168 and C137 serve this function. The IC must also be properly initialized when it is first powered up. Q106 and its associated circuitry perform this task. C139 charges through R167 when power is first applied, thus allowing Q106 to conduct until nearly full charge is achieved, grounding the appropriate pins on the chip. Once C139 has charged, Q109 ceases to conduct, and the initialization pins on the IC are ungrounded, allowing it to operate. When power is removed, CR122 allows C139 to discharge rapidly.

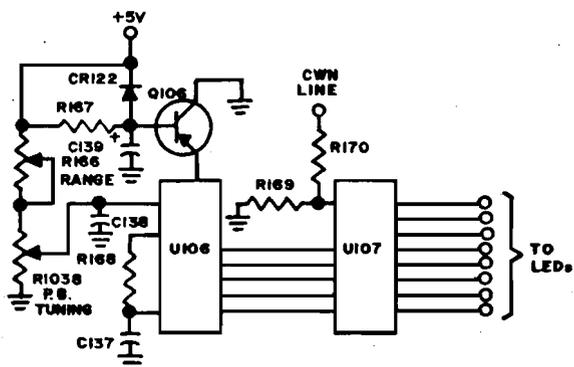
The digitally-coded output of U107 is coupled to the inputs of PROM U107. The internally stored code in the PROM generates the required signals to drive the



BLANKER AGC



PULSE DETECTOR &
PULSE AMPLIFIER

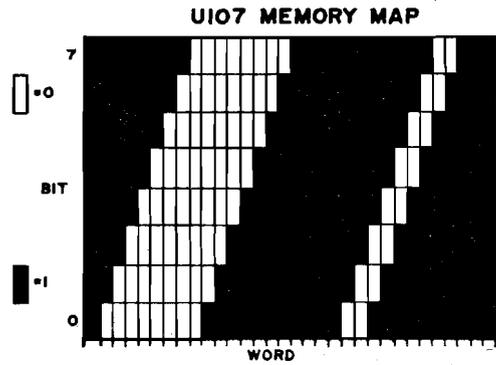


PASSBAND TUNING INDICATOR



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front-panel LEDs used as the passband tuning status indicator. When in the CW narrow mode, the CWN line energizes another input of the PROM, changing the code presented to the LEDs such that only two adjacent devices, representing the frequency range being passed by the PBT circuitry, are lighted.





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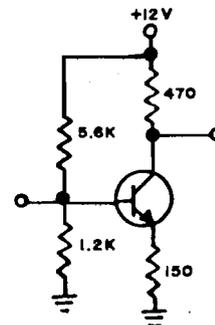
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TRANSISTOR TROUBLESHOOTING

Many techniques for troubleshooting transistor circuits have been evolved, of varying degrees of complexity and reliability. One system, perhaps the simplest and most reliable, is outlined here for your information. With it, you can determine, with only a few minutes thought and basic arithmetic calculations, what the normal operating voltages on any given transistor stage should be, and by comparing them with those actually measured, locate the fault in the circuit.

The key to the scheme is to remember that, for normal operation, the base-emitter junction of a transistor must be biased into conduction--and that when this is so, the voltage drop across that junction will be approximately 0.7 volts for silicon devices and about 0.25 volts for germanium.

To illustrate how the system works, let's take a simple amplifier stage (at the right). To start with, we know that the base current is very small, on the order of microamperes. For our purposes, then, we can ignore it, for it would be masked by circuit tolerances sufficiently that we couldn't measure a voltage drop caused by it with our usual methods. We therefore treat the bias network (the 56 k Ω and 1.2 k Ω resistors) as a simple voltage divider, and can compute the voltage that would appear at their junction (the base of the transistor). In this case, it works out to about 2.1 volts. Since we know that this silicon transistor has a base-emitter drop of about 0.7 volts, it follows that the emitter voltage is that amount less than the base voltage, or about 1.4 volts. The emitter current can then be calculated by Ohm's law, and comes out to be about 9.3 mA.



We know that both the base current and the collector current flow through the emitter resistor, but the base current is so small that we can say for practical purposes that the emitter and collector currents are the same; therefore, the current through the 470 Ω collector resistor is also about 9.3 mA, and the voltage drop across it is therefore about 4.4 volts. This means that the collector voltage would be 12 - 4.4, or 7.6 volts.

Actual measured values on a normally operating circuit would be close to these values, while a malfunctioning transistor would result in greatly different values being found. Remember, transistors do not get "weak", as do vacuum tubes (with the exception of some emitter-ballasted power devices) so when they fail, they do so catastrophically--they open or short, or both. Thus, the voltages found on their terminals will be greatly different than if it were operating normally. For example, a shorted base-emitter junction would result in no 0.7 volt drop between those terminals; an open base-emitter junction would leave the emitter at ground potential (no base current



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flowing, so no collector current, so no drop across the emitter resistor). And so on. It isn't hard to figure out just what is wrong with the device, although this isn't really necessary--if the voltages are not close to what you calculated, the device is probably bad.

INTEGRATED CIRCUIT TROUBLESHOOTING

Very little can be written concerning the finding of internal faults in integrated circuits. Often, the exact internal circuitry is both complex and unknown to the service technician, for manufacturer's data sheets generally show only an equivalent circuit at best, and at worst, only the pinout.

The data sheets often do, however, give a truth table or timing (waveform) diagram for digital circuits, or some other description, not of what the internal circuitry is, but rather what it does. This, then, is the approach we must use in troubleshooting them also.

In short, we troubleshoot IC's by the process of elimination; Are the voltages at each of the pins about what they should be? Is the proper signal going into it? Then, if the proper signal isn't coming out of it, it is bad and must be replaced. Never mind what is wrong inside--you can't get inside to fix it anyway, and time spent figuring it out is wasted. Just replace it.

A good voltmeter, a high impedance VTVM or better yet one of the newer digital voltmeters that will read to tenths of a volt or less, and a good oscilloscope are then necessary pieces of test equipment, and no shop should be without them. If you don't have them, you'll have to spend your time in speculation, and for the most part, the results will depend on guesswork. Either you'll use more time than necessary (and have to charge the customer for it) or you'll wind up missing the cause of intermittent problems, replacing perfectly good parts, or the like. In either case, the increased cost to the customer (or decreased profit to the shop) is something that you can hardly justify.

MEASURING SIGNAL TO NOISE RATIO

The procedure for measuring the signal to noise ratio of a receiver is really quite simple, and it is a check that should be made on every receiver before it leaves your shop--finding a weak receiver and fixing the problem while it's in the shop is one of the best ways to keep a customer happy, and it will pay dividends in repeat business.

Connect an unmodulated signal generator that has a 50Ω output impedance to the antenna terminals, and tune it for about 1 kHz beat note audible in the speaker. Adjust the generator's output for about 0.25 μV at the antenna terminals, so that the AGC circuit isn't activated. (Note that some generators are calibrated in terms of their open circuit output voltage, not what is present when connected to a load--check yours out, so you can get the right setting.)

Connect an AC voltmeter across the speaker terminals, and adjust the volume control for a convenient reading on the meter. Note that reading. Now remove the signal generator connection and short out the antenna terminals without changing anything else on the receiver. Note that reading.

The first is the reading for the signal-plus-noise; the latter is the reading for noise only. The S/N ratio is 20 times the common log of the ratio between the first and second values. Some AC meters have log (or dB) scales and can be used directly.



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SOLID STATE SWITCHING

One of the more useful innovations in recent years is the application of solid state switching to signals within receivers and transmitters. It allows switching to be accomplished at the site, without the need for routing long signal leads to a bulky, complex, and often troublesome multi-pole mechanical switch. Instead, a simple switch controls a DC voltage which in turn is applied to all of the points where switching of the signal is to take place.

The simplest form of a solid state switch is the diode. We know that when it is reverse biased, it presents a very high resistance--high enough to be considered an open circuit when used in low or medium impedance circuits. Modern manufacturing techniques have reduced the junction capacitance of switching diodes so low that they can also be used effectively in most high impedance circuits, too. Thus, a diode which has a reverse bias voltage greater than the peak value of any AC signal applied to it, so that it does not conduct during any part of the signal cycle, will act as an open circuit.

Conversely, modern diodes have a very low "on" resistance, so if forward biased with a current greater than the peak signal current, so that it conducts during all parts of the signal cycle, it passes the signal with little or no attenuation.

All that is needed, then, is a circuit arrangement of capacitors to block the DC but pass the signal, (and perhaps bypasses, if high-level RF is near) and resistors to apply the bias and switching voltages, and the diode itself.

Field Effect Transistors (FET's) can be used as even better solid state switches. Remembering that the source to drain path of the FET is a pure resistance, normally conducting, we can see that, as with any other resistance, current can flow in either direction (bilaterally), from source to drain or from drain to source, depending on the polarity of the applied voltage. Therefore, AC signals will pass.

Now, if we apply a voltage to the gate that is sufficient to "pinch off" the source-drain path, the effective resistance of that path increases greatly, effectively opening the circuit, and thence the signal path.

Normally, N-channel, depletion mode devices, with good bilateral characteristics in the source-drain path and low "on" resistance are selected for service in switching applications, although P-channel devices are also used.

All, then, that is needed for a FET switching circuit is the FET, suitable blocking capacitors and load and biasing resistors, just as in the case of the diode switch. In some instances, even these can be omitted, using the signal voltages themselves to provide any bias.

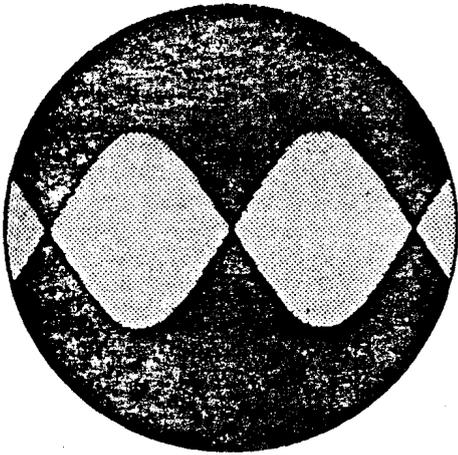
TWO TONE TESTING

Probably the most useful and yet least often performed test of a single sideband transmitter's performance a technician can make is the two tone test, and yet it is easily performed. The two tone test will disclose quickly and easily most of the major faults that are to be found in an operating transmitter by showing nonlinearities, improperly adjusted bias, over-driving, and many other problems.

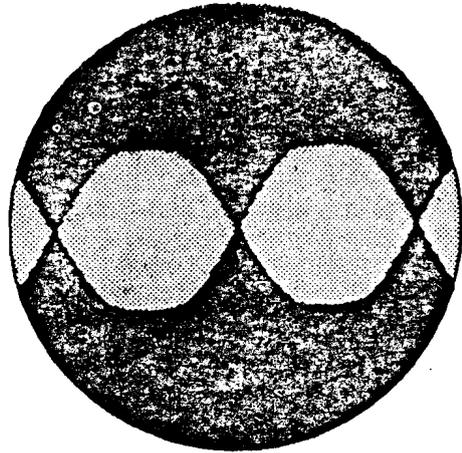
While a full discussion of the two tone test and its results is beyond the scope of this manual, a brief discussion is in order. More thorough



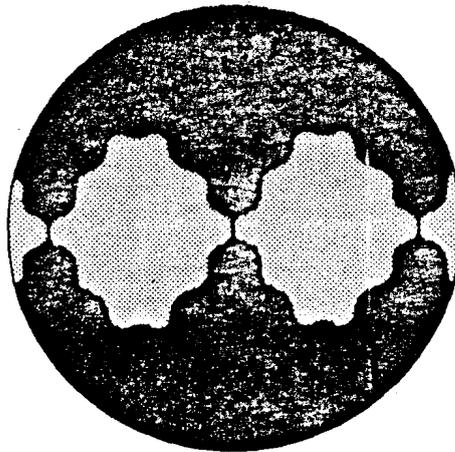
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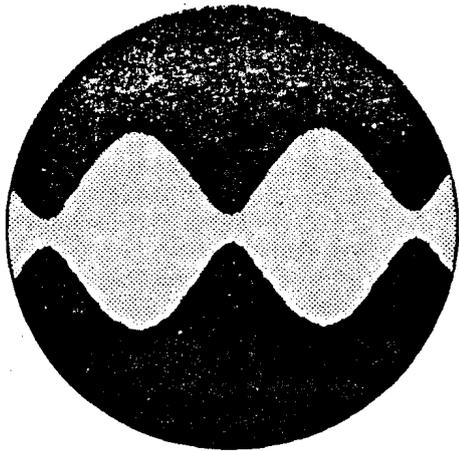
Two-Tone Pattern, Correctly
Adjusted



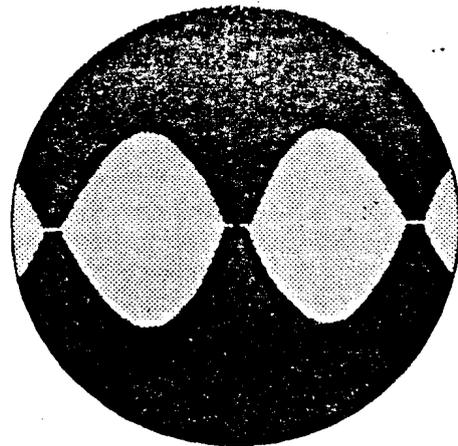
Two-Tone Pattern,
Overdriven



Two-Tone Pattern, Carrier
Present



Two-Tone Pattern, Unequal
Tones



Two-Tone Pattern, Improper
P.A. Bias



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treatment is available in many competent references for those who wish to pursue the matter further.

Basically, this test is performed by applying two non-harmonically related audio tones, of equal amplitude and within the pass band of the radio, to the microphone input and observing the output across a dummy load on an oscilloscope. In this manner, the entire transmitter, from microphone jack to antenna terminal, is tested in one simple operation.

These tones can come from two audio signal generators, or better yet, from a two tone test set specifically designed for the purpose. Several such designs of adequate quality are included in amateur handbooks and other readily available literature. The tones must be very pure sine waves, and of equal amplitude, and not harmonically related to each other as mentioned.

The oscilloscope used to view the transmitter's output must be capable of displaying the frequencies at least as high as those in use, and preferably higher. A 30 MHz bandwidth instrument is adequate for all HF amateur bands, while the more common 15 MHz bandwidth instrument would serve for the 160, 80, 40 and 20 meter bands. Since any problems of nonlinearity, bias, etc., could be expected to show up on all bands, testing on one band only is usually considered adequate.

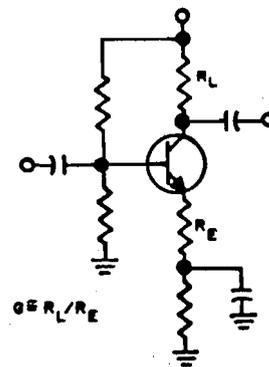
Several waveforms and their common causes are included here for reference, and others are available in current literature.

FEEDBACK AMPLIFIERS

The gain of individual transistors, within a given type number, unfortunately varies over a wide range. Often, this is satisfactory for the designer's purpose, but occasionally there arises a situation where the gain of the stage must be controlled more precisely. In that case, it is often advantageous to use an amplifier stage employing emitter degeneration (feedback) to set the gain of the stage. The accompanying diagram shows one such typical stage. The gain of the stage is approximately equal to the ratio of the collector load to the unbypassed portion of the emitter resistance. In the case of choke or tuned circuit loads, the value used in this calculation is the absolute value of the collector load impedance.

Utilizing this technique also raises the input and output impedances to higher values than would otherwise be the case, a condition that is often desirable. The bandwidth of the circuit can also be increased, under the right circumstances, although, under other conditions, it might be decreased instead. It is also possible to select the value of the capacitor bypassing a portion of the emitter resistance such as to provide frequency compensation for the inherent 6 dB per octave drop off in gain as the frequency is increased, that is a characteristic of all bipolar transistors.

Another type of feedback amplifier is shown in the second diagram. In this instance, the gain is approximately equal to R_2 divided by R_1 , provided that the load resistance is much much greater than R_2 , and the impedance of the source feeding the circuit is much less than R_1 . The input impedance of





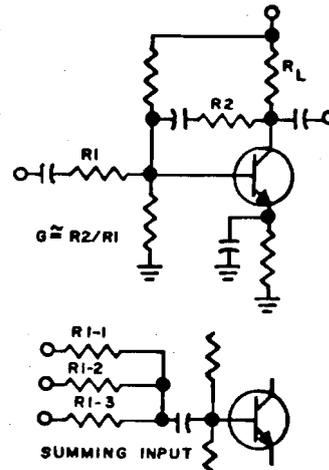
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this stage is equal to R_1 's value, and the output impedance is low. Since both input and output impedances can be quite low, the bandwidth may be very wide--100 MHz or greater.

Since the feedback path of the circuit (R_2) allows just enough signal from the output to be fed back to the base to cancel out that coming in through R_1 (and the feedback signal is out of phase with the incoming signal), little or no signal will be seen at the base. It is a "virtual" ground, so far as voltage is concerned!

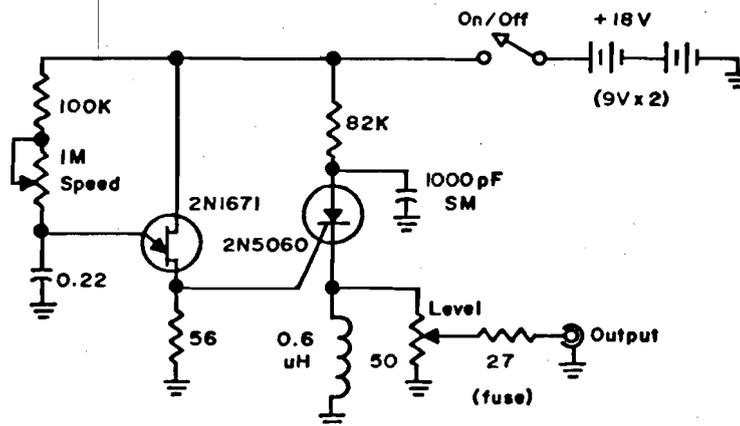
This characteristic can be used to sum two or more signals, setting different gain values for each signal, if desired. The gain for each signal is proportional to the ratio of the feedback resistor (R_2) to its own input resistor only; the other input resistors do not affect the gain of that particular signal. It is interesting to note that this is a summing, not mixing, amplifier, often another useful property of the circuit.



A SIMPLE IMPULSE NOISE GENERATOR

The noise blanker circuit used in SWAN radios, like all effective noise blankers, is designed to detect the presence of impulse noise above a certain threshold, and to mute, or blank, the output of the receiver for the duration of that pulse. (There is no circuit or scheme that can eliminate static or background hiss types of noise.) Since operation of the blanker circuit depends upon the presence of this high level impulse type of noise, it is difficult if not impossible to service the circuit unless a source of such impulses is available. Efforts to service it using the commonly available test equipment lineup are ineffective, and may well lead to misadjustments--most often, this section of the receiver is never checked out, but merely accepted on faith.

It follows, then, that a simple, inexpensive instrument that generates this type of signal would be most useful in the service



Noise Generator



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shop, yet commercial instruments are prohibitively expensive. For that reason, the circuit of such an instrument is included here, so that it may be built up locally and added to the shop equipment inventory for such service.

Referring to the accompanying diagram, we see that the 2N1671 is a uni-junction transistor, connected in an oscillator circuit. The 0.22 mfd capacitor is charged through the 100K and 1M resistors, with the latter made adjustable to control the charging rate. When the charge reaches a certain level, the UJT fires, discharging the capacitor, and generating a sharp pulse of current through the 56 ohm resistor. This in turn fires the 2N5060 delivering thereby a relatively large current pulse through the inductor. This pulse is used to simulate the impulse noise. Level is adjusted by the 50 ohm potentiometer, and the small wattage 27 ohm series resistor acts as an output fuse, for protection from the circuit to which it is connected. Power is shown as two 9-volt batteries in series, although a suitable AC supply delivering approximately 18 volts DC at a few milliamperes would also be suitable.

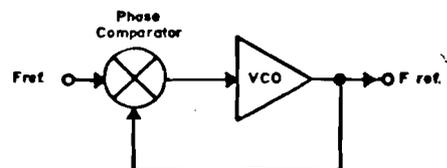
THE PHASE LOCKED LOOP SYNTHESIZER

Electronic phase locked loops (PLL) have been in use since the 1930's where they were used for radar synchronization. In later years, they came into more widespread use as the synchronization system in television receivers and other applications. It is only in recent years that they have found widespread use as frequency synthesizers, where they have found many applications in satellite communications systems, airborne navigation systems, FM communications, and, most recently, in HF SSB communications equipment.

In the basic PLL system, the output of a local voltage controlled oscillator (VCO) is compared with an incoming, or reference, signal, and if the two are not of the same frequency and phase, an error signal is generated to tune the VCO in such a direction, and to the required degree, that they become so. This is the system used in television sync systems, and is shown in the accompanying diagram.

The usefulness of such a simple system is limited, however, to such synchronization tasks; however, it was found that, if a means of dividing the output frequency of the VCO could be inserted in the path between the VCO and the comparator, the output of the VCO could be made to automatically assume a frequency that was a multiple of the reference frequency, that multiple being equal to the division factor of the divider circuit.

By making the divider circuit programmable, that is, making it so that the division ratio could be varied at will, and making the VCO of an appropriate frequency range, true frequency synthesis could be achieved; that is, the frequency of the VCO could be made to vary, in integer multiple steps of the reference frequency. This scheme is shown on the following page.



BASIC PHASE LOCKED LOOP



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Digital circuitry lent itself quite handily to the implementation of the frequency divider, in that a number of available chips could be used as programmable dividers, or in the present terminology, "divide-by-N" counters, where N is the dividing integer. VCO's of various configurations were easily achieved, using varicaps as the tuning element.

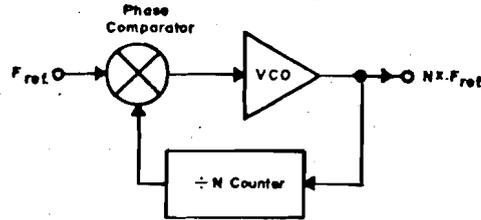
Initial PLL designs used phase comparators constructed out of discrete components, and were often very complex and difficult to "tame".

The development of specially designed integrated circuit phase comparators that were basically digital mixers greatly alleviated many problems, but created another. In such a mixer, leak-through of the reference frequency components to the error, or tuning line to the VCO is common unless specific steps are taken to prevent it. Such leak-through results in frequency modulation of the VCO at the reference frequency, and if held low enough, will be unnoticeable in the reception of AM or FM signals, but is quite difficult to reduce to a level where SSB or CW signals can be received without objectionable distortion caused by this FMing. The means taken to reduce this distortion is the inclusion in the loop, between the phase comparator and the VCO, of a filtering arrangement to reduce the amplitude of the reference frequency feedthrough to the VCO. Usually a low pass filter is used for this purpose.

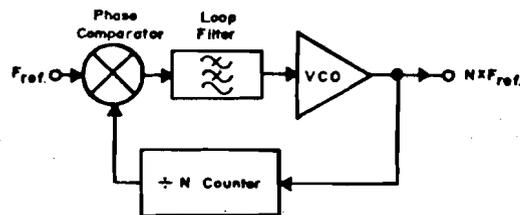
Since the loop filter contains considerable capacity to ground, of necessity, and its cutoff frequency is below the reference frequency, it controls the time required for the loop to reach lock after a change has been introduced, such as when the divide ratio of the counter has been changed. At low reference frequencies, lockup time can become objectionably long. In the Astro 102BX, a synthesizer is used to generate the different band frequencies which are mixed with the PTO output to produce the local oscillator signal. The reference frequency is sufficiently high that a relatively simple loop filter is all that is required. Setting the division ratio into the programmable counter is accomplished by the BAND switch, in conjunction with a diode matrix and programmable read-only memory integrated circuit.

PASSBAND TUNING

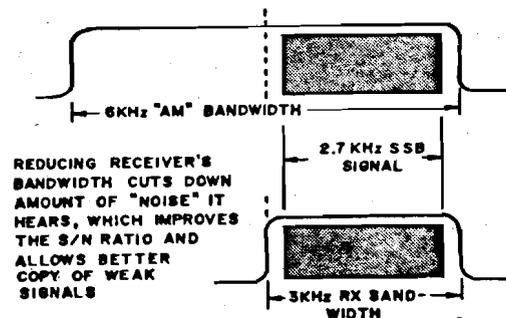
It is a fact of communications life that the narrower the bandwidth of a re-



BASIC MULTIPLIER PLL



PRACTICAL MULTIPLIER PLL





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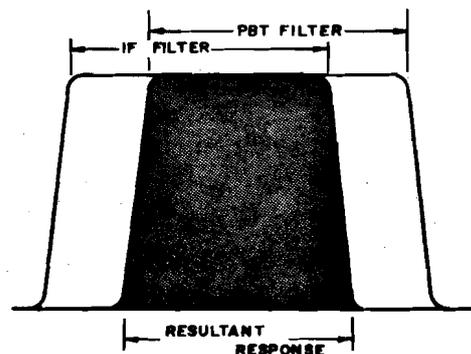
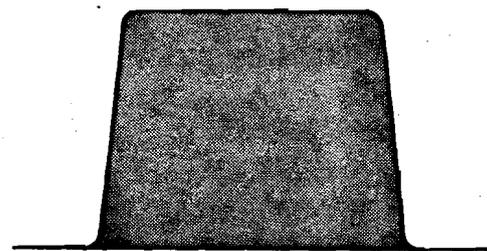
ceiving system, the more readily a signal of a given strength can be received and understood. This phenomenon occurs because what we really hear is the signal to noise ratio, rather than the absolute signal strength, and the narrower the received bandwidth, the less noise is received; hence a better signal to noise ratio and a more understandable recovered signal. The limiting factor, of course, is the bandwidth required for intelligibility of the desired signal. This is one of the chief advantages of single sideband over other communications methods. Since the necessary bandwidth is less than half that necessary for AM, for instance, it will result in more than twice the signal to noise ratio than an AM signal of comparable power, due solely to the reduction in received noise.

Studies show that the minimum bandwidth required for intelligible transmission of the human voice is about 2.5 kHz, although one can "get by" on a bandwidth of as low as 2.0 kHz, if a bit more degradation of the voice quality can be tolerated. In actual fact, however, these are average figures, and individual voice requirements vary widely. It has been the practice (and still is, in many cases), to use a fixed bandwidth, set by a high quality crystal filter in the IF of the receiver, to improve the signal to noise ratio. The response of a typical filter is shown to the right.

Since individual voices vary in their requirement for bandwidth, however, it would be advantageous in many instances, to be able to vary the bandwidth to lower limits. By being able to cut off the top or the bottom of the passband, thus reducing the bandwidth, it is possible to reduce the effects of close-by interfering signals, often at acceptable levels of degradation of the desired signal quality. Crystal filters, however, do not lend themselves to such operator adjustment.

Quite recently, a scheme for accomplishing this has been developed; it is called "Passband Tuning". In this scheme, the basic bandwidth is set by a high-quality crystal filter in the IF as before. But, after that filter, a circuit is included to translate that IF frequency to another frequency, usually higher. The signal is then passed through another crystal filter, of similar bandwidth as the first, and then translated back to the first IF frequency. If the frequency of the oscillator used to translate the signal to and back from the second IF is such that the passband of the two filters line up, no change in the bandwidth is noticed; however, if this oscillator frequency is made variable, the passbands of the two filters no longer line up, and either the upper or the lower end of the passband of the first filter is cut off by the second, as shown in the accompanying diagram. Since the frequency of this passband tun-

TYPICAL SSB FILTER CURVE

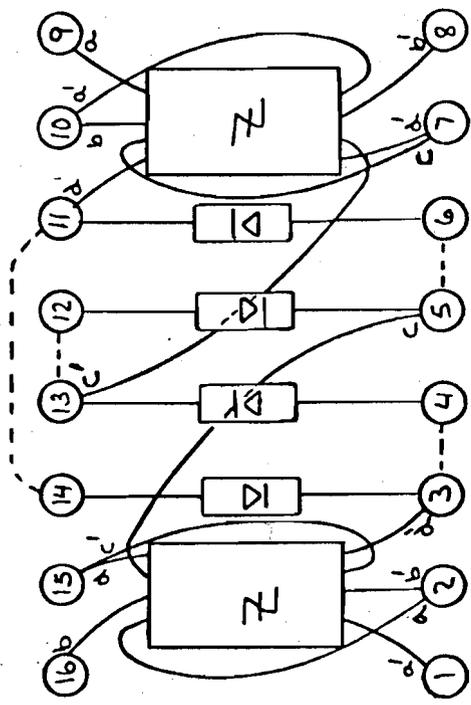
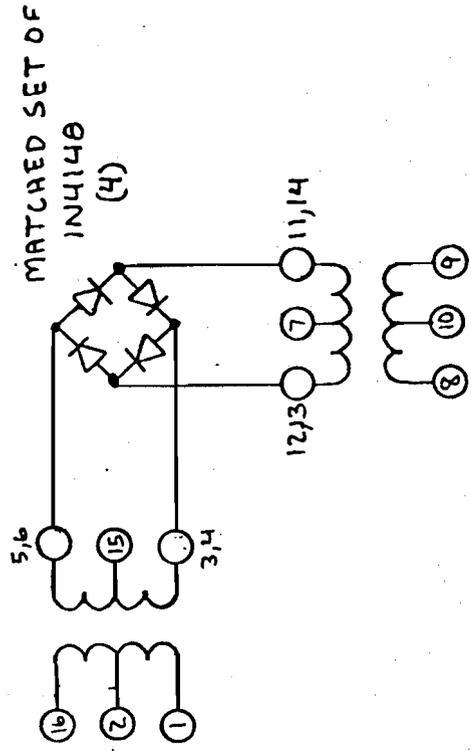




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ing oscillator is continuously variable, we have achieved continuously variable bandwidth. Skillful operation of this system by the operator can result in useful copy of signals that would otherwise be uncopiable due to heavy interference from nearby signals. Such a scheme, with a unique visual indication of the bandwidth to which it is adjusted, is included in the Astro 102BX.

The following two pages provide data on the diode ring double balanced mixers used for Z2101, Z2102, and Z5101. The first type uses discrete diodes and the second uses a monolithic diode array. The two units are interchangeable.

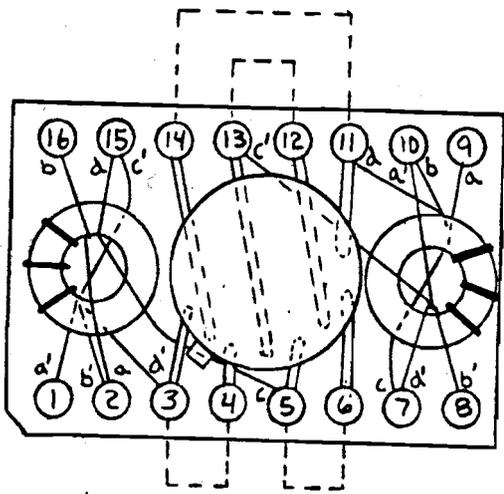


5. THE FOLLOWING CONNECTIONS MADE EXTERNALLY
3 TO 4, 5 TO 6, 12 TO 13, 11 TO 14
4. MOUNTED ON 16 PIN SOCKET P.N. CH6170-16
3. WIRE COLORS
a - RED
b - BLUE
c - GREEN
a' - CLEAR
2. USE (Z) Z BEAD TRANSFORMERS, TYPE 1
USE (H) MATCHED DIODES IN4148

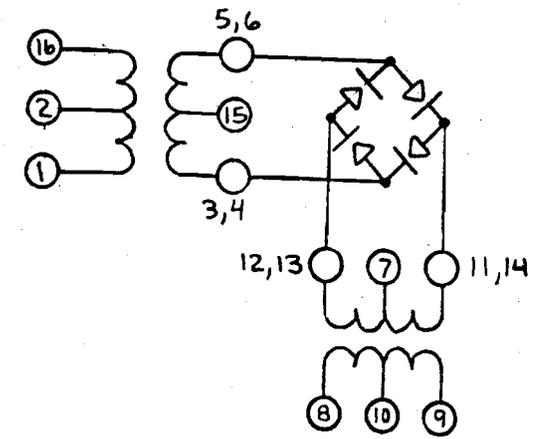
SWAN ELECTRONICS

SCALE: NONE	APPROVED BY: <i>Jew</i>	DRAWN BY: C. ORVIDS (M)
DATE: 5-26-77		REVISED
MIXER		DRAWING NUMBER

LTR	DESCRIPTION	DATE	APPD
A	REVISED DWG. TO SHOW CA3039 DIODE PACKAGE INSTEAD OF SEPARATE DIODES	3-5-80	AS



TOP VIEW



- 4. (1) CA3039 MODIFIED PER DWG. NO. 0800-5404
- 3. (2) RF TRANSFORMERS 014-063

2. WIRE COLORS

- a - RED
- b - BLUE
- c - GREEN
- d - CLEAR

1. THE FOLLOWING CONNECTIONS MADE EXTERNALLY
3 TO 4, 5 TO 6, 12 TO 13, 11 TO 14

NOTES

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SCALE: NONE	APPROVED BY: <i>AS</i>	DRAWN BY: C. DAVIDSON
DATE: 3-4-80		REVISED
DOUBLE BALANCED MIXER		DRAWING NUMBER
		0800-2004A



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TEST EQUIPMENT REQUIRED

A certain amount of quality test equipment is necessary to service today's sophisticated communications equipment. Below is a list of that required for the ASTRO 102BX.

- Microphone, high impedance
- Wattmeter, 0-200W scale
- Dummy load, non-reactive, 50 ohms, capable of $\geq 200W$ dissipation
- Light bulb load, 100W, 10 ohms cold
- Oscilloscope, 30 MHz minimum bandwidth, with x10 attenuator probe to be used for all measurements
- Frequency counter, at least 100 mV sensitivity, high impedance input, counts to 44 MHz or higher
- VTVM or DVM with high input impedance to be used for all AC and DC measurements
- Two-tone generator (See the "Servicing Hints" section of this manual)
- Noise generator (See the "Servicing Hints" section of this manual)
- Signal generator, 1.5-30 MHz, calibrated output
- Audio generator, 300-3000 Hz
- Power supply, 11-14V DC adjustable, 22 ampere or greater regulated output, with current metering
- "T" coaxial connector
- Attenuator for monitoring transmitter output with counter and oscilloscope

INITIAL INSPECTION AND SET-UP

Inspect the unit for physical damage; i.e., broken components, knobs, switches, meter, panel, heatsink, controls, circuit boards, cabinet, etc.



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burned wires, components and boards; loose and improperly mounted plugs; frayed or pinched wires; loose hardware, etc.

Connect a suitable power supply to the POWER 13.8 volt connector on the rear apron of the unit. Connect the wattmeter, dummy load and "T" connector with the attenuator to the ANTENNA connector. Connect a suitable microphone to the KEY/MIC jack on the front panel.

Set the front panel controls as follows: AF GAIN off; RF GAIN, fully clockwise; IF GAIN fully clockwise; AGC DELAY fully counterclockwise; PASS-BAND 12 o'clock; NOTCH FILT fully counterclockwise; MIC GAIN fully counterclockwise; PTO MODE to PTO A; MODE to LSB and BAND to 20.

INITIAL CURRENT AND LIGHT CHECKS

With the power off, the total current drain should be less than 15 ma. Turn the AF GAIN control to turn the power on, and the total current drain should be less than 2 amperes, the meter light should come on, the display should light, and the PTO A and PASSBAND KHZ lights should come on.

Key the unit with the microphone button. The total current drain should increase between 1 to 1.5 amps.

PTO MODE SWITCHING AND RIT OPERATION

Set the PTO MODE switch to EXT, and the display should read 11000.1 ± 1 . Set the MODE to USB, and the display should read 10996.8 ± 1 . Both PTO lights should be off.

Set the PTO MODE to A and adjust PTO A for 14260.0 with the RIT off (RIT light off). The PTO A light should be on and the PTO B light off. Key the unit. The display frequency should not change, and there should be no change in the PTO lights. Unkey the unit.

Set the PTO MODE switch to B and adjust PTO B for 14280.0 with the RIT off. The PTO B light should be on and the PTO A light should be off. Key the unit, and the display frequency should not change, with no change in the PTO lights. Unkey the unit.

Set the PTO MODE switch to REC A-XMIT B. The PTO A light should be on, the PTO B light should be off, and the display frequency should be 14260.0. Key the unit; the PTO A light should go off, the PTO B light should be on, and the display frequency should change to 14280.0. Unkey the unit.

Set the PTO MODE switch to REC B-XMIT A; the PTO A light should be off, the PTO B light on. The display frequency should be 14280.0. Key the unit, and the PTO A light should come on, and the PTO B light extinguish. The display frequency should be 14260.0. Unkey the unit.

Set the PTO MODE switch to PTO A, MODE to LSB. The display frequency should change less than 0.2 kHz. Set the RIT knob pointer to 0 and push it in to turn the RIT on. The RIT light should come on, and the display frequency should change less than 0.2 kHz. Adjust the RIT control from full counterclockwise to fully clockwise. The display frequency should vary between ± 0.8 to 1.5 kHz. Key the unit. The RIT light should go off, and the display frequency should be the same as if the RIT were off, and the RIT control should have no effect on the display frequency. Unkey the unit. Push the RIT control to turn it off. The RIT control should have no effect on the display frequency. Set the MODE switch to USB.

Set the PTO MODE switch to B and make the same checks as for PTO A.



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PTO RANGE AND DISPLAY OPERATION

Set the PTO MODE switch to PTO A, turn the PTO A knob counter clockwise to its limit. The display frequency should be between 13940.0 and 13880.0. Turn the PTO A knob clockwise to its stop, and the display frequency should be between 14560.0 and 14620.0. Set the BAND switch to 10D. The display frequency should be stable. Set the BAND switch to 20.

Set the PTO MODE switch to PTO B and repeat the range checks for PTO B.

Set the BAND switch to 10B, and adjust PTO B for a display frequency of 28888.8 and check that the segments and decimal point are properly lighted on the display.

DISPLAY FREQUENCY ACCURACY

Connect a frequency counter to the "T" coupling and attenuator in the antenna line. Disconnect the microphone, and connect an audio generator to the EXT MOD jack on the rear apron of the unit. Connect an SPST switch to the KEY jack on the rear apron.

Adjust the audio generator's output to 1000 Hz \pm 10 Hz. Key the unit with the SPST switch and adjust the MIC GAIN control and audio generator output level for approximately 20 watts output, or until the frequency counter has a stable count. Check the following:

That the carrier (output) frequency equals the display frequency minus 1.0 kHz in the LSB mode, \pm 0.4 kHz.

That the carrier (output) frequency equals the display frequency plus 1.0 kHz in the USB mode, \pm 0.4 kHz.

That the carrier (output) frequency equals the display frequency plus 0.8 kHz in the CW and CWN modes, \pm 0.4 kHz.

TRANSMITTER OPERATION

Disconnect the frequency counter from the "T" connector in the antenna line and connect the oscilloscope in its place. Keep the attenuator in the line to protect the oscilloscope input circuitry. Disconnect the audio generator from the EXT MOD jack and connect the two-tone generator to the EXT MOD jack.

Check the power output and the total drain current on all bands in the CW mode, with the MIC GAIN control fully clockwise, and with the output frequency adjusted to the high end of each band. The power output should be 100 to 120 watts on all bands and the total current drain from the power supply should be 18 amps or less at 100 watts output. Power output should vary from less than 5 watts to full power as the MIC GAIN control is varied from fully counterclockwise to fully clockwise. There should be no output until the unit is keyed with the SPST switch.

Check the meter accuracy in the FWD position at 100 watts output on the 20 meter band. Accuracy should be \pm 10%. Disconnect the coax at the ANTENNA connector on the rear apron, and set the METER switch to REFL, the MIC GAIN fully clockwise, and key the unit momentarily. The panel meter should indicate in the red area. Reconnect the coax to the ANTENNA connector. Set the meter switch to ALC, key the unit, and vary the MIC GAIN control from fully counterclockwise to fully clockwise. The meter reading should vary from approximately 0 to +20 or higher. Unkey the unit, and the meter should read approximately 0 in any of the METER switch positions.



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ALC OPERATION

Disconnect the 50 ohm dummy load and substitute a standard 100W light bulb (10 ohms cold) as the load. Check the power output with the MIC GAIN control fully clockwise on all bands. Power output should be 40-70 watts if the ALC circuit is operating properly.

With the antenna connector open (i.e., no load), the total set current in transmit should not exceed 12 amperes. If so, the ALC circuit is not working properly.

NOTE: The purpose of the ALC is to limit power output and therefore PA device dissipation to safe limits, by limiting collector current. If there is too much ALC control, it will not be possible to obtain full output into loads with SWRs less than 1.5:1. If there is too little ALC control, then the PA transistors can draw excessive current, especially when the load is poorly matched, and possibly go into oscillation, causing them to overheat and fail. The temptation to increase the power output of the transmitter by reducing ALC control must be resisted--to do so will almost guarantee the failure of expensive components in the PA.

MODULATION OPERATION

Check the two-tone signal on each band and in both USB and LSB modes for crossover distortion, carrier leakage, and spurious outputs. None of the above should be detectable in the output (see the "Servicing Hints" section of this manual for examples and procedures for making the two-tone test.) Output should go to 100 W. PEP without distortion being introduced into the two-tone pattern.

NOTE: If a two-tone source is not available, a close examination of a modulated output display using a high quality microphone and/or monitoring the signal on another radio should show up any major discrepancy, although not so accurately as does the two-tone test.

Two-tone and microphone modulation checks should be made with the speech processor off. Disconnect the two-tone generator and reconnect the microphone. The MIC LEVEL trimpot (R138) on the audio board should be adjusted for 100 W. PEP output with the MIC GAIN control set at 10 o'clock and speaking into the microphone that is to be used with the unit, in a normal voice. Note the average power reading on the wattmeter. Switch the SPEECH PROCESSOR on and note that the average power reading increases by approximately 20 watts. It should also be noticeable on the oscilloscope display that the peak to average modulation levels are less with the speech processor on than when it is off.

With the VOX-PTT switch in the VOX position, adjust the VOX GAIN trimpot (R140) on the audio board so that speaking into the microphone instantly keys the unit. Adjust the ANTI TRIP trimpot (R149) on the audio board so that audio from the speaker does not key the unit. Varying the VOX DELAY trimpot (R144) on the audio board should vary the unkeying delay time from 0 to 5 seconds. There should be no loud popping noises in the speaker as the unit keys or unkeys. Disconnect the microphone.



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Set the MODE switch to CW, the BRK IN switch to FULL, the CW HARD-SOFT switch to HARD. Key and unkey the unit rapidly several times; the receiver audio should return the instant the unit is unkeyed. There should be no objectionable pops or clicks from the speaker when keying or unkeying at any power output setting. Set the BRK IN switch to SEMI. Key and unkey the unit several times. There should be a 0.5 to 6 second delay between unkeying and receiver turn on that varies with the setting of the CW DELAY trimpot (R174) on the audio board.

Set the BRK IN switch to FULL, key the unit, and adjust the MIC GAIN control for a reading of 75 on the meter with the METER switch in the ALC position. Rapidly key and unkey the unit and compare the oscilloscope display to the illustration presented here, to check for proper waveshaping. Set the CW HARD/SOFT switch to SOFT and make the same check for waveshape.

The SIDETONE trimpot (R124) on the audio board should vary the level of the audio tone heard in the speaker when the transmitter is keyed. The tone should be present only in the CW or CWN MODE of operation, and should not be heard with the unit unkeyed. Output should vary from no output to approximately 1 watt of audio with the setting of the sidetone level control.

Connect one lead of a 12 volt lamp (less than 200 ma) to +12 volts from the power supply and connect the other lead from the lamp to the center contact on the EXT RLY jack on the rear apron of the unit. The lamp should light only when the unit is in transmit in any mode.

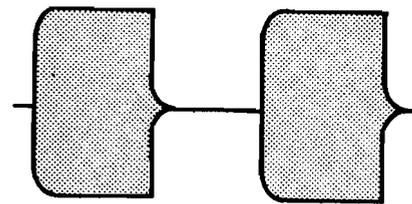
RECEIVER OPERATION

Disconnect the microphone, the SPST switch, wattmeter, "T" connector and attenuator, and the dummy load from the unit. Connect an RF signal generator to the ANTENNA jack. Connect an AC voltmeter and frequency counter across the speaker terminals. Set the MODE switch to USB, VOX/PTT switch to PTT, MIC GAIN control fully counterclockwise, and PTO MODE to PTO A.

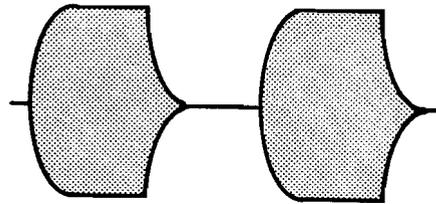
Check for 0.35 μ V sensitivity at 10 dB S+N/N ratio on all bands. See the "Servicing Hints" section of this manual for the procedure. Check the sensitivity with the PTO MODE switch in the PTO B position also. Check that the sensitivity is better than 1.0 μ V at 10 dB S+N/N ratio with the input voltage set at 11V DC on all bands.

Set the RF generator output to 1 μ V and note the S meter reading. Tune the unit to each internally generated spurious signal and note that they each should be less than the S meter reading noted above.

Check that the S meter reads $S 9 \pm 1$ S unit for 50 μ V input signal at a supply voltage of 13.8 V DC. The S meter reading should vary with the input signal. Changing the input signal from 1 μ V to 0.1 V should result in 6 dB or less increase in audio output (6 dB is a voltage ratio of 2). The



"Hard" keying



"Soft" keying



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AF GAIN control should vary the audio output from inaudible to 3.5V RMS before clipping occurs, with 0.5 uV of input signal.

Turning the IF GAIN control fully counterclockwise should increase the S meter reading to full scale and decrease the units sensitivity. Set the IF GAIN control back to its fully clockwise setting.

Turning the RF GAIN control counterclockwise should decrease the units input sensitivity and the S meter reading should decrease. With the RF GAIN fully counterclockwise, input sensitivity should be reduced approximately 50 dB. Set the RF GAIN control back to its fully clockwise position.

With the AGC DECAY control fully counterclockwise, the unit should have no AGC delay time. This is indicated by the S meter reading increasing and decreasing instantly as the PTO is tuned across a signal. As the AGC DECAY control is advanced clockwise, the amount of time required for the AGC to decay should increase to approximately 15 seconds at fully clockwise. This is indicated by the slow drop in S meter readings after tuning off of a signal. Set the AGC DECAY control back to its fully counterclockwise position.

Adjust the RF generator so that the speaker audio tone is 1650 Hz \pm 20 Hz. Adjust the NOTCH FILTER control for minimum speaker audio. The audio signal should decrease approximately 25 dB. Adjust the RF generator so that the speaker audio tone is 2500 Hz \pm 20 Hz. Adjust the NOTCH FILT control for minimum speaker audio. The audio signal should decrease about 25 dB. Repeat the foregoing at 400 Hz \pm 10 Hz audio tone. The audio signal should decrease by about 25 dB. Set the NOTCH FILT control back to its fully counterclockwise position.

NOISE BLANKER OPERATION

To check the noise blanker circuit, connect a pulse type of noise generator to the antenna connector along with the signal generator using the "T" connector. If a noise generator is not available, see the "Servicing Hints" section of this manual for the schematic diagram of a simple inexpensive set that may be constructed and kept for future use.

Tune in a 0.5 uV signal from the generator; turn on the noise generator and set the noise level to S3 to S8 with the NOISE BLANKER switch off. Turn the NOISE BLANKER switch on; the signal should now be audible above the residual noise. Check on all bands.

Tune the signal generator to another frequency at least 1 MHz away from the set frequency and modulate the signal generator at 100% modulation. Increase the generator output to about 100,000 uV and at this point the noise level should come back up to S4 to S8; switching the NOISE BLANKER switch from on to off should have no effect.

PASSBAND TUNING OPERATION

With the PASSBAND control set at 12 o'clock, all eight PASSBAND KHZ lights should be on in LSB, USB, and CW modes. In CWN mode, only the 1.5 and 1.8 lights should be on. In LSB, USB and CW mode, as the PASSBAND control is turned clockwise, the PASSBAND KHZ lights should go off sequentially proceeding from left to right. At about the 4 o'clock position of the control, all lights should be out. As the PASSBAND control is turned counterclockwise from the 12 o'clock position, the PASSBAND KHZ lights should go off sequentially proceeding from right to left. At about the 8 o'clock pos-



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ition of the PASSBAND control, all lights should be out. Set the PASSBAND control back to the 12 o'clock position.

CWN TEST

Set the MODE switch to CW, and adjust the RF generator for 50 uV output and adjust the frequency for a 1650 ± 20 Hz speaker audio tone. Switch the MODE switch to CWN and note that the S meter reading changes by one S unit or less. Set the MODE switch to CW.

Adjust the RF generator frequency for a $2700 \text{ Hz} \pm 20 \text{ Hz}$ speaker tone and set the RF generator output for S9 on the S meter. Turn the PASSBAND control counterclockwise until the S meter reading drops to less than S5. At this point, only the 2.7 and/or 2.4 PASSBAND KHZ lights should be off. Adjust the RF generator frequency for $400 \text{ Hz} \pm 20 \text{ Hz}$ tone in the speaker and set the generator output for an S9 reading on the S meter. Turn the PASSBAND control clockwise until the S meter reading drops to less than S5. At this point only the 0.6 and/or 0.9 PASSBAND KHZ lights should be off. Set the PASSBAND control back to its 12 o'clock position.

PTO CHECK

Set the PTO MODE switch to PTO A and adjust the RF generator for 50 uV output. Tune PTO A across the signal and listen to the speaker audio tone for any indication of tuning backlash. Tune PTO A for a $1000 \text{ Hz} \pm 20 \text{ Hz}$ tone in the speaker.

Set the PTO MODE switch to PTO B. Tune PTO B across the signal and listen to the speaker audio tone for any indication of tuning backlash. Tune PTO B for a $1000 \text{ Hz} \pm 20 \text{ Hz}$ speaker tone. Both PTOs are now set to the same frequency and there should be no interference between the two. Slowly tune PTO A back and forth while listening for a change in the audio tone. There should be no detectable change.

EXTERNAL SPEAKER CHECK

Connect an external speaker to the EXT SPKR/PHONE jack on the rear apron of the set. The internal speaker should mute and the added speaker now should have audio output.

EXTERNAL L.O. CHECK

Disconnect the RF generator from the ANTENNA connector and reconnect it to the EXT LO jack on the rear apron of the unit. Adjust the RF generator frequency to 30 MHz and approximately 0 dBm output. Set the MODE switch to LSB, PTO MODE switch to EXT, and BAND to 15. The display frequency should be the RF generator output frequency minus $9000.0 \text{ kHz} \pm 0.1 \text{ kHz}$. The display should be stable and tuning PTO A or PTO B should have no effect on the display frequency.

This completes the operational test of the unit. Disconnect all test equipment and reinstall any covers that may have been removed.



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ALIGNMENT PROCEDURE

Alignment should be performed only after making a complete performance check of the unit. It is advisable to then align only those areas of the unit necessary to bring performance up to specification. Also, the replacement of a defective component will usually restore the units performance without requiring any realignment, in most cases. Following this procedure will save time and help to avoid the possibility of inadvertently misaligning a section of the unit.

INITIAL SETUP

Remove the top and bottom covers of the unit. Set the front panel controls as follows: AF GAIN to off; RF GAIN to fully clockwise; IF GAIN to fully clockwise; AGC DECAY to 12 o'clock; PASSBAND to 12 o'clock; NOTCH FILT to fully counterclockwise; MIC GAIN to fully counterclockwise; PTO MODE to PTO A; MODE to LSB; BAND to 160 and PTT/VOX switch to PTT.

Connect a suitable power supply to the POWER 13.8 V connector on the rear apron of the unit.

VOLTAGE REGULATOR ADJUSTMENT

Turn the AF GAIN control clockwise to turn the power on. Adjust the power supply voltage for 14 V DC.

Measure the voltage at the collector of Q116 on the distribution board and adjust the 10.5 V SET trimpot (R141) on the same board for a reading of 10.55 ± 0.05 V DC on the voltmeter. Vary the power supply voltage from 11 to 15 volts. The measured voltage should change by less than 0.2 V DC. Reset the power supply voltage to 14 V DC.

BAND VCO ADJUSTMENT

Measure the voltage at the point labeled 160-15 M EL (near C138) on the L.O. board. Adjust the coils according to the following chart for 3.75 ± 0.25 V DC.

<u>BAND</u>	<u>COIL</u>
160M	T101
80M	T102
40M	T103
20M	T104
15M	T105

Measure the voltage at the point labeled 10 M EL on the LO board. Set the BAND switch to 10A and adjust T106 for 3.20 ± 0.1 V DC. Switch to 10B, 10C, and 10D and note that voltage reading increases approximately 0.4 V DC for each band.

BAND REFERENCE OSCILLATOR ADJUSTMENT

Connect a frequency counter to collector of Q111 on the LO board. Set bandswitch to 10D. Adjust the 2 MHz oscillator trimmer capacitor (C246) for a frequency of $44.000 \text{ MHz} \pm 20 \text{ Hz}$. Disconnect the frequency counter.



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CARRIER OSCILLATOR ADJUSTMENT

Connect the microphone to the MIC/KEY jack on the front panel. Connect the oscilloscope probe to the emitter of Q117 on the exciter board. Key the unit with the microphone button and adjust transformer T105 on the exciter board for a maximum indication on the oscilloscope of approximately 1 V p-p. Unkey the unit. Disconnect the oscilloscope probe and reconnect the frequency counter to the same point. Key the unit and make adjustments according to the following table, in the order listed.

<u>MODE</u>	<u>CAPACITOR</u>	<u>FREQUENCY</u>
LSB	C194	9.00000 MHz \pm 10 Hz
USB	C197	9.00330 MHz \pm 10 Hz
CW	C199	9.00250 MHz \pm 10 Hz

Unkey the unit and disconnect the frequency counter and microphone.

PASSBAND TUNING OSCILLATOR ADJUSTMENT

Measure the voltage at the center leg of the PASSBAND tuning control (R103B, rear section) and adjust the PASSBAND control for 5.25 ± 0.05 V DC.

Connect the frequency counter to G2 of Q113 on the exciter board and adjust the PBT trimmer capacitor (C206) for a frequency of 22.80165 MHz \pm 20 Hz. Vary the PASSBAND control from fully counterclockwise to fully clockwise and note that the PBT oscillator has a frequency range greater than 3.6 kHz.

Disconnect the frequency counter and reconnect the oscilloscope probe to the same point. Adjust coil T106 for maximum indication on the oscilloscope screen, approximately 1.5 V p-p. Disconnect the oscilloscope probe.

COUNTER REFERENCE OSCILLATOR ADJUSTMENT

Remove the cover from the units frequency counter and connect the shop frequency counter to pin 9 of U114 on the counter board. Adjust the reference oscillator trimmer (C110) for a frequency of 1.31072 MHz \pm 2 Hz. Disconnect the frequency counter and reinstall the counter cover.

PASSBAND TUNING INDICATOR ADJUSTMENT

Set the PASSBAND control to its 12 o'clock position and adjust the A-D RANGE trimpot (R166) on the audio board so that all eight PASSBAND KHZ lights are on.

PTO AND RIT ADJUSTMENT

Set the MODE switch to LSB, and the BAND switch to 20, turn the RIT to its off position (RIT light extinguished) and adjust PTO A for a display frequency of 14270.0. Switch the MODE switch to USB, and if the display frequency changes, adjust the USB SHIFT trimmer (C608) on PTO A so that there is no change in the display frequency when shifting between LSB and USB modes.



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Set the RIT control to 0. Push the RIT control to turn it on (RIT light lighted). If the display frequency changes, adjust the RIT CENTER trim-pot (R536) on the PTO control board so that there is no change in the display frequency between RIT on and RIT off. Verify that the RIT control varies the frequency of the display ± 800 to 1500 Hz.

Turn the PTO A control fully counterclockwise and note how much the display frequency goes below 14000.0 kHz. Now turn the PTO A control to its clockwise limit and note how much the display frequency goes above 14500.0 kHz. The amount that the frequency extends beyond the lower and upper band limits should be greater than 50 kHz and within 10 kHz of each other. If this is not the case, adjust trimmer C606 on PTO A for the proper frequency range.

Set the PTO MODE switch to PTO B and repeat the above procedures for B.

EXCITER I.F. ADJUSTMENTS

Set the MODE switch to CW, the PTO MODE switch to PTO A, the PASSBAND control to its 12 o'clock position, and adjust PTO A for a display frequency of 14300.0 kHz. Connect the output of the RF generator to the ANTENNA connector on the rear apron of the unit. Set the RF generator output for 50 μ V and adjust its frequency for maximum S meter reading on the unit. Adjust transformers T101, T102, T103 and T104 on the exciter board for a maximum S meter reading.

AGC AND S METER CALIBRATION

Use the same test setup as previous section. Connect the oscilloscope probe to the cathode of diode CR123 (AF in line) on the audio board. Adjust the AGC THRESH trimpot (R101) on the audio board for 600 mV p-p indication on the oscilloscope screen. Disconnect the oscilloscope probe.

Adjust the S METER CAL trimpot (R110) on the audio board for an S 9 indication on the unit's meter.

CWN FILTER ADJUSTMENT

Set the MODE switch to CWN and connect the frequency counter across the units speaker terminals, keeping the rest of the test setup the same as for the previous section. Adjust PTO A for a 1650 Hz ± 20 Hz speaker audio tone and adjust CWN trimmer capacitors C130 and C134 on the exciter board for a maximum S meter reading. Switch the MODE to CW and verify that the S meter reading changes by less than one S unit.

NOTCH FILTER ADJUSTMENT

Use the same test setup as before. Connect the AC voltmeter or oscilloscope across the speaker terminals. Adjust PTO A for a 1650 ± 20 Hz tone in the speaker. Adjust the NOTCH FILT control for minimum speaker audio output, then adjust the NOTCH FILTER ADJUST trimpot (R178) on the audio board for minimum speaker audio output. Repeat the adjustments of NOTCH FILT and N F ADJ controls until there is no further decrease in the speaker audio output. The notch filter should attenuate the speaker audio by more than 25 dB. Verify that speaker audio output can also be attenuated by the notch filter with speaker audio tones of 400 Hz and 2500 Hz. Disconnect the freq-



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uency counter, AC voltmeter or oscilloscope and RF generator from the unit.

ALC AND METER ADJUSTMENTS

Connect the microphone to the MIC/KEY jack on the front panel of the unit. Connect the RF wattmeter and 50 ohm dummy load to the ANTENNA connection on the rear apron. Set the MODE switch to CW and adjust PTO A for a display frequency of 14500.0 kHz.

Connect the DC oscilloscope probe to the "high" potential leg of the REFL trimpot (R107) on the preselector board. Key the unit with the microphone button and adjust the MIC GAIN control for 100 watts of output. Quickly adjust the SWR NULL trimmer capacitor (C103) on the SWR/wattmeter board for minimum DC voltage on the oscilloscope (< 0.5 V DC).

NOTE: During this and subsequent CW tests, limit the "key down" time to 30 seconds or less to prevent overheating and resultant damage to the power amplifier devices. Allow time between transmissions to permit them to cool.

Disconnect the oscilloscope probe. Set the METER switch to the FWD position. Key the unit, and adjust the MIC GAIN for 100 watts of output and quickly adjust the FWD trimpot (R147) on the distribution board for a reading of 100 on the unit's meter.

Set the MIC GAIN control fully clockwise, key the unit, and quickly adjust the FWD ALC trimpot (R104) on the preselector board for 110 watts of output.

Disconnect the 50 ohm dummy load and reconnect the 100 watt (10 ohm cold) light bulb in its place. With the MIC GAIN control fully clockwise, key the unit and quickly adjust the REFL ALC trimpot (R107) on the preselector board for 50-60 watts of output. Set the METER switch to REFL, key the unit, and quickly adjust the REFL trimpot (R149) on the distribution board for a reading of 100 on the unit's meter. (10 watts reflected power)

Check the output on all bands for 40 to 70 watts of output using the light bulb as a load.

Disconnect the light bulb load and reconnect the 50 ohm dummy load. Check the power output for 100-120 watts on all bands, with the MIC GAIN control fully clockwise.

Disconnect the coax lead at the ANTENNA connector of the unit. Key the unit with the MIC GAIN control fully clockwise and note that the total current drawn from the power supply is less than 12 amperes on all bands. Reconnect the coax lead to the ANTENNA connector.

NOTE: It may be necessary to slightly readjust the FWD and REFL ALC trimpots and SWR NULL trimmer capacitor to obtain the proper indications on all bands.

Set the BAND switch to 20 meters, the METER switch to ALC and the MIC GAIN control fully counterclockwise. Key the unit and adjust the ALC ZERO trimpot (R110) on the preselector board for a reading of S 2 on the units meter. Adjust the MIC GAIN control to its fully clockwise position. The meter reading should increase to +20 or greater. Unkey the unit.



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PRESELECTOR AND L.O. BANDPASS FILTER ADJUSTMENT

The alignment of the bandpass filters should be performed only if absolutely necessary, and then only for those bands that require alignment. Indications of misalignment are significant reduction in power output and receiver sensitivity that is not the result of a component failure or misalignment of transformers, coils and/or oscillators on the exciter board.

If alignment is to be performed using a sweep generator, follow the procedure supplied with the test equipment and test the boards as follows:

Preselector Bandpass Filters: (with sweeper)

Connect the sweep generator output to the RX IN jack (J132) and the spectrum analyzer's input to the RX OUT jack (J136). Sweep each band according to the accompanying chart.

L.O. Bandpass Filters: (with sweeper)

Disconnect the leg of C177 from pin 7 of Z101 on the LO board and connect the sweep generator output to the leg of C177. Connect the analyzer input to the LO OUT jack (J103).

Sweep each band according to the accompanying chart.

Preselector Bandpass Filters: (without sweeper)

Disconnect the TX OUT coax at J134 on the preselector board and connect the oscilloscope probe to J134. Set the MODE switch to CW, and MIC GAIN control to fully clockwise, and key the unit. Adjust the oscilloscope for a reasonable indication.

Adjust the bandpass coils for maximum indication on the oscilloscope at the center frequency of each band.

Tune the PTO across each band and readjust the bandpass coils as necessary to obtain a flat response (± 2 dB) across the band without significantly reducing the maximum output.

L.O. Bandpass Filters: (without sweeper)

Disconnect the LO OUT coax at J103 on the LO board and connect the oscilloscope probe to J103. Use the same procedure for adjusting these bandpass coils as in the preceding section.

NOTE: It is not necessary to key the unit for LO bandpass filter adjustment.

PRESELECTOR BANDPASS FILTER ALIGNMENT TABLE

<u>BAND</u>	<u>RANGE, MHZ</u>	<u>CENTER FREQ.</u>	<u>COILS</u>
160	1.8-2.0	1.9	T101, T102, T103
80	3.5-4.0	3.750	T104, T105, T106
40	7.0-7.5	7.250	T107, T108, T109
20	14.0-21.5	14.250	T110, T111, T112
15	21.0-11.5	21.250	T113, T114, T115
10A, B, C, D	28.0-30.0	29.0	T116, T117, T118



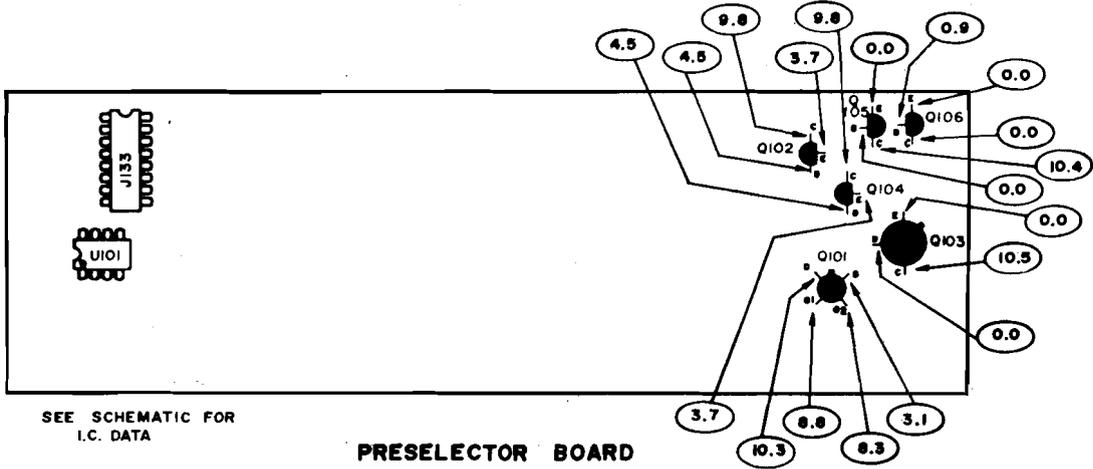
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L.O. BANDPASS FILTER ALIGNMENT TABLE

<u>BAND</u>	<u>RANGE, MHZ</u>	<u>CENTER FREQ.</u>	<u>COILS</u>
160	10.8-11.0	10.9	T107, T108, T109
80	12.5-13.0	12.750	T110, T111, T112
40	16.0-16.5	16.250	T113, T114, T115
20	23.0-23.5	23.250	T116, T117, T118
15	30.0-30.5	30.250	T119, T120, T121
10A, , C, D	37.0-39.0	38.0	T122, T123, T124



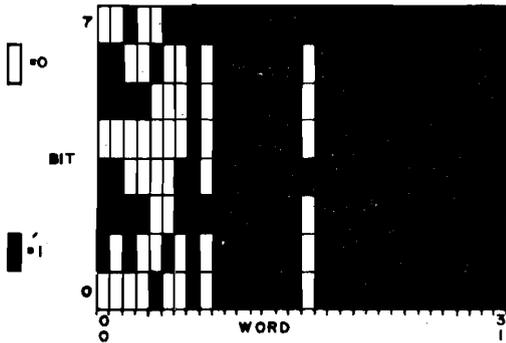
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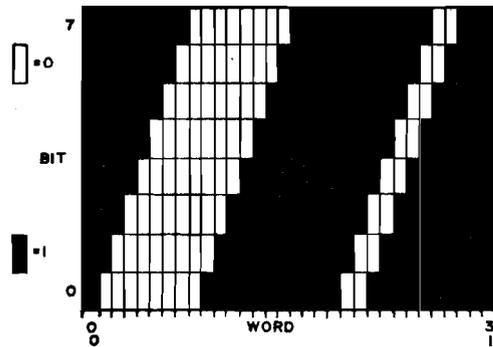
SEE SCHEMATIC FOR
I.C. DATA

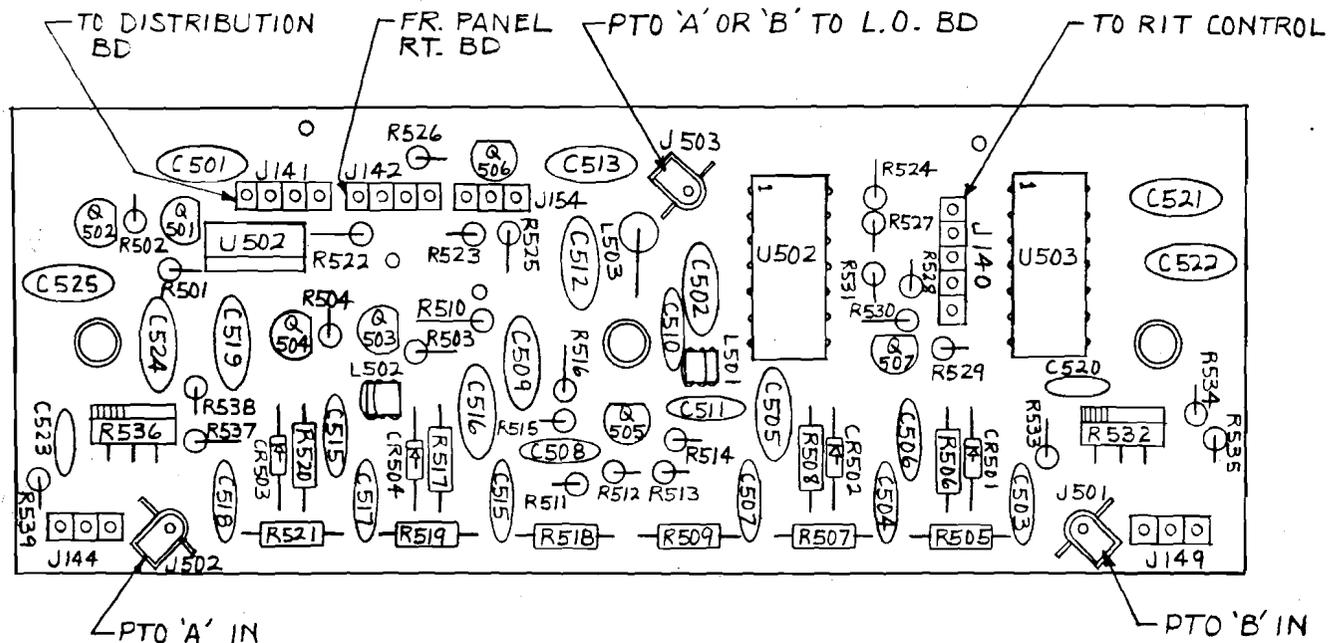
**PRESELECTOR BOARD
LEVELS**

UI05 MEMORY MAP



UI07 MEMORY MAP





2. COMPONENT DESIGNATORS: 7500 SERIES
 1. REF. ELEC. ASSY 102 BX-2001
 REF. CIRCUIT BD 102 BX-2101
 REF. DRILL DWG 102 BX-2201
 NOTES:

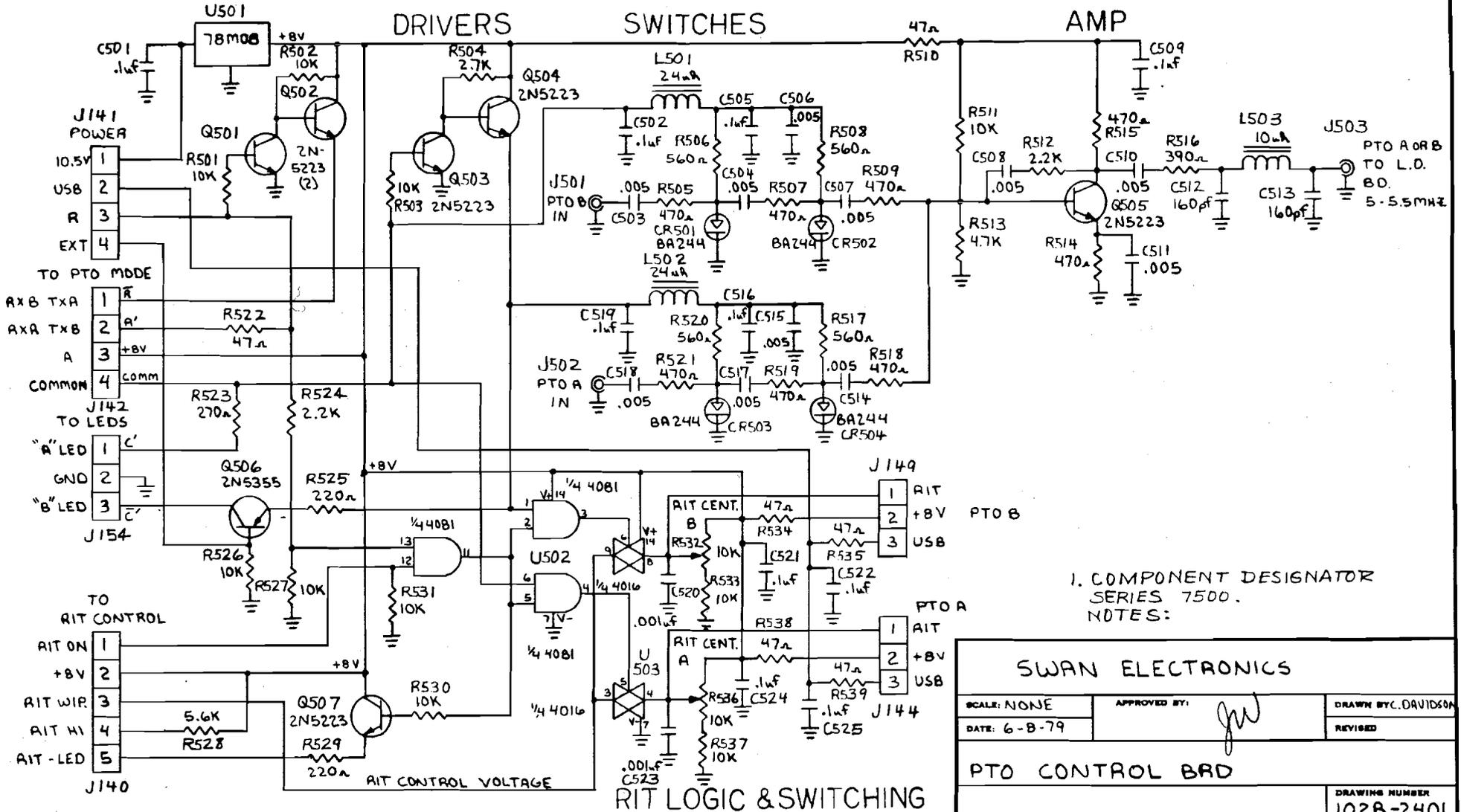
SWAN ELECTRONICS

SCALE: ~	APPROVED BY: <i>JW</i>	DRAWN BY: AJG
DATE: 9-18-79		REVISED
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		DRAWING NUMBER 102 BX-2301

PIN DIODE
DRIVERS

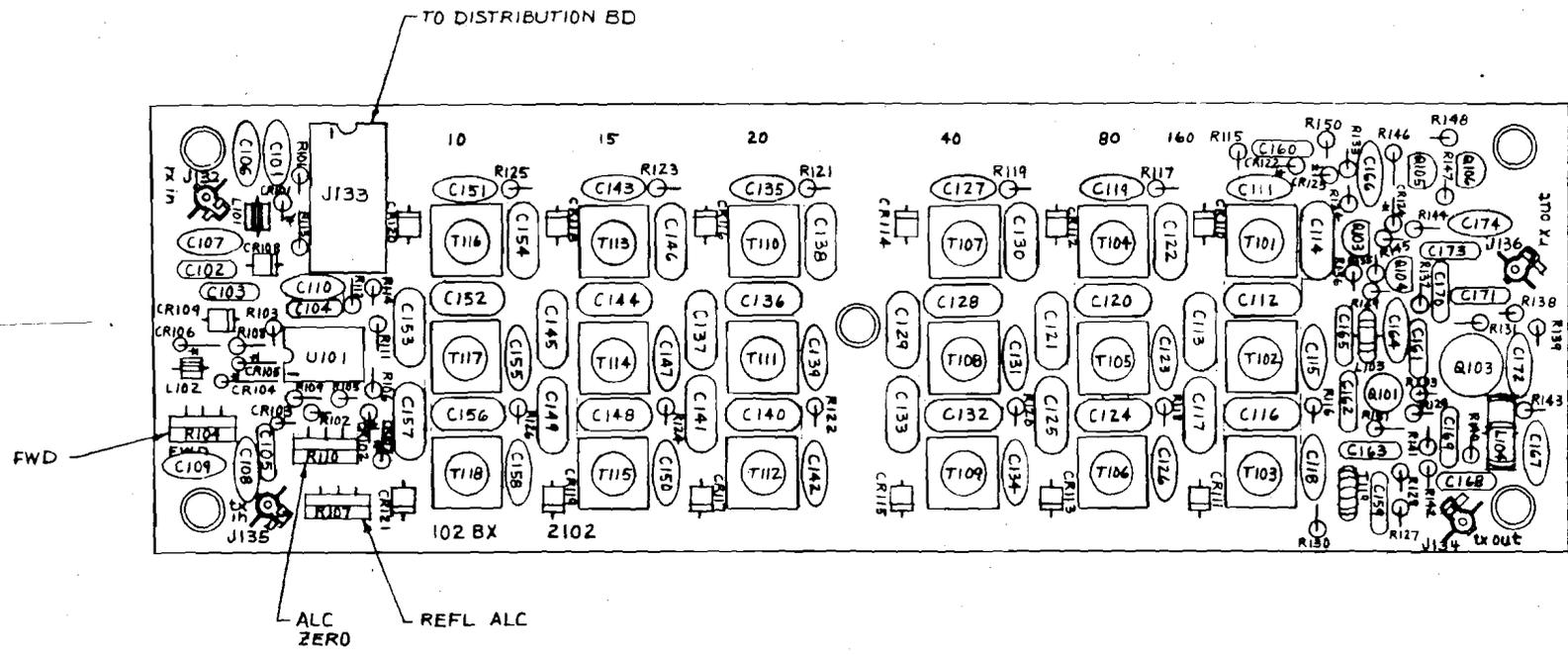
PTO
SWITCHES

OUTPUT
AMP



1. COMPONENT DESIGNATOR
SERIES 7500.
NOTES:

SWAN ELECTRONICS		
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DATE: 6-8-79		REVISED
PTO CONTROL BRD		
		DRAWING NUMBER 1028-2401



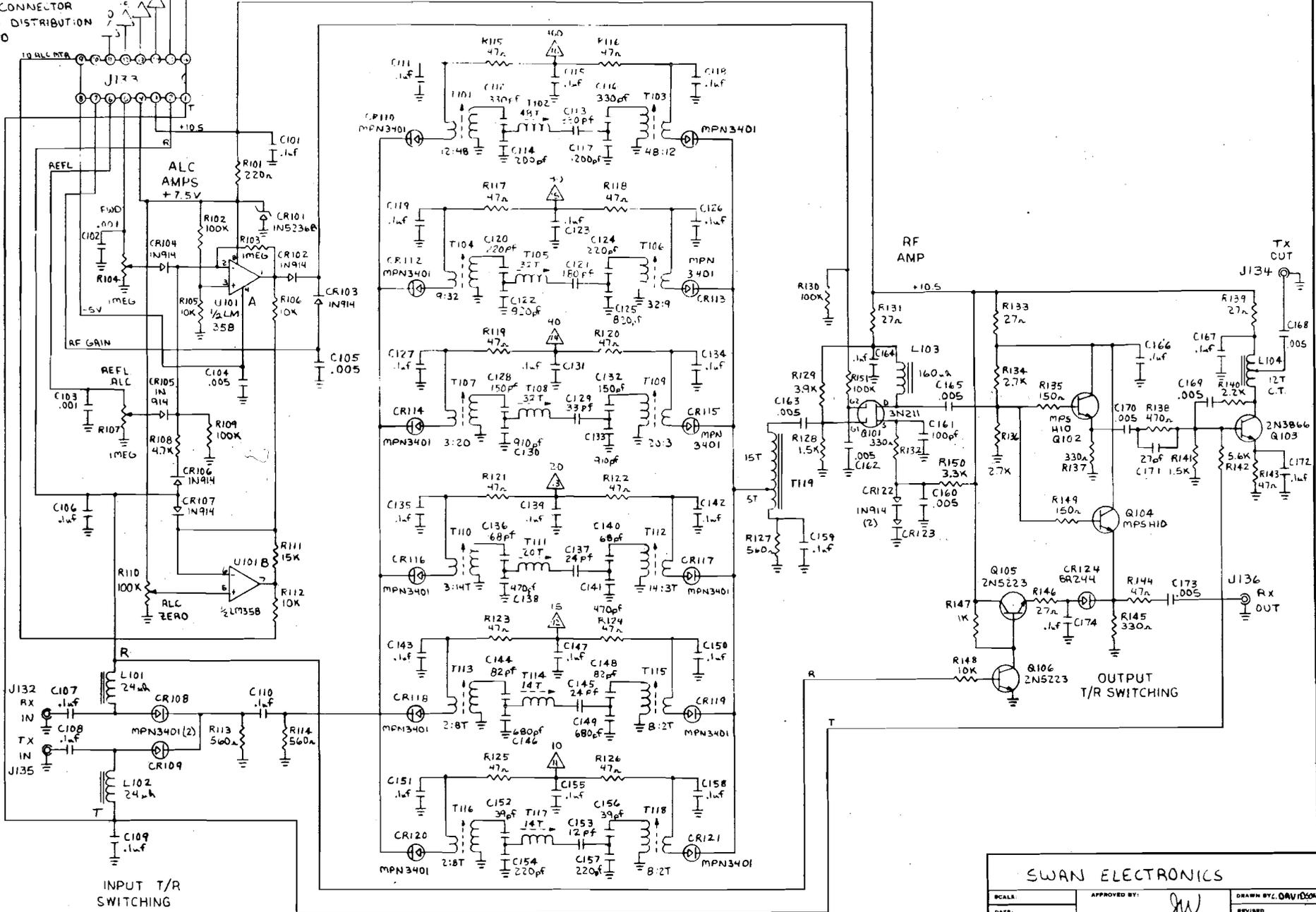
2. COMPONENT DESIGNATION SERIES 8000 .
1. REF. ELECT. ASSY 102 BX-2002
 - REF. CIRCUIT BD 102 BX-2102
 - REF. DRILL DWG 102 BX-2202
- NOTES:

SWAN ELECTRONICS		
SCALE: NONE	APPROVED BY: <i>ju</i>	DRAWN BY: AJG
DATE: 7-24-79		OFFICE:
PRESELECTOR BOARD LAYOUT		
REV:		DRAWING NUMBER: 102 BX-2302

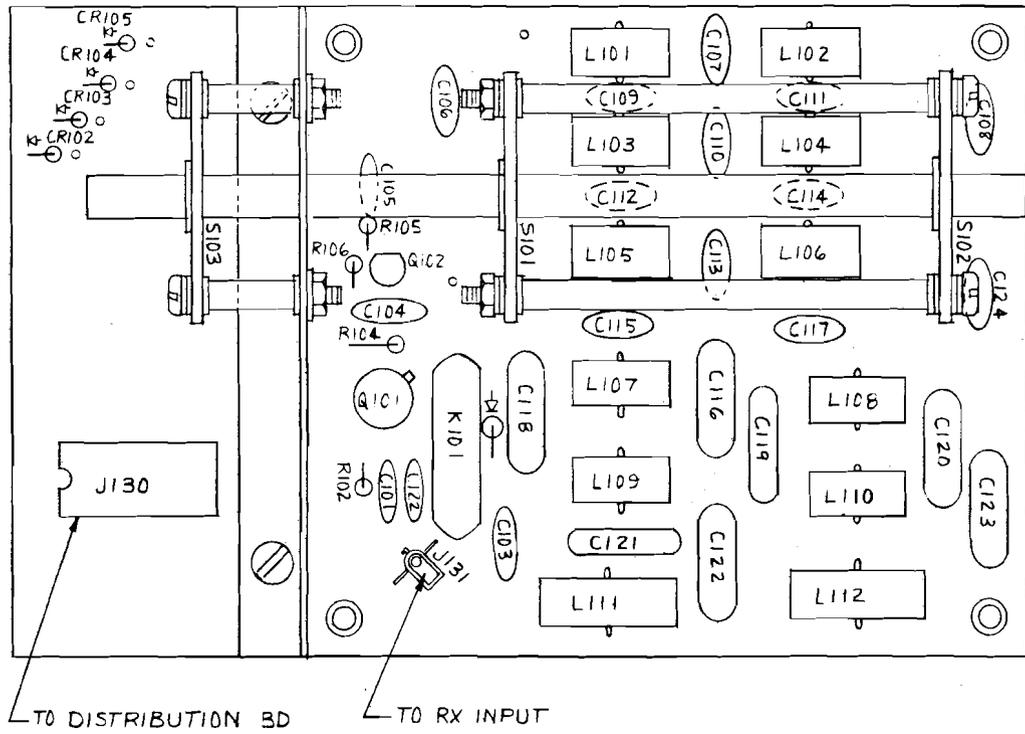
COMPONENT DESIGNATORS:
8000 SERIES

DIP CONNECTOR
FROM DISTRIBUTION
800

BANDPASS FILTERS

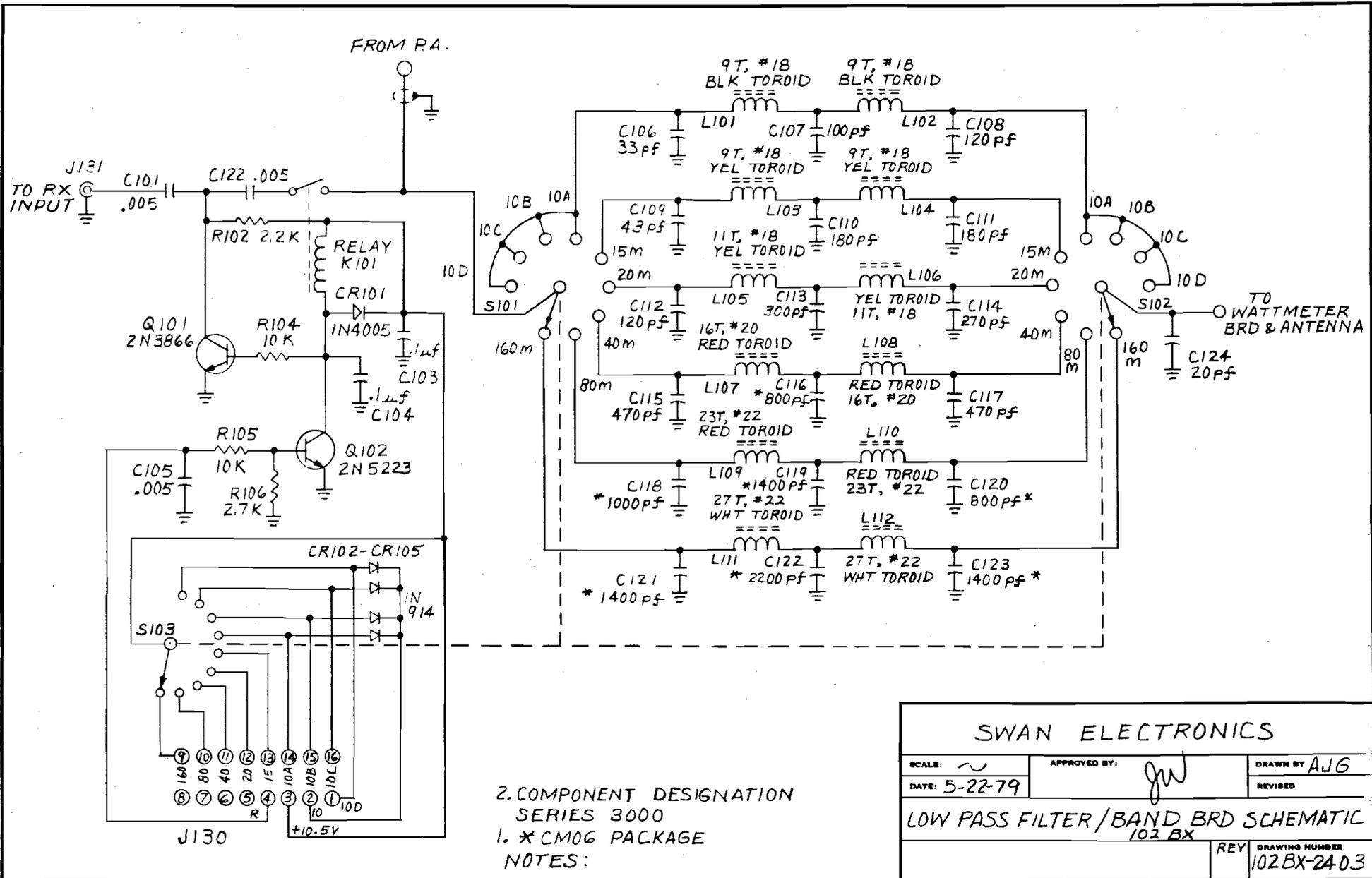


SWAN ELECTRONICS		
SCALE:	APPROVED BY:	DRAWN BY: DAVIDSON
DATE:	<i>JW</i>	REVISED:
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DRAWING NUMBER		282-02



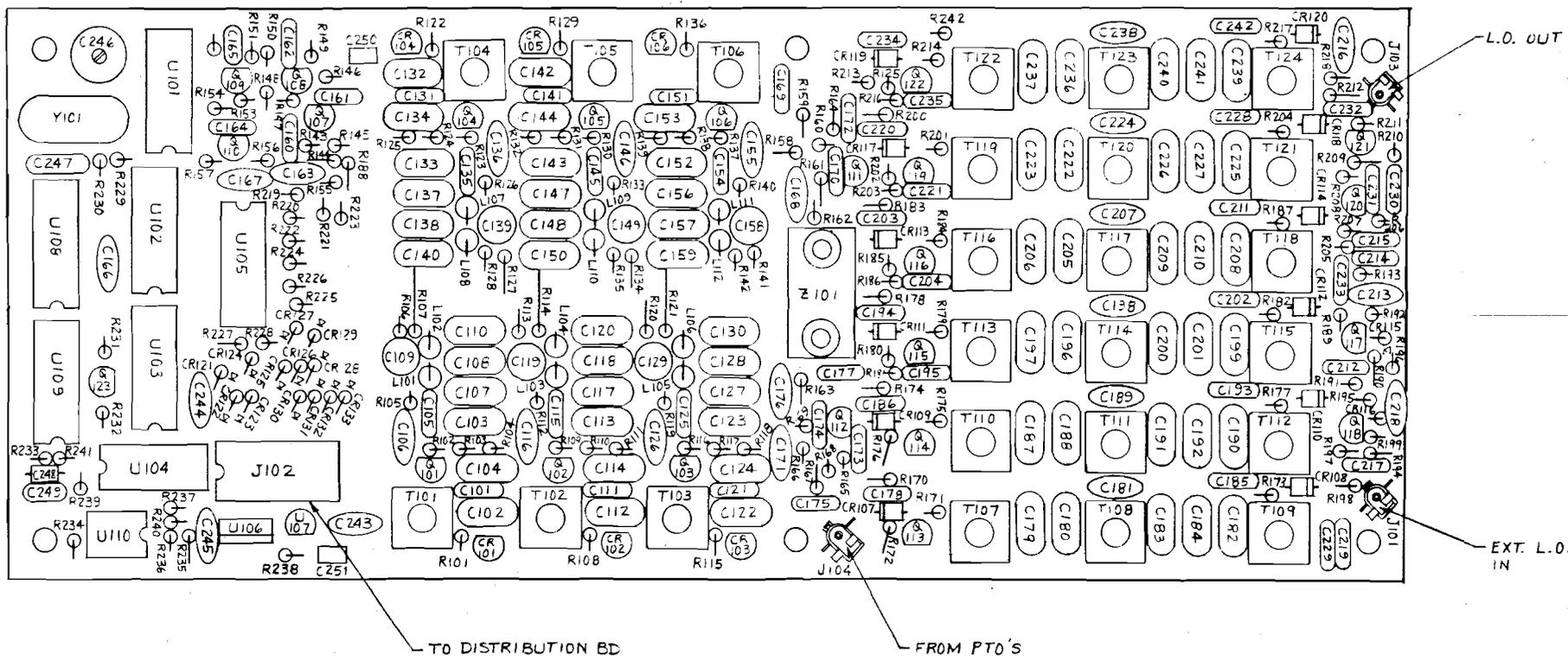
2. COMPONENT DESIGNATORS 3000 SERIES.
 1. REF ELEC. ASSY 102BX-2003
 REF CIRCUIT BD 102BX-2103
 REF DRILL DWG 102BX-2203
 NOTES:

SWAN ELECTRONICS		
SCALE: ~	APPROVED BY: <i>JW</i>	DRAWN BY: AJG
DATE: 9-18-79		REVISED:
B'SWITCH & L.P. FILT. BD LAYOUT		
		DRAWING NUMBER 102BX-2303



2. COMPONENT DESIGNATION
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 1. *CM06 PACKAGE
 NOTES:

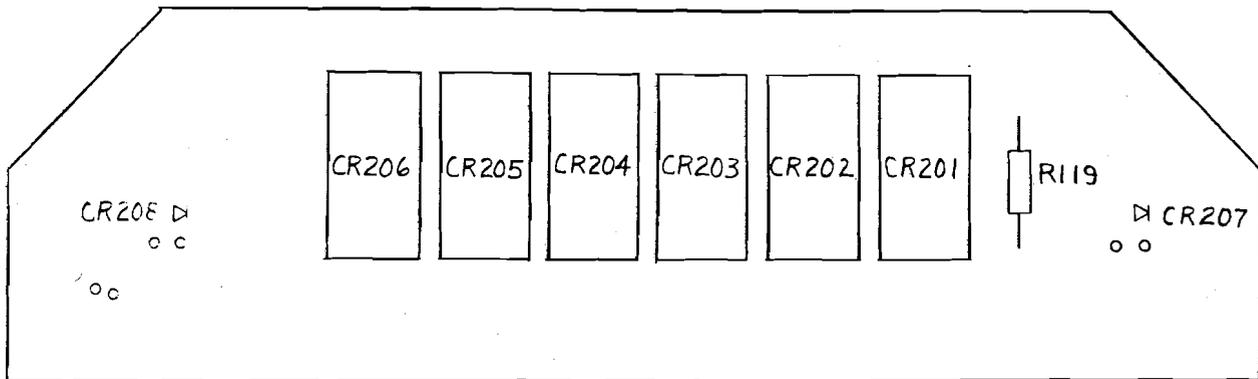
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SCALE: ~	APPROVED BY: <i>JW</i>	DRAWN BY: AJG
DATE: 5-22-79		REVISED
LOW PASS FILTER/BAND BRD SCHEMATIC 102 BX		
REY	DRAWING NUMBER 102BX-2403	



2. COMPONENT DESIGNATORS: 5000 SERIES

1. REF. ELECT. ASSY 102BX-2004
 - REF. CIRCUIT BOARD 102BX-2104
 - REF. DRILL DWG 102PX-2204
- NOTES.

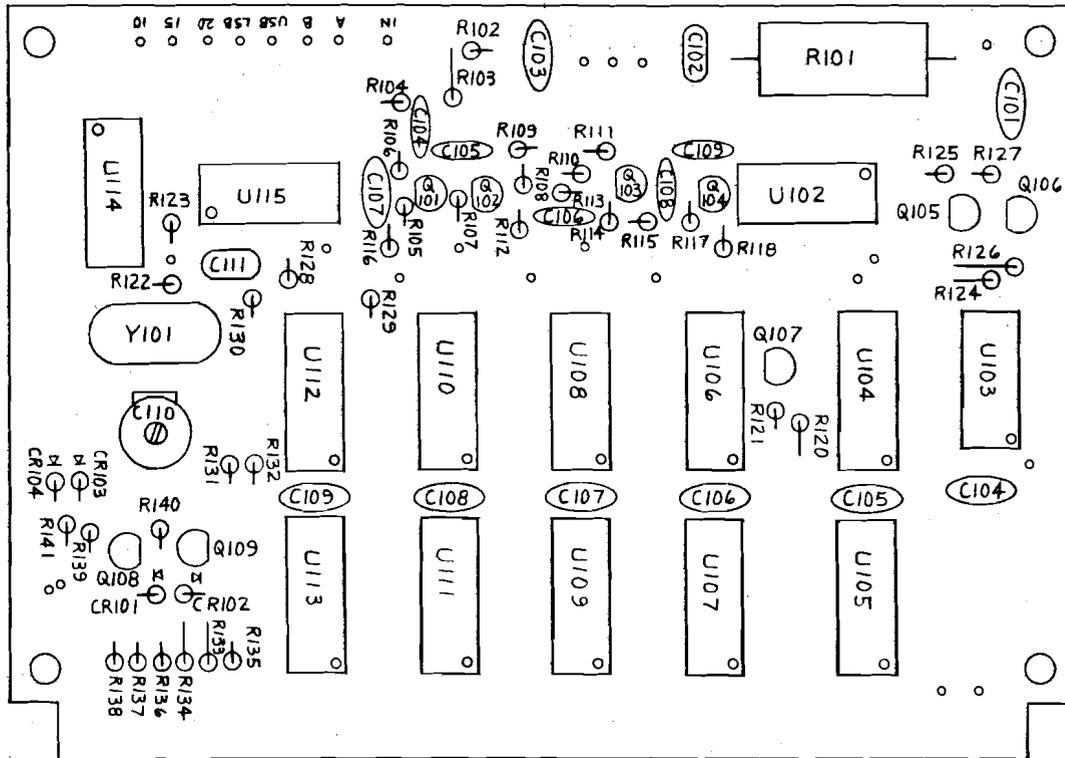
SWAN ELECTRONICS			
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DATE: 7-30-79		REVISED	
L.O. BOARD COMPONENT LAYOUT			
REV: 1	DRAWING NUMBER: 102BX-2304		



2. COMPONENT DESIGNATOR SERIES 7200
 1. REF. ELECT. ASSY 102BX-2006
 REF. CIRCUIT BD 102BX-2106
 REF. DRILL DWG 102BX-2206
 NOTES:

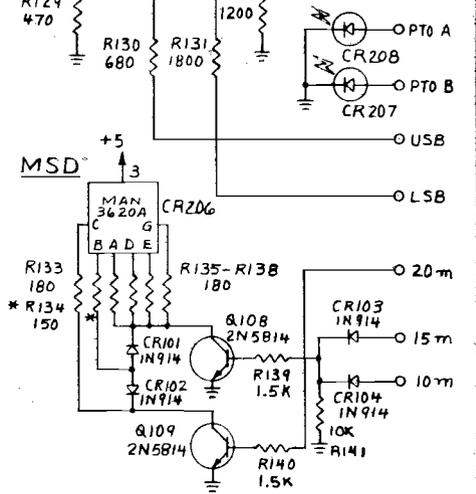
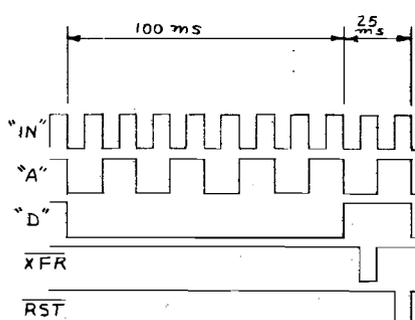
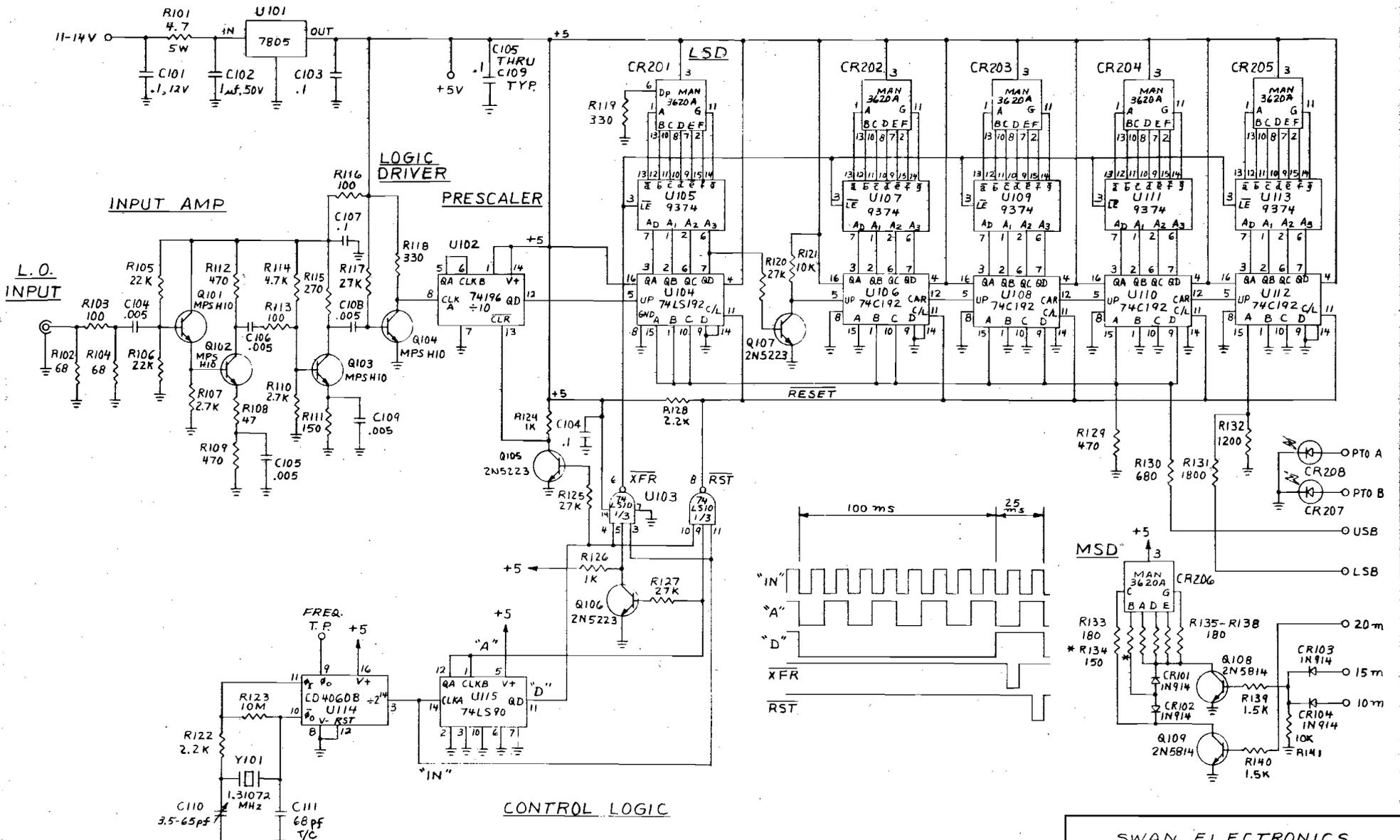
SWAN ELECTRONICS		
SCALE: ~	APPROVED BY: <i>JW</i>	DRAWN BY: AJG
DATE: 9-19-79		REVISED
DISPLAY BOARD LAYOUT		
		DRAWING NUMBER 102BX-2306

11X17 PRINTED ON NO. 1000H CLEARPRINT



2. COMPONENT DESIGNATORS 7100 SERIES
 1. REF. ELEC. ASSY 102BX-2005
 REF. CIRCUIT BD 102BX 2105
 REF. DRILL DWG 102BX 2205
 NOTES:

SWAN ELECTRONICS		
SCALE: ~	APPROVED BY: <i>JW</i>	DRAWN BY: AJG
DATE: 9-19-79		REVISION:
COUNTER BOARD LAYOUT		
		DRAWING NUMBER: 102BX-2305

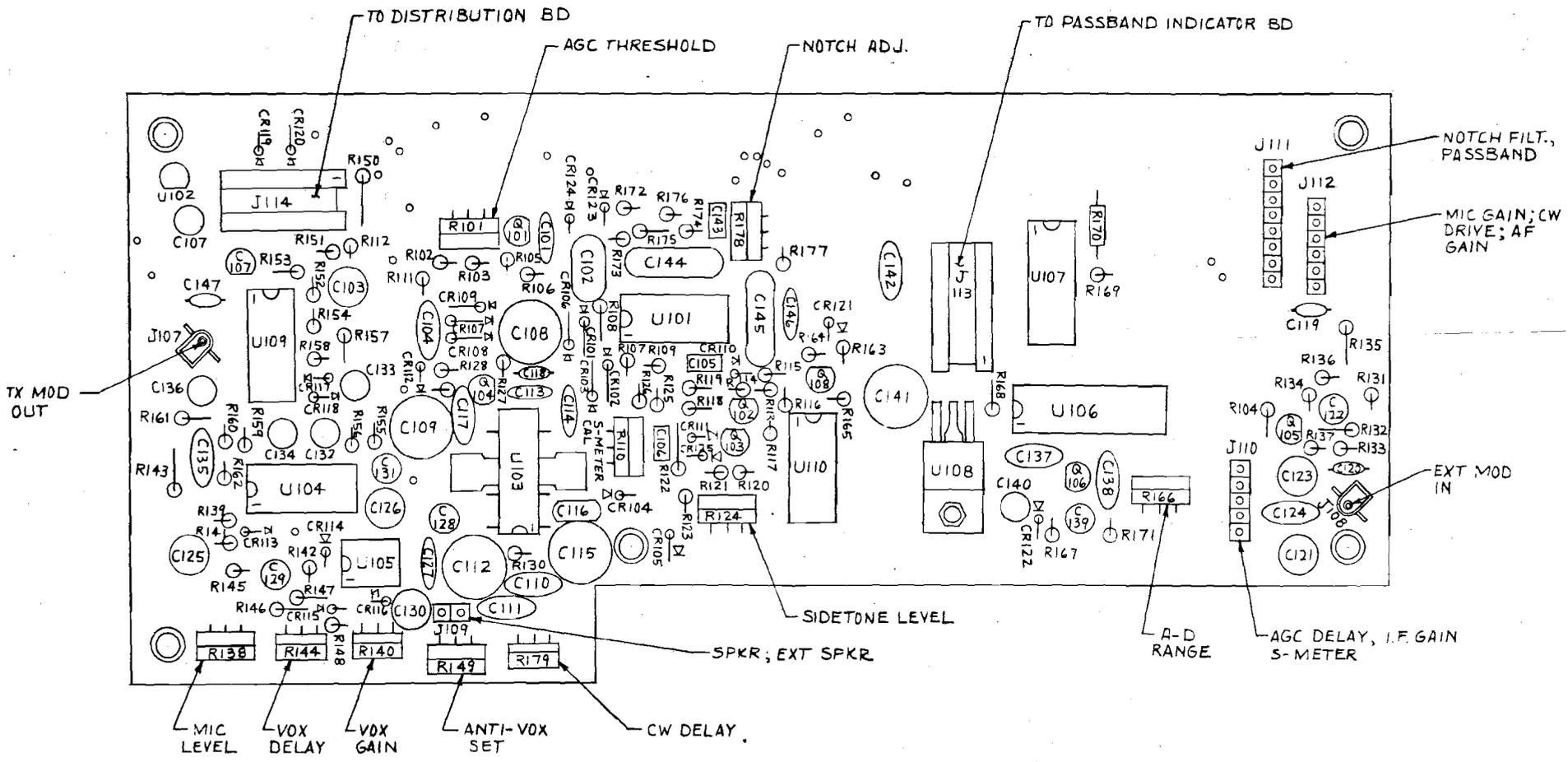


REF OSC/DIVIDER

CONTROL LOGIC

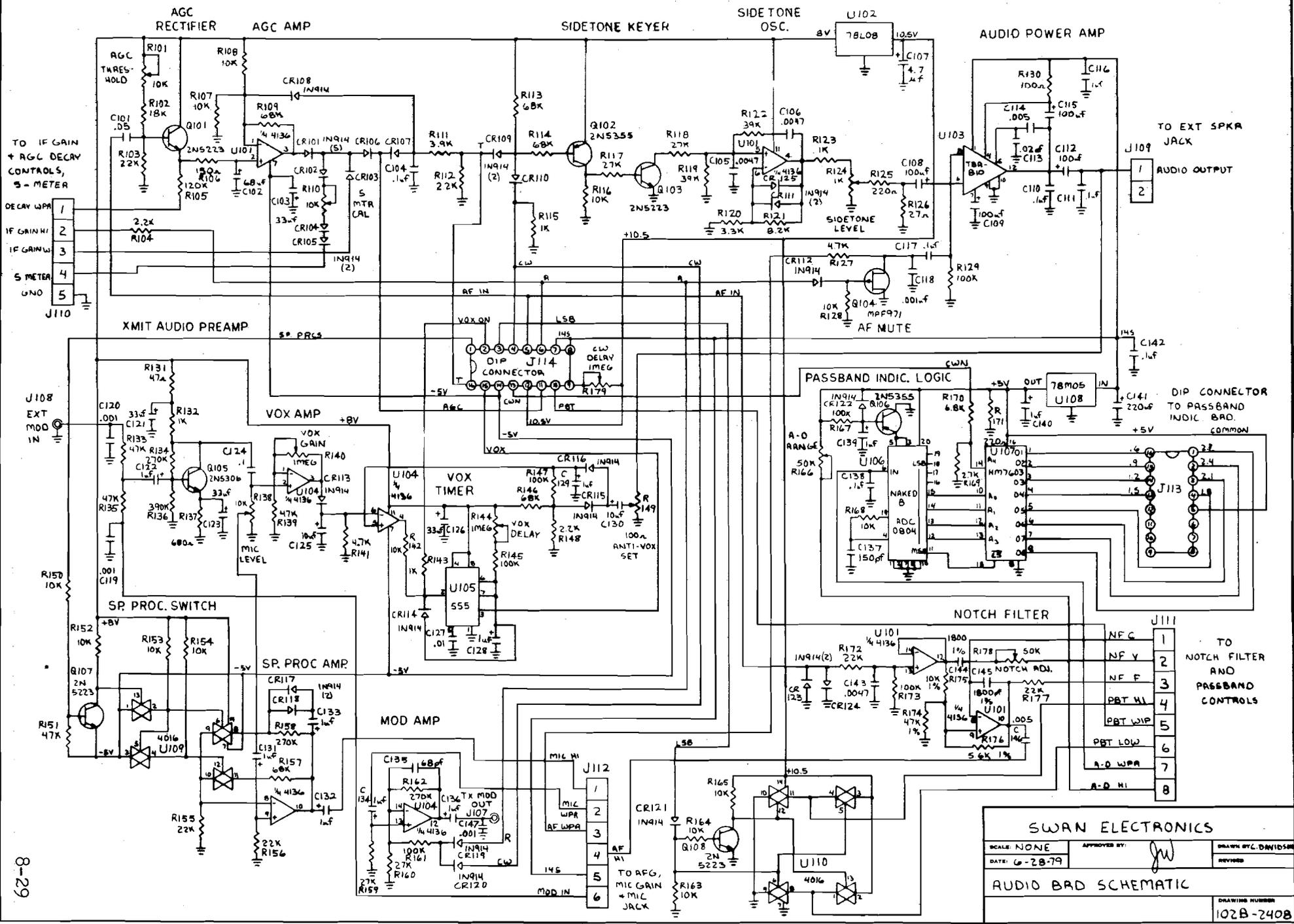
2. DISPLAY REF DESIGNATOR SERIES 720C
 1. COUNTER REF DESIGNATOR SERIES 7100
 NOTES:

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DATE: 6-8-79		REVISED:	
COUNTER / DISPLAY BD SCHEMATIC 102 BX			
REV	DRAWING NUMBER 102BX-2405		



2. COMPONENT DESIGNATORS 4000 SERIES.
 1. REF. ELECT. ASSY 102BX-2008
 REF. CIRCUIT BOARD 102BX-2108
 REF. DRILL DWG 102BX-2208
 NOTES:

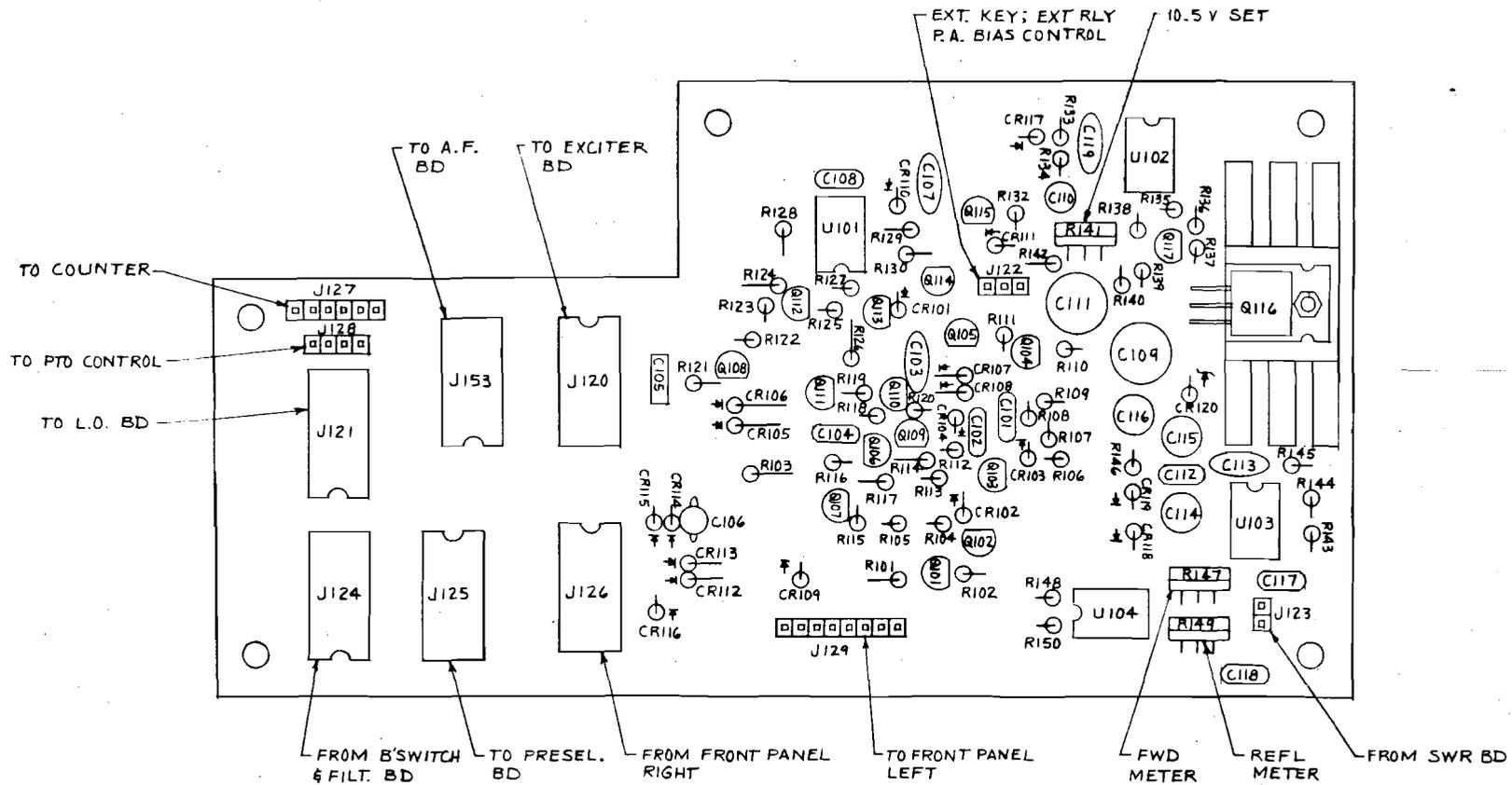
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DATE:		REVISED:
AUDIO BOARD LAYOUT		
		DRAWING NUMBER 102BX-2308



8-29

SWAN ELECTRONICS

SCALE: NONE	APPROVED BY: <i>JW</i>	DRAWN BY: DAVIDSON
DATE: 6-28-79		REVISION:
AUDIO BAD SCHEMATIC		
		DRAWING NUMBER 102B-240B



2. COMPONENT DESIGNATORS: 9000 SERIES

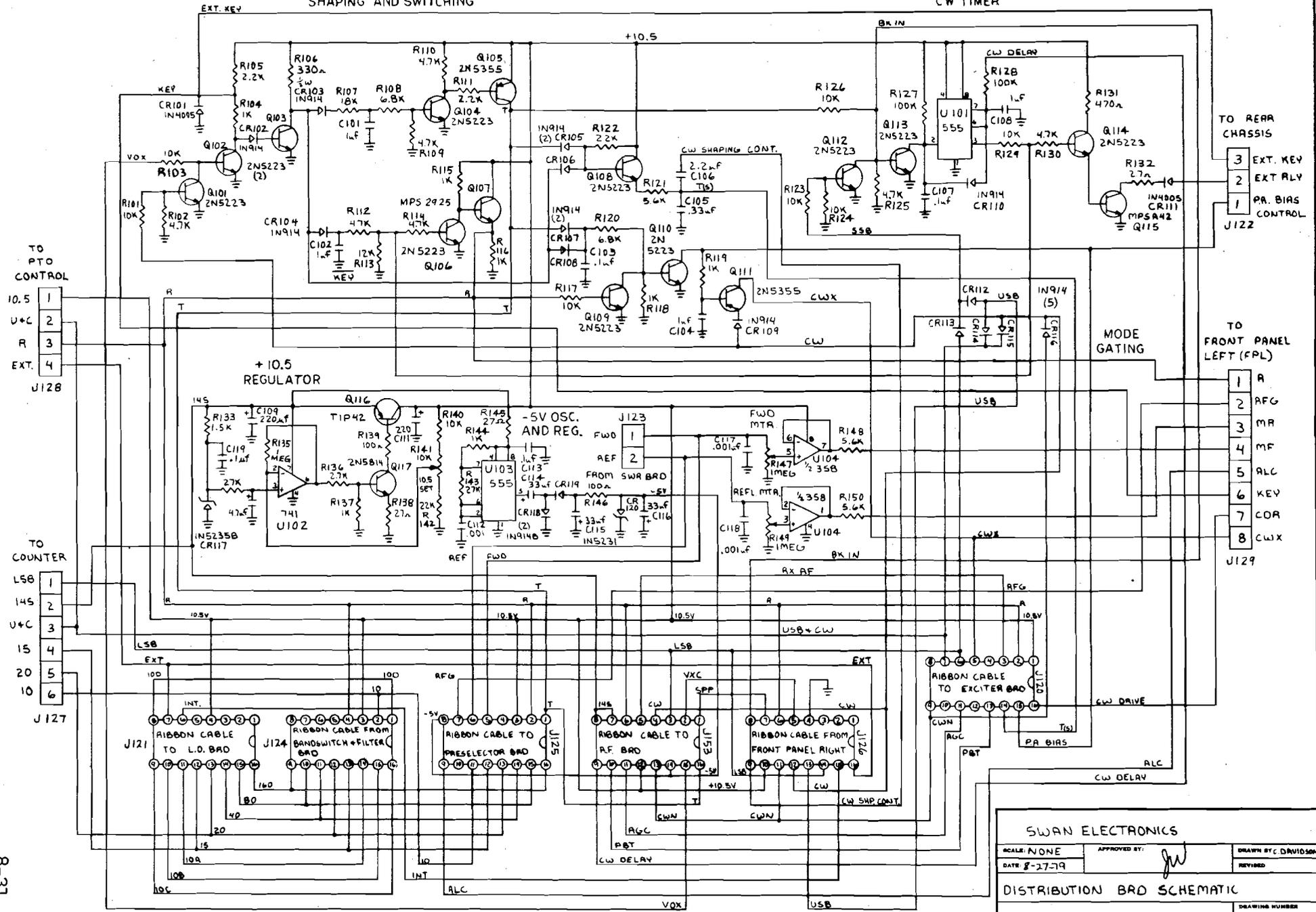
- 1. REF. ELECT. ASSY 102BX-2009
- REF. CIRCUIT BD 102BX-2109
- REF. DRILL DWG 102BX-2209

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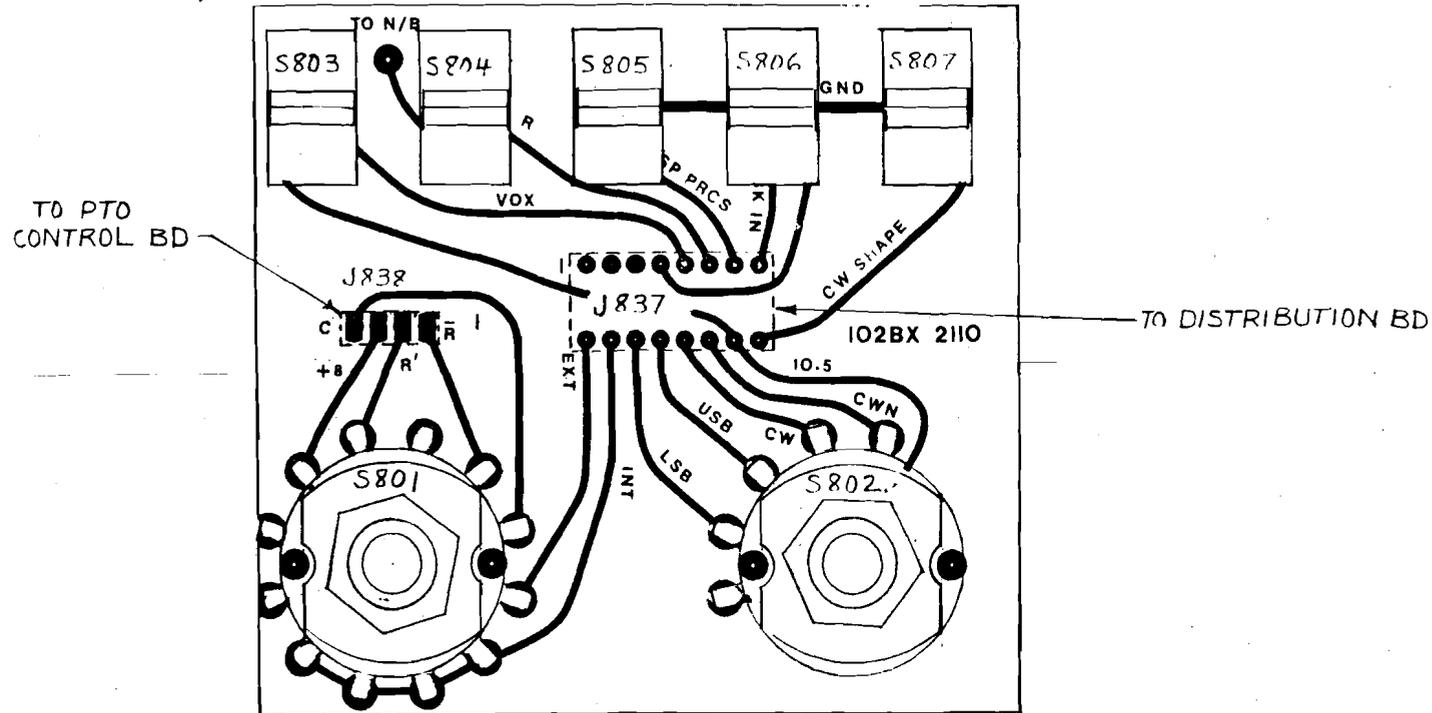
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SCALE: NONE	APPROVED BY: <i>[Signature]</i>	DRAWN BY: AJB	
DATE: 7-25-79		REVISION:	
DISTRIBUTION BOARD COMPONENT LAYOUT			
REV		DRAWING NUMBER	102BX-2309

CONTROL VOLTAGE
SHAPING AND SWITCHING

CW TIMER



SWAN ELECTRONICS		
SCALE: NONE	APPROVED BY: <i>JW</i>	DRAWN BY: DAVIDSON
DATE: 8-27-79		REVISED:
DISTRIBUTION BRD SCHEMATIC		
		DRAWING NUMBER
		102B-2409



3. J837 & J838 ON FARSIDE.
 2. COMPONENT DESIGNATOR SERIES 7800.
 1. REF. ELECTRICAL ASSY 102BX-2010
REF. CIRCUIT BOARD 102BX-2110
REF. DRILL DRAWING 102BX-2210
- NOTES:

SWAN ELECTRONICS

SCALE: 2 = 1

APPROVED BY:

DRAWN BY ALG

DATE: 9-12-79

REVISED

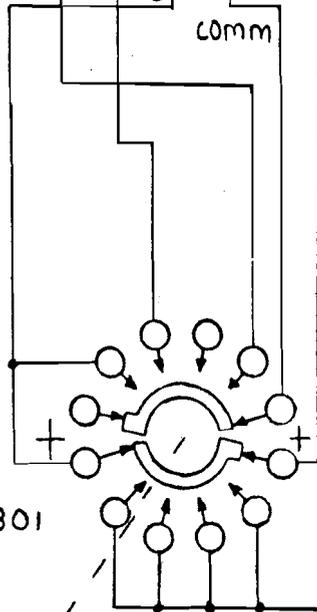
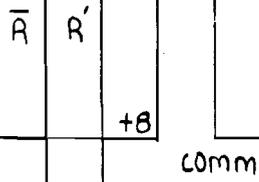
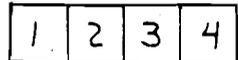
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DRAWING NUMBER
102BX-2310

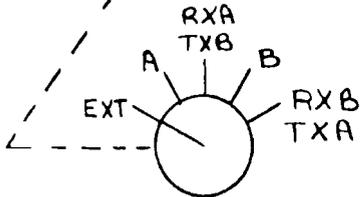
TO PTO.
CONTROL BAD

DIP CONNECTOR
TO DISTRIBUTION BAD

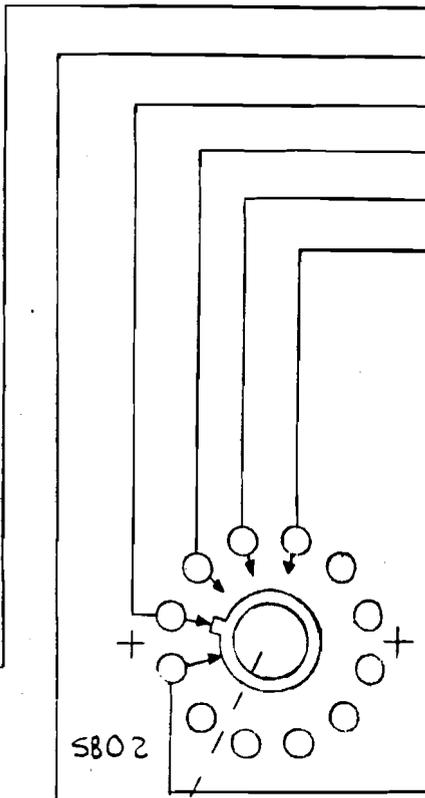
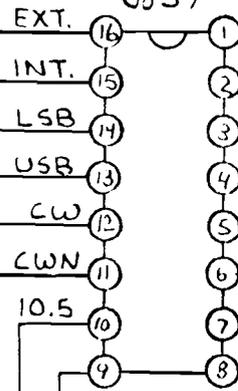
J838



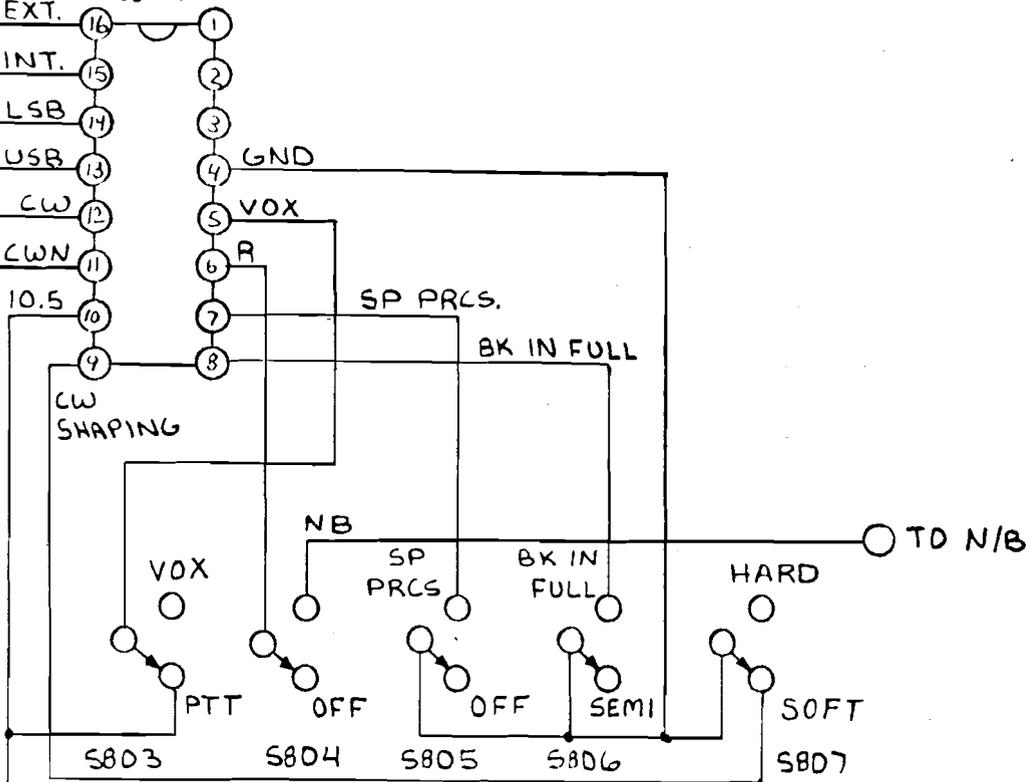
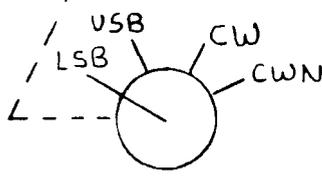
PTO MODE SW



J837



MODE SW



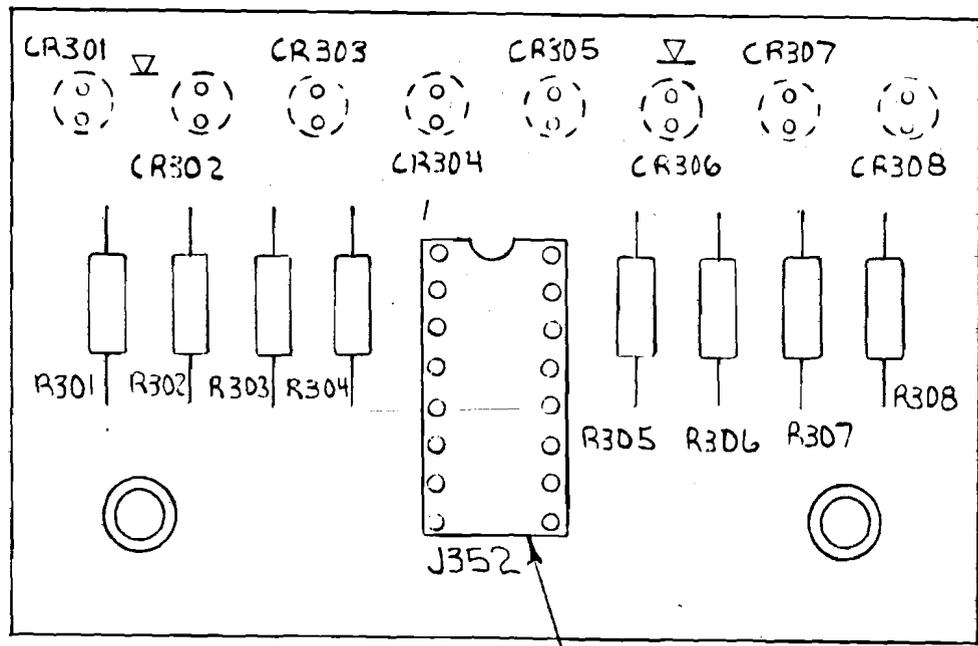
SWAN ELECTRONICS

SCALE: NONE	APPROVED BY: <i>JW</i>	DRAWN BY: DAVIDSON
DATE: 7-11-79		REVISED

FRONT PANEL RIGHT BOARD

COMPONENT DESIGNATORS (7000 SERIES) 102 BX-2410

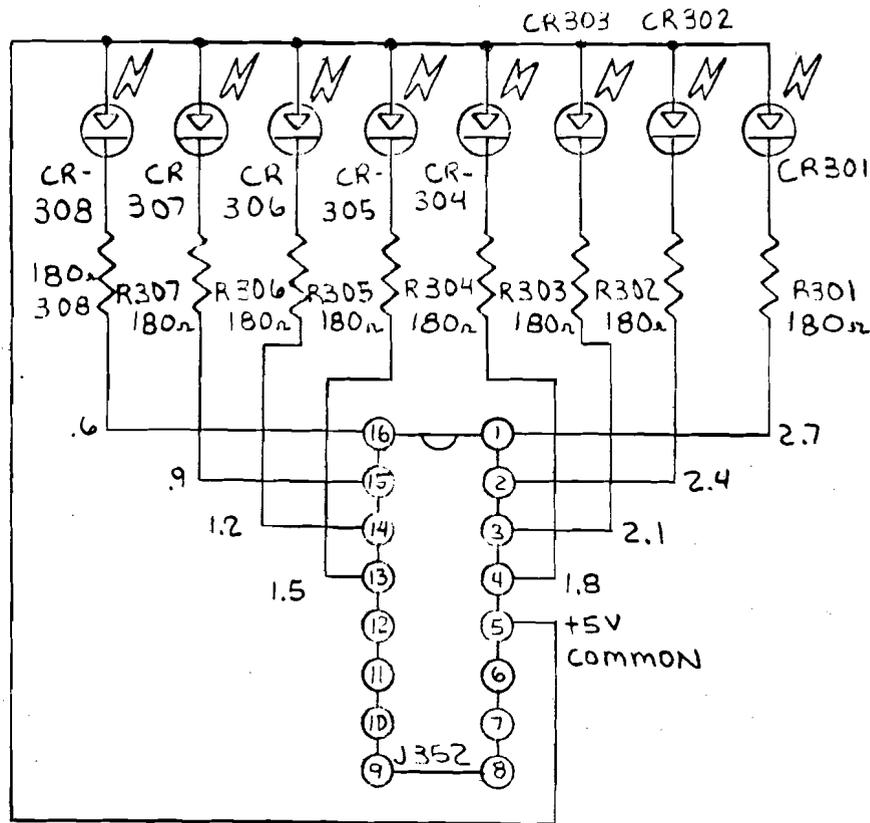
DRAWING NUMBER



TO AUDIO BD

- 3. REF. ELECTRICAL ASSY 102 BX-2011
 - REF. CIRCUIT BOARD 102 BX-2111
 - REF. DRILL DWG 102 BX-2211
 - 2. LEDS MOUNTED FAR SIDE.
 - 1. COMPONENT DESIGNATORS 7300 SERIES
- NOTES

<h2 style="margin: 0;">SWAN ELECTRONICS</h2>		
SCALE: NONE	APPROVED BY: <i>[Signature]</i>	DRAWN BY AJG
DATE:		REVISED
<h3 style="margin: 0;">PASSBAND IND. BD LAYOUT</h3> <p style="margin: 0;">102 BX</p>		
		DRAWING NUMBER 102 BX-2311



DIP CONNECTOR
FROM AUDIO BRD.

SWAN ELECTRONICS

SCALE: NONE

APPROVED BY:

DRAWN BY: DAVIDSON

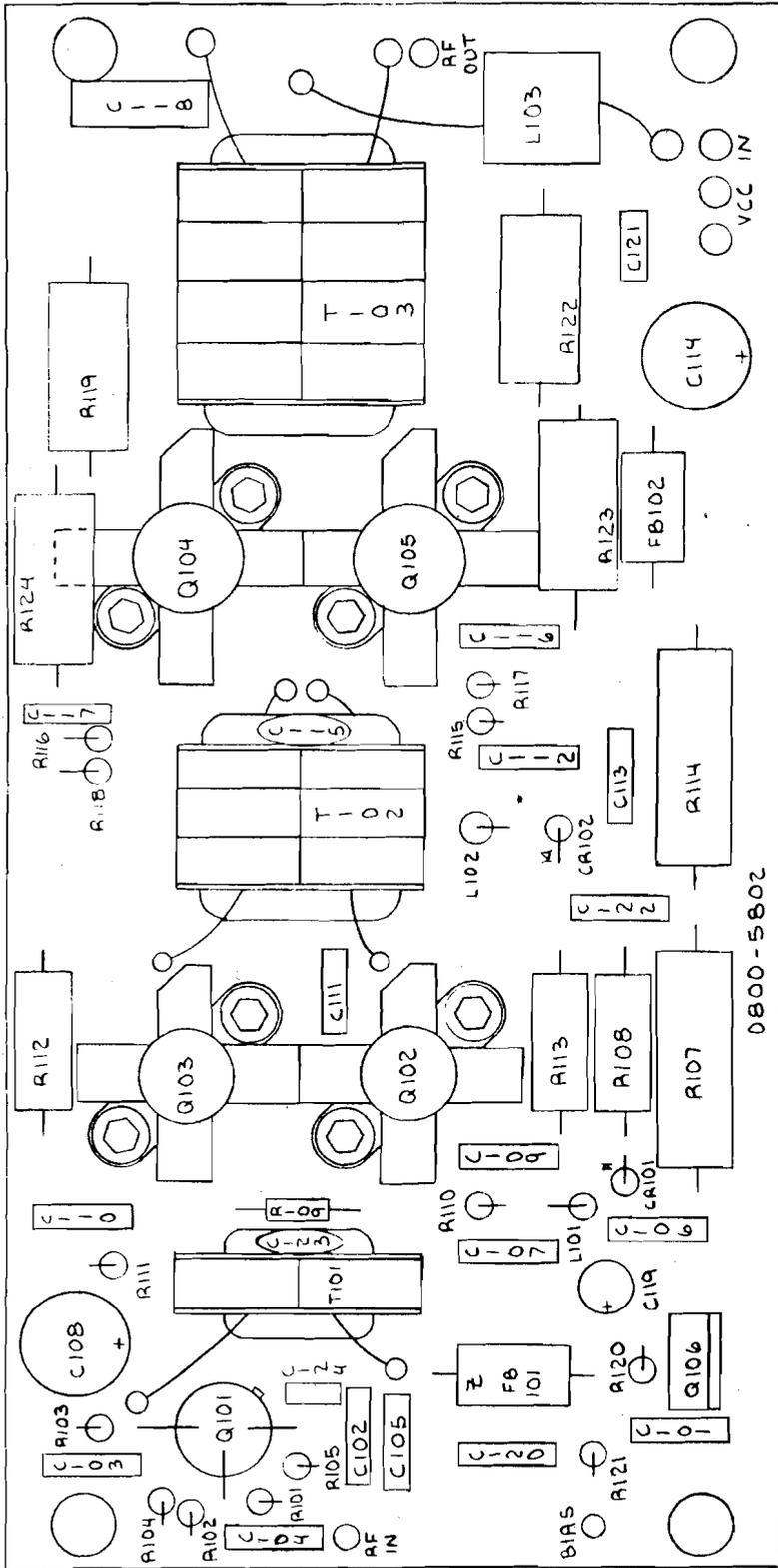
DATE: 7-10-79

REVISED

PASSBAND INDICATOR BOARD SCHEMATIC

DRAWING NUMBER

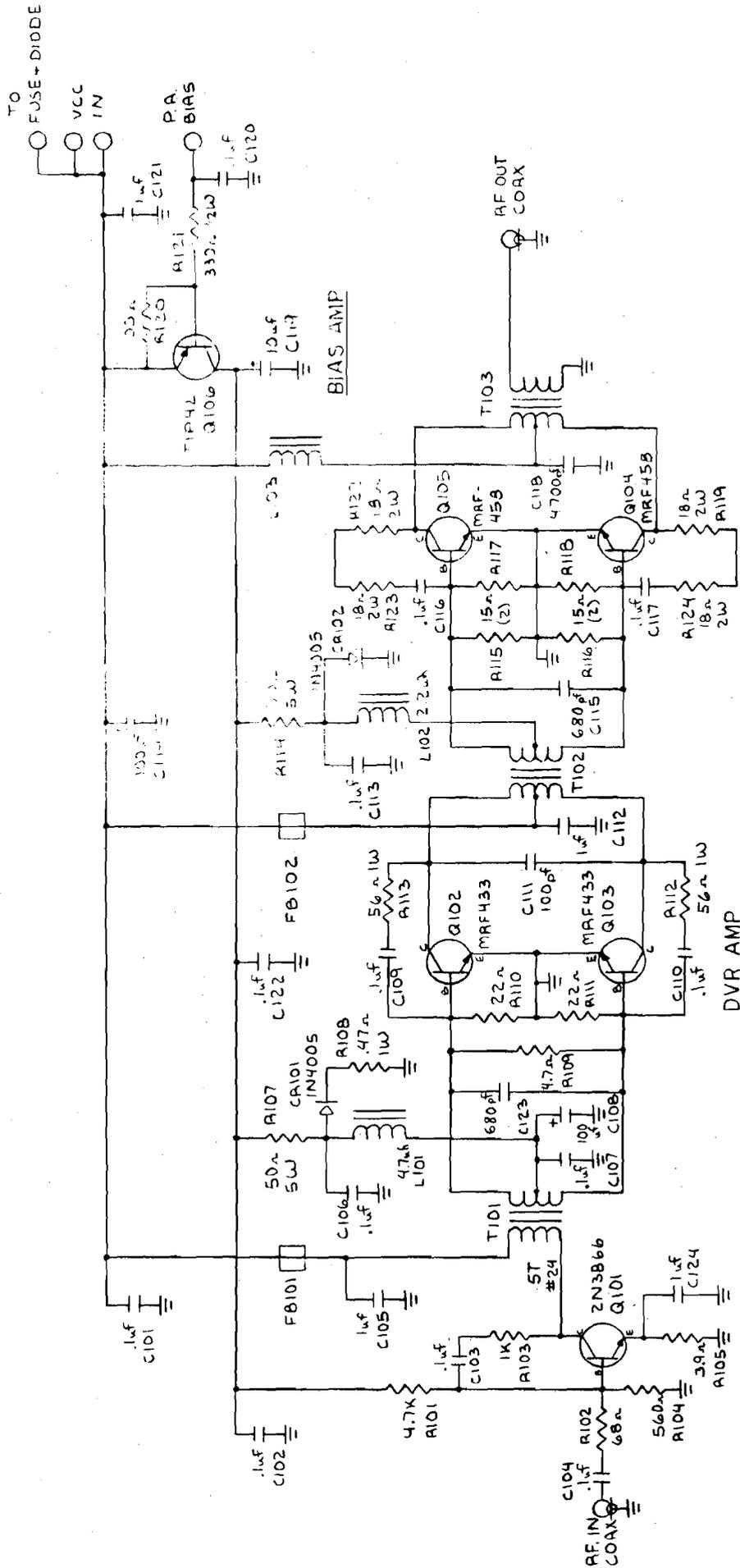
1020 2411



SWAN ELECTRONICS	
SCALE: NONE	APPROVED BY:
DATE: 1-2-79	REVIEWED:
POWER AMP BOARD LAYOUT	
DRAWN BY: C. DAVIDSON REVISED: 0800-2302	

1. COMPONENT DESIGNATORS (6000 SERIES)
NOTES:

11217 REVISED ON NO. 10000 CLEARPRINT



SWAN ELECTRONICS

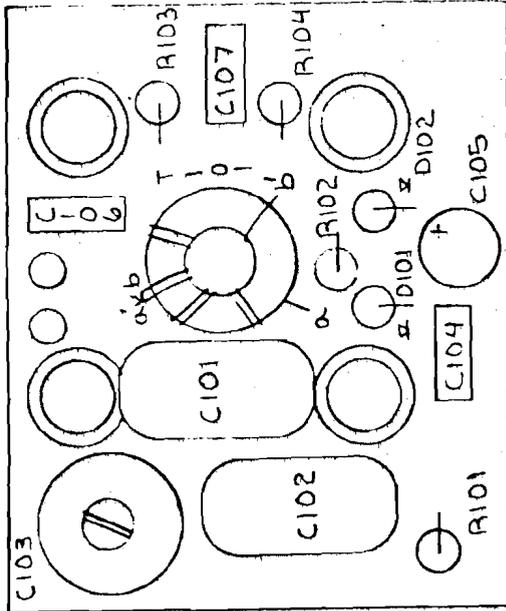
SCALE: NONE
 DATE: 1-2-78
 APPROVED BY: [Signature]
 DRAWN BY: DAVIDSON
 REVISED

POWER AMP BOARD SCHEMATIC
 REV B
 DRAWING NUMBER 0800-2402B

TR	DESCRIPTION	DATE	APPD
B	REPLACED ALL .05uf CAPS WITH .1uf	6-1-79	JW
	CD 5-30-79		

1. COMPONENT DESIGNATORS (GODO SERIES)

1117 PRINTED ON NO. 100K CLEARPRINT



SWAN ELECTRONICS

SCALE: NONE

APPROVED BY:

DRAWN BY C. DAVIDSON

DATE: 1-11-79

REVISED

SWR / WATTMETER BAD LAYOUT

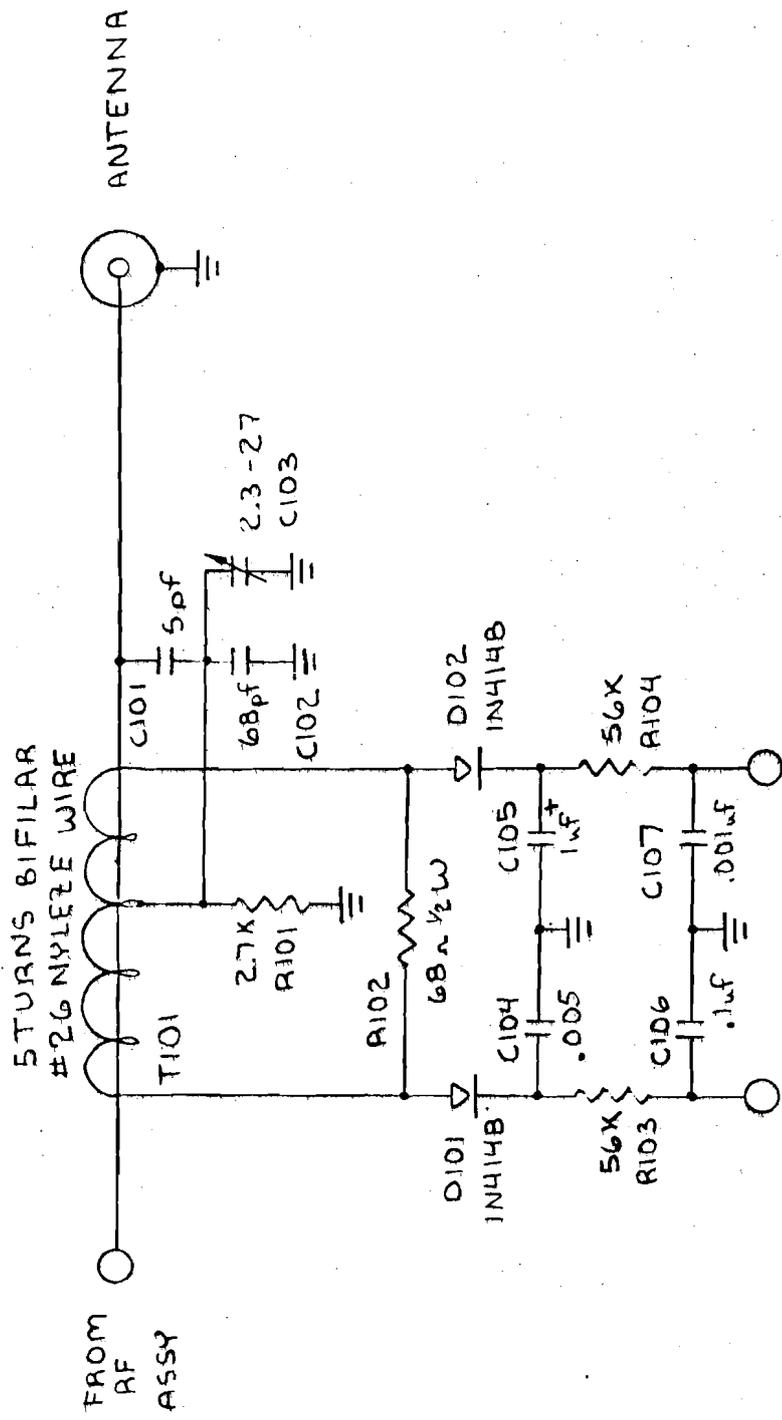
DRAWING NUMBER

0800-2303

COMPONENT DESIGNATORS (7700 SERIES)

NOTES:

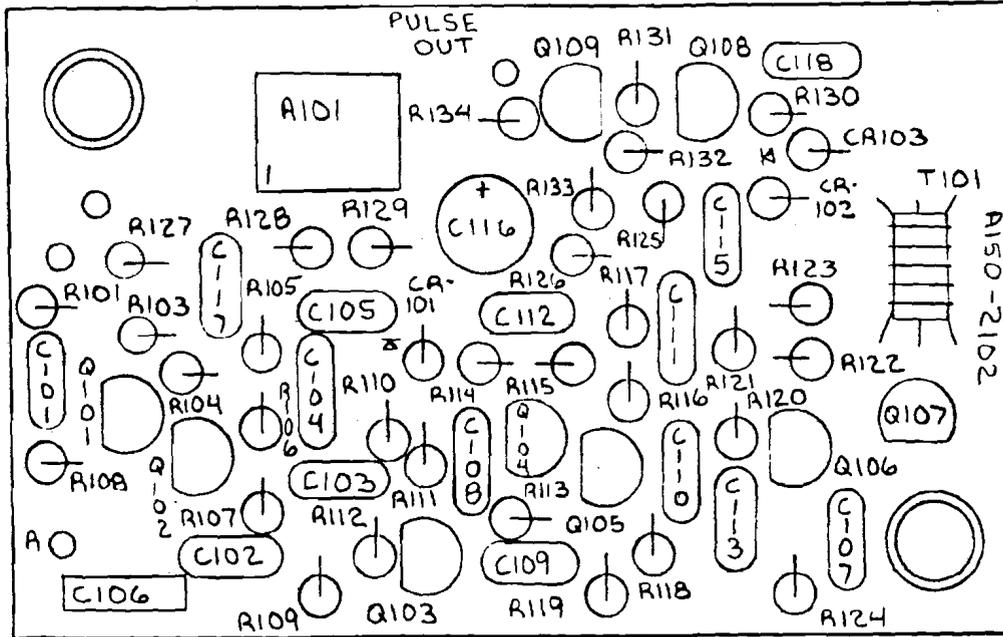
REV	DESCRIPTION	DATE	APPRO
A	CHANGED C106 FROM .001 TO .1μf	8-24-79	gm



SCALE: NONE		APPROVED BY:	
		DRAWN BY: DAVIDSON	
DATE: 1-11-79		REVISED	
SWAN ELECTRONICS			
SWR/WATTMETER BRO SCHEMATIC			
DRAWING NUMBER			0800-2403A

1. COMPONENT DESIGNATORS (7700 SERIES)

NOTES

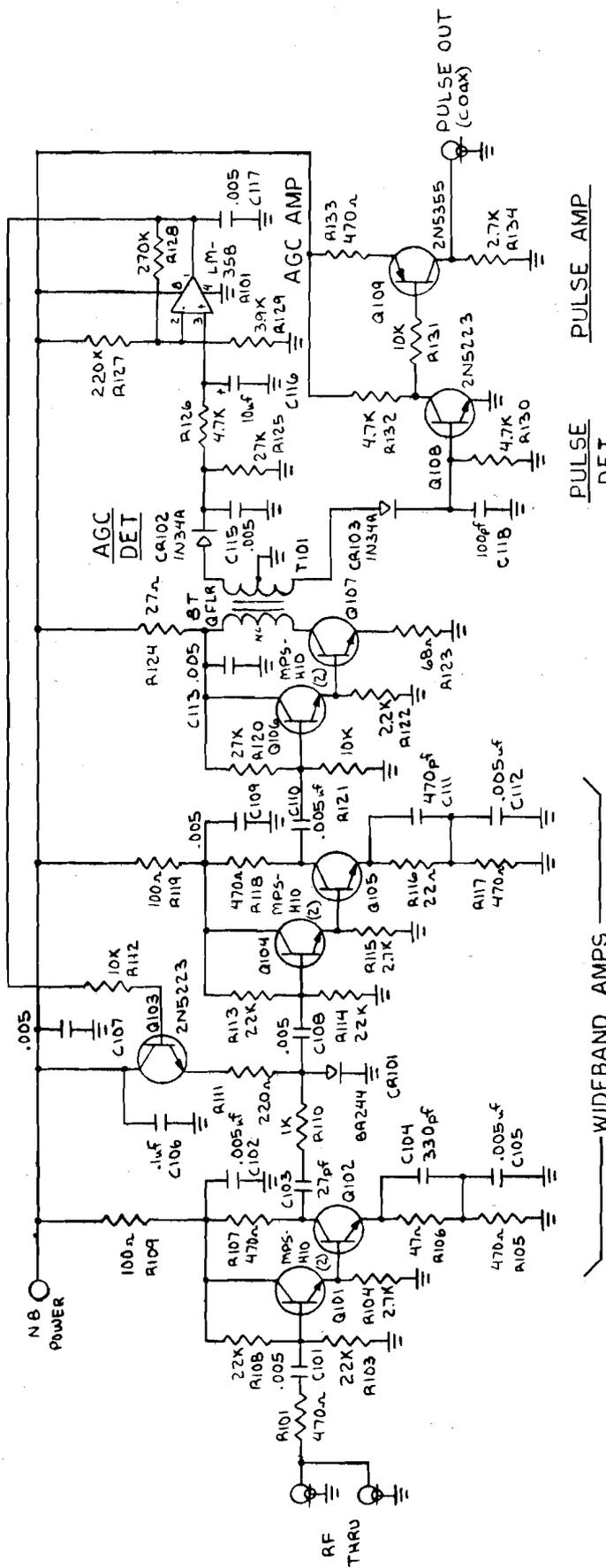


SWAN ELECTRONICS

SCALE: NONE	APPROVED BY: <i>ju</i>	DRAWN BY: DAVIDSDA
DATE: 1-12-79		REVISED

PROJ.	A150 NOISE BLANKER BRD LAYOUT	
0176		DRAWING NUMBER 0800-2304

1. COMPONENT DESIGNATORS (7400 SERIES)
NOTES



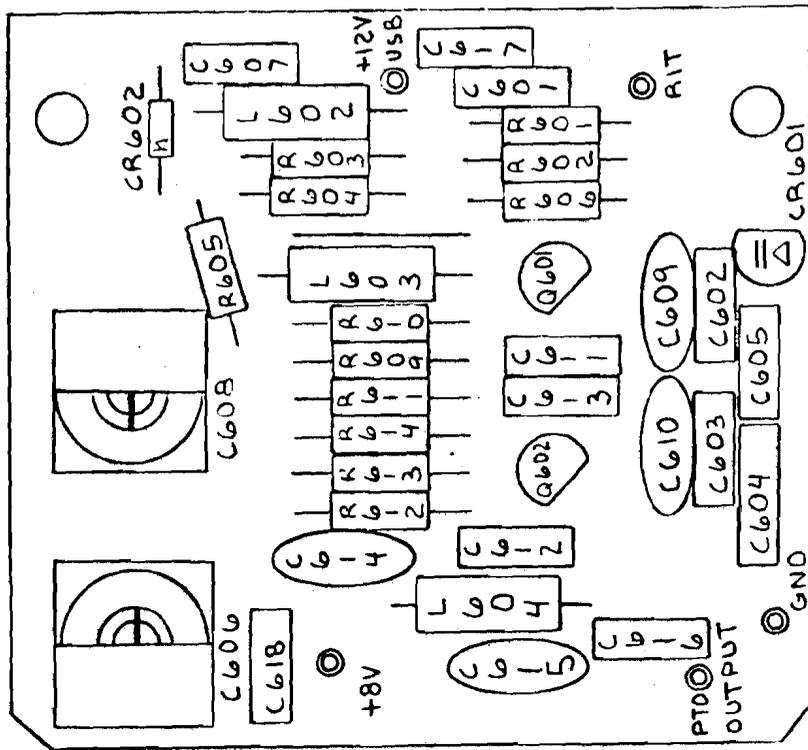
PULSE AMP
DET.

WIDEBAND AMPS

SWAN ELECTRONICS	
SCALE: NONE	APPROVED BY: <i>JW</i>
DATE: 1-12-78	REVISED
PROJ. A150 NOISE BLANKER BRD SCHEMATIC	DRAWING NUMBER 0800-2404A
0176	

1-COMPONENT DESIGNATORS (7400 SERIES)
NOTES

1217 PRINTED ON NO. 10000 CELLULOSE



SWAN ELECTRONICS

SCALE: NONE APPROVED BY:

DRAWN BY: DAVIDSON

DATE: 9-14-78

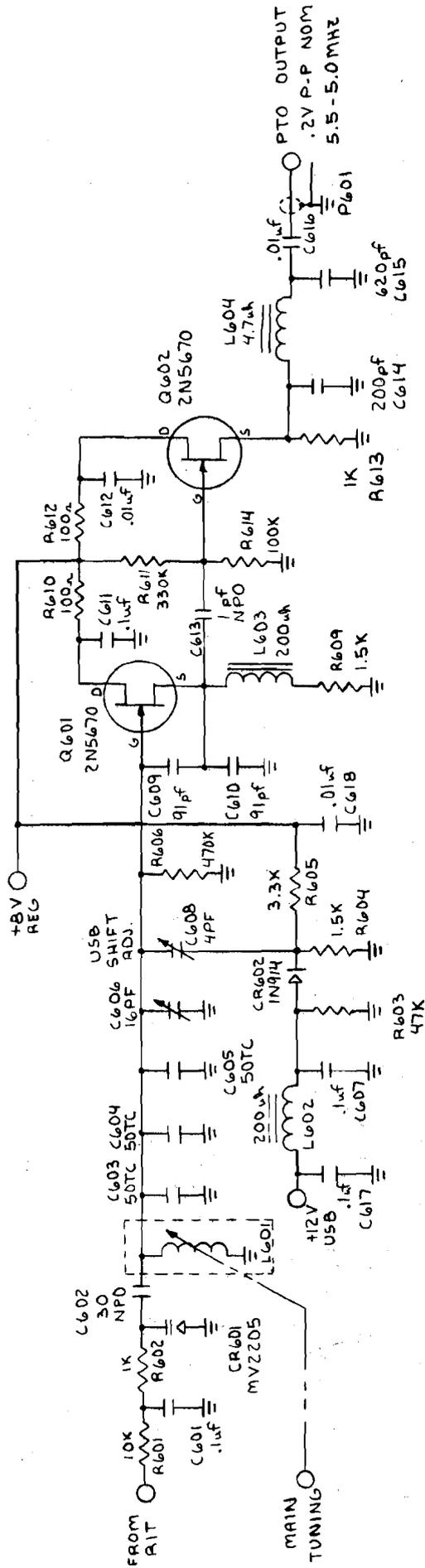
REVISED

PTO BRD LAYOUT

DRAWING NUMBER

0800-7205

1. COMPONENT DESIGNATORS 7600 SERIES
NOTES

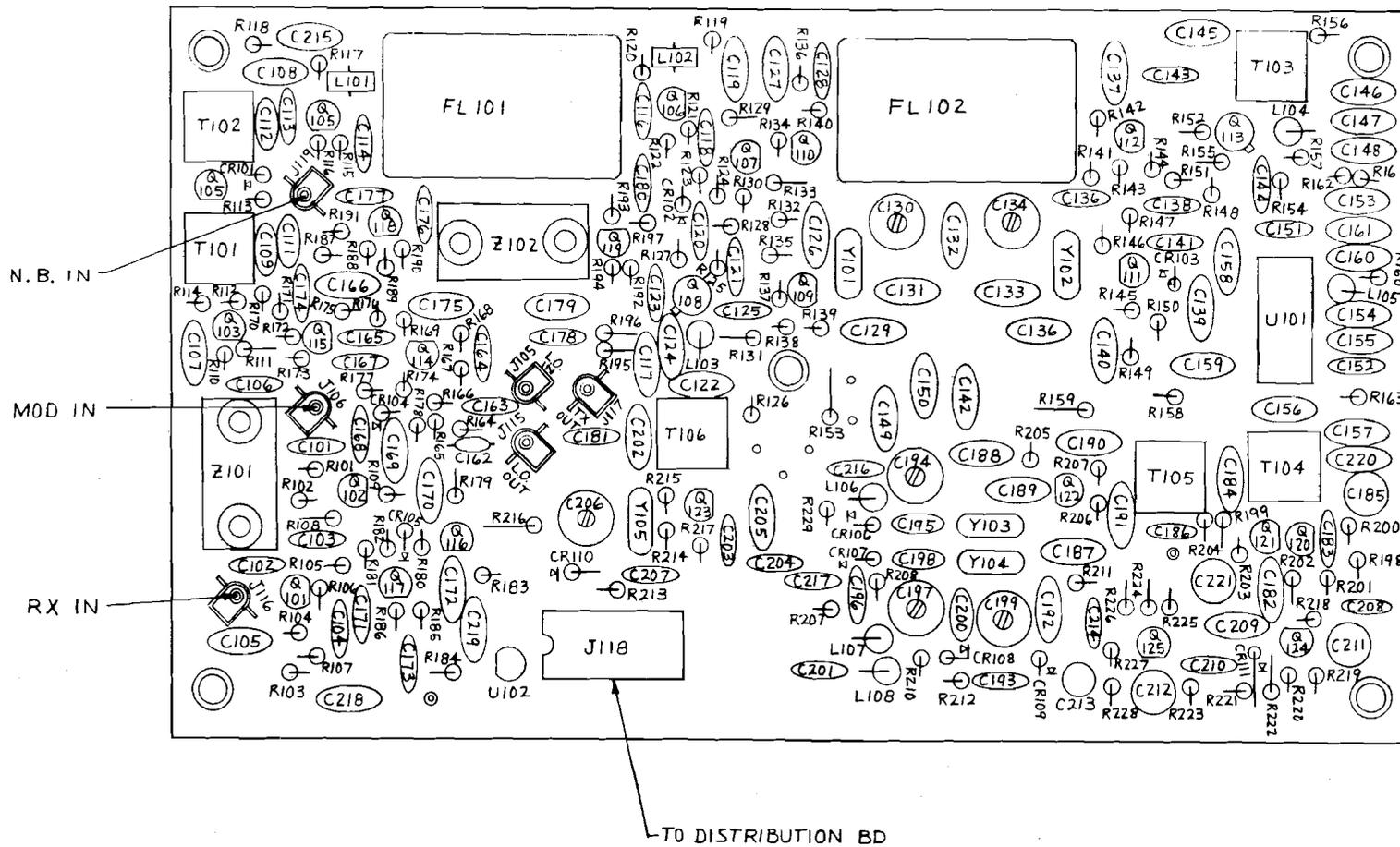


SWAN ELECTRONICS

SCALE: NONE	APPROVED BY:	DRAWN BY: C. DAVIDSON
DATE: 9-22-78	REVISED:	
PTO BRD SCHEMATIC (038-188A)		DRAWING NUMBER
		0800-2405

1. COMPONENT DESIGNATORS 7600 SERIES
 NOTES

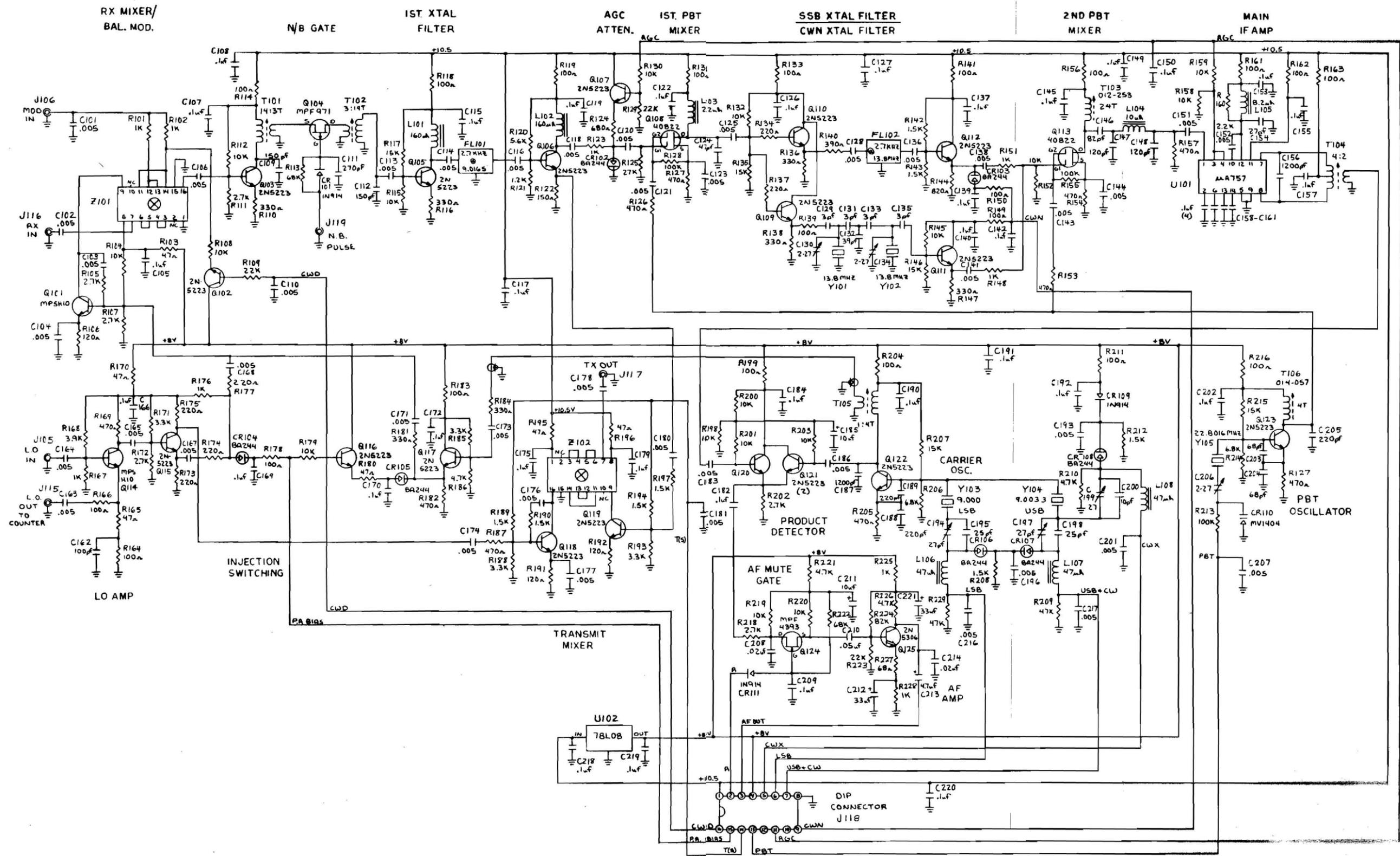
11117 PRINTED ON NO. 10080 CLAMPBURY



2. COMPONENT DESIGNATORS 2000 SERIES.
 1. REF. ELECT. ASSY 102 BX-2007
 REF. CIRCUIT BOARD 102 BX-2107
 REF. DRILL DWG 102 BX-2204

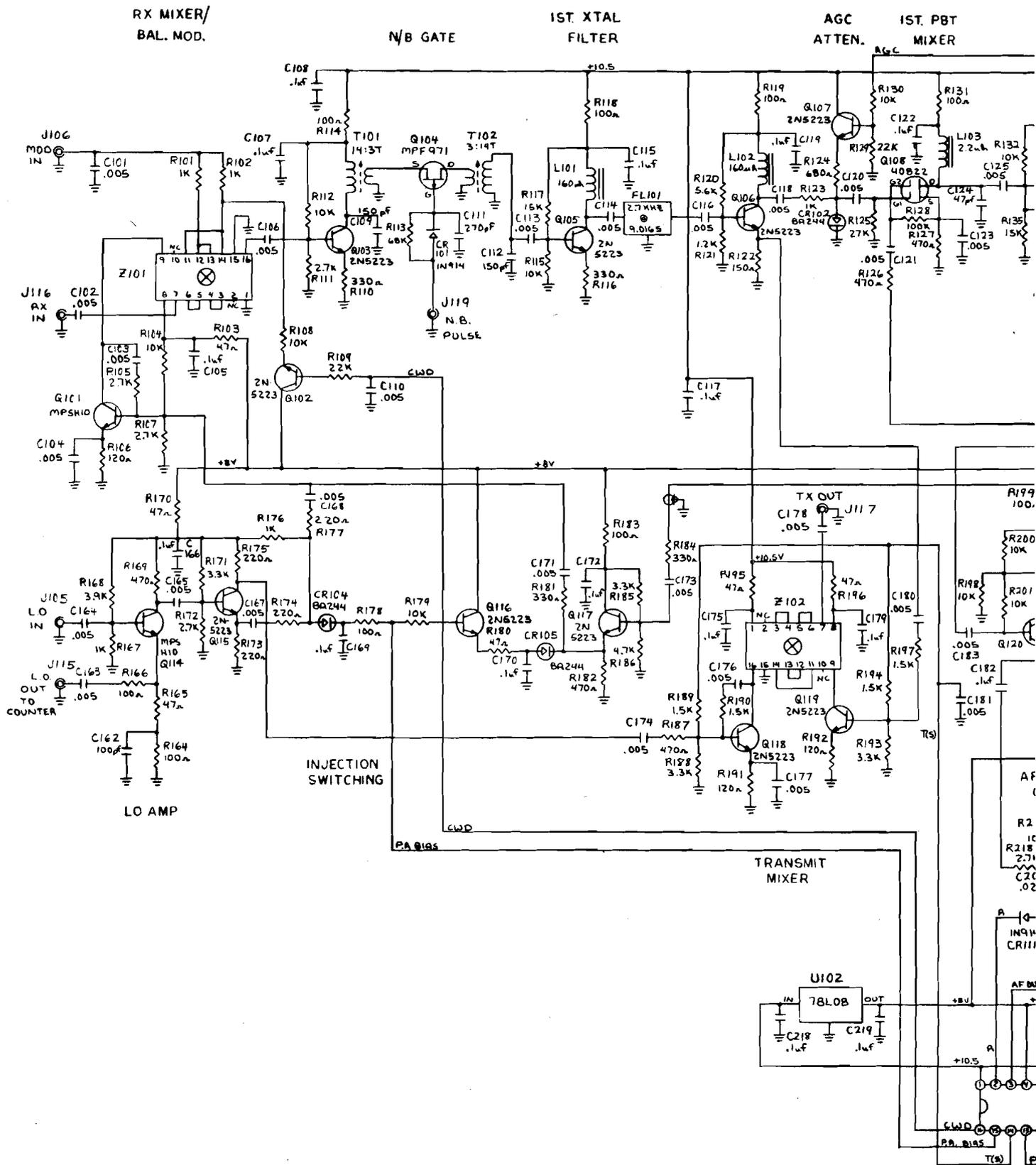
NOTES:

SWAN ELECTRONICS		
SCALE: NONE	APPROVED BY: <i>JW</i>	DRAWN BY AJG
DATE: 9-24-79		REVISED:
EXCITER BOARD LAYOUT		
DRAWING NUMBER: 102 BX-2204		



I. COMPONENT DESIGNATORS SERIES 2000.
 NOTES:

SWAN ELECTRONICS
 1000 1/2" SWAN
 FACILE AND SCHEMATIC
 1988-1989



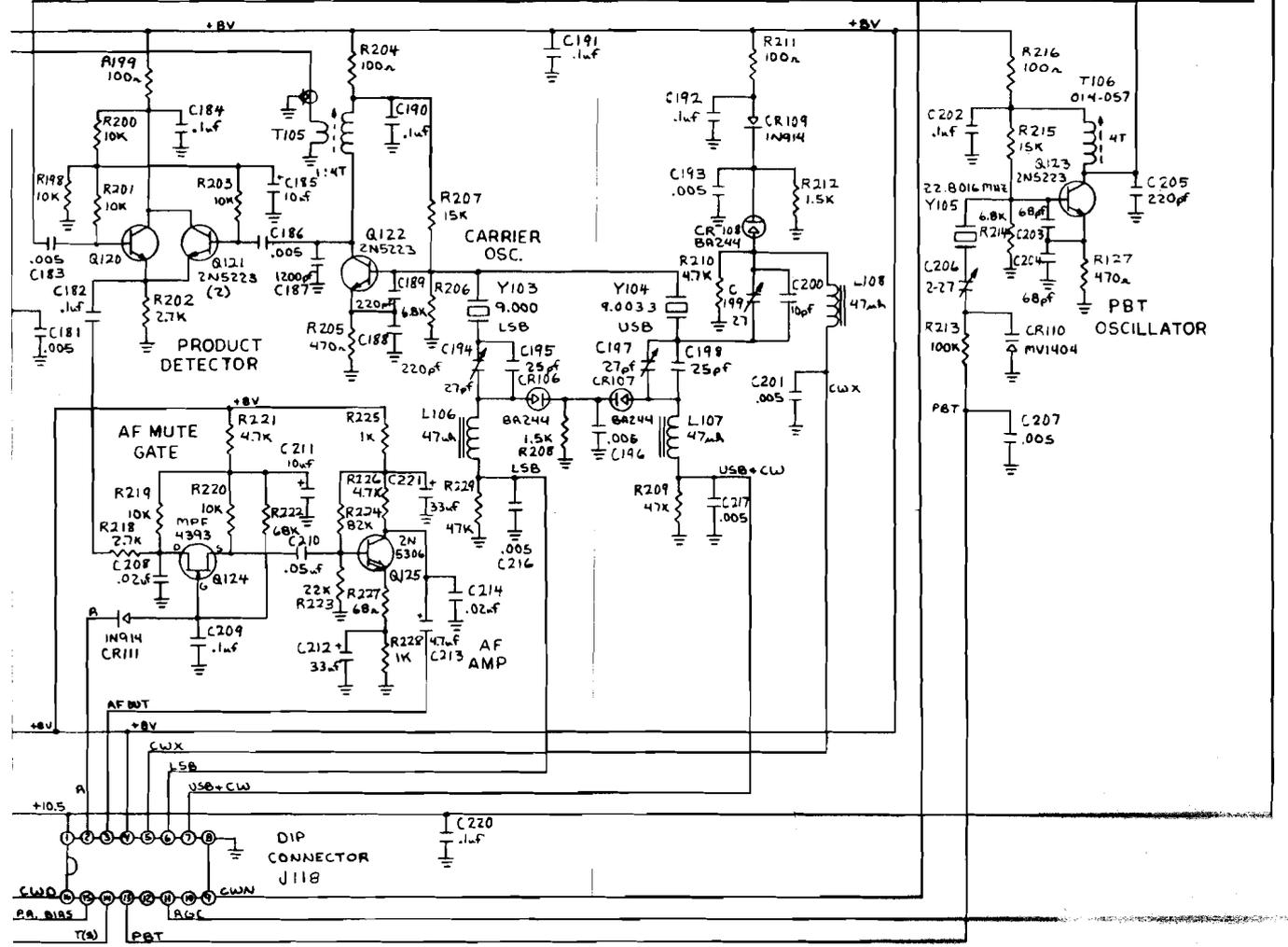
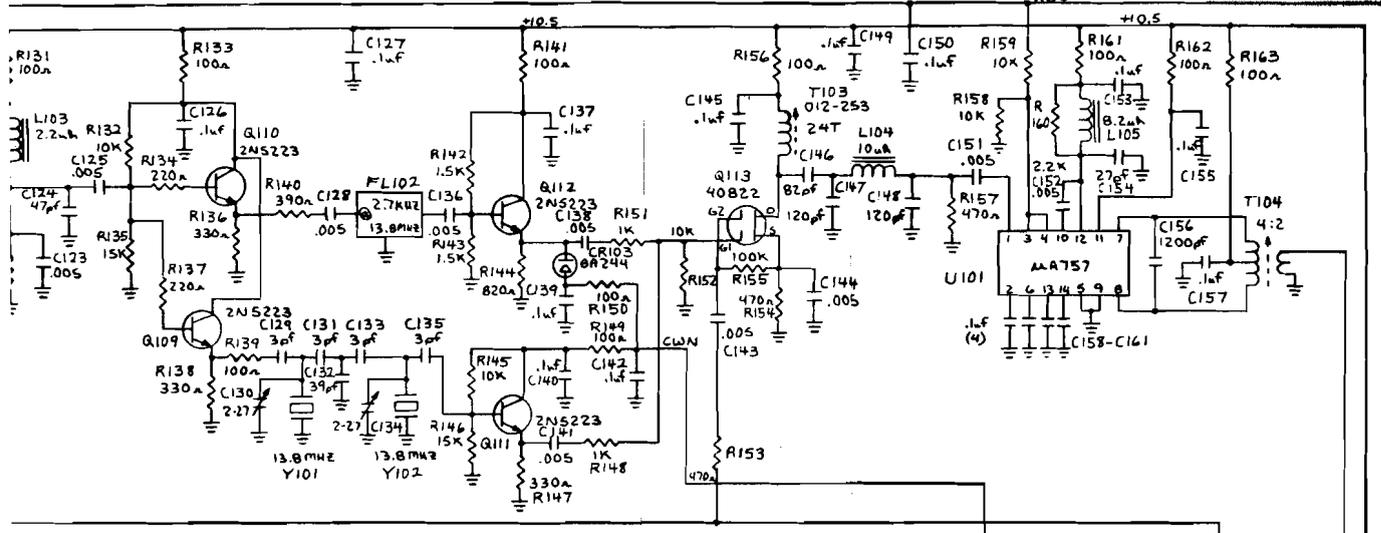
I. COMPONENT DESIGNATORS SERIES 2000.
 NOTES:

BT
ER

SSB XTAL FILTER
CWN XTAL FILTER

2ND PBT
MIXER

MAIN
IF AMP



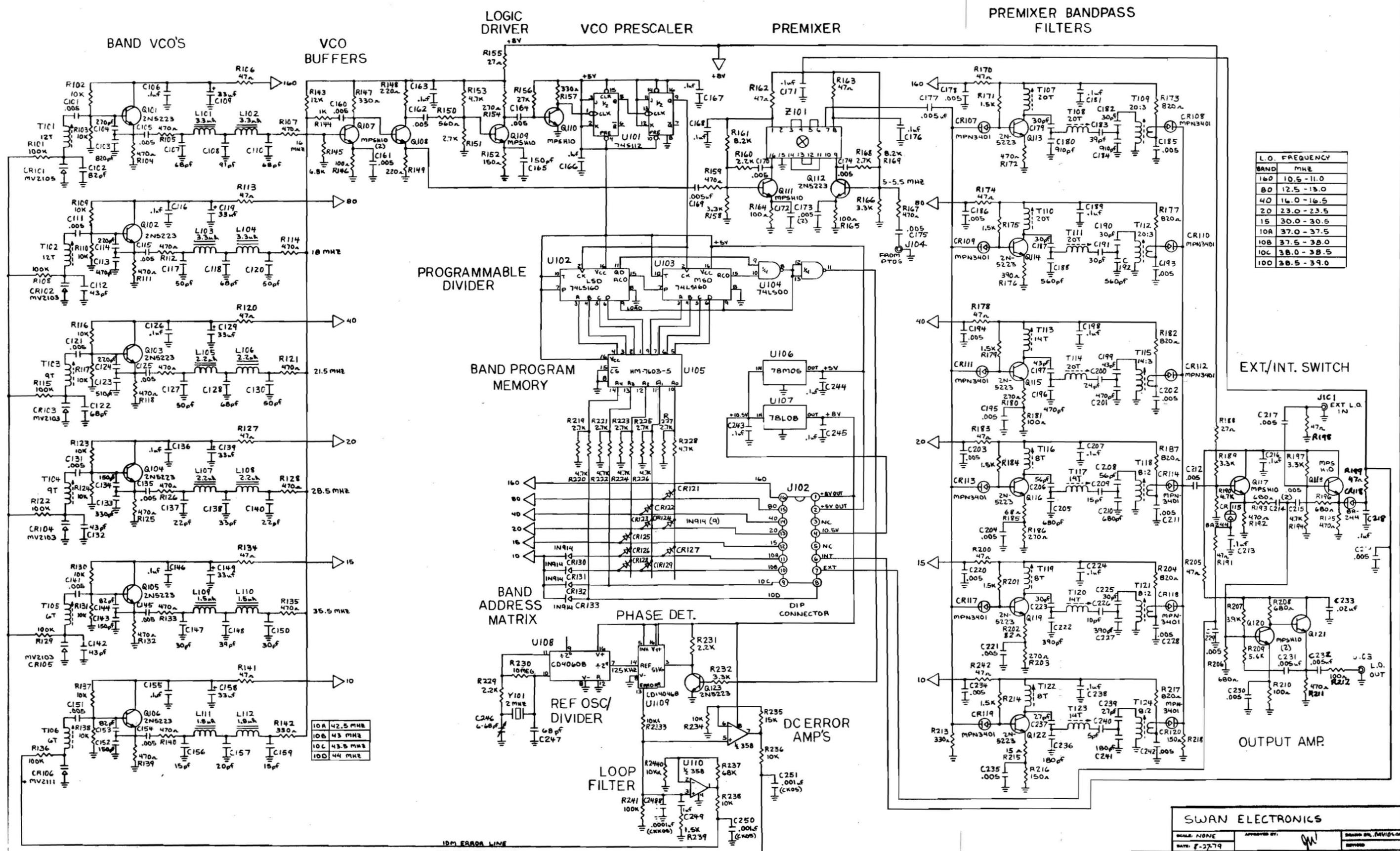
SWAN ELECTRONICS

NAME: []

DATE: []

EXCITER AND SCHEMATIC

1998-148



BAND	MHZ
160	10.5 - 11.0
80	12.5 - 13.0
40	16.0 - 16.5
20	23.0 - 23.5
15	30.0 - 30.5
10A	37.0 - 37.5
10B	37.5 - 38.0
10C	38.0 - 38.5
10D	38.5 - 39.0

10A	42.5 MHz
10B	43 MHz
10C	43.5 MHz
10D	44 MHz

SWAN ELECTRONICS

SCALE: NONE APPROVED BY: *[Signature]* DRAWN BY: DAVIDSON

DATE: 8-27-79 REVISED:

PROJ: L.O. BAND SCHEMATIC

0177 DRAWING NUMBER: 1028-2404

1. COMPONENT DESIGNATORS SERIES 5000 - NOTES:

BAND PHASE LOCKED LOOP

10M ERROR LINE
160-15M ERROR LINE

BAND VCO'S

VCO BUFFERS

LOGIC DRIVER

VCO PRESCALER

PROGRAMMABLE DIVIDER

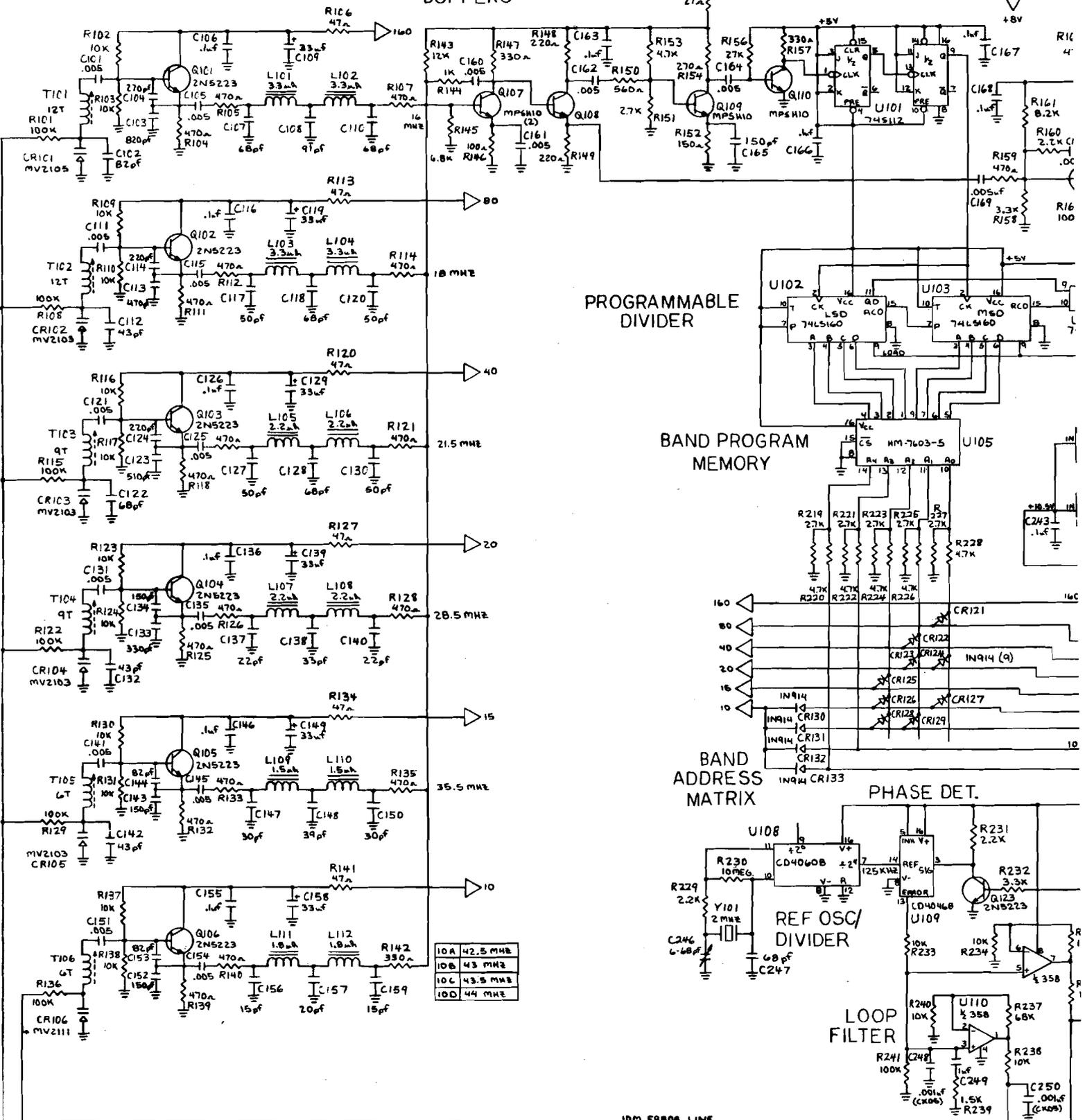
BAND PROGRAM MEMORY

BAND ADDRESS MATRIX

PHASE DET.

REF OSC/DIVIDER

LOOP FILTER



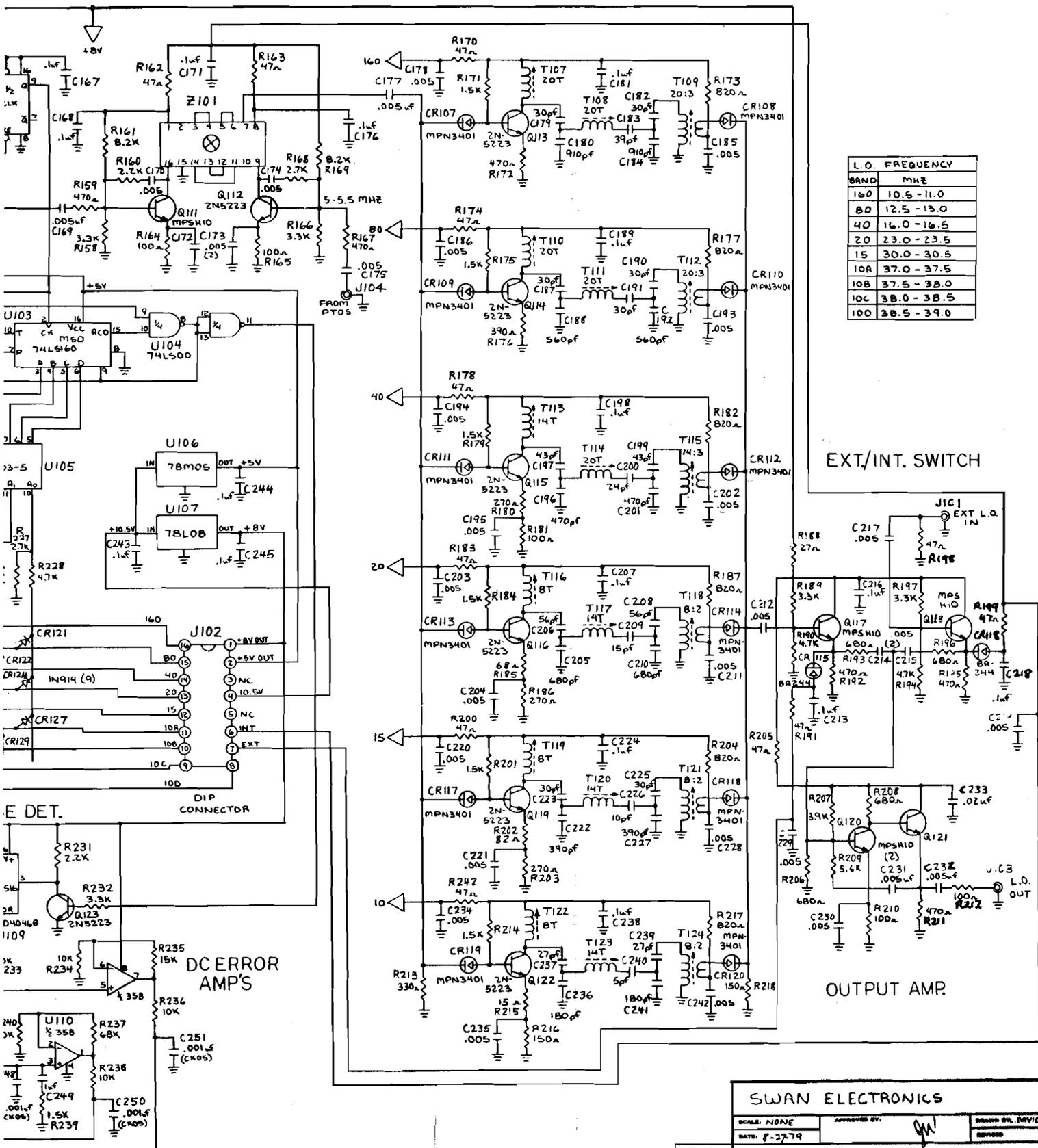
10A	42.5 MHz
10B	43 MHz
10C	43.5 MHz
10D	44 MHz

10M E8A8A LINE
160-15M E8A8A LINE

BAND PHASE LOCKED LOOP

PREMIXER BANDPASS FILTERS

ALER PREMIXER



L.O. FREQUENCY	
BAND	MHZ
160	10.5 - 11.0
80	12.5 - 13.0
40	16.0 - 16.5
20	23.0 - 23.5
15	30.0 - 30.5
10A	37.0 - 37.5
10B	37.5 - 38.0
10C	38.0 - 38.5
10D	38.5 - 39.0

EXT./INT. SWITCH

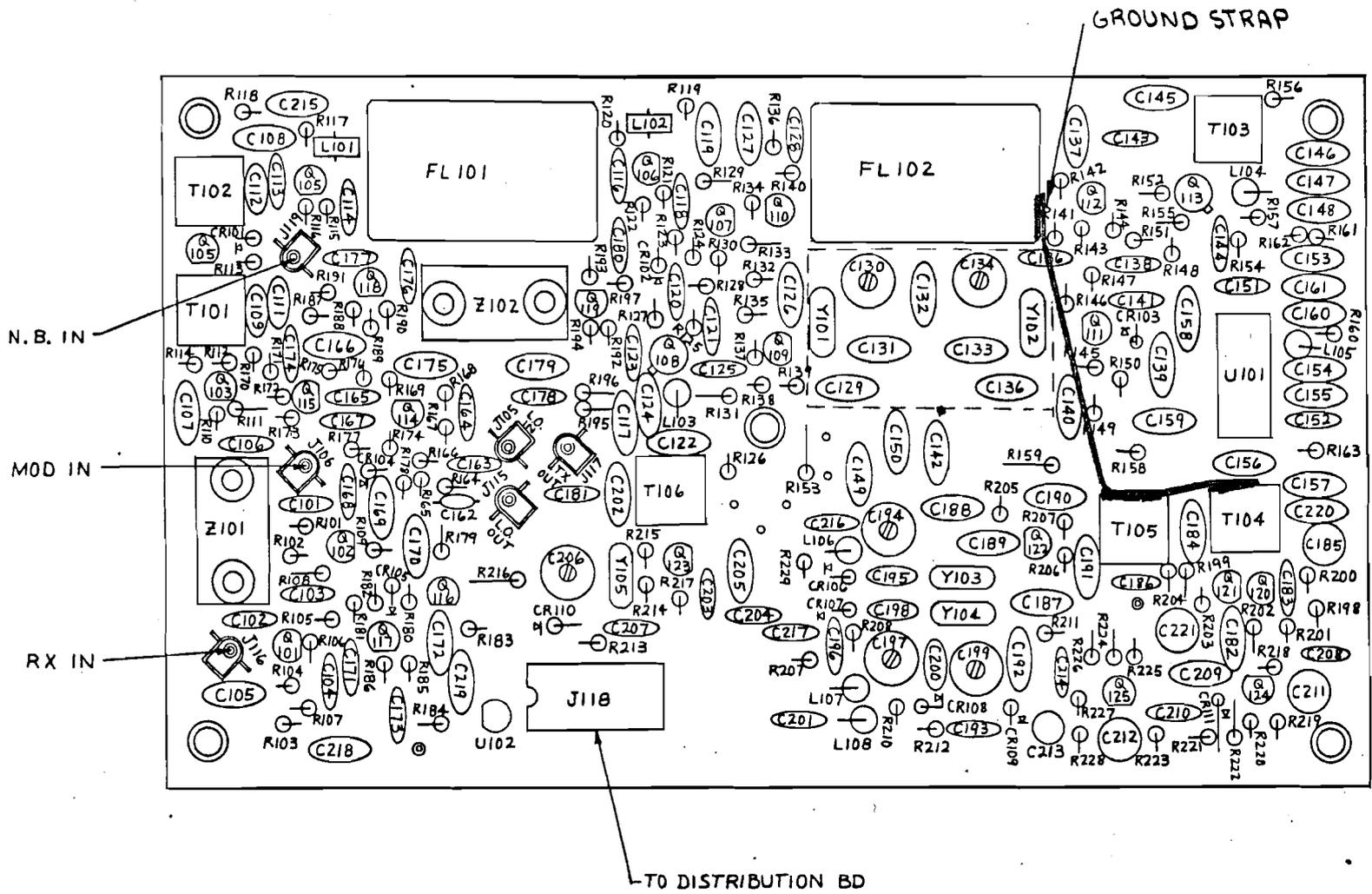
OUTPUT AMP.

E DET. DC ERROR AMP'S

SWAN ELECTRONICS

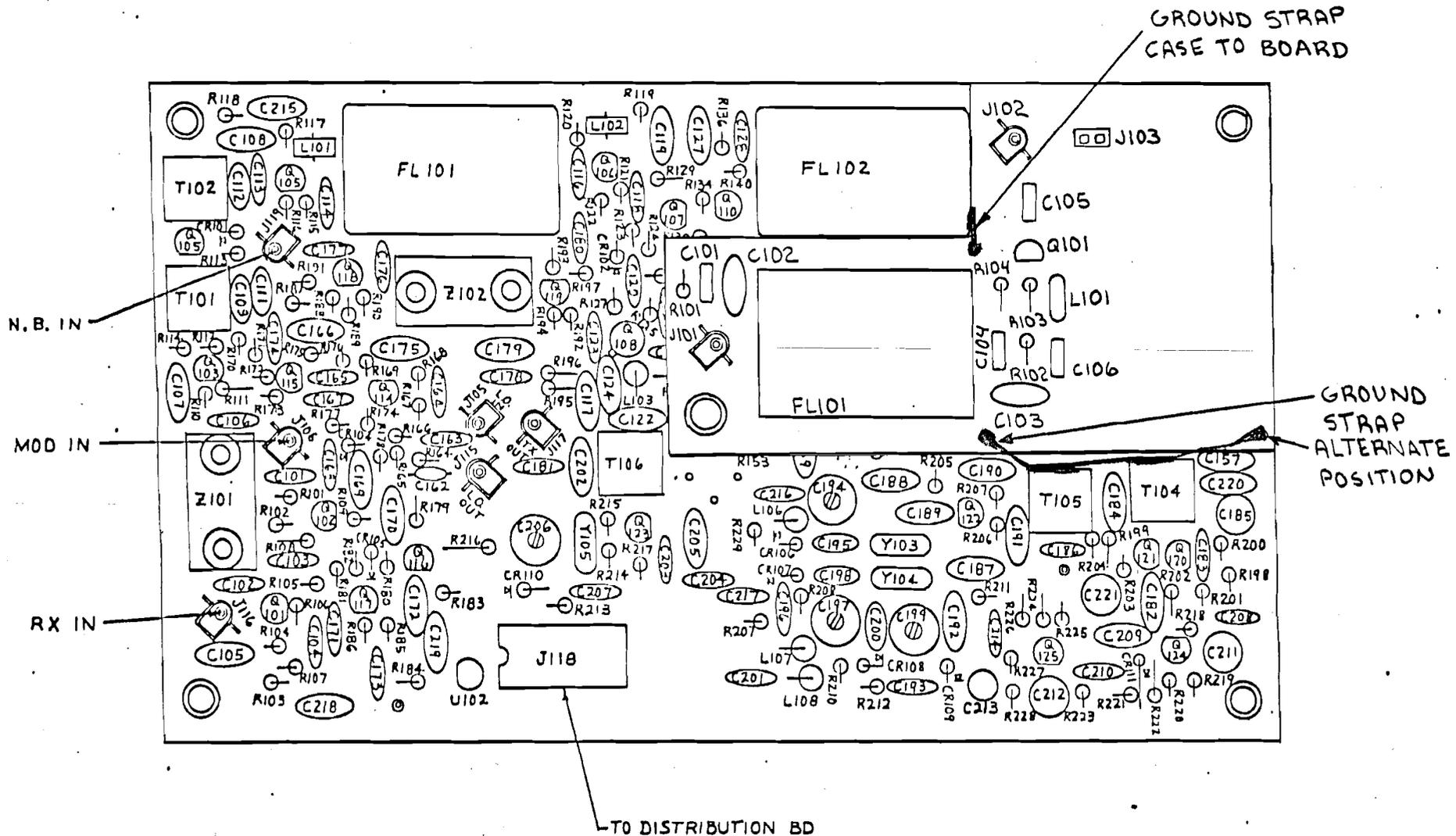
SCALE: NONE	APPROVED BY: <i>[Signature]</i>	DRAWN BY: RMV/04
DATE: 7-27-79		REVISED
PROJ: L.O. BAND SCHEMATIC		PRINTED NUMBER: 1028-2404
O177		

I. COMPONENT DESIGNATORS SERIES 5000 .
NOTES:



2. COMPONENT DESIGNATORS 2000 SERIES.
 1. REF. ELECT. ASSY 102 BX-2007
 REF. CIRCUIT BOARD 102 BX-2107
 REF. DRILL DWG 102 BX-2204

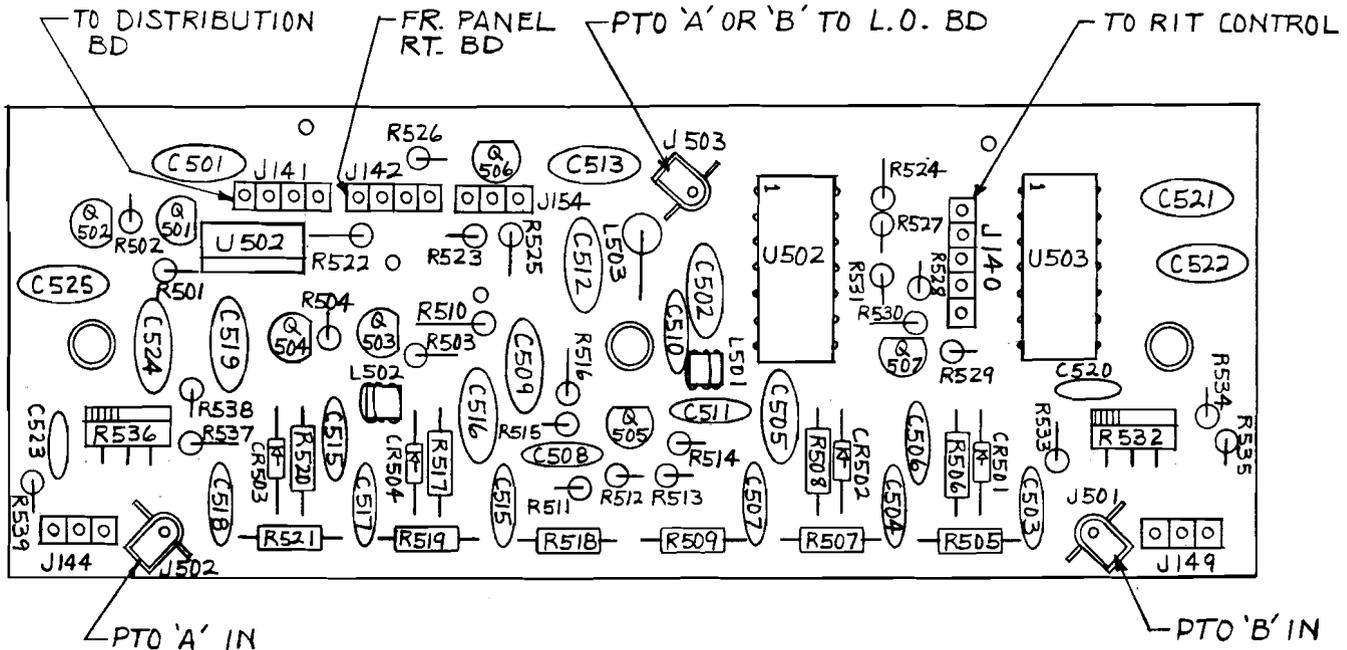
SCALE: NONE	APPROVED BY: <i>ju</i>	DRAWN BY: A.J.G.
DATE: 9-24-74		REVISION:
EXCITER BOARD LAYOUT		



2. COMPONENT DESIGNATORS 2000 SERIES.
 1. REF. ELECT. ASSY 102BX-2007
 REF. CIRCUIT BOARD 102BX-2107
 REF. DRILL DWG 102BX-2204

SCALE: NONE	APPROVED BY: <i>JW</i>	DRAWN BY: AJ
DATE: 9-24-79		

EXCITER BOARD LAYOUT

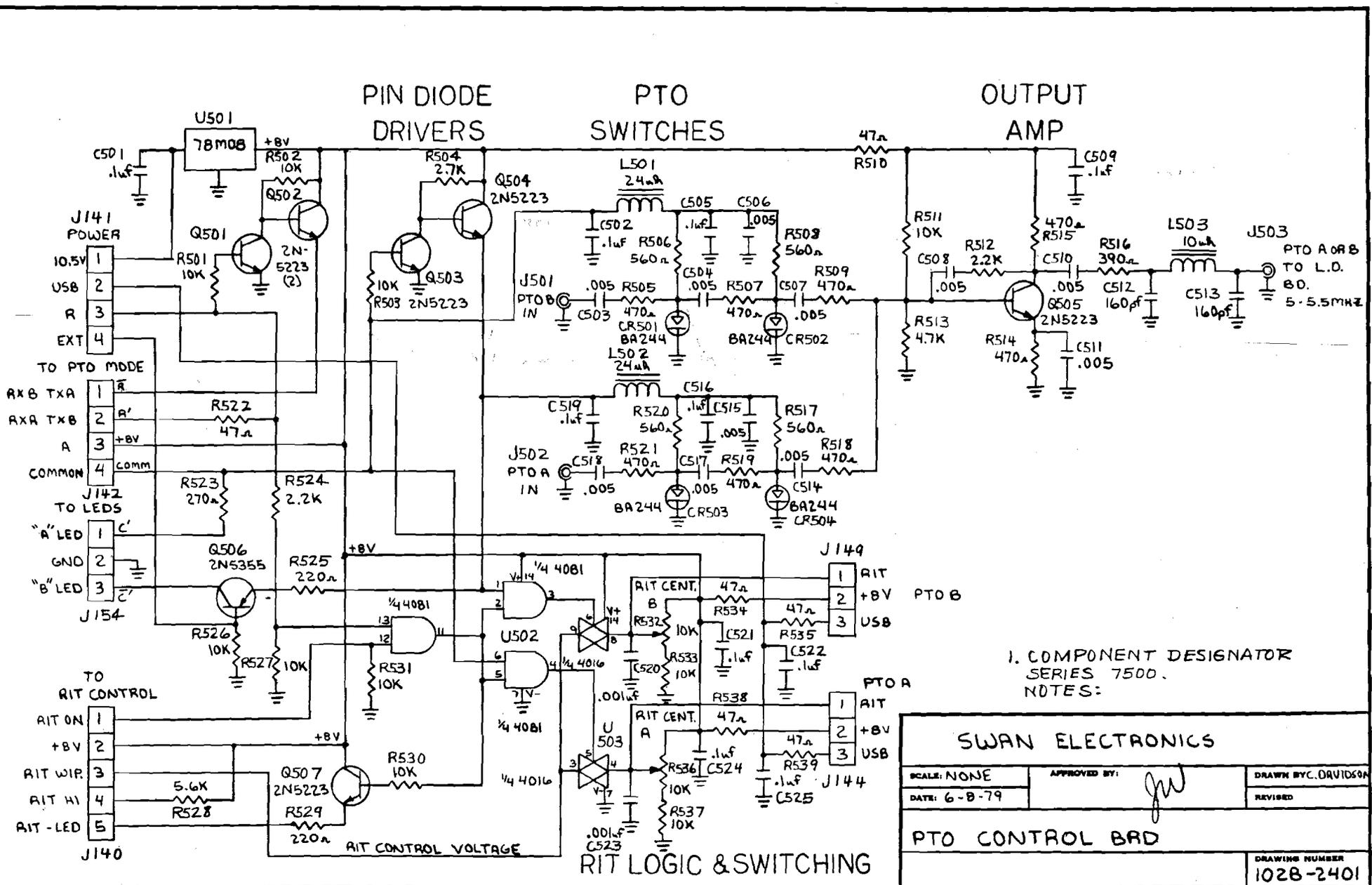


2. COMPONENT DESIGNATORS: 7500 SERIES

- 1. REF. ELEC. ASSY 102 BX-2001
- REF. CIRCUIT BD 102 BX-2101
- REF. DRILL DWG 102 BX-2201

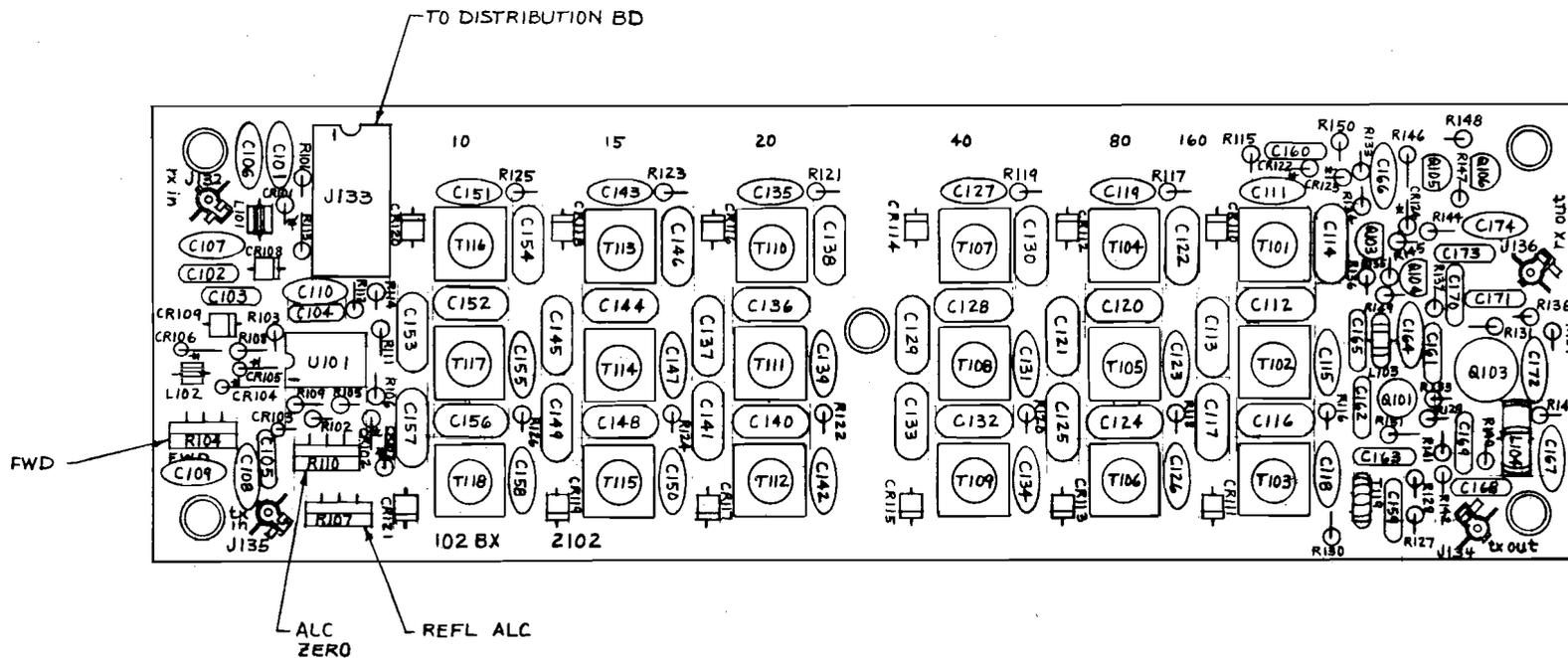
NOTES:

SWAN ELECTRONICS		
SCALE: ~	APPROVED BY: <i>JW</i>	DRAWN BY: AJG
DATE: 9-18-79		REVISED
PTO CONTROL BOARD LAYOUT		
		DRAWING NUMBER 102 BX-2301



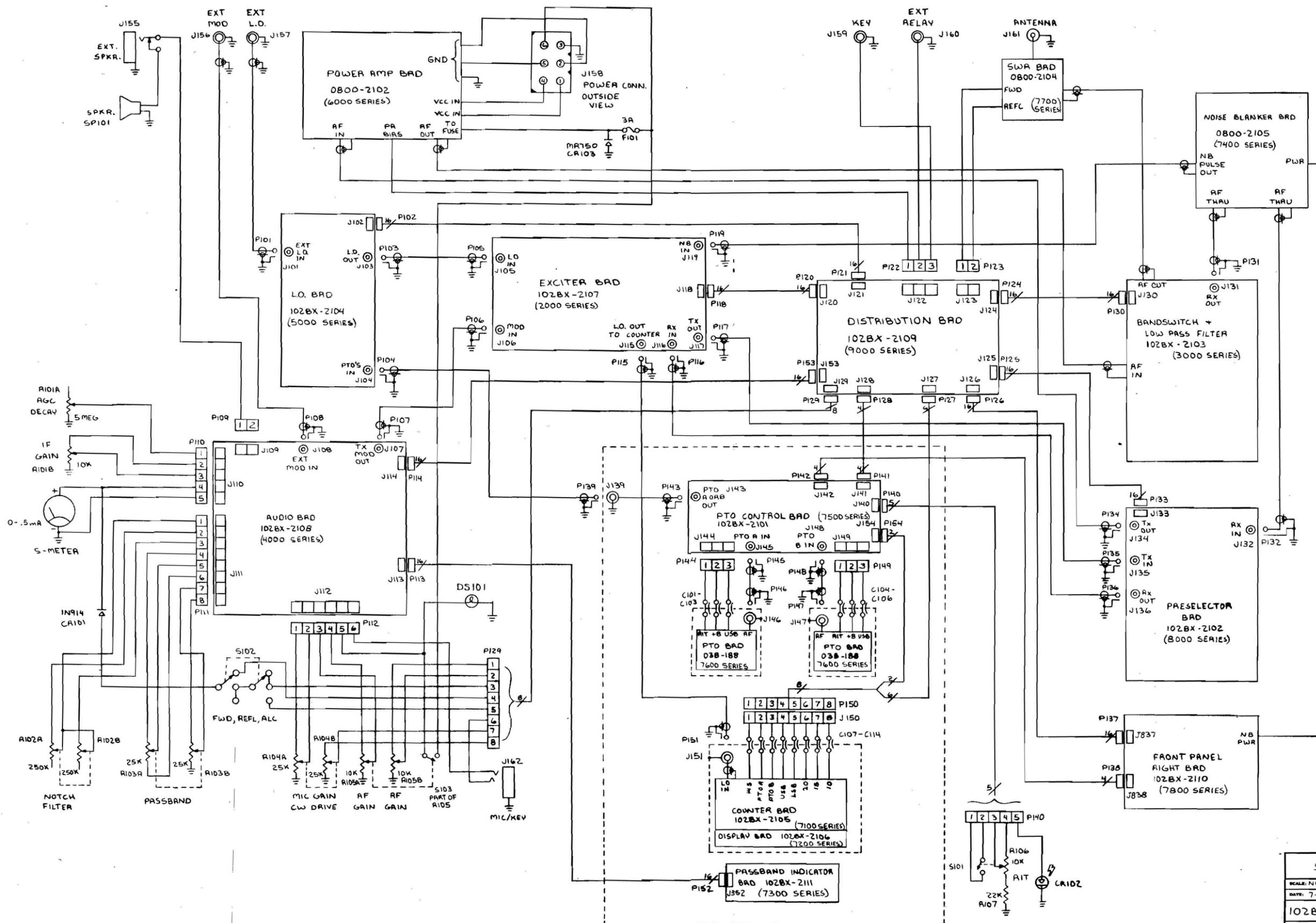
1. COMPONENT DESIGNATOR SERIES 7500.
 NOTES:

SWAN ELECTRONICS		
SCALE: NONE	APPROVED BY: <i>[Signature]</i>	DRAWN BY: DAVIDSON
DATE: 6-8-79		REVISED
PTO CONTROL BRD		
		DRAWING NUMBER 1028-2401



2. COMPONENT DESIGNATION SERIES 8000 .
 1. REF. ELECT. ASSY 102 BX-2002
 REF. CIRCUIT BD 102 BX-2102
 REF. DRILL DWG 102 BX-2202
 NOTES:

SWAN ELECTRONICS		
SCALE: NONE	APPROVED BY: <i>JW</i>	DRAWN BY: AJG
DATE: 7-24-79	DESIGNER:	
PRESELECTOR BOARD LAYOUT		
REV:	DESIGNER NUMBER:	102 BX-2302



NOTES:

- DENOTES MULTI CONDUCTOR CABLE ASSY, N=NO. OF CONDUCTORS
- DENOTES 16 LEAD CABLE WITH DIP PIN
- ALL COMPONENT DES. CONSIST OF ONE OR TWO LETTERS FOLLOWED BY DIGITS. EXAMPLE: Q6101

TRANSISTOR
 PWR
 SEQL NUM

TRANSISTOR DP BOTTOM VIEW: UNLESS SPECIFIED

- MPS410 (E C L)
- 78L08 (P O O) OUT COM IN
- 2N3866 (E C L)
- TIP 42 (T O P)
- MAF433 MRF458 (E T O P) C B
- 2N5814 (C E B)
- 7805 78M05 78M08 (T O P)
- 40822 3N211 (S O G)
- MPS-442 2N5223 (E C L)
- 2N5306 (E C B)
- 2N5355 (E C B)
- MPF-971 MPF4393 2N5670 (D S G)

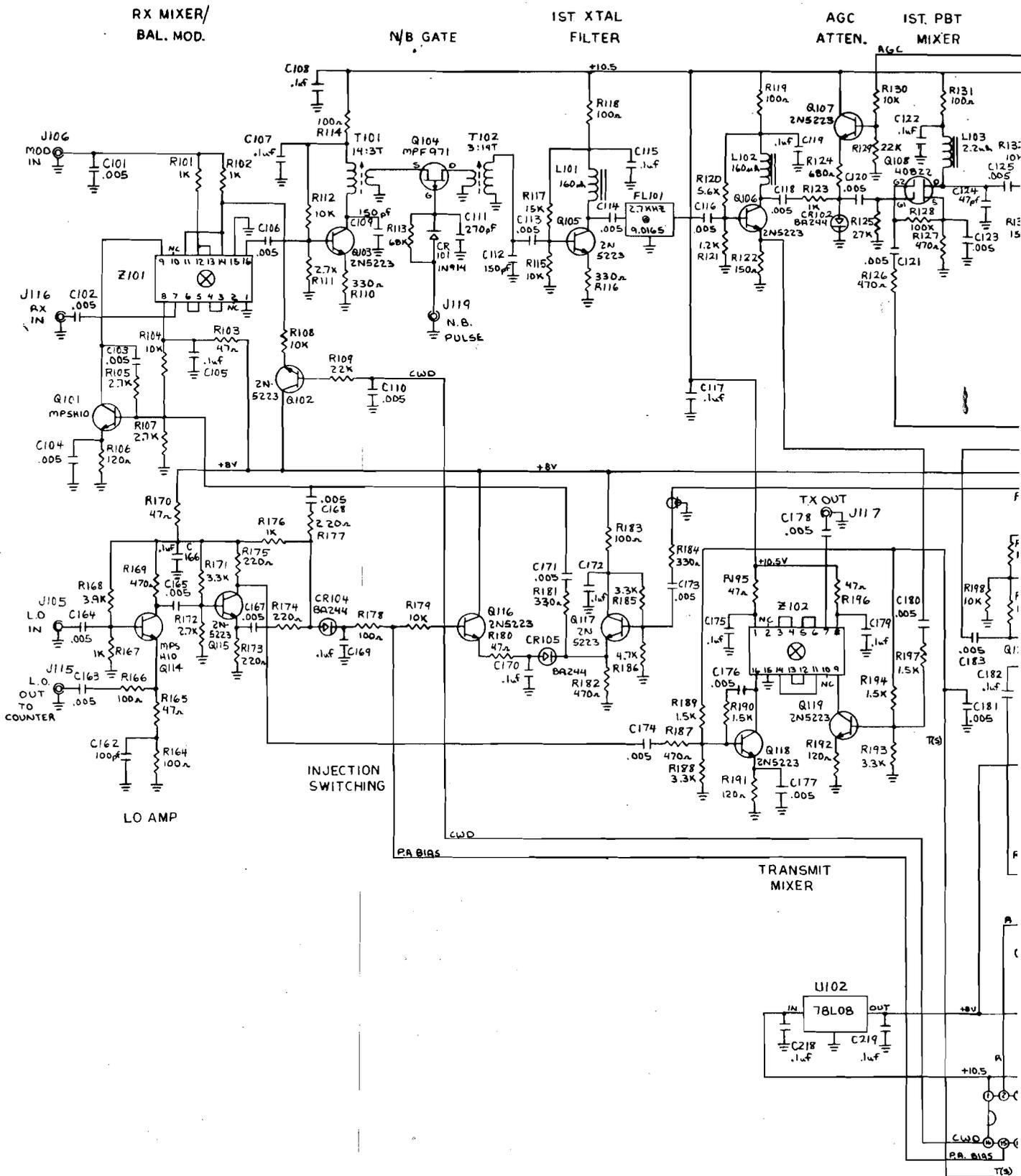
SWAN ELECTRONICS

SCALE: NONE APPROVED BY: *JW* DRAWN BY: *JW*

DATE: 7-13-79

102BX MAIN CHASSIS + INTERCONN

REVISION: *JW*



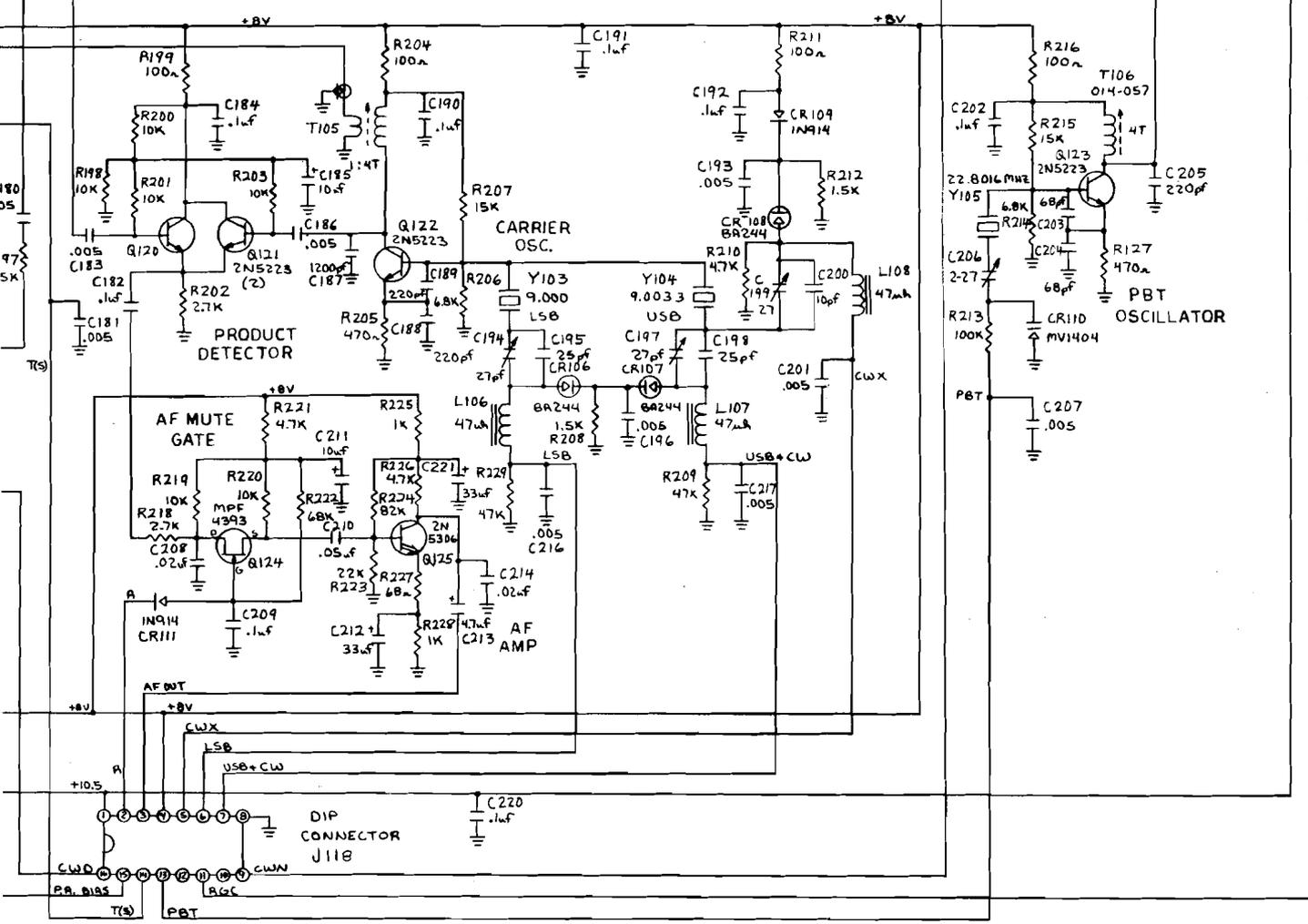
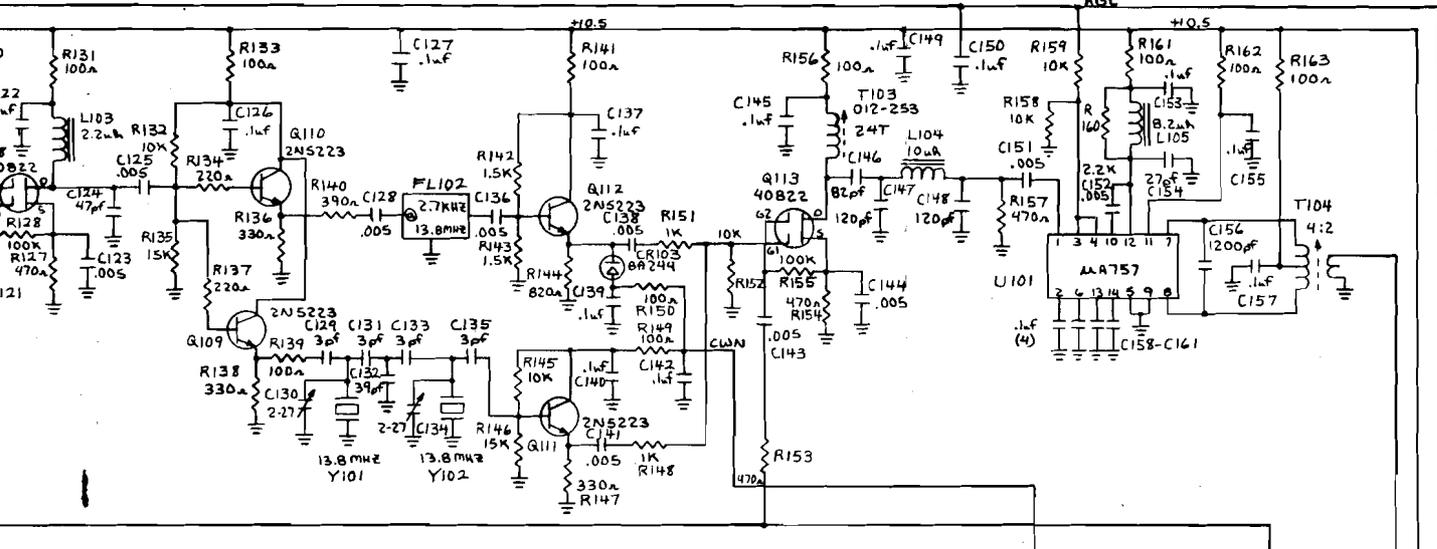
I. COMPONENT DESIGNATORS SERIES 2000.
 NOTES:

1ST. PBT
MIXER

SSB XTAL FILTER
CWN XTAL FILTER

2ND PBT
MIXER

MAIN
IF AMP



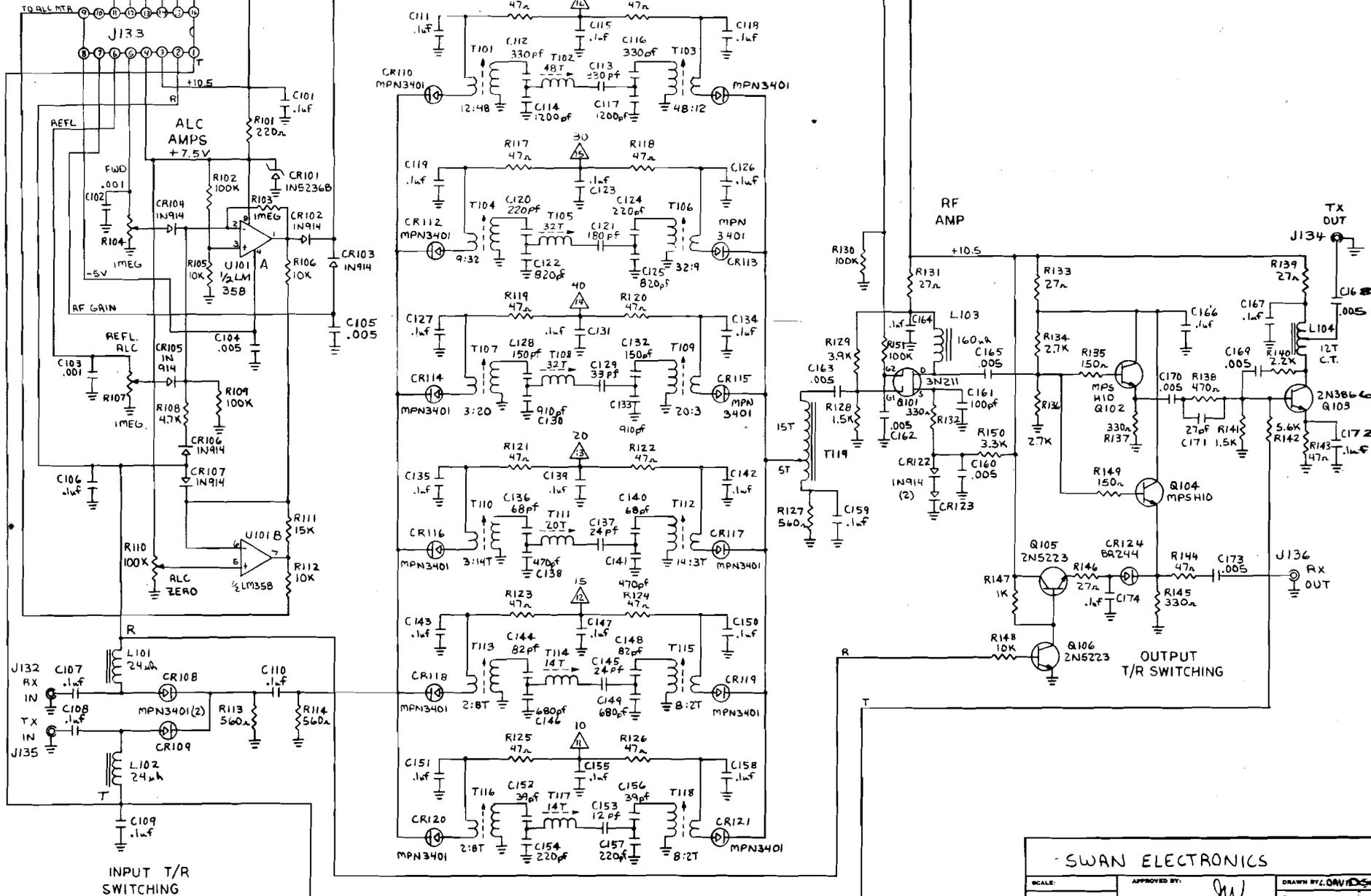
SWAN ELECTRONICS

SCALE: NONE	APPROVED BY: <i>gw</i>	DRAWN BY: JF
DATE: 8-27-79		REVISED:
EXCITER BUD SCHEMATIC		
1028-2		

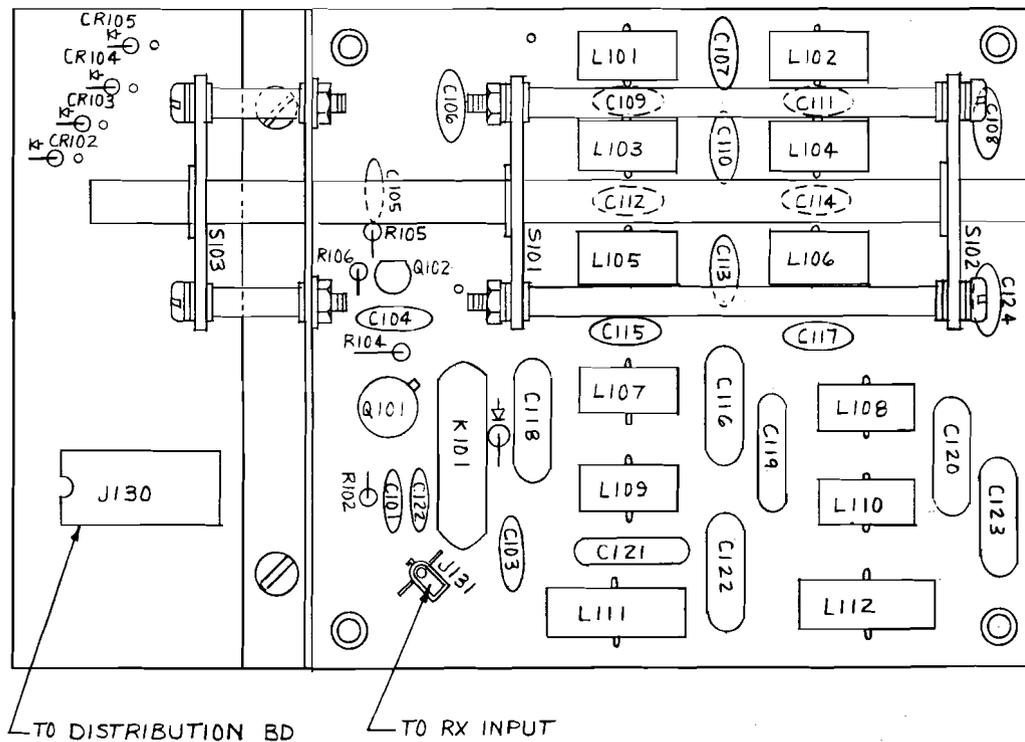
DIP CONNECTOR FROM DISTRIBUTION BAD

BANDPASS FILTERS

COMPONENT DESIGNATORS: 8000 SERIES

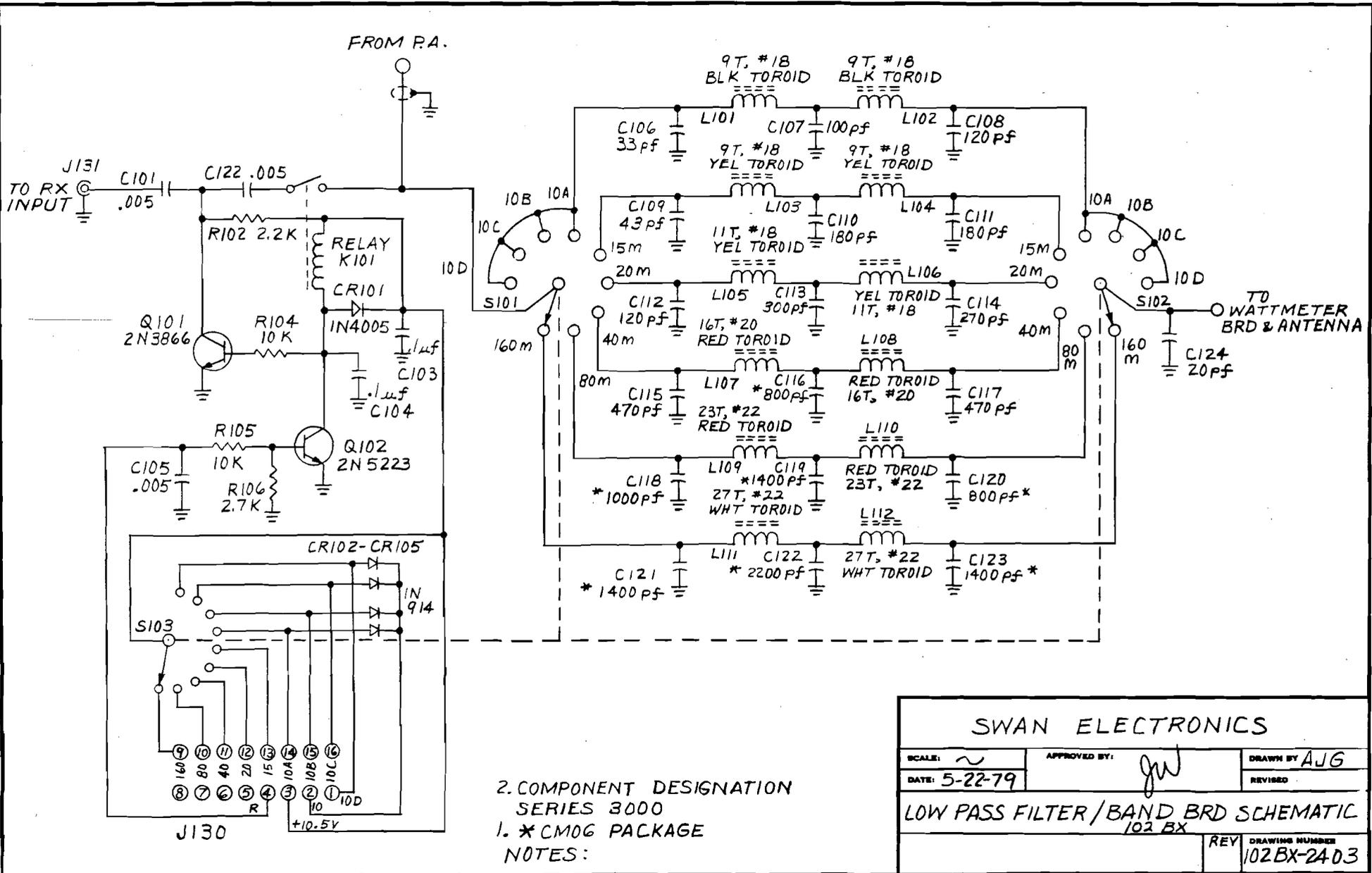


SWAN ELECTRONICS		
SCALE:	APPROVED BY: <i>JW</i>	DRAWN BY: DAVI DSON
DATE:		REVISED:
PRESELECTOR BAD 1028X		
		DRAWING NUMBER
		1028-2402



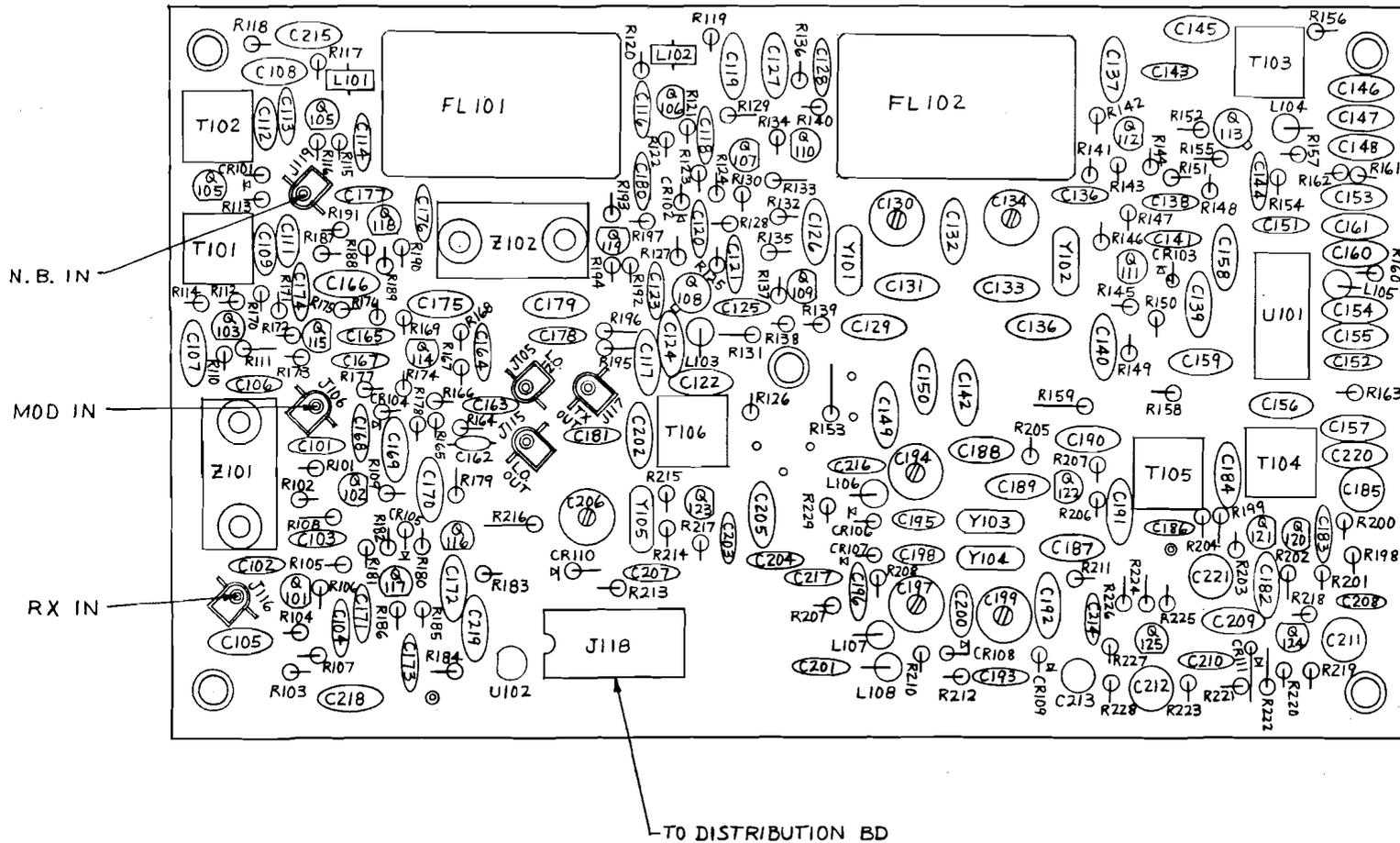
2. COMPONENT DESIGNATORS 3000 SERIES.
 1. REF. ELEC. ASSY 102BX-2003
 REF. CIRCUIT BD 102BX-2103
 REF. DRILL DWG 102BX-2203
 NOTES:

SWAN ELECTRONICS		
SCALE: ~	APPROVED BY: <i>yw</i>	DRAWN BY: AJG
DATE: 9-18-79		REVISED
B'SWITCH & L.P. FILT. BD LAYOUT		
		DRAWING NUMBER: 102BX-2303



2. COMPONENT DESIGNATION
 SERIES 3000
 1. *CMOG PACKAGE
 NOTES:

SWAN ELECTRONICS			
SCALE: ~	APPROVED BY: <i>ju</i>	DRAWN BY: AUG	
DATE: 5-22-79		REVISED:	
LOW PASS FILTER/BAND BRD SCHEMATIC 102 BX			
REV	DRAWING NUMBER 102 BX-2A03		

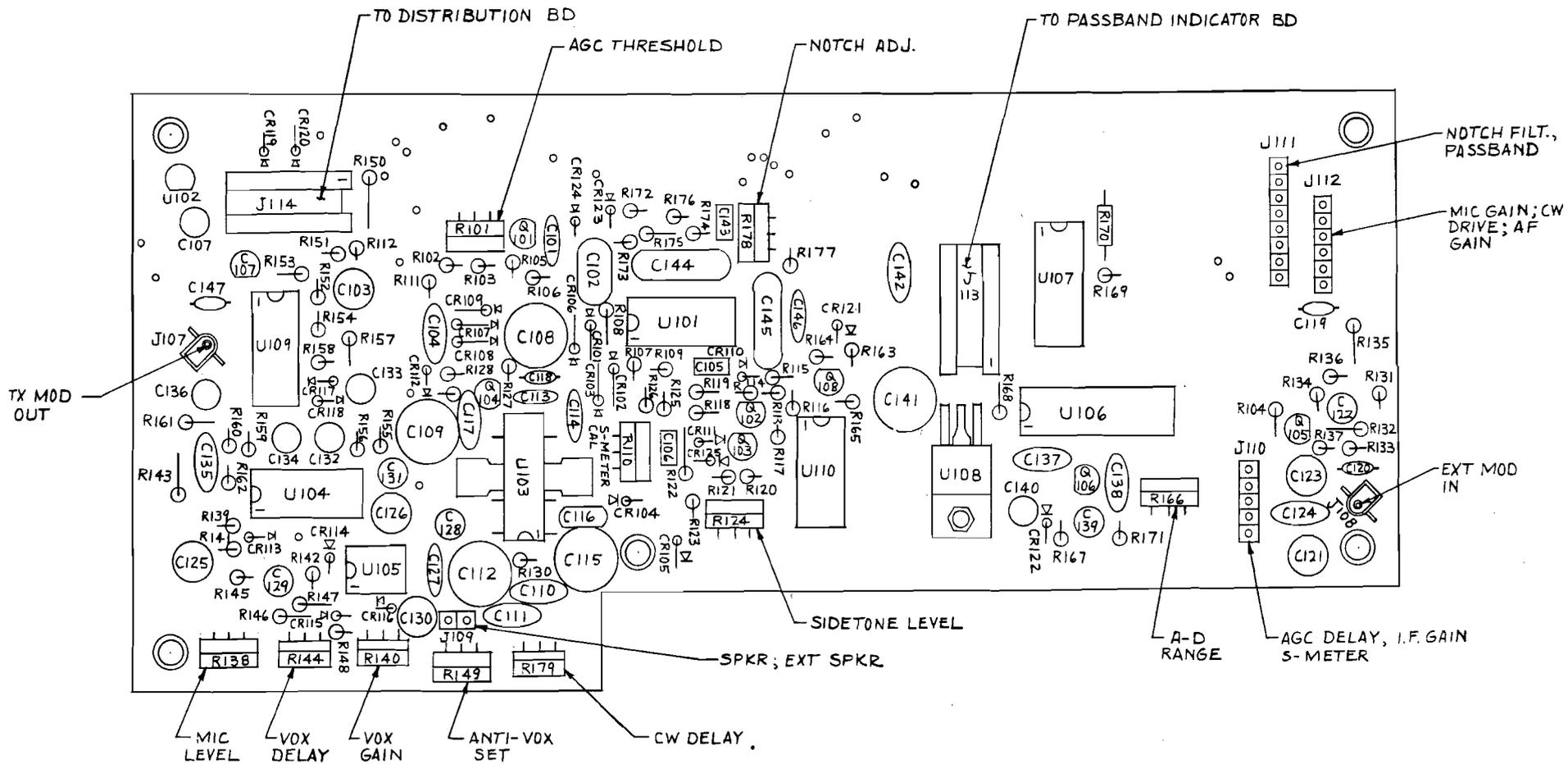


2. COMPONENT DESIGNATORS 2000 SERIES.

- 1. REF. ELECT. ASSY 102 BX-2007
- REF. CIRCUIT BOARD 102 BX-2107
- REF. DRILL DWG 102 BX-2204

NOTES:

SWAN ELECTRONICS		
SCALE: NONE	APPROVED BY: <i>JW</i>	DRAWN BY: A.J.G.
DATE: 9-24-79		REVISED:
EXCITER BOARD LAYOUT		
		DRAWING NUMBER: 102 BX-2307



2. COMPONENT DESIGNATORS 4000 SERIES.

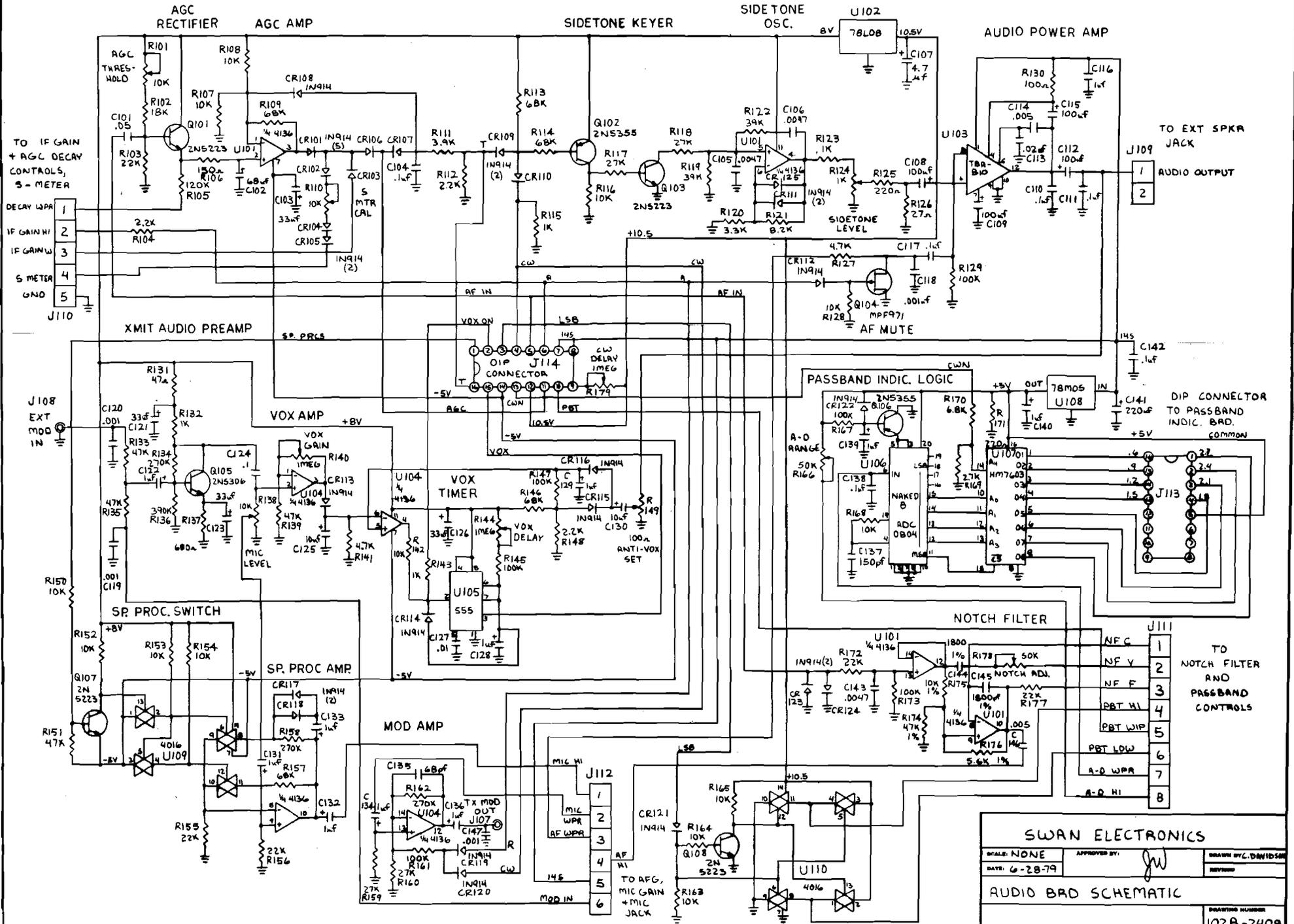
1. REF. ELECT. ASSY 102BX-2008

REF. CIRCUIT BOARD 102BX-2108

REF. DRILL DWG 102BX-2208

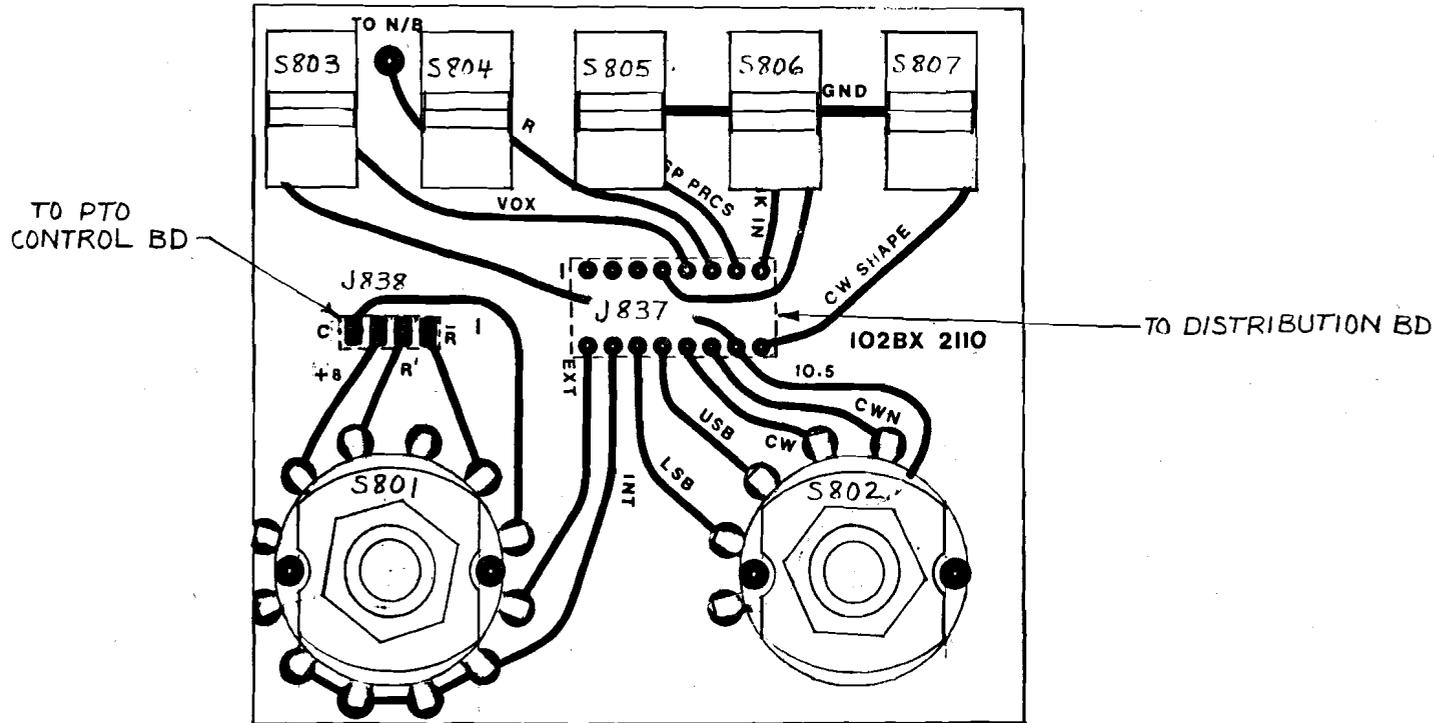
NOTES:

SWAN ELECTRONICS		
SCALE: NONE	APPROVED BY: <i>JW</i>	DRAWN BY: AJG
DATE:		REVISED:
AUDIO BOARD LAYOUT		
DRAWING NUMBER 1102BV 2200		



SWAN ELECTRONICS

SCALE: NONE	APPROVED BY: <i>JW</i>	DRAWN BY: DAVIDSON	REVIEW:
DATE: 6-28-79			
AUDIO BAD SCHEMATIC			
DRAWING NUMBER: 102B-2408			



3. J837 & J838 ON FAR SIDE.
 2. COMPONENT DESIGNATOR SERIES 7800.
 1. REF. ELECTRICAL ASSY 102BX-2010
REF. CIRCUIT BOARD 102BX-2110
REF. DRILL DRAWING 102BX-2210
- NOTES:

SWAN ELECTRONICS

SCALE: 2:1
DATE: 9-12-79

APPROVED BY:

ju

DRAWN BY ALJ
REVISED

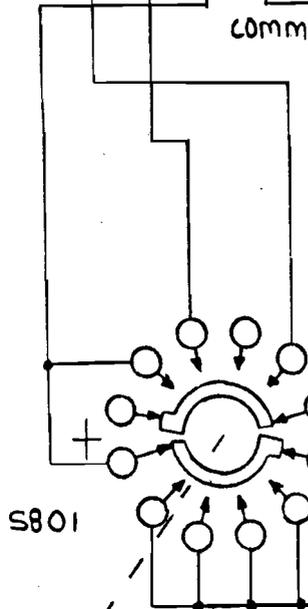
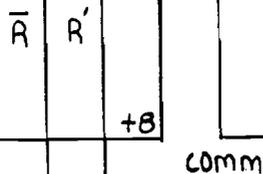
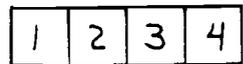
FRONT PANEL RIGHT BD LAYOUT

DRAWING NUMBER
102BX-2310

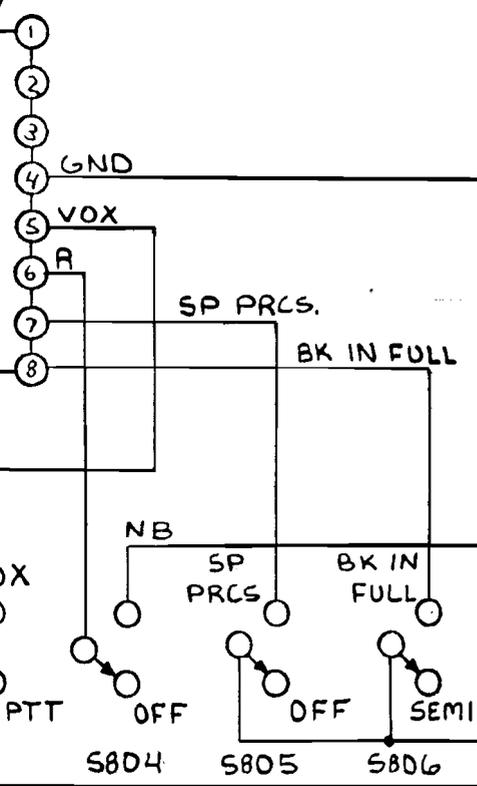
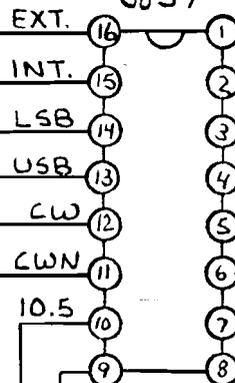
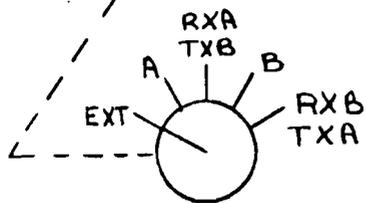
TO PTO
CONTROL BAD

DIP CONNECTOR
TO DISTRIBUTION BAD

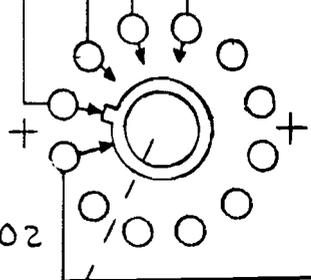
J838



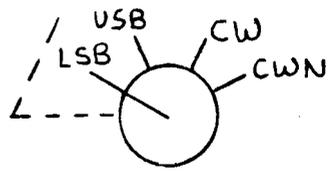
PTO MODE SW



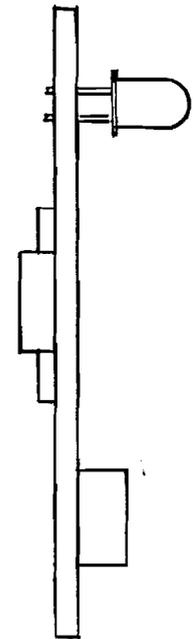
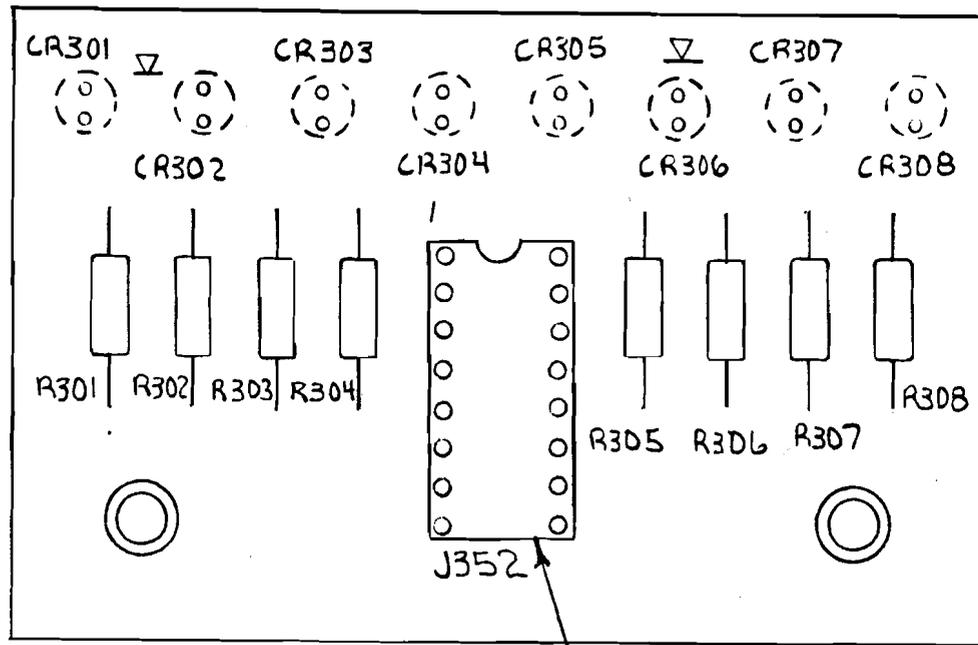
S802



MODE SW



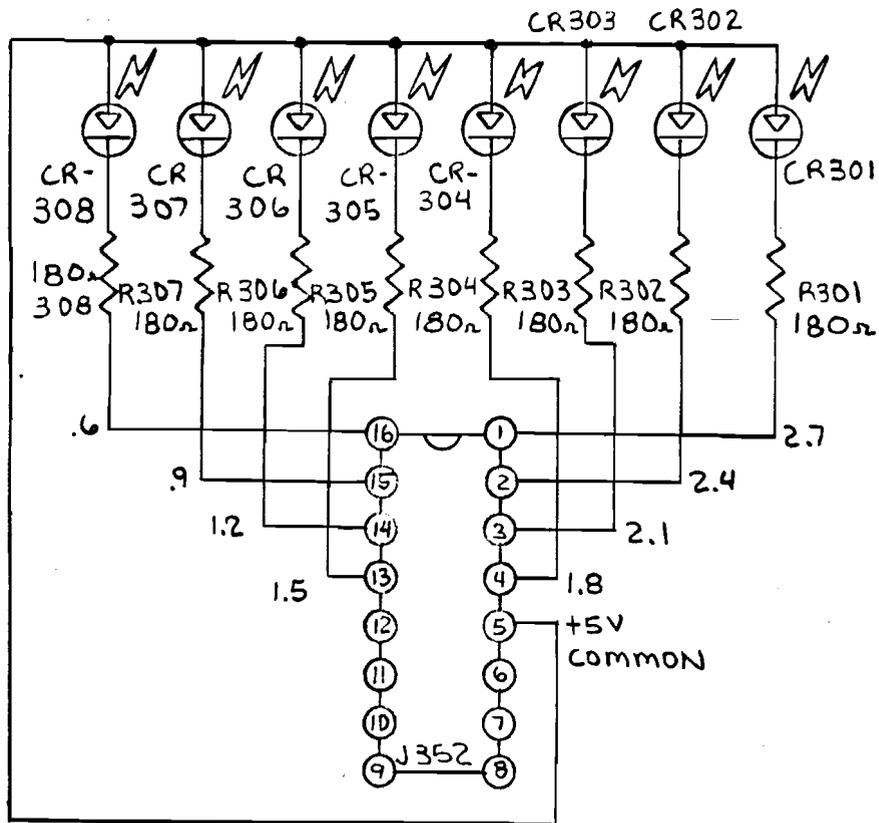
SWAN ELECTRONICS		
SCALE: NONE	APPROVED BY: <i>JW</i>	DRAWN BY: DAVIDSON
DATE: 7-11-79		REVISED
FRONT PANEL RIGHT BOARD		
COMPONENT DESIGNATORS (7800 SERIES)		DRAWING NUMBER 102BX-2410



TO AUDIO BD

3. REF. ELECTRICAL ASSY 102BX-2011
 REF. CIRCUIT BOARD 102BX-2111
 REF. DRILL DWG 102BX-2211
2. LEDS MOUNTED FARSIDE.
1. COMPONENT DESIGNATORS 7300 SERIES
- NOTES

SWAN ELECTRONICS		
SCALE: NONE	APPROVED BY: <i>ju</i>	DRAWN BY AJG
DATE:		REVISED
PASSBAND IND. BD LAYOUT 102 BX		
		DRAWING NUMBER 102BX-2311



DIP CONNECTOR
FROM AUDIO BRD.

SWAN ELECTRONICS

SCALE: NONE

APPROVED BY:

DRAWN BY: DAVIDSON

DATE: 7-10-79

REVISED

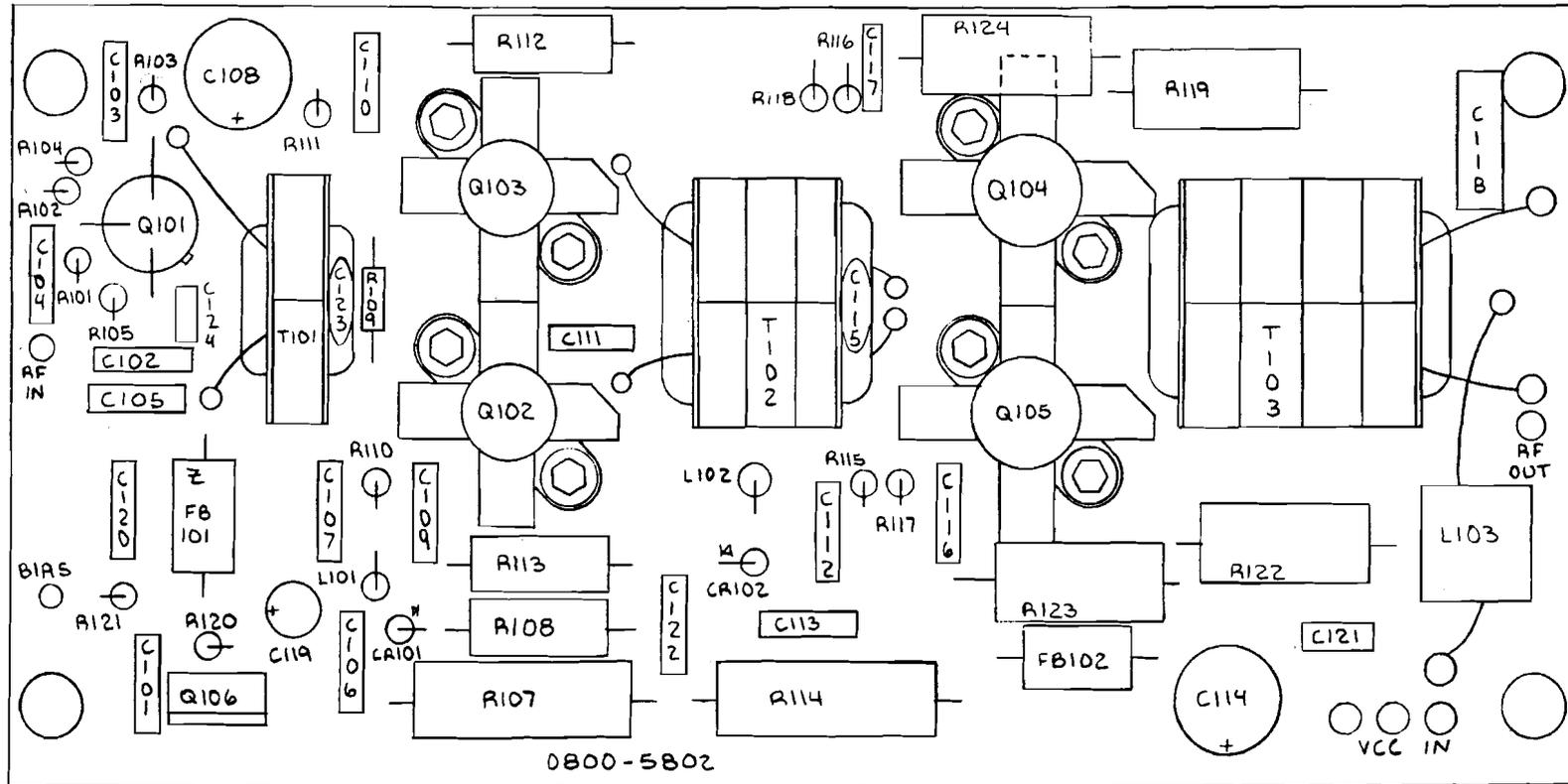
PASSBAND INDICATOR BOARD SCHEMATIC

DRAWING NUMBER

102B-2411

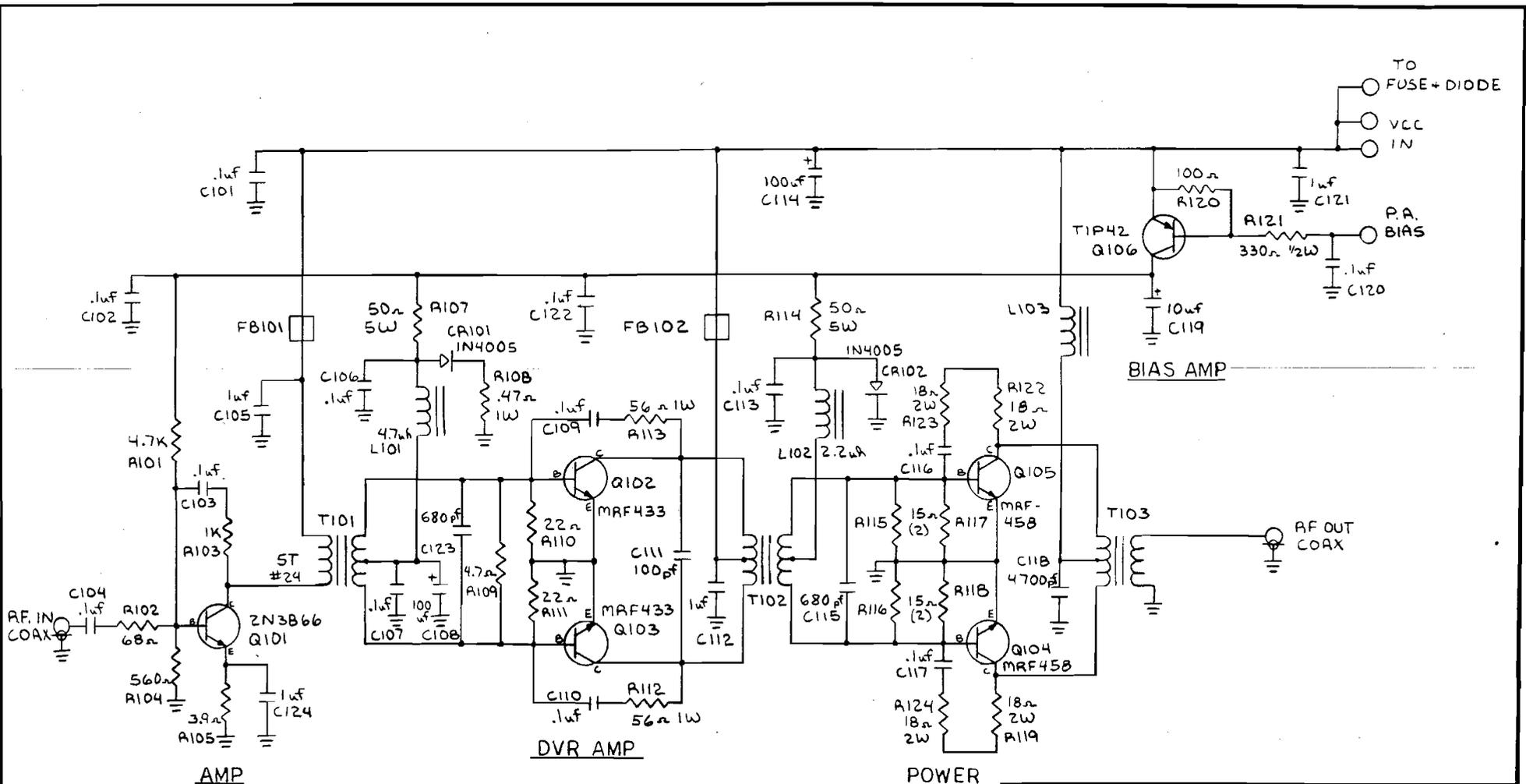
1. COMPONENT DESIGNATORS 7300 SERIES

NOTES:



1. COMPONENT DESIGNATORS (6000 SERIES)
 NOTES:

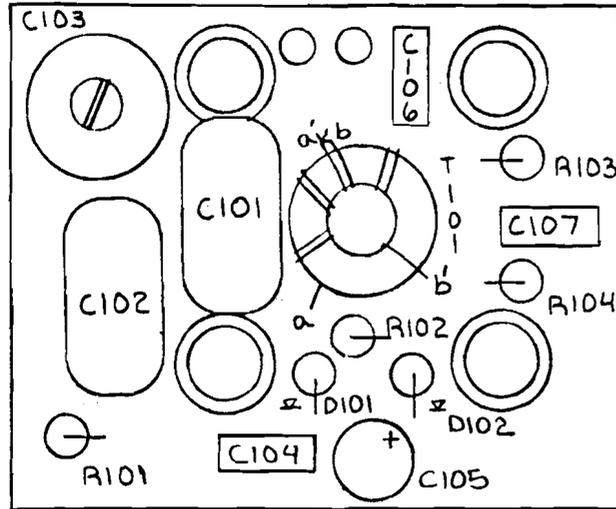
SWAN ELECTRONICS		
SCALE: NONE	APPROVED BY:	DRAWN BY: GAYDESA
DATE: 1-2-78		REVISED
POWER AMP BOARD LAYOUT		
		DRAWING NUMBER 0800-2302



SWAN ELECTRONICS			
SCALE: NONE	APPROVED BY:	DRAWN BY: DAVIDSON	
DATE: 1-2-78		REVISED	
POWER AMP BOARD SCHEMATIC			
REV B	DRAWING NUMBER 0800-2402B		

ECN#	DESCRIPTION	DATE	APPO
B	REPLACED ALL .05uF CAPS WITH .1uF C05-30-79	6-1-79	JW
LTR	REVISIONS		

1. COMPONENT DESIGNATORS (6000 SERIES)
NOTES



SWAN ELECTRONICS

SCALE: NONE

APPROVED BY:

DRAWN BY: DAVIDSON

DATE: 1-11-79

REVISED

SWR/WATTMETER BOARD LAYOUT

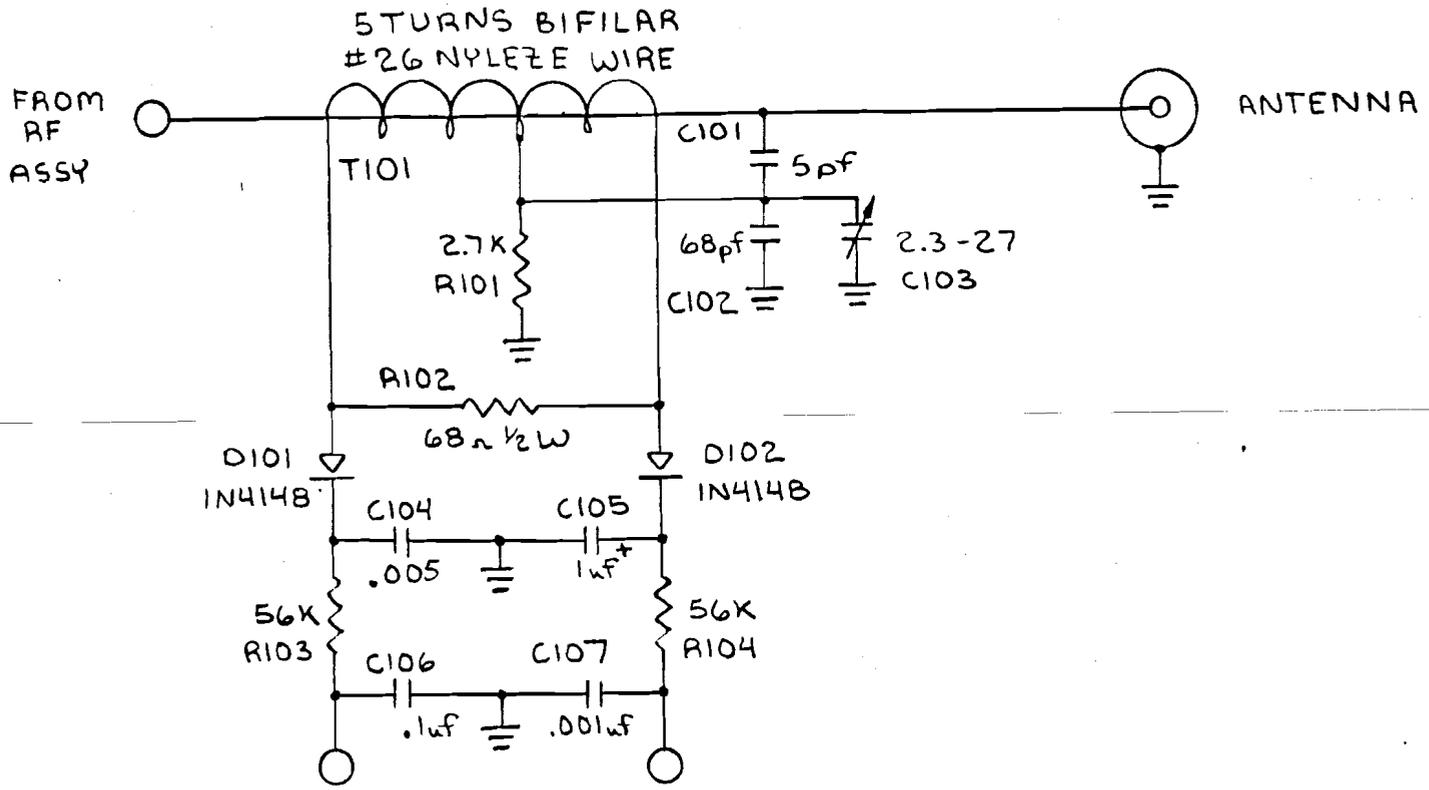
DRAWING NUMBER

0800-2303

1. COMPONENT DESIGNATORS (7700 SERIES)

REVISIONS

LTR	DESCRIPTION	DATE	APP'D
A	CHANGED C106 FROM .001 TO .1uf CD 8-24-79	8-24-79	JW



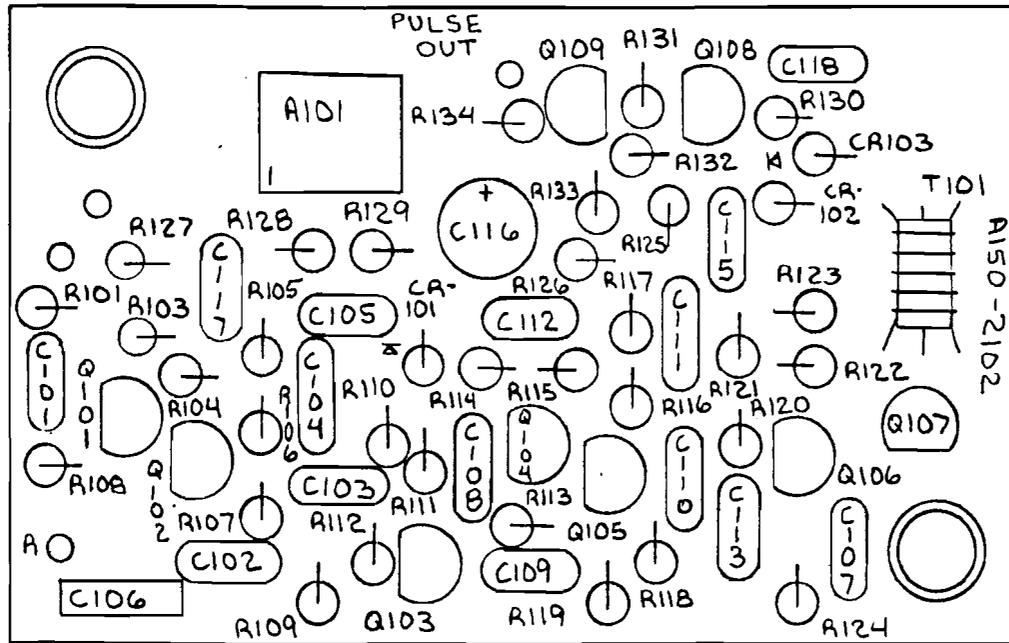
SWAN ELECTRONICS

SCALE: NONE	APPROVED BY:	DRAWN BY: DAVIDSON
DATE: 1-11-79		REVISED

SWR / WATTMETER BRD SCHEMATIC

DRAWING NUMBER
0800-2403A

1. COMPONENT DESIGNATORS (7700 SERIES)



SWAN ELECTRONICS

SCALE: NONE

APPROVED BY:

ju

DRAWN BY: DAVIDSDA

DATE: 1-12-79

REVISED

PROJ.

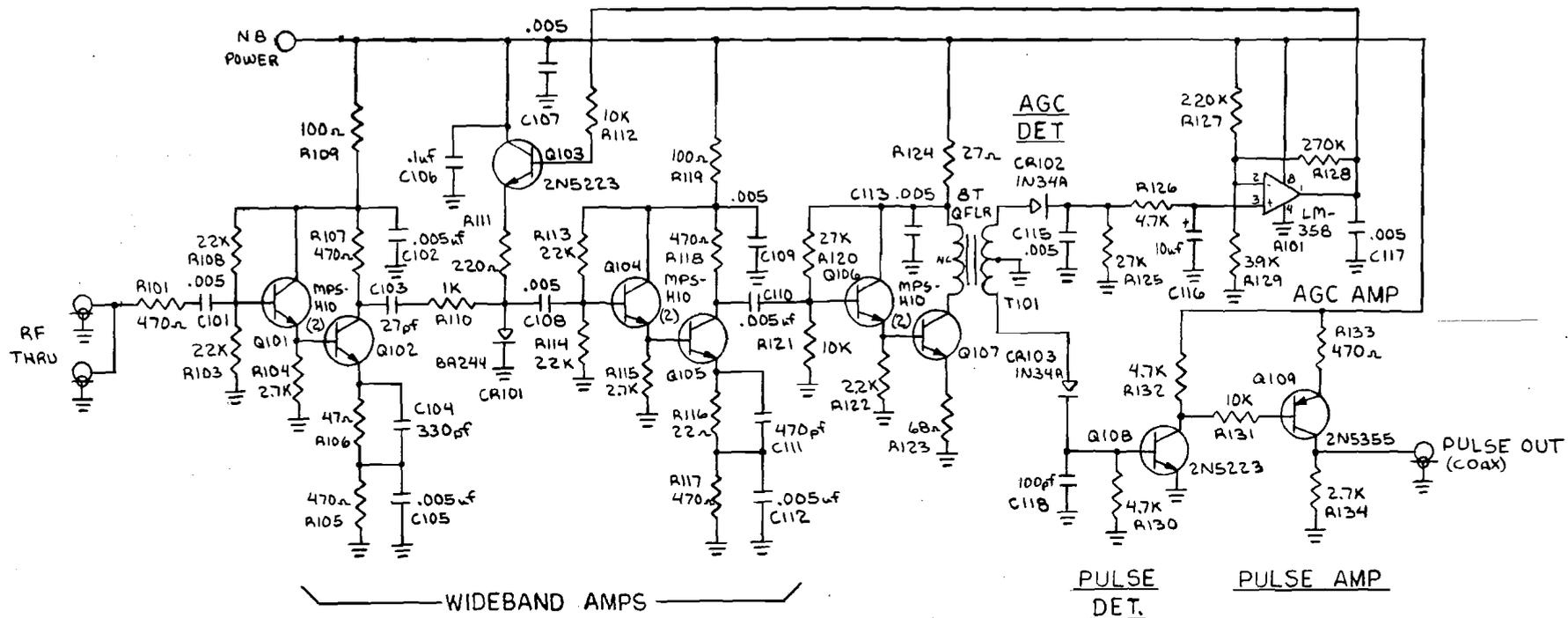
A150 NOISE BLANKER BRD LAYOUT

1. COMPONENT DESIGNATORS (7400 SERIES)
NOTES

0176

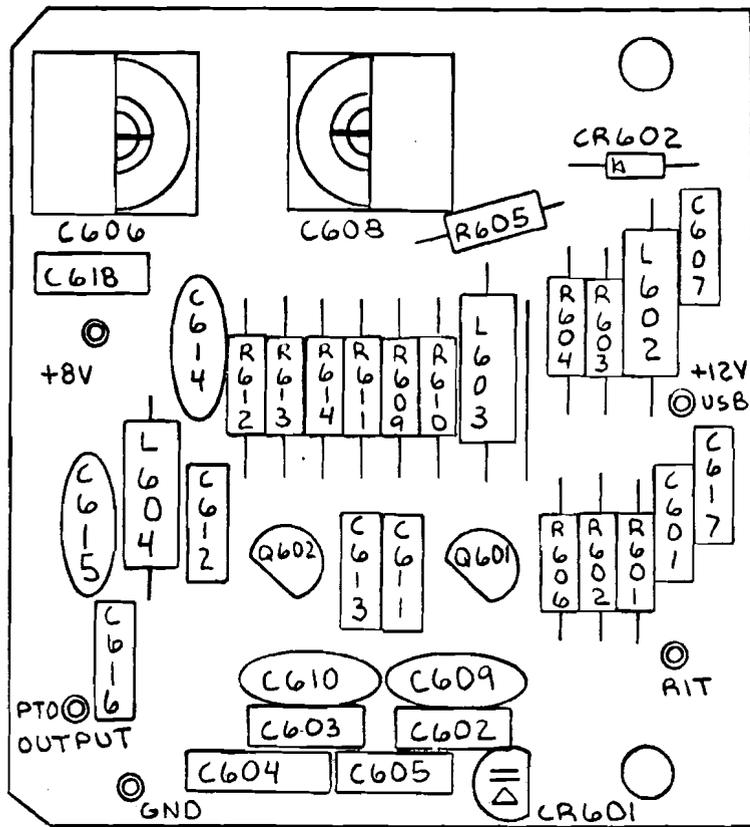
DRAWING NUMBER

0800-7204



1. COMPONENT DESIGNATORS (7400 SERIES)
 NOTES

SWAN ELECTRONICS		
SCALE: NONE	APPROVED BY: <i>JW</i>	DRAWN BY: C. DAVID
DATE: 1-12-78		REVISED
PROJ. 0176	A150 NOISE BLANKER BRD SCHEMATIC	
		DRAWING NUMBER 0800-2404A



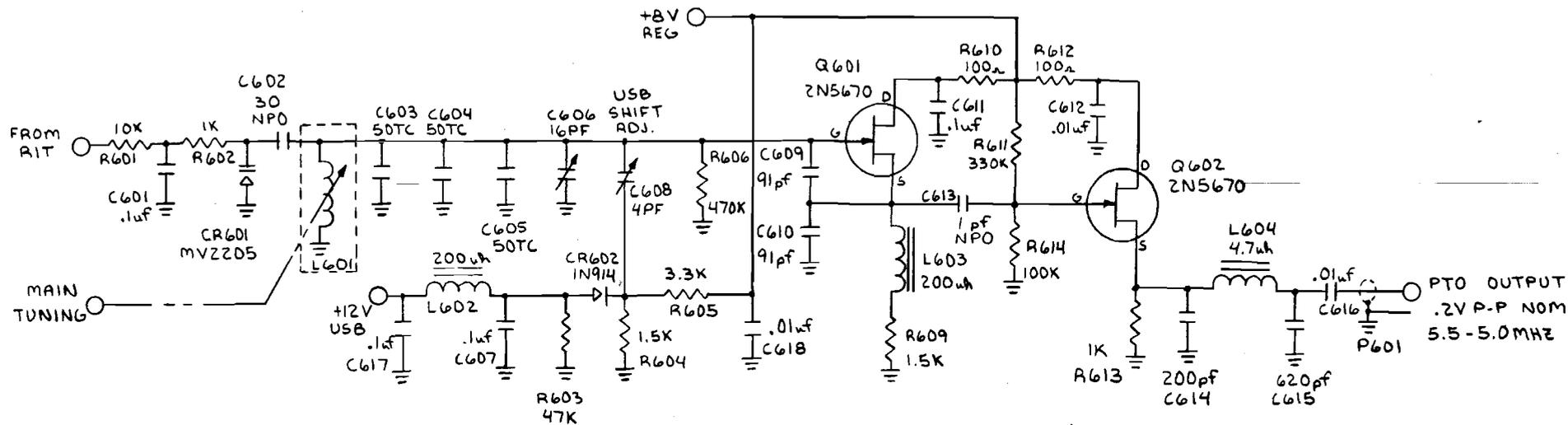
SWAN ELECTRONICS

SCALE: NONE	APPROVED BY:	DRAWN BY: DAVIDSON
DATE: 9-14-78		REVISED

PTO BRD LAYOUT

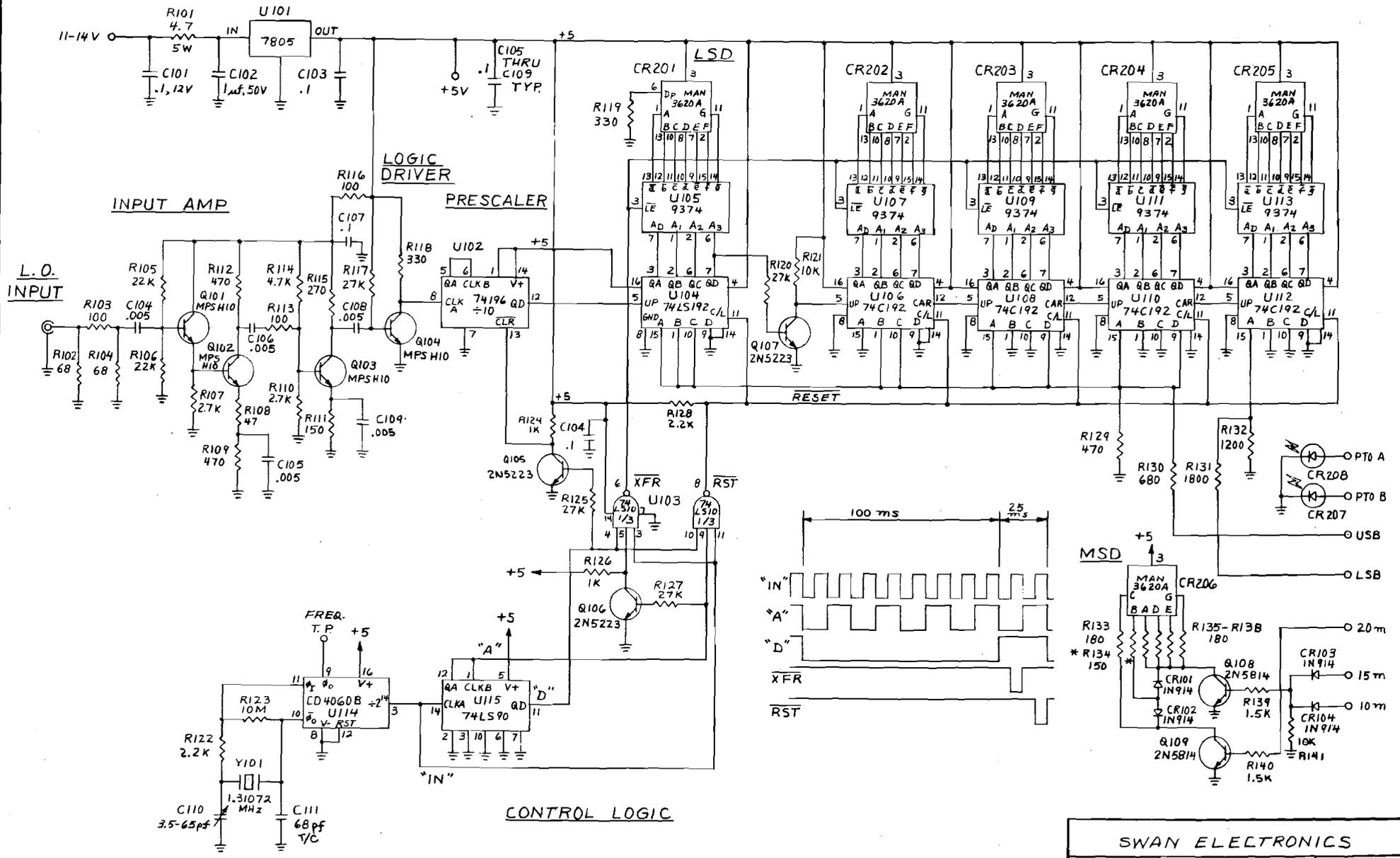
	DRAWING NUMBER 0800-2305
--	-----------------------------

I. COMPONENT DESIGNATORS 7600 SERIES
NOTES

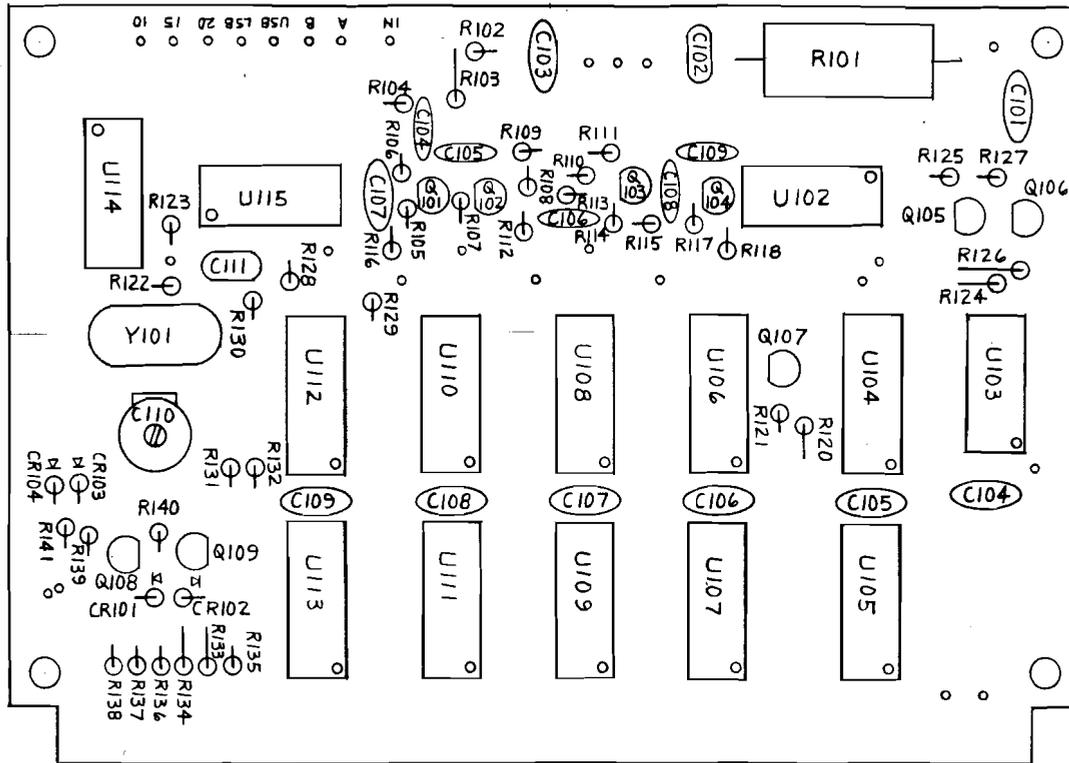


1. COMPONENT DESIGNATORS 7600 SERIES
 NOTES

SWAN ELECTRONICS		
SCALE: NONE	APPROVED BY:	DRAWN BY: C. DAVIDSON
DATE: 9-22-78		REVISED
PTO BRD SCHEMATIC (038-188A)		
		DRAWING NUMBER 0800-2405

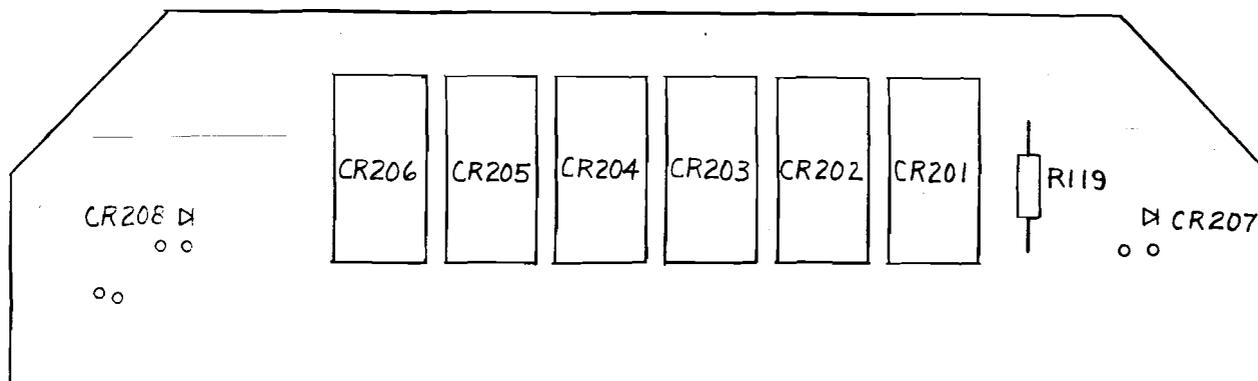


2. DISPLAY REF DESIGNATOR SERIES 7200
 1. COUNTER REF DESIGNATOR SERIES 7100
 NOTES:



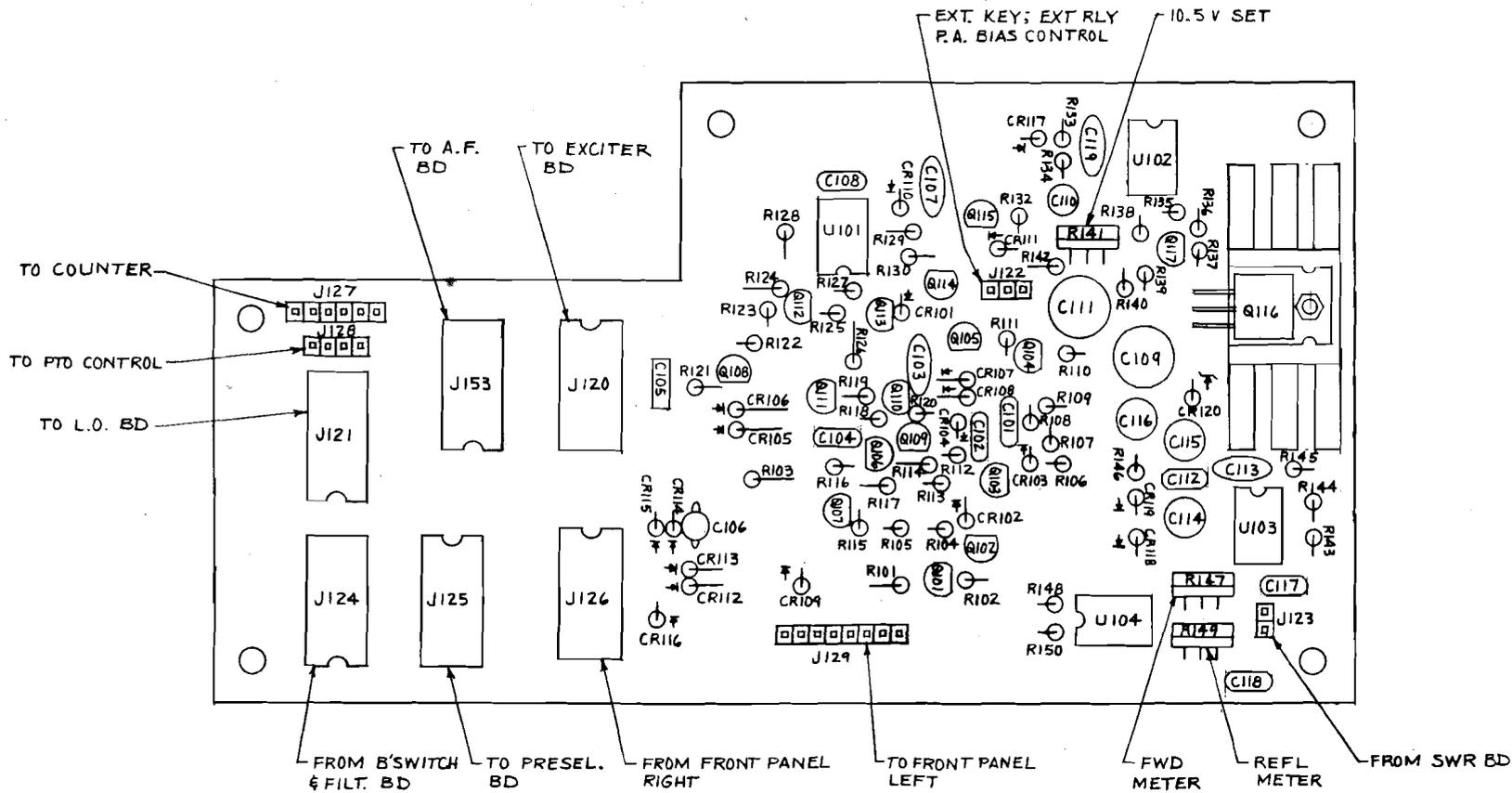
2. COMPONENT DESIGNATORS 7100 SERIES
 1. REF. ELEC. ASSY 102BX-2005
 REF. CIRCUIT BD 102BX 2105
 REF. DRILL DWG 102BX 2205
 NOTES:

SWAN ELECTRONICS			
SCALE: ~	APPROVED BY: <i>fw</i>	DRAWN BY AJG	
DATE: 9-19-79		REVISED	
COUNTER BOARD LAYOUT			
			DRAWING NUMBER: 102BX-2305



2. COMPONENT DESIGNATOR SERIES 7200
 1. REF. ELECT. ASSY 102BX-2006
 REF. CIRCUIT BD 102BX-2106
 REF. DRILL DWG 102BX-2206
 NOTES:

SWAN ELECTRONICS		
SCALE: ~	APPROVED BY: <i>ju</i>	DRAWN BY: AJG
DATE: 9-19-79		REVISED
DISPLAY BOARD LAYOUT		
		DRAWING NUMBER 102BX-2306



2. COMPONENT DESIGNATORS: 9000 SERIES

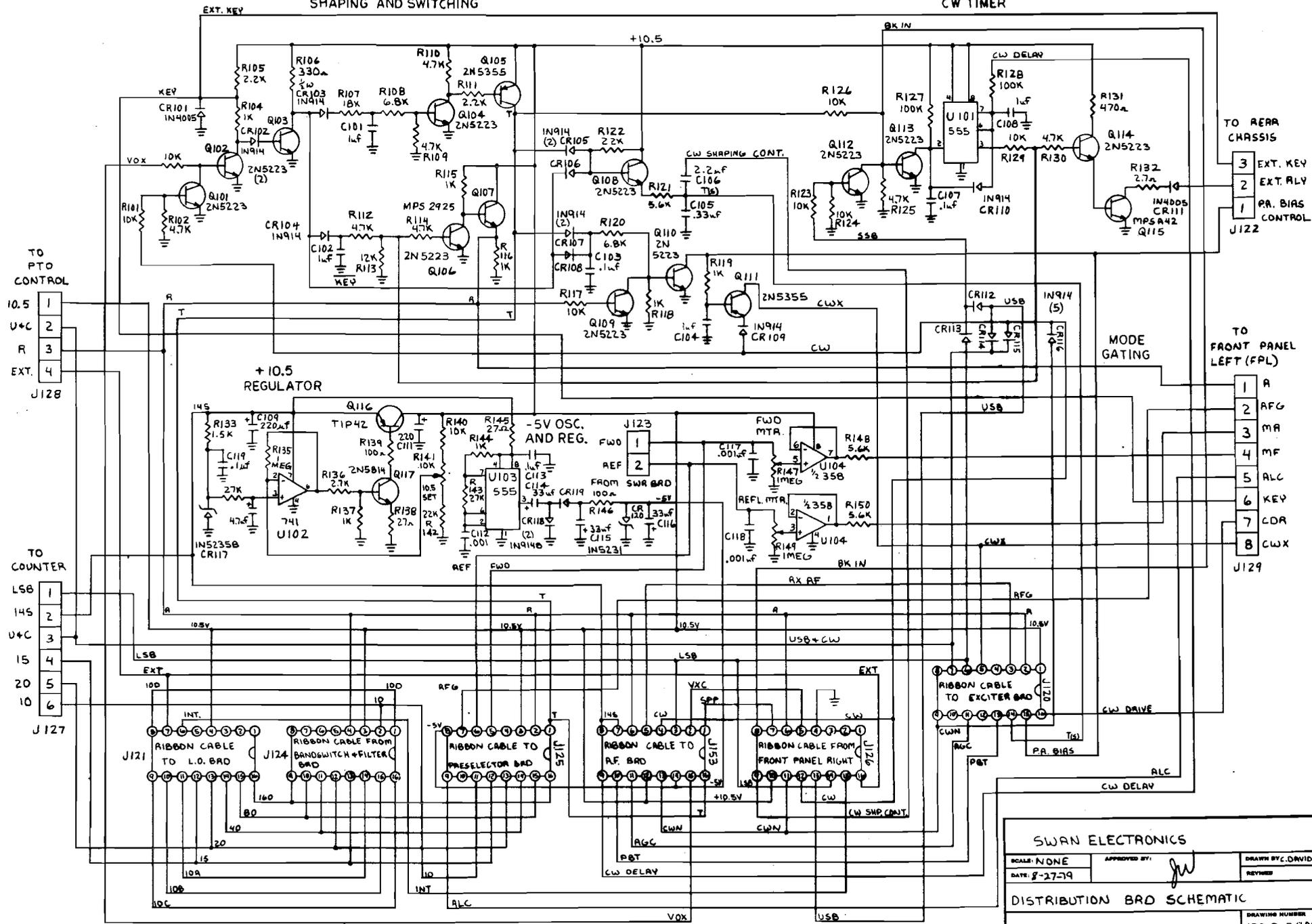
- 1. REF. ELECT. ASSY 102BX-2009
- REF. CIRCUIT BD 102BX-2109
- REF. DRILL DWG 102BX-2209

NOTES:

SWAN ELECTRONICS		
SCALE: NONE	APPROVED BY: <i>[Signature]</i>	DRAWN BY: A.J.B.
DATE: 7-25-79		
DISTRIBUTION BOARD COMPONENT LAYOUT		
REV	ISSUED	102BX-2309

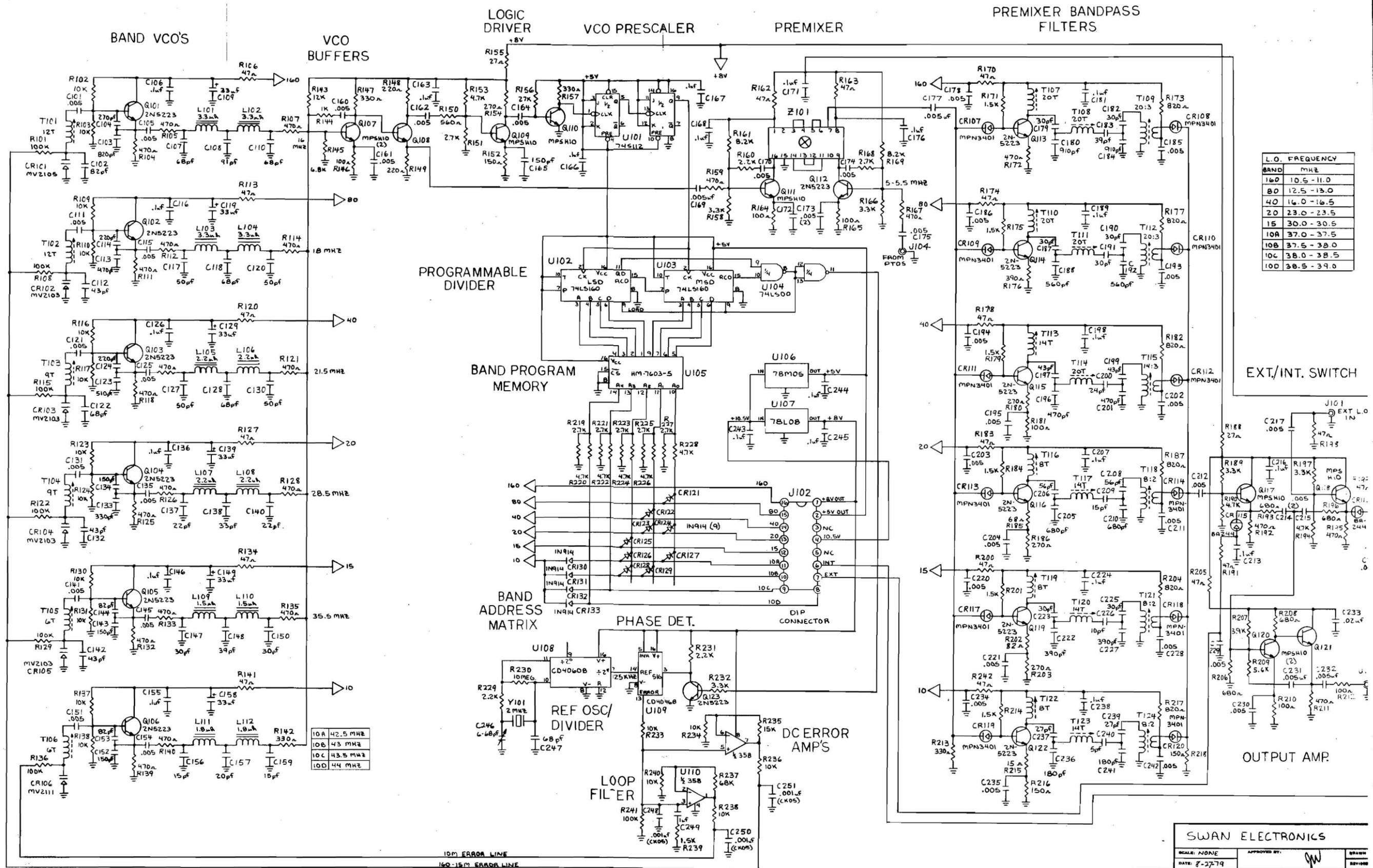
CONTROL VOLTAGE
SHAPING AND SWITCHING

CW TIMER



SWAN ELECTRONICS

SCALE: NONE	APPROVED BY: <i>JW</i>	DRAWN BY: DAVIDSON
DATE: 8-27-79		REVISED
DISTRIBUTION BRD SCHEMATIC		
		DRAWING NUMBER 107 R-740A



BAND	L.O. FREQUENCY
160	10.5 - 11.0
80	12.5 - 13.0
40	16.0 - 16.5
20	23.0 - 23.5
15	30.0 - 30.5
10A	37.0 - 37.5
10B	37.5 - 38.0
10C	38.0 - 38.5
10D	38.5 - 39.0

EXT./INT. SWITCH

OUTPUT AMP.

BAND PHASE LOCKED LOOP

1. COMPONENT DESIGNATORS SERIES 5000 - NOTES:

SWAN ELECTRONICS

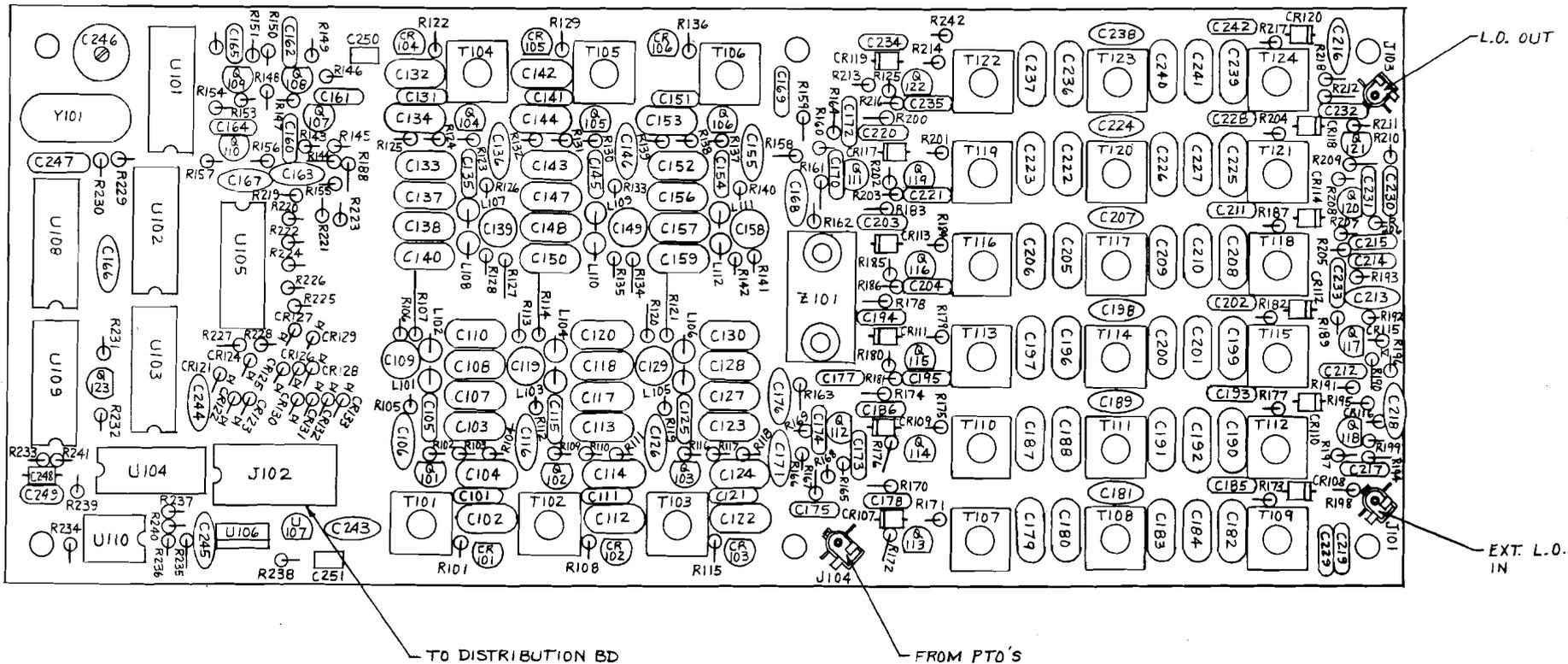
SCALE: NONE APPROVED BY: *[Signature]* DRAWN: *[Signature]*

DATE: 8-27-79

PROJ: L.O. BAND SCHEMATIC

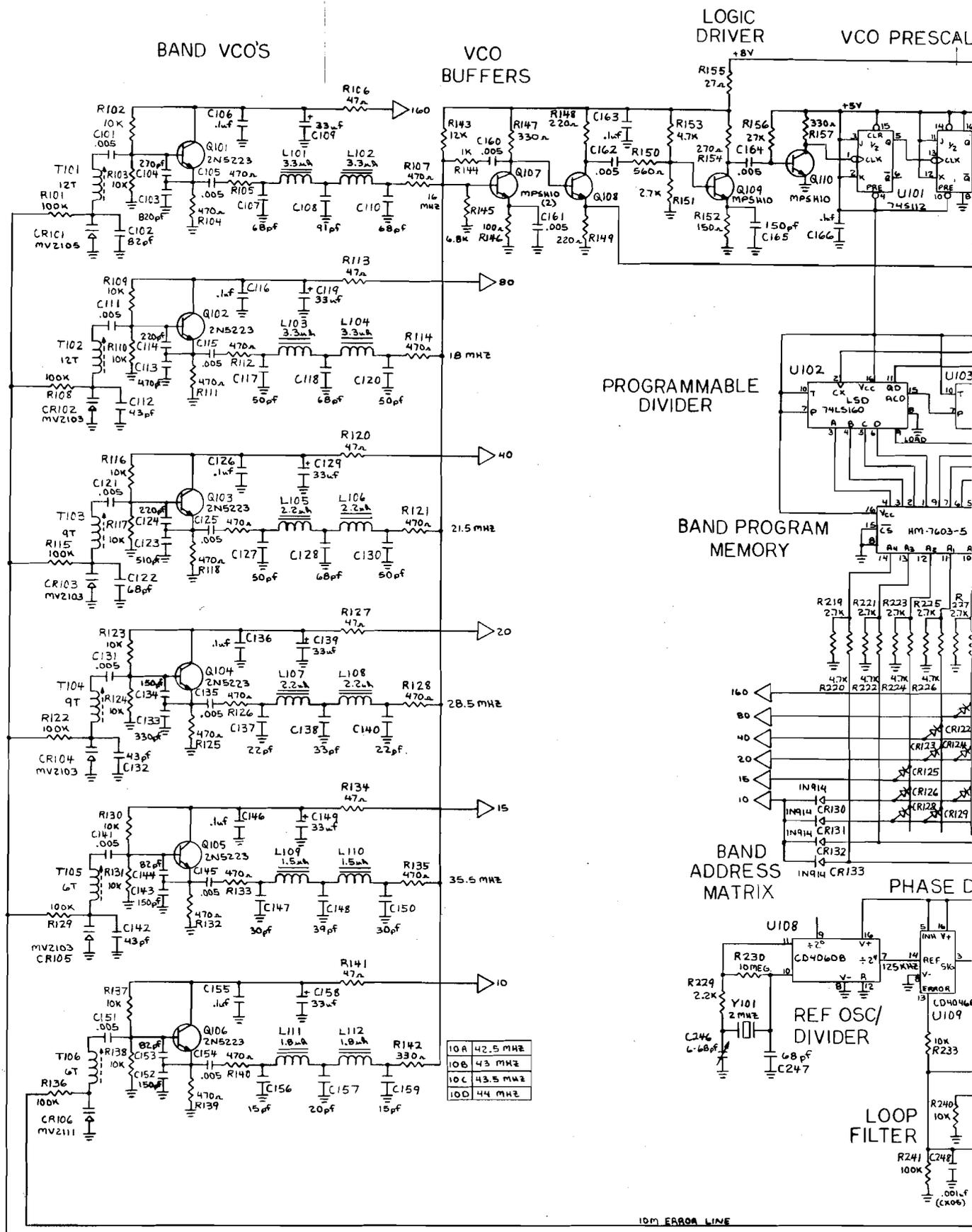
0177

10M ERROR LINE
160-15M ERROR LINE



2. COMPONENT DESIGNATORS: 5000 SERIES
- REF. ELECT. ASSY 102BX-2004
 - REF. CIRCUIT BOARD 102BX-2104
 - REF. DRILL DWG 102BX-2204
- NOTES.

SWAN ELECTRONICS			
SCALE: NONE	APPROVED BY: <i>fw</i>	DRAWN BY: AJG	
DATE: 7-30-79		REVISED	
L.O. BOARD COMPONENT LAYOUT			
REF:	DRAWING NUMBER: 102BX-2304		



10A	42.5 MHz
10B	43 MHz
10C	43.5 MHz
10D	44 MHz

BAND PHASE LOCKED LOOP

10M ERROR LINE
160-15M ERROR LINE

PREMIXER BANDPASS FILTERS

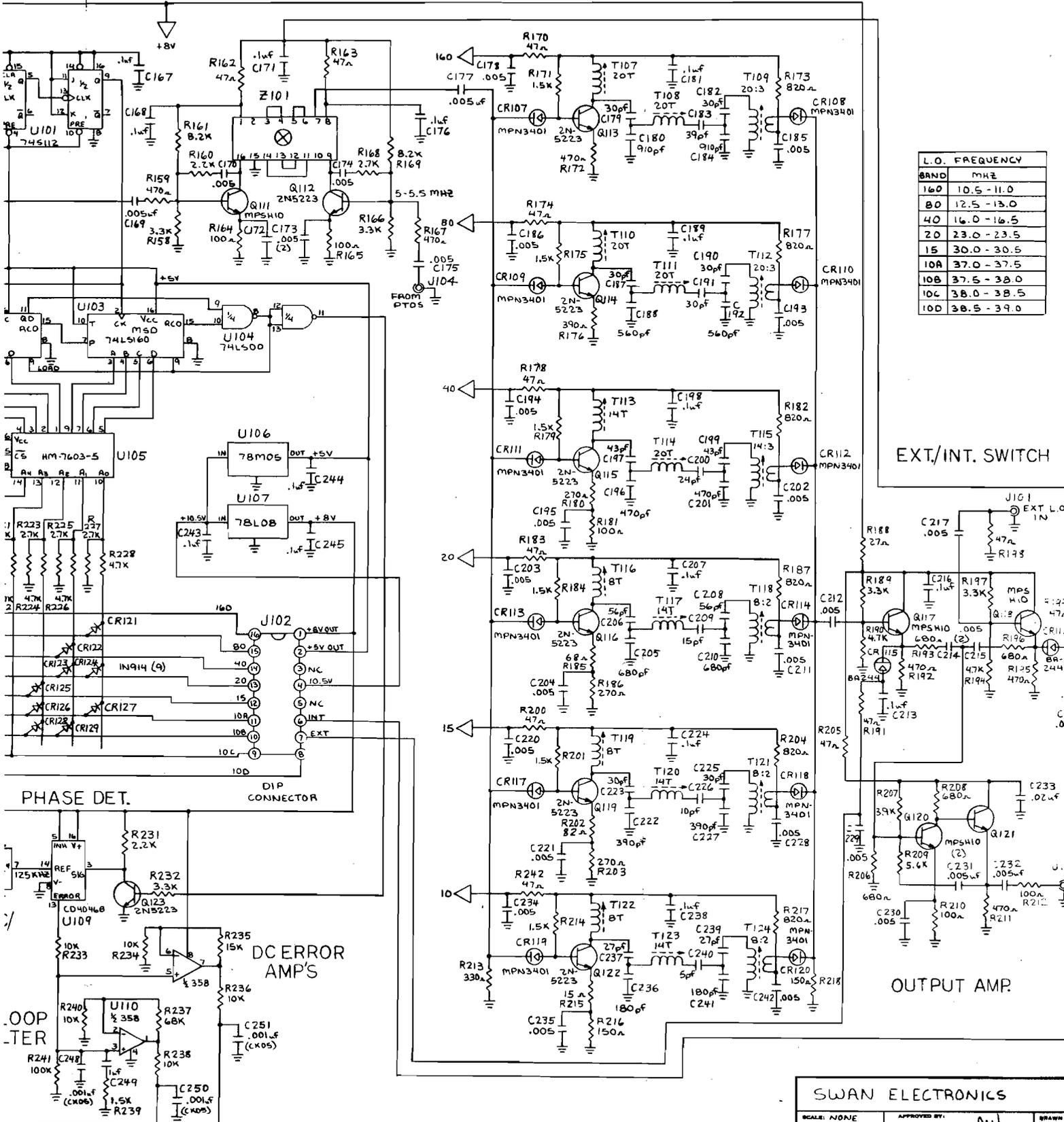
BAND	MHZ
160	10.5 - 11.0
80	12.5 - 13.0
40	16.0 - 16.5
20	23.0 - 23.5
15	30.0 - 30.5
10A	37.0 - 37.5
10B	37.5 - 38.0
10C	38.0 - 38.5
10D	38.5 - 39.0

EXT./INT. SWITCH

OUTPUT AMP.

PRESCALER

PREMIXER



1. COMPONENT DESIGNATORS SERIES 5000.
NOTES:

SWAN ELECTRONICS

SCALE: NONE APPROVED BY: *[Signature]* SWAN REV 006

PROJ L.O. BAND SCHEMATIC
0177

72 Hour Burn-In ✓

Lead Dress ✓

10.5V

10.54

-5V Reg.

4.75

OSCILLATOR ALIGNMENT

Performed By

942

Carrier LSB ✓

USB ✓

CW ✓

2 MHz REF ✓

PBT 22.80165 @ 5.25V ✓

PBT RANGE

3.473

ERL 3.75V 160-15 ✓

ERL 10A

3.18

V,10B

3.55

V,10C

3.96

V,10D

4.1

RECEIVER CHECKS

Performed By

942

AGC Threshold ✓

S-Meter Adjust S-9 @ 50uv. ✓

RF Gain ✓

IF Gain ✓

AGC Decay 10

Sec. Notch Fil 1650HZ ✓

2500HZ ✓

400HZ ✓

CWN Adj

PBT Ind ✓

PBT LSB ✓

USB ✓

CW ✓

CWN ✓

Band	Sens. (10DB = S+N/N)	N.B.	AGC Action	Shock Test
160	.30 uv	✓	✓	✓
80	.35 uv	✓	✓	✓
40	.25 uv	✓	✓	✓
20	.3 uv	✓	✓	✓
15	.15 uv	✓	✓	✓
10	.10 uv	✓	✓	✓

PTO CALIBRATION + OPERATION

Performed By

942

Counter Adj. ✓

Display ✓

PTO	Range KHZ	Rit Cal	Rit Off TX	PTO Lite	USB Shift	Tension	Interaction
A	687	✓	✓	✓	✓	✓	✓
B	682	✓	✓	✓	✓	✓	✓

SWITCHING EXT ✓

A ✓

RA-TB ✓

B ✓

RB-TA ✓

TRANSMITTER CHECKS

Performed By

942

Wattmeter Null ✓

CAL FWD. ✓

CAL REF ✓

ALC-0 ✓

Band	Watts Out	SWR Shutdown	2-Tone	Mic Modulation	Emission Purity	Shock Test
160	100	✓	✓	✓	✓	✓
80	20	✓	✓	✓	✓	✓
40	20	✓	✓	✓	✓	✓
20	110	✓	✓	✓	✓	✓
15	110	✓	✓	✓	✓	✓
10	100	✓	✓	✓	✓	✓

CW Operation: Full ✓

Semi ✓

Delay ✓

Shaping ✓

Sidetone ✓

SSB Operation: PIT ✓

VOX; Gain ✓

Delay ✓

Anti ✓

Mic Level ✓

Speech Proc ✓

REAR PANEL FUNCTIONS

Performed By

942

EXT Speaker ✓

Key ✓

EXT Mod ✓

EXT Rly ✓

EXT L.O. ✓

FINAL INSPECTION & OPERATIONAL CHECKS

Performed By

942

Cosmetics Knobs ✓

Switches ✓

Meter ✓

Display ✓

TX Operation Output LSB ✓

USB ✓

CW ✓

TX Operation

Audio Quality ✓

Sensitivity ✓

Selectivity ✓

PIT Operation ✓

PACKING LIST

OK 942



OPERATING MANUAL
MODEL PSU-6 POWER SUPPLY

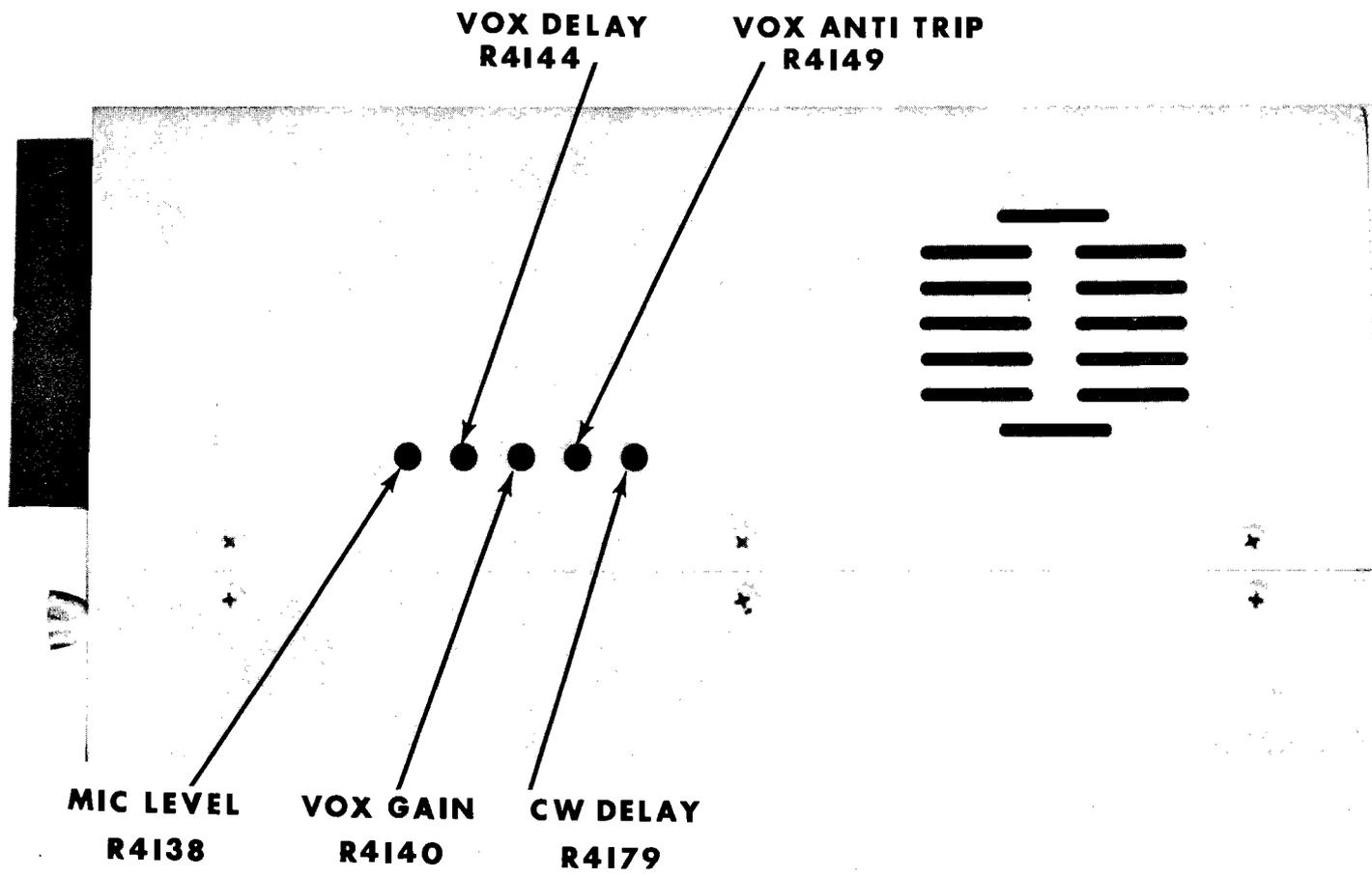
1. The Swan PSU-6 fixed station power supply-speaker provides a regulated D.C. voltage for operation of all Swan solid state transceivers, but is intended particularly to match the Swan ASTRO-102BX Transceiver.
2. The PSU-6 is designed to operate from nominal 117 volts A.C., 50-60 Hz or 230 volts A.C. 50-60 Hz. All assemblies are factory wired for 117 v.a.c. operation, however, they may easily be re-wired for 230 v.a.c. operation.
3. The PSU-6 is conservatively rated at 20 amps at 13.6 volts for intermittent operation and 10 amps semi-continuous operation.
 - * Intermittant operation: Operated under a cycle of one minute on and four minutes off.
 - * Semi-continuous: Eight hours continuous in 24 hours.

The output voltage is factory set to 13.6 v.d.c. and is adjustable over a range of approximately 10 to 23 volts. The output regulation at full load is 3%, ripple is less than 1%. The heatsink is adequate for operation under the above operating conditions, however, under prolonged operation, the heatsink will reach temperatures too hot to touch. The supply should not be positioned so that circulation of air around the heatsink is inhibited. If operation is intended over a long period of time or under environmental conditions of high ambient temperature, it is recommended that a small fan be used to direct air against the heatsink.

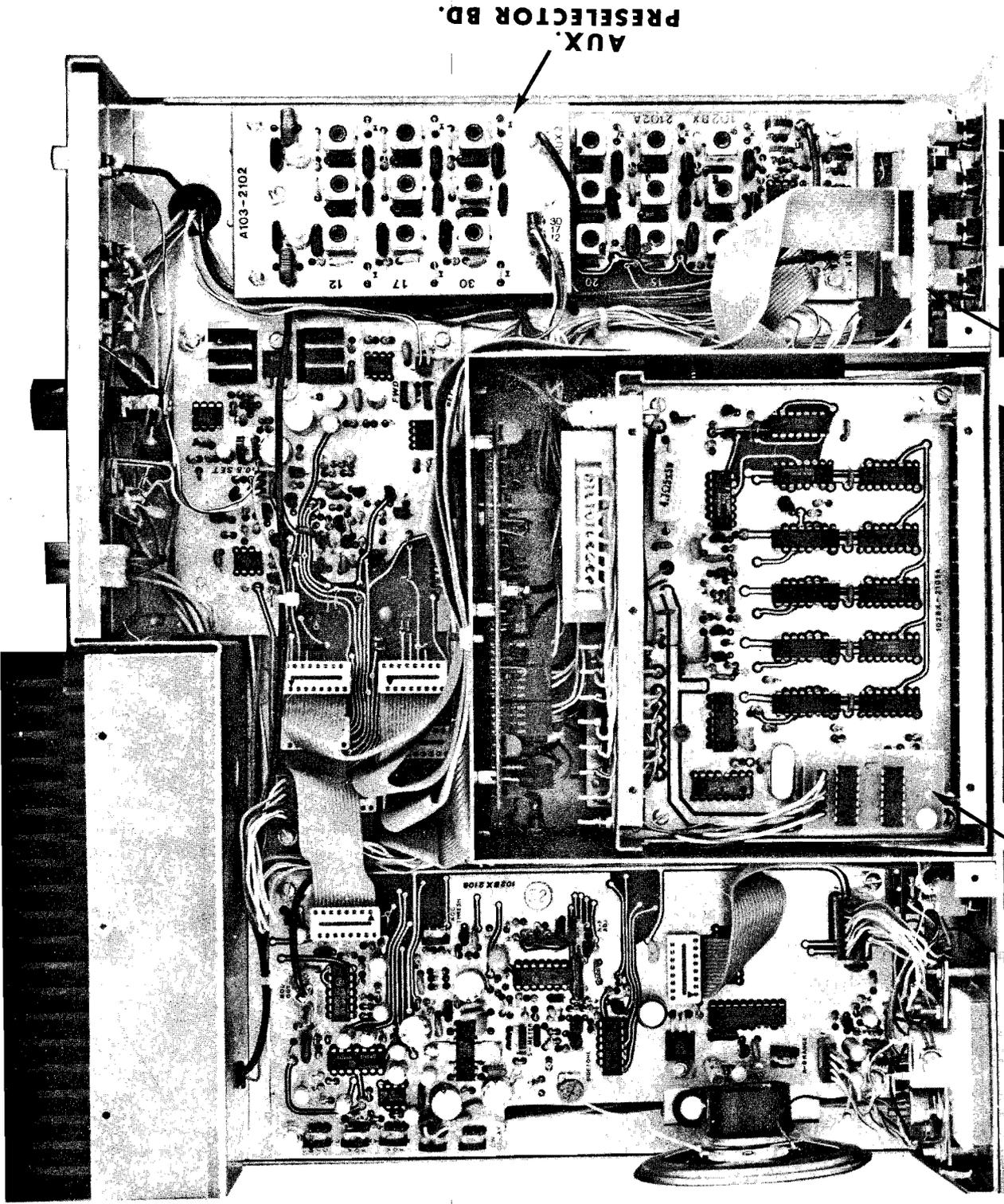
4. The PSU-6 is styled to match the Swan transceivers and is complete with A.C. line cord, D.C. power cable with connector for the transceiver. The front panel contains ON-OFF switch and indicator light. The PSU-6 also has a speaker for external speaker operation, and a jack for low impedance headphones.
5. A two conductor connector at the end of the D.C. power cable is provided to power certain accessories (i.e., Pilot Lights of Antenna Tuner) and is fused by fuse in transceiver.

Specifications:

Average Power Consumption:	117 watts receive 700 watts transmit
Input:	117/230 VAC 50-60 Hz
Dimensions:	9 3/4" W x 5 3/4" H x 10 3/4" D
Weight:	19 lbs, 12 oz.; 8.96 Kg



LEFT SIDE VIEW

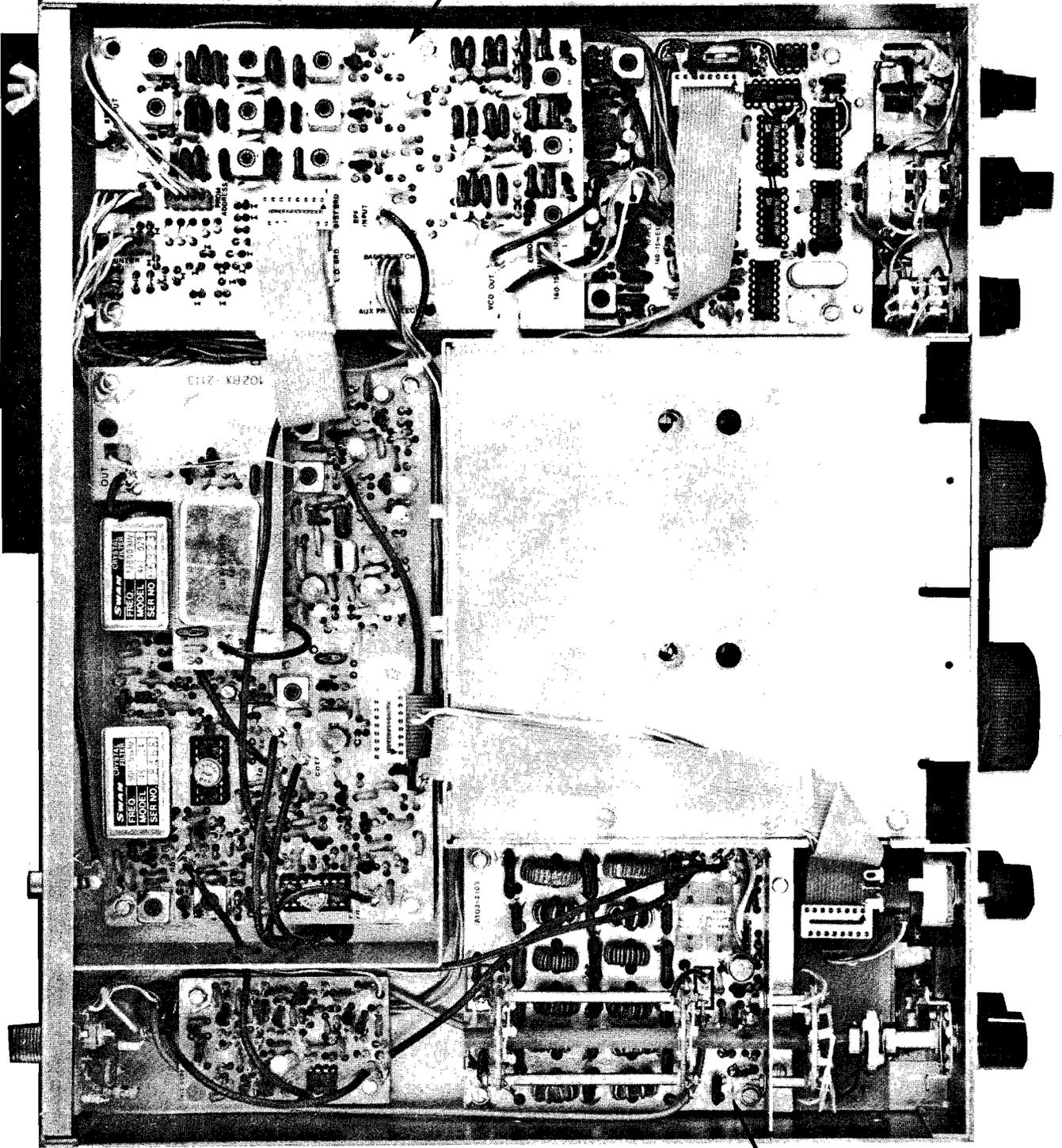


AUX.
PRESECTOR BD.

FRONT PANEL
RIGHT BD.

TOP VIEW

AUX. COUNTER BD.



AUX.
L.O. BD.

LOW PASS
FILTER BD.

BOTTOM VIEW



CUBIC
COMMUNICATIONS
SWAN DIVISION

Parts

Semiconductors.....	9-1
Integrated Circuits.....	9-1
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Exciter Board (2000 Series).....	9-2
Low Pass Filter/Band Switch Board (3000 Series).....	9-3
Audio Board (4000 Series).....	9-4
Local Oscillator Board (5000 Series).....	9-5
Power Amplifier Board (6000 Series).....	9-6
Counter Board (7100 Series).....	9-6
Noise Blanker Board (7400 Series).....	9-7
PTO Control Board (7500 Series).....	9-7
PTO Board (7600 Series).....	9-7
SWR/Wattmeter Board (7700 Series).....	9-7
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Preselector Board (8000 Series).....	9-8
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CUBIC
COMMUNICATIONS
SWAN DIVISION

NOTE: Only "parts peculiar" are listed in this section of the manual; that is, only those parts which might otherwise be difficult for the servicing facility to obtain. Common resistors and capacitors are omitted; their value is shown on the schematic diagrams, and the type, size, wattage, etc., can be determined from the part being replaced. Since any service shop can be expected to have a stock of these common parts available, it is unlikely that they would be ordered from Cubic Communications in any event.

Circuit symbols shown on the schematics should be correlated with the 'series' number also shown on the schematic, as only the last three digits of the circuit symbol are used on the diagrams; for instance integrated circuit U101 on the exciter board (2000 series) schematic would be shown in the parts list under circuit symbol U2101; C106 on the low pass filter board (3000 series) would be shown under circuit symbol C3106 in the parts list. The full circuit symbol, the description of the part, and the model and serial number of the radio should be supplied with any parts order to ensure that the correct part is shipped. Semiconductors are listed separately, by manufacturer's type number and Cubic Communications part number only.

SEMICONDUCTORS

Transistors

2N3866.....	476-015
2N5223.....	476-077
2N5306.....	476-024
2N5355.....	476-016
2N5670.....	476-039
2N5814.....	476-017
3N211.....	476-107
MPF971.....	476-094
MPF4393.....	476-060
MPS-A42.....	476-048
MPS-H10.....	476-026
MRF433.....	476-075
MRF458.....	476-076
TIP-42.....	476-118
MPS2925.....	476-074

Integrated Circuits

ADC0804.....	477-121
CD4016.....	477-056
CD4046.....	477-110
CD4060.....	477-003
CD4081.....	477-119
LM358.....	477-072
LM555.....	477-067
TBA810.....	477-047
uA741.....	477-093
uA757.....	477-069



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SWAN DIVISION

Integrated Circuits, Continued

74LS00.....477-062
 74LS10.....477-123
 74LS90.....477-088
 74LS112.....477-120
 74LS160.....477-112
 74C192.....477-192
 74LS192.....477-082
 74196.....477-035
 78L08.....477-074
 78M05.....477-024
 78M08.....477-010
 7805.....677-207
 4136.....477-111
 9374.....477-036
 HM7603 (L.O. counter) 478-008
 HM7603 (BPF indicator) 478-009

Diodes

1N34A.....475-008
 1N914.....475-021
 1N4005.....475-023
 1N5231B.....475-061
 1N5235A.....475-065
 1N5236B.....475-032
 BA244.....475-048
 MAN3620A.....475-087
 MPN3401.....475-049
 MV1404.....475-092
 MV2103.....475-069
 MV2105.....475-089
 MV2111.....475-094
 MV2205.....475-050
 MV5174B.....475-093

EXCITER BOARD (2000 Series)

<u>Circuit Symbol</u>	<u>Cubic Part Number</u>	<u>Description</u>
C2130	089-028	Capacitor, trimmer, 2-27 pF
C2134	089-028	Capacitor, trimmer, 2-27 pF
C2185	073-052	Capacitor, Electrolytic, 10 uF
C2188	084-084	Capacitor, temp. comp, 220 pF, N2200
C2189	084-084	Capacitor, temp. comp, 220 pF, N2200
C2194	089-028	Capacitor, trimmer, 2-27 pF
C2195	084-111	Capacitor, temp. comp. 25 pF, N470
C2197	089-028	Capacitor, trimmer, 2-27 pF
C2198	084-111	Capacitor, temp. comp. 25 pF, N470
C2199	089-028	Capacitor, trimmer, 2-27 pF
C2206	089-028	Capacitor, trimmer, 2-27 pF



CUBIC

COMMUNICATIONS

SWAN DIVISION

C2211	073-052	Capacitor, electrolytic, 10 uF
C2212	073-085	Capacitor, electrolytic, 33 uF
C2213	073-055	Capacitor, electrolytic, 4.7 uF
C2220	084-060	Capacitor, temp. comp, 10 pF, NPO
C2221	073-085	Capacitor, electrolytic, 33 uF
L2101	012-247	Inductor, 160 uH
L2102	012-247	Inductor, 160 uH
L2103	027-061	RF choke, 2.2 uH
L2104	027-044	RF choke, 10 uH
L2105	027-083	RF choke, 8.2 uH
L2106	027-040	RF choke, 47 uH
L2107	027-040	RF choke, 47 uH
L2108	027-040	RF choke, 47 uH
T2101	014-067	Transformer, RF
T2102	014-067	Transformer, RF
T2103	012-253	Transformer, RF
T2104	014-057	Transformer, RF
T2105	014-058	Transformer, RF
T2106	014-057	Transformer, RF
Y2101	486-102	Crystal, HC18, 13.800 MHz, 20 pF
Y2102	486-102	Crystal, HC18, 13.800 MHz, 20 pF
Y2103	486-080	Crystal, HC18, 9.0000 MHz, 32 pF
Y2104	486-081	Crystal, HC18, 9.0033 MHz, 32 pF
Y2105	486-103	Crystal, HC18, 22.80165 MHz, 10 pF
Z2101	0800-2004	Double balanced mixer
Z2102	0800-2004	Double balanced mixer
FL2101	487-024	Filter, crystal, 9.00165 MHz
FL2102	487-029	Filter, crystal, 13.800 MHz
	341-026	Socket, 16 pin
	344-114	Coax connector, vertical receptical
	344-115	Coax connector, spring socket

LOW PASS FILTER/BAND SWITCH BOARD (3000 Series)

Circuit Symbol	Cubic Part Number	Description
K3101	111-036	Relay, reed, SPST
L3101	027-072	Coil, RF, .35 uH, 10 meter
L3102	027-072	Coil, RF, .35 uH, 10 meter
L3103	027-073	Coil, RF, .46 uH, 15 meter
L3104	027-073	Coil, RF, .46 uH, 15 meter
L3105	027-074	Coil, RF, .62 uH, 20 meter
L3106	027-074	Coil, RF, .62 uH, 20 meter
L3107	027-075	Coil, RF, 1.5 uH, 40 meter
L3108	027-075	Coil, RF, 1.5 uH, 40 meter
L3109	027-076	Coil, RF, 2.8 uH, 80 meter
L3110	027-076	Coil, RF, 2.8 uH, 80 meter
L3111	027-079	Coil, RF, 4.5 uH, 160 meter
L3112	027-079	Coil, RF, 4.5 uH, 160 meter



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S3101	171-176	Switch, band
S3102	171-176	Switch, band
S3103	171-176	Switch, band
	341-026	Socket, 16 pin
	344-114	Coax connector, vertical receptical
	344-115	Coax connector, spring socket

AUDIO BOARD (4000 Series)

Circuit Symbol	Cubic Part Number	Description
C4102	069-024	Capacitor, tantalum, 68 uF
C4103	073-085	Capacitor, electrolytic, 33 uF
C4105	070-001	Capacitor, stable ceramic, .0047 uF
C4106	070-001	Capacitor, stable ceramic, .0047 uF
C4107	073-055	Capacitor, electrolytic, 4.7 uF
C4108	073-064	Capacitor, electrolytic, 100 uF
C4109	073-064	Capacitor, electrolytic, 100 uF
C4112	073-064	Capacitor, electrolytic, 100 uF
C4115	073-064	Capacitor, electrolytic, 100 uF
C4116	070-012	Capacitor, stable ceramic, 1 uF
C4121	073-085	Capacitor, electrolytic, 33 uF
C4122	073-051	Capacitor, electrolytic, 1 uF
C4123	073-085	Capacitor, electrolytic, 33 uF
C4125	073-052	Capacitor, electrolytic, 10 uF
C4126	073-085	Capacitor, electrolytic, 33 uF
C4128	073-051	Capacitor, electrolytic, 1 uF
C4130	073-052	Capacitor, electrolytic, 10 uF
C4131	073-051	Capacitor, electrolytic, 1 uF
C4132	073-051	Capacitor, electrolytic, 1 uF
C4133	073-051	Capacitor, electrolytic, 1 uF
C4134	073-051	Capacitor, electrolytic, 1 uF
C4136	073-051	Capacitor, electrolytic, 1 uF
C4139	073-051	Capacitor, electrolytic, 1 uF
C4140	073-051	Capacitor, electrolytic, 1 uF
C4141	073-088	Capacitor, electrolytic, 220 uF
C4143	070-001	Capacitor, stable ceramic, .0047 uF
C4144	088-137	Capacitor, silver mica, 1800 pF, 1%, DM19
C4145	088-137	Capacitor, silver mica, 1800 pF, 1%, DM19
R4101	052-119	Trimpot, 10 kΩ
R4110	052-119	Trimpot, 10 kΩ
R4124	052-131	Trimpot, 1 kΩ
R4138	052-119	Trimpot, 10 kΩ
R4140	052-133	Trimpot, 1 MΩ
R4144	052-133	Trimpot, 1 MΩ
R4149	052-148	Trimpot, 100 Ω
R4166	052-151	Trimpot, 50 kΩ
R4174	040-005	Resistor, 47 kΩ, $\frac{1}{4}$ watt, 1%
R4175	040-004	Resistor, 10 kΩ, $\frac{1}{4}$ watt, 1%
R4176	040-006	Resistor, 5.6 kΩ, $\frac{1}{4}$ watt, 1%
R4178	052-151	Trimpot, 50 kΩ
R4179	052-133	Trimpot, 1 MΩ



CUBIC
COMMUNICATIONS
SWAN DIVISION

341-026 Socket, 16 pin
344-114 Coax connector, vertical receptical
344-115 Coax connector, spring socket

LOCAL OSCILLATOR BOARD (5000 Series)

Circuit Symbol	Cubic Part Number	Description
C5109	073-085	Capacitor, electrolytic, 33 uF
C5119	073-085	Capacitor, electrolytic, 33 uF
C5129	073-085	Capacitor, electrolytic, 33 uF
C5139	073-085	Capacitor, electrolytic, 33 uF
C5149	073-085	Capacitor, electrolytic, 33 uF
C5158	073-085	Capacitor, electrolytic, 33 uF
C5246	089-030	Capacitor, trimmer, 3.5-65 pF
C5248	070-002	Capacitor, stable ceramic, .001 uF
C5249	070-012	Capacitor, stable ceramic, 1 uF
C5250	070-002	Capacitor, stable ceramic, .001 uF
C5251	070-002	Capacitor, stable ceramic, .001 uF
L5101	027-069	RF Choke, 3.3 uH
L5102	027-069	RF Choke, 3.3 uH
L5103	027-069	RF Choke, 3.3 uH
L5104	027-069	RF Choke, 3.3 uH
L5105	027-061	RF Choke, 2.2 uH
L5106	027-061	RF Choke, 2.2 uH
L5107	027-061	RF Choke, 2.2 uH
L5108	027-061	RF Choke, 2.2 uH
L5109	027-059	RF Choke, 1.5 uH
L5110	027-059	RF Choke, 1.5 uH
L5111	027-060	RF Choke, 1.8 uH
L5112	027-060	RF Choke, 1.8 uH
T5101	012-254	Transformer, RF
T5102	012-254	Transformer, RF
T5103	012-255	Transformer, RF
T5106	012-255	Transformer, RF
T5107	014-068	Transformer, RF
T5108	014-068	Transformer, RF
T5109	014-068	Transformer, RF
T5110	014-068	Transformer, RF
T5111	014-068	Transformer, RF
T5112	014-068	Transformer, RF
T5113	014-067	Transformer, RF
T5114	014-068	Transformer, RF
T5115	014-067	Transformer, RF
T5116	014-066	Transformer, RF
T5117	014-067	Transformer, RF
T5118	014-066	Transformer, RF
T5119	014-066	Transformer, RF
T5120	014-067	Transformer, RF
T5121	014-066	Transformer, RF
T5122	014-066	Transformer, RF



CUBIC
COMMUNICATIONS
SWAN DIVISION

T5123	014-067	Transformer, RF
T5124	014-066	Transformer, RF
Y5101	486-100	Crystal, HC33, 2.000 MHz, $\pm .005\%$
Z5101	0800-039	Double balanced mixer
	341-026	Socket, 16 pin
	344-114	Coax connector, vertical receptical
	344-115	Coax connector, spring socket

POWER AMPLIFIER BOARD (6000 Series)

Circuit Symbol	Cubic Part Number	Description
C6105	070-012	Capacitor, stable ceramic, 1 uF
C6108	073-064	Capacitor, electrolytic, 100 uF
C6112	070-012	Capacitor, stable ceramic, 1 uF
C6114	073-064	Capacitor, electrolytic, 100 uF
C6119	073-060	Capacitor, electrolytic, 10 uF
C6121	070-012	Capacitor, stable ceramic, 1 uF
C6124	070-012	Capacitor, stable ceramic, 1 uF
FB6101	027-055	Ferrite bead
FB6102	027-055	Ferrite bead
L6101	027-050	RF choke, 4.7 uH
L6102	027-061	RF choke, 2.2 uH
L6103	027-071	RF choke
R6107	049-060	Resistor, 50 Ω 5 W, 10%
R6108	049-017	Resistor, 0.47 Ω , 2 W, 5%
R6114	049-060	Resistor, 50 Ω 5 W, 10%
R6119	048-180	Resistor, 18 Ω , 2 W, 5%
R6122	048-180	Resistor, 18 Ω , 2 W, 5%
R6123	048-180	Resistor, 18 Ω , 2 W, 5%
R6124	048-180	Resistor, 18 Ω , 2 W, 5%
T6101	273-014	Transformer, RF, interstage
T6102	273-013	Transformer, RF, interstage
T6103	273-006B	Transformer, RF, output
	116-002	Heatsink
	116-019	Heatsink, power amplifier

COUNTER BOARD (7100 Series)

Circuit Symbol	Cubic Part Number	Description
C7102	070-012	Capacitor, stable ceramic, 1 uF
C7110	089-030	Capacitor, trimmer, 3.5 to 65 pF
C7111	084-116	Capacitor, temp. comp, 68 pF, N5200
R7101	049-068	Resistor, wirewound, 4.7 Ω , 5 W.
Y7101	486-101	Crystal, 1.31072 MHz, HC33, 20 pF parallel



CUBIC

COMMUNICATIONS
SWAN DIVISION

NOISE BLANKER BOARD (7400 Series)

Circuit Symbol	Cubic Part Number	Description
C7416	073-060	Capacitor, electrolytic, 10 uF
T7401	014-062	Transformer, RF

PTO CONTROL BOARD (7500 Series)

Circuit Symbol	Cubic Part Number	Description
L7501	027-078	RF Choke, 24 uH
L7502	027-078	RF Choke, 24 uH
L503	027-044	RF Choke, 10 uH
R7532	052-119	Trimpot, 10 kΩ
R7536	052-119	Trimpot, 10 kΩ
	344-114	Coax connector, vertical receptical
	344-115	Coax connector, spring socket
	344-117	Wafer connector, 4 pin
	344-147	Wafer connector, 3 pin
	344-148	Wafer connector, 5 pin

PTO BOARD (7600 Series)

Circuit Symbol	Cubic Part Number	Description
C7602	084-011	Capacitor, temp. comp, 30 pF, NPO
C7603	084-057	Capacitor, temp. comp, 50 pF, N3300
C7604	084-057	Capacitor, temp. comp, 50 pF, N3300
C7605	084-088	Capacitor, temp. comp, 50 pF, N75
C7606	075-005	Capacitor, trimmer, 1.8 to 13 pF
C7608	075-017	Capacitor, trimmer, 1.2 to 4.2 pF
C7613	084-093	Capacitor, temp. comp., 1 pF NPO
L7602	027-049	RF choke, 200 uH
L7603	027-049	RF choke, 200 uH
L7604	027-050	RF choke, 4.7 uH

SWR/WATTMETER BOARD (7700 Series)

Circuit Symbol	Cubic Part Number	Description
C7703	089-028	Capacitor, trimmer, 4-30 pF
C7705	073-051	Capacitor, electrolytic, 1 uF
T7701	012-256	Transformer, RF
	0800-5303	Coax receptical, modified S0239



CUBIC

COMMUNICATIONS

SWAN DIVISION

FRONT PANEL RIGHT BOARD (7800 Series)

Circuit Symbol	Cubic Part Number	Description
S7801	171-188	Switch, PTO Mode
S7802	171-189	Switch, Mode
S7803	172-035	Switch, VOX/PTT
S7804	172-035	Switch, Noise Blanker
S7805	172-035	Switch, Speech Processor
S7806	172-035	Switch, Breakin
S7807	172-035	Switch, Hard/Soft Keying
	344-117	Wafer connector, 4 circuit
	341-026	Socket, 16 pin

PRESELECTOR BOARD (8000 Series)

Circuit Symbol	Cubic Part Number	Description
L8101	027-078	RF Choke, 24 uH
L8102	027-078	RF Choke, 24 uH
L8103	012-247	RF Choke, 160 uH
L8104	012-257	Transformer, RF
R8104	052-133	Trimpot, 1 M Ω
R8107	052-133	Trimpot, 1 M Ω
R8110	052-132	Trimpot, 100 k Ω
T8101	014-070	Transformer, RF
T8102	014-070	Transformer, RF
T8103	014-070	Transformer, RF
T8104	014-069	Transformer, RF
T8105	014-069	Transformer, RF
T8106	014-069	Transformer, RF
T8107	014-068	Transformer, RF
T8108	014-069	Transformer, RF
T8109	014-068	Transformer, RF
T8110	014-067	Transformer, RF
T8111	014-068	Transformer, RF
T8112	014-067	Transformer, RF
T8113	014-066	Transformer, RF
T8114	014-067	Transformer, RF
T8115	014-066	Transformer, RF
T8116	014-066	Transformer, RF
T8117	014-067	Transformer, RF
T8118	014-066	Transformer, RF
	344-114	Coax connector, vertical receptacle
	344-115	Coax connector, spring socket
	341-026	Socket,



CUBIC
COMMUNICATIONS
SWAN DIVISION

DISTRIBUTION BOARD (9000 Series)

Circuit Symbol	Cubic Part Number	Description
C9101	070-012	Capacitor, stable ceramic, 1 uF
C9102	070-012	Capacitor, stable ceramic, 1 uF
C9103	070-013	Capacitor, stable ceramic, 0.1 uF
C9104	070-012	Capacitor, stable ceramic, 1 uF
C9105	070-020	Capacitor, stable ceramic, 0.33 uF
C9106	069-017	Capacitor, tantalum, 2.2 uF
C9108	070-012	Capacitor, stable ceramic, 1 uF
C9109	073-088	Capacitor, electrolytic, 220 uF
C9111	073-088	Capacitor, electrolytic, 220 uF
C9114	073-085	Capacitor, electrolytic, 33 uF
C9115	073-085	Capacitor, electrolytic, 33 uF
C9116	073-085	Capacitor, electrolytic, 33 uF
C9120	073-055	Capacitor, electrolytic, 4.7 uF
R9141	052-119	Trimpot, 10 kΩ
R9147	052-133	Trimpot, 1 MΩ
R9149	052-133	Trimpot, 1 MΩ
	116-020	Heat sink for TIP42
	311-014	Insulating washer
	341-026	Socket, 16 pin
	344-117	Wafer connection, 4 pin
	344-136	Wafer connection, 8 pin
	344-150	Wafer connection, 2 pin
	344-147	Wafer connection, 3 pin
	344-149	Wafer connection, 6 pin

COUNTER BOX ASSEMBLY

Cubic Part Number	Description
077-001	Capacitor, feed through, 1000 pF
344-146	Connector, 3 circuit
344-151	Receptacle, 8 circuit
344-152	Plug, 8 circuit
344-153	Crimp terminal for plug
344-154	Crimp terminal for socket

MISCELLANEOUS

Cubic Part Number	Description
222-001	Rubber feet, small
223-002	Tilt stand, 10"
102B-1310	Cabinet top
102B-1311	Cabinet bottom
0800-5403	Bezel
150-032	D.C. Power cord
222-002	Rubber feet, large

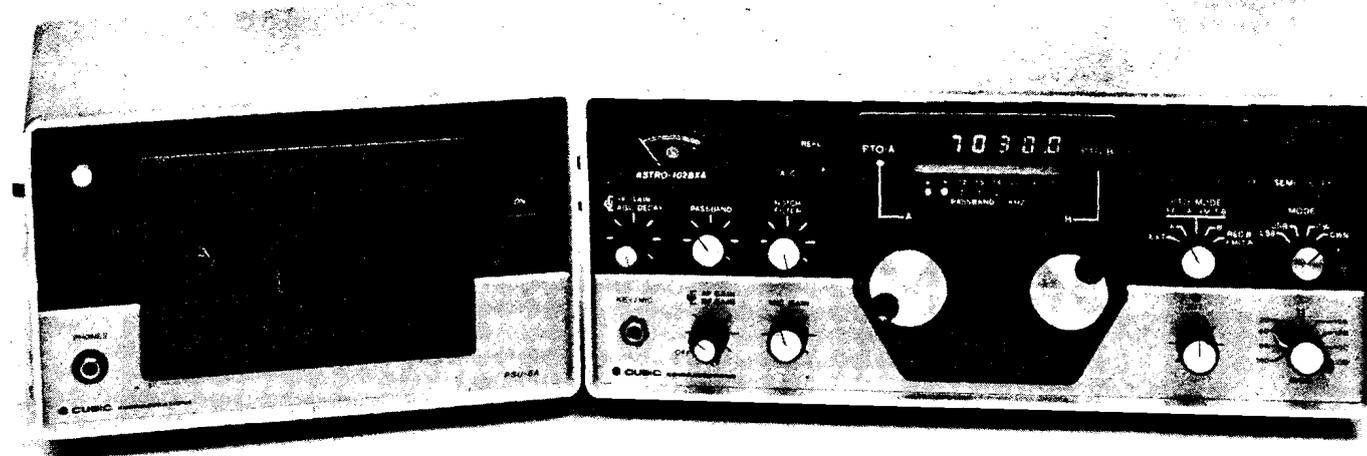


CUBIC

COMMUNICATIONS
SWAN DIVISION

045-223F	Potentiometer, RIT, with switch
052-112	Potentiometer, AF/RF Gain, with switch
052-152	Potentiometer, MIC Gain and Passband Tuning
052-153	Potentiometer, IF and AGC
052-154	Potentiometer, tandem, Notch Filter
112-038	Meter
152-008	Speaker
171-190	Bandswitch detent
172-036	Switch, rocker, level handle
211-043	Knob, 3/4" with insert
211-044	Wing knob, 3/4", with insert
211-072	Knob, dual, 4mm and 6mm shafts
211-073	Knob, 3/4", with insert; .187 dia shaft
211-047	Knob, dual, with bar
211-080	Knob, with spinner
344-082	Receptacle, 6 circuit, power
344-083	Pins for above
344-118	Connector, 4 pin, housing only
344-135	Connector, 8 pin, housing only
344-146	Connector, 3 pin, housing only
344-155	Connector, 2 pin, housing only
344-156	Connector, 5 pin, housing only
344-157	Connector, 6 pin, housing only
344-119	Crimp terminal for above
455-123	Escutcheon
455-124	Filter for digital readout
471-007	Lamp, 12 volt, miniature
680-004	Ribbon cable assembly, 3 3/4"
680-005	Ribbon cable assembly, 9"
680-006	Ribbon cable assembly, 18 1/8"
680-007	Ribbon cable assembly, 11 1/2"
680-009	Ribbon cable assembly, 15"
680-010	Ribbon cable assembly, 16 1/8"
102B-3203	PTO Assembly, complete

Cubic Astro 102BXA Transceiver



American made? Yes, indeed! The Astro 102BXA (formerly Swan/Astro) is built by a tenured engineering firm, Cubic Corporation, of Oceanside, California. The manufacturer once stated that "75 of our engineers were involved in the design of the Astro." Those who subscribe to the "buy American" doctrine should be pleased with this product.

If your buying urge is stimulated by the presence of dazzling geegaws, this rig may not be for you. But if truly functional and important operating features inspire you, the 102BXA might be what you've been waiting for. It has what the operator needs, and nothing more.

Coverage is from 160 through 10 meters in six bands. This transceiver is completely transistorized (inclusive of ICs and diodes). Twin PTOs are included to provide split-band operation when desired. Other features are variable age time constant, passband tuning, and separate controls for rf and i-f gain. It also has RIT, selectable break-in delay or full QSK, noise blanker and speech processor. The panel meter indicates forward and reflected power in watts, alc level and the relative strength of incoming signals.

A large red digital display provides readout of the operating frequency to six places, such as 21,025.3 kHz. An eight-level LED string shows the status of the passband tuning from 0.6 to 2.7 kHz. There is also a notch filter that is adjustable from the front panel of the transceiver.

The passband-tuning control sets the i-f bandwidth with either a high-pass or low-pass cutoff. Clockwise rotation of the control attenuates low-frequency audio, while counter-clockwise rotation reduces the high-frequency response. The LEDs mentioned earlier indicate the effective audio passband of the receiver. I learned that the control needs to be set for approximately 1.0 kHz or higher when the sharp

cw accessory filter (300 Hz) is being used. Otherwise, no cw beat note is heard.

The microphone impedance is specified as 47,000 ohms. A key jack is located on the rear panel of the transceiver, but the PTT line (accessible at the mike jack) can also be used as a keying-control line.

Other connection points on the rear apron of the equipment are EXT RELAY, EXT MODULATION, EXT LO, ANTENNA, GND and EXT SPEAKER. There is a built-in speaker, plus provision for an external one. The EXT MODULATION jack provides an interface for AFSK, and the MIC GAIN control on the front panel is used in that mode to control the level.

The speech-processor action is determined automatically by the setting of the MIC GAIN. There is no separate external adjustment for the processor. Similarly, the noise blanker is factory-adjusted. It has no external threshold control. Carrier-level control during cw operation is provided by the MIC GAIN control.

I am mystified by the presence of a SOFT/HARD keying switch on the transceiver front panel. The keying waveform in the "hard" position is what we at ARRL consider objectionable in terms of clicks (see Fig. 3). The "soft" position yields an excellent waveform, closely approaching the desired 5-ms rise and fall times that result in click-free keying. That panel switch might have been put to better use as a CARRIER LOCK control, which has not been included in the design. This makes tune-up difficult unless the keyer has a "carrier hold" switch.

Other features that aren't present in the Astro 102BXA are a crystal calibrator or WWV band-switch position. Fortunately, the 40-meter coverage is from 7.0 to 7.5 MHz, which permits reception of Canada's CHU time/standard station in some areas of the country.

The internal switching feature for an external amplifier is compatible with the manufacturer's Astro 1200Z and 1500Z amplifiers. Un-

fortunately, the internal solid-state switching circuit is limited to a maximum of +200 V and 200 mA. Therefore, most amplifiers of different manufacture can't be switched by the Astro 102BXA — at least not directly. I had to interface the transceiver with my Heath SB-221 by means of an external relay that was actuated by the solid-state switch in the Astro. A 12-V dc relay can be used (low-current coil), and power for it can be borrowed from the +12-V bus in the transceiver. If an external relay is used, it will negate the use of full QSK since many control relays will not follow the cw speeds that are used by most operators.

I was impressed with the skirt selectivity of the i-f system. The variable passband tuning of the receiver complements the i-f filters to reduce wideband noise and enhance the effective selectivity. In fact, acceptable cw selectivity can be had when using the ssb i-f filter by ad-

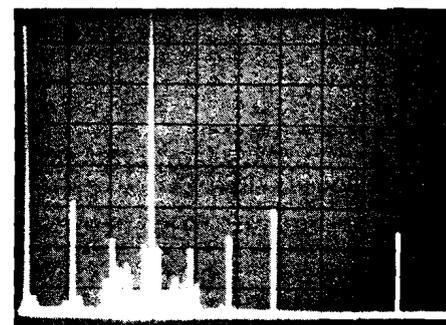


Fig. 1 — Worst-case spectral display of the Cubic Astro 102BXA. Vertical divisions are each 10 dB; horizontal divisions are each 10 MHz. Output power is approximately 100 watts at a frequency of 28 MHz. Spurious emissions are at least 49 dB down from peak fundamental output. The Astro 102BXA complies with current FCC specifications for spectral purity.

*Assistant Technical Editor

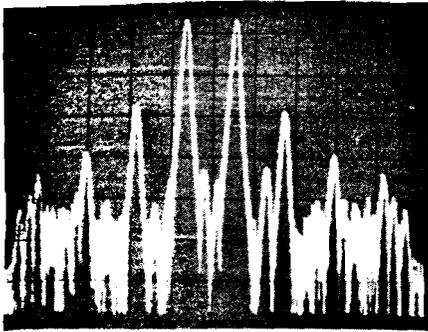


Fig. 2 — Spectral display of the Astro 102BXA output during transmitter two-tone IMD test. Third-order products are 28 dB below PEP, and fifth-order products are 39 dB down. Vertical divisions are each 10 dB; horizontal divisions are each 1 kHz. The transceiver was being operated at rated input power on 14 MHz.

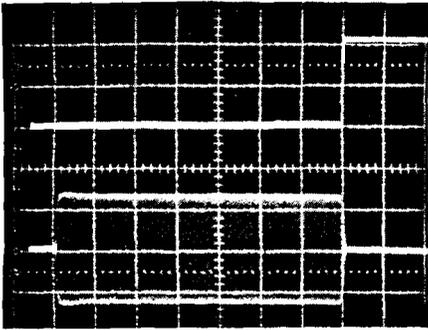


Fig. 3 — Cw keying waveform of the Astro 102 with the selection switch in the "hard" keying position. The upper trace is the actual key closure; lower trace is the rf output envelope. Each horizontal division is 5 ms. This waveform will generate key clicks.

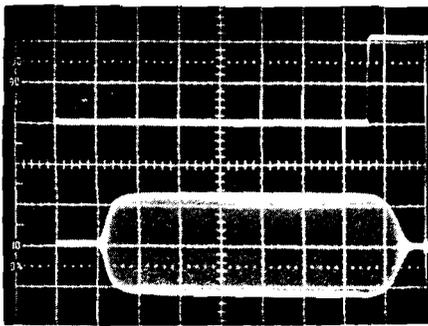


Fig. 4 — Cw keying waveform of the Astro 102 with the selection switch in the "soft" keying position. The upper trace is the actual key closure; lower trace is the rf output envelope. Each horizontal division is 5 ms. This waveform is essentially click-free.

justing the variable passband control to the counterclockwise end of its range.

Cw offset is 800 Hz. In the sharp cw mode (300-Hz accessory filter installed), the cw filter is operated in series with one of the two 8-pole ssb filters. This greatly reduces wideband noise from the i-f amplifiers and provides an apparent improvement in overall receiver signal-to-noise ratio. During ssb operation the two

Cubic Astro 102BXA HF Transceiver Serial No. 659

Manufacturer's Claimed Specifications

Frequency coverage: 160, 80, 40, 20, 15, 10 meters.

Operating modes: Cw and ssb.

Readout: Digital (red LEDs).

Resolution: 100 Hz.

Backlash: Not specified.

Power requirements: 12-14 volts dc, negative ground, 20-A peak.

Transmitter rf power output: 100-W PEP into 50-ohm load at 13.5 V dc.

Transmitter third-order IMD: Not specified.

Spurious suppression: 55 dB below peak power.

Harmonic suppression: 45 dB below peak power.

Frequency stability: Not specified.

Receiver audio output power: Greater than 3 W into a 4-ohm load.

RIT range: Not specified.

S-meter sensitivity ($\mu\text{V}/\text{S9}$): Not specified.

Receiver sensitivity: 10 dB S + N/N, 0.35 μV typ.

Size (HWD): 6-3/8 x 14-1/4 x 13-1/4 in.

Weight: 23-1/2 lb.

Color: Not specified.

*mm = in. x 25.4, kg = lb x 0.454.

Measured in ARRL Lab

As specified, plus additional coverage above and below each band: 1378-2106 kHz; 3379-4106 kHz; 6879-7606 kHz; 13,878-14,606 kHz; 20,878-21,606 kHz; 27,878-30,106 kHz.

As stated.

25 kHz per 360° turn of tuning knob.

Nil.

As stated.

80/40 m = 125 W; 20/15 m = 108 W; 10 m = 100 W.

Approximately -28 dB (worst case) on 20 m (see photo).

Approximately 49 dB (worst case), 10 m (see photo).

Approximately 50 dB (worst case), 10 m (see photo).

80 Hz from cold start to one hour later. Not measured.

± 1 kHz.

160 m = 85; 80 m = 65; 40 m = 55; 20 m = 50; 15 m = 50; 10 m = 75.

Receiver dynamics measured with optional 300-Hz crystal filter installed:

Noise floor (MDS) dBm:	80 m	20 m
	-125	-129
Blocking DR (dB):	.	.
Two-tone, third-order: IMD DR (dB):	90	84
Third-order input intercept (dBm):	-10	-3

*unmeasured — noise limited.

8-pole filters are in use. The ssb filters have a bandwidth of 2.4 kHz, and the shape factor is 1.4, referenced to the 6- and 100-dB points on the response curve.

Other Features

The transmitter is rated at 100 watts output for peak ssb and cw. Power output is limited to this level by the alc circuit. Available output power is 100% of this amount with VSWR values up to 1.7:1 at 50 ohms. It drops to 60% when the VSWR is 3:1. During an open or short condition the factor is 25% (equivalent voltage). A built-in VSWR sensor causes the foregoing shutdown power amounts to protect the PA transistors from damage.

Mobile operation is possible from the automotive dc-voltage system. The safe operating range is specified as 10 to 15 volts dc. Apart from the fairly large dimensions of the Astro 102, it is well suited to mobile use because it employs broadband tuning in the receiver and transmitter sections. Only minor adjustments are necessary when changing bands. The receiver is a single-conversion type with a 9-MHz i-f. Five weak birdies were noted in the receiver tuning range.

Those wishing to have full RTTY capability, plus inclusion of the WARC-sanctioned 10-, 18- and 24-MHz amateur bands, may want to consider purchasing the Astro 103BXA transceiver. The 102 and 103 models are otherwise identical. Price class: \$1200. Manufactured by Cubic Communications, Inc., 305 Airport Rd., Occanside, CA 92054. — Doug DeMaw, W1FB

KENWOOD TR-9000 MULTIMODE 144-MHz TRANSCEIVER

□ If you read the survey article in March 1981 *QST* carefully, you may have been surprised to learn how much activity was reported on "vhf/uhf, a-m/cw/ssb." Of the survey respondents active in Amateur Radio, 18% said they averaged at least an hour of such activity per week. For comparison with other vhf/uhf figures, the percentage for fm was 48%, for "other modes" 3% and for satellite communications (where cw and ssb are also used), 2%. Numbers like that make it easy to understand why new vhf transceivers with multimode capability keep popping up in the marketplace. (Less easy to understand is why Japanese manufacturers have totally dominated this particular market, but that's another story.) Not surprisingly, 2 meters has been the most popular band for the vhf multimode rigs, as it has been for fm rigs.

In the past, these multimode transceivers generally could be characterized in two ways: whether they were designed primarily for fm or for ssb, and whether they were designed primarily with fixed station or mobile operation in mind. If a rig is intended mainly for ssb, it will give the operator a "feel" very similar to a conventional high-frequency transceiver; if for fm, it will have the features you have come to look for in a sophisticated fm rig — ease of selection of the most frequently used channels,

†D. Sumner, "Survey of Amateur Radio, 1980," *QST*, March 1981, pp. 11-18.

102BX 184

CUSTOMER SERVICE BULLETIN

2 December 1980

Ref: 0809/80

SUBJECT: ASTRO-102BX EXCITER BOARD

Receiver audio on the ASTRO-102BX and ASTRO-102BXA Transceivers has been reported to be distorted on some units. This distortion, if noticed, may be eliminated by the addition of a ground strap to the exciter board. Strap should be made of a flat braided strap such as a coaxial cable shield braid (RG-58 type) or equivalent type conductor. Use the braid only, not the whole cable. This modification note only applies to the original ASTRO-102BX configuration with the 2 pole CW narrow crystal filter with or without the 6 pole CW narrow crystal filter installed on an auxiliary circuit board. Later model circuit boards will have provisions for the 6 pole filter on the exciter board and will have adequate grounding installed at the factory.

INSTALLATION PROCEDURE

1. Remove the six screws which fasten the bottom cover and remove cover.
2. Locate the exciter board (the board in the center towards the rear of the chassis).
3. If the exciter board has not had the optional 6 pole CW narrow filter added to the unit, solder the ground strap between the tops of transformers T104 and T105 and the top of crystal filter FL102. Refer to the attached layout drawing for locations. Be careful not to overheat either the transformers or the filter case while soldering.
4. If the exciter board has had the optional 6 pole CW narrow filter installed on the auxiliary board, solder one piece of the ground strap between the tops of T104 and T105 and from the top of T105 to the top foil on the auxiliary board near the filter. Solder a second piece of ground strap between the top foil of the 6 pole CW narrow filter board near FL102 and the top of FL102. Be careful not to overheat either the transformers or the filters while soldering.
5. Turn the transceiver power on and observe audio quality while listening to a signal. Vary the PASSBAND tuning control while listening to noise. If an increase in distortion or nulls or peaks in noise are observed, the effects are due to phase shift through the filter. In this case, try an alternate position for the ground strap and repeat the observation until satisfactory performance is obtained.
6. Replace the bottom cover.



CUBIC COMMUNICATIONS

305 Airport Road, Oceanside, CA 92054 (714) 757-7525 / Telex: 695435; ANS BK: Cubicom, OCEN.

+5 Volt Regulator Modification

CAUTION

This modification should only be attempted by experienced electronic personnel. Serious damage can be done to the set if it is not accomplished properly, especially the expensive frequency counter.

Cubic Communications
June 1981

ASTRO 102BX, 102 BXA, and 103
+5 Volt Regulator Modification

In order to decrease the high temperature being generated in the frequency counter and the PTO compartment in the above sets, it is recommended that the following modification be accomplished.

This modification simply removes the +5 volt regulator and its dropping resistor, inside the frequency counter, and moves these components to the rear panel.

The following parts are required to accomplish this modification:

- 1 @ 049-068 4.7 ohm 5W resistor
- 1 @ 141-035 Terminal Strip
- 2 @ 072-023 .01 mf Disc capacitor
- 1 @ Jumper wire 24 gauge 5/8" long (red)
- 1 @ Jumper wire 24 gauge 1½" long (red)
- 1 @ 765-011 #4 Int. lock washer
- 1 @ 24 gauge 7 5/8" long wire (red) with a molex clip connected on one end
(For ASTRO 102BX and 102BXA only).

NOTE: For molex connector pin layout, reference figure #5. Molex connector clips can be removed by using a dental tool or very small screwdriver to push on the clip locking tab through the cut outs of the rubber connector.

1. Removal of the frequency counter:

Remove all cables, cords, and coaxes connected to the set. Remove the top cabinet (6 screws) and the bottom cover (6 screws). Remove the cover on the frequency counter (5 screws). Disconnect the 8 pin white plastic connector (P150) and the coax with a RCA plug (P151) on the rear of the frequency counter box. To disconnect P150, gently push down on both sides of the plug (there are ears on each side). Remove the counter box by removing the four #4-40 screws (one at each of the four corners) which mount the box to brackets underneath (don't remove the screws on the printed circuit board). Lift the counter box out of the set. If the box will not release, the PTOA and PTOB light emitting diodes (L.E.D.s) may be caught between the front panel and the escutcheon. To release these L.E.D.s, remove both PTO knobs and the #6-32 screws (2) behind the knobs (these screws are the straight slotted machine screws directly above the PTO shafts).

2. Modification of the frequency counter:

Remove the large printed circuit board, from the counter box, by removing the four #4-40 screws (one at each corner). Disconnect the three pin molex connector from the +5 volt regulator (U101) which is mounted on the right rear of the box. In the ASTRO 103, be sure to note the positioning of the small aux. counter printed circuit board at the left rear of the box and its molex connector (pin 1 of J166 goes toward the front).

Dress the wires at the left rear of the large printed circuit board so a loop is formed towards the front. Push the large board toward the rear of the box, now the display board should clear the front top lip of the box (gently remove this assembly from the box, the PTOA and PTOB L.E.D.s can bend downward to clear the box front top lip). Remove the +5 volt regulator with its mounting hardware, save these items. Be careful that the thermalcote compound on the +5V regulator does not get removed. Turning the box on its side will help accomplish the modifications to the large printed circuit board. Remove R101 (4.7 ohm 5W resistor) and replace with the 1½" jumper wire (see figure #1). Remove the wires to the three pin molex connector from the large printed circuit board and install the 5/8" jumper wire between the points where the red wire and the orange wire for the molex connector were soldered (see figure #1). Save the molex connector.

3. Reinstallation of frequency counter board(s)

Check for broken wires on the large board and repair if necessary. Reinstall this board in its box by reversing the removal procedure. Make sure the PTOA and PTOB L.E.D.s stick straight out before installing the board mounting hardware. ASTRO 103 only: Please follow the note on the left side of figure #1 concerning lead dress for the wires to the aux. counter board. Check and repair any broken wires to the feed-thru capacitors at the rear of the box. ASTRO 103 only: Install the aux. counter board and its connector the way they were before removal (Reference figure #2 and #5). Set the counter box aside.

4. +5V regulator terminal strip wiring:

Reference figure #3. Use the original +5V regulator and its 3 pin molex connector which were removed from the counter box earlier. Drill and de burr a #4 hole through the rear panel 1" below the top edge, between the power connector (J158) and the EXT. speaker jack (J155).

5. ASTRO 102BX and 102BXA ONLY

Rewiring the set: Remove pin 2 (red or Red/Vio) from P127 molex connector (mates to J127 on left rear of distribution board) and cut off this pin. Pull back the wire and reroute on right side and rear of distribution board to area where the hole was drilled in step #4. Install a new 7 5/8" red wire with clip in P127 (for pin 2) and route along rear of distribution board to area where the hole was drilled in step #4. Solder this wire to lug #1 (bottom lug) of the new regulator terminal strip. (Reference figure #3). Solder the other wire, previously rerouted, to lug #3 on the terminal strip. Make sure there is thermalcote on the back of the +5 volt regulator, connect the molex connector to it, and mount it along with the terminal strip to the rear panel (reference figure #4).

Use the hardware that originally mounted the regulator in the counter box and the new #4 lockwasher supplied.

6. ASTRO 103 ONLY

Rewiring the set: Turn the set upside down and very carefully remove the shield on the right side (covers the L.O. and Aux. L.O. boards). Locate the two molex connectors on the left rear of the Aux. L.O. board. Remove the pin #2 in both connectors (P173 and P174, which mate to J173 and J174) and cut these pins off their wires. Pull the wires back to the top of the chassis. Carefully reinstall the large shield over the boards, do not pinch any wires or ribbon cables. Turn the set upright and reroute these two wires. The red or red/vio. wire on pin 2 of P127 (mates to J127, left rear molex connector on the distribution board) should be rerouted along the rear of the distribution board to the area where the hole was drilled in the rear panel in step #4. Solder this wire to lug #1 (bottom lug) of the new regulator terminal strip. Reroute the other wire (red or red/vio.) along the right side and the rear of the distribution board and solder to lug #3 of the new regulator terminal strip. Make sure there is thermalcote on the back of the +5 volt regulator, connect the molex connector to it and mount it along with the terminal strip to the rear panel (reference figure #4). Use the hardware that originally mounted the regulator in the counter box and the new #4 lockwasher supplied.

7. Reinstalling the frequency counter box:

Reinstall the box by reversing the removal procedure (reference step #1). Make sure that the PTOA and PTOB L.E.D.s are in their respective holes in the escutcheon. Install the four screws which mount the box to the brackets underneath and realign and tighten down the escutcheon if it was loosened during counter box removal. Reinstall the PTO knobs if they were removed. Connect P150 to J150 (the white plastic connectors on the rear of the box). Plug in the RCA plug (P151, coax line) in the rear of the counter box. Make very sure these connectors are tight.

8. Testing:

Extreme caution is required in this step because over voltage in the frequency counter could destroy some of the I.C.s. Make sure the set's power switch is "off." Connect a power supply to the set and turn it "on". Connect a voltmeter to the frequency counter and monitor the +5V bus (reference figure #1, the +5V is the left connection of the small jumper which was installed). Turn the set "on!" Quickly turn the set "off" if this voltage is not close to +5 Volts and investigate. If the voltage is close to +5 Volts and the frequency counter readout lights, remove the voltmeter and turn the set "off".

9. Button-up:

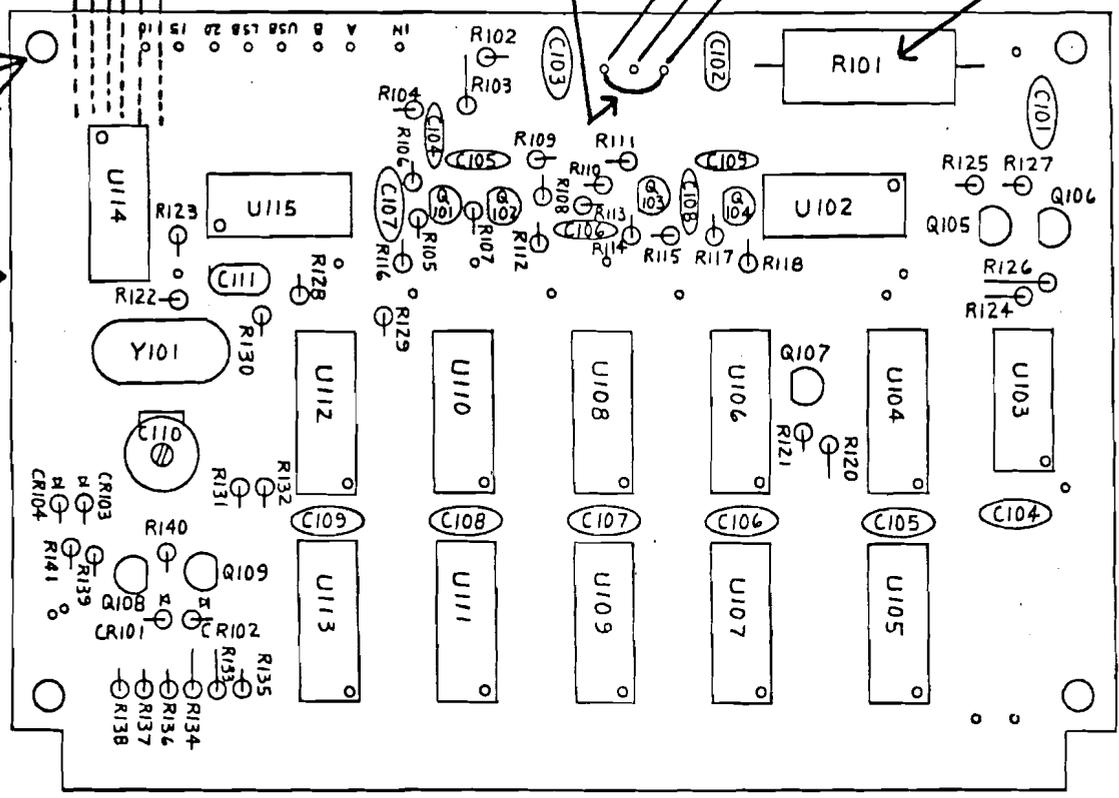
Disconnect the power supply and reinstall the counter box cover (5 hex-head screws), make sure no wires get pinched, especially near the left side of the boards. Reinstall the bottom cover (6 screws) and the top cabinet (6 screws). Reconnect all cables, cords, and coaxes.

10. This completes the modification.

Dress the six wires to the Aux. counter board under this board and to the right of this spacer. Do not allow wires to get to the left of this edge. Do not pinch any wire under the above spacer.

Astro 103 (U101) & add 5/8" jumper. ONLY 6 wires
 WAS ORANGE WAS BLACK WAS

Remove and replace with 1/2" jumper.



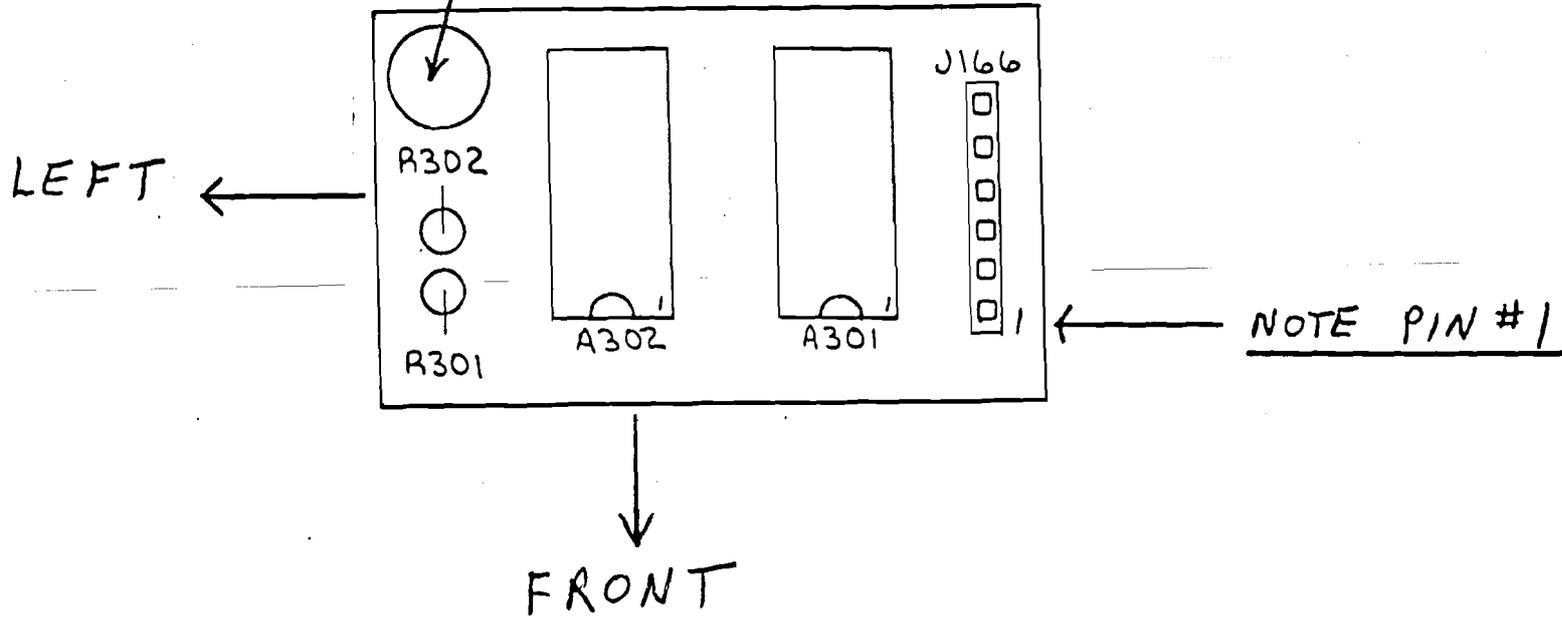
+5 Volt Regulator Modification

FIGURE #1

2. COMPONENT DESIGNATORS 7100 SERIES
 1. REF. ELEC. ASSY 102BX-2005
 REF. CIRCUIT BD 102BX 2105
 REF. DRILL DWG 102BX 2205
 NOTES:

SWAN ELECTRONICS		
SCALE: ~	APPROVED BY: <i>ju</i>	DRAWN BY: AJG
DATE: 9-19-74		REVISED:
COUNTER BOARD LAYOUT		
		REVISION NUMBER: 102BX-2305

Mounting spacer goes over left rear hole of
large counter printed circuit board.



Astro 103 ONLY

Figure #2.

SCALE: NONE	APPROVED BY: <i>C. Ballman</i> 7-25-80	DRAWN BY: C. DAVIDSW
DATE: 7-14-80	<i>LEL</i> 7/28/80	REVISED
AUX COUNTER BD LAYOUT		
		DRAWING NUMBER A103-2305

COMPONENT DESIGNATOR 8300 SERIES
 NOTES

CUBIC

+5 volt regulator terminal strip wiring.

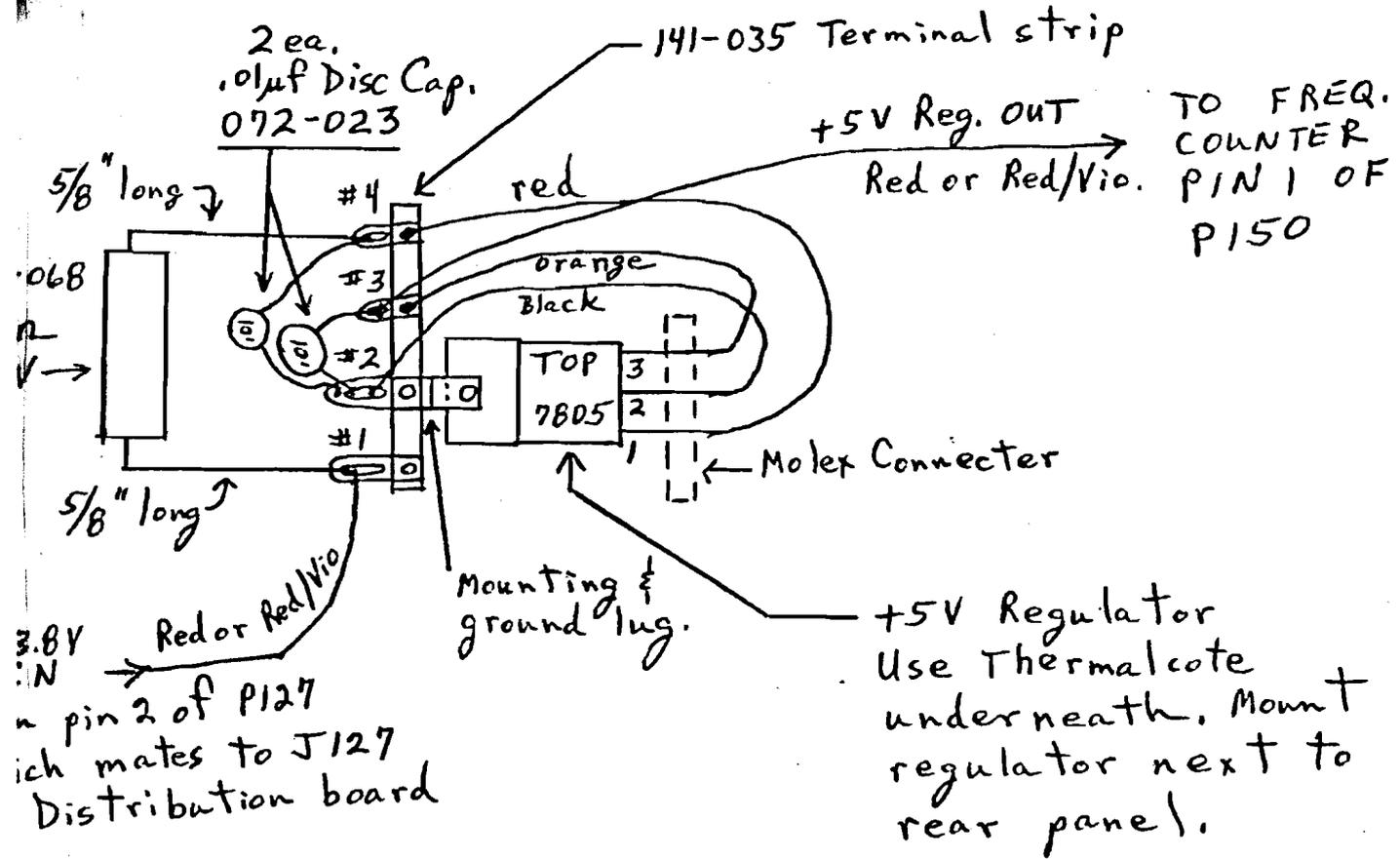
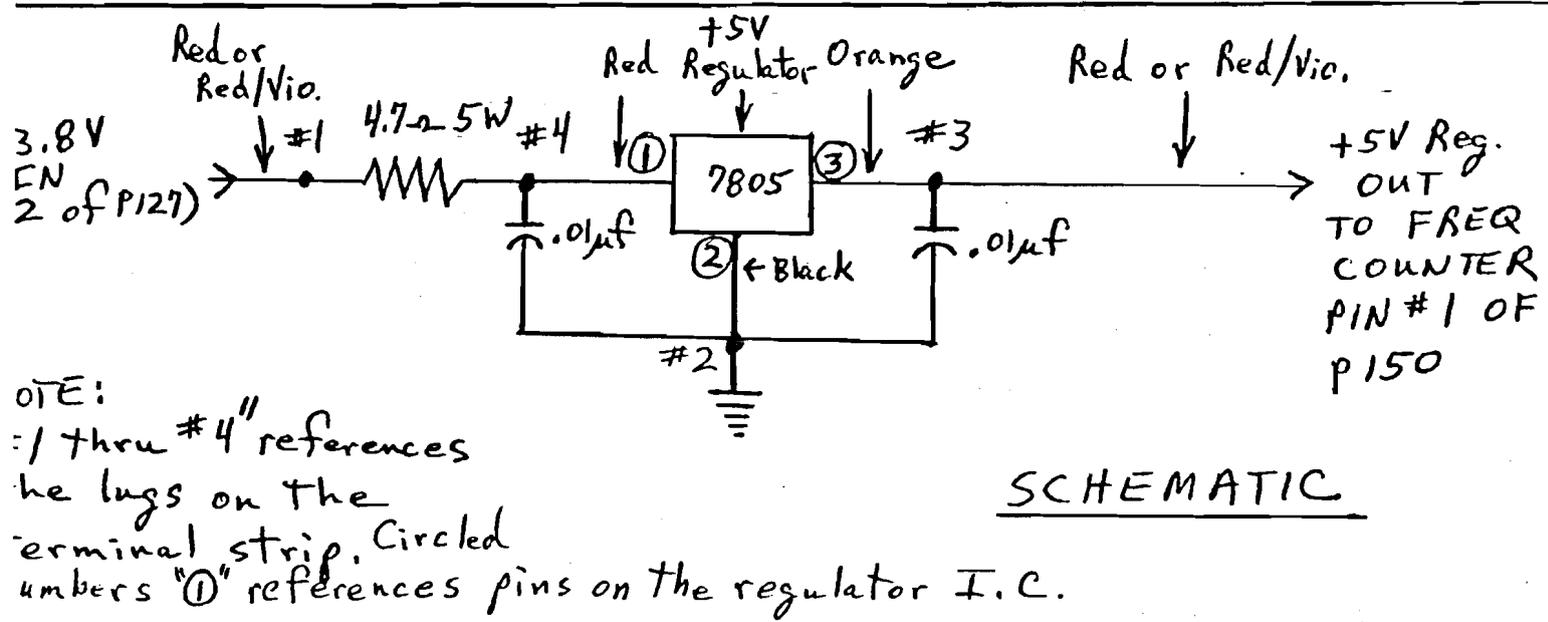


FIGURE #3
Front View Shown



Installation of regulator & its terminal strip on rear panel.

Top View Shown

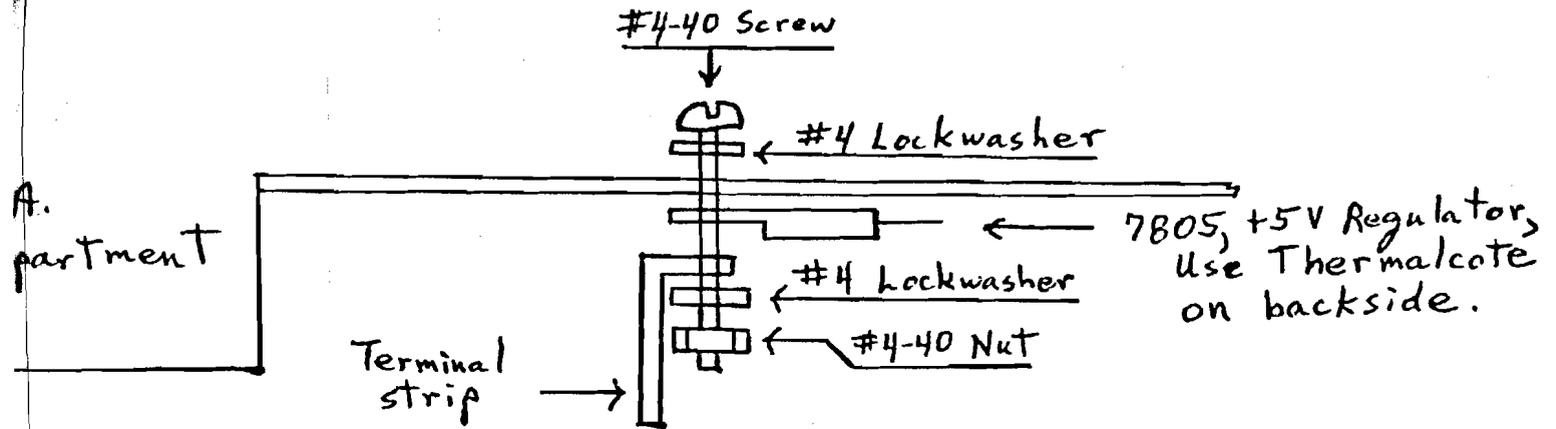


FIGURE #4

Molex Connector Pin Layout

Front Side Shown

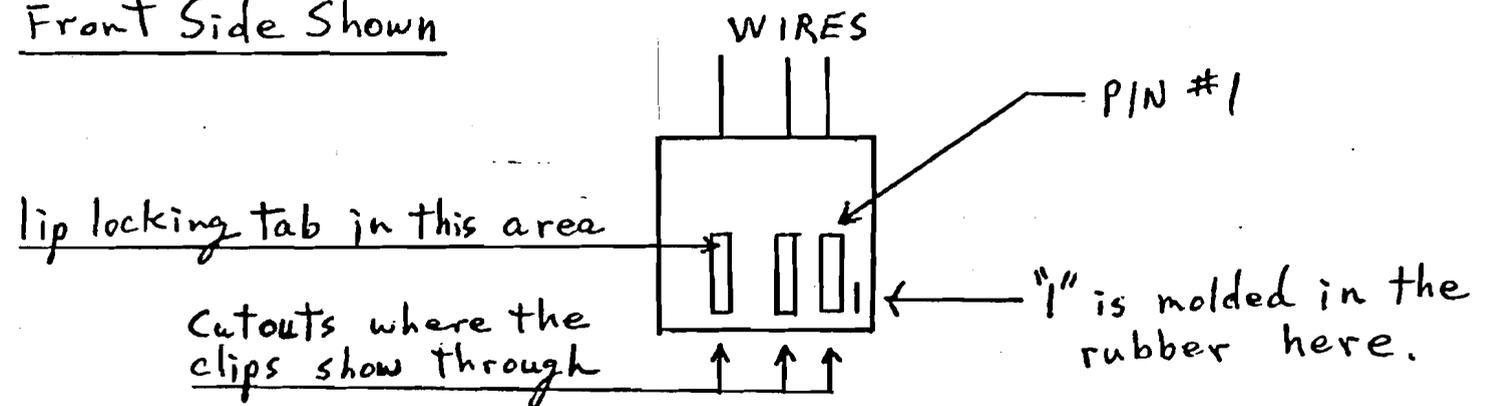


FIGURE #5