

TABLE OF CONTENTS

General Description	1
Guaranteed Minimum Performance	2
Operating Instructions	3
Block Diagram	4
Circuit Description	5
Receiver	5
Frequency Control	6
Channel Selection	6
Alignment	7
Troubleshooting	10
Troubleshooting Chart	12
Voltage Chart	13
Integrated Circuits Chart	14
Semi-Conductor Pin Identification	17
	Diagrams & Schematics
TCXO	18
Mixer	21
Receiver Multiplier	24
I.F	28
Squelch	30
Receiver Audio	34
Master Interconnect	36
Front Panel	40
Rear Panel	42
	Parts Lists
Options:	
1091 Audio Amplifier	(Description) 43
10 W Receive Audio Board	44
1088 Preamp	(Description) 47
R. F. Preamp Board	48
Repeat Audio Interface	(Description) 51
Repeat Audio Interface Board	56
Carrier Operated Relay Board	58
Master Interconnect Schematic	61

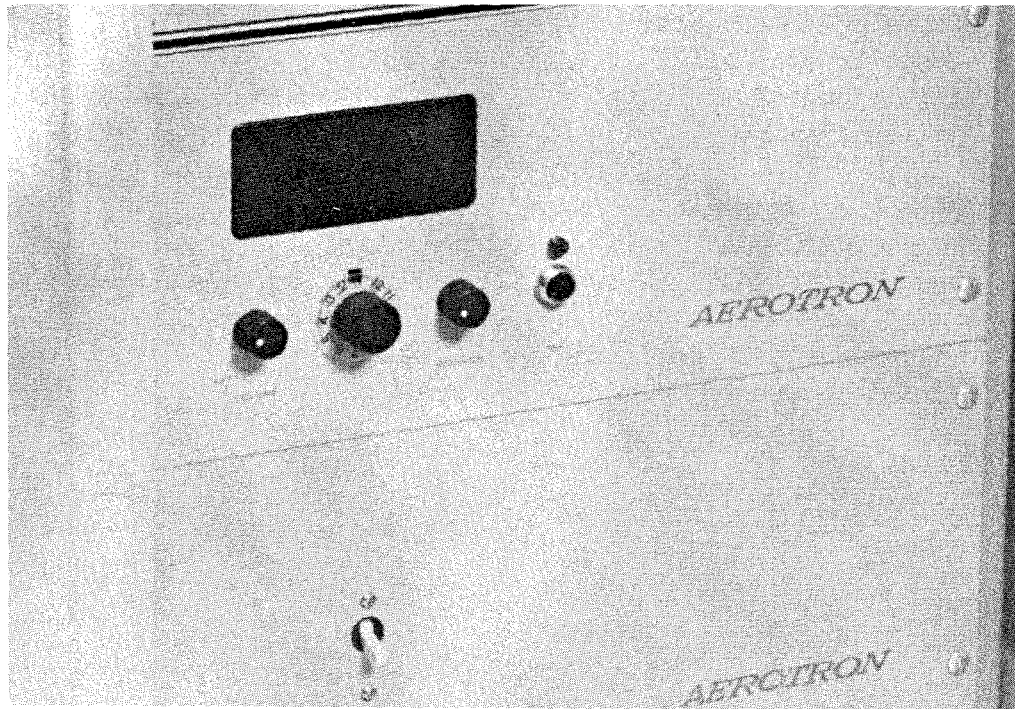
INSTRUCTION MANUAL

Section 1

GENERAL DESCRIPTION

The 80B R 1 base station receiver is a small high-performance, fully modular receiver capable of operating in the most demanding environments in FM simplex and duplex base stations and repeaters.

Plug-in circuit boards minimize the use of interconnecting wire. Modern solid-state devices, FET's integrated circuits, TCXO's and completely electronic function switching results in high quality and reliability at a reasonable price.



Changed information, if any, affecting this section is found at the rear of the m manual.

Section 2

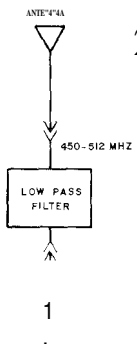
OPERATING INSTRUCTIONS

Controls:

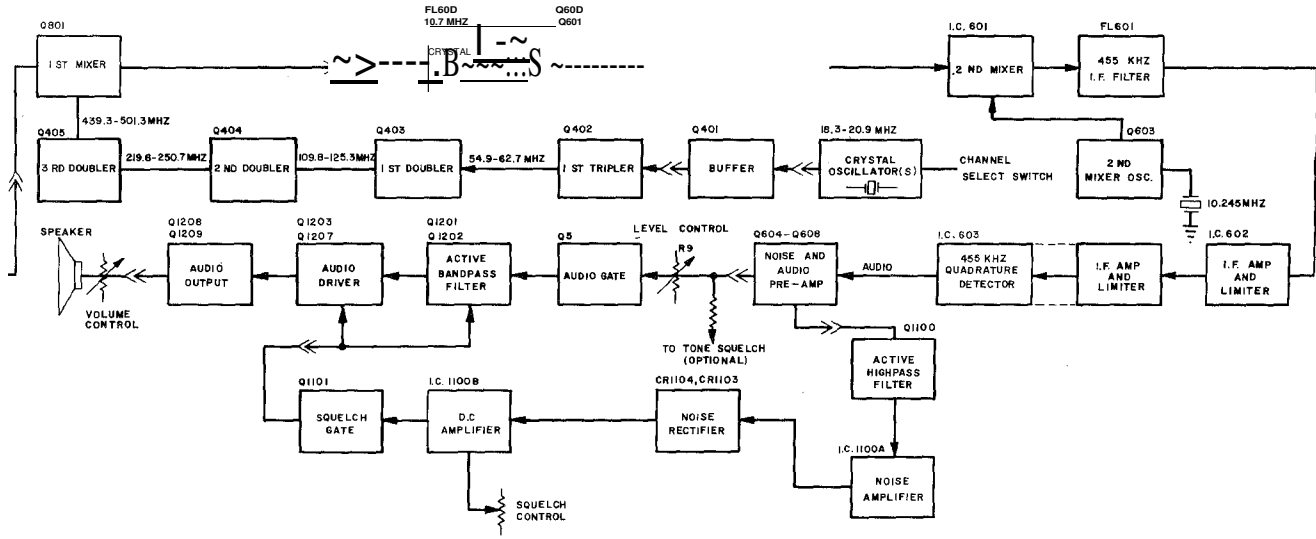
All controls for normal operation are on the front panel. The on-off switch controls power to all circuits. Volume and squelch are rotary controls for ease of adjustment. Channel selection, when provided, is also affected by a rotary switch; Optional front panels without controls for remote controlled operation, or with additional microphone inputs or handsets, are available.

Operation:

To turn the unit on, switch power switch to the 'ON' position. Rotate the squelch control until speaker noise is obtained. Adjust the volume control for desired noise level. Now adjust the squelch control (no signal present) until the receiver is silenced.



2.



80BRI

CIRCUIT DESCRIPTION

Receiver:

The receiver in this equipment is a dual-conversion superheterodyne design, which will receive on any of four switch selected crystal controlled channels in the 406 to 512 MHz range.

The front end assembly consists of five highly selective resonators tuned to the receive frequency, a mixer assembly which converts the desired frequency to 10.7 MHz, and two resonators tuned to the local oscillator injection frequency (10.7 MHz below receive frequency of 450 + 512 MHz and 10.7 above for receive frequency of 406 to 450 MHz).

All entry and exit of signals and power from the front-end is made through coaxial cables.

The mixer is a junction FET in a common source configuration. Local oscillator signal is injected at the source while desired signals are coupled in the gate. The intermediate frequency of 10.7 MHz is selected by a resonant network in the drain circuit. The IF frequency is carried out and DC power for the mixer brought in by the same coaxial cable.

The receive TCXO (temperature compensated crystal oscillator) assemblies are added on a per channel basis. Crystal frequencies in the 17 to 20 MHz range are used for basic frequency selection. Oscillator outputs are connected to the input of a buffer for amplification and isolation from subsequent amplifier/multipliers.

The buffered oscillator signal is multiplied twenty-four times by the receiver multiplier circuit. The sequence of multiplication is $3 \times 2 \times 2 \times 2$. Each stage, except 0401 and 0405, is followed by double-tuned circuits to eliminate undesired output products. The output of the multiplier assembly is coupled by coaxial cable to the front end assembly where the 416.7 to 501.3 injection frequency is selected and coupled to the mixer.

The mixer output is coupled to the I.F. at J601. The I.F. selectivity is established by an eightpole monolithic crystal filter. I.F. noise figure is determined by filter insertion loss and a high gain, low noise cascode input amplifier. The 10.7 MHz signal is mixed with a 10.245 MHz signal from a crystal-controlled oscillator to produce a 455 kHz second I.F. frequency.

A three-pole miniature ceramic filter is employed to select the desired mixer product and to further improve I.F. selectivity.

An integrated circuit differential amplifier follows the ceramic filter and provides approximately 25 dB of gain. The output of this stage is tuned and matched to the input of IC-603 where the majority of I.F. gain is obtained. IC-603 contains a quadrature detector which requires only one tuning adjustment for proper alignment.

The output of the quadrature detector is amplified by a broadband amplifier. The output of this amplifier is connected through a de-emphasis network to an emitter follower and out to the level control. The output of the broadband amplifier is also filtered for RF and coupled to an emitter and subsequently to the input of the squelch circuit.

The squelch circuit consists of a bandpass filter, a detector, and a switch. The input circuit is a high pass filter. This is followed by a low pass filter/amplifier. The detector rectifies noise and the subsequent D.C. amplifier controls the squelch gate. The reference level for squelch action is set with the squelch potentiometer.

The audio amplifier consists of an active bandpass filter and a direct coupled audio amplifier using compound connected class AB output amplifiers. The input stage serves as a high pass filter while 0302 is connected in an active lowpass amplifier configuration.

All receiver circuits except the direct coupled amplifier portion of the audio amplifier are supplied by regulated 9.5 VDC from the regulator circuit. The receiver regulator delivers output whenever the radio is "ON" .

. Frequency Control:

Frequency Control is obtained by using high stability crystals which maintain $\pm 0.0005\%$ stability from -60°C to $+60^{\circ}\text{C}$. A negative temperature coefficient thermistor located adjacent to the channel crystal senses the crystal ambient temperature. At nominal ambient temperature, (001:0 60<t) the resistance of thermistor is very low, placing a selected fixed NPO capacitor essentially across the crystal to produce a nominally 32 pf load capacitance. At low ambient temperatures (below OOC) at which high stability AT cut crystals drop in resonant frequency, the resistance of this thermistor increases exponentially. This causes a net reduction in the load capacitance across the crystal, so that the oscillator frequency is held constant within $\pm 0.0005\%$. A high-stability air dielectric capacitor is used for frequency adjustment, and the oscillator is powered from a regulated 9.5V supply. Resistive isolation of the oscillator output as well as an untuned buffer amplifier assure that load variations do not affect the transmitter frequency. The oscillators are housed in a metal compartment to minimize radiation of unwanted spurious signals as well as to provide an isothermal surface surrounding both the crystal and thermistor.

Channel Selection:

The basic 80BR 1 is supplied with four channel capability, selected by applying +9.5 VDC to individual TCXO's from the front panel switch or rear panel terminal strip.

3.

ALIGNMENT

A. Preliminary Voltage Adjustment:

- (a) Connect a 15.0 volt power supply TB 1-5 or 28 volt power supply to TB 1-6.
- (b) Turn the unit on and connect voltmeter to TP902 (white) (J4-14) on the regulator board. Set R904 (9.5 adjust) for 9.5 volts.
- (c) Connect the voltmeter to TP901 (red) (J4-13) on regulator board. Set R912 for 13.8 volts.

B. Receiver Alignment Procedure:

1. Receiver Multiplier Alignment

- (A) Connect VTVM to TP1 tune L401 for maximum reading (.6 - .8V). (TP1 is terminal "1" on connector J4).
- (B) With VTVM connected to TP1 Tune L402 for a dip or minimum. Tune L409 and L403 for a maximum.
- (C) Connect VTVM to TP2. Tune L404 for a minimum. Tune L405 for a maximum.
- (D) Connect VTVM to TP3. Adjust L402, L403, L409, L404, and L405 for a maximum. Reading should be .4 volt or greater.
- (E) Connect VTVM to TP4, Adjust L407 for a maximum indication. Adjust alternately L406 and L407 for a maximum indication.
- (F) Adjust C429 (VTVM still at TP4) for minimum indication on scale. Reading should be .4 volts or more.

5. R.F. Front End Alignment

- (A) Connect an on-frequency unmodulated signal to the antenna terminal. Increase signal level until receiver quieting is detected. If front end is badly misaligned or tuned to a frequency 20MHz from the new frequency, signals as great as 30 Mv. may be required for quieting. Tune C806 and C807 (injection frequency resonators) for best quieting.
- (B) Tune C801 through C805 for best quieting. Continually reduce signal input level as alignment progresses. Each front end resonator should be repeaked twice or three times (in complete sequence) for proper alignment and optimum selectivity.
- (C) Realign C806 and C807 for best quieting.
- (D) If I.F. output circuit hasn't been aligned, refer to I.F. and passband alignment (this section) for correct procedure.
- (E) Quieting sensitivity (20 dB) without pre-amp should be 0.5 uv. or better.

3. Receiver Oscillator Frequency Adjustment

Use one of the following procedures.

- (A) With a 10.7 MHz signal source loosely coupled to the I.F., connect a generator exactly on-frequency to the antenna input and adjust the receiver oscillator trimmer for a zero beat at the audio output.

- (B) Connect a frequency counter to P110 (17-21 MHz) on osc. carrier assembly and adjust the receiver oscillator trimmer for the correct crystal frequency.

$$F_{\text{crystal}} = \frac{(450 - 512 \text{ MHz})}{24} - 10.7 \text{ MHz}$$

$$F_{\text{crystal}} = \frac{(406 - 450 \text{ MHz})}{24} + 10.7 \text{ MHz}$$

Receiver:

4. I.F. and Passband alignment

- (A) Connect a 10.7 MHz signal generator through a capacitor to the input connector of the I. F. With a scope connected to TP-60 1, adjust the level of 10.7 MHz signal for presentation on the scope. Adjust L-600, L-601 and L-602 for maximum indication.
- (B) Connect scope to TP602. Reducing input to I.F. as necessary to prevent limiting, adjust T600 and T601 for maximum indication.
- (C) Disconnect 10.7 MHz generator and connect front-end output to I.F input. Connect signal generator capable of external FM modulation to antenna connector. If front end is not properly aligned, perform that procedure next.

(D) Connect oscilloscope probe to TP601. Adjust RF output level to 1000-3000 uv on channel. Connect sweep output of oscilloscope (sawtooth) to Ext. Mod. input terminals of signal generator. Adjust modulation level for at least + 8 KHz deviation for full scope presentation and adjust scope sweep rate for approximately 5-10 milliseconds/division.

Observe passband on scope and adjust signal generator frequency and level and scope sweep rate for best presentation (be sure waveform is not amplitude limited). Adjust L-600 and L-601 for minimum ripple.

(E) Move oscilloscope probe to TP602. Reduce input signal level to 5-15 uv. Adjust oscilloscope and generator level for best oscilloscope presentation. Tune T600 for optimum flatness of the response trace. It may be necessary to remove the cover from the front-end assembly and adjust L809. Adjust L600, L601 and L809 alternately for minimum ripple. It should be possible to reduce aggregate ripple amplitude to less than 1.5 dB. The signal generator attenuator can be used to measure the ripple amplitude in the following manner:

(1) Choose a point in the I. F. passband response presentation that has an adjacent maximum and minimum response. Set the maximum response point at an arbitrary position on the scope face. Make a mental note of the relative dB level on the generator output until the minimum point is at the same level as the previously established reference. Take this dB level indicated by the attenuator and subtract it from the first reading. The difference is the aggregate ripple amplitude and should be less than 1.5 dB.

Discriminator Alignment:

NOTE: Caution - Do not adjust L600 and L601. If adjustment of these coils becomes necessary refer to passband alignment in the alignment instructions.

The I F amplifier uses a quadrature detector discriminator. This type does not have a DC "zero" and cannot be used to net the receiver to a transmitter. Discriminator alignment is limited to adjusting a single quadrature coil for maximum recovered audio with a normal input signal, modulated 3-5 KHz at 1 KHz audio.

- (a) Apply a modulated on-channel signal to the receiver.
- (b) With the oscilloscope probe at J602 (top of the audio preset potentiometer) or AC VOM/VTVM across the speaker terminals and the receiver unskelched, peak L603 for a maximum output.
- (c) Adjust R32 (audio level preset) for rated receiver audio output. Volume control on front panel must be fully clockwise.

TROUBLESHOOTING

(Refer to schematics and parts list in the manual when performing maintenance on the unit. Also, refer to circuit descriptions in Section 3. Transistor and integrated circuit pin layouts as well as color code information is given below.)

The radio is constructed with individual circuit "blocks" contained on separate modules or plugin printed circuit boards. The major assemblies are shown opposite the schematic diagrams to aid in fault isolation as well as normal preventive maintenance and alignment.

Most of the assemblies simply plug in, and fault isolation can often be simplified by substituting a known good module for the suspect assembly.

Because individual boards plug in, emergency repairs can usually be made by simply replacing the defective board. The defective board can then be repaired at the serviceman's convenience.

BE SURE NOT TO TRANSPOSE WIRES WHEN SERVICING THE UNIT, SINCE SEVERE DAMAGE TO CIRCUIT BOARD AND COMPONENTS MAY RESULT.

Troubleshooting Equipment:

The following equipment is helpful for troubleshooting the radio.

1. 1037 Test Set
2. Oscilloscope, to observe RX and TX audio and for sweep alignment.
3. Power supply adjustable from 14.0 to 16.0 VDC or 24 to 28 VDC at 2 amp load.
4. Signal Generator, 406-512 MHz, 0.1 microvolt to 200 millivolt output, internal 1 kHz modulation. (Measurements Model 800 or equivalent)
5. Frequency Counter with time base stability of $\pm .0001\%$ or better.
6. 10.7 M Hz signal source (in lieu of the 1037 test set)
7. VOM or VTVM with low DC voltage range and 20K ohm/V or higher input impedance (SIMPSON 260 or equivalent) (in lieu of 1037 Test Set)

A number of companies manufacture combined test equipment that may be used for most adjustments and troubleshooting.

When circuit malfunctions exist, a visual check of the unit may reveal the portion of the unit in which the trouble is located. Check for broken or disconnected wires, damaged circuit boards, damaged components, etc.

To isolate trouble to a circuit, note the symptom. For example, failure of the squelch to function at any setting of the squelch indicates that the squelch board is probably at fault. However, failure of the squelch to open with a signal, although it will open when the squelch control is rotated, indicates that oscillator, front end, IF, or squelch board problems may exist.

In this case a more complete determination must be made by signal tracing and/or voltage measurements.

In any signal tracing analysis, a good oscilloscope is indispensable. Care should be exercised, of course, to avoid misinterpretation of readings which appear to indicate malfunctions in tuned circuits. A scope can severely detune a critical circuit so that any readings taken are rendered meaningless. This is minimized with a compensated 10X probe, but not entirely eliminated.

TROUBLESHOOTING CHART

The following chart may be helpful, in conjunction with schematic, voltage charts, and circuit description, for all troubleshooting work.

PROBLEM	CHECK CIRCUIT BLOCK
1. Receiver dead, audio and squelch function with front panel controls	Oscillators, mixer board, Rec. multiplier, IF
2 Receiver audio dead	Receiver audio board, squelch board, voltage regulator,
3. Squelch malfunction	Squelch board, oscillators, IF, front end, voltage regulator,
4. Receiver signal distorted	Audio amp, receiver oscillators, IF, voltage regulator, level control
5. Poor receiver sensitivity	Mixer board, I F board, receiver audio, receiver multiplier.
6. Fuse blows when power is connected	Regulator circuit, Rec. audio amp, master interconnect, wiring, cables.

VOLTAGE CHART (80BR1)

Q	E	B	C
6	.8	1.4	5.6
7	5.3	5.6	8.9
101	18	17.5	12.5
102	17.5	16.9	0
103	8.9	9.5	16.9
104	8.9	9.5	12.5
105	18	17.4	9.5
401	.4	1.7	9.5
402	.35	.2	9.5
403	.4	.2	9.4
404	.45	.2	9.5
405	.6	0	9.5
601	2.3	3.0	6.7
602	6.7	7.35	9.0
603	2.6	2.2	9.3
604	3.9	4.5	8.5
605	3.9	4.5	9.0
606	8.9	8.5	4.8
607	4.0	4.6	9.0
608	4.0	4.6	9.0
701	3.8	4.1	9.5
801	S O	GO	07.8
1101	9.5 Sq.	9.5	.8 Sq.
	9.1 Unsq.	8.5 Unsq.	7.8 Unsq.
1102	9.5 Sq.	9.5 Sq.	.8 Sq.
	9.1 Unsq.	8.5 Unsq.	7.8 Unsq.
1201	2.6 Unsq.	3.1 Unsq.	7.1 Unsq.
1202	1.35 Unsq.	1.8 Unsq.	7.1 Unsq.
1203	6.3 Unsq.	6.9 Unsq.	13.0 Unsq.
1204	6.3 Unsq.	6.9 Unsq.	13.6 Unsq.
1205	13.6 Unsq.	13.0 Unsq.	7.5 Unsq.
1206	6.9 Unsq.	7.5 Unsq.	13.0 Unsq.
1207	6.9 Unsq.	.6 Unsq.	.62 Unsq .
1208	13.6 Unsq.	13.0 Unsq.	6.9 Unsq.
1209	0 Unsq.	.62 Unsq.	6.9 Unsq.

INTEGRATED CIRCUITS

Pin Number	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
IC101	1.4	17.4	18.0	0	1.6	1.6	2.6	1.4
IC601	6.0	3.0	0	2.25	6.0	9.0	9.0	9.0
IC602	4.9	1.0	0	.28	4.9	9.5	4.9	9.5
IC1100A	6.2	6.2	6.2	0	NA	NA	NA	9.5
IC1100B	NA	NA	NA	0	4.5	3.5-4.5 unsq. 3.3-3.5 sq.	2.0 unsq. 8.3 sq.	9.5

Pin Number	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
IC603	1.9	1.9	1.9	0		6.4	6.4	5.5	5.5	5.5	8.5	4.9	2.0	0	4.5	0

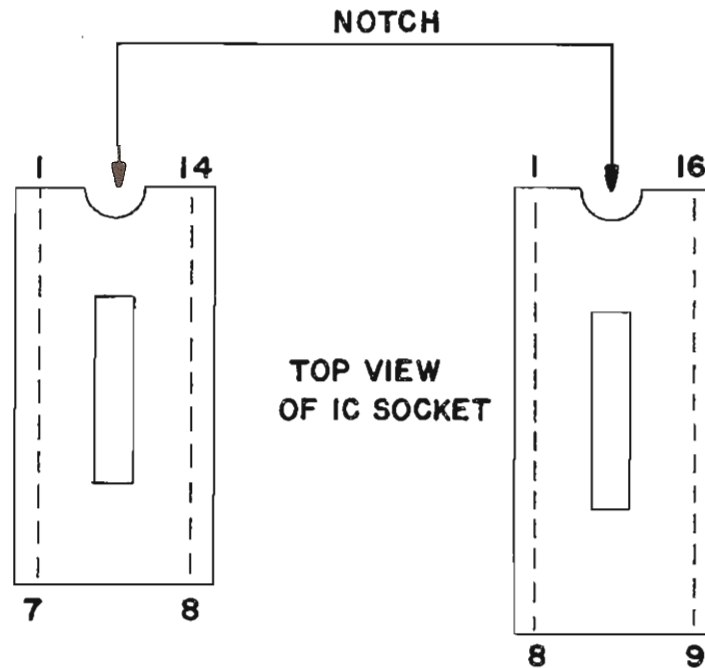
Warning:

It is advisable to disconnect the unit from the power source before replacing modules or components, but the unit should, in any case, be turned off. USE ONLY ROSIN CORE SOLDER AND LOW HEAT IRONS, preferably not exceeding 30 Watts.

When components must be replaced, check the parts list and schematic to determine whether exact replacement parts must be used. In certain cases, component type, as well as value is highly critical. ALL subminiature capacitors MUST BE REPLACED WITH EXACT REPLACEMENT. Also, substitution of values in certain circuits may result in improper performance, INCLUDING VIOLATION OF FCC RULES AND REGULATIONS.

Removing components from plated-through-hole printed boards may be more difficult than from standard boards, because a pronounced solder "wicking" effect is obtained with plated through boards. However, use only sufficient heat and tension to remove any components. It may be easier to remove some by simply cutting the component off the top side of the board (if the part is known to be defective); the leads will then come out easily by heating the pad.

Care should be exercised in replacing dual in-line integrated circuits, as the pins are quite delicate. The easiest way to insert an in-line pin IC is to place one row of pins lightly in the socket, use a straight edge to push the other row of pins into alignment, and press firmly in the IC to seat it. Do NOT attempt to remove an IC with fingers - use an IC puller or a soldering aid to lightly pry the IC from the socket. All IC's mounted in sockets should be oriented so the notch on one end of the IC is aligned with the notch in the socket. See the figure below.

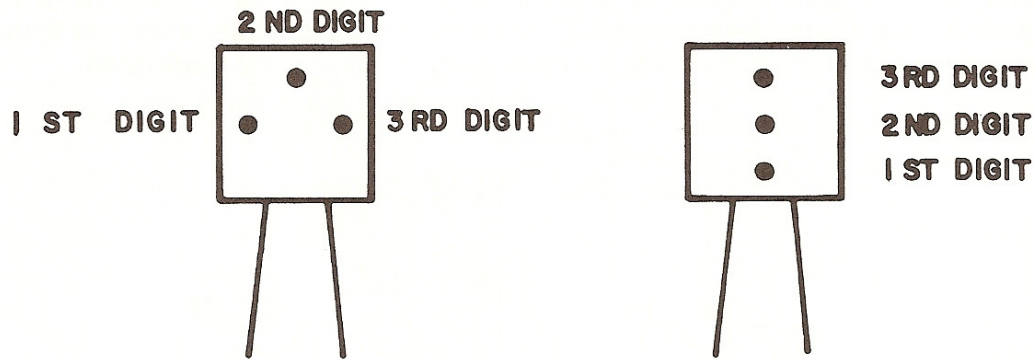


Component color codes:

All resistor color codes are standard. However, some resistors have an additional band which should not be confused with the value color code.

Most capacitors actually have values stamped on the capacitor body. In some cases, however, stamped values are coded as a combination number and letter. Unfortunately, all manufacturers are not entirely consistent in coding capacitors with a single numbering system, so some judgement must be used. In general, the capacitor will be marked, for example, 271J, which signifies 270 pf, $\pm 5\%$, so that at least two significant figures are known, and a final value determination can be made by reference to the schematic.

A few capacitors will be color-coded, and a three dot system is used. The value is read as follows:



*Exception: For 1-10pf, the least digit will be white.

EXAMPLES:

- 1pf = Brown/Black/White (109)
- 10 pf = Brown/Black/Black (100)
- 100 pf = Brown/Black/Brown (101) 1000 pf = Brown/Black
- 1000 pf = Brown/Black/Red (102)
- 10 uf = Brown/Black/Blue (106)

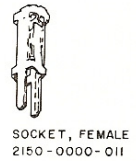
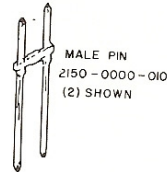
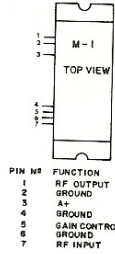
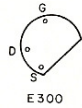
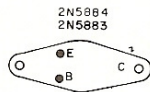


LEAD	2N5222	2N5485	MSD6150
1	BASE	DRAIN	CATHODE
2	EMITTER	SOURCE	CATHODE
3	COLLECTOR	GATE	ANODE

NOTE IF IT IS NECESSARY TO REMOUNT THE FOLLOWING TRANSISTORS:

MJE 2901	2N5986	2N5591
MJE 370	MJE 371	MJE 520
MJE 2801	2N5590	

THEN CARE MUST BE TAKEN TO NOT EXCEED 6IN-LBS OF MOUNTING TORQUE AND SILICONE GREASE SHOULD BE REAPPLIED.



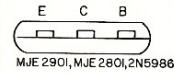
LEAD	2N5398	3N187	MRF502 40242
1	SOURCE	DRAIN	EMITTER
2	DRAIN	GATE 2	BASE
3	GATE	GATE 1	COLLECTOR
4	CASE	SOURCE	CASE



2N5209	2N3415
MPS3638A	2N5223
MPS 3646	2N5226
MPS 6514, 2N5225	

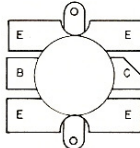


2N3646, 2N3638

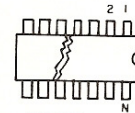


CA3028B (BOTTOM VIEW)
CA3085A,

CM25-12 CM40-12
CM40-12 JØ 3030
BM70-12 JØ 3701
CD2772 CD2773
CD3286



SD1134
2N4427
2N5913
SD1270
2N2219
2N2222

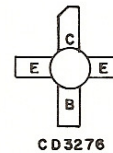


CA3086
MC 1733CL
CA3089E



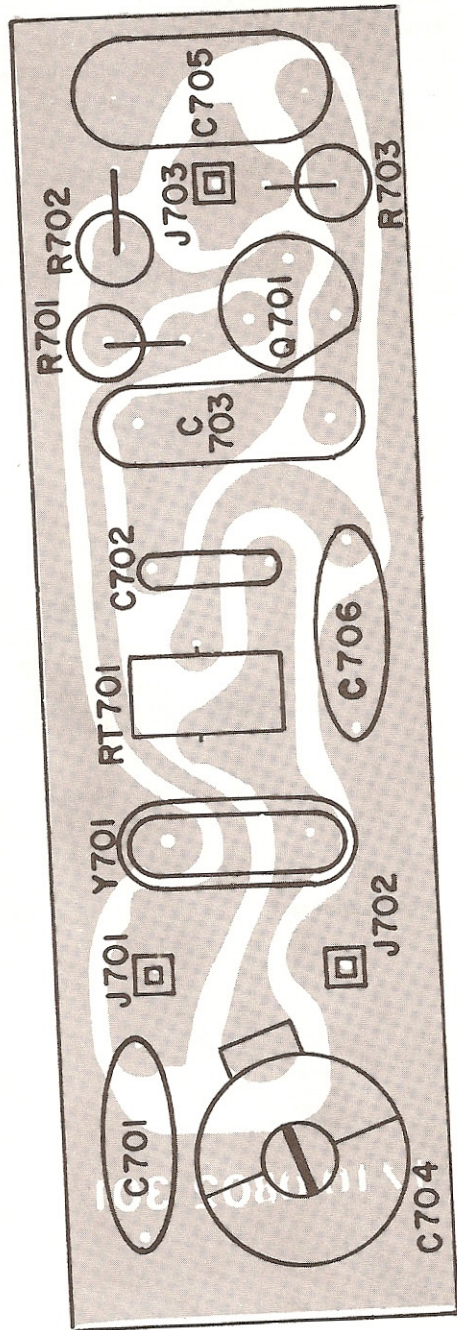
E 421

1.	SOURCE	1
2.	DRAIN	1
3.	GATE	1
4.	SOURCE	2
5.	DRAIN	2
6.	GATE	2

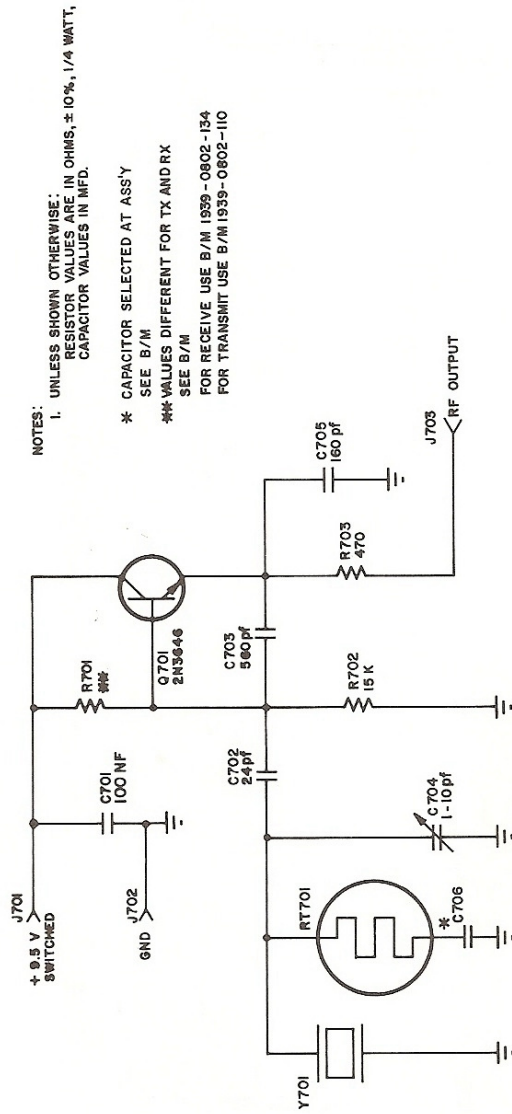


2N6084	A 3-12
2N5589	A 60-12
2N5590	B 12-28
2N5591	A 30-12
2N6080	
2N6081	
2N6083	
CD2188	

SEMICONDUCTOR PIN IDENTIFICATION



TCXO MODULE PARTS LOCATION



NOTES:
 1. UNLESS SHOWN OTHERWISE,
 RESISTOR VALUES ARE IN OHMS, ±10%, 1/4 WATT,
 CAPACITOR VALUES IN MFD.

* CAPACITOR SELECTED AT ASS'Y
 SEE B/M

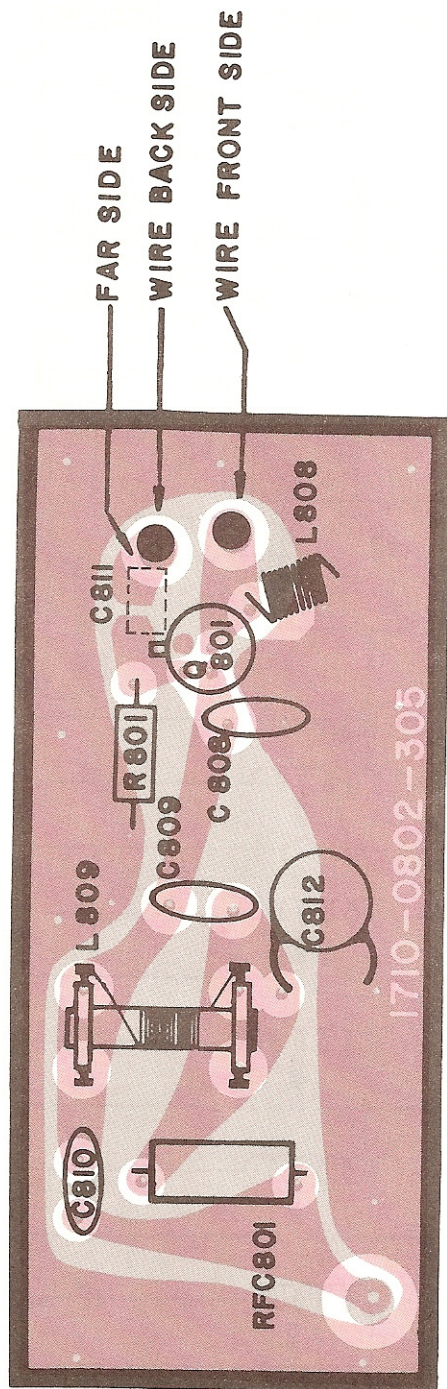
##VALUES DIFFERENT FOR TX AND RX
 SEE B/M

FOR RECEIVE USE B/M 1939-0802-134
 FOR TRANSMIT USE B/M 1939-0802-110

TCXO SCHEMATIC DIAGRAM

PARTS LIST

Item	Description	Part No
	<p data-bbox="753 369 837 386">TCXOBOARO</p> <p data-bbox="623 470 932 487">Component parts selected at manufacture to comply with</p> <p data-bbox="591 516 932 558">FCC stability requirements. To order complete assembly, state part number and channel frequency.</p> <p data-bbox="721 583 867 600">Receive: 1939-0802-134</p>	



MIXER MODULE PARTS LOCATION