1. Receiver

1.1 DESCRIPTION

The low-band *SYNTOR X* radio has a dual-conversion receiver with intermediate frequencies of 75.7 MHz and 10.7 MHz. The cascade of PA low-pass harmonic filter, antenna switch, and receive high-pass filter is wide enough to accommodate all frequencies in the receive bandwidth without tuning. However, the high IF board does get three tuning adjustments at the factory. Because proper tuning of these adjustments is critical for extender and IF operation, field tuning of the high IF filter is not recommended.

The receiver circuits are in the RF internal casting and on the PA board, the RF board, the personality board, and the common circuits board.

1.2 THEORY OF OPERATION

1.2.1 Front End and High IF

The low-band preselector is a cascade of two filters separated by the antenna switch. The receive signal goes first to a low-pass filter with a cutoff frequency of approximately 54 MHz. (This filter also serves as the transmitter harmonic filter.) If the radio is in the receive mode, the antenna switch passes the receive signal and applies it to the high-pass portion of the preselector, a seventh-order elliptical filter with a cutoff frequency of approximately 29 MHz. The signal then goes to a standard NPN BJT preamplifier in a common emitter configuration.

The signal leaving the preamp goes to the extender front-end board, where it divides into two parts. One goes to the extender and the other to the RX first mixer. The synthesizer injection output of 105.4–125.7 MHz also goes to the first mixer—via a three-pole injection filter. The first mixer is a double-balanced diode design that uses an up-conversion scheme to generate the 75.7-MHz first IF.

The 75.7-MHz IF signal leaving the first mixer goes to the high IF board, where it goes through the first IF amplifier, an NPN BJT operating in a common-emitter configuration. The amplified output signal goes on to a tunable three-pole bandpass filter with a 4-MHz bandwidth and then to a surface acoustical wave (SAW) filter. The SAW device gives the radio IF selectivity, and also generates a 2.5-microsecond delay that gives the extender circuitry time to shut off the blanker switches if noise pulses are present.

The 75.7-MHz IF signal leaving the high-IF board and RF internal casting goes to the RF board and the second mixer. The third harmonic of the frequency synthesizer's 14.4-MHz reference oscillator is picked off and applied to the RX doubler hybrid, which generates the injection frequency of 86.4 MHz for the second mixer. The second mixer, a JFET device in a common-gate configuration, uses these two input signals (86.4 MHz and 75.7 MHz) to produce the second intermediate frequency, 10.7 MHz.

1.2.2 Second IF

The second IF circuitry uses several stages of filtering and amplification, performing selective IF filtering with dual-resonator, mode-coupled monolithic crystals cut to a fundamental frequency of 10.7 MHz. This circuitry requires no tuning.

The second mixer's output goes to two blanking switches (Q203 and Q204) which, in conjunction with the extender circuitry, shunt ignition noise in the IF to ground. Following the blanking switches are a two-pole crystal filter (Y250) and the first 10.7-MHz IF amplifier (Q250), a FET device used in a common

gate configuration. The output of the first 10.7-MHz IF amplifier goes to an additional four poles of crystal filtering (Y251 and Y252). At this point in the IF, the receive signal strength is monitored by the circuitry on the AGC hybrid (HY200) and used to control the extender's noise blanking circuitry. Also following Y251 and Y252 is the high-gain (approximately 50 dB) second 10.7-MHz IF amplifier (U250), the output of which goes to the final four poles of crystal filtering (Y253 and Y254) and then to the limiter/detector (U251).

1.2.3 DC Supply Hybrids

The receive switch hybrid (HY201) is supplied with switched B+ (13.6 V), regulated 9.6 V, and keyed 9.4 V from the personality board. Using these voltages, the circuitry on the hybrid generates: (1) switched filtered B+ to be used on the front-end bias hybrid, the first 10.7-MHz IF amplifier, and the second mixer; and (2) not keyed 9.4 V (RX 9.4) to be used on the extender back end and extender front end, and on the TX mixer.

The front-end bias hybrid (HY160), which receives switched filtered B+ from the RX switch hybrid, serves as a current source for the 75.7-MHz IF amplifier and the preamplifier.

1.2.4 Limiter/Detector

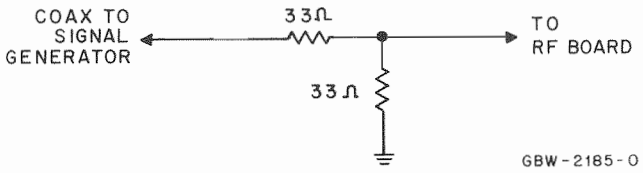
The limiter/detector (U251) generates a limiting function. It also has a quadrature detector which, with an external two-pole dual-resonator crystal, recovers the audio from the second IF signal. The recovered audio then passes through an emitter-follower buffer (Q250) and goes to the audio stages on the personality board (via the personality board and the control head). The detector buffer supplies approximately 650 millivolts RMS to the control head. No tuning is required in the detector circuitry.

1.3 RECEIVER TROUBLESHOOTING

If the receiver does not receive any signal, check power supplies 9.6 V, 5.0 V, A+, RX 9.4, and switched filtered A+. Check the audio power out (15 watts with no input signal), and check for proper injection frequencies at the first and second mixers. Also, determine the injection level at the first mixer by measuring the resistance across R153. Use an ohmmeter probe with a 10-μH choke in series with the + lead. A resistance of less than 10 ohms (in the receive mode) indicates adequate injection power. Determine the injection level in the second mixer by measuring the dc voltage at the Source of Q202. A voltage reading of 3.5–4.0 V indicates a proper injection level. A reading of approximately 2.5 V indicates no injection signal is present. The receiver sensitivity (12 dB Sinad) can be measured at several points to help isolate a receiver malfunction.

If the sensitivity has degraded by 20 to 40 dB, one of the first RF stages is probably defective. Check the bias to the preamp by unplugging P300 and measuring the current from J300 center conductor to ground. It should be 30 to 38 mA. This indicates that the biasing circuitry is working correctly. If the dc voltages do not agree with the schematic, the problem is with the preamp.

Measure the sensitivity at J300 through an attenuator (preferably 10 dB) to insure a dc path from J300 to ground. The sensitivity should be better than −103 dBm (1.5 μV). Measure sensitivity at the high-IF input by removing the lead from the first mixer, and soldering in a coax at this point. The sensitivity should be better than −119 dBm (.25 μV). Measure sensitivity at the RF board by removing the coax from the internal casting and inserting the network shown below. The sensitivity should be better than −105 dBm (1.2 μV).



When the problem is isolated to a circuit board, restore the receiver's normal wiring configuration. See the voltages listed on the schematic to find what component is defective.

Test the blanker switches by first unplugging J200. The sensitivity should be unchanged. Now, short J200-1 to 9.6 V. If the sensitivity degrades by 55 to 60 dB, the blanker switches are operating properly.

2. Extender

2.1 DESCRIPTION

The extender receives, detects, and blanks wideband noise pulses from ignition systems and other man-made sources. It can be tuned through the entire receive bandwidth (29.7–50 MHz) in two ranges.

Extender circuits are in the RF internal casting (extender front-end and back-end boards and the SAW filter on the high IF board) and on the RF board (blanking switches Q203 and Q204 and the extender AGC hybrid HY200).

2.2 THEORY OF OPERATION

2.2.1 RF and Detector Circuitry

The extender front-end board splits the receive input signal into two equal signals. One signal goes to the first receive mixer and the other goes to the three-pole bandpass filter on the extender front end. The three-pole filter, which limits the input signal, is tunable (L300, L301, L302) over the entire receive bandwidth in two ranges. (The first range, 29.7 to 40 MHz, requires chip resistors R300, R301, and R302 to be in place. The second range, 39.0 to 50 MHz, requires the same chip resistors to be removed.) The division of the extender into two ranges and the proper selection of tuning coil polarity have made it possible to maintain a constant extender front-end bandwidth of approximately one MHz over the extender's entire bandwidth.

The signal leaving the bandpass filter goes to the first extender RF amplifier (Q300), an NPN BJT device in a common-base configuration. At this point, the signal leaves the extender front-end board and goes via a small coax to the high-gain (approximately 50 dB) second RF amplifier (U318) on the extender back-end board. The gain of this amplifier is controlled by the extender AGC hybrid (HY200) on the RF board, which greatly reduces this gain when it senses relatively high RF levels in the second IF.

When it leaves the second RF amplifier, the signal goes to a one-pole capacitively-tuned resonant circuit. (To tune the extender, insert the tuning tool through the hole in the internal casting and the hole in the RF board and adjust C321. These holes are aligned, so that you need not remove the internal casting to make this adjustment.) The output of the resonant circuit goes to a balanced AM detector that detects noise pulses. The output of the detector is monitored via the extender test point (Pin 4 of P201) that is used in conjunction with L300, L301, L302, and C321 to tune the extender channel. Q330 follows the extender detector and serves as an impedance buffer between the detector and the pulse shaping circuitry.

2.2.2 Pulse-Shaping Circuitry

The pulse-shaping section has circuits that generate, amplify, shape, and filter pulses, and limit the maximum pulse rate. When the detector circuitry detects a pulse greater than approximately 0.65 volt in amplitude and 1.5 microseconds in period, the detector buffer, Q330, applies a pulse to amplifier Q331, an NPN BJT device in a common-emitter configuration. Q331 drives a retriggerable monostable multivibrator. The multivibrator sends a rectangular pulse to transistor Q350, which acts as an integrator to convert it to a triangular pulse with its time constants governed by R350, R351, and C351. This triangular output goes to transistor Q360. Q360 is biased near saturation so that when the output of the preceding integrator circuit begins to go negative, the leading edge of the trapezoidal blanker pulse follows immediately. Q360 (collector) continues to rise until it reaches cutoff, effectively clipping the triangular drive waveform and turning it into a trapezoidal waveform. This waveform goes through a one-MHz cutoff low-pass filter (R363 and C361) that removes excessive noise, and then to the blanker switches.

The pulse-shaping circuitry of the extender also includes a Schmitt trigger formed by Q370 and Q371. It senses the duty cycle of the monostable multivibrator, and disables the integrator at pulse rates greater than 110 kHz. The monostable multivibrator continues to run, and when the pulse rate drops to below 110 KHz, the integrator is again enabled.

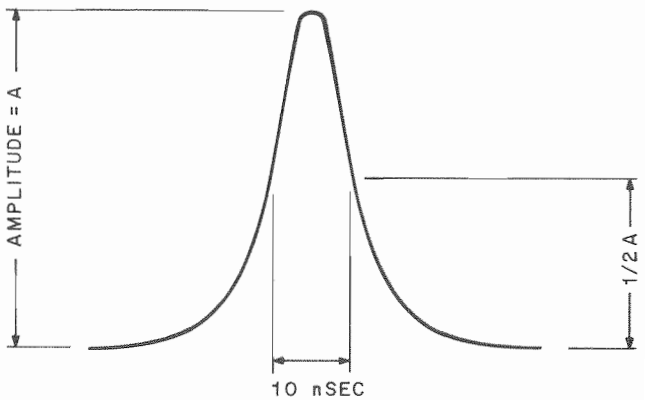
2.2.3 Programing

The low-band *SYNTOR X* extender can be programed on or off for any mode, because the C0 receive frequency bit in the EEPROM has been defined as the extender ON/OFF bit. (The low-band radio does not use a prescaler, and that leaves C0 available for this purpose.) The divider latches "C0" to Q241 (RF board) for extender ON/OFF control, rather than to the prescaler.

2.3 TROUBLESHOOTING

2.3.1 General

If the radio has problems that could originate in the extender, first measure receiver sensitivity and distortion. Correct any receiver problems before troubleshooting the extender. When testing the extender in the shop, sum pulses resembling that shown below with the selected carrier.



PULSE REPETITION FREQ = 10KHz GBW-2184-O

You can switch off the extender (for comparison) (a) from the control head if the EEPROM is so

programed, (b) by forcing the AGC voltage to 76.5 V, or (c) by disconnecting J200 from the RF board.

2.3.2 Troubleshooting Diagram

Use the troubleshooting diagram at the end of this section for identifying and correcting faults in the extender.

2.3.3 Troubleshooting the Extender AGC

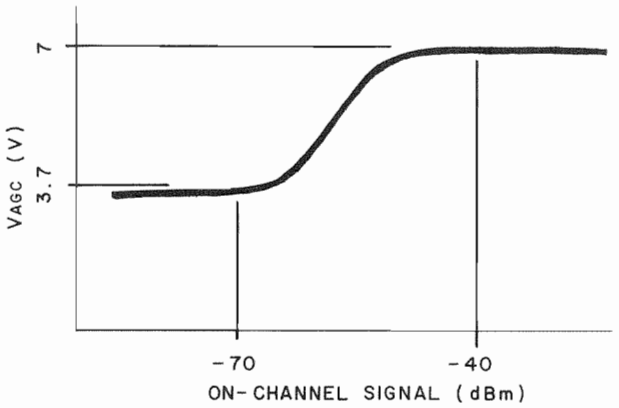
(1) Check receiver performance. Low gain or oscillation affects AGC operation.

(2) Disconnect J201 (5-pin molex connector to internal casting), isolating the AGC circuit on RF board from the extender back-end board.

(3) Measure the AGC voltage at Pin 3 (red wire) with:

a. Extender "OFF," no on-channel signal; VAGC should be approximately 9 V (V_c Q241 $\approx$ 9 V).

b. Extender "ON," variable on-channel signal level (V_c Q241 $\approx$ .2 V).



GBW-2183-0

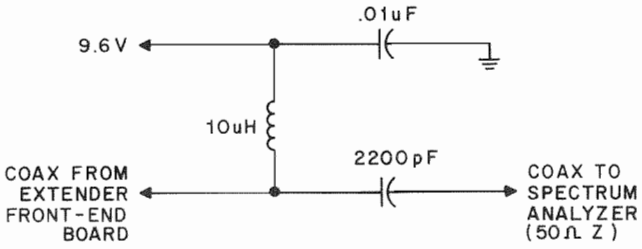
If the above is not the case, check dc inputs to the AGC amplifier hybrid on the RF board (HY200). Troubleshoot or replace the hybrid if the problem still persists.

2.3.4 Troubleshooting the Extender RF Circuits

When troubleshooting an extender sensitivity problem (after checking receive performance, AGC voltage, supply voltages, and detector biasing), it may be necessary to RF troubleshoot the extender. The first step is to isolate the problem to the correct board. The impedance at the front-end/back-end interface is approximately 400 ohms. For ease of measurement, use the following procedure, which tests the extender front-end board with a 50-ohm load.

(1) Lift the center conductor of the coax from the back-end board.

(2) Connect the signal generator to the phono connector where the preamp/high-pass-filter board was previously connected.



GBW-2181-0

(3) Set the frequency of the generator to the extender tune-up frequency.

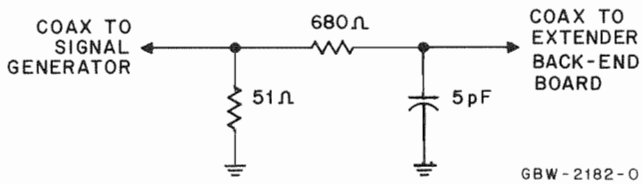
(4) Set the generator level to -30 dBm.

(5) Check that the level is approximately -33 dBm at 30–40 MHz and -35 dBm at 50 MHz.

2.3.5 Checking the Extender Front-End Board

To check the extender front-end board separately:

(1) Supply 9.6 V to the input, ground the AGC input, and connect the following network to the input of the extender back-end board.



GBW-2182-0

(2) Tune the signal generator to the center frequency of the extender, as determined by peaking the meter out voltage.

(3) With the signal generator set for -25 dBm, 100% AM, and 1 kHz modulation frequency, check that the extender puts out a pulse that is somewhat longer than shown on the schematic.

When troubleshooting the front-end board, check for tuning slugs out of place, possibly indicating a bad capacitor or shorted coil. Check the R-pad resistors with an ohmmeter. When changing L300, L301, or L302, be sure the coils are properly oriented. (See schematic for details.)

2.3.6 Checking the Extender Back-End Board

When troubleshooting the back-end board, watch for shorted/open chip inductors. A defective L316 can make front-end board gain appear low. L321 and L322

feed dc to the gain block and partially resonate C321. DC voltage measurements cannot identify a single defective coil. If a high-impedance probe is available, balance can be checked at the junction of L321, L322, and R324. The RF level should be near zero because of symmetry (compared to Pins 5 and 6 of U315). Balance can also be degraded by defective U315, C321, or C322, or a defective detector circuit (Q320 and Q321).

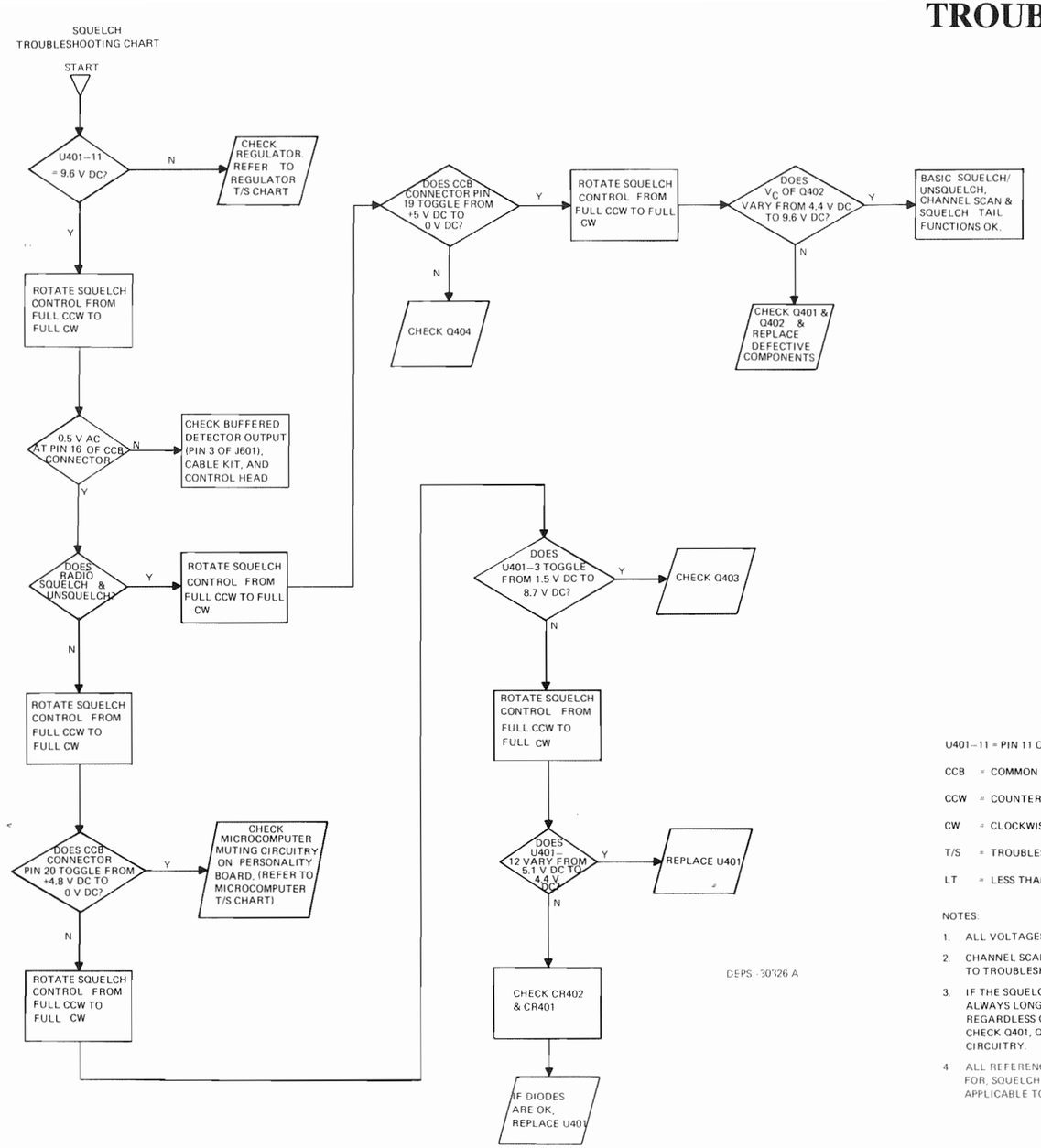
2.3.7 Troubleshooting the Rate Shut-Off Circuitry

This circuit consists of a rectifier and integrator that generate a dc level proportional to the pulse repetition frequency (CR370, R370, R371, and C370), a Schmitt trigger (Q370 and Q371), and a buffer amplifier (Q372).

Rate shut-off can be measured with a pulse of any amplitude that triggers the extender. When the repetition frequency approaches 120 kHz, Q370 should snap "ON" and Q371 should snap "OFF," switching Q372 "ON." Note that a shorted or permanently "ON" Q372 causes all extender operation to cease. An open Q372 causes rate shut-off operation to cease.

Measurement of dc voltages should identify defective components in this circuit. (See schematic.)

TROUBLESHOOTING CHART FOR SQUELCH



SYMBOLS AND ABBREVIATIONS USED IN CHART

= ACTION

= DECISION

= FAULT

U401–11 = PIN 11 OF U401

CCB = COMMON CIRCUITS BOARD

CCW = COUNTERCLOCKWISE

CW = CLOCKWISE

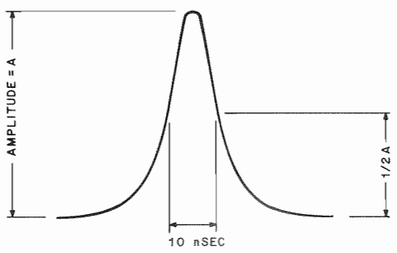
T/S = TROUBLESHOOTING

LT = LESS THAN

NOTES:

1. ALL VOLTAGES ARE DC.
2. CHANNEL SCAN MUST BE TURNED OFF TO TROUBLESHOOT THE SQUELCH.
3. IF THE SQUELCH TAIL LENGTH IS ALWAYS LONG OR ALWAYS SHORT, REGARDLESS OF THE SIGNAL STRENGTH, CHECK Q401, Q402 & ASSOCIATED CIRCUITRY.
4. ALL REFERENCES TO, AND TEST PROCEDURES FOR, SQUELCH OPERATION ARE NOT APPLICABLE TO TRUNKED RADIOS.

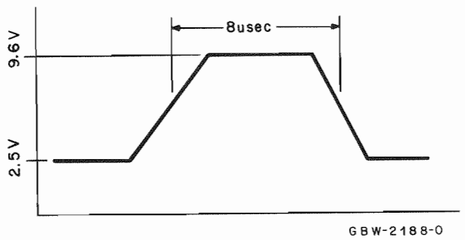
DETAIL 1



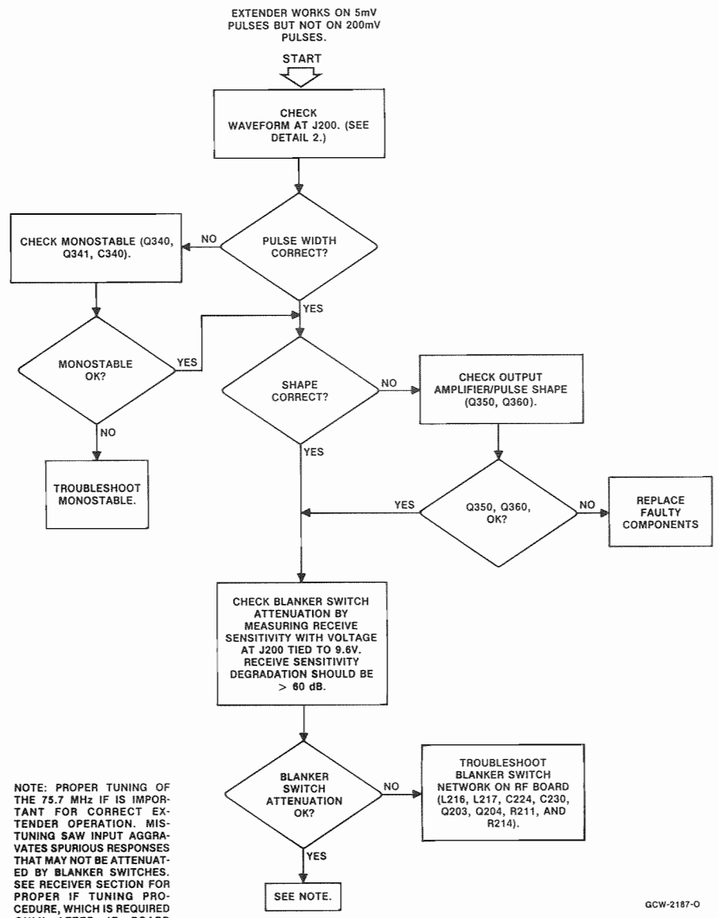
PULSE REPETITION FREQ = 10KHz

GBW-2184-O

DETAIL 2

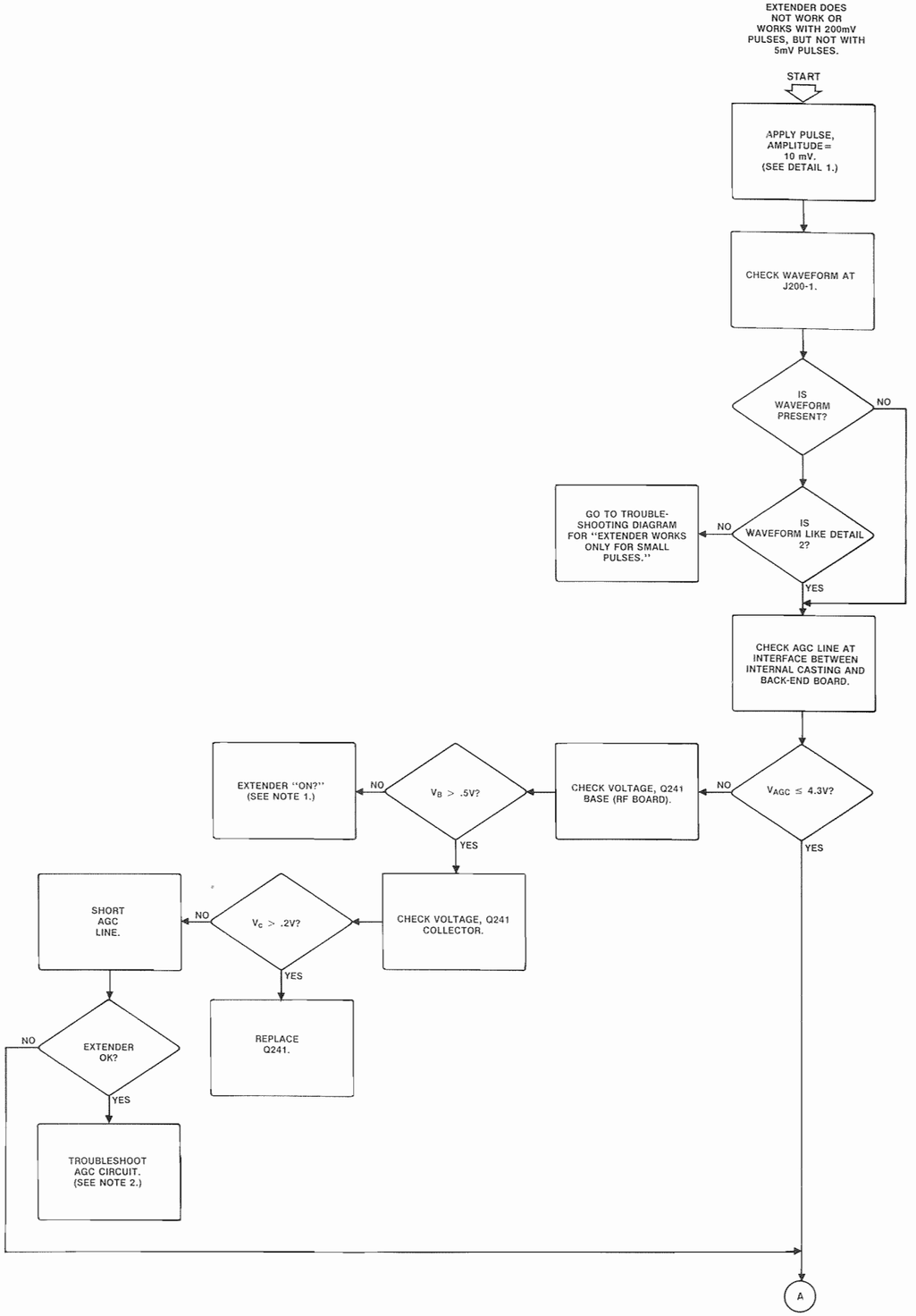


GBW-2188-O



NOTE: PROPER TUNING OF THE 75.7 MHz IF IS IMPORTANT FOR CORRECT EXTENDER OPERATION. MISTUNING SAW INPUT AGGRAVATES SPURIOUS RESPONSES THAT MAY NOT BE ATTENUATED BY BLANKER SWITCHES. SEE RECEIVER SECTION FOR PROPER IF TUNING PROCEDURE, WHICH IS REQUIRED *ONLY* AFTER IF BOARD REPAIR.

GCW-2187-O



Troubleshooting Diagrams
for Extender
PDW-2190-O
8/28/85

EXTENDER DOES NOT WORK OR WORKS WITH 200mV PULSES, BUT NOT WITH 5mV PULSES.

START

APPLY PULSE, AMPLITUDE = 10 mV. (SEE DETAIL 1.)

CHECK WAVEFORM AT J200-1.

IS WAVEFORM PRESENT?

NO

IS WAVEFORM LIKE DETAIL 2?

NO

GO TO TROUBLE-SHOOTING DIAGRAM FOR "EXTENDER WORKS ONLY FOR SMALL PULSES."

YES

CHECK AGC LINE AT INTERFACE BETWEEN INTERNAL CASTING AND BACK-END BOARD.

$V_{AGC} \leq 4.3V$?

NO

YES

CHECK VOLTAGE, Q241 BASE (RF BOARD).

$V_B > .5V$?

NO

EXTENDER "ON?" (SEE NOTE 1.)

YES

CHECK VOLTAGE, Q241 COLLECTOR.

$V_c > .2V$?

NO

SHORT AGC LINE.

YES

REPLACE Q241.

EXTENDER OK?

NO

YES

TROUBLESHOOT AGC CIRCUIT. (SEE NOTE 2.)

REPLACE FAULTY COMPONENTS

A

CHECK DC VOLTAGE AT 9.6V FEEDTHRU TO BACK-END BOARD, AT INTERFACE BETWEEN FRONT-END AND BACK-END BOARDS, AND U316-5, 6, AND 7.

VOLTAGES > 8V?

NO

REPLACE DEFECTIVE FEED COMPONENT, TRANSISTOR, OR IC.

YES

CHECK EXTENDER TEST POINT VOLTAGE WITH NO RF OR PULSE INPUT.

$1V < V_{TSTPT} < 3V$?

NO

CHECK DETECTOR BIASING (Q322–R326) AND CHIP INDUCTOR L323. BOTH DETECTOR TRANSISTORS SHOULD BE SLIGHTLY "ON." V ACROSS C324 AND C325 SHOULD BE ≈ 50 mV. CORRECT ANY BAD CONNECTIONS. REPLACE ANY FAULTY COMPONENTS.

YES

TUNE EXTENDER. WATCH FOR ABNORMAL SLUG POSITION. BE SURE EXTENDER FRONT-END BOARD IS IN CORRECT RANGE. LOOK FOR BROKEN OR BADLY CONNECTED CHIP CAPACITORS ON FRONT-END BOARD, AND BE SURE COVER IS NOT SHORTING COMPONENTS ON FRONT-END BOARD.

APPLY SINUSOIDAL −85 dBm SIGNAL AT TUNEUP FREQUENCY TO FRONT-PANEL CONNECOR. MEASURE VOLTAGE AT EXTENDER TEST POINT.

DOES TEST POINT VOLTAGE RISE ABOVE QUIESCENT VALUE?

NO

TROUBLESHOOT RF GAIN IN EXTENDER CHANNEL.

YES

APPLY 10-mV PULSES (DETAIL 1) AT FRONT-PANEL CONNECTOR.

B

B

CHECK WAVEFORMS AT Q330 BASE, Q331 (PULSE AMPLIFIER) COLLECTOR.

ARE WAVEFORMS OK? (SEE SCHEMATIC.)

NO

TROUBLESHOOT PULSE AMPLIFIER.

YES

CHECK WAVEFORMS IN MONOSTABLE (Q340 AND Q341).

ARE WAVEFORMS OK? (SEE SCHEMATIC.)

NO

TROUBLESHOOT MONOSTABLE.

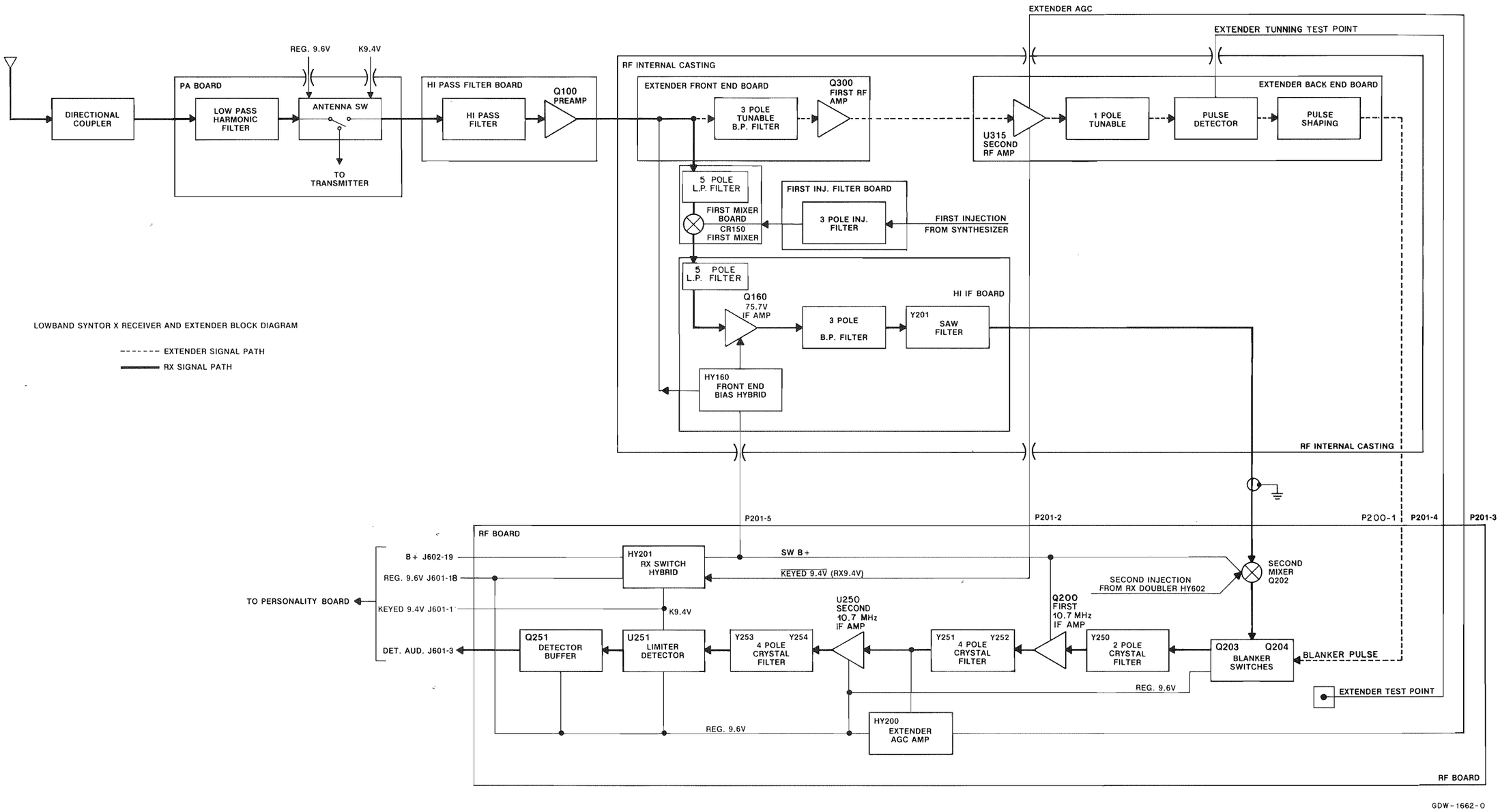
YES

CHECK WAVEFORMS IN OUTPUT AMPLIFIER PULSE SHAPER (Q350, Q360). CHECK RATE CUTOFF CIRCUITRY. TROUBLESHOOT AS NECESSARY.

NOTES:
1. EEPROM CAN PROGRAM EXTENDER OFF OR ON FOR EACH MODE.
2. UPON COMPLETION, UNSHORT AGC AND CHECK IT.

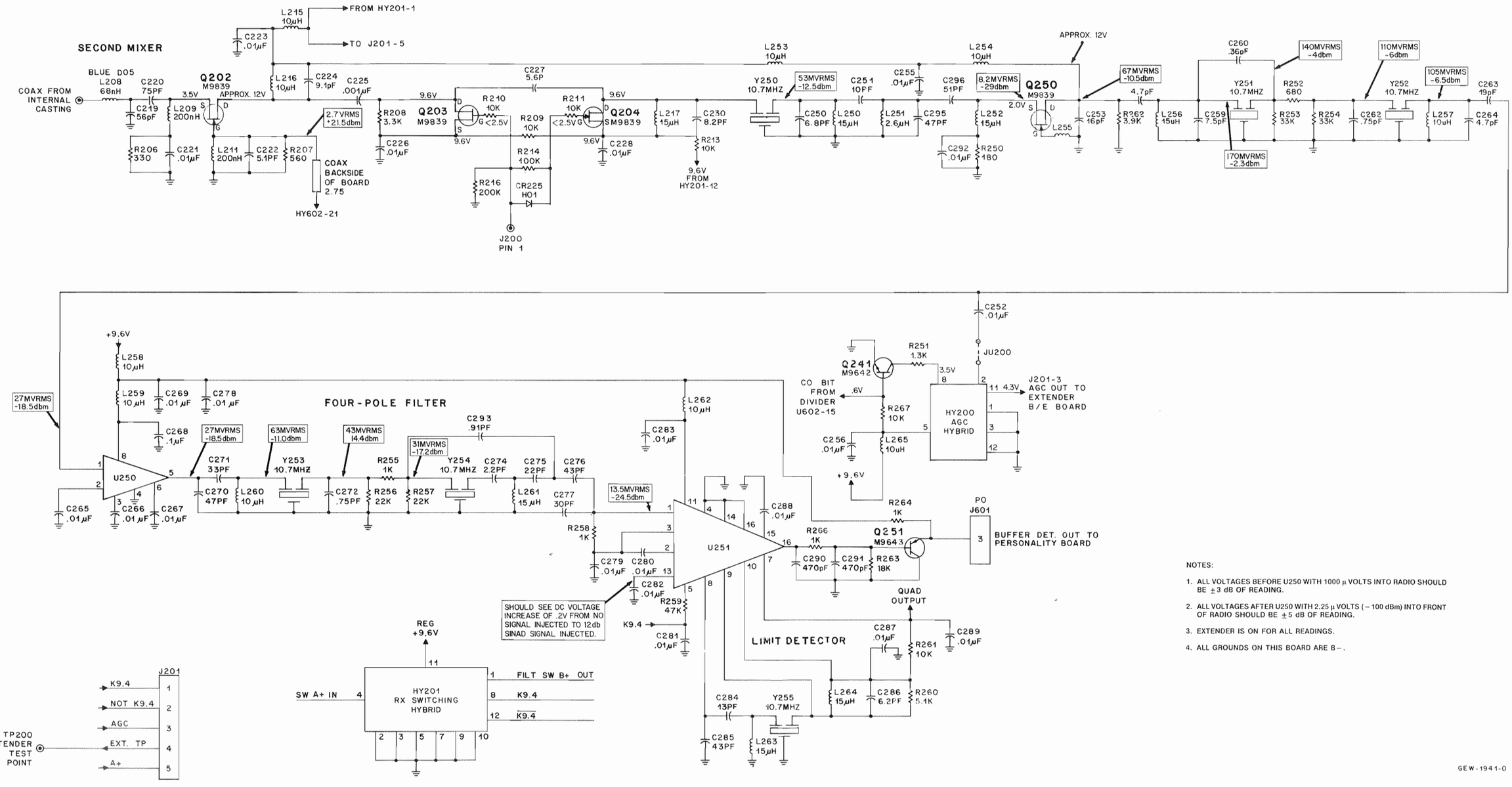
GCW-2187-O

GDW-2186-O



GDW-1662-O

Functional Block Diagram
for Extender
PBW-1699-O
8/28/85



NOTES:

1. ALL VOLTAGES BEFORE U250 WITH 1000 µ VOLTS INTO RADIO SHOULD BE ±3 dB OF READING.
2. ALL VOLTAGES AFTER U250 WITH 2.25 µ VOLTS (−100 dBm) INTO FRONT OF RADIO SHOULD BE ±5 dB OF READING.
3. EXTENDER IS ON FOR ALL READINGS.
4. ALL GROUNDS ON THIS BOARD ARE B−.

Schematics, Circuit Board Diagrams, and Parts Lists for Receiver
PEW-1692-O
(Sheet 1 of 4)
8/28/85

parts list

HLB4087A RF Board (Receiver Section) MXW-1691-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed, pF ±5%, 100V unless otherwise stated
C219	21-11014H43	56
C220	21-11014H46	75
C221	21-11015A07	.01 µF +80, −20%
C222	21-11014H18	5.1 ±.5
C223	21-11015A07	.01 µF +80, −20%
C224	21-83406D94	9 ±.5, 500V
C225	21-11015B13	.001 µF ±10%
C226	21-11015A07	.01 µF +80, −20%
C227	21-11014H19	5.6 ±.5
C228	21-11015A07	.01 µF +80, −20%
C230	21-11014H23	8.2 ±.5
C250	21-11014H21	6.8 ±.5
C251	21-11014H25	10 ±.5
C252	21-11015A07	.01 µF +80, −20%
C253	21-11014H30	16
C255, 256	21-11015A07	.01 µF +80, −20%
C258	21-11014H17	4.7 ±.25
C259	21-11014H22	7.5 ±.5
C260	21-00842041	.36, 500V
C262	21-82450B48	.75, 500V
C263	21-84493B35	19, 500V
C264	21-11014H17	4.7 ±.25
C265	21-11015A07	.01 µF +80, −20%
C266, 267	21-11015A07	.01 µF +80, −20%
C268	08-11051A13	.1 µF, 63V
C269	21-11015A07	.01 µF +80, −20%
C270	21-11014H41	47
C271	21-11014H37	33
C272	21-82450B48	.75, 500V
C274	21-11014H09	2.2 ±.25
C275	21-11014H33	22
C276	21-11014H40	43
C277	21-11014H36	30
C278–283	21-11015A07	.01 µF +80, −20%
C284	21-11014H28	13
C285	21-11014H40	43
C286	21-11014H20	6.2 ±.5
C287–289	21-11015A07	.01 µF +80, −20%
C290	21-11015B09	470 ±10% (p/o RF radial A/1 hybrid)
C290	21-84547A24	.1 µF ±20%, 25V (p/o receive switch hybrid)
C291	21-11015B09	470 ±10% (p/o RF radial A/1 hybrid)
C291	23-84677D13	10 µF ±10%, 35V, tantalum (p/o receive switch hybrid)
C292	21-11015A07	.01 µF +80, −20%
C293	21-82450B39	.91, 500V
C294	21-11015A07	.01 µF +80, −20%
C295	21-11014H41	47
C296	21-11014H42	51
C381	21-84547A22	.047 µF, 25V
C382	21-05157A07	100 ±20%, 25V
C383	21-84547A22	.047 µF, 25V
C384	21-84547A11	.01 µF ±20%, 50V
C385, 386	21-84547A24	.1 µF ±20%, 25V
C387, 388	21-84547A22	.047 µF ±10%, 25V
		diode (see note)
CR225	48-83654H01	silicon
CR290	48-05129M12	silicon rectifier
CR291	48-80056K25	leadless zener, 15V ±5%
CR292	48-84939C29	MMBD 6050
CR381, 382	48-84939C35	hot carrier
		hybrid (see note)
HY200	01-80736T09	extender AGC
HY201	01-80737T82	receiver switch
		connector receptacle
J200	28-84324M01	2-contact connector plug
J201	28-84324M03	connector plug
J210–220	29-80146B01	terminal
		jumper
JU200	06-11009B23	resistor jumper
		coil
L208	24-11030D05	blue
L209, 211	24-82723H11	.2 µH brown/brown
L215	24-80138G05	10 µH
L216	24-83397L07	10 µH blue/blue
L217	24-83397L08	15 µH gray/gray
L250	24-83397L08	15 µH gray/gray
L251	24-82723H19	2.6 µH red/gold/blue
L252	24-83397L08	15 µH gray/gray
L253	24-80138G05	10 µH
L254	24-83397L07	10 µH blue/blue
L255	76-83960B01	ferrite core
L256	24-83397L08	15 µH gray/gray
L257	24-83397L07	10 µH blue/blue
L258, 259	24-80138G05	10 µH
L260	24-83397L07	10 µH blue/blue
L261	24-83397L08	15 µH gray/gray
L262	24-80138G05	10 µH
L263	24-82549D24	15 µH
L264	24-82549D24	15 µH

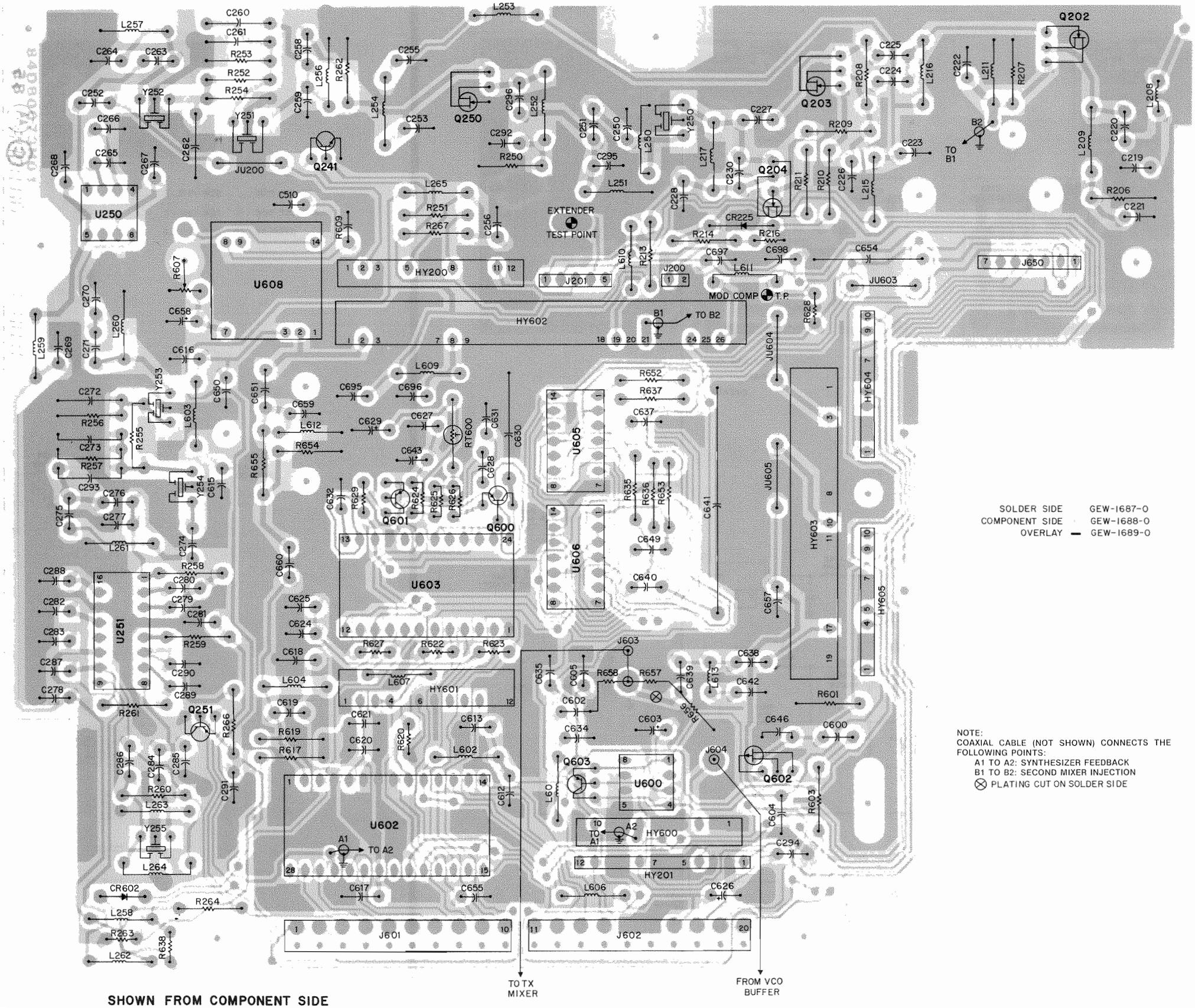
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
L265	24-80138G05	10 µH
L290	24-80140E16	10 µH
		transistor (see note)
Q202–204	48-80182D21	FET, type M8221
Q241	48-80182D08	NPN, type M8208
Q250	48-00869839	FET, N-channel, type M9839
Q251	48-80182D09	NPN, type M8209
Q290	48-84939C24	NPN, type M3924
Q291	48-05148G48	NPN, type MXTA14 SOT89
Q292	48-80182D36	PNP, type 23
Q381, 382	48-84939C31	NPN, type M3931
		resistor, fixed, Ω ±5%, ¼ W unless otherwise stated
R206	06-11009A37	330
R207	06-11009A43	560
R208	06-11009A61	3.3k
R209–213	06-11009A73	10k
R214	06-11009A97	100k
R216	06-11009F05	200k
R250	06-11009A31	180
R251	06-11009A52	1.3k
R252	06-11009A45	680
R253, 254	06-11009A85	33k
R255	06-11009A49	1k
R256, 257	06-11009A81	22k
R258	06-11009A49	1k
R259	06-11009A89	47k
R260	06-11009A66	5.1k
R261	06-11009A73	10k
R262	06-11009A63	3.9k
R263	06-11009E79	18k
R264, 266	06-11009A49	1k
R267	06-11009A73	10k
R386	06-11024A11	27, ⅛ W
R396	06-11024A01	10, ⅛ W
		transformer
TP200	29-80146B01	terminal
		integrated circuit (see note)
U250	51-80066C02	IF amplifier
U251	51-80069C03	FM IF system
		crystal (see note)
Y200	91-80160J01	monolithic crystal filter
Y250	01-80700T57	crystal and insulator
Y251–255	01-80700T59	crystal and insulator

mechanical parts

	26-84898M01	circuit board shield, 6 used
	26-80299H01	fence shield AGC
	26-80199K01	second mixer side shield
	26-80198K01	low IF shield, solder side
	26-84898M01	circuit board shield
	26-83596M01	top circuit board shield, 4 used
	26-83595M01	shield detector, component side
	26-80289H01	RF shield
	46-83948M01	RF board stud, 2 used

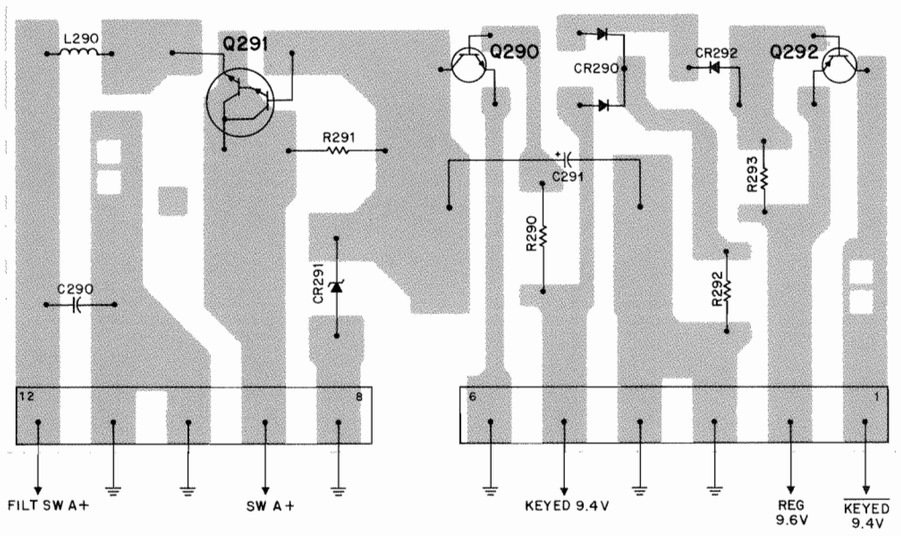
note: For best performance, order diodes, transistors, and integrated circuits by Motorola part number.

RF BOARD

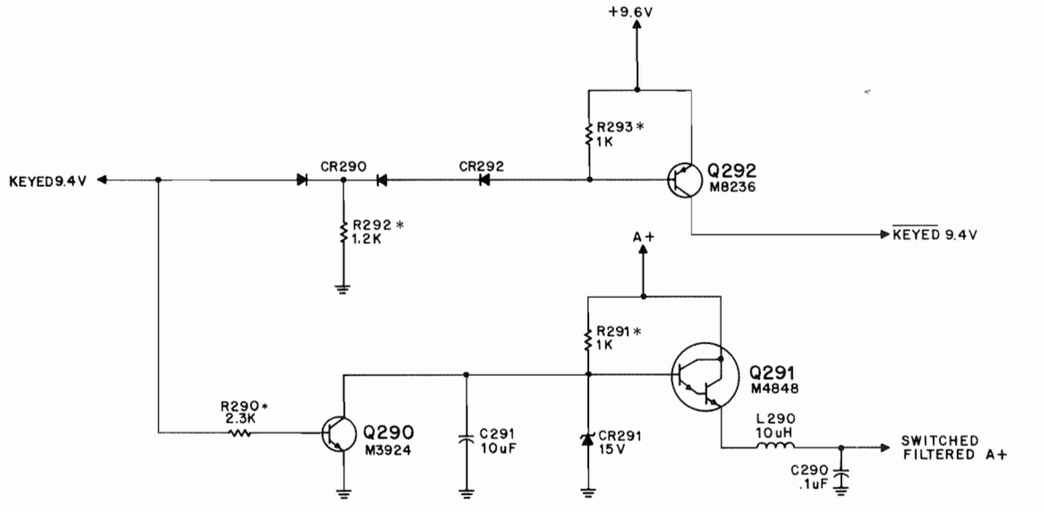


SHOWN FROM COMPONENT SIDE

RX MIXER



SUBSTRATE GCW-2015-0
OVERLAY — GCW-2016-0

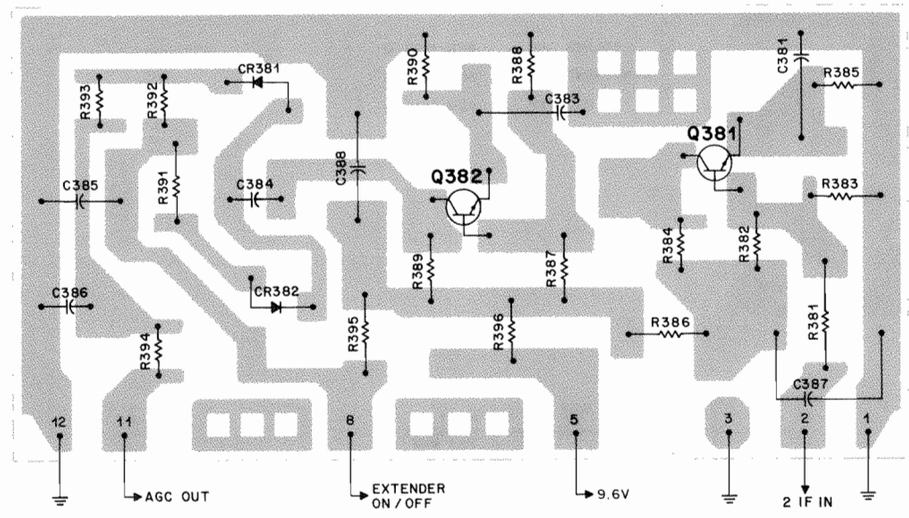


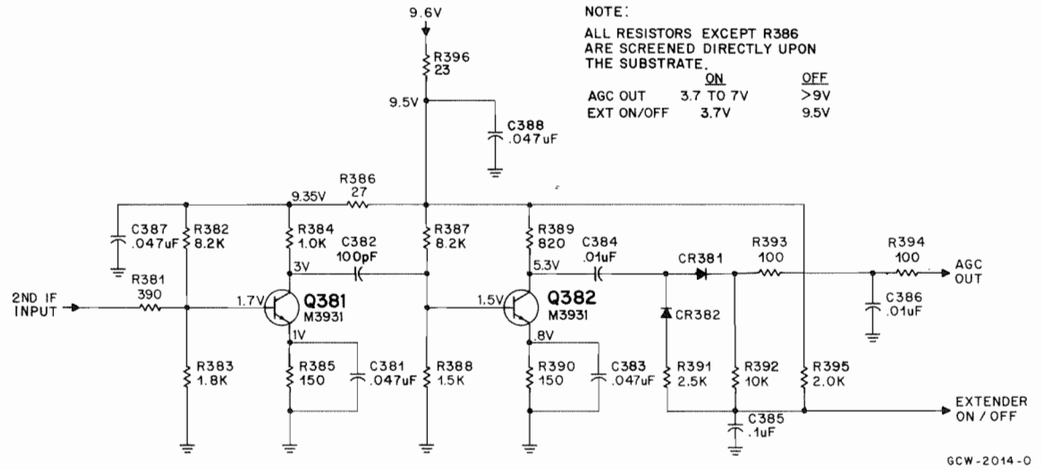
NOTE:
1. COMPONENTS MARKED WITH ASTERISK (*) ARE SCREENED DIRECTLY ON THE SUBSTRATE.

GCW-2017-0

EXTERNAL AGC AMPLIFIER

SUBSTRATE GCW-2012-0
OVERLAY — GCW-2013-0



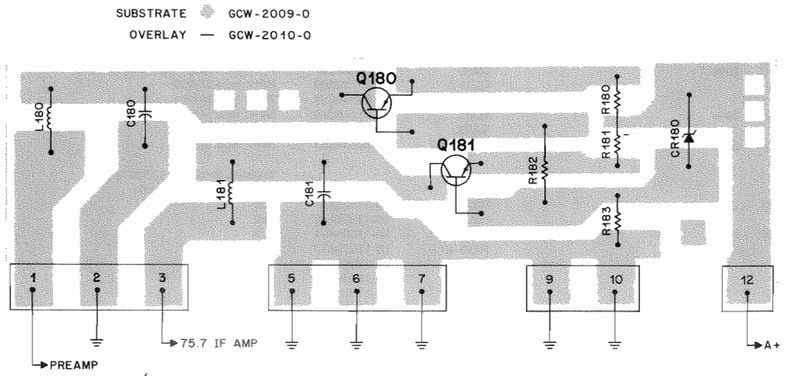


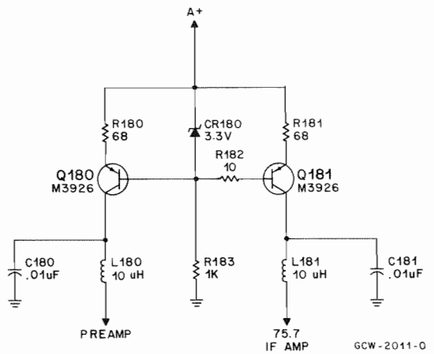
NOTE:
ALL RESISTORS EXCEPT R386 ARE SCREENED DIRECTLY UPON THE SUBSTRATE.

	ON	OFF
AGC OUT	3.7 TO 7V	>9V
EXT ON/OFF	3.7V	9.5V

GCW-2014-0

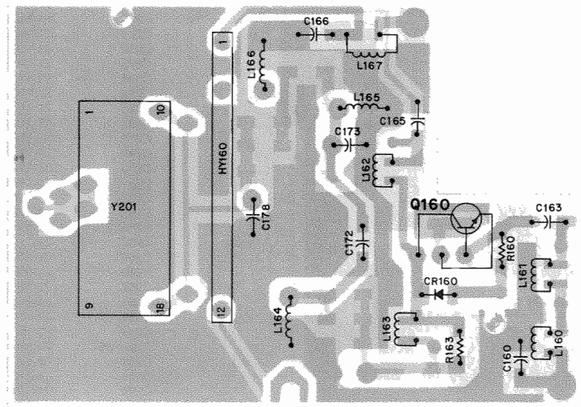
FRONT END BIAS





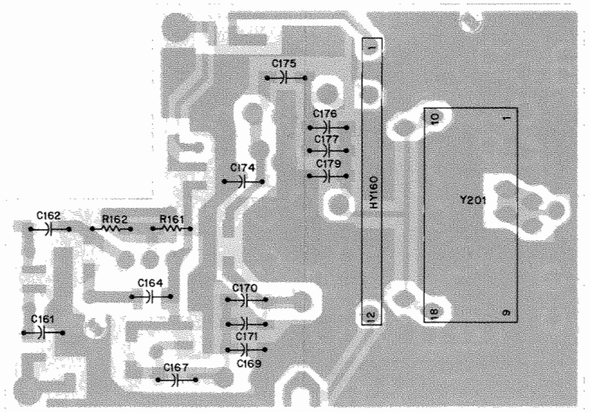
HI-IF

COMPONENT SIDE VIEW



SOLDER SIDE GEW-1900-0
COMPONENT SIDE GEW-1901-0
OVERLAY — GEW-1903-0

SOLDER SIDE VIEW



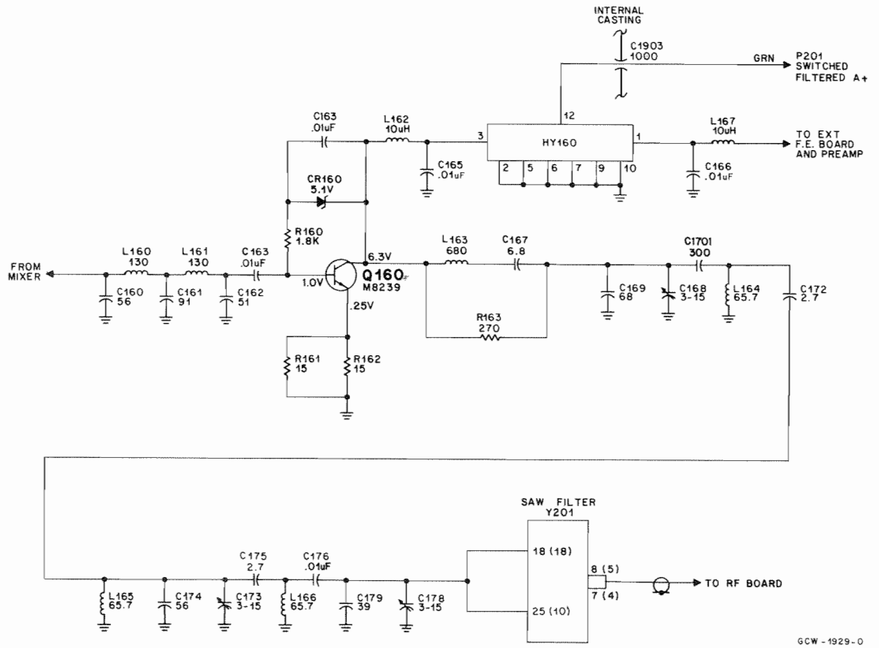
SOLDER SIDE GEW-1900-0
COMPONENT SIDE GEW-1901-0
OVERLAY — GEW-1902-0

parts list

HLB4098A High IF Board MXW-1959-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed, pF ±5%, 50V unless otherwise stated
C160	21-11031A35	68
C161	21-11031A38	91
C162	21-11031A32	51
C163–166	21-11032B07	.01 +80, −20% µF
C167	21-11031A11	6.8 ±.5
C168	01-80740T21	trimmer and insulator
C169	21-11031A35	68
C170	21-11031A50	300
C172	21-11031A06	2.7 ±.25
C173	01-80740T21	trimmer and insulator
C174	21-11031A33	56
C175	21-11031A06	2.7 ±.25
C176	21-11032B07	.01 +80, −20% µF
C178	01-80740T21	trimmer and insulator
C179	21-11031A29	39
C180, 181	21-84547A11	.01 ±20% µF
		diode (see note)
CR160	48-80056K11	zener, 5.1V ±5%
CR180	48-80056K06	zener, 3.3V ±5%
		coil
L160, 161	24-80140E06	130 nH
L162	24-80140E16	10 µH
L163	24-80140E07	680 nH
L164–166	24-11030D05	blue
L167	24-80140E16	10 uH
L180, 181	24-80140E16	10 uH
		transistor (see note)
Q160	48-80182D39	NPN, type M8239
Q180, 181	48-84939C26	PNP, type M3926
		resistor, fixed, Ω ±5%, ⅛ W unless otherwise stated
R160	06-11024A55	1.8k
R161, 162	06-11024A05	15
R163	06-11024A35	270
R182	06-11024A01	10
		filter (see note)
Y201	91-80003J01	75.5 MHz, SAW
Y201	91-80003J02	75.5 MHz, SAW (alternate part)
		mechanical parts
	26-80238K01	fence shield, high IF coil
	29-10134A89	lug terminal

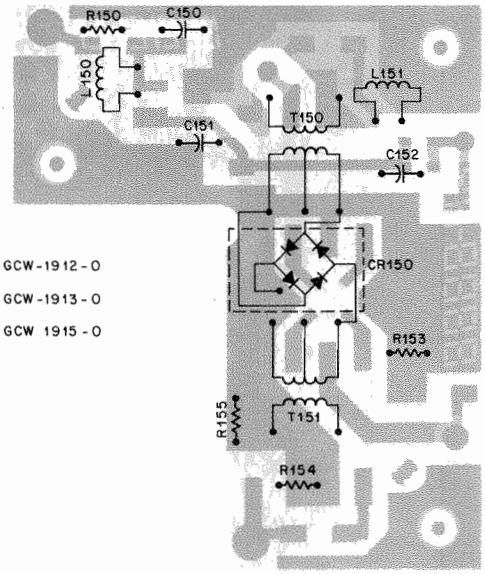
note: For best performance, order diodes, transistors, and integrated circuits by Motorola part number.



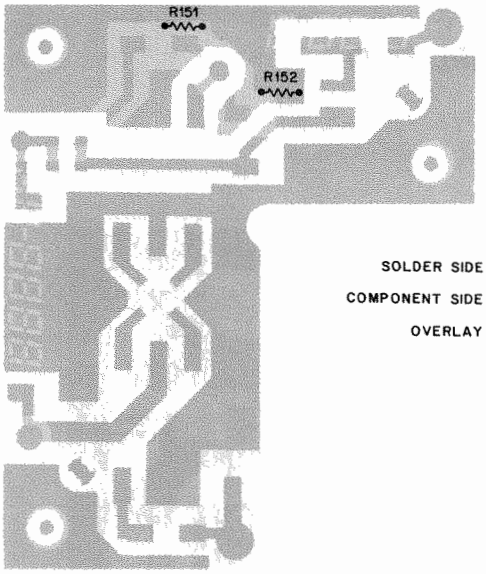
NOTE:
UNLESS OTHERWISE INDICATED, ALL RESISTANCES ARE MEASURED IN OHMS, ALL CAPACITANCES IN PICOFARADS, AND ALL INDUCTANCES IN NANOHENRIES.

RX MIXER

COMPONENT SIDE VIEW

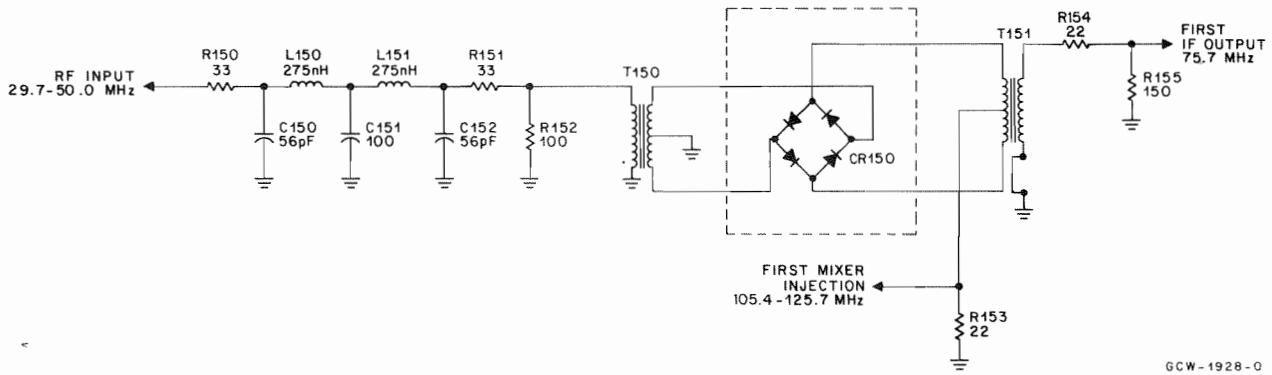


SOLDER SIDE VIEW



SOLDER SIDE GCW-1912-O
COMPONENT SIDE GCW-1913-O
OVERLAY GCW 1915-O

SOLDER SIDE GCW-1912-O
COMPONENT SIDE GCW-1913-O
OVERLAY GCW-1914-O



parts list

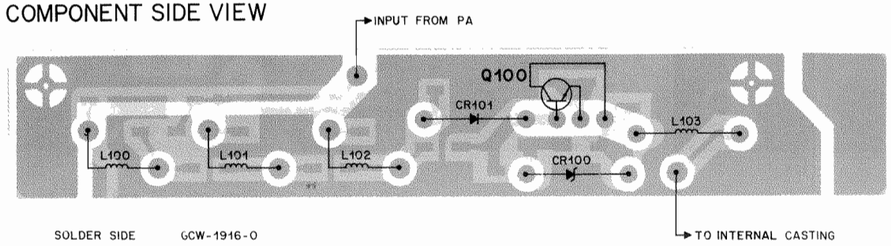
HLB4085A First Mixer Board — MXW-1698-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed, pF ±5% 50V unless otherwise stated
C150	21-11031A33	56
C151	21-11031A39	100
C152	21-11031A33	56
		diode (see note)
CR150	48-80236E09	silicon quad ring
		coil
L150, 151	24-80140E15	.275 μH
		resistor, fixed, Ω ±5%, ⅛ W unless otherwise stated
R150, 151	06-11024A13	33
R152	06-11024A25	100
R153, 154	06-11024A09	22
R155	06-11024A29	150
		transformer
T150, 151	25-80125J01	trifilar

note: For best performance, order diodes, transistors, and integrated circuits by Motorola part number.

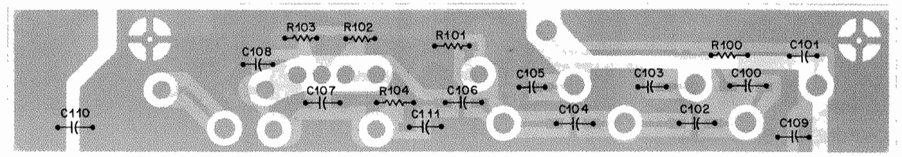
HIGH-PASS FILTER/PREAMP

COMPONENT SIDE VIEW

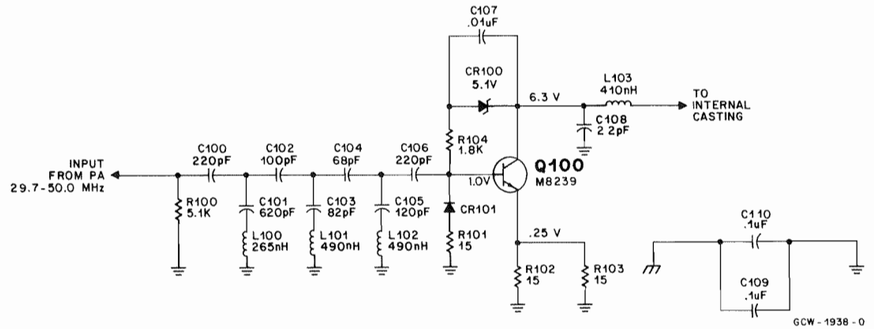


SOLDER SIDE — GCW-1916-O
COMPONENT SIDE — GCW-1917-O
OVERLAY — GCW-1919-O

SOLDER SIDE VIEW



SOLDER SIDE — GCW-1916-O
COMPONENT SIDE — GCW-1917-O
OVERLAY — GCW-1918-O



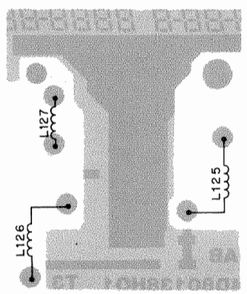
parts list

HFB4000A High-Pass Filter/Preamp Board — MXW-1960-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed, pF ±5%, 50V unless otherwise stated
C100	21-11031A47	220
C101	21-11031A58	620
C102	21-11031A39	100
C103	21-11031H22	82 ±1%
C104	21-11031A35	68
C105	21-11031A41	120
C106	21-11031A47	220
C107	21-11032B07	.01 µF +80, −20%
C108	21-11031A23	22
C109, 110	21-11032B13	.1 µF +80, −20%
		diode (see note)
CR101	48-80012E01	hot carrier
		coil
L100	24-84411B02	14.5 turns, yellow
L101, 102	24-84411B08	17.5 turns, violet
L103	24-82723H05	.41 µH, yellow
		connector plug
PO100	28-82331G01	phono
		transistor (see note)
Q100	48-80182D39	NPN, type M8239
		resistor, fixed, Ω ±5%, ⅛ W unless otherwise stated
R100	06-11024A66	5.1k
R101–103	06-11024A05	15
R104	06-11024A55	1.8k
		voltage regulator
VR100	48-80007E01	zener 5.1V

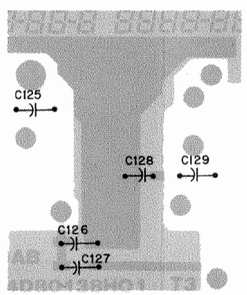
note: For best performance, order diodes, transistors, and integrated circuits by Motorola part number.

RX INJECTION FILTER



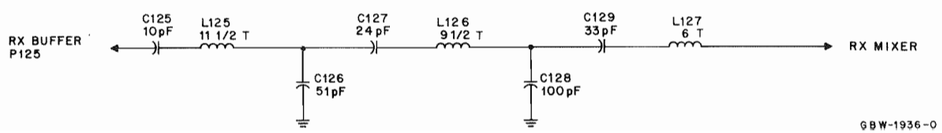
SOLDER SIDE — GBW-1904-O
COMPONENT SIDE — GBW-1905-O
OVERLAY — GBW-1907-O

COMPONENT SIDE VIEW



SOLDER SIDE VIEW

SOLDER SIDE — GBW-1904-O
COMPONENT SIDE — GBW-1905-O
OVERLAY — GBW-1906-O



parts list

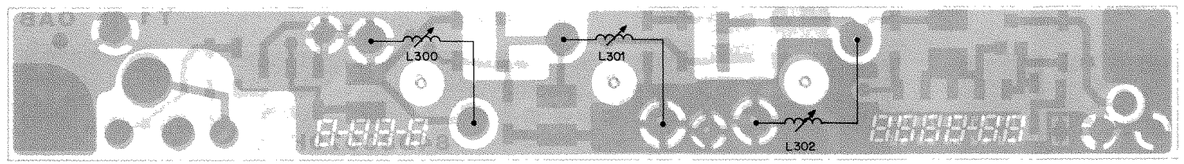
HFB4001A Receive Injection Filter Board — MXW-1958-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed, pF ±5%, 50V unless otherwise stated
C125	21-11031A15	10 ±.5
C126	21-11031A32	51
C127	21-11033B22	24, 100V
C128	21-11031A39	100
C129	21-11031A27	33
		coil
L125	24-84411B03	11.5 turns, brown
L126	24-83884G05	9.5 turns, white
L127	24-11030D05	6 turns, blue

note: For best performance, order diodes, transistors, and integrated circuits by Motorola part number.

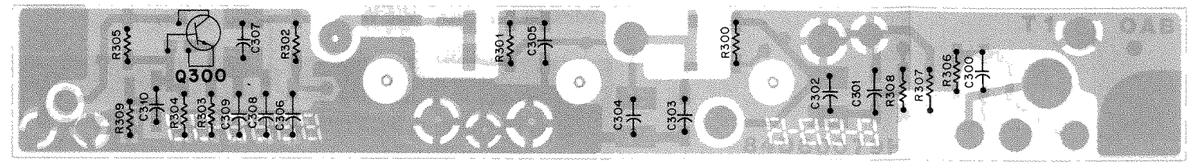
Schematics, Circuit Board Diagrams, and Parts Lists for Receiver
PEW-1692-O
(Sheet 4 of 4)
8/28/85

EXTENDER FRONT END



COMPONENT SIDE VIEW

SOLDER SIDE — GDW-1895-O
COMPONENT SIDE — GDW-1896-O
OVERLAY — GDW-1898-O



SOLDER SIDE VIEW

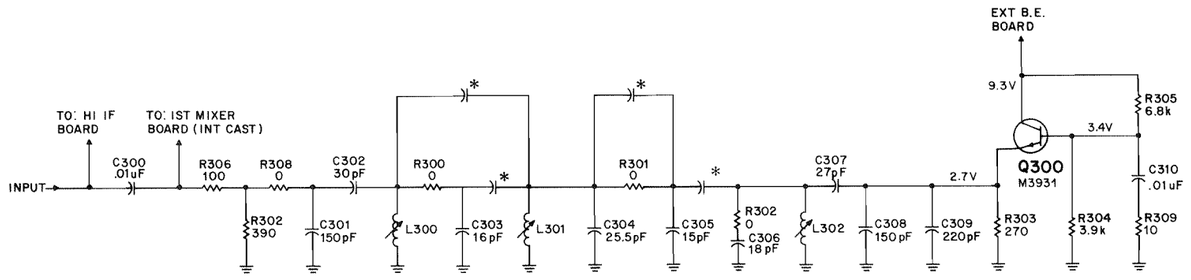
SOLDER SIDE — GDW-1895-O
COMPONENT SIDE — GDW-1896-O
OVERLAY — GDW-1897-O

parts list

HLB4090A Extender Front End Board — MXW-1962-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed, pF ±5%, 50V unless otherwise stated
C300	21-11032B07	.01 µF +80, −20%
C301	21-11031A43	150
C302	21-11033B24	30, 100V
C303	21-11031A20	16
C304	21-11059C10	25 ±2%
C305	21-11031A19	15
C306	21-11031A21	18
C307	21-11033B23	27, 100V
C308	21-11031A47	220
C309	21-11031A43	150
C310	21-11032B07	.01 µF +80, −20%
		coil
L300–302	24-80068A05	9 turns, adjustable
		transistor (see note)
Q300	48-84939C31	NPN, type 39C31
		resistor, fixed, Ω ±5%, ⅛ W unless otherwise stated
R300–302	06-11024B23	jumper
R303	06-11024A35	270
R304	06-11024A63	3.9k
R305	06-11024A69	6.8k
R306	06-11024A55	100
R307	06-11024A39	390
R308	06-11024B24	jumper
R309	06-11024A01	10
		mechanical part
W320	30-83361G01	1½″ coax

note: For best performance, order diodes, transistors, and integrated circuits by Motorola part number.



NOTES:

1. (*) INDICATES AREA CAPACITOR
2. COIL ORIENTATION IMPORTANT

GCW-1937-O

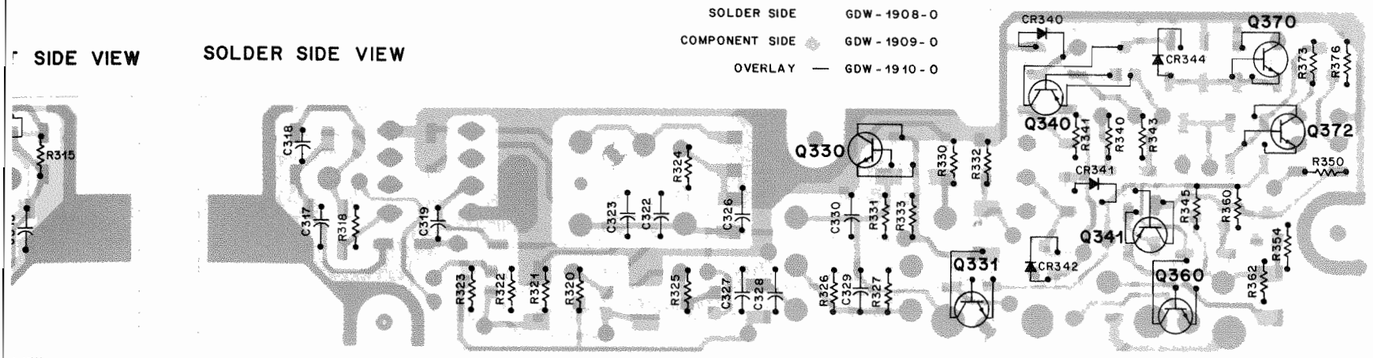
Schematics, Circuit Board Diagrams, and Parts Lists for Extender
PEW-2191-O
(Sheet 1 of 2)
8/28/85

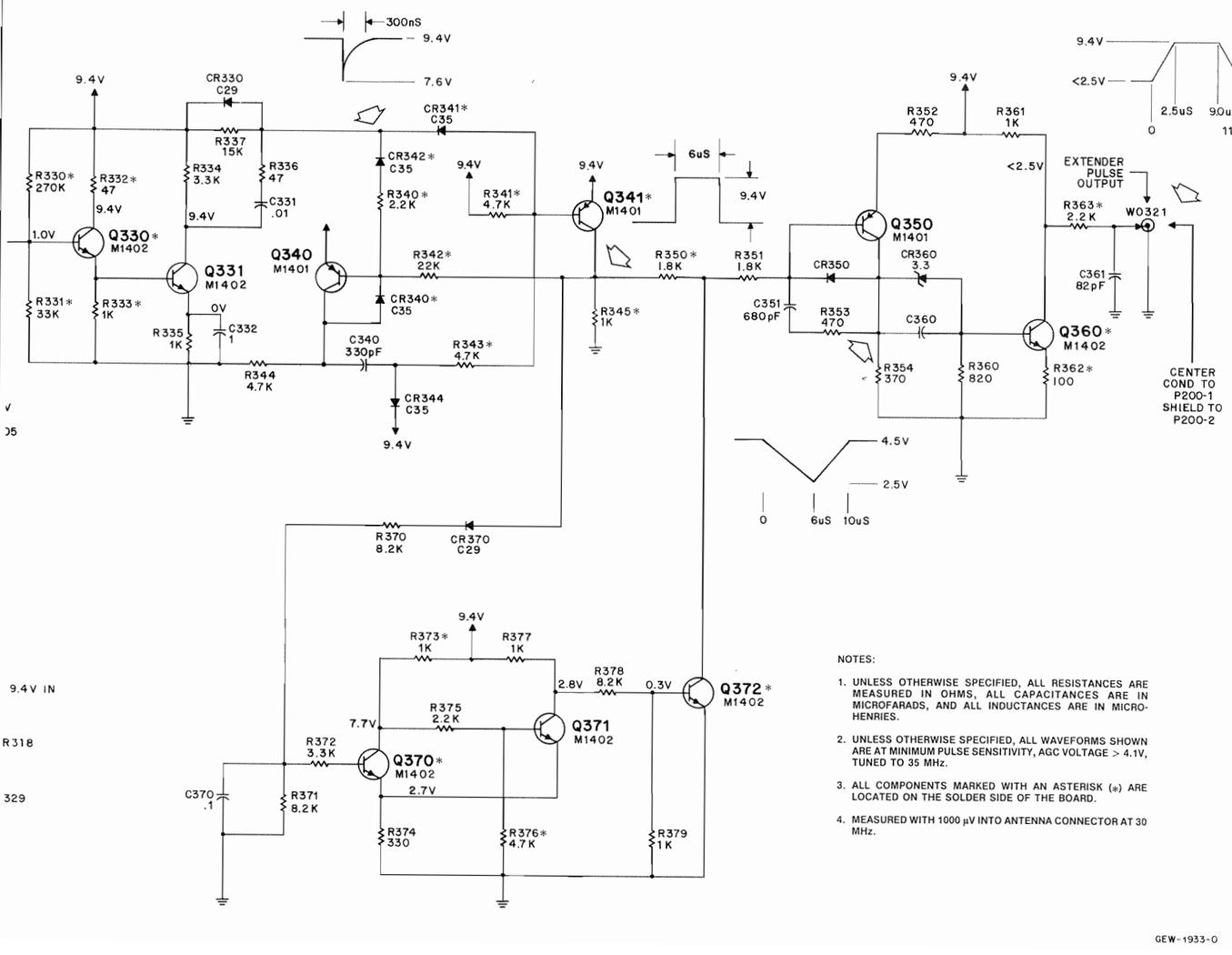
EXTENDER BACK END

SOLDER SIDE — GDW-1908-O
COMPONENT SIDE — GDW-1909-O
OVERLAY — GDW-1910-O

SIDE VIEW

SOLDER SIDE VIEW





NOTES:

1. UNLESS OTHERWISE SPECIFIED, ALL RESISTANCES ARE MEASURED IN OHMS, ALL CAPACITANCES ARE IN MICROFARADS, AND ALL INDUCTANCES ARE IN MICROHENRIES.
2. UNLESS OTHERWISE SPECIFIED, ALL WAVEFORMS SHOWN ARE AT MINIMUM PULSE SENSITIVITY, AGC VOLTAGE > 4.1V, TUNED TO 35 MHz.
3. ALL COMPONENTS MARKED WITH AN ASTERISK (*) ARE LOCATED ON THE SOLDER SIDE OF THE BOARD.
4. MEASURED WITH 1000 μV INTO ANTENNA CONNECTOR AT 30 MHz.

GEW-1933-O

parts list

HLB4091A Extender Back End Board — MXW-1961-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed, pF ±5%, 50V unless otherwise stated
C315–319	21-11032B07	.01 μF +80, −20%
C321	20-82399D07	15–60 pF, variable, 200V
C322, 323	21-11031A23	22
C324, 325	23-84677D06	1 μF ±10%, 20V, tantalum
C326	21-11032B07	.01 μF +80, −20%
C327	21-11031A19	15
C328	21-11031A39	100
C329	21-11032B07	.01 μF +80, −20%
C330	21-11031A32	51
C331	21-11032B07	.01 μF +80, −20%
C332	23-84677D06	1 μF ±10%, 20V, tantalum
C340	21-11031A51	330
C351	21-11031A59	680
C360	23-84677D06	1 μF ±10%, 20V, tantalum
C361	21-11031A37	82
C370	21-11032B13	.10 μF +80, −20%
C371, 372	23-84677D06	1 μF ±10%, 20V, tantalum
		diode (see note)
CR330	48-84939C29	silicon
CR340–342	48-84939C35	hot carrier
CR344	48-84939C35	hot carrier
CR350	48-84939C35	hot carrier
CR360	48-82256C26	zener, 3.3V
CR370	48-84939C29	silicon
		jumper
JU320	06-11009B23	jumper
		coil
L315	24-80140E01	1.2 μH
L320	24-84411B08	500 nH
L321, 322	24-80140E02	1.8 μH
L323	24-80140E16	10 μH
L370	24-82549D27	470 μH
		transistor (see note)
Q320–322	48-80214G01	PNP, type M3906
Q330, 331	48-80214G02	NPN, type M3904
Q340, 341	48-80214G01	PNP, type M3906
Q350	48-80214G01	NPN, type M3906
Q360	48-80214G02	PNP, type M3904
Q370–372	48-80214G02	PNP, type M3904

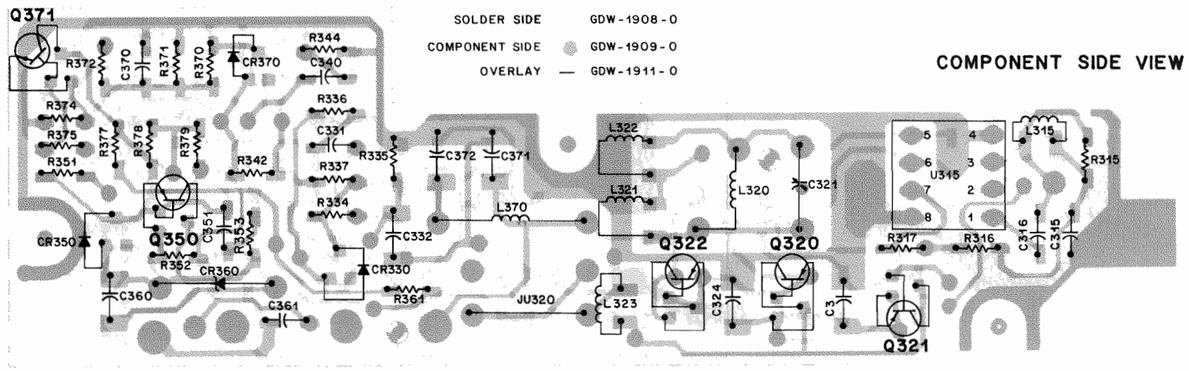
MXW-1961-O (2)

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		resistor, fixed, Ω ±5%, ⅛ W unless otherwise stated
R315	06-11024A41	470
R316	06-11024A11	27
R317	06-11024A01	10
R318	06-11024A71	8.2k
R320, 321	06-11024A71	8.2k
R322, 323	06-11024A35	270
R324	06-11024A18	51
R325	06-11024A71	8.2k
R326	06-11024A65	4.7k
R327	06-11024A89	47k
R330	06-11024B08	270k
R331	06-11024A85	33k
R332	06-11024A17	47
R333	06-11024A49	1k
R334	06-11024A61	3.3k
R335	06-11024A49	1k
R336	06-11024A17	47
R337	06-11024A77	15k
R340	06-11024A57	2.2k
R341	06-11024A65	4.7k
R342	06-11024A81	22k
R343	06-11024A65	4.7k
R345	06-11024A49	1k
R350, 351	06-11024A55	1.8k
R352–354	06-11024A41	470
R360	06-11024A47	820
R361	06-11024A49	1k
R362	06-11024A25	100
R363	06-11024A57	2.2k
R370, 371	06-11024A71	8.2k
R372	06-11024A61	3.3k
R373	06-11024A49	1k
R374	06-11024A37	330
R375	06-11024A57	2.2k
R376	06-11024A65	4.7k
R377	06-11024A49	1k
R378	06-11024A71	8.2k
R379	06-11024A49	1k
		integrated circuit (see note)
U315	51-84320A22	amplifier
		mechanical parts
W0321	01-80736T37	cable and connectors
	26-80121A01	shield can

note: For best performance, order diodes, transistors, and integrated circuits by Motorola part number.

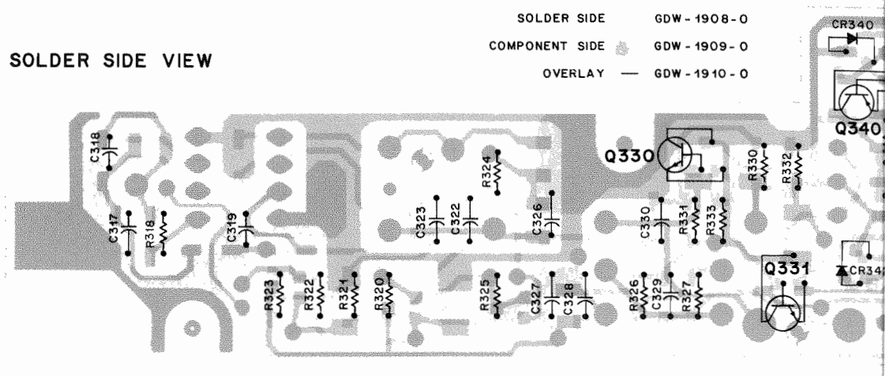
Schematics, Circuit Board Diagrams, and Parts Lists for Extender
PEW-2191-O
(Sheet 2 of 2)
8/28/85

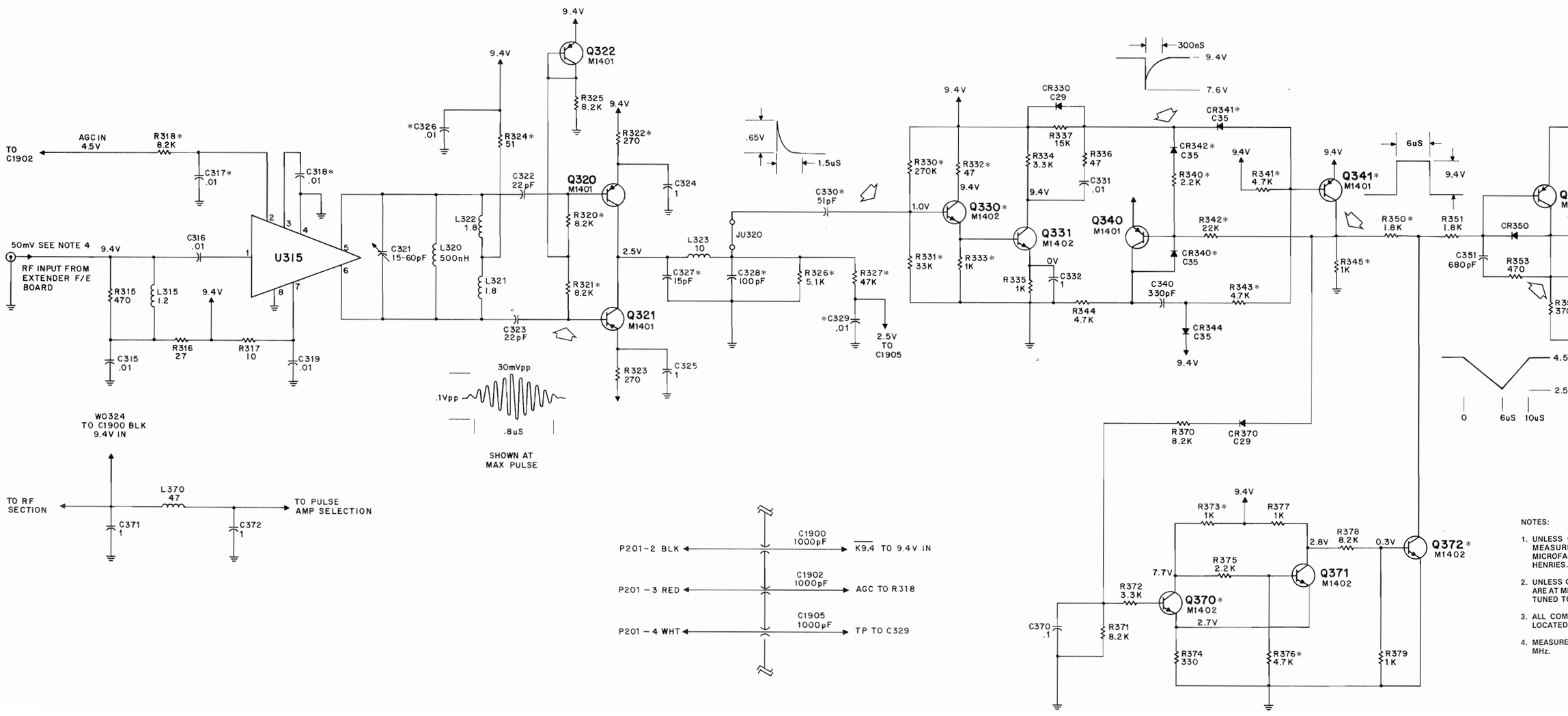
EXTENDER BACK END



COMPONENT SIDE VIEW

SOLDER SIDE VIEW





NOTES:

1. UNLESS OTHERWISE S MEASURED IN OHM MICROFARADS, AND A HENRIES.
2. UNLESS OTHERWISE SI ARE AT MINIMUM PULSE TUNED TO 35 MHz.
3. ALL COMPONENTS MA LOCATED ON THE SOL
4. MEASURED WITH 1000 MHz.