HAMTRONICS® RWX WEATHER BROADCAST RECEIVER: INSTALLATION, OPERATION, AND MAINTENANCE INSTRUCTIONS

GENERAL INFORMATION.

The RWX is a very sensitive and selective receiver to monitor critical broadcasts from NOAA/NWS or Environment Canada. You can depend on it for demanding applications requiring reliability and superior reception.

Excellent 0.15µV sensitivity provides good reception even at distances of 70 miles or more with suitable antenna. No comparison with ordinary consumer radios or scanners!

Automatic mode provides storm watch, keeping quiet normally, but alerting you by unmuting receiver and providing an output to trip remote equipment when the weather station broadcasts an alert tone. **STORM WATCH** LED indicates that receiver is actively monitoring for warnings. Listen mode allows you to manually unmute receiver anytime to get up to date on weather conditions and then reset the automatic alerting circuit when done.

The RWX Receiver is small enough for emergency or portable use, and it can be powered from a small 9-12V battery when needed. The receiver uses crystal control for accuracy, and all 7 channels are provided, including the new split channels. An internal switch allows you to select whichever channel you receive best from your location.

INSTALLATION.

Mounting.

The RWX pc board can be mounted to a chassis with 4-40 screws and standoffs. See A26 Mounting Kit on our website for an example.

Power Source.

The RWX Receiver is designed to operate on +9 to +15Vdc. It requires about 40 mA of current with no audio output and up to 100 mA with audio turned all the way up.

Ideally, the Receiver only needs 12Vdc. You can operate from any 12Vdc regulated power supply if you wish.

The power supply wires should be soldered to terminals on the pc board. Stranded wire is best for the power supply connections, and #18 AWG wire works well. The leads from the power supply should be as short as possible, less than 3 feet. Be sure to observe polarity to avoid damage to the unit. Solder the positive wire to E6 and the negative wire to E7. Solder to the pads on the BOTTOM of the board to avoid shorts to the ground plane.

WARNING: Reverse polarity will damage the receiver. Also, be sure that the power source does not carry high voltage or reverse polarity transients on the line, since semiconductors in the receiver can be damaged.

If you want to have a backup source of power so the receiver operates during power outage emergencies, the easiest method is to operate the receive all the time from a 12Vdc storage battery with a trickle charger connected to it. If the power fails, the battery will continue to provide operation for many hours.

Antenna.

The success of reception is dependent on having a good antenna. The RWX Receiver is very sensitive, and you can receive stations from long distances – up to 70 miles or more with a suitable antenna and feedline.

If you want to receive local stations, you may do so with a very modest antenna. A short length of wire may be used for stations within 10 miles, about 18 inches is ideal. For medium distances, you probably need to install a rooftop antenna; and scanner radio antennas, such as a ground plane antenna, may be a good choice. For long distances, a directional Yagi-type antenna would be best to get some gain in the direction of the station you seek.

Good quality, low-loss 50Ω coax should be used as a feedline. The coax should be stripped to pigtails (no longer than 3/8 inch) and soldered to terminals E8 (hot) and E9 (shield) on the rear of the board. Solder to the pads on the BOTTOM of the board to avoid shorts to the ground plane.

It is convenient to have a connector on the rear of the chassis so you can unplug the coax and use heavy gauge cable. To do so, mount the jack on the chassis and use a solder lug on one ground screw inside the cabinet. Run a short length of miniature coax (such as the RG-174/u cable we sell on our website) from the pc board to the connector on the chassis. Keep the stripped pigtails of the coax as short as possible to minimize losses.

Alarm Output.

If you have the receiver in the AUTO mode, the receiver is quiet until the station sends an alert tone. At that time, the receiver is unmuted so you can hear the message and an ALARM signal appears at Alarm output terminal E1 on the pc board. This allows remote equipment to be activated in the event of a weather alert. This could be an audible alarm device or something like the alarm feature on our REP-200 Repeater.

The receiver's alarm output circuit is an open collector npn switching transistor, which is capable of sinking up to 50 mA of current when active, with a positive voltage supply of up to 15Vdc. This is referenced to pc board ground, accessible at E2. Refer to schematic diagram for a better understanding.

If you have a use for the alarm output, because of the low voltage and current, you can wire it to your external circuit with any length of light gauge wire, such as #22 wire or telephone type cable. If you connect this output to an inductive device, such as a relay coil, be sure to connect a diode across the coil with reverse polarity to absorb any inductive surge when the circuit is turned off. Otherwise, the high transient voltage may damage semiconductors in the receiver.

Solder the wires for your external alarm circuit to terminals E1 and E2 on the pc board.

Remote Reset Modification.

Normally, the alarm circuit is reset manually with the front panel RESET

Table 1. Specifications of RWX Receiver

Channels supplied: 162.400, 162.425, 162.450, 162.475, 162.500, 162.525, 162.550. Crystal controlled, selected by DIP switch.
Sensitivity: 0.15µV for 12dB SINAD
Selectivity: ±10kHz @ -6dB, ±20kHz @ -70dB
Audio output: 2W (8Ω load).
Operating Power: 9-15Vdc @ 40-100 mA.
Size: PCB excluding controls, connectors: 3.5 x 3.5 inches.
RF Input: 50Ω, solder terminals on pcb.
Alarm Output: Open collector npn transistor, can sink up to 50 mA at up to 15Vdc.

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switch. When you no longer need to listen to the message, momentarily push the toggle switch to the RESET position to reactivate the Storm Watch feature of the receiver and mute the speaker until the next alert tone is received for another event.

If you have a need to reset the alarm circuit by remote control, you could add a small PNP switching transistor to perform the function normally done by the toggle switch. Refer to the schematic diagram. The emitter of the transistor should connect to the +8Vdc terminal of the switch and the collector should be connected to the center lug of the switch. The base should connect through about a 10K resistor to the external reset contacts, which should return to ground. Pulling the resistor to ground will turn on the transistor to reset the receiver just as the toggle switch on the front panel does.

Speaker.

Terminal pads E4 and E5 provide connections for a speaker. You can make the external speaker connections with any length of light gauge wire, such as #22 wire. E2 and E3 provide an extra set of terminals if you need another output for EAS system, etc. The two audio outputs are simply connected in parallel, and you can use either or both.

OPERATION.

General.

Operation of the receiver is fairly obvious, but we will comment on several features of interest.

The RWX is a very sensitive and selective receiver to monitor broadcasts from NOAA/NWS or Environment Canada. Excellent 0.15µV sensitivity provides good reception even at distances of 70 miles or more with a suitable antenna. Although a simple piece of wire can provide good reception of nearby stations, an outdoor antenna is required for good reception of distant stations.

Automatic Mode .

This mode, with the toggle switch in the center position, provides a storm watch, keeping quiet normally, but alerting you by unmuting the receiver and providing an output to trip remote equipment when the weather station broadcasts an alert tone. To put the receiver in the automatic mode, momentarily press the handle of the toggle switch to the RESET position (to the left) and let it return to the center AUTO position.

In this mode, the STORM WATCH LED indicates that receiver is actively monitoring for warnings, even though you don't hear anything.

Listen Mode.

This feature allows you to manually unmute receiver anytime to get up to date weather conditions. Simply set the toggle switch to the LISTEN position (to the right) to hear. When done, you can reset the automatic alerting feature by momentarily setting the toggle switch to the left to RESET.

Channel Selection.

The receiver uses crystal control for accuracy, and all 7 channels are provided. A dip switch allows you to select whichever channel you receive best from your location. Since you normally listen only to the nearest weather broadcast station, and to keep crystal wiring from affecting performance, we elected not to design the unit with a front panel switch.

The first time you use the unit, set the switch for the desired channel. If you already know the frequency of the station serving your area, you can simply set the switch for that channel. If you don't know or you want to experiment, you can turn on one channel at a time.

The DIP switch is at the right rear of the pc board, just in front of the channel crystals. The channels are numbered 1 through 7 on the switch, and table 2 relates the frequency of each channel. The switch is marked to indicate which way to depress each switch lever for ON and OFF. You can use a tool, such as a pencil point or toothpick, to aid in setting the switch.

Do not turn on more than one channel at a time as results are unpredictable. You will not harm the unit; however, it may not operate properly.

Table 2. Channel Frequencies

Switch Position	Channel Frequency
1	162.400
2	162.425
3	162.450
4	162.475
5	162.500
6	162.525
7	162.550

Volume Control.

The VOLUME control operates as you might expect, setting the loudness of the local or external speaker. When the receiver is muted in the AUTO mode, of course, it has no function, although if turned very loud, a small level of audio might be heard even when muted.

☹ *Caution: The audio output stage is rated at 1W with a speaker having an impedance of 8Ω or higher. To avoid damage from overheating, do not run into loads below 8Ω or run at very high audio levels for extended periods.*

Audio Quality.

We have noticed, at least on our local station, that the audio heard is not what you would consider high fidelity quality. It sometimes has minor distortion due to the heavy processing through remote phone lines from distant weather service offices, digital recording techniques, and heavy clipping by the limiter in the transmitter.

However, we should mention that all crystals age, meaning the frequency changes slightly over a period of years. Therefore, minor realignment of the crystal oscillator circuit is considered normal routine maintenance every few years for best results, as is expected for any radio communications equipment. If distortion increases after a number of years, the oscillator should be checked as follows.

Testing Automatic Mode.

The National Weather Service provides test transmissions of its alert tone periodically which you can use to verify that your receiver is responding. For instance, in our area, they test every Wednesday morning. They normally announce on the air ahead of time that they will be testing that day so you know enough to set the receiver to the Automatic mode to test it. Although the time in your area may be different, you should be able to test your receiver in this fashion periodically. If necessary, you can call your local office to find out when they do tests.

ALIGNMENT.

Equipment needed for alignment is an rf signal generator and a sensitive dc voltmeter. (Analog meters are easier to use for tuning than digital meters.)

Slug tuned coils should be adjusted with the proper .062" square tuning tool to avoid cracking the powdered iron slugs. See A28 Tuning Tool in catalog.

The variable capacitor and the i-f transformer should be adjusted with a plastic tool with a small metal bit on the

end. See A2 Tuning Tool in catalog.

a. Connect power and speaker to appropriate terminals on the pc board if 12Vdc adapter and internal speaker are not used.

b. Apply power, and set VOLUME control for a comfortable listening level.

c. Turn on the DIP switch section for the channel you expect to use. Be sure all other sections are turned off so only the desired channel is activated.

d. Connect dc voltmeter to oscillator test point TP-1, which is the top lead of R8 (near L7). Alternately adjust L6 and L7 for maximum dc voltage. (Typical indication is roughly +1.5 to 2.5Vdc.)

e. Connect stable signal generator to 10.7 MHz test point TP-3, the top lead of R4 (below coil L4). Use a coax clip lead and a .01 µf disc capacitor to block the dc. Connect coax cable shield to pcb ground. Set generator to exactly 10.700 MHz. (Use a frequency counter or synthesized signal generator to obtain accuracy.) Set the signal generator level high enough to provide a full quieting signal. No modulation is needed.

f. Connect dc voltmeter to test point TP-2, which is the top of R17 (near U2). Adjust discriminator coil T1 for +3.3V.

g. Connect signal generator to E8 and E9.

h. Adjust signal generator to exact frequency of the channel you selected with the DIP switch. Turn output level up fairly high. Adjust frequency trimmer capacitor C13 (next to DIP switch) to fine tune the crystal to channel frequency, indicated by 3.3V at test point TP-2.

☺ ***Note****: To adjust the mixer and front end, you can use one of three methods to indicate improvement in the signal-to-noise ratio. When tuning with a relatively weak input signal, improvement in tuning will have the same effect as increasing the signal generator level, namely, the noise level will drop.*

The easiest method is using a professional SINAD meter with a 60% modulated tone signal. If you do not have such equipment available, you can also use a sensitive ac voltmeter or oscilloscope to monitor the noise level at the speaker and look for a decrease in noise voltage as tuning proceeds. If you don't have either meter or scope available, you can even tune by ear.

In any case, it is necessary to keep the signal generator output adjusted to a moderately weak signal so that you have some noise left to tune with. As tuning progresses, turn the attenuator down so you continue to have a relatively weak signal.

A convenient place to connect the probe for the meter is E3 along the right edge of the pc board.

Note that once the receiver is nearly tuned, you may have interference from the broadcast signal if the station is nearby. If this is a problem, select another channel to use for peaking the coils and then change back after alignment.

i. Set signal generator attenuator for relatively weak signal. Peak coils in the following order, and then repeak them, working out any interactions between them.

- Do L9 first, because it benefits most from tuning.
- Then, do L8 and L9.
- Then, do L2, L3, and L4.

When properly tuned, the sensitivity should be about 0.15µV for 12dB SINAD and about 0.25µV for 20dB quieting.

j. This completes alignment. If you purchased the unit as a kit and have not already done so, you can now install the pc board in its cabinet.

MAINTENANCE.

Theory of Operation.

Refer to the schematic diagram. The vhf signal from the antenna is amplified by low-noise dual-gate fet Q1. Antenna impedance matching is provided by the tuned circuit at the input of Q1, and rf choke L1 is a static drain. A double-tuned output tank circuit with L3 and L4 provides image rejection and rejection of interference from out of band signals. First mixer Q2 converts the 162.xxx MHz signal to the 10.7 MHz i-f, and ceramic filter FL1 passes the i-f signal to i-f amplifier ic U1.

The injection signal for the first mixer is obtained from crystal oscillator Q3, and one of seven channel crystals is selected by DIP switch S1. The 16.xxx MHz signal from the selected oscillator is tripled once in the double-tuned tank circuit at the collector of the oscillator (L6-L7) to the 50.5xx MHz range. This frequency is tripled again in tripler Q9, with double-tuned tank circuit L8-L9, to the 151.7xx MHz range.

The 10.7 MHz first i-f signal is further processed in i-f amplifier ic U1. Pins 1 and 2 form a 10.245 MHz oscillator. This signal is used in the second mixer within the ic to convert the input signal at pin 16 to 455 kHz at pin 3. A narrow band ceramic filter between pins 3 and 5 provides adjacent channel selectivity. Regulated 8Vdc power is applied to the ic at pin 4. The 455 kHz i-f signal is converted to audio by a quadrature detector at pins 6-8. Quadrature coil T1 sets the center frequency of the detector, and resistor R16 sets the modulation acceptance bandwidth.

It is important to note that all the circuits along the bottom of the ic on the schematic are referenced to B+ bus and not to ground. C28 is a master bypass capacitor which ties this B+ bus to ground all at one point. C26 and C27 bypass parts of the internal circuitry in the detector.

The signal path continues right to left across the top of U1 on the schematic. Detected audio or white noise at pin 9 is applied to the VOLUME control through blocking capacitor C33 and de-emphasis network R17/C32.

The NWS standard alert tone is 1050 Hz for a duration of 10 sec ±1 second. Inside the ic, there is an op amp between pins 10 and 11 which acts as an active bandpass filter peaked at 1050 Hz. The active filter is formed by R15, R14, R11, C29, and C30. The output of this stage is ac coupled through C31 to tone detector D1. When a tone is received at the proper frequency and amplitude, the resulting negative voltage pulls down the positive voltage from R13, and the transistor circuit between pins 12 and 14 is turned on. Feedback through R13 causes the circuit to stay on until reset by S2.

The result of tripping the tone alarm circuit is twofold. First, the output of ic pin 14 controls Q6, which mutes the audio at the VOLUME control. This signal also operates Q7 to turn on STORM WATCH led D2. Second, the output of ic pin 13 controls Q5, the output transistor for the external alarm circuit.

Audio from the VOLUME control is applied to the internal and external speaker outputs through audio power amplifier U2.

Dc power for all stages other than the audio output amplifier is regulated at 8Vdc by U3. Power for the receiver can be any source of filtered dc in the range of 9 to 15V.

Crystals.

Table 3 shows the normal complement of crystals installed in the receiver. However, it is possible to install crystals for other frequencies, providing they are close to the normal operating range of the receiver. We can provide crystals for any other frequencies you may want.

If you order your own crystals, be sure to order only close-tolerance commercial grade crystals, and supply the following specs. The receiver uses 30 pF parallel resonant crystals in HC-49/u holders. Crystals operate in fundamental mode at a frequency of (F-10.7)/9. Frequency tolerance is .0005%.

Table 3. Crystal Frequencies

Channel Frequency	Crystal Frequency
162.400	16.855,556
162.425	16.858,333
162.450	16.861,111
162.475	16.863,888
162.500	16.866,667
162.525	16.869,444
162.550	16.872,222

Frequency Adjustment.

Crystals normally age. Although the amount of long-term frequency drift due to aging is usually less than 500Hz/year at the channel frequency, it is normal for any communications equipment to check the frequency of the channel oscillator once two years to see if it is necessary to trim it back on frequency.

To do the checks and adjustments, refer to steps (e.) through (h.) of the ALIGNMENT procedure, found earlier in the manual.

Troubleshooting.

The usual troubleshooting techniques of checking dc voltages and signal tracing work well in troubleshooting the receiver. DC voltage charts and a list of typical audio levels are given to act as a guide to troubleshooting. Although voltages may vary widely from set to set and under various operating and measurement conditions, the indications may be helpful when used in a logical troubleshooting procedure.

Signal Tracing.

If the receiver is completely dead, try a 10.700 MHz signal applied to test point TP-3 (the top lead of R4) with a coax cable clip lead and a .01µf blocking capacitor. You should be able to hear the quieting effect of a 4µV carrier at 10.700 MHz. (If you have a SINAD meter, the 12 dB SINAD sensitivity should also be about 4µV.) Also, check the 10.245 MHz oscillator with a scope or by listening with an hf receiver or service monitor.

A signal generator on the channel frequency can be injected at various points in the front end. If the mixer is more sensitive than the rf amplifier, the rf stage is suspect. Check the dc voltages looking for a damaged fet, which can occur due to lightning damage or due to voltage transients or reverse polarity on the dc power line. It is possible to have the input gate (gate 1) of the rf amplifier fet damaged by high static charges or high levels of rf on the antenna line with no apparent change in dc voltages, since the input gate is normally at dc ground.

If audio is present at the VOLUME control but not at the speaker, the audio ic may have been damaged by reverse polarity or a transient on the B+ line. This is fairly common with lightning damage. If no audio is present on the VOLUME control, the muting circuit may not be operating properly. Check Q6 and the voltages at U1 pins 12, 13, and 14.

Current Drain.

Dc current drain normally is about 40 mA with VOLUME control turned down or audio muted and up to 100 mA with full audio output.

If the current drain is approximately 100 mA with no audio output, check to see if voltage regulator U3 is hot. If so, and the voltage on the 8V line is low, there is a short circuit on the +8Vdc line somewhere and U3 is limiting the short circuit current to 100mA to protect the receiver board. If you clear the short circuit, the voltage should rise again. U3 should not be damaged by short circuits on its output line; however, it may be damaged by reverse voltage or high transient voltages. To track down short circuits, you can temporarily disconnect various ferrite beads to isolate parts of the circuitry.

Test Point Indications.

Tables 4 and 5 indicate voltages typical of those found at the built-in test points used for alignment. They can vary considerably without necessarily indicating a problem, however; so use with other findings to analyze problems, don't jump to conclusions.

Typical Dc Voltages.

The dc levels shown in tables 6 and 7 were measured with an fet voltmeter on a sample unit with 12 Vdc power applied. All voltages may vary considerably without necessarily indicating trouble. The chart should be used with a logical troubleshooting plan.

All voltages are positive with respect to ground except as indicated. Voltages are measured with no signal applied but with crystals installed and oscillators running properly and with audio circuits unmuted unless otherwise specified.

Table 4. Oscillator Test Point TP-1

Approx. +1.5 to 2.5Vdc with oscillator running and output tuned circuits aligned. Varies as L6 and L7 are aligned. 0Vdc with oscillator not running or coils not properly aligned.

Table 5. Discriminator (Freq. Adj.) TP-2

Varies with frequency of input signal. Voltage at this point normally adjusted for +3.3Vdc with a signal exactly on frequency. Can vary a little without being a problem.

Table 6. Transistor Measurements

Xstr	Condition	E(S)	B(G1)	C(D)	G2
Q1		0	0	8	4
Q2		0	0	8	0
Q3	oscillating	2.7	2.4	8	-
	not osc.	1.8	2.5	8	-
Q4	rf drive	1.5 - 2.5	0	8	-
	no drive	0	0	8	-
Q5	alarm	0	0.7	hi	-
	off	0	0	lo	-
Q6	mute	0	0.7	0	-
	off	0	0	0	-
Q7	lit	0	0.7	6	-
	off	0	0	6.8	-

Table 7. IC Measurements		
IC Pin	**Condition**	**DC Volts**
U1-1		8V
U1-2		7.6V
U1-3		7.8V
U1-4		8V
U1-5		7.7V
U1-6		7.7V
U1-7		7.7V
U1-8		8V
U1-9	on freq, varies w/ freq	3.3V
U1-10		0.76V
U1-11		1.1V
U1-12	muted listen	0.7V 0V
U1-13	muted listen	0V 7V
U1-14	muted listen	4.2V 0V
U1-15		0V
U1-16		1.8V
U2-1		0V
U2-2		0.01V
U2-3		0V
U2-4		0V
U2-5		0V
U2-6		7V*
U2-7		16V*
U2-8		8V*
* Voltage varies with power supply voltage. Values shown for unit powered by 12Vdc wall adapter. Voltages will vary if powered by regulated dc power supply or battery.		

Typical Audio Levels.

Table 8 gives rough measurements of audio circuits, using an oscilloscope. Measurements were taken with no input signal, just white noise so conditions can be reproduced easily.

Repairs.

Since the pc board uses plated through holes, some care must be taken in desoldering to remove parts. A vacuum desoldering tool or solder wick braid is helpful. If you don't have tools which make it easy to remove ic's and other multiple lead parts from the board, you can cut the individual leads at the base of the part and then unsolder leads individually after the part is cut free.

If one of the fet's is replaced, refer to the detail drawing above the component location diagram for lead identification, and be sure to install the transistor on the board so the lettering is readable after the transistor is mounted. Since the fet's are static sensitive, normal static handling procedures are required to avoid damage.

To remove the pc board from the cabinet, first remove the knob, nut, and lockwasher from the VOLUME control. Then, unsolder the power and speaker cables and the wire attaching the antenna connection to the BNC jack. Remove the BNC jack. Remove four screws securing pc board, and slide the rear of the board up and rearward to remove from cabinet. When reinstalling, be sure to put the thick lockwasher on the VOLUME control before sliding the board back in the cabinet.

Table 8. Audio Test Voltages.	
Test Point	**Normal Level**
U1-9 (discriminator)	3V p-p
TP-2 (freq. test point)	400 mV p-p
Top of VOLUME Control R18	400mV p-p
U2-2 (af ampl input)	0 to 90mV p-p (dep. on volume)
U2-6 or E3/E4 (af ampl output)	0 to 4V p-p

PARTS LIST.

Notes:
- ❶ Observe polarity.
- ❷ Install flat end oriented as shown.
- ❸ Leave 1/16" test point loop at top and face as shown.
- ❺ Caution: Static sensitive part!
- ❻ 1206 smt part under board
- ❼ 0805 smt part under board

Ref Desig	Description (marking)
C1❼	20 pf
C2❼	62 pf
C3-C4❼	390 pf
C5❼	12 pf
C6❼	0.3 pf
C7❼	12 pf
C8❼	2 pf
C9❼	220 pF
C10❼	.001 µF
C11-C12❻	150 pF
C13❷	2-30 pf var. (green)
C14❼	15 pf
C15❼	.001 µF
C16	56 pf
C17	1 pf
C18	47 pf disc
C19❼	.001 µF
C20❼	390 pf
C21❼	15 pf
C22❼	not used
C23❼	18 pf
C24❼	220 pf
C25	62 pf
C26-C28❼	0.1 µf cap
C29-C30	.01µf mylar (103)
C31	0.15µf mylar (red)
C32❻	.01µf
C33	0.15µf mylar (red)
C34❶	47µf electrolytic
C35❶	10µf electrolytic
C36-C37❶	47µf electrolytic
C38❻	.01µf
C39❶	47µf electrolytic
D1❶	1N4148 diode
D2❶	T-1 red L.E.D.
FL1	10.7 MHz cer filter(10.7MA)
FL2	455 kHz ceramic filter
L1	0.33µH rf choke (red-sil-orn-orn)
L2-L4	2½ turn slug-tuned (red)
L5	1µH rf choke (plain wire)
L6-L7	7½ turn slug-tuned (vio)
L8-L9	2½ turn slug-tuned (red)
Q1-Q2❶❺	3SK122 mosfet
Q3-Q7❶	2N5770
R1-R2❼	100K
R3❼	2.2K
R4❸	100K
R5❼	15K
R6❼	27K
R7❼	270Ω
R8❸	1K
R9❼	10K
R10❼	4.7K
R11❼	330K
R12❼	47K
R13❼	330K
R14❼	680Ω
R15❼	100K
R16❼	47K
R17❸	27K
R18	100K panel mount pot
R19❼	4.7K
R20❼	47K
R21❼	4.7K
S1	DIP Switch
S2	mom-off-on toggle switch
T1	455 kHz IF Xfmr (T1003)
U1❶	MC3361BP IF ampl
U2❶	LM-380N-8 audio out
U3❶	78L08 voltage regulator
Y1	162.400 (16.855,556)
Y2	162.425 (16.858,333)
Y3	162.450 (16.861,111)
Y4	162.475 (16.863,888)
Y5	162.500 (16.869,444)
Y6	162.525 (16.872,222)
Y7	162.550 (16.872,222)
Y8	10.245
Z1-Z6	Ferrite bead, prestrung

Note: Install LED D2 with the long lead (anode) toward the left side of the board. The leads need to be bent at a right angle 1/16 inch from the back edge of the plastic body. Then, install LED with the bend in the leads 1/8 inch above the top of the board. When done properly, the back edge of the LED body will be aligned with the front edge of the pc board.