HAMTRONICS® R138 WEATHER SATELLITE RECEIVER KIT: ASSEMBLY INSTRUCTIONS

ASSEMBLY PRACTICES.

Most assembly is done simply by following the parts list and component location diagrams in the maintenance manual; however, the sequence to use for easiest assembly and some special notes are given below to help you.

Be sure to follow instructions as given, and don't arbitrarily do things differently. For example, some people add ic sockets to modules they build, but this kit is designed without them for proper heatsinking and rf performance. Adding them would cause problems.

Note that vhf equipment requires precise construction using short, direct leads. This is especially true for bypass capacitors, which do not work well if leads are not as short as possible. Take some time to be sure capacitors are as close as possible to the board.

Some parts, such as the piston capacitors, coils, pots, and filters, may not stay down tight on the board as they are soldered. In such cases, you may need to remelt the solder and reseat some of the leads after inspection. It is worth taking a little extra time to do this, both for appearance and for good performance.

Because of the small size of the 0.1μf monolithic capacitors, you may not be able to read the value stamped on the part. However, they have small, rectangular, yellow or orange, glossy cases so you can distinguish them from disc capacitors.

When installing resistors and diodes that are mounted vertically, be sure to orient the body of the resistor as shown by large circles in parts location diagram.

Be sure to observe polarity of diodes, ic's, transistors, and electrolytic capacitors.

Field effect transistors, Q1 and Q2 are static and heat sensitive. Do not open the static packaging until you have grounded yourself and your soldering iron, and use a minimum amount of heat when soldering. They have diode protection built in, but do not take chances. If you do not have a grounded wrist strap to wear, you can make one using your watch band to hold a temporary wire. Be sure to connect a resistor of about 100K in series with the ground wire to protect yourself from electric shock. Any soldering iron used on modern circuitry should have a third ground wire.

It is easiest to identify pads for mounting small parts if the ic's, coils, and other landmark parts are mounted first, as described.

ASSEMBLY SEQUENCE.

a. Set board on bench or in holding jig oriented as shown in diagram.

b. Solder ic's U1, U2, and U3 to the board, observing polarity. DIP IC's may have a dot over pin 1 for identification or a band at the pin 1 end of the ic. They almost always have a small notch at the center of the pin 1 end of the ic.

c. Install slug tuned coils as shown, and install coil shields. The 2½ turn (red) coils come with shields already on the coils. The 6½ turn (blue) coils have shields supplied separately. Make sure the coils and shields are fully seated, and solder both shield lugs. (Do not bend lugs over, but you can bend the coil leads over a little to hold them in place while soldering.)

d. In like manner, install transformer L9.

e. Install filters FL1 and FL2 and potentiometers R20 and R25 (on the left side of the board).

f. Install transistors Q3-Q7, orienting as shown.

g. Install FET's Q1 and Q2 from top of board, ORIENTING AS SHOWN. Seat them as close to board as possible without straining leads. The drain lead is identified by the LONG LEAD. Note that the LETTERING SHOULD BE UP. Form the leads down at a right angle, insert leads through the holes, and solder leads under board.

h. Install socket pins for crystals Y1-Y4. Cut socket pins from carrier strip close to body. Grip (one wall only) with fine nose pliers. Rock them while firmly pressing into board. They will snap in place. Solder lightly under board to avoid solder filling crystal sockets.

i. Install four piston trimmer capacitors: C12, C17, C22, C27. Check to be sure they are straight when soldering.

j. Install 10.245 crystal Y5 and rf choke L4. The rf choke has no markings, but has wire turns exposed.

k. Install ferrite beads Z1-Z5. They are already strung on wires. Just bend the leads and install like a horizontal resistor.

l. Install diode CR1, observing polarity. The banded end of the diode is the cathode; it goes down. The anode lead loops over the top as shown.

m. Install electrolytic capacitors as shown: C41, C45, C57, C53, C54, and C56. Observe polarity.

n. Install resistors vertically as shown. The body of the resistor is shown as a circle. Be sure to install resistors with bodies in the positions shown. Top lead of R14, R17, and R24, which are used as test points, should be left a little higher than normal so you can connect a test probe for alignment.

o. Install remaining capacitors as shown. Make sure the leads are as short as possible.

p. Check over all parts and solder connections. If you are missing any parts, check to see if you have other parts left over. You may have installed a wrong value somewhere; so recheck all values looking for the missing parts. Color codes and printed numbers are difficult to read on many small parts, so special care is sometimes needed to avoid mix-ups.

WHAT NEXT?

After inspecting your receiver, you are ready to install crystals and connect up the receiver to align it. Refer to the Installation, Operation, and Maintenance Manual for full details.

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HAMTRONICS® R138 WEATHER SATELLITE RECEIVER: INSTALLATION, OPERATION, & MAINTENANCE

GENERAL INFORMATION.

The R138 is a commercial-grade, four-channel, crystal-controlled vhf fm receiver optimized for operation on the 137 MHz weather satellite channels. It features wide i-f filters (38 kHz modulation acceptance to accommodate the wide deviation used for wefax), low-noise dual-gate FET rf amplifier and mixer stages, and an integrated circuit i-f strip.

The R138 is the successor to the R137 Receiver, popular for many years. Advantages of the R138 include built-in multichannel capability, improved stability due to double-sided pc board, and ease of assembly.

CRYSTALS.

The channel crystal plugs into sockets identified in component location diagram as Y1. We normally stock crystals for 137.500 and 137.620 MHz U.S. NOAA satellites and the 137.300, 137.400, and 137.850 Meteor (Russian) satellites. Also, we can order crystals for any other frequencies you may want.

If you order your own crystals, be sure to supply the following specs. The receiver uses 32 pF parallel resonant crystals in HC-25/u holders. Crystals operate in the fundamental mode at a frequency of (F-10.7)/9. Frequency tolerance is .0005%.

CONNECTIONS TO EXTERNAL CIRCUITS.

The R138 Receiver has solder pads for #22 hookup wire for all external connections. They are identified on the drawings and on the top of the board with 'E' numbers. To make these connections as needed, strip the end of the wire about 1/8 inch, insert it into the appropriate pad, and solder to the pad under the board.

Following is general information about uses for the various connections. Figure 1 shows a typical installation, but your installation may vary from this. More detailed information on use of these terminals follows later, after alignment.

You may want to solder some hookup wires to the pads you will use so that they are available for testing and later when the unit is installed in your case or chassis.

E8 is the ground plane on the board, which is used as the common connection for both the 13.6 Vdc power input (-) and the audio output to the speaker or wefax demodulator. If you need other ground connections, you can also tack-solder other hookup wires anywhere on the ground plane.

E6 is the +13.6 Vdc power input.

E7 is the audio output (hot lead).

E12 and E13 are the antenna coax center conductor and shield, respectively. Normally, when the pc board is installed in a cabinet, a short length of miniature coax, such as RG-174/u, is connected from these terminals to a connector, such as an SO-239 UHF jack or a BNC jack on the rear of the cabinet. For testing, you may want to install a short length of cable now with a connector for your signal generator. Be sure to keep all stripped coax leads as short as possible.

The connections mentioned above are all the basic connections required for operation. Following are notes on optional connections.

E9 and E10 provide a means of de-

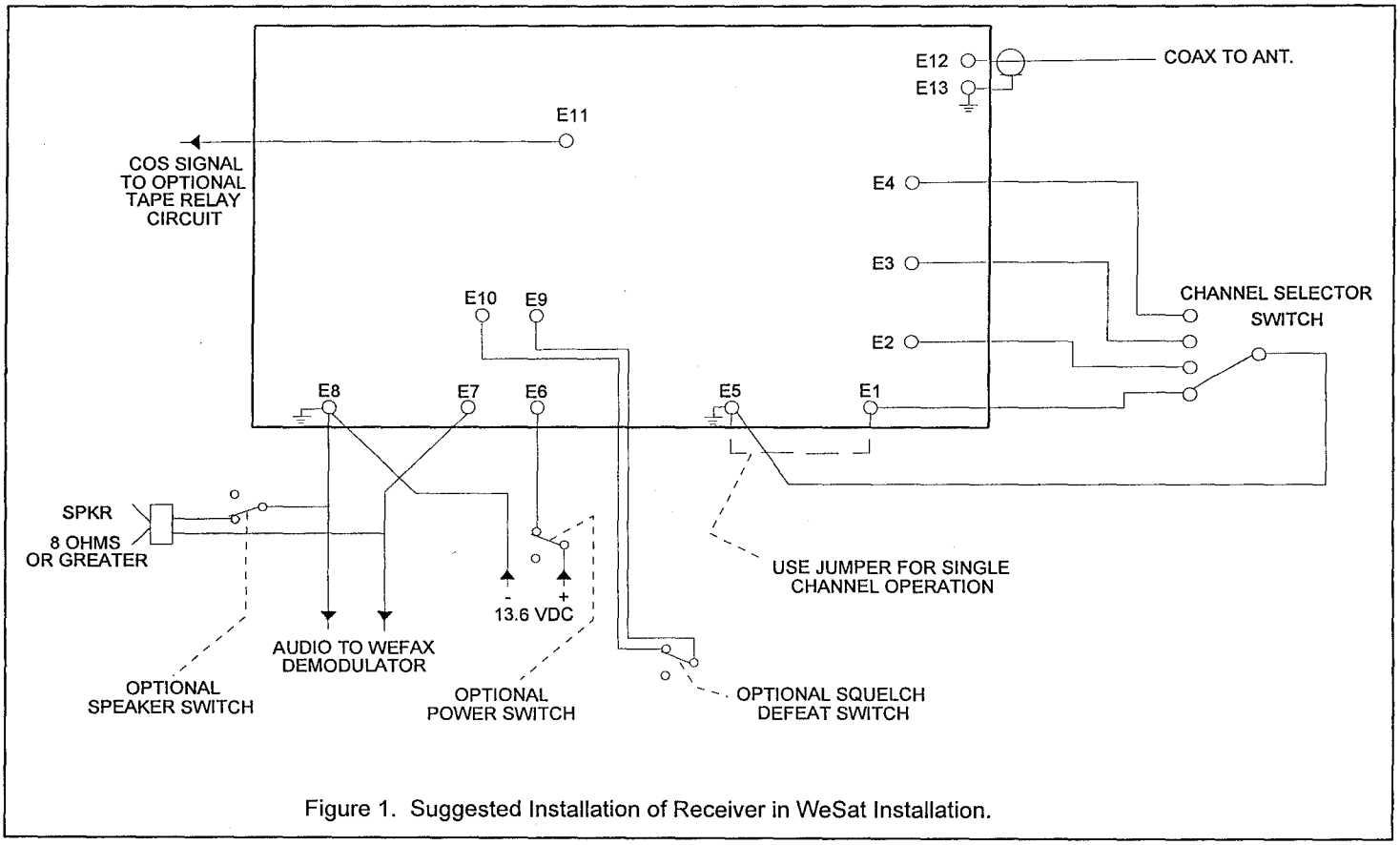

Figure 1. Suggested Installation of Receiver in WeSat Installation.

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feating the squelch circuit, which mutes the audio when no signal is present. Instead of using a squelch potentiometer on the front panel and constantly adjusting it, the squelch pot on the pc board is set once to proper threshold. If you wish to defeat the squelch during operation to listen for weak signals, it is easy to provide a small toggle switch on your front panel to turn the squelch on and off. A closed switch is off (squelch defeated).

There are four channel oscillators on the receiver, allowing for selection of various satellite frequencies. If you only want to use one frequency, simply connect a jumper from ground pad E5 to channel 1 pad E1 in order to activate that oscillator circuit. However, if you want to be able to switch between up to four channels, you can provide a front panel rotary switch to switch the ground from E5 to any of the four channel oscillator activation pads, E1-E4, as shown in figure 1.

E11 provides a COS output from the squelch circuit in the receiver, which is +7Vdc when the squelch is open and ground when the squelch is closed. This can be used to provide a logic signal to tell an external circuit to activate a tape recorder when the satellite is audible.

ALIGNMENT.

Equipment needed for alignment is an fet voltmeter (preferably analog not digital to observe tuning), an rf signal generator, and a regulated 13.6Vdc power supply with a 0-200 mA meter internally or externally connected in the supply line.

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.)

Variable capacitors should be adjusted with a plastic tool with a small metal bit on the end. (See A2 Tuning Tool in catalog.) If the receiver has not been aligned previously, the variable capacitors should be set to the center of their range (about 5/16 inch of the piston is exposed).

a. Install channel crystals in sockets. Refer to figure 3 for component locations.

b. Connect 13.6 Vdc power supply to E6 (+) and E8 (-), as shown in fig. 1.

c. Connect speaker to E7 and E8.

d. Set the SQUELCH control R20 fully counterclockwise. Adjust VOLUME control R25 for a comfortable listening level.

e. Connect dc voltmeter to test point A, which is the top lead of R14. Alternately adjust L5 and L6 for maximum dc voltage. (Typical indication is roughly +0.7 to 1.8 Vdc.) 1.09 @ 137.5

f. Connect stable signal generator to the top lead of L4 (output of mixer Q2), using coax clip lead and a .01 μf disc capacitor to block the dc. Connect coax shield to pcb ground. Set generator to exactly 10.700 MHz. Use a frequency counter or synthesized signal generator. Set the signal generator level high enough to provide a full quieting signal.

g. Connect meter to test point C, which is the top of R24 (under U1). Adjust discriminator coil L9 for +3.3Vdc.

h. Connect signal generator to antenna terminals E12-E13, using miniature coax soldered to the terminals.

i. If a channel selector switch has been installed, set it to channel 1. If the receiver is set up to use on only one channel, there should be a jumper installed between E1 and E5, as shown in figure 1. If you will be using more than one channel, but you have not yet installed a switch, simply connect a clip lead to the appropriate control terminal, E1-E4, to ground it for testing. For testing, it is convenient to clip to the resistor lead adjacent to the terminal pad.

j. Adjust signal generator to exact channel frequency, and turn output level up fairly high. Adjust appropriate frequency trimmer capacitor, C12, C17, C22, or C27, to net the crystal to channel frequency, indicated by 3.3V at test point C.

k. Repeat this adjustment procedure for any additional channels you wish to use. Ground the appropriate channel control terminal, apply the appropriate signal generator signal, and adjust the appropriate piston trimmer capacitor for 3.3 Vdc at test point C.

Note: To adjust the mixer and front end, use an fet voltmeter on the 2Vdc range with test point B, which is the top lead of R17. The voltage at this point is inversely proportional to the amount of noise detected in the squelch circuit; so it gives an indication of the quieting of the receiver.

A signal peak is indicated by maximum dc voltage. The reading varies with the setting of the squelch control. Best results are obtained with the squelch control set just counter-clockwise enough to open the squelch. That allows the audio to be heard and provides a good range of dc voltage readings with changing rf signal levels. Under these conditions, the dc voltage will be about +0.7Vdc with no signal and about +1.2Vdc with a full-quieting signal.

A weak to moderate signal is required to observe any change in noise. If the signal is too strong, there will be no change in the reading as tuning progresses; so keep the signal generator turned down as the sensitivity of the receiver increases during tuning.

l. If a channel selector switch has been installed, set it to the channel to be used for rf alignment, usually the frequency closest to the center of the range of channels to be used. For example, if the lowest frequency is 137.300 and the highest is 137.850, do alignment at 137.620 or 137.500. If the receiver is set up to use on only one channel, there should be a jumper installed between E1 and E5, as shown in figure 1. If you will be using more than one channel, but you have not yet installed a switch, simply connect a clip lead to the appropriate control terminal, E1-E4, to ground it for testing. For testing, it is convenient to clip to the resistor lead adjacent to the terminal pad.

m. With dc fet voltmeter still connected to test point B, set signal generator for relatively weak signal, one which shows a little change in the test point indication. Alternately peak multiplier coils L7 and L8 and rf amplifier coils L1, L2, and L3 until no further improvement can be made. When properly tuned, the sensitivity should be about 0.15 to 0.2 μV for 12 dB SINAD and about 0.25 μV for 20 dB quieting.

n. Check operation on the other channels. They should all have about the same sensitivity.

INSTALLATION.

Following alignment if you built a kit, or after becoming familiar with the information in the *Connections to External Circuits* section if you purchased an assembled unit, you are ready to install the receiver in some sort of chassis, adding controls you might want and connections to power supply, speaker, and wefax demodulator. The following information

describes tasks to be done.

Mounting.

Some form of support should be provided under the pc board, generally mounting the board with screws and standoffs to a chassis. The choice of a cabinet or chassis type is based solely on aesthetics; it is not necessary to shield the unit unless you are near a noisy computer.

Power Connections.

The receiver operates on +12Vdc or +13.6Vdc at about 120 mA peak. Current drain with no audio is only about 45-50 mA. A well regulated power supply should be used. 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. Positive and negative power leads should be connected to the E6 and E8, respectively. Be sure to observe polarity.

If you like, a toggle switch can be installed in series with the positive lead to allow power to be turned off when not in use.

Audio Output.

A loudspeaker with 8Ω or higher impedance and/or wefax demodulator unit should be connected to E7 with ground return to E8. (Use of lower impedance speaker or shorting of speaker terminal can result in distortion or even ic damage due to overheating at high volume levels.) If you like, a toggle switch could be installed in series with the audio lead to the speaker to allow it to be muted when only audio to the demodulator unit is needed.

Antenna Connections.

E12 and E13 are the antenna coax center conductor and shield, respectively. Normally, when the pc board is installed in a cabinet, a short length of miniature coax, such as RG-174/u, is connected from these terminals to a connector, such as an SO-239 UHF jack or a BNC jack on the rear of the cabinet. You can then use heavy low loss cable to your antenna. Make sure the stripped ends of the coax are as short as possible; since such pig tails are lossy.

Channel Selection.

There are four channel oscillators on the receiver, allowing for selection of various satellites. If you only want to use one frequency, simply connect a jumper from ground pad E5 to channel 1 pad E1 in order to activate that oscillator circuit. However, if you want to be able to switch between up to four channels, you can provide a front panel rotary switch to switch the ground from E5 to any of the four channel oscillator activation pads, E1-E4, as shown in figure 1.

Squelch Defeat Switch.

E9 and E10 provide a means of defeating the squelch circuit, which mutes the audio when no signal is present. Instead of using a squelch potentiometer on the front panel and constantly adjusting it, the squelch pot on the pc board is set, once, to proper threshold.

If you wish to defeat the squelch during operation to listen for weak signals, it is easy to provide a small toggle switch on your front panel to turn the squelch on and off. A closed switch is off (squelch defeated).

Of course, if you prefer the old-style front panel squelch control, you can connect a front panel potentiometer of the same value in place of the one on the board.

Tape Recorder.

E11 provides a COS output from the squelch circuit in the receiver, which is +7Vdc when the squelch is open and ground when the squelch is closed. This can be used to provide a logic signal to tell an external circuit to activate a tape recorder when the satellite is audible.

Figure 2 shows such a circuit you can build. The transistor is any npn switching transistor, such as a 2N3904. Be sure to include the reverse polarity diode across the relay coil to prevent transient voltage damage to the transistor when the relay coil is de-energized.

OPERATION.

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

Normally, when used to drive a wefax demodulator, you will want to listen on a speaker to hear what the signal sounds like. This is especially true during the initial acquisition period. However, most times, you probably want the ability to mute the speaker; so installing a switch in line with the receiver output to the speaker is handy. The volume control can be adjusted to whatever level is comfortable for listening and proper for the wefax demodulator.

Likewise, once the squelch control is set properly, there is no need to change it. However, it is handy to be able to defeat the squelch to monitor for weak signals during the acquisition period. So a switch to defeat the squelch is handy.

The squelch circuit uses hysteresis, which requires that the signal level be greater to open the squelch than to close it. Once open, the squelch will not repeatedly open and close if a weak signal varies in strength a little. Therefore, you will notice that the squelch does not open and close at the exact same setting of the squelch control. To adjust it properly, turn it clockwise just a little beyond the point where the squelch closes with no signal (just noise). Be careful not to set it too far clockwise, because the squelch might not open even with a signal, especially one having a strong tone as used for wefax transmissions.

Once the receiver is aligned, you can switch from one satellite to another with the channel switch. If you have the receiver set up for only one channel, then it is possible to simply plug in the crystal for another satellite; however, it is better to make a permanent installation of crystals so each crystal trimmer can be adjusted, independently, right on frequency.

☹ *Caution: The audio output stage is rated at 2W peak for short periods or 1W average over long periods. To avoid damage from overheating, do not run into loads below 8Ω or run at very high audio levels for extended periods. The audio output ic normally gets very warm, but not so hot that you can't touch it briefly without discomfort.*

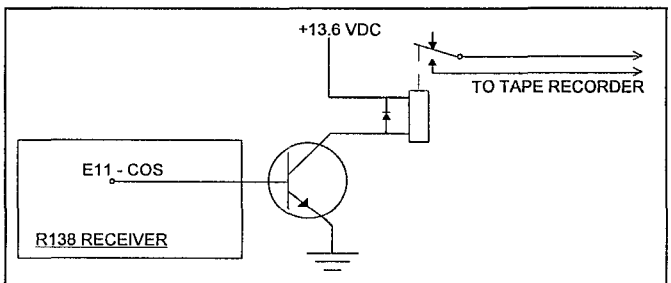

Figure 2. Circuit To Activate Tape Recorder

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 the top lead of L4 (input of second mixer) with a coax cable clip lead and a .01μf blocking capacitor. You should be able to hear the quieting effect of a 2.5 μV carrier at 10.700 MHz. (If you have a SINAD meter, the 12 dB SINAD sensitivity should also be 2.5 μV.) 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 transients or reverse polarity on the dc power line. Also, 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 squelch circuit may not be operating properly. Check the dc voltages, and look for noise in the 10 kHz region, which should be present at the top lead of R19 (U1-pin 11) with no input signal. (Between pins 10 and 11 of U1 is an op-amp active filter tuned to 10 kHz.)

Current Drain.

Power line current drain normally is 45-50 mA with volume turned down or squelched and up to 120 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 unit. 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.

Test Point Indications.

The following measurements are typical of those found at the three 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.

Oscillator Test Point A
Approx. +0.7 to 1.8 Vdc with osc running and output tuned circuits aligned. Varies as L5 and L6 are aligned. 0Vdc with oscillator not running or coils not properly aligned.

Signal Strength Test Point B
With full noise (no signal), varies from +0.15Vdc with squelch control fully ccw to +1Vdc with squelch control fully cw.
With squelch control adjusted until squelch just opened, approx. +0.7 Vdc. Under this condition, if signal is introduced, TP voltage will increase up to +1.2Vdc, proportional to signal strength.
With squelch control adjusted until squelch just closes, approx. +0.6Vdc.

Discriminator Test Point C
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.

Typical Dc Voltages.

The following dc levels were measured with an fet voltmeter on a sample unit with +13.6 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 crystal(s) installed and oscillator(s) running properly and with squelch open unless otherwise specified.

XSTR	Cond.	E(S)	B(G1)	C(D)	G2
Q1		0	0	8	4
Q2		0	0	8	0
Q3-Q6	on	3	2.2	8	-
	off	2	2.5	8	-
Q7	drive	0.7 to 1.8	0	8	-
	no drv	0	0	8	-

IC Measurements		
U1-1: 8V	U1-10: 2.1V	U2-1: 0V
U1-2: 7.5V	U1-11: 2.1V	U2-2: 1V
U1-3: 7.8V	U1-12: 0.7V	U2-3: 0V
U1-4: 8V	(with squelch	U2-4: 0V
U1-5: 1.1V	just closed)	U2-5: 0V
U1-6: 1.1V	U1-13: +7V	U2-6: 7.4V
U1-7: 1.1V	(sq open),	U2-7: 13.6V
U1-8: 8V	0V (sq closed)	U2-8: 6.8V
U1-9: 3.3V	U1-14: 0V	
(On freq.;	U1-15: 0V	
Varies w/freq)	U1-16: 2V	

Typical Audio Levels.

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

Audio Test Point	Normal Level
U1-9 or TP-C (Discriminator)	6.5V p-p audio
U1-11, top of R19 (noise ampl output)	5V p-p noise
Top of Volume Control R25	0.2V p-p audio
U2-3 (af ampl input)	0 to 0.2V p-p (dep. on volume control)
U2-6 or E7 (af ampl output)	0 to 8V p-p audio

R138 WEATHER SATELLITE RECEIVER, PARTS LIST.

Ref Desig	Description (marking)
C1	22 pf np0
C2	62 pf np0
C3-C4	.001 uF (102 or 1nK)
C5	15 pf np0
C6	0.5 pf
C7	18 pf np0
C8	2 pf np0
C9	.01 uF (103)
C10	68 pf np0
C11	.001 uF (102 or 1nK)
C12	1-11 pf piston trimmer
C13	43 pf np0
C14-C15	150 pf np0 (151)
C16	.01 uF (103)
C17	1-11 pf piston trimmer
C18	43 pf np0
C19-C20	150 pf np0 (151)
C21	.01 uF (103)
C22	1-11 pf piston trimmer
C23	43 pf np0
C24-C25	150 pf np0 (151)
C26	.01 uF (103)
C27	1-11 pf piston trimmer
C28	43 pf np0
C29-C30	150 pf np0 (151)
C31	.01 uF (103)
C32	82 pf np0
C33	1 pf np0
C34	82 pf np0
C35-C37	.001 uF (102 or 1nK)
C38	22 pf np0
C39	0.5 pf
C40	22 pf np0
C41	1µf electrolytic
C42	0.1µf monolithic (104)
C43-C44	680 pf (681)
C45	1µf electrolytic
C46	0.1µf monolithic (104)
C47	68 pf np0
C48	220 pf (221)
C49-C50	0.1µf monolithic (104)
C51	10 pf np0
C52	0.1µf monolithic (104)
C53-C54	47µf electrolytic
C55	0.1µf monolithic (104)
C56	470µf electrolytic
C57	47µf electrolytic
CR1	1N4148 diode
FL1	10.7 MHz ceramic filter #10.7MA
FL2	Wideband 455 kHz ceramic filter #LF-H30S or CFW-455B
L1-L3	2-1/2 turns (red)
L4	3µH rf choke (no marking, but wire showing)
L5-L6	6-1/2 turns (blue)
L7-L8	2-1/2 turns (red)
L9	IF Transformer #831-5
Q1-Q2	N.E.C. 3SK122 dual-gate mos fet *static sensitive!*
Q3-Q7	2N3904 or 2N4124
R1-R2	100K
R3-R4	15K
R5	100K
R6	10K
R7	680Ω
R8	10K
R9	680Ω
R10	10K
R11	680Ω
R12	10K
R13	680Ω
R14	1.2K
R15	10K
R16	100K
R17	1.2K
R18	4.7K
R19	330K
R20	20K or 22K horizontal pot
R21	330K
R22	680Ω
R23	15K
R24	68K
R25	20K or 22K horizontal pot
R26-R27	1.5K
R28	47K
R29	27K
R30	3.3Ω (orn-orn-gold)
U1	MC-3357P if ampl
U2	LM-380N-8 audio output (8 pin version of LM-380N)
U3	78L08 voltage regulator
Y1-Y4	Channel Crystal (see text)
Y5	10.245 MHz i-f crystal
Z1-Z5	Ferrite Bead

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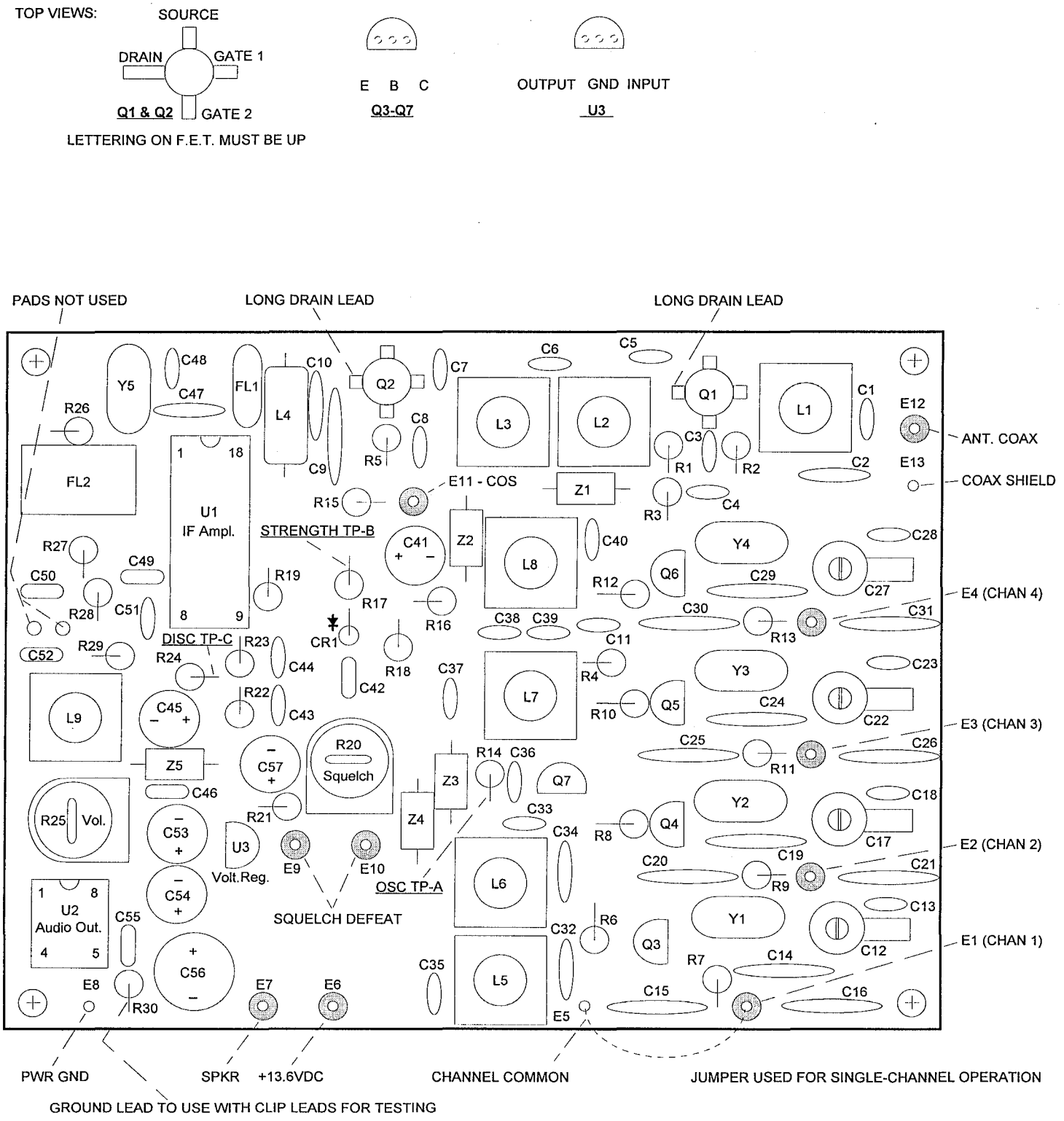

Figure 3. R138 Weather Satellite Receiver, Component Location Diagram

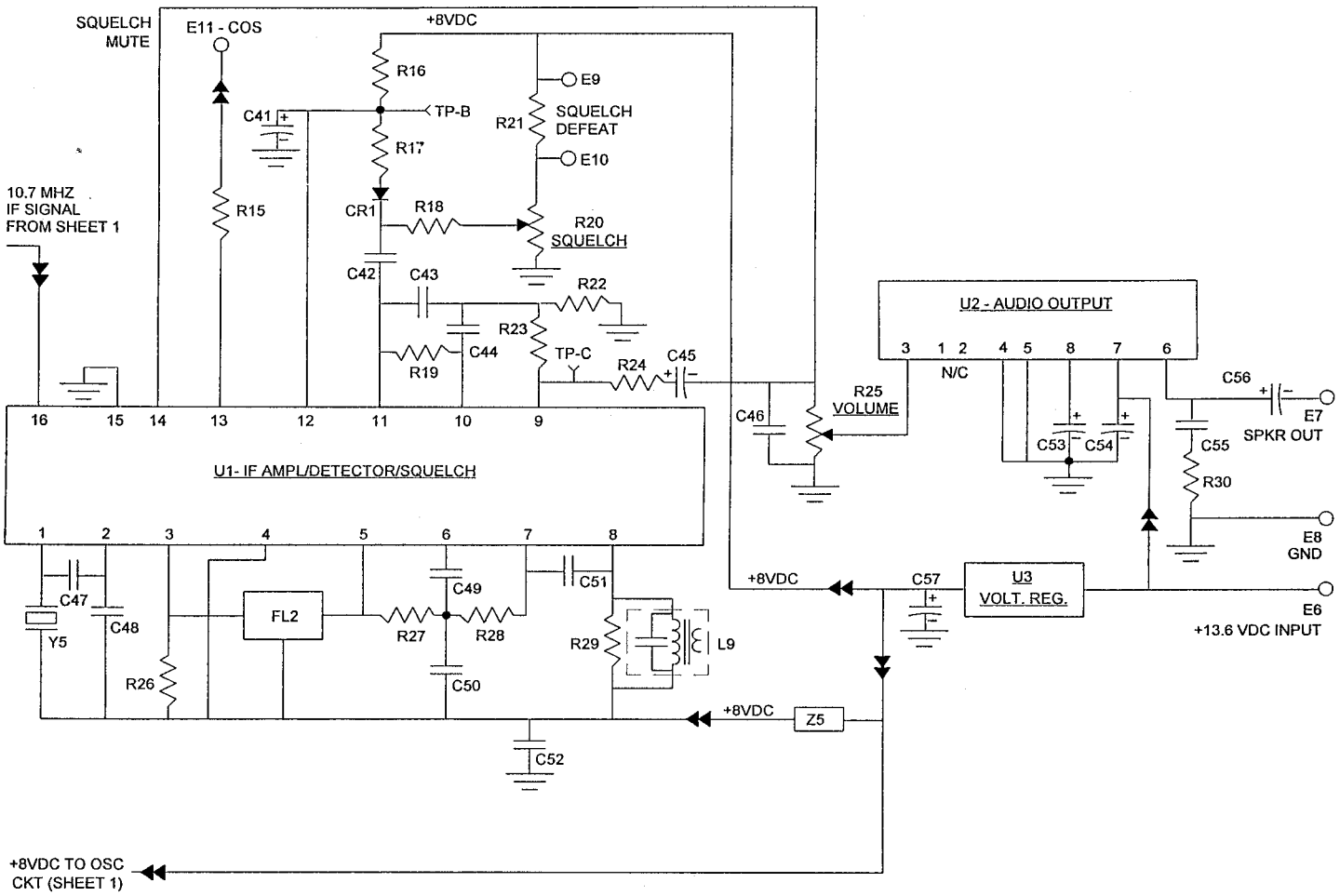

Figure 4B. R138 Weather Satellite Receiver, Schematic Diagram

