

# HAMTRONICS® R139 REV C WEATHER SATELLITE RECEIVER: INSTALLATION, OPERATION, & MAINTENANCE

## GENERAL INFORMATION.

The R139 is a commercial-grade, five-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 R139 is crystal controlled, and it has five channel oscillators. All five popular satellite frequencies are installed in the receiver. You can easily substitute other channel crystals if you choose.

You can select a particular satellite simply by stepping the SCAN switch on the front panel. LED's on the panel indicate which channel is active. An adjustable squelch circuit allows you to determine how weak a signal you want to hear.

If you prefer automatic scanning, the R139 will continually scan the five channels looking for a satellite signal it can hear. When it hears one, the receiver locks onto that satellite.

A tape recorder control output can be used to activate a tape recorder automatically whenever a satellite is heard, even if you are not home at the time. This allows you to play back the tape whenever you have time to reproduce the satellite images on your computer.

The R139 is powered by 12Vdc. If you purchase the unit wired and tested or buy the kit with the cabinet option, a 115Vac-12Vdc power adapter is supplied as well as a 9-pin plug for the power, audio, and tape control connections.

## CRYSTALS.

Channel crystals for the 137.100, 137.500, 137.62, and 137.9125 MHz US NOAA satellites and the 137.400 MHz Meteor satellites are installed in the R139 Receiver. The following chart correlates fundamental crystal frequency with channel frequency for the five popular satellite frequencies installed in the receiver.

CHANNEL	CRYSTAL (MHz)
137.100	14.044444
137.400	14.077778
137.500	14.088889
137.620	14.102222
137.9125	14.134722

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%.

Note that R139 receivers manufactured before June 2005 have a different channel lineup based on older satellites as follows.

CHANNEL	CRYSTAL (MHz)
137.300	14.066667
137.400	14.077778
137.500	14.088889
137.620	14.102222
137.850	14.127778

## EXTERNAL CONNECTIONS.

### Plug Assembly.

The R139 Receiver has a DB-9 male jack. The mating plug with female contacts is provided with the cabinet kit option if you purchased a kit receiver, or with the wired/tested receiver, which comes in a cabinet. If you purchased a receiver kit without the cabinet, you can provide your own plug or not use the jack on the board and solder wires directly to the pc board.

The plug looks just like a jack, except it is the opposite sex and has a plastic hood. Hardware to assemble the hood is included. Nuts fit in recesses in the plastic hood shells, and one screw is installed from each side.

Also included is hardware to assemble a clamp to fit around the cable inside the plug to provide strain relief. It is easiest to do this by laying one metal clamp piece in the rear of the shell, setting the plug/cable assembly in place, and then attaching the other metal clamp piece with a short screw. This will position the clamp properly. With the one screw tightened, you

can flip the cable assembly over and install the second screw in the other side of the clamp.

Additional hardware is provided for occasions where the plug is used on a computer; the hardware being long screws and backup plates to hold the plug on the rear of the computer. These are not needed for this application; so they can be discarded.

### Making Connections.

Following are descriptions of the three major connections you may need to make. Note that the hot wires connect to the top row of pins, with tape recorder control connected to pin 2, audio for a speaker and the line input on your computer's sound card connected to pins 3 and 4, and dc power connected to pin 5. All the ground returns are connected to the bottom row on pins 6-9. These connections are illustrated in figure 1.

Connections can be made most easily with #22 solid or pretinned hookup wire. It is easiest to solder wires to the pins if you clamp the plug in a vise and solder one row of pins at a time. The solder cups can be preloaded with solder. Then, to make each connection, strip the end of the wire about 1/8 inch, melt the solder in the solder cup, insert the wire, and allow the solder to cool.

### DC Power.

The R139 Receiver is designed to operate on +12 to +18Vdc. It requires about 50 mA of current with no audio output and up to 100 mA with audio turned all the way up.

Ideally, the R139 only needs 12Vdc. You can operate from any 12Vdc regulated power supply if you wish. If you purchased the receiver with a cabinet and 12Vdc power adapter, the actual voltage will be higher than 12Vdc, but the receiver is designed to accommodate the voltage of the adapter. 12Vdc power

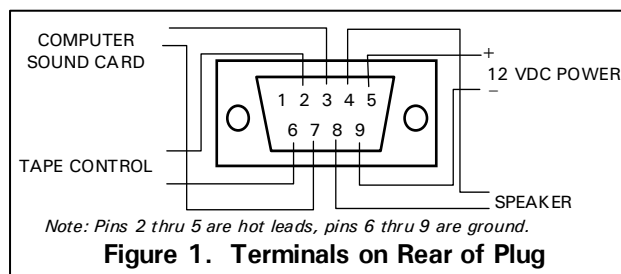


Figure 1. Terminals on Rear of Plug

adapters are not regulated, and they typically put out 18-20Vdc with no load and drop to 12Vdc only with their full rated load. (The adapter we supply is conservatively rated, and the receiver will never draw the full rated load current of the adapter.)

The power supply or 12Vdc power adapter should be connected with its positive lead on pin 5 and its negative lead on pin 9. If you are using the 12Vdc adapter, cut about an inch off the end of the cable to get to clean copper never exposed to the air. Then, separate the two leads about an inch and strip them 1/8 inch. **BE VERY CAREFUL TO OBSERVE POLARITY; THE POSITIVE LEAD HAS A STRIPE AND THE NEGATIVE LEAD IS PLAIN.** The lead with the small grooves molded into it is positive, and the smoother lead is negative. It can be a little difficult to tell the difference, and it is important not to reverse the polarity and damage the equipment it is powering.

Wait to actually connect power to the receiver; there is a procedure later to test the polarity at first power up.

⚠ **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.

### Audio Output.

There are 2 sets of audio output pins so that you can run individual lines to both a speaker and the line input on your computer's sound card. The two outputs are simply connected in parallel, and you can use either or both. Pins 3 and 4 are the hot leads and pins 7 and 8 can be used for ground returns. The output ic in the R139 can provide up to 1 watt of audio to a load of 8Ω or more. (A lower load impedance might cause distortion or overheating at high volume levels.)

Normally, when used to drive a computer sound card, 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 lis-

tening and proper for the computer's sound card.

### Tape Recorder Control.

The squelch circuit in the R139 Receiver continually looks for an active satellite. If it hears one, it stops on that channel and turns on a switching transistor. The transistor output can be used to activate a tape recorder, allowing you to play back the tape into your computer's sound card whenever you have time to reproduce the satellite images on your computer. The transistor can sink up to 50 mA of positive current to ground, with a voltage not to exceed 15Vdc.

Figure 2 illustrates one possible method of activating a tape recorder. If your tape deck has a motor circuit which returns to ground which is common with the receiver ground and draws less than 50 mA, you can use the transistor directly to switch the motor on and off. If the motor circuit draws more than 50 mA or if you are not sure about polarity, current, or voltage, then adding a small external relay wired as shown will provide a buffer for the output transistor.

In either case, be sure to connect a transient protection diode across the device you are switching with the transistor. Motors and relays generate a large reverse transient voltage when the current path is broken. Such transients will damage any transistors or ic's they reach. Providing a diode, as shown, to conduct and shunt this reverse polarity current will prevent the voltage from building up to a high enough level to do any damage.

If you have your tape recorder ptt switch wired to respond to the tape recorder control from the receiver, then you need to somehow disable this motor control to allow the motor to operate normally for playback. You can do this by unplugging the cable going to the ptt jack on the tape recorder; but a nicer method would be to add a toggle switch to short the relay contacts together when you want to play back the tape.

### Antenna Connections.

The success of reception is very much dependent on having a good antenna. The

ARRL *Weather Satellite Handbook*, which we sell, is a good source of information on building antennas. Good quality, low-loss 50Ω coax should be used because the satellite signals are weak. The coax should be plugged into the BNC jack on the rear of the receiver.

If you are using large diameter coax, it may be necessary to use a UHF-BNC adapter. Such adapters are shown in the rear of our catalog. Another alternative is to use a short length of smaller diameter, more flexible, coax between the main cable and the receiver. That cable can have a BNC plug on one end and a UHF plug and double female adapter on the other.

If you use a preamp, such as our LNG-137, you can overcome some cable losses by installing the preamp right up at the antenna. This establishes a low noise figure before going through the loss of the cable.

Note that we do not recommend trying to feed B+ to power the preamp through the coax as some try to do. It doesn't pay to try to save the small cost of light weight hook up wire and mess up the performance of the preamp in the process. We have tested many such methods of feeding B+ on the coax, and we have not found a very good way to do it without some compromise in performance.

### INITIAL TESTING AT FIRST POWER UP.

Following is a safe start-up procedure, assuming you either built a kit or are using a power supply setup the first time. This procedure will check the voltages and polarity to be sure that no damage will occur.

⚠ **CAUTION:** Reverse polarity or voltage transients from relays, motors, etc. can damage semiconductors. Use only proper, filtered power supplies of the correct voltage, and check to make sure any inductive devices, such as motors or relay coils, operating from the same power source have transient absorbing di-

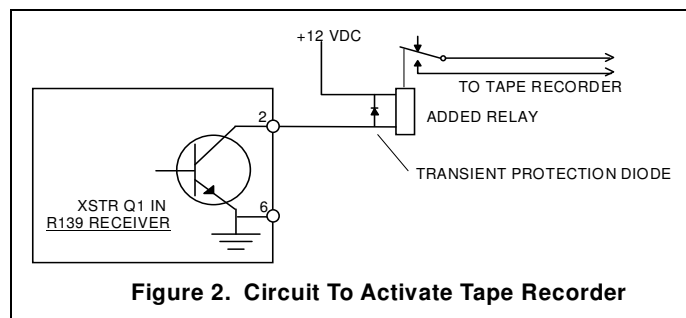


Figure 2. Circuit To Activate Tape Recorder

odes connected across them.

### Input Voltage Range.

The R139 has an 8 volt regulator built in. The only circuit which uses power taken before the regulator is the audio output ic. These two branches both may operate with filtered, but not necessarily regulated, power with a voltage up to 18 Vdc and having a little ripple. Filtering circuits in the receiver can eliminate a little ripple, the type you might get from an unregulated 12Vdc power adapter. They can also contend with some voltage variation with load current, which you ordinarily see with changes in audio output level.

It is normal for the 12Vdc power adapter to put out about 20Vdc with no load at all and drop to 12Vdc only at full load. In the case of the very conservatively rated adapter we supply with cabinets, the receiver never draws enough current to draw the voltage down to 12V.

### Start-up Voltage Checks.

Assuming you have wired up the 9-pin plug to the power adapter or a 12Vdc power supply and have double checked the polarity, do the following.

a. Before plugging in the power plug, turn off the front panel POWER switch.

b. Connect the 9-pin plug, and connect a dc voltmeter from the left-hand lug of POWER switch S2 on the pc board. The voltmeter should show a positive voltage of about 20Vdc if using the 12Vdc power adapter or about 12Vdc or 13.6Vdc if using a regulated power supply.

☛ Pay special attention to verifying the correct polarity before turning on the POWER switch. Damage to the receiver will occur if the polarity is reversed.

c. Turn on POWER switch, and turn the VOLUME control fully counterclockwise. If you are using the 12Vdc power adapter, the voltage will drop to about 17-18Vdc. If you are using a regulated power supply, the voltage should not change.

d. Connect a speaker and turn VOLUME control fully clockwise. With lots of white noise, the supply voltage should drop to about 15-16Vdc if using the 12Vdc power adapter or remain constant if using a regulated power supply. Turn down VOLUME when done.

e. Reconnect positive lead of voltmeter to the lead of ferrite bead Z1, just above the POWER switch on

the pc board. This carries regulated voltage to the rest of the receiver; it should be close to +8Vdc.

f. This completes preliminary tests. Now it is safe to operate, or in the case of a kit, to align the receiver.

### ALIGNMENT.

*Equipment needed for alignment is an rf signal generator and an fet voltmeter. (If you have one, analog meters make it easier to observe tuning.)*

*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.*

a. Connect power and speaker to J1.

b. Turn on power, and click the SCAN switch to the left several times to get to the channel which is about in the center of the tuning range, which presumably is channel 3. The LED's should indicate which channel is selected

c. Set SQUELCH control R2 fully counterclockwise and VOLUME control R1 for a comfortable listening level.

d. Connect dc voltmeter to oscillator test point TP-1, which is the top lead of R29, just to the right of the BNC jack. Alternately adjust L4 and L5 for maximum dc voltage. (Typical indication is roughly +0.7 to 1.8 Vdc.)

e. Connect stable signal generator to 10.7 MHz test point TP-2, the top lead of R17 next to mixer Q3. Use a 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. No modulation is needed.

f. Connect dc voltmeter to test point TP-4, which is the top of R6 (under i-f amplifier ic U1). Adjust discriminator coil L8 for +3.3Vdc.

g. Connect signal generator to BNC jack J2.

Note: The following procedure assumes you are using the five channel frequencies normally installed in the R139 Receiver for the US and Russian weather satellites. If not, use the appropriate channel frequencies of your crystals when doing the

alignment procedure which follows.

h. Adjust signal generator to exact channel frequency of your mid channel. We assume channel 3, which is 137.500 MHz. Turn output level up fairly high. Adjust frequency trimmer capacitor C33 to net the crystal to channel frequency, indicated by 3.3V at test point TP-4.

i. Repeat this adjustment procedure for the other 4 channels. Use the STEP position of the SCAN switch to change channels. Following is a list of the capacitors to adjust and frequencies to set the signal generator.

Channel	Frequency MHz	Trimmer
1	137.100	C31
2	137.400	C32
3	137.500	C33
4	137.620	C34
5	137.9125	C35

**Note:** To adjust the mixer and front end, use an fet voltmeter on the 2Vdc range with test point TP-3, which is the top lead of R9. 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 also varies with the setting of the SQUELCH control. Best results are obtained with the SQUELCH control set just counterclockwise 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.

With no signal, the test point voltage varies from about -1.5Vdc with the SQUELCH control fully open (CCW) to about -2.5Vdc with it fully closed (CW). With the SQUELCH control adjusted to where the squelch first opens, the test point voltage is about -1.5Vdc.

We tell you all this just so you have a feel for what is happening as you tune. A voltage from the noise detector is summed with a voltage from the SQUELCH control, and the tuning action will move the test point voltage in a positive direction from a reference where the SQUELCH control sets it.

*Under these conditions, with the squelch just opened with no signal, the dc voltage will vary from about -1.5Vdc with no signal to about +0.65Vdc with a full-quieting signal. Although the test point voltage changes polarity as the signal level increases, the crossover point at 0Vdc*

will occur with a fairly full quieting signal, about  $0.6\mu\text{V}$  with a fully tuned receiver. Therefore, using a 1.5 or 2 Vdc range with negative polarity on the voltmeter will allow you to see all of the tuning range you need for alignment.

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. This will be in the negative voltage range.

j. Select the channel closest to the center of the frequency range of channels to be used. Usually, this will be channel 3 as described earlier.

k. Set signal generator to channel frequency. Set attenuator for relatively weak signal, one which allows some white noise so changes in signal strength allow variation in the test point indication. Peak coils in the following order, and then repeak them, working out any interactions between them.

- Do L3 first, because it benefits most from tuning.
- Then, do L6 and L7.
- Then, do L1, L2, and L3.

When properly tuned, the sensitivity should be about  $0.2\mu\text{V}$  for 12dB SINAD and about  $0.25\mu\text{V}$  for 20dB quieting.

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

m. This completes alignment. If you purchased the unit as a kit, you can now install the pc board in its cabinet.

## OPERATION.

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

Normally, when used to drive a computer's sound card, you will want to listen on a speaker to hear what the signal sounds like. The VOLUME control can be adjusted to whatever level is comfortable for listening and proper for the computer's sound card. 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.

⊗ *Caution: The audio output stage is rated at 1W with a speaker*

having an impedance of  $8\Omega$  or higher. To avoid damage from overheating, do not run into loads below  $8\Omega$  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.

To adjust the SQUELCH control, turn it clockwise just a little beyond the point where the squelch closes with no signal (just noise). The squelch circuit has adjustable sensitivity – the further clockwise you set the control, the stronger the signal must be to open the squelch. This is handy to set how strong you want the satellite signal to be before the tape recorder turns on. Be careful not to set it too far clockwise, though, because the squelch might not open even with a strong signal.

Channel selection is done with the SCAN switch. Normally, you may wish to leave it in the center MAN position, which keeps the receiver locked on the current channel. To change channels manually, flick the switch to the left STEP position once for each incremental change you wish to make. To move over several channels at once, you can hold the switch in the STEP position until you reach the desired channel.

If you wish to scan all channels and stop when the receiver discovers a satellite within reception range, set the SQUELCH control just above the point where the squelch closes with no signal. Then, set the SCAN switch to AUTO.

⚡ *Note: It is possible that the channel selection/scan circuit will not operate properly until power has been applied for several hours the first time it is used. Due to high impedances, an electrolytic capacitor in the scan circuit must have low leakage, which requires that the unit be in operation regularly. The solution is to leave the power on overnight. After being in storage for a long time, electrolytic capacitors require re-forming to have low leakage. Once the unit is in operation regularly, this should not be a problem. If the scan circuit does not scan normally after power has been applied more than one or two days, contact us at [questions@hamtronics.com](mailto:questions@hamtronics.com).*

## TROUBLESHOOTING.

### General.

The usual troubleshooting techniques of checking dc voltages and signal tracing work well in trouble-

shooting 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-2 (the top lead of R17) with a coax cable clip lead and a  $.01\mu\text{f}$  blocking capacitor. You should be able to hear the quieting effect of a  $4\mu\text{V}$  carrier at 10.700 MHz. (If you have a SINAD meter, the 12 dB SINAD sensitivity should also be about  $4\mu\text{V}$ .) 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 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 R8 (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 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.

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 TP-1

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 TP-3

With full noise (no signal), voltage varies from about -1.3Vdc with squelch control fully ccw to about -2.4Vdc with squelch control fully cw.

With squelch control adjusted until squelch just opened, approx. -1.4Vdc. Under this condition, if signal is introduced, TP-3 voltage will increase up to +2.1Vdc, proportional to signal strength.

#### Discriminator (Freq.) Test Point TP-4

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 dc levels shown in the tables were measured with an fet voltmeter on a sample unit with +12Vdc 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 squelch open unless otherwise specified.

Transistor Measurements					
Xstr	Cond.	E(S)	$\beta$ (G1)	C(D)	G2
Q1	sq. open	0	0.7	0	-
	sq. closed	0	0	-	-
Q2		0	0	8	4
Q3		0	0	8	0
Q4-Q8	selected	2	2	8	-
	not select.	0	0	8	-
Q9	drive	0.7 to 1.8	0	8	-
	no drv	0	0	8	-

IC Measurements		
U1-1: 8V	U1-10: 0.76	U2-1: 7V*
U1-2: 7.6V	U1-11:	U2-8: 6V
U1-3: 7.8V	2.1V U1-12:	U2-14:
U1-4: 8V	0.7V	12V*
U1-5: 7.7V	(squelch	
U1-6: 7.7V	just closed)	
U1-7: 7.7V	U1-13:	
U1-8: 8V	+7.6v (sq	
U1-9: 3.3V	closed),	
(On freq.;	0V (sq	
varies w/freq)	open)	
	U1-14: 0V	
	U1-15: 0V	
	U1-16:	
	1.8V	

\* Voltage varies with power supply voltage. Values shown for 12Vdc input. Values will be higher with "12DC" power adapter.

Note that logic circuits are not covered in the tables because high/low level information is indicated by symbols on the schematic diagrams.

### 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.

## MAINTENANCE.

### 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.

### Frequency Adjustment.

Crystals normally age. Although the amount of long-term frequency drift due to aging is usually less than 1kHz/year at the channel frequency, it is normal to check the frequency of each channel oscillator once every year or two to see if it is necessary to trim it back on frequency.

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

Audio Test Point	Normal Level
U1-9 or TP-4 (Discriminator)	2V p-p audio
U1-11, top of R8 (noise ampl output)	4V p-p noise
Top of Volume Control R1	150mV p-p audio
U2-3 (af ampl input)	0 to 150mV p-p (dep. on volume)
U2-6 or J1-3&4 (af ampl output)	0 to 4V p-p audio

## THEORY OF OPERATION.

Refer to the schematic diagram in figure 4, sheet 1. The vhf signal from the antenna is amplified by low-noise dual-gate fet Q2. Antenna impedance matching is provided by the tuned circuit at the input of Q2. A double-tuned output tank circuit provides image rejection and rejection of interference from out of band signals. First mixer Q3 converts the 137.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, shown on sheet 2 of the schematic.

The injection signal for the first mixer is obtained from one of five crystal oscillators, Q4-Q8, which are selected by the scan circuitry shown on sheet 2. The 14.xxx MHz signal from the selected oscillator is tripled once in the double-tuned tank circuit at the collector of the oscillator (L4-L5) to the 42 MHz range. This frequency is tripled again in tripler Q9 to the 126 MHz range.

Refer now to schematic figure 4, sheet 2. 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 wideband 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 L8 sets the center frequency of the detector, and resistor R4 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. C6 is a master bypass capacitor which ties this B+ bus to ground all at one point. C7 and C8 bypass parts of the inter-

nal 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 C12 and partial de-emphasis network R5/C11.

Pin 14 is the collector of a squelch muting transistor switch inside the ic. This transistor is controlled by the dc signal at pin 12 and effectively grounds the audio line to squelch it when only noise is present in the detected signal. The signal at pin 12 is derived from two sources, bias from the SQUELCH control and detected noise from pin 11 through voltage doubler rectifier C15, CR1, CR2. C16 averages signal peaks. Combined with hysteresis action in the ic at pin 12, this prevents the squelch from bouncing on and off with fading signals and makes the squelch action positive acting.

Inside the ic, there is an op amp between pins 10 and 11 which acts as an active bandpass filter peaked at about 10 kHz, looking for white noise above the normal audio frequency range. The active filter is formed by R6, R7, R8, C13, and C14.

Audio from the VOLUME control is applied to the speaker and computer's sound card through power amplifier U2. C5/R3 is a parasitic suppression network, which normally is not used in this application, but we left space for it just in case.

Channel selection is done by the scan circuit, consisting of U4 and U5. Ring counter U5 is clocked at a 4 pps scanning rate by U4B-U4C. This turns on each channel for a ¼ Sec period, which is long enough for the receiver squelch circuit to respond if it hears a signal for that satellite frequency, even if there is some fading. When pin U5-13 is enabled (low), U5 continually sequences from one output to another. The counter stops when the enable signal at pin 13 is removed.

The selected output from the counter is a positive current to operate the appropriate LED and channel oscillator. The output voltage is limited by the LED to about 2Vdc. This voltage acts as bias for the base of the selected oscillator transistor shown on sheet 1.

Scanning control is done by OR-gate U4-D. When the SCAN switch is in the AUTO position, pin 12 is held low, and the output of U4-D is controlled by the COS (carrier operated

switch) signal from the squelch circuit. When the squelch is closed, the ring counter is enabled and it changes channels. When the squelch circuit opens due to a received signal, the ring counter stops on that channel.

With the SCAN switch set to MAN, a positive voltage from R12 is fed to U4 pin 12 constantly to lock on the enable signal for the ring counter. However, the positive voltage through R13 disables the clock oscillator; so the ring counter stays on one channel. When you want to change channels, operating the SCAN switch to the STEP position grounds U4-B and allows the clock to run. If you flick the switch momentarily to the STEP position, the clock only cycles once. If you hold the switch in the STEP position, the clock continues to run until the switch is released.

## PARTS LIST.

Ref Desig	Description	(marking)
C1-C3	10 uF electrolytic	①
C4	47 uF electrolytic	①
C5	not used	
C6-C8⑦	0.1 uF	
C9⑦	220 pF	
C10	68 pF	
C11⑦	.0047 uF	
C12	0.15 uF mylar	(red)
C13-C14⑦	.001 uF	
C15	0.15 uF mylar	(red)
C16	1 uF electrolytic	①
C17⑦	.0047 uF	
C18①	Two 2.2uF electrolytics back to back as per dwg	
C19⑦	.0047 uF	
C20⑦	27 pF	
C21	68 pF	
C22-C23⑦	.0047 uF	
C24⑦	18 pF	
C25⑦	0.5 pF	
C26⑦	15 pF	
C27⑦	4 pF	
C28-C30⑦	.0047 uF	
C31-C35	2-30 pF variable	② (green)
C36-C40⑦	22 pF	
C41-C50⑦	150 pF	
C51-C55⑦	.0047 uF	
C56	82 pF	
C57⑦	1 pF	
C58	82 pF	
C59⑦	.0047 uF	
C60⑦	27 pF	
C61⑦	0.5 pF	
C62⑦	22 pF	
CR1-CR2	1N4148 diode	①
DS1-DS5	T-1 red L.E.D.	①
FL1	10.7 MHz cer filter	(10.7MA)
FL2	455 kHz ceramic filter	(455B)
J1	DB-9 male jack	
J2	BNC right-angle jack	
L1-L3	2½ turn slug-tuned	(red)
L4-L5	6½ turn slug-tuned	(blue)
L6-L7	2½ turn slug-tuned	(red)

L8	455 kHz i-f xfmr (T1003 or RLC-352)
Q1	2N5770
Q2-Q3	BF998 mosfet ① ⑤
Q4-Q9	2N5770 ①
R1-R2	100K panel mount pot
R3	not used
R4⑦	15K
R5⑦	510K
R6⑦	4.7K
R7⑦	680Ω
R8⑦	510K
R9⑦	150K
R10	150K
R11⑦	4.7K
R12⑦	27K
R13⑦	150K
R14⑦	330K
R15-R16⑦	100K
R17 ③	100K
R18	270Ω
R19-R23⑦	6.8K
R24-R28⑦	270Ω
R29 ③	1K
R30⑦	3.9 meg
S1	mom-off-on toggle sw ④
S2	on-on toggle switch ④
U1	MC3361BP IF ampl ①
U2	LM-380 audio out ①
U3	78L08 voltage regulator ①
U4	4001B quad nor gate ① ⑤
U5	4017B ring counter ① ⑤
Y1	137.100 ⑥ (14.044,444)
Y2	137.400 ⑥ (14.077,778)
Y3	137.500 ⑥ (14.088,889)
Y4	137.620 ⑥ (14.102,222)
Y5	137.9125 ⑥ (14.134,722)
Y6	10.245 ⑥
Z1-Z5	Ferrite bead, prestrung

## Notes:

- ① Observe polarity.
- ② Install flat end oriented as shown.
- ③ Leave 1/16" test point loop at top and face as shown.
- ④ There are two different switches.
- ⑤ Caution: Static sensitive part!
- ⑥ Caution: Fragile part!
- ⑦ Surface mount part under board

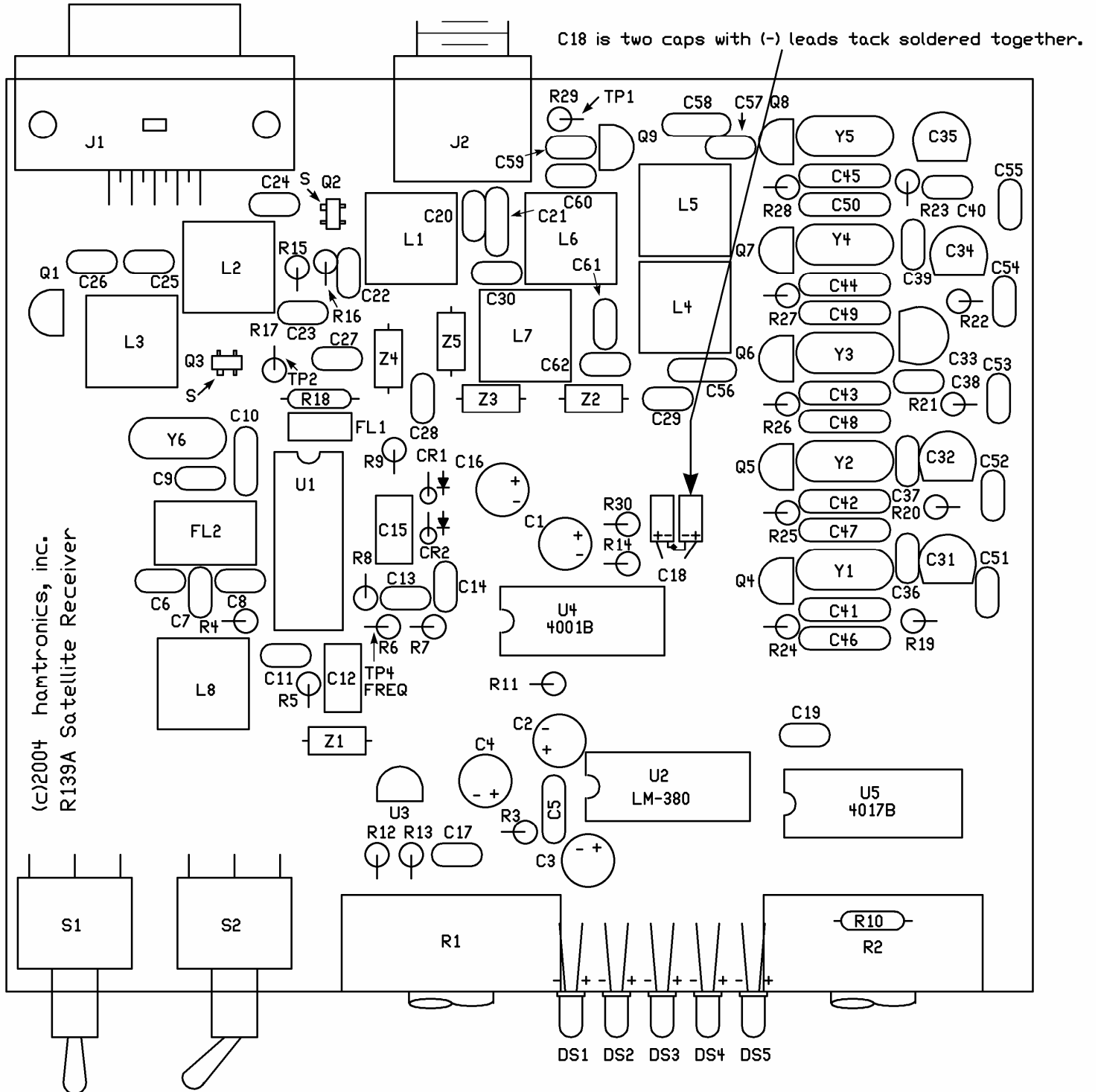
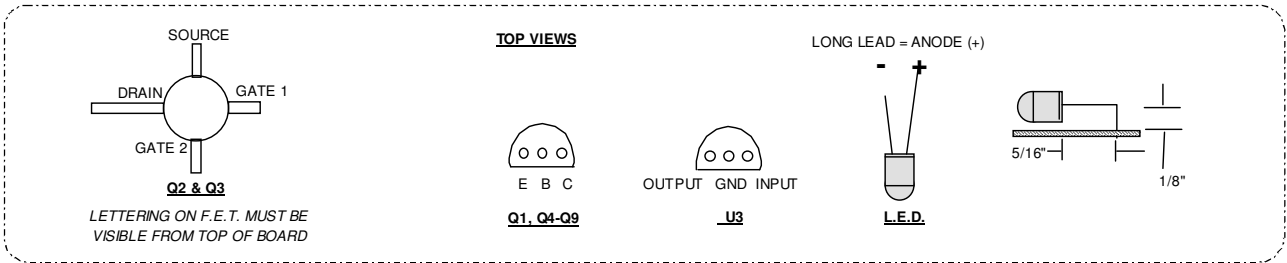


Figure 3. R139 Component Location Diagram

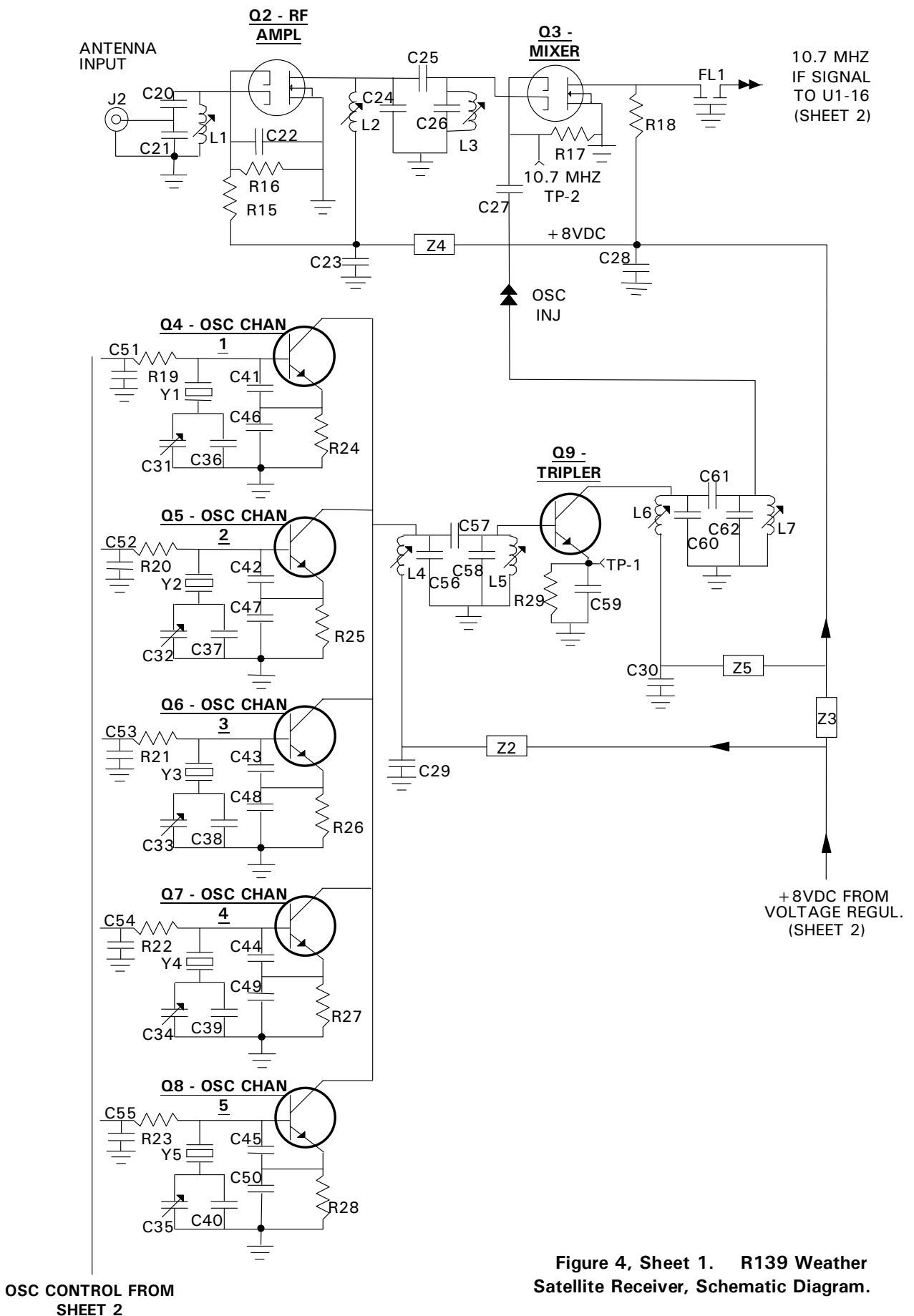


Figure 4, Sheet 1. R139 Weather Satellite Receiver, Schematic Diagram.



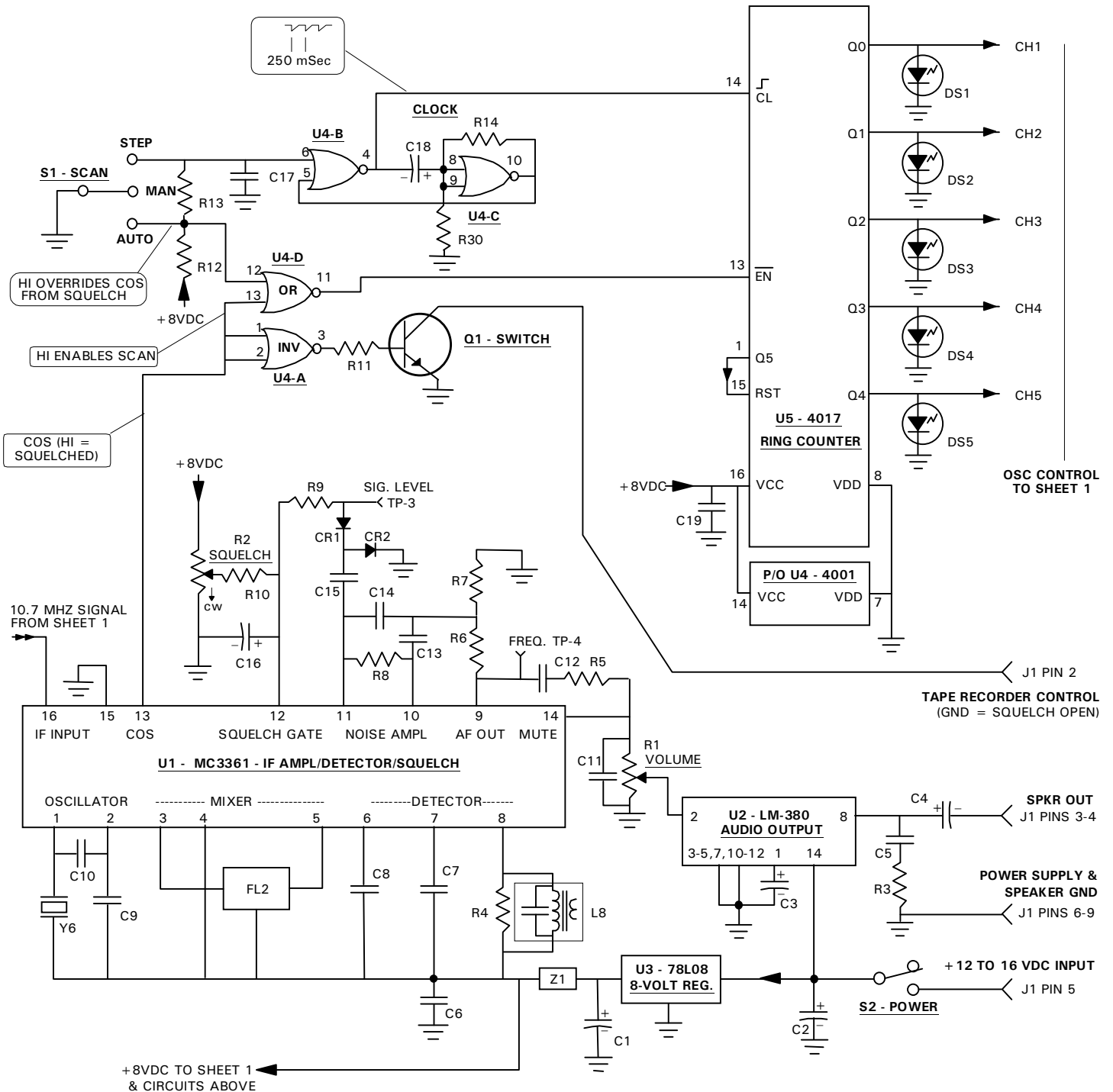


Figure 4, Sheet 2. R139 Weather Satellite Receiver, Schematic Diagram.