OPERATING INSTRUCTIONS
FOR
SR-C146

5 CHANNEL 1 WATT
VHF・FM
PERSONAL 2 WAY RADIO FOR AMATEUR

Scanned by
-ELKOBA-
for NED-Radio

STANDARD RADIO CORP.

3622 Kamitsuruma, Sagamihara-shi Kanagawa
Phone : 0427-43-1111
Cable : TLX 2872-210 DRADNATS TOKYO

SPECIFICATION

GENERAL :

Frequency range :	144~148 MHz
Number of channel :	5 spot frequencies (bandspread within 2 MHz)
Power supply :	12.6 V DC
Power consumption :	Stand by (SQL on) Approx. 15.0 mA
	Receive 〃 72.2 mA
	Transmit 〃 370.0 mA
Battery life :	10 hours or more
	(10% transmit / 10% receive / 80% stand by)
Dimensions :	75 (W) × 210 (H) × 31 (D) m/m
Weight :	Approx. 1 kg (with battery)

TRANSMITTER

RF output :	1.0 watt or more
Frequency stability :	± 0.003% (−10°C~+45°C)
Modulation :	±5 KHz (narrow band)
	±15 KHz (wide band)
Crystal multiplication :	12 times
Spurious & harmonics :	More than 50 dB below carrier
FM noise :	At least 45 dB
Audio response :	+1 dB, −3 dB of 6 dB/octave pre-emphasis between 300-3000 Hz

RECEIVER

Sensitivity :	0.4 uV or less (20 dB noise quiet method)
Squelch sensitivity :	0.2 uV or less
Selectivity :	60 dB down at adjacent channels
Audio output :	0.5 watt to built-in speaker
Frequency stability :	±0.003% (−10°C~+45°C)
Circuitry :	Double conversion superheterodyne

* Specifications subject to change without notice,

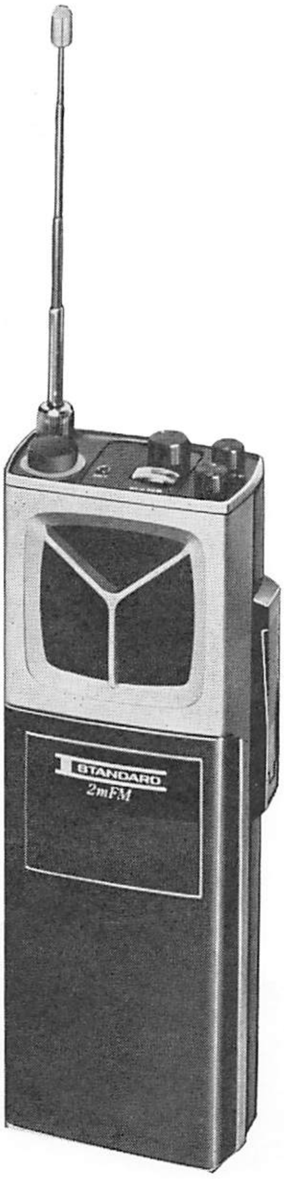
SECTION I

DESCRIPTION

1-1 Description

STANDARD SR-C146 solid state personal VHF/FM Amateur Transceiver is designed for a compact, high performance, 5 channel, 1 watt RF output and for the operation in the range of between 144 to 148 MHz.

The audio section of the transmitter contains an IC to minimize the size. Both the transmitter and receiver are taken into the consideration to employ IC and transistorization for a better reliability and lower battery drain.



The power for the radio is supplied by AA size eight pieces carbone zinc batteries, eight pieces mercury cells or ten rechargeable Ni-cad batteries.

All the operating controls are concentrated to the top of the radio. The collapsible antenna can be pushed it down into the radio for easy carrying and for short range communication. On the operation of the radio with a flexible antenna SR-CAT12 or herical antenna SR-CAT08, the collapsible antenna may be replaced by either of them.

Auxiliary jacks are provided for an external microphone, an external micspeaker, an earphone, a lapel speaker, an external antenna, a battery charger and other accessories.

1-2 Operation

Befere operating the radio, check and see if the batteries are correctly installed. When using the collapsible antenna, make sure that the antenna is in upright, fully extended position for a maximum length.

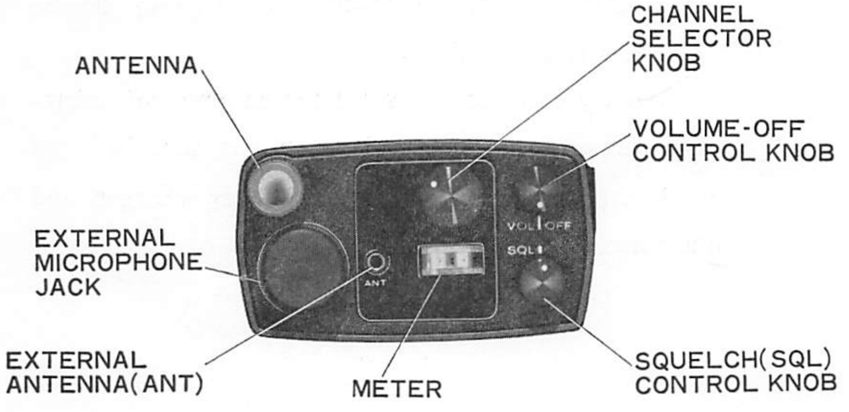
To receive a message ;

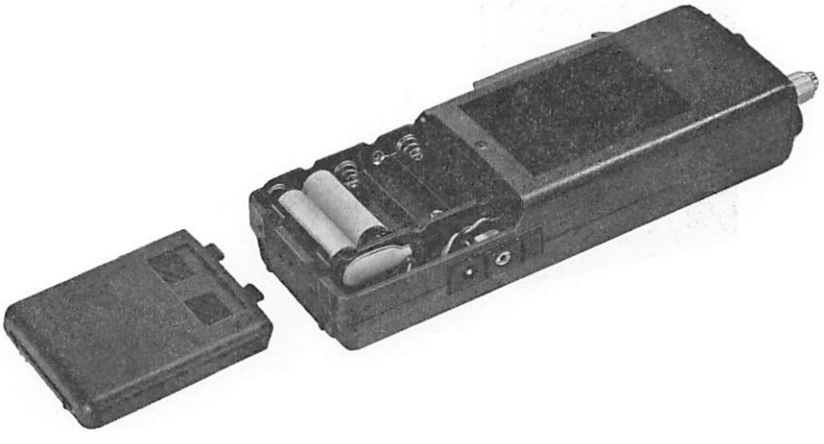
1. Turn on the SQUELCH (SQL) control fully counterclockwise.
2. Turn the volume-off control clockwise until a hissing sound is heard from the speaker.
3. Turn the squelch control clockwise until the hissing sound just fade out.
4. Select the proper channel by rotating the channel selector knob. The set is now ready to receive a message from other radios by this system.
5. The meter indicator indicates the strength of the incoming signal.

To send a message ;

1. Turn the radio on as described in " To receive a message ".
2. Hold the radio so that the antenna becomes vertical, and press the push-to-talk button to put the transmitter on the air. Release the push-to-talk button as soon as you stop talking then you can receive an answer to your call. The receiver will operate only with the button released. After you receive an answer, you complete your massege.

   In order to turn the radio off, turn the volume knob to counterclockwise until it clicks.





1-3 To check the battery life

The meter which is located on the top of the radio indicates a battery voltage.

The red marked zone on the meter indicator means voltase over 10. 5 V which is the usable effective battery. If you find the meter indicating less than 10. 5 V, replace all the batteries or charge them.

SECTION II

THEORY OF OPERATION

2-1 FUNCTIONAL OPERATION

Functional operation of the SR-C146 of VHF/FM personal transceiver is illustrated in the Block Diagram, Figure 2-1. The transceiver consists of a crystal controlled receiver and transmitter, employing solid state circuitry throughout, and is designed to operate from 12 volt batteries or negative ground source.

2-2 Receiver

The receiver is a double-conversion superheterodyne type. A crystal controlled first local oscillator provides for selection of up to 5 channels.

The input signal is amplified by an RF stage and applied to a mixer where it is heterodyned with the output of the first local oscillator and converted to the first IF, 11.7 MHz. The 11.7 MHz signal is then amplified and applied to the second mixer where it is heterodyned with the output of a second crystal controlled local osillator, and converted to the second IF, 455 KHz.

The 455 KHz signal is applied through a selective filter to shape the IF passband, amplified in four cascade stage, and applied to a limiter and FM detector. The limiter removes any vestige of amplitude modulation from the signal, while the FM detector functions to recover the modulation, producing an audio output in response to a corresponding frequency (or phase) shift in the 455 KHz IF signal. The FM detector output is then amplified by an IC and two transistors and applied to the speaker.

A "noise-actuated" squelch circuit is included to silence the receiver output when no carrier is present. This is accomplished by amplifying and detecting the "noise" component in the 455 KHz output to produce a DC level. This DC level is removed, opening the audio channel, when a carrier is received and the "noise" component decreases due to the quieting action of the limiter.

2-3 Transmitter

The transmitter is designed for FM (phase modulated) transmission. A crystal controlled oscillator provides for selection of up to 5 channels within 2.0 MHz range at the output frequency.

Generation of Phase Modulated Signal. The oscillator is crystal controlled and generates the initial RF signal in the frequency range of 12 MHz, depending on the output frequency. The RF signal is then applied to the phase modulator, together with the audio modulating signal. The audio modulating signal varies the internal and input capacities of the phase modulator transistor, in turn causing the applied RF signal to be shifted in phase at an audio rate.

The angular phase shift produced by the modulator without distortion is relatively small. Therefore, the oscillator frequency is multiplied 12 times to obtain the desired deviation at the output frequency. A tripler stage and doublers provide the necessary 12 times frequency multiplication, followed by driver and final RF power amplifier.

The final RF Power amplifier develops the output signal applied to a four-section pi-network. The pi-network in turn matches the output impedance of the power amplifier to the 50-ohm antenna, as well as providing the selectivity to attenuate spurious and harmonic signals which might appear in the output.

Instantaneous Deviation Control. The transmitter contains an instantaneous deviation control (IDC) circuit. This circuit limits the output frequency deviation to the desired deviation preventing overdeviation when a higher than normal microphone output occurs.

The audio signal from the microphone is applied through two stages of speech amplifier a peak limiter, low-pass filter, and an integrater circuit, to the phase modulator. The phase modulator has an inherent 6 dB/octave pre-emphasis characteristic, and under normal output levels from the microphone the transmitter FM carrier output is pre-emphasized 6 dB/octave.

The component values employed in the speech amplifier are such that a 6 dB/octave pre-emphasis is applied to the input audio. The peak limiter will have no effect on the audio signal until the microphone output increases to a point where overdeviation would occur. Therefore the non-limited pre-emphasesed signal is applied through the filter to the integrator which has 6 dB/octave de-emphasis characteristics. This offsets the pre-emphasis applied in the speech stages, resulting in a "flat" output being applied to the phase modulater. The 6 dB/octave pre-emphsis characteristic of the modulator then becomes the only factor affecting the RF output.

If the microphone output level increases to a point where overdeviation would occur, the limiter "clips" both positive and negative peaks of the audio waveform. This results in an essentially square wave signal of constant amplitude, removing the 6 dB/octave pre-enphasis from the speech amplifier. The limited audio waveform is then reshaped in the low-pass filter, and applied to the integrator. As the signal at the integrator input is of constant amplitude, the output will be de-emphasized 6 dB/octave as applied to the phase modulator. This then offsets the inherent 6 dB/octave pre-emphasis characteristic of the phase modulator where frequency deviation vs. frequency is essentially flat.

2-4 Receiver section

RF amplifier stage. A Metal Oxide Silicon Field Effect Transistor (MOS FET) is employed as the RF amplifier, Q1. This minimizes responses to spurious signals and intermodulation products, and provides a low "noise figure" for the receiver input.

The RF input signal from the antenna is applied across a double tuned circuit and coupled to gate "1" of Q1. Forward bias is applied to gate "2" of Q1, and the output at the drain is applied across a second double tuned circuit and coupled to the base of the first mixer, Q2.

First Mixer and 11.7 MHz IF Amplifier. The first mixer, Q2, is a high performance transistor with the RF input signal, and the first local oscillator injection signal applied at the base, together. The two signals are heterodyned by Q2, and the resulting 11.7 MHz difference signal at the collector is then coupled through a double tuned circuit to the base of Q3, which functions as an 11.7 MHz IF amplifier. The signal from the collector of Q3 is then coupled through a second double tuned circuit to the base of the second mixer, Q4.

First Local Oscillator Circuit. The first local oscillator injection frequency is 11.7 MHz below the input signal frequency in all cases. The fundamental crystal frequencies are in the 16 MHz range, and are multiplied nine times to reach the injection frequency. The proper crystal frequency for a desired receiver signal frequency may be determined from the following equation:

$$fc=(fi-11.7)/9$$

where: fc=fundamental crystal frequency in MHz
fi=desired receiver signal frequency in MHz

The Channel Selector. The switch will select up to 5 crystals to control the frequency of the oscillator. Trimmer capacitors C55 thru C62 permit the individual crystals to be "netted" to the exact channel frequency. Transistor Q12 functions as a fundamental forward biased modified Colpitts oscillator, and also trippler with the selected crystal connected between base and ground. The 3 times of 16 MHz output is taken at the emitter, and coupled to the base of the first tripler, Q13.

The collector output of Q13 is resonated to the third harmonic of the crystal frequency by a double tuned circuit, and applied to the base of the 1st Mixer Q2.

Q3 is a first IF amplifier. The input side coils L5, L6 and collector side coils L7 and L8 are tuned for 11.7 MHz. C19 is used as a neutral capacitor for Q3.

Second Mixer. The 11.7 MHz signal from Q3 is applied to the base of Q4, while a 12.155-MHz injection signal derived from the second local oscillator, Q14, is applied at the emitter.

The two signals are heterodyned by Q4, and the resulting 455 KHz difference signal (12.155-11.700 MHz at the collector becomes the second IF, across the primary winding of L8).

Transistor Q14 functions as a fundamental forward biased modified Colpitts oscillator, with a 12.155 MHz crystal connected between base and ground. The second local oscillator injection signal is taken at the emitter of Q14, and coupled through C23 at the base of Q4.

455 KHz IF Filter. The 455 KHz signal from Q4 is applied through a bandpass filter to obtain the IF passband characteristics. The filter circuit produces a steep skirted shape factor to attenuate signals falling outside of the required IF passband, thus establishing the overall receiver selectivity.

455 KHz IF Amplifier Circuit. Transistors Q5, and Q6 thru Q8 function in a DC connected four stage cascade circuit, with the output applied to the base of the limiter, Q9.

Limiter Circuit. The four cascade IF stages provide some limiting action. However, the primary limiting is accomplished in Q9, due to the overall gain, together with application of forward bias on the base. This causes Q9 to saturate at a very low signal level. The collector output of Q9 is applied across the series connected primary windings of L9 and L10 to provide an input to the FM detector, D1 and D2. A sample of the collector output from Q9, across R34 is also applied to the "noise-actuated" squelch circuit.

FM Detector Circuit. The secondary widing of L9 is connected in series with the center-tap on the secondary of L10, while diodes D1 and D2 are connected to detect a positive or negative voltage in the secondary winding of L10. As the secondary winding of L10 and the two diodes represent a balanced cricuit, an unmodulated 455 kHz signal from Q9 will produce "zero" voltage at the center-tap. However, a frequency deviation in either direction in the 455 kHz signal (from an FM modulated component) causes a phase shift in the winding developing a corresponding positive or negative voltage at the center-tap to reproduce the audio signal originally impressed on the carrier.

The audio signal is then applied through a de-emphasis filter network, and across the VOL control, R40, to the first audio IC.

Noise-Actuated Squelch Cricuit. Gaussian noise appears as an AM signal in the 455 kHz IF output. This is sampled across R34 in the collector return for the limiter, Q9. This signal is filtered, peaked by a low-frequency tuned circuit, and applied across the SQL control, R62 to the base of the noise amplifier, Q16. The noise is amplified by Q16, Q17, detected by D6 and D7, and applied to the base of the squelch amplifier, Q18. Transistor Q18 is a NPN type, the collector output is applied to the IC.

When no carrier is present, "noise" in the 455 kHz IF is amplified and detected to forward bias Q18 into conduction. This develops a voltage drop across R44 to silence the receiver audio output. The SQL control, R62, permits the threshould level for the "noise" signal to be adjusted, thus setting the point where the squelch circuit will actuate.

When a carrier is present the "noise" in the 455 kHz IF decreases due to the quieting action of the limiter, in turn reducing the output from the squelch detector and cutting Q18 off.

Audio Circuit. The audio signal from the FM detector is applied across the VOL control R40 to the IC. This IC works as audio amplifiers and phase convertor for the next class "B" push-pull amplifier stage. Q10, Q11 function in a complimentary symmetry circuit, since Q10 is NPN transistor and Q11 is PNP. The PA stage delivers the audio power to the speaker which has 32 ohms impedance.

2-5 Transmitter Section

Speech Amplifier. The transmitter employs a magnetic type microphone, which is located by the speaker on the front pannel of the radio, to convert the impressed speech to a variable voltage or an audio signal. The audio signal is then applied through an RF filter network C450, C453, R437, to IC. This IC is equivalent to two stages direct coupled audio amplifier. The output of this IC applied to the IDC limitter, diodes D404 and D405. The values of components used in the RC network of microphone and IC applie a 6 dB/octave pre-emphasis to the audio signal over the speech frequency range.

IDC Limiter and Low-Pass Filter. Diodes D404 and D405 are biased through R425 to "clip" both positive and negative peaks if the input waveform exceeds the pre-determined level. Thus, up to the limiting level the audio waveform will exhibit a 6 dB/octave pre-emphasis characteristic, and exhibit a constant amplitude output when the level is exceeded. The limiter output is then applied to the low-pass filter.

The low-pass filter performs a post limiter audio roll-off function, attenuating frequencies above 3000 Hz as required by the law. This attenuation of audio frequencies above the nominal speech range limits the transmitter modulated spectrum to the required bandwidth, and reshapes the audio waveform. The filter output is then applied to the base of the integrator, Q409.

Integrator. The integrator, Q409, provides a 6 dB/octave de-emphasis to the audio signal. Where the input speech level was of normal amplitude this de-emphasis will offset the 6 dB/octave pre-emphasis from the speech amplifier, resulting in an essentially flat frequency response for the audio modulating signal applied to the phase modulator, Q402. However, in a case where the input audio waveform has been limited, the output to the phase modulator will be de-emphasized 6 dB/octave.

The integrator output at the collector of Q409 provides an impedance match between the deviation limiting circuit and the phase modulator stage. The IDC potentiometer, R432, in turn adjusts the audio level applied to the emitter of the phase modulator, Q402, thus setting (and limiting) the transmitter deviation to ±5 kHz (narrow band) or ±15 kHz (wide band).

Oscillator Circuit. The crystal oscillator, Q401, functions in a fundamental frequency range of 12 MHz. This oscillator is a modified Colpitts circuit, with Q401 functioning in a forward biased common collector configuration. The emitter output from Q401 is then applied to the base of the phase modulator, Q402.

The temperature characteristics of capacitors C401 thru C403, C409 and C410, compensate for the frequency drift characteristics of the crystal.

Phase Modulator. The RF signal from the oscillator is applid at the base of Q402, while the audio modulating signal is applied at the emitter. The modulating signal at the emitter varies the capacity of Q402 in accordance with the audio voltage. With a fixed phase shift shunting the stage, and a variable phase shift through Q402, an overall variable phase shift is produced in the output, across L401. This output is then coupled to the base of the first doubler, Q403. Variable inductor L401 permits the modulator output to be maximized.

Frequency Multipliers. The 12 MHz phase modulated signal from Q402 is multiplied 2 times by Q403, and coupled through a double tuned circuit to the base of th tripler, Q404. Forward bias is applied to the base of Q403 to increase the sensitivity of this stage.

This is required due to the relatively low output obtained from the phase modulator stage.

The tripler, Q404, and doubler, Q405, function as conventional class "B" frequency multipliers, developing the output frequency signal applied to the driver stage, Q406 and Q407.

Final RF Power Amplifier and Output Circuit. The RF signal from Q406 and Q407 is amplified by Q408, which functions as a conventional class "C" power amplifier. The four-section pi-network, L411 thru L412, matches the collector output of Q408 to the 50-ohm antenna, and also functions as a low-pass filter attenuate signals above the transmitters operating range.

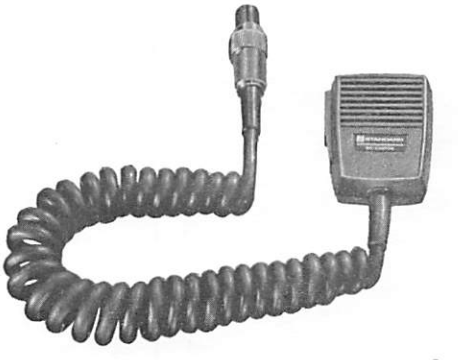
T/R Switching Circuit. T/R (Transmit and Receive) switching circuit consist of D401, D402, D407, Q410 and Q411. In the receiving mode, the supply voltage is appeared at the emitter of Q410. This voltage is used for the operation of whole the receiver. The collector voltage of Q405, Q406, Q407, and Q408 is always appeared, however Q401, Q402, Q403, Q404 mic. amp. IC and Q409 do not work due to no voltage. In the transmit mode, by turning S001, the voltage at the emitter of Q410 disappears, but the voltage at the collector of Q411 appears. This causes to work whole the transmitter, also the current flows through R418, L413 (RF choke) D401, L414 (L414, C443 series tuned for operating frequency) D402 to the ground. This means that D402 which is connected with the receiver antenna circuit in parallel conducts and D401 also works at conducted mode.

S E C T I O N III

OPTINAL ACCESSORY

Options.
Following optional parts for SR-C146 are available on customer's request.

SR-CMP08 External microphone. A small high reliable dynamic microphone is combined in a hi-impact cycolac case with retractable neoprene coiled cord. When this external microphone is connected to the radio, the internal microphone is disconnected.



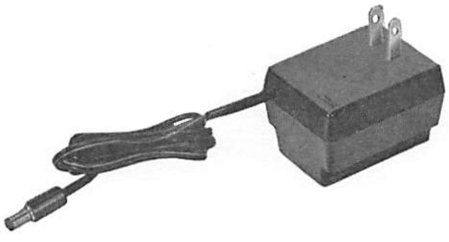
SR-CAT08 Flexible rubber coated antenna. This antenna will withstand rough handling, can be bent at different angles without distroying its effectiveness. This is completely insulated and cannot accidentally be shorted out but talking range of th e radio should be shorter than normal of 1/4 wave length antenna.

SR-CAT12 Flexible antenna. This is 1/4 wave length antenna made by music wire.

SR-CSA Base master. This is the AC Battery charger for Ni-Cd batteries. This is able to charge the Ni-Cd batteries built in the radio or Ni-Cd batteries in the battery-holder. Also this base master has an antenna connector-converter from UHF female to the external antenna plug for the radio, thus the base master can be used as the desk top type holder.

SR-CMA Mobile master. This has two functions, combined in the metal case with the magnet mount. The line filter choke is built in the case to avoide the alternator whine trouble, and a UHF female connector on the case to connect the external antenna to the antenna connector on the radio.

SR-C12/120-6 Charger. This is a low cost type Ni-Cd battery charger.

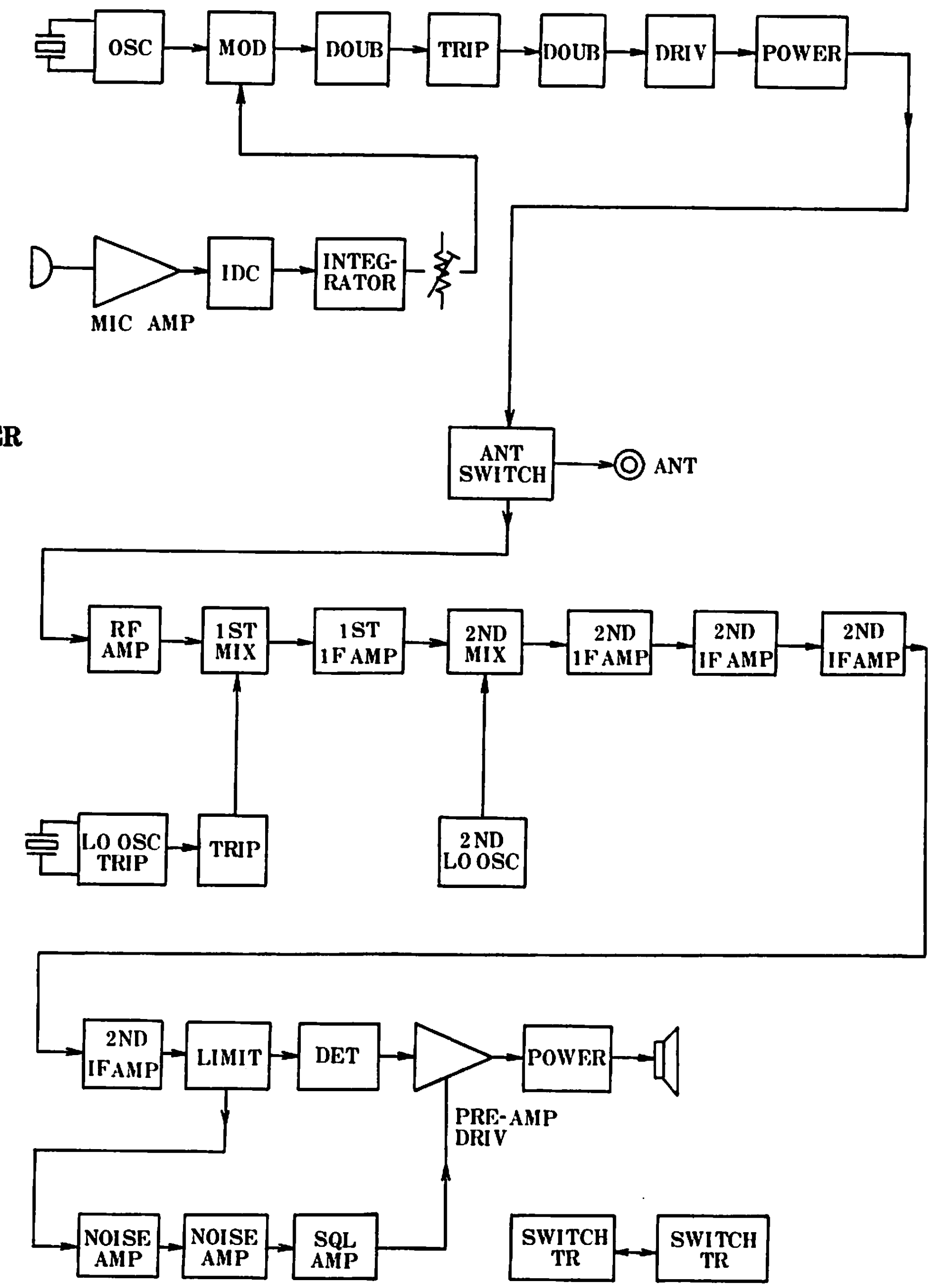


SR-CAD Antenna adaptor. This is a connector to connect the nornal antenna which has a UHF connector to the external anenna connector on the radio.

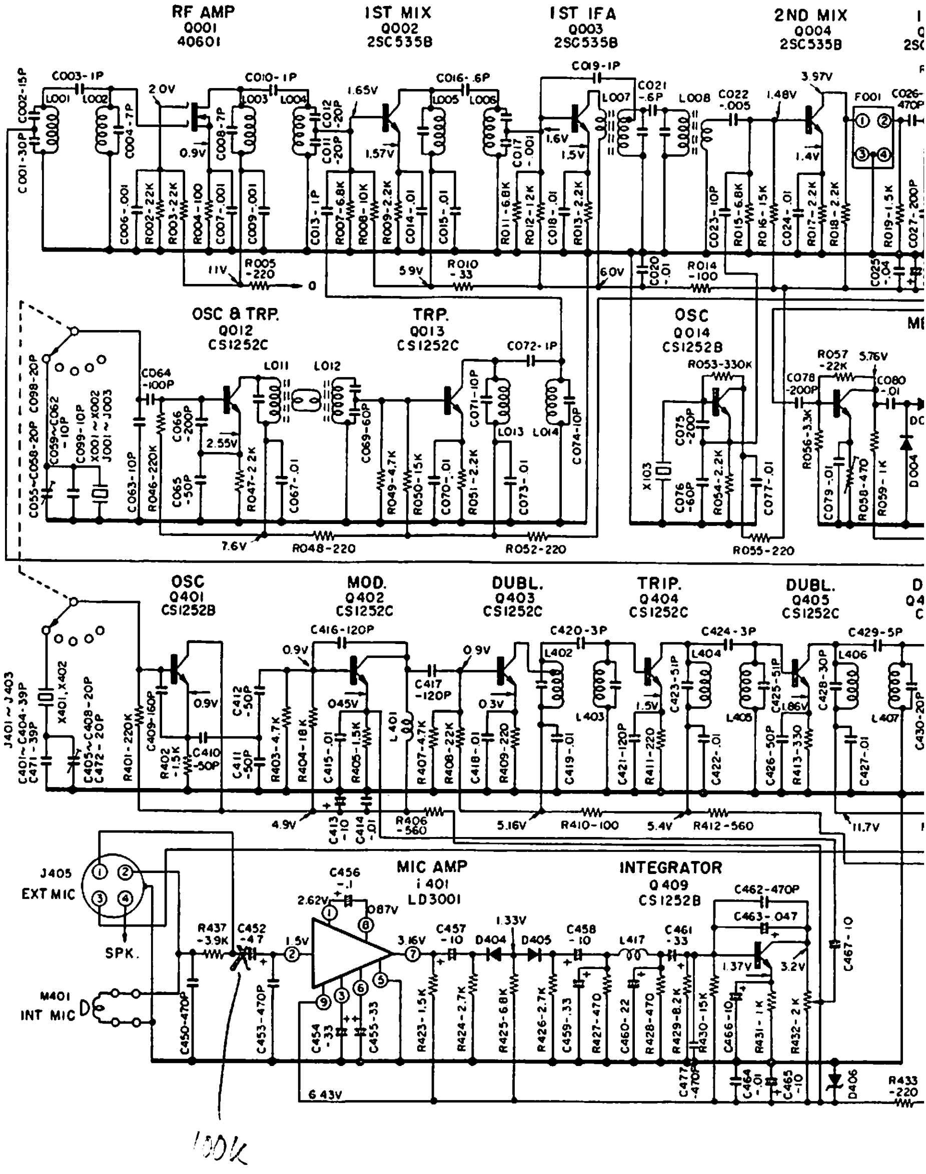
SR-C146 BLOCK DIAGRAM

TRANSMITTER

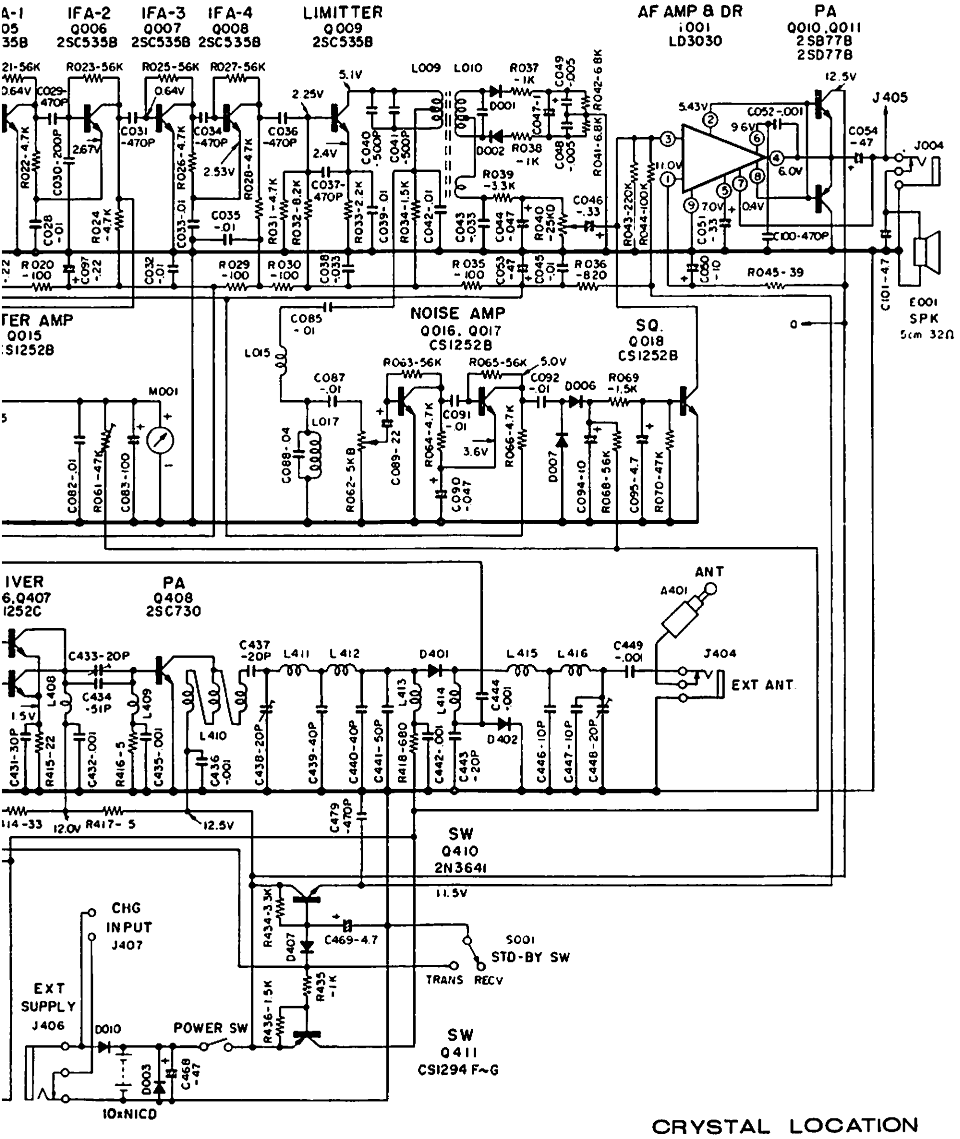
RECEIVER



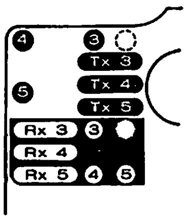
SR-C146 SCHE


RF AMP
Q001
40601
1ST MIX
Q002
2SC535B
1ST IFA
Q003
2SC535B
2ND MIX
Q004
2SC535B
OSC & TRP.
Q012
CS1252C
TRP.
Q013
CS1252C
OSC
Q014
CS1252B
OSC
Q401
CS1252B
MOD.
Q402
CS1252C
DUBL.
Q403
CS1252C
TRIP.
Q404
CS1252C
DUBL.
Q405
CS1252C
MIC AMP
I 401
LD3001
INTEGRATOR
Q 409
CS1252B
J405
EXT MIC
SPK.
M401
INT MIC

MATIC DIAGRAM



CRYSTAL LOCATION



CH 1, 2 are factory installed.