



COMMUNICATIONS INC.

SERVICE MANUAL

ON CALL ALERT RECEIVER

MODEL MCA-611

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SECTION 4 PARTS LIST

SECTION 1 GENERAL INFORMATION

1-1 DESCRIPTION

The MCA 611 is a two channel crystal controlled FM Receiver. The channel frequencies may be selected from any of three public service communications bands; Low VHF band (30-50) MHz, High VHF band (146-174) MHz and UHF band (450-512) MHz. The bands are jumper pin selectable and the two channels need not be in the same band.

The primary use of this receiver is as a tone alert device; it can also be used to monitor uncoded traffic on your alert channel at the user's discretion. In the alert mode the receiver is held in the squelched condition until its special coded signal is received.

There are two different two-tone codes that will activate each receiver. The codes are made up of three tones A, B and C. The first tone called A for convenience must be the lead tone of the two-tone sequence, the second tone can be either B or C but not both. This will allow all radios to have a common code as well as an individual code. (A,B) can be a common code and individual call codes can be (A,C), (A,D), (A,E), (A,F), etc.

The number of possible combinations of codes can be greatly increased by the installation of an MA 301 option. This essentially doubles the number of tones that can be received and allows for two first tones, or A tones which can be either the same or different depending on the owner's requirements.

The MCA 611 utilizes silicon transistors for reliability as well as ten integrated circuits. The tone decoder is a digital device unlike older models that used reeds. In addition, both a crystal first I.F. filter and a ceramic second I.F. filter are employed. This provides superior performance in areas where there are many closely-spaced channels.

In addition, this radio features both carrier controlled reset and timer controlled reset. Either one or the other may be used to reset the digital filter and return the radio to a squelched condition. The timer will run from 30 sec to 3 minutes and the other system resets and squelches the radio when the carrier stops. In order for the carrier reset to work, the radio must be squelched.

An external speaker jack and connectors for an AC or DC igniter have also been included on the back panel. The user has the option of either a pulsed or unpulsed igniter (jumper pin selectable).

1-2 SPECIFICATIONS

See page 2

1-3 EQUIPMENT SUPPLIED

- | | |
|-------------------------------|----------------------------|
| a. Receiver Unit | h. Antenna clip |
| b. DC Power Cord | i. Mobile Mounting Bracket |
| c. Telescopic Antenna | |
| d. Carrying Handle | |
| e. Owners' Instruction Manual | |
| f. Warranty Card | |
| g. AC Power Cord | |

1-4 EQUIPMENT NOT SUPPLIED WITH UNIT (ACCESSORIES)

- Antenna Splitter - MA-5
- Battery - MA-181
- DC Igniter - MA-24
- Remote Speaker - MA-108

1-2 SPECIFICATIONS

GENERAL

Channels.....	2
Operating temperature.....	-30°C to 60°C
Operating duty cycle.....	8 hr 10% alert
Size.....	6 1/2"W x 10 3/4"L x 2 5/8"H 16.5 x 27.3 x 6.7 cm
Weight.....	3.12 lb/1.42 kg
Voltage Req.....	117 vac, 12-17 VDC. Batt. 10.8 VDC
Current drain.....	@ 13.8 VDC
Receiver squelch.....	55mA
Receiver max audio.....	145mA
Antenna.....	50 ohm

RECEIVER

Sensitivity.....	20dB QUIETING/12dB SINAD
LL 30- 39 MHz.....	.5 / .4
LH 39- 50 MHz.....	.5 / .4
HL 146-160 MHz.....	.5 / .4
HH 160-170 MHz.....	.5 / .4
UL 450-470 MHz.....	.55 / .45
UH 475-500 MHz.....	.55 / .45
Audio sq. sensitivity -	
Threshold.....	.3 µv UHF
Tight.....	.34µv UHF
Adjacent channel.....	20dB QUIETING/12dB SINAD
Low VHF 30- 50 MHz.....	60 /45
High VHF 146-170 MHz.....	65 /65
UHF 450-500 MHz.....	45 /58
Spurious rejection (except primary image).....	50dB
Intermodulation attenuation.....	20dB QUIETING/12dB SINAD
Low VHF 30- 50 MHz.....	55 /45
High VHF 146-170 MHz.....	55 /55
UHF 450-500 MHz.....	45 /46
MAB.....	8.5 KHz
Freq stab temp.....	.0006% VHF
Freq stab volt.....	.001% VHF
Audio response.....	EIA +2/-8 6dB/octave de-emphasis
Audio out power (max).....	.5W
Squelch blocking.....	Meets EIA specs
Receiver attack time.....	150ms (max)
Receiver sq. closing.....	250ms (max)
Hum & noise ratio.....	38dB unsquelched, 50 squelched
Undesired conducted (AC).....	-85dB m (max)
Undesired conducted (RF).....	-94dB m (max)
Undesired radiated.....	FCC

DECODER

Frequency range..... 208 Hz - 3906 Hz
(continuously adjustable)
Audio input impedance..... greater than 10K ohm

6dB bandwidth..... 20 Hz

Inputs -

A0 audio input..... .2 - 1vrms
D12 RST input (MCA-611 only)..... 9V max.
K5 Microphone hang-up..... 0v (enable) open (reset)

Outputs -

D0 MSG lamp driver (MICRO-COM 2-way only)..... 30ma sink
D11 MSG latch Q output (MCA-611 only)..... 13ma source
K7 sq. control (MICRO-COM 2-way only)..... 15ma source

Sensitivity (decoder with audio).....12dB sinad 100% detect
..... 6dB sinad 75% detect

1-5 INSTALLATION

Mobile 12 VDC Installation:

The MCA 611 is designed for mobile installation in any vehicle that has a 12 VDC negative ground system. The red lead with the fuseholder must be connected to the positive terminal side of the battery. In the event that the battery is remotely located, it may be necessary to install additional wires or pick up +V from some other location in the vehicle's electrical system. Ground may be picked up from the optional mounting hardware but a hard wired ground to the phillips head screw on the back of the chassis is preferred.

Remove the antenna by rotating it counter clockwise. Install an MA-5 antenna splitter so the MCA 611 can share the vehicle's built-in antenna with the existing radio. Mount the bracket MA-63 to any convenient location and screw the radio into position with the two knurled knobs.

Battery Installation:

Remove the antenna by rotating it counter clockwise; remove the two knurled knobs and pull the case off. Place the connector end of the battery (MA-181) gently between the spring retainers and slide it forward until it makes good contact. Then attach the battery retaining bracket on the back of the battery and "snug" it forward until the battery is held firmly; tighten the bracket screw.

Crystal Installation:

The following Regency Part Number crystals are used:

Low VHF: 301-542
High VHF: 301-532
UHF: 301-603

Crystal socket X201 (XTL socket furthest from speaker) corresponds to the "normal" position of the front panel frequency select switch. X201's band select pin is on the anode of CR209. The band is selected by putting the other end of the jumper pin on one of the following pins, depending on the required frequency.

LL 30- 39MHz	HH 160-170MHz
LH 39- 50MHz	UL 450-470MHz
HL 146-160MHz	UH 475-500MHz

X202's jumper pin is connected to the anode of CR210 and corresponds to the "alternate" frequency.

After the crystals are installed, it will be necessary to tune it up in accordance with the instructions in the service manual.

Igniter Installation:

Two igniter drivers are provided on the main board; a pulsed drive and an unpulsed drive. The later is already wired to the bottom lug of the three terminal connector on the back panel of the radio. This makes the radio immediately compatible with the MA-24 Igniter Option.

If you require an ON-OFF feature for your igniter, simply remove the female jumper connector from Q213 and put it on the collector pin of Q212.

1-6 OPERATION

Volume Control:

This control varies the audio output level for the internal speaker. It also varies the level of audio present at the external speaker connection. Moving the control up increases the Volume level.

Squelch Control:

The squelch only works when the radio is in the monitor mode. It eliminates background noise in the absence of a signal. Full squelch is all the way down.

Alert Monitor Switch:

In the alert mode only the properly coded signal can open the squelch. In the monitor mode any traffic on the selected frequency can be monitored.

Frequency Switch:

This selects either F1 or F2.

Duty Switch:

Used only with an MA-301 option, otherwise it is left in the "Normal" position. This switch would allow an appropriately equipped radio to decode either AB and AC or ZE and ZF. (An internal connection will allow the radio to decode AB, AC AND ZE, ZF regardless of the duty switch position.

Alert and Ex. Pwr. Light:

Steady light indicates AC Power ON.
No light indicates radio is on battery.
Slow Flashing - Low battery.
Fast Flashing - a signal has been received.

Rear Panel:

For convenience of mobile operation, we have included two +V connectors on the back of the radio; one for the vehicle's battery and one to power the igniter option MA-24. The bottom connector is for the igniter drive. In addition, there is an external speaker jack which allows for a remotely located speaker, MA-108, as well as an external antenna jack to go with the MA-5 y coupler antenna.

1-7 CRYSTAL SPECIFICATIONS

Due to the numerous frequencies or channels involved, the crystals are not normally installed by the factory, but by the seller or owner of the unit. The Regency part numbers are listed in Section 1-5. When ordering from another manufacturer, the following information should be provided:

1. Crystal frequency, determined as follows:

Low Band: Crystal frequency = channel frequency +10.7 MHz

Example:

$$\text{Crystal frequency} = 39.5 \text{ MHz} = 50.2 \text{ MHz} - 10.7 \text{ MHz}$$

High Band: Crystal frequency = $\frac{\text{channel frequency} - 10.7 \text{ MHz}}{3}$

Example:

$$\text{Crystal frequency} = \frac{155.55 \text{ MHz} - 10.7 \text{ MHz}}{3} = \frac{144.85 \text{ MHz}}{3}$$

48.2833 MHz

UHF Band; Crystal frequency = $\frac{\text{channel frequency} - 10.7 \text{ MHz}}{9}$

Example:

$$\text{Crystal frequency} = \frac{458.0 \text{ MHz} - 10.7 \text{ MHz}}{9} = \frac{447.30 \text{ MHz}}{9}$$

49.70000 MHz

2. Frequency tolerance of 0.001% on High Band and UHF Band, 0.002% on Low Band.
3. UHF Band - 3rd overtone, load capacity of 18pf; drive level of 2 milliwatts.
4. VHF Bands - 3rd overtone, series resonance minus 450 Hz.
5. Maximum impedance of 35 ohms.
6. Holder is an HC-25/U with pin leads (plug-in type).

SECTION 2 CIRCUIT DESCRIPTION

2-1 CRYSTAL SELECT CIRCUIT

The two crystals X201 and X202 are selected by jumpering pins on the anodes of CR209 and CR210 to the appropriate pin corresponding to the frequency divisions on the device specification page. When a band is selected, bias is applied to the appropriate front end by causing the associated diodes to conduct through the frequency selector switch SW401 to ground.

When the UH Pin is selected, ground is applied to R229 and R224 thus biasing the UHF amp and mixer. In all cases except the LH select case, the low band varactors are held close to ground by CR223, 222 and 221. When the UL Pin is selected the tuning varactors CR205 and CR206 have a variable bias through R243.

By selecting any other band the AFC which is only needed for the UHF is disabled by diodes CR215 and CR218.

Selecting HH applies ground to the High VHF RF amp Q203 and mixer Q204 bias resistors. Varactors CR203 and CR204 are at +8 volts. Selecting HL grounds R250 providing variable bias to those diodes, (CR203 and CR204).

Selecting LH grounds R203 and R216 and puts 8 volts on the cathodes of CR201 and CR202. Selecting LL grounds CR201 and CR202.

2-2 RF FRONT END

Q201 is the Low Band VHF amplifier. Varactor tuning is used in the input and output circuits to determine whether the circuits are tuned to the upper or lower segment of the low band. The RF signal from Q201 is coupled to the input of the low band mixer Q202.

Q203 is the High Band VHF RF amplifier. The input circuit is double-tuned. Varactor tuning is used to tune both parts of the double-tuned circuits to determine whether the circuits are tuned to the upper or lower segments of the high band. The RF output signal from Q203 is coupled to the input of the high band mixer Q204.

Q205 is the VHF RF amplifier. Varactor tuning is used in the input and output to determine whether the circuits are tuned to the upper or lower segments of the UHF band.

2-3 OSCILLATOR/MULTIPLIER

Q208 is the crystal controlled local oscillator. The fundamental frequency of the crystal is taken from the emitter circuit for low band VHF injection. The third harmonic of the crystal frequency is taken from the collector circuit for high band injection. When operating on UHF, the third harmonic of the crystal frequency at the collector of Q208 is coupled to a frequency tripler Q207 which multiplies the frequency by three for UHF injection. Q207 is turned on only for UHF operation. The fundamental frequency of the crystal is multiplied by nine for UHF injection.

2-4 I.F.

The first I.F. frequency 10.7 MHz, from any one of the mixers, is fed through XF201 (a monolithic crystal filter) to the input of IC201 (Pin 18). Between Pins 18 and 3 is the second I.F. mixer circuit. Crystal X203 is used to generate the second L.O. frequency (10.245 MHz) used to mix with the 10.7 MHz I.F. to produce the second I.F. frequency 455 KHz. The 455 KHz signal at Pin 3 of IC201 is fed through CF201, a narrow band ceramic filter centered at 455 KHz, to Pin 5 of IC201. Between Pins 5 and 10 of IC201, there are amplifiers, limiters and a quadrature detector circuit. The adjustable quadrature coil is connected between Pins 8 and 4 of IC201.

2-5 AUDIO

The demodulated audio from Pin 10 is de-emphasized by R262 and C265 and capacitively coupled through the squelch switch Q209 to the audio amplifier IC202. The squelch amp and squelch switch are inside IC201. A logical low on Pin 14 (audio being received) sets Pin 16 High thereby providing bias to Q209 and allowing audio to pass into IC202. A High on Pin 14 of IC201 (noise) produces a low on Pin 16, IC201, grounding the bias current on Q209 and squelching the audio. The noise level at which the squelch switch engages is controlled by R403, the squelch control.

2-6 TWO-TONE SEQUENTIAL DECODER

Audio enters at A0 and is limited by CR301 and CR302. The audio is then filtered by a high-Q digital filter and the amplified output appears at Pin 1 of IC304. The voltage has to be 4 vpp in order to trigger the detector in IC303. The audio is further amplified by IC304 and the output Pin 7, IC304 is fed to the harmonic detector of IC303 (Pin 5). The harmonic detector will stop the decoder from detecting any harmonics of the tone to be decoded.

When the correct tone is present, the detector output, after being delayed, fires a one-shot. The one shot time constant is set by R316, R317 and C313 and can be varied by R317 to fit the user's particular inter-tone timing.

The digital filter itself is an 8-pole filter. The filtered output frequency is determined from the clock frequency. The relationship is $f_{\text{clock}}/8 = f_{\text{filter}}$.

The clocks are gated from either Pin 1 of IC301 or IC302, depending on whether it is the first or second tone to be decoded. The clock is selected by the oscillator switch output of IC303.

Tone A (the first to be decoded) is selected by the adjustment of R301. Similarly Tones B and C are set by grounding manually Pin 7, IC302 via J0301 and setting the second tone and then ungrounding it to set the third using the trimming potentiometers R320 and R318, respectively.

When Tone A is received, the one-shot is fired. Oscillator switch 1 is grounded and oscillator switch 2 goes high (.5v). IC302 is now the clock source and IC301 is used to alternate between the two clocks for Tones B and C, by alternately grounding and ungrounding Pin 7 of IC302 gating first the clocks for Tone B and the Tone C into IC303. The period of oscillation on Pin 7 of IC302 is 200ms.

When the second tone has been received (Tone B or Tone C) before the one-shot has timed out, the latch is set and D11 is grounded. This causes Pin 14 of IC201 to go low turning off that the squelch switch, which turns on Q209 thus unsquelching the radio.

2-7 LAMP LOGIC AND IGNITER DRIVES

When a signal is decoded and Pin D11 goes low, it sets the latch Pin 6, IC206C "Low", Pin 4, IC206B "High", thereby turning on both the high rate "ALERT" flasher consisting of IC205D and IC206E and the two igniter drives. The user may select, via a jumper pin, which drive he requires either pulsed or unpulsed. The low on Pin 6, IC206C disables both the AC on logic consisting of IC204A and the low battery indicator consisting of IC204B.

IC206F and IC205C are the slow light logic circuits for the low battery indicator.. All of the logic elements activate the LED on the front panel by forward biasing Q211 into conduction.

2-8 DECODER RESET

Resetting the decoder is accomplished by driving Pin 13 of IC303 to less than 1V for at least 25ms. This may be done in three ways; the carrier controlled reset, the time out reset and front panel switch SW405. The front panel switch is the only way to reset both the signal light and the decoder.

A jumper is installed at the factory from JU-D15 to JU-D13. This allows the decoder to reset in the absence of a carrier so that it can be ready to decode the next message. The flashing light indicating that the radio has already received a message must be reset manually via SW405.

To monitor the radio traffic for 30 sec to 3 minutes after a message has been received, switch the jumper from JU-D15 to JU-D14 and set the RC timing network R293 for the time you desire. When the circuit has timed out, Q214 will stop conducting making the base of Q304 go high causing it to conduct and thereby resetting the decoder. Again the flashing light will remain on until manually reset to let the user know a message has been received.

SECTION 3

ALIGNMENT PROCEDURE

REV A	APPLICATION		REVISIONS			
	NEXT ASSY	USED ON	REV	DESCRIPTION	DATE	APPROVED
			A	R-204	11-12-79	ISAP

S
 TP-14-254
 DWG. NO.

FINAL TEST PROCEDURE

MCA 611 ON CALL ALERT RECEIVER

A. R.F. Alignment Procedure

I. Test Set-Up


A. Equipment

1. F.M. Signal Generator
2. AC VTVM capable of measuring 455 KHz
3. DC Voltmeter

Note: If a radio has two crystals in the same band, a frequency midway between them should be used for the tune-up procedure so that the RF amp will be broad tuned. The anode of CR209 must be jumpered to the spare pin on the anode of CR210 and then jumpered to the correct band pin (LL, UH, HH, etc.). If the radio uses both bands of a given preselector, tune the upper range to a middle frequency first, then switch to the lower range and check the mid band sensitivity there. In the case of UHF adjust R243 to achieve rated sensitivity and for high VHF adjust R250 to achieve the lower band sensitivity. For the low VHF bands tune for the best combined sensitivity. Some compromise in sensitivity may be necessary between any two bands. If only one frequency is being used for a given preselector then tune up the radio for best sensitivity on that particular frequency.

B. Radio Preset

1. Connect DC power supply to DC power connection, top pin of 3-pin connector on the back of the radio. (The DC power supply can be substituted by using the radio's own AC supply; 117V 60Hz.)
2. Set radio controls as follows:
 - a. Volume - comfortable listening level
 - b. Squelch - upper most slide position
 - c. Alert/monitor switch - in monitor position

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. TOLERANCES ARE FRACT. DEC ANG. ± .XX± ± .XXX±	APPROVALS	DATE	 COMMUNICATIONS INC. SATELLITE BEACH, FLORIDA 32937 FINAL TEST PROCEDURE MCA 611 ON CALL ALERT RECEIVER		
	DRAWN				
	CHECKED				
	DFTG. SUPV.				
MATERIAL	ENGR. ISAP	11/2/79	SIZE	PART NUMBER	REV.
FINISH			A	TP-14-254	A
DO NOT SCALE DRWG.			SCALE		SHEET 1 OF 8

- d. Duty Switch - in normal position
 - e. Frequency switch - on frequency to be aligned
 - f. On/Off switch - in ON position
3. Install crystals
- a. Put crystal in socket X201 (XTL socket farthest from speaker). X201 corresponds to "normal" freq.
 - b. Run band select jumper from anode of CR209 to the correct range select pin.
 - c. X202 corresponds to the two band select pins farthest from speaker.

LL	30-39	MHz	HH	160-170	MHz
LH	39-50	MHz	UL	450-470	MHz
HL	146-160	MHz	UH	475-500	MHz

C. Quadrature Alignment

- 1. With no signal applied, put the DC Voltmeter's probe on Pin 10 of IC201 (A0 Pin) and adjust L216 until the voltage is 3.5 volts.

D. I.F. Alignment

- 1. Connect the FM Signal Generator to the antenna input jack. Accurately set the frequency to the center of the channel being used for alignment. Modulate the Signal Generator with 1,000 Hz, 3K KHz deviation.
- 2. Connect the AC Voltmeter to Pin 5 of IC201 (foil side of board).
- 3. Set AC Voltmeter to the 100mv scale.
- 4. Adjust the Signal Generator output until the AC Voltmeter reading is mid-range.
- 5. Adjust L208 for maximum AC Voltmeter reading. Re-adjust the Signal Generator's output to maintain voltmeter reading near mid-range.

Note: If the RF segments refuse to tune up or will not allow full rated sensitivity, check the position of the band select pin with respect to the frequency of the crystal and the band select jumper.

With the frequency select switch SW401 in the normal position crystal X201 (farthest from speaker) and the pin closest to speaker are "turned on".

E. Low VHF Segment (30-50 MHz)

- 1. Connect AC Voltmeter to Pin 5, IC201.
- 2. Set AC Voltmeter to the 100 millivolt scale.
- 3. Make sure band select pins are set up as per Note.
- 4. Set the Signal Generator accurately to the frequency of the channel being used for alignment. Connect the generator's output to the antenna input jack. Adjust Signal Generator's output until AC Voltmeter reading is mid-range.
- 5. Adjust L201 and L206 for maximum AC Voltmeter reading. Re-adjust Signal Generator's output to maintain voltmeter

DRAWN	DATE	SIZE	PART NUMBER	REV.
APPROVED <i>Bern G. Brown</i>	DATE 11/12/79	A	TP-14-254	A
DO NOT SCALE DWG.	SCALE			SHEET 2

reading near mid-range. Repeat adjustments until no further improvements can be made.

F. High VHF Segment (146-170 MHz)

1. Connect AC Voltmeter to Pin 5, IC201.
2. Set AC Voltmeter to the 100 millivolt scale.
3. Make sure the band select pins are set up as per Note.
4. Set the Signal Generator accurately to the frequency being used for alignment. Connect generator's output to antenna input jack. Adjust Signal Generator's output until AC Voltmeter reading is mid-range.
5. Adjust L203 and L205 for maximum AC Voltmeter reading. Re-adjust Signal Generator's output to maintain voltmeter reading near mid-range.
6. Now adjust L209 and L211 and repeat all adjustments until no further improvement can be made.

G. UHF Segment (450-500 MHz)

1. Connect AC Voltmeter to Pin 5, IC201.
2. Set AC Voltmeter to the 100 millivolt scale.
3. Make sure the band select pins are set up as per Note.
4. Set the Signal Generator accurately to the frequency being used for alignment. Connect generator's output to antenna input jack. Adjust Signal Generator's output until AC Voltmeter reading is mid-range.
5. Adjust C226, C228 and C245 in that order for maximum AC Voltmeter reading. Re-adjust Signal Generator's output to maintain voltmeter reading near mid-range. Repeat adjustments until no further improvement can be made.

Note: If sensitivity is poor (greater than .7mv) or if sensitivity varies more than 3dB while AFC voltage is varied from 1 to 7 volts, detune L211 two turns CCW.

H. AFC Alignment

1. With the unit on a channel with a UHF crystal and no RF input, adjust L216 for a voltmeter reading of approximately 3.8 volts at the junction of R253 and R249. Its setting should be within a turn of the setting in the quadrature alignment.

B. Carrier Reset Option (See Note on Page 4)

1. Set alert/monitor switch into monitor position.
2. With no RF signal applied, adjust squelch for desired squelching action.
3. Return alert/monitor switch back to the alert position.

DRAWN	DATE	SIZE	PART NUMBER	REV.
APPROVED <i>Bern A. Pearson</i>	DATE <i>11/12/75</i>	A	TP-14-254	A
DO NOT SCALE DWG.		SCALE		SHEET 3

4. Apply enough RF signal to quiet the receiver and signal the unit with proper two-tone sequence.
5. The squelch should open allowing the listener to hear the remainder of the second tone's duration and the message lamp should flash at a high rate.
6. Turn off applied RF signal so that the radio goes into the squelched mode. The decoder is now reset and no signal other than the proper two-tone sequence will open the squelch.
7. The MSG LED should remain flashing until the reset switch is moved into the reset position.

C. Time-Out Reset Option

1. Unsolder the factory installed carrier reset jumper from JU-D15 and solder it to JU-D14 (collector of Q214).
2. Turn up RF signal enough to quiet the receiver.
3. Modulate the Signal Generator with the proper two-tone sequence.
4. The squelch should open, allowing the receiver to operate normally for a given period of time. This time period can be adjusted by varying R293. The MSG LED will be flashing at a very fast rate and will remain flashing when the decoder has been reset.
5. The MSG LED can be reset by pushing the reset switch to the right.

D. Battery Voltage Warning Adjustment
(for battery equipped models only)

1. Place a DC Voltmeter probe on test point M1 and adjust R296 for 4.0 volts. The slow flash rate alarm will trigger when the battery voltage reaches approximately 9.9 volts.

E. Igniter Drive (used with MA-24)

1. A jumper (factory installed) runs from the bottom solder lug of the three terminal connector on the rear panel to the collector of Q212.
2. To provide a pulsed output, simply pull the pin from Q213 and put it on the collector pin of Q212.

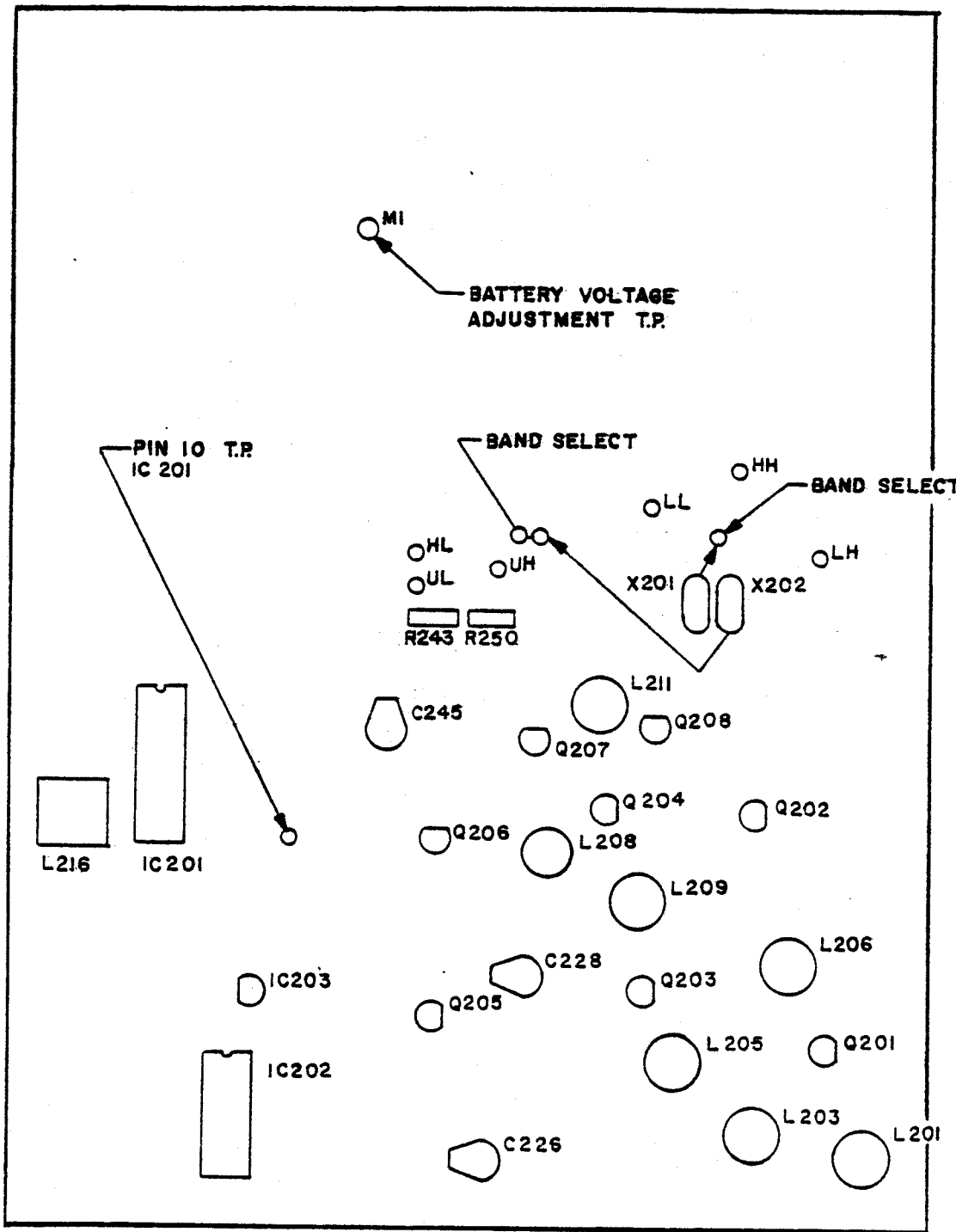
F. Acceptable Performance Limits

Sensitivity .48 μ v worst case
 Audio power . 5 watt

Note: Carrier reset should not be used in areas of low signal strength, as it will decrease the radio's decode sensitivity to around 12dB sinad. If this is the case in your area, use time-out reset.

DRAWN	DATE	SIZE	PART NUMBER	REV.
APPROVED <i>Tom C. Pearson</i>	DATE 11/12/79	A	TP-14-254	A
DO NOT SCALE DWG.		SCALE		SHEET 4

FRONT OF RADIO

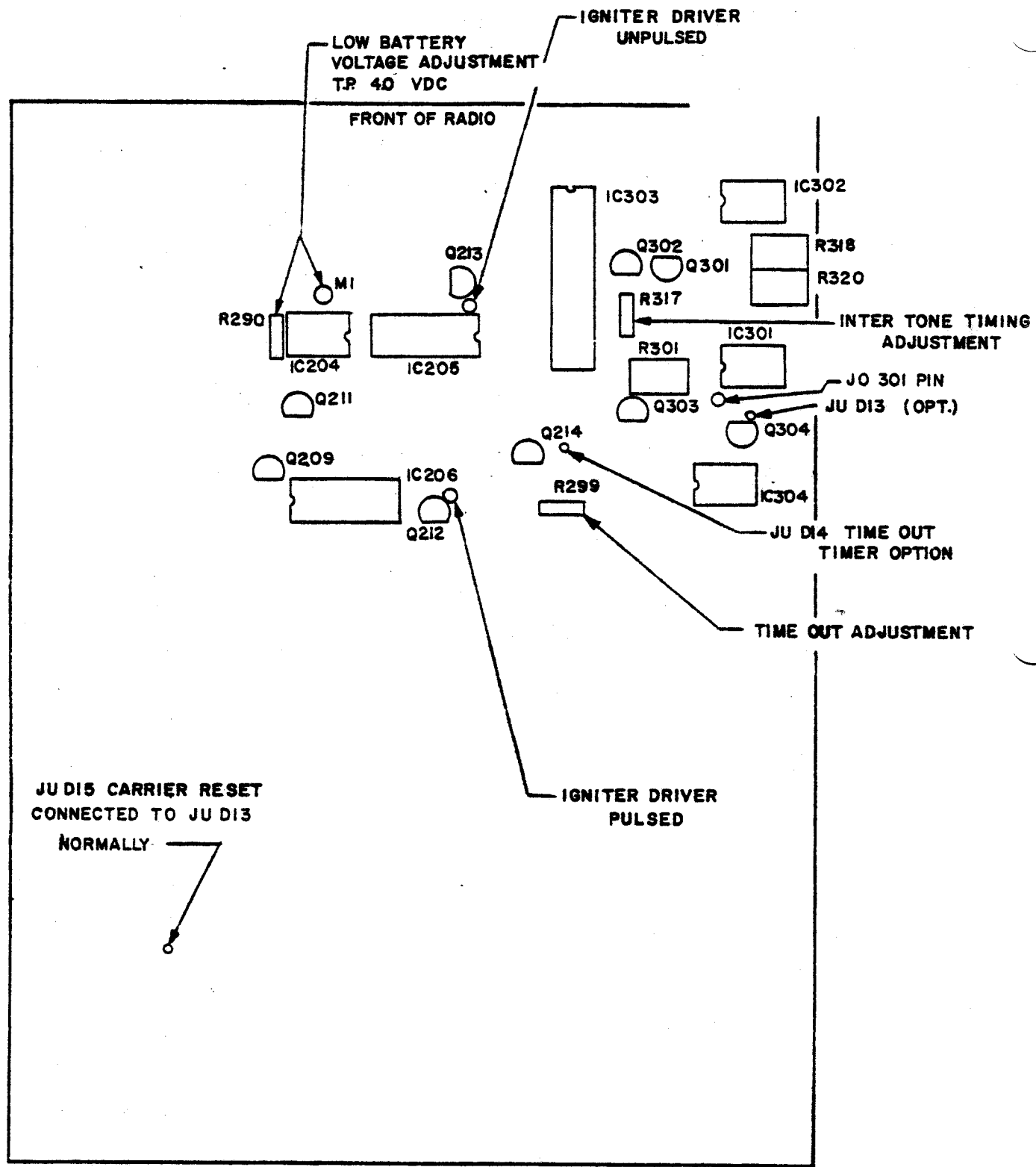


RECEIVER AND CHRYSTAL SECTION

FIGURE 1

DRAWN	DATE	SIZE	PART NUMBER	REV.
APPROVED <i>Penn Co. B...</i>	DATE 11/2/79	A	T'P14-254	A
DO NOT SCALE DWG.		SCALE		SHEET 5

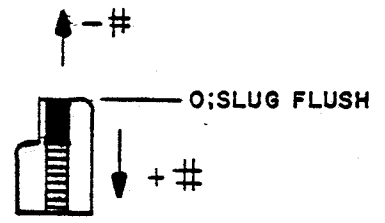
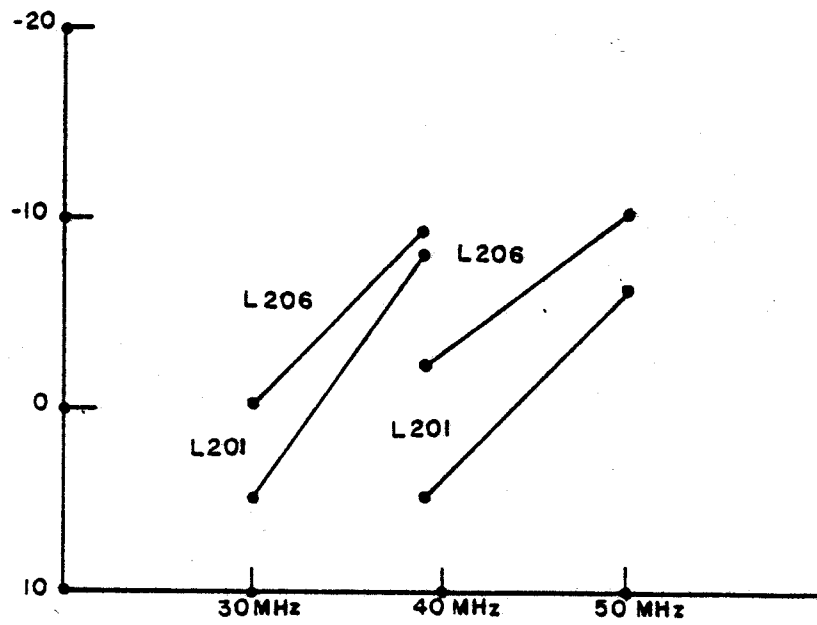
TP14-254



DIGITAL FILTER, IGNITER DRIVES, LOW BATT. INDICATOR, CARRIER, TIME OUT RESET

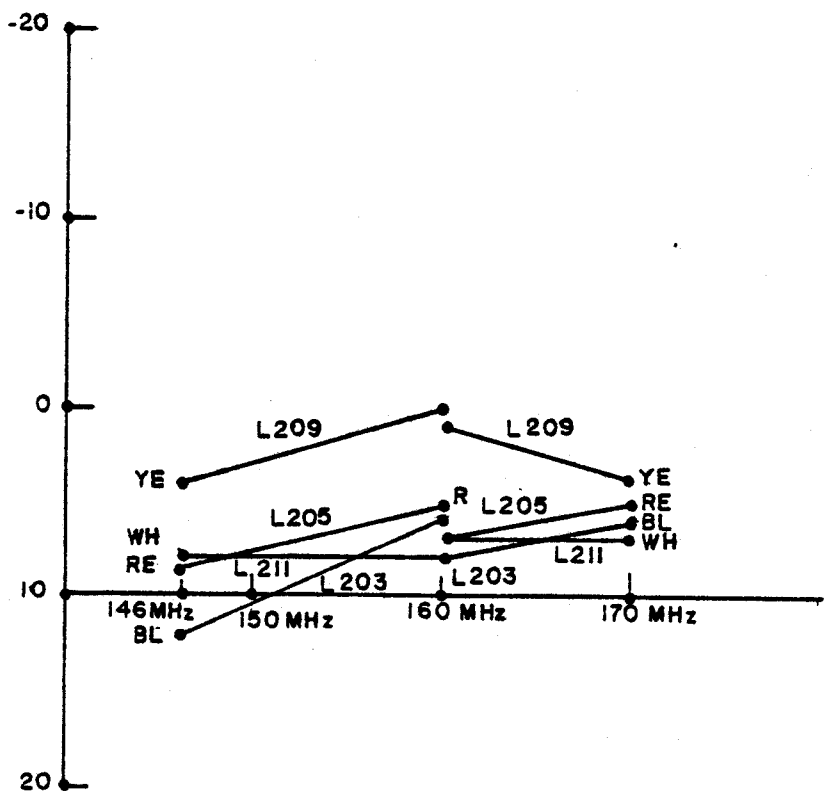
FIGURE 2

DRAWN	DATE	SIZE	PART NUMBER	REV.
APPROVED <i>Bernard C. Pearson</i>	DATE <i>11/12/72</i>	A	TP14-254	A
DO NOT SCALE DWG.		SCALE		SHEET 6



POSITIVE NUMBERS ARE COUNTED AS NUMBER OF TURNS CLOCKWISE FROM FLUSH POSITION.

LOW VHF TUNING CHART

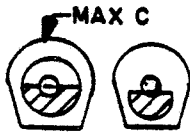


HIGH VHF TUNING CHART

FIGURE 3

DRAWN	DATE	SIZE	PART NUMBER	REV.
APPROVED <i>[Signature]</i>	DATE 11/14/20	A	TP14-254	A
DO NOT SCALE DWG.		SCALE		SHEET 7

90°



180° (MIN C)

0 DEGREES (MAX C)

CAPACITOR TOP PLATE SHOWN IN POSITION OF MAX C

ALL VALUES ARE GIVEN IN DEGREES FROM MAX C COUNTER CLOCKWISE

270

360°

360°

270°

270°

180°

180°

90°

90°

0°

0°

360°

360°

270°

270°

180°

180°

90°

90°

0°

0°

450 MHz

460 MHz

470 MHz

C226

C245

C228

475 MHz

480 MHz

485 MHz

490 MHz

490 MHz

500 MHz

C226

C245

C228

UHF TUNING CHART

FIGURE 4

REV A	APPLICATION		REVISIONS			
	NEXT ASSY	USED ON	REV	DESCRIPTION	DATE	APPROVED
			A	R-165	10/26/78	TSAP

SH 1
TP14-219
DWG. NO.

TEST PROCEDURE

TWO-TONE SEQUENTIAL DECODER

(APPLIED TO MCA-611)

I. Sequential Tone Decoder Set-Up and Testing


A. Equipment required

1. R.F. Signal Generator
2. Two-Tone Sequential Generator
3. High input Impedance Amplifier*
4. Frequency Counter*
5. Power Supply (13-16 VDC)

*Note: In place of a high input Impedance Amplifier and a Frequency Counter, an Oscilloscope with an accurate time base may be used to set up the clock frequencies.

B. Radio Preset

1. Connect DC power supply to DC power connection, top pin of 3-pin connector on the back of the radio. (The DC power supply can be substituted by using the radio's own AC supply; 117V 60Hz.)
2. Set radio controls as follows:
 - a. Volume - comfortable listening level.
 - b. Squelch - upper most slide position.
 - c. Alert/monitor switch - in alert position.
 - d. Duty switch - in normal position.
 - e. Frequency switch - in normal position.
 - f. On/Off switch - in ON position.
3. Set the frequency of the RF signal generator to the normal crystal frequency (the frequency of the crystal in the socket farthest from the speaker).

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. TOLERANCES ARE FRACT. DEC ANG. ± .xx± ± .xxx±	APPROVALS	DATE	 COMMUNICATIONS INC. SATELLITE BEACH, FLORIDA 32937
	DRAWN		
	CHECKED		
	DFTG. SUPV.		
MATERIAL	ENGR. <i>TSAP</i>	11/28	TEST PROCEDURE - TWO-TONE SEQUENTIAL DECODER -
FINISH			SIZE A PART NUMBER TP14-219 REV. A
DO NOT SCALE DRWG.		SCALE	SHEET 1 OF 6

4. Externally modulate the RF signal generator with the two-tone oscillator, making sure each tone is modulated at 3KHz deviation.

C. Clock adjustments

1. Using a frequency counter -
- Connect a high input impedance amplifier to Pin 1 of IC301 in the radio.
 - Connect the output of the amplifier to the input of an accurate frequency counter.
 - Adjust R301 until the counter reads eight times the value of the first tone (Tone A).
 - Remove the end of JO301 that connects with Pin 1 of IC301 and let that end hang free.
 - Disconnect the probe of the amplifier going to Pin 1 of IC301 and connect it to Pin 1 of IC302.
 - Adjust R318 until a frequency of eight times tone frequency B is read on the frequency counter.
 - Ground the end of JO301 leading to Pin 7 of IC302.
 - Adjust R320 until eight times the frequency of Tone C is read on the frequency counter.
 - Replace JO301 on the pin.

2. Using an oscilloscope -

- Connect probe of oscilloscope to Pin 1 of IC301. Set vertical sensitivity to .1v per division.
- Adjust R302 so that the period of the oscillation displayed on the oscilloscope is as follows:

$$t_{\text{osca}} = 1/(8 \times f_A), \text{ where } f_A \text{ is the frequency of Tone A}$$

- Put in enough signal to quiet the receiver and modulate the signal generator with just Tone A. The oscilloscope will now be switching between a high and a low frequency oscillation.
- Now connect the oscilloscope to Pin 1 of IC302. You will observe two different oscillator frequencies being switched at about 100ms rate.
- One oscillation period will vary with the adjustment of R318. Adjust this period to -

$$t_{\text{oscB}} = 1/(8 \times f_B), \text{ where } f_B \text{ is the frequency of Tone B}$$

- The other oscillation period is adjusted by R320. Adjust R320 for a period to -

$$T_{\text{oscC}} = 1/(8 \times f_C), \text{ where } f_C \text{ is the frequency of Tone C}$$

DRAWN	DATE	SIZE	PART NUMBER	REV.
APPROVED <i>Bernard Keenan</i>	DATE 11/12/77	A	TP14-219	A
DO NOT SCALE DWG.		SCALE		SHEET 2

D. Adjusting the Inter-Tone Timing

1. Modulate RF signal generator with Tone A.
2. Connect oscilloscope to Pin 17 of IC303.
3. Adjust R317 for this period.

One shot period - period of 1st tone + period delay + period 2nd tone.

4. Modulate RF signal with the two-tone sequence.
5. The message light will come on and the squelch will open.

Example: Suppose the following frequencies were needed:

TONE A - 349.0
 TONE B - 389.0
 TONE C - 410.8

Using an accurate frequency counter -

The reading at Pin 1 of IC301 must be adjusted to $8 \times 349.0 \text{ Hz} = 2,792 \text{ Hz}$.
 The adjustment is done with R301.

The order of the next two Tones B and C is unimportant.

With the probe on Pin 2 of IC302 and J0301 pulled up, adjust R318 for eight times one of the other tones - say Tone C, $8 \times 410.8 \text{ Hz} = 3,286.4 \text{ Hz}$.
 Now ground the jumper against the case and adjust R320 for $8 \times 389.0 \text{ Hz} = 3,112 \text{ Hz}$.

Now adjust the inter-tone timing according to your requirements. Suppose the period of the first tone is .75 sec. and the period between tones is .5 sec the final tone is also .75 sec, then

$$\begin{aligned} \text{One shot period} &= \text{period of 1st tone} + \text{period delay} + \text{period 2nd tone} \\ &= .75\text{s} + .5\text{s} + .75\text{s} = 2\text{s} \end{aligned}$$

The adjustment is made with R317 and set with the scope probe on Pin 17 of IC303.

To do the same example problem with an oscilloscope instead of a frequency counter -

$$t_{\text{osca}} = \frac{1}{8 \times f_A} = 358 \times 10^{-6}$$

Set the scope for about $50 \times 10^{-6} \text{ s/Div}$

$$\text{Then divide } \frac{358 \times 10^{-6}}{50 \times 10^{-6} \text{ Div}} = 7.16 \text{ Div} \text{ - for one cycle}$$

The other two tones are set in the same fashion.

DRAWN	DATE	SIZE	PART NUMBER	REV.
APPROVED <i>Ben A. Brown</i>	DATE <i>11/12/70</i>	A	TP14-219	A
DO NOT SCALE DWG.	SCALE			SHEET 3

E. Unit Testing

1. With Carrier Reset Option -
 - a. Set alert/monitor switch into monitor position.
 - b. With no RF signal applied, adjust squelch for desired squelching action.
 - c. Return alert/monitor switch back to the alert position.
 - d. Apply enough RF signal to quiet the receiver and signal the unit with the proper two-tone sequence.
 - e. The squelch should open allowing the listener to hear the remainder of the second tone's duration and the message lamp should flash at a high rate.
 - f. Turn off applied RF signal so that the radio goes into the squelched mode. The decoder is now reset and no other signal other than the proper two-tone sequence will open the squelch.
 - g. The MSG LED should remain flashing until the reset switch is moved into the reset position.

2. With Time-Out Reset Option -
 - a. Turn up RF signal enough to quiet the receiver.
 - b. Modulate the signal generator with the proper two-tone sequence.
 - c. The squelch should open, allowing the receiver to operate normally for a given period of time. This time period can be adjusted by varying R293. The MSG LED will be flashing at a very fast rate and will remain flashing when the decoder has been reset.
 - d. The MSG LED can be reset by pushing the reset switch to the right.

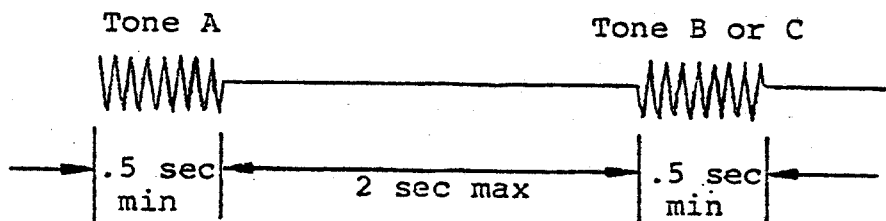
F. Acceptable Performance Limits

Frequency Range *	208 - 3,906 Hz
Frequency Counter will read	1,664.- 31,248.
Decoder Sensitivity	12dB Sinad 100% detect 6dB Sinad 75% detect

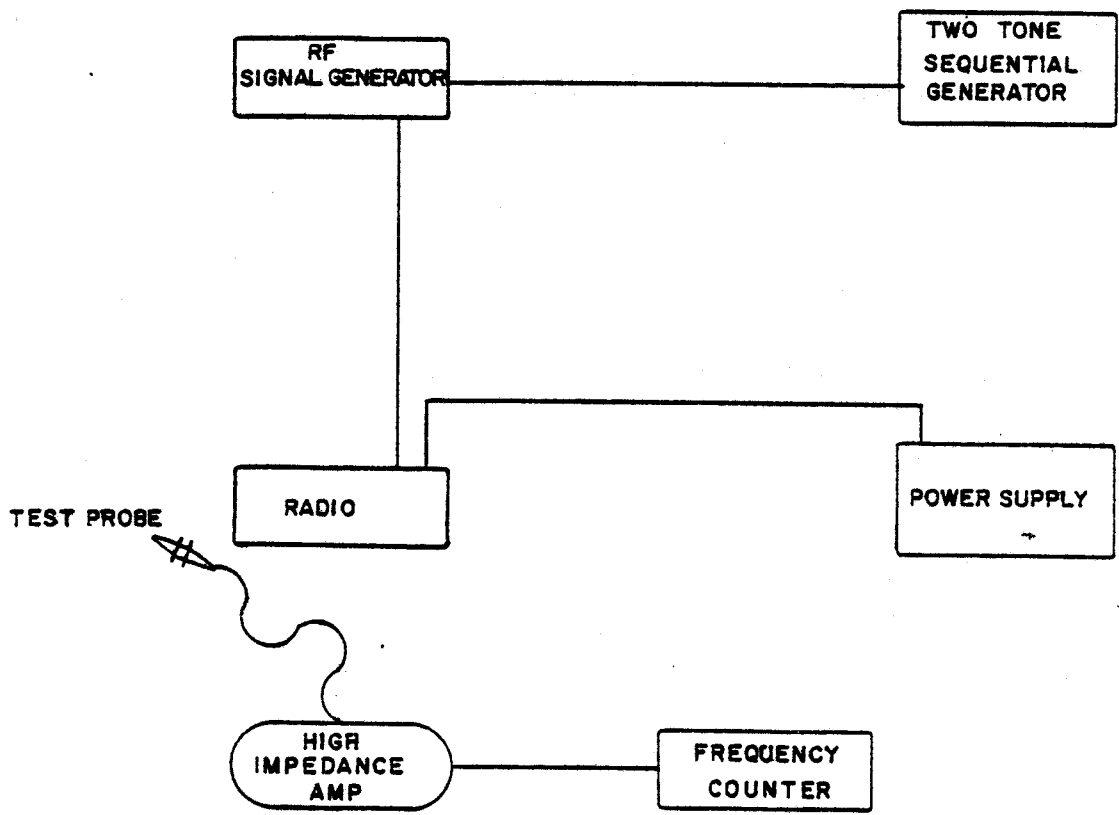
Audio Input at Pin 6 of IC303
must be 1.3Vpp or greater

*For tone frequencies lower than 300 Hz it may be necessary to change C301, C316 or C317 respectively to 820pf. for those oscillators below 300 Hz only.

PROPER TONE SEQUENCE



DRAWN	DATE	SIZE	PART NUMBER	REV.
APPROVED <i>William A. Pearson</i>	DATE 11/12/71	A	TP14-219	A
DO NOT SCALE DWG.	SCALE			SHEET 4

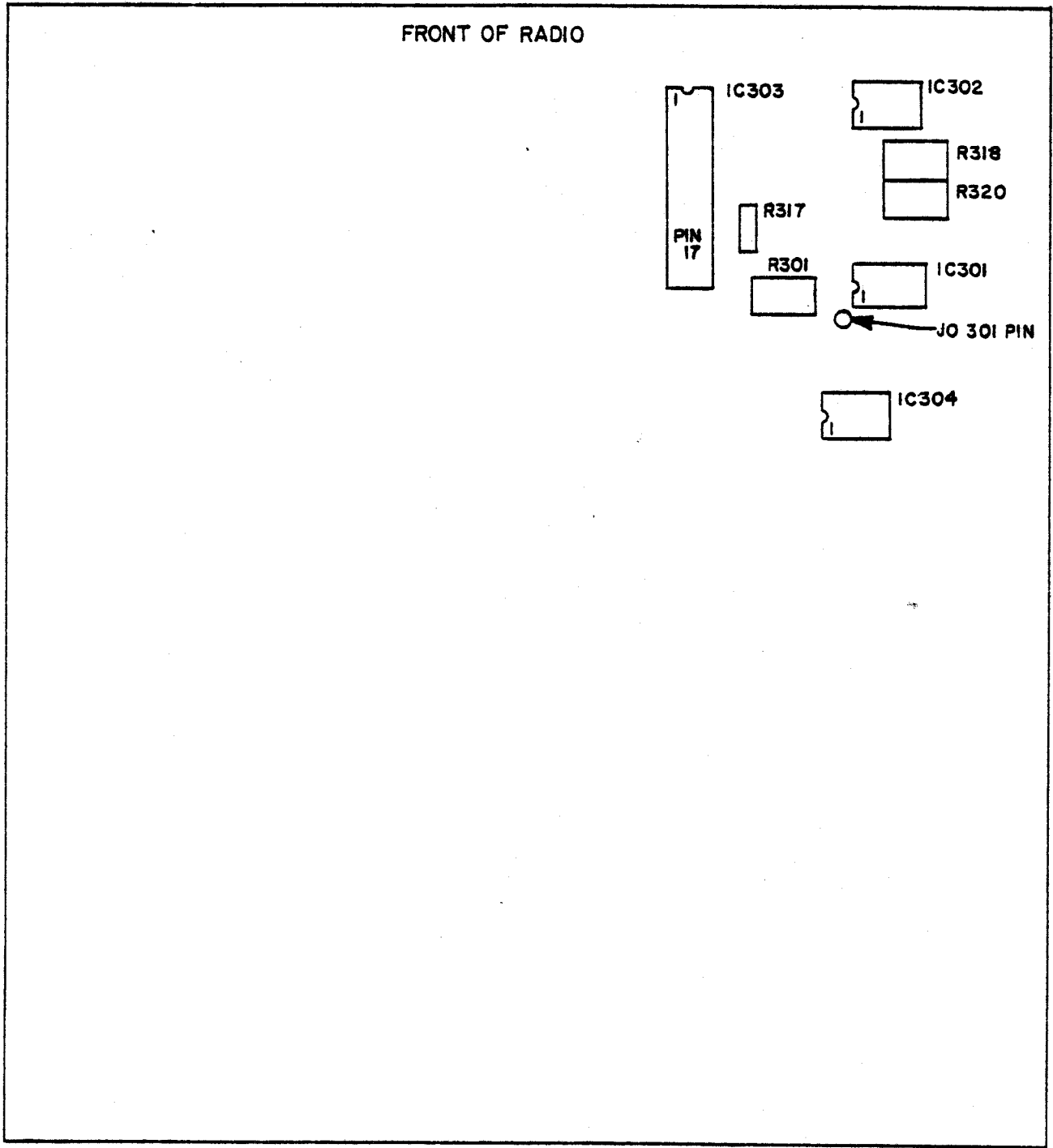


TEST INTERCONNECTION DIAGRAM

FIGURE - 1

DRAWN	DATE	SIZE	PART NUMBER	REV.
APPROVED <i>Bern A. Reese</i>	DATE 11/12/52	A	TP14-219	A
DO NOT SCALE DWG.	SCALE		SHEET	5

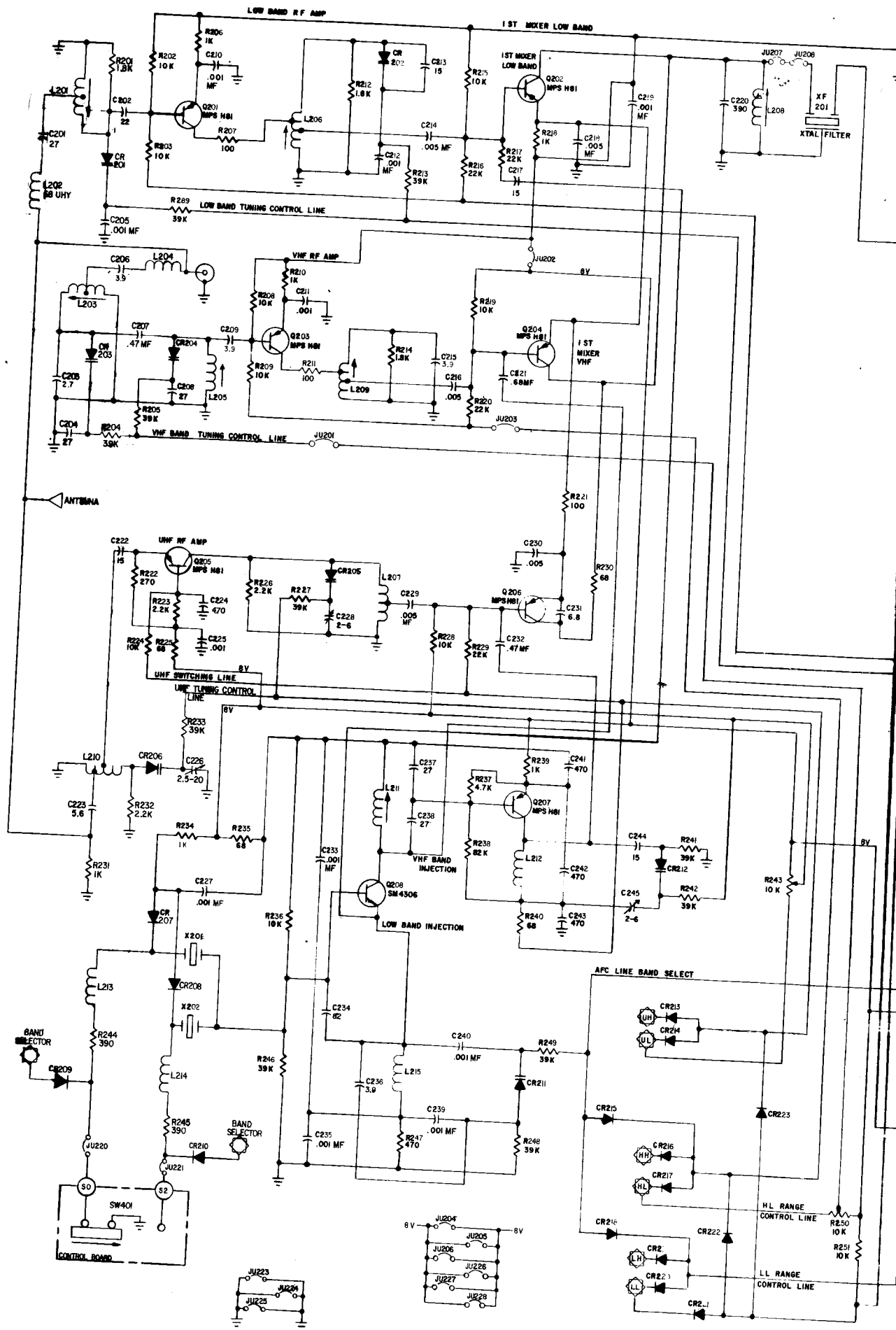
TP14-219
REV. 6
A
DWG. NO.

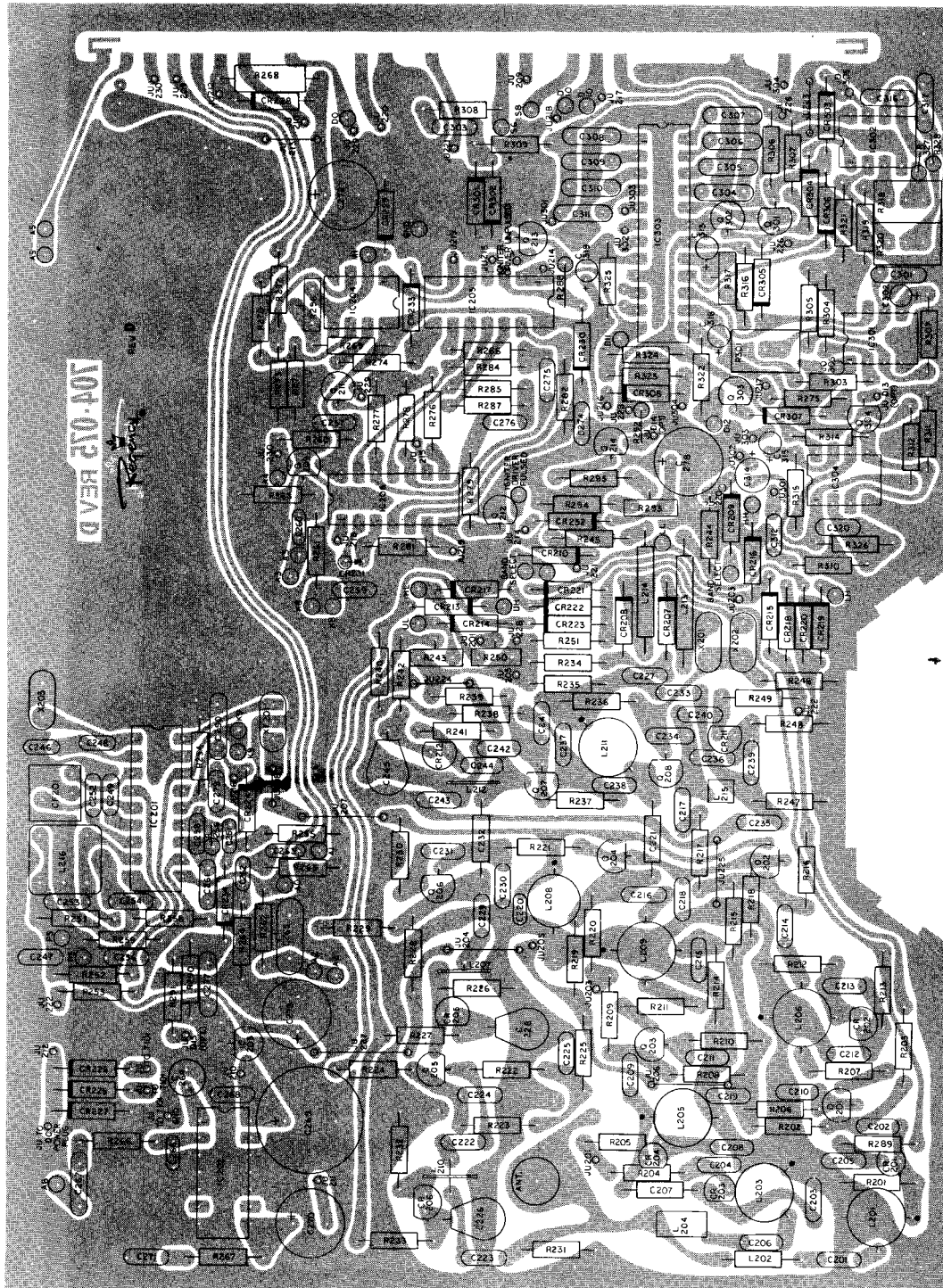


TWO TONE DECODER

FIGURE - 2

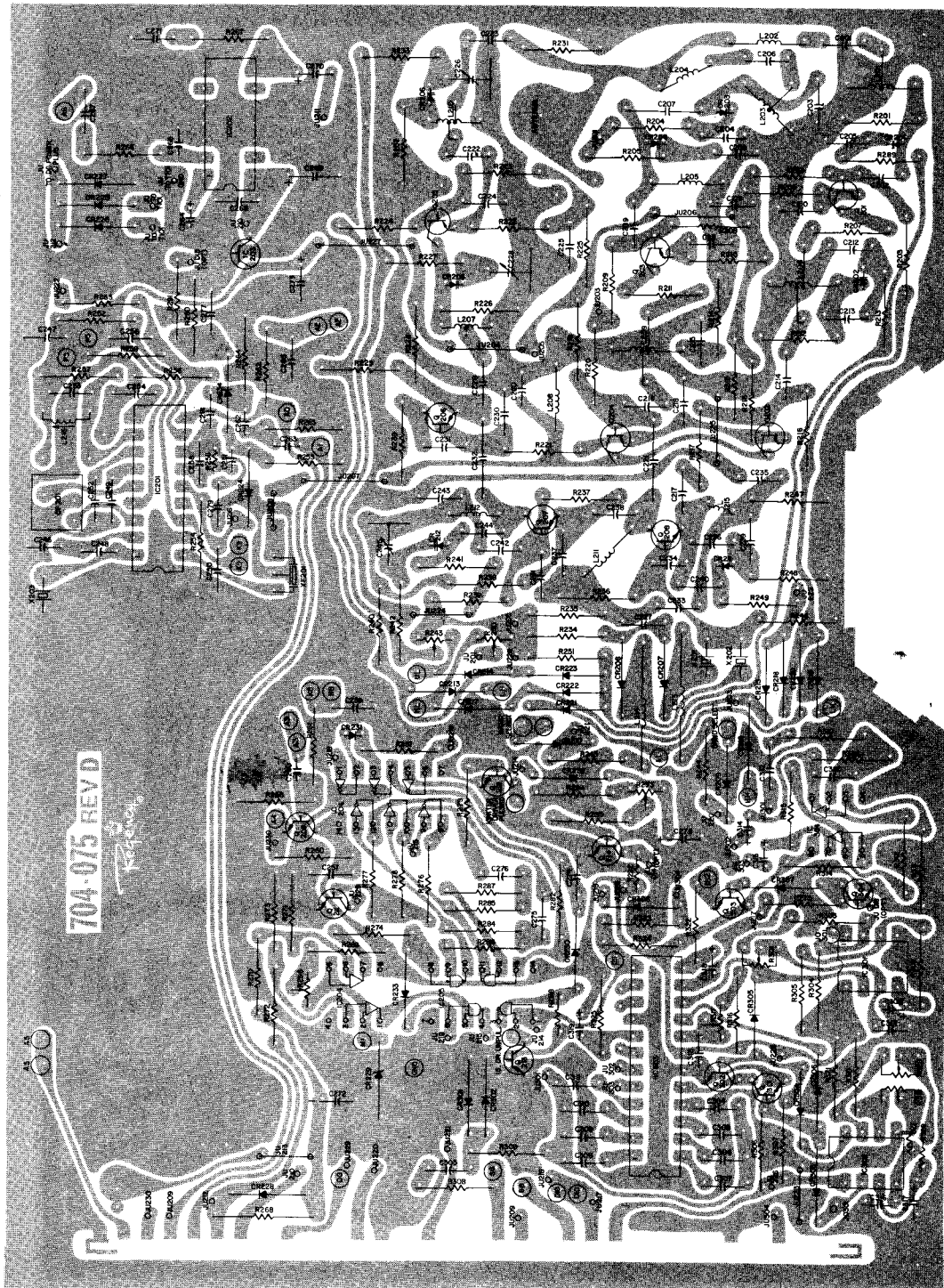
DRAWN	DATE	SIZE	PART NUMBER	REV.
APPROVED <i>T. Brown</i>	DATE <i>11/12/70</i>	A	TP14-219	A
DO NOT SCALE DWG.		SCALE		SHEET 6





3-4

TOP VIEW



704-075 REV D
Preston

3-5

BOTTOM VIEW

SECTION 4

PARTS LIST

RECEIVERCAPACITORS

<u>LOCATION</u>	<u>DESCRIPTION</u>	<u>PART NUMBER</u>
C201	27pf 10 NPO 50V	1500-0270-650
C202	22pf 10 NPO 500V	1500-0220-605
C203	2.7pf NPO 500V	1500-0279-205
C204	27pf 10 NPO 50V	1500-0270-650
C205	.001mf +8-2 50V	1503-0102-003
C206	3.9pf 10 NPO 500V	1500-0399-905
C207	.47pf 10 Type MC	1510-0478-900
C208	27pf 10 NPO 50V	1500-0270-650
C209	3.9pf 10 NPO 500V	1500-0399-905
C210	.001mf +8-2 50V	1503-0102-003
C211	.001mf +8-2 50V	1503-0102-003
C212	.001mf +8-2 50V	1503-0102-003
C213	15pf 10 NPO 500V	1500-0150-605
C214	.005mf +8-2 50V	1503-0502-005
C215	3.9pf 10 NPO 500V	1500-0399-905
C216	.005mf +8-2 50V	1503-0502-005
C217	15pf 10 NPO 500V	1500-0150-605
C218	.005mf +8-2 50V	1503-0502-005
C219	.001mf +8-2 50V	1503-0102-003
C220	390pf 50V 5 LCQ-17	1506-0391-550
C221	.68pf 10 Type MC209	1510-0688-900
C222	15pf 10 NPO 500V	1500-0150-605
C223	5.6pf 10 NPO 500V	1500-0569-905
C224	470 pf 20 50V Z5F	1523-0471-002
C225	.001mf +8-2 50V	1503-0102-003
C226	Trim 2.5 -20pf	1517-0000-034
C227	.001mf +8-2 50V	1503-0102-003
C228	Trim 2-6pf	1517-0000-035
C229	.005mf +8-2 50V	1503-0502-005
C230	.005mf +8-2 50V	1503-0502-005
C231	6.8pf 10 NPO 500V	1500-0689-905
C232	.47pf 10 Type MC	1510-0478-900
C233	.001mf +8-2 50V	1503-0102-003
C234	82pf 5 NPO 50V	1524-0820-002
C235	.001mf +8-2 50V	1503-0102-003
C236	3.9pf 10 NPO 500V	1500-0399-905
C237	27pf 10 NPO 50V	1500-0270-650
C238	27pf 10 NPO 50V	1500-0270-650
C239	.001mf +8-2 50V	1503-0102-003
C240	.001mf +8-2 50V	1503-0102-003
C241	470pf 20 50V Z5F	1523-0471-002
C242	470pf 20 50V Z5F	1523-0471-002
C243	470pf 20 50V Z5F	1523-0471-002
C244	15pf 10 NPO 500V	1500-0150-605
C245	Trim 2-6pf	1517-0000-035
C246	150pf 50V 5 LCQ-17	1506-0151-550
C247	.01mf +8-2 50V	1503-0103-007
C248	68pf 5 NPO 50V	1524-0680-002
C249	.1mf +8-2 50V	1503-0104-010
C250	.47mf 15V 20	1515-0478-003

LOCATIONDESCRIPTIONPART NUMBER

C251	.001mf 10 100V	1508-0102-610
C252	.1mf +8-2 50V	1503-0104-010
C253	33pf 10 NPO 500V	1500-0330-605
C254	470pf 20 50V Z5F	1523-0471-002
C255	not used	
C256	.2mf+8-2 12V	1502-0204-006
C257	.01mf +8-2 50V	1503-0103-007
C258	8.2pf 10 NPO 500V	1500-0829-905
C259	.01mf +8-2 50V	1503-0103-007
C260	.0047mf 10 100V	1508-0472-610
C261	150pf 5 50V LCQ-17	1506-0151-550
C262	.001mf 10 100V	1508-0102-610
C263	.001mf 10 100V	1508-0102-610
C264	5mf 25V Type U	1513-0050-003
C265	.068mf 10 100V	1508-0683-610
C266	.0033mf 10 100V	1508-0332-610
C267	.01mf +8-2 50V	1503-0103-007
C268	.05mf +8-2 25V	1502-0503-003
C269	1000mf 15V Type U	1513-0182-002
C270	100mf 16V 85D Type U	1513-0101-002
C271	.2mf +8-2 12V	1502-0204-006
C272	220mf 16V 85D	1513-0221-002
C273	220mf 10V 85D Type U	1513-0221-001
C274	.1uf +80-20 12V	1502-0104-006
C275	.1uf +80-20 12V	1502-0104-006
C276	.05mf +8-2 25V	1501-0503-003
C277	1mf 15V 20 tant	1515-0010-003
C278	220mf 10V 85D Type U	1513-0221-002

COIL

L201	coil	1800-3152-013
L202	choke .68uhy Wilco	1802-0688-003
L203	coil TMRH RF Ant	1800-3152-001
L204	choke LM-2	1803-5125-903
L205	RF Input	1800-3152-002
L206	coil	1800-3152-012
L207	coil	1800-3160-006
L208	coil RF (Wht)	1800-3191-401
L209	coil	1800-3152-014
L210	Loop (T)	1800-3160-004
L211	coil	1800-3152-009
L212	Osc 450MHz	1800-3160-003
L213	choke 12 uhy	1803-1313-100
L214	choke 12 uhy	1803-1313-100
L215	coil TMR	1801-1236-900
L216	coil	1800-6055-801

INTEGRATED CIRCUITS

<u>LOCATION</u>	<u>DESCRIPTION</u>	<u>PART NUMBER</u>
IC201	IF Sub Sys	3130-6056-500
IC202	Nat LM 380N	3130-3157-614
IC203	78-L08 8V	3130-0000-014
IC204	LM358N	3130-3167-909
IC205	MCl4011 CP	3130-3157-628
IC206	MM 74C04N	3130-3157-617

RESISTORS

(All resistors are $\frac{1}{4}$ W 5% unless otherwise noted)

R201	1.8K	4704-0182-032
R202	10K	4704-0103-032
R203	10K	4704-0103-032
R204	39K	4704-0393-032
R205	39K	4704-0393-032
R206	1K	4704-0102-032
R207	100 ohm	4704-0101-032
R208	10K	4704-0103-032
R209	10K	4704-0103-032
R210	1K	4704-0102-032
R211	100 ohm	4704-0101-032
R212	1.8K	4704-0182-032
R213	39K	4704-0393-032
R214	1.8K	4404-0182-032
R215	10K	4704-0103-032
R216	22K	4704-0223-032
R217	22K	4704-0223-032
R218	1K	4704-0102-032
R219	10K	4704-0103-032
R220	22K	4704-0223-032
R221	100 ohm	4704-0101-032
R222	270 ohm	4704-0271-032
R223	2.2K	4704-0222-032
R224	10K	4704-0103-032
R225	68 ohm	4704-0680-032
R226	2.2K	4704-0222-032
R227	39K	4704-0393-032
R228	10K	4704-0103-032
R229	22K	4704-0223-032
R230	68 ohm	4704-0680-032
R231	1K	4704-0102-032
R232	2.2K	4704-0222-032
R233	39K	4704-0393-032
R234	1K	4704-0102-032
R235	68 ohm	4704-0680-032
R236	10K	4704-0103-032
R237	4.7K	4704-0472-032
R238	82K	4704-0823-032
R239	1K	4704-0102-032
R240	68 ohm	4704-0680-032
R241	39K	4704-0393-032
R242	39K	4704-0393-032
R243	10K var	4751-0103-002
R244	390 ohm	4704-0391-032

<u>LOCATION</u>	<u>DESCRIPTION</u>	<u>PART NUMBER</u>
R245	390 ohm	4704-0391-032
R246	39K	4704-0393-032
R247	470 ohm	4704-0471-032
R248	39K	4704-0393-032
R249	39K	4704-0393-032
R250	10K var	4751-0103-002
R251	10K	4704-0103-032
R252	47K	4704-0473-032
R253	39K	4704-0393-032
R254	180K	4704-0184-032
R255	100K	4704-0104-032
R256	680K	4704-0684-032
R257	270K	4704-0274-032
R258	1.5 meg	4704-0155-032
R259	1.5 meg	4704-0155-032
R260	47K	4704-0473-032
R261	470K	4704-0474-032
R262	8.2K	4704-0822-032
R263	470K	4704-0474-032
R264	27K	4704-0273-032
R265	27K	4704-0273-032
R266	270K	4704-0274-032
R267	3.3 ohm	4704-0339-032
R268	120 ohm $\frac{1}{2}$ W 5%	4704-0121-034
R269	10K	4704-0103-032
R270	68K	4704-0683-032
R271	47K	4704-0473-032
R272	68K	4704-0683-032
R273	27K	4704-0273-032
R274	10K	4704-0103-032
R275	27K	4704-0273-032
R276	10K	4704-0103-032
R277	10K	4704-0103-032
R278	10K	4704-0103-032
R279	10K	4704-0103-032
R280	not used	
R281	100K	4704-0104-032
R282	100K	4704-0104-032
R283	not used	
R284	2.7 meg	4704-0275-032
R285	1 meg	4704-0105-032
R286	2.7 meg	4704-0275-032
R287	1 meg	4704-0105-032
R288	10K	4704-0103-032
R289	39K	4704-0393-032
R290	1 meg	4704-0105-032
R291	100K	4704-0104-032
R292	1 meg	4704-0105-032
R293	470K var	4751-0474-002
R294	120K	4704-0124-032
R295	470K	4704-0474-032
R296	470K var	4751-0474-002

TRANSISTORS

<u>LOCATION</u>	<u>DESCRIPTION</u>	<u>PART NUMBER</u>
Q201	MPS H81 PNP	4801-0000-026
Q202	MPS H81 PNP	4801-0000-026
Q203	MPS H81 PNP	4801-0000-026
Q204	MPS H81 PNP	4801-0000-026
Q205	MPS H81 PNP	4801-0000-026
Q206	MPS H81 PNP	4801-0000-026
Q207	MPS H81 PNP	4801-0000-026
Q208	SM-4306-5	4801-0000-100
Q209	SPS-952-2	4801-0000-016
Q210	not used	
Q211	SPS-952-2	4801-0000-016
Q212	MPS A05	4801-0000-005
Q213	MPS A05	4801-0000-005
Q214	SPS-952-2	4801-0000-016

DIODES

CR201	MV1172	4809-0000-001
CR202	MV1172	4809-0000-001
CR203	MV2201	4809-0000-004
CR204	MV2201	4809-0000-004
CR205	MV2201	4809-0000-004
CR206	MV2201	4809-0000-004
CR207	IN4148	4805-1241-200
CR208	IN4148	4805-1241-200
CR209	IN4148	4805-1241-200
CR210	IN4148	4805-1241-200
CR211	MV1172	4809-0000-001
CR212	MV2201	4809-0000-004
CR213	IN4148	4809-1241-200
CR214	IN4148	4809-1241-200
CR215	IN4148	4809-1241-200
CR216	IN4148	4809-1241-200
CR217	IN4148	4809-1241-200
CR218	IN4148	4809-1241-200
CR219	IN4148	4809-1241-200
CR220	IN4148	4809-1241-200
CR221	IN4148	4809-1241-200
CR222	IN4148	4809-1241-200
CR223	IN4148	4809-1241-200
CR224	IN4148	4809-1241-200
CR225	IN4002	4806-0000-004
CR226	IN4002	4806-0000-004
CR227	IN4002	4806-0000-004
CR228	IN4002	4806-0000-004
CR229	Zener 5.1V IN5231B	4808-0000-031
CR230	IN4148	4805-1241-200
CR231	IN4148	4805-1241-200
CR232	IN4148	4805-1241-200
CR233	IN4148	4805-1241-200
CR234	IN4148	4805-1241-200

<u>LOCATION</u>	<u>DESCRIPTION</u>	<u>PART NUMBER</u>
<u>CRYSTAL</u>		
X203	Crystal 10.245 MHz	2301-3151-601
<u>CRYSTAL FILTER</u>		
XF201	Xtal filt. 2P 10.7 MHz	2705-3232-200
<u>CERAMIC FILTER</u>		
CF201	Cer filter CFU455D2	2700-3209-500

DECODER

CAPACITORS

<u>LOCATION</u>	<u>DESCRIPTION</u>	<u>PART NUMBER</u>
C301	470pf 50V LCQ-17	1506-0471-550
C302	.47mf 15V 20	1515-0478-003
C303	.1mf 50V +8-2 Y5B	1503-0104-010
C304	.047mf 100V 10	1508-0473-610
C305	.047mf 100V 10	1508-0473-610
C306	.047mf 100V 10	1508-0473-610
C307	.047mf 100V 10	1508-0473-610
C308	.047mf 100V 10	1508-0473-610
C309	.047mf 100V 10	1508-0473-610
C310	.047mf 100V 10	1508-0473-610
C311	.047mf 100V 10	1508-0473-610
C312	.1uf 12V +80-20 BC-12	1502-0104-006
C313	.1mf 15V	1515-0010-003
C314	10mf 10V 85D III Type U	1513-0100-001
C315	1mf 16V 85D III Type U	1513-0010-002
C316	470pf 50V LCQ-17	1506-0471-550
C317	470pf 50V LCQ-17	1506-0471-550
C318	1mf 15V 20 T360	1515-0010-003
C319	.47mf 15V 20	1515-0478-003
C320	10pf NPO 500V	1501-0100-001

INTEGRATED CIRCUITS

IC301	2 tone osc SC74204	3130-6060-700
IC302	2 tone osc SC74204	3130-6060-700
IC303	2 tone dig fil SC74203	3130-6062-000
IC304	LM358N	3130-3167-909

RESISTORS

R301	500K var	4751-5429-005
R302	120K	4704-0124-032
R303	10K	4704-0103-032
R304	6.8K	4704-0682-032
R305	22K	4704-0223-032
R306	1 meg	4704-0105-032
R307	1 meg	4704-0105-032
R308	10K	4704-0103-032
R309	270K	4704-0274-032
R310	220K	4704-0224-032
R311	10K	4704-0103-032
R312	6.8K	4704-0682-032
R313	not used	
R314	10K	4704-0103-032

LOCATIONDESCRIPTIONPART NUMBER

R315	1 meg	4704-0105-032
R316	470K	4704-0474-032
R317	1 meg var	4751-0105-002
R318	500K var	4751-5429-005
R319	6.8K	4704-0682-032
R320	500K var	4751-5429-005
R321	6.8K	4704-0682-032
R322	68K	4704-0683-032
R323	15K	4704-0153-032
R324	4.7K	4704-0472-032
R325	1 meg	4704-0105-032
R326	3.3 meg	4704-0335-032
R327	10K	4704-0103-032
R328	10K	4704-0103-032

TRANSISTORS

Q301	SPS 1476 Blue Top	4801-0000-003
Q302	SPS 1476 Blue Top	4801-0000-003
Q303	SPS-952-2	4801-0000-016
Q304	SPS-952-2	4801-0000-016

DIODES

CR301	IN4148	4805-1241-200
CR302	IN4148	4805-1241-200
CR303	Diode Germ	4807-1233-900
CR304	Diode Germ	4807-1233-900
CR305	Diode Germ	4807-1233-900
CR306	Diode Germ	4807-1233-900
CR307	IN4148	4805-1241-200
CR308	IN4148	4805-1241-200

CONTROL BOARD

RESISTORS

(All resistors are $\frac{1}{2}$ W 5% unless otherwise noted)

R401	470 ohm $\frac{1}{2}$ W	4704-0471-034
R402	5K var	4752-5135-302
R403	7.5K var	4752-5135-307

SWITCHES

SW401	switch, slide SPDT	5113-3231-601
SW402	switch, slide SPDT	5113-3231-601
SW403	switch, slide	5113-5135-203
SW404	switch, slide	5113-5135-203
SW405	switch SPDT	5113-3231-501

DIODE

LD401	Diode LED Red	4810-1282-900
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CHASSIS

<u>LOCATION</u>	<u>DESCRIPTION</u>	<u>PART NUMBER</u>
R101	resistor 1 meg	4701-0105-044
T101	transformer	5604-5100-600
SP101	spkr 2 x 6 8 ohm	1301-5101-000