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INSTRUCTION MANUAL

CMC 131-958 **OCTOBER 30, 1969**

FOR

CP24 SINGLE SIDEBAND PORTABLE TRANSCEIVER
CMC 189-924

1.6 MHz - 15.0 MHz **1 TO 4 CHANNELS**

CANADIAN MARCONI COMPANY

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CONTENTS

SECTION	TITLE	PAGE
1	INTRODUCTION	
	General	1-1
	Technical Specifications	1-1
	Electrical Specifications	1-2
	Crystal Information	1-5
	Batteries	1-5
	Diagram of Connections /14 Battery Charger	1-6
	Parts List,/14 Battery Charger	1-6
	Carrying Bag	1-7
	Humidity Protection	1-7
2	OPERATION	
	Controls	2-1
	Microphone	2-2
	Antennas	2-2
	C. W. Operation	2-5
3	MOBILE INSTALLATION	
	General	3-1
	Installation	3-1
	Antenna Connectors	3-3
	Parts List - Mobile Mounting Kit	3-5
4	ALIGNMENT AND SERVICING	
	General	4-1
	Test Equipment Required	4-1
4-2	RECEIVER	
	General	4-1
	Alignment	4-1
	Specification Tests	4-2

Section	Title	Page
4.3	TRANSMITTER	
	General	4-3
	Alignment	4-3
	Specification Tests	4-4
	Lower Sideband Operation	4-5
	H.F.O. Connections	4-5
	H.F.O. Netting	4-6
	Alternate TX Alignment	4-6
	Temperature Compensation Capacitors	4-7
	Channel Kits	4-7
	Table of Connection for Channel Kits	4-8
	Parts Lists	4-10
	Diagram of Connections	4-23
5	AVAILABLE OPTIONS	5-1

ILLUSTRATIONS

Figure	Title	Page
1	Battery Placement	1-4
2	CP24 Controls	1-8
3	Antenna Connections	2-3
4	Typical Antenna Installations	2-6
5	Adjustable Load Coil Calibration Chart	2-7
5A	Adjustable Load Coil Calibration Chart	2-8
6	Mobile Installation Diagram	3-2
7	Antenna Connectors and Field Strength Meter	3-4
8	CP24 Block Diagram	3-6
9	H.F.O. Connections	4-7
10	Two Tone Oscilloscope Traces	4-9
11	Top View of Printed Circuit Board	4-21
12	Bottom View of Printed Circuit Board	4-22

SECTION 1

INTRODUCTION

A. GENERAL

The CP24 is a portable, fully solid state SSB transmitter/ receiver, designed for reliable and efficient operation under extreme conditions of weather and temperature. Contained in a high impact plastic case with a cast aluminum front panel, the unit is sealed and weatherproof.

Internal batteries are easily accessible and will supply power for up to fifty hours operation. Nine size D cells are used, and may be regular zinc-carbon, alkaline, or rechargeable nickel cadmium batteries. It is also possible to operate the unit from a vehicle's 12 V. DC supply.

An internal tone oscillator provides the signal necessary to tune the antenna for maximum transmitter output. A knurled knob on the antenna coil tunes the built-in loading coil. Transmitter output is indicated on the front panel meter. The oscillator can also be used to alert the distant station with a tone signal.

A combined R.F gain and audio squelch control greatly reduces normal atmospheric noise between incoming signals. With the output squelched when standing by, receiver battery drain is reduced.

B. TECHNICAL SPECIFICATIONS - GENERAL

Frequency Range	1.6 MHz to 15 MHz
Temperature Range	-40°C to +60°C
Frequency Stability	± 100 Hz from -30°C to + 60°C
Battery Drain	Receiver (squelched) 25 mA @ 11.5V. Transmit: 0.75A average 1.7 maximum

C. ELECTRICAL SPECIFICATIONS

1. Transmitter

Power Output	10 watts P. E. P. at 11.5V. input.
Output Load Impedance	50 ohms nominal, unbalanced
Automatic Load Control	10 db excess input produces less than 1 db increase at 10W. P. E. P.
A. F. Response	-3 db at 600 and 2200 Hz approx.
Spurious and Harmonic Emissions	43 db below P. E. P. at 50 ohms
Carrier Suppression	50 db below P. E. P.
Unwanted Sideband Suppression	better than 50 db below P. E. P.
Intermodulation Distortion	26 db below P. E. P.
Output Protection	No damage to unit if antenna is mismatched or disconnected.

2. Receiver

Type	Superheterodyne, Crystal Filter
Sensitivity	0.5 uV at 12 db S/N Ratio
Selectivity	2.1 KHz at 6 db down 6.0 KHz at 60 db down
Image Rejection and Spurious Responses	1.6 MHz to 10 MHz: 50 db down 10 MHz to 15 MHz: 43 db down
Automatic Gain Control	Input Variation from 1 uV to 1 volt produces less than 12 db output change.
Clarifier Range	$\pm$0.002% of Channel Frequency
A. F. Bandwidth	-3 db, at 600 Hz and 2200 Hz approx.
A. F. Output	250 mW at 5% distortion and 1000 Hz 2-1/2 inch weatherproof speaker.

Battery Life (at 20°C or 68°F)	(1 minute transmit: 10 minutes receive- repeated) Zinc Carbon cells 15 hours (Industrial type preferred) Alkaline cells 50 hours Rechargeable Nickel Cadmium Cells 50 hours
Effective Temperature limits for different type batteries	Zinc Carbon: 0° to 60°C (32°F to 140°F) Alkaline cells: - 10°C to 60°C (+14°F to 140°F) Nickle Cadmium - 30°C to 60°C (- 22°F to 140°F)
Channels	(a) 1 or 2 with no restrictions, or (b) 2 with common TX and RX frequencies, plus (c) 2 others, less than 1% from (b) frequencies, or (d) (b) + upper / lower sideband switching.
Modes	USB - normally supplied LSB - if specified or both USB/LSB. CW - 1000 Hz from suppressed carrier add kit /12
Antenna Options	Center fed dipole (cut to frequency) Mobile 8' whip (supplied to frequency) Tunable portable whip (2 options) Tunable long wire kit.
Antenna Matching	Not required for mobile and dipole antennas. Tuner and loading coils provide full coverage for long wire. and portable whips.
Dimensions	Height 4 inches (10. 1 cm) Width 9 inches (23 cm) Depth 12 inches (30. 5 cm) Weight 10 lbs. (4. 5 kg) with Zinc- carbon batteri

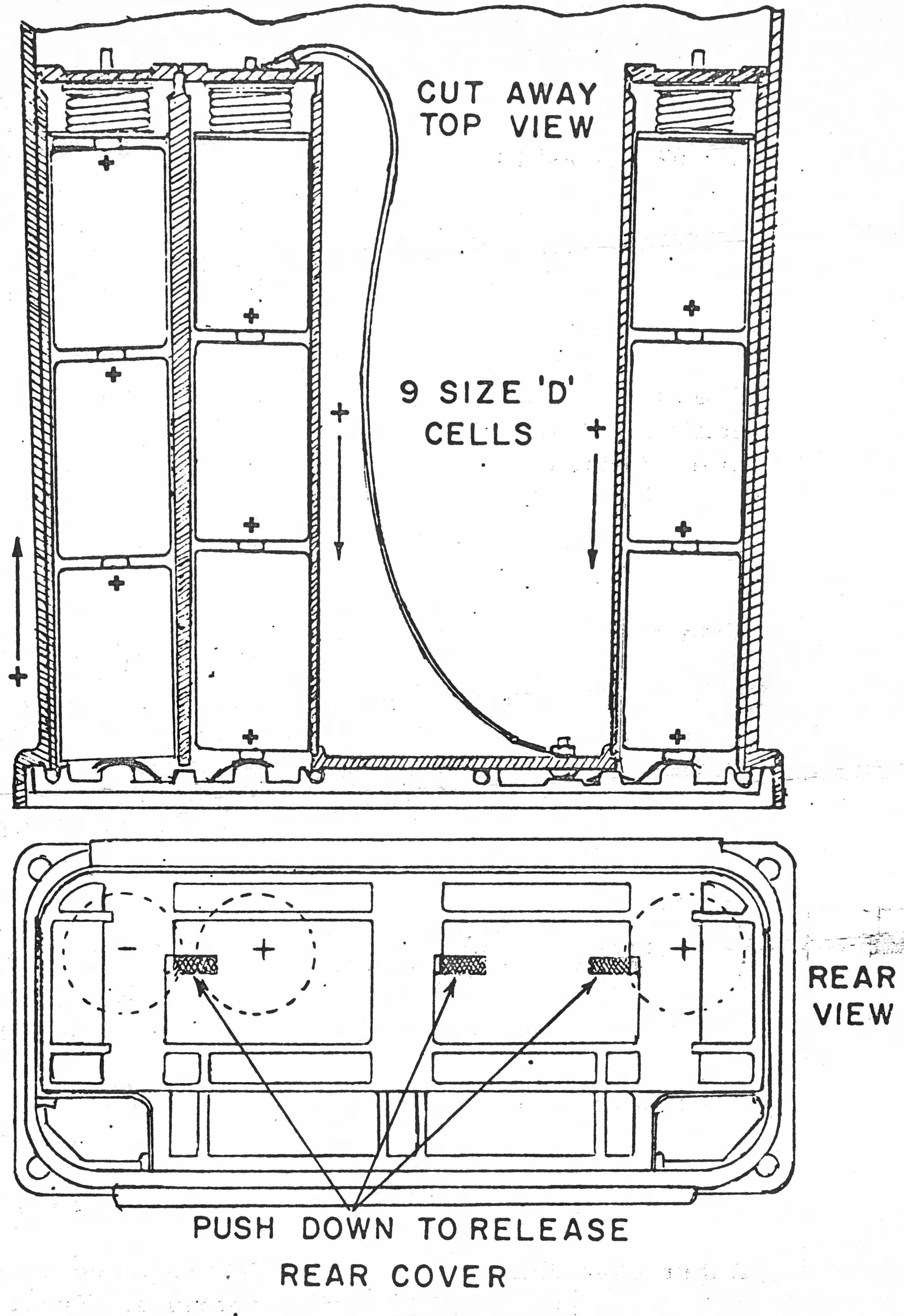


FIGURE I

REAR AND TOP VIEWS
TO SHOW BATTERY PLACEMENT

D. CRYSTAL INFORMATION

Beat Frequency Oscillator Crystal CMC 730-055
Frequency 456.500 KHz

High Frequency Oscillator
(channel determining crystal)

USB use crystal CMC 730-054 USB

FX (crystal frequency) = Fc (carrier freq. *) + 456.500 KHz

LSB use crystal CMC 730-054 LSB
FX = Fc - 456.500 KHz

* NOTE

The carrier frequency is the frequency of the SSB suppressed carrier frequency. It is not the assigned channel frequency on SSB.

E. BATTERIES

Nine size D, regular flashlight type cells, supply power for the CP24. These are contained in the case in three groups of three, and are accessible from the rear of the unit. All cells are connected in series to provide a nominal value of 12 volts. A detachable rear door keeps the batteries in place and provides a waterproof cover for them. To reach the batteries, push down the three spring loaded knurled knobs in the rear door. Spring pressure on the batteries will push the cover open. Polarity is indicated on the rear of the cover.

Rechargeable nickel cadmium batteries are recommended. These will withstand many charging cycles and will give long periods of service between charges.

These batteries may be charged from the 115/230V AC line with the CMC 244-722414-001 charger. This charger connects into the antenna socket of the unit when the antenna is disconnected. A charger adaptor (/15) is available which will allow the antenna and battery charger to be connected at the same time. A charging rate of 400 mA for 14 to 20 hours will be sufficient to fully charge the batteries. A trickle charge of 50 mA will maintain the cells at full charge. A switch on the battery charger provides these two outputs as required.

A Battery Holder (/16) is also available, which may be used with the /14 charger, when charging batteries removed from the CP24.

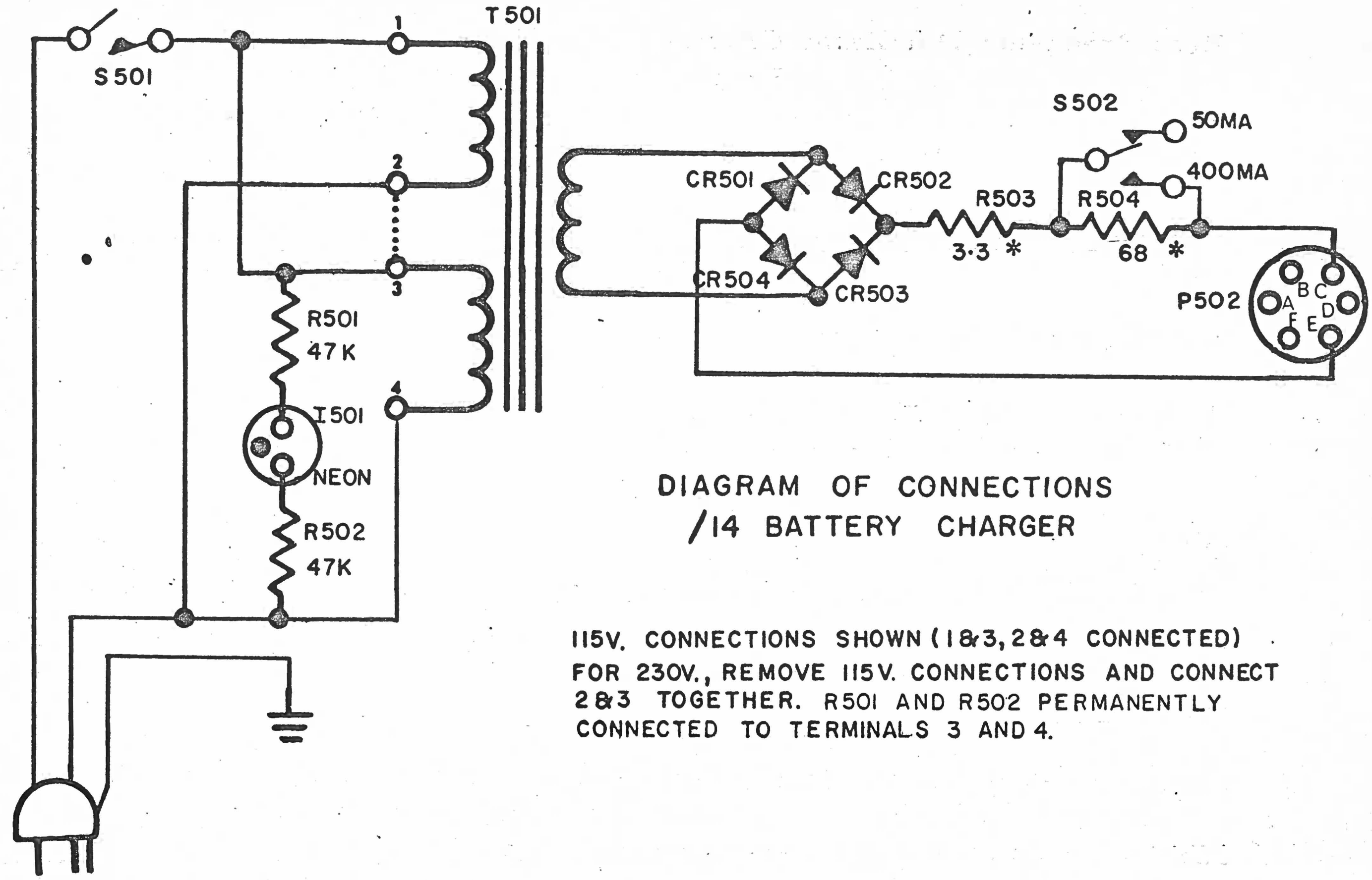


DIAGRAM OF CONNECTIONS
/14 BATTERY CHARGER

115V. CONNECTIONS SHOWN (1&3, 2&4 CONNECTED)
FOR 230V., REMOVE 115V. CONNECTIONS AND CONNECT
2&3 TOGETHER. R501 AND R502 PERMANENTLY
CONNECTED TO TERMINALS 3 AND 4.

Battery Charger Parts List

ITEM	DESCRIPTION	TYPE
R501	RESISTOR, 47K ohms, 10%, 1/4W	CMC 286-702473-001
R502	Same as R501	
* R503	RESISTOR, 3.3 Ohms, 7W, 10%	CMC 288-990070-633
* R504	RESISTOR, 68 ohms, 10%, 2W	CMC 286-934680-001
CR501, CR502		
CR503, CR504	Diode, 1 amp, 400 P. I. V. G100B	CMC 296-990070-659
S501	Switch, SPST, 6 Amp.	CMC 312-990070-700
S502	Switch, SPST, 1/2 Amp.	CMC 312-990070-702
I501	Neon lamp,	CMC 266-990070-569
T501	Power transformer	CMC 322-730056-001
P502	Connector, plug, 6 pin	CMC 230-990070-510

* On some earlier units, R503 = 10 ohms, R504 = 150 ohms.

Non rechargeable zinc-carbon or alkaline type batteries may also be used. The alkaline type will give over three times the service life of the zinc carbon cells. When zinc-carbon cells are used, the industrial type is preferred over standard cells.

F. CARRYING BAG

A carrying bag (/21) is available, that will accomodate the complete unit with its accessories. Space is provided inside the bag to store the microphone, antennas (whip and long wire) and loading coils in separate pockets. The whip antenna may be the single long section or the collapsible section type which can be dismantled for storage. To store the single section antenna, a long plastic tube, formed into a coil is fastened to the rear of the bag. The antenna is inserted into the coil, and pushed in for its entire length. The inside of the coil should be lubricated periodically with Tygaflor standard spray. This is available in a 16 oz. aerosal spray can from Johnston Industrial Plastics Limited.

The bag is made from PVC plastic covered nylon mesh, and is water and fungus proof, flame resistant and flexible in extreme cold.

An adjustable carrying strap on the bag allows it to be carried over the shoulder or on the back, like a knapsack. The strap may also be detached and used to carry the CP24 by itself. This strap is an option (/22) and must be ordered separately.

G. HUMIDITY PROTECTION

Mounted inside the case of the CP24 is a small white bag containing silica-gel, which should be checked regularly. This is added as a precaution against excessive humidity in the unit. The crystals in the bag have a blue tint, which can be seen through the bag. If the crystals have turned slightly pink, it indicates that they have absorbed their limit of moisture, and must be dried out. Remove the bag and place it in a 250°F (120°C) oven for 2 hours. When dry, the blue tint will return. After drying, replace the bag in the CP24.

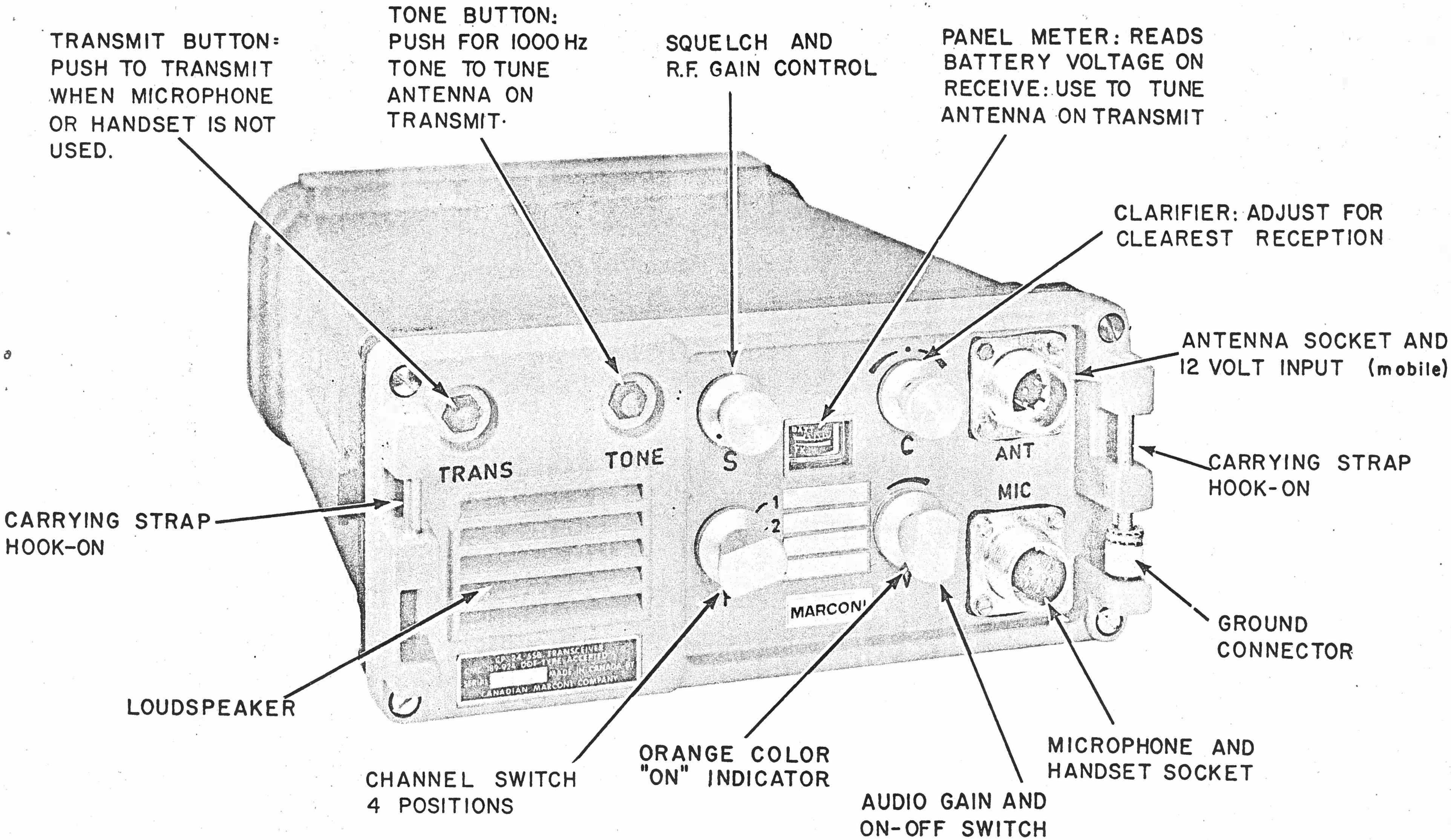


FIGURE 2

CP24 CONTROLS

SECTION 2

OPERATION

A. CONTROLS

All controls are on the front panel (See Figure 2)

These are:

1) Audio gain and ON-OFF switch (V), lower right hand knob.
   Note: Antenna plug must be in Antenna socket before unit will operate(removing antenna plug disconnect internal batteries)

2) Squelch control (S), upper left hand knob.

3) Channel switch (F), lower left hand knob.

4) Clarifier control (C), upper right hand knob.

5) Transmit button, left hand button above speaker.

6) Tone, right hand button above speaker.

1. Audio gain (V). The ON-OFF switch is mounted on this control. Turning the knob clockwise turns the switch on. Maximum receiver output is fully clockwise. Adjust for desired volume. An orange colored band under this knob is visible through the small cut-out in the knob skirt. This is to indicate at a glance that the switch is ON. No color is visible when the switch is OFF.

2. Squelch control (S) is used to reduce the amount of noise heard in the receiver when no signals are being received. Turn the volume control (V) to maximum output, and adjust the S control CCW until the receiver is just squelched. In strong signal areas, it may be necessary to turn this control further counter clockwise to reduce the sensitivity of the receiver. There is a slight time delay in the squelch action of this control to prevent unnecessary clipping of speech at certain levels.

3. Channel switch (F). Four position switch. Be sure that proper channel frequency is selected.

4. Clarifier control (C), is used to fine tune the high frequency oscillator for clearest reception.

5. Transmit button is used when there is no microphone or hand set connected. In this condition, the loud speaker is used as a microphone by speaking directly into it while the transmit button is pressed.

6. Tone button, when held in on transmit, produces a 1000 Hz tone, which can be used to tune the antenna. This tone can also be used to call distant stations.

The panel meter reads battery voltage on receive. When it reads less than one quarter scale, the batteries should be replaced or recharged. On transmit it is used to tune the antenna. Meter deflection will vary when speaking into the microphone.

B. MICROPHONE

Connect the microphone or handset to the MIC socket at the lower right hand corner of the panel. The Push to Talk switch on the handset or microphone operates the transmitter. To transmit without a microphone or handset, the TRANSMIT button on the front panel is used as the PTT switch: the speaker is used as a microphone, (only when the MIC socket is not used).

C. ANTENNAS

The basic CP24 antenna consists of the adjustable antenna kit (/2). Other forms of antennas are optional, and are ordered separately.

When the tuning coil is used with the 5' whip, the antenna operates as a center loaded whip. Frequency coverage with the adjustable loading coil is between 2 MHz and 15 MHz. To extend this range below 2 MHz to 1.6 MHz, a fixed loading coil is inserted in series between the whip and the adjustable loading coil. See Figure 3.

To extend the antenna range without using the fixed loading coil, a long wire should be substituted for the collapsible, whip. The long wire antenna with its adaptor, is connected to the adjustable loading coil in place of the whip antenna. The long wire antenna is tuned the same way as the whip antenna. A good ground is essential, and may be in the form of a large conductive surface area such as the frame of a motor vehicle or a wire mesh fence.

Due to inherent ground and loading coil losses at the lower frequencies, the long wire antenna with a good ground will have a distinct advantage over the whip and should be used where possible.

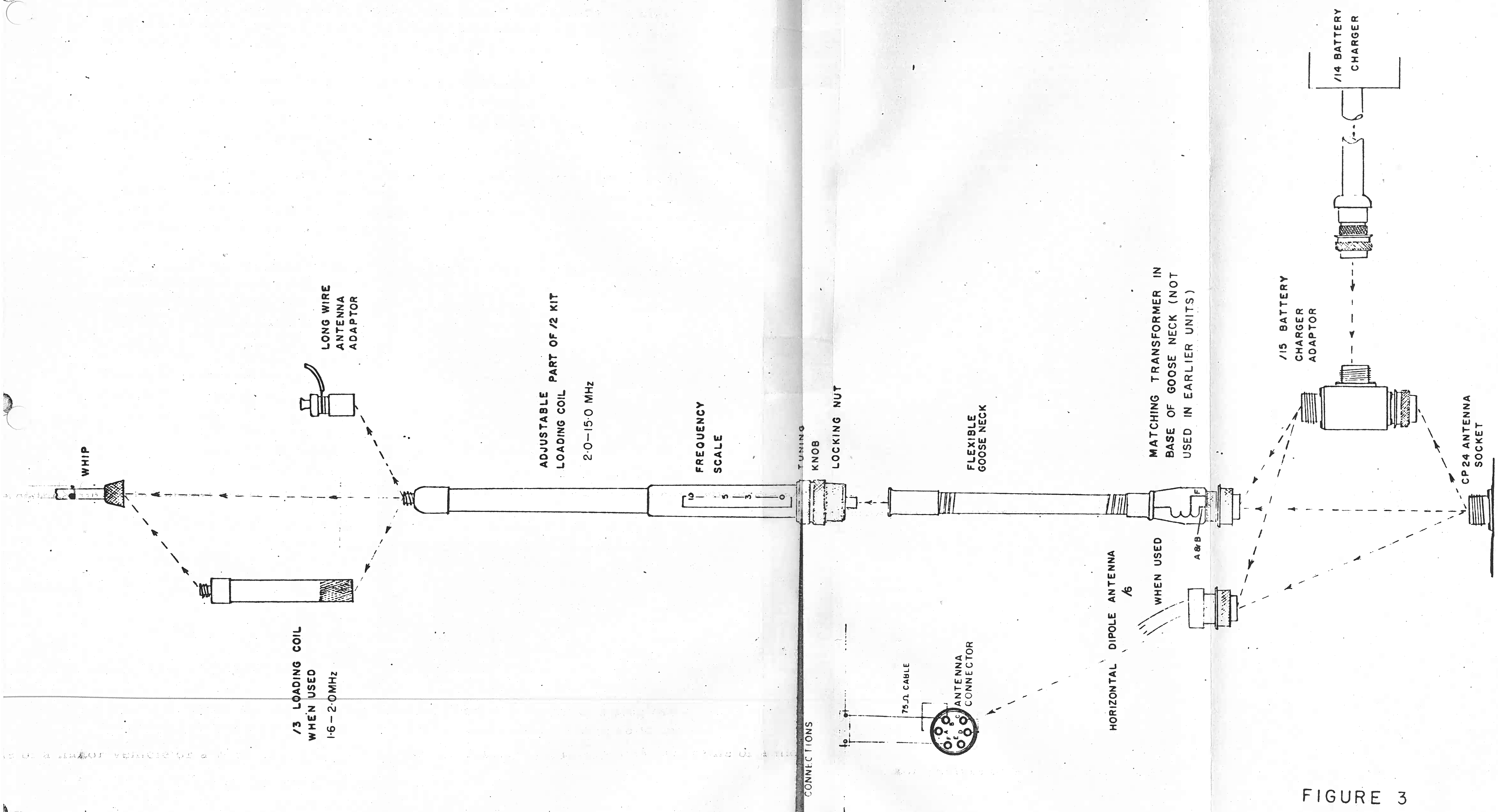


FIGURE 3
WHIP & LONG WIRE
ANTENNA CONNECTORS

Tuning the adjustable loading coil is done by turning the black knurled knob with the bright orange band. Just below this knob is a smaller one which is used to lock the tuning in position.

The 0-10 scale on the side of the transparent coil housing indicates the approximate frequency to which the whip is tuned. Start tuning with the scale set to 10 and use the first peak as the coil is tuned. A calibration chart for this scale is shown in Figure 5.

Tune the coil first on receive, to maximum noise output from the speaker. Then operate the transmitter with the test tone (press Tone and *Transmit buttons together) and retune the antenna coil for maximum output as indicated on the front panel meter.

The transmitter should be tuned in as short a time as possible to avoid excessive battery drain. More power is required from the batteries with the TONE button ON, than when transmitting speech. After tuning, tighten the locking knob.

Antenna tuning is critical, and should be checked periodically. Tuning will change with movement of the unit, and will be effected by the proximity of trees, buildings, etc.

In cases where it is impossible to have a suitable ground, or if there is no ground connection at all, the reading on the panel meter may be too small to allow accurate antenna tuning, particularly at the lower frequencies. In this case, tune the antenna for maximum noise on receive.

Figure 4 shows how the dipole antenna should be mounted. The two halves are horizontal and at a height above ground equal to one half the total length. The ends of the antenna can be fastened to trees, flag-poles, buildings or other existing objects of suitable height. A connector on the end of the lead-in plugs directly into the antenna socket, J101.

The dipole antenna does not require tuning.

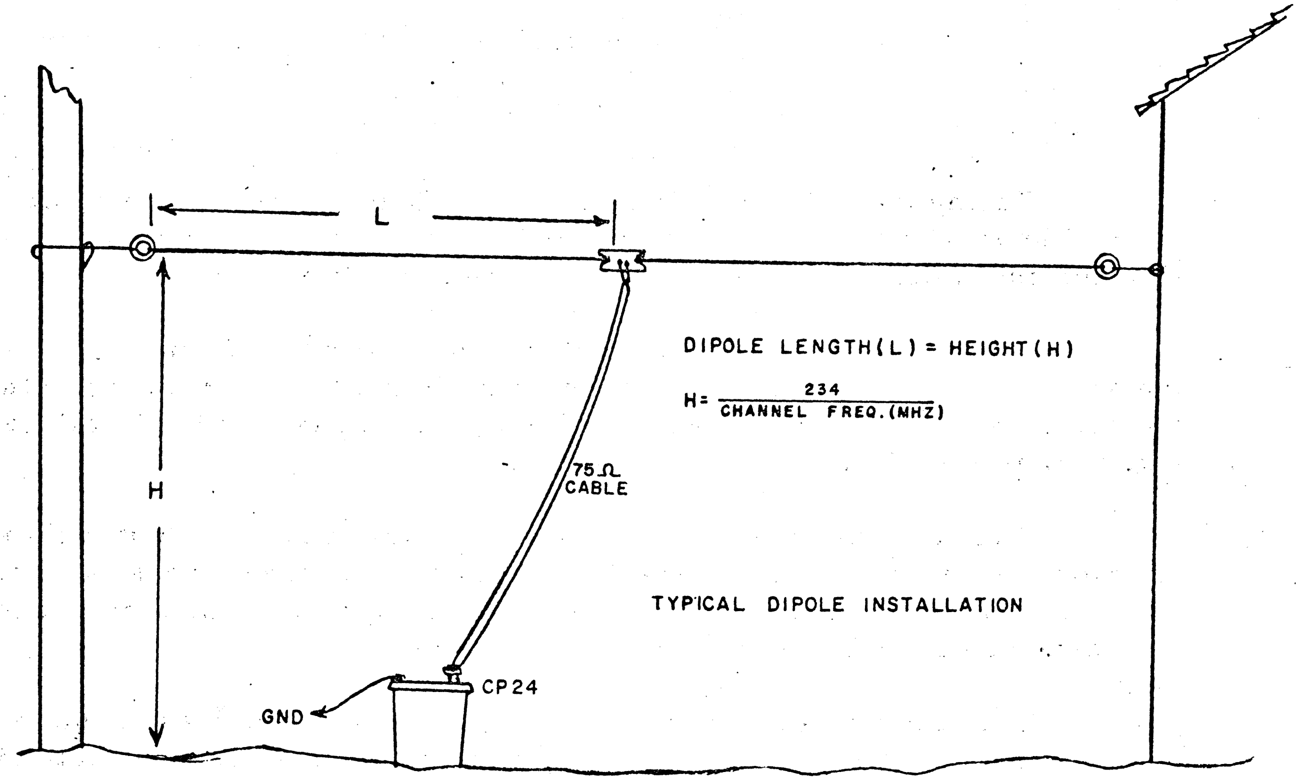
D. C. W. OPERATION

Remove the microphone, if used, from its socket and plug the telegraph key in its place. The key may be hand held or strapped to the operator's leg.

Press the transmit switch.

Operate the key to produce a C. W. output.

* On later units it is unnecessary to push the two together as the tone button also turns on the transmitter.



GROUND NOT NECESSARY FOR DIPOLE OPERATION
USE FOR STATIC DISCHARGE ONLY

TYPICAL LONG WIRE ANTENNA INSTALLATION

REFER TO CHART— FIGURE 5

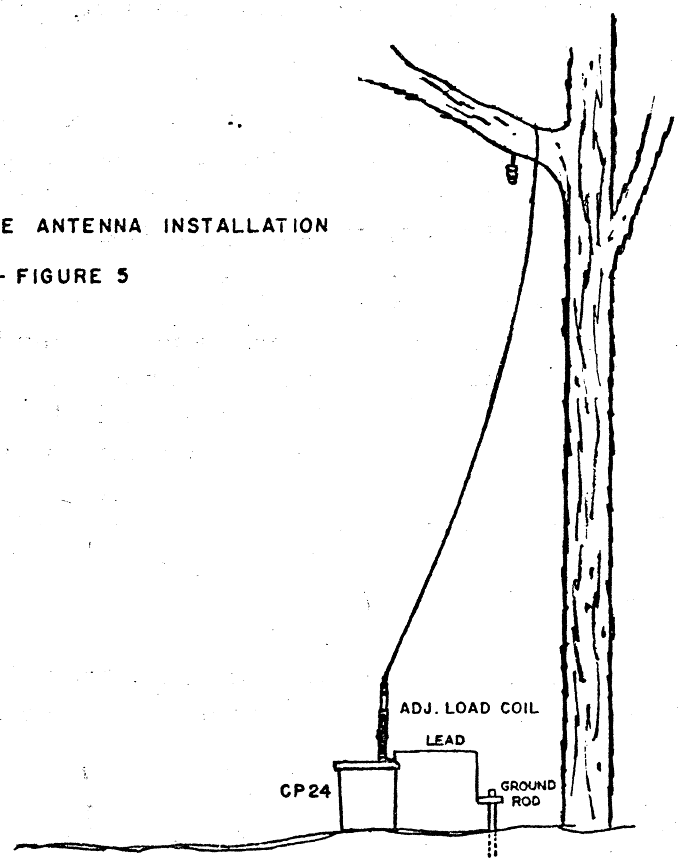


FIGURE 4 - TYPICAL ANTENNA INSTALLATIONS

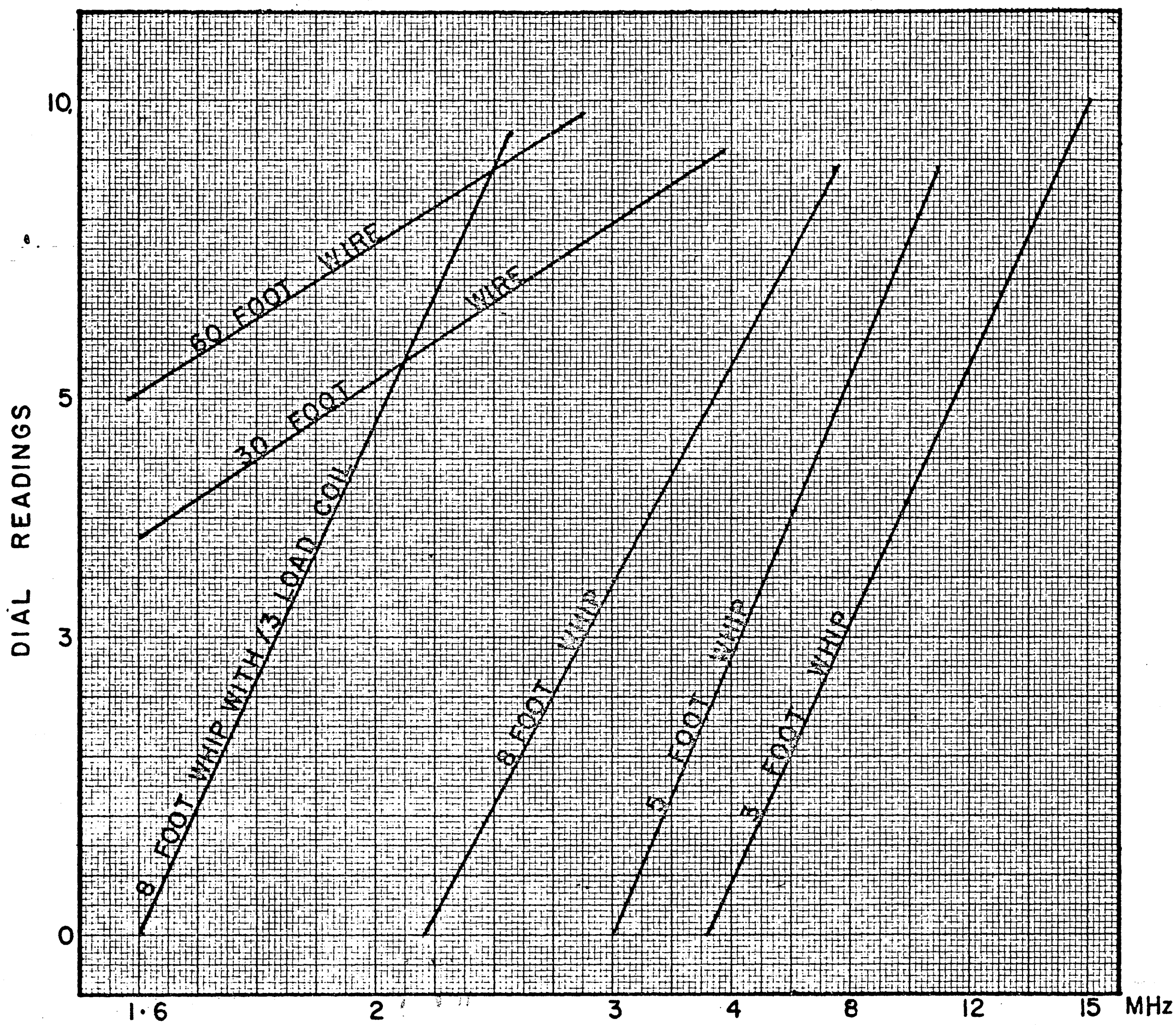


FIGURE 5

ADJUSTABLE LOAD COIL CALIBRATION CHART

EXAMPLE 1.

To find dial calibration when using a 30 ft. long wire antenna at 3.0 MHz.

A) Draw a vertical line from the base of the graph at 3.0 MHz to the 30 ft. long wire antenna line.

B) Point where these two lines intercept will give the approximate dial reading at the left side of graph

EXAMPLE 2.

To find dial calibration when using an 8 ft. whip antenna at 1.8 MHz.

A) Draw a vertical line from the base of the base of the graph at 1.8 MHz. This line will not intercept the 8 ft. WHIP line, but will intercept the 8 ft. WHIP WITH/3 LOAD COIL, line.

B) Point where these two lines intercept will give the approximate dial reading at the left side of the gr Below 2.0 MHz, therefore, a /3 load coil must be used in conjunction with the whip.

NOTE:

At the frequency of 1.8 MHz, it is also possible to use the 30 or 60 foot long wire antennas as shown on the graph.

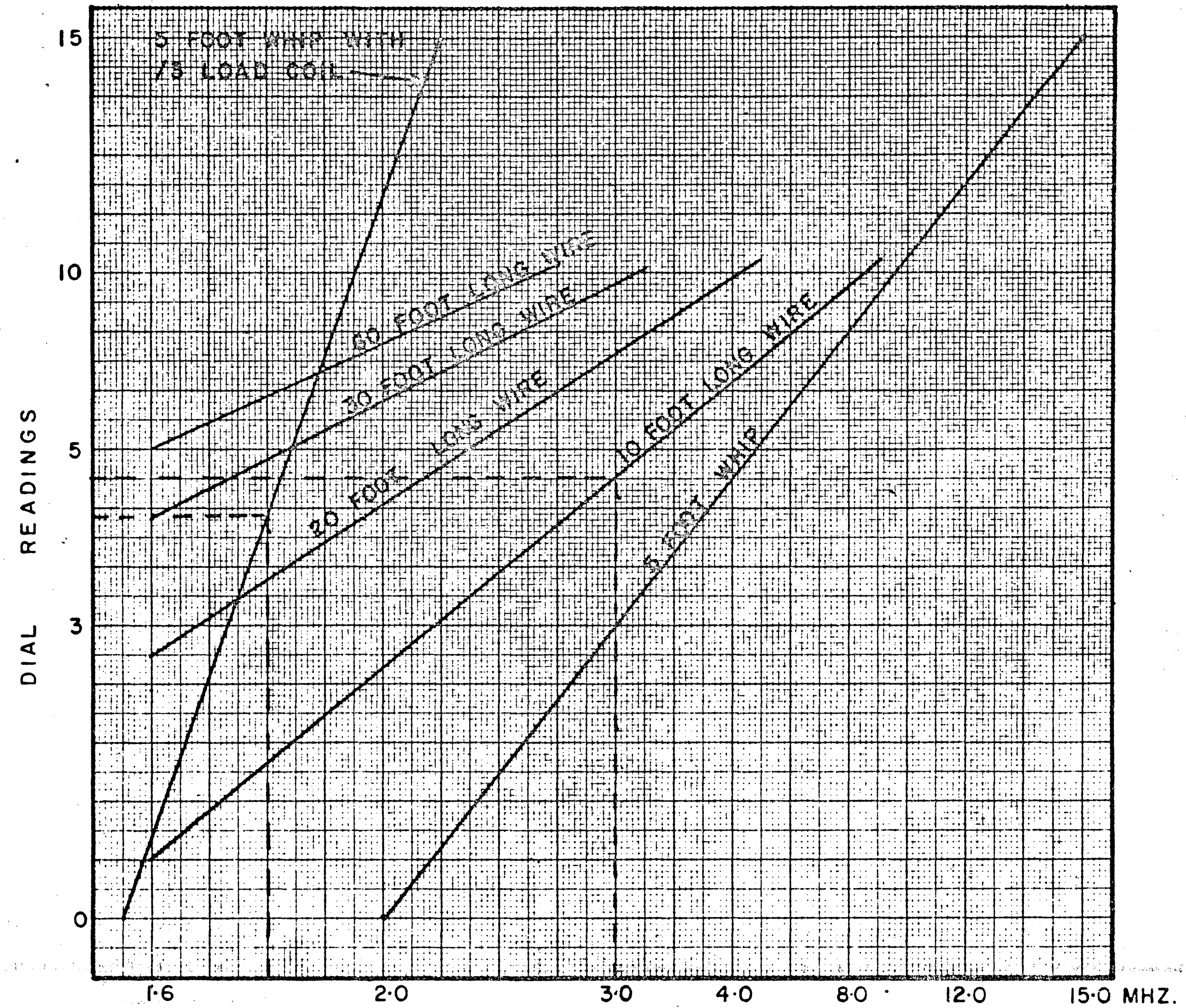


FIGURE 5A
ADJUSTABLE LOAD COIL CALIBRATION CHART

EXAMPLE 1.

To find dial calibration when using a 10 ft. Long wire antenna at 3.0 MHz.

A) Draw a vertical line from the base of the graph at 3.0 MHz to the 10 ft. long wire antenna line.

B) Point where these two lines intercept will give the approximate dial reading at the left side of grap

EXAMPLE 2.

To find dial calibration when using a 5 ft. whip antenna at 1.8 MHz.

A) Draw a vertical line from the base of the base of the graph at 1.8 MHz. This line will not interce the 5 ft. WHIP line, but will intercept the 5 ft. WHIP WITH/3 LOAD COIL, line.

B) Point where these two lines intercept will give the approximate dial reading at the left side of the Below 2.0 MHz, therefore, a /3 load coil must be used in conjunction with the whip.

NOTE:

At the frequency of 1.8 MHz, it is also possible to use the 10ft, 20 ft, or 30 ft. Long wire antenn as shown on the graph. The vertical line will intercept these lines at approximate dial points of 1.5, 3.5 and 4.5 respectively.

This chart is for earlier units with adjustable load coil calibrated 0-15

SECTION 3

MOBILE INSTALLATION

A. GENERAL

The CP24 may be either dash or floor mounted in a vehicle with the /7 Mobile Mounting Kit. Power for the unit may be taken from the vehicle's 12V supply.

B. INSTALLATION

Refer to Figure 6 and install the mounting bracket as shown. Floor or dash mount may be used as required.

Install the microphone hanger where convenient: preferably on or near the dashboard.

Connections to the 12 volt supply are provided by the cable assembly CMC 730-064. The red battery lead must be connected to the positive supply. If the vehicle has a positive ground system, the red lead would then be connected to ground. If the vehicle has a negative ground system, then the black lead would be connected to ground.

The limiter assembly on the cable may be mounted on the side of the mounting bracket in the holes provided. However, if more convenient, it may be mounted elsewhere close by, as determined by the length of cable between the connector and the assembly.

Connect the high, or hot, side of the cable to the battery side of the ignition switch. If the nickel-cadmium batteries are used in the unit, they will be recharged from the 12 volt supply, even when the motor is not running. If the non rechargeable batteries are used, they may be left in place. The 12 volt supply connected across them will help to extend their life.

It is not advisable to leave the internal batteries in the CP24 for extended periods of time, as damage could result from overcharging. The CP24 operates directly from the vehicle's battery. If the mobile installation is permanent, the internal batteries are not required.

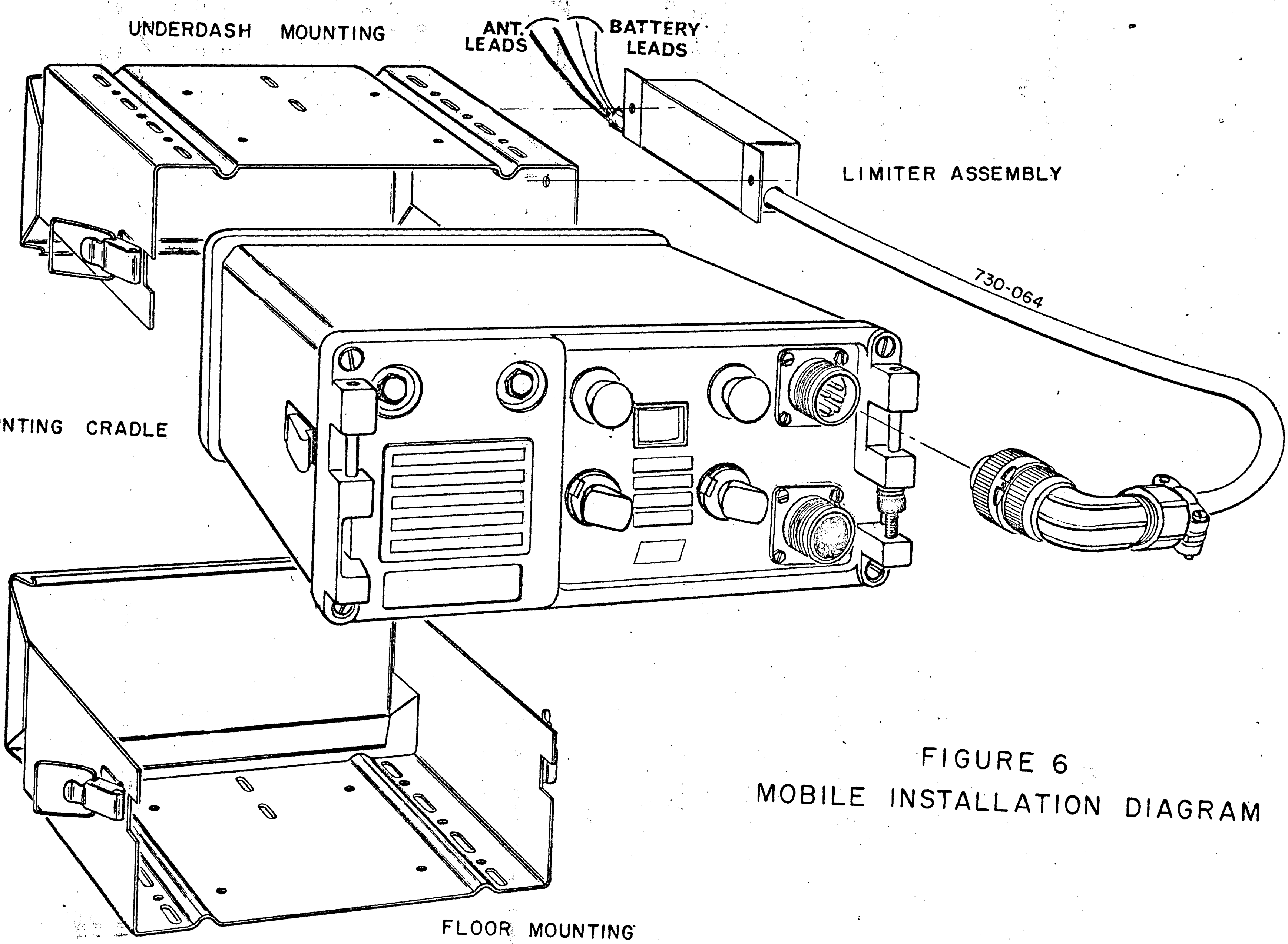


FIGURE 6
MOBILE INSTALLATION DIAGRAM

C. ANTENNA CONNECTORS

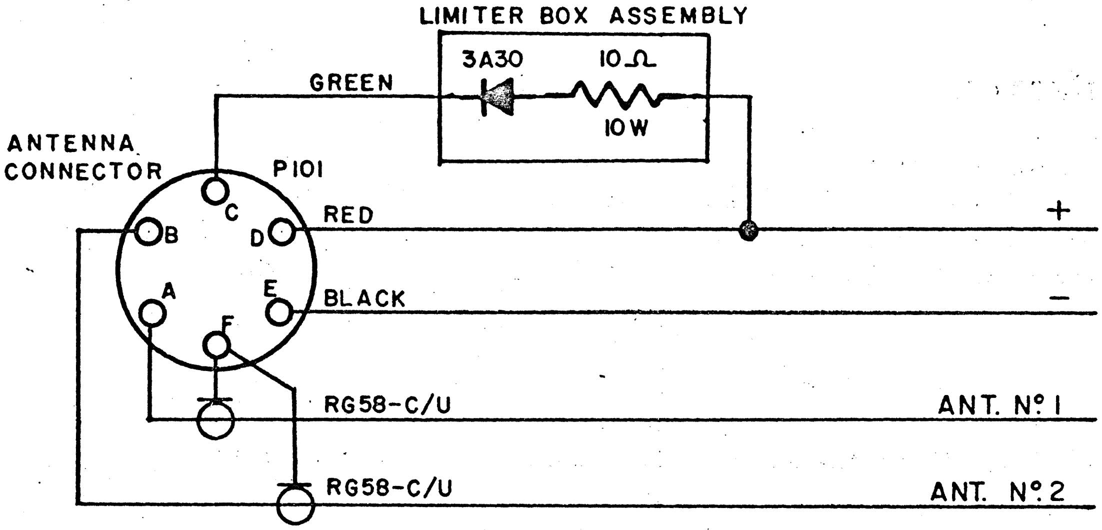
Connections to the antenna (or antennas) is provided by cable assembly 730-064. Two coaxial cables in this assembly allow the use of a separate antenna for each channel. When two antennas are used for this purpose, they should be mounted at least three feet apart on the vehicle.

To tune the antenna, a field strength meter is required. If none is available, a sensitive VOM with a diode connected in a wire loop may be used (See Figure 7). Tune the adjustable loading coil for maximum reading on the field strength meter. If a fixed antenna is used, the field strength meter should be used to check that it is properly connected.

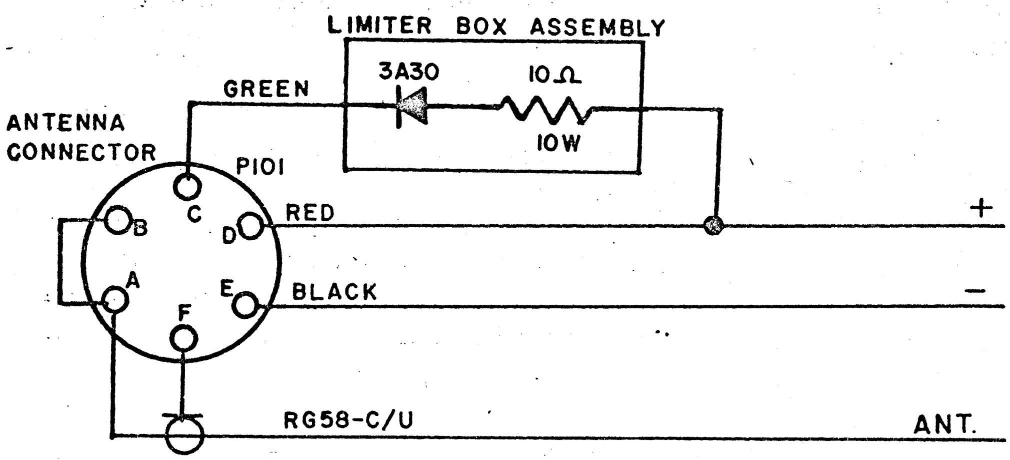
If only a single channel and antenna is used, the unused cable may be left in place and rolled up under the floor mat or other convenient place. It is not necessary to disconnect it.

For two channel operation with one antenna, the cable assembly must be modified as shown in Figure 7 on the next page. In this case, it will be necessary to retune the antenna each time the channel is switched.

NOTE: The front panel meter on the main unit cannot be used for antenna tuning in a mobile installation. The meter reads R.F. current at the antenna connector, and is not a reliable indicator of antenna current if a feeder cable is used between the CP24 and the antenna.



CONNECTIONS WHE
TWO ANTENNAS AR
USED



CONNECTIONS WHEN
ONE COMMON ANTENNA
IS USED

LIMITER BOX ASSEMBLY AND ANTENNA
CONNECTOR DIAGRAMS

SETUP FOR USING A V.O.M.
(20,000 Ω PER VOLT OR BETTER)
FOR ANTENNA TUNING

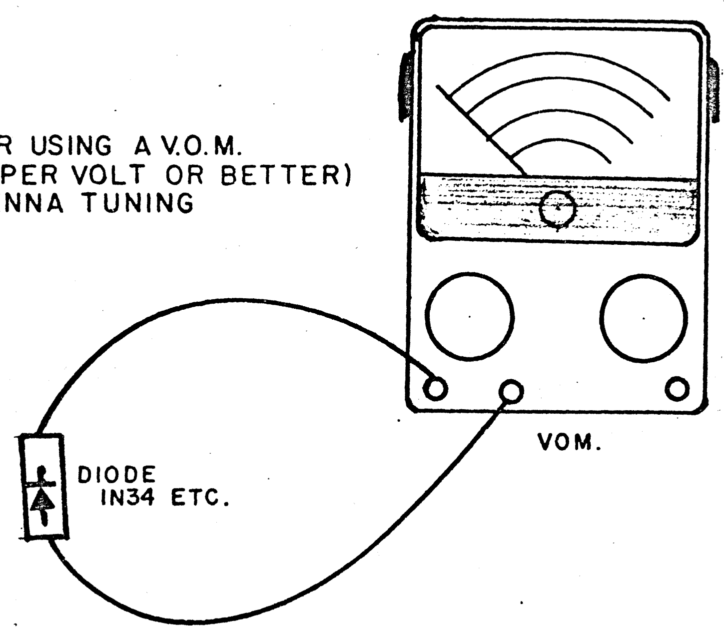


FIGURE 7
ANTENNA CONNECTORS AND
FIELD STRENGTH METER

CP 24 MOBILE MOUNTING KIT

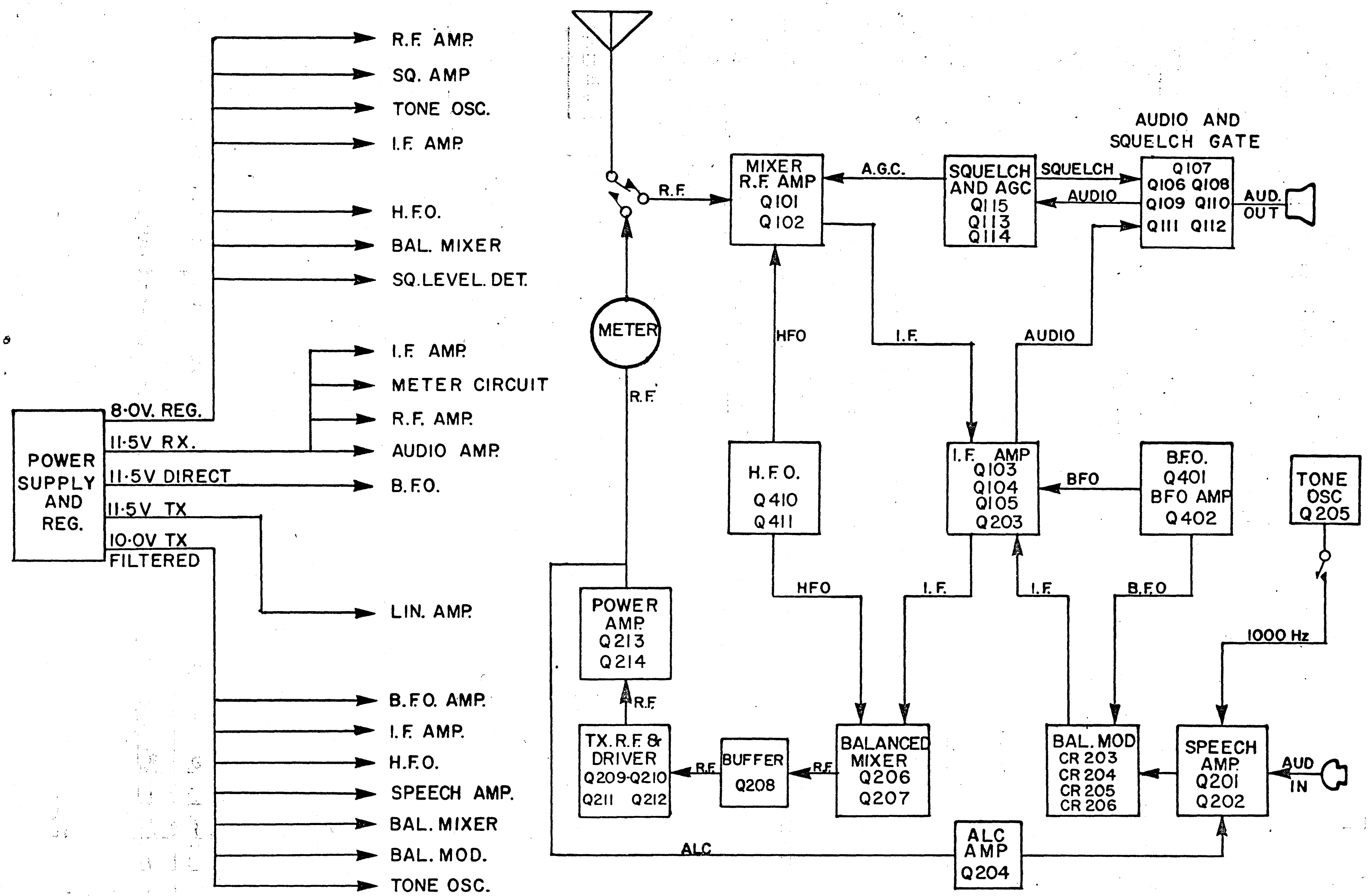
CMC 189-924-007

ITEM	TYPE NO.	DESCRIPTION	QTY
1.	CMC 769-735	Bracket Assembly	1
2.	CMC 730-065	Limiter Assembly	1
3.	CMC 306-788	Mounting Strap	2
4.	CMC 730-063	Pad	1
5.	731	Rubber Bushing	2
6.		Screw, 1/4-20 x 3/4"	4
7.		Screw, 1/4-20 x 2	4
8.		Screw, self tapping, #14 x 1-1/2	4
9.		Screw, #6-32 x 5/16	2
10.		Nut, 1/4-20, Hex, steel	6
11.	1114	Lockwasher 1/4"	6
12.		Washer, 1/4" plain, steel	6

LIMITER ASSEMBLY CMC 730-065

CMC 730-064	Cable Assembly
97-3108B-14S-6S-639	Connector (Amphenol)
3A 30	Diode, Solitron
IRC - PW 10	Resistor, 10 ohms, $\pm$ 10%, 10W

NOTE: A Field Strength Meter is recommended when installing mobile units. Used to tune and/or check antenna output.


POWER SUPPLY AND REG.
8·0V. REG.
11·5V RX.
11·5V DIRECT
11·5V TX
10·0V TX FILTERED
R.F. AMP.
SQ. AMP.
TONE OSC.
I.F. AMP.
H.F.O.
BAL. MIXER
SQ.LEVEL. DET.
I.F. AMP.
METER CIRCUIT
R.F. AMP.
AUDIO AMP.
B.F.O.
LIN. AMP.
B.F.O. AMP.
I.F. AMP.
H.F.O.
SPEECH AMP.
BAL. MIXER
BAL. MOD.
TONE OSC.
METER
R.F.
MIXER R.F. AMP Q101 Q102
A.G.C.
SQUELCH AND AGC Q115 Q113 Q114
SQUELCH
AUDIO
AUDIO AND SQUELCH GATE
Q107 Q106 Q108 Q109 Q110 Q111 Q112
AUD. OUT
HFO
I.F.
AUDIO
H.F.O. Q410 Q411
I.F. AMP Q103 Q104 Q105 Q203
BFO
B.F.O. Q401 BFO AMP Q402
TONE OSC Q205
POWER AMP. Q213 Q214
HFO
I.F.
I.F.
B.F.O
1000 Hz
TX. R.F. & DRIVER Q209-Q210 Q211 Q212
BUFFER Q208
BALANCED MIXER Q206 Q207
BAL. MOD CR 203 CR 204 CR 205 CR 206
SPEECH AMP. Q201 Q202
AUD IN
ALC
ALC AMP Q204

SECTION 4

ALIGNMENT AND SERVICING

A. GENERAL

This section deals with routine service and alignment details, should the performance of the unit deteriorate in any way, or should the frequency require changing.

B. TEST EQUIPMENT REQUIRED

		Type used to obtain readings shown
1.	DC Power Supply - 9-16 Volts 2A	
2.	Multimeter	Avo Model 8
3.	VTVM, with probe	Ballantine 317
4.	Frequency Counter	Hewlett-Packard 524B
5.	Oscilloscope	Tektronic 547 with type 1A1 plug-in
6.	Audio Oscillators (2 required)	Hewlett Packard 200CD
7.	R.F. Generators (2 required)	Marconi Instruments TF144
8.	R.F. Wattmeter	Marconi Instruments TF1152
9.	A.F. Distortion Analyzer	Heathkit HD-1
10.	A.F. Wattmeter	General Radio 583A
11.	H.F. Spectrum Analyzer	Panoramic SB-126

4.2 RECEIVER

A. GENERAL

Remove the unit from its case, and connect it to the power supply.

Disconnect the speaker and substitute the audio wattmeter, set for a 40 ohm load. Connect the oscilloscope and distortion meter across the wattmeter terminals. Connect the RF signal generator to the antenna input.

B. ALIGNMENT

Turn all equipment on
Set channel switch to the appropriate channel
Set squelch (S) control to maximum
Set volume (V) control approximately half way.

Set the RF signal Generator to CW and adjust its attenuator for maximum output, and its frequency for an audio output from the receiver of around 1000 Hz. Check that the frequency of the generator is approx. that of the channel frequency before tuning, to avoid trying to set up the receiver on a spurious response or on the wrong side of the HFO.

Tune coils T101 and T102 for maximum output on the VTVM section of the distortion meter, reducing the input voltage progressively as sensitivity increases, until maximum sensitivity is obtained.

NOTE: When tuning double-tuned coils always start with the slugs at the ends of the coils and tune them slowly towards the center. Tune on the first peak.

Receiver coils are double-tuned above 4.3 MHz for T101 and above 6 MHz for T102.

C. SPECIFICATION TESTS

1. Set R129, (I.F. Gain Control) to minimum (CCW) *
Set R177, (AGC Control) and R144 (squelch bias control) to maximum (CW).
Turn R158 CCW until an increase of 0.5 mA is noted in the total current drain.

2. With a 40 ohm load in place of the speaker, apply an EMF of 1 mV to the antenna, and adjust its frequency to give an output of approximately 1000 Hz at audio output (pin 24 on printed circuit board). Set the volume control (R147) to minimum (CCW) and adjust R177 for a reading of 320 mV at the junction of L103 and R143 with VTVM. Set volume control (R147) for 250 mW output. Audio distortion should be 5% or less.

3. Reduce input to 0.5 uV EMF, and set R129 (I.F. gain) to give an output of 25 mW ± 5 db.

4. Set the squelch control (R173-R101) fully CW. Disconnect the R.F. signal and connect the audio generator to the junction of L103 and R143 through a 10 uF capacitor. Set generator output to 100 mV at 1000 Hz. Adjust Volume Control (R147) for an output of 200 mW, (or 2.8V), reset R173-R101 to mid-position, and turn R144 (squelch bias control) CCW until the output drops to 10 mV. (.002 mW across 40 ohm load). Increase output of audio generator until output meter reads 220 mW output. Audio input should be less than 200 mV.

5. Reconnect R.F. Generator to antenna input, and adjust it to 0.5 uV EMF output. Set volume control (V) for 100 mW output. Check SINAD reading should not be less than 12 db.

* When adjusting controls, use a screwdriver with an insulated blade to avoid transistor damage due to accidental contact with exposed leads e

4.3 TRANSMITTER

A. GENERAL

Remove the unit from its case, and connect it to the power supply.

Connect a 50 ohm RF wattmeter to the antenna connector. Set transmitter permanently on by shorting the TRANS button with a short jumper.

B. ALIGNMENT

NOTE: Be careful not to tune the transmitter to the image frequency, which is close to the channel frequency. For USB units it is 912 KHz above the channel frequency. For LSB units, it is 912 KHz below the channel frequency.

1. Remove crystals.

2. Connect the RF signal generator to the base of Q212 thru a .01 uF capacitor. Tune the generator to the channel frequency and set its output to 2V. EMF. Turn the channel switch (F) to the channel being used.

3. Adjust C246/1 (or /2 depending on channel) and L216/1 (or /2) for maximum output.

4. Switch to the other channel, reset the frequency, and adjust C246/2 (or /1) and L216/2 (or /1) for maximum output.

5. The following procedure is suggested as the easiest way to ensure setting up on the correct frequency.

   (a) Turn R249 (balanced mixer control) fully CCW.

   (b) With the RF signal generator set to the channel frequency, inject a signal of 50 mV through pin 45 of the printed circuit board.

   (c) Set R257 (channel gain control) to mid point, and set R233 to mid-point.

   (d) Adjust T202 and T203 for maximum output, reducing the generator output progressively as transmitter output increases. Keep output below 5 watts for proper tuning. When tuning double tuned coils, always start with the cores at the ends of the coil, away from each other, and turn towards the center. (T202 is doubled tuned above 6 MHz).

   (e) Adjust R249 for a minimum peak on the output meter.

*

(f) Disconnect the generator and re-install crystals.

(g) Set R204 (transmitter audio gain) fully CW. To adjust see paragraph C3.

(h) Connect the two audio oscillators to pin B of the microphone socket. Tune one oscillator to 1 KHz and the other to 1.6 KHz. Output of each oscillator should be 2 mV.

(i) Touch up the tuning of T202 and T203, C246 and L216 for maximum output on the RF wattmeter. Adjust R257 for 5 watts output, RMS.

C. SPECIFICATION TESTS

1. With the equipment connected as in para. B, loosely couple the oscilloscope, or if available, a spectrum analyzer to the antenna output. (Do not connect a low impedance scope or analyzer directly to the antenna). Short pin B of the microphone socket to ground. Adjust C210 and R223 (balanced modulator control) for minimum carrier output. C210 (pin 51 on the printed circuit board) should be connected to pin 48 or pin 49, whichever pin gives the minimum output. The carrier and any noise modulation should be at least 40 dB below either of the two tones. If no spectrum analyzer is available, adjust R249 for minimum output as shown on the oscilloscope. This should be done on a higher frequency channel. A more accurate method is outlined in the following paragraph.

2. Remove short from pin B, and with the two audio generators connected as in para B-5 (h), adjust R249 for minimum HFO indication. This is the mixer balance control and is used to balance out the HFO frequency from the mixer output. Observe the two tone pattern on the oscilloscope (Figure 10) and adjust R249 until any 'furring' at the edges of the pattern become sharp and clear. When using a spectrum analyzer, it should be set up on the HFO frequency, and R249 adjusted for minimum. This adjustment should be done on the higher frequency channel as the effect of R249 is sharper at higher frequencies: it should not be re-adjusted on the lower frequency channel. HFO output should be at least 37 dB below either of the two tones.

3. ALC: Reduce output to 3 W. RMS by turning R204 CCW. Increase each input tone by 10 dB. Adjust ALC control R233 for 5W. RMS output.

* See para G for alternate alignment procedure in place of steps g, h and i, below, when audio generators are not available.

4. Using the spectrum analyzer, measure the intermodulation products. They should be 20 dB or more below one of the two tones with an output of 5 watts RMS. Re-adjust L216 and C246 for best I.P. (Intermodulation Products) reading. Vary the supply voltage from 9 to 16 volts. No instability should result.

5. Remove the two tone signal. Press the TONE button: output should be 5.9 $\pm$ .5 watts RMS. The harmonic distortion should not exceed -30 dB with respect to signal.

6. Meter Adjustment: Turn the supply voltage down to 10 V.DC. Adjust R304 until meter reads 1/4 scale.

D. LOWER SIDEBAND OPERATION (LSB)

1. The setting-up procedure as listed above is for USB. For LSB operation select HFO Crystal as in Sect. 1. This will give an oscillator frequency 456.500 KHz below the suppressed carrier frequency. Alignment for LSB is the same as detailed for USB in para 'B'.

E. H.F.O CONNECTIONS (Figure 9)

1. Simplex Operation.
Connect together contacts 2 and 11 on S105A.
Connect together contacts 10 and 11 on S105B
Channels 1, 2, 3 and 4 are now used, with channels 1 & 3, and 2 & 4 the related pairs (using the same tuned circuits)

2. Simplex-Duplex Operation.

On the printed circuit board, connect pin N to L, also pin G to H.
Channel 2 is now normal simplex channel (using Xtal 2)
Channel 3 is now normal duplex channel (using Xtal 3 for transmit and Xtal 4 for receive). Note: there is no separate netting adjustment for receiver Xtal 4.

3. Two Duplex Channels.

Connect together S105A contact #11 and S105B, contact #11.
Connect together pins K and L on the printed circuit board.
Connect together pins G and M on the printed circuit board
Channel 3 uses Xtal 3 for transmit and Xtal 4 for receive.
Channel 4 uses Xtal 1 for transmit and Xtal 2 for receive.

Note: there is no separate netting adjustment for receiver crystals 4 and 2, also when channel 4 duplex is used, the transmit netting capacitor for transmit crystal 1 is the trimmer adjacent to Xtal 4.

F. H.F.O. NETTING

1. Check connection as detailed in para E, and Figure 9. Refer to para G for correct value of C411.

2. Set clarifier control to mid position.

3. Connect frequency counter to pin 45 on the printed circuit board. Operate the transmitter without any modulation and adjust C412 to within 10 Hz of frequency.

G. ALTERNATE TX ALIGNMENT See Note, para B5, (f).

1. Set ALC control R233 fully clockwise (no ALC action). Turn R204 (transmitter audio gain) fully counterclockwise.

2. Apply 455KHz through 2.2 KΩ to TP52 (filter IN). Adjust level to read 175 mV at TP52. This is equivalent level for 2.5W out, single tone.

3. Adjust R257 (channel gain) for 2.5W RMS out. (No audio input).

4. Switch off 455 KHz (Leave generator connected).

5. With both TRANS and TONE buttons pressed adjust R204 (Tx audio gain) for 175 mV at TP52. This should also give 2.5W RMS out.

6. Switch 455 KHz generator on again. With both TRANS and TONE buttons pressed, check for proper two-tone envelope on scope. Touch up T202, (T203), C246, L216 for best envelope. Disregard RF watt-meter reading, unless watt-meter is a thermo type (slow reading), which should read about 5W. Peaks of 2-tone pattern on scope should be about twice the amplitude of single tone. Release tone button momentarily for single tone amplitude indication.

7. Disconnect 455KHz generator. Set ALC control R233 fully CCW. (full ALC action)

8. With TRANS and TONE buttons pressed, first adjust R204 (Tx audio gain) for full gain (fully clockwise), then adjust R233 (ALC control) for 6W output.

9. Press TRANS and TONE buttons and turn R204 (Tx audio gain) down slowly until the output just begins to drop (usually about half way).

H. TEMPERATURE COMPENSATION CAPACITORS (C411)

To obtain the correct temperature compensation for the crystals, the following capacitors must be connected in the circuit as shown below, for the specific crystals.

Xtal 1 (Y410-1): Connect C411-1 between P and M on the board
Xtal 2 (Y410-2): Connect C411-2 between N and R on the board
Xtal 3 (Y410-3): Connect C411-3 between H and S on the board
Xtal 4 (Y410-4): Connect C411-4 between T and V on the board

Note: C424 is used only for LSB operation below 2.45 MHz.

Crystal Code (on side of case)	Capacitor Used for C411
Red	100pF N470
Yellow	100pF N750
Green	47pF NPO Plus 47pF N2200 *
Blue	100pF N1500
Two Red	220pF Silver Mica ±10%
Two Yellow	220pF Silver Mica ±10%
Two Green	150 pF Silver Mica ±10%
Two Blue	100 pF Silver Mica ±10%

*connected in parallel

I. CHANNEL KITS

The Table on the following page details the parts used for the various channel kits that are available with the CP24.

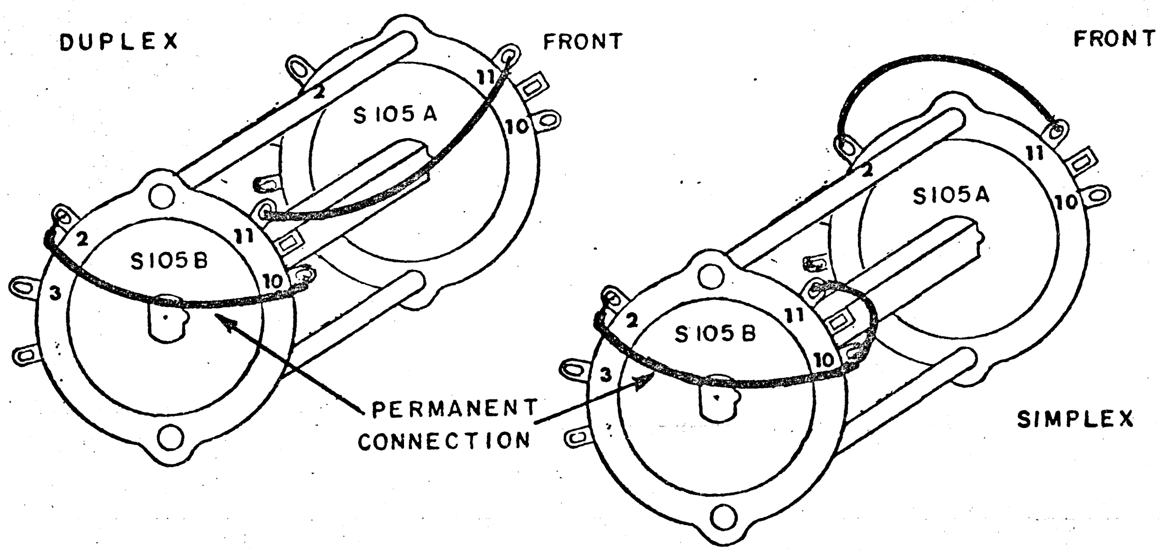
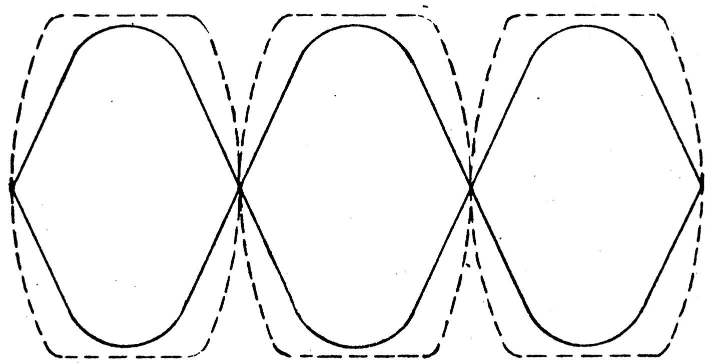


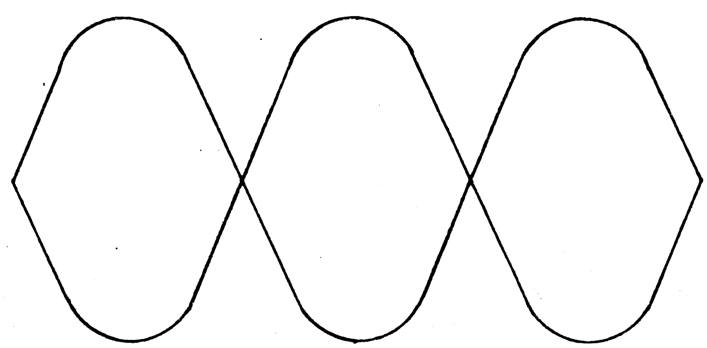
FIGURE 9
H.F.O. CONNECTIONS

Transmitter Channel Kits		T202	C234	R267 (Ohms)	L210	C245	C248	L216	C253	C254	C255	C256	REMARKS
189-924-030	1.6 MHz to 1.9 MHz	188-158	NIL	100 1/4W	18 uH WD180	.0033uF Mylar 10%, 200V	.001uF Mylar 10% 200V	188950-007 (Violet)	2200pF (Mica) 10% 500V	.0033uF Mylar 10% 200V	.0047uF Mylar 10% 200V	.0015uF Mylar 10% 200V	For Channels 1 and 3, join A to pin 2 of T202/1: Join 44 to pin 7 of T202/1.
189-924-030	1.9 MHz to 2.25 MHz	188-158	NIL	100 1/4W	18 uH WD180	.0033uF Mylar 10% 200V	.001uF Mylar 10% 200V	188950-007 (Violet)	2200pF Mica 10% 500V	.0033uF Mylar 10% 200V	.0047uF Mylar 10% 200V	NIL	For Channels 2 and 4, join B to pin 2 of T202/2: join 43 to pin 7 of T202/2
189-924-031	2.25 MHz to 2.75 MHz	188-160		220 1/4W	10uH WD100	.0033uF Mylar 10% 200V		188950-006 (Blue)	2200 pF Mica 10% 500V	.0022uF Mylar 10% 200V	.0033uF Mylar 10% 200V	.001uF Mylar 10% 200V	For Channels 1 and 3, join A to pin 2 of T202/1: join 44 to pin 7 of T202/1
189-924-031	2.75 MHz to 3.1 MHz	188-160		220 1/4W	10uH WD100	.0033uF Mylar 10% 200V		188950-006 (Blue)	2200pF Mica 10% 500V	.0022uF Mylar 10% 200V	.0033uF Mylar 10% 200V	NIL	For Channels 2 and 4, join B to pin 2 of T202/2: join 43 to pin 7 of T202/2
189-924-032	3.1 MHz to 3.8 MHz	188-162	1500 pF Mica 5% 100V	470 1/4W	6.8uH WD68G	.0022uF Mylar 10% 200V		188950-006 (Green)	1500pF Mica 10% 500V	.001uF Mylar 10%200V	.0022uF Mylar 10%200V	.001uF Mylar 10% 200V	For Channels 1 and 3, join A to D: join 44 to pin 7 of T202/1: join pin 3 of T202/1 to T202/1 pin 7.
189-924-032	3.8 MHz to 4.3 MHz	188-162	1500 pF Mica 5% 100V	470 1/4W	6.8uH WD68G	.0022 uF Mylar 10%200V		188950-005 (Green)	1500pF Mica 10%500V	.001uF Mylar 10%200V	.0022uF Mylar 10%200V	NIL	For Channels 2 and 4, join B to F: join 43 to T202/2 pin 7: join T202/2 pin 3 to T202/2 pin 7.
189-924-033	4.3 MHz to 5.2 MHz	188-164	820pF Mica 5% 300V	470 1/4W	3.9uH WD39G	.0015uF Mylar 10%200V		188950-004 (Yellow)	1200pF Mica 10%500V		.0015uF Mylar 10%200V	560pF Mica 10%300V	For Channels 1 and 3, join A to D: join 44 to T202/1 pin 7: join T202/1 pin 3 to T202/1 pin 7.
189-924-033	5.2 MHz to 6.0 MHz	188-164	820 pF Mica 5% 300V	470 1/4W	3.9uH WD39G	.0015uF Mylar 10%200V		188950-004 (Yellow)	1200pF Mica 10%500V		.0015uF Mylar 10%200V	NIL	For Channels 2 and 4, join B to F: join 43 to T202/2 pin 7: join T202/2 pin 3 to T202/2 pin 7.
189-924-034	6.0 MHz to 7.3 MHz	188-166	330 pF Mica 10%300V	470 1/4W	2.2uH WD22G	1200pF Mica 10%100V		188950-003 (orange)	1000 pF Mica 10%500V		1200pF Mica 10%100V	330pF Mica 10%300V	For Channels 1 and 3, join A toD: join 44 to T202/1 pin 5.
189-924-034	7.3 MHz to 8.3 MHz	188-166	330pF Mica 10%300V	470 1/4W	2.2uH WD22G	1200pF Mica 10%100V		188950-003 (orange)	1000pF Mica 10%500V		1200pF Mica 10%100V	NIL	For Channels 2 and 4, join B toF: join 43 to T202/2 pin 5.
189-924-035	8.3 MHz to 9.9 MHz	188-168	120 pF Mica 10%500V		1.2uH WD126	820 pF Mica 10%300V		188950-002 (red)	820pF Mica 10%500V		820pF Mica 10%300V	330pF Mica 10%500V	For Channels 1 and 3, join A to D: join 44 to T202/1 pin 5.
189-924-035	9.9 MHz to 11.4 MHZ	188-168	120pF Mica 10% 500V		1.2uH WD12G	820pF Mica 10%300V		188950-002 (red)	820pF Mica 10%500V		820pF Mica 10%300V	NIL	For Channels 2 and 4, join 43 to T202/2 pin 5: join B to F
189-924-036	11.4 MHz to 13.5 MHz	188-170			0.68 uH 203-11	560pF Mica 10%300V		188950-001 (brown)	680pF Mica 10%500V		680pF Mica 10%300V	270pF Mica 10%500V	For Channels 1 and 3, join A to D: join 44 to T202/1 pin 5.
189-924-036	13.5 MHz to 15.0 MHz	188-170			0.68 uH 203-11	560pF Mica 10%300V		188950-001 (brown)	680pF Mica 10%500V		680pF Mica 10%300V	NIL	For Channels 2 and 4, join 43 to T202/2 pin 5: join B to F.

DOTTED TRACE SHOWS EFFECT OF MISALIGNMENT OF TANK CIRCUIT OR EXCESSIVE DRIVE



OUTPUT PATTERN OF TRANSMITTER ADJUSTED FOR MINIMUM DISTORTION



OSCILLOSCOPE TRACES SHOWING EFFECT ON TRANSMITTER OUTPUT OF TWO EQUAL AUDIO TONES APPLIED TO THE MICROPHONE INPUT

FIGURE 10

PARTS LIST

PRINTED CIRCUIT BOARD ASSEMBLY 189-925

REF	DESCRIPTION	SUPPLIER
C100	CAPACITOR, fixed, 05uF, +80-20%, 25V.DC	Erie 5855
C102	CAPACITOR, fixed, .01uF, +80-20%, 25V.DC	Erie 5835
C103	Same as C102	
C104	Same as C102	
C105	Same as C100	
C106	Same as C102	
C107	Same as C100	
C108	CAPACITOR, fixed, 1300pF, ± 5%, 100V.DC	Elmenco DM15
C109	Same as C102	
C110	CAPACITOR, fixed, 0.47uF, +80-20%, 25V.DC	Erie 5865
C111	CAPACITOR, fixed, 180pF, ± 5%, 100V.DC	Elmenco DM-15
C112	Same as C100	
C113	Same as C102	
C114	Same as C100	
C115	CAPACITOR, fixed, 1000pF, ± 10%, 500V.DC	Erie 851
C116	Same as C100	
C117	Same as C102	
C118	Same as C102	
C119	Same as C102	
C120	CAPACITOR, fixed, 10uF, 20V.DC	CMC 188-188H
C121	CAPACITOR, fixed, .2uF, +80-20%, 25V.DC	Erie 5815
C122	Same as C102	
C123	Same as C102	
C124	Same as C102	
C125	Same as C121	
C126	Same as C121	
C127	CAPACITOR, fixed, .1uF, +80-20%, 25V.DC	Erie 5815
C128	Same as C120	
C129	CAPACITOR, fixed, 1.uF, 20V.DC	CMC 188-188K
C130	Same as C102	
C131	Same as C120	
C132	CAPACITOR, fixed, 47uF, 6V.DC	CMC 188-188J
C133	CAPACITOR, fixed, 3300pF, ± 10%, 500V.DC	Erie 875
C134	Same as C120	
C136	CAPACITOR, fixed, 68uF, 15V.DC	CMC 188-188C
C137	Same as C120	
C138	CAPACITOR, fixed, 2.2uF, 20V.DC	CMC 188-188L
C139	CAPACITOR, fixed, 1uF, ± 20%, 250V.DC	TCC PMX 4
C141	CAPACITOR, fixed, .047uF, ± 20%, 250V.DC	TCC PMX 3
C142	Same as C141	
C143	Same as C129	
C201	CAPACITOR, fixed, 1uF, 20V.DC	CMC 188-188K
C202	CAPACITOR, fixed, 1000pF, ± 10%, 500V.DC	Erie 851
C203	CAPACITOR, fixed, 10uF, 20V.DC	CMC 188-188H
C204	Same as C201	
C205	Same as C201	

REF	DESCRIPTION	SUPPLIER
C206	CAPACITOR, fixed, 47uF, 6V. DC	CMC 188-188J
C207	Same as C201	
C208	CAPACITOR, fixed, .01uF, +80-20%, 25V. DC	Erie 5835
C209	CAPACITOR, fixed, .05uF, +80-20%, 25V. DC	Erie 5855
C210	CAPACITOR, variable	CMC 187-777-009
C211	Same as C208	
C212	CAPACITOR, fixed, .1uF, +80-20%, 25V. DC	Erie 5815
C213	Same as C208	
C214	Same as C203	
C215	Same as C201	
C218	CAPACITOR, fixed, .033uF, ± 20%, 250V. DC	TCC PMX5
C219	Same as C218	
C221	Same as C218	
C223	Same as C218	
C224	Same as C206	
C225	Same as C208	
C226	Same as C209	
C227	CAPACITOR, fixed, 3300pF, ±10%, 500V. DC	Erie 875
C229	Same as C209	
C230/1	CAPACITOR, fixed, 2.2pF, ± .25pF, 500V. DC NPO	RMC Discap
C230/2	Same as C230/1	
C231	Same as C209	
C232	Same as C209	
C233	Same as C212	
C234	Part of Multichannel kits - See page 4-8	
C235/1	Same as C208	
C235/2	Same as C208	
C236	Same as C202	
C237	Same as C212	
C238	Same as C202	
C239	Same as C202	
C241	Same as C212	
C243	Same as C212	
C244	Same as C208	
C245		
C248		
C253	Part of Multichannel kit. See page 4-8	
C254		
C255		
C256		
C260	Same as C209	
C301	CAPACITOR, fixed, 10uF, 20V. DC	CMC 188-188H
C312	Same as C301	
C401	CAPACITOR, fixed, 10uF, 20V. DC	CMC 188-188H
C402	CAPACITOR, fixed, 39pF, ± 5%, 100V. DC	Elmenco DM-15
C403	Same as C402	
C404	CAPACITOR, fixed, 1 uF, 20V. DC	CMC 188-188K
C405	CAPACITOR, fixed, .01uF, +80-20%, 25V. DC	Erie 5835

REF	DESCRIPTION	SUPPLIER
C406	Same as C405	
C407	CAPACITOR, fixed, 1000pF, ± 10%, 500V. DC	Erie 851
C412/1	CAPACITOR, variable	CMC 187-777-009
C412/2	Same as C412/1	
C412/3	Same as C412/1	
C412/4	Same as C412/1	
C413	CAPACITOR, fixed, 10pF, ± 10%, 1000V. DC	RMC Discap Type C
C415	Same as C405	
C416	CAPACITOR, fixed, 220pF, ± 5%, 100V. DC	Elmenco DM15
C417	CAPACITOR, fixed, .1uF ± 20%, 250V. DC	TCC PMX4
C418	Same as C405	
C419	Same as C405	
C420	Same as C417	
C421	CAPACITOR, fixed, .05uF, +80-20%, 25V. DC	Erie 5855
C422	CAPACITOR, fixed, 47pF, ± 5%, 100V. DC	Elmenco DM-15
C423	Same as C422	
C424	Part of Multichannel Kits. see page 4-8	
R102	RESISTOR, fixed, 12K ohms, ± 5%, 1/4W	CMC 701-123
R103	RESISTOR, fixed, 10K ohms, ± 5%, 1/4W	CMC 701-103
R104	RESISTOR, fixed, 220 ohms, ± 10%, 1/4W	CMC 702-221
R105	RESISTOR, fixed, 1000 ohms, ± 5%, 1/4W	CMC 701-102
R106	RESISTOR, fixed, 100 ohms, ± 10%, 1/4W	CMC 702-101
R107	RESISTOR, fixed, 1000 ohms, ± 10%, 1/4W	CMC 702-102
R108	RESISTOR, fixed, 22K ohms, ± 5%, 1/4W	CMC 701-223
R109	RESISTOR, fixed, 390 ohms, ± 10%, 1/4W	CMC 702-391
R111	RESISTOR, fixed, 3.3K ohms, ± 10%, 1/4W	CMC 702-332
R112	Same as R103	
R113	RESISTOR, fixed, 5.6K ohms, ± 10%, 1/4W	CMC 702-562
R114	RESISTOR, fixed, 2.7K ohms, ± 5%, 1/4W	CMC 701-272
R115	Same as R107	
R116	Same as R107	
R117	Same as R106	
R118	RESISTOR, fixed, 47 ohms, ± 10%, 1/4W	CMC 702-470
R119	Same as R103	
R120	RESISTOR, fixed, 560 ohms, ± 5%, 1/4W	CMC 701-561
R122	Same as R103	
R123	RESISTOR, fixed, 680 ohms, ± 5%, 1/4W	CMC 701-681
R124	RESISTOR, fixed, 330 ohms, ± 5%, 1/4W	CMC 701-331
R125	Same as R103	
R126	Same as R108	
R127	Same as R107	
R128	RESISTOR, fixed, 2.2 K ohms, ± 10%, 1/4W	CMC 702-222
R129	RESISTOR, variable, 1K ohms, ± 30%, 1/4W	Murata 1417
R131	RESISTOR, fixed, 56 ohms, ± 10%, 1/4W	CMC 702-560
R132	RESISTOR, fixed, 4.7K ohms, ± 10%, 1/4W	CMC 702-472
R133	RESISTOR, fixed, 27K ohms, ± 5%, 1/4W	CMC 701-273
R134	Same as R114	

REF	DESCRIPTION	SUPPLIER
[illegible]	Same as R111	
136	RESISTOR, fixed, 220 ohms, ± 5%, 1/4W	CMC 701-221
137	Same as R102	
138	RESISTOR, fixed, 100K ohms, ± 5%, 1/4W	CMC 701-104
139	RESISTOR, fixed, 270 ohms, 10%, 1/4W	CMC 702-271
140	Same as R106	
141	RESISTOR, fixed, 2.7K ohms, ± 10%, 1/4W	CMC 702-272
142	RESISTOR, fixed, 470 ohms, ± 10%, 1/4W	CMC 702-471
143	RESISTOR, fixed, 10K ohms, ± 10%, 1/4W	CMC 702-103
144	RESISTOR, variable, 50K ohms, ± 30%, 1/4W	Murata 1417
145	Same as R143	
146	RESISTOR, fixed, 100K ohms, ± 10%, 1/4W	CMC 702-104
148	Same as R108	
149	Same as R128	
150	RESISTOR, fixed, 68K ohms, ± 5%, 1/4W	CMC 701-683
151	RESISTOR, fixed, 3.9K ohms, ± 5%, 1/4W	CMC 701-392
152	Same as R107	
153	RESISTOR, fixed, 22 ohms, ± 5%, 1/4W	CMC 701-220
154	RESISTOR, fixed, 1.5K ohms, ± 5%, 1/4W	CMC 701-152
155	RESISTOR, fixed, 2.2K ohms, ± 5%, 1/4W	CMC 701-222
156	Same as R142	
157	RESISTOR, fixed, 1.8K ohms, ± 10%, 1/4W	CMC 702-182
1[illegible]	RESISTOR, variable, 5K ohms, ± 30%, 1/4W	Murata 1417
159	RESISTOR, fixed, 270 ohms, ± 5%, 1/4W	CMC 701-271
160	Same as R107	
161	RESISTOR, fixed, 18K ohms, ± 5%, 1/4W	CMC 701-183
162	RESISTOR, fixed, 4.7K ohms, ± 5%, 1/4W	CMC 701-472
163	RESISTOR, fixed, 1 ohm ± 10%, 1/2W	Allen Bradley
164	Same as R163	
165	RESISTOR, fixed, 470 ohms, ± 5%, 1/4W	CMC 701-471
166	RESISTOR, fixed, 330K ohms, ± 10%, 1/4W	CMC 702-334
167	Same as R143	
168	Same as R142	
169	RESISTOR, fixed, 100 ohms, ± 5%, 1/4W	CMC 701-101
170	RESISTOR, fixed, 3.9K ohms, ± 10%, 1/4W	CMC 702-392
171	Same as R146	
172	RESISTOR, fixed, 470K ohms, ± 10%, 1/4W	CMC 702-474
174	RESISTOR, fixed, 82K ohms, ± 5%, 1/4W	CMC 701-823
175	Same as R103	
176	Same as R123	
177	RESISTOR, variable, 10K ohms, ± 30%, 1/4W	Murata 1417
178	Same as R132	
179	RESISTOR, fixed, 4.7 Meg, ± 10%, 1/4W	CMC 702-475
201	RESISTOR, fixed, 1K ohms, ± 10%, 1/4W	CMC 702-102
[illegible]	RESISTOR, fixed, 68K ohms, ± 5%, 1/4W	CMC 701-683
03	RESISTOR, fixed, 8.2K ohms, ± 5%, 1/4W	CMC 701-822
04	RESISTOR, variable, 5K ohms, ± 30%, 1/4W	Murata 1417

REF	DESCRIPTION	SUPPLIER
R205	RESISTOR, fixed, 470 ohms, ± 5%, 1/4W	CMC 701-471
R207	Same as R201	
R208	RESISTOR, fixed, 2.7K ohms, ± 5%, 1/4W	CMC 701-272
R209	RESISTOR, fixed, 5.6K ohms, ± 5%, 1/4W	CMC 701-562
R210	Same as R209	
R212	RESISTOR, fixed, 18 ohms, ± 5%, 1/4W	CMC 701-180
R213	RESISTOR, fixed, 330 ohms, ± 5%, 1/4W	CMC 701-331
R214	RESISTOR, fixed, 680 ohms, ± 10%, 1/4W	CMC 702-681
R215	RESISTOR, fixed, 220 ohms, ± 10%, 1/4W	CMC 702-221
R216	Same as R215	
R217	Same as R215	
R218	Same as R215	
R219	RESISTOR, fixed, 47 ohms, ± 10%, 1/4W	CMC 702-470
R221	Same as R219	
R222	RESISTOR, fixed, 270 ohms, ± 10%, 1/4W	CMC 702-271
R223	RESISTOR, variable, 100 ohms, ± 30%, 1/4W	CTS Type X-201
R224	Same as R222	
R225	RESISTOR, fixed, 15K ohms, ± 5%, 1/4W	CMC 701-153
R226	Same as R209	
R227	RESISTOR, fixed, 100 ohms, ± 5%, 1/4W	CMC 701-101
R228	RESISTOR, fixed, 1K ohms, ± 5%, 1/4W	CMC 701-102
R229	RESISTOR, fixed, 1.2K ohms, ± 10%, 1/4W	CMC 702-122
R232	RESISTOR, fixed, 470 ohms, ± 10%, 1/4W	CMC 702-471
R233	RESISTOR, variable, 10K ohms, ± 30%, 1/4W	Murata 1417
R236	RESISTOR, fixed, 10K ohms, ± 10%, 1/4W	CMC 702-103
R237	Same as R204	
R238	RESISTOR, fixed, 4.7K ohms, ± 5%, 1/4W	CMC 701-472
R239	RESISTOR, fixed, 12K ohms, ± 5%, 1/4W	CMC 701-123
R240	RESISTOR, fixed, 1.5K ohms, ± 5%, 1/4W	CMC 701-152
R241	RESISTOR, fixed, 15 ohms, ± 5%, 1/4W	CMC 701-150
R242	RESISTOR, fixed, 390 ohms, ± 5%, 1/4W	CMC 701-391
R243	RESISTOR, fixed, 100K ohms, ± 10%, 1/4W	CMC 702-104
R244	RESISTOR, fixed, 10 ohms, Thermistor	Siemens 151-10
R245	RESISTOR, fixed, 2.7K ohms, ± 10%, 1/4W	CMC 702-272
R246	RESISTOR, fixed, 8.2K ohms, ± 10%, 1/4W	CMC 702-822
R247	RESISTOR, fixed, 6.8K ohms, ± 5%, 1/4W	CMC 701-682
R248	RESISTOR, fixed, 27K ohms, ± 5%, 1/4W	CMC 701-273
R249	Same as R233	
R250	Same as R219	
R251	RESISTOR, fixed 220 ohms, ± 5%, 1/4W	CMC 701-221
R252	Same as R251	
R253	Same as R248	
R254	Same as R247	
R255	Same as R215	
R256	Same as R251	
R257/1	Same as R204	
R257/2	Same as R204	
R258/1	Same as R243	

REF	DESCRIPTION	SUPPLIER
R258/2	Same as R243	
R259/1	Same as R243	
R259/2	Same as R243	
R260	RESISTOR, fixed, 10K ohms, ± 5%, 1/4W	CMC 701-103
R261/1	Same as R260	
R261/2	Same as R260	
R262	Same as R251	
R263	RESISTOR, fixed, 1.2K ohms, ± 5%, 1/4W	CMC 701-122
R264	Same as R238	
R265	RESISTOR, fixed, 220 ohms, ± 10%, 1/2W	CMC 931-221
R266	Same as R227	
R267	Part of Multichannel Kits - see page 4-8	
R268	RESISTOR, fixed, 560 ohms, ± 5%, 1/4W	CMC 701-561
R269	Same as R208	
R270	RESISTOR, fixed, 47 ohms, ± 5%, 1/4W	CMC 701-470
R271	RESISTOR, fixed, 100 ohms, ± 10%, 1/4W	CMC 701-101
R272	Same as R268	
R274	Same as R242	
R275	RESISTOR, fixed, 5.6 ohms, ± 5%, 1/4W	CMC 701-056
R276	Same as R240	
R277	RESISTOR, fixed, 33 ohms, ± 10%, 1/4W	CMC 702-330
R279	Same as R242	
R281	Same as R240	
R310	RESISTOR, fixed, 3.9K ohms, ± 10%, 1/4W	CMC 702-392
R311	RESISTOR, fixed, 3.3K ohms, ± 5%, 1/4W	CMC 701-332
R312	RESISTOR, fixed, 10K ohms, ± 5%, 1/4W	CMC 701-103
R401	RESISTOR, fixed, 220 ohms, ± 10%, 1/4W	CMC 701-221
R402	RESISTOR, fixed, 100K ohms, ± 5%, 1/4W	CMC 701-104
R403	RESISTOR, fixed, 220K ohms, ± 5%, 1/4W	CMC 701-224
R404	RESISTOR, fixed, 1.8K ± 5%, 1/4W	CMC 701-182
R405	RESISTOR, fixed, 560K ohms, ± 5%, 1/4W	CMC 701-564
R406	RESISTOR, fixed, 1.5K ohms, ± 5%, 1/4W	CMC 701-152
R407	RESISTOR, fixed, 3.9K ohms, ± 5%, 1/4W	CMC 701-392
R408	RESISTOR, fixed, 3.3K ohms, ± 5%, 1/4W	CMC 701-332
R409	RESISTOR, fixed, 18K ohms, ± 5%, 1/4W	CMC 701-183
R413	RESISTOR, fixed, 1K ohms, ± 5%, 1/4W	CMC 701-102
R415	RESISTOR, fixed, 27K ohms, ± 5%, 1/4W	CMC 701-273
R416	Same asR407	
R417	RESISTOR, fixed, 2.2K ohms, ± 5%, 1/4W	CMC 701-222
R418	Same as R401	
R419	RESISTOR, fixed, 470 ohms, ± 10%, 1/4W	CMC 702-471
R420	RESISTOR, fixed, 100 ohms, ± 10%, 1/4W	CMC 702-101
R421	RESISTOR, fixed, 100 ohms, ± 10%, 1/4W	CMC 702-101
R422	RESISTOR, fixed, 1.8K ohms, ± 10%, 1/4W	CMC 702-182
R423	RESISTOR, fixed, 56K ohms, ± 10%, 1/4W	CMC 702-563
R424	Same as R401	
CR101	Diode, Type FDH 6027	Fairchild
CR102	Same as CR101	

REF	DESCRIPTION	SUPPLIER
CR103	Same as CR101	
CR104	Same as CR101	
CR105	Same as CR101	
CR201	Diode, Type FDH 6027	Fairchild
CR202	Same as CR201	
CR203	Same as CR201	
CR204	Same as CR201	
CR205	Same as CR201	
CR206	Same as CR201	
CR207	Same as CR201	
CR208/1	Same as CR201	
CR208/2	Same as CR201	
CR209/1	Same as CR201	
CR209/2	Same as CR201	
CR210	DIODE, zener, IN752A	Fairchild
CR301	DIODE, zener	CMC 187-798
CR302	DIODE, Type G 1006	General Instruments
CR410	DIODE, Type FDH 6027	Fairchild
Q101	TRANSISTOR, Type S24103	Fairchild
Q102	Same as Q101	
Q103	TRANSISTOR, type S2748	Fairchild
Q104	TRANSISTOR, type 2N4250	Fairchild
Q105	Same as Q103	
Q106	Same as Q104	
Q107	TRANSISTOR, type S22009	Fairchild
Q108	Same as Q103	
Q109	TRANSISTOR, type S22008	Fairchild
Q110	Same as Q109	
Q111]	TRANSISTOR Matched Pair	CMC 187-781
Q112]	Same as Q111	
Q113	Same as Q103	
Q114	Same as Q103	
Q115	Same as Q107	
Q201	TRANSISTOR, type S2748	Fairchild
Q202	TRANSISTOR, type 2N4250	Fairchild
Q203	Same as Q201	
Q204	Same as Q201	
Q205	Same as Q201	
Q206	TRANSISTOR, type S24103	Fairchild
Q207	Same as Q206	
Q208	TRANSISTOR, type S22008	Fairchild
Q209	Same as Q208	
Q210	Same as Q208	
Q211	TRANSISTOR, type S22010	Fairchild
Q301	TRANSISTOR, type S2748	Fairchild
Q302	TRANSISTOR, type S22008	Fairchild
Q401	TRANSISTOR, type 2N4250	Fairchild
Q402	TRANSISTOR, type S2748	Fairchild

REF	DESCRIPTION	SUPPLIER
Q410	TRANSISTOR, type S24103	Fairchild
Q411	Same as Q410	
L101	COIL, R.F. Choke, 100 uH	Wilco WD 101
L102	COIL, I.F. Choke, 2.2 mH	CMC 186-055
L103	Same as L102	
L104	Same as L102	
L201	COIL, I.F. Choke, 2.2 mH	CMC 186-055
L202	Same as L201	
L203	COIL, R.F. Choke, 4.7uH	Wilco WD47D
L204	COIL, r.F. choke, 33 uH	Wilco WD330
L205	Same as L201	
L206	COIL, R.F. choke, 47 uH	Wilco WD470
L208	COIL, R.F. Choke, 10uH	Wilco WD100
L210] L216]	Part of Multichannel Kits.See page 4-8	
J101/1	SOCKET, 9 pin, type 121-S1-10-044	Cinch
J101/2	Same as J101/1	
J102/1	Same as J101/1	
J102/2	Same as J101/1	
J103	SOCKET, for relay	CMC 187-775
J201/1	SOCKET, 9 pin, type 121-S1-10-044	Cinch
J201/2	Same as J201/1	
J401	SOCKET, for crystal	CMC 187-774
J402	Same as J401	
J403	Same as J401	
J404	Same as J401	
T201	TRANSFORMER, toroid assembly	CMC 188-924
T202	Part of Multichannel Kits.see page 4-8	
T203/1	TRANSFORMER, coil assembly	CMC 188-911
T203/2	Same as T203/1	
T204	TRANSFORMER, toroid assembly	CMC 188-926
S105A thru-F	SWITCH, channel Selector	CMC 769-574
FL101	FILTER, type TO-02A-455 Transfilter	Clevite
FL102	FILTER, crystal	CMC 769-732
K101	RELAY, DPDT	CMC 188-795
Y401	CRYSTAL UNIT (456 500 KHz)	CMC 730-055

PARTS LIST

CP24 MAIN ASSEMBLY.

REF	DESCRIPTION	SUPPLIER
	TRANSCEIVER ASSEMBLY 189-924-001	
C101	CAPACITOR, fixed, .01uF, +80 - 20%, 500V. DC	RMC Discap, Type SM
C303	CAPACITOR, fixed, .047uF, ± 20%, 250V. DC	TCC PMX3
C304	Same as C303	
C305	Same as C303	
C306	CAPACITOR, fixed, .01uF, +80 - 20%, 25V. DC	Erie Transcap
C307	Same as C306	
C308	CAPACITOR, fixed, .01uF, +80 - 20%, 500V. DC	RMC Discap, Type SM
C309	Same as C303	
C310	CAPACITOR, fixed, .1uF, ± 20%, 250V. DC	TCC PMX4
C311	CAPACITOR, fixed, 1000pF, ± 10%, 500V. DC	Erie 851
R100	RESISTOR, fixed, 1K ohms, ± 5%, 1/4W.	CMC 701-102
R306	RESISTOR, fixed, 330 K ohms, ± 10%, 1/4W	CMC 702-334
R307	Same as R306	
R308	Same as R306	
R309	Same as R306	
R313	RESISTOR, fixed, 3.9K ohms, ± 5%, 1/4W.	CMC 702-392
S105/G/H	SWITCH, wafer	CMC 187-772
XF 101	FUSEHOLDER, 8AG. Type S #387001	
F101	FUSE, 2 amp. 8AG. Type 362002	Littlefuse
Y410	CRYSTAL unit, Freq to order	CMC 730-054
	POWER AMPLIFIER ASSEMBLY 188-930	
C246/1	CAPACITOR, variable, 190 to 760 pF, Mica	Arco-Elmenco 305
C246/2	Same as C246/1	
C247	CAPACITOR, fixed, 0.1uF, +80-20%, 25V. DC	Erie 5815
C252	CAPACITOR, fixed, 0.05uF, +80-20%, 25V. DC	Erie 5855
C257	CAPACITOR, fixed, 1000pF, ± 10%, 500V. DC	Erie 851
C258	Same as C247	
C302	CAPACITOR, fixed, 1000uF, 25V. DC	CMC 187-788
R282	RESISTOR, fixed, 1 ohm, ± 10%, 1/2W.	Allan Bradley
R283	Same as R282	
R286	RESISTOR, fixed, 390 ohms, ± 10%, 1/4W.	CMC 702-391
R287	RESISTOR, fixed, 470 ohms, ± 5%, 1/2W.	CMC 941-471
R288	RESISTOR, fixed, 270 ohms, ± 10%, 1W	CMC 932-271
R289	RESISTOR, fixed, 15 ohms, ± 5%, 1/4W.	CMC 701-150
R290	RESISTOR, fixed, 4.7 ohms, ± 5%, 1/4W.	CMC 701-047
R291	RESISTOR, fixed, 18 ohms, ± 5%, 1/4W.	CMC 701-180
R292	RESISTOR, thermistor, 10 ohms	Siemens 151-10

REF	DESCRIPTION	SUPPLIER
R293	Same as R290	
R294	Same as R290	
R296	RESISTOR, fixed, 470 ohms, ±10%, 1/4W.	CMC 702-471
R300	RESISTOR, fixed, 10K ohms, ± 10%, 1/4W.	CMC 702-103
R304	RESISTOR, variable, 10K	CMC 186-237A
CR214	DIODE, IN4148	Fairchild
CR215	DIODE, FDH6027	Fairchild
CR216	Same as CR215	
Q212	TRANSISTOR	CMC 187-773
L209	COIL, RF Choke, 22 uH	Wilco WD 220
L213	TOROID, assembly	CMC 187-789
L214	COIL, R. F. Choke, 100 uH	Wilco WD101
K102	RELAY, DPDT	CMC 188-796
J104	SOCKET, For relay	CMC 187-776
	FRONT PANEL ASSEMBLY 769-580	
C261	CAPACITOR, fixed, 0.01uF, +80 -20%, 25V. DC	Erie 5835
C414	CAPACITOR, variable	CMC 187-770
R101	RESISTOR, variable,) dual	CMC 188-773
R173	RESISTOR, variable)	
R305	RESISTOR, fixed, 10K, ± 10%, 1/4W.	CMC 702-103
R147	RESISTOR, variable	CMC 188-774
S104	SWITCH, part of R147	
S101	SWITCH, SPST, push-on	Grayhill
S102	SWITCH, DPST, push-on	C&K P8221
J101	CONNECTOR, 6 pin, antenna	Amphenol
J102	CONNECTOR, 6 pin, microphone	Amphenol
LS101	LOUDSPEAKER	CMC 188-772
M101	METER, panel	CMC 188-794
	HEATSINK ASSEMBLY 188-931	
Q213	TRANSISTOR	CMC 187-773
Q214	Same as Q213	
CR211	DIODE, FDH6027	Fairchild

REF	DESCRIPTION	SUPPLIER
	METERING PRINTED CIRCUIT BOARD 188-955	
C256	CAPACITOR, fixed, .01uF, +80-20%, 25V.DC	Erie Transcap
C262	Same as C256	
C263	Same as C256	
R299	RESISTOR, fixed, 470 ohms ± 5%, 1/4W	CMC 701-471
R300	RESISTOR, fixed, 39K ohms, ± 5%, 1/4W	CMC 701-393
R301	RESISTOR, fixed, 2.2K ohms, ± 5%, 1/4W	CMC 701-222
CR212	DIODE, type FDH6027	Fairchild
CR213	Same as CR212	
T205	TRANSFORMER, toroid assembly	CMC 187-825

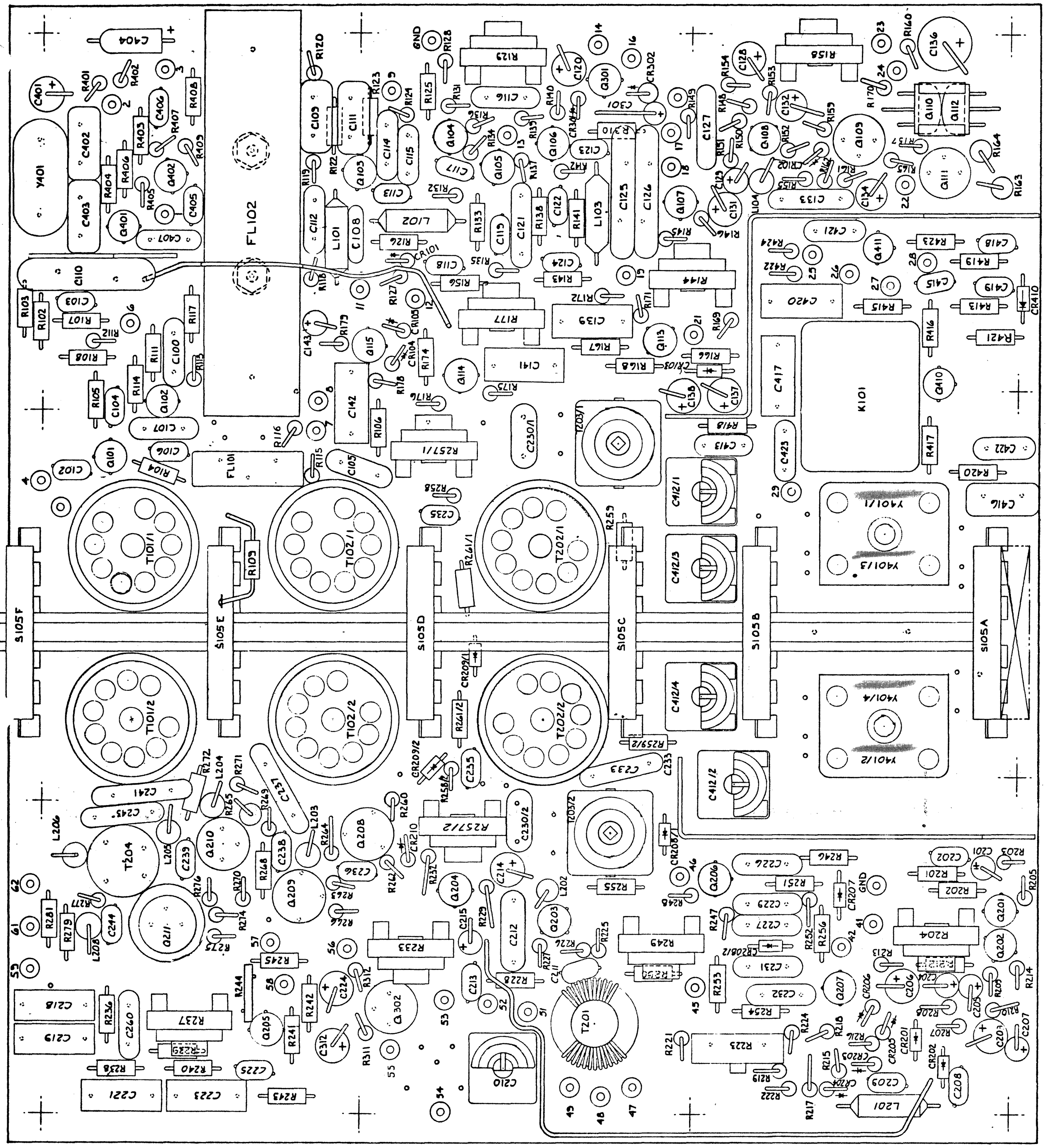


FIGURE 11

TOP VIEW OF PRINTED CIRCUIT BOARD

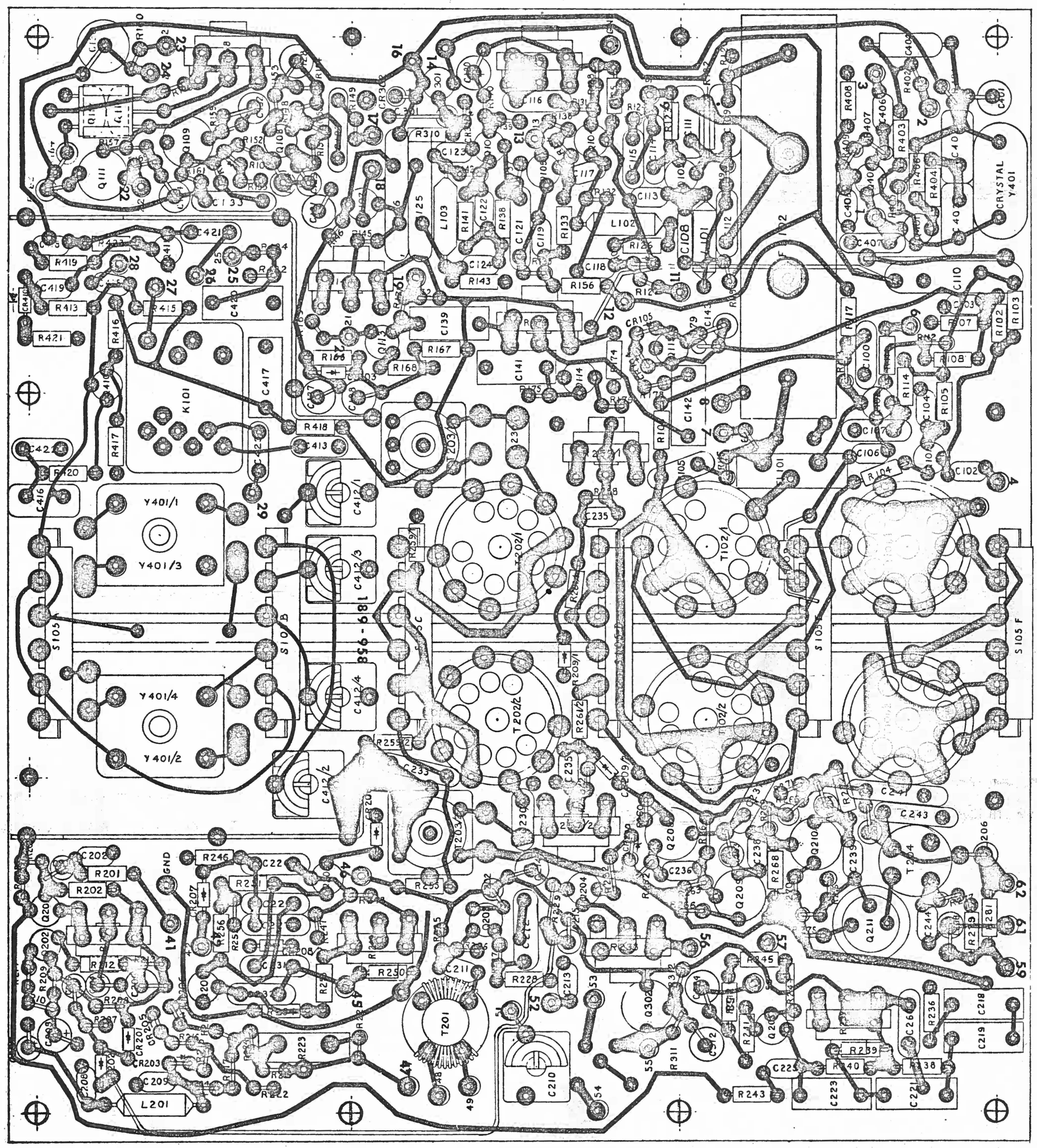
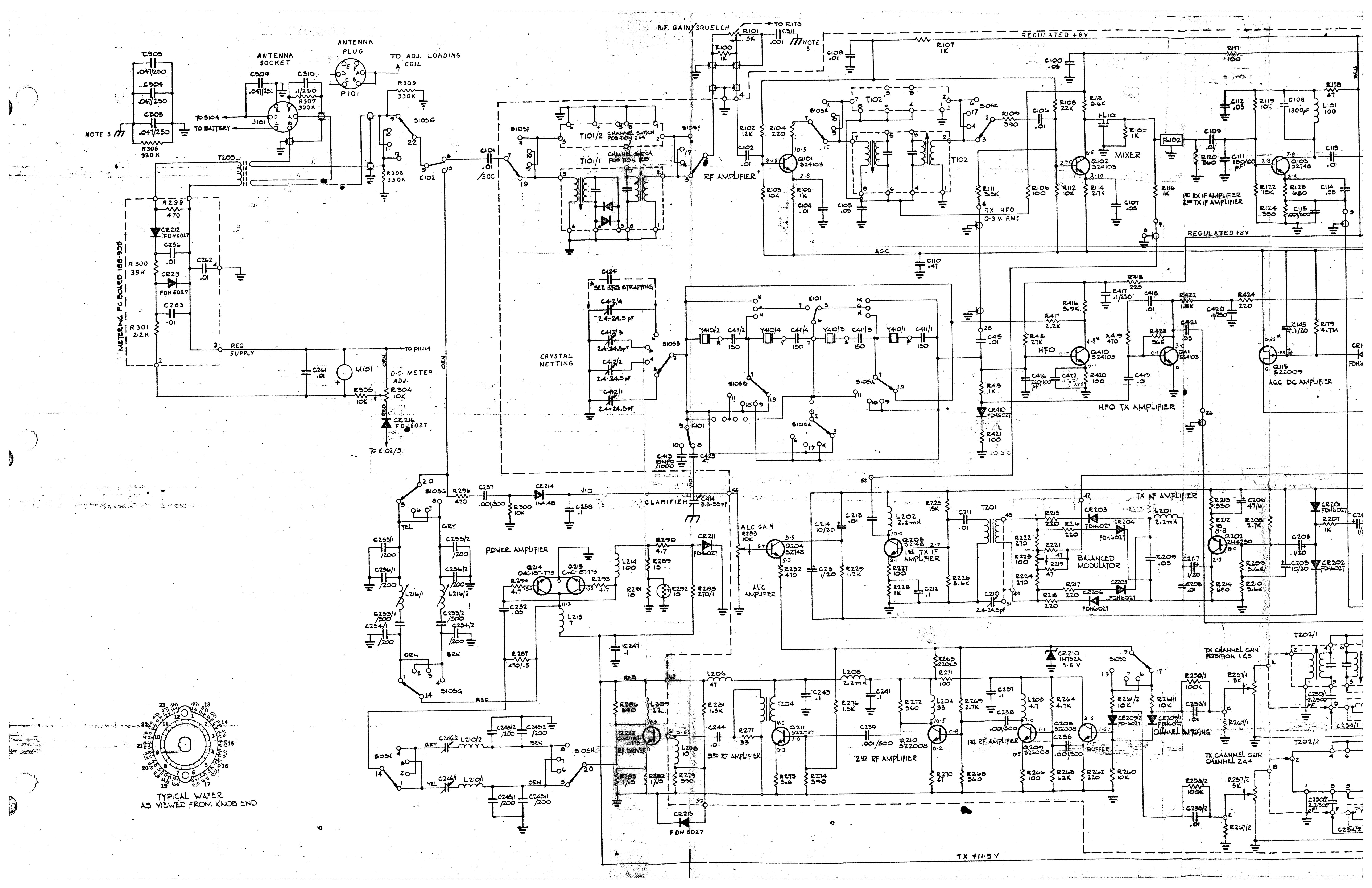
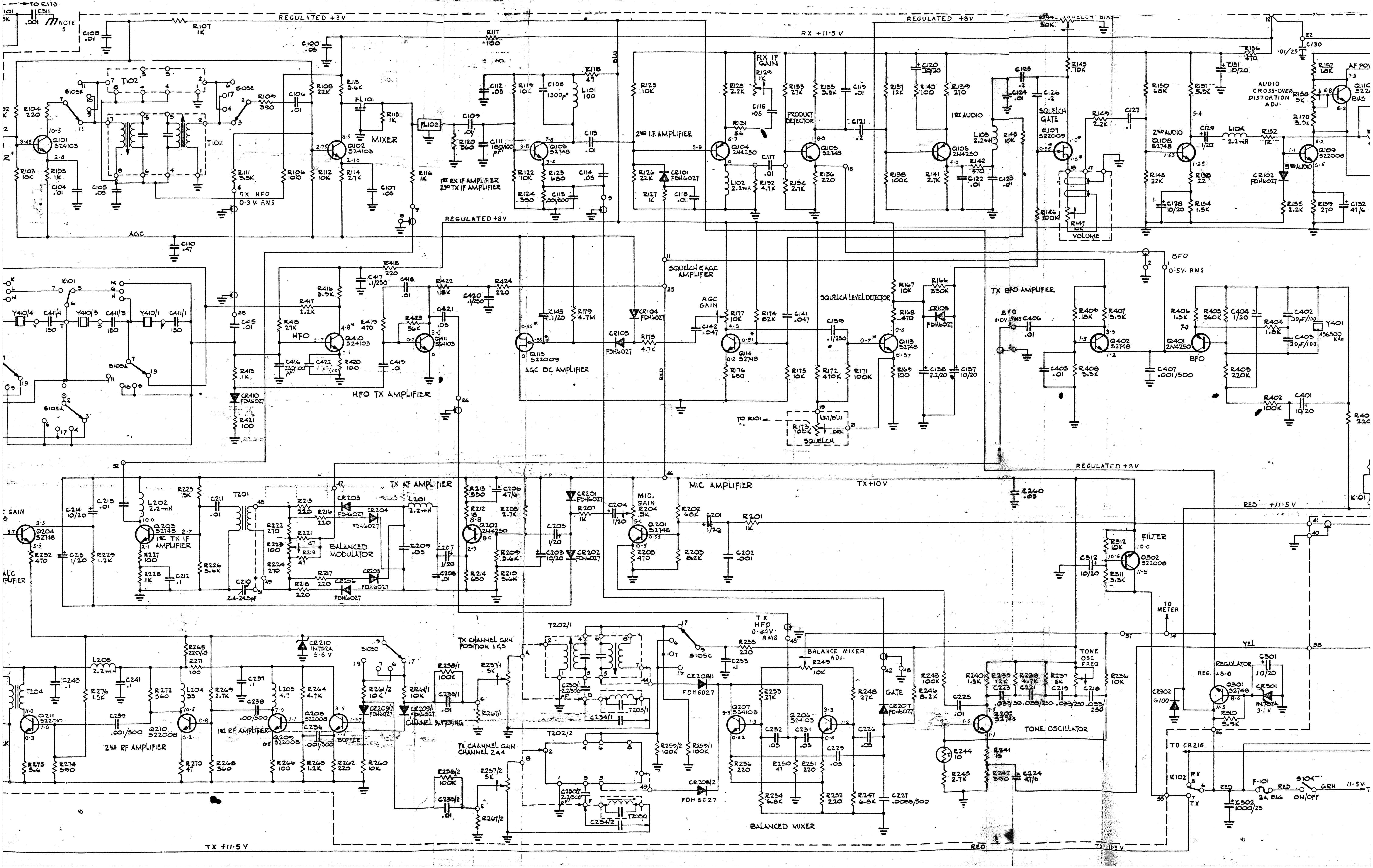


FIGURE 12

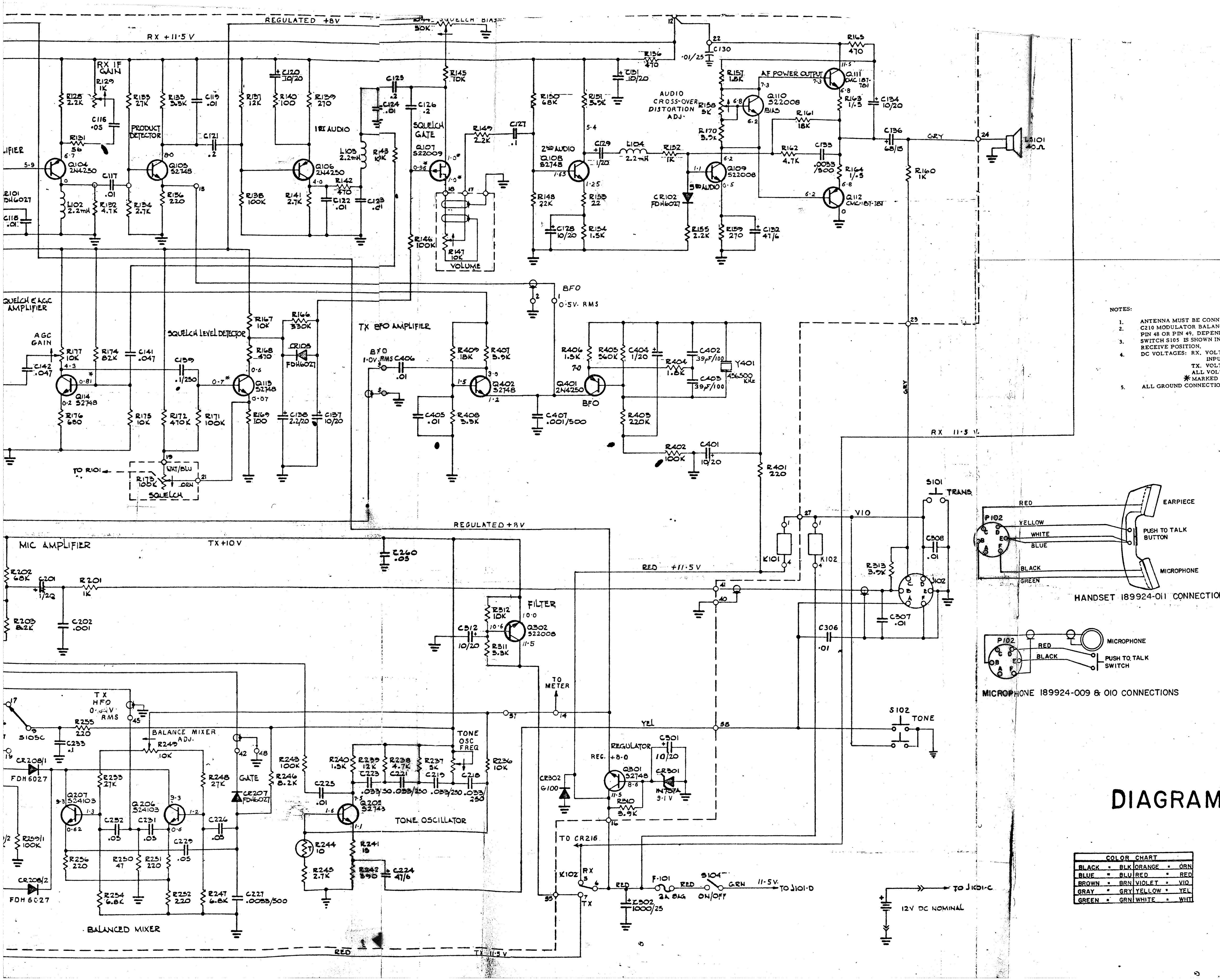
BOTTOM VIEW OF PRINTED CIRCUIT BOARD



R.F. GAIN/SQUELCH
TO R173
NOTE 5
REGULATED +8V
ANTENNA SOCKET
ANTENNA PLUG
TO ADJ. LOADING COIL
TO S104
TO BATTERY
NOTE 5
RF AMPLIFIER
MIXER
1ST RX IF AMPLIFIER
2ND TX IF AMPLIFIER
RX HFO
0.3 V. RMS
AGC
REGULATED +8V
METERING PC BOARD 188-955
REG SUPPLY
TO PIN 14
D.C. METER ADJ.
TO K102/5
CRYSTAL NETTING
*SEE HFO STRAPPING
HFO
HFO TX AMPLIFIER
AGC DC AMPLIFIER
CLARIFIER
ALC GAIN
ALC AMPLIFIER
POWER AMPLIFIER
1ST TX IF AMPLIFIER
BALANCED MODULATOR
TX AF AMPLIFIER
RF DRIVER
3RD RF AMPLIFIER
2ND RF AMPLIFIER
1ST RF AMPLIFIER
BUFFER
CHANNEL SWITCHING
TX CHANNEL GAIN POSITION 1 & 3
TX CHANNEL GAIN CHANNEL 2 & 4
TX +11.5 V
TYPICAL WAFER AS VIEWED FROM KNOB END



REGULATED +8V
RX +11.5V
MIXER
1st RX IF AMPLIFIER
2nd TX IF AMPLIFIER
2nd I.F. AMPLIFIER
RX IF GAIN
PRODUCT DETECTOR
1st AUDIO
SQUELCH GATE
SQUELCH BIAS
2nd AUDIO
3rd AUDIO
AUDIO CROSS-OVER DISTORTION ADJ.
AF POWER
VOLUME
AGC
RX HFO 0.3V RMS
HFO
HFO TX AMPLIFIER
AGC DC AMPLIFIER
SQUELCH & AGC AMPLIFIER
AGC GAIN
SQUELCH LEVEL DETECTOR
TX BFO AMPLIFIER
BFO
BFO 0.5V RMS
TO R101
SQUELCH
TX AF AMPLIFIER
BALANCED MODULATOR
MIC AMPLIFIER
MIC. GAIN
TX +10V
RED +11.5V
FILTER
1st TX IF AMPLIFIER
TO METER
TX CHANNEL GAIN POSITION 1&3
TX CHANNEL GAIN CHANNEL 2&4
CHANNEL SWITCHING
TX HFO 0.3V RMS
BALANCE MIXER ADJ.
GATE
TONE OSC FREQ
TONE OSCILLATOR
BALANCED MIXER
REGULATOR
2nd RF AMPLIFIER
1st RF AMPLIFIER
BUFFER
TO CR216
TX +11.5V
ON/OFF



NOTES:

1. ANTENNA MUST BE CONNECTED BEFORE POWER CAN BE APPLIED TO SET.
2. C210 MODULATOR BALANCE CAPACITOR: PIN 51 IS CONNECTED TO EITHER PIN 48 OR PIN 49, DEPENDING UPON SELECTION MADE IN PRODUCTION TEST.
3. SWITCH S105 IS SHOWN IN POSITION 1. RELAYS K101, K102 ARE SHOWN IN RECEIVE POSITION.
4. DC VOLTAGES: RX. VOLTAGES MEASURED WITH "V" AND "S" FULLY CLOCKWISE WITH NO INPUT SIGNAL.
   TX. VOLTAGES MEASURED UNDER SINGLE TONE 5W O/P CONDITIONS.
   ALL VOLTAGES MEASURED WITH 20,000 OHM/VOLT METER EXCEPT THOSE
   * MARKED WHERE V.T.V.M. WAS USED.
5. ALL GROUND CONNECTIONS SHOWN ⏚ ARE FRONT PANEL CONNECTIONS.

RESISTANCE	IN OHMS K = 1,000 OHMS M = 1,000,000 OHMS	¼ WATT OR AS SHOWN
CAPACITY	IN → PICOFARADS pF MICROFARADS OR AS SHOWN	25 VOLTS WKG OR AS SHOWN
INDUCTANCE	IN MICROHENRY mH = MILLIHENRY H = HENRY	

DIAGRAM OF CP24 CONNECTIONS

COLOR CHART			
BLACK	= BLK	ORANGE	= ORN
BLUE	= BLU	RED	= RED
BROWN	= BRN	VIOLET	= VIO
GRAY	= GRY	YELLOW	= YEL
GREEN	= GRN	WHITE	= WHT

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SECTION 5
AVAILABLE OPTIONS

The CP24 is ordered by number, including the numbers of the optional equipment required.

EXAMPLE CP24/ 1/2 / 3 / 4/ 6 / 9 / 14/ 15/ 18/ 2 1/22 / 30/ 40

The numbers after the oblique strokes are taken from the table below. The above unit would consist of the following.

The CP24 unit (/1), with basic antenna kit (/2), loading coil (/3), 5 foot whip antenna (/4), waterproof microphone (/ 9), batter y charger with adaptor (/14 & /15), nickel cadmium batterie s (/18), carrying bag (/ 21), with strap (/ 22), and frequency kit s (/ 30 & / 40).

Other options may be ordered from the table.

Numbers of the equipment are as follows:

1. Transceiver, less coils, crystals, and accessories.
2. Adjustable Antenna Kit: includes tuner, goose neck, ground wire, and long wire antenna. Must be used with /4 or /5.
3. Loading Coil: Use with tuner and whip between 1.6 MHz and 2.25 MHz.
4. Flexible 5 foot fiberglass whip antenna with storage tube which is attached to carrying bag.
5. Rigid, collapsible 5 foot whip antenna.
6. Horizontal Diploe Antenna: cut to frequency.
7. Mobile Mounting Kit.
8. Mobile Whip Antenna; with base and loading coil adjusted to frequency.
9. Waterproof Hand Microphone
10. Mobile Hand Microphone
11. Waterproof Handset.

12. C. W. Kit: including key

14. Battery Charger: 115/230 V. AC. Connects to antenna socket.

15. Charger Adapter Plug: Allows antenna and charger to be connected at the same time.

16. Battery Holder.

18. Nickel Cadmium Battery: 9 size D cells.

19. Alkaline Battery: 9 size D cells.

20. Zinc – Carbon Battery: 9 size D cells.

21. Carrying bag less shoulder strap

22. Carrying Strap.

23. Rigid Collapsible 3 foot whip antenna.

24. Rigid Collapsible8 foot whip antenna

Transmitter Coil Kits

Specify appropriate channel options and frequency kits, and whether USB or LSB. All frequencies should be that of suppressed carrier.

30.	1. 6 - 2. 25 MHz	Channel options (a) and (b) (see - Section 1, para. B) require one kit per channel, unless second channel is less than 1% removed, in which case only one kit is required.
31.	2. 25 - 3. 1 MHz	
32.	3. 1 - 4. 3 MHz	
33.	4. 3 - 6. 0 MHz	
34.	6. 0 - 8. 3 MHz	
35.	8. 3 - 11. 4 MHz	
36	11. 4 - 15. 0 MHz	Options (c) & (d) require no kits, but extra crystals are necessary.

Receiver Coil Kits

40.	1. 6 - 2. 25 MHz	Channel options (a) and (b) (see Section 1, para. B) require one kit per channel, unless second channel is less than 1% removed in which case only one kit is required.
41.	2. 25 - 3. 1 MHz	
42.	3. 1 - 4. 3 MHz	
43.	4. 3 - 6. 0 MHz	
44.	6. 0 - 8. 3 MHz	
45.	8. 3 - 11. 4 MHz	Options (c) & (d) require no kits,
46	11. 4 - 15. 0 MHz	but extra crystals are necessary.

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