hallicrafters

COMMAND LINE

INSTALLATION AND SERVICE INSTRUCTIONS

TWO-WAY FM MOBILE RADIO TRANSMITTER/RECEIVER MODEL CSMT-30-2

WARRANTY

"This product is warranted to be free from defective material or parts, and it is agreed to furnish a new part in exchange for any part of this unit which under normal installation, use and service discloses such defect, provided the unit is delivered by the owner to the authorized radio dealer or wholesaler from whom purchased, intact, for examination with all transportation charges prepaid, within one year from the date of sale to original purchaser and provided that such examination discloses that it is thus defective. Warranty on tubes, pilot lights, transistors, and silicon diodes is effective for a period of 90 days.

This warranty does not extend to any radio products which have been subjected to misuse, neglect, accident, improper installation, or to use in violation of instructions furnished by us, nor does it extend to units which have been repaired or altered outside of our authorized facilities, nor to cases where the serial number thereof has been removed, defaced or changed, nor to accessories used therewith not of our own manufacture.

This warranty is in lieu of other warranties expressed or implied and no representative or person is authorized to assume for us any other liability in connection with the sale of our radio products."

the **hallicrafters** co.

156-001623

INSTALLATION AND SERVICE

INSTRUCTIONS

FOR

COMMAND LINE

FM TWO-WAY RADIO TRANSMITTER/RECEIVER

●

MODEL CSMT-30-2

(MOBILE)

Manufactured by

hallicrafters

5th AND KOSTNER AVES.

CHICAGO 24, ILL.

U.S.A.

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766

Printed in U.S.A.

156-008343

Hallicrafters' Model CSMT-30-2 Transmitter/Receiver.

SECTION I

GENERAL DESCRIPTION

The Hallicrafters' Model CSMT-30-2 is a transistorized crystal-controlled, two-way radio transmitter/receiver designed for narrow-band FM service (16F3 emission) in the 148 to 174 MHz range. The CSMT-30-2 has a DC supply (12 volts only) for mobile application.

Various features and control options are available, including: 1) dual-frequency operation, 2) continuous tone-controlled squelch system (EIA RS-220): 3) microphone (carbon or transistorized dynamic) and 4) mounting configuration (one or two piece mount). All of these options are available as standard factory equipment.

The mechanical design features rugged, military-type construction throughout. Installation flexibility is achieved by means of a removable control assembly. This assembly, which includes all necessary controls for operation of the unit, is an integral part of the transmitter/receiver for single-unit installations. For extended local-control applications (i.e., trunk-mounted mobile) a miniaturized control head is utilized. Designated the No. C-2102T Control Head, it is capable of all of the control functions and options of its larger counterpart; however, it requires the use of an external speaker (normally used with the C-3401 Speaker).

The main-unit cabinet includes a key lock which prevents access to the chassis frequency-determining elements by unauthorized personnel. No tools are required for chassis removal.

All alignment and test points are readily accessible on the top of the chassis for easy service and maintenance.

Efficient heat conduction and radiation out of the cabinet have been emphasized throughout the mechanical design.

Circuit design and construction employ the latest up-to-date techniques to provide the ultimate in performance and long-term reliability. A receiver selectivity factor of less than 2 to 1 is obtained by use of a full eight-section crystal-lattice filter. This filter, with an ultimate attenuation of better than 100 DB, reduces interference from strong adjacent-channel stations and insures maximum on-channel performance. The transmitter output stage employs a quick heat type 8647 tube, developed especially for two-way service, providing more useful power output than any other tube in its power class.

The Model CSMT-30-2 is approved for use under parts 89, 91, 93 and 21 of the FCC Rules and Regulations.

SECTION II

SPECIFICATIONS

MECHANICAL SPECIFICATIONS AND FEATURES

CABINET

Steel; Gray

CONSTRUCTION (Except Cabinet)

Brass and Steel; Cadmium finish.

OVERALL SIZE (HWD)

3-1/2 by 10-1/4 by 15-1/4 inches.

NET WEIGHT

16-3/4 pounds.

POWER SUPPLY

Self-contained; dual transistors with silicon rectifiers.

INSTALLATION

Under dash or trunk mount.

CONTROL HEAD

Plug-in, removable. Miniaturized control head with separate speaker for extended local control (up to 25 feet).

SPEAKER

Part of standard control head, or separate four-inch PM with miniaturized control head.

MICROPHONE (Mobile)

Hand-held carbon standard. Transistorized dynamic, optional extra.

CONTROLS

Power on/off-squelch.
Volume.
Power on indicator lamp.
Transmit indicator lamp.
Channel selector, 1-2 (optional extra).

ANTENNA CONNECTOR

Screw type (SO-239).

ELECTRICAL SPECIFICATIONS AND PERFORMANCE

General (Receiver and Transmitter):

FREQUENCY RANGE

148 to 174 MHz.

FREQUENCY STABILITY

±0.0005%, oven controlled.

AMBIENT TEMPERATURE RANGE

-30°C to +60°C (exterior of case).

VIBRATION

Meets mobile requirements of CD I-100.

INPUT VOLTAGE

12 Volts DC nominal (13.6 volts EIA Standard).

TRANSISTOR COMPLEMENT

First RF Amplifier	2N2360
Second RF Amplifier	2N2360
First Mixer	2N2495
First Oscillator	2N2671
10.7 MHz IF Amplifier	2N2672
Second Mixer	2N2672
Second Oscillator	2N2672
First 455 KHz IF Amplifier	2N388
Second 455 KHz IF Amplifier	2N2672
First Limiter	2N388
Second Limiter	2N2672
Discriminator	2 - 1N4154
Noise Amplifier	40314
Squelch Gate	2N3053
First Audio	TN59
Second Audio	40319
Third Audio	40314
Audio Output	36634/40250
Regulator Reference	TRW 3020B
Converter Switch	2N3053 (NEG GND) or 2N4037 (POS GND)
Voltage Regulator	2N3053
Power Converter	2 - 2N1554
Microphone Amplifier	40233
Automatic Deviation Control/Clipper	2N414
Transmitter Crystal Oscillator	2N3640
Phase Modulator	2 - 1N3162
Buffer Amplifier	2N2671
First Multiplier (Tripler)	PT3160A
Second Multiplier (Doubler)	PT3160B
Third Multiplier (Doubler)	PT3160C
Pre-Driver	PT3160D
Driver	PT3160E

TUBE COMPLEMENT

Output Power Amplifier 8647

Receiver:

SENSITIVITY

Less than 0.5 μV for 20 DB quieting.
Less than 0.35 μV for 12 DB SINAD.

SQUELCH SENSITIVITY

Threshold - 0.3 μV maximum.
Tight - 2.0μV maximum.

CRYSTAL

Third-overtone, series-resonant, similar to MIL Type CR-32A/U.

CONVERSION SYSTEM

Dual; 10.7 MHz and 0.455 MHz.

SECOND CONVERSION OSCILLATOR

Crystal controlled.

SELECTIVE ELEMENT

Eight-section crystal-lattice filter at 10.7 MHz.

SELECTIVITY

2 x down (-6 DB)
±7.5 KHz.
1000 x down (-60 DB)
±14.5 KHz.
100,000 x down (-100 DB)
±20 KHz.

OSCILLATOR RADIATION

Within limits established by FCC Rules and Regulations, Part 15, Sub-Part C.

AUDIO POWER OUTPUT

2.0 watts at less than 10% distortion.

AUDIO FREQUENCY RESPONSE

Within +2 to -8 DB of a standard 6 DB/octave de-emphasis curve from 300 to 3000 CPS reference at 1000 CPS (EIA Standard).

DUTY CYCLE

Continuous.

POWER DRAIN

Receive (squelched) 0.057 ampere +0.5 ampere intermittent (oven) +0.026 ampere (panel light). Receive (unsquelched) 0.850 ampere +0.5 ampere intermittent (oven).

SPURIOUS RESPONSE ATTENTUATION

-85 DB.

Transmitter:

RF POWER OUTPUT

30 watts.

ANTENNA OUTPUT IMPEDANCE

52 ohms.

CRYSTAL

Fundamental frequency type, similar to MIL Type CR-27A/U.

MULTIPLICATION ORDER

3 x 2 x 2 = 12

SPURIOUS EMISSIONS

Attenuated in excess of EIA Standards.

MODULATION

Crystal-controlled FM (phase) type F3.

MODULATION DEVIATION

±5 KHz (16F3 emission).

MODULATION CHARACTERISTIC

Within +1 to -3 DB of a standard 6 DB/octave pre-emphasis curve from 300 to 3000 CPS reference at 1000 CPS (EIA Standard).

DEVIATION LIMITER

Automatic; prevents deviation beyond set amount.

MICROPHONE INPUT IMPEDANCE

500 ohms.

POWER DRAIN

9.5 amperes +0.5 ampere internal oven (at 13.6 VDC).

DUTY CYCLE

Intermittent (EIA).

SECTION III
INSTALLATION

3-1. UNPACKING.

After unpacking the equipment, it should be carefully inspected for any possible damage which may have occurred during transit. Should any sign of damage be apparent, immediately file a claim with the carrier stating the extent of damage. Carefully check all shipping labels and tags for any special instructions before removing or destroying them.

IMPORTANT NOTE

According to FCC Rules and Regulations: only persons holding radio-telephone operator licenses (second class or higher) or persons working under their direct supervision are authorized to perform adjustments or tests coincident with the installation, servicing, or maintenance of a radio station, which may affect the proper operation of the equipment as set forth in the Rules and Regulations governing the class of service for which the equipment is licensed.

3-2. MOBILE INSTALLATIONS.

The following instructions outline the basic steps required to install the equipment in a vehicle in both under-dash and trunk-mount configurations.

Installation requirements will vary greatly depending on space available, operator preference, service accessibility, etc., and it is somewhat up to the discretion and ingenuity of the installer to plan the best possible installation in a particular case. A few moments spent in planning the installation, prior to its commencement, will pay dividends later in terms of performance and ease of maintenance.

1 - Mount the unit so that it is in as protected an environment as possible. Avoid mounting it in a position where it might be subjected to water damage or in direct exposure to dust or dirt. Select a mounting that will provide adequate ventilation around the cabinet and will allow free air circulation through transistor heat sink.

2 - Mount under-dash components for convenient access by the operator. Very often holes exist on the under side of the dashboard for vehicle accessories and these may sometimes be conveniently used for purposes of mounting the radio equipment.

3 - Use extreme care when drilling holes so as not to puncture the vehicle's fuel tank or damage electrical wires, hydraulic lines, etc.

4 - Route control cables, power cables, and antenna leads in protected places, out of the way of the operator's feet or possible heavy objects which may cause abrasion and subsequent failure.

3-2-1. DC UNIT FRONT-MOUNT INSTALLATION
(one-piece unit, control head attached, CSMT-30-2 FAAC, refer to figures 1 & 2).

The unit is mounted by securing the trunion handle to the underside of the dashboard in a position providing operator accessibility to the front panel controls.

The microphone holder should be mounted with self-tapping screws on the dashboard as near the operator as possible. The microphone holder must be grounded.

The relay switch line (fused NO. 20 AWG black lead coming out of the cable connector) should be connected to the accessory terminal of the vehicle's ignition switch. This prevents unauthorized persons from keying the transmitter.

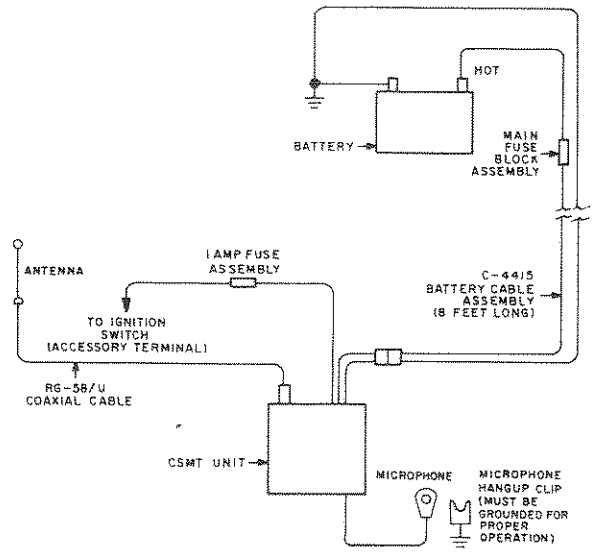

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Figure 1. Front Mount Mobile Installation.

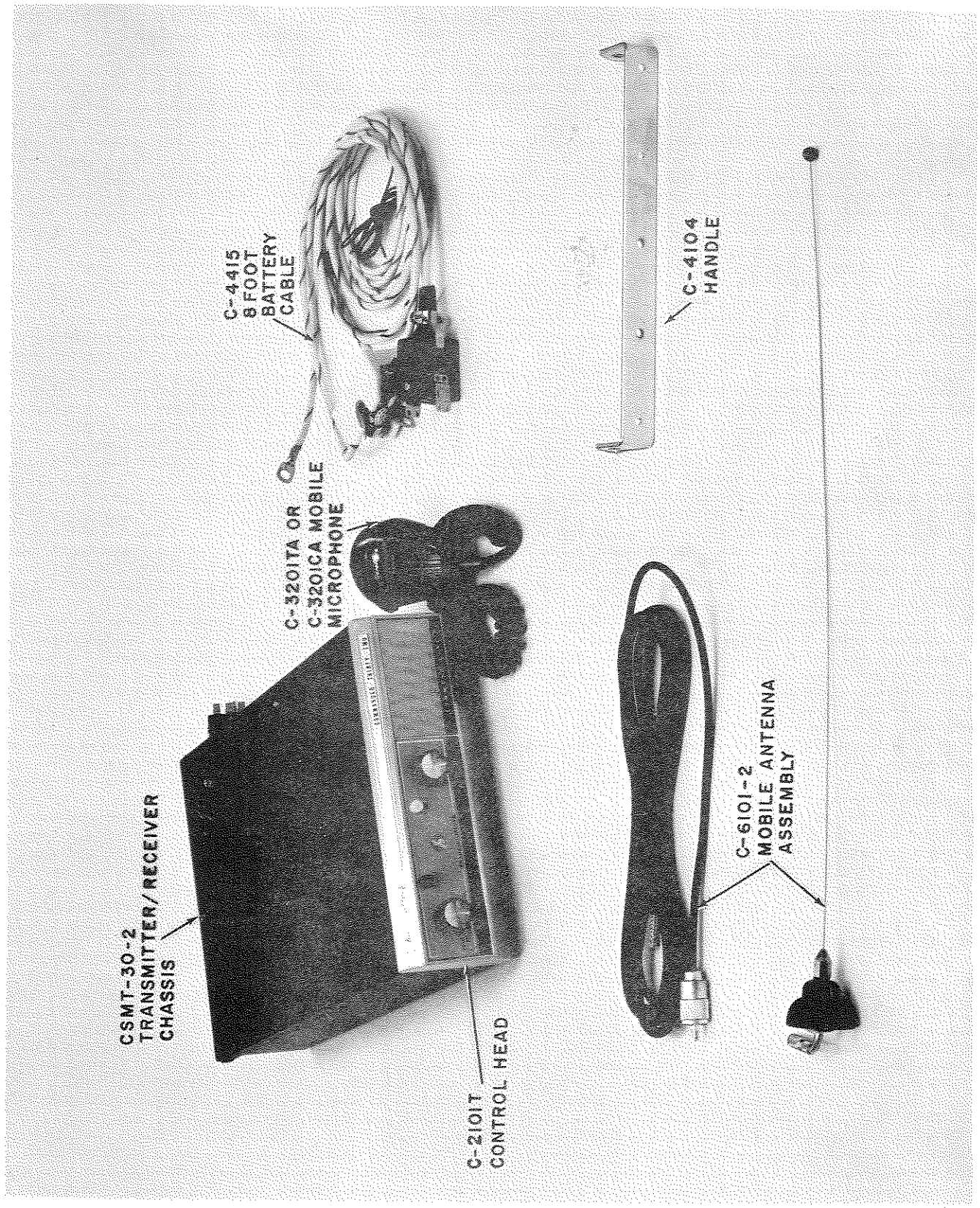

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Figure 2. Hallicrafters' Model CSMT-30-2 (FAAC and FAAT) Mobile Transmitter/Receiver.
(For under dash installations.)

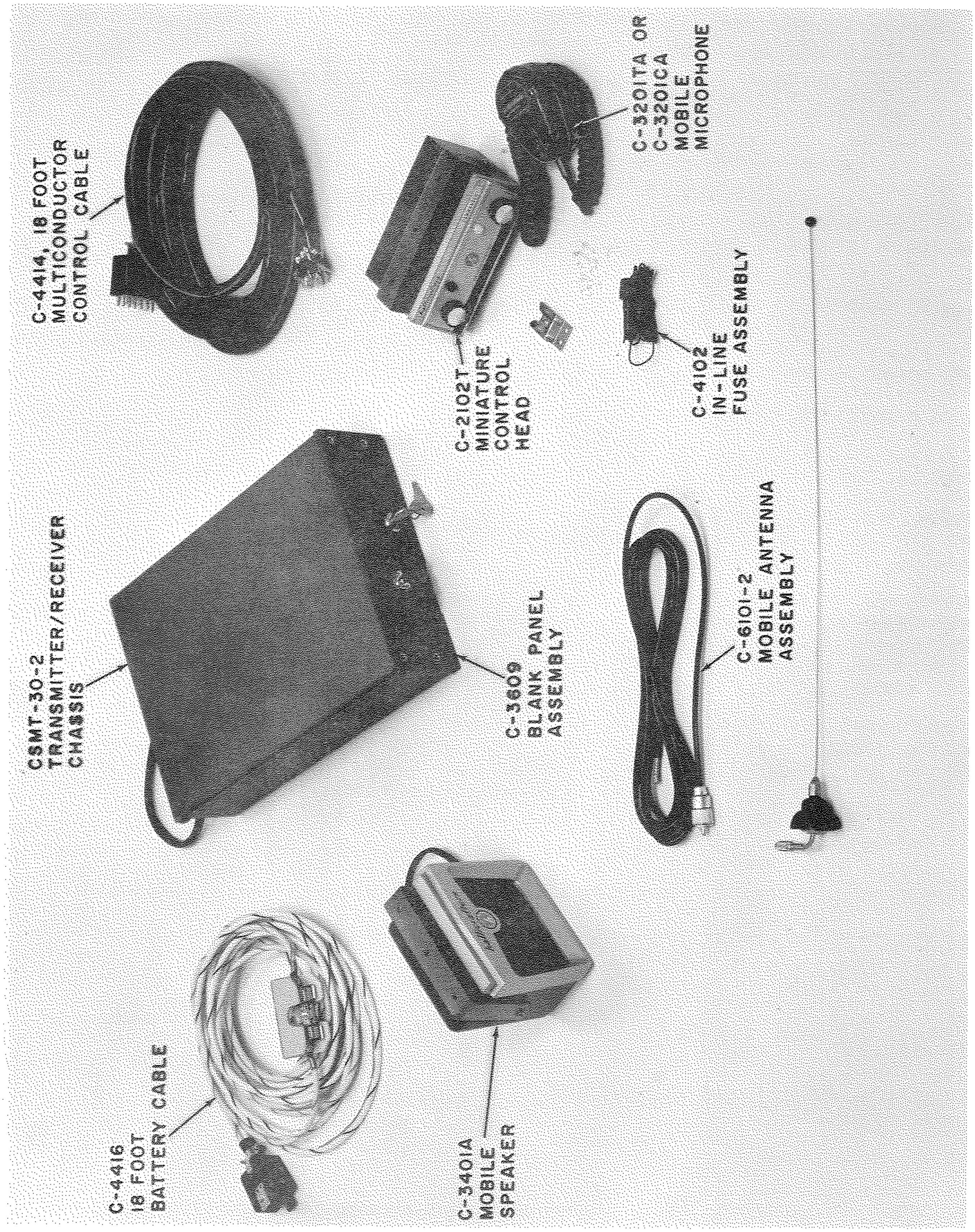

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Figure 3. Hallicrafters' Model CSMT-30-2 (TABC and TABT) Mobile Transmitter/Receiver.

(For trunk mount installations.)

3-2-2. DC UNIT TRUNK-MOUNT INSTALLATION (separate control head units, CSMT-30-2 TABC and TABT).

The components shown in figure 3 in combination with the installation drawing, figure 4, show the various trunk-mount configurations possible with the CSMT-30-2 equipment.

The transmitter/receiver chassis should be removed from its cabinet and the cabinet fastened to the mounting surface by means of self-tapping screws or bolts through each of the four bottom feet. In some installations, it may be advantageous to first attach the transmitter/receiver unit cabinet to a plywood board, slightly larger than the unit, and subsequently fasten the board to the mounting surface. This will provide a good flat mounting surface for the unit.

The control head should be mounted under the dashboard in a position convenient to the operator.

The separate speaker assembly, when used (as with the C-2102T control head), may be mounted as space permits.

Connect the control cable between the control head and main unit. Connect the relay switch line (fused NO. 20 AWG black lead coming out of the control head) to the accessory terminal of the vehicle's ignition switch.

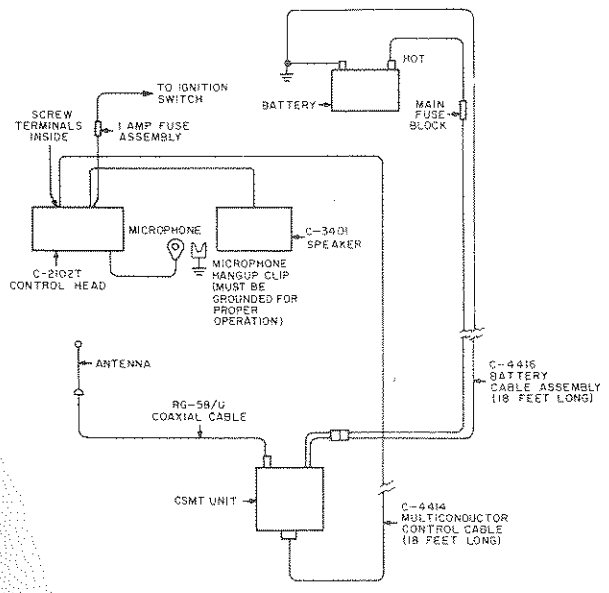

Figure 4. Trunk-Mount Installation, Using Two-Piece Control Head. 156-007551

3-2-3. BATTERY LEADS (mobile installation).

The battery leads should be run from the main chassis to the battery by direct a means as possible. Generally, there are holes in the firewall which will permit access to the battery in the engine compartment. Route the leads neatly to the battery, taping or clamping as required, to prevent them from coming in contact with the hot engine or becoming frayed on sharp metal corners.

IMPORTANT NOTE

The CSMT-30-2 is designed for conventional negative ground or positive ground 12-volt systems. Be sure of polarity and voltage before connecting battery leads, The red lead should be connected to the hot ungrounded terminal through a fuse block. The black lead should be connected directly to chassis ground. Unless this is observed, damage to the vehicle or radio equipment may result. For connection to other DC systems, ask your Hallicrafters' representative for assistance, outlining particulars of the required installation.

3-2-4. MOBILE ANTENNA INSTALLATION.

Supplied as standard equipment with the CSMT-30-2 is a quarter-wave vertical-whip antenna (C-6101). This antenna should be installed according to instructions included with it.

It is desirable to mount the antenna at or near the center of the vehicle's metal roof, as the roof, acting as a ground plane, will insure uniform performance in all directions.

On convertibles or other vehicles where a roof-top installation is impossible, the antenna may be mounted on the rear deck or truck lid; however, with a probable decrease in overall performance. In these instances, the installation of a gain antenna is highly recommended. This type of antenna will generally out-perform the standard roof-top quarter-wave antenna and is a means by which even roof-top installations may be improved to give increased range or denser coverage.

3-2-5. MOBILE NOISE SUPPRESSION.

The built-in noise suppression characteristics of the CSMT-30-2 equipment make special precautions against noise sources in the vehicle normally unnecessary. If ignition noise is noticed after the installation, however, check for proper alignment and accurate netting to the base-station transmitter. If ignition noise is still present, perform the following checks on the vehicle.

1. Check distributor points, capacitor, and rotor and all the spark plugs. Replace worn plugs

and any other obviously defective parts. Reset spark plug gaps to the correct spacing.

2. Check with the automobile manufacturer's specifications to find whether the noise suppressor is in the leads from the spark plug connector the distributor, or in the spark plug from the cap to the center post of the spark gap. With an ohmmeter, check to see that each lead or each spark plug has a high resistance (greater than 10K ohms). Replace any loose connections in the ignition system.

3. If ignition noise is not yet eliminated, continue the following procedure step-by-step:

   a. Install one of the following, depending on automobile manufacturer's recommendations:

      1) A standard automobile radio distributor suppressor in the center lead from the ignition coil in the distributor.

      2) Resistor-type spark plugs. Be sure to use the correct type plug set to the recommended gap.

      3) Resistor type ignition leads.

   b. Connect a 0.01 to 0.5 μF coaxial feedthrough capacitor in series with the primary lead to the distributor. The capacitor used should have a 50-volt, five-ampere minimum rating.

   c. Install bonding straps across the rubber engine-support shock mounts between the engine and the vehicle frame.

Hallicrafters has available a mobile noise suppression kit, Model HA-3, which is suitable to this application. For generator noise suppression refer to the instructions with the HA-3 or other applicable noise suppression kits.

3-3. CRYSTAL INFORMATION (operating frequency determing crystals).

After the installation is completed, crystals should be installed in the approporiate sockets in the crystal oven. Crystal position marking will be found on the inside of the oven when the cover is removed. The crystals are to be inserted in their appropriate position. (T, transmit; R, receive.)

Crystals may be ordered from The Hallicrafters Co. Service Department, 5th and Kostner Avenues, Chicago, Illinois, 60624. Transmitting crystals should be ordered under part number 019-002949, and receiving crystals should be ordered under part number 019-002950. Be sure to specify operating frequencies when ordering crystals.

If crystals are obtained from sources other than The Hallicrafters Co., specify:

for the transmitter,

Crystal type:	MIL CR-27A/U
Oven temperature:	75°C
Load capacity:	32 PF
Frequency:	$\frac{\text{Channel frequency}}{12}$

for the receiver,

Crystal type:	MIL CR-32A/U
Oven temperature:	75°C
Resonance:	Series
Frequency:	$\frac{\text{Channel frequency} - 10.7\ \text{MHz}}{3}$

SECTION IV

THEORY OF OPERATION

4-1. GENERAL.

Hallicrafters Model CSMT-30-2 is a Transmitter/Receiver utilizing transistor circuitry, except for the Transmitter Final Amplifier which is a quick heated beam power tetrode. Refer to figures 5 and 6 for block diagrams of the receiver and transmitter sections and to the back of this manual for the schematic diagram of the CSMT-30-2 equipment.

4-2. RECEIVER.

The receiver section of the CSMT-30-2 consists of nineteen transistors functioning in a crystal-controlled, dual-conversion superheterodyne circuit.

4-2-1. RF AMPLIFIERS.

The input from the antenna relay K502, is applied to the antenna coil L101, and coupled to the base of Q101 RF amplifier. The output circuit of 1st RF Amplifier Q101 is connected to the second RF Amplifier, Q102, via two tuned circuits. The output of the 2nd RF Amplifier is coupled to the base of the receiver first mixer, Q103, thru two additional tuned circuits.

4-2-2. RECEIVER OSCILLATOR.

The receiver oscillator circuit, Q104, is a modified Pierce type oscillator employing a phase-inverting inductance to operate CR-32A/U overtone crystals at their natural series resonant frequency. The crystal, Y101, is housed in a standard plug-in oven which maintains a constant crystal temperature of 75° ±2°C. Small changes in receiver oscillator frequency can be made by adjustment of coil, L107. This adjustment is used to zero (net) the receiver to the exact channel frequency. RF output from the oscillator is coupled from the collector of Q104 to the oscillator multiplier diode.

4-2-3. OSCILLATOR MULTIPLIER.

A diode (1N4154) is connected as a multiplier with its output circuit (L110) tuned to the third harmonic of the crystal frequency. The multiplied frequency is coupled to the emitter of the receiver first mixer, Q103 through C126.

4-2-4. RECEIVER FIRST MIXER.

RF signals from the 2nd RF Amplifier, and from the receiver oscillator multiplier, are applied to the base and emitter respectively of the receiver

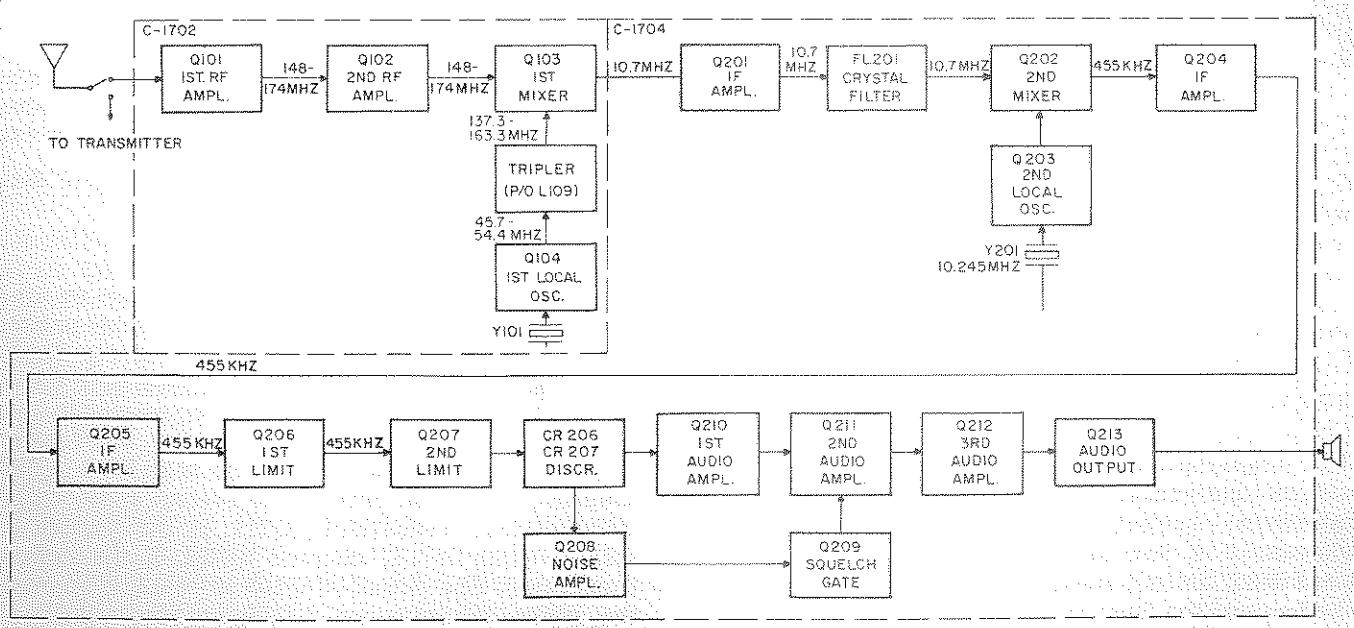

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Figure 5. Receiver Block Diagram.

first mixer, Q103. These signals are mixed and produce a difference frequency of 10.7 MHz. The 10.7 MHz output from Q103 is fed into an IF amplifier, Q201, through an impedance matching network (L106, C117, and C118).

4-2-5. RECEIVER 10.7 MHz IF AMPLIFIER.

Transistor Q201 is used as a conventional IF amplifier at 10.7 MHz. The amplified 10.7 MHz signal from the collector of this transistor is coupled through an impedance matching network (L201, C203, C204) to the crystal-lattice filter.

4-2-6. CRYSTAL LATTICE FILTER.

The crystal-lattice filter establishes the overall selectivity characteristic of the receiver. The filter components are housed in a hermetically sealed enclosure which guarantees their stability and reliable performance. No attempt should be made to service this filter. The output from the crystal-lattice filter is coupled through an impedance matching network (T201) to the base of the 2nd mixer, Q202.

4-2.7. RECEIVER SECOND CONVERSION OSCILLATOR.

The receiver second conversion oscillator, Q203, is a transistor operated as a Pierce type oscillator which requires no adjustment. The circuit uses a standard CR-64/U crystal on 10.245 MHz. A frequency of 10.245 MHz is used in this circuit because that frequency is 0.455 MHz above the first IF frequency, thus producing a second IF frequency. The crystal output is coupled through capacitor C207 to the base of the receiver second mixer, Q202.

4-2-8. RECEIVER SECOND MIXER.

The 10 MHz IF signal from the crystal lattice filter and the 10.245 MHz oscillator signal from Q203 are applied to the base of the receiver second mixer, Q202. These signals are mixed and produce a difference frequency of 455 KHz (0.455 MHz). The 455 KHz output from Q202 is applied through the IF transformer, T202, to the base of the first 455 KHz IF amplifier, Q204.

4-2-9. 455 KHz IF AMPLIFIERS.

The transistors Q204 and Q205 used in these stages operate as untuned IF amplifiers in the presence of weak signals and, with signals in excess of a few microvolts, as limiters. The amplified/limited signal output is RC coupled to the base of the first IF limiter, Q206.

4-2-10. 455 KHz LIMITERS.

Transistors Q206 and Q207 normally function as limiters under all signal conditions. The gain preceding this stage is sufficient to produce limiter action even on thermal noise. The developed limiter voltage can be measured at test point TP202. The output from Q207 is coupled to the discriminator, T203.

4-2-11. DISCRIMINATOR.

The function of the phase discriminator is to recover the audio from the IF signal. The operation is dependent upon the 90° phase shift which occurs at resonance between the primary and secondary voltages of the tuned transformer, T203.

4-2-12. SQUELCH CIRCUIT.

The squelch circuit consists of Q208 and Q209 with Q208 functioning as a noise amplifier and Q209 as a control gate. A high-pass filter, preceding the input of Q208, rejects normal voice frequencies. The noise is amplified to a high level by Q208 and is then rectified by the squelch noise rectifiers, CR204 and CR205.

The rectifiers are connected so as to produce positive voltage. The SQUELCH control applies part of this voltage to the base of the gate, Q209. As the control is advanced, Q209 will conduct, dropping the emitter voltage of the second audio stage Q211 to cut off. An incoming RF signal will quiet the discriminator noise and restore Q211 to normal conduction.

With the VOLUME control set for normal listening and with no input signal, the SQUELCH control should be advanced until the speaker noise is just cut off.

4-2-13. AUDIO AMPLIFIERS.

The discriminator output passes through matching transformer, T204, through the volume preset control, R245, and the VOLUME control, R501, to a T-NOTCH filter which will attenuate tones from tone coded signals (audio frequencies below 300 Hz), then to the base of the first audio transistor, Q210. The first audio is an RC coupled amplifier into the base of the second audio amplifier, Q211. Transistor, Q211, is DC coupled to Q212, which is DC coupled to Q213, the output transistor. The output of Q213 is coupled through the audio transformer, T205, to the speaker.

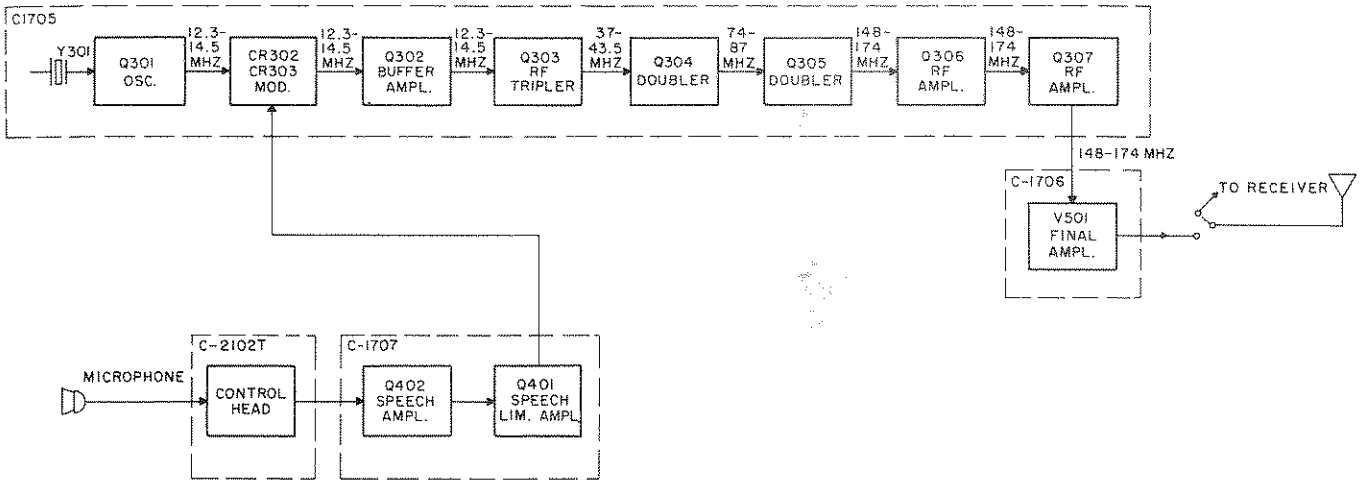

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Figure 6. Transmitter Block Diagram.

4-3. TRANSMITTER.

The transmitter section of the CSMT-30-2 consists of nine transistors and one tube functioning in a crystal-controlled, phase-modulated type circuit with a 30-watt, single-ended output operating class C.

4-3-1. MICROPHONE AMPLIFIER.

The audio input from the microphone is applied through coupling capacitor, C410, to the base of the microphone amplifier transistor, Q402. The amplified output from Q402 is coupled to the base of the speech limiter, Q401, through capacitor, C406.

4-3-2. SPEECH LIMITER.

A sufficiently large audio signal applied to transistor Q401 will produce limiting action of this transistor. The clipped output is filtered and applied to the deviation adjust potentiometer, R401 which drives the transmitter phase modulator, CR302 and CR303.

NOTE

Potentiometer R401 is not an audio gain control. Its function is to set the maximum deviation limit. Therefore, R401 should be adjusted only when there is sufficient audio signal present to produce clipping action by Q401.

4-3-3. CRYSTAL OSCILLATOR.

The transmitter oscillator, Q301, is a Colpitts type oscillator, using a fundamental frequency type CR-27A/U crystal. The exact frequency is determined by the adjustment of trimmer, C304. The oscillator output is coupled through capacitor, C309, to the phase modulator.

4-3-4. PHASE MODULATOR AND BUFFER AMPLIFIER.

The phase modulator consists of two tuned circuits - L303, CR302 and L304, CR303 - coupled together by R307. Each coil resonates with the junction capacitance of its assoicated varactor diode which is reverse biased.

Audio applied to the diodes through R308 and R309 changes the diodes' reverse bias and therefore, their junction capacitance. This causes the phase of the RF signal passing through to be shifted plus and minus at an audio rate. It can be shown that this is equivalent to frequency modulation proportional to the amount of phase shift and the modulating frequency.

The modulated output is coupled through capacitor C318 to the base of the transmitter buffer amplifier, Q302. Transistor Q302 isolates and amplifies the signal which is then applied to the base of the transmitter first multiplier, Q303, through capacitor C321. Coil L305 in the collector circuit of Q302 is tuned to the exact oscillator frequency.

4-3-5. FIRST MULTIPLIER.

Transistor Q303 is a tripler circuit with the collector transformer T301 tuned to exactly three times the oscillator frequency. The output from Q303 is coupled to the base of the transmitter second multiplier Q304.

4-3-6. SECOND MULTIPLIER.

Transistor Q304 is a doubler circuit with the collector circuit tuned to exactly six times the oscillator frequency. The output from Q304 is transformer coupled through T302 to the base of the transmitter third multiplier Q305.

4-3-7. THIRD MULTIPLIER-PRE-DRIVER AND DRIVER

Transistor, Q305 is a frequency doubler circuit. The output of Q305 is transformer coupled through T303 to the base of the predriver and then through T304 to the driver transistor. The predriver and driver bring the power to the level necessary to drive the Power Amplifier.

4-3-8. POWER AMPLIFIER.

The type 8647 power pentode, V501 amplifies the signal to the output level applied to the antenna. Trimmer C516 in the grid circuit, and coils L507 and L508, and trimmers C522 and C523 in the plate circuit are tuned to the exact channel frequency. The output from V501 is coupled through L507 and L508, filtered through the low pass filter and applied through the antenna relay K502 to the antenna for transmission to other stations in the system.

SECTION V

MAINTENANCE AND ALIGNMENT

5-1. GENERAL.

Instructions outlined in this section are directed mainly to servicemen familiar with industrial communications radios. This section contains information on preventive and corrective maintenance.

Preventive maintenance differs from corrective maintenance in that its objective is to prevent troubles from occurring. Preventive maintenance consists of work performed to keep equipment in good working order and reduce breakdowns and interruptions in service. Corrective maintenance is required when a malfunction of the equipment becomes apparent and an electrical or mechanical adjustment and/or replacement of components is necessary.

5-2. PREVENTIVE MAINTENANCE.

Periodic checks should be performed by qualified servicemen to minimize equipment failure and maintain continuity of service. The following procedures should be of aid in checking the CSMT-30-2 equipment for items which could result in either equipment breakdown or shortening the time of its useful service:

A. Remove all dirt, corrosion, and moisture from sockets, plugs, and case.

B. Examine all plugs and sockets for firm seating and positive contact.

C. Remove dust covers and examine all components, such as capacitors, resistors, tubes, diodes, and transistors, for outward signs of damage.

D. Inspect internal flexible wiring for signs of breaks, improper dress, and burned or damaged insulation.

5-3. CORRECTIVE MAINTENANCE.

If the CSMT-30-2 equipment fails to operate properly, the trouble may be corrected by mechanical or electrical adjustment or, if necessary, by replacement of one or more defective components. The normal procedure is to identify the trouble and localize the source to a particular stage or component by means of the Signal Strength Chart, Troubleshooting Chart, and Schematic Diagram appearing in the back of this manual.

5-3-1. SIGNAL STRENGTH CHART.

Table 1 lists the signal strength required for 20 DB receiver quieting with a normal signal. Signal is to be injected from a 50-ohm (terminated) output from a Marconi Model 1066B or equivalent signal generator through an appropriate coupling capacitor.

TABLE 1. RECEIVER SIGNAL STRENGTH CHART.

Injected Signal Frequency	Signal Injected at	Maximum Required Signal
455 KHz through a 0.01 UF capacitor	Q206 Base	100 Millivolts
	Q201 Base	400 Microvolts
10.700 MHz through 0.002 UF capacitor	Q201 Base	3 Microvolts
	Q103 Base	2.5 Microvolts
Channel frequency through a 4.7 PF capacitor	Q103 Base	30 Microvolts
	Q102 Base	10 Microvolts
	Q101 Base	3 Microvolts
Channel frequency directly from generator (not terminated)	Antenna Receptacle	0.5 Microvolts

5-3-2. TROUBLE SHOOTING CHART.

Table 2 lists the most common troubles which occur in this type of equipment, their causes and remedies. The table is broken down into receiver, transmitter, and power supply problems to help isolate the malfunction.

TABLE 2. TROUBLE SHOOTING CHART.

SYMPTOM	PROBABLE CAUSE	REMEDY
RECEIVER		
No speaker output	(A) Fuse F502 blown.	Replace.
	(B) Regulator Q504 defective.	Replace.
	(C) Squelch gate Q209 defective.	Replace.
	(D) Audio Section: Transistors Q210, 211, 212, 213 and/or associated circuitry defective.	Identify defective stage by voltage and gain measurements (table 1). Locate and replace defective component.
	(E) IF Section: Transistors Q202, 204, 205, 206, 207 and/or associated circuitry defective.	
Squelch Inoperative	(A) Defective CR504 or Q504, Q208, Q209 and/or associated circuitry defective.	Locate and replace defective component.
Low Quieting Sensitivity	(A) Receiver misaligned.	Realign receiver per paragraph 5-4.
	(B) Defective antenna, antenna cable, or relay K502.	Locate and replace defective component.
	(C) Defective stage in RF, or IF.	Identify defective stage by voltage, and gain measurements (table 1). Locate and replace defective component.
Audio Distored	(A) Defective or misadjusted channel crystal, Y201.	Re-net to frequency or replace crystal if necessary.
	(B) Discriminator misaligned.	Realign per paragraph 5-4-3.
	(C) Rheostat R258 misadjusted.	Re-adjust per paragraph 5-4-2.
	(D) Transistors Q210, 211, 212, 213 and/or associated circuitry defective.	Locate and replace defective component.
TRANSMITTER		
No RF Output	(A) Transistors Q301 through Q307, tube V501 and/or associated circuitry defective.	Following the alignment procedure (paragraph 5-5), identify defective stage, and replace defective component.
	(B) Defective relay, K502.	
	(C) Defective channel crystal, Y301.	
	(D) Defective K501 Relay.	
	(E) Defective CR504 or Q504.	

TABLE 2. TROUBLE SHOOTING CHART (CONT)

SYMPTOM	PROBABLE CAUSE	REMEDY
Low RF Output	(A) Defective or weak transistors Q301 through Q307, tube V501.	Following the alignment procedure (paragraph 5-5), identify defective stage; locate and replace defective component.
	(B) Transmitter misaligned.	Realign transmitter per paragrah 5-5.
	(C) Defective Tune-Operate Switch, S501.	Check and replace switch as necessary.
	(D) Low B+ voltage.	Check power supply.
Modulation Deviation Low	(A) Microphone defective.	Replace.
	(B) Transistors Q401, 402 defective.	Locate and replace defective component.
	(C) Deviation control, R401, misadjusted.	Re-adjust control per paragraph 5-5-4.
Modulation Distorted	(A) L303 or L304 misaligned.	Realign per paragraph 5-5.
	(B) Q401, 402 and/or associated circuitry.	Locate and replace defective component.
POWER SUPPLY		
Does not start	(A) Fuse F504 blown.	Locate and replace defective component.
	(B) Defective ON/OFF switch.	
	(C) Q501, 502 defective.	
	(D) Defective power transformer.	
Blows Fuses	(A) Transistor Q501, 502 defective.	Locate and replace defective component.
	(B) Silicon diodes CR502, CR503 shorted.	
	(C) Power transformer T501 defective.	
	(D) B+ shorted.	
Low B+ Voltage	(A) Shorted tube (V501) or B+ bypass capacitor.	Locate and replace defective component.
	(B) Defective diodes in power supply.	
	(C) Defective power supply filter capacitor.	

5-4. RECEIVER ALIGNMENT.

Complete alignment of the receiver requires the use of RF signals at 10.700 MHz, and the desired operating frequency. Normally, complete alignment will not be required unless a major component has been replaced. In most cases only RF alignment and netting to the system frequency will be required, in which instances proceed directly with paragraph 5-4-4.

IMPORTANT NOTE

Before turning the unit on, the microphone hang-up disc must be shorted to battery ground. This prevents starting of the high voltage power supply which is needed only under transmit conditions. Ungrounding the microphone applies high voltage to the final amplifier tube.

Before beginning receiver alignment, disconnect audio output lead from speaker and connect to audio power meter.

5-4-1. EQUIPMENT REQUIRED.

1. FM Signal Generator; Boonton Type 202E, Marconi Model 1066B, Measurements 560 FM, or equivalent.
2. Multimeter; Simpson Model 260, or equivalent.
3. 10.7 MHz Crystal-controlled Oscillator; International C-12, or equivalent.
4. Audio Power Output Meter - GR type 1840A, or equivalent.

5-4-2. AUDIO BIAS AND VOLUME PRESET ADJUSTMENT.

With receiver unsquelched, adjust rheostat R258 for +700 MV DC at the emitter of audio output transistor Q213. (Measure at ungrounded lead of R259 - 1 ohm, 5 watt resistor.)

Volume Preset, R243, is factory adjusted for 2 watts output while receiving a signal modulated with a 1000 Hz tone at 3.3 KHz deviation and with volume control R601 set at maximum. Replacement of any audio circuit components may require preset readjustment.

5-4-3. IF AND DISCRIMINATOR ALIGNMENT.

Monitor TP201 with multimeter on +2.5 volt scale (lower if available). Couple 10.7 MHz signal to input of crystal filter, FL201, and tune T202 and T201 for maximum test-point reading.

NOTE

TP201 saturates at +1 volt. Reduce signal level as necessary to remain in the linear region.

Couple 10.7 MHz signal to the first mixer base, Q103, through a 0.001 μF capacitor. Peak L201 and L106 on TP201 and then repeak T202, T201, L201 and L106.

The discriminator transformer, T203, contains two adjustable cores. Move the upper core to the top of the transformer and the lower core to the bottom.

In the presence of a 10.7 MHz signal, monitor TP202 (+2.5V scale) and adjust the lower core for minimum voltage.

NOTE

If two nulls are observed, adjust for the second.

Monitor TP203 and adjust the upper core for zero voltage.

NOTE

TP203 will initially be negative and will swing positive as the proper tuning point is passed.

5-4-4. FIRST OSCILLATOR ALIGNMENT.

This oscillator (Q104) is crystal-controlled on 45 to 55 MHz depending on the exact channel frequency. The oscillator frequency is multiplied to produce the channel frequency minus the 10.7 MHz first IF frequency. For crystal information, refer to paragraph 3-3. The exact receiver operating frequency, using a particular crystal, can be determined by the following formula:

Receiver Operating Frequency = (Crystal Frequency x 3) + 10.7

Insert the proper crystal and oven unit in its socket and allow a five-minute oven warmup. Monitor TP101 and adjust L109 for maximum voltage (approximately +2V).

5-4-5. TRIPLER AND RF ALIGNMENT.

Connect the FM signal generator to the antenna connector and turn the generator output to maximum.

Monitor TP203 and tune the generator to the channel frequency. As the channel frequency is reached, TP203 will swing off zero and then return as the speaker noise quiets. Adjust generator frequency for zero reading.

Monitor TP201 and adjust L110, 105, 104, 103, 102 and 101 for maximum reading. Reduce generator output as necessary to stay in the linear region.

Reduce generator output to zero and adjust VOLUME control for 500 MW noise output. Increase

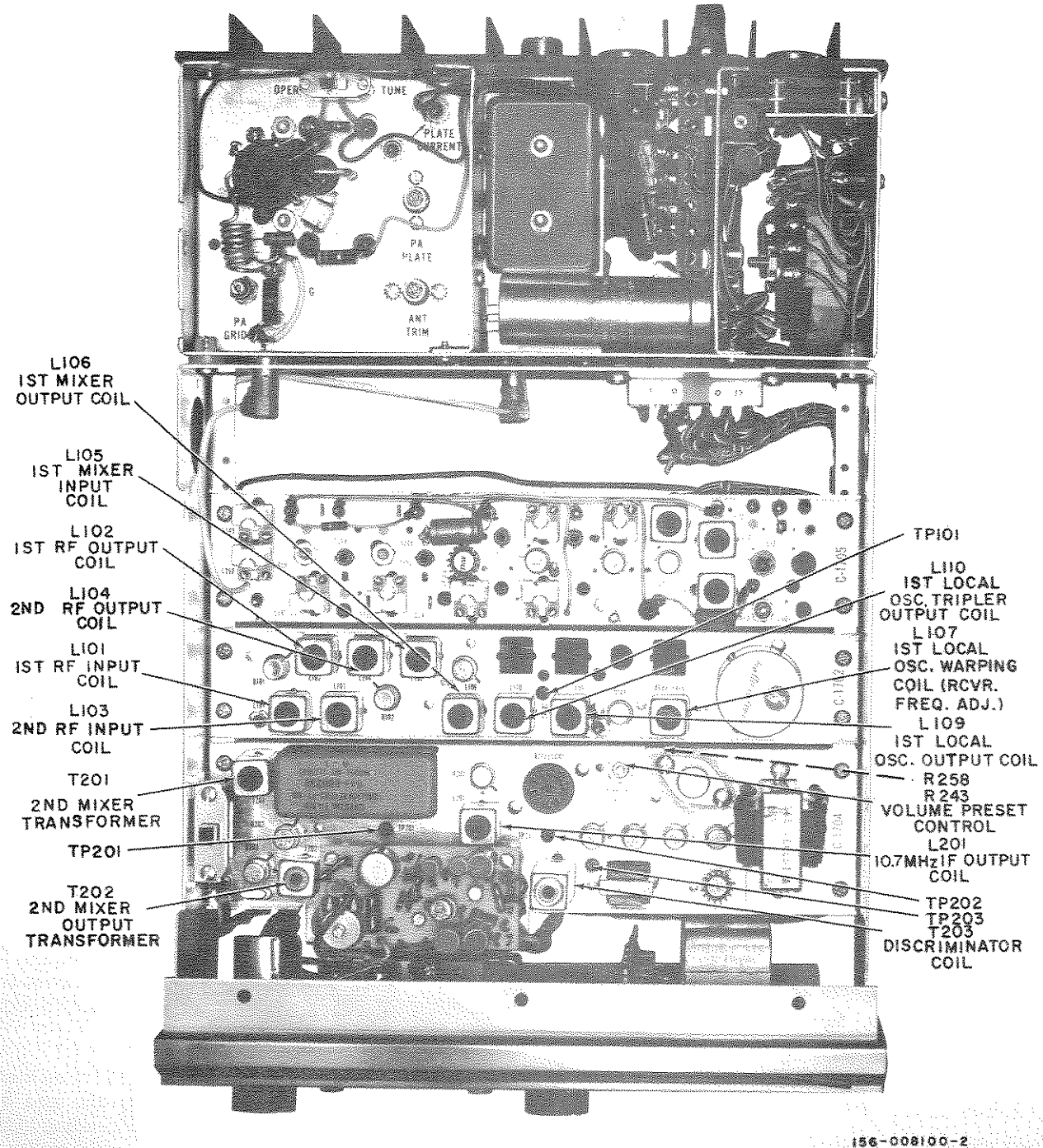


Figure 7. Top View of Chassis, Showing Receiver Alignment Points.

generator output until the noise is reduced 20 DB. Re-align L105, 104, 103, 102 and 101 for minimum noise. Re-align L101 and 102 twice more.

5-4-6. RECEIVER FREQUENCY ADJUSTMENT.

NETTING. In order that the receiver frequency exactly coincides with the system channel frequency, the receiver oscillator must be adjusted so as to "net" the receiver on frequency.

A signal source, known to be on the desired channel frequency, either an accurately adjusted signal generator or a signal from the system control transmitter, should be connected to the receiver antenna input. (Also refer to paragraph 5-5-4.)

The oscillator frequency warping coil (L107) should be adjusted for a zero voltage indication at TP203.

5-5. TRANSMITTER ALIGNMENT.

IMPORTANT NOTE

According to FCC Rules and Regulations: Only persons holding radio-telephone operator licenses (second class or higher) or persons working under their direct supervision are authorized to perform adjustments or tests coincident with the installation, servicing, or maintenance of a radio station, which may affect the proper operation of the equipment as set forth in the Rules and Regulations governing the class of service for which the equipment is licensed.

5-5-1. EQUIPMENT REQUIRED.

1. Wattmeter/Load: Bird Model 612, or equivalent.
2. Multimeter: Simpson Model 260, or equivalent.
3. VTVM, Voltohmyst.
4. Deviation meter: Radio Specialties, Marconi Model TF-79D, or equivalent.
5. Audio Generator: HP200CD, or equivalent.

5-5-2. LOW LEVEL TRANSMITTER ALIGNMENT.

Turn the unit on and leave it in "Receive" (microphone disc grounded) for a minimum of five minutes to permit oven warmup. Remove the upper power supply cover exposing the final amplifier tube socket. Put the operate-tune switch in the tune position to prevent excessive plate current during initial tune up.

Unground the microphone and key the transmitter with the microphone push-to-talk switch while performing the following adjustments:

Connect the DC probe of the VTVM to TP301. Adjust trimmer capacitor, C304, to midrange and tune L303 and L304 for maximum voltage (approximately +1.5V).

Connect the VTVM to test point TP302 and peak the buffer coil, L305, and readjust the modulator coils for maximum meter reading (approximately +2.0 volts).

Connect the VTVM to test point TP303. If the output frequency is higher than 160 MHz, turn the iron core in T301, of the tripler output, to the bottom of the coil form and tune trimmers, C325 and C328 for maximum output. If the output frequency is lower than 160MHz, set trimmers C325 and C328 to approximately 10% from maximum capacity and tune the core in T301 for maximum output. This reading should be between +1 and +2 volts.

Connect the VTVM to test point TP304. If the output frequency is higher than 160 MHz, turn the iron core in T302, of the first doubler output, to the bottom of the coil form and tune trimmers, C333 and C335 for maximum output. If the output frequency is lower than 160 MHz, set trimmers, C333 and C335 to approximately 10% from maximum capacity and tune the core in T302 for maximum output. This reading should be between +1.5 and +2.0 volts.

Connect the VTVM to test point TP305 and adjust the inputs of the predriver and driver transistors, C341 and C345 for maximum. This should be between +8 and +10 volts.

NOTE

On frequencies below 160 MHz capacitors C341 and C345 should tune at more than 50% capacity. Above 160 MHz they should tune at less than 50%.

5-5-3. FINAL AMPLIFIER ALIGNMENT.

While in "Receive", connect multimeter to test point "G" on the -250V scale. Ungrounding the microphone should produce approximately -70V fixed bias on TPG.

Key the transmitter and tune C516 for an increased TPG reading. Peak C516, 349, 350 and 345 for maximum TPG voltage. If TPG reading is greater than -120 volts, or less than -100 volts, adjust transmitter output with R319.

Return to "Receive" and move the output coupling lever to minimum (towards the receiver).

Connect the multimeter, on the 2.5 VDC range, to the final metering points, TP502, (+lead) and TP501 (Caution: These points are at a potential of approximately 500 VDC with respect to the chassis — do not allow meter leads to contact

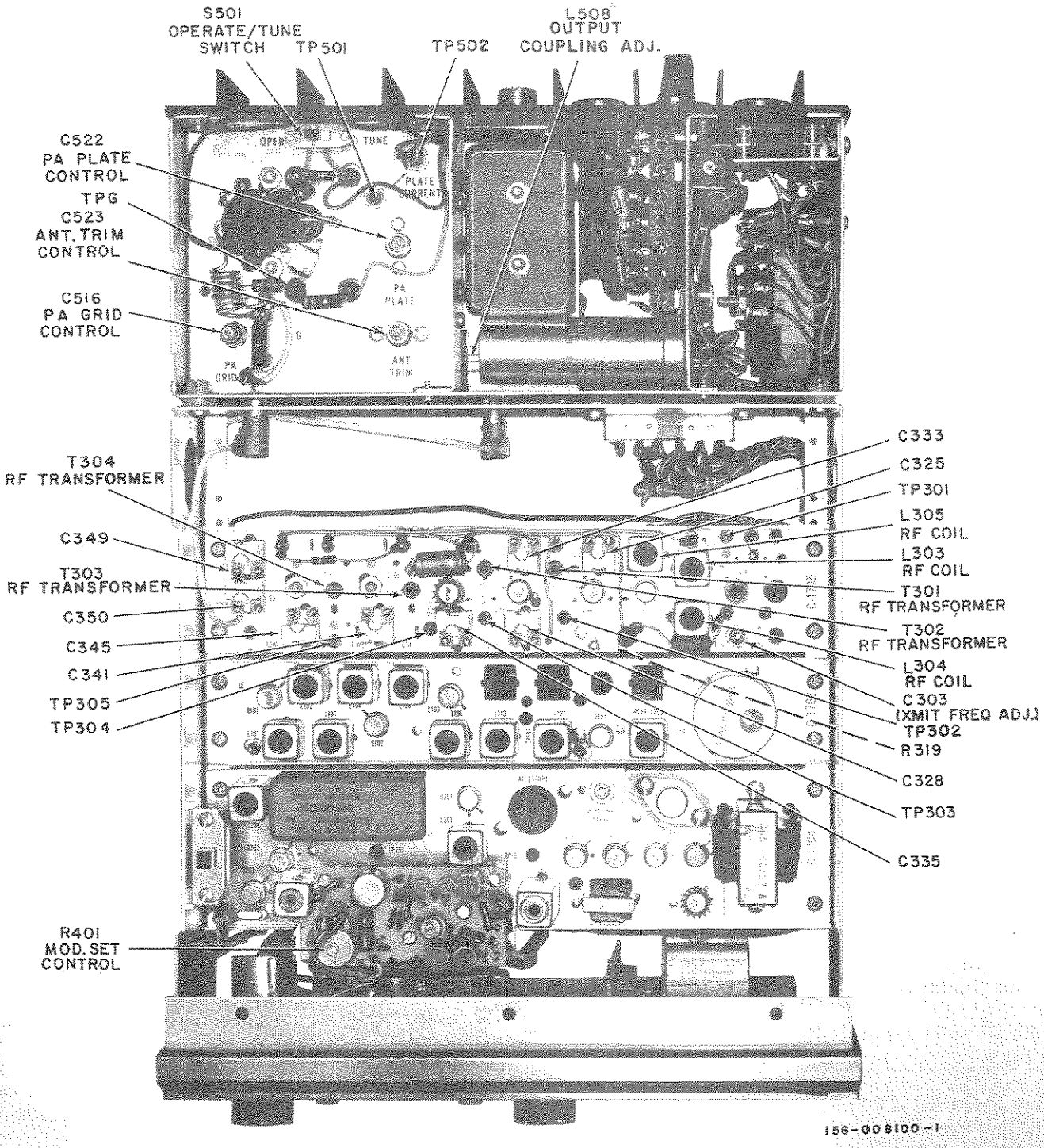


Figure 8. Top View of Chassis, Showing Transmitter Alignment Points.

chassis or ground). The meter, connected in this fashion, is set to read plate current directly on the 2.5-volt scale (2.5V = 250 MA). Adjust the final plate-tank trimmer, C522, for minimum plate current. Release the microphone key and push the operate-tune switch in to the "operate" position. Key the transmitter and retune the plate-tank trimmer for minimum (i.e., dip). Adjust the output coupling capacitor, C523, for maximum power output.

Re-dip C522 and repeak C523 once more. Increase output coupling for maximum power, but do not exceed 150 MA plate current. Readjust C522 for minimum plate current.

Monitor TPG and repeak with C516. Adjust TPG reading to -90V with R319.

The DC input to the tube is to be adjusted to 70 watts. DC power input is defined as:

P_{in} = DC Plate Voltage x Plate Current

Connect multimeter from TP502 to ground on the +1000 volt scale and key transmitter. Note plate voltage and refer to Table 3 for the required plate current.

TABLE 3. PLATE VOLTAGE VS PLATE CURRENT AT 70 WATT INPUT.

Plate Voltage (Volts)	Plate Current (MA)
475	147
500	140
525	133
550	127

Monitor plate current with multimeter and adjust coupling for this current.

NOTE

Under no circumstances should the output coupling be increased beyond the point of maximum output.

With 70 watts input, RF output should be 30 watts minimum.

5-5-4. TRANSMITTER FREQUENCY ADJUSTMENT.

Monitor receiver TP203. Depress NETTING Switch S201 and adjust transmitter trimmer capacitor, C303, until TP203 swings through zero. Set C303 at the zero volts position.

This puts the transmitter on the same frequency as the receiver which was previously set on Standard Channel Frequency.

Alternately, the transmitter frequency may be set on a frequency counter with C303. Then, with the dummy load still attached to the antenna terminal, monitor receiver TP203 and depress the NETTING switch, S201. Adjust receiver warping coil L107 for test point zero.

NOTE

If the transmitter and receiver are to operate on different channels, the transmitter must be set on frequency with a frequency counter or equivalent frequency standard.

5-5-5. DEVIATION ADJUSTMENT.

Sample the RF output with a pickup loop connected to the deviation monitor. Couple a 1 KC signal from the audio generator to the printed circuit board audio input terminal through a 10 μF electrolytic capacitor. Set the generator output to 1 volt RMS and adjust the deviation control R401 for ±5 KC deviation.

5-5-6. FINAL ADJUSTMENT.

Connect the unit to the vehicle antenna system.

If the channel is unoccupied, key the transmitter and adjust the plate-tank capacitor, C522, for plate-current dip. Adjust the coupling trimmer, C523, for the same plate-current reading as obtained when tuning into the dummy load. Alternately, a directional wattmeter may be used in the transmission line in order to obtain optimum output.

Replace the upper power supply cover. Monitor TPG, taking care that the probe does not short TPG to the cover. Key the transmitter and retune C516 for maximum TPG voltage.

This completes tune-up.

5-5-7. FREQUENCY ADJUSTMENTS IN THE FIELD.

Transmitter frequency can be checked at any time by the following procedure:

1. Note TP203 reading while receiving a call from the control station which is assumed to be on the correct frequency.

2. Depress Netting Switch S201 and adjust C303 for the same TP203 reading.

Receiver frequency can be checked as follows:

1. Note TP203 reading with no incoming signal

(noise only). A reading of greater than ±100 MV (VOM) indicates that the discriminator is off frequency and should be re-aligned per Paragraph 5-4-3. As a temporary measure, the upper core of T203 may be adjusted for zero TP203 reading on noise.

2. While receiving a call from the control station, adjust L107 for zero TP203 reading.

RECEIVER ALIGNMENT

Condensed form - Refer to Paragraph 5-4 for detailed procedure

Step	Test Point	Input	Procedure
1	Q213 Emitter	None - Audio Unsquelched	Adjust R258 for +700 MVDC.
2	201	10.7 MH_Z Loosely coupled to Q103	Adjust T201, T202, L201 and L106 for maximum.
3	202	10.7 MH_Z Same as step 2	Adjust lower core of T203 for minimum.
4	203	10.7 MH_Z Same as step 2	Adjust upper core of T203 for zero.
5	101	None	Adjust L109 for maximum.
6	203	RF Channel Frequency (J504)	Adjust RF Generator frequency for zero volts at test point.
7	201	Same as step 6	Adjust L110, 105, 104, 103, 102 and 101 for maximum.
8	Audio Output Meter	Same as step 6	With no input, adjust VOLUME Control for 500 MW noise power. Apply sufficient to reduce noise 20 DB. Readjust L105, 104, 103, 102 and 101 for minimum noise.
9	203	Exact Channel Frequency	Adjust L107 for zero volts at test point.

TRANSMITTER ALIGNMENT

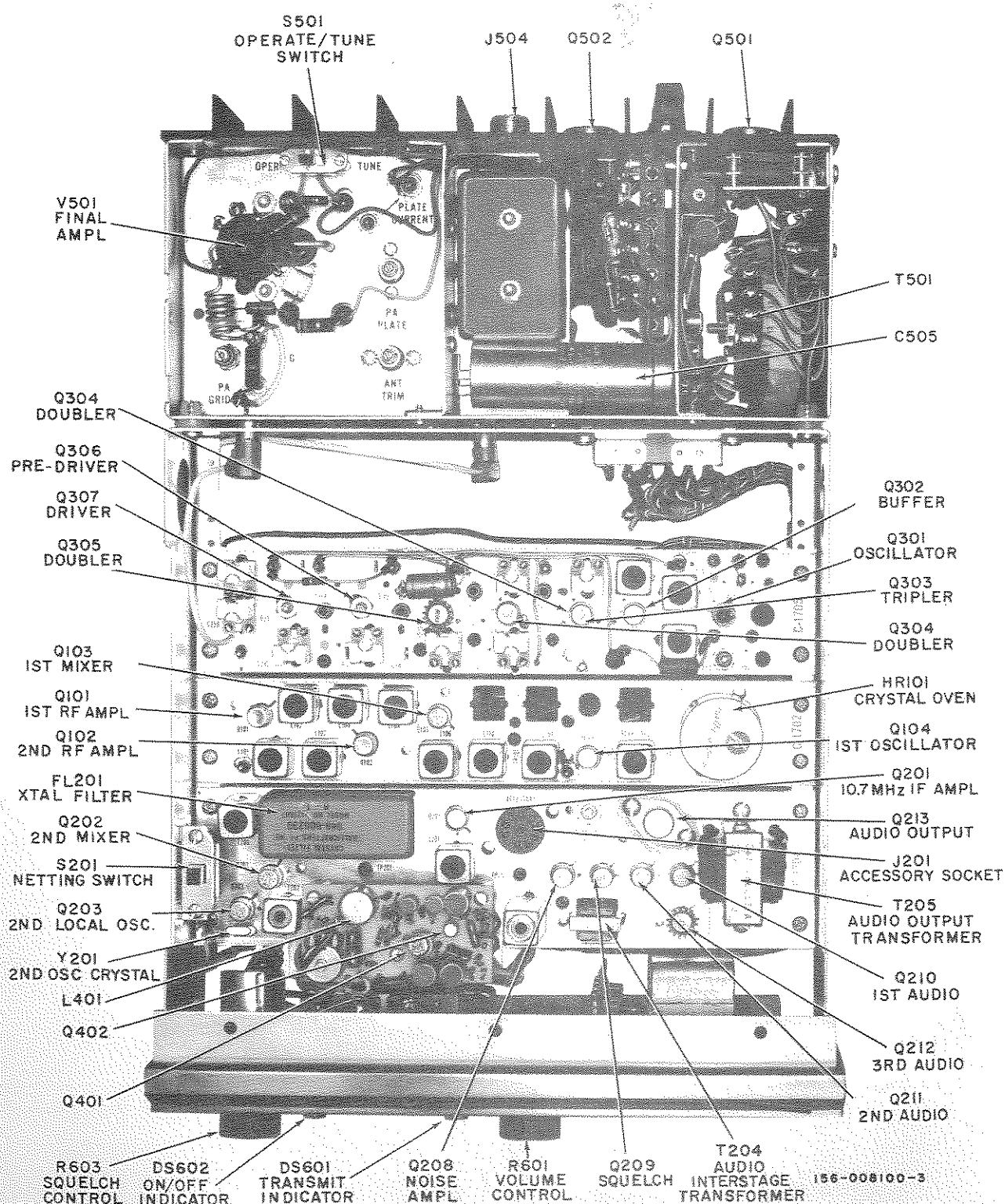
Condensed form - Refer to Paragraph 5-5 for detailed procedure

Step	Test Point	Procedure	Typical Test Point Reading
1	301	Tune L303, L304 for maximum.	+1.5 V (VTVM) +0.3 V (VOM)
2	302	Tune L305 for maximum. Retune L303, 304 and 305 until no further increase in TP302 reading can be obtained.	+1.8 V
3	303 304	If carrier frequency is below 160 MHz: close C325, 328 333 and 335 to 90% mesh. Tune T301 for maximum TP303. Tune T302 for maximum TP304. If carrier frequency is above 160 MHz: turn the core in T301 and 302 to the bottom of the coil form. Tune C325 and C328 for maximum TP303. Tune C333 and C335 for maximum TP304.	(TP303) +1.2 V (TP304) +1.8 V
4	305	Preset C341 and C345 to 50% mesh. If carrier frequency is below 160 MHz, increase mesh of C341 and C345 for maximum TP reading. If above 160 MHz, reduce mesh for maximum reading.	+10.0 V (VTVM) +1.5 V (VOM)
5	G	Tune C516, 350, 349, 345 and 341 for maximum reading. Adjust R319 for a TP reading of -110 V.	-110.0 V
6	501 (-) 502 (+)	Tune C522 for minimum reading (i.e., dip).	(200 MV indicated) 20 MA
7	Watt-meter	Tune C523 for maximum output power.	1 Watt
8	---	Move the Operate-Tune Switch to Operate and repeat Steps 6 and 7.	70 MA 8 Watts
9	Watt-meter	Increase output coupling, L508, for maximum power. Do not exceed 150 MA plate current.	20 + Watts
10	G	Repeak grid per Step 5 and adjust R319 for a TP reading of -90 V.	-90 V
11	---	Repeat Steps 6 and 7.	150 MA Max. 30 Watts Min.
12	501 (-) 502 (+)	Determine required plate current for 70 watts plate input. Adjust output coupling to obtain this current, but do not increase coupling beyond the point of maximum output power.	70 W Max. Input 30 W Min. Output
13	TPG	Replace Power Supply cover. Repeak PA GRID capacitor, C516, for maximum.	-90 V
14	---	Monitor output with suitable frequency meter and adjust C303 for exact channel frequency.	----
15	---	Couple a 1 VRMS, 1 KC signal to the audio board input through a 10 UF capacitor. Adjust R401 for ±5 KC deviation.	----

MODEL CSMT-30-2
TWO-WAY FM MOBILE
TRANSMITTER/RECEIVER CHASSIS

Hallicrafters' Model CSMT-30-2 is a transmitter/receiver chassis designed for operation in the 148 to 174 MHz range. The chassis includes a self-contained transistorized power supply which operates from a 12-volt DC source. This transmitter/receiver chassis is used in all single channel versions of the Model CSMT-30-2 Two-Way FM Land-Mobile Radio equipment.

Detailed information regarding overall performance may be found in the Specifications section of the handbook on the CSMT-30-2 equipment.



2N2672
SK3006

RECEIVER 2ND IF AND AUDIO (10.7 MC THRU AUDIO) C-1704

LOW LEVEL TRANSMITTER C-1705

POWER SUPPLY AND FINAL AMPLIFIER C-1706

CONTROL HEAD C-2101T

CSMT-30-2 Schematic Diagram

2N2672
SK3006

RECEIVER, SINGLE CHANNEL (FRONT END) C-1702

RECEIVER 2ND IF AND AUDIO (10.7 MC THRU AUDIO) C-1704

LOW LEVEL TRANSMITTER C-1705

TRANSMITTER AUDIO C-1707

POWER SUPPLY AND FINAL AMPLIFIER C-1706

NOTES:
1. UNLESS OTHERWISE SPECIFIED,
   ALL RESISTORS ARE IN OHMS ±10%, 1/4 WATT
   ALL CAPACITORS ARE IN MICROFARADS
   ALL INDUCTORS ARE IN MICROHENRIES
2. US — INDICATES UNSQUELCHED
   FS — INDICATES FULLY SQUELCHED
   T — INDICATES TRANSMIT
3. JUMPER REMOVED WHEN CERTAIN MICROPHONE TYPES ARE USED. SEE TEXT.
4. NEGATIVE GROUND,
   J503 JUMPERS — 9-11, 10-8
   Q503 — 2N3053
   DIODE CR506 AS SHOWN
   POSITIVE GROUND,
   J503 JUMPERS — 9-8, 10-11
   Q503 — 2N4037
   DIODE CR506 REVERSE POLARITY
5. SCHEMATIC SYMBOLS:
   VEHICLE GROUND —
   FLOATING GROUND —
   FERRITE BEAD —

BOTTOM VIEW OF RF COILS

SERVICE REPAIR PARTS LIST

C-1702 SINGLE CHANNEL RECEIVER

Schematic Symbol	Description	Hallicrafters Part Number
	CAPACITORS	
C101,122	1000 PF, Feed-thru	047-001308
C102	2.2 PF, 10%, 100V, Mica	506-940220-111
C103,105, 106,109, 114,130	150 PF, 2%, 100V, Mica	506-910151-314
C104	4.7 PF, ±0.5 PF, 100V, Mica	506-940470-111
C107,108, 112,115, 116,125,126, 127,129	0.001 µF, 20%, 500V, Ceramic	047-001671
C110,113	0.12 PF, 5%, 500V, Mica	047-300430-043
C111	1.2 PF, ±0.5 PF, 100V, Mica	506-940120-711
C117,121	12 PF, 2%, 100V, Mica	506-910120-311
C118	33 PF, 2%, 100V, Mica	506-910330-313
C119,120	0.01 µF, 20%, 250V,	047-002141-001
C123	6.8 PF, 5%, 100V, Mica	506-940680-211
C128	50 µF, 40V, Electrolytic	045-001348-050
	*RESISTORS	
R101	22K Ohm	451-152223
R102,114	3300 Ohm	451-152332
R103	820 Ohm	451-152821
R104,108, 120	100 Ohm	451-152101
R105,116, 117	10K Ohm	451-152103
R106	4700 Ohm	451-152472
R107,115	1500 Ohm	451-152152
R109	1000 Ohm	451-152102
R111	18 Ohm	451-152180
R112	1800 Ohm	451-152182
R113	2700 Ohm	451-152272
R118,119	100K Ohm	451-152104
R121	2200 Ohm	451-152222
R122	220 Ohm	451-152221
RI10	15K Ohm	451-152153

*All RESISTORS are carbon type 10%, 1/4 watt unless otherwise stated.

	COILS	
L101	Input, First RF	050-001998
L102	Output, First RF	050-001997
L103	Input, Second RF	050-001996
L104	Output, Second RF	050-001995
L105	Input, First Mixer	050-001994
L106	Output, First Mixer	050-001993
L107	Input, First Local Osc.	050-002003
L108,111	Choke, 1.5 µH	050-002463
L109	Output, First Local Osc.	050-001991
L110	Output, First Local Osc. Tripler	050-001992
	TRANSISTORS AND DIODES	
Q101,102	Transistor, Type 2N2360	019-003831
Q103	Transistor, Type 2N2495	019-003715
Q104	Transistor, Type 2N2362	019-003707
CR101	Diode, Type 1N4154	019-003713
	MISCELLANEOUS	
E101,102	Bead, Ferrite	077-002960
	Cable, RF	087-008999-001
Y101	Crystal, Receiver, CR-32A/U	019-002950
HR101	Oven, Crystal (includes S101)	021-000872
	Socket, Octal	006-100359
	Socket, Transistor (4)	006-001210-003
TP101	Test Point	035-000089
P505	Plug, includes RF cable	087-008999-001

C-1704 RECEIVER 2ND IF AND AUDIO

Schematic Symbol	Description	Hallicrafters Part Number
	CAPACITORS	
C201,202	0.01 µF, +80%, -20%, 100V, Ceramic	047-002211
C207	15 PF, 2%, 100V, Mica	506-910150-311
C204	22 PF, 2%, 100V, Mica	506-910220-312
C205,206, 210,211, 213,214, 215,219,220,223,226,243,254	0.1 µF, 20%, 250V, Mylar	047-002141-007
C209	33 PF, 2%, 100V, Mica	506-910330-312
C216,228, 230,244	0.01 µF, 20%, 250V,	047-002141-001
C217,222	400 PF, 2%, 100V, Mica	506-910401-314
C203	43 PF, 2%, 100V, Mica	506-910430-313
C218,221, 225	0.002 µF, 20%, 500V, Ceramic	047-100395
C224,232, 241,248	0.22 µF, 20%, 250V	047-002141-009
C227	150 PF, 2%, 100V, Mica	506-910151-314
C231	820 PF, 2%, 100V, Mica	506-910821-314
C233,234, 235,236	0.47 µF, 20%, 250V	047-002141-011
C237,253, 255	10 µF, 16V, Electrolytic	045-001348-029
C242	0.047 µF, 20%, 250V	047-002141-005
C239	0.015 µF, 20%, 250V	047-002141-002
C240	0.068 µF, 20%, 250V	047-002141-006
C245	0.022 µF, 20%, 250V	047-002141-003
C238,246, 250	15 µF, 20V, Electrolytic	045-001150-001
C247	0.033 µF, 20%, 250V	047-002141-004
C249	125 µF, 18V Electrolytic	045-001348-034
C251	50 µF, 40V, Electrolytic	045-001348-050
C252	120 PF, 2%, 100V, Mica	506-910121-314
	*RESISTORS	
R201,213, 218,221, 227,264, 267	100 Ohm	451-152101
R202,211, 217,223, 228	22K Ohm	451-152223
R203,209, 216,224, 229,260	4700 Ohm	451-152472
R204,208, 214,220, 225,230,232,235, 261	1000 Ohm	451-152102
R205,265	1500 Ohm	451-152152
R206,233	33K Ohm	451-152333
R207,219, 226,231, 248,249, 255	2200 Ohm	451-152222
R210,251	10K Ohm	451-152103
R212,215, 244,246, 253,262	3300 Ohm	451-152332
R222	27K Ohm	451-152273
R234	220 Ohm	451-152221
R236	1 Megohm	451-152105
R237,238, 240,241,269	100K Ohm	451-152104
R239	220K Ohm	451-152224
R243	Variable, 2000 Ohm, ±20%, Volume Preset	025-002724
R245,252	1800 Ohm	451-152182
R247	8200 Ohm	451-152822
R250	390 Ohm	451-152391
R254,268	1200 Ohm	451-152122
R256	47 Ohm, 1/2 Watt	451-252470
R257	22 Ohm, 1/2 Watt	451-252220
R258	Variable, 3000 Ohm, ±20%, Bias Set	025-002723
R259	1.0 Ohm, 5Watt, Wirewound	445-012010
R263	820 Ohm	451-152821
R266	2700 Ohm	451-152272

*All RESISTORS are carbon type, 10%, 1/4 watt unless otherwise stated.

	COILS AND TRANSFORMERS	
L201	Coil, 10.7 MC IF Output	050-002001
L202	Choke, 50 MH	050-001044-009
L203	Choke, 560 µH	050-002155
L204	Choke, 8H	058-000729
T201	Transformer, Filter, 2ND Mixer	050-002004
T202	Transformer, Output, 2ND Mixer	050-002002
T203	Coil, Discriminator	050-002000
T204	Transformer, Audio Interstage	055-000558
T205	Transformer, Audio Output	055-000557
	TRANSISTORS AND DIODES	
Q201,202, 203,205, 207	Transistor, Type 2N2672	019-003384
Q204,206	Transistor, Type 2N388	019-003830
Q208,212	Transistor, Type 40314	019-003873
Q210	Transistor, Type TN59	019-003850
Q211	Transistor, Type 40319	019-003874
Q209	Transistor, Type 2N3053	019-003810
Q213	Transistor, Type 38634	019-003485
CR201, 202	Diode, Type 1N34A	019-001918
CR203, 204,205, 206,207	Diode, Type 1N4154	019-003713
	MISCELLANEOUS	
J201	Connector, 9-pin	006-001112
Y201	Crystal, 10,245 MC	019-003714
FL201	Filter, Crystal	049-000230
	Heat Sink, Plate	063-007077
	Printed Circuit Board	129-001033
	Socket, Transistor (4-pin)	006-001210-003
TP201, 202,203	Test Point	035-000089
RT201	Thermistor, 1000 Ohm, wirewound	024-001626

C-1705 LOW LEVEL TRANSMITTER

Schematic Symbol	Description	Hallicrafters Part Number
	CAPACITORS	
C301,305, 320,327, 334,339,343,348, 352,353	1000 PF, Feed-thru	047-001308
C302,337, 342,347,360	150 PF, 2%, 100V, Mica	506-910151-314
C303	Variable, Trimmer, 2-18 PF	044-000643
C304	15 PF, 2%, 100V, Mica	506-910150-311
C306,307, 319,323, 326,338,342, 347,354,356	0.01 µF, +80%, -20%, 100V, Ceramic	047-002211
C312	12 PF, 2%, 100V, Mica	506-910120-311
C308,361, 362	15 µF, 20V, Electrolytic	045-001150
C309,344	1 PF, ±0.5 PF, 100V Mica	506-910010-711
C310	27 PF, 2%, 100V, Mica	506-910270-313
C311,337, 358,359	0.001 µF, 20%, 500V, Ceramic	047-001671
C312,318	10 PF, ±0.5 PF, N2200, 500V, Ceramic	479-022100
C313,314, 315,316	0.01 µF, 20%, 250V,	047-002141-001
C317	0.1 µF, 20%, 250V,	047-002141-007
C321,357	1000 PF, 100V, Mica	506-110102-314
C322	120 PF, 2%, 100V, Mica	506-910120-313
C324	75 PF, 2%, 100V, Mica	506-910750-313
C325,328, 333,335, 345,349, 350	Variable, Trimmer, 3-34 PF	048-000644
C329	180 PF, 2%, 100V, Mica	506-910181-314
C331	22 PF, 2%, 100V, Mica	506-910220-311
C336	43 PF, 2%, 100V, Mica	506-910430-313
C340	50 µF, 40V, Electrolytic	045-001348-050
C341	Variable, Trimmer, 1.4-13 PF	048-000661
C348	110 PF, 2%, 100V, Mica	506-910111-314
C351	10 PF, ±0.5 PF, N330, 500V, Ceramic	491-002100-073
C330,332	400 PF, 2%, 100V, Mica	506-910401-314
	*RESISTORS	
R301,304	8200 Ohm	451-152822
R302	1000 Ohm	451-152102
R303	1200 Ohm	451-152122
R305,320	220K Ohm	451-152224
R306	10K Ohm	451-152103
R307,311	4700 Ohm	451-152472
R308,309	56K Ohm	451-152563
R310	39K Ohm	451-152393
R312	47K Ohm	451-152473
R313	150 Ohm	451-152151
R314,318 324,325,326	100 Ohm	451-152101
R316	24 Ohm, 5%, 1/2 Watt	451-251240
R319	Variable, 100 Ohm, 20%, 3 Watt, Drive Level Control	025-002731
R321	470 Ohm	451-152471
R322	820 Ohm, 1 Watt	451-352821
R323	10 Ohm, 1/2 Watt	451-252100
R315,317	47 Ohm, 5%, 1/2 Watt	451-251470

*All RESISTORS are carbon type 10%, 1/4 watt unless otherwise stated.

	COILS AND TRANSFORMERS	
L301,302, 306	Choke, 120 µH	050-002259
L303	Coil, RF	050-002006
L304	Coil, RF	050-002473
L305	Coil, RF	050-002007
L307	Choke, 2.7 µH	053-000670
L308	Coil, RF	050-002252
L309,310	Choke, 0.47 µH	053-000664
L311	Coil, RF	050-002254
L312	Coil, RF	050-002255
T301	Transformer, RF	050-002249
T302	Transformer, RF	050-002250
T303	Transformer, RF	050-002251
T304	Transformer, RF	050-002253
	TRANSISTORS AND DIODES	
Q301	Transistor, Type 2N3640	019-003924
Q302	Transistor, Type 2N2671	019-003718
Q303	Transistor, Type PT 3160A	019-003833
Q304	Transistor, Type PT 3160B	019-003834
Q305	Transistor, Type PT 3160C	019-003835
Q306	Transistor, Type PT 3160D	019-003836
Q307	Transistor, Type PT 3160E	019-003837
CR301, 304	Diode, Type 1N34A	019-001918
CR302, 303	Diode, Type 1N3182	019-003316
	MISCELLANEOUS	
E301 thru E310	Bead, Ferrite	077-002960
	Cable, RF Output	087-008999-002
Y301	Crystal, Type CR27A/U	019-002949
	Socket, Transistor (3-pin)	006-001210-008
	Socket, Transistor (4-pin)	006-001210-003
TP301 thru TP305	Test Point	035-000089
P506	Plug, includes RF cable	087-008999-002

C-1706 POWER SUPPLY AND FINAL AMPLIFIER

Schematic Symbol	Description	Hallicrafters Part Number
	CAPACITORS	
C501	20 µF, 150V, Electrolytic	045-001350
C502,508, 509	0.002 µF, 20%, 1000V, Ceramic	047-100794
C503,517	250 PF, 10%, 350V, Silver Mica	047-002221
C504	0.02 µF, 20%, 1000V, Ceramic	047-001528
C505A, B,C	40 µF, 2 x 10 µF; 400V, Electrolytic	045-001351
C506,510	10 µF, 400V, Electrolytic	045-001227
C512,513, 515,519	470 PF, Feed-thru	047-002147
C514,521	1500 PF, Feed-thru	047-001921
C516	Variable, 2.7 PF - 19.6 PF	048-000636
C518,520	0.001 µF, 20%, 500V, Ceramic	047-100503
C522,523	Variable, 3.8 PF - 10.8 PF	048-000620
C524	640 µF, 25V, Electrolytic	045-001349-024
C525,526, 527	250 µF, 40V, Electrolytic	045-001349-027
C528	0.01 µF, 20%, 250V	047-002141-001
C529	7 PF, Feed-thru	047-002208
C530,533	7 PF, 2%, 500V, Mica	482-131070
C531,532	22 PF, Feed-thru	047-001734
C534	7 PF, Stand-Off	047-001730
C535	0.01 µF, +80%, -20%, 100V, Ceramic	047-002211
	*RESISTORS	
R501	10 Ohm, 10 Watt	024-001617
R502	270 Ohm, 10 Watt	024-001618
R503	330 Ohm, 1/2 Watt	451-252331
R505	10 Ohm, 15 Watt	024-001601
R506	2500 Ohm, 15 Watt	024-001619
R507	25 Ohm, 15 Watt	024-001515
R508	25K Ohm, 15 Watt	024-001623
R509,510	100K Ohm, 2 Watt	451-652104
R511	4700 Ohm	451-352472
R512	100K Ohm, 1/2 Watt	451-252104
R513	100 Ohm	451-352101
R514	10 Ohm, 5%	451-351100
R516	150 Ohm	451-352151
R517	1800 Ohm, 1/2 Watt	451-252182
R515	820 Ohm, 1 Watt	451-352821

*All RESISTORS are carbon type, 10%, 1 Watt unless otherwise stated.

	COILS AND TRANSFORMERS	
L501	Choke, RF, 2.7 µH	053-000670
L502	Coil, Link (Final Input)	050-002262
L503	Coil, Tank (Final Input)	050-002260
L504	Choke, RF, 1.8 µH	053-000489
L505	Choke, 1.5 µH	050-002463
L506	Coil, Hash Choke, 40 µH	050-000998
L507	Coil, Tank (Final Output)	050-002282
L508	Coil, Link (Final Output)	050-002264
L509,511	Coil, Low Pass (Input and Output)	051-003657
L510	Coil, Low Pass	051-003664
T501	Transformer, Power	050-002266
	TUBES, TRANSISTORS, AND DIODES	
V501	Electron Tube, Type 8647	090-001658
Q501,502	Transistor, Type 2N1554	112-000107
Q503,504	Transistor, Type 2N3053	019-003810
CR501	Diode, Type 1N3254	019-002939-002
CR502, 503	Diode, Type 1N3256	019-002939-004
CR504	Diode, Zener, Type Z10	019-003719
CR505	Diode, Type 1N1199RA (includes hardware)	019-003720
CR506	Diode, Type 1N4154	019-003713
Q503 is 2N4037 for positive ground.		
	MISCELLANEOUS	
E501,502	Bead, Ferrite	077-002960
J502	Connector, 18-pin	010-002694
J505,506	Connector, Female	010-003411
J504	Connector, Flange Mount (UHF)	010-003399
F501	Fuse, 0.5 Ampere	039-000808
F502	Fuse, 2 Ampere	039-000807
	Fuseholder (2)	006-001202
	Heat Sink	067-012991
P503	Plug, DC Power	010-003452
P505	Plug, Phono Type (includes RF cable)	087-008999-001
P506	Plug, Phono Type (includes RF cable)	087-008999-002
K501	Relay, Power	021-000671
K502	Relay, P-T-T	021-000831
	Socket, Transistor (Q501,502)	006-000922
	Socket, Transistor (Q503,504)	006-001210-008
	Socket, Tube (V501)	006-001201
S501	Switch, Slide (SPST)	060-002846
TP501, 502	Test Point	035-000089

C-1707 TRANSMITTER AUDIO

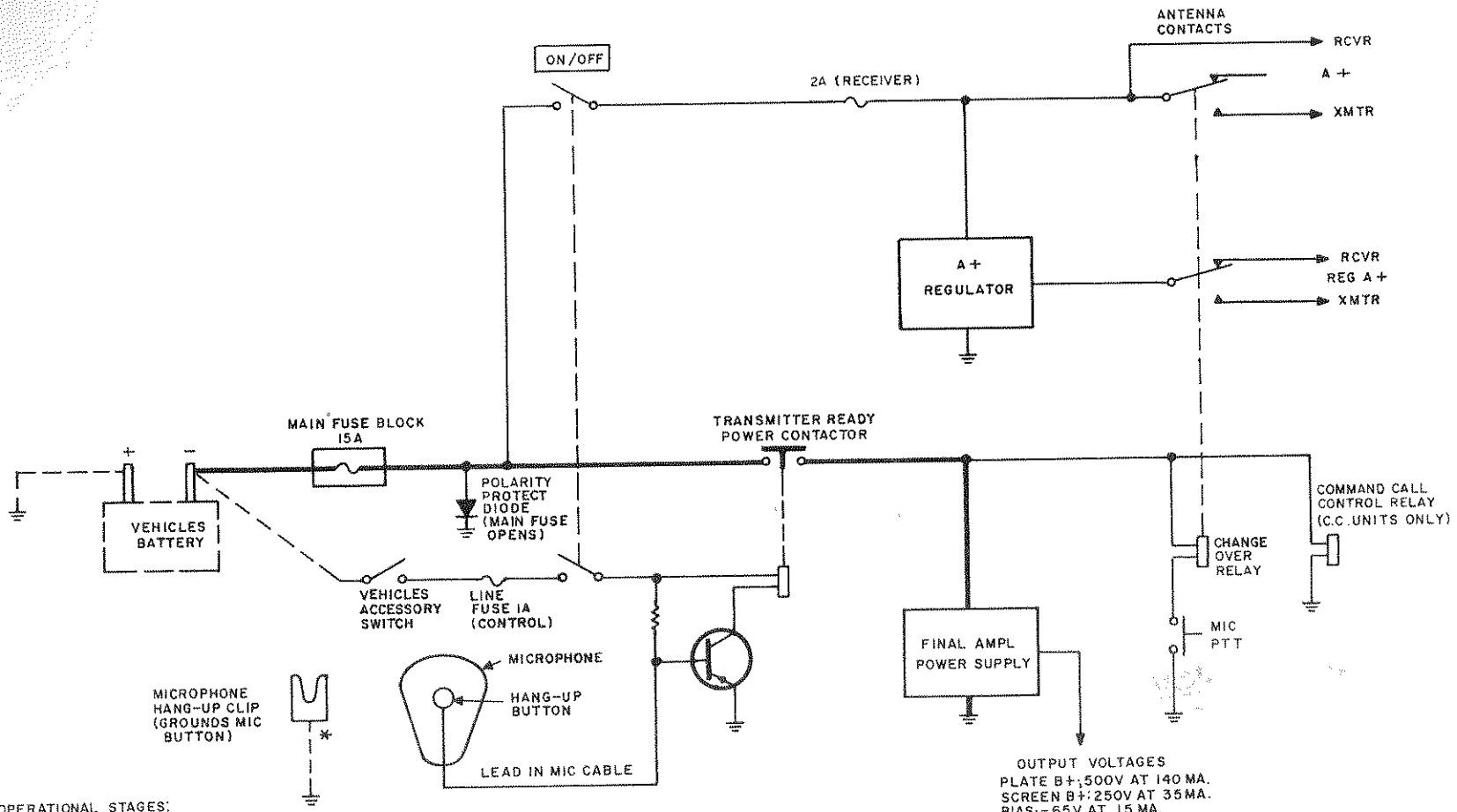
Schematic Symbol	Description	Hallicrafters Part Number
	CAPACITORS	
C401	0.22 µF, 20%, 250V,	047-002141-009
C402,403	1500 PF, 2%, 100V, Mica	506-910152-314
C404,408	470 PF, 2%, 100V, Mica	506-110471-314
C411	50 µF, 20V, Electrolytic	045-001401
C406	9 µF, 15V, Electrolytic	045-001400
C409,410	0.015 µF, 20%, 250V,	047-002141-002
C405,407	15 µF, 20V, Electrolytic	045-001150
	*RESISTORS	
R401	Variable, 50K Ohm, Mod. Set	025-002550
R402	100K Ohm	451-152104
R403,413	39K Ohm	451-152393
R404	820 Ohm	451-152821
R405	27 Ohm	451-152270
R406	560 Ohm	451-152561
R415	6800 Ohm	451-152682
R408,410, 412	1000 Ohm	451-152102
R409,411	1800 Ohm	451-152182
R407	5600 Ohm	451-152562
R414	3300 Ohm	451-152332
R416,418	100 Ohm	451-152101
R417	560 Ohm, 1/2 Watt	451-252561

*All RESISTORS are carbon type, 10%, 1/4 watt unless otherwise stated.

	TRANSISTORS	
Q401	Type 2N414	019-003711
Q402	Type 40233	019-003869
	MISCELLANEOUS	
L401	Choke, AF, 3.0 HY	056-000833
	Printed Circuit Board	129-001145
RT401	Thermistor, 3000 Ohm, 10%	024-001620

C-1701 MAIN FRAME

P502	Plug, 18-pin	010-002695
J502	Socket, 18-pin	010-002694
S201	Switch, Netting	060-002920



OPERATIONAL STAGES:

1-OFF (AS SHOWN) RECEIVER INOPERATIVE, TRANSMITTER INOPERATIVE.
A-ON/OFF SWITCH "OFF."

2-RECEIVER (SQUELCHED OR UNSQUELCHED) RECEIVER FULLY OPERATIVE.
A-ON/OFF SWITCH "ON."

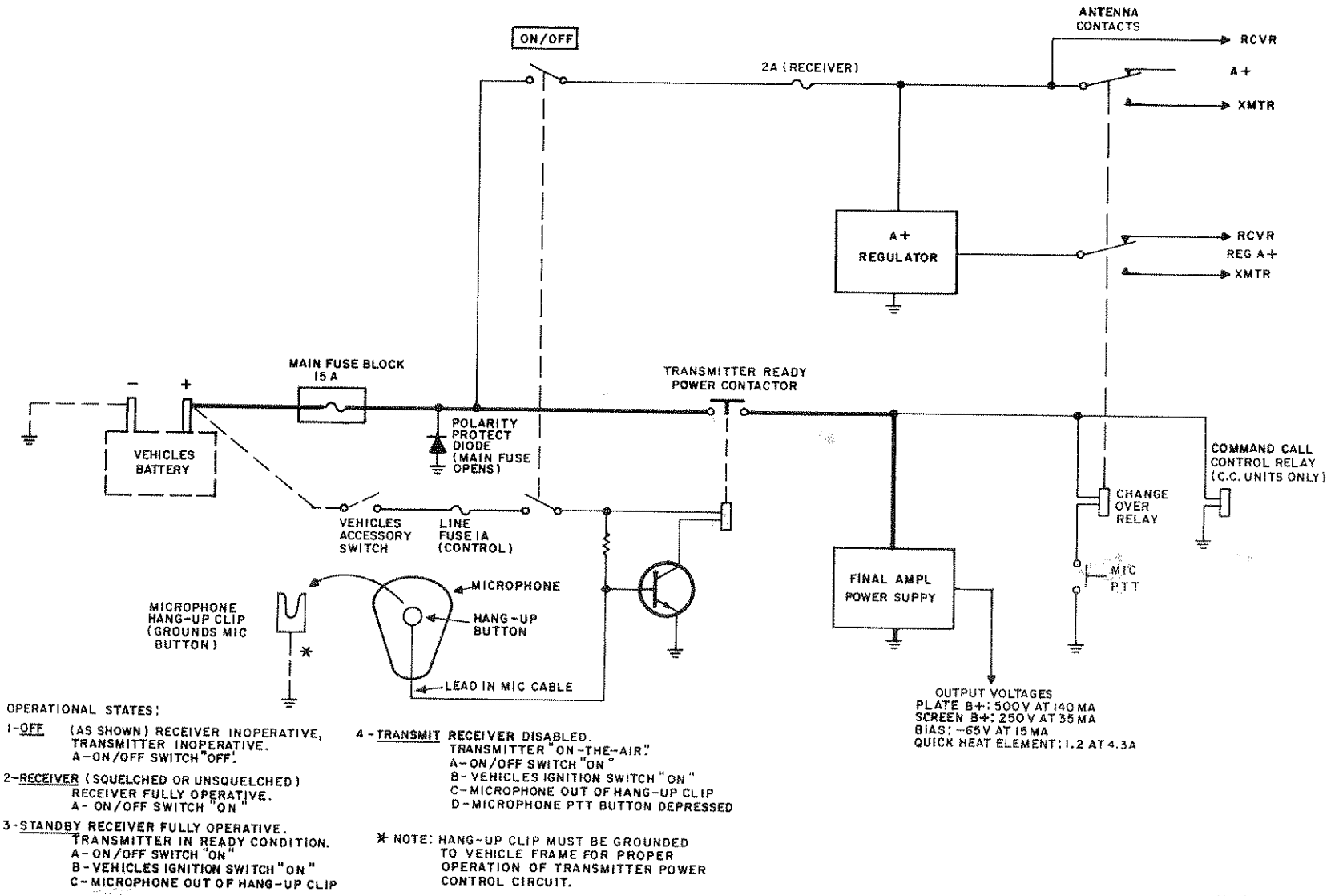
3-STANDBY RECEIVER FULLY OPERATIVE. TRANSMITTER IN READY CONDITION.
A-ON/OFF SWITCH "ON"
B-VEHICLES IGNITION SWITCH "ON"
C-MICROPHONE OUT OF HANG-UP CLIP

4-TRANSMIT RECEIVER DISABLED. TRANSMITTER "ON-THE-AIR".
A-ON/OFF SWITCH "ON"
B-VEHICLES IGNITION SWITCH "ON"
C-MICROPHONE OUT OF HANG-UP CLIP
D-MICROPHONE PTT BUTTON DEPRESSED

* NOTE: HANG-UP CLIP MUST BE GROUNDED TO VEHICLE FRAME FOR PROPER OPERATION OF TRANSMITTER POWER CONTROL CIRCUIT.

156-007898

Simplified Power and Control Circuit, Positive Ground Installation.



OPERATIONAL STATES:

1-OFF (AS SHOWN) RECEIVER INOPERATIVE, TRANSMITTER INOPERATIVE.
A-ON/OFF SWITCH "OFF."

2-RECEIVER (SQUELCHED OR UNSQUELCHED)
RECEIVER FULLY OPERATIVE.
A- ON/OFF SWITCH "ON"

3-STANDBY RECEIVER FULLY OPERATIVE.
TRANSMITTER IN READY CONDITION.
A-ON/OFF SWITCH "ON"
B-VEHICLES IGNITION SWITCH "ON"
C-MICROPHONE OUT OF HANG-UP CLIP

4-TRANSMIT RECEIVER DISABLED.
TRANSMITTER "ON-THE-AIR."
A-ON/OFF SWITCH "ON"
B-VEHICLES IGNITION SWITCH "ON"
C-MICROPHONE OUT OF HANG-UP CLIP
D-MICROPHONE PTT BUTTON DEPRESSED

* NOTE: HANG-UP CLIP MUST BE GROUNDED TO VEHICLE FRAME FOR PROPER OPERATION OF TRANSMITTER POWER CONTROL CIRCUIT.

156-007699

Simplified Power and Control Circuit, Negative Ground Installation.

MODEL C-2102T
MINIATURE CONTROL HEAD

156-008665

DESCRIPTION

Hallicrafters' Model C-2102T Miniature Control Head has been designed for use with mobile two-way industrial radio equipment. This control head contains all the switching and control circuitry necessary for operation of a radio transmitter/receiver. The C-2102T requires the use of a separate speaker, such as the Model C-3401. All connections to the control head are made to an internally mounted 20-pin screw-type terminal strip. Connections are made as shown in the schematic diagram.

CONTROLS AND INDICATORS

The following controls and indicators are located on the front panel of the C-2102T Control Head:

ON/OFF-SQUELCH: In the extreme counterclockwise position (OFF) power is removed from the equipment by breaking contact with the primary power source. As the control is rotated clockwise, power is applied to the equipment. Further clockwise rotation activates the squelch circuitry. The SQUELCH should be set to the point that just quiets the speaker noise under no signal conditions.

VOLUME: The VOLUME control adjusts the level of sound in the speaker and should be set to a point suitable to the operator.

ON-OFF INDICATOR: As soon as power is applied to the equipment, the white lamp becomes illuminated.

TRANSMIT INDICATOR: When the equipment is on, if the push-to-talk switch on the microphone is depressed, the red lamp will illuminate showing that the equipment is in the transmit mode of operation.

ACCESSORIES

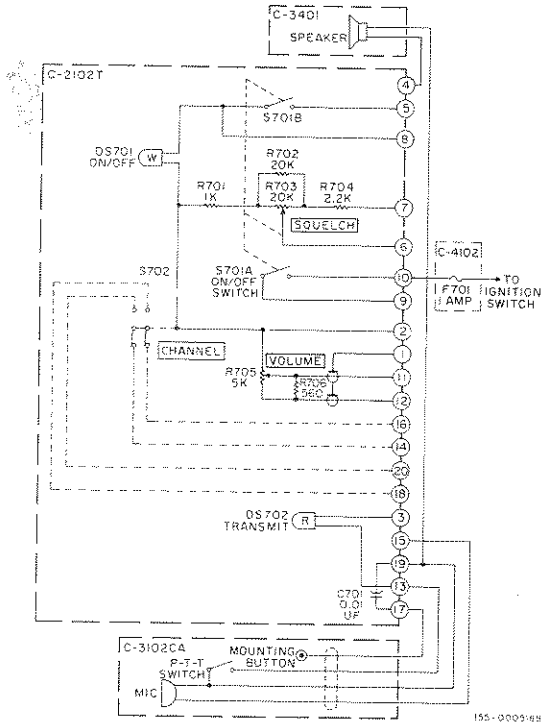
The C-2102T Control Head is so constructed that it can be modified for dual-channel and/or tone controlled squelch operation with a minimum of expended effort.

PARTS LIST

Schematic Symbol	Description	Hallicrafters Part Number
C701	Capacitor, 0.01 μF, +80%, -20%, 100V, Ceramic	047-002211
	Cover	066-004088-001
	Flex Relief, Microphone Cable	016-002381
	Grommet, Rubber	016-100002
	Handle	030-000910-001
	Knob (2)	015-001916-001
DS701	Lamp, Neon (White)	086-000687-001
DS702	Lamp, Neon (Red)	086-000687
	*Microphone, Carbon (C-3201CA)	085-000274
	*Microphone, Transistorized (C-3201TA)	085-000275
	Panel, Front	068-002254
	Panel, Inlay	007-000950
R701	Resistor, 1000 Ohm, 10%, 1/2 Watt	451-252102
R702	Resistor, 20K Ohm, 10%, 1/2 Watt	451-252203
R703	Resistor, Variable, 20K Ohm, SQUELCH	025-002284-001
R704	Resistor, 2200 Ohm, 10%, 1/2 Watt	451-252222
R705	Resistor, Variable, 5K Ohm, VOLUME	025-002729
R706	Resistor, 560 Ohm, 10%, 1/2 Watt	451-252561
S701	Part of R703	

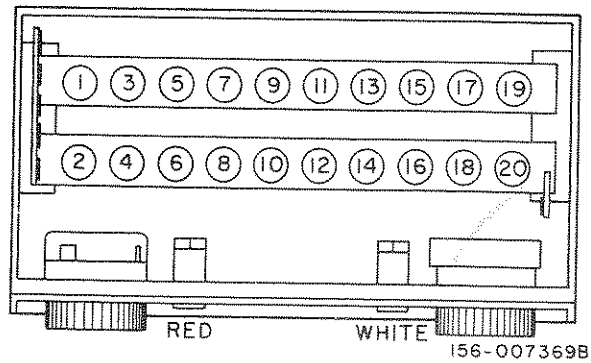
*Any of these microphones and others with appropriate connections may be used with the C-2102T Control Head.

SCHEMATIC DIAGRAM



INTERNAL VIEW

TOP VIEW

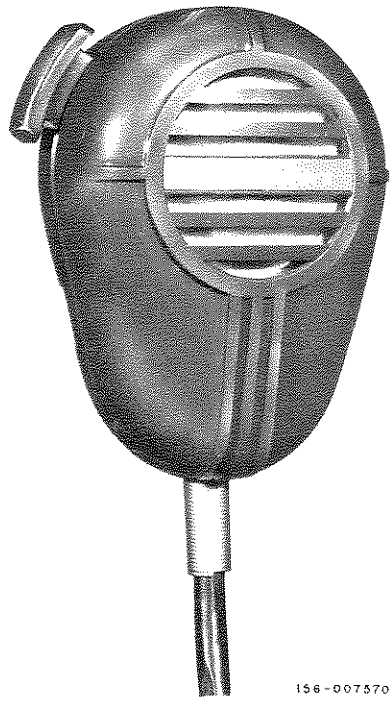


156-007369B

MODEL C-3201TA
MOBILE HAND-HELD
TRANSISTORIZED MICROPHONE

Hallicrafters' Model C-3201TA is a controlled magnetic hand microphone designed for use with two-way industrial radio equipment. This microphone contains a transistor amplifier to increase the output to a higher level and improve speech intelligibility. The microphone is made of charcoal-gray high-impact plastic (cycolac) with a push-to-talk switch on the upper left side. The attached cable can be extended to approximately five feet.

The DC voltage necessary for operation of the transistor amplifier should be supplied by the microphone input circuit of the associated transmitter. This voltage is the same as that required to operate a standard carbon microphone. The Model C-3201TA is directly interchangeable with carbon microphone equipped units.

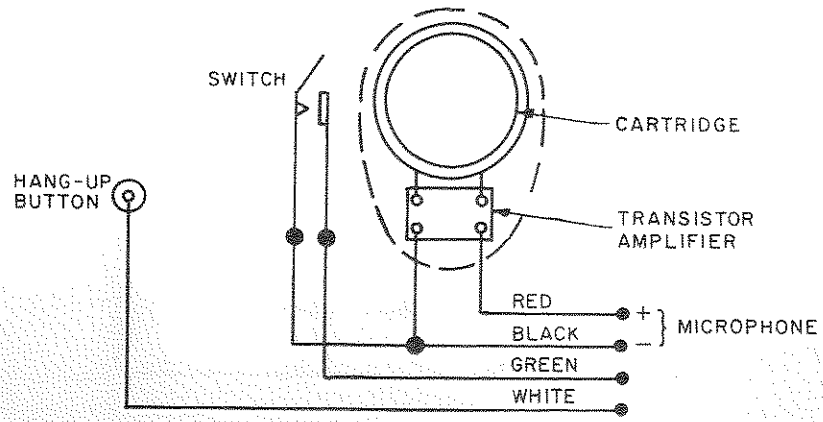


156-007570

IMPORTANT

Be certain of polarity when interconnecting the microphone and its associated transmitter. The red microphone lead must be connected to a positive voltage source not to exceed 24 volts or permanent damage to the transistor will result.

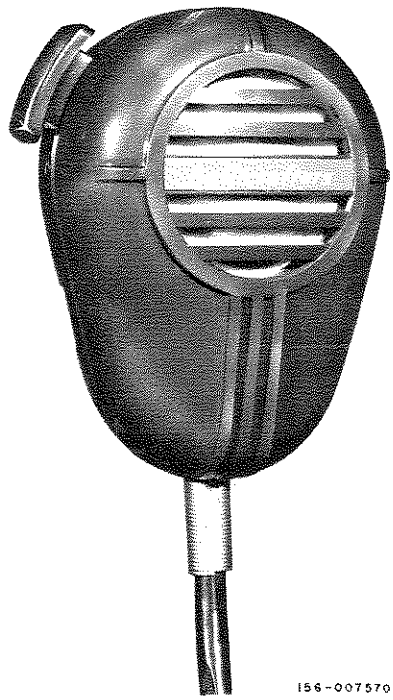
SCHEMATIC DIAGRAM



156-007771

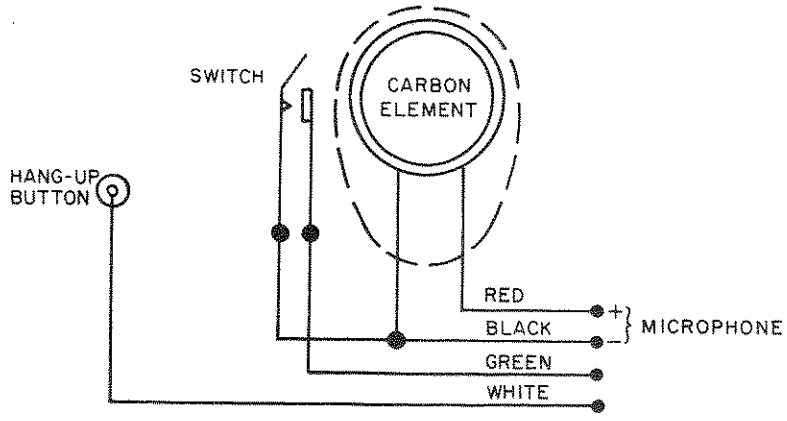
MODEL C-3201CA
MOBILE HAND-HELD
CARBON MICROPHONE

Hallicrafters' Model C-3201CA is a carbon type hand microphone designed for use with two-way industrial radio equipment. The microphone is made of characoal-gray high impact plastic (cycolac) with a push-to-talk switch on the upper left side. The attached cable can be extended to approximately five feet.



156-007570

SCHEMATIC DIAGRAM

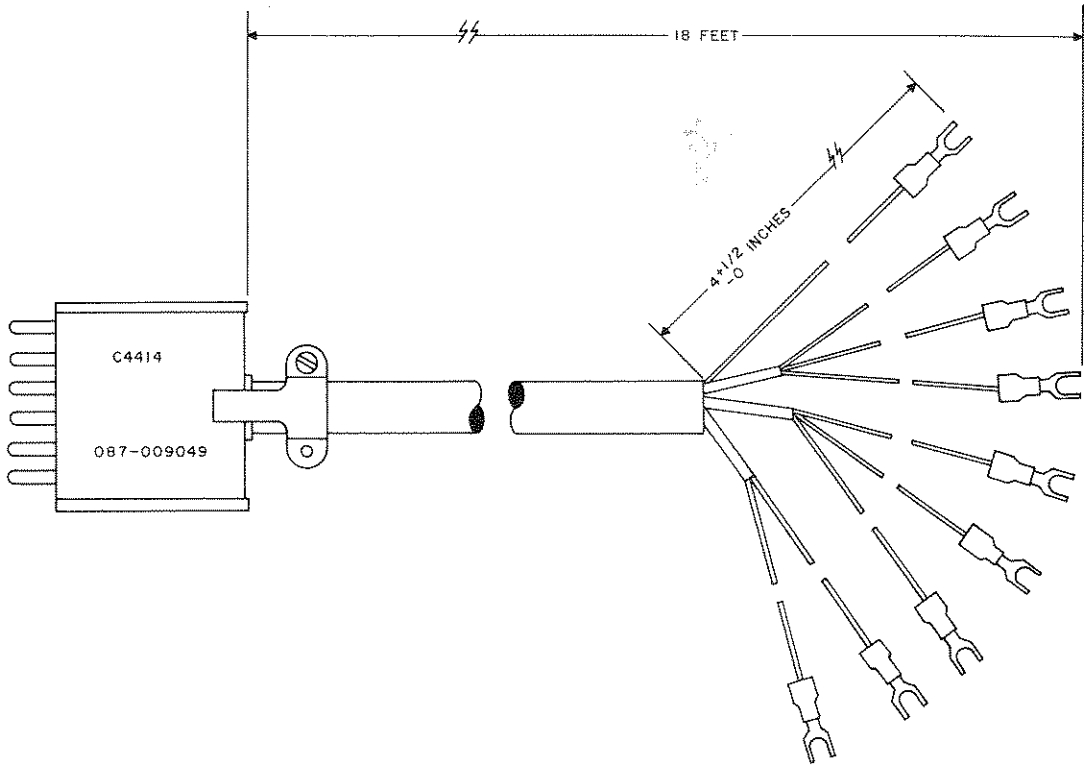


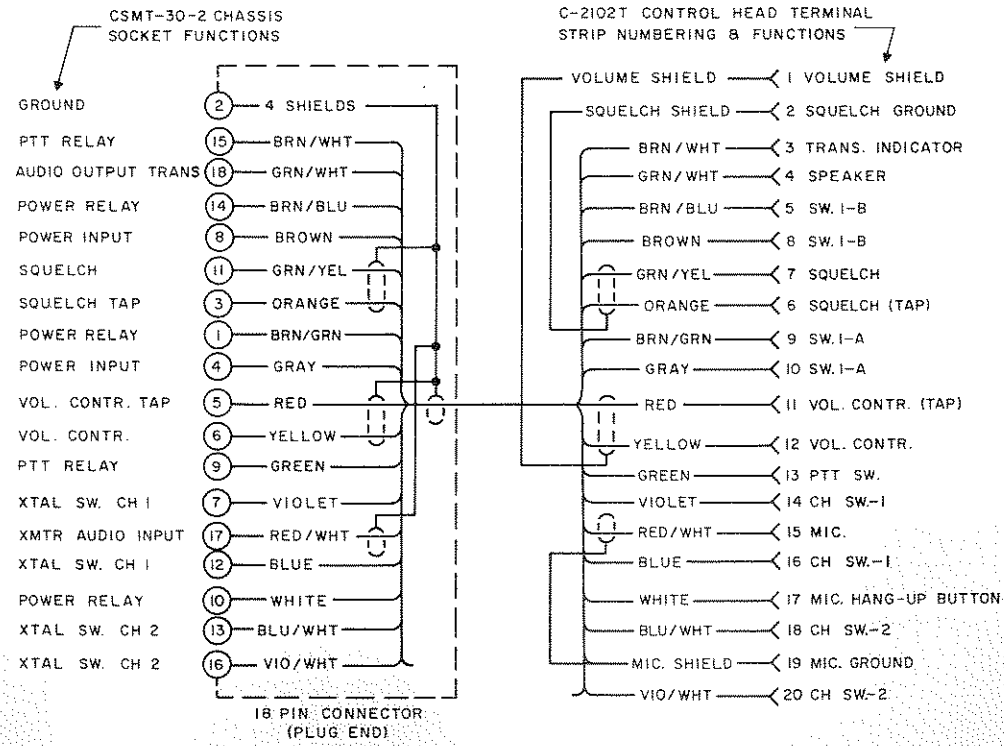
156-007770

MODEL C-4414

18-FOOT CONTROL CABLE ASSEMBLY

(MODEL C-2102T MINIATURE CONTROL HEAD TO TRUNK MOUNTED UNIT)



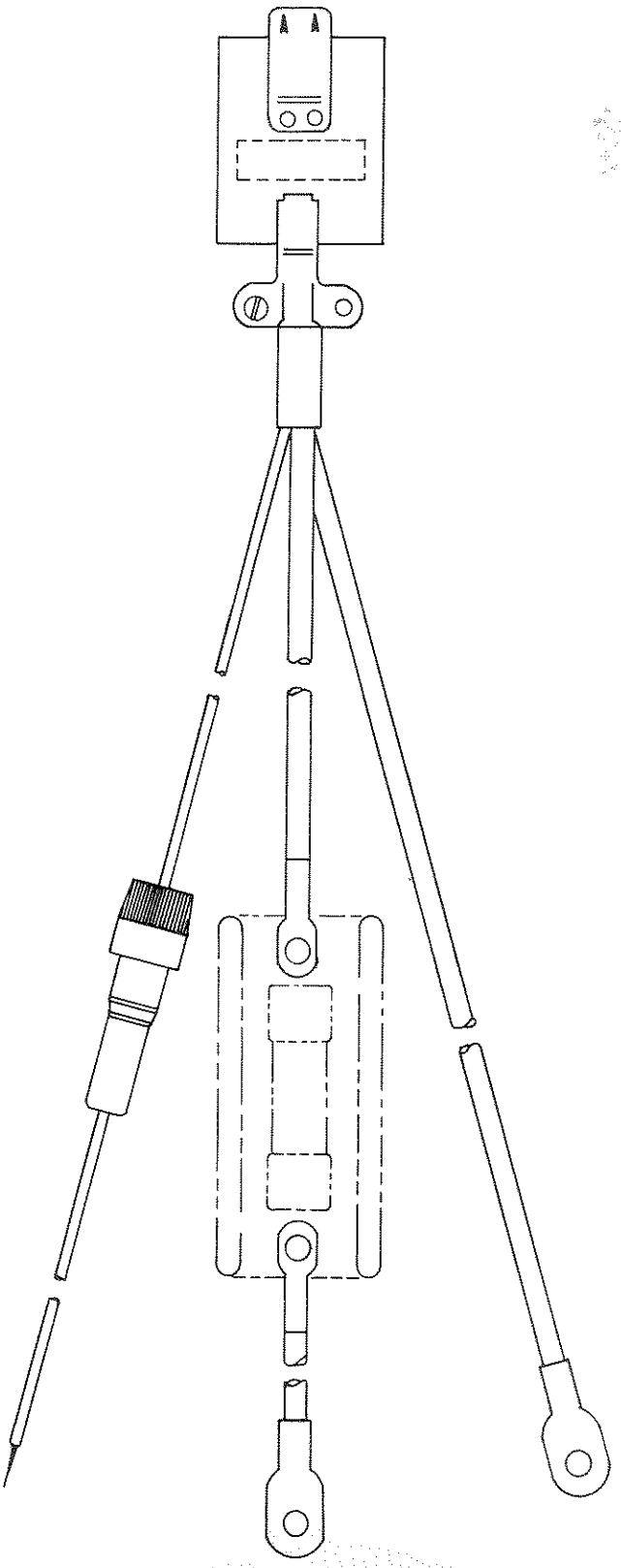


156-007809

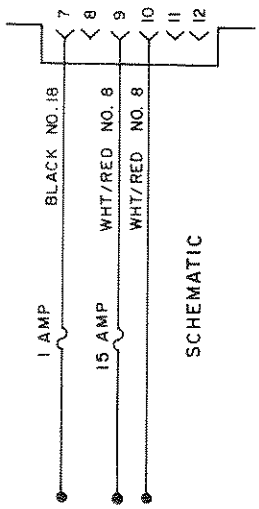
MODEL C-4415

8-FOOT POWER CABLE ASSEMBLY

(MODEL CSMT-30-2 FRONT MOUNT TO BATTERY)



156-007559



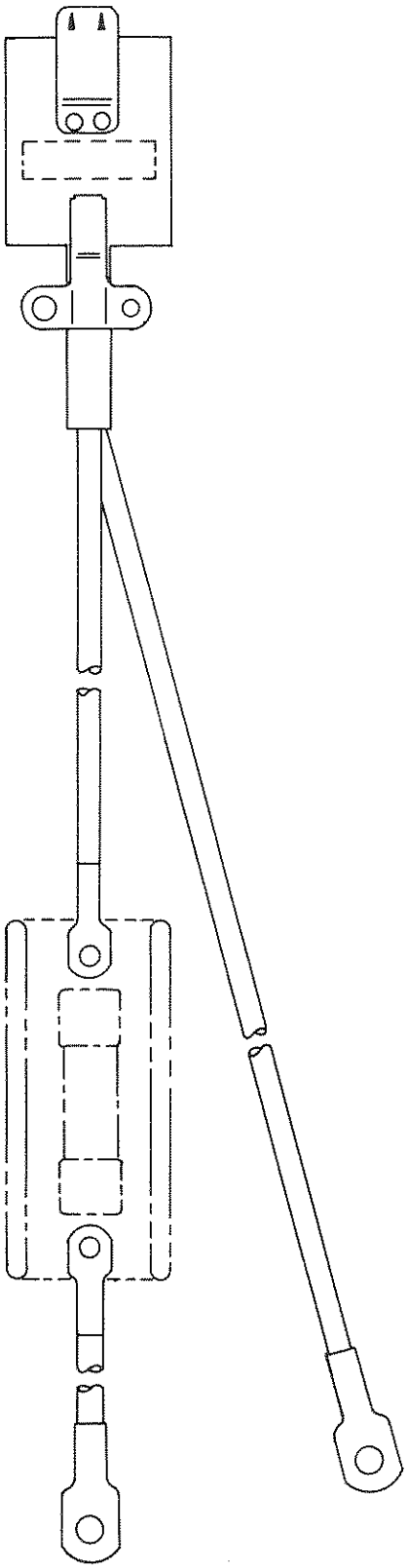
SCHEMATIC

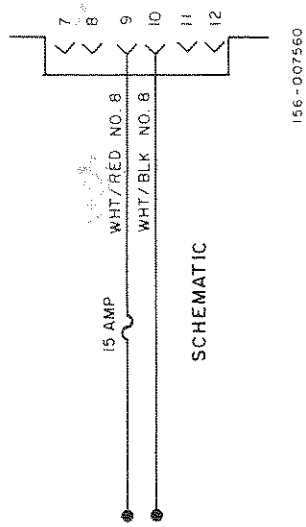
PART NUMBER	GROUND	JUMPER	MARKING
087-009023-001	-(NEG)	9-11 & 10-8	NEG. GND.
087-009023-002	+(POS)	9-8 & 10-11	POS. GND.

MODEL C-4416

18-FOOT POWER CABLE ASSEMBLY

(MODEL CSMT-30-2 TRUNK MOUNT TO BATTERY)





PART NUMBER	GROUND	JUMPER	MARKING
087-009023-001	- (NEG)	9-11 & 10-8	NEG. GND
087-009023-002	+ (POS)	9-8 & 10-11	POS GND