UNCLASSIFIED

TECHNICAL MANUAL

*for*

# SIDEBAND EXCITER
# MODEL CBE-1, 2
# (O-714/UR)


THE TECHNICAL MATERIEL CORPORATION

MAMARONECK, N.Y. OTTAWA, ONTARIO

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Issue Date: 15 June 1961

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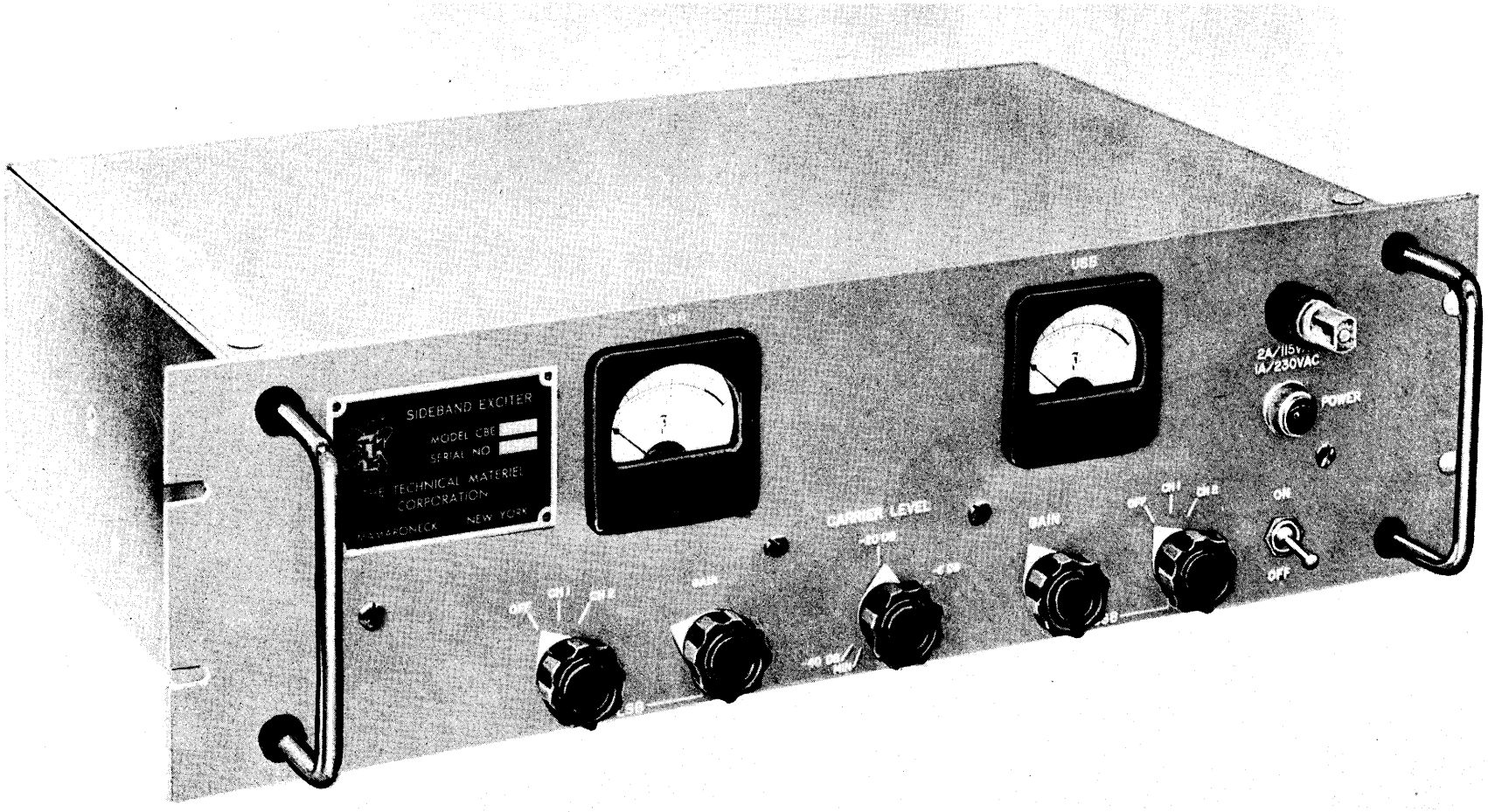



Figure 1-1a. Front Angle View, Sideband Exciter CBE-1

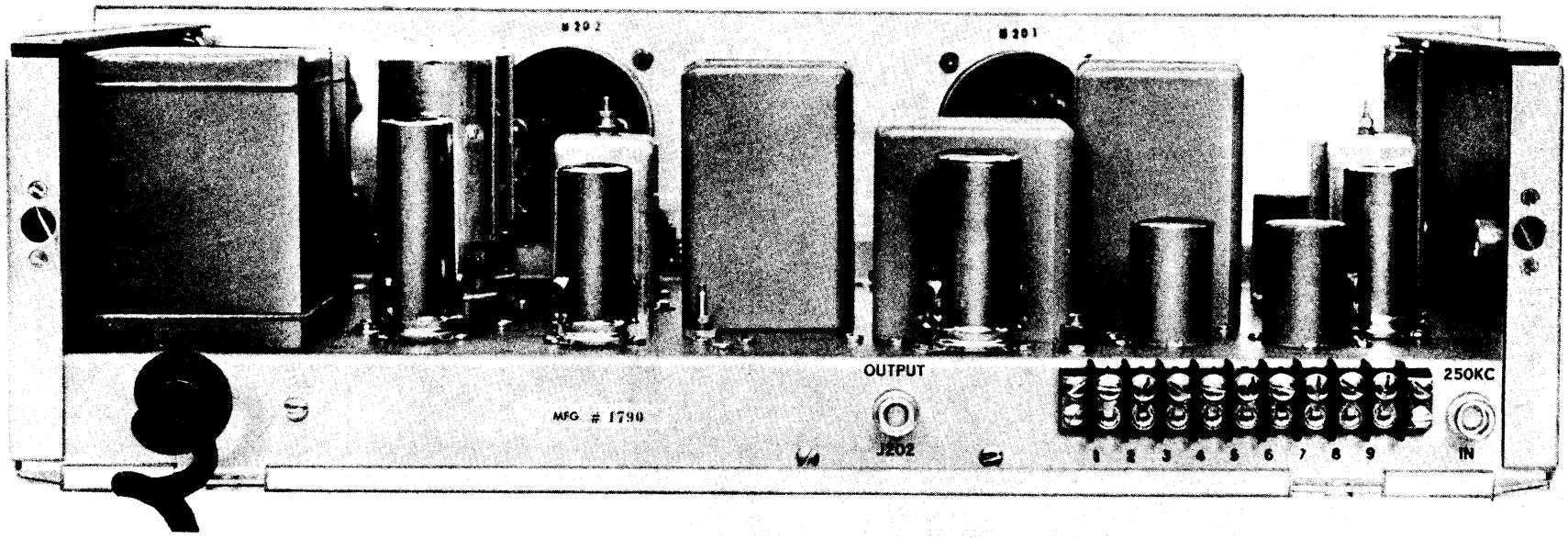



Figure 1-1b. Rear Angle View, Sideband Exciter CBE-1

# SECTION 1
# GENERAL DESCRIPTION

## 1-1. PURPOSE AND BASIC PRINCIPLES.

Technical Materiel Corporation's Sideband Exciter, CBE, is a filter-type, single- or double-sideband generator that receives two audio inputs and translates the audio into sidebands at 250-kc. In conjunction with associated equipment, the CBE can be used to develop, single-, or double-, or independent-sideband transmissions with various degrees of carrier insertion as desired.

Two models of the exciter are available, differing only in width of sideband generated.

| CBE-2 | CBE-1 |
|---|---|
| ±3.5-kc sideband width | ±7.5-kc sideband width |

Commercial and military nomenclature for the CBE is as follows:

| Commercial | Military |
|---|---|
| Sideband Exciter, CBE-1 | Oscillator, Radio Frequency 0-714/UR |
| Sideband Exciter, CBE-2 | Not assigned at date of manual issue |

## 1-2. DESCRIPTION OF UNIT.

The CBE is shown in figure 1-1. The front panel is 3/16-inch thick by 19 inches long and 5-1/8 inches high and is finished in TMC gray enamel. The chassis extends 10-3/4 inches behind the panel and is self supporting. The unit weighs 16-1/4 pounds.

Controls and switches for the operation of the unit are located on the front panel. All vacuum tubes are readily accessible from the rear of the CBE. The unit contains its own power supply. The equipment is manufactured in accordance with JAN/MIL specifications whenever practicable. All parts and assemblies meet or exceed the highest quality standards.

## 1-3. REFERENCE DATA.

The crated dimensions of the CBE are 23 by 24-1/2 by 10 inches. It weighs 54 pounds gross, packed for shipment. Tables 1-1 through 1-4 contain additional reference data pertinent to the CBE.

### TABLE 1-1. ELECTRICAL CHARACTERISTICS

| ITEM | CHARACTERISTICS |
|---|---|
| Audio input: | Two independent 600-ohm channels, balanced or unbalanced, -20-db level for full RF output. |
| Audio response per sideband: | CBE-1: Within 3-db from 350 to 7500 cps.<br>CBE-2: Within 3-db from 250 to 3500 cps. |
| Carrier insertion: | Continuously adjustable in all operating modes. |
| Carrier input requirements: | 250 kc with stability of 1-PPM for 24-hr. period and amplitude of 1.0-volt constant to within ± 10%. |
| Carrier suppression: | At least 55-db down from PEP. |

## TABLE 1-1. ELECTRICAL CHARACTERISTICS (Cont.)

| ITEM | CHARACTERISTICS |
|---|---|
| Connections: | Audio input-terminal block<br>250-kc input-BNC<br>RF output-BNC |
| Frequency range: | CBE-1: 242.5- to 257.5-kc<br>CBE-2: 246.5- to 253.5-kc |
| Input power: | 115- or 230-volts, 50- or 60-cps, single-phase, 30-watt average consumption. |
| Metering: | Peak reading VTVM's indicate relative sideband power levels for USB and LSB before final power amplifier stage. |
| Non-harmonic spurious output: | At least 60-db below PEP output. |
| Operating modes: | Single sideband<br>Double sideband<br>Independent sideband (separate intelligence on each sideband) |
| Output impedance: | 70-ohms, nominal |
| Output power: | Continuously adjustable from zero to a max. of 10-milliwatts (PEP). |
| Rejection of unused sideband: | 500-cps tone 60-db below transmitter PEP |
| Single sideband width (with suppressed carrier) | CBE-1: 7.2-kc @ 3-db points<br>CBE-2: 3.3-kc @ 3-db points |

## TABLE 1-2. FRONT PANEL CONTROLS

| CONTROL | FUNCTIONS |
|---|---|
| CARRIER LEVEL (MIN -40DB -20DB -6DB 0DB) potentiometer | Controls level of carrier insertion. The extreme MIN position switches off the carrier. |
| LSB and USB meters | Indicate relative power levels in lower and upper sidebands. |
| LSB (GAIN) potentiometer | Adjusts level of LSB audio input. |
| LSB (OFF CH 1 CH 2) selector switch | Selector audio input source for lower sideband channel. |
| ON-OFF switch | ON-Applies line voltage to CBE.<br>OFF-Turns off entire CBE. |
| POWER FUSE indicator | Glows to indicate that fuse is blown. |
| POWER indicator | Glows during operation. Indicates power is applied. |
| USB (GAIN) potentiometer | Adjusts level of USB audio input. |
| USB (OFF CH 1 CH 2) selector switch | Selects audio input source for upper sideband channel. |

## TABLE 1-3. CHASSIS ADJUSTMENTS

| ADJUSTMENT | REFERENCE DESIGNATION | FUNCTION |
|---|---|---|
| Carrier balance, LSB | C233 | Balances out 250-kc in LSB output. |
| Carrier balance, LSB | R244 | Balances out 250-kc in LSB output. |
| Carrier balance, USB | C216 | Balances out 250-kc in USB output. |
| Carrier balance, USB | R213 | Balances out 250-kc in USB output. |
| Carrier insert | R236 | Coarse control of 250-kc insertion. |
| Meter adjustment, USB | R216 | Calibrates M201 (db scale). |
| Combining network | R237 | Balances USB and LSB output levels. |
| Transformer tuning | T203 | Tunes USB modulator output to 250-kc. |
| Transformer tuning | T206 | Tunes LSB modulator output to 250-kc. |

## TABLE 1-4. VACUUM TUBE COMPLEMENT

| SYMBOL | TYPE | FUNCTION |
|---|---|---|
| V201 | 6X4 | Rectifier |
| V202 | OA2 | Voltage regulator |
| V203 | 6C4 | USB audio amplifier |
| V204 | 6C4 | USB RF amplifier |
| V205 | 12AT7 | USB meter amplifier |
| V206 | 12AU7 | Power amplifier |
| V207 | 6C4 | LSB audio amplifier |
| V208 | 6C4 | LSB RF amplifier |
| V209 | 12AT7 | LSB meter amplifier |

# SECTION 2
# INSTALLATION

## 2-1. INITIAL INSPECTION.

Each CBE has been calibrated and tested at the factory before shipment. Upon arrival at the operating site, inspect the packing case and its contents immediately for possible damage. Unpack the equipment carefully. Inspect all packing material for parts which may have been shipped as "loose items". Although the carrier is liable for any damage to the equipment, Technical Materiel Corporation will assist in describing and providing for repair or replacement of damaged items.

The equipment is shipped with all tubes and other plug-in components installed. Check that all such components are properly seated in their sockets.

## 2-2. 115- VS. 230-VOLT POWER SUPPLY CONNECTIONS.

CBE's power supply is designed for 115- or 230-volt, 50- or 60-cps, single-phase power; it is factory-wired for 115 volts. If 230-volt operation is required, minor wiring changes to CBE's power supply section are necessary. These are shown in figure 2-1. The 2-amp fuse should be replaced with a 1-amp fuse for 230-volt operation.

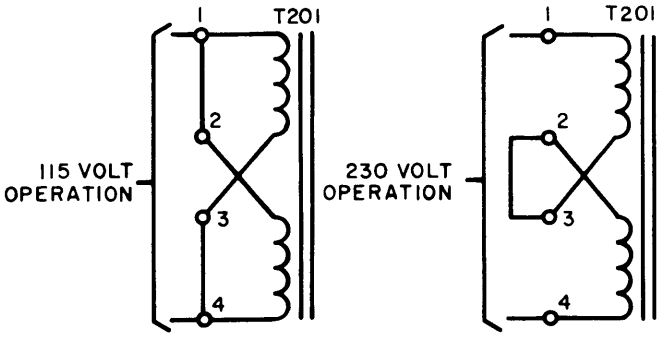



Figure 2-1. Installation Diagram Showing 115- Vs. 230-Volt Power Supply Connections

## 2-3. INSTALLATION PROCEDURE.

**NOTE**

Do not reset any of the chassis screwdriver adjustments listed in Table 1-3. These were correctly set and locked in position during calibration of the CBE prior to shipment.

a. Install the CBE unit in a standard 19-inch relay rack or other housing as desired. Figure 2-2 is an outline dimensional drawing of this unit.

b. Set ON-OFF toggle switch S201, on front panel, to OFF.

c. Connect plug P201 on power cable leading out of back of unit to an AC source.

d. Connect OUTPUT jack J202 of the CBE to the input of the associated frequency amplifier unit. Use the cable specified in the TMC technical manual for the TMC exciter frame rack. This cable is part of the rack wiring harness. If the CBE is not used in this equipment, a 50-ohm coaxial cable with type BNC fittings will be required.

e. Connect 250 KC IN jack J201 of the CBE to the 250-kc source provided in the associated equipment of the TMC exciter rack. Use the cable specified in the TMC exciter rack technical manual. This cable is part of the rack wiring harness. If the CBE is not used in this equipment, a 50-ohm coaxial cable with type BNC fittings will be required.

f. Connect audio input to the CBE by connecting leads from the audio source provided in the associated equipment of the TMC exciter rack. Use leads and connections specified in the TMC exciter rack technical manual. These leads and connections are part of the rack wiring harness. If the CBE is not used in this equipment, refer to figure 2-3 to determine connections for any audio source with a 2-channel audio output of 600-ohm impedance.

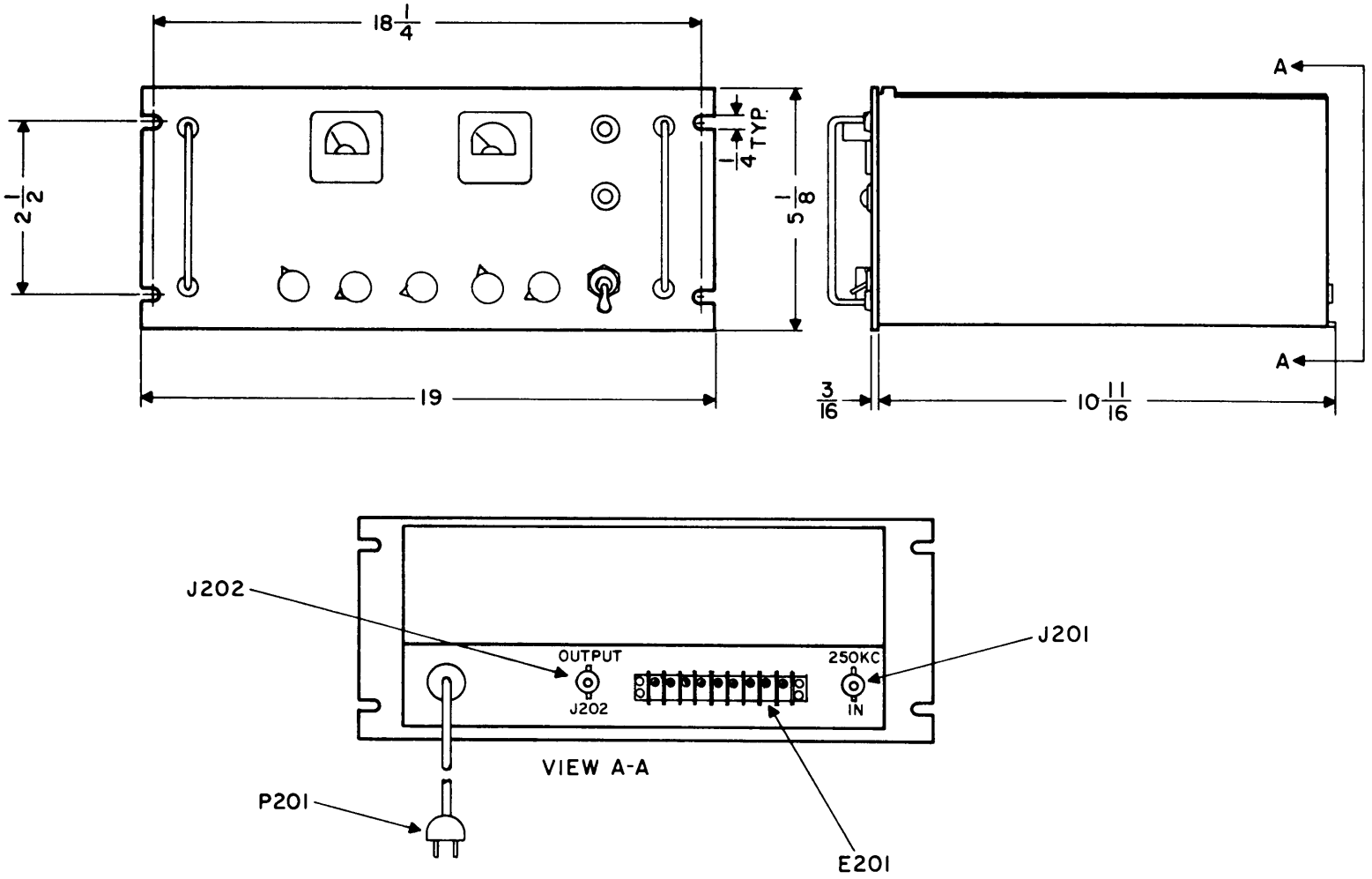



Figure 2-2. Outline Dimensional Drawing, CBE-1, -2

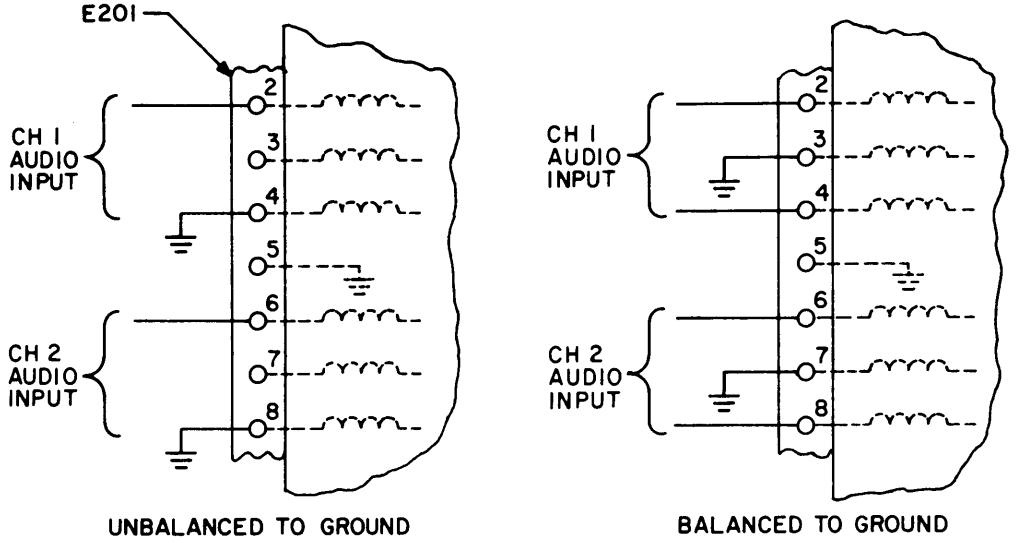



Figure 2-3. Connection Diagram-Audio Input

# SECTION 3
# OPERATOR'S SECTION

## 3-1. PRELIMINARY CONSIDERATIONS.

Do not operate the CBE until desired operating conditions are determined. These are:

a. Mode of transmission desired.

b. CBE input circuit control

c. CBE sideband power level

d. Degree of 250-kc carrier insertion desired from CBE.

There are four modes of transmission available. These are:

a. 250-kc output (used for pretuning successive stages of associated transmitting equipment).

b. Single sideband (with any degree of carrier insertion).

c. Double sideband (with any degree of carrier insertion).

d. Independent sideband (with any degree of carrier insertion).

CBE input circuit controls are as follows:

a. USB-OFF, CH1, CH2

b. LSB-OFF, CH1, CH2

USB-OFF, CH1, CH2 places audio channel 1 or 2 in the upper sideband position; LSB-OFF, CH1, CH2 places audio channel 1 or 2 in the lower sideband position.

CBE sideband power level controls are as follows:

a. USB GAIN

b. USB meter

c. LSB GAIN

d. LSB meter

USB and LSB GAIN knobs control the amplitude of CBE upper and lower sidebands respectively. USB and LSB meters indicate relative power levels of upper and lower sidebands before carrier re-insertion and power amplification in the CBE. Magnitude of the sideband(s) in the final stage of transmission may be determined by use of a frequency spectrum analyzer connected across the output of the associated transmitting equipment.

Degree of 250-kc carrier insertion desired from CBE is controlled by the CARRIER LEVEL (MIN -40DB -20DB -6DB -0DB) control on the front panel. Magnitude of the carrier relative to the sideband(s) in the final stage of transmission may be determined by use of a frequency spectrum analyzer connected across the output of the associated transmitting equipment. The extreme MIN position switches the carrier off.

## 3-2. OPERATOR'S INSTRUCTIONS.

Table 3-1 provides equivalent control designations for the operating controls shown in figure 3-1 and the component designations of figure 8-1. Use table 3-1 and figure 3-1 while employing tables 3-2 through 3-5 as operating charts for the CBE.

a. TUNE-UP ON 250-KC OUTPUT. Operate CBE as outlined in table 3-2. Requires 250-kc source connected to the CBE at J201 at rear of chassis.)

b. TUNE-UP ON SINGLE SIDEBAND WITH ANY DEGREE OF CARRIER INSERTION. Operate CBE as outlined in table 3-3.

c. TUNE-UP ON DOUBLE SIDEBAND WITH ANY DEGREE OF CARRIER INSERTION. Operate CBE as outlined in table 3-4. For convenience, it is assumed that channel 1 is used on both upper and lower sidebands with either 0- or 10-percent carrier insertion. If channel 2 is used on both upper and lower sidebands with either 0- or 10-percent carrier insertion, substitute CH2 for CH1 and vice versa in the settings of USB (OFF CH1 CH2) and LSB (OFF CH1 CH2) controls.

d. TUNE-UP ON INDEPENDENT SIDEBAND WITH ANY DEGREE OF CARRIER INSERTION. Operate CBE as outlined in table 3-5. For convenience, it is assumed that channel 1 is used on the lower sideband and channel 2 is used on the upper sideband with either 0- or 10-percent carrier insertion. If channel 1 is used on the upper sideband and channel 2 is used on the lower sideband with either 0- or 10-percent carrier insertion, substitute CH2 for CH1 and vice versa in the settings of USB (OFF CH1 CH2) and LSB (OFF CH1 CH2) controls.

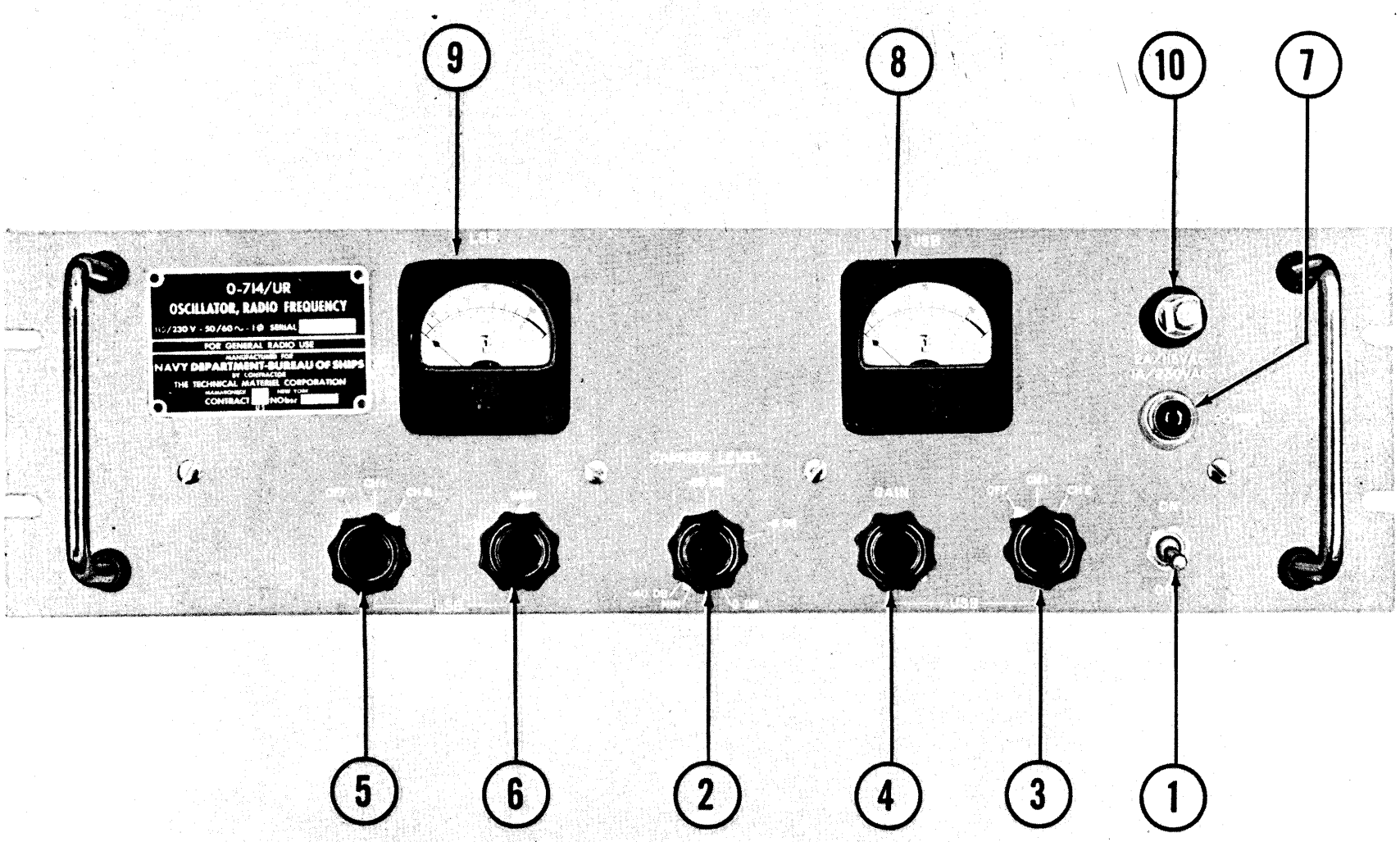



Figure 3-1. Panel View of CBE-1 Showing Operating Controls

## TABLE 3-1. TABLE OF EQUIVALENT CONTROL DESIGNATIONS

| SERIAL DESIGNATION (SEE FIGURE 3-1) | PANEL DESIGNATION (SEE FIGURE 3-1) | COMPONENT DESIGNATION ON OVERALL SCHEMATIC DIAGRAM |
|---|---|---|
| 1 | ON-OFF | Toggle switch S201 |
| 2 | CARRIER LEVEL (MIN -40DB -20DB -6DB -0DB) | Knob potentiometer R207 and included switch S204 |
| 3 | USB (OFF CH1 CH2) | Knob (3-position) selector switch S202 |
| 4 | USB (GAIN) | Knob potentiometer R219 |
| 5 | LSB (OFF CH1 CH2) | Knob (3-position) selector switch S203 |
| 6 | LSB (GAIN) | Knob potentiometer R222 |
| 7 | POWER | Indicator I201 |
| 8 | USB | Meter M201 |
| 9 | LSB | Meter M202 |
| 10 | 2A/115 VAC 1A/230 VAC | Fuseholder XF201 |

## TABLE 3-2. TUNE-UP ON 250-KC OUTPUT

| STEP | PANEL SERIAL DESIGNATION | OPERATION | PURPOSE |
|---|---|---|---|
| 1 | 1 | Turn power switch to ON. | Energizes unit. |
| 2 | 3, 5 | Turn USB (OFF CH1 CH2) and LSB switches to OFF. | Cuts off audio input. |
| 3 | 2 | Turn CARRIER LEVEL control to 0DB. | Provides full-level 250-kc output. |

## TABLE 3-3. TUNE-UP ON SSB WITH ANY DEGREE OF CARRIER INSERTION

| STEP | PANEL SERIAL DESIGNATION | OPERATION | PURPOSE |
|---|---|---|---|
| 1 | 1 | Turn power switch to ON | Energizes unit. Indicator 7 lights. |
| 2 | 2 | Turn CARRIER LEVEL to extreme MIN position | Shuts off carrier. |
| 3* | 3, 4 | Set USB (OFF CH1 CH2) switch to CH1 or CH2. Set USB (GAIN) control to mid-position. | Places audio channel in upper sideband. |
| 4* | 5, 6 | Set LSB (OFF CH1 CH2) switch to CH1 or CH2. Set LSB (GAIN) control to mid-position. | Places audio channel in lower sideband. |
| 5 | 4 or 6 | Advance or decrease appropriate GAIN control until corresponding meter 8 or 9 shows desired sideband level ** | Adjusts upper or lower sideband gain to desired level. |
| 6 | 2 | Turn CARRIER LEVEL control to desired value for carrier re-insertion. ** | Re-inserts 250-kc carrier into CBE output. |
| 7 | 2 | If no carrier is to be transmitted, turn CARRIER LEVEL control to extreme MIN position. | Shuts off 250-kc carrier. |

* Perform either step 3 or 4.

** To be determined by operational procedure set up for complete transmitting system.

## TABLE 3-4. TUNE-UP ON DSB WITH ANY DEGREE OF CARRIER INSERTION

| STEP | PANEL SERIAL DESIGNATION | OPERATION | PURPOSE |
|---|---|---|---|
| 1 | 1 | Turn power switch to ON | Energizes unit. Indicator 7 lights. |
| 2 | 2 | Turn CARRIER LEVEL control to extreme MIN position. | Shuts off carrier. |
| 3 | 3, 4 | Set USB (OFF CH1 CH2) switch to CH1; set USB (GAIN) to quarter-scale. | Places audio channel 1 in upper sideband. |

## TABLE 3-4. TUNE-UP ON DSB WITH ANY DEGREE OF CARRIER INSERTION (C nt.)

| STEP | PANEL SERIAL DESIGNATION | OPERATION | PURPOSE |
|---|---|---|---|
| 4 | 5, 6 | Set LSB (OFF CH1 CH2) switch to OFF; set LSB (GAIN) to quarter-scale. | Cuts off audio channel in lower sideband. |
| 5 | 4, 8 | Adjust USB (GAIN) control until USB meter shows the following readings on audio peaks:<br><br>Carrier Insertion Eventually Wanted — Audio Peaks<br>0 — 50%<br>10% (20-db) — 45% | Obtains desired audio channel level in upper sideband with or without 10% carrier insertion. |
| 6 | 3 | Set USB (OFF CH1 CH2) switch to OFF | Cuts off audio channel 1 in upper sideband. |
| 7 | 5, 6 | Set LSB (OFF CH1 CH2) switch to CH1. | Places audio channel 1 in lower sideband. |
| 8 | 2 | Leave CARRIER LEVEL control on MIN. | Keeps carrier off. |
| 9 | 6, 9 | Adjust LSB (GAIN) until LSB meter shows the following readings on audio peaks:<br><br>Carrier Insertion Eventually Wanted — Audio Peaks<br>0 — 50%<br>10% (-20-db) — 45% | Obtains desired audio channel level in lower sideband with or without 10% carrier insertion. |
| 10 | 3 | Set USB (OFF CH1 CH2) switch to CH1 | Replaces audio channel 1 in upper sideband. |
| 11 | 4, 6, 8, 9 | Adjust USB (GAIN) and LSB (GAIN) controls until USB and LSB meters read equally | Equalizes gain in upper and lower sidebands. |
| 12 | 2 | Turn CARRIER LEVEL control to desired value for carrier re-insertion. * | Re-inserts 250-kc carrier into CBE output. |
| 13 | 2 | If no carrier is to be transmitted, leave CARRIER LEVEL control in extreme MIN position. | Shuts off 250-kc carrier. |

* To be determined by operational procedure set up for complete transmitting system.

## TABLE 3-5. TUNE-UP ON ISB WITH ANY DEGREE OF CARRIER INSERTION

| STEP | PANEL SERIAL DESIGNATION | OPERATION | PURPOSE |
|---|---|---|---|
| 1 | 1 | Turn power switch to ON. | Energizes unit. Indicator 7 lights. |
| 2 | 2 | Turn CARRIER LEVEL control to extreme MIN position. | Shuts off carrier. |
| 3 | 5, 6 | Set LSB (OFF CH1 CH2) switch to CH1. Set LSB (GAIN) to quarter-scale. | Places audio channel 1 in lower sideband. |
| 4 | 3, 4 | Set USB (OFF CH1 CH2) switch to OFF. Set USB (GAIN) to quarter-scale. | Cuts off audio channel in upper sideband. |
| 5 | 6, 9 | Adjust LSB (GAIN) control until LSB meter shows the following readings on audio peaks:<br>Carrier Insertion Eventually Wanted — Audio Peaks<br>0 — 50%<br>10% (-20-db) — 45% | Obtains desired audio channel level in lower sideband with or without 10% carrier insertion. |
| 6 | 5 | Set LSB (OFF CH1 CH2) switch to OFF. | Cuts off audio channel 1 in lower sideband. |
| 7 | 3, 4 | Set USB (OFF CH1 CH2) switch to CH2. | Places audio channel 2 in upper sideband. |
| 8 | 2 | Leave CARRIER LEVEL control on MIN. | Keeps carrier off |
| 9 | 4, 8 | Adjust USB (GAIN) until the USB meter shows the following readings on audio peaks:<br>Carrier Insertion Eventually Wanted — Audio Peaks<br>0 — 50%<br>10% (20-db) — 45% | Obtains desired audio channel level in upper sideband with or without 10% carrier insertion. |
| 10 | 5 | Set LSB (OFF CH1 CH2) switch to CH1. | Replaces audio channel 1 in lower sideband. |
| 11 | 4, 6, 8, 9 | Adjust USB (GAIN) and LSB (GAIN) controls until USB and LSB meters read equally. | To equalize gain in upper and lower sidebands. |
| 12 | 2 | Turn CARRIER LEVEL control to desired value for carrier re-insertion. * | Re-inserts 250-kc carrier into CBE output. |
| 13 | 2 | If no carrier is to be transmitted, leave CARRIER LEVEL control in extreme MIN position. | Shuts off 250-kc carrier. |

* To be determined by operational procedure set up for complete transmitting system.

## 3-3. OPERATOR'S MAINTENANCE.

The operator should note general condition of panel switches, observe whether the panel indicator lamp lights, and check the condition of the fuse as well as that of all the tubes. The fuse and a power indicator lamp are located on the front panel of the CBE. The locations of all tubes in the CBE are indicated by the tube location diagram of figure 5-1.

If the POWER lamp (control 7 on figure 3-1) fails to light or all the tube filaments fail to glow when the power ON-OFF switch (control 1 on figure 3-1) is in the ON position, check POWER lamp I201 (control 7 on figure 3-1) and F201 fuse. F201 fuse is in series with the primary of the AC power supply transformer and is a "quick-acting" type for protecting the unit from overload due to shorts in the CBE or shorts or maladjustment in the associated equipment. I201 POWER lamp is installed across the AC power supply for the electron tube filaments.

**CAUTION**

Do not replace the fuse with one of higher rating. If a fuse burns out immediately after replacement, do not replace it a second time until the trouble has been located and corrected.

If, while the majority of tube filaments glow, any tube filament fails to glow, remove questionable tube and test it with a reliable tube tester. Reinstall tube shields after testing or replacing tubes.

# SECTION 4
# PRINCIPLES OF OPERATION

## 4-1. INTRODUCTION.

As shown in figure 4-1, the CBE has four principal sections. These are:

a. Audio input section

b. 250-kc input and balanced modulator section

c. Meter section

d. Power supply section

a. The audio input section has two identical channels. Each channel has an input transformer and an audio-frequency amplifier. Function switches S202 and S203 route the incoming intelligence to the desired channels. A signal from channel 1 may be routed to either V203 or V207 or to both V203 and V207; the same is true of a channel-2 signal. If desired, a signal received from channel 1 may be routed to V203 while a signal from channel-2 is independently routed to V207. The audio output is applied to the balanced modulators.

b. The 250-kc input and balanced modulator section modulates the audio section output, placing the intelligence in the 250-kc upper and/or lower sideband frequency regions (250 ± 7. 5-kc for CBE-1 and 250 ± 3. 5-kc for CBE-2).

**NOTE**

Frequency inversion is avoided when the CBE is operated in conjunction with TMC's sideband transmitting equipment. This is accomplished by arranging filter Z203 in the LSB circuit to pass USB frequencies, and filter Z201 in the USB circuit to pass LSB frequencies. The operator should not consider this technicality and should operate according to panel markings. The maintenance technician should consider this technicality. All USB and LSB references in this manual reflect CBE panel markings.

The output of "USB" filter Z201 consists of a small amount of 250-kc carrier and signals in the 250-7. 5 kc (CBE-1) or 250-3. 5 kc (CBE-2) frequency range; the output of "LSB" filter Z203 consists of a small amount of 250-kc carrier and signals in the 250 + 7. 5 kc (CBE-1) or 250 + 3. 5 kc (CBE-2) frequency range. Notch filter Z202 removes the 250-kc carrier in these two sidebands. The output of power amplifier V206 contains the USB and LSB signals with 250-kc carrier reinsertion. The amount of carrier reinsertion is determined by the setting of CARRIER LEVEL (MIN -40DB -20DB -6DB 0DB) potentiometer R207. Including 250-kc carrier, the signal bandwidth at this point is 15-kc (CBE-1) or 7-kc (CBE-2) in DSB operation; signal bandwidth is 7. 5-kc (CBE-1) or 3. 5-kc (CBE-2) in SSB or ISB operation. Without carrier, single sideband width is 7. 2-kc and 3. 3-kc, respectively, for CBE-1 and CBE-2.

c. The M201 and M202 sections indicate USB and LSB power levels, respectively.

d. The power supply section provides 6. 3-volt AC filament and regulated +130-, +140-, and +50-DC plate voltages.

## 4-2. AUDIO INPUT SECTION.

Figure 4-2 is a schematic diagram of the audio input section. Two 600-ohm audio input channels can be connected to terminal board E201. Input channel 1 connects to terminals 2, 3 and 4; input channel 2 connects to terminals 6, 7 and 8. Terminals 3 and 7 are grounded for 600-ohm balanced systems; terminals 4 and 8 are grounded for unbalanced systems. Approximately -20-db of 1000-cps is required at each channel input for full output of the CBE. Step-up transformers T207 and T208 couple the audio input to the audio amplifier stages.

The output of these transformers are fed to sideband selector switches S202 (USB) and S203 (LSB). The audio (channel 1 or channel 2) then goes to R219, USB (GAIN), and R222, LSB (GAIN), controls. This adjusted audio is amplified by audio amplifiers V203 and V207. Outputs of the amplifiers are coupled through transformers T202 and T205 to the balanced modulator section.

## 4-3. 250-KC AND BALANCED MODULATOR SECTION.

Figure 4-3 is a schematic diagram of the 250-kc input and balanced modulator section. CR202 and CR203 are bridge-type diode modulators. The audio signals are applied to the modulation circuit through T202 and T205. A stable, amplitude-regulated 250-kc frequency is introduced into the modulation circuit at the center arms of carrier balance potentiometers R213 and R244. These resistors equalize the injection voltage to CR202 and CR203. When this is achieved, the tuned outputs of T203 and T206 consist largely of both 250-kc + audio and 250-kc-audio. The 250-kc carrier is almost completely balanced out by the proper adjustment of carrier balance R213, R244, potentiometers and capacitors C216 and C233. Upper and lower sidebands are passed by Z201 and Z203 (see note in paragraph 4-1.) Notch filter Z202, with

considerable loss in the immediate region of 250-kc, will pass the upper and/or lower sidebands but will sharply attenuate the 250-kc carrier residue from the balanced modulators. On the other hand, the 250-kc modulated audio signals experience relatively small losses. The proportion of one sideband to the other in the output is equalized by the chassis-mounted combining network potentiometer R237. Two-stage power amplifier V206 amplifies the sideband frequencies that pass through Z202 and feeds the amplified signals to output jack J202.

A portion of the 250-kc carrier at 250-kc input jack J201 can be reinserted into the output at pin 2 of power amplifier V206. The amount of carrier reinserted is determined by carrier insert potentiometer, R236, mounted on the chassis, and by CARRIER LEVEL (MIN -40DB -20DB -6DB 0DB) control R207, mounted on the front panel. Carrier insert potentiometer, R236, the larger of the two potentiometers, provides coarse control of the amount of carrier reinserted. It is adjusted so that with CARRIER LEVEL (MIN -40DB -20DB -6DB 0DB) control R207 set at maximum, enough carrier is reinserted to produce a full output (0DB) reading on the associated transmitting equipment. When CARRIER LEVEL (MIN -40DB -20DB -6DB 0DB) control R207 is set a MIN, it closes switch S204. The switch grounds the arm of R207, reducing the carrier level to zero.

## 4-4. METER SECTION.

Figure 4-4 is a simplified schematic diagram of the meter section. The outputs of Z201 and Z203 are sampled by meter amplifiers V205 and V209. Outputs of these amplifiers are connected to CR201 and CR204 respectively where incoming peaks are rectified and coupled to bridge-type VTVM's, M201 and M202. The meters are peak reading. For example, they would read 0.7 mv on a continuous sine wave of 1-mv peak or on a series of short pulses of 1-mv peak.

## 4-5. POWER SUPPLY SECTION.

Figure 4-5 is a simplified schematic diagram of the power supply section. The power supply is a conventional electronic type supplying 6.3-volt AC filament and regulated +130-, +140-, and +50-DC plate voltages. For 230-volt operation the leads are removed from terminals 2 and 3 of the primary windings of T201 and both primary windings connected in series.

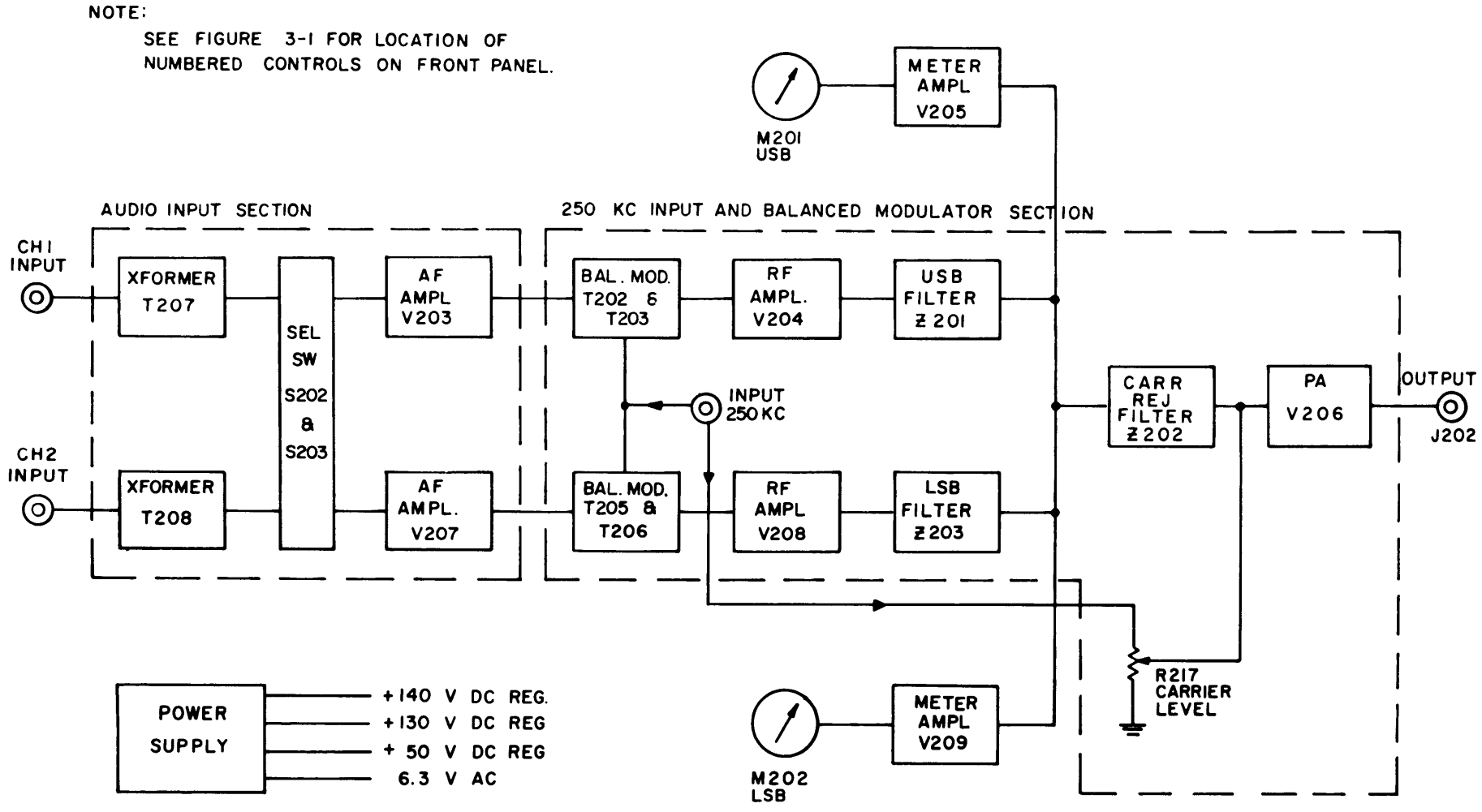



Figure 4-1. Block Diagram, CBE Sideband Exciter

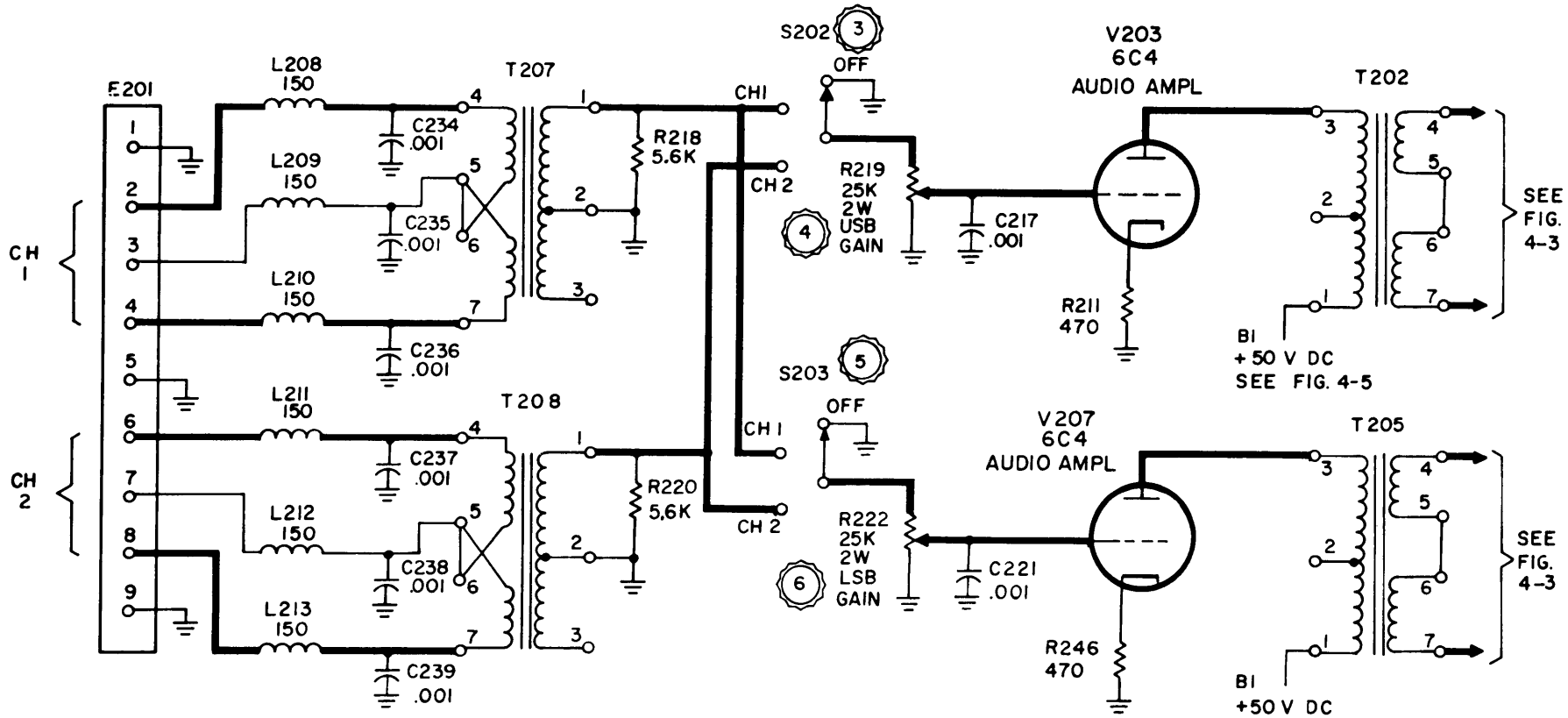



Figure 4-2. Simplified Schematic Diagram, Audio Input Section

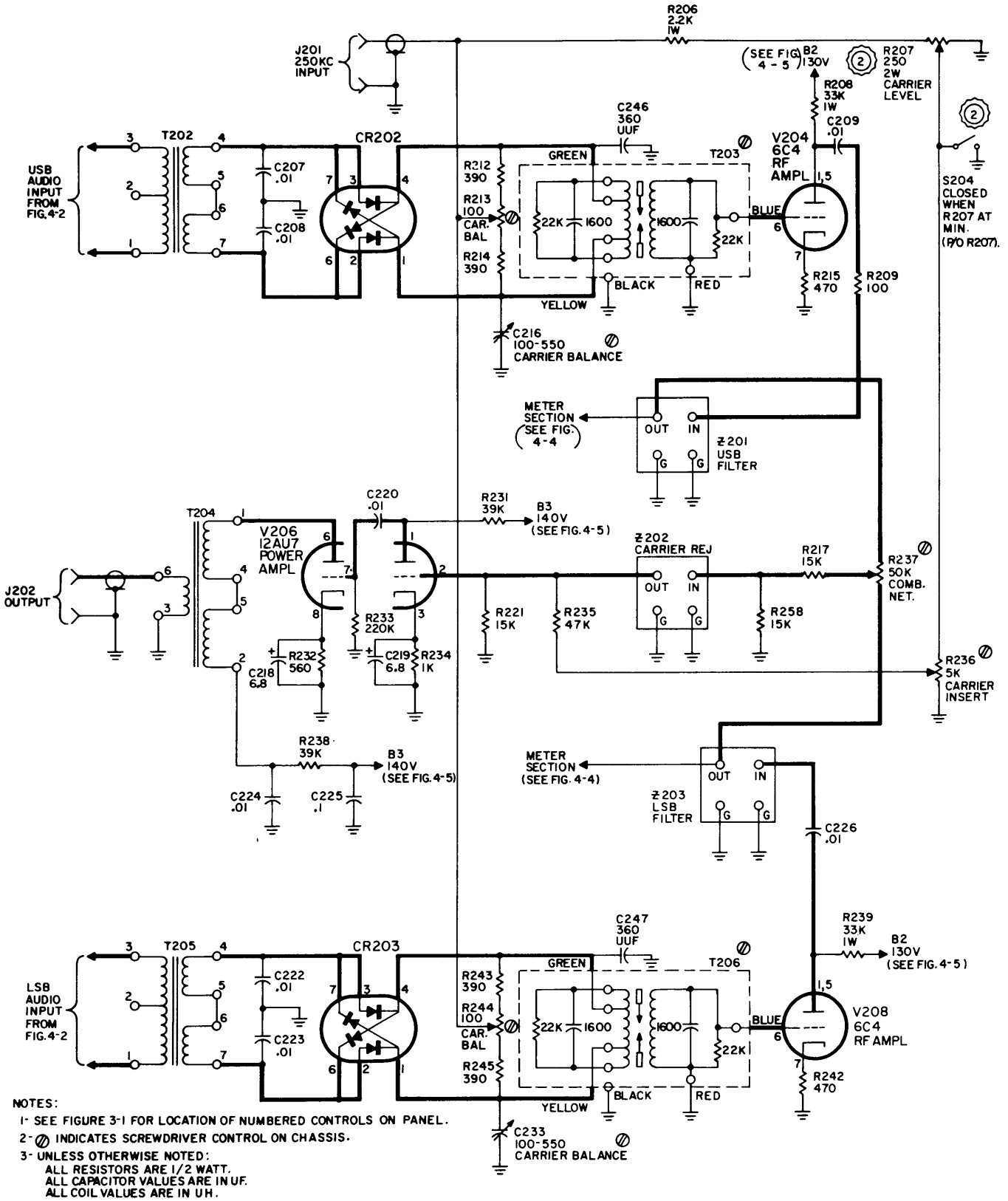



Figure 4-3. Simplified Schematic Diagram 250-Kc Input And Balanced Modulator Section

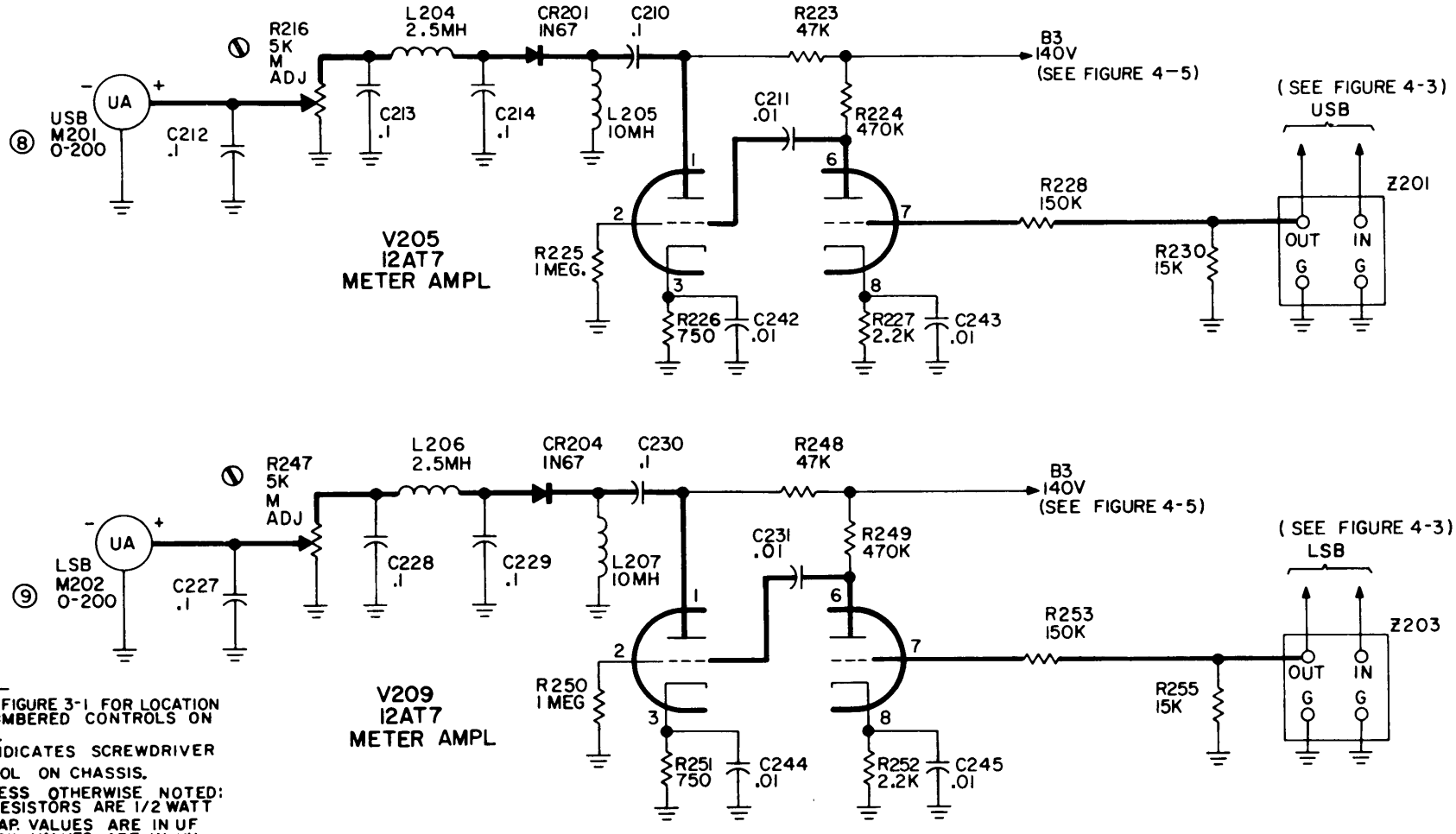



Figure 4-4. Schematic Diagram, Meter Section

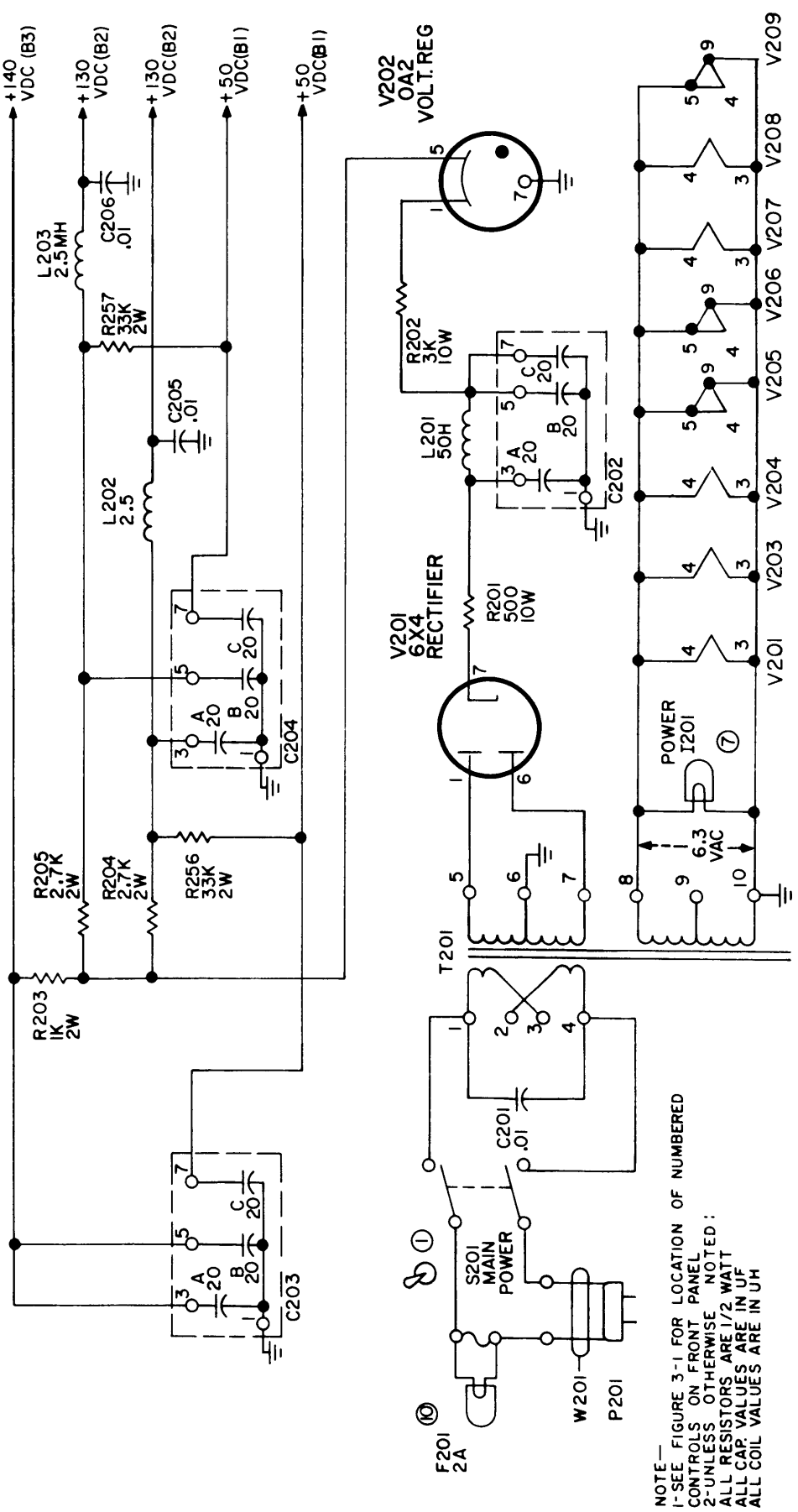



Figure 4-5. Schematic Diagram, Power Supply Section

# SECTION 5
# TROUBLE-SHOOTING

## 5-1. INTRODUCTION.

This section explains how to locate and diagnose equipment troubles and maladjustments. The information necessary to remedy the troubles and maladjustments will be found in Section 6 of this manual under the heading "Maintenance".

The following aids to troubleshooting are provided:

a. Schematic diagram.

b. Voltage and resistance diagram.

c. Parts location data.

d. Troubleshooting techniques.

e. Troubleshooting chart, based on operating procedures.

f. Troubleshooting procedures based on circuit sectionalization.

## 5-2. TROUBLE-SHOOTING TECHNIQUES.

a. GENERAL CONSIDERATIONS. When a piece of equipment has been working satisfactorily and suddenly fails, the cause of failure may be apparent either because of circumstances occurring at the time of failure or because of symptoms analogous to past failures. In this case, it is unnecessary to follow a lengthy and orderly course of troubleshooting in order to localize and isolate the faulty part.

A second short cut in troubleshooting is to ascertain that all tubes and fuses are in proper working order; also that the equipment receives proper supply voltages. This may eliminate further investigation.

A third short cut is to examine the equipment section by section, for burned out elements, charring, corrosion, arcing, excessive heat, dirt, dampness, etc.

Component defects may be internally or externally caused.

b. TROUBLESHOOTING CHARTS BASED ON OPERATING PROCEDURES. The general purpose of these charts is to narrow the area of trouble to one or more sections of the equipment in order to minimize the labor of locating the source of trouble. These charts present a prescribed order "to turn on" the equipment, indicate what to expect as each step is taken, and give clues as to possible "areas of troubles".

c. TABLE OF VOLTAGE AND RESISTANCE. This table gives nominal values of voltage-to-frame and resistance-to-frame, generally at tube elements and sometimes at connectors and terminal board elements. Large deviations from the nominal values should be carefully investigated. During this process, accurate schematic diagrams and location data are essential. A schematic diagram of the CBE is found in Section 8.

d. TROUBLESHOOTING PROCEDURES BASED ON CIRCUIT SECTIONALIZATION. Equipment usually consists of a number of subassemblies or sections. It is frequently helpful to treat these subassemblies or sections as independent entities. In so doing, however, they must be properly powered. Observations may then be made with VTVM's, CRO's, or other test equipment at selected points under given types and magnitudes of injection voltages. Again, the subassemblies or sections may be examined for rated performance, according to specification, for the presence of extraneous grounds, for opens, or unusual voltages.

## 5-3. SIDEBAND EXCITER UNIT CBE-1 AND CBE-2.

a. VOLTAGE AND RESISTANCE DIAGRAM. Figure 5-1 shows voltage-and resistance-to-chassis measurements at tube pins in the CBE.

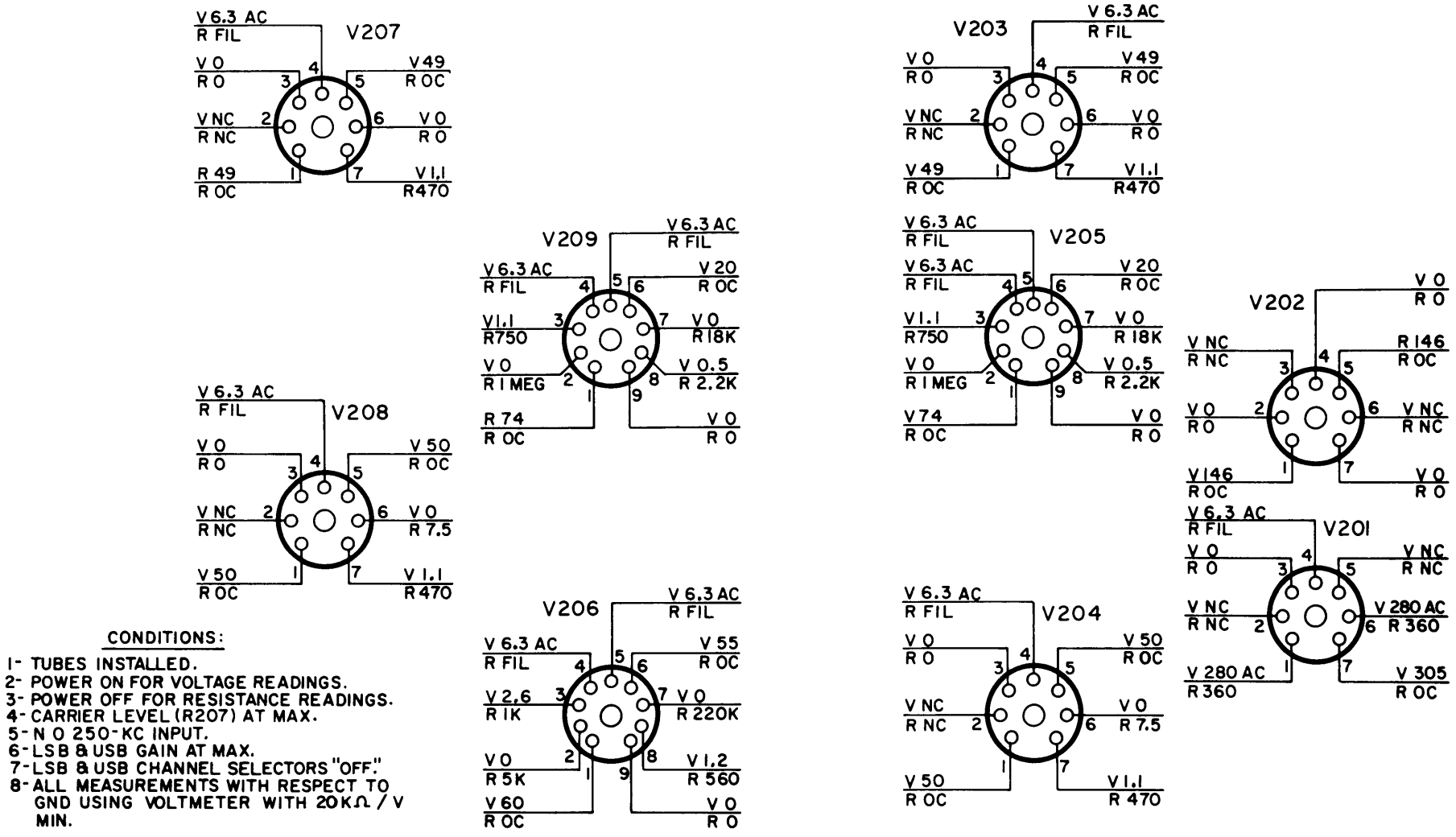
b. LOCATION DATA. Figures 5-2 and 5-3 locate the major electronic components of the CBE by reference designation.

c. TROUBLE-SHOOTING CHART BASED ON OPERATING PROCEDURES. See Figure 3-1 for interpretation of control designation. Refer to table 5-1. Remedies recommended in this table are made under the assumption that associated equipment is functioning correctly.

d. TROUBLE-SHOOTING PROCEDURES BASED ON CIRCUIT SECTIONALIZATION. The following paragraphs present selected factory checkout performance data of the CBE unit.

(1) POWER SUPPLY SECTION. The CBE has fuse protection for the primary winding of its power transformer. If the fuse holder lamp goes on or the POWER lamp fails to go on when the power switch is ON position, check fuse. See figure 5-1 and check the voltages at tube pins with a reliable 20,000 ohms-per volt meter.

(2) AUDIO INPUT SECTION. With power switch ON, USB (OFF CH1 CH2) switch at CH1, LSB (OFF CH1 CH2) switch at OFF, USB (GAIN) at minimum




CONDITIONS:

1- TUBES INSTALLED.
2- POWER ON FOR VOLTAGE READINGS.
3- POWER OFF FOR RESISTANCE READINGS.
4- CARRIER LEVEL (R207) AT MAX.
5- N O 250-KC INPUT.
6- LSB & USB GAIN AT MAX.
7- LSB & USB CHANNEL SELECTORS "OFF."
8- ALL MEASUREMENTS WITH RESPECT TO GND USING VOLTMETER WITH 20KΩ / V MIN.

Figure 5-1. Voltage and Resistance Diagram

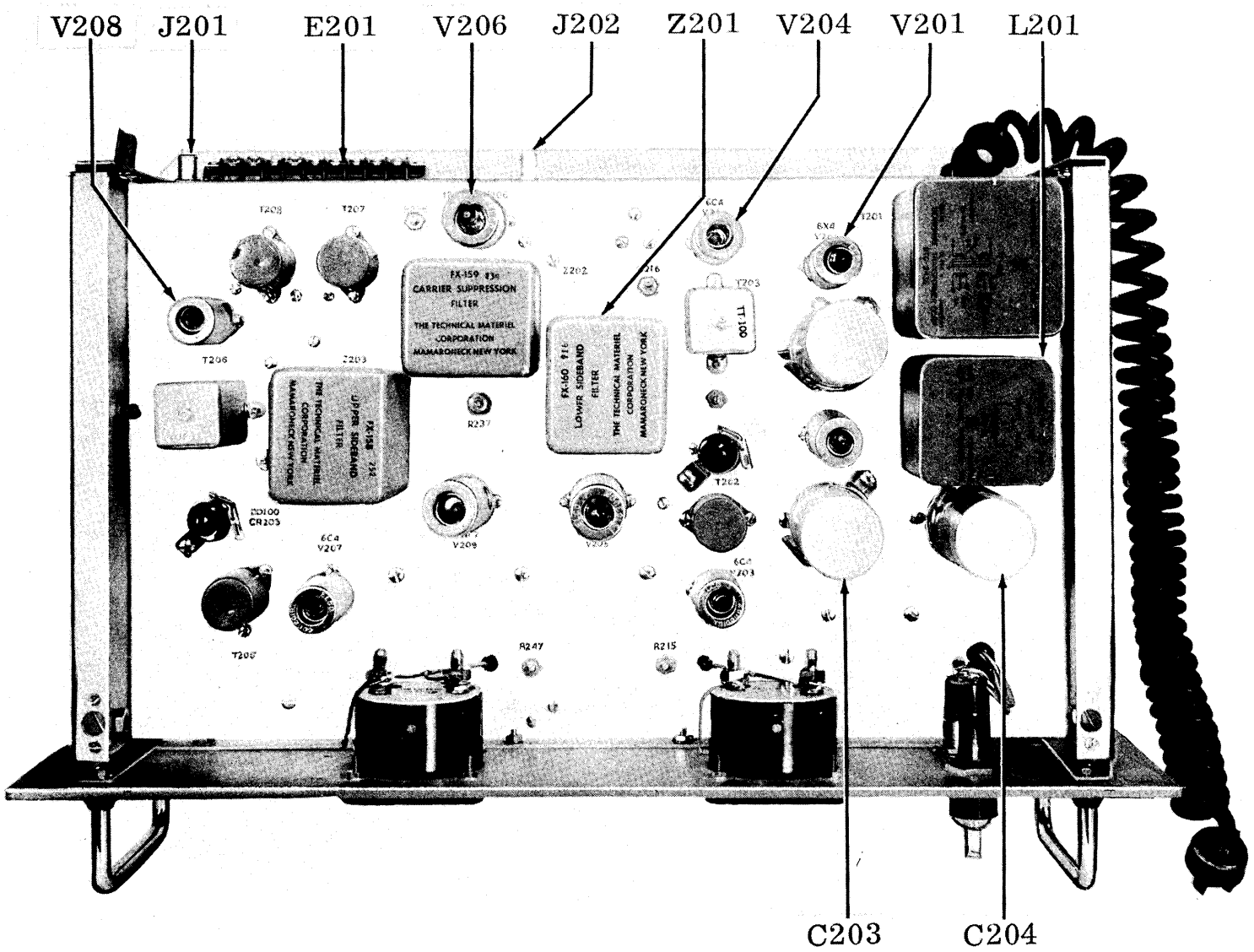



Figure 5-2. Location Diagram of Major Electronic Equipment Components, Top View

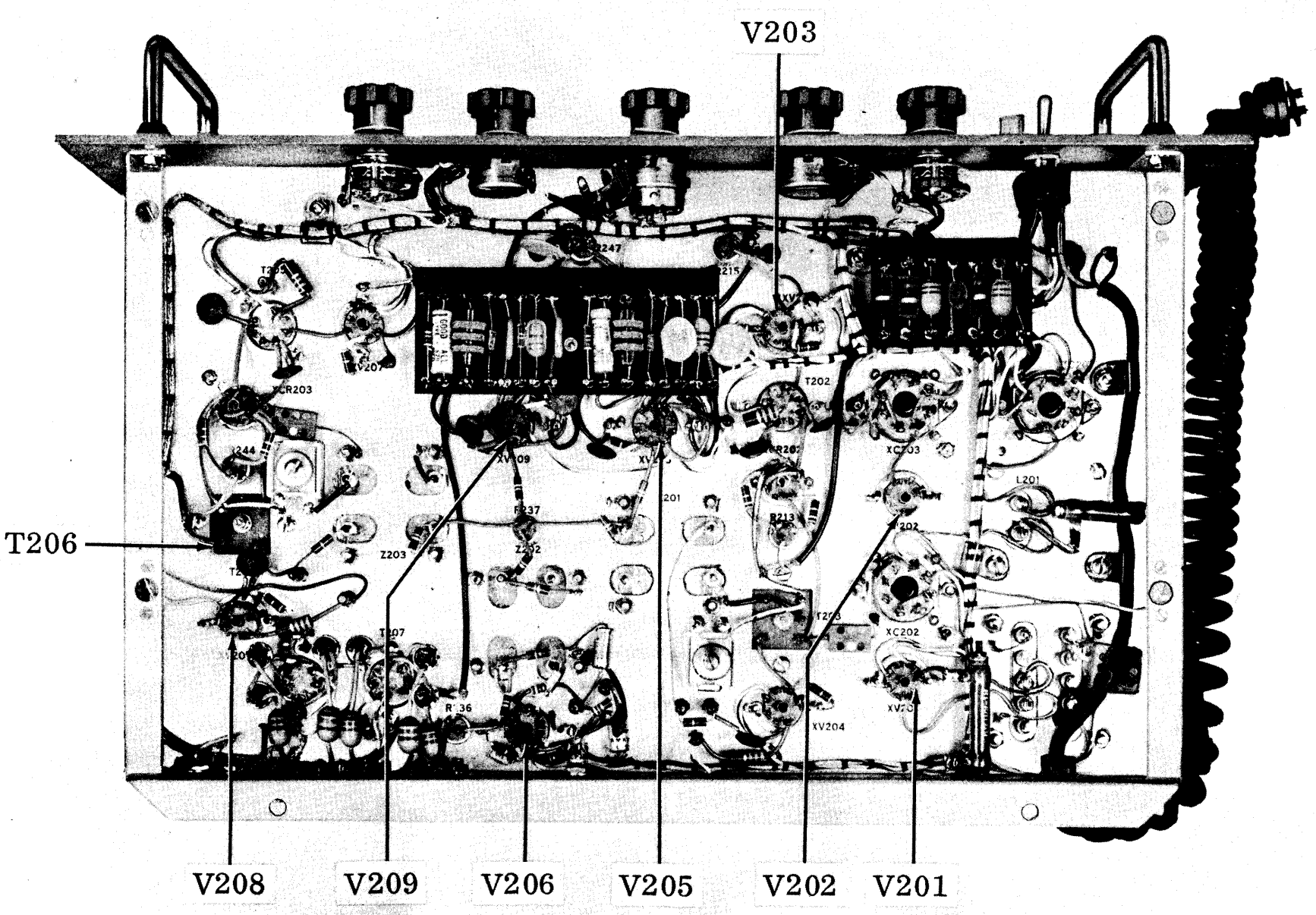



Figure 5-3. Location Diagram of Major Electronic Equipment Components, Bottom View

(fully counterclockwise), no 250-kc input, and audio signal across terminals 2 and 4 of E201 of 1-kc at .015-volt, attach VTVM across terminals 1 and 3 of T202. A nominal reading of .07-volt should be obtained. Turn USB (GAIN) control to maximum (fully clockwise); a nominal reading of 0.56-volt should be obtained. If readings appear abnormal, refer to figure 5-1 and check voltages and resistances at pins of V203 with a 20,000 ohms-per-volt meter. Repeat similar process for CH2 on LSB.

(3) 250-KC INPUT AND BALANCED MODULATOR SECTION. If audio input section is found to be normal, the following check for bandwidth may be performed. Connect an audio signal generator to pins 2 and 4 of E201. Switch USB (OFF CH1 CH2) switch to CH1 and LSB (OFF CH1 CH2) switch to OFF. Turn USB (GAIN) to maximum (fully clockwise). Connect a 70-ohm noninductive load across OUTPUT jack J202. Set audio signal generator at 1-kc at 0.05 volt. Connect INPUT jack J201 to a highly stable crystal-controlled 250-kc source set at 1 volt ± 10%. * Turn power switch ON, and connect VTVM probe to output of USB filter Z201 and Frequency Counter to same point (see note in paragraph 4-1). Vary audio signal generator between 350-7500 cycles for the CBE-1, or 250-3500 for the CBE-2 to obtain peak readings on the VTVM. Adjust the meter to any convenient reference point. This will appear at approximately 2000-cycles for both units, CBE-1 and CBE-2. Vary the frequency of the audio signal generator towards the lower frequency side, 350-cycles for the CBE-1 or 250-cycles for the CBE-2. Note and record the frequency when the meter indicates a reduction of 1-db, 2-db, and 3-db. Adjust the frequency of the audio signal generator towards 7500-cps. Note and record the second frequency at the 1-db, 2-db, and 3-db points. While adjusting the signal generator to 7500-cycles from 350-cycles (CBE-1), 3500-cycles from 250-cycles (CBE-2), watch the meter for any variation greater than 3-db below the point which has been set as a reference point. Subtract the two frequencies at the 3-db points. This should be more than 7150-cycles (CBE-1) or 3250-cycles (CBE-2). If bandwidth is abnormal, refer to figure 5-1 and check voltages at tube pins and resistances with a reliable 20,000 ohms-per-volt meter. Check Z201 filter. Repeat for LSB.

(4) METER SECTION. With power switch ON, apply 250-kc source at 5.6-millivolts to pin 7 of V205 USB meter amplifier. USB meter should indicate approximately 100%. If indication is abnormal, refer to figure 5-1 and check tube pin voltages and resistances at tube pins with a 20,000 ohms-per-volt meter. Check for maladjustment of R216 (see section 6). Repeat for LSB.

* Available from TMC associated transmitting equipment (see table 6-1)

**TABLE 5-1. TROUBLE-SHOOTING CHART**

| STEP | CONTROL OPERATED | NORMAL INDICATION | ANALYSIS |
|---|---|---|---|
| 1 | Set power ON-OFF switch S201 to ON position. | POWER indicator lamp I201 and tube filaments should go on. Fuse holder should not light. | Set switch S201 switch to OFF position. Check fuse F201 and the power cord. Check incoming power. If these are normal, check switch S201, lamp I201, and transformer T201. |
| 250-KC OUTPUT | | | |
| 2 | Switch USB (OFF CH1 CH2) and LSB (OFF CH1 CH2) selector controls OFF. Turn CARRIER LEVEL (MIN -40DB -20DB -6DB 0DB) control to 0DB. | 250-kc should appear at associated equipment to the required level. | Check wiring continuity and components in carrier-reinsertion portion of modulation section. Check for maladjustment of potentiometer R236. |
| SSB OPERATION WITH AND WITHOUT SUPPRESSED CARRIER USB (OFF CH1 CH2) switch on CH1 | | | |
| 3 | Turn CARRIER LEVEL (MIN -40DB -20DB -6DB 0DB) control to MIN position until switch snaps off. Turn LSB | When USB (GAIN) control is advanced toward maximum USB meter reading should increase. | Check audio and meter sections. |

**TABLE 5-1. TROUBLE-SHOOTING CHART (Cont.)**

| STEP | CONTROL OPERATED | NORMAL INDICATION | ANALYSIS |
|---|---|---|---|
| 3 (Cont.) | (OFF CH1 CH2) switch to OFF and USB(OFF CH1 CH2) switch to CH1. Turn USB (GAIN) to maximum. | At associated equipment, USB bandwidth should not be more than 7. 2-kc (CBE-1) or 3. 3-kc (CBE-2) at -3-db points. LSB should not be above -60-db, non-harmonic spurious output should be below -60db and harmonic spurious output should be below -50db. | Check Z201 filter in modulator section. |
| | | At associated equipment there should be no carrier above -60db. | Check Z202 notch filter in modulator section. Check condition of S204 (switch with R207) in carrier reinsertion section. |
| 4 | Turn CARRIER LEVEL (MIN -40DB -20DB -6DB 0DB) control to level required for transmission. | Carrier should appear at associated equipment to required level. | Check wiring continuity and components in carrier-reinsertion portion of modulator section. Check for maladjustmen of potentiometer R236. |
| DSB OPERATION WITH ANDWITHOUT SUPPRESSED CARRIER. | | | |
| 5 | Turn CARRIER LEVEL (MIN -40DB -20DB -6DB 0DB) control to MIN position until switch snaps off. Turn USB (OFF CH1 CH2) switch to desired channel and LSB (OFF CH1 CH2) to same channel. Turn USB (GAIN) and LSB (GAIN) controls to maximum. | When sideband GAIN is advanced toward maximum, corresponding meter reading should increase. | Check audio and meter sections. |
| | | At associated equipment, sideband widths should not be more than 7. 2-kc (CBE-1) or 3. 3-kc (CBE-2) at -3-db points. Non-harmonic spurious output should be below -60-db and harmonic spurious output should be below -50-db. | Check Z201 and Z203 filters in modulator section. (see note in paragraph 4-1). |
| | | At associated equipment there should be no carrier above -60-db. | Check Z202 notch filter in modulator section. Check condition of S204 (switch with R207) in carrier reinsertion section. |
| 6 | Turn CARRIER LEVEL (MIN -40DB -20DB -6DB 0DB) control to level required for transmission. | Carrier should appear at associated equipment to required level. | Check wiring continuity and components in carrier-reinsertion portion of modulator section. Check for maladjustment of potentiometer R236. |
| ISB OPERATION WITH AND WITHOUT SUPPRESSED CARRIER. | | | |
| 7 | Turn CARRIER LEVEL (MIN -40DB -20DB -6DB 0DB) control to MIN position until switch snaps off. Turn USB (OFF CH1 CH2) switch to desired channel and LSB (OFF | When sideband (GAIN) control is advanced toward maximum, corresponding meter reading should increase. | Check audio and meter sections: |

## TABLE 5-1. TROUBLE-SHOOTING CHART (C nt.)

| STEP | CONTROL OPERATED | NORMAL INDICATION | ANALYSIS |
|---|---|---|---|
| 7 (Cont.) | CH1 CH2) switch to other channel. Turn USB (GAIN) and LSB (GAIN) controls to maximum. | At associated equipment, side-bandwidths should not be more than 7. 2-kc (CBE-1) or 3. 3-kc (CBE-2) at -3-db points. Non-harmonic spurious output should be below -60-db and harmonic spurious output should be below -50-db. | Check Z201 and Z203 filters in modulator section. (see note in paragraph 4-1). |
| | | At associated equipment there should be no carrier above -60-db. | Check Z202 notch filter in modulator section. Check condition of S204 (switch with R207) in carrier-reinsertion section. |
| 8 | Turn CARRIER LEVEL (MIN -40DB -20DB -6DB 0DB) control to level required for transmission. | Carrier should appear at associated equipment to required level. | Check wiring continuity and components in carrier-reinsertion portion of modulator section. Check for maladjustment of potentiometer R236. |

# SECTION 6
# MAINTENANCE

## 6-1. INTRODUCTION.

Maintenance may be divided into three categories: operator's maintenance, preventive maintenance, and corrective maintenance. Corrective maintenance is sometimes considered as consisting of information useful in locating and diagnosing equipment troubles and maladjustments, existing and/or pending, and information necessary to remedy the equipment troubles and maladjustments. For reasons stated in Section 5, the remedial type of information is presented under corrective maintenance (Section 6) while the diagnosis type of information is presented under troubleshooting (Section 5). Operator's maintenance is included in Operator's section (Section 3).

The CBE has been designed to provide long-term, trouble-free operation under continuous duty conditions. It is recommended that any necessary maintenance be done by a competent maintenance technician familiar with sideband techniques. If trouble cannot be corrected by following the procedures outlined in this section, it is recommended that the CBE be returned to Technical Materiel Corporation for servicing. To expedite the return of the serviced equipment to you, it is recommended that the equipment be shipped to us by Air Freight and that we be authorized to return it the same way.

## 6-2. PREVENTIVE MAINTENANCE.

a. In order to prevent failure of the equipment due to corrosion, tube failure, dust, or other destructive elements, it is suggested that a schedule of preventive maintenance be set up and adhered to.

b. At periodic intervals (at least every six months) the equipment should be removed from the rack for cleaning and inspection. All accessible covers should be removed and the wiring and all components inspected for dirt, corrosion, charring, discoloring, or grease; in particular, the tube sockets should be carefully inspected for deterioration. Dust may be removed with a soft brush or a vacuum cleaner if one is available. Remove dirt or grease from electrical parts with trichlorethylene. Remove dirt or grease from other parts with any good dry cleaning fluid.

**WARNING**

When using trichlorethylene, make certain that adequate ventilation exists. Avoid prolonged contact with skin.

c. While unit is out of the rack and covers are removed, check the tubes, all of which are accessible from the top of the chassis.

d. Carefully inspect for loose solder connections or screws, especially those on solder lugs. Recommended time interval is every 6 to 12 months, depending on the amount of vibration encountered in service.

## 6-3. CORRECTIVE MAINTENANCE.

The corrective maintenance procedure presented below is essentially Technical Materiel Corporation's factory alignment procedure. To obtain the most precise final adjustment, the CBE unit should be aligned with the particular type of transmitting equipment in which it is used. When correctly aligned, the CBE unit is then interchangeable in any transmitting equipment of the same type. In addition, the test equipment listed in table 6-1 is required.

Adjustment for the CBE resolves itself into the following four general alignments and shall be performed in that sequence.

1. Modulator carrier balance and transformer tuning.
2. Adjustment of meters.
3. Balance of combining network.
4. Adjustment of carrier level.

Table 6-2 provides a step-by-step procedure which may be followed for the above alignments. For simplicity, the procedure for USB with audio input at channel 1 only is given. Alignment 1 should be repeated for LSB before proceeding with 2, 3, and 4.

## TABLE 6-1. TEST EQUIPMENT FOR ALIGNMENT

| ITEM | MANUFACTURER |
|---|---|
| A-c vacuum tube voltmeter | Hewlett Packard Model 410, or equivalent. |
| Audio Signal Generator | Hewlett Packard Model 200 CD, or equivalent. |
| Frequency Spectrum Analyzer | TMC Model FSA-1, or equivalent. |
| Two-Tone Audio Signal Generator | TMC Model TTG, or equivalent. |
| 250-kc Crystal-controlled Oscillator | Highly stable 250-kc source available from TMC High Frequency Amplifier, Model CHG-1 combined with TMC primary Standard, Model CSS-1. This equipment is generally present in TMC synthesized sideband transmitting systems. |
| 70-ohm non-inductive load | A 68-ohm non-inductive 2 watt resistor may be used. |

## TABLE 6-2. COMPLETE ALIGNMENT PROCEDURE

| ALIGNMENT | STEP | OPERATION |
|---|---|---|
| 1 | 1 | Turn all panel controls to OFF or minimum. |
| | 2 | Connect 70-ohm non-inductive load across J202 OUTPUT. |
| | 3 | Connect 115/230 VAC source at P201. (Refer to paragraph 2-3.) |
| | 4 | Connect 250-kc crystal controlled oscillator to J201 250-kc INPUT. Set oscillator output voltage at 1.3 volts. |
| | 5 | Leave LSB (OFF CH1 CH2) switch S203 on OFF. Turn USB (OFF CH1 CH2) switch S202 to CH1. Turn R219 USB (GAIN) control to maximum (fully clockwise). |
| | 6 | Switch power switch S201 to ON. |
| | 7 | Set two-tone audio signal generator for a single tone. With an audio output voltage of .025 volt, apply this voltage into channel 1 at terminals 2 and 4 of E201. |

## TABLE 6-2. COMPLETE ALIGNMENT PROCEDURE (C nt.)

| ALIGNMENT | STEP | OPERATION |
|---|---|---|
| 1 (Cont. ) | 8 | Place probe of a-c vacuum tube voltmeter at grid of Audio Amplifier V203 pin 6. The meter should read approximately 0. 05 volt here, before continuing with the remainder of the alignment procedure. |
| | 9 | Place probe of the a-c vacuum tube voltmeter on the plate of the r-f amplifier V204, pin 1. Unbalance carrier balance potentiometer R213 to feed 250-kc to transformer T203. |
| | 10 | Adjust bottom slug of transformer T203 for a maximum indication on the a-c vacuum tube voltmeter; repeat the same procedure for the top slug. (This reading should be about 0. 8 to 1. 0 volt. ) |
| | 11 | Rebalance potentiometer R213 for minimum indication on the a-c vacuum tube voltmeter. |
| | 12 | Leave probe of the a-c vacuum tube voltmeter on pin 1 of V204, turn USB (OFF CH1 CH2) switch to OFF and USB (GAIN) control to minimum (fully counterclockwise. ) Make sure that R207 CARRIER LEVEL (MIN -40DB -20DB -6DB 0DB) control is in extreme MIN position. Adjust carrier balance potentiometer R213 and carrier balance capacitor C216 alternately to obtain minimum leakage (should not exceed 10 mv). |
| | 13 | Lock potentiometer R213 and capacitor C216. |
| | 14 | Repeat steps 5 to 13 for LSB using equivalent controls. |
| 2 | 15 | Set panel controls and make connections as listed in Alignment 1, steps 1 through 4. |
| | 16 | Turn USB (OFF CH1 CH2) switch and LSB (OFF CH1 CH2) switch (S202 and S203) to CH1. Turn USB (GAIN) and LSB (GAIN) (R219 and R222) to maximum (fully clockwise). |
| | 17 | Turn power switch S201 to ON. |
| | 18 | Set two-tone audio signal generator for a single tone, with an audio output voltage of 0. 025 volt. Apply this voltage into channel 1 at terminals 2 and 4 of E201. |
| | 19 | Place probe of a-c vacuum tube voltmeter at the center arm of potentiometer R237. Adjust R237 to obtain minimum voltage reading on a-c vacuum tube voltmeter. |
| | 20 | Adjust potentiometers R216 and R247 to obtain "100%" readings on USB and LSB meters. |
| | 21 | Lock potentiometers R216 and R247. |

## TABLE 6-2. COMPLETE ALIGNMENT PROCEDURE (C nt.)

| ALIGNMENT | STEP | OPERATION |
|---|---|---|
| 3 | 22 | Set panel controls and make connections as listed in alignment 2, steps 15 through 18. |
| | 23 | Remove load from OUTPUT jack J202. Replace with connection to associated transmitting equipment fed by CBE. |
| | 24 | Set USB (GAIN) and LSB (GAIN) controls to obtain "25%" reading on USB and LSB panel meters. |
| | 25 | With a-c vacuum tube voltmeter probe at the center-arm of potentiometer R237, turn LSB (OFF CH1 CH2) switch S203 to OFF and note voltage reading. Turn USB (OFF CH1 CH2) S202 to OFF and LSB (OFF CH1 CH2) switch S203 to CH1. Note voltage switch reading. If readings are not equal, adjust potentiometer R237 until they are. Each reading must be taken with one sideband switched to CH1 and the other OFF. |
| | 26 | Lock potentiometer R237. |
| 4 | 27 | Set panel controls and make connections as listed in Alignment 3, steps 22 and 23. |
| | 28 | Attach Frequency Spectrum Analyzer to output of associated equipment and adjust two sidebands appearing on Analyzer screen to 0DB. |
| | 29 | Turn USB (OFF CH1 CH2) and LSB (OFF CH1 CH2) switches, S202 and S203 to OFF. |
| | 30 | Turn R207 CARRIER LEVEL (MIN -40DB -20DB -6DB 0DB) control to 0DB. |
| | 31 | Adjust potentiometer R236 until carrier appearing on Analyzer screen is brought to 0DB. |
| | 32 | Lock potentiometer R236. |

# SECTION 7
# PARTS LIST

## INTRODUCTION

Reference designations have been assigned to identify all maintenance parts of the equipment. They are used for marking the equipment (adjacent to the part they identify) and are included on drawings, diagrams, and the parts list. The letters of a reference designation indicate the kind of part (generic group), such as resistor, amplifier, electron tubes, etc. The number differentiates between parts of the same generic group. Parts of the CBE unit are numbered in the 200 series. Sockets associated with a particular plug-in device, such as electron tube or fuse, are identified by a reference designation which includes the reference designations of the plug-in device. For example, the socket for fuse F201 is designated XF201. Column 1 lists the reference series of each major unit, followed by the reference designations of the various parts in alphabetical and numerical order. Column 2 gives the name and describes the various parts. Major part assemblies are listed in their entirety; subparts of a major assembly are listed in alphabetical and numerical order with reference to its major assembly. Column 3 indicates how the part is used within a major component. Column 4 lists each Technical Materiel Corporation part number.

| SYM. | DESCRIPTION | FUNCTION | TMC DWG. OR PART NO. |
|---|---|---|---|
| C201 | CAPACITOR, fixed: ceramic dielectric, .01 uf, +80%, -20%. | Primary T201 | CC-100-16 |
| C202 | CAPACITOR, fixed: 3-section, 20-20-20 uf, 450 wvdc. | Filter V201 | CE-108-1 |
| C203 | CAPACITOR, fixed: same as C202. | Filter | CE-108-1 |
| C204 | CAPACITOR, fixed: same as C202. | Filter | CE-108-1 |
| C205 | CAPACITOR, fixed: same as C201. | Filter | CC-100-16 |
| C206 | CAPACITOR, fixed: same as C201. | Filter | CC-100-16 |
| C207 | CAPACITOR, fixed: same as C201. | RF Bypass, T202 | CC-100-16 |
| C208 | CAPACITOR, fixed: same as C201. | RF Bypass, T202 | CC-100-16 |
| C209 | CAPACITOR, fixed: same as C201. | Coupling, V204 | CC-100-16 |
| C210 | CAPACITOR, fixed: mylar dielectric, .1 uf, ±5%, 200 wvdc. | Coupling, USB Meter Filter | CN 108 C 100 3 J |
| C211 | CAPACITOR, fixed: ceramics C201. | Coupling, USB Meter Amplifier | CC-100-16 |
| C212 | CAPACITOR, fixed: ceramics dielectric, .1 uf, +80%, -20%, 500 wvdc. | DC Filter, USB Meter | CC-100-28 |
| C213 | CAPACITOR, fixed: same as C212. | DC Filter, USB Meter | CC-100-28 |
| C214 | CAPACITOR, fixed: same as C212. | DC Filter, USB Meter | CC-100-28 |
| C215 | NOT USED. | | |
| C216 | CAPACITOR, variable: 100-550 ufd, 250 wvdc. | USB Carrier Balance | CV-103-304 |
| C217 | CAPACITOR, fixed: ceramic dielectric; 1000 uuf, +10% -0%, 500 wvdc. | RF Bypass, R219 | CC-100-9 |
| C218 | CAPACITOR, fixed: solid tantalum, 6.8 uf ± 20% 6 VDC. | Cathode Bypass V206B | CE-106 |
| C219 | CAPACITOR, fixed: same as C218 | Cathode Bypass, V206A | CE-106 |
| C220 | CAPACITOR, fixed: same as C201. | Coupling, V206 | CC-100-16 |
| C221 | CAPACITOR, fixed: same as C217 | RF Bypass, R222 | CC-100-9 |
| C222 | CAPACITOR, fixed: same as C201. | RF Bypass, T205 | CC-100-16 |
| C223 | CAPACITOR, fixed: same as C201. | RF Bypass, T205 | CC-100-16 |
| C224 | CAPACITOR, fixed: same as C201. | RF Bypass, T204 | CC-100-16 |

| SYM. | DESCRIPTION | FUNCTION | TMC DWG. OR PART NO. |
|---|---|---|---|
| C225 | CAPACITOR, fixed: mylar dielectric, . 1 uf, ±10%, 200 wvdc | RF Bypass, T204 | CN 106 C 104 K |
| C226 | CAPACITOR, fixed: same as C201. | Coupling, V208 | CC-100-16 |
| C227 | CAPACITOR, fixed: same as C212. | DC Filter, LSB Meter | CC-100-28 |
| C228 | CAPACITOR, fixed: same as C212. | DC Filter, LSB Meter | CC-100-28 |
| C229 | CAPACITOR, fixed: same as C212. | DC Filter, LSB Meter | CC-100-28 |
| C230 | CAPACITOR, fixed: same as C210. | Coupling, LSB Meter Filter | CM 108 C 100 3 J |
| C231 | CAPACITOR, fixed: same as C201. | Coupling, LSB Meter Ampl. | CC-100-16 |
| C232 | NOT USED | | |
| C233 | CAPACITOR, variable: same as C216. | LSB Carrier Balance | CV-103-304 |
| C234 | CAPACITOR, fixed: mica; button type. 1000 uuf, ±10%, 300 wvdc, char. B. | RF Bypass Cap. E201 | CB 210 B 102 K |
| C235 | CAPACITOR, fixed: same as C234. | RF Bypass Cap. E201 | CB 210 B 102 K |
| C236 | CAPACITOR, fixed: same as C234. | RF Bypass Cap. E201 | CB 210 B 102 K |
| C237 | CAPACITOR, fixed: same as C234. | RF Bypass Cap. E201 | CB 210 B 102 K |
| C238 | CAPACITOR, fixed: same as C234. | RF Bypass Cap. E201 | CB 210 B 102K |
| C239 | CAPACITOR, fixed: same as C234. | RF Bypass Cap. E201 | CB 210 B 102 K |
| C240 | NOT USED. | | |
| C241 | NOT USED. | | |
| C242 | CAPACITOR, fixed: same as C201. | Cathode Bypass, V205A | CC-100-16 |
| C243 | CAPACITOR, fixed: same as C201. | Cathode Bypass, V205B | CC-100-16 |
| C244 | CAPACITOR, fixed: same as C201. | Cathode Bypass, V209B | CC-100-16 |
| C245 | CAPACITOR, fixed: same as C201. | Cathode Bypass, V209A | CC-100-16 |

| SYM. | DESCRIPTION | FUNCTION | TMC DWG. OR PART NO. |
|---|---|---|---|
| C246 | CAPACITOR, fixed: mica dielectric, 360 uuf ± 10%, 500 wvdc, char. C. | RF Bypass, T203 | CM 20C 361K |
| C247 | CAPACITOR, fixed: same as C246. | RF Bypass, T206 | CM 20C 361K |
| CR201 | Diode, germanium. | DC Filter, USB Meter | 1N67 |
| CR202 | Diode ASSY, germanium; four diodes; hermetically sealed. | USB Balance Mod | DD-100 |
| CR203 | Diode ASSY., germanium; four diodes; hermetically sealed. | LSB Balance Mod | DD-100 |
| CR204 | Diode, germanium. | DC Filter, LSB Meter | 1N67 |
| E201 | BOARD, terminal: general purpose barrier type; 9 nickel plated 6-32 binding, head machine screws; moulded phenolic body. | Terminal Board, Audio Input | TM-100-9 |
| F201 | FUSE cartridge; 2 amp, quick - acting. | | FU-100-2 |
| I201 | LAMP, incandescent; min. bayonet base; 6-8 volts, . 15 amp; brown lens, T-3-1/4. | POWER Indicator | BI-101-47 |
| J201 | CONNECTOR, receptacle: coaxial, type BNC. | 250-KC INPUT | UG-625/U |
| J202 | CONNECTOR, receptacle; same as J201. | RF OUTPUT | UG-625/U |
| L201 | REACTOR, filter; 50H, 30 ma dc, 800 ohms dc. | Choke | TF-166 |
| L202 | COIL, R. F. : fixed: 2. 5 mh, ± 10%, 100 ma. | Smoothing Choke | CL-140-1 |
| L203 | COIL, R. F. : fixed: same as L202. | Smoothing Choke | CL-140-1 |
| L204 | COIL, R. F. : fixed: same as L202. | Smoothing Choke | CL-140-1 |
| L205 | COIL, R. F. : fixed: 10 mh, 75 ma. | Choke | CL-101-4 |
| L206 | COIL, R. F. : fixed: same as L202. | Smoothing Choke | CL-140-1 |
| L207 | COIL, R. F. : fixed: same as L205. | Choke | CL-101-4 |
| L208 | COIL, R. F. : fixed: 150 mh, ± 10%, 100 ma. | Filter, E201 | CL-140-2 |
| L209 | COIL, R. F. : fixed: same as L208. | Filter, E201 | CL-140-2 |
| L210 | COIL, R. F. : fixed: same as L208. | Filter, E201 | CL-140-2 |
| L211 | COIL, R. F. : fixed: same as L208. | Filter, E201 | CL-140-2 |
| L212 | COIL, R. F. : fixed: same as L208. | Filter, E201 | CL-140-2 |
| L213 | COIL, R. F. : fixed: same as L208. | Filter, E201 | CL-140-2 |
| M201 | METER, D. C. : Micro amp., 0-20. | USB Power Ind. | MR-100-8 |

## SIDEBAND EXCITER CBE-1, 2

| SYM. | DESCRIPTION | FUNCTION | TMC DWG. OR PART NO. |
|---|---|---|---|
| M202 | METER, D. C. : same as M201 | LSB Power Ind. | MR-100-8 |
| P201 | CONNECTOR, plug: 2 prong, Male. | AC Power Input | PL-171 |
| R201 | RESISTOR, fixed: wire wound; 500 ohms, ± 5%, 10 watts. | Dropping Power | RW-109-19 |
| R202 | RESISTOR, fixed: wire wound; 3k, ± 5%, 10 watts. | Dropping Power | RW-109-30 |
| R203 | RESISTOR, fixed: composition; 1k, ± 10%, 2 watts. | Voltage Divider | RC42GF102K |
| R204 | RESISTOR, fixed: composition; 2. 7k, ± 10%, 2 watts. | Voltage Divider | RC42GF272K |
| R205 | RESISTOR, fixed: same as R204. | Voltage Divider | RC42GF272K |
| R206 | RESISTOR, fixed: composition; 2. 2k, ± 10%, 1 watt. | Dropping, Carrier Insert | RC32GF222K |
| R207 | RESISTOR, variable: composition; 250 ohms, ± 20%, 2 watts (with DPST switch). | CARRIER LEVEL | RV4DTRD251C |
| R208 | RESISTOR, fixed: composition; 33k, ± 10%, 1 watt. | Plate Load V204 | RC32GF333K |
| R209 | RESISTOR, fixed: composition; 100 ohms, ± 10%, 1/2 watt. | Dropping Z201 | RC20GF101K |
| R210 | NOT USED. | | |
| R211 | RESISTOR, fixed: composition; 470 ohms, ± 10%, 1/2 watt. | Cathode V203 | RC20GF471K |
| R212 | RESISTOR, fixed: composition; 390 ohms, ± 10%, 1/2 watt. | Dropping CR202 | RC20GF391K |
| R213 | RESISTOR, variable: composition; 100 ohms, ± 10%, 1/2 watt. | Carrier Balance CR202 | RV106UX8B101A |
| R214 | RESISTOR, fixed: same as R212. | Dropping CR202 | RC20GF391K |
| R215 | RESISTOR, fixed: same as R211. | Cathode Res. V204 | RC20GF471K |
| R216 | RESISTOR, variable: composition; 5k, ± 10%, 1/2 watt. | Meter Adj. | RV106UX8B502A |
| R217 | RESISTOR, fixed: composition; 15k, ± 10%, 1/2 watt. | Dropping Z202 | RC20GF153K |
| R218 | RESISTOR, fixed: composition; 5. 6k, ± 10%, 1/2 watt. | Terminating Res. T207 | RC20GF562K |
| R219 | RESISTOR, variable: composition; 25k, ± 10%, 2 watts. | USB Gain Control | RV4ATRD253A |
| R220 | RESISTOR, fixed: same as R218. | Terminating Res. T208 | RC20GF562K |

| SYM. | DESCRIPTION | FUNCTION | TMC DWG. OR PART NO. |
|---|---|---|---|
| R221 | RESISTOR, fixed: same as R217. | Grid Return V206. | RC20GF153K |
| R222 | RESISTOR, variable: same as R219. | LSB Gain Control | RV4ATRD253A |
| R223 | RESISTOR, fixed: composition; 47k, ± 10%, 1/2 watt. | Plate Load V205A | RC20GF473K |
| R224 | RESISTOR, fixed: composition; 470k, ± 10%, 1/2 watt. | Plate Load V205A | RC20GF474K |
| R225 | RESISTOR, fixed: composition; 1 meg, ± 10%, 1/2 watt. | Grid Return V205B | RC20GF105K |
| R226 | RESISTOR, fixed: composition; 750 ohms, ± 10%, 1/2 watt. | Cathode V205B | RC20GF751K |
| R227 | RESISTOR, fixed: composition; 2. 2k, ± 10%, 1/2 watt. | Cathode V205A | RC20GF222K |
| R228 | RESISTOR, fixed: composition; 150k, ± 10%, 1/2 watt. | Isolation Z201 | RC20GF154K |
| R229 | NOT USED | | |
| R230 | RESISTOR, fixed: same as R217. | Z201 Impedance | RC20GF153K |
| R231 | RESISTOR, fixed: composition; 39k, ± 10%, 1/2 watt. | Plate Load V206A | RC20GF393K |
| R232 | RESISTOR, fixed: composition; 560 ohms, ± 10%, 1/2 watt. | Cathode V206B | RC20GF561K |
| R233 | RESISTOR, fixed: composition; 220k, ± 10%, 1/2 watt. | Grid Return V206B | RC20GF224K |
| R234 | RESISTOR, fixed: composition; 1k, ± 10%, 1/2 watt. | Cathode V206A | RC20GF102K |
| R235 | RESISTOR, fixed: same as R223. | Carrier Dropping | RC20GF473K |
| R236 | RESISTOR, variable: same as R216. | Carrier Insert | RV106UX8B502A |
| R237 | RESISTOR, variable; composition; 50k, ± 10%, 1/2 watt. | Combining Z201 and Z203 | RV106UX8B503A |
| R238 | RESISTOR, fixed: same as R231. | Plate Load V206B | RC20GF393K |
| R239 | RESISTOR, fixed: same as R208. | Plate Load V208 | RC32GF333K |
| R240 | RESISTOR, fixed: same as R209. | Dropping Z203 | RC20GF101K |
| R241 | NOT USED. | | |
| R242 | RESISTOR, fixed: same as R211. | Cathode Res. V208 | RC20GF471K |
| R243 | RESISTOR, fixed: same as R212. | Dropping CR203 | RC20GF391K |
| R244 | RESISTOR, variable: same as R213. | Carrier Balance CR203 | RV106UX8B101A |

| SYM. | DESCRIPTION | FUNCTION | TMC DWG. OR PART NO. |
|---|---|---|---|
| R245 | RESISTOR, fixed: same as R212. | Dropping CR203 | RC20GF391K |
| R246 | RESISTOR, fixed: same as R211. | Cathode V207 | RC20GF471K |
| R247 | RESISTOR, variable: same as R216. | Meter Adj. | RV106UX8B502A |
| R248 | RESISTOR, fixed: same as R223. | Plate Load V209B | RC20GF473K |
| R249 | RESISTOR, fixed: same as R224. | Plate Load V209A | RC20GF474K |
| R250 | RESISTOR, fixed: same as R225. | Grid Return V209B | RC20GF105K |
| R251 | RESISTOR, fixed: same as R226. | Cathode V209A | RC20GF751K |
| R252 | RESISTOR, fixed: same as R227. | Cathode V209B | RC20GF222K |
| R253 | RESISTOR, fixed: same as R228. | Isolation Z203 | RC20GF154K |
| R254 | NOT USED. | | |
| R255 | RESISTOR, fixed: same as R217. | Z203 Impedance | RC20GF153K |
| R256 | RESISTOR, fixed: composition; 33k, ± 10%, 2 watts. | Voltage Divider | RC42GF333K |
| R257 | RESISTOR, fixed: same as R256. | Voltage Divider | RC42GF333K |
| R258 | RESISTOR, fixed: same as R217. | Z202 Impedance | RC20GF153K |
| S201 | SWITCH, toggle: DPST, On-None-Off, 6 amps. | AC Power Switch | ST-22K |
| S202 | SWITCH, rotary: non-shorting, 3 positions, single section. | USB Switch | SW-276 |
| S203 | SWITCH, rotary: same as S202. | LSB Switch | SW-276 |
| S204 | Part of R207. | Carrier Cutoff | |
| T201 | TRANSFORMER, power. | Power Transformer | TF-126 |
| T202 | TRANSFORMER, audio: pri. imp. 20K C. T.; sec. imp. 150/600 ohms, 7 terminals | Audio, V203 | TF-138 |
| T203 | TRANSFORMER, R. F.: 250 kc Double Tuned. | LF Transformer | TT-100 |
| T204 | TRANSFORMER, pulse: pri. induct 4.7 mh, turns ratio 5:5:1. | RF Output | TT-228K15 |
| T205 | TRANSFORMER, audio: same as T202. | Audio, V207 | TF-138 |
| T206 | TRANSFORMER, R. F.: same as T203. | LF Transformer | TT-100 |
| T207 | TRANSFORMER, audio; same as T202. | Input Channel 1 | TF-138 |
| T208 | TRANSFORMER, audio: same as T202. | Input Channel 2 | TF-138 |
| V201 | TUBE, electron: duo diode; rectifier. | Rectifier | 6X4 |

| SYM. | DESCRIPTION | FUNCTION | TMC DWG. OR PART NO. |
|---|---|---|---|
| V202 | TUBE, electron: voltage regulator. | Voltage Reg. | OA2 |
| V203 | TUBE, electron: triode, 7 pin miniature. | USB Audio Amplifier | 6C4 |
| V204 | TUBE, electron: triode 7 pin miniature. | RF Amplifier | 6C4 |
| V205 | TUBE, electron: duo triode, 9 pin miniature. | USB Meter Amplifier | 12 AT 7 |
| V206 | TUBE, electron: duo triode, 9 pin miniature. | Power Amplifier | 12 AU 7 |
| V207 | TUBE, electron: triode, 7 pin miniature. | LSB Audio Amplifier | 6C4 |
| V208 | TUBE, electron: triode, 7 pin miniature | RF Amplifier | 6C4 |
| V209 | TUBE, electron: duo triode 9 pin miniature | LSB Meter Amplifier | 12 AT 7 |
| W201 | CABLE AC power: coiled. | AC Cable | CA-575-1 |
| XF201 | FUSE HOLDER, extractor post type, lamp indicating neon. | Holder, F201 | FH-104-3 |
| XI201 | SOCKET, indicator: W/red frosted lens. | Socket, I201 | TS-106-1 |
| XV201 | SOCKET, tube: 7 pin miniature molded plastic. | Socket, V201 | TS 102 P 01 |
| XV202 | SOCKET, tube: same as XV201. | Socket, V202 | TS 102 P 01 |
| XV203 | SOCKET, tube: same as XV201. | Socket, V203 | TS 102 P 01 |
| XV204 | SOCKET, tube: same as XV201. | Socket, V204 | TS 102 P 01 |
| XV205 | SOCKET, tube: 9 pin miniature, molded plastic. | Socket, V205 | TS 103 P 01 |
| XV206 | SOCKET, tube: same as XV205. | Socket, V206 | TS 103 P 01 |
| XV207 | SOCKET, tube: same as XV201. | Socket, V207 | TS 102 P 01 |
| XV208 | SOCKET, tube: same as XV201. | Socket, V208 | TS 102 P 01 |
| XV209 | SOCKET, tube: same as XV205. | Socket, V209 | TS 103 P 01 |
| Z201 | FILTER, bandpass | USB Filter | FX-160 (CBE-1), FX-165 (CBE-2) |
| Z202 | FILTER, carrier suppression. | Carrier Reject | FX-159 |
| Z203 | FILTER, bandpass | LSB Filter | FX-158 (CBE-1), FX-166 (CBE-2) |
| XC202 | SOCKET, tube: 8 pin molded plastic. | Socket, C202 | TS 101 P 01 |
| XC203 | SOCKET, tube: same as XC202. | Socket, C203 | TS 101 P 01 |

## SIDEBAND EXCITER CBE-1, 2

| SYM | DESCRIPTION | FUNCTION | TMC DWG. OR PART NO. |
|---|---|---|---|
| XC204 | SOCKET, tube: same as XC202. | Socket, C204 | TS 101 P 01 |
| XCR202 | SOCKET, diode: 7 pin miniature, bakelite, center shield. | Socket, CR202 | TS-130MPW |
| XCR203 | SOCKET, diode: same as SCR202. | Socket, CR203 | TS-103MPW |

# SECTION 8
# SCHEMATIC DIAGRAMS

FOR 230 VOLT OPERATION OF T201
1- REMOVE JUMPERS BETWEEN TERMINALS 1&2 AND 3&4
2- ADD JUMPER BETWEEN 2&3

S201 MAIN POWER
F201 2A
C201 .01
T201
W201
P201
1201 POWER
V201 6X4 RECTIFIER
R201 500 10W
L201 50H
R202 3K 10W
C202
V202 0A2 VOLT REG
C203
R203 1K 2W
R204 2.7K 2W
R205 2.7K 2W
R256 33K 2W
C204
L202 2.5
C205 .01
R257 33K 2W
L203 2.5MH
C206 .01
J201 250KC INPUT
V203 6C4 AUDIO AMPL
R211 470
T202
C207 .01
C208 .01
CR202
R212 390
R213 100 CAR. BAL.
R214 390
C216 100-550 CARRIER BALANCE
C246 360UUF
T203
V204 6C4 RF AMPL
R215 470
R206 2.2K 1W
R208 33K
R207 250 2W CARRIER LEVEL
C209 .01
S204 CLOSED WHEN R207 AT MIN (P/O R207)
R209 100
GREEN
YELLOW
BLACK
RED
BLUE
22K
1600

V201 V203 V204 V205 V206 V207 V208 V209

E201
CHANNEL 1
CHANNEL 2
L208 150
L209 150
L210 150
L211 150
L212 150
L213 150
C234 .001
C235 .001
C236 .001
C237 .001
C238 .001
C239 .001
T207
T208
R218 5.6K
R220 5.6K
CH 1
CH 2
S202 OFF
S203 OFF
R219 25K 2W USB GAIN
R222 25K 2W LSB GAIN
C217 .001

M201 0-200 UA
C212 .1
L204 2.5MH
CR201 1N67
C210 .1
R216 5K M ADJ
C213 .1
C214 .1
L205 10MH
R223 47K
C211 .01
R224 470K
R225 1MEG
R226 750
C242 .01
R227 2.2K
C243 .01
V205 12AT7 METER AMPL

T204
J202 OUTPUT
C220 .01
V206 12AU7 POWER AMPL
R233 220K
C218 6.8
R232 560
C219 6.8
R234 1K
R221 15K
R235 47K
Z202 CARRIER REJ.
R258 15K
R217 15K
R231 39K
R237 50K COMB NET
R236 5K CARRIER INSERT
R238 39K
C224 .01
C225 .1
R239 33K 1W
C226 .01
C247 360UUF
T206
V208 6C4 RF AMPL
R243 390
R244 100 CAR. BAL.
R245 390
C233 100-550 CARRIER BALANCE
R242 470
C222 .01
C223 .01
CR203
T205
V207 6C4 AUDIO AMPL
C221 .001
R246 470

Z201 USB FILTER
R228 150K
R230 15K
OUT
IN
G

M202 0-200 UA
C227 .1
L206 2.5MH
CR204 1N67
C230 .1
R247 5K M ADJ
C228 .1
C229 .1
L207 10MH
R248 47K
C231 .01
R249 470K
R250 1MEG
R251 750
C244 .01
R252 2.2K
C245 .01
V209 12AT7 METER AMPL
R240 100
Z203 LSB FILTER
R253 150K
R255 15K

NOTES-
1- SEE FIGURE 3-1 FOR LOCATION OF NUMBERED CONTROLS ON PANEL.
2- UNLESS OTHERWISE NOTED-
ALL RESISTORS ARE 1/2 WATT.
ALL CAPACITOR VALUES ARE IN UF.
ALL COIL VALUES ARE IN UH
3- ⊘ INDICATES SCREWDRIVER CONTROL ON CHASSIS.

Figure 8-1. Schematic Diagram, Sideband Exciter, CBE-1 and -2.