The HFO is a modified Colpitts (Vacker) circuit enclosed in an oven that is closely regulated by the proportional oven control A1301. Oven temperature is maintained at $75^{o}C \pm 1/2$ degree in the following manner: Changes in oven temperature cause corresponding changes in the resistance of thermistor RT1001; proportional oven control A1301 responds to resistance changes of RT1001 and changes the conduction through oven heaters HR1001 and HR1002 accordingly, to maintain a constant oven temperature.

TECHNICAL MANUAL

for

R-F TRANSLATOR, MODEL CHGR-3

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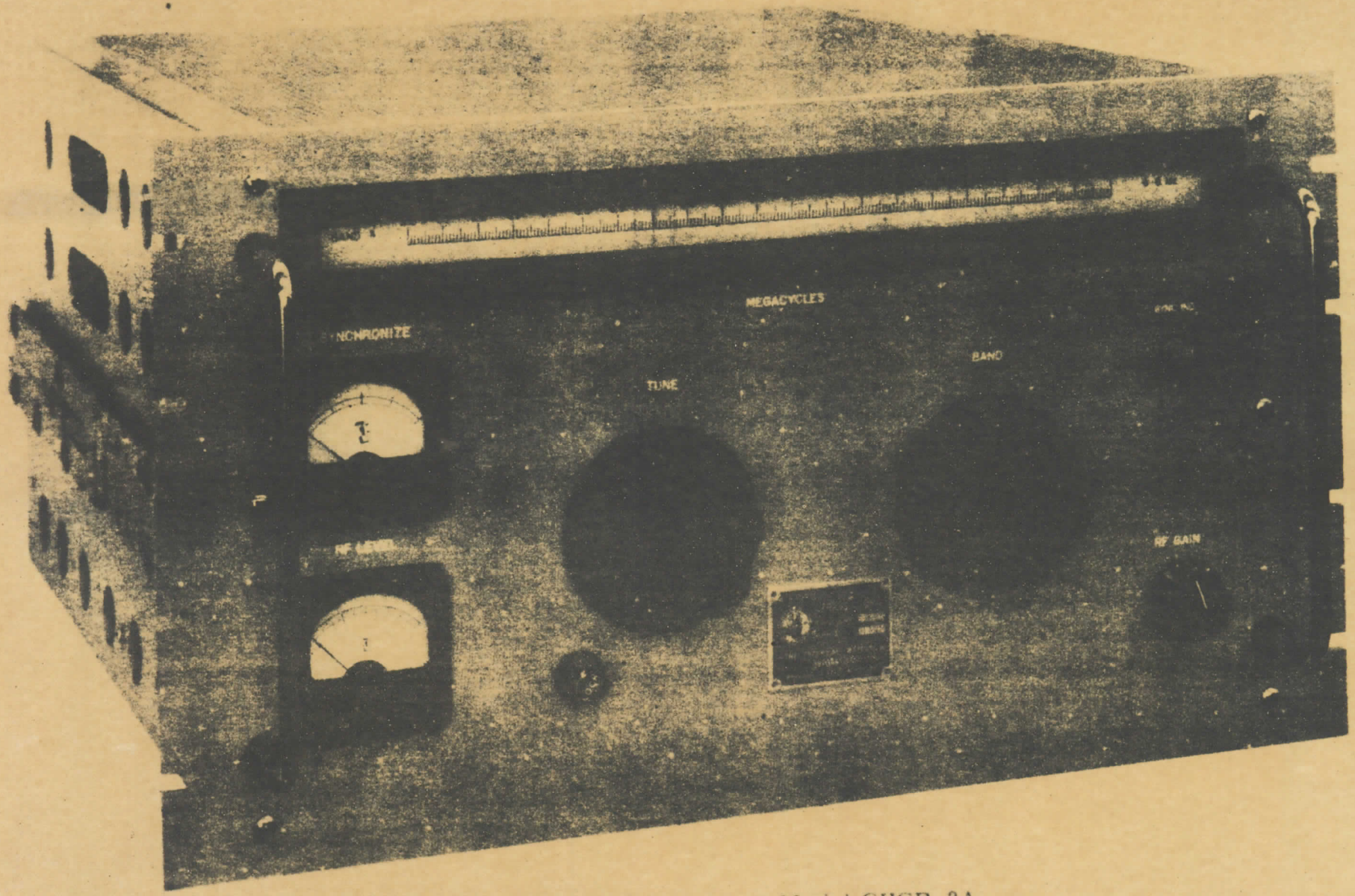

Figure 1-1. RF Translator, Model CHGR-3A

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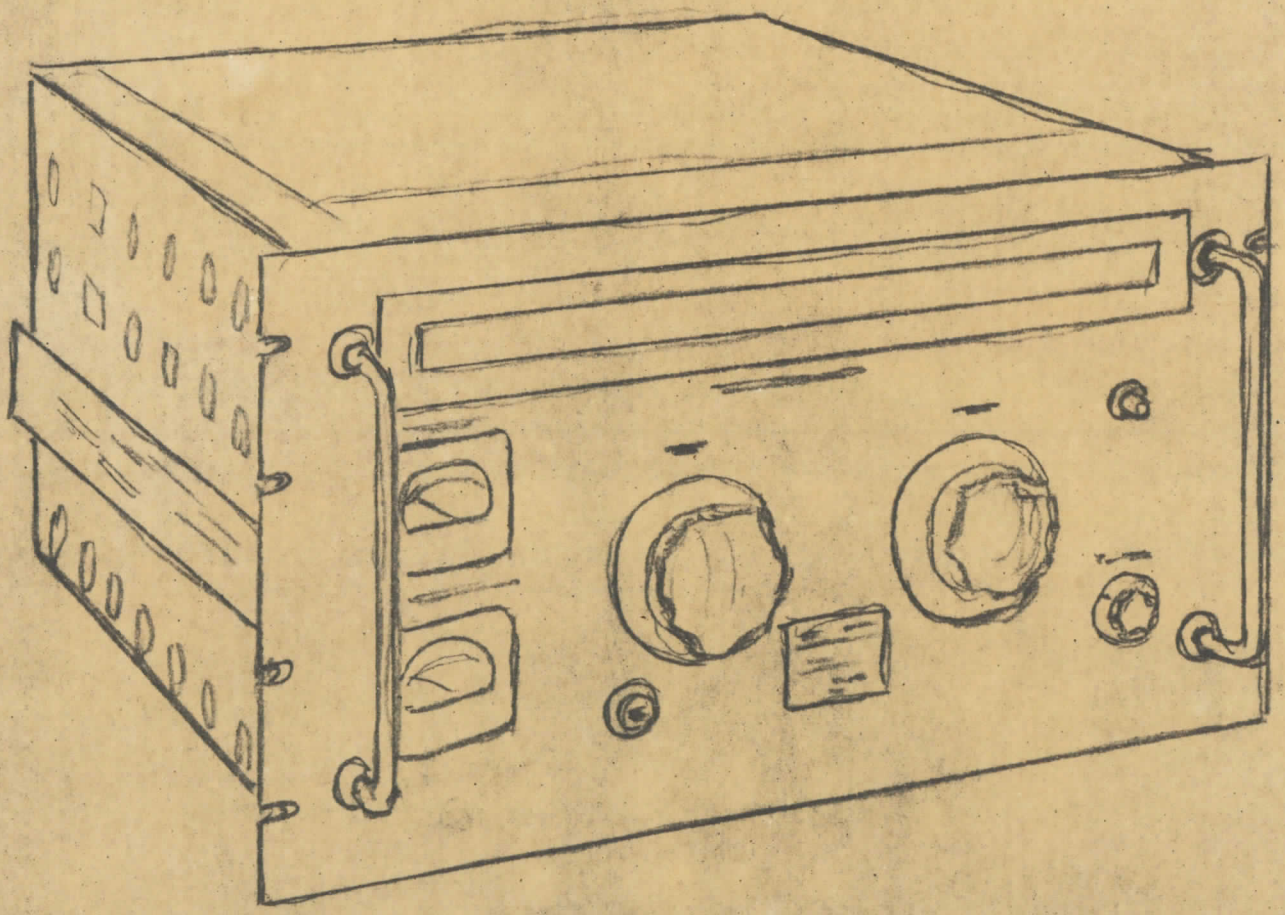

Figure 1-1. R-F Translator, Model CHGR-3A

SECTION 1

GENERAL INFORMATION

1-1. FUNCTIONAL DESCRIPTION.

R-F Translator, Model CHGR-3A(figure 1-1), provides controlled (local or remote control) frequencies in the 2- to 32- megacycle range in 100-cps steps. As shown in the functional block diagram (figure 1-2), the CHGR operates in conjunction with a sideband exciter (CMRA), a control synthesizer (HFS), and a power supply (HFP), as a modular unit of a TechniMatiC* transmitter system.

The CHGR receives a 1.75 mc input from the sideband exciter (CMRA) and heterodynes this signal to the desired output frequency. A sample of high frequency oscillator output (3.75 to 33.75 mc) of CHGR is applied to the control synthesizer (HFS), and the synthesizer in turn supplies a d-c control voltage to the CHGR to stabilize the high frequency oscillator. CHGR receives a-c and d-c power from the power supply (HFP). The r-f output of the CHGR is in the 2- to 32- megacycle range. (Refer to table 1-1 for electrical specifications.)

Remote selection of any of the eight bands and any freguency within the selected band is provided through a band switching and a dial tuning mechanism contained within the CHGR and operated by associated equipment.

* Patent applied for.

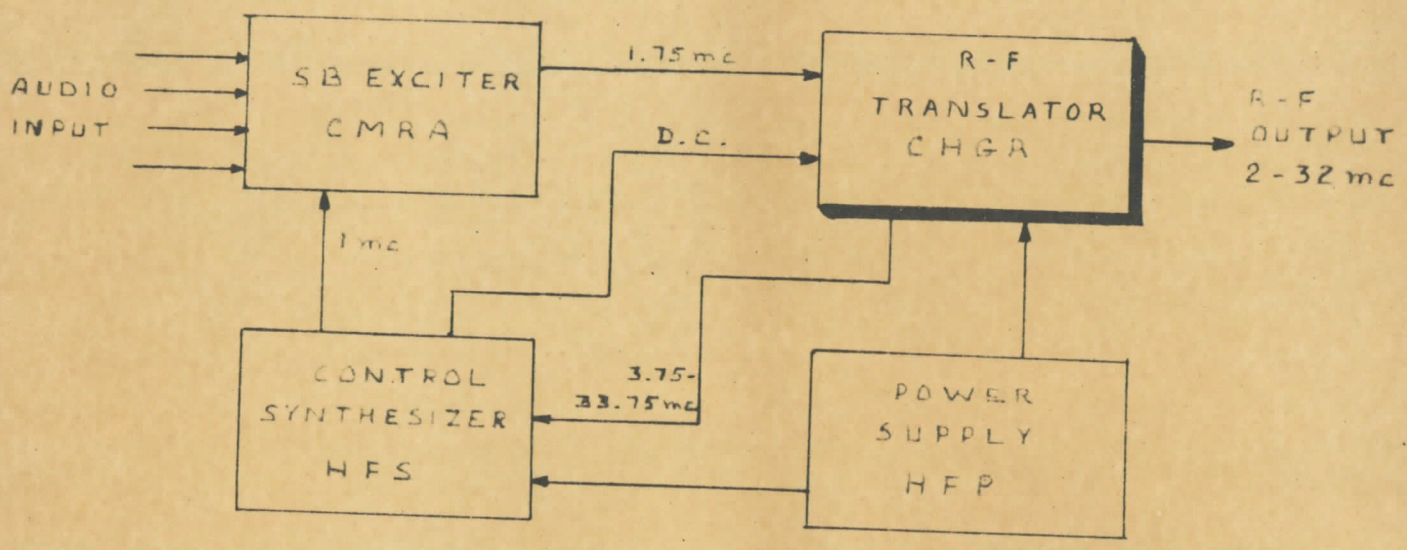

Figure 1-2. Functional Block Diagram, CHGR

1-2. PHYSICAL DESCRIPTION.

The CHGR is designed for installation in a standard 19-inch wide equipment cabinet. All controls and indicators necessary for operation of the unit are located on the front panel. Tilt-lock slide mechanisms are provided with the CHGR. Removable top and bottom protective covers are provided. The CHGR is 19 inches wide, 10-1/2 inches high, 20 inches deep, and weighs approximately 60 pounds.

TABLE 1-1. ELECTRICAL SPECIFICATIONS

Frequency Range:	2 to 32 mc, synthesized, in 100 cps steps
	2 to 32 mc, continuous coverage, non-synth.
Stability:	Synthesized, 1 part 10^8 or 10^9 per day (dependent upon synthesier used)
	Unsynthesized, 20 to 50 parts in 10^6.
Power Output:	500 milliwatts PEP.
Output Impedance:	50 ohms.
Input Requirements:	1.75 mc, modulated or unmodulated.
	DC control from synthesizer (optional).
	3.75 to 33.75 mc at 0.8 v - 1.5 volts from master oscillator (optional).
Output to Associated Units:	3.75 to 33.75 mc to synthesizer.
	3.75 to 33.75 mc (when CHGR is master oscillator).
Intermodulation Distortion:	3rd and 5th order products at least 45 db below tone level of a two-tone test at full PEP output.
Power Requirements:	Supplied by Power Supply HFP.

SECTION 2

INSTALLATION

2-1. GENERAL.

The CHGR is tested at the factory and is carefully packaged to prevent damage during shipment. When it is delivered at the operating site, inspect the packing case and its content for damage that might have occured during transit. Unpack the equipment carefully, and inspect all packaging material for parts that may have been shipped as loose items. With respect to damage to the equipment for which the carrier is liable, The Technical Materiel Corporation will assist in describing methods of repair and furnishing of replacement parts.

2-2. MECHANICAL INSTALLATION.

The CHGR is equipped with a standard 19-inch wide front panel; install the CHGR in equipment rack as follows (refer to figures 2-1 and 2-2):

a. Pull out center sections of tracks, located in equipment rack, until they lock in extended position.

b. Position slide mechanisms of CHGR in tracks, and ease the unit into the rack until release fingers engage holes in tracks.

c. Depress release fingers and slide CHGR completely into rack; secure front panel of CHGR to the rack with screws and washers.

d. Make necessary electrical connections as described in paragraph 2-3.

NOTE

To prevent CHGR cables from snagging, attach reel-mounted springs (NEGATOR B motors) located inside the rack to the cables.

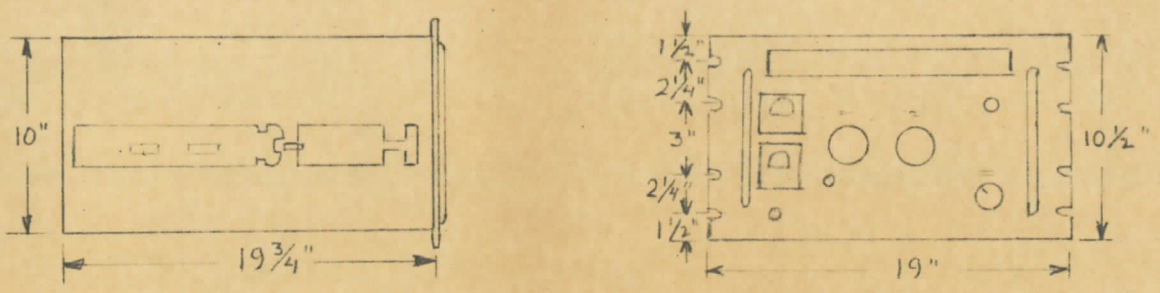

Figure 2-1. Dimensional Outline, CHGR

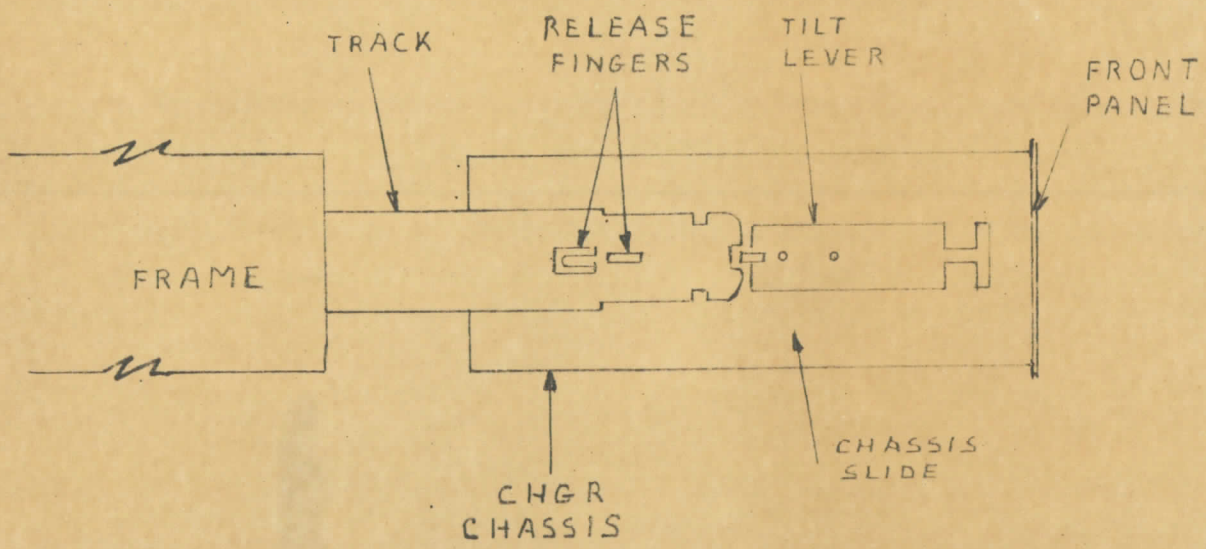

Figure 2-2. Tilt-lock Slide Mechanism Details

2-3. ELECTRICAL INSTALLATION.

a. INTERCONNECTIONS. - Refer to the installation section of the applicable system manual and make cabling connections between CHGR and related units, as indicated.

b. POWER SUPPLY. - CHGR is designed for 115- or 230-volt, 50- or 60-cycle, single phase power operation. CHGR is wired at the factory for 115-volt operation; if 230-volt operation is required, wiring changes must be made as indicated in figure 2-3.

c. INITIAL ADJUSTMENTS. - CHGR is checked at the factory in accordance with the manufacturer's specifications and therefore no initial adjustments are required before installation and operation.

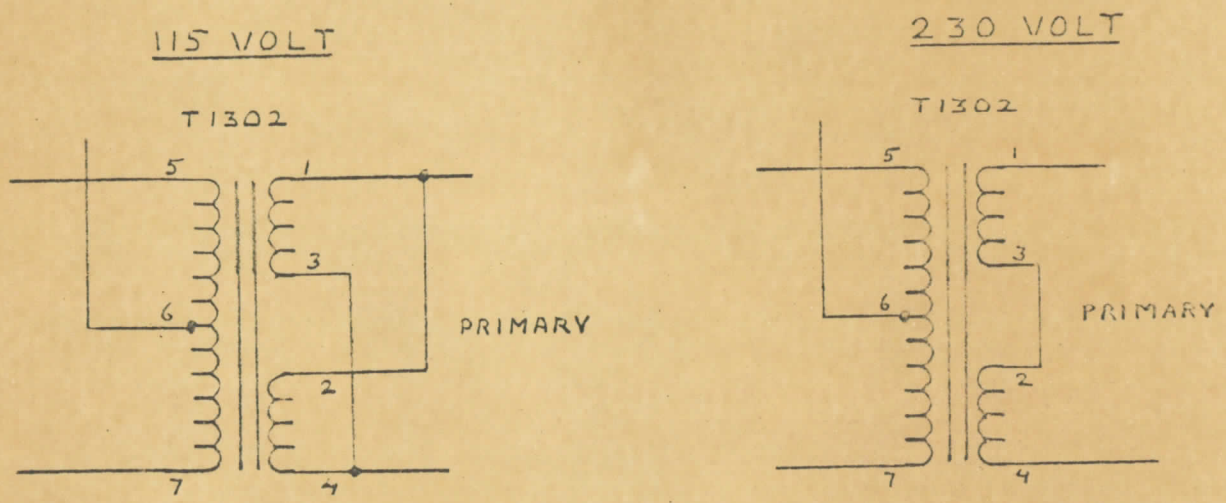

Figure 2-3. Transformer Wiring Diagram, CHGR

SECTION 3

OPERATOR'S SECTION

3-1. CONTROL AND INDICATOR FUNCTIONS.

The functions of the controls and indicators of CHGR are explained in table 3-1; all controls and indicators are identified by front panel markings, as shown in figure 3-1. CHGR operates in non-synthesized continuous coverage or in synthesized 100 cycle steps, within the frequency range of 2 to 32 megacycles (through eight RF bands).

3-2. OPERATING PROCEDURE.

CHGR is tuned to the desired frequency by the TUNE control after the appropriate frequency band and dial is selected by means of the BAND control. Procedures for synchronizing CHGR with other units for synthesized and non-synthesized operation are included in the appropriate system manual.

3-3. OPERATOR'S MAINTENANCE.

Observe operation of lamps and meters. Check controls for smooth operation. Check cable connections and wire terminals at rear apron.

TABLE 3-1. OPERATING CONTROLS AND INDICATORS

Item No. (See Fig. 3-1)	Control or Indicator	Function
1	MEGACYCLES dial	Displays illuminated RF band dial, selected by operating BAND control knob, item 3.
2	TUNE control	Moves pointer to appropriate frequency along dial of selected band. (TUNE control is fitted with a lock, item 6.)
3	BAND switch	Rotates MEGACYCLES dial, item 1, and switches in desired RF band, as follows: BAND 1 = 2 - 3 mc BAND 2 = 3 - 4 mc BAND 3 = 4 - 6 mc BAND 4 = 6 - 8 mc BAND 5 = 8 - 12 mc BAND 6 = 12 - 16 mc BAND 7 = 16 - 24 mc BAND 8 = 24 - 32 mc
4	SYNC IND lamp	Lights to indicate system is synchronized (indicates only when CHGR is in synthesized operation).
5	RF GAIN control	Controls amplitude of RF output signal.
6	LOCK knob	Locks TUNE control, item 2, to prevent accidental shift off selected frequency.
7	SYNCHRONIZE meter	Indicates amount and polarity of DC voltage. When system is out of synchronization, meter reads zero (meter functions only when CHGR is in synthesized operation).
8	RF LEVEL meter	Indicates strenght of antenna input signal or alignment signal in db above 1 μV.

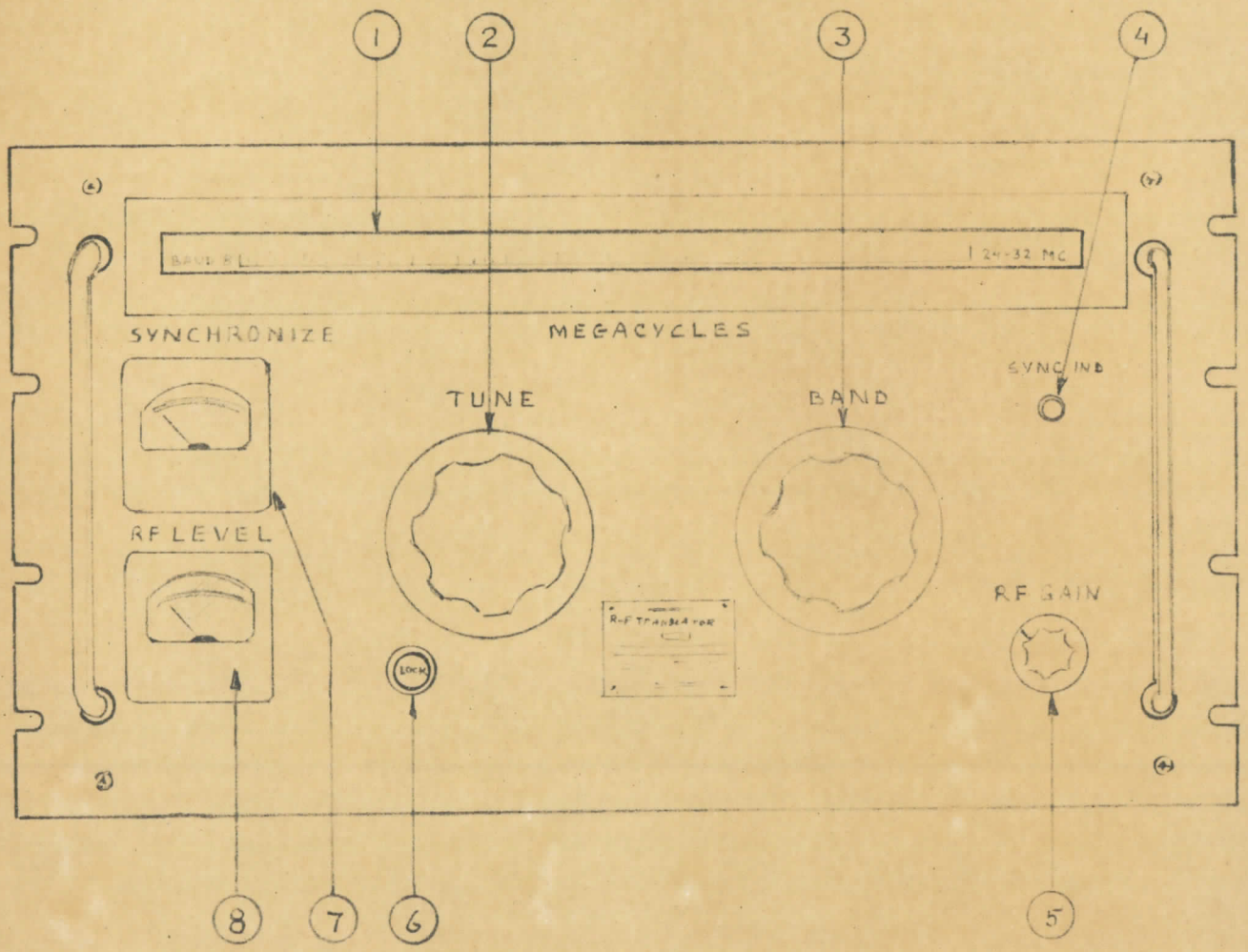

Figure 3-1. Controls and Indicators, CHGR-3

Figure 3-1. Controls and Indicators, CHGR

SECTION 4

PRINCIPLES OF OPERATION

4-1. GENERAL.

The R-F Translator receives a 1.75-mc signal and converts it to the 2- to 32-mc range. The R-F Translator consists basically of the high frequency balanced modulator, the high frequency oscillator, and three r-f amplifiers (refer to figure 4-1). A 1.75-mc signal (from associated sideband exciter) and a translating signal in the 3.75- to 33.75-mc range (from high frequency oscillator) is applied to the balanced modulator. The output of the balanced modulator (the difference product in the 2- to 32-mc range) is routed through three stages of tuned r-f amplification to produce the r-f output. The high frequency oscillator output is also made available for connection to the control synthesizer.

4-2. CIRCUIT ANALYSIS (REFER TO FIGURE 7-1).

a. HIGH FREQUENCY OSCILLATOR. - The HFO and isolation amplifier circuit comprises high frequency oscillator V1007, isolation amplifier V1006, tuning capacitor C1002, a Varicap circuit consisting of C1048, C1049, C1052, C1053, R1044, and R1045, and oscillator tuner strips A1002 through A1016, even-numbered assembly designations. Turret contacts engage fixed chassis contacts to connect V1007 and HFO SYNC INPUT jack J1311 to the required elements of oscillator tuner strips A1002 through A1016, tuning capacitor C1002, and the Varicap circuit.

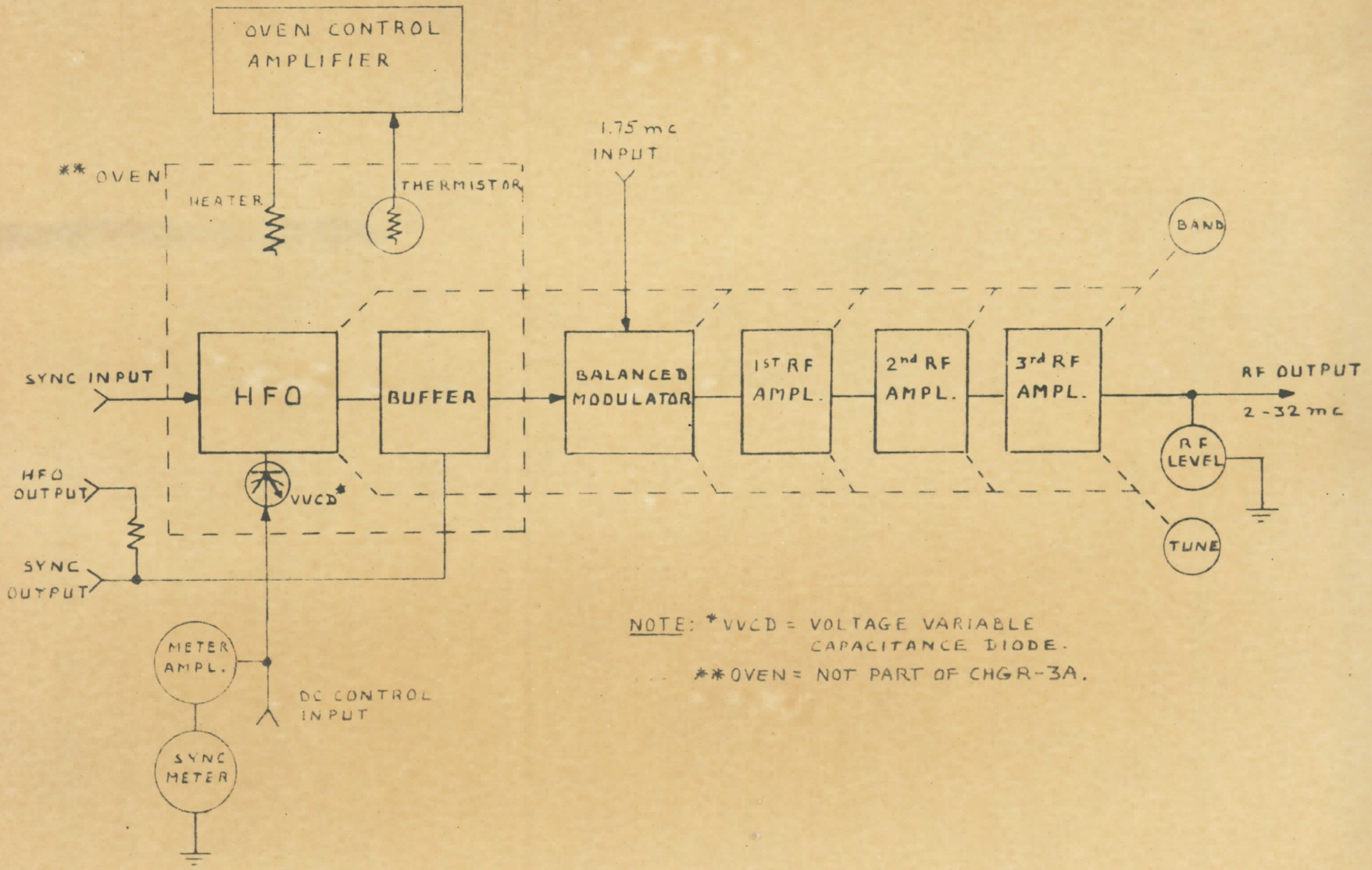

Figure 4-1. Functional Block Diagram, CHGR

The HFO is a modified Colpitts (Vacker) circuit.

In synthesized operation, HFO frequency is controlled by the Varicap circuit, shown in simplified schematic diagram figure 4-2. A d-c correction voltage from the associated synthesizer biases C1049 and C1051, thereby changing the capacity shunting C1002A and C1002B. The Varicap and tuning capacitors are shown in figure 4-2 connected to oscillator tuner strip A1002 (BAND 1 position); circuit configurations for oscillator strips A1004 through A1016 are similar. Both sections of C1002 are not utilized with all tuner strips; regardless of the tuner strip engaged, at least one Varicap control is inserted to pull the frequency as required.

Isolation amplifier V1006 presents a constant load to the grid of V1007 and thus prevents HFO frequency modulation.

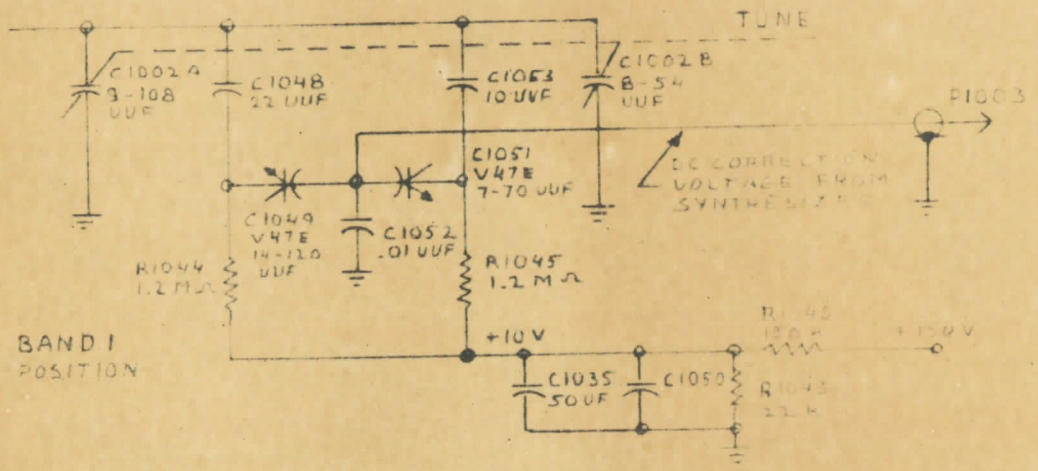

Figure 4-3. Simplified Schematic Diagram, Varicap

b. BALANCED MODULATOR AND R-F AMPLIFIERS. - Balanced modulator V1005 receives the 3.75 to 33.75 mc output of the high frequency oscillator. This signal is applied to the two halves of the tube in parallel, and the output of the stage is a push-pull circuit. The high frequency oscillator signal is, therefore, self-canceling. The 1.75 mc signal from the associated sideband exciter unit is applied to the balanced modulator in push-pull via jack J1312 and RF GAIN control R1011. The signals at the plates of V1005 include the 1.75 mc i-f input, the 4.5 to 34.5 mc sum products, and the 2- to 32-mc difference products. The tuning circuits for the balanced modulator and succeeding amplifier stages pass only the difference products. The balanced modular is self-biased by resistors R1006, R1007 and R1008; R1007 is adjusted so that the two halves of the tube conduct equally. Additional bias (ALDC voltage, automatic load and drive control) may be supplied to the grids via jack J1304. The balanced modulator is operative only when terminal 4 of TB1301 (KEY) is grounded.

Tubes V1004, V1003 and V1002 are linear r-f amplifiers. The tuning circuits for the modulator and r-f amplifiers comprise sections A through H of capacitor C1001 and tuner strips A1001 through A1015 (odd numbers). Tube V1004 is self-biased. The grid of V1003 is biased -9.5v with respect to ground by the voltage divider consisting of resistors R1010, R1018, and R1019. The grid of V1002 is biased -2.8 v with respect to ground by the voltage divider consisting of resistors R1010, R1023 and R1024. When pin 4 of TB 1301 (VOX) is ungrounded, V1003 and V1004 are cut-off by the -150 v RF LEVEL meter M1002 indicates the peak-envelope-power level of the r-f output signal.

The balanced modulator and r-f amplifiers are disabled by switch S1006, operated by a cam on the band switch shaft, whenever the band switch turret is not correctly positioned to connect the tuner strips to their associated circuits. S1006 is in series with the B+ line for the modulator and amplifier stages.

c. TUNING AND BAND-SWITCHING CIRCUITS. - The tuning and band-switching circuitry functions to select the desired band, and to position the dial for the desired frequency; both operations are performed by direct relays and stepping switch controls, which are controlled by remote equipment.

As shown in figure 4-3, a motor, a homing switch, a detent release solenoid and a cam switch are mechanically linked to the band switching shaft. Controlling voltage from external equipment actuates the band switch motor in the CHGR, moving the band switch control in search of the band selected by the remote equipment. The homing switch in the CHGR is activated by a master stepping switch in the external equipment, and stops the motor (by cutting off the power supply voltage) in the CHGR at the correct band.

As shown in figure 4-4, remote tuning is accomplished by external master and slave stepping switches which send controlling voltages to the CHGR tune control drive motors. (A relay controls the CHGR tune motor so that it is deactivated whenever the band-switching motor is activated.) External equipment circuitry determines whether the tune motor in the CHGR will search to the left or to the right on the band dial for the desired frequency.

Refer to the system manual for a detailed description of the of the remote tuning and band-switching operation.

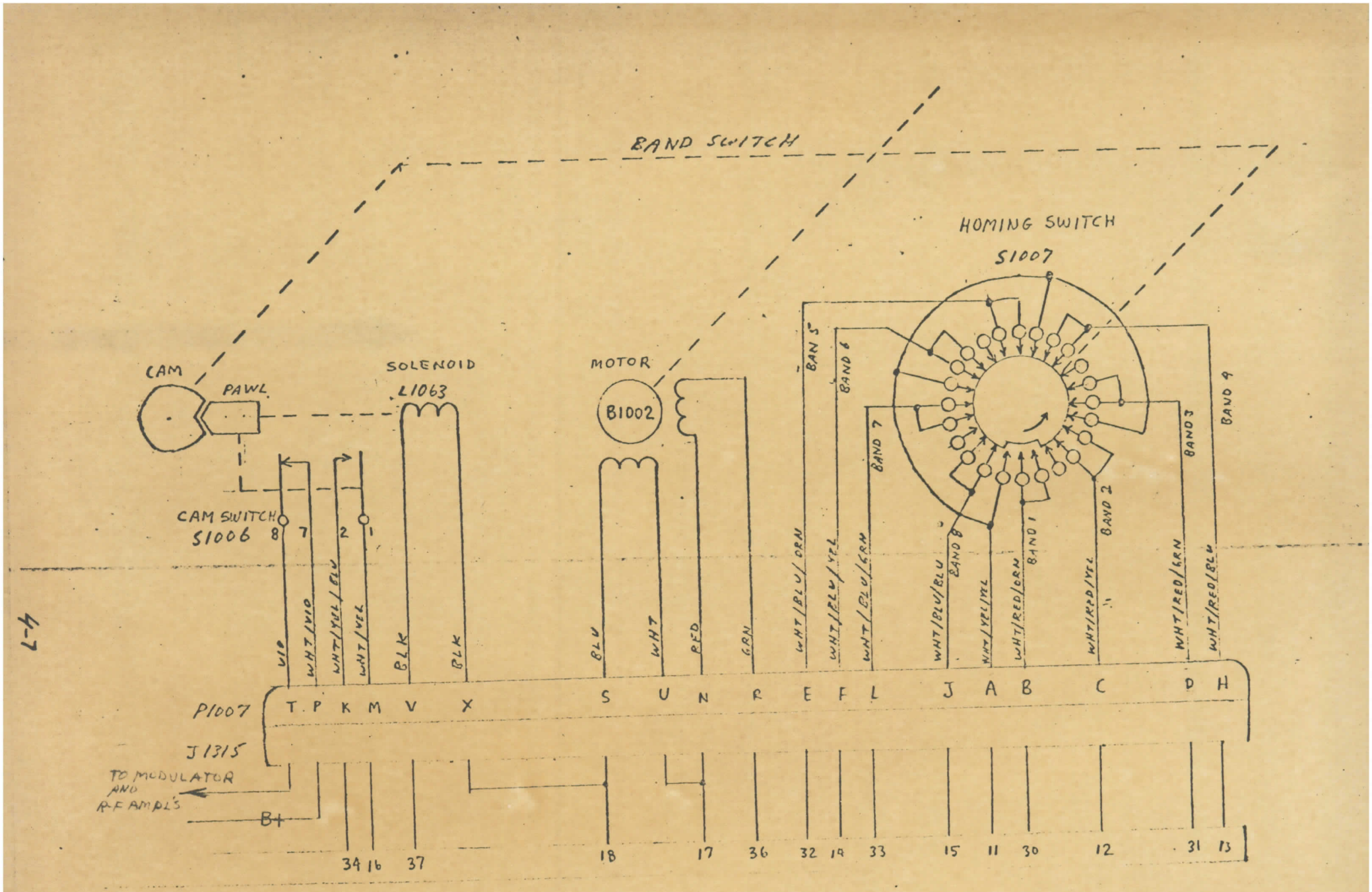

Figure 4-3. Automated Band Switch, Circuit Diagram, CHGR

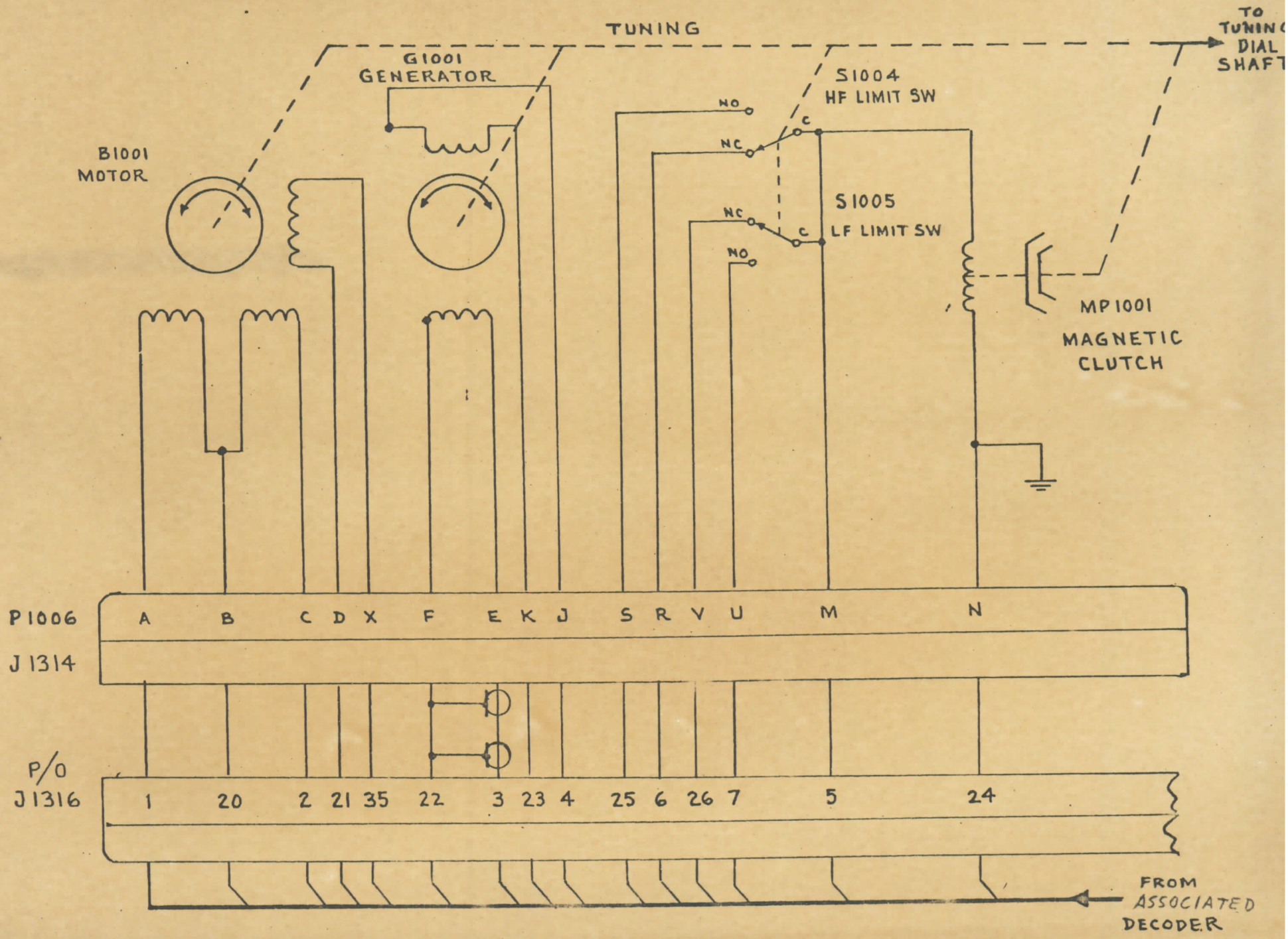

Figure 4-4. Automated Tune Control, Circuit Diagram, CHGR

d. POWER SUPPLY. - The low voltage power supply consists of transformer T1301 and a full wave bridge rectifier comprising diodes CR1301, CR1302, CR1303, and CR1304 (refer to figure 4-2). Line voltage (115- or 230-VAC) applied to the primary of transformer T1301 is stepped down to 61 VAC in the secondary, rectified by the full wave bridge, and dropped and regulated at 28 VDC ±5% by resistors R1331 and R1332, and diode CR1305. Plus 28 VDC is extended through jack J1305 to the frequency standard of the associated sythesizer. Plus 28 VDC is further dropped by resistor R1333 and regulated at 6.3 VDC by diode CR1306; 6.3 VDC is extended through jack J1306 to the HFO (V1007) filament. In addition to their normal function in the full wave bridge rectifier the diodes supply 32 VDC to J1316 for the associated control terminator circuits.

SECTION 5

MAINTENANCE

5-1. PREVENTIVE MAINTENANCE.

Periodically, remove the CHGR from the rack and inspect for general cleanliness and condition of connections at the rear of the unit. Remove all covers, and check all components for discoloration, damaged wiring, broken or loose solder connections, and corrosion. Clean the components with a soft brush, vacuum cleaner, or clean, dry, filtered, compressed air. Check all hardware for tightness.

WARNING

Electrical parts may be cleaned with any good dry-cleaning fluid, or with trichlorethylene. When using trichlorethylene or carbon tetrachloride, be sure that adequate ventilation exists in the area, and avoid prolonged skin contact with the fluid. Use caution when applying trichlorethylene near painted surfaces, as the fluid may act as a paint remover.

5-2. TROUBLESHOOTING (REFER TO FIGURE 7-1).

When the CHGR has been operating 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. Also, failure or malfunction of associated equipment may be reflected in the performance of the CHGR. Under such conditions it is unnecessary to follow a lengthy and systematic course of troubleshooting in order to isolate the faulty part.

After ascertaining that the malfunction is in the CHGR, remove the unit from the rack and apply the troubleshooting steps outlined in table 5-1.

SECTION 6

PARTS LIST

(To be supplied)

SECTION 7

SCHEMATIC DIAGRAM

(To be supplied)