Broadcast Products
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TV1E V/U

SOLID STATE
1 WATT VHF TRANSLATOR

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TV1E V/U

SOLID STATE
1 WATT VHF TRANSLATOR

BROADCAST PRODUCTS

★ TV1EV indicates VHF input
★ TV1EU indicates UHF input

07/99

IMPORTANT

Transient Overvoltage Protection

Transient overvoltage of micro- and nano-seconds durations are a continuous threat to all solid-state circuitry. The resulting costs of both equipment repairs and system downtime make preventative protection the best insurance against these sudden surges. Types of protection range from isolation transformers and uninterruptible power supplies to the more cost effective AC power line protectors. As transient culprits are most often lightning induction and switching surges, AC power line protectors are the most practical solution. An effective AC power line protector is one capable of dissipating impulse energy at a low enough voltage to ensure the safety of the electronic components it is protecting. The protection unit should be across the AC line at **all** times even during periods of total blackout. It should also reset immediately and automatically to be 100% ready for repeated transients.

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THE TV1E V/U TRANSLATOR

1.1 Introduction:

The EMCEE TV1E V/U Translator is designed to receive a single, composite, VHF or UHF television signal while simultaneously retransmitting that signal on any desired VHF channel. This transformation is accomplished by shifting the received information to an intermediate frequency and then converting that frequency to the required VHF output. The visual and aural carriers contained in the received signal are jointly amplified throughout the translator's frequency conversion process using linear, class A, transistor amplifiers. Incorporating AGC circuitry, the TV1E V/U is capable of providing a constant (±1dB) 1 watt peak visual output with a received signal variation of 40dB. Combined with this output, the TV1E V/U is rated to deliver a maximum of 100mW average aural power.

The TV1E V/U is completely solid state, modular in design, and composed of four individual sections. Three of these sections, the Downconverter, IF Section, and Upconverter are contained in the translator drawer. The fourth section is the Power Amplifier drawer which contains the necessary power supplies and power amplifier modules.

The TV1E V/U is compatible with NTSC, PAL, and SECAM color systems and can be tuned to accommodate any CCIR International Television Standard bandwidth up to 8MHz. The TV1E V/U is designed for the express purpose of broadcasting as authorized by the Federal Communications Commission under Part 74, Subpart G of the FCC Rules and Regulations.

1.2 Specifications:

Output Power	1 watt peak visual 0.1 watt average aural
Emissions	Visual - 5M75C3F Aural - 250KF3E
Output Frequency	FCC Ch.2-6 (54-88MHz) FCC Ch.7-13 (174-216MHz) CCIR Band I, III
Input Frequency	FCC Ch.2-6 (54-88MHz) FCC Ch.7-13 (174-216MHz) FCC Ch.14-69 (470-806MHz) CCIR Bands I, III, IV, V
Color Transmission	Compatible with NTSC, PAL, and SECAM systems
Bandwidth	FCC - 6MHz @ 1dB CCIR - 6 to 8MHz @ 1dB

Input Signal	
with preamplifier	-85dBm to -45dBm
without preamplifier	-70dBm to -30dBm
Output Power Variation	<±1dB with a 40dB input signal variation
Frequency Tolerance	±1kHz
Intermodulation Products	>54dB below peak sync
Spurious Output	>40dB below peak sync
Harmonic Output	>60dB below peak sync
Differential Gain	3% maximum
Differential Phase	3° maximum
Noise Figure	3dB maximum with preamplifier
Translator ON/OFF	Automatic with input signal
Input Impedance	50 ohms
Output Impedance	50 ohms
Ambient Temperature	-30°C to +50°C
Power Requirements	115Vac @ 60Hz, 175W 220Vac @ 50Hz (OPTIONAL)
Mechanical Dimensions	
Translator drawer	3.5"H x 19"W x 21.5"D
Power Amplifier drawer	5.25"H x 19"W x 24.5"D
Weight	
with cabinet	75 lbs.
without cabinet	50 lbs.

1.3 Installation:

The connectors mentioned in the following instructions are located on the rear of the equipment.

1. After unpacking the TV1E V/U, a thorough inspection should be conducted to reveal any damage which may have occurred during shipment. If damage is found, immediately notify the shipping agency and advise EMCEE Broadcast Products (Customer Service) or its field representative. Also check to see that a Remote Preamplifier (if ordered) is included, along with any connectors, cables, or miscellaneous equipment which may have been ordered separately.

2. It is recommended that the TV1E V/U be placed in a clean, weatherproof environment with adequate ventilation provided for the heat sink and exhaust fan at the rear of the Power Amplifier drawer. Insure that the TV1E V/U's ambient temperature does not exceed the -30°C and +50°C limits.

3. Place the TV1E V/U in its permanent location near a 120Vac, 60Hz, single-phase receptacle. Unless the customer has specifically requested a power requirement of 220Vac at 50Hz, the TV1E V/U will operate only from a 120Vac source. The ac source should have a minimum power capacity of 200 watts.

> IMPORTANT
>
> Do not apply ac power to the TV1E V/U at this time since its RF output must be properly loaded before being placed in operation.

4. Place an appropriate ac power line protector (surge suppressor) across the ac line that supplies the translator.

5. Connect the transmitting antenna cable to the Power Amplifier drawer's RF OUT connector (J2).

NOTE: If your TV1E V/U is already packaged in a cabinet, proceed to step #8; otherwise, continue with step #6.

6. Locate the type N-to-N connector cable supplied by EMCEE. Fasten this cable to the translator drawer's RF OUT connector (J2) and the Power Amplifier drawer's RF IN connector (J1).

7. Locate the dc harness supplied by EMCEE. Each end of the harness has different type plugs that cannot be connected to the wrong drawer. Fasten one end of the harness to the translator drawer's CONTROL connector (J3) and the opposite end to the Power Amplifier drawer's DC connector (J4).

8. Mount the Remote Preamplifier (if required) on the receiving antenna tower as close to the antenna as possible. Attach the output of the antenna to the Remote Preamplifier's IN connector. To the Preamplifier's OUT connector, attach the receiving antenna cable which leads to the translator's input.

9. Attach the receiving antenna cable and the preamplifier power supply coupler to the translator drawer's RF IN connector (J1).

10. Check the dc harness and RF cables to insure that they are connected properly.

11. Plug the TV1E V/U's ac power cord into a receptacle that supplies 120Vac at 60Hz unless operation at 220Vac and 50Hz was specifically requested by the customer.

1.4 Operation:

Assuming the installation instructions of section 1.3 have been completed and the TV1E V/U is receiving the proper input signal, proceed with the following steps to place the translator in operation. The controls, switches, and indicators mentioned in these steps are located on the front of the equipment.

1. For the translator drawer, turn its POWER ADJUST control fully counterclockwise and place its OPERATE/ALIGN switch to OPERATE and its OUTPUT AGC switch to OFF.

2. For the Power Amplifier drawer, place its POWER circuit breaker to ON and its % POWER switch to FWD.

    a. Verify that its front panel test points provide the proper voltage indications.

    b. Verify that its rear panel fan is operating.

    c. Verify that the translator drawer's CARRIER PRESENT indicator is illuminated green. When illuminated, this LED indicates that the TV1E V/U is receiving a VHF or UHF visual carrier of correct frequency and sufficient amplitude.

    d. Verify that its FINAL ON indicator is illuminated green. This indicator should light approximately 10 seconds after the POWER circuit breaker is placed to ON. When illuminated, this LED indicates that +28Vdc is applied to the 1W VHF Amplifier module.

3. Turn the POWER ADJUST control clockwise until a 100% indication appears on the % POWER meter. When the TV1E V/U is properly calibrated as outlined in section 3.4, a 100% reading on this meter indicates an output of 1 watt peak visual and 100mW average aural assuming the input signal is composed of 10% aural power.

4. Place the OUTPUT AGC switch to ON. The % POWER meter should still read 100%. If the reading is incorrect, vary the translator drawer's OUTPUT AGC ADJUST control for a 100% indication.

5. Place the % POWER switch to REFLD. The % POWER meter should show no more than 10% returned power. If the reflected power is more than 10%, shut down the system and check the VSWR of the transmitting antenna and its associated transmission cable.

6. Place the % POWER switch back to FWD for constant monitoring of the TV1E V/U output power.

The TV1E V/U Translator is now in operation. Check the system's coverage area for clean, sharp television reception. If the reception or picture quality is unsatisfactory, examine the amount of power delivered to the transmitting antenna (see section 3.4) and, if necessary, examine the antenna orientation, antenna VSWR, and transmission line VSWR to insure maximum radiation in the proper direction.

1.5 Warranty and Parts Ordering:

Warranty – EMCEE warrants its equipment to be free from defects in material and workmanship for a period of one year after delivery to the customer. Equipment or components returned as defective

(prepaid) will be, at our option, repaired or replaced at no charge as long as the equipment or component part in question has not been improperly used or damaged by external causes (i.e., water or lightning). Semiconductors are excepted from this warranty and shall be warranted for a period of not more than ninety (90) days from date of shipment. Equipment or component parts sold or used by EMCEE, but manufactured by others, shall carry the same warranty as extended to EMCEE by the original manufacturer.

Equipment Returns – If the customer desires to return a unit, drawer, or module to EMCEE for repair, follow the procedure described below:

1. Contact EMCEE Customer Service Department by phone or fax for a RETURN AUTHORIZATION NUMBER.

2. Provide Customer Service with the following information:

   Equipment model and serial numbers.
   Date of purchase.
   Unit input and output frequencies.
   Part number (PN) and Schematic Diagram designator if a module is being sent.
   Detailed information concerning the nature of the malfunction.

The customer shall designate the mode of shipping desired (i.e., Air Freight, UPS, Fed Ex, etc.). EMCEE will not be responsible for damage to the material while in transit. Therefore, it is of utmost importance that the customer insure the returned item is properly packed.

Parts Ordering – If the customer desires to purchase parts or modules, utilize the following procedure:

1. Contact EMCEE Customer Service by phone or fax indicating the customer's purchase order number. If the purchase order number is provided by phone, written confirmation of the order is required.

2. Also provide:

   The equipment model and serial number.
   The unit input and output frequencies.
   The quantity, description, vendor, number, and designation of the parts needed as found in the Spare Module and Component Lists section of this manual.
   If a module is required, give the part number (PN) and Schematic Diagram designator (i.e., B331-44).
   Designate the mode of shipping desired (i.e., Air Freight, UPS, Fed Ex, etc.).
   Shipping and billing addresses.

Spare and Replacement Parts – The Spare Modules and Components section of this manual provides a listing of the modules and some discrete components contained within the transmitter or translator. This list contains those modules or components considered to be essential bench-stock items and should be available to the maintenance technician at all times. The Schematic or Interconnection Diagram is the governing document of this manual. Should there be a discrepancy between a modules or components list and a diagram, the diagram takes precedence. Such a discrepancy is possible since manufacturing changes cannot always be incorporated immediately into the instruction manual.

Component Referencing – The transmitter/translator consists of a number of modules mounted in one or more drawers. Components mounted in a module take the drawer number and the module number in addition to a component number. Thus the reference designator A1AR1Q1 means transistor Q1 in module AR1 of drawer A1. Components mounted in a drawer take only the drawer number and a component number (i.e., A1S1 designates switch S1 of drawer A1). Components mounted directly to the cabinet take only a component number.

For EMERGENCY technical assistance, EMCEE offers a toll free, 24-hour, 7-day-a-week customer service hot line – 1-800-233-6193.

SECTION II

CIRCUIT DESCRIPTION

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CIRCUIT DESCRIPTION

2.1 Translator Drawer:

Interconnection Diagram 30331001/Rev A (VHF Input Crystal Oscillator) ★ A1
Interconnection Diagram 30331173/Rev C (UHF Input Crystal Oscillator) ★ A1
Interconnection Diagram 30331324/Rev 52 (VHF Input Synthesizer) ★ A1
Interconnection Diagram 30331328/Rev 52 (UHF Input Synthesizer) ★ A1

Nominal Input	-30dBm to -70dBm
Nominal Output	0dBm
LO Samples	-10dBm

The translator drawer provides highly selective signal conversion, amplification and prevention of unauthorized radiation if the proper input signal is not received. Additionally, it insures that the TV1E V/U does not exceed or deviate from its rated power while receiving signal variations of up to 40dB (-30dBm to -70dBm). This is accomplished through a complex gain control system employing Input and Output AGC circuits. The translator drawer is composed of three individual sections: the Downconverter, IF Section and Upconverter.

The DOWNCONVERTER section is essentially the receiver or front end of the translator. Under normal applications, this section will receive its designated VHF or UHF television signal from a remote preamplifier attached to the receiving antenna. If the incoming signal is strong enough however, the remote preamplifier can be eliminated and the Downconverter will be fed directly by the antenna. The received signal is then filtered, amplified and mixed with the output of a local oscillator. The LO is generated by a 10MHz Reference Oscillator and Synthesizer unless an offset is required, in which case a Crystal Oscillator and Multiplier are used. The resulting difference product at the output of the mixer in the Downconverter/Preamplifier is then separated, amplified and fed to the IF Section.

The IF SECTION is the signal processing and control center of the translator. Here the IF signal, taken from the Downconverter, is further amplified and fed through an extremely selective surface acoustic wave (SAW) filter. If the translator's input signal power fluctuates or the gain of the final amplifier changes (during warm-up, over long periods of time and under varying temperatures), the automatic gain controls located in the IF Section will compensate for both variations, keeping the unit's output power constant. After amplification, filtering and gain control, the IF signal is fed to a precorrector network (optional) which provides limited correction for slight nonlinearities inherent in the translator's amplifiers or in the received signal. From here the IF signal is fed to the Upconverter through a manual output power adjustment. This variable attenuator controls the amount of power delivered to the Upconverter, consequently controlling the amount of power at the output of the translator.

The UPCONVERTER is the final segment of the translator drawer. Its primary purpose is to convert the IF Section signal to the prescribed VHF frequency and then amplify that signal to the proper output level. The signal delivered by the IF Section is fed to the Upconverter's mixer circuit where it is combined with the output of a local oscillator. The LO is generated by a 10MHz Reference Oscillator and Synthesizer unless an offset is required, in which case a Crystal Oscillator and Multiplier are used. At the mixer's RF port, a bandpass filter selects the appropriate product which will be amplified before entry into the Power Amplifier drawer.

– – – DOWNCONVERTER SECTION – – –

2.1a VHF/UHF Remote Preamplifier: (OPTIONAL)

Scala Model 8000

Specifications	See Data Pak

2.1b VHF Bandpass Filter:

Schematic A280-92/Rev 1 (Ch.2-6) ★ A1FL1
Schematic A280-89/Rev 1 (Ch.7-13) ★ A1FL1

Frequency Response (J1-J2)	7MHz @ 1dB
Insertion Loss (J1-J2)	-2dB Max.

The high band VHF bandpass filter is a two-section overcoupled circuit that rejects all frequencies other than the single VHF channel to which it is tuned. The bandpass filter is tuned to provide a 7MHz @ 1dB frequency response with an insertion loss of approximately 2dB or less. In the filter, inductors L3 and L4, in conjunction with stagger-tuned capacitors C1 through C4, provide the required bandpass response. Capacitor C5 also effects the response by changing the effective coupling between the two circuits. Impedance matching is accomplished by inductors L1 and L2 along with variable capacitors C1 and C2.

2.1c UHF Bandpass Filter:

Schematic A284-6/Rev B (Ch.14-83) ★ A1FL1

Frequency Response	7MHz @ 1dB
Insertion Loss	2dB Max.

The filter is composed of two overcoupled, 1/4 wave coaxial cavities that reject all frequencies other than the single UHF channel to which it is tuned. When used in the RF amplifier chain, the UHF Filter provides a 7MHz bandwidth at 1dB and the filter has an insertion loss of 1dB or less. In the filter, components L2 and L3 are solid brass rods acting as 1/4 wave shorted transmission lines. The length of these lines, controlled by variable capacitors C1 and C2, dictates the resonant frequency of the filter. Inductors L1 and L4 link couple the UHF signal into and out of the filter. The position of these two inductors in relation to the 1/4 wave brass rods determines the filter's input and output impedance, as well as skirt selectivity and insertion loss. The Variable Coupling Barrier regulates the amount of signal passed between the two coaxial cavities and therefore controls the bandwidth of the filter.

2.1d Crystal Oscillator:

Vectron CO-254D57 ★ A1G1

Supply Voltage	28V
Output Power	+13dBm
Operating Temperature	-30°C to +70°C
Stability	$\pm 5 \times 10^{-7}$

The CO-254D57 is a high stability, temperature-compensated crystal oscillator (TCXO) manufactured by Vectron Laboratories, Inc. This oscillator, in conjunction with a X2, X4 or X16 Multiplier, is used in place of the EMCEE Synthesizer when ±10kHz precision offset is required. See Data Pak for further information.

2.1e X2 Multiplier and X4 Multiplier:

Schematic B280-35/Rev E (Ch.2-6) ★ A1A3 (X2 Multiplier)
Schematic C331-24/Rev D (Ch.7-13) ★ A1A3 (X4 Multiplier)

	Multiplier	Q1	Q2	Q3
Collector V		25	15	15
Output Power	10-40mW			
Output Frequency	Osc. 2nd/4th Harmonic			

The VHF Multiplier consists of an amplifier and two doubler stages fed by the fundamental frequency of the HSO-9 Crystal Oscillator. Transistor Q1 is an untuned class A VHF amplifier coupled to a resonated idler loop tuned to the fundamental frequency (series circuit L3 and C7). Transistor Q2 is a class AB X2 frequency multiplier that feeds an LC series circuit (L5, C12) tuned to the second harmonic. Capacitors C13 through C17 and inductors L6 through L8 make up a three-section bandpass filter which passes only the second harmonic frequency. If the multiplier is a X4 type, transistor Q3 is a class C frequency doubler with both input and output tuning. Tuning consists of a second harmonic idler circuit (L9 and C19) at the input and an output network (L12, C22 and C23) that is tuned to the oscillator's 4th harmonic. C26 through C29 and inductors L13 and L14 make up a two-section bandpass filter tuned to pass the oscillator's fourth harmonic. An LO sample (≈1mW) port (J3) is provided on the front panel of the translator drawer for convenient monitoring or mixing.

2.1f X16 Multiplier:

Schematic Diagram 30367226/Rev A ★ A1A3

INPUT power	0 to +10dBm Typical +4dBm
LO OUT (J2)	
Output power	+15dBm Min.
Output frequency	16th harmonic of input
Gain (J1-J2)	Typical 14dB ± 1dB

The X16 Multiplier provides three sections of frequency multiplication.

Section 1 consists of a frequency multiplier (A1), a bandpass filter (FL1), and an amplifier (U1). A1 produces harmonics from the input signal of the Crystal Oscillator. The desired harmonic from A1 is the fourth, whose level should typically be 30dB below the oscillator level (-26dBm to -30dBm). FL1 is a narrow bandpass filter, which also employs two tunable notch filters. When properly tuned, FL1 has a typical insertion loss of 2 to 2.5dB. The notch filters are tuned to the 3rd and 5th harmonics providing an additional minimum attenuation of 15dB to these harmonics. Output level from FL1 is approximately -28 to -32dBm. U1 is a monolithic amplifier with a typical gain of 33dB at these frequencies. U1 provides the nominal level of 0dBm for the next section of frequency multiplication.

Section 2 consists of a frequency multiplier (A2), a filter FL2, and a two-stage amplifier (U2, U3). A2 produces harmonics of the signal from section 1. The desired frequency from this section is the 2nd harmonic of the input (8th harmonic of OSC.). The output level of A2 at the 2nd harmonic is typically -15dBm. FL2 is a tunable microstrip bandpass filter. The filter has a frequency range of 250-470MHz, an insertion loss of 2dB and is tuned to pass the 2nd harmonic of A2. The output level from FL2 is a nominal -17dBm. U2 and U3 are monolithic amplifiers with a combined typical gain of 25dB. These are used to produce an input level of +8dBm to the third section.

Section 3 consists of a frequency multiplier (A3), two different stages of amplification (U4 and U5, U6), and two filters (FL3, FL4). A3 is used to produce harmonics of the frequency from Section 2. The desired frequency from A3 is the second harmonic of its input (16th of OSC.). Output level of the second harmonic from A3 is typically -6dBm. U4 is used to amplify the output of A3 before filtering by FL3. The output level of U4 at the 2nd harmonic of A3 is at a nominal 2dBm level. FL3 is a tunable microstrip bandpass filter with a frequency range of 500-940MHz and an insertion loss of 2dB. The filter is tuned to the 2nd harmonic of A3. The output level of FL3 is 0dBm. U5 is a monolithic amplifier with a 12dB gain. U5 is run in compression allowing the oscillator level to vary while the output of U5 remains constant. The output of U5 drives U6, another monolithic amplifier with a gain of 11.5dB. This amplifier is also operated in compression for the same reason as U5. The output of U6 is +18 to +20dBm. FL4 is tuned for the second harmonic from A3 and provides additional filtering to suppress the undesired harmonics from previous frequency multiplication. Secondly, the filter removes any additional undesired signals caused by compressing amplifiers U5 and U6. The output level from FL4 is typically +16dBm to +18dBm.

2.1g 10MHz Reference Oscillator:

Schematic Diagram 10368037/Rev B ★ A3A2

10MHz REF. OUT (J1, J2) 3.5V P/P square wave

The Reference Oscillator provides a 10MHz reference signal for the Synthesizer (A3A1). This module is centered around a 10MHz temperature-compensated crystal oscillator (G1). The output from G1 is applied to two exclusive-OR gates used as inverting buffers. The output signal from each gate is a 10MHz low-level square wave with a frequency stability of 3 parts per million (PPM).

2.1h VHF Synthesizer:

Schematic Diagram 30362003/Rev D ⋆ A3A1 (Band III)
Schematic Diagram 30362427/Rev C ⋆ A3A1 (Band I)

10MHz REF. IN (J1)	3.5V P/P square wave
LO OUT (J2)	+13dBm min. (see Table 2–1 for freq.)
SYNTH. LOCK (Pin A of J4)	logic high (locked)
	logic low (unlocked)

The VHF Synthesizer uses one of the 10MHz reference signals from the Reference Oscillator (A3A2) and develops a programmable LO signal for the Mixer in the Downconverter/Preamplifier (A1A1). The frequency of the LO signal is calculated as the sum of the visual IF carrier and the visual VHF carrier of the specified output channel. The LO signal's frequency is programmed by switches S1 through S4 which are accessible through the top cover of the module. The relationship between the settings of these switches and the resulting LO frequency is provided in Table 2–1 for each channel.

2.1i UHF Synthesizer:

Schematic Diagram 30367094/Rev B ⋆ A3A1

10MHz REF. IN (J1)	3.5V P/P square wave
LO OUT (J2)	+15.25dBm min. (see Table 2–2 or 2–3 for freq.)
SYNTH. LOCK (Pin A of J4)	logic high (locked)
	logic low (unlocked)

The UHF Synthesizer is a phase-lock loop type and uses one of the 10MHz reference signals from the Reference Oscillator (A3A2) and develops a programmable LO signal for the Mixer in the Downconverter/Preamplifier (A1A1). The frequency of the LO signal is calculated as the sum of the visual IF carrier and the visual UHF carrier of the specified output channel. The LO signal's frequency is programmed by the setting of switches S1 through S4 which are accessible through the module's cover via access holes on the right lower side wall of the transmitter drawer. The relationship between the setting of these switches and the resulting LO frequency is provided in Table 2–2 or 2–3 for each UHF channel.

A 10MHz reference signal is brought in from the Reference Oscillator (A3A2) through J1, 10MHz IN. Both sections of U4 perform binary divide-by-5 counting to provide a 400kHz signal to the OSC_{in} input of U1, pin 27. To create U1's internal 50kHz reference signal, U1 performs a binary divide-by-8 operation on the OSC_{in} signal.

Controlling the VCO, G1, is the output of op-amp U3. U3 compares and integrates the ϕ_V and ϕ_R phase detector outputs of U1. The output of U3 is filtered to create the dc control voltage for the VCO. The output of G1, RF OUT, is amplified by U5 and available as the transmitter's LO at J2, OUT.

The output of G1 is also amplified by U6 and then fed to a +64/+65 prescaler, U2. After prescaling, the signal is connected to U1 pin 1, F_{in}, from U2 pin 4, OUT, completing the loop. The prescaling factor of U2 is selected by the MOD CONTROL, pin 9, of U1. Switches S1 to S4 set two divide-by-ratios, counters A and N, within U1. When divide-by-A is being performed on the signal

at F_{in}, MOD CONTROL is set high, selecting +64 in the prescaler, U2. MOD CONTROL goes low for divide-by-N selecting +65 in U2.

The A and N counters form a binary number from A0 to N9 with A0 being the LSB and N9 being the MSB. The decimal equivalent of this number, when multiplied by the internal reference frequency 50kHz, gives the synthesizer's output frequency. Hence, for NTSC operation, A0 and A1, pins 21 and 23 on U1, are grounded. For PAL operation, A0 and A1 are made high by cutting the traces from pins 21 and 23 to ground thereby adding the 150kHz to the LO that is characteristic of the PAL system.

When the synthesizer is locked onto a frequency, LD is high. This saturates Q1 and puts a low on SYNTH LOCK. C28 provides a time delay to ensure that the synthesizer has successfully locked before indicating so on the SYNTH LOCK line. For an unlocked condition, LD pulses low preventing C28 from charging and saturating Q1. +5V is therefore present on the SYNTH LOCK line for the unlocked condition.

2.1j Downconverter/Preamplifier:

Schematic A331-29/Rev B ★ A1A1

Gain with Conversion (J1-J2)	3.0dB
Collector V (Q1)	7.9V
LO Input (Min.) (J3)	+7dBm

The Downconverter preamplifier (A1) consists of a single stage, low noise, broadband amplifier with a double balanced mixer. The VHF or UHF input signal is coupled to Q1 where it is amplified before driving the mixer. The mixer combines the composite VHF or UHF television signal from Q1 with a constant amplitude unmodulated RF signal (LO) from the reference oscillator/synthesizer pair or the crystal oscillator/multiplier pair. Both signals are heterodyned in the mixer where their sum and difference frequencies are developed. Capacitors C10 through C13 along with inductors L4 through L7 comprise a low-pass filter network allowing only the modulated difference frequency (IF) to pass.

– – – IF SECTION – – –

2.1k IF SAW Filter/Amplifier:

Schematic B331-21/Rev D ★ A1A2

	Q1	Q2	Q3	J1-J2
Gain				21dB
Collector V	15V	18V	11V	
Collector I	16mA	56mA	16mA	

The IF Surface Acoustic Wave (SAW) Filter/Amplifier is a three-stage amplifier. Transistors Q1/Q2 amplify the IF input signal while their associated feedback networks maintain a flat

passband response. The SAW filter provides high selectivity with no need for tuning or alignment. Transistor amplifier Q3 overcomes the loss associated with the SAW filter. Its feedback circuitry is also designed to compensate for nonlinear gain characteristics (i.e., lower gain at the higher frequencies).

2.1l IF AGC Amplifier:

Schematic C331-37/Rev G ★ A1AR1

	Q1	Q2	Q3	J1-J2
Gain				0-40dB
Collector V	20V	25V	23V	
Collector I	5mA	27mA	60mA	
Power Output				+2dBm

The IF AGC Amplifier is a variable gain circuit with its own automatic gain control section. It is calibrated to provide a constant output level of +2dBm with a Downconverter section input range of -60dBm to -20dBm. The amplifier portion consists of three common emitter RF transistor stages (Q1, Q2, Q3) that produce a combined gain of ≈50dB. Overall gain is adjustable via R15 (GAIN ADJ) by varying the amount of Q1's emitter bypass. Q2 and Q3 are fixed bias amplifiers separated by a 9dB 50 ohm matching pad (R22, 23, 24). Q3's feedback network consisting of TILT potentiometer R31, inductor L2 and capacitor C12 is designed to compensate for the overall frequency characteristics of the module. TILT potentiometer R31 controls the amplifier's frequency response by varying the amount of Q3's negative feedback.

The automatic gain control portion is centered around op amp U1. A portion of the IF signal is coupled off of Q3 to a tank circuit (C14, L3) tuned to the visual carrier frequency (45.75MHz). The tank energy forward biases detector diode CR8 and then becomes filtered by an RC network (C13, R29) where it becomes a negative dc voltage proportional to the peak value of the visual signal. U1 will produce a positive voltage (AGC) proportional to the IF signal level. This positive AGC voltage serves three purposes: It controls the biasing (thus attenuation) of the pin diodes (CR1, 2, 4); it supplies the limiter circuit with a working reference voltage; and it activates the automatic-on circuit.

NOTE: When the front panel Operate/Align switch is in the Align position, the IF AGC Amplifier's AGC is replaced by a fixed reference voltage (+5V).

2.1m Precorrector: (OPTIONAL)

Schematic A274-36/Rev E ★ A1A4

Insertion Loss (J1-J2) ≈3dB

The IF Precorrection network is used to change the characteristics of the video signals being amplified by the translator. It compensates for the linearity distortions, normally associated with any wideband amplifier, by generating signals opposite in phase with the original distortion. The result is a cancellation of distortion and a significant reduction in the degradation of the signals

passing through the unit. The Predistortion Network has the capability of simultaneously improving the differential gain, intermodulation distortion and sync amplitude of the transmitted signal. Adjustment of the network is limited to two controls (R6, R8) accessible through the holes on the top of the module. The third control (R10) is used to insure that the circuit's frequency response is flat.

2.1n Power Adjust:

Schematic 10331255/Rev A ★ A1AT1

Insertion Loss 5-30dB

The Power Adjust is a dual ganged 50 ohm potentiometer with two 51 ohm resistors added so that it is configured to function as a variable bridged "T" attenuator.

2.1o Limiter/Output AGC:

Schematic B331-34/Rev C ★ A1PC1

The Limiter/Output AGC PC board is a dual monitoring and control circuit. The Limiter prevents the translator's output amplifier stages from being overdriven when the input signal returns to normal after periods of signal loss or reduction. The Output AGC circuit compliments the IF amplifier's Input AGC by compensating for gain variations after the IF Section.

With the Upconverter's front panel AGC switch set to ON and the Operate/Align switch set to OPERATE, the Upconverter's front panel AGC ADJUST potentiometer (R3) controls the pin diode attenuation in the IF AGC Amplifier which, in turn, controls the output power of the translator. On the Limiter/Output AGC board the Output AGC summing circuit U1A tracks the translator's output power metering voltage from the peak detector. Variations in peak output power will affect the AGC REFERENCE voltage set by R8. (AGC REFERENCE potentiometer R8 is the level adjustment that establishes the AGC's operating level in accordance with the translator's output power.) Variations in output power will produce a proportional Output AGC voltage from U1B. This Output AGC voltage is fed back to the IF AGC Amplifier. This reference voltage compensates for translator gain variations that occur after the IF AGC Amplifier.

NOTE: When the Operate/Align switch is in the ALIGN position, +5 volts from the Multi-Output Power Supply (PS1) is applied directly to the IF Amplifier AGC line (AR1J3-1). This voltage facilitates the alignment process by manually replacing the lost AGC voltage that accompanies a loss of input signal. The signal dependent Automatic-On circuit and the pin diode biasing of the automatic gain control circuit are essentially kept in operation. With the correct input signal and the switch in the Operate position, the +5 volts is removed and replaced by the Input AGC voltage thus allowing the Auto-On and AGC circuits to resume normal operation.

During a temporary loss or reduction of the input signal, the IF AGC voltage decreases and the pin diodes of the IF AGC Amplifier cannot attenuate the input signal fast enough once the input regains its strength. However, using the faster AGC voltage from U1B of the IF AGC Amplifier, the Limiter's exponential amplifier U2 quickly responds by turning on transistor Q4 of the IF AGC Amplifier. This reverse biases PIN diode CR9 of the IF AGC Amplifier thus reducing the IF output

by approximately -20dB. The limiter releases its attenuation after the AGC has had time to "catch up". Limiter Adjustment potentiometer R13 is set to activate the Limiter when the output of the IF AGC Amplifier reaches ≈+5dBm.

During the period that the Limiter is activated, the translator's output power metering voltage drops significantly. So that the Output AGC voltage to the IF AGC Amplifier does not change during the temporary reduction in output, relay K1 is deactivated by transistors Q1 and Q2 due to the negative voltage from U2D. A voltage (PRE AGC REF), similar in value to that from U1A via the AGC ON/OFF switch, is applied to the input of U1B from R25. This prevents the Output AGC voltage from increasing the gain of the IF AGC Amplifier preventing the final amplifiers from being overdriven when the Limiter stops attenuating.

The Carrier Present LED is also operated by the Limiter circuit. When a sufficient input signal is detected in the IF AGC Amplifier, the Limiter Reference Voltage is produced and delivered to U2B. This voltage forces U2B's voltage positive causing the Carrier Present LED to illuminate.

2.1p Automatic-On:

Schematic B331-44/Rev C ★ A1PC2

The Auto-On circuit uses differential amplifier U1A to compare the AGC voltage, developed by the IF AGC Amplifier, to a preset Auto-On threshold voltage set by potentiometer R4. An input signal above the minimum acceptable input level will produce an AGC voltage above the Auto-On threshold potential. As the AGC voltage (pin 3 of U1A) exceeds the threshold reference (pin 2 of U1A), amplifier U1A saturates in the positive mode charging capacitor C1. Once C1 charges above the reference potential at pin 6 of U1B, U1B will also go positive activating relay K1 through forward biased transistor Q1. The closed contacts of K1 complete the interlock loop that allows the translator's Power Amplifier to be turned on. An Auto-On delay network consisting of R8, R9 and C1 slows down the turn-on and turn-off activation time. This delay prevents on/off cycling from occurring during periods of temporary signal loss or reduction.

2.1q Digital Code ID Unit: (OPTIONAL)

Schematic 20258029/Rev A ★ A1PC3

According to FCC Rules and Regulations, Section 74.783, each television broadcast transmitter in the United States of over 1 watt peak visual power must transmit its call sign in International Morse Code every 60 minutes or arrange for the primary station to visually or aurally identify the transmitter and its location. The Digital Code Identification Unit is available for the customer who wishes to identify a transmitter station with Morse Code. The ID unit is a sixteen word by eight bit sequencer which generates a series of pulses used to shift the frequency of the transmitted carriers by frequency shift keying (FSK) the transmitter's Upconverter Oscillator.

The Digital Code ID Unit is composed of four integrated circuits: a Dual Timer (U4), a Dual 4 Bit Counter (U3), a Programmable Read Only Memory (U2) and an 8 to 1 Line Multiplex (U1). The Dual Timer or master clock contains two sections which control the operation of the ID unit by dictating when and at what rate pulses will be fed to the Upconverter oscillator. The first section of the timer is a gated astable oscillator or bit clock which produces square-wave pulses at a rate of approximately 20Hz. The bit rate is controlled by U4 resistors R11, R12 and capacitor C2. The

second section of U4 is a 20 minute timer controlled by resistors R9, R10 and capacitor C1. When C1 charges to 63% of its capacity (after 20 minutes), pin 9 of U4 will go low, reverse biasing transistor Q3 which presents a high (4Vdc) at pin 4. This high gates on the bit generator which feeds the 20Hz pulses to pin 1 of the Dual 4 Bit Counter (U3).

As each clock pulse reaches pin 1 of U3, the 4 Bit Counter "counts" the number of pulses entering the chip and displays that count in binary code at its own pins 3, 4 and 5. For example, as the first pulse is fed to U3, pin 3 goes high representing the decimal number 1 in binary code (001). With the second clock pulse, U3 pin 4 goes high and pin 3 goes low representing the binary number 2 (010). This counting process will continue up to the number 7 (111) and, as the eighth pulse is fed to the counter, pins 3, 4, and 5 will all go low (000) to begin the sequence over again. During this time integrated circuit U2, the Programmable Read Only Memory (PROM), has a series of high and low voltages present at its pins 1 through 9 (excluding pin 8 which is ground). These voltages are bits which make up the first word (Morse code letters or numbers) of the transmitter's call sign. (The transmitter's call sign is programmed into the PROM by the EMCEE test department.) In order for this information to be delivered to the Upconverter oscillator, it must be converted from parallel form to serial form by the 8 Line to 1 Line Multiplexer (U1). The binary numbers developed by the Dual 4 Bit Counter are fed to pins 9, 10, and 11 of the 8 to 1 Line Multiplexer. Each binary number (or voltage fluctuation) presented to U1 signals the multiplexer circuit to individually read (take) the parallel bits presented by the PROM and deliver them serially to the oscillator via transistor Q4. Therefore, as the Dual 4 Bit Counter (U3) feeds the binary numbers 1 (001) to pins 9, 10 and 11 of the Line Multiplexer (bit address), the Multiplexer reads the bit at pin 1 of the PROM (U2) and delivers it to the base of transistor Q4. With each subsequent binary number (010, 011, 100, 101, 110, 111, 000) provided by the Dual Counter, the Line Multiplexer will read each individual PROM bit present at U2 pins 2 through 9 (exclude pin 8) until the Dual Counter reaches 111. The next pulse then resets the count to 0 (000). The transition from high to low (1 to 0) at pin 5 of the counter is seen by pin 13, causing pin 11 of U3 to go high. This binary number 1 (0001) seen by pins 10, 11, 12 and 13 (word address) of U2 causes the PROM to present the second set (word) of eight bits to the Line Multiplexer. The Dual Counter (U3 – pins 3, 4, 5) presents another binary eight count to the Line Multiplexer (U1 – pins 9, 10, 11) which individually reads the eight new PROM bits (U2 – pins 1 through 9) and delivers them to transistor Q4. At the end of the second eight count, pin 13 of U3 again sees a high to low transition which causes pin 10 of U3 to go high while pin 11 goes low (binary number 2 = 0010). With U2 pins 10 through 13 receiving a binary number 2, a third word is presented to the Line Multiplexer by the PROM. This entire process occurs so that the PROM delivers 16, eight bit words to the Upconverter oscillator via the Line Multiplexer. After word 16, pins 8 through 10 of U3, which were all high (binary number 16 = 1111), drop to zero. The negative going transition at pin 8 of U3 is coupled to transistor Q1 via C3. This action forward biases transistor Q2 which discharges capacitor C1. As the voltage at pin 12 of the Dual Timer drops, pin 9 goes high causing pin 4 of U4 to go low. The Dual Timer's bit clock is gated off, disabling the Digital Code Identification Unit for 20 minutes until capacitor C1 recharges.

– – – UPCONVERTER SECTION – – –

2.1r Crystal Oscillator:

Vectron CO-254D57 ⋆ A1G2

See paragraph 2.1d for description.

2.1s X2 Multiplier and X4 Multiplier:

Schematic B280-35/Rev E (Ch.2-6) ★ A1A6 (X2 Multiplier)
Schematic C331-24/Rev D (Ch.7-13) ★ A1A6 (X4 Multiplier)

See paragraph 2.1e for description.

2.1t 10MHz Reference Oscillator:

Schematic Diagram 10368037/Rev B ★ A6A2

See paragraph 2.1g for description.

2.1u VHF Synthesizer:

Schematic Diagram 30362003/Rev D ★ A6A1 (Band III)
Schematic Diagram 30362427/Rev C ★ A6A1 (Band I)

See paragraph 2.1h for description.

2.1v Mixer:

Schematic A331-189/Rev A ★ A1A7

Conversion Loss (J1-J3)	13dB Max.
LO Input (J2)	+7dBm Nom
IF Input (J1)	-10dBm Max.

The Upconverter Mixer is a double-balanced circuit which combines an inverted composite television signal from the output of the IF Section and an unmodulated CW signal (LO) from the multiplier or synthesizer. These two signals are heterodyned in the mixer where the sum and difference frequencies are developed and coupled to the RF output. The difference frequency is selected by the VHF Bandpass Filter (A1FL2) and is then amplified by the Upconverter Amplifier (A1A5). To insure the mixer operates in its most linear region, a 5dB attenuator has been placed at the IF input of the circuit.

2.1w VHF Bandpass Filter:

Schematic A280-92/Rev 1 (Ch.2-6) ★ A1FL2
Schematic A280-89/Rev 1 (Ch.7-13) ★ A1FL2

See paragraph 2.1b for description.

2.1x Upconverter Amplifier:

Schematic 20331117/Rev A ⋆ A1A5

	Q1	Q2	Q3	J1-J2
Gain	+9dB	+8dB	+7dB	+20dB Min.
Collector V	+5Vdc	+5Vdc	+5Vdc	
Collector I	25mA	35mA	50mA	

The Upconverter Amplifier contains three broadband monolithic amplifiers (Q1, Q2, Q3) capable of delivering a total of more than 20dB gain at both VHF and UHF frequencies. Resistors R4, R5 and R6 are used to properly bias each device with capacitors C1 through C4 acting as signal coupling components. The pi attenuator (R1, R2, R3) configured at the amplifier's input provides isolation and impedance matching with the adjoining bandpass filter. The incoming UHF signal is amplified to the proper level (≈0dBm) necessary to drive the Power Amplifier drawer.

2.2 Power Amplifier Drawer:

Interconnection Diagram 30331330/Rev 51 ⋆ A2

The Power Amplifier drawer contains one VHF Amplifier module: The 1W Amplifier (A1). Also contained in the drawer is a Directional Coupler/Detector (DC1), a Power Metering DC Amplifier Board (PC1), a Final Amplifier Control Board (PC2) and two power supplies – one supplying ±15V/+5Vdc (PS1) and the other +28Vdc (PS2). The main purpose of the amplifier drawer is to amplify the incoming VHF signal from the Upconverter drawer to the required 1 watt output level. At the same time this output is sampled and fed to meter circuitry which provides forward and reflected power output indications.

2.2a 1W VHF Low Band Amplifier:

Schematic 20331081/Rev 58 (Ch.2-6) ⋆ A2A1

	Q1	J1-J2
Gain	31dB	31dB Min.
Collector I	400mA	
Collector V	27.3Vdc	

The 1W VHF Low Band Amplifier consists of a single transistor stage Q2 capable of delivering 31dB minimum gain. The transistor is designed using strip lines and inductors (L1, L2, L3) to match the input and output impedance of the device. Variable capacitors C4, C6 and C9 are used to tune the reactance of each strip line so that the transistor's input and output impedances are optimized for broadband operation. Capacitors C2, C3, C7, and C8 further enhance the matching of the amplifier. Inductors L4 and L5, located in the base and collector circuits of the transistor serve as both RF choke and amplifier load respectively. To operate Q2 in its most linear mode,

control circuit Q1 maintains the collector current of Q2 at a specific operating level. The setting of R3 dictates the amount of current delivered to the collector of Q2. Capacitors C1 and C10 are coupling components. All other capacitors not mentioned are used for bypassing.

2.2b 1W VHF High Band Amplifier:

Schematic B331-12/Rev 54 (Ch.7-13) ★ A2A1

	Q1	Q2	J1-J2
Gain	16dB	16dB	31dB Min.
Collector I	400mA	400mA	
Collector V	27.3Vdc	27.3Vdc	

The 1W VHF High Band Amplifier consists of two RF power transistor stages (Q1, Q2) capable of delivering a total of 40dB minimum gain. The transistor stages are identical in design, using strip lines (L3, L5, L11, L13) and various components (L1, C3, C4, L2, C5, C6, L7, C9, C10, L8, C11, etc.) to match the input and output impedance of each device. Variable capacitors C2 and C14 are used to tune the transistor input for a flat frequency response. Resistors R1, R2 and R3 form a 3dB attenuator for further matching and amplifier stability. Inductors L4 and L12 function as RF chokes while inductors L6, L18, L14 and L15 act as RF loads. Signal coupling is provided by capacitors C1, C12, C13, and C24. In order to operate the RF power transistors in their most linear mode, bias control circuits have been provided for each stage. These control circuits (Q3, Q4) are constant current regulators maintaining the collector current of each power transistor (Q3, Q4) at a specific operating level. Potentiometers R11 and R16 dictate the amount of current to be delivered to amplifiers Q1 and Q2.

2.2c VHF Output Filter:

Schematic A280-68/Rev1B (Ch.2-6) ★ A2FL1
Schematic A280-69/Rev 1B (Ch.7-13) ★ A2FL1

Insertion Loss (J1-J2)	0.5dB
Notch Depth (J1-J2)	10dB
2nd Harmonic Rejection (J1-J2)	20dB

The VHF Output Filter is a four-section notch and low-pass circuit combination. The two sections which comprise the notch filter (L1/C2, L4/C7) are adjustable circuits resonated to absorb the upper and lower 4.5MHz products contained in the transmitted VHF channel. The low-pass portion of the filter, made up of capacitors C3, C4 and C6 (plus C9 and C10 for low band) and inductors L2, L3, is tuned to attenuate the second harmonic of the VHF channel.

2.2d Directional Coupler/Detector:

Schematic B199-89/Rev C (Ch.2-6) ★ A2DC1
Schematic B199-140/Rev B (Ch.7-13) ★ A2DC1

Insertion Loss (J1-J2) 0.5dB Max.

The two port Directional Coupler/Detector is used to sample and detect the forward and reflected RF signals found at the output of the translator. A small portion of the forward power fed to it from the VHF 1 Watt Amplifier is absorbed from the coupler's "through line" and detected by diode CR1. The remaining RF component is eliminated by capacitors C1 and C2 with resistor R3 providing the correct time constant for peak detection. The resulting positive dc voltage, which is proportional to the translator's peak output power, is then fed to pin 8 of the Power Metering DC Amplifier A2PC1. The Directional Coupler/Detector's reflected coupling line furnishes a fraction of any standing-wave power which might be present at the output of the translator. The reflected power sample is detected by diode CR2 and filtered by capacitor C3. This resistor-capacitor combination delivers a positive dc voltage, proportional to the translator's average reflected output power, to pin 10 of the Power Metering DC Amplifier A2PC1. Resistors R1, R2, R4 and R5 provide 50 ohm input and output terminations for the forward and reverse coupling lines adjacent to the coupler's "through line." Due to the light coupling employed, the module's insertion loss is less than 0.5dB.

2.2e Power Metering DC Amplifier:

Schematic B331-184/Rev D ★ A2PC1

The Power Metering DC Amplifier is used to operate the translator's Front Panel % POWER meter. The positive dc voltages developed by the Directional Coupler/Detector, proportional to the peak and reflected power outputs of the translator, are fed to pins 8 (PEAK PWR DC IN) and 10 (REFL PWR DC IN) of the plug-in PC board. Operational Amplifiers U1A and U1B act as noninverting buffers, isolating the Directional Coupler's peak detector circuit from the % POWER meter. Capacitor C2 charges to a positive dc voltage proportional to the peak power output of the translator. When monitoring forward peak power, the current provided by U1A and B to drive the Front Panel % POWER meter is controlled by potentiometer R8. This resistor is set so that with meter switch A2S1 set to the PEAK PWR position the % POWER meter registers 100% when the translator is producing its rated output power. Resistor R5 is a current limiter placed in series with the output of U1B to protect both the op amp and the meter if potentiometer R8 is inadvertently set to minimum resistance. Resistor R6 and the Upconverter front panel OUTPUT AGC ADJUST A1R3 also form a voltage divider at the output of U1B. OUTPUT AGC potentiometer A1R3 is adjusted to provide a reference voltage, proportional to the translator's peak output power, for the Output AGC circuit located on the Limiter/Output AGC Board (A1PC1). (The purpose of this voltage is explained in the TRANSLATOR portion of this manual.)

In order to calibrate the Front Panel meter for reflected power monitoring, the reflected power dc voltage developed by the Directional Coupler/Detector is placed across resistor R9 of the Power Metering DC Amplifier. A portion of this dc voltage is picked off and sent to the Front Panel % POWER meter via the two-position meter switch (A2S1). Potentiometer R8 is calibrated so that an open output circuit of the Final Amplifier will register a 100% meter indication with switch A2S1 placed in the REFL PWR position.

2.2f Final Amplifier Control:

Schematic 10331074/Rev B ⋆ A2PC2

The Final Amplifier Control supplies +28V to the 1W VHF Amplifier module (A2A1) when an input signal is detected by the translator. AGC voltage is developed and applied to the Auto-on board where A1PC2K1 energizes (see circuit description 2.1m). This in turn provides a ground path from pin 12 to 11 in the Final Amplifier Control which energizes K1 closing contacts 6 to 7, 12 to 13, and 15 to 16. Closure of contacts 15 to 16 supplies +28V to the 1W Amplifier via pin 8 and the Final On LED (A3DS1) via pin 5.

2.2g ±15V/+5V Power Supply:

Schematic B326-12/Rev D ⋆ A2PS1

Voltage	Rated Current
+15V	1A
-15V	1A
+5V	1A
-5V	1A

120Vac is placed across the primary of transformer T1 which is provided voltage transient protection by surge suppressor E1. Transformer T1 supplies a secondary voltage to bridge rectifier CR1. The output of CR1 is divided, with the negative voltage applied to -15V regulator U2 and the positive potential fed to +15V regulator U1. Voltage regulators U3 and U4 tap off of the 15V lines to provide a +5V and -5V respectively. The capacitors provide filtering for the different regulators.

2.2h +28V Power Supply:

Schematic N/A ⋆ A2PS2

Voltage	Rated Current
28V	6A

Field repair NOT recommended.

VHF SYNTHESIZER PROGRAMMING CHART (NTSC)

VHF CHANNEL	BAND LIMIT (MHz)	VIS/AUR Freq. (MHz)	LO OUT Freq. (MHz)	S4	S3	S2	S1
2	54-60	55.25-59.75	101	0	3	F	1
3	60-66	61.25-65.75	107	0	4	2	7
4	66-72	67.25-71.75	113	0	4	6	5
5	76-82	77.25-81.75	123	0	4	C	7
6	82-88	83.25-87.75	129	0	5	0	5
7	174-180	175.25-179.75	221	0	4	5	1
8	180-186	181.25-185.75	227	0	4	6	F
9	186-192	187.25-191.75	233	0	4	8	D
10	192-198	193.25-197.75	239	0	4	A	B
11	198-204	199.25-203.75	245	0	4	C	9
12	204-210	205.25-209.75	251	0	4	E	7
13	210-216	211.25-215.75	257	0	5	0	5

TABLE 2–1

UHF SYNTHESIZER PROGRAMMING CHART (NTSC)

Channel	Visual Frequency (MHz)	LO Freq (MHz)	S4	S3	S2	S1
14	471.25	517	0	A	1	9
15	477.25	523	0	A	3	7
16	483.25	529	0	A	5	5
17	489.25	535	0	A	7	3
18	495.25	541	0	A	9	1
19	501.25	547	0	A	A	F
20	507.25	553	0	A	C	D
21	513.25	559	0	A	E	B
22	519.25	565	0	B	0	9
23	525.25	571	0	B	2	7
24	531.25	577	0	B	4	5
25	537.25	583	0	B	6	3
26	543.25	589	0	B	8	1
27	549.25	595	0	B	9	F
28	555.25	601	0	B	B	D
29	561.25	607	0	B	D	B
30	567.25	613	0	B	F	9
31	573.25	619	0	C	1	7
32	579.25	625	0	C	3	5
33	585.25	631	0	C	5	3
34	591.25	637	0	C	7	1
35	597.25	643	0	C	8	F
36	603.25	649	0	C	A	D

TABLE 2–2

UHF SYNTHESIZER PROGRAMMING CHART (NTSC)

Channel	Visual Frequency (MHz)	LO Freq (MHz)	S4	S3	S2	S1
37	609.25	655	0	C	C	B
38	615.25	661	0	C	E	9
39	621.25	667	0	D	0	7
40	627.25	673	0	D	2	5
41	633.25	679	0	D	4	3
42	639.25	685	0	D	6	1
43	645.25	691	0	D	7	F
44	651.25	697	0	D	9	D
45	657.25	703	0	D	B	B
46	663.25	709	0	D	D	9
47	669.25	715	0	D	F	7
48	675.25	721	0	E	1	5
49	681.25	727	0	E	3	3
50	687.25	733	0	E	5	1
51	693.25	739	0	E	6	F
52	699.25	745	0	E	8	D
53	705.25	751	0	E	A	B
54	711.25	757	0	E	C	9
55	717.25	763	0	E	E	7
56	723.25	769	0	F	0	5
57	729.25	775	0	F	2	3
58	735.25	781	0	F	4	1
59	741.25	787	0	F	5	F

TABLE 2–2

UHF SYNTHESIZER PROGRAMMING CHART (NTSC)

Channel	Visual Frequency (MHz)	LO Freq (MHz)	S4	S3	S2	S1
60	747.25	793	0	F	7	D
61	753.25	799	0	F	9	B
62	759.25	805	0	F	B	9
63	765.25	811	0	F	D	7
64	771.25	817	0	F	F	5
65	777.25	823	1	0	1	3
66	783.25	829	1	0	3	1
67	789.25	835	1	0	4	F
68	795.25	841	1	0	6	D
69	801.25	847	1	0	8	B

TABLE 2–2

UHF SYNTHESIZER PROGRAMMING CHART (PAL)

Channel	Visual Frequency (MHz)	LO Freq (MHz)	S4	S3	S2	S1
21	471.25	510.15	0	9	F	6
22	479.25	518.15	0	A	1	E
23	487.25	526.15	0	A	4	6
24	495.25	534.15	0	A	6	E
25	503.25	542.15	0	A	9	6
26	511.25	550.15	0	A	B	E
27	519.25	558.15	0	A	E	6
28	527.25	566.15	0	B	0	E
29	535.25	574.15	0	B	3	6
30	543.25	582.15	0	B	5	E
31	551.25	590.15	0	B	8	6
32	559.25	598.15	0	B	A	E
33	567.25	606.15	0	B	D	6
34	575.25	614.15	0	B	F	E
35	583.25	622.15	0	C	2	6
36	591.25	630.15	0	C	4	E
37	599.25	638.15	0	C	7	6
38	607.25	646.15	0	C	9	E
39	615.25	654.15	0	C	C	6
40	623.25	662.15	0	C	E	E
41	631.25	670.15	0	D	1	6
42	639.25	678.15	0	D	3	E
43	647.25	686.15	0	D	6	6
44	655.25	694.15	0	D	8	E

For PAL operation the grounds to Pins 21 and 23 of U1 (MC145152) must be removed.
TABLE 2–3

UHF SYNTHESIZER PROGRAMMING CHART (PAL)

Channel	Visual Frequency (MHz)	LO Freq (MHz)	S4	S3	S2	S1
45	663.25	702.15	0	D	B	6
46	671.25	710.15	0	D	D	E
47	679.25	718.15	0	E	0	6
48	687.25	726.15	0	E	2	E
49	695.25	734.15	0	E	5	6
50	703.25	742.15	0	E	7	E
51	711.25	750.15	0	E	A	6
52	719.25	758.15	0	E	C	E
53	727.25	766.15	0	E	F	6
54	735.25	774.15	0	F	1	E
55	743.25	782.15	0	F	4	6
56	751.25	790.15	0	F	6	E
57	759.25	798.15	0	F	9	6
58	767.25	806.15	0	F	B	E
59	775.25	814.15	0	F	E	6
60	783.25	822.15	1	0	0	E
61	791.25	830.15	1	0	3	6
62	799.25	838.15	1	0	5	E
63	807.25	846.15	1	0	8	6
64	815.25	854.15	1	0	A	E
65	823.25	862.15	1	0	D	6
66	831.25	870.15	1	0	F	E
67	839.25	878.15	1	1	2	6
68	847.25	886.15	1	1	4	E

For PAL operation the grounds to Pins 21 and 23 of U1 (MC145152) must be removed.
TABLE 2–3

SECTION III

MAINTENANCE

SECTION III

MAINTENANCE

3.1 Periodic Maintenance Chart:

CHECK	RECOMMENDATION
ALIGNMENT RESPONSE	Upon installation and at one year intervals thereafter (see section 3.3).
OUTPUT POWER CALIBRATION	SAME AS ABOVE (see section 3.4).
FANS	Check for blockage. No lubrication necessary. Check for proper vent space.
ENVIRONMENT	Keep moisture, dust and dirt to a minimum.
AMBIENT TEMPERATURE	-30°C to +50°C; however, cooler temperature equals longer life.

3.2 Troubleshooting:

3.2a Front Panel Indications:

POWER ON/OFF	Controls the ac line voltage that is fed to all power supplies in the Power Amplifier drawer.
28V/+15V/-15V/+5V	Provides convenient test points on the Power Amplifier drawer that can be used to measure the voltages from the power supplies without having to open the unit.
% POWER FWD/REFLD	Provides a peak forward or average reflected power indication from the translator's output.
OPERATE/ALIGN	Controls the IF AGC loop placing it in the OPERATE (closed loop) or ALIGN (open loop) mode.
POWER ADJUST	Controls the output power of the translator.
RECEIVE LO	Provides a sample of the Downconverter's LO signal which is used to mix the input channel to IF.

CARRIER PRESENT	Indicates that the translator is receiving an adequate input signal which is necessary to develop the IF AGC voltage.
FINAL ON	Indicates that supply voltage has been applied to the 1W VHF Amplifier in the Power Amplifier drawer.
TRANSMIT LO	Provides a sample of the Upconverter's LO signal which mixes the IF to the output channel.
OUTPUT AGC ON/OFF	Opens or closes the secondary or output AGC loop.

3.2b Recommended Test Equipment:

EQUIPMENT	MANUFACTURER	MODEL #
Digital Multimeter	HEWLETT PACKARD	E2378A
Oscilloscope	TEKTRONIX	2232
Sweep Generator	WAVETEK	2001
RF Detector	TELONIC BERKELEY	8553
10dB Attenuator	NARDA	766-10
20dB Attenuator	NARDA	766-20
Power Meter	HEWLETT PACKARD	435B
Frequency Counter	HEWLETT PACKARD	5386A
Spectrum Analyzer	HEWLETT PACKARD	8594E
NTSC Video Generator	TEKTRONIX	TSG100

3.2c Troubleshooting Procedure:

If the translator's output signal appears distorted, noisy or nonexistent, check the unit's front panel indications. The monitoring of both Forward and Reflected power is possible with the front panel % POWER meter while Power Supply voltages can be measured at test points located on the Power Amplifier front panel. The Carrier Present LED indicates an input signal is present when illuminated, and the Final ON LED is illuminated when supply voltage is applied to the 1W amplifier. Both must be activated for the translator to operate. The front panel Indications may point to a problem area and should not be overlooked.

Since the 5, 15 and 28 volt power supplies contain short circuit protection, an unusually low supply voltage reading may indicate a short in any circuit using that supply. The short circuit can be isolated by individually removing the plugs from the modules in each drawer.

NOTE: After removing a short circuit from the output of either the ±15 or +5 volt supply, wait 5 minutes before checking the supply voltage so that the associated IC regulator cools sufficiently. The voltage regulators within the ±15V/±5V Power Supplies feature thermal shutdown protection and must cool before returning to their normal operating voltages.

A problem area can also be determined by dividing the system into subsystems or sections, each of these smaller sections having a separate function. This unit is divided into two separate drawers, the translator and the Power Amplifier, while the translator drawer is subdivided into the Downconverter Section, the IF Section and the Upconverter Section. Using the Signal Flow Chart (Figure 3–1), in conjunction with a sweep and marker generator, will aid in pinpointing the problem to a specific module. This procedure assumes the cabling, connectors, power supplies and front panel indications are correct.

3.3 Alignment:

The primary purpose of this section is to aid the operator in troubleshooting and maintaining the performance (frequency response, gain, etc.) of the translator. If the operator determines that a malfunction or misalignment has occurred within the translator, then completion of the following procedure should prove effective in locating the problem. Alignment should not be performed unless the recommended test equipment (section 3.2b) is available.

NOTE: Before applying ac power to the translator, insure that a proper 50 ohm RF load (20dB attenuator) is attached to the RF Out connector (A2J2) located on the rear panel of the Power Amplifier.

3.3a Local Oscillator Chain:

If translator operation requires precision offset, the Upconverter or Downconverter synthesizer has been replaced by an oscillator-multiplier combination. This procedure applies to either the Upconverter or Downconverter oscillator-multiplier section. Before proceeding with the following steps, first determine if L.O. chain alignment is necessary. Apply ac power to the translator by placing the POWER circuit breaker (CB1, front panel of Power Amplifier drawer) to ON. Check the oscillator (A1G1/A1G2) output (Point A, Figure 3–3) for a minimum of 10mW and a measured frequency within 20Hz of its correct frequency. (Oscillator frequency equals the input or output channel visual frequency plus the IF visual frequency divided by 2 for a low band channel, 4 for a high band channel or 16 for a UHF channel.)

NOTE: The Vectron precision oscillator is not field repairable and should be returned to EMCEE if defective.

If the oscillator output is correct, check the multiplier (A1A3/A1A6) output for a minimum of 10mW. A X2 multiplier is used for channels 2-6, a X4 multiplier is used for channels 7-13 and the X16 multiplier is used for channels 14-69. If the multiplier output power and frequency are correct, proceed to section 3.3b, RF Amplifier Chain alignment.

1. Set up the test equipment as shown in Figure 3–3 and place the translator ac POWER switch (A2CB1) to the ON position for B+ (28Vdc) to be applied to the oscillator (G1 or G2).

2. Wait approximately fifteen (15) minutes for the oscillator to heat or until the frequency stabilizes.

3. If, after the warm-up period, the measured frequency differs from the oscillator frequency entered on the Test Data Sheet (refer to last page of this manual) by more than 20Hz, proceed to step #4. If the measured frequency is within 20Hz of the frequency marked on the Test Data Sheet, then remove the counter from the oscillator output, reconnect the cable leading to the multiplier module and proceed to step #6.

4. Remove the frequency adjust access cover screw and, with a tuning tool or small screwdriver, slowly rotate the slotted adjustment for the proper oscillator frequency.

5. Disconnect the frequency counter from the output of the oscillator and connect the power meter. The oscillator output power should be no less than 10mW.

6. Remove the power meter from the output of the oscillator and reconnect the oscillator to the input of the multiplier (A3 or A6).

7. Check the output power of the multiplier. If there is less than 10mW, remove the retaining screws and lift the module off the drawer floor.

8. Connect the output of the multiplier to a spectrum analyzer (Point **B**, Figure 3–3) and tune the analyzer to the second, fourth, or sixteenth harmonic of the oscillator. (L.O. frequency equals the sum of the input or output channel visual carrier frequency and the IF visual carrier frequency.)

9. Carefully "touch up" the capacitors accessible through the bottom cover of the module for maximum power (10mW min/30mW max) at the proper harmonic of the oscillator frequency. If power is low or nonexistent, proceed to step #10, #11 or #12. Otherwise, proceed to step #13.

10. X2 Multiplier (Ch.2-6)

    a. Remove the module's bottom cover and tune capacitors C7, C12, C13, C14, C15, C16, C17 and inductors L7, L8 for a minimum of 10mW at the oscillator's second harmonic (see Schematic B280-35). Insure that the fundamental and other harmonics are down at least -20dB.

    b. If the multiplier output power is low or nonexistent, troubleshoot the circuit and repeat the tuning procedure.

11. X4 Multiplier (Ch.7-13)

    a. Remove the bottom cover of the module and disconnect the jumper wire attached to terminal post D on the multiplier PC board (see Schematic C331-24).

    b. Solder an open ended 50 ohm coaxial cable to terminal posts D (center conductor) and K (shield) and connect a spectrum analyzer to the cable's opposite end.

    c. Tune the spectrum analyzer to the second harmonic of the oscillator's output frequency and adjust capacitors C7, C12 through C17 and inductors L6, L7 and L8 for maximum power (25 to 50mW) at the second harmonic of the oscillator frequency. Insure that the other harmonics are at least 40dB below the second by tuning

capacitors C14 and C16 near minimum coupling (least capacitance) without sacrificing power.

d. Remove the coaxial cable from terminal posts D and K. Resolder the jumper wire which connects terminal posts D and E.

e. Disconnect the jumper wire attached to terminal post M on the multiplier PC board (see Schematic C331-24).

f. Solder the open ended coax cable to terminal post M (center conductor) and N (shield). Connect a spectrum analyzer to the cable's opposite end.

g. Tune the test equipment to the frequency of the oscillator's fourth harmonic and adjust capacitors C19, C22 and C23 for maximum power (75 to 100mW) at that frequency. Insure that all other harmonics are at least 20dB lower.

h. Remove the coaxial cable from terminal post M and ground. Resolder the jumper wire to terminal post M.

i. Attach the spectrum analyzer to the output connector (J2) of the X4 Multiplier module (B, Figure 3–3).

j. Tune the test equipment to the frequency of the oscillator's fourth harmonic and adjust capacitors C26, C27 and C29 for maximum power (10 to 30mW) at the same frequency. Insure that all other harmonics are at least 20dB down.

NOTE: If the output power of any section of the X4 Multiplier is low or nonexistent, troubleshoot the circuit responsible and repeat the alignment procedure.

k. Replace the bottom cover and slightly readjust all of the multiplier's variable capacitors for the specifications stated above.

12. X16 Multiplier (Ch.14-69)

a. Remove the bottom cover from the module and disconnect the leads of capacitor PC1C1 and inductor PC2L2 which connect to capacitor PC2C2 (see Schematic 30367226).

b. Solder an open ended coax cable to the input side of capacitor PC2C2. Insure that the coax center conductor is connected to the RF line and the shield is at ground.

c. Connect the cable to a spectrum analyzer and tune capacitors PC1C6/C7/C11/C13/C15 and PC1C18 for 100 to 200mW at the oscillator's fourth harmonic.

d. Remove the coaxial cable from the circuit and reconnect the leads of PC2C1 and inductor PC2L1 to each side of PC2C2.

e. Connect the spectrum analyzer to the output connector of the module (A3J2) and tune capacitors PC2C1/C2/C3/C4 for maximum power at the 16th harmonic of the oscillator. Only if necessary, carefully expand or compress the turns of inductor PC2L1 for the proper output and retune the adjoining capacitors. Insure that the other harmonics are 20dB down.

NOTE: If the output power of either multiplier section is low or nonexistent, trouble-shoot the circuit responsible.

f. Replace the bottom cover and slightly readjust all of the variable capacitors for the correct specifications.

13. Reconnect the output of the multiplier to the LO input (L) of the associated mixer module.

3.3b RF Amplifier Chain:

– – – DOWNCONVERTER SECTION – – –

14. Set the translator drawer OPR/ALIGN switch to the ALIGN position and remove the drawer cover.

15. Set up the test equipment as shown in Figure 3–4 with the 10dB attenuator and RF detector connected to the output of the bandpass filter (FL1 - point **B**, Figure 3–2).

16. Adjust the sweep and marker generator for an oscilloscope display width of 10MHz at the input frequency of the translator. To prevent overdriving any amplifiers, set the oscilloscope for maximum sensitivity and the sweeper for minimum output.

17. a. For VHF input: Adjust capacitors C1 through C5 of the VHF Bandpass Filter (FL1) to obtain a response similar to that shown in Figure 3–5A. There should be less than 2dB of insertion loss.

b. For UHF input: Through the rear of the translator drawer tune capacitors C1 and C2 of the UHF Filter (FL1) for a frequency response as that shown in Figure 3–5A. Only if absolutely necessary, adjust the Variable Coupling Barrier and inductors L1 and L4 for the correct response (see Schematic A284-6) with less than 2dB of insertion loss.

18. Remove the attenuator and RF detector from the output of the Bandpass Filter (FL1) and connect them to the output **C** of the Downconverter/Preamplifier module (A1). Reconnect the filter to the input of the Downconverter/Preamplifier.

19. Check the output of the Downconverter/Preamplifier for a minimum conversion gain of 3dB (±1dB) and a frequency response as shown in Figure 3–5A. Correct any slight frequency response variations (tilt) with the VHF or UHF Bandpass Filter as explained in step #17 above. If there are any major frequency response or gain problems, sweep and trouble-shoot the amplifier by itself. The module frequency response can be found in Figure 3–5B.

– – – IF SECTION – – –

20. Remove the detector and attenuator from the output of the Downconverter/Preamplifier and connect them to the output of the IF SAW Filter/Amplifier (A2) (Point **D**, Figure 3–2). Reconnect the output of the Downconverter/Preamplifier to the input of the IF SAW Filter/ Amplifier.

21. Check for a frequency response as shown in Figure 3–5C and a minimum gain of 20dB. If there is a major discrepancy in frequency response or gain, sweep and troubleshoot the circuit by itself.

22. Disconnect the attenuator and detector from the output of the IF SAW Filter/Amplifier and connect them to the output of the IF AGC Amplifier (**E**, Figure 3–2). Reconnect the output of the IF SAW Filter/Amplifier to the input of the IF AGC Amplifier.

23. With the front panel OPERATE/ALIGN switch in the ALIGN position, adjust the IF AGC Amplifier TILT control (R31) to obtain a flat frequency response as shown in Figure 3–5C. The TILT pot is accessible through the top of the amplifier module. Check for a module gain of approximately 25dB. This gain is dependent on the align voltage provided to the module's AGC circuit.

24. Remove the cable from the IF AGC Amplifier output and connect it to the Precorrector (optional) out jack (**F**, Figure 3–2). Reconnect the output of the IF AGC Amplifier to the IF input (I) of the Mixer. The oscilloscope display should resemble Figure 3–5C. If necessary, adjust TILT potentiometer (R10) for a flat response and check for the proper gain (≈-2dB).

– – – DOWNCONVERTER SECTION – – –

25. Remove the cable from the Precorrector out jack and connect it to the Mixer RF (R) output (**G**, Figure 3–2). Reconnect the Precorrector output to the Power Adjust. The oscilloscope display should resemble Figure 3–5C.

26. Vary the Power Adjust potentiometer on the translator drawer front panel to insure proper operation. Remember, this adjustment presents loss to the signal.

27. Remove the attenuator and detector from the Mixer (A7) and connect the Mixer RF port (R) to the VHF Bandpass Filter (FL2).

28. Connect the test equipment to the output of the bandpass filter (**H**, Figure 3–2), and check for a frequency response resembling Figure 3–5C. If necessary, slightly tune filter capacitors C1 through C5 for minimum loss (-2dB) and the correct response. (Since the response presented is actually that of the SAW Filter, it may be necessary to sweep the VHF Bandpass Filter [FL2] by itself at its proper operating frequency. It should have a response similar to that of Figure 3–5A.)

29. Connect the attenuator and detector to the output of the translator drawer (**I**, Figure 3–2) and reconnect the bandpass filter to the input of the Upconverter Amplifier. The amplifier should provide the same frequency response as Figure 3–5C (Figure 3–5A if sweeping filter FL2 alone with the Upconverter Amplifier) and at least 20dB of gain. If the response is tilted, slight adjustment of the VHF Bandpass Filter (FL2) may be necessary due to termination differences between the test equipment and the Upconverter Amplifier.

– – – POWER AMPLIFIER DRAWER – – –

30. Shut off the circuit breaker (CB1) on the front panel of the Power Amplifier drawer. Replace the RF cable connecting the translator drawer OUTput (A1J2) to the Power Amplifier drawer RF INput (A2J1).

31. Remove the top cover from the center portion of the Power Amplifier drawer and attach the detector and attenuator to the output of the 1 Watt VHF Amplifier (J, Figure 3–2). Reapply power with CB1 ON. This amplifier should provide a flat response (Figure 3–5C) and at least 31dB of gain.

32. If there is a problem with frequency response or gain, remove the module from the drawer bottom and take off the amplifier cover. For channels 2 to 6 tune capacitors C4, C6 and C9 of the 1 Watt VHF Low Band Amplifier (see Schematic 20331081) for the proper parameters. For channels 7 to 13, tune capacitors C2 and C14 of the 1 Watt VHF High Band Amplifier (see Schematic B331-12) for the proper response. If proper gain or frequency response cannot be obtained, troubleshoot the circuit and retune.

33. Place the POWER switch (CB1) back to the OFF position and remove the test equipment from the output of the 1 Watt VHF Amplifier (A1).

34. Connect the test equipment to the output of Power Amplifier drawer (M, Figure 3–2) and reconnect the output of the 1 Watt VHF Amplifier to the input of the VHF Output Filter (FL1).

35. Reapply ac power via CB1 and check for approximately 1dB of loss through the VHF Output Filter (FL1) and Directional Coupler (DC1). Insure that capacitors C3, C4 and C6 of the VHF Output Filter (FL1) are adjusted for minimum loss and a flat frequency response (see Schematic A280-68 for Ch.2-6 or A280-69 for Ch.7-13).

NOTE: Capacitors C2 and C7 mounted on top of the VHF Output Filter control the frequency of each 4.5MHz notch used to attenuate the out-of-band spurs of the transmitted channel. Because of the highly selective response of the IF SAW Filter/Amplifier (A1A2), these notches cannot be seen when viewing the overall sweep response of the translator. Therefore, in order to check the position of each notch, the VHF Output Filter must be swept by itself.

36. Remove the sweep generator output from the translator drawer INput (A1J1 or A, Figure 3–2) and connect it to the input of the VHF Output Filter (K, Figure 3–2).

37. Tune the sweep generator to the translator's output channel using a 15 to 20MHz sweep width on the oscilloscope.

38. Check the oscilloscope display for a notch 4.5MHz above the aural frequency and 4.5MHz below the visual frequency of the output channel (see Figure 3–5D). If the notches are not in their correct position, carefully adjust VHF Output Filter capacitors C2 and C7 (see Schematic A280-68 or 69).

NOTE: If a spectrum analyzer is available, disconnect the sweep equipment and connect the spectrum analyzer to the output of the translator. With the translator receiving the correct input signal and operating at its rated output power, tune the analyzer to each 4.5MHz product and carefully null its power with the appropriate tuning capacitor (C2/C7).

39. Disconnect all test equipment from the translator and replace all interconnection cables between modules.

3.3c AGC/Limiter Calibration:

1. Connect a power meter or spectrum analyzer to the output of the IF AGC Amplifier (A1AR1J2).

2. Connect a continuous wave generator (CW mode of sweep generator) or IF modulator to the input of the IF AGC Amplifier (A1AR1J1). Adjust the generator to deliver the visual carrier frequency (45.75MHz) at -38dBm peak power. Place the translator drawer front panel OPERATE/ALIGN switch (A1S1) to OPERATE and the OUTPUT AGC switch (A2S2) to OFF.

3. Turn AGC REFerence potentiometer R8 fully CW and turn LIMITER ADJUST potentiometer R13 fully CCW. Potentiometers R8 and R13 are located on the Limiter/Output AGC board PC1 (see Schematic B331-34).

4. Adjust IF AGC Amplifier potentiometer R15 (GAIN) for a +2dBm output (see Schematic C331-37). The GAIN control is accessible through the top of the IF AGC Amplifier module.

5. Center AGC REFerence potentiometer R8 on the Limiter/Output AGC board and recalibrate the input generator so that it now delivers a 0dBm peak visual signal to the amplifier module. Slowly adjust IF AGC Amplifier inductor L3 of the visual tank circuit so that a minimum power indication is seen on the external power meter or spectrum analyzer.

NOTE: If the IF AGC Amplifier tank circuit (L3, C14) tuned to the IF visual carrier becomes severely detuned and the output power of the module cannot be nulled, remove the module from the bottom of the drawer. Attach a high impedance voltmeter to the cathode of diode CR8 (pin 5 of U1B, Schematic C331-37) and slowly tune tank capacitor C14 for a maximum negative voltage. As the voltage becomes more negative, the output power of the amplifier will drop.

6. Adjust the AGC REFerence potentiometer R8 on the Limiter/Output AGC board for a +6dBm output from the IF AGC Amplifier (AR1).

7. Slowly adjust Limiter Reference potentiometer R13 CW until the +6dBm output level begins to fluctuate, i.e., as the limiter begins to activate.

8. Readjust AGC REF potentiometer R8 to bring the IF AGC Amplifier output level from +6dBm down to +2dBm.

9. Short capacitor C2 on the Limiter/Output AGC board. Relay K1 on the Limiter/Output AGC board will deenergize causing the AGC voltage to be replaced by the PRE AGC Reference Voltage set by potentiometer R25.

10. Adjust potentiometer R25 for a +3dBm output level. This PRE AGC REFerence ADJust is located on the Limiter/Output AGC board.

11. Remove the short from across C2.

12. Disconnect the power meter or spectrum analyzer from the IF AGC Amplifier output and reconnect the module's input and output cables.

3.3d Precorrector Adjustment: (OPTIONAL)

Adjustment of the Precorrector is limited to two controls and should not be realigned unless absolutely necessary. To adjust the Precorrector a spectrum analyzer for measurement of sync and intermodulation is needed. If this equipment is not available and a situation occurs warranting Precorrection readjustment, a linear diode detector and oscilloscope may be used to inspect and adjust sync amplitude. Also, the Precorrector ON/OFF switch can be placed to the OFF position as a temporary defeat in case the circuit causes adverse distortion due to misalignment or malfunction. The ON/OFF switch is further utilized to compare the effects of precorrection against a normally amplified translator output signal. However, changing the position of this switch will slightly alter (±1dB) the output power of the translator unless the OUTPUT AGC switch (A1S2) is ON. It is assumed that the translator's overall frequency response is correct, allowing the unit to operate with maximum efficiency. Set up the test equipment and perform the following steps.

1. To the output of the translator connect the test equipment available for monitoring intermodulation distortion and sync amplitude. Insure that the translator is operating at its rated output.

2. While viewing the test equipment display, vary the two potentiometers (R6, R8), accessible through the holes in the top of the module, to correct for 100% sync amplitude. With the horizontal sync corrected, the intermodulation distortion will be well below the -54dB level.

3. Recheck and, if necessary, correct the translator's output power with the POWER ADJUST or OUTPUT AGC ADJUST.

3.4 Output Power Calibration:

To insure correct transmission parameters the output power level and % POWER meter calibration of the TV1E V/U Translator should be checked at least once every six months. With the % POWER switch in the FWD position, the % POWER meter has been factory calibrated for 100% with the translator providing 1 watt peak visual and 0.1 watt average aural power. The following calibration procedure assumes that the composite VHF signal emanating from the translator has a visual/aural carrier power ratio of 10:1 with the visual carrier consisting of 87.5% video modulation and 0% average picture level (APL).

In the following steps, the power levels stated are those expected at the output of the TV1E V/U. Therefore, when measuring these power levels via an external power meter and a 20dB attenuator (see Figure 3–6), be sure to take into account the attenuation factor provided by this attenuator. Power levels at 50% APL are included in brackets following the power levels at 0% APL.

3.4a Forward Power:

1. Place the POWER circuit breaker to OFF and set up the test equipment as shown in Figure 3–6 with the external power meter connected to the 20dB attenuator. Provide the

translator with the correct input signal (-70 to -30dBm peak visual power) from either the originating station, from an on-channel (VHF/UHF output) television modulator, or by mixing a modulator's IF carriers up to the correct input frequencies.

NOTE: Using an off-the-air signal from the primary or originating station will result in some calibration inaccuracy when monitoring the translator's output with an average power meter. As the picture content (brightness) of the input signal varies, the average output power of the translator will also change causing fluctuations in the readings of the external power meter. The customer must, therefore, estimate a 50% (gray) or 0% (black) average picture level when calibrating for 1 watt peak visual power.

2. Place the POWER circuit breaker to ON, the OPERATE/ALIGN switch to OPERATE, the OUTPUT AGC switch to OFF, and the % POWER switch to FWD.

3. With the POWER ADJUST control, set the output power of the TV1E V/U so that the external power meter registers .695W [.44W]. (1W peak visual with 0% APL and 87.5% video modulation is equal to .595W [.34W at 50% APL] average visual while 10% aural power is equal to 100mW average aural.) It is assumed that the received visual carrier consists of 87.5% video modulation with a visual/aural carrier power ratio of 10:1. A spectrum analyzer can be used to check the visual/aural carrier ratio. If the aural carrier can be turned off, the average power should drop to .595W [.34W].

4. With the external power meter reading .695W [.44W], check the % POWER meter for a 100% indication. If the reading is incorrect, adjust potentiometer R8 on the Power Metering DC Amplifier board (A2PC1) for a 100% indication (see Schematic Diagram B331-184). This board is located in the Power Amplifier drawer.

5. Place the OUTPUT AGC switch to ON and check the % POWER meter for a 100% indication. If the reading is incorrect, set the OUTPUT AGC ADJUST control for a 100% indication.

3.4b Reflected Power:

6. With the external power meter still reading .695W [.44W], place the POWER circuit breaker to OFF. Remove and reverse the cables connected to the input (J1) and output (J2) ports of the Directional Coupler/Detector (A2DC1). In other words, connect input cable to output port and connect output cable to input port. The reflected power circuit of the Directional Coupler/Detector will now monitor the translator's forward power, simulating an open circuit (total returned power) at the translator's output.

7. Place the POWER circuit breaker to ON. With the visual carrier consisting of 87.5% video modulation and 0% APL, place the % POWER switch to REFLD and check for a 100% (70% for 50% APL) indication on the % POWER meter. If this reading is not obtained, adjust potentiometer R9 on the Power Metering DC Amplifier for a 100% indication (see Schematic Diagram B331-184).

8. Place the POWER circuit breaker to OFF.

   a. Remove the cables connected to the input and output ports of the Directional Coupler/ Detector and connect them to their original positions.

b. Reinstall the top cover to each drawer. Slide each drawer back into the cabinet and secure them properly.

c. Disconnect the test equipment from the translator.

d. Reconnect the transmitting antenna's associated cable to the RF OUT connector (J2) of the TV1E V/U Power Amplifier drawer.

e. If applicable, reconnect the receiving antenna's associated cable to the RF IN connector (J1) of the TV1E V/U Translator drawer.

9. Place the POWER circuit breaker to ON to place the TV1E V/U in an on-the-air condition. For constant monitoring of the translator's output power, place the % POWER switch to FWD.