Continental Electronics Corporation

Dallas, Texas

TRAINING MANUAL

816R FM TRANSMITTERS

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April, 1998

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FEATURES
816R SERIES FM TRANSMITTERS

- Completely Self Contained (power levels through (30.0 KW)

- 4CX15000A Final Amplifier Tube

  Easy to cool.
  Plate dissipation approximately 50% rated.
  Rebuilt tubes give excellent results.
  No frequency selected components - Same components cover all frequencies.
  1/4 Wave wideband cavity.
  Screen grid at DC ground for stability.

- Wideband Solid State IPA

  Complete Protection.
    VSWR.
    Excess Output Power.
    Over Voltage.
    Over Temperature.
  700 Watt rating - Typically runs at 500-550 watts.
  High Gain - No Driver Required.

- 802B Wideband Exciter

  No production or test selected components.
  No Tuned circuits in the RF path following the Modulated Oscillator.
  50 Watt output will drive Power Amplifier to approximately 25% Power.
  Low Noise.

- SCR Primary Power Control

  Controls Primary voltage for Plate and Screen Power Supplies. Maintains constant plate voltage/screen voltage ratio for excellent Synchronous AM noise.

- Regulated Filament Voltage

- VSWR Protection

  VSWR Foldback
    Allows transmitter to operate at maximum safe power output under antenn icing conditions.
    Controls Plate and Screen voltage - not drive power.

  High Speed VSWR Overload
    Automatic Recycle.
    Easily adjusted.

- Easy Maintenance Access

- All Features Standard - No Options

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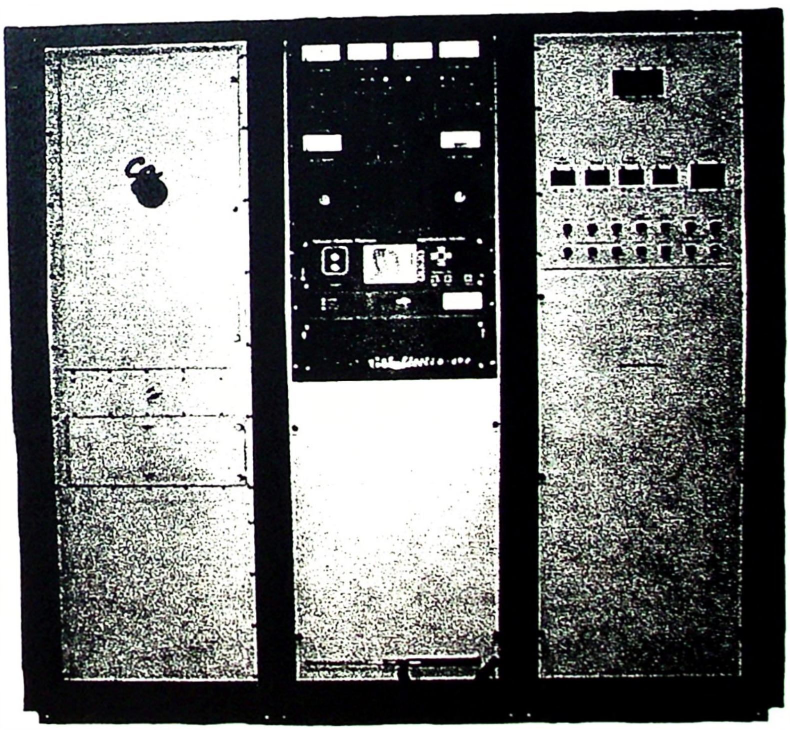
816R Series FM TRANSMITTERS



816R FM TRANSMITTER
TRAINING MANUAL

I. GENERAL INFORMATION

A. INTRODUCTION

The 816R transmitters operate in the FM broadcast range (88-108 MHz) with maximum power outputs of 21.5 kW (816R-2C), 25 kW (816R-3C), 27.5 kW (816R-4C), 30 kW (816R-6C), and 35 kW (816R-5C). Reduced power is available by tap changes of the plate and screen transformer to meet customer requirements. When the exciter receives input from the optional stereo generator and SCA generator, the transmitter provides continuous monaural, stereophonic, and SCA (subsidiary communication authorization) frequency-modulated programs.

B. FUNCTIONAL DESCRIPTION

The transmitter consists of an exciter, a solid-state driver, and a power amplifier. The output of the exciter is applied to the driver. The driver consists of a 700-watt module. The input to the driver is amplified to approximately 500 watts and applied to the power amplifier that contains one 4CX15000A in power levels of 27.5mkW and lower. The 30 and 35 kW transmitters use the YC130 tube. All are operated class C. The output of the power amplifier is applied to a 50-ohm unbalanced load. Power control circuits monitor the RF output power level. When a change in output power is detected, these circuits change the plate voltage to compensate. Other control circuits within the transmitter monitor reflected power, forward power, operating voltage, air pressure and exhaust air temperature within the power amplifier section. They protect the transmitter by removing power when excessive currents, VSWR, loss of air pressure, or excessive air exhaust temperature occur.

C. PHYSICAL DESCRIPTION

The transmitter is housed in a unistrut cabinet that contains all transmitter components. Refer to drawing on inside back cover. The transmitter contains three sections. The section on the left contains the power amplifier. The center section houses the control panel, exciter, driver circuits, and control circuits. The section on the right contains the power supplies, the circuit breakers, and fuse panel. (The 35 kw transmitter's High Voltage Power Supply is external and contains the High Voltage Transformer, Rectifiers, and Transient Suppression Circuits.)

II. OPERATION

A. GENERAL

The transmitter may be operated from the local control panel or by remote control. Once the transmitter has been installed and properly tuned, it is only necessary to monitor meter indications and to make periodic minor tuning and loading adjustments. Instructions for the 802B exciter are found in the Exciter Instruction Manual.

B. INITIAL TURN-ON PROCEDURE

1. Ensure transmitter has been assembled and connected.

2. Remove access panel of Card Cage Assembly for access to the control circuit cards. Check the circuit cards for proper installation.

3. Install Card Cage access panel and ensure all doors and panels are properly closed or installed.

4. Ensure all transmitter circuit breakers on A6 panel are OFF.

5. Connect primary power to transmitter and set AC LINE circuit breaker on AC Metering Panel to ON.

6. Set the 28 VDC POWER SUPPLY and BLOWERS circuit breakers to ON. Check the PHASE LOSS indicator on the A1 Control Panel. If this indicator is not on, set AC LINE circuit breaker on AC Metering Panel to OFF. Remove the right front bay access panel. Locate A8K5 (the phase loss/phase rotation monitor) and turn its control to minimum (full counterclockwise). Install the access panel and restore primary power. If the PHASE LOSS

indicator is still not on, turn primary power off and disconnect AC power input lines. Interchange any two primary input leads at A8TB1. Restore primary power and check indicator.

7. Adjust the Phase Monitor A8K5 phase loss threshold fully counterclockwise (190 VAC) if not done in Step 6.

NOTE

The phase loss/phase rotation monitor will turn the transmitter off when phase loss or incorrect sequence is detected. A phase loss will be detected if the line voltage drops below the threshold voltage level which is set by the adjustment control on A8K5. The threshold voltage range is 190-270V and it must be set below the lowest expected line voltage. The only components in the transmitter that are sensitive to low line voltage are the blower and cabinet fan motors which must have at least 190 VAC.

8. Loosen the two retaining bolts at the bottom of the left cabinet side panel. Grip the panel securely and lift it off.

9. Apply primary power and press FILAMENT ON switch on PA Power Control Panel.

10. Remove primary power and observe direction of rotation of the PA cavity blower and the cabinet fan as they come to a stop. Cabinet fan rotation may be observed by lifting the foam filter from the top right side of the cabinet. PA cavity blower rotation should be counterclockwise when viewed from the shaft end. Cabinet fan rotation should be counterclockwise when viewed from the top. Install cabinet side panel.

11. Set all circuit breakers to ON and apply primary power. Press FILAMENT ON switch.

12. Set the TEST METER selector switch to 28V SUPPLY (40V SCALE). The test meter will indicate 28 ±2.0 V dc.

13. Set the AC Metering selector switch to FIL. The test meter should indicate 6.0 volts (7.2 ±0.1 volts for 816R-5C and 816R-6C). Adjust filament voltage if it is not correct. Use procedure in Maintenance Manual. These adjustments are required to be made at customer's normal line voltage.

14. Verify that the exciter is on.

NOTE

The transmitter is adjusted and pre-tuned at the factory for specific customer power output and frequency requirements. In normal applications, the fine-tuning and adjustment procedures provided in Steps 14 through 27 are adequate to ensure proper transmitter operation.

15. Press the POWER CONTROL switch MANUAL for manual power control operation.

16. Set the POWER switch to FORWARD.

17. Set the TRANSMITTER CONTROL switch to LOCAL.

18. Press the PLATE ON switch. The PLATE ON switch lamp will light.

19. Adjust PA GRID TUNING for minimum IPA reflected power.

20. Slightly adjust the PA LOADING and PA TUNING controls until maximum power output is displayed on the POWER OUTPUT meter.

21. As the transmitter warms up, the IPA reflected power will rise. Re-tune the PA GRID TUNING as needed to keep the reflected power below 75 watts (final value is less than 20 watts). Once the IPA reflected power appears stabilized, repeat Steps 19 & 20. The final setting should be established after the transmitter has been on for at least 30 minutes. Do not re-tune the grid after the final setting has been established.

NOTE

Operating parameters will become stable within 15-20 minutes. All fine tuning and recording of

operating parameters should be performed only after the transmitter has stabilized.

22. RAISE or LOWER the POWER ADJUST control until the POWER OUTPUT meter displays the station's authorized power level. If specified by the customer, the meter was calibrated at the factory to indicate 100% at this power.

23. Compare meter readings with those listed in the factory test data.

24. Set POWER CONTROL switch to AUTOMATIC. Adjust the power monitor/control card A2A6R8, located in the card cage, for 100% output power if necessary.

C. ANTENNA SYSTEM VSWR CHECK

The REFLECTED POWER OUTPUT meter should not indicate more than five percent which is a VSWR of 1.57. The transmitter is set at the factory to trip OFF at ten percent Reflected Power. Typically, VSWR is less than 1.1:1 which is less than 0.25 percent Reflected Power.

D. PA TUNING AND LOADING (For best efficiency).

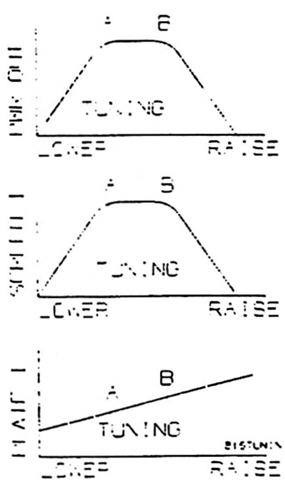


Fig. 1, PA Plate Tuning

There is not likely to be a plate current dip within the normal range of tuning control. There are, however, three indicators to be observed for proper PA TUNE. Power output and screen current will be maximum. PA plate current will change as the tuning is changed. Plate current will increase when the tuning control is held in the raise position. When the shorting plane is positioned correctly, the PA screen current and power output will go through a peak. Refer to Figure 1 for an indication of what to expect as the tuning control is run through its total mechanical range, from one limit to the other. Notice that power output is the same at point A and point B, but that plate current is greater at point B. The proper tuning point is at point A which results in maximum output and also the least amount of plate current (not plate current dip). The loading control is adjusted for maximum RF output. PA screen current decreases when loading is raised and increases when loading is lowered. Normally, screen current is between 150 - 550 mA. The screen current is dependent upon loading, power output requirements, plate and screen voltage, and individual tube characteristics. When the PA tube is replaced, screen voltage may have to be changed in order to obtain the desired power output.

E. MAXIMUM POWER OUTPUT ADJUSTMENT.

NOTE

This procedure is intended to maintain authorized station maximum power output with line voltage variations.

1. Set the POWER ADJUST control to RAISE until maximum power output is displayed on the POWER OUTPUT METER.

2. If the maximum power output is not more than 5% above the authorized station maximum output, skip to Step h. If the maximum power output is more than 5% above the authorized station maximum output, proceed to Step c.

3. Press the PLATE OFF and FILAMENT OFF switches on control panel A1.

4. Turn off primary power to the transmitter.

5. If TPO is greater than 15 kW, the Plate Transformer taps are set to match the line voltage. The Screen Transformer has primary and secondary taps which are used to set the transmitter to the desired TPO plus about five to ten percent headroom. The Screen Transformer secondary taps are 70%, 85%, and 100%

relative to 800 VDC when the primary taps match the line voltage. The primary taps can be used to adjust TPO providing that the taps used must not be more than two taps lower than line voltage. Example--line voltage is 230 VAC. You may use any Screen Transformer primary tap higher than 210 VAC but not the 200 VAC tap. If your line voltage is 245 VAC, you may use any primary tap higher than 230 VAC but not the 220 VAC tap.

6. Reapply primary power and press the FILAMENT ON and PLATE ON switches on control panel A1.
7. Repeat Steps c through f until the maximum transmitter output is approximately 5% above the authorized station maximum output.
8. Adjust the POWER ADJUST control until the POWER OUTPUT meter displays the authorized station maximum power output.

F. 2nd POWER LEVEL (low pwr) ADJUSTMENT

NOTE

Perform this step only if using a second power level.

1. Switch transmitter to AUTO POWER CONTROL mode.
2. Apply 28 V dc to A10TB2-1, Remote Control, to activate relay A2A6K1.
3. Adjust Power Monitor (Control Card) A2A6R7 for the desired power level.

G. AUTOMATIC RECYCLE RESETTING

Automatic transmitter shutdown occurs when PA Screen, PA Plate, or VSWR is overloaded. An overload indicator, A1CR16 through A1CR18, illuminates on Control Panel A1. The automatic recycling circuits restart the transmitter. The indicator lamp remains on until the transmitter operator presses the FAULT RESET switch on the main control panel. The fault indicator lamp cannot be RESET from Remote Control location. Perform maintenance procedures if the automatic recycling circuits fail to restart the transmitter.

The fault recycling circuits may be tested by using switch the RECYCLE TEST SWITCH A2A5S1 or disabled by switching the AUTO RECYCLE switch A2A5S2 to OFF.

III. THEORY OF OPERATION

A. GENERAL

The FM Transmitter, 816R transmitters, operate in the 88 to 108 MHz range at maximum rated RF outputs of 21.5 (816R-2C), 25 (816R-3C), 27.5 (816R-4C), 30 (816R-6C) and 35 kW (816R-5C). A CEC 802B solid state, wideband, FM exciter provides excitation. The transmitter is equipped with circuits that maintain constant power output and protect the transmitter from overload conditions. A control panel provides complete transmitter metering and tuning controls. Refer to the overall schematic diagrams for detailed circuit information.

B. FUNCTIONAL DESCRIPTION

Refer to Figure 2, an input signal (monaural, stereo composite, or SCA) is supplied to the exciter. The exciter's RF output drives a two stage power amplifier. The first stage, the intermediate power amplifier (IPA), amplifies the input to a level of 500 Watts. The last stage, the RF power amplifier, amplifies the RF signal to the transmitter's rated power output. The power amplifier is followed by a low pass filter and a directional coupler which is connected to the station's antenna system. A dc sample of the forward power from the directional coupler (DC1) is monitored by the auto power control circuit. If a change in output power is detected, a signal is sent to the power control board that increases or decreases the plate and screen power supply input voltage to compensate. A sample of the reflected power is also monitored by the power control circuits. If an excessive amount of reflected power is detected, the control circuits remove the transmitter plate voltage. The 28 V dc power supply provides power for the control circuits.

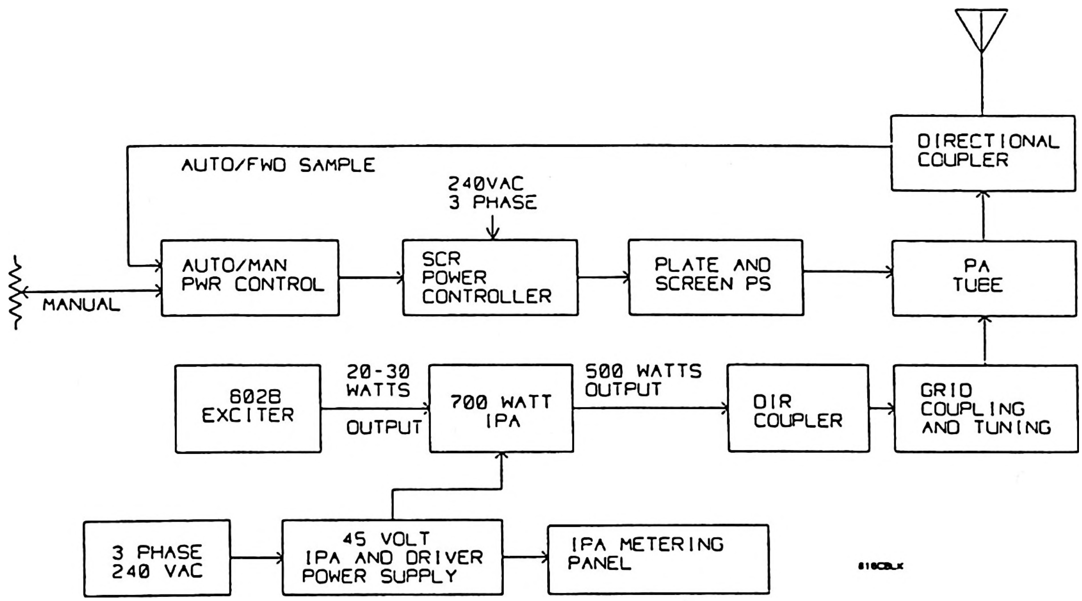


Figure 2, 816R Functional Block Diagram

1. RF CIRCUITS

Refer to Figures 2 and 4 for a simplified diagram of the RF drive path. The drive path consists of the exciter A4, intermediate power amplifier (IPA) A3AR1 with its directional coupler A3DC1, coupling capacitor A12C1, and power amplifier (PA) V1 with its grid tuning components A12C3, A12L1-L3, and A12C2.

IPA Amplifier Module, A3AR1

The IPA is a modular amplifier mounted in a roll-out drawer. The amplifier is a broadband solid state (MOSFET) design, rated to 700 Watts with internal protection if the VSWR, supply voltage, RF output power, or heat sink temperature exceed preset limits. The protection circuit will turn the module off and render a "fault" indication until the above parameters return to normal.

The IPA receives its dc power from a 45 V dc supply on A5. The IPA is followed by a directional coupler, A3DC1. The coupler drives the IPA RF power meter. The RF output of the directional coupler is connected to the RF power amplifier cavity.

IPA Metering, A3.

The IPA metering panel permits measurement of IPA supply voltage, current, forward RF power, and reflected RF power. Additionally, the panel has three LEDs which indicate power on, high VSWR, and IPA module fault. The module fault lamp lights when the module's internal protection circuitry shuts the module off. The metering panel printed circuit board contains all meter calibration pots, a voltage regulator (U1), an op amp/comparator (U2), and the metered parameter select switch (S1). The op amp amplifies the reflected power signal (U2-5) from the IPA directional coupler. This signal is compared to a reference voltage using the comparator of U2. When the reflected power signal (U2-3) exceeds the reference voltage (U2-2), U2-1 goes high, causing the VSWR LED to light. The metering circuitry is powered from the 45 V dc IPA supply through R1 and U1 on the card. Device U1 is a 12 V dc regulator.

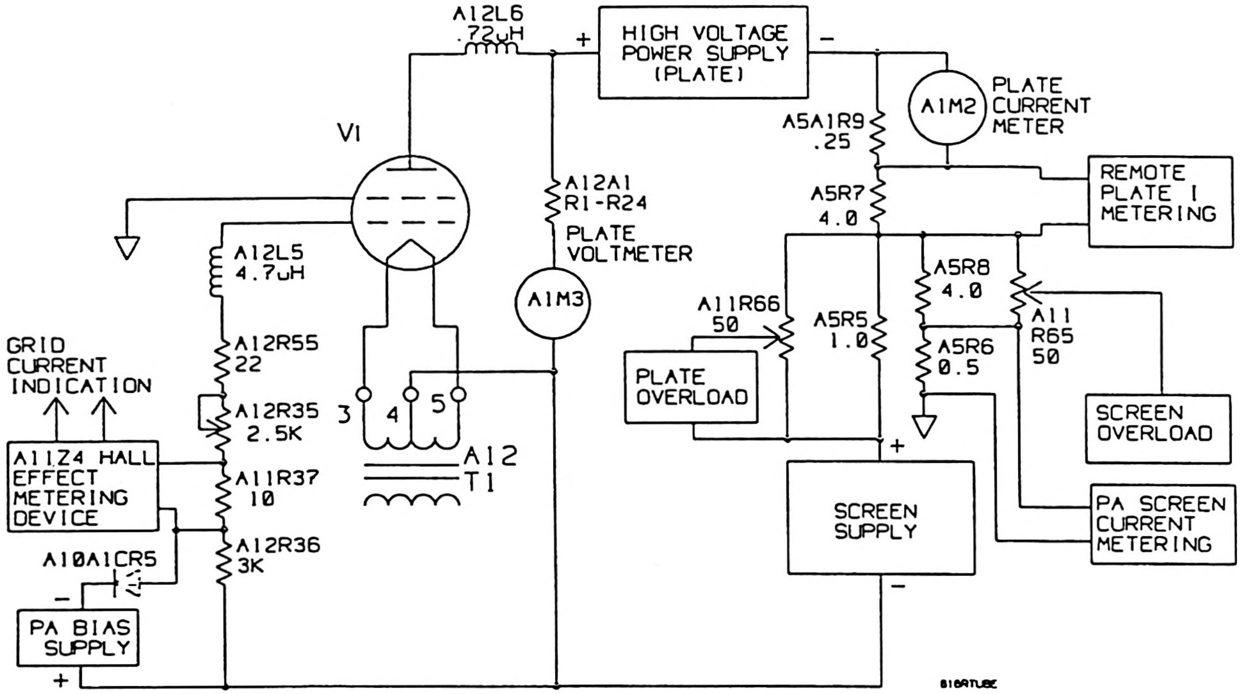


Figure 3, 816R PA DC Voltage Distribution

RF Power Amplifier, A12 (Refer to Figure 4)

The RF power amplifier is driven by the IPA through a matching network consisting of the COUPLING control (C1), the PA GRID TUNE control (C2), and L1,2,3. Capacitor C3 and resistor R1 swamps the power amplifier grid circuit and provide a more uniform impedance to the IPA under varying drive conditions. Inductor A12L14 and the distributed capacity of resistor A12R75 couple A12R75 to the cavity, forming a suppressor that dampens the higher order cavity resonances that can occur near the third harmonic of the output frequency. Cathode tuning (or peaking) capacitor A12A3C39 improves the bypass action at the operating frequency. Inductor A12L5 is the power amplifier grid bias feed choke.

The power amplifier is a plate tuned tube that is operated as Class C. The tube screen is grounded and the cathode is placed 750 Volts (nominal) negative with respect to ground to provide screen voltage, as shown in Figure 3. A fixed bias from the power amplifier bias power supply is applied to the control grid through terminal board A11TB8-19, resistor A11R37, and terminal board A11TB8-20. When an input signal is present, grid current flows and develops grid leak bias across resistors A12R35 and A12R36. The increased negative potential on the grid causes the diode in the power amplifier bias supply to reverse bias, preventing grid current flow through the supply. Hall effect probe A11Z4 monitors the amount of grid current for control panel metering.

The power amplifier plate circuit is coarse-tuned from 88 to 108 MHz by resonating the adjustable coaxial resonator. The resonator is the area between the tube shelf and the sliding shorting plane. Two motor-driven capacitors permit more precise tuning (capacitor A12C51) and loading(capacitor A12C50). RAISE/LOWER switches S3 (PA TUNING) and S4 (PA LOADING) on control panel A1, control capacitor drive motors. The dc blocking capacitor C2 is located between the top of power amplifier tube and input to the air chimney.

Low-Pass Filter, A7.

Low Pass filter A7 consists of two coaxial filters in tandem. The first filter has a cutoff frequency of 130 MHz, while the second has a cutoff frequency of 300 MHz.

Directional Coupler, DC1.

The directional coupler provides a proportional dc voltage to both the forward and reflected circuits of A2A6. The output of each is then routed to, and can be displayed on, the Forward/ Reflected Meter (A1M4).

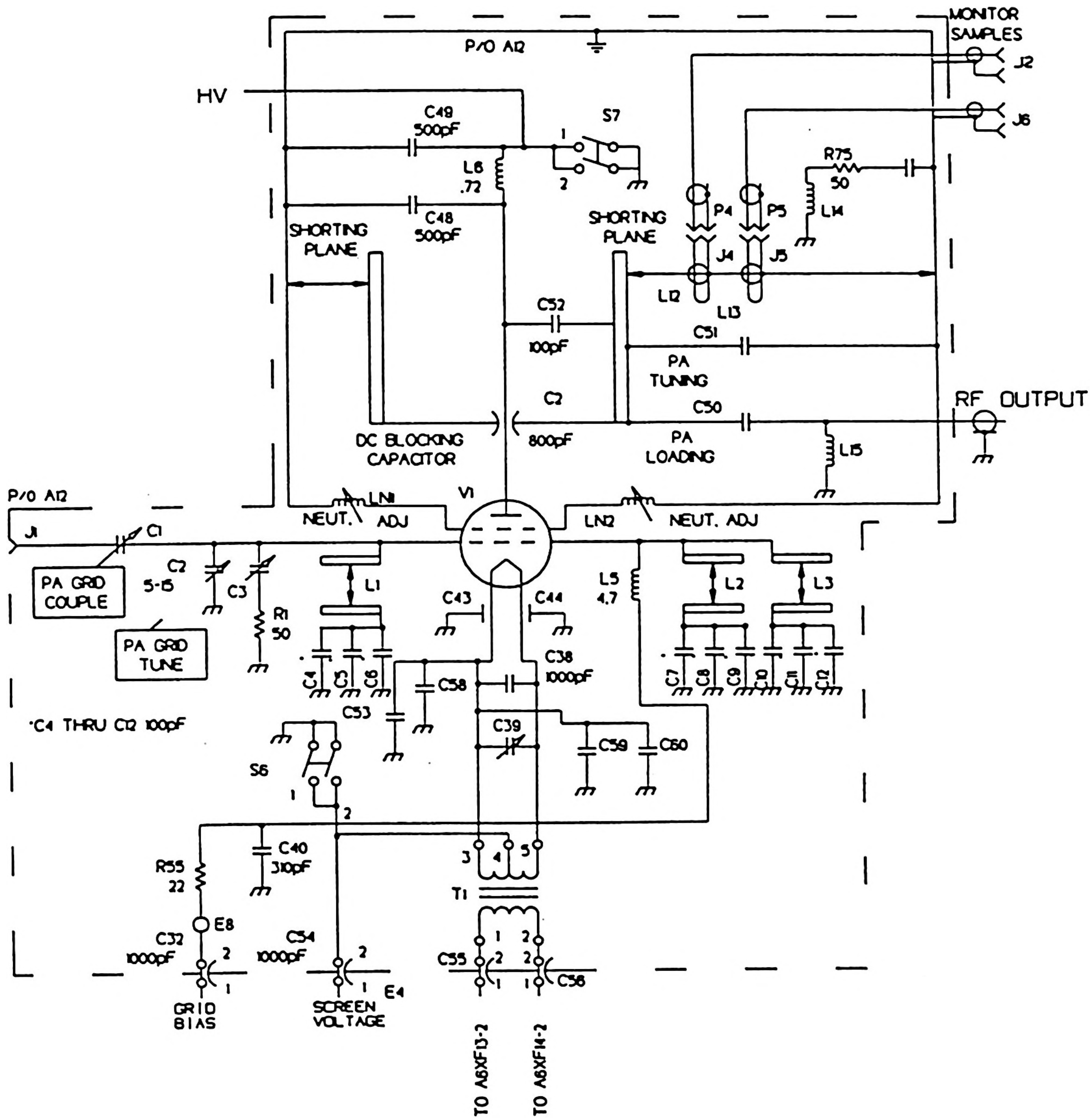


Figure 4, Power Amplifier

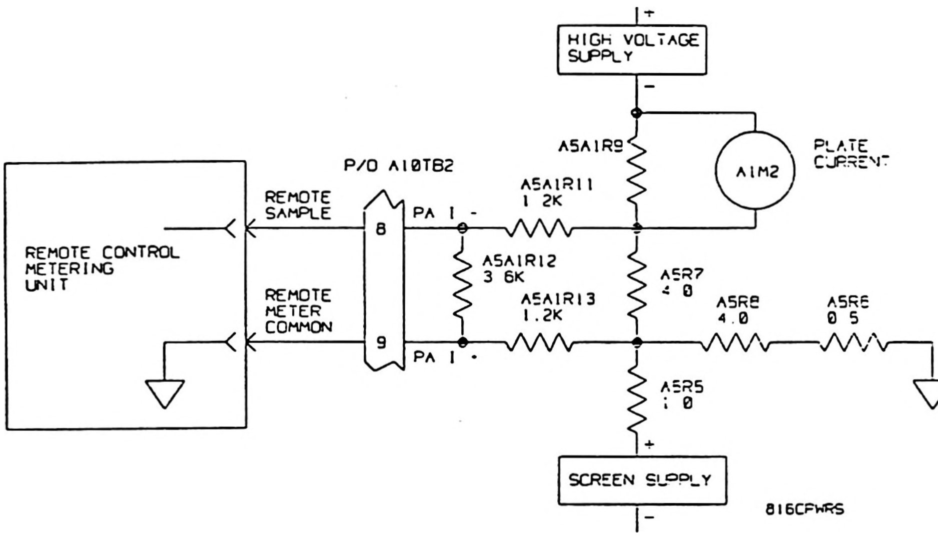


Figure 5, Remote Control Plate Current Connections

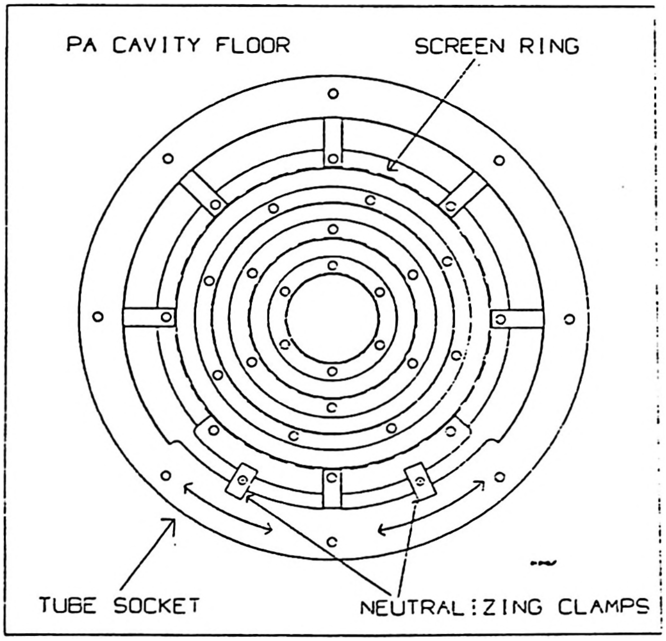


Figure 6, 816R Socket and Neutralization Straps

2. POWER SUPPLIES AND POWER CONTROL CIRCUITS

General.

There are five separate power supplies in the transmitter. Three of the five, the plate, screen and power amplifier bias power supplies provide voltages to the power amplifier. The IPA supply, furnishes voltage to the IPA stage. The 28 V dc power supply provides power to the control circuits.

28 V dc Power Supply, P/O A10.

The 28 V dc supply is a fully self-contained regulated power supply mounted on the inside of the A10 Panel.

Power Amplifier Bias Power Supply, P/O A10.

The power amplifier bias power supply provides the power amplifier with fixed grid bias that holds the tube near cutoff when no drive signal is present on the grid. Single-phase primary power is applied through contactor A8K1 and step-up transformer T1 to a bridge rectifier network. An L-section filter is formed by inductor L1 and capacitor C2. The bias supply voltage is approximately 275 VDC, depending upon line voltage.

The power supply output is applied to the grid of the power amplifier through diode CR5. Diode CR5 blocks grid current flow through the supply when the grid leak bias exceeds the fixed bias. A sample of the bias voltage is applied through resistor R3 to front panel meter A1M1 for monitoring.

Power Amplifier Plate Supply

The power amplifier plate power supply provides part of the plate voltage to the power amplifier. Primary components of the supply are transformer T1, 3-phase bridge rectifier assembly Z1, filter choke L1, and filter capacitor C1. A meter multiplier board, A12A1, samples plate voltage and allows constant monitoring. Input power to transformer T1 is controlled by SCR (silicon-controlled rectifier) power control unit A9. This unit, connected as a closed loop regulator, maintains constant power output to offset conditions of varying line voltage.

PA Screen Power Supply.

The 3-phase regulated voltage from the power control unit is applied through transformer T2 to a silicon 3-phase full-wave bridge rectifier assembly Z2 in the power amplifier screen power supply. The output of Z2 is filtered and applied to the cathode circuit of the power amplifier at the secondary center tap of filament transformer T5.

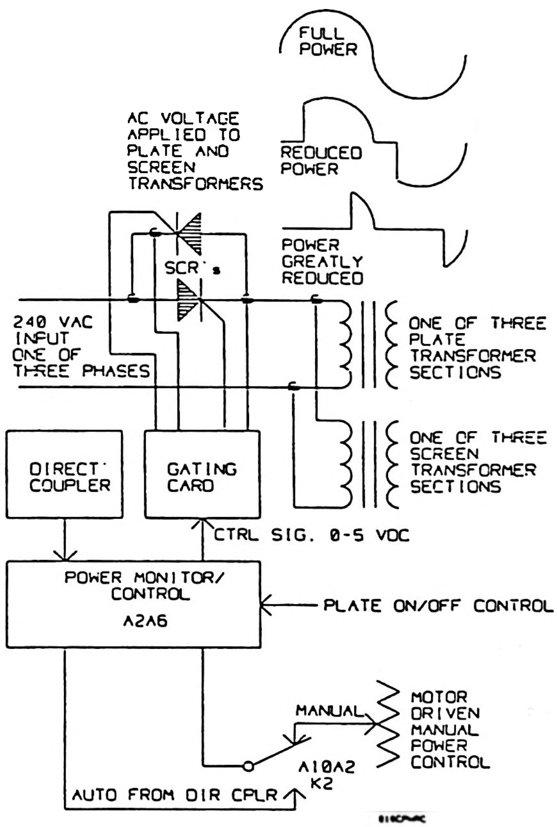


Figure 7, SCR Control

IPA Power Supply, P/O A5.

The IPA power supply is a 3-phase full-wave type using a single section choke input filter. It nominally delivers 45 V dc at 25 amperes to its load. The supply's primary power is switched through relay A5K1 which is operated by the

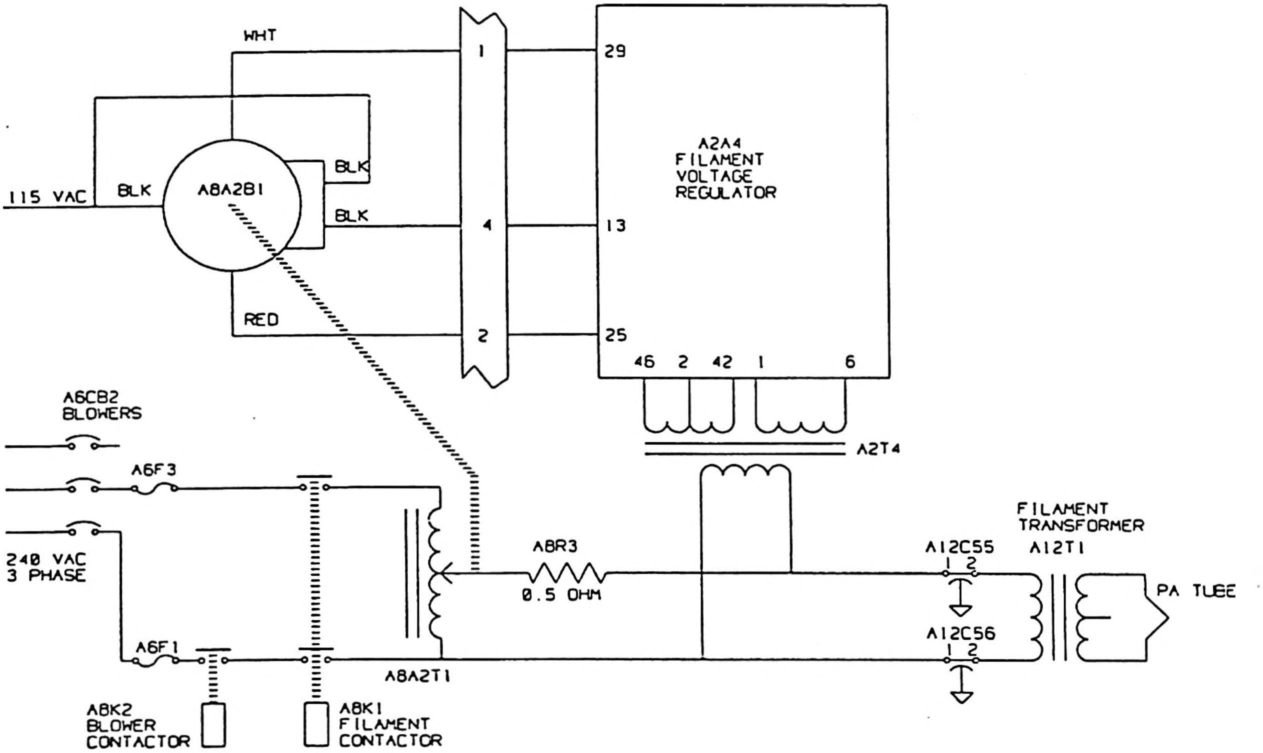


Figure 8, Filament Voltage Distribution

PLATE ON circuitry. The supply is protected through circuit breaker A6CB3.

Power Control Unit, A9.

Power control unit A9 regulates the 3-phase ac power input to the power amplifier plate and the power amplifier screen transformer. SCR assembly A9Z1 has three SCR pairs; one pair in series with each primary winding of the 3-phase power transformers. Each pair is connected within the delta circuit of the transformer primaries. Three control cards are located within the A2 card cage. Each control card controls the firing (turn-on) point of one SCR pair (Refer to Figures 7).

A common dc control signal from power control regulator A2A6 is fed simultaneously to each control card. This control signal governs the firing of the SCR pairs that regulate the input power applied to the power supplies. Upon receipt of a PLATE OFF control signal, a ground is placed across the inputs of each card.

Power Control Regulator, P/O A2A6.

The power control regulator located on A2A6 provides the necessary control signals to operate power SCR control unit A9. Assembly A2A6 supplies a soft-start power amplifier plate supply turn-on signal, a negative voltage for manual power control, and amplifier mixer functions for automatic power control.

When the PLATE ON switch is pressed, 28 V dc is supplied to A2A6J1-32. The 28 V dc activates transistor Q1 to turn on relay A8K6. Relay A8K6 in turn supplies 3-phase ac control power to A2T1,2,and 3. An RC time delay circuit formed by resistor A2A6R41 and capacitor A2A6C12 maintains A8K6 closed for a short interval after the PLATE OFF switch is pressed. Transistors Q2, Q3, and Q4, also energized by the 28 V dc, provide the dc turn-on signal to the gate cards. Resistors R24 and R36, and capacitor C11 modify this signal to soft-start the high voltage power amplifier plate power supply. Zener regulator VR4 provides -10 V dc to MANUAL power adjust resistor A2A9R1. Transistors Q4 and Q5 amplify the control signal and apply the signal to the gating cards. Capacitor C5 and resistor A6R36 phase compensate the power control servo loop.

Filament Voltage Regulator, A2A4.

When the Filament Regulator Card is in the automatic mode, the filament voltage regulator detects and compensates for sustained fluctuations in the input ac voltage. The fluctuations are detected by a true rms detection circuit which in conjunction with associated circuitry, including motor control circuits, adjusts the setting of variable transformer A8A2T1. The output voltage of the variable transformer is then applied to the primary of power amplifier filament transformer A12T1. The variable transformer voltage is also applied to the primary of filament control transformer A2T4.

Voltage for the power supply circuits on the filament regulator board is obtained from the transmitter 28 VDC supply. This 28 volts source is supplied to voltage dropping resistor R33. Capacitor C26 provides filtering. A three-terminal 15 V dc regulator U9 supplies voltage to the 15 V dc circuits with additional regulation provided by capacitors C27 and C28. Voltage dropping resistor R34 feeds three-terminal 5 V dc regulator U10 while capacitors C29 and C30 provide additional voltage regulation. LED DS5 indicates voltage present on the 5 V dc line which implies that the 15 V dc circuits are powered also. Negative supply voltage is provided via diodes CR1 and CR2 via resistor R3 and capacitor C24 to card edge connection 38 for distribution to other circuit cards in the transmitter.

A sample of the voltage feeding the power amplifier tube filament transformer is applied via transformer A2T4. This ac signal is applied to RF filtering components inductor L1 and capacitor C14. Inductor L1 has a 4.7 μh parallel resonance which falls in the FM broadcast band providing a high impedance path for frequency modulated RF signals. Capacitor C14 is a 100 pf capacitor whose series resonance falls in the FM broadcast band providing a low impedance shunt path for frequency modulated RF signals. These filtering components are used in several locations in the filament regulator card, and provide the same filtering functions as described here.

The filament voltage sample signal is then applied to the RMS-to-dc converter circuit via voltage divider resistors R1 and R2, and through capacitor C15. This RMS-to-dc converter circuit is based around U7, a true rms-to-dc converter integrated circuit. The converter directly computes the true RMS of any complex input waveform containing ac components. It has crest factor compensation which allows very accurate measurements up to 300 kHz. The crest factor of a waveform is the ratio of the peak signal swing to the RMS value. Components C17, R17, R18, C18, R19, and C20 provide time constant and filtering functions for the converter.

Test point 3 (TP3) provides easy access to the dc voltage representation of the filament RMS voltage. During normal operation of the filament voltage regulator, resistor R2 is adjusted so the output of the RMS-to-dc converter circuit is 5.00 V dc when the filament voltage has been preset to the nominal value by the operator. The output voltage is then fed to window comparator composed of U8 and related devices. The voltage references for the window comparator are provided by U11, a very high precision 10-Volt regulator, and voltage divider components R20, R21, R22, and R23. In normal operation, resistor R20 is adjusted to provide 5.00 V dc at TP2. The corrected reference voltages are then applied to their respective comparators. Pin 5 of U8 has 5.05 V dc applied, and pin 10 of U8 has 4.95 Volts applied. These voltages will be correct if resistor R20 has been properly adjusted for 5.00 V dc on TP2. The 50 mV voltage drops are provided by voltage divider resistors R21 and R22. This 100 mV total window provides a total $\pm$ 1% window for the voltage comparator, and hence for the voltage regulator circuitry.

If the voltage from the RMS-to-dc converter circuit is within the 4.95 to 5.05 V dc window, the outputs of the comparators will both be high and the output of AND gate U4C will go high illuminating green LED DS4 indicating proper filament voltage is present. If the voltage from the RMS-to-dc converter is not within the 4.95 - 5.05 V dc window, the circuit will then operate to make the necessary corrections if switch S1 is in the AUTO position.

Assuming that switch S1 is in the AUTO position, if the filament voltage rises above +1% of the nominal value setting, the following actions are taken. The output of the 5.05 V dc comparator will go low at U8-2 causing the output of U4 to go low and DS4, the LOCK LED, will extinguish. Device U8-11 will go high bringing the input of U1-13 high. When either of the comparators goes low, indicating a correction is necessary, U2B, U2D, and U2C in combination act as an OR gate forcing U1-10 high which in turn triggers timer, U6. When U6 is timing, the output pin 3 goes high illuminating yellow LED DS1. At the same time, U1-3 output goes low which takes the input of U4-1 low. This output is fed through switch S1A to inputs U1-9, U1-12 and U2-1 bringing them all low. Hence, while the timer is in its timing state, the outputs of U1C, U1D, and U2A are all high, inhibiting the actuation of relays K1, K2, and K3 respectively. Once the timer U6 has timed out, the inputs of U1C, U1D, and U2A fed from switch S1A are brought high. At this point if the filament voltage is still above the +1% nominal value, both inputs of U1 will be high, enabling actuation of relay K1 and the clutch assembly on the filament voltage adjust variac motor. Simultaneously, both inputs of U1D will go high forcing its output pin 11 to go low. The LOWER LED (DS2) will be illuminated and relay K2 will be activated which in turn actuates the lower winding in the motor driving the filament voltage control variac. Once the variac brings the filament voltage back inside the range of nominal operation, the comparator output of U8-2 will go high, and the above logic actions are reversed removing power from the filament voltage regulator variac motor.

The raise function operates just as the lower function described above, but instead activates the raise circuits. It may be noted that if future adjustments by the operator are required in the automatic mode, resistor A4R2 may be used as a simple filament voltage adjustment control.

The timing period of timer U6 is provided to guard against constantly correcting momentary excursions in the filament voltage. This delay timing period is adjustable from 0 to 12 seconds with resistor R7.

If automatic operation of the filament voltage regulator circuit is not desired, switch S1 can be put in the MAN (manual) position. This effectively takes the regulator out of the circuit, but the green LED lock indicator will still show if the filament voltage is within nominal range.

While in the manual mode, momentary switches S2 and S3 can be used to manually activate the clutch and raise or lower circuits respectively. Other than the timer not being active in this mode, these switches simulate the output of the comparators per the operator's command, thus manually raising or lowering the filament voltage. This provides a convenient way to determine if most of the digital logic and the solid state relay are functioning properly should a problem occur. Devices U3A and U3B are provided to insure that the raise and lower functions are not activated simultaneously by circuit failure or accidentally by the operator using the manual control.

While in the manual mode, the operator may depress both the raise and lower switches simultaneously and the only action to take place is the timing of U6 as noticed by the illumination of yellow LED DS1. This allows the operator a convenient way to set the time delay of U6 without affecting the other circuits.

Solid state relays K1, K2 and K3 provide a return for the ac voltages already on the windings of the clutch, and the lower and raise circuits of the variac drive motor. Relays K2 and K3 also have the return path for the ac voltages routed through micro-switches S1 and S2 on the variac assembly. This provides a secondary measure against operating the filament voltage regulator outside of the prescribed range provided by the mechanical stops on the variac drive motor.

The filament voltage distribution is shown in Figure 8. Filament voltage regulator A2A4 maintains a constant rms voltage on the filaments as discussed above.

3. PRIMARY POWER DISTRIBUTION CONTROL AND OVERLOAD CIRCUITS

Primary Power Distribution.

The 60 Hz, 3-phase primary power is distributed to the various circuits of the transmitter via circuit breakers and fuses mounted on circuit breaker panel A6. Circuit breaker A6CB5 is connected inside the delta of plate transformer T1. It also serves to interrupt primary power to the PA screen transformer T2 through associated circuit breaker A6CB4. Circuit breaker A6CB3 controls power to driver power supply (IPA) transformer T5. AC line voltage metering is provided by ac meter A2M1. In addition to the three phase-to-phase voltages, a fourth position of switch A2S1 is used to monitor the power amplifier filament voltage. BLOWERS circuit breaker A6CB2 controls application of primary power to cavity blower B1 and FAN fuses A6F7, F9, and F12 through filament-on relay A8K2. Relay A8K2 is energized when the filament switch (S2) is turned on. Application of primary power to the filament circuits, the exciter, the power amplifier bias power supply, and the power amplifier tuning and loading motors is relay controlled. Filament-on relay A8K1 and blower-on relay A8K2 control application of power to the regulated filament circuit through auto-transformer A8A2T1. Relay A8K1 also controls application of power to 802B exciter A4, to power amplifier bias power supply, P/O A10, and to the power amplifier tuning and loading motors B2 and B3 respectively. Power to the exciter and the motors is through isolation transformer T4. Time totalizing meter A2M2 is placed across the load side of filament-on relay A8K1.

The filament, exciter, and power amplifier bias supply input power circuits are protected by associated fuses. These circuits receive power from the blowers circuit breaker, A6CB2.

Transmitter Turn-On.

The transmitter is energized by pressing FILAMENT ON switch A1S2 on the A1 control panel. Relay A8K2 is energized and is applied to the blower motors. After sufficient air pressure is created in the power amplifier cabinet, air switch A12S1 is closed and relay A8K1 is energized.

After a 30-second delay, relay A8K4 is energized. The PLATE ON switch is pressed energizing relay A8K3 which applies 28 V dc to the base of transistor A2A6Q3. This turns on the control amplifier, which applies input voltage to the plate and power supplies.

The transmitter may also be energized by pressing the PLATE ON switch which latches relay A8K3, and energizes relay A8K2 through contacts 8 and 5. Pressing this single switch (PLATE ON) enables the transmitter to go through the above sequence of blower, filament, time delay and plate on.

An output override voltage is supplied to the 802B exciter when the plate voltage is turned OFF. This mutes the output of the exciter while the power amplifier plate voltage is turned OFF (Figure 7). The voltage is applied from the 28 V dc power supply through contacts 3 and 9 of relay A8K4 to the 802B exciter power supply regulator.

FWD/REFL Calibrate and Auto Power Control Unit, A2A6.

Functions.

The FWD/REFL CALIBRATE AND AUTO POWER CONTROL portion of the A2A6 card performs these functions (Refer to Schematic 180162):

1. The forward power signal from the directional coupler is buffered and amplified to provide a panel power meter reading of 100% at the customer's specified transmitter power output (TPO). Full scale meter indication is 120% in the FORWARD POWER position.

2. The forward power signal from the directional coupler is compared against either of two internal, adjustable voltages for automatic power control. Two discrete levels of power control are remotely selectable and maintain the desired power to within 1%.

3. The reflected power signal from the directional coupler is buffered and amplified to provide a full scale reading of 12% of the customer's specified TPO on the panel power meter in the REFLECTED POWER position.

4. The reflected power signal from the directional coupler is compared against an internal limit to smoothly fold the forward power level back when a slowly rising VSWR level is detected. Forward power is reduced to keep the reflected power at 5 to 6% of the customer's specified TPO.

5. A reflected power signal from the directional coupler can remove power from the transmitter and light the VSWR tally LED when a rapidly rising reflected power level greater than 10% of the customer's specified TPO is detected.

Theory of Operation.

The forward power signal from the directional coupler, DC1, is amplified and buffered by U4. Resistor R9 is an offset null adjusted for zero output at TP1 when no input signal is present. Resistor R10 is adjusted to provide a 100% forward power indication on the panel power meter (A1M4) at the customer's specified TPO.

The output of U1 is also present on terminal board A10TB2-13, terminal 34, through a 2.2K ohm isolation resistor, R13, to provide remote metering of forward power.

The positive output of U4 is coupled through diode CR11 and compared at the inverting input of U3 against the negative voltage from either resistor R8 (Normal Power) or resistor R7 (Second Power) in the automatic mode. The output of U3 is used to raise or lower the transmitter plate voltage, as necessary, to maintain the selected power level. The input to U3 is switched from resistor R8 to resistor R7 by relay K1 which is activated by applying +28 V dc to relay K1 coil through terminal board A10TB2-1. Normally, resistor R8 sets the normal operating TPO reference while resistor R7 is adjusted for some lower value, perhaps necessary during emergency operation with a generator unable to supply the full power load.

The reflected power signal from directional coupler DC1 is amplified and buffered by U1. Resistor R1 is an offset null adjustment for zero output at TP2 when no input signal is present. Resistor R2 is adjusted to cause a 10% reflected power indication on the panel power meter A1M4 when the reflected power reaches 10% of the customer's specified TPO. Resistor R3 is adjusted to simulate that 10% reflected power level when the TEST switch S1 is depressed. This allows testing of the VSWR protection and metering circuits. The output of U1 is fed through resistor R43 to the gate of the VSWR overload SCR A2A5Q4 when the VSWR protect is in the enable position. Resistor R40 is adjusted to fire SCR A2A5Q4 when the reflected power reaches 10% of the customer's specified TPO. When SCR Q4 fires, VSWR overload relay A11K9 activates, removing power from the transmitter and illuminating the VSWR OVERLOAD LED.

The output of U2 is also present on terminal board A10TB2-12 through 2.2K ohm resistor R23 to provide remote metering of reflected power.

Devices U6 and U7 form the VSWR foldback circuit. A sample of the buffered reflected power signal from U1 is fed to U2 through resistor R5. Resistor R6 is the offset null adjustment for U2 and is adjusted to give zero output at U2-6 when no input signal is present. The output of U2 is coupled through diode CR6 to the automatic power comparator, U3. Resistor R5 sets the gain so that the output voltage of U2 will exceed that of U4, causing the power to be reduced, when the reflected power exceeds 5-6% of the normal TPO. The VSWR foldback circuit is defeated by the circuitry of the ten second timer U5. The timer is triggered by sampling the anode voltage of VSWR overload SCR A2A5Q4. The response time of the VSWR foldback circuit is relatively slow. A sudden significant increase in VSWR, as in an arc, would cause the VSWR overload SCR to fire. Power to the transmitter is removed, the VSWR OVERLOAD LED is illuminated and the VSWR foldback circuit is disabled for ten seconds. The VSWR foldback circuit is disabled to allow the VSWR overload circuit to sample the VSWR at full power thereby preventing operation into a dangerously deficient load.

Overload Protection.

Relays A11K6, A11K7, and A11K9 are adjusted to energize and remove power from the transmitter when an overload occurs in the plate or screen supply or when the VSWR exceeds a preset level. Screen current through resistor A5R8 produces a voltage that is applied to relay A11K7 through resistor A11R65. The plate current through resistor

A5R7 produces a voltage that is applied to relay A11K6 through resistor A11R66. When SCR A2A2Q5 is gated on, a ground is applied and relay A11K9 is energized. Each relay is adjusted to trip at a factory preset current level. The relay contacts are in series with plate control relay A8K3. If an overload occurs, the corresponding relay trips and de-energizes relay A8K3, removing plate power from the transmitter.

Overload and Recycle Board, A2A5.

Overload and recycle board A2A5 contains circuits that provide overload indication and memory, automatic power on recycling, and filament control circuit interlock status (Refer to Schematic 180167).

When an overload occurs in the PA plate, PA screen, or VSWR circuits, a 28 V dc pulse is supplied to the appropriate SCR Q4, Q7, or Q8. The SCR latches and lights its associated LED indicator on the A1 panel to indicate which overload has occurred. All indicators that have been lighted by an overload function remain lighted until FAULT RESET switch A1S11 on the main control panel is pressed. Plate voltage is removed by overload relays A11K6, A11K7, or A11K9. The 28 V dc pulse that triggers the SCR is simultaneously routed to the recycle circuit via diodes CR9, CR11, or CR12 to be used to automatically restart the transmitter.

The automatic recycle circuit provides a timed restart pulse for up to four overload occurrences within a 30-second period. The card as shipped will allow only two restart pulses in a 30-second period. However, it may be reconfigured to allow four restart pulses in a 30-second period by removing the jumper between terminals A and B on the card and replacing it between A and C.

The auto recycle begins when the 28 V dc pulse is applied to the base of transistor Q2 causing it to conduct. The output of Q2 is fed to timers U1 and U4. Timer U1 provides a 0.5-second delay, then triggers timer U3 which generates a 0.5-second output pulse. This pulse is fed through gate U2A to inverter Q3 which causes Q6 to conduct and charge capacitor C22. The charging current of capacitor C22 momentarily energizes relay K1 which closes the PLATE ON circuit through switch S2. The charging current of capacitor C22 also flows through RECYCLE PULSE indicator LED CR6 giving an indication of the recycle circuit operation.

Gate U2D conducts the output pulse from timer U1 to counter U5. Counter U5 counts the number of recycle pulses and provides a logic 1 output at terminal C when four pulses have been received. Depending on which terminal has been strapped to terminal A, two or four recycle attempts in a 30-second period will close gates U2A, U2B, U2C and U2D and prevent any further attempts by the card to restart the transmitter. RECYCLE LOCKOUT indicator LED CR2 will light to indicate this condition. When the 30-second period of time has elapsed, a pulse is generated, inverted by transistor Q1, and applied to U5 to reset it to zero. This clears the memory and allows another sequence to begin. If the maximum count of two or four pulses has not been received in the 30-second period, the timer will also reset the counter automatically.

AUTO-RECYCLE switch S2 may be used to disable the auto recycle card when desired. This is usually done during tune-up or maintenance procedures. RECYCLE TEST switch S1 may be used to test the automatic recycle circuit during maintenance procedures by simulating an overload pulse at the input to the recycle circuit.

Power Failure Recycle Board, A8A1.

In the event of momentary loss of primary power, the power failure recycle circuit restores the transmitter to operational status. Capacitor C3 maintains current flow through time delay relay A8K4 keeping the time delay circuit active for short term power outages and a separate circuit provides a momentary ground at pin 10 when power is restored. The momentary ground is applied to capacitor A2A5C22 and the charging current of this capacitor pulls relay A2A5K8 in and initiates the power ON command.

The latching relay permits local or remote selection of manual or automatic power control. The latching relay is connected to the remote control panel through terminal board A10A2. A 28 V dc signal applied by local control switch A1S5 or through remote control interface board will latch relay K2 in one of two stable states. AUTO PWR

CONTROL indicator LED A1CR31 indicates automatic power control is selected and MAN PWR CONTROL indicator LED A1CR30 indicates manual power control is selected.

Power Control Relays, P/O A10A2.

Assembly A10A2 provides remote manual power lower and raise control. When power is decreased at the remote control panel, relay K4 is energized. Closed contacts provide 115 V ac to motor A2A9B1 which adjusts the resistance of A2A9R1 to decrease the transmitter power output. When the power is increased at the remote control panel, relay K6 is energized and closed contacts provide 115 V ac to motor A2A9B1 which adjusts the resistance of A2A9R1 to increase the transmitter power output.

Remote Relays, P/O A10A2.

Remote relays in A10A2 parallel the front panel control operations. Failsafe relay K8 is energized only when 28 V dc is present in the control circuit. If the 28 V dc is lost, the relay de-energizes and removes plate power from the transmitter. Second power level (low power) relay K7 must also be energized continuously (28 V dc) to maintain the second power level.

IV. TRANSMITTER COOLING

In many locations ventilating a building is preferred over air conditioning. Air conditioning equipment is mechanical and can break down, is initially expensive, and is expensive to maintain and operate. The 816R-6C transmitter can operate in a room environment where temperatures can be as low as -4° F to as high as 122° F. There are several different ways to ventilate a room that will be discussed in following paragraphs.

Exhaust Fans.

There are times when exhaust fans are the best means of ventilating a transmitter space. If the room is large and it is not possible to locate the transmitter near an outside wall, exhaust fans may be the only reasonable way to ventilate a room. It is better in this situation to vent the transmitter directly to the room or through a short duct to the attic and use exhaust fans in the room or the attic. It is important to arrange the transmitter exhaust so that there is no chance of recirculation of exhaust air back into the transmitter.

There are many good ways to make an installation utilizing exhaust fans and one method will be described here. If the room has a high ceiling (more than 10 feet), install a drop ceiling about eight feet from the floor. Vent the transmitter exhaust directly into the space above the drop ceiling. Let the transmitter take air from the room. At the four corners of the drop ceiling install air registers that will allow air from the room to escape into the area above the drop ceiling. Install an exhaust fan that will evacuate the area above the drop ceiling. This method will not have the exhaust fan competing with the transmitter fan and blower, will prevent recirculation (providing exhaust fan does not fail), and will provide ventilation for the transmitter space. There are variations of this scheme that will allow recirculation (controlled by a thermostat) in the winter to heat the transmitter space.

Although exhaust fans and blowers are the most common method of ventilating transmitter spaces they are not the best in some cases. The three cautions listed below are some reasons for choosing another method when there is a choice.

1. An exhaust fan allows unfiltered air into the transmitter by expelling air from the room or building and pulling air into the room through any and all openings in the room. The transmitter space should be as clean and dust free as possible. It is not likely that the transmitter space can be air tight except for the filtered air intake. The unfiltered openings will allow dust and dirt into the transmitter space.

2. An exhaust fan results in dead air spaces since it does not "stir" the air in a room which makes "dead air spaces" possible. There is usually only one intended air inlet to a transmitter space and the air movement is from that inlet directly to the exhaust fan.

3. In installations where the transmitter is ducted to the outside and takes air from the room, the exhaust fan is competing with the transmitter cabinet fan and cavity blower for air through the same room airinlet. In this situation, the greater capacity of the exhaust fan will reduce the transmitter cooling if the room air inlet is not large in size. Where exhaust fans or blowers are used, the room air intake must be large enough so that the room in not under negative pressure. Negative pressure at the transmitter air inlet has the same detrimental effect as back pressure of the same amount at the transmitter air exhaust.

Positive Pressure

Positive pressure ventilation forces air into the room and the air escapes through openings in the room. The air may be forced into the room with propeller type fans or with centrifugal blowers. Propeller type fans move more air with smaller motors than will centrifugal blowers. A 30 or 36 inch fan is quiet and can move more than 3000 cfm of air into a room and use only a 1/4HP motor. Some of the advantages of positive pressure ventilation are:

1. All the air entering the room comes through one opening which can be easily filtered. When doors or windows are opened, air moves out through the opening.

2. A fan blowing air into a room will "stir" the room air reducing the risk of dead air space.

Deflectors at the fan can be used to direct air into areas that might not otherwise have moving air.

3. All fans aid each other. The fan that is forcing air into a room is aiding the transmitter fans in cooling the transmitter. All the fans, the room fan, the transmitter cabinet fan, and the power amplifier cavity blower are moving the air in the same direction through the transmitter.

4. Like the exhaust system, the pressure system will also ventilate the room. The transmitter will exhaust about 500 cu-ft/min. of air to the outside. If the room fan is capable of moving three or four thousand cu-ft/min. of air into the room, another opening in the room must be provided for room ventilation.

An example of positive room ventilation will be described here. This is intended only as an example and can be modified to meet your particular requirements.

Locate the left end or the rear of the transmitter near an outside wall in order to keep the exhaust ductwork as short as possible. Position the transmitter so that the exhaust duct will not interfere with the coaxial RF output line. If the total duct run is eight feet or less and there are no more than two elbows, 16 inch round or the equivalent square duct can be connected directly over the transmitter exhaust output using sheet metal screws. (Use care when drilling holes for sheet metal screws so as to avoid metal shavings falling into the transmitter.) The duct will have to be turned down at the outside to prevent rain and snow from getting into it. A bell type transition should be used at the end of the duct to reduce turbulence.

The duct above the transmitter will have two dampers and an opening to the room. The dampers will be motor controlled and mechanically linked together so that the opening to the room will be closed off at the same time that the air from the transmitter will be directed to the outside. With the dampers in the second position, the air from the transmitter will be directed to the room instead of outside. The mechanical linkage is necessary to prevent the possibility of both dampers being closed at the same time. This arrangement will allow the transmitter to exhaust to the outside in the summer and recirculate to the inside in the winter.

A fan that has enough capacity to change the room air at least once each minute is installed in the wall. This fan pulls filtered air into the room through motor controlled louvers. A 3000 cfm fan will change the air once a minute in a 15X20 foot room having a 10 foot ceiling.

An opening with motor controlled louvers is provided in the same wall where the fan is mounted. The reason for intake fan and room air outlet being on the same wall is to minimize the effects of wind on the ventilation system. If both inlet and outlet are on the same wall, the effects of wind, regardless of direction, is neutralized since the wind pressure is the same on both. The transmitter air exhaust should be on this wall also. The transmitter exhaust should not be positioned so that there is a risk of recirculation.

With motor control on inlet and outlet louvers and transmitter duct dampers, it is possible to control the operation of louvers, dampers, and the ventilation fan with thermostats. Set the thermostats, based on environmental conditions, to maintain the required equipment operating temperature at all times. Three conditions are described below that will give different results:

1. A condition of maximum ventilation and cooling will result during the hottest periods. The transmitter will be ducted to the outside and the intake fan will be running. The outlet wall louvers will also be opened to permit room ventilation.

2. A condition of minimum ventilation will exist at times when it is not necessary to run the room intake fan, but the transmitter should be vented to the outside. Under these conditions the transmitter exhaust dampers will direct the transmitter exhaust to the outside, the outlet wall louvers will be closed, the fan will be off, and the inlet fan louvers will be open to allow fresh filtered air into the room and transmitter.

3. A condition of recirculation for heating will exist during cold periods. The transmitter exhaust dampers will be positioned to allow

transmitter exhaust air into the room and all outside outlets and inlets will be closed.

The system described will require two heating type thermostats and control relays. One will be set to approximately 65° F and the second will be set to approximately 85° F.

At temperatures above 85° F, the first condition described above will exist.

For temperatures between 65° F and 85° F the second condition described above will exist.

For temperatures below 65° F the third condition described above will exist.

The thermostats should be mounted approximately seven feet off the floor and in an area of the room where the temperature is not influenced by heat radiated by the transmitter or by direct air flow from the room intake fan.

The transmitter space should also be provided with a thermostatically controlled heater that can be set to approximately 50° F. This will provide heat during maintenance periods or during times that the transmitter is off-the-air, if not a 24 hour operation.

Transmitter Exhaust Duct

Regardless which air system is used, careful consideration must be given to location of transmitter, air intake, and air outlet vent when using outside air for cooling room and equipment. First, consider where to place the transmitter. The transmitter exhaust will be vented to the outside and transmitter will take air from the room. Since the transmitter will exhaust to the outside, the exhaust vent on the transmitter should be placed as close as possible to an outside wall. Although it is highly undesirable, it is possible to exhaust through the roof but extreme care must be used to weatherproof and leak proof the ductwork above the transmitter. Since water that may leak at the ductwork will likely get into the transmitter, it is absolutely necessary to check for leak proofing often. In any case the ducts must be kept as short as possible to minimize back pressure at the transmitter outlet. Remember that elbows, vent caps, and hoods all add extra resistance to air flow through the transmitter. In most installations, the transmitter can be placed so that no more than eight feet of exhaust duct is needed. If this is possible, 16 inch round duct or the equivalent rectangular duct will be acceptable. Do not use more than two elbows. It is not a good practice to connect more than one transmitter to the same exhaust duct. Let each transmitter have its own individual exhaust duct.

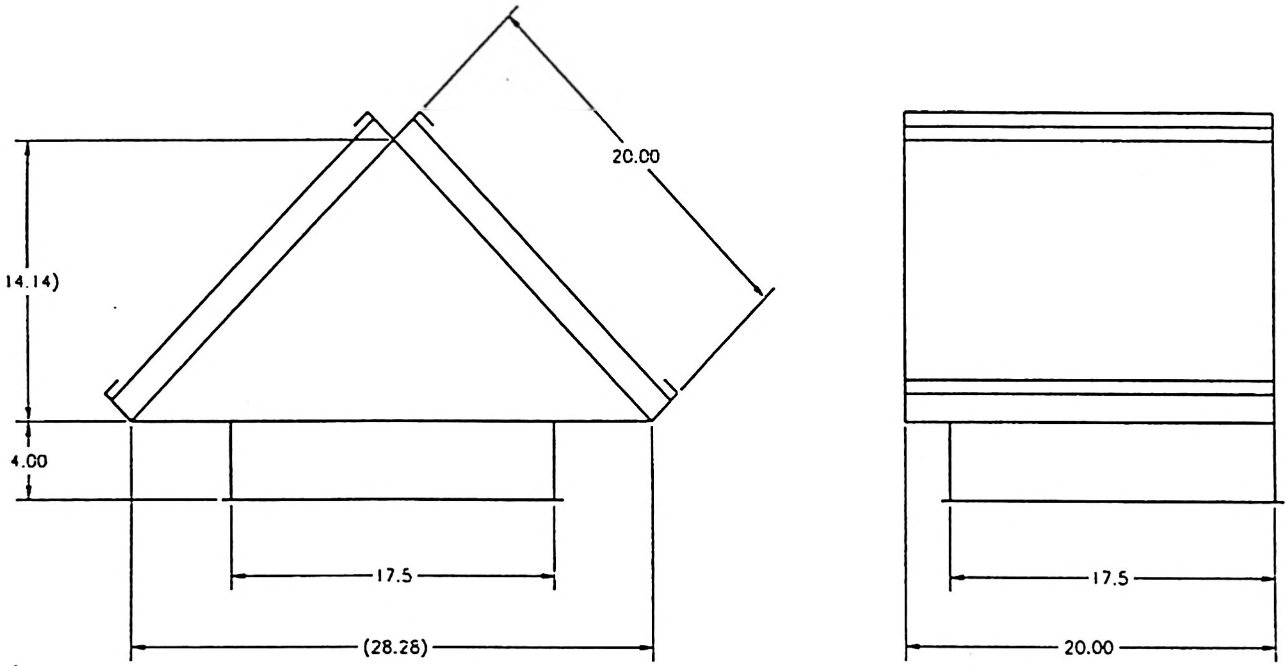
Where possible use large ductwork instead of duct fans. Duct fans may be required if the duct run is long but duct fans increase air resistance if they fail; therefore, some method of monitoring and interlocking to the transmitter must be used if there is no alternative to the use of duct fans.

External Air Filter

The original air filter for the 816R series transmitters is adequate for most installations. There are situations where the air may be extremely dirty. Because the air intake opening is only 16 inches square, you must not place additional filters or furnace type filters on the transmitter's air intake opening in an attempt to correct this situation. An external filter assembly may be necessary if the transmitter room is not clean or if the air entering the room is difficult to filter properly.

The external filter holder assembly shown on the reverse side of this page is designed to accept two 20" X 20" X 2" Extended Surface Pleated filters. This filter assembly can be attached directly to the top of the transmitter over the air intake replacing the original filter. Just one 20" X 20" X 2" filter of this type has about nine square feet of filter surface. Grainger, a supplier found in most larger cities, carries the "Air Handler" brand. FARR is another popular manufacturer of this type filter.

In addition to the greater surface area of the filter material, two 20" X 20" openings reduce the air velocity through each filter and allows them to be much more effective than with the original 16" square filter opening.



External Air Filter Holder Assembly

MECHANICAL

Weight	816R-2C	1962 lbs.
	816R-3C	2000 lbs
	816R-4C	2050 lbs
	816R-5C	2558 lbs
	816R-6C	2100 lbs
Size:		
Transmitter	Height: 73 in (188 cm) with directional coupler Width: 70.7 in (180 cm) Depth: 28 in (71 cm)	
816R-5C Plate Transformer	Height: 46 inches Width: 35 inches Depth: 24 inches	
Finish:	Front Panel: Grey Cabinet: Black	

ENVIRONMENTAL

Ventilation:	Squirrel cage type blower mounted under the cavity. Axial fan in the right section that provides positive air pressure within the entire cabinet
Ambient Temperature Range:	-4°F to +122°F operating (-20°C to +50°C)
Relative Humidity Range:	0 to 95% relative humidity
Altitude:	Up to 7,500 ft (2,285m) at 95°F (+35°C) Up to 10,000 ft (3,046m) at 104°F (+40°C) with optional high altitude blower
Shock and Vibration:	Normal handling & transportation

ELECTRICAL

Frequency Range:	88 to 108 MHz
Output Power:	21.5 kW, 816R-2C 25.0 kW, 816R-3C 27.5 kW, 816R-4C 30.0 kW, 816R-6C 35.0 kW, 816R-5C
Output Impedance:	50 ohms, unbalanced
Standing Wave Ratio:	2:1 Maximum

Power Source:	200 to 250 volts, 60 Hz, 3 phase. Available voltage taps on plate & screen transformers: 200, 210, 220, 230, 240 and 250. (50 Hz operation available on special order)
Power Line Variations:	±5% overall power line variations; in addition, the phase angle and voltage unbalance shall be within 5% of the average of all three phases
Harmonic & Spurious Radiation:	Any emission appearing on a frequency removed from the carrier by between 120 kHz and 240 kHz inclusive is attenuated at least 25 dB below the level of the unmodulated carrier. Any emission appearing on a frequency removed from the carrier by more than 240 kHz and up to and including 600 kHz is attenuated at least 35 dB below the level of the unmodulated carrier. Any emission appearing on a frequency removed from the carrier by more than 600 kHz is attenuated at least 80 dB below the level of the unmodulated carrier.
Modulation Characteristics:	Wideband direct FM
Input Power Requirements:	816R-2C, at 21.5 kW rf output 34.3 kW 816R-3C, at 25.0 kW rf output 41.0 kW 816R-4C, at 27.5 kW rf output 43.4 kW 816R-5C, at 35.0 kW rf output 53.0 kW 816R-6C, at 30.0 kW rf output 46.1 kW
Excitation Source:	Continental 802B exciter
Output Impedance:	50 Ohms, unbalanced
Carrier Frequency Stability:	Frequency will not vary more than ±250 Hz for an ambient temperature range of +32°F to +131°F (0 to +55°C).
Modulation Input:	Monaural - 600 Ohms, balanced, +10 dBm ±2 dB, for ±75 kHz deviation Composite - 5,000 Ohms, switchable balanced or unbalanced, 1.25 Vrms, for ±75 kHz deviation SCA: 3 adjustable, 15,000 Ohms, unbalanced, 1.25 Vrms, for 10% injection
Audio Frequency Response:	Monaural - ±0.5 dB; flat, 25, 50, 75 microsecond pre-emphasis, 20 Hz to 15 kHz.
Audio Frequency Distortion:	Monaural - Not more than 0.08%, 20 Hz to 15 kHz (Measured with spectrum analyzer)
FM Noise Level:	75 dB below 100% modulation (±75 kHz)
AM Noise Level:	Asynchronous - 55 dB below equivalent 100% AM modulation Synchronous - 50 dB below equivalent 100% AM modulation

816R TRANSMITTER
INFORMATION SHEETS

PRODUCT BULLETIN
EIMAC 4CX15,000A AND YC130
MARCH 23, 1990

INTRODUCTION:

EIMAC has learned more about the best way to operate these tubes in regard to filament management. These revised operating instructions conflict with the advice given in the original EIMAC Application Bulletin AB-18, "Extending Transmitter Tube Life". AB-18 recommends against operating the filament at a voltage less than 95% of nominal.

The following instructions supersede all previous suggestions and instructions. Specifically, you should lower the filament voltage after the first 200 hours of operation. There is no longer a lower limit of 95% of full filament voltage. This is the principal change in Eimac Product Bulletin AB-18. After operating a new tube for 200 hours, the filament voltage should be reduced to the power emission knee required for your output power.

WARNING

High voltage is used in high power equipment. High voltage can cause severe injury or death. Insure that all circuit breakers are off and primary power is disabled when making adjustments inside the transmitter.

Discharge all power supplies before making any adjustments.

PROCEDURE:

First stabilize the new tube emission by operating it at rated filament voltage for a minimum of 200 hours. Raise the transmitter output power to approximately 105% of normal power. Carefully lower the filament voltage in 0.2 volts steps, pausing for about 30 seconds after each decrement, until you see a significant (greater than 2%) change in power output or plate current. This is the filament emission knee. Now raise the filament voltage 0.2 volts above the knee voltage. This is the correct filament operating voltage for your power output. Operation at this reduced filament voltage insures maximum possible tube life.

Check for a change in the filament voltage knee one week after you lower the filament voltage. Keep the operating voltage 0.2 volts above the knee. Repeat this check monthly throughout the life of the tube.

NOTICE:

It is imperative that the EIMAC "Warranty Claim Service Report" be completed and returned with all tubes that are still in warranty. This information provides Eimac and our engineers with information concerning tube performance and service obtained.

Note:

The preceding information was taken from EIMAC Product Bulletins for the 4CX15,000A and YC130 tubes dated March 23, 1990.

TECHNICAL INFORMATION LETTER

October 30, 1991

THREE PHASE TRANSMITTER PRIMARY POWER SOURCE

The purpose of this Information Letter is to describe the primary power source for Continental transmitters that require Three Phase Primary Power. Our specification sheets, instruction manuals, and sales brochures state the primary power requirements for individual transmitters but do not state reasons for exempting certain types of power sources. Questions have come to our attention that indicate a need for us to express our concern about the use of Open Delta power sources for radio transmitters and to make recommendations.

The Open Delta three phase connection is sometimes referred to as "Phantom three phase" connection or "V-V" connection. The only reason that this configuration is ever used is to reduce power line and transformer costs to the power company which may be passed on to the subscriber. This configuration requires two transformers instead of three and one less power transmission wire to the subscriber's location. Non-sinusoidal phase voltage, excessive third harmonic content, susceptibility to line and switching transients, and imbalance of phase voltages are problems inherent with the Open Delta connection. Because of this lack of stability, peak ratings of power supply components may be exceeded, resulting in frequent power supply component failure and impaired performance. For these reasons, the open Delta connection must be avoided as a primary power source for transmitters.

Conventional WYE and Closed Delta are the only acceptable power sources for three phase transmitters. Both offer acceptable phase to phase voltage and phase characteristics under changing load conditions. Lightning and transient protection devices can perform their function when used with either type and a proper ground system. The WYE configuration is prefered when there is a choice between WYE and Closed Delta.

This is not to say that a transmitter will not function with other types of primary power configuration, but reliability and performance will likely be affected by using another type.

For further information or if there are questions, please contact our Field Service group at (214) 388-5800.

POWER AMPLIFIER GRID ADJUSTMENT PROCEDURE

There may be several reasons for readjustment of the PA Grid Tuning and Coupling circuits. When an IPA Module fails and is replaced, the following procedure should be used to make certain that some failure within the PA Grid circuit does not cause another IPA failure. Tube replacement is another reason for using this procedure. In general, the following procedure should be used if there is any reason to suspect that there may be a bad load on the IPA or if changes have been made in the PA Grid circuit.

When the IPA internal VSWR protection circuits are utilized, the IPA will turn OFF if the VSWR presented by the PA input exceeds 3:1. This can make grid tuning difficult if the grid is far out of tune. The 802A Exciter can be used to adjust the Grid Circuit to approximately correct tuning and coupling positions. The 802A Exciter has a Reflected Power Foldback circuit that limits the reflected power output to a safe level for the exciter regardless of the VSWR presented to the Exciter by the PA Grid Circuit. The first six steps of the following procedure allows you to tune the grid circuit using the output of the Exciter.

1. Use a coax cable and BNC to Type N adapter to connect the Exciter RF output directly to the Grid input connector. This bypasses the Driver and the IPA.

2. Turn the Transmitter Plate Breaker, CB5, OFF.

3. Turn Filament and Plate Control ON. After the filament time delay, there will be IPA and Driver Collector voltage but no IPA or Driver Collector current. There will be no PA plate voltage or Screen Voltage since the Plate Breaker is OFF.

4. Set the Exciter RF output level to approximately 15 watts.

5. Adjust the PA Grid TUNING and COUPLING controls for minimum indication on the Exciter Reflected Power Meter.

6. Increase the Exciter RF output to approximately 40 watts and repeat step 5.

7. Turn Plate and Filament Control OFF and remove Primary Power from transmitter. Restore the Exciter, IPA, and Driver to original configuration. Turn Plate Breaker, CB5, ON.

8. Remove the thyrectors (voltage absorbers) that may be in parallel with the Plate Power Supply choke L1. This is necessary to prevent damage to the thyrectors when the power control is used to reduce the plate voltage to zero in later steps.

NOTE:

The PA Tube input impedance decreases as the Grid input power is increased. The Grid Tuning and Coupling must be readjusted when the IPA and Driver are reconnected and when IPA output power is increased to normal.

In the following steps you will start with low IPA output power and with zero or minimum plate voltage. You will adjust Grid Tuning and Coupling as you slowly increase drive power until normal drive power is reached and then you will slowly increase plate voltage while adjusting Grid Tuning and Coupling until normal operating plate voltage is reached. Keep the IPA Reflected Power to a minimum as you make adjustments to IPA power output and plate voltage.

9. Restore primary power to the transmitter and turn the Filament control ON.

10. Set the Exciter Power Output Adjustment fully CCW.

11. Press the Exciter MUTE Switch. Turn Plate control ON and reduce the plate voltage to zero or to minimum with the Manual Power Control.

12. Release the Exciter MUTE switch and slowly increase the Exciter output while watching the IPA Reflected Power. Do not let the IPA Reflected power exceed 60 watts.

13. Adjust the PA Grid Tuning and Coupling for minimum IPA Reflected Power as the Exciter output is increased to normal. DO NOT EXCEED 20 AMPERES ON IPA COLLECTOR CURRENT. The normal range of IPA Collector current is 18 - 20 Amps.

14. Slowly increase the plate voltage with the Manual Power Control. You will notice that the IPA Reflected Power will increase as the plate voltage is increased. Adjust the Grid Tuning and Coupling to keep the IPA Reflected Power at minimum as the plate voltage is increased toward maximum.

15. This completes the adjustment procedure. Restore the transmitter to normal configuration.

NOTE:

The 816R-2C, 3C, 4C, and 5C transmitters do not use the 150 watt driver and the normal exciter output will be in the range of 20 to 35 watts.

The Exciter RF output will be 10 watts if the IPA power output is controlled by the collector voltage on the 150 watt Driver. The Driver collector voltage and the IPA output is set by adjustment of R40 on the IPA Meter Board.

The Exciter output will be approximately seven watts if the IPA output is controlled by the Exciter RF Output Level Control only and the transmiter uses the 150 driver module.

Please contact Continental Technical Support at (214) 388-5800 if you have questions about this Information Letter.

CONTINENTAL 816R and COLLINS 831G POWER CONTROLLER CHECKOUT

A. PRELIMINARY

1. Remove primary power from the transmitter and ground high voltage supply components.

2. Remove the Thyrectors (Voltage Absorbers CR1-CR5, not used of recent transmitters) that may be in parallel with the High Voltage Inductor L1.

NOTE:

The following tests will apply single phase voltages to the RF Tube Power Supplies. Failure to remove the Thyrectors will result in damage to the Thyrectors across the High Voltage Inductor L1.

3. Locate the Power Controller Assembly A9AR1 at the top of the transmitter center cabinet. The Power Controller is accessible from the rear center cabinet on all Continental and some late model Collins Transmitters.

   On older model Collins Transmitters, the Power Controller is accessible from the front of the Center Cabinet. Use the following procedure to gain access to the Power Controller on older model Collins Transmitters only:

   Remove the Control Panel and set it on top of the transmitter. Remove the screws that secure the Card Cage Assembly and move the Card Cage Assembly forward just enough so that the Gating Cards can be removed.

B. TEST PROCEDURE

1. Remove two of the three Gating Cards from the A9AR1 Assembly.

2. Restore the primary power to the transmitter and turn FIL ON.

3. Place Transmitter in MANUAL POWER CONTROL and after the time delay has expired, turn PLATES ON. The transmitter plate and screen power supplies will be operating with only one power phase applied in the following tests. The plate voltage, screen voltage, and power output will be lower than usual. It is not important what the exact voltages are in these tests.

5. Operate POWER CONTROL ADJUST and observe that the plate voltage, plate current and power output change smoothly. Note the maximum plate voltage. If the Power Controller Phase under test is good, there should be no breaker trips, no unusual noises form the power transformers and no building lights blinking.

WARNING:

Remove primary power from the transmitter each time a gating card is moved or changed.

If none of the cards operate properly in the selected Power Controller receptacle, use a different card receptacle and run the test again. Perform the same test with each (one at a time) of the remaining gating cards in the same Power Controller card receptacle. You should get exactly the same results with each card if the card is good. If all the cards operate properly, use one of the cards to test each of the two remaining receptacles. This will check the other two Power Controller phases.

If all the cards operate properly in one or two receptacles but not in another, you can safely assume that the cards are good but either an A9AR1 control transformer or one of the SCR banks are defective. Our experience indicates that the SCR's are least likely thing to fail.

Continental Electronics Corporation

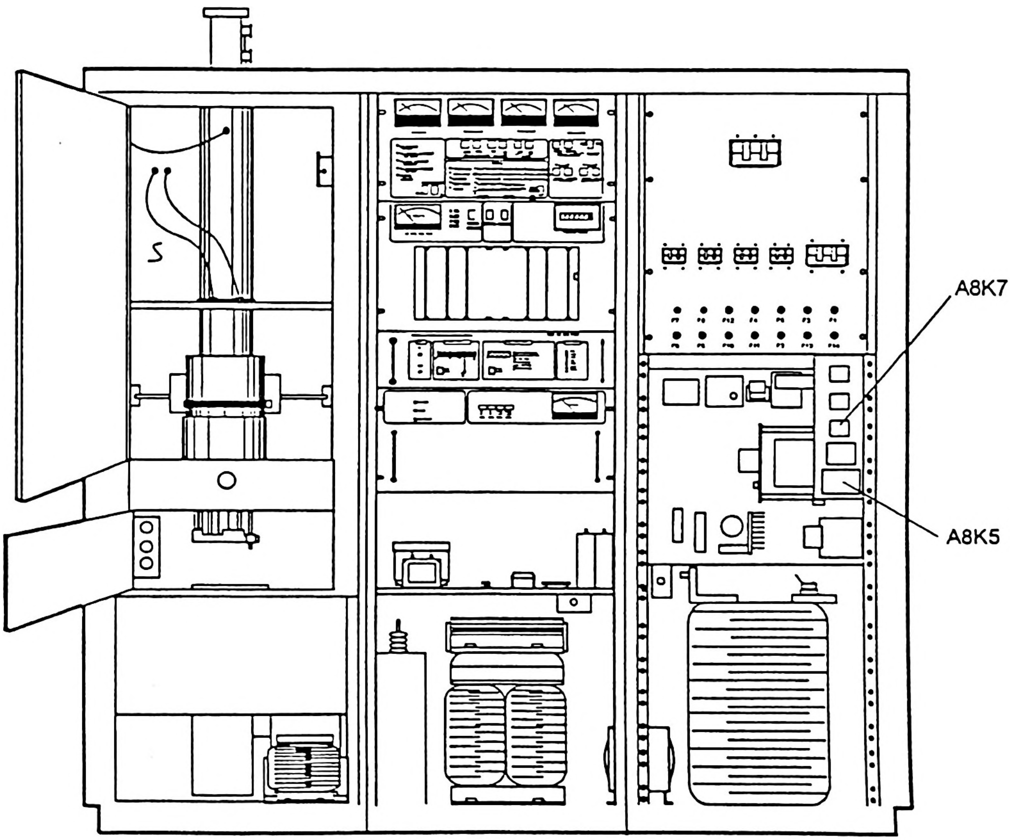
816R PHASE LOSS WIRING MODIFICATION

The phase loss/low voltage sensor circuits in the 816R transmitters are intended to protect the three phase blower and fan motors by removing all primary line voltage frrm the motors if the line voltage is too low or if there is a missing phase. This is accomplished by interrupting the 28 volt control voltage. These circuits function reliably when only filament control is on. However, there is a possibility that a "sneak" path through Q1 on the Power Monitor/Control module, A2A6, can bypass these phase loss protection circuits when plate control is ON and may damage the three phase motors if one phase is missing or if the line voltage is low.

Modification Procedure

Using the drawing below, locate relays A8K5 and A8K7 in your transmitter. There are three wires on terminal 8 of the orange colored phase loss relay K5. Move the white wire with brown tracer and the green wire to terminal 8 of relay K7. There should be one solid white wire still connected to terminal 8 of K5. This completes the modification.

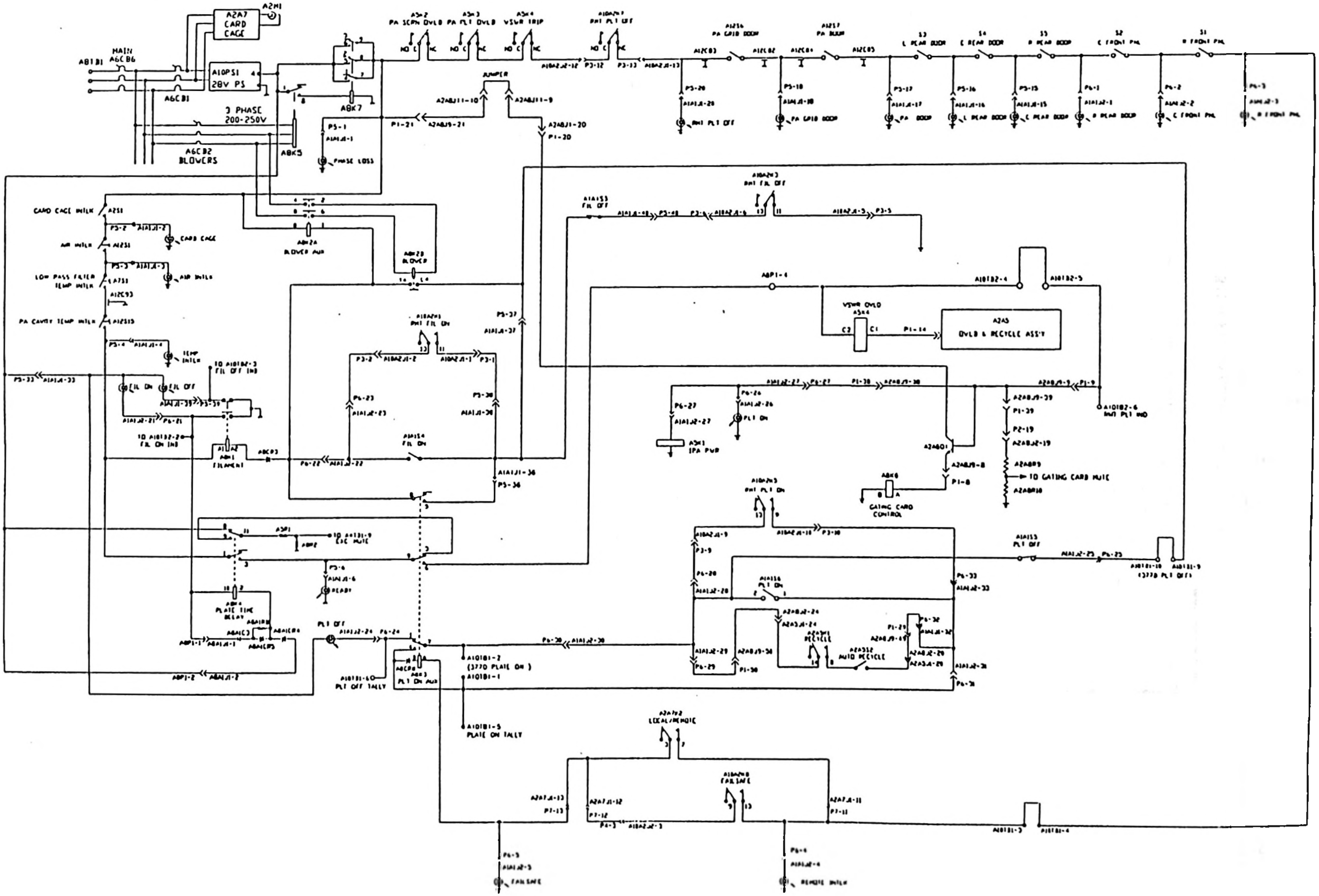
Check for proper operation by turning just filament control ON and adjusting the Phase Loss adjustment that is located on K5 in a clockwise direction until the indicator lamp on K5 goes OFF. The blower and filament control should go OFF at this time. Rotate the phase loss threshold adjustment counterclockwise until the indicator lamp K5 comes ON. It should now be possible to turn the filament and plate control ON. With plate control turned ON, adjust the phase loss threshold adjustment in a clockwise direction until the indicator lamp on K5 goes OFF. Filament and plate control should go OFF at this time also. Adjust the phase loss threshold adjustment on K5 fully counterclockwise. This completes the check.



816R Phase Loss Relay Location

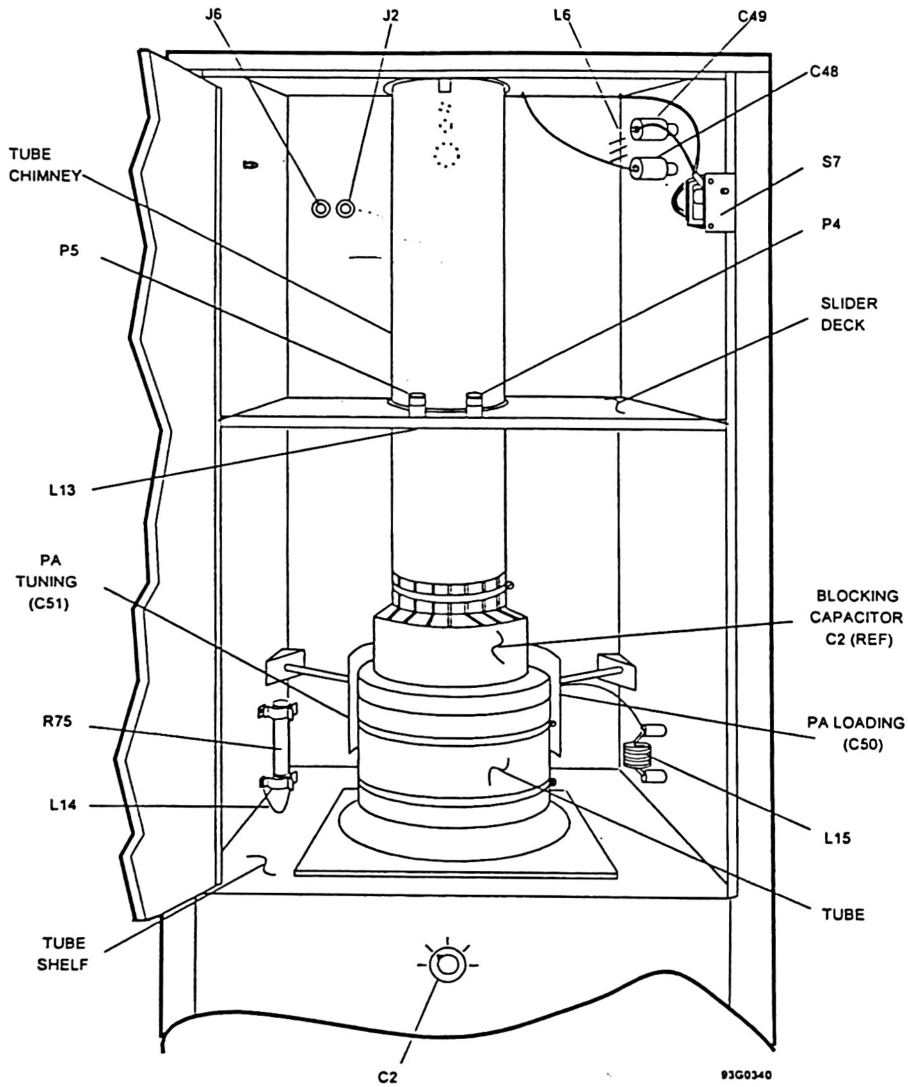
P.O. BOX 270879 • DALLAS, TEXAS 75227-0879 • (214) 381-7161 • FAX (214) 381-4949 • http://www.contelec.com

A TECH-SYM COMPANY

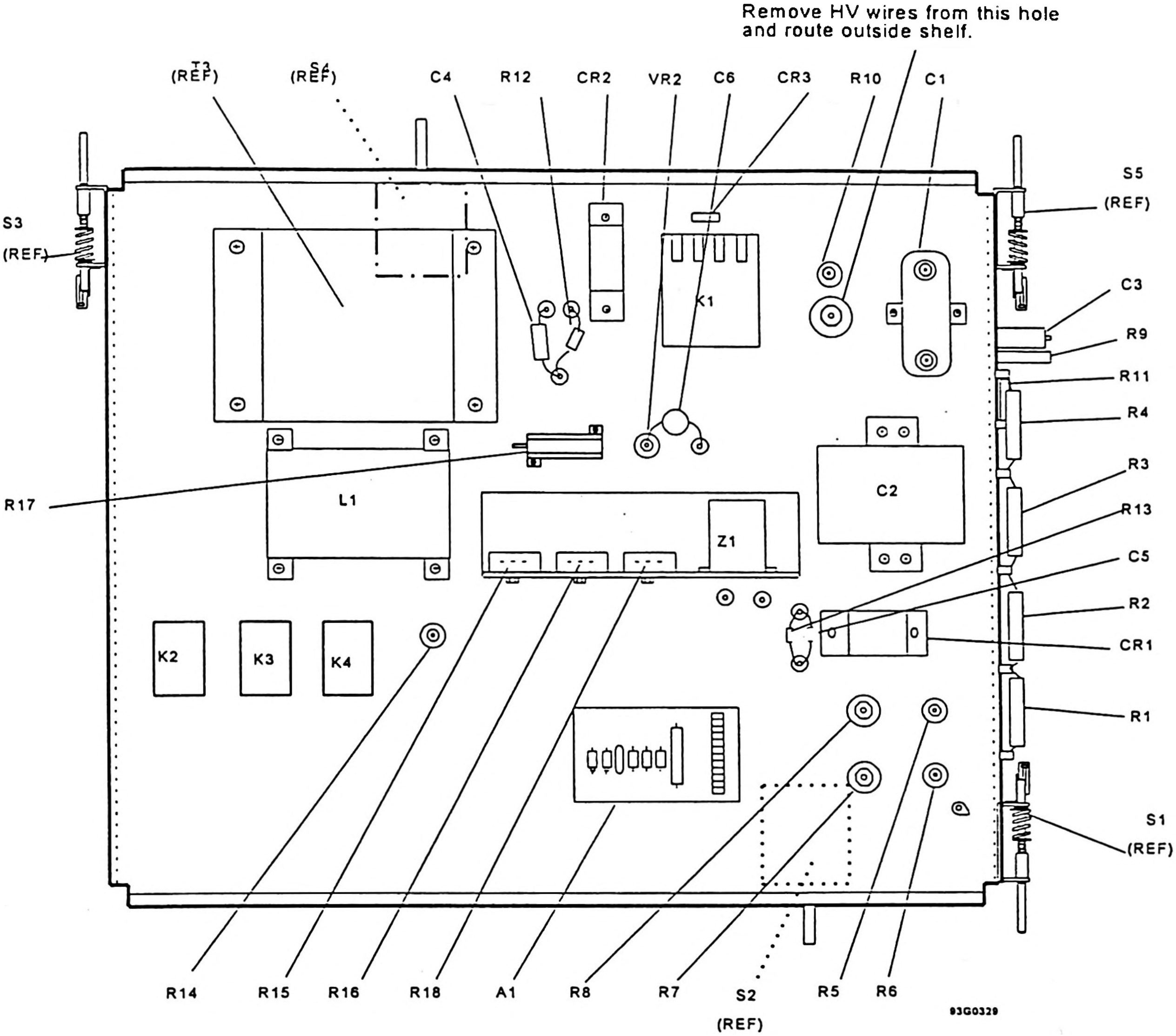


A2A7
CARD
CAGE
A2M1
MAIN
A6CB6
A10PS1
28V PS
A6CB1
3 PHASE
200-250V
A6CB2
BLOWERS
A8K5
A8K7
JUMPER
VSWR OVLD
A2A5
OVLD & RECYCLE ASS'Y
TO GATING CARD MUTE
GATING CARD
CONTROL
PLATE ON TALLY
LOCAL/REMOTE
FAILSAFE

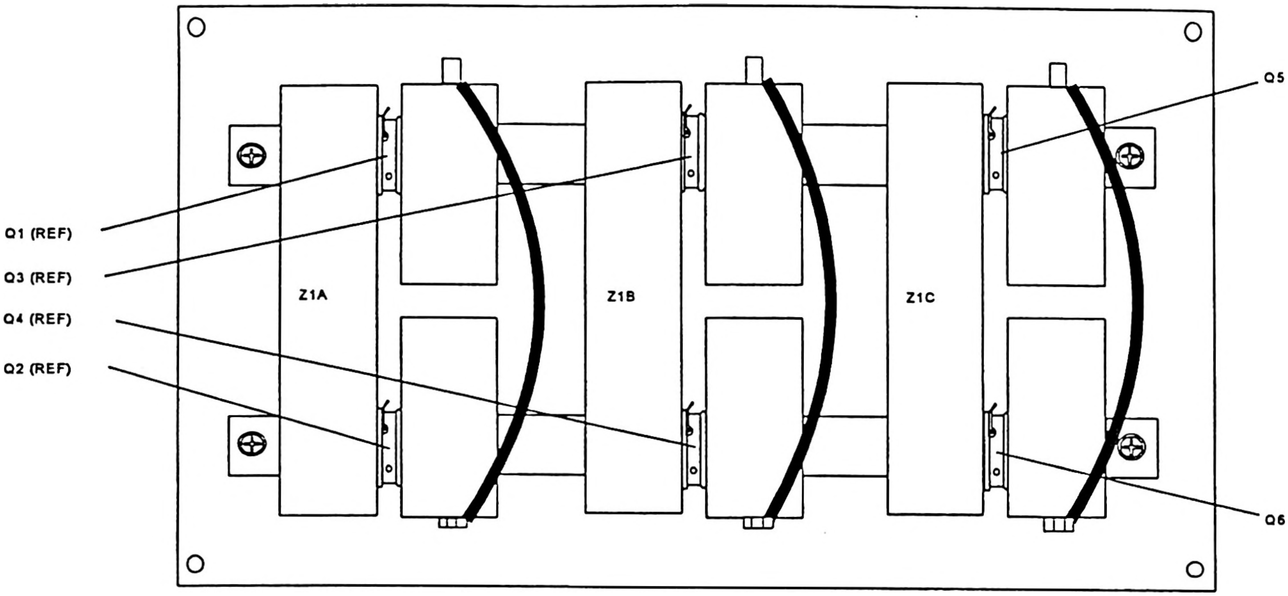
Drawings



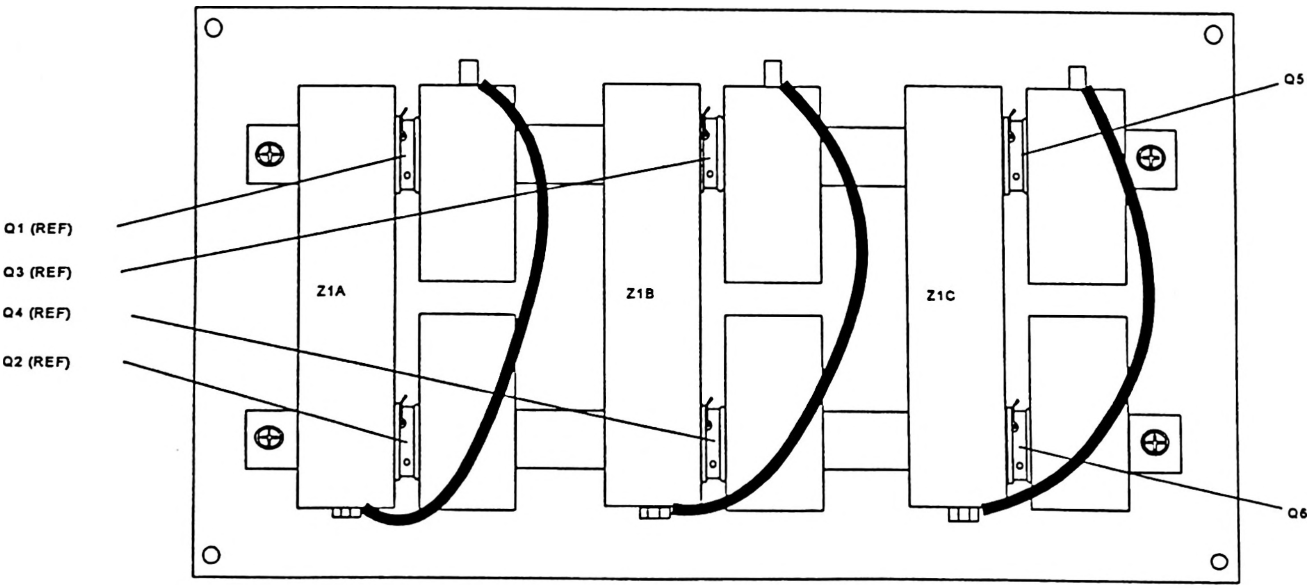
816R Power Amplifier Cavity



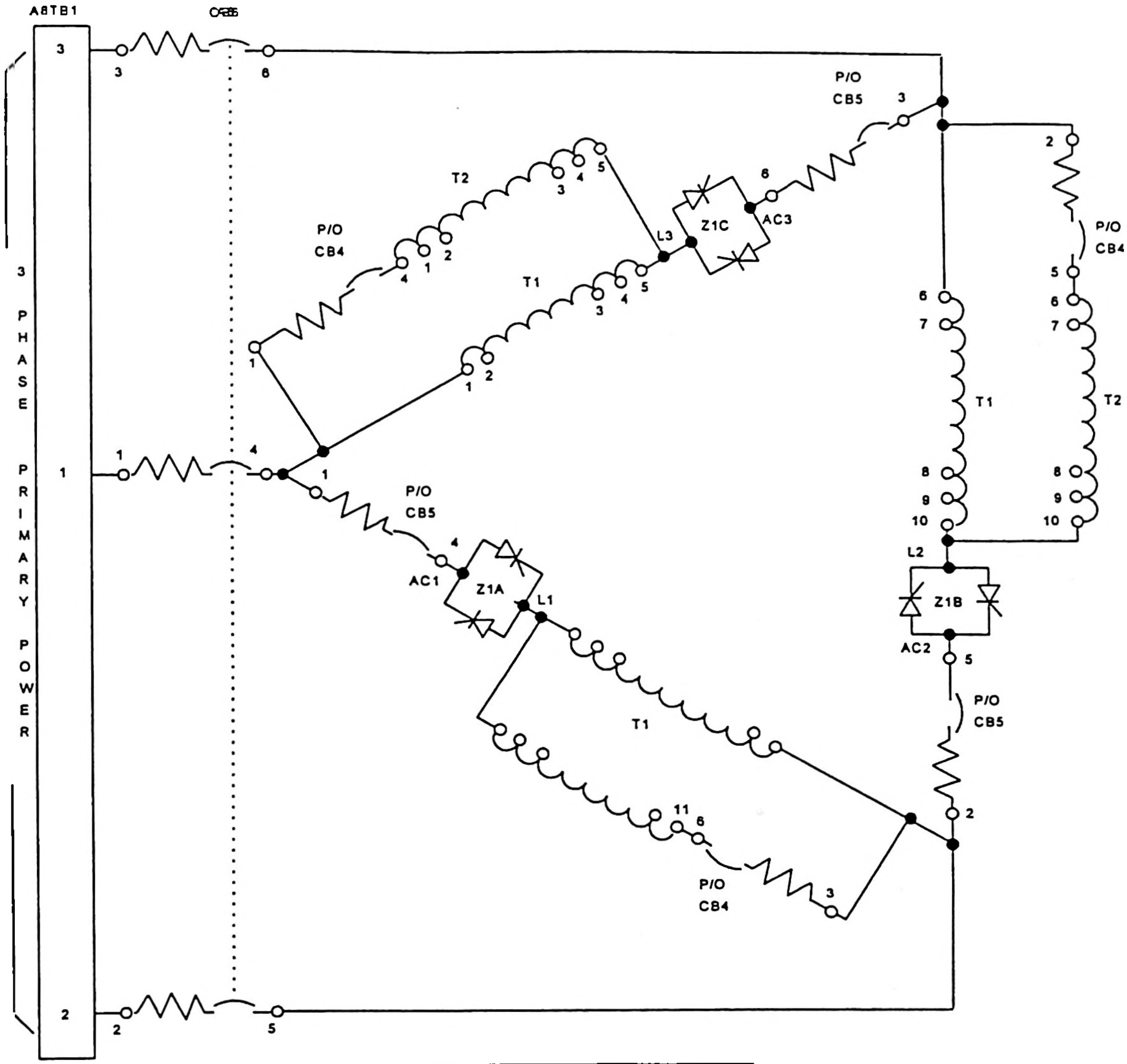
A5 Component Shelf Assembly



SCR Normal Connection



SCR Bypass Connection



LINE VOLTAGE	T1,T2 TERMINALS	A10T1 TERM. CONNECTION
200V	2&3, 7&8, 12&13	1 &2
210V	2&4, 7&9, 12&14	1 &2
220V	2&5, 7&10, 12&15	1 &2
230V	1&3, 6&8, 11&13	1 &3
240V	1&4, 6&9, 11&14	1 &3
250V	1&5, 6&10, 11&15	1 &3

T1 - PLATE TRANSFORMER

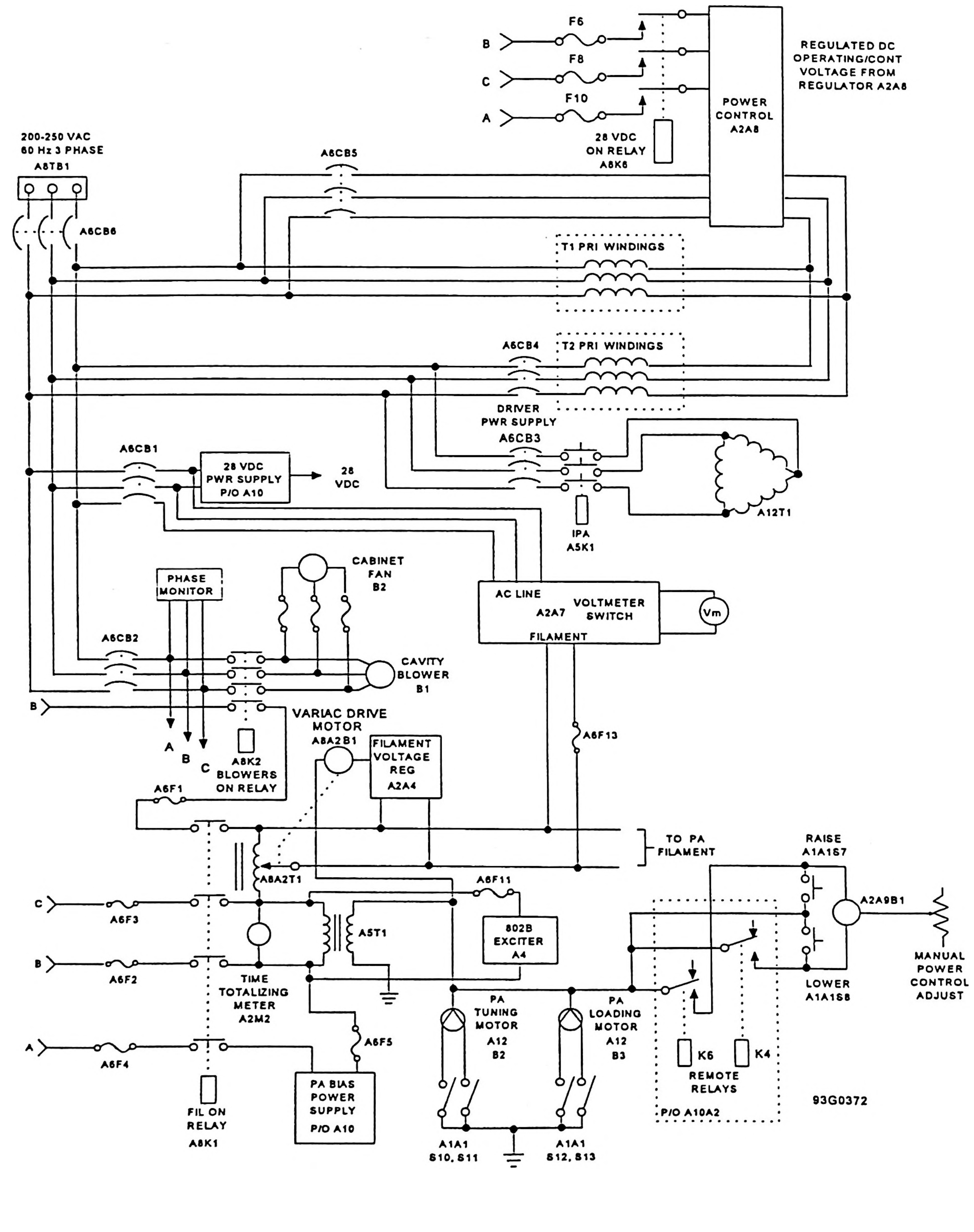
T2 - SCREEN TRANSFORMER

A10T1 - PA BIAS SUPPLY

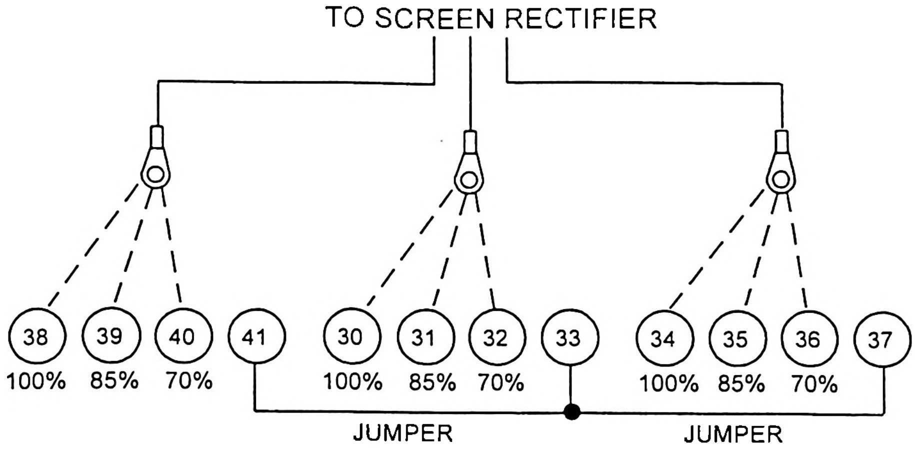
94Q0051

Transformer Connection Schedule

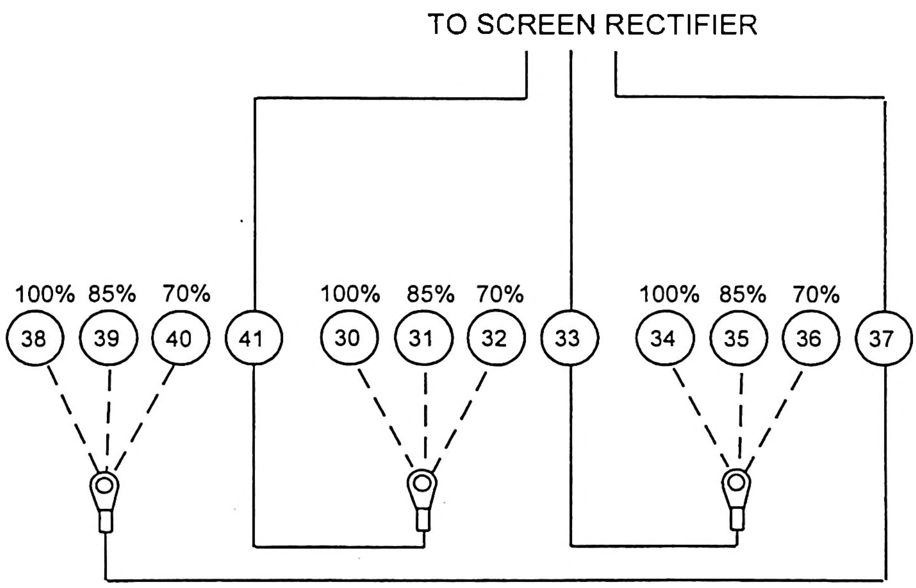
FOR 816R-2C,3C,



Primary AC Wiring



SCREEN SECONDARY WYE CONNECTION



SCREEN SECONDARY DELTA CONNECTION

95G0242

Notes:

Notes:

Notes: