FM-25K Service Information Supplement

This FM-25K Service Information Supplement is a technical manual intended for use by your transmitter maintenance personnel.

The goals of this manual are to assist you in getting the best performance from your FM-25K transmitter, and to save you time.

We included "how to" information, and other knowledge acquired through the experience of Harris service personnel.

Also included is some of the life history of the FM-25K transmitter and concise information about updates.

This information is grouped alphabetically by section, and then alphabetically by topic.

For a topical reference, please refer to the index.

For help in the identification of part numbers, please refer to the applicable drawing.

R:\service\Radio\Product_Support\Fm\Fmseries\Fm25k\Service Supplement\Fm25serv 4/25/00

Caution!

This transmitter contains lethal voltages. Use safe working practices, and make use of the protection devices provided in the transmitter.

Control Section

AC Phase Loss Protection

The original means of protecting the transmitter from an AC phase loss was accomplished on contactor assembly K1. Part of the contactor assembly was a thermal type cutout, which opened the circuit if the current to the blower motor was too high.

Better methods of protecting against an AC phase loss are available now, and the function of K1 can be changed to simply being a contactor. A device called a phase monitor relay can be installed to monitor the 3 AC phases. It not only will monitor the presence of the 3 phases, but is also sensitive to phase balance, and phase sequence. Its contacts can be wired to interrupt the blower contactor circuit if there is a detected AC phase problem.

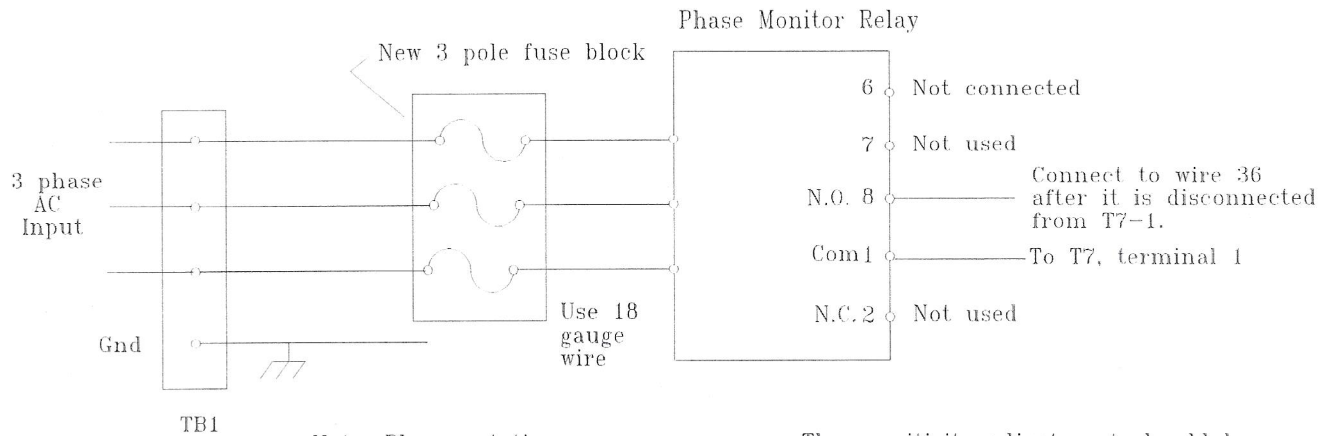
We recommend that the phase monitor relay be installed with its contacts in series with the primary of the low voltage power supply. With this connection, the transmitter will incur a complete shutdown if there is a loss of phase, thereby protecting all 3 phase circuits.

Parts required to install the Phase Monitor Relay:

Qty	Part Number	Description
1	740-0495-000	Phase Monitor Relay
1	404-0707-000	Socket
1	402-0142-000	Fuse Block
3	398-0011-000	Fuses
12	354-0634-000	Push-on lugs
12	354-0010-000	Ring lugs
12	354-0005-000	Spade lugs
4	336-1138-000	#6 self tapping screws
4	310-0012-000	#6 flat washers

Refer to the attached diagram for the recommended connections.

FM-25K Phase Monitor Relay Installation

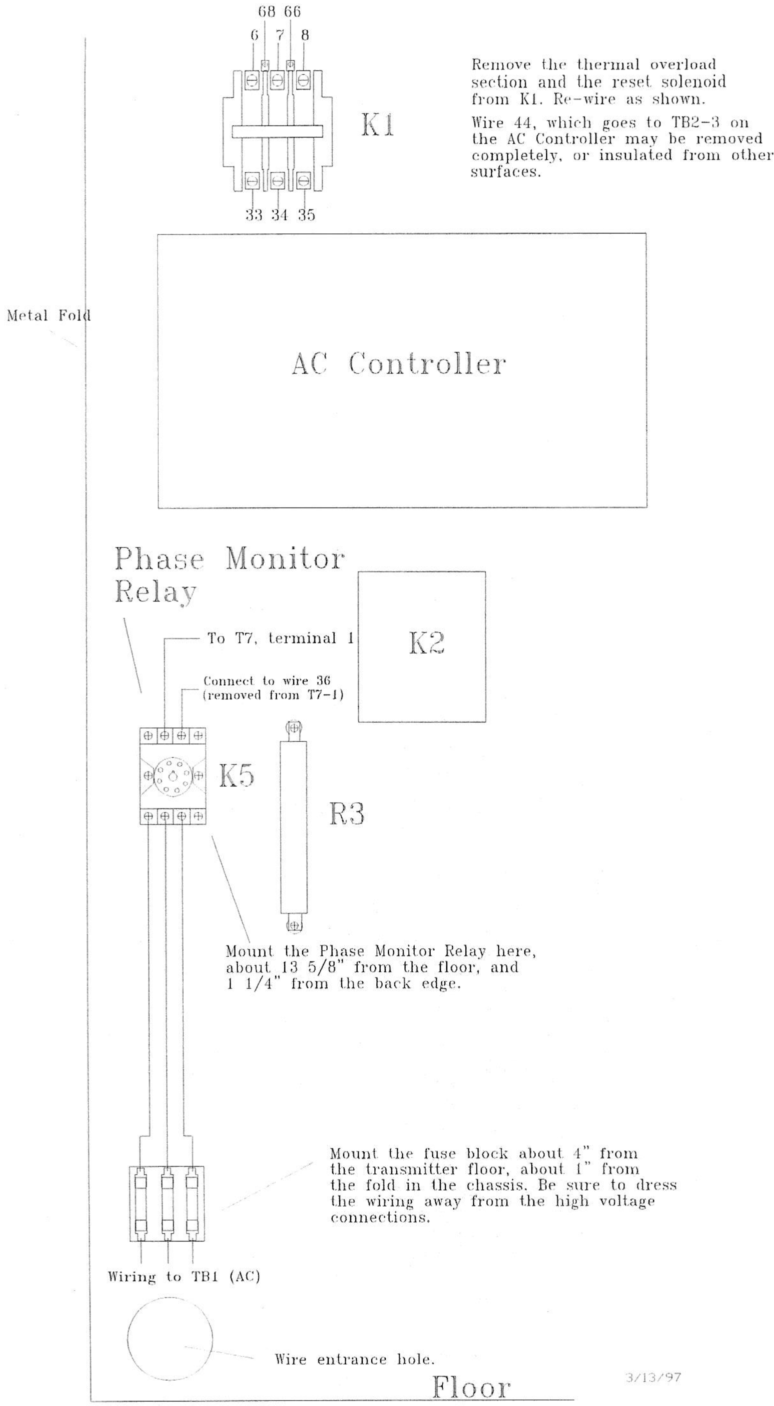


Note: Phase rotation may need to be changed in order for the unit to light the led. Change the phase rotation by swapping any two of the 3 phase wires to the monitor relay.

The sensitivity adjustment should be set about 5% below the threshold where the led on the monitor relay illuminates.

FM-25K Phase Monitor Relay Installation

(View from back door, looking left)



Air Switch (604-0397-000)
With age, pressure type air switches eventually lose their ability to sense that there is air pressure. Adjustment can usually restore closure, however, the switch will soon open again. Replacement is then needed.

Unfortunately, protective devices such as air switches often get bypassed in the interest of getting back on the air, then subsequently become forgotten.

For this reason it is a good idea to keep a spare air switch on hand, and periodically check the air switch operation.

Check the air switch operation with just the Filaments on. Use a piece of cardboard to block off part of the air intake. The air switch should remove the filament voltage when you have blocked off about half of the air intake.

The air switch is mounted to the side of cavity nearest the Controller housing. The adjusting screw is located in the center of one side of the switch. Turning the adjusting screw counterclockwise will increase the sensitivity (to make the switch close).

If you prefer a more exact method of checking the air switch adjustment, you can insert a manometer into the pressurized portion of the cavity. Use any of the screw holes that are just below the cavity shorting deck.

You can make a crude manometer by forming some clear plastic tubing in the shape of a "U". Use enough tubing so that you have a vertical length of about 6 inches per side of the "U".

Put enough water in the tubing so that the water level is about half way up.

Insert one end of the tubing into the pressurized area. The degree to which the water is displaced between one side of the "U" and the other is the measurement of air pressure in inches of water.

> *Example: The water level on one side drops 1 inch, and the other side raises 1 inch. The air pressure is 2 inches.*

The normal amount of pressure is 2.5 inches or more. The desired dropout threshold for the air switch is 2.0 inches.

Digital Logic Board (992-5433-001)
With older version Digital Logic boards, some have experienced a random control problem wherein the HV will not come up unless you turn the Filaments off, then start the turn on sequence all over again.

The problem centers around filament flip flop circuit U3B on the Digital Logic board. Transient energy can cause the flip flop to go into the wrong state, and it will not be reset without a Filament OFF command. Impulses that can cause this can come from an AC line transient, a tube arc, or other similar disturbance.

This problem can be reduced or sometimes eliminated by adding a .01 uF capacitor from TP5 to ground on the Digital Logic board.

A more effective solution is accomplished in newer Digital Logic boards by the inclusion of integrated circuit U8. The newer type Digital Logic board is a direct replacement for any older versions.

Interlock Switches

The interlock switches have two poles, one that is in the coil circuit of the contactors and HV shorting solenoids, and one that is used to operate the led indicator circuit.

Sometimes the interlock switch contacts that are in the coil circuit may open, but the contacts that are in the indicator circuit may not close. This creates a situation in which you have symptoms of an open interlock, but no indication to that effect. In an FM-25K, an open interlock in the HV cabinet will disable the contactors so that the screen and plate supplies do not energize. In the Main cabinet, an open interlock will keep the blower motor, bias supply, and HV Power Supply from running.

If you experience these symptoms, test the AC side of the interlock switches for closure. This can be done with the power off, using an ohmmeter. Exercising of the switches may clear the problem, so be conscious of this possibility. Otherwise, you may defer the problem to another time by not knowing which switch was the problem.

Power Cutback

Several customers have had a need for a power level cutback function. Typically the reason for this is operation on a standby AC power generator that is unable to handle the normal full power load of the transmitter.

There are various ways to do this, each with their own advantages. The best in terms of electrical performance and functionality is to switch variacs in the screen power supply. This gives you the ability to easily and independently set the two power levels, and yields the most stable operation for the low power mode.

At the other end of the spectrum in terms of cost is switching another potentiometer in the IPA power control circuit.

In either case, steps will need to be taken to either disable or accommodate the automatic power control circuit.

If you have a need for power cutback, you may contact us to discuss your situation and alternatives.

Remote/Local Switching

Depending on whether the remote local switch breaks before it makes, your transmitter might sometimes trip off when you switch between one mode and the other.

To solve the problem, add a 1 uF capacitor, Harris part number 526-0050-000, across R99 on the Analog board.

VSWR Foldback Kit (994-9006-001)

Automatic VSWR Foldback circuit is available to retrofit older transmitters. The VSWR Foldback kit provides the means of automatically lowering the screen voltage as the VSWR gradually becomes too high, then automatically returns it to the normal level as the VSWR problem clears. This is a very useful function in climates and installations affected by the accumulation of ice on the antenna.

Also please refer to the discussion of the Full Range Screen Control.

General Topics

Circuit Breaker Information
AC line surges at a few sites necessitated changes in the trip curve of some of the circuit breakers. If you experience random tripping of the circuit breakers listed below, please check yours to see what trip curve you have. A change of circuit breaker type may be all that is required.

The present breaker part numbers and types for the Main Cabinet are as follows:

CB1	Filament breaker	606-0806-000	15A, curve 65F
CB2	Bias breaker	606-0827-000	5A, curve 65F
CB3	IPA breaker	606-0581-000	20A, curve 62
CB4	Blower breaker	606-0581-000	20A, curve 62

For the High Voltage Power Supply, the circuit breakers should be:

CB1	Screen breaker	606-0579-000	10A, curve 61
CB2	Blower breaker	606-0552-000	3A, curve 3

Frequency change
Changing frequency involves skills and test equipment not readily available at most stations. Several parts are often required.

If you have a need to change frequency, we can work up an information packet for you. This packet includes a list of components to change, a procedure, and some target values for the power level you require. There is a fee for this service.

Incidental AM/Bandwidth Considerations
The basic requirements for good bandwidth are sufficient RF drive to the tube, proper tuning, and heavy loading of the PA. There are other contributing factors, but these are the main ingredients in adjustments for good bandwidth as far as the power amplifier is concerned.

Proper loading is with the power output peaked. Going beyond this will sacrifice efficiency.

The power output should also be peaked with the PA Tuning control.

The IPA reflected power should be minimized with the Grid Tuning and Input Match controls.

A minimum target value for PA grid current is 15 to 20 ma.

The FM-25K generally has good bandwidth. The exception to this is when the power level is significantly reduced, but the Plate Voltage is left at the full amount. See the discussion on TPO changes.

Spurs, AM Intermod
In installations where an FM transmitter is co-located with an AM transmitter, it is possible that spurs will be generated that are a product of the AM signal mixing with the FM. In our experience, this is a result of the AM RF getting onto the cable between the stereo generator (or STL) and the exciter. This is most likely to happen in a system where a balanced composite source is feeding a balanced input. In this case, the shield of the coax is not really functioning as a shield. It is more like a pickup device for the AM signal.

The solution is to install a triaxial cable in place of the composite coax, and ground the shield of the triax.

We sell triaxial cables with connectors and ground lugs installed. Select the part number you need based on length:

3ft	922-0014-001
5ft	922-0014-002
10ft	922-0014-003
15ft	922-0014-004
25ft	922-0014-005
40ft	922-0014-006

Spurs, FM Intermod
When two stations are close geographically and in frequency, RF intermod spurs can be generated. This is a result of mixing in the PA tube of one station's second harmonic with a signal received from another. This produces an in-band difference signal.

For example, suppose there are two stations in close proximity and one station is on 100.1 MHz and the other is on 100.9 MHz. The transmitter on 100.1 MHz has a second harmonic within its PA stage which is 200.2 MHz.

Note: This intermod effect has nothing to do with second harmonic output of the transmitter. In other words, the problem does not depend on adjustment of the output filtering.

In the PA, 200.2 MHz will mix with 100.9 MHz from the other station to produce a difference signal of 99.3 MHz.

To solve the problem, a cavity type filter is needed in the output coax to filter out the other signal. The amount of filtering needed depends on frequency separation, and the level of the offending signal. Contact our Sales department for further information.

Spurs, In-Band
Aside from the possibility of RF intermod products, a transmitter can generate spurs on its own if there is an instability problem in one of its amplifier circuits. In such cases, it becomes necessary to isolate the problem to the offending stage.

One method of isolating instability in a particular stage is to rock the tuning controls back and forth through their normal setting to see if the spurious problem is affected. This will generally give you a "feel" for where the problem lies.

If the problem is unaffected by basic tuning adjustments, the problem may be the exciter. In a number of instances we have found that spurs at about 200 kHz or 400 kHz intervals are generated by the MS and MX-15 exciters. The cause has often been the electrolytic capacitors in the RF Amp drying out.

The life expectancy of electrolytic capacitors is about 10 years, so C8 and C18 in the RF Amp should be replaced if this problem is suspected. They are 20 uF, 50 volt axial lead capacitors. The Harris part number is 522-0256-000.

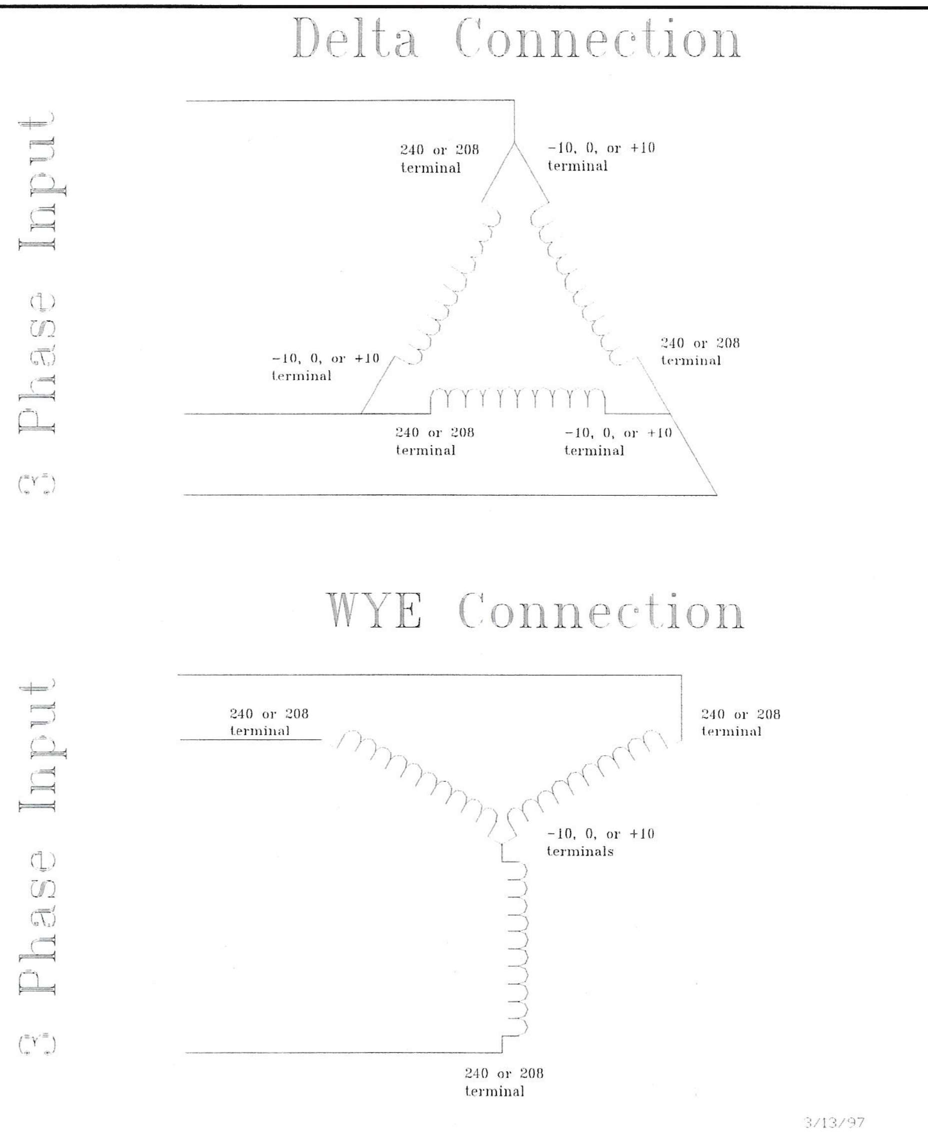
TPO (Transmitter Power Output) Changes

The type accepted power output range for the FM-25K is 7350 watts to 25730 watts. Within this range, there are various criteria for best operation. For power levels below 10 kW, it is best to set the HV Power Supply transformer in a wye configuration. This will reduce the Plate Voltage to about 5300 volts, which will be a major step in reducing the power and maintaining good performance.

See the attached drawing of the Wye and Delta configurations. To connect the HV transformer primary in a wye, you would first need to disconnect all the primary connections, then join the +10 terminals together. The AC wires from the contactor would then connect to the 240 volt terminals. This would give you the lowest voltage output. Tapping the transformer to the lower numbered terminals (208, 0 for example) will give you somewhat higher plate voltage.

For power levels above 10 kW, you will probably have to leave the HV transformer in the delta connection. However, you should connect the primary wires to the highest numbered terminals to give you the lowest usable plate voltage. Reducing the plate voltage is your best initial step in changing to a lower TPO because it helps accomplish the goal without any sacrifice.

Other handles for power reduction are screen voltage, bias, and IPA power.



Joining the +10 terminals together, and applying the AC to the 208/240 volt terminals forms a wye circuit. For a given line voltage and tap setting, this reduces the output voltage by the square root of 3. Using the higher numbered taps results in lower output. Using lower numbered primary tap settings results in higher voltage output.

HV Power Supply

Dash pots (magnetic overload relays)
A small bottle of lightweight oil is supplied with the magnetic overload relays, or dash pots, as they are often called. The magnetic overload relays are K1 and K2 at the AC entrance in the High Voltage Power Supply.

The purpose of the oil is to slow the response of the magnetic overload relays. This is usually not needed for an FM transmitter because the AC line current is relatively steady. However, in rare cases where the magnetic overload relays trip randomly, you should first check the trip settings. If you need to add oil, use just enough to cover the bottom of the cup on the magnetic overload relay assemblies.

To remove the cup, release the spring tension by moving the spring off the cup. The cup assembly should then come out in your hand.

The plunger that extends from the cup assembly has grooves in it that correspond to the current trip markings on the stationary piece still in the transmitter. The plunger adjusts vertically by turning it the appropriate direction. The normal setting is the second line up, which corresponds to 162 amps.

HV Rectifier Emergency Connection

Sometimes you will have one bad rectifier and no replacement on hand. In this instance, it is often possible to use the half-tap setting of the High Voltage Supply to your advantage.

In the half-tap position (using the High/Low knife switch), the power supply only uses half of the rectifiers. The trick is then to utilize the good halves of your rectifiers in those positions that are in circuit in the half tap position. Be sure to disconnect the shorted rectifier sections because they will otherwise still be in circuit.

HV Rectifier Testing (384-0650-000)

Usually when a HV rectifier fails, it goes to a shorted mode that is easy to identify with an ohmmeter.

Good rectifiers usually measure open on an ohmmeter, so there may be times that you would like a little assurance that the rectifiers are good; not just open.

You can do this with an ordinary 120-volt light bulb, and some connections to 120 volts AC. Take the rectifier out of circuit, and wire it in series with a 120 volt, 40-watt light bulb, then connect that combination to a 120 volt AC source.

If the rectifier is shorted, the light bulb will be at full brilliance.

If the rectifier is open, the bulb will not light at all.

A good rectifier will result in the bulb being half-lit.

HV Shorting Solenoids (590-0037-000)

Failure of the HV shorting solenoids will overload the Bias circuit breaker, and cause it to trip.

AC brown out conditions can stress the solenoids, thus contributing to their failure. The reliability of the solenoids can be improved by providing the solenoids with a stiffer and somewhat higher voltage power source.

Service Bulletin FM-364 covers this modification in greater detail.

HV Supply Secondary Wiring
We have observed in several transmitters that the brown HV wire that goes between the transformer and rectifiers can develop a whitish discoloration where the wires are bundled or run along the chassis. This whitish discoloration is an effect of corona.

When replacing the wiring, it is best to route it directly from the transformer to rectifiers without bundling them or routing them along the chassis. Bulletin FM-399 covers this in further detail.

IPA Section

Note: The following information applies mostly to the original 5 module IPA system. See the information on the Outboard IPA for information on an IPA upgrade.

8 Port Combiner (992-5440-001)
The 8 Port Combiner has given very few problems, but one that has been encountered can occur as a result of one or more of the coaxes being stretched too tight to reach its designated connector. In some cases, this has resulted in one of the 8 Port Combiner coaxes being pulled loose from the circuit board.

If a problem is suspected, examine the solder connections for the 8 BNC jacks on the Combiner. Re-solder as needed, with the coaxes disconnected.

Since the 8 Port Combiner is symmetrical, it does not actually matter which coax is on what connector. They may be connected in any order which suits the reach of the coaxes.

C4 Grounding
The IPA power supply filter capacitor C4 will be able to filter transient energy more effectively if it has a fairly direct ground.

In some units, C4 obtained its ground (-) connection through a cable to the IPA mainframe. The transient filtering can be helped by adding a copper strap or heavy wire from the minus (-) side of C4 to the mounting hardware for C4. If you install a wire, use 14 gauge or larger.

Coax Cable Aging
With heat and time, we find that the RG-213 coaxial cables used for the IPA output circuit get stiff and eventually brittle. This loss in flexibility can lead to a loss in connection reliability.

Check the condition of your cables periodically.

The part number for the coax from the 8 Port Combiner to the IPA Lowpass Filter is 929-7815-001.

The part number for the coax from the IPA Lowpass Filter to the PA input is 929-7814-001.

Exciter Output Setting
The optimum drive level from the exciter is determined partly by the difference between IPA Unregulated Voltage (Vunreg) and the Regulated Voltage (Vreg). Frequency is also a factor.

In general, the gain of the RF Driver and IPA is the highest at the low end of the band. Therefore, the exciter output requirements are least at the low end of the band, and highest at the high end of the band. Having the exciter output too low can cause RF stability problems, and inability to produce enough IPA power.

Too high of output from the exciter can over drive the RF Driver module, and damage components on its input circuit. Having too much exciter output can also cause you to set the regulated voltage (IPA Power control) lower than it should be, thus resulting in excessive power dissipation in the IPA regulator transistors.

One method of setting the exciter output is to first set the Regulated Voltage to the ideal range (23 to 27 volts). Do this with the exciter level lower than normal.

Then, raise the exciter output until you have the required IPA power. Minor adjustments in IPA power should subsequently be made with the IPA power control.

IPA LPF/DC (992-5620-001)
If you suspect a problem with the IPA Lowpass Filter/Directional Coupler unit, the best and simplest approach is to give it a good visual inspection. Detach it from the wall of the transmitter cabinet, then inspect it under good light.

In particular, look at the variable capacitors, C1 and C3. Their glass should be clear. If you find one of them has glass that has turned foggy, chances are it has failed. Also inspect for any other components that may have over heated.

The IPA LPF/DC is a 50 ohm device on its input and output. Therefore, the input can be checked to see if its impedance is 50 ohms at the carrier frequency with the output terminated into a known good 50 ohm load. We do this with a tracking generator, calibrated directional coupler, and spectrum analyzer. It can also be checked with an in-line wattmeter, but with lesser precision.

Various improvements have been made in the IPA LPF/DC. Most of these came about from using it in higher power transmitters.

Improvements were made to handle higher IPA power levels. Another change was made to reduce its reflected metering sensitivity to harmonic energy. This results in better capability to null the IPA reflected power reading, even in the presence of harmonics in the drive signal.

IPA Mainframe
In cases where there are recurring IPA module failures, the problem might not be the modules. The problem might be in the Mainframe.

Solder joints can fail after several years. Components such as resistors may also change in value. These can affect the load impedance to the modules, and affect the balance of loading on the modules.

When there is some question about the integrity of the inner workings of the IPA Mainframe, it may be advisable to remove the IPA Mainframe for inspection of the Motherboard and Splitter/Combiner Board. When the solder connections look dull, it is best to remove the old solder, and apply new solder.

IPA Mainframe Removal
Disconnect the cabling from the underside of the IPA unit. This would include the RF input coax which comes from the exciter, and the DC power cables coming from the IPA power supply.

Separate the white in-line connector in the cabling from the IPA power control pot to the IPA housing. This cable consists of 3 white wires.

Disconnect the eight brown coaxes that connect to the 8 Port Combiner. Position the connectors where they will not grab as you later pull the IPA assembly forward.

Remove the top module from the IPA section. This will provide a place for a hand when you are ready to remove the IPA section.

Remove the screws from the left and right edges of the front panel which contains the IPA section and the PA tuning controls. At this point, the whole front panel should come forward. Note: The PA tuning controls will uncouple; there is no need to remove any set screws.

Putting the IPA section back in place will require an assistant to get the pin-coupled shafts lined up.

IPA Multimetering Kit (994-8491-001)
Early version transmitters did not include a multimeter for the IPA other than the IPA forward and reflected metering. The IPA multimeter kit adds metering for Unregulated Voltage, Regulated Voltage, IPA 1, IPA 2, IPA 3, IPA 4, and Driver. This can be especially useful to find out if the module current readings are balanced.

IPA Oscillations
Symptoms of instability of the IPA section will show up in the IPA reflected power reading. You will find that the reflected power reading will move in abrupt steps as you tune the PA input controls.

If you observe such actions, you may need to add a feedback circuit on the IPA modules. This is a resistor-capacitor series combination from the base to the collector of the RF transistors. See service bulletin FM-218 for further details.

If your modules already have this modification, there may be a matching problem between the RF Driver and the IPA modules. In this case, adjustment of the coax length between the 2 Port Combiner and 8 Port Splitter may be needed. Depending on your circumstances, it may be advisable to inspect the Splitter board before making any adjustment. The most likely time to require any adjustment is when doing a frequency change.

IPA Supply Voltage
For the typical 300 to 350 watts operation, the required IPA Supply voltage needs to be 30 to 32 volts. This is measured at the Vunreg test jack on the lower front of the transmitter.

The optimum voltage difference between the unregulated and regulated voltage is 5 to 8 volts. For typical operation, this means that the optimum regulated voltage is in the range of 22 to 27 volts.

If the voltage drop across the regulator is too low, there will be an AM noise problem because the regulator is unable to take out the power supply ripple.

If the voltage drop is too high, the regulator pass transistors will be stressed by excessive dissipation.

For situations when you are using much less IPA power, the IPA Supply Voltage could be possibly be reduced by changing to a higher tap setting on the primary. This, of course, depends of what your AC line voltage is. If your AC line voltage is high (240 to 250), your transformer is probably tapped all the way up already. Lowering the IPA Supply Voltage may improve the reliability of the IPA by reducing the stress on the IPA Regulator pass transistors.

IPA Transistor Types
The RF transistor type available for use in the IPA modules is the Thomson SD1019-13, Harris part number 380-0589-000.

Other types used in the past that are now generally unavailable are the Motorola SRF3344, and the CD2315.

Transistor types generally mix okay, however, you should compare the current draw of the various modules to see if there is a load sharing problem. Gain variations can be a problem, even from one batch to another of the same transistor type.

Outboard IPA (992-8466-001/002)
New developments in solid state amplifier technology have enabled us to now offer a single stage power amplifier assembly for use as an upgrade for the present IPA assembly in the FM-25K transmitter. This upgrade greatly simplifies the IPA section, and should yield more rugged performance. Installation instructions are contained in Service Bulletin FM-400-SLA that is included with the upgrade parts kit.

The assembly is a self contained, rack mountable broad band RF amplifier with its own power supply, cooling and protective circuitry. A conservative 350 watts of power is available with no more than 15 watts input. Power output is controlled by drive from the exciter. The amplifier is internally protected against overdrive, over current and VSWR conditions. The only connections necessary are RF input, RF output, and a 197-250 single-phase AC input. A front panel led indicates a fault condition should the units internal control circuitry inhibit the RF output. External front panel test jacks make available samples of the units voltage and current. A front panel circuit breaker provides for on/off power switching.

All necessary items to implement the modification are included in a kit. The Harris part number for the domestic 60hz kit is # 992-8466-001. The Harris part number for a 50hz kit is # 992-8466-002. The IPA upgrade is warranted against component failures for a period of 6 months from date of shipment.

Installation of the unit requires it be rack mounted near the transmitter. It requires 7 inches of vertical rack space. The unit is 23 inches deep. The weight of the unit (100 lb.) necessitates that it be housed in a mounting frame and supported from the rear. The unit has been tested with cable lengths up to 25 feet. If your installation requires longer cables contact our field service department for advice. At frequencies above 104 MHz we recommend that the exciter also be mounted in the rack with the IPA so that cable length from exciter output to IPA input can be as short as possible.

When the installation is complete the present IPA modules will normally be left in the transmitter as they provide back pressure to the air system which is necessary for proper air flow and cooling to the PA cavity. The old IPA assembly still being intact allows it to be available as a standby.

PA Section

Cathode Inductor L8
The cathode inductance, L8, is varied according to frequency in order to achieve optimum efficiency.

L8 is a copper strap on the underside of the socket, from the outer filament ring to the base plate of the socket (ground). This strap is varied in length, width, and shape to form the correct amount of inductance to achieve optimum efficiency.

Although it may look like only a copper strap, L8 is a highly critical adjustment. Because of this, it is not often possible to obtain the correct adjustment without some experimentation.

The transmitter will function with almost any size of strap in circuit, but will achieve full output power and efficiency only when L8 is in proper adjustment.

The L8 strap can be removed from the underside of the socket by leaving the PA tube in the socket while removing the screws that hold L8 in place. The purpose of leaving the tube in the socket is to hold four posts in position on the top side of the socket.

When re-installing L8, be sure to tighten the L8 hardware as tight as you can get it because any loss of contact will affect the result, and cause L8 to over heat.

It is fairly unlikely that you will have to do any adjustment of L8 unless you are changing frequency.

Cavity Cover Fasteners (448-0896-000)
All four walls of the cavity, including the PA Access Cover, carry RF current. For this reason and others, it is important to always fasten all of the thumbscrews on the access cover. Securely finger tightening them might be good enough, however, finishing the tightening with a screwdriver is best.

Later model transmitters include fingerstock between the PA access cover and the back wall of the cavity, plus more fasteners have been added. The new cover part number is 922-0446-013.

The back wall that accommodates the new access cover is 943-4754-026.

Filament RFI
With more equipment types being co-located, the importance of minimizing cabinet radiation has increased. Meeting FCC specifications for cabinet radiation is not always enough.

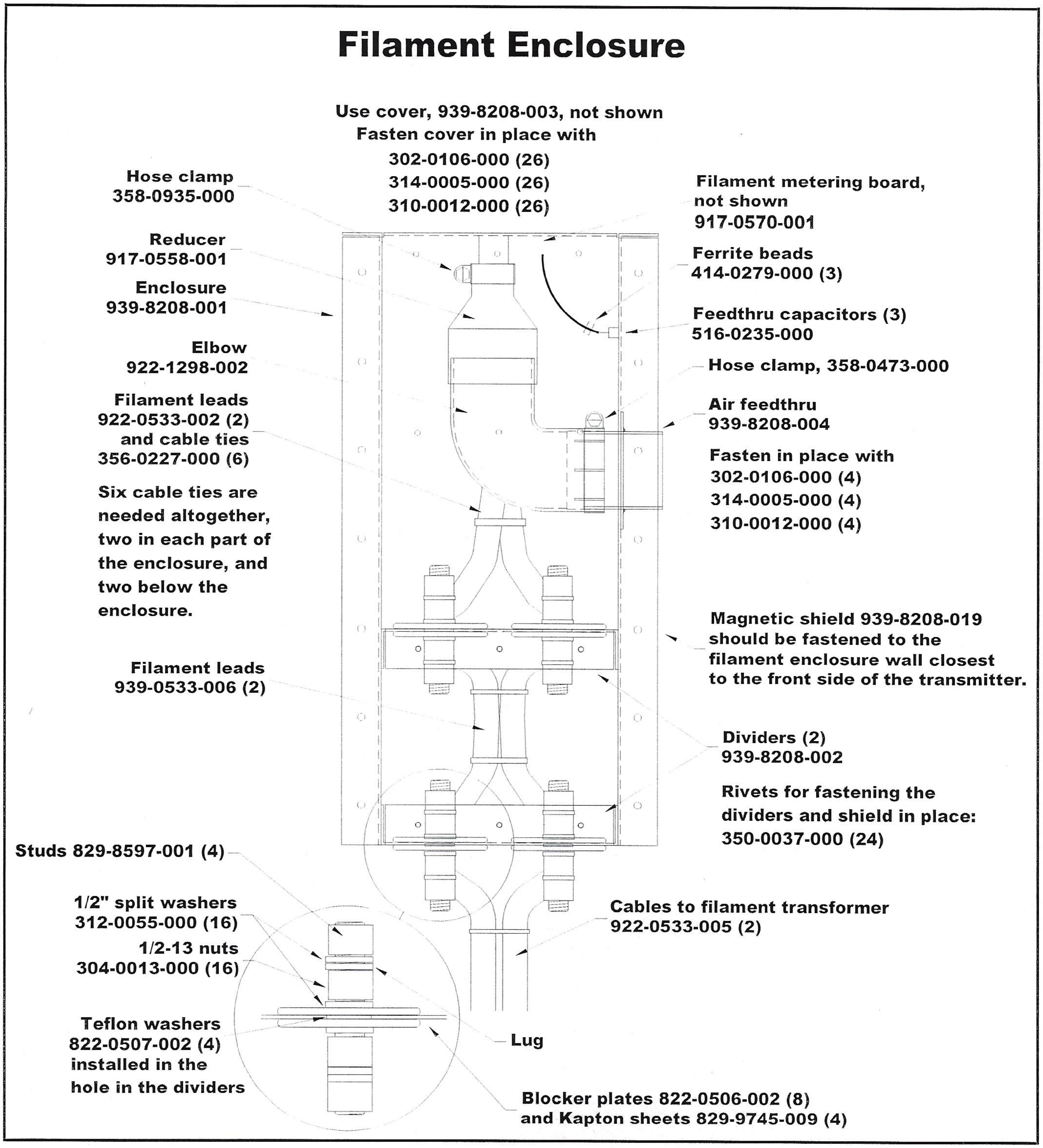
One of the areas that require good shielding is the filament circuit. The filament circuit is RF hot because it also happens to be the cathode (as is the case of all directly heated cathodes). For this reason, it is important to shield and de-couple the filament leads.

A rectangular enclosure was added below the cavity to accomplish more effective shielding. See drawing.

If you determine your transmitter needs the additional shielding, you will need the following materials:

Qty	Part Number	Description
30	302-0106-000	Screw, 6-32 X 3/8
16	304-0013-000	½-13 nuts
30	310-0012-000	#6 flat washer
16	312-0055-000	½" split washers
30	314-0005-000	#6 split washer
24	350-0037-000	Pop rivets, 0.125 X 0.265
6	356-0227-000	Cable ties, high temp.
1	358-0473-000	Hose clamp 2.25" max
1	358-0935-000	Hose clamp 1.25" max
3	414-0279-000	Ferrite beads
3	516-0235-000	Feedthru caps, 1000 pf
8	822-0506-002	Blocker plates
4	822-0507-002	Teflon washers
4	829-8597-001	Studs, ½-13 X 3.25
4	829-9745-009	Kapton sheets
1	917-0558-001	Reducer
1	917-0570-001	Filament metering board
2	922-0533-002	Filament leads, top
2	922-0533-005	Filament cables, bottom
1	922-1298-002	Elbow
2	939-0533-006	Filament leads, middle
1	939-8208-001	Enclosure
2	939-8208-002	Divider shelves
1	939-8208-003	Cover
1	939-8208-004	Air feedthru tubing
1	939-8208-019	Magnetic shield

Filament Enclosure



Neutralization Eccosorb Tile (917-2428-002)

The purpose of the square black block on the neutralization flag assembly is to absorb RF energy in a certain frequency range. It was included in the design when some 360 MHz feedback was discovered in the neutralization circuit. All transmitters should have the Eccosorb tile.

Output Plumbing Configurations

In some installations it has been desirable to locate the Output Lowpass Filter in a position that differs from the recommended setup. This presents some risk in terms of harmonic attenuation, and harmonics effects on the output directional coupler.

For these reasons, it is advisable to measure the harmonic output of the transmitter while it is operating into a dummy load to be sure it is within FCC specifications. If the harmonic output is out of tolerance, some adjustment in line length ahead of the filter may be required.

> *Note: Harmonic readings taken by sampling the signal going up to the antenna can be misleading. This is because the impedance is not a flat 50 ohms, but rather can be very different at the harmonic frequencies. This difference in impedance affects the dB relationship.*

For the effects on the directional coupler, it would be best to re-locate it so that it is on the output side of the Output Lowpass Filter.

Output Pre-filter (939-7451-001)

In transmitters made after July 1986, a filter section was put in place of the regular center conductor in the vertical section of 3 1/8 inch coax on the output of the cavity. This is a smaller diameter pipe with two larger brass cylinders on it. This forms a pi circuit consisting of two capacitors and a series inductor.

The purpose of this change was to add harmonic attenuation for some harmonic frequencies. This was especially beneficial when the output directional coupler was installed ahead of the output lowpass filter. With the lowpass filter in this position, we found that the length of line ahead of the filter was especially critical with respect to the VSWR and Forward power readings. Adding the pre-filter reduced this sensitivity somewhat, however, the coaxial line length can still affect harmonic output.

Installing the pre-filter, or determining if your transmitter has one, will require that you disassemble the plumbing at the output of the cavity.

PA Cavity Parts List

Following is a list of cavity parts, not all of which are included in the regular instruction manual. This list can be used in combination with the cavity drawings provided with this information packet. Most of the common usage items in the following list are in bold type.

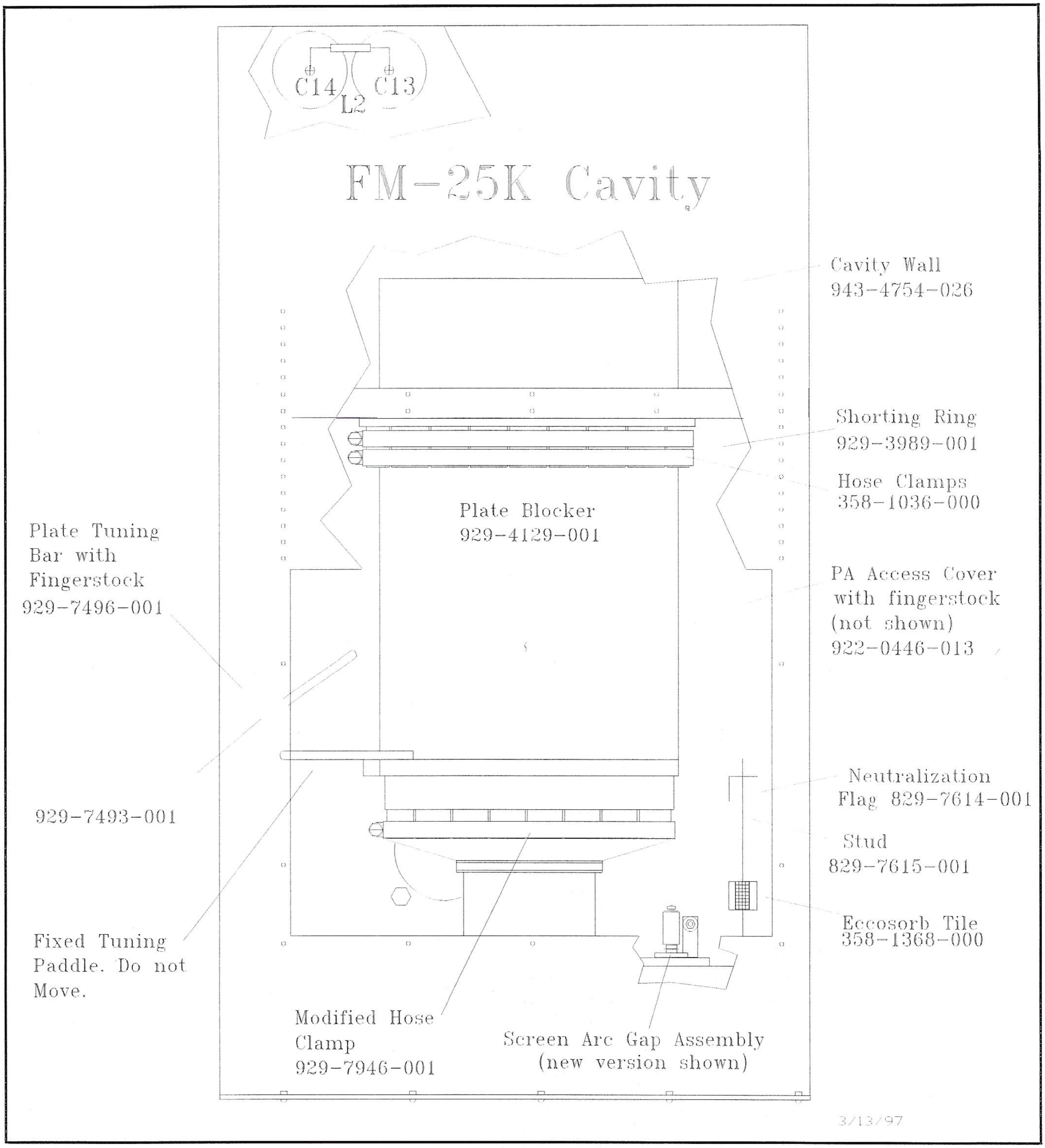
Qty	Part Number	Description
1	9925567001	Socket & Input Ckt Assy (Entire Deck)
1	**9294129001**	**Plate Blocker (Chimney)**
1	**9294923001**	**PA Tube Access Cover With Fingerstock***
2	**3581036000**	**Clamp, Hose For Top Of Plate Blocker**
1	**9293989001**	**Shorting Ring At Top Of Plate Blocker**
1	9294322001	Conductor Assy
1	9169985001	Support Assy
1	8293899001	Inductor
1	8294253001	Extension (Grid Tuning, 1/2" Aluminum Rod)
1	9297916001	Flexible Coupling
1	8170685001	Strap
1	9395926001	Plate Bottom Weld
1	8394165001	Plate Short
1	9294927001	Side Assy Cavity
1	9294931001	Side Assy Cavity
1	**9434754026**	**Rear Wall Of Cavity (Compatible With 9220446013)**
1	9294934001	Front Wall
1	**9170432001**	**Anode Connector**
1	4100153000	Insulator Bshg NS5W-4104
1	4100157000	Insulator Bshg NS5W-4204
2	3350041000	Washer Nylon .75 Id
6	3350010000	Washer Nylon .195 Id
2	4100152000	Insulator Bshg NS5W-4103
1	8135611123	Stud
2	4100156000	Insulator Bshg NS5W-4203
4	3350080000	Washer Nylon .5 Hole
2	8135611038	Stud, 2-7/16 Lg.
1	**3581944000**	**Coupling 1/4 Bore (Black, With Brass Center)**
2	9170559001	Bearing Block Assy
1	6200498000	Adapter 3-1/8 301-014
1	8297490001	Plate Side
1	8297574001	Plate Side
1	**9297493001**	**Plate Tuning Rod**
1	**9297496001**	**Plate Tuning Paddle With Fingerstock**
1	9297576001	Bearing Plate Assy
1	9297576002	Plate Assy Bearing
2	3581165000	Collar 1/4 Hole
1	9298140001	Pulley Assy
1	9298139001	Pulley Assy
1	**4240491000**	**Plate Tuning Belt (See Gear Drive Upgrade)**
4	8135010033	Stdoff 8-32x1-3/4 1/2 Rd
4	8170084001	Spacer Bushing Plate
1	9297885001	Cable Assy

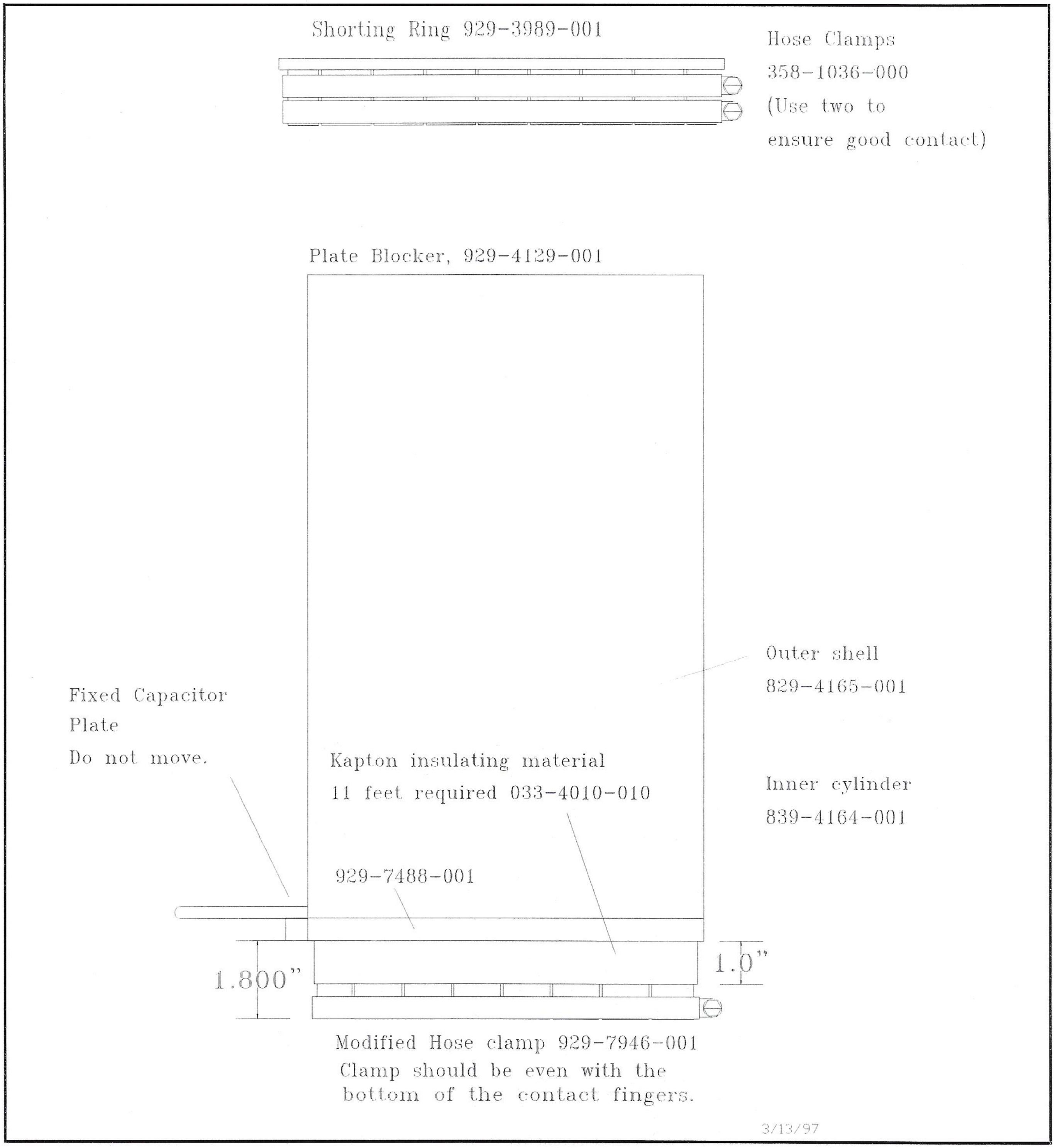
1	8170719001	Strap
2	**5160713000**	**Cap 500pf 15kvdc 10%** (Can Also Use 5160402000)
1	5140194000	Cap Vari 10-100pf
3	**5160235000**	**Cap Feed-Thru 1000pf**
4	5160206000	Cap HV 1000 Pf 5000
1	9147670002	R.F. Choke Assy (2uh
1	**9297884001**	**Anode Lead****
1	4480224000	Handle Alum
1	**9297946001**	**Modified Hose Clamp To Go Around Tube**
1	8297987001	Block, Shipping
1	8170839001	Brkt Stop
1	**9297496002**	**Bar Contact, Short (Paddle To Wall)**
1	8395902001	Plate
2	9395900001	Plate, Shield
1	9395917001	Plate, Shield
1	9395921001	Plate, Shield Assy
4	8171078001	Strap
2	**9298607001**	**Short (Upper) Filament Cables**
2	8298597001	Stud Feed Thru
2	8298596001	Bushing Feed Thru
2	8298595001	Washer Feed Thru
3	4140279000	Toroid 10mhz .300 OD
2	**4140138000**	**Toroid Ferrite For Filament Leads**
2	8135604005	Stud Brs 6-32 X 5/8
1	9395917002	Plate, Shield
1	9171137001	Block Assy
1	8220362001	Stop, Fail Safe (Plate Tuning Stop)

* Access Cover Fastening Hardware:
4480896000 Thumb Screws, Press Fit
3240283000 Pem Nuts For Cavity Back Wall

** Plate Lead Consists Of The Following:
2.21 Ft 2550020000 Wire, HV 12 gauge stranded
1 3540245000 Term Lug Yel Ring 10
1 3540262000 Lug 8 Ring
2.16 Ft 2960294000 Tubing Teflon O Gauge

1 **9298609002** **Filament Cables** (not for use when the filament leads are enclosed in a metal box.)


C14
C13
L2
FM-25K Cavity
Cavity Wall
943-4754-026
Shorting Ring
929-3989-001
Hose Clamps
358-1036-000
Plate Blocker
929-4129-001
Plate Tuning
Bar with
Fingerstock
929-7496-001
PA Access Cover
with fingerstock
(not shown)
922-0446-013
929-7493-001
Neutralization
Flag 829-7614-001
Stud
829-7615-001
Eccosorb Tile
358-1368-000
Fixed Tuning
Paddle. Do not
Move.
Modified Hose
Clamp
929-7946-001
Screen Arc Gap Assembly
(new version shown)
3/13/97



<u>PA Coupling versus Tuning</u>

At times, a transmitter problem becomes compounded by improper settings of the Tuning and Loading controls. Generally this occurs when the Loading control is too heavy, or in other words, over-coupled. This occurs when the control is advanced too far clockwise.

With the PA over-coupled, it is likely that you will be misled to a false resonance when adjusting the Plate Tuning. The results of this can be very strange.

Of course, it is good practice to know what the normal settings are for your transmitter, and to avoid deviating too far from these positions. However, if this information becomes lost or otherwise unavailable it may be necessary to verify that the PA is correctly tuned.

To do this, your starting point should be with the PA screen control and IPA power control turned down, and the PA Loading control fully counter clockwise. The main objective here will be to establish the correct PA resonance in the fully unloaded condition. It is necessary to have the drive and screen voltage turned down. Otherwise the PA screen current will be excessive to the point of an overload.

With this preset condition, turn the HV on and adjust the PA Tuning for a peak in the power output.

Next, adjust the Loading for a peak in output power. This peak may occur very near the present setting.

Increase the IPA drive, then readjust the PA Loading and then the Plate Tuning.

Also raise the screen voltage, and repeat the adjustments. You should find that the Loading control has to go significantly further clockwise as you bring up the IPA power and PA screen voltage. The Plate Tuning will probably go slightly clockwise in relation to the initial setting in the unloaded condition.

PA Shorting Deck Adjustment

The shorting deck referred to here is what sets the height of the cavity. This is a frequency determining adjustment, and you should not normally need to adjust it unless you are changing frequency.

Before making any adjustment, make sure that the Plate Blocker Assembly is fully seated onto the tube. The Plate Blocker has a shoulder inside which should actually bottom out on the top of the tube. The contact fingers on the Plate Blocker should extend to the bottom of the cooling fins of the tube.

Also, the fixed paddle on the blocker assembly should never be moved. See the Plate Blocker drawing for its correct position.

With this verified, you can determine which direction to move the shorting deck based on which position the tuning paddle is in when you are approaching a peak in output power.

If you find that the Plate Tuning paddle capacitor is open (with the paddle rotated against the wall), then the shorting deck should be moved down.

Conversely, if the paddle is rotated to maximum capacity (the horizontal position), the shorting deck should be moved up.

To re-position the shorting deck, the back cover of the cavity must be removed, as well as the screws holding the deck.

Note: The shorting deck can be moved in two different size increments. The spacing of the screw holes in the shorting deck is half of the spacing of the holes in the outside wall of the cavity. This *allows a smaller adjustment than would initially appear to be available. The smaller adjustment is determined by which screw holes are used in the shorting deck.*

Plate Blocker Clamps (358-1036-000) and (929-7946-001)
The hose clamp connections at the top and bottom of the Plate Blocker assembly are very important connections. The top connection is the more critical of the two because it is the high current point in the cavity.

If either connection is not drawn down tightly, there will be some contact resistance and formation of small arc gaps. With the high RF current flow, this can lead to pitting of the metal, which will become worse with usage.

To ensure good contact, use two hose clamps at the top of the cavity, and tighten them to about 35 inch pounds. Since you may not have a torque wrench available, 35 inch pounds is between what the average man can do with a nut driver (about 30 inch pounds), and the point which the hose clamps are stressed (50 inch pounds). A ratchet type wrench is a useful tool for tightening the upper clamps.

The clamp around the tube is modified in order to limit the amount of clamping pressure it can apply to the tube. It should be tightened to the point where the kinks begin to flatten out.

Plate Tuning Belt Drive (424-0491-000)
If your transmitter does not have the gear type Plate Tuning drive mechanism, it has a centipede type belt which loops around a sprocket assembly. If yours has broken, it would be a good time to consider retrofitting your transmitter with the gear type drive. The gear type drive is covered in detail in service bulletin FM-392.

However, if you would like to just replace the centipede belt, here is some advice. Access to the belt drive assembly can be obtained by either taking off the right side panel (as viewed from the front), or by taking out the front panel section that includes the tuning knobs.

Refer to the description of Removing the IPA Mainframe for directions on removing the front panel.

Once you have gained access to the belt drive assembly, you will probably see that the front plate of the belt drive assembly must be removed to allow the new belt to be installed.

When putting the front plate back on, do not arbitrarily tighten the mounting screws. Instead, very progressively tighten each screw, alternating between them, while rotating the tuning control through its range. Rotating the control back and forth will serve to position the front plate so that there is a minimum of side loading or binding on the shaft.

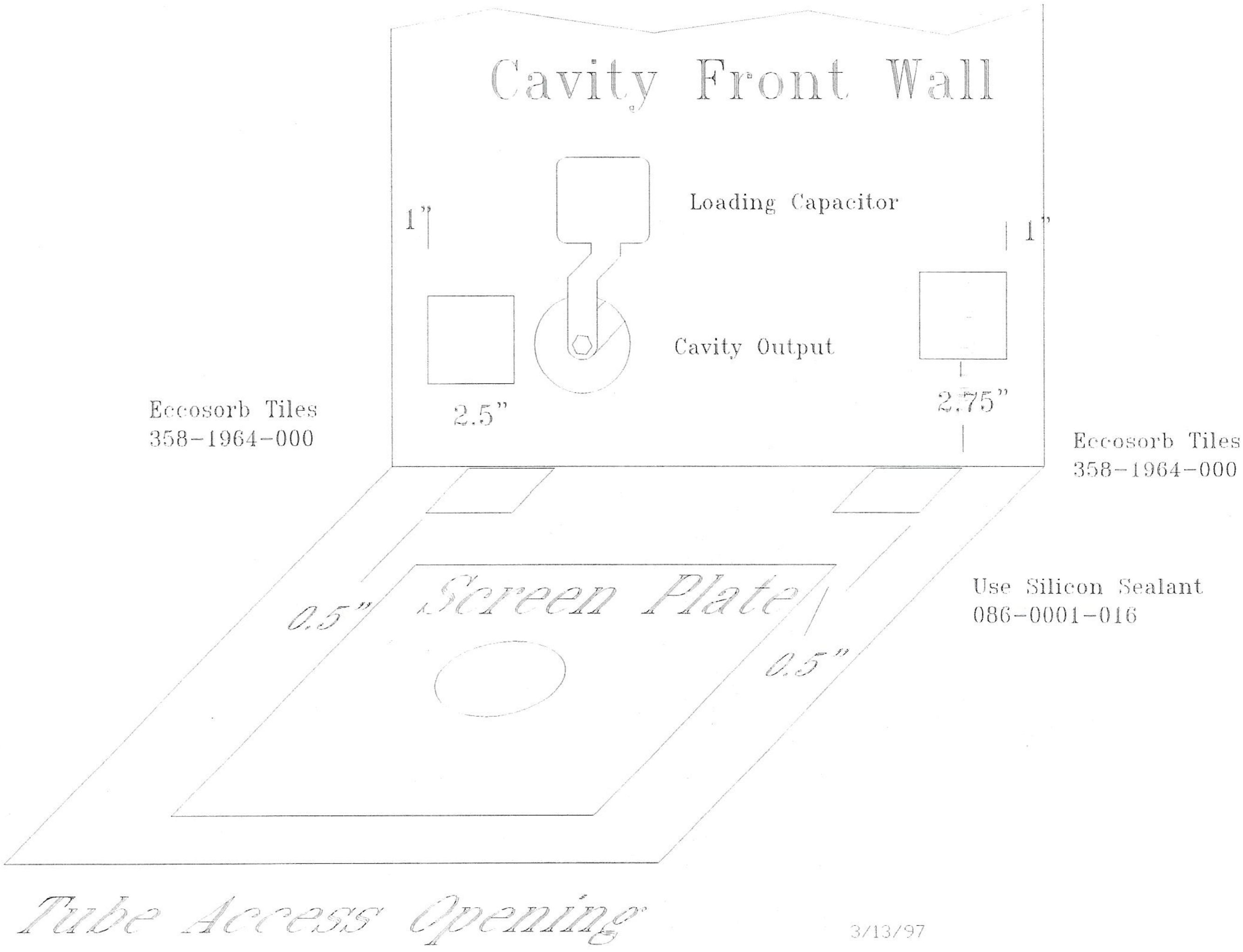
Satellite Reception
In sites where the transmitter is co-located with a satellite receiver, sometimes there have been interference problems. Aside from dealing with issues such as equipment grounding, and shielding of the equipment, in a few installations it has been necessary to add Eccosorb tile to the cavity.

Eccosorb is an RF absorbing material. Its characteristics and dimensions determine the frequency range it affects. Placement of the Eccosorb is also very important with respect to amount of spurious energy it absorbs, and is a factor in how much fundamental energy is absorbed.

See the following drawing for details on absorbing energy above 1.5 GHz.

Tile Installation

Glue the tiles in place, using a liberal amount of the specified adhesive applied to the back surface of the tiles. Remove excessive adhesive after pressing them into place.
Initially tape the tiles in place with masking tape to hold them in position until the adhesive cures (about 24 hours). Remove tape after ahesive cures.
Note: It is safe to turn the transmitter back on immediately following installation of the tiles.
However, inspect the masking tape on each tile after 5 minutes of operation for any signs of noticeable discoloration. The tiles should only be warm to the touch.



Screen Arc Gap
The purpose of the arc gap on the screen bypass plate is to protect the Kapton insulating material from over voltage when the tube arcs from plate to screen. In this event, the plate voltage appears on the screen circuit. The arc gap is needed to shunt that energy.

The proper setting for the screen arc gap is 0.013 to 0.015 inches, depending on altitude. At high elevations, the wider setting will probably be needed. This setting also depends on having smooth surfaces. Rough, pitted, or sharp edges will fire at a lower voltage than a smooth arc gap at a given gap setting.

Also, a newer carbon rod type arc gap is available. Unlike the metal type, the carbon rod type can fire a number of times without becoming bridged across. See the attached drawings for details on its parts and its assembly.

Screen Bypass Plate (829-4043-001)
In early model FM-25K transmitters, the center hole in the top plate of the screen bypass capacitor assembly had a right angle cut. See drawing. To allow a greater distance between the grid ring and the nearest edge of the screen bypass plate, we chamfered this edge.

To prevent arc tracks from forming across the underside of the Teflon shoulder washers, place a small amount of silicon RTV under each Teflon shoulder washer, then rotate them in place. This will spread the RTV, and fill the air void, thus improving the insulation between the stud and Kapton.

Screen Control, Full Range (994-8955-001)
When we introduced VSWR Foldback into the FM-25K, we included a screen control variac that gave full control of the screen voltage. This typically allows the power level to be turned down to about 15%, which is much further than without this change.

This kit also has the circuitry required to enable direct remote control of the variac. This kit can be used independent of the VSWR Foldback, but the VSWR Foldback kit has very limited effect if the full range screen control is not installed first.

Screen Ring Fingerstock
With age and heating, fingerstock material loses its spring tension and easily becomes broken. Loss of contact between the screen ring and the tube will cause a change in neutralization, which can cause a variety of effects. It is good practice to periodically examine the screen fingerstock for its condition.

One way to do this is by looking at the scratch marks on the contact ring of the tube. When the contact is good, you should be able to see small vertical scratch marks in the metal.

You can also try inserting a small strip of paper between the tube and fingerstock, then pull the strip out while feeling how much drag there is on the paper strip. You would then have to repeat this test at various points around the tube.

To make sure the contact ring is properly positioned around the tube, insert the tube, and loosen the screen ring mounting screws.

Note: At some frequencies, we do not use all the mounting hardware for the screen ring.

The tension of the fingerstock will automatically position the contact ring. Then, tighten the screws.

There have been two ways in which the fingerstock was fastened to the screen ring. Many were assembled with the fingerstock held in place with a piece of buss wire wedged into a groove in the ring.

The above method is the least costly means of making the assembly, however, does create some risk in terms of distorting the fingerstock.

We now make the screen contact ring with the fingerstock silver soldered to the ring. As such, replacement involves replacing the ring as an assembly. The part number for the assembly is 939-5890-001.

If you have a ring made up with buss wire to secure the fingerstock in place and want to keep it that way, the part number for the fingerstock is 007-4060-063. The buss wire is 254-0004-000. You will need 1.2 feet of each.

Screen Studs (817-1864-001)
In early model FM-25K transmitters, the studs that fasten the screen bypass capacitor together were threaded all the way through. In some cases, the proximity of these threads to the inside edge of the copper clad Kapton material eventually contributed to an arc track across the Kapton insulating material. To improve the long-term voltage handling capabilities, we changed the threading of the studs so that there is now a smooth surface opposing the copper edge on the copper clad Kapton material.

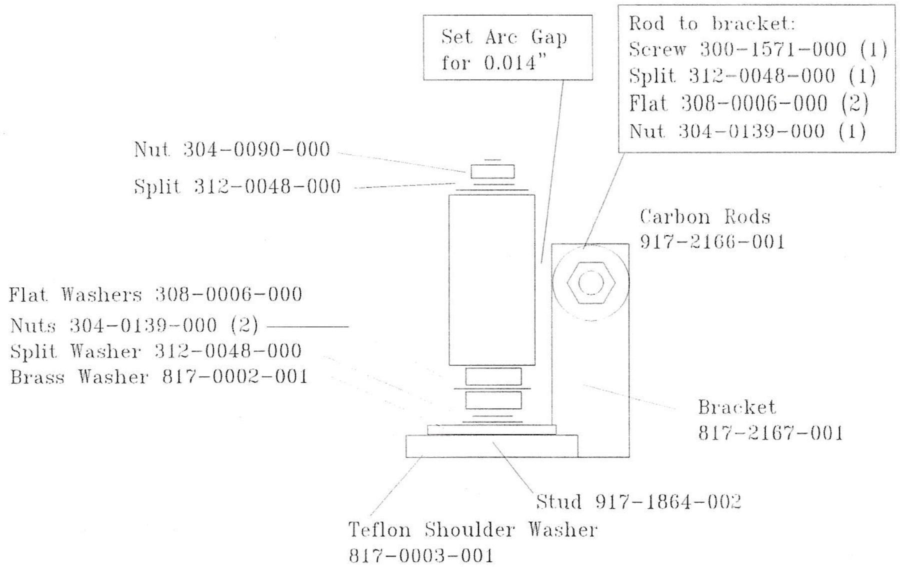
Sola Filament Transformer
A regulator transformer can be installed to maintain a constant voltage to the primary of the filament transformer.

The Sola transformer is wired in line with the power to the primary of the filament transformer. Since this is a fairly large transformer, it must be mounted external to the cabinet.

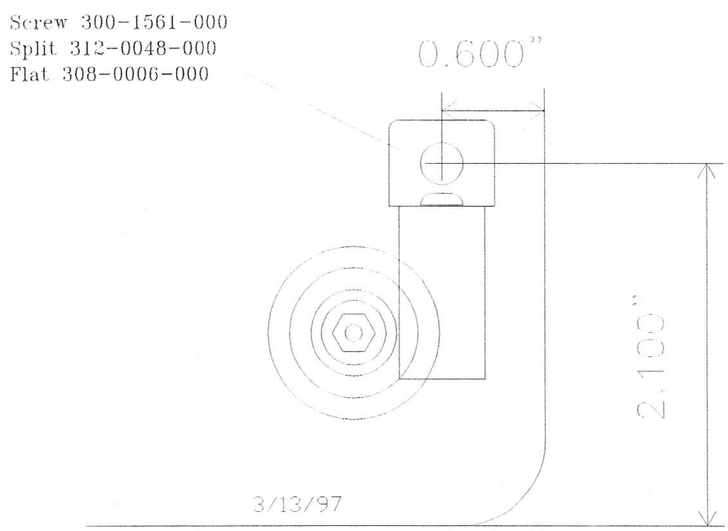
Parts Required for Sola Filament Transformer Installation:

Qty	Part Number	Description
1	472-1250-000	Sola transformer, 3 kVA
1	614-0048-000	Terminal board, 4 term.

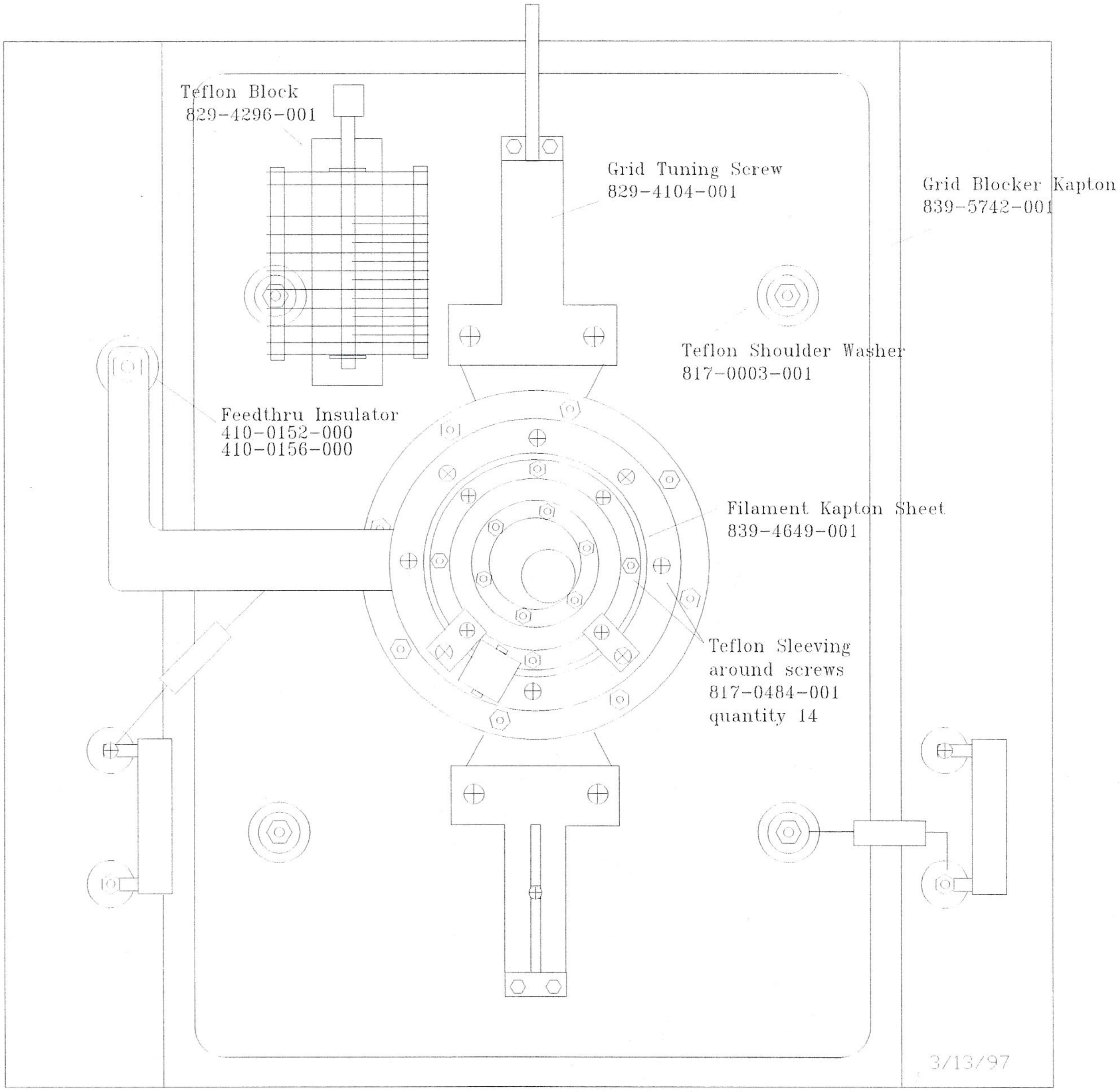
Screen Arc Gap Assembly
Side View



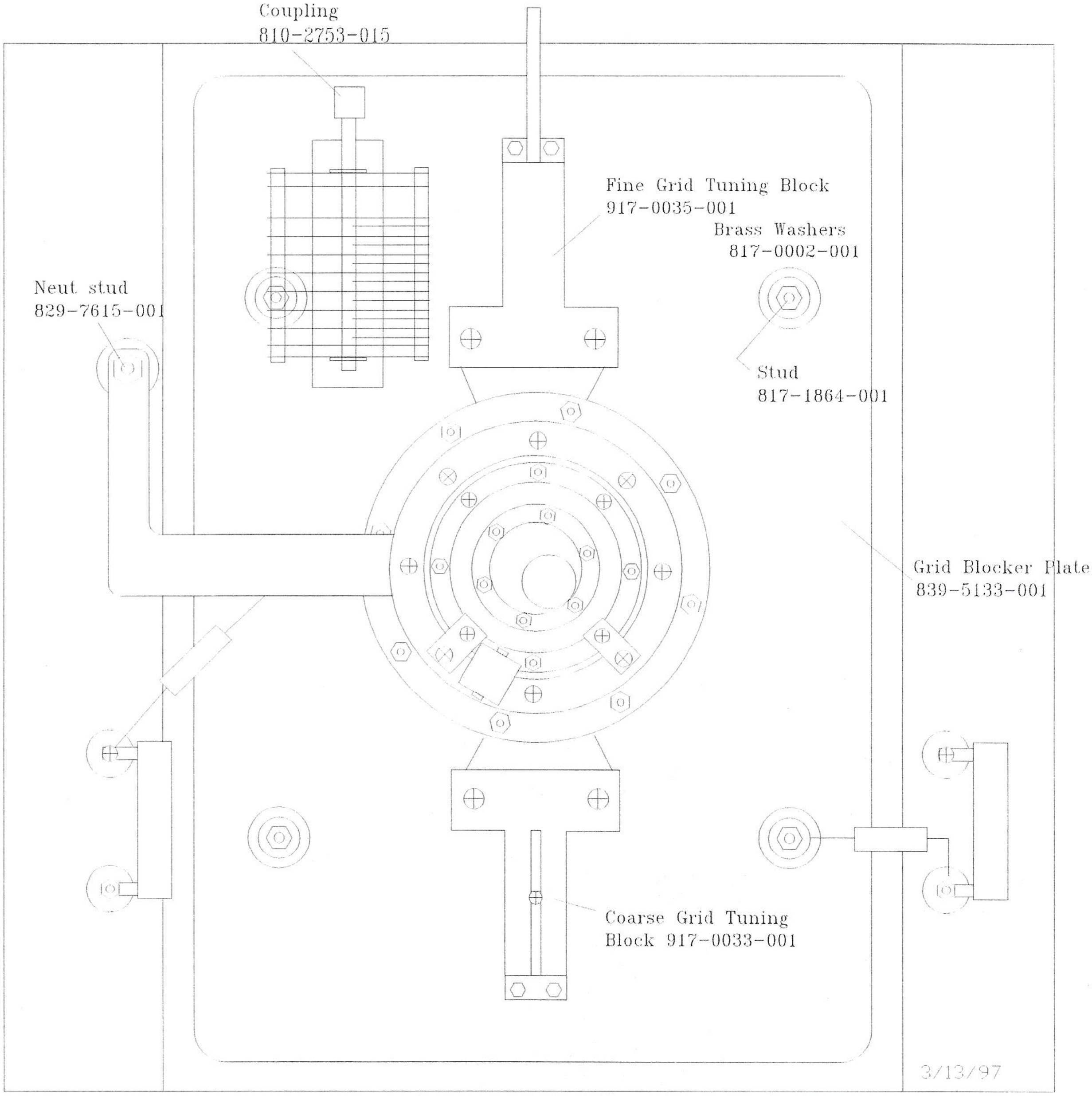
Top View



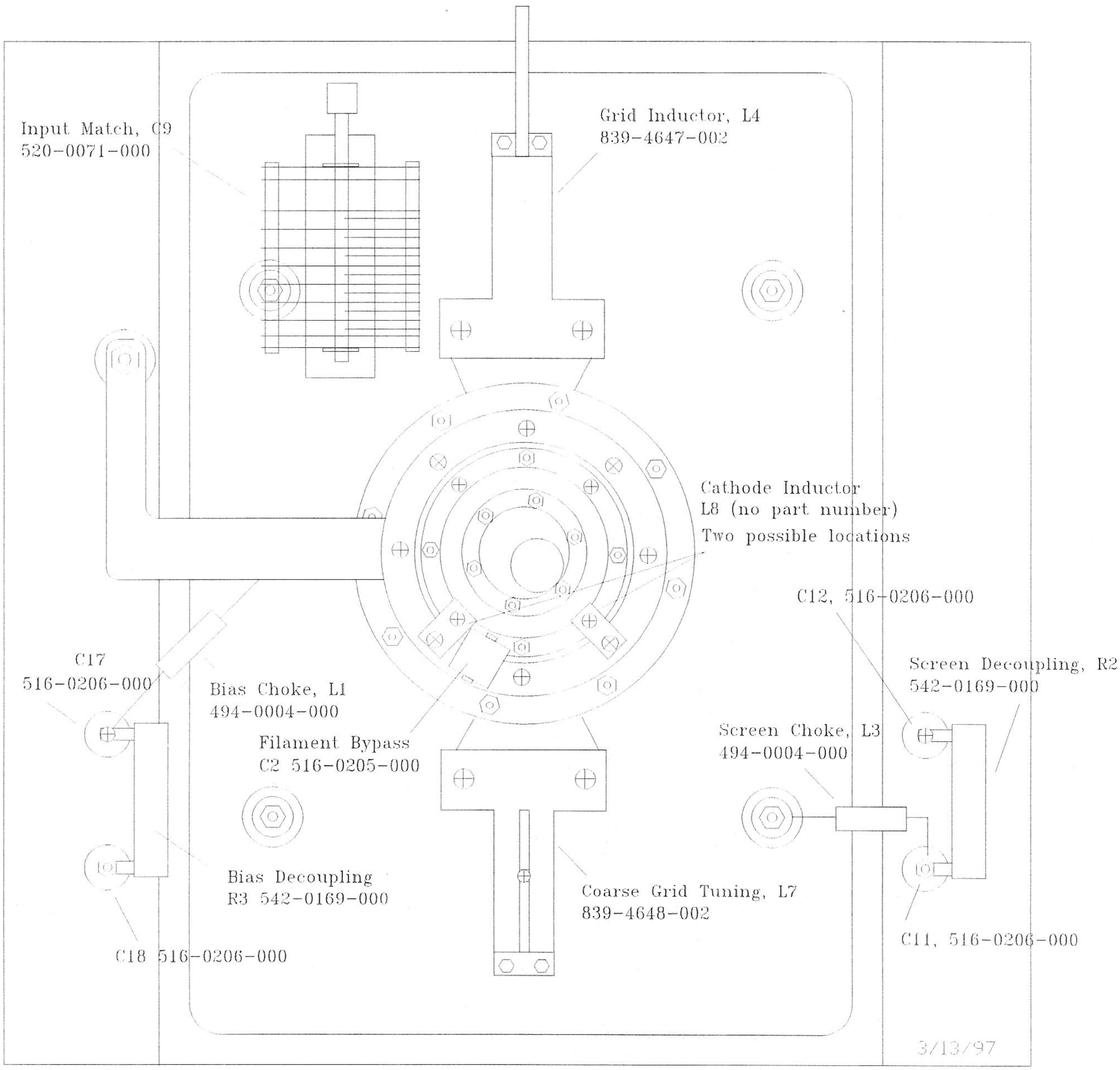
FM-25K Socket & Input Circuit
View from the Underside
Non-Metallic Parts



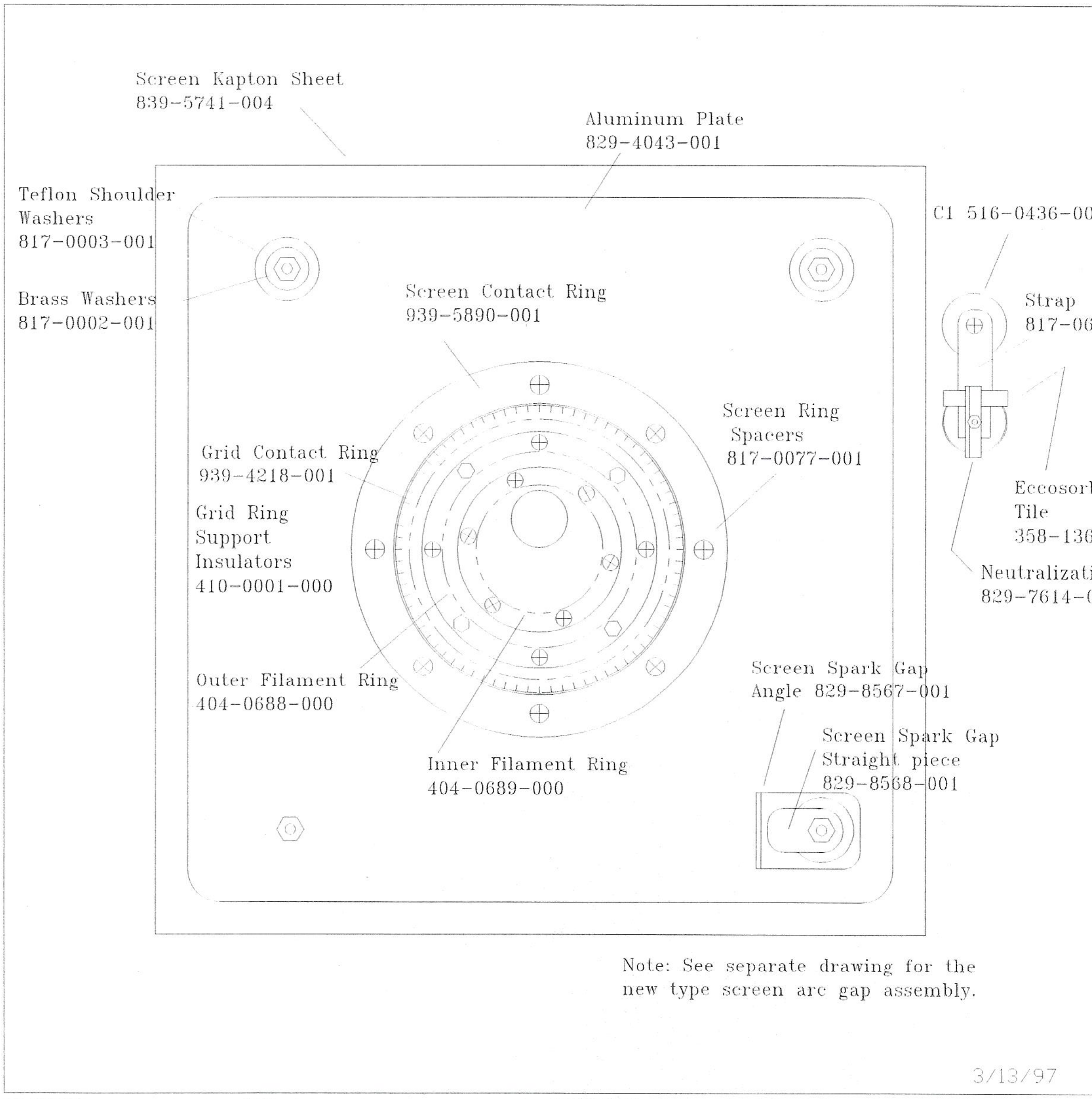
FM-25K Socket & Input Circuit
View from the Underside
Metal Parts



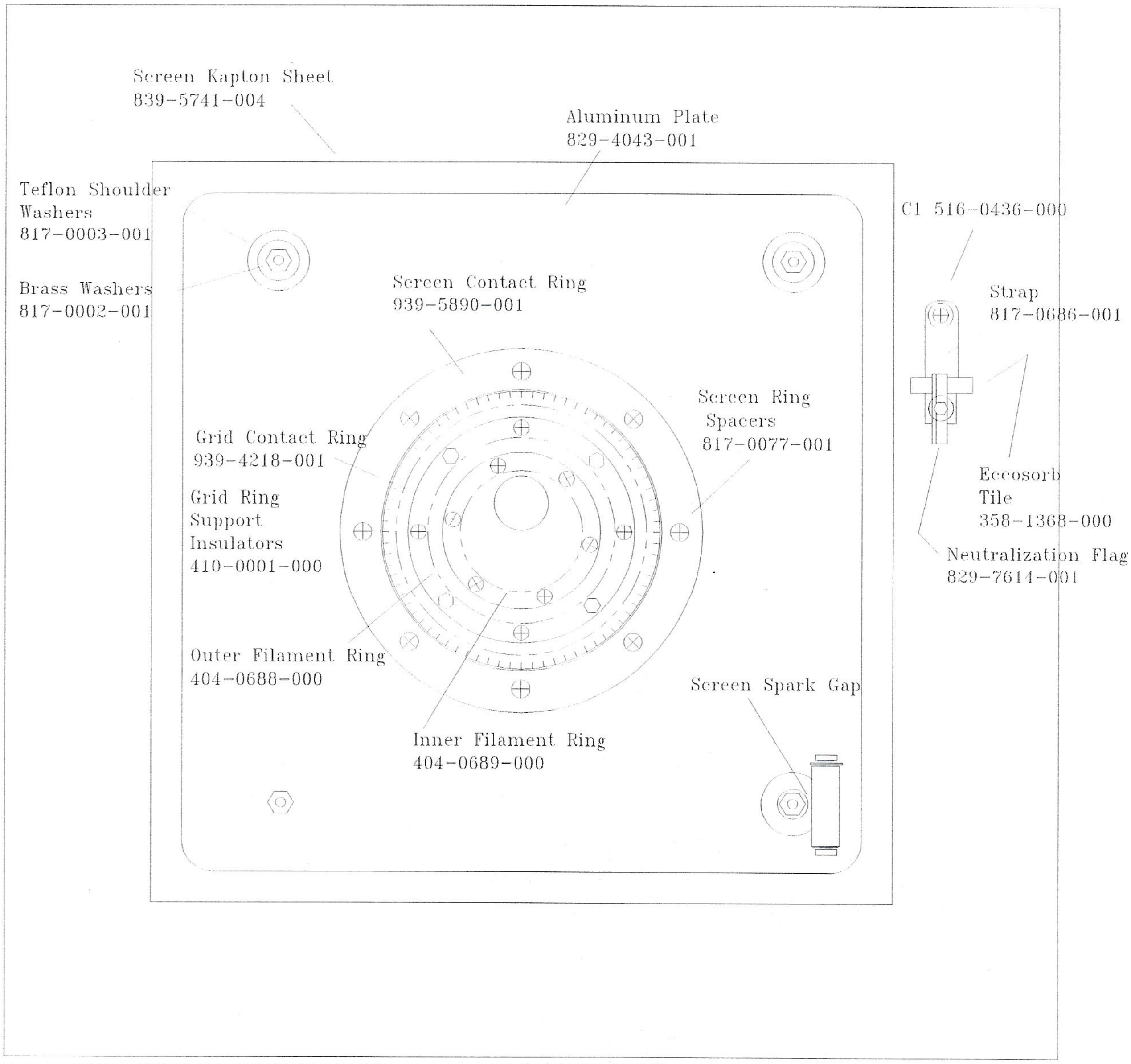
FM-25K Socket & Input Circuit
View from the Underside
Parts with Component Designators

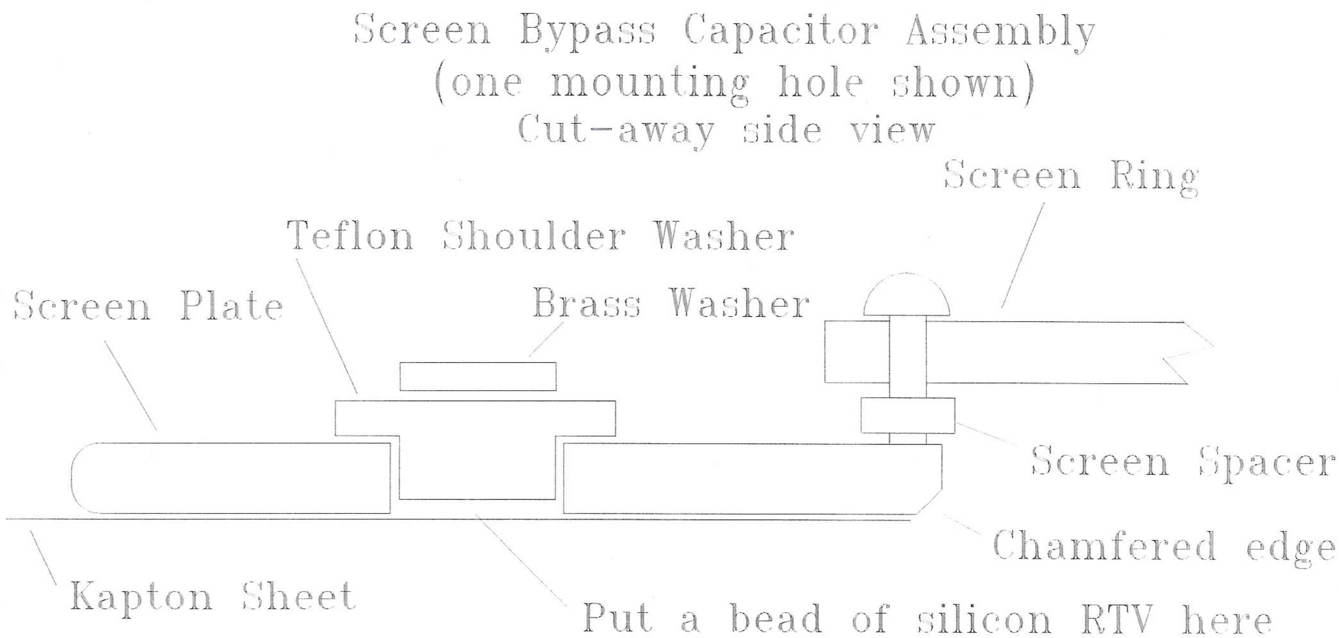


FM-25K Socket & Input Circuit
View from the Topside



FM-25K Socket & Input Circuit
View from the Topside





Tube Deck Parts List

Qty	Part Number	Description
1	8432778001	Base Plate Tube Socket
1	8294043001	Screen Capacitor Plate, 1/4" Aluminum
1	8294296001	1/2" Teflon For C9 Mounting
7	**8170003001**	**Teflon Shoulder Washers, Grid And Screen**
7	8170002001	Brass Washers, Screen & Grid Cap Mounting
1	8170253001	Strap Cathode Inductor
1	8298567001	Angle Spark Gap
1	9294684001	Filament Ring For Underside-Not Fingerstock
1	9294683001	Cathode Ring For Underside-Not Fingerstock
1	9294028001	Tube Socket Assy
1	8298568001	Plate Spark Gap
1	9294018001	Base Plate Assy
1	**9170035001**	**Fine Grid Tuning Block**
1	9170033001	Coarse Grid Tuning Block
1	**8294104001**	**Grid Tuning Screw**
1	8395133001	Grid Capacitor Plate, 1/4" Aluminum
1	**8395742001**	**Grid Blocker Kapton**
1	8297614001	Neutralization Flag

1	8170577001	Strap L9
1	8297610001	Strap L5
1	8297609001	Strap L6
2	8297612001	Strap
4	**8171864001**	**Threaded Studs For Screen/Grid Cap Mounting**
1	8297615001	Neutralization Stud (Made From 0051020040)
1	**8395741004**	**Screen Kapton**
1	**9394218001**	**Grid Fingerstock Ring**
8	8170077001	Screen Ring Spacers
2	**8394649001**	**Filament Kapton Sheets**
1	8170686001	Strap C1
1	8394647002	Inductor L4
1	8394648002	Inductor L7
1	**9395890001**	**Screen Contact Ring, Includes Fingerstock***
14	**8170484001**	**Teflon Sleeving, Cathode Mounting Screws****
4	8135604002	Stud Brass 6-32 X 7/16
4	8294006001	Standoff
1	8170557001	Block Mtg
5	3001535000	Scr, 6-32 X 3/16
4	4100004000	Insulator Round NS5W 0108
4	4100001000	Insulator Round NS5W 0104
1	4100152000	Insulator Bshg NS5W-4103
1	4100156000	Insulator Bshg NS5W-4203
1	**4040689000**	**Filament Contact Assy, Inner**
1	**4040688000**	**Cathode Contact Assy, Outer**
8	3540147000	Lug Shake .150 Mtg
8	3540146000	Lug Shake .176 Mtg
8	3350104000	Washer Plain .156 Id
2	3350080000	Washer Nylon .5 Hole
1	**3581368000**	**Tile For Neutralization Assembly**
4	3040034000	Nut Cap 6-32 Brass
1	8170718001	Bushing
1	8102753015	Coupling
2	8298862001	Brass Sheet For Grid Tuning Slider
1	5160436000	Cap 5pf 7500v 10% C1
1	5200071000	Cap Var 11 To 53pf C9
1	5160205000	Cap HV 500 Pf 5000v C2
4	5160206000	Cap HV 1000 Pf 5000 C11, C12, C17, C18
1	9297616001	Cable Assy J1
2	4940004000	Choke RF 7uh L1, L3
2	5420169000	Res 25.0 Ohm 25w R2, R3
10	3002104000	Scr, 6-32 X 1/2

*** Some Screen Contact Rings Hold The Finger-Stock In Place With Buss Wire. For Those, You Can Use 2540004000 Buss Wire And 0074060063 Fingerstock, 1.2 Feet Each.**

**** Made From 2960340000**

Tube Deck Removal

Removing the tube deck will require access to screws on the front side of the cavity. To access these, you will need to remove either the exciter or the IPA Mainframe. Refer to the instructions on removal of the IPA Mainframe if needed.

Remove the back wall of the PA cavity. This requires removal of numerous screws which fasten the cavity wall to the other walls of the enclosure and the tube deck and shelf.

Disconnect the grid bias and screen supply leads from feedthru insulators E2 and E3 on the underside of the tube deck.

Remove the rear cover from the filament enclosure below the cavity.

Disconnect the filament leads and the filament cooling air tube from the bottom of the PA socket.

Remove the screws from the perimeter of the PA tube deck.

At this point, it should be possible to slide the tube deck out the rear opening of the cavity.

Plate Blocker Removal

First remove the tube, there are instructions in the transmitter manual, see Figure 5-1 in section 5 (manual 888-1859-007). During this procedure make sure to note which hardware is used in each location: brass and stainless screws are not interchangeable. Take care to avoid bumping or bending the neutralizing flag.

The blocker may stay clamped into the shorting deck and these two pieces can be removed together.

Remove the back wall of the PA cavity taking care to note how the RF braid is installed.

Tuck the high voltage anode lead up between C13 and C14 so it will stay out of the way. Use a wire tie or string to hold it there if needed.

Before removing the upper cavity shorting deck that holds the plate blocker assembly: carefully mark it's position and which screw holes are used. Prop up the deck or have a helper hold it while you are removing the screws. Remove the screws around the perimeter of the deck and remove it.

An alternative method is to remove the blocker through the top of the transmitter. Overhead conduits, low ceiling or the lowpass filter, for example, may prevent this method from being practical. The fixed tuning paddle will have to be removed and the vented panel above the cavity will need to be removed.

Tube Information (374-0151-000)

The 8990 and 4CX20000A are the same. These are just two names for the same thing.

The typical tube life reported to us is in the range of 3 to 5 years. This, of course, is dependent on proper treatment of the tube.

It is importance to properly maintain the filament voltage, proper tuning, and proper ventilation. Keep the room, air filters and transmitter clean.

During the first 100 to 300 hours of operation with a new tube, the filament voltage should be set at the rated value (10 volts), then lowered to nearly the minimum that can be achieved without a loss of output. The tube is to be operated at a voltage slightly higher than the point where performance starts to degrade.

Troubleshooting Reference

The following is a guide to solving some fairly typical problems. They are listed in alphabetical order, with the possible causes listed below in order of likelihood.

Bias breaker trips upon turn on

HV Shorting Solenoids L1 and L2 in the HV Power Supply. One of these may have a shorted coil.

Bias Rectifiers Z2 and Z3. Check with an ohmmeter to see if any are shorted.

Bias transformer T1. Try applying AC to the transformer with the secondaries disconnected. If it still trips the Bias breaker, the transformer is definitely shorted.

Blower Keeps Running past the 3 minute rundown cycle.

Solid state relay K4 is probably shorted.

Filament Voltage Pinned Negative

No Actual Filament Voltage. When the filament voltmeter is pinned negatively it is usually a sign that there is actually no filament voltage. This is a characteristic of the RMS to DC converter IC, U1 on the AC Control board. If you get a negative reading on the filament voltage meter, it is advisable to check for presence of filament voltage on the secondary of the filament transformer, and at the filament connections on the cavity.

If the voltage is not present, the problem may be a bad circuit breaker or bad filament cable.

Filament Voltage Will Not Energize

Air Switch. Assuming that the blower motor is running properly, and that there are no air flow obstructions, the problem may be the air switch. Please refer to the discussion of the air switch.

Filament Circuit Breaker. Check to see if the breaker has tripped. Also, sometimes a circuit breaker can lose contact even though it is mechanically closed.

Overload Meanings & Possible Causes

AFC Overload This indicates the exciter lost lock in the phase locked loop circuit.

Persisting Loss of AFC Lock? Check the multimeter readings on the exciter. The AFC reading will most likely be out of its normal range. Loss of a supply voltage (+/-20 volts, 5 volts) could point to a problem in the exciter mainframe. Loss of the Mod Osc reading points to the failure of the Modulated Oscillator.

With the AFC module removed, the MS or MX-15 exciter will normally produce RF output. It will not be on frequency, however this test will serve to prove whether the Modulated Oscillator is working.

Intermittent Loss of AFC Lock? Check to see if the AFC voltage is in a good range (3 to 8 volts).

Try scrubbing the edge connections on the AFC and Mod Osc boards. Sometimes some contact resistance will form from oxidation, and cause the loop to unlock.

The problem could also be external. Squelching of the STL or a strong glitch from the stereo generator can kick the exciter out of lock momentarily.

IPA VSWR Overload This indicates too much reflected power to the IPA.

IPA Lowpass Filter. Remove the IPA Lowpass Filter/Directional Coupler from its location on the wall near the back door interlock switch. Inspect its glass capacitors and coils connections. The glass should be clear in each capacitor.

Bad Coax. Check the coax that runs from the IPA Lowpass Filter to the PA Input with an ohmmeter.

PA Grid Circuit. Inspect the PA grid circuit for broken or loose connections. Include in these checks an examination of the cathode circuit, and the L8 inductor.

PA VSWR Overload This indicates the output VSWR exceeded 1.5:1.

Burned bullet. Inspect the output coax connections for a burned bullet or other outward indication of a hot spot.

Coaxial Switch. If your system includes any coaxial switches, inspect them for any signs of a burned connection.

Antenna Fault. Try operating the transmitter into a dummy load.

Plate Overload This indicates too much plate current.

Plate Blocker. There may have been an arc through the Kapton insulating material. Initially, this would have been audible, but may not be once a carbon arc path has been established. The point at which the arc occurred will probably be visible. If not, you can isolate the problem by disconnecting the coax which feeds the HV to the cavity. A convenient point to do this is at the standoff insulator where the HV enters the main cabinet (lower left inside the back door). If disconnecting this allows the HV to come up, you will know that the problem is associated with the coax, tube, and cavity.

HV Coax. With an ohmmeter check the coax which runs between the HV Supply and the Main cabinet, and the coax which runs from the HV entrance in the Main cabinet to the front of the PA cavity.

HV Feedthru. This is where the high voltage feeds into the cavity, on the front side. The best way of checking the feedthru is by disassembling it to inspect it. However, this requires access to both sides of it.

In order to access the front side, you will have to remove the meter panel. The meter panel can stay connected, but you should position it carefully so that it will not get damaged.

To access the back side of the HV feedthru, you will need to remove the back wall of the cavity. There is no trick to this; just a lot of screws to remove.

Bypass Capacitor. Like the HV feedthru, access to these capacitors is gained by removing the rear cavity wall.

Filter Capacitor. Look for any signs that one of the insulated terminals on the top of the capacitor has failed. Usually, there will be a crack and an arc track. Since the HV capacitor is non-polarized, it is possible to turn it around so that the other insulator has HV on it. This, of course, assumes that the insulator at the near-ground end is still good.

Tube. The tube may have developed an internal short, and you probably will not be able to measure it with an ohmmeter. Do not be alarmed if you hear something move inside the tube when you turn it upside down, then right side up. This is normal. The best means of determining fault with the tube is to try another.

No Bias to Tube. Check the Bias Voltage reading on the multimeter. If it is zero, there may be a failure in the bias supply, or a short in the PA grid circuit. The Bias current reading should pin negatively if there is a short in the grid circuit. There would also be no bias to the tube if one of the components leading up to the grid connection were open.

Screen Overload This indicates too much screen current.

Kapton insulator. Use an ohmmeter to check to see if the screen bypass capacitor is shorted (this is essentially the top of the tube socket). If the insulating material has arced, it will usually measure a low resistance.

Screen Arc Gap. Visually inspect the screen arc gap to see if it has bridged across. If necessary, refer to the additional information in this document on the screen arc gap.

Plate Voltage Will Not Energize

Does the Plate ON lamp illuminate? If so, the logic in the control section is doing its job. Based on the answer to this question, refer to the appropriate paragraphs below.

Logic Problem. Check the inputs to the "Plate Gate" circuit by checking the DC voltage at the cathode of diodes CR23, CR24, CR25, and CR26. Each should be near +12 volts (a logic high) after the filament warm-up time, and a Plate ON command is given. If any are not high, check each source of the voltage. Typical causes are a shorted reed relay K3, or failed flip flop IC, U3 or U5.

AC Control Board. If the Plate ON lamp is indicating correct operation of the logic circuitry, the problem may be with the Q1 circuit on the AC Control board. It takes a DC input from the logic, and starts the high voltage turn on sequence with relays K1 and K2 on the AC Control board.

HV Power Supply. If the contactors in the HV Power Supply are not activating, check the 3 phase power source to the HV Power Supply. Possibly there is no AC voltage being applied to the contactor coils, or there is a failed contactor.

Index