

INSTRUCTION MANUAL

QEI model FMQ-3500
FM BROADCAST TRANSMITTER

*RECEIVED WITH
BID (1988)*

* NOTE *

YOUR QEI TRANSMITTER IS A SOPHISTICATED PIECE OF ELECTRONIC EQUIPMENT THAT REQUIRES CARE IN INSTALLATION TO INSURE LONG TROUBLE FREE OPERATION. A FEW MINUTES SPENT ACQUAINTING YOURSELF WITH THIS INSTRUCTION MANUAL BEFORE STARTING INSTALLATION WILL SAVE TIME AND ASSURE A PROFESSIONAL TROUBLE-FREE INSTALLATION.

QEI CORPORATION
1 Airport Drive
P.O. Box "D"
Williamstown, NJ 08094

Rev 6/87

CUSTOMER INFORMATION

Station Call Sign..... BOISE STATE UNIV.

Station Frequency..... 91.3 MHZ

Station Transmitter Power Output..... 1500 W.

Transmitter Model Number..... FMQ-3500

FCC ID NUMBER AL09U7FMQ3500

Serial Number..... T3.5KW081

PA Efficiency at Station TPO..... 58.5%
LINE 240

CUR 770
57% 77
1350 W
CUSTOMER
1-13-89

* SHOULD BE 91.7 MHZ

QEI SAWS SAME SETTINGS INSIDE FOR 91.7 AS 91.3
DUE TO BROADBANDING. JUST ADJUST INPUT TUNING. (1-13-89)

~~THIS MANUAL SHIPPED WITH KMTB~~

Date Shipped..... DECEMBER 1988

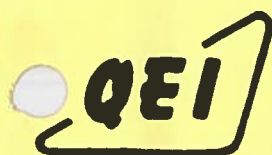
Warranty Expiration..... DECEMBER 1989

QEI Corporation
Airport Drive
P.O. Box "D"
Williamstown, NJ 08094

Rev 11/84

1-800-334-9154

ASK FOR DAN GARFIELD



CORPORATION

ONE AIRPORT DRIVE, P. O. BOX D • WILLIAMSTOWN, N. J. 08094

NOTICE

SPARE PARTS KIT

The spare parts kit supplied with this transmitter should be used to facilitate the repair of the transmitter in the unlikely event of a component failure.

When using parts from the kit, new parts should be put back into the kit for future use. By replacing parts used from the spare parts kit, you should always have proper components to repair the transmitter in the future.

If replacement parts are needed, contact the Customer Service Department of QEI Corporation.

WARRANTY

All equipment designed and manufactured by QEI Corporation is warranted against defects in workmanship and material that develop under normal use within a period of one (1) year from the date of original shipment subject to the following conditions and limitations:

1. The purchaser is not in default under his contract of purchase.
2. The sole responsibility of QEI Corporation for any equipment not conforming to this warranty shall be, at QEI's option:
 - a. To repair or replace such equipment or otherwise cause it to meet the represented specifications either at the purchaser's installation or upon return thereof F.O.B. Williamstown, New Jersey, as directed by QEI Corporation; or
 - b. To demonstrate that the equipment has no defect in workmanship or material and that it meets the represented specifications, in which event all expenses reasonably incurred by QEI Corporation in so demonstrating, including but not limited to cost of travel to and from the purchaser's installation, and subsistence, shall be paid by purchaser to QEI Corporation.
3. In case of any equipment thought to be defective, the purchaser must, within seven (7) days notify QEI Corporation, in writing, giving full particulars as to the defects. Upon receipt of such notice, QEI Corporation will give instructions respecting the shipment of the equipment, or such other manner as it elects to service this warranty as above provided.
4. Equipment shall not be deemed to be defective if, after examination by QEI Corporation, the equipment evidences damage from moisture, temperature, lightning, improper handling, installation, operation, accident, or abuse.
5. Equipment, accessories, tubes, and batteries not manufactured by QEI Corporation are subject to only such adjustments as QEI Corporation may obtain from the supplier thereof.
6. This warranty extends only to the original purchaser and is not assignable or transferable.
7. QEI Corporation further guarantees that any radio transmitter described herein will deliver specified radio frequency power output at the antenna lead when connected to a suitable load, but such guarantee shall not be construed as a guarantee of any definite coverage or range of said apparatus.
8. NO OTHER WARRANTIES, EXPRESS OR IMPLIED INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE SHALL BE APPLICABLE TO ANY EQUIPMENT SOLD BY QEI CORPORATION, AND NO REPRESENTATIVE OR OTHER PERSON IS AUTHORIZED BY QEI CORPORATION TO ASSUME FOR IT ANY LIABILITY OR OBLIGATION WITH RESPECT TO THE CONDITION OR PERFORMANCE OF ANY EQUIPMENT SOLD BY IT, EXCEPT AS PROVIDED IN THIS WARRANTY. THIS WARRANTY PROVIDES FOR THE SOLE RIGHT AND REMEDY OF THE PURCHASER AND QEI CORPORATION SHALL IN NO EVENT HAVE ANY LIABILITY FOR CONSEQUENTIAL DAMAGES OR FOR LOSS, DAMAGE, OR EXPENSE DIRECTLY OR INDIRECTLY ARISING FROM THE USE OF EQUIPMENT PURCHASED FROM QEI CORPORATION.

EXTENDED TUBE WARRANTY

QEI Corporation warrants the TRIODE TUBE SUPPLIED AS ORIGINAL EQUIPMENT with and factory installed in QEI FM Broadcast Transmitters for a period of 15000 hours of Filament ON time or two years from date of shipment whichever occurs first. This Warranty is subject to the following conditions:

1. The purchaser is not in default under his contract of purchase.
2. The tube must be the same tube supplied as original equipment with the transmitter and must be returned freight prepaid to QEI Corporation for verification of failure and serial number.
3. The tube must not show evidence of abuse- mechanical damage, cracked seals, overheating, etc.
4. The SOLE RESPONSIBILITY of QEI Corporation shall be to REPLACE the defective tube with a new tube. Shipping charges and labor costs are the responsibility of the customer.
5. If a tube failure occurs before 10000 hours, a new tube will be provided at no charge. If tube failure occurs between 10000 and 15000 hours, a new tube will be provided and the charge to the customer prorated according to the following formula.

Cost = (Filament Hours minus 10000) divided by 5000 and then multiplied by the tube manufacturer's current suggested list price

6. Customer retains title to the tube returned for evaluation until QEI acknowledges adjustment responsibility in writing.
7. If QEI finds that a returned tube is still serviceable, the customer will be notified and the tube returned at his expense.
8. Upon notification by the customer that a suspected tube failure has occurred, QEI will ship a replacement tube to the customer by UPS freight prepaid. Any expedited shipping charges are the responsibility of the customer. The customer will also be invoiced the current manufacturer's list price for the tube. The customer must then return the suspected tube freight prepaid along with the Filament Hours reading WITHIN 10 WORKING DAYS. Upon verification by QEI that the tube is defective, an appropriate credit will be issued.
9. NO OTHER WARRANTIES, EXPRESS OR IMPLIED SHALL BE APPLICABLE, AND NO REPRESENTATIVE OR OTHER PERSON IS AUTHORIZED BY QEI TO ASSUME FOR IT ANY OTHER LIABILITY OR OBLIGATION, EXCEPT AS PROVIDED IN THIS WARRANTY. THIS WARRANTY PROVIDES FOR THE SOLE RIGHT AND REMEDY OF THE PURCHASER AND QEI CORPORATION SHALL IN NO EVENT HAVE ANY LIABILITY FOR CONSEQUENTIAL DAMAGES OR FOR LOSS, DAMAGE OR EXPENSE DIRECTLY OR INDIRECTLY ARISING FROM THE USE OF EQUIPMENT PURCHASED FROM QEI CORPORATION.



CAUTION — KEEP THIS SHEET WITH TUBE UNTIL INSTALLED IN EQUIPMENT

OPERATING HAZARDS READ THIS SHEET AND TAKE ALL SAFETY PRECAUTIONS

PROPER USE AND SAFE OPERATING PRACTICES WITH RESPECT TO POWER TUBES ARE THE RESPONSIBILITY OF EQUIPMENT MANUFACTURERS WHO INCORPORATE THE TUBE INTO EQUIPMENT AND USERS OF SUCH TUBES AND EQUIPMENT. THE SUPPLIER OF THIS POWER TUBE PROVIDES INFORMATION ON ITS PRODUCTS AND ASSOCIATED HAZARDS, BUT IT ASSUMES NO RESPONSIBILITY FOR AFTER-SALE OPERATING AND SAFETY PRACTICES. LIMITED LIFE AND RANDOM FAILURES ARE INHERENT CHARACTERISTICS OF ELECTRON TUBES. TAKE APPROPRIATE ACTION THROUGH REDUNDANCY OR OTHER SAFEGUARDS TO PROTECT PERSONNEL AND PROPERTY FROM TUBE FAILURE.

ALL PERSONS WHO WORK WITH OR ARE EXPOSED TO POWER TUBES OR EQUIPMENT WHICH UTILIZES SUCH TUBES MUST TAKE PRECAUTIONS TO PROTECT THEMSELVES AGAINST POSSIBLE SERIOUS BODILY INJURY. DO NOT BE CARELESS AROUND SUCH PRODUCTS.

OPERATING INSTRUCTIONS

This Operating Hazards Sheet, any packing and unpacking instructions, installation instructions, operating instructions, and relevant test data which may be included with this Power Tube can help you to operate this tube safely and efficiently. READ THEM. The Technical Data Sheet for this power tube provides operating specifications for individual products and other application information. Uninformed or careless operation of this tube can result in poor performance, damage to the tube or property, serious bodily injury, and possibly death.

Questions regarding tube operation or safety matters should be addressed to the Applications Engineering Department.

WARNING—SERIOUS HAZARDS EXIST IN THE OPERATION OF POWER TUBES

The operation of power tubes involves one or more of the following hazards, any one of which, in the absence of safe operating practices and precautions, could result in serious harm to personnel:

- HIGH VOLTAGE**—Normal operating voltages can be deadly. See below for additional information.
- RF RADIATION**—Exposure to RF radiation may cause serious bodily injury possibly resulting in blindness or death. **Cardiac pacemakers may be affected.** See below for additional information.
- X-RAY RADIATION**—High voltage tubes can produce dangerous, possibly fatal X-rays. See below for additional information.
- BERYLLIUM-OXIDE POISONING**—Dust or fumes from BeO ceramics used as thermal links with some conduction cooled power tubes are highly toxic and can cause serious injury or death. See below for additional information.
- GLASS EXPLOSION**—Many electron tubes have glass envelopes. Breaking the glass can cause an implosion, which will result in an explosive scattering of glass particles. Handle glass tubes carefully. See below for additional information.
- HOT WATER**—Water used to cool tubes reaches scalding temperatures. Touching or rupture of the cooling system can cause serious burns. See below for additional information.
- HOT SURFACES**—Surfaces of air-cooled radiators and other parts of tubes can reach temperatures of several hundred degrees centigrade and cause serious burns if touched. See below for additional information.

Additional specific information about power tube hazards:

HIGH VOLTAGE

Many power tubes operate at voltages high enough to kill through electrical shock. Design equipment utilizing these tubes to prevent personnel contact with high voltages. Securely attach prominent hazard warnings. Personnel should always break the primary circuits of the power supply and discharge high voltage capacitors when direct access to the tube is required.

RADIO FREQUENCY RADIATION

EXPOSURE OF PERSONNEL TO RF RADIATION SHOULD BE MINIMIZED. PERSONNEL SHOULD NOT BE PERMITTED IN THE VICINITY OF OPEN ENERGIZED RF GENERATING CIRCUITS, OR RF TRANSMISSION SYSTEMS (WAVEGUIDES, CABLES, CONNECTORS, ETC.), OR ENERGIZED ANTENNAS. It is generally accepted that exposure to "high levels" of rf radiation can result in severe bodily injury including blindness. **Cardiac pacemakers may be affected.**

The effect of prolonged exposure to "low level" rf radiation continues to be a subject of investigation and controversy. While there continues to be support for lower limits, it is generally agreed among official standard-setting groups in the U.S. that prolonged exposure of personnel to rf radiation at frequencies of 10 MHz-100 GHz should be limited to average power densities of ten milliwatts per square centimeter (10 mW/cm²) or lower, using any possible one tenth of an hour (.1 hour)

as the averaging period. It is also generally agreed that exposure should be reduced in working areas where personnel heat load is above normal. The 10 mW/cm² average level has been adopted by several U.S. Government agencies including the Occupational Safety and Health Administration (OSHA) as the standard or protection guide for employee work places.

Rf energy must be contained properly by shielding and transmission lines. ALL INPUT AND OUTPUT RF CONNECTIONS, SUCH AS CABLES, FLANGES AND GAS-KETS MUST BE RF LEAKPROOF. NEVER OPERATE A POWER TUBE WITHOUT A PROPERLY MATCHED RF ENERGY ABSORBING LOAD ATTACHED. NEVER LOOK INTO OR EXPOSE ANY PART OF THE BODY TO AN ANTENNA OR OPEN RF GENERATING TUBE OR CIRCUIT OR RF TRANSMISSION SYSTEM WHILE IT IS ENERGIZED. MONITOR THE TUBE AND RF SYSTEM FOR RF RADIATION LEAKAGE AT REGULAR INTERVALS AND AFTER SERVICING.

X-RAY RADIATION

As operating voltages increase beyond 15 kilovolts, power tubes are capable of producing progressively more dangerous X-ray radiation. Dangerous X-ray radiation is more likely from high-power transmitting tubes, many pulse-modulator tubes, high-vacuum rectifier tubes, and all older high voltage tubes that may have undergone changes in emission characteristics with aging and gradual deterioration. Provide adequate X-ray shielding on all sides of these tubes, particularly around the anode as well as the modulator and pulse transformer where these are used. Check X-ray levels. NEVER OPERATE HIGH VOLTAGE TUBES WITHOUT ADEQUATE X-RAY SHIELDING IN PLACE. MONITOR THE TUBE AFTER SERVICING AND AT REGULAR INTERVALS FOR POSSIBLE CHANGES IN X-RAY LEVELS DUE TO AGING.

DANGER:

BERYLLIUM OXIDE CERAMICS (BeO) - AVOID BREATHING DUST OR FUMES

BeO ceramic material is used as a thermal link to carry heat from the tube to a heat sink in a number of conduction cooled power tubes. The BeO thermal link may be brazed to the anode section of the power tube, or may be a separate accessory. Do not perform any operation on any BeO ceramic which might produce dust or fumes, such as grinding, grit blasting, and acid cleaning. **BERYLLIUM OXIDE DUST OR FUMES ARE HIGHLY TOXIC AND BREATHING THEM CAN RESULT IN SERIOUS PERSONAL INJURY OR DEATH.** Because BeO warning labels may become obliterated or removed, you are urged to contact your tube supplier before performing any work which might affect any external thermal link on any conduction-cooled power tube.

When BeO ceramics are to be salvaged or disposed of, special precautions must be taken to protect personnel. All such personnel must be made aware of the deadly hazards involved and the necessity of great care and attention to safety precautions. Any tube with a BeO thermal link, or any separate BeO thermal link will be disposed of without charge, provided it is returned freight prepaid to the supplier from which it was purchased with a written request for disposal. The supplier will then return it to the manufacturer for proper disposal.

GLASS EXPLOSION

Every power tube is pumped to a very high vacuum, which, in some cases, is contained by a glass envelope. When handling glass tubes, remember that glass is a relatively fragile material, and accidental breakage can result at any time. Breakage can cause an implosion, which will result in an explosive scattering of flying glass particles and fragments. Serious personal injury can result. The larger the tube envelope, the greater the potential hazard. When handling such tubes, safety glasses (or even better, a face shield), heavy clothing and leather gloves should be worn for protection.

HOT WATER

EXTREME HEAT occurs in the anode portion of power tubes during operation. Water channels used for cooling also reach high temperatures (as high as boiling, 100°C or 212°F. or above) and the hot water is under pressure (sometimes as high as 100 PSI). A rupture of the water channel or other contact with hot portions of this tube could scald or burn. Take precautions to prevent and avoid such rupture or contact.

HOT SURFACES

The anode portion of power tubes is often air-cooled or conduction-cooled. The air-cooled external surface normally operates at a high temperature (up to 200° to 300°C). Other portions of the tube may also reach high temperatures, especially the cathode insulator and the cathode/heater surfaces. All hot surfaces may remain hot for an extended time after the tube is shut off. To prevent serious burns, take care to prevent and avoid any bodily contact with these surfaces both during and for a reasonable cool-down period after tube operation.



Varian, EIMAC Division
1678 South Pioneer Road
Salt Lake City, Utah 84104

WARRANTY CLAIM SERVICE REPORT

POWER GRID TUBES

PLEASE READ IMMEDIATELY UPON RECEIVING TUBE

Adjustment will not be considered unless this Warranty Claim Service Report is completed in full and returned with the tube or circuit component to the Eimac factory where manufactured.

BREAKAGE AND DAMAGE

UNDER U.S. SHIPPING REGULATIONS, DAMAGE CLAIMS MUST BE COLLECTED BY THE CONSIGNEE. UNLESS OTHERWISE INSTRUCTED, MOST SHIPMENTS ARE INSURED. DO NOT RETURN DAMAGED MATERIAL TO EIMAC.

IMPORTANT: This merchandise was carefully packed and thoroughly inspected before leaving our factory. It should be unpacked, examined, and tested immediately on receipt. Responsibility for safe delivery was assumed by the carrier upon acceptance for shipment; claims for loss or damage sustained in transit must therefore be made upon the carrier, as follows:

CONCEALED LOSS OR DAMAGE: Concealed loss or damage means loss or damage which does not become apparent until the merchandise has been unpacked or tested. The contents may be damaged in transit due to rough handling even though the carton may not show external damage. When the damage is discovered upon unpacking and/or testing, make a written request for inspection by the carrier's agent within 15 days of the delivery date. (NOTE: Within 7 days of delivery date outside of U.S.A.) Then file a claim with the carrier since such damage is the carrier's responsibility.

VISIBLE LOSS OR DAMAGE: Any external evidence of loss or damage must be noted on the freight bill or express receipt and signed by the carrier's agent. Failure to adequately describe such external evidences of loss or damage may result in the carrier refusing to honor a damage claim. The form required to file such a claim will be supplied by the carrier.

WARRANTY

Varian, EIMAC Division warrants most tube types for 3000 hours of filament ON-TIME, with prorated adjustment from 300 to 3000 hours. Warranty time for each tube is specified in the EIMAC price list; inquiries on warranty time for any product may be made to any Varian Sales Office, or to any EIMAC franchised distributor. Warranty on all tubes expires one year from date of sale to the ultimate user, or 18 months from the shipment date from EIMAC, whichever first elapses. Tubes are warranted to be free from defects in workmanship and materials only.

In the interest of conservation of scarce materials tubes may contain recycled parts which are required to meet the same high standards of quality control applied to other materials and components used. This warranty applies only to tubes which are operated within the maximum ratings specified by EIMAC for the type of service employed. The entire obligation of EIMAC under this warranty is to replace defective products, or at its option, to credit the purchaser. In no event will EIMAC be liable for breakage or damage incurred in shipment (see BREAKAGE AND DAMAGE, above), or for consequential or resulting loss or damage, whether or not due to causes covered by this warranty.

RETURN PROCEDURE FOR WARRANTY CLAIMS

Where no obvious or externally visible fault exists, be sure the tube actually is inoperable before returning it. This should be done by operating the associated equipment, first with a tube known to be good to verify the functioning of the equipment, and then attempt to operate the questionable tube in the same equipment under similar conditions.

1. If the tube was obtained from a Distributor or an Equipment Manufacturer, it should be returned to them and not EIMAC. Be sure to enclose a completed Service Report. This is important.
2. If the tube was purchased directly from the factory, the following applies:
 - a. Authorization for return is required if more than 10 tubes are involved, or if the value of the shipment exceeds \$500.00. Customers outside the United States must request authorization before any return is made.
 - b. Complete the form on the back of this sheet giving all the data asked for. Adjustment will be considered only if this completed report accompanies the tube.
 - c. Repack the tube carefully in the same way it was packaged originally for shipment, preferably using the original materials.
 - d. Ship via PREPAID Express (do NOT ship by Parcel Post) to the EIMAC factory as shown on the reverse side of this report. DO NOT RETURN TUBES TO AN EIMAC SALES OFFICE OR SALES REPRESENTATIVE. Customers outside the United States should return electron tubes by Air Freight. Ocean shipments are acceptable provided the items are adequately export packed for this mode of transportation. The sender and the shipping agency must assume responsibility for damage from improper packing or handling. Insurance charges for returned goods must be borne by the sender.
3. Customer retains title to material returned for evaluation until EIMAC acknowledges adjustment responsibility in writing.
4. If EIMAC finds the tube has been returned without cause and is still serviceable, the customer will be notified and the tube returned at his expense.
5. If EIMAC finds that a replacement or credit allowance is in order, the customer will be notified. In the case of a replacement, a new tube will be shipped prepaid. Credit allowance will be made for shipping charges incurred by the customer in returning the produce provided EIMAC approved transportation methods are used.

It is often necessary to dismantle an inoperative tube to determine the cause of failure. In returning a tube, the customer grants permission to dismantle at the discretion of EIMAC.
7. Unserviceable tubes will be destroyed 30 days after notice of evaluation is sent to the customer. If the customer desires return of an unserviceable tube, he should notify EIMAC within that time and it will be returned at his expense. Any item for which credit is given or replacement is made under warranty becomes the property of EIMAC and will not be returned.

BE SURE TO FILL IN THE REVERSE SIDE OF THIS PAGE COMPLETELY



VARIAN, EIMAC DIVISION

1678 SO. PIONEER RD. • SALT LAKE CITY, UTAH 84104

SERVICE REPORT

PLEASE READ INSTRUCTIONS ON REVERSE SIDE BEFORE FILLING IN

Tube Type _____ Serial Number _____ When Purchased _____
(The Serial Number is a digit letter combination inside the tube at the base end, or on the external radiator).

From whom purchased _____

Type of Service. Broadcast , Communications , Navigation, Radar, etc. , Amateur , Medical ,
 General Industry , Experimental , Other _____

Type of Equipment in which Tube was used; _____
(Manufacturer's Name and Type Number)

Call letters of Station (if in licensed service) _____

Operating Conditions:

Total Hours of Filament Operation _____ Hours. Frequencies Used _____

How Used: RF Power Ampl.-Unmod. , FM , FSK , AM Plate Mod. , Teleg. , Pulse Service ,
 RF Power Ampl.-Linear , Grid Mod. , Screen Mod. , Suppressor Mod. , Doubler , Tripler ,
 Other Uses: Audio , Pulse Ampl. or Mod. , Control Ampl. , Oscillator .

Others

Voltage and Current Values PER TUBE: TUBE OPERATING,
 Such as Key Down, (If pulsed service give peak values)
Carrier, Pulse on, or Work in Place.

TUBE NON-OPERATING, Such as Key Up
Pulse Interval, or Work Removed.

Plate Voltage <input type="checkbox"/> DC <input type="checkbox"/> AC _____	Volts _____	Volts _____
Plate Current DC Per Tube _____	MA _____	MA _____
Screen Voltage <input type="checkbox"/> DC <input type="checkbox"/> AC _____	Volts _____	Volts _____
Screen Current DC Per Tube _____	MA _____	MA _____
Total Control Grid Bias Voltage DC _____	Volts _____	Volts _____
Control Grid Current DC Per Tube _____	MA _____	MA _____
Suppressor Grid Voltage <input type="checkbox"/> DC <input type="checkbox"/> AC _____	Volts _____	Volts _____
Filament Voltage <input type="checkbox"/> DC <input type="checkbox"/> AC _____	Volts _____	Volts _____

What are extremes of filament voltage due to variations of supply lines and operating conditions?
 _____ to _____ volts.

How is screen voltage obtained? _____

Is a screen bleeder used? _____

What is value of screen resistor, if any. (Note if for more than one tube). _____ Ohms

How is control grid bias voltage obtained? Resistor Supply Combination _____

Is grid bias adjustable? _____

What is value of grid resistor, if used; (Note if for more than one tube). _____ Ohms

If pulsed service: duty cycle _____; pulse width _____ Microsec.

Was plate voltage on at time of failure? _____ Was excitation off tube at time of failure? _____

Was stage being adjusted at time of failure? _____ If so what were conditions? _____

Part of Tube Air or Water Cooled	Temp. (°C.)		Air or Water Flow		Pressure Drop Across Tube Air: inches of H ₂ O or Water. <small>pounds square inches</small>
	Inlet	Outlet	cubic feet minute	or gallons minute	

Describe what happened at time of failure _____

Name of Company or Person owning tube (Please Print) _____

Address _____

Date _____ Signature _____

NO TUBE CAN BE CONSIDERED FOR ADJUSTMENT UNLESS THIS FORM HAS BEEN COMPLETED AND RETURNED WITH TUBE

* WARNING *

TRANSMITTERS CONTAIN VOLTAGES THAT CAN KILL. ALWAYS DE-ENERGIZE THE TRANSMITTER BY SHUTTING THE POWER OFF AT THE WALL DISCONNECT AND SHORTING THE HIGH VOLTAGE FILTER CAPACITORS WITH THE GROUNDING STICK BEFORE ATTEMPTING ANY MAINTENANCE. IT IS SUGGESTED THAT THE GROUNDING STICK BE LEFT ACROSS THE HIGH VOLTAGE SUPPLY WHILE WORK IS BEING DONE. DO NOT UNDER ANY CIRCUMSTANCES JUMPER ANY OF THE SAFETY INTERLOCK LOCK SWITCHES. IT IS ALSO HIGHLY RECOMMENDED THAT NO ONE PERSON PERFORM MAINTENANCE ON THE TRANSMITTER WITHOUT A SAFETY PERSON AVAILABLE.

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SECTION 1

GENERAL INFORMATION

1-1 INTRODUCTION

This manual contains information for installation, operation and maintenance of the QEI model FMQ-3500 Broadcast Transmitter. This transmitter is designed for FM service in the 87.9 to 107.9 MHz band and is FCC and Canadian DOC approved for operation from 1000 to 3750 watts output.

1-2 PHYSICAL DESCRIPTION

The transmitter is housed in a single 23" wide by 30" deep by 76" high steel cabinet. Metering, control, and indicator functions are contained in a tilt out panel mounted at normal reading level for ease of operation. The Meter Panel also contains the Fault Detect circuitry and the Automatic Power Control circuitry. The Meter Panel also contains the microprocessor diagnostic and remote control circuits if the transmitter is equipped with the O1 option.

The solid state IPA is accessible through a hinged panel located below the Meter Panel. The transmitter uses only one tube, a 3CX3000A7 ceramic triode in grounded grid configuration. Access to the PA and high voltage components is through the rear door.

The transmitter uses easily replaceable disposable air filters. The cabinet is maintained at a positive air pressure to prevent the intrusion of dust and dirt thus reducing the need for maintenance.

Approximately 17" of standard 19" rack space and a 120 volt outlet strip are provided above the Meter Panel. The exciter is normally mounted in this space and requires 5 and 1/4". The remainder of this space may be used to mount your STL receiver, stereo generator, etc. The positive pressure fan provides enough airflow to maintain this area between 5 and 10 degrees C above ambient.

1-3 ELECTRICAL DESCRIPTION

The transmitter requires a single phase power source of 208 to 240 Vac at 60 Hz (50 Hz optional). The RF section consists of an exciter (QEI model 675 or 695), a 250 watt solid state IPA, and a single 3CX3000A7 ceramic triode in a grounded grid configuration for the PA. The RF harmonic filter and VSWR bridge are internal to the unit. RF output is via a 1 and 5/8" EIA flanged connector.

All control functions are operated from a 24 volt power supply for safety and convenience. Provision for accepting remote control functions and supplying remote readings are included as standard equipment. VSWR overload protection is also included as well as internal IPA and PA protection.

Automatic Power Control is provided which maintains the DC power input to the PA constant. This not only maintains power output by the FCC indirect method but also provides additional PA protection from VSWR effects.

The O1 option provides microprocessor diagnostics in addition to a built in remote control that may be operated either via Telco or STL/SCA link. See Section 8 for details.

1-4 MECHANICAL SPECIFICATIONS

Cabinet Dimensions...76"(193cm)H x 23"(58.5cm)W x 30"(76.2)D
Weight (approx).....800 lbs (364 Kg)
Floor Loading.....160 lbs/sq ft (817 Kg/sq m)
Ambient Temperature.....32 to 120 deg F (0 to 50 deg C)
Altitude.....10000 Ft (3050 m)
Humidity.....95% max (non-condensing)

1-5 ELECTRICAL SPECIFICATIONS

Frequency Range.....87.9 to 107.9 MHz
Type of Emission.....180F3 or 300F9
AM Noise.....greater than -55 dBc
Incidental (Synchronous) AM.....greater than -50 dBc
Power Output.....1000 to 3750 watts
RF Output Impedance.....50 ohms (1 and 5/8" EIA Flanged)
VSWR (output > 1500W).....1.6 : 1
VSWR (output < 1500W).....Infinite
Harmonic and Spurious outputs.....greater than -80 dBc
Primary Power Source.....208/240 Vac single phase
50 amp service
Power Consumption (3500 W output).....6.8 Kw
Tube Type.....3CX3000A7 (Eimac)

See appropriate Exciter manual (675 or 695) for exciter dependent specifications, e.g. distortion, noise, separation, frequency stability, etc.

1-6 EQUIPMENT IDENTIFICATION

The transmitter is identified by a Model Number and Serial Number located below the Meter Panel behind the lower front door. All correspondence to your sales representative or the factory should reference the complete Model and Serial Numbers.

1-7 OPTIONS

The transmitter is available as a Model FMQ-3500/01. This option includes microprocessor based diagnostics and built in remote control via the ARC-27 Studio Control Unit which is included.

SECTION 2
INSTALLATION

2-1 INITIAL INSPECTION

Carefully inspect the transmitter after receipt for any shipping damage. This inspection should include the inside of the PA box. Check the shipping documents against the received material for completeness. Notify the shipping carrier and QEI immediately of any damaged or missing material.

2-2 ENVIRONMENTAL REQUIREMENTS

The transmitter must be located in a clean, dry environment. Adequate external heat must be provided to keep the temperature above 32 deg F (0 deg C). Sufficient ventilation and/or air conditioning should be provided to keep the temperature below 104 deg F (40 deg C). The maximum altitude must be less than 10000 Ft (3050 m).

The transmitter exhausts approximately 12,000 BtuH while operating at an RF output of 3500 Watts. Most of this heat is exhausted from the 4" stack at the top. If this air is ducted out of the building, it may be necessary to provide an exhaust fan in the duct so as not to restrict the air flow through the PA tube. It will also be necessary to provide an air inlet to the building to "make up" for the air exhausted by the blower.

* WARNING *

DAMAGE CAUSED TO TRANSMITTERS BY INADEQUATE AIR FLOW IS NOT COVERED BY WARRANTY. KEEP FILTERS AND SOCKET SCREENS CLEAN. DO NOT UNDER ANY CIRCUMSTANCES CHEAT THE AIR FLOW INTERLOCKS. DO NOT RESTRICT THE EXHAUST IN ANY WAY. DO NOT VENT THE EXHAUST WHERE WIND, ETC. CAN CAUSE BACK PRESSURE.

2-3 MECHANICAL REQUIREMENTS

The transmitter must be placed on a sturdy floor which can safely support the weight of the unit. Since the tube manufacturer specifies that the tube be operated in a vertical position, it is suggested that the unit be reasonably plumb and level. At least 24" (60 cm) should be provided above the unit to allow for the exhaust heat to dissipate.

Adequate space should be provided at the front and rear of the transmitter for ease of access for service. A minimum of 36" (1 m) is suggested. In addition, adequate lighting should be provided and sufficient grounded three prong wall outlets should be available for test equipment, soldering irons, etc. If the transmitter has the O1 option, a telephone and modem will allow direct communications between the transmitter and a computer terminal.

2-4 ELECTRICAL REQUIREMENTS

The transmitter requires a 208 to 240 Vac single phase primary power supply capable of 50 amperes. The power must be routed through a wall disconnect switch or breaker which will remove all power from the transmitter when opened. THIS IS AN IMPORTANT SAFETY REQUIREMENT.

Since the transmitter has an auxilliary power strip inside to provide 120 Vac for the exciter and other peripheral equipment, a separate 15 ampere 120Vac circuit is also required.

* NOTE *

THIS POWER STRIP IS INTENDED ONLY TO SUPPLY EQUIPMENT SUCH AS STL RECEIVERS AND STEREO GENERATORS WHICH ARE MOUNTED IN THE SPARE RACK SPACE PROVIDED IN THE TRANSMITTER.

It is the responsibility of the customer to check and adhere to all local and national electrical codes regulating the installation of transmitting equipment.

2-5 SYSTEM CONNECTIONS

A. Primary Power

* NOTE *

HOLES ARE PROVIDED AT THE TOP REAR OF THE TRANSMITTER ON THE DOOR HINGE SIDE FOR PRIMARY POWER CABLE ACCESS, TB1 AND TB5 ARE LOCATED UNDER A COVER BELOW THESE HOLES.

1. Connect a suitable 208 to 240 volt 60 Hz power source to TB1. There are three terminals on TB1. The center terminal must be grounded. The two outside terminals are connected to the hot supply lines.
2. Connect a suitable 120 volt 60 Hz power source to TB5. There are three terminals on TB5. The top terminal is for the hot (black) lead. The center terminal is for the ground (green) lead. The bottom terminal is for the neutral (white) lead.
3. Measure the 208/240 volt line. Change the wires on A1T1 (HV Xfmr), A1T2 (IPA Xfmr), [NOTE: DO NOT MOVE THE WHITE/RED AND WHITE/BLACK WIRES ON A1T2. THE RED AND BLACK WIRES SHOULD BE MOVED TO CHANGE TAPS.] and A5T1 (PA Filament Xfmr--located in PA box) to the taps which most closely approximate the operating line voltage.

LINE VOLTAGE	TAP
198	208 and -10
208	208 and 0
218	208 and +10
230	240 and -10
240	240 and 0
250	240 and +10

4. Connect at least a 3" wide copper strap from the transmitter cabinet to a properly built station ground system. This ground system is necessary for consistent, reliable operation and should be custom designed and installed by an experienced consultant familiar with the entire installation.

B. RF Output

1. Connect a 1 and 5/8 transmission line to the RF output connector on top of the transmitter. BE SURE THE LINE AND ANTENNA VSWR ARE WITHIN SPECIFICATION AND THAT ALL BULLETS ARE IN PLACE. Verify that the line is clean and dry and that all connections are tight. Provide strain relief so that no excess force is placed on the transmitter output connector. Position the line so that rain or condensation cannot run down the outside of the line and collect on the top of the transmitter.

C. Audio (Composite Stereo) and SCA

1. Refer to the Exciter Manual QEI 675 or 695 for appropriate information.

D. Remote Control (external--does not apply to 01 option)

1. Provide normally closed contacts from TB6-17 (REMOTE FIL OFF) and TB6-15 (REMOTE DC OFF) to ground. Momentarily opening these contacts will either turn the HV DC off (TB6-15) or both DC and PA filament off (TB6-17).
2. Provide normally open contacts to ground from TB6-16 (REMOTE FIL ON), TB6-14 (REMOTE DC ON), TB6-18 (REMOTE RESET), TB6-8 (REMOTE RAISE), and TB6-7 (REMOTE LOWER). Momentarily close these contacts to cause the desired function.
3. PA Plate Voltage sample is available at TB6-12 (+Ep) and TB6-11 (-Ep). TB6-11 is connected to ground.
4. PA Plate Current sample is available at TB6-10 (+Ip) and TB6-9 (-Ip). NOTE: This sample is NOT referenced to ground.
5. RF output sample is available at TB6-5 (FWD PWR)
6. Reflected RF sample is available at TB6-6 (REV PWR)
7. Connect a normally open "fail safe" contact across the AUX interlock from TB6-19 to TB6-20. This contact should close when the remote control link is operational.

NUMERICAL SUB-ASSEMBLY LISTING

<u>SUB-ASSEMBLY #</u>	<u>DESCRIPTION</u>	<u>DRAWING #</u>
A1A	Series Overload Board	350310
A2	Control Box Assy. Conn. Diagram	350202
A2A2	Interface	350302
A2A3	Fault Detector	350301
A2A5	Multimeter Switch	350305
A2A6	IPA Current Switch	350306
A2A7	Voltmeter Switch	350304
A2A8	Final Meter Assy.	350333
A2A9	Control Switch	350314
A2A10	Fault Annunciator	350315
A3A2	Splitter	350331
A3A2B	Power Control	350330
A3A3	Combiner Module (Schematic)	350334
A3A3	Combiner Module (Pictorial)	350215
A3A4	250 W. Broadband Module	350327
A4	PA Input Tuning Assy.	350307
A5	PA Assy.	350324
A6	DC & LPF Assy.	350313
A7	Relay & Breaker Panel (Pictorial)	350218
A7	Relay & Breaker Panel (Schematic)	350336
	Simplified Schematic Diagram	350337

Remote Control Interface (TB6) Connections

TB6-1	Twr. Light	(01 or 02 option only)
2	Amb. Light	(01 or 02 option only)
3	Fire	(01 or 02 option only)
4	Security	(01 or 02 option only)
5	RF Out FWD	Sample
6	RF Out REV	Sample
7	REM Lower	(Normal open to ground)
8	REM Raise	(Normal open to ground)
9	PA PLATE Current (Ip+)	**NOT REFERENCED TO GROUND**
10	PA PLATE Current (Ip-)	**NOT REFERENCED TO GROUND**
11	Ground	
12	PA PLATE Voltage	Sample
13		
14	REM HV ON	(Normal open to ground)
15	REM HV OFF	(Normal close to ground)
16	REM FIL ON	(Normal open to ground)
17	REM FIL OFF	(Normal close to ground)
18	REM RESET	(Normal open to ground)
19	AUX INTERLOCK	(Normal close from 19
20	AUX INTERLOCK	to 20 for operation)

E. Remote Control (01 option)

1. Telco -- Connect a dedicated voice metering grade telephone line from the ARC-27 at the control point to TB7-1 and TB7-3. Connect the shield ground if used to TB7-2.
2. STL/SCA--Connect a coaxial cable from the MUX (subcarrier) output of the composite STL receiver to A2J5 (MUX IN). Verify that a coaxial cable is connected between A2J6 (SCA OUT) and an SCA IN jack on the exciter.

SECTION 3

OPERATION

3-1 CONTROLS AND INDICATORS

A. Meter Panel Group

1. MULTIMETER switch and meter--4 position push button is used to select the function displayed on meter. The color of the pushbutton when depressed corresponds to the scale color used on the meter for that function.

AC VOLTS-LINE.....208/240 primary power

AC VOLTS-PA FIL.....PA Filament voltage

DC VOLTS-+24.....24 volt control power

DC VOLTS-+5.....5 volt logic power

Meter should indicate within normal tolerance marks for each function.

2. IPA METERING switch and meter--9 function push button is used to display various IPA parameters. The Ic button is used to enable the lower 4 buttons which select the current function to be displayed. The color of the pushbutton when depressed corresponds to the scale color used on the meter for that function.

Vcc.....IPA collector supply voltage

Ic.....IPA current functions

TOTAL.....Total IPA current (all stages)

Q1.....IPA Module A Current

Q2.....NOT USED IN FMQ-3500

Q3.....NOT USED IN FMQ-3500

RF IN-FWD.....RF drive to IPA input

RF IN-REV.....RF reflected from IPA input

RF OUT-FWD.....RF output from IPA to PA input

RF OUT-REV.....RF reflected from PA input

3. PA METERING/CONTROL

- a. PLATE VOLTAGE meter--displays PA plate voltage
- b. PLATE CURRENT meter--displays PA plate current
- c. GRID CURRENT/RF OUTPUT meter--used in conjunction with METER switch to display the following:

REV.....RF reflected from load (antenna)

GRID.....PA grid current

FWD.....RF output to load (antenna)

* NOTE *

THE SCREWDRIVER ADJUSTMENT IMMEDIATELY BELOW THE [METER] SWITCH SHOULD BE USED TO SET THE METER TO 100% IN THE [RF OUTPUT--FWD] POSITION WHEN THE TRANSMITTER IS OPERATING AT THE LICENSED TRANSMITTER POWER OUTPUT (TPO) FOR THE STATION.

- d. RF OUT control--3 position momentary (center OFF) switch used to RAISE or LOWER the RF output power

4. FAULT ANNUNCIATOR--Indicator panel and lamp used to indicate that a fault has occurred. The panel and lamp will remain lit until the RESET switch is depressed even if the transmitter output was restored via a remote control. This feature allows maintenance personnel to determine the cause of an outage without an immediate trip to the transmitter site.

5. STATUS--Lamps and LEDs which indicate the following when illuminated:

LINE READY.....Primary power is available

FIL ON.....Filament power is applied to PA

H.V. READY.....Filament 30 second time out is finished and all interlocks closed

LOW POWER.....Transmitter is in low RF output mode

H.V. ON.....High Voltage power supply is on

INTERLOCK group indicates which safety interlock is open as follows:

AIR/TEMP.....Rear door fan or PA blower has insufficient air flow OR ground-stick not in hold down clamps
METER.....Meter Panel not in place
FRONT.....Lower front panel not in place
REAR.....Rear door open
PA.....PA rear cover not in place
AUX.....Aux interlock terminals TB6-19 and TB6-20 not shorted

6. LOCAL CONTROL--pushbutton switches used to control the operation of the transmitter. The buttons perform the following functions when depressed:

a. OFF.....Turns transmitter off. Removes High Voltage and Filament power from the PA and collector voltage from the IPA. Does not remove +24, +5, +12 or -12 from control and metering circuits.

* NOTE *

THE [OFF] BUTTON WILL NOT TURN THE TRANSMITTER OFF UNLESS THE [LOCAL/REMOTE] SWITCH IS IN LOCAL.

b. FIL ON-HV OFF....Applies filament power to the PA without energizing the High Voltage supply.
c. RF ON-LOW.....Turns on High Voltage supply and places transmitter in the low RF output mode.
d. RF ON-HIGH.....Turns on High Voltage supply and places transmitter in the high (normal) RF output mode.

* NOTE *

THE [RF ON--HIGH] BUTTON MUST BE DEPRESSED TO PLACE THE TRANSMITTER IN HIGH RF OUTPUT MODE EVEN IF [LOCAL/REMOTE] SWITCH IS IN REMOTE POSITION.

e. LOCAL/REMOTE.....Places the transmitter in either local or remote operation. REMOTE position disables local functions except as outlined above.

7. AUTO REMOTE CONTROL--This grouping is supplied only with the 01 option. See Section 8 for details.

B. PA TUNING PANEL

1. TUNE and LOAD controls--3 position momentary (center OFF) switches used to adjust PA tuning networks for optimum output
2. PA INPUT TUNE and LOAD--Controls used to tune PA input circuitry for optimum transfer of power from IPA

C. Lower Front Panel

1. FILAMENT ADJUST--Control used to maintain filament voltage to PA tube within tube manufacturer's specifications.
2. FILAMENT TIME--Meter which totalizes hours that power has been applied to PA tube filament.
3. HIGH VOLTAGE, +45, and FILAMENT Circuit Breakers--Protective devices for power supplies. The control power supply is fed through the +45 breaker along with the IPA collector supply.

* WARNING *

EVEN IF THESE CIRCUIT BREAKERS ARE OFF, PRIMARY POWER IS STILL WITHIN THE TRANSMITTER CABINET. THE CUSTOMER MUST SUPPLY A WALL DISCONNECT SWITCH TO COMPLETELY REMOVE ALL POWER FROM THE CABINET.

3-2 INITIAL OPERATION

- A. Confirm that primary power is disconnected from the transmitter. (Customer installed Wall Disconnect OFF)

* WARNING *

THIS TRANSMITTER USES VOLTAGES THAT CAN KILL. DO NOT ATTEMPT ANY ADJUSTMENTS OR MAINTENANCE THE TRANSMITTER WITHOUT FIRST REMOVING PRIMARY POWER BY OPENING THE WALL DISCONNECT. USE THE GROUNDING STICK TO DISCHARGE THE HIGH VOLTAGE FILTER CAPACITORS EVERY TIME YOU ENTER THE TRANSMITTER. IT IS SUGGESTED THAT THE GROUNDING STICK BE LEFT ACROSS THE HIGH VOLTAGE SUPPLY WHENEVER WORK IS BEING PERFORMED.

B. Installation Checkout

1. Recheck all electrical and mechanical details for conformance to requirements set out in Section 2.
2. Recheck that electrical connections are properly made and tight.
3. Recheck that all transformer taps are set for the station power line voltage.
4. Check that the PA tube is firmly seated in its socket.
5. Check that all access panels and doors are closed and that all PA box fasteners are secure. Verify that the AUX interlock(TB6-19 to TB6-20) is shorted.

C. Initial Turn On Procedure

* CAUTION *

IT IS PRESUMED THAT THE TRANSMITTER IS TO BE OPERATED ON THE FREQUENCY AND AT THE POWER LEVEL FOR WHICH IT WAS ALIGNED AT THE FACTORY. DO NOT ATTEMPT TO OPERATE THE TRANSMITTER AT A DIFFERENT FREQUENCY OR POWER LEVEL WITHOUT FIRST CONSULTING QEI CORPORATION. WARRANTY IS VOIDED IF THIS INSTRUCTION IS NOT FOLLOWED.

1. Place the following switches and controls in the indicated position:
 - a. LOCAL/REMOTE pushbutton.....LOCAL
 - b. LOCAL CONTROL pushbutton.....OFF
 - c. MULTIMETER pushbutton.....LINE
 - d. IPA METERING pushbutton.....Vcc
 - e. PA METERING/CONTROL-METER switch....FWD
 - f. Exciter POWER switch.....OFF
 - g. Exciter RF ADJ control.....MIN (Full CCW)
 - h. MAIN circuit breaker.....ON
 - i. +45 circuit breaker.....ON
 - j. FILAMENT circuit breaker.....ON
2. Apply Primary power to the transmitter. (Turn Wall Disconnects for 208/240 Vac and 120 Vac ON). The green LINE READY STATUS lamp will be illuminated.
3. Verify that MULTIMETER reads proper line voltage. Use MULTIMETER switch to verify +24 and +5 supplies. Place MULTIMETER switch in AC VOLTS-PA FIL position
4. Depress LOCAL CONTROL--FIL ON pushbutton. Fan and PA blower will start, AIR/TEMP interlock LED will extinguish, and yellow FIL ON STATUS lamp will illuminate.
5. Use MULTIMETER to verify that PA Filament Voltage is 7.5 Vac. Use FILAMENT ADJUST control if necessary.
6. The PA filament requires a warm up time of approximately 30 seconds. After this time has elapsed, the blue H.V. READY STATUS lamp will light.
7. Depress LOCAL CONTROL--RF ON-HIGH pushbutton.
8. Verify that PLATE VOLTAGE meter reads approximately 3800 volts and that PLATE CURRENT meter reads approximately 0.2 to 0.3 amps. (NOTE: 3000 volts if transmitter is to run at less than 2500 watts.)

9. Verify that the IPA Collector supply is below 49 volts using the IPA METERING meter. Check that the IPA is not drawing any current at this time by depressing the Ic and TOTAL pushbuttons. Depress the IPA METERING--RF OUT-REV pushbutton.
10. Hold PA METERING/CONTROL--RF OUT switch in RAISE position for 30 seconds.
11. Turn Exciter POWER on and wait a few seconds until Exciter AFC locks. Rotate Exciter PWR ADJ control slowly CW while watching the PA RF OUTPUT meter, the PA PLATE CURRENT Meter, and the IPA METERING meter (IPA RF OUT-REV position). NOTE: DO NOT EXCEED 1.5 AMPS PLATE CURRENT. RF output of transmitter should increase as Exciter power is increased. Use the PA INPUT TUNE and LOAD controls as required to null the indication on the IPA METERING meter. Use PA OUTPUT TUNE and LOAD controls as required to peak the indication on the PA RF OUTPUT meter. DO NOT EXCEED 110% ON THE PA RF OUTPUT METER. Reduce Exciter output if necessary.
12. Depress LOCAL CONTROL--RF ON-LOW pushbutton. RF output should momentarily go to zero and then ramp up to the low power level.
13. Depress LOCAL CONTROL--RF ON HIGH pushbutton. RF output should momentarily go to zero and then ramp up to the high power level.
14. Determine the DC Plate Power Input to the PA required to provide the licensed transmitter power output (TPO) for the station by dividing the TPO by the Efficiency Factor. This factor is determined from the chart that was supplied with the transmitter.
15. Adjust the Exciter output until the product of the Plate Voltages times the Plate Current equals the DC Plate Power Input required.
16. Use PA OUTPUT TUNE and LOAD controls as required to peak the indication on the PA RF OUTPUT meter.
17. Repeat steps 15 & 16 until no further improvement is noted.
18. Set the PA METERING/CONTROL--RF OUTPUT meter to 100% using the screwdriver adjustment immediately below the PA METER switch.
19. Adjust the Exciter output until the PA METERING/CONTROL--RF OUTPUT meter reads 110%.
20. Hold the PA METERING/CONTROL--RF OUT switch in LOWER position until the RF output is 100%. Leave the Exciter output as set in step 19. These steps (19 and 20) set up the Automatic Power Control.

3-3 NORMAL OPERATION

A. Local Control

1. Place LOCAL/REMOTE switch in LOCAL position
2. Depress LOCAL CONTROL--RF ON-HIGH pushbutton. transmitter will automatically cycle through Filament time delay to High Voltage on.
3. Use PA METERING/CONTROL RF OUT switch to RAISE or LOWER the RF output power. This switch changes the set point of the Automatic Power Control.
4. Depress LOCAL CONTROL--OFF pushbutton to turn the transmitter off.

B. Remote Control

1. Place LOCAL/REMOTE switch in REMOTE position.
2. Depress LOCAL CONTROL--RF ON-HIGH pushbutton.
3. Use Remote Control functions as required to control transmitter.

C. General Operating Practice

1. Keep a regular log of the various meter readings to assist in maintenance and troubleshooting.
2. Occasionally check the PA Filament Voltage and PA Input and Output Tuning to insure optimum operation.
3. Since the PA tube (3CX3000A7) has a thoriated tungsten filament, it is recommended that the filament be shut off whenever the transmitter is to be off for more than 15 minutes. This type of filament is gradually losing emission as long as it is hot regardless of whether high voltage is applied.

D. Typical Meter Readings Table

The following readings are typical. Variations of 15 % can be expected.

RF POWER OUTPUT	* 1500 watts	* 2500 watts	* 3500 watts
* PA PLATE VOLTAGE	* 3000 volts	* 2900 volts	* 3800 volts
* PA PLATE CURRENT	* 1.10 amps	* 1.44 amps	* 1.30 amps
* PA GRID CURRENT	* 0.10 amps	* 0.17 amps	* 0.27 amps
* IPA Vcc	* 46 volts	* 45 volts	* 45 volts
* IPA Ic TOTAL	* 4.40 amps	* 5.70 amps	* 7.50 amps
* IPA Ic Qd	* 0.30 amps	* 0.50 amps	* 0.70 amps
* IPA Ic Q1	* 2.10 amps	* 2.60 amps	* 3.40 amps
* IPA Ic Q2	* 2.10 amps	* 2.60 amps	* 3.40 amps
* IPA RF IN--REV	* < 6	* < 6	* < 6
* IPA RF IN--FWD	* 80	* 80	* 80
* IPA RF OUT--REV	* < 5	* < 5	* < 5
* IPA RF OUT--FWD	* 50	* 70	* 85

58.53
eff

58.67
eff

$$1500 = 3000 \times 1.1 \times \text{eff}$$

$$\text{eff} = \frac{1500}{3000 \times 1.1} = \frac{1500}{3300} = .45$$

SECTION 4

THEORY OF OPERATION

4-1 RF GENERATION

RF originates in the Exciter (QEI Type 675 or 695). This unit accepts the audio inputs, (mono, stereo, SCA) and produces a frequency modulated RF carrier within the range of 87.9 MHz to 107.9 MHz. The power level of this carrier is variable from 5 to 20 watts. (For information on the Exciter units, refer to their Instruction Books.)

Approximately 10 to 15 watts of RF from the Exciter is fed to A3AJ1 on the IPA Assembly A3. The signal path within this assembly is through a fixed attenuator pad, the IPA Input VSWR bridge, and a voltage controlled attenuator. The voltage controlled attenuator is used to accomplish both RF output power control and IPA protection. The RF output at A3AJ3 is fed to a solid state 250 watt module A3BJ1. The RF output of this module (A3BJ2) is fed to a directional coupler located in the A3E module.

The RF output of the IPA is fed to A4J1 on the Tuner Assembly A4. This assembly along with its output cable (A4J2 to A5J1) is used to match the 50 ohm output impedance of the IPA to the PA tube cathode. DO NOT CHANGE THE LENGTH OF THE CABLE FROM A4J2 TO A5J1. Approximately 160 to 180 watts is required to drive the PA tube.

The PA consists of a 3CX3000A7 ceramic triode and its matching networks arranged in a grounded grid configuration. RF drive is applied to the tube cathode (filament) via A5J1. RF output is taken from the plate and fed via matching networks to Low Pass Filter and Directional Coupler Assembly A6. The transmission line connection is at A6J1. A6J2 is the Forward Power sample, A6J4 is the Reflected Power sample, and A6J3 is the RF sample for the modulation monitor.

4-2 POWER SUPPLIES

A. High Voltage (PA Plate) Supply

Primary power is supplied to TB1. Power is then routed through circuit breaker A1CB1 (HIGH VOLTAGE), and contactor A1K1 to the primary of the high voltage transformer A1T1. The high voltage AC is rectified by diode stacks A1CR1a, A1CR1B, A1CR2a, and A1CR2b to produce approximately 4000 volts DC. The DC is filtered by A1L1, A1C1, A1L2, and A1C2. A1R1, A1R2, and A1R3 are the high voltage bleeder resistors.

* WARNING *

IF ANY OF THESE BLEEDER RESISTORS FAIL, THEY MUST BE REPLACED IMMEDIATELY BY AN EXACT REPLACEMENT. AN OPEN BLEEDER IS EXTREMELY DANGEROUS BECAUSE THE FILTER CAPACITORS CAN HOLD A LETHAL CHARGE FOR WEEKS UNDER CERTAIN CONDITIONS EVEN AFTER PRIMARY POWER HAS BEEN DISCONNECTED. DO NOT OPERATE THE TRANSMITTER WITH AN OPEN BLEEDER--ALWAYS USE THE GROUNDING STICK EVERY TIME YOU ENTER THE TRANSMITTER CABINET.

Resistors A1R4, A1R5, and A1R7 are voltage metering sample dividers. A1R13 is the plate current meter sample resistor and A1R14 is the grid current meter sample resistor. A1K2 and A1K3 are the plate and grid overload relays respectively. Since the high voltage return lead is returned to ground through the grid current sampling resistors, diode pair A1CR5 is included to prevent the return lead from moving more than + or - 7.5 volts off ground under fault conditions. The 90 volt spark gap provides safety back up for A1CR5.

B. +45 volt (IPA Collector) Power Supply

Primary Power is supplied through circuit breaker A1CB2 (+45) to A1T2. The low voltage AC from A1T2 is rectified by diode bridge A1CR4 and filtered by A1L3 and A1C5 through A1C8. A1R6 is the bleeder resistor. Approximately +45 volts of filtered DC is fed via relay A1K1 and metering shunts A1R18 through A1R21 to the IPA assembly A3.

C. Filament Power Supply

Primary Power is supplied through circuit breaker A1CB3, relay A1K5 and rheostat A1R17 to the filament transformer A5T1 which is located in the PA box. (Draw.#350311) A1R17 is the FILAMENT ADJUST control. A5T1 is a specially designed transformer which limits the filament cold inrush current to a safe value thereby extending tube life. Replace only with an exact duplicate.

D. Control Power Supply

The Control Power Supply provides +24 volt to operate the relay ladder, +12 and -12 for metering and fault detect amplifiers and comparators, and +5 for the fault detect logic circuitry. These power supplies are contained in the Meter Panel subassembly. Primary power for these supplies is fed through the +45 circuit breaker and then through 2 line fuses. The fuses are on the power Front Panel.

E. Cooling

The PA tube is cooled by a high pressure squirrel cage blower mounted to the PA box. Positive cabinet pressure and auxiliary cooling is accomplished by a fan mounted in the rear of the transmitter. Power for cooling is supplied through HIGH VOLTAGE circuit breaker, 2 line fuses (located on the Lower Front Panel), and relay A1K10.

F. Automatic Power Control

PA Plate voltage and Plate current samples are fed to subassembly A3A1 (Dwg. 350303). These samples are multiplied by a four quadrant multiplier and compared to a reference voltage obtained from a motor driven potentiometer. The output voltage produced (0 to 2 volts) is used to drive the voltage controlled RF attenuator in the A3 IPA assembly. Therefore, the DC Plate Power Input to the PA is held constant. This not only satisfies the FCC indirect power computation but also prevents VSWR effects from causing possible overdrive conditions.

4-3 CONTROL LADDER

A. Sequence

1. Depress LOCAL CONTROL--FIL ON or RF ON-HIGH
2. A1K8 energizes which in turn energizes A1K10
3. A1K10 turns on fan and PA blower
4. If air flow is sufficient, vane switches A1S1 and A1S2 close.
5. If the grounding stick is in place, (S3) A1K5 is energized through A1S1 and A1S2. A1K5 applies power to the PA tube filament and turns on the FIL ON-HV OFF lamp.
6. At this time, A1K9 (30 second time delay relay) is also energized.
7. After A1K9 times out, the H.V. READY lamp will light provided all interlocks are closed and A1K7 relay is energized (no faults detected).
8. The sequence stops at this point if FIL ON was depressed. If RF ON-HIGH was depressed, the sequence automatically continues.
9. A1K6 energizes which energizes A1K1 (High Voltage Supply) and A1K4 (+45 IPA Collector Supply).
10. If there are no IPA or PA faults detected, Exciter RF drive is available, and the +45 IPA collector supply is less than +49 volts, the RF drive will ramp up to full output within a few seconds.

B. Overload Protection

Overload sensing is accomplished by circuitry contained within the A2 Meter Panel Assembly on the A2A2 Interface and the A2A3 Fault Detector Circuit boards. Operational amplifiers are used to buffer the various samples and the outputs of these amplifiers are compared with reference voltages to determine if a fault has occurred. Once a fault has been detected, the logic circuits must be reset manually locally or remotely. The FAULT ANNUNCIATOR panel will show the type and location of the fault. This indication will remain until reset at the transmitter even if the fault itself has been reset remotely.

C. Fault Table

FAULT	TRIP POINT	ACTION
* IPA OVERCURRENT	* 13 amps/Module	* HV off--RF off *
* IPA OVERTEMP	* 100 degrees C	* HV off--RF off *
* IPA OVERVOLTAGE	* 53 volts	* RF off *
* IPA OVERVOLTAGE	* 58 volts	* HV off--RF off *
* IPA VSWR	* 3:1	* RF LOW POWER *
* PA GRID OVERCURRENT	* 0.5 amps	* HV off--RF off *
* PA PLATE OVERCURRENT	* 1.6 amps	* HV off--RF off *
* OVERTEMP (PA Stack)	* 120 degrees C	* HV off--RF off *
* OVERTEMP (Cabinet)	* 60 degrees C	* HV off--RF off *
* OUTPUT VSWR	* 1.6:1	* RF LOW POWER *

SECTION 5
MAINTENANCE

* WARNING *

TRANSMITTERS CONTAIN VOLTAGES THAT CAN KILL. ALWAYS DE-ENERGIZE THE TRANSMITTER BY SHUTTING THE POWER OFF AT THE WALL DISCONNECT AND SHORTING THE HIGH VOLTAGE FILTER CAPACITORS WITH THE GROUNDING STICK BEFORE ATTEMPTING ANY MAINTENANCE. IT IS SUGGESTED THAT THE GROUNDING STICK BE LEFT ACROSS THE HIGH VOLTAGE SUPPLY WHILE WORK IS BEING DONE. DO NOT UNDER ANY CIRCUMSTANCES JUMPER ANY OF THE SAFETY INTER-LOCK SWITCHES. IT IS ALSO HIGHLY RECOMMENDED THAT NO ONE PERFORM MAINTENANCE ON THE TRANSMITTER WITHOUT A SAFETY PERSON AVAILABLE.

5-1 PREVENTIVE MAINTENANCE

- A. It is extremely important that the transmitter be kept clean and free from any accumulation of dust and lint. Positive pressure design reduces the need for cleaning but does not eliminate it. The following procedures should be accomplished at least MONTHLY but more often under extremely dusty conditions.
1. Change the disposable air filter. These filters are readily available 16" x 20" x 1" fiberglass units for furnace or air conditioning use.
 2. Inspect and clean interior of transmitter as required.
 3. Inspect fan blades and blower squirrel cage for accumulation of dust. Vacuum as required.
 4. Inspect the screen mesh in the PA box air outlet for accumulation of dust and lint. Vacuum as required.
 5. Inspect PA tube anode fins for accumulation of dust. Vacuum as required.
 6. Inspect all connections and components for evidence of rust, corrosion or discoloration due to overheating.

- B. Blower and fan motors have sealed bearings and require no further lubrication.

5-2 ACCESS TO COMPONENTS

- A. All components prefixed A1 are part of the transmitter main cabinet assembly. Most of these components are accessible through the rear door. See Pictorial Assembly Drawing 350204 for locations.
- B. All components prefixed A2 are part of the Meter Panel assembly. The Meter Panel tilts out from the front of the transmitter. The Meter Panel hinged rear cover can then be unscrewed for access to the inside. See Pictorial Assembly Drawing 350202 for detail.
- C. All components prefixed A3 are part of the IPA assembly. This unit is mounted behind the lower front door of the transmitter. Access to the inside of the A3 assembly is through the hinged front panel which is secured with quarter turn fasteners.
- D. All components prefixed A4 are part of the PA Tune/Load assembly. This unit is mounted on the front of the transmitter immediately below the Meter Panel.
- E. All components prefixed A5 are part of the PA Box assembly. This unit is mounted in the rear of the transmitter and is accessed through the rear door. The rear of the PA Box is removeable for service. It is secured by quarter turn fasteners.

* CAUTION *

THE PA BOX REAR COVER MUST BE IN PLACE AND ALL FASTENERS SECURE BEFORE ENERGIZING THE TRANSMITTER.

- F. The A6 assembly is the Harmonic Filter and Directional Coupler. It is mounted to the top of the PA Box.

5-3 TUBE REPLACEMENT

- A. Remove primary power from transmitter by opening wall disconnect.
- B. Open rear door and USE GROUNDING STICK TO DISCHARGE THE HIGH VOLTAGE FILTER CAPACITORS. LEAVE THE GROUNDING STICK ACROSS THE HIGH VOLTAGE SUPPLY.
- C. Remove the rear cover of the PA Box.
- D. Loosen the clamp around the PA tube.
- E. Remove the tube by pulling straight up. Tube may be "rocked" slightly from side to side to facilitate removal, however, DO NOT TWIST THE ASSEMBLY IN THE SOCKET.
- F. Carefully press the new tube straight into the socket. Verify that the tube connector flanges have "bottomed" against the socket.
- G. Tighten the clamp around the tube.
- H. Secure the PA Box rear cover, replace the grounding stick in its clamps, and close the rear door.
- I. Follow initial turn on procedure in Section 3-2

SECTION 6
PARTS LISTS

6-1 ORDERING INFORMATION

A. To order parts for the FMQ-3500 transmitter, write:

QEI Corporation
P.O. Box "D"
Williamstown, NJ 08094

or call:

1-609-728-2020

B. Provide the following information:

1. Station Call
2. Transmitter model and serial no.
3. QEI Part No. or manufacturers part no.
4. Shipping Address
5. Billing Address
6. Desired method of shipment

6-2 PARTS LISTS

A 1 TRANSMITTER ASSEMBLY

<u>REF. DES.</u>	<u>DESCRIPTION</u>	<u>QEI PART NO.</u>
C1, C2	Cap. Oil 4uf, 5KV	110-8046
C5 - C7	Cap.Elect.5000uf 75V	110-3508-75
C8	Cap. N.P. 60uf	110-3606
C10, C11	Cap.Oil 4uf 370 VAC	110-3405
C12, C13	Cap.Elect. 15uf 100V	110-3156-100
C14	Cap.Elect.500uf 50V	110-3507-50
C15	Cap.Elect. 4900uf 50V	110-3498
C16, C17	Cap.Elect. 5000uf 25V	110-3508-25
C18	Cap.Elect. 22000uf 16V	110-3239
C19 - C21	Cap.Elect. 100uf 25V	110-3107
C22, C23	Cap. Mica 1000pf	110-1102
CB1	Circuit Brkr, H.V. 60A	120-1060
CB2	Circuit Bkr.45V 10A	120-1010-2
CB3	Circuit Bkr. Fil.3A	120-1003
CR1,CR2,CR3,CR4	Diodes High Voltage	113-0103-3
CR5	Diodes High Voltage	113-0103
CR6	Diode,Br.Rec MDA-990-3	113-1990-3
CR7 - CR18	Diode,Sil.1N4001	113-04001
CR19 - CR21	Diode,Br.Rec.MDA-960-1	113-1960-1
CR22 - CR23	Diode,Zener, 12v	113-25242
K1	Relay, High Voltage	136-0009
K5	Relay, 3PDT	136-0012
K6 - K8	Relay, 4PDT	136-0003
K9	Relay, Time Delay	136-0015
K10	Relay, DPDT	136-0011
L1	Inductor, High Vol.	180-22218
L2	Inductor, High Vol.	180-22027
L3	Inductor 45V	180-22225
M1	Meter, Filiment Time	145-0013
R1 - R3	Resist. W.W.30K 200W.	166-0303
R4, R10	Resist. W.W.10M 1%	166-0106
R6	Resist. W.W.30 ohm 160W	166-0300
R5, R7	Resist. Film 100K 1%	165-1003
R16	Resist.Cathode Selected	
R17	Resist.Var.25 ohm 150W	167-0250
R18 - R21	Resist.WW.02 ohm 10W.1%	166-0R02-10
	CH. MTG>	
R22	Resist.Film 20K 1%	165-2002

<u>REF. DES.</u>	<u>DESCRIPTION</u>	<u>QEI PART NO.</u>
S1, S2	Switch, Interlock AIR	175-0023
S4 - S6	Switch, Interlock	175-0024
S3	Switch, Interlock Ground Stick	
T1	Trans., High Voltage	180-22217
T2	Trans., 45V	180-22224
T3	Trans. Control	180-3266
T4 - T6	Transformer Metering	180-3008
TB1	Term.Block 240 VAC	181-1100.2
TB4	Term.Block, Fuse	181-2489.2
TB5	Term.Block, 115 VAC	181-1100.2
TB6	Term.Board, Remote	181-0020
TB7	Term.Board, Telco	181-0006
U1	I.C.Volt.Reg.-12V LM320T-12	182-320T
U2	I.C.Volt.Reg.+12V LM340T-12	182-340T-12
U3	I.C.Volt.Reg. +5V LM323	182-323K
U4 - U6	I.C.Temp.Sensor AD590	182-0590

A1A OVERLOAD BOARD

<u>REF. DES.</u>	<u>DESCRIPTION</u>	<u>QEI PART NO.</u>
A1A	Circuit Board	100-821001A
A1A	Circuit Board	100-821001B
C1-C5	Cap., Cer., .01uf, 1KV	110-0103-K
K2, K3	Relay, DPDT	136-0010
L1, L2	Choke, Wideband	140-2008
R8, R9, R10	Res. W.W. 10 ohm 10W	166-0011
R11	Res. Film, 2.55K 1%	165-2551
R12	Res. Film, 4.99K, 1%	165-4991
R13, R14	Res. W.W. .5 ohm 10W 1%	166-00R5
R15, R16	Res. Var., 1K	RV4LAYS A102A

A2 CONTROL BOX ASSEMBLY

<u>REF.DES.</u>	<u>DESCRIPTION</u>	<u>QEI PART NO.</u>
B1	Motor, Raise/Lower	194-2M024
CR1 - CR6	Diode, LED Red	113-3000
DS1	Lamp, Cover, Green	192-0008
DS2, DS4, DS6	Lamp Cover, Amber	192-0007
DS3	Lamp Cover, Blue	192-0006
DS5	Lamp Cover, Red	192-0021
J1	Connector, 8 Pin	130-3003
J2 - J4	Connector, BNC	130-0001
J8	Connector, 37 pin	130-8037MR
J9	Connector, 37 pin	130-8037FR
J10	Connector, 10 pin	130-3004
J11	Connector, 17 pin	130-3029
M1	Meter, Voltmeter	145-0006
M2	Meter, Multimeter	145-0006
M3	Meter, Final Voltage	145-0006
M4	Meter, Final Current	145-0006
M5	Meter Rev/Grid/Fwd	145-0006
R1, R2	Res. Carb. 2.2K	RC20GF222J
R3	Res. Var., 20K 10 turn	200-0203
S1	Switch Reset	175-0031-F
S2	Switch, Tune	175-0016-F
S3	Switch, Load	175-0016-F
S4	Switch Raise/Lower	175-0016-F
S5	Switch Rev/Grid/Fwd	175-0014-F
XDS1 - XDS6	Socket, Lamp	192-0001

A2A2 INTERFACE ASSEMBLY

<u>REF. DES.</u>	<u>DESCRIPTION</u>	<u>QEI PART NO.</u>
A2A2	Circuit Board	100-T100020
C1 - C5, C21, C22	Cap. Mica 1000pf	110-1102
C6, C16-C20		
C23, C49	Cap. Tant. 1uf	110-3105T
C7 - C11	Cap. Cer. .01 uf	110-0103
C12, C14, C24-C36		
C38-C48	Cap. Cer. .1uf	110-0104
C13, C15	Cap. Elect. 100uf	110-3107
CR1	Diode, Zener, 5.6V	113-25232
CR2	Diode, Zener, 4.7V	113-25230
CR3, CR4	Diode, Silicon	113-04446
J101-J108		
J1A, J1B	Socket, 16 pin DIP	130-0316-1
L1 - L7	Choke, Wideband	140-2008
Q1 - Q5	Transistor, PNP 2N5401	160-05401
R1, R8, R22, R28	Res. Film, 2.49K 1%	165-2491
R3, R10, R17, R24,		
R30	Res. Film, 4.99K 1%	165-4991
R4 - R7	Res. Var. 1K	167-3102
R9, R16, R23, R29,		
R36, R38, R40, R41,		
R42, R44, R46, R103,		
R106, R114	Res. Film, 1.00K 1%	165-1001
R12, R19, R32, R51,		
R72, R82, R87, R91,		
R94, R98, R102, R108,		
R110	Res. Carb., 10K	RC20GF103J
R13, R20, R26, R33,		
R52, R54, R60, R62,		
R65, R66, R69, R70,		
R73, R74, R76, R78,		
R80	Res. Carb., 1K	RC20GF102J
R14, R21, R27, R34	Res. Film, 1.5K 1%	165-1501
R35, R37, R39,		
R47-R49, R56-R58,		
R68, R75, R77, R79, R84	Res. Film, 10K 1%	165-1002
R45	Res. Film, 20K 1%	165-2002
R50, R59, R116, R117	Res. Film, 499 ohm 1%	165-4990
R53, R55, R61, R63	Res. Carb., 12K	RC20GF123J
R64, R71	Res. Var., 10K	167-3103
R67	Res. Film, 5.11K 1%	165-5111
R81, R83, R92, R93,		
R99, R100, R109, R111	Res., Carb. 1Meg	RC20GF105J
R85	Res. Var., 250 ohm	167-3251
R86	Res. 221 ohm 1%	165-2210

<u>REF. DES.</u>	<u>DESCRIPTION</u>	<u>QEI PART NO.</u>
R88	Res., Carb. 56K	RC20GF563J
R89, R118	Res., Carb. 5.6K	RC20GF562J
R90, R97	Res., Carb. 100K	RC20GF104J
R96	Res., Carb. 220K	RC20GF224J
R101	Res. Film, 1.00K 1%	165-1001
R105	Res., Film, 2.67K 1%	165-2671
R107, R113	Res., Carb. 15K	RC20GF153J
R112	Res. Film, 2.0K 1%	165-2001
R2, R152	NOT USED	
R119, R120	Res., Carb., 10K 1/4	RC07GF103J
U1 - U9	IC, Dual Op Amp. NE532	182-0532
U10 - U13	IC, Quad Comp. LM339	182-0339

A2A3 FAULT DETECTOR ASSEMBLY

<u>REF. DES.</u>	<u>DESCRIPTION</u>	<u>QEI PART NO.</u>
A2A3	Circuit Board	100-T350023
C1,C8	Cap.Tant. 1.0 uf	110-3105T
C2,C3	Cap.Elect. 15 uf	110-3156
C4,C5	Cap.Elect. 100 uf	110-3107
C7	Cap., Cer. .1 uf	110-0104
C9 - C20	Cap. Cer., .01 uf	110-0103
CR1 - CR3	Diode, Silicon	113-04446
CR4	Diode, Silicon	114-04001
J1D,J202-J208	Socket, 16 pin DIP	130-0316-1
Q1 - Q11	Transistor, NPN 2N4401	160-04401
R1-R14,R36,R37, R42,R43,R62,R63	Res.,Carb. 1K	RC07GF102J
R15,R55	Res. Carb. 1K	RC20GF102J
R16,R56	Res., Carb. 1.2K	RC20GF122J
R17,R54	Res. Film, 46.4K 1%	165-4642
R18	Res. Film, 2.21K 1%	165-2211
R19,R53	Res., Carb. 27K	RC20GF273J
R20,R31,R38,R40	Res. Carb. 4.7K	RC07GF472J
R21,R32-R35	Res. Carb. 1.5K	RC20GF152J
R22	Res. Carb. 220K	RC20GF224J
R23	Res. Carb. 3.3K	RC20GF332J
R24	Res. Carb. 2.2M	RC20GF225J
R25,R52	Res. Carb. 4.7K	RC20GF472J
R26 - R28	Res. Carb. 33K	RC20GF333J
R29,R48	Res. Carb. 22K	RC20GF223J
R30,R45,R46,R50, R51,R61	Res. Carb. 2.2K	RC20GF222J
R39,R41	Res. Carb. 10K	RC07GF103J
R44,R49	Res.Carb. 820 ohm	RC20GF821J
R57	Res. Film 2.49K 1%	165-2491
R59	Res. Carb. 47K	RC20GF473J
R60	Res. Carb. 12K	RC20GF123J
R58	Res. Carb. 100K	RC20GF104J
U1	I.C. TTL 7410	182-7410
U2,U3,U12,U15	I.C. TTL 7440	182-7440
U4 - U11	I.C. TTL 7400	182-7400
U13	I.C. TTL 7402	182-7402
U14	I.C. Quad Comp. LM339	182-0339
U16	I.C. TTL 7405	182-7405

A2A4 POWER CONTROL ASSEMBLY

<u>REF. DES.</u>	<u>DESCRIPTION</u>	<u>QEI PART NO.</u>
A2A4	CIRCUIT BOARD	100-APC0024
C1	Cap. Elect. 15 UF	110-3156
C2,C3, C4,C5,C10-C14, C18,C19	Cap. Elect. 100 uf	110-3107
C6	Cap. Cer. .01uf	110-0103
C7-C9	Cap. Tant. 1uf	110-3105T
C15	Cap. Elect. 200uf	110-3207
C16,C17,C20	Cap. Elect. 5uf	110-3505
C21-C23	Cap. Cer. .1uf	110-0104
	Cap. Mica 470pf	110-1471
CR1	Diode, Zener 12V.	113-25242
CR2,CR3	Diode, Silicon	113-04001
CR4	Diode, Zener 4.7V	113-25230
J302	Socket, 16 pin DIP	130-0316-1
K1,K2	Relay, DPDT DIP	136-0014
Q1,Q3	Transistor NPN 2N4401	160-04401
Q2	Transistor NPN 2N3053	160-03053
R2,R3,R6,R7	Res. Film 499 ohms 1%	165-4990
R4,R1,R30	Res. Film 110 ohms 1%	165-1100
R8,R9	Res. Film 7.87K 1%	165-7871
R11,R20	Res. Var. 10K	167-3103
R10,R12	Res. Film 11K 1%	165-1102
R13	Res. Carb. 2.2K 5%	RC20GF222J
R14,R15	Res. Film, 2.21K 1%	165-2211
R18,R19	Res. Film 100K 1%	165-1003
R21	Res. Carb. 5.6K 5%	RC20GF562J
R22	Res. Carb. 10K 5%	RC07GF103J
R23	Res. Carb. 39K 5% **	RC07GF393J
R24	Res. Carb. 100K 5%	RC20GF104J
R25	Res. Carb. 1K 5%	RC20GF102J
R26,R29	Res. Carb. 4.7K 5%	RC20GF472J
R27	Res. Carb. 120 ohms 5%	RC20GF121J
R28	Res. Carb. 1.5M 5%	RC20GF155J
R16,R17	Res. Film 5.11K 1%	165-5111
U1	IC Multiplier MC1595	182-1595
U2,U3	IC Dual Op-Amp NE532	182-0532

A2A5 MULTIMETER SWITCH

<u>REF. DES.</u>	<u>DESCRIPTION</u>	<u>QEI PART NO.</u>
A2A5	Circuit Board	100-T10012
CR1,CR2	Diode, Silicon	113-04001
J502	Socket, 16 pin DIP	130-0316-1
R1	Res. Film 470K 1%	165-4703
R2	Res. Film 24.9K 1%	165-2492
R3	Res. Film 1.5K 1%	165-1501
S1	Switch, 6 position	175-0028

A2A6 IPA CURRENT SWITCH

<u>REF. DES.</u>	<u>DESCRIPTION</u>	<u>QEI PART NO.</u>
A2A6	Circuit Board	100-T350011
J601	Socket 16 pin DIP	130-0316-1
S1	Switch, 4 position	175-0027

A2A7 VOLTMETER SWITCH

<u>REF. DES.</u>	<u>DESCRIPTION</u>	<u>QEI PART NO.</u>
A2A7	Circuit Board	100-T350011
CR1,CR2	Diode Silicon	113-04001
J703	Socket 16 pin DIP	130-0316-1
R1	Res. Film 46.4K 1%	165-4642
R2	Res. Film 121K 1%	165-1203
R3	Res. Film 321K 1%	165-3213
R4	Res. Film 221K 1%	165-2213
R5	Res. Film 28.7K 1%	165-2872
S1	Switch, 4 position	175-0026

A2A8 FINAL METER ASSEMBLY

<u>REF. DES.</u>	<u>DESCRIPTION</u>	<u>QEI PART NO.</u>
A2A8	Circuit Board	100-T350015
C1 - C3	Cap. Cer. .001	110-0102
CR1 - CR6	Diode, Silicon	113-04001
J804	Socket 16 pin DIP	130-0316-1
R1	Res. Var. 25K Dual	200-0253-2
R2	Res. Film 768 ohm 1%	165-7680
R3	Res. Film, 1.5K 1%	165-1501
R4	Res. Film 6.61K 1%	165-6611
R5	Res. Film 332 ohm 1%	165-3320
R6	Res. Film 23.7K 1%	165-2372
R7	Res. Film 649 ohm 1%	165-6490

A2A9 TRANSMITTER CONTROL SWITCH

<u>REF. DES.</u>	<u>DESCRIPTION</u>	<u>QEI PART NO.</u>
A2A9	Circuit Board	100-T350008
J906	Socket 16 pin DIP	130-0316-1
R1 - R5	Res. Carb. 68 ohm 2W	RC42GF680K
S1	Switch 5 position	175-0029

A2A10 FAULT ANNUNCIATOR ASSEMBLY

<u>REF. DES.</u>	<u>DESCRIPTION</u>	<u>QEI PART NO.</u>
A2A10	Circuit Board	100-TX009-1
C1 - C10	Cap. Cer. .01 uf	110-0103
CR1 - CR10	Indicator LED Red	113-3003
CR11 - CR20	Diode, SCR	113-45061
J1005	Socket 16 pin DIP	130-0316-1
Q1	Transistor PNP	160-04403
R1	Res. Carb. 51 ohm 5%	RC20GF510J
R2	Res. Carb. 100 ohm 5%	RC20GF101J
R3	Res. Carb. 68 ohm 2W.	RC42GF680K
R4 - R13	Res. Carb. 270 ohm 1W.	RC32GF271J
R14 - R22	Res. Carb. 510 ohm 5%	RC20GF511J
R23 - R33	Res. Carb. 1.2K 5%	RC20GF122J

A3 IPA ASSEMBLY

<u>REF. DES.</u>	<u>DESCRIPTION</u>	<u>QEI PART NO.</u>
AMPL.A3A	Amplifier Assembly (See A3A Part List)	
ATT1	Attenuator	
ATT2	Attenuator, Hybrid	161-10261-3
C1,C2,C8,C9	Cap. Cer. .001 uf	110-0102
C3 - C7	Cap. Mica 470 pf	110-1471
CR1,CR2,CR5,CR6	Diode, Silicon	113-0005
CR3, CR4	Diode, Silicon 1N4001	113-04001
J1,J2	Connector Type "N"	130-0004
J3	Connector 5 pin	130-3023
J4	Connector 10 pin	130-0004
J5	Connector BNC	130-0001
L1,L2	Choke Wideband	140-2008
R1,R4	Res. Carb. 130 ohm	RC20GF131J
R2,R3	Res. Carb. 4.7K **	RC20GF472J
R5 - R9	Res. Carb. 100 ohm 2W.	RC42GF101J
R10,R13	Res. Carb. 100 ohm	RC20GF101J
R11,R12	Res. Carb. 18K **	RC20GF183J
U1	I.C. Temp.Sensor AD590	182-0590

A3A IPA AMPLIFIER ASSEMBLY

<u>REF. DES.</u>	<u>DESCRIPTION</u>	<u>QEI PART NO.</u>
A3A	Circuit Board	100-821003A
C1,C18,C28	Cap. Elect. 5uf 100V	110-3505-100
C2,C17,C27	Cap. Cer. .01uf 1KV	110-0103K
C3,C14-C16, C24-C26	Cap. UC Mica 1000pf	110-2102
C4,C6,C8,C9, C13,C23	Cap. UC Mica 470 pf	110-2471
C5,C7,C10	Cap. Var. 16-150 pf	110-6615
C11	Cap. UC Mica 120pf	110-2121
C12,C22	Cap. UC Mica 270 pf	110-2271
C19,C29	Cap. UC Mica 50pf	110-2500
C20,C21	Cap. Var. 25-150pf	110-6515
L1,L10,L15	Inductor	140-Q8002
L2,L6	Inductor	140-Q8003
L3,L8,L13	Inductor	140-Q8004
L4,L7,L12	Choke, Wideband	140-2016
L5	Inductor	140-Q8005
L9,L14	Inductor	140-Q8006
L11	Inductor	140-Q8007
Q1	Transistor RF S100-50	160-0100
Q2,Q3	Transistor RF S175-50	160-0175
R1 - R4	Res. Carb. 10 ohm 2W.	RC42GF100J

A4 TUNER ASSEMBLY

<u>REF. DES.</u>	<u>DESCRIPTION</u>	<u>QEI PART NO.</u>
C1, C2	Cap. Air Var. 4-50 pf	110-9450
J1, J2	Connector, Type "N"	130-0004
L1	Inductor	140-Q8001

A5 POWER AMPLIFIER ASSEMBLY

<u>REF. DES.</u>	<u>DESCRIPTION</u>	<u>QEI PART NO.</u>
C2	Cap. Cer. 500pf 5KV	110-0500
C4	Cap. Tune	110-Q8700
C5	Cap. Load	110-Q8800
C6	Cap. Socket By-Pass	110-Q8701
C7, C8	Cap. Filament By-Pass	110-Q8702
C9 - C16	Cap. Feed-Thru 1000pf	110-7102
J1	Connector Female Cable End	130-0030
J2	Connector Female	130-0004
L2	Inductor, Shunt Tune	140-Q8700
L3, L4	Inductor Filament	140-Q8701
L5	Inductor Series Tune	140-Q8702
L7	Inductor Shunt Trap	140-Q8703
P1	Plug Type "N" Right Angle	130-0032
S1	Switch Interlock	175-0024
T1	Transformer, Filament	180-22010
V1	Tube, 3CX3000A7	162-3000

A6 LOW PASS FILTER & DIRECTIONAL COUPLER ASSEMBLY

<u>REF. DES.</u>	<u>DESCRIPTION</u>	<u>QEI PART NO.</u>
A6	Board P.C.	100-821006
C1, C4	Cap. Teflon 27 pf	110-Q9001
C2, C3	Cap. Teflon 52 pf	110-Q9002
C5, C6	Cap. Cer. .001uf	110-0102
C7	Cap. RF Pickup	110-Q9003
CR1,CR2	Diode, Silicon	113-0005
J1	Connector EIA 1 5/8" Flanged	
J2 - J4	Connector, BNC	130-0001
L1 - L3	Inductor	140-Q8008
R1, R4	Res. Carb. 390 ohm	RC20GF391J
R2, R3	Res. Carb. 10K **	RC20GF103J
R5, R6	Res. Var. 1K	167-3102