

**QEI MODEL 695B-50  
FM BROADCAST EXCITER**

**INSTALLATION AND INSTRUCTION  
MANUAL**

**NOTE**

The Model 695B-50 has the same operational specification and controls as the Model 695 Exciter. The only specification change is the power output of 50 Watts.

YOUR QEI EXCITER 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 TROUBLEFREE INSTALLATION.

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FM BROADCAST EXCITER  
INSTRUCTION MANUAL

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REV. 7/94

## TABLE OF CONTENTS

SECTION 1	GENERAL INFORMATION
1-1	Description
1-2	Electrical Specifications
1-3	Mechanical Specifications
1-4	Equipment Identification
SECTION 2	INSTALLATION
2-1	Initial Inspection
2-2	Preparation for Use
2-3	Electrical Connections
2-4	Repacking for Shipment
SECTION 3	OPERATION
3-1	Controls and Indicators (Front Panel)
3-2	Controls (Rear Panel)
3-3	Initial Operation
3-4	Normal Operation
SECTION 4	THEORY OF OPERATION
4-1	General
4-2	Automatic Modulation Control
SECTION 5	ALIGNMENT
5-1	Equipment Required but Not Supplied
5-2	A2 PLL & Modulation Control
5-3	A3 Display & Interface (Initial Set Up)
5-4	A4 Receiver & Log Amp (Initial Set Up)
5-5	A5 Automod & Bar Graph Driver
5-6	Final Automod and Receiver Set Up
5-7	Frequency Programming
SECTION 6	PARTS LISTS
SECTION 7	SCHEMATICS

## SECTION 1

### GENERAL DESCRIPTION

#### 1-1 DESCRIPTION

The QEI Type 695 FM Exciter is an all solid state, on carrier direct FM, phase locked, synthesized exciter designed to exceed the FCC requirements for use in the FM broadcast band (87.9 to 107.9 Mhz). The Exciter also features extensive metering, a high quality demodulator, and a microprocessor controlled modulation controller that uses the actual RF peak deviation to set the audio input level to the FMO. The Power Amplifier is broadbanded across the entire FM band and is capable of withstanding any magnitude or phase of VSWR. Power output is adjustable from less than 5 to greater than 20 watts and the amplifier is unconditionally stable regardless of power output or VSWR.

The 695 Exciter is manufactured in a standard 5.25"(133.4mm) x 19"(482.6mm) rack mount and is convection cooled.

#### 1-2 ELECTRICAL SPECIFICATIONS

##### General Performance

Power Output.....	5 - 20 Watts
Output Impedance.....	50 Ohms
Output Connector.....	'N' female
Frequency Range.....	87.5 - 108 MHz
Operating Temp. Range.....	0 to +50 deg C
Frequency Stability.....	+ or - 200 Hz
AM Noise.....	At least -65 dBc
Incidental (Synchronous) AM.....	At least -60 dBc
Harmonic Suppression.....	At least -80 dBc
Spurious Suppression.....	At least -90 dBc
Type of Emission.....	180F3 or 300F9

##### Wideband (Composite) Performance

Intermodulation Distortion (60 Hz/ 7 KHz; 4:1)....	0.025%
Total Harmonic Distortion.....	0.025%
Transient Intermod Distortion (TIM).....	0.025%
Frequency Response	
Amplitude.....	+ or - 0.01% (30 Hz to 53 KHz)
Phase.....	+ or - 0.1 deg ( 30 Hz to 53 KHz)
Stereo Separation Capability.....	At least 60 dB
Crosstalk (Main to SCA).....	Better than -70dB
Crosstalk (SCA to Main).....	Better than -70dB
Input (1).....	3.5Vpp across 10K (75 KHz dev)
SCA Input (3).....	1Vrms across 5K (10% Injection)

## Monaural Performance

Intermodulation Distortion.....0.025%  
Total Harmonic Distortion.....0.025%  
Transient Intermod Distortion.....0.025%  
Frequency Response.....+ or - 0.5dB (30 Hz - 15KHz)  
Pre-Emphasis.....75usec (50usec opt.)  
Input (600 ohm balanced).....+10 dBm (75 KHz dev)  
FM Noise (de-emphasized).....At least -75 dB

## Features

Automatic Modulation Control  
Built in Demodulator  
Built in Spectrum Analyzer (requires ext. X-Y scope)  
Bar Graph Peak Modulation Display  
Eight Function Multimeter  
Six Function Fault Annunciator  
Incidental AM Detector  
Digital Peaks per Minute Display  
Bessel Function Calibrator

## 1-3 MECHANICAL SPECIFICATIONS

Dimensions.....5.25"(13.3cm)H x 19"(48.4cm)Wx 12"(31.5cm)D  
Net Weight.....32 lb (14.5 Kg)  
Packed Weight.....38 lb (17.3 Kg)

## 1-4 EQUIPMENT IDENTIFICATION

This equipment is identified by a Model number and a six digit serial number on the rear panel. All correspondence to your sales representative or the factory should reference the complete Model and Serial numbers.



## SECTION 2

### INSTALLATION

#### 2-1 INITIAL INSPECTION

Check the shipping carton for external damage. If the carton exhibits evidence of abuse in handling (holes, broken corners etc.) ask the carrier agent to be present when the unit is unpacked. Carefully unpack the unit and inspect all equipment for physical damage. Immediately after unpacking, any bent or broken parts or scratches should be noted. Keep all packing material for proof of damage claim or possible future use.

#### 2-2 PREPARATION FOR USE

The equipment is designed to be mounted in a standard 19"(48.4cm) rack. Air space should be provided above and below the equipment so that heat generated by the circuitry may be dissipated. Additional cooling must be provided if the ambient temperature exceeds 50 degrees C (122 F).

Mount the equipment to the rack using (4) #10 oval head screws and finishing washers.

The equipment requires a 105-125Vac or a 210-250Vac 50 or 60 Hz power source. A switch inside the power supply compartment is used to change the power transformer primary. Equipment shipped to the U.S. or Canada will have this switch in the 115Vac position.

#### 2-3 ELECTRICAL CONNECTIONS

Connect a suitable 50 ohm RF load to RF OUT jack J8 using a type N connector and RG-8/U or equivalent cable.

Connect the composite stereo signal from the stereo generator or composite STL receiver to J2. The grounding lug may be disconnected if required to eliminate a "ground loop". Place S1 MONO/COMP switch in COMP position for stereo. 3.5Vpp across 10K is required for 100% modulation.

Connect the mono audio line to TB1. The outside terminals are the balanced 600 ohm connections. The center terminal is grounded. Place S1 MONO/COMP switch in MONO position for mono. This input is pre-emphasized internally. +10dBm is required for 100% modulation.

Connect SCA signals to SCA jacks J3, J4 or J5. 1 Vrms across 5K is required for 10% injection.

Connect a coaxial jumper between DEMOD IN jack J6 and RF SAMPLE jack J7. Alternatively an RF sample between 1 and 5 Vrms from the transmitter output may be connected to DEMOD IN jack J6.

Connector J1 is the interface connection to QEI Microprocessor Diagnostic equipped Transmitters.

## 2-4 REPACKING FOR SHIPMENT

NOTE: Before returning a unit for repair or calibration, contact the factory or your authorized representative for a RETURN AUTHORIZATION. Attach a tag showing owner's name and address. A description of the service required should also be included. UNIT MUST BE SHIPPED PREPAID AND INSURED FOR FULL VALUE. Use the original shipping carton and packing material for shipment. If these are not available, proceed as follows:

- A. Use a carton with a minimum strength of 250 lb.
- B. Be sure the carton is large enough so that there is at least 4 inches clearance on all sides of the equipment.
- C. Pack these 4 inches with extra firm polyurethane foam or equivalent. DO NOT USE NEWSPAPER OR FOAM "POPCORN" FOR PACKING. The vibration and shock of shipment make these materials unsuitable.
- D. Use heavy reinforced shipping tape to secure the outside of the carton.
- E. Use large FRAGILE labels on each surface.

## SECTION 3

### OPERATION

#### 3-1 CONTROLS AND INDICATORS (Front Panel)

- a) POWER switch--Push Button which controls AC power to the unit. Button is green when power is on.
- b) CAL switch--Momentary push button used to verify calibration of modulation metering in the unit. Depressing this button removes the program input from the FMO and substitutes a 32KHz sine wave. This frequency produces the first Bessel carrier null at 102.6% modulation. This corresponds to the CAL mark on the MULTIMETER.
- c) PROGRAMMED FREQUENCY / 100% PEAKS PER MINUTE switch and display--Push-push switch and LED numeric display. When push button is out (black), Automatic Modulation Control is disabled and LED displays the channel frequency for which the unit is programmed. (NOTE: This indication is NOT an actual frequency count.) When push button is depressed (white), Automatic Modulation Control is enabled and LED indicates the number of 100% modulation peaks which have occurred. This indication resets to 0 once a minute, has a maximum count of 19 and flashes if the number of peaks exceeds 10 in any given minute. In keeping with the FCC's rules for ATS, one peak is counted for any modulation burst of 100% up to 5msec duration.
- d) MULTIMETER switch and meter--8 position push button is used to select function displayed on meter. The color of the push button depressed corresponds to the scale color used on the meter for that function.
- |          |       |                         |
|----------|-------|-------------------------|
| MOD(+)   | ..... | Positive modulation     |
| MOD(-)   | ..... | Negative modulation     |
| MOD(10%) | ..... | Modulation (13.3% FS)   |
| PA VOLTS | ..... | Final Collector voltage |
| PA AMPS  | ..... | Final Collector current |
| IPA AMPS | ..... | IPA Collector current   |
| RF FWD   | ..... | RF Output (100% = 20 W) |
| RF REV   | ..... | Reflected power         |
- e) PWR--Screwdriver adjustment used to set RF power output.
- f) FREQ--Screwdriver adjustment used to set carrier frequency exactly. Range is approximately + or - 500 Hz.



### 3-1 CONTROL AND INDICATORS (continued)

- g) MOD CONTROL ON--Indicator lit when Automatic Modulation Control is in operation.
- h) PEAK MODULATION--Bar graph display which shows actual demodulated modulation level (not just the audio input to the FMO). The bar segment indicating the highest peak stays illuminated until automatically reset once per minute. This feature allows easy determination of dynamic range and loudness.
- i) Fault Annunciator--Indicators lit under the following conditions:
  - 1. MOD CONTROL FAULT.....Lit if modulation exceeds 100% more than 10 times per minute for 3 consecutive minutes OR if modulation falls below a preset level for 3 consecutive minutes. This level is normally set at 85%. See section 5-5.
  - 2. AFC FAULT.....Lit if any failure occurs in the frequency control circuitry.
  - 3. Vcc FAULT.....Lit if Final Collector supply is out of tolerance.
  - 4. +12 FAULT.....Lit if +12 supply is out of tolerance.
  - 5. -12 FAULT.....Lit if -12 supply is out of tolerance.
  - 6. +5 FAULT.....Lit if +5 supply is out of tolerance.
- j) RF TEST--BNC jack used to measure incidental (synchronous) AM. Ratio of AC to DC at this jack indicates level of AM on carrier.
- k) MODULATION TEST--BNC jacks used for audio measurements.
  - 1. INPUT.....Signal at this jack is the signal being fed to the FMO. This signal should be used as a reference. The OUT-WB signal will look substantially the same as the INPUT signal when the unit is operating properly.
  - 2. OUT WB.....Signal at this jack is demodulated composite output of either the exciter or the transmitter depending upon the sample supplied to the DEMOD IN jack on the rear panel.
  - 3. OUT-DE.....Signal at this jack is the same as OUT-WB except with 75 usec de-emphasis.

- 1) SPECTRUM ANALYZER--BNC Jacks used in conjunction with an X-Y Oscilloscope to generate a spectrum analyzer display. Connect the X jack to the scope horizontal input and the Y jack to the scope vertical input. Set the scope horizontal sensitivity to 0.5 volts/div and the vertical sensitivity to 0.2 volts/div. Insure that both scope inputs are DC coupled. The display generated will show the carrier frequency + or - approximately 120 KHz horizontally and approximately 10 dB per division vertically. This display can be used to show bandwidth occupied and Bessel nulls. Bessel functions can be used to accurately determine modulation levels. Information can be found in virtually any text on FM systems.

### 3-2 CONTROLS (Rear Panel)

- a) MONO/COMP switch S1--Switch selects which input is fed to the FMO.
- b) CLIP/OFF switch S2--Switch which controls built in composite clipper. Clipper is normally set to limit spikes to approximately 108%. See section 5-4 and 5-6.

### 3-3 INITIAL OPERATION

\*\*\*\*\*  
\* CAUTION \*  
\*\*\*\*\*

The input tuning of some transmitters can be mistuned to the point where the tube may oscillate. If this happens, enough power may be fed back into the exciter to destroy the output transistor. If there is any doubt concerning the stability of the transmitter, it is recommended that a 20 watt 3dB pad be inserted between the exciter and the transmitter.

- A. Turn PWR adjustment full counterclockwise (minimum RF out).
- B. Insure that the unit is connected to a proper power source and that an appropriate RF load is connected to RF OUT jack J8. See Section 2-3.
- C. Depress POWER switch.
- D. Verify that all FAULT Indicators are extinguished.
- E. Depress RF REV Button.
- F. Slowly rotate PWR adjustment Clockwise while observing transmitter power output and exciter MULTIMETER. Tune the transmitter input for minimum RF REV indication on the MULTIMETER. Continue rotating the PWR adjustment until the exciter is supplying adequate RF drive to the transmitter.

### 3-4 NORMAL OPERATION

For normal operation, use PWR adjustment to set RF output to the level desired. Use FREQ adjustment to fine tune exciter to the exact carrier frequency using an external counter or frequency measuring service. It is suggested that modulation be removed while performing a frequency measurement with a digital counter. Counter must have a gate time of at least 4 seconds to obtain an accurate count when modulation is present. If FREQ adjustment can not bring the exciter exactly on frequency, see Section 5-2 for coarse adjustment.

It is suggested that MULTIMETER readings be observed and logged periodically.

The MOD(+) and MOD(-) positions of the MULTIMETER and the PEAK MODULATION Bar Graph may be used to determine accurate modulation levels. These indications are derived from an actual monitor grade wide band demodulator which receives its input from the RF output of the exciter or transmitter. NOTE: An RF sample must be connected to DEMOD IN jack J6 in order for the modulation indications to function.

Depressing the PROGRAMMED FREQUENCY / 100% PEAKS PER MINUTE switch will enable the Automatic Modulation Control feature. This feature uses the demodulated output to control the level of the composite signal fed to the FMO. A microprocessor algorithm is used which maintains 4 to 9 peaks of 100% modulation per minute even if the input signal to the exciter varies as much as plus or minus 3 dB. This is accomplished without affecting stereo pilot injection or phase. This feature will automatically adjust the composite signal to compensate for SCA injection. See Section 5-4 if you wish to take advantage of the 110% rule for SCA.

An internal Composite Clipper is included to limit overshoots to a specific level. See Section 5-6. The clip level is controlled by the microprocessor when in Automatic Modulation Control. CLIP / OFF switch S2 on the rear panel is used to defeat the clipping feature if desired.



## SECTION 4

### THEORY OF OPERATION

#### 4-1 GENERAL

The exciter circuitry is on six major subassemblies. A description of the functions contained on each of these follows.

##### a) A2 Phase Lock Loop & Modulation Control

This board contains the reference 8 MHz crystal oscillator, the reference divider, the programmable divider, phase detector and 2 stage loop filter which generates the AFC voltage for the FMO. It also contains the audio composite and SCA input amplifiers and summing networks, digitally controlled electronic attenuator, and a composite clipper which sets the level of the modulating signal fed to the FMO.

##### b) A3 Display and Interface

This board contains the circuitry required to generate the various display and metering functions. It also supplies the diagnostic samples used with the QEI diagnostic equipped transmitters. In addition, it is used as a junction or "mother" board among the other subassemblies. The frequency programming plugs are also located on this board.

##### c) A4 Receiver and Log Amp

This board contains the crystal controlled precision wide band low noise demodulator and the circuitry required to generate the spectrum analyzer display outputs. It also contains the reference voltage generator for the composite clipper located on the A2 assembly.

##### d) A5 AUTOMOD and Bar Graph Driver

This board contains the microprocessor and peripheral circuitry which drives the electronic attenuator on the A2 assembly and the Peak Modulation Bar Graph on the A3 assembly.

##### e) A6 FMO and Buffer Amplifier

This board contains the sealed FMO and a broadband RF amplifier which drives the RF power amplifier.

##### f) A7 RF Power Amplifier

This assembly contains the IPA and PA stages. They are broadbanded and require no tuning to cover the entire FM band. Power output is in excess of 20 watts.



## 4-2 AUTOMATIC MODULATION CONTROL

There are two versions of the Automatic Modulation Control software available:

- A. The first (standard) version controls the modulation fed to the composite input connector or alternately the monaural input on the rear of the exciter over a +/- 5dB range.

The control is set for expansion (gain increase) over a total of 256 equal steps at the rate of 2 steps/second.

When the internal receiver / detector senses a modulation peak at or in excess of the 100% modulation setpoint, the gain is set back by 8 steps for a gain reduction of approximately 1/3dB.

- B. The second (Classical) version controls the modulation fed to the composite input connector or alternately the monaural input on the rear of the exciter over a +/- 2.5dB range.

The control is set for expansion (gain increase) over a total of 256 equal steps at the rate of 1 step/second.

When the internal receiver / detector senses a modulation peak at or in excess of the 100% modulation setpoint, the gain is set back by 8 steps for a gain reduction of approximately 1/6dB.

The modulation control circuitry in the QEI 695 Exciter is designed to control the stereo modulating signal without variations in the level of the 19KHz pilot signal. The insertion of subcarrier signals connected to any of the three subcarrier input connectors on the exciter is after the modulation control circuitry. The composite input circuitry is designed for differential operation and a wide input frequency response. In the case where a composite baseband signal (including SCA Subcarriers) is fed into the composite input of the exciter, the level of the subcarrier injection will vary with the action of the exciter to control total modulation.

Automatic Modulation Control within the exciter is enabled by one of two means. It may be enabled at the exciter by means of the "Prog Fcy / 100% PPM" button on the front of the exciter. It may also be controlled remotely by the optional transmitter control package. If it is enabled (on) locally, it will not be overridden (off) remotely. If it is not enabled at the exciter, it may be controlled (on/off) from the remote terminal.

The modulation level is controlled by varying the gain of U19 on the PLL and MOD CONTROL ASSY (A2) of the exciter. The gain of the amplifier is controlled by the action of the analog switches U20, U21 (DG-202's). These switches are controlled by the data lines D0-D7 which originate at U11 (74LS374) on the AUTOMOD (A5) assembly. Nine resistors connect to the inverting input of U19. One of the resistors (R44, 2.49K) is used as part of the feedback circuit for this amplifier. This resistor (R44) is connected to R68 & R69. R68 (620 ohm) is an amplifier buildout resistor and R69 (1K ohm) provides isolation from the FMO audio input line. An absolute peak clipper circuit is also connected to this junction.

The other end of each of the remaining (eight) resistors used to control the gain of U19 connect to one of the individual analog switches in U20 or U21. The other end of the analog switches connect to a ground reference point. In this circuit, however, the reference point is one end of a tuned circuit consisting of L1, C23 tuned to 19,000Hz. The other end of this tuned circuit is connected to circuit common. The tuned circuit provides a high impedance at 19KHz and a (near) short at all other frequencies. This has the effect of providing a fixed gain at 19KHz with the ability to vary (control) the gain at all other frequencies. The fixed gain at 19KHz is relatively low. The gain at the other frequencies is much higher. The circuit compensates for this by making this same point the reference for resistive divider on the input signal. At 19KHz, the signal on the non-inverting input to U19 is higher than at all other frequencies. This is due to the added impedance of the tuned circuit shifting the value of the divider at 19KHz.

The 19KHz tuned circuit MUST be adjusted for best 38KHz phase response through the exciter.

The input circuit is a differentially connected Opamp (NE5532) using only the internal compensation of the IC. The resultant circuit is very broadbanded and readily passes a full composite signal (subcarriers included). The input is terminated into a 10Kohm pot and reflects a constant 10Kohm load to the input connector. As this input is differentially connected, the composite input connector is installed with the outer shell isolated from the exciter chassis (floating). A switch is provided to allow the user to connect this point to chassis ground if it is required.

The exciter also has a transformer isolated monaural input. A switch (double pole, double throw) is provided to select between the composite and mono inputs. When the mono input is selected, the 19KHz tuned circuit is shorted and the gain control reference is connected to circuit ground.



After the switch is a resistively isolated output that connects to a front panel test point labeled "mod test input". This point is connected prior to any modulation control circuitry and available to view or test the incoming signal.

While the control of the modulation is under the control of the microprocessor in the exciter, there are a number of other circuits necessary for proper operation of the Automatic Modulation control in the exciter.

The Receiver / Log Amp (A4) assembly is used to receive / demodulate a signal either from the exciter test point or from a transmitter or transmission line test point. The assembly also contains the circuitry for the spectrum analysis display portion of the exciter. Of primary importance to the automatic modulation control is the composite output of the unit. The composite level control (A4R49) on this board directly effects the action of the AMC circuits. The composite signal leaves this assembly via J409-1.

The Automod (A5) assembly receives the composite signal from the Receiver / Log Amp (A4) via J509-1. The signal then is connected to both the comparator circuitry for the automod and to the driving circuitry for the bargraph display. The circuitry on this assy. allows the comparison of both positive and negative peaks to a preset reference. If a peak is present, the circuitry then provides the proper signal to drive a fixed length "one-shot" pulse that provides the Z80 Microprocessor/Controller with a "interrupt" signal. The gain control action is taken in software and the processor changes the gain control signals to the analog switches on the Mod Control (A2) assembly. These signals leave the assembly via connector J506.

The processor also provides the signals used to drive the "Peaks Per Minute" (PPM) indicator on the front of the Exciter. These signals leave the assembly via connector J506.

There is an overmodulation alarm contained in the AMC software. It will trigger an alarm if there are three continuous minutes in which there are ten or more overmodulation peaks. The alarm signal leaves this assembly via J509-16.

Also contained on this assembly is circuitry for setting the low modulation alarm point of the Exciter. The Low Mod control R2 is used to set the Low Mod alarm point. It has a nominal range of 30% modulation to 70% modulation. The software limits are set so that the Low Mod alarm will be triggered when the low modulation detector remains below its preset alarm point for three continuous minutes. The alarm signal leaves this assembly via J509-15.

There is also a summary "mod fault" alarm that leaves the board via J509-10.

Automodulation control into this assembly is via a signal brought in on J509-9. This signal is brought into an interface IC U14-13 (8286).

The AMC signal is brought to this assy. from the Display and Interface (A3) assy. This signal when pulled low indicates that the AMC has been enabled. This signal is pulled low by A3Q5. The drive for this transistor is derived from the PPM selector on the front of the exciter. When the signal is high it also switches U3, U4 (74157) to cause the Pulse Per Minute to be displayed on the front panel. This High signal is isolated from the transistor by a series resistor. The same signal also drives Q6 which causes the "Auto Mod On" indicator on the front of the exciter to be illuminated.

There is another connector on this assembly (J308) that carries the signals to/from the optional (O1) transmitter controller. This signal will control the AMC if the PPM switch on the front panel has not been set.



## SECTION 5

### ALIGNMENT

#### 5-1 EQUIPMENT REQUIRED BUT NOT SUPPLIED

\*\*\*\*\*  
\* CAUTION \*  
\*\*\*\*\*

DO NOT ATTEMPT TROUBLESHOOTING OR ALIGNMENT OF THIS EQUIPMENT WITHOUT ADEQUATE TOOLS AND TEST EQUIPMENT

- a) RF Dummy Load (50 ohms @ 88-108MHz--25 Watts minimum)
- b) RF Wattmeter (Bird 43 or equivalent)
- c) Dual Trace DC coupled Oscilloscope with X-Y function and 10 MHz minimum bandwidth
- d) Audio Generator (less than 0.01% THD)
- e) Distortion Analyzer or Audio Spectrum Analyzer capable of measuring less than 0.01% THD and 80dB S/N
- f) 110 MHz Frequency Counter (Stability better than 1 part per million)
- g) FM Modulation Monitor (QEI 691 or equivalent-- if required to check operation of A4 assembly)
- h) RF Spectrum Analyzer
- i) Digital Voltmeter (3 1/2 digits min.)
- j) Stereo Generator

NOTE: BEFORE STARTING ALIGNMENT OR TROUBLESHOOTING, VERIFY THAT ALL SUPPLY VOLTAGES ARE PRESENT AND CORRECT. MAKE SURE THAT THE EXCITER IS CONNECTED TO A PROPER RF LOAD.

NOTE: THE ALIGNMENT OF THIS UNIT SHOULD BE DONE WITH THE MODULATION CONTROL (AUTOMOD) OFF AND THE CLIPPER SWITCH S2 OFF UNLESS OTHERWISE NOTED.

#### 5-2 A2 PLL & MODULATION CONTROL

##### A. Mono Input Level Adjustment

1. Place S1 MONO/COMP switch in MONO position
2. Connect the 600 ohm output of the audio generator to TB1 (Mono Input)
3. Set the generator to produce 100 Hz at a level of +10 dBm

## 5-2 A2 PLL & MODULATION CONTROL (continued)

4. Adjust A2R54 for 100% modulation

### B. Composite Input Level Adjustment

1. Place S1 MONO/COMP switch in COMP position
2. Connect the output of the audio generator to J2 COMP IN jack
3. Set the generator to produce 400 Hz at a level of 3.5 Vpp
4. Adjust A2R59 for 100% modulation

### C. SCA Input Level Adjustment

1. Connect the output of the audio generator to J3 SCA #1 IN jack
2. Set the generator to produce a frequency between 53kHz and 99kHz at a level of 1 Vrms
3. Adjust A2R83 for 10% modulation
4. Repeat steps 1 through 3 for J4 SCA #2 jack and A2R84 and for J5 SCA #3 jack and A2R85

### D. Pilot Phase Adjustment

1. Connect the output of a stereo generator to J2 COMP IN jack and to channel A of an oscilloscope
2. Place S1 MONO/COMP switch in COMP position
3. Set the stereo generator to produce a 90% L=-R signal at 400 Hz with 10% pilot
4. Connect channel B of the oscilloscope to the MODULATION TEST INPUT jack on the front panel
5. NOTE: Do Not use an attenuator probe on either scope input. Unless these probes are exactly matched, they can cause apparent phase errors. Verify that both channels are DC coupled. Trigger the scope externally with 400 Hz and set the gain and time controls so that the pilot phase crossover or "diamond" may be observed.
6. Adjust A2L1 until the crossover on channel B matches channel A

### E. Coarse Frequency Adjustment

1. Connect a frequency counter to J7 RF SAMPLE jack on the rear panel
2. Center the FREQ adjustment screw on the front panel
3. Remove modulation from the exciter
4. Adjust A2C17 until carrier frequency is exact

### 5-3 A3 DISPLAY AND INTERFACE (Initial Set Up)

#### A. Diagnostic Current Zero

1. Remove RF drive to the A6 Assembly by removing the FMO connector A11J1
2. Adjust A3R99 until J1 pin (Diagnostic connector on rear panel) reads 0.00 volts
3. Adjust A3R98 until J1 pin reads 0.00 volts
4. Reconnect A11J1

#### B. Modulation Meter Zero

1. Allow approximately 30 seconds settling time if exciter has just been turned on
2. Verify that no modulation is applied to the exciter
3. Depress MOD(+) button on the MULTIMETER switch
4. Adjust A3R38 until meter reads zero

#### C. Power Leveling Adjustment

1. Connect a calibrated wattmeter and dummy load to the RF OUT jack J8
2. Depress POWER switch
3. Depress RF FWD button on the MULTIMETER switch
4. Alternately adjust PWR adjust screw on the front panel and the A3R73 until 100% on the MULTIMETER equals 20 watts as read on the wattmeter
5. Set A3R74 to the same position as A3R73

### 5-4 A4 RECEIVER AND LOG AMP (Initial Set Up)

#### A. Local Oscillator Adjustment

1. Connect a coax cable from the junction of A4L1 and A4C29 to a frequency counter
  2. Adjust A4T1 until LO stabilizes at your operating frequency plus 10.7 MHz
- NOTE: The oscillator should "snap" on and off as the adjustment is varied. The frequency should not be able to be moved more than a few hundred Hz from the crystal frequency.
3. Turn the exciter off and on a few times to insure that the LO starts and locks

#### B. Distortion and Output Level Adjustments

1. Connect a coaxial cable from RF SAMPLE jack J7 to DEMOD IN jack J6
2. Connect a distortion analyzer or audio spectrum analyzer to the OUTPUT-DE connector on the front panel
3. Connect an audio generator to the composite jack J2. Set the generator for 400 Hz at 3.5 Vpp
4. Carefully adjust A4C18 and A4C21 for minimum distortion



#### 5-4 A4 RECEIVER AND LOG AMP (continued)

5. Connect the analyzer to MODULATION TEST-INPUT jack. Distortion level here should be substantially the same as that measured at OUTPUT-DE thus verifying the transparency of the exciter
6. Connect an oscilloscope to the OUTPUT-WB jack and adjust A4R49 for 6 Vpp

#### C. Swept Oscillator Adjustment

1. Connect a frequency counter to the junction of A4C38 and A4Z2
2. Short A4U3b-5 to ground. Adjust A4L10 for 11.155 MHz
3. Remove short and disconnect frequency counter
4. Connect an oscilloscope to the SPECTRUM ANALYZER X jack. Set the scope for DC coupled, 1 volt/div
5. Adjust A4R8 so that the positive peak of the sawtooth is equal to + 3 V
6. Adjust A4R14 so that the negative peak of the sawtooth is equal to - 3 V

#### D. Log Amplifier Adjustment

1. Connect the SPECTRUM ANALYZER X jack to the horizontal input of an oscilloscope. Set the horizontal sensitivity for external, 0.5 volts/div, DC coupled
2. Connect the SPECTRUM ANALYZER Y jack to the vertical input of the oscilloscope. Set the vertical sensitivity for 0.2 volts/div, DC coupled
3. Connect a coaxial cable from RF SAMPLE jack J7 to DEMOD IN jack J6 through an RF step attenuator ( 0 to 50dB)
4. Depress CAL pushbutton
5. Adjust A10R1 ( located on Power Switch assembly ) until carrier nulls on scope display
6. Adjust A4R18, A4R20, A4R28 and A4L10 until four symmetrically spaced sidebands appear on either side of the carrier
7. Adjust A4C37 for maximum amplitude of the display
8. Adjust A4R69 so that a 10dB decrease in RF sample will produce a 0.2 volt drop in the display

#### 5-5 A5 AUTOMOD AND BAR GRAPH DRIVER

##### A. Low Modulation Adjustment

1. Connect an oscilloscope to A5U1c-13
2. Modulate the exciter with a 400 Hz tone to the level desired for the low modulation alarm
3. Adjust A5R2 until pulses just appear on the scope

##### B. Bar Graph Alignment

1. Modulate the exciter with a 400 Hz tone to 100%. Adjust A5R20 until the 100% bar graph segment just lights



## 5-6 FINAL AUTOMOD AND RECEIVER SET UP

1. Connect an oscilloscope to the exciter so as to produce a spectrum analyzer display ( See Section 3-1 (1))
2. Modulate the exciter with a 13586 Hz tone
3. Adjust the input level for the 2nd carrier null on the spectrum analyzer display
4. Depress the MOD (-) pushbutton on the MULTIMETER switch. Adjust A3R48 until the meter reads 100%
5. Depress the MOD (+) pushbutton on the MULTIMETER switch. Adjust A3R46 until the meter reads 100%
6. Depress the PROGRAMMED FREQUENCY/100% PEAKS PER MINUTE switch. Verify that MOD CONTROL ON indicator lights
7. Watch the modulation level and note the point where it "kicks back". This is the point where the modulation control circuitry thinks the 100% modulation level is. Alternately adjust A4R49 and A3R48 until the "kick back", 2nd carrier null, and 100% modulation indication coincide
8. Adjust A5R20 if necessary until the 100% bar graph segment just lights
9. Release the PROGRAMMED FREQUENCY/100% PEAKS PER MINUTE switch. Verify that MOD CONTROL ON indicator is extinguished
10. Connect the oscilloscope to the OUT-WB connector on the front panel
11. Turn the CLIPPER switch S2 on the rear panel ON
12. Modulate the exciter with a 400 Hz tone to 108%. Adjust A4R83 until the signal viewed on the scope just starts to clip

## 5-7 FREQUENCY PROGRAMMING

- A. The carrier frequency of the 695 Exciter can be changed by moving the switches on JU1 and JU2 on the A3 Display and Interface Assembly. To program a new frequency proceed as follows:

NOTE: The 695 may be programmed for increments other than 100 KHz. Contact the factory for information.

1. To program from 87.9 to 89.9 MHz, switch JU2 as follows:
  - a. JU2-3 ON
  - b. JU2-7 ON
  - c. JU2-8 ON
2. To program from 90.0 to 99.9 MHz, switch JU2 as follows:
  - a. JU2-3 ON
  - b. JU2-7 ON
3. To program from 100.0 to 107.9 MHz, switch JU2 as follows:
  - a. JU2-3 ON
  - b. JU2-8 ON
4. Write the BCD code for the megahertz and kilohertz digits of the new frequency. EXAMPLE- 97.3 , write 0111 (7) and 0011 (3)
5. Close the switches on JU1 per the BCD code you wrote in step 4 above. Refer to drawing 695300 for pin identification on JU1 and J301. NOTE: True BCD code is used in the switches, i.e., "0" means turn switch on, "1" means leave off.
6. Turn exciter on and place PROGRAMMED FREQUENCY/100% PEAKS PER MINUTE switch in PROGRAMMED FREQUENCY position. Verify that frequency displayed is as required and that AFC FAULT indicator is extinguished.

FREQUENCY PROGRAMMING CHART  
QEI 695 EXCITER

FREQUENCY PROGRAMMING STEPS				.1M	.2M	.4M	.8M	1M	2M	4M	8Mhz
JU2-3to	JU2-7to	JU2-8to	JU1	1to	2to	3to	4to	5to	6to	7to	8to
JU2-14	JU2-10	JU2-9	JU1	16	15	14	13	12	11	10	9

NON COMMERCIAL

FREQUENCY

X	X	X	87.9	X			X	X	X	X	
X	X	X	88.1	X							X
X	X	X	88.3	X	X						X
X	X	X	88.5	X		X					X
X	X	X	88.7	X	X	X					X
X	X	X	88.9	X			X				X
X	X	X	89.1	X				X			X
X	X	X	89.3	X	X			X			X
X	X	X	89.5	X		X		X			X
X	X	X	89.7	X	X	X		X			X
X	X	X	89.9	X			X	X			X
X	X		90.1	X							
X	X		90.3	X	X						
X	X		90.5	X		X					
X	X		90.7	X	X	X					
X	X		90.9	X			X				
X	X		91.1	X				X			
X	X		91.3	X	X			X			
X	X		91.5	X		X		X			
X	X		91.7	X	X	X		X			
X	X		91.9	X			X	X			



FREQUENCY PROGRAMMING CHART  
QEI 695 EXCITER

FREQUENCY PROGRAMMING STEPS				.1M	.2M	.4M	.8M	1M	2M	4M	8Mhz
JU2-3to	JU2-7to	JU2-8to	JU1	1to	2to	3to	4to	5to	6to	7to	8to
JU2-14	JU2-10	JU2-9	JU1	16	15	14	13	12	11	10	9

COMMERCIAL		FREQUENCY									
X	X	92.1	X							X	
X	X	92.3	X	X						X	
X	X	92.5	X		X					X	
X	X	92.7	X	X	X					X	
X	X	92.9	X				X			X	
X	X	93.1	X					X		X	
X	X	93.3	X	X				X		X	
X	X	93.5	X		X			X		X	
X	X	93.7	X	X	X			X		X	
X	X	93.9	X				X	X		X	
X	X	94.1	X								X
X	X	94.3	X	X							X
X	X	94.5	X		X						X
X	X	94.7	X	X	X						X
X	X	94.9	X				X				X
X	X	95.1	X					X			X
X	X	95.3	X	X				X			X
X	X	95.5	X		X			X			X
X	X	95.7	X	X	X			X			X
X	X	95.9	X				X	X			X
X	X	96.1	X						X		X
X	X	96.3	X	X					X		X
X	X	96.5	X		X				X		X
X	X	96.7	X	X	X				X		X
X	X	96.9	X				X		X		X
X	X	97.1	X					X	X		X
X	X	97.3	X	X				X	X		X
X	X	97.5	X		X			X	X		X
X	X	97.7	X	X	X			X	X		X
X	X	97.9	X				X	X	X		X
X	X	98.1	X								X
X	X	98.3	X	X							X
X	X	98.5	X		X						X
X	X	98.7	X	X	X						X
X	X	98.9	X				X				X
X	X	99.1	X					X			X
X	X	99.3	X	X				X			X
X	X	99.5	X		X			X			X
X	X	99.7	X	X	X			X			X
X	X	99.9	X				X	X			X

FREQUENCY PROGRAMMING CHART  
 QEI 695 EXCITER

FREQUENCY PROGRAMMING STEPS				.1M	.2M	.4M	.8M	1M	2M	4M	8Mhz
JU2-3to	JU2-7to	JU2-8to	JU1	1to	2to	3to	4to	5to	6to	7to	8to
JU2-14	JU2-10	JU2-9	JU1	16	15	14	13	12	11	10	9

COMMERCIAL FREQUENCY

COMMERCIAL	FREQUENCY	.1M	.2M	.4M	.8M	1M	2M	4M	8Mhz
X	100.1	X							
X	100.3	X	X						
X	100.5	X		X					
X	100.7	X	X	X					
X	100.9	X			X				
X	101.1	X				X			
X	101.3	X	X			X			
X	101.5	X		X		X			
X	101.7	X	X	X		X			
X	101.9	X			X	X			
X	102.1	X						X	
X	102.3	X	X					X	
X	102.5	X		X				X	
X	102.7	X	X	X				X	
X	102.9	X			X			X	
X	103.1	X				X		X	
X	103.3	X	X			X		X	
X	103.5	X		X		X		X	
X	103.7	X	X	X		X		X	
X	103.9	X			X	X		X	
X	104.1	X							X
X	104.3	X	X						X
X	104.5	X		X					X
X	104.7	X	X	X					X
X	104.9	X			X				X
X	105.1	X				X			X
X	105.3	X	X			X			X
X	105.5	X		X		X			X
X	105.7	X	X	X		X			X
X	105.9	X			X	X			X
X	106.1	X						X	X
X	106.3	X	X					X	X
X	106.5	X		X				X	X
X	106.7	X	X	X				X	X
X	106.9	X			X			X	X
X	107.1	X				X		X	X
X	107.3	X	X			X		X	X
X	107.5	X		X		X		X	X
X	107.7	X	X	X		X		X	X
X	107.9	X			X	X		X	X

SECTION 6  
PARTS LISTS

6-1 ORDERING INFORMATION

A. To order parts for the 695 Exciter, write:

QEI Corporation  
P.O. Box 805  
Williamstown, NJ 08094

or call:

1-609-728-2020

B. Provide the following information:

1. Station Call
2. Exciter Serial No.
3. QEI Part No.
4. Shipping Address
5. Billing Address
6. Desired method of shipment



A1 CHASSIS ASSEMBLY

<u>REF. DES.</u>	<u>DESCRIPTION</u>	<u>QEI PART NO.</u>
C1,C2	Cap., Cer., .01uf, 1KV	110-0103-K
C3	Cap., Elect., 4900uf	110-3498
C4,C5	Cap., Cer., .05uf, 100V	110-0503-100
C6,C7	Cap., Elect., 5000uf, 25V	110-3508-25
C8,C10	Cap., Elect., 100uf, 25V	110-3107
C9	Cap., Elect., 500uf, 50V	110-3507-50
CR1,CR4,CR5	Diode, Bridge Rectifier	113-1960-1
CR2,CR5	Diode, Silicon, 1N4001	113-04001
F1	Fuse, 1A	120-0002
J1	Connector, BNC	130-0038
J2-J5	Connector, BNC	130-0001
J6	Connector, "N" Female	130-0004
J7-J11	Connector, BNC	130-0001
M1	Meter	145-0015
P1	Line Cord	130-5004
Q1,Q2	Transistor, NPN, 2N4401	160-04401
R1	Resistor, Carb., 270 ohm	RC20GF271J
R2	Resistor, Carb., 1.5K	RC20GF152J
R3	Resistor, Carb., 330 ohm	RC20GF331J
R4	Resistor, Carb., 820 ohm	RC20GF821J
R5	Resistor, Carb., 4.7K	RC20GF472J
R6	Resistor, Var., 5K	RV4NAYSK502A
R7,R8	Resistor, WW, 0.27 ohm 5W	166-0027
R9	Resistor, WW, 33 ohm, 10W	166-0340
R10	Resistor, Carb., 82 ohm 2W	RC42GF820J
S1,S3	Switch, DPDT	175-0003-F
S2	Switch, SPDT	175-0006
T1	Transformer, Power	180-3140
T2	Transformer, Power	180-340X
TB1	Terminal Board, 3 pt.	181-0003
U1	I.C., Voltage Reg., LM350	182-0350
U2	I.C., Voltage Reg., LM323	182-323K
U3	I.C., Voltage Reg., LM340T-12	182-340T-12
U4	I.C., Voltage Reg., LM320T-12	182-320T

## 6-2 LISTS

A2 PLL & MOD CONTROL ASSEMBLY

<u>REF. DES.</u>	<u>DESCRIPTION</u>	<u>QEI PART NO.</u>
A2	Circuit Board	100-6950022
C1,C12,C18,C19,C31	Cap., Mica, 470 pf	110-1471
C2,C5,C25-C27	Cap., Cer., .01 uf	110-0103
C3,C9	Cap., Cer., .001 uf	110-0102
C4,C13	Cap., Mica, 1000 pf	110-1102
C6,C22,C32	Cap., Tant., .22 uf	110-3224T
C7	Cap., Mica, 620 pf	110-1621
C8,C14,C24,C34-C36	Cap., Cer., .1 uf	110-0104
C10,C20,C21	Cap., Elect., 5 uf	110-3505
C11	Cap., Elect., 15 uf	110-3156
C15	Cap., Mica, 10 pf	110-1100
C16	Cap., Mica, 22 pf	110-1220
C17	Cap., Var., 1-10 pf	110-6110
C23	Cap., Film, .027 uf	110-5273
C28,C29,C37,C38	Cap., Tant., 1 uf	110-3105T
C30	Cap., Poly., 2200 pf	110-4222
C33	Cap., Poly., .01 uf	110-4103
J1-J3	Connector, Phono	130-0010
J201,J202,J203	Connector, 16 Pin DIP	130-0316-1
Q1,Q6	Transistor, NPN, 2N5179	160-05179
Q2-Q4,Q8-Q10,Q13,Q14	Transistor, NPN, 2N4401	160-04401
Q5	FET, 2N5345	160-13819
Q7,Q11,Q12	Transistor, DNP, 2N4403	160-04403
R1,R38	Resistor, Carb., 100 ohms	RC20GF101J
R2	Resistor, Carb., 390 ohms	RC20GF391J
R3,R4	Resistor, Carb., 270 ohms	RC20GF271J
R5	Resistor, Carb., 620 ohms	RC20GF621J
R6,R56,R57	Resistor, Carb., 330 ohms	RC20GF331J
R8-R17	Resistor, Carb., 1k, 1/4W	RC07GF102J
R18,R19,R37, R49-R51,R66,R70	Resistor, Carb., 4.7K	RC20GF472J
R20,R40,R53	Resistor, Carb., 1.5K	RC20GF152J
R21,R28,R35,R47	Resistor, Carb., 33K	RC20GF333J
R22	Resistor, Carb., 6.8K	RC20GF682J
R23	Resistor, Carb., 150K	RC20GF154J
R24	Resistor, Carb., 56K	RC20GF563J
R25	Resistor, Carb., 47K	RC20GF473J
R26,R41,R60,R61	Resistor, Carb., 100K	RC20GF104J
R27,R30-R32	Resistor, Carb., 3.3K	RC20GF332J
R29,R33,R42,R43,R58	Resistor, Carb., 10K	RC20GF103J
R34,R36	Resistor, Carb., 330K	RC20GF334J
R39	Resistor, Carb., 510 ohms	RC20GF511J

A2 PLL & MOD CONTROL ASSEMBLY (continued)

<u>REF.DES.</u>	<u>DESCRIPTION</u>	<u>QEI PART NO.</u>
R45,R69,R79-R81	Resistor, Carb., 1K	RC20GF102J
R46	Resistor, Carb., 4.7K, 1/4W	RC07GF472J
R48	Resistor, Carb., 15K	RC20GF153J
R52	Resistor, Carb., 82 ohms	RC20GF820J
R54,R83-R85	Resistor, Var., 1K	167-3102
R55	Resistor, Film, 7.87K 1%	165-7871
R59	Resistor, Var., 10K	167-3103
R62,R63	Resistor, Carb., 180K	RC20GF184J
R64,R65,R67,R68	Resistor, Carb., 2.2K	RC20GF222J
R44,R78	Resistor, Film., 2.49K, 1%	165-2491
R71	Resistor, Film., 470K,1%	165-4703
R72	Resistor, Film., 200K, 1%	165-2003
R73	Resistor, Film., 100K, 1%	165-1003
R74	Resistor, Film., 49.9K, 1%	165-4992
R75	Resistor, Film., 23.7K, 1%	165-2372
R76	Resistor, Film., 11K, 1%	165-1102
R77	Resistor, Film., 5.11K, 1%	165-5111
R82	Resistor, Carb., 51 ohms	RC20GF510J
R86-R88	Resistor, Carb., 2.2K, 1/4W	RC07GF222J
T1	Transformer, Bifilor	180-Q9002
T2	Transformer, Audio	180-2001
U1	I.C., ECL, 10131	182-10131
U2	I.C., Counter, 745196	182-8290
U3,U9,U10	I.C., Gate, 7400	182-7400
U4,U8	I.C., Filp-Flop, 7474	182-7474
U5,U7	I.C., Counter, 74192	182-4192
U11	I.C., Dual op-amp,NE532	182-0532
U12-U15	I.C., Counter, 7490	182-7490
U16	I.C., Gate, 7440	182-7440
U17	I.C., Dual one-shot, 74123	182-4123
U18,U19	I.C., Dual op-amp, NE5532	182-5532
U20,U21	I.C., Analog Switch,DG202	182-0202
Y1	Crystal, 8MHz	198-0800



PARTS LIST

A3 INTERFACE ASSEMBLY

<u>REF. DES.</u>	<u>DESCRIPTION</u>	<u>QEI PART NO.</u>
A3	Circuit Board	100-695002
C1,C15,C17	Cap., Elect., 100 uf	110-3107
C2	Cap., Tant., .47 uf	110-3474T
C3,C4,C6-C10	Cap., Cer., .01 uf	110-0103
C5,C18-C20	Cap., Cer., .1 uf	110-0104
C11	Cap., Tant., 1 uf	110-3105T
C12-C14	Cap., Mica, 1000 pf	110-1102
CR1-CR3	Diode, Silicon, 1N4446	113-04446
CR4	Diode, Zener, 1N5230	113-25230
DS1,DS2	Display, Led, MAN6710	192-16710
DS3-DS8,DS13	Display, Led, Red, HLMP-2685	113-3003
DS9,DS10	Display, Led, Yellow,HLMP-2720	113-3008
DS11	Display, Led, Green,HLMP-2820	113-3006
DS12	Display, Led, Red, HLMP-2620	113-3007
J301-J309,JU1,JU2	Connector, 16 Pin, DIP	130-0316-1
L1,L2	Inductor, Wideband	140-2008
Q1-Q6	Transistor, NPN, 2N4401	160-04401
Q7,Q8,Q11,Q12	Transistor, DNP, 2N4403	160-04403
Q9,Q10,Q13	Transistor, DNP, 2N5401	160-05401
R1-R15,R17-R24,R40	Resistor, Carb., 270ohms, 1/4W	RC07GF271J
R16,R25-R28	Resistor, Carb., 4.7K, 1/4W	RC07GF472J
R29,R32,R69,R94	Resistor, Carb., 1K	RC20GF102J
R30,R36,R54,R78	Resistor, Carb., 22 ohms	RC20GF220J
R31,R51,R76	Resistor, Carb., 1.5K	RC20GF152J
R33-R35,R61,R82,R86	Resistor, Carb., 4.7K	RC20GF472J
R37	Resistor, Carb., 27K	RC20GF273J
R38,R46,R73,R74	Resistor, Var., 10K	167-3103
R39,R43	Resistor, Carb., 100K	RC20GF104J
R41	Resistor, Carb., 10K	RC20GF103J
R42	Resistor, Carb., 8.2K	RC20GF822J
R44	Resistor, Carb., 3.3M	RC20GF335J
R45	Resistor, Film., 2.67K, 1%	165-2671
R47	Resistor, Film., 7.5K, 1%	165-7501
R48,R98,R99	Resistor, Var., 1K	167-3102
R49	Resistor, Film., 2.21K, 1%	165-2211
R50,R63	Resistor, Film., 6.81K, 1%	165-6811
R52,R62,R84,R89,R91	Resistor, Film., 499 ohms	165-4990

## PARTS LIST (Cont'd)

A3 INTERFACE ASSEMBLY

<u>REF. DES.</u>	<u>DESCRIPTION</u>	<u>QEI PART NO.</u>
R55	Resistor, Film., 20K, 1%	165-2002
R56,R80	Resistor, Film., 1.5K, 1%	165-1501
R57,R59,R87	Resistor, Film., 2.0K, 1%	165-2001
R58,R104	Resistor, Film., 110 ohms, 1%	165-1100
R60,R70,R75, R103,R107	Resistor, Film., 1K, 1%	165-1001
R64	Resistor, Carb., 270 ohms	RC20GF271J
R65,R68	Resistor, Carb., 3.3K	RC20GF332J
R66,R67	Resistor, Film., 2.55K, 1%	165-2551
R71,R72	Resistor, Film., 5.11K, 1%	165-5111
R79	Resistor, Film., 8.25K, 1%	165-8251
R81	Resistor, Film., 750 ohms, 1%	165-7500
R83	Resistor, Film., 5.62K, 1%	165-5621
R85	Resistor, Film., 3.92K, 1%	165-3921
R88,R105,R106	Resistor, Film., 221 ohms, 1%	165-2210
R90,R92,R97	Resistor, Film., 2.49K, 1%	165-2491
R93,R95	Resistor, Carb., 6.8K	RC20GF682J
R96	Resistor, Carb., 2.2K	RC20GF222J
R100	Resistor, Film., 4.99K, 1%	165-4991
R101,R102	Resistor, Carb., 62 ohms	RC20GF620J
U1,U2	I.C., Decoder, Driver 7447	182-7447
U3,U4	I.C., Multiplexer, 74157	182-4157
U5	I.C., Dual op-amp, 5532	182-5532
U6	I.C., Op-Amp, 741	182-1741
U7,U8	I.C., Quad Comparator, 1M339	182-0339
U9,U10	I.C., Dual op-amp, 532	182-0532

## PARTS LIST

A4 RECEIVER/LOG AMPLIFIER ASSEMBLY

<u>REF. DES.</u>	<u>DESCRIPTION</u>	<u>QEI PART NO.</u>
A4	Circuit Board	100-6950024
C1,C5,C24,C27, C38,C42,C43	Cap., Cer., .01 uf	110-0103
C2	Cap., Mica, 470 pf	110-1471
C3,C9,C11,C23, C26,C35,C46,C49- C51,C56,C57,C62-C64	Cap., Cer., .1 uf	110-0104
C4,C31,C33, C36,C40,C41	Cap., Mica, 1000 pf	110-1102
C6,C29,C55	Cap., Mica, 27 pf	110-1270
C7	Cap., Mica, 22 pf	110-1220
C8	Cap., Mica, 39 pf	110-1390
C10	Cap., Elect., 5 uf	110-3505
C12,C13,C44	Cap., Cer., .05 uf	110-0503
C14,C22	Cap., Tant., 1 uf	110-3105T
C15,C34,C60,C65	Cap., Elect., 100 uf	110-3107
C16	Cap., Tant., 2.2 uf	110-3225T
C17,C20,C25	Cap., Mica 68 pf	110-1680
C18,C21	Cap., Var., 2-22 pf	110-6518
C19,C54	Cap., Mica, 10 pf	110-1100
C28,C61	Cap., Mica, 120 pf	110-1121
C30	Cap., Mica, 300 pf	110-1301
C32	Cap., Mica, 270 pf	110-1271
C37	Cap., Var., 5-65 pf	110-6565
C39	Cap., Mica, 500 pf	110-1501
C45	Cap., Mica, 620 pf	110-1621
C47	Cap., Mica, 220 pf	110-1221
C48	Cap., Cer., .001 uf	110-0102
C52,C53,C58,C59	Cap., Cer., 1 uf	110-0105
C66	Cap., Mica, 51 pf	110-1510
CR1-CR4,CR6, CR10,CR15	Diode, Silicon 1N4446	113-04446
CR5	SCR, 2N5061	113-45061
CR7	Diode, Zener, 4.7V, 1N5230	113-25230
CR8,CR9	Diode, Varicap, MV1650	113-5650
CR11,CR12	Diode, Germanium, 1N34	113-0034
CR13,CR14	Diode, Zener, 5.2V, 1N5234	113-25234
FL1	Filter, Ceramic, 455KHz	146-455KI
J1	Connector	130-0010
J409	Connector, 16 Pin DIP	130-0316-1



A4 RECEIVER/LOG AMPLIFIER ASSY. (cont.)

<u>REF. DES.</u>	<u>DESCRIPTION</u>	<u>QEI PART NO.</u>
L1,L2	Inductor	140-Q8019
L3,L4	Inductor	140-Q8020
L5	Inductor, Wideband Choke	140-2008
L6	Inductor	140-Q8021
L7,L8	Inductor	140-Q8022
L9	Inductor	140-Q8023
L10	Inductor	140-8024
Q1,Q4,Q5	Transistor, NPN, 2N5179	160-05179
Q2,Q6	Transistor, NPN, 2N4401	160-04401
Q3	Transistor, JFET, 2N5245	160-13819
R1	Resistor, Carb., 47k	RC20GF473J
R2,R45	Resistor, Carb., 22 ohms	RC20GF220J
R3,R21,R34,R43	Resistor, Carb., 51 ohms	RC20GF510J
R4,R5,R23,R25,R27	Resistor, Carb., 10k	RC20GF103J
R6,R46	Resistor, Carb., 620 ohms	RC20GF621J
R7,R24	Resistor, Carb., 820 ohms	RC20GF821J
R8,R14,R83	Resistor, Var., 1k	167-3102
R9,R12,R35	Resistor, Carb., 220 ohms	RC20GF221J
R10,R58	Resistor, Carb., 180k	RC20GF184J
R11,R38	Resistor, Carb., 2.7k	RC20GF272J
R13,R71-R74	Resistor, Carb., 1k, 1/4W	RC07GF102J
R15,R55-R57,		
R66,R67,R82,R85	Resistor, Carb., 4.7k, 1/4W	RC07GF472J
R16	Resistor, Carb., 1k	RC20GF102J
R17,R54,R63,R65,		
R68,R70,R86-R88	Resistor, Carb., 10k, 1/4W	RC07GF103J
R18,R20,		
R28,R49,R69	Resistor, Var., 10k	167-3103
R19,R22	Resistor, Carb., 4.7k	RC20GF472J
R26,R30	Resistor, Carb., 100k	RC20GF104J
R29	Resistor, Carb., 33k	RC20GF333J
R31	Resistor, Carb., 56k	RC20GF563J
R32,R41	Resistor, Carb., 3.3k	RC20GF332J
R33	Resistor, Carb., 180 ohms	RC20GF181J
R36,R52	Resistor, Carb., 15k	RC20GF153J
R37	Resistor, Carb., 1M	RC20GF105J
R39,R40	Resistor, Film, 11k, 1%	165-1102

A4 RECEIVER/LOG AMPLIFIER ASSY.(cont)

<u>REF.DES.</u>	<u>DESCRIPTION</u>	<u>QEI PART NO.</u>
R42,R50,R51, R59,R61,R80	Resistor, Carb., 2.2k	RC20GF222J
R44	Resistor, Film, 768 ohms, 1%	165-7680
R47,R48	Resistor, Carb., 22k	RC20GF223J
R53	Resistor, Carb., 82k	RC20GF823J
R60	Resistor, Carb., 7.5k	RC20GF752J
R62	Resistor, Carb., 1.2k	RC20GF122J
R64,R75	Resistor, Carb., 330 ohms	RC20GF331J
R76	Resistor, Carb., 82 ohms, 2W	RC42GF820J
R78	Resistor, Carb., 100 ohms, 2W	RC42GF101J
R81	Resistor, Carb., 6.8k	RC20GF682J
R84	Resistor, Film, 2.49k, 1%	165-2491
T1	Transformer, L.O.	180-Q9001
T2	Transformer, Bifilor	180-Q9002
U1	I.C., Demodulator, LA1235	182-1235
U2-U5,U9,U10	I.C., Dual op-amp, 5532	182-5532
U6,U7	I.C., Diff. Amp., UA733	182-0733
U8	I.C., Log Amp., TL441	182-0441
Y1	Crystal, Fc+10.7 MHz	
Z1,Z2	Mixer	179-0021

## PARTS LIST

A5 AUTOMOD ASSEMBLY

<u>REF. DES.</u>	<u>DESCRIPTION</u>	<u>QEI PART NO.</u>
A5	Circuit Board	100-6950023
C1,C2,C4, C7,C11-C13	Cap., Cer., .1uf	110-0104
C3	Cap., Tant., .22uf	110-3224T
C5	Cap., Tant., .1uf	110-3104T
C6	Cap., Tant., .47uf	110-3474T
C8	Cap., Poly., 3000pf	110-4302
C9	Cap., Elect., 5uf	110-3505
C10	Cap., Elect., 100uf	110-3107
CR1-CR3	Diode, Germanium, 1N34	113-0034
CR4-CR9	Diode, Silicon, 1N4446	113-04446
J506,J507,J509	Connector, 16 Pin DIP	130-0316-1
Q1	Transistor, JFET, 2N5245	160-13819
R1,R6	Resistor, Carb., 1k, 1/4W	RC07GF102J
R2	Resistor, Var., 1k	167-3102
R3-R5,R7, R8,R10,R16	Resistor, Carb., 10k, 1/4W	RC07GF103J
R9,R14,R25	Resistor, Carb., 100k, 1/4W	RC07GF104J
R11,R12,R13,R18, R21-R24,R26,R29	Resistor, Carb., 4.7k, 1/4W	RC07GF472J
R15,R27,R47,R48	Resistor, Carb., 2.2k, 1/4W	RC07GF222J
R17	Resistor, Carb., 12M	RC20GF126J
R19	Resistor, Carb., 150k	RC20GF154J
R20	Resistor, Var., 100k	167-3104
R28	Resistor, Carb., 560k	RC20GF564J
R30	Resistor, Carb., 330 ohms	RC20GF331J
R31-R46	Resistor, Carb., 270ohms, 1/4W	RC07GF271J
U1,U2	I.C., Quad Comparator, LM339	182-0339
U3	I.C., Dual op-amp, 5532	182-5532
U4	I.C., One Shoe, 74121	182-4121
U5	I.C., Decoder, 74LS138	182-74LS138
U6	I.C., CPU, Z80	182-0Z80
U7	I.C., EPROM, 2732	182-2732
U8	I.C., RAM, 6116	182-6116
U9	I.C., Timer, 8253	182-8253
U10-U13	I.C., Octal Latch, 74LS374	182-74LS374
U14	I.C., Bus Tranciever, 8286	182-8286



## PARTS LIST

A6 BUFFER AMP ASSEMBLY

<u>REF. DES.</u>	<u>DESCRIPTION</u>	<u>QEI PART NO.</u>
A6	Circuit Board	100-6950025
C1-C4	Cap., Mica, 1000pf	110-1102
C5-C7	Cap., UC Mica, 1000pf	110-2102
C8,C9	Cap., Mica, 27pf	110-1270
C10	Cap., UC Mica, 470pf	110-2471
P1	Plug, Male, Phono	130-0011
Q1,Q2	Transistor, NPN, 2N5179	160-05179
Q3	Transistor, NPN, 2N3866	160-03866
R1,R2,R12	Resistor, Carb., 10 ohms	RC20GF100J
R3	Resistor, Carb., 120 ohms	RC20GF121J
R4,R5	Resistor, Carb., 1.5k	RC20GF152J
R6,R7	Resistor, Carb., 510 ohms	RC20GF511J
R8,R9	Resistor, Carb., 100 ohms	RC20GF101J
R10	Resistor, Carb., 10k	RC20GF103J
R11	Resistor, Carb., 470 ohms	RC20GF471J
R13	Resistor, Carb., 270 ohms	RC20GF271J
T1-T3	Transformer, Bifilor	180-Q9002

## PARTS LIST

A7 POWER AMP ASSEMBLY

<u>REF. DES.</u>	<u>DESCRIPTION</u>	<u>QEI PART NO.</u>
A7	Circuit Board	100-695003
C1	Cap., Var., 16-100pf	110-6610
C2,C8,C9,C14	Cap., Var., 16-150pf	110-6615
C3,C4	Cap., UC Mica, 120pf	110-2121
C5,C11	Cap., Cer., .01uf	110-0103
C6,C12	Cap., Elect., 5uf	110-3505
C7,C13	Cap., UC Mica, 1000pf	110-2102
C10	Cap., UC Mica, 470pf	110-2471
C15	Cap., UC Mica, 270pf	110-2271
L1,L9	Inductor	
L2,L7	Inductor	
L3,L6	Inductor, Widebank Choke	140-2016
L4,L8	Inductor	
L5	Inductor	
Q1	Transistor, NPN, 2N5641	160-05641
Q2	Transistor, NPN, 2N5643	160-05643
R1,R2,R4	Resistor, Carb., 10 ohms	RC20GF100J
R3	Resistor, Carb., 180 ohms	RC20GF181J
R5	Resistor, Carb., 10 ohms, 2W	RC42GF100J

## PARTS LIST

A8 DIRECTIONAL COUPLER & LPF ASSEMBLY

<u>REF. DES.</u>	<u>DESCRIPTION</u>	<u>QEI PART NO.</u>
A8	Circuit Board	100-6950026
C1,C6	Cap., Mica, 27pf	110-1270
C2,C4	Cap., Mica, 51pf	110-1510
C3,C5	Cap., Mica, 5pf	110-1050
C7,C8	Cap., Cer., .001uf	110-0102
CR1,CR2	Diode, Silicon, HPA2800	113-0005
L1-L3	Inductor	140-Q8019
R1,R3	Resistor, Carb., 130 ohms	RC20GF131J
R2,R4	Resistor, Carb., 4.7k	RC20GF472J



PARTS LIST

A9 METER SWITCH ASSEMBLY

<u>REF.DES.</u>	<u>DESCRIPTION</u>	<u>QEI PART NO.</u>
A9	Circuit Board	100-695002A
J904	Connector, 16 Pin DIP	130-0316-1
R1	Resistor, Carb., 10k	RC20GF103J
R2	Resistor, Film, 7.87k, 1%	165-7871
R3	Resistor, Film, 28.7k, 1%	165-7872
R4,R5	Resistor, Film, 120 ohms, 1%	165-1200
S1	Switch, 8 Position	175-0033

PARTS LIST

A10 POWER SWITCH ASSEMBLY

<u>REF. DES.</u>	<u>DESCRIPTION</u>	<u>QEI PART NO.</u>
A10	Circuit Board	100-695002B
C1,C2	Cap., Cer., .01uf	110-0103
C3	Cap., Cer., .1uf	110-0104
J10	Connector, 16 Pin DIP	130-0316-1
L1	Inductor	140-Q8025
R1	Resistor, Carb., 820 ohms	RC20GF821J
R2	Resistor, Var., 250 ohms	167-3251
S1	Switch, 3 Position	175-0032

SECTION 7  
SCHEMATICS