QEI CORPORATION

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# SECTION 1

## GENERAL INFORMATION

### 1-1 DESCRIPTION

The QEI Type 675 FM Exciter is an all solid state, on carrier direct FM, phase locked, frequency synthesized exciter designed to meet or exceed the FCC requirements for use in the standard FM broadcast band (88-108 MHz). The Exciter may be programmed to operate on any 100 KHz increment in the FM band using the same high stability 8 MHz crystal as a reference.

The Exciter is manufactured in a standard 3½" X 19" rack mount. All operator controls, adjustments and indicators are located on the front panel. Signal input and output connections, fuse, AC power and the MONO-COMP switch are located on the rear panel.

The Exciter is all solid state, employing silicon transistors, diodes and integrated circuits. The Exciter features phase locked stability and on carrier direct FM for full multiplex operation with freedom from spurious responses. The Power Amplifier is capable of withstanding any magnitude or phase of VSWR and the power output is adjustable from less than 5 to greater than 20 watts.

### 1-2 ELECTRICAL SPECIFICATIONS

| | |
|---|---|
| Primary Power | 105-125/210-250 Vac 50/60 Hz. |
| Power Consumption | Approximately 50 watts max. |
| Power Output | Adjustable from less than 5 to greater than 20 watts. |
| Frequency Range | 88 MHz to 108 MHz (programmable). |
| Type of Emission | 180F3 or 300F9. |
| Modulation Capability (less than 1% THD) | 150 KHz peak. |
| Frequency Stability | ± 500 Hz (-10°C to +55°C). |
| Output Impedance | 50 Ohms. |
| VSWR Protection | Any magnitude or phase. |
| Harmonic and Spurious Suppression | Better than 80dB. |

Mono Input

| | |
|---|---|
| a. Impedance | 600 Ohms (balanced). |
| b. Level | +10 dBm for 75 KHz dev. @400 Hz. |
| c. Pre-emphasis | 75 usec ± 1 dB (50 usec optional). |

Stereo Input

| | |
|---|---|
| a. Impedance | 10K. |
| b. Level | $4V_{pp}$ for 75 KHz deviation. |

SCA Inputs (2)

| | |
|---|---|
| a. Impedance | 10K. |
| b. Level | $1V_{pp}$ for 10% injection. |

| | |
|---|---|
| Distortion | 0.35% max. THD @ 75 KHz dev. |
| FM Noise (below 75KHz dev. with 75 usec de-emp.) | Better than -70dB. |
| AM Noise | Better than -55dB. |
| Stereo Separation | Better than 40dB from 30Hz to 15KHz with QEI Model 772 Stereo Generator. |
| Crosstalk (Main to SCA) | -55dB. |
| Crosstalk (SCA to Main) | -65dB. |
| Environmental | 0°C to +55°C operating. (-15°C to +55°C with 30 minute warm up.) |

## 1-3 MECHANICAL SPECIFICATIONS

| | |
|---|---|
| Dimensions | 3½"H x 19"W x 14"D. |
| Mounting Dimensions | Figure 2-1. |
| Net Weight | 13 pounds |
| Shipping Weight | 17 pounds |
| Maximum Operating Temp. | 131°F (55°C) Ambient. |

## 1-4 INSTRUMENT IDENTIFICATION

This unit is identified by a Model Number and a six digit serial number located on the rear panel. All correspondence to your sales representative or the factory in regard to this unit should reference the complete Model and Serial Numbers.

## 1-5 ACCESSORIES

The Exciter may be used as a 10 Watt Transmitter with the accessory Meter Panel. This Panel contains Final Amplifier, and Incident and Reflected Power Metering, directional coupler and signal sampler.

# 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 for possible future use.

## 2-2 PREPARATION FOR USE

The unit is designed to be mounted in a standard 19" rack. Air space should be provided above and below the unit so that heat generated by the circuitry may be dissipated. Additional cooling may be required if the unit is placed above high heat generating equipment in order to keep the ambient temperature below the maximum specified.

Mount the unit to the rack using (4) #10 countersunk screws and finishing washers.

The unit requires a 105-125V single phase, 50 or 60 Hz power source or a 210-250V single phase, 50 or 60 Hz power source. The identification place on the back panel shows for which power source the unit is wired. See Section 5-5 for information on changing taps.

Connect a suitable 50 ohm RF load to RF OUT jack J1 using a type N connector and RG-8/U or equivalent cable. Connect Mono audio line to TB1 and/or Stereo Generator to COMP jack J2. Connect SCA Generator to either SCA jack J3 or J4. Connect AC power plug to appropriate power source.

C A U T I O N

When connecting the Exciter to the Transmitter, tuning of the transmitter input circuitry will be facilitated by the use of a 3dB 30 watt pad and a thru-line wattmeter between the Exciter and the Transmitter. If these devices are not available reduce the output power of the exciter and tune the input of the transmitter until a somewhat reasonable match is obtained. If the transmitter is already tuned to exciter frequency a "touch up" adjustment should be all that is necessary. If the IPA of the transmitter can be mistuned to the point of oscillation be sure to use the 3dB pad. It is possible to drive large amounts of power back into the Exciter from an oscillating IPA thereby destroying the output transistor.

In some transmitters it is possible to overdrive the IPA of the transmitter causing it to break up. Therefore, you should keep the PWR ADJ control of the exciter at minimum, then slowly increase it until the IPA of the transmitter indicates the same amount of grid current as with your previous exciter. The final stage of the transmitter can be tuned for full output at this time.

## 2-3 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 re-shipment. If they are not available, proceed as follows:

A. Use a carton with minimum test strength of 250 lbs.

B. Use heavy paper or sheets of cardboard to protect all surfaces.

C. Use at least four inches of tightly packed shock absorbing material such as extra firm polyurethane foam or rubberized hair. NEWSPAPER IS NOT SUFFICIENT CUSHIONING MATERIAL.

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 OPERATOR CONTROLS AND INDICATORS (FRONT PANEL)

1. POWER Switch S1 and POWER Indicator CR2

   This switch controls primary power to the unit. The LED (CR2) will light indicating power on. If the LED flashes, it indicates a power supply overload or an extreme RF load mismatch.

2. MULTIMETER Switch S2 and MULTIMETER M1.

   This switch controls the function monitored by the meter. A list of multimeter readings is supplied by the factory with each unit. Since these readings are only a relative indication, it is recommended that they be checked and logged periodically so that any excessive deviation from normal will be recognized.

3. PWR ADJ Control R1

   This screwdriver adjustment can be used to vary the RF output from less than 5 watts to over 20 watts. If the Exciter is to be used below approximately 12 watts output, it is recommended that the tap on the power transformer secondary be moved to the 75% point. This will limit the maximum output power to less than 12 watts but will cut down on the primary power consumed and lower heat dissipation within the unit. See Section 5-6.

4. FREQ ADJ Control R2

   This screwdriver adjustment can be used to fine tune the Exciter over a range of approximately $\pm$ 500 Hz.

5. AFC LOCKED Lamp DS1 and Socket XDS1

   This lamp indicates when the FMO is locked to the reference crystal oscillator. If the FMO is not locked to the reference, sensing circuitry will extinguish lamp DS1 and shut down the RF output of the Exciter. It is normal for this lamp to light and RF power to appear within a few seconds after the Exciter is energized.

## 3-2 CONTROLS AND CONNECTIONS (REAR PANEL)

1. MONO/COMP Switch S3

   This switch selects either the mono or stereo input signals. In the mono position, the input signal is automatically pre-emphasized in accordance with the 75 usec curve.

2. RF OUT Jack J1.

3. COMP Jack J2.

   Approximately $4V_{pp}$ across 10K is required for 75 KHz deviation.

4. SCA Jacks Js and J4.

   Approximately $1V_{pp}$ across 10K is required for 7.5 KHz deviation.

5. METER Jack J5.

   This jack provides access to the PA voltage and current information required by the optional meter panel. This panel is used when the Exciter is used as a low power transmitter.

6. TB1.

   This is a 600 ohm balanced audio input. +10 dBm $\pm$ 1 dB is required for 75 KHz deviation at 400 Hz. This input is always pre-emphasized. The center terminal of TB1 is connected to chassis ground.

7. FUSE F1 and XF1.

   This is the primary power fuse for the unit. It is the only fuse necessary since all power supplies are short circuit protected. It should be replaced only with a fuse of the same type and rating as the original (3AG 1A).

## 3-3 INITIAL OPERATION

1. Operate POWER switch and verify that LED CR2 is lit.

2. Verify that AFC LOCKED lamp lights and RF output appears within a few seconds.

3. Check MULTIMETER readings against factory supplied information. Readings should agree within $\pm$ 10%.

   NOTE: The RF reading will vary somewhat depending on the RF load connected to the Exciter.

## 3-4 NORMAL OPERATION

For normal operation, use PWR ADJ Control R1 to set power output to level required. Check MULTIMETER readings periodically to verify that no drastic changes have taken place.

Use FREQ ADJ control R2 to fine tune Exciter to exact frequency. Remember that a phase locked Exciter does not exhibit the drift of a frequency locked exciter. Be sure that any frequency error is in the Exciter and not in the measuring instrument before you attempt to tune the Exciter.

Use signal levels in Section 3-2 to get approximate 100% levels and use an FCC Type Approved modulation monitor QEI Model 671 (with Model 771 for stereo) or equivalent for exact determination of modulation.

SECTION 4

THEORY OF OPERATION

## 4-1 GENERAL

Refer to block diagram of the Exciter. The Exciter circuitry is on three circuit boards: A2-FMO and Phase Lock Assembly; A3-IPA and PA Assembly; and A4-Power Supply Regulator Assembly.

1. A2 FMO and Phase Lock Assembly.

   A packaged on carrier direct FM oscillator sub-assembly produces the basic signal. This signal is amplified by the FMO buffer and control amplifier to a level of approximately 100 mw. A sample of this signal is fed to a high speed divider which reduces the frequency to nominally 5 MHz (fc/20). This 5 MHz signal is then processed by the programmable divider whose output is 5 KHz regardless of the assigned frequency. The output of an 8 MHz crystal controlled oscillator is digitally divided to 5 KHz. This signal is phase compared with the output of the programmable divider and the resulting signal is filtered and used to control the FM oscillator sub-assembly. Thus, the programmable divider allows the use of the same high stability 8 MHz reference crystal regardless of channel assignment.

It should be noted that a phase locked loop required a phase error <u>not</u> a <u>frequency</u> error to generate its correction signal. Because of this, the output of a phase locked exciter exhibits long term phase coherence with the reference oscillator without the frequency drift associated with frequency locked loop exciters.

Circuitry is included that senses lock and provides a signal that cuts off the control amplifier thereby shutting off the RF output until lock is established.

2. A3-IPA and PA Assembly.

   This board contains a two stage amplifier which raises the 100 mw output of the A2 assembly to a level of 20 watts. The transistors are of the emitter ballasted type and this in conjunction with the circuit and power supply design allow operation into any magnitude or phase of VSWR without damage. However, good operating practice dictates that this VSWR protection not be abused. Do not knowingly operate the Exciter without a proper RF load.

3. A4-Power Supply Regulator Assembly.

This board contains three power supplies. The IPA-PA power supply regulator, the +15V FMO regulator and the 5V FMO logic regulator. All of these supplies are short circuit protected. The IPA-PA supply can be varied from approximately 14V to 24V using the PWR ADJ control for the purpose of controlling the output power of the Exciter.

## 4-2 DETAIL CIRCUIT DESCRIPTION

1. A2 FMO and Phase Lock Assembly.

The output of the FMO sub-assembly is fed to the base of Q1, the FMO buffer. This stage drives Q3, the control amplifier and U1, a high speed emitter coupled logic (ECL) flip-flop. Q3 raises the power level to approximately 100 mw, a level sufficient to drive the IPA. If an unlocked condition is sensed, a signal is developed which causes Q2 to conduct thereby shorting the base of Q3 to ground and shutting off the RF output.

Q4 provides level matching between the output of U1 (fc ÷ 2) and the input of U2. U2 is a high speed divide by 10 circuit. The output of U2 is therefore fc÷20. U3, U4, U5 and U6 make up the programmable divider. By grounding the appropriate points (as shown in Table 5-1 ), this circuit can be made to divide by any whole number from 2 to 2000. For operation in the FM band, the circuit is made to divide by a number between 881 and 1079. When this is done, the output frequency of the programmable divider is 5 KHz when the FMO is operating on the assigned channel.

Q7, Y1 and associated circuitry form a stable 8 MHz crystal oscillator which provides the reference frequency for the system. C27 is the coarse tune capacitor and Q8 (a transistor used as a varicap) provides the voltage controlled fine tuning. Q8 is controlled by the FREQ ADJ pot on the front panel. Q9 buffers the output of the reference oscillator and provides level matching to drive U7. U7, U8 and U9 are TTL integrated circuits. The output of U9 is 8 MHz ÷ 1600 or 5 KHz. This 5 KHz square wave is differentiated and applied to Q7. When Q7 conducts, it discharges C21. C21 is charged through constant current source Q6, R46 and R47. The result of this action is to convert the 5 KHz square wave to a linear 5 KHz sawtooth. R47 is an amplitude and linearity adjustment.

The 5 KHz output of the programmable divider drives pulse amplifier Q5. The output of Q5 and the sawtooth converter are coupled to U12. This IC and associated circuitry form a "sample hold" phase detector. U12 is a gated Operational Transconductance Amplifier. This device has a high impedance (constant current) output. R39 and C20 form a

storage circuit. U12 charges this storage circuit to the point on the input sawtooth which is coincident with the pulse from Q5. Therefore, as the phase angle between the reference derived and the FMO derived 5 KHz signals changes, the voltage on C20 rides up or down. However, since the voltage can change only when the pulse from Q5 is present, the filter required to eliminate the reference frequency is greatly reduced. U11 is a high input impedance voltage follower which eliminates any loading of the storage circuit. The low impedance output of U11 is filtered and applied to the AFC control port of the FMO sub-assembly thereby closing the control loop.

Q10 buffers the output of U9 (reference 5 KHz) and drives the REF position on the MULTIMETER.

U10, Q11 and Q12 dorm the circuit that senses lock. A5 KHz square wave from U9 and a 5 KHz pulse from the programmable divider are fed to U10. If the two inputs are not locked, a square wave will appear at pin 6 of U10. This signal is converted to a DC level by Q11 and this level is applied to Q12 which drives the other half of U10. The output of U10 is then fed to Q2 where it shuts down the RF output and to Q13 which turns off the AFC LOCKED lamp.

2. A3 IPA and PA Assembly

The output of the A2 Assembly (approximately 100 mw) is applied to T1. T1 and T2 provide impedance matching to the base of Q1, the IPA. C2 stabilizes the amplifier throughout the power adjust range. C7, C8 and L2 provide impedance matching between the collector of Q1 and the base of Q2, the PA. L5, C14 and C15 provide impedance matching between the collector of Q2 and the load. CR1 and associated circuitry drives the RF position on the MULTIMETER. Parallel bypass capacitors are used on both stages to insure that the power supply is bypassed for all frequencies. This precaution is necessary due to the extremely high low frequency gain of RF power transistors. If adequate bypassing is not used, low frequency oscillations of a sufficient magnitude to destroy the transistor can occur. Do not operate the Exciter with any of these bypass capacitors disconnected. Although the PA can withstand VSWR without damage, good operating practice dictates that the Exciter should not knowingly be operated without a proper load.

3. A4 Power Supply Regulator Assembly.

a. IPA-PA Regulator

A 12 volt zener diode, CR4, is the reference for this supply. The PWR ADJ control R1 (front panel control) supplies all or part of the 12 volts across CR4 to the base of Q2. Q2 and Q3 form a DC amplifier with a gain of approximately 2. This raises the voltage supplied to the base of pass transistor A1Q1 (mtd. on heat sink on rear of unit) to approximately 24.7 volts max.

The emitter of the pass transistor supplies the load through R12. If the current drawn through R12 is excessive, the voltage drop across R12 will exceed the forward voltage necessary to cause Q4 to conduct. When Q4 conducts, it fires SCR CR3 which shorts out the reference thereby causing the supply to shut down. When this occurs, C1 starts to charge through R11. When the voltage at the junction of R11 and C1 becomes more negative than the gate voltage of SCR CR1, CR1 fires discharging C1. The resulting pulse causes Q1 to momentarily interrupt the holding current through CR3 thereby cutting off CR3. This action resets the supply automatically.

b. 15 Volt Regulator

Zener diode CR6 is the reference for this regulator. Q5 and Q7 amplify the voltage across this diode to approximately 15 volts. Q6 acts similar to Q4 if the current drawn from the supply exceeds approximately 100 ma.

c. 5 Volt Regulator

A 6.3 volt zener diode CR5 is the reference for this regulator. Q8 buffers the voltage across this diode and drives the chassis mounted pass transistor A1Q2. Q9 and R25 provide the current limit function for this supply. The limit point is approximately 500 ma.

## SECTION 5

## ALIGNMENT AND TROUBLESHOOTING

### 5-1 EQUIPMENT REQUIRED BUT NOT SUPPLIED

1. RF Load (50 ohms - 20 watts min.)
2. RF Wattmeter (Bird 43 or equivalent)
3. FM Modulation Monitor (QEI 671 or equivalent)
4. Audio Generator (less than .1% distortion)
5. Distortion Analyzer (Hewlett Packard 331 or equivalent)
6. Dual Trace 10 MHz Oscilloscope (Telequipment D54 or equivalent
7. 110 MHz Counter (Stability better than 1 part in $10^6$)
8. Signal Sampler (-20 to -30 dB output)
9. Spectrum Analyzer

NOTE: DO NOT ATTEMPT TROUBLESHOOTING OR ALIGNMENT OF THIS UNIT WITHOUT ADEQUATE TOOLS AND TEST EQUIPMENT.

Before starting alignment of this unit, verify that three supply voltages are present and correct. Connect the Exciter to a suitable (50 ohm - 20 watt) RF load through the signal sampler.

### 5-2 FMO AND PHASE LOCK ASSEMBLY ALIGNMENT

1. AFC Adjustment

   a. Connect a scope to test point "L". Adjust A2R47 for the greatest amplitude linear 5 KHz sawtooth obtainable.

   b. Connect a scope to pin 6 of A2U11. Adjust trimmer accessible through hole in FMO can until pin 7 shows a DC level. Either side of lock will give a sawtooth signal whose frequency becomes lower as lock is approached.

2. Modulation Level Adjustment

   a. Connect an FM Modulation Monitor to the low level output of the signal sampler.

   b. Connect a 400 Hz +10 dBm signal to TB1. Place S3 in MONO position. Adjust A2R31 until monitor reads 100%.

   c. Connect a 400 Hz $4V_{pp}$ ($1.41V_{rms}$) signal to COMP jack J2. Place S3 in COMP position. Adjust A2R65 until monitor reads 100%.

3. Coarse Frequency Adjustment.

   a. Connect a counter to the low level output of the signal sampler.

NOTE: BE SURE OF THE ACCURACY AND STABILITY OF THE COUNTER.

b. Remove all modulation from the Exciter. If any modulation is present, it is necessary for the counter to have a gate time of at least four seconds in order to obtain a correct reading.

c. Set FREQ ADJ pot R2 to the center of its range.

d. Adjust A2C27 until Exciter is on frequency.

e. Vary FREQ ADJ pot R2 from end to end. Frequency should vary approximately $\pm$ 500 Hz. Reset Exciter on frequency.

## 5-3 POWER AMPLIFIER ALIGNMENT

1. Coarse Alignment

a. Connect a power meter capable of displaying 25W to the RF OUT jack J1 located on the rear panel of the unit. Connect a signal sampling probe to the output of the power meter. Connect a spectrum analyzer to the probe. Connect a 50 ohm dummy load to the output of the signal sampling probe. Be sure that the power meter and dummy load are designed for use at FM broadcast frequencies.

b. Apply power to the unit and observe pilot lamp CR2 and AFC LOCKED lamp DS1. If lamp does not illuminate refer to FM0 alignment procedure.

c. Set PWR ADJ control R1 full clockwise. Set the MULTIMETER switch S2 to the IPA position. Set A3C2 to mid-range.

d. Observe an indication of IPA collector current on the multimeter. Maximize this indication by adjusting A2C6 and A2C7 of the A2 board.

e. Set the multimeter switch to the PA position. Adjust A3C7 and A3C8 for a maximum reading in this position.

f. Set the multimeter switch to the RF position. Adjust A3C14 and A3C15 for a maximum reading in this position. The coarse alignment is now complete.

2. Final Alignment

a. Set MULTIMETER switch S2 to the RF position. Adjust A3C14 and A3C15 for maximum reading on the multimeter. If the Power Amplifier draws excessive current and trips the power supply overload circuitry, adjust A3C15 clockwise until this condition is corrected. When this condition appears, the output power is in excess of 20 watts. Adjust A3C15 clockwise to reduce the output power to 20 watts. Readjust A3C14 for a maximum reading on the multimeter.

b. Adjust A3C7 and A3C8 for a maximum reading on the MULTIMETER.

c. Adjust A3C2 for stability as observed on the spectrum analyzer as follows:

Turn the PWR ADJ control R1 to the max, CCW position. Adjust A3C2 for stability as observed on the spectrum analyzer. Turn the PWR ADJ control to the max. CW position. Adjust A3C2 if necessary to stabilize the unit.

## 5-4 EXCITER-TRANSMITTER INTERFACE

When connecting the Exciter to the Transmitter, tuning of the transmitter input circuitry will be facilitated by the use of a 3dB 20watt pad and a thru-line wattmeter between the Exciter and the Transmitter. If these devices are not available reduce the output power of the exciter and tune the input of the transmitter until a somewhat reasonable match is obtained. If the Transmitter is already tuned to exciter frequency a "touch up" adjustment should be all that is necessary. If the IPA of the transmitter can be mistuned to the point of oscillation be sure to use the 3dB pad. It is possible to drive large amounts of power back into the Exciter from an oscillating IPA thereby destroying the output transistor.

## 5-5 TROUBLESHOOTING

Refer to schematics for waveform and voltage information. Using these, the theory of operation in Section 4 and the test equipment listed should allow a competent engineer to diagnose most problems. If factory help is required, it is as close as your telephone.

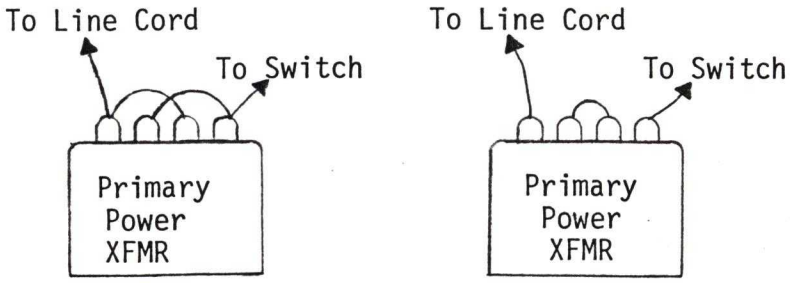
In addition, do not attempt replacement of components on printed circuit boards unless you are familiar with this work. All PC boards can be severely damaged by using the wrong tools or methods. Do not use a soldering iron over 25 watts or anything other than 60/40 ROSIN core solder. Use a "solder sucker" or "solder wick" wire to remove a component.

Because the Power Supplies are overload protected, it is possible for a defect on the A2 or A3 boards to cause a voltage to be either missing or less than nominal. If a voltage is low or missing remove the load and see if the voltage returns.

## 5-6 POWER TRANSFORMER WIRING

1. Input Voltage Change

a. Change jumpers as shown on next page.




105-125V Connection  210-250V Connection

NOTE: Refer to Chasis Schematic for further details.

b. Mark rear of chassis to show supply for which unit is wired.

2. Tap Change

a. If Exciter is to be used below 12 watts, connect Red/Yellow lead to CR1 instead of Yellow lead. This change will limit output power to approximately 12 watts, but will reduce heat dissipation within the unit.

b. Change A4R10 from 820 ohm to 1.5K. This insures that the IPA-PA supply stays in regulation with the reduced input voltage.

c. Change A4R19 from 120 ohm 2 watt to 68 ohm 2 watt. This insures that the +15 volt supply stays in regulation.

TABLE 5-1

PROGRAM KEY

X---TIE TO GROUND  O---OPEN  *--- SHORT

| FREQ. MHz | X1-X2 | A1 | B1 | C1 | D1 | A2 | B2 | C2 | D2 | A3 | B3 | C3 | D3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 88.1 | 0 | | X | X | | | | | X | X | X | X | |
| 88.3 | 0 | | X | X | X | X | X | X | | X | X | X | |
| 88.5 | 0 | | | X | X | X | X | X | | X | X | X | |
| 88.7 | 0 | | X | | X | X | X | X | | X | X | X | |
| 88.9 | 0 | | | | X | X | X | X | | X | X | X | |
| 89.1 | 0 | | X | X | | X | X | X | | X | X | X | |
| 89.3 | 0 | | X | X | X | | X | X | | X | X | X | |
| 89.5 | 0 | | | X | X | | X | X | | X | X | X | |
| 89.7 | 0 | | X | | X | | X | X | | X | X | X | |
| 89.9 | 0 | | | | X | | X | X | | X | X | X | |
| 90.1 | 0 | | X | X | | | X | X | | X | X | X | |
| 90.3 | 0 | | X | X | X | X | X | X | X | | X | X | |
| 90.5 | 0 | | | X | X | X | X | X | X | | X | X | |
| 90.7 | 0 | | X | | X | X | X | X | X | | X | X | |
| 90.9 | 0 | | | | X | X | X | X | X | | X | X | |
| 91.1 | 0 | | X | X | | X | X | X | X | | X | X | |
| 91.3 | 0 | | X | X | X | | X | X | X | | X | X | |
| 91.5 | 0 | | | X | X | | X | X | X | | X | X | |
| 91.7 | 0 | | X | | X | | X | X | X | | X | X | |
| 91.9 | 0 | | | | X | | X | X | X | | X | X | |
| 92.1 | 0 | | X | X | | | X | X | X | | X | X | |
| 92.3 | 0 | | X | X | X | X | | X | X | | X | X | |
| 92.5 | 0 | | | X | X | X | | X | X | | X | X | |
| 92.7 | 0 | | X | | X | X | | X | X | | X | X | |
| 92.9 | 0 | | | | X | X | | X | X | | X | X | |
| 93.1 | 0 | | X | X | | X | | X | X | | X | X | |
| 93.3 | 0 | | X | X | X | | | X | X | | X | X | |
| 93.5 | 0 | | | X | X | | | X | X | | X | X | |
| 93.7 | 0 | | X | | X | | | X | X | | X | X | |
| 93.9 | 0 | | | | X | | | X | X | | X | X | |
| 94.1 | 0 | | X | X | | | | X | X | | X | X | |
| 94.3 | 0 | | X | X | X | X | X | | X | | X | X | |
| 94.5 | 0 | | | X | X | X | X | | X | | X | X | |
| 94.7 | 0 | | X | | X | X | X | | X | | X | X | |
| 94.9 | 0 | | | | X | X | X | | X | | X | X | |

| FREQ. MHZ | X1-X2 | A1 | B1 | C1 | D1 | A2 | B2 | C2 | D2 | A3 | B3 | C3 | D3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 95.1 | 0 | | X | X | | X | X | | X | | X | X | |
| 95.3 | 0 | | X | X | X | | X | | X | | X | X | |
| 95.5 | 0 | | | X | X | | X | | X | | X | X | |
| 95.7 | 0 | | X | | X | | X | | X | | X | X | |
| 95.9 | 0 | | | | X | | X | | X | | X | X | |
| 96.1 | 0 | | X | X | | | X | | X | | X | X | |
| 96.3 | 0 | | X | X | X | X | | | X | | X | X | |
| 96.5 | 0 | | | X | X | X | | | X | | X | X | |
| 96.7 | 0 | | X | | X | X | | | X | | X | X | |
| 96.9 | 0 | | | | X | X | | | X | | X | X | |
| 97.1 | 0 | | X | X | | X | | | X | | X | X | |
| 97.3 | 0 | | X | X | X | | | | X | | X | X | |
| 97.5 | 0 | | | X | X | | | | X | | X | X | |
| 97.7 | 0 | | X | | X | | | | X | | X | X | |
| 97.9 | 0 | | | | X | | | | X | | X | X | |
| 98.1 | 0 | | X | X | | | | | X | | X | X | |
| 98.3 | 0 | | X | X | X | X | X | X | | | X | X | |
| 98.5 | 0 | | | X | X | X | X | X | | | X | X | |
| 98.7 | 0 | | X | | X | X | X | X | | | X | X | |
| 98.9 | 0 | | | | X | X | X | X | | | X | X | |
| 99.1 | 0 | | X | X | | X | X | X | | | X | X | |
| 99.3 | 0 | | X | X | X | | X | X | | | X | X | |
| 99.5 | 0 | | | X | X | | X | X | | | X | X | |
| 99.7 | 0 | | X | | X | | X | X | | | X | X | |
| 99.9 | 0 | | | | X | | X | X | | | X | X | |
| 100.1 | * | X | X | X | X | X | X | X | X | X | X | X | X |
| 100.3 | * | X | | X | X | X | X | X | X | | | | |
| 100.5 | * | X | X | | X | X | X | X | X | X | X | X | X |
| 100.7 | * | X | | | X | X | X | X | X | X | X | X | X |
| 100.9 | * | X | X | X | | X | X | X | X | X | X | X | X |
| 101.1 | * | X | X | X | X | | X | X | X | X | X | X | X |
| 101.3 | * | X | | X | X | | X | X | X | X | X | X | X |
| 101.5 | * | X | X | | X | | X | X | X | X | X | X | X |
| 101.7 | * | X | | | X | | X | X | X | X | X | X | X |
| 101.9 | * | X | X | X | | | X | X | X | X | X | X | X |
| 102.1 | * | X | X | X | X | X | | X | X | X | X | X | X |
| 102.3 | * | X | | X | X | X | | X | X | X | X | X | X |
| 102.5 | * | X | X | | X | X | | X | X | X | X | X | X |
| 102.7 | * | X | | | X | X | | X | X | X | X | X | X |
| 102.9 | * | X | X | X | | X | | X | X | X | X | X | X |

| FREQ. MHz | X1-X2 | A1 | B1 | C1 | D1 | A2 | B2 | C2 | D2 | A3 | B3 | C3 | D3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 103.1 | * | X | X | X | X | | | X | X | X | X | X | X |
| 103.3 | * | X | | X | X | | | X | X | X | X | X | X |
| 103.5 | * | X | X | | X | | | X | X | X | X | X | X |
| 103.7 | * | X | | | X | | | X | X | X | X | X | X |
| 103.9 | * | X | X | X | | | | X | X | X | X | X | X |
| 104.1 | * | X | X | X | X | X | X | | X | X | X | X | X |
| 104.3 | * | X | | X | X | X | X | | X | X | X | X | X |
| 104.5 | * | X | X | | X | X | X | | X | X | X | X | X |
| 104.7 | * | X | | | X | X | X | | X | X | X | X | X |
| 104.9 | * | X | X | X | | X | X | | X | X | X | X | X |
| 105.1 | * | X | X | X | X | | X | | X | X | X | X | X |
| 105.3 | * | X | | X | X | | X | | X | X | X | X | X |
| 105.5 | * | X | X | | X | | X | | X | X | X | X | X |
| 105.7 | * | X | | | X | | X | | X | X | X | X | X |
| 105.9 | * | X | X | X | | | X | | X | X | X | X | X |
| 106.1 | * | X | X | X | X | X | | | X | X | X | X | X |
| 106.3 | * | X | | X | X | X | | | X | X | X | X | X |
| 106.5 | * | X | X | | X | X | | | X | X | X | X | X |
| 106.7 | * | X | | | X | X | | | X | X | X | X | X |
| 106.9 | * | X | X | X | | X | | | X | X | X | X | X |
| 107.1 | * | X | X | X | X | | | | X | X | X | X | X |
| 107.3 | * | X | | X | X | | | | X | X | X | X | X |
| 107.5 | * | X | X | | X | | | | X | X | X | X | X |
| 107.7 | * | X | | | X | | | | X | X | X | X | X |
| 107.9 | * | X | X | X | | | | | X | X | X | X | X |

SECTION 6

PARTS LIST (CHASSIS)

| REF DES | DESCRIPTION | QEI PART NO. |
|---|---|---|
| A1A2 | Assembly, FMO & Phase Lock | 6753002 |
| A1A3 | Assembly, IPA-PA | 6753003 |
| A1A4 | Assembly, Power Supply Reg. | 6753004 |
| A1C1 | Cap, Cer., .01uf 1KC | 110-0103-K |
| A1C2 | Cap, Cer., .01uf 1KC | 110-0103-K |
| A1C3 | Cap., Elect 4900uf 50V | 110-3498 |
| A1C4 | Cap., Elect 3000uf 15V | 110-3308 |
| A1C5 | Cap., Feed thru 1000pf | 110-7102 |
| A1C6 | Cap., Feed thru 1000pf | 110-7102 |
| A1C7 | Cap., Feed thru 1000pf | 110-7102 |
| A1C8 | Cap., Feed thru 1000pf | 110-7102 |
| A1C9 | Cap., Feed thru 1000pf | 110-7102 |
| A1C10 | Cap., Feed thru 1000pf | 110-7102 |
| A1C11 | Cap., Feed thru 1000pf | 110-7102 |
| A1C12 | Cap., Feed thru 1000pf | 110-7102 |
| A1C13 | Cap., Feed thru 1000pf | 110-7102 |
| A1C14 | Cap., Feed thru 1000pf | 110-7102 |
| A1C15 | Cap., Feed thru 1000pf | 110-7102 |
| A1C16 | Cap., Elect 500uf 25V | 110-3507 |
| A1C17 | Cap., Cer. .05uf | 110-0503 |
| A1C18 | Cap., Cer. .05uf | 110-0503 |
| A1C19 | Cap., Cer. .01uf 100V | 110-0103 |
| A1CR1 | Rectifier Bridge | 113-1000 |
| A1CR2 | Diode, LED | 113-3000 |
| A1DS1 | Lamp, Incandescent 28V (327) | 117-0002 |
| A1F1 | Fuse, AGC 1 | 120-0002 |
| A1J1 | Jack, RF UG-58 | 130-0004 |
| A1J2 | Jack, Coax UG-625 | 130-0001 |
| A1J3 | Jack, Coax UG-625 | 130-0001 |
| A1J4 | Jack, Coax UG-625 | 130-0001 |
| A1J5 | Jack, 3 Ckt. | 130-2000 |
| A1J6 | Jack, Phono | 130-0010 |
| A1M1 | Meter, 0-1 ma | 145-0004 |
| A1P1 | Plug, Power/w line cord | 130-5003 |
| A1Q1 | Transistor, NPN | 160-3055 |
| A1Q2 | Transistor | 160-5294 |
| A1R1 | Res. Var. 5K | RV4LAYSD502A |
| A1R2 | Res. Var. 5K | RV4LAYSD502A |
| A1R3 | Res. Carb. 5.6K, ½W, 5% | RC20GF562J |
| A1R4 | Res. Carb. 220 ohm, ½W, 5% | RC20GF221J |
| A1S1 | Switch, SPDT | 175-0006 |
| A1S2 | Switch, Rotary | 175-0005 |
| A1S3 | Switch, SPDT | 175-0006 |

| REF DES | DESCRIPTION | QEI PART NO. |
|---|---|---|
| A1T1 | Trans. | 180-3140 |
| A1TB1 | Terminal Board | 181-0003 |
| A1XDS1 | Socket, Lamp | 192-0001 |
| A1XF1 | Holder, Fuse | 193-0001 |

## PARTS LIST

## FMO AND PHASE LOCK ASSEMBLY A2

| | | |
|---|---|---|
| A2 | Assembly, P.C. | 6753002 |
| A2A1 | Sub-assembly, FMO | 6752001 |
| A2C1 | Cap. Mica, 470 pf, DM15 | 110-1471 |
| A2C2 | Cap., Feed-thru, 1500 pf | 110-7152 |
| A2C3 | Cap., Feed-thru, 1500 pf | 110-7152 |
| A2C4 | Cap., Cer., .001 uf | 110-0102 |
| A2C5 | Cap., Cer., .001 uf | 110-0102 |
| A2C6 | Cap., Var., 5-65 pf | 110-6565 |
| A2C7 | Cap., Var., 5-65 pf | 110-6565 |
| A2C8 | Cap., Mica, 51 pf, DM15 | 110-1510 |
| A2C9 | Cap., Mica, 10 pf, DM15 | 110-1100 |
| A2C10 | Cap., Cer., .001 uf | 110-0102 |
| A2C11 | Cap., Cer., .1 uf | 110-0104 |
| A2C12 | Cap., Tant., 1.0 uf | 110-3105 |
| A2C13 | Cap., Mica, 470 pf | 110-1471 |
| A2C14 | Cap., Cer., .001 uf | 110-0102 |
| A2C15 | Cap., Cer., .01 uf | 110-0103 |
| A2C16 | Cap., Cer., .01 uf | 110-0103 |
| A2C17 | Cap., Poly, .01 uf, 5% | 110-4103 |
| A2C18 | Cap., Mica, DM15 | SELECTED |
| A2C19 | Cap., Mica, 24 pf, DM15 | 110-1240 |
| A2C20 | Cap., Mica, 120 pf, DM15 | 110-1121 |
| A2C21 | Cap., Cer., .01 uf | 110-0103 |
| A2C22 | Cap., Cer., .001 uf | 110-0102 |
| A2C23 | Cap., Elect, 5.0 uf | 110-3505 |
| A2C24 | Cap., Mica, 470 pf, DM15 | 110-1471 |
| A2C25 | Cap., Mica, 470 pf, DM15 | 110-1471 |
| A2C26 | Cap., Mica, 22 pf, DM15 | 110-1220 |
| A2C27 | Cap., Var., 1-10 pf | 110-6110 |
| A2C28 | Cap., Mica, 10 pf, DM15 | 110-1100 |
| A2C29 | Cap., Cer., .1 uf | 110-0104 |
| A2C30 | Cap., Tant, 1.0 uf | 110-3105 |
| A2C31 | Cap., Cer., .001 uf | 110-0102 |
| A2C32 | Cap., Elect, 100 uf, 25V | 110-3107 |
| A2C33 | Cap., Tant, 1.0 uf | 110-3105 |
| A2C34 | Cap., Cer., .1 uf | 110-0104 |
| A2C35 | Cap., Tant., 1.0 uf | 110-3105 |
| A2C36 | Cap., Elect., 5 uf, @25V | 110-3505 |
| A2C37 | Cap., Cer., .001 uf | 110-0102 |

| REF DES | DESCRIPTION | QEI PART NO. |
|---|---|---|
| A2C38 | Cap., Cer., .05 uf | 110-0503 |
| A2C39 | Cap., Mica, 1000 pf | 110-1102 |
| A2C40 | Cap., Elect., 15 uf | 110-3156 |
| A2C41 | Cap., Cer., .1 uf | 110-0104 |
| A2C42 | Cap., Elect., 100 uf | 110-3107 |
| A2CR1 | Diode | 113-04446 |
| A2CR2 | Diode | 113-04446 |
| A2CR3 | Diode | 113-04446 |
| A2CR4 | Diode | 113-04446 |
| A2CR5 | Diode | 113-04446 |
| A2CR6 | Diode | 113-04446 |
| A2CR7 | Diode | 113-04001 |
| A2CR8-CR11 | Diode Assembly | 113-04446-4 |
| A2L1 | Inductor, RFC | 140-2008 |
| A2L2 | Inductor, RF | 140-2007 |
| A2P1 | Plug, Coax | 130-0011 |
| A2Q1 | Transistor, NPN | 160-3866 |
| A2Q2 | Transistor, NPN | 160-4401 |
| A2Q3 | Transistor, NPN | 160-3866 |
| A2Q4 | Transistor, NPN | 160-5179 |
| A2Q5 | Transistor, PNP | 160-4403 |
| A2Q6 | Transistor, FET | 160-13819 |
| A2Q7 | Transistor, NPN | 160-4401 |
| A2Q8 | Transistor, PNP | 160-4403 |
| A2Q9 | Transistor, NPN | 160-4401 |
| A2Q10 | Transistor, NPN | 160-4401 |
| A2Q11 | Transistor, NPN | 160-4401 |
| A2Q12 | Transistor, NPN | 160-4401 |
| A2Q13 | Transistor, NPN | 160-4401 |
| A2Q14 | Transistor, NPN | 160-4401 |
| A2R1 | Res., Carb., 2.2K, ½W, 5% | RC20GF222J |
| A2R2 | Res., Carb., 560 Ohm, ½W, 5% | RC20GF561J |
| A2R3 | Res., Carb., 51 Ohm, ½W, 5% | RC20GF510J |
| A2R4 | Res., Carb., 270 Ohm, ½W, 5% | RC20GF271J |
| A2R5 | Res., Carb., 2.2K, ½W, 5% | RC20GF222J |
| A2R6 | Res., Carb., 220 Ohm, ½W, 5% | RC20GF221J |
| A2R7 | Res., Carb., 4.7K, ½W, 5% | RC20GF472J |
| A2R8 | Res., Carb., 2.2K, ½W, 5% | RC20GF222J |
| A2R9 | Res., Carb., 2.2K, ½W, 5% | RC20GF222J |
| A2R10 | Res., Carb., 51 Ohm, ½W, 5% | RC20GF510J |
| A2R11 | Res., Carb., 3.3K, ½W, 5% | RC20GF332J |
| A2R12 thru A2R24 | Res., Carb., 4.7, ¼W, 5% | RC07GF472J |
| A2R25 | Res., Carb., 330 Ohm, ½W, 5% | RC20GF331J |
| A2R26 | Res., Carb., 3.3K, ½W, 5% | RC20GF332J |
| A2R27 | Res., Carb., 620 Ohm, ½W, 5% | RC20GF621J |
| A2R28 | Res., Carb., 220 Ohm, ½W, 5% | RC20GF221J |
| A2R29 | Res., Carb., 560 Ohm, ½W, 5% | RC20GF561J |
| A2R30 | Res., Carb., 1.5K, ½W, 5% | RC20GF152J |
| A2R31 | Res., Var., 1K | 167-3001 |

| REF DES | DESCRIPTION | QEI PART NO. |
|---|---|---|
| A2R32 | Res., Film, 7.87K, ¼W, 1% | 165-7871 |
| A2R33 | Res., Film, 2.21K, ¼W, 1% | 165-2211 |
| A2R34 | Res., Carb., 1K, ½W, 5% | RC20GF102J |
| A2R35 | Res., Carb., 1K, ½W, 5% | RC20GF103J |
| A2R36 | Res., Carb., 33K, ½W, 5% | RC20GF333J |
| A2R37 | Res., Carb., 33K, ½W, 5% | RC20GF333J |
| A2R38 | Res., Carb., 4.7K ¼W, 5% | RC07GF472J |
| A2R39 | Res., Carb., 270 Ohm, ½W, 5% | RC20GF271J |
| A2R40 | Res., Carb., 3.3K, ½W, 5% | RC20GF332J |
| A2R41 | Res., Carb., 3.3K, ½W, 5% | RC20GF332J |
| A2R42 | Res., Carb., 27K, ½w, 5% | RC20GF273J |
| A2R43 | Res., Carb., 1.5K, ½W, 5% | RC20GF152J |
| A2R44 | Res., Carb., 4.7K, ½W, 5% | RC20GF472J |
| A2R45 | Res., Carb., 8.2K, ½W, 5% | RC20GF822J |
| A2R46 | Res., Carb., 1K, ½W, 5% | RC20GF102J |
| A2R47 | Res., Var., 10K | 167-3002 |
| A2R48 | Res., Carb., 4.7K ½W, 5% | RC20GF472J |
| A2R49 | Res., Carb., 330 Ohm, ½W, 5% | RC20GF331J |
| A2R50 | Res., Carb., 10K, ½W, 5% | RC20GF103J |
| A2R51 | Res., Carb., 10K, ½W, 5% | RC20GF103J |
| A2R52 | Res., Carb., 270 ohm, ½W, 5% | RC20GF271J |
| A2R53 | Res., Carb., 2.2K, ½W, 5% | RC20GF222J |
| A2R54 | Res., Carb., 100K, ½W, 5% | RC20GF104J |
| A2R55 | Res., Carb., 2.7K, ½W, 5% | RC20GF272J |
| A2R56 | Res., Carb., 1.5K, ½W, 5% | RC20GF152J |
| A2R57 | Res., Carb., 470 Ohm, ½W, 5% | RC20GF471J |
| A2R58 | Res., Carb., 2.2K, ½W, 5% | RC20GF222J |
| A2R59 | Res., Carb., 1.5K ½W, 5% | RC20GF152J |
| A2R60 | Res., Carb., 4.7K, ½W, 5% | RC20GF472J |
| A2R61 | Res., Carb., 820 Ohm, ½W, 5% | RC20GF821J |
| A2R62 | Res., Carb., 1.5K ½W, 5% | RC20GF152J |
| A2R63 | Res., Carb., 10K, ½W, 5% | RC20GF103J |
| A2R64 | Res., Carb., 10K, ½W, 5% | RC20GF103J |
| A2R65 | Res., Var., 10K | 167-3002 |
| A2R66 | Res., Carb., 10K, ½W, 5% | RC20GF103J |
| A2R67 | Res., Carb., 470K, ½W, 5% | RC20GF474J |
| A2R68 | Res., Carb., 10K, ½W, 5% | RC20GF103J |
| | | |
| A1T1 | Trans., RF | 140-2006 |
| A2T2 | Trans., Audio | 180-2001 |
| A2U1 | IC, ECL | 182-1034 |
| A2U2 | IC, TTL | 182-8290 |
| A2U3 | IC, TTL | 182-8192 |
| A2U4 | IC, TTL | 182-8192 |
| A2U5 | IC, TTL | 182-8192 |
| A2U6 | IC, TTL | 182-7474 |
| A2U7 | IC, TTL | 182-7493 |
| A2U8 | IC, TTL | 182-7490 |
| A2U9 | IC, TTL | 182-7490 |
| A2U10 | IC, TTL | 182-7474 |
| A2U11 | IC, Op Amp | 182-1741 |
| A2U12 | IC, OTA | 182-3080 |
| A2Y1 | Crystal, 2.5 PPM, 8 MHz | 198-0800 |

# PARTS LIST

## IPA-PA ASSEMBLY A3

| REF DES | DESCRIPTION | QEI PART NO. |
|---|---|---|
| A3 | Assembly, Printed Circuit | 6753003 |
| A3C1 | Cap., Mica, 68 pf, DM15 | 110-1680 |
| A3C2 | Cap., Var., 5-65 pf | 110-6565 |
| A3C3 | Cap., Cer., .01 uf @ 100V | 110-0103 |
| A3C4 | Cap., Elect., 5 uf @ 35V | 110-3503 |
| A3C5 | Cap., Cer., Feed-thru, 1500 pf | 110-7152 |
| A3C6 | Cap., Mica, 22 pf, DM15 | 110-1220 |
| A3C7 | Cap., Var., 70-350 pf | 110-6735 |
| A3C8 | Cap., Var., 16-150 pf | 110-6615 |
| A3C9 | Cap., Cer., .01 uf @ 100V | 110-0103 |
| A3C10 | Cap., Cer., .01 uf @ 100V | 110-0103 |
| A3C11 | Cap., Cer., .01 uf @ 100V | 110-0103 |
| A3C12 | Cap., Elect., 5 uf @ 35V | 110-3505 |
| A3C13 | Cap., Cer., feed-thru, 1500 pf | 110-7152 |
| A3C14 | Cap., Var., 4-40 pf | 110-6440 |
| A3C15 | Cap., Var., 4-40 pf | 110-6440 |
| A3C16 | Cap., Cer., 0.5 pf | 110-00R5 |
| A3C17 | Cap., Cer., feed-thru, 1500 pf | 110-7152 |
| A3CR1 | Diode, Sil | 113-04446 |
| A3L1 | Inductor RF | 140-2015 |
| A3L2 | Inductor,RF | 140-2015 |
| A3L3 | Inductor, Wideband Choke | 140-2016 |
| A3L4 | Inductor, RF | 140-2014 |
| A3L5 | Inductor, RF | 140-2014 |
| A3L6 | Inductor, Wideband Choke | 140-2016 |
| A3Q1 | Transistor, NPN | 160-5641 |
| A3Q2 | Transistor, NPN | 160-5643 |
| A3R1 | Res., Carb., 18K, ½W, 5% | RC20GF183J |
| A3R2 | Res., W.W., 34 Ohm, 5W | 166-0340 |
| A3R3 | Res., Carb., 2.2K ½W, 5% | RC20GF222J |
| A3R4 | Res., W.W., .27 Ohm, 3W | 166-0027 |
| A3R5 | Res., Carb., 830 Ohm, ½W, 5% | RC20GF821J |
| A3R6 | Res., Carb., 2.2K, ½W, 5% | RC20GF222J |
| A3R7 | Res., Carb., 1.0K ½W, 5% | RC20GF102J |
| A3R8 | Res., Carb., 10.0K, ½W, 5% | RC20GF103J |
| A3R9 | Res., Carb., 15K, ½W, 5% | RC20GF153J |
| A3R10 | Res., Carb., 100 Ohm, ½W, 5% | RC20GF101J |
| A3R11 | Res., Carb., 100 ohm, ½W, 5% | RC20GF101J |
| A3T1 | Trans., Bifilar Wound | 140-2006 |
| A3T2 | Trans., Bifilar Wound | 140-2006 |

PARTS LIST

POWER SUPPLY ASSEMBLY A4

| REF DES | DESCRIPTION | QEI PART NO. |
|---|---|---|
| A4 | Assembly, Printed Circuit | 6753004 |
| A4C1 | Cap., Tant., 1 uf, 35V | 110-3105 |
| A4C2 | Cap., Cer., .05 uf, 16V | 110-0503 |
| A4C3 | Cap., Elect., 100 uf, 25V | 110-3107 |
| A4C4 | Cap., Elect., 100 uf, 25V | 110-3107 |
| A4CR1 | Diode, SCR | 113-45061 |
| A4CR2 | Diode, Silicon | 113-04446 |
| A4CR3 | Diode, SCR | 113-45060 |
| A4CR4 | Diode, Zener, 12V | 113-2012 |
| A4CR5 | Diode, Zener, 6.3V | 113-2062 |
| A4CR6 | Diode, Zener, 5.6V | 113-2056 |
| A4CR7 | Diode, Silcon | 113-04001 |
| A4CR8 | Diode, Silicon | 113-04001 |
| A4CR9 | Diode, Silicon | 113-04001 |
| A4CR10 | Diode, Silicon | 113-04001 |
| A4Q1 | Transistor, NPN | 160-4401 |
| A4Q2 | Transistor, NPN | 160-4401 |
| A4Q3 | Transistor, PNP | 160-40410 |
| A4Q4 | Transistor, PNP | 160-4403 |
| A4Q5 | Transistor, NPN | 160-40409 |
| A4Q6 | Transistor, PNP | 160-4403 |
| A4Q7 | Transistor, NPN | 160-4401 |
| A4Q8 | Transistor, NPN | 160-3053 |
| A4Q9 | Transistor, NPN | 160-4401 |
| A4R1 | Res., Carb., 22K, ½W, 5% | RC20GF223J |
| A4R2 | Res., Carb., 620 Ohm, ½W, 5% | RC20GF621J |
| A4R3 | Res., Carb., 10K, ½W, 5% | RC20GF103J |
| A4R4 | Res., Carb., 1.5K, ½W, 5% | RC20GF152J |
| A4R5 | Res., Carb., 2.7K, ½W, 5% | RC20GF272J |
| A4R6 | Res., Carb., 2.7K, ½W, 5% | RC20GF272J |
| A4R7 | Res., Carb., 470 Ohm, ½W, 5% | RC20GF471J |
| A4R8 | Res., Carb., 1.2K, ½W, 5% | RC20GF122J |
| A4R9 | Res., Carb., 1.2K, ½W, 5% | RC20GF122J |
| A4R10 | Res., Carb., 820 Ohm, ½W, 5% | RC20GF821J |
| A4R11 | Res., Carb., 1.5M, ½W, 5% | RC20GF155J |
| A4R12 | Res., W.W., .15 Ohm, 3W, 10% | 166-0015 |
| A4R13 | Res., Carb., 47K, ½W, 5% | RC20GF473J |
| A4R14 | Res., Carb., 2.2K, ½W, 5% | RC20GF222J |
| A4R15 | Res., Carb., 2.2K, ½W, 5% | RC20GF222J |
| A4R16 | Res., Carb., 3.3K, ½W, 5% | RC20GF332J |
| A4R17 | Res., Carb., 820 Ohm, ½W, 5% | RC20GF821J |
| A4R18 | Res., Carb., 4.7 Ohm, ½W, 5% | RC20GF4R7J |

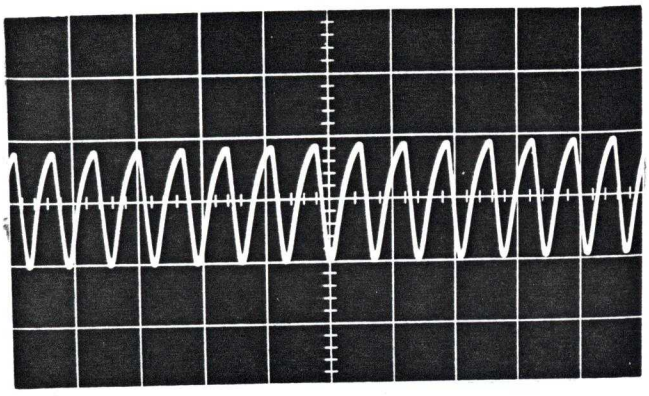
| REF DES | DESCRIPTION | QEI PART NO. |
|---|---|---|
| A4R19 | Res., Carb., 120 Ohm, 2W, 10% | RC42GF121J |
| A4R20 | Res., Carb., 27K, ½W, 5% | RC20GF273J |
| A4R21 | Res., Carb., 820 Ohm, ½W, 5% | RC20GF821J |
| A4R22 | Res., Carb., 180 Ohm, ½W, 5% | RC20GF181J |
| A4R23 | Res., Carb., 180 Ohm, ½W, 5% | RC20GF181J |
| A4R24 | Res., Carb., 6.8K, ½W, 5% | RC20GF682J |
| A4R25 | Res., W.W., .56 Ohm, 3W, 10% | 166-0056 |
| A4R26 | Res., Carb., 10K, ½W, 5% | RC20GF103J |
| A4R27 | Res., Carb., 180 Ohm, ½W, 5% | RC20GF181J |
| A4R28 | Res., Carb., 3.3K, ½W, 5% | RC20GF332J |

# SECTION 7

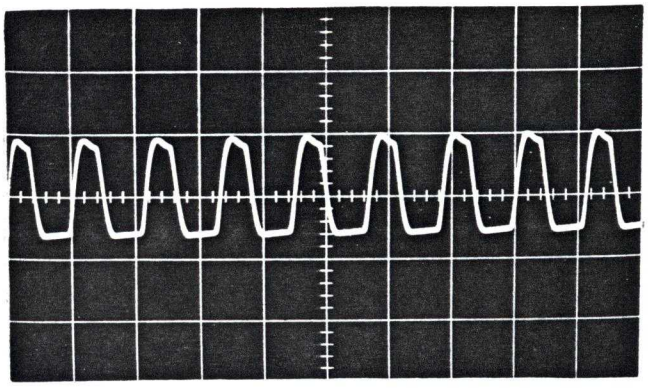
## SCHEMATICS, LAYOUTS, WAVEFORMS

# WAVEFORMS

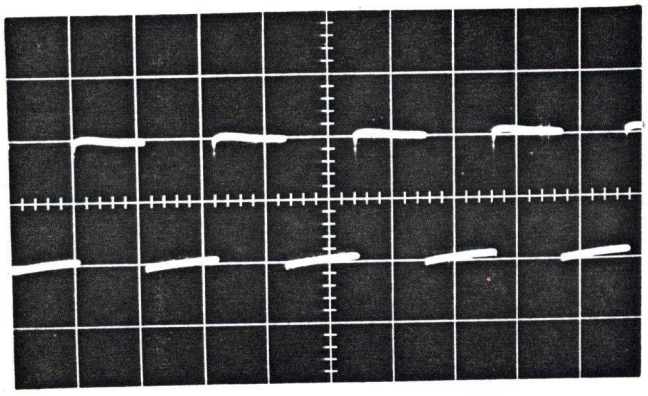
The following waveforms were measured on a 15MHz bandwidth oscilloscope using a 10X low capacity probe. The number below each waveform corresponds to the point at which the measurement was made.



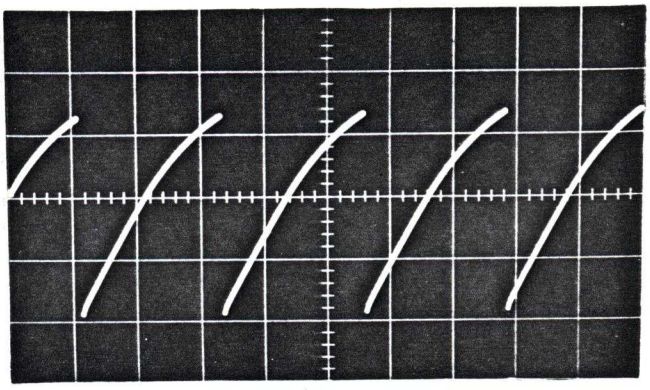
(1) .2usec/cm
.2V/cm



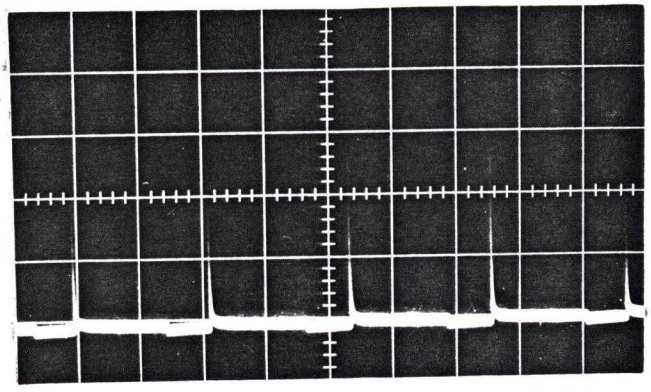
(2) .2usec/cm
.2V/cm



(3) .1msec/cm
.2V/cm



(4) .1msec/cm
.2V/cm



(5) .1msec/cm
.1V/cm

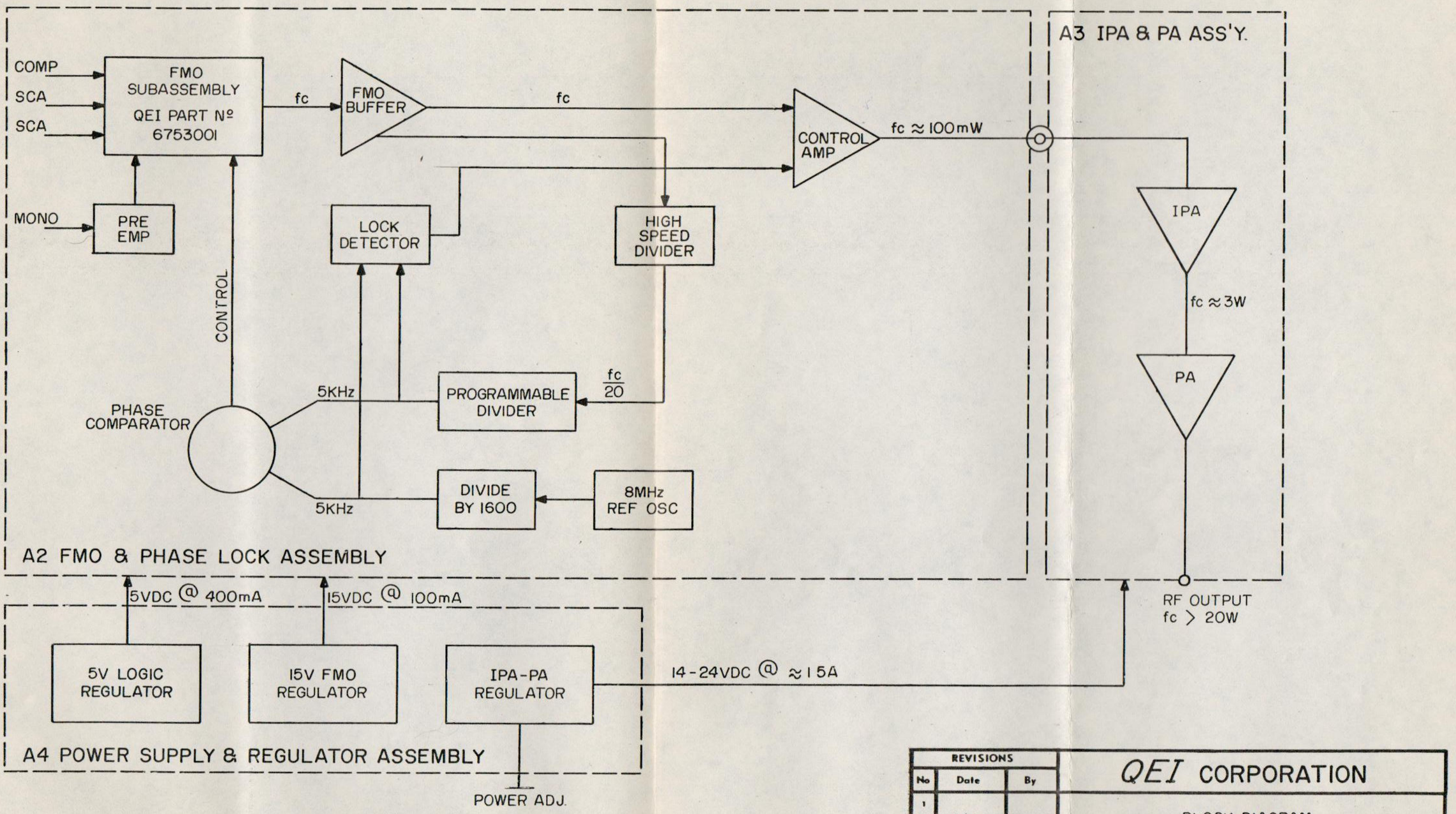
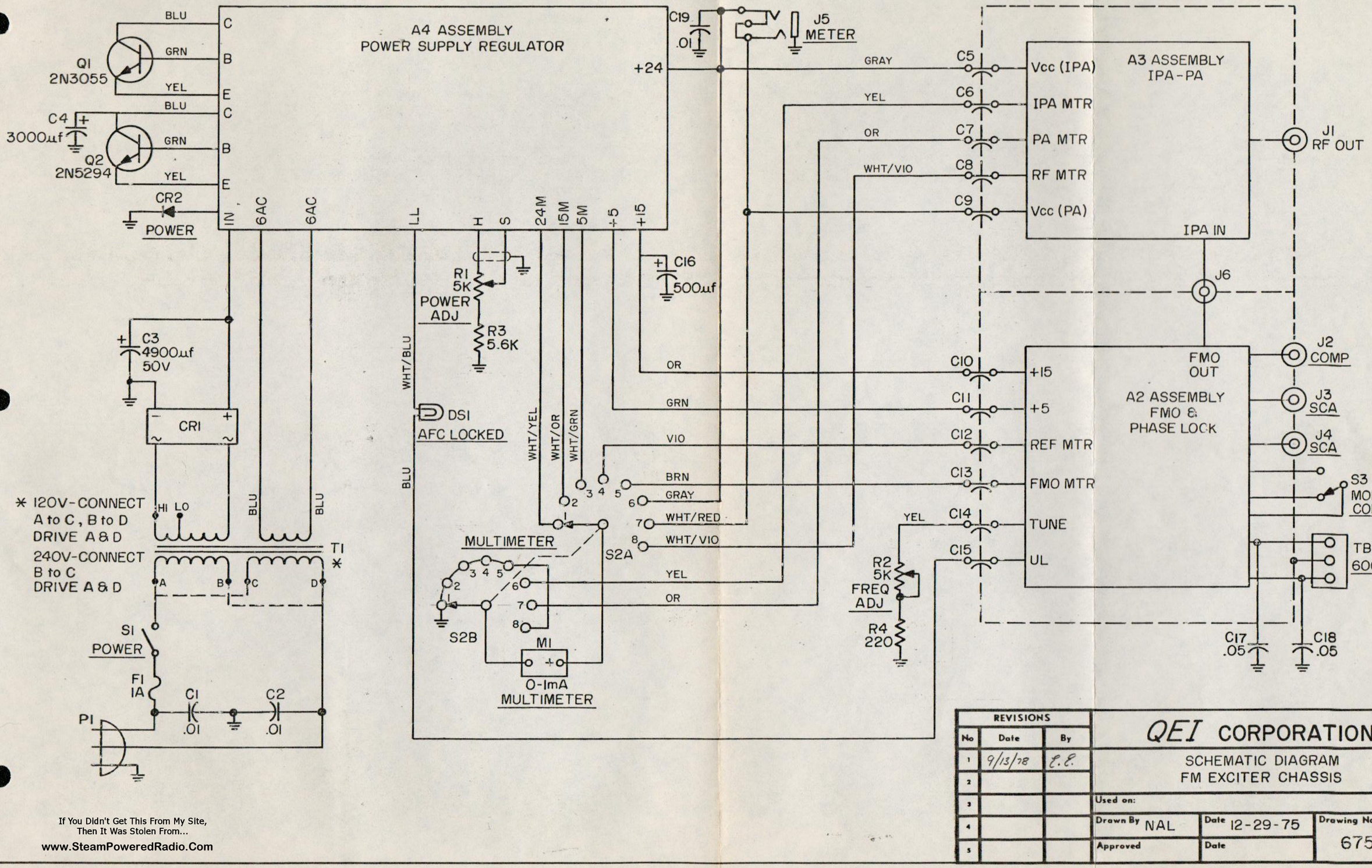



FIGURE 4-1

| REVISIONS | | | QEI CORPORATION | | |
|---|---|---|---|---|---|
| No | Date | By | | | |
| 1 | | | BLOCK DIAGRAM | | |
| 2 | | | | | |
| 3 | | | Used on: FM EXCITER-MODEL 675 | | |
| 4 | | | Drawn By NAL | Date 12-23-75 | Drawing No. 6751001 |
| 5 | | | Approved | Date | |




| REVISIONS | | |
|---|---|---|
| No | Date | By |
| 1 | 9/13/78 | E.E. |
| 2 | | |
| 3 | | |
| 4 | | |
| 5 | | |

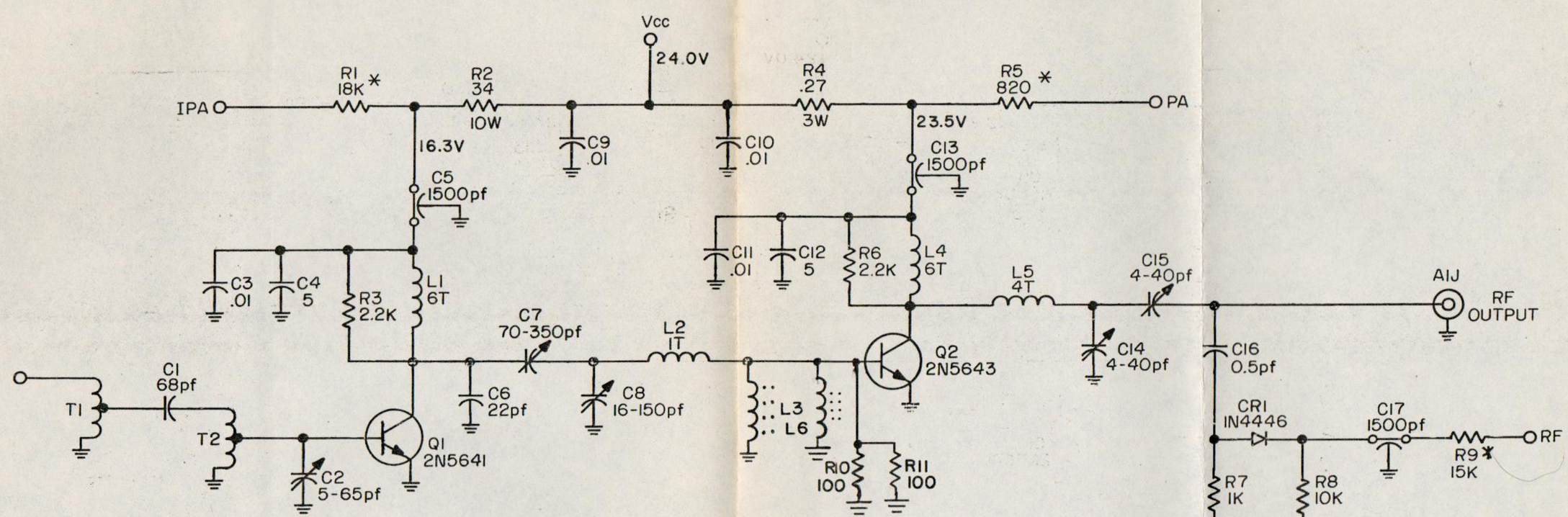
# QEI CORPORATION

SCHEMATIC DIAGRAM
FM EXCITER CHASSIS

Used on:

| Drawn By | Date | Drawing No. |
|---|---|---|
| NAL | 12-29-75 | 6752005 |

Approved | Date




LAST USED

C17
CR1
L6
Q2
R11
T2

* FACTORY SELECTED

ALL VOLTAGES MEASURED WITH VTVM

INPUT = 10 MEGOHMS

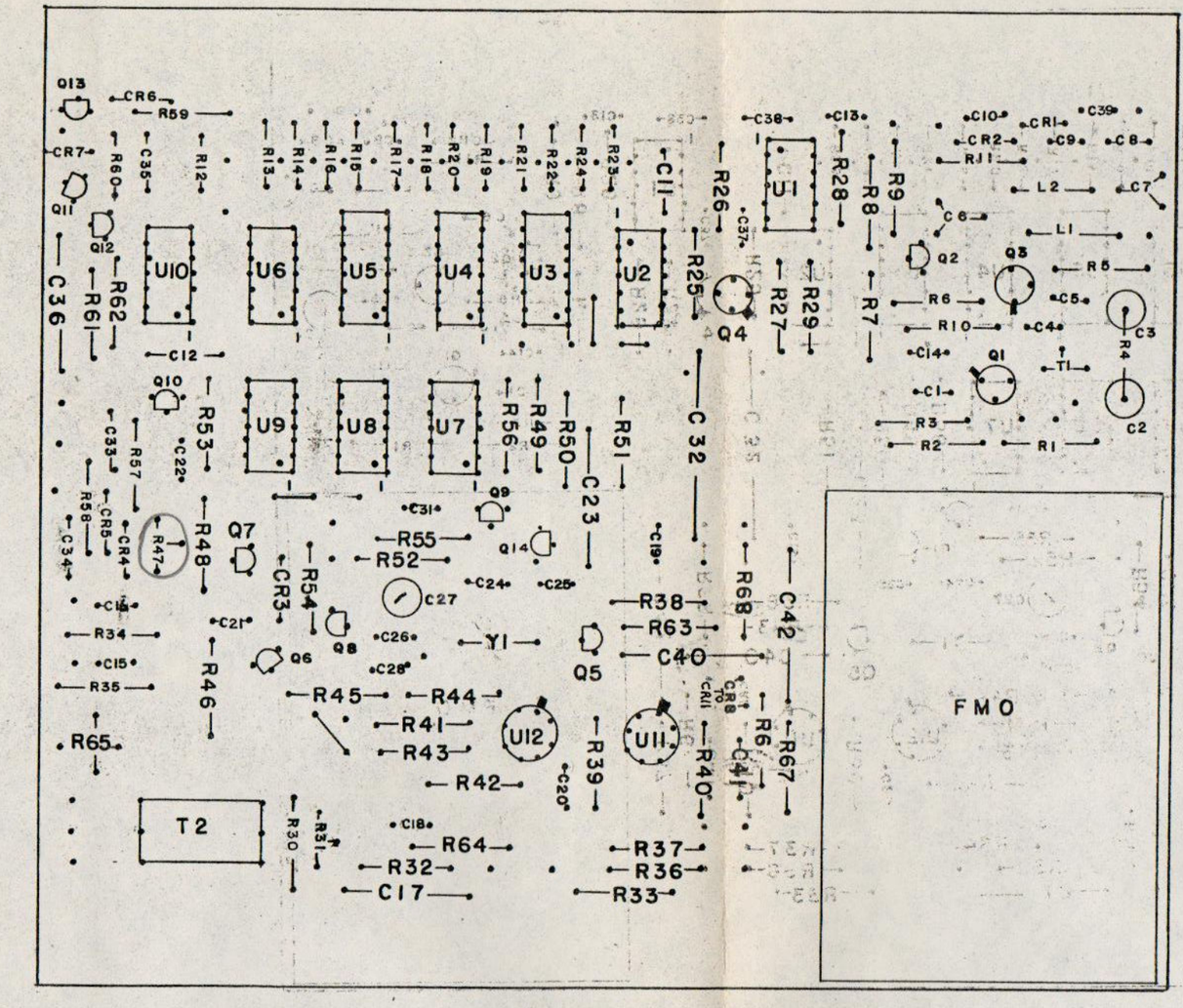
| REVISIONS | | |
|---|---|---|
| No | Date | By |
| 1 | 9/13/78 | EE |
| 2 | | |
| 3 | | |
| 4 | | |
| 5 | | |

QEI CORPORATION

POWER AMPLIFIER

Used on: FM EXCITER

| Drawn By | Date | Drawing No. |
|---|---|---|
| NAL | 12-18-75 | 6753004 |
| Approved | Date | |




FMO & PHASE LOCK LOOP ASSEMBLY

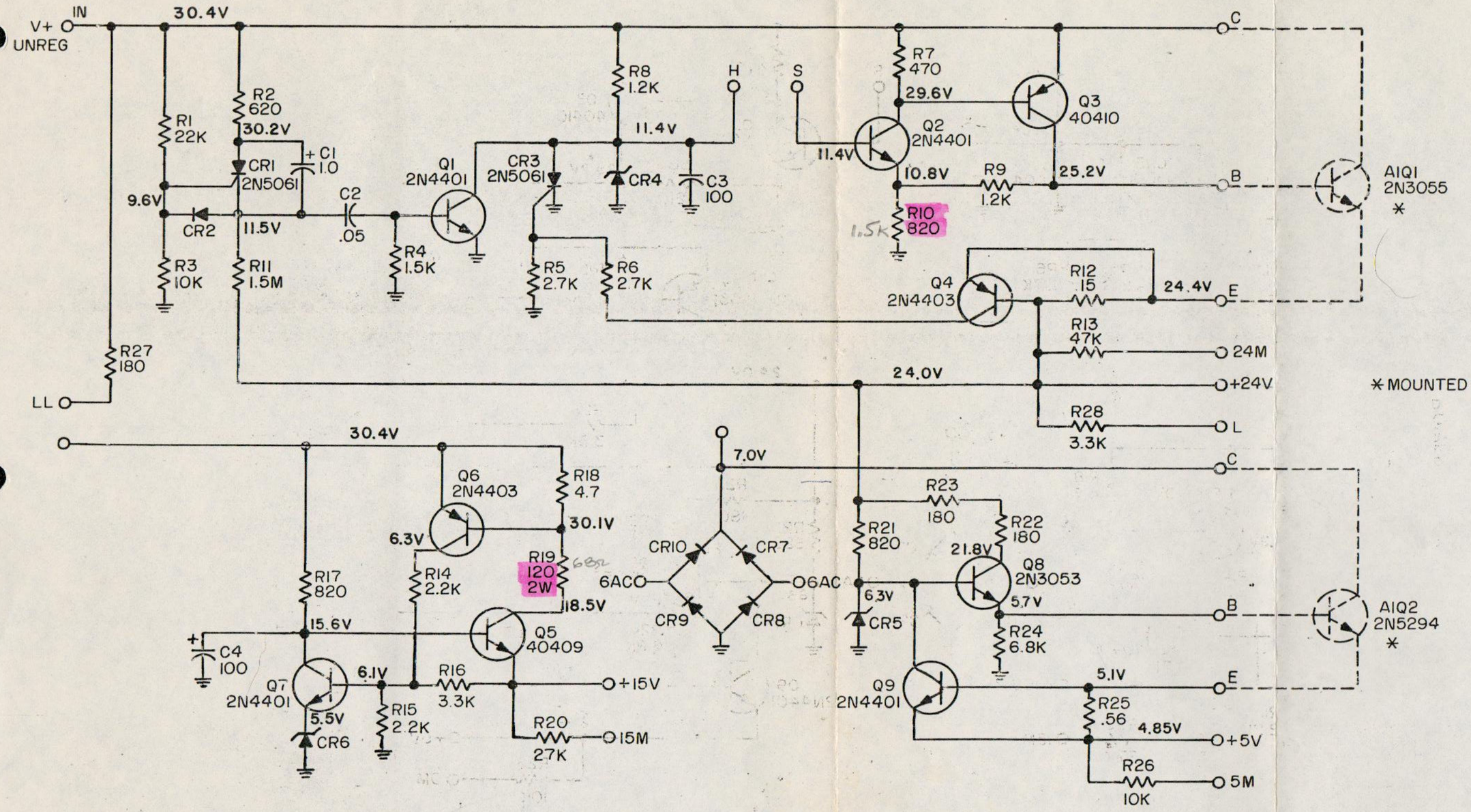
| REVISIONS | | |
|---|---|---|
| NO. | DATE | BY |
| 1 | 9-13-78 | EE |
| 2 | | |
| 3 | | |
| 4 | | |
| 5 | | |

QEI CORPORATION

COMPONENT LAYOUT

A2 ASSY

| | | |
|---|---|---|
| DRAWN BY ELE | SCALE | MATERIAL |
| CHK'D ELE | DATE 1-19-77 | DRAWING NO. 6752006 |
| TRACED | APP'D | |




* MOUNTED ON CHASSIS

ALL VOLTAGES MEASURED WITH VTVM

INPUT = 10 MEGOHMS

LAST USED

C4
CR10
Q9
R28

| REVISIONS | | |
|---|---|---|
| No | Date | By |
| 1 | | |
| 2 | | |
| 3 | | |
| 4 | | |
| 5 | | |

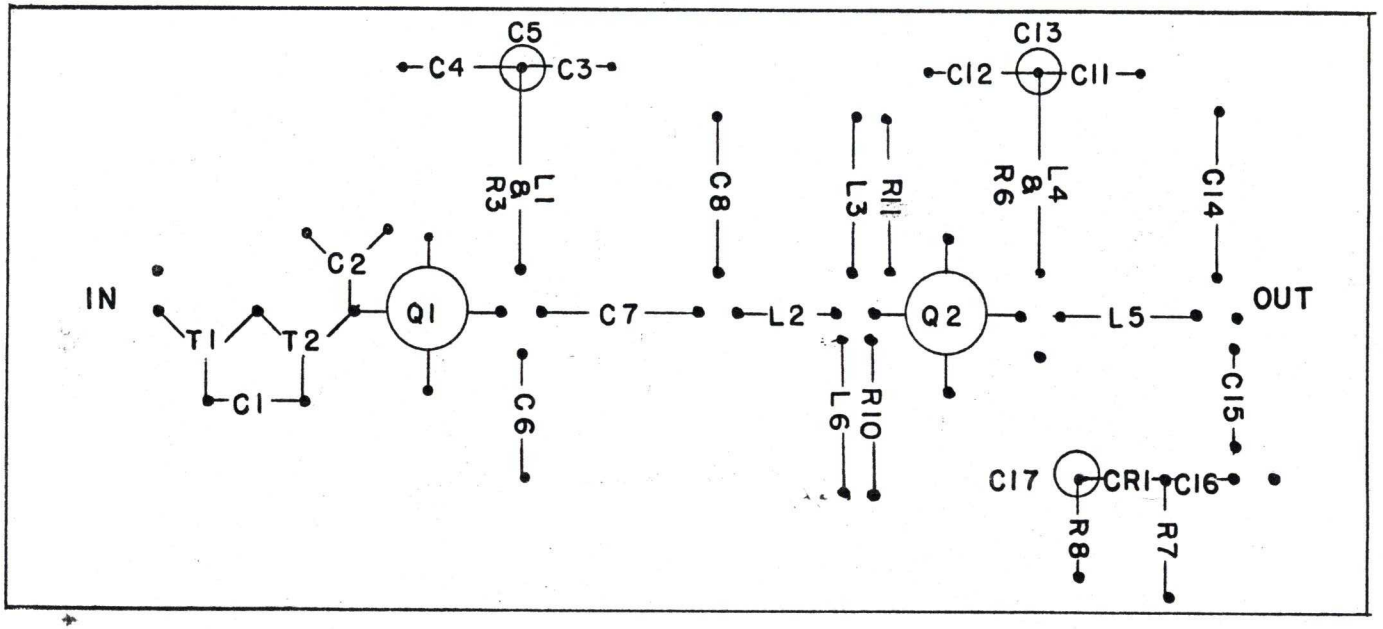
**QEI CORPORATION**

SCHEMATIC DIAGRAM
POWER SUPPLY

Used on: 6753004

Drawn By: NAL | Date: 12-19-75 | Drawing No.: 6752004

Approved | Date



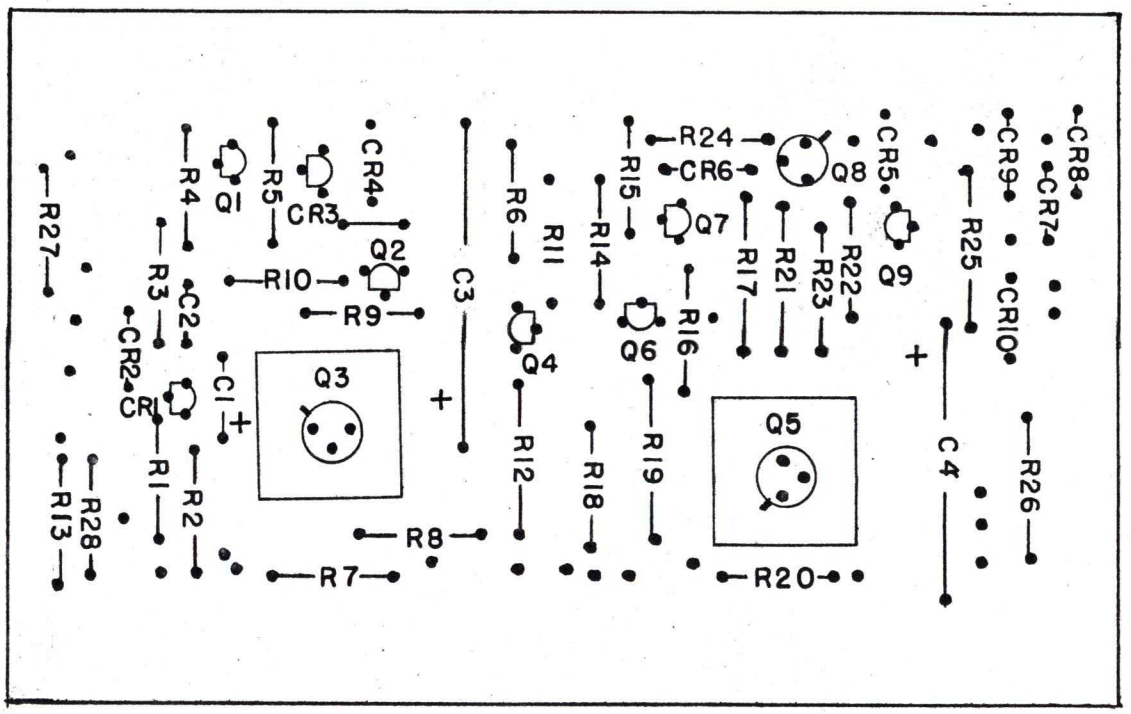

POWER AMPLIFIER

| REVISIONS | | |
|---|---|---|
| NO. | DATE | BY |
| 1 | 11-7-77 | ELE |
| 2 | 9-13-78 | EE |
| 3 | | |
| 4 | | |
| 5 | | |

# QEI CORPORATION

COMPONENT LAYOUT
A3 ASSY

| | | |
|---|---|---|
| DRAWN BY ELE | SCALE | MATERIAL |
| CHK'D ELE | DATE 1-19-77 | DRAWING NO. 6751002 |
| TRACED | APP'D | |




POWER SUPPLY

| REVISIONS | | |
|---|---|---|
| NO. | DATE | BY |
| 1 | | |
| 2 | | |
| 3 | | |
| 4 | | |
| 5 | | |

# QEI CORPORATION

COMPONENT LAYOUT
A4 ASSY

| | | |
|---|---|---|
| DRAWN BY ELE | SCALE | MATERIAL |
| CHK'D ELE | DATE 1-19-77 | DRAWING NO. 6751001 |
| TRACED | APP'D | |

# QEI MODEL 675 FM EXCITER TEST REPORT

Serial No. 675514

Frequency _____

Station _____

Distributor _____

Control No. 1650

## I Inspection

A. Mechanical-screws tightened, metal fits, etc. OK

B. Electrical-solder joints, wiring, neatness, etc. OK

## II Electrical

A. Power Supply

+24 VDC 24.2

+15 VDC 15.10

+5 VDC 4.95

B. Power Measurements

Power Output 23 W

Power Adjust range 5-23 W

P.A. Volt. 24V
P.A. Current 1.3A

C. ~~Frequency~~ Measurements

Frequency _____

Frequency Adjust Range ± 100 Hz

D. Input Levels

Mono (for 75KHz deviation) +10 dbm

Composite (for 75 KHz deviation) 3.5V p-p

SCA (for 10% injection) 1.2Vp-p

E. Distortion

| Frequency | Distortion | Pre-emp Level |
|---|---|---|
| 50 Hz | .22% | 0 |
| 400 Hz | .20% | 0 |
| 1000 Hz | .18% | -.8 |
| 5000 Hz | .14% | -8.4 |
| 7500 Hz | .16% | -11.0 |
| 10000 Hz | .14% | -13.2 |
| 15000 Hz | .18% | -15.8 |

F. Noise

FM -74 Db

AM -65 Db

Inc. AM -60 Db

G. Stereo Separation

With an input signal of 56 Db separation at 400 Hz and a compensation cap of 0 pf, output signal has separation of 56 Db.

H. Meter Readings - (at full power output)

Vcc 15.2

+15 15.8

+5 1.48

REF 1.50

FMO 1.60

IPA 1.40

PA 1.60

RF 1.42

Tested by _____

1.5 – 2.2K

FMO
QEI Part Nº
6752001

P1
RF OUT

6.9V

17500

T2
600Ω BAL

R30 1.5K
R31 1K
C17 01
R32 7.87K

AIS3
MONO-COMP
(REAR PANEL)

AIJ2
COMP

R65 10K
R64 10K
C18
R36 33K
R37 33K
R33 2.21K

AIJ3
SCA 1

C16 01
R34 1K

AIJ4
SCA 2

C15 01
R35 1K

15.3

R4 270
C2 1500
R1 2.2K
6.8V
T1
C4 001
C14 001

2.1V
Q1 2N3866
1.4V
R2 560
R3 51
C1 470

+15V
C3 1500
L1
Q3 2N3866
1.4V
1.1V
R5 2.2K
R6 220
C5 001
R10 51

Q2 2N4401
.02V
R7 4.7K
R8 2.2K
R9 2.2K

C6 5-60
L2
C7 5-60
C8 51
C9 10
CR1
CR2
C10 001
R11 3.3K
C39 1000

+15V
RF
FMO MTR
SHUT DOWN

+5V

R28 220 *
C38 .05
3.6V
R29 560
U1 MC1034
C13 470
C37 001
.6V
Q4 2N5179
1.5V
R27 620
R26 33K
R25 330

C11 .1

R24 4.7K
R23 4.7K
R22 4.7K
R21 4.7K
A1 B1 C1 D1
U3 74192

R20 4.7K
R19 4.7K
R18 4.7K
R17 4.7K
A2 B2 C2 D2
U4 74192

R16 4.7K
R15 4.7K
R14 4.7K
R13 4.7K
A3 B3 C3 D3
U5 74192

C12 1uf
R12 4.7K
X1 X2
U6a 7474
U6b 7474

U2 82S90 74S196

C32 100uf
R44 4.7K
8.4V
Q6 2N3819
7.2V
4.8V
R46 1K
R47 10K
C21 01
.5V
Q7 2N4401
C22 001
R48 4.7K
CR3

R63 10K
R38 4.7K
15.3V
C40 15
.4V
Q5 2N4403
15.8V
C19 24

CR8 CR9
CR10 CR11
R69 10K
R67 470K
R66 10K
C42 100
C41 .1

U11 741
U12 3080
3.4V
4.8V
R43 1.5K
R40 3.3K
R42 27K
R39 270
C20 120
R41 3.3K

R49 330
3.9V
R53 2.2K
C23 5uf
R50 10K
1.8V
Q14 2N4401
1.7V
C31 001
2.6V
R54 100K
Y1
R51 10K
C24 470
R52 270
C28 10
C27 1-10
C26 22
C25 470
Q8 2N4403

C30 1uf
R56 1.5K
1.6V
Q9 2N4401
R55 2.7K

U7 7493
U8 7490
U9 7490

TUNE
C29 1

R62 1.5K

C33 1.0uf
CR5
R58 2.2K
REF MTR
R57 470
1.5V
CR4
C34 1
1.8V
4.9V
Q10 2N4401
R59 1.5K
1.4V
4V
Q13 2N4401
.7V
CR7
UNLOCK LAMP
C36
C35 1uf
U10 7474
R60 4.7K
Q11 2N4401
R61 820
4.9V
.04V
Q12 2N4401

LAST USED
C42
CR11
L2
P1
Q14
R69
T2
U12
Y1

1. ALL VOLTAGES MEASURED WITH VTVM
INPUT = 10 MEGOHMS

2. CIRCLED NUMBERS CORRESPOND TO WAVEFORMS

| REVISIONS | | | QEI CORPORATION |
|---|---|---|---|
| No | Date | By | SCHEMATIC DIAGRAM |
| 1 | 7/10/76 | S.E. | FMO & PHASE LOCK ASS'Y |
| 2 | | | Used on: |
| 3 | | | Drawn By NAL Date 7-13-76 Drawing No 6753003 |
| 4 | | | Approved Date |
| 5 | | | |