MOTOROLA INC.

AM STEREO SYSTEM C-QUAM®

EXCITER MODEL 1300
MONITOR MODEL 1310

FCC I.D. ABY89F1300

MOTOROLA INC., 1216 Remington Road, Schaumburg, IL 60195 (312) 576-2879

MOTOROLA C-QUAM AM STEREO BROADCAST EQUIPMENT

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SAFETY PRECAUTIONS

This manual is intended for trained and qualified operating or service personnel who are familiar with the dangers inherent to handling potentially hazardous electrical and/or electronic circuits. It is not intended to contain a complete statement of all safety precautions which should be observed by personnel in using this or other electronic equipment.

As with all electronic equipment, care should be taken to avoid electrical shock in all circuits where substantial currents or voltages may be present.

The procedures outlined in this Manual are based on the information available at the time of publication. However, the manufacturer cannot assume liability with respect to technical application of the contents and shall, under no circumstances, be responsible for damage or injury (whether to person or property) resulting from its use.

REPLACEMENT PARTS

To obtain new service replacement or warranty items, contact Motorola at the location shown below and please supply Product Identification (Model Number, and Serial Number) and Replacement Part Identification (including Stock Number and Description). Requests for replacements may be unduly delayed if all this information is not supplied. A complete parts list is provided in this manual.

EQUIPMENT DAMAGED IN TRANSIT

If concealed damage is discovered, immediately notify the carrier, confirming the notification in writing, and secure an inspection report. This item should be unpacked and inspected for damage WITHIN 15 DAYS after receipt. Report all shortages and damages to Motorola at the location shown below.

Motorola will file all claims for loss and damage on this equipment so long as the inspection report is obtained. Disposition of the damaged item will be furnished by Motorola.

FIELD ENGINEERING SERVICE

Requests for installation, field engineering or service assistance should be directed to Motorola at the location shown below.

MOTOROLA INC., 1216 REMINGTON ROAD, SCHAUMBURG IL 60195 312/576-2879

COMMERCIAL WARRANTY
(STANDARD)

Motorola AM stereo radio broadcast products are warranted to be free from defects in material and workmanship for a period of one (1) year, (except for crystals and channel elements which are warranted for a period of ten (10) years) from the date of shipment. In the event of a defect during the applicable warranty period, if customer returns the defective part or product to Motorola, transportation prepaid, Motorola, at its option, will either repair or replace such part or product, and such action by Motorola shall be the full extent of Motorola's obligation hereunder. Motorola will pay the transportation charges to return the part or product to customer. Parts, including crystals and channel elements, will be replaced free of charge for the full applicable warranty period, but the labor to repair the product or replace defective parts will only be provided for One Hundred-Twenty (120) days from the date of shipment. Thereafter, customer must pay for labor involved in repairing the product or replacing defective parts at Motorola's then prevailing rates together with any transportation charges to and from the place where warranty service is provided.

This warranty is void if:

a. the product is used in other than its normal and customary manner;
b. the product is subject to misuse, accident, neglect or damage;
c. unauthorized alterations or repairs are made, or unapproved parts are used in the equipment.

This warranty extends only to individual products. Because each radio broadcast system is unique, Motorola disclaims liability under this warranty or otherwise for range, coverage, performance or operation of the system as a whole. This warranty applies only within the United States and is extended by Motorola Inc., 1216 Remington Road, Schaumburg, Illinois 60195, to the original purchaser, and only to those purchasing the product solely for commercial, industrial, or governmental use. In order to obtain performance of this warranty, customer must contact its Motorola salesperson or Motorola at the address stated herein, attention: Quality Assurance Department.

THIS WARRANTY IS GIVEN IN LIEU OF ALL OTHER WARRANTIES EXPRESS OR IMPLIED, ALL OF WHICH ARE SPECIFICALLY EXCLUDED, INCLUDING, BUT NOT LIMITED TO, THE WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. IN NO EVENT SHALL MOTOROLA BE LIABLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES.

SYSTEM SPECIFICATIONS

EXCITER

RF Output:

Adjustable internally up to 5 watts into 50 ohms

$(L+R)_I$:

Adjustable under cover on front panel via 10 turn potentiometer up to +16 dBm, 600 ohms balanced.

Stereo-Monaural:

Switched under cover on front panel.
Switches L=R for monaural. Stereo, monaural indicated by LED on front panel.

Audio Input:

Right 0 dBm to +10 dBm Balanced 600 ohms
Left 0 dBm to +10 dBm Balanced 600 ohms
Both inputs adjustable with factory installed pad per customer requirement

Meter Functions:

$(L+R)_Q$ $(L-R)_Q$ Range −20 dB to +3 dB
0 dB = 100% Modulation.

Right, Left:
Meter functions switched at front panel between meters.

Phase Equalization:

Internally adjustable phase equalization is provided to compensate for phase variations in the transmitter chain.

Delay Circuit:

Provides wide band delay for propagation path differences in transmitter.

Night Feature:

A duplicate set of both delay and equalization to allow the exciter to work with either two separate transmitters or two significantly different antenna systems.

Sample Transmitter Output:

A sample transmitter output is provided on the rear. This contains all of the modulation aspects $(L+R)_Q$, $(L+R)_I$, $(L-R)_Q$. This is provided for diagnostics and comparison of transmitter characteristics vs. exciter characteristics.

Sample transmitter output 2 volts peak to peak into 50 ohms.

MONITOR

RF Input:

Frequency crystal controlled
Input level = 1 volt to 10 volts RMS
Impedance = 50 ohms

Modulation Meters:
Meter range 0 to 140% (−20 dB to +3 dB)
Attenuator range 0 to −50 dB in −10 dB steps
Accuracy at 100% modulation 400 Hz $\pm$ 2%
Meters switchable to + or −
LEFT or (L+R)
RIGHT or (L−R)

Peak Modulation Indicators:

(L+R) Group:

−100% Indicator internally set to flash when modulation exceeds −99%
+125% Indicator internally set to flash when modulation exceeds +124%
Peak Indicator adjustable via thumb wheel switches from 30% to 150%. Modulation selectable via push button switches + or −.

(L−R) Group:

Negative limit set internally to flash at 1.46 radians or 83.67°.
(L−R) limit set internally to flash when modulation exceeds 99%.
Peak flasher adjustable via thumb wheel switches for 30% to 125%.

Output BNC connectors on rear:

Remote Flashers (L+R)
(L−R)
Remote Meters (L+R)
(L−R)

Left Audio 600 ohms balanced & unbalanced
Right Audio 600 ohms balanced & unbalanced
(L+R)
(L−R)
25 Hz Pilot tone

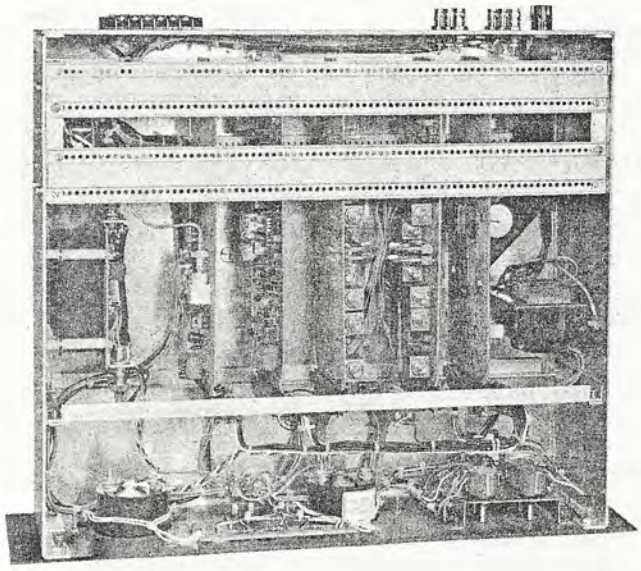
AM STEREO • GENERAL DESCRIPTION

The name "C-Quam" is derived from the phrase Compatible Quadrature Modulation. This means that the system has the advantages of quadrature modulation for stereo transmission, and is compatible with the hundreds of millions of existing monaural AM radios. In fact, the C-Quam system simply takes the sum of left and right stereo channels (L+R) and directly amplitude modulates the broadcast signal. This is the precise signal that monaural radios were designed to receive.

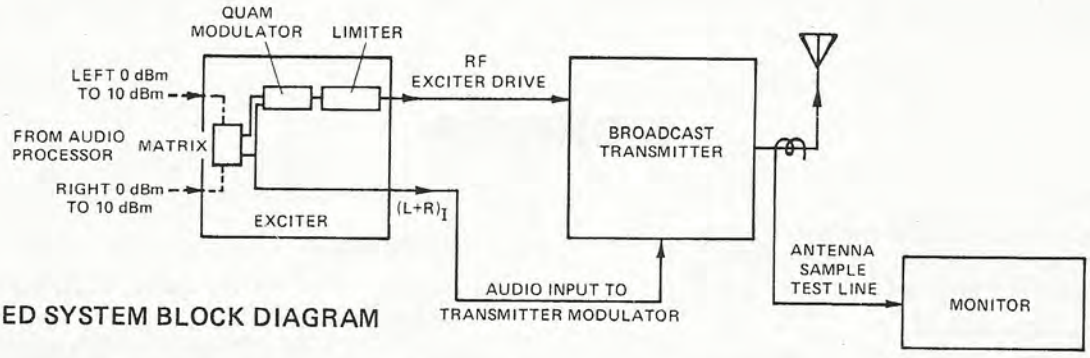
To provide stereophonic information, angle modulation results from straight forward Quadrature Modulation followed by limiting. That is, the monophonic (L+R) provides in-phase modulation while (L—R) provides quadrature phase modulation. The limiter assures constant level exciter drive to the transmitter.

A separate signal, 25Hz pilot tone, is added to the quadrature difference (L—R) signal for indicating the presence of a received stereophonic C-Quam broadcast.

Existing AM broadcast transmitters may be adapted to C-Quam with relatively simple and inexpensive modifications.



CARD CAGE CONSTRUCTION



SIMPLIFIED SYSTEM BLOCK DIAGRAM

SYSTEM SPECIFICATIONS

The following performance is typical closed loop performance of the Exciter operating into the Monitor.

Stereo Separation:

35 dB Minimum from 100Hz to 5kHz

Frequency Response:

L, R 100Hz -- 10KHz ± 1.0dB

Distortion, Harmonic:

L=R Monaural 0.25% max. at 85% mod.
L=—R Pure Stereo 0.5% max. at 85% mod.
*L,R Single Channel 1.0% max. at 70% mod.

*NOTE: This is equivalent of 140% modulation, 70% envelope modulation, simultaneous with 70% stereo information.

INSTALLATION

I. UNPACKING AND MECHANICAL CHECKOUT

The shipping cartons for the exciter and monitor are designed to protect the equipment for normal handling during shipment. Thoroughly inspect the equipment for any evidence of mishandling and report damage to the carrier immediately.

For additional information, refer to the general information section.

CAUTION! COMPLETE THIS PROCEDURE BEFORE APPLYING POWER TO UNITS

To prevent breakage, the circuit cards are not rigidly secured in their guides. Therefore, occasonally during shipment, the circuit cards may become loose. Prior to operating this equipment, all circuit cards should be reseated in their sockets as follows:

Remove all screws from the top and back panels of both the exciter and the monitor. Carefully move each circuit card from its socket by pulling it toward the rear of the cabinet and then push it back into its socket until fully seated. The circuit cards should only be moved by pulling on the top of the card itself and NOT by any components.

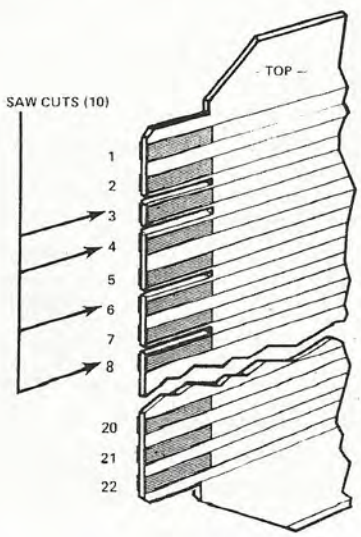
After reseating all circuit cards, secure the top metal cover to the monitor only. The exciter cover and back will be replaced after adjustments have been completed, however, on models incorporating a top access plate, the exciter cover may also be secured now.

II. CLOSED LOOP CHECKOUT

Recommended Test Equipment

The following test equiment is recommended for use during installation of the Motorola AM stereo exciter and monitor.

1. Low distortion oscillator, 600 ohms output, +10 dBm, less than 0.1% distortion.
2. Distortion analyzer, capable of indicating distortion levels of less than 0.1% distortion.
3. Oscilloscope, bandwidth 10 MHz or better, capable of X-Y display of audio frequencies with no appreciable phase shift.
4. Spectrum analyzer, frequency range covering the AM broadcast band, better than 60 dB logarithmic scale, and a resolution of better than 300 Hz.
5. Vector card extender with receptacle, part number 3690-6 which must be modified as shown below.



MODIFICATION TO BYPASS KEYING PLUGS

1. Designate a "TOP" reference
2. Make (10) Saw Cuts Approximately 1/16" wide by 3/8" deep between the following lands.

2/3	11/12
3/4	12/13
5/6	14/15
7/8	16/17
9/10	18/19

The spectrum analyzer may not normally be part of a broadcast station test equipment. It can normally be rented for a reasonable fee, and it is highly recommended that it be available during the installation.

Checkout and Installation Outline

There are a number of steps which should be taken in sequence to achieve the best results with the Motorola AM stereo system. The first part of the procedure involves checking the exciter and monitor connected directly together (closed loop) in order to confirm that the equipment operates with essentially the same performance as it did when final tested at the factory.

After it has been confirmed that the Motorola equipment is operating properly, the monitor is then used to make performance measurements on the broadcast transmitter. Of particular importance is the level of incidental phase modulation generated by the broadcast transmitter. This level of IPM must be sufficiently low before attempting stereophonic operation.

When the broadcast transmitter has achieved acceptable IPM performance, then the Motorola AM stereo exciter is connected. First the R.F. interface is completed so that the transmitter takes its R.F. drive from the exciter, and then audio connections are made.

Adjustments of audio drive, the delay networks, and other procedures are then conducted until the overall stereo performance meets the FCC and the more stringent Motorola standards. Finally, the required FCC equipment performance measurements are made.

After the technical specifications are met and proven, tests are made under program conditions including adjustment of modulation and audio processing equipment.

Closed Loop Connections

The distortion analyzer, oscilloscope and spectrum analyzer should be initially connected to the exciter and monitor as shown below in Figure 1.

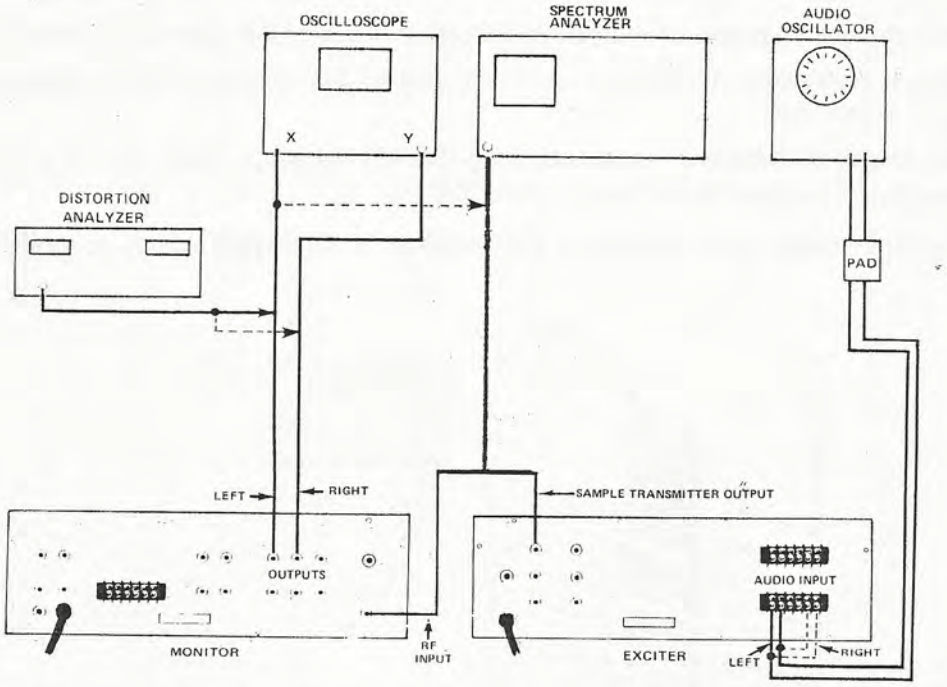


Figure 1. Closed Loop Equipment Arrangement

The input impedance to the spectrum analyzer is usually 50 ohms as is the input impedance of the monitor and the output of the exciter sample transmitter. The oscilloscope input can be paralled with the spectrum analyzer input because the oscilloscope input is usually high impedance. The distortion analyzer input can also be unbalanced and it will be used to take measurements from several of the monitor outputs appearing at BNC connectors on the rear of the unit.

An audio oscillator is connected to 600 ohm unbalanced exciter input terminals, and the following test input modes are required: left only, right only, left plus right and left minus right. In the left or right only function, the audio oscillator (balanced or unbalanced) can be directly connected to the input terminals. For L+R or L—R, the exciter audio inputs are paralleled either in phase, or out of phase. In either case, the input impedance of the paralleled inputs is 300 ohms. Although usually not necessary with high quality audio oscillators, a matching pad can be constructed as follows.

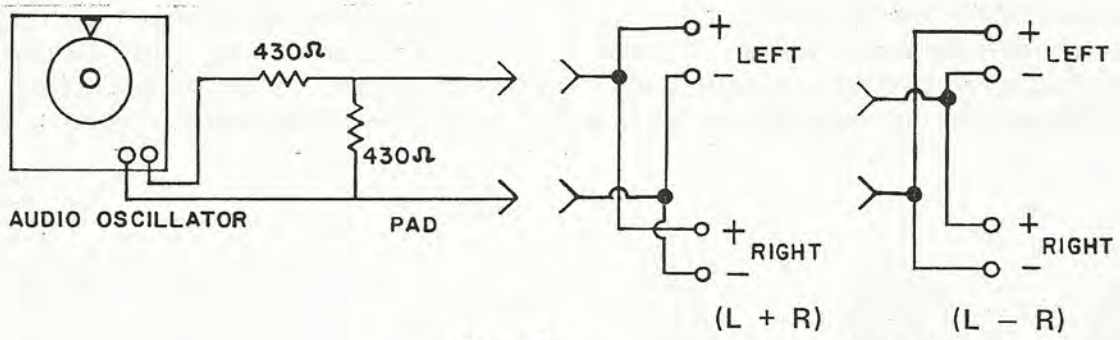


Figure 2.

Some oscillators already contain the switching and matching for the four modes of operation which simplify testing for AM or FM stereo.

Exciter to Monitor Closed Loop Checkout (Start of Test)

Before attempting to connect the Motorola AM stereo equipment to the station transmitter, it is most important to make a check of the stereo equipment performance by directly connecting the AM stereo exciter to the modulation monitor. This not only will provide a check of the equipment performance prior to installation, but will also help acquaint the broadcast station personnel with the operation of the stereo equipment.

The exciter unit has a self-contained amplitude modulator which provides an output signal of approximately 1 volt RMS at 50 ohms and contains the completely encoded C-Quam AM stereo signal. This output (labeled — Sample Transmitter Output) could also be used to test receivers without having to use the broadcast transmitter.

The Sample Transmitter Output should be connected to the monitor "R.F. Input" with a BNC to BNC coaxial cable. The A.C. power to the exciter and the monitor can be applied by plugging in the line cords to a suitable A.C. outlet. There are no power switches to either the exciter or the monitor. Therefore, the line cords must be unplugged to turn either unit off.

After applying A.C. power, the lights for all meters should be illuminated. The small toggle switch on the monitor under the carrier level meter should be thrown to the right-hand position, toward the carrier set knob. This is a meter switch and normally will be switched to the right-hand position except when checking the pilot tone level.

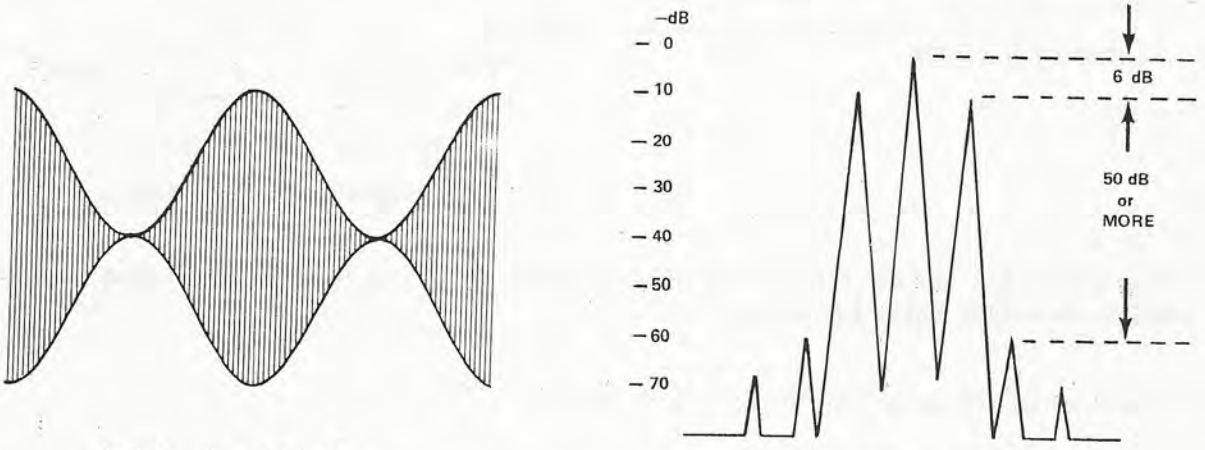
The appropriate R.F. input level to the monitor is adjusted by a step attenuator which is controlled by a rotary switch on the rear of the monitor (MR8) and the potentiometer front panel control (MF11). Observe the carrier level meter while adjusting the input level using the front panel knob. The time con-

stant for the meter circuitry is very long, so wait about 10 seconds after adjusting the knob to determine if the adjustment is within range of the front panel control. If not, reset the switch attenuator and readjust the front panel control for a center indication on the carrier meter.

With no audio input to the exciter, the noise level indicated on the monitor should be lower than 50 dB for L+R or –40 dB for L–R. This is read by selecting on the monitor front panel L+R for the left meter (MF4) and L–R for the right-hand meter with (MF6). For each meter there is a row of pushbuttons providing meter ranges in 10 dB steps. The push button selection and the meter indication on the red dB scale are added together for a measurement referenced to 100% modulation.

Left Plus Right (AM) Operation

The output of the audio oscillator should now be connected through the pad to the left and right audio input terminals of the exciter, phasing the inputs for L+R operation. The monitor left-hand meter control buttons (MF4) should select (–) and (L+R). Set the oscillator frequency to 1 kHz and advance the audio level from the audio oscillator until the meter reads 100 percent modulation. Observe both the oscilloscope display of envelope modulation, and the spectrum analyzer (at the exciter sample transmitter output). If the range of the instruments are set properly, the displays should appear as follows:



Oscilloscope Envelope **Spectrum Analyzer**

Figure 3.

At 100 percent negative modulation, the oscilloscope envelope pattern should just pinch off to zero signal and the first order sidebands on the spectrum analyzer display should be exactly 6 dB down from the carrier. The high order sidebands on the spectrum analyzer should be at least 50 dB below the fundamental sidebands indicating AM distortion less than 0.3 percent. However, be careful in setting the oscillator level because if the modulation is even slightly more than 100 percent negative, the high order distortion sidebands will increase very rapidly. Make the adjustment in modulation level more than 100 percent and watch the high order sidebands change.

After finding the 100 percent negative point from the test instruments, observe the monitor modulation meter indication and flasher lights. The 100 percent negative light should be illuminated and the left-hand panel meter should indicate 100 percent modulation. Adjust the digital switch immediately to the left of the meter to 100 percent, and the corresponding LED indicator should also light.

For distortion measurements on L+R, it is recommended that 95% modulation be used preventing erroneous distortion measurements which can result from inadvertant over modulation. So, reduce slightly the oscillator level until 95% modulation is shown on the meter. Connect the distortion analyzer to the L+R (MR11) BNC connector on the rear of the monitor.

At this time a series of audio measurements can be made to determine if the performance is within specifications. Generally the performance should be at least as follows:

Frequency response:	±1.0 dB from 30 Hz to 10 kHz
Distortion:	Less than 0.3%
Noise:	Lower than 60 dB below 100% modulation

Main to Subchannel Crosstalk (L+R to L—R Crosstalk)

The isolation between the normal amplitude modulation and the added stereo information will have a direct bearing on the separation obtainable between the left and right stereo channels. Closed loop measurements should be made to confirm that the exciter to monitor operation is capable of transmitting and indicating sufficient isolation.

The transmitted signal is the same as the previous L+R (AM) measurements. However, instead of looking at the L+R monitor output, measurements will be made of the residual signal in the L—R detector.

First modulate the exciter with 95% L+R with a 1 kHz tone and observe the right-hand meter (MF1). Select the L—R function with the push buttons (MF6), and push the range selector buttons (MF3) until a reading is obtained. On the exciter, adjust balance control (EF13) until a null in the monitor L—R indicator is obtained. Readjust the oscillator output for 95% amplitude (L+R) modulation.

The main to subchannel crosstalk can now be measured over the audio frequency range. The measurements should be within the following specifications:

Crosstalk, L+R to L—R:	35 dB from 20 Hz to 5 kHz
	25 dB from 20 Hz to 10 kHz

The residual signal which appears in the L—R channel can result from the limitations in the modulation monitor but under normal broadcast transmitter operation the first limitation is likely to be the incidental phase modulation (IPM) of the transmitter. When the AM transmitter is modulated, not only is the RF amplitude modulated, but there is a small amount of phase modulation, especially at higher negative levels of modulation. The readings of L—R modulation on the monitor will be used later to adjust the transmitter for minimum incidental phase modulation, or more accurately, for the Motorola system, minimum incidental quadrature modulation.

— NOTE —

The following forms are provided for your convenience to record measurements while becoming familiarized with the equipment. It is left to your judgement if the indicated measurements are to be recorded.

Exciter Serial _____

Monitor Serial _____

Radio Station _____

Date _____

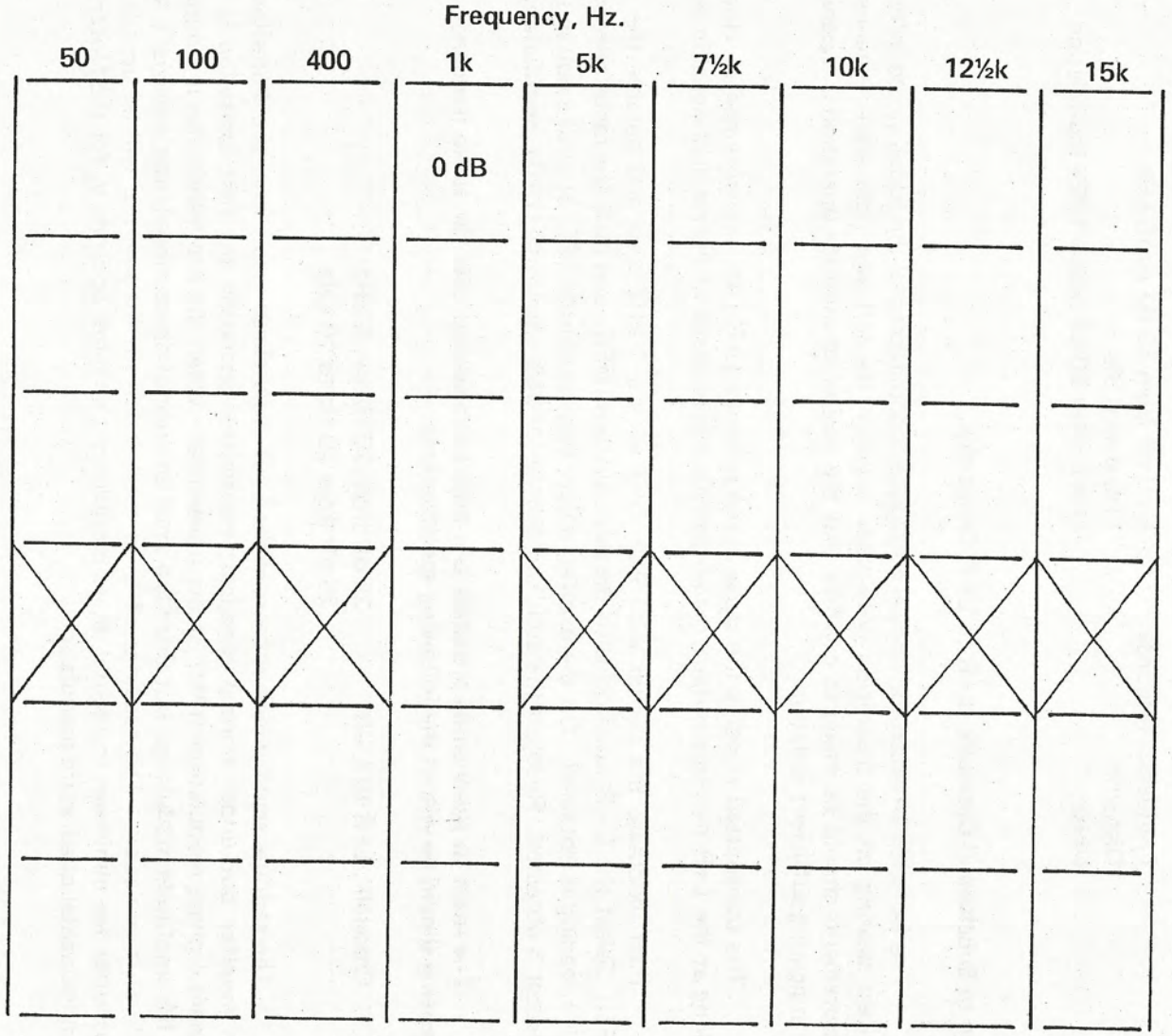
Exciter to Monitor Closed Loop Checkout
L + R Performance

L + R Frequency Response
95% Modulation

L + R Distortion
95% Modulation

L + R into L – R
Crosstalk (IPM)

L + R Noise Level

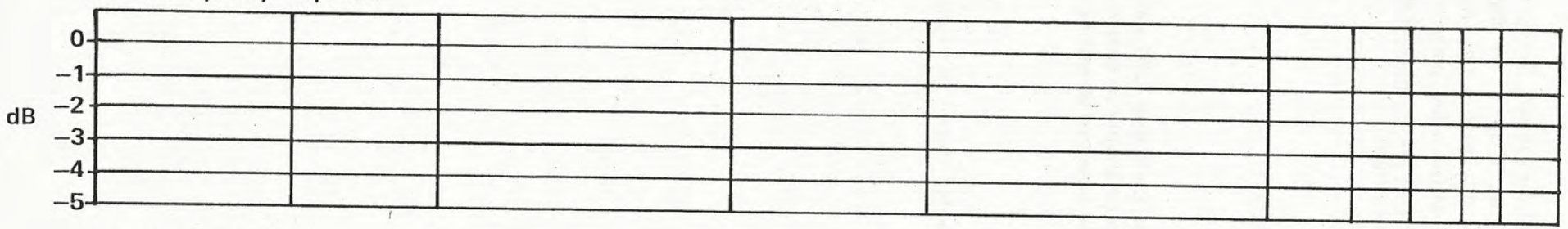


Exciter to Monitor Closed Loop Checkout

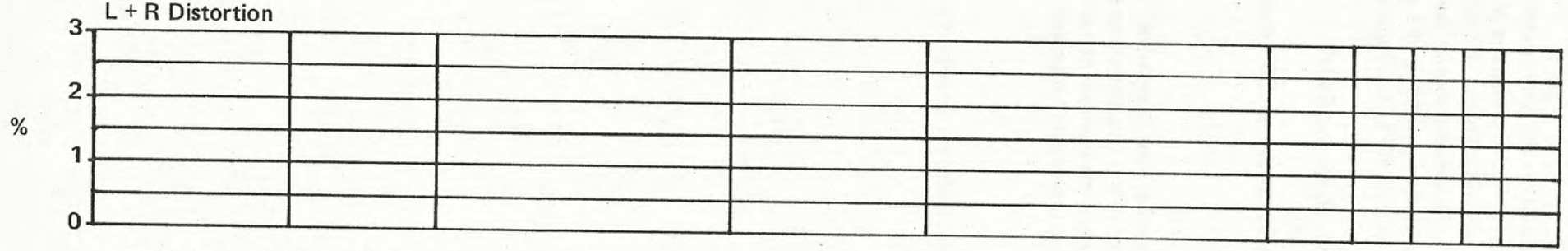
L + R Performance

L + R

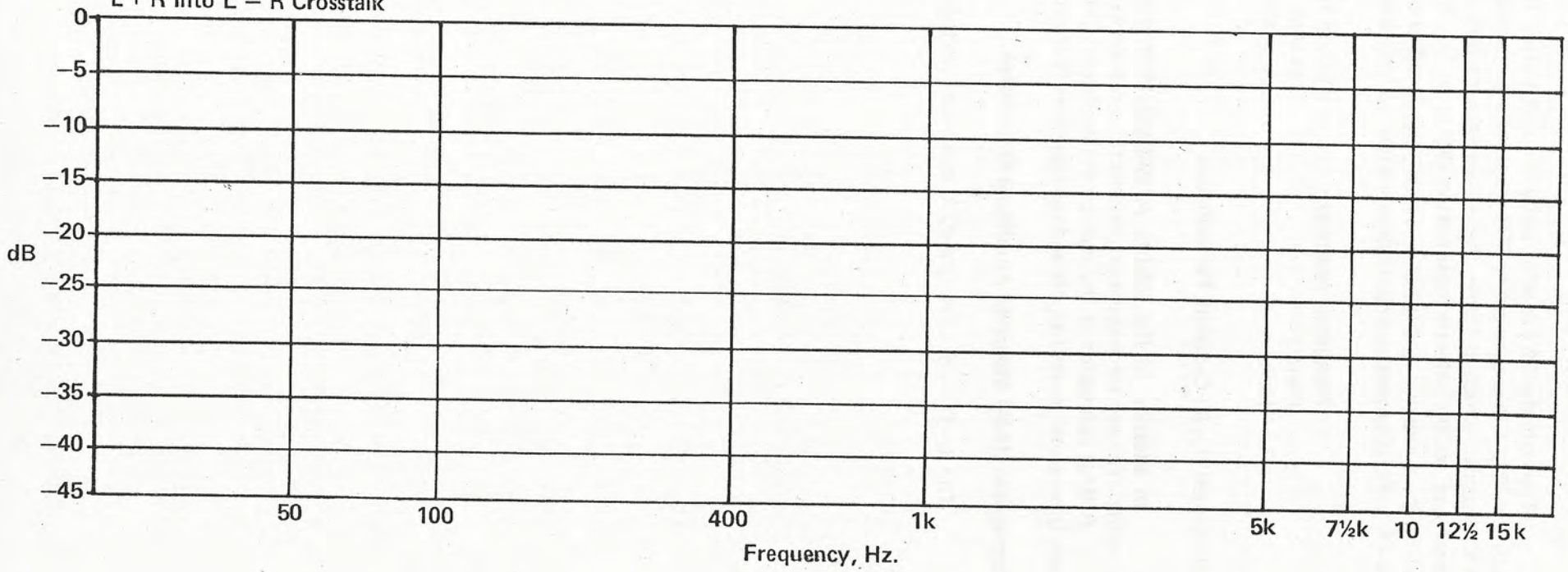
L + R Frequency Response



L + R Distortion



L + R into L − R Crosstalk



Subchannel (L−R) Performance Fidelity

Turn off the 25 Hz pilot using the pushbutton located on the front panel of the exciter. Set up the exciter with a 1 kHz tone set to 95% amplitude modulation (L+R). Reverse the polarity of one of the inputs to the exciter which switches the modulation to 95% L−R modulation. Observe the monitor right-hand meter and set the selector pushbutton (MF6) to "L−R". The meter should read within a few percent of 95%. The distortion and noise meter are connected to the BNC connector in the rear of the monitor labeled "L−R". Fidelity measurements should show performance within the following specification:

Frequency response:	±1.0 dB from 30 Hz to 10 kHz
Distortion:	Less than 0.3%
Noise:	Lower than 50 dB below 100% modulation

Subchannel (L−R) Crosstalk Performance

In addition to the fidelity assessment, measurement of the "crosstalk" or L−R into L+R should be made. The exciter audio input connections remain as above but the distortion meter should be connected to L+R BNC connector at the rear of the monitor. Crosstalk measurements can be observed by setting the right front panel meter to L+R and reading directly from the modulation monitor.

Subchannel (IAM) Indicated Amplitude Modulation

The L−R into L+R crosstalk minimum performance should exceed the value shown in Figure 8.

Exciter Serial _____

Monitor Serial _____

Radio Station _____

Date _____

Exciter to Monitor Closed Loop Checkout
L – R Performance

L – R

Frequency, Hz.

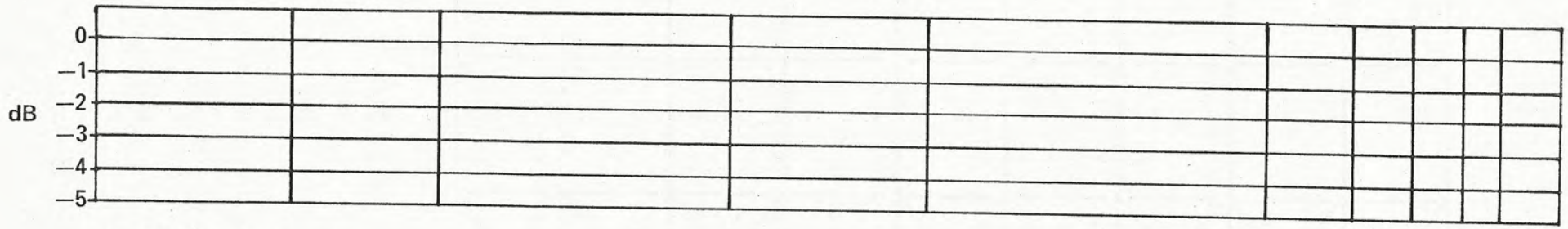
	50	100	400	1k	5k	7½k	10k	12½k	15k
L – R Frequency Response, 95% Modulation				0 dB					
L – R Distortion 95% Modulation									
L – R into L + R Crosstalk, (Incidential Amplitude Modulation)									
L – R Noise Level									

Exciter to Monitor Closed Loop Checkout

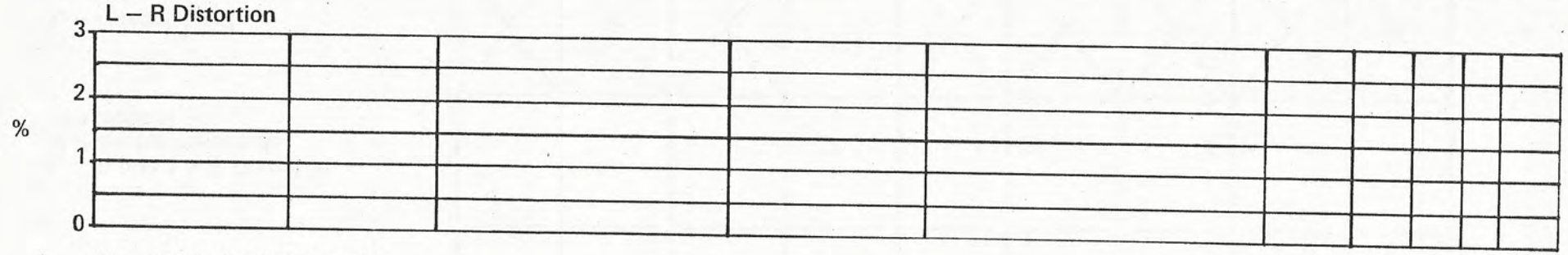
L – R Performance

L – R

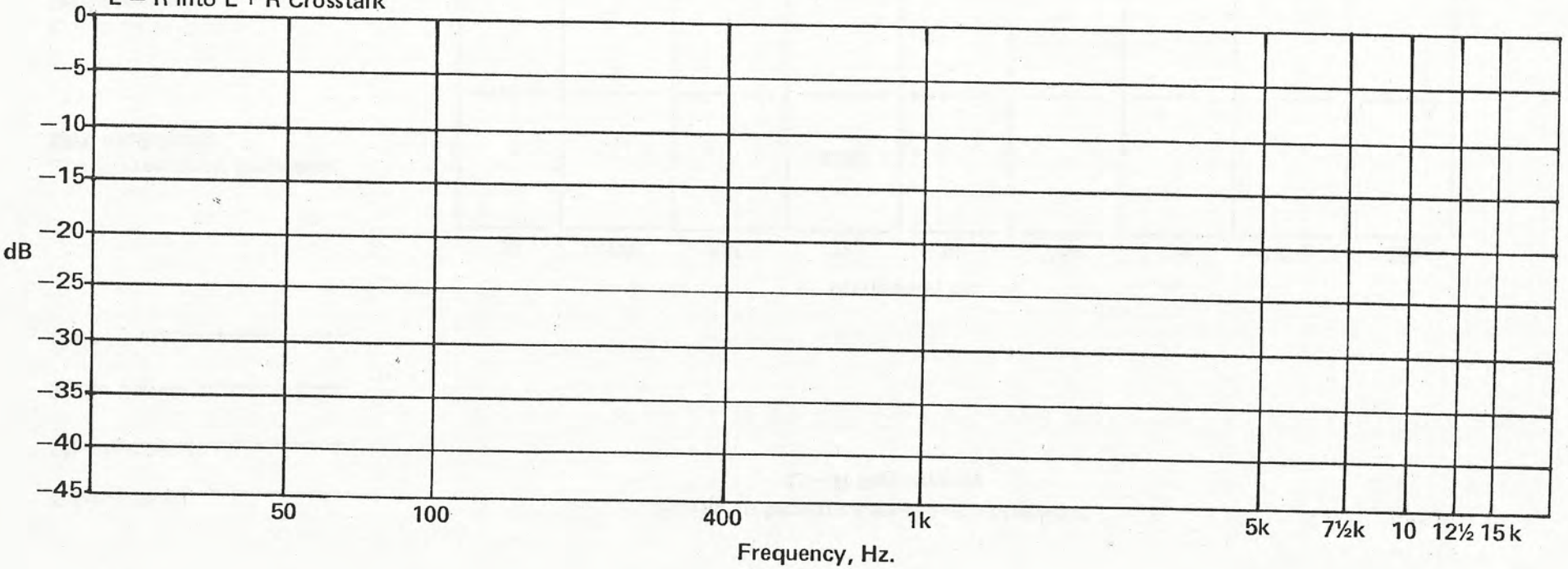
L – R Frequency Response



L – R Distortion



L – R into L + R Crosstalk



Single Channel Performance

Connect the audio oscillator to the exciter left channel input and adjust a 1 kHz tone to 50% modulation. The monitor indication of 50% modulation should be shown on the left meter in the L+R and left positions. The left-hand meter on the modulation monitor is switched from reading L+R to Left with pushbuttons (MF4). The right-hand meter can be switched from reading L—R to Right channel output using pushbutton (MF6). The separation for 100% modulation can be read directly on the right meter by selecting the appropriate scale with pushbuttons (MF3).

— NOTE —

For 50% modulation, the reference (on the dB scale) is 6 dB lower, therefore the separation will be 6 dB less than that indicated. This would be called the left into right separation. Connecting the oscillator to the right channel and reading the residual into the left channel would be the right into left separation.

The separation between the two channels should meet the following specification both ways.

Separation between:	200 Hz and 5 kHz — 30 dB
	30 Hz and 15 kHz — 15 dB

If the separation specification is not obtainable, then the setting of the delay equalization should be checked, see page number 23.

Exciter Serial _____

Monitor Serial _____

Radio Station _____

Date _____

Right

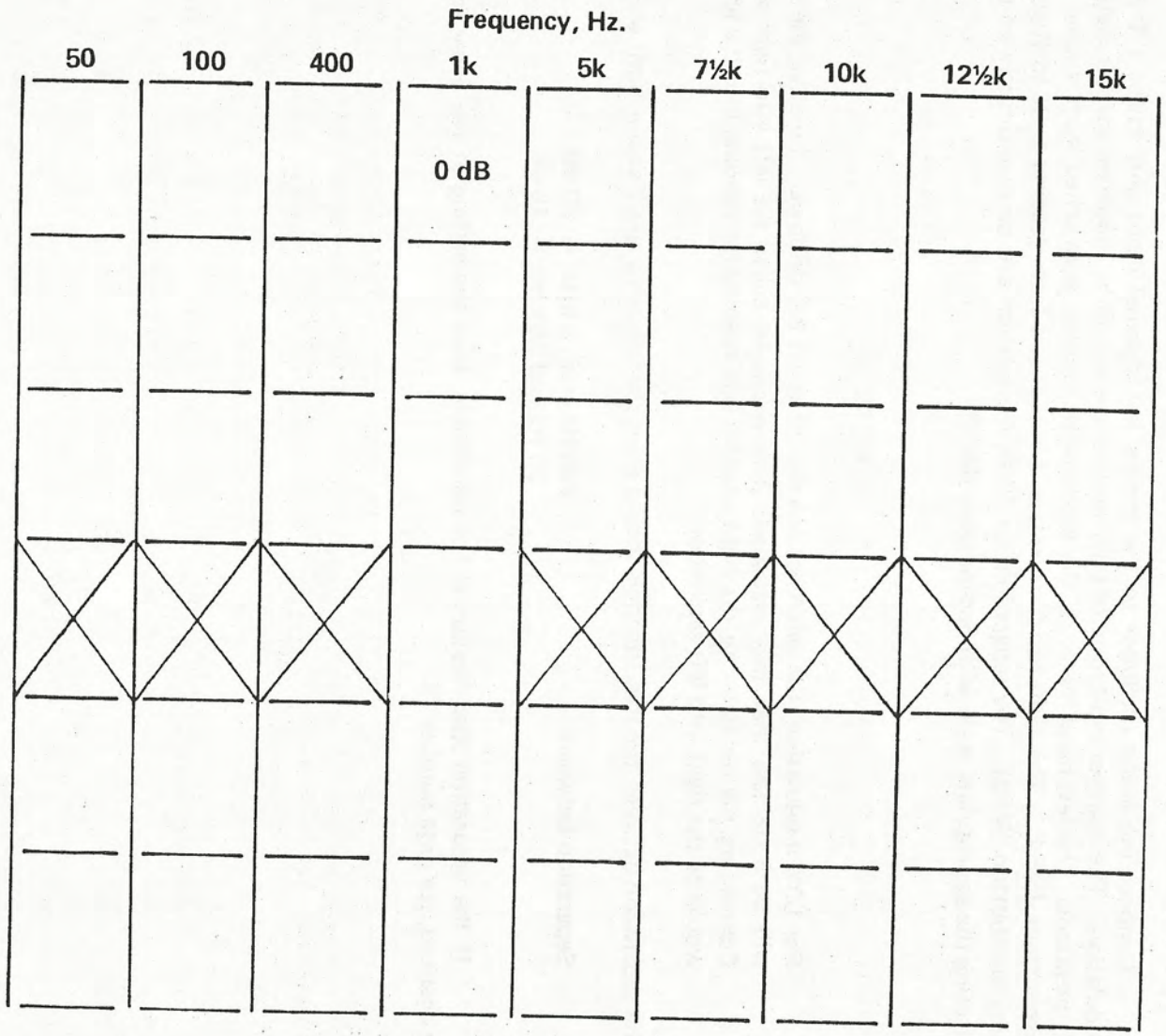
Exciter to Monitor Closed Loop Checkout
Right Channel Performance

Right Channel Audio Frequency Response, 50% Modulation

Right Channel Distortion 50% Modulation

Right Channel into Left Separation, 50% Modulation

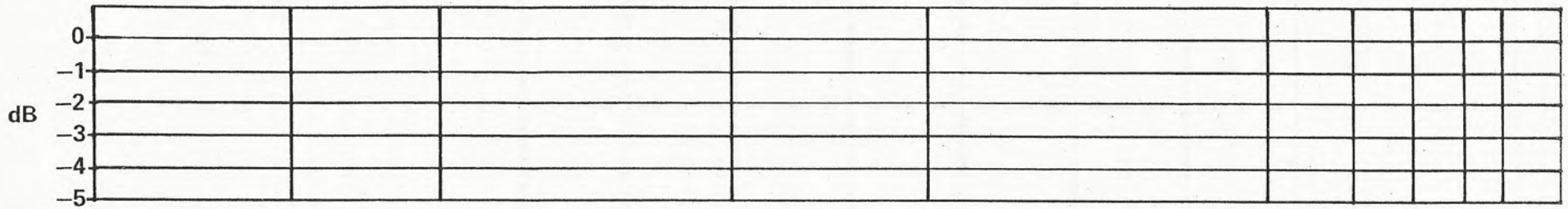
Right Channel Noise Level



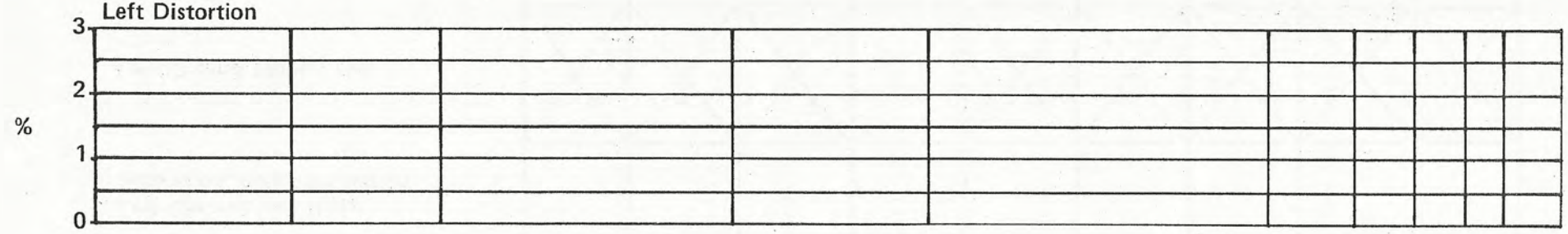
Exciter to Monitor Closed Loop Checkout
Left Channel Performance

Left

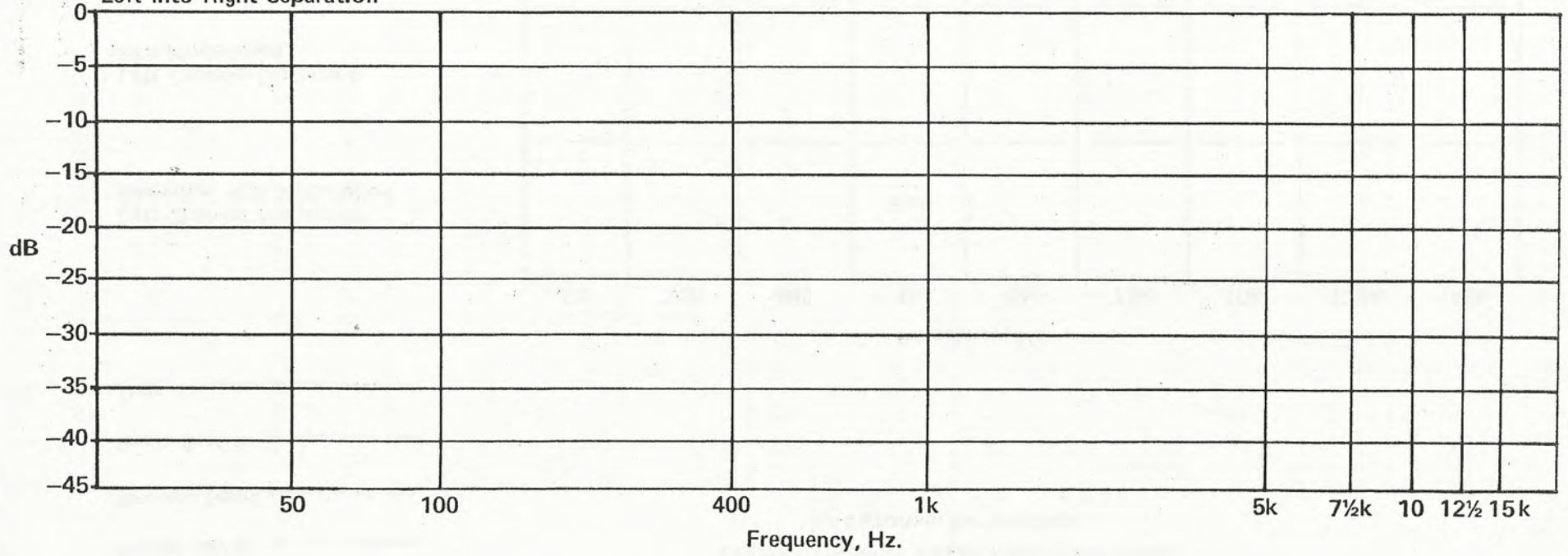
Left Frequency Response



Left Distortion



Left into Right Separation



Exciter Serial _____

Monitor Serial _____

Radio Station _____

Date _____

Exciter to Monitor Closed Loop Performance
Left Channel Performance

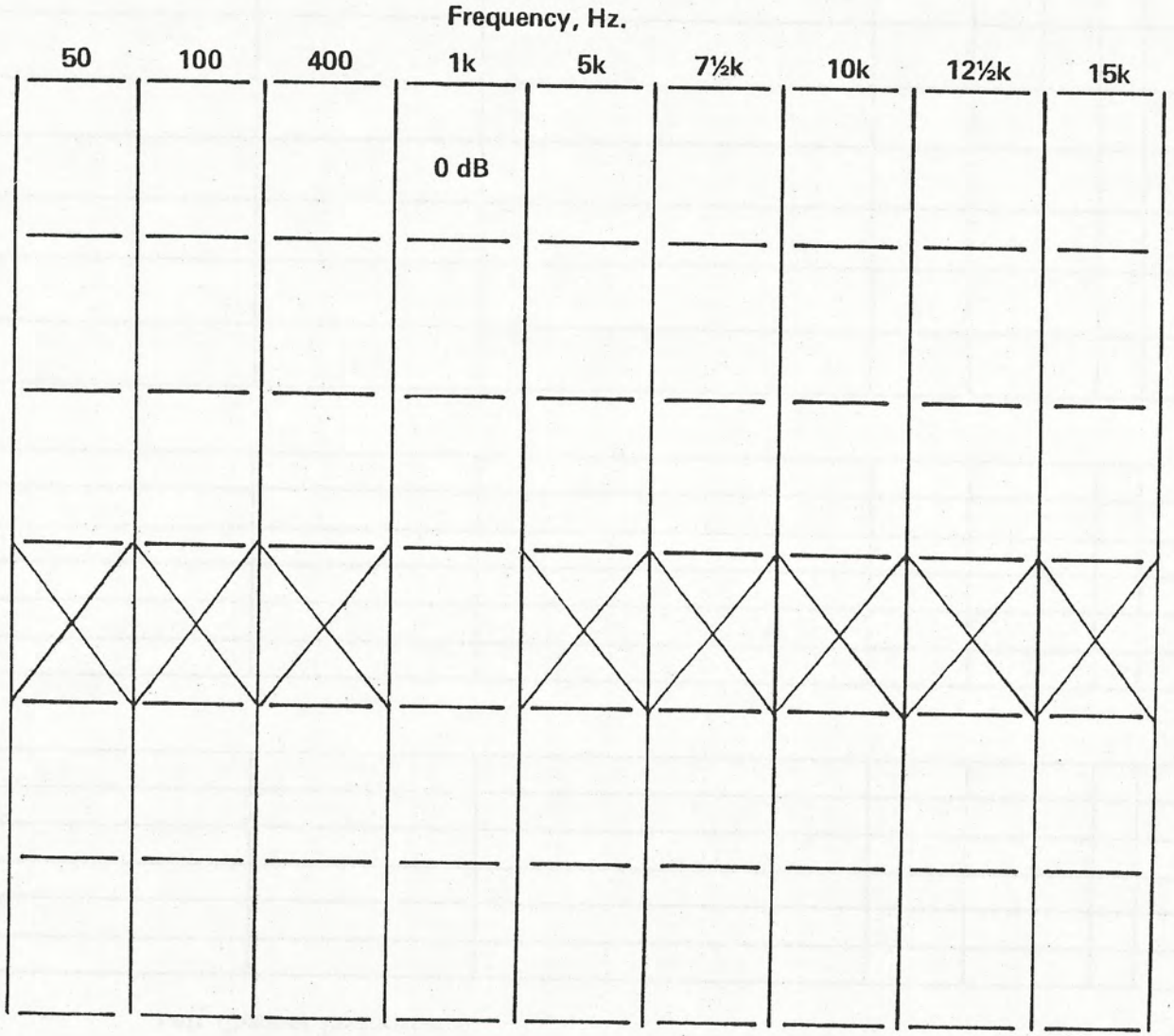
Left

Left Channel Frequency Response, 50% Modulation

Left Channel Distortion 50% Modulation

Left Channel into Right, Separation, 50% Modulation

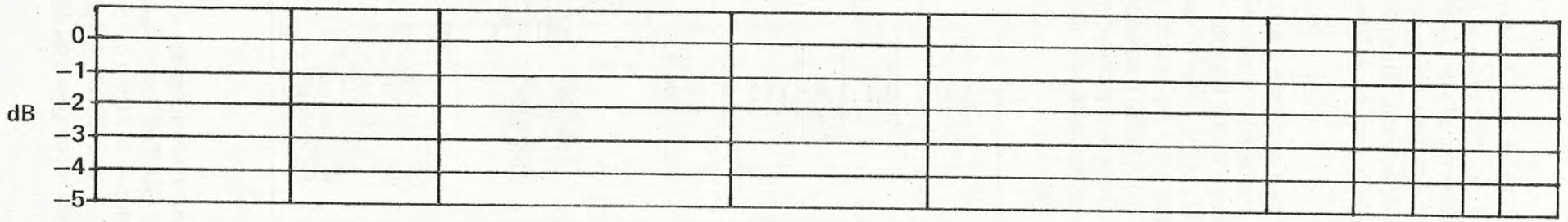
Left Channel Noise Level



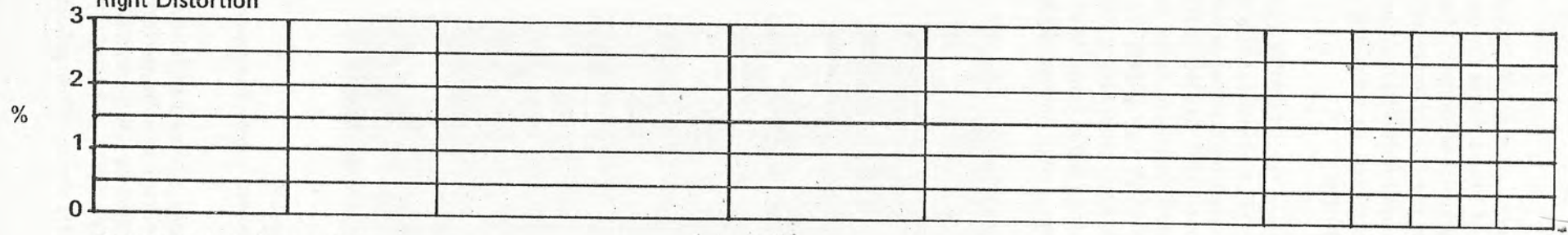
Exciter to Monitor Closed Loop Checkout
Right Channel Performance

Right

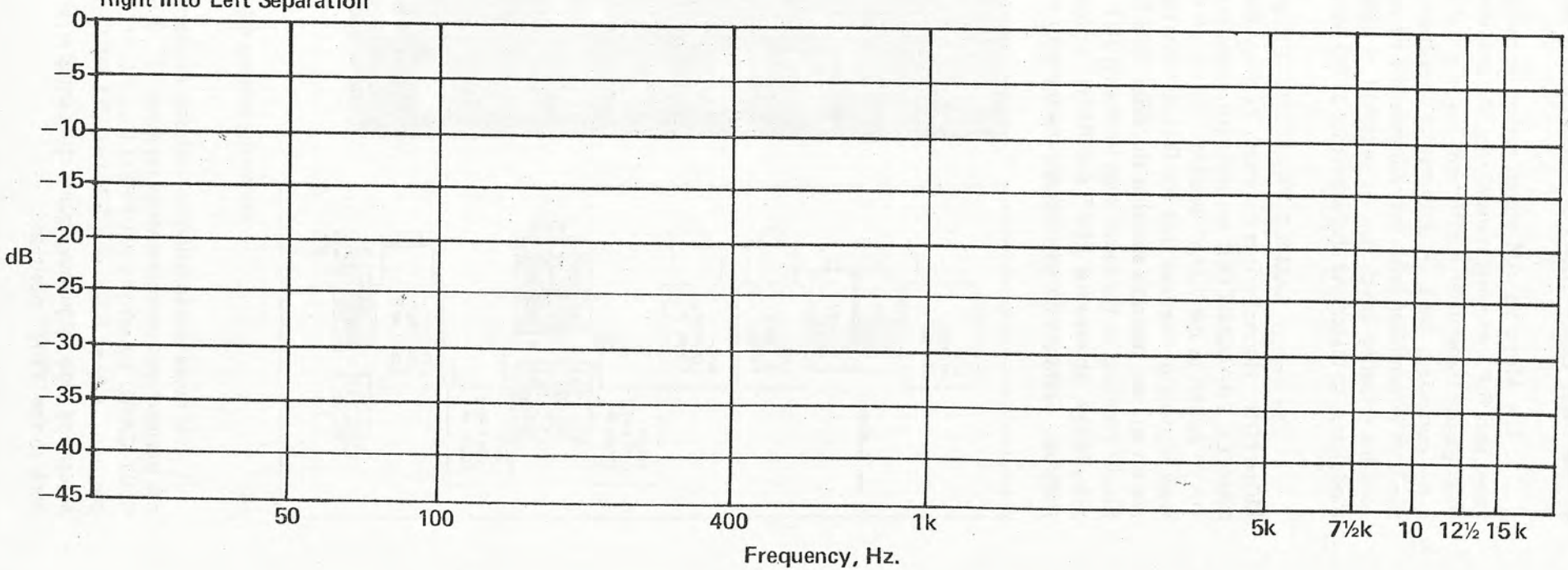
Right Frequency Response



Right Distortion



Right into Left Separation



Exciter Delay Equalization (for sample transmitter)

The Motorola AM stereo system is connected to the AM broadcast transmitter via two inputs; audio and R.F. In most transmitters, the amount of time it takes for the R.F. and the audio to propagate through the transmitter is different, (usually the audio takes longer). If the difference in propagation time is not corrected, the L−R information contained in the R.F. channel will arrive at the receiver earlier than the L+R information with the resultant loss of separation due to improper dematrixing. Thus, the exciter contains circuitry which can be switched in and adjusted to delay the audio fed to the exciter internal modulators to match the characteristics of the transmitter.

The exciter SAMPLE TRANSMITTER is used for CLOSED LOOP testing of the EXCITER and MONITOR. Normally it is necessary to delay the "Q" channel because the propagation times through the SAMPLE TRANSMITTER are different, therefore requiring compensation. Set FRONT PANEL "NIGHT/DAY" switch to the "DAY" position. Check on the NIGHT AUDIO CIRCUIT CARD (refer to component view in back of manual) that the DELAY SWITCHES S608 and S609 (located near the rear of the card) are set to zero position and that the PROCESS DEFEAT switch S607 is in the DEFEAT position (switch handle pointing to the outer edge of the NIGHT AUDIO CIRCUIT CARD. Using and oscilloscope set for x-y display, observe the LEFT and RIGHT unbalanced signal outputs at the ports J808 and J809 on the monitor. Compare the oscilloscope display with those shown on Page 18 and 19.

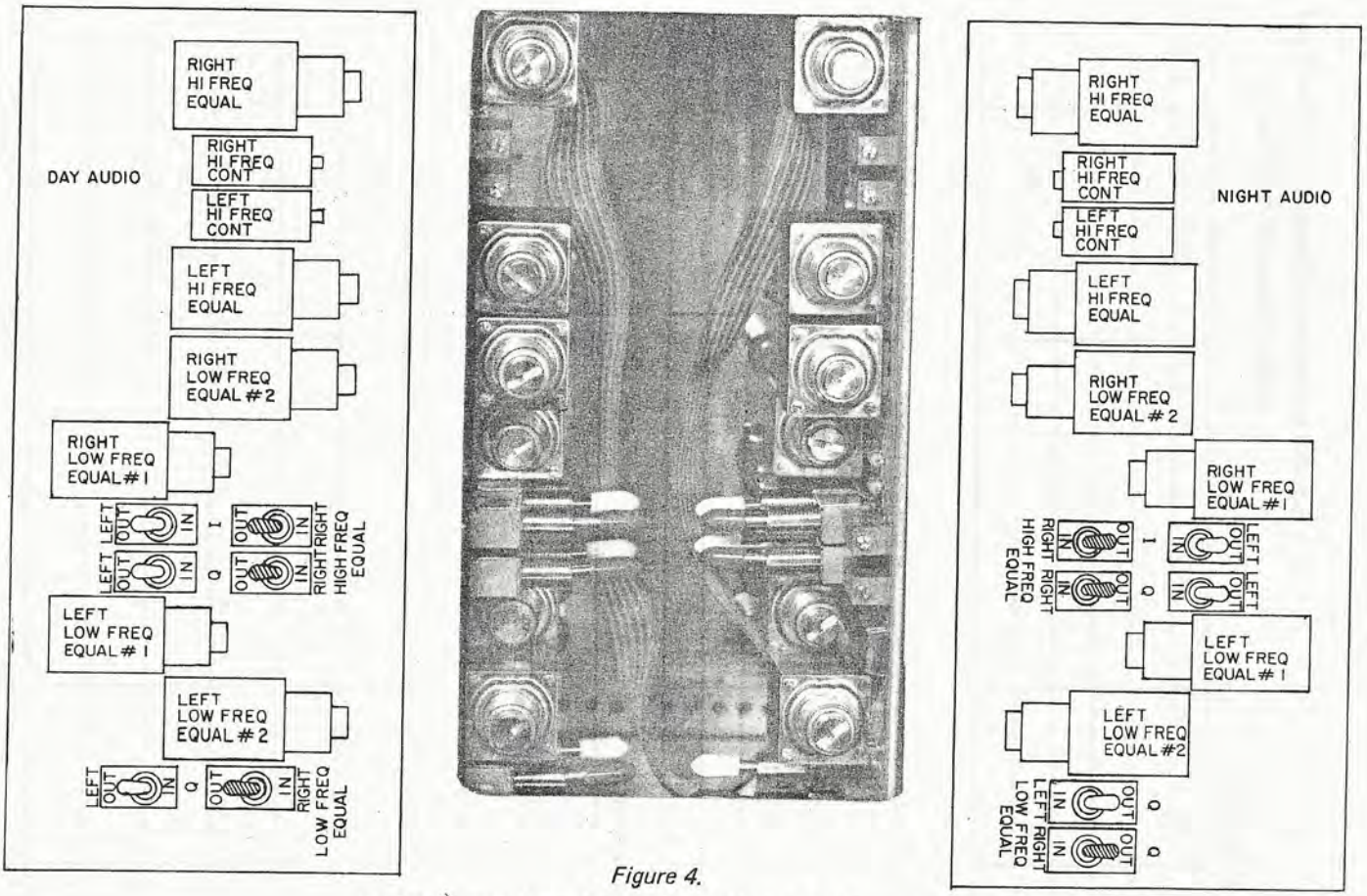


Figure 4.

Exciter Equalization Adjustments (Under Top Cover Access)

If delay equalization corrections are necessary, proceed as follows and then repeat the single channel performance measurements on Page 11. The corrections are performed ON THE DAY AUDIO CIRCUIT CARD by setting (HI FREQ EQUAL "I") switches S303 and S305 (shown in Figure 4) to the "IN" position. Adjust R389 and R391 (LEFT HI FREQ CONT) and (RIGHT HI FREQ CONT) fully CW, then adjust the high frequency equalization using a 10 kHz signal. When adjustment is complete, set all switches back to the "OUT" position.

– NOTE –

If night audio card in installed, set FRONT PANEL "NIGHT/DAY" switch to the "NIGHT" position and repeat all delay equalization corrections identical to those performed on the DAY AUDIO CIRCUIT CARD. The corrections are performed on the NIGHT AUDIO CIRCUIT CARD by first setting the NIGHT CARD switches S603 and S605 (HI FREQ EQUAL "I") to the "IN" position, and adjust R689 and R391 (LEFT HI FREQ CONT) and (RIGHT HI FREQ CONT) fully CW, and then adjust the high frequency equalization using a 10 kHz signal. Monitor the LEFT and RIGHT signal as described in the DAY AUDIO CIRCUIT CARD section outlined above. When adjustment is complete, set all switches back to the "OUT" position.

– NOTE –

The points of maximum separation and minimum total harmonic distortion (THD) should fall at the same point. However, the final adjustment may be a compromise requiring your best judgement.

III. MONITOR MEASUREMENTS OF BROADCAST TRANSMITTER

Phase Hum and Noise, and Incidental Phase Modulation

Before attempting to initiate stereophonic operation with the broadcast transmitter, the Motorola AM stereo modulation monitor should be connected to a transmitter R.F. sample so that hum, noise phase modulation and incidental phase modulation can be measured.

The monitor can be calibrated on input R.F. levels from 300 mV to 10 volts RMS unmodulated. A 10 dB per step attenuator is controlled by a knob at the rear of the monitor, and the fine adjustment is made with a knob on the front panel. Using an unmodulated transmitter, set the monitor R.F. input level for a center indication on the carrier meter.

The broadcast transmitter can now be modulated with a 1 kHz tone inserted at the normal audio input terminals. The Motorola monitor can simultaneously monitor the normal AM on the left-hand meter (button MF4 set to L+R) and the incidental phase (or quadrature) modulation on the right-hand meter by selecting L–R on pushbutton (MF6).

Although most AM broadcast transmitters can easily meet the FCC AM noise specification of 45 dB down and many can make more than 60 dB down, the transmitter phase hum can be very different. Power supply PM hum and residual phase noise can originate in the transmitter and be completely harmless for AM operation, but can become very troublesome for stereo broadcasting.

After the Motorola stereo modulation monitor is calibrated for the correct R.F. input level, the audio input to the transmitter should be terminated and a measurement of the L–R modulation level be made. It would be useful to look at the audio output of the L–R channel with a conventional display on the oscilloscope to determine the waveform of the residual noise. The scope can be triggered with a line signal to observe if hum components are the primary component to the residual signal.

Generally, the residual L–R noise should be at least 40 dB below 100% L–R modulation. If this is not the case, then work needs to be done on the transmitter to improve the noise level. This generally consists of improving the power supply filtering on the lower level R.F. stages in the transmitter, but also can be traced to the dressing of leads having A.C. currents on them. The transmitter manufacturer may have some experience or may be willing to help solve the P.M. hum problems in order to make the transmitter more usable for AM stereo operation.

It is recommended that an oscilloscope be continually used in an X–Y mode to display the stereophonic operation of the Motorola exciter and monitor. The X–Y display requires an oscilloscope of sufficient sensitivity, bandwidth and phase characteristics such that both the horizontal and vertical axes display audio signals of approximately 0.5 volts peak to peak with no appreciable phase shifting. Figure 5 indicates the ideal displays of sine wave modulation under the indicated modes of stereo operation. Additional sample X–Y displays are shown in Figures 6 and 7.

Refering to Figure 1 on Page 2, the oscilloscope should be connected to the monitor unbalanced left and right BNC outputs (MR6 and MR7). The left output should be connected to the X axis oscilloscope input. Under no modulation conditions, the trace will consist of a single dot which could burn the phospher of the cathode ray tube. The intensity of the oscilloscope should, therefore, be reduced if the no modulation condition exists over an extended period of time.

The X–Y display can be very useful in troubleshooting and adjusting AM stereo. It can indicate the amount and nature of incidental phase modulation, audio delays or phase shifts, operation of audio processing equipment, amount of stereo in programming and many other characteristics limited only by the expertise of the observer.

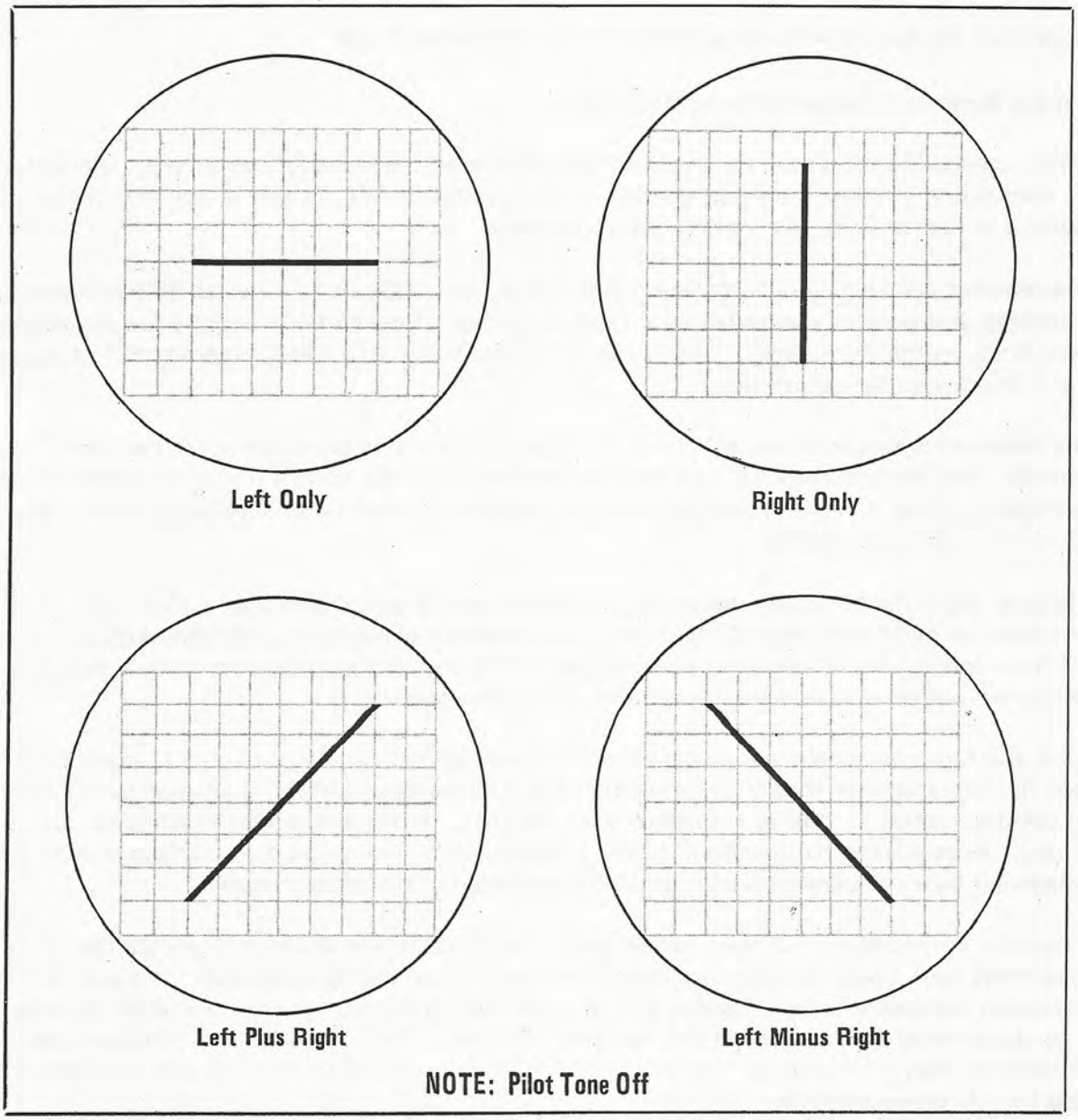


Figure 5. Ideal Oscilloscope Displays of Stereo Signals

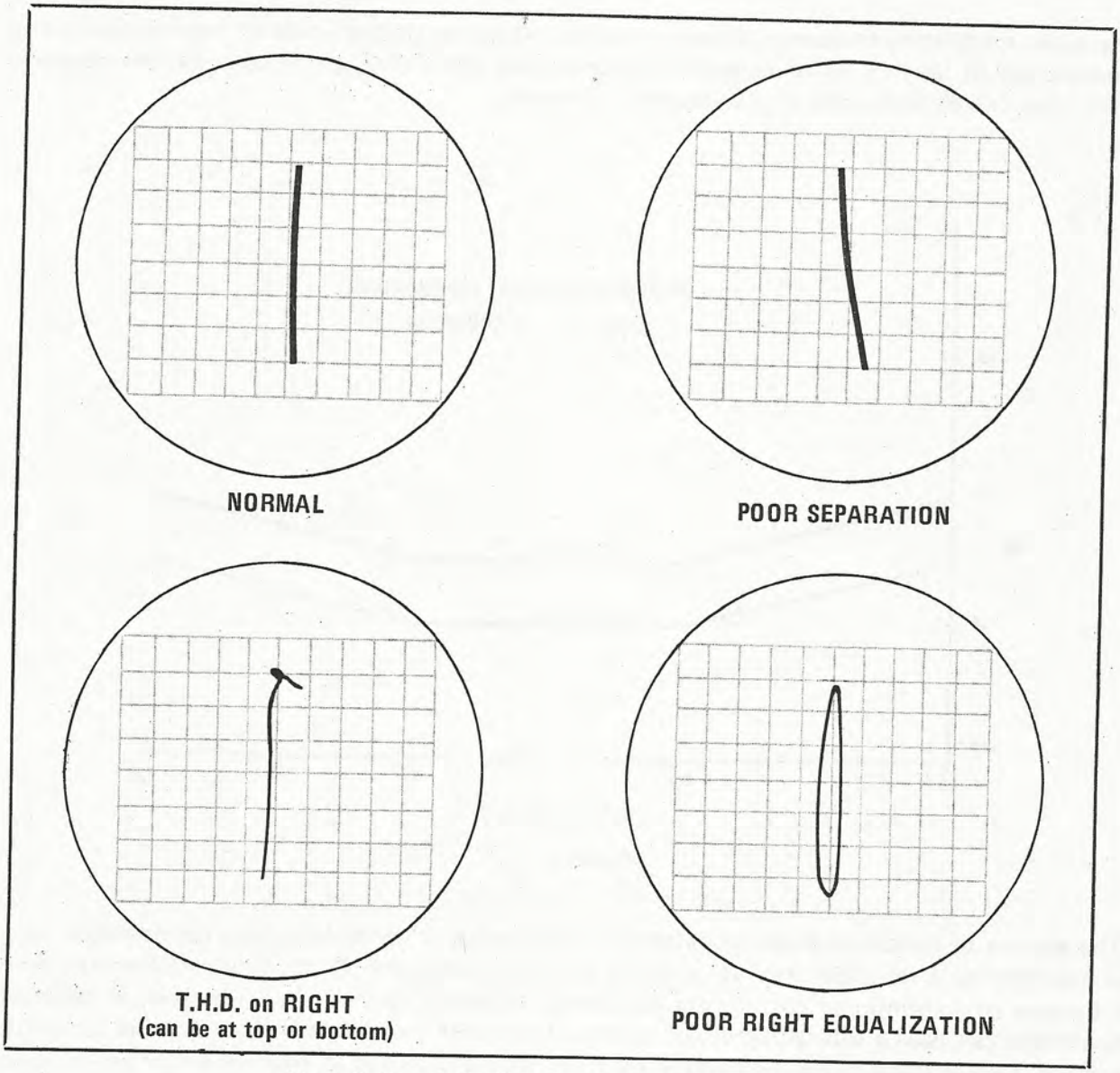


Figure 6. Sample Oscilloscope Displays of Stereo Signals

Incidental Phase Modulation

With the transmitter modulated at 25, 50, 75, and 95% AM with a 1 kHz tone, measurements of L–R should be made. This information can be dynamically read on the X–Y display and could look like the simulated displays shown below.

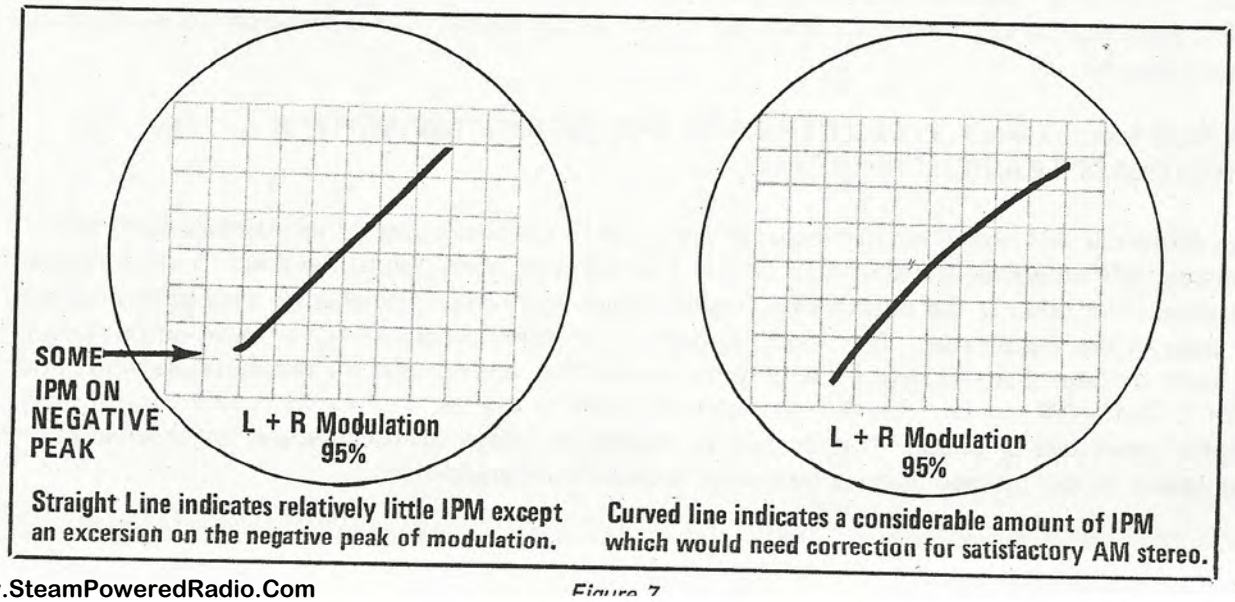


Figure 7

The audio modulating frequency should be varied and measurements made of the crosstalk due to IPM. Generally for at least 25 dB of separation under typical stereo program modulation, the measured L+R to L—R cross talk should be less than indicated in Figure 8.

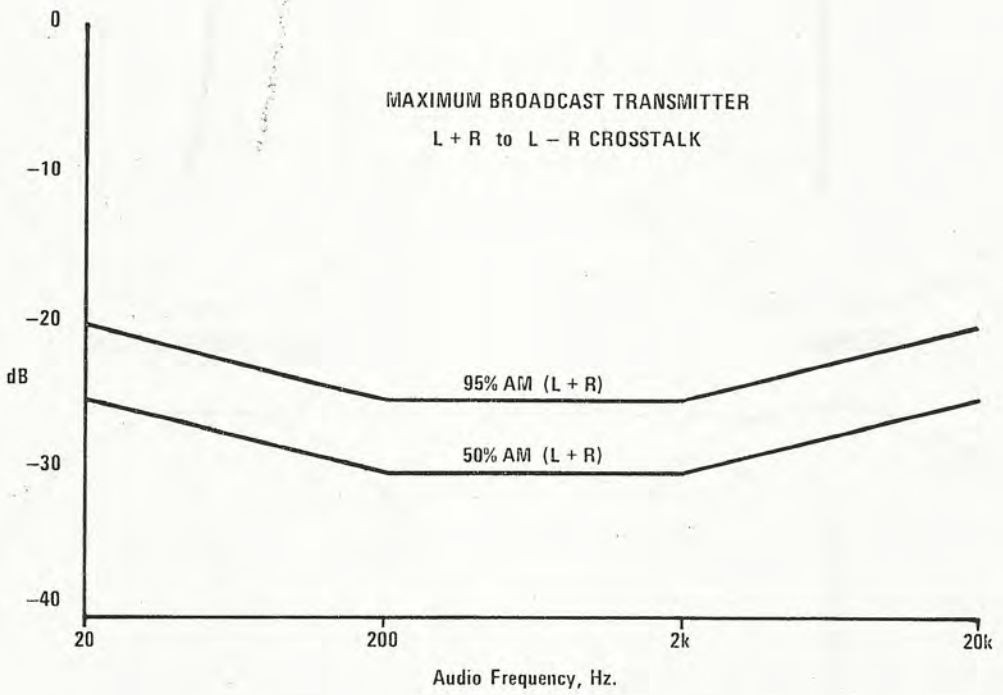


Figure 8

The sources of incidental phase modulation in AM broadcast transmitters vary considerably. However, two contributing areas often are: 1) the final amplifier tuning and 2) the final amplifier neutralization. In the case of conventional AM, neither adjustment is usually very critical. However, in AM stereo these adjustments can have a substantial effect in IPM. If the IPM measurement show that the transmitter does not make the maximum values indicated in Figure 8, or if it is desired to improve on the performance, adjustments to tuning and neutralization can be made. This is usually done by modulating the transmitter with a higher frequency audio tone, (5 or 7.5 kHz) and watching the crosstalk in the L—R channel on the monitor as the tuning and loading is adjusted. Neutralization adjustment often can not be made from the transmitter front panel, but has to be done with the transmitter plate voltage off and then the transmitter put back on for a measurement.

Many transmitter manufacturers now have some experience in AM stereo with one system or another. For some assistance, it would be advisable to discuss the measurements and crosstalk performance with the manufacturer.

IV. STEREO EXCITER R.F. CONNECTIONS TO BROADCAST TRANSMITTER (BROADCAST TRANSMITTER SET-UP)

The Motorola AM stereo exciter includes several R.F. outputs designed to interface with most, if not all, existing AM broadcast transmitters. One is a 5 volt logic level output designed to drive standard digital circuitry. The other is the output of a 5 watt square wave amplifier which is used to drive a lower level R.F. stage in the transmitter. This amplifier can be internally programmed for lower output levels if required. Both of these outputs have no amplitude modulation, but do have the proper phase modulation required for C-Quam AM stereo. Another output is available at the rear of the exciter which is not modulated in either amplitude or phase. This output is provided to trigger an oscilloscope for observations of phase modulation, or can be used to drive frequency measurement equipment.

The Motorola exciter will be preadjusted to the station frequency and all R.F. outputs of the exciter are on the station's carrier frequency. The oscillator in the exciter is designed to hold the station frequency well within the F.C.C. specification over a temperature range from 0 to 50 degrees centigrade. Generally, the output should stay within a few Hertz of the assigned frequency.

If the transmitter has a TTL input, then the TTL output of the exciter is to be connected to the transmitter digital circuitry at a point where it is operating on the station frequency. Some transmitters now use higher frequency crystals which are divided down to the operating frequency. The input is to be made after the division.

Many transmitters, however, will be best interfaced by taking the 5 watt exciter output and applying it to the highest level R.F. stage in the transmitter which can be fully driven. It is possible for the transmitter output signal to be coupled back through the exciter and the connecting cables which in turn can cause incidental phase modulation. Therefore, the higher the level on the cable and the higher the R.F. stage in the transmitter being driven, the less opportunity for incidental phase modulation.

The 5 watt amplifier in the exciter has a square wave output with a level of approximately 42 volts peak to peak into 50 ohms resistive. The lower level R.F. stages in the transmitter should be studied to determine where is the best point for inserting drive of this voltage level. If the instruction book for the transmitter does not indicate the normal R.F. levels, they can be measured with a suitable R.F. voltmeter or the manufacturer can be consulted.

If a transistor is to be driven, it is recommended initially that the connecting circuitry be as shown below.

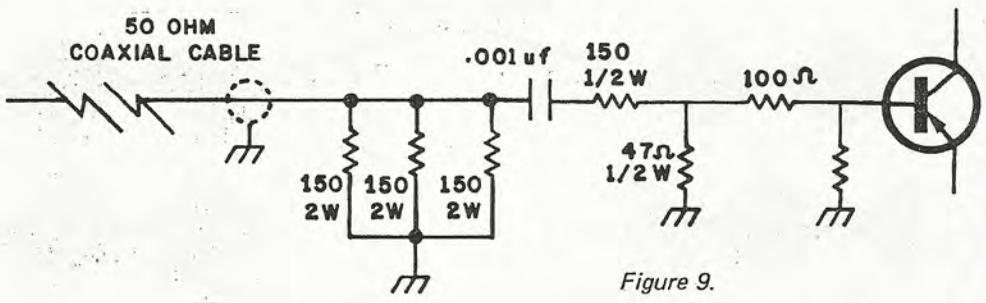


Figure 9.

If more current is required to pull up the base of the transistor, the values of the "T" pad can be changed.

In the case of driving a tube R.F. stage, the 50 ohm inpedance can be stepped up by tapping down on a coil in the grid circuit of the stage if it is tuned, or by using a toroidal step up transformer.

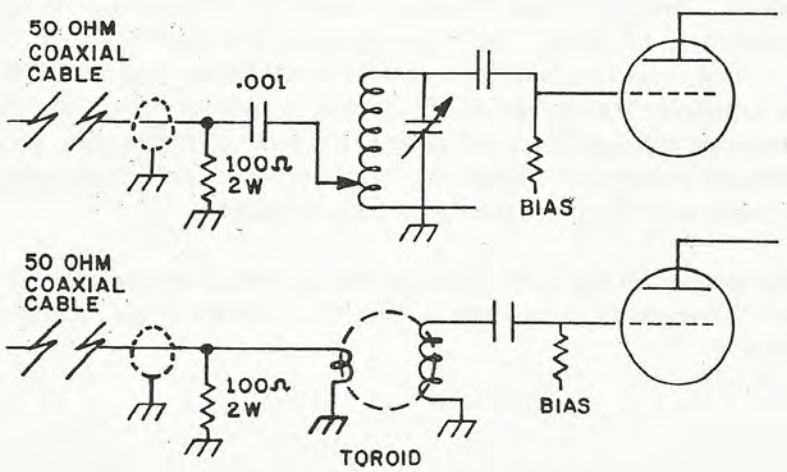


Figure 10

After sufficient drive from the stereo exciter to your transmitter has been accomplished, a recheck of the phase modulated hum and noise, and incidental phase modulation should be made. Using the normal audio input to the transmitter, checks should be made of the L—R noise level and crosstalk between AM (L+R) and L—R channels as was perviously done. It is also advisable to check the audio performance of the L—R channel to be sure that the broadcast transmitter is not substantially degrading the L—R performance (see Page 8).

V. STEREO EXCITER AUDIO CONNECTIONS TO THE BROADCAST TRANSMITTER

The Motorola AM stereo exciter simply takes the left and right audio channels and sums them into L+R for the broadcast transmitter audio input. Two basic objectives must be met in connections to the transmitter. One is the phasing of the transmitter audio input, and two the input level must be precisely adjusted so that the C-Quam modulation will be transmitted properly. The audio frequency response and distortion of the circuitry is sufficiently low that it should not affect the monaural performance of the transmitter. Initially, an audio oscillator set to 1 kHz should be connected to the left and right audio inputs of the stereo exciter, phased for L+R modulation.

The phasing of the exciter audio output to the broadcast transmitter can be checked by comparing the envelope display of the exciter sample transmitter output with the broadcast transmitter envelope. This should be done with a dual trace oscilloscope in the chop mode with the triggering taken from the audio oscillator (see Figure 11).

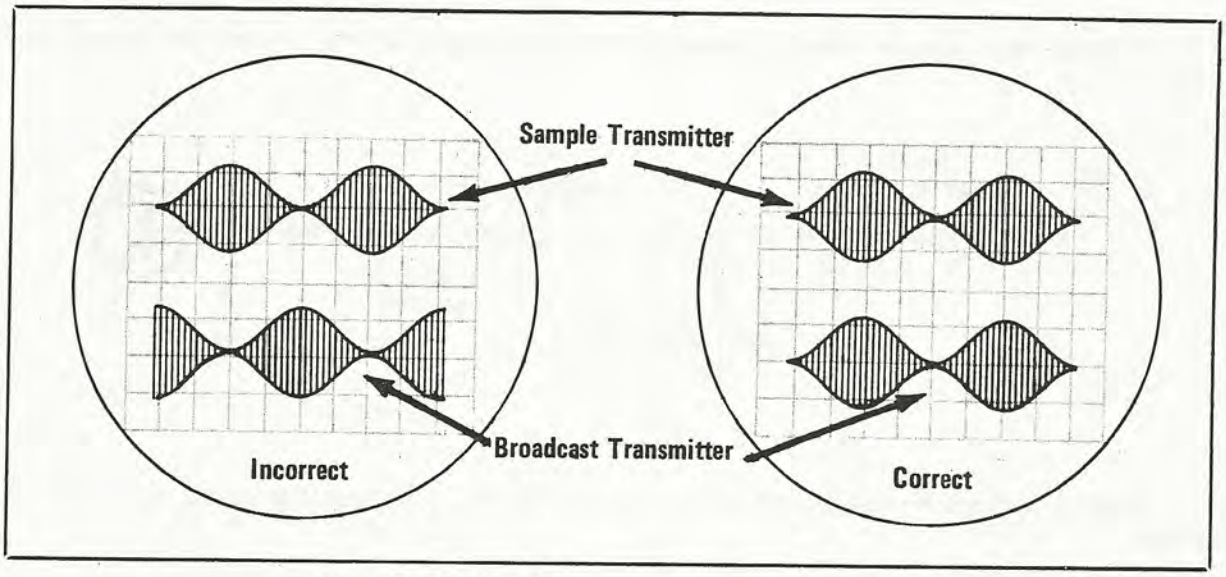


Figure 11. Phasing of Broadcast Transmitter Audio Input

While observing the dual trace display of envelope modulation (ER3) the depth of modulation can also be approximately adjusted. Start by adjusting the tone to the exciter left plus right channels from the oscillator until the broadcast transmitter is modulating about 50%. Next, adjust the exciter audio drive to the broadcast transmitter (EF8), (a screwdriver adjust on the front panel under the plastic cover) until the envelope modulation is the same as the sample transmitter. Increase the audio input to the exciter until the sample transmitter modulation is 100%, and then adjust the broadcast transmitter modulation to the same value with the front panel screwdriver adjust.

The precise setting of the L+R drive to the broadcast transmitter can be more accurately set by observing separation. However, separation at this time is most likely limited by the difference in delays between L+R and L—R.

VI. ADJUSTING THE DELAY NETWORKS AND EQUALIZATION

— NOTE —

1. The 25 Hz pilot tone must be turned off with the front panel switch.
2. The process defeat switch S607 must be in the "DEFEAT" position (located on the night audio circuit card.)
3. CAUTION: Do not touch the following setting on the front panel at this time. Refer to section VII Limiter Adjustments and the Alignment Procedure.
   - 3.1 + LIMIT
   - 3.2 – LIMIT
   - 3.3 BALANCE
4. The night circuit card is an option and may not be used in your exciter.

Delay Adjustments

In order to adjust the delay, the cover plate in the middle of the top cover must be removed and the back cover must be opened. At this time it might be easier to have the EXCITER placed on a table rather than in a rack so that the switches and controls can be more accessible. Even without setting the delay networks it is quite possible to achieve 15 dB of separation or more, however, this varies considerably with the transmitter type.

To start the process, set the OSCILLATOR to 1 kHz 50% envelope modulation, LEFT input only. Using an oscilloscope set for X-Y display, observe the LEFT and RIGHT unbalanced signal outputs at the ports J808 and J809 on the monitor. Adjust LEFT DELAY SWITCH S608 from its zero position in 1 microsecond steps for best closure. Compare the oscilloscope display with those shown in Page 18 and 19.

Repeat procedure for RIGHT input only by adjusting RIGHT DELAY SWITCH S609 from its zero position in 1 microsecond steps for best closure.

Bulk Delay Adjustment

— NOTE —

If the maximum of 15 microseconds of delay does not produce adequate closure add BULK DELAY CARD BD705 to the bottom of the NIGHT AUDIO CIRCUIT CARD and connect into circuit. Each switch section on the BULK DELAY CARD adds 8 microseconds of delay for a total of 32 microseconds. The maximum total system delay for both the LEFT and RIGHT audio channels with the BULK DELAY is 32 + 15 or 47 microseconds.

Return the LEFT and RIGHT DELAY SWITCHES S608 and S609 to their ZERO position. Repeat the above procedure for both the LEFT only and RIGHT only sections by adding BULK DELAY in 8 microsecond groups and using LEFT and RIGHT DELAY SWITCHES S608 and S609 for fine adjustment until best closure is obtained.

HiFrequency Equalization Adjustment

To continue the equalization, set the HI FREQ EQUAL "I" switches on both the DAY and NIGHT CIRCUIT CARDS (S303, S305, S603, S605) to the "OUT" positions. Set the HI FREQ EQUAL "Q" and LOW FREQ EQUAL "Q" switches on both the DAY and NIGHT CIRCUIT CARDS (S304, S306, S302, S301, S604, S606, S602 and S601) to the "IN" position. See Figure 4.

Set the OSCILLATOR to 10 kHz 50% envelope modulation, FRONT PANEL NIGHT/DAY SWITCH to DAY position, LEFT input only.

Adjust LEFT HI FREQ EQUAL CONTROLS, R302 C-D and R389 for best closure.

Change to RIGHT input only and adjust RIGHT HI-FREQ EQUAL controls, R302 A-B and R391 for best closure.

Optional Night Function Adjustment

Set FRONT PANEL NIGHT/DAY SWITCH to NIGHT position with EXCITER switched to NIGHT TRANSMITTER.

Repeat LEFT and RIGHT HI FREQ EQUALIZATION using the identical controls on the NIGHT CIRCUIT CARD directly opposite the DAY CIRCUIT CARD controls described above.

Low Frequency Equalization Adjustment

To continue the equalization, set the OSCILLATOR to 100 Hz 50% envelope modulation, FRONT PANEL NIGHT/DAY SWITCH to DAY position LEFT input only.

Adjust LEFT LOW FREQ EQUAL No. 1 and No. 2 controls, R304 C-D and R307 C-D for best closure.

Change to RIGHT input only and adjust RIGHT LOW FREQ EQUAL No. 1 and No. 2 CONTROLS, R304 A-B and R307 A-B for best closure.

Optional Night Function Adjustment

Set FRONT PANEL NIGHT&DAY SWITCH to NIGHT position with EXCITER switched to NIGHT TRANSMITTER.

Repeat LEFT and RIGHT LOW FREQ EQUALIZATION using the identical controls on the NIGHT CIRCUIT CARD directly opposite the DAY CIRCUIT CARD controls described above.

Separation Checks

Separation measurements should now be made over the audio spectrum with the LEFT channel driven and then the same measurements with the RIGHT channel driven. It is most useful to prepare a graph of the separation in order to judge the action of the various controls. Also, the stereophonic distortion should be measured, that is the LEFT channel distortion when LEFT is driven, and the RIGHT channel distortion when RIGHT is driven. Many times there will be a tradeoff between separation and distortion, and there may be very good separation in one direction (RIGHT into LEFT) and marginal separation the other way (LEFT into RIGHT).

At this point, separation should be better than 25 dB both ways. The adjustments will not follow a prescribed pattern, but improvements can be made by trial and error. Include in the adjustments a trimming of the FRONT PANEL "L+R ADJ" audio drive control. If the transmitter has sufficient low Incidental Phase Modulation (IPM), there should typically be 30 dB separation between 100 Hz and 5 kHz.

The separation below and above this range will be limited by the equalization to precisely match the transmitter, and by bandwidth limits of the transmitter/antenna system.

– NOTE –

Return the PROCESS DEFEAT SWITCH S607 to the "ON" position.

VII EXCITER LIMITER ADJUSTMENTS

– NOTE –

Normally the + limit and – limit controls on the front panel are set at the factory and should not require adjustment.

The + LIMIT AND – LIMIT CONTROLS set the level beyond which the audio signals will be limited (clipped). The $(L+R)_Q$, $(L-R)_Q$ and the $(L+R)_I$ audio signals + and – limit levels are set simultaneously.

The + and – limiters for the $(L+R)_I$ audio signal that is returned to the TRANSMITTER MODULATOR are disconnected. (DIODES D302 and D308 are removed from the DAY CIRCUIT CARD). This requires that both the + and – limiting action, (to prevent over modulation), be accomplished in the stations Audio Processor or in the transmitter proper.

The – LIMITER for the $(L+R)_Q$ and $(L-R)_Q$ audio signal channels is set to the limit the C-QUAM point to approximately the 98% modulations level.

The + LIMITER is usually set for no + LIMITING unless required by the station, (control set fully ccw).

VIII OPERATION INTO THE ANTENNA

After satisfactory stereo operation into the dummy load, the final adjustment should be checked by operating into the antenna system during experimental hours. There are two basic effects to look for when operating into the antenna. One is that the impedance/bandwidth of the antenna system often is much narrower than the dummy load and the radiation from the antenna back into the transmitter building can increase the possibility of Incidental Phase Modulation.

With the transmitter operating into the antenna system, measure the stereo separation and distortion. If the high frequency performance (above 5 kHz) has degraded, readjust the high frequency equalization for the best compromise between separation and distortion. If the separation has degraded considerably on all audio frequencies, check the level of Incidental Phase Modulation by Modulating the transmitter with the audio oscillator connected directly to the transmitters audio input terminals. Measure the residual L–R out of the MONITOR and compare with previous measurements. If the level is much greater than previously measured into the DUMMY LOAD the indication is that the increase in Incidental Phase Modulation is being caused by the RADIATED R.F. signal from the ANTENNA. Appropriate corrective action must be undertaken.

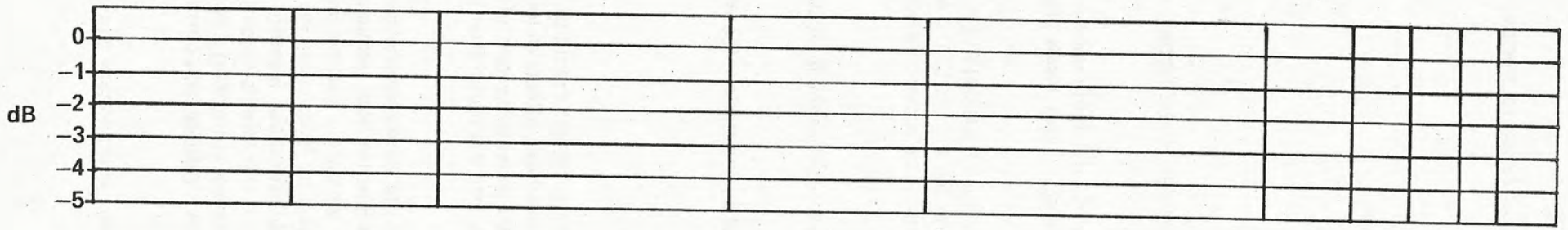
This completes the check out and adjustment. Tighten all covers and position equipment in its permanent location.

Radio Station_____ Broadcast Transmitter Worksheet

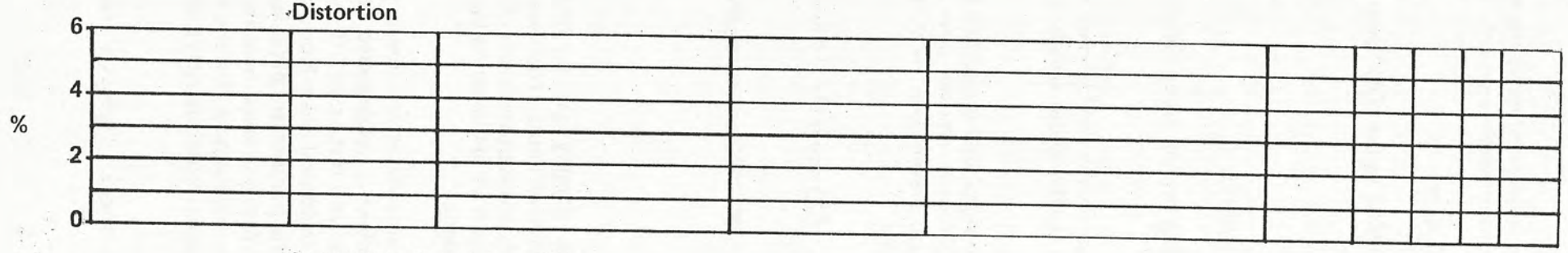
Day_____ Date_____

Xmttr_____ Power_____ Load: Dummy_____ Day_____ Night _____

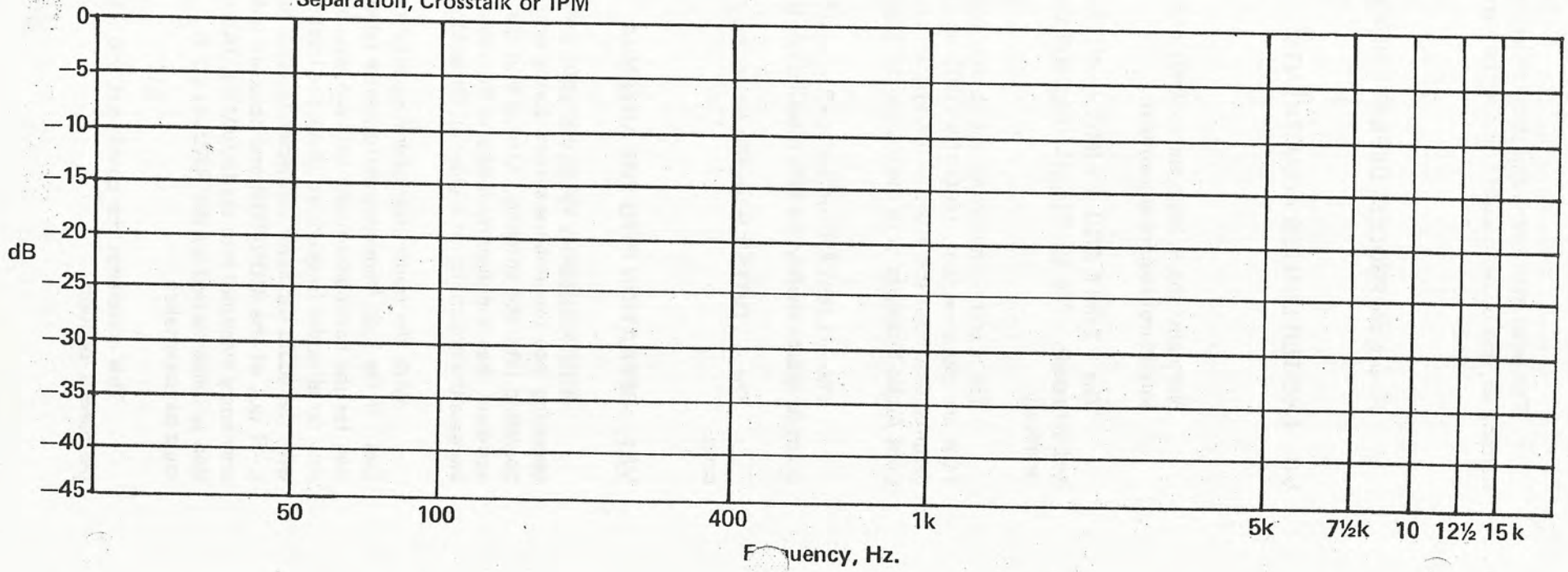
Audio Response



Distortion



Separation, Crosstalk or IPM

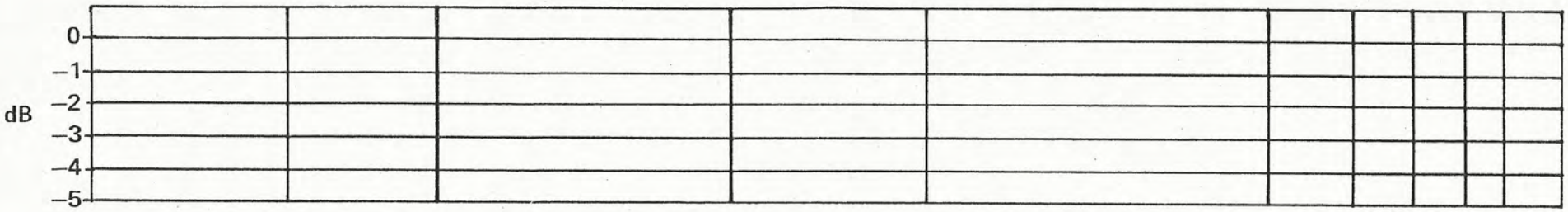


Radio Station_____ Broadcast Transmitter Worksheet

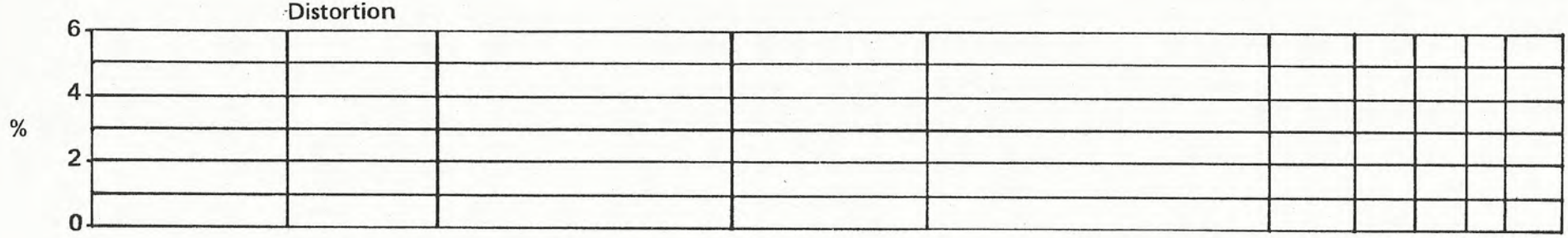
Day_____ Date_____

Xmttr_____ Power_____ Load: Dummy_____ Day_____ Night_____

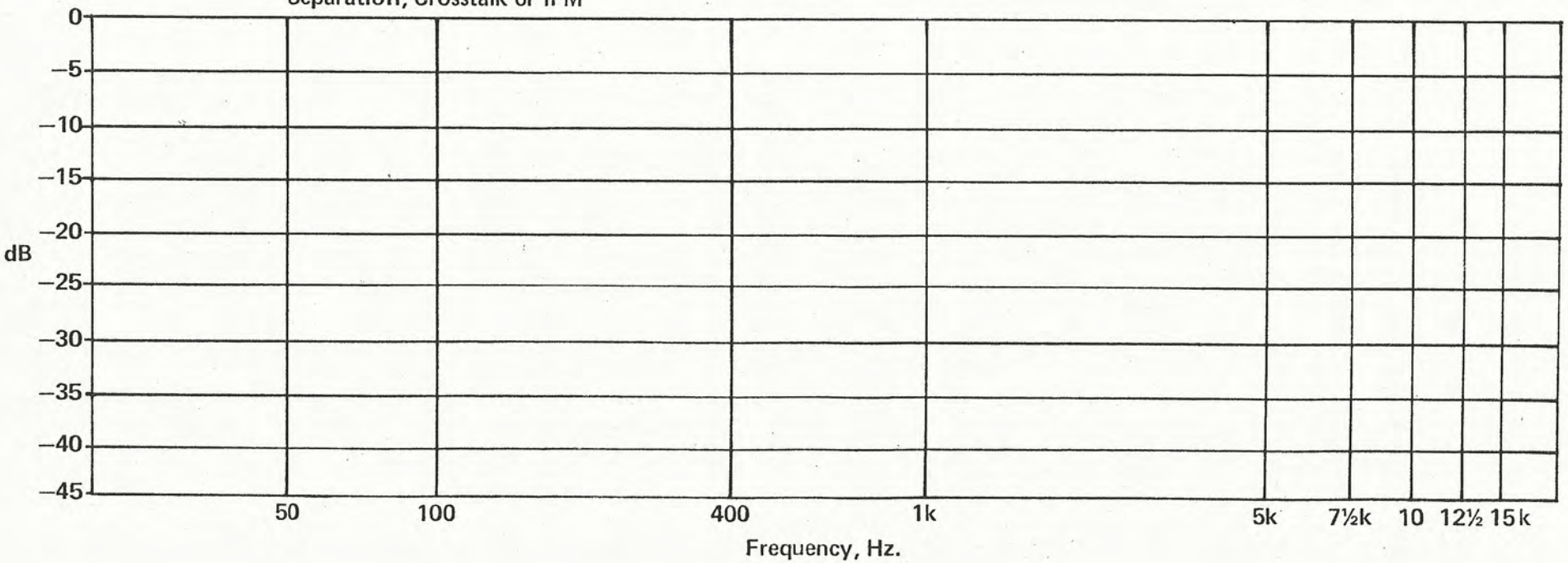
Audio Response



Distortion



Separation, Crosstalk or IPM



AM STEREO
EQUIPMENT PERFORMANCE MEASUREMENTS
(Audio Proof)

The FCC requires AM broadcast stations to conduct equipment performance measurements after installation of AM stereo transmitting equipment. The characteristics to be measured are described in Section 73.1590 and the minimum performance specifications are described in Sections 74.40 and 73.128. Copies of these sections of the FCC Rules are reproduced in Appendix A.

The FCC requirements are quite extensive and a considerable number of data points must be taken. For the broadcaster's convenience, forms for tabulating and plotting the data are included in this section. A summary of the FCC proof requirements is shown in Figure 1.

SUMMARY OF FCC REQUIRED AM STEREO EQUIPMENT PERFORMANCE MEASUREMENTS

Measurement	Modulation Level	FCC Limit	Modulation Mode			
			L + R	Left	Right	L − R
Frequency Response	95%	±2 dB	X			
	75%		X	X	X	
	50%		X	X	X	
	25%	100 Hz – 5 kHz	X	X	X	
Harmonic Distortion	95%	7.5%	X			
	75%	5%	X	X	X	
	50%	5%	X	X	X	
	25%	5%	X	X	X	
Carrier Shift	100%	5%	X			
	85%	5%	X			
	50%	5%	X			
	25%	5%	X			
Noise Level	100%	45 dB below 400 Hz	X	X	X	
Incidental Phase Modulation	95%	None Specified	X			
Main to Subchannel Crosstalk	95%	None Specified	X			
Subchannel to Main Crosstalk	95%	None Specified				X
Separation	No Spec.	15 dB 0 – 5 years 20 dB 5+ years 400 Hz – 5 kHz	Measurement not required			
Harmonic and Spurious Radiation	95%		X			X
	75%			X	X	
	75%			X	X	

Figure 1.

PROCEDURE

Although the FCC requires that equipment performance measurements be made between a common audio input amplifier at the studio to the transmitting antenna terminals, the following instructions are written to aid the broadcaster in making initial measurements of AM stereo performance at the transmitter. After satisfactory tests have been completed with the transmitting equipment, the audio oscillator signal can be fed to the required common audio input amplifier at the studio for the actual required performance measurements. Thus, when the following specifies a connection to the exciter audio input, the connection would then be to the common audio input amplifier at the studio.

Motorola will provide to the broadcast station a complete AM exciter and modulation monitor capable of generating and accurately demodulating and indicating the operation of the C-Quam system. The modulation monitor is capable of demodulating and accurately indicating: amplitude modulation, left minus right modulation, left channel modulation, right channel modulation, carrier shift, right or left channel noise levels, separation, and level of pilot tone. In addition, the level of incidental phase modulation can be readily calculated from the left minus right modulation indication when modulating with AM. The frequency of pilot tone modulation can be measured with instruments connected to the modulation monitor. The distortion and noise levels of the modulation monitor are sufficiently low that the measurements made of the various performance characteristics will be reflective of the limits of the broadcast transmitter/stereo encoder performance.

Referring to Figure 2, the measurement of main (L+R) modulation capability is made by paralleling the left (A) and right (B) audio inputs to the stereo exciter (phased for L+R modulation) and connecting the audio oscillator through the pad to the junction. The main (L+R) modulation can be read directly on the modulation monitor by selecting "L+R" for the indication on the left hand meter (see Figure 2). The level of the audio oscillator can be increased until at least 85% modulation is read on the monitor. The frequency of the oscillator can be varied over the range of 50 to 5000 Hz while observing the level on the modulation monitor for the required modulation level.

For (L) left, or (R) right only modulation, the audio oscillator should be directly connected without the pad to first the left (A), and then the right (B) inputs to the AM stereo exciter. The oscillator level should be advanced until the main channel (L+R) modulation reaches at last 75% modulation as indicated on the monitor. The oscillator frequency is then varied over the range of 50 to 5000 Hz while observing the monitor.

For measurement of distortion, the audio oscillator is connected to the stereo exciter as previously described. For main (L+R) distortion measurements, the distortion meter should be connected to the BNC connector on the rear of the modulation monitor labeled "L+R". For left or right distortion measurements, connect the oscillator directly to the left input on the exciter and connect the distortion analyzer to the left output on the modulation monitor. The same process is repeated for right only distortion measurements. If the 600 ohm balanced output is used, terminate with a 600 ohm load.

The audio oscillator is connected as previously described for main (L+R), left (L) and right (R) modulation. The frequency response can be directly observed by selecting "L+R" for main channel response or "L" for the left channel response on the left meter or "R" for right channel response on the right meter of the modulation monitor. Response can also be read on the distortion meter in the audio voltmeter function by connecting to the appropriate left, right or left + right outputs of the modulation monitor at the rear of the unit.

The carrier shift can be read by observing the carrier level indicator on the Motorola AM stereo modulation monitor or on the station's type approved amplitude modulation monitor. With no modulation applied to the AM stereo exciter, the carrier level indicator should be carefully set to the zero or calibrate point. The audio oscillator is to be connected to the paralleled left and right inputs of the AM stereo encoder (phased for L+R modulation) through the pad. The output level of the oscillator is to be advanced while observing the carrier level indicator in the modulation monitor. The maximum change in carrier level indication is to be recorded for modulation levels from zero to 100% amplitude modulation.

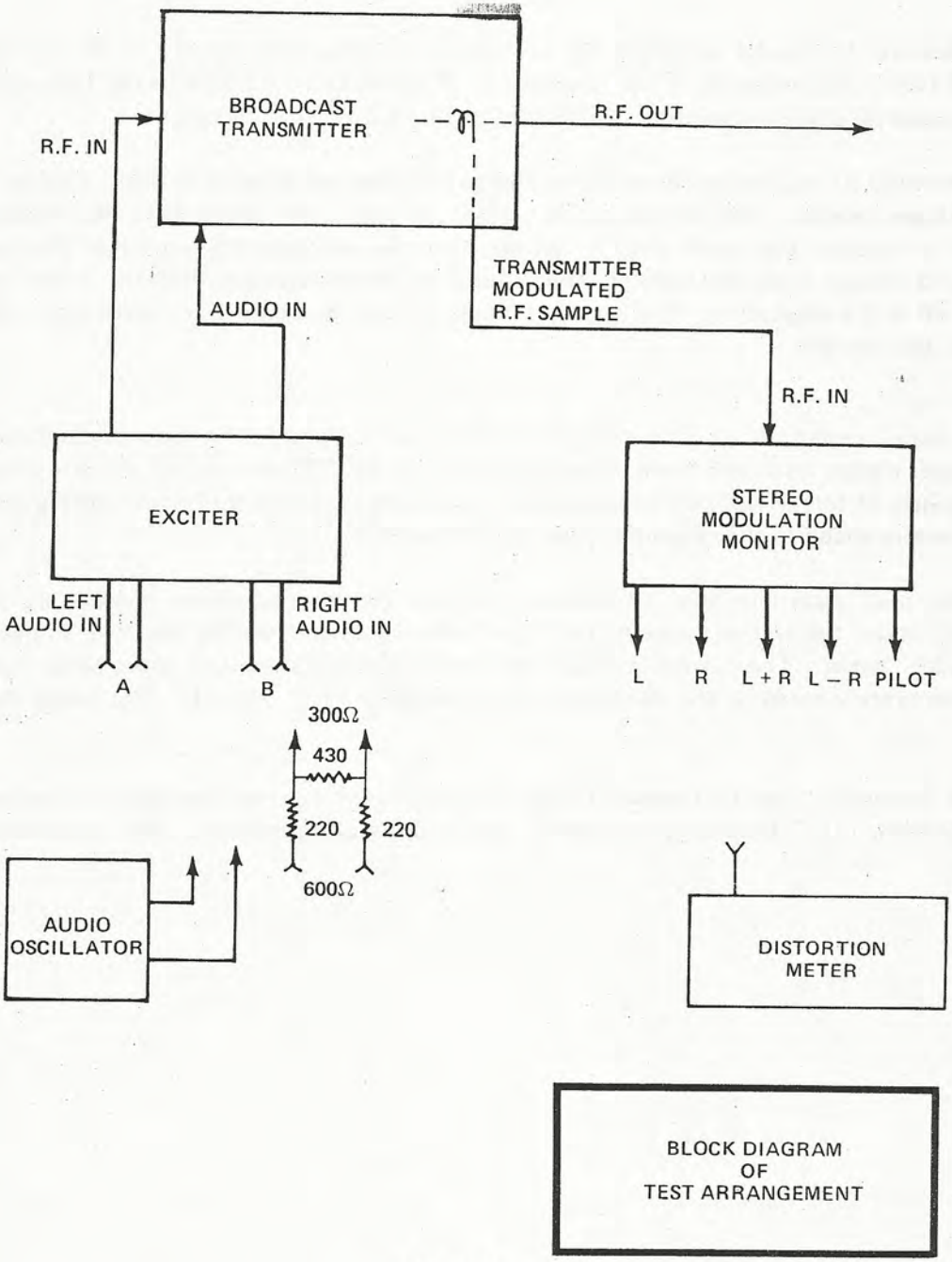


Figure 2.

Both left (L) and right (R) audio inputs to the AM stereo exciter are terminated with 600 ohm resistors. Main (L+R), left (L) and right (R) channel noise levels can be directly read on the Motorola AM stereo modulation monitor by selecting the appropriate mode for the left or right meters, and depressing the meter range buttons until an on scale reading is obtained. The noise level is obtained by adding the meter range value with the indication of the red dB scale on the meter. It is already calibrated against 100 percent modulation.

Indicidental phase modulation is measured as follows. Connect the audio oscillator through the pad to the parallel left and right audio inputs to the stereo exciter, making sure that the audio inputs are phased for main (L+R) modulation. The left hand meter is set to (L+R) on the modulation monitor and the right hand meter is set to (L−R). The audio oscillator output is adjusted to the various modulation levels and audio frequencies required and the readings of the (L−R) meter are observed. The meter range will have to be chosen by selecting the appropriate push button. Record the sum of the push button meter range and the red dB scale on the (L−R) meter for each combination of modulation level and frequency. The inci-

dental phase modulation in radians is simply the voltage ratio below 100 percent L—R modulation expressed in decimal form. For instance, if the observed L—R modulation is 50 dB below 100 percent L—R modulation, the incidental phase modulation is .0032 radians or 3.2×10^{-3} radians.

For measurement of separation, the audio oscillator is connected directly to the (L) left or (R) right input of the AM stereo exciter. The left channel is modulated with a tone and a distortion meter or audio voltmeter is used to measure the audio output voltage from the left channel output of the modulation monitor. The audio voltage from the right channel output of the modulation monitor is then measured. The difference in dB is the separation. The reverse process is used to measure the separation of a modulated right channel into the left.

The front panel meters can be used directly when set to "L" and "R". The separation can be read directly on the panel meters with the meter range buttons only for 100 percent left or right only modulation. For lesser values of left or right only modulation, separation is computed by subtracting the readings in dB of the two meters added to the respective push button settings.

The relative pilot tone level may be measured directly on the modulation monitor by setting the small toggle switch under the carrier meter to the "pilot tone" side and reading the level of pilot tone on the carrier level panel meter. The correct level of pilot tone indication should be at the black block on the meter scale. To accurately measure the pilot level, set pushbuttons R-L and -20. The meter should indicate -26 dB.

Pilot tone frequency may be measured from the pilot tone port on the back of the modulation monitor. Use Sigmotek ITC-3 frequency counter or similar computing counter. Pilot tone should be 25 Hz $\pm$ 0.1 Hz.

AM STEREO

Equipment Performance Measurements

EXTRA FORMS

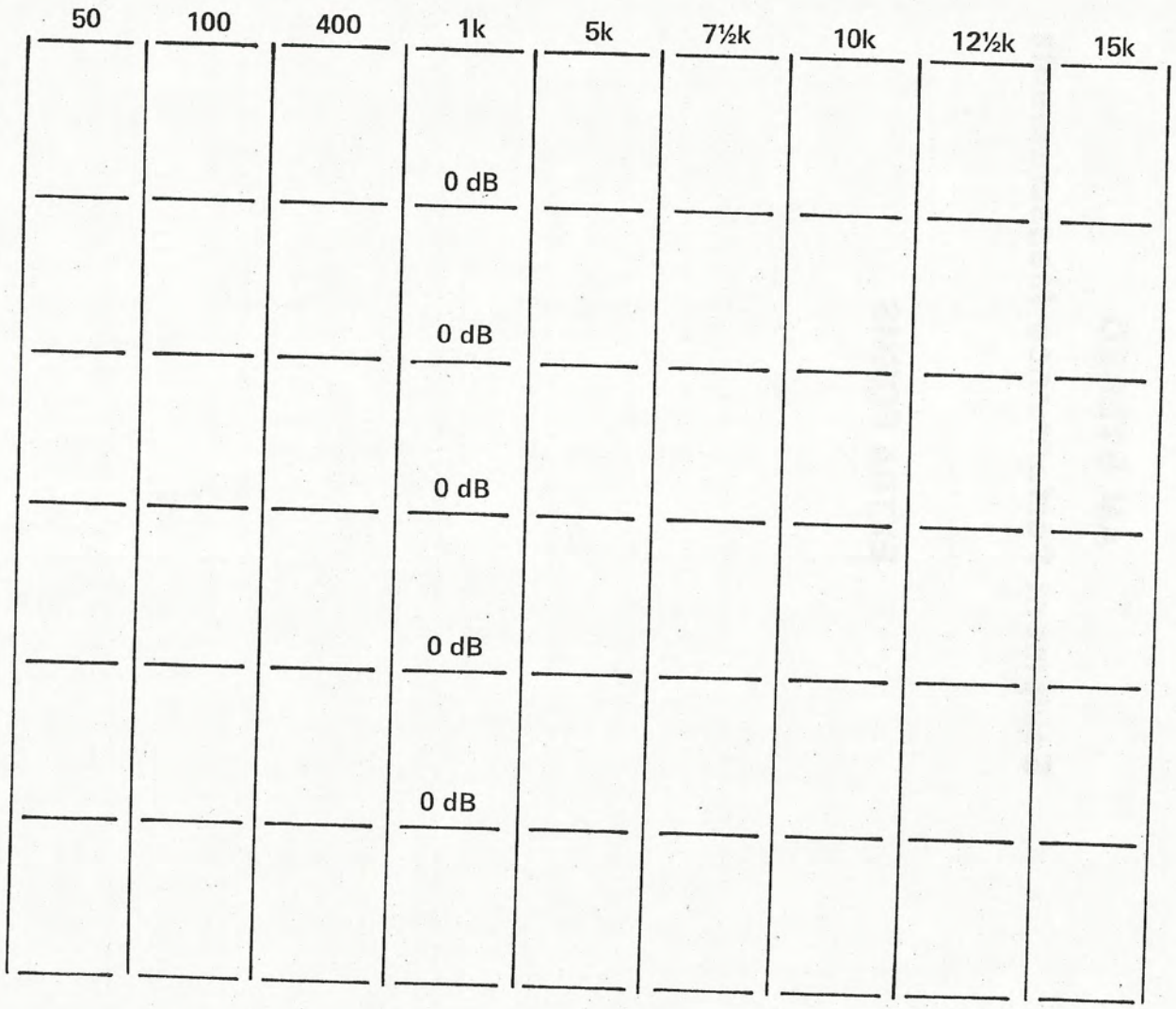
L + R
Response

EQUIPMENT PERFORMANCE MEASUREMENTS
TABULATION OF DATA

Station _____

Date _____

Audio Frequency Response



L + R
Distortion

EQUIPMENT PERFORMANCE MEASUREMENTS
TABULATION OF DATA

Station _____

Date _____

Audio Frequency Harmonic Content
(Distortion)

	50	100	400	1k	5k	7½k*	10k*	12½k*	15k*
L + R, 95% Modulation (7.5% Max.)									
L + R, 75% Modulation (5% Max.)									
L + R, 50% Modulation (5% Max.)									
L + R, 25% Modulation (5% Max.)									

* When attainable

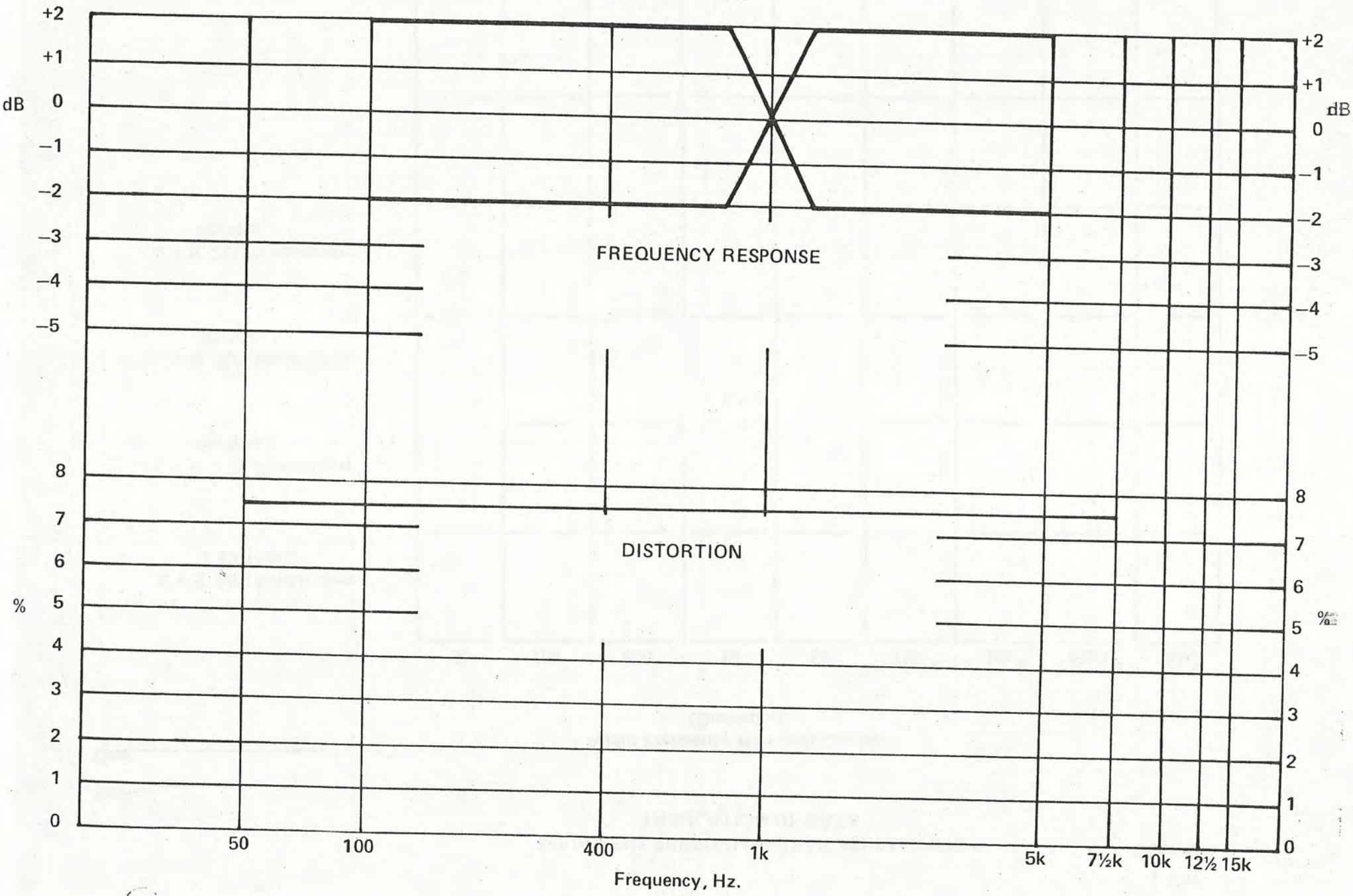
Radio Station _____

Date _____

B8

L + R
95%

L + R
95% MODULATION

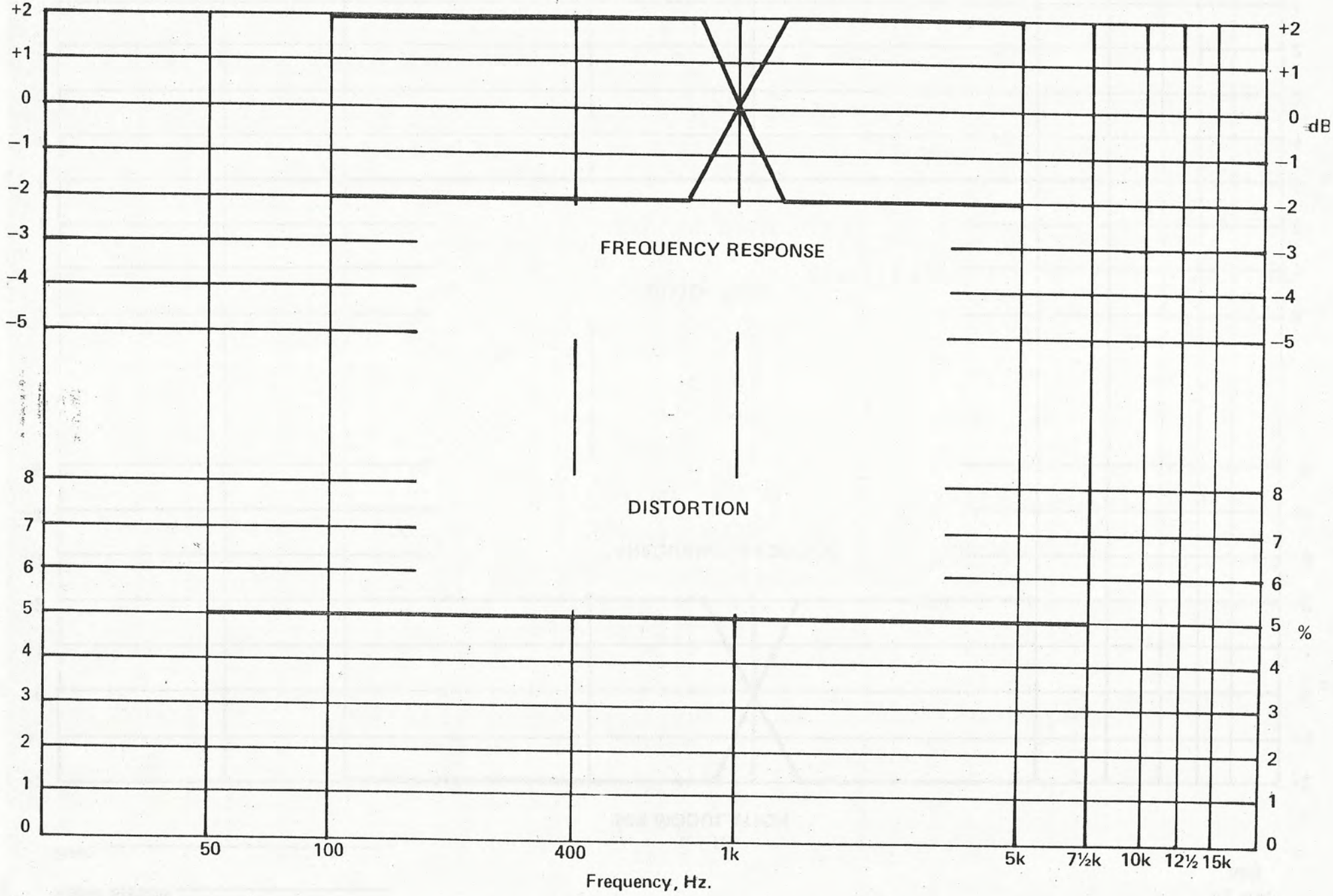


Radio St[illegible]on _____

Date _____

L + R
75%

L + R
75% MODULATION



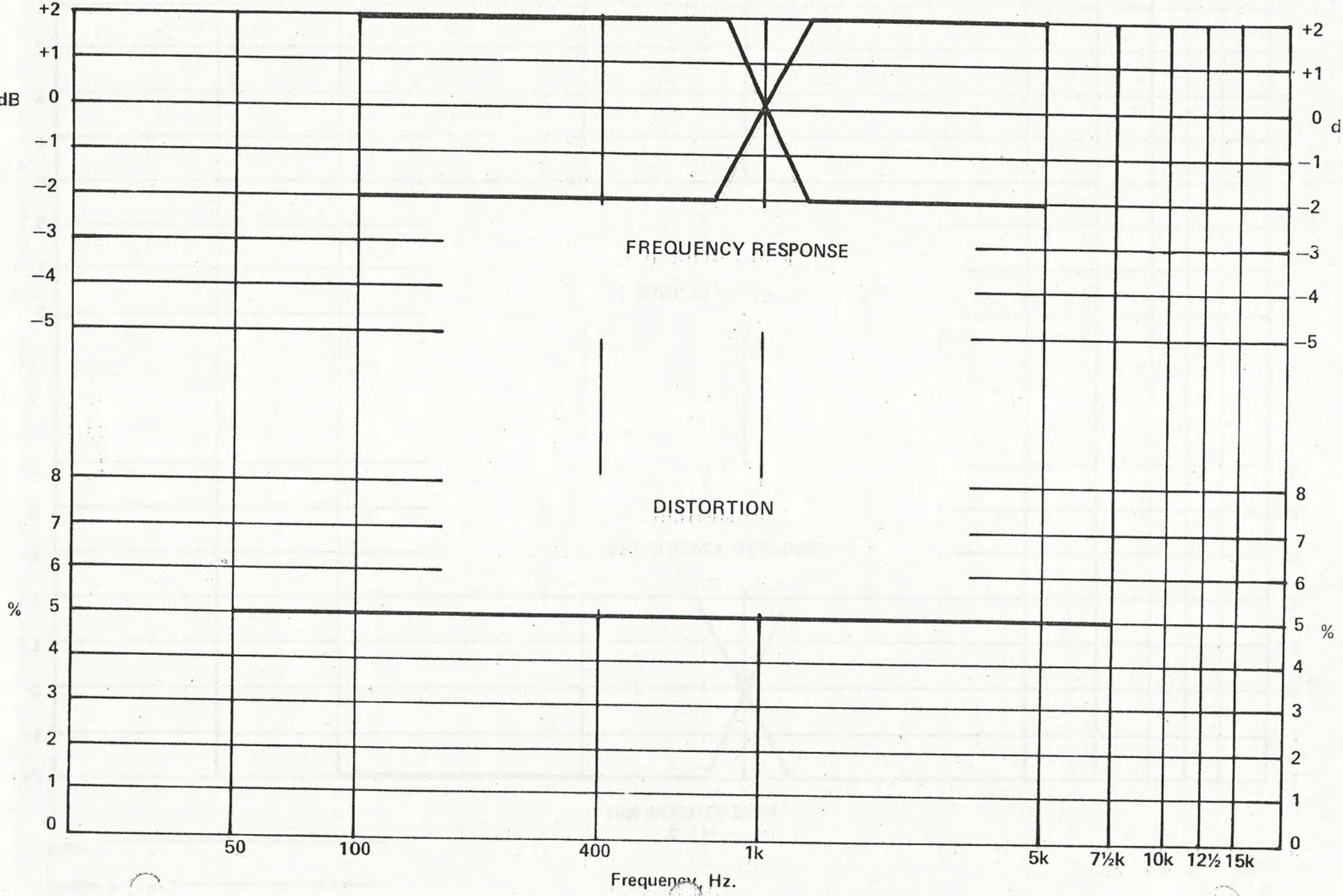
B10

Radio Station _____

Date _____

L + R
50%

L + R
50% MODULATION

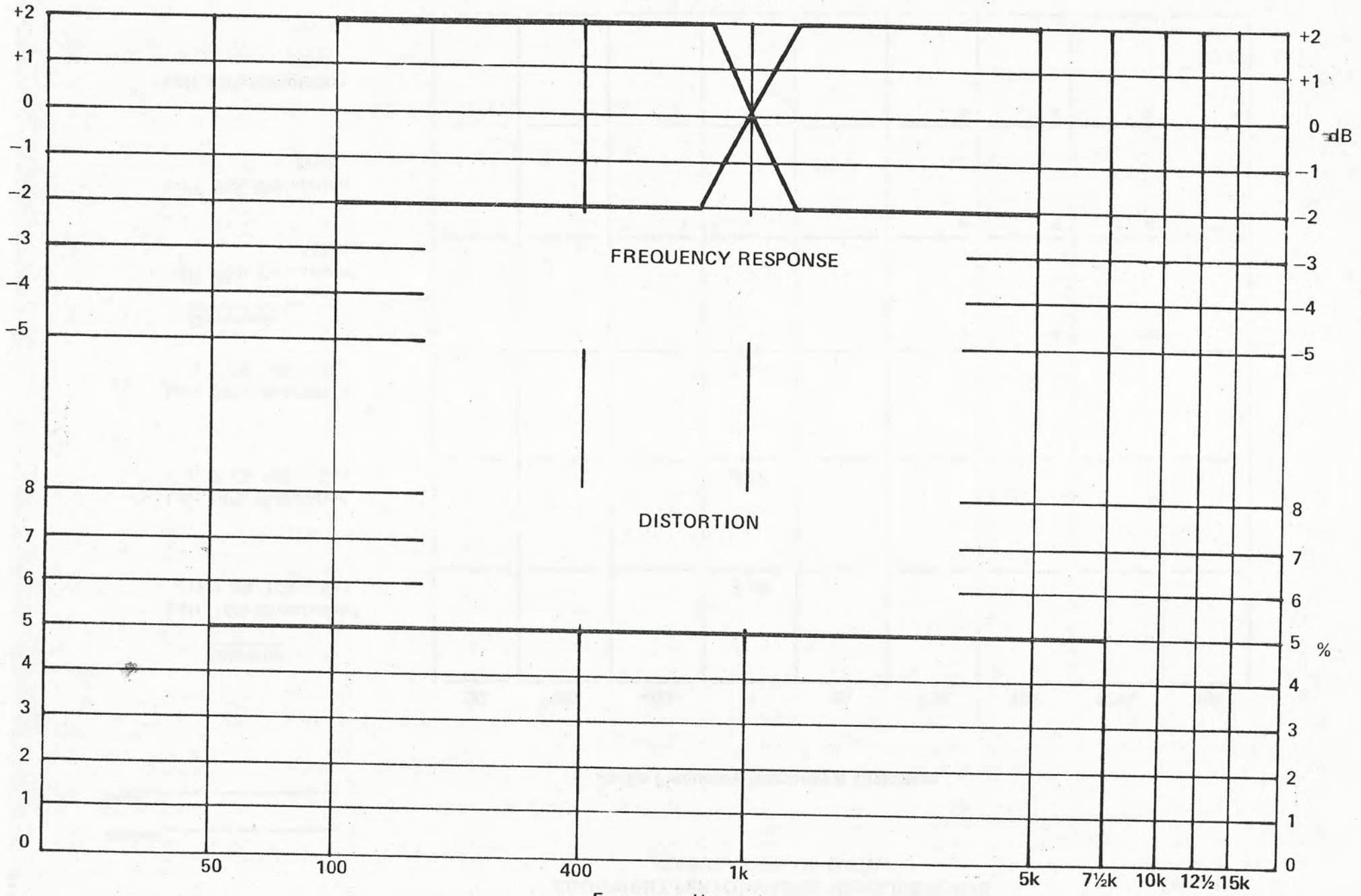


Radio Station _____

Date _____

L + R
25%

L + R
25% MODULATION



R11

EQUIPMENT PERFORMANCE MEASUREMENTS
TABULATION OF DATA

Station _____

Date _____

Audio Frequency Response & Distortion

	50	100	400	1k	5k	7½k	10k	12½k	15k
Response									
Left, 75% Modulation* (± 2 dB, 100 – 5k)				0 dB					
Left, 50% Modulation (± 2 dB, 100 – 5k)				0 dB					
Left, 25% Modulation (± 2 dB, 100 – 5k)				0 dB					
Distortion									
Left, 75% Modulation* (5%)						*	*	*	*
Left, 50% Modulation (5%)						*	*	*	*
Left, 25% Modulation (5%)						*	*	*	*

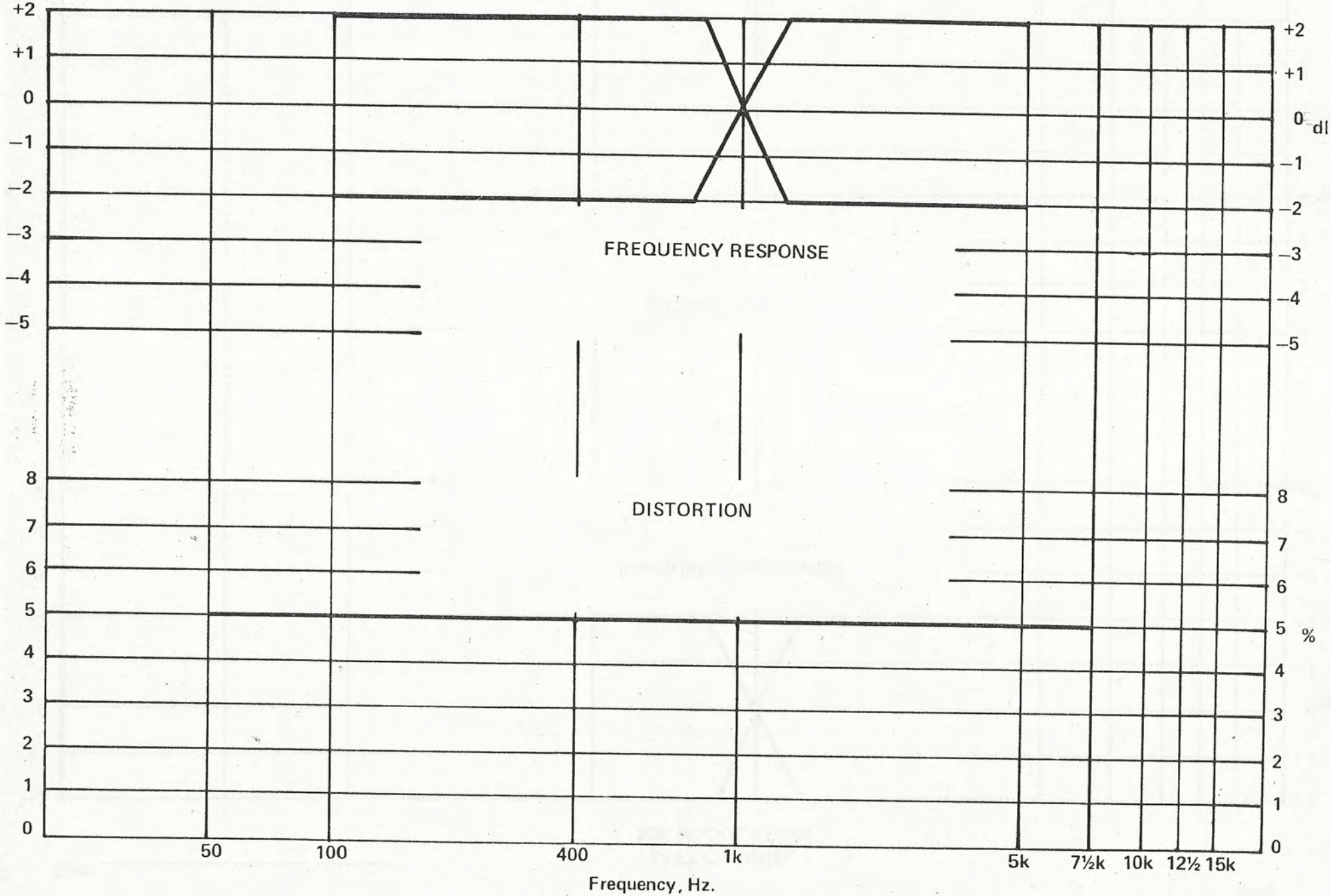
* When attainable

Radio Station _____

Date _____

Left
75%

LEFT CHANNEL
75% MODULATION



B13

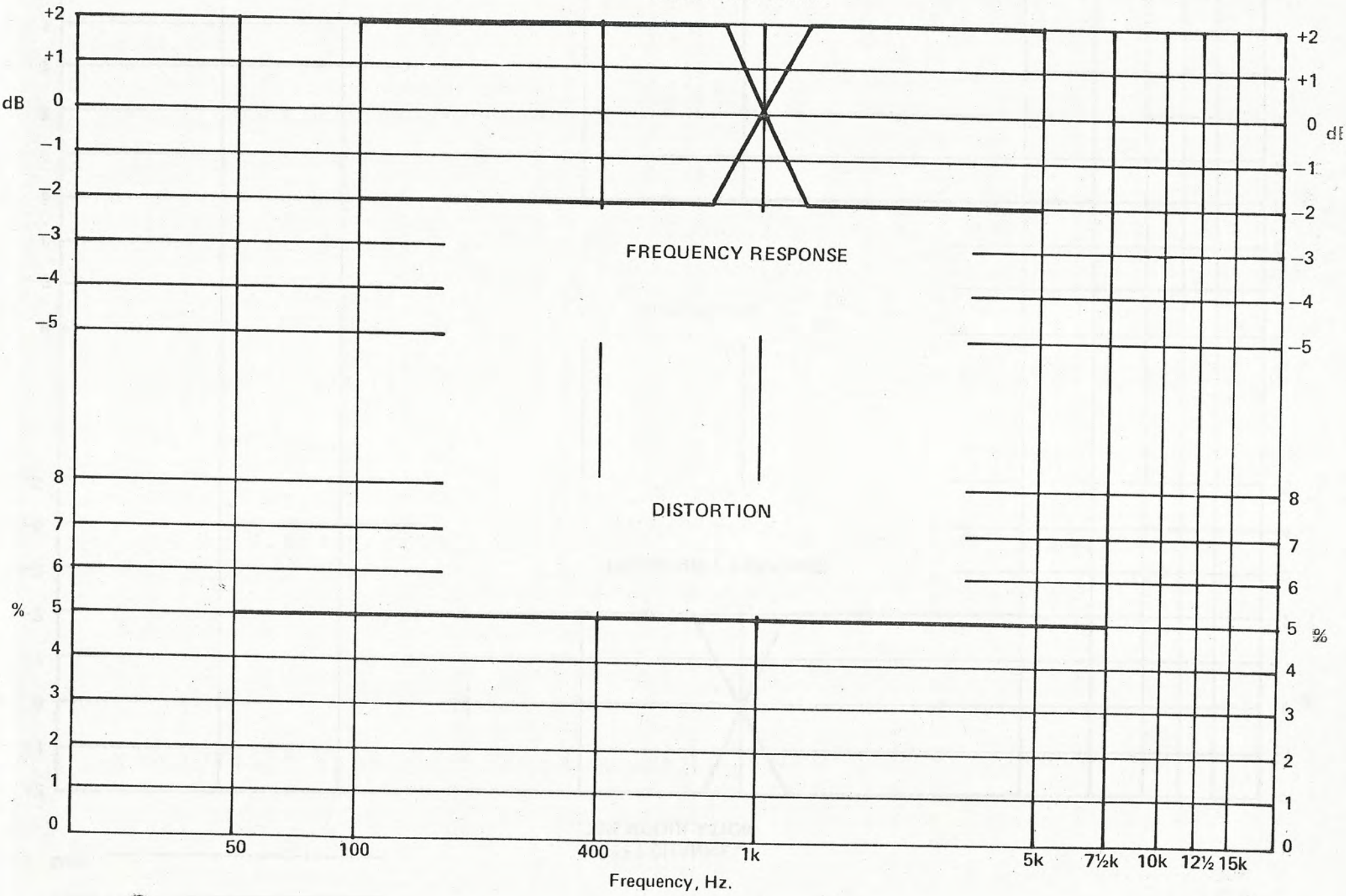
B14

Radio Station _____

Date _____

Left
50%

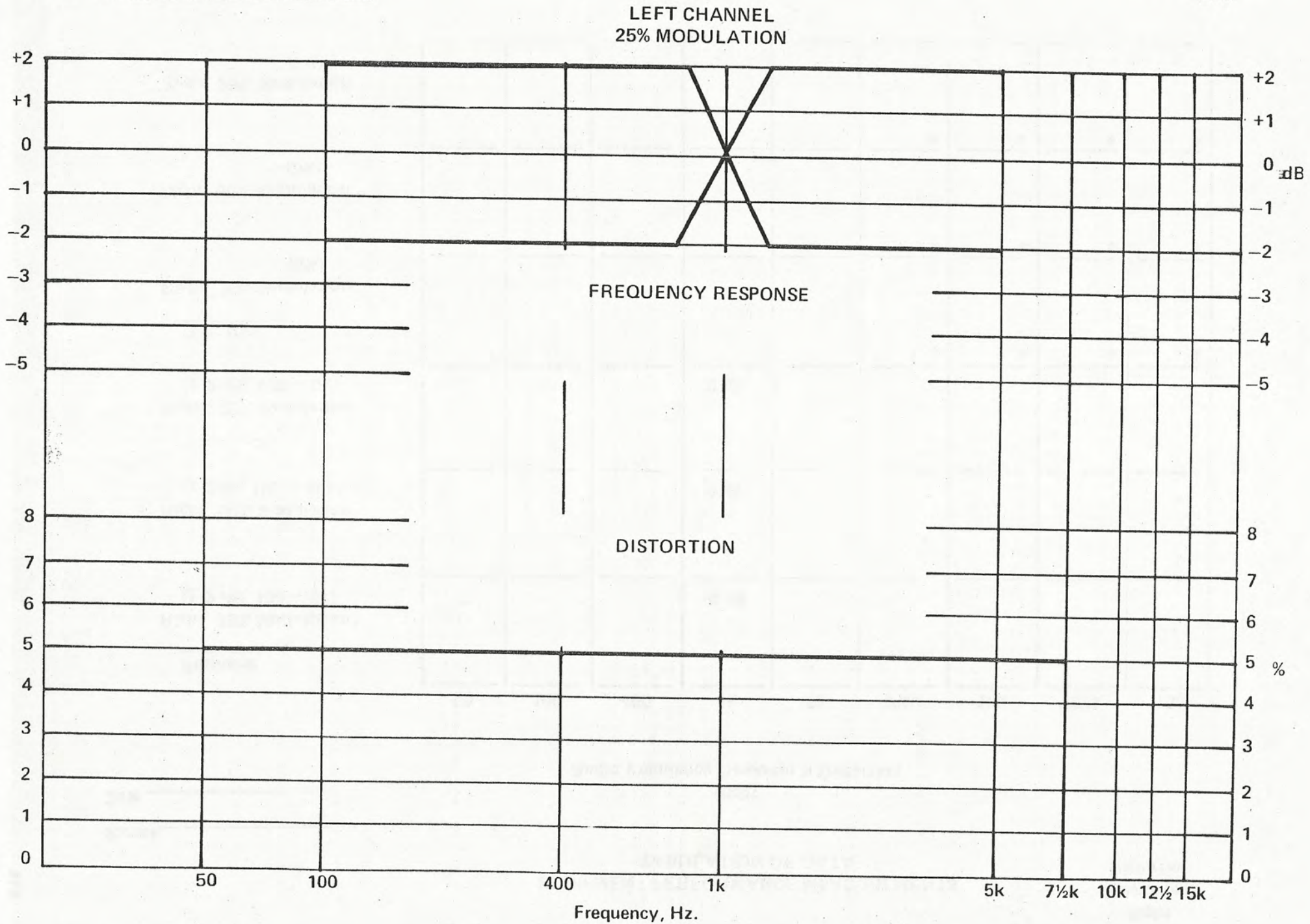
LEFT CHANNEL
50% MODULATION



Radio Station _____

Date _____

Left
25%



EQUIPMENT PERFORMANCE MEASUREMENTS
TABULATION OF DATA

Station _____

Date _____

Right
Audio Frequency Response & Distortion

	50	100	400	1k	5k	7½k	10k	12½k	15k
Response									
Right, 75% Modultaion* (± 2 dB, 100 – 5k)				0 dB					
Right, 50% Modulation (± 2dB, 100 – 5k)				0 dB					
Right, 25% Modulation (± 2 dB, 100 – 5k)				0 dB					
Distortion									
Right, 75% Modulation* (5%)						*	*	*	*
Right, 50% Modulation (5%)						*	*	*	*
Right, 25% Modulation (5%)						*	*	*	*

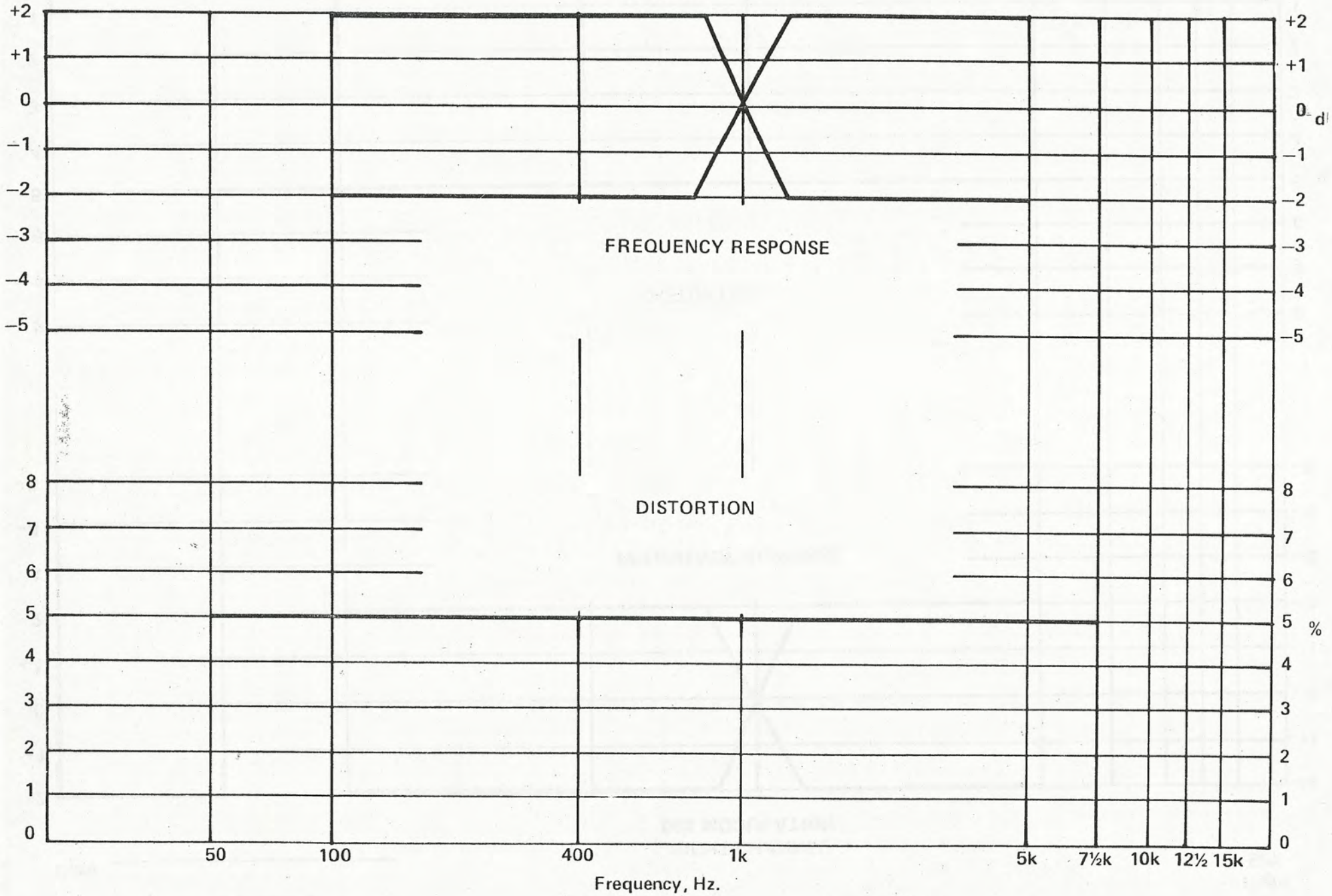
*When attainable

Radio Station _____

Date _____

Right
75%

RIGHT CHANNEL
75% MODULATION



B17

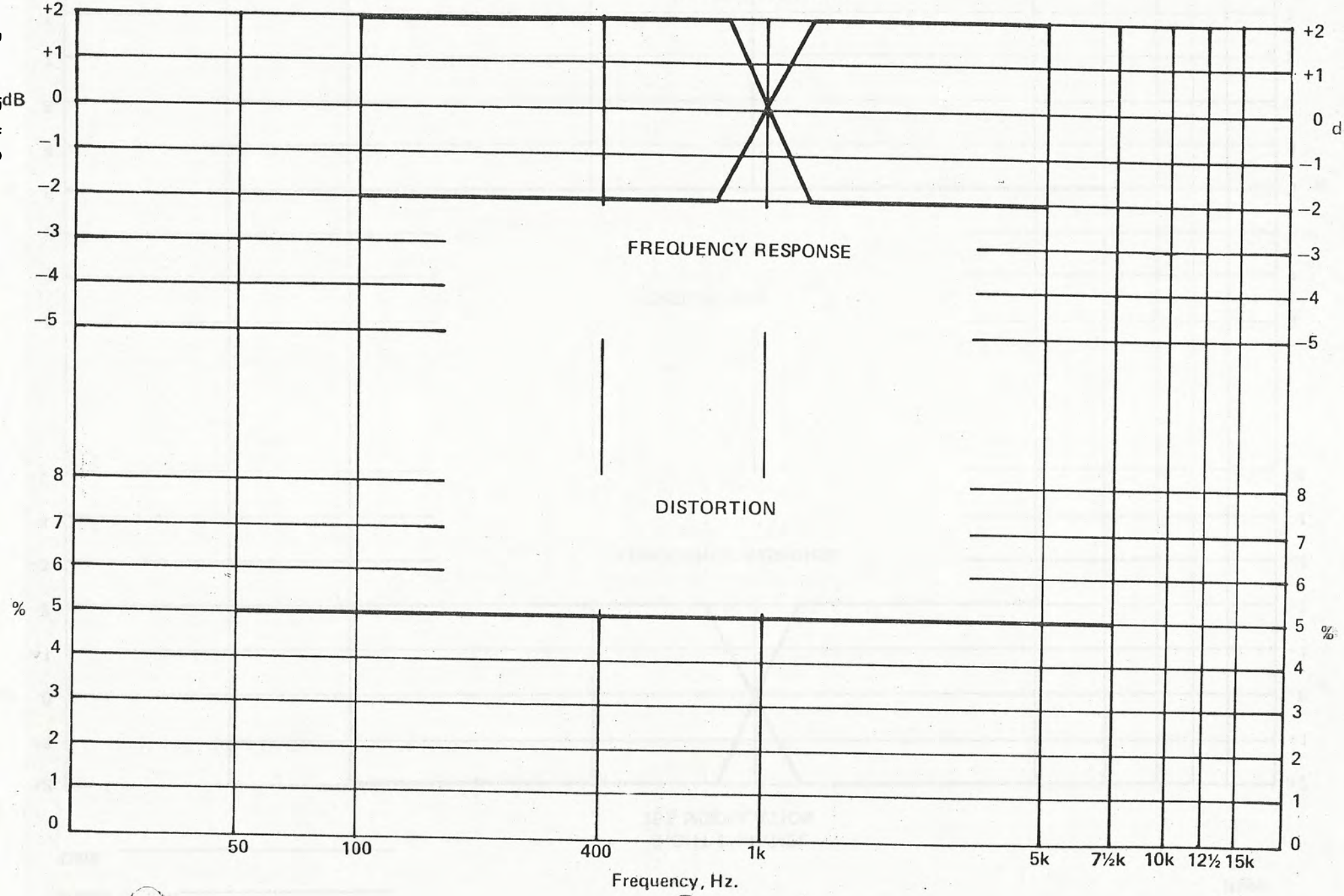
B18

Radio Station _____

Date _____

Right
50%

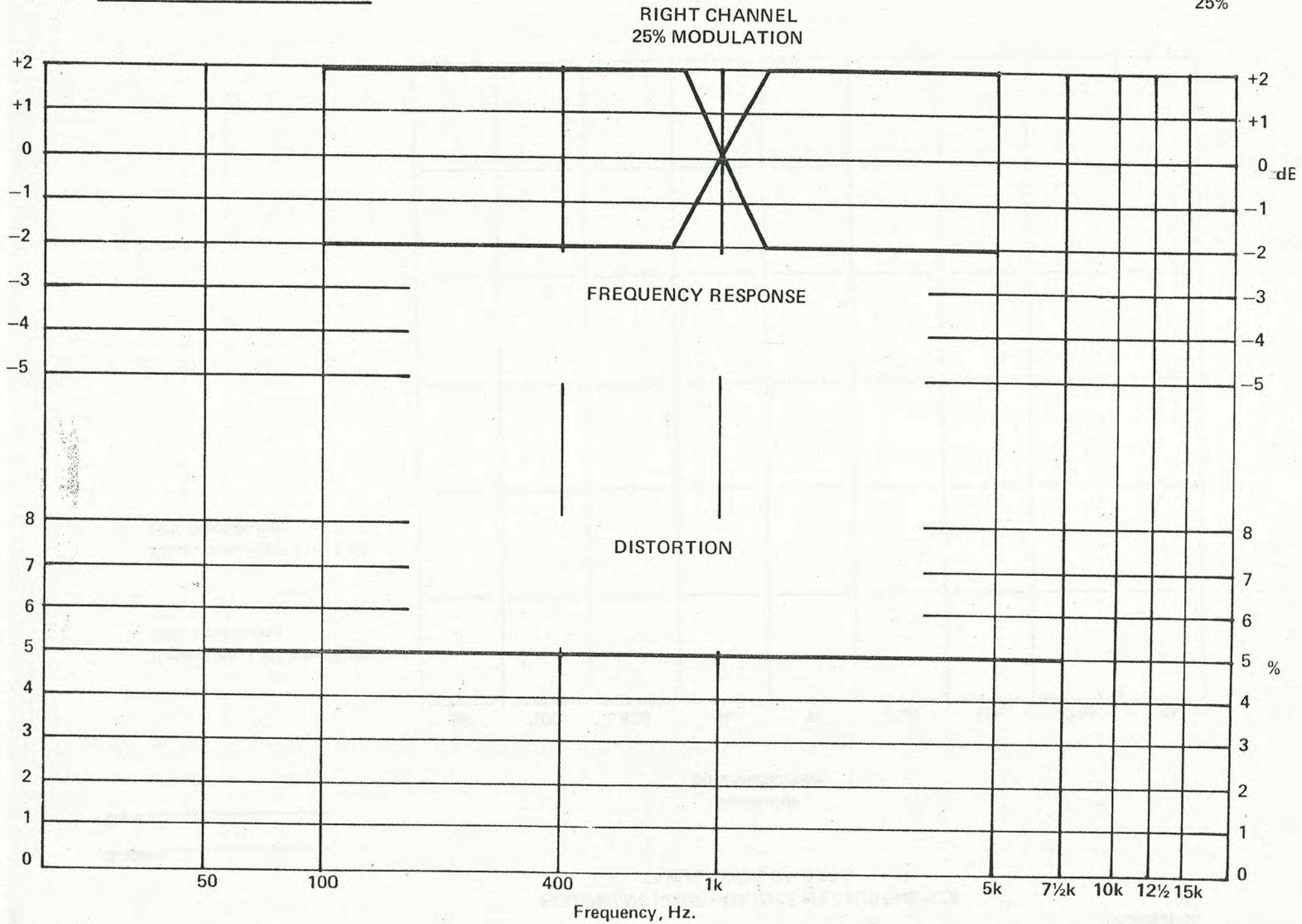
RIGHT CHANNEL
50% MODULATION



Radio S[illegible]on _____

Date _____

Right
25%



EQUIPMENT PERFORMANCE MEASUREMENTS
TABULATION OF DATA

Station _____

Date _____

Separation
50% Modulation

	50	100	400	1k	5k	7½k	10k	12½k	15k
Separation, Left into Right 50% Modulation									
Separation, Right into Left 50% Modulation									

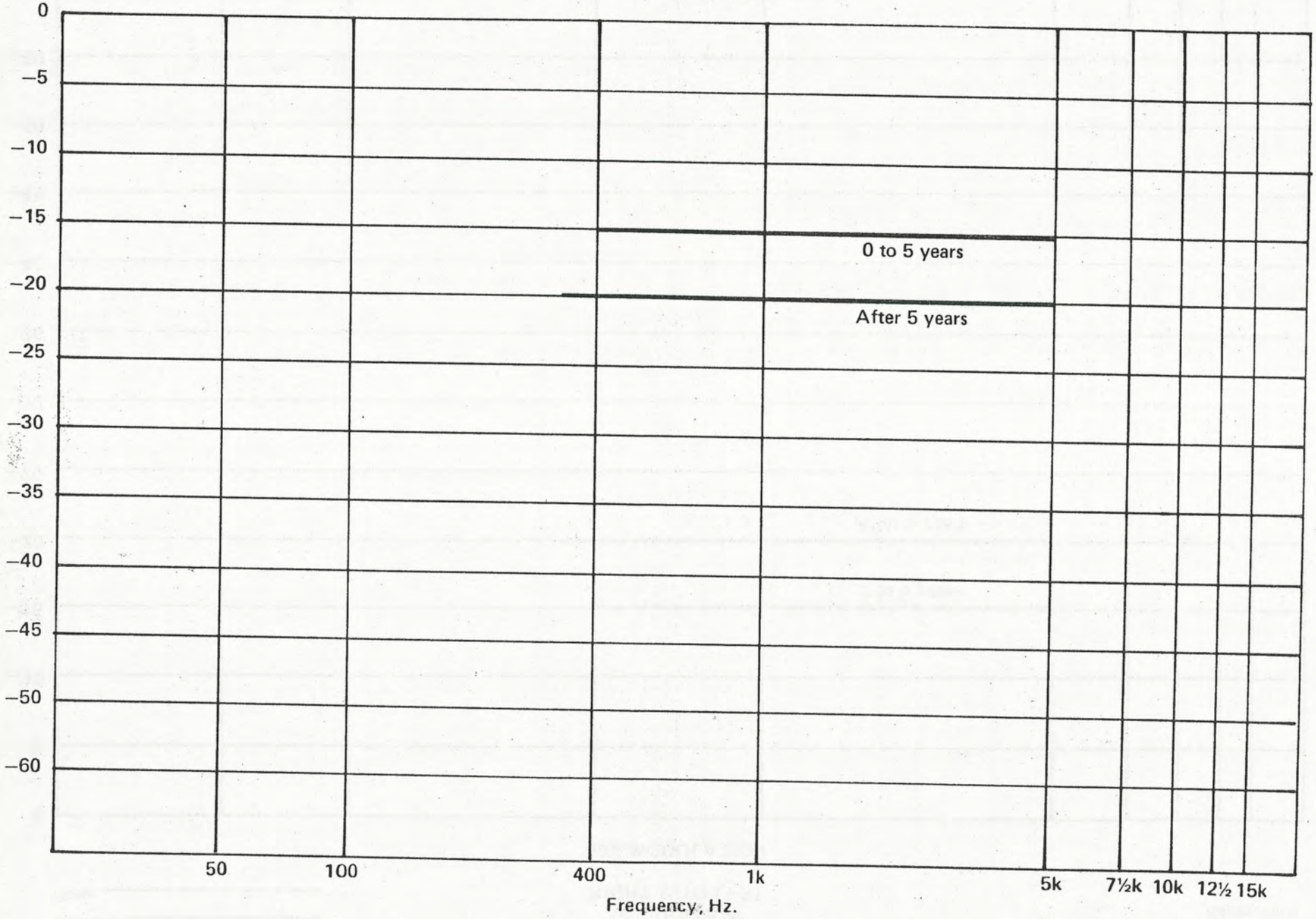
Stati... _____

Date _____

SEPARATION
LEFT INTO RIGHT

eft
Separation

50% MODULATION



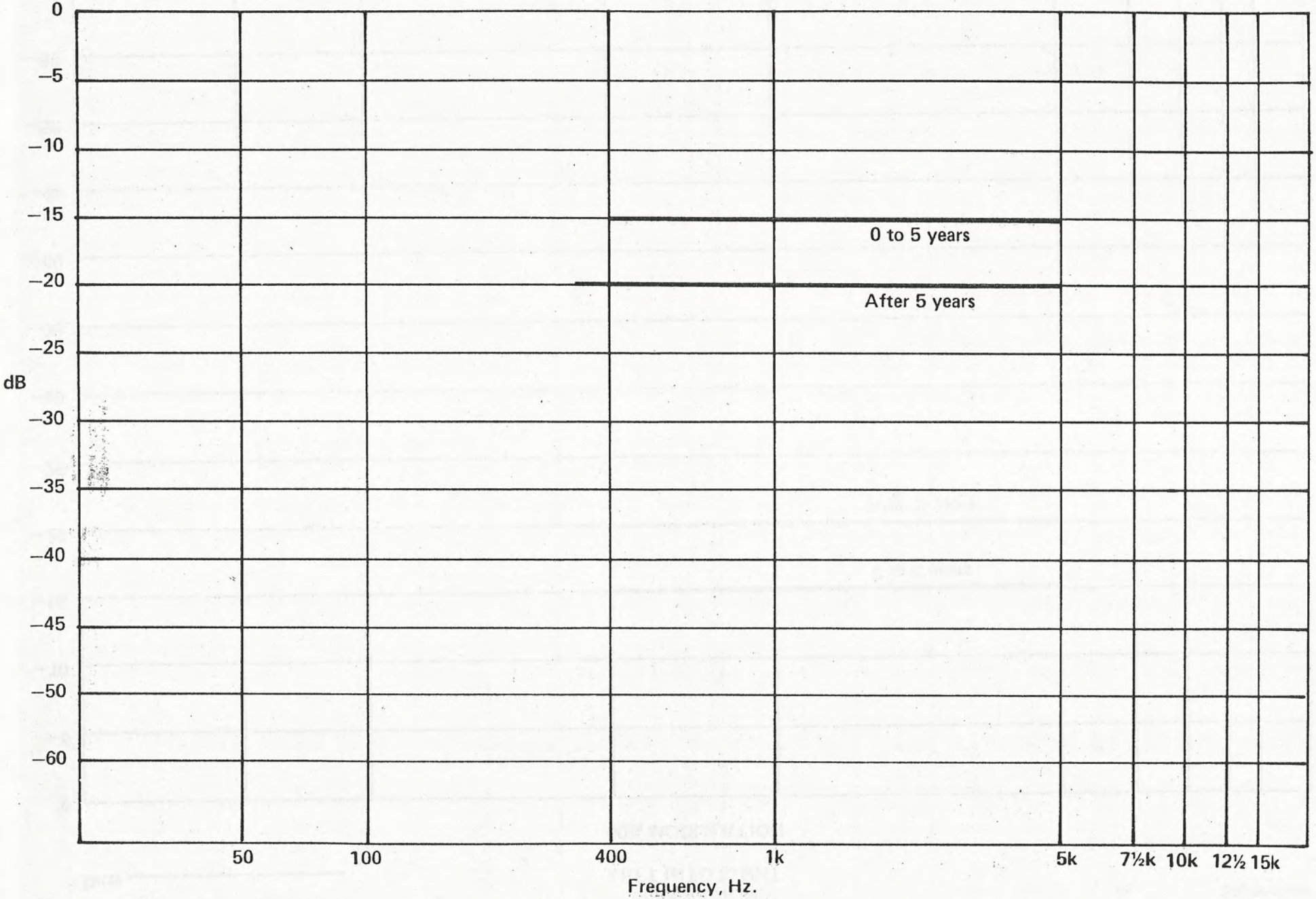
Station _____

Date _____

Right Separation

SEPARATION RIGHT INTO LEFT

50% MODULATION



IPM
L+R to L−R
&
L−R to L+R
Crosstalk

EQUIPMENT PERFORMANCE MEASUREMENTS
TABULATION OF DATA

Station _____

Date _____

Frequency, Hz.

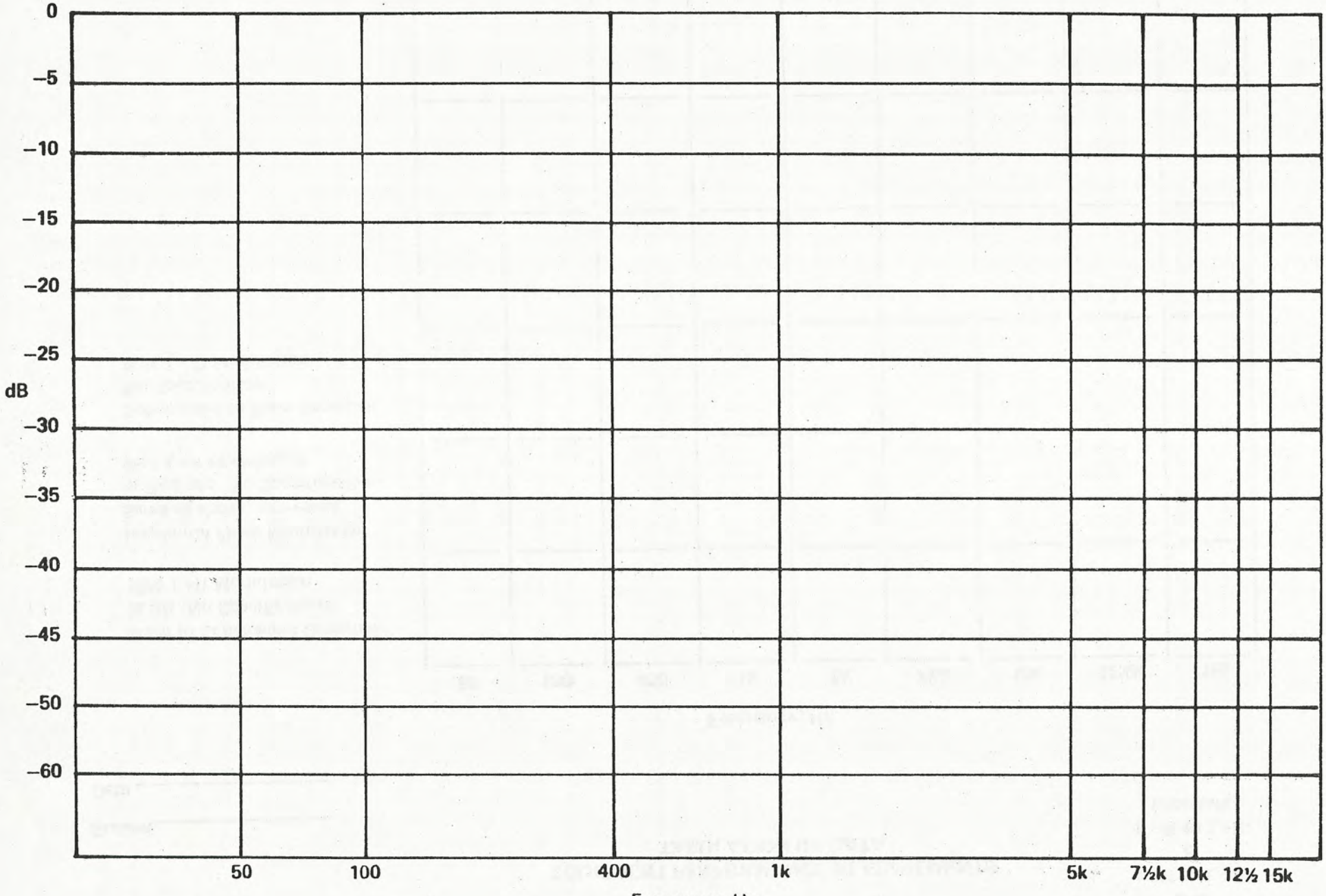
	50	100	400	1k	5k	7½k	10k	12½k	15k
Main to Subchannel Crosstalk in dB (No Specification) 95% L+R Modulation									
Incidental Phase Modulation Same as above, expressed in Radians. No Specification 95% L+R Modulation									
Subchannel to Main Crosstalk No Specification 95% L−R Modulation									

Station _____

Date _____

MAIN TO SUBCHANNEL CROSSTALK
(ALSO)
INCIDENTAL PHASE MODULATION
L + R, 95% MODULATION

IPM &
L + R to L – R
Crosstalk



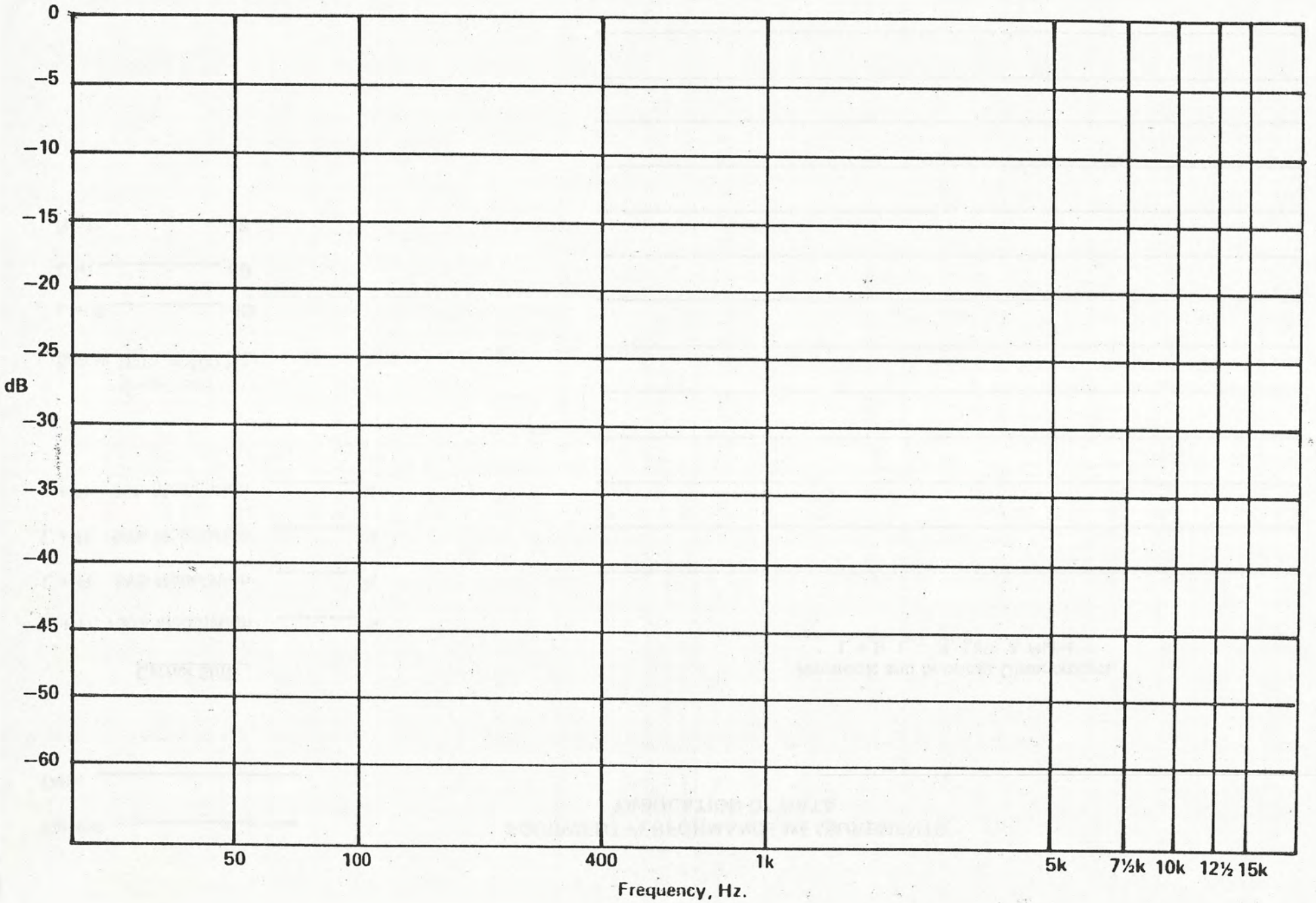
Station _____

Date _____

L – R to L + R
sstalk

SUBCHANNEL TO MAIN CROSSTALK

L – R, 95% MODULATION



Station _____

Date _____

EQUIPMENT PERFORMANCE MEASUREMENTS
TABULATION OF DATA

Carrier Shift

L + R, 100% Modulation _____ %

L + R, 85% Modulation _____ %

L + R, 50% Modulation _____ %

L + R, 25% Modulation _____ %

Noise Level
Below 100% at 400 Hz.

L + R _____ dB

Left _____ dB

Right _____ dB

Harmonic and Spurious Observations,
L + R, L – R, Left, & Right

Appendix A

FCC REGULATIONS FOR CONDUCTING EQUIPMENT PERFORMANCE MEASUREMENTS

§ 73.1590 Equipment Performance Measurements

a. The licensee of each AM, FM and TV station, except licensees of Class D non-commercial educational FM stations authorized to operate with 10 watts or less output power, must make equipment performance measurements for each main transmitter as follows:

1. Upon initial installation of a main new or replacement transmitter.
2. Upon modification of an existing transmitter made under the provisions of §73.1690. Modification of transmission systems, and specified therein.
3. Installation of AM stereophonic transmission equipment pursuant to §73.170.
4. Installation of FM stereophonic transmission equipment pursuant to §§73.297 or 73.597.
5. When required by other provisions of the rules or the station license.
6. AM and FM stations (except 10 watt non-commercial educational stations), once each calendar year. (One set of measurements must be made during the 4 month period immediately preceding the filing date of the application for renewal of the station license. Successive measurements are to be made at least annually by the anniversary calendar month, and completed within an additional 2 months, with no more than 14 months between measurements.)

b. *Audio measurements.* Audio equipment performance measurements must be made with the equipment adjusted for normal program operation and must include all circuits between the main studio microphone terminals or amplifier input and the antenna circuit, including any correcting equalizer circuits normally used. Any dynamic audio processing or non-correcting equalizers must be disabled or neutralized. The measurements must yield the following information:

1. *AM monophonic stations.*

i. Data and curves showing overall audio frequency response from 50 to 5000 Hz for approximately 25, 50, 85 and if obtainable, 100% modulation. A family of curves must be plotted (one for each percentage above) with dB above and below the 1000 Hz reference frequency as ordinate and audio frequency as abscissa.

ii. Data and curves showing audio frequency harmonic content for 25, 50, 85 and, if obtainable, 100% modulation for the audio frequencies of 50, 100, 400, 1000, 5000 and 7500 Hz (either arithmetical or RSS (root sum square) values up to the 10th harmonic or 16,000 Hz). A family of curves must be plotted (one for each percentage above) with percent distortion as ordinate and audio frequency as abscissa.

iii. Data showing percentage of carrier amplitude regulation (carrier shift) for 25, 50, 85 and, if obtainable, 100% modulation with 400 Hz tone.

iv. The carrier hum and extraneous noise level generated within the equipment, and measured throughout the audio spectrum, or bands, in dB below the reference level of 100% modulation by a 400 Hz tone.

v. Measurements or evidence showing that spurious radiations, including radio frequency harmonics, are suppressed or are not present to a degree capable of causing objectionable interference to other radio services. Field strength measurements are preferred but observations made with a communications type receiver are acceptable. However, in particular cases involving interference or controversy, the FCC may require field strength measurements.

2. *AM stereophonic stations.*

i. Data and curves showing the overall audio frequency response from 50 to 15,000 Hz for approximately 25%, 50%, 75% and 100% modulation with equal left and right (L+R) main channel signal; 25%, 50%, and 75% modulation with both a left (L) channel only and right (R) channel only signals.

ii. Data and curves showing audio frequency harmonic contect for 25%, 50%, 75%, and (main channel only) 100% modulation for the audio frequencies 50, 100, 400, 1000, 5000, and when attainable 7,500, 10,000, 12,500, and 15,000 Hz (either arithmetical or RSS (root sum square) values up to the 10th harmonic or 30,000 Hz) for equal left and right (L=R), left (L) only and right (R) only signals. A family of curves must be plotted as specified in paragraph (b) (1) (ii) above.

iii. Data showing percentage of carrier amplitude regulation as specified in paragraph (b) (1) (iii) above for main channel modulation with equal left and right (L=R) signals.

iv. The carrier hum and extraneous noise level generated within the equipment, and measured throughout the audio spectrum, or band, in dB below the reference level of 100% amplitude modulation by a 400 Hz tone for the main, left, and right channels.

v. Measurements or observations for spurious and harmonic radiations as specified in paragraph (b) (1) (v) above while modulating the transmitter main (L+R) channel, left (L) channel only, right (R) channel only and a stereophonic channel only (L—R) signal. The tests shall be made with the tones and maximum attainable normal modulation as specified in 73.128 (b).

vi. The degree of incidental phase modulation of the carrier wave, in radians, when the main (L+R) channel is amplitude modulated without pilot tone. The tests shall be made with the tones and maximum attainable modulation levels as specified in (2) (i) of this paragraph.

vii. The main to stereophonic channel and the stereophonic to main channel crosstalk. The tests shall be made with the tones and maximum attainable normal modulation as specified in (2) (i) of this paragraph.

viii. In the above measurements, if 100% negative peak amplitude modulation is not attainable, the highest attainable modulation percentage between 95% and 100% modulation shall be used.

FCC MINIMUM PERFORMANCE SPECIFICATIONS FOR AM STEREO

§ 73.40 AM Transmission System Performance Requirements

a. The design, installation, and operation of a monophonic AM broadcast transmission antenna terminals must meet the following specifications.

b. The design, installation, and operation of a stereophonic AM broadcast transmission system between audio input amplifiers used for all programming for both the left and right program channels to the transmitting antenna terminals must meet the following specifications.

1. Except when due to equipment failures or other conditions beyond the licensee's control, the transmitter must be capable of operating at the authorized power for each mode of operation, with a main (L+R) channel amplitude modulation not less than 85% and a left (L) only or right (R) only signal of not less than 75% over the audio frequency range from 50 to 5,000 Hz.
2. For main channel modulation only, the transmission system shall meet the distortion specifications of paragraph (a) (2) above with harmonics observed to 20,000 Hz. When stereophonic transmission is used, the distortion must be measured in the left and right channels separately modulated using a suitable stereophonic demodulator.
3. The audio frequency transmitting characteristics for main (L+R), left (L) only and right (R) only modulation shall conform to the requirements of paragraph (a) (3) above, except that measurements shall extend to 7,500 Hz.
4. The carrier-amplitude regulation (carrier shift) at any percentage of amplitude modulation by a main (L+R) channel signal shall not exceed 5%.
5. The carrier hum and extraneous noise level, unweighted noise, over the frequency band 50 to 20,000 Hz for main channel (L+R), left (L), and right (R) channels must be at least 45 dB below the reference level of 100% amplitude modulation of the carrier by a 400 Hz tone. Measurements shall be made with a suitable stereophonic demodulator.
6. The incidental phase modulation of the transmitter must be measured with the main (L+R) channel modulated at the audio frequencies and modulation levels specified in paragraph (b) (2) above.

   NOTE: Specifications for incidental phase modulation are not established.
7. For the first five years following installation of stereophonic transmitting equipment, stereophonic separation between left and right stereophonic channels must be at least 15 dB at audio modulating frequencies between 400 and 5,000 Hz. After five years, stereophonic separation between left and right stereophonic channels must be at least 20 dB at audio modulating frequencies between 300 and 5,000 Hz.

§ 73.128 AM Stereophonic Broadcasting

a. An AM broadcast station may, without specific authority from the FCC, transmit stereophonic programs upon installation of type accepted stereophonic transmitting equipment and the necessary measuring equipment to determine that the stereophonic transmissions conform to the modulation characteristics specified for the stereophonic transmission system in use.

b. The FCC does not specify the composition of the transmitted stereophonic signal. However, the following limitations on the transmitted wave must be met to insure compliance with the occupied bandwidth limitations, compatibility with AM receivers using envelope detectors, and any applicable international agreements to which the United States is a party:

1. The transmitted wave must meet the occupied bandwidth specifications of 73.44 under all possible conditions of program modulation. Compliance with requirement shall be demonstrated either by the following specific modulation tests or other documented test procedures that are to be fully described in the application for type acceptance and the transmitting equipment instruction manual. (See 2.983 paragraphs (d) (8) and (j)).

   i. Main channel (L+R) under all conditions of amplitude modulation for the stereophonic system but not exceeding amplitude modulation on negative peaks of 100%.

   ii. Stereophonic subchannel (L—R) modulated with audio tones of the same amplitude at the transmitter input terminals as in (i) above but with the phase of either the L or R channel reversed.

   iii. Left and Right Channel only, under all conditions of modulation for the stereophonic system in use but not exceeding amplitude modulation on negative peaks of 100%.

2. The total harmonic distortion as measured by an envelope detector having an input radio frequency bandwidth of 30 kHz (3 dB points) many not exceed 5% for the conditions of modulation specified (1) of this paragraph.

c. Each licensee or permitee of an AM station engaging in stereophonic broadcasting using a system with a pilot tone shall measure the quiescent pilot tone frequency and injection level and calibrate at intervals as often as necessary to insure compliance with the specifications for the system in use. However, in any event, the measurements shall be made at least once each calendar month with not more than 40 days between successive measurements.

Introduction to the Motorola C-Quam AM Stereo System

WHAT IS C-QUAM?

C-Quam is a mixed mode system using amplitude modulation for the main (L + R) signal, and a completely different and independent type of quadrature modulation for the stereo (L – R) information. Quadrature combines two signals at a phase angle of 90 degrees for transmission, and then at the receiver separates them again. It is another form of multiplexing. This technique is used to transmit the color information in the U.S. TV color system and is used for encoding of SQ and QS quadraphonic records. In the application to AM stereo, quadrature is really transmitting two AM signals on the same channel. For relatively narrow bandwidth applications such as we have with AM radio, AM is really the most efficient emission because amplitude modulation requires the minimum bandwidth and it is independent of noise. What this means is that in an AM receiver, the effective background noise remains the same with or without modulation. This is not so with FM or PM, which under modulation, "kicks up" additional noise not present under no modulation conditions. So in AM quadrature, an additional channel can be created and heavily modulated without "kicking up" excessive noise. In other words, for narrow bandwidth communications systems, there is a signal to noise advantage to using AM quadrature.

Another important point is for AM stereo the long transmission path from the transmitter, through a directional antenna, over a difficult propagation path, and through a narrow bandwidth and possibly mistuned receiver is a very rough one. In order to be demodulated with the least distortion and maintaining separation, the signal must be very resilient . . . able to withstand the difficult transmission experience. This also is best done with AM quadrature because two of the same type of signals are being transmitted and therefore undergo the same type of distortions which can in many instances be canceled at the other end. In other words, for AM stereo the differences between the two signals must be preserved, and if each undergoes the identical distortions during transmission, the differences between the two signals will be maintained. This is another reason why the AM/FM and AM/FM stereo systems are not very good because distortions to the AM component are very different from the distortions to the PM or FM component during transmission, and the result is a much more distorted AM stereo signal.

Although many have tried to use AM quadrature for AM stereo the most difficulty is encountered when modifications are made to make it compatible with envelope detectors in existing AM radios. The Motorola scientists and engineers found a way of taking advantage of the quadrature characteristics, while transmitting a perfectly compatible AM component.

THE NATURE OF AM AND FM SIDEBANDS

In order to describe the system, some basics must be understood about certain types of modulation and how it is detected or not detected. To check our understanding, let's look at two basic types of transmission, AM and FM, modulated by a very low distortion sine wave.

When a signal is amplitude modulated by a sine wave, we can describe it in several ways. One is to simply look at the amplitude and trace it vs time. This would be the typical display on an oscilloscope of the R.F. envelope. See Figure 1. Another is to look at it on a spectrum analyzer which would show three vertical lines in the center, a taller line representing the carrier, and the two sidebands, lesser in amplitude, shown on either side of the carrier. In these two representations, there is no phase information given but for now think of the two sidebands as being in-phase sidebands or "I" sidebands. Thus in a perfect AM signal with no distortion there are no higher order sidebands or harmonics of the primary AM sidebands and there is no net phase modulation of the total of the carrier and the two sidebands.

The other case, FM (or PM) is where the phase or frequency is modulated according to our low distortion sine wave, and let's say the deviation is at least a few kHz. In this case, the R.F. envelope does not vary and the A.C. output of the envelope detector would be zero. The spectrum, however, would usually consist of a component at the carrier frequency and a family of sidebands located a multiples of the modulating frequency away from the carrier. For instance if the carrier frequency was 1000 kHz, and the modulation was 1 kHz, there would be symmetrical sidebands at 999 and 1001 kHz, 998 and 1002 kHz, and so on.

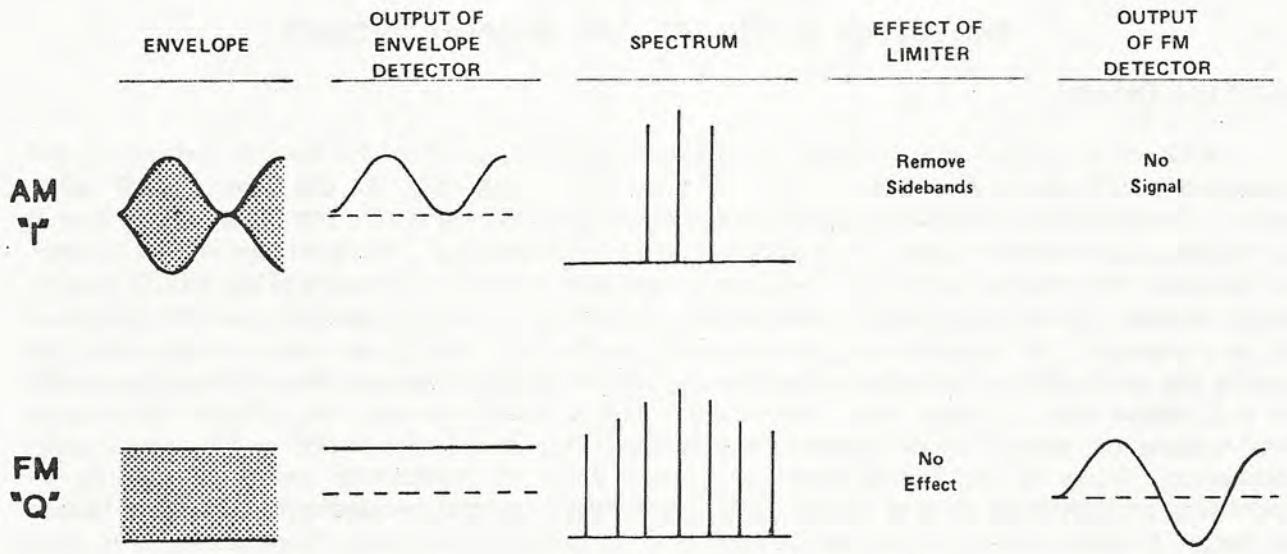


Figure 1.

If there is a carrier and sidebands, why doesn't the envelope detector detect the modulation? The reason is that in FM and PM, the instaneous phase and amplitude of the carrier component and all the sidebands always add up to the same power as the unmodulated carrier. As the modulation is turned up, the carrier is reduced in amplitude and the missing carrier power is given to the sidebands, but the sum total at all times remains the same. It is in the phasing of the sidebands that determines whether they will add and subtract with the carrier to produce differences in amplitude or whether they will add and subtract with the carrier component to always give the same amplitude. In the case of FM or PM, let's call the sidebands quadrature or "Q" sidebands.

Now, the interesting thing is that "Q" sidebands don't need a linear amplifier to be amplified and can be crunched to death by limiters and class C amplifiers and still the same spectrum comes out the other end. On the other hand "I" sidebands must have linear amplification in order to survive and can be totally stripped from the signal by a good limiter. An envelope detector will be blind to the existence of perfect PM or FM sidebands, and a phase or frequency demodulator will not see perfect "I" sidebands or amplitude modulation.

Another interesting fact is that all modulation can be represented by a combination of the "I" sideband components and the "Q" sideband components. This is very important in AM stereo broadcasting because it is necessary to split any of the AM stereo system's signals into the "I" and "Q" signals for transmission on an existing AM transmitter. See Figure 2. For all systems, the "I" signal is given to the transmitter in audio form at the audio input to the transmitter and then it amplitude modulates the signal in the normal way recreating an AM or an "I" sideband signal. For all systems, the "Q" components are fed to the transmitter in R.F. form as a phase modulated signal that replaces the crystal oscillator in the transmitter. Of course the "Q" signal sidebands can pass through the intermediate and final amplifier R.F. stages of the transmitter even though these stages are non linear and usually operate class C. The Motorola AM stereo system also required that it be reconstructed for such transmission but certain modifications are made for compatibility with the millions of existing AM radios.

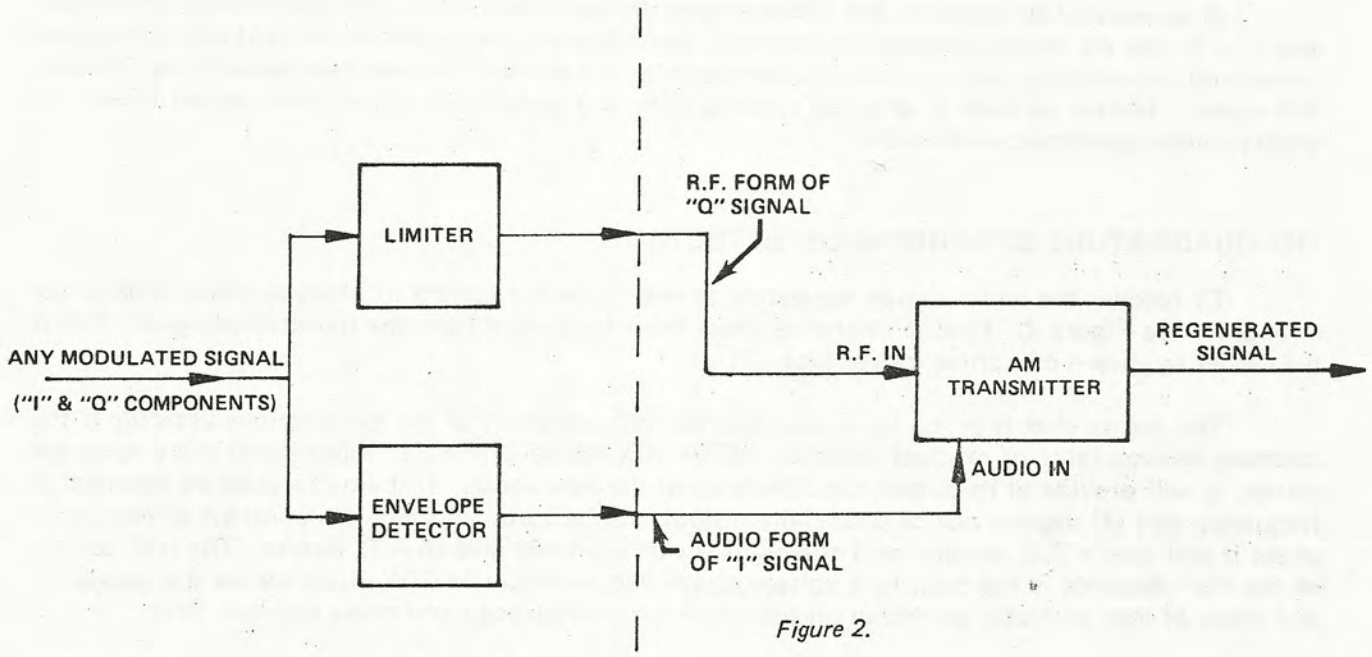


Figure 2.

PURE QUADRATURE

Observe Figure 3. Pure AM-AM quadrature can be generated by two transmitters connected so that their outputs add. One transmitter would be a standard AM generator producing the carrier at, let's say, zero phase, and sidebands associated with that carrier ("I" sidebands). A second transmitter is fed from the same master oscillator as the AM transmitter, but the phase is shifted 90 degrees. Because we already have a full carrier at zero degrees phase from the AM transmitter providing a phase reference for the receiver, the second transmitter does not need a carrier and is set up with a balanced modulator cancelling out the carrier and producing only sidebands. Because these sidebands are generated from a carrier which is 90 degrees out of phase from the AM transmitter, these sidebands will be 90 degrees out of phase with the AM sidebands and "in quadrature." These become our "Q" sidebands.

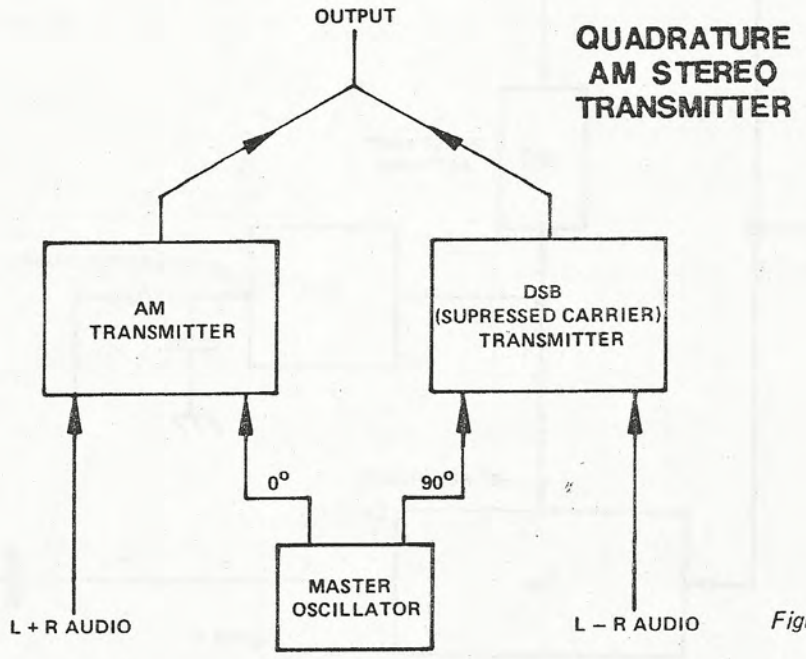


Figure 3.

If we wanted to make an AM stereo system we could transmit L + R into the AM transmitter, and L – R into the double sideband transmitter. Sounds good, but under left or right only conditions where both transmitters are contributing sidebands to the output, the resultant would be a distorted AM signal. Before we look at why, let's take a look at a quadrature demodulator which is also the widely touted synchronous detector.

THE QUADRATURE (SYNCHRONOUS) DETECTOR

To recover the audio signals separately at the receiver a system of phase sensitive detectors is arranged. See Figure 4. First, a reference phase must be derived from the transmitted signal. This is the carrier by means of a phase locked loop (PLL).

The device that is primarily responsible for the operation of the synchronous detector is the balanced demodulator or product detector. When this device is given an input signal and a reference carrier, it will provide at its output the difference of the two signals. If the two signals are identical in frequency and 90 degrees out of phase, the output will be zero. If there is a constant difference in phase it will give a D.C. output or if the phase is varying it will give an A.C. output. The D.C. output of the "Q" detector is fed back to a voltage controlled oscillator (VCO) which causes the frequency and phase of that oscillator to zero in on the input carrier frequency and phase and lock to it.

This provides the phase reference for the "I" and "Q" detectors. The A.C. output from the "I" demodulator provides the original L + R audio from the AM transmitter, but it does not see the "Q" sidebands from the double sideband transmitter. The second demodulator is also fed from the VCO but its carrier reference signal is automatically shifted 90 degrees. Therefore it sees the "Q" sidebands from the double sideband transmitter and sees nothing from the AM transmitter input audio which is L + R.

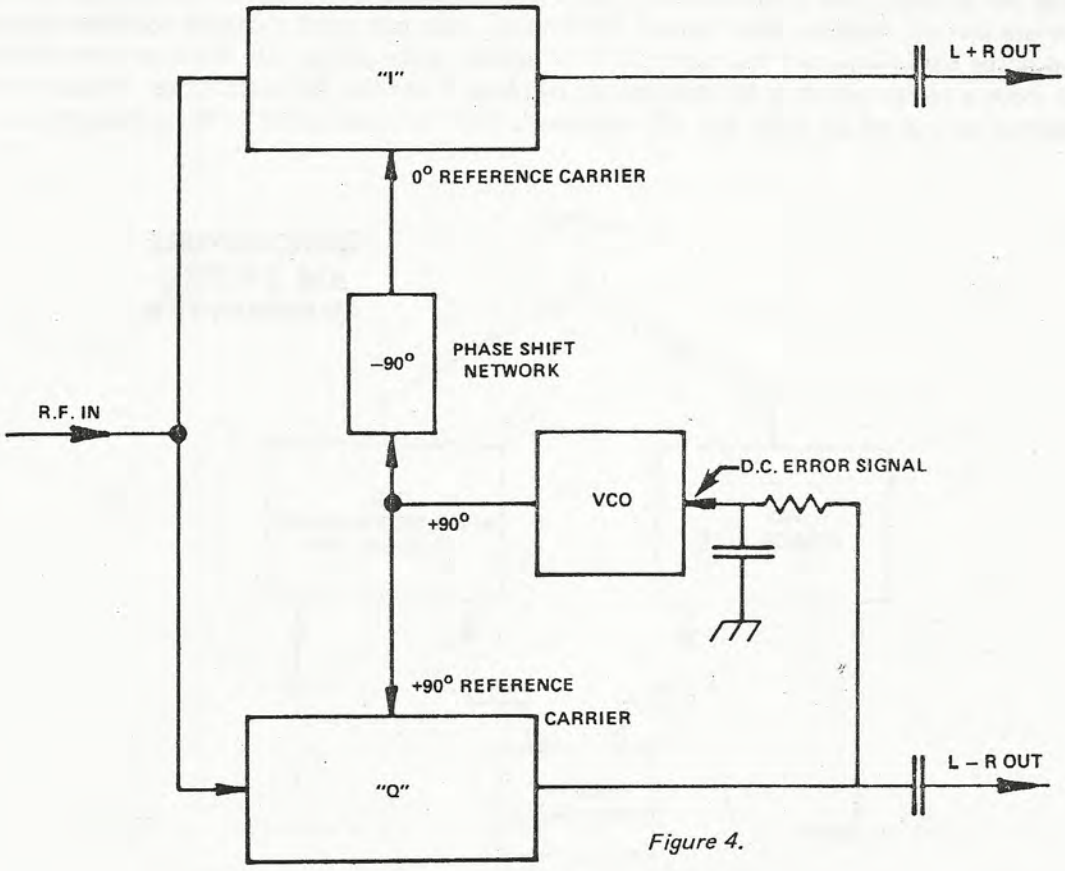
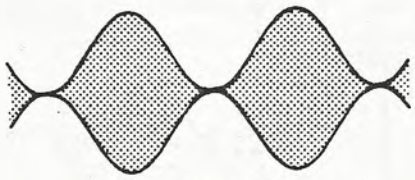


Figure 4.

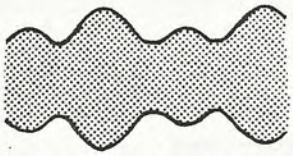
The AM-AM quadrature system would be excellent for AM stereo except that the envelope detectors in normal AM radios don't see only the "I" sidebands or the "Q" sidebands but see the simple vector addition of both. The envelope detector is not capable of seeing any phase information and only sees the absolute total of the modulation regardless of phase.

Under L + R (L = R) only modulation conditions (monaural), there is no problem, because only the AM transmitter is modulated and the envelope detector recovers AM perfectly. (The double sideband transmitter receives no audio because when L = R, L – R = 0.) However, under stereo conditions, for instance, when L only is transmitted, full sideband components are contributed by both the AM and double sideband transmitters and the envelope looks like Figure 5. This would not be compatible with existing radios and a very distorted signal would be heard.

QUADRATURE MODULATION ENVELOPES



L + R MODULATION



L ONLY OR R ONLY

Figure 5.

COMPATIBLE QUADRATURE

The Motorola AM stereo system is not complicated at all. It simply takes a pure quadrature signal as just described, and extracts the phase modulation components of the quadrature signal and phase modulates the broadcast transmitter, and sends L + R audio to the audio input of the transmitter. That's it! The advantage is that a very nice AM signal is always transmitted so that the envelope detectors are happy, but that the phase modulation of the carrier is derived from quadrature. The result is a signal with the advantages of quadrature modulation while maintaining monaural compatability.

THE C-QUAM TRANSMITTER

The C-Quam transmitter is diagramed in Figure 6. Note that pure quadrature is generated by taking L + R and L – R and modulating two balanced modulators fed with R.F. signals out of phase by 90 degrees. In this case the 90 degrees phase shift is derived by using a Johnson counter which divides an input frequency (four times station carrier frequency) by four and automatically provides digital signals precisely 90 degrees out of phase for the balanced modulators. The carrier is inserted directly from the Johnson counter. At the output of the summing network, the result is a pure quadrature AM stereo signal. From there it is passed through a limiter which strips the AM components from the signal and leaves only the phase modulation "Q" sidebands. This is not the same as the simple output of the "Q" modulator because the addition of the "I" and "Q" balanced modulators produced some phase shifting not present in the "Q" modulator alone. The output of the limiter is amplified and sent to the broadcast transmitter in place of the crystal oscillator.

The left and right audio signals are precisely added and sent to the audio input terminals of the broadcast transmitter. That's the Motorola C-Quam encoder.

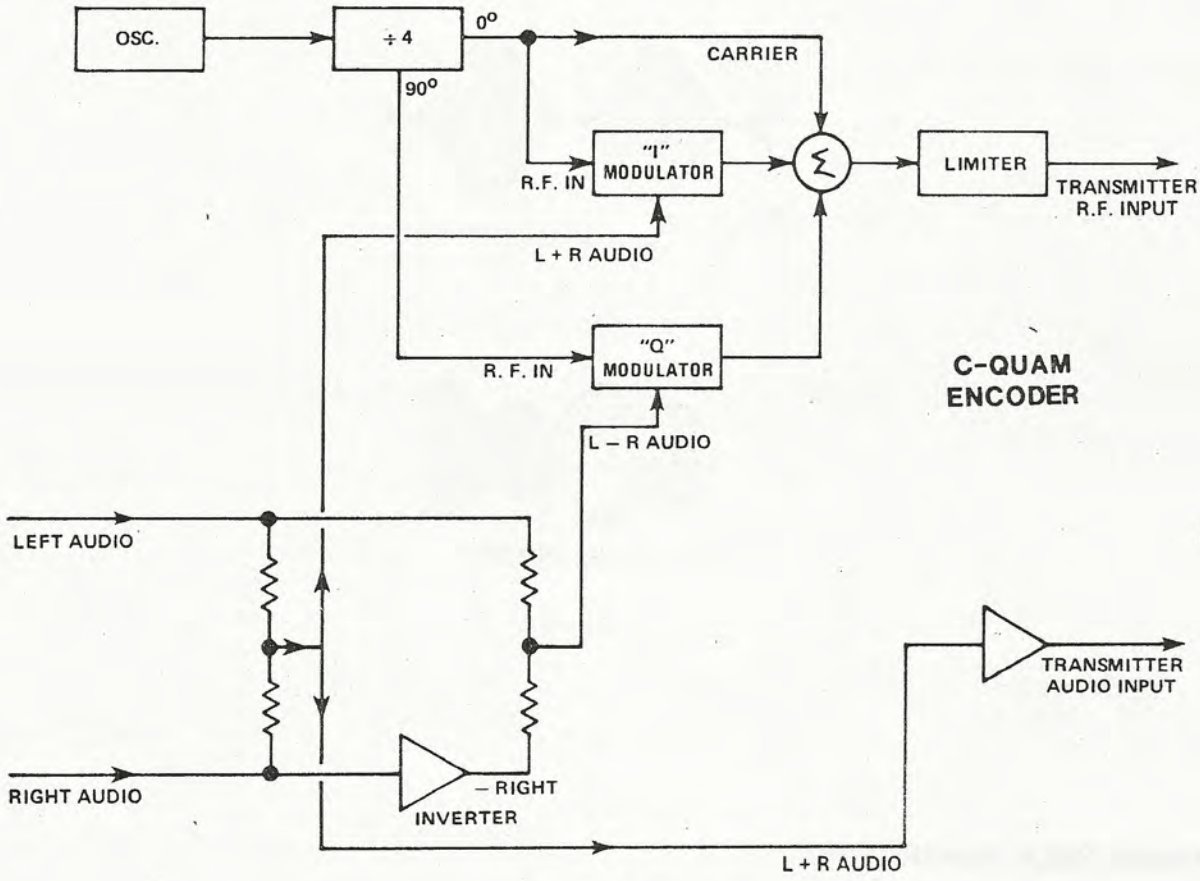


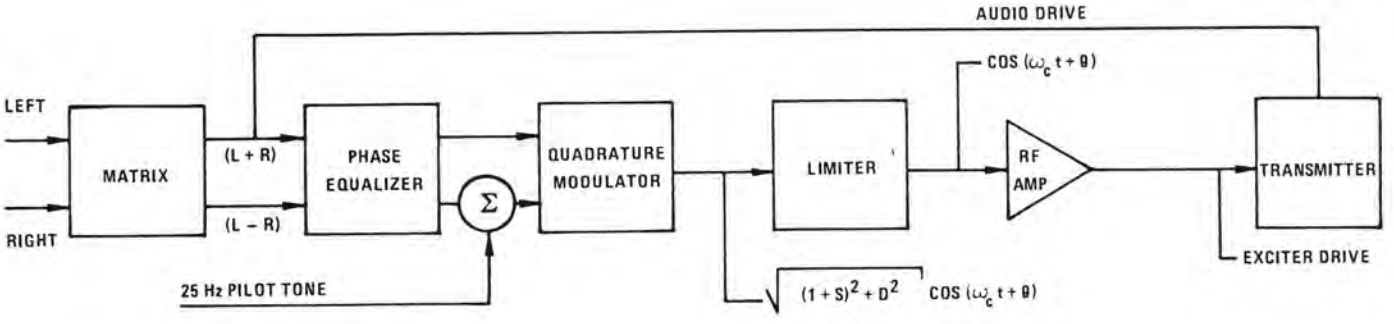
Figure 6.

DECODING C-QUAM

C-Quam is decoded by simply converting the broadcast signal which is already "almost" pure quadrature to pure quadrature and then using a quadrature detector to extract and L – R. Refer to Figure 7. Note that the demodulator contains a section which is the pure quadrature demodulator as previously described. In order to prepare the broadcast signal for the quadrature demodulator, it has to be converted from the envelope detector compatible signal that is broadcast to the original

ENCODING COMPATIBLE QUADRATURE MODULATION

The existing RF oscillator of the transmitter is replaced by a substitute reference which has the angular modulation of a quadrature signal. The existing AM modulation technique is basically unchanged.



Note that the audio modulation sum information is unchanged and that a quadrature phase modulated RF drive is substituted for normal RF drive. The only change is the presence of a Phase Equalizer to compensate for the differences in Amplitude/Phase relationships between the audio signal path and the RF path. This is necessary to maintain separation over a wide bandwidth.

Any suitable stereophonic audio processors may be used.

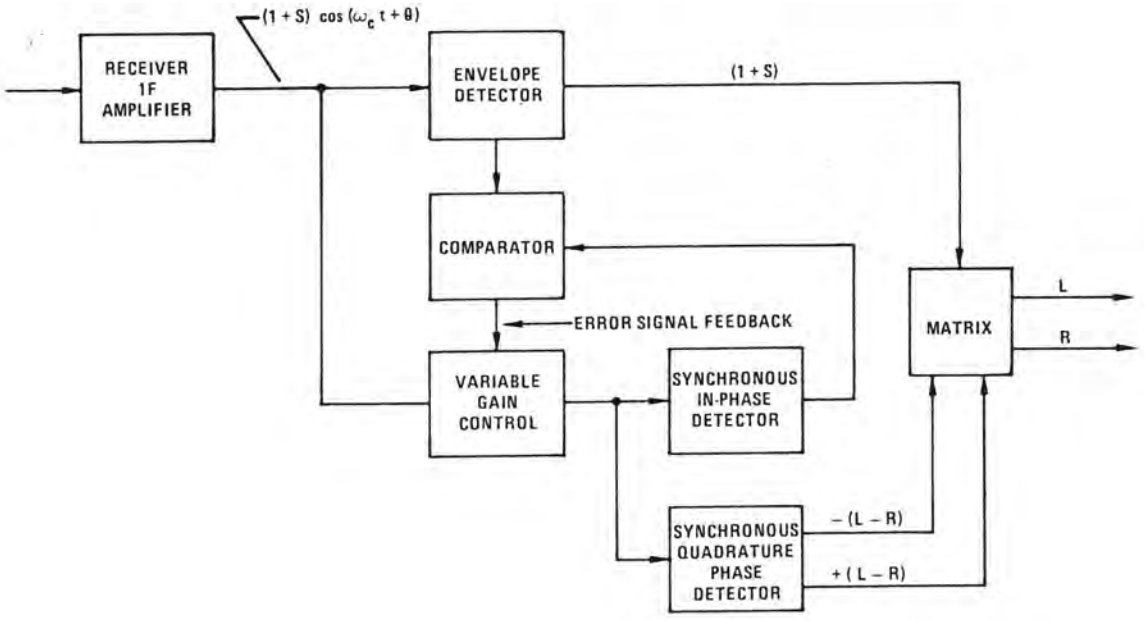
DECODING THE COMPATIBLE QUADRATURE SIGNAL

The received compatible quadrature signal is a quadrature signal which has been modulated by the cosine of its relative phase angle information. It is also a compatible envelope detector signal. Therefore, sum information may be decoded with either an envelope detector or a synchronous detector that is inversely modulated by the cosine of the phase modulation. Difference information may be decoded with a synchronous quadrature demodulator which is in inversely modulated by the cosine of the phase modulation. In fact, there exists a multiplicity of decoding methods since:

$$L - R = S \tan\theta = S \times \sin\theta \div \cos\theta$$

Hence, any sequence of operations which results in L – R is a valid decoding algorithm. Even non-PLL decoders are allowed since a descriminator, integrator, tangent function sequence results in L – R.

Motorola has evolved a preferred decoder design which maximizes performance benefits at minimum of cost and adjustments. The approach is shown in the following figure.



In the absence of the feedback loop, the In-Phaser/detector would produce (1 + S) cosθ . The feedback loop forces the In-Phase detector output – but, this action also forces the Variable Gain Control to be in inverse cosθ modulator. Hence, the output of the Quadrature Phase Detector becomes the desired L – R information.

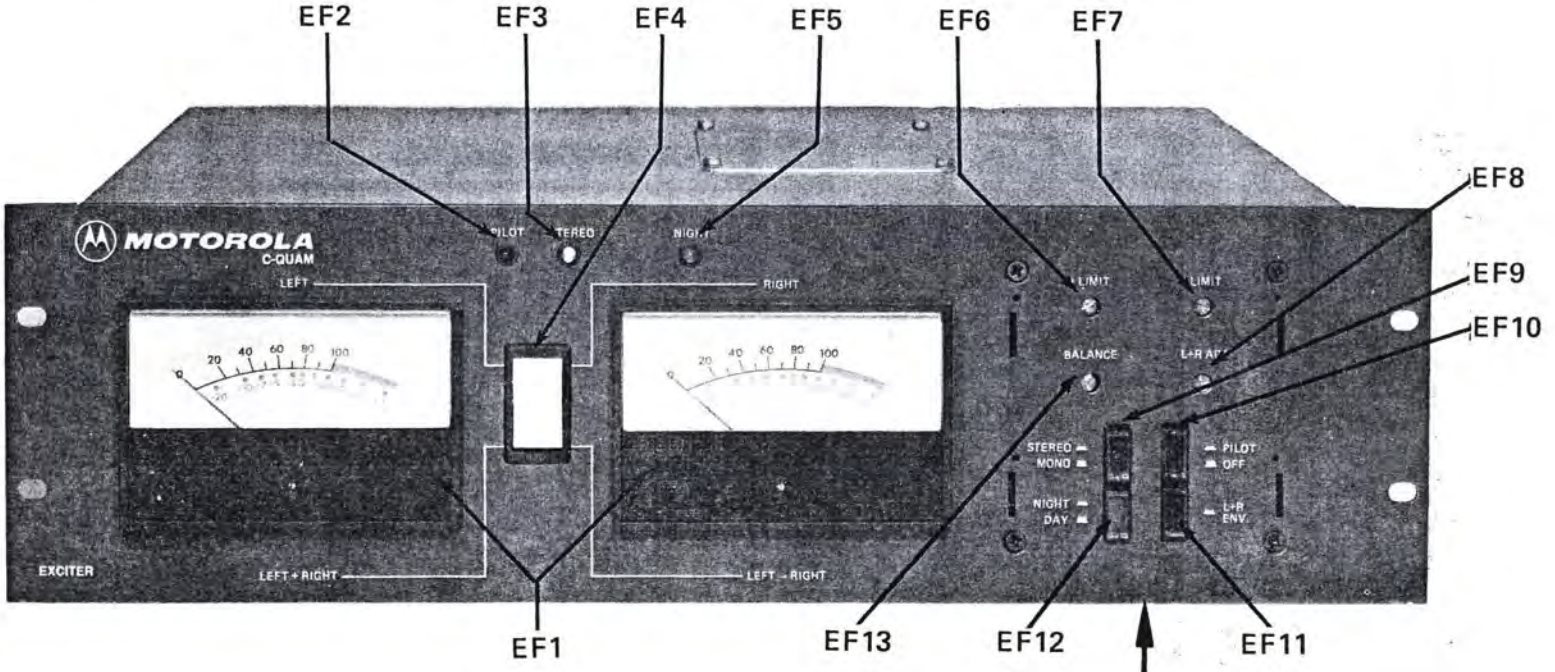
SIGNAL EQUATION FOR MOTOROLA COMPATIBLE QUADRATURE SYSTEM

$$E_c = A_c\,(1 + M_s\,(L(t) + R\,(t))\cos\left[\omega_c t + \tan^{-1}\left\{\frac{M_d\,(L\,(t) - R\,(t)) + .04\sin 50\pi t}{1 + M_s\,(L\,(t) + R\,(t))}\right\}\right]$$

where: M_s = index of modulation for sum information
M_d= index of modulation for difference information
$.04\sin 50\pi t$ = 25 Hz. pilot tone.

EXCITER AND MONITOR

OUTPUTS AND CONTROLS
DESCRIPTION AND FUNCTION



EXCITER FRONT VIEW

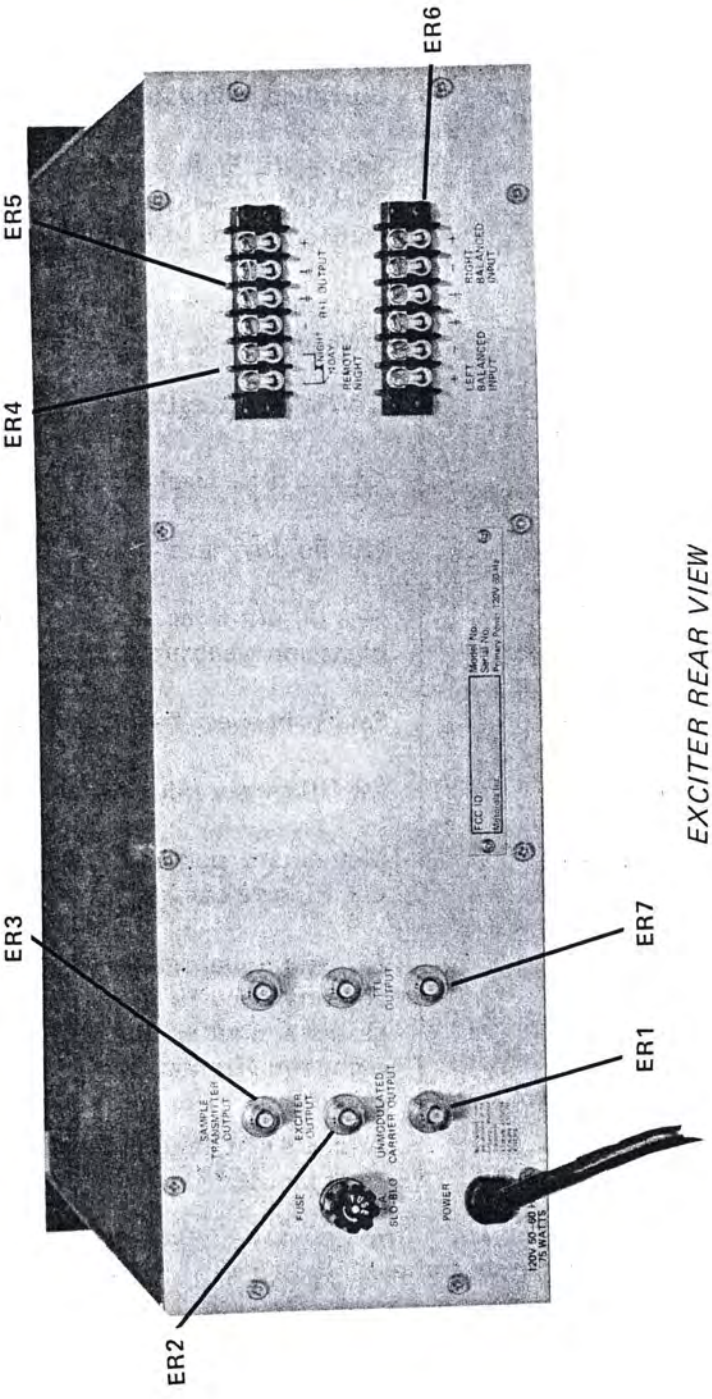
REMOVAL OF FRONT TRIM ESCUTCHEON

1) **TO ACCESS THE FRONT CONTROLS, FIRST REMOVE THE LEFT AND RIGHT TRIM PIECES BY PULLING STRAIGHT BACK**
2) **REMOVE THE FOUR (4) SCREWS AND REMOVE COVER.**

EXCITER
FRONT PANEL CONTROLS

REF	DESCRIPTION	FUNCTION
EF1	Meters	Audio level meters for test and set up
EF2	Pilot Indicator Light	Go/No-go indication of pilot output
EF3	Stereo Indicator Light	Go/No-go indication of stereo operating mode
EF4	Function Switch	Top – $(L + R_I)$ Set up position indicating the relative level of left and right channel audio drive. Note: the meters are not to be used as an indication of modulation. Bottom – $(L + R_Q)$ indicates L + R and L – R audio drive levels
EF5	Night Indicator Light	Go/No-go indication of night operating mode
EF6	+ Limit	*Audio drive level limiting adjustment
EF7	– Limit	*Audio drive level limiting adjustment
EF8	L+R Adj	Sets output level of L + R signal fed to modulation input of station transmitter
EF9	Mono/Stereo Switch	Selects between mono and stereo mode
EF10	Stereo Pilot Switch	On-Off carrier pilot switch
EF11	L + R Envelope Switch	Momentary push on type of switch to test if drive to the $L + R_I$ envelope is present
EF12	Night Day Switch	Changes equalization for use with another transmitter or antenna. Works in parallel with remote switch on back. Optional control used only if exciter is equipped with the night equalization feature.
EF13	Balance	Allows slight amplitude adjustment between left and right inputs.

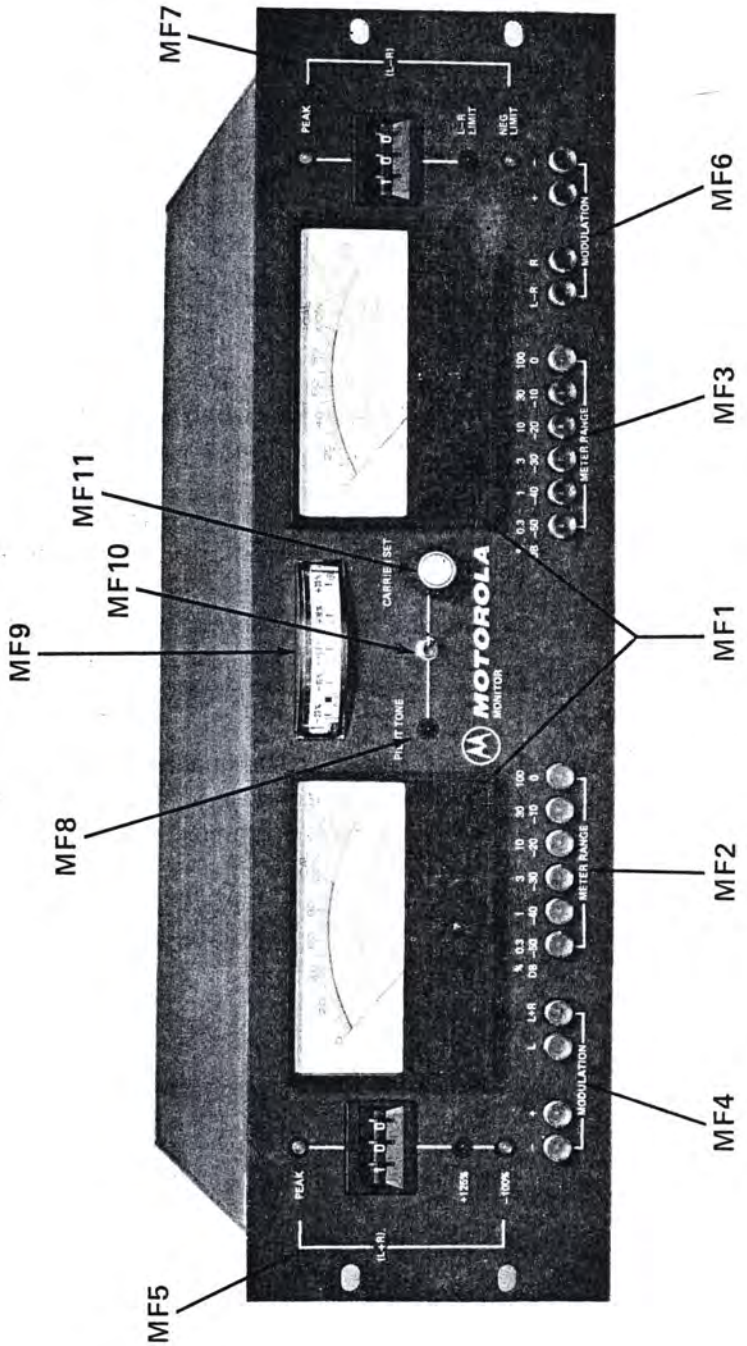
*Misadjustment will reduce stereo separation.



EXCITER REAR VIEW

EXCITER REAR PANEL OUTPUTS

REF	DESCRIPTION	FUNCTION
ER1	Unmodulated Carrier	Sync from encoder to evaluate amount of phase modulation of master carrier frequency.
ER2	Exciter Output	Square wave output to AM transmitter for high power drive (0.5 to 5.0 watts in steps). This signal is the phase modulated substitute for the transmitters oscillator.
ER3	Sample Transmitter Output	Composite output for test of exciter to modulator.
ER4	Remote Night Day Switch	Works in parallel with front panel switch for changing equalization when using another transmitter or antenna. (See exciter front panel controls.)
ER5	Audio Input	Left and right 600 Ω balanced audio input 0 dBm to 10 dBm (determined at time of installation).
ER6	R + L Output (Envelope Modulation)	Balanced output from L + R amplifier to station transmitter (normal AM modulation input). Adjusted by L + R Adj. front panel control, +16 dBm maximum.
ER7	TTL Output	Phase modulated signal which is acceptable for TTL compatible transmitters. Substitutes for normal oscillator of station transmitter.



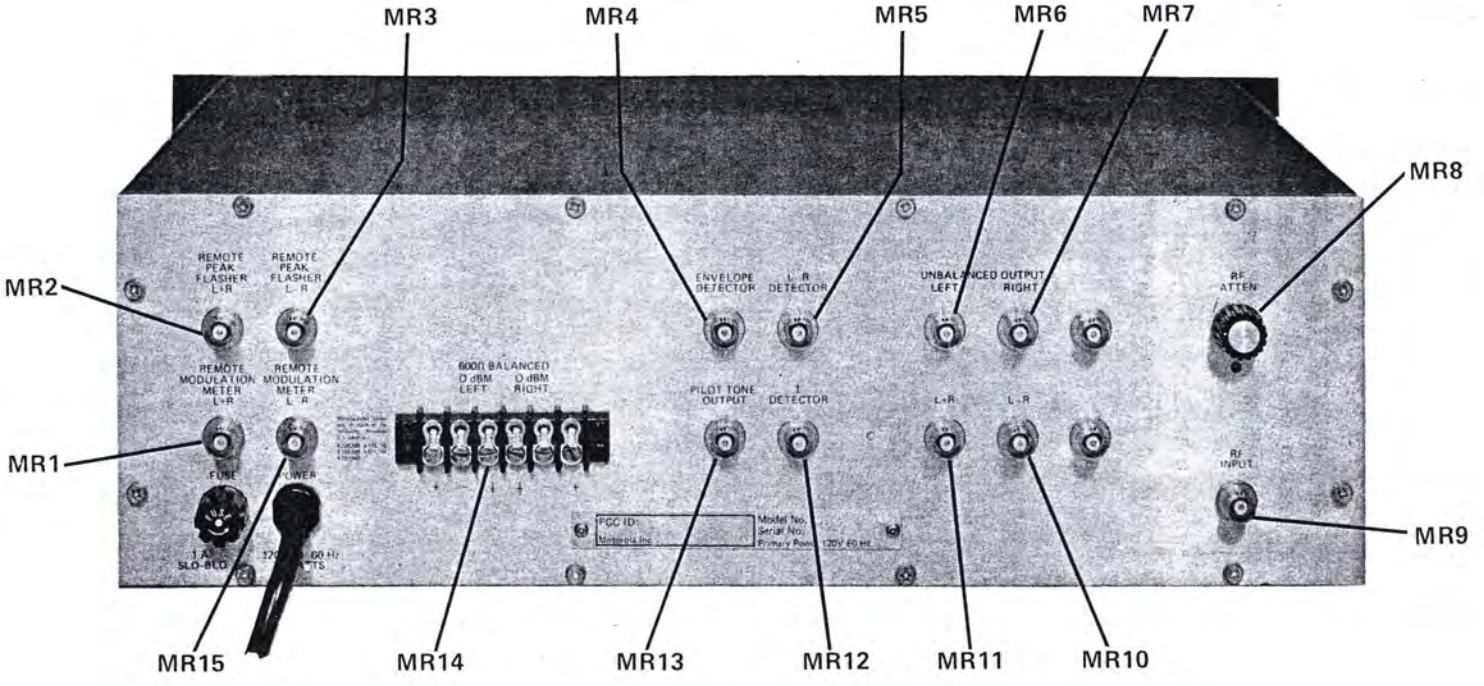
MONITOR FRONT VIEW

MONITOR
FRONT PANEL CONTROLS

REF	DESCRIPTION	FUNCTION
MF1	Meters	Modulation meters for test and set up.
MF2	Meter Range Switches	Left channel meter range selection switches.
MF3	Meter Range Switches	Right channel meter range selection switches.
MF4	Left Channel Modulation Function Switch	Switches peak flasher (MF5) and left meter between (L + R), (L), (+) or (–) functions.
MF5	(L + R) Flashers and Controls	The yellow (L + R) peak flasher modulation range is set via the front thumb wheel switch. Its function depends on the modulation switch setting (MF4). The monaural red (–100%) envelope and green (+125%) envelope limits have no external settings and are both fixed factory adjustments. Peak amplitude can be accurately determined by increasing the reading on the thumb wheel until the light goes out. The number on the thumb wheel will be the peak modulation.
MF6	Right Channel Modulation Function Switch	Switches peak flasher (MF7) and right meter between (L – R), (R), (+) or (–) functions.
MF7	(L – R) Flashers and Controls	The yellow (L – R) peak flasher modulation range is set via the front thumb wheel switch. Its function depends on the modulation switch setting (MF6). The red (L – R limit) and green (neg limit) have no external setting and are both fixed factory adjustments. The (L – R limit) is equivalent of a 100% phase modulation signal. The (neg limit) indicates that the L – R component is overmodulating the combined modulation envelope. Peak amplitude can be accurately determined by increasing the reading on the thumb wheel until the light goes out. The number on the thumb wheel will be the peak modulation.
MF8	Pilot Tone Indicator	Indicates presence of 25 Hz pilot tone.
MF9	Carrier Level Meter	Establishes a carrier reference level necessary to insure that the circuits driving the modulation meters are affected only by modulation changes. The carrier level meter indicates the average RF signal level input to the monitor decoder circuits. The RF signal input is set to a level (indicated on the meter and determined by the manufacturer) by means of the carrier set control (MF11). As long as the carrier level indication is within the range of the meter (± 20% change of RF level), the modulation circuits will be within their design accuracy.

MONITOR
FRONT PANEL CONTROLS (Continued)

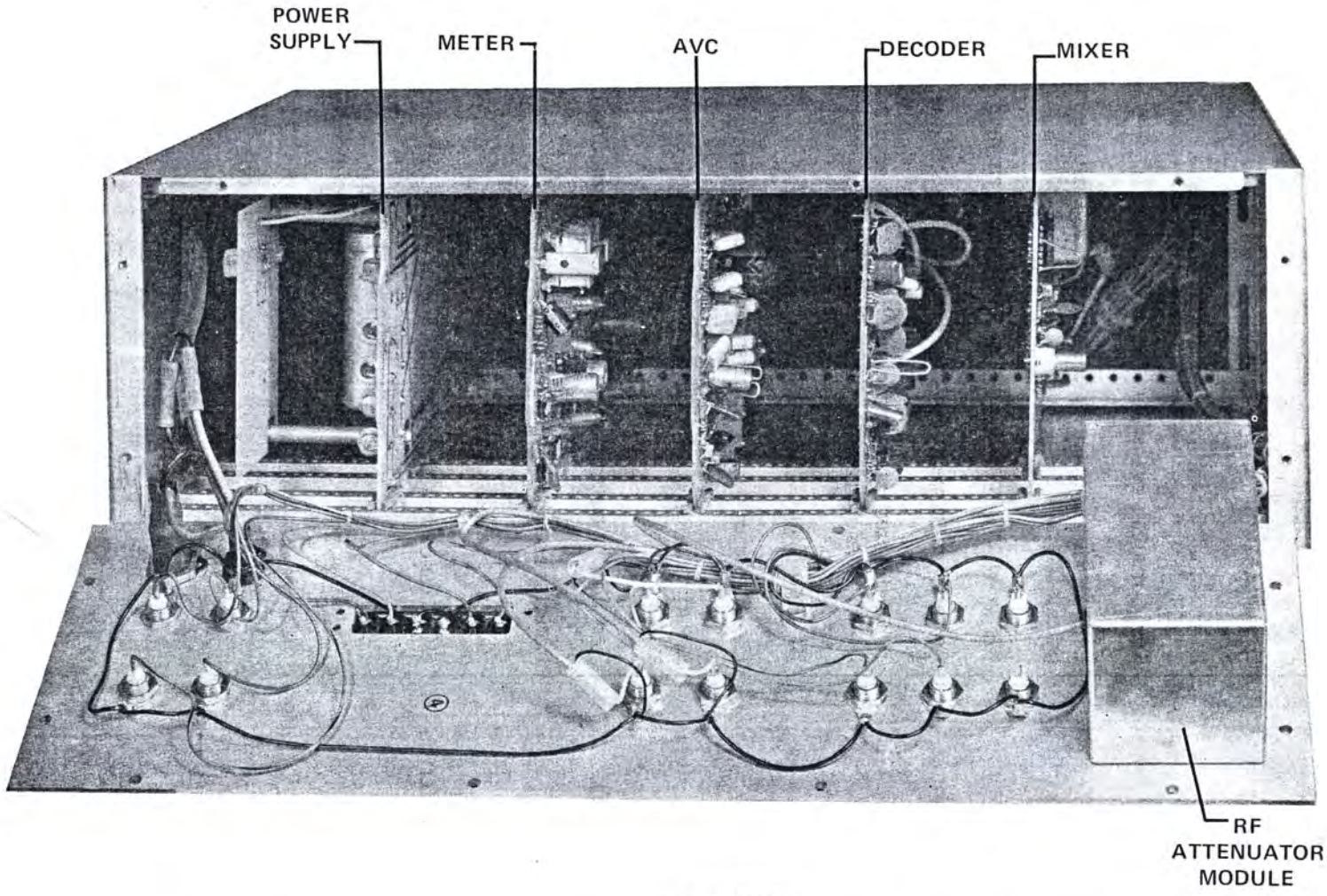
REF	DESCRIPTION	FUNCTION
MF10	Switch	Two position calibration meter function switch. In the pilot tone position, the carrier meter must indicate in the black square (pilot) position. This is a fixed factory adjustment which does not have an external setting. In the carrier set position, the meter must indicate in the center on (set). The set position can be adjusted with the (carrier set) and rear panel (RF attenuator) controls.
MF11	Carrier Set Control	Vernier control which operates in conjunction with the 60 dB RF step attentuator on the back panel.



MONITOR REAR VIEW

MONITOR
REAR PANEL OUTPUTS

REF	DESCRIPTION	FUNCTION
MR1	Remote Modulation Meter L + R	DC drive current for remote panel meter operation
MR2	Remote Peak Flasher L + R	Drive signal for remote operation of flasher
MF3	Remote Peak Flasher L – R	Drive signal for remote operation of flasher
MF4	Envelope Detector	Test output to evaluate monitor decoder
MR5	L – R Detector	L – R (quad) detector test output to evaluate monitor decoder
MR6	Unbalanced Output Left	For distortion measurements of left audio channel
MR7	Unbalanced Output Right	For distortion measurements of right audio channel
MF8	RF Atten	A 60 dB step attenuator in 10 dB steps used with the front panel carrier set control to calibrate the monitor
MR9	RF Input	RF input from transmitter link
MR10	L – R	L – R output for transmitter testing of stereo signal
MR11	L + R	L + R (mono) output for transmitter testing of monaural signal
MR12	In Phase Detector (I Det)	Test output to evaluate monitor decoder operation.
MF13	Pilot Tone Output	Counter connection for measurement of pilot frequency
MR14	600 Ω Balanced	Balanced 600 ohm audio output
MR15	Remote Modulation Meter L – R	DC drive current for remote panel meter operation



– CAUTION –

REINSERT CARDS ORIENTATED IN THE SAME POSITION AS THEY WERE REMOVED.

MONITOR CIRCUIT CARD LOCATION

MONITOR
BASIC CIRCUIT CARD FUNCTIONS

POWER SUPPLY: The power supply operates from a 110V AC source and is protected with a 2 amp fuse. It provides (+5), (−15), and (+15) volt DC outputs, and the 28 volts for the modulation meter lamps.

METER: This circuit card contains the audio amplifiers and peak detectors which drive the DC meters. Additionally, it provides the circuitry to drive both right and left yellow peak flashers operating in conjunction with the front panel mounted thumb wheels. It also provides the audio matrix of balanced and unbalanced outputs to the rear cabinet ports. Pilot reject filters are included on this circuit card which eliminate the 25 Hz pilot tone from the meters when making measurements of the left or right channel.

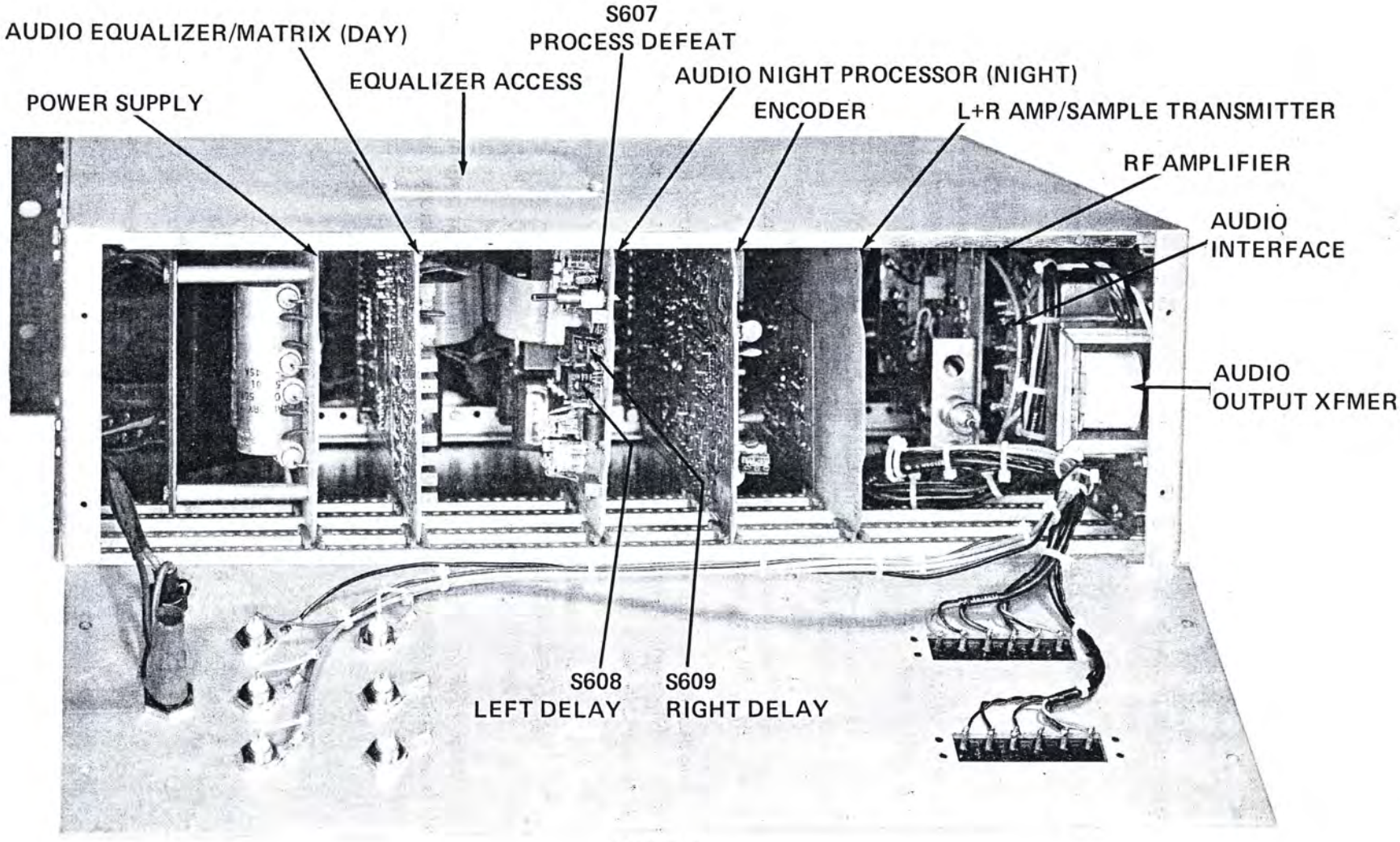
AVC: The AVC circuit card controls the audio signal level allowing the audio signal to be used as an instantaneous indication of the modulation level. This card also contains the carrier level detector and carrier meter drive circuitry, along with the pilot detector and meter drive circuits. With the exception of the two yellow peak flashers, the five remaining flasher drivers are on the AVC panel:

1) +125% envelope limit
2) −100% envelope
3) L − R limit (measures recovered audio)
4) Neg limit (combined overmodulation indicator)
5) Pilot tone indicator

DECODER: The decoder receives 450 KHz from the mixer circuit card, then detects and separates the envelope and $(L - R)_Q$ signals which are sent to the AVC card. For test purposes it provides three detected outputs to rear cabinet ports:

1) Envelope detector output
2) In-phase detector
3) L − R quadrature detector

MIXER: The station RF signal is coupled to this panel via a link or antenna. It has a wide band front end which is switch programmed to the station frequency at the factory.



– CAUTION –

REINSERT CARDS ORIENTATED IN THE SAME POSITION AS THEY WERE REMOVED.

EXCITER CIRCUIT CARD LOCATION

EXCITER BASIC CIRCUIT CARD FUNCTIONS

Power Supply

The POWER SUPPLY operates from a 117V AC, 60 Hz source and is protected with a 1.5 amp fuse. It provides (+5), (−15), and (+15) volt DC regulated outputs and −24V DC unregulated for the meter lamps and front panel LED's.

Audio-Equalization, Matrix (Day Card)

This unit receives the LEFT and RIGHT audio inputs and passes these signals through the HIGH and LOW FREQUENCY EQUALIZATION sections, compensating for signal path differences in various transmitters. The signals then pass to the audio matrix circuitry that produces the L+R and L−R,I and Q signals. + and − limiting of these signals is provided and finally this unit drives the front panel meters that display the relative audio drive levels.

Audio, Night, Processor (Night Card)

This unit, when the FRONT PANEL SWITCH is in the NIGHT position receives the LEFT, and RIGHT audio inputs and passes these signals through the HIGH and LOW FREQUENCY EQUALIZATION sections, compensating for signal path differences in the NIGHT transmitter. LEFT and RIGHT audio signal DELAY from 0 to 15 microseconds is also provided to compensate for both the DAY and NIGHT transmitter signal path delay differences.

A PROCESSOR circuit to prevent single channel (LEFT or RIGHT audio signals only) operation causing undesirable transmitter problems is located on this unit.

Encoder

The encoder generates the primary frequency of the station. It causes the carrier to be modulated with two "Q" signals $(R + L)_Q$ and $(R - L)_Q$ 90^o out of phase. Limiters are provided to eliminate AM modulation. The source for the pilot frequency is located on this card.

L+R Amplifier/Sample Transmitter

The L+R amplifier located on this circuit card generates an output which drives the envelope modulation of the normal station transmission. It also originates a sample C-Quam transmitter signal which simulates the full transmitted stereo for the purpose of checking the monitor receiver.

RF Amplifier

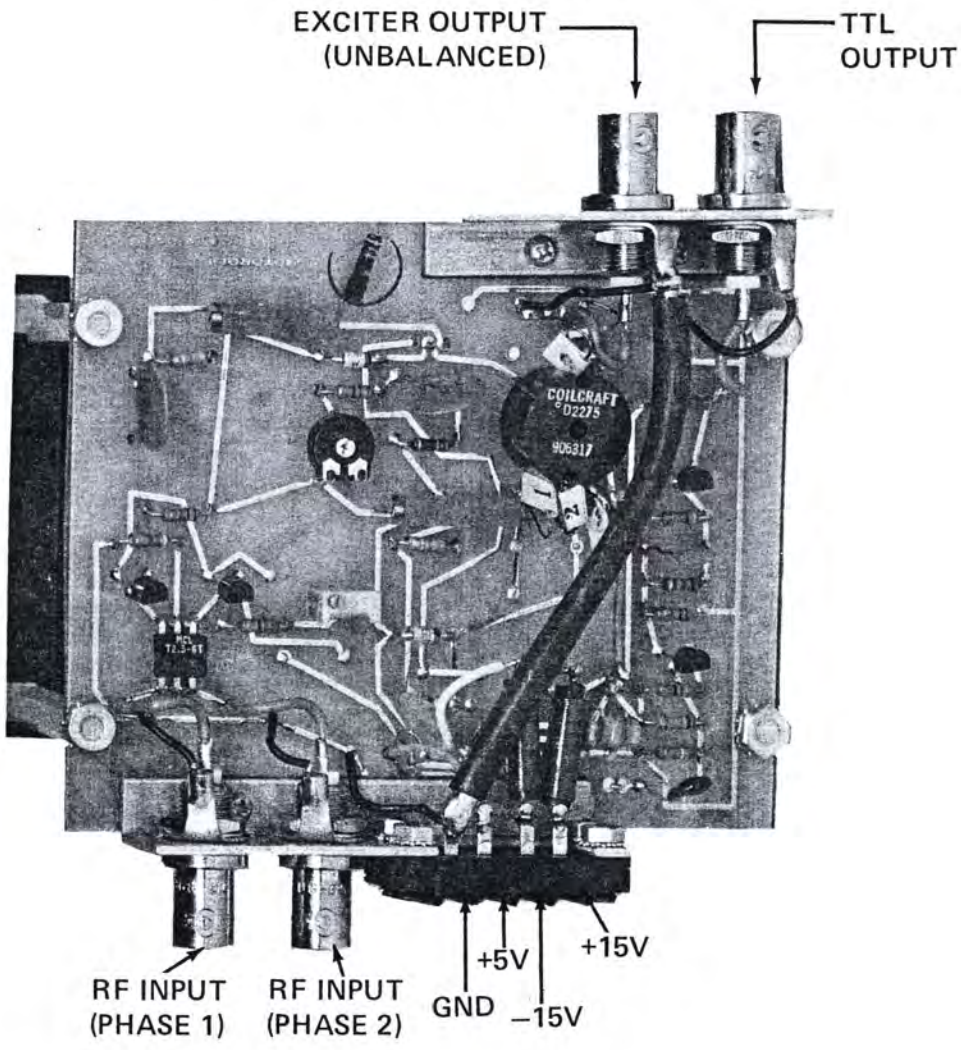
The RF amplifier produces a variable high power phase modulated output and a TTL level output which replaced the transmitter master oscillator.

Bulk Delay Card (Not Shown)

This unit supplements the LEFT and RIGHT audio signal DELAY of the AUDIO, NIGHT, PROCESSOR (NIGHT CARD) by providing four 8 microsecond delay sections for a total of 32 microseconds of additional delay. This unit is only added into the EXCITER when required.

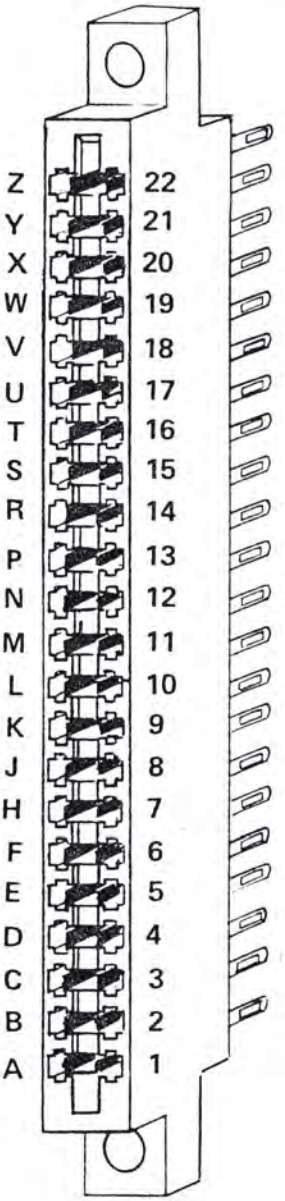
Audio Interface Card

This circuit card mounted on the left side of the EXCITER provides the interconnections for the two 600 ohm attenuator pads that reduce the station's LEFT and RIGHT input audio (typically +10 dBm level for 100% modulation) by 16 dB before the signals reach the balanced input TRANSFORMERS. Provisions for a RF trap filter to be added to the LEFT and RIGHT audio input lines are provided when required. The $(L+R)_I$ audio signal output transformer is also interconnected on this card.



EXCITER RF AMPLIFIER CIRCUIT CARD
CONNECTOR AND TERMINAL STRIP IDENTIFICATION

MONITOR CIRCUIT CARDS
EDGE CONNECTOR PIN IDENTIFICATION



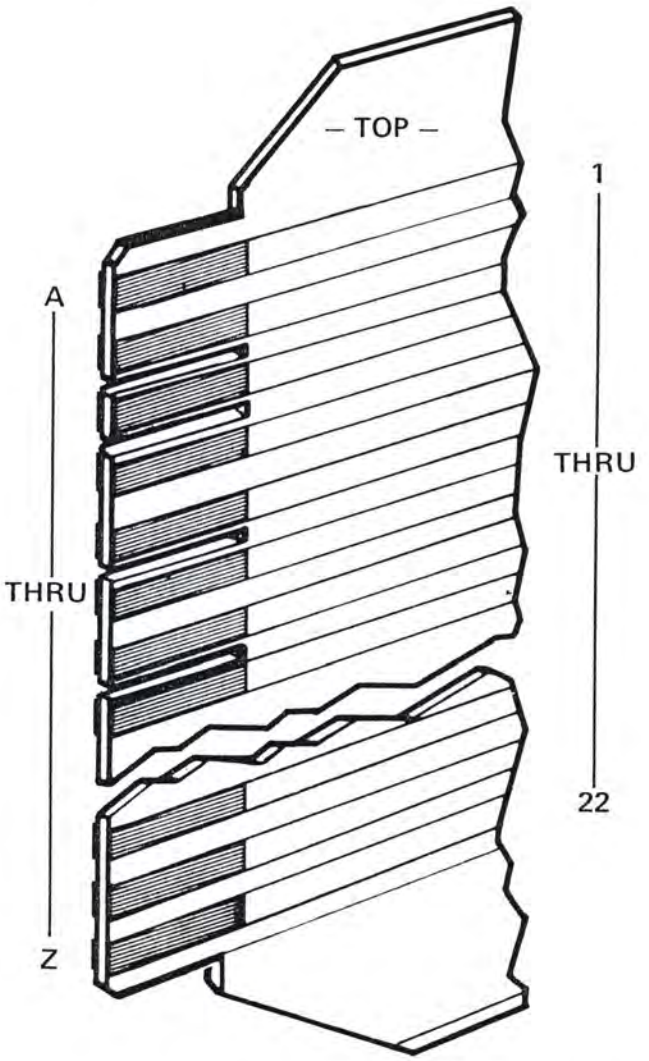
The monitor circuit card has 22 connections on each side of the card. When viewed from the rear, numerical contacts 1 through 22 are always on the right, and alpha contacts A through Z are always on the left as shown above.

NOTE: The card pin outs are keyed to the socket.

– CAUTION –

Be sure to reinsert cards oriented in the same position as they were removed.

EXCITER CIRCUIT CARDS
EDGE CONNECTOR PIN IDENTIFICATION



The exciter circuit card has 22 connections on each side of the card. When viewed as shown above, the alphabetical pin outs are always on the left and the numerical are on the right.

– CAUTION –

Be sure to reinsert cards oriented in the same position as they were removed.

EXCITER ALIGNMENT

NOTE:

1. All adjustments are at 1 kHz unless specified otherwise.
2. All adjustments are without equalization. Set the following switches on the (L+R Amplifier/ Sample Transmitter) as indicated.

   S301 and S304 switch lever up.
   S302 and S306 switch lever down.
   S303 and S305 switch lever to rear.
3. Reset switches after alignment.

AUDIO EQUALIZATION MATRIX CIRCUIT CARD (E2)
– DAY CARD –

NOTE 4: Set all equalization switches on both day and night cards to the out position. The process defeat switch S607 to defeat, and delay switches S608, S609 to zero. Turn both + limit and – limit controls full CCW.

STEP	INPUT SETTING	ADJUST	OUTPUT	FUNCTION BEING CHECKED/REMARKS	TEST EQUIP.
1	Set Front Panel Night/Day Switch to Day Position				
2	L+R at Station Specification for 100% Modulation +10 dBm Typical	Front Panel Balance R783	Day Card TP1 and TP2 for Equal Level (–8 dBm Typical)	Left and Right Audio Input Balance ± 0.1 dB	DVM, Oscilloscope and/or Distortion Analyzer
3	L–R at 100% Modulation	R320	Null at TP5	$(L+R)_Q$ Matrix Null	DVM, Oscilloscope and/or Distortion Analyzer
4	L+R at 100% Modulation	R322	600 mV PP at TP5	$(L+R)_Q$ Signal Level	DVM, Oscilloscope and/or Distortion Analyzer
4A*	See Below				
5	L+R at 100% Modulation	R334	Null at TP6	$(L-R)_Q$ Matrix Null	DVM, Oscilloscope and/or Distortion Analyzer
6	L–R at 100% Modulation	R337	600 mV PP at TP6	$(L-R)_Q$ Signal Level	DVM, Oscilloscope and/or Distortion Analyzer
6A*	See Below				
7	L–R at 100% Modulation	R342	Null at TP7	$(L+R)_I$ Matrix Null	DVM, Oscilloscope and/or Distortion Analyzer
8	L+R at 100% Modulation	R344	600 mV PP at TP7	$(L+R)_I$ Signal Level Sample Transmitter	DVM Oscilloscope and/or Distortion Analyzer
8A*	See Below				
9	L+R at 100% Modulation	R378	1200 mV PP at TP8	$(L+R)_I$ Signal Level L+R Amplifier	DVM, Oscilloscope and/or Distortion Analyzer
9A*	See Below				
10	L+R at 100% Modulation Front Panel Meter Switch L+R/L–R Position	R351 Meter Switch in L+R/L–R Position	100% Indication on L+R Front Panel Meter	Meter Calibration	
11	L–R at 100% Modulation Front Panel Meter Switch L+R/L–R Position	R359 Meter Switch in L+R/L–R Position	100% Indication on L–R Front	Meter Calibration	
12	If your exciter contains both night/day cards proceed to Step 1 of Audio Night Processor Alignment. If not, complete Steps 5 and 6 only.				
*	+ Limit Control 100% Modulation	R781	Check for + Limiter Function as Control is Turned CW	+ Limit Function, after Test Return to Fully CCW Position	DVM, Oscilloscope and/or Distortion Analyzer
	– Limit Control 100% Modulation	R782	Check for – Limiter Function as Control is Turned CW	– Limit Function, after Test Return to Fully CCW Position	DVM, Oscilloscope and/or Distortion Analyzer

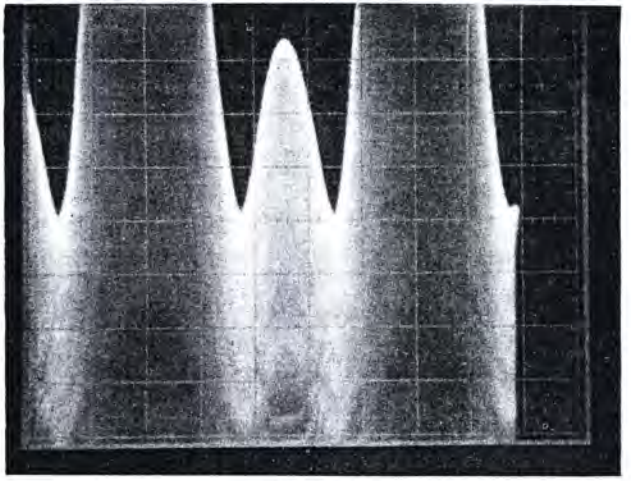


Figure 1.

AUDIO NIGHT PROCESSOR CIRCUIT CARD (E6)
– NIGHT CARD –

NOTE 5: Prior to this procedure the audio equalization matrix circuit card must be aligned and the switches set as indicated in Note 4 above.

STEP	INPUT SETTING	ADJUST	OUTPUT	FUNCTION BEING CHECKED/REMARKS	TEST EQUIP.
1	L 100% Modulation	Adjust R619 from Day to Night Back & Forth Until Levels are Identical ± 0.1 dB	Day Card TP5 Approx. 300 mV PP	Sets Identical Level for Left Q Channel on Day and Night Cards	DVM, Oscilloscope and/or Distortion Analyzer
2	R 100% Modulation	R622 – Same Procedure	Day Card TP5 Approx. 300 mV PP	Sets Identical Level for Right Q Channel on Day and Night Cards	DVM, Oscilloscope and/or Distortion Analyzer
3	L 100% Modulation	R611 – Same Procedure	Day Card TP7 Approx. 300 mV PP	Sets Identical Level for Left I Channel on Day and Night Cards	DVM, Oscilloscope and/or Distortion Analyzer
4	R 100% Modulation	R625 – Same Procedure	Day Card TP7 Approx. 300 mV PP	Sets Identical Level for Right I Channel on Day and Night Cards	DVM, Oscilloscope and/or Distortion Analyzer
5	Front Panel Meter Switch L+R/L–R Position. R655 Fully CW. R662 Fully CCW. S607 to On Position (Handle Towards Connector End of Card).				
6	L Only Input – Adjust Level for 65% Modulation on Both Meters	R655	CCW Until Right Meter Just Starts to Drop Below 65% Modulation Point	Processor Function	

ENCODER CIRCUIT CARD (E1)

STEP	INPUT SETTING	ADJUST	OUTPUT	FUNCTION BEING CHECKED/REMARKS	TEST EQUIP.
1	None*	C151	Sample Transmitter Port	Sets Carrier Frequency	Digital Counter
2	Remove AC Power Plug From Source and Remove IC U102 From Its Socket				
3	None**	R135 and R205	Minimum RF at TP110		Oscilloscope
4	Remove AC Power Plug From Source and Insert IC U102 Back in Its Socket				
5	L+R at Station Specification for 100% Modulation	R123	Closure at TP110	Should Track Output at Sample Transmitter J901	Oscilloscope
6	L or R at 10 kHz	T101 and T102	Maximum at TP110 and Symmetry of Depth of Trough (See Figure 1)	Assures Proper Quam Bandwidth	Oscilloscope
7	L+R at 100% Modulation	R158	4.0V PP at TP110		Oscilloscope
8	L+R and L–R at 100% Modulation	R129 (L+R) and R200 (L–R)	Sideband Amplitude at TP110, Repeat until L+R Spectrum = L–R Spectrum	Sets Defined System Performance for C-Quam	Spectrum Analyzer
9	L+R at 105% Modulation	R782 – Limit Front Panel	Until Audio Becomes Fuzzy at Pin 8, U105 (See Figure 2)	Sync Scope on TP102	Oscilloscope
10	L+R at 105% Modulation	R155 and R205	Center Incidental Phase at Pin 8, U105 (See Figure 3)	Sync Scope on TP102, Reduces Incidental Phase to Minimum	Oscilloscope
11	L+R at 125% Modulation	R782 – Limit Front Panel	Until Phase Noise is Minimum at Pin 8, U105	Sync Scope on TP102	Oscilloscope
12	L+R at 125% Modulation		Check for 95% or Greater Modulation in Trough at TP110		Oscilloscope

* Front panel stereo/mono switch in mono position.

** Front panel stereo/mono switch in stereo position, 0% modulation (no audio signal).

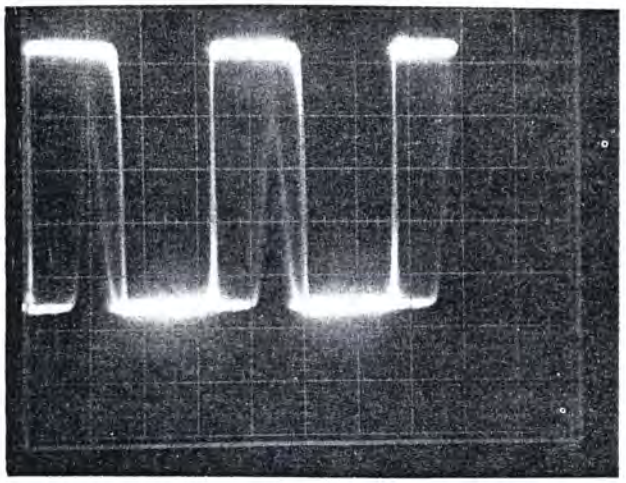


Figure 2.

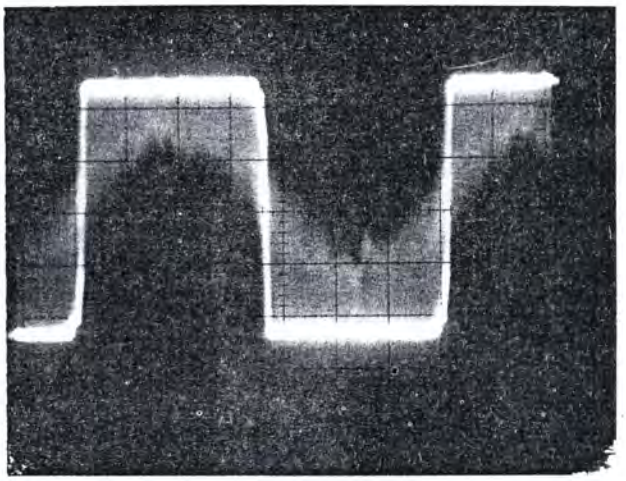


Figure 3.

L+R AMPLIFIER/SAMPLE TRANSMITTER CIRCUIT CARD (E3)

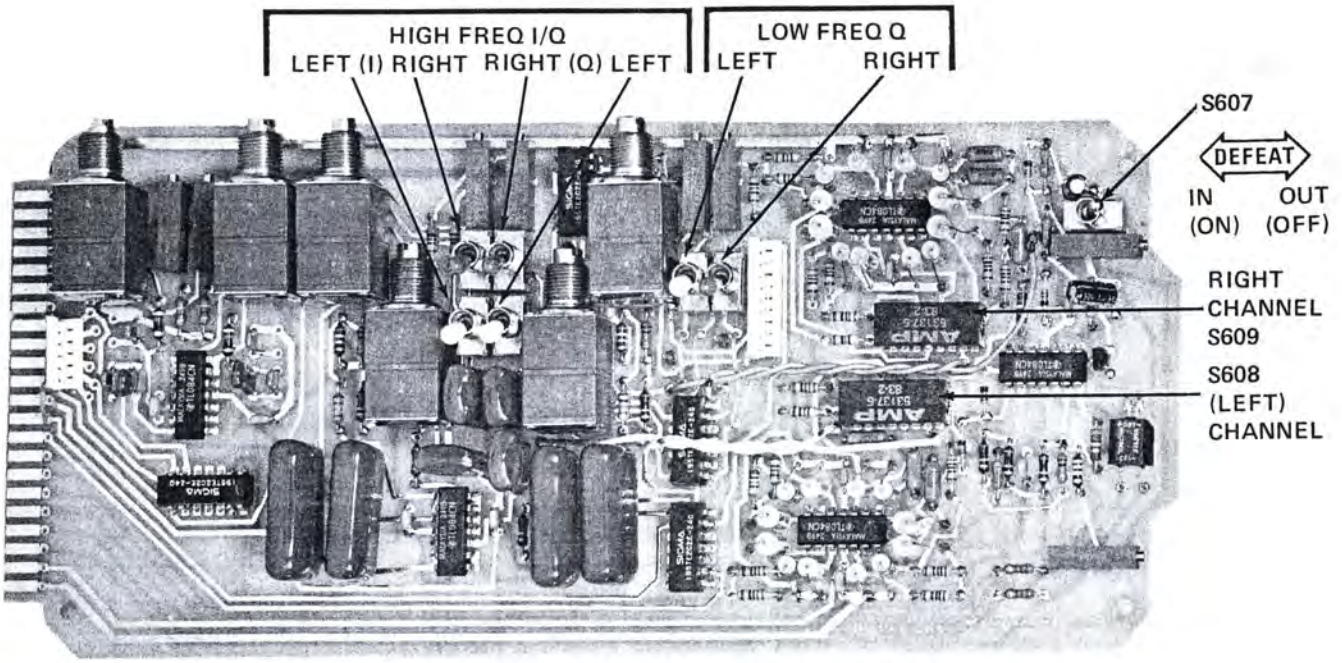
STEP	INPUT SETTING	ADJUST	OUTPUT	FUNCTION BEING CHECKED/REMARKS	TEST EQUIP.
1	L+R Station Specification for 100% Modulation	R902	Closure at J901	Should Track with TP110	Oscilloscope
2	L+R Station Specification for 100% Modulation at 40 kHz	T901, T902 and C913	Maximum Output and Symetry of Sidebands at J901	The RF Sine Wave Should Be Clean	Spectrum Analyzer
3	L+R Station Specification for 100% Modulation	R938	4.0V PP at J901		
4	L+R Station Specification for 100% Modulation	L+R Adj (Front Panel)	Per Stations Specified Output at R+L Rear Terminal Strip with 600 Ω Load.	Test of tht L+R Amplifier	DVM

RF AMPLIFIER CIRCUIT CARD (E5)

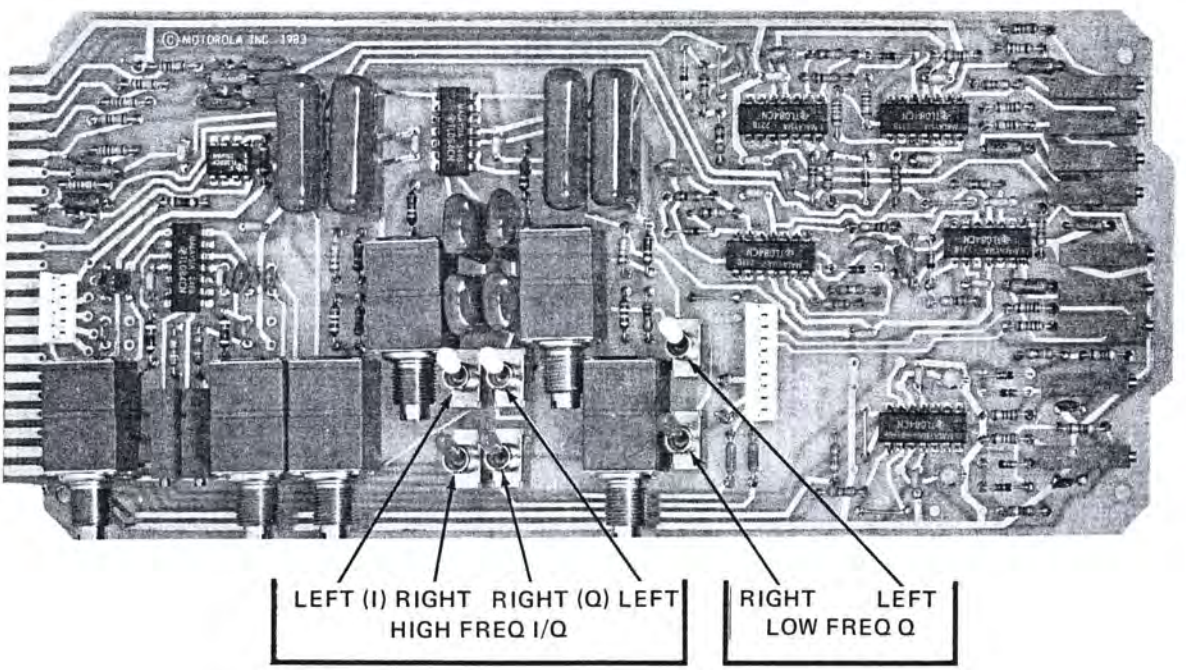
STEP	INPUT SETTING	ADJUST	OUTPUT	FUNCTION BEING CHECKED/REMARKS	TEST EQUIP.
1	Set R518 and R250 Fully CW Before AC is Applied				
2	Remove Input Drive, (2) BNC Connectors From RF Amplifier				
3	None	R518 and R520 Fully CCW	Add 10mA Total Current on +15V Input Lead (5mA With Each Control)	Insures Drive Over Ambient Temperature Range	Clip-On DC Milliammeter
4	Replace (2) BNC Connectors on RF Amplifier				
5	Normal Encoder Drive	R508	Symetry at J503 with a 50 Ω Load	Slight Correction Only	Oscilloscope
6	Normal Encoder Drive	R502	Maximum Rise Time With Minimum Ringing at J503	Will Vary with Zener Voltage. Note Zener Value Selected per Station Requirement	Oscilloscope
7	Normal Encoder Drive	R502 and R508	Best Symetry and Minimum Ringing at TTL Output	Sets TTL Output (If Required)	Oscilloscope

EXCITER ALIGNMENT SWITCH LOCATION

ALL SWITCHES SHOWN IN (OUT) POSITION



AUDIO NIGHT PROCESSOR CIRCUIT CARD



ALL SWITCHES SHOWN IN (OUT) POSITION

AUDIO EQUALIZATION MATRIX CIRCUIT CARD

MONITOR ADJUSTMENT AND ALIGNMENT

DESCRIPTION OF SYSTEM OPERATION

The sample transmitter output of the exciter is attentuated, then down converted to 450 kHz. The IF signal is decoded as two channels of audio. The envelope (L+R) and the quadrature (L−R) channels are the input to an AVC (automatic volume control) circuit. This circuit regulates the audio amplitude so as to be in direct proportion to the modulation level, regardless of the RF level.

The regulated envelope and quadrature signal are matrixed to produce the left and right audio signals.

Two peak detectors with LED indicators monitor the envelope audio. One indicates −100% envelope modulation, and the other indicates +125% envelope modulation. An additional detector and indicator monitors the quadrature audio for the "L−R limit" condition. The envelope audio and quadrature audio are simultaneously monitored for the "negative limit" condition.

A set of pushbutton switches allow the left meter circuit to be driven by one of the following: + (L+R) audio, − (L+R) audio, +L audio, and −L audio. A peak indicator light circuit receives the same signal as sent to the meter circuit. The LED indicator is labeled "peak." A thumbwheel dial determines the percent of modulation at which this indicator will fire.

A pushbutton attenuator with a 50 dB range is provided for each meter.

The pilot signal, which is a part of the quadrature audio, is separated by a selective amplifier and is routed to a rear panel port. It is also detected by a PLL type detector circuit which turns on a pilot indicator. An average value detector circuit enables the pilot level to be indicated at a front panel meter.

The envelope audio is routed to an average value detector, which enables the carrier level to be indicated at a front panel meter. This same meter is shared by the pilot level circuits, and the meter inputs are selected by a front panel toggle switch.

The L, R, L+R (envelope), and L−R (quadrature) signals are available at ports on the rear panel. The L and R signals are derived from the L+R and L−R signals by means of a matrix circuit that is separate from that used to derive the meter circuit inputs.

See Drawing FD-M20 for an overall functional diagram of the system.

LOCATION OF CIRCUITS FOR SPECIFIC FUNCTIONS

RF attenuator: A step attenuator is located on the back panel, and an attenuator pot is located on the front panel.

Frequency conversion, station frequency to IF: M17 panel.

Decoding, IF to envelope and quadrature audio signals: M16 panel.

Pilot Detection and Metering: M10 panel.

Audio matrixing, L and R outputs to rear panel: M11 panel.

Carrier level circuits: M10

−100% Mod. Indicator Circuit: M10

+125% Mod. Indicator Circuits: M10

L−R Limit Indicator: M10

Negative Limit Indicator: M10

Both Peak Indicators: M11

Right and Left Meter Circuits: M11

Pilot Rejection Circuits, for metering: M11

INDICATOR AND METER CIRCUIT ADJUSTMENTS

Initial calibration and adjustment of the meter circuits and the indicator circuits, require the M10 and M11 panels only. The M16 and M17 panels should be pulled loose from their sockets.

A bias supply, a 680 ohm resistor, a 1000 uF coupling capacitor, an audio oscillator, and an oscilloscope should be connected per Figure 1. The bias supply is set to −1 volt, and input through the resistor to the envelope detector port on the back panel. The 1000 uF capacitor provides DC isolation so that a 1000 Hz audio signal may be input to the same port. The adjustments also require audio input into the L−R detector port.

All trimpots on both M10 and M11 panels should be set to center travel before beginning the alignment procedure. Card extenders will be necessary to get access to the adjustments.

BNC to terminal post adapters would be useful to set up the circuit connections called for in Figure 1.

AVC ADJUSTMENT (M10 PANEL)

Connect the test circuit called for in Figure 1. Locate the components by referring to the circuit card layouts in the service manual.

1. The bias supply and audio generator should be off. S101 is set open. Observe U104 pin 8 for DC voltage. Adjust L+R zero (R135) to obtain 0 volts DC.
2. With bias supply off and the generator off, and S101 closed, observe U104 pin 8 for DC voltage. Adjust L+R null (R133) to obtain 0 volts DC.

3. Repeat 1 and 2 to overcome interaction effects.
4. With the bias supply and the audio generator off, and S101 open, observe U106 pin 1 for DC voltage. Adjust L—R zero (R134) to obtain 0 volts DC.
5. With the bias supply and the audio generator off, and S101 closed, observe U106 pin 1 for DC voltage. Adjust L—R null (R132) to obtain 0 volts DC.
6. Repeat 4 and 5 to overcome interaction effects.
7. With the bias supply on, the audio generator off, observe U105 pin 8 (offset amp). Adjust R252 (L+R +/— Balance) for 0 volts DC.
8. Adjust R246 such that the DC voltage at S101 center lead is —4 volts.

CARRIER CIRCUIT ADJUSTMENT (M10 PANEL)

S806 is the toggle switch on the front panel. It selects the input (DC) to the center meter (M803). With the handle to the right, the meter will indicate carrier level.

1. Set S806 to read carrier level. Set bias supply at —1 volts and the audio generator off. Observe meter M803 and adjust R245 (carrier set). The meter is adjusted to read at the center mark.
2. Set the bias supply at —1.2 volts. The audio generator is off. Observe meter M803. Adjust R260 (carrier gain) to get an indication of +20% on meter M803.
3. Return bias supply to —1 volts.

FRONT PANEL METER ADJUSTMENT

1. **Left Meter**

The left meter is able to monitor 4 signals through push button selection. These are L+R, —(L+R), L, and —L. Set the push buttons to monitor L+R.

Turn the bias supply on and set to —1 volts (see Figure 1). Turn the audio generator on at an amplitude of 2 volts peak to peak. The oscilloscope monitoring the envelope detector port, should be in the DC mode. The positive loops of the observed signal should be just touching the 0 volt line. Adjust the audio generator to obtain this condition. See Figure 2.

Observe the left meter M801. Adjust R817 such that M801 reads 100%. R817 is located on the left push button panel (M13). See Drawing FD-M20 for the electrical function of R817. It is located near S801 on the drawing.

Now that the left meter has been adjusted, it will be used to set the amplitude of the audio generator (see Figure 1) in many of the steps that follow.

For the adjustments that follow, the bias supply will be on and at −1 volts. The audio generator will be on and adjusted per the readings on the left meter (M801). Refer to Figure 1 for the connections.

2. **L+R Channel vs L−R Channel Gains on the M10 Panel**

Set the audio generator such that M801 reads 100%. Observe U104 pin 8 with the oscilloscope, and note the amplitude. Observe U106 pin 1 and set R247 (L−R) for an equal amplitude.

3. **Right Meter**

The right meter is able to monitor four signals through push button selection. These are L−R, −(L−R), R, and −R. Set the push buttons to monitor L−R.

Set the audio generator to 100% as indicated by the left meter (M801). The bias supply is on. Adjust R818 such that the right meter (M802) reads 100%. R818 is mounted on the right push button panel (M12). See Drawing FD-M20 for the electrical function of R818.

INDICATOR LIGHT ADJUSTMENTS

1. **−100% Modulation Indicator**

The −100% modulation indicator should turn on as the audio generator output (Figure 1) is increased, and the left meter (M801) indicates 100% or greater. If this does not happen, observe the waveform at U104 pin 8. The oscilloscope display should be in DC display mode. When the left meter indicates 100%, the waveform at U104 pin 8 should be as shown in Figure 3. If the negative waveform loops do not touch the 0 volts line, then adjust R133 of panel M10 (L+R null). The waveform will be displaced vertically, and will change in amplitude. Adjust until the loops touch the 0 volt line as shown in Figure 3.

Readjust the left front meter per the method given under "front panel meter adjustments." Readjust the right front meter also.

2. **125% Modulation Indicator**

Adjust the audio generator until the left meter indicates 125%. Adjust R255 of panel M10 until the indicator turns on at this audio level.

With the multi-turn pots, it may be easier to adjust the audio level upward until the indicator first turns on, and note the meter indication. Adjust the trim pot, drop the audio level, and bring up again. Note the new meter indication where the indicator light turns on. Readjust the pot. Repeat this procedure until the indicator turns on at 125% as indicated by the left meter.

3. **L–R Limit Indicator**

Adjust the audio generator until the right meter indicates 100%. Adjust R256 of panel M10 until the indicator turns on at this level.

4. **Negative Limit Indicator**

Adjust the audio generator until both the left and right meters read 90%. Adjust R258 of panel M10 until the indicator turns on at this level.

5. **Left Peak Indicator**

The left peak indicator monitors the same signal as is switched to the left meter circuit. The percent of modulation at which the indicator will flash is set by the left thumbwheel dial. Set the dial to 100. Adjust the audio to read 100% on the left meter. Adjust R402 of panel M11 until the indicator turns on at this level.

6. **Right Peak Indicator**

The right peak indicator monitors the same signal as is switched to the right meter circuit. The percent of modulation at which the indicator will flash is set by the right thumbwheel dial. Set the dial to 100. Adjust the audio to read 100% on the right meter. Adjust R413 on panel M11 until the indicator turns on at this signal level.

7. **Pilot Level Meter**

Set the audio generator to a frequency of 25 Hz. The accuracy of the frequency should be within 1 Hz. The front panel toggle switch (S806) handle should be placed to the left. The right meter pushbuttons are set to read L–R on the 10% range. Set the audio generator amplitude such that the meter reads a modulation level of 5% or –26 dB. R259 of panel M10 should be adjusted to the center of its travel. Adjust R225 of panel M10 such that the center meter indicates within the wide mark at the left of the meter. If fine adjustment is required, R259 may be used.

8. **Pilot Presence Indicator**

The input conditions are the same as in 7. Pilot detection is accomplished by means of a PLL circuit. Adjustment is accomplished by tuning the VCO with R230 of the M10 panel. The pilot indicator light will flash at a decreasing rate as the VCO is tuned closer in frequency (25 Hz). It will remain on constantly when the VCO is on frequency. It is a good practice to tune on through the frequency, and return to locate the best setting of R230.

PILOT REJECTION CIRCUITS (METER CIRCUITS)

1. Left Pilot Rejection Circuit

The left pilot rejection circuit is tuned by R325 of panel M11. This circuit rejects the 25 Hz pilot from the meter circuit input when the push buttons are set for L or −L input. The input conditions are the same as described in the section 7 "Pilot Level Meter." However, the audio generator connection to the "L-R detector" port shown in Figure 1 should be removed. Null the indication on the left meter.

2. Right Pilot Rejection Circuits

The right pilot rejection circuit is tuned by R363 on panel M11. This circuit rejects the 25 Hz when the push buttons are set for a R or −R input. The input conditions are the same as described in the section 1 "Left Pilot Rejection Circuit." Null the indication on the right meter.

The circuits per Figure 1 should be disconnected at this time.

MIXER PANEL ADJUSTMENTS (M17)

The mixer panel provides down conversion from the station frequency to 450 kHz. A test signal should be input to the rear panel RF input port from the sample transmitter in the exciter unit.

The rear panel attenuator and the front panel attenuator pot should be set for a 100 millivolt peak to peak signal (unmodulated) at the edge connector contact 8 of panel M17.

1. L.O. Frequency

The L.O. frequency is derived by a PLL circuit programmed to the correct frequency by the setting of S701. S701 is an 8 section DIP switch whose sections are numbered 1 to 8 starting at the end toward the edge connector. The "1" condition of each switch is with the end toward U702 and U703 depressed. The switch section numbers are printed on the switch body. To tune the L.O. for a given station frequency, set the individual switch sections as listed in Table 1.

2. L.O. Tuning

Connect M17 through a card extender to its socket. Set switch S701 per Table 1. Check the local oscillator frequency (see Table 1) by sampling with a counter at U704 pins 14 or 15. Adjust the trim cap C710 to bring the L.O. to correct frequency.

3. **Coil Tuning**

Observe the waveform at Q704 emitter. Tune L701 and L703 for maximum amplitude of the observed signal.

The conversion gain through the mixer panel should be nominally 1.

DECODER PANEL ADJUSTMENT (M16)

Warning: A decoder panel first being placed in service should have R501 set at the middle of its travel.

The waveforms are most conveniently observed at an audio rate using the external sync mode. The external sync input of the scope would be connected to the source driving the exciter unit input.

Set the audio modulation frequency at 1000 Hz. The decoder panel is connected to its socket by a card extender.

1. **Envelope Detector**

A. **Coil Tuning**

An input signal from the mixer (450 kHz) should have a peak to peak amplitude of 100mV (unmodulated). This would be observed at contact W of the edge connector.

Tune L502 and L501 to maximize the waveform at R509 or R510.

B. **Limiter Adjustment**

Provide 75% envelope modulation at the exciter. Observe the waveform at U510 pin 6 and pin 7. See Figure 4. Adjust R505 such that the indentations at the top and the bottom of the waveforms are equal.

C. **900 kHz Trap at Envelope Detector**

L503 is tuned while observing the waveform at pin 6 or pin 12 of U505. Tuning is for minimum RF. Observe while synced to the modulation frequency. Use 75% envelope modulation.

D. **Envelope Detector Balance**

The envelope detector balance R503 is adjusted during the adjustment of the quadrature output, and is left at center adjustment at this time.

E. **Final Tuning of the Band Pass Coils**

L502 and L501 on the M16 panel should be final tuned using an audio meter attached to the L+R output port on the back panel. The exciter input should be 75% envelope modulation. The coils are adjusted for maximum output.

2. Quadrature Detector

Output from the quadrature detector (U509) requires the operation of two closed loop functions. One of the functions is the PLL (phase lock loop) circuit which locks on the 450 kHz IF signal. This PLL circuit provides the 450 kHz switching signal necessary to the operation of the quadrature detector (U509) and the inphase detector (U508).

A. PLL Loop Description

The switching signal is derived from a 3.6 MHz VCO which is counted down to 450 kHz by U513 and U512. The U512 Johnson Counter provides a 90 degree phase relation between the switching waveforms applied to the quadrature detector and the inphase detector. The quadrature detector acts as the phase detector of the PLL loop. One input is the IF signal (450 kHz) received from the "divider" circuit (U501 and U502) and the other input is the synchronous switching signal received from the VCO by means of the counters U512 and U513. Any variation of the phase between the signals results in a DC shift at the output of the phase detector at U504 pin 8. This DC shift is coupled through the PLL loop filter (U504 pin 14) to correct the VCO frequency by means of the varactor D503.

B. Corrector Loop Description

The "divider" circuit (U501 and U502) is so named because the IF input amplitude is divided by the amplitude of the voltage applied at pins 2 and 4 of U501, to produce the currents through R544 and R545 (pins 1 and 5 of U502). See Figure 5.

The basic action of the divider circuit is to modify the IF amplitude before it is applied to the inphase detector or the quadrature detector. When the corrector loop is closed and operating, the output of the inphase detector is made to match the output of the envelope detector. The output of the two detectors are compared by means of the comparitor consisting of U506, U507, Q511 and Q512. The comparitor output is conducted by means of Q510 to the control input (pins 2 and 4 of U501) of the divider.

The amplitude correction performed by the divider circuit enables the quadrature detector to recover the correct L−R audio.

C. "New" Panel Alignment

The steps that are described in this section apply to a new (replacement) panel and some steps may be unnecessary when just retuning a panel already in service.

D. PLL Operation

Before any adjustments of the corrector loop are possible, the PLL must be operating. Wrong settings of the envelope detector balance (R503), the quadrature balance (R504) or the control limiter pot (R501) can cause the PLL to fail to lock on frequency.

The most reliable indication that the PLL is operating and is locked on frequency is to test pin 14 of U504. Pin 14, U504 should be holding a constant voltage between 3 and 8 volts. There should be no ripple. A very obvious indication of lack of lock is to observe a running waveform, not synced to the modulation freq on the L-R output from the panel (M16 edge connector contact P).

The following steps may be necessary to bring the PLL into lock initially.

1. Adjust R501 (control limit pot) so that pin 2 and 4 of U501 is at −3 volts. The post in common with the emitter of Q510 provides a convenient test point. This insures that the divider circuit is passing IF signal to the quadrature detector.

2. Adjust R504 (quadrature detector balance) to reduce the beat frequency output of the quadrature detector until the PLL latches. Use an unmodulated signal.

E. Corrector Loop Operation

Assume R501 (control line limit pot) has been set per Section D. U501 pin 2 is at or near −3 volts. R503 (Envelope Detector Balance) should be near the center of its travel. The RF input to the panel should be approximately 170 millivolts peak to peak with 75% envelope modulation.

1. Control Line Limit Pot, Initial Adjustment

Observe Q510 emitter (test post) with an oscilloscope in DC display mode. (Same as U501 pins 2 and 4). Adjust R501 control line limit pot so that the observed voltage moves negative. The waveform shown in Figure 6 should soon appear, and the test point voltage (Q510 emitter) will no longer change as the pot is adjusted. The points of the waveform (Figure 6) may point down as shown or may point up. Discontinue adjustment of R501.

2. Envelope Detector Balance

Adjust R503 (Envelope Detector Balance) so that the points in the waveform on Q510 null.

3. Quadrature Detector Balance

Apply audio to the exciter such that only L−R modulation is present. Observe the waveform at the Q510 emitter. The waveform will probably be as shown in Figure 7A. Adjust R504 (Quadrature Detector Balance) such that the waveform is as shown in Figure 7B.

4. 900 kHz Trap at Quadrature Detector

L505 is tuned while observing the waveform at pin 6 or pin 12 of U509. Tuning is for minimum RF. Use 75% L−R modulation.

5. **900 kHz Trap at Inphase Detector**

L504 is tuned while observing the waveform at pin 6 or pin 12 of U508. Tuning is for minimum RF. Use 75% envelope modulation.

6. **Control Line Limit, Final Adjustment**

Apply 80% L only modulation at the exciter. The Q510 emitter waveform will probably look as shown in Figure 8. Adjust R501 (control line limit pot) such that the clipping of the negative loops no longer occurs.

Warning: The control line voltage (Q510 emitter) must not reach a value near −7 volts. See Figure 5 and note the dotted line area near −7 volts. The corrector loop may lock up. R501 must be adjusted to prevent the control line from reaching this area. The pot setting should be such that limiting occurs on the control line just above the loop lock point.

7. **Envelope Detector Balance, Final Adjustment**

Adjust R503 such that the distortion as measured at the L−R rear panel port is minimum and equal with either 50% L only modulation or 50% R only modulation. Repeat the adjustment in "6" above if required.

8. **PLL Loop Pilot Signal Rejection**

The PLL loop includes special filtering to keep 25 Hz signal off the varactor control line. A selective amplifier (U504 pin 1) samples the 25 Hz pilot on the L−R output. This signal is then injected out of phase into the loop filter. The resulting effect is to null the 25 Hz signal on the varactor control line (U504 pin 14). Adjust as follows:

Observe the waveform on U504 pin 1. Apply the pilot but no other modulation. Adjust R502 to maximize the 25 Hz signal.

Observe the waveform at the junction of R572, R573, and R574. Adjust R571 to null the 25 Hz pilot signal at this point.

DECODER PANEL, AVC PANEL MATCHING

Interconnection of the decoder panel (M16) with the AVC panel (M10) requires adjustment of R133 (L+R null), R247 (L−R gain) and R132 (L−R null) on panel M10. Adjust the rear and front panel RF attentuators such that the carrier meter indicates 0 (center).

1. **L+R Null (R133 of panel M10)**

Observe the waveform at U104 pin 8 with the oscilloscope in DC display mode. Modulate the envelope at 100%. Adjust R133 such that the waveform negative loops touch and 0 volt line as shown in Figure 3. The left meter with the push buttons set to read +(L+R) modulation should now read 100%. The −100% modulation indicator should be on as should the negative limit indicator.

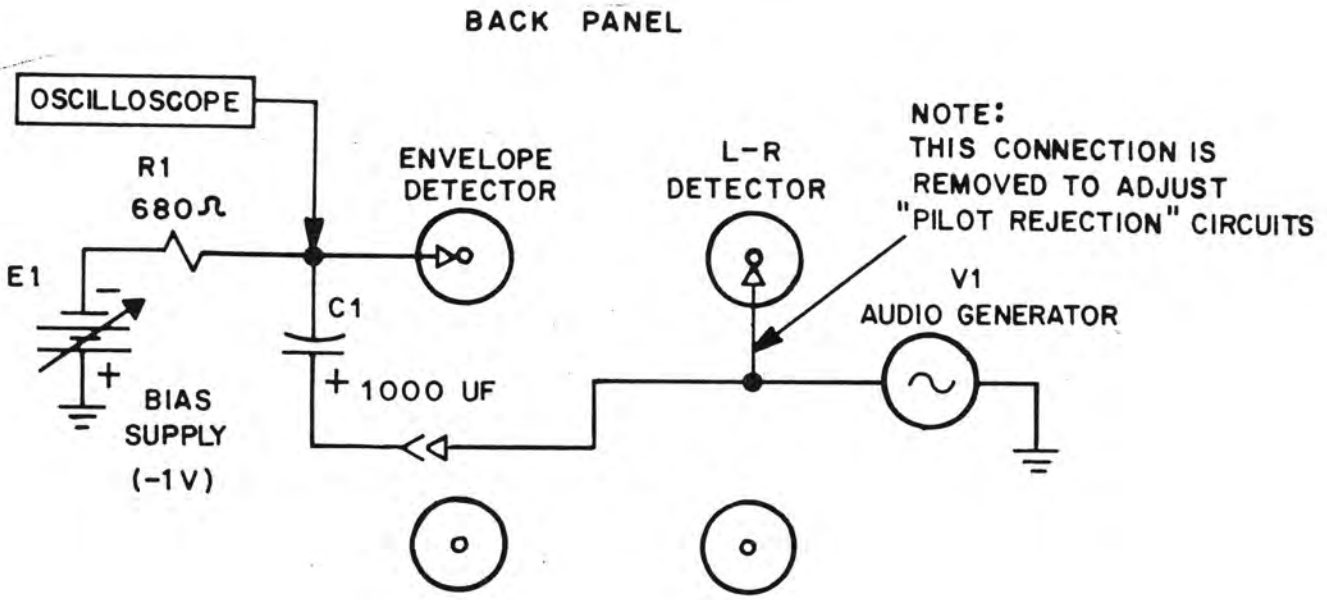
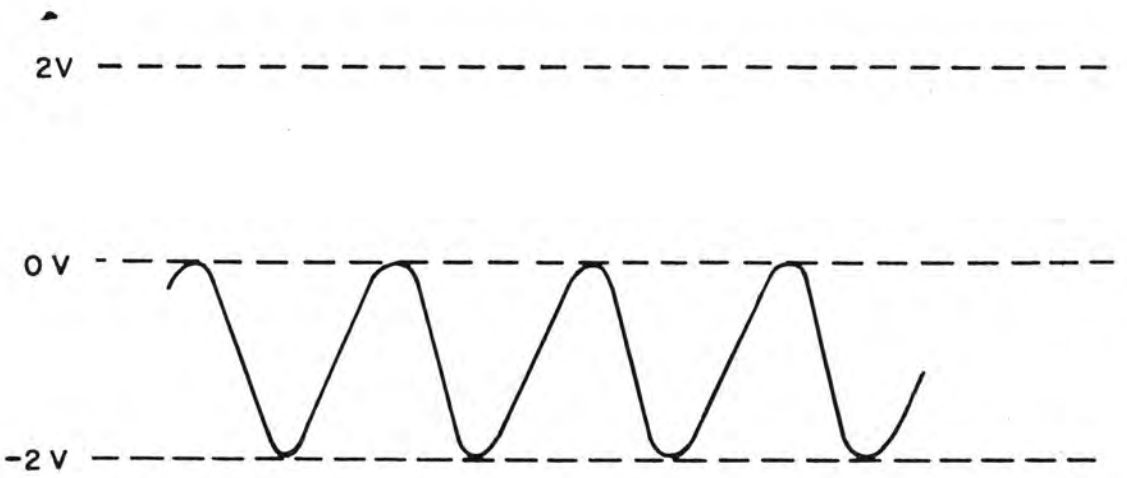
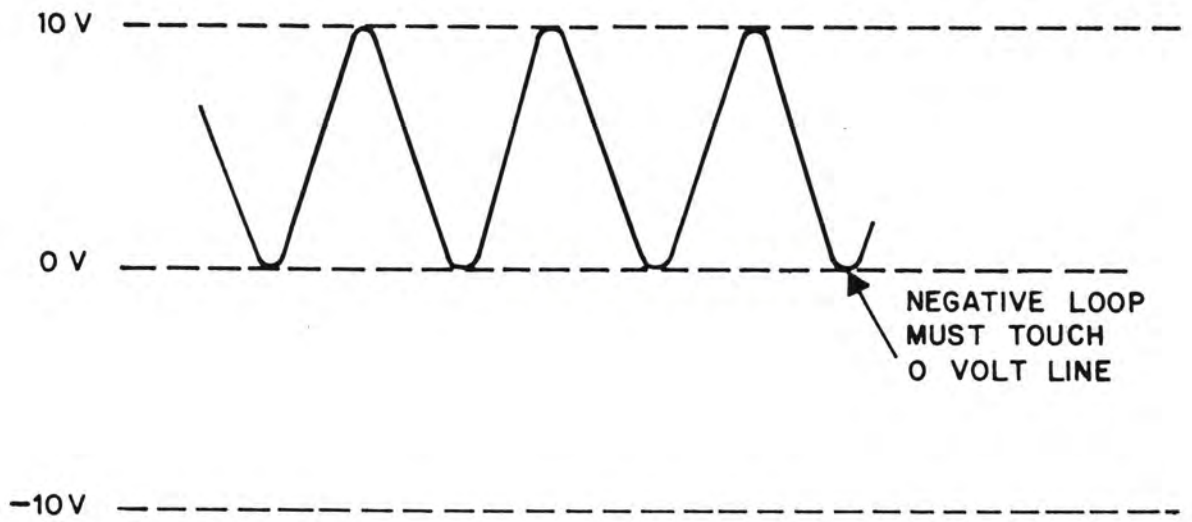


FIGURE 1.



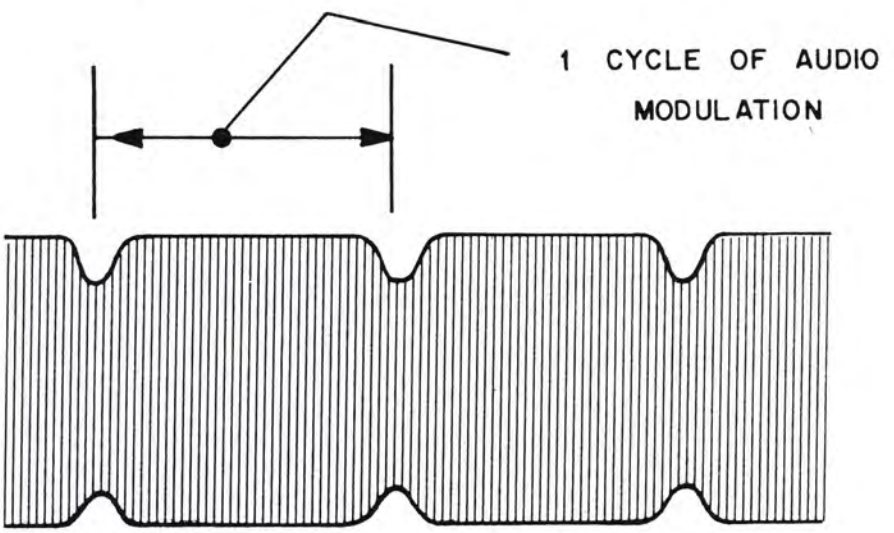
SIGNAL OBSERVED AT ENVELOPE DET PORT (SEE CONNECTION SHOWN IN FIG. 1)

FIGURE 2.



U108 PIN 8 WAVEFORM AT 100%. ENVELOPE MODULATION

FIGURE 3.



WAVEFORM AT U510 PINS 6 AND 7

FIGURE 4.

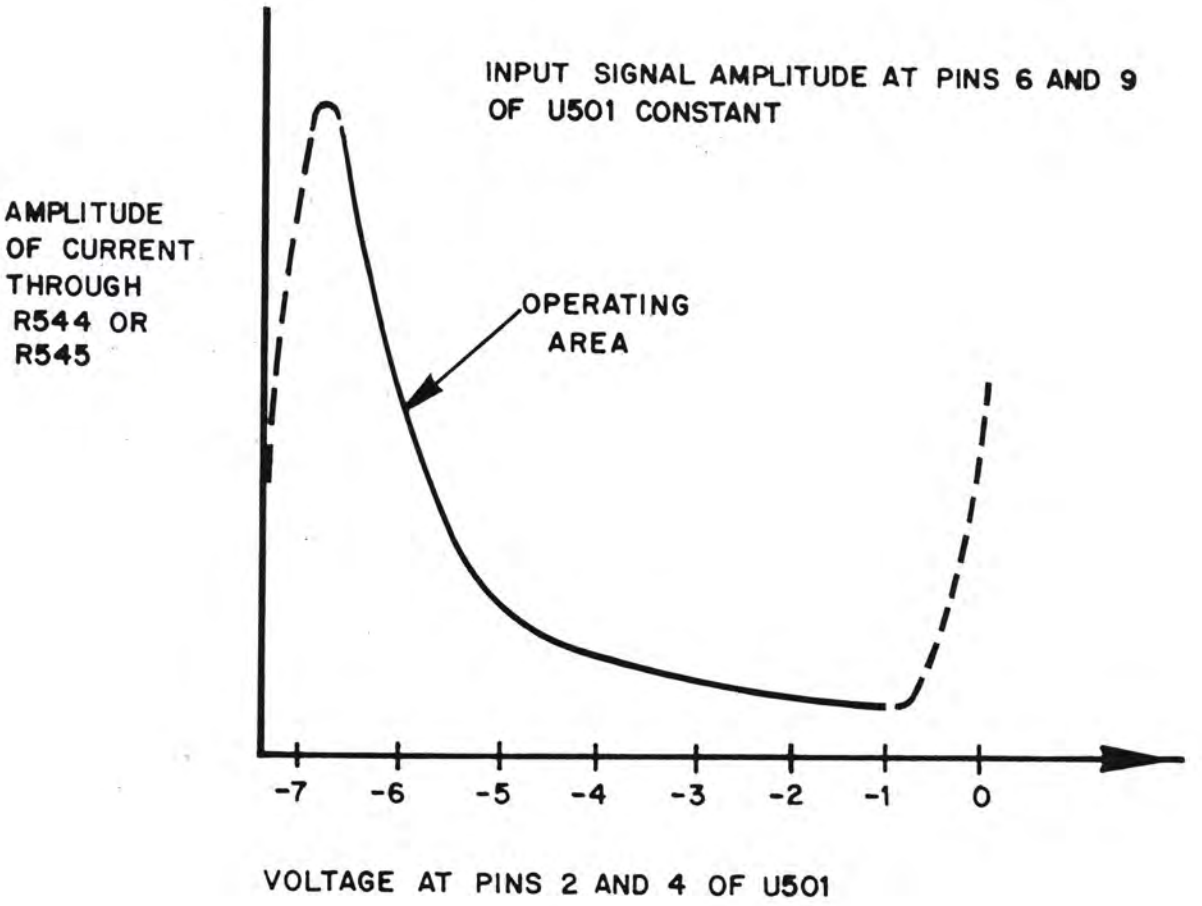


FIGURE 5.

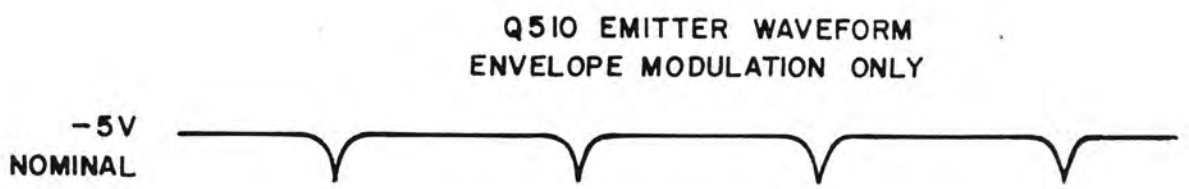


FIGURE 6.

Q510 EMITTER WAVEFORM

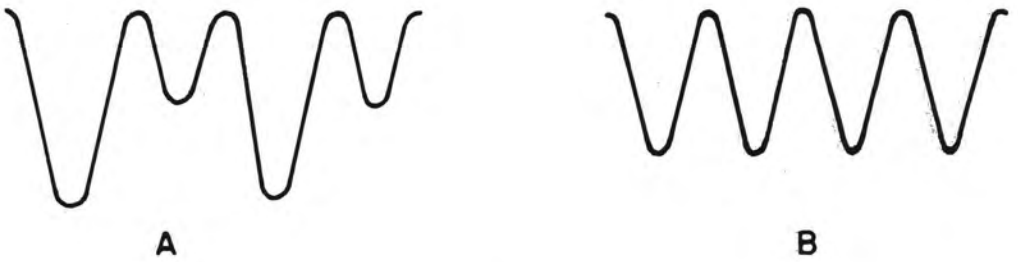


FIGURE 7.

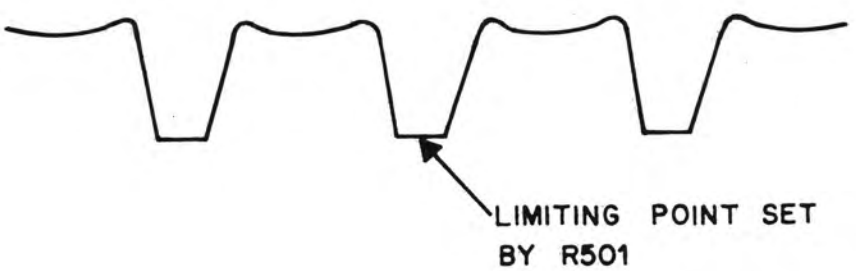
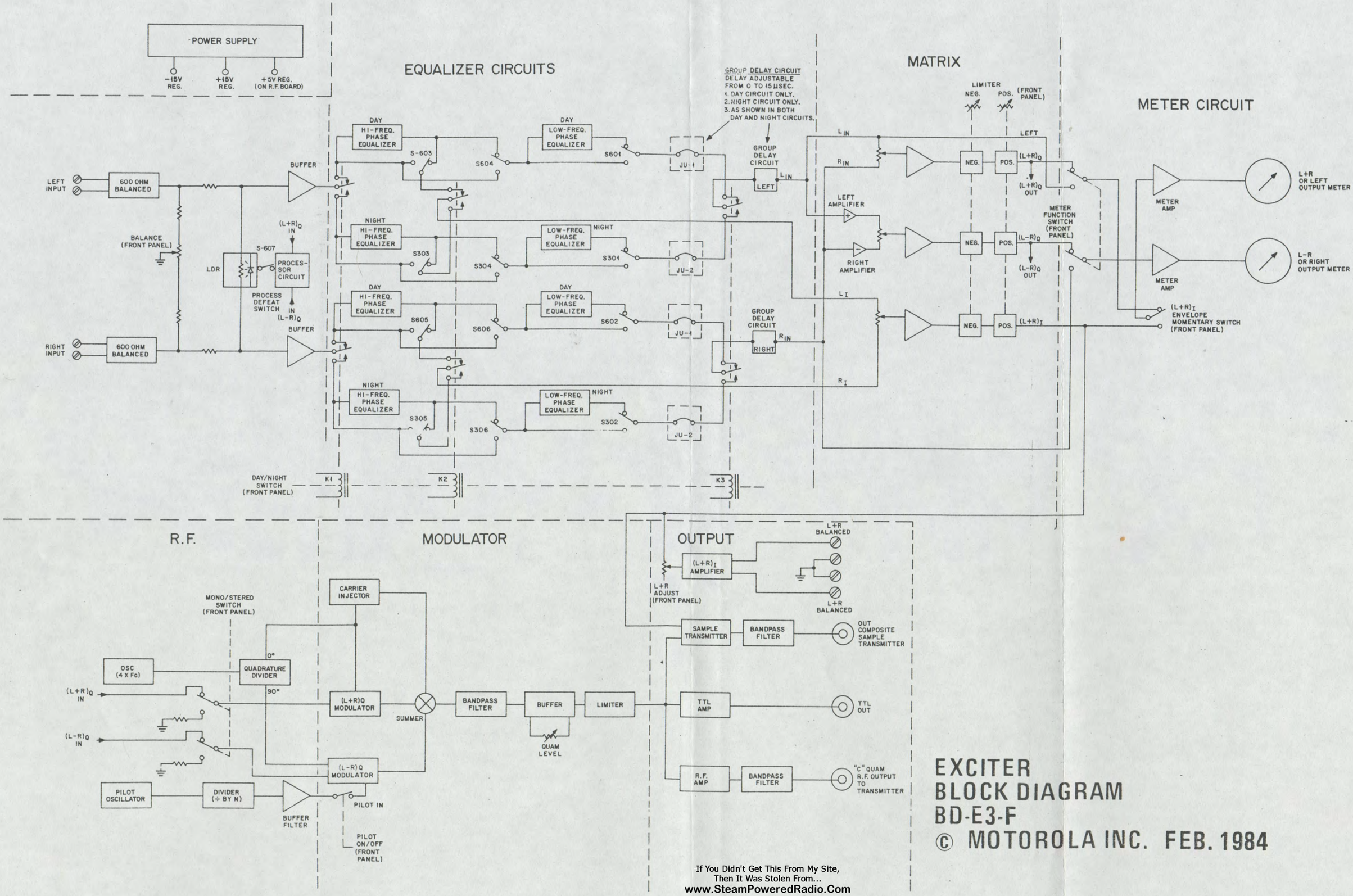


FIGURE 8.

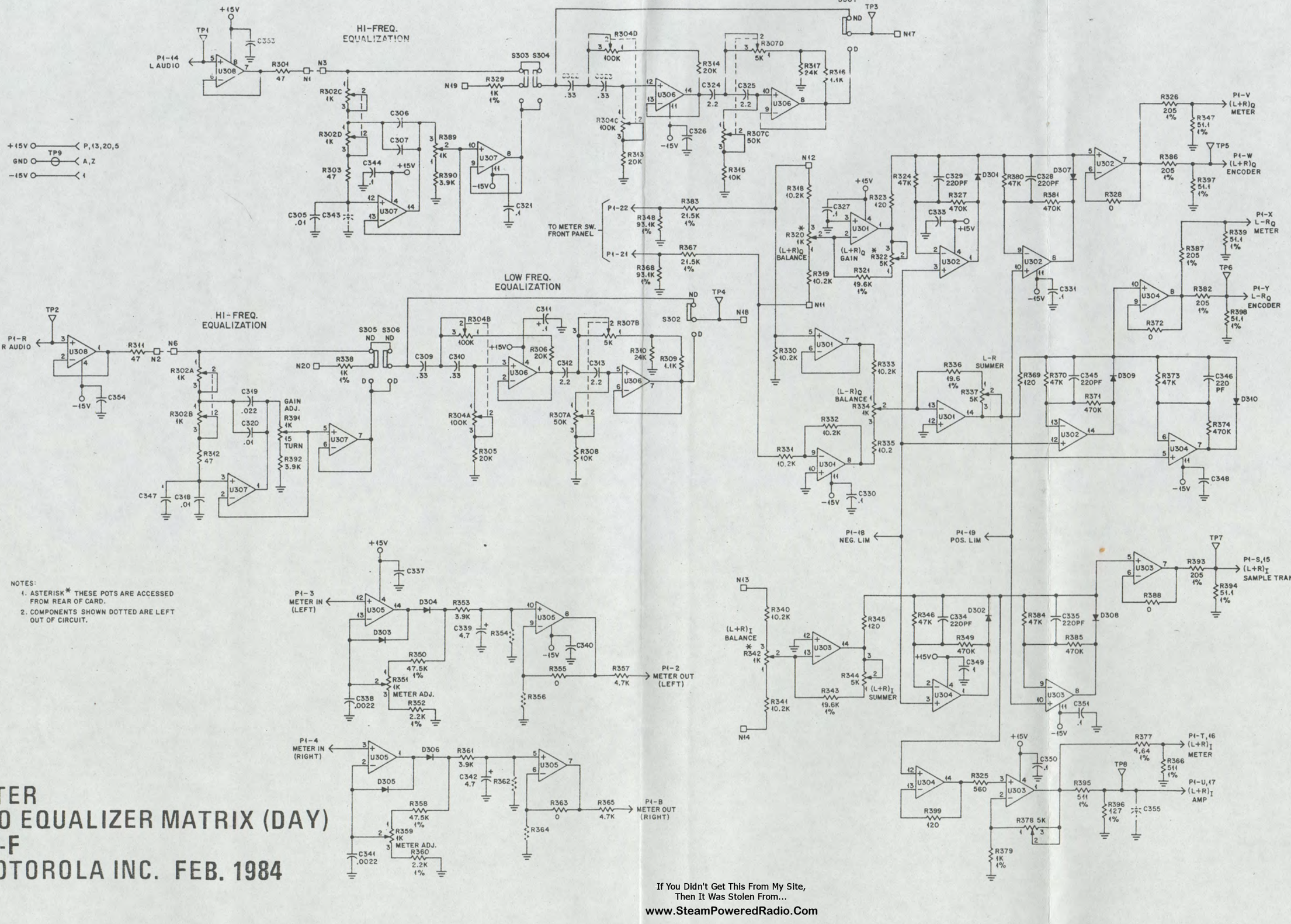
SCHEMATICS

EXCITER

MONITOR



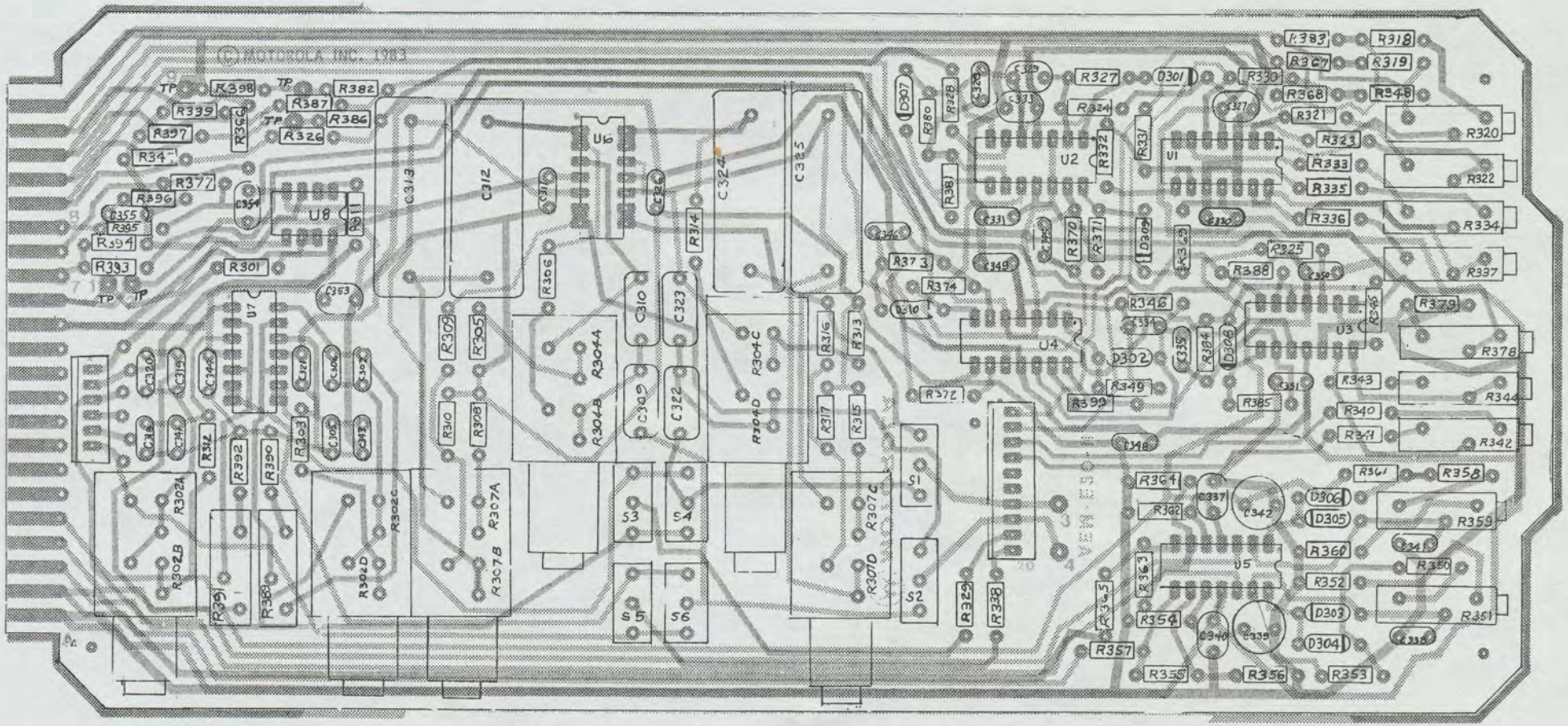
EXCITER BLOCK DIAGRAM BD-E3-F



NOTES:

1. ASTERISK * THESE POTS ARE ACCESSED FROM REAR OF CARD.
2. COMPONENTS SHOWN DOTTED ARE LEFT OUT OF CIRCUIT.

EXCITER
AUDIO EQUALIZER MATRIX (DAY)
SC-E2-F



EXCITER AUDIO EQUALIZER MATRIX CIRCUIT CARD E2D-II

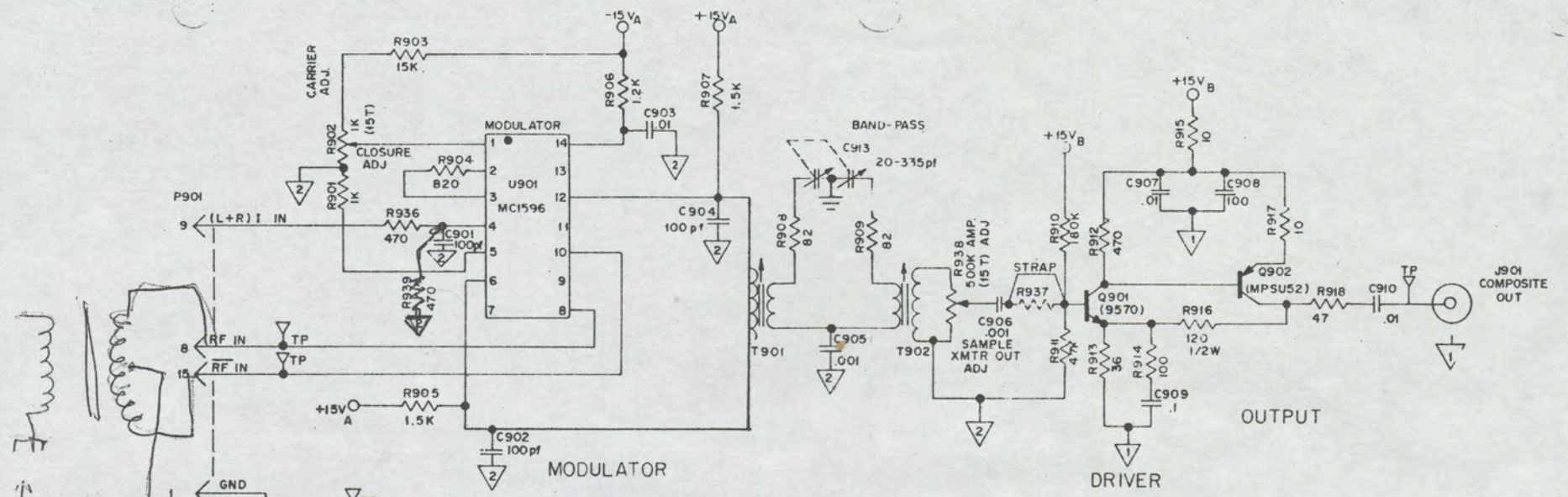
COMPONENT VIEW

ENCODER
SC-E1-C
© MOTOROLA INC. FEB. 1984

RECOMMEND VALUES AT START OF ALIGNMENT		
FREQ. RANGE KHZ	R143 & R145	C121
	1/4 W 5%	
500-600 KHZ	120 Ω	1800pf
600-690	160	
700-790	200	
800-890	240	
900-990	300	
1000-1090	330	820
1100-1190	360	
1200-1290	390	
1300-1390	430	
1400-1490	470	
1500-1590	510	500
1600	560	

NOTES

1. ALL RESISTORS IN OHMS AND 1/4 WATT UNLESS OTHERWISE SPECIFIED.
2. ALL CAPACITORS IN M.F. UNLESS OTHERWISE SPECIFIED.
3. (*) THESE CAPACITORS TO BE REPLACED WITH CAPACITORS OF EQUV. TEMP. COEFFICIETS.

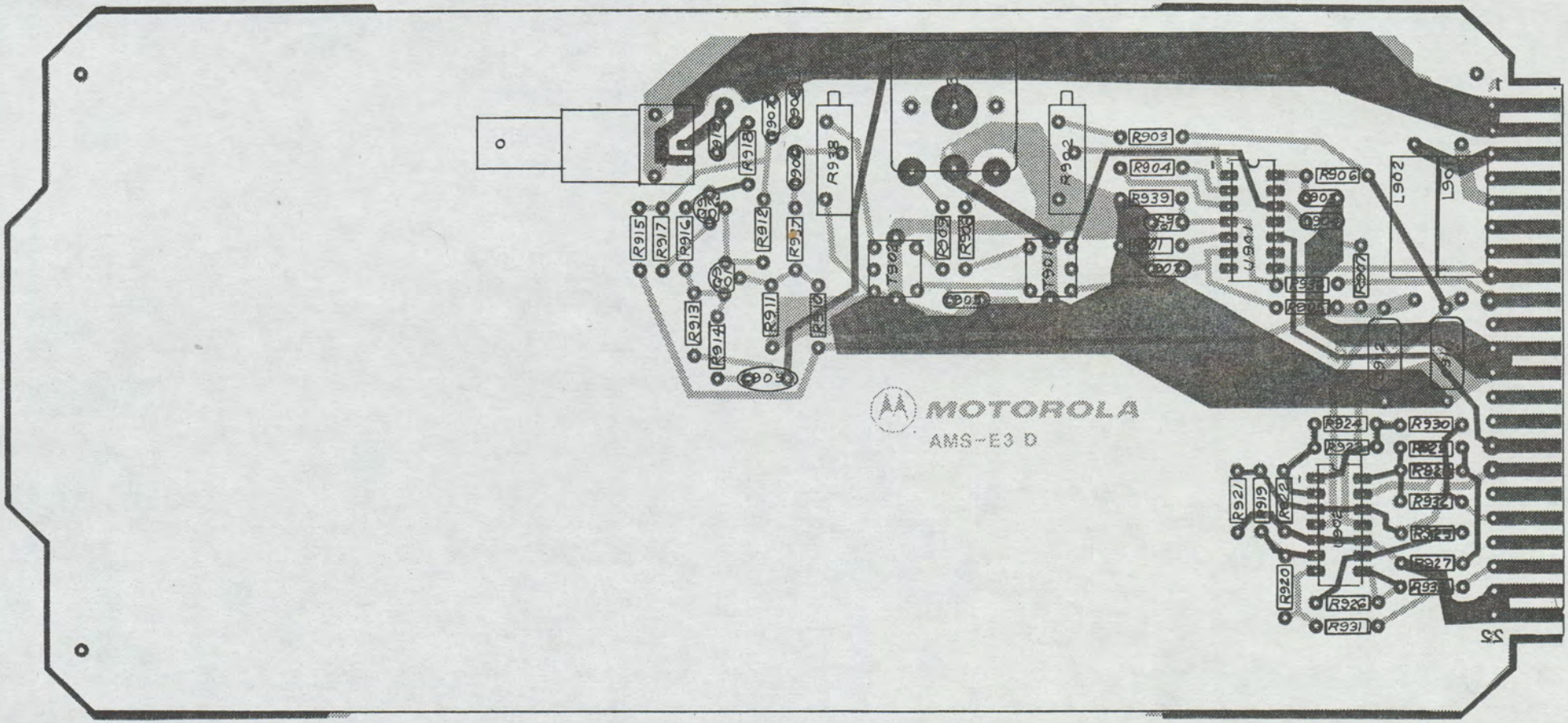


EXCITER
L+R AMPLIFIER/SAMPLE TRANSMITTER
SC-E3-D © MOTOROLA INC. FEB. 1984

NOTES

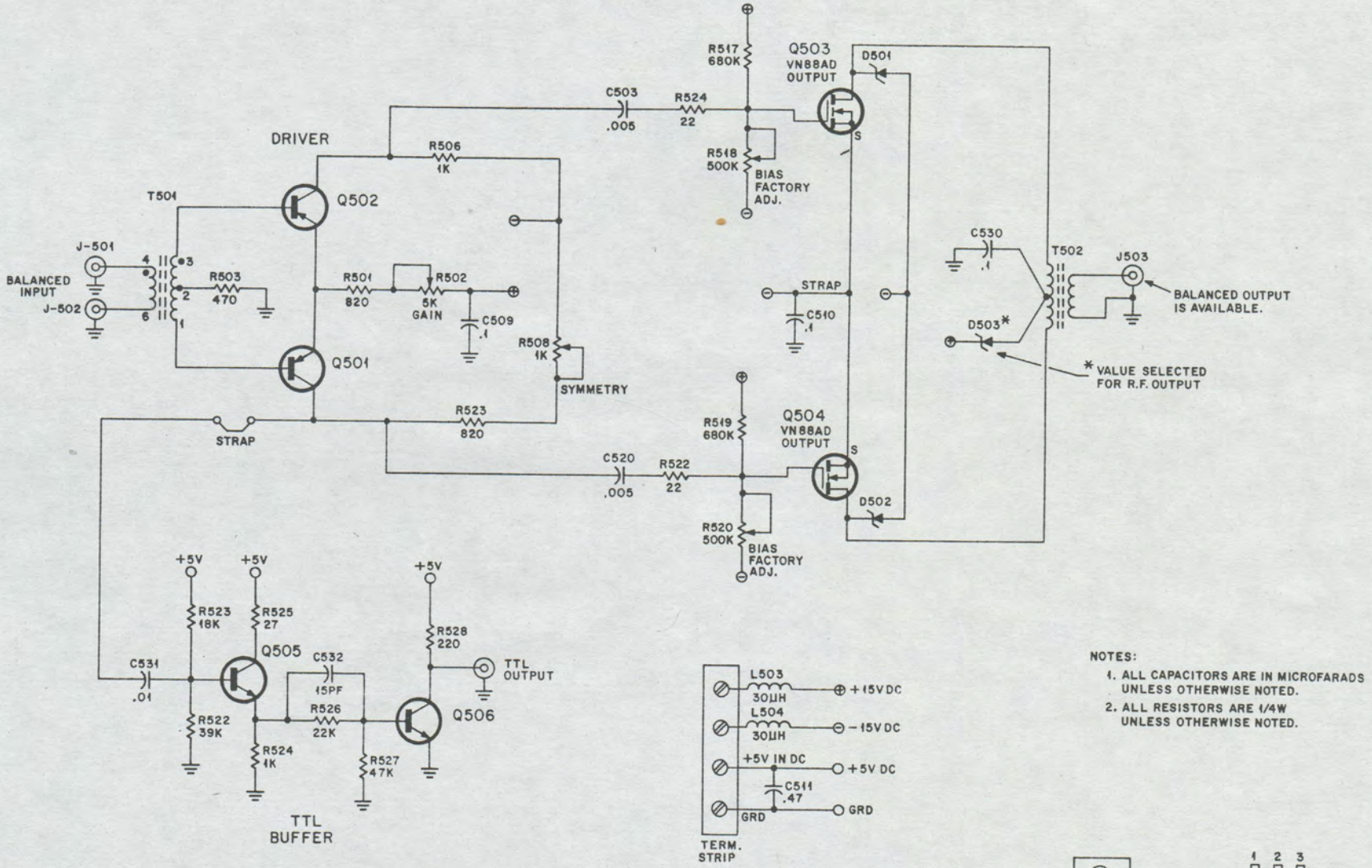
1. ALL CAPACITORS IN µf UNLESS OTHERWISE NOTED.
2. ALL RESISTORS 1/4 WATT UNLESS OTHERWISE NOTED
3. INPUT AUDIO REQUIREMENTS

AUDIO INPUT MVPP	R936	R939
1200	YES	YES
600	YES	NO



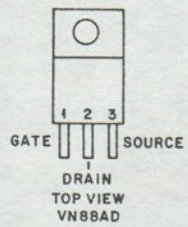
EXCITER L + R AMPLIFIER SAMPLE TRANSMITTER CIRCUIT CARD E3D

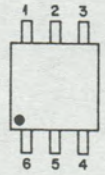
COMPONENT VIEW



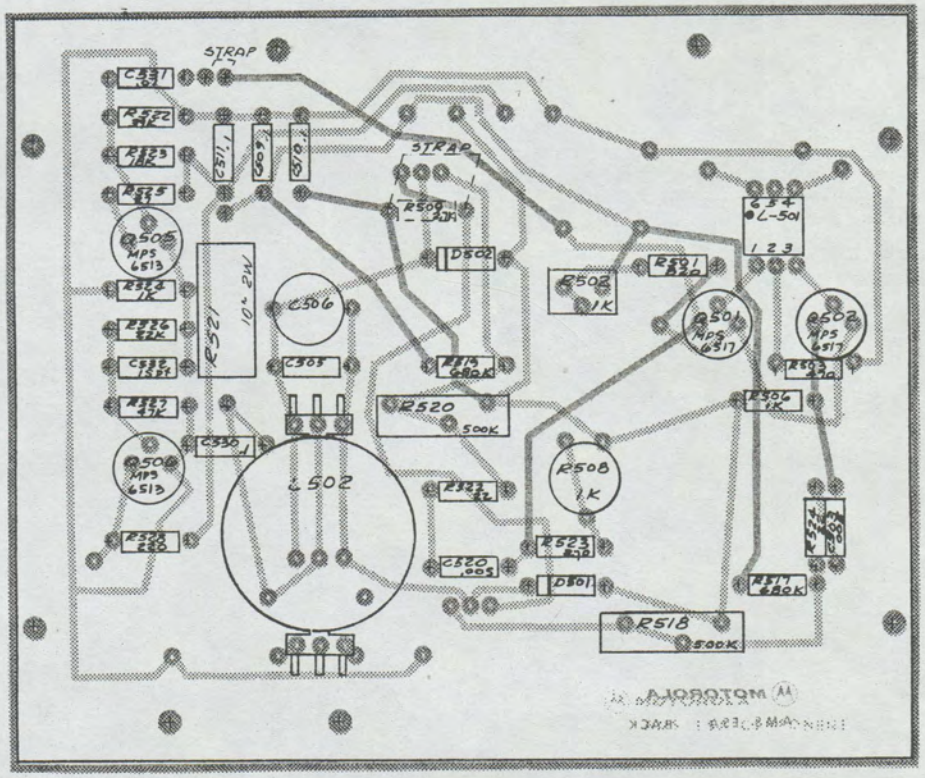
NOTES:

1. ALL CAPACITORS ARE IN MICROFARADS UNLESS OTHERWISE NOTED.
2. ALL RESISTORS ARE 1/4W UNLESS OTHERWISE NOTED.



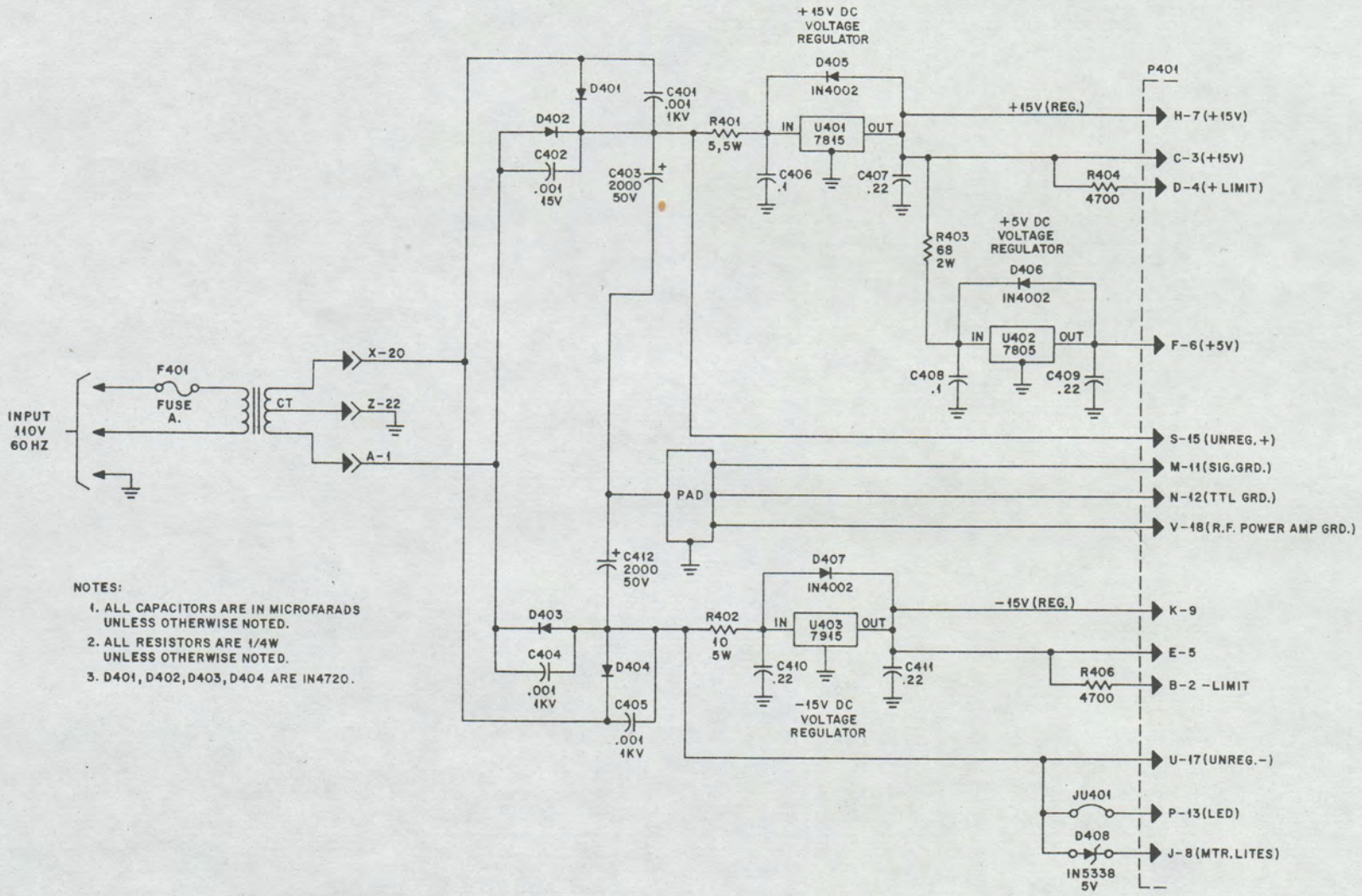


EXCITER
R.F. AMPLIFIER
SC-E5-C

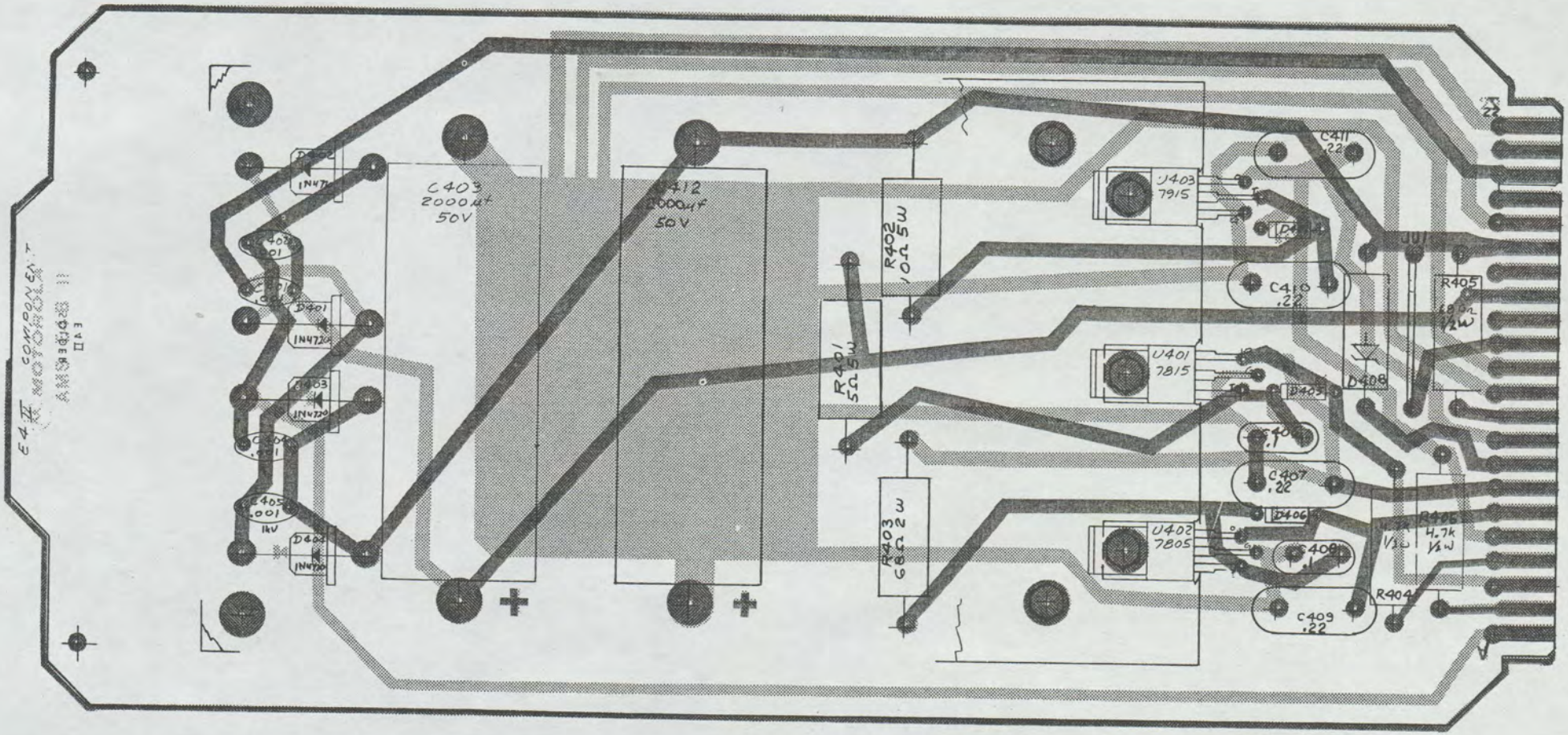


EXCITER R.F. AMPLIFIER CIRCUIT CARD E5A

COMPONENT VIEW



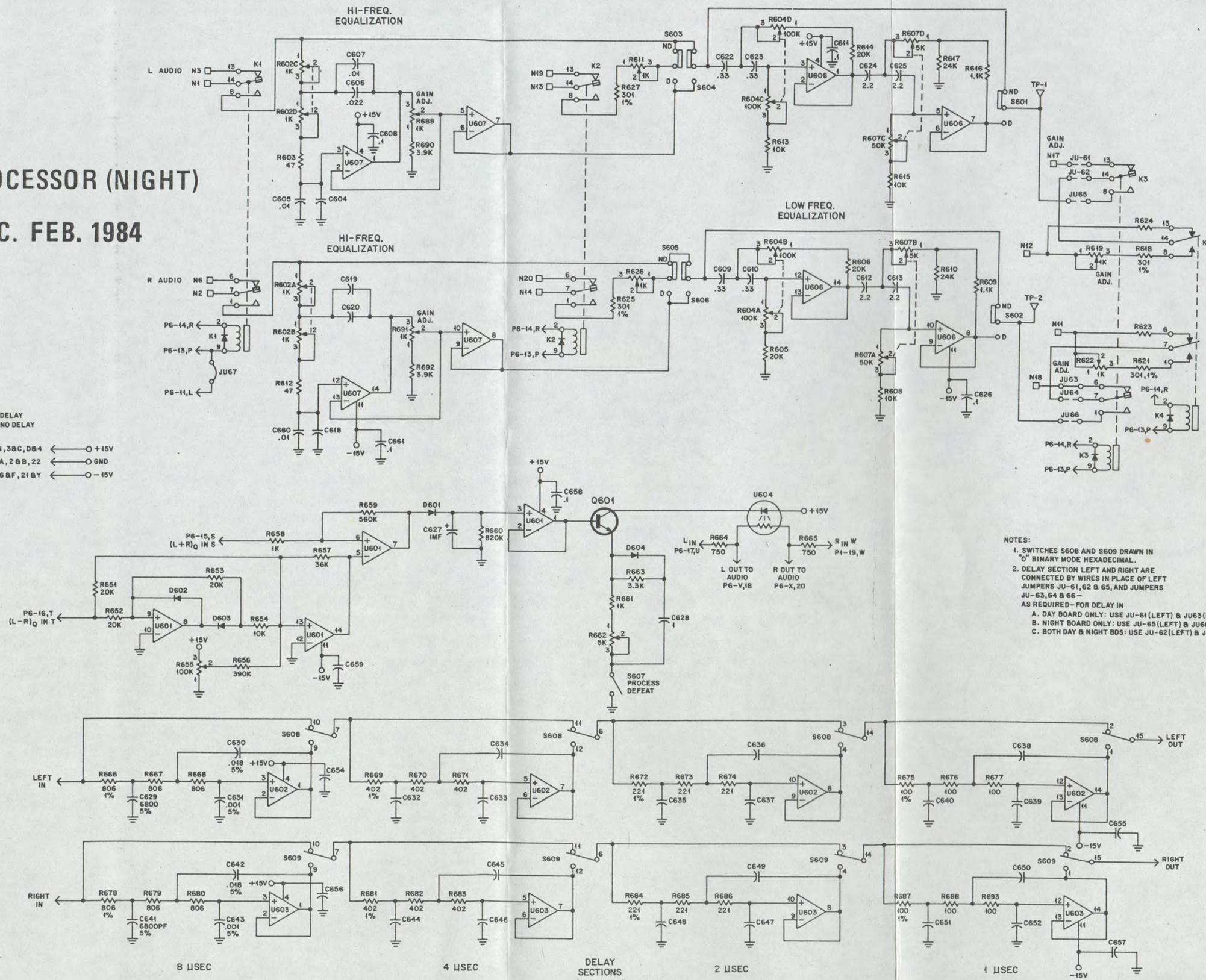
EXCITER
POWER SUPPLY
SC-E4-C



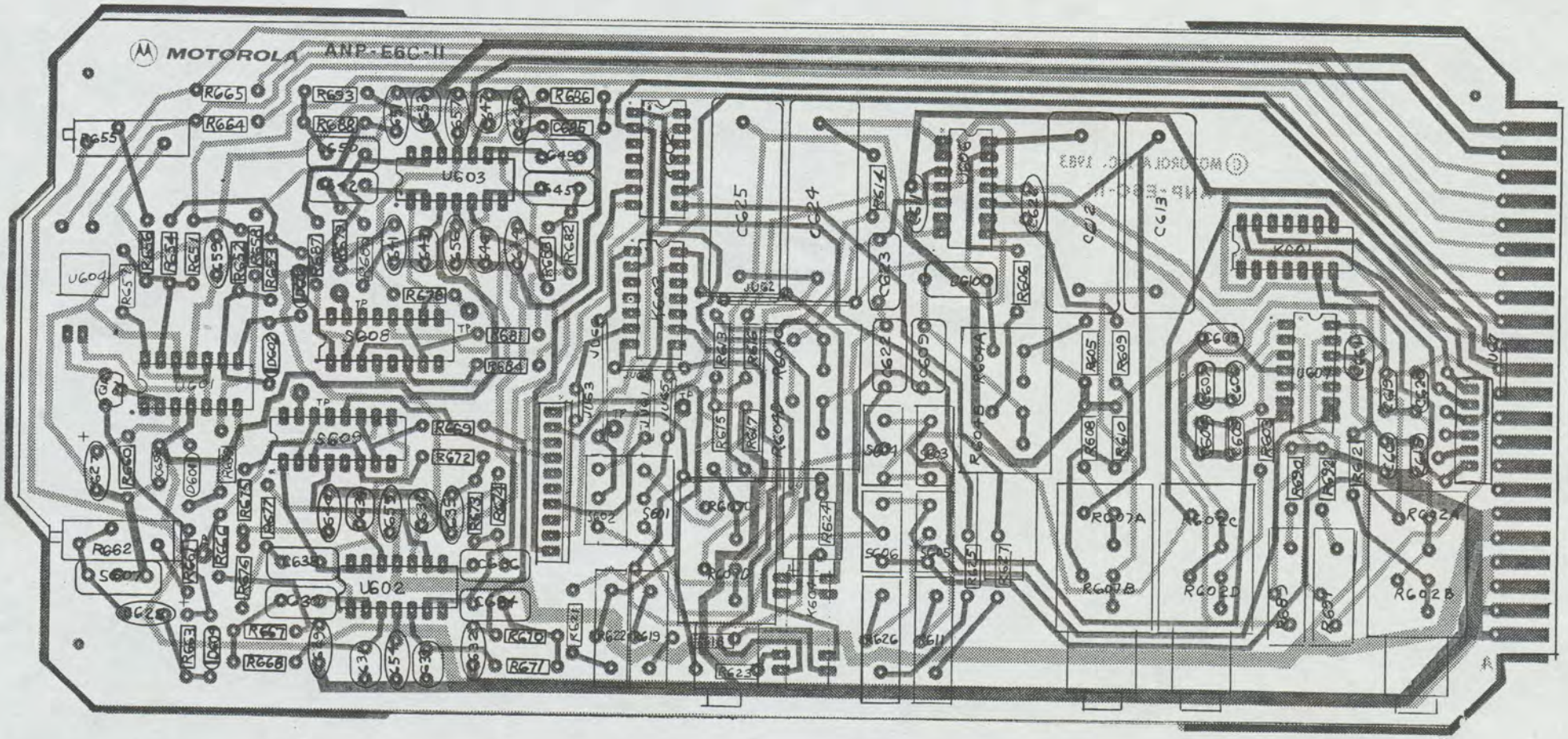
EXCITER POWER SUPPLY CIRCUIT CARD E4B-II

COMPONENT VIEW

EXCITER
AUDIO NIGHT PROCESSOR (NIGHT)
SC-E6-E



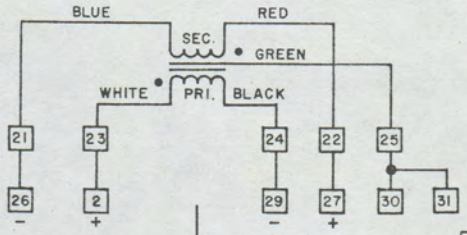
NOTES:
1. SWITCHES S608 AND S609 DRAWN IN "0" BINARY MODE HEXADECIMAL.
2. DELAY SECTION LEFT AND RIGHT ARE CONNECTED BY WIRES IN PLACE OF LEFT JUMPERS JU-61,62 & 65, AND JUMPERS JU-63,64 & 66 — AS REQUIRED — FOR DELAY IN
   A. DAY BOARD ONLY: USE JU-61 (LEFT) & JU63 (RIGHT)
   B. NIGHT BOARD ONLY: USE JU-65 (LEFT) & JU66 (RIGH
   C. BOTH DAY & NIGHT BDS: USE JU-62 (LEFT) & JU64 (R



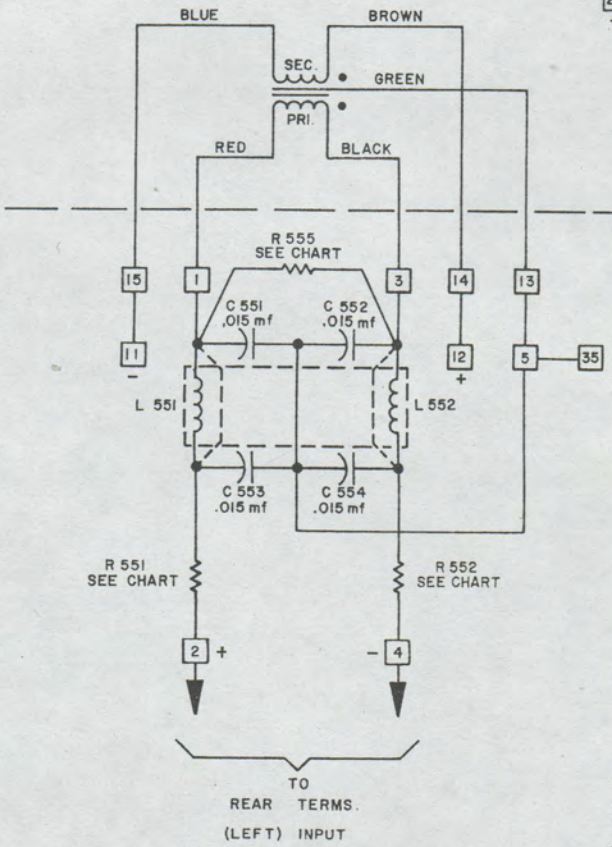
EXCITER AUDIO NIGHT PROCESSOR CIRCUIT CARD E6C-II

COMPONENT VIEW

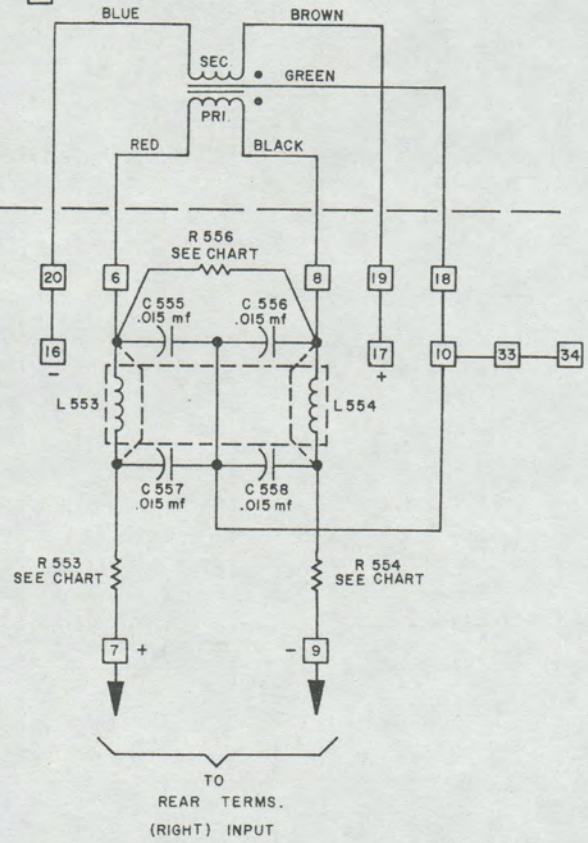
T-703



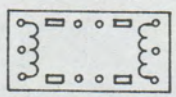
T-701



T-702



100% MODULATION		
STATION LEFT & RIGHT AUDIO INPUT INTO 600 Ω DBM	R 555 & R 556 1% OHMS	R 551, R 552 R 553, R 554 1% OHMS
+10	113	249
+ 8	147	243
+ 6	205	226
+ 4	280	205
+ 2	402	182
0	604	150
− 2	1020	110
− 4	2260	61.9
− 6	∞	0



BOTTEM VIEW
OF
L 551 TO L 554

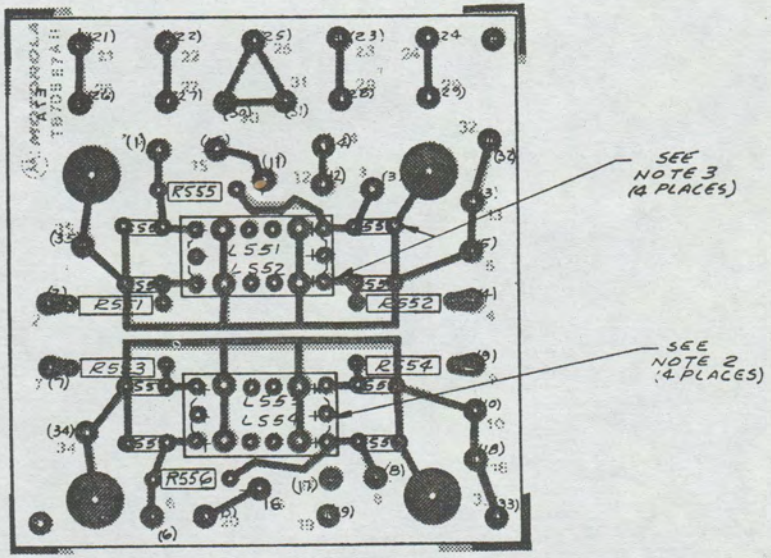
NOTES-

1-MODULATION CHART INDICATES RESISTORS AS REQUIRED PER CUSTOMER SPECIFICATION.

2-L551, L552, L553, L554 AND C551, C552, C553, C554, C555, C556, C557, C558 INSTALLED AS CUSTOMER REQUIRMENTS DICTATE.

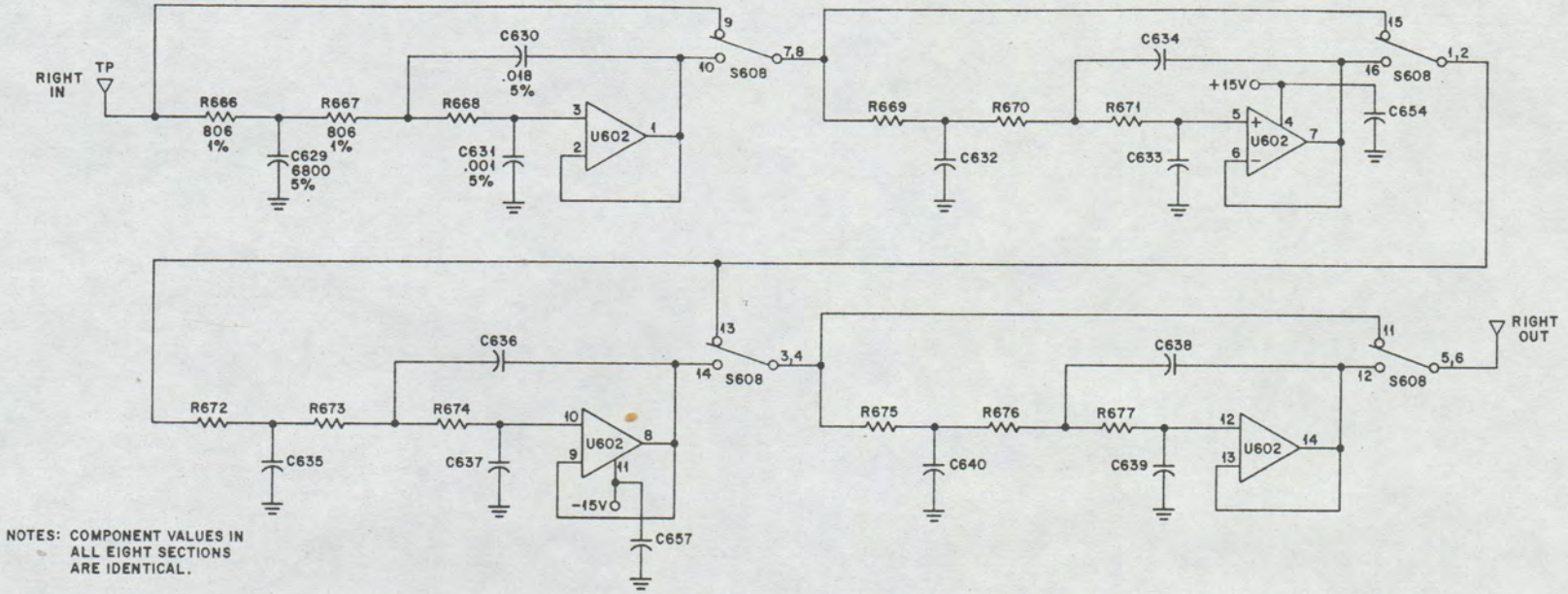
3-DOTTED STRAPS NORMALLY INSTALLED.

EXCITER
AUDIO INTERFACE
SC-E7-B

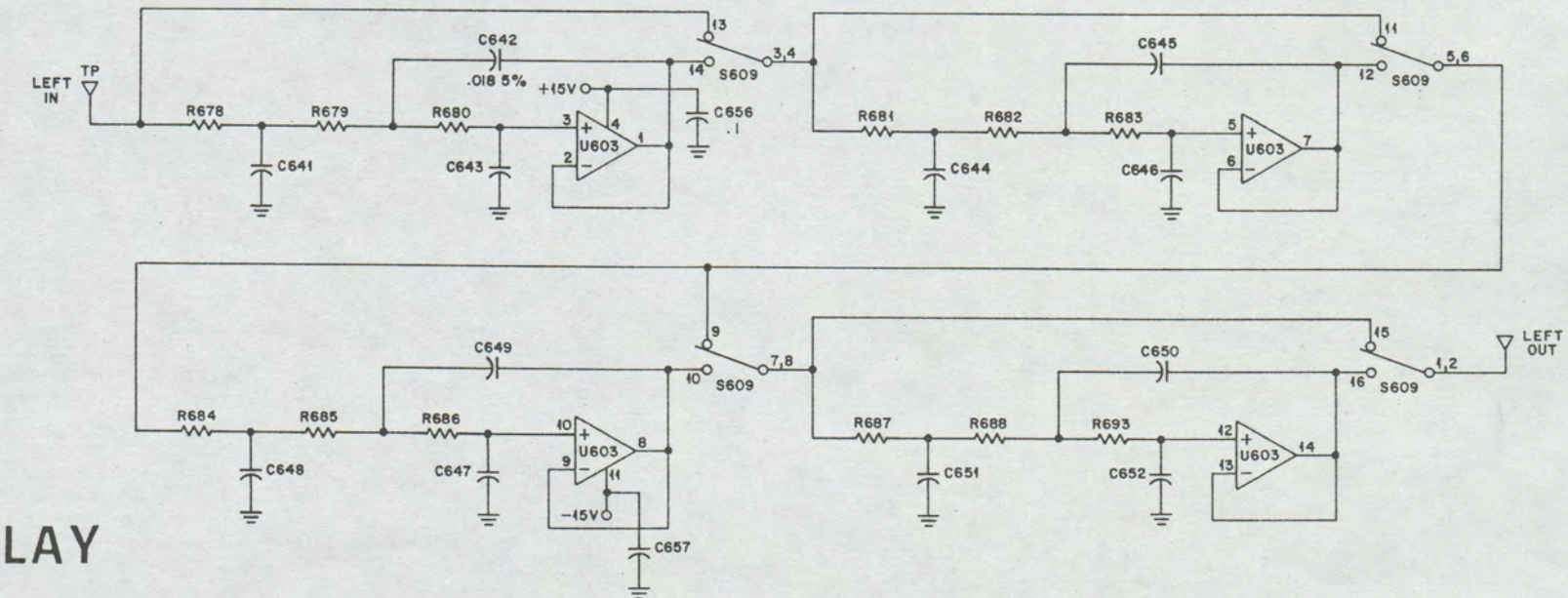


EXCITER AUDIO INTERFACE CIRCUIT CARD E7A-II

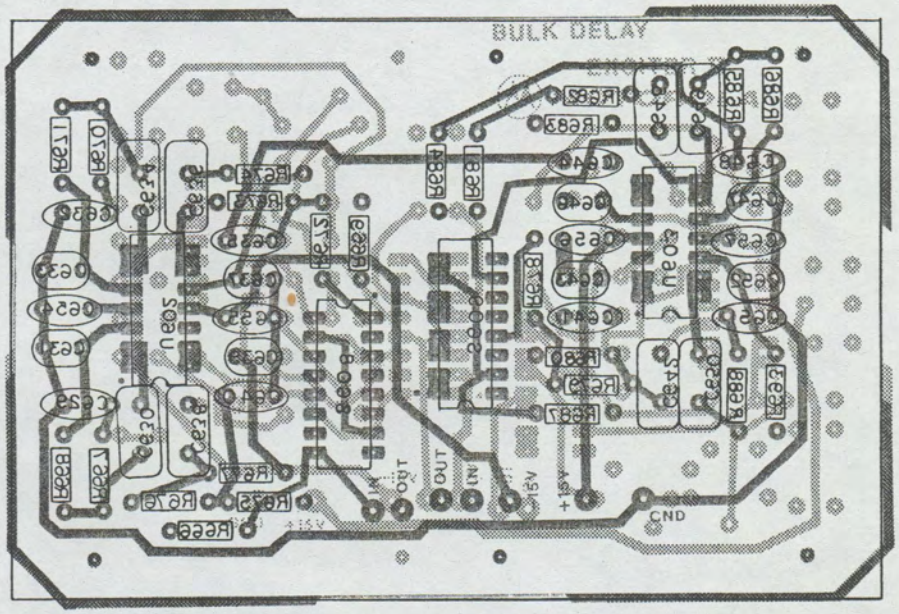
COMPONENT VIEW



NOTES: COMPONENT VALUES IN ALL EIGHT SECTIONS ARE IDENTICAL.



EXCITER
BULK DELAY
SC-E8-A

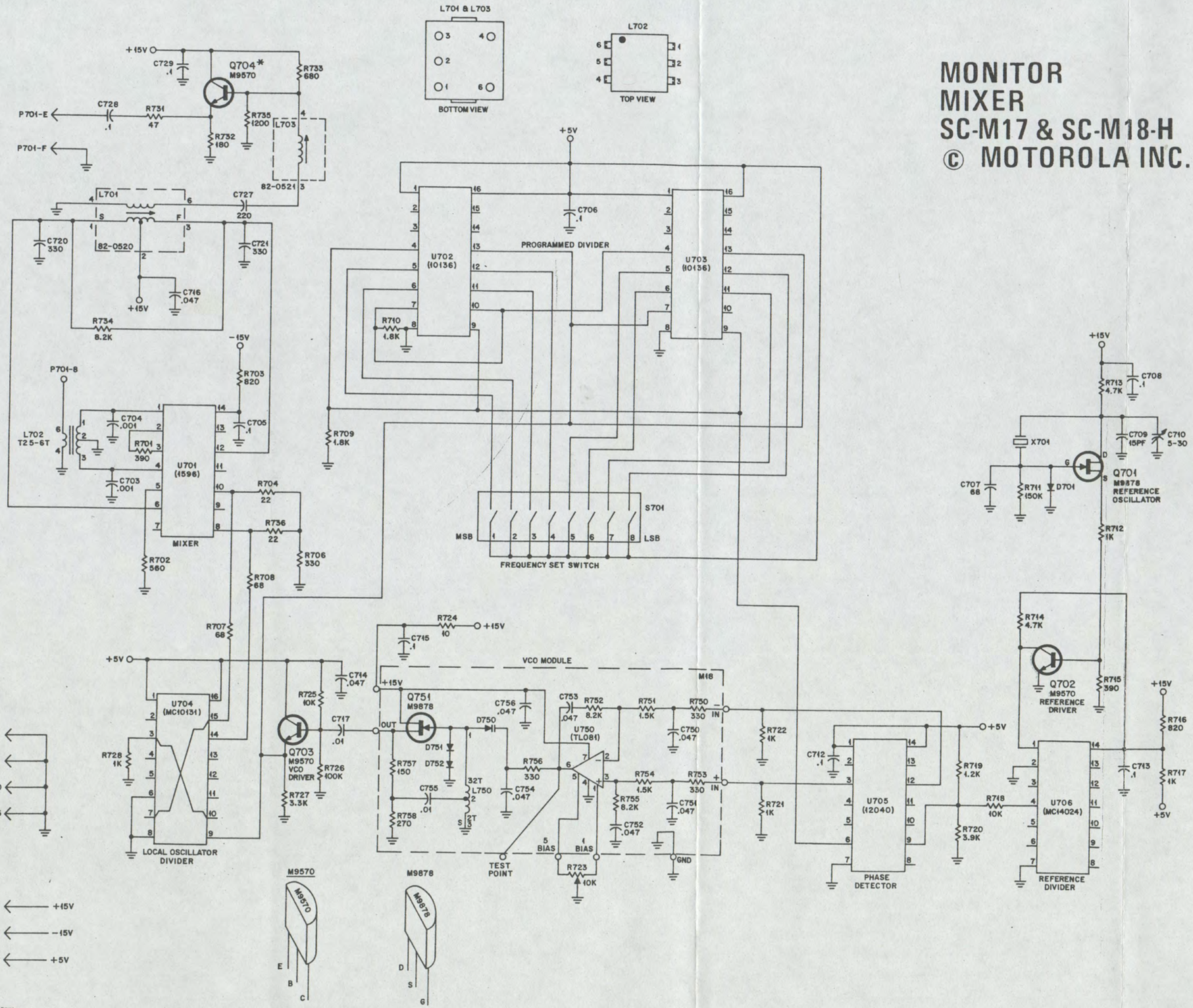


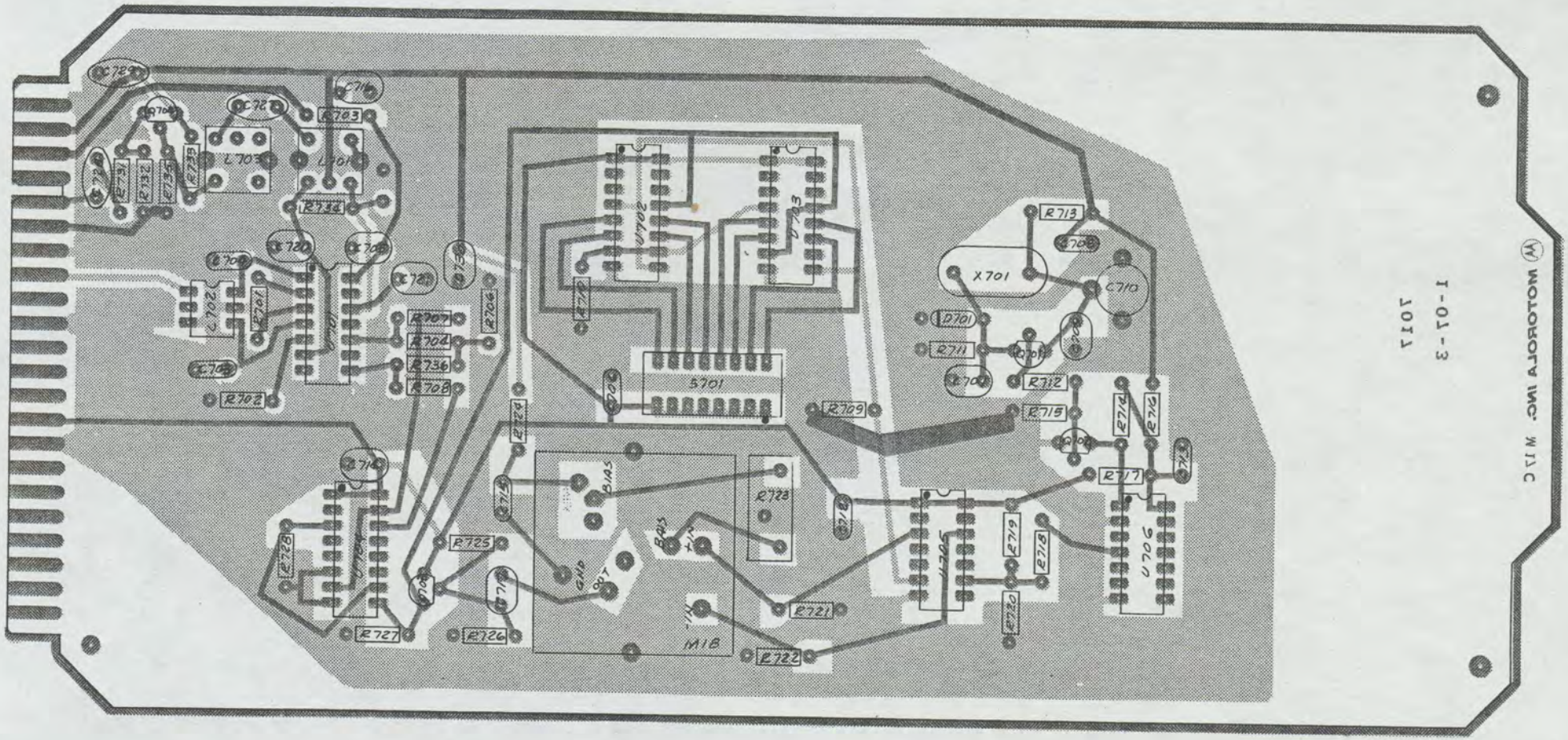
EXCITER BULK DELAY CIRCUIT CARD E8A-II

COMPONENT VIEW

MONITOR
FUNCTIONAL DIAGRAM
FD-M20-F

MONITOR
MIXER
SC-M17 & SC-M18-H





MONITOR MIXER CIRCUIT CARD M17C & M18C

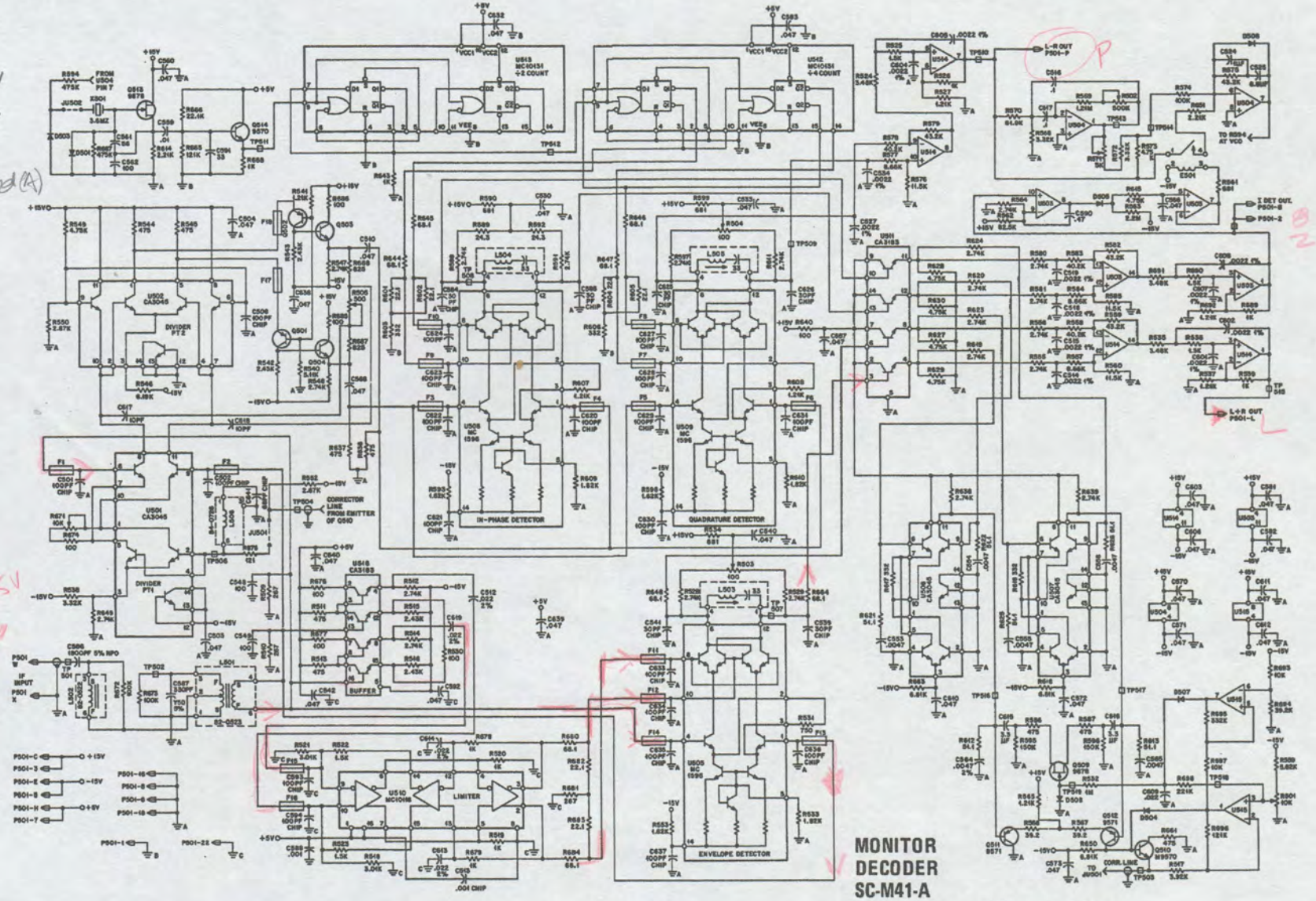
COMPONENT VIEW

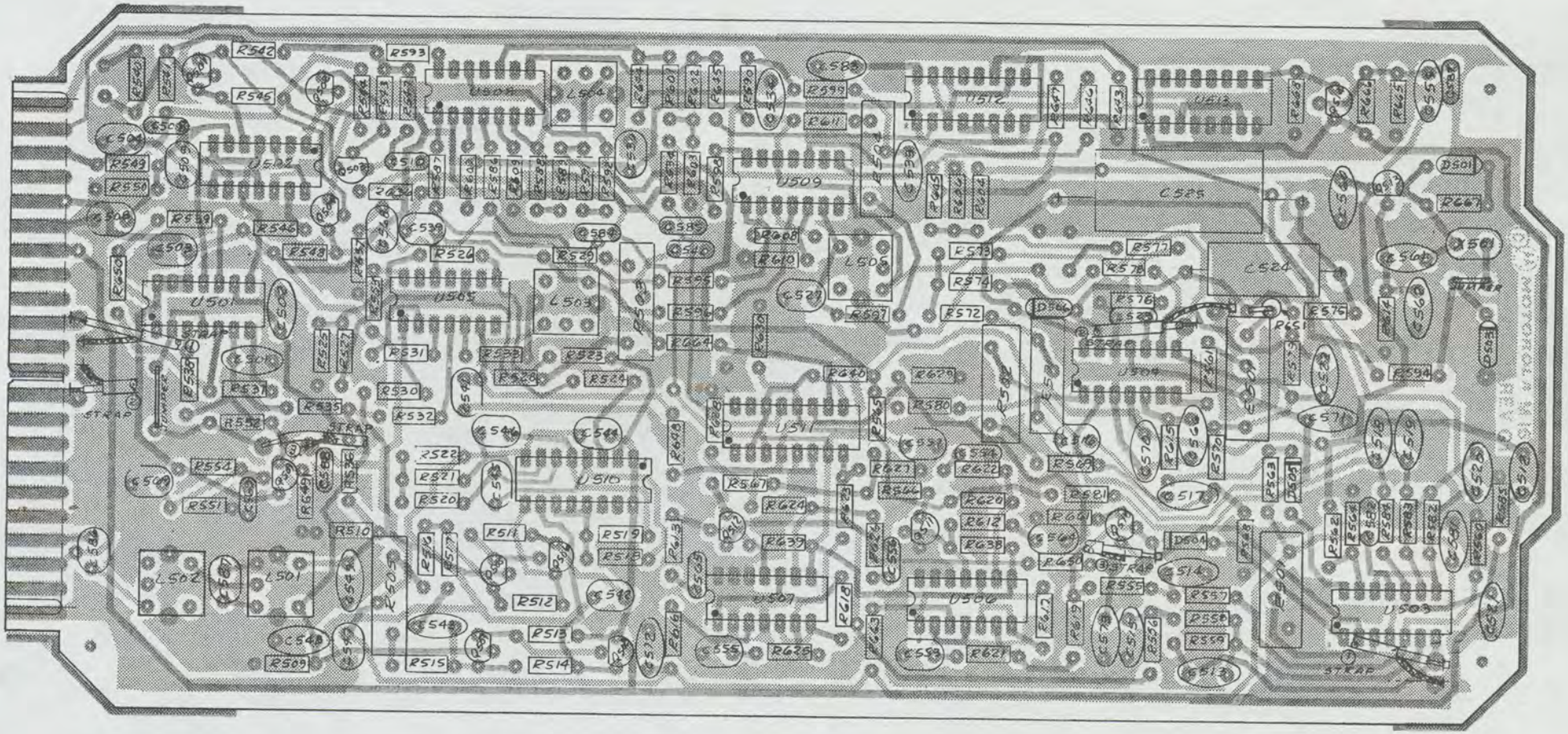
P501-W — IF input
P501-X — IF gnd

P501-L → L+R out
P501-P → L-R out

P501-2/8 → I out

P501-C/3 – +15V
P501-E/5 – -15V
P501-14/7 – +5V
P501-16/8/6/18 – gnd(A)
P501-1 gnd(B)
P501-22 gnd(C)



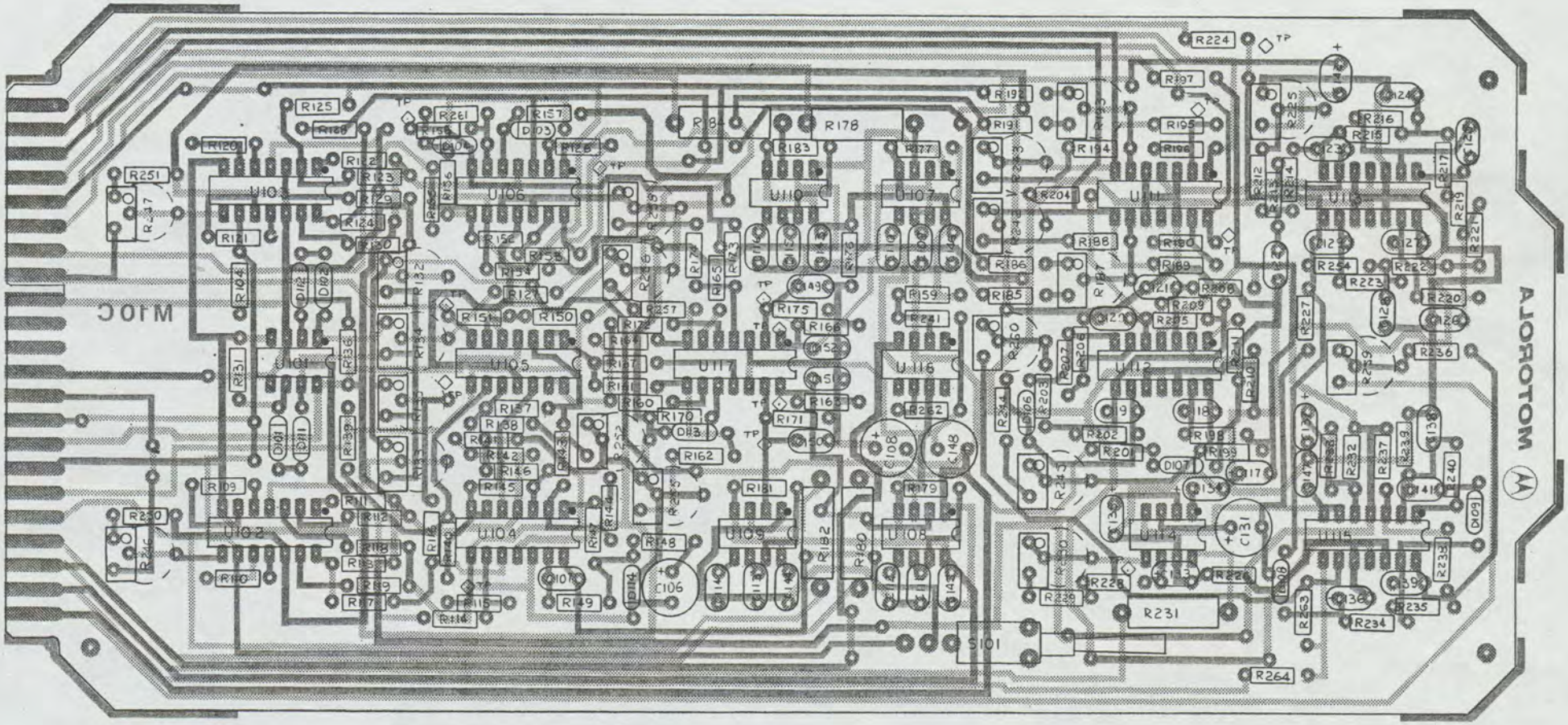


MONITOR DECODER CIRCUIT CARD M16G1

COMPONENT VIEW

MONITOR
AVC
SC-M10-E
© MOTOROLA INC. FEB. 1984

NOTE:
UNLESS OTHERWISE SPECIFIED,
ALL CAPACITORS ARE IN MICROFARADS.



MONITOR AVC CIRCUIT CARD M10C

COMPONENT VIEW

MONITOR METER SC-M11-K

FEB. 1984

LEFT PILOT REJECT

RIGHT PILOT REJECT

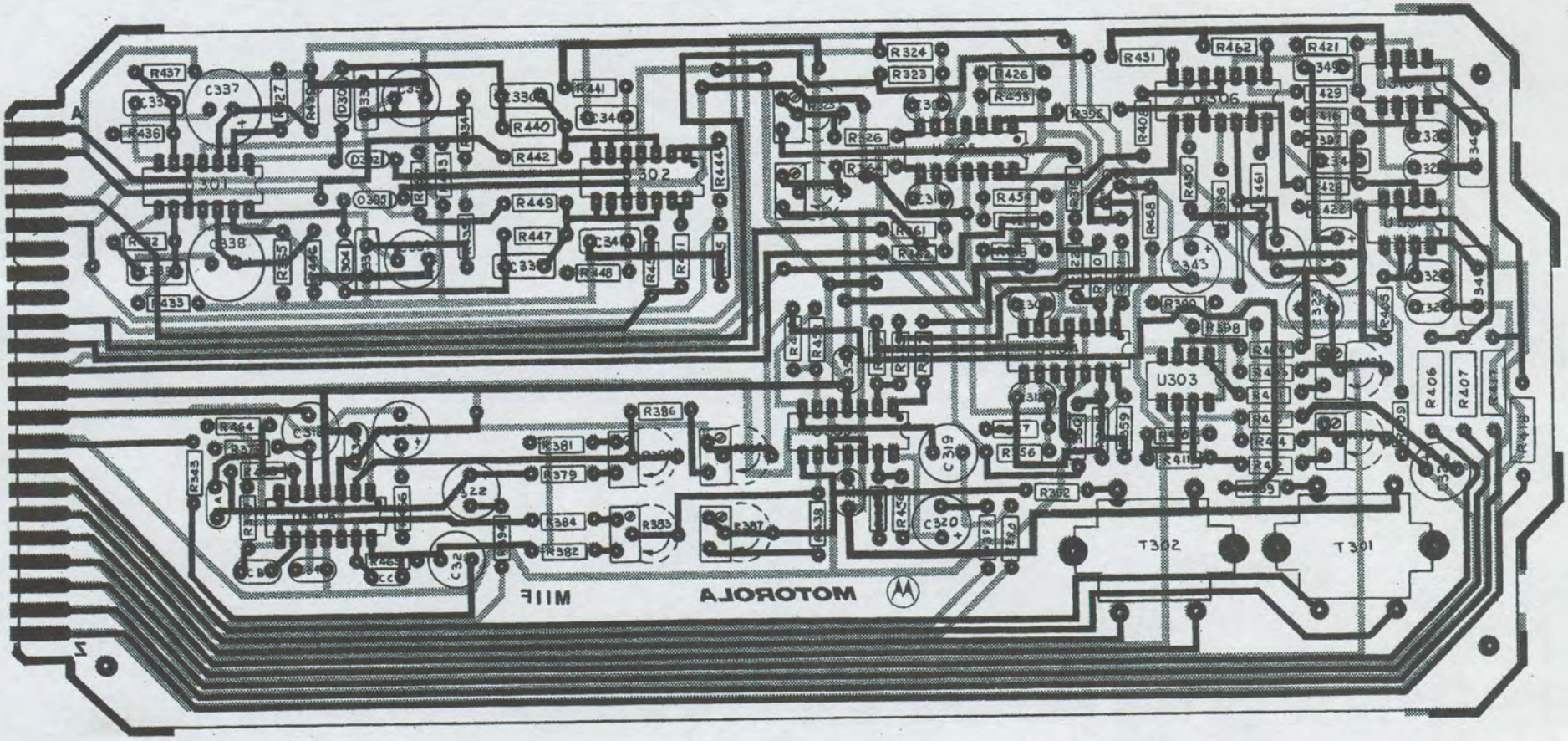
LEFT METER CHANNEL

RIGHT METER CHANNEL

LEFT PEAK INDICATOR CIRCUIT

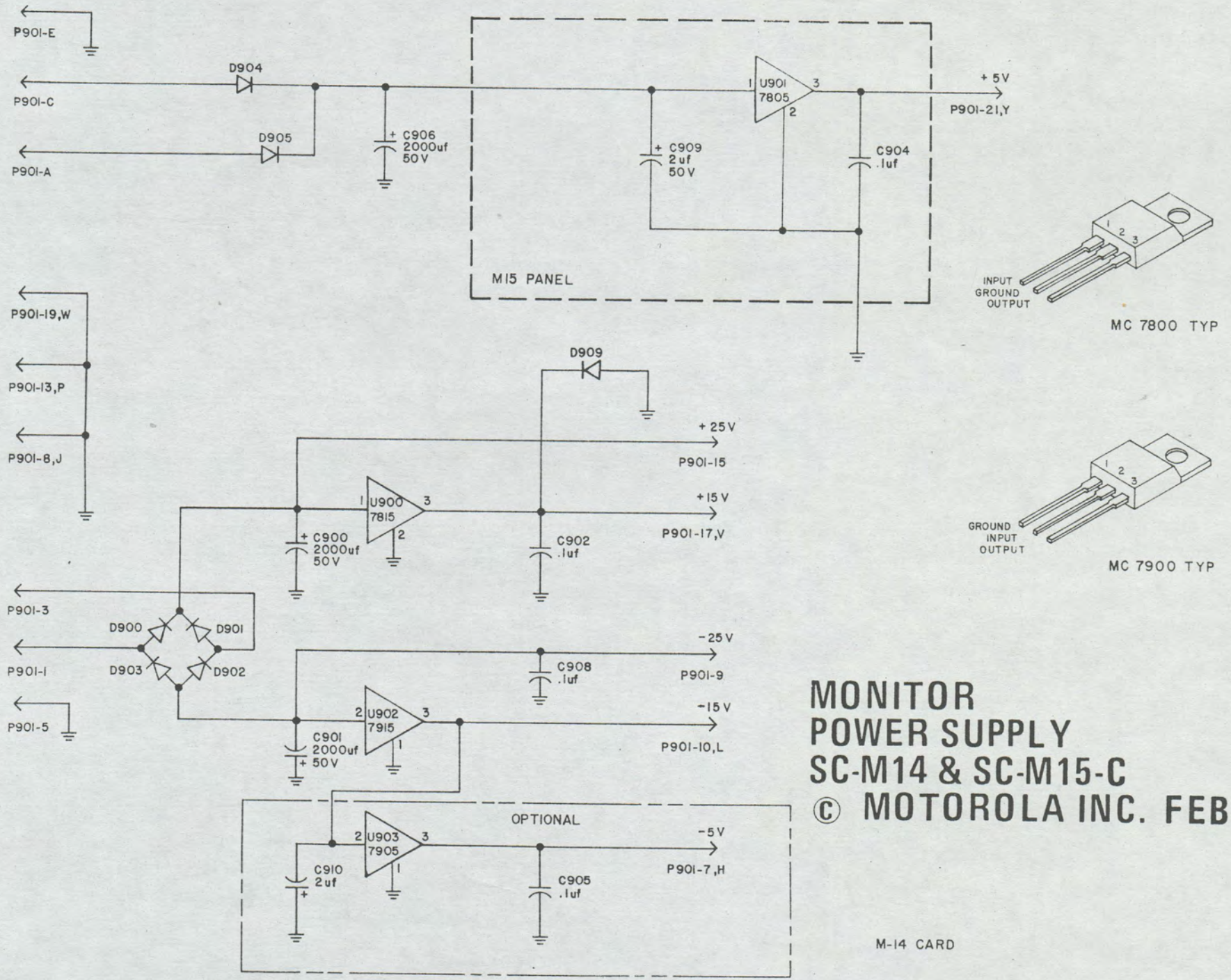
RIGHT PEAK INDICATOR CIRCUIT

BOTTOM VIEW



MONITOR METER CIRCUIT CARD M11F

COMPONENT VIEW

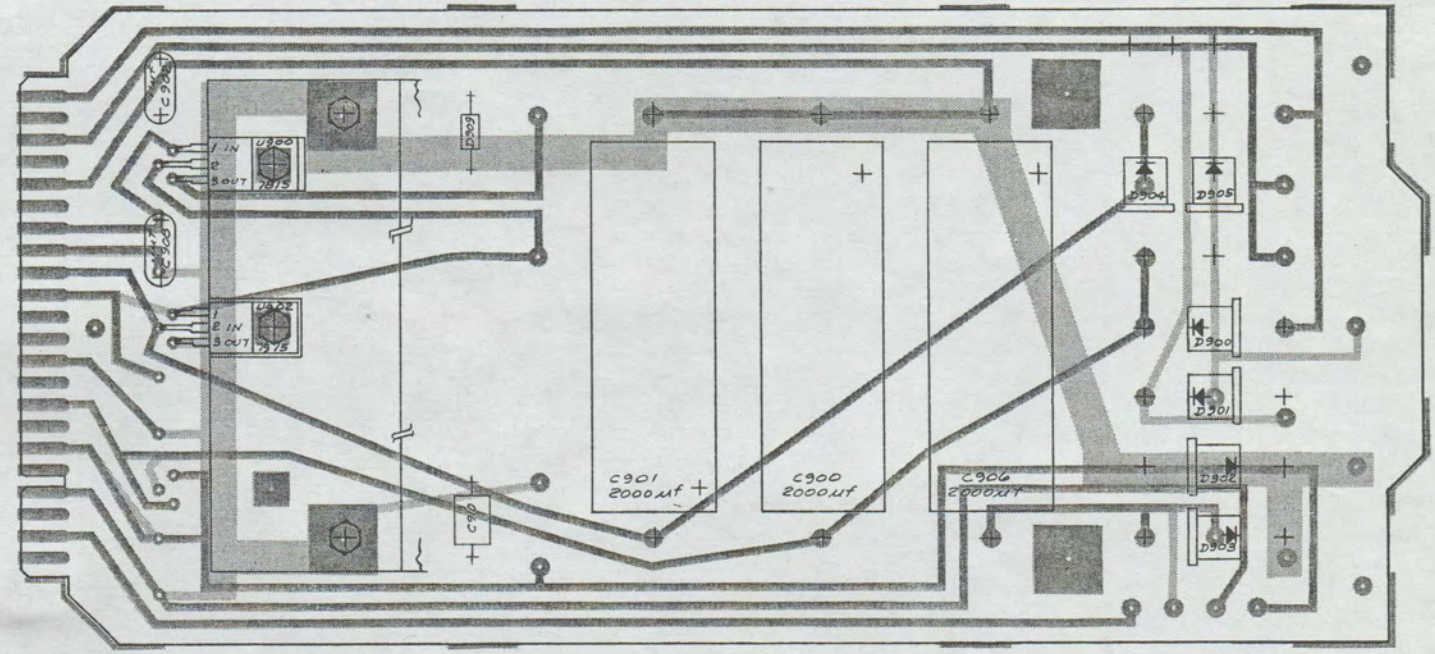


MC 7800 TYP

MC 7900 TYP

MONITOR POWER SUPPLY SC-M14 & SC-M15-C

M-14 CARD



MONITOR POWER SUPPLY CIRCUIT CARD M14A & M15A
COMPONENT VIEW

MONITOR WIRING DIAGRAM

WD-M20-M

FRONT PANEL POINT TO POINT WIRING
(LEADS NOS. 200 TO 239)
24 AWG R/O UNLESS LABELED OTHERWISE.

FIG. A – LEAD CONVENTIONS.

EXCITER PARTS LIST

REC#	AS	ID	PN	VAL	X	TYPE	DESCR
1		D701	48D88245C04	.0000		DIODE	LED RED
2		D702	48-88245C09	.0000		DIODE	LED YELLOW
3		D703	48-88245C06	.0000		DIODE	LED GREEN
4		M701	591C42-20B	.0000		METER	PANEL MODULATION
5		M702	591C42-20B	.0000		METER	PANEL MODULATION
6		S701	57005-03	.0000		SWITCH	DPDT ROCKER
7		S702	07-A-108	.0000		SWITCH	PB DPDT 2 SECT SHAD.
8		S703				SWITCH	PB DPDT ATT. S702
9		S704	07-A-109	.0000		SWITCH	PB DPDT 2 SECT SHAD.
10		S705				SWITCH	PB DPDT ATT. S704
11	ETB	R551	EMF-1/4-249	249.0000		RESIST	1/8W 1% 50PPM
12	ETB	R552	EMF-1/4-249	249.0000		RESIST	1/8W 1% 50PPM
13	ETB	R553	EMF-1/4-249	249.0000		RESIST	1/8W 1% 50PPM
14	ETB	R554	EMF-1/4-249	249.0000		RESIST	1/8W 1% 50PPM
15	ETB	R555	EMF-1/4-113	113.0000		RESIST	1/8W 1% 50PPM
16	ETB	R556	EMF-1/4-113	113.0000		RESIST	1/8W 1% 50PPM
17	ETB	T701	67F5848	5.0000	K	TRIMPOT	CERMET 25T
18	ETB	T702	67F5848	5.0000	K	TRIMPOT	CERMET 25T
19	ETB	T703	M47A258A	.0000		TRANNSF	AUDIO 600 OHM MARVEL
20	ETB	T704	F-54X	.0000		TRANSF	POWER TRIAD-UTRAD
21	E1	C101	21K865440	180.0000	P	CAP	MICA 5% 300V DM5
22	E1	C102	23-11019A46	100.0000	U	CAP	LYTIC 25V
23	E1	C103	8S11017A14	.0470	U	CAP	MYLAR 50V 5%
24	E1	C104	21K865440	180.0000	P	CAP	MICA 5% 300V DM5
25	E1	C105	21-84494B41	24.0000	P	CAP	MICA 5% 300V DM5
26	E1	C106	21R40020S03	.1000	U	CAP	CERAMIC 50V 20% Z5U
27	E1	C107	21R40020S03	.1000	U	CAP	CERAMIC 50V 20% Z5U
28	E1	C108	21R40020S03	.1000	U	CAP	CERAMIC 50V 20% Z5U
29	E1	C109	21R40020S03	.1000	U	CAP	CERAMIC 50V 20% Z5U
30	E1	C110	21R40020S03	.1000	U	CAP	CERAMIC 50V 20% Z5U
31	E1	C111	21R40020S03	.1000	U	CAP	CERAMIC 50V 20% Z5U
32	E1	C112	21D82133G03	100.0000	P	CAP	DISC 500V 5% N750
33	E1	C113	21D82133G03	100.0000	P	CAP	DISC 500V 5% N750
34	E1	C114	21D82133G03	100.0000	P	CAP	DISC 500V 5% N750
35	E1	C115	21D82133G03	100.0000	P	CAP	DISC 500V 5% N750
36	E1	C116	21D82133G03	100.0000	P	CAP	DISC 500V 5% N750
37	E1	C117	21D82133G03	100.0000	P	CAP	DISC 500V 5% N750
38	E1	C118	21D82133G03	100.0000	P	CAP	DISC 500V 5% N750
39	E1	C119	21D82133G03	100.0000	P	CAP	DISC 500V 5% N750
40	E1	C120	CY2-027PT	335.0000	U	TUN.CAP	TUNING DUAL
41	E1	C125	21R40020S14	.4700	U	CAP	CERAMIC 100V 20% Z5U
42	E1	C126	21R40020S14	.4700	U	CAP	CERAMIC 100V 20% Z5U
43	E1	C130	*	30.0000	P	CAP	MICA 5% 300V DM5
44	E1	C131	21-84494B41	24.0000	P	CAP	MICA 5% 300V DM5
45	E1	C132	8D82905G11	.2200	U	CAP	MYLAR 50V 10%
46	E1	C135	8S11017A03	.0022	U	CAP	MYLAR 50V 5%
47	E1	C136	8-11017A17	.1000	U	CAP	MYLAR 50V 5%
48	E1	C137	8-11017A17	.1000	U	CAP	MYLAR 50V 5%
49	E1	C138	8-11017A17	.1000	U	CAP	MYLAR 50V 5%
50	E1	C139	8-11017A17	.1000	U	CAP	MYLAR 50V 5%
51	E1	C140	21R40020S03	.1000	U	CAP	CERAMIC 50V 20% Z5U
52	E1	C141	21R40020S03	.1000	U	CAP	CERAMIC 50V 20% Z5U
53	E1	C143	8D82905G11	.2200	U	CAP	MYLAR 50V 10%
54	E1	C144	8D82905G11	.2200	U	CAP	MYLAR 50V 10%
55	E1	C145	8D82905G11	.2200	U	CAP	MYLAR 50V 10%
56	E1	C146	21D82187B08	220.0000	P	CAP	DISC 1KV 10% Z5F

EXCITER PARTS LIST

REC#	AS	ID	PN	VAL	X	TYPE	DESCR
57	E1	C147	GXB18000	18.0000	P	TRIMCAP	6-18 PFD
58	E1	C150	8S11017A14	.0470	U	CAP	MYLAR 50V 5%
59	E1	C151	81F3650	18.0000	P	TRIMCAP	5.5-18 PFD
60	E1	C152	*	33.0000	P	CAP	MICA 5% 300V DM5
61	E1	C155	21D82133G03	100.0000	P	CAP	DISC 500V 5% N750
62	E1	C156	21D82133G03	100.0000	P	CAP	DISC 500V 5% N750
63	E1	C157	21R40020S14	.4700	U	CAP	CERAMIC 100V 20% Z5U
64	E1	C158	8-11017A08	.0100	U	CAP	5%
65	E1	C159	21R40020S03	.1000	U	CAP	CERAMIC 50V 20% Z5U
66	E1	C162	21R40020S14	.4700	U	CAP	CERAMIC 100V 20% Z5U
67	E1	C163	23D84908S01	2.2000	U	CAP	LYTIC ALU 50V NONPOL
68	E1	D101	1N4148	.0000		DIODE	SIGNAL ITT
69	E1	D102	1N4148	.0000		DIODE	SIGNAL ITT
70	E1	D103	1N4148	.0000		DIODE	SIGNAL ITT
71	E1	D104	1N4148	.0000		DIODE	SIGNAL ITT
72	E1	D105	1N4148	.0000		DIODE	SIGNAL ITT
73	E1	D106	1N4148	.0000		DIODE	SIGNAL ITT
74	E1	D107	1N4148	.0000		DIODE	SIGNAL ITT
75	E1	D108	1N4148	.0000		DIODE	SIGNAL ITT
76	E1	Q101	48R00869878	.0000		TRANSIST	FET 9878
77	E1	Q102	48R00869570	.0000		TRANSIST	NPN 9570
78	E1	Q103	48R00869571	.0000		TRANSIST	PNP 9571
79	E1	Q104	48R00869571	.0000		TRANSIST	PNP 9571
80	E1	Q105	48R00869570	.0000		TRANSIST	NPN 9570
81	E1	Q106	48R00869570	.0000		TRANSIST	NPN 9570
82	E1	Q107	48R00869570	.0000		TRANSIST	NPN 9570
83	E1	Q108	48R00869571	.0000		TRANSIST	PNP 9571
84	E1	Q109	48R00869570	.0000		TRANSIST	NPN 9570
85	E1	Q110	48R00869570	.0000		TRANSIST	NPN 9570
86	E1	Q111	48R00869571	.0000		TRANSIST	PNP 9571
87	E1	Q112	48R00869571	.0000		TRANSIST	PNP 9571
88	E1	Q113	48R00869878	.0000		TRANSIST	FET 9878
89	E1	Q114	48R00869570	.0000		TRANSIST	NPN 9570
90	E1	Q115	48R00869570	.0000		TRANSIST	NPN 9570
91	E1	R101	6S11009C97	100.0000	K	RESIST	FCF 1/4W 5%
92	E1	R102	6S11009C25	100.0000		RESIST	FCF 1/4W 5%
93	E1	R103	6S11009C49	1.0000	K	RESIST	FCF 1/4W 5%
94	E1	R104	6S11009C73	10.0000	K	RESIST	FCF 1/4W 5%
95	E1	R105	6S11009C87	39.0000	K	RESIST	FCF 1/4W 5%
96	E1	R106	6S11009C19	56.0000		RESIST	FCF 1/4W 5%
97	E1	R107	6S11009C19	56.0000		RESIST	FCF 1/4W 5%
98	E1	R108	6S11009C09	22.0000		RESIST	FCF 1/4W 5%
99	E1	R109	6S11009C09	22.0000		RESIST	FCF 1/4W 5%
100	E1	R110	6S11009C37	330.0000		RESIST	FCF 1/4W 5%
101	E1	R111	6S11009C19	56.0000		RESIST	FCF 1/4W 5%
102	E1	R112	6S11009C19	56.0000		RESIST	FCF 1/4W 5%
103	E1	R113	6S11009C09	22.0000		RESIST	FCF 1/4W 5%
104	E1	R114	6S11009C09	22.0000		RESIST	FCF 1/4W 5%
105	E1	R115	6S11009C37	330.0000		RESIST	FCF 1/4W 5%
106	E1	R116	6S11009C46	750.0000		RESIST	FCF 1/4W 5%
107	E1	R117	3006P-001-101	100.0000		TRIMPOT	CERMET 15T
108	E1	R118	6S11009C41	470.0000		RESIST	FCF 1/4W 5%
109	E1	R119	6S11009C49	1.0000	K	RESIST	FCF 1/4W 5%
110	E1	R120	6S11009C51	1.2000	K	RESIST	FCF 1/4W 5%
111	E1	R121	6S11009C59	2.7000	K	RESIST	FCF 1/4W 5%

EXCITER PARTS LIST

REC#	AS	ID	PN	VAL	X	TYPE	DESCR
112	E1	R122	6S11009C43	560.0000		RESIST	FCF 1/4W 5%
113	E1	R123	3006-001-102	1.0000	K	TRIMPOT	CERMET 15T
114	E1	R124	6S11009C71	8.2000	K	RESIST	FCF 1/4W 5%
115	E1	R125	6S11009C43	560.0000		RESIST	FCF 1/4W 5%
116	E1	R126	6S11009C25	100.0000		RESIST	FCF 1/4W 5%
117	E1	R127	6S11009C25	100.0000		RESIST	FCF 1/4W 5%
118	E1	R128	6S11009C46	750.0000		RESIST	FCF 1/4W 5%
119	E1	R129	3006P-001-101	100.0000		TRIMPOT	CERMET 15T
120	E1	R130	6S11009C51	1.2000	K	RESIST	FCF 1/4W 5%
121	E1	R131	6S11009C41	470.0000		RESIST	FCF 1/4W 5%
122	E1	R132	6S11009C49	1.0000	K	RESIST	FCF 1/4W 5%
123	E1	R133	6S11009C81	22.0000	K	RESIST	FCF 1/4W 5%
124	E1	R134	6S11009C33	220.0000		RESIST	FCF 1/4 W 5%
125	E1	R135	3006P-001-101	100.0000		TRIMPOT	CERMET 15T
126	E1	R136	6S11009C41	470.0000		RESIST	FCF 1/4W 5%
127	E1	R137	6S11009C81	22.0000	K	RESIST	FCF 1/4W 5%
128	E1	R138	6S11009C33	220.0000		RESIST	FCF 1/4 W 5%
129	E1	R139	6S11009C25	100.0000		RESIST	FCF 1/4W 5%
130	E1	R140	6S11009C25	100.0000		RESIST	FCF 1/4W 5%
131	E1	R141	6S11009C63	3.9000	K	RESIST	FCF 1/4W 5%
132	E1	R142	6S11009C63	3.9000	K	RESIST	FCF 1/4W 5%
133	E1	R144	6S11009C73	10.0000	K	RESIST	FCF 1/4W 5%
134	E1	R146	6S11009C65	4.7000	K	RESIST	FCF 1/4W 5%
135	E1	R147	6S11009C37	330.0000		RESIST	FCF 1/4W 5%
136	E1	R148	6S11009C59	2.7000	K	RESIST	FCF 1/4W 5%
137	E1	R149	6S11009C37	330.0000		RESIST	FCF 1/4W 5%
138	E1	R151	6S11009C47	820.0000		RESIST	FCF 1/4W 5%
139	E1	R152	6S11009C59	2.7000	K	RESIST	FCF 1/4W 5%
140	E1	R153	6S11009C57	2.2000	K	RESIST	FCF 1/4W 5%
141	E1	R154	6S11009C17	47.0000		RESIST	FCF 1/4W 5%
142	E1	R155	3006-001-102	1.0000	K	TRIMPOT	CERMET 15T
143	E1	R156	6S11009C59	2.7000	K	RESIST	FCF 1/4W 5%
144	E1	R157	6S11009C57	2.2000	K	RESIST	FCF 1/4W 5%
145	E1	R158	3006P-001-502	5.0000	K	TRIMPOT	CERMET 15T
146	E1	R159	6S11009C37	330.0000		RESIST	FCF 1/4W 5%
147	E1	R161	6S11009C47	820.0000		RESIST	FCF 1/4W 5%
148	E1	R162	6S11009C37	330.0000		RESIST	FCF 1/4W 5%
149	E1	R163	6S11009C59	2.7000	K	RESIST	FCF 1/4W 5%
150	E1	R164	6S11009C65	4.7000	K	RESIST	FCF 1/4W 5%
151	E1	R165	6S11009C41	470.0000		RESIST	FCF 1/4W 5%
152	E1	R166	6S11009C41	470.0000		RESIST	FCF 1/4W 5%
153	E1	R167	6S11009C09	22.0000		RESIST	FCF 1/4W 5%
154	E1	R168	6S11009C63	3.9000	K	RESIST	FCF 1/4W 5%
155	E1	R169	6S11009C57	2.2000	K	RESIST	FCF 1/4W 5%
156	E1	R170	6S11009C49	1.0000	K	RESIST	FCF 1/4W 5%
157	E1	R171	6S11009C09	22.0000		RESIST	FCF 1/4W 5%
158	E1	R172	6S11009C63	3.9000	K	RESIST	FCF 1/4W 5%
159	E1	R173	6S11009C35	270.0000		RESIST	FCF 1/4W 5%
160	E1	R174	6S11009C35	270.0000		RESIST	FCF 1/4W 5%
161	E1	R175	6S11009C73	10.0000	K	RESIST	FCF 1/4W 5%
162	E1	R176	6S11009C69	6.8000	K	RESIST	FCF 1/4W 5%
163	E1	R177	6S11009C69	6.8000	K	RESIST	FCF 1/4W 5%
164	E1	R178	6S11009C61	3.3000	K	RESIST	FCF 1/4W 5%
165	E1	R179	6S11009C57	2.2000	K	RESIST	FCF 1/4W 5%
166	E1	R180	6S11009C57	2.2000	K	RESIST	FCF 1/4W 5%
167	E1	R181	6S11009C73	10.0000	K	RESIST	FCF 1/4W 5%

EXCITER PARTS LIST

REC#	AS	ID	PN	VAL	X	TYPE	DESCR
168	E1	R182	6S11009C35	270.0000		RESIST	FCF 1/4W 5%
169	E1	R183	6S11009C59	2.7000	K	RESIST	FCF 1/4W 5%
170	E1	R184	6S11009C21	68.0000		RESIST	FCF 1/4W 5%
171	E1	R185	6S11009C65	4.7000	K	RESIST	FCF 1/4W 5%
172	E1	R186	6S11009C09	22.0000		RESIST	FCF 1/4W 5%
173	E1	R187	6S11009C09	22.0000		RESIST	FCF 1/4W 5%
174	E1	R188	6S11009C21	68.0000		RESIST	FCF 1/4W 5%
175	E1	R189	6S11009C65	4.7000	K	RESIST	FCF 1/4W 5%
176	E1	R190	6S11009C35	270.0000		RESIST	FCF 1/4W 5%
177	E1	R191	6S11009C59	2.7000	K	RESIST	FCF 1/4W 5%
178	E1	R192	*	22.0000	M	RESIST	FCF 1/4W 5%
179	E1	R193	6S11009D06	220.0000	K	RESIST	FCF 1/4W 5%
180	E1	R194	6S11009C65	4.7000	K	RESIST	FCF 1/4W 5%
181	E1	R195	6S11009C49	1.0000	K	RESIST	FCF 1/4W 5%
182	E1	R196	6S11009C73	10.0000	K	RESIST	FCF 1/4W 5%
183	E1	R197	6S11009C65	4.7000	K	RESIST	FCF 1/4W 5%
184	E1	R198	6S11009D12	390.0000	K	RESIST	FCF 1/4W 5%
185	E1	R199	6S11009C46	750.0000		RESIST	FCF 1/4W 5%
186	E1	R200	3006P-001-101	100.0000		TRIMPOT	CERMET 15T
187	E1	R201	6S11009C41	470.0000		RESIST	FCF 1/4W 5%
188	E1	R202	6S11009C49	1.0000	K	RESIST	FCF 1/4W 5%
189	E1	R203	6S11009C81	22.0000	K	RESIST	FCF 1/4W 5%
190	E1	R204	6S11009C33	220.0000		RESIST	FCF 1/4 W 5%
191	E1	R205	3006P-001-101	100.0000		TRIMPOT	CERMET 15T
192	E1	R206	6S11009C41	470.0000		RESIST	FCF 1/4W 5%
193	E1	R207	6S11009C81	22.0000	K	RESIST	FCF 1/4W 5%
194	E1	R208	6S11009C33	220.0000		RESIST	FCF 1/4 W 5%
195	E1	R209	6S11009C66	5.1000	K	RESIST	FCF 1/4W 5%
196	E1	R210	6S11009D20	820.0000	K	RESIST	FCF 1/4W 5%
197	E1	R211	6S11009D12	390.0000	K	RESIST	FCF 1/4W 5%
198	E1	R212	6S11009C66	5.1000	K	RESIST	FCF 1/4W 5%
199	E1	R213	6S11009C51	1.2000	K	RESIST	FCF 1/4W 5%
200	E1	R214	6S11009C25	100.0000		RESIST	FCF 1/4W 5%
201	E1	R215	6S11009C25	100.0000		RESIST	FCF 1/4W 5%
202	E1	R216	6S11009D20	820.0000	K	RESIST	FCF 1/4W 5%
203	E1	R217	3006P-001-502	5.0000	K	TRIMPOT	CERMET 15T
204	E1	R218	6S11009C65	4.7000	K	RESIST	FCF 1/4W 5%
205	E1	R222	6S11009C43	560.0000		RESIST	FCF 1/4W 5%
206	E1	R223	6S11009C49	1.0000	K	RESIST	FCF 1/4W 5%
207	E1	R224	6S11009C35	270.0000		RESIST	FCF 1/4W 5%
208	E1	R225	6S11009C01	10.0000		RESIST	FCF 1/4W 5%
209	E1	R226	6S11009C97	100.0000	K	RESIST	FCF 1/4W 5%
210	E1	R227	6S11009C53	1.5000	K	RESIST	FCF 1/4W 5%
211	E1	R228	6S11009C53	1.5000	K	RESIST	FCF 1/4W 5%
212	E1	R229	6S11009C35	270.0000		RESIST	FCF 1/4W 5%
213	E1	R230	6S11009C35	270.0000		RESIST	FCF 1/4W 5%
214	E1	R231	6S11009C57	2.2000	K	RESIST	FCF 1/4W 5%
215	E1	R232	6S11009C65	4.7000	K	RESIST	FCF 1/4W 5%
216	E1	T101	82-0984	.0000		TRANSF	RF BELTRONICS
217	E1	T102	82-0984	.0000		TRANSF	RF BELTRONICS
218	E1	U101	MC10131L	.0000		IC	D FF DUAL
219	E1	U102	MC1596L	.0000		IC	BALANCED MODULATOR
220	E1	U103	MC1596L	.0000		IC	BALANCED MODULATOR
221	E1	U104	MC1596L	.0000		IC	BALANCED MODULATOR
222	E1	U105	CA3054	.0000		IC	TRANSISTOR ARRAY
223	E1	U106	MC14040B	.0000		IC	RRIPPLE CTR

EXCITER PARTS LIST

REC#	AS	ID	PN	VAL	X	TYPE	DESCR
224	E1	U107	TL082CP	.0000		IC	OP. AMP. DUAL
225	E1	X101	61A590A42-1	.0000		XTAL	4XSTAT.FREQ.
226	E1	X102	48-80055C01	.0000		XTAL	WATCH
227	E2	C305	21R40020S04	.0100	U	CAP	CERAMIC 50V 20% Z5U
228	E2	C306	8S11017A11	.0220	U	CAP	MYLAR 50V 5%
229	E2	C307	8-11017A08	.0100	U	CAP	5%
230	E2	C309	*	.3300	U	CAP	MYLAR 50V 5%
231	E2	C310	*	.3300	U	CAP	MYLAR 50V 5%
232	E2	C311	21R40020S03	.1000	U	CAP	CERAMIC 50V 20% Z5U
233	E2	C312	*	2.2000	U	CAP	MYLAR 250V 10%
234	E2	C313	*	2.2000	U	CAP	MYLAR 250V 10%
235	E2	C318	21R40020S04	.0100	U	CAP	CERAMIC 50V 20% Z5U
236	E2	C319	8S11017A11	.0220	U	CAP	MYLAR 50V 5%
237	E2	C320	8-11017A08	.0100	U	CAP	5%
238	E2	C321	21R40020S03	.1000	U	CAP	CERAMIC 50V 20% Z5U
239	E2	C322	*	.3300	U	CAP	MYLAR 50V 5%
240	E2	C323	*	.3300	U	CAP	MYLAR 50V 5%
241	E2	C324	*	2.2000	U	CAP	MYLAR 250V 10%
242	E2	C325	*	2.2000	U	CAP	MYLAR 250V 10%
243	E2	C326	21R40020S03	.1000	U	CAP	CERAMIC 50V 20% Z5U
244	E2	C327	21R40020S03	.1000	U	CAP	CERAMIC 50V 20% Z5U
245	E2	C330	21R40020S03	.1000	U	CAP	CERAMIC 50V 20% Z5U
246	E2	C331	21R40020S03	.1000	U	CAP	CERAMIC 50V 20% Z5U
247	E2	C333	21R40020S03	.1000	U	CAP	CERAMIC 50V 20% Z5U
248	E2	C337	21R40020S03	.1000	U	CAP	CERAMIC 50V 20% Z5U
249	E2	C338	8S11017A03	.0022	U	CAP	MYLAR 50V 5%
250	E2	C339	23D84538G02	4.7000	U	CAP	TANTULUM 20V 20%
251	E2	C340	21R40020S03	.1000	U	CAP	CERAMIC 50V 20% Z5U
252	E2	C341	8S11017A03	.0022	U	CAP	MYLAR 50V 5%
253	E2	C342	23D84538G02	4.7000	U	CAP	TANTULUM 20V 20%
254	E2	C344	21R40020S03	.1000	U	CAP	CERAMIC 50V 20% Z5U
255	E2	C348	21R40020S03	.1000	U	CAP	CERAMIC 50V 20% Z5U
256	E2	C349	21R40020S03	.1000	U	CAP	CERAMIC 50V 20% Z5U
257	E2	C350	21R40020S03	.1000	U	CAP	CERAMIC 50V 20% Z5U
258	E2	C351	8-11017A08	.0100	U	CAP	5%
259	E2	C353	21R40020S03	.1000	U	CAP	CERAMIC 50V 20% Z5U
260	E2	C354	21R40020S03	.1000	U	CAP	CERAMIC 50V 20% Z5U
261	E2	D301	1N4148	.0000		DIODE	SIGNAL ITT
262	E2	D302	1N4148	.0000		DIODE	SIGNAL ITT
263	E2	D303	1N4148	.0000		DIODE	SIGNAL ITT
264	E2	D304	1N4148	.0000		DIODE	SIGNAL ITT
265	E2	D305	1N4148	.0000		DIODE	SIGNAL ITT
266	E2	D306	1N4148	.0000		DIODE	SIGNAL ITT
267	E2	D307	1N4148	.0000		DIODE	SIGNAL ITT
268	E2	D308	1N4148	.0000		DIODE	SIGNAL ITT
269	E2	D309	1N4148	.0000		DIODE	SIGNAL ITT
270	E2	D310	1N4148	.0000		DIODE	SIGNAL ITT
271	E2	R301	6S11009C17	47.0000		RESIST	FCF 1/4W 5%
272	E2	R302A	81A20B16A10A10	1.0000	K	POT	4 SECT CERMET
273	E2	R302B		.0000		POT	SEE R302A
274	E2	R302C		.0000		POT	SEE R302A
275	E2	R302D		.0000		POT	SEE R302A
276	E2	R303	6S11009C17	47.0000		RESIST	FCF 1/4W 5%
277	E2	R304A	81A20B16A20A20	100.0000	K	POT	4SECT CERMET
278	E2	R304B		.0000		POT	SEE R304A
279	E2	R304C		.0000		POT	SEE R304A

EXCITER PARTS LIST

REC#	AS	ID	PN	VAL	X	TYPE	DESCR
280	E2	R304D		.0000		POT	SEE R304A
281	E2	R305	6S11009C80	20.0000	K	RESIST	FCF 1/4W 5%
282	E2	R306	6S11009C80	20.0000	K	RESIST	FCF 1/4W 5%
283	E2	R307	6S11009C80	20.0000	K	RESIST	FCF 1/4W 5%
284	E2	R307A	81A2DB16A13A18	50.0000	K	POT	2 SECT CERMET
285	E2	R307B				POT	SEE R307A
286	E2	R307C				POT	SEE R307A
287	E2	R307D				POT	SEE R307A
288	E2	R308	6S110C9C73	10.0000	K	RESIST	FCF 1/4W 5%
289	E2	R309	6S110C9C50	1.1000	K	RESIST	FCF 1/4W 5%
290	E2	R310	6S11009C82	24.0000	K	RESIST	FCF 1/4W 5%
291	E2	R311	6S11009C17	47.0000		RESIST	FCF 1/4W 5%
292	E2	R312	6S11009C17	47.0000		RESIST	FCF 1/4W 5%
293	E2	R313	6S11009C80	20.0000	K	RESIST	FCF 1/4W 5%
294	E2	R314	6S11009C80	20.0000	K	RESIST	FCF 1/4W 5%
295	E2	R315	6S11009C73	10.0000	K	RESIST	FCF 1/4W 5%
296	E2	R316	6S11009C50	1.1000	K	RESIST	FCF 1/4W 5%
297	E2	R317	6S11009C82	24.0000	K	RESIST	FCF 1/4W 5%
298	E2	R318	EMF-1/4-10.2K	10.2000	K	RESIST	1/8W 1% 50PPM
299	E2	R319	EMF-1/4-10.2K	10.2000	K	RESIST	1/8W 1% 50PPM
300	E2	R320	3006-001-102	1.0000	K	TRIMPOT	CERMET 15T
301	E2	R321	EMF-1/4-19.6K	19.6000	K	RESIST	1/8W 1% 50PPM
302	E2	R322	3006P-001-502	5.0000	K	TRIMPOT	CERMET 15T
303	E2	R323	6S11009C27	120.0000		RESIST	FCF 1/4W 5%
304	E2	R324	6S11009C89	47.0000	K	RESIST	FCF 1/4W 5%
305	E2	R325	6S11009C43	560.0000		RESIST	FCF 1/4W 5%
306	E2	R326	EMF-1/4-205	205.0000		RESIST	1/8W 1% 50PPM
307	E2	R327	6S11009D14	470.0000	K	RESIST	FCF 1/4W 5%
308	E2	R329	EMF-1/4-1K	1.0000	K	RESIST	1/8W 1% 50PPM
309	E2	R330	EMF-1/4-10.2K	10.2000	K	RESIST	1/8W 1% 50PPM
310	E2	R331	EMF-1/4-10.2K	10.2000	K	RESIST	1/8W 1% 50PPM
311	E2	R332	EMF-1/4-10.2K	10.2000	K	RESIST	1/8W 1% 50PPM
312	E2	R333	EMF-1/4-10.2K	10.2000	K	RESIST	1/8W 1% 50PPM
313	E2	R334	3006-001-102	1.0000	K	TRIMPOT	CERMET 15T
314	E2	R335	EMF-1/4-10.2K	10.2000	K	RESIST	1/8W 1% 50PPM
315	E2	R336	EMF-1/4-19.6K	19.6000	K	RESIST	1/8W 1% 50PPM
316	E2	R337	3006P-001-502	5.0000	K	TRIMPOT	CERMET 15T
317	E2	R338	EMF-1/4-1K	1.0000	K	RESIST	1/8W 1% 50PPM
318	E2	R339	EMF-1/4-51.1	51.1000		RESIST	1/8W 1% 50PPM
319	E2	R340	EMF-1/4-10.2K	10.2000	K	RESIST	1/8W 1% 50PPM
320	E2	R341	EMF-1/4-10.2K	10.2000	K	RESIST	1/8W 1% 50PPM
321	E2	R342	3006-001-102	1.0000	K	TRIMPOT	CERMET 15T
322	E2	R343	EMF-1/4-17.8K	17.8000	K	RESIST	1/8W 1% 50PPM
323	E2	R344	3006P-001-502	5.0000	K	TRIMPOT	CERMET 15T
324	E2	R345	EMF-1/4-93.1K	93.1000	K	RESIST	1/8W 1% 50PPM
325	E2	R345	6S11009C27	120.0000		RESIST	FCF 1/4W 5%
326	E2	R346	6S11009C89	47.0000	K	RESIST	FCF 1/4W 5%
327	E2	R347	EMF-1/4-51.1	51.1000		RESIST	1/8W 1% 50PPM
328	E2	R348	EMF-1/4-93.1K	93.1000	K	RESIST	1/8W 1% 50PPM
329	E2	R349	6S11009D14	470.0000	K	RESIST	FCF 1/4W 5%
330	E2	R350	EMF-1/4-47.5K	47.5000	K	RESIST	1/8W 1% 50PPM
331	E2	R351	3006-001-102	1.0000	K	TRIMPOT	CERMET 15T
332	E2	R352	EMF-1/4-2.2K	2.2000	K	RESIST	1/8W 1% 50PPM
333	E2	R353	6S11009C63	3.9000	K	RESIST	FCF 1/4W 5%
334	E2	R357	6S11009C65	4.7000	K	RESIST	FCF 1/4W 5%
335	E2	R358	EMF-1/4-47.5K	47.5000	K	RESIST	1/8W 1% 50PPM
336	E2	R359	3006-001-102	1.0000	K	TRIMPOT	CERMET 15T

EXCITER PARTS LIST

REC#	AS	ID	PN	VAL	X	TYPE	DESCR
337	E2	R360	EMF-1/4-2.2K	2.2000	K	RESIST	1/8W 1% 50PPM
338	E2	R361	6S11009C63	3.9000	K	RESIST	FCF 1/4W 5%
339	E2	R365	6S11009C65	4.7000	K	RESIST	FCF 1/4W 5%
340	E2	R366	EMF-1/4W-511	511.0000		RESIST	1/8W 1% 50PPM
341	E2	R367	EMF-1/4-21.5K	21.5000	K	RESIST	1/8W 1% 50PPM
342	E2	R368	EMF-1/4-93.1K	93.1000	K	RESIST	1/8W 1% 50PPM
343	E2	R369	6S11009C27	120.0000		RESIST	FCF 1/4W 5%
344	E2	R370	6S11009C89	47.0000	K	RESIST	FCF 1/4W 5%
345	E2	R371	6S11009D14	470.0000	K	RESIST	FCF 1/4W 5%
346	E2	R373	6S11009C89	47.0000	K	RESIST	FCF 1/4W 5%
347	E2	R374	6S11009D14	470.0000	K	RESIST	FCF 1/4W 5%
348	E2	R377	EMF-1/4-4.64K	4.6400	K	RESIST	1/8W 1% 50PPM
349	E2	R378	3006P-001-502	5.0000	K	TRIMPOT	CERMET 15T
350	E2	R379	EMF-1/4-1K	1.0000	K	RESIST	1/8W 1% 50PPM
351	E2	R380	6S11009C89	47.0000	K	RESIST	FCF 1/4W 5%
352	E2	R381	6S11009D14	470.0000	K	RESIST	FCF 1/4W 5%
353	E2	R382	EMF-1/4-205	205.0000		RESIST	1/8W 1% 50PPM
354	E2	R383	EMF-1/4-21.5K	21.5000	K	RESIST	1/8W 1% 50PPM
355	E2	R384	6S11009C89	47.0000	K	RESIST	FCF 1/4W 5%
356	E2	R385	6S11009D14	470.0000	K	RESIST	FCF 1/4W 5%
357	E2	R386	EMF-1/4-205	205.0000		RESIST	1/8W 1% 50PPM
358	E2	R387	EMF-1/4-205	205.0000		RESIST	1/8W 1% 50PPM
359	E2	R389	3006-001-102	1.0000	K	TRIMPOT	CERMET 15T
360	E2	R390	6S11009C63	3.9000	K	RESIST	FCF 1/4W 5%
361	E2	R391	3006-001-102	1.0000	K	TRIMPOT	CERMET 15T
362	E2	R392	6S11009C63	3.9000	K	RESIST	FCF 1/4W 5%
363	E2	R393	EMF-1/4-205	205.0000		RESIST	1/8W 1% 50PPM
364	E2	R394	EMF-1/4-51.1	51.1000		RESIST	1/8W 1% 50PPM
365	E2	R395	EMF-1/4W-511	511.0000		RESIST	1/8W 1% 50PPM
366	E2	R396	EMF-1/4-127	127.0000		RESIST	1/8W 1% 50PPM
367	E2	R397	EMF-1/4-51.1	51.1000		RESIST	1/8W 1% 50PPM
368	E2	R398	EMF-1/4-51.1	51.1000		RESIST	1/8W 1% 50PPM
369	E2	R399	6S11009C27	120.0000		RESIST	FCF 1/4W 5%
370	E2	U301	TL082CP	.0000		IC	OP. AMP. DUAL
371	E2	U302	TL084CN	.0000		IC	OP. AMP. QUAD
372	E2	U303	TL084CN	.0000		IC	OP. AMP. QUAD
373	E2	U304	TL084CN	.0000		IC	OP. AMP. QUAD
374	E2	U305	TL084CN	.0000		IC	OP. AMP. QUAD
375	E2	U306	TL084CN	.0000		IC	OP. AMP. QUAD
376	E2	U307	TL084CN	.0000		IC	OP. AMP. QUAD
377	E2	U308	TL084CN	.0000		IC	OP. AMP. QUAD
378	E3	C901	21082133G03	100.0000	P	CAP	DISC 500V 5% N750
379	E3	C902	21082133G03	100.0000	P	CAP	DISC 500V 5% N750
380	E3	C903	8-11017A08	.0100	U	CAP	5%
381	E3	C904	21082133G03	100.0000	P	CAP	DISC 500V 5% N750
382	E3	C905	8S11017A01	.0010	U	CAP	MYLAR 50V 5%
383	E3	C906	8S11017A01	.0010	U	CAP	MYLAR 50V 5%
384	E3	C907	8-11017A08	.0100	U	CAP	5%
385	E3	C908	23-11019A46	100.0000	U	CAP	LYTIC 25V
386	E3	C909	21840020S03	.1000	U	CAP	CERAMIC 50V 20% Z5U
387	E3	C910	8-11017A08	.0100	U	CAP	5%
388	E3	C911	8D32905G11	.2200	U	CAP	MYLAR 50V 10%
389	E3	C912	8D32905G11	.2200	U	CAP	MYLAR 50V 10%
390	E3	C913	CY2-027PT	335.0000	U	TUN.CAP	TUNING DUAL
391	E3	L901	24-83397L01	30.0000	U	COIL	RF CHOKE
392	E3	L902	24-83397L01	30.0000	U	COIL	RF CHOKE

EXCITER PARTS LIST

REC#	AS	ID	PN	VAL	X	TYPE	DESCR
393	E3	Q901	48R00869570	.0000		TRANSIST	NPN 9570
394	E3	Q902	MPS-U52	.0000		TRANSIST	PNP GP AMP
395	E3	R901	6S11009C49	1.0000	K	RESIST	FCF 1/4W 5%
396	E3	R902	3006-001-102	1.0000	K	TRIMPOT	CERMET 15T
397	E3	R903	6S11009C77	15.0000	K	RESIST	FCF 1/4W 5%
398	E3	R904	6S11009C47	820.0000		RESIST	FCF 1/4W 5%
399	E3	R905	6S11009C53	1.5000	K	RESIST	FCF 1/4W 5%
400	E3	R906	6S11009C51	1.2000	K	RESIST	FCF 1/4W 5%
401	E3	R907	6S11009C53	1.5000	K	RESIST	FCF 1/4W 5%
402	E3	R908	6S11009C23	82.0000		RESIST	FCF 1/4W 5%
403	E3	R909	6S11009C23	82.0000		RESIST	FCF 1/4W 5%
404	E3	R910	6S11009D04	180.0000	K	RESIST	FCF 1/4W 5%
405	E3	R911	6S11009C89	47.0000	K	RESIST	FCF 1/4W 5%
406	E3	R912	6S11009C41	470.0000		RESIST	FCF 1/4W 5%
407	E3	R913	6S11009C14	36.0000		RESIST	FCF 1/4W 5%
408	E3	R914	6S11009C25	100.0000		RESIST	FCF 1/4W 5%
409	E3	R915	6S11009C01	10.0000		RESIST	FCF 1/4W 5%
410	E3	R916	6S11009C27	120.0000		RESIST	FCF 1/4W 5%
411	E3	R917	6S11009C01	10.0000		RESIST	FCF 1/4W 5%
412	E3	R918	6S11009C17	47.0000		RESIST	FCF 1/4W 5%
413	E3	R919	6S11009C49	1.0000	K	RESIST	FCF 1/4W 5%
414	E3	R920	6S11009C80	20.0000	K	RESIST	FCF 1/4W 5%
415	E3	R922	6S11009C49	1.0000	K	RESIST	FCF 1/4W 5%
416	E3	R923	6S11009C80	20.0000	K	RESIST	FCF 1/4W 5%
417	E3	R924	6S11009D12	390.0000	K	RESIST	FCF 1/4W 5%
418	E3	R925	6S11009C49	1.0000	K	RESIST	FCF 1/4W 5%
419	E3	R926	6S11009C80	20.0000	K	RESIST	FCF 1/4W 5%
420	E3	R927	6S11009C49	1.0000	K	RESIST	FCF 1/4W 5%
421	E3	R928	6S11009D12	390.0000	K	RESIST	FCF 1/4W 5%
422	E3	R929	6S11009C80	20.0000	K	RESIST	FCF 1/4W 5%
423	E3	R930	6S11009C25	100.0000		RESIST	FCF 1/4W 5%
424	E3	R931	6S11009C25	100.0000		RESIST	FCF 1/4W 5%
425	E3	R932	6S11009C25	100.0000		RESIST	FCF 1/4W 5%
426	E3	R933	6S11009C25	100.0000		RESIST	FCF 1/4W 5%
427	E3	R936	6S11009C41	470.0000		RESIST	FCF 1/4W 5%
428	E3	R938	3006P-001-504	500.0000	K	TRIMPOT	CERMET 15T
429	E3	T901	82-0984	.0000		TRANSF	RF BELTRONICS
430	E3	T902	82-0984	.0000		TRANSF	RF BELTRONICS
431	E3	U902	LF347BN	.0000		IC	OP AMP QUAD
432	E4	C401	8S11017A01	.0010	U	CAP	MYLAR 50V 5%
433	E4	C402	8S11017A01	.0010	U	CAP	MYLAR 50V 5%
434	E4	C403	23C05253D01	2000.0000	U	CAP	LYTIC 50V
435	E4	C404	8S11017A01	.0010	U	CAP	MYLAR 50V 5%
436	E4	C405	8S11017A01	.0010	U	CAP	MYLAR 50V 5%
437	E4	C406	8D82905G11	.2200	U	CAP	MYLAR 50V 10%
438	E4	C407	8D82905G11	.2200	U	CAP	MYLAR 50V 10%
439	E4	C408	8D82905G11	.2200	U	CAP	MYLAR 50V 10%
440	E4	C409	8D82905G11	.2200	U	CAP	MYLAR 50V 10%
441	E4	C410	8D82905G11	.2200	U	CAP	MYLAR 50V 10%
442	E4	C411	8D82905G11	.2200	U	CAP	MYLAR 50V 10%
443	E4	C412	23C05253D01	2000.0000	U	CAP	LYTIC 50V
444	E4	D401	IN4720	.0000		DIODE	RECTIFIER POWER
445	E4	D402	IN4720	.0000		DIODE	RECTIFIER POWER
446	E4	D403	IN4720	.0000		DIODE	RECTIFIER POWER
447	E4	D404	IN4720	.0000		DIODE	RECTIFIER POWER
448	E4	D405	IN4002	.0000		DIODE	RECTIFIER 100V

EXCITER PARTS LIST

REC#	AS	ID	PN	VAL	X	TYPE	DESCR
449	E4	D406	IN4002	.0000		DIODE	RECTIFIER 100V
450	E4	D407	IN4002	.0000		DIODE	RECTIFIER 100V
451	E4	D408	1N5338B	.0000		DIODE	ZENER 5.1V
452	E4	R401	17D82177B04	5.0000		RESIST	WW 5W 10%
453	E4	R402	13F146	10.0000		RESIST	WW 5W 5%
454	E4	R403	6S10164D55	68.0000		RESIST	FCF 2W 5%
455	E4	R404	6S10164A52	4.7000	K	RESIST	FCF 1/2W 5%
456	E4	R406	6S10164A52	4.7000	K	RESIST	FCF 1/2W 5%
457	E4	U401	MC7815CT	.0000		IC	REGULATOR 15V
458	E4	U402	MC7805CT	.0000		IC	REGULATOR 5V
459	E4	U403	MC7815CT	.0000		IC	REGULATOR 15V
460	E5	C503	21D82428B15	.0050	U	CAP	DISC 100V 20% X5R
461	E5	C509	21R40020S03	.1000	U	CAP	CERAMIC 50V 20% Z5U
462	E5	C510	21R40020S03	.1000	U	CAP	CERAMIC 50V 20% Z5U
463	E5	C511	21R40020S14	.4700	U	CAP	CERAMIC 100V 20% Z5U
464	E5	C520	21D82428B15	.0050	U	CAP	DISC 100V 20% X5R
465	E5	C520	21D82428B15	.0050	U	CAP	DISC 100V 20% X5R
466	E5	C530	21R40020S03	.1000	U	CAP	CERAMIC 50V 20% Z5U
467	E5	C531	8-11017A08	.0100	U	CAP	5%
468	E5	C532	81F3650	18.0000	P	TRIMCAP	5.5-18 PFD
469	E5	D501	IN4759A	.0000		DIODE	ZENER 62V
470	E5	D502	IN4759A	.0000		DIODE	ZENER 62V
471	E5	D503	*	.0000		DIODE	1N5333 TO 1N5358
472	E5	L503	15F2259	500.0000	U	COIL	RF CHOKE
473	E5	L504	15F2259	500.0000	U	COIL	RF CHOKE
474	E5	Q501	48R00869571	.0000		TRANSIST	PNP 9571
475	E5	Q502	48R00869571	.0000		TRANSIST	PNP 9571
476	E5	Q503	VN88AD	.0000		TRANSIST	FET NCH SILICONIX
477	E5	Q504	VN88AD	.0000		TRANSIST	FET NCH SILICONIX
478	E5	Q505	48R00869570	.0000		TRANSIST	NPN 9570
479	E5	Q506	48R00869570	.0000		TRANSIST	NPN 9570
480	E5	R501	6S11009C47	820.0000		RESIST	FCF 1/4W 5%
481	E5	R502	67F5848	5.0000	K	TRIMPOT	CERMET 25T
482	E5	R503	6S11009C41	470.0000		RESIST	FCF 1/4W 5%
483	E5	R504	6S11009C37	330.0000		RESIST	FCF 1/4W 5%
484	E5	R505	6S11009C37	330.0000		RESIST	FCF 1/4W 5%
485	E5	R506	6S11009C49	1.0000	K	RESIST	FCF 1/4W 5%
486	E5	R507	6S11009C47	820.0000		RESIST	FCF 1/4W 5%
487	E5	R508	18D84944C01	2.0000	K	TRIMPOT	CARBON
488	E5	R516	6S11009C09	22.0000		RESIST	FCF 1/4W 5%
489	E5	R517	6S11009D18	680.0000	K	RESIST	FCF 1/4W 5%
490	E5	R518	3006P-001-504	500.0000	K	TRIMPOT	CERMET 15T
491	E5	R519	6S11009D18	680.0000	K	RESIST	FCF 1/4W 5%
492	E5	R520	3006P-001-504	500.0000	K	TRIMPOT	CERMET 15T
493	E5	R521	6S11009C09	22.0000		RESIST	FCF 1/4W 5%
494	E5	R522	6S11009C87	39.0000	K	RESIST	FCF 1/4W 5%
495	E5	R523	6S11009C79	18.0000	K	RESIST	FCF 1/4W 5%
496	E5	R524	6S11009C49	1.0000	K	RESIST	FCF 1/4W 5%
497	E5	R525	6S11009C11	27.0000		RESIST	FCF 1/4W 5%
498	E5	R526	6S11009C81	22.0000	K	RESIST	FCF 1/4W 5%
499	E5	R527	6S11009C89	47.0000	K	RESIST	FCF 1/4W 5%
500	E5	R528	6S11009C33	220.0000		RESIST	FCF 1/4 W 5%
501	E5	T501	T2.5-6T	.0000		TRANSF	RF BROAD BAND
502	E5	T502	D2275	.0000		TRANSF	RF POT CORE
503	E6	C605	21R40020S04	.0100	U	CAP	CERAMIC 50V 20% Z5U
504	E6	C606	8S11017A11	.0220	U	CAP	MYLAR 50V 5%

EXCITER PARTS LIST

REC#	AS	ID	PN	VAL	X TYPE	DESCR
505	E6	C607	8-11017A08	.0100	U CAP	5%
506	E6	C608	21R40020S03	.1000	U CAP	CERAMIC 50V 20% Z5U
507	E6	C609	*	.3300	U CAP	MYLAR 50V 5%
508	E6	C610	*	.3300	U CAP	MYLAR 50V 5%
509	E6	C611	21R40020S03	.1000	U CAP	CERAMIC 50V 20% Z5U
510	E6	C612	*	2.2000	U CAP	MYLAR 250V 10%
511	E6	C613	*	2.2000	U CAP	MYLAR 250V 10%
512	E6	C619	8S11017A11	.0220	U CAP	MYLAR 50V 5%
513	E6	C620	8-11017A08	.0100	U CAP	5%
514	E6	C622	*	.3300	U CAP	MYLAR 50V 5%
515	E6	C623	*	.3300	U CAP	MYLAR 50V 5%
516	E6	C624	*	2.2000	U CAP	MYLAR 250V 10%
517	E6	C625	*	2.2000	U CAP	MYLAR 250V 10%
518	E6	C626	21R40020S03	.1000	U CAP	CERAMIC 50V 20% Z5U
519	E6	C627	23S11019A09	1.0000	U CAP	LYTIC ALU 50V 20%
520	E6	C628	23S11019A09	1.0000	U CAP	LYTIC ALU 50V 20%
521	E6	C629	8S11017A07	.0068	U CAP	MYLAR 50V 5%
522	E6	C629A	8S11017A07	.0068	U CAP	MYLAR 50V 5%
523	E6	C630	8S11017A10	.0180	U CAP	MYLAR 50V 5%
524	E6	C630A	8S11017A10	.0180	U CAP	MYLAR 50V 5%
525	E6	C631	8S11017A01	.0010	U CAP	MYLAR 50V 5%
526	E6	C631A	8S11017A01	.0010	U CAP	MYLAR 50V 5%
527	E6	C632	8S11017A07	.0068	U CAP	MYLAR 50V 5%
528	E6	C632A	8S11017A07	.0068	U CAP	MYLAR 50V 5%
529	E6	C633	8S11017A01	.0010	U CAP	MYLAR 50V 5%
530	E6	C633A	8S11017A01	.0010	U CAP	MYLAR 50V 5%
531	E6	C634	8S11017A10	.0180	U CAP	MYLAR 50V 5%
532	E6	C634A	8S11017A10	.0180	U CAP	MYLAR 50V 5%
533	E6	C635	8S11017A07	.0068	U CAP	MYLAR 50V 5%
534	E6	C635A	8S11017A07	.0068	U CAP	MYLAR 50V 5%
535	E6	C636	8S11017A10	.0180	U CAP	MYLAR 50V 5%
536	E6	C636A	8S11017A10	.0180	U CAP	MYLAR 50V 5%
537	E6	C637	8S11017A01	.0010	U CAP	MYLAR 50V 5%
538	E6	C637A	8S11017A01	.0010	U CAP	MYLAR 50V 5%
539	E6	C638	8S11017A10	.0180	U CAP	MYLAR 50V 5%
540	E6	C638A	8S11017A10	.0180	U CAP	MYLAR 50V 5%
541	E6	C639	8S11017A01	.0010	U CAP	MYLAR 50V 5%
542	E6	C639A	8S11017A01	.0010	U CAP	MYLAR 50V 5%
543	E6	C640	8S11017A07	.0068	U CAP	MYLAR 50V 5%
544	E6	C640A	8S11017A07	.0068	U CAP	MYLAR 50V 5%
545	E6	C641	8S11017A07	.0068	U CAP	MYLAR 50V 5%
546	E6	C641A	8S11017A07	.0068	U CAP	MYLAR 50V 5%
547	E6	C642	8S11017A10	.0180	U CAP	MYLAR 50V 5%
548	E6	C642A	8S11017A10	.0180	U CAP	MYLAR 50V 5%
549	E6	C643	8S11017A01	.0010	U CAP	MYLAR 50V 5%
550	E6	C643A	8S11017A01	.0010	U CAP	MYLAR 50V 5%
551	E6	C644	8S11017A07	.0068	U CAP	MYLAR 50V 5%
552	E6	C644A	8S11017A07	.0068	U CAP	MYLAR 50V 5%
553	E6	C645	8S11017A10	.0180	U CAP	MYLAR 50V 5%
554	E6	C645A	8S11017A10	.0180	U CAP	MYLAR 50V 5%
555	E6	C646	8S11017A01	.0010	U CAP	MYLAR 50V 5%
556	E6	C646A	8S11017A01	.0010	U CAP	MYLAR 50V 5%
557	E6	C647	8S11017A01	.0010	U CAP	MYLAR 50V 5%
558	E6	C647A	8S11017A01	.0010	U CAP	MYLAR 50V 5%
559	E6	C648	8S11017A07	.0068	U CAP	MYLAR 50V 5%
560	E6	C648A	8S11017A07	.0068	U CAP	MYLAR 50V 5%

EXCITER PARTS LIST

REC#	AS	ID	PN	VAL	X	TYPE	DESCR
561	E6	C649	8S11017A10	.0180		U CAP	MYLAR 50V 5%
562	E6	C649A	8S11017A10	.0180		U CAP	MYLAR 50V 5%
563	E6	C650	8S11017A10	.0180		U CAP	MYLAR 50V 5%
564	E6	C650A	8S11017A10	.0180		U CAP	MYLAR 50V 5%
565	E6	C651	8S11017A07	.0068		U CAP	MYLAR 50V 5%
566	E6	C651A	8S11017A07	.0068		U CAP	MYLAR 50V 5%
567	E6	C652	8S11017A01	.0010		U CAP	MYLAR 50V 5%
568	E6	C652A	8S11017A01	.0010		U CAP	MYLAR 50V 5%
569	E6	C654	21R40020S03	.1000		U CAP	CERAMIC 50V 20% Z5U
570	E6	C654A	21R40020S03	.1000		U CAP	CERAMIC 50V 20% Z5U
571	E6	C655	21R40020S03	.1000		U CAP	CERAMIC 50V 20% Z5U
572	E6	C655A	21R40020S03	.1000		U CAP	CERAMIC 50V 20% Z5U
573	E6	C656	21R40020S03	.1000		U CAP	CERAMIC 50V 20% Z5U
574	E6	C656A	21R40020S03	.1000		U CAP	CERAMIC 50V 20% Z5U
575	E6	C657	21R40020S03	.1000		U CAP	CERAMIC 50V 20% Z5U
576	E6	C657A	21R40020S03	.1000		U CAP	CERAMIC 50V 20% Z5U
577	E6	C658	21R40020S03	.1000		U CAP	CERAMIC 50V 20% Z5U
578	E6	C659	21R40020S03	.1000		U CAP	CERAMIC 50V 20% Z5U
579	E6	C660	21R40020S04	.0100		U CAP	CERAMIC 50V 20% Z5U
580	E6	C661	21R40020S03	.1000		U CAP	CERAMIC 50V 20% Z5U
581	E6	D601	1N4148	.0000		DIODE	SIGNAL ITT
582	E6	D602	1N4148	.0000		DIODE	SIGNAL ITT
583	E6	D603	1N4148	.0000		DIODE	SIGNAL ITT
584	E6	D604	1N4148	.0000		DIODE	SIGNAL ITT
585	E6	Q601	48R00869570	.0000		TRANSIST	NPN 9570
586	E6	R602A	81A20B16A10A10	1.0000	K	POT	4 SECT CERMET
587	E6	R602B				POT	SEE R602A
588	E6	R602C				POT	SEE R602A
589	E6	R602D				POT	SEE R602A
590	E6	R603	6S11009C17	47.0000		RESIST	FCF 1/4W 5%
591	E6	R604A	81A20B16A20A20	100.0000	K	POT	4SECT CERMET
592	E6	R604B				POT	SEE R604A
593	E6	R604C				POT	SEE R604A
594	E6	R604D				POT	SEE R604A
595	E6	R605	6S11009C80	20.0000	K	RESIST	FCF 1/4W 5%
596	E6	R606	6S11009C80	20.0000	K	RESIST	FCF 1/4W 5%
597	E6	R607A	81A20B16A13A18	50.0000	K	POT	2 SECT CERMET
598	E6	R607B				POT	SEE R607A
599	E6	R607C				POT	SEE R607A
600	E6	R607D				POT	SEE R607A
601	E6	R608	6S11009C73	10.0000	K	RESIST	FCF 1/4W 5%
602	E6	R609	6S11009C50	1.1000	K	RESIST	FCF 1/4W 5%
603	E6	R610	6S11009C82	24.0000	K	RESIST	FCF 1/4W 5%
604	E6	R611	3006-001-102	1.0000	K	TRIMPOT	CERMET 15T
605	E6	R612	6S11009C17	47.0000		RESIST	FCF 1/4W 5%
606	E6	R613	6S11009C80	20.0000	K	RESIST	FCF 1/4W 5%
607	E6	R614	6S11009C80	20.0000	K	RESIST	FCF 1/4W 5%
608	E6	R615	6S11009C73	10.0000	K	RESIST	FCF 1/4W 5%
609	E6	R616	6S11009C50	1.1000	K	RESIST	FCF 1/4W 5%
610	E6	R617	6S11009C82	24.0000	K	RESIST	FCF 1/4W 5%
611	E6	R618	EMF-1/4-301	301.0000		RESIST	1/8W 1% 50PPM
612	E6	R619	3006-001-102	1.0000	K	TRIMPOT	CERMET 15T
613	E6	R621	EMF-1/4-301	301.0000		RESIST	1/8W 1% 50PPM
614	E6	R622	3006-001-102	1.0000	K	TRIMPOT	CERMET 15T
615	E6	R623	EMF-1/4-1K	1.0000	K	RESIST	1/8W 1% 50PPM
616	E6	R624	EMF-1/4-1K	1.0000	K	RESIST	1/8W 1% 50PPM

EXCITER PARTS LIST

REC#	AS	ID	PN	VAL	X	TYPE	DESCR
617	E6	R625	EMF-1/4-301	301.0000		RESIST	1/8W 1% 50PPM
618	E6	R626	3006-001-102	1.0000	K	TRIMPOT	CERMET 15T
619	E6	R627	EMF-1/4-301	301.0000		RESIST	1/8W 1% 50PPM
620	E6	R651	6S11009C80	20.0000	K	RESIST	FCF 1/4W 5%
621	E6	R652	6S11009C80	20.0000	K	RESIST	FCF 1/4W 5%
622	E6	R653	6S11009C80	20.0000	K	RESIST	FCF 1/4W 5%
623	E6	R654	6S11009C73	10.0000	K	RESIST	FCF 1/4W 5%
624	E6	R655	3006P-001-104	100	K	TRIMPOT	CERMET 15T
625	E6	R656	6S11009D12	390.0000	K	RESIST	FCF 1/4W 5%
626	E6	R658	6S11009C49	1.0000	K	RESIST	FCF 1/4W 5%
627	E6	R659	6S11009D16	560.0000	K	RESIST	FCF 1/4W 5%
628	E6	R660	6S11009D20	820.0000	K	RESIST	FCF 1/4W 5%
629	E6	R661	6S11009C49	1.0000	K	RESIST	FCF 1/4W 5%
630	E6	R662	3006P-001-502	5.0000	K	TRIMPOT	CERMET 15T
631	E6	R663	6S11009C61	3.3000	K	RESIST	FCF 1/4W 5%
632	E6	R664	6S11009C46	750.0000		RESIST	FCF 1/4W 5%
633	E6	R665	6S11009C46	750.0000		RESIST	FCF 1/4W 5%
634	E6	R666	EMF-1/4-806	806.0000		RESIST	1/8W 1% 50PPM
635	E6	R667	EMF-1/4-806	806.0000		RESIST	1/8W 1% 50PPM
636	E6	R668	EMF-1/4-806	806.0000		RESIST	1/8W 1% 50PPM
637	E6	R669	EMF-1/4-402	402.0000		RESIST	1/8W 1% 50PPM
638	E6	R670	EMF-1/4-402	402.0000		RESIST	1/8W 1% 50PPM
639	E6	R671	EMF-1/4-402	402.0000		RESIST	1/8W 1% 50PPM
640	E6	R672	EMF-1/4-221	221.0000		RESIST	1/8W 1% 50PPM
641	E6	R673	EMF-1/4-221	221.0000		RESIST	1/8W 1% 50PPM
642	E6	R674	EMF-1/4-221	221.0000		RESIST	1/8W 1% 50PPM
643	E6	R675	EMF-1/4-100	100.0000		RESIST	1/8W 1% 50PPM
644	E6	R676	EMF-1/4-100	100.0000		RESIST	1/8W 1% 50PPM
645	E6	R677	EMF-1/4-100	100.0000		RESIST	1/8W 1% 50PPM
646	E6	R678	EMF-1/4-806	806.0000		RESIST	1/8W 1% 50PPM
647	E6	R679	EMF-1/4-806	806.0000		RESIST	1/8W 1% 50PPM
648	E6	R680	EMF-1/4-806	806.0000		RESIST	1/8W 1% 50PPM
649	E6	R681	EMF-1/4-402	402.0000		RESIST	1/8W 1% 50PPM
650	E6	R682	EMF-1/4-402	402.0000		RESIST	1/8W 1% 50PPM
651	E6	R683	EMF-1/4-402	402.0000		RESIST	1/8W 1% 50PPM
652	E6	R684	EMF-1/4-221	221.0000		RESIST	1/8W 1% 50PPM
653	E6	R685	EMF-1/4-221	221.0000		RESIST	1/8W 1% 50PPM
654	E6	R686	EMF-1/4-221	221.0000		RESIST	1/8W 1% 50PPM
655	E6	R687	EMF-1/4-100	100.0000		RESIST	1/8W 1% 50PPM
656	E6	R688	EMF-1/4-100	100.0000		RESIST	1/8W 1% 50PPM
657	E6	R689	3006-001-102	1.0000	K	TRIMPOT	CERMET 15T
658	E6	R690	6S11009C63	3.9000	K	RESIST	FCF 1/4W 5%
659	E6	R691	3006-001-102	1.0000	K	TRIMPOT	CERMET 15T
660	E6	R692	6S11009C63	3.9000	K	RESIST	FCF 1/4W 5%
661	E6	R693	EMF-1/4-100	100.0000		RESIST	1/8W 1% 50PPM
662	E6	U601	TL084CN	.0000		IC	OP. AMP. QUAD
663	E6	U602	LF347BN	.0000		IC	OP AMP QUAD
664	E6	U603	LF347BN	.0000		IC	OP AMP QUAD
665	E6	U604	VTL5C1	.0000		COUPLER	OPTICAL VACTEC
666	E6	U606	TL084CN	.0000		IC	OP. AMP. QUAD
667	E6	U607	TL084CN	.0000		IC	OP. AMP. QUAD
668	E6	U901	MC1596L	.0000		IC	BALANCED MODULATOR
669	E8	R666A	EMF-1/4-806	806.0000		RESIST	1/8W 1% 50PPM
670	E8	R667A	EMF-1/4-806	806.0000		RESIST	1/8W 1% 50PPM
671	E8	R668A	EMF-1/4-806	806.0000		RESIST	1/8W 1% 50PPM
672	E8	R669A	EMF-1/4-806	806.0000		RESIST	1/8W 1% 50PPM

EXCITER PARTS LIST

REC#	AS	ID	PN	VAL	X	TYPE	DESCR
673	E8	R670A	EMF-1/4-402	402.0000		RESIST	1/8W 1% 50PPM
674	E8	R671A	EMF-1/4-806	806.0000		RESIST	1/8W 1% 50PPM
675	E8	R672A	EMF-1/4-806	806.0000		RESIST	1/8W 1% 50PPM
676	E8	R673A	EMF-1/4-806	806.0000		RESIST	1/8W 1% 50PPM
677	E8	R674A	EMF-1/4-806	806.0000		RESIST	1/8W 1% 50PPM
678	E8	R675A	EMF-1/4-806	806.0000		RESIST	1/8W 1% 50PPM
679	E8	R676A	EMF-1/4-806	806.0000		RESIST	1/8W 1% 50PPM
680	E8	R677A	EMF-1/4-806	806.0000		RESIST	1/8W 1% 50PPM
681	E8	R678A	EMF-1/4-806	806.0000		RESIST	1/8W 1% 50PPM
682	E8	R679A	EMF-1/4-806	806.0000		RESIST	1/8W 1% 50PPM
683	E8	R680A	EMF-1/4-806	806.0000		RESIST	1/8W 1% 50PPM
684	E8	R681A	EMF-1/4-806	806.0000		RESIST	1/8W 1% 50PPM
685	E8	R682A	EMF-1/4-806	806.0000		RESIST	1/8W 1% 50PPM
686	E8	R683A	EMF-1/4-806	806.0000		RESIST	1/8W 1% 50PPM
687	E8	R684A	EMF-1/4-806	806.0000		RESIST	1/8W 1% 50PPM
688	E8	R685A	EMF-1/4-806	806.0000		RESIST	1/8W 1% 50PPM
689	E8	R686A	EMF-1/4-221	221.0000		RESIST	1/8W 1% 50PPM
690	E8	R687A	EMF-1/4-806	806.0000		RESIST	1/8W 1% 50PPM
691	E8	R688A	EMF-1/4-806	806.0000		RESIST	1/8W 1% 50PPM
692	E8	R693A	EMF-1/4-806	806.0000		RESIST	1/8W 1% 50PPM
693	E8	R781	3540S-1-102	.0000		POT	4 SECT 10T WW 0.1%
694	E8	R782	3540S-1-102	.0000		POT	4 SECT 10T WW 0.1%
695	E8	R783	3540S-1-102	.0000		POT	4 SECT 10T WW 0.1%
696	E8	R784	3540S-1-502	5.0	K	POT	10T WW 0.1%
697	E8	R791	48-82525G07	.0000		DIODE	RECTIFIER POWER
698	E8	R792	6S10164A79	1.0000	K	RESIST	FCF 1/2W 5%
699	E8	R793	6S10164A79	1.0000	K	RESIST	FCF 1/2W 5%
700	E8	R794	6S11009C25	100.0000		RESIST	FCF 1/4W 5%
701	E8	R795	6S11009C25	100.0000		RESIST	FCF 1/4W 5%
702	E8	R798	6S10164A78	100.0000		RESIST	FCF 1/2W 5%
703	E8	R799	6S10164A78	100.0000		RESIST	FCF 1/2W 5%
704	E8	U602A	LF347BN	.0000		IC	OP AMP QUAD
705	E8	U603A	LF347BN	.0000		IC	OP AMP QUAD

MONITOR PARTS LIST

REC#	AS	ID	PN	VAL	X	TYPE	DESCR
1	M10	C106	23-11019A46	100.0000	U	CAP	LYTIC 25V
2	M10	C107	8C42208B18	.0470	U	CAP	MYLAR 50V 10%
3	M10	C108	23D82747L20	100.0000	U	CAP	LYTIC 100V 20%
4	M10	C109	21R40020S14	.4700	U	CAP	CERAMIC 100V 20% Z5U
5	M10	C110	8-11017A08	.0100	U	CAP	5%
6	M10	C111	21R40020S14	.4700	U	CAP	CERAMIC 100V 20% Z5U
7	M10	C112	8-11017A08	.0100	U	CAP	5%
8	M10	C113	21R40020S14	.4700	U	CAP	CERAMIC 100V 20% Z5U
9	M10	C114	8-11017A08	.0100	U	CAP	5%
10	M10	C116	8-11017A08	.0100	U	CAP	5%
11	M10	C117	23D82783B25	4.7000	U	CAP	TANTULUM 25V
12	M10	C118	23D81908L01	2.2000	U	CAP	LYTIC 50V NONPOLARIZED
13	M10	C119	21R40020S03	.1000	U	CAP	CERAMIC 50V 20% Z5U
14	M10	C120	21R40020S03	.1000	U	CAP	CERAMIC 50V 20% Z5U
15	M10	C121	21R40020S03	.1000	U	CAP	CERAMIC 50V 20% Z5U
16	M10	C122	104F01PP680	.1000	U	CAP	POLYPROPYLENE 100V 1% NPO
17	M10	C123	15F801	82.0000	P	CAP	MICA 2%
18	M10	C124	8C42208B18	.0470	U	CAP	MYLAR 50V 10%
19	M10	C125	21-83162H09	.0010	U	CAP	DISC 25V 5% N150
20	M10	C126	8C42208B15	.0100	U	CAP	MYLAR 50V 10%
21	M10	C127	8-11017A08	.0100	U	CAP	5%
22	M10	C128	104F01PP680	.1000	U	CAP	POLYPROPYLENE 100V 1% NPO
23	M10	C129	15F801	82.0000	P	CAP	MICA 2%
24	M10	C131	23D82747L20	100.0000	U	CAP	LYTIC 100V 20%
25	M10	C133	23D82783B25	4.7000	U	CAP	TANTULUM 25V
26	M10	C134	23D82783B25	4.7000	U	CAP	TANTULUM 25V
27	M10	C137	23D82783B25	4.7000	U	CAP	TANTULUM 25V
28	M10	C138	21R40020S03	.1000	U	CAP	CERAMIC 50V 20% Z5U
29	M10	C138	21R40020S03	.1000	U	CAP	CERAMIC 50V 20% Z5U
30	M10	C139	21R40020S03	.1000	U	CAP	CERAMIC 50V 20% Z5U
31	M10	C139	21R40020S03	.1000	U	CAP	CERAMIC 50V 20% Z5U
32	M10	C141	21R40020S03	.1000	U	CAP	CERAMIC 50V 20% Z5U
33	M10	C142	23D82747L19	10.0000	U	CAP	LYTIC 50V 20%
34	M10	C143	21R40020S14	.4700	U	CAP	CERAMIC 100V 20% Z5U
35	M10	C144	21R40020S14	.4700	U	CAP	CERAMIC 100V 20% Z5U
36	M10	C145	21R40020S14	.4700	U	CAP	CERAMIC 100V 20% Z5U
37	M10	C146	21R40020S14	.4700	U	CAP	CERAMIC 100V 20% Z5U
38	M10	C147	21R40020S14	.4700	U	CAP	CERAMIC 100V 20% Z5U
39	M10	C148	23-11019A46	100.0000	U	CAP	LYTIC 25V
40	M10	C149	21D83596E23	.0047	U	CAP	DISC 200V 10% Y5R
41	M10	C150	21D83596E23	.0047	U	CAP	DISC 200V 10% Y5R
42	M10	C151	21D83596E23	.0047	U	CAP	DISC 200V 10% Y5R
43	M10	C152	21D83596E23	.0047	U	CAP	DISC 200V 10% Y5R
44	M10	D101	48-02054A00	.0000		DIODE	GENERAL PURPOSE
45	M10	D102	48-02054A00	.0000		DIODE	GENERAL PURPOSE
46	M10	D103	48-02054A00	.0000		DIODE	GENERAL PURPOSE
47	M10	D104	48-02054A00	.0000		DIODE	GENERAL PURPOSE
48	M10	D106	48-02054A00	.0000		DIODE	GENERAL PURPOSE
49	M10	D107	48-02054A00	.0000		DIODE	GENERAL PURPOSE
50	M10	D108	48-02054A00	.0000		DIODE	GENERAL PURPOSE
51	M10	D109	48-02054A00	.0000		DIODE	GENERAL PURPOSE
52	M10	D111	48-02054A00	.0000		DIODE	GENERAL PURPOSE
53	M10	D112	48-02054A00	.0000		DIODE	GENERAL PURPOSE
54	M10	D113	48-02054A00	.0000		DIODE	GENERAL PURPOSE
55	M10	D114	48-02054A00	.0000		DIODE	GENERAL PURPOSE
56	M10	R104	6S11C09C71	8.2000	K	RESIST	FCF 1/4W 5%

MONITOR PARTS LIST

REC#	AS	ID	PN	VAL	X	TYPE	DESCR
57	M10	R109	6S11009C67	5.6000	K	RESIST	FCF 1/4W 5%
58	M10	R110	6S11009C73	10.0000	K	RESIST	FCF 1/4W 5%
59	M10	R111	6S11009C61	3.3000	K	RESIST	FCF 1/4W 5%
60	M10	R112	MF55D4751F	4.7500	K	RESIST	FMF 1/4W 1%
61	M10	R113	MF55D4751F	4.7500	K	RESIST	FMF 1/4W 1%
62	M10	R114	6S11009C33	27.0000	K	RESIST	FCF 1/4W 5%
63	M10	R115	6S11009D10	330.0000	K	RESIST	FCF 1/4W 5%
64	M10	R116	6S11009D10	330.0000	K	RESIST	FCF 1/4W 5%
65	M10	R117	6S11009C19	56.0000		RESIST	FCF 1/4W 5%
66	M10	R118	6S11009C77	15.0000	K	RESIST	FCF 1/4W 5%
67	M10	R119	6S11009C81	22.0000	K	RESIST	FCF 1/4W 5%
68	M10	R120	6S11009C67	5.6000	K	RESIST	FCF 1/4W 5%
69	M10	R121	6S11009C73	10.0000	K	RESIST	FCF 1/4W 5%
70	M10	R122	6S11009C61	3.3000	K	RESIST	FCF 1/4W 5%
71	M10	R123	MF55D4751F	4.7500	K	RESIST	FMF 1/4W 1%
72	M10	R124	MF55D4751F	4.7500	K	RESIST	FMF 1/4W 1%
73	M10	R125	6S11009C33	27.0000	K	RESIST	FCF 1/4W 5%
74	M10	R126	6S11009D10	330.0000	K	RESIST	FCF 1/4W 5%
75	M10	R127	6S11009D10	330.0000	K	RESIST	FCF 1/4W 5%
76	M10	R128	6S11009C83	27.0000	K	RESIST	FCF 1/4W 5%
77	M10	R129	6S11009C77	15.0000	K	RESIST	FCF 1/4W 5%
78	M10	R130	6S11009C81	22.0000	K	RESIST	FCF 1/4W 5%
79	M10	R131	6S11009C67	5.6000	K	RESIST	FCF 1/4W 5%
80	M10	R132	3299Y-001-502	5.0000	K	TRIMPOT	CERMET 25T
81	M10	R133	3299Y-001-502	5.0000	K	TRIMPOT	CERMET 25T
82	M10	R134	3299Y-001-502	5.0000	K	TRIMPOT	CERMET 25T
83	M10	R135	3299Y-001-502	5.0000	K	TRIMPOT	CERMET 25T
84	M10	R136	6S11009C67	5.6000	K	RESIST	FCF 1/4W 5%
85	M10	R137	6S11009C71	8.2000	K	RESIST	FCF 1/4W 5%
86	M10	R138	6S11009C73	10.0000	K	RESIST	FCF 1/4W 5%
87	M10	R139	6S11009C75	12.0000	K	RESIST	FCF 1/4W 5%
88	M10	R140	6S11009C71	8.2000	K	RESIST	FCF 1/4W 5%
89	M10	R141	6S11009C53	3.9000	K	RESIST	FCF 1/4W 5%
90	M10	R142	6S11009C71	8.2000	K	RESIST	FCF 1/4W 5%
91	M10	R143	6S11009C71	8.2000	K	RESIST	FCF 1/4W 5%
92	M10	R144	6S11009C71	8.2000	K	RESIST	FCF 1/4W 5%
93	M10	R145	6S11009C71	8.2000	K	RESIST	FCF 1/4W 5%
94	M10	R146	6S11009C71	8.2000	K	RESIST	FCF 1/4W 5%
95	M10	R146	6S11009D04	180.0000	K	RESIST	FCF 1/4W 5%
96	M10	R147	6S11009D10	330.0000	K	RESIST	FCF 1/4W 5%
97	M10	R148	6S11009C73	10.0000	K	RESIST	FCF 1/4W 5%
98	M10	R149	6S11009C95	82.0000	K	RESIST	FCF 1/4W 5%
99	M10	R150	MF55D2492F	24.9000	K	RESIST	FMF 1/4W 1%
100	M10	R151	MF55D2492F	24.9000	K	RESIST	FMF 1/4W 1%
101	M10	R152	MF55D1002F	10.0000	K	RESIST	FMF 1/4W 1%
102	M10	R153	MF55D1002F	10.0000	K	RESIST	FMF 1/4W 1%
103	M10	R154	6S11009C81	22.0000	K	RESIST	FCF 1/4W 5%
104	M10	R155	6S11009C85	33.0000	K	RESIST	FCF 1/4W 5%
105	M10	R156	MF55D3322F	33.2000	K	RESIST	FMF 1/4W 1%
106	M10	R157	MF55D3322F	33.2000	K	RESIST	FMF 1/4W 1%
107	M10	R158	MF55D3322F	33.2000	K	RESIST	FMF 1/4W 1%
108	M10	R159	6S11009C77	15.0000	K	RESIST	FCF 1/4W 5%
109	M10	R160	6S11009C47	820.0000		RESIST	FCF 1/4W 5%
110	M10	R161	6S11009C73	10.0000	K	RESIST	FCF 1/4W 5%
111	M10	R162	6S11009C73	10.0000	K	RESIST	FCF 1/4W 5%
112	M10	R163	6S11009C53	1.5000	K	RESIST	FCF 1/4W 5%

MONITOR PARTS LIST

REC#	AS	ID	PN	VAL	X	TYPE	DESCR
113	M10	R164	6S11009C47	820.0000		RESIST	FCF 1/4W 5%
114	M10	R165	6S11009C47	820.0000		RESIST	FCF 1/4W 5%
115	M10	R166	6S11009C53	1.5000	K	RESIST	FCF 1/4W 5%
116	M10	R167	6S11009C47	820.0000		RESIST	FCF 1/4W 5%
117	M10	R170	6S11009C47	820.0000		RESIST	FCF 1/4W 5%
118	M10	R171	6S11009C53	1.5000	K	RESIST	FCF 1/4W 5%
119	M10	R172	6S11009C47	820.0000		RESIST	FCF 1/4W 5%
120	M10	R173	6S11009C47	820.0000		RESIST	FCF 1/4W 5%
121	M10	R174	6S11009C25	100.0000		RESIST	FCF 1/4W 5%
122	M10	R175	6S11009C53	1.5000	K	RESIST	FCF 1/4W 5%
123	M10	R176	6S11009C31	180.0000		RESIST	FCF 1/4W 5%
124	M10	R177	6S11009D04	180.0000	K	RESIST	FCF 1/4W 5%
125	M10	R178	6S10164B19	330.0000		RESIST	FCF 1/2W 5%
126	M10	R179	6S11009D04	180.0000	K	RESIST	FCF 1/4W 5%
127	M10	R180	6S10164B19	330.0000		RESIST	FCF 1/2W 5%
128	M10	R181	6S11009D04	180.0000	K	RESIST	FCF 1/4W 5%
129	M10	R182	6S10164B19	330.0000		RESIST	FCF 1/2W 5%
130	M10	R183	6S11009D04	180.0000	K	RESIST	FCF 1/4W 5%
131	M10	R184	6S10164B19	330.0000		RESIST	FCF 1/2W 5%
132	M10	R185	6S11009C69	6.8000	K	RESIST	FCF 1/4W 5%
133	M10	R186	6S11009C69	6.8000	K	RESIST	FCF 1/4W 5%
134	M10	R187	3299Y-001-502	5.0000	K	TRIMPOT	CERMET 25T
135	M10	R188	6S11009C63	3.9000	K	RESIST	FCF 1/4W 5%
136	M10	R189	MF55D1002F	10.0000	K	RESIST	FMF 1/4W 1%
137	M10	R190	MF55D1002F	10.0000	K	RESIST	FMF 1/4W 1%
138	M10	R191	6S11009C69	6.8000	K	RESIST	FCF 1/4W 5%
139	M10	R192	6S11009C69	6.8000	K	RESIST	FCF 1/4W 5%
140	M10	R193	3299Y-001-502	5.0000	K	TRIMPOT	CERMET 25T
141	M10	R194	6S11009C63	3.9000	K	RESIST	FCF 1/4W 5%
142	M10	R195	MF55D1002F	10.0000	K	RESIST	FMF 1/4W 1%
143	M10	R196	MF55D1002F	10.0000	K	RESIST	FMF 1/4W 1%
144	M10	R197	6S11009D02	150.0000	K	RESIST	FCF 1/4W 5%
145	M10	R198	6S11009C95	82.0000	K	RESIST	FCF 1/4W 5%
146	M10	R201	6S11009C73	10.0000	K	RESIST	FCF 1/4W 5%
147	M10	R202	6S11009C99	120.0000	K	RESIST	FCF 1/4W 5%
148	M10	R203	MF55D3322F	33.2000	K	RESIST	FMF 1/4W 1%
149	M10	R203	6S11009C69	6.8000	K	RESIST	FCF 1/4W 5%
150	M10	R204	6S11009C87	39.0000	K	RESIST	FCF 1/4W 5%
151	M10	R205	6S11009C75	12.0000	K	RESIST	FCF 1/4W 5%
152	M10	R206	6S11009C51	1.2000	K	RESIST	FCF 1/4W 5%
153	M10	R207	6S11009C75	12.0000	K	RESIST	FCF 1/4W 5%
154	M10	R208	6S11009C87	39.0000	K	RESIST	FCF 1/4W 5%
155	M10	R209	6S11009C75	12.0000	K	RESIST	FCF 1/4W 5%
156	M10	R210	6S11009C51	1.2000	K	RESIST	FCF 1/4W 5%
157	M10	R211	6S11009C75	12.0000	K	RESIST	FCF 1/4W 5%
158	M10	R212	MF55D1214F	1.2100	M	RESIST	FMF 1/4W 1%
159	M10	R213	MF55D1004F	1.0000	M	RESIST	FMF 1/4W 1%
160	M10	R214	MF55D4754F	4.7500	M	RESIST	FMF 1/4W 1%
161	M10	R215	MF55D1214F	1.2100	M	RESIST	FMF 1/4W 1%
162	M10	R216	MF55D5623F	562.0000	K	RESIST	FMF 1/4W 1%
163	M10	R217	MF55D2214F	2.2100	M	RESIST	FMF 1/4W 1%
164	M10	R219	6S11009D12	390.0000	K	RESIST	FCF 1/4W 5%
165	M10	R220	6S11009D08	270.0000	K	RESIST	FCF 1/4W 5%
166	M10	R221	6S10164K36	1.2000	M	RESIST	FCF 1/4W 5%
167	M10	R222	MF55D1214F	1.2100	M	RESIST	FMF 1/4W 1%
168	M10	R223	MF55D1004F	1.0000	M	RESIST	FMF 1/4W 1%

MONITOR PARTS LIST

REC#	AS	ID	PN	VAL	X	TYPE	DESCR
169	M10	R224	6S11009?43	560.0000		RESIST	FCF 1/4W 5%
170	M10	R225	3299Y-0?1-502	5.0000	K	TRIMPOT	CERMET 25T
171	M10	R226	6S11009?25	100.0000		RESIST	FCF 1/4W 5%
172	M10	R227	6S11009?61	3.3000	K	RESIST	FCF 1/4W 5%
173	M10	R228	6S11009?67	5.6000	K	RESIST	FCF 1/4W 5%
174	M10	R229	6S1100?49	1.0000	K	RESIST	FCF 1/4W 5%
175	M10	R230	3299Y-0?1-502	5.0000	K	TRIMPOT	CERMET 25T
176	M10	R231	6S10164?19	330.0000		RESIST	FCF 1/2W 5%
177	M10	R232	6S11009?71	8.2000	K	RESIST	FCF 1/4W 5%
178	M10	R233	6S11009?71	8.2000	K	RESIST	FCF 1/4W 5%
179	M10	R234	6S11009?99	120.0000	K	RESIST	FCF 1/4W 5%
180	M10	R235	6S11009?99	120.0000	K	RESIST	FCF 1/4W 5%
181	M10	R236	6S11009?69	6.8000	K	RESIST	FCF 1/4W 5%
182	M10	R237	6S11009?87	39.0000	K	RESIST	FCF 1/4W 5%
183	M10	R238	6S11009?75	12.0000	K	RESIST	FCF 1/4W 5%
184	M10	R239	6S11009?51	1.2000	K	RESIST	FCF 1/4W 5%
185	M10	R240	6S11009?75	12.0000	K	RESIST	FCF 1/4W 5%
186	M10	R241	6S11009?73	10.0000	K	RESIST	FCF 1/4W 5%
187	M10	R242	3299Y-0?1-502	5.0000	K	TRIMPOT	CERMET 25T
188	M10	R243	3299Y-0?1-502	5.0000	K	TRIMPOT	CERMET 25T
189	M10	R244	6S11009?67	5.6000	K	RESIST	FCF 1/4W 5%
190	M10	R245	3299Y-0?1-253	25.0000	K	TRIMPOT	CERMET 25T
191	M10	R246	3299Y-0?1-502	5.0000	K	TRIMPOT	CERMET 25T
192	M10	R247	3299Y-0?1-502	5.0000	K	TRIMPOT	CERMET 25T
193	M10	R250	6S11009?67	5.6000	K	RESIST	FCF 1/4W 5%
194	M10	R251	6S11009?61	3.3000	K	RESIST	FCF 1/4W 5%
195	M10	R252	3006P-0?1-502	5.0000	K	TRIMPOT	CERMET 15T
196	M10	R254	MF55D4754F	4.7500	M	RESIST	FMF 1/4W 1%
197	M10	R255	3299Y-0?1-502	5.0000	K	TRIMPOT	CERMET 25T
198	M10	R256	3299Y-0?1-502	5.0000	K	TRIMPOT	CERMET 25T
199	M10	R257	6S11009?49	1.0000	K	RESIST	FCF 1/4W 5%
200	M10	R258	3299Y-0?1-501	500.0000		TRIMPOT	CERMET 25T
201	M10	R259	3299Y-0?1-502	5.0000	K	TRIMPOT	CERMET 25T
202	M10	R260	3299Y-0?1-502	5.0000	K	TRIMPOT	CERMET 25T
203	M10	R262	6S11009?37	330.0000		RESIST	FCF 1/4W 5%
204	M10	R263	6S11009?73	10.0000	K	RESIST	FCF 1/4W 5%
205	M10	R264	6S11009?73	10.0000	K	RESIST	FCF 1/4W 5%
206	M10	S101	40-83249K05	.0000		SWITCH	SPDT PC MOUNT RT. ANGLE
207	M10	U101	TL082CP	.0000		IC	OP. AMP. DUAL
208	M10	U102	MC1495L	.0000		IC	ANALOG MULTIPLIER
209	M10	U103	MC1495L	.0000		IC	ANALOG MULTIPLIER
210	M10	U104	TL084CN	.0000		IC	OP. AMP. QUAD
211	M10	U105	TL084CN	.0000		IC	OP. AMP. QUAD
212	M10	U106	TL084CN	.0000		IC	OP. AMP. QUAD
213	M10	U107	51R84320A35	.0000		IC	TIMER MC1455P1
214	M10	U108	51R84320A35	.0000		IC	TIMER MC1455P1
215	M10	U109	51R84320A35	.0000		IC	TIMER MC1455P1
216	M10	U110	51R84320A35	.0000		IC	TIMER MC1455P1
217	M10	U111	TL084CN	.0000		IC	OP. AMP. QUAD
218	M10	U112	TL084CN	.0000		IC	OP. AMP. QUAD
219	M10	U113	TL084CN	.0000		IC	OP. AMP. QUAD
220	M10	U114	51R84320A50	.0000		IC	PLL NE567V
221	M10	U115	TL084CN	.0000		IC	OP. AMP. QUAD
222	M10	U116	51R84320A13	.0000		IC	OP. AMP. MC1741CP
223	M10	U117	51R84320A51	.0000		IC	COMPARATOR MC3302P
224	M10	V/C1	21R40020S14	.4700	U	CAP	CERAMIC 100V 20% Z5U

MONITOR PARTS LIST

REC#	AS	ID	PN	VAL	X	TYPE	DESCR
225	M11	C304	473F01PP580	.0470		U CAP	POLYPROPYLENE 100V 1% NPO
226	M11	C305	473F01PP580	.0470		U CAP	POLYPROPYLENE 100V 1% NPO
227	M11	C312	473F01PP580	.0470		U CAP	POLYPROPYLENE 100V 1% NPO
228	M11	C313	473F01PP580	.0470		U CAP	POLYPROPYLENE 100V 1% NPO
229	M11	C317	23D84538G02	4.7000		U CAP	TANTULUM 20V 20%
230	M11	C318	23D84538G02	4.7000		U CAP	TANTULUM 20V 20%
231	M11	C319	23D82397D15	10.0000		U CAP	TANTULUM 20V 20%
232	M11	C320	23D82397D15	10.0000		U CAP	TANTULUM 20V 20%
233	M11	C321	23D82397D15	10.0000		U CAP	TANTULUM 20V 20%
234	M11	C322	23D82397D15	10.0000		U CAP	TANTULUM 20V 20%
235	M11	C323	23-110[illegible]9A46	100.0000		U CAP	LYTIC 25V
236	M11	C324	21R40020S14	.4700		U CAP	CERAMIC 100V 20% Z5U
237	M11	C325	21R40020S14	.4700		U CAP	CERAMIC 100V 20% Z5U
238	M11	C326	23-11019A46	100.0000		U CAP	LYTIC 25V
239	M11	C327	21R40020S14	.4700		U CAP	CERAMIC 100V 20% Z5U
240	M11	C328	21R40020S04	.0100		U CAP	CERAMIC 50V 20% Z5U
241	M11	C329	23D82747L20	100.0000		U CAP	LYTIC 100V 20%
242	M11	C330	21-82428B10	.0033		U CAP	DISC 100V 10% X5R
243	M11	C331	21-82428B10	.0033		U CAP	DISC 100V 10% X5R
244	M11	C332	21D82428B48	.0010		U CAP	CERAMIC 100% X7R
245	M11	C333	21D82428B48	.0010		U CAP	CERAMIC 100% X7R
246	M11	C334	23D82747L20	100.0000		U CAP	LYTIC 100V 20%
247	M11	C335	21R40020S03	.1000		U CAP	CERAMIC 50V 20% Z5U
248	M11	C336	21R40020S03	.1000		U CAP	CERAMIC 50V 20% Z5U
249	M11	C337	23D82747L19	10.0000		U CAP	LYTIC 50V 20%
250	M11	C338	23D82747L19	10.0000		U CAP	LYTIC 50V 20%
251	M11	C339	23D82747L20	100.0000		U CAP	LYTIC 100V 20%
252	M11	C340	8C42208B18	.0470		U CAP	MYLAR 50V 10%
253	M11	C341	8C42208B18	.0470		U CAP	MYLAR 50V 10%
254	M11	C342	23-11019A46	100.0000		U CAP	LYTIC 25V
255	M11	C343	23D82747L20	100.0000		U CAP	LYTIC 100V 20%
256	M11	C344	21D83596E23	.0047		U CAP	DISC 200V 10% Y5R
257	M11	C345	21R40020S14	.4700		U CAP	CERAMIC 100V 20% Z5U
258	M11	C346	21R40020S14	.4700		U CAP	CERAMIC 100V 20% Z5U
259	M11	C347	21R40020S14	.4700		U CAP	CERAMIC 100V 20% Z5U
260	M11	C348	21R40020S14	.4700		U CAP	CERAMIC 100V 20% Z5U
261	M11	C349	21D83596E23	.0047		U CAP	DISC 200V 10% Y5R
262	M11	C350	21R40020S14	.4700		U CAP	CERAMIC 100V 20% Z5U
263	M11	C351	21R40020S14	.4700		U CAP	CERAMIC 100V 20% Z5U
264	M11	D301	21R40020S04	.0100		U CAP	CERAMIC 50V 20% Z5U
265	M11	D302	21R40020S04	.0100		U CAP	CERAMIC 50V 20% Z5U
266	M11	D304	21R40020S04	.0100		U CAP	CERAMIC 50V 20% Z5U
267	M11	D305	21R40020S04	.0100		U CAP	CERAMIC 50V 20% Z5U
268	M11	Q301	48R00869570	.0000		TRANSIST	NPN 9570
269	M11	R318	MF55D6813F	681.0000	K	RESIST	FMF 1/4W 1%
270	M11	R319	MF55D6813F	681.0000	K	RESIST	FMF 1/4W 1%
271	M11	R320	MF55D5622F	56.2000	K	RESIST	FMF 1/4W 1%
272	M11	R321	MF55D5622F	56.2000	K	RESIST	FMF 1/4W 1%
273	M11	R322	MF55D5622F	56.2000	K	RESIST	FMF 1/4W 1%
274	M11	R323	MF55D5622F	56.2000	K	RESIST	FMF 1/4W 1%
275	M11	R324	MF55D5622F	56.2000	K	RESIST	FMF 1/4W 1%
276	M11	R325	3299Y-001-104	100.0000	K	TRIMPOT	CERMET 25T
277	M11	R326	6S11009D08	270.0000	K	RESIST	FCF 1/4W 5%
278	M11	R327	6S11009C53	1.5000	K	RESIST	FCF 1/4W 5%
279	M11	R343	6S11009C25	100.0000		RESIST	FCF 1/4W 5%
280	M11	R357	MF55D6813F	681.0000	K	RESIST	FMF 1/4W 1%

MONITOR PARTS LIST

REC#	AS	ID	PN	VAL	X	TYPE	DESCR
281	M11	R358	MF55D5622F	56.2000	K	RESIST	FMF 1/4W 1%
282	M11	R359	MF55D5622F	56.2000	K	RESIST	FMF 1/4W 1%
283	M11	R360	MF55D5622F	56.2000	K	RESIST	FMF 1/4W 1%
284	M11	R361	MF55D5622F	56.2000	K	RESIST	FMF 1/4W 1%
285	M11	R362	MF55D5622F	56.2000	K	RESIST	FMF 1/4W 1%
286	M11	R363	3299Y-001-104	100.0000	K	TRIMPOT	CERMET 25T
287	M11	R364	6S11009D08	270.0000	K	RESIST	FCF 1/4W 5%
288	M11	R365	MF55D6813F	681.0000	K	RESIST	FMF 1/4W 1%
289	M11	R365	6S11009C53	1.5000	K	RESIST	FCF 1/4W 5%
290	M11	R377	6S11009C85	33.0000	K	RESIST	FCF 1/4W 5%
291	M11	R378	6S11009C73	10.0000	K	RESIST	FCF 1/4W 5%
292	M11	R379	6S11009C71	8.2000	K	RESIST	FCF 1/4W 5%
293	M11	R380	3299Y-001-502	5.0000	K	TRIMPOT	CERMET 25T
294	M11	R381	6S11009C71	8.2000	K	RESIST	FCF 1/4W 5%
295	M11	R382	6S11009C71	8.2000	K	RESIST	FCF 1/4W 5%
296	M11	R383	3299Y-001-502	5.0000	K	TRIMPOT	CERMET 25T
297	M11	R384	6S11009C71	8.2000	K	RESIST	FCF 1/4W 5%
298	M11	R385	3299Y-001-502	5.0000	K	TRIMPOT	CERMET 25T
299	M11	R386	6S11009C57	2.2000	K	RESIST	FCF 1/4W 5%
300	M11	R387	3299Y-001-502	5.0000	K	TRIMPOT	CERMET 25T
301	M11	R389	6S11009C25	100.0000		RESIST	FCF 1/4W 5%
302	M11	R390	6S11009C25	100.0000		RESIST	FCF 1/4W 5%
303	M11	R391	6S11009C25	100.0000		RESIST	FCF 1/4W 5%
304	M11	R392	6S11009C25	100.0000		RESIST	FCF 1/4W 5%
305	M11	R394	6S11009C25	100.0000		RESIST	FCF 1/4W 5%
306	M11	R395	6S11009C47	820.0000		RESIST	FCF 1/4W 5%
307	M11	R396	6S11009C47	820.0000		RESIST	FCF 1/4W 5%
308	M11	R397	6S11009C53	1.5000	K	RESIST	FCF 1/4W 5%
309	M11	R398	MF55D1213F	121.0000	K	RESIST	FMF 1/4W 1%
310	M11	R399	MF55D3322F	33.2000	K	RESIST	FMF 1/4W 1%
311	M11	R401	6S11009C25	100.0000		RESIST	FCF 1/4W 5%
312	M11	R402	3299Y-001-501	500.0000		TRIMPOT	CERMET 25T
313	M11	R403	MF55D3322F	33.2000	K	RESIST	FMF 1/4W 1%
314	M11	R404	MF55D1213F	121.0000	K	RESIST	FMF 1/4W 1%
315	M11	R405	6S11009D04	180.0000	K	RESIST	FCF 1/4W 5%
316	M11	R406	6S10164B19	330.0000		RESIST	FCF 1/2W 5%
317	M11	R407	6S10164B19	330.0000		RESIST	FCF 1/2W 5%
318	M11	R408	6S11009C47	820.0000		RESIST	FCF 1/4W 5%
319	M11	R409	6S11009C47	820.0000		RESIST	FCF 1/4W 5%
320	M11	R410	MF55D1213F	121.0000	K	RESIST	FMF 1/4W 1%
321	M11	R411	MF55D3322F	33.2000	K	RESIST	FMF 1/4W 1%
322	M11	R412	6S11009C25	100.0000		RESIST	FCF 1/4W 5%
323	M11	R413	3299Y-001-501	500.0000		TRIMPOT	CERMET 25T
324	M11	R414	MF55D3322F	33.2000	K	RESIST	FMF 1/4W 1%
325	M11	R415	MF55D1213F	121.0000	K	RESIST	FMF 1/4W 1%
326	M11	R416	6S11009D04	180.0000	K	RESIST	FCF 1/4W 5%
327	M11	R417	6S10164B19	330.0000		RESIST	FCF 1/2W 5%
328	M11	R418	6S10164B19	330.0000		RESIST	FCF 1/2W 5%
329	M11	R419	6S11009C73	10.0000	K	RESIST	FCF 1/4W 5%
330	M11	R421	6S11009C53	1.5000	K	RESIST	FCF 1/4W 5%
331	M11	R422	6S11009C29	150.0000		RESIST	FCF 1/4W 5%
332	M11	R425	6S11009C67	5.6000	K	RESIST	FCF 1/4W 5%
333	M11	R426	6S11009C57	2.2000	K	RESIST	FCF 1/4W 5%
334	M11	R427	6S11009C57	2.2000	K	RESIST	FCF 1/4W 5%
335	M11	R428	6S11009C53	1.5000	K	RESIST	FCF 1/4W 5%
336	M11	R429	6S11009C53	1.5000	K	RESIST	FCF 1/4W 5%

MONITOR PARTS LIST

REC#	AS	ID	PN	VAL	X	TYPE	DESCR
337	M11	R430	6S1L009C97	100.0000	K	RESIST	FCF 1/4W 5%
338	M11	R431	6S1L009C97	100.0000	K	RESIST	FCF 1/4W 5%
339	M11	R432	6S1L009C61	3.3000	K	RESIST	FCF 1/4W 5%
340	M11	R433	6S1L009C25	100.0000		RESIST	FCF 1/4W 5%
341	M11	R434	6S1L009C01	10.0000		RESIST	FCF 1/4W 5%
342	M11	R435	6S1L009C01	10.0000		RESIST	FCF 1/4W 5%
343	M11	R436	6S1L009C61	3.3000	K	RESIST	FCF 1/4W 5%
344	M11	R437	6S1L009C25	100.0000		RESIST	FCF 1/4W 5%
345	M11	R438	6S1L009C57	2.2000	K	RESIST	FCF 1/4W 5%
346	M11	R439	6S1L009C73	10.0000	K	RESIST	FCF 1/4W 5%
347	M11	R440	6S1L009C75	12.0000	K	RESIST	FCF 1/4W 5%
348	M11	R441	6-00124B54	22.0000	M	RESIST	FC 1/8W 5%
349	M11	R442	6S1L009C69	6.8000	K	RESIST	FCF 1/4W 5%
350	M11	R443	6S1L009C73	10.0000	K	RESIST	FCF 1/4W 5%
351	M11	R444	6S1L009C41	470.0000		RESIST	FCF 1/4W 5%
352	M11	R445	6S1L009C21	68.0000		RESIST	FCF 1/4W 5%
353	M11	R446	6S1L009C65	4.7000	K	RESIST	FCF 1/4W 5%
354	M11	R447	6S11009C75	12.0000	K	RESIST	FCF 1/4W 5%
355	M11	R448	6-00124B54	22.0000	M	RESIST	FC 1/8W 5%
356	M11	R449	6S11009C69	6.8000	K	RESIST	FCF 1/4W 5%
357	M11	R450	6S11009C73	10.0000	K	RESIST	FCF 1/4W 5%
358	M11	R451	6S11009C41	470.0000		RESIST	FCF 1/4W 5%
359	M11	R452	6S11009C21	68.0000		RESIST	FCF 1/4W 5%
360	M11	R453	6S11009C57	2.2000	K	RESIST	FCF 1/4W 5%
361	M11	R454	6S11009C57	2.2000	K	RESIST	FCF 1/4W 5%
362	M11	R455	MF55D1002F	10.0000	K	RESIST	FMF 1/4W 1%
363	M11	R456	MF55D1002F	10.0000	K	RESIST	FMF 1/4W 1%
364	M11	R457	MF55D1002F	10.0000	K	RESIST	FMF 1/4W 1%
365	M11	R458	MF55D1002F	10.0000	K	RESIST	FMF 1/4W 1%
366	M11	R46R	6S11009C73	10.0000	K	RESIST	FCF 1/4W 5%
367	M11	R461	6S11009C73	10.0000	K	RESIST	FCF 1/4W 5%
368	M11	R462	6S11009C73	10.0000	K	RESIST	FCF 1/4W 5%
369	M11	R463	6S11009C81	22.0000	K	RESIST	FCF 1/4W 5%
370	M11	R465	6S11009C85	33.0000	K	RESIST	FCF 1/4W 5%
371	M11	R466	6S11009C73	10.0000	K	RESIST	FCF 1/4W 5%
372	M11	R467	6S11009C49	1.0000	K	RESIST	FCF 1/4W 5%
373	M11	R468	6S11009C37	330.0000		RESIST	FCF 1/4W 5%
374	M11	T301	M47A254	.0000		TRANSF	AUDIO 1500 OHM PRI 600 OH
375	M11	T302	M47A254	.0000		TRANSF	AUDIO 1500 OHM PRI 600 OH
376	M11	U301	TL084CN	.0000		IC	OP. AMP. QUAD
377	M11	U302	TL084CN	.0000		IC	OP. AMP. QUAD
378	M11	U303	TL082CP	.0000		IC	OP. AMP. DUAL
379	M11	U304	TL084CN	.0000		IC	OP. AMP. QUAD
380	M11	U305	TL084CN	.0000		IC	OP. AMP. QUAD
381	M11	U306	51R84320A51	.0000		IC	COMPARATOR MC3302P
382	M11	U307	51R84320A35	.0000		IC	TIMER MC1455P1
383	M11	U308	TL084CN	.0000		IC	OP. AMP. QUAD
384	M11	U309	TL084CN	.0000		IC	OP. AMP. QUAD
385	M11	U310	51R84320A35	.0000		IC	TIMER MC1455P1
386	M14	C900	23C05253D01	2000.0000	U	CAP	LYTIC 50V
387	M14	C901	23C05253D01	2000.0000	U	CAP	LYTIC 50V
388	M14	C902	8-11017A17	.1000	U	CAP	MYLAR 50V 5%
389	M14	C904	8-11017A17	.1000	U	CAP	MYLAR 50V 5%
390	M14	C906	23C05253D01	2000.0000	U	CAP	LYTIC 50V
391	M14	C908	8-11017A17	.1000	U	CAP	MYLAR 50V 5%
392	M14	C909	23D84669A27	2.0000	U	CAP	LYTIC 25V +150-10%

MONITOR PARTS LIST

REC# AS	ID	PN	VAL	X TYPE	DESCR
393 M14	C910	23D84669A27	2.0000	U CAP	LYTIC 25V +150-10%
394 M14	D900	IN4720	.0000	DIODE	RECTIFIER POWER
395 M14	D901	IN4720	.0000	DIODE	RECTIFIER POWER
396 M14	D902	IN4720	.0000	DIODE	RECTIFIER POWER
397 M14	D903	IN4720	.0000	DIODE	RECTIFIER POWER
398 M14	D904	48-82525G07	.0000	DIODE	RECTIFIER POWER
399 M14	D905	48-82525G07	.0000	DIODE	RECTIFIER POWER
400 M14	D909	IN4002	.0000	DIODE	RECTIFIER 100V
401 M14	U900	MC7815	.0000	IC	REGULATOR 15V
402 M14	U901	MC7805	.0000	IC	REGULATOR 5V
403 M14	U902	MC7915	.0000	IC	REGULATOR -15V
404 M16	C501	21D82133G33	6.8000	P CAP	DISC 500V .5 NPO
405 M16	C502	21D82133G33	6.8000	P CAP	DISC 500V .5 NPO
406 M16	C503	8C42208B18	.0470	U CAP	MYLAR 50V 10%
407 M16	C504	8C42208B18	.0470	U CAP	MYLAR 50V 10%
408 M16	C508	21R40020S14	.4700	U CAP	CERAMIC 100V 20% Z5U
409 M16	C509	21D82133G33	6.8000	P CAP	DISC 500V .5 NPO
410 M16	C510	8C42208B18	.0470	U CAP	MYLAR 50V 10%
411 M16	C512	21D82133G35	56.0000	P CAP	DISC 500V 5% NPO
412 M16	C513	21D82133G35	56.0000	P CAP	DISC 500V 5% NPO
413 M16	C514	8C42208B27	.0010	U CAP	MYLAR 50V 10%
414 M16	C515	8C42208B27	.0010	U CAP	MYLAR 50V 10%
415 M16	C516	8-11017A13	.0330	U CAP	METALIZED POLYESTER 5%
416 M16	C517	8-11017A13	.0330	U CAP	METALIZED POLYESTER 5%
417 M16	C518	21R40020S23	.0010	U CAP	CERAMIC 100V 10% X7R
418 M16	C519	21R40020S23	.0010	U CAP	CERAMIC 100V 10% X7R
419 M16	C520	21D82133G35	56.0000	P CAP	DISC 500V 5% NPO
420 M16	C521	21D82133G35	56.0000	P CAP	DISC 500V 5% NPO
421 M16	C522	21D82133G35	56.0000	P CAP	DISC 500V 5% NPO
422 M16	C523	21D82133G35	56.0000	P CAP	DISC 500V 5% NPO
423 M16	C524	8-10212A10	1.0000	U CAP	100V 10%
424 M16	C525	8-10299B13	6.8000	U CAP	100V 10%
425 M16	C527	8C42208B27	.0010	U CAP	MYLAR 50V 10%
426 M16	C530	8C42208B18	.0470	U CAP	MYLAR 50V 10%
427 M16	C533	8C42208B18	.0470	U CAP	MYLAR 50V 10%
428 M16	C534	21D82428B48	.0010	U CAP	CERAMIC 100% X7R
429 M16	C539	21D82133G83	33.0000	P CAP	DISC 500V 5% N150
430 M16	C540	8C42208B18	.0470	U CAP	MYLAR 50V 10%
431 M16	C541	21D82133G83	33.0000	P CAP	DISC 500V 5% N150
432 M16	C542	8C42208B18	.0470	U CAP	MYLAR 50V 10%
433 M16	C543	21D82133G03	100.0000	P CAP	DISC 500V 5% N750
434 M16	C544	8C42208B18	.0470	U CAP	MYLAR 50V 10%
435 M16	C545	8C42208B15	.0100	U CAP	MYLAR 50V 10%
436 M16	C546	8C42208B15	.0100	U CAP	MYLAR 50V 10%
437 M16	C547	8C42208B18	.0470	U CAP	MYLAR 50V 10%
438 M16	C548	21D82133G03	100.0000	P CAP	DISC 500V 5% N750
439 M16	C549	21D82133G03	100.0000	P CAP	DISC 500V 5% N750
440 M16	C553	8C42208B16	.0047	U CAP	MYLAR 50V 10%
441 M16	C554	8C42208B16	.0047	U CAP	MYLAR 50V 10%
442 M16	C555	8C42208B16	.0047	U CAP	MYLAR 50V 10%
443 M16	C556	8C42208B16	.0047	U CAP	MYLAR 50V 10%
444 M16	C557	8C42208B18	.0470	U CAP	MYLAR 50V 10%
445 M16	C559	8C42208B15	.0100	U CAP	MYLAR 50V 10%
446 M16	C560	8C42208B18	.0470	U CAP	MYLAR 50V 10%
447 M16	C561	21D82133G35	56.0000	P CAP	DISC 500V 5% NPO
448 M16	C562	23D82783B25	4.7000	U CAP	TANTULUM 25V

MONITOR PARTS LIST

REC#	AS	ID	PN	VAL	X	TYPE	DESCR
449	M16	C564	8C42208B16	.0047		U CAP	MYLAR 50V 10%
450	M16	C565	8C42208B16	.0047		U CAP	MYLAR 50V 10%
451	M16	C566	21R40020S14	.4700		U CAP	CERAMIC 100V 20% Z5U
452	M16	C567	8C42208B18	.0470		U CAP	MYLAR 50V 10%
453	M16	C568	8C42208B18	.0470		U CAP	MYLAR 50V 10%
454	M16	C569	21R40020S14	.4700		U CAP	CERAMIC 100V 20% Z5U
455	M16	C570	8C42208B18	.0470		U CAP	MYLAR 50V 10%
456	M16	C571	8C42208B18	.0470		U CAP	MYLAR 50V 10%
457	M16	C572	8C42208B18	.0470		U CAP	MYLAR 50V 10%
458	M16	C573	8C42208B18	.0470		U CAP	MYLAR 50V 10%
459	M16	C581	8C42208B18	.0470		U CAP	MYLAR 50V 10%
460	M16	C582	8C42208B18	.0470		U CAP	MYLAR 50V 10%
461	M16	C583	8C42208B18	.0470		U CAP	MYLAR 50V 10%
462	M16	C584	21D82133G83	33.0000		P CAP	DISC 500V 5% N150
463	M16	C585	21D82133G83	33.0000		P CAP	DISC 500V 5% N150
464	M16	C586	21D83162H33	.0018		U CAP	CERAMIC 50V 5% NPO
465	M16	C587	21D83596E23	.0047		U CAP	DISC 200V 10% Y5R
466	M16	C588	21R40020S03	.1000		U CAP	CERAMIC 50V 20% Z5U
467	M16	D501	48-02054A00	.0000		DIODE	GENERAL PURPOSE
468	M16	D503	48-82190H32	.0000		DIODE	VARACTOR MV109
469	M16	D504	48-02054A00	.0000		DIODE	GENERAL PURPOSE
470	M16	D505	48-02054A00	.0000		DIODE	GENERAL PURPOSE
471	M16	D506	48-02054A00	.0000		DIODE	GENERAL PURPOSE
472	M16	E501	741A7	.0000		RELAY	REED GORDOS
473	M16	L501	82-0523	.0000		TRANSF	RF IF4 10MM
474	M16	L502	82-0522	.0000		TRANSF	RF IF3 10MM
475	M16	Q501	48R00869571	.0000		TRANSIST	PNP 9571
476	M16	Q502	48R00869571	.0000		TRANSIST	PNP 9571
477	M16	Q503	48R00869570	.0000		TRANSIST	NPN 9570
478	M16	Q504	48R00869570	.0000		TRANSIST	NPN 9570
479	M16	Q505	48R00869570	.0000		TRANSIST	NPN 9570
480	M16	Q506	48R00869571	.0000		TRANSIST	PNP 9571
481	M16	Q507	48R00869570	.0000		TRANSIST	NPN 9570
482	M16	Q508	48R00869571	.0000		TRANSIST	PNP 9571
483	M16	Q509	48R00869571	.0000		TRANSIST	PNP 9571
484	M16	Q510	48R00869570	.0000		TRANSIST	NPN 9570
485	M16	Q511	48R00869571	.0000		TRANSIST	PNP 9571
486	M16	Q512	48R00869571	.0000		TRANSIST	PNP 9571
487	M16	Q513	48R00869878	.0000		TRANSIST	FET 9878
488	M16	Q514	48R00869570	.0000		TRANSIST	NPN 9570
489	M16	RR50	3006P-001-101	100.0000		TRIMPOT	CERMET 15T
490	M16	R501	3006P-001-103	10.0000	K	TRIMPOT	CERMET 15T
491	M16	R502	3006P-001-504	500.0000	K	TRIMPOT	CERMET 15T
492	M16	R503	3006P-001-101	100.0000		TRIMPOT	CERMET 15T
493	M16	R504	3006P-001-101	100.0000		TRIMPOT	CERMET 15T
494	M16	R509	6S11009C35	270.0000		RESIST	FCF 1/4W 5%
495	M16	R510	6S11009C35	270.0000		RESIST	FCF 1/4W 5%
496	M16	R511	MF55D4020F	402.0000		RESIST	FMF 1/4W 1%
497	M16	R512	MF55D3010F	301.0000		RESIST	FMF 1/4W 1%
498	M16	R513	MF55D4020F	402.0000		RESIST	FMF 1/4W 1%
499	M16	R514	MF55D3010F	301.0000		RESIST	FMF 1/4W 1%
500	M16	R515	MF55D1001F	1.0000	K	RESIST	FMF 1/4W 1%
501	M16	R516	MF55D1001F	1.0000	K	RESIST	FMF 1/4W 1%
502	M16	R517	6S11009C25	100.0000		RESIST	FCF 1/4W 5%
503	M16	R518	6S11009C49	1.0000	K	RESIST	FCF 1/4W 5%
504	M16	R519	6S11009C49	1.0000	K	RESIST	FCF 1/4W 5%

MONITOR PARTS LIST

REC#	AS	ID	PN	VAL	X	TYPE	DESCR
505	M16	R520	6S11009C25	100.0000		RESIST	FCF 1/4W 5%
506	M16	R521	6S11009C25	100.0000		RESIST	FCF 1/4W 5%
507	M16	R522	6S11009C37	330.0000		RESIST	FCF 1/4W 5%
508	M16	R523	6S11009C21	68.0000		RESIST	FCF 1/4W 5%
509	M16	R524	6S11009C21	68.0000		RESIST	FCF 1/4W 5%
510	M16	R525	6S11009C37	330.0000		RESIST	FCF 1/4W 5%
511	M16	R526	6S11009C09	22.0000		RESIST	FCF 1/4W 5%
512	M16	R527	6S11009C09	22.0000		RESIST	FCF 1/4W 5%
513	M16	R528	MF55D2741F	2.7400	K	RESIST	FMF 1/4W 1%
514	M16	R529	MF55D2741F	2.7400	K	RESIST	FMF 1/4W 1%
515	M16	R530	6S11009C21	68.0000		RESIST	FCF 1/4W 5%
516	M16	R531	6S11009C45	680.0000		RESIST	FCF 1/4W 5%
517	M16	R532	6S11009C21	68.0000		RESIST	FCF 1/4W 5%
518	M16	R533	6S11009C55	1.8000	K	RESIST	FCF 1/4W 5%
519	M16	R534	6S11009C45	680.0000		RESIST	FCF 1/4W 5%
520	M16	R535	6S11009C21	68.0000		RESIST	FCF 1/4W 5%
521	M16	R536	6S11009C21	68.0000		RESIST	FCF 1/4W 5%
522	M16	R537	6S11009C47	820.0000		RESIST	FCF 1/4W 5%
523	M16	R538	6S11009C49	1.0000	K	RESIST	FCF 1/4W 5%
524	M16	R539	6S11009C47	820.0000		RESIST	FCF 1/4W 5%
525	M16	R540	6S11009C66	5.1000	K	RESIST	FCF 1/4W 5%
526	M16	R541	6S11009C54	1.6000	K	RESIST	FCF 1/4W 5%
527	M16	R542	6S11009C58	2.4000	K	RESIST	FCF 1/4W 5%
528	M16	R543	6S11009C58	2.4000	K	RESIST	FCF 1/4W 5%
529	M16	R544	6S11009C41	470.0000		RESIST	FCF 1/4W 5%
530	M16	R545	6S11009C41	470.0000		RESIST	FCF 1/4W 5%
531	M16	R546	6S11009C63	3.9000	K	RESIST	FCF 1/4W 5%
532	M16	R547	6S11009C59	2.7000	K	RESIST	FCF 1/4W 5%
533	M16	R548	6S11009C59	2.7000	K	RESIST	FCF 1/4W 5%
534	M16	R549	6S11009C65	4.7000	K	RESIST	FCF 1/4W 5%
535	M16	R550	6S11009C59	2.7000	K	RESIST	FCF 1/4W 5%
536	M16	R551	6S11009C75	12.0000	K	RESIST	FCF 1/4W 5%
537	M16	R552	6S11009C59	2.7000	K	RESIST	FCF 1/4W 5%
538	M16	R553	6S11009C54	1.6000	K	RESIST	FCF 1/4W 5%
539	M16	R554	6S11009C75	12.0000	K	RESIST	FCF 1/4W 5%
540	M16	R555	6S11009C59	2.7000	K	RESIST	FCF 1/4W 5%
541	M16	R556	6S11009C59	2.7000	K	RESIST	FCF 1/4W 5%
542	M16	R557	6S11009C83	27.0000	K	RESIST	FCF 1/4W 5%
543	M16	R558	6S11009C83	27.0000	K	RESIST	FCF 1/4W 5%
544	M16	R559	6S11009C91	56.0000	K	RESIST	FCF 1/4W 5%
545	M16	R560	6S11009C91	56.0000	K	RESIST	FCF 1/4W 5%
546	M16	R561	6S11009C45	680.0000		RESIST	FCF 1/4W 5%
547	M16	R562	6S11009C95	82.0000	K	RESIST	FCF 1/4W 5%
548	M16	R563	6S10164K42	2.2000	M	RESIST	FCF 1/4W 5%
549	M16	R564	6S11009C49	1.0000	K	RESIST	FCF 1/4W 5%
550	M16	R565	6S11009C51	1.2000	K	RESIST	FCF 1/4W 5%
551	M16	R566	6S11009C21	68.0000		RESIST	FCF 1/4W 5%
552	M16	R567	6S11009C21	68.0000		RESIST	FCF 1/4W 5%
553	M16	R568	6S11009C61	3.3000	K	RESIST	FCF 1/4W 5%
554	M16	R569	6S10164K36	1.2000	M	RESIST	FCF 1/4W 5%
555	M16	R570	6S11009C92	62.0000	K	RESIST	FCF 1/4W 5%
556	M16	R571	3006P-001-502	5.0000	K	TRIMPOT	CERMET 15T
557	M16	R572	6S11009C61	3.3000	K	RESIST	FCF 1/4W 5%
558	M16	R573	6S11009C41	470.0000		RESIST	FCF 1/4W 5%
559	M16	R574	6S11009D08	270.0000	K	RESIST	FCF 1/4W 5%
560	M16	R575	6S11009C88	43.0000	K	RESIST	FCF 1/4W 5%

MONITOR PARTS LIST

REC#	AS	ID	PN	VAL	X	TYPE	DESCR
561	M16	R576	6S11009C91	56.0000	K	RESIST	FCF 1/4W 5%
562	M16	R577	6S11009C83	27.0000	K	RESIST	FCF 1/4W 5%
563	M16	R578	6S11009C83	27.0000	K	RESIST	FCF 1/4W 5%
564	M16	R579	6S11009C91	56.0000	K	RESIST	FCF 1/4W 5%
565	M16	R580	6S11009C59	2.7000	K	RESIST	FCF 1/4W 5%
566	M16	R581	6S11009C59	2.7000	K	RESIST	FCF 1/4W 5%
567	M16	R582	6S11009C91	56.0000	K	RESIST	FCF 1/4W 5%
568	M16	R583	6S11009C83	27.0000	K	RESIST	FCF 1/4W 5%
569	M16	R584	6S11009C83	27.0000	K	RESIST	FCF 1/4W 5%
570	M16	R585	6S11009C91	56.0000	K	RESIST	FCF 1/4W 5%
571	M16	R586	6S11009C21	68.0000		RESIST	FCF 1/4W 5%
572	M16	R587	6S11009C21	68.0000		RESIST	FCF 1/4W 5%
573	M16	R588	MF55D2741F	2.7400	K	RESIST	FMF 1/4W 1%
574	M16	R589	6S11009C10	24.0000		RESIST	FCF 1/4W 5%
575	M16	R590	6S11009C45	680.0000		RESIST	FCF 1/4W 5%
576	M16	R591	MF55D2741F	2.7400	K	RESIST	FMF 1/4W 1%
577	M16	R592	6S11009C10	24.0000		RESIST	FCF 1/4W 5%
578	M16	R593	6S11009C54	1.6000	K	RESIST	FCF 1/4W 5%
579	M16	R594	6S11009D14	470.0000	K	RESIST	FCF 1/4W 5%
580	M16	R595	6S11009C21	68.0000		RESIST	FCF 1/4W 5%
581	M16	R596	6S11009C21	68.0000		RESIST	FCF 1/4W 5%
582	M16	R597	MF55D2741F	2.7400	K	RESIST	FMF 1/4W 1%
583	M16	R598	6S11009C54	1.6000	K	RESIST	FCF 1/4W 5%
584	M16	R599	6S11009C45	680.0000		RESIST	FCF 1/4W 5%
585	M16	R601	6S11009C09	22.0000		RESIST	FCF 1/4W 5%
586	M16	R602	6S11009C09	22.0000		RESIST	FCF 1/4W 5%
587	M16	R603	6S11009C37	330.0000		RESIST	FCF 1/4W 5%
588	M16	R604	6S11009C45	680.0000		RESIST	FCF 1/4W 5%
589	M16	R605	6S11009C09	22.0000		RESIST	FCF 1/4W 5%
590	M16	R606	6S11009C37	330.0000		RESIST	FCF 1/4W 5%
591	M16	R607	6S11009C57	2.2000	K	RESIST	FCF 1/4W 5%
592	M16	R608	6S11009C57	2.2000	K	RESIST	FCF 1/4W 5%
593	M16	R609	6S11009C55	1.8000	K	RESIST	FCF 1/4W 5%
594	M16	R610	6S11009C55	1.8000	K	RESIST	FCF 1/4W 5%
595	M16	R611	MF55D2741F	2.7400	K	RESIST	FMF 1/4W 1%
596	M16	R612	6S11009C18	51.0000		RESIST	FCF 1/4W 5%
597	M16	R613	6S11009C18	51.0000		RESIST	FCF 1/4W 5%
598	M16	R614	6S11009C57	2.2000	K	RESIST	FCF 1/4W 5%
599	M16	R615	6S11009C65	4.7000	K	RESIST	FCF 1/4W 5%
600	M16	R616	6S11009C69	6.8000	K	RESIST	FCF 1/4W 5%
601	M16	R617	6S11009C39	390.0000		RESIST	FCF 1/4W 5%
602	M16	R618	6S11009C39	390.0000		RESIST	FCF 1/4W 5%
603	M16	R619	MF55D2741F	2.7400	K	RESIST	FMF 1/4W 1%
604	M16	R620	MF55D2741F	2.7400	K	RESIST	FMF 1/4W 1%
605	M16	R621	6S11009C18	51.0000		RESIST	FCF 1/4W 5%
606	M16	R622	6S11009C18	51.0000		RESIST	FCF 1/4W 5%
607	M16	R623	MF55D2741F	2.7400	K	RESIST	FMF 1/4W 1%
608	M16	R624	MF55D2741F	2.7400	K	RESIST	FMF 1/4W 1%
609	M16	R625	6S11009C18	51.0000		RESIST	FCF 1/4W 5%
610	M16	R626	6S11009C18	51.0000		RESIST	FCF 1/4W 5%
611	M16	R627	6S11009C65	4.7000	K	RESIST	FCF 1/4W 5%
612	M16	R628	6S11009C65	4.7000	K	RESIST	FCF 1/4W 5%
613	M16	R629	6S11009C65	4.7000	K	RESIST	FCF 1/4W 5%
614	M16	R630	6S11009C65	4.7000	K	RESIST	FCF 1/4W 5%
615	M16	R636	6S11009C41	470.0000		RESIST	FCF 1/4W 5%
616	M16	R637	6S11009C41	470.0000		RESIST	FCF 1/4W 5%

MONITOR PARTS LIST

REC#	AS	ID	PN	VAL	X	TYPE	DESCR
617	M16	R638	MF55D2741F	2.7400	K	RESIST	FMF 1/4W 1%
618	M16	R639	MF55D2741F	2.7400	K	RESIST	FMF 1/4W 1%
619	M16	R640	6S11009C25	100.0000		RESIST	FCF 1/4W 5%
620	M16	R643	6S11009C49	1.0000	K	RESIST	FCF 1/4W 5%
621	M16	R644	6S11009C21	68.0000		RESIST	FCF 1/4W 5%
622	M16	R645	6S11009C21	68.0000		RESIST	FCF 1/4W 5%
623	M16	R646	6S11009C21	68.0000		RESIST	FCF 1/4W 5%
624	M16	R647	6S11009C21	68.0000		RESIST	FCF 1/4W 5%
625	M16	R648	6S11009C21	68.0000		RESIST	FCF 1/4W 5%
626	M16	R649	6S11009C73	10.0000	K	RESIST	FCF 1/4W 5%
627	M16	R650	6S11009C69	6.8000	K	RESIST	FCF 1/4W 5%
628	M16	R651	6S11009C57	2.2000	K	RESIST	FCF 1/4W 5%
629	M16	R661	6S11009C37	330.0000		RESIST	FCF 1/4W 5%
630	M16	R663	6S11009C69	6.8000	K	RESIST	FCF 1/4W 5%
631	M16	R664	6S11009C21	68.0000		RESIST	FCF 1/4W 5%
632	M16	R665	6S11009C87	39.0000	K	RESIST	FCF 1/4W 5%
633	M16	R666	6S11009C99	120.0000	K	RESIST	FCF 1/4W 5%
634	M16	R667	6S11009D14	470.0000	K	RESIST	FCF 1/4W 5%
635	M16	R668	6S11009C49	1.0000	K	RESIST	FCF 1/4W 5%
636	M16	R669	6S11009C21	68.0000		RESIST	FCF 1/4W 5%
637	M16	R670	6S11009C21	68.0000		RESIST	FCF 1/4W 5%
638	M16	R671	6S11009C57	2.2000	K	RESIST	FCF 1/4W 5%
639	M16	U501	CA3045	.0000		IC	TRANSISTOR ARRAY
640	M16	U502	CA3045	.0000		IC	TRANSISTOR ARRAY
641	M16	U503	TL084CN	.0000		IC	OP. AMP. QUAD
642	M16	U504	TL084CN	.0000		IC	OP. AMP. QUAD
643	M16	U505	MC1596L	.0000		IC	BALANCED MODULATOR
644	M16	U506	CA3045	.0000		IC	TRANSISTOR ARRAY
645	M16	U507	CA3045	.0000		IC	TRANSISTOR ARRAY
646	M16	U508	MC1596L	.0000		IC	BALANCED MODULATOR
647	M16	U509	MC1596L	.0000		IC	BALANCED MODULATOR
648	M16	U510	MC10116L	.0000		IC	LINE RECEIVER
649	M16	U511	CA3183	.0000		IC	TRANSISTOR ARRAY
650	M16	U512	MC10131L	.0000		IC	D FF DUAL
651	M16	U513	MC10131L	.0000		IC	D FF DUAL
652	M16	X501	48-40089S02	3.6000	M	XTAL	3.6MHZ
653	M17	C703	21D82428B48	.0010	U	CAP	CERAMIC 100% X7R
654	M17	C704	21D82428B48	.0010	U	CAP	CERAMIC 100% X7R
655	M17	C705	21R40020S03	.1000	U	CAP	CERAMIC 50V 20% Z5U
656	M17	C706	21R40020S03	.1000	U	CAP	CERAMIC 50V 20% Z5U
657	M17	C707	21S180E36	68.0000	P	CAP	DISC 5% NPO
658	M17	C708	21R40020S03	.1000	U	CAP	CERAMIC 50V 20% Z5U
659	M17	C709	21-82610C84	39.0000	P	CAP	DISC 450V 5% NPO
660	M17	C710	10-S-T-06	30.0000	P	TRIMCAP	CERAMIC 5/30 PFD N750
661	M17	C712	21R40020S03	.1000	U	CAP	CERAMIC 50V 20% Z5U
662	M17	C713	21R40020S03	.1000	U	CAP	CERAMIC 50V 20% Z5U
663	M17	C714	21R40020S03	.1000	U	CAP	CERAMIC 50V 20% Z5U
664	M17	C715	21R40020S03	.1000	U	CAP	CERAMIC 50V 20% Z5U
665	M17	C716	21R40020S03	.1000	U	CAP	CERAMIC 50V 20% Z5U
666	M17	C717	8-11017A08	.0100	U	CAP	5%
667	M17	C720	21D82428B54	330.0000	P	CAP	DISC 500V 5% Y5D
668	M17	C721	21D82428B54	330.0000	P	CAP	DISC 500V 5% Y5D
669	M17	C727	21D82187B08	220.0000	P	CAP	DISC 1KV 10% Z5F
670	M17	C728	21R40020S03	.1000	U	CAP	CERAMIC 50V 20% Z5U
671	M17	C729	21R40020S03	.1000	U	CAP	CERAMIC 50V 20% Z5U
672	M17	C730	8C42208B18	.0470	U	CAP	MYLAR 50V 10%

MONITOR PARTS LIST

REC#	AS	ID	PN	VAL	X	TYPE	DESCR
673	M17	D701	48-02054A00	.0000		DIODE	GENERAL PURPOSE
674	M17	L701	82-0520	.0000		TRANSF	RF IF1 10MM
675	M17	L702	T2.5-6T	.0000		TRANSF	RF BROAD BAND
676	M17	L703	82-0521	.0000		TRANSF	RF IF2 10MM
677	M17	Q701	48R00869878	.0000		TRANSIST	FET 9878
678	M17	Q702	48R00869570	.0000		TRANSIST	NPN 9570
679	M17	Q703	48R00869570	.0000		TRANSIST	NPN 9570
680	M17	Q704	48R00869570	.0000		TRANSIST	NPN 9570
681	M17	R701	6S11009C39	390.0000		RESIST	FCF 1/4W 5%
682	M17	R702	6S11009C43	560.0000		RESIST	FCF 1/4W 5%
683	M17	R703	6S11009C47	820.0000		RESIST	FCF 1/4W 5%
684	M17	R704	6S11009C09	22.0000		RESIST	FCF 1/4W 5%
685	M17	R705	6S11009C09	22.0000		RESIST	FCF 1/4W 5%
686	M17	R706	6S11009C37	330.0000		RESIST	FCF 1/4W 5%
687	M17	R707	6S11009C21	68.0000		RESIST	FCF 1/4W 5%
688	M17	R707	6S11009C61	3.3000	K	RESIST	FCF 1/4W 5%
689	M17	R708	6S11009C21	68.0000		RESIST	FCF 1/4W 5%
690	M17	R709	6S11009C55	1.8000	K	RESIST	FCF 1/4W 5%
691	M17	R710	6S11009C55	1.8000	K	RESIST	FCF 1/4W 5%
692	M17	R711	6S11009D02	150.0000	K	RESIST	FCF 1/4W 5%
693	M17	R712	6S11009C49	1.0000	K	RESIST	FCF 1/4W 5%
694	M17	R713	6S11009C65	4.7000	K	RESIST	FCF 1/4W 5%
695	M17	R714	6S11009C65	4.7000	K	RESIST	FCF 1/4W 5%
696	M17	R715	6S11009C65	4.7000	K	RESIST	FCF 1/4W 5%
697	M17	R716	6S11009C47	820.0000		RESIST	FCF 1/4W 5%
698	M17	R717	6S11009C49	1.0000	K	RESIST	FCF 1/4W 5%
699	M17	R718	6S11009C73	10.0000	K	RESIST	FCF 1/4W 5%
700	M17	R719	6S11009C51	1.2000	K	RESIST	FCF 1/4W 5%
701	M17	R720	6S11009C63	3.9000	K	RESIST	FCF 1/4W 5%
702	M17	R721	6S11009C49	1.0000	K	RESIST	FCF 1/4W 5%
703	M17	R722	6S11009C49	1.0000	K	RESIST	FCF 1/4W 5%
704	M17	R723	3006P-001-103	10.0000	K	TRIMPOT	CERMET 15T
705	M17	R724	6S11009C01	10.0000		RESIST	FCF 1/4W 5%
706	M17	R725	6S11009C73	10.0000	K	RESIST	FCF 1/4W 5%
707	M17	R726	6S11009C97	100.0000	K	RESIST	FCF 1/4W 5%
708	M17	R728	6S11009C49	1.0000	K	RESIST	FCF 1/4W 5%
709	M17	R731	6S11009C17	47.0000		RESIST	FCF 1/4W 5%
710	M17	R732	6S11009C31	180.0000		RESIST	FCF 1/4W 5%
711	M17	R733	6S11009C45	680.0000		RESIST	FCF 1/4W 5%
712	M17	R734	6S11009C85	33.0000	K	RESIST	FCF 1/4W 5%
713	M17	R735	6S11009C51	1.2000	K	RESIST	FCF 1/4W 5%
714	M17	R736	6S11009C09	22.0000		RESIST	FCF 1/4W 5%
715	M17	R737	6S11009C25	100.0000		RESIST	FCF 1/4W 5%
716	M17	R738	6S11009C01	10.0000		RESIST	FCF 1/4W 5%
717	M17	S701	T2.5-6T	.0000		TRANSF	RF BROAD BAND
718	M17	U701	MC1596L	.0000		IC	BALANCED MODULATOR
719	M17	U702	MC10136L	.0000		IC	HEX COUNTER PROGRAMMABLE
720	M17	U703	MC10136L	.0000		IC	HEX COUNTER PROGRAMMABLE
721	M17	U704	51R83081F07	.0000		IC	D FF (DUAL MC10131
722	M17	U705	MC12040	.0000		IC	PHASE DETECTOR
723	M17	U706	MC14024CP	.0000		IC	RIPPLE COUNTER 7 BIT
724	M17	X701	48R03092A01	2.5600		XTAL	2.56MHZ
725	M18	C750	8C42208B18	.0470	U	CAP	MYLAR 50V 10%
726	M18	C751	8C42208B18	.0470	U	CAP	MYLAR 50V 10%
727	M18	C752	8C42208B18	.0470	U	CAP	MYLAR 50V 10%
728	M18	C753	8C42208B18	.0470	U	CAP	MYLAR 50V 10%

MONITOR PARTS LIST

REC#	AS	ID	PN	VAL.	X	TYPE	DESCR
729	M18	C755	8C42208B15	.0100		U CAP	MYLAR 50V 10%
730	M18	C756	8C42208B18	.0470		U CAP	MYLAR 50V 10%
731	M18	D750	48R40019S04	.0000		DIODE	VARACTOR
732	M18	D751	48-02054A00	.0000		DIODE	GENERAL PURPOSE
733	M18	D752	48-02054A00	.0000		DIODE	GENERAL PURPOSE
734	M18	D752	48-02054A00	.0000		DIODE	GENERAL PURPOSE
735	M18	L750	82-0497	.0000		TRANSF	RF VCO
736	M18	Q751	48R00869878	.0000		TRANSIST	FET 9878
737	M18	R750	6S11009A37	330.0000		RESIST	FCF 1/4W 5%
738	M18	R751	6S11009C53	1.5000	K	RESIST	FCF 1/4W 5%
739	M18	R752	6S11009C71	8.2000	K	RESIST	FCF 1/4W 5%
740	M18	R753	6S11009A37	330.0000		RESIST	FCF 1/4W 5%
741	M18	R754	6S11009C53	1.5000	K	RESIST	FCF 1/4W 5%
742	M18	R755	6S11009C71	8.2000	K	RESIST	FCF 1/4W 5%
743	M18	R756	6S11009A37	330.0000		RESIST	FCF 1/4W 5%
744	M18	R757	6S11009C29	150.0000		RESIST	FCF 1/4W 5%
745	M18	R758	6S11009C35	270.0000		RESIST	FCF 1/4W 5%
746	M18	U750	TL081CP	.0000		IC	OP. AMP. SINGLE
747	M20	E801	EM20-1	.0000		LAMP	DIAL LAMP 28V
748	M20	E802	EM20-1	.0000		LAMP	DIAL LAMP 28V
749	M20	E803	EM20-1	.0000		LAMP	DIAL LAMP 28V
750	M20	E804	EM20-1	.0000		LAMP	DIAL LAMP 28V
751	M20	I803	48-88245C09	.0000		DIODE	LED YELLOW
752	M20	I804	48-88245C06	.0000		DIODE	LED GREEN
753	M20	I805	48D88245C04	.0000		DIODE	LED RED
754	M20	I805	48-88245C06	.0000		DIODE	LED GREEN
755	M20	I805	48D88245C04	.0000		DIODE	LED RED
756	M20	I806	48-88245C09	.0000		DIODE	LED YELLOW
757	M20	M801	591C42-20A	.0000		METER	PANEL MODULATION
758	M20	M802	591C42-20A	.0000		METER	PANEL MODULATION
759	M20	M803	282	.0000		METER	PANEL EDGE
760	M20	R803	MF55D2211F	2.2100	K	RESIST	FMF 1/4W 1%
761	M20	R804	MF55D2211F	2.2100	K	RESIST	FMF 1/4W 1%
762	M20	R805	MF55D6810F	681.0000		RESIST	FMF 1/4W 1%
763	M20	R806	MF55D6810F	681.0000		RESIST	FMF 1/4W 1%
764	M20	R807	MF55D2210F	221.0000		RESIST	FMF 1/4W 1%
765	M20	R808	MF55D2210F	221.0000		RESIST	FMF 1/4W 1%
766	M20	R809	MF55D68R1F	68.1000		RESIST	FMF 1/4W 1%
767	M20	R810	MF55D68R1F	68.1000		RESIST	FMF 1/4W 1%
768	M20	R811	MF55D22R1F	22.1000		RESIST	FMF 1/4W 1%
769	M20	R812	MF55D22R1F	22.1000		RESIST	FMF 1/4W 1%
770	M20	R813	MF55D10R0F	10.0000		RESIST	FMF 1/4W 1%
771	M20	R814	MF55D10R0F	10.0000		RESIST	FMF 1/4W 1%
772	M20	R817	18D84944C12	5.0000	K	TRIMPOT	CARBON
773	M20	R818	18D84944C12	5.0000	K	TRIMPOT	CARBON
774	M20	R819	MF55D1001F	1.0000	K	RESIST	FMF 1/4W 1%
775	M20	R820	MF55D1000F	100.0000		RESIST	FMF 1/4W 1%
776	M20	R821	MF55D1000F	100.0000		RESIST	FMF 1/4W 1%
777	M20	R822	MF55D4020F	402.0000		RESIST	FMF 1/4W 1%
778	M20	R823	MF55D3010F	301.0000		RESIST	FMF 1/4W 1%
779	M20	R824	MF55D10R0F	10.0000		RESIST	FMF 1/4W 1%
780	M20	R825	MF55D10R0F	10.0000		RESIST	FMF 1/4W 1%
781	M20	R826	MF55D40R2F	40.2000		RESIST	FMF 1/4W 1%
782	M20	R827	MF55D30R1F	30.1000		RESIST	FMF 1/4W 1%
783	M20	R828	MF55D1001F	1.0000	K	RESIST	FMF 1/4W 1%
784	M20	R829	MF55D1000F	100.0000		RESIST	FMF 1/4W 1%

MONITOR PARTS LIST

REC#	AS	ID	PN	VAL	X	TYPE	DESCR
785	M20	R830	MF55D1000F	100.0000		RESIST	FMF 1/4W 1%
786	M20	R831	MF55D4020F	402.0000		RESIST	FMF 1/4W 1%
787	M20	R832	MF55D3010F	301.0000		RESIST	FMF 1/4W 1%
788	M20	R833	MF55D10R0F	10.0000		RESIST	FMF 1/4W 1%
789	M20	R834	MF55D10R0F	10.0000		RESIST	FMF 1/4W 1%
790	M20	R835	MF55D40R2F	40.2000		RESIST	FMF 1/4W 1%
791	M20	R836	MF55D30R1F	30.1000		RESIST	FMF 1/4W 1%
792	M20	R837	10F459	500.0000		POT	CARBON 2W 10%LIN
793	M20	R839	6-00127C23	82.0000		RESIST	FC 2W 10%
794	M20	R840	6S11009C23	82.0000		RESIST	FCF 1/4W 5%
795	M20	R841	6S11009C23	82.0000		RESIST	FCF 1/4W 5%
796	M20	R842	6S11009C21	68.0000		RESIST	FCF 1/4W 5%
797	M20	R843	6S11009C21	68.0000		RESIST	FCF 1/4W 5%
798	M20	R844	6-00127C25	100.0000		RESIST	FC 2W 10%
799	M20	R845	6-00125A18	51.0000		RESIST	FC 1/2W 5%
800	M20	R846	6S11009C18	51.0000		RESIST	FCF 1/4W 5%
801	M20	R847	6S11009C18	51.0000		RESIST	FCF 1/4W 5%
802	M20	R848	6S11009A13	33.0000		RESIST	FCF 1/4W 5%
803	M20	R849	6S11009D04	180.0000	K	RESIST	FCF 1/4W 5%
804	M20	R850	6S11009D04	180.0000	K	RESIST	FCF 1/4W 5%
805	M20	R851	6S11009C09	22.0000		RESIST	FCF 1/4W 5%
806	M20	R847	6S11009C18	51.0000		RESIST	FCF 1/4W 5%
807	M20	R848	6S11009A13	33.0000		RESIST	FCF 1/4W 5%
808	M20	R849	6S11009D04	180.0000	K	RESIST	FCF 1/4W 5%
809	M20	R850	6S11009D04	180.0000	K	RESIST	FCF 1/4W 5%
810	M20	R851	6S11009C09	22.0000		RESIST	FCF 1/4W 5%
811	M20	R852	6S11009C19	56.0000		RESIST	FCF 1/4W 5%
812	M20	R857	6S11009C13	33.0000		RESIST	FCF 1/4W 5%
813	M20	S801	591C42-18B	.0000		SWITCH	PB 10 SECT SCHADOW L
814	M20	S802	591C42-18A	.0000		SWITCH	PB 10 SECT SCHADOW R

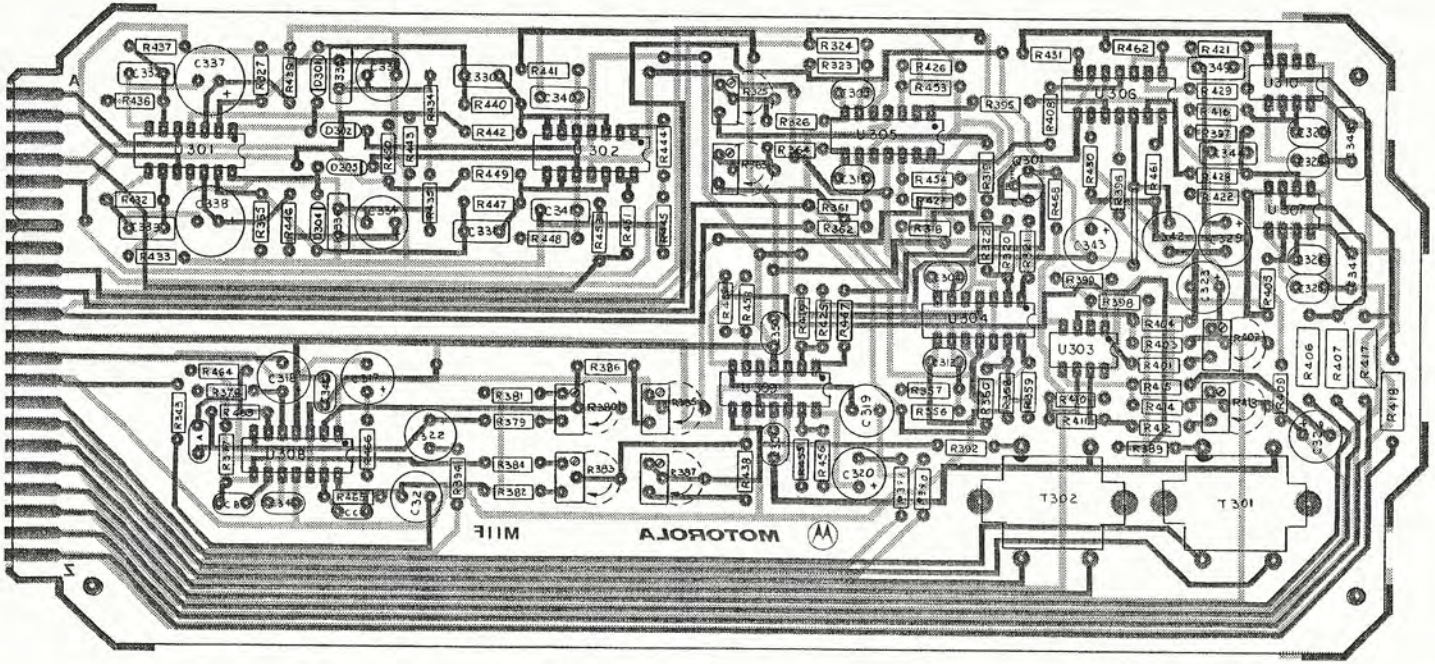
TABLE 1: M27

STATION	L.O.	VCO	SET	SWITCH 87654321
530	980	3920	98	01100010
540	990	3960	99	01100011
550	1000	4000	100	01100100
560	1010	4040	101	01100101
570	1020	4080	102	01100110
580	1030	4120	103	01100111
590	1040	4160	104	01101000
600	1050	4200	105	01101001
610	1060	4240	106	01101010
620	1070	4280	107	01101011
630	1080	4320	108	01101100
640	1090	4360	109	01101101
650	1100	4400	110	01101110
660	1110	4440	111	01101111
670	1120	4480	112	01110000
680	1130	4520	113	01110001
690	1140	4560	114	01110010
700	1150	4600	115	01110011
710	1160	4640	116	01110100
720	1170	4680	117	01110101
730	1180	4720	118	01110110
740	1190	4760	119	01110111
750	1200	4800	120	01111000
760	1210	4840	121	01111001
770	1220	4880	122	01111010
780	1230	4920	123	01111011
790	1240	4960	124	01111100
800	1250	5000	125	01111101
810	1260	5040	126	01111110
820	1270	5080	127	01111111
830	1280	5120	128	10000000
840	1390	5160	129	10000001
850	1300	5200	130	10000010
860	1310	5240	131	10000011
870	1320	5280	132	10000100
880	1330	5320	133	10000101
890	1340	5360	134	10000110
900	1350	5400	135	10000111
910	1360	5440	136	10001000
920	1370	5480	137	10001001
930	1380	5520	138	10001010
940	1490	5560	139	10001011
950	1400	5600	140	10001100
960	1410	5640	141	10001101
970	1420	5680	142	10001110
980	1430	5720	143	10001111
990	1440	5760	144	10010000
1000	1450	5800	145	10010001
1010	1460	5840	146	10010010
1020	1470	5880	147	10010011
1030	1480	5920	148	10010100
1040	1490	5960	149	10010101
1050	1500	6000	150	10010110
1060	1510	6040	151	10010111
1070	1520	6080	152	10011000

TABLE 1: M27 (Cont.)

STATION	L.O.	VCO	SET	SWITCH 87654321
1080	1530	6120	153	10011001
1090	1540	6160	154	10011010
1100	1550	6200	155	10011011
1110	1560	6240	156	10011100
1120	1570	6280	157	10011101
1130	1580	6320	158	10011110
1140	1590	6360	159	10011111
1150	1600	6400	160	10100000
1160	1610	6440	161	10100001
1170	1620	6480	162	10100010
1180	1630	6520	163	10100011
1190	1640	6560	164	10100100
1200	1650	6600	165	10100101
1210	1660	6640	166	10100110
1220	1670	6680	167	10100111
1230	1680	6720	168	10101000
1240	1690	6760	169	10101001
1250	1700	6800	170	10101010
1260	1710	6840	171	10101011
1270	1720	6880	172	10101100
1280	1730	6920	173	10101101
1290	1740	6960	174	10101110
1300	1750	7000	175	10101111
1310	1760	7040	176	10110000
1320	1770	7080	177	10110001
1330	1780	7120	178	10110010
1340	1790	7160	179	10110011
1350	1800	7200	180	10110100
1360	1810	7240	181	10110101
1370	1820	7280	182	10110110
1380	1830	7320	183	10110111
1390	1840	7360	184	10111000
1400	1850	7400	185	10111001
1410	1860	7440	186	10111010
1420	1870	7480	187	10111011
1430	1880	7520	188	10111100
1440	1890	7560	189	10111101
1450	1900	7600	190	10111110
1460	1910	7640	191	10111111
1470	1920	7680	192	11000000
1480	1930	7720	193	11000001
1490	1940	7760	194	11000010
1500	1950	7800	195	11000011
1510	1960	7840	196	11000100
1520	1970	7880	197	11000101
1530	1980	7920	198	11000110
1540	1990	7960	199	11000111
1550	2000	8000	200	11001000
1560	2010	8040	201	11001001
1570	2020	8080	202	11001010
1580	2030	8120	203	11001011
1590	2040	8160	204	11001100
1600	2050	8200	205	11001101
1610	2060	8240	206	11001110
1620	2070	8280	207	11001111

dip switch is backwards
0 = on
1 = off
+380?



MONITOR METER CIRCUIT CARD M11F
COMPONENT VIEW