McMARTIN INDUSTRIES, INC.
605 North 13th Street
Omaha, Nebraska 68102

McMartin ®

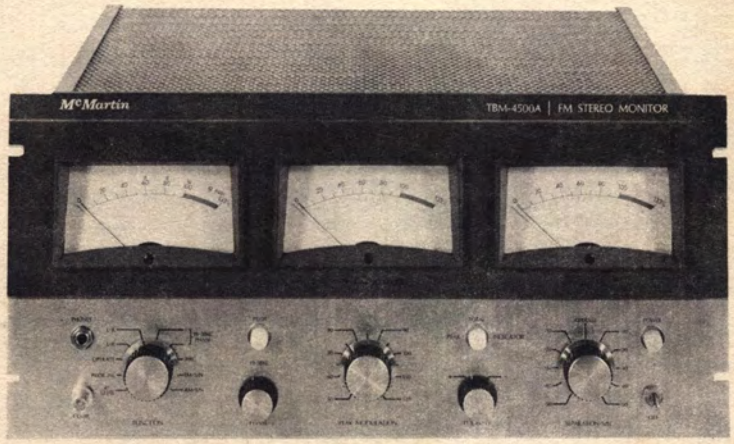
I.S. Wingfield (his book)

MEMBER EIA

NATIONAL ASSOCIATION OF BROADCASTERS NAB

TBM-4500A

FM STEREO MONITOR



INSTRUCTION MANUAL

TABLE OF CONTENTS

TECHNICAL SPECIFICATIONS

Operating Range	88 - 108 MHz
Modulation Range	± 75 kHz deviation - 100% mod. ± 100 kHz deviation - 133% mod.
RF Demodulator Input	
Impedance	50 ohms unbalanced
Sensitivity	0.1 to 1 watt
Composite Input	
Impedance	50K ohms
Sensitivity	1 to 1.5 volts peak-to-peak
Outputs - Left & Right	
Audio output for monitoring circuits	
Source Impedance	600 ohms balanced
Level	+ 4 dbm @ 100% modulation at 400 Hz
Distortion	Less than 1% (50 - 15,000 Hz)
Audio output for distortion measurement	
Impedance	10K or greater
Level	7 volts @ 100% modulation at 400 Hz
Frequency Response	30 - 15,000 Hz ± 0.5 db
Distortion	
Monaural	0.25% (30 - 15,000 Hz)
Stereo	0.5% (30 - 15,000 Hz)
Noise Level	-66 db below 100% modulation at 400 Hz
Stereo phones output	
Impedance	20K ohms
Level	2.0 volts

TECHNICAL SPECIFICATIONS (Cont'd.)

Outputs - Left & Right (Cont'd.)

Composite output

Source Impedance	300 ohms
Level	0.30 volts peak-to-peak
Frequency Response	50 - 100,000 Hz ± 0.2 db

Pilot Injection Circuit

Accuracy	± 0.5%
Meter Indication	6 - 12%
Indicator	Pilot lamp (operates at 6% injection or higher)

Peak Flasher

Peak flasher meets FCC requirements	Peak light adjustable to read positive and negative peaks from 50% to 120% modulation

Modulation Meters

Left or Right

Accuracy	± 0.5 db
Frequency Response	30 - 15,000 Hz ± 0.5 db
Meter characteristic meets FCC requirements	

Total

Accuracy	± 0.5 db
Frequency Response	30 - 75,000 Hz ± 0.5 db
Meter characteristic meets FCC requirements	

Separation

Left into right	35 db or better (50 - 15,000 Hz)
Right into left	35 db or better (50 - 15,000 Hz)
67 kHz into either channel	-60 db or better
	NOTE: SEPARATION CAN BE MEASURED INTERNALLY DOWN TO -70 db

TECHNICAL SPECIFICATIONS (Cont'd.)

Measurement of Suppressed 38 kHz Carrier

Modulated 100% with frequencies above 5 kHz	Better than 46 db
No modulation	Better than 55 db

Cross Talk

Main to stereo sub	46 db or better
Stereo sub-channel to main	46 db or better
67 kHz into main or stereo	66 db or better

Power Requirements	105 - 125 volts AC, 50/60 Hz, 45 watts
Fuse	0.5 amp. slo-blo
Ambient Temperature Range	10 - 50° C

Dimensions

Width	Standard 19 inch rack panel mount
Height	8¼ inches
Depth	14 inches overall
Weight	25 pounds

Finish	McMartin blue and brushed aluminum

MODULE, TRANSISTOR & DIODE COMPLEMENT

Symbol	Description	Function
MM-601	1 per unit	Plug-in composite amplifier
MM-602	1 per unit	Plug-in amplitude correction amplifier
MM-603	5 per unit	Plug-in audio amplifier
MM-604	3 per unit	Plug-in DC meter amplifier
MM-606	1 per unit	FM wide-band demodulator
MM-607	1 per unit	Peak flasher
MM-608	1 per unit	Phase inverter
MM-609	1 per unit	db amplifier
MM-611	1 per unit	19 kHz amplifier
MM-612	1 per unit	19 kHz amplifier doubler
MM-613	1 per unit	19 kHz phasing amplifier
Q-1	SE-4010	Emitter follower
Q-2	SE-4001*	Right channel amplifier
Q-3	2N2102	Right channel amplifier
Q-4	SF-4863A	Composite amplifier
Q-5	SF-4863A	db amplifier
Q-6	2N3053	db amplifier
Q-7	SE-4001*	Left channel amplifier
Q-8	2N2102	Left channel amplifier
Q-9	40328	Voltage regulator
Q-10	40328	Voltage regulator

MODULE, TRANSISTOR & DIODE COMPLEMENT (Cont'd.)

Symbol	Description	Function
Q-11	40328	Voltage regulator
D-1	1N3604	Demodulator diode
D-2	1N3604	Demodulator diode
D-3	1N3604	Demodulator diode
D-4	1N3604	Demodulator diode
D-5	1N3606	Voltmeter diode
D-6	1N3606	Voltmeter diode
D-7	1N3606	Voltmeter diode
D-8	BY127	Power rectifier
D-9	BY127	Power rectifier
Z-1	24V	Zener diode
Z-2	36V	Zener diode
Z-3	24V	Zener diode
Z-4	24V	Zener diode
Z-5	90V	Zener diode
Z-6	36V	Zener diode

*Selected in production for optimum performance

PLUG-IN MODULE, TRANSISTOR & DIODE COMPLEMENT

COMPOSITE AMPLIFIER MM-601

Q-1	SE-4001	Voltage amplifier
Q-2	2N3053	Audio amplifier
Q-3	SE-4001	Voltage amplifier
Q-4	2N3053	Audio amplifier

AMPLITUDE CORRECTION AMPLIFIER MM-602

Q-1	SE-4001	Left channel amplifier
Q-2	SE-4001	Right channel amplifier

WIDE-BAND PLUG-IN AUDIO AMPLIFIER MM-603

Q-1	SE-4001	Amplifier
Q-2	2N2102	Amplifier

DC METER AMPLIFIER MM-604

Q-1	SF-4863A	½ of DC amplifier
Q-2	SF-4863A	½ of DC amplifier

WIDE-BAND FM DEMODULATOR MM-606

Q-1	40245	Local oscillator
Q-2	40243	Mixer
Q-3	40245	Limiter

WIDE-BAND FM DEMODULATOR MM-606 (Cont'd.)

Q-4	40245	Limiter
Q-5	40245	Limiter
Q-6	SE-4001	Audio amplifier
Q-7	2N2102	Audio amplifier
D-1	1N51	RF doubling diode
D-2	1N3604	Counter detector
D-3	1N3604	Counter detector

PEAK FLASHER CIRCUIT MM-607

Q-1	SF-4863A	Isolation amplifier
Q-2	SE-4001	½ of a Schmitt trigger
Q-3	SE-4001	½ of a Schmitt trigger
Q-4	2N3053	Low impedance pulse amplifier
Q-5	SF-4863A	DC amplifier
Q-6	2N2102	Buffer
Q-7	2N2102	Switching transistor

PHASE SPLITTER MM-608

Q-1	2N2102	Anode follower
Q-2	2N2102	Phase splitter
Q-3	2N2102	Negative peak amplifier
Q-4	2N2102	Positive peak amplifier

PLUG-IN MODULE, TRANSISTOR & DIODE COMPLEMENT (Cont'd.)

HI-GAIN AUDIO AMPLIFIER MM-609

Q-1	SE-4001	Amplifier
Q-2	2N2102	Amplifier

19 kHz AMPLIFIER MM-611

Q-1	SE-4010	Hi-Z amplifier
Q-2	SE-4001	Hi-Z amplifier
Q-3	SE-4001	Emitter follower

19 kHz AMPLIFIER DOUBLER MM-612

Q-1	SE-4001	Hi-Z amplifier
Q-2	2N2102	38 kHz pulse amplifier
Q-3	2N2102	DC relay control

19 kHz PHASING AMPLIFIER MM-613

Q-1	SE-4001	Hi-Z amplifier
Q-2	SE-4001	Hi-Z amplifier
Q-3	SE-4001	Emitter follower

GENERAL DESCRIPTION

The McMartin TBM-4500A, all silicon solid-state stereo monitor, is a completely self-contained unit for measurements of all modulation characteristics of the FM broadcast station. The TBM-4500A features three modulation meters for simultaneous measurements of left channel, right channel, and total modulation.

For simplicity of operation the various metering functions are incorporated in one switch to measure all the important characteristics of the stereo signal. These functions include RF input level, pilot injection, left channel modulation, L + R (main channel modulation), L - R (stereo sub-channel modulation), proper phasing of internal 19 kHz and 38 kHz circuits, 38 kHz carrier suppression, FM-S/N, and AM-S/N. In addition, the TBM-4500A will measure separation between the left and right channels, cross talk between main and stereo sub-channel, cross talk between the 67 kHz SCA channel and the stereo sub-channel or the main channel.

The modulation meters are peak indicating devices capable of measuring true peak value, regardless of waveform. The right and left meters are also used as audio voltmeters which are used to measure separation between the left and right channels, cross talk between the main and the stereo sub-channels, FM-S/N and AM-S/N. When the function switch is in the FM-S/N or AM-S/N position, the signal is automatically de-emphasized. Also, the meter is highly damped in all the db positions. With the separation switch in the operate position, the meter ballistics conform to the FCC requirements. NOTE: THE VOLTMETER IS PROTECTED AGAINST SEVERE OVERLOAD. The level is automatically compensated between the stereo and monaural mode. When no stereo is broadcasted, all three meters will read identically.

A BNC connector located on the left side of the front panel gives a true display of the modulation present. It is also switched so that the pilot, main channel, stereo sub-channel or the composite signal can be seen separately depending on the position of the function switch. The output impedance is low, minimizing error when a reasonable length of cable is used. A wide-band oscilloscope can be used to verify all measurements. Also, a frequency measuring device, such as the McMartin TBM-3005 frequency counter, can be connected and the pilot frequency measured at any time without removing the main channel modulation.

The TBM-4500A features modular construction; almost all of the circuits are plug-in units for simplified service in the field. Each plug-in module is isolated from the power supply so that in case of failure or short circuit in any one unit, it will not short circuit the power supply, disabling the rest of the monitoring functions.

All the critical circuits have double regulation in the power supply for added stability. All transistors are operated at one-half or less of their rated voltage for greater reliability.

The wide-band demodulator automatically mutes if the RF input signal falls below proper operating level, thus eliminating noise in the monitoring system in case of loss of RF input.

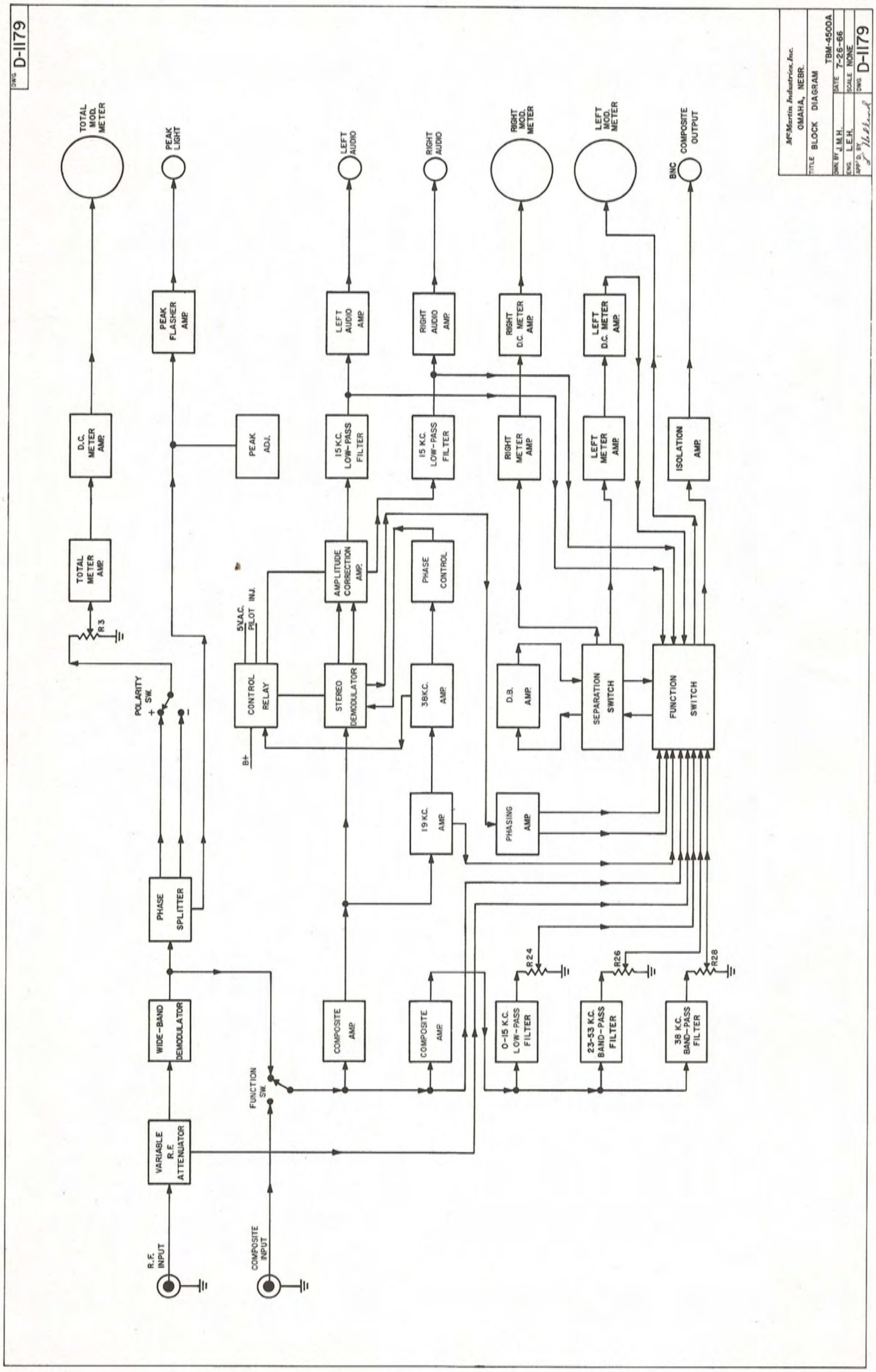
A high speed peak indicating light, located on the front panel, is adjustable from 50 - 120% modulation. The light remains on for a period of two to four seconds as required by the FCC, regardless of the duration of the overmodulation peak. A jack is provided for a remote peak indicator light. The addition of the cable capacity will not affect the performance. The peak indicating light will flash when positive and negative peaks exceed the preset level. In addition, a polarity switch is provided to measure modulation in both positive and negative directions read only on the modulation meter.

An indicator light, located on the front panel, lights when the 19 kHz pilot carrier exceeds 6% main channel modulation, thus indicating stereo transmission. A phasing control, located on the front panel, allows adjustments of the internal 19 kHz circuits for a precise zero crossing. This may be checked at any time with or without modulation.

Two terminal strips, located on the rear of the chassis, provide connections for aural monitoring of either left or right channel, also for connection of an external distortion meter.

A composite/normal function switch, located on the rear of the chassis, allows direct monitoring of a stereo generator, bypassing the exciter and the transmitter's P.A. This is adjustable from 0.35 to 1.5V RMS.

Remote metering kit (RM-M45) contains the rack panel assembly, left and right meters, total peak indicator light and remote amplifiers.


DWG D-1179
McMartin Industries, Inc.
OMAHA, NEBR.
TITLE BLOCK DIAGRAM
TBM-4500A
DRN BY J.M.H.
DATE 7-26-66
ENG. L.E.H.
SCALE NONE
APP'D. BY
DWG D-1179
TOTAL MOD. METER
PEAK LIGHT
LEFT AUDIO
RIGHT AUDIO
RIGHT MOD. METER
LEFT MOD. METER
BNC COMPOSITE OUTPUT
PEAK FLASHER AMP.
LEFT AUDIO AMP.
RIGHT AUDIO AMP.
RIGHT D.C. METER AMP.
LEFT D.C. METER AMP.
D.C. METER AMP.
PEAK ADJ.
15 K.C. LOW-PASS FILTER
15 K.C. LOW-PASS FILTER
RIGHT METER AMP.
LEFT METER AMP.
ISOLATION AMP.
TOTAL METER AMP.
AMPLITUDE CORRECTION AMP.
PHASE CONTROL
R3
5V.A.C.
PILOT INJ.
POLARITY SW.
CONTROL RELAY
STEREO DEMODULATOR
38K.C. AMP.
D.B. AMP.
SEPARATION SWITCH
FUNCTION SWITCH
B+
19 K.C. AMP.
PHASING AMP.
PHASE SPLITTER
R24
R26
R28
WIDE-BAND DEMODULATOR
COMPOSITE AMP.
COMPOSITE AMP.
0-15 K.C. LOW-PASS FILTER
23-53 K.C. BAND-PASS FILTER
38 K.C. BAND-PASS FILTER
FUNCTION SW.
VARIABLE R.F. ATTENUATOR
R.F. INPUT
COMPOSITE INPUT

CIRCUIT DESCRIPTION

The sampled RF from the transmitter is fed to the adjustable RF input attentuator. The RF is adjusted by the RF level control, located on the rear of the unit, to a level suitable for proper operation. The correct level is indicated by the left meter (with the function switch in the RF level position). Two diode rectifiers convert the RF into a DC voltage to drive the meter. A meter reading of 100% indicates that the proper RF level is being fed to the input of the wide-band demodulator (MM-606). This adjustment is not critical except when making an AM-S/N reading.

The RF signal from the variable attenuator is further attenuated by a fixed resistor which feeds the MM-606 FM wide-band demodulator. An output from the MM-606 is fed through isolation resistor R-1 (5600 ohms) to the input of phase splitter MM-608. A front panel polarity switch is used to select modulation in either the positive or negative direction as read on the modulation meter only. The output from the polarity switch is fed to Q-1, an isolation stage used to eliminate loading of the phase splitter. The output of Q-1 feeds R-3 (5K ohm) calibration potentiometer. This controls the amount of modulation fed to the input of the wide-band audio amplifier (MM-603). The output impedance of this amplifier is very low, suitable for feeding diode D-5, thus charging capacitor C-4 to a peak value. This peak value is measured with an extremely high input impedance VTVM type circuit. DC meter amplifier MM-604 consists of two FET's in a balanced differential amplifier. Modulation meter M-1 is connected between the two source elements. Thus, the meter sees an extremely low impedance. This gives a meter circuit with rapid rise time and excellent damping.

A second output from the MM-608 which contains both negative and positive pulses is fed to the peak light calibration potentiometer. This controls the level of the MM-607. The peak flasher amplifier will respond to negative and positive modulation peaks of very short duration. Capacitor C-10 and resistor R-13 comprise a RC time delay which will hold the light on for at least two to four seconds, regardless of the length of the overmodulation pulse. The power supply is double regulated to insure stable operation under all conditions. A socket is provided on the rear of the chassis for an external peak light. The capacity of the cable will not affect the performance in any way.

A second output from the MM-606 wide-band FM demodulator is fed to the rear chassis switch SW-1. This switch enables the operator to bypass the RF section of the system and sample a composite signal directly from the stereo generator. The signal from switch SW-1 is fed through capacitor C-12 to the input of 19 kHz amplifier MM-611. The low output impedance of MM-611 is fed through capacitor C-21 to the center of the stereo switching bridge. This amplifier consists of two stages of amplification using low impedance Hi-Q coils giving high selectivity and rejecting all frequencies excepting the 19 kHz pilot. Another output from MM-611 is fed through capacitor C-15 to the input of the amplifier doubler (MM-612). The output of the amplifier doubler consists of 38 kHz pulses, which feeds L-3, a 38 kHz phasing coil. This restores the 38 kHz pulses into a sine wave. The output of the 38 kHz phasing coil is fed through capacitor C-20 (6800 pf) to matching transformer L-4. This transformer feeds the stereo demodulator. The stereo demodulator circuit separates the original left and right audio channels from the composite signal. This demodulation is accomplished by alternately switching the incoming composite signal at a 38 kHz rate. This switching is accomplished in diodes D-1, D-2, D-3 and D-4.

The left and right audio channels from the stereo demodulator are fed to the amplitude correction amplifier (MM-602). The amplitude correction amplifier corrects for the inefficiency in the switching diodes. The left and right outputs of the correction amplifier are fed through 15 kHz low-pass filters FL-4 and FL-5 which remove all frequencies present above 15 kHz.

The output of filters FL-4 and FL-5 feeds the right and left amplifier modules. De-emphasis is accomplished by a feedback network in each unit. A de-emphasis switch is provided in each channel by SW-3 and SW-4 which are located on the rear chassis. The left and right audio outputs from the two MM-603 amplifiers are fed to their respective terminal boards marked Hi-Z on the rear of the chassis. Strapping the two Hi-Z terminals gives a balanced 600 ohms output at the 600 ohm terminals.

The right and left signals from FL-4 and FL-5 are fed through the function switch to the separation switch. In the operate position the signal is fed directly to the right and left meter amplifiers (MM-603). In any of the other positions of the switch the signal is amplified by the audio voltmeter amplifier module (MM-609). The signal is amplified in 10 db steps as the separation switch is rotated. A maximum of 50 db gain is available.

A second output from SW-1 is fed through capacitor C-17 (5 mfd) to the input of the composite amplifier (MM-601). The low output impedance of the MM-601 is suitable for driving the three filters (0 to 15 kHz low-pass filter, 23 to 53 kHz bandpass filter and 38 kHz bandpass filter). Potentiometers in the output of these filters allow for calibration of the peak reading meter through the function switch SW-5.

The composite output circuit primarily consists of Q-4, a field-effect transistor with extremely high input impedance and a low source impedance. This eliminates any error when a reasonable length of cable is used in feeding an oscilloscope. The composite output is available through a BNC connector on the front panel. This output is switched to the output of the bandpass filters. Thus, you can view the L plus R, L minus R, composite, or 19 kHz pilot at any time on an oscilloscope. The FET also gives complete isolation so that no loading is reflected on any of the circuits.

The audio voltmeter consists of amplifiers Q-5 and Q-6 in conjunction with R-60, R-61, R-62, R-63 and R-64. Q-5 is a FET with very high input impedance which will not load the voltage divider, thus minimizing error. The output of Q-6 is low which makes it suitable for driving either the right or left meter amplifier.

To insure proper zero crossing of the 19 and 38 kHz signals, a switch is used to measure the voltage difference that occurs betweeen the junction of diodes D-1, D-2, D-3 and D-4. The 19 kHz pilot carrier voltage across the demodulator diodes will be unbalanced if the phasing is incorrect. Switching the function switch from positive phase to negative phase samples the voltage present on each side of the demodulator diodes. If the voltage is equal, exact zero crossing is achieved. This voltage is measured with the 19 kHz phasing amplifier (MM-613).

A second output from Pin No. 5 of the amplifier doubler (MM-612) drives relay RLY-1. The relay control circuit performs the following functions:

1. Activates the stereo pilot light PL-1.

2. Short circuits R-39 in the stereo mode and feeds a small positive voltage which back-biases the switching diode to insure low distortion in the monaural mode.

3. Short circuits R-44 which is the monaural calibrate potentiometer. This increases the gain of the correction amplifier to give exactly the same audio output as when in the monaural mode.

4. Short circuits Points W & Z compensating the diode D-5 threshold point. D-5 will not conduct until a potential of 0.35 volts is applied. This corrects for the approximate 0.3 db error when measuring a composite signal.

The audio voltmeter is automatically damped when the separation switch is turned to any position except operate. Capacitors C-36 and C-45 are shunted across the meter movement, which highly damps the meter for more precise noise measurement.

The ballistics of the meters are controlled by R-6, C-3, R-59, C-34, R-76 and C-44. The rise time is controlled by these capacitors. Meter decay is controlled by resistors shunted across diodes D-5, D-6 and D-7. The resistors are selected at the factory for proper decay. The three DC meter amplifiers (MM-604) are stabilized by a special balancing circuit and double regulation in the power supply.

The power supply is well regulated, using a Darlington type emitter follower employing three transistors and two Zener reference voltage diodes. The circuit also functions as a capacity multiplier, eliminating any AC ripple in the power supply. Several of the plug-in amplifiers are further regulated by Zener diodes. The voltage is held within 1% with the line voltage varying from 105 to 150 volts. All stages are fed through isolation resistors and are all decoupled. Any one stage could be short circuited without seriously affecting the others.

INSTALLATION

Upon receipt of your TBM-4500A, remove it from the shipping carton and inspect carefully for any damage caused in transit due to rough handling. If damage is found, notify the shipping agency and advise McMartin Industries, Incorporated of such action.

The top cover of the TBM-4500A should be removed and the packing material removed. An inspection of the plug-in modules should be made to insure that they are firmly seated in their proper sockets.

The TBM-4500A should be mounted where there is adequate ventilation. The unit should not be mounted above high heat producing equipment.

CAUTION: THE TEMPERATURE SHOULD NOT EXCEED 110° F

Connect the AC cord to the 117 volt AC source. Connect the RF cable from the pick-up loop to the input jack on the rear of the chassis.

CAUTION: DO NOT EXCEED 1 WATT RF INPUT

The TBM-4500A has been thoroughly checked and calibrated prior to shipment and should require no adjustment. However, after the unit has been installed, the following checks should be made.

1. Check the mechanical zero setting of each meter before turning the monitor on.

2. Turn power on and allow sufficient time for stabilization. The monitor has extensive filtering and requires some time for stabilization.

OPERATION

ADJUSTMENT OF RF INPUT LEVEL:

CAUTION: BEFORE APPLYING RF INPUT, TURN THE RF LEVEL CONTROL TO MINIMUM. Slowly adjust RF level for a reading of 100% on left meter (with function switch in RF level position). If the meter tends to reverse when increasing the level control, this indicates too much RF applied to monitor.

NOTE: MONITOR NEED NOT HAVE AC POWER APPLIED FOR THIS ADJUSTMENT

This is the only adjustment required for monitoring the RF output of the transmitter.

CAUTION: THE COMPOSITE INPUT LEVEL CONTROL MUST BE FULLY CLOCKWISE AND FUNCTION SWITCH IN NORMAL OPERATION POSITION.

The unit is now ready for operation. If the station is transmitting monaural, all three meters will read the same. One-hundred percent modulation reading is equivalent to ±75 kHz deviation of the transmitter. The center meter will read total peak modulation at all times.

MONITORING TOTAL MODULATION:

Total modulation may be read on the center meter at all times.

POLARITY SWITCH:

The switch may be left in either the positive or negative positions, as the peak flasher automatically will respond to positive and negative peaks.

PEAK MODULATION ADJUSTMENT:

This adjusts the overmodulation peak indicator, and should never be set to exceed 100%. This is the most important function of the monitor. The peak light will remain on for at least two seconds every time overmodulation occurs, in either positive or negative direction.

SPECIAL NOTE: With normal broadcast program material, it will not be uncommon for the peak flasher to light at a 100% setting while the total modulation will average about 50 to 70% on peaks. The peak flasher will catch modulation peaks which are much too short for complete meter response. THE PEAK LIGHT MUST BE THE PRIME SOURCE OF INDICATING OVERMODULATION.

OPERATION (Cont'd.)

MONITORING THE PILOT INJECTION:

If the station is transmitting stereo, place the function switch in the pilot injection position, then adjust the pilot injection of the transmitter to get the desired injection (8-10% is required by the FCC), read on the upper scale of the left meter. (The 19 kc pilot may be viewed on a scope through the BNC connector on the front panel). Return the function switch to the operate position.

INTERNAL 19 kHz PHASE CALIBRATION:

A 19 kHz pilot carrier must be present and adjust to approximately 10% injection. Turn the function switch to positive (+) phase and note the reading on the left meter. Switch to the negative (-) phase position. If the two readings are not identical, adjust the phase control located on front panel while switching between the readings. Exact zero crossing or perfect phase occurs when the positive (+) and negative (-) readings are equal.

This function may be checked at any time with or without modulation. It is suggested that this be done daily to insure accurate monitoring.

PILOT PHASE ADJUSTMENT OF TRANSMITTER:

The internal 19 and 38 kHz phasing of the monitor must be adjusted before making any phase adjustment in the transmitter. Applying equal out-of-phase signals (L= -R) (80 - 100 Hz) to the left and right input of the transmitter. Adjust the pilot phase of the transmitter for maximum reading on either left or right meter. If a good wide-band oscilloscope is available, the adjustment may be verified by connecting a low capacity cable to the BNC connector located on the front panel.

CAUTION: IF A COMPENSATED PROBE IS USED, CARE MUST BE TAKEN TO SEE THAT IT IS PROPERLY ADJUSTED.

NOTE: IT IS IMPERATIVE THAT CORRECT PHASE IS MAINTAINED AT ALL TIMES.

The display should resemble Figure 6A. The two points in the diamond should coincide. Figure 6B shows incorrect pilot phase.

OPERATION OF SEPARATION SWITCH:

The separation switch is in effect an audio voltmeter calibrated in 10 db steps. Turning the switch to either the left or right increases the gain 10 db in each position. However, the high gain amplifier is automatically switched to the appropriate left or right meter. An example for reading S/N ratio: If the meter reads -3 db in the 50 db position, the noise ratio would be -53 db below 100% modulation.

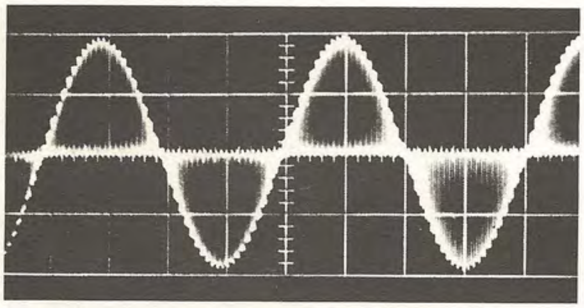


FIG. 1
IDEAL COMPOSITE SIGNAL

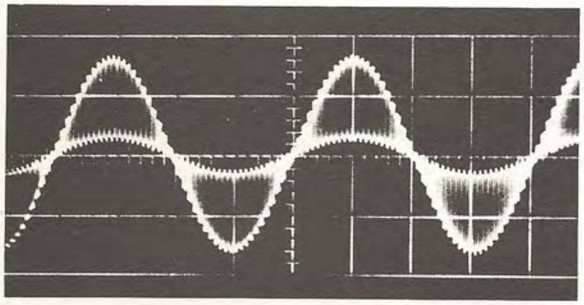


FIG. 2
L-R SIGNAL TOO LOW

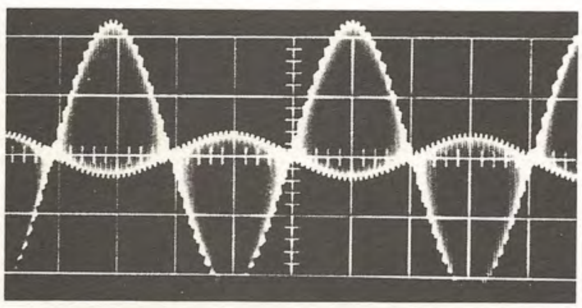


FIG. 3
L-R SIGNAL TOO HIGH

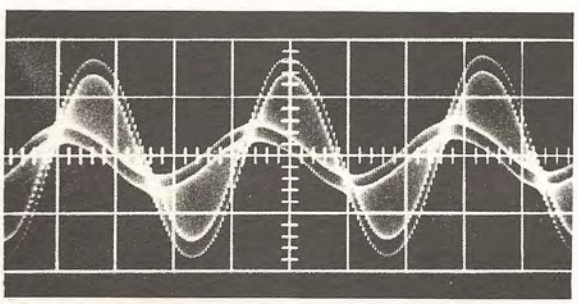


FIG. 4
EXCESSIVE TIME DELAY

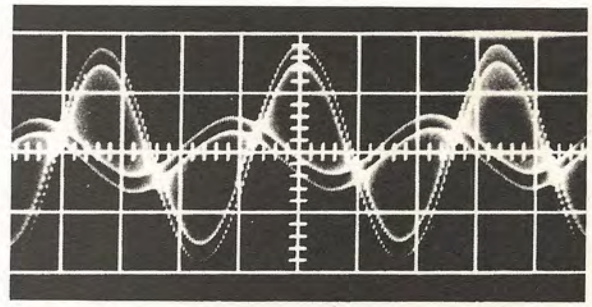


FIG. 5
TIME DELAY AND AMPLITUDE ERROR

FIG. 6A
PILOT PHASE ON COMPOSITE SIGNAL

FIG. 6B
PILOT PHASE ERROR ON COMPOSITE SIGNAL

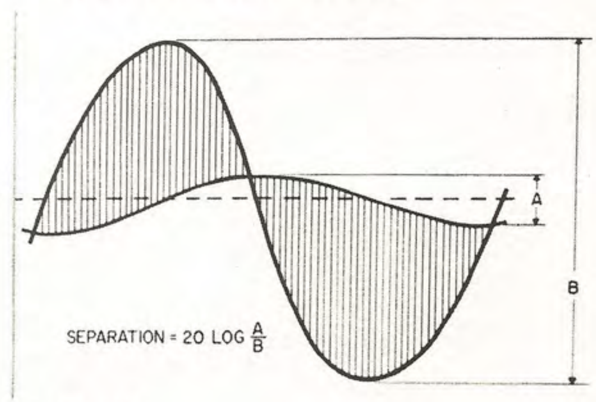


FIG. 7
SEPARATION MEASUREMENT WITH SCOPE

OPERATION (Cont'd.)

MEASUREMENT OF L INTO R CHANNEL SEPARATION:

Modulate the left channel of the transmitter until the left meter reads 90% (80% if SCA is being transmitted). The right meter should now read near zero, if everything is functioning properly. The separation can be measured by rotating the separation switch to the right, (L into R) until a reading is obtained on the right meter.

FOR EXAMPLE:

If the meter reads -6 db with the separation switch in the -30 db position, the channel separation would be -36 db. This procedure is used for any frequency from 50 to 15,000 Hz.

Return the separation switch to operate position.

NOTE: IN STEREO SYSTEMS USING SQUARE WAVE RATHER THAN SINE WAVE SWITCHING, REDUCED SEPARATION WILL BE NOTED. REFER TO STEREO DEMODULATOR CALIBRATION, PAGE 31, FOR ADJUSTMENTS TO BE MADE IN MONITOR.

MEASUREMENT OF R INTO L CHANNEL SEPARATION:

Modulate the right channel of the transmitter until the right meter reads 90% (80% if SCA is being transmitted). The left meter should read near zero. The separation can be measured by rotating the separation switch to the left (R into L) until a reading is obtained on the left meter. This procedure is identical to the measurement of L into R.

Return the separation switch to the operate position.

If the separation between the left and right channel is inadequate, (30 db minimum is required by FCC) the following procedures are recommended:

Connect a wide-band scope to the composite output jack (BNC) located on the front panel of the TBM-4500A. The display should look like Figure 1. Any departure from this will reduce separation.

Figure 2 indicates the amplitude of the L-R is too low, and Figure 3 too high.

Figure 4 indicates excessive time delay. Figure 5 indicates both time delay and amplitude error. Again adjust transmitter for the straightest base line at all frequencies.

MEASUREMENT OF R INTO L CHANNEL SEPARATION: (Cont'd.)

If no scope is available, adjust transmitter for best overall separation at all frequencies as read on the separation meter of the TBM-4500A.

The amount of separation in decibels is the ratio of the peak to peak value of the composite signal to the base line variation. See Figure 7.

In actual practice, separation losses are attributable to a combination of both amplitude and phase error that exists somewhere in the system.

MEASUREMENT OF CROSSTALK - STEREO SUB-CHANNEL INTO MAIN CHANNEL:

1. Modulate the transmitter 90% (as read on total modulation meter) with 400 Hz L= -R (equal but out of phase signals) applied to left and right inputs of the transmitter.

2. Turn the function switch to the L + R position. (L + R signal may be viewed on a scope through the BNC connector on the front panel).

3. Turn the separation switch to the left to read the crosstalk of the double sideband sub-carrier into the main channel. (Refer to Operation of Separation Switch). This will be read on left meter.

4. Return function switch to the operate position.

5. Return separation switch to the operate position.

NOTE: IF POOR CROSSTALK READINGS ARE OBTAINED IT MAY BE NECESSARY TO CHECK THE L= +R SIGNAL AND L= -R SIGNAL WITH A WIDEBAND SCOPE TO INSURE THAT THE SIGNAL HAS ADEQUATE SEPARATION. SPURIOUS FREQUENCY PRESENT IN EITHER SIGNAL MAY GIVE FALSE CROSSTALK READINGS IN THE MONITOR.

MEASUREMENT OF CROSSTALK - MAIN CHANNEL INTO STEREO SUB-CHANNEL:

1. Modulate the transmitter 90% (as read on total modulation meter) with 400 Hz L= +R (equal in phase signals) applied to left and right inputs of the transmitter.

2. Turn the function switch to the L -R position. (L -R signal may be viewed on a scope through the BNC connector on the front panel).

OPERATION (Cont'd.)

MEASUREMENT OF CROSSTALK - MAIN CHANNEL INTO STEREO SUB-CHANNEL: (Cont'd.)

3. Turn the separation control to the right to read crosstalk of the main channel into the stereo sub-channel. This will be read on the right meter.

4. Return function switch to the operate position.

5. Return separation switch to the operate position.

NOTE: IF POOR CROSSTALK READINGS ARE OBTAINED IT MAY BE NECESSARY TO CHECK THE L= +R SIGNAL AND L= -R SIGNAL WITH A WIDEBAND SCOPE TO INSURE THAT THE SIGNAL HAS ADEQUATE SEPARATION. SPURIOUS FREQUENCY PRESENT IN EITHER SIGNAL MAY GIVE FALSE CROSSTALK READINGS IN THE MONITOR.

MEASUREMENT OF THE 38 kHz SUPPRESSED CARRIER WITHOUT MODULATION:

1. Remove all signals from both channels of the transmitter.

2. Remove the 19 kHz pilot carrier.

3. Turn the function switch to 38 kHz position.

4. Turn the separation switch to the left and read the residual 38 kHz carrier on the left meter. (Refer to Operation of Separation Switch).

5. Adjust transmitter for the null of the 38 kHz carrier.

6. Return the function switch to operate position.

7. Return the separation switch to operate position.

NOTE: FCC REQUIRES THAT THE 38 kHz SUPPRESSED CARRIER MUST BE SUPPRESSED 40 db OR 1% MODULATION.

MEASUREMENT OF THE 38 kHz SUPPRESSED CARRIER WITH MODULATION (5kHz to 15kHz)

1. Modulate the transmitter 90% (as read on total modulation meter) with any frequency between 5 kHz and 15 kHz.

2. Turn the function switch to 38 kHz position.

3. Turn the separation switch to the left and read the residual 38 kHz carrier on the left meter. (Refer to OPERATION OF SEPARATION SWITCH).

4. Return the separation and function switches to operate position.

MEASUREMENT OF DISTORTION OF THE LEFT AND RIGHT CHANNEL:

1. Modulate the left channel of the transmitter 100% as read on total modulation meter.

2. Remove the jumper between the (HI-Z) terminal on the rear terminal board on the left channel.

3. Connect a distortion analyzer to the terminals marked "Ground" and "HI-Z".

4. Measurement of the right channel is identical to above.

5. The de-emphasis switch should be in the "IN" position when distortion measurements are taken.

6. Distortion may also be measured from the stereo phone jack on the front panel.

MEASUREMENT OF DISTORTION OF MONAURAL SIGNAL:

1. Modulate the transmitter 100% as read on total modulation meter.

2. Remove the jumper between the (HI-Z) terminals on the rear terminal board of either the left or right channel.

3. Connect a distortion analyzer to the terminals marked GROUND and HI-Z.

4. The de-emphasis switch should be in the "IN" position when distortion measurements are taken.

5. Distortion may also be measured from the stereo phone jack on the front panel.

MEASUREMENT OF AM SIGNAL TO NOISE RATIO OF THE TRANSMITTER:

1. Adjust the RF input level for a reading of exactly 100% on the left meter with the function switch in the RF level position.

2. Remove all modulation from the transmitter.

3. Turn the function switch to AM-S/N position.

OPERATION (Cont'd.)

MEASUREMENT OF AM SIGNAL TO NOISE RATIO OF THE TRANSMITTER: (Cont'd.)

4. Turn the separation switch to the left and read the AM-S/N on the left meter (Refer to Operation of Seperation Switch).

5. Return function switch and separation switch to operate position.

MEASUREMENT OF FM SIGNAL TO NOISE RATIO OF THE TRANSMITTER:

1. Remove all modulation from the transmitter.

2. Turn the function switch to FM-S/N position.

3. Turn the separation switch to the left and read the FM-S/N on the left meter (Refer to Operation of Seperation Switch).

4. Return the function switch and separation switch to operation position.

MAINTENANCE

GENERAL:

If the TBM-4500A fails to function properly, first be sure that the RF input level is correct. Check to see if the unit performs properly in the monaural mode. One meter will read higher than the other if the relay is not functioning properly. A 20 db difference will be noted. Check to see that all plug-in modules are securely seated in their sockets. Also check the mechanical meter zero. Be sure all transistors are in their sockets.

CALIBRATION:

The TBM-4500A has been properly calibrated at the factory and should not require calibration. However, if the unit should require calibration after a period of time, it is recommended that the unit be returned to the factory.

If proper test equipment is available, the following calibrations may be made:

CAUTION: R-19 MUST BE FULLY CLOCKWISE FOR ALL ADJUSTMENTS.

CALIBRATION OF THE WIDE-BAND FM DEMODULATOR:

1. Remove the side plate from MM-606.

2. The frequency of the crystal is determined by the formula:

$$\text{Crystal Frequency } X_f = \frac{\text{Operating Freq. (mHz)} + 1000\text{ kHz}}{2}$$

3. Connect a VTVM to test point "A".

4. Tune the oscillator coil (L-1) for maximum voltage at test point "A". Reduce the voltage 10% on the slope side of the response curve.

5. Tune the doubler coil (L-2) for a null at test point "A".

6. Remove VTVM from test point "A".

7. The 1000 kHz output of the mixer may be viewed on an oscilloscope from test point "B".

8. A perfect sine wave should be viewed at test point "B". If not, retune doubler coil (L-2) for a clean sine wave.

CALIBRATION OF THE WIDE-BAND FM DEMODULATOR: (Cont'd.)

This is all the tuning required in the FM demodulator. The untuned IF's and counter detector are very wide-band and require no tuning. This results in no degradation of the transmitted signal. The unit will handle deviations in excess of ± 300 kHz with very low distortion.

MODULATION CALIBRATION OF WIDE-BAND DEMODULATOR:

For accurate calibration of the modulation, a good quality, stable communication receiver with BFO is required. The receiver must be tunable to 1000 kHz, also a good low distortion audio generator is required.

1. Remove all modulation from the transmitter.

2. Tune the communication receiver to the IF frequency (1000 kHz). This signal is easily received by connecting the antenna to TP-B inside of the MM-606 case.

3. Adjust the BFO for a beat note of around 200-300 Hertz.

4. Connect an audio generator to the input of the transmitter, adjust the generator to 13,586 Hz. Accurate calibration depends on the accuracy of this audio frequency.

5. Increase the modulation of the transmitter slowly, until the first null is reached. Continue increasing modulation until a second null is reached. This is exactly 100% modulation or ± 75 kHz deviation.

NOTE: THE SIDE BANDS WILL PRODUCE NUMEROUS OTHER BEAT FREQUENCIES BETWEEN THE NULLS.

6. Adjust the level control (R-37) for exactly 1 volt peak to peak (0.35v RMS) output at test point "B". The accuracy of this voltage determines the accuracy of the monitor. 13,586 Hertz HAS BEEN CHOSEN BECAUSE THE SECOND NULL OR CARRIER DISAPPEARANCE IS EXACTLY 100% MODULATION. These nulls are very sharp. If you wish to use other frequencies to check other modulation percentages, use the following table:

TABLE OF AUDIO FREQUENCIES vs. PERCENTAGE OF MODULATION
FOR VARIOUS NULLS

(Communication Receiver Tuned to 1000 kHz)

Null Number	Modulation Index	Frequency Deviation	Percentage of Modulation	Audio Frequency
2	5,520	75,000	100.0%	13,586
2	5,520	55,200	73.6%	10,000
2	5,520	27,600	36.8%	5,000
3	8,654	75,000	100.0%	8,670
3	8,654	86,550	115.4%	10,000
3	8,654	43,275	57.7%	5,000
4	11,792	75,000	100.0%	6,360
4	11,792	58,950	78.6%	5,000
4	11,792	23,550	31.4%	2,000
5	14,931	75,000	100.0%	5,023

DC METER BALANCE

DC BALANCE CALIBRATION, MM-604:

1. Short circuit the meter terminals and adjust the meter for mechanical zero.

2. Remove all input signal.

3. Adjust the balance controls (located on the top of the MM-604's) for exact zero meter readings.

4. Turn the composite - normal switch (SW-1) on rear chassis to composite input position.

DC METER BALANCE (Cont'd.)

DC BALANCE CALIBRATION, MM-604: (Cont'd.)

5. Apply 1 volt peak to peak audio signal into the composite input jack on the rear of the chassis.

6. Adjust R-3, R-52 and R-83 for readings of 100% modulation as read on each meter.

NOTE: THIS IS ONLY A PRELIMINARY ADJUSTMENT OF THE LEFT AND RIGHT METER.

CALIBRATION OF THE TOTAL MODULATION METER:

1. Inject a (400 Hertz) signal, 1 volt peak to peak (0.35V RMS) into the composite input jack on the rear chassis, with SW-1 switch in composite position.

2. Adjust potentiometer R-3 for an exact reading of 100% on M-1.

3. Frequencies from 50 Hertz to 75,000 Hertz should be checked for flat frequency response. The deviation should not exceed ± 0.2 db.

NOTE: THE TOTAL MODULATION METER MAY NOW BE USED FOR ALL REFERENCES.

CALIBRATION OF THE TOTAL PEAK FLASHER:

1. Turn the composite-normal (SW-1) switch to composite input.

2. Inject a (400 Hertz) signal until the total modulation meter reads exactly 100%.

3. Turn the peak indicator control to exactly 100%.

4. Adjust R-11 so that the light will just come on. Reducing the modulation 0.1 db should turn the light off.

5. Decrease the input signal so that the total modulation meter will read exactly 50%.

6. Set the peak indicator to exactly 50%.

MAINTENANCE (Cont'd.)

CALIBRATION OF THE TOTAL PEAK FLASHER: (Cont'd.)

7. If the light does not track at 50%, adjust R-14 until the light just comes on.

8. Again, check the tracking at 100%. Readjust R-11 for proper tracking, as the two controls interact on each other.

9. Repeat the above steps until perfect tracking is realized at all settings of the peak indicator.

10. Return the SW-1 switch to normal position.

PILOT INJECTION CALIBRATION:

1. Turn the rear function switch (SW-1) to the composite input position.

2. Inject a 19 kHz signal $\pm$ 1 Hz, 0.1 volt peak to peak (0.035V RMS) into the composite input jack on the rear of the chassis.

NOTE: THE ACCURACY OF THIS VOLTAGE DETERMINES THE ACCURACY OF THE MONITOR.

3. Turn the front panel function switch to pilot injection position.

4. Tune L1 and L2 for maximum reading on the left meter.

5. Adjust R-29 for exactly 10% injection reading as read on the top (pilot) scale on the left meter.

6. Connect a wide-band scope to the junction of R-35, R-36 and ground.

7. Tune L-3 and L-4 for maximum output, as viewed on scope.

8. Adjust the front panel phasing control (C-19) in mid-position, vary the phase of the 19 kHz coil (L-3) so that the 38 kHz carrier crosses the time axis with a positive slope simultaneously to each crossing by the 19 kHz pilot carrier as viewed on a dual trace scope.

PILOT INJECTION CALIBRATION: (Cont'd.)

9. Switch the function switch from the positive (+) phase to the negative (-) phase and no difference in reading should occur. If they do not agree, repeat Steps 6, 7 and 8 until readings are identical.

10. Return switch SW-1 to normal position.

STEREO DEMODULATOR CALIBRATION:

NOTE: WHEN STEREO DEMODULATOR IS CALIBRATED USING A SQUARE WAVE SWITCHING STEREO GENERATOR, RESISTOR R-42 MUST BE CHANGED TO A 4700 OHM TO ENABLE PROPER READING TO BE OBTAINED IN STEPS 6 THROUGH 13. THIS RESISTOR CHANGE IS NECESSARY IN ORDER TO COMPENSATE FOR THE DIFFERENCE IN THE RECOVERED L -R SIGNAL.

1. Modulate the transmitter 100% in the monaural mode as read on the total modulation meter.

2. Place a jumper between pin #5 and pin #7 of the MM-602 amplitude correction amplifier.

3. Adjust right meter calibration (R-52) for a reading of 100% on the right meter.

4. Adjust the left meter calibrate potentiometer (R-83) for a reading of 100% on the left meter.

5. Remove jumper from MM-602.

6. Modulate the transmitter in the Stereo mode with in-phase signal (L= +R) to the left and right input with equal amplitude.

7. Adjust the Stereo balance control R-43 for equal output of both right and left meter.

8. Modulate the transmitter in the Stereo mode with equal out-of-phase signals (L= -R) and equal amplitude.

9. Adjust R-41 separation control for equal reading of the out-of-phase signal above.

STEREO DEMODULATOR CALIBRATION: (Cont'd.)

10. Repeat Steps 6, 7, 8 and 9 until all readings are identical. The amplitude into the transmitter must be kept constant for these adjustments.

11. Modulate the transmitter with a "left only" signal 100% as indicated on the total modulation meter.

12. Adjust R-41 for maximum separation on the right meter providing that the composite input signal is known to be correct. (See Figure 1, Page 23).

13. Modulate the right channel 100% and check the separation on the opposite channel. The same separation should be read on each channel. If not, check Steps Nos. 6 through 9 until the same performance is achieved on both channels. This completes the Stereo demodulator calibration.

MONAURAL CALIBRATION OF LEFT AND RIGHT METER:

1. Modulate the transmitter 100% (400 Hertz) as indicated on the total modulation meter.

2. Adjust R-44 for exactly 100% modulation as read on both left and right meter.

STEREO CALIBRATION OF LEFT AND RIGHT METER:

1. Modulate the transmitter 100% Stereo (10% 19 kHz pilot: 90% left) as indicated on the total modulation meter.

2. Adjust left meter calibration potentiometer (R-93) for a reading of 90% on left meter.

3. Modulate the transmitter 100% Stereo (10% pilot: 90% right) as indicated on the total modulation meter.

4. Adjust right meter calibrate potentiometer (R-52) for a reading of 90% on right meter.

5. Recheck monaural calibration of left and right meter as listed above. There is a slight interaction between R-44, R-83, and R-52.

CALIBRATION OF MAIN CHANNEL (L +R):

1. Modulate the transmitter (400 Hertz) to 100% as read on total modulation meter.

2. Turn the function switch to the (L +R) position.

3. Adjust potentiometer R-24 for exactly 100% modulation as read on the left meter.

CALIBRATION OF STEREO SUB-CHANNEL (L -R):

1. Turn Composite-Normal switch (SW-1 to composite input position.

2. Inject a 38 kHz signal (± 1 Hz) into the composite input jack on rear of chassis until the total modulation meter reads exactly 100%.

3. Turn the function switch to (L -R) position.

4. Adjust R-26 for exactly 100% modulation as read on the right meter.

5. Return switch SW-1 to normal position.

CALIBRATION OF THE 38 kHz (SUPPRESSED CARRIER):

1. Turn Composite-Normal switch (SW-1) to composite input position.

2. Inject a 38 kHz signal (±1 Hz) into the composite input jack on rear chassis until the total modulation meter reads 100%.

3. Turn the Function Switch to 38 kHz position.

4. Adjust R-28 for exactly 100% modulation as read on the left meter.

5. Return switch SW-1 to normal position.

CALIBRATION OF COMPOSITE OUTPUT (BNC):

1. Turn Composite-Normal switch (SE-1) to composite input position.

CALIBRATION OF COMPOSITE OUTPUT (BNC): (Cont'd.)

2. Inject a 400 Hertz signal into the composite input jack on rear chassis until the total modulation meter reads 100%.

3. Connect a wide-band scope to BNC connector located on front panel.

4. Turn Function Switch to Operate position.

5. Set reference level on scope.

6. Inject a 19 kHz signal (±1 Hz) into composite input.

7. Turn Function Switch to Pilot injection.

8. Adjust potentiometer (R-30) for <u>exactly</u> 0.1 of the deviation of the reference voltage on the oscilloscope.

9. Inject a 38 kHz signal (±1 Hz) into the composite input jack on the rear chassis until the total modulation meter reads 100%.

10. Turn function switch to (L -R) position.

11. Adjust potentiometer (R-25) for the reference level as set up on the scope, Step 5.

12. Inject a (400 Hertz) signal in the composite input jack on the rear chassis until the total modulation meter reads 100%.

13. Turn function switch to (L +R) position.

14. Adjust potentiometer (R-23) for the reference level as set up on scope, Step 5.

15. Return switch SW-1 to normal position.

CALIBRATION OF AUDIO VOLTMETER AMPLIFIER:

1. Turn the Composite-Normal switch (SW-1) to composite input position.

2. Inject (400 Hertz) signal into the composite input jack on rear chassis until the total modulation meter reads 100%.

NOTE: ALL METERS SHOULD READ EXACTLY 100% MODULATION. If left and right meters do not read 100% refer back to monaural calibration.

CALIBRATION OF AUDIO VOLTMETER AMPLIFIER: (Cont'd.)

3. Reduce the input signal by exactly 10 db.

4. Turn separation switch to -10 db position (either left or right).

5. Adjust potentiometer (R-45) DB amplifier calibration for 100% modulation reading respective right or left meter.

6. Reduce the input signal another 10 db.

7. Turn the separation switch to -20 db and the meter should again read 100% modulation. This verifies proper operation.

8. Return separation switch to Operate position.

9. Return switch SW-1 to normal position.

CALIBRATION OF AM NOISE METER:

1. Remove internal RF shield.

2. Bridge the two capacitors which are located under the RF shield, with external 2 mfd capacitors.

3. Turn the function switch to RF input level position.

4. Inject (60 Hertz) signal into the RF input jack until the RF indicates exactly 100% reading on the left meter.

5. Measure the exact voltage required to give this 100% reading on the meter.

6. Remove external capacitors from circuit.

7. Inject this measured voltage into the high side of AM-S/N potentiometer (R-31).

8. Turn function switch to AM-S/N position.

9. Adjust potentiometer for a reading of exactly 100% as read on the left meter.

10. Replace internal RF shield.

11. Return function switch to operate position.

MAINTENANCE (Cont'd.)

FINAL TOTAL MODULATION CHECK:

Modulate the transmitter with a known 100% modulation. The total modulation meter should now read exactly 100%. This should be verified by using Bessell's function. Refer to page 28.

TROUBLE SHOOTING

1. Refer to schematic diagram for voltage reading.

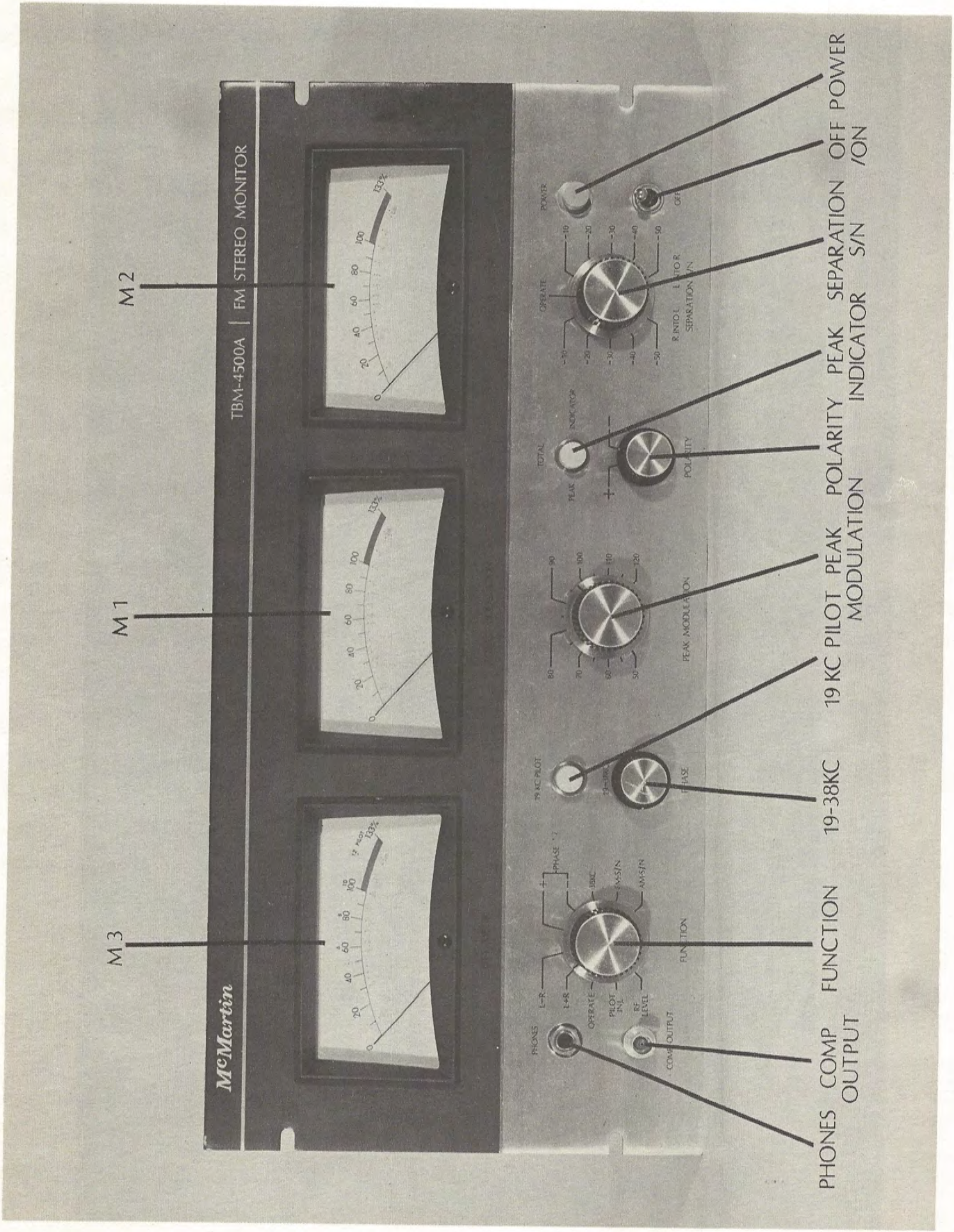
2. Check the B^+ voltage at the output of the buss which is fed from voltage regulator transistor Q-9. This voltage should be plus 90v (± 1%).

3. Check the B^+ voltage at each leg in the power supply. The voltage should be within ±10% of the voltage on the schematic.

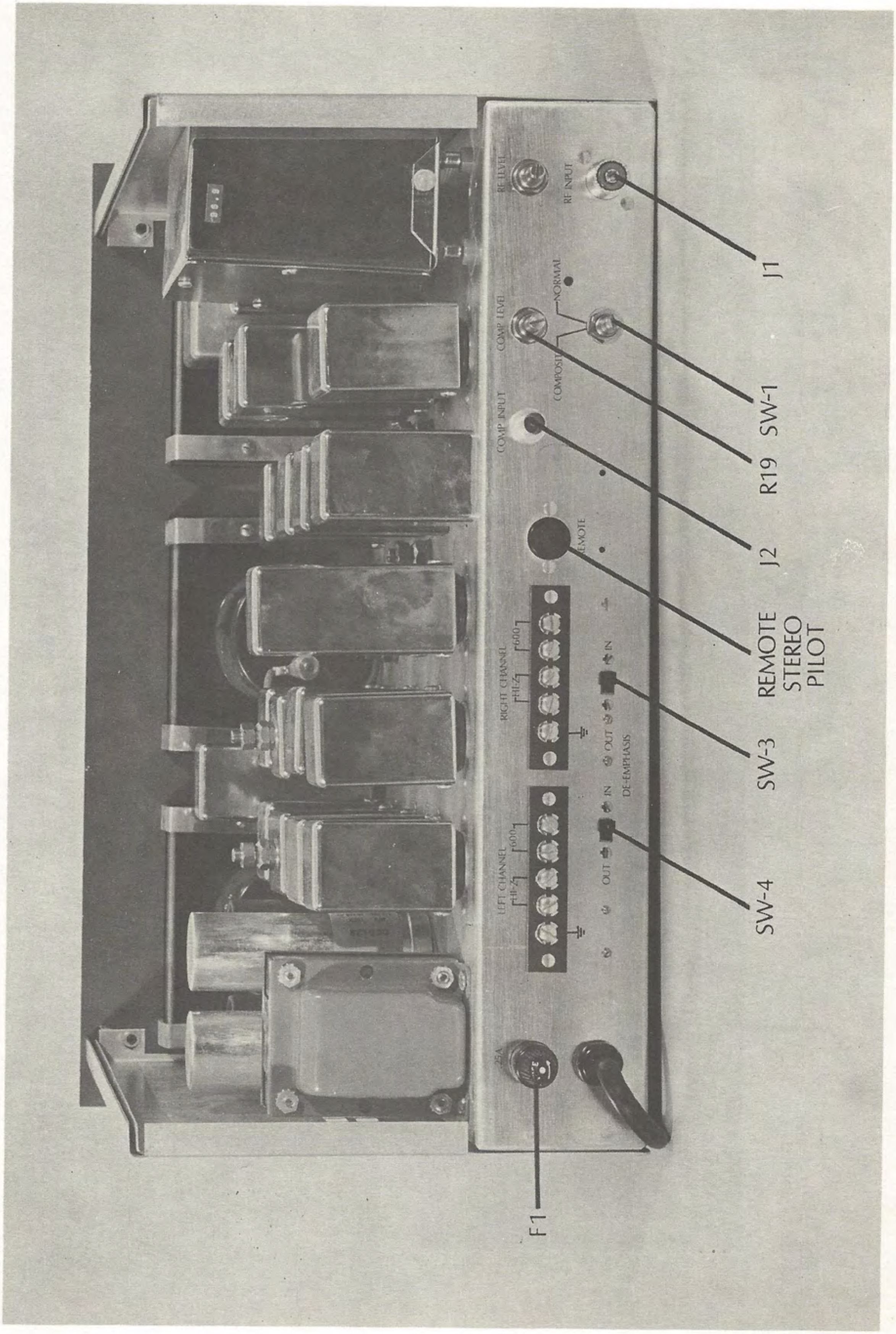
4. If the voltage differs considerably from the correct voltage, this would indicate a defective module.

5. If a plug-in module is found to be defective, it is recommended that it be returned to the factory for repair or replacement. Spare plug-in modules may be purchased from McMARTIN INDUSTRIES, INCORPORATED, Omaha, Nebraska.

   CAUTION: When replacing modules in the field, the calibration must be rechecked.



M 2
M 1
M 3
McMartin
TBM-4500A | FM STEREO MONITOR
PHONES
COMP OUTPUT
FUNCTION
19-38KC
19 KC PILOT
PEAK MODULATION
POLARITY
PEAK INDICATOR
SEPARATION S/N
OFF /ON
POWER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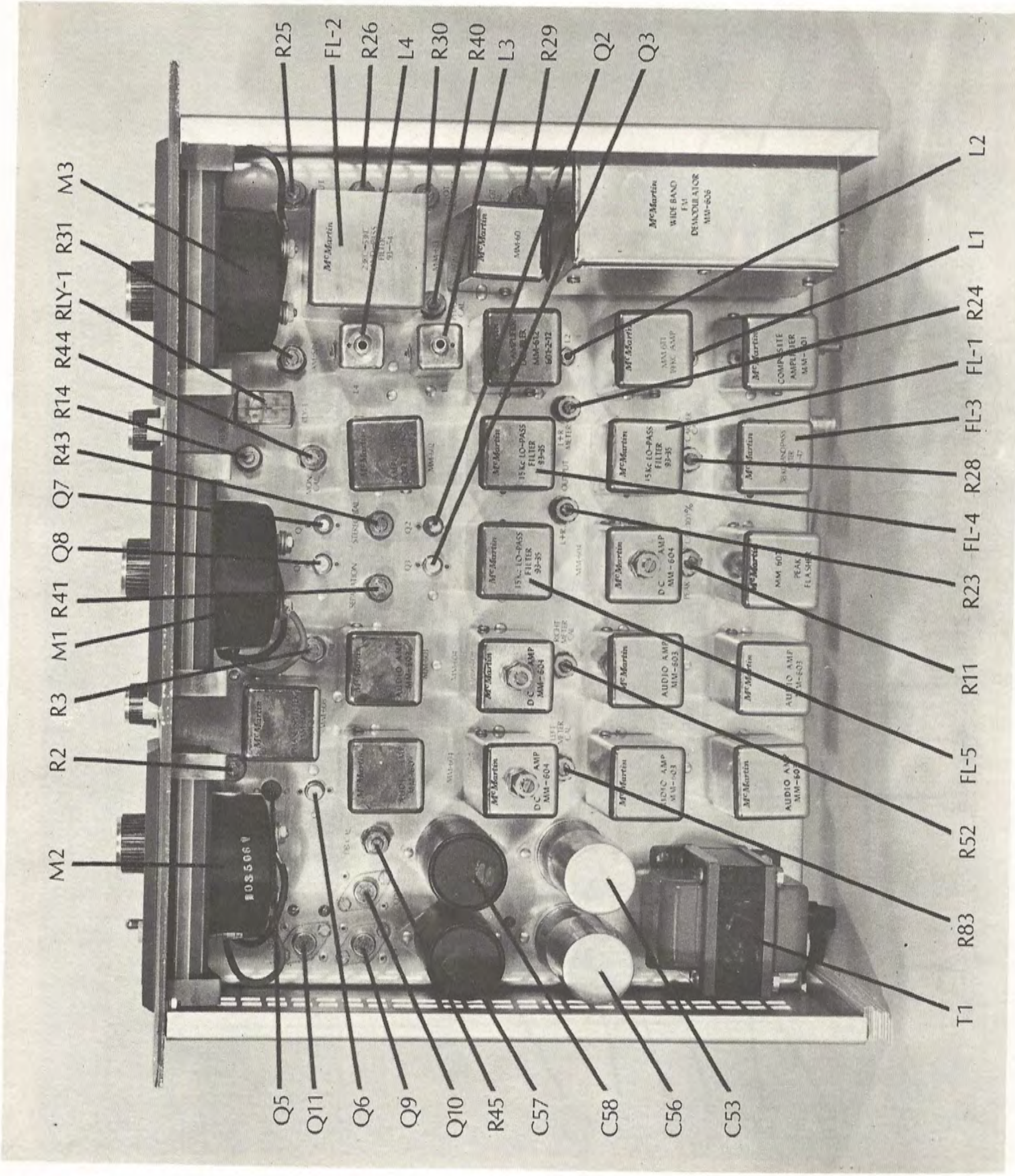
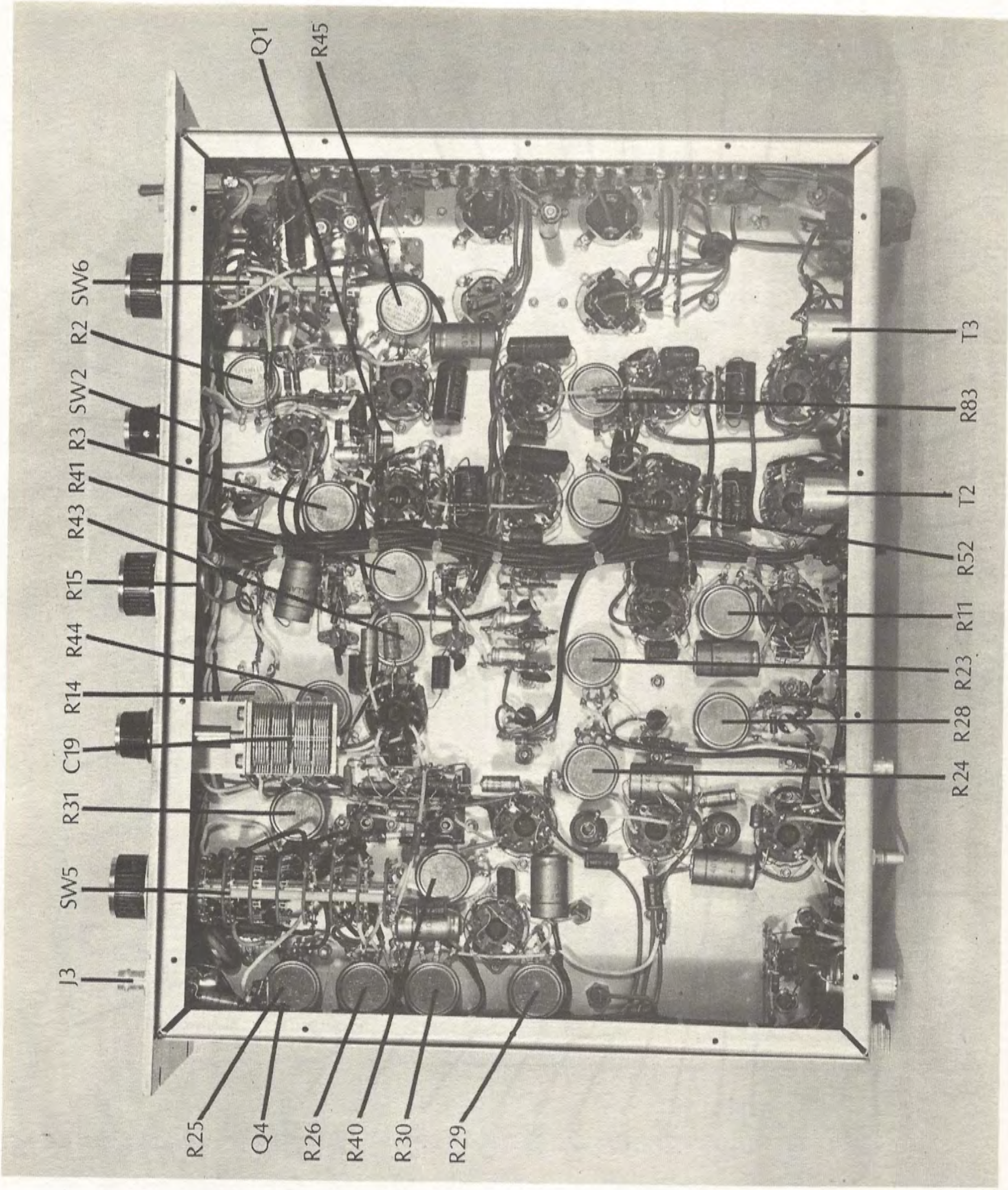
RF INPUT
COMP LEVEL
NORMAL
COMPOSITE
COMP INPUT
REMOTE
RIGHT CHANNEL
HI-Z
600
LEFT CHANNEL
HI-Z
600
OUT
IN
DE-EMPHASIS
OUT
IN
J1
SW-1
R19
J2
REMOTE
STEREO
PILOT
SW-3
SW-4
F1


M3
R31
RLY-1
R44
R14
R43
Q7
Q8
R41
M1
R3
R2
M2
R25
FL-2
R26
L4
R30
R40
L3
R29
Q2
Q3
L2
L1
R24
FL-1
FL-3
R28
FL-4
R23
R11
FL-5
R52
R83
T1
Q5
Q11
Q6
Q9
Q10
R45
C57
C58
C56
C53


Q1
R45
SW6
R2
SW2
R3
R41
R43
R15
R44
R14
C19
R31
SW5
J3
R25
Q4
R26
R40
R30
R29
T3
R83
T2
R52
R11
R23
R28
R24

WARRANTY

McMARTIN Broadcast and Audio Products are warranted to be free from defects in workmanship -- FOREVER.

At our discretion, we will exchange or repair any defective unit or components, at any time, without charge. Material and components are guaranteed for a minimum period of ninety days from the date of original purchase. Transportation charges must be prepaid on equipment returned for warranty service.

This warranty does not extend to any of our products which have been subjected to misuse, neglect, accidents, incorrect wiring not our own, improper installation, or to use in violation of the instructions furnished by us; nor to units that have been altered outside our factory.

TBM-4500A PARTS LIST

SYMBOL	MC MARTIN STOCK NO.	DESCRIPTION
C1		Not used
C2	60-11	Capacitor, 50 mfd/25V, electrolytic
*C3	63-30	Capacitor, 0.04 mfd/400V, mylar
C4	63B-10	Capacitor, 0.1 mfd/200V, metalized paper
C5	63B-9	Capacitor, 0.68 mfd/200V, metalized paper
C6	60-27	Capacitor, 20 mfd/16V, electrolytic
C7	63B-3	Capacitor, 1 mfd/200V, metalized paper
C8	60-20	Capacitor, 400 mfd/40V, electrolytic
C9	60-11	Capacitor, 50 mfd/25V, electrolytic
C10	63B-3	Capacitor, 1 mfd/200V, metalized paper
*C11	66-19	Capacitor, 240 pfd/500V, temp. compensating ceramic
C12	60-11	Capacitor, 50 mfd/25V, electrolytic
C13	60-20	Capacitor, 400 mfd/40V, electrolytic
C14	63B-10	Capacitor, 0.1 mfd/200V, metalized paper
C15	63B-10	Capacitor, 0.1 mfd/200V, metalized paper
C16	60-20	Capacitor, 400 mfd/40V, electrolytic
C17	60-33	Capacitor, 5 mfd/64V, electrolytic
C18	60-20	Capacitor, 400 mfd/40V, electrolytic
C19	66-18	Capacitor, 680 pfd variable, air
C20	65-42	Capacitor, 6800 pfd, ±5%/500V, dipped mica
C21	60-11	Capacitor, 50 mfd/25V, electrolytic
C22	63B-1	Capacitor, 0.022 mfd/400V, metalized paper
C23	63B-10	Capacitor, 0.1 mfd/200V, metalized paper
C24	60-11	Capacitor, 50 mfd/25V, electrolytic
C25	60-11	Capacitor, 50 mfd/25V, electrolytic
C26	63B-9	Capacitor, 0.068/200V, metalized paper
C27	60-27	Capacitor, 20 mfd/16V, electrolytic
*C28	65-17	Capacitor, 910 pfd, ±5%/500V, dipped mica
C29	65-48	Capacitor, 7500 pfd ±5%/500V, dipped mica
C30	65-11	Capacitor, 270 pfd, ±5%/500V, dipped mica
C31	60-34	Capacitor, 32 mfd/64V, electrolytic
C32	65-48	Capacitor, 7500 pfd, ±5%/500V, dipped mica
C33	60-11	Capacitor, 50 mfd/25V, electrolytic
*C34	63-30	Capacitor, 0.04 mfd/400V, mylar
C35	63B-10	Capacitor, 0.1 mfd/200V, metalized paper
C35A	63B-3	Capacitor, 0.1 mfd/200V, metalized paper
C36	60-22	Capacitor, 250 mfd/6V, electrolytic
C37	63B-3	Capacitor, 1 mfd/200V, metalized paper
C38	60-20	Capacitor, 400 mfd/40V, electrolytic
C39	60-11	Capacitor, 50 mfd/25V, electrolytic
C40	60-33	Capacitor, 5 mfd/64V, electrolytic
C41	65-48	Capacitor, 750 pfd ±5%/500V, dipped mica
C42	60-11	Capacitor, 50 mfd/25V, electrolytic
C43	63B-10	Capacitor, 0.1 mfd/200V, metalized paper
C43A	63B-3	Capacitor, 1 mfd/200V, metalized paper
*C44	63-30	Capacitor, 0.04 mfd/400V, mylar
C45	60-22	Capacitor, 250 mfd/6V, electrolytic

SYMBOL	MC MARTIN STOCK NO.	DESCRIPTION
C46	60-34	Capacitor, 32 mfd/64V, electrolytic
C47	65-48	Capacitor, 750 pfd/500V, dipped mica
C48	65-11	Capacitor, 270 pfd ±5%/500V, dipped mica
*C49	65-17	Capacitor, 910 pfd ±5%/500V, dipped mica
C50	60-27	Capacitor, 20 mfd/16V, electrolytic
C51		Selected in production
C52	63B-9	Capacitor, 0.068 mfd/200V, metalized paper
C53A	60A-22	Capacitor, 200 mfd/150V, electrolytic
C53B	60A-22	Capacitor, 150 mfd/150V, electrolytic
C53C	60A-22	Capacitor, 150 mfd/150V, electrolytic
C54		Not used
C55	60-20	Capacitor, 400 mfd/40V, electrolytic
C56A	60A-22	Capacitor, 150 mfd/150V, electrolytic
C56B	60A-22	Capacitor, 200 mfd/150V, electrolytic
C56C	60A-22	Capacitor, 150 mfd/150V, electrolytic
C57A	60A-1	Capacitor, 40 mfd/150V, electrolytic
C57B	60A-1	Capacitor, 80 mfd/150V, electrolytic
C57C	60A-1	Capacitor, 60 mfd/150V, electrolytic
C57D	60A-1	Capacitor, 100 mfd/150V, electrolytic
C58A	60A-1	Capacitor, 40 mfd/150V, electrolytic
C58B	60A-1	Capacitor, 60 mfd/150V, electrolytic
C58C	60A-1	Capacitor, 100 mfd/150V, electrolytic
C58D	60A-1	Capacitor, 80 mfd/150V, electrolytic
C59	65-17	Capacitor, 910 pfd ±5%/500V, dipped mica
C60	65-3	Capacitor, 24 pfd ±5%/500V, dipped mica
C61	60-20	Capacitor, 400 mfd/40V, electrolytic
C62		Selected in production
C63	65-41	Capacitor, 1800 pfd ±5%/500V, dipped mica
*C64	65-16	Capacitor, 68 pfd ±5%/500V, dipped mica
*C65	65-16	Capacitor, 68 pfd ±5%/500V, dipped mica
R1	50B-106	Resistor, 5600 ohm ±5%, ½ watt, deposited carbon film
R2	42-13	Control, 1000 ohm ± 10% 2 watt composition carbon
R3	42-3	Control, 5K ohm ± 10% 2 watt composition carbon
R4	50B-117	Resistor, 16K ohm ± 5% ½ watt deposited carbon film
R5	50B-102	Resistor, 3.9K ohm ± 5% ½ watt deposited carbon film
R6	50B-176	Resistor, 4.7M ohm ± 5% ½ watt deposited carbon film
R7	50B-168	Resistor, 2.2M ± 5% ½ watt deposited carbon film
R9	54-21	Resistor, 4750 ± 1% metal film
R10	50B-172	Resistor, 3.3M ± 5% ½ watt deposited carbon film
R11	42-7	Control, 50K ohm ± 10% 2 watt composition carbon

SYMBOL	MC MARTIN STOCK NO.	DESCRIPTION
R12	51A-18	Resistor, 470 ± 10% 1 watt composition carbon
*R13	50B-168	Resistor, 22M ohm ± 5% ½ watt deposited carbon film
R14	42-10	Control, 10K ohm ± 10% 2 watt composition carbon
R-15	42-13	Control, 1000 ohm ± 10% 2 watt composition carbon
R16		Selected in production
R18	50B-56	Resistor, 47 ohm ± 5% ½ watt deposited carbon film
R19	42-1	Control, 25K ohm ± 10% 2 watt composition carbon
*R20	50B-104	Resistor, 4700 ohm ± 5% ½ watt deposited carbon film
R21	50B-86	Resistor, 820 ohm ± 5% ½ watt deposited carbon film
R22	50B-90	Resistor, 1200 ohm ± 5% ½ watt deposited carbon film
R23	42-10	Control, 10K ohm ± 5% 2 watt composition carbon
R24	42-10	Control, 10K ohm ± 10% 2 watt composition carbon
R25	42-4	Control, 2.5K ohm ± 10% 2 watt composition carbon
R26	42-4	Control, 2.5K ohm ± 10% 2 watt composition carbon
R27	50B-128	Resistor, 47K ohm ± 5% ½ watt deposited carbon film
R28	42-9	Control, 100K ohm ± 10% 2 watt composition carbon
R29	42-10	Control, 10K ohm ± 10% 2 watt composition carbon
R30	42-10	Control, 10K ohm ± 10% 2 watt composition carbon
R31	42-7	Control, 50K ohm ± 10% 2 watt composition carbon
R32	54-11	Resistor, 40.2K ± 1% ½ watt metal film
R33	54-21	Resistor, 4750 ohm ± 1% ½ watt metal film
R34	54-21	Resistor, 4750 ohm ± 1% ½ watt metal film
R35	54-1	Resistor, 10K ohm ± 1% ½ watt metal film
R36	54-1	Resistor, 10K ohm ± 1% ½ watt metal film
R37	54-1	Resistor, 10K ohm ± 1% ½ watt metal film
R38	54-1	Resistor, 10K ohm ± 1% ½ watt metal film
R39	50B-160	Resistor, 1M ohm ± 5% ½ watt deposited carbon film
R40	42-10	Control, 10K ohm ± 10% 2 watt composition carbon
R41	42-4	Control, 2500 ohm ± 10% 2 watt composition carbon

SYMBOL	MC MARTIN STOCK NO.	DESCRIPTION
R42	54-19	Resistor, 3.01K ohm ± 1% $\frac{1}{2}$ watt metal film
R43	42-13	Control, 1000 ohm ± 10% 2 watt composition carbon
R44	42-3	Control, 5000 ohm ± 10% 2 watt composition carbon
R45	42-10	Control, 10K ohm ± 10% 2 watt composition carbon
R46	50B-134	Resistor, 82K ohm ± 5% $\frac{1}{2}$ watt deposited carbon film
R47	50B-168	Resistor, 2.2M ohm ± 5% $\frac{1}{2}$ watt deposited carbon film
R48	50B-104	Resistor, 4700 ohm ± 5% $\frac{1}{2}$ watt deposited carbon film
R49	50B-116	Resistor, 15K ohm ± 5% $\frac{1}{2}$ watt deposited carbon film
R50	50B-100	Resistor, 3300 ohm ± 5% $\frac{1}{2}$ watt deposited carbon film
*R51	50B-104	Resistor, 4700 ohm ± 5% $\frac{1}{2}$ watt deposited carbon film
R52	42-3	Control, 5000 ohm ± 10% 2 watt composition carbon
R53	50B-130	Resistor, 56K ohm ± 5% $\frac{1}{2}$ watt deposited carbon film
R54	50B-128	Resistor, 47K ohm ± 5% $\frac{1}{2}$ watt deposited carbon film
R55	54-12	Resistor, 12.1K ohm ± 1% $\frac{1}{2}$ watt metal film
R56	50B-120	Resistor, 22K ohm ± 5% $\frac{1}{2}$ watt deposited carbon film
R57	54-12	Resistor, 12.1K ohm ± 1% $\frac{1}{2}$ watt metal film
R58	50B-102	Resistor, 3900 ohm ± 5% $\frac{1}{2}$ watt deposited carbon film
R58A	50B-120	Resistor, 22K ohm ± 5% $\frac{1}{2}$ watt deposited carbon film
R58B	50B-172	Resistor, 3.3M ohm ± 5% $\frac{1}{2}$ watt deposited carbon film
R59	50B-176	Resistor, 4.7M ohm ± 5% $\frac{1}{2}$ watt deposited carbon film
R60	54-8	Resistor, 21,620 ohm ± $\frac{1}{4}$% $\frac{1}{2}$ watt metal film
R61	54-7	Resistor, 6,838 ohm ± $\frac{1}{4}$% $\frac{1}{2}$ watt metal film
R62	54-6	Resistor, 2,162 ohm ± $\frac{1}{4}$% $\frac{1}{2}$ watt metal film
R63	54-5	Resistor, 683.8 ohm ± $\frac{1}{4}$% $\frac{1}{2}$ watt metal film
R64	54-15	Resistor, 316.2 ohm ± $\frac{1}{4}$% $\frac{1}{2}$ watt metal film
R65	50B-184	Resistor, 10M ohm ± 5% $\frac{1}{2}$ watt deposited carbon film
R66	50B-104	Resistor, 4700 ohm ± 5% $\frac{1}{2}$ watt deposited carbon film
R67	50B-136	Resistor, 100K ohm ± 5% $\frac{1}{2}$ watt deposited carbon film
R68	50B-168	Resistor, 2.2M ohm ± 5% $\frac{1}{2}$ watt deposited carbon film

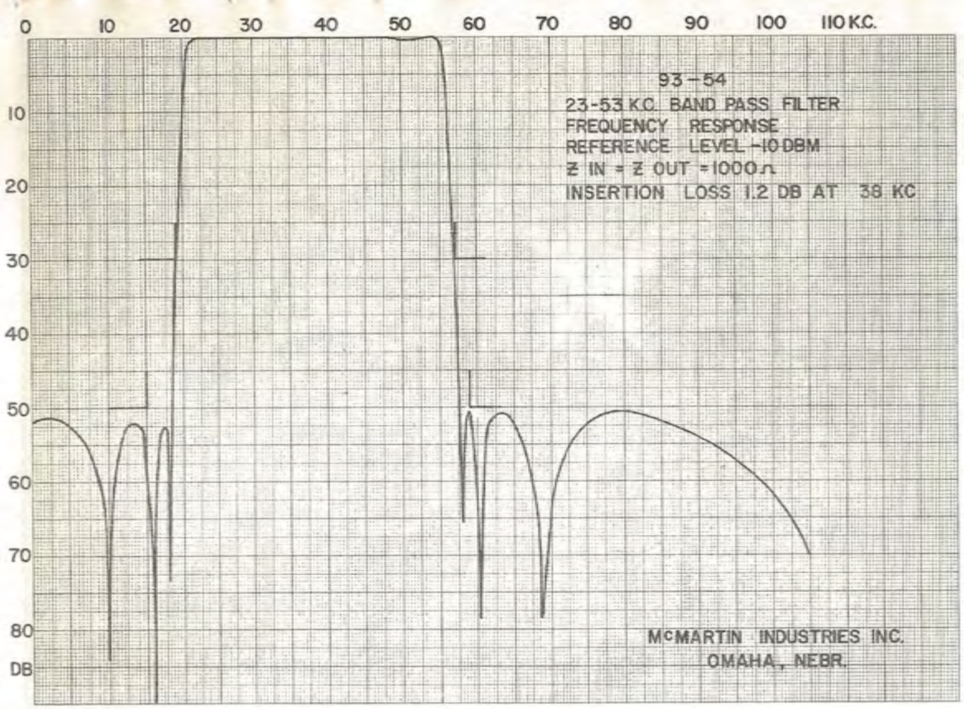
SYMBOL	MC MARTIN STOCK NO.	DESCRIPTION
R69	50B-100	Resistor, 3300 ohm ± 5% ½ watt deposited carbon film
R70	50B-84	Resistor, 680 ohm ± 5% ½ watt deposited carbon film
R71	50B-116	Resistor, 15K ohm ± 5% ½ watt deposited carbon film
R72	50B-100	Resistor, 3300 ohm ± 5% ½ watt deposited carbon film
R73	50B-128	Resistor, 47K ohm ± 5% ½ watt deposited carbon film
R74	54-12	Resistor, 12.1K ohm ± 1% ½ watt metal film
R75	50B-102	Resistor, 3900 ohm ± 5% ½ watt deposited carbon film
R75A	50B-172	Resistor, 3.3M ohm ± 5% ½ watt deposited carbon film
R75B	50B-120	Resistor, 22K ohm ± 5% ½ watt deposited carbon film
R76	50B-176	Resistor, 4.7M ohm ± 5% ½ watt deposited carbon film
R77	50B-120	Resistor, 22K ohm ± 5% ½ watt deposited carbon film
R78	50B-168	Resistor, 2.2M ohm ± 5% ½ watt deposited carbon film
R79	50B-104	Resistor, 4700 ohm ± 5% ½ watt deposited carbon film
R80	50B-116	Resistor, 15K ohm ± 5% ½ watt deposited carbon film
R81	50B-100	Resistor, 3300 ohm ± 5% ½ watt deposited carbon film
*R82	50B-104	Resistor, 4700 ohm ± 5% ½ watt deposited carbon film
R83	42-3	Control, 5K ohm ± 10% composition carbon
R84	50B-130	Resistor, 56K ohm ± 5% ½ watt deposited carbon film
R85	50B-128	Resistor, 47K ohm ± 5% ½ watt deposited carbon film
R86	54-12	Resistor, 12.1K ohm ± 1% ½ watt metal film
R87	50B-116	Resistor, 15K ohm ± 5% ½ watt deposited carbon film
R88	53E-3	Resistor, 750 ohm wire wound 10 watt (10%)
R89	53C-21	Resistor, 7000 ohm wire wound 5 watt (10%)
R91	52B-2	Resistor, 4700 ohm ± 5% 2 watt composition carbon
R92	52B-7	Resistor, 10K ohm ± 5% 2 watt composition carbon
R93	52B-2	Resistor, 4.7K ohm ± 5% 2 watt composition carbon

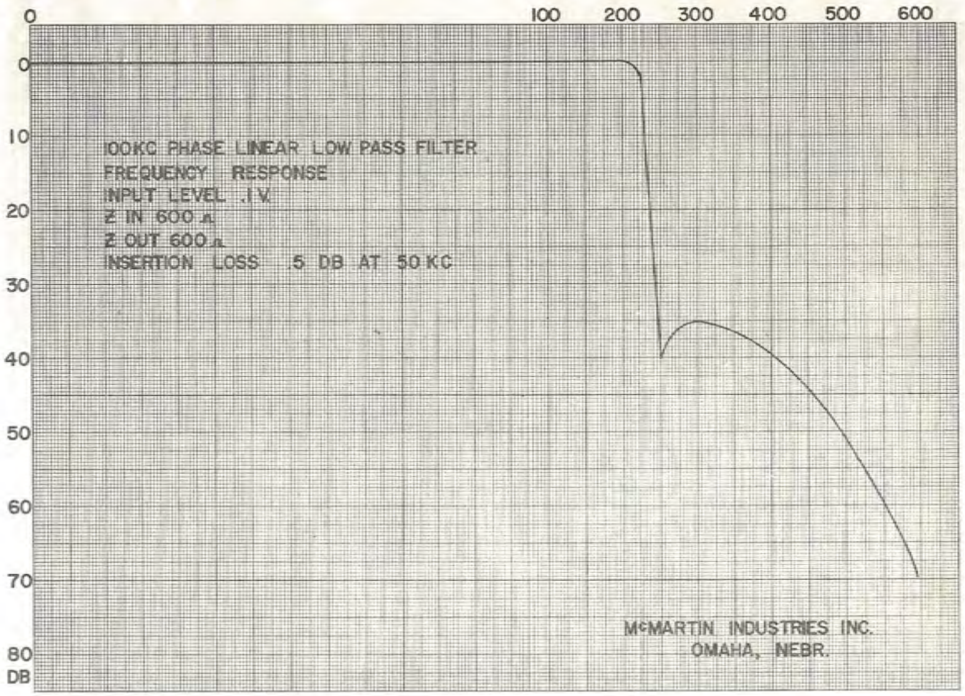
SYMBOL	MC MARTIN STOCK NO.	DESCRIPTION
R94	52B-8	Resistor, 33K ohm ± 5% 2 watt composition carbon
R95	52B-2	Resistor, 4700 ohm ± 5% 2 watt composition carbon
R96	52B-2	Resistor, 4700 ohm ± 5% 2 watt composition carbon
R97	52B-12	Resistor, 3.3K ohm ± 5% 2 watt composition carbon
R98	52B-12	Resistor, 3.3K ohm ± 5% 2 watt composition carbon
R99	52B-12	Resistor, 3.3K ohm ± 5% 2 watt composition carbon
R100	52B-9	Resistor, 2.2K ohm ± 5% 2 watt composition carbon
R101	52B-13	Control, 1.5K ohm ± 5% 2 watt composition carbon
R102	52B-12	Control, 3.3K ohm ± 5% 2 watt composition carbon
R103	52B-6	Control, 6800 ohm ± 5% 2 watt composition carbon
R104	52B-6	Control, 6800 ohm ± 5% 2 watt composition carbon
R105	52B-10	Control, 18K ohm ± 5% 2 watt composition carbon
R106	53E-3	Resistor, 750 ohm ± 10% 10 watt wire wound
R107	54-1	Resistor, 10K ohm ± 1% ½ watt metal film
R108	54-1	Resistor, 10K ohm ± 1% ½ watt metal film
R109	54-21	Resistor, 4750 ohms ± 1% ½ watt metal film
R110	54-11	Resistor, 40.2K ohms ± 1% ½ watt metal film
R111	54-10	Resistor, 7500 ohms ± 1% ½ watt metal film
*R112	50B-144	Resistor, 220K ohms ± 5% ½ watt composition carbon
R113	42-6	Control, 250 ohms ± 10% 2 watt deposited carbon, RF attenuator
R114	52B-4	Resistor, 220 ohm ± 5% 2 watt deposited carbon, RF attenuator
R115	52B-4	Resistor, 220 ohm ± 5% 2 watt deposited RF attenuator
R116	52B-4	Resistor, 220 ohm ± 5% 2 watt deposited RF attenuator
R117	50B-80	Resistor, 470 ohm ± 5% ½ watt deposited carbon film, RF attenuator
R118	50B-98	Resistor, 2700 ohm ± 5% ½ watt deposited carbon film, RF attenuator
*Q1	20A-45	Transistor, 2N3242A
*Q2	20A-45	Transistor, 2N3242A
Q3	20A-33	Transistor, 2N2102

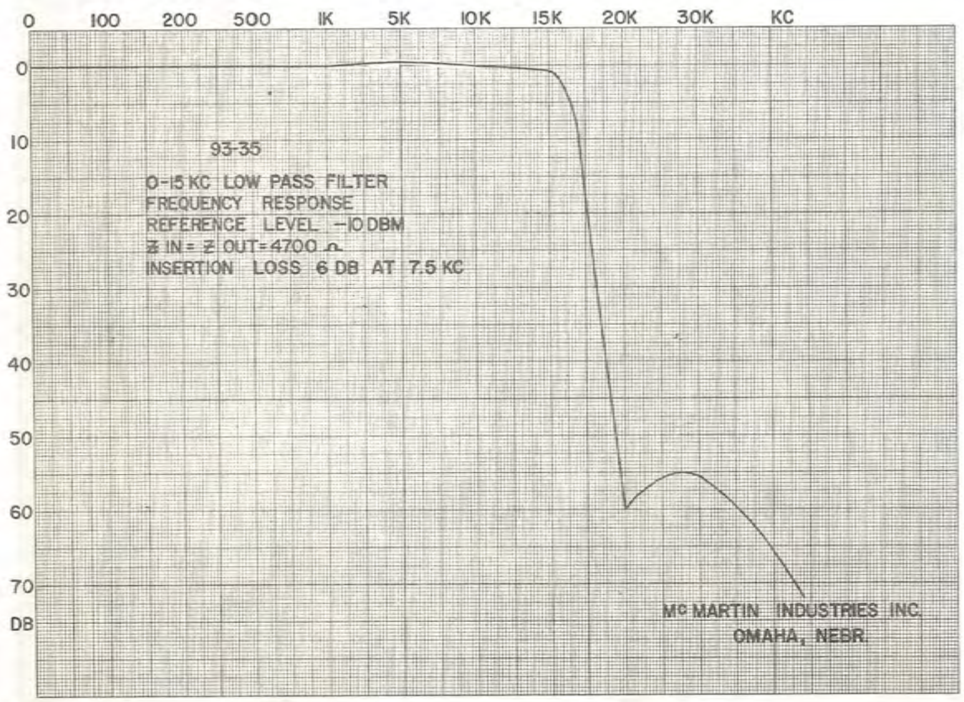
SYMBOL	MC MARTIN STOCK NO.	DESCRIPTION
Q4	20A-32	Transistor, SE-4863A
Q5	20A-32	Transistor, SE-4863A
Q6	20A-24	Transistor, 2N3053
*Q7	20A-45	Transistor, 2N3242A
Q8	20A-33	Transistor, 2N2102
Q9	20A-34	Transistor, 40328
Q10	20A-34	Transistor, 40328
Q11	20A-34	Transistor, 40328
L1	93-53	Coil, 19 kHz tuning coil
L2	93-53	Coil, 19 kHz tuning coil
L3	93-52	Coil, 38 kHz phasing coil
L4	93-38	Coil, 38 kHz transformer
J1	17-39	Connector, Coaxial Female Receptacle
J2	17-40	Connector, BNC, Coaxial
J3	17-40	Connector, BNC, Coaxial
J4	17-56	Jack, Phone 3 conductor
TB1	15-33	Terminal Board, 5 screw
TB2	15-33	Terminal Board, 5 screw
T1	90-24	Transformer, Power
T2	91-3	Transformer, Output
T3	91-3	Transformer, Output
M1	70-24	Meter, Right Modulation
M2	70-23	Meter, Left Modulation
M3	70-23	Meter, Total Modulation
D1	22-5	Diode, 1N3604
D2	22-5	Diode, 1N3604
D3	22-5	Diode, 1N3604
D4	22-5	Diode, 1N3604
D5	22-15	Diode, 1N3606
D6	22-15	Diode, 1N3606
D7	22-15	Diode, 1N3606
D8	21-8	Rectifier, BY-127
D9	21-8	Rectifier, BY-127
D10	22-5	Diode, 1N3604
D11	22-5	Diode, 1N3604
Z1	22-11	Diode, Zener 24 volt ± 5%
Z2	22-8	Diode, Zener 36 volt ± 5%
Z3	22-11	Diode, Zener 24 volt ± 5%
Z4	22-11	Diode, Zener 24 volt ± 5%
Z5	22-10	Diode, Zener 90 volt ± 5%
Z6	22-8	Diode, Zener 36 volt ± 5%

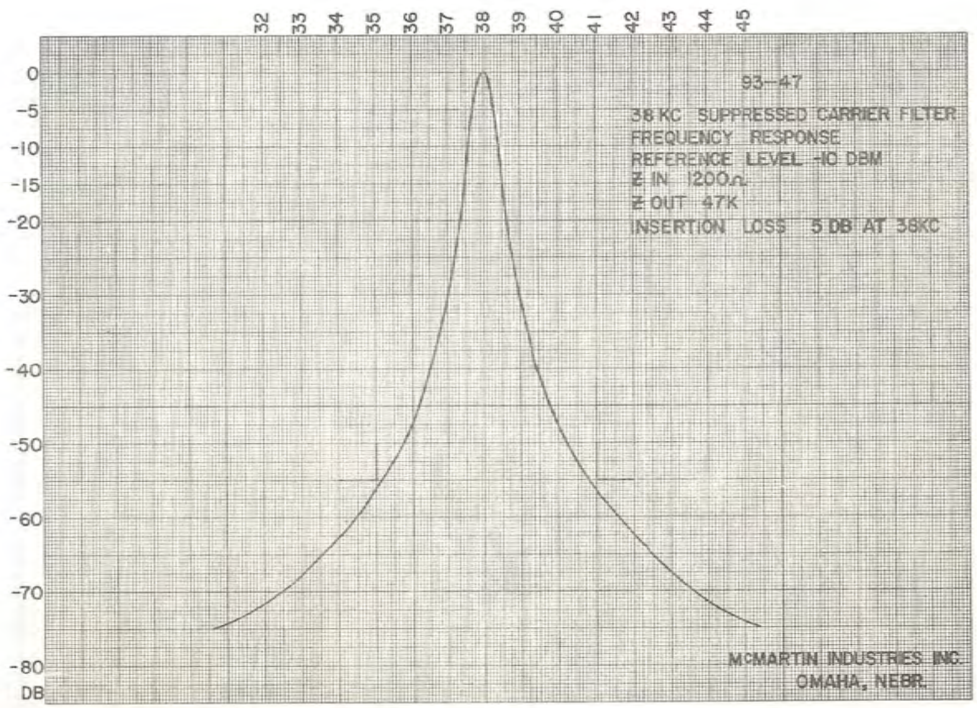
SYMBOL	MC MARTIN STOCK NO.	DESCRIPTION
F1	28-1	Fuse, 0.5A slo-blo 125V
FL1	93-35	Filter, 15 kHz Low Pass
FL2	93-54	Filter, 23-53 kHz Band Pass
FL3	93-47	Filter, 38 kHz Band Pass
FL4	93-35	Filter, 15 kHz Low Pass
FL5	93-35	Filter, 15 kHz Low Pass
PL1	29-17	Pilot Injection Lamp Assembly
PL2	29-17	Peak Lamp Assembly
PL3	29-17	Power Lamp Assembly
SW1	49-1	Composite Switch, 2 pole 2 position
SW2	49-1	Polarity Switch, 2 pole 2 position
SW3	48-7	Slider Switch, DPDT, De-Emphasis
SW4	48-7	Slider Switch, DPDT, De-Emphasis
SW5		Function Switch, 8 pole, 2-11 position, 8 section
	49-6	Index Assembly
	49-16	Wafer Sections
SW6		Separation Switch, 6 pole, 2-11 position, 6 section
	49-15	Index Assembly
	49-16	Wafer Sections
SW7	48-2	On-Off Switch, SPST, Toggle
RLY1	47-11	Relay, 5000 ohm - 67 DST-43C
MM-601	MM-601	Composite Amplifier, Plug-in unit
MM-602	MM-602	Amplitude Correction Amplifier, Plug-in unit
MM-603	MM-603	Audio Amplifier, Plug-in unit
MM-604	MM-604	DC Meter Amplifier, Plug-in unit
MM-606	MM-606	Wide Band RF Demodulator, Plug-in unit
MM-607	MM-607	Peak Flasher, Plug-in unit
MM-608	MM-608	Phase Inverter, Plug-in unit
MM-609	MM-609	DB Audio Amplifier, Plug-in unit
MM-611	MM-611	19 kHz Amplifier, Plug-in unit
MM-612	MM-612	19 kHz Amplifier and Doubler, Plug-in unit
MM-613	MM-613	19-38 kHZ Phasing amplifier

*Nominal value, selected in production

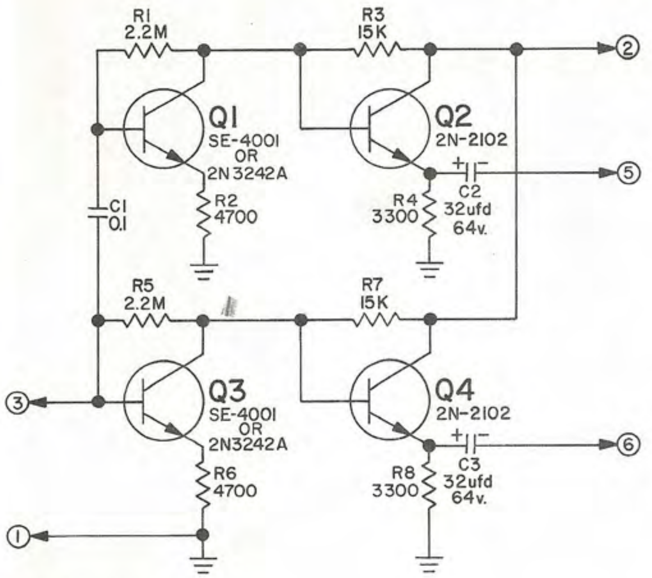

0 10 20 30 40 50 60 70 80 90 100 110 KC.
10 20 30 40 50 60 70 80 DB
93-54
23-53 KC. BAND PASS FILTER
FREQUENCY RESPONSE
REFERENCE LEVEL -10 DBM
Ƶ IN = Ƶ OUT = 1000 Ω
INSERTION LOSS 1.2 DB AT 38 KC
McMARTIN INDUSTRIES INC.
OMAHA, NEBR.


0 100 200 300 400 500 600
0 10 20 30 40 50 60 70 80 DB
100 KC PHASE LINEAR LOW PASS FILTER
FREQUENCY RESPONSE
INPUT LEVEL .1 V.
Ƶ IN 600 Ω
Ƶ OUT 600 Ω
INSERTION LOSS .5 DB AT 50 KC
McMARTIN INDUSTRIES INC.
OMAHA, NEBR.


0 100 200 500 1K 5K 10K 15K 20K 30K KC
0 10 20 30 40 50 60 70 DB
93-35
0-15 KC LOW PASS FILTER
FREQUENCY RESPONSE
REFERENCE LEVEL -10 DBM
Ƶ IN = Ƶ OUT = 4700 Ω
INSERTION LOSS 6 DB AT 7.5 KC
Mc MARTIN INDUSTRIES INC.
OMAHA, NEBR.


32 33 34 35 36 37 38 39 40 41 42 43 44 45
0 -5 -10 -15 -20 -30 -40 -50 -60 -70 -80 DB
93-47
38 KC SUPPRESSED CARRIER FILTER
FREQUENCY RESPONSE
REFERENCE LEVEL -10 DBM
Ƶ IN 1200 Ω
Ƶ OUT 47K
INSERTION LOSS 5 DB AT 38KC
McMARTIN INDUSTRIES INC.
OMAHA, NEBR.

DWG. A-1466



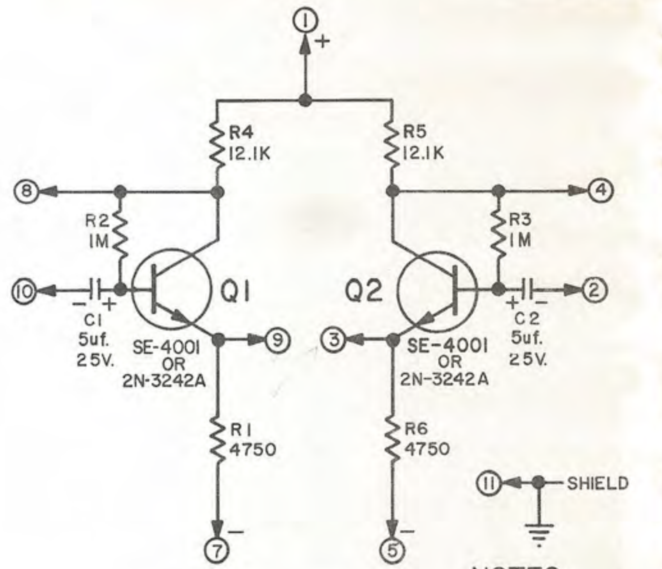
PIN CONNECTIONS
1. SIGNAL GND.
2. B+ 35v.
3. INPUT
4. ———
5. OUTPUT
6. OUTPUT
7. ———
8. SHIELD

ALL RESISTORS 5 %

MM-601

McMartin Industries, Inc. OMAHA, NEBR.	
TITLE SCHEMATIC, PLUG-IN COMPOSITE AMP.	
DWN BY J.M. Hansen	DATE 11-30-66
ENG. HEDLUND	SCALE NONE
APP'D BY L. Hedlund	DWG. A-1466

DWG. A-1184



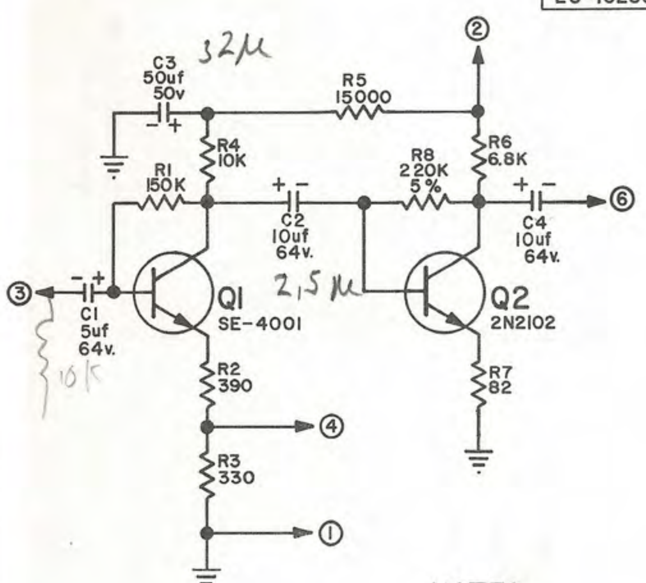
NOTES
ALL RESISTORS METAL FILM 1%

PIN CONNECTIONS
1. B+ 25V.
2. INPUT
3. CROSS COUPLING
4. OUTPUT
5. BAL-POT.
6. ———
7. BAL-POT.
8. INPUT
9. CROSS COUPLING
10. OUTPUT
11. SHIELD

MM-602

McMartin Industries, Inc. OMAHA, NEBR.	
TITLE SCHEMATIC, PLUG-IN AMPLITUDE CORRECTION AMP.	
DWN. BY J.M. Hansen	DATE 7-18-66
ENG. HEDLUND	SCALE NONE
	DWG. A-1184

DWG. A-1172
ES-10236



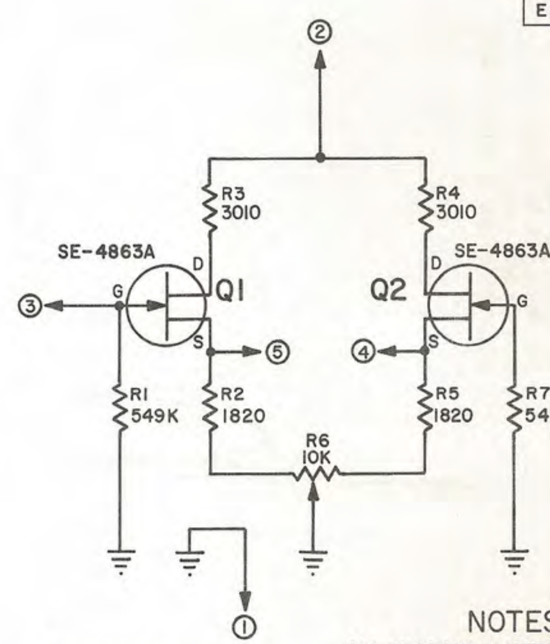
NOTES
ALL RESISTORS 5%

PIN CONNECTIONS
1. SIG. GND.
2. B+ 60V.
3. INPUT
4. FEED-BACK
5. ———
6. OUTPUT
7. ———
8. SHIELD

MM-603

McMartin Industries, Inc. OMAHA, NEBR.	
TITLE SCHEMATIC, PLUG-IN AUDIO AMPLIFIER	
DWN BY J.M. Hansen	DATE 6-2-66
ENG HEDLUND	SCALE NONE
APP'D. BY L. Hedlund	DWG. A-1172

DWG A-1180
ES-10241



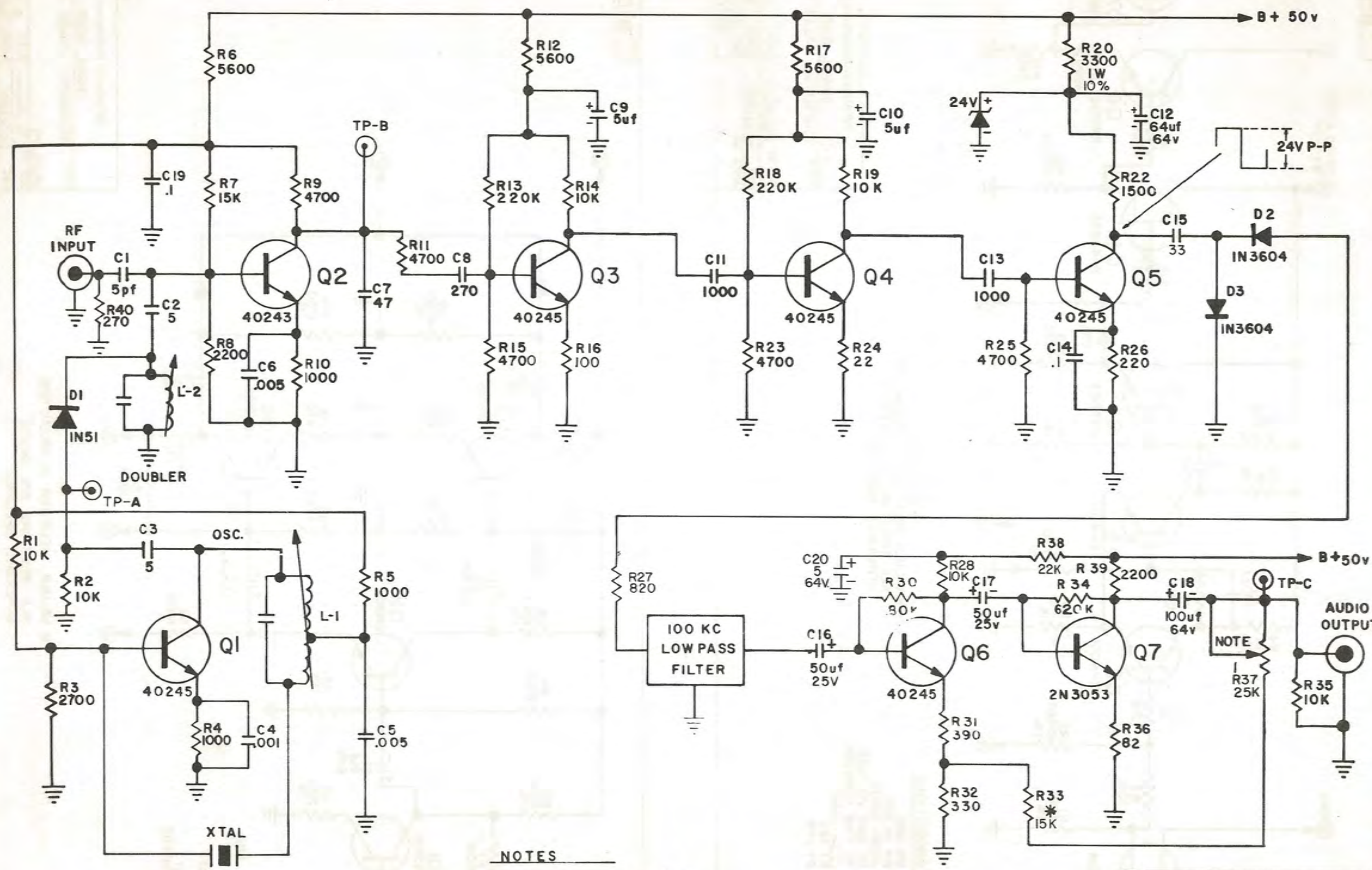
NOTES
ALL RESISTORS METAL FILM 1%

PIN CONNECTIONS
1. SIG. GND.
2. B+ 24V.
3. INPUT
4. METER
5. METER
6. ———
7. ———
8. SHIELD

MM-604

McMartin Industries, Inc. OMAHA, NEBR.	
TITLE SCHEMATIC, PLUG-IN D.C. METER AMP.	
DWN BY J.M. Hansen	DATE 6-2-66
ENG HEDLUND	SCALE NONE
APP'D BY L. Hedlund	DWG A-1180

C-1178



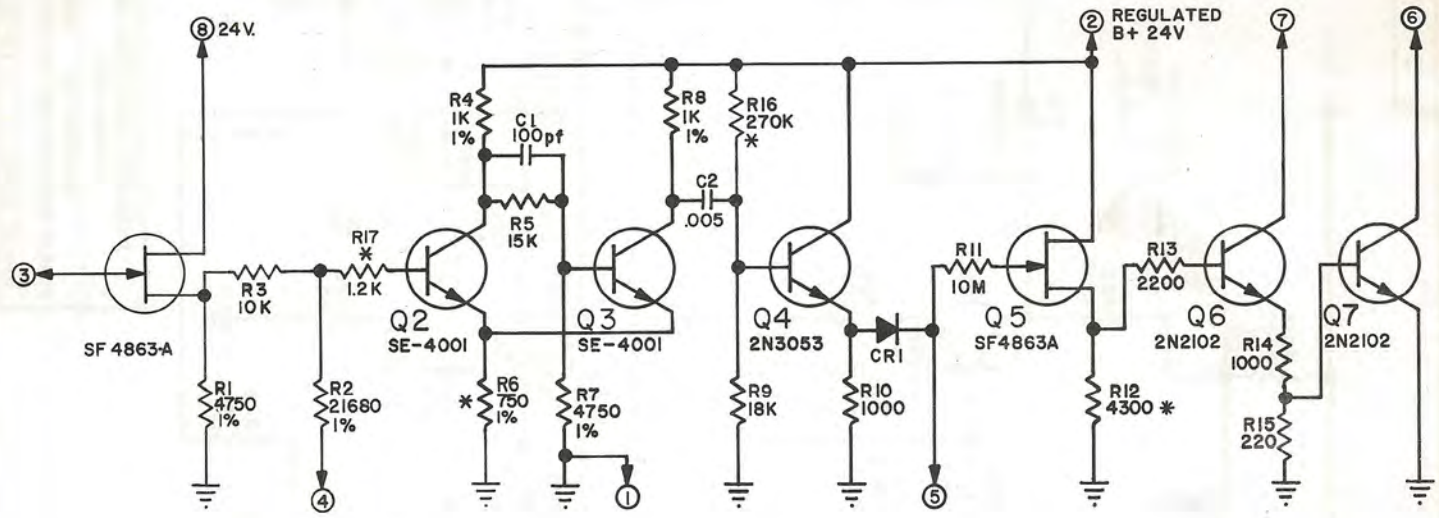
<u>NOTES</u>

ALL RESISTERS 1/2W ± 5%

1. ADJUST EXACTLY FOR 0.35 V R.M.S. WITH ± 75KC DEVIATION

McMARTIN INDUSTRIES INC. OMAHA, NEBR.	
SCHEMATIC MM-606 PLUG IN WIDE BAND (88-108) FM DEMOD.	
DWN. BY PLATZ	11-22-65
HEDLUND	NO SCALE
APP'D. L. Hedlund	C-1178

DWG. B-1222



PIN CONNECTIONS

1. SIG. GND.
2. B+ 24 REG.
3. AUDIO INPUT
4. DC BIAS VOLTAGE
5. RC TIME CONSTANT
6. PEAK LAMP
7. B+ 36V
8. B+ 24V

NOTES

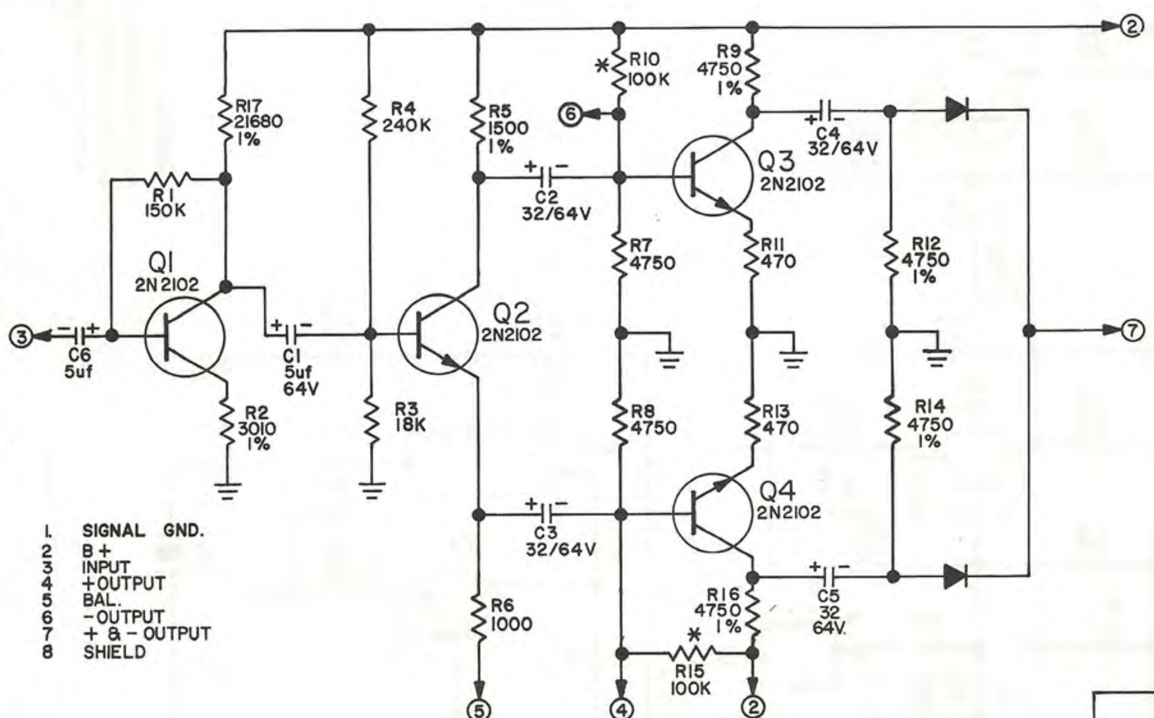
* VALUES SELECTED IN PRODUCTION
ALL RESISTORS 5% UNLESS OTHERWISE INDICATED.

MM-607

McMartin Industries, Inc.
OMAHA, NEBR.

TITLE SCHEMATIC, PEAK FLASHER	
DWN BY J.M. Hanson	DATE 7-20-66
ENG. HEDLUND	SCALE NONE
APP'D. BY	DWG B-1222

DWG. B-1283



1. SIGNAL GND.
2. B+
3. INPUT
4. +OUTPUT
5. BAL.
6. -OUTPUT
7. + & - OUTPUT
8. SHIELD

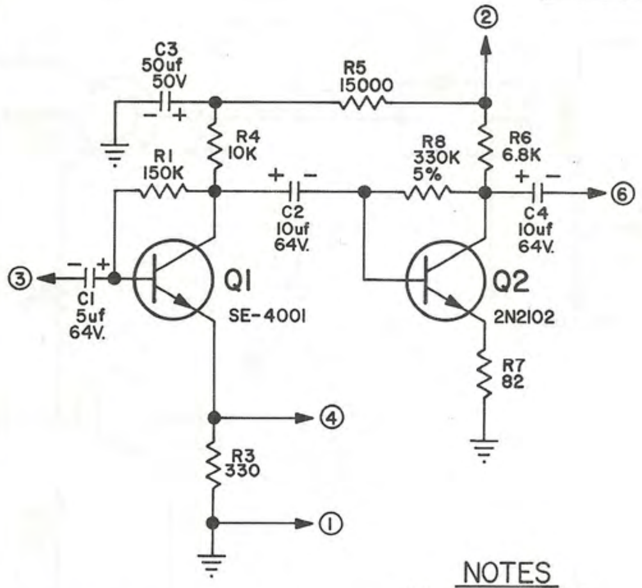
MM-608

McMartin Industries, Inc.
OMAHA, NEBR.

TITLE SCHEMATIC, PHASE SPLITTER (PLUG IN)	
DWN. BY J.M. Hanson	DATE 8-26-66
ENG. HEDLUND	SCALE NONE
APP D. BY	DWG. B-1283

* VALUES SELECTED IN PRODUCTION
ALL RESISTORS 5% UNLESS OTHERWISE SPECIFIED

A-1396
ES-10236



NOTES

ALL RESISTORS 5%

PIN CONNECTIONS

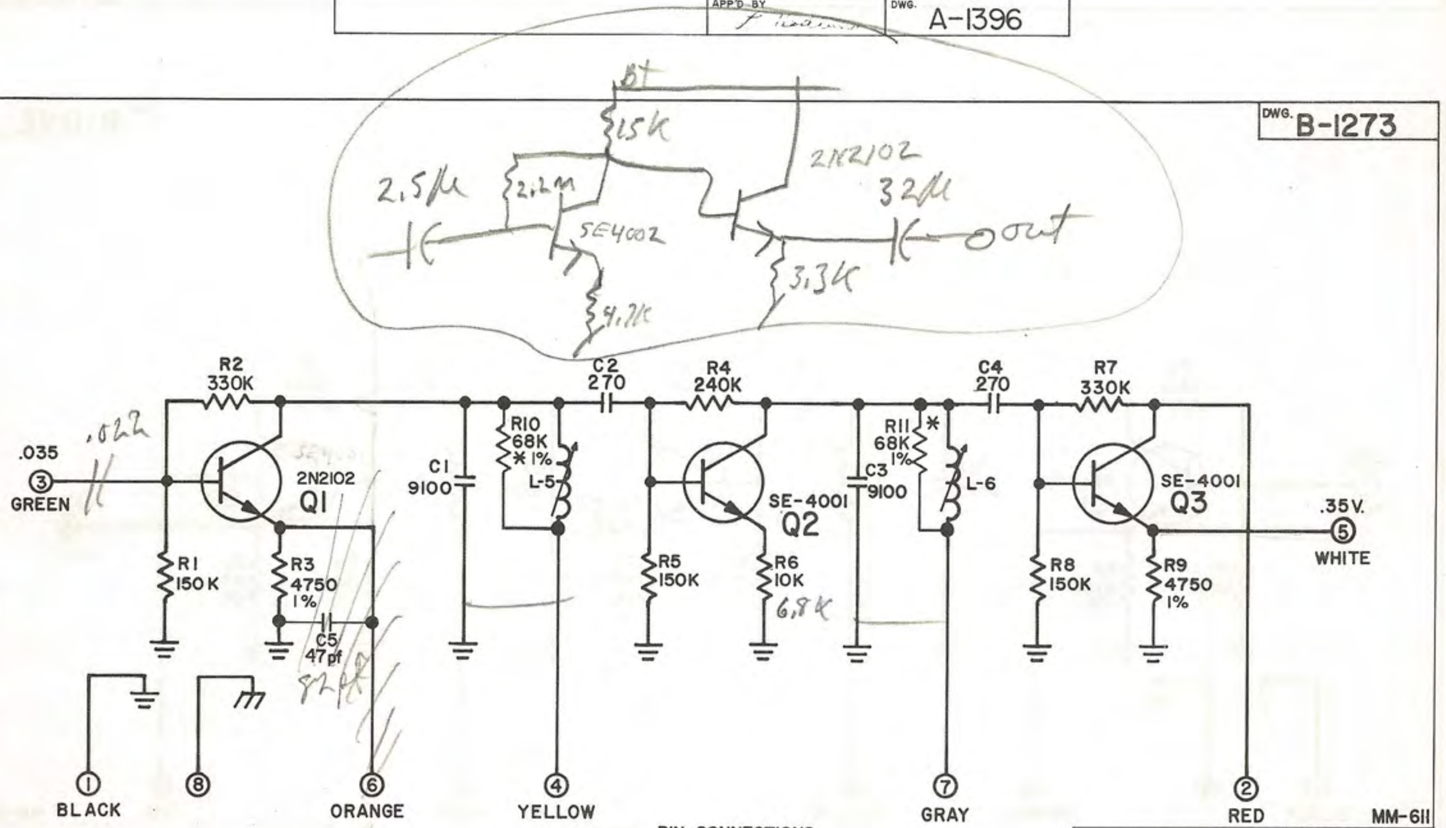
1. SIG. GND.
2. B+ 60V
3. INPUT
4. FEED-BACK
5. ________
6. OUTPUT
7. ________
8. SHIELD

MM-609

McMartin Industries, Inc.
OMAHA, NEBR.

TITLE SCHEMATIC, PLUG-IN AUDIO-DB AMPLIFIER	
DWN BY Kimball	DATE 6-2-66
ENG HEDLUND	SCALE NONE
APP'D BY	DWG. A-1396

DWG. B-1273



MM-611

NOTES

ALL RESISTORS 5%, 1/2W UNLESS OTHERWISE SPECIFIED.
* VALUES SELECTED IN PRODUCTION

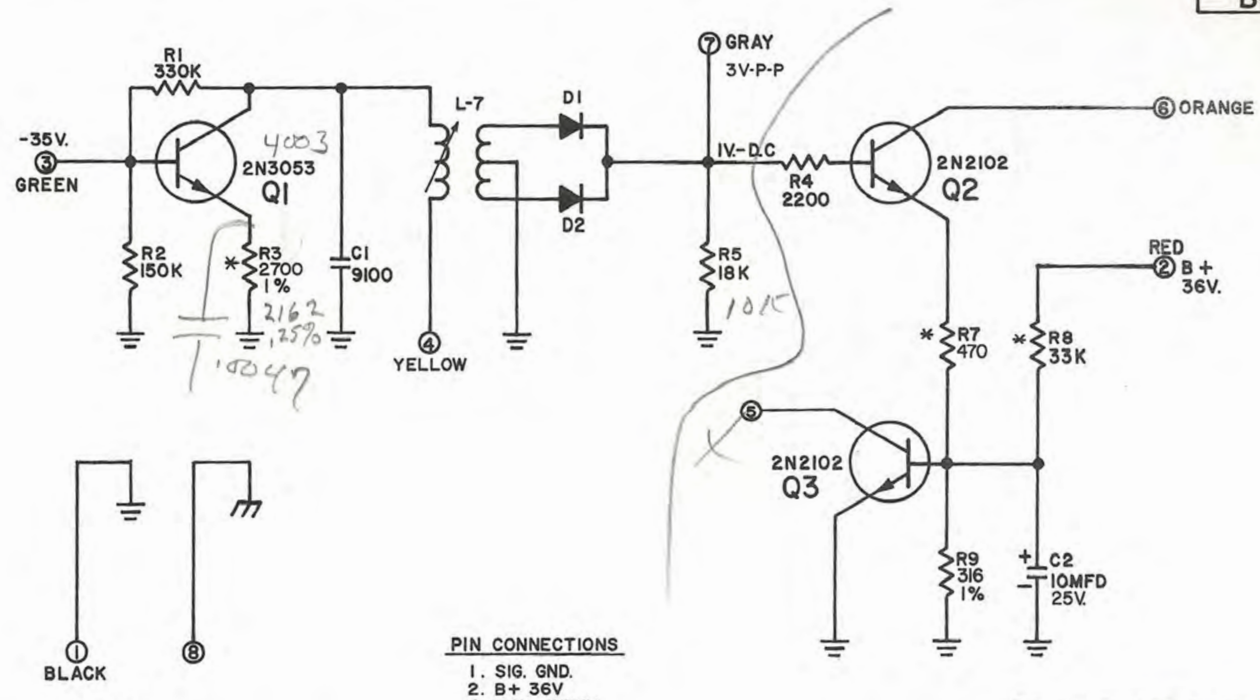
PIN CONNECTIONS

1. SIG. GND.
2. B+ 24V REG.
3. 19 KC INPUT
4. B+
5. 19 KC OUTPUT
6. OUTPUT
7. B+
8. SHIELD

McMartin Industries, Inc.
OMAHA, NEBR.

TITLE SCHEMATIC, 19 KC AMPLIFIER	
DWN BY J.M. Hansen	DATE 6-20-66
ENG. HEDLUND	SCALE NONE
	DWG. B-1273

DWG. B-1274



PIN CONNECTIONS

1. SIG. GND.
2. B+ 36V
3. 19KC INPUT
4. B+
5. RELAY
6. 38KC OUTPUT
7. TEST POINT
8. SHIELD

NOTES

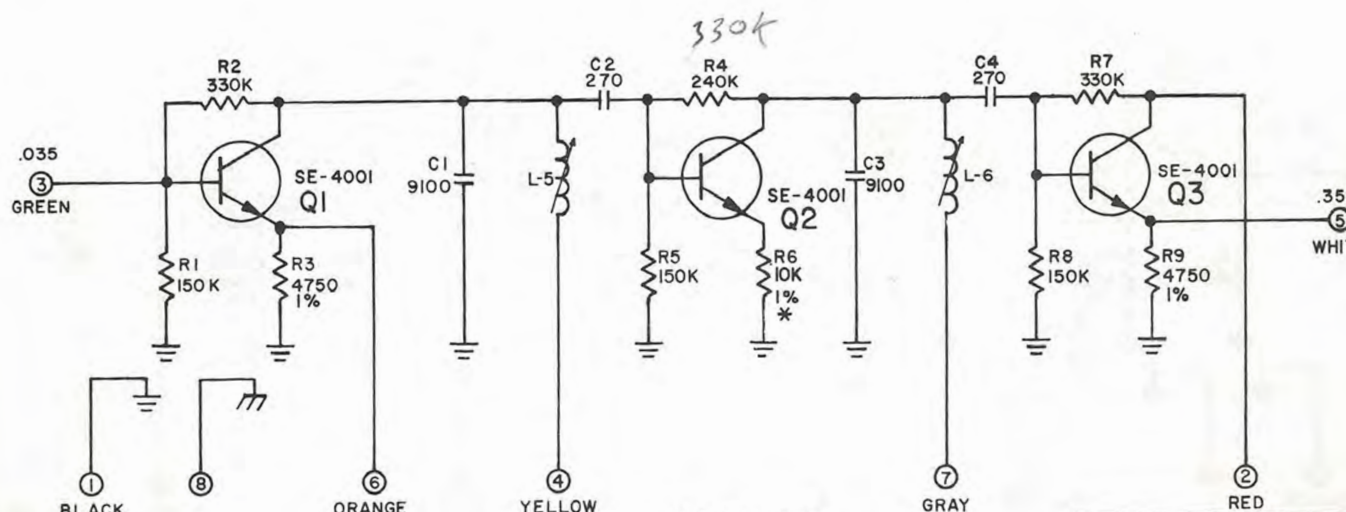
ALL RESISTORS 5%
* VALUES SELECTED IN PRODUCTION

MM-612

McMartin Industries, Inc.
OMAHA, NEBR.

TITLE SCHEMATIC, 19 KC AMPLIFIER-DOUBLER	
DWN. BY J. M. Hansen	DATE 6-20-66
ENG. HEDLUND	SCALE NONE
L. Hedlund	DWG. B-1274

DWG. B-1292



MM-613

PIN CONNECTIONS

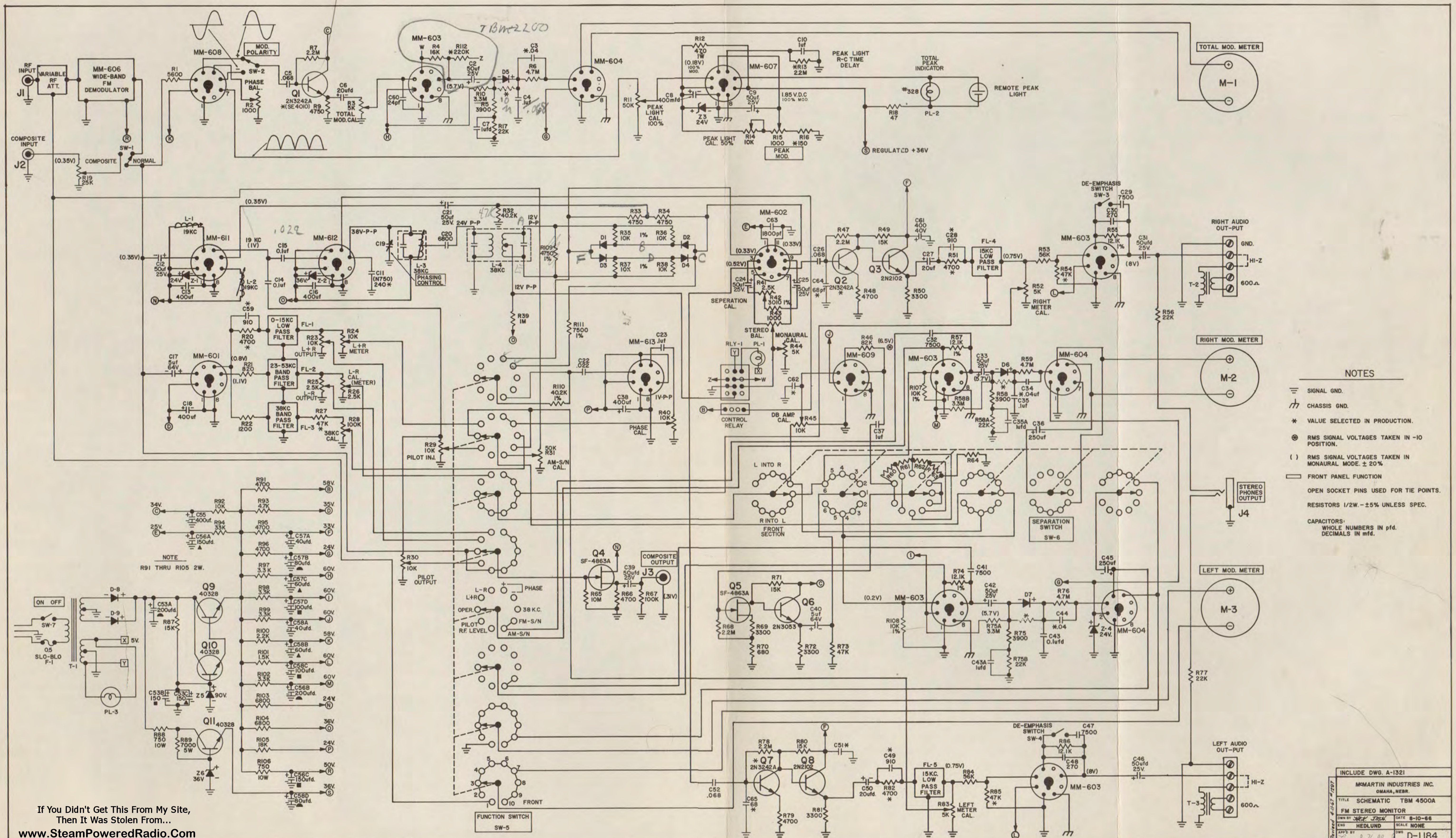
1. SIG. GND.
2. B+ 24V REG.
3. 19 KC INPUT
4. B+
5. 19 KC OUTPUT
6. OUTPUT
7. B+
8. SHIELD

NOTES

ALL RESISTORS 5% UNLESS OTHERWISE SPECIFIED.
* VALUES SELECTED IN PRODUCTION

McMartin Industries, Inc.
OMAHA, NEBR.

TITLE SCHEMATIC, 19 KC PHASING AMPLIFIER	
DWN BY J. M. Hansen	DATE 6-20-66
ENG. HEDLUND	SCALE NONE
L. Hedlund	DWG. B-1292



TOTAL MOD. METER
RIGHT MOD. METER
LEFT MOD. METER
RIGHT AUDIO OUT-PUT
LEFT AUDIO OUT-PUT
STEREO PHONES OUTPUT
PEAK LIGHT R-C TIME DELAY
TOTAL PEAK INDICATOR
REMOTE PEAK LIGHT
REGULATED +36V
MM-606 WIDE-BAND FM DEMODULATOR
VARIABLE RF ATT.
RF INPUT
COMPOSITE INPUT
MOD. POLARITY
PHASE BAL.
TOTAL MOD. CAL.
PEAK LIGHT CAL. 100%
PEAK LIGHT CAL. 50%
PEAK MOD.
DE-EMPHASIS SWITCH SW-3
DE-EMPHASIS SWITCH SW-4
PHASING CONTROL
0-15KC LOW PASS FILTER
23-53KC BAND PASS FILTER
38KC BAND PASS FILTER
15KC LOW PASS FILTER
SEPERATION CAL.
STEREO BAL.
MONAURAL CAL.
CONTROL RELAY
DB AMP CAL.
PHASE CAL.
PILOT INJ.
AM-S/N CAL.
PILOT OUTPUT
COMPOSITE OUTPUT
RIGHT METER CAL.
LEFT METER CAL.
L INTO R
R INTO L
FRONT SECTION
SEPARATION SWITCH SW-6
FUNCTION SWITCH SW-5
NOTE
R91 THRU R105 2W.
ON OFF
SLO-BLO
NOTES
SIGNAL GND.
CHASSIS GND.
* VALUE SELECTED IN PRODUCTION.
⊛ RMS SIGNAL VOLTAGES TAKEN IN -10 POSITION.
( ) RMS SIGNAL VOLTAGES TAKEN IN MONAURAL MODE. ± 20%
FRONT PANEL FUNCTION
OPEN SOCKET PINS USED FOR TIE POINTS.
RESISTORS 1/2W.-±5% UNLESS SPEC.
CAPACITORS:
WHOLE NUMBERS IN pfd.
DECIMALS IN mfd.
INCLUDE DWG. A-1321
McMARTIN INDUSTRIES INC.
OMAHA, NEBR.
TITLE SCHEMATIC TBM 4500A
FM STEREO MONITOR
DATE 8-10-66
ENG HEDLUND
SCALE NONE
D-1184