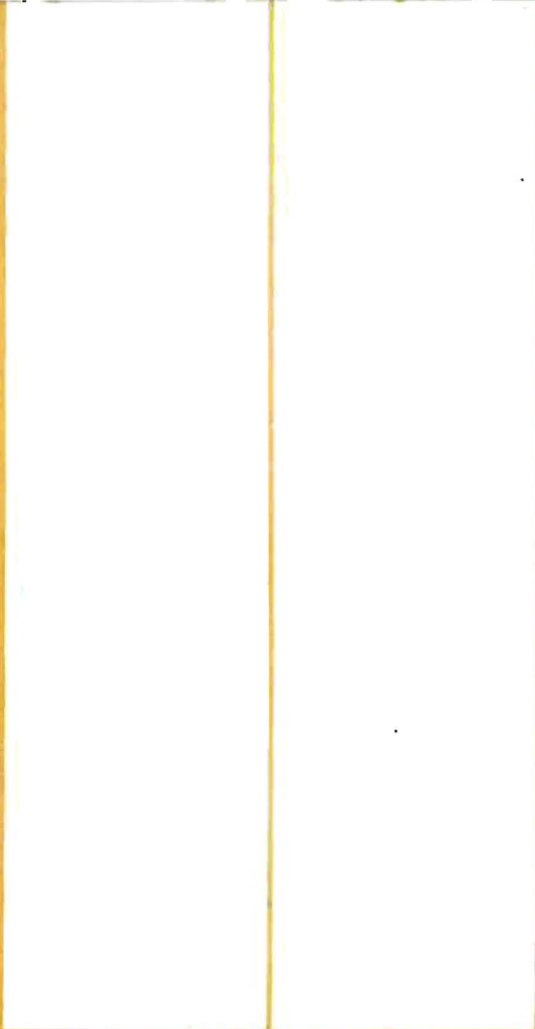




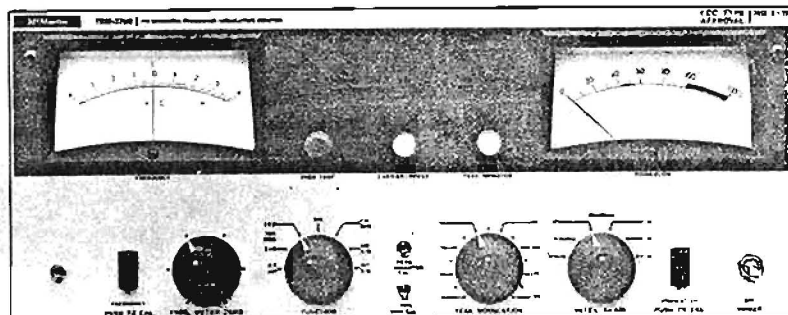
McMARTIN

TBM-3700

**FM FREQUENCY/MODULATION
MONITOR**

INSTRUCTION MANUAL

McMartin.



McMartin®

TBM-3700

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MONITOR**

INSTRUCTION MANUAL

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I. TECHNICAL SPECIFICATIONS

OPERATING RANGE	88-108 MHz
MODULATION RANGE	± 75 kHz deviation - 100% modulation ± 100 kHz deviation - 133% modulation
RF INPUT	
Impedance.....	50 ohms unbalanced
Sensitivity.....	0.1 to 1 watt
OUTPUTS	
Audio output for monitoring circuits	
Source	
Impedance....	600 ohms balanced
Level.....	+2 dBm at 100% modulation at 400 Hz
Distortion...	Less than 0.5% (50 to 15,000 Hz)
Audio output for distortion measurement	
Impedance....	10K ohms, or greater
Level.....	5 volts at 100% modulation at 400 Hz
Frequency Response...	30 to 15,000 Hz ± 0.5 dB
Distortion	
Monaural....	0.25% (30 to 15,000 Hz)
Noise Level...	-66 dB below 100% modulation at 400 Hz
Composite Output (2)	
Source	
Impedance....	300 ohms
Level.....	1.0 volts peak-to-peak
Frequency Response...	± 0.2 dB, 50 to 100,000 Hz
PEAK FLASHER	
Peak flasher meets FCC requirements	Peak light adjustable to read positive and negative peaks from 50 percent to 120% modulation
MODULATION METER	
Main Channel	
Position	
Accuracy....	± 0.5 dB
Frequency Response...	± 0.5 dB, 30 to 15,000 Hz
Meter characteristics meet FCC requirements	
Total Modulation	
($\pm$) Position	
Accuracy....	± 0.5 dB
Frequency Response...	± 0.5 dB, 30 to 75,000 Hz
Meter characteristics meet FCC requirements	
CARRIER FREQUENCY METER RANGE ...	± 4 kHz full scale in increments of 100 Hz
Accuracy.....	Indicator accuracy better than ± 500 Hz

Crystal Oven Temperature Range.....

.....75°C, ± 2 degrees (proper oven operation indicated by front panel light indicator)

REMOTE MONITORING FACILITIES.....

.....(Optional) RM-37 T/R kit available

Modulation.....

.....Modulation may be remotely monitored with 2,500 ohm external loop resistance plus remote meter resistance. Remote meter is completely independent of internal meter.

Carrier

Frequency.....

.....Frequency deviation may be remotely monitored with 3,000 ohm external loop resistance plus remote meter resistance.

Peak

Indicator.....

.....The peak light may be remotely monitored.

ALARM INDICATOR AND MUTE.....

.....Relay contact closures are available on the rear terminals when the RF carrier fails or falls below a preset value. Also all functions of the monitor are muted, preventing annoying noise in audio monitoring system.

POWER REQUIREMENTS..

...105 to 125 volts ac, 50/60 Hz, 45 watts

FUSE..

.....0.5 amp. SLO BLO

AMBIENT TEMPERATURE RANGE.....

.....10° to 50° C

DIMENSIONS

Width.....

Standard 19 inch rack panel mount

Height.....

.....7 inches

Depth.....

.....13 inches overall

Weight.....

.....20 pounds

FINISH.....

...McMartin beige with woodgrain trim

FCC TYPE APPROVAL NUMBER.....

.....3-190

II. GENERAL DESCRIPTION

The McMartin TBM-3700, solid state monitor is a completely self-contained unit for measurement of the carrier frequency deviation and the base band modulation characteristics of the FM Broadcast Station. The left meter indicates the carrier frequency deviation and the right meter the total peak modulation and other characteristics of the FM transmission.

In simplicity of operation of the TBM-3700, the various metering functions are incorporated in one switch. These functions read on the right meter are as follows: RF input

level, total positive or negative modulation, main channel modulation, FM signal-to-noise, AM signal-to-noise and internal signal-to-noise of the monitor. In addition, the TBM-3700 features push-button calibration of the frequency and modulation meters.

The modulation meter is a peak indicating device capable of measuring true peak value, regardless of waveform. The meter is also used as an audio volt-meter to measure the FM signal-to-noise, AM signal-to-noise ratio of the FM Broadcast station and also the inherent internal S/N of the monitor. When the function switch is in the FM S/N, AM S/N or internal S/N position, the audio is automatically deemphasized. Also, the meter is highly damped in all the dB positions. When in the "operate" position, the meter ballistics conform to the FCC requirement. **NOTE: The voltmeter is protected against severe overload.**

In the McMartin TBM-3700 monitor, the carrier frequency deviation measuring circuitry and the modulation circuitry are completely independent of each other. This allows regular frequency measurements without any interruptions of the modulation percentage reading or audio feed to house monitoring systems. Complete isolation exists between the circuitry so that in case of failure of one circuit the other will not be affected.

A low noise 900 kHz oscillator and additional circuitry are used to calibrate the modulation meter. In addition, this low noise oscillator is used to verify the inherent low internal FM noise of the TBM-3700 which is typically at least -75 dB below 100 percent modulation.

The frequency meter is automatically protected against severe overload in the absence of an RF carrier. A carrier/power light (orange lens) located in the center of the front panel indicates presence of both the RF carrier and ac power.

A high speed peak indicating light (white lens), located adjacent to the modulation meter is adjustable from 50-120 percent 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. The peak indicating light responds to both positive and negative peaks exceeding the preset level.

An indicator light (green lens) located adjacent to the frequency meter is used to indicate the proper operation of the crystal oven. Proper operation is indicated by a periodic on-and-off of the indicator light.

The TBM-3700 has complete facilities for remote monitoring of the modulation, carrier frequency deviation and a peak modulation indicator light.

Two separate composite output (BNC) jacks located on the rear chassis are available for feeding the wide band output to external stereo or SCA monitors such as the McMartin TBM-2200 or TBM-2000A. The output impedance is low, minimizing error when a reasonable length of cable is used.

The TBM-3700 automatically mutes when the RF carrier is lost or falls below a predetermined level. A relay is activated, one pair of relay closures are available on the rear chassis for operation of an external alarm system.

Almost all of the circuits are plug-in cards for ease of servicing in the field. Each plug-in card is isolated from the power supply so that in case of failure or short circuit,

it will not short circuit the power supply, disabling the rest of the monitoring functions. A separate 36 volt regulated supply is used for the peak flasher.

All the critical circuits have double regulation for added stability. All solid state devices are operated far below their rated voltage for greater reliability.

A five terminal barrier strip, located on the rear chassis, provides connections for aural monitoring of the main channel, also for connection of an external distortion meter.

An eight terminal barrier strip located on the rear chassis provides connections for a remote peak light, remote modulation meter, remote frequency meter and one pair used for an external alarm system.

III. INSTALLATION

Upon receipt of your TBM-3700, remove it from the shipping carton and inspect it carefully for any damage caused in transit due to rough handling. If any damage is found, notify the shipping agency and advise McMartin Industries of such action.

The top cover of the TBM-3700 should be removed. An inspection of the plug-in cards should be made to insure that they are firmly seated in their proper sockets. The relay must be in the socket for proper operation.

The TBM-3700 should be mounted where there is adequate ventilation. The unit should not be mounted above high heat producing equipment.

CAUTION: Ambient temperature should not exceed 110° F.

Check the mechanical zero setting of the frequency and modulation meters before turning the monitor on.

Connect the ac cord to the 117 volt ac source. Connect the RF cable from the pick-up loop in the transmitter to the input jack marked "RF" on the rear of the chassis.

NOTE: The crystal oven indicator light is not controlled by the front panel on/off switch and will light when ac power is applied. The carrier/power light is controlled by the on/off switch and the presence of the RF carrier. Both RF input and ac power must be applied to activate monitor.

CAUTION: Do not exceed 1 watt RF energy at the input to the monitor.

The TBM-3700 has been thoroughly checked and calibrated prior to shipment and should require no adjustment. Turn power on and allow sufficient time for stabilization. The monitor has extensive filtering and requires some time for stabilization.

IV. NORMAL OPERATION

ADJUSTMENT OF RF INPUT LEVEL

CAUTION: Before applying RF input, turn the rear chassis RF level control counterclockwise (as viewed from the

rear) to minimum. Slowly adjust RF level control clockwise for a reading of 100 percent on the modulation meter with the front panel RF function switch in the RF position. If the meter tends to reverse when increasing the level control, this indicates too much RF is applied to the monitor input.

The RF level from the transmitter pick-up loop should be such that RF level control on the monitor is approximately 1/2 to 3/4 way open.

NOTE: The monitor need not have ac power applied for this adjustment.

Turn the ac power switch on and carrier/power light should light, indicating that the TBM-3700 is now ready for operation.

MONITORING TOTAL MODULATION

The function switch must be positioned in either the "+" or "-" modulation position. The accuracy of the modulation calibration should be verified by depressing the "Mod - push to cal" switch. The modulation meter should read: 100 percent, ± 1 percent. If the modulation meter does not read 100 percent: (a) insert a small screwdriver into the front panel recessed vernier modulation control located between the function switch and the peak modulation control and adjust for a reading of 100 percent, (b) release the "Mod - push to cal" switch. It is advisable to check this once a day to verify proper operation of the monitor. This may be done at any time with or without modulation. The recessed modulation control has a range of ± 2 dB which is adequate to correct for minor variations.

NOTE: This recessed modulation control should rarely have to be adjusted unless a malfunction occurs in the monitor.

The modulation meter will respond to the positive or negative peak depending on the position of the function switch.

NOTE: The function switch must be in the "+" or "-" position at all times, excepting when used for measuring purposes.

MONITORING MAIN CHANNEL MODULATION

When stereo or SCA operation is employed the main channel position is used for measuring crosstalk from these modes into the main channel.

1. Turn the front panel function switch to the "MN" position.
2. Turn the front panel meter range switch to the right and measure the residual crosstalk. (Refer to operation of internal voltmeter.)
3. Return the function switch to the "+" or "-" total mod. position.

PEAK MODULATION ADJUSTMENT

This adjusts the overmodulation peak indicator and should never be set to exceed 100 percent in normal operation. 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 the positive or negative direction.

NOTE: With normal broadcast program material, it will not be uncommon for the peak flasher to light at a 100 percent setting of the peak modulation control while the total

modulation meter will show about 50 to 70 percent 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 over-modulation.

MEASURING CARRIER FREQUENCY

1. Depress the frequency "push to cal" switch with the left hand and with the right hand slowly adjust the "freq. meter zero" control for exact center zero reading on the frequency meter. **NOTE:** Frequency meter response is slow because it is highly damped to prevent it from following modulation.
2. Release "push to cal" switch to measure the operating frequency. **NOTE:** The frequency meter indicates the error frequency of the transmitter carrier.

LOCAL OSCILLATOR FREQUENCY CALIBRATION

The TBM-3700 is shipped adjusted to the customer's frequency. A lot of time and care was used to insure that the frequency calibration is correct; however, it is recommended that it be checked against an external frequency standard as follows:

1. The actual transmitter operating frequency should be confirmed by an outside measuring service.
2. Depress the "push to cal" switch and adjust the "Freq. meter zero" control for exact zero reading on the frequency meter.
3. Release "push to cal" switch and note reading. If the frequency meter does not coincide with the measurement obtained in step 1, adjust the internal frequency as follows:
 - a. Insert a small screwdriver into the front panel recessed vernier frequency control located on the extreme left of the front panel.
 - b. Adjust the internal frequency of the monitor until the frequency meter agrees with the measurement obtained in step 1. The range of this control is greater than ± 1.5 kHz.

OPERATION OF INTERNAL PEAK AUDIO VOLTMETER

The internal audio voltmeter is calibrated in 10 dB steps and is controlled by the six position "meter range" switch. Turning the "meter range" switch to the right increases the gain 10 dB per step. An example for reading signal-to-noise ratio: If the meter reads -3 dB in the 50 dB position, the measured noise ratio would be -53 dB below the reference of 100 percent modulation at 400 Hz.

MEASUREMENT OF THE INTERNAL FM SIGNAL-TO-NOISE RATIO OF THE MONITOR

The internal noise of the monitor is verified by substituting a low-noise, crystal-controlled signal source for the normal transmitter signal.

1. Turn the front panel function switch to the "Int. S/N" position.
2. Increase the sensitivity of the internal audio voltmeter by turning the front panel meter range switch to the right. The internal signal-to-noise can be read directly on the meter. (Refer to operation of internal voltmeter.)

NOTE: The internal noise may be measured at any time with or without modulation. The internal noise should be at least 70 dB below 100 percent modulation at 400 Hz.

REMOTE MONITOR OPERATION

REMOTE MODULATION METER

1. Connect the remote modulation meter line to the two terminals marked "RM Mod" on the eight terminal barrier strip located on the rear chassis. NOTE: Remote line resistance must not exceed 2,500 ohms.
2. Refer to remote monitoring under the maintenance section for calibration.

REMOTE FREQUENCY DEVIATION METER

1. Connect the remote frequency deviation meter to the two terminals marked "RM Freq." on the eight terminal barrier strip located on the rear chassis. NOTE: Remote line resistance must not exceed 3,000 ohms.
2. Refer to remote monitoring under the maintenance section for calibration.

REMOTE PEAK INDICATOR

1. Connect the remote indicator line to the two terminals marked "Peak Light" located on the eight terminal barrier strip located on the rear chassis.
2. Refer to remote monitoring under the maintenance section for proper operation. CAUTION: Do not short circuit the remote peak light terminal together or to ground as this may damage the transistor switch in the monitor.

V. PROOF OF PERFORMANCE

MEASUREMENT OF FM SIGNAL-TO-NOISE RATIO OF TRANSMITTER

1. Turn the front panel function switch of the monitor to the "Int S/N" position.
2. Turn the "Meter Range" switch to the right and verify the internal residual noise of the monitor. This should be at least -70 dB. (Refer to operation of internal voltmeter.)
3. Return the meter range switch to the operate position.
4. Remove all modulation from transmitter.
5. Turn the front panel function switch to the "FM S/N" position.
6. Turn the "meter range" switch to the right until an appropriate "on scale" reading is obtained. This is the residual FM signal-to-noise ratio of the transmitter.
7. Return the "meter range" switch to the operate position and the function switch to either the "+" or "-" total modulation position.

MEASUREMENT OF AM SIGNAL-TO-NOISE RATIO OF THE TRANSMITTER

1. Remove all modulation from the transmitter.
2. Turn the front panel function switch to the RF position.

3. Adjust the transmitter RF input level for a reading of exactly 100 percent on the modulation meter.
4. Turn the front panel function switch to the "AM S/N" position.
5. Turn the meter range switch to the right until an appropriate "On Scale" reading is obtained. (Refer to operation of internal voltmeter.) The reading obtained is the AM signal-to-noise ratio of the transmitter.
6. Return the "Meter Range" switch to the operate position and the function switch to either "+" or "-" modulation position.

MEASUREMENT OF DISTORTION

1. Remove the jumper between the HI-Z terminals located on the five terminal barrier strip on the rear of the chassis.
2. Connect a distortion analyzer to the terminal marked "HI-Z" and "Ground".
3. The deemphasis switch located on plug-in card A-10 must be in the deemphasized position. The deemphasis switch must be in the out position.
4. Modulate the transmitter with the desired audio frequency and verify the level with the modulation meter. NOTE: The front panel function switch must be in either the "+" or "-" total modulation position for verifying the modulation level.
5. Proceed with distortion measurements.

FREQUENCY RESPONSE

1. Turn the front panel function switch to either the "+" or "-" total modulation position.
2. Modulate the transmitter with an audio oscillator which is monitored with an ac voltmeter, such as one contained in a typical distortion analyzer.
3. Feed a 400 Hz signal into the transmitter at a level to give a reading of 100 percent modulation on the TBM-3700 monitor. Note the dB reading on the ac voltmeter or distortion analyzer as this will become a reference level.
4. Change the frequency of the audio oscillator to all the frequencies to be measured, adjusting the oscillator output to give a reading of 100 percent modulation on the monitor at all times.
5. Note the dB readings on the ac voltmeter or distortion analyzer at each frequency checked. The ac voltmeter dB indication should follow the inverse of the standard FCC 75 microsecond preemphasis curve.

STEREO AND SCA MEASUREMENTS

A McMartin TBM-2200 stereo monitor and/or a McMartin TBM-2000A SCA monitor must be used with the TBM-3700 for complete stereo and/or SCA measurements. Wide band composite signal is available at the two BNC jacks located on the rear of the TBM-3700 chassis.

VI. DETAILED CIRCUIT DESCRIPTION

The TBM-3700 frequency and modulation monitor utilizes completely separate circuitry for modulation and frequency measurement. The modulation circuitry will be described first.

The sampled RF from the transmitter is fed to an adjustable RF input attenuator located on the rear chassis. The RF level is adjusted by the rear chassis RF level control. The correct level is indicated by the right modulation meter when the front panel function switch is in the RF position. Two diode rectifiers located on the wide band and squelch mixer board convert the RF into a dc voltage to drive the meter. A meter reading of 100 percent indicates that the proper RF level is applied to the board located underneath the chassis. Any meter reading of 30 percent or higher is adequate; however, this adjustment is critical for the AM-S/N reading and must be adjusted to 100 percent for this measurement.

The RF signal from the attenuator is fed through a 330 ohm isolation resistor to the input of Q-1, an FET ground-gate isolation amplifier. This stage gives extremely good isolation and prevents local oscillator signals being fed back through the attenuator. A broad tuned circuit (L-1) is used in the drain circuit of Q-1. This grounded gate circuit produces approximately 3 dB gain. The signal is fed from a low impedance tap on the coil to a bipolar mixer (Q-2).

The local oscillator is crystal controlled and operates at a frequency of

$$\frac{\text{operating frequency} + 900 \text{ kHz}}{2}$$

The oscillator frequency is doubled by L-3 and coupled into the base of mixer Q-2. The 900 kHz output from the collector of Q-2 is fed to the input of plug-in card A-3, (wide band demodulator). The signal is controlled by diode switches D-1 and D-2 on the A-3 card which will be described later.

The 900 kHz IF signal in the A-3 card is fed to a symmetrical limiter (Q-3 and Q-4). Potentiometer R-7 is used to compensate for variations in transistor characteristics and is factory adjusted for precise symmetrical limiting.

The limited signal is fed to an IC limiter (IC-1) which produces very hard limiting. The square wave output from IC-1 is fed to transistor switch Q-5. This transistor is driven to complete saturation and cutoff producing a 24 volt (P-P) square wave signal, thus temperature, transistor and component variations have little or no effect on the amplitude of this signal. This signal is integrated by Diodes D-5 and D-6. The pulses produced are fed through the low pass filter (FL-1) which removes the 900 kHz IF signal. Only the modulating signal remains.

The plug-in card (A-3) also utilizes a crystal controlled 900 kHz oscillator (Q-1) and circuitry for accurate calibration of the modulation meter circuit. Diode switches D-1, D-2 and D-3 are controlled by the front panel "Mod-Push to Cal" switch (SW-3). In normal operation, a dc voltage is applied through switch SW-3 to diodes D-1 and D-2 turning them on and allowing the 900 kHz IF frequency from the mixer through to the symmetrical limiter and normal operation.

When switch SW-3 is depressed, the voltage is removed from Diodes D-1 and D-2 which blocks the 900 kHz IF

signal derived from the mixer. The dc voltage from the switch SW-3 is now applied to Diode D-3, turning it on. At the same time the DC supply voltage is applied to the 900 kHz crystal oscillator and this signal is fed to the IF system.

A 60 Hz signal from the power transformer is fed through Section 3 of SW-3 through resistor R-5 on card A-3 to switching Diode D-4. This completely short-circuits the 900 kHz oscillator to ground 60 times per second, thus the IF frequency is deviated from 0-900 kHz (equivalent to a frequency deviation of 900 kHz P-P at a 60 Hz frequency). This deviation is six times greater than normal FM modulation which is ± 75 kHz or 150 kHz P-P. A 6 to 1 voltage divider consisting of R-17 and R-21 on card A-4 is incorporated along with a separately mounted filter (FL-2). This reduces the 900 kHz deviation to a calibrating voltage equal to precisely 150 kHz P-P deviation, or ± 75 kHz.

This precise calibrating voltage from FL-2 is fed through Section 2 of switch SW-3 to the modulation measuring circuits. Section 4 of the switch (SW-3) is used to mute the audio system and prevent the 60 Hertz from being fed from the monitor.

When function switch SW-2 is turned to the "Int. S/N" position, the dc voltage is removed from diodes D-1 and D-2 on Card A-3 blocking the 900 kHz IF signal from the mixer. The dc voltage is now applied to diode D-3, turning it on. DC voltage is also applied to the low noise 900 kHz crystal oscillator. This signal is fed to the IF and demodulator systems and used for determining the internal FM signal-to-noise ratio of the monitor. The level of the crystal oscillator signal is adjusted with potentiometer R-30 (Card A-3) to equal the amplitude of the 900 kHz signal derived from the mixer.

The low level audio signal from the low-pass filter (FL-1) is fed directly to the input of plug-in card A-4 (wide band amplifier and emitter followers). Q-1 and Q-2 amplify the low level signal approximately 30 dB. The gain is adjusted by potentiometer R-10 which controls the amount of negative feedback. This type of gain control does not change the frequency response of the amplifier. The output signal from Q-2 is fed to an emitter follower (Q-3) with a very low output impedance suitable for feeding all the various measuring circuits. The precision voltage divider resistors (R-17 and R-21) are used as the emitter load of Q-3. The two output signals are routed to Section 2 of the front panel "Mod-Push to Cal" switch (SW-3). The output signal from switch SW-3 is fed to the recessed front panel vernier modulation control (R-16). This control will change the modulation meter reading ± 2 dB when properly adjusted in midrange. The output from this control is fed to the two emitter followers (Q-4 and Q-5) and filter amplifiers Q-6 and Q-7, located on plug-in card A-4. The two emitter followers (Q-4 and Q-5) feed the two composite output jacks located on the rear chassis. The amplifier consisting of Q-6 and Q-7 is used to drive the 15 kHz low pass filter (FL-3) which is used for measuring main channel modulation.

The signal from the recessed front panel modulation control (R-16) is also fed to the input of plug-in card A-5 (phase splitter). The positive and negative output signals from Card A-5 are fed to the front panel function switch (SW-2). This selected signal is returned to isolation amplifier Q-5 (an emitter follower) located on plug-in card A-5. This low output impedance feeds the total modulation calibrate potentiometer (R-13) and the remote total modulation calibrate potentiometer (R-20) on main chassis.

The signal from the total "Mod Cal Pot" (R-13) is routed through the front panel function switch (SW-2) to the input of meter amplifier plug-in card A-8.

Transistors Q-1 and Q-2 on plug-in card A-8 amplify the audio signal to a level suitable for feeding peak Diode D-1. This peak voltage is measured with an extremely high input impedance FET circuit, Q-3 and Q-4, minimizing error.

The modulation meter is connected between the two source elements of Q-3 and Q-4 in a balanced FET differential amplifier circuit. The modulation meter is driven from a very low source impedance. This gives a meter circuit with rapid rise time and excellent damping. Resistor R-15 and capacitor C-8 control the rise time of the modulation meter. Resistor R-12 controls the decay and is adjusted at the factory for proper meter ballistics.

Remote modulation calibration potentiometer R-20 on the main chassis is used for calibrating the optional remote modulation meter amplifier which is identical to the A-8 card excepting for minor changes in the time constants of the circuitry controlling the ballistics of the meter. R-20 on card A-8 controls the dc balance of the modulation meter.

The negative and positive modulation from the output of the phase splitter (Q-2) on Card A-5 is amplified by Q-3 and Q-4 and applied to two diodes (D-1 and D-2). The output, pin "F", on card A-5 consists of only positive-going pulses which are fed to the input of plug-in card A-6 (peak flasher) through the recessed front panel "Peak Flasher Calibrate" control, R-28. R-28 is a vernier adjustment to R-1, Card A-6.

The input level of the dc pulses is controlled by potentiometer R-1 on Card A-6 which sets the threshold level for triggering the Schmitt trigger (Q-2 and Q-3) at 100 percent modulation.

Potentiometer R-17 sets the threshold reference at 60 percent modulation while the front panel peak level control R-18 is used to set the threshold to the desired level.

The triggered output pulses from the Schmitt trigger feed transistor switch Q-4. This transistor is a power device with very low output impedance. The power output pulses charge capacitor C-5. Capacitor C-5 and resistor R-14 comprise an RC time delay circuit which will hold the charge for at least two to four seconds. The dc voltage output from this capacitor (C-5) is fed to FET Q-5. The input impedance is almost infinite and does not affect the RC time constant of C-5 and R-14. The positive pulses produce a high dc voltage on the gate of Q-5. This turns on transistor Q-6, an isolation amplifier which turns on transistor switch Q-7.

The power for the peak light is supplied from a separate 36 volt supply. The remote peak light is driven by the same power supply and transistor switch.

The output of the 15 kHz low pass filter (FL-3) is connected to the modulation meter via the function switch (SW-2). The level is adjusted by the "Main Mod Cal" control (R-15) located on the top of the chassis.

The audio signal is amplified by plug-in card A-10 to a level of approximately 5 volts, (RMS) suitable for driving a distortion analyzer. A deemphasis switch is mounted on the A-10 card and is used for test purposes. This switch must be operated in the deemphasized position (out position).

DETAILED DESCRIPTION OF THE FREQUENCY MEASURING CIRCUITS

The sampled RF from the rear panel RF attenuator is fed through isolation resistors R-3 and R-3A to the input of plug-in card A-1 (oscillator, multiplier and mixer). The

signal is fed to Q-5, a FET grounded gate isolation amplifier. This stage gives extremely good isolation and prevents local oscillator signal being fed back through the attenuator. A broad-tuned circuit (L-6) is used in the drain circuit of Q-5. The signal is fed from a low impedance tap on coil L-6 to a bipolar mixer, Q-4.

The local oscillator transistor Q-1 is connected as a common collector crystal controlled oscillator. The crystal is operated in parallel resonance mode with C-2 in series with the parallel combination of C-4 and voltage variable capacitor D-1 and stray capacitance of L-2. C-3 and C-3A are temperature compensation capacitors. Output loading has little effect on the crystal frequency. The oscillator power supply is triple regulated. In addition to the main power supply regulator, a 13 volt zener diode Z-2 plus a 5.6 volt low temperature coefficient zener diode Z-1 are employed. Oscillator frequency is controlled by recessed front panel potentiometer R-6 located on the left side of the front panel. This varies the capacity of D-1.

The frequency of the local oscillator crystal frequency is operating frequency plus 100 kHz divided by 8. The local oscillator operates in the 12 MHz region. The crystal temperature is maintained at $75^{\circ}\text{C} \pm 2^{\circ}$ by the crystal oven.

The oscillator output appears across the resonant circuit (L-1) in the collector circuit of Q-1. This signal is multiplied by 4 in the quadrupler stage (Q-2). A double tuned circuit (L-3 and L-4) is used to produce a virtually pure sine wave free from any residual oscillator frequency. This signal is again multiplied by 2 in the doubler stage (Q-3). A high "Q" circuit (L-5) is used in the collector of Q-3 to produce a pure signal at the operating frequency. The signal is fed from a low impedance tap to minimize loading of L-5 and also properly matches the low impedance of the mixer Q-4. The 100 kHz output of the mixer is filtered by the low pass filter (C-21) and the cable capacity of the coaxial cable feeding the input of plug-in card A-2.

The front panel "Freq. Push to Cal" switch (SW-1) controls the 100 kHz IF signal fed into plug-in card A-2. When the front panel switch SW-1 is in the normal position, a dc voltage is applied to diode switches D-1 and D-2. This allows the 100 kHz IF signal from the mixer to pass through to the IF system.

When the front panel switch SW-1 is depressed the voltage is removed from diodes D-1 and D-2 which blocks the IF signal derived from the mixer. The dc voltage is now applied to Diode D-3, turning it on, at the same time the dc voltage is applied to the 100 kHz crystal controlled reference oscillator Q-1, and this signal is fed to the IF system. Potentiometer R-7 is used to adjust the oscillator level to the same level as the signal derived from the mixer which is 2 volts (P-P).

The IF signal is fed to the first symmetrical limiter (Q-2). This device is a dual unit on one chip and is matched as to temperature, gain, etc., to give precise symmetrical limiting. (See figure 10). Q-2, Q-3 and Q-4 are identical devices. The square wave output of Q-2 is controlled to the proper level to drive the second identical symmetrical limiter (Q-3). The output level of the second limiter is of sufficient level to drive the first half of the dual unit (Q-4) to complete saturation and cut-off. This output drives the second half of Q-4 to complete cut-off and saturation producing a very stable 47 volts P-P square wave signal. Temperature, transistor and component variation have little or no effect on the amplitude or shape of the square wave signal. (See figure 9).

Large coupling capacitors are used so that hard limiting extends down to a few thousand Hz. The collector resistors are low so that hard limiting occurs up to several MHz. This is necessary because of the large percentage of deviation with the low IF frequency used. The IF must swing down to 25 kHz and up to 175 kHz with no change in amplitude.

The negative going 47 volt square wave pulses are integrated by diodes D-4 and D-5, and filtered by resistor R-28 and capacitors C-20 and C-21, producing a negative voltage (free from modulation) at the junction of R-28, C-20 and C-21. A positive voltage from the 47 volt supply (feeding Q-4) is fed through the precise resistor R-29, the front panel "meter zero cal" control (R-8) and the coarse frequency calibration potentiometer (R-7) (top of chassis) then back to the junction of R-28, C-20 and C-21. With a precise 100 kHz signal applied to the input derived from the calibration crystal, the coarse frequency calibration potentiometer R-7 is adjusted to give a zero voltage reading at this junction, (the front panel "Freq. Meter Zero" control R-8 must be in its mid-position for this adjustment).

Capacitor (C-17) and resistor (R-29) have been chosen so that the negative and the positive produced voltages change equally when the 47 volt supply is varied. Thus the frequency meter discriminator is insensitive to supply voltage variations; however, the supply is regulated with a 47 volt zener diode for excellent stability.

The zero voltage from the discriminator is fed through the 25 microampere zero center meter, the rear chassis remote switch SW-5 and a precision 3010 ohm resistor (R-10) to ground. Whenever the voltage departs from zero in either the positive or negative direction, a current is produced causing a like deviation reading of the frequency meter.

Two diodes (D-6 and D-7) on card A-2 are used in the meter circuit to limit the current through the meter to a safe value when the frequency deviation is excessive.

When a remote meter is used to read frequency, the rear chassis remote switch (SW-5) must be in the remote position. The external loop resistance must equal 3,000 ohms for accurate frequency reading of the remote meter.

A special mute circuit is used in the McMartin TBM-3700 monitor. The circuitry is incorporated on the wide band oscillator/mixer and squelch board located under the chassis. The 900 kHz output from the mixer (Q-2) is buffered by transistor Q-3 and fed to an external 900 kHz bandpass filter with high selectivity, FL-4. The bandwidth is ± 90 kHz at the 40 dB points. The output of the filter FL-4 is rectified by the voltage doubling diodes D-1 and D-2 producing a negative voltage. This negative voltage controls the transistor switching circuits Q-4, Q-5 and Q-6. A relay is the collector load of Q-6 and is energized when the carrier level falls below 2 percent or when the incoming frequency is outside the ± 90 kHz bandpass window of the filter under these conditions. The carrier deviation and modulation circuits are disabled. Relay contact closures are brought out to rear chassis terminal strip for connection to an external alarm circuit. The monitor will not respond to the channels outside its assigned frequency. Severe overmodulation will also cause the monitor to mute.

VII. MAINTENANCE

This section contains maintenance and calibration information for the TBM-3700 frequency and modulation monitor. The unit utilizes completely separate circuitry for

modulation and frequency measurements. The modulation circuitry will be described first.

Before performing calibration, check to see that all the plug-in cards are properly seated in their sockets. Also definitely determine that the monitor is at fault (modulation level and internal S/N are self-checking) before performing recalibration.

MODULATION CIRCUITRY CALIBRATION

The following calibration may be made if appropriate test equipment is available. NOTE: Remove relay for all calibrations.

WIDE BAND OSCILLATOR, MIXER AND SQUELCH BOARD.

1. Remove the bottom plate of the monitor.
2. Check the correct frequency of the crystal.
 - A. The crystal frequency is determined by the formula:

$$\frac{\text{Operating Frequency Plus 900 kHz}}{2}$$
3. Connect a VOM to oscillator test point (negative voltage 5 volts scale).
4. Turn the oscillator coil (red) slug counterclockwise (out). Slowly turn slug clockwise (in) until meter reading rises abruptly. Continue past this point at least a half turn.
5. Tune the doubler coil (blue) for a sharp null.
6. Connect an oscilloscope to the IF output on the collector of mixer Q-2.
7. Adjust L-1 (yellow) for maximum amplitude and clean sine wave. See figures 1 and 2. NOTE: Proper level of RF input must be present for this adjustment.

WIDE BAND DEMODULATOR CALIBRATION (Plug-in Card A-3)

1. Remove A-3 card.
2. Plug-in extender card (insert A-3 card into extender card).
3. Turn front panel function switch to the "Int S/N" position. NOTE: This activates the internal 900 kHz calibration oscillator.
4. Connect the oscilloscope to the arm of oscillator level potentiometer (control R-30).
5. Adjust R-30 for a 1-volt P-P or greater signal as measured on the arm of the control.
6. Connect an oscilloscope to the junction of C-6 and R-13. NOTE: A low capacitor probe must be used for this calibration.
7. Adjust R-7 for symmetrical limiting as viewed on the oscilloscope. See figures 3 and 4.
8. Connect the oscilloscope to the collector of Q-5. This signal must have an amplitude of 24 volts P-P. See figures 5 and 6.
9. Remove extender card and reinsert plug-in card A-3.

CAUTION: Use care so that the potentiometer calibration is not disturbed when reinserting plug-in card.

10. Turn function switch to the "+" or "-" modulation position.

WIDE BAND AMPLIFIER CALIBRATION (Plug-in Card A-4)

1. Adjust recessed front panel vernier modulation control R-16 located between the function switch and peak modulation control to its midposition.
2. Connect an accurate ac voltmeter to one of the rear BNC composite output jacks.
3. Depress front panel "Mod-push to Cal" switch SW-3 (this activates the internal calibrate signal.)
4. Adjust R-10, located on the rear of plug-in card A-4 for an exact output level of 0.35 volts (RMS) 1V (P-P) measured at the rear BNC connector. **NOTE:** All the other circuits are calibrated from this reference voltage.

MODULATION METER DC ZERO CALIBRATION (Plug-in Card A-8)

1. Remove all modulation.
2. Short circuit modulation meter terminals.
3. Check the mechanical zero of the modulation meter and adjust to zero if necessary.
4. Adjust R-20 meter balance potentiometer located on the plug-in card (A-8). **NOTE:** The same procedure is used for adjusting the optional remote plug-in card (A-7).

PHASE SPLITTER AND BUFFER CALIBRATION (Plug-in Card A-5)

1. Turn the front panel function switch to "+" total modulation.
2. Depress front panel "Mod-push to cal" switch. (This activates the internal IF modulation calibrate audio signal) and note modulation reading.
3. Turn the front panel function switch to "-" total modulation and note modulation reading.
4. If the "-" total modulation reading does not agree with the "+" total modulation reading, adjust the trimpot R-9 located at the rear of plug-in card A-5 for exactly equal "+" or "-" readings.
5. Connect an oscilloscope to the output terminal "F" of the plug-in card A-5.
6. Depress front panel "Mod-push to cal" switch.
7. Adjust R-14 for equal amplitude of all positive pulses. (See figures 7 and 8).

TOTAL MODULATION CALIBRATION

1. Turn front panel function switch to either "+" or "-" total modulation position.
2. Recessed front panel vernier modulation control (R-16) must be in "MID" position and the wide band amplifier card A-4 properly calibrated. Refer to wide band plug-in card A-4 calibration.

3. Depress front panel "Mod-push to Cal" switch (this activates the internal calibrate signal.)
4. Adjust total modulation calibrate potentiometer R-13 (located on top of chassis) for a reading of exactly 100 percent as read on modulation monitor.
5. Switch the function switch between "-" and "+" modulation. If readings do not agree, refer to phase splitter plug-in card A-5 calibration.

REMOTE MODULATION CALIBRATION POTENTIOMETER R-20 (top of chassis)

NOTE: Optional remote plug-in card A-7 must be installed for this calibration.

1. Connect remote modulation meter to the two terminals marked "RM Mod".
NOTE: The connecting wires should not exceed two or three feet for this connection.
2. Turn the rear chassis remote mod meter calibrate (R-19) control clockwise for maximum resistance.
3. Depress front panel "Mod-push to Cal" switch (this activates the internal calibrate signal).
4. Internal modulation meter should read 100 percent modulation. Adjust remote modulation meter calibrate potentiometer R-20 located on top of chassis for a reading of 100 percent on remote meter.
NOTE: If meter reads backwards, reverse wires to meter. This is an internal calibration and is not associated with remote meter installation. Refer to installation of remote metering.

MAIN CHANNEL MODULATION CALIBRATION

1. Turn front panel function switch to either "+" or "-" total modulation.
NOTE: The total modulation must be properly calibrated (refer to total modulation calibration).
2. Modulate the transmitter exactly 100% (400 Hz) as verified by the 100% reading of the meter in the "+" or "-" position.
3. Turn function switch to "MN CH" position. Adjust main modulation calibrate potentiometer (R-15) located on top of chassis for an identical reading obtained in the "+" or "-" total modulation position.

AM SIGNAL-TO-NOISE CALIBRATION

1. Remove bottom cover.
2. Temporarily connect one 2 mfd capacitor across C-18 and another across C-19, located on the wide band mixer board under the chassis. **NOTE:** Use non-polarized capacitors.
3. Turn the front panel function switch to RF input level position.
4. Inject (60 Hertz) signal into the RF input jack until the RF indicates exactly 100 percent reading on the modulation meter.
5. Measure the exact (60 Hz) voltage required to give 100% modulation.
6. Remove the signal source from the RF input jack and connect it to the high side of AM S/N cal. Pot. (R-5).

7. Adjust the signal level to the value measured in Step 5.
8. Turn the function switch to the "AM S/N" position and adjust potentiometer R-5 for a reading of 100 percent on the modulation meter.
9. Remove the two temporarily connected 2 mfd capacitors and replace bottom cover.

ISOLATION AND DB AMPLIFIER CALIBRATION (Plug-In Card A-9)

1. Turn the front panel function switch to the "FM S/N" position.
2. Modulate the transmitter exactly 100 percent (100 Hertz) as read on the modulation meter.
3. Reduce the modulation exactly 10 dB. This change in input level may be verified by an accurate audio voltmeter.
4. Turn the front panel "meter range" switch to the -10 dB position.
5. Adjust trimpot R-1 on the plug-in Card A-9 for a reading of 100 percent on the modulation meter.
6. Reduce the modulation another 10 dB. Turn the "meter range" switch to -20 dB to verify proper operation.
7. Return "meter range" switch to operate position.

PEAK FLASHER CALIBRATION (Plug-In Card A-6)

1. Modulate the transmitter exactly 100 percent as verified by the modulation meter.
2. Turn the front panel "Peak Modulation" control (R-18) to 100 percent setting.
3. Adjust the bottom trimpot (R-1) on Card A-6 for trigger point of peak light.

NOTE: Vernier adjustment of the 100% point is made by adjustment of the recessed front panel "Peak Flasher Cal" control, R-28.

4. Reduce modulation to 60 percent as read on the modulation meter.
5. Turn the "Peak Modulation" control to 60 percent setting.
6. Adjust the top trim potentiometer (R-17) on Card A-6 for the trigger point of peak light.
7. Repeat steps 1 through 6 until perfect tracking occurs as there is slight interaction between the combination of R-28, R-1 and R-17.

LOCAL OSCILLATOR CALIBRATION

Proper Oven Operation is indicated by a periodic on/off of the oven indication light (green). The bulb should be checked if the light does not cycle properly. The bulb must be replaced with a 14 volt bulb (number 330).

The local oscillator frequency is determined by the carrier frequency plus 100 kHz divided by 8. For touch up of local oscillator frequency, refer to the "Local oscillator calibration" section.

Complete oscillator, multipliers and mixer alignment.

1. Allow crystal oven temperature to stabilize. Allow at least ½ hour before calibration. NOTE: Plug-in Card A-1 must be in the socket for the following adjustments.
2. Connect an oscilloscope probe to the junction of C-8 and R-8. NOTE: The scope must have response up to at least 15 MHz, as the oscillator operates in the 12 MHz region. Also, a low capacity probe must be used.
3. Tune L-1 for maximum output on the oscilloscope.
4. Connect a frequency counter to the junction of C-3 and R-8. NOTE: The counter must be adjusted to 1 PPM (part per million) time base accuracy.
5. Adjust recessed frequency potentiometer R-6 located on the extreme left of the front panel for the correct frequency.
6. Disconnect frequency counter.
7. Connect the oscilloscope to the 100 kHz output terminal "J" on the plug-in Card (A-1).
8. Tune L-3, L-4, L-5 and L-6 for maximum output on the scope. NOTE: RF input level must be correct.
9. Modulate transmitter 100 percent. Adjust L-6 for clean sine wave and flat ribbon. See figures 1 and 2.

FREQUENCY METER CALIBRATION

1. Short circuit the frequency meter terminals and check the mechanical zero.
2. Turn the front panel "freq. meter zero" control (R-8) to its midposition.
3. Depress the "Freq.-push to Cal" switch.
4. Adjust the coarse centering control (R-7) located on the top of the chassis for exact center zero on meter.

FREQUENCY DEVIATION CALIBRATION

1. Remove oscillator multiplier and mixer card A-1.
2. Feed an accurate 98 kHz (± 5 Hz) signal into the input (B) of the 100 kHz IF amplifier card A-2.
3. Depress front panel "Freq.-push to cal" switch and adjust meter for zero reading.
4. Release front panel switch.
5. Adjust frequency deviation control R-9 located on top of chassis for an exact 2 kHz deviation of the meter.
6. Feed an accurate 102 kHz (± 5 Hz) signal into the input of card A-2 to verify the opposite 2 kHz deviation.
7. Reinsert Card A-1.

ADJUSTMENT OF INTERNAL SQUELCH

1. Remove bottom cover.
2. Turn front panel function switch to the "RF" position.
3. Adjust rear chassis input level control for a reading of 2 percent on the modulation meter.
4. Adjust squelch threshold trimpot (R-17) on the wide band oscillator, mixer and squelch board, located on

the bottom of the chassis, for the squelch point. NOTE: Transmitter should be modulated 100 percent (13,586 Hz) for this adjustment.

5. Return RF level to a reading of 100 percent.
6. Replace bottom cover.

REMOTE MONITORING

REMOTE MODULATION METER

1. Connect the remote modulation meter line to the two terminals marked "RM Mod" on the eight terminal barrier strip located on the rear chassis.
2. Turn the front panel function switch to the "+" or "-" total modulation position.
3. Tone Modulate the transmitter 100 percent as read on the front panel modulation meter.
4. Adjust the rear chassis remote mod meter calibrate control (R-19) located between the 8 terminal barrier strip and the composite output jack. Turn counterclockwise until the remote meter agrees with the internal meter of the monitor. This control will compensate for external loop resistance of 2,500 ohms. NOTE: If remote meter reads backwards, reverse meter leads. NOTE: The remote modulation meter will function only when the front panel function switch is in the "+" or "-" total modulation position.

REMOTE FREQUENCY DEVIATION METER

1. Connect the remote frequency meter line to the two terminals marked "Freq. Meter Rem" on the eight terminal barrier strip located on the rear chassis.

2. Depress the front panel "Freq.-push to Cal" switch and adjust the frequency deviation meter on the monitor for a reading of +2 kHz deviation.

3. Switch the rear chassis "Remote Freq. Meter" switch to the remote position.
4. Depress the front panel "Freq.-push to Cal" switch and the remote meter should be adjusted to read +2 kHz frequency. NOTE: Reverse line if meter reads -2 kHz. 3,000 ohm line is the maximum resistance that can be used.
5. Return the front panel meter calibration to zero.

REMOTE PEAK INDICATOR

1. Connect the remote peak indicator line to the two terminals marked "peak light" located on the 8 terminal barrier strip.
2. The remote bulb used must be determined by the voltage drop in the remote line. A 1,000 loop resistance may be used with a 10 volt bulb (number 344). The light will be dim but usable. NOTE: The brilliancy of the remote peak indicator is determined by the external loop resistance and voltage rating of the bulb.

EXTERNAL ALARM SYSTEM

1. Connect the external alarm system to the two terminals marked "alarm" on the eight terminal barrier strip.
2. Remove the RF carrier and relay contact closure will occur. NOTE: The contacts are rated 0.5 amperes at 24 volts. Contact closure also occurs when the ac power switch is turned off.

IX. PARTS LIST

The majority of components used in the TBM-3700 are of standard values and tolerance and are readily available from local electronic parts jobbers. Those parts which are of critical value or tolerance or of McMartin manufacture are listed below.

CARD A-1

Symbol	Part Number	Description
xtal oven	700031	Oven assembly 75° ±2°
xtal	090001	Local oscillator
L-1	930096	Oscillator tank coil
L-2	930095	Oscillator choke coil
L-3	930079	Quadrupler coil
L-4	930079	Quadrupler coil
L-5	930080	Doubler coil
L-6	930080	RF amplifier coil
Q-1	201065	MPS6539 oscillator
Q-2	201079	2N5179 quadrupler
Q-3	201079	2N5179 doubler
Q-4	201079	2N5179 mixer
Q-5	201062	2N5246 RF amplifier
Z-1	220019	5.6 volt zener diode
D-1	220023	Varicap D1876

CARD A-2

Symbol	Part Number	Description
xtal	090032	100 kHz ref oscillator
L-1	930165	Oscillator tank coil
R-7	400053	2500 ohm trimpot
R-25	540021	4750 ohm 1% metal film resistor
R-27	540026	34K 1% metal film resistor
R-28	540013	1500 ohm 1% metal film resistor
R-29	540008	21,620 ohm 1% TC resistor
Q-1	201022	SE-4001 100 kHz oscillator
Q-2	201074	2N2060 limiter
Q-3	201074	2N2060 limiter
Q-4	201074	2N2060 switching transistor
C-17	116129	62 pf temperature comp. capacitor
C-17A	116008	120 pf Mica

CARD A-3

Symbol	Part Number	Description
xtal	090031	900 kHz reference oscillator
R-7	401007	50K ohm trimpot (limiter bal.)
R-30	401015	25K ohm trimpot (oscillator ampl.)
L-1	930095	900 kHz oscillator coil
C-13	660026	2-25 pf variable cap.
Q-1	201022	SE-4001 oscillator
Q-2	201050	SE-4010 900 kHz amplifier
Q-3	201050	SE-4010 limiter
Q-4	201050	SE-4010 limiter
IC-1	230004	CA-3028A limiter
Q-5	201079	2N5179 switching transistor

CARD A-4

Symbol	Part Number	Description
Q-1	201050	SE-4010 wide band amplifier
Q-2	201050	SE-4010 wide band amplifier
Q-3	201050	SE-4010 emitter follower
Q-4	201050	SE-4010 emitter follower
Q-5	201050	SE-4010 emitter follower
Q-6	201050	SE-4010 wide band amplifier
Q-7	201033	2N2102 emitter follower
R-10	400055	10K ohm trimpot (wide band amplifier gain)
R-17	540024	750 ohm 1% metal film resistor
R-21	540005	683.8 ohms 1% metal film resistor

CARD A-5

Symbol	Part Number	Description
Q-1	201033	2N2102 wide band amplifier
Q-2	201033	2N2102 phase splitter
Q-3	201033	2N2102 peak amplifier
Q-4	201033	2N2102 peak amplifier
Q-5	201050	SE-4010 emitter follower
R-3	540008	21,620 ohm 1% metal film resistor
R-4	540019	3010 ohm 1% metal film resistor
R-6	540013	1500 ohm 1% metal film resistor
R-9	400101	1K ohm trimpot (phase bal.)
R-12	540021	4750 ohm 1% metal film resistor
R-13	540021	4750 ohm 1% metal film resistor
R-14	400050	250 ohm trimpot (peak bal.)
R-15	540021	4750 ohm 1% metal film resistor
R-16	540021	4750 ohm 1% metal film resistor
R-18	540021	4750 ohm 1% metal film resistor
R-19	540021	4750 ohm 1% metal film resistor
R-21	540021	4750 ohm 1% metal film resistor
R-22	400102	5K trimpot (main cal.)

CARD A-6

Symbol	Part Number	Description
Q-1	201032	SF 4863 A dc amplifier
Q-2	201022	SE-4001 ½ Schmitt trigger
Q-3	201022	SE-4001 ½ Schmitt trigger
Q-4	201024	2N 3053 emitter follower
Q-5	201032	SF 4863A isolation amplifier
Q-6	201033	2N2102 dc amplifier
Q-7	201033	2N2102 peak light switch
R-1	400105	50K ohm trimpot (100% cal.)
R-2	540021	4750 ohm 1% metal film resistor
R-3	540001	10K ohm 1% metal film resistor
R-4	540008	21620 ohm 1% metal film resistor
R-6	540006	2162 ohm 1/4% metal film resistor
R-10	540024	750 ohm 1% metal film resistor
R-11	540021	4750 ohm 1% metal film resistor
R-17	400102	5K trimpot (60% cal.)
R-21	540015	316.2 ohm 1/4% metal film resistor
R-22	540015	316.2 ohm 1/4% metal film resistor

CARD A-7 and A-8

Symbol	Part Number	Description
Q-1	201049	SE-4002 wide band amplifier
Q-2	201033	2N2102 wide band amplifier
Q-3	201032	SF4863A meter dc amplifier
Q-4	201032	SF4863A meter dc amplifier
R-8	540012	12.1K 1% metal film resistor
R-16	540018	549K ohm 1% metal film resistor
R-17	540019	3010 ohm 1% metal film resistor
R-18	540019	3010 ohm 1% metal film resistor
R-19	540020	1820 ohm 1% metal film resistor
R-20	400055	10K ohm trimpot (meter zero)
R-21	540020	1820 ohm 1% metal film resistor
R-22	540018	549K ohm 1% metal film resistor

CARD A-9

Symbol	Part Number	Description
Q-1	201022	SE-4001 dB amplifier
Q-2	201033	2N-2102 dB amplifier
Q-3	201032	SF4863A HI-Z amplifier
Q-4	201024	2N3053 emitter follower
R-1	400103	10K trimpot (dB amp. cal.)

CARD A-10

Symbol	Part Number	Description
Q-1	201022	SE-4001 audio amplifier
Q-2	201033	2N2102 audio amplifier
R-11	540012	12.1K ohm 1% metal film resistor
SW-1	484004	de-emphasis switch

MAIN CHASSIS

Symbol	Part Number	Description
T-1	900055	power transformer
T-2	910003	audio output transformer
FL-1	930034	100 kHz linear phase low pass filter
FL-2	935024	60 Hz low pass filter
FL-3	935002	15 kHz low pass filter
FL-4	935025	900 kHz band pass filter
Z-4	220022	Temperature Comp. 11.8V zener diodes
R-2	402002	100 ohm 2W potentiometer (RF cal.)
R-5	402007	50K ohm 2W potentiometer (AM-SN cal.)
R-6	401012	5K ohm 1/2W potentiometer (freq. adj.)
R-7	402007	50K ohm 2W potentiometer (coarse meter zero)
R-8	402004	2.5K ohm 2W potentiometer (meter zero)
R-9	402007	50K ohm 2W potentiometer (deviation adj.)
R-10	540019	3010 ohm 1% metal film resistor
R-13	402010	10K ohm 2W potentiometer (Mod. cal.)
R-15	402003	5K ohm 2W potentiometer (main cal.)
R-16	401013	1K ohm 1/2W potentiometer (front panel mod. cal.)
R-18	402013	1K ohm 2W potentiometer (peak mod.)
R-19	402004	2.5K ohm 2W potentiometer (remote cal.)
R-20	402010	10K ohm 2W potentiometer (remote cal.)
R-27	540006	2162 ohm 1% metal film resistor
R-28	401016	10K ohm potentiometer (peak flasher cal.)
Q-1	201034	40328 83 volt power regulator
Q-2	201034	40328 36 volt power regulator
M-1	700028	Frequency Meter
M-2	700023	Modulation Meter
SW-1	484026	2 pole-2 position push type switch
SW-2	492033	9 pole-7 position rotary type switch
SW-3	484027	4 pole-2 position push type switch
SW-4	492032	4 pole-6 position rotary type switch
Relay	470011	Control relay (5K ohm)
Socket	170022	Relay socket

dB ATTENUATOR CARD

Symbol	Part Number	Description
R-1	540016	6.83K ohm 1/4% metal film resistor
R-2	540006	2.162K ohm 1/4% metal film resistor
R-3	540005	683.8 ohm 1/4% metal film resistor
R-4	540003	216.2 ohm 1% metal film resistor
R-5	540002	100 ohm 1% metal film resistor

WIDE BAND, OSCILLATOR, MIXER AND SQUELCH BOARD

Symbol	Part Number	Description
xtal	090011	High frequency local oscillator
Q-1	201062	2N5246 RF isolation amp.
Q-2	201079	2N5179 RF mixer
Q-3	201050	SE-4010 kHz isolation amp.
Q-4	201050	SE-4010 squelch switch
Q-5	201050	SE-4010 squelch switch
Q-6	201033	2N2102 squelch relay switch
Q-7	201022	SE-4001 high frequency oscillator
L-1	930080	RF amplifier tank coil
L-2	930083	Oscillator tank coil
L-3	930079	Doubler tank coil
R-17	400038	1 Meg ohm trimpot (squelch control)

WARRANTY

McMartin products are warranted to be free from defects and workmanship for a period of one year after shipping date, when subjected to normal usage and service. All warranties are void if (a) equipment has been altered or repaired by others without McMartin's specific prior authorization; or (b) equipment is operated under environmental conditions or circumstances other than those specifically described in McMartin literature or instruction manuals.

Upon notification within the applicable warranty period, McMartin agrees without charge, to repair, replace, or supply replacement parts for any properly maintained equipment or parts that are defective as to design, materials, or workmanship and that are returned in accordance with McMartin's instructions to the Buyer. At McMartin's sole discretion, the Buyer may be requested to return the defective part of equipment to McMartin, FOB Omaha, Nebraska. Parts or equipment may be returned only with McMartin's prior authorization and must be identified by a return authorization number issued by McMartin's Customer Service Department. All merchandise so returned must be sent transportation prepaid, at Buyer's risk. Full details of the failure or malfunction should be included so as to expedite repair or replacement. Repair parts or repaired or replaced equipment will be returned to the Buyer, FOB factory.

VIII. WAVE FORMS

FIG 1
UNMODULATED 900 KHZ
IF OUTPUT AT COLLECTOR
OF Q-2 WIDE BAND
OSCILLATOR MIXER AND
SQUELCH BOARD

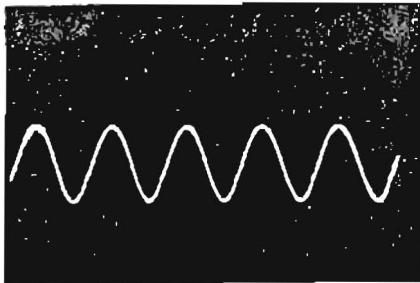


FIG 2
FULLY MODULATED
900 KHZ IF OUTPUT

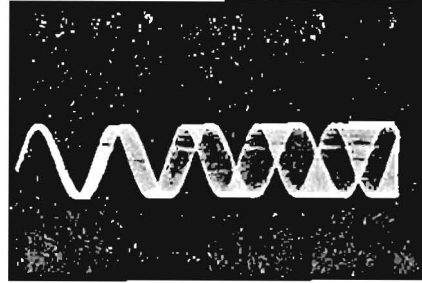


FIG 3
UNMODULATED LIMITED
900 KHZ SIGNAL AT
JUNCTION OF C-6 - R-12,
ON CARD A-3

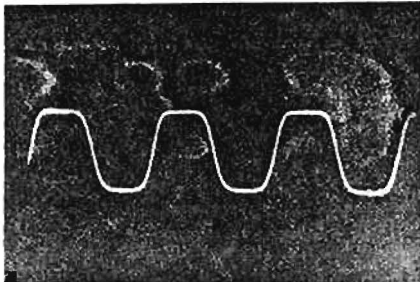


FIG 4
FULLY MODULATED 900 KHZ
LIMITED
SIGNAL AT JUNCTION
OF C-6 - R-12 ON CARD
A-3

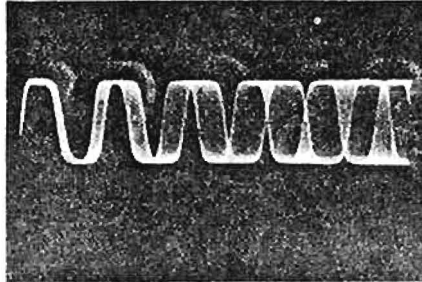


FIG 5
UNMODULATED 24 VOLT
IF (P-P) 900 KHZ SIGNAL
AT COLLECTOR OF
Q-4 ON PLUG-IN CARD
A-3



FIG 6
FULLY MODULATED 24
VOLT (P-P) 900 KHZ
SIGNAL AT COLLECTOR
OF Q-4 ON PLUG-IN CARD
A-3



FIG 7
R-14 PROPERLY ADJUSTED
FOR EQUAL POSITIVE
PULSES PIN F OF PLUG-IN
CARD A-5

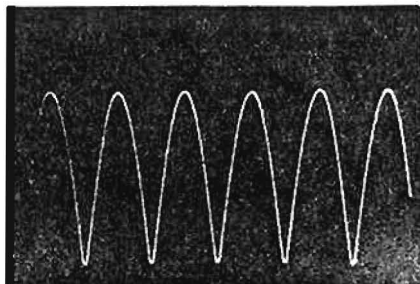


FIG 8
R-14 IMPROPERLY
ADJUSTED

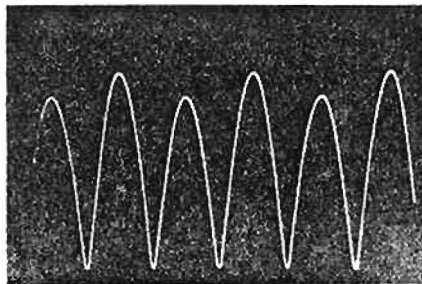


FIG 9
COLLECTOR OF LAST
LIMITER Q-4 ON PLUG-IN
CARD A-2. 42 VOLTS (P-P)
LEADING EDGE INTEGRATED
BY DIODES D-4 - D-5

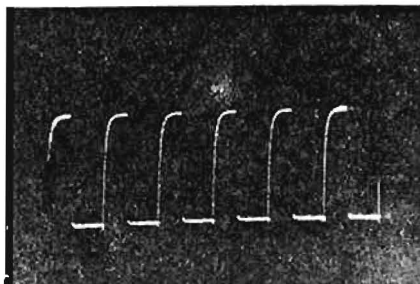
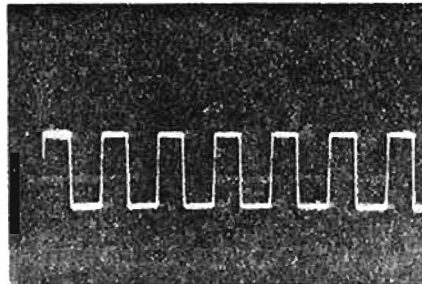
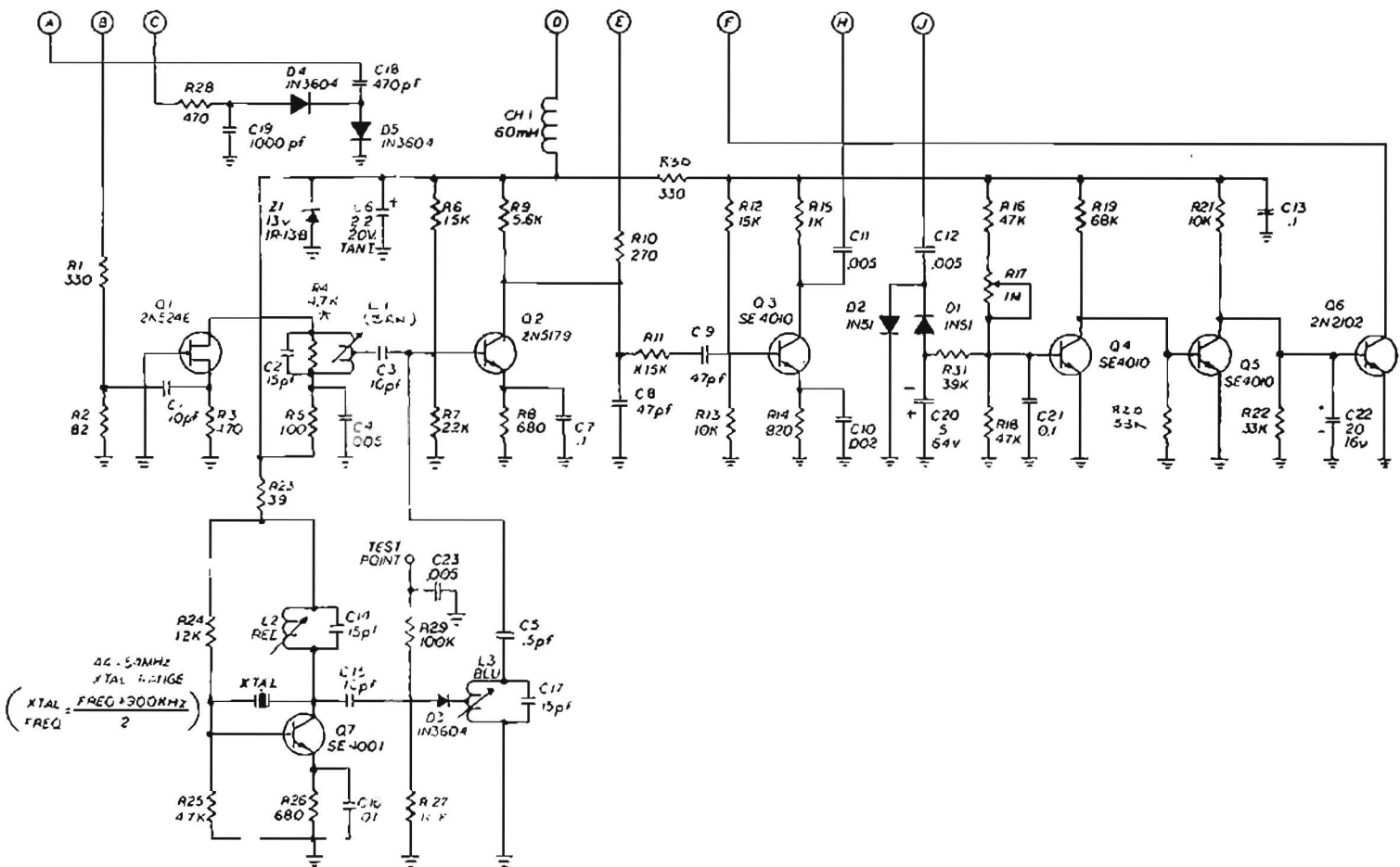


FIG 10
COLLECTOR OF LIMITER
Q-2 (EQUAL UNIT) ON
PLUG-IN CARD A-2



X. SCHEMATICS

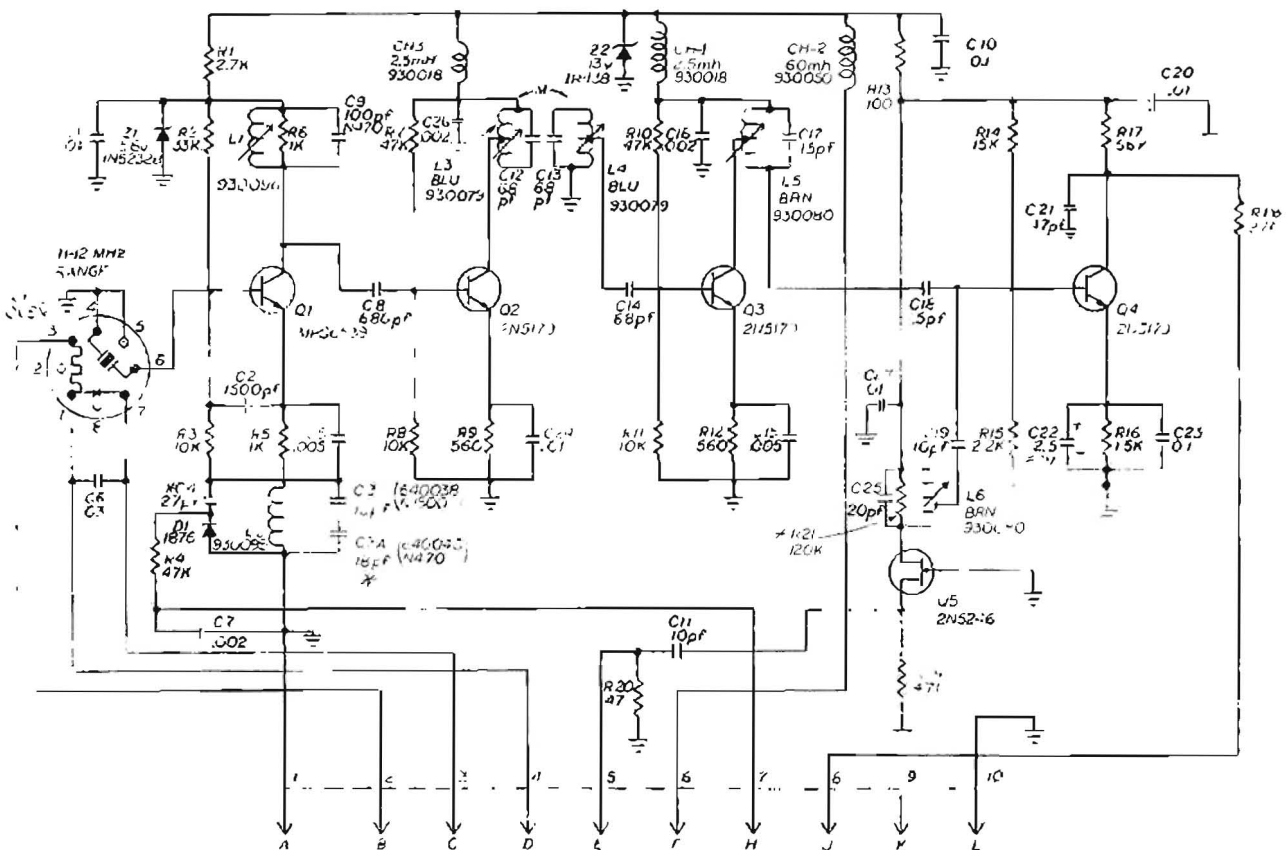
		page
WIDE BAND OSCILLATOR, MIXER & SQUELCH BOARD	P/N 550025	17
OSCILLATOR, MULTIPLIER & MIXER	P/N 550023	18
100 kHz IF AMP, LIMITER & FREQ METER	P/N 552017	19
WIDE BAND DEMODULATOR & CALIBRATION OSCILLATOR	P/N 550024	20
WIDE BAND AMP & EMITTER FOLLOWER AMP	P/N 552018	21
PHASE SPLITTER & BUFFER AMP	P/N 551004	22
PEAK FLASHER	P/N 550157	23
REMOTE METER AMP	P/N 551014	24
LOCAL METER AMP	P/N 551005	25
DB & ISOLATION AMP	P/N 551001	26
MONITOR AUDIO AMP	P/N 552019	27
FUNCTION DIAGRAM		28



NOTES

1. STARRED (*) VALUED COMPONENTS SELECTED IN PRODUCTION.
2. UNLESS OTHERWISE SPECIFIED, RESISTORS IN OHMS .5W 5% CAPACITORS IN μF.

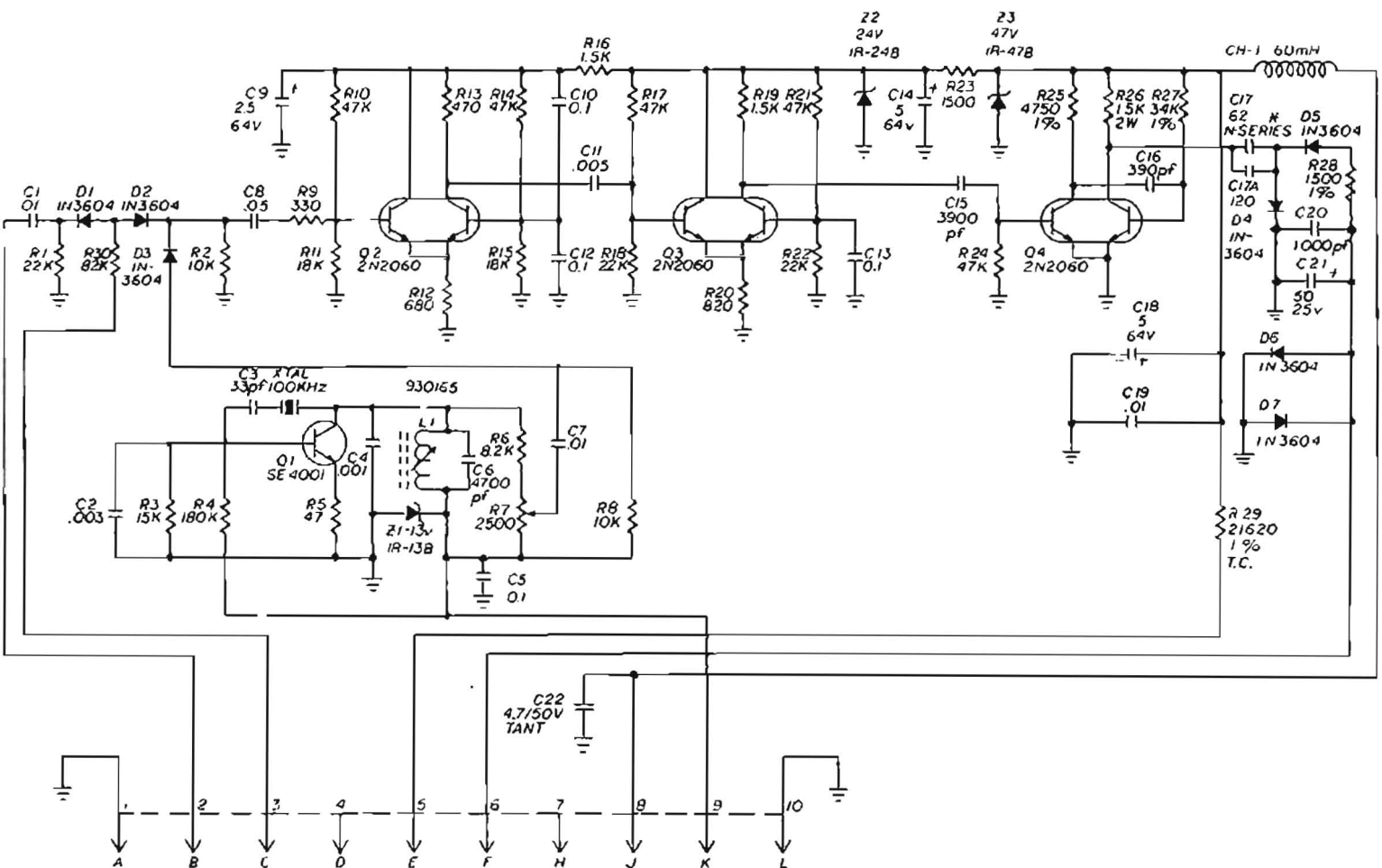
TBM-3700
WIDE BAND OSCILLATOR,
MIXER & SQUELCH BOARD
P/N 550025



NOTES

1. UNLESS OTHERWISE SPECIFIED
RESISTORS IN OHMS 1/2 W.-5%
2. SELECTED IN PRODUCTION

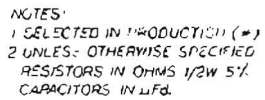
TBM-3700
OSCILLATOR, MULTIPLIER
& MIXER
P/N 550023



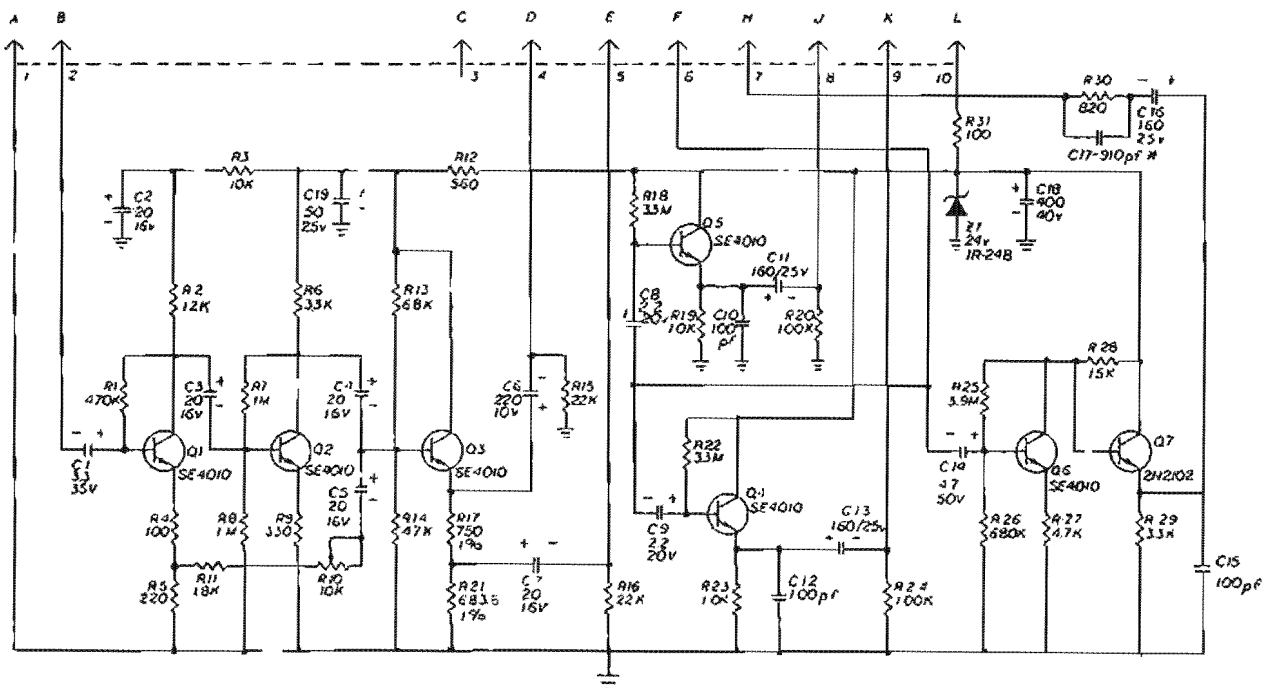
NOTES

- 1 * SELECTED IN PRODUCTION
- 2 UNLESS OTHERWISE SPECIFIED
RESISTORS 1/2 W - 5%
CAPACITORS IN pfd

TBM-3700
100 KHZ IF AMP, LIMITER &
FREQ METER
P/N 552017

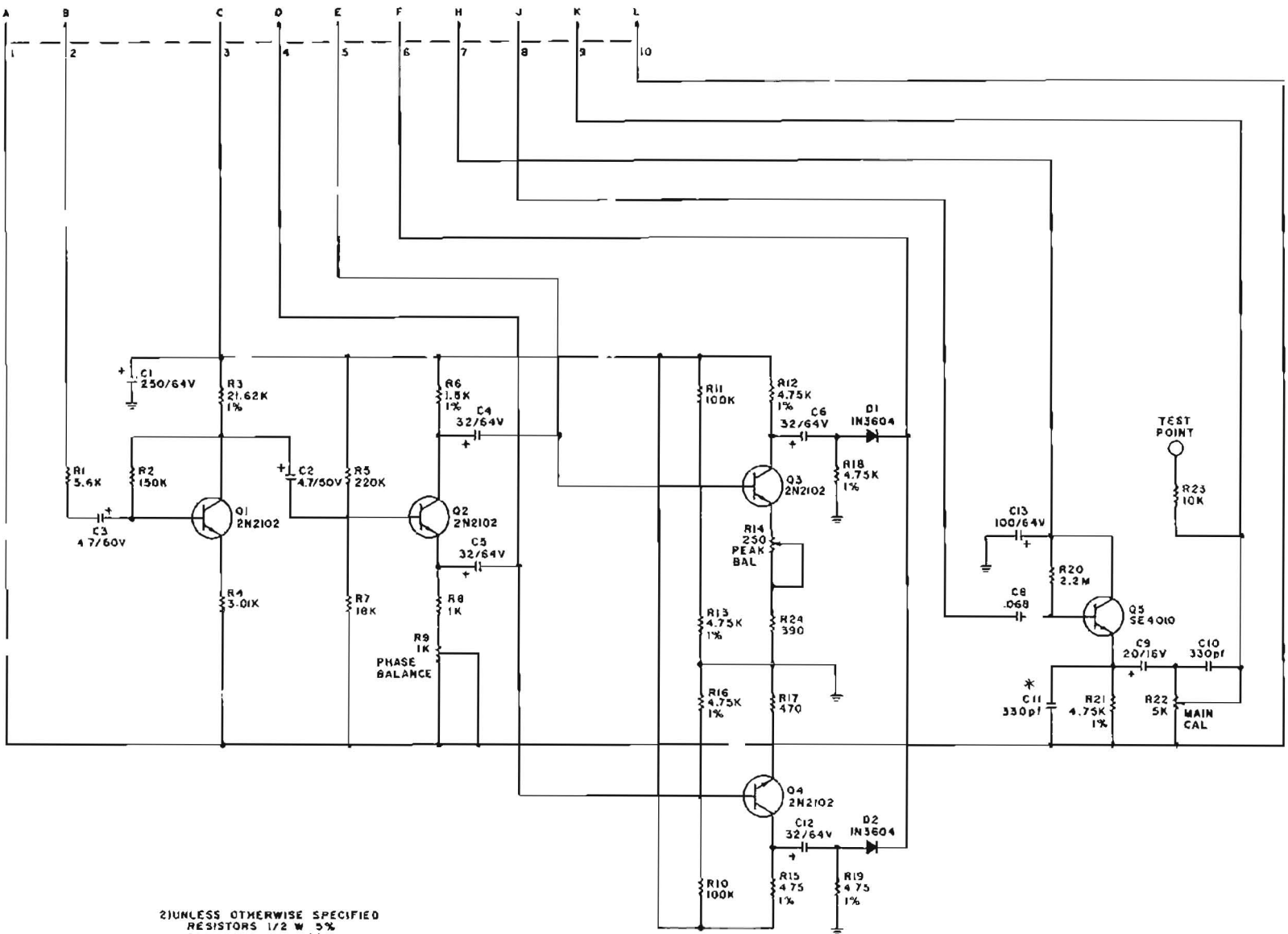


20



NOTES
 1. CAPACITORS IN μF
 2. RESISTORS IN OHMS 5%
 3. UNLESS OTHERWISE SPECIFIED

TBM-3700
 WIDE BAND AMP &
 EMITTER FOLLOWER AMP
 P/N 552018

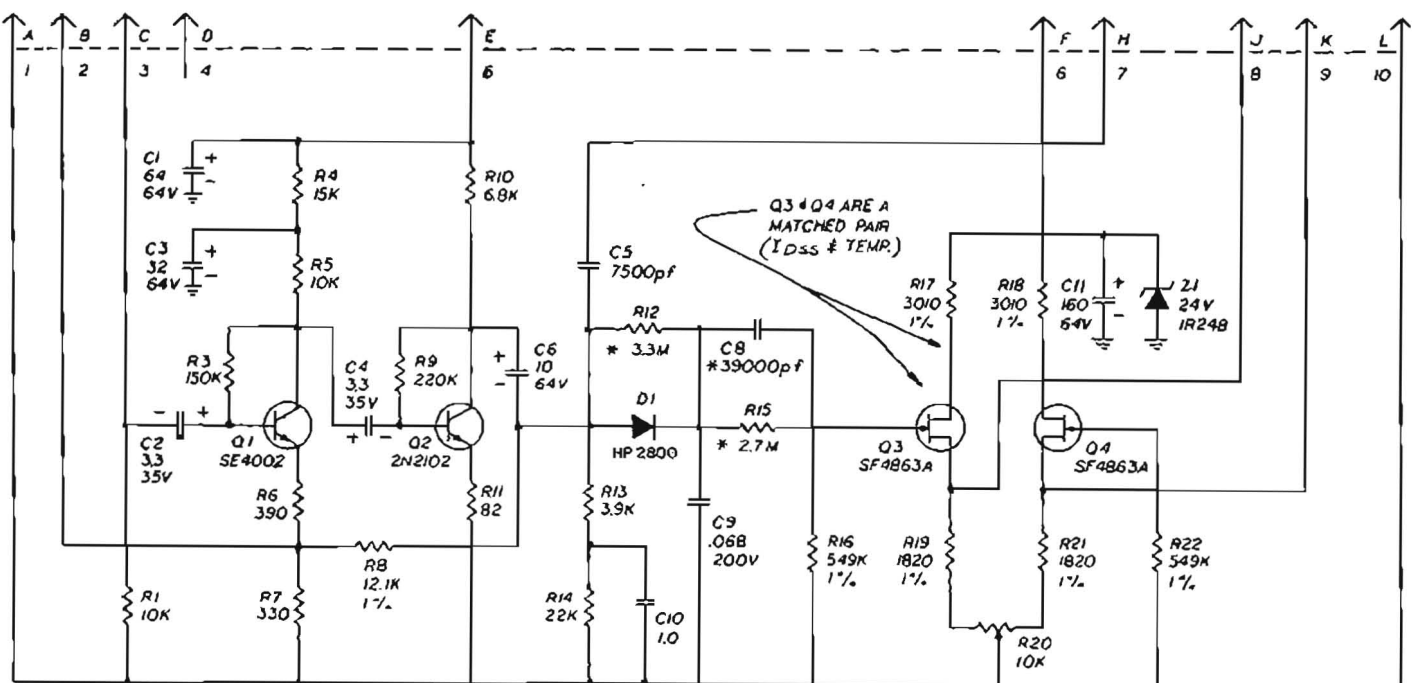


2) UNLESS OTHERWISE SPECIFIED
RESISTORS 1/2 W 5%
CAPACITORS IN MFD
NOTES: 1) *SELECTED IN PRODUCTION

TBM-3700
PHASE SPLITTER &
BUFFER AMP
P/N 551004



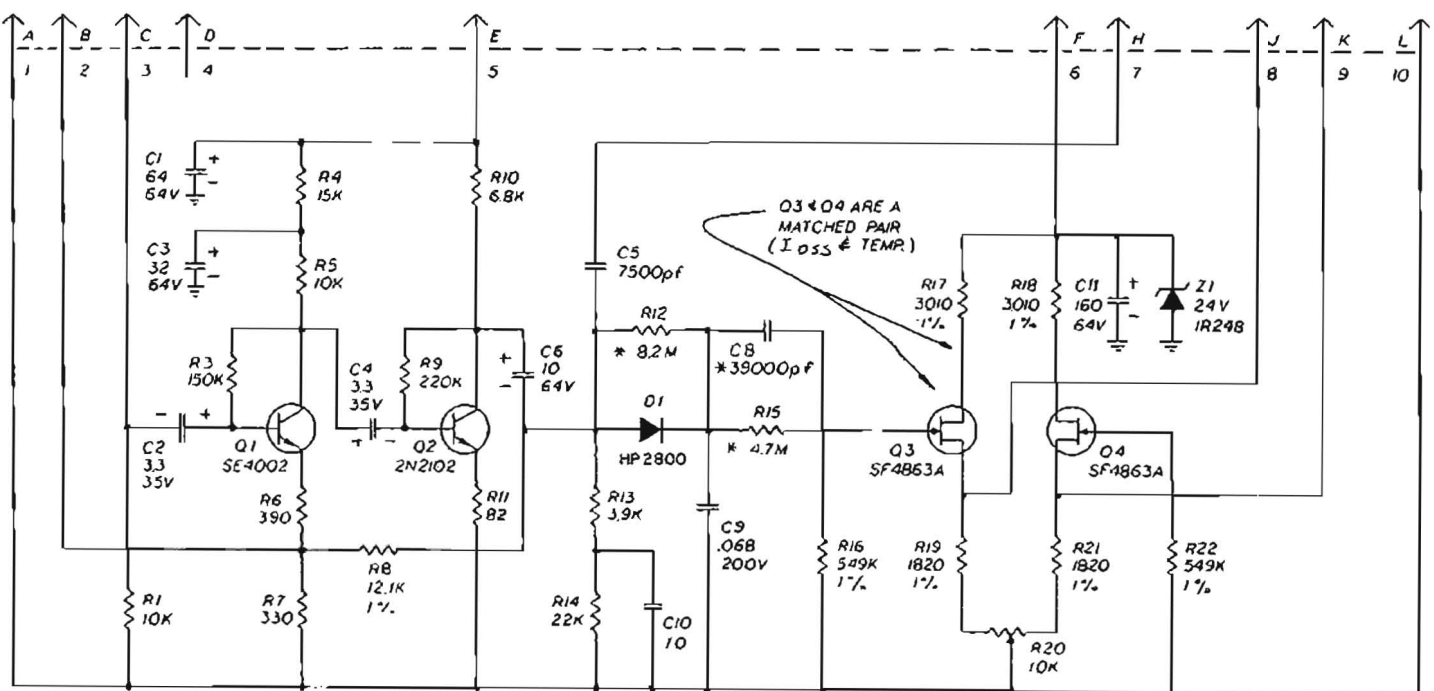
TBM-3700
PEAK FLASHER
P/N 550157



NOTES:

1. STARRED (*) VALUED COMPONENTS SELECTED IN PRODUCTION.
2. UNLESS OTHERWISE SPECIFIED:
RESISTORS IN OHMS 1/2 W 5%,
CAPACITORS IN μ Fd

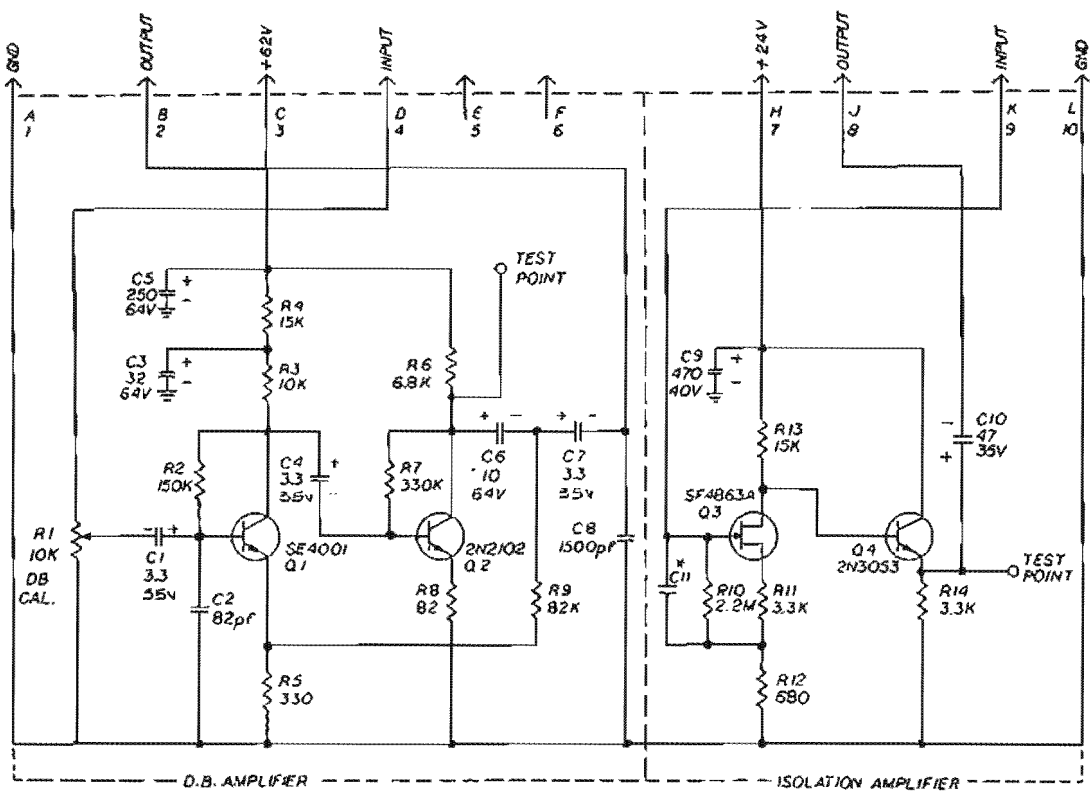
TBM-3700
REMOTE METER AMP
P/N 551014



NOTES:

1. STARRED (*) VALUED COMPONENTS
SELECTED IN PRODUCTION.
2. UNLESS OTHERWISE SPECIFIED,
RESISTORS IN OHMS 1/2 W 5%
CAPACITORS IN μ Fd.

TBM-3700
LOCAL METER AMP
P/N 551005



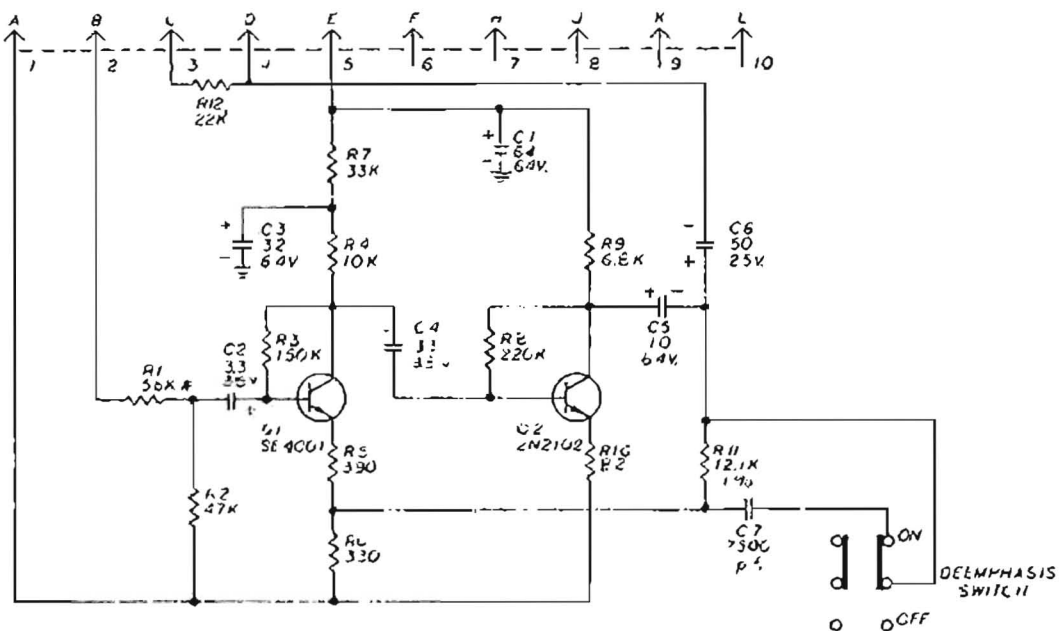
NOTES

1. UNLESS OTHERWISE SPECIFIED:
CAPACITORS IN μFd ,
RESISTORS IN OHMS 5W 5%.

2. *SELECTED IN PRODUCTION.

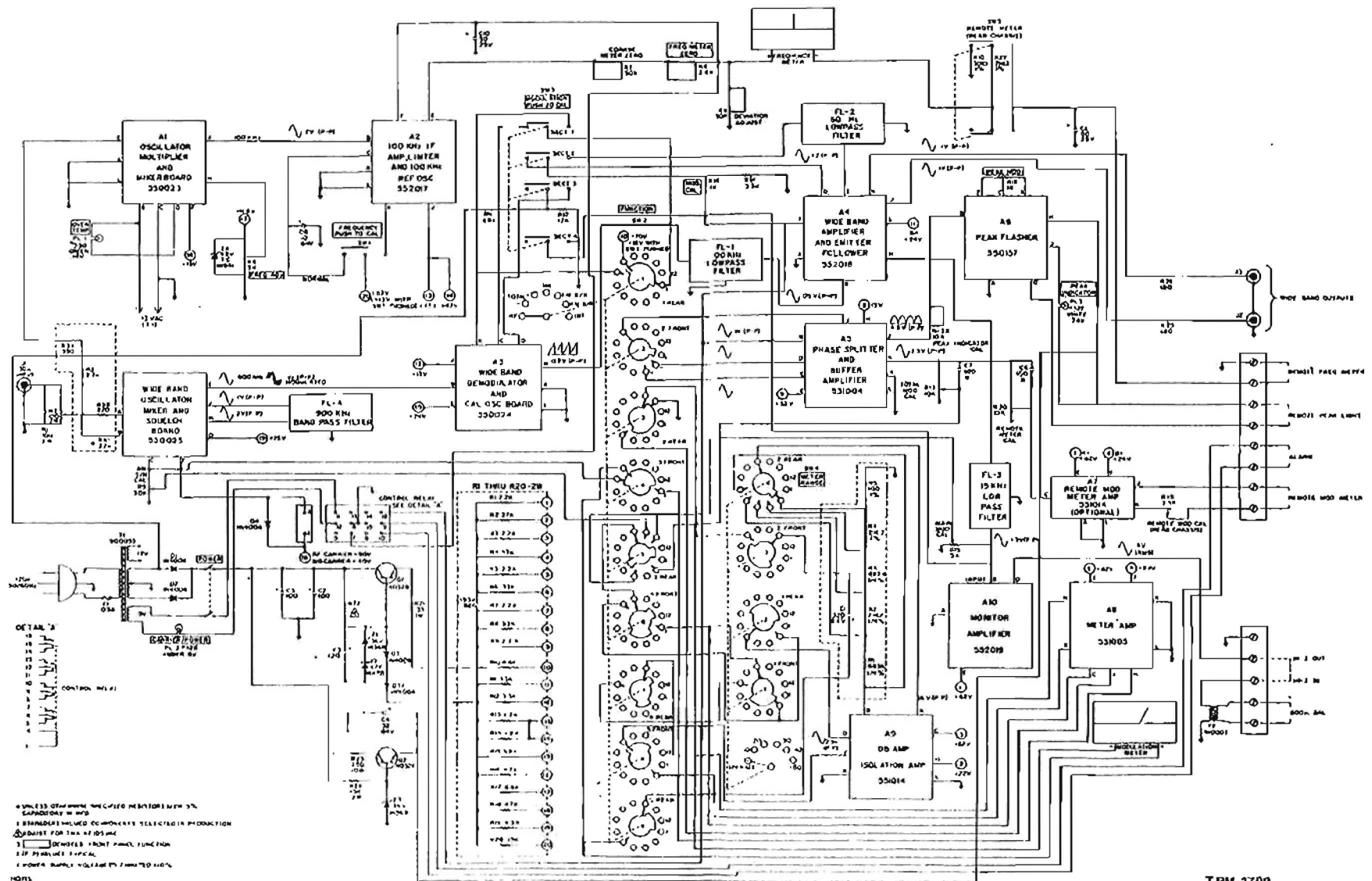
PN. 551001
DB & ISOLATION AMP
TBM-3700 (A9)
TBM-8500B (A3)
TBM-2000B (A9)

TBM-3700
DB & ISOLATION AMP
P/N 551001



NOTES:
 1 SELECTED IN PRODUCTION
 STARRED (*) VALUE COMPONENTS
 2 CAPACITORS IN μ F
 RESISTORS IN OHMS 5%
 UNLESS OTHERWISE SPECIFIED:

TBM-3700
 MONITOR AUDIO AMP
 P/N 552019

TBM-3700
FUNCTION DIAGRAM