instruction manual

McMartin

TBM-2000B

SOLID-STATE MONITOR

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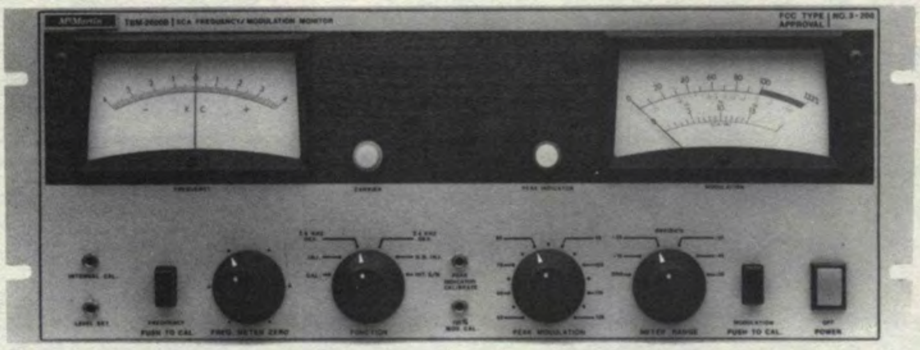

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INDEX

I. TECHNICAL SPECIFICATIONS

Operating Range	67 kHz standard (26, 41, 42 and 65 kHz frequencies optional)
Modulation Range	±6 kHz deviation - 100 percent modulation ±4 kHz deviation - 100 percent modulation Selection is made by front panel function switch
Composite Input	
Impedance	2000 ohms
Level adjustable by front panel level set	0.3 volts rms or greater
Modulation Meter	
Accuracy	±0.5 dB
Frequency Response	30-7500 Hz ±1 dB (67 kHz) 30-5000 Hz ±1 dB (41 kHz)
Peak Flasher Indicator	Peak light adjustable to read modulation peaks from 50 to 120 percent. Responds to modulation peaks of 0.1 millisecond duration and remains on for 2 to 4 seconds as required by the FCC.
Internal Modulation Calibration Accuracy	±2%
SCA Frequency Meter	
Deviation Range	±4000 Hz, Center zero
Accuracy	Better than ±50 Hz at 67 kHz
Stability	Maintained by crystal with 0.005 percent tolerance
SCA Injection Circuit	
Accuracy	±1 percent
Meter indication	0-15 percent in 1 percent increments 0-30 percent in 2 percent increments
Internal Injection Calibrator Accuracy	±0.5 percent
Outputs - SCA Sub-Channel	
Audio Output for Monitoring Circuits	
Source Impedance	600 ohms balanced
Level	+4 dBm at ±6 kHz deviation (100 percent modulation) - 400 Hz
Distortion	Less than 1 percent (400 Hz)

Audio Output for Distortion Measurements	
Impedance	10K ohms or greater
Level	5 volts at ±6 kHz deviation (100 percent modulation) - 400 Hz
Frequency Response	30-7500 Hz ±1 dB (67 kHz)
Distortion	1.0 percent, or less - 400 Hz
Noise Level	66 dB or greater below ±6 kHz deviation (100 percent modulation) - 400 Hz
Crosstalk (front panel range control measures down to -70 dB)	
Main Channel (30-15000 Hz) into SCA Sub-Channel	66 dB or better
Stereo (23-53 kHz into SCA Sub-Channel (67 kHz)	55 dB or better
SCA Number 1 Channel into SCA Number 2 channel	66 dB or better
Power Requirements	105 - 125 volts AC, 50/60 Hz 35 watts
Fuse	0.5 amp slo-blo
Ambient Temperature Range	10° - 50° C
Remote Monitoring Facilities	
Modulation	(Optional) RM-37 T/R kit available. Modulation may be remotely monitored with 2,500 ohm external loop resistance plus remote meter resistance. Remote meter is completely independent of internal meter.
Frequency	Subcarrier frequency may be remotely monitored with remote line resistance up to 3,000 ohms
Peak Flasher	Termination provided for remote peak flasher installation
Subcarrier Presence Indicator	Termination provided of relay closure for remote "Subcarrier On" indicator (or carrier failure alarm external devices)
Dimensions	
Width	Standard 19" rack panel mount
Height	7"
Depth	13" overall
Weight	20 pounds
Finish	Beige with wood grain trim

II. GENERAL DESCRIPTION

The McMartin TBM-2000B silicon solid-state SCA monitor, in conjunction with the McMartin TBM-3700, TBM-3500A, TBM-3500B, TBM-4000A or TBM-4500A monitors, will monitor all the characteristics of the SCA transmission. The TBM-2000B features the measurement of injection level, modulation and frequency of the the SCA carrier; SCA FM signal-to-noise; and crosstalk.

For simplicity of operation, the various metering functions are incorporated in one switch. The functions read on the right meter are as follows: Set level-cal., injection level, ±6 kHz deviation, ±4 kHz deviation, narrow band injection, and internal signal-to-noise of the monitor. In addition, the TBM-2000B features push-button calibration of the frequency meter, injection level, and modulation meter.

The modulation meter is a peak indicating device capable of measuring true peak value. The meter is also used as an audio voltmeter to measure the FM signal-to-noise of the sub-channel, main channel crosstalk into the sub-channel, crosstalk between two sub-channels, and also the inherent internal FM S/N of the monitor. The modulation meter is highly damped in all the dB positions of the meter range switch and the audio is also automatically de-emphasized. When the meter range switch is in the "Operate" position, the meter ballistics conform to the FCC requirements.

NOTE: The meter range switch is automatically locked out when the function switch is in either of the two injection positions. This allows accurate injection measurements if the meter range switch is accidentally switched into any of the dB positions.

A crystal reference oscillator is used to calibrate the frequency meter. This oscillator and additional circuitry are used to accurately calibrate the modulation meter and the internal calibrate system. In addition, this low noise oscillator is used to verify the inherent low internal FM noise of the TBM-2000B which is typically -70 dB below 100% modulation.

The frequency meter is automatically protected against severe overload. A carrier light (orange lens) located adjacent to the frequency meter indicates presence of the sub-channel. The audio is automatically muted and the frequency meter deactivated in the absence of the sub-carrier. The mute thres-hold is controlled by a potentiometer located on the rear chassis adjacent to the composite input jack.

A high speed peak modulation 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 modulation peak.

Dual bandwidth filters are incorporated. One section (narrow band) can be used to measure the injection level of sub-carriers separated by 5 kHz or greater. The other section is a wide band phase linear filter used for audio recovery of the FM modulated signal and also permits accurate monitoring of injection with modulation.

The TBM-2000B has complete facilities for remote monitoring of the modulation, carrier frequency deviation, peak modulation indication and subcarrier presence indicator.

Two separate composite output (BNC) jacks located on the rear chassis are available for viewing the wide band output. The output impedance is low, minimizing error when a reasonable length of cable is used.

A relay is activated when the SCA carrier is muted or falls below a predetermined level. One pair of relay closures are available on the rear chassis for operation of an external signal system for indication of carrier "On" or "Off" condition.

Almost all of the circuits are on 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 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 sub 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 connection of a carrier "On" or carrier "Off" indicator. This termination provides contact closure whenever the subcarrier is present.

III. INSTALLATION

Upon receipt of your TBM-2000B, 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-2000B 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-2000B 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 100° F.

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

Connect the ac input to the 117V ac source and connect a low capacity cable from the composite output jack of a TBM-3700, TBM-3500A, TBM-3500B, TBM-4000A or TBM-4500A to the input BNC connector located on the rear of the TBM-2000B chassis.

The TBM-2000B has been thoroughly checked and calibrated prior to shipment and should require no adjustment. Turn power on and allow sufficient time for stabilization.

IV. OPERATION

Adjustment of Level Set Control

CAUTION: This adjustment is critical and must be adjusted carefully. Modulate the transmitter "Main" channel with a 400 Hz sine wave until the base band monitor (TBM-3700, TBM-4000A, TBM-4500A, TBM-3500A or TBM-3500B) reads exactly 100% in the total modulation position. Insert a small screwdriver into the lower recessed front panel "Level Set" control located on the left side of the front panel of the TBM-2000B. Adjust for a reading of exactly 100% on the right meter of the TBM-2000B with the front panel function switch in the "Cal" position. This calibrates the TBM-2000B to the composite 100% level of the base band monitor.

NOTE: If a TBM-3700 base band monitor is used, the calibration of the TBM-2000B may be achieved by simply depressing the "Mod-Push to Cal." switch on the TBM-3700. The 100% modulation should be verified by switching the front panel function switch of the TBM-3700 to either the "+" or "-" modulation position. This 100% reference level may be used to adjust the "Level Set" control on the TBM-2000B.

Adjustment of "Internal Calibration" Control

CAUTION: This adjustment is critical and must be adjusted carefully. After the recessed front panel "Level Set" control has been properly adjusted to the base band monitor as previously described, depress the "Freq-Push to Cal." switch on the TBM-2000B. Insert a small screwdriver into the front panel "Internal Cal." control (located directly above the "Level Set" control). Adjust for a reading of exactly 100% on the right hand meter in the "Cal." position. Switch the front panel function switch to the injection position while depressing the "Freq-Push to Cal." switch. The injection level should read exactly 10% on the lower injection scale of the right meter. This verifies that the monitor is calibrated properly.

IT IS IMPERATIVE THAT BOTH THE "LEVEL SET" SIGNAL FROM THE BASE BAND MONITOR AND THE "INTERNAL CALIBRATE" SIGNAL READ EXACTLY 100% ON THE RIGHT METER OF THE TBM-2000B WITH THE FUNCTION SWITCH IN THE "CAL" POSITION.

NOTE: The recessed "Level Set" and "Internal Cal" controls should rarely have to be adjusted unless a malfunction occurs in either the base band monitor or the TBM-2000B.

Monitoring the Frequency of the Sub Carrier

1. Depress the "Freq-Push to Cal." switch and adjust the "frequency meter zero" control for exactly center zero reading on the left frequency meter.

NOTE: Frequency meter response is slow as it is highly damped to prevent it from following low frequency modulation.

2. Release "Freq-Push to Cal." switch to measure operating frequency.

NOTE: The frequency meter indicates the error frequency of the sub carrier.

Monitoring Sub Carrier Injection Level

1. Turn the function switch to the injection position.

2. Adjust the level of the sub-carrier of the transmitter for the desired injection level as read on the injection scale. The narrow band "NB inj" position of the function switch can be used, however, the injection will fluctuate severely with modulation. This position should be used only for measuring an unmodulated carrier or if two sub -carriers are used separated by only 5 kHz.

CAUTION: THE INJECTION SWITCH (SW-6) LOCATED ON TOP OF THE CHASSIS IS NORMALLY IN THE 0-15 PERCENT INJECTION POSITION. IF THE OPERATOR DESIRES TO INCREASE THE INJECTION MORE THAN 15 PERCENT, THE SWITCH MUST BE SWITCHED TO THE 0-30 PERCENT POSITION AND THE INJECTION READING OBTAINED SHOULD BE MULTIPLIED BY TWO.

Peak Modulation Adjustment

The peak modulation indicator should never be set to exceed 100 percent in normal operation. This sets the threshold for the peak indicator light. The peak indicator will light and remain on for at least two seconds every time modulation exceeds the preset level of the sub carrier.

The peak modulation automatically adjusts itself to the ±6 kHz or ±4 kHz deviation position of the function switch.

The peak indicator light will catch modulation peaks which are much too short for complete meter response. The peak light must be the prime source of indicating overmodulation.

Internal Modulation Meter Calibrate

An external sub channel must be present for this calibration. The modulation circuitry is muted in the absence of the sub channel.

1. Turn the front panel function switch to the desired ±6 kHz or ±4 kHz position.

2. Depress the "Mod-Push to Cal." switch and note reading. If reading is not 100%, within ±2%, (a) insert a small screwdriver into the lower recessed front panel control (100% Mod. Cal.) located in the center of the front panel (b) adjust for a reading of 100% modulation. It is advisable to check this occasionally to verify accuracy of monitor. Audio output is muted whenever the "Mod-Push to Cal." switch is depressed.

NOTE: 1. 100% modulation in the ±6 kHz position indicates a sub-carrier deviation of ±6 kHz.

2. 100% modulation in the ±4 kHz position indicates a sub-carrier deviation of ±4 kHz.

3. It is recommended that the ±6 kHz deviation position be used whenever possible as a better signal-to-noise ratio is obtained.

4. This recessed modulation control should seldom have to be adjusted unless a malfunction occurs in the monitor.

Internal Peak Indicator Calibrate

An external sub channel must be present for this calibration. The modulation circuitry is muted in the absence of a sub channel.

1. Depress "Mod-Push to Cal." switch and note modulation meter reading. The meter should read 100%. If it does not, refer to internal modulation meter calibrate.

2. Adjust peak modulation control for exactly 100% modulation.

3. Depress the "Mod-Push to Cal." switch.

4. Insert a small screwdriver into the recessed front panel control located in the center of the front panel marked "Peak Indicator Calibrate" and adjust for the trigger point of peak indicator light.

5. Advance peak modulation control to 102% and peak light should go out after at least three seconds. This verifies accurate peak indicator operation. The modulation meter 100% reading and peak modulation indicator control setting must be within ±2 percent at all times.

It is advisable to check this occasionally to insure accurate operation of the peak indicator light. The calibration of the modulation meter and peak indicator may be done simultaneously.

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 of the Monitor

The internal noise of the monitor is verified by substituting a low-noise, internal crystal-controlled signal source for the normal SCA 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 400 Hz. A sub carrier must be present to unmute the modulation circuitry.

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 Flasher" 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 flasher terminal together or to ground, as this may damage the transistor switch in the monitor.

Measurement of FM Signal-to-Noise Ratio of Sub Channel

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. Turn the front panel function switch to either the desired ±6 kHz or ±4 kHz deviation position.

5. Remove all sub channel modulation. Main channel crosstalk may give false readings.

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 sub channel.

7. Return the "meter range" switch to the "operate" 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 desired deemphasis, 75 or 150 microseconds, may be selected by the alternate action pushbutton deemphasis switch located on plug-in Card A-10. The "in" position is 75 microseconds and the "out" position is 150 microseconds. This will affect distortion at the higher audio frequencies.

4. Modulate the sub channel with the desired audio frequency and verify the level with the modulation meter.

5. Proceed with distortion measurements.

Measurement of Crosstalk - Main into Sub Channel

1. Turn the function switch to the desired ±6 kHz ±4 kHz position.

2. Remove sub channel modulation.

3. Modulate the "Main Channel" with desired modulation level. NOTE: The total of the sub carrier injection level and main channel modulation must not exceed 100% as read on the total modulation meter of the base band monitor.

4. Turn the meter range switch clockwise until a midscale reading appears and read the crosstalk (refer to "Operation of Internal Audio Voltmeter"). NOTE: Crosstalk may also be checked with normal program material on the main channel.

Measurement of Crosstalk - Sub Channel into Sub Channel

1. Turn the function switch to the desired ±6 kHz or ±4 kHz position.

2. Remove sub channel modulation from the channel being measured.

3. Modulate the other subchannel with desired modulation level.

4. Turn the meter range switch clockwise until a midscale reading appears and read the crosstalk (refer to "Operation of Internal Audio Voltmeter").

NOTE: Crosstalk may also be checked with normal program material on the second sub channel.

V. DETAILED CIRCUIT DESCRIPTION

The composite signal from the base band monitor is fed to the "Level Set" recessed front panel control, R-3. The composite signal from R-3 is routed through two sections of the "Freq. - Push to Cal." switch, SW-1, to the composite calibrate control R-1 located on top of the chassis. The composite signal from R-1 is routed through section #3 of the function switch, SW-2. With SW-2 in the calibrate position, the composite signal is routed through to the modulation meter circuitry. Properly adjusted, a meter reading of 100% indicates the correct level of the composite signal from the base band monitor.

Depressing the "Freq. - Push to Cal." switch SW-1 blocks the composite signal from the base band monitor. This also activates the reference crystal oscillator on plug-in Card A-2. The reference oscillator signal is routed through R-11 to the "internal cal." recessed front panel control R-5. This signal is now routed through SW-1 to the modulation meter circuitry. R-5 adjusts the level of the reference oscillator signal for a meter circuitry. R-5 adjusts the level of the reference oscillator signal for a meter reading of 100%, thus adjusting the internal calibrate voltage to precisely equal the 100% composite signal from the base band monitor. This 100% reference signal, through SW-1, is also fed to a precision voltage divider, R-2A and R-4B, which gives a precise 10% injection calibrate voltage.

This precise 10% injection voltage is routed through SW-1 into the sub channel amplifier, plug-in Card A-1, whenever SW-1 is depressed. This is used to calibrate the injection readings of the monitor.

The sub carrier signal, through SW-1, is fed into two emitter followers on plug-in Card A-1. The output of the two emitter followers feed the wide and narrow band pass filters, FL-1. The band pass filters remove all signals excepting the desired subchannel.

Function switch SW-2 selects either of the two outputs, which is routed through the 0-15% or 0-30% injection switch SW-6 located on the top of the chassis. The signal from SW-6 is fed through another section of SW-2 to the modulation meter. The injection level is adjusted by potentiometer R-34 located on plug-in Card A-1. The narrow band injection "NB inj." is adjusted by R-33 located on plug-in Card A-1.

The output from the wide band pass filter is used for feeding the modulation and frequency meter circuits. This selected signal from plug-in Card A-1 is fed into the input of plug-in Card A-2.

The signal is fed through diode switches (which will be described later) 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 limiting. (See Figure 2.) 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 is sufficient to drive the first half of the dual unit Q-5 to complete saturation and cutoff.

This output drives the second half of Q-4 to complete cutoff and saturation, producing a very stable 36 volt P-P square wave signal. Temperature, transistor or component variation have little or no effect on the amplitude or shape of the square wave signal (See Figure 6 & 7).

The negative going 36 volt square wave pulses are partially integrated by diodes D-4 and D-5 and fed through R-14 and potentiometer R-16 (located on the main frame) to ground. These partially integrated pulses are also fed through resistor R-15 and C-4 (located on main frame) to a 10 kHz low pass filter which removes the sub carrier signal. Only the modulating signal remains.

A positive voltage from the 36 volt supply (feeding Q-4) is fed through the precision resistor R-29, the front panel "Meter Zero Cal." control R-13 and the coarse frequency calibration potentiometer R-12, located on top of chassis. This positive voltage is fed to the junction of R-14 and potentiometer R-16. With a precise sub carrier frequency applied to the input derived from the reference crystal oscillator, the coarse frequency potentiometer R-12 is adjusted to give a zero voltage reading at the junction of R-14 and R-16. The front panel "Freq. Meter Zero" control must be in its mid-position for this adjustment.

C-17 and R-29 values have been chosen so that the negative and positive produced voltages change equally when the 36 volt supply is varied. Thus the frequency meter discriminator is insensitive to supply voltage variations; however, the supply is regulated with a 36 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-20 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. C-3 (100 mfd), located on the main frame removes all audio modulation and prevents the frequency meter from following modulation. Deviation Cal. potentiometer R-16 is used to control the deviation sensitivity of the monitor.

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.

Plug-in Card A-2 utilizes a crystal reference oscillator Q-1. This oscillator is used for calibration of the frequency meter discriminator, internal calibration of the injection level, and with additional circuitry, is used for accurate calibration of the modulation meter circuitry.

Diode switches D1, D2 and D3 are controlled by the front panel "Mod-Push to Cal." switch SW-3 and "Freq-Push to Cal." switch, SW-1.

In normal operation, a DC voltage is applied through switches SW-1 and SW-3 to diodes D1 and D2 turning them on and allowing the sub channel carrier through to the limiters and normal operation.

When "Mod-Push to Cal." switch SW-3 is depressed, the DC voltage is removed from diodes D1 and D2 which blocks the sub channel carrier from Card A-1. The switch now applies dc voltage to diode D3, turning it on. The dc voltage is also applied to the reference crystal oscillator and this signal is fed to the limiters and demodulator.

A 60 Hz signal from the power transformer is also fed through section #4 of switch SW-3 to switching diode D6. This completely short circuits the oscillator signal to ground 60 times per second, thus the crystal reference oscillator is deviated from 0- to operating frequency.

Example: If a 67 kHz crystal oscillator is used, the frequency deviation would be 0-67 kHz, equivalent to a P-P frequency deviation of 67 kHz at a 60 Hz modulating frequency. This 67 kHz P-P deviation is divided down to 12 kHz P-P deviation by a voltage divider consisting of R-17 and R-21 on plug-in Card A-4, along with a separately mounted filter FL-2. 12 kHz P-P deviation is equivalent to ±6 kHz deviation.

This calibrating voltage from FL-2 is routed through section #9 of the function switch SW-2 and section #2 of switch SW-3 to the modulation measuring circuits. Section #1 of SW-3 short-circuits the frequency meter and section #5 of SW-3 mutes the audio system and prevents the 60 Hz from being fed from the monitor whenever the "Mod Push to Cal." switch is depressed.

When the function switch is turned to the "Int. S/N" position, the dc voltage is removed from diodes D1 and D2 on Card A-2 blocking the sub channel carrier. The dc voltage is now applied to diode D3 and the reference oscillator. This signal is fed to the limiters and demodulator system and is used for determining the internal S/N ratio of the monitor. The level of the crystal oscillator is approximately equivalent to 10% injection.

The low level audio signal from the low pass filter FL-3 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-18. This control will change the modulation meter reading ±2 dB when properly adjusted in mid-range. 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 7.5 kHz low pass filter FL-4 which is used for measuring sub channel modulation and feeding the audio amplifier.

The output of FL-4 feeds the local Mod. Cal. potentiometer R-22 and remote meter cal. potentiometer R-23 located on the top of the chassis. The signal is routed through function switch SW-2 to the meter amplifier Card A-8 and peak amplifier Card A-5.

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-27 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 audio modulation via the function switch is fed to the peak amplifier and mute plug-in Card A-5. The peak modulation from Card A-5 is fed to the recessed front panel "peak Indicator Cal." control, R-24. The peak modulation from R-24 is fed to the input of plug-in Card A-6, (peak flasher).

The input level of the peak modulation 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% modulation. R-11 sets the threshold level at 60% modulation. The front panel modulation peak control R-35 is used to set the threshold to the desired level.

The output pulses from the Schmitt trigger feed a one shot multivibrator. The pulse width of the multivibrator is set for approximately 3 seconds and is controlled by C-6 and R-15. Transistor switch Q-5 is turned on and activates the peak light.

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 audio signal is amplified by plug-in Card A-10 to a level of approximately 5 volts rms suitable for driving a distortion analyzer. An alternate-action deemphasis switch located on plug-in Card A-10 is used for changing the deemphasis from 75 to 150 microseconds. The "out" position provides 150 microsecond deemphasis.

A sample of the sub channel carrier from plug-in Card A-1 is fed into the mute section of plug-in Card A-5. A rear chassis potentiometer sets the mute threshold. A relay is the collector load of transistor switch Q-5 and is energized when the sub carrier level falls below the predetermined level. Relay contact closures are brought out to the rear chassis terminal board for connection to an external signal system. One set of relay contacts short circuit the frequency meter in the absence of the sub carrier.

Depressing the "Freq.-Push to Cal." switch on the front panel will produce an internal sub carrier and unmute the relay allowing calibration of the frequency meter and sub carrier injection. This will not activate the audio modulation circuitry.

VI. MAINTENANCE

This section contains maintenance and calibration information for the TBM-2000B SCA frequency and modulation monitor.

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 before performing recalibration. The modulation, modulation peak control, injection level, internal cal, and internal S/N are self-checking.

Modulation Circuitry Calibration

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

Wide Band Demodulator Calibration (Plug-in Card A-2)

1. Remove A-2 card.

2. Plug-in extender card (insert A-2 card into extender card).

3. Turn front panel function switch to the "Int S/N" position. NOTE: This activates the internal reference calibration oscillator.

4. Connect the oscilloscope to the junction of C-8 and R-9.

5. Adjust the oscillator level control R-7 for at least a 3 volt P-P signal at the junction of C-8 and R-9.

6. Connect an oscilloscope to the junction of C-11 and R-13. NOTE: A low capacitance probe must be used.

7. Symmetrical limiting must occur at this junction as viewed on the oscilloscope. See Figures 3 & 4.

8. Connect the oscilloscope to the collector of Q-4. This signal must have an amplitude of 36 volts P-P. See Figures 6 & 7.

9. Remove extender card and reinsert plug-in Card A-2.

Wide Band Amplifier Calibration (Plug-in Card A-4)

1. Adjust recessed front panel vernier modulation control R-18 located between the function switch and peak modulation control to its mid-position.

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 meter Card A-7.

Calibration of Injection Level

1. Feed a sub channel carrier of the correct frequency of the monitor at a level of exactly 0.3V rms.

2. Turn the front panel recessed "Level Set" control located on the front panel fully clockwise.

3. Turn the function switch to the cal. position.

4. Adjust R-1 located on the top of chassis for a meter reading of 100%.

5. Depress the "Freq.-Push to Cal." switch and adjust the front panel recessed "internal Calibrate Control" for a meter reading of exactly 100%.

6. Turn function switch to the injection position.

7. Adjust R-34 on plug-in Card A-1 for precisely 10% injection on the injection scale. "Frequency-Push to Cal." switch must be depressed for this calibration.

8. Turn the function switch to the NB injection position.

9. Adjust R-33 on plug-in Card A-1 for precisely 10% injection on the injection scale. "Frequency-Push to Cal" switch must be depressed for this calibration.

Modulation Calibration

1. Turn front panel function switch to the ±6 kHz deviation position.

2. Recessed front panel vernier modulation control R-18 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 modulation calibrate potentiometer R-22 (located on top of chassis) for a reading of exactly 100 percent as read on modulation monitor.

Remote Modulation Calibration Potentiometer R-23 (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 calibration.

2. Turn the rear chassis remote mod meter calibrate control R-27 clockwise for maximum resistance.

3. Depress front panel "Mod-Push to Cal." switch. This activates the internal calibrate signal.

4. The desired deviation must be selected at this time as the remote meter is not automatically compensated between the ±4 kHz or ±6 kHz deviation.

5. Internal modulation meter should read 100 percent modulation in the desired deviation position. Adjust remote modulation meter calibrate potentiometer R-23 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.

Isolation and dB Amplifier Calibration (Plug-in Card A-9)

1. Turn the front panel function switch to either the ±6 kHz or ±4 kHz deviation.

2. Modulate the sub channel (100 Hertz) exactly 100 percent 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 trim pot 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 sub channel exactly 100 percent as verified by the modulation meter in the ±4 kHz deviation position.

2. Turn the front panel "Peak Modulation"control R-35 to 100 percent setting.

3. Adjust the bottom trim pot R-1 on Card A-6 for trigger point of peak light.

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-11 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 R-1 and R-11.

8. Turn the function switch to ±6 kHz position and adjust the modulation for 100% meter reading.

9. Set the peak modulation control R-35 to 100%.

10. Adjust R-10 (located on the function switch under the chassis) for the trigger point. This will track the peak light in both the ±6 kHz or ±4 kHz position.

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-13 to its mid-position.

3. Depress the "Freq.-Push to Cal." switch.

4. Adjust the coarse centering control R-12 (located on the top of the chassis) for exact center zero on meter.

Frequency Deviation Calibration

1. Remove sub channel amplifier Card A-1.

2. Feed an accurate sub carrier frequency which is -2 kHz (±5 Hz) below the subcarrier operating frequency into the input (B) of the sub carrier, limiter 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-16 located on top of chassis for an exact -2 kHz deviation of the meter.

6. Feed an accurate sub carrier frequency which is +2 kHz (±5 Hz) above the sub carrier operating frequency into the input of Card A-2 to verify the opposite +2 kHz deviation.

7. Reinsert Card A-1.

Adjustment of Internal Squelch

1. Turn front panel function switch to the injection position.

2. Adjust sub carrier injection level for a reading of 5 percent on the modulation meter.

3. Adjust squelch threshold potentiometer R-26 (located on the rear chassis) for the squelch point.

4. Return sub carrier level to the desired level.

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 ±6 kHz or ±4 kHz deviation position.

3. Tone modulate the sub carrier 100 percent as read on the front panel modulation meter.

4. Adjust the rear chassis remote mod meter calibrate control R-27 (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 selected 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 resistance is the maximum which can be accommodated.

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 flasher" 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 Signal System

1. Connect the external signal system to the two terminals marked "alarm" on the eight terminal barrier strip.

2. Remove the sub carrier and the relay contact closure will open. NOTE: The contacts are rated 0.5 amperes at 24 volts. Contact release also occurs when the ac power switch is turned off.

VII. PARTS LIST

The majority of the electronics components used in the TBM-2000B are of standard values and tolerances available from local electronics parts jobbers. Those of unusual tolerances, of specific types or of McMartin manufacture are listed below.

CHASSIS

SYMBOL	P/N	DESCRIPTION
C-4	670004	2.2 mfd, 20 volt tantalum capacitor
C-6A/B/C	601027	100/100/120 mfd, 150 wvdc electrolytic capacitor
D-1 through 5	210008	Type 1N4006 silicon diode
FL-1	935027	67 kHz filter
FL-2	935028	60 Hz low pass filter
FL-3	935029	10 kHz low pass filter
FL-4	935003	7.5 kHz filter
K-1	470011	Relay, 5K ohms, 29 volt
M-1	700028	Frequency deviation meter
M-2	700029	Modulation Meter
Q-1,2	201034	Type 40328 transistor
R-1	402010	10K ohms, potentiometer (Comp.Cal.)
R-2	540016	6838 ohms, 0.25%, film resistor
R-3, 5	401015	2.5K ohm, potentiometer (zero level set)
R-7	540020	1820 ohm, 1.0%, wirewound resistor
R-8,9	540015	316.2 ohm, 1.0%,wirewound resistor
R-10	400053	2.5K ohm, potentiometer (no shaft)
R-12, 16	402007	50K ohm, potentiometer
R-13, 22, 23,27	402004	2.5K ohm, potentiometer
R-14	540013	1.5K ohm, 1.0%, film resistor
R-15	540001	10K ohm, 1.0%, film resistor
R-18, 35	402013	1K ohm, potentiometer
R-20	540019	3010 ohm, 1%, resistor
R-21	540006	2162 ohm, 0.25%, resistor
R-24	401016	10K ohm, potentiometer
R-26	402008	500K ohm, potentiometer

SW-1		Frequency calibrate switch
SW-2		Function switch
SW-3		Modulation calibrate switch
SW-4		Meter range switch
SW-5	480022	Remote metering switch
SW-6	480007	Injection switch
SW-7	484024	Power switch
T-1	900055	Power transformer
T-2	910003	Audio output transformer
Z-1,3	220008	Type 1R36B, 36 volt zener diode
Z-2	220016	Type 1R47B, 47 volt zener diode

67 kHz AMPLIFIER (Card A-1, P/N 550155)

SYMBOL	P/N	DESCRIPTION
C-5,7,10,11,14,15,18,19	670004	2.2 mfd. 20V tantalum capacitor
Q-1,2,3,4,5,6,8	201085	Type SE-4010 transistor
R-33,34	400041	1K ohm, trimpot

SUB IF AMP/LIMITER/FREQUENCY METER (Card A-2, P/N 552064)

SYMBOL	P/N	DESCRIPTION
CH-1	930050	Choke coil
D-1,2,3,4,5,6	220005	Type 1N3604 diode
L-1	930166	Coil
Q-1	201022	Type SE-4001, silicon transistor
Q-2,3,4	201074	Type 2N2060, dual silicon transistor
R-7	400053	2.5K ohm, trimpot
R-25	540021	4750 ohm, 1%, resistor
R-27	540026	34K ohm, 1%, resistor
R-28	540024	750 ohm, 1%, resistor
R-29	540008	21.62K ohm, 1%, resistor

WIDEBAND AND EMITTER FOLLOWER AMPLIFIER (Card A-4, P/N 552018)

SYMBOL	P/N	DESCRIPTION
C-1	670002	3.3 mfd, 35 volt, tantalum capacitor
C-6	670005	220 mfd, 10 volt, tantalum capacitor
C-8,9	670004	2.2 mfd, 20 volt, tantalum capacitor
C-14	670007	47 mfd, 50 volt, tantalum capacitor
Q-1,2,3,4,5,6	201050	Type SE-4010 silicon transistor
Q-7	201033	Type 2N2102 silicon transistor
R-10	400055	10K ohm, trimpot
R-17	540024	750 ohm, 1%, resistor
R-21	540005	683.8 ohm, 1%, resistor
Z-1	220011	Type 1R24B, 24 volt zener diode

PEAK FLASHER AMP AND MUTE (Card A-5, P/N 550156)

C-1,2,3,4,9,11	670004	2.2 mfd, 20 volt, tantalum capacitor
D-1,2,3,4	220004	Type 1N542, silicon diode
Q-1,2,3,4	201050	Type SE-4010 silicon transistor

Q-5,6	201033	Type 2N2102 silicon transistor
Z-1	220007	Type 1R13B, 13 volt zener diode

PEAK FLASHER (Card A-6, P/N 550157)

SYMBOL	P/N	DESCRIPTION
C-6A	670003	47 mfd, 35 volt, tantalum capacitor
C-6B	670002	3.3 mfd, 35 volt, tantalum capacitor
D-1	220005	Type 1N3604 silicon diode
Q-1	201032	Type SF4863A FET
Q-2,3	201022	Type SE-4001 silicon transistor
Q-4,5,6	201056	Type 2N3569 silicon transistor
R-1	400105	50K ohm, trimpot
R-2,9	540021	4.75K ohm, 1%, resistor
R-3	540001	10K ohm, 1%, resistor
R-4	540008	21.62L ohm, 0.25%, resistor
R-8	540024	750 ohm, 1%, resistor
R-10	540006	2.162K ohm, 0.25%, resistor
R-11	400102	5K ohm, trimpot
R-22,23	540015	316.2 ohm, 0.25% resistor
Z-1	220011	Type 1R24B, 24 volt, zener diode
Z-2	220012	Type 1R15B, 15 volt, zener diode

REMOTE METER AMPLIFIER (Card A-7, P/N 551014)

SYMBOL	P/N	DESCRIPTION
C-2,4	670002	3.3 mfd, 35 volt, tantalum capacitor
D-1	220015	Type 1N3606 silicon diode
Q-1	201049	Type SE-4002 silicon transistor
Q-2	201033	Type 2N2102 silicon transistor
Q-3,4	201032	Type SF4863A FET
R-8	540012	12.1K ohm, 1%, resistor
R-16,22	540018	549K ohm, 1%, resistor
R-17,18	540019	3010 ohm, 1%, resistor
R-19,21	540021	1820 ohm, 1%, resistor
R-20	400055	10K ohm, potentiometer
Z-1	220011	Type 1R24B, 24 volt zener diode

LOCAL METER AMPLIFIER (Card A-8, P/N 551047)

SYMBOL	P/N	DESCRIPTION
C-2,4	670002	3.3 mfd, 35 volt, tantalum capacitor
D-1	220005	Type 1N3604 silicon diode
Q-1	201049	Type SE-4002, silicon transistor
Q-2	201033	Type 2N2102, silicon transistor
Q-3,4	201032	Type SF5863A, FET
R-8	540012	12.1K ohm, 1%, resistor
R-16, 22	540018	549K ohm, 1%, resistor
R-17, 18	540019	3010 ohm, 1%, resistor
R-19, 21	540020	1820 ohm, 1%, resistor
R-20	400055	10K ohm, trimpot
Z-1	220011	Type 1R24B, 24 volt, zener diode

dB and ISOLATION AMPLIFIER (Card A-9, P/N 551006)

SYMBOL	P/N	DESCRIPTION
C-1,4,7,10	670002	3.3 mfd, 35 volt, tantalum capacitor
Q-1	201022	Type SE-4001, silicon transistor
Q-2	201033	Type 2N2102, silicon transistor
Q-3	201032	Type SF4863A FET
Q-4	201024	Type 2N3053, silicon transistor
R-1	400103	10K, ohm, potentiometer

MONITOR AUDIO AMPLIFIER (Card A-10, P/N 552065)

SYMBOL	P/N	DESCRIPTION
C-2,4	670002	3.3 mfd, 35 volt, tantalum capacitor
Q-1	201022	Type SE-4001, silicon transistor
Q-2	201033	Type 2N2102, silicon transistor
Q-3	201056	Type 2N3569, silicon transistor
R-11	540012	12.1K ohm, 1%, resistor

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

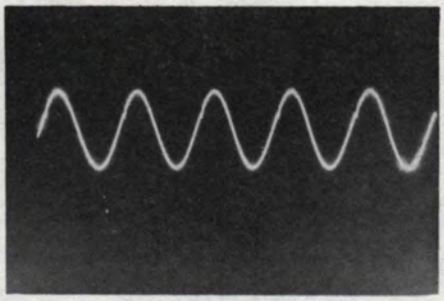


FIG 1
UNMODULATED SCA CARRIER

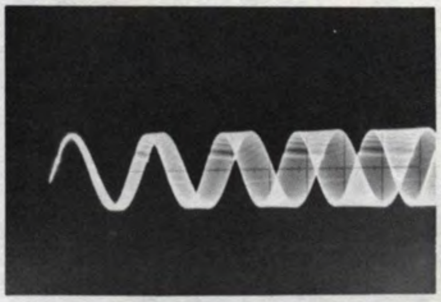


FIG 2
MODULATED SCA CARRIER

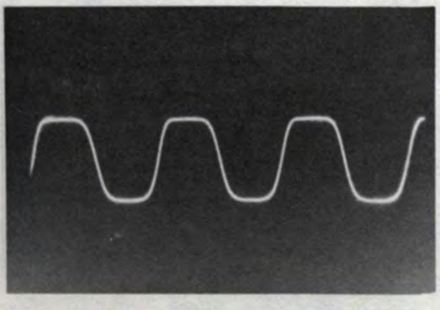


FIG 3
UNMODULATED PARTIALLY LIMITED SIGNAL AT OUTPUT OF FIRST LIMITER Q-2-CARD A-2

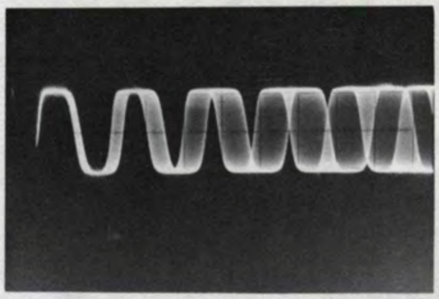


FIG 4
MODULATED PARTIALLY LIMITED SIGNAL AT OUTPUT OF FIRST LIMITER Q-2-CARD A-2

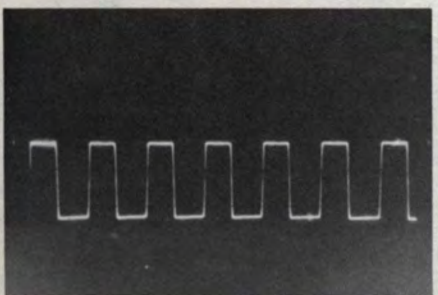


FIG 5
HARD LIMITED SIGNAL AT OUTPUT OF SECOND LIMITER Q-3-CARD A-2

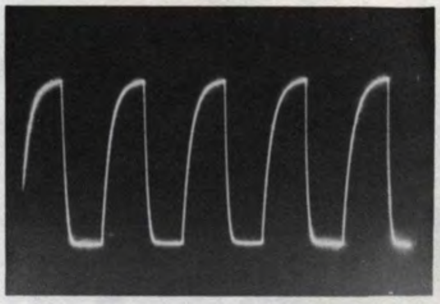


FIG 6
UNMODULATED 36V (P-P) SIGNAL AT COLLECTOR OF Q-4 CARD A-2

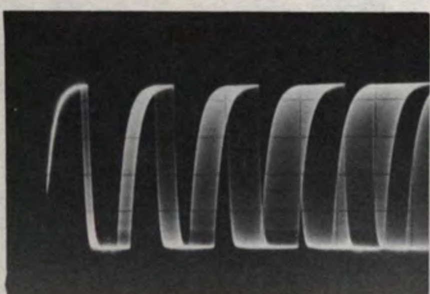
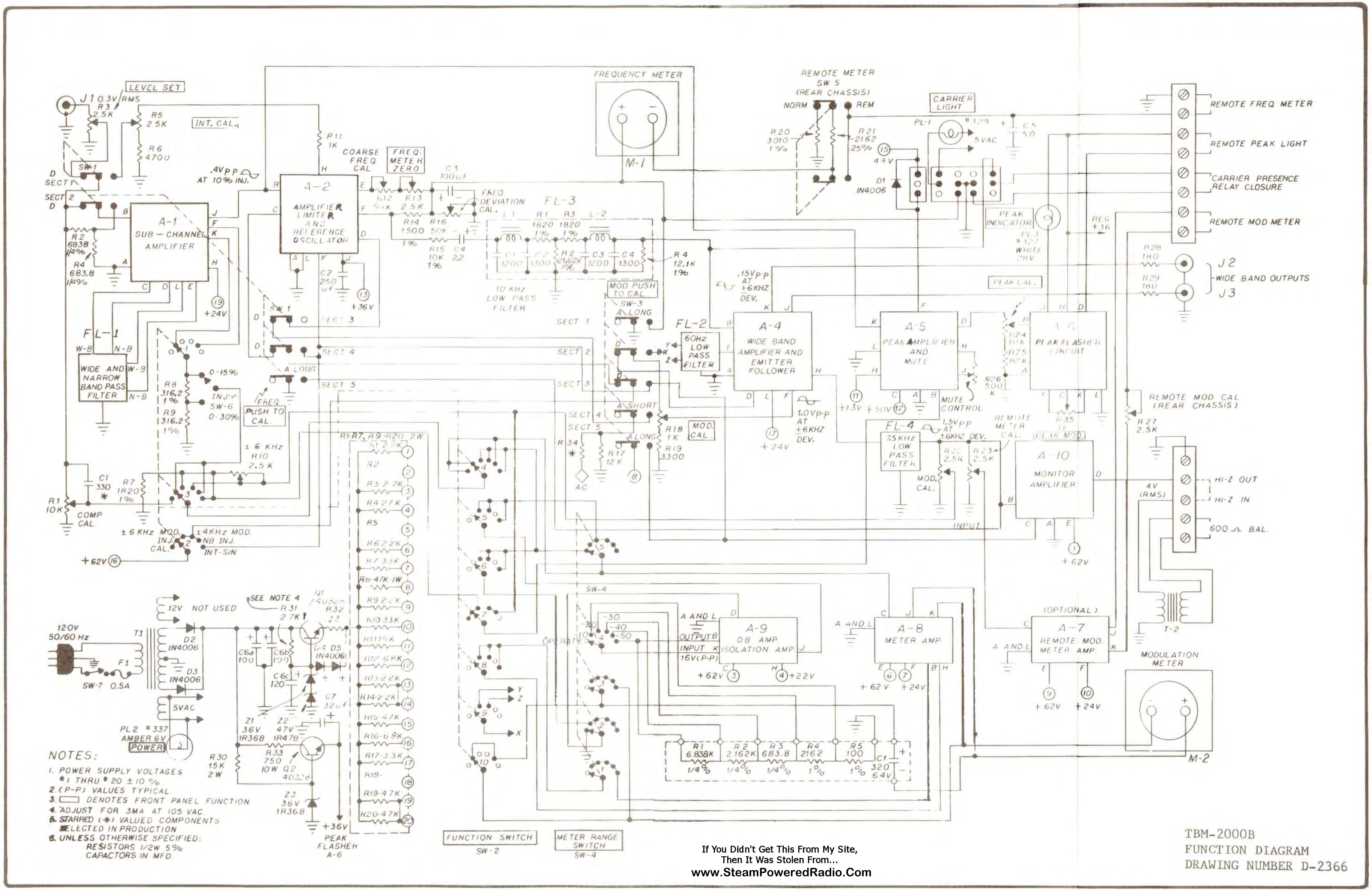
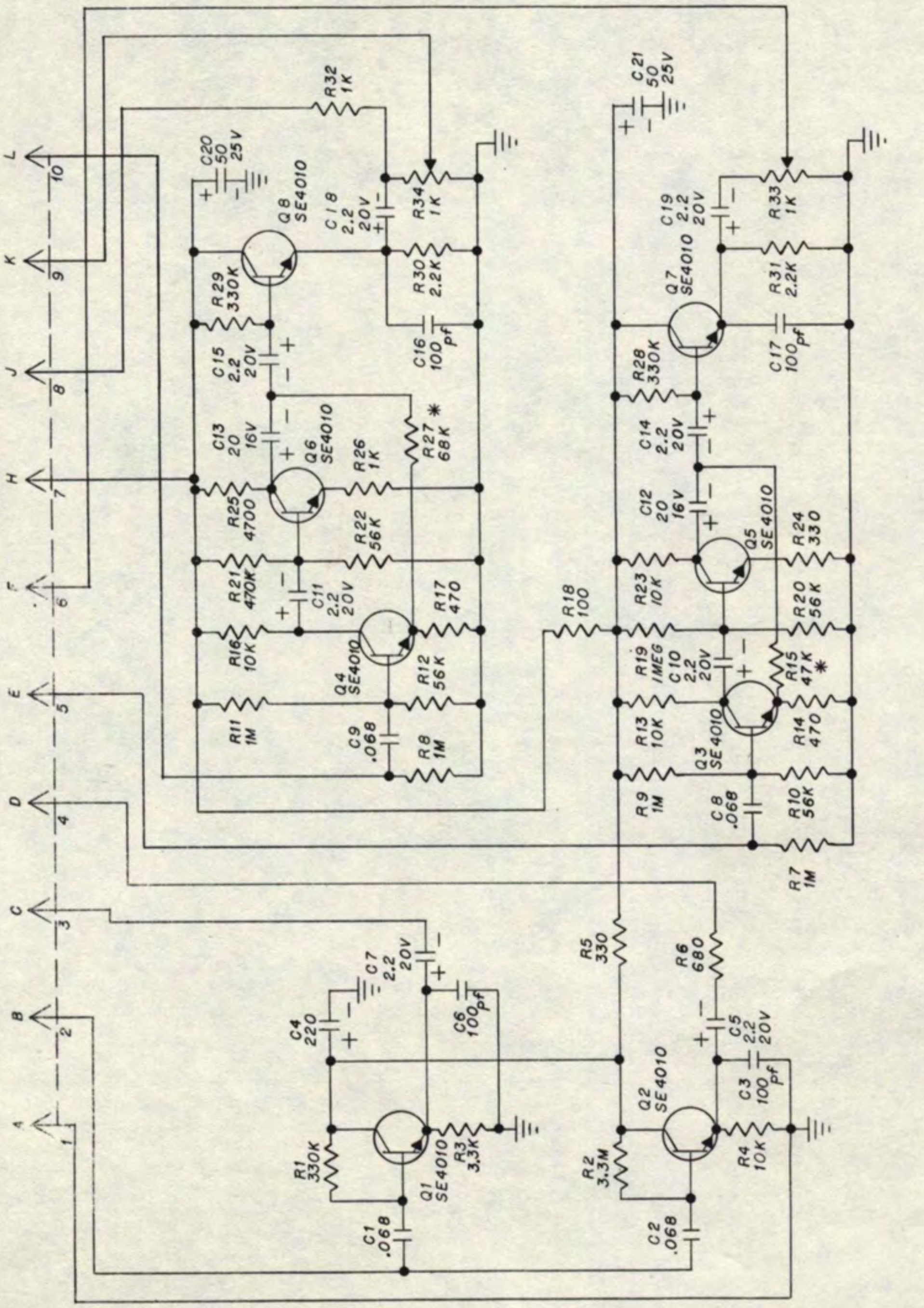


FIG 7
MODULATED 36V (P-P) SIGNAL AT COLLECTOR OF Q-4-CARD A-2

IX. SCHEMATIC DIAGRAMS

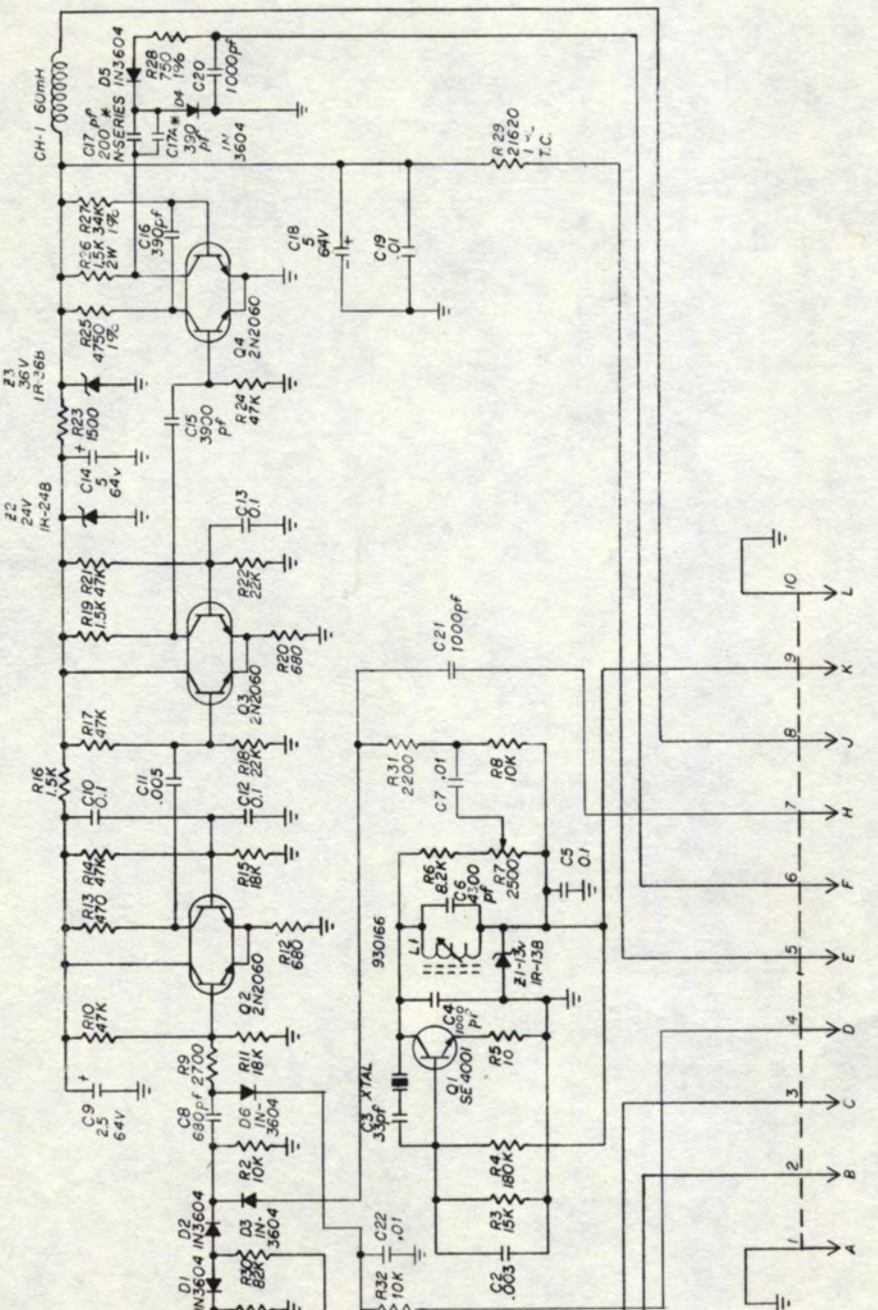

FREQUENCY METER
M-1
REMOTE METER
SW 5
(REAR CHASSIS)
NORM
REM
CARRIER LIGHT
REMOTE FREQ METER
REMOTE PEAK LIGHT
CARRIER PRESENCE RELAY CLOSURE
REMOTE MOD METER
J 2
WIDE BAND OUTPUTS
J 3
LEVEL SET
INT. CAL.
A-1
SUB - CHANNEL AMPLIFIER
A-2
AMPLIFIER LIMITER AND REFERENCE OSCILLATOR
COARSE FREQ CAL.
FREQ. METER ZERO
FREQ DEVIATION CAL.
FL-3
10 KHz LOW PASS FILTER
FL-1
WIDE AND NARROW BAND PASS FILTER
MOD PUSH TO CAL.
FL-2
60Hz LOW PASS FILTER
A-4
WIDE BAND AMPLIFIER AND EMITTER FOLLOWER
A-5
PEAK AMPLIFIER AND MUTE
A-6
PEAK FLASHER CIRCUIT
PEAK INDICATOR
PEAK CAL.
MUTE CONTROL
REMOTE MOD CAL (REAR CHASSIS)
FL-4
7.5 KHz LOW PASS FILTER
A-10
MONITOR AMPLIFIER
HI-Z OUT
HI-Z IN
600 Ω BAL.
A-9
DB AMP ISOLATION AMP
A-8
METER AMP
(OPTIONAL)
A-7
REMOTE MOD METER AMP
MODULATION METER
M-2
T-2
120V 50/60 Hz
SW-7 0.5A
12V NOT USED
5VAC
PL2 #337 AMBER 6V
POWER
PEAK FLASHER A-6
FUNCTION SWITCH
SW-2
METER RANGE SWITCH
SW-4
NOTES:
1. POWER SUPPLY VOLTAGES #1 THRU #20 ± 10 %.
2. (P-P) VALUES TYPICAL
3. ▭ DENOTES FRONT PANEL FUNCTION
4. ADJUST FOR 3MA AT 105 VAC.
5. STARRED (*) VALUED COMPONENTS SELECTED IN PRODUCTION
6. UNLESS OTHERWISE SPECIFIED: RESISTORS 1/2W 5% CAPACITORS IN MFD.
TBM-2000B
FUNCTION DIAGRAM
DRAWING NUMBER D-2366



1. UNLESS OTHERWISE SPECIFIED:
ALL RESISTORS IN OHMS 1/2 WATT 5%.
ALL CAPACITORS IN MFD.

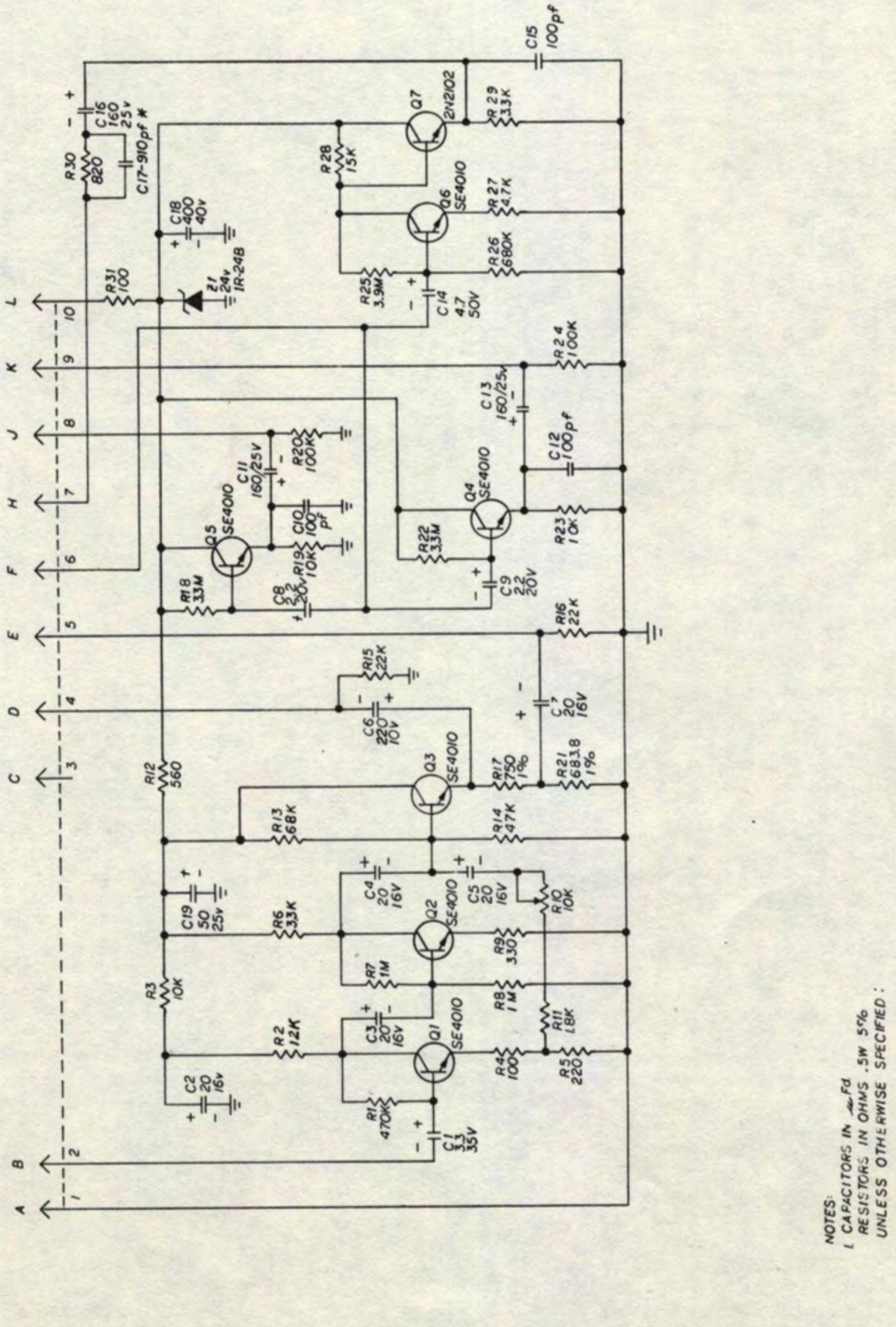
2. ✱ STARRED VALUES ARE SELECTED IN PRODUCTION.

TBM-2000B (A-1)
67 kHz AMPLIFIER
P/N 550155
DRAWING NUMBER C-2365



NOTES:
1: * SELECTED IN PRODUCTION FOR SUBCARRIER SELECTED.
2. UNLESS OTHERWISE SPECIFIED
RESISTORS 1/2 W ±5%
CAPACITORS IN mfd.

TBM-2000B(A-2)
SUBCHANNEL IF AMP LIMITER & FREQ METER
P/N 552064
DRAWING NUMBER C-2422

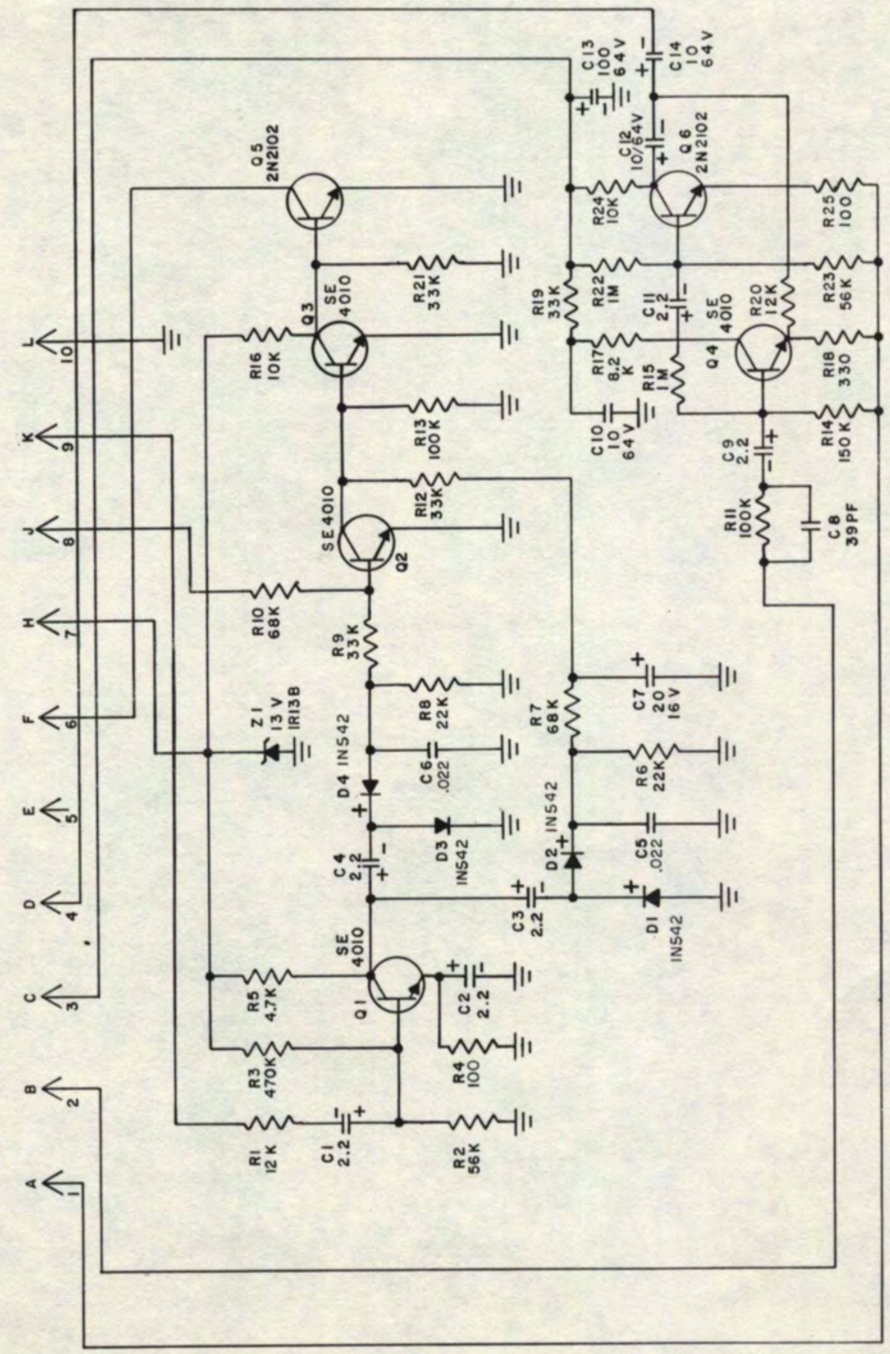


P. N. 552018

WIDE BAND AMP & EMITTER FOLLOWER AMP.

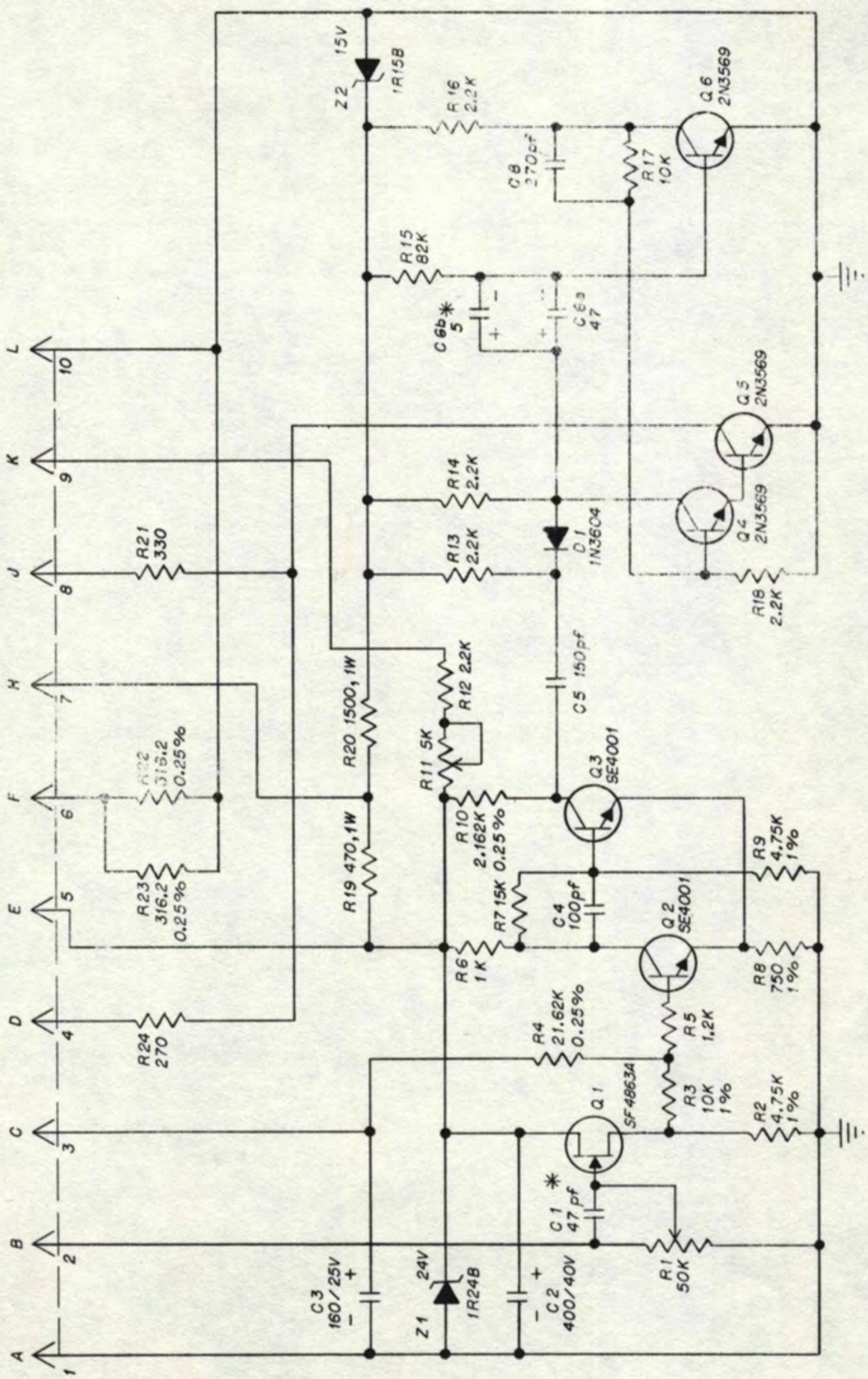
TBM-3700 (A-4)

TBM-2000B (A-4)



1. UNLESS OTHERWISE NOTED:
ALL RESISTORS 1/2 WATT ±5%
ALL CAPACITORS IN MFD

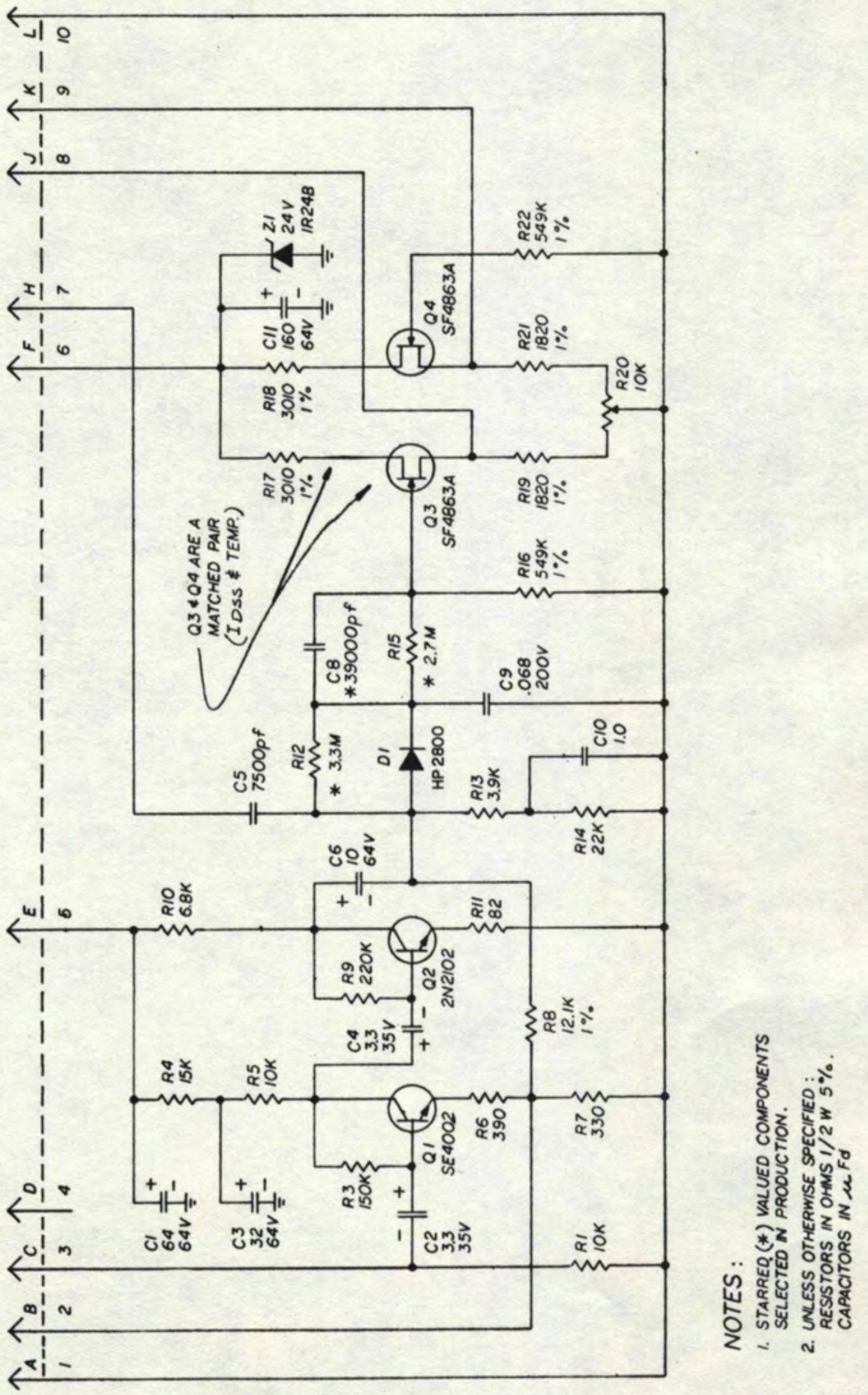
TBM-2000B (A-5)
PEAK FLASHER AMP & MUTE
P/N 550156
DRAWING NUMBER C-2367



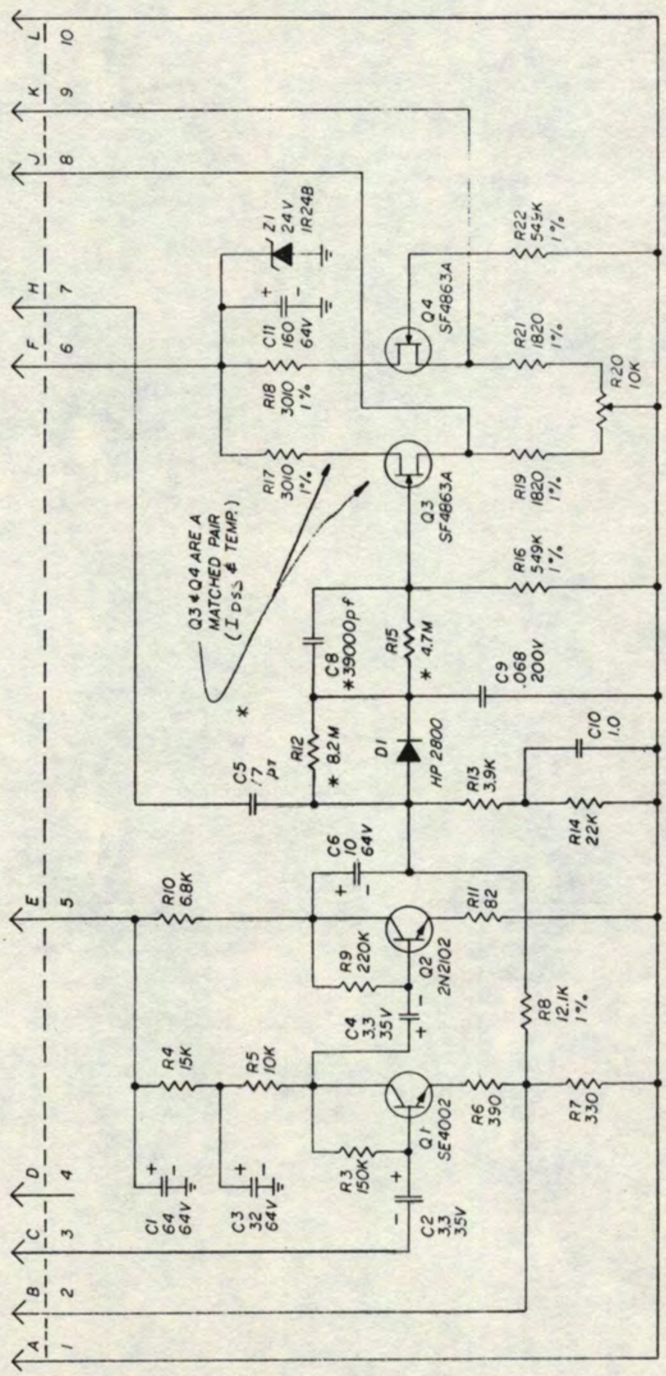
NOTES:

1. UNLESS OTHERWISE SPECIFIED.
ALL RESISTORS IN OHMS 1/2 WATT 5%.
ALL CAPACITORS IN MFD.
2. * STARRED VALUES ARE SELECTED IN PRODUCTION.

TBM-2000B (A-6)
PEAK FLASHER
P/N 550157
DRAWING NUMBER C-2424



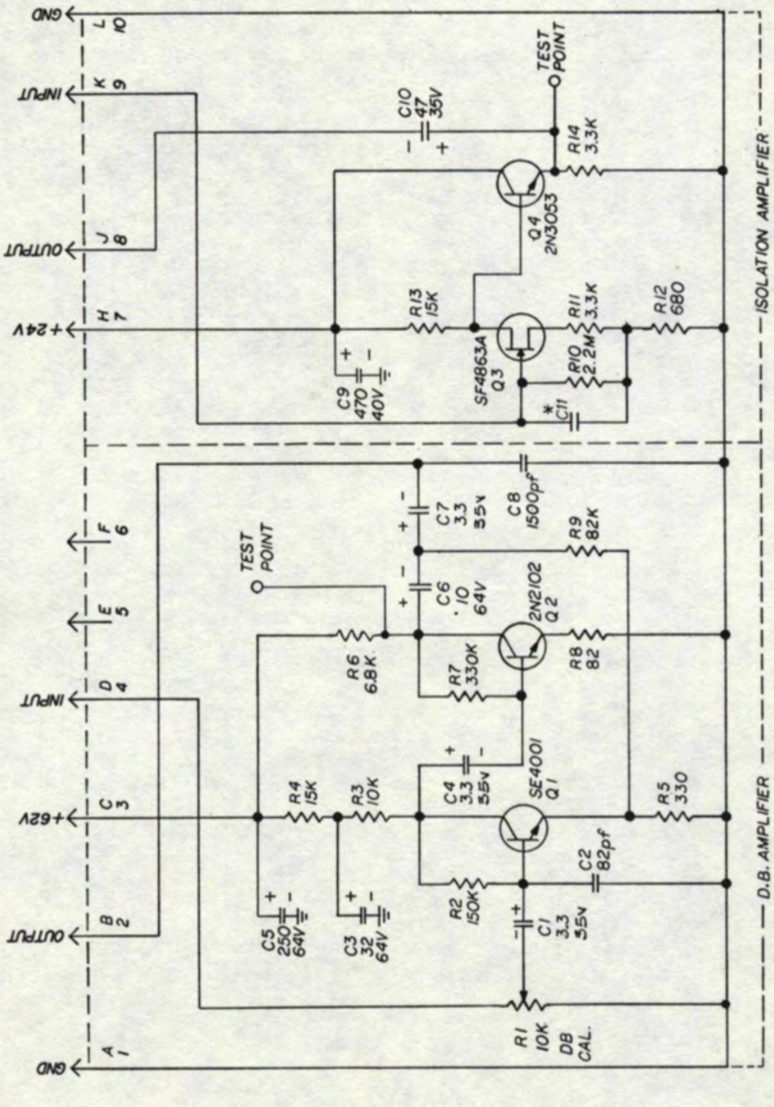
TBM-2000B (A-4)
TBM-3700 (A-7)
REMOTE METER AMP
P/N 551014
DWG-C-2129-A
MARCH 21, 1973



NOTES:

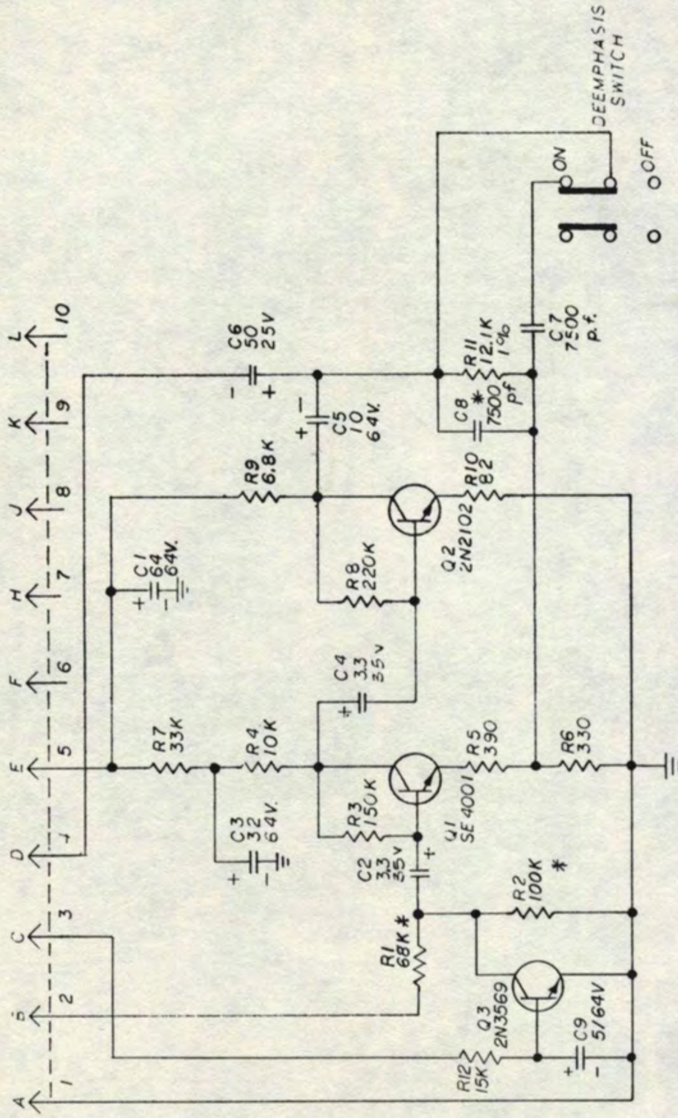
1. STARRED (*) VALUED COMPONENTS SELECTED IN PRODUCTION.
2. UNLESS OTHERWISE SPECIFIED: RESISTORS IN OHMS 1/2 W 5%. CAPACITORS IN µFd.

TBM-2000B (A-8)
METER AMP
P/N 551047
DRAWING NUMBER C-2426



NOTES:
1. UNLESS OTHERWISE SPECIFIED:
CAPACITORS IN µFd,
RESISTORS IN OHMS .5W 5%,
2. * SELECTED IN PRODUCTION.

P.N. 551001
DB & ISOLATION AMP
TBM-3700 (A-9)
TBM-8500B (A-3)
TBM-2000B (A-9)



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

TBM-2000B (A-10)
MONITOR AUDIO AMP
P/N 552065
DRAWING NUMBER C-2423

McMartin

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