

S.C.A. MODULATION MONITOR

MODEL 730A

TFT

**TIME AND FREQUENCY
TECHNOLOGY, INC.**

SECTION 1

GENERAL INFORMATION

1.1 General Description.

The Model 730A SCA Monitor normally is used in conjunction with the Model 763 FM Modulation Monitor to monitor the characteristics of the SCA transmission in FM broadcasting. It can also be used for recovering the SCA information in the composite signal used in FM broadcasting. The Model 730A measures SCA injection level, SCA modulation percentage, SCA FM signal-to-noise ratio, and crosstalk. The desired function is selected by front-panel pushbutton switches. A six-position, pushbutton-selectable precision attenuator is also provided for use in making these measurements. SCA injection and SCA modulation are indicated by a front-panel meter. SCA subcarrier frequency can be measured by the six-digit counter on the Model 764 or an external counter. The Model 730A can monitor either of two SCA carrier frequencies -- 41 kHz or 67 kHz -- selectable by front-panel pushbutton switches. Other SCA frequencies are available on special orders. Also, either ± 4 kHz or ± 6 kHz can be selected by front-panel pushbutton switches as the deviation that represents 100% modulation.

Other features of the Model 730A include:

- Digitally settable peak modulation flashers that display positive and negative peaks simultaneously.
- Built-in calibration circuits for meter and peak flashers.
- Outputs for Model 704B Remote Meter and Peak Flasher panel and SCA subcarrier alarm.

1.2 Specifications.

SCA Subcarrier Frequency

41 kHz and/or 67 kHz, pushbutton selectable

SCA Frequency Measurement

The selected SCA signal is filtered and returned to the frequency counter input of the Model 764 FM Preselector and displayed on the 6-digit digital readout.

Signal Input Requirement

Accepts composite signal from Model 763, 0.5 V RMS for 100% modulation reading.

1.2 (Continued).

Main Channel Modulation measurement

Deviation for 100%.....	+75 kHz
Modulation Accuracy, 50 Hz to 15 kHz.....	+4%
Out of Band Rejection, 20 kHz to 75 kHz..	56 dB

SCA Injection

Accuracy (30% to 1%).....	+0.5%
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SCA Subchannel Modulation Measurement

Deviation for 100%.....	+4 kHz or +6 kHz
Carrier Frequencies	
#1.....	67 kHz (standard)
#2.....	41 kHz (optional)
Modulation Accuracy (0dB Meter Attenuator Switch Position) @1 kHz, 100%.....	+2%
Frequency Response	
Composite Input	
20 Hz to 6 kHz.....	+1dB
20 Hz to 7.5 kHz.....	+2dB
Wideband Input	
20 Hz to 7.5 kHz.....	+0.5dB
Selectivity (Composite Input)	
Narrow	
BW, 3 dB.....	3 kHz (typical)
BW, 60 dB.....	20 kHz (maximum)
Wide	
BW, 3 dB.....	20 kHz (typical)
BW, 60 dB.....	60 kHz (maximum)

Meter

Scale Range.....	0 to 40%, 0 to 133% (-2 dB to + 2 dB)
Attenuator Range.....	0 to -50 dB in 10 dB steps

1.2 (Continued).

Crosstalk Rejection (Composite Input)

Main Channel (50 Hz to 15 kHz) into SCA Subchannel (Narrow).....	66 dB
Stereo (23 kHz to 53 kHz, excluding subharmonics of SCA Subchannel) into SCA Subchannel (#1, Narrow).....	66 dB
SCA Subchannel into Main Channel.....	66 dB

SCA Peak Modulation Indicator

Range.....	50% to 129%
Resolution.....	1%
Accuracy.....	<u>+10%</u>
Response Time.....	1 cycle of 2 kHz

SCA Modulation and Injection Level Calibrator

Built-in modulation and injection level calibrator for calibrating the modulation meter and the positive and negative peak flashers from the front panel.

Outputs

SCA Subcarrier

Level, at 10% SCA Injection..... 500 mV, nominal into 5K ohms

SCA Subcarrier Alarm..... Contact closure when subcarrier is below muting level

Audio (with or without de-emphasis, 75/150 u sec)

Level (600 ohms), 100% modulation, 400 Hz nominal..... 2 V RMS (8.2 dBm)

Distortion

Composite input

+6 kHz at 400 Hz..... 1.5%
+4 kHz at 400 Hz..... 1%

Wideband input

+6 kHz at 400 Hz..... 0.5%

1.2 (Continued).

Noise Level, relative to 6 kHz
deviation (with de-emphasis)
Composite Input, or Wideband Input. -66 dB
R.F. Input at 10 mV..... -55 dB

Power

115/230 $\pm 10\%$ VAC, 50 to 400 Hz, 25 watts maximum

Physical and Environmental

Operating Temperature..... 0° to +50°C
Size..... 7" high x 19"
wide x 16" deep
Weight..... Approx. 15 lbs.

1.3 Accessory Equipment

1.3.1 Model 704B Remote Meter and Peak Flasher Panel.

Duplicates meter and peak flasher readings of the Model 730A.
Fifty feet of cable and plug provided.

1.4

Warranty.

TIME & FREQUENCY TECHNOLOGY, INC., warrants each of the instruments of its manufacture to be produced to meet the specifications delivered to the BUYER; and to be free from defects in material and workmanship and will repair or replace, at its expense, for a period of one year from the date of delivery of equipment, any parts which are defective from faulty material or poor workmanship.

Instruments found to be defective during the warranty period shall be returned to the factory with transportation charges prepaid by BUYER. It is expressly agreed that replacement and repair shall be the sole remedy of BUYER with respect to any nonconforming equipment and parts thereof and shall be in lieu of any other remedy available by applicable law. All returns to the factory must be authorized by the SELLER, prior to such returns. Upon examination by the factory, if the instrument is found to be defective, the unit will be repaired and returned to the BUYER, with transportation charges prepaid by SELLER.

Transportation charges for instruments found to be defective within the first thirty (30) days of the warranty period will be paid both ways by the SELLER.

Transportation charges for warranty returns, wherein failure is found not to be the fault of the SELLER, shall be paid both ways by the BUYER.

This warranty does not apply to instruments which, in the opinion of the SELLER, have been altered or misused.

NO OTHER WARRANTY IS EXPRESSED OR IMPLIED. TFT IS NOT LIABLE FOR CONSEQUENTIAL DAMAGES.

1.5

Claim for Damage in Shipment.

Your instrument should be inspected and tested as soon as it is received. The instrument is insured for safe delivery. If the instrument is damaged in any way or fails to operate properly, file a claim with the carrier, or if insured separately, with the insurance company.

WE SINCERELY PLEDGE OUR IMMEDIATE AND FULLEST COOPERATION TO ALL USERS OF OUR PRECISION ELECTRONICS INSTRUMENTS.

PLEASE ADVISE US IF WE CAN ASSIST YOU IN ANY MANNER.

Time & Frequency Technology, Inc.
3090 Oakmead Village Dr.
Santa Clara, CA 95051

408-727-7272

SECTION 2
INSTALLATION

2.1 Unpacking and Inspection.

Upon receiving the instrument, inspect the packing box and instrument for signs of possible shipping damage. Operate the instrument in accordance with the procedures of Section 3 of this manual. If the instrument is damaged or fails to operate properly, file a claim with the transportation company, or with the insurance company if insured separately.

2.2 Power Requirements.

The Model 730A normally operates from a 115 volt AC source; if it is wired for 230 volts, the line cord will be so marked. The line frequency must be between 50 and 400 Hz. Maximum power required is 25 watts.

2.3 Installation With the Model 763.

- a. Mount the Model 730A in the equipment rack.

NOTE

If the Model 730 is not mounted in a common rack with the Model 763, a ground wire of 18 AWG or larger must be connected between the two chassis.

- b. Connect one of the furnished coaxial cables between COMPOSITE INPUT connector J1 on the rear panel of the Model 730A and SCA MONITOR OUTPUT connector J6 on the rear panel of the Model 763.
- c. Connect the other coaxial cable between SUB-CARRIER FREQUENCY connector J4 on the rear panel of the Model 730A and SCA CARR connector J13 on the rear panel of the FM Preselector.

2.4 Model 704B Remote Readout Panel Connection (Optional).

When a Model 704B is to be used with the Model 730A, connect the five-wire cable of the Model 704B to terminals a, C, D, E, and G of terminal strip J7 on the rear panel of the Model 730. The wire color code is given in Section 3.2.2 of this manual under Reference No. 10.

2.5

Subcarrier-Off Alarm Connection.

Connect the external alarm device to SCA SUBCARRIER ALARM banana jacks J2 and J3 on the Model 730A rear panel. These jacks are shorted together when the SCA subcarrier level drops below the threshold set by the SCA MUTE LEVEL control R39 on Board A2 (see Section 3.11). Neither one of the jacks is grounded in the Model 730. Maximum power-handling capability is 1.0 ampere at 115 V AC.

SECTION 3

OPERATION

3.1 General

The Model 730A SCA Monitor is used in conjunction with the Model 763 FM Modulation Monitor to monitor the SCA subcarrier from an FM broadcast transmitter. SCA injection level, SCA modulation percentage, SCA FM signal-to-noise ratio, and crosstalk can be measured on the front-panel meter. No external equipment except the Model 763 is needed for calibrating the meter.

3.2 Controls, Connectors, and Indicators.

3.2.1 Front Panel.

Fig. 3-1
Ref. No.

	<u>Name</u>	<u>Function</u>
1	FLASHER CAL control	Used in calibrating the peak flasher (see Section 3.6) in SCA Modulation mode.
2	PWR switch	When depressed, energizes the instrument.
3.	MAIN CHAN switch	When depressed, meter indicates main-channel modulation. 10% represents \pm 75 kHz FM deviation.
4	SCA INJ switch	When depressed, meter indicates SCA injection level. 100% = \pm 75 kHz deviation.
5	SCA MOD switch	When depressed, meter indicates modulation of the SCA subcarrier.
6	SCA SUBCHANNEL #1 switch	This switch is depressed for monitoring a 67 kHz subcarrier.
7	SCA SUBCHANNEL #2 switch	This switch is depressed for monitoring a 41 kHz subcarrier (Optional).

3.2.1 (Continued).

Fig. 3-1
Ref. NO.

	<u>Name</u>	<u>Function</u>
8	NARROW SELECTIVITY switch	When depressed, provides a 3-dB bandwidth of 3 kHz and a 60-dB bandwidth of 20 kHz.
9	WIDE SELECTIVITY switch	When depressed, provides a 3-dB bandwidth of 20 kHz.
10	<u>+4</u> kHz switch	When depressed, meter indicates 100% for an FM deviation of <u>+4</u> kHz on SCA subcarrier.
11	<u>+6</u> kHz switch	When depressed, meter indicates 100 % for an FM deviation of <u>+6</u> kHz on SCA subcarrier.
12	METER CAL switch	When depressed, allows calibration of all three modes of operation: Main Channel, SCA Injection, and SCA Modulation. When calibrating the main channel (composite level adjustment), the Calibrate switch on the 763 must also be depressed (see Sections 3.4, 3.5, and 3.6).
13	METER "+" switch	When depressed, meter reads positive SCA or Main Channel modulation peaks.
14	METER "-" switch	When depressed, meter reads negative SCA or Main Channel modulation peaks.
15	SCA INJ CAL control	Used in SCA injection calibration (see Section 3.6).
16	SCA MOD CAL control	Used in SCA modulation calibration (see Section 3.6).
17	Modulation meter	Reads modulation and injection level, both in percent and in dB above and below 100%. Either positive or negative modulation peaks will be indicated, depending on whether the METER "+" or METER "-" switch is depressed. When the 100% METER ATTENUATOR

3.2.1

(Continued).

Fig. 3-1
Ref. No.

Name

Function

18

METER ATTENUATOR
switches

switch is depressed, the meter reads directly; when any other attenuator switch is depressed, the scale factor of the selected switch must be applied.

Depressing one of these switches changes the gain marked thereon in the modulation meter circuit. The resulting measurement is the algebraic sum of the meter reading and the inserted attenuation. For example, a meter indication of - 2 dB with the -30 dB switch depressed would indicate a measurement of - 32 dB below 100% modulation. Three of the switches are marked 1%, 10%, and 100%. These indicate the actual modulation percentage when the meter needle is at the 100% mark. For example, a meter reading of 70% with the 1% switch depressed would indicate a measurement of 0.7% modulation.

When in the 0-dB position, the switch selects the output of the peak detector on the Meter Amp Board A1 to drive the MODULATION METER. When in any other position, the switch selects the output of the average detector on the Meter Amp Board to drive a MODULATION METER.

When the 730 is operating in the SCA MODULATION mode, any setting of the METER ATTENUATOR setting except "0dB" will switch a 75 u sec or 150 u sec, (selectable by means of an internal jumper), into the audio

3.2.1

(Continued)Fig. 3-1
Ref. No.NameFunction

		output circuitry of the Discriminator Board A2 so that the SCA modulation delivered to the Meter Amp Board A1 is de-emphasized. When the switch is in the 0dB position the de-emphasis network is switched out of the circuit.
19	SCA SUBCARRIER indicator	Lights when the SCA subcarrier is present (i.e., when the SCA subcarrier level is above the threshold set by the SCA MUTE LEVEL control).
20	PEAK MODULATION	The switches set the peak modulation percentage at which the indicators will flash. The indicators flash when the modulation peaks exceed the setting of the switches: the + indicator for positive modulation peaks and the - indicator for negative peaks.

3.2.2

Rear Panel.Fig. 3-2
Ref. No.NameFunction

1	COMPOSITE INPUT Connector J1	Provides means for introducing a composite signal from the Model 763.
2	COMPOSITE LEVEL SET Control R2	Used to adjust level of incoming composite signal from the Model 763. (See Section 3.4, 3.5, and 3.6)

3.2.2

(Continued).Fig. 3-2
Ref. No.

	<u>Name</u>	<u>Function</u>
3	SCA SUBCARRIER ALARM Connectors J2 and J3	When the SCA subcarrier level drops below the level set by the SCA MUTE LEVEL control, these two connectors are shorted together by an internal relay to operate an external alarm.
4	WIDEBAND INPUT LEVEL R6	Adjusts level of incoming SCA signal for the WIDEBAND INPUT.
5	WIDEBAND INPUT J9	Provides an input which bypasses the I.F. filtering, thus providing desirable modulation characteristics such as flatter frequency response and lower distortion. Can be used when the SCA signal alone is injected onto the main carrier.
6	SCA SUBCARRIER connector J4	Provides SCA subcarrier frequency output.
7	AUDIO OUTPUT connector J5	Delivers the recovered SCA audio signal without de-emphasis. Output is 2 volts RMS for 100% modulation.
8	AUDIO OUTPUT connector J6	Delivers a recovered SCA audio output from the de-emphasis network. Level is 2 volts RMS for 100% SCA modulation at 400 Hz.
9	1A SLO BLO fuse	Fuses the AC power circuit.

3.2.2

(Continued).Fig. 3-2
Ref. No.NameFunction

10

115 VAC line cord

For connecting the Monitor to a power source. If the Monitor is wired for 230V input, the line cord will be so marked.

11

Terminal strip J8

Provides the following outputs:

A: The same voltage that operates the modulation meter, to operate the Model 704B Remote Readout Panel. Connect 704B red wire.

C: The same voltage that operates the front-panel + PEAK MODULATION indicator, for operating the corresponding indicator on the Model 704B brown wire.

D: Ground. Connect 704B black wire.

E: The same voltage that operates the front-panel-PEAK MODULATION indicator, for operating the corresponding indicator on the Model 704B Remote Readout Panel. Connect 704B white wire.

G: +5 V DC. Connect the 704B green wire.

3.3

Turn-On and Warm-Up.

Make sure the Model 730A is cabled to other equipment as described in Section 2. Check the line cord to make sure the Model 730A

3.3 (Continued).

is wired for the line voltage to be used (115 or 230 volts). Plug the line cord into the power source and press the PWR switch. Since the Model 730A is a completely solid-state instrument, warm-up time is very minimal. One or two minutes should be more than adequate to provide consistent readings.

3.4 Main Channel Calibration.

- a. Depress the MAIN CHAN switch.
- b. Depress the METER CAL switch.
- c. Depress the 0dB METER ATTENUATOR switch.
- d. On the Model 763, press the CAL switch.
- e. Adjust the rear-panel COMPOSITE LEVEL SET control for a 100% reading on the meter.

3.5 SCA Injection Calibration.

- a. Depress the METER CAL switch.
- b. Depress either the WIDE or NARROW SELECTIVITY switch.
- c. Depress the SCA INJ MEASURE/CAL switch.
- d. Depress the -20 dB METER ATTENUATOR switch.
- e. Adjust the SCA INJ CAL control for a meter reading of 100% (10% injection).

3.6 SCA Modulation Calibration.

- a. Depress the 0dB METER ATTENUATOR switch.
- b. Depress the SCA MOD MEASURE/CAL switch.
- c. Depress the +6 kHz switch.
- d. Adjust the SCA MOD CAL control for a meter reading of 100%.
- e. Set Peak Modulation Thumbwheel switches for 100% and adjust FLASHER CAL POT so that flashers just come on.

REVISIONS		
LTR	Description	Date
A	RELEASED TO PRODUCTION PER ECO 206	1-7-75
B	REVISED PER ECO 342	7-16-75

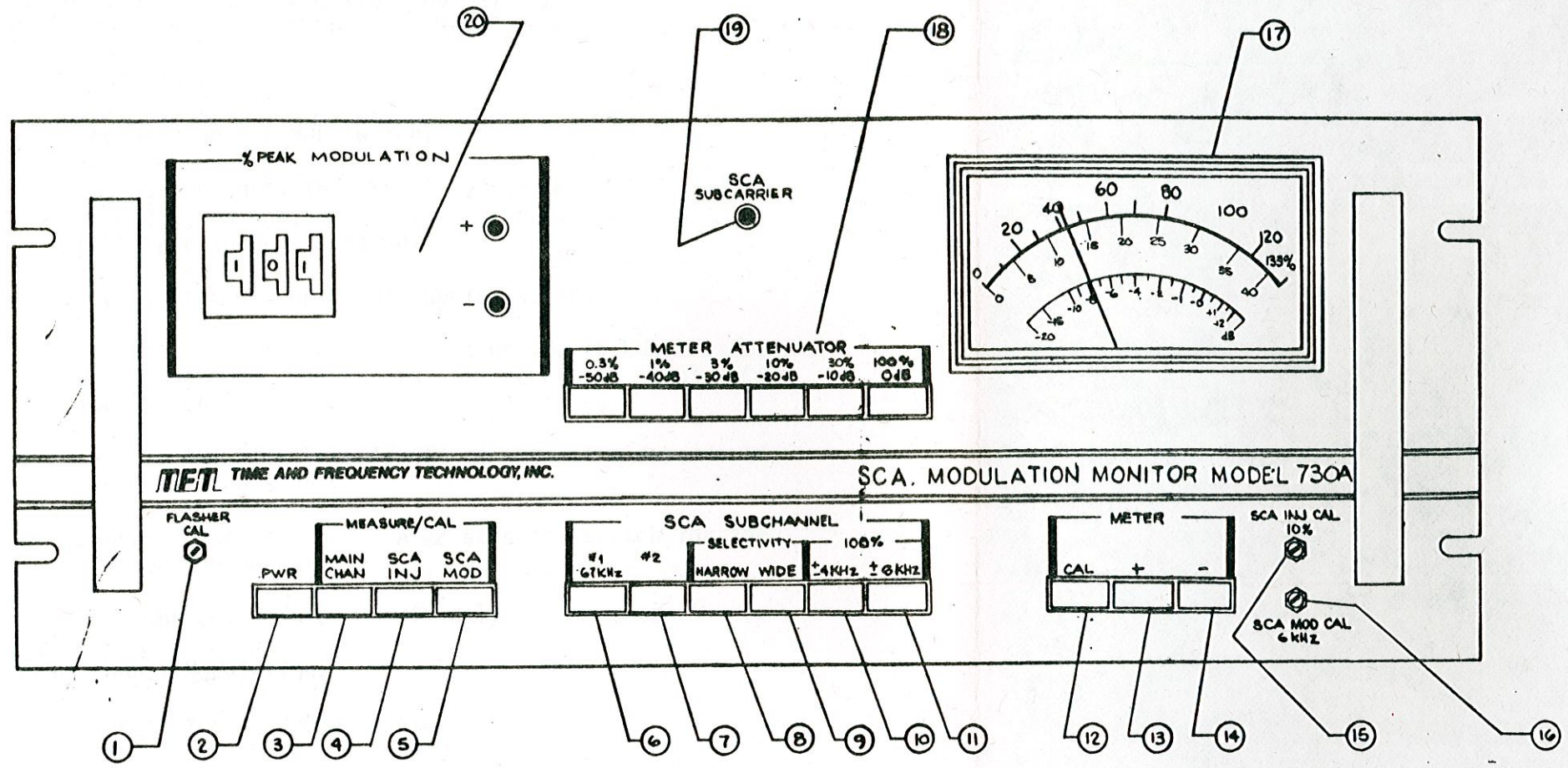


FIGURE 3-1

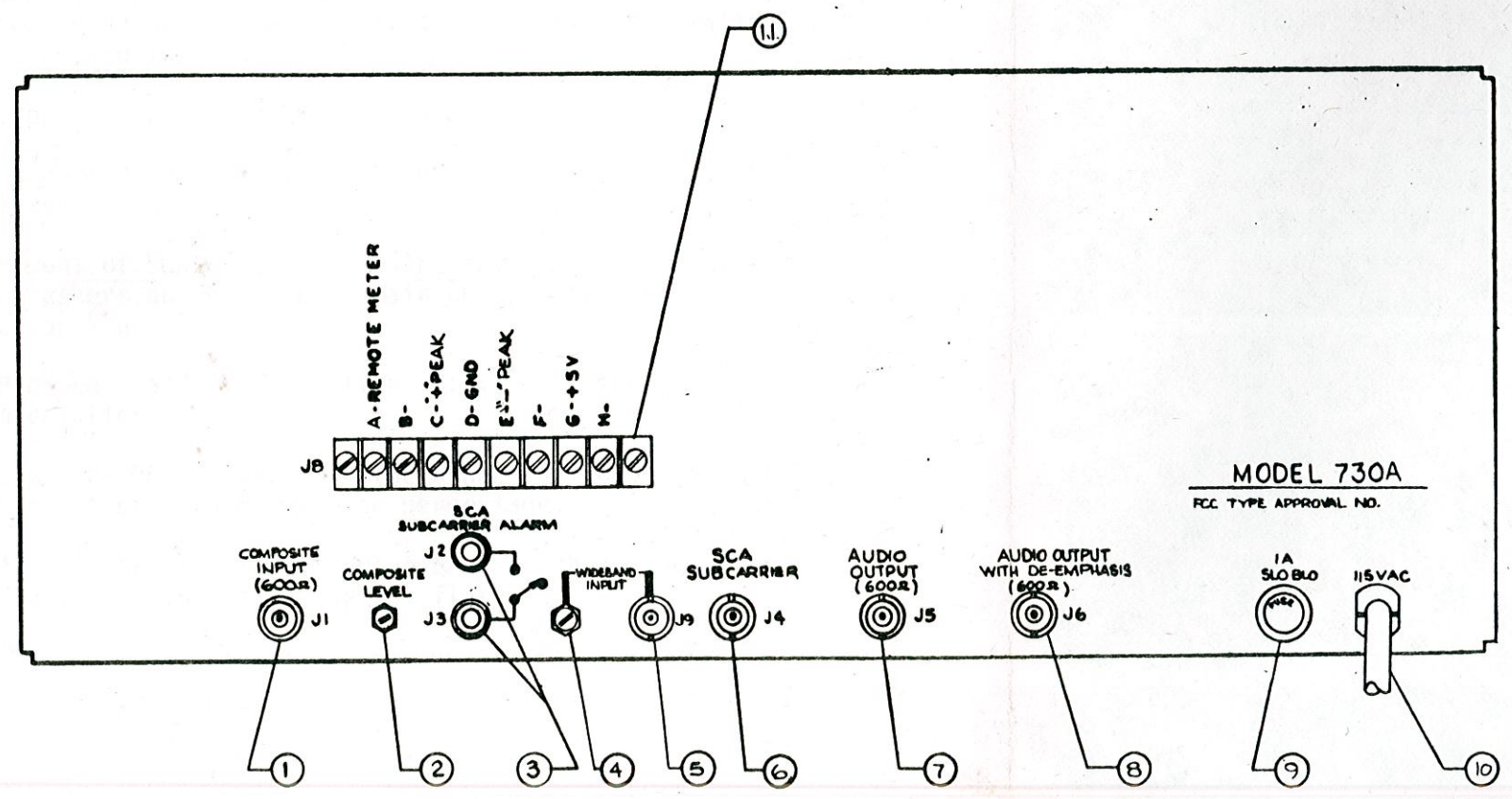


FIGURE 3-2

ITEM NO	QTY PER ASSY	EN NO	PART NO	DESCRIPTION	REF DES
REMOVE ALL BURRS AND SHARP EDGES					
TOLERANCES UNLESS OTHERWISE SPECIFIED .XX ± ANGLULAR ± .XXX ±					
DO NOT SCALE THIS PRINT					
DRAWN BY R.G. DATE 11-25-75 CHK BY J.M. DATE 1/16/76 PROJ ENG DATE 1/16/76 APPD ECO NO				TFT TIME & FREQUENCY TECHNOLOGY INC 1070 J. 23rd St. Santa Clara, CA 95050 408.748-4103 TITLE: PANEL, FRONT & REAR SIZE: DRAWING NO: B 6600-0290 SCALE: 1/1 SHEET OF 1	

3.7 Measurement of SCA Modulation and Main Channel Modulation Using the Modulation Meter.

3.7.1 SCA Modulation.

- a. Depress the SCA MOD switch.
- b. Depress either the METER "+" or METER "-" switch, depending on whether positive or negative modulation peaks are to be monitored.
- c. Depress the 0dB METER ATTENUATOR switch.
- d. Depress either the +4 kHz or the +6 kHz switch, depending on which is to represent 100% SCA modulation.
- e. Depress the WIDE SELECTIVITY to get all sidebands of the modulated signal.
- f. Depress SCA #1 or SCA #2 selector switch for the desired subchannel.
- g. Read the SCA modulation directly on the meter.

3.7.2 Main Channel Modulation.

- a. Depress the MAIN CHAN switch.
- b. Depress either the METER + or METER - switch, depending on whether positive or negative modulation peaks are to be monitored.
- c. Depress the 0dB METER ATTENUATOR switch.
- d. Read the main channel modulation directly on the meter.

3.8 Measurement of SCA Modulation Using the Peak Flashers.
(Peak Flashers do not work in Main Channel or SCA Injection Modes.)

- a. Proceed as in Section 3.7.1 to monitor SCA modulation.
- b. Set the PEAK MODULATION thumbwheel switches for the highest desired modulation percentage.
- c. Adjust transmitter modulation so that the PEAK MODULATION indicators do not flash.

3.9

Measurement of SCA Injection Using the Modulation Meter.

- a. Depress the SCA INJ switch.
- b. Depress either the SCA SUBCHANNEL #1 or #2 switch, depending on whether a 67-kHz or a 41-kHz subcarrier is to be measured.
- c. Depress the NARROW SELECTIVITY switch if stereo modulation or two closely spaced subchannels are used. Otherwise, depress the WIDE SELECTIVITY switch.
- d. Depress the appropriate METER ATTENUATOR switch depending on the nominal SCA injection level (1 to 30 percent).
- e. Read the SCA injection level on the meter.

3.10

Audio Output.

The recovered SCA audio signal out of the deemphasis network is available at rear-panel AUDIO OUTPUT connector J6. Its level is 2 volts RMS into 600 ohms for 100-percent modulation at 400 Hz, and it can be fed into a distortion analyzer to measure SCA distortion. It can also be used to operate high-impedance earphones if desired. Either 75-microsecond or 150-microsecond deemphasis can be selected by means of an internal jumper. The audio signal without deemphasis, at the same level, is available at rear-panel AUDIO OUTPUT connector J5.

3.11

Subcarrier-Off Alarm.

When the subcarrier level falls below the threshold set by the SCA MUTE LEVEL control, an internal relay shorts SCA SUBCARRIER connectors J2 and J3 to operate an external alarm. To adjust the SCA MUTE LEVEL control, proceed as follows:

- a. Place the Model 730A in the SCA injection mode as described in Section 3.9.
- b. At the transmitter, set the SCA injection level to approximately 2% below the desired operating injection level (up to 30 percent).
- c. Adjust the SCA MUTE LEVEL control, R39 on Discriminator Board A2, so that the SCA SUBCARRIER ALARM connectors J2 and J3 short, and the front-panel SCA SUBCARRIER indicator goes off.

3.11 (Continued).

- d. Increase the SCA injection to the normal operating level.
- e. The circuit between J2 and J3 should open and the SCA SUBCARRIER indicator should light.

3.12 Model 704B Remote Readout panel (Optional).

The Model 704B Remote Readout Panel will duplicate the indications of the modulation meter and peak flashers. See section 3.2.2 Item 11 for hook-up to J8.

3.13 Using the Wideband Input for SCA Measurements.

3.13.1 Calibration of Wideband Input Level.

With the 730A set to the SCA Injection Mode as described in Section 3.9, inject an unmodulated SCA Signal onto the Main Carrier. The SCA Subcarrier should be the only signal present on the main carrier. Adjust the SCA injection level on the Main Carrier to a convenient level of 10% or 31.6% indicated by the Model 730A. Now disconnect the Composite Output of the Model 763 from the Composite Input of the 730A and connect the Composite Output of the 763 to the Wideband Input of the 730A. Now adjust the Wideband Input Level pot R6 on Model 730A rear panel so that 730A indicates the same injection level as read above.

3.13.2 Reading SCA Injection with the Wideband Input

When the 730A Wideband Input Level has been calibrated as described in Section 3.13.3, SCA injection readings may be made by using the procedure described in Section 3.9, except the NARROWBAND/WIDEBAND switches are non functional.

3.13.3 Reading SCA Modulation with the Wideband Input.

With the 730A Wideband Input Level calibrated as described in section 3.13.1, SCA Modulation Measurements may be made as described in Sections 3.7 and 3.8.

SECTION 4

THEORY OF OPERATION

4.1 General Block Diagram Discussion.

The block diagram discussion is divided into four functional descriptions: main channel monitoring (Section 4.1.1), SCA injection monitoring (Section 4.1.2), SCA modulation monitoring (Section 4.1.3), and calibration circuits (Section 4.1.4). Refer to the block diagram, Figure 6-1, for this discussion.

Power to operate the Model 730A comes from three separate power supplies on Board A4. Each of these supplies consists of a bridge rectifier, filter, and regulator. The power supplies deliver +5 volts, +15 volts, and -15 volts. AC input to the supplies is furnished by a transformer on the main chassis.

NOTE

When one front-panel switch in a group is depressed (closed), the other switches in the same group should be released (open).

4.1.1 Main Channel Monitoring.

Assume that the MAIN CHAN switch is depressed and that the CAL switch is not depressed. The composite signal from the Model 763 at rear-panel connector J1 is fed through a 15-kHz low-pass filter on Board A4, which removes the SCA subcarriers, to Meter Amplifier Board A1.

The direct or inverted audio signal is selected by the front-panel METER "+" or METER "-" switch, respectively, and applied to the attenuator. The desired attenuation is selectable in 10-dB steps by the front-panel METER ATTENUATOR switches. The audio signal is then amplified and fed to both a peak detector and an average detector. The 0-dB attenuation switch selects the output of the peak detector to feed to the modulation meter, since this attenuator position is used with the higher level modulation where peak values are significant. The -10 dB, -20 dB, -30 dB, -40 dB, and -50 dB attenuator switches select the output

4.1.1 (Continued).

of the average detector, since average values are more significant when measuring the lower level noise and crosstalk voltage.

4.1.2 SCA Injection Monitoring.

Assume that the SCA INJ switch is depressed and that the CAL switch is not depressed. The composite signal from the Model 763 containing the 41-kHz and/or the 67-kHz SCA subcarriers to be measured, enters the Model 730 at rear-panel COMPOSITE INPUT connector J1. The composite signal is applied to one input of a mixer on Board A3. The L.O. input to the mixer comes from a crystal oscillator on Board A1. The L.O. frequency is either 10.767 MHz (for a 67-kHz SCA subcarrier) or 10.741 MHz (for a 41-kHz SCA subcarrier); the desired L.O. frequency is selected by depressing either the SCA SUBCHANNEL #1 or #2 switch on the front panel, which switches in the appropriate crystal for the L.O. The purpose of the mixer is to convert the SCA subcarrier to a 10.7-MHz signal for ease of filtering out the other components of the composite signal.

Both wide-band and narrow-band filtering are available. When the front-panel WIDE SELECTIVITY switch is depressed, the narrow-band filter is bypassed, and the selectivity is that of the wideband filter, which has a 3-dB bandwidth of 20 kHz. When the NARROW SELECTIVITY switch is depressed, both filters are in the circuit, and the selectivity is determined by the narrow-band filter.

The filtered SCA subcarrier is downconverted to either 67 kHz or 41 kHz by a second mixer whose L.O. input is the same as that of the first mixer. A 95-kHz low-pass filter removes the high-frequency components from the mixer output, and the amplified SCA subcarrier is delivered to Meter Amplifier Board A1, where it is processed in the same way as the main channel signal to drive the modulation meter.

4.1.3 SCA Modulation Monitoring.

Assume that the SCA MOD switch is depressed and that the CAL switch is not depressed. The composite signal at rear-panel connector J1 is upconverted, filtered, and downconverted on Board A3 in the same way as the composite signal was handled for SCA injection monitoring (Section 4.1.2). The filtered SCA subcarrier (either 67 kHz or 41 kHz as selected by the front-panel #1 or #2 switch) from Board A3 is fed to Board A2, where it is demodulated by a one-shot which acts as a pulse-averaging discriminator. The discriminator output contains the audio modulation as well as the subcarrier frequency. The low-pass filter following the one-shot removes the subcarrier frequency. The audio output from the low-pass filter is applied to an operational amplifier. When the front-panel +4 kHz switch is depressed, a trans-

4.1.3 (Continued).

istor switch parallels an additional resistor to increase the gain of this amplifier. When the front-panel +6 kHz switch is depressed, the transistor switch is turned off, lowering the gain of the amplifier. These different gains are necessary to deliver the correct audio level to the metering circuits for two conditions -- one where +4 kHz represents 100 percent modulation and the other where +6 kHz represents 100 percent modulation. The audio output of this operational amplifier is fed to Board A1, where it is processed to drive the modulation meter and peak flashers as described in Section 4.1.1. The audio output of this amplifier is also fed through two amplifiers, one of which contains a deemphasis network, and delivered to the two rear-panel audio output connectors.

When the 730A is operating in the SCA MODULATION mode, any setting of the METER ATTENUATOR setting except "0dB" will switch a 75 u sec or 150 u sec, (selectable by means of an internal jumper), into the audio output circuitry of the Discriminator Board A2 so that the SCA modulation delivered to the Meter Amp Board A1 is de-emphasized. When the switch is in the "0dB" position, the de-emphasis network is switched out of the circuit.

The subcarrier input to Board A2 is also applied to a comparator which acts as a muting circuit. When the SCA subcarrier level drops below the level set by the SCA Mute level control, the muting circuit performs the following functions:

- a. Turns off the front-panel SCA SUBCARRIER LED;
- b. Energizes a relay whose contacts close to operate an external alarm circuit through rear-panel connectors J2 and J3; and
- c. Shorts out the audio output from Z6 to eliminate noise from the speakers or headset in the absence of an SCA signal.

4.1.4 Calibration Circuits.

In the following discussion, assume that the front-panel METER CAL switch is depressed. There are three calibration circuits in the Model 730A -- one for SCA injection, one for SCA modulation, and one for main-channel modulation. The SCA injection calibration signal is derived from a 2144-kHz crystal oscillator on Board A4. This crystal-oscillator output frequency is divided by 32 to give a 67-kHz calibration signal, which is amplified and applied to the input of the first mixer on Board A3.

4.1.4

(Continued).

The SCA modulation calibration signal is also derived from the 2144-kHz crystal oscillator on Board A4. The crystal-oscillator output frequency is divided by 16 and then by 4 to give a 33.5-kHz signal, and is then divided again by 4 to give an 8.375-kHz signal. These latter two frequencies are applied to a NAND gate whose output is a 33.5-kHz signal gated on and off at an 8.375-kHz rate. This calibration signal is fed to the input of the pulse-averaging discriminator on Board A2.

The third calibration signal is for the main channel. This signal is generated by the Model 763 in the calibration mode. In this mode, the composite signal containing a 5 kHz audio tone from the Model 763 is the right level to cause the modulation meter on the Model 730A to read 100 percent.

SECTION 5
MAINTENANCE

5.1 General.

Since the Model 730A is a solid-state instrument and its power requirements are low, no maintenance problems due to high temperature should be encountered, provided the instrument is installed well away from vacuum-tube and other heat-generating equipment. Likewise, because the operating voltages are low, excessive dust accumulation associated with high-voltage devices should not occur.

5.2 Access.

To gain access to the top-of-chassis components, remove six screws from the top cover, three on each side, and then remove the top cover. Removing six similar screws from the bottom cover provides access to the below-chassis components.

5.3 Periodic Maintenance.

Once a year, or more often in dusty locations, remove the printed-circuit boards and blow off the dust with compressed air.

On a regular basis, check the main-channel, SCA injection, and SCA modulation calibrations as described in Sections 3.4, 3.5, and 3.6, respectively.

5.4 Main-Channel Modulation Accuracy Check.

NOTE

For all of the following maintenance checks and adjustments, depress the following pushbuttons unless otherwise directed in the procedure:

METER ATTENUATOR 100% (0dB)
PWR
MEASURE/CAL SCA MOD
#1 67 kHz
SELECTIVITY WIDE
+6 kHz
METER +

To check the accuracy of the modulation meter readings on the main channel, modulate the monitored transmitter with a 1-kHz sinewave, and increase the modulation percentage until the Model 763 meter reads 100%. Depress the MAIN CHAN pushbutton on the Model 730A. The Model 730A meter should also read 100% $\pm 2\%$.

Vary the modulating frequency from 50 Hz to 15 kHz, keeping the modulation percentage at 100% on the Model 763 meter. The Model 730A meter should read 100% $\pm 4\%$ at all frequencies.

If the Model 730A meter does not read within the above tolerances, proceed as follows:

- a. On the Model 730A, depress the METER CAL and the 0 dB METER ATTENUATOR switches.
- b. On the Model 763, depress the CAL switch.
- c. On the Model 730A rear panel, adjust the COMPOSITE LEVEL SET control for a 100% reading on the Model 730A meter.

The above procedure calibrates the Model 730A main-channel measurement circuitry against the calibration standard in the Model 763. If calibration against a laboratory standard is desired, a Bessel-null measurement using a spectrum analyzer must be performed.

5.5 SCA Injection Accuracy Check.

To check the accuracy of SCA injection measurements, proceed as follows:

- a. Modulate the monitored transmitter with precisely 67 kHz at a level that produces a 10% reading on the Model 763 meter. Use a frequency synthesizer for the modulation source, or measure the modulation with a frequency counter to ensure that the frequency is precisely 67 kHz.
- b. On the Model 730A front panel, depress the following buttons:

MEASURE/CAL SCA INJ

Either METER + or METER -

METER ATTENUATOR -20 dB

SELECTIVITY WIDE.

- c. The meter should read 100% $\pm 1\%$, indicating 10% injection. If it does not, adjust the front-panel SCA INJ CAL control until it does.
- d. Depress the SELECTIVITY NARROW pushbutton. The meter should still read 100% $\pm 1\%$. If it does not, adjust GAIN BALANCE potentiometer R27 on Board A3 until the meter reading is the same with either the NARROW or WIDE SELECTIVITY switch depressed.
- e. Depress the METER CAL pushbutton. The meter should read 100% $\pm 5\%$. This represents an SCA injection of 10% $\pm 0.5\%$.

5.6

SCA Modulation Accuracy Check.

To verify the accuracy of SCA modulation measurements, it is necessary to perform a Bessel-null calibration on the 67-kHz subcarrier using a spectrum analyzer and an audio generator with a frequency counter.

- a. Set the audio generator to precisely 1087 Hz, and verify this with a counter. Use the 1087-Hz signal to modulate the 67-kHz SCA subcarrier.
- b. Observe the 67-kHz subcarrier on a spectrum analyzer, and increase the amplitude of the 1087-Hz modulation until a second Bessel null is achieved.
- c. Modulate the transmitter with this 67-kHz signal, or feed the 67-kHz signal directly into the COMPOSITE INPUT (J1) or WIDEBAND INPUT (J9) of the Model 730A.
- d. Depress the following 730A front-panel pushbuttons:
 - SCA MOD
 - EITHER METER + or METER -
 - SELECTIVITY WIDE
 - ± 6 kHz
 - METER ATTENUATOR 100% (0 dB)
- e. The meter should read 100% $\pm 4\%$. If it does not, adjust the SCA MOD CAL control until it does.
- f. With the % PEAK MODULATION thumbwheel switches set for 100%, the + and - flashers should be on. If they are not, adjust the FLASHER CAL control so that the flashers just come on.

- g. Depress the 730A front-panel METER CAL pushbutton. The meter should read 100% +4% and the flashers should come on when the thumbwheel switches are set to 100% +4%.

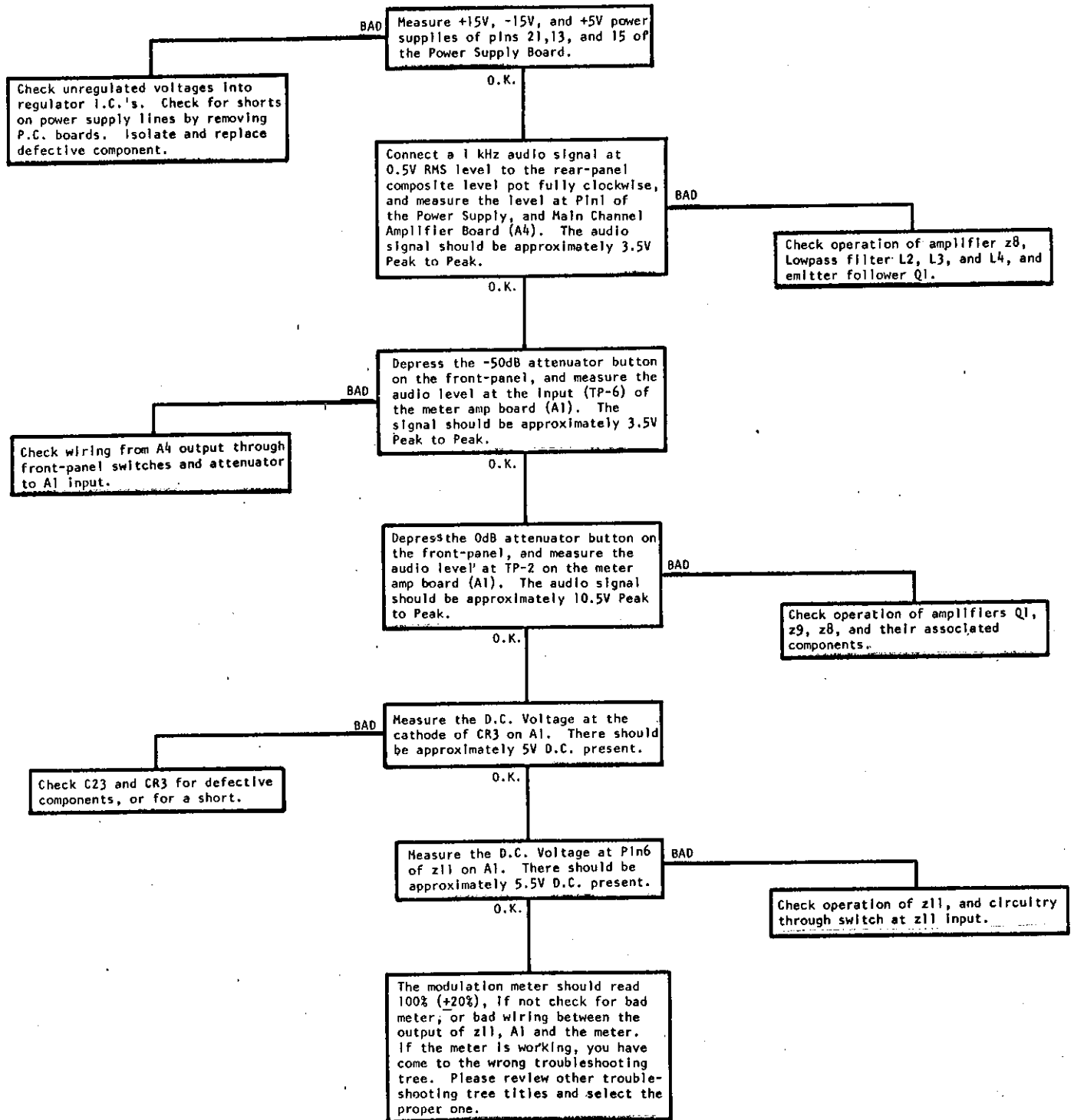
5.7

Troubleshooting Guides.

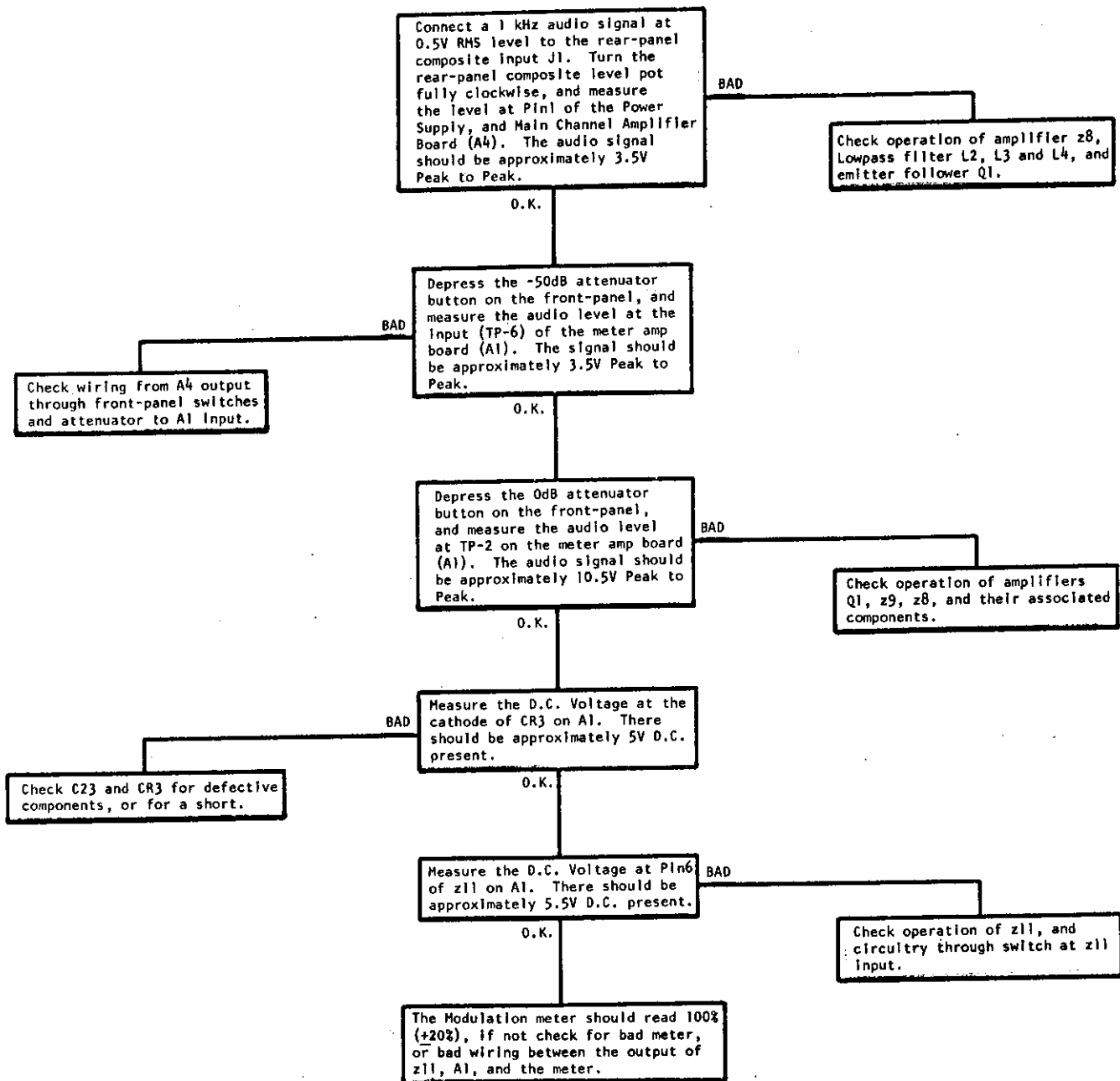
Four troubleshooting trees are presented in Sections 5.7.1 through 5.7.4 as an aid in isolating the causes of a failure. To use the guides, start at the top and do whatever is required to answer the question in the first box. Then proceed to the next operation along the route determined by the answer to the first question. Continue this sequence until the fault is found.

5.7.1 Instrument does not work in any mode.

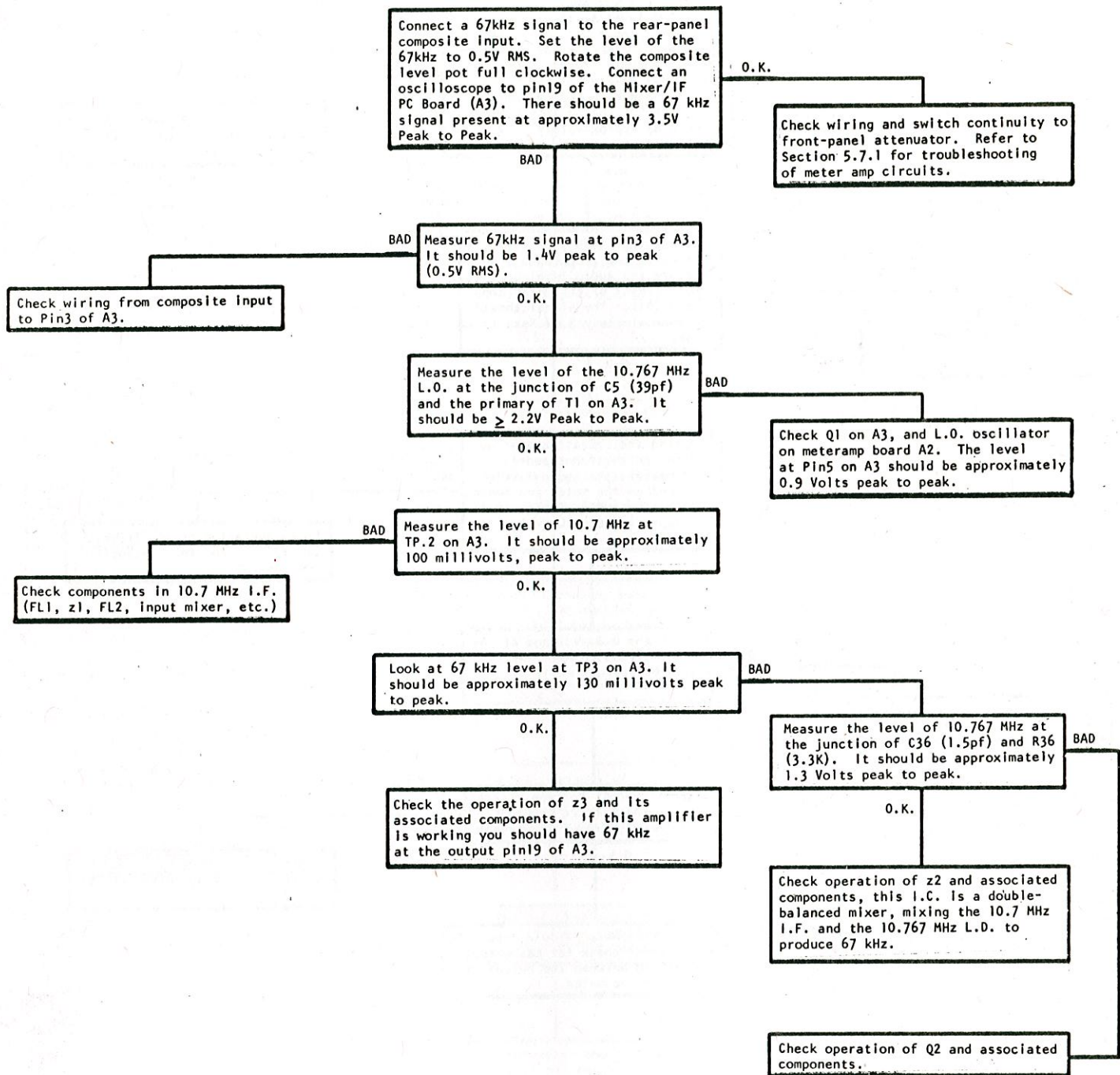
If the Instrument does not work in any mode, first check the power line fuse, and look at all P.C. Boards for obviously "Burned" or defective components. If fuse is blown, remove all P.C. Boards by re-inserting one at a time, starting with the power supply board. If fuse is O.K. go to troubleshooting tree below.



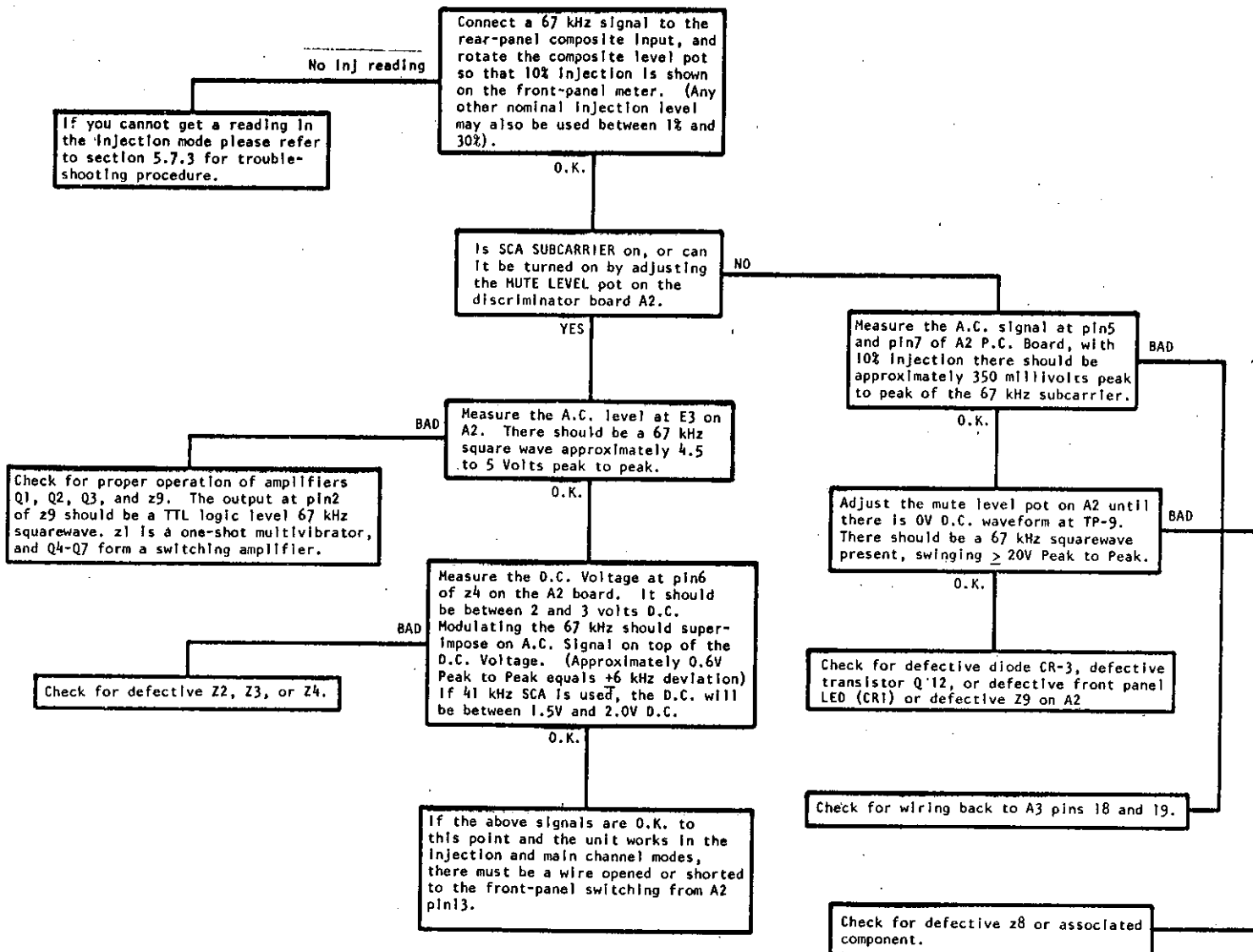
5.7.2 Main Channel (L + R) does not work, but SCA Injection and SCA Modulation functions do work.



5.7.3 SCA Injection does not work, but main channel (L + R) does work.



5.7.4 SCA Modulation does not work but SCA Injection does.



+5V

WI

50