BROADCAST EQUIPMENT

FM-10BM

10 WATT MULTIPLEX EXCITER

INSTRUCTION BOOK

INDUSTRIAL TRANSMITTERS AND ANTENNAS, INC.

LANSDOWNE · PENNSYLVANIA

FM-10BM

10 WATT MULTIPLEX EXCITER

INSTRUCTION BOOK

TABLE OF CONTENTS

FOREWORD

This instruction book is intended to serve as reference for the tuning and maintenance of the ITA multiplex equipment.

In general, the arrangement of the equipment will be in two systems. In one, the multiplex equipment will be housed in the same cabinet as the main carrier exciter. This combination is identified as the FM-10BM multiplex exciter.

In a second arrangement, the sub-carrier generator and mixer panel are housed in a separate 19" cabinet and interconnected with the main carrier exciter which is located with the FM broadcast transmitter.

In order to reduce the complexity of this instruction book, complete tuning instructions for each arrangement will be presented. In addition, the description and theory associated with the sub-carrier generator, mixer panel and power supply are included.

PERFORMANCE SPECIFICATIONS - PROGRAM EXCITER

Type of Emission	FM
Frequency Range	88 to 108 mc
(On Request)	44 to 54 mc
Rated Power Output	10 watts
RF Output Impedance	50 ohms
Input Impedance	600
Input Audio Level	+10 ±2 dbm
Amplitude vs. Frequency	±1 db from 50 to 15000 cycles
Carrier Frequency Stability	±1000 cycles
Modulation Capability	±100 kc
Audio Frequency Distortion	1.0% max. 50-100 cycles
	.5% max. 100-7500 cycles
	1.0% max. 7500-15000 cycles
FM Noise Below ±75 kc	65 db
AM Noise, r.m.s.	55 db below carrier

ELECTRICAL SPECIFICATIONS - PROGRAM EXCITER

POWER LINE REQUIREMENTS:

Voltage	115 volts, 50/60 cycles, 1 phase
Slow Line Variations	±5%
Rapid Line Variations	±3%
Regulation	3%
Power Consumption	175 watts (approximately)
Power Factor (approx.)	90%

* MECHANICAL SPECIFICATIONS - PROGRAM EXCITER

Width	19"
Height	21"
Depth	3½"
Weight	60 lbs. approximately
Maximum Altitude	7500 feet
Ambient Temperature	45°C. max. =10°C. min.

* TUBE COMPLEMENT - PROGRAM EXCITER

Type Number	Quantity
12AT7	4
12AX7	1
12AU7	1
6BH6	6
5763	1
6146	1
5R4GY	1
OD3	2

* WITH POWER SUPPLY

PERFORMANCE SPECIFICATIONS - SUB-CARRIER GENERATOR

Type of Emission..... FM
Frequency Range..... 26 to 67 kc
Input Impedance ..... 600 ohms
Input Audio Level..... +10 ±2 dbm
Amplitude vs. Frequency..... ±1 db from 50 to 15000 cycles
Carrier Frequency Stability..... ±1000 cycles
Modulation Capability..... 12.5 kc
Audio Frequency Distortion..... 1.0% max. 50-100 cycles
.5% max. 100-7500 cycles
1.0% max. 7500-15000 cycles
FM Noise Below 12.5 kc..... 50 db
AM Noise r.m.s. ..... 55 db below carrier

ELECTRICAL SPECIFICATIONS - SUB-CARRIER GENERATOR

POWER LINE REQUIREMENTS:

Voltage..... 115 volts, 50/60 cycles, 1 phase
Slow Line Variations..... ±5%
Rapid Line Variations..... ±3%
Regulation..... 3%
Power Consumption..... 125 watts (approximately)
Power Factor (approx.) 90%

MECHANICAL SPECIFICATIONS - SUB-CARRIER GENERATOR

Width..... 19"
Height..... 17½"
Depth..... 3½"
Weight..... 60 lbs. approximately
Maximum Altitude..... 7500 feet
Ambient Temperature..... 45°C. max. + 10°C. min.

TUBE COMPLEMENT - SUB-CARRIER GENERATOR

Type No.	Quantity
12AT7	6
12AX7	3
12AU7	1
6BH6	4
5R4GY	1
OD3	1

OVERALL CROSS MODULATION SPECIFICATIONS

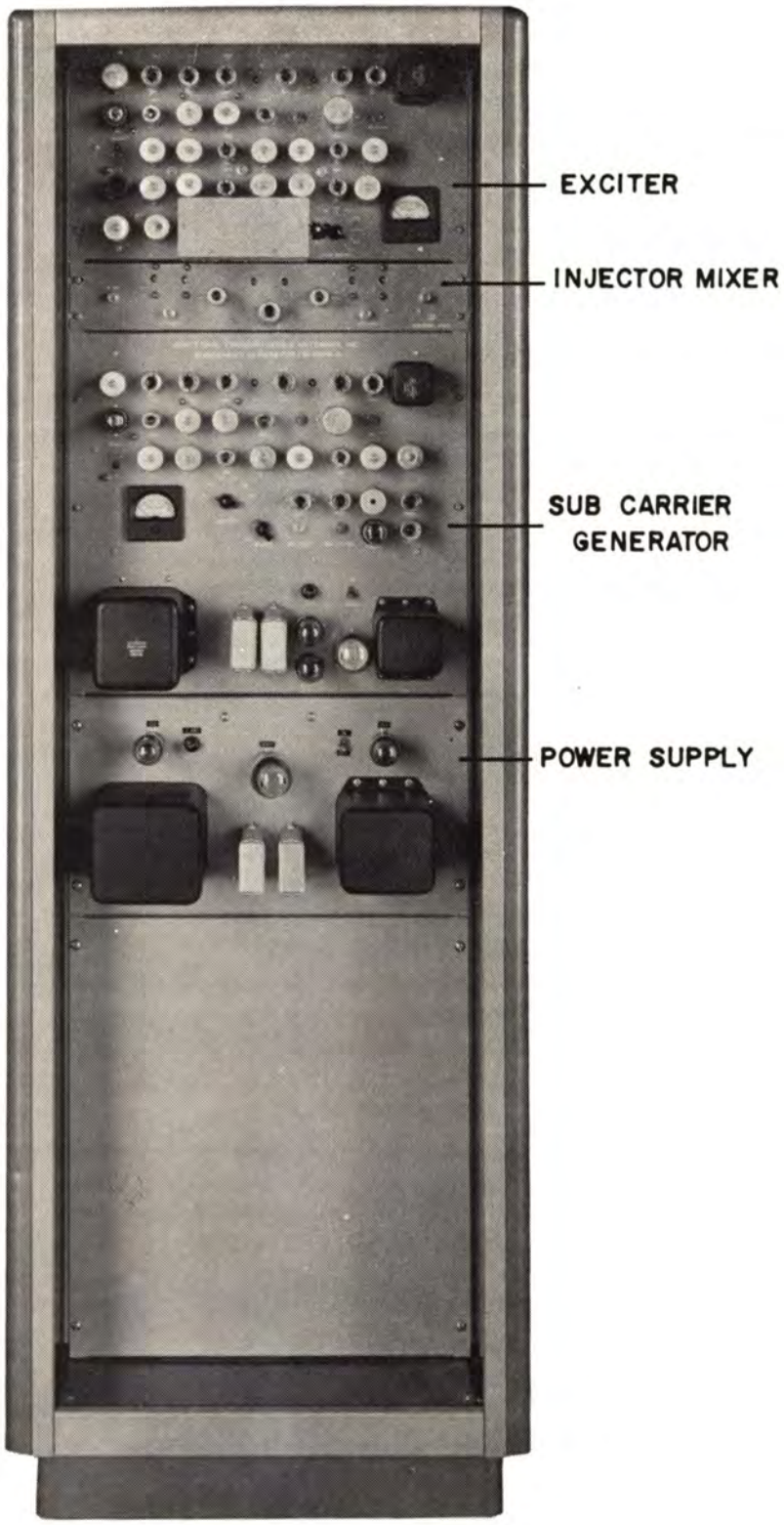
SUB-CARRIER TO MAIN

With 100% modulation on the sub-carrier using a modulation of 400 CPS and measuring with a standard 75 microsecond de-emphasis and a 15 KC low pass filter, the energy available on the main carrier will be at least 65 db below the level required to modulate the main carrier 100%.

MAIN TO SUB-CARRIER

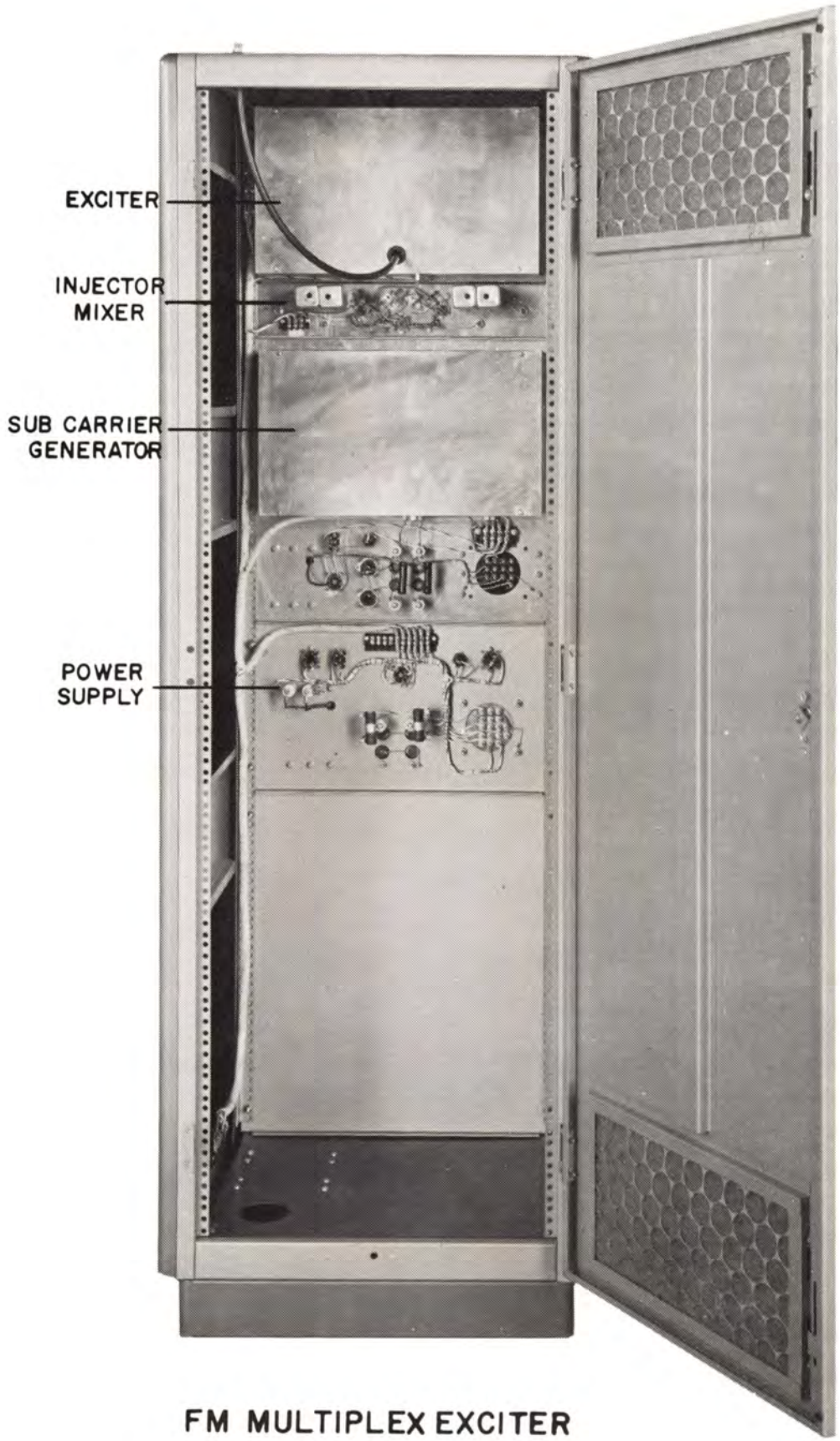
With 70% modulation of the main carrier, measuring with a standard 75 microsecond de-emphasis and a 7.5 KC low pass filter the energy available on the sub-carrier will be at least 50 db below the energy required to modulate it 100% at 400 cycles.

* * * * * *



FM MULTIPLEX EXCITER

Figure 1, Front View



FM MULTIPLEX EXCITER

Figure 2, Rear View

TUNING INSTRUCTIONS

for

ITA FM-10BM MULTIPLEX EXCITER

Step #1

Install the FM-10BM cabinet in place. Install a substantial ground between the cabinet and a known station ground.

Step #2

Connect 115VAC to the power line terminals located on the bottom of the cabinet. Entrance may be had through a hole in the cabinet base. In addition, connect the audio lines to both the main carrier exciter and the sub-carrier exciter.

Step #3

Connect the RF output of the carrier exciter to the input of the RF stage within the transmitter it is intended to drive. This output is available at the type N receptacle at the top of the cabinet.

Step #4

Install one 5R4GY and two OD3 tubes in the carrier exciter power supply panel.

Step #5

Turn the switch on the main carrier exciter power supply to ON. Then follow the tuning instructions for the main carrier exciter located in the "main carrier exciter" section of this instruction book.

Step #6

Install one 5R4GY and two OD3 tubes in the sub-carrier generator panels. Turn on its power switch and follow the tuning instructions for the "sub-carrier generator" in this instruction book.

Step #7

Turn off the switch on the exciter power supply panel and remove the short jumper that is located on the main exciter panel. Interconnect the mixer panel with the main carrier panel by connecting a cable from the output of V11 (j1) to the RF input jack on the mixer panel and by connecting the RF cable from the input to V12 of the main carrier exciter (J2) and the RF output jack on the mixer panel. In addition, connect a cable from the sub-carrier generator output jack to one of the audio input jacks of the mixer panel.

Step #8

Turn on the main program exciter power supply. Remove tube V1, 6AU6, from the mixer panel and quickly tune the mixer panel capacitors C1 and C2 and then capacitors C5 and C6 for maximum indication of the V12 meter reading on the main program exciter.

Step #9

Restore V1 to its position on the mixer panel and observe the output before de-emphasis of a multiplex receiver. Adjust capacitors C3 and C4 on the mixer panel to obtain the cleanest sub-carrier waveform while maintaining 15% sub-carrier injection.

Step #10

Retune capacitors C1 and C2 for maximum RF drive to V12 of the program exciter.

Step #11

Modulate the main carrier with 70% modulation at 400 cycles and observe the crosstalk from a multiplex receiver. Then adjust the RF stages from V11 in the exciter to the output of the transmitter for minimum crosstalk consistent with maximum drive. If any neutralization controls exist they should also be adjusted for minimum crosstalk.

INTERCONNECTION OF SUB-CARRIER GENERATOR
and
INJECTOR PANEL
with
ITA FM BROADCAST TRANSMITTER

Step #1

Install the sub-carrier generator to the left of the driver cabinet.

Step #2

Install the mixer panel on the same rack.

Step #3

Connect jumper wires between the 300 volt regulated voltage of the sub-carrier generator to the mixer panel and the 6.3 volt filament terminal of the sub-carrier panel to the mixer panel. These terminals are the first and third feed thru capacitors on the sub-carrier frame respectively when viewed from the rear.

Step #4

Connect an RF cable between the output of the sub-carrier generator and one of the input terminal jacks of the injector panel.

Step #5

Be sure that the line switch is "off" and connect the 110 volt AC to the appropriate terminals on the sub-carrier generator.

TUNING INSTRUCTIONS

Step #1

Refer to the tuning instructions for the sub-carrier generator and tune it properly.

Step #2

Turn on the program exciter and without touching any of its tuning controls, refer to the alignment procedure in the sub-carrier instructions.

Step #3

Modulate the main program channel with 70% modulation at 400 cycles and observe the crosstalk from the multiplex receiver. Then adjust the RF stage from V11 in the exciter to the output of the transmitter to obtain minimum crosstalk. These adjustments will be in the vicinity of maximum drive positions. If any neutralization controls exist, they should also be adjusted for minimum crosstalk.

FM-10BM PROGRAM EXCITER

MECHANICAL DESCRIPTION

This panel requires only 10½" of panel space in a standard 19" rack. Its power supply requires an additional 10½" of panel space. All of its tuning controls are available from the front panel. RF connectors are available on the RF panel to interconnect the program exciter with the multiplex mixer.

ELECTRICAL DESCRIPTION

Referring to the block diagram, it can be seen that this unit is a conventional phase modulated exciter. It consists of a low frequency oscillator which triggers a sawtooth oscillator. This sawtooth wave is truncated by the grid conductance of a triode which serves as the modulator. By introducing an audio voltage in series with the cathode of this stage, the point of truncation changes at an audio rate. This truncation is differentiated and multiplied by a frequency multiplier to produce a sine wave at three times the crystal frequency. A series of frequency multipliers follow which produce an output of 10 watts at the final frequency. The grid current of each stage is monitored and helps facilitate the tuning of the double tuned circuits that intercouple the RF multipliers. The exciter contains a pre-emphasis circuit in accordance with the standard 75 microsecond pre-emphasis curve.

The circuit between tubes V11 and V12 is completed by either a short jumper cable or by interconnection with the injector panel.

TUNING PROCEDURE

Step #1

Inspect the program exciter and its power supply and install on these panels all of their respective tubes and shields.

Step #2

Terminate the output of the exciter with a suitable load such as the input of an amplifier, antenna, or conventional resistance load.

Step #3

Attach the 115VAC line to the power input terminals. Turn the exciter line switch to ON. (In the FM-10BM exciter this switch is located on the power supply)

Step #4

Turn the selector switch to V1 position and adjust L1 until the meter reads approximately 20% below the maximum value on the slow rising side of the

tuning curve. (Refer to exciter panel layout for coil location)

Step #5

Turn the selector switch to V8 and adjust L2 and L3 for a maximum indication.

Step #6

Turn the selector switch to V9 and adjust L5 and then L4 for a maximum indication.

Step #7

Turn the selector switch to V10 and adjust L7 and then L6 for a maximum indication.

Step #8

Turn the selector switch to V11 and adjust L9 and then L8 for a maximum indication.

Step #9

Turn the selector switch to V12 and adjust L11 and then L10 for a maximum indication.

Step #10

Turn the selector switch to V13 and adjust L13 and then L12, then L12A for a maximum indication.

Step #11

Turn the selector switch to V14 and adjust L15, then L14, and then L14A for a maximum indication.

Step #12

Turn the selector switch to V14C and adjust the output tuning of the 6146 for a dip in cathode current or maximum drive on the following stage.

Step #13

Turn the program exciter off and connect the audio line to the program exciter. Then turn the exciter on and observe the audio level required at 400 cycles to produce 100% modulation. It should be approximately 10 dbm.

THE PROGRAM EXCITER HAS NOW BEEN TUNED.

MISCELLANEOUS CONTROLS

There exists within the FM-10BM program exciter controls that are preset at the factory and, in general, will not require any field adjustment. A brief description of these controls follows:

Exciter Chassis

C9

This front panel air capacitor is used for fine frequency adjustment. It is identified as "trimmer".

C23

This variable ceramic capacitor (available at the front of the panel) controls the slope of the sawtooth wave and hence the sensitivity of the modulator proper. The indication is the carrier frequency deviation as observed on a monitor. With plus 10 dbm at an audio frequency between 200 and 500 cycles, the capacitor is adjusted to give a deviation of plus and minus 75 kilocycles peak.

C79

This variable ceramic capacitor rarely requires readjustment, and should only be moved if 50 cycle distortion is excessive or random noise is high. It should then be readjusted for minimum of either of the above two indications.

R40

This variable resistor controls the cathode bias of the first section of V4, the modulator. This bias determines the amplitude and hence the phase at which truncation of the sawtooth wave occurs. The proper phase is in a reasonably large range (about 60 degrees) midway between discharges of the sawtooth wave. The most satisfactory way of adjusting this element is as follows: applying a high amplitude tone- plus 15 to 20 dbm at 50 cycles to the audio input terminals, determine the two positions of the control between which the recovered tone from the monitor is clean. This may be judged aurally or visually according to convenience. The correct setting is midway between these extremes.

The break from a clean signal to a distorted one is abrupt and drastic.

* * * * *

EXCITER VOLTAGES

Pin No.	VI	V2	V3	V4	V5	V6	V7
1	175	35	13	30	75	247	-11.8
2	-18	-8	-4.4	14	2.5	75	-
3	-	-	-	17	3	160	-
4	6.3AC	6.3AC	6.3AC	6.3AC	6.3AC	6.3AC	6.3AC
5	6.3AC	6.3AC	6.3AC	6.3AC	6.3AC	6.3AC	230
6	160	250	255	30	123	240	175
7	-40	-20	12	0	15	80	-
8	-	1.25	16	-	16	75	-
9	-	-	-	-	-	-	-

Pin No.	V8	V9	V10	V11	V12	V13	V14
1	-12	-12	-10	-12	-10.5	175	11
2	-	-	-	-	-	-	6.3AC
3	-	6.3AC	6.3AC	0	6.3AC	3.2	115
4	6.3AC	-	-	6.3AC	6.3AC	-	11
5	220	225	225	215	215	-	4.5
6	115	115	120	195	125	200	11
7	-	-	-	-	-	3.2	-
8	-	-	-	-	-	-4.2	-
9	-	-	-	-	-	-4.2	Cap.250

NOTE: All voltage readings made with vacuum tube voltmeter. All readings are taken with respect to GROUND and are DC unless otherwise noted.

EXCITER PARTS LIST

SYMBOL NO.

C1	Capacitor	Fixed	Met. paper	1mfd
C2	"	"	Paper	.05mfd
C3	"	"	Mica	1500mmfd
C4	"	"	Mica	470mmfd
C5	"	"	Mica	39mmfd
C6	"	"	Disc	.04mfd
C7	"	"	Electrolytic	20mfd (Part of quad unit)
C8	"	"	Met. paper	1mfd
C9	"	Variable	Ceramic	7-45mmfd
C10	"	Fixed	Met. paper	1mfd
C11	"	"	Mica	1200mmfd
C12	"	"	"	3.3mmfd
C13	"	"	Paper	1mfd
C14	"	"	Disc	.01mfd
C15	"	"	Disc	.01mfd
C16	"	"	Met. paper	.1mfd
C17	"	"	Disc	.01mfd
C18	"	"	"	.01mfd
C19	"	"	Paper	.005mfd
C20	"	"	Met. paper	1mfd
C21	"	"	Disc	.01mfd
C22	"	"	Mica	330mmfd
C23	"	Variable	Ceramic	7-45mmfd
C24	"	Fixed	Paper	.005mfd
C25	"	"	Met. paper	2mfd
C26	"	"	Disc	.01mfd
C27	"	Variable	Air	E.F.Johnson 10LB15
C28	"	Fixed	Paper	.005mfd
C29	"	"	Disc	.01mfd
C30	"	"	Mica	220mmfd
C31	"	"	Disc	.01mfd
C33	"	"	Mica	220mfd
C34	"	"	"	47mmfd
C35	"	"	Disc	.01mfd
C36	"	"	"	.01mfd
C37	"	"	Mica	35mmfd
C38	"	"	"	5mmfd
C39	"	"	Ceramic	.5mmfd
C40	"	"	Mica	27mmfd
C41	"	"	"	47mmfd
C42	"	"	Disc	.01mfd
C43	"	"	"	.01mfd
C44	"	"	"	.01mfd
C45	"	"	Ceramic	3.3mmfd
C46	"	"	"	.5mmfd
C47	"	"	"	3.3mmfd
C48	"	"	Disc	.01mfd
C49	"	"	Mica	47mmfd

SYMBOL NO.

C50	Capacitor	Fixed	Disc	.01mfd
C51	"	"	"	.01mfd
C52	"	"	Ceramic	.5mmfd
C53	"	"	Disc	.01mfd
C54	"	"	Mica	47mmfd
C55	"	"	Disc	.01mfd
C56	"	"	"	.01mfd
C57A	"	"	Mica	10mmfd
C57B	"	"	"	51mmfd
C58A	"	"	"	39mmfd
C58B	"	"	"	3.3mmfd
C59A	"	"	"	3.3mmfd
C59B	"	"	"	51mmfd
C60	"	"	"	47mmfd
C61	"	"	Disc	.01mfd
C62	"	"	"	.01mfd
C63	"	"	"	.01mfd
C65A	"	"	Mica	1mmfd
C65B	"	"	"	1mmfd
C67	"	"	Disc	.01mfd
C68	"	"	"	47mmfd
C69	"	"	"	.01mfd
C70	"	"	"	.01mfd
C71	"	"	"	.01mfd
C72A	"	"	Mica	5mmfd
C72B	"	"	"	.5mmfd
C73	"	"	Disc	.01mfd
C74	"	"	Mica	47mmfd
C75	"	"	Disc	.01mfd
C76	"	"	"	.01mfd
C77	"	"	Feed thru	.001mfd
C78	"	"	Mica	330mmfd
C79	"	"	Ceramic	7-45mmfd
C80	"	"	Feed thru	.001mfd
C81A	"	"	Mica	.5mmfd
C81B	"	"	"	5mmfd
C82	"	"	"	15mmfd
C83	"	"	"	5mmfd
C84	"	"	Feed thru	.001mfd
C85	"	"	" "	.001mfd
C86	"	"	Paper	.02mfd
C87	"	"	Feed thru	.001mfd
C88	"	"	" "	.001mfd

L1	Inductor	Variable	Miller	#4414
L2	"	"	"	#4413
L3	"	"	"	#4413
L4	"	"	"	#4413
L5	"	"	"	#4413
L6	"	"	"	#4411

SYMBOL NO.

L7	Inductor	Variable	Miller	#4411
L8	"	"	"	#4409
L9	"	"	"	#4409
L10	"	"	"	#4406
L11	"	"	"	#4406
L12	"	"	"	#4404
L12A	"	"	"	#4406
L13	"	"	"	#4404
L14	"	"	"	#4403 Mod.
L14A	"	"	"	#4404
L15	"	"	"	#4403 Mod.
L16	"	Fixed	Special Stock	
RFC1	Choke	Fixed	Ohmite Z50	
RFC2	"	"	" "	
RFC3	"	"	" "	

RESISTORS

R4	Fixed	150K-1W
R5	"	15K-1W
R6	"	18K
R7	"	100K
R8	Potentiometer	2500-2W
R9	Fixed	4.7K
R10	"	10K-1W
R11	"	1 Meg.
R12	"	330K-1W
R13	"	330K-1W
R14	"	8.2K
R15	"	470
R16	"	39K-1W
R17	"	100K-1W
R18	"	4.7K-1W
R19	"	8.2K-2W
R20	"	180
R21	"	22K-1W
R22	"	1.2 Meg
R23	"	47
R24	"	1 Meg
R25	"	33K-1W
R26	"	27K-2W
R27	"	3.9K-1W
R28	"	2.7K
R29	"	3.3K
R30	"	270K-1W
R31	"	39K-1W
R32	"	27K-1W
R33	"	1.5K-1W
R34	"	100K
R35	"	2.2K
R36	Fixed	1.2 Meg.
R37	"	68K
R38	"	750
R39	"	4.7K-1W
R40	Potentiometer	50K-2W
R41	Fixed	390K-1W
R42	"	4.7K
R43	"	47K-1W
R44	"	15K-1W
R45	"	390K-1W
R46	"	100K
R47	"	100K
R48	"	2.7K-1W
R49	"	27K
R50	"	1.5K
R51	"	2.2K
R52	"	47K
R53	"	100K
R54	"	2.7K-1W
R55	"	2.2K
R56	"	2.2K
R57	"	47K
R58	"	100K
R59	"	2.7K-1W
R60	"	1.5K
R61	"	2.2K
R62	"	47K
R63	"	100K
R64	"	2.7K-1W
R65	"	3.3K
R66	"	2.2K
R67	"	100K

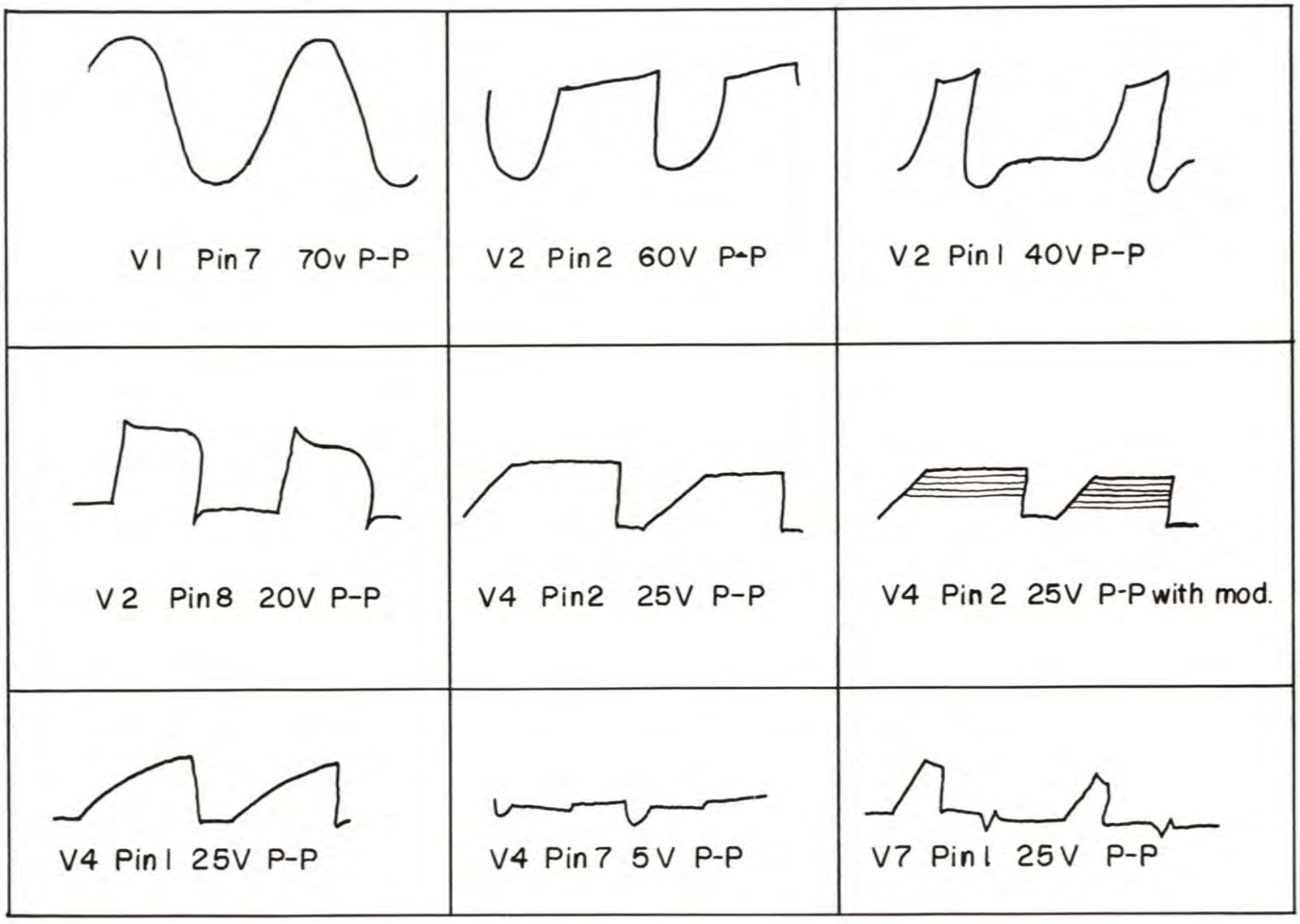
RESISTORS

R68	Fixed	100K
R69	"	2.7K-1W
R70	"	2.2K
R71	"	2.2K
R72	"	100K
R73	"	27K
R74	"	2.7K-1W
R75	"	2.2K
R76	"	2.2K
R77	"	100K
R78	"	150-2W
R79	"	10K-2W
R80	"	3K-5W
R81	"	10K
R82	Fixed	2.2K
R83	"	100K
R84	"	100K
R85	"	500-10W
R86	"	100K-1W
R87	"	1K-10W
R88	"	180
R89	"	180
R90	"	180
R91	"	180
R92	"	470
R96	"	150K
R97	"	47K-1W
R100	"	1K

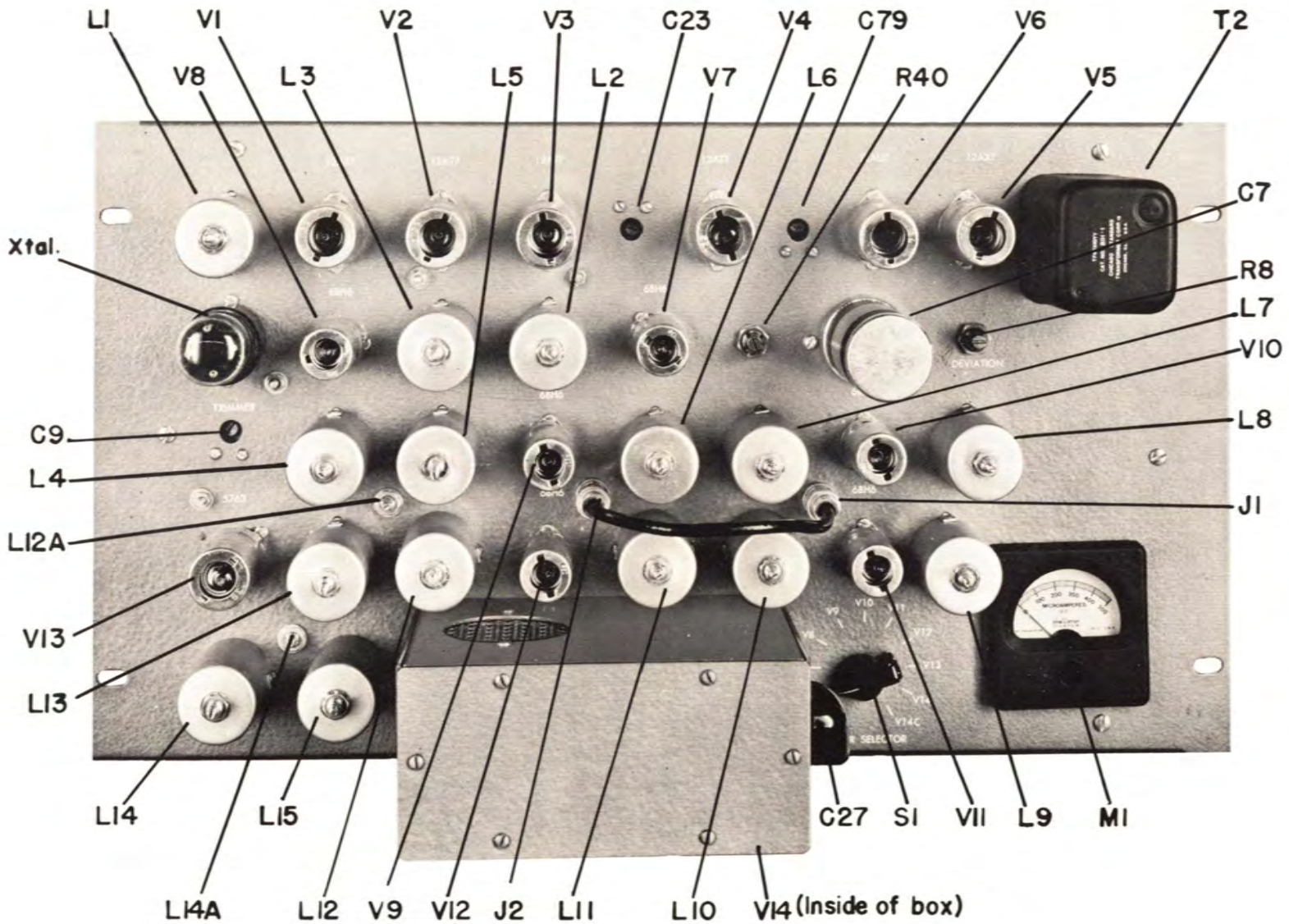
NOTE: - Power ratings $\frac{1}{2}$ watt unless noted differently. All values in ohms.

TUBES

V1	12AT7
V2	"
V3	"
V4	"
V5	12AX7
V6	12AU7
V7	6BH6
V8	6BH6
V9	"
V10	"
V11	"
V12	"
V13	5763
V14	6146



EXCITER WAVEFORMS

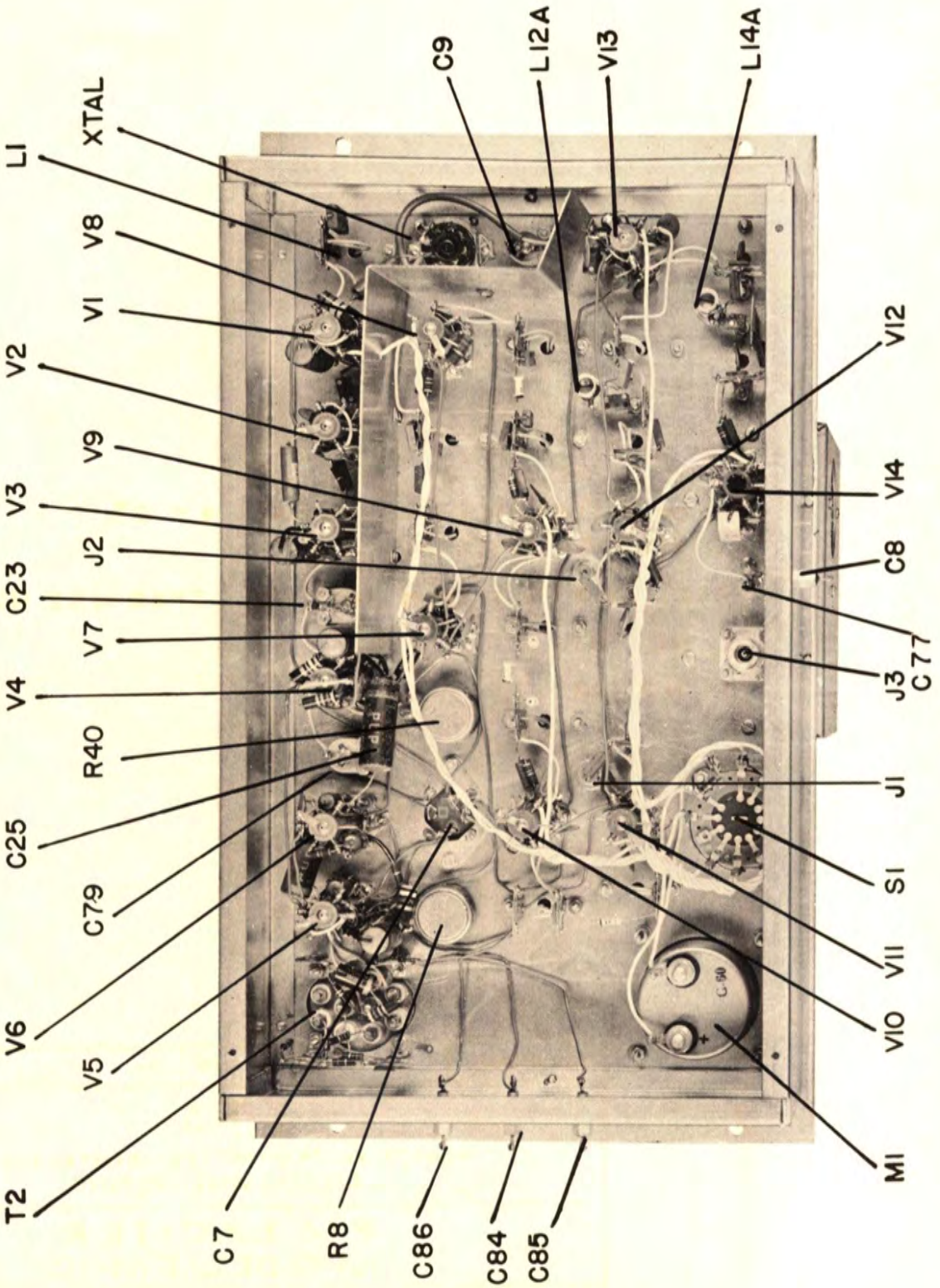


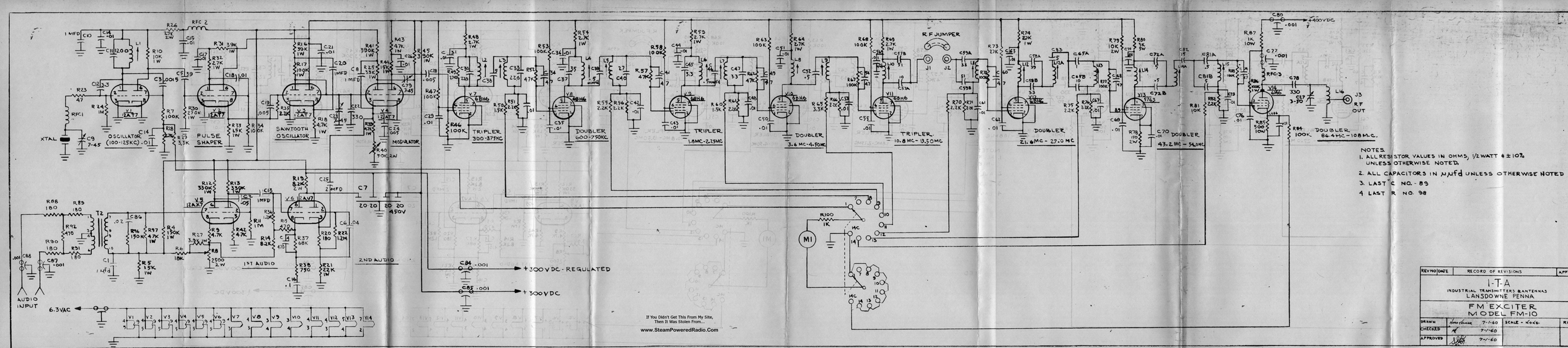
EXCITER UNIT—FRONT VIEW

Figure - XA

EXCITER UNIT—REAR VIEW

Figure 'XB





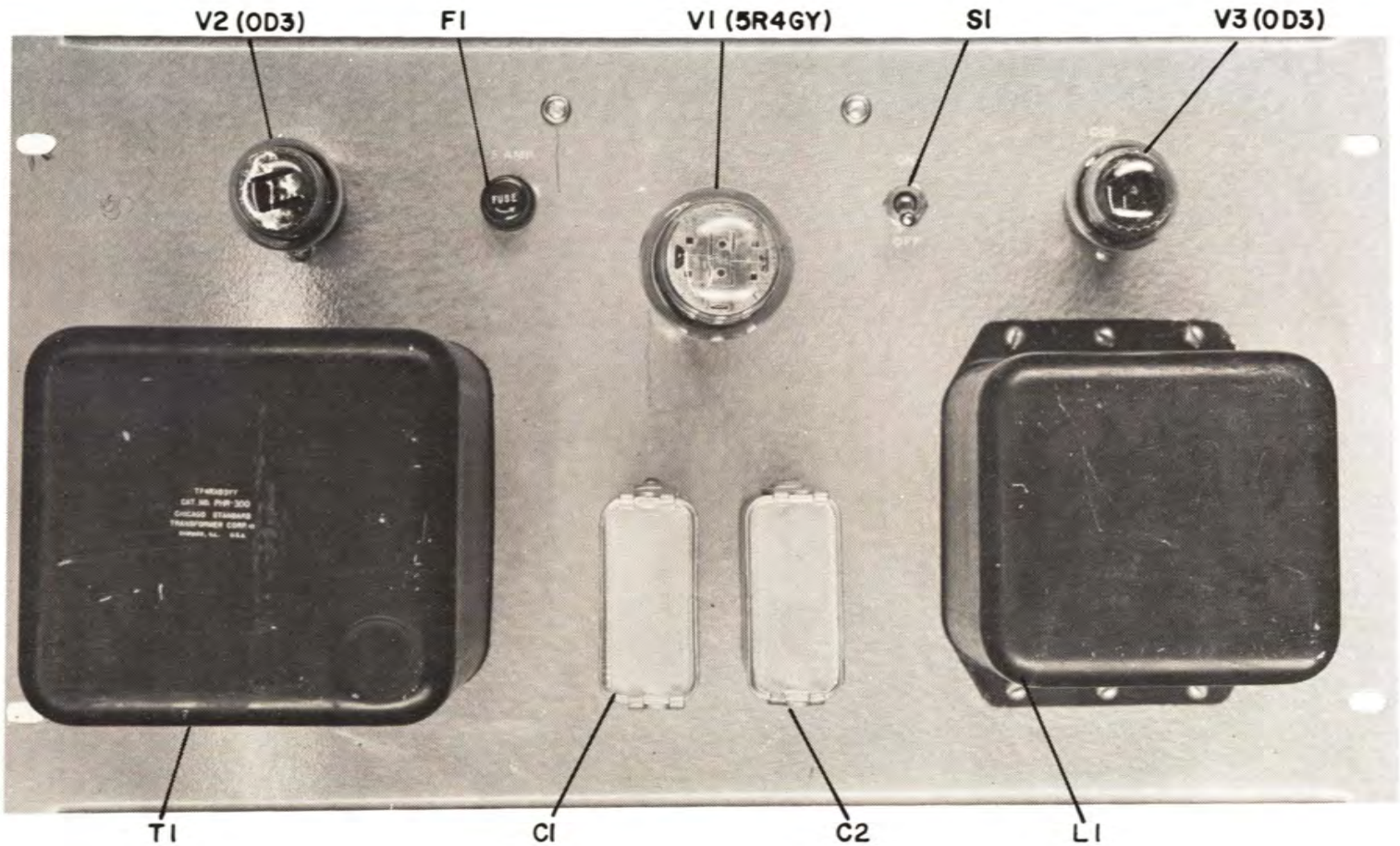
NOTES.
1. ALL RESISTOR VALUES IN OHMS, 1/2 WATT ± 10% UNLESS OTHERWISE NOTED.
2. ALL CAPACITORS IN mmfd UNLESS OTHERWISE NOTED
3. LAST C NO. - 83
4 LAST R NO. 98

REV NO	DATE	RECORD OF REVISIONS	APP'D

I-T-A
INDUSTRIAL TRANSMITTERS & ANTENNAS
LANSDOWNE PENNA

FM EXCITER
MODEL FM-10

DRAWN	[illegible]	7-1-60	SCALE - NONE
CHECKED	[illegible]	7-1-60	REV
APPROVED	[illegible]	7-1-60	

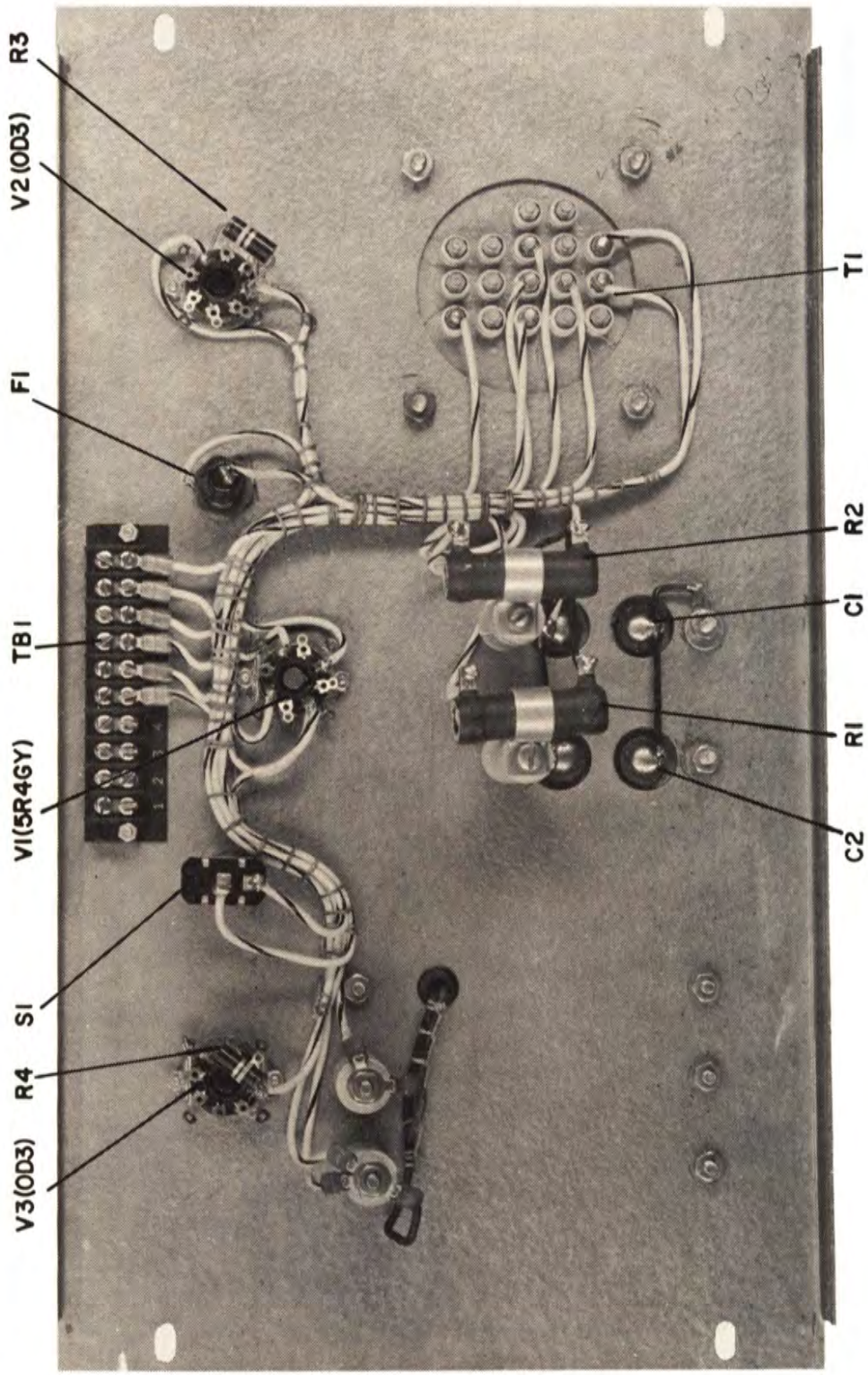


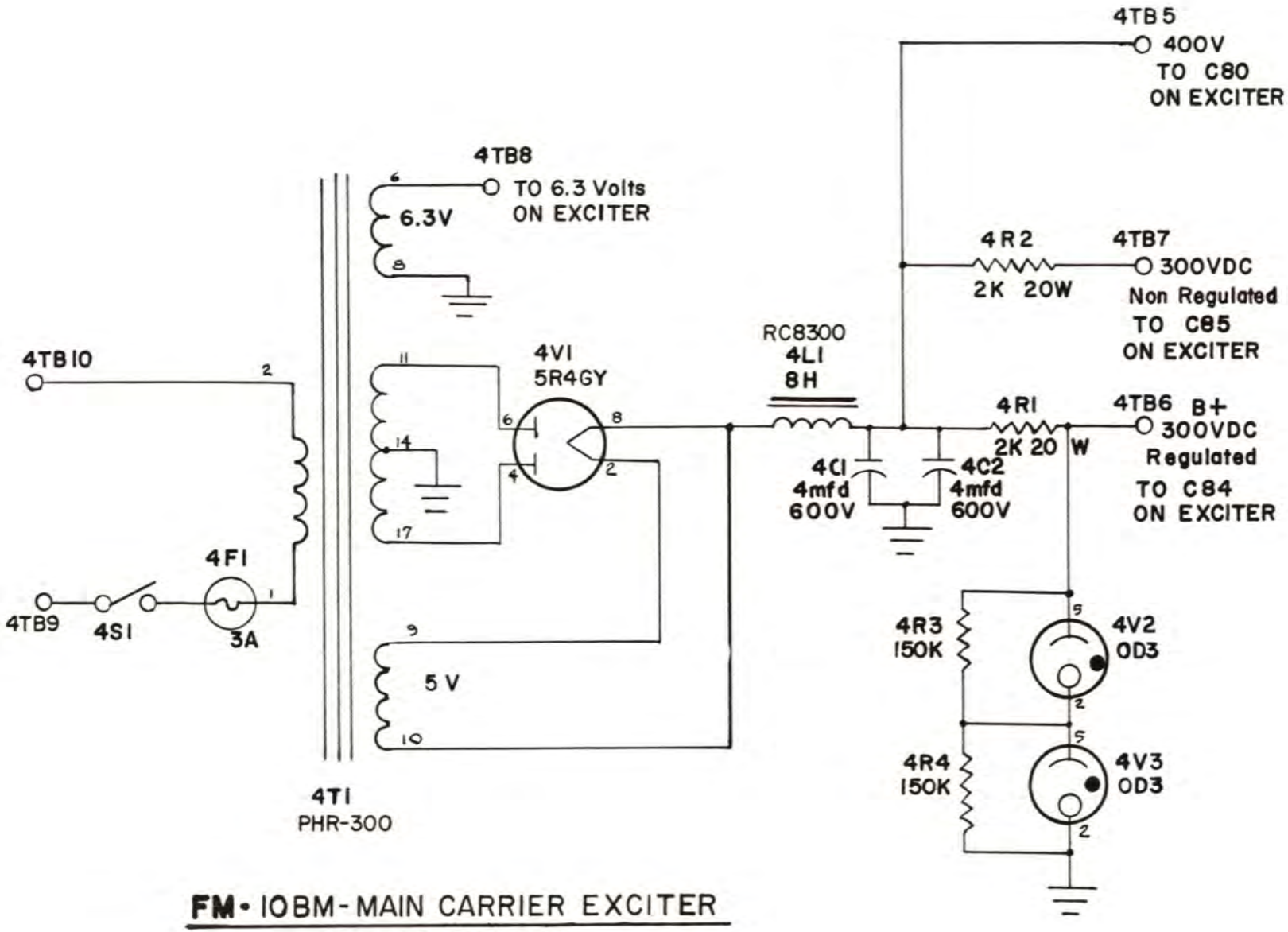
FM-10BM MAIN CARRIER EXCITER POWER SUPPLY

Figure 3, Front View

FM-10BM MAIN CARRIER EXCITER POWER SUPPLY

Figure 4, Rear View





FM-10BM-MAIN CARRIER EXCITER

POWER SUPPLY

FM-10BM SUB-CARRIER GENERATOR

MECHANICAL DESCRIPTION

The FM-10BM sub-carrier generator requires 17½" of panel space in a standard 19" rack. It has provisions on its panel for interconnection with the injector panel as well as terminal boards for audio and power line connections.

ELECTRICAL DESCRIPTION

The sub-carrier generator is a high fidelity phase modulator whose first six stages are identical to that of the program exciter of the FM-10BM. Thus, for a theoretical explanation of the modulation, refer to the electrical description of the program exciter.

The modulated carrier is frequency multiplied until a frequency of 10.8 mc is achieved. At this point in the RF chain it is mixed together with a local crystal oscillator whose frequency differs from the modulated carrier by the desired sub-carrier frequency. For example, if a 67KC sub-carrier is desired a 10.867 mc crystal oscillator is used.

The output from the mixer is fed through a controlled output amplifier and from there to an output termination for insertion in the injector panel.

A sub-carrier muting circuit is incorporated in the generator. This removes the sub-carrier automatically, which in connection with the multiplex receiver squelch circuits prevent the reception of noise during periods of no modulation of the sub-carrier. The time between the end of modulation and removal of the sub-carrier is adjustable from approximately two seconds and ten seconds. The rate of removal of the sub-carrier is adjusted to prevent noise transients at the receivers when the sub-carrier is removed.

TUNING PROCEDURE

Step #1

Install all of the tubes in the sub-carrier generator panel as well as the 100KC crystal and second crystal in their sockets. The 100KC crystal socket is in the upper left hand corner.

Step #2

Attach 115V to the power terminals and turn the power switch to ON.

Step #3

Set the meter switch to V1. Then tune L1 for an indication approximately 20% below the maximum indication on the slow rising side of the tuning curve.

Step #4

Turn the meter switch to V8. Adjust L2 and L3 to maximum indication.

Step #5

Turn the meter switch to V9. Adjust L5 and then L4 to maximum.

Step #6

Turn the meter switch to V10. Adjust L7 and L6 to maximum.

Step #7

Turn the meter switch to V13. Adjust L9 (second oscillator) to maximum and then counter clockwise to about 20% below maximum.

Step #8

Turn the meter switch to "OUT". Adjust L8 for maximum reading. Be sure the output control R57 is opened up. Turn meter switch to position other than "OUT". This "OUT" position has a diode connected in the circuit which may distort the output waveform and is used only to maximize tuning. It should, therefore, not be kept in this position during operation.

The sub-carrier wave may be taken from J1 to an oscilloscope for examination of the waveform when unmodulated.

MISCELLANEOUS CONTROLS

The normal audio input level for sub-carrier modulation is +8 to +10 VU at 600 ohms for 7½KC swing of the multiplex sub-carrier.

There exist within the sub-carrier generator several controls that are preset at the factory and, in general, will not require any field adjustment. These controls are similar to those described in the "Miscellaneous Controls" of the program exciter. Accordingly, it is suggested that you refer to this section.

Sub-carrier muting is disabled in the "OFF" position and each clockwise step of this switch increases the muting time constant approximately two seconds. The proper step should be as short as permissible for the type program being handled.

* * * * * *

FM-10BM SUB-CARRIER GENERATOR VOLTAGES

TUBE	PIN 1	2	3	4	5	6	7	8	9	
V1	160	-18	0	F	F	150	-26	0	-	
V2	30	-2.7	0	F	F	300	-16	2.7	-	
V3	12	-7.5	0	F	F	275	+12	16	-	
V4	24	12	15	F	F	33	0	0	-	
V5	175	0	2.0	F	F	270	22	26	-	
V6	195	50	115	F	F	185	75	75	-	
V7	-18	0	F	F	270	180	0			
V8	-16	0	F	F	260	120	0			
V9	-6	0	F	F	270	130	0			
V10	-1.5	0	F	F	270	120	0			
V11	250	0	5	F	F	215	0	5	-	
V12	275	0	2*	F	F	185	0	1.8	-	
V13	275	-23	0			270	0	5	-	
V14	275	0	0			210	0	1.8	-	Mute Off
	275		8			160	0	3.2	-	Muted

* 8 Volts when muted

Measurements using 11 meg V.T.V.M.

MULTIPLEX GENERATOR PARTS LIST

C1	Capacitor	Variable	7-45 mmfd
C2	"	Fixed	3.3 mmfd
C3	"	"	1500 mmfd
C4	"	"	1.0 mfd
C5	"	"	.01 mfd
C6	"	"	.0015 mfd
C7	"	"	39 mmfd
C8	"	"	.01 mfd
C9	"	"	.01 mfd
C10	"	"	.01 mfd
C11	"	"	.005, 600V
C12	"	"	.01 mfd
C13	"	"	1.0 mfd
C14	"	"	330 mmfd
C15	"	Variable	7-45 mmfd
C16	"	Fixed	1.0 mfd
C17	"	"	.005 mfd
C18	"	Variable	7-45 mmfd
C19	"	Fixed	.01 mfd
C20	"	"	.005 mfd
C21	"	"	.01 mfd
C22	"	"	.01 mfd
C23	"	"	220 mmfd
C24	"	"	5 mmfd
C25	"	"	220 mmfd
C26	"	"	.01 mfd
C27	"	"	47 mmfd
C28	"	"	.01 mfd
C29	"	"	.01 mfd
C30	"	"	50 mmfd
C31	"	"	5 mmfd
C32	"	"	100 mmfd
C33	"	"	.01 mfd
C34	"	"	47 mmfd
C35	"	"	.01 mfd
C36	"	"	.01 mfd
C37	"	"	15 mmfd
C38	"	Feed thru	.001
C39	"	Fixed	.5 mmfd
C40	"	"	15 mmfd
C41	"	"	.01 mfd
C42	"	"	47 mmfd
C43	"	"	.01 mfd
C44	"	"	.01 mfd
C45	"	"	15 mmfd
C46	"	"	5 mmfd
C47-C48	"	"	.01 mfd
C50	"	"	.0015 mfd
C51	"	"	.01 mfd
C52	"	"	.0015 mfd
C53	"	"	.0015 mfd

C54	Capacitor	Fixed	.0015 mfd
C55	"	"	.01 mfd
C56	"	"	.01 mfd
C57	"	"	.01 mfd
C58	"	"	15 mmfd
C59	"	"	51 mmfd
C60	"	"	.01 mfd
C61	"	"	100 mmfd
C62	"	"	.1 mfd
C63	"	"	.01 mfd
C64	"	"	.1 mfd
C65	"	"	.1 mfd
C66	"	"	.02 mfd
C67	"	"	1.0 mfd
C68	"	"	.05 mfd
C69	"	"	1.0 mfd
C70	"	"	470 mmfd
C71	"	"	.1 mfd
C72	"	"	2.0 mfd
C73	"	"	Electrolytic 4 section 20 mfd ea.
C74	"	"	.04 mfd
C75	"	Feed thru	.001 mfd
C76	"	"	.001 mfd
C77	"	"	.001 mfd
C78	"	"	.001 mfd
C79	"	"	4 mfd, 600V
C80	"	"	4 mfd, 600V

RESISTORS: ALL RESISTORS $\frac{1}{2}$ WATT UNLESS NOTED

R1	47 ohms	R26	100K	R50	100K
R2	1 meg	R27	27K, $\frac{1}{2}$W	R51	47K
R3	10K, 1W	R28	2.7K, 1W	R52	1.5K, 1W
R4	27K, 2W	R29	1.5K	R53	47K, 1W
R5	100K	R30	2.2K	R54	47K, 1W
R6	2.7K	R31	47K	R55	2.2K
R7	3.3K	R32	100K	R56	100K
R8	270K, 1W	R33	2.7K	R57	5K Potentiometer
R9	27K, 1W	R34	2.2K	R58	10K
R10	3.9K	R35	2.2K	R59	4.7K
R11	1.5K, 1W	R36	47K	R60	1.5K, 1W
R12	100K	R37	100K	R61	50K Variable
R13	2.2K	R38	2.7K, 1W	R62	470K
R14	39K, 1W	R39	1.5K	R63	100K
R15	100K, 1W	R40	2.2K	R64	47K
R16	4.7K	R41	47K	R65	1 Meg
R17	4.7K, 1W	R42	100K	R66	2 Meg
R18	47K, 1W	R43	2.7K, 1W	R67	2 Meg
R19	390K, 1W	R44	4.7K	R68	2 Meg
R20	50K, Variable	R45	47K	R69	2 Meg
R22	15K, 1W	R46	680 ohms	R70	1 Meg
R23	3.3K, 1W	R47	100 ohms	R71	47K, 1W
R24	390K, 1W	R48	10K, 1W	R72	5.6 Meg
R25	100K	R49	47K, 2W	R73	10 Meg

RESISTORS (continued)

R74	2.2K	R87	4.7K	R99	2W
R75	1.5K	R88	1 meg	R100	1K
R76	750 ohms	R89	330K, 1W	R101	2K, 20W
R77	1.5K	R90	330K, 1W	R102	2K, 20W
R78	150K	R91	1.2 meg	R103	180 ohms, 2W
R79	47K, 1W	R92	470 ohms	R104	150K
R80	150K, 1W	R93	8.2K	R105	150K
R81	1 meg	R94	68K	R106	1.5K
R82	15K, 1W	R95	750 ohms ±5%	RFC1	Ohmite Z50
R83	18K	R96	22K, 1W	RFC2	Ohmite Z50
R84	3.9K	R97	180 ohms		
R85	4.7K	R98	1.2 meg		

TRANSFORMERS

T1	Chicago #PHR150
T2	Chicago BIH #1

FUSE

F1	3 amp

DIODES

D1	IN450
D2	IN34A

TUBES

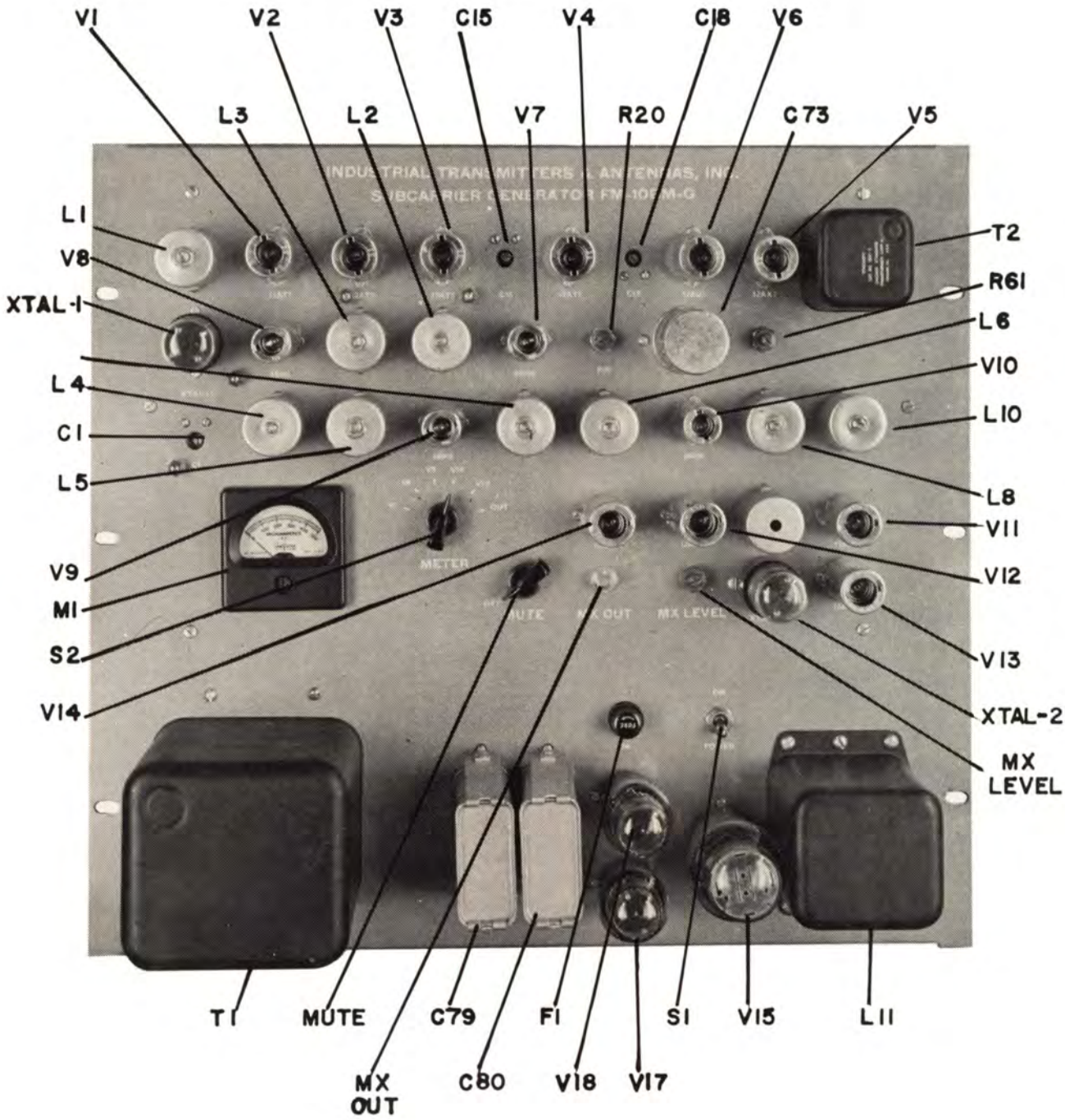
V1 to V4	12AT7
V5	12AX7
V6	12AU7
V7 to V10	6BH6
V11	12AT7
V12	12AX7
V13	12AT7
V14	12AX7
V15	5R4GY
V17	OD3
V18	OD3

SWITCHES

S1	SPST, Power
S2	2P 6 Position Muter
S3	2P 6 Position Mute Control

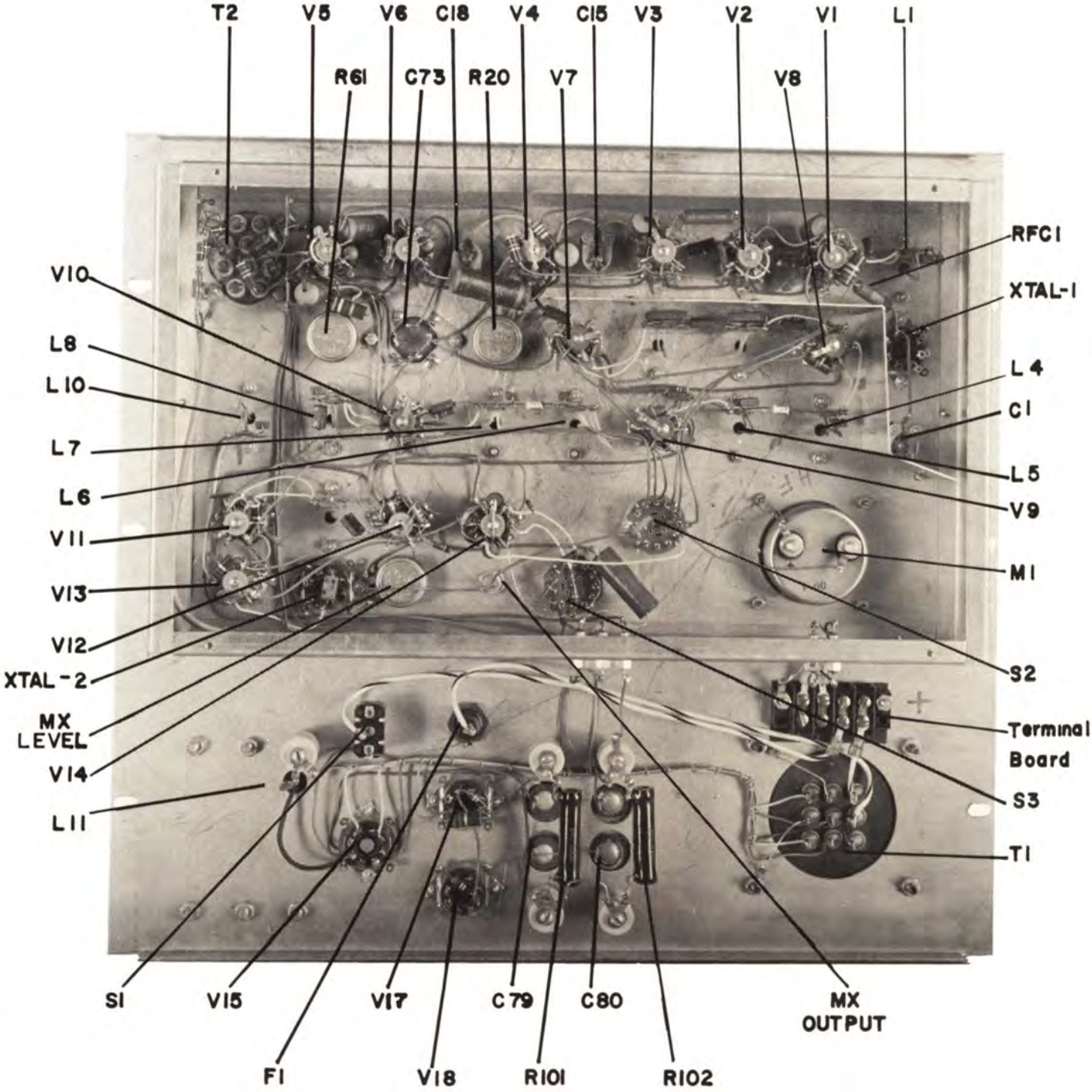
CRYSTALS

XTAL-1	100KC
XTAL-2	10.8 + desired sub-carrier frequency



SUB CARRIER GENERATOR
FM 10 BM G

Figure 5, Front View



SUB CARRIER GENERATOR
FM 10 BM-G

Figure 6, Rear View

FM-10BMM INJECTOR

MECHANICAL DESCRIPTION

The FM-10BMM mixer injector requires only $5\frac{1}{4}$" of panel space on a standard 19" rack. Jacks are available on its front panel to attach the program exciter and two sub-carrier generator interconnections.

ELECTRICAL DESCRIPTION

The function of the mixer panel is to frequency modulate the program exciter carrier with one or two sub-carriers and their intelligence.

Referring to Figure 1, it can be seen that it consists of a 6AU6 phase modulator, a 12AX7 which serves as a sub-carrier amplifier and finally, a 6AU6 limiter.

GENERAL TUNING PROCEDURE

Step #1

Install the mixer panel in the rack planned for its use. Place a substantial ground strap between it and a known ground point.

Step #2

Attach the B+ and filament voltages taken from an appropriate source, preferably the exciter power supply.

Step #3

Install all the tubes in their indicated sockets.

Step #4

Attach a cable between the mixer panel and the RF source. Attach a cable between the RF output plug and the unit which the panel is intended to drive.

Step #5

Turn on the power to the RF source and the injector panel. Quickly tune capacitors C1, C2, C5 and C6 of the mixer panel for a maximum indication of drive to the RF load of the mixer panel.

Step #6

Connect the sub-carrier generator to the injector panel and observe the output before de-emphasis of a multiplex receiver. Adjust Capacitors C3 and C4 to obtain the cleanest sub-carrier waveform at the lowest frequency sub-carrier maintaining 15% sub-carrier injection.

Step #7

Retune capacitors C1 and C2 for maximum RF drive.

INJECTOR PANEL VOLTAGES

TUBE	PIN 1	2	3	4	5	6	7	8	9
V1	-0.3	0	F	F	100	75	0		
V2	90	0	0.8	F	F	90	0	0.8	
V3	0	0.5	F	F	150	50	0		

Measurements using 11 meg V.T.V.M.

FM-10BMM INJECTOR PARTS LIST

CAPACITORS

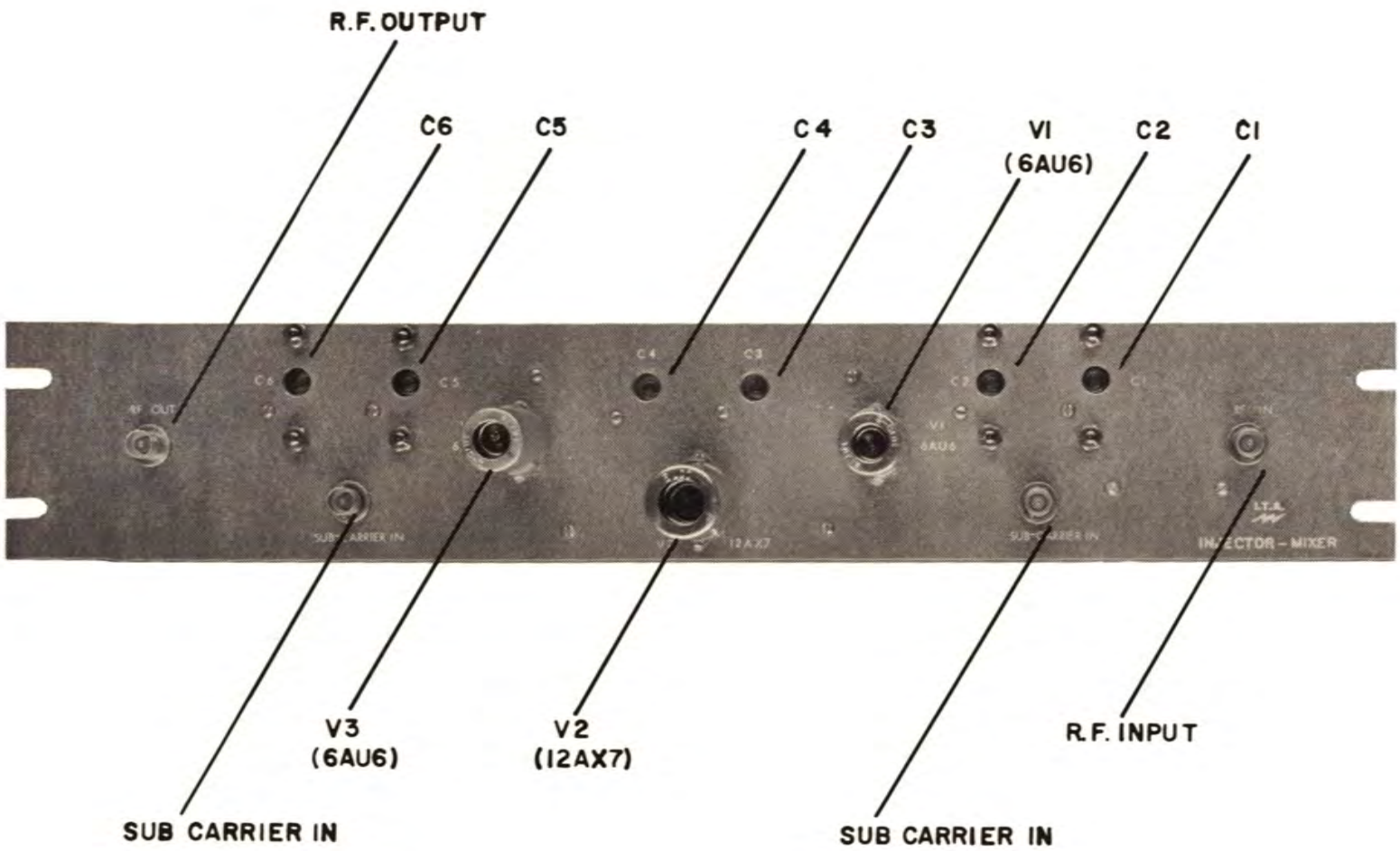
C1	5-80 mmf, variable, Mica	C11	.005 mf, Fixed Disc
C2	5-80 mmf, " "	C12	33 mmf, Silver Mica
C3	2-30 mmf, " "	C13	100 mmf, Silver Mica
C4	2-30 mmf, " "	C14	100 mmf, " "
C5	9-180 mmf, " "	C15	.01 mf, Disc
C6	9-180 mmf, " "	C16	.01 mf, "
C7	.005 mf, Fixed, Disc	C17	.01 Disc, Fixed
C8	.005 mf, " "	C18	.01 " "
C9	47 mmf, Silver Mica	C19	.01 " "
C10	.005 mf, Fixed Disc	C20	.01 " "

COILS

L1	6.2 microhenry
L2	6.2 microhenry
L3	2.5 mmh
L4	60 mmh
L5	60 mmh
L6	6.2 mmh
L7	6.2 mmh

TUBES

V1	6AU6
V2	12AX7
V3	6AU6

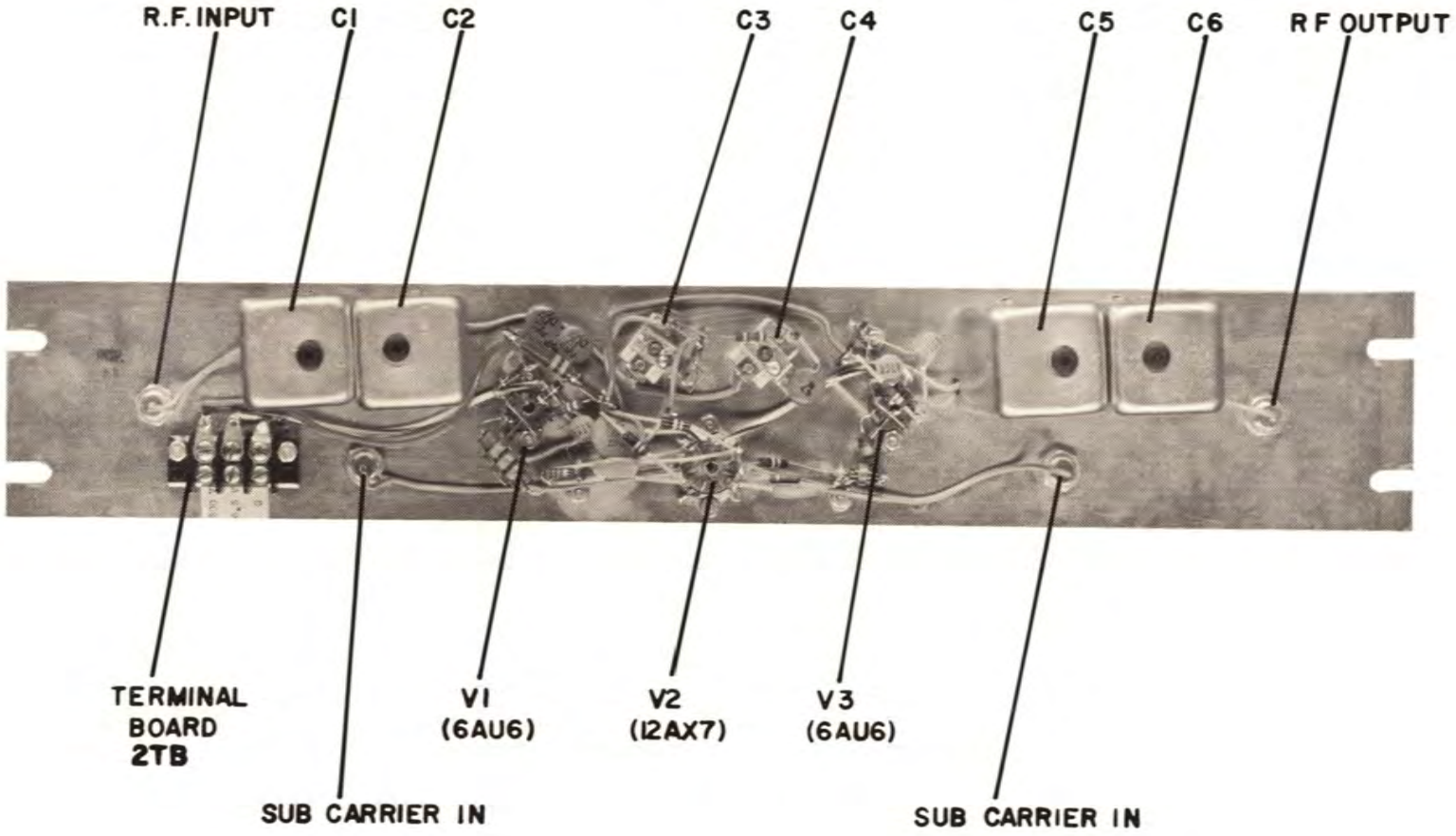


INJECTOR — MIXER

Figure 7, Front View

INJECTOR MIXER

Figure 8, Rear View



PULSE SHAPER

SAWTOOTH OSCILLATOR

MODULATOR

TRIPLER 300KC

TRIPLER 900KC

TRIPLER 2.7 M.C.

QUADRAUPLER 108 MC

MIXER

MULTIPLEX AMPL

AUDIO

INJECTOR - MIXER

NOTE:
1. ALL RESISTORS ARE IN OHMS & 1/2 WATT UNLESS OTHERWISE NOTED.
2. CAPACITORS NOTED IN DECIMALS ARE IN MFD. ALL OTHERS ARE IN MMFD. EXCEPT AS NOTED.

REVISIONS			INDUSTRIAL TRANSMITTERS & ANTENNAS LANSDOWNE PA
NO.	DATE	BY	
1	6/23/60	SSF	SCHEMATIC DIAGRAM
2	10/28/60	HHK	SUB-CARRIER GENERATOR FM-10BM-G
3			DRAWN BY H. KELMAR / SCALE ~ / MATERIAL ~
4			CHK'D / DATE / DRAWING NO. D-100
5			TRACED / APP'D

JOB NO 131060

SUB CARRIER GENERATOR

XTAL #1 100K.C.

V1 12AT7 100K.C. OSCILLATOR

V2 12AT7 PULSE SHAPER

V3 12AT7 SAWTOOTH OSCILLATOR

V4 12AT7 MODULATOR

V7 6BH6 TRIPLER

V8 6BH6 TRIPLER

V9 6BH6 TRIPLER

V10 6BH6 QUADRUPLER

V6 12AU7 2ND AUDIO

V5 12AX7 1ST AUDIO

V14 12AX7 MUTE

V12 12AX7 MULTIPLEX AMPLIFIER

V11 12AT7 MIXER

T1 MODULATION TRANSFORMER

V13 12AT7 OSCILLATOR

AUDIO INPUT

XTAL #2

INJECTOR-MIXER

V1 6AU6 PHASE MODULATOR

R.F. INPUT

INPUT #1

INPUT #2

V2 12AX7 SUB CARRIER AMPLIFIER

V3 6AU6 LIMITER

R.F. OUTPUT

MAIN CARRIER EXCITER

V1 12AT7 OSCILLATOR

V2 12AT7 PULSE SHAPER

V3 12AT7 SAWTOOTH GENERATOR

V5 12AX7 1ST AUDIO

V6 12AU7 2ND AUDIO

V4 12AT7 MODULATOR

AUDIO INPUT

V9 6BH6 X3

V8 6BH6 X2

V7 6BH6 X3

V10 6BH6 X2

V11 6BH6 X3

V12 6BH6 X2

V13 5763 X2

V14 6146 X2

R.F. OUTPUT

REVISIONS			INDUSTRIAL TRANSMITTERS & ANTENNAS LANSDOWNE PA
NO.	DATE	BY	BLOCK DIAGRAM MULTIPLEXER
1			
2			
3			DRAWN BY H. Kelmar 11-18-60 / SCALE NJ / MATERIAL NJ
4			CHK'D / DATE / DRAWING NO. D-102
5			TRACED / APP'D

JOB-131060