LSG-215A
STANDARD SIGNAL GENERATOR
SERVICE MANUAL

LEADER

CONTENTS

****

NOTE

These servicing instructions are for use by qualified personnel only. To avoid electrical shock, do not perform any servicing other than that contained in the service manual unless you are qualified to do so.

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1. Specifications

(1) Frequency

Range	2 ranges:	0.1 to 30 MHz and 30 to 120MHz
Indication		6-digit digital indication
	Resolution:	0.1 to 30 MHz; 100 Hz
		30 to 120 MHz; 1 kHz
Accuracy		within($\pm 5 \times 10^{-5} + 1$ count)
Drift		within $\pm 5 \times 10^{-5}$

(2) RF Output

Range	−10 to 120 dBμ (0 dB=1μV, open terminal)
Indication	3-digit digital indication
Reference level accuracy	within ± 1 dB at 120 dBμ
Attenuator accuracy	within ± 1.5 dB (more than 0 dB)
	within ± 2 dB (less than 0 dBμ)
Output impedance	50Ω, VSWR less than 1.3
Spurious output	less than −30 dB

(3) Modulation

Internal modulation frequency	400 Hz, 1 kHz within ±1%
External modulation input impedance	approx. 10 kΩ

FM

Frequency deviation	0 to 100 kHz (carrier of more than 1 MHz)
Deviation indicator	5, 10, 50 & 100 kHz full scale
Accuracy	1 to 120 MHz; ± 10% of full scale
Distortion	1 to 120 MHz; less than 0.1% for 75-kHz deviation (demodulation band 80 Hz to 100 kHz)
External modulation frequency range	20 Hz to 100 kHz
External modulation frequency response	± 1 dB (reference 1 kHz)

AM

Modulation rate	0 to 50%
Modulation meter	5, 10, 50 & 100% full scale
Accuracy	± 10% of full scale
Distortion	0.1 to 30 MHz, less than 1% at 30% modulation
	30 to 120 MHz, less than 3% at 30% modulation
External modulation frequency range	20 Hz to 10 kHz
External modulation frequency response	± 1 dB (reference 1 kHz)

Residual Modulation (S/N)

FM component	more than 70 dB in S/N for 75-kHz deviation (FM linear detector: demodulation band, 80 Hz to 20 kHz)
AM component	more than 50 dB in S/N for 30% modulation rate

(4) Preset

- Using the internal memory, 100 points of presettings can be stored for combinations of frequency, modulation type, and output level.
- Separately available memory unit, EPROM, can be ordered.

(5) Miscellaneous

Power voltage	100, 120, 220, and 240 V
Power consumption	approx. 30 VA
Size and weight	400(W) x 100(H) x 300(D) mm
	7 kg
Accessory	output cable 1 (50Ω BNC 3D−2V)

2. Test Equipment Required

The following test equipment is required for calibration and servicing of the Model LSG-215A. The suggested specifications are the minimum necessary for proper calibration of this instrument.

Test Equipment	Minimum Spec.
- Multimeter	Accuracy < 1%
- Frequency Counter	120MHz
- RF Millivoltmeter	120MHz bandwidth +20dBm sensitivity
- AF Millivoltmeter	1 - 5V sensitivity
- Oscilloscope	20MHz bandwidth 10mV sensitivity
- Distortion Meter	1kHz
- FM Linear Detector	120MHz 75kHz deviation
- AM Linear Detector	30MHz
- Sine Wave Generator	1kHz 1Vrms
- Spectrum Analyzer	120MHz

3. Calibration Procedure

* Calibration should be performed after a 30 minute warm-up period. It should also be confirmed that the unit is connected to the rated power line voltage.

* All adjustment should be completed in the given order, because some adjustments interact with others.

* During the adjustment procedure, remove the case only when necessary and replace immediately after making an adjustment. This will maintain all circuit at constant operating temperature.

1) Initial Control Settings

The initial control settings to be used for each check and adjustment are listed below. Any variations from these settings are stated in the applicable procedure.

FREQUENCY	100.000MHz
OUTPUT	120dBμ
MODULATION	OFF
METER RANGE	100

2) Adjustment of Meter Mechanical Zero

a) Turn the instrument off and allow 30 second for all capacitors discharge.

b) Rotate zero adjustment screw clockwise or counterclockwise so that pointer indicates exactly zero.

c) After pointer is exactly at zero, rotate the screw slightly opposite direction to release tension of meter suspension.

3) Power Supply

a) Connect the DC voltmeter between test point and chassis.

b) Adjust as required, using the adjustment shown in Table-1.

Test point	Voltage	Tolerance	Adjustment
TP1(T-3062)	+5V	+4.75V to +5.25V	-
TP2(T-3062)	+15V	+14.7V to +15.3V	VR1(T-3062)
TP3(T-3062)	-15V	-14.7V to -15.3V	-

Table-1

4) AF Oscillator

a) Set: MODULATION MOD ON
1kHz
AM

b) Connect the distortion meter to TP4(T-3062).

c) Adjust VR6(T-3062) for minimum distortion.

5) PLL unit

a) Connect the frequency counter to OUTPUT connector.

b) Adjust VC1(T-2793) for a frequency reading of 100.000MHz.

6) RF unit

a) Output Voltage Adjustment

- Connect the RF millivoltmeter to OUTPUT connector via 50 ohm termination.

- Adjust VR6(T-2980) for a meter reading of 0.5Vrms (+7dBm).

b) FM Deviation Adjustment-1 (VCO)

- Set: MODULATION MOD ON
1kHz
FM

- Connect the FM linear detector to OUTPUT connector via 50 ohm termination.

- Adjust FM control, screw driver adjustment on the front panel, for a deviation reading of 75kHz on the FM linear detector.

- The deviation reading should be between 70kHz and 80kHz from 85MHz to 120MHz. If not, adjust L10(T-2980) to obtain a deviation above mentioned.

- Apply the same procedure for VCO-3, -2 and -1, using the adjustment shown in Table-2. (Adjust the FM control for a deviation of 75kHz on the FM linear detector at each adjustment.)

VCO	Frequency	Deviation	Adjustment
VCO-4	85MHz - 120MHz	70kHz - 80kHz	L10(T-2980)
VCO-3	60MHz - 84MHz	65kHz - 85kHz	L9(T-2980)
VCO-2	42MHz - 59MHz		L8(T-2980)
VCO-1	30MHz - 41MHz		L7(T-2980)

Table-2

c) FM Deviation Adjustment-2

- Set: FREQUENCY 35MHz
  MODULATION MOD ON
  1kHz
  FM

- Connect the FM linear detector to OUTPUT connector via 50 ohm termination.

- Adjust the FM control for a deviation reading of 75kHz on the FM linear detector. (Do not touch while next adjustment.)
- Apply the same procedure for other frequency points, using the adjustment shown in Table-3

Frequency	Deviation	Adjustment
35MHz	75kHz	FM control
52MHz		VR1(T-2980)
72MHz		VR2(T-2980)
100MHz		VR3(T-2980)

Table-3

d) Sprious

- Set: FREQ RANGE B
  MODULATION MOD OFF

- Connect the spectrum analyzer to OUTPUT connector via 50 ohm termination.

- Adjust VR5, VC1, 2 and L17 (T-2980) for minimum sprious signal.

7) METER RANGE

a) Gain Adjustment of Meter Amplifier

- Set: FREQUENCY 100.000MHz
  MODULATION MOD ON
  EXT
  FM
  METER RANGE 100

- Connect the sine wave generator to EXT MOD INPUT connector and set the frequency to 1kHz, output voltage to 1Vrms.

- Connect the FM linear detector to OUTPUT connector via 50 ohm termination.

- Adjust FM control for a deviation reading of 75kHz on the FM linear detector.

- Connect the AF millivoltmeter to TP5(T-3062).

- Adjust VR3(T-3062) for a meter reading of 5Vrms.

- Set: MODULATION MOD ON
  1kHz

- Adjust VR7(T-3062) for a deviation reading of 75kHz on the FM linear detector.

b) FM Deviation Adjustment

- Set: MODULATION — MOD ON
  1kHz
  FM
  METER RANGE — 100

- Connect the FM linear detector to OUTPUT connector via 50 ohm termination.

- Adjust FM control for a deviation reading of 70kHz on the FM linear detector.

- Adjust VR4(T-3062) for a meter reading of 70kHz.

- Set: METER RANGE — 50

- Adjust VR11(T-3062) for a deviation reading of 35kHz on the FM linear detector.

- Apply the same procedure for other METER RANGE, using the adjustment shown in Table-4.

METER RANGE	Indication of FM linear det.	Adjustment
50	35kHz	VR11(T-3062)
10	7kHz	VR12(T-3062)
5	3.5kHz	VR13(T-3062)

Table-4

c) AM Modulation Adjustment

- Set: FREQUENCY — 10.0000MHz
  MODULATION — MOD ON
  1kHz
  AM
  METER RANGE — 100

- Connect the AM linear detector to OUTPUT connector via 50 ohm termination.

- Adjust AM control, screw driver adjustment on the front panel, for a modulation reading of 50% on the AM linear detector.

- Adjust VR2(T-3062) for a meter reading of 50%.

- Set: METER RANGE 50

- Adjust VR8(T-3062) for a modulation reading of 25% on the AM linear detector.

- Apply the same procedure for other METER RANGE, using the adjustment shown in Table-5.

METER RANGE	Indication of AM linear det.	Adjustment
50	25%	VR8(T-3062)
10	5%	VR9(T-3062)
5	2.5%	VR10(T-3062)

Table-5

4. Troubleshooting Procedure

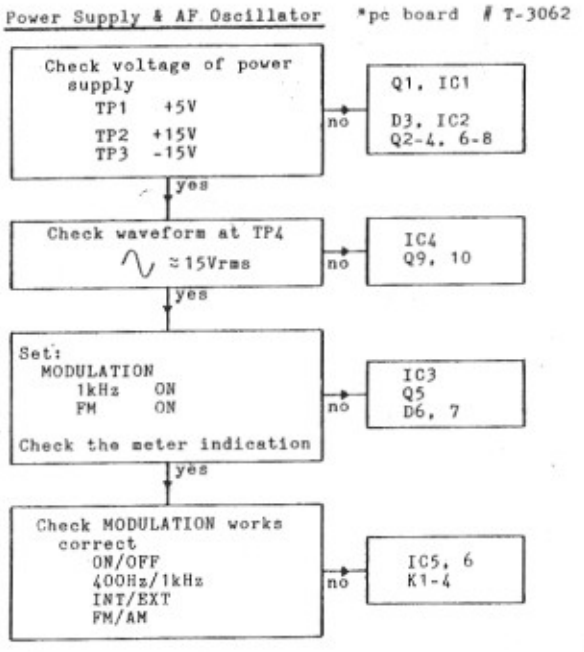
1) Check all control settings, because an incorrect setting can make a good unit appear defective.

2) Some trouble can be solved with proper adjustment.

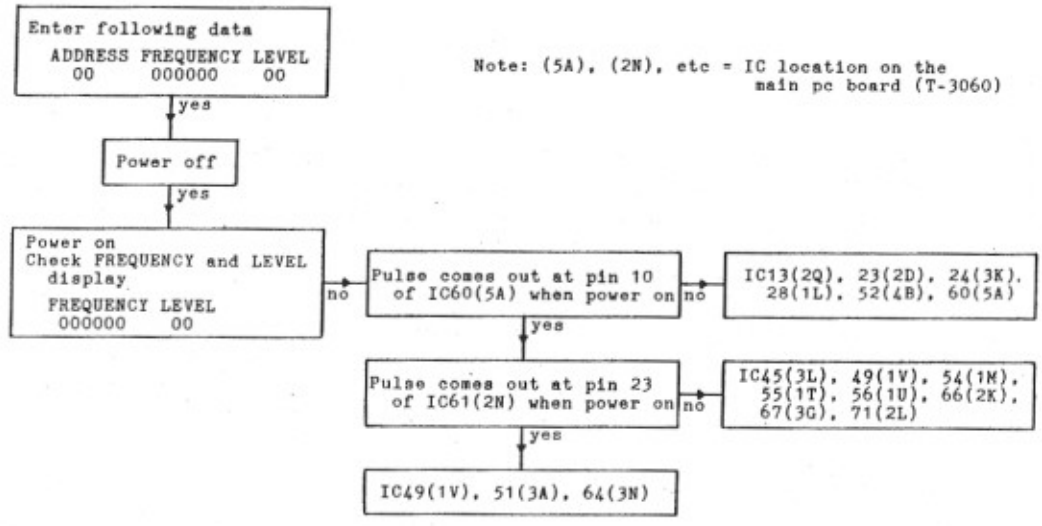
3) Check the DC voltage and waveform as shown in the schematic diagram to locate the defective circuit.
Start with the power supply.

4) Check all circuit for visual defects such as broken components, loose connections and poor soldering which could be a cause of trouble.

5) Troubleshooting Chart

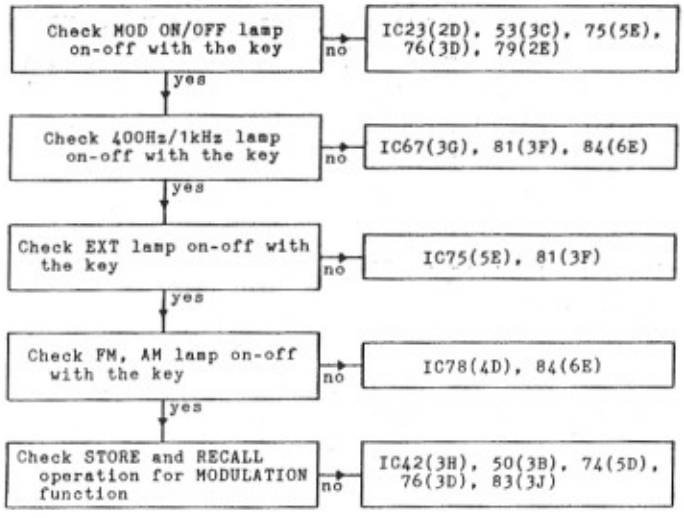


Initial Settings *pc board # T-3060

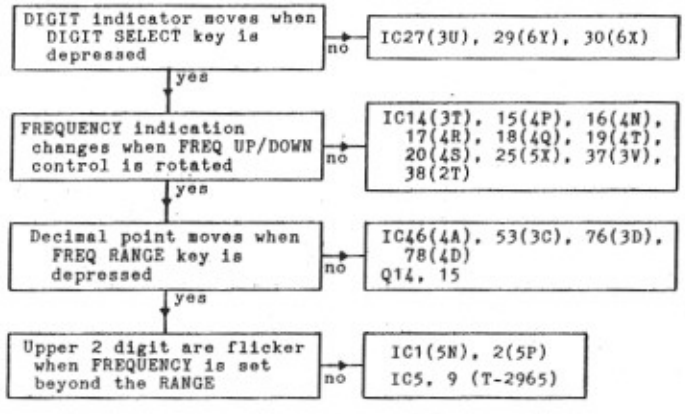


Note: (5A), (2N), etc = IC location on the main pc board (T-3060)

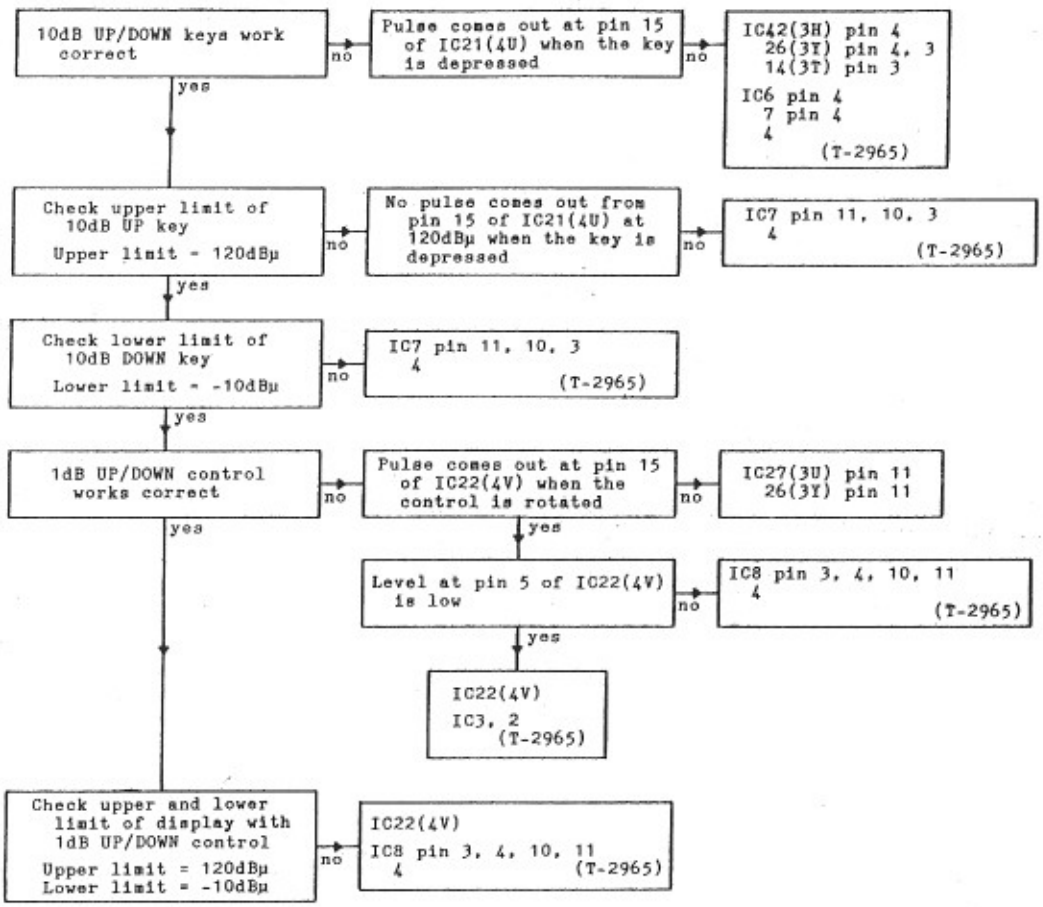
Control Circuit (Modulation) *pc board # T-3060



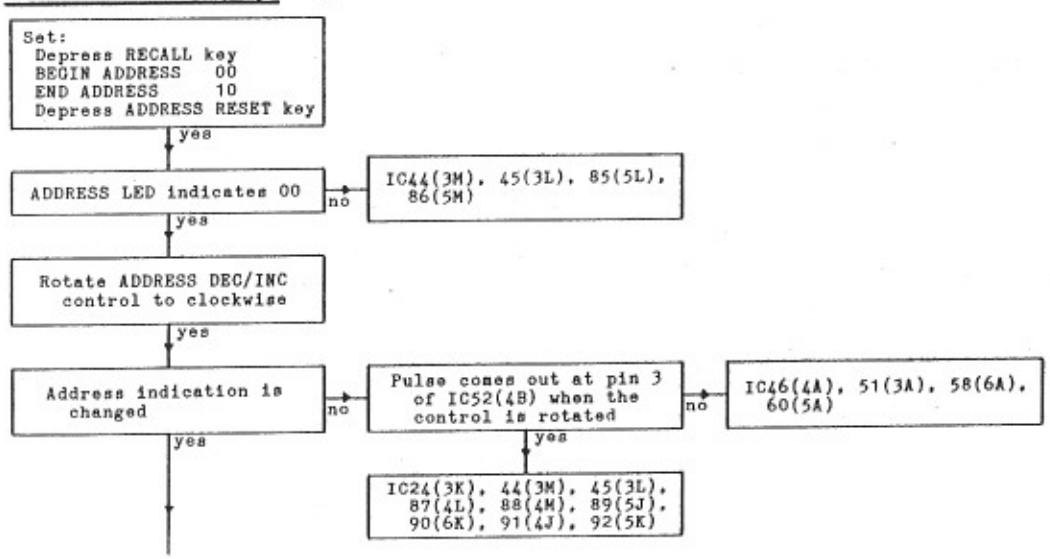
Control Circuit (Frequency) *pc board # T-3060, T-2965

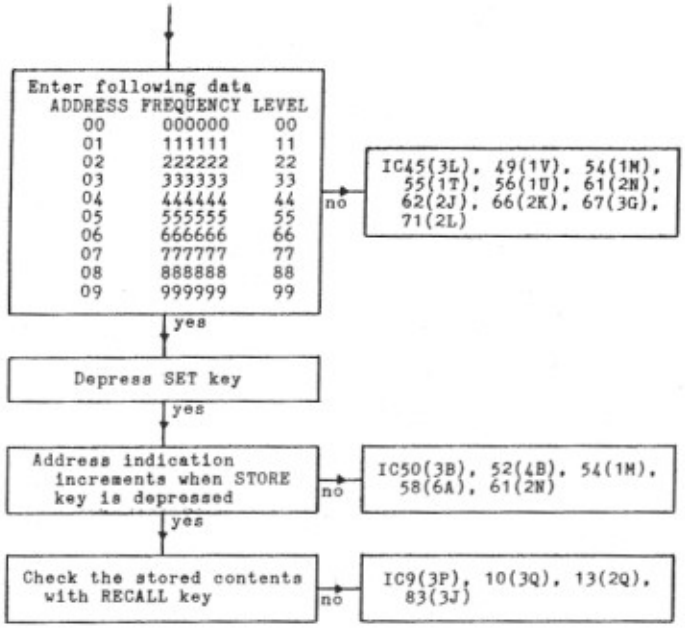


Control Circuit (Level) *pc board # T-3060, T-2965

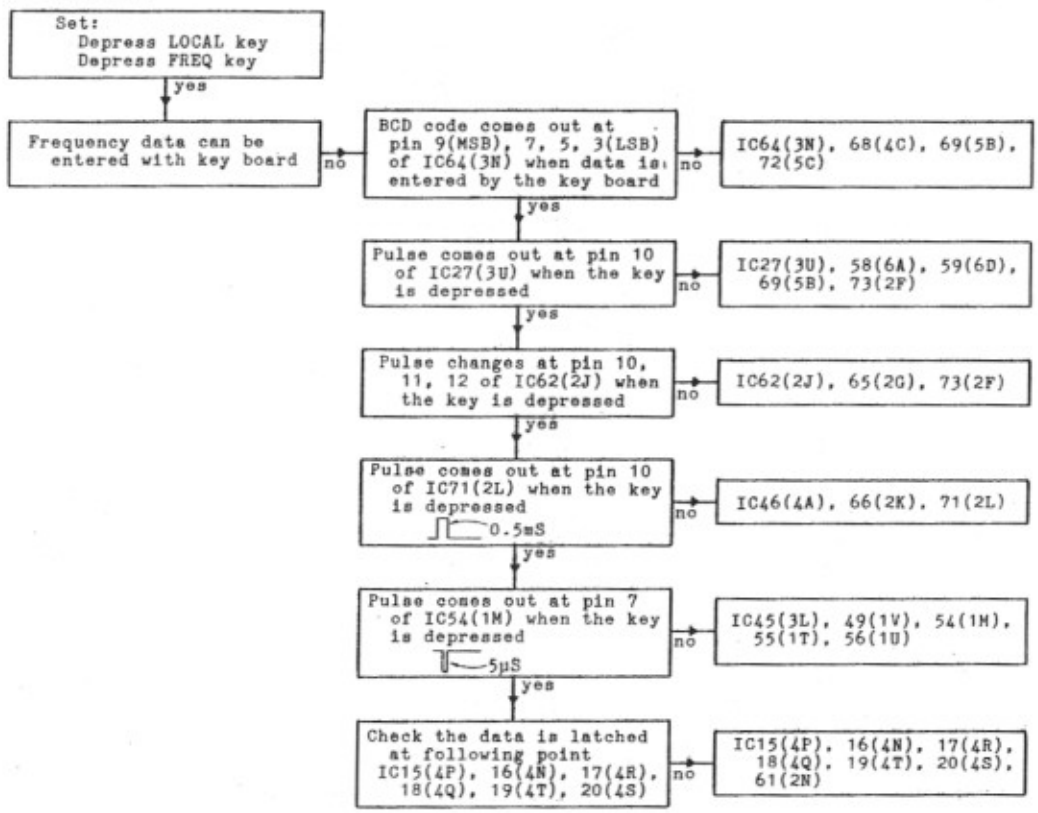


Control Circuit (Memory) *pc board # T-3060

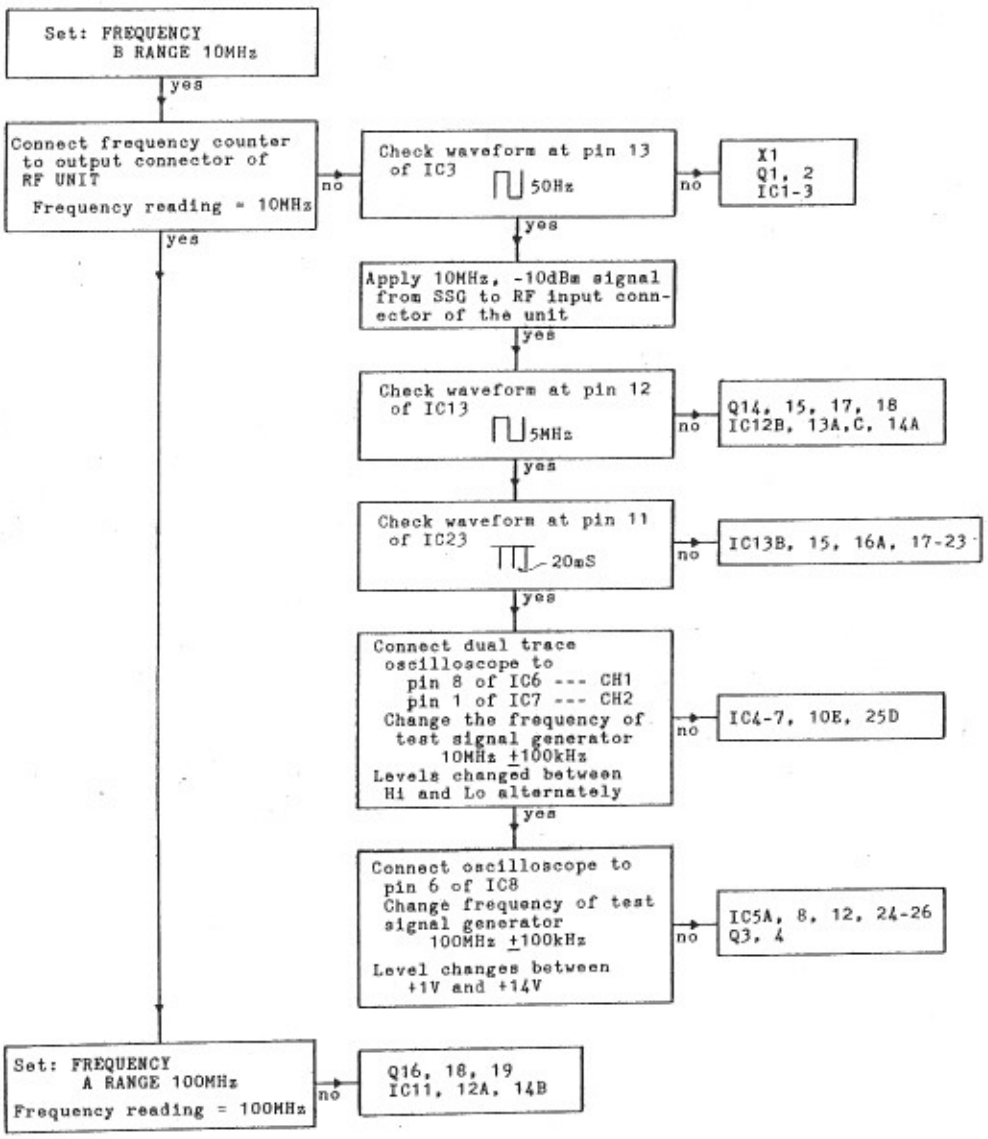




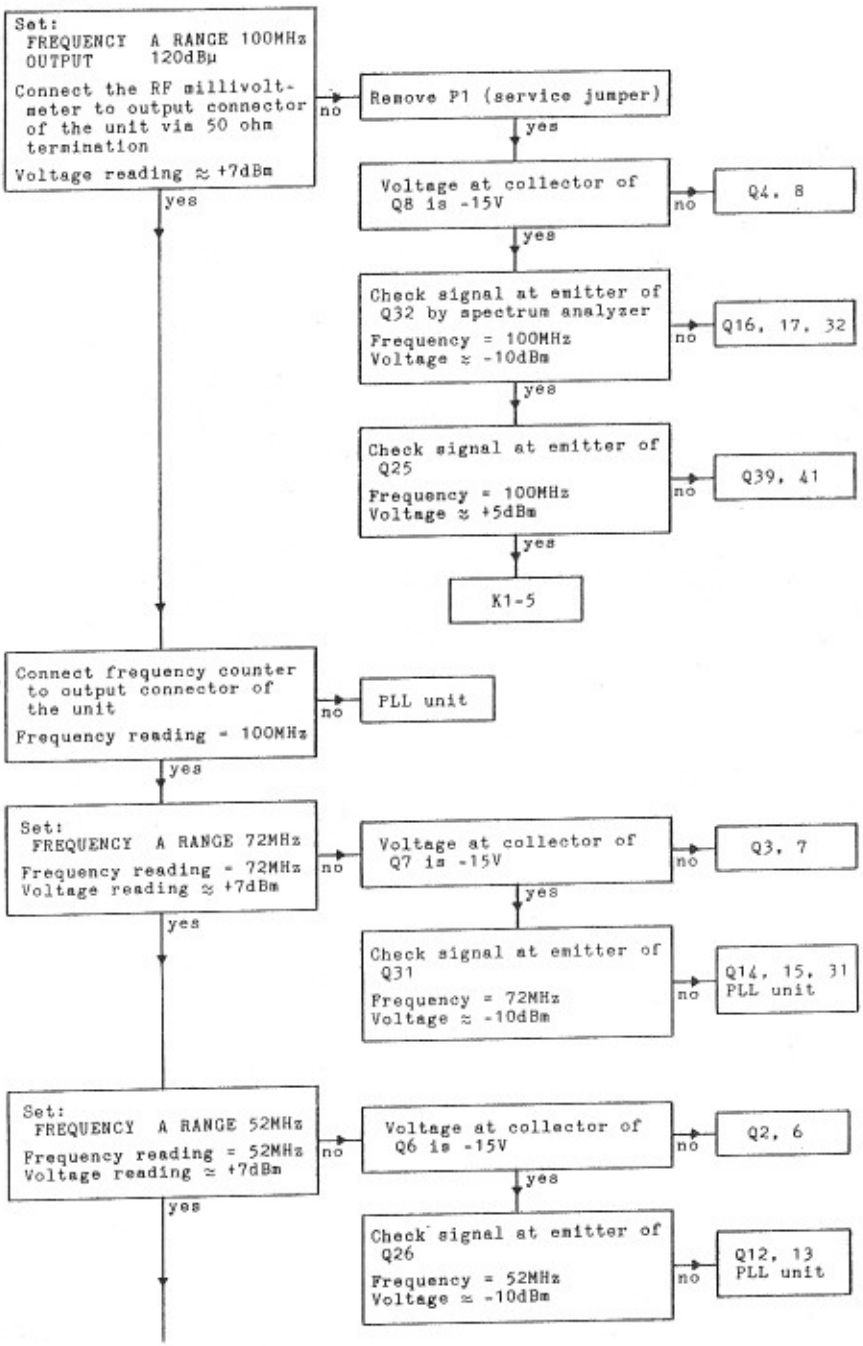
Ten-key Board *pc board # T-3060

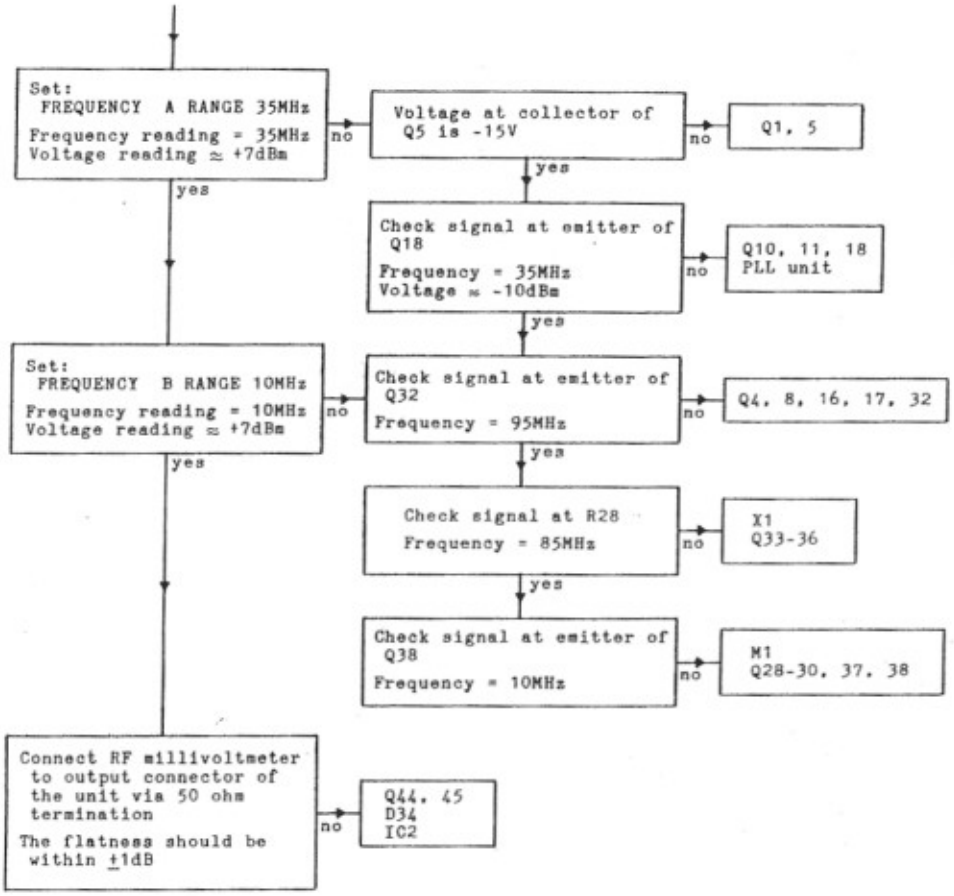


PLL unit

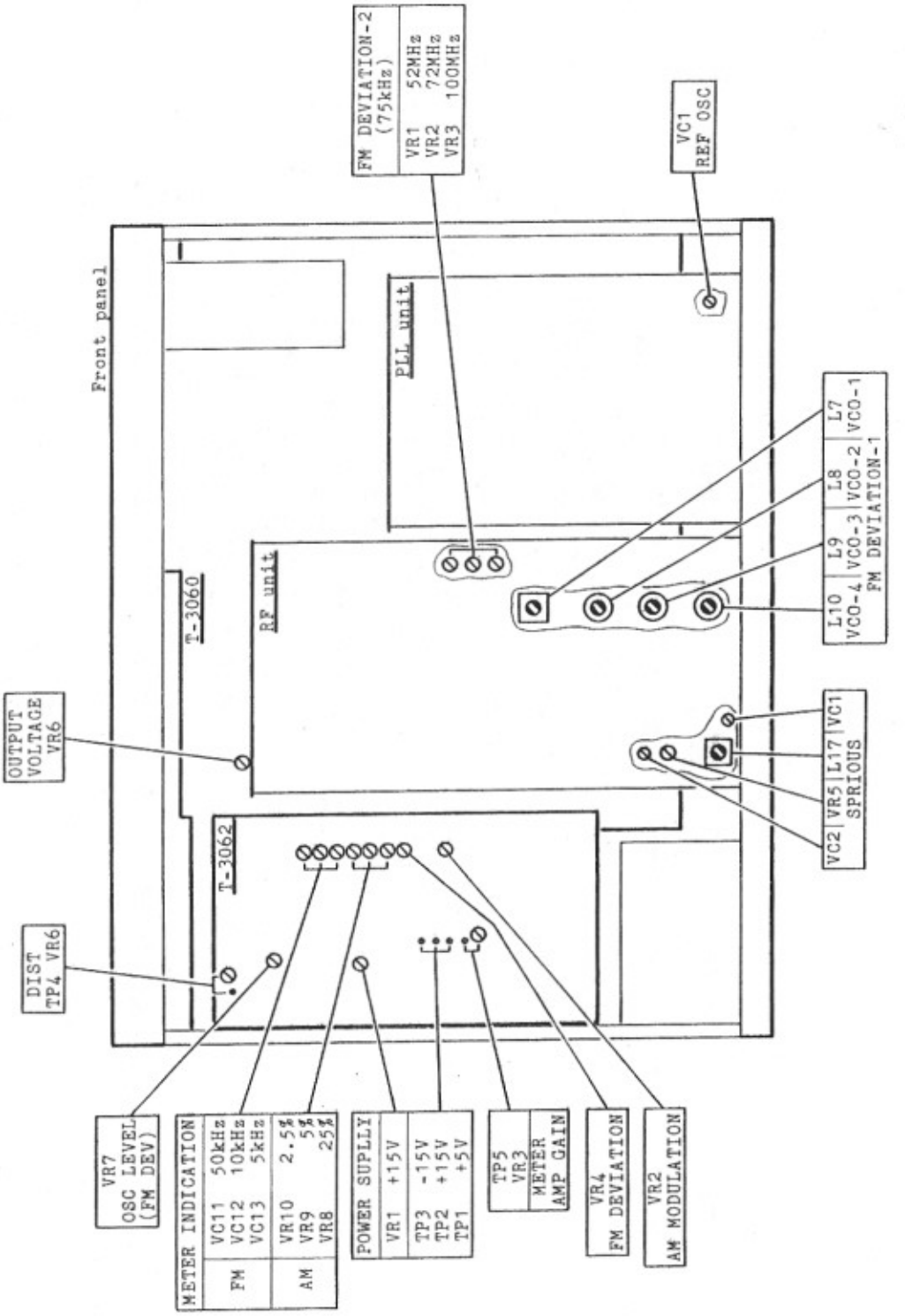

Set: FREQUENCY
B RANGE 10MHz
yes
Connect frequency counter to output connector of RF UNIT
Frequency reading = 10MHz
no
Check waveform at pin 13 of IC3
50Hz
no
X1
Q1, 2
IC1-3
yes
Apply 10MHz, -10dBm signal from SSG to RF input connector of the unit
yes
Check waveform at pin 12 of IC13
5MHz
no
Q14, 15, 17, 18
IC12B, 13A,C, 14A
yes
Check waveform at pin 11 of IC23
20mS
no
IC13B, 15, 16A, 17-23
yes
Connect dual trace oscilloscope to
pin 8 of IC6 --- CH1
pin 1 of IC7 --- CH2
Change the frequency of test signal generator
10MHz ±100kHz
Levels changed between Hi and Lo alternately
no
IC4-7, 10E, 25D
yes
Connect oscilloscope to pin 6 of IC8
Change frequency of test signal generator
100MHz ±100kHz
Level changes between +1V and +14V
no
IC5A, 8, 12, 24-26
Q3, 4
Set: FREQUENCY
A RANGE 100MHz
Frequency reading = 100MHz
no
Q16, 18, 19
IC11, 12A, 14B

RF unit

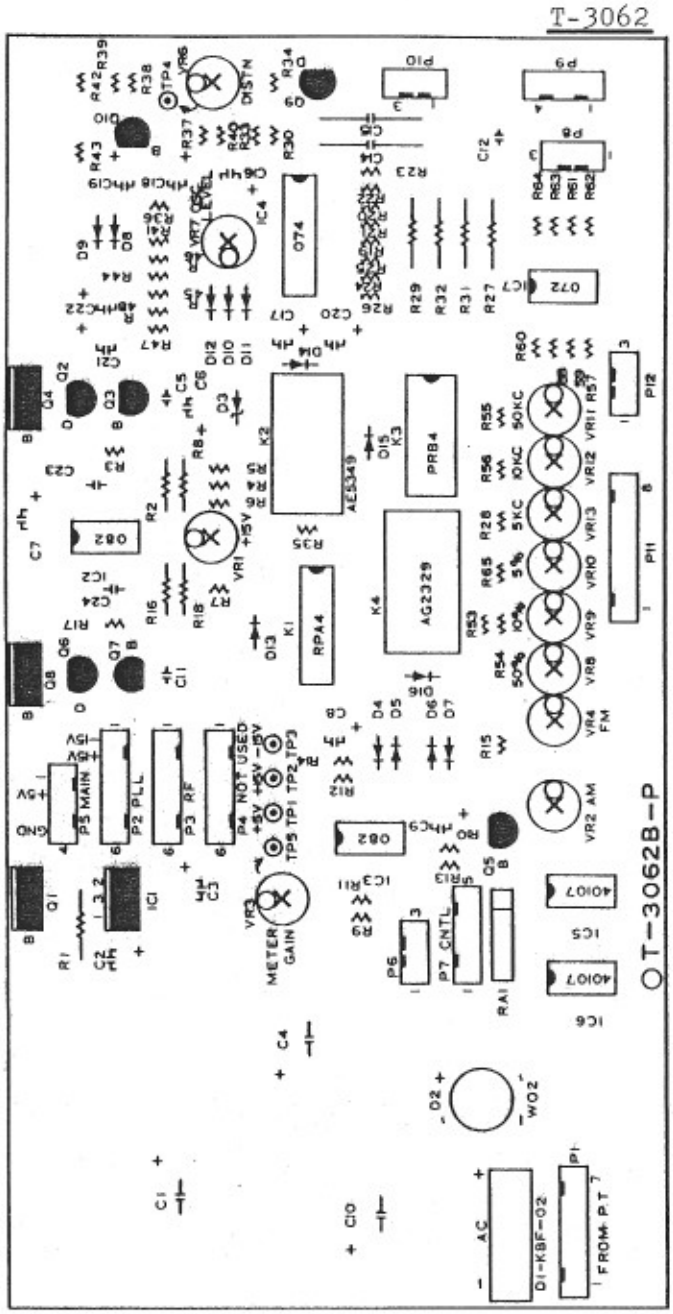

Set:
FREQUENCY A RANGE 100MHz
OUTPUT 120dBμ
Connect the RF millivoltmeter to output connector of the unit via 50 ohm termination
Voltage reading ≈ +7dBm
no
Remove P1 (service jumper)
yes
Voltage at collector of Q8 is -15V
no
Q4, 8
yes
Check signal at emitter of Q32 by spectrum analyzer
Frequency = 100MHz
Voltage ≈ -10dBm
no
Q16, 17, 32
yes
Check signal at emitter of Q25
Frequency = 100MHz
Voltage ≈ +5dBm
no
Q39, 41
yes
K1-5
yes
Connect frequency counter to output connector of the unit
Frequency reading = 100MHz
no
PLL unit
yes
Set:
FREQUENCY A RANGE 72MHz
Frequency reading = 72MHz
Voltage reading ≈ +7dBm
no
Voltage at collector of Q7 is -15V
no
Q3, 7
yes
Check signal at emitter of Q31
Frequency = 72MHz
Voltage ≈ -10dBm
no
Q14, 15, 31
PLL unit
yes
Set:
FREQUENCY A RANGE 52MHz
Frequency reading = 52MHz
Voltage reading ≈ +7dBm
no
Voltage at collector of Q6 is -15V
no
Q2, 6
yes
Check signal at emitter of Q26
Frequency = 52MHz
Voltage ≈ -10dBm
no
Q12, 13
PLL unit
yes


Set:
FREQUENCY A RANGE 35MHz
Frequency reading = 35MHz
Voltage reading ≃ +7dBm
no
Voltage at collector of Q5 is -15V
no
Q1, 5
yes
Check signal at emitter of Q18
Frequency = 35MHz
Voltage ≃ -10dBm
no
Q10, 11, 18
PLL unit
yes
yes
Set:
FREQUENCY B RANGE 10MHz
Frequency reading = 10MHz
Voltage reading ≃ +7dBm
no
Check signal at emitter of Q32
Frequency = 95MHz
no
Q4, 8, 16, 17, 32
yes
yes
Check signal at R28
Frequency = 85MHz
no
X1
Q33-36
yes
Check signal at emitter of Q38
Frequency = 10MHz
no
M1
Q28-30, 37, 38
Connect RF millivoltmeter to output connector of the unit via 50 ohm termination
The flatness should be within ±1dB
no
Q44, 45
D34
IC2

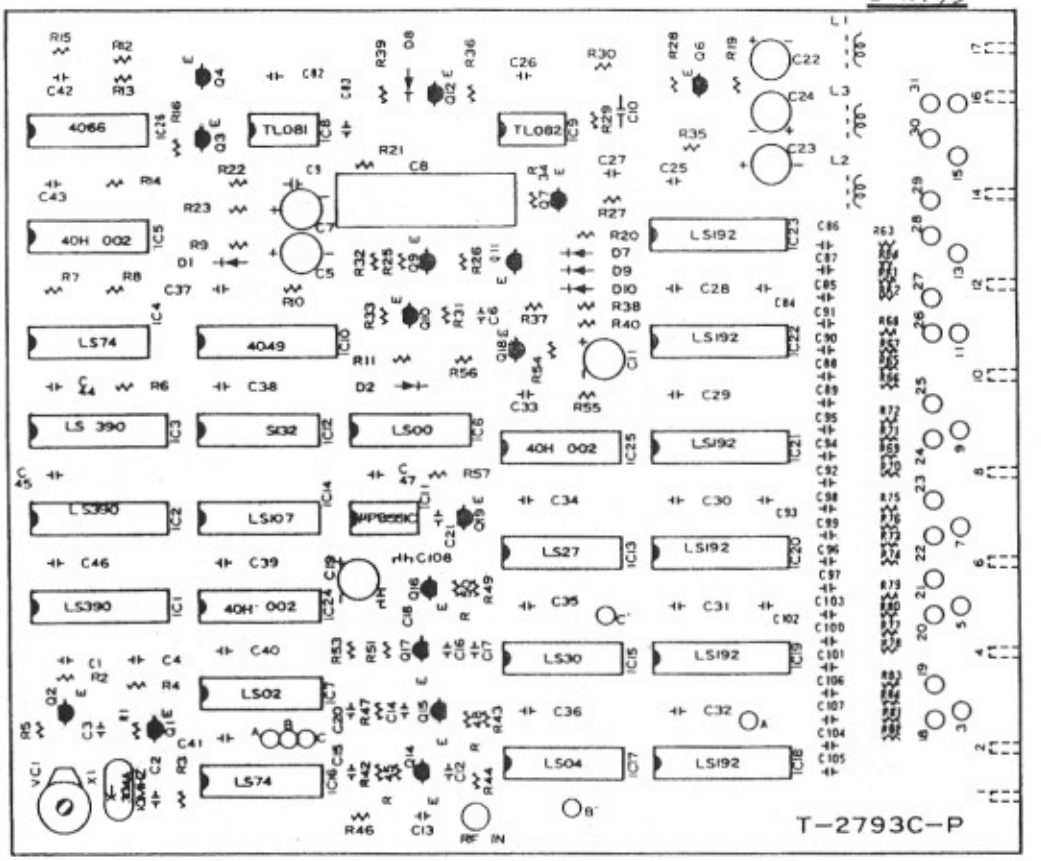
5. Location of Adjustment



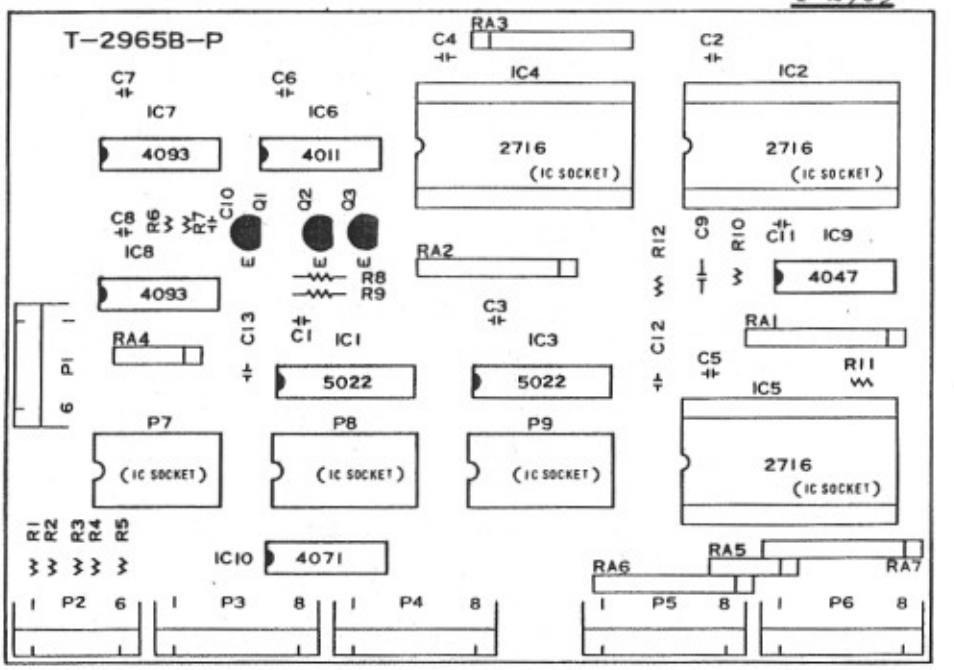
6. Printed Circuit Board

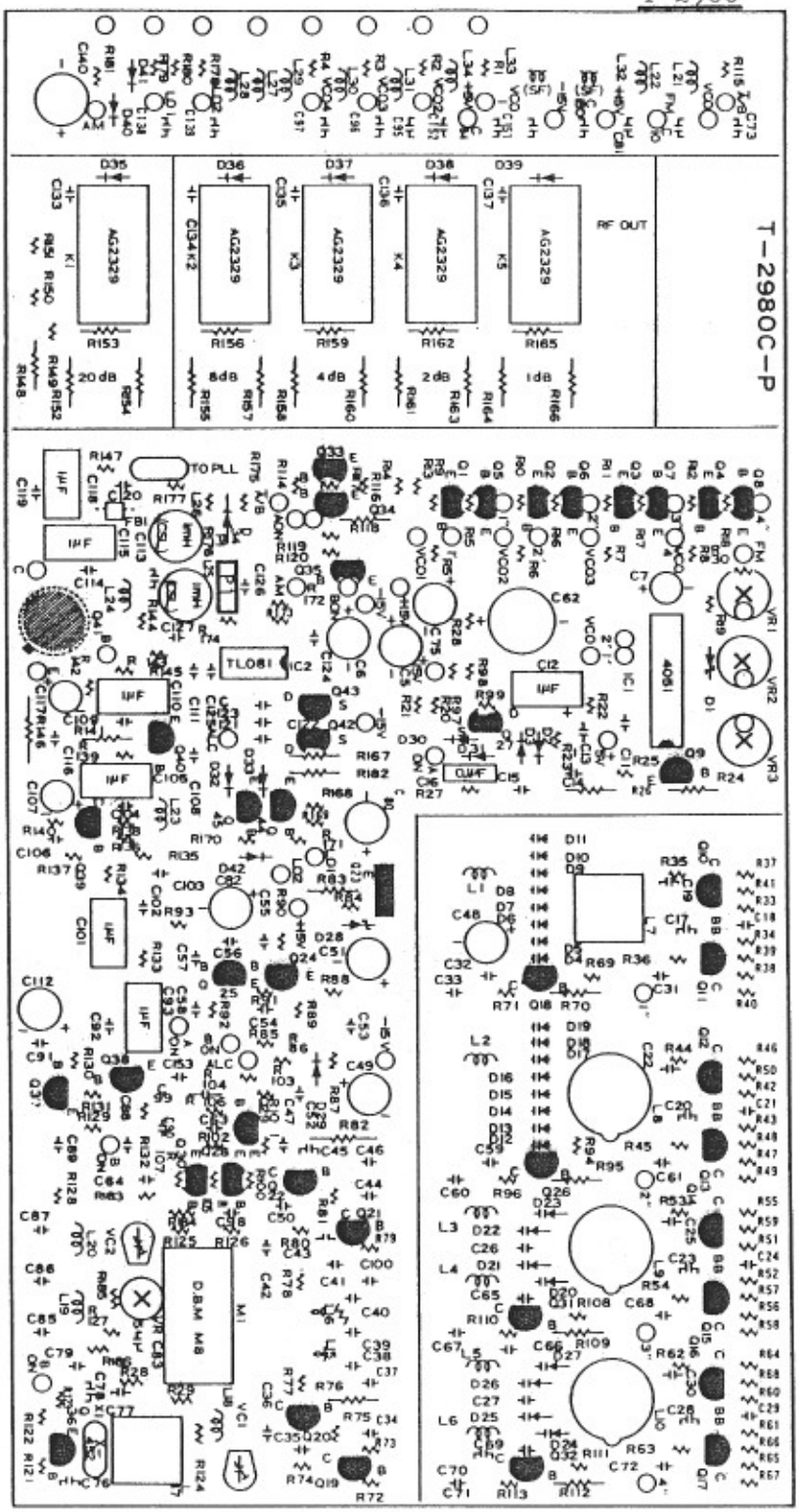


T-2793

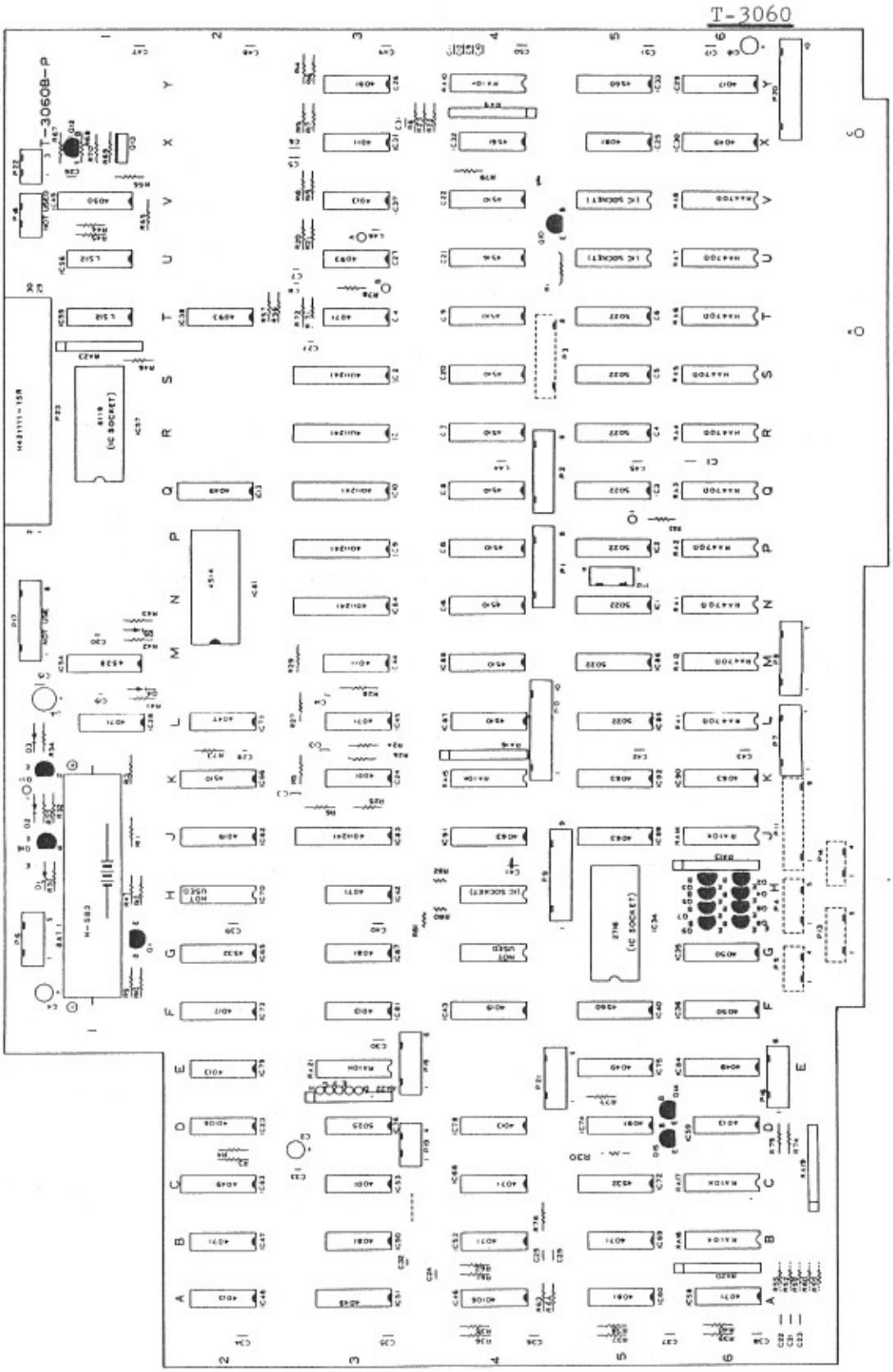

4066
TL081
TL082
40H 002
LS74
4049
LS 390
SO32
LS00
LS390
LSI07
LS27
LS30
LS04
LSI92
T-2793C-P

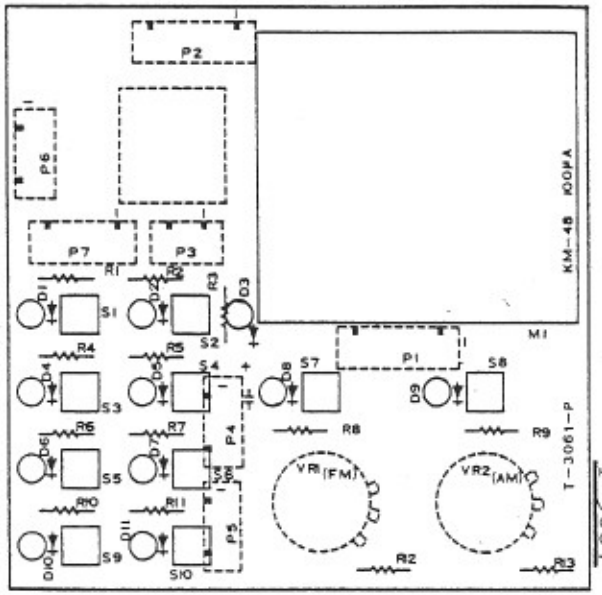
T-2965

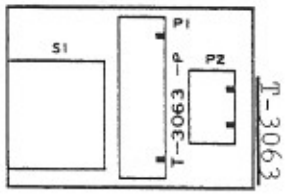

T-2965B-P
4093
4011
2716
(IC SOCKET)
4047
5022
4071
P1
P2
P3
P4
P5
P6
P7
P8
P9

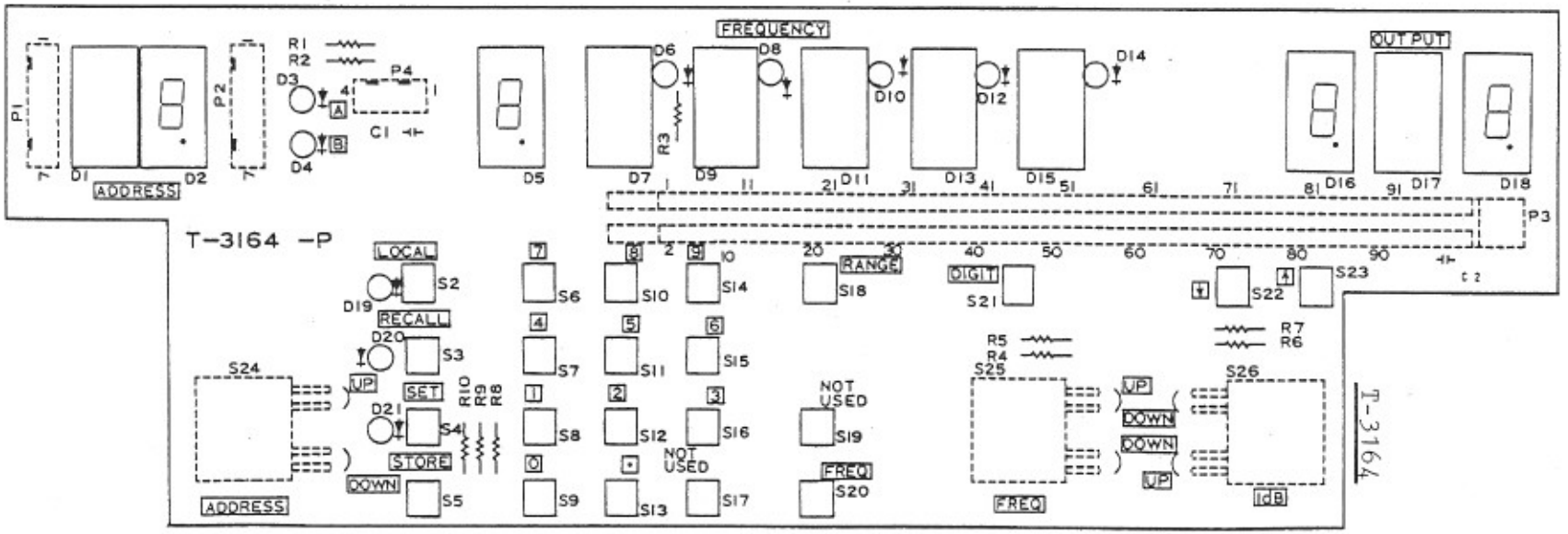

T-2980C-P
RF OUT
AG2329
TO PLL
TL081
4081
D.B.M M8
20dB
8dB
4dB
2dB
1dB

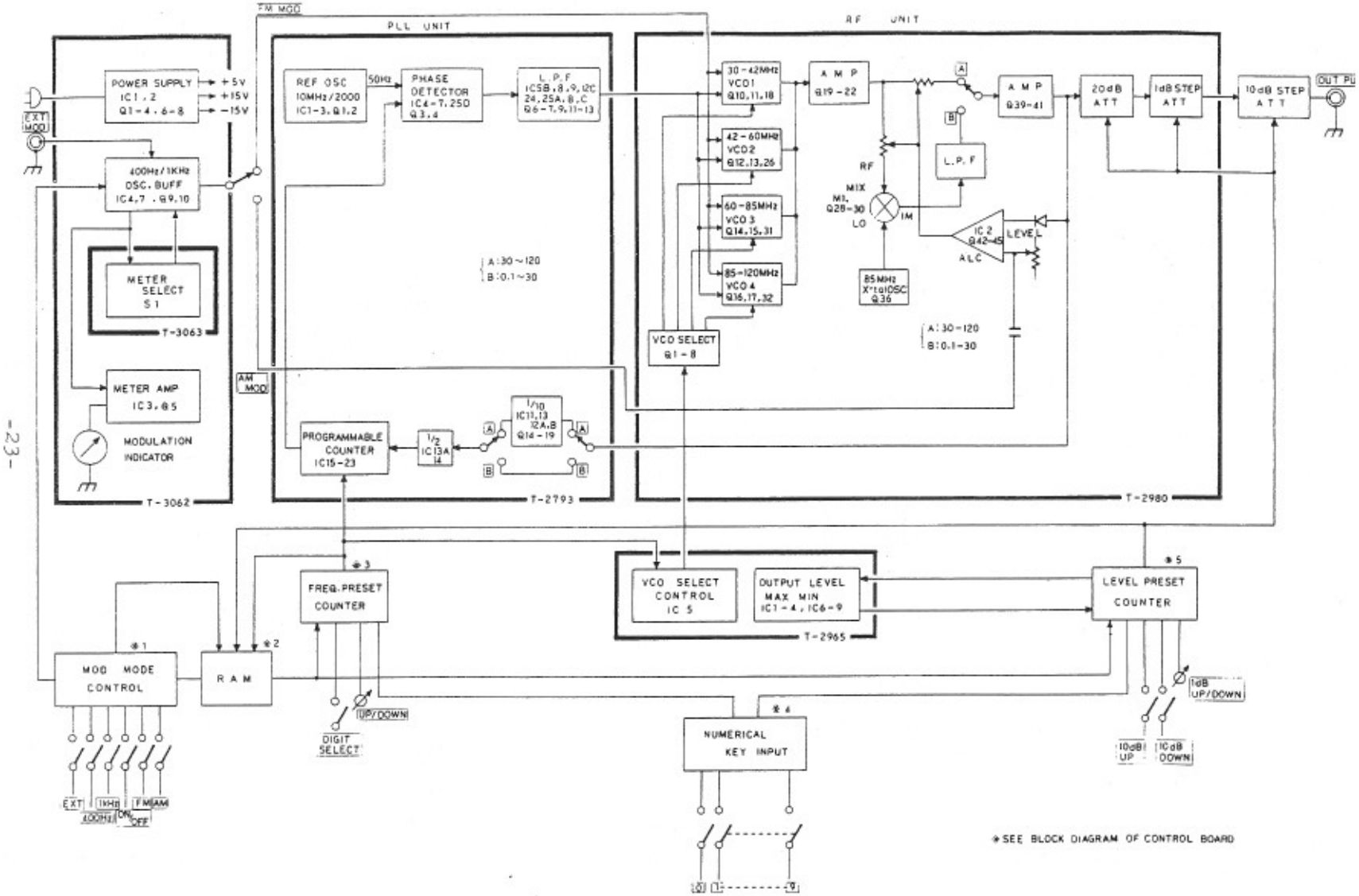
T-3060

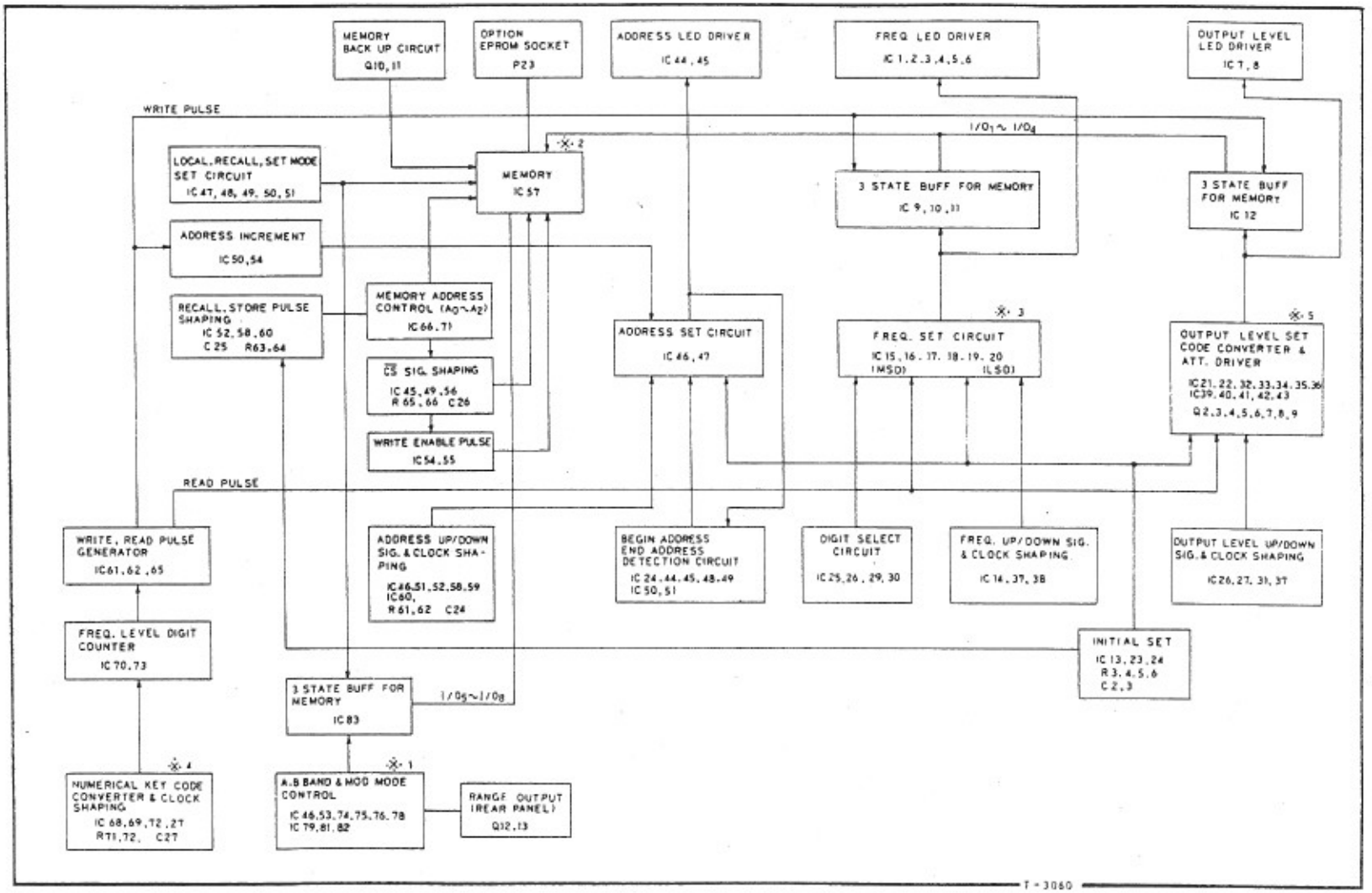


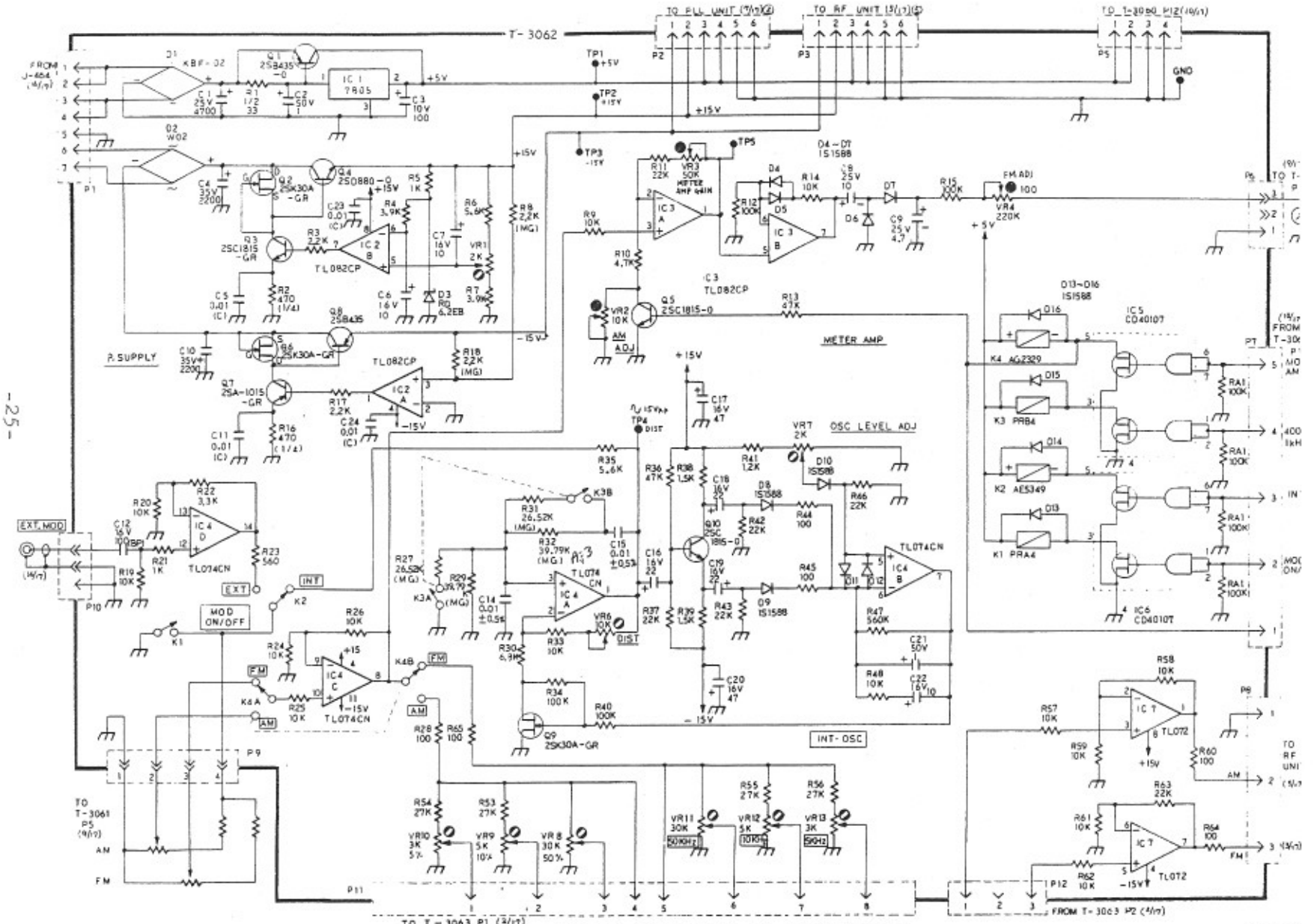

P2
P6
P7
P3
KM-48 KOMA
M1
S1
S2
S3
S4
S5
S6
S7
S8
S9
S10
P1
P4
P5
R8
R9
R2
R3
VR1 (FM)
VR2 (AM)
T-3061-P
T-3061

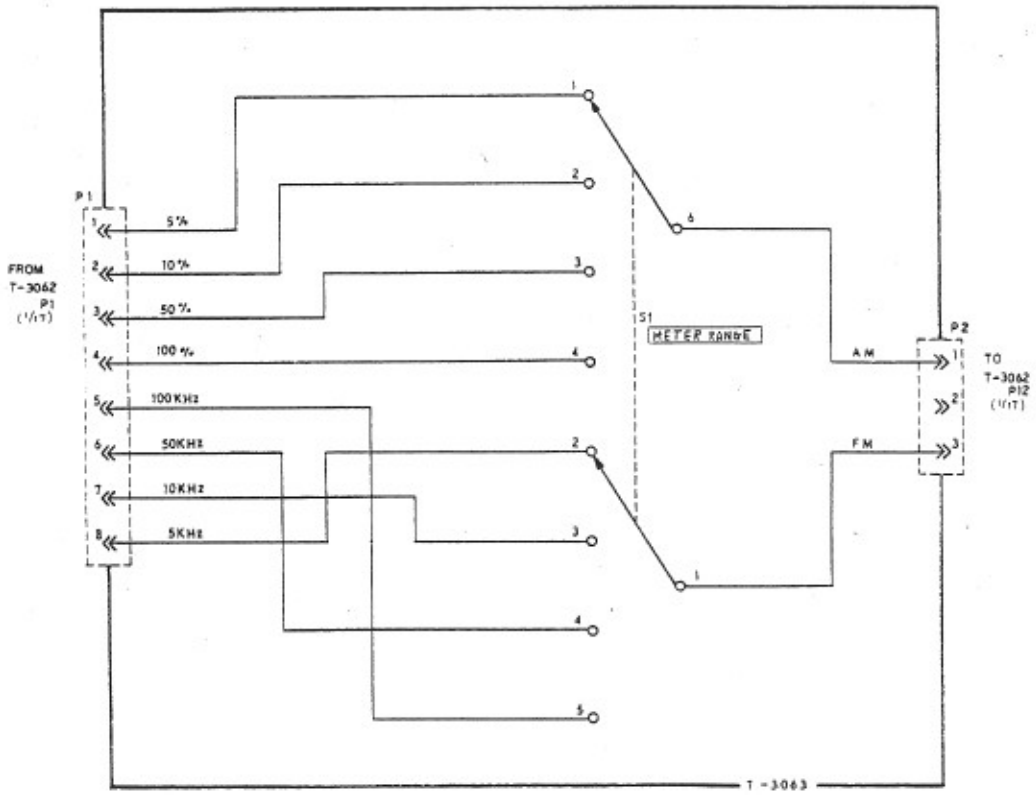

S1
P1
P2
T-3063-P
T-3063


P1
P2
R1
R2
D3
D4
P4
C1
A
B
D1
D2
ADDRESS
D5
FREQUENCY
D6
D7
R3
D8
D9
D10
D11
D12
D13
D14
D15
D16
OUT PUT
D17
D18
P3
T-3164 -P
LOCAL
D19
S2
RECALL
D20
S3
UP
SET
D21
S4
STORE
DOWN
S5
S24
ADDRESS
S6
S7
S8
S9
S10
S11
S12
S13
S14
S15
S16
S17
S18
RANGE
DIGIT
S21
NOT USED
S19
FREQ
S20
S22
S23
R7
R6
R5
R4
S25
S26
UP
DOWN
DOWN
UP
FREQ
1dB
T-3164


FM MOD
PLL UNIT
RF UNIT
POWER SUPPLY
IC1, 2
Q1-4, 6-8
+5V
+15V
-15V
EXT MOD
400Hz/1KHz
OSC. BUFF
IC4,7, Q9,10
METER
SELECT
S1
T-3063
METER AMP
IC3, 5
MODULATION
INDICATOR
T-3062
AM MOD
REF OSC
10MHz/2000
IC1-3, Q1,2
50Hz
PHASE
DETECTOR
IC4-7, 250
Q3, 4
L.P.F
ICSB, 8, 9, 12C
24, 25A, B, C
Q6-7, 9, 11-13
A:30~120
B:0.1~30
T-2793
30-42MHz
VCO1
Q10, 11, 18
42-60MHz
VCO2
Q12, 13, 26
60-85MHz
VCO3
Q14, 15, 31
85-120MHz
VCO4
Q16, 17, 32
VCO SELECT
Q1-8
AMP
Q19-22
AMP
Q39-41
20dB
ATT
1dB STEP
ATT
10dB STEP
ATT
OUT PU
L.P.F
RF
MIX
M1, Q28-30
LO
IM
IC2
Q42-45
ALC
LEVEL
85MHz
X'tal OSC
Q36
A:30-120
B:0.1-30
T-2980
PROGRAMMABLE
COUNTER
IC15-23
1/2
IC13A
14
1/10
IC11, 13
12A, B
Q14-19
FREQ. PRESET
COUNTER
VCO SELECT
CONTROL
IC5
OUTPUT LEVEL
MAX MIN
IC1-4, IC6-9
T-2965
LEVEL PRESET
COUNTER
MOD MODE
CONTROL
RAM
UP/DOWN
DIGIT
SELECT
NUMERICAL
KEY INPUT
1dB
UP/DOWN
10dB
UP
1dB
DOWN
EXT
1MHz
400Hz
ON
OFF
FM
AM
0
1
9
*1
*2
*3
*4
*5
*SEE BLOCK DIAGRAM OF CONTROL BOARD


MEMORY BACK UP CIRCUIT Q10, 11
OPTION EPROM SOCKET PZ3
ADDRESS LED DRIVER IC 44, 45
FREQ. LED DRIVER IC 1, 2, 3, 4, 5, 6
OUTPUT LEVEL LED DRIVER IC 7, 8
WRITE PULSE
I/O1 ~ I/O4
※ 2
LOCAL, RECALL, SET MODE SET CIRCUIT IC 47, 48, 49, 50, 51
MEMORY IC 57
3 STATE BUFF FOR MEMORY IC 9, 10, 11
3 STATE BUFF FOR MEMORY IC 12
ADDRESS INCREMENT IC 50, 54
RECALL, STORE PULSE SHAPING IC 52, 58, 60 C 25 R 63, 64
MEMORY ADDRESS CONTROL (A0~A2) IC 66, 71
ADDRESS SET CIRCUIT IC 46, 47
※ 3
FREQ. SET CIRCUIT IC 15, 16, 17, 18, 19, 20 (MSD) (LSD)
※ 5
OUTPUT LEVEL SET CODE CONVERTER & ATT. DRIVER IC 21, 22, 32, 33, 34, 35, 36 IC 39, 40, 41, 42, 43 Q 2, 3, 4, 5, 6, 7, 8, 9
CS SIG. SHAPING IC 45, 49, 56 R 65, 66 C 26
WRITE ENABLE PULSE IC 54, 55
READ PULSE
WRITE, READ PULSE GENERATOR IC 61, 62, 65
ADDRESS UP/DOWN SIG. & CLOCK SHAPING IC 46, 51, 52, 58, 59 IC 60, R 61, 62 C 24
BEGIN ADDRESS END ADDRESS DETECTION CIRCUIT IC 24, 44, 45, 48, 49 IC 50, 51
DIGIT SELECT CIRCUIT IC 25, 26, 29, 30
FREQ. UP/DOWN SIG. & CLOCK SHAPING IC 14, 37, 38
OUTPUT LEVEL UP/DOWN SIG. & CLOCK SHAPING IC 26, 27, 31, 37
FREQ. LEVEL DIGIT COUNTER IC 70, 73
INITIAL SET IC 13, 23, 24 R 3, 4, 5, 6 C 2, 3
3 STATE BUFF FOR MEMORY IC 83
I/O5~I/O8
※ 4
※ 1
NUMERICAL KEY CODE CONVERTER & CLOCK SHAPING IC 68, 69, 72, 27 R 71, 72, C 27
A, B BAND & MOD MODE CONTROL IC 46, 53, 74, 75, 76, 78 IC 79, 81, 82
RANGE OUTPUT (REAR PANEL) Q 12, 13
T-3060


T-3062
TO PLL UNIT (7/17)(2)
TO RF UNIT (5/17)(4)
TO T-3060 M12 (16/17)
P2
P3
P5
GND
+5V
+15V
-15V
TP1
TP2
TP3
TP4
TP5
P.SUPPLY
METER AMP
AM ADJ
FM ADJ
OSC LEVEL ADJ
INT-OSC
TL082CP
TL074CN
TL072
CD4010T
MOD ON/OFF
EXT. MOD
INT
EXT
AM
FM
DIST
K1 PRA4
K2 AES349
K3 PRB4
K4 AG2329
TO T-3061 P5 (9/17)
TO T-3063 P1 (3/17)
FROM T-3063 P2 (4/17)
TO T-30
Power supply & AF oscillator
(1/17



METER RANGE switch (2/17)