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SERVICE MANUAL

MODEL 7202
SWEEP/FUNCTION GENERATOR

DAGATRONICS CORPORATION

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1. PERFORMANCE CHECK PROCEDURE

1-1. General

This section contains the Procedures required to check and maintain specified instrument performance. The adjustments should be performed at an ambient temperature of 25°C ±2°C and a relative humidity of less than 60%. It allows the instrument to stabilize at this environment for a minimum of 30 minutes.

1-2. Equipment's required

Table 1-1 is shown test equipment's required.

Table 1-1 Equipment's required

No	Equipment name	Specification	Remark
1.	Frequency Counter	DC to 60 MHz	
2.	Oscilloscope	DC to 20 MHz	
3.	AC Millivolt Meter	Up to 30 Vrms	
4.	Distortion Analyzer		
5.	DC Power Supply	DC 0 to 10V	
6.	Signal Generator	200mHz to 50 MHz	
7.	FEEDTHROUGH TERMINATION 50 Ω		

1-3. Performance check

1-3-1. OUTPUT FREQUENCY RANGE

SPECIFICATION

0.02 Hz TO 2 MHz

ACCURACY

+/- 5 % OF SETTING

EQUIPMENT

FREQUENCY COUNTER

BNC CABLE

FEEDTHROUGH TERMINATION 50 Ω (if necessary)

PROCEDURE

2. Set 7202 as follows;

- Function ; SINE WAVE ()

- ATT ; 0 dB(PULL OUT)
- AMPLITUDE; CENTER
- COUNT ; INT(PULL OUT)
- DC OFFSET; OFF(PUSH IN)
- SYM ; OFF(PUSH IN)
- SWEEP ; OFF(PUSH IN)

2. Connect the frequency counter to output terminal.
3. Set the frequency counter to frequency measurement.
4. Set the output frequency of 7202 by FREQUENCY RANGE and DIAL and verify counter frequency reading as follows;

7202 setting		Counter reading
Range	Frequency	
1M	2.000 MHz 20.00 kHz	
100k	200.0 kHz 2.000 kHz	
10k	20.00 kHz 200.0 Hz	
1k	2.000 kHz 20.00 Hz	
100	200.0 Hz 2.000 Hz	
10	20.00 Hz 200.0 mHz	
1	2.000 Hz 20.00 mHz	

** For reading less than 200 mHz, you can read by period value.

200mHz ; 5.000 sec

20 mHz ; 50.000 sec

1-3-2. AMPLITUDE AND ATTENUATION

SPECIFICATION

Amplitude range ;100mVp-p to 10Vp-p IN TO 50Ω

Attenuation ;20 dB

ACCURACY

Lower than 100mVp-p(IN TO 50Ω) at MIN.

Higher than 10Vp-p(IN TO 50Ω) at MAX.

EQUIPMENT

Oscilloscope


AC Millivoltmeter

BNC CABLE

FEEDTHROUGH TERMINATION 50 Ω

PROCEDURE

1. Set 7202 as follows;

- Function ; SINE WAVE ()
- ATT ; 0 dB(PULL OUT)
- AMPLITUDE ; CENTER
- COUNT ; INT(PULL OUT)
- DC OFFSET ; OFF(PUSH IN)
- SYM ; OFF(PUSH IN)
- SWEEP ; OFF(PUSH IN)

2. Connect the oscilloscope through FEEDTHROUGH TERMINATION 50 Ω to output terminal.

3. Set Amplitude Control to Min. position and check the output level is lower than 100mVp-p(less 5div in 20mV/div).

4. Set Amplitude Control to Max. position and check the output level is higher than 10Vp-p(higher than 4div in 5V/div).

5. Set Amplitude Control to Min. position and connect AC Millivoltmeter to output terminal.

6. Set the Range of AC millivoltmeter to 3V range and adjust Amplitude control for 0dB reading on AC millivoltmeter.

7. Push in "20dB ATT switch" and check the reading of AC Millivoltmeter is -20 dB

1-3-3. SINE WAVE CHARACTERISTICS

SPECIFICATION

Total harmonic Distortion(THD) ; $\leq 1\%$ (10Hz to 100kHz)

EQUIPMENT


Distortion analyzer

BNC CABLE

FEEDTHROUGH TERMINATION 50 Ω (if necessary)

PROCEDURE

1. Set 7202 as follows;

- Function ; SINE WAVE ()
- ATT ; 0 dB(PULL OUT)
- AMPLITUDE ; CENTER

- COUNT ; INT(PULL OUT)
 - DC OFFSET ; OFF(PUSH IN)
 - SYM ; OFF(PUSH IN)
 - SWEEP ; OFF(PUSH IN)
2. Connect the distortion analyzer to output terminal.
 3. Check the distortions of output signal are less than 1% from 10Hz to 100kHz.

1-3-4. TRIANGLE/SQUARE WAVE CHARACTERISTICS

SPECIFICATION

Linearity of Triangle Wave ; $\geq 99\%$ (10Hz to 100kHz)

Rise and Fall Time of Square Wave ; Less than 140nS



EQUIPMENT

Oscilloscope

BNC CABLE

FEEDTHROUGH TERMINATION 50 Ω (if necessary)

PROCEDURE

1. Set 7202 as follows;
 - Function ; TRIANGLE WAVE ()
 - ATT ; 0 dB(PULL OUT)
 - AMPLITUDE ; CENTER
 - COUNT ; INT(PULL OUT)
 - DC OFFSET ; OFF(PUSH IN)
 - SYM ; OFF(PUSH IN)
 - SWEEP ; OFF(PUSH IN)
2. Connect the oscilloscope to output terminal.
3. Check the linearity of Triangle wave from 10Hz to 100kHz.
4. Change the function to "SQUARE WAVE()" and check the rise and fall time from 10Hz to 100kHz.

1-3-5. TTL/CMOS OUTPUT

SPECIFICATION

TTL OUTPUT - Rise and Fall Time ; Less than 140nS

- Output Level ; TTL LEVEL ($H \geq 2.4V$, $L \leq 0.4V$)

CMOS OUTPUT - Rise and Fall Time ; Less than 140nS(max. out)

- Output Level ; 4V TO 15V , VARIABLE

EQUIPMENT

Oscilloscope

BNC CABLE

PROCEDURE

1. Set 7202 as follows;
 - FREQ. RANGE ; 10k
 - FREQ. DIAL ; 10kHz
 - COUNT ; INT(PULL OUT)
 - DC OFFSET ; OFF(PUSH IN)
 - SYM ; OFF(PUSH IN)
 - SWEEP ; OFF(PUSH IN)
 - TTL/CMOS ; TTL(PUSH IN)
3. Set the oscilloscope to 1V/div, 5uS/div and connect to TTL/CMOS output terminal.
4. Check the TTL SQUARE WAVE on CRT(5div).
5. Pull out TTL/CMOS control and adjust from Min. to Max. position.
6. Check the output level is varied from 4V to 15V.

1-3-5. DC OFFSET CONTROL

SPECIFICATION

MIN. ; lower than -10 V DC (Open circuit)


MAX. ; higher than +10 V DC (Open circuit)

EQUIPMENT

Oscilloscope

BNC CABLE

PROCEDURE

1. Set 7202 as follows;
 - Function ; SQUARE ()
 - ATT ; 0 dB(PULL OUT)
 - FREQ. RANGE ; 10k
 - FREQ. DIAL ; 10kHz
 - AMPLITUDE ; CENTER
2. Set Oscilloscope to 5V/DIV, 10uS/DIV, DC Coupling and connect to output terminal.
3. Adjust Amplitude Control for 2DIV on CRT.
4. Pull out "DC OFFSET" Control and set to "MIN." position and check the DC OFFSET level is lower than -10V(Lower than -2DIV).
5. Set "DC OFFSET" Control to "MAX." position and check the DC OFFSET level is higher than +10V(Higher than +2DIV).

1-3-6. SYMMETRY CONTROL

SPECIFICATION

MIN. ; lower than 1:10

MAX. ; higher than 10:1

EQUIPMENT


Oscilloscope

BNC CABLE

FEEDTHROUGH TERMINATION 50 Ω (if necessary)

PROCEDURE

1. Set 7202 as follows;

- Function ; SQUARE ()
- ATT ; 0 dB(PULL OUT)
- AMPLITUDE; CENTER
- COUNT ; INT(PULL OUT)
- DC OFFSET ; OFF(PUSH IN)
- SYM ; OFF(PUSH IN)
- SWEEP ; OFF(PUSH IN)

2. Connect the oscilloscope to output terminal.

3. Set the output frequency to 20kHz .

4. Pull out SYM Control and adjust to Min. position. And check the symmetry(duty ratio) is "lower than 1:10".

5. Adjust SYM Control to Max. position and check the symmetry(duty ratio) is "higher than 10:1".

1-3-7. SWEEP FUNCTION

SPECIFICATION

Sweep Width ; 1:1 to 100:1

Sweep Rate ; 0.5Hz to 50Hz(20mS to 2 S)

EQUIPMENT

Oscilloscope


Frequency Counter

BNC CABLE

FEEDTHROUGH TERMINATION 50 Ω (if necessary)

PROCEDURE

1. Set 7202 as follows;

- Function ; SINE WAVE ()
- ATT ; 0 dB(PULL OUT)

- AMPLITUDE ; CENTER
- COUNT ; INT(PULL OUT)
- DC OFFSET ; OFF(PUSH IN)
- SYM ; OFF(PUSH IN)

2. Connect the oscilloscope and Frequency Counter to output terminal.
3. Set Freq. Range to 10k and adjust Freq. Dial to 200Hz (Start Frequency).
4. Pull out SWIDTH Control and adjust to max. position (20kHz, Stop frequency).
5. Adjust Sweep Rate Control for desired rate and check sweep operating.

1-3-8. VCF IN FUNCTION

SPECIFICATION


Out-put frequency should be changed from minimum frequency to maximum frequency in each frequency range by changing VCF INPUT Voltage from 0 to 10V DC.

EQUIPMENT

Power supply

BNC CABLE

PROCEDURE

1. Set 7202 as follows;
 - Function ; SINE WAVE ()
 - Frequency Range ; 10K
 - Frequency Control ; Max.
 - ATT ; 0 dB(PULL OUT)
 - AMPLITUDE ; CENTER
 - COUNT ; INT(PULL OUT)
 - DC OFFSET ; OFF(PUSH IN)
 - SYM ; OFF(PUSH IN)
2. Set Power Supply to "0V" and connect to "VCF IN" Terminal.
3. Check the output frequency is "200Hz ± 20Hz".
4. Increase the output voltage of Power Supply up to +10V and check the output frequency as following table.

VCF Voltage	Output Frequency	Tolerance
0	200.0 Hz	± 20Hz
2.000 V	4.000 kHz	± 400Hz
4.000 V	8.000 kHz	± 800Hz
6.000 V	12.00 kHz	± 1.2 kHz
8.000 V	16.00 kHz	± 1.6 kHz
10.00 V	20.00 kHz	± 2.0 kHz

1-3-9. FREQUENCY COUNTER

SPECIFICATION

Frequency range ; 200mHz to 50MHz

Input sensitivity ; 100mVrms

EQUI PMENT

Signal generator

PROCEDURE

1. Set the CONT to EXT(PUSH IN).
2. Connect the signal generator to EXT COUNT IN terminal.
3. Set the signal generator to 100mVrms, 200mHz and check the reading of 7101.
4. Vary the output frequency from 200mHz to 50MHz and check the 7202 displays correct frequencies.

2. ADJUSTMENT PROCEDURE

2-1. Preliminary Set-up

Remove top cover. Apply power, and allow at least 30 minutes for warm-up.

2-2. Power supply

- a. Check the voltage in each position according to table 2-1.

Table 2-1 Power supply outputs

Check position	Supplying Voltage	Tolerance	Remark
Pin no. 5 of u4	+ 5 V	± 0.5V	
Right leg of C61	+ 5 V	± 0.5V	
Anode of ZD1	- 5 V	± 0.5V	
Pin no. 4 of U2	+ 15 V	± 1 V	
Pin no. 11 of U2	- 15 V	± 1 V	
Upper leg of R68	+ 22 V	± 2 V	
Right leg of R67	- 22 V	± 2 V	

2-4. PRE-ADJUSTMENTS

2-4-1. TRIANGLE WAVE OFFSET, SQUARE & SINE WAVE LEVEL ADJUST




EQUI PMENT

Oscilloscope

BNC CABLE

FEEDTHROUGH TERMINATION 50 Ω (if necessary)

PROCEDURE

1. Set 7202 as follows;
 - Function ; TRI ANGLE WAVE ()
 - ATT ; 20 dB(PUSH IN)
 - AMPLITUDE ; MIN.
 - FREQUENCY ; 10kHz
 - COUNT ; INT(PULL OUT)
 - DC OFFSET ; OFF(PUSH IN)
 - SYM ; OFF(PUSH IN)
2. Set the oscilloscope to 0.5V/DIV, 5uS/DIV , DC Coupling and set the vertical position to horizontal graticule center.
3. Connect the oscilloscope to output terminal.
4. Set "AMPLITUDE" control for 2DIV on CRT and adjust SFR14(OFFSET ADJUSTER) for "0 OFFSET of waveform"(The waveform should be in center. +/- 1DIV from horizontal graticule center).
5. Change the function to "SQUARE WAVE ()" and adjust SFR9 for displaying "2DIV(± 1DIV from horizontal graticule center)" on CRT.
6. Change the function to "SINE WAVE ()" and adjust SFR10 , SFR13 for displaying "2DIV" on CRT. (SFR10 : + 1DIV from horizontal graticule center for up-side of waveform , SFR13 : - 1DIV from horizontal graticule center for down-side of waveform)

2-4-2. SINE WAVE DISTORTION ADJUST


EQUIPMENT

Distortion Analyzer

BNC CABLE

FEEDTHROUGH TERMINATION 50 Ω (if necessary)

PROCEDURE

1. Set 7202 as follows;
 - Function ; SINE WAVE ()
 - ATT ; 20 dB(PUSH IN)
 - AMPLITUDE ; Max.
 - FREQUENCY ; 10kHz
2. Connect Distortion analyzer to Output terminal.
3. Adjust SFR8, SFR11, SFR12 for minimum distortion reading on Distortion analyzer.
(less than 0.5 %)

2-4-3. AMPLITUDE CONTROL AND ATTENUATOR CHECK

EQUIPMENT


Oscilloscope

AC Millivoltmeter

BNC CABLE

FEEDTHROUGH TERMINATION 50 Ω

PROCEDURE

1. Set 7202 as follows ;
 - Function ; SINE WAVE ()
 - ATT ; 0 dB(PULL OUT)
 - AMPLITUDE ; CENTER
 - COUNT ; INT(PULL OUT)
 - DC OFFSET ; OFF(PUSH IN)
 - SYM ; OFF(PUSH IN)
 - SWEEP ; OFF(PUSH IN)
2. Connect the oscilloscope through FEEDTHROUGH TERMINATION 50 Ω to output terminal.
3. Set Amplitude Control to Min. position and check the output level is lower than 100mVp-p(less 5div in 20mV/div).
4. Set Amplitude Control to Max. position and check the output level is higher than 10Vp-p(higher than 4div in 5V/div).
5. Set Amplitude Control to Min. position and connect AC Millivoltmeter to output terminal.
6. Set the Range of AC millivoltmeter to 3V range and adjust Amplitude control for 0dB reading on AC millivoltmeter.
7. Push in "20dB ATT switch" and check the reading of AC Millivoltmeter is -20 dB.
8. Check the amplitude of TRIANGLE & SQUARE WAVE same as paragraph 3 to 7.

2-5. FREQUENCY RANGE ADJUSTMENT


EQUIPMENT

Frequency Counter

BNC CABLE

FEEDTHROUGH TERMINATION 50 Ω

PROCEDURE

1. Set 7202 as follows;
 - Function ; TRIANGLE WAVE ()
 - ATT ; 20 dB(PUSH IN)
 - AMPLITUDE ; CENTER
 - COUNT ; INT(PULL OUT)
 - DC OFFSET ; OFF(PUSH IN)
 - SYM ; OFF(PUSH IN)
 - SWEEP ; OFF(PUSH IN)
2. Connect the Frequency Counter to Output Terminal.
2. Set Frequency Range to "1M" and Frequency Control(Dial) to MAX. Position.

3. Adjust SFR1 for 2.100 MHz frequency reading on counter.
4. Change Frequency Range to "100k" and adjust SFR2 for 210.00 kHz frequency reading on counter.
5. Change Frequency Range to "10k" and adjust SFR3 for 21.000 kHz frequency reading on counter.
6. Change Frequency Range to "1k" and adjust SFR4 for 2.1000 kHz frequency reading on counter.
7. Change Frequency Range to "100" and adjust SFR2 for 210.00 Hz frequency reading on counter
8. Change the frequency range to 10 and 1, and check the frequency reading in each range. (10 : 21.000 Hz , 1 : 2.1000 Hz)
9. After adjustment, check the frequency Control(Dial) at MIN. and MAX. as following table.

7202 setting		Tolerance
Range	Frequency Control	
1M	MIN. MAX.	Less than 19 kHz Higher than 2.1 MHz
100k	MIN. MAX.	Less than 1.9 kHz Higher than 210 kHz
10k	MIN. MAX.	Less than 190 Hz Higher than 21 kHz
1k	MIN. MAX.	Less than 19 Hz Higher than 2.1 kHz
100	MIN. MAX.	Less than 1.9 Hz Higher than 200 Hz
10	MIN. MAX.	Less than 190 mHz Higher than 21 Hz
1	MIN. MAX.	Less than 19 mHz Higher than 2.1 Hz

2-6. SYMMETRY ADJUST


EQUIPMENT

Oscilloscope

BNC CABLE

FEEDTHROUGH TERMINATION 50 Ω (if necessary)

PROCEDURE

1. Set 7202 as follows;
 - Function ; SQUARE ()
 - ATT ; 0 dB(PULL OUT)
 - AMPLITUDE ; CENTER
 - COUNT ; INT(PULL OUT)
 - DC OFFSET ; OFF(PUSH IN)

- SYM ; OFF(PUSH IN)
- SWEEP ; OFF(PUSH IN)

2. Connect the oscilloscope to output terminal.
3. Set the output frequency to 20kHz.
4. Pull out SYM Control and adjust to Min. position. And adjust SFR6 the symmetry(duty ratio) is "lower than 1:10".
5. Adjust SYM Control to Max. position and adjust the symmetry(duty ratio) is "higher than 10:1".

2-7. FREQUENCY COUNTER ADJUST

EQUIPMENT

10MHz Standard Signal Source
Signal Generator up to 50MHz

BNC CABLE

FEEDTHROUGH TERMINATION 50 Ω (if necessary)

PROCEDURE

1. Set 7202 as follows;
 - COUNT ; EXT(PUSH IN)
2. Connect 10MHz Standard Signal to the EXT COUNT IN terminal and adjust TC1 for 10.0000 MHz reading on Counter Display.
3. Set Signal generator to 50MHz, 100mVrms and connect the EXT COUNT IN terminal.
4. Adjust SFR16 for 50.0000 MHz reading on Counter Display. Reduce the output level of Signal Generator Slowly and adjust SFR16 for Minimum input sensitivity(as possible as less than 100mVrms).
5. Change the out frequency of Signal Generator from 50MHz to 200MHz and check the minimum input voltage is less than 100mVrms.

3. Troubleshooting Procedure

3-1. Troubleshooting techniques

3-1-1. Check the function selector and switch setting. Incorrect switch settings can give a false indication of instrument malfunction. If there is any question about the correct function or operation, Refer to 7202 OPERATOR'S MANUAL.

3-1-2. Check associated equipment's

Before proceeding, ensure that any equipment's used with 7202 is operating correctly and verify that out and input signals are properly connected and that the interconnecting cables are not defective.

3-1-3. Visual Check

Look for broken terminals, damaged components, mounting status of components, damaged circuit boards, or other clues to the cause of a malfunction.

3-2. Troubleshooting procedure

3-2-1. NO Display

1. Check the "FUSE" and if it is broken, change to new one with same rating.
2. Check the output voltage of power transformer.
 - . 20 to 24 Vac between pin 1 and 2 of CN14, and between pin 2 and 3 of CN14 on main board.
 - . 6 to 8 Vac between pin 1 and 2 of CN4, and between pin 2 and 3 of CN4 on main board.
3. Check the DC Power Voltage.
 - . +5VDC at U15 output
4. Check the frequency at pin 19 of U12. It should be "10MHz".
5. Check the connector cable from CN12(main board) to display board.

3-2-2. Triangle Wave Out-put

1. Check the Function switch operation and select Triangle Wave
2. Check the DC Power Voltage for Generator Circuit.
 - . +15VDC at U5 output
 - . +5VDC at U6 output
 - . -5VDC at C27 -
 - . -15VDC at U7 output
 - . +21VDC at C20 +
 - . -21VDC at C26 -
3. Check the waveform at Q7 Emitter. The Triangle Wave should be appeared.
4. If not, check the operation of Amplifier and Triangle oscillator (U1 A/B/D, U2 A/B, Q3,Q4,Q5,Q6,D3,D4,D5,Q7).
5. Check the Range Selector Switch operation and Frequency Control Volume and Cable connection from VR1 to CN2(Main Board).
6. Check the "Amplitude VR" and Cable connection from VR to CN5 on main board.
7. Check the waveform at R62. The Triangle Wave should be appeared.
8. If not, check the operation of Differential Amplifier(Q12,Q13,Q14,Q15,Q16).
9. Check the Attenuator switch(20 dB) and cable connection from CN7 to Output terminal.

3-2-3. Square Wave Out-put

1. Check the Function switch operation and select Square Wave
2. Check the waveform at D1 Anode. The Triangle Wave should be appeared.
3. If not, check the step 3-2-2. 4 and 5.

4. Check the waveform at 9pin of U3. The Square Wave should be appeared.
5. If not, check the operation of U3.
6. Check the waveform at R62. The Square Wave should be appeared.
7. If not, check the step 3-2-2. 8 and 9.

3-2-4. Sine Wave Out-put

1. Check the Function switch operation and select Sine Wave.
2. Check the waveform at Q7 Emitter. The Triangle Wave should be appeared.
3. If not, check the step 3-2-2. 4 and 5.
4. Check the waveform at Q11 Collector. The Sine Wave should be appeared.
5. If not, check the operation of Sine Shaper(Q8,Q9,Q10,Q11).
6. Check the waveform at R62. The Sine Wave should be appeared.
7. If not, check the step 3-2-2. 8 and 9.

3-2-5. TTL/CMOS Out-put

1. Check the connection of cable for output terminal and Control Volume.
2. Set to TTL(Push in) and check the waveform at Pin 9 of U3. The Square Wave should be appeared.
3. If not, check the step 3-2-3.
4. Check the waveform at pin 6 of U4. The TTL Level Square Wave should be appeared.
5. If not, check the operation of U4.
6. Set to CMOS(Pull out) and check the waveform at pin 8 of U4. The TTL Level Square Wave should be appeared.
7. Vary the CMOS Level control and check the CMOS level is varied from 5V to 15V at TTL/CMOS output terminal.
8. If not, check the R82 and cable connection.

3-2-6. Sweep Operation(Width and Rate)

1. Check the cable connection(CN8,CN9) for Width and Rate Control Volume.
2. Vary the Width volume and check the period of Pulse at pin 14 of U2 is varied.
3. Vary the Rate volume and check the level of Pulse at pin 14 of U2 is varied.
4. If not, check the operation of U2 C/D , D9 and Q17.

3-2-7. Frequency Range and Frequency Dial

1. Check the cable connection from CN2(Main Board) to Frequency Control Volume.
2. Check the operation of Range selector switch(Key Switch operation).

3-2-8. Attenuator(20dB)

1. Check the operation of each Attenuator switch.
2. If not working, check the R63,R64,R65.

3-2-9. Frequency Counter(INT/EXT)

1. Check the INT/EXT selector switch operation and set to INT.
2. Check the output frequency at Output terminal by using Frequency counter and check the frequency at R83 is same with output frequency.
3. Check the frequency of reference signal at pin18 and 19 of U12. It should be "10.000MHz".
4. If not, check Reference Oscillator(X1,T1,C54,C57).
5. Check the frequency at pin3 of U9. It should be same as output frequency.
6. If not, check the operation of Input Amplifier(Q18,Q19,U8,Q20,Q21).
7. Check the cable connection between CN12(main board) and CN13(Display Board).
8. Check the operation of Display Controller(U13,U14,Q22-28) on Display Board.

4. PARTS LIST

Table 4-1 is shown Parts list.

5. CIRCUIT DIAGRAM

Fig. 5-1 is shown Circuit diagram.

6. COMPONENTS LAY-OUT

Fig. 6-1 is shown Components lay-out of main board and front board.

TABLE 4-I PARTS LIST

1. MAIN BOARD

NO	PART NAME	SPECIFICATION	UNIT	Q'TY	REF.NUMBER	REMARK
1	IC	MC10116	EA	1	U8	
2	IC	GAL 16V8	EA	1	U9	
3	IC	74HC393	EA	2	U10,11	
4	IC	89C52	EA	1	UI2	
5	IC	2981	EA	1	UI3	
6	IC	GL324	EA	2	U1,2	
7	IC	75107AN	EA	1	U3	
8	IC	74soo	EA	1	U4	
9	IC	7805	EA	2	U6,15	
10	IC	7815	EA	1	U5	
11	IC	7915	EA	1	U7	
12	IC	7426	EA	1	UI6	
13	FET	K30A-Y	EA	2	Q5,6	
14	TRANSISTOR	2N3904	EA	5	Q2,4,7,12,13	
15	TRANSISTOR	2N3906	EA	7	Q1,3,14,17,19,20, 21	
16	TRANSISTOR	2SC1815GR/C3198	EA	4	Q8,9,10,11	
17	TRANSISTOR	2N2219A CAN TYPE	EA	1	Q15	
18	TRANSISTOR	2N2905A CAN TYPE	EA	1	Q16	
19	TRANSISTOR	2N5486	EA	1	Q18	
20	LINE FILTER	5mH	EA	1	LI	
21	X-TAL	10 MHz	EA	1	XI	
21	DIODE, RECTIFIER	1 N4003	EA	2	D12,13	
22	DIODE, SWITCHING	1 N4148	EA	11	D1,2,3,4,5,6,7, 8,9,10,11	
23	ZENER DIODE	5.1V 1/2W	EA	1	ZD1	
24	BRIDGE DIODE	DF06M	EA	1	BD1	
25	KEY SWITCH	PBL-12NCC-107T5F	EA	1		
26	CAP.TRIMER	50P (2 READ)	EA	1	TI	
27	CAP.CERAMIC	30p/50V	EA	1	c54	
28	CAP.CERAMIC	39p/50V	EA	1	C16	
29	CAP.CERAMIC	56p/CH TYPE	EA	1	c57	
30	CAP.CERAMIC	68p/CH TYPE	EA	1	C10	
3 1	CAP.CERAMIC	82p/50V	EA	1	C9	
32	CAP.CERAMIC	130p/50V	EA	2	C38,41	
33	CAP.STYROL	180p/CH TYPE	EA	1	C3	
34	CAP.CERAMIC	150p/50V	EA	1	C13	

NO	PART NAME	SPECIFICATION	UNIT	Q'TY	REF.NUMBER	REMARK
35	CAP.CERAMIC	330p/50V	EA	1	C19	
36	CAP.CERAMIC	470p/50V	EA	1	C44	
37	CAP.STYROL	2200p/50V	EA	1	C4	
38	CAP.METAL FILM	4700pF/500V	EA	2	C64,65	
39	CAP.CERAMIC	0.01uF/50V	EA	10	33,34,39,45,47	
40	CAP.METAL FILM	0.022uF/63V	EA	1	C5	
41	CAP.METAL FILM	0.047/250V	EA	1	C37	
42	CAP.METAL FILM	0.1uF/400V	EA	2	C62,63	
43	CAP.METAL FILM	0.22uF/250V	EA	1	C6	
44	CAP.,MYLER	0.22uF	EA	1	C36	
45	CAP.CERAMIC	0.22uF/50V	EA	2	C17,18	
46	CAP.CERAMIC	0.1uF/50V	EA	7	C49,50,51,52,56,59,61	
47	CAP.METAL FILM	2.2uF/250V	EA	1	C7	
48	CAP.ELECTRIC.	10uF/35V	EA	1	C55	
49	CAP.ELECTRIC.	22uF/16V	EA	9	C1,12,14,22,23,25,30,32,35	
50	CAP.ELECTRIC.	47uF/35V	EA	7	C27,28,40,42,43,46,48	
51	CAP.ELECTRIC.	220uF/35V	EA	2	C20,26	
52	CAP.ELECTRIC.	470uF/25V	EA	1	C60	
53	CAP.ELECTRIC.	1000uF/35V	EA	3	C21,24,58	
54	RES.SEMI-FIXED	p10 100B	EA	2	SFR11,14	
55	RES.SEMI-FIXED	p10 1KB	EA	3	SFR9,10,13	
56	RES.SEMI-FIXED	p10 2.0KB	EA	1	SFR8	
57	RES.SEMI-FIXED	p10 5.0KB	EA	5	SFR1,2,3,4,5	
58	RES.SEMI-FIXED	p10 10KB	EA	3	SFR6,7,16	
59	RES.SEMI-FIXED	p10 100KB	EA	1	SFR12	
60	RES.METAL FILM	62 1/4W,F	EA	2	R63,65	
61	RES.METAL FILM	240 1/4W,F	EA	1	R64	
62	RES.METAL FILM	430 1/4W,F	EA	2	R22,24	
63	RES.METAL FILM	1 K 1/4W,F	EA	2	R20,21	
64	RES.METAL FILM	1.76K 1/4W,F	EA	1	R32	
65	RES.METAL FILM	2.2K 1/4W,F	EA	2	R12,16	
66	RES.METAL FILM	11K 1/4W,F	EA	2	R23,25	
67	RES.METAL FILM	211K 1/4W,F	EA	2	R13,17	
68	RES.CARBON FILM	10 1/4W,J	EA	3	R18,44,69	
69	RES.CARBON FILM	22 1/4W,J	EA	5	R28,59,60,79,102	

NO	PART NAME	SPECIFICATION	UNIT	Q'TY	REF.NUMBER	REMARK
70	RES.CARBON FILM	33 1/4W,J	EA	2	R27,72	
71	RES.CARBON FILM	47 1/4W,J	EA	1	R114	
72	RES.CARBON FILM	100 1/4W,J	EA	1	R45	
73	RES.CARBON FILM	120 1/4W,J	EA	2	R47,103	
74	RES.CARBON FILM	150 1/4W,J	EA	2	R88,92	
75	RES.CARBON FILM	220 1/4W,J	EA	4	R4,29,31,50	
76	RES.CARBON FILM	270 1/4W,J	EA	1	R49	
77	RES.CARBON FILM	300 1/4W,J	EA	1	R39	
78	RES.CARBON FILM	330 1/4W,J	EA	4	R34,95,98,99	
79	RES.CARBON FILM	470 1/4W,J	EA	10	R54,55, 80,81, 93,94,96,97,100, 101	
80	RES.CARBON FILM	510 1/4W,J	EA	3	R41,86,87	
81	RES.CARBON FILM	750 1/4W,J	EA	3	R37,48,56	
82	RES.CARBON FILM	1K 1/4W,J	EA	9	R2,3,8,26,35,3638, 42,70	
83	RES.CARBON FILM	1.5K 1/4W,J	EA	2	R19,43	
84	RES.CARBON FILM	2K 1/4W,J	EA	2	R33,46	
85	RES.CARBON FILM	2.2K 1/4W,J	EA	4	R9,10,90,91	
86	RES.CARBON FILM	2.7K 1/4W,J	EA	2	R6,11	
87	RES.CARBON FILM	3.3K 1/4W,J	EA	1	R78	
88	RES.CARBON FILM	4.7K 1/4W,J	EA	2	R30,53	
89	RES.CARBON FILM	5.1K 1/4W,J	EA	3	R74,75,76	
90	RES.CARBON FILM	6.8K 1/4W,J	EA	1	R57	
91	RES.CARBON FILM	7.5K 1/4W,J	EA	4	R7,51,52,73	
92	RES.CARBON FILM	8.2K 1/4W,J	EA	1	R104	
93	RES.CARBON FILM	10K 1/4W,J	EA	5	R1,14,15,77,83	
94	RES.CARBON FILM	22K 1/4W,J	EA	1	R89	
95	RES.CARBON FILM	33K 1/4W,J	EA	1	R40	
96	RES.CARBON FILM	39K 1/4W,J	EA	1	R71	
97	RES.CARBON FILM	100K 1/4W,J	EA	1	R85	
98	RES.CARBON FILM	10 1/2W,J	EA	2	R67,68	
99	RES.CARBON FILM	100 1/2W,J	EA	2	R61,62	
100	RES.CARBON FILM	1K 1/2W,J	EA	1	R58	
101	RES.CARBON FILM	560 1W,J	EA	1	R66	
102	PCB,MAIN	208x170x1 .6t(DOUBLE	EA	1		
103	WIRE WITH LUG	G/Y,150mmp3 R	EA	1	REAL-MAIN PCB	
104	GND WIRE	G/Y,250mmp3 R	EA	1	MAIN-TOP CASE	
105	WAFER	2P 2.54mm	EA	3	CN1,7,11	

NO	PART NAME	SPECIFICATION	UNIT	Q'TY	REF.NUMBER	REMARK
106	WAFER	3P 2.54mm	EA	4	CN2,5,8,9	
107	WAFER	4P 2.54mm	EA	2	CN3,6	
108	WAFER	13P 2.54mm	EA	1	CN12	
109	WAFER	3P 2.54mm	EA	2	CN4,14	
110	WAFER	3P 3.96mm	EA	2	CN15,16	
111	WAFER	5P 2.54mm	EA	1	CN10	
112	HEAT SINK	φ 16.0(8.3φ INSIDE)	EA	2	Q12,Q16	
113	HEAT SINK	□ TYPE(19x13)	EA	4	U5,6,7,15	
114	TR SOCKET	9p	EA	2	Q15,Q16	
115	SPRING	GND 6x2x7	EA	1	MAIN SHIELD	
116	SHIELD BOX	110x98x15	EA	1		
117	SCREW	T 3x6	EA	4	HEAT SINK	

2. DISPLAY BOARD

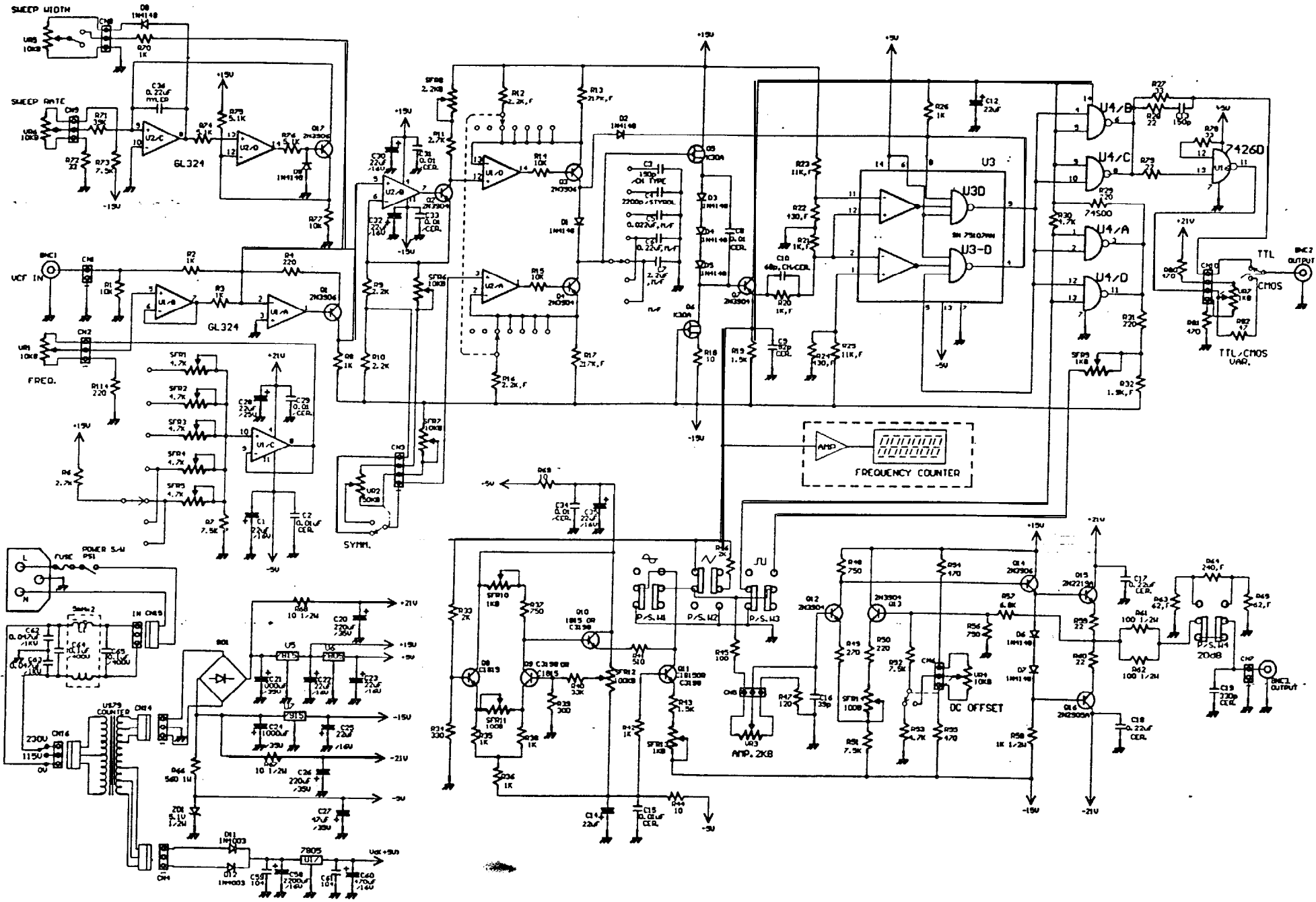
NO	PART NAME	SPECIFICATION	UNIT	Q'TY	REF.NUMBER	REMARK
1	IC	74HC138	EA	1	U14	
2	TR	2SA1015 /A1 266	EA	7	Q22-28	
3	CAP., CERAMIC	0.1 uF/50V	EA	1	c57	
4	LED(DISPLAY)	3.5x6 SQUARE TYPE	EA	5	LED1 -5	
5	FND(7-seg.)	LTD-4708G	EA	3	FND1,2,3	
6	PCB DISPLAY	43x83x1.6t(DOUBLE)	EA	1		
7	WAFER	13PIN	EA	1	CN13	
8	RES.CARBON FILM	3.3 1/4W,J	EA	6	R108-113	

3. OTHERS

NO	PART NAME	SPECIFICATION	UNIT	Q'TY	REF.NUMBER	REMARK
1	POWER SWITCH	PUSH/PUSH (250V/2A)	EA	1		
2	RES.VARIABLE	V16L415KC B10K	EA	2	VR1,6	RATE,FREQ
3	RES.VARIABLE	V16L4(7x5)N.15KCB1K	EA	1	VR7	TTL/CMOS
4	RES.VARIABLE	V16L4(7x5)N.15KCB10K	EA	2	VR4,5	WITH,OFFS
5	RES.VARIABLE	VI 6L415KCB2K	EA	1	VR3	AMP.
6	RES.VARIABLE	V16L4(7x5)N.15KCB50K	EA	1	VR2	SYMM.
7	SHIELD CABLE	1 P SHIELD 100mm	EA	2	BNC	CN7,11
8	SHIELD CABLE	1 P SHIELD 120mm	EA	1	VCF IN	CN1
9	SHIELD CABLE	2P SHIELD 120mm	EA	1	AMP.VR	CN5
10	SHIELD CABLE	5P(2P SHx2W) 170mm	EA	1	BNC,VR	CN10
11	WIRE ASS'Y	3P(120mm)	EA	3	FRQ.,SWEEP	CN2,8,9
12	WIRE ASS'Y	4P(120mm)	EA	1	TTL. , SYM	CN3
13	WIRE ASS'Y	4P(150mm)	EA	1	DC OFFSET	CN6

NO	PART NAME	SPECIFICATION	UNIT	Q'TY	REF.NUMBER	REMARK
14	WIRE ASS'Y	13P 160mm	EA	1		CN12
15	WIRE ASS'Y	3P 200mm	EA	1		CN15
16	LEAD WIRE(T/S)	RED 300mm DIW	EA	2	POWER SNV	
17	LEAD WIRE	15mm	EA	4		
18	LEADWIRE	60mm DIW	EA	1		
19	GND WIRE	G/Y, 80mm p3 R	EA	1	INLET-REAR	
20	POWER TRANS	48mm,24-0-24 , 8-O-8	EA	1	REAR PANEL	
21	AC INLET	SS-7B UL,VDE	EA	1	REAR PANEL	
22	FUSE	250V 0.2A	EA	1	AC INLET	
23	CONNECTOR	BNC-RB	EA	4	FRONT PANEL	
24	GND TERMIAL	p9x13.5mm	EA	1		
25	HEAT TUBE	p5.0 , 15 mm	EA	2	POWER S/W	
26	HEAT TUBE	p15.0 , 40 mm	EA	1	FUSE HOLDER	
27	HEATTUBE	p30.0 , 40 mm	EA	1	AC INLET	
28	SHEILD PLATE	248x172x0.2t	EA	2		
29	FRONT CHASSI	211.6x73.6x1.2t	EA	1		
30	REAR CHASSI	185x75x1.3t	EA	1		
31	BRACKET	5.75x15	EA	6		
32	FRONT PLATE	208x70x0.3t	EA	1		
33	REAR PLATE	185x75x0.3t	EA	1		
34	ACRYLIC FILTER	82x31x2t	EA	1		
35	FRONT PANEL	221.5x84x3.5t, ABS	EA	1		
36	TOP CASE	219x231 x40, ABS	EA	1		
37	BOTTOM CASE	219x231 x40, ABS	EA	1		
38	HANDLE	234x105x58, ABS	EA	1		
39	KNOB(P/P)	9.6x9x10, ABS	EA	13		
40	KNOB(VR)	22x16.5, ABS	EA	1		
41	KNOB(VR)	13~10.2, ABS	EA	6		
42	INSERT	10x6	EA	4		
43	RUBBER FOOT	32x8.5t	EA	2		
44	RUBBER FOOT	37x8.5t	EA	2		
45	SCREW	M 3x6 NI-PL	EA	2	DISPLAY	
46	SCREW	M 4x45m/m	EA	4	TOP-BOTOM	
47	SCREW	T 3x8 ZN-PL	EA	4	MAIN	
48	SCREW	M 3x6 H5 (OVERL)	EA	2	INLET.GND /T	
49	SCREW	M 3x8 NI-PL	EA	2	TRANS	
50	SCREW	T 2x6 ZN-PL	EA	6	BRACKET	
51	SCREW	T 2.6x8 ZN-PL	EA	2	POWER S/W	

FIG. 5-1(A) CIRCUIT DIAGRAM(GENERATOR PART)



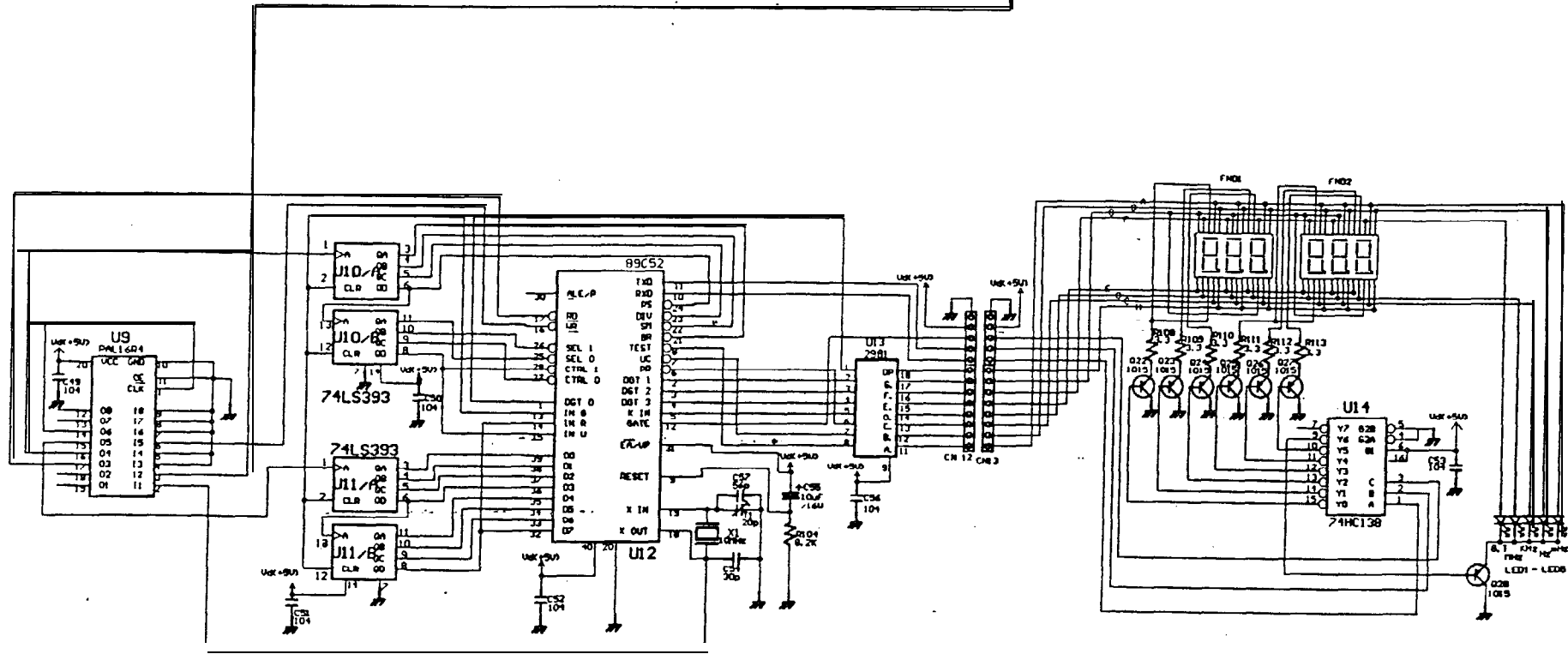
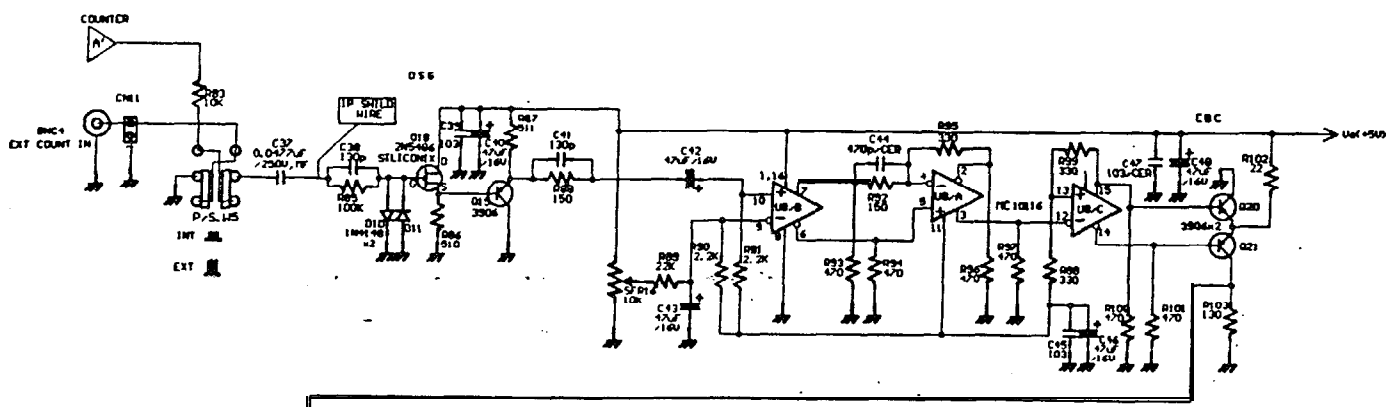
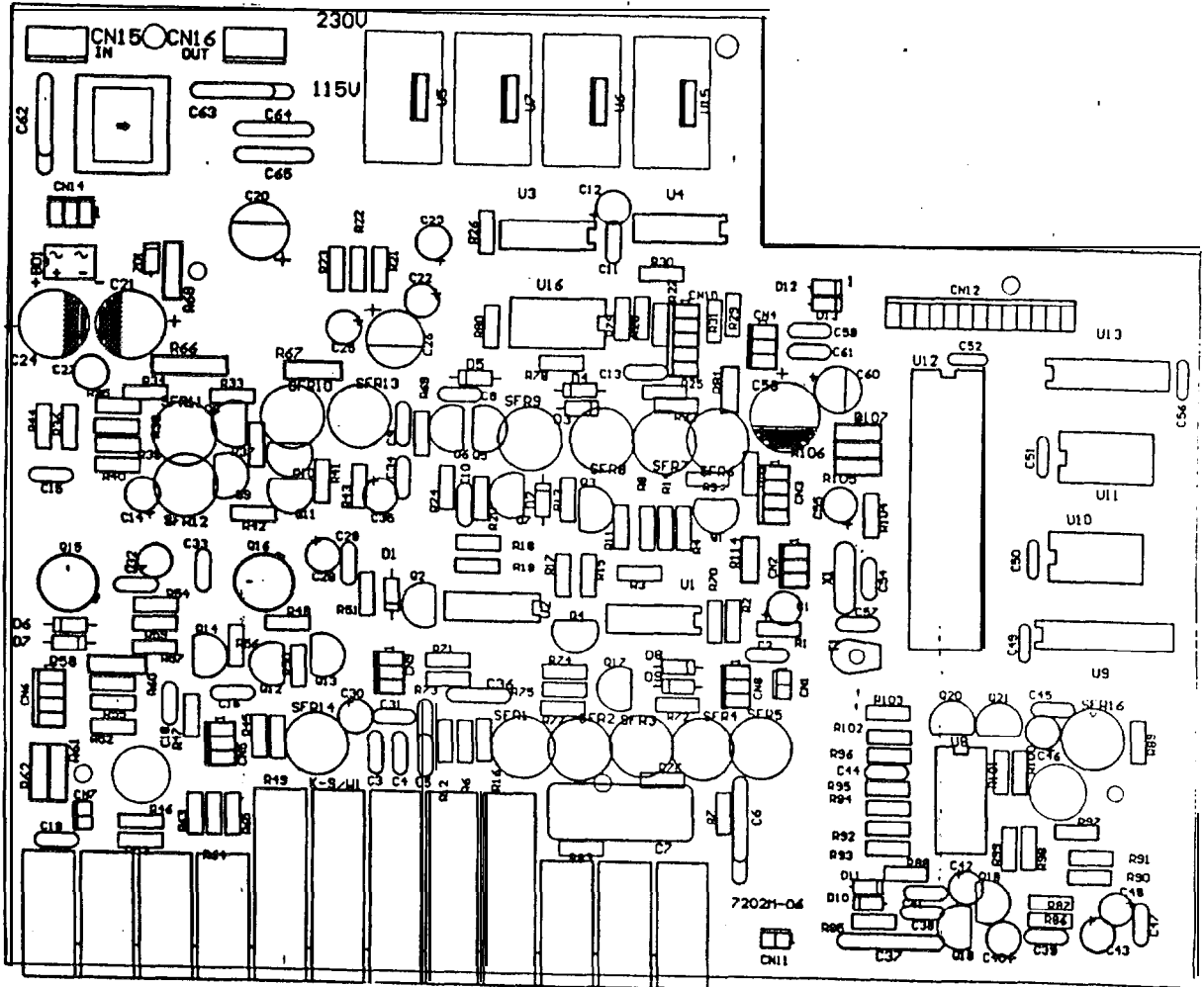
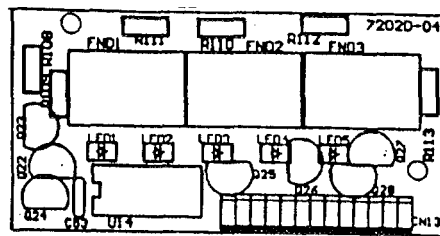


FIG. 5-1(B) CIRCUIT DIAGRAM(COUNTER PART)

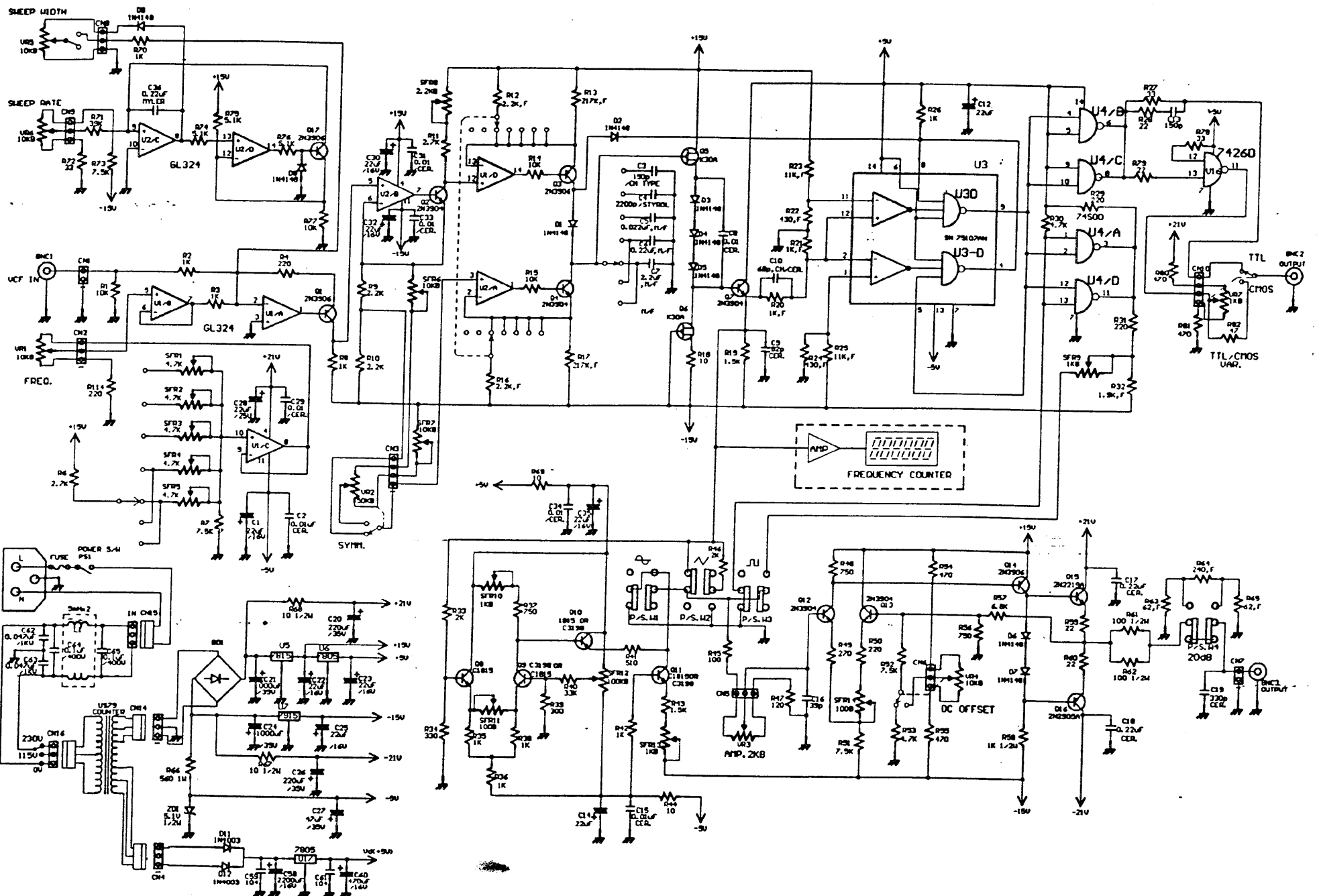


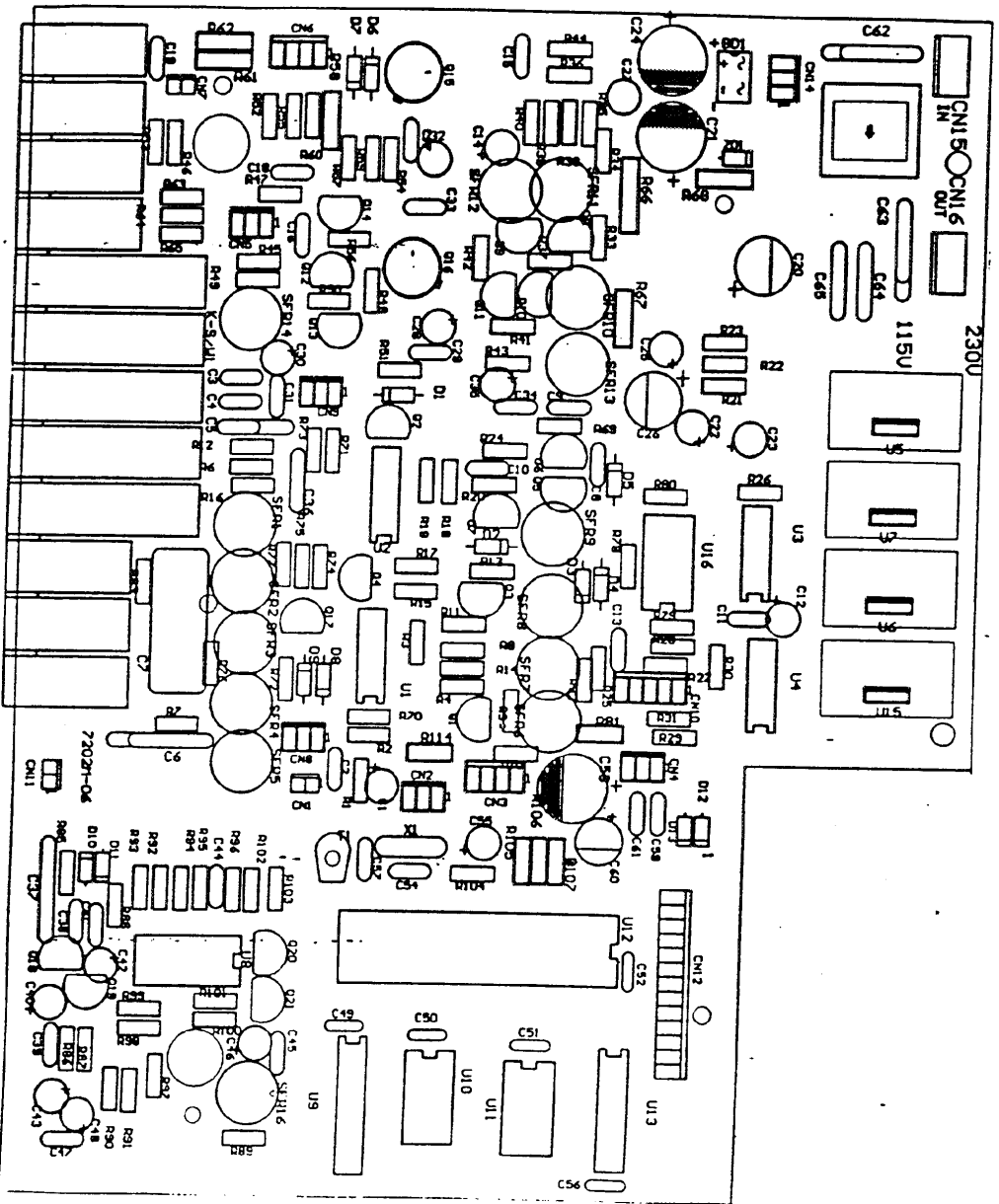
MAIN BOARD



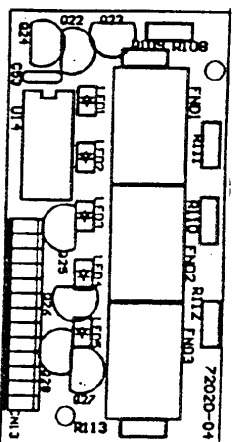
DISPLAY BOARD

FIG. 6-1 COMPONENTS LAY-OUT





MAIN BOARD



DISPLAY BOARD

