Trimmer on DC offset
Model 8112 : R 135

INSTRUCTION MANUAL

DIGITAL SWEEP FUNCTION GENERATOR

Model: **8115**

Topward

TABLE of CONTENTS

PICTURE of MODEL 8115

INTRODUCTION

The Topward 8115 is a portable, bench type multi-purpose digital function generator/counter capable of producing 9 different waveforms. These are Sine, Square, Triangle, Pulse, Ramp, Sweep, Trigger, Gate and Burst.

The model 8115 provides: adjustable frequency range from 0.1 Hz to 5 MHz in 7 Up/Down ranges, variable amplitude from 5 mV to 20 Vp-p, variable symmetry/duty cycle from 20% to 80% in the Ramp/Pulse mode, continuous, gated, triggered or swept output, variable internal Lin/Log sweep generator which has sweep range of over 1000:1, inverted and attenuated outputs.

Added unique features are digital display for Start/Stop frequency and built-in 100 MHz frequency counter with 25 mV input sensitivity.

BEFORE WE BEGIN

Your Topward 8115 is packed in styrofoam to protect it during shipment. You should keep this material, and the shipping box, in case the unit must be moved or shipped again.

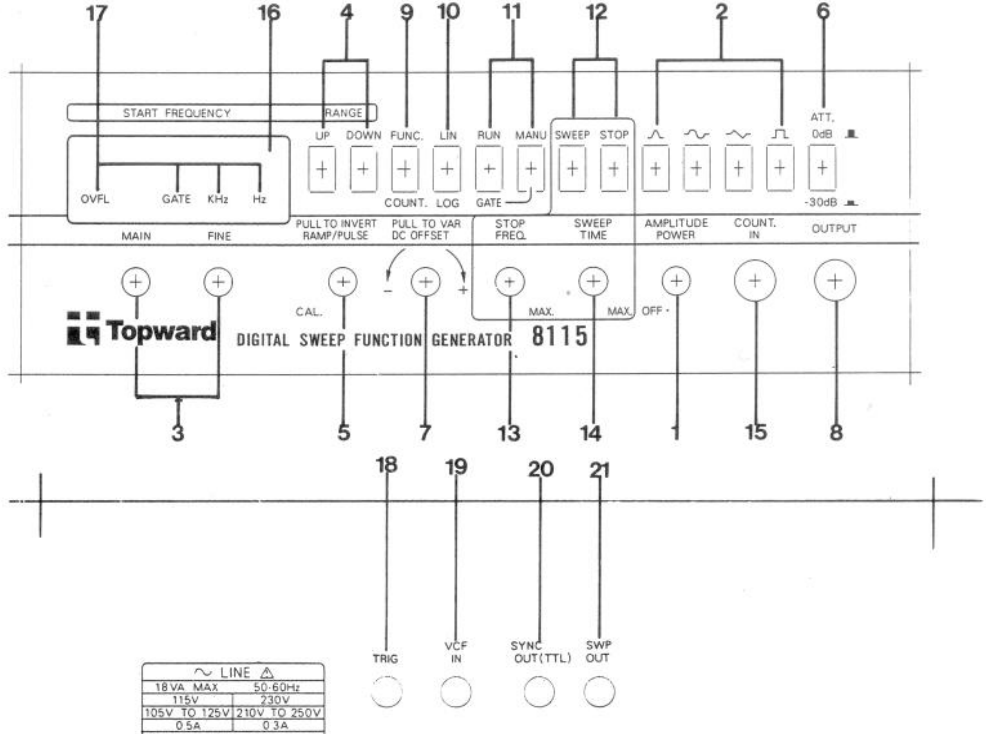
The box should contain the following items:

Model 8115 Digital Sweep Function Generator
Removable AC line cord
BNC to Alligator clip cable
Instruction manual

Please check to see that all of the above items are included. You should contact your Topward dealer if anything is missing.

FRONT / REAR PANELS CONTROLS AND INDICATORS

Figure - 1



FRONT/REAR PANELS FUNCTIONAL DESCRIPTION

The following is an explanation of the function of the front and rear panel controls and connectors. Please refer to Figure 1 for location of each control/connector.

1. **POWER/AMPLITUDE** - This is the main power switch and the amplitude adjustment knob. Turning the control clockwise will increase the amplitude.

2. **FUNCTION** - This bank of switches is used to select the output waveform. Only one of these switches can be depressed at a time.

3. **FREQUENCY CONTROL** - This pair of knobs is used to adjust the output frequency. The frequency is dependent upon the setting of this pair of knobs and the **RANGE UP/DOWN** switches (4).

4. **RANGE UP/DOWN** - This pair of momentary switches is used to select the freqency range produced. At the same time, the counter gate time is changed.

5. **RAMP/PULSE** - This knob is used to adjust the duty cycle of the square or triangle wavefroms. When the knob is turned to CAL. (fully CCW position), the duty cycle is fixed at 50%. Otherwise, the duty cycle is adjustable between 20% to 80%. When the knob is pulled on, the output signal will be inverted.

6. **ATTENUATOR** - When this switch is out, the signal is passed to the Output/Input unchanged. If the switch is depressed, the Output/Input singal is reduced by 30 dB (Function output / Counter input).

7. **DC OFFSET** - This knob allows a variable DC voltage between -10V to +10V to be added to the output signal. Note that the knob has to be pulled out for the offset to affect the signal. When the control is pushed in, no offset voltage is added.

8. **OUTPUT** - This connector provides the output signal for all waveforms.

9. **FUNC/COUNT** - When this push button is out, the 5 Digits **Display** (16) shows the main function frequency. If the switch is depressed, the **Display** (16) shows the input frequency of counter.

10. **LIN/LOG** - This is the sweep mode selector. When this button is out, a recurring linear sweep is selected. If the button is depressed, a recurring logarithmic sweep is selected.

11. **RUN/GATE/MANU** - When **RUN/GATE** button is out, the output is in free running. If the **RUN/GATE** switch is depressed, the output will run continuously as long as a **Trigger** (18) singal is present. **MANU** momentary switch is used to manually gate or trigger the main output.

12. **SWEEP/STOP** - When SWEEP button is depressed, the internal sweep generator produces a Linear or Log ramp which sweeps the frequency of the main generator. When STOP button is depressed, the stop frequency can be set by **STOP FREQ** (13) knob. Releasing the STOP knob will initiate the recurring sweep generator.

13. **STOP FREQ** - In sweep mode, the stop frequency is set by this knob.

14. **SWEEP TIME** - This knob is used to set the sweep time from the START Frequency to the STOP Frequency. The rate is variable from 10 mS to 1 second.

15. **COUNT IN** - This is the input connector for the 100 MHz frequency counter. **FUNC/COUNT** switch (9) must be depressed.

16. **FREQUENCY DISPLAY** - This is a 5 digits LED display that shows the output frequency of the main generator or the input frequency of the counter.

17. **INDICATORS - OVFL, GATE, KHz, Hz** LEDs enunciate frequency overflow, gate time and frequency units in **KHz, Hz.**

18. **TRIG** - This input connector is used for external burst control. The input sensitivity is 1.4 V into 10 K ohm.

19. **VCF IN** - This input connector is used to modulate the main frequency with

an external source of 0 - 5 Vdc.

20. **SYNC OUT** - This connector supplies a TTL compatible output signal which is unaffected by either the **FUNCTION** (2) or **AMPLITUDE** (1) controls. The output frequency is the same as that of **OUTPUT** connector (8).

21. **SWEEP OUT** - This connector supplies the internal sweep generator signal.

OPERATING INSTRUCTIONS

1. Instrument Turn-on

WARNING: Before applying power to your 8115 , make sure that the input voltage setting is correct for your power source.

Connect the 8115 to an AC power source and turn on the **POWER** switch (1).

2. Main Generator

A. Select the desired waveform using the **FUNCTION** switch (2). To generate a ramp or pulse output, turn on the **RAMP/PULSE** knob (5) and set to the desired duty cycle.

B. Set the desired frequency with the frequency control **MAIN** and **FINE** (3) and the **RANGE** switches (4).

C. Adjust the output amplitude with the **AMPLITUDE** control (1) to the desired level. If a very small signal is required, depress the **ATTENUATOR** switch (6).

D. Set DC offset voltage with the **DC OFFSET** control (7).

E. Use the **SYNC** output terminal (20) if TTL compatible level is required.

F. Pull out the **INVERT** switch (5) to introduce a 180 degree phase shift.

3. **Voltage Controlled Frequency**
   A. Supply a trim voltage between 0 and 5 VDC to the **VCF IN** terminal (19) will vary the main frequency over 1000:1.

4. **Burst**
   A. Set **FUNCTION** switch (2) to burst ⩘ . Depress **RUN/GATE** switch (11).

   B. Supply an external signal to **TRIG** terminal (18) or push **MANU** trigger (11) to cause a burst signal at **OUTPUT** (8).

5. **Sweep**
   A. Select **FUNCTION** (2) waveform.

   B. Set **START** frequency (3).

   C. Select **LIN/LOG** (10) sweep mode.

   D. Depress **SWEEP, STOP** switches (12).

   E. Set **STOP** frequency (13).

   F. Set **SWEEP TIME** (14) between 10uS and 1S.

G. Push **STOP** (12) again to initiate sweep generator.

6. **Frequency Counter**
   A. Push in **FUNC/COUNT** switch (9).

   B. Apply input signal to **COUNT IN** (15).

   C. Select **RANGE UP/DOWN** (4) for best resolution.

   D. Use **ATTANUATOR** (6) for large input signal to avoid damage to the instrument.

OPERATING CAUTIONS

To assure operation within the published specifications, allow the unit to warm up and stablize for at least 20 minutes.

Failure to observe the operating procedure listed below will result in damage to the unit and void your warranty.

Do not supply more than 10 Volts (AC + DC) into:

Output terminal (8)
TRIG IN terminal (18)
VCF IN terminal (19)
SYNC terminal (20)

THEORY OF OPERATION

Counter Section

1. **Counter Amplifier (refer to circuit diagram sheet 1)**

   A. The buffer amplifiers (Q201 and Q202) make up the impedance buffer circuit.

   B. U202A-U202C form a secondary high voltage gain stage. Q203 and Q204 form a level shifter.

2. **Counter Control Circuit (refer to circuit diagram sheet 4)**

   A. U209 (7216D) is a single chip counter IC. U208 and U204 form a gate time selecting circuit.

   B. U207 and U204 form a decimal point selecting circuit.

   C. U211A-U211D form a generator frequency display / counter input frequency display selecting circuit.

   D. U210 is a divide-by-ten IC, use for the high frequency input measurement.

   E. U203, U204, U205, U206 form a presetable UP/DOWN counter with Hz, KHz indicating circuit.

Generator Section

1. **Tuning Amplifier and Constant Current Source (refer to circuit diagram sheet 1 and 2)**

A. The first stage of the tuning amplifier (U7) is a inverting input amplifier, providing a fixed voltage for frequency control **MAIN** and **FINE** (3). Except in sweep mode the tuning amplifier output voltage is weighted average of the sweep generator output. The frequency control **MAIN** and **FINE** (3) varies the amount of voltage which determines the generator output frequency.

B. The second stage of the tuning amplifier (U6 and Q33) form a level shifter circuit, this circuit with Q40, Q41, Q42, U8B and nearby component consists of a linear or logarithmic negative feedback circuit.

C. Q33 voltage output applies to U8. The U8C is the negative current source for the timing capacitor (C230-C235). U8E, Q38, Q39 provide the positive current source by matching the negative current source.

D. U206, U204 and K1 - K7 form the timing capacitor selecting circuit.

2. **Triangle Generator and Comparator (refer to circuit diagram sheet 2)**

The triangle generator buffer (Q29, Q30 and Q31) outputs signal to the voltage comparator (Q25, Q26) which acts as an amplitude limiter. As the triangle waveform alternately crosses the upper and lower switching levels of

the limiter input, a square wave is generated at the outout of the voltage comparator. The square wave is feedback to the triangle generator where it controls the charge / discharge cycle of the triangle output.

3. Sine Shaper (refer to circuit diagram sheet 3)

Sine wave is generated by shaping triange wave through a diode network (CR8-CR19). Three-stage diodes network acts as a non-linear load which varies the attenuation of the input triangle.

4. PRE-Amplifier (refer to circuit diagram sheet 3)

The PRE-Amplifier is a non-inverting closed loop amplifier. Q10 and Q11 form the differential input stage that provides DC stability. Q8 forms the second gain stage. Q43 provides the collector of Q8 with high impedance for increased gain. Q9 is the output buffer.

5. Output Amplifier (refer to circuit diagram sheet 3)

The output amplifier works much alike the PRE-Amplifier except that it is inverting and the second gain stage is buffered by Q1 and Q2 prior to the output stage Q3 and Q4.

6.Sweep Generator (refer to circuit diagram sheet 1)

A. By integrating the pulse signal (Q15 collector) at its input, the integrator (U2, Q21) generates a ramp waveform.

B. The level of the ramp is then compared to the pulse signal. When the voltage at the input node to the comparator (U1) equals zero, the comparator output switches state and turns on Q15 reset current, which rapidly returns the ramp to 0V, and then another cycle begins.

7. **Gate and Burst control (refer to circuit diagram sheet 2)**

A. The function generator output is stopped by removing the positive current source from timing capacitors (C230-C235). Q34 and Q36 form a differential amplifier with the voltage at the base of Q36 being the lockout voltage. The base of Q34 is connected to the output of the triangle buffer. When the triangle level reaches the lockout voltage. Q34 is turned on and the positive current source is taken away from capacitor.

B. Lockout is disabled by pulling the emitters of Q34 and Q36 to 0V. Via the lockout flip-flop U4C and U4D. The R/S flip-flop receives signals from the trigger comparator (U5).

8. **Capacitance Multiplier (refer to circuit diagram sheet 2)**

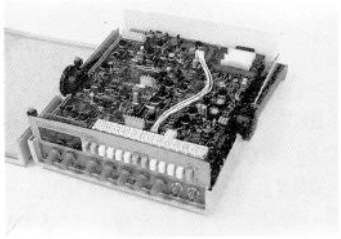
U3 is a capacitance multiplier used on the 1Hz range only. It inverts and amplifies the triangle signal to +10V. This is applied to the opposite end of the 10uF timing capacitor and make it appears to be a 100uF capacitor.

CALIBRATION

CAUTIONS : Services performed by unauthorized person will void your warranty.

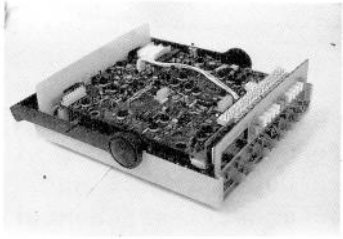
To assure the most stable operation possible, your Model 8115 should be periodically adjusted. To perform the following adjustment procedures, you will need a Phillips screwdriver, Timer/Counter, Voltmeter, an Oscilloscope (50MHz minimum), Distortion meter, and high frequency (up to 100MHz) signal generator. As you perform this procedure, please refer to the disassembly layout and adjustment location layout drawing.

screws



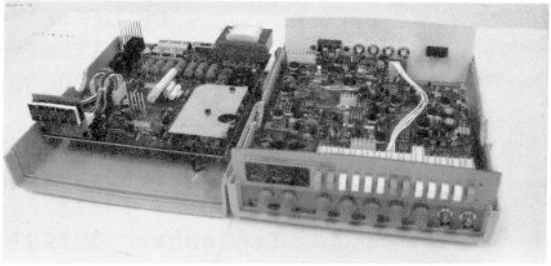
Open top cover and unscrew 3 screws

conector
BNC line



Remove connector and counter BNC line and separate two PCBs

optional cable



Use optional connector for connecting the counter PCB and function PCB

Calibration should be performed under laboratory conditions having an ambient temperature of 18° to 28° C (64° to 82° F), and a relative humidity of less than 80%.

1. Set the 8115 controls as follows:

LIN/LOG (10)	LIN
RUN/GATE (11)	RUN
RANGE (4)	1K
SWEEP (12)	OFF
STOP (12)	OFF
STOP FREQ (13)	CCW (minimum)
FUNCTION (2)	⎍
DC OFFSET (7)	OFF
AMPLITUDE (1)	CW (maximum)
RAMP/PULSE (5)	CAL.

2. Connect the oscilloscope to TP2. Adjust R112 (BUF DC) for the triangle to be symmetrical about DC 0V ± 50mV.

3. Connector **OUTPUT** (8) to a Timer/Counter TFC-130 (or equiralent with duration measurement capability). Turn **START FREQUENCY** (3) for a reading of approximately 750 usec. Alternately switch the TFC-130 to measure the two halves of the waveform separately. Adjust R178 (TOP SYM) for both halves to be

the same ± 0.3% (0.5 uS).

4. Turn **START FREQUENCY** (3) for a reading on the TFC-130 of approximately 50 msec. (If it can not be adjusted low enough, see step 5) Adjust R121 (BOT SYM) as in step 3, and repeat step 3 and 4 until no more improvement can be obtained.

5. Turn **START FREQUENCY** (3) to CCW. Adjust R145 (1000:1) for a frequency of 4 Hz ± 2 Hz.

6. Turn **START FREQUENCY** (3) to CW. Adjust R179 (TOP FREQ.) to 5.3 KHz ± 100 Hz.

7. Set **RANGE** (4) to 1 Hz (display about 5 Hz). Adjust R177 (5Hz) for 5.3 Hz ± 0.1 Hz (192mS to 185mS).

8. Set **RANGE** (4) to 1 MHz (display about 5 MHz). Adjust C235 (5 MHz, in counter PCB) for 5.3 MHz ± 50 KHz.

9. Set **LIN/LOG** (10) to LOG location. Set **RANGE** (4) to 10 K (display 50 KHz). Adjust R182 (LOG TOP) for 53 KHz ± 500 Hz. Turn **START FREQUENCY** (3) to CCW. Adjust R180 (LOG BOT) for 2 Hz (500mS ± 50mS). Repeat adjustment of R182 and R180 until no more improvement can be obtained, and then disengage **LIN/LOG** (10) to LIN location.

10. Set **RANGE** (4) to 10 K and **FUNCTION** (2) to SINE. Turn the **START FREQUENCY** (3) to 50 KHz. Connect **OUTPUT** (8) to a Distortion meter. Adjust R76 (SINE DIST 1) and R172 (SINE DIST 2) for a minimum distortion reading.

11. Connect **OUTPUT** (8) to Digital multimeter (TDM-105, DCV 200mV) turn **AMPLITUDE** (1) to CCW. Adjust R181 (PA DC) for DC 0V ± 10mV. Select **FUNCTION** (2) to TRIANGLE. Turn **AMPLITUDE** (1) to CW. Adjust R25 (TRI DC) to be DC 0V ± 10mV. Change output to oscilloscope. Adjust R7 (TRI AMPL) for the triangle peak to peak to be 20.8 V ± 200 mV.

12. Select **FUNCTION** (2) to SINE. Adjust R53 (SINE DC) for DC offset to be DC 0V ± 10mV. Adjust R173 (SINE AMPL) for the sine wave peak to peak to be 20.8V ± 200mV.

13. Select **FUNCTION** (2) to SQUARE. Adjust R175 (SQU AMPL) and R176 (SQU DC) for square wave output peak to peak to be 20.8V ± 200mV.

14. Set **START FREQUENCY** (3) and **RANGE** (4) to 3 MHz. Adjust C11 (SQU COMP) for rise and fall time less than 40ns and overshoot less than 5%.

15. Set **RANGE** (4) to 10 K. Select **FUNCTION** (2) to TRIANGLE. Press **RUN/GATE** (11) to GATE location. Adjust R122 (LOCK OUT) for output DC 0V ± 50mV.

16. Depress **SWEEP** (12) and **STOP** (12) buttons. Turn the **STOP FREQ** (13) to CCW

(minimum). Adjust R174 (STOP FREQ) for a minimum frequency output. Depress button **STOP** (12) again, **SWEEP TIME** (14) to CW (maximum). Adjsut R111 (Sweep Time) until the **SWP OUT** (21) RAMP just stop.

17. Press the **FUNC/COUNT** switch (9) in. Connect a 10MHz ± 1ppm frequency standard to the **COUNT** input (15). Adjust trimmer capacitor C219 until the display reads 00.000 KHz ± 1 digits (Hz) and OVFL LED comes on.

18. Set the **RANGE** switch (4) to 1 MHz. Apply a 100MHz, 50mV signal to **COUNT** input (15). Adjust trimmer resistor R253 to display same.

TROUBLESHOOTING

If you are experiencing trouble with your Model 8115 Digital sweep Function Generator, follow the procedures below to find and correct the problem.

1. **Power Supply**

   A. Verify that the voltage selector switch (S 201) is set correctly (115V or 230V) for your available power.

   B. Turn the **POWER** (1) on and using an DC voltmeter to measure the voltages at the following points:

U201	pin 1	+ 9V ± 10%
U212	pin 1	+20V ± 10%
U213	pin 2	-20V ± 10%

If not, check and repair the components from the line cord to test points.

   C. Measure the DC voltages at the following points:

U201	pin 3	+ 5V ± 5%
U212	pin 3	+12V ± 5%

U213 Pin 3 ..... -12V ± 5%

If not, check and repair U201, U212, U213.

2. **Counter Amplifier**

Set the **RANGE** switch (4) to 1M. Press **FUNC/COUNT** switches (9) in. The **DISPLAY** (16) will blank out. Apply a 1MHz 25mV signal to **COUNTER INPUT** (15). Using an oscilloscope to trace signals at the following points:

Q201	source	1 MHz	∿	55mVp-p ± 20%
Q202	collector	1 MHz	∿	150mVp-p ± 20%
U202	pin 7.....	1 MHz	∿	750mVp-p ± 20%
	pin 2.....	1 MHz	⎍	1 Vp-p ± 20%
	pin15.....	1 MHz	⎍	1 Vp-p ± 20%
Q204	collector	1 MHz	⎍	1.8 Vp-p ± 20%
U211	pin 3.....	1 MHz	⎍	1.8 Vp-p ± 20%
	pin 1.....	1 MHz	⎍	3 Vp-p ± 20%
	pin 4.....	1 MHz	⎍	3.5 Vp-p ± 20%

If not, check and repair Q201, Q202, Q204 ,Q205, U202 and U211.

3. **Counter Control Circuit**

Refer to circuit diagram sheet 4 and theory of operation counter control circuit block. Press the **RANGE** switch (4) the gate time and decimal point will

be changed. If there occurs functional error, check and repair U203, U204, U205, U206, U207, U208 and U209 or nearby components.

4. **Tuning Amplifier and Constant Current Source**

A. Turn the frequency control **MAIN** and **FINE** (3) to CCW (minimum) position. Depress off the sweep mode. Check the DC voltage ratings at the following points:

U7	pin 6.....	+ 5V ± 20%
U6	pin 6.....	+1.5V ± 20%
Q33	Collector.....	-11V ± 20%
U8	pin 6.....	0V ± 100mV
	pin 7.....	-11.5V ± 20%
	pin10.....	+11.5V ± 20%

B. Turn the frequency control **MAIN** and **FINE** (3) to CW (maximum) position. Check the DC voltage ratings at the following points:

U7	pin 6.....	+ 5V ± 20%
U6	pin 6.....	+ 7V ± 20%
Q33	Collector.....	- 6V ± 20%
U8	pin 6.....	- 5V ± 20%
	pin 7.....	- 7V ± 20%
	pin10.....	+ 7V ± 20%

If not, check and rpair U6, U7, Q33, U8, Q38 or Q39.

5. **Triangle Buffer and Comparator**

Set the **RANGE** switch (4) to 1 KHz. Turn the **AMPLITUDE** (1) to CW location. Check the waveform and voltage at the following points:

Q31 Emitter.....	∿	2Vp-p ± 10%
Q26 Base.....	∿	1Vp-p ± 10%
Q25 Base.....	⎍	1Vp-p ± 10%
Q16 Emitter.....	⎍	4Vp-p ± 10%

If not, check and repair Q16, Q18, Q19, Q25, Q26, Q29 or Q31.

6. **Sine Shaper and PRE-Amplifier**

Select the **FUNCTION** switch (2) to SINE wave. Check the waveform and voltage at the following points:

TP5.....	∿	2Vp-p ± 10%
TP6.....	∿	0.5Vp-p ± 10%
Q9 Emitter.....	∿	4Vp-p ± 10%

If not, check and repair CR8-CR19, Q8-Q11, or Q43.

7. **Power Amplifier**

Check the waveform and voltage at the following points:

TP7 ..... ~ 4Vp-p ± 10%
R6 (each side)..... ~ 20.8Vp-p ± 10%

If not, check and repair Q1-Q7 or Q12.

8. **Sweep Generator**

Push on the **SWEEP** switch (12). Turn the **STOP FREQ** (13) and **SWEEP TIME** (14) to CCW position. Check the waveform and voltage at the following points:

Q21 Emitter.....  5Vp-p ± 10%
U1 pin 7.....  3.5Vp-p ± 10%
Q15 Collector.....  6Vp-p ± 10%
Q27 Collector.....  0.5Vp-p ± 10%

If not, check and repair U1, U2, Q15, Q21, Q24 or Q27.

9. **Gate and Burst Control**

Push on the **RUN/GATE** switches (11) to GATE mode. Set the **RANGE** switch (4) to 100KHz. Apply a 3Vp-p square wave signal to **TRIG IN** (18). Check the waveform and voltage at the following points:

U5 pin 7.....  3Vp-p ± 10%

U4 pin11..... ⎍ 3Vp-p ± 10%
Q37 Collector..... ⎍ 2.2Vp-p ± 10%
Q31 Emitter..... ⩙ 2Vp-p ± 10%

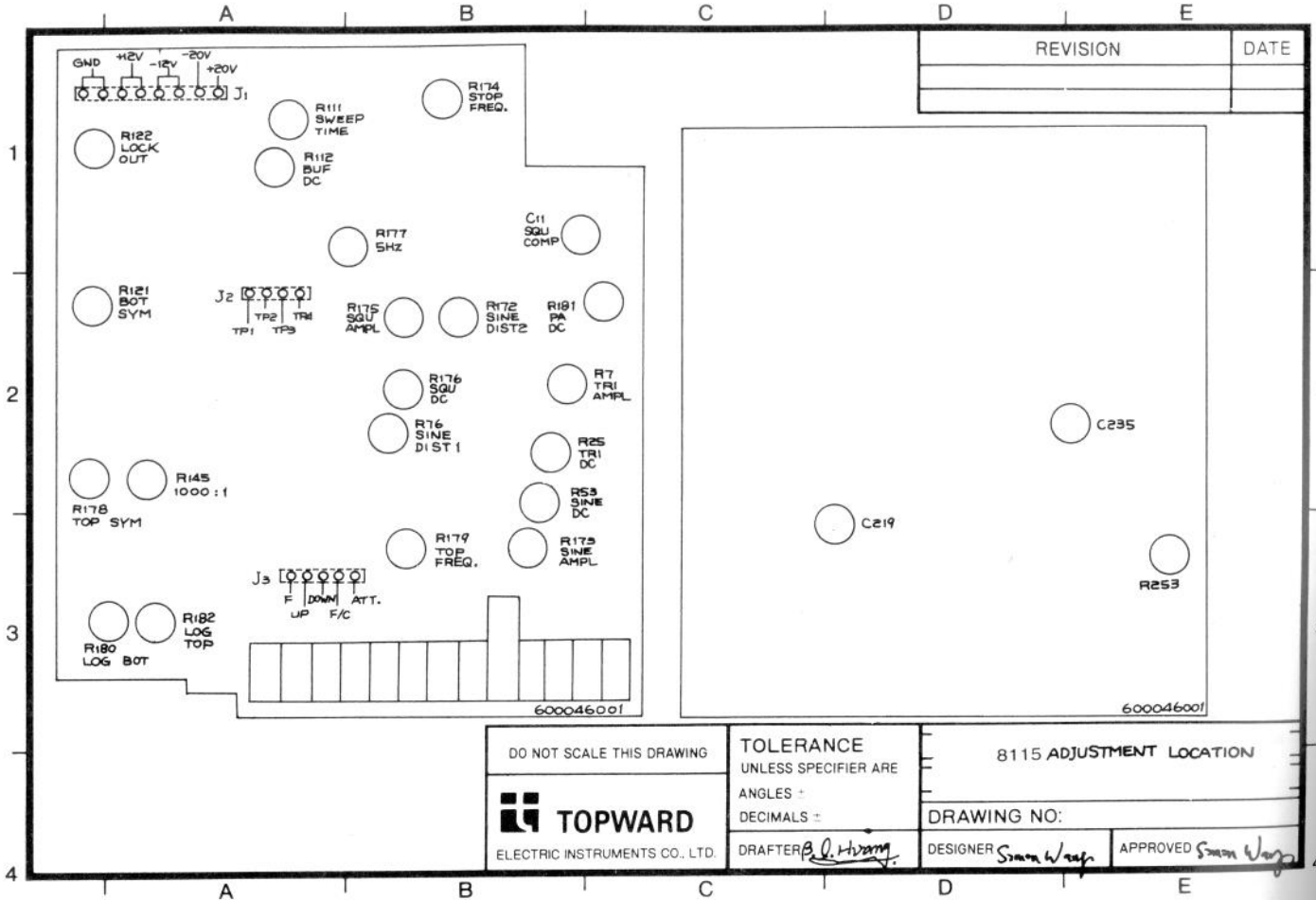
If not, check and repair U5, U4, Q34-Q37 or U9.

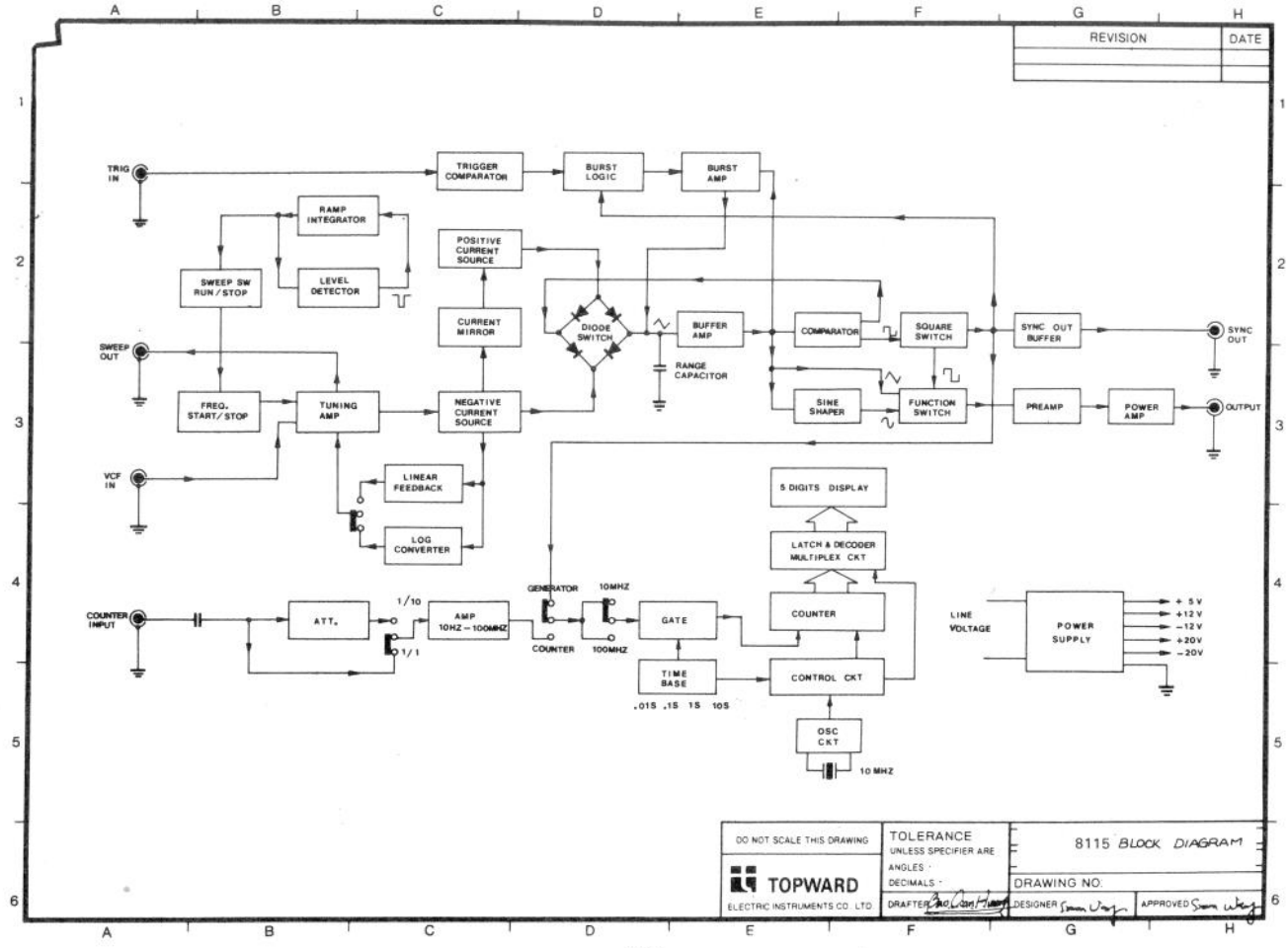
10. **Capacitor Multiplier**

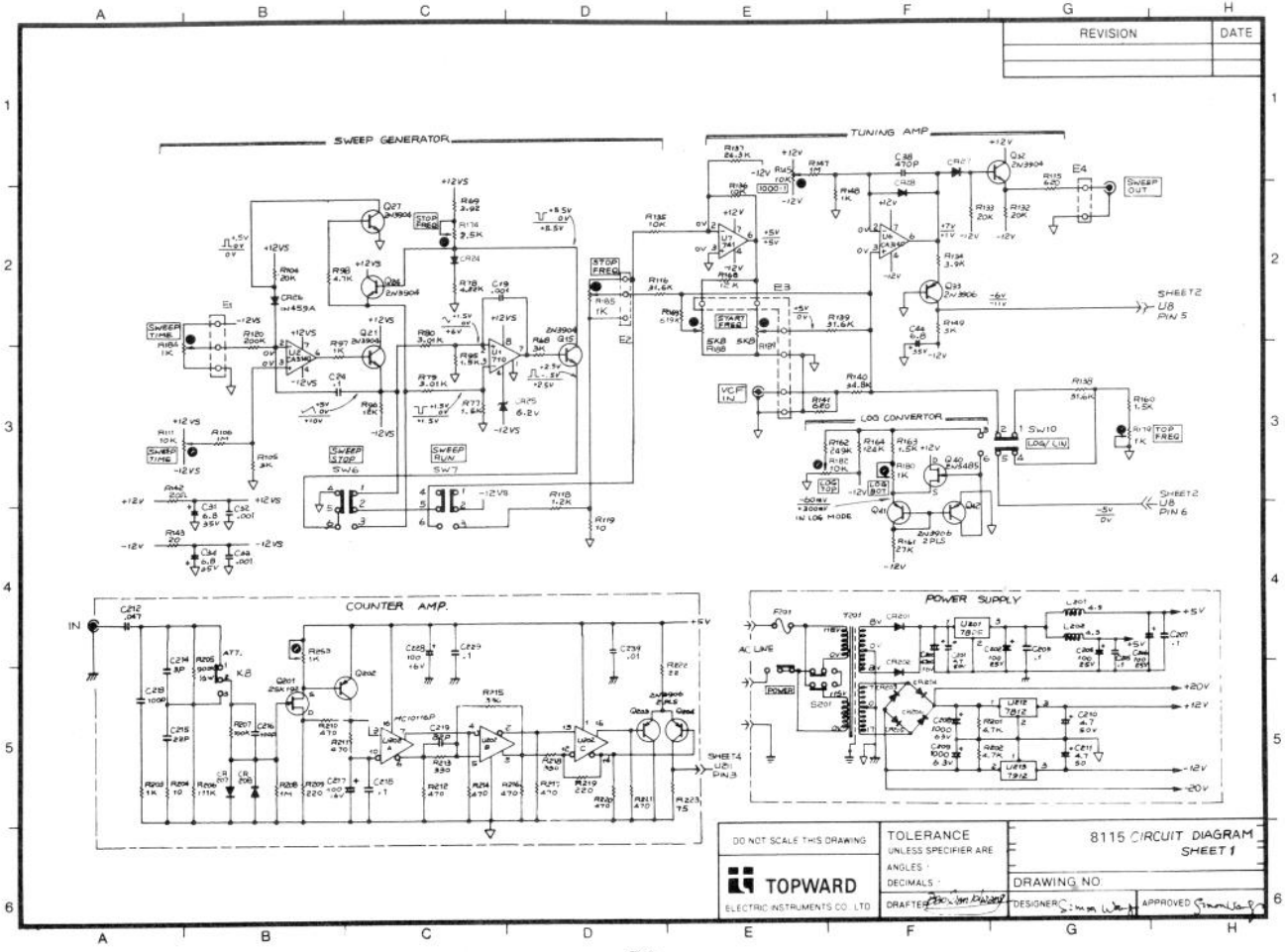
Set the **RANGE** switch (4) to 1Hz. Check the waveform and voltage of the following points:

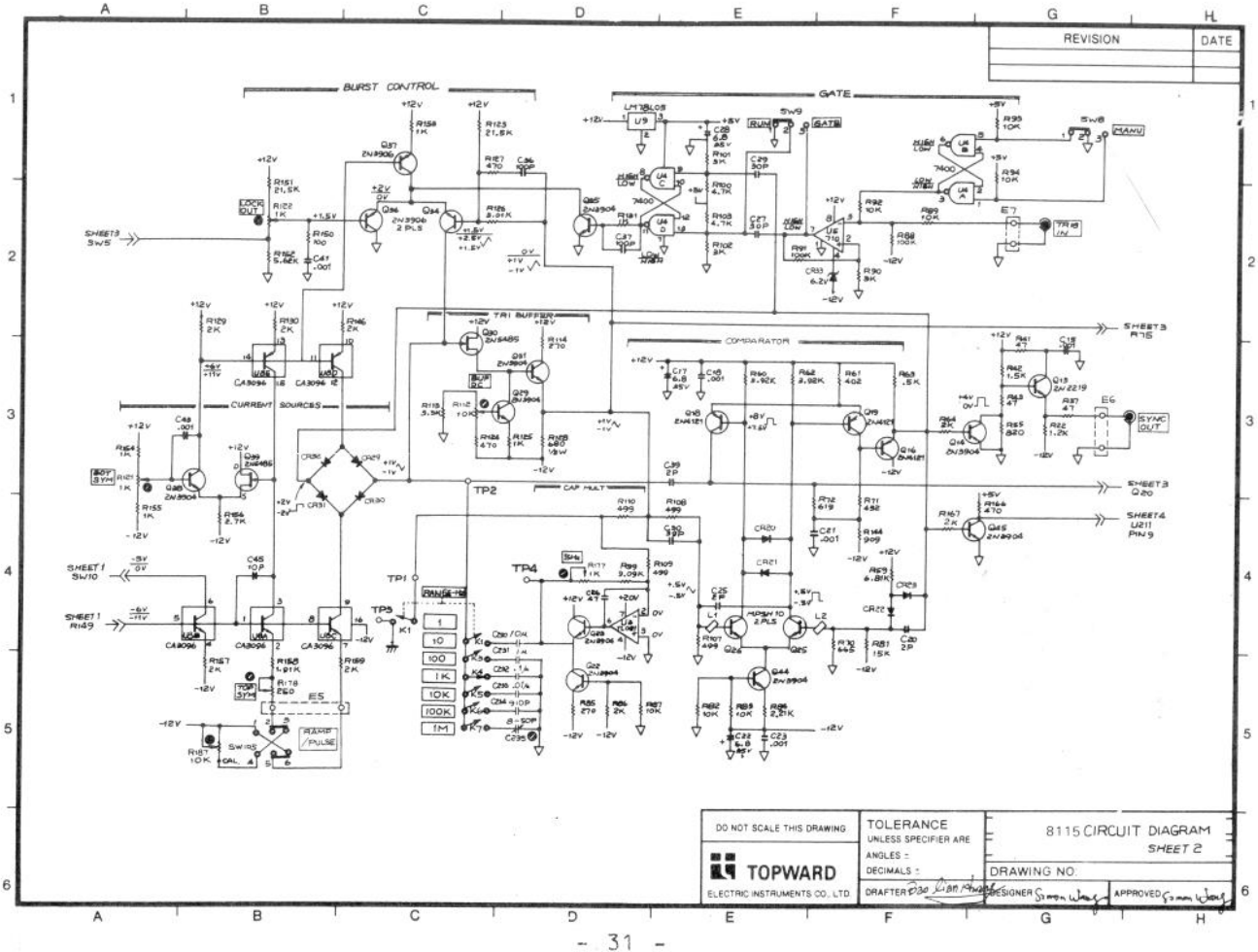
TP1..... ∿ 1Vp-p ± 10%
TP4..... ∿ 20Vp-p ± 10%

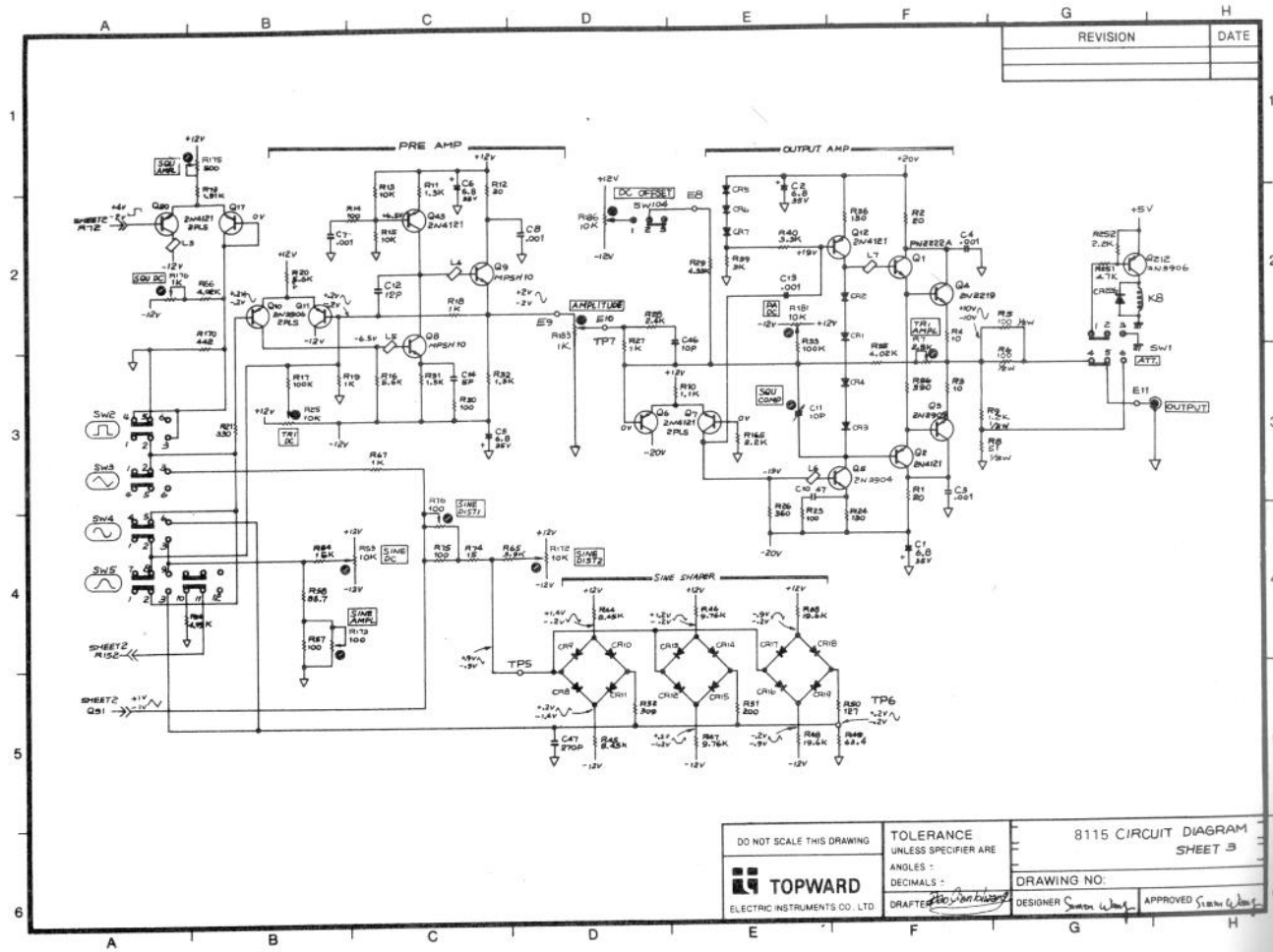
If not, check and repair U3, Q22, Q23 or K3.

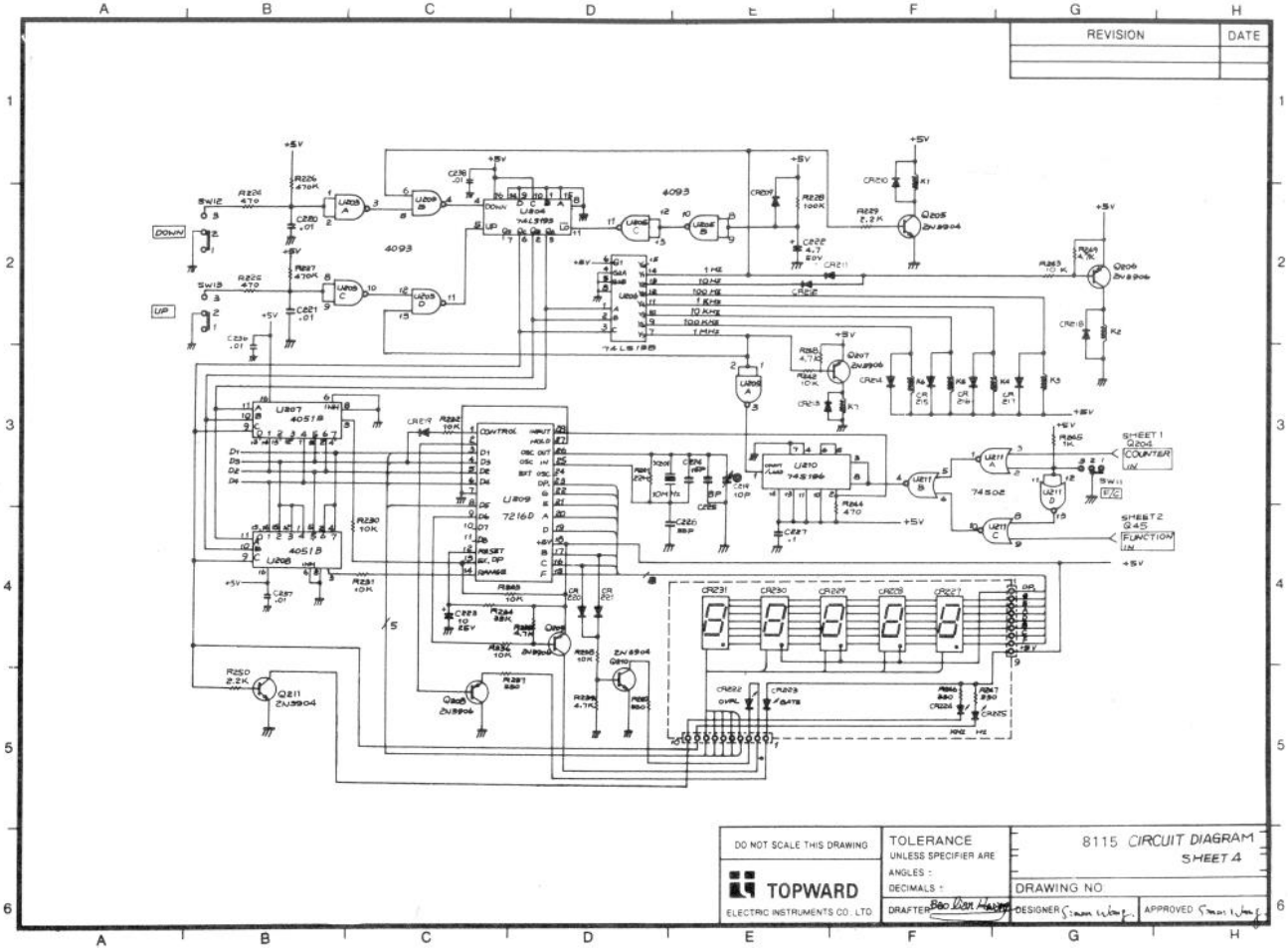

GND
+12V
-12V
-20V
+20V
J1
R111 SWEEP TIME
R174 STOP FREQ.
R122 LOCK OUT
R112 BUF DC
R177 5Hz
C11 SQU COMP
R121 BOT SYM
J2
TP1
TP2
TP3
TRI
R175 SQU AMPL
R172 SINE DIST2
R181 PA DC
R176 SQU DC
R7 TRI AMPL
R76 SINE DIST1
R25 TRI DC
R145 1000:1
R178 TOP SYM
R53 SINE DC
R179 TOP FREQ.
R173 SINE AMPL
J3
F
DOWN
ATT.
UP
F/C
R182 LOG TOP
R180 LOG BOT
600046001
C235
C219
R253
600046001
REVISION
DATE
DO NOT SCALE THIS DRAWING
TOLERANCE
UNLESS SPECIFIER ARE
ANGLES ±
DECIMALS ±
8115 ADJUSTMENT LOCATION
TOPWARD
ELECTRIC INSTRUMENTS CO., LTD.
DRAWING NO:
DRAFTER
DESIGNER
APPROVED

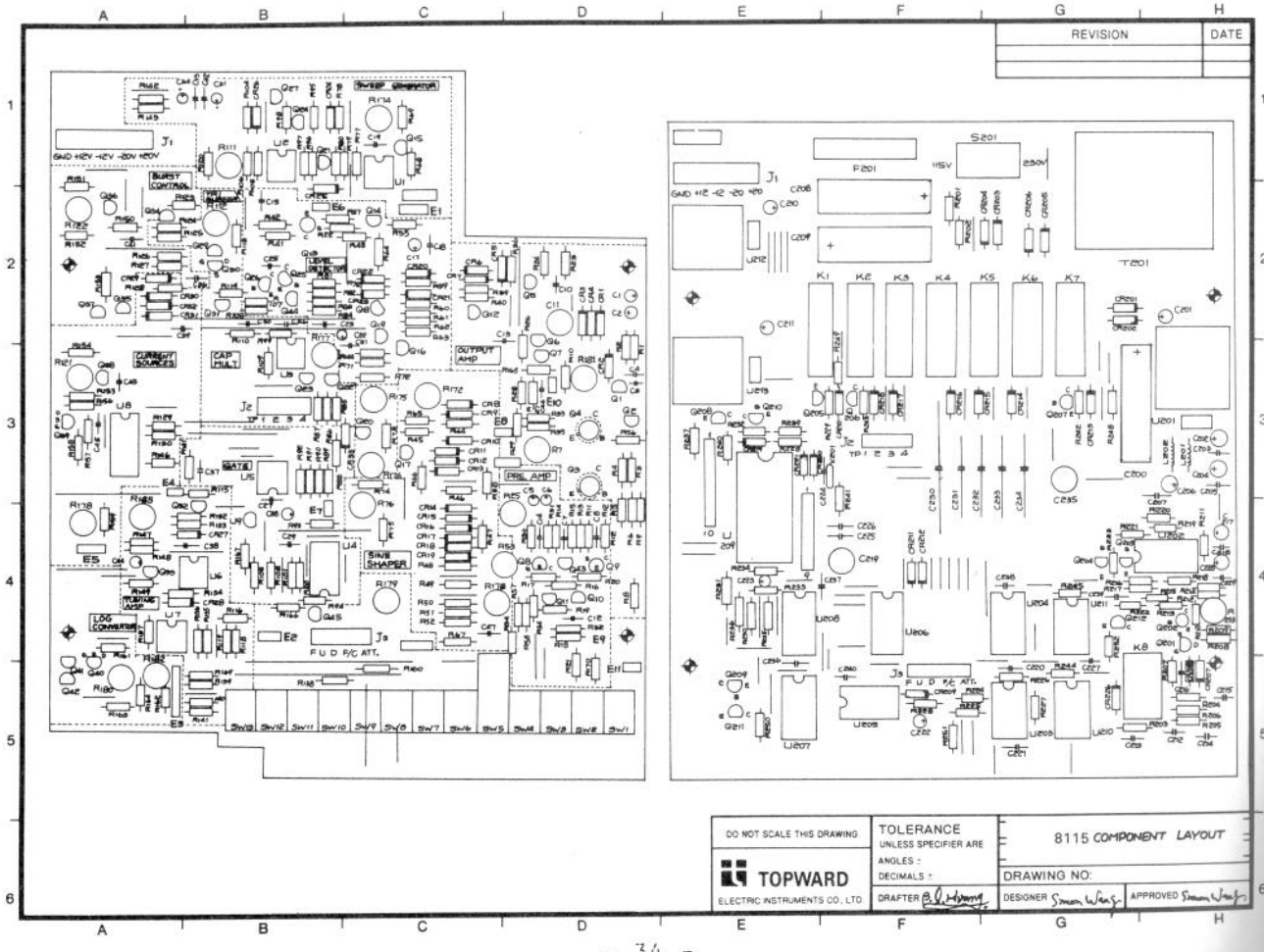

REVISION
DATE
TRIG IN
TRIGGER COMPARATOR
BURST LOGIC
BURST AMP
RAMP INTEGRATOR
SWEEP SW RUN/STOP
LEVEL DETECTOR
POSITIVE CURRENT SOURCE
CURRENT MIRROR
DIODE SWITCH
BUFFER AMP
COMPARATOR
SQUARE SWITCH
SYNC OUT BUFFER
SYNC OUT
SWEEP OUT
FREQ. START/STOP
TUNING AMP
NEGATIVE CURRENT SOURCE
RANGE CAPACITOR
SINE SHAPER
FUNCTION SWITCH
PREAMP
POWER AMP
OUTPUT
VCF IN
LINEAR FEEDBACK
LOG CONVERTER
5 DIGITS DISPLAY
LATCH & DECODER MULTIPLEX CKT
COUNTER INPUT
ATT.
1/10
1/1
AMP 10HZ – 100MHZ
GENERATOR
COUNTER
10MHZ
100MHZ
GATE
COUNTER
TIME BASE
.01S .1S 1S 10S
CONTROL CKT
OSC CKT
10 MHZ
LINE VOLTAGE
POWER SUPPLY
+5V
+12V
-12V
+20V
-20V
DO NOT SCALE THIS DRAWING
TOPWARD
ELECTRIC INSTRUMENTS CO. LTD.
TOLERANCE
UNLESS SPECIFIER ARE
ANGLES :
DECIMALS :
8115 BLOCK DIAGRAM
DRAWING NO.
DRAFTER
DESIGNER
APPROVED


SWEEP GENERATOR
TUNING AMP
LOG CONVERTOR
COUNTER AMP.
POWER SUPPLY
REVISION
DATE
DO NOT SCALE THIS DRAWING
TOLERANCE
UNLESS SPECIFIED ARE
ANGLES :
DECIMALS :
TOPWARD
ELECTRONIC INSTRUMENTS CO. LTD
DRAFTER
DESIGNER
APPROVED
DRAWING NO.
8115 CIRCUIT DIAGRAM
SHEET 1


REVISION
DATE
BURST CONTROL
GATE
TRI BUFFER
COMPARATOR
CURRENT SOURCES
CAP MULT
RANGE-HZ
TP1
TP2
TP3
TP4
TP5
SHEET3 SW5
SHEET3 R16
SHEET3 Q20
SHEET4 U11 PIN9
SHEET1 SW10
SHEET1 R149
DO NOT SCALE THIS DRAWING
TOLERANCE
UNLESS SPECIFIER ARE
ANGLES :
DECIMALS :
TOPWARD
ELECTRIC INSTRUMENTS CO., LTD.
8115 CIRCUIT DIAGRAM
SHEET 2
DRAWING NO.
DRAFTER
DESIGNER
APPROVED


REVISION
DATE
PRE AMP
OUTPUT AMP
SINE SHAPER
DC OFFSET
AMPLITUDE
OUTPUT
SQU AMPL
SQU DC
SQU COMP
SINE DC
SINE AMPL
SINE DIST1
SINE DIST2
TRI AMPL
TRI DC
ATT
SHEET2 R152
SHEET2 Q51
TP5
TP6
DO NOT SCALE THIS DRAWING
TOLERANCE
UNLESS SPECIFIER ARE
ANGLES :
DECIMALS :
TOPWARD
ELECTRIC INSTRUMENTS CO., LTD.
DRAFTER
DESIGNER
APPROVED
8115 CIRCUIT DIAGRAM
SHEET 3
DRAWING NO:


REVISION
DATE
DOWN
UP
4093
74LS192
4051B
7216D
74502
SHEET 1
Q204
COUNTER
UN
SHEET 2
Q45
FUNCTION
UN
DO NOT SCALE THIS DRAWING
TOLERANCE
UNLESS SPECIFIER ARE
ANGLES :
DECIMALS :
TOPWARD
ELECTRIC INSTRUMENTS CO. LTD
8115 CIRCUIT DIAGRAM
SHEET 4
DRAWING NO.
DRAFTER
DESIGNER
APPROVED


REVISION
DATE
DO NOT SCALE THIS DRAWING
TOLERANCE
UNLESS SPECIFIER ARE
ANGLES :
DECIMALS :
TOPWARD
ELECTRIC INSTRUMENTS CO., LTD.
DRAFTER
8115 COMPONENT LAYOUT
DRAWING NO:
DESIGNER
APPROVED

SPECIFICATIONS

GENERATOR

Waveforms:	Sine, Square, Triangle, Pulse, Ramp, Sweep, Trigger, Gate, Burst
Frequency:	0.1Hz - 5MHz, Up - Down Ranges
Display:	5 Digits with Hz, KHz, Gate, OVFL
Freq. Error:	Counter Accuracy
Output Impedance:	50 +10%
Output Level:	300mV to 20Vp-p at 0dB, Ripple < 3% 5mV to 750mV at -30dB
Attenuator:	0dB, -30dB
DC Offset:	+10 Volts Continuously Variable (open circuit)
Duty Cycle:	20% - 80% Continuously Variable with 50% Calibrated Switch
Sine Distortion:	< 1% , 1Hz - 100KHz. 24dB Below Fundamental, 100KHz - 5MHz
Triangle Linearity:	< 1%, 1Hz-100KHz
Rise/Fall Time:	< 40nS
Sync Out:	4Vp-p (open circuit), Tr < 40nS
VCF in:	0 - 5 Vdc Control Frequency to 1000:1(LIN), 10000:1(LOG) Guaranteed 100:1(LIN), 1000:1(LOG)
Sweep Width:	1000:1(LIN), 10000:1(LOG) Guaranteed 100:1(LIN), 1000:1(LOG)
Sweep Rate:	10mS to > 1S
Trigger/Gate:	Manual or EXT. (TTL compatible, DC - 1MHz)
Trig Sensitivity:	+ 1.4V into 10K ohm

COUNTER

Range:	10Hz - 100MHz
Gate Time:	0.01S, 0.1S, 1S, 10S Controlled by Up / Down Ranges
Accuracy:	±(1 Count + Time Base Accuracy)
Sensitivity:	25mVrms(10Hz - 10MHz), 50mVrms(10Hz - 100MHz)
Attenuator:	0dB, -30dB Controlled by ATT. Switch
Max. Allowable Input:	150Vrms(DC + Peak AC)
Impedance:	1MΩ // 100pF
Time Base:	10MHz, ±10ppm (0°C - 40°C)
Display:	5 digits 7 segment LED display. LED Indicators for Gate, Overflow, Hz, KHz

GENERAL

Dimension:	251(W) x 92(H) x 288(D) mm
Weight:	2.0Kg
Power:	115V/230V ±10%, 50/60Hz, 18VA
Accessory:	Test Lead - ACS-003 BNC to Alligator Clip Cable

PARTS LIST

DESIGNATION		DESCRIPTION		
(600046001)				
C	1	CAP	ELEC 6.8UF 35V	+80%-20%
C	2	CAP	ELEC 6.8UF 35V	+80%-20%
C	3	CAP	CER .001UF 1KV	+-10%
C	4	CAP	CER .001UF 1KV	+-10%
C	5	CAP	ELEC 6.8UF 35V	+80%-20%
C	6	CAP	ELEC 6.8UF 35V	+80%-20%
C	7	CAP	CER .001UF 1KV	+-10%
C	8	CAP	CER .001UF 1KV	+-10%
C	10	CAP	CER NPO 47PF 300V	+-5%
C	11	CAP	CER SVC 10PF	+-10%
C	12	CAP	CER NPO 12PF 300V	+-5%
C	13	CAP	CER .001UF 1KV	+-10%
C	14	CAP	CER NPO 5PF 300V	+-5%
C	15	CAP	CER .001UF 1KV	+-10%
C	17	CAP	ELEC 6.8UF 35V	+80%-20%
C	18	CAP	CER .001UF 1KV	+-10%
C	19	CAP	CER .001UF 1KV	+-10%
C	20	CAP	CER NPO 2PF 300V	+-5%
C	21	CAP	CER .001UF 1KV	+-10%
C	22	CAP	ELEC 6.8UF 35V	+80%-20%
C	23	CAP	CER .001UF 1KV	+-10%
C	24	CAP	MYLAR .1UF 50V	+-5%

DESIGNATION		DESCRIPTION				
C	25	CAP	CER NPO	2PF	300V	+-5%
C	26	CAP	CER NPO	47PF	300V	+-5%
C	27	CAP	CER NPO	30PF	300V	+-5%
C	28	CAP	ELEC	6.8UF	35V	+80%-20%
C	29	CAP	CER NPO	30PF	300V	+-5%
C	30	CAP	CER NPO	39PF	300V	+-5%
C	31	CAP	ELEC	6.8UF	35V	+80%-20%
C	32	CAP	CER	.001UF	1KV	+-10%
C	33	CAP	CER	.001UF	1KV	+-10%
C	34	CAP	ELEC	6.8UF	35V	+80%-20%
C	36	CAP	CER NPO	100PF	300V	+-5%
C	37	CAP	CER NPO	100PF	300V	+-5%
C	38	CAP	CER NPO	240PF	300V	+-5%
C	39	CAP	CER NPO	2PF	300V	+-5%
C	41	CAP	CER	.001UF	1KV	+-5%
C	43	CAP	CER	.001UF	1KV	+-5%
C	44	CAP	ELEC	6.8UF	35V	+80%-20%
C	45	CAP	CER NPO	10PF	300V	+-5%
C	46	CAP	CER NPO	10PF	300V	+-5%
C	47	CAP	CER NPO	270PF	300V	+-5%
CR	1	DIODE	1N4148			
CR	2	DIODE	1N4148			

DESIGNATION	DESCRIPTION
CR 3	DIODE 1N4148
CR 4	DIODE 1N4148
CR 5	DIODE 1N4148
CR 6	DIODE 1N4148
CR 7	DIODE 1N4148
CR 8	DIODE 1N4148
CR 9	DIODE 1N4148
CR 10	DIODE 1N4148
CR 11	DIODE 1N4148
CR 12	DIODE 1N4148
CR 13	DIODE 1N4148
CR 14	DIODE 1N4148
CR 15	DIODE 1N4148
CR 16	DIODE 1N4148
CR 17	DIODE 1N4148
CR 18	DIODE 1N4148
CR 19	DIODE 1N4148
CR 20	DIODE 1N4148
CR 21	DIODE 1N4148
CR 22	DIODE 1N4148
CR 23	DIODE 1N4148
CR 24	DIODE 1N4148
CR 25	ZENER DIODE 6.2V

DESIGNATION	DESCRIPTION
CR 26	DIODE 1N459A
CR 27	DIODE 1N4148
CR 28	DIODE 1N4148
CR 29	DIODE 1N4148
CR 30	DIODE 1N4148
CR 31	DIODE 1N4148
CR 32	DIODE 1N4148
CR 33	ZENER DIODE 6.2V
Q 1	TRANS PN2222A
Q 2	TRANS 2N4121
Q 3	TRANS 2N2905
Q 4	TRANS 2N2219
Q 5	TRANS 2N3904
Q 6	TRANS 2N4121
Q 7	TRANS 2N4121
Q 8	TRANS MPSH10
Q 9	TRANS MPSH10
Q 10	TRANS 2N3906
Q 11	TRANS 2N3906
Q 12	TRANS 2N4121
Q 13	TRANS 2N2219
Q 14	TRANS 2N3904

DESIGNATION		DESCRIPTION
Q	15	TRANS 2N3904
Q	16	TRANS 2N4121
Q	17	TRANS 2N4121
Q	18	TRANS 2N4121
Q	19	TRANS 2N4121
Q	20	TRANS 2N4121
Q	21	TRANS 2N3904
Q	22	TRANS 2N3904
Q	23	TRANS 2N3904
Q	24	TRANS 2N3904
Q	25	TRANS MPSH10
Q	26	TRANS MPSH10
Q	27	TRANS 2N3904
Q	29	TRANS 2N3904
Q	30	TRANS 2N5485
Q	31	TRANS 2N3904
Q	32	TRANS 2N3904
Q	33	TRANS 2N3906
Q	34	TRANS 2N3906
Q	35	TRANS 2N3904
Q	36	TRANS 2N3906
Q	37	TRANS 2N3906
Q	38	TRANS 2N3904

DESIGNATION		DESCRIPTION				
Q	39	TRANS	2N5485			
Q	40	TRANS	2N5485			
Q	41	TRANS	2N3906			
Q	42	TRANS	2N3906			
Q	43	TRANS	2N4121			
Q	44	TRANS	2N3904			
Q	45	TRANS	2N3904			
R	1	RES	CARBON	20	OHM	+-5% 1/4W
R	2	RES	CARBON	20	OHM	+-5% 1/4W
R	3	RES	CARBON	10	OHM	+-5% 1/4W
R	4	RES	CARBON	10	OHM	+-5% 1/4W
R	5	RES	CARBON	100	OHM	+-5% 1/2W
R	6	RES	CARBON	100	OHM	+-5% 1/2W
R	7	RES	SVR 2.5K	+-10%		
R	8	RES	CARBON	51	OHM	+-5% 1/2W
R	9	RES	CARBON	1.2K		+-5% 1/2W
R	10	RES	MF	1.1K		+-1% 1/4W
R	11	RES	MF	1.3K		+-1% 1/4W
R	12	RES	CARBON	20	OHM	+-5% 1/4W
R	13	RES	CARBON	10K		+-5% 1/4W
R	14	RES	CARBON	100	OHM	+-5% 1/4W
R	15	RES	CARBON	10K		+-5% 1/4W

DESIGNATION		DESCRIPTION			
R	16	RES	CARBON	5.6K	+-5% 1/4W
R	17	RES	CARBON	100K	+-5% 1/4W
R	18	RES	MF	1K	+-1% 1/4W
R	19	RES	MF	1K	+-1% 1/4W
R	20	RES	CARBON	5.6K	+-5% 1/4W
R	21	RES	CARBON	330 OHM	+-5% 1/4W
R	22	RES	CARBON	1.2K	+-5% 1/4W
R	23	RES	CARBON	100 OHM	+-5% 1/4W
R	24	RES	MF	130 OHM	+-1% 1/4W
R	25	RES	SVR 10K	+-10%	
R	26	RES	MF	357 OHM	+-1% 1/4W
R	27	RES	MF	1K	+-1% 1/4W
R	28	RES	MF	2.4K	+-1% 1/4W
R	29	RES	MF	4.53K	+-1% 1/4W
R	30	RES	CARBON	100 OHM	+-5% 1/4W
R	31	RES	MF	1.3K	+-1% 1/4W
R	32	RES	MF	1.3K	+-1% 1/4W
R	33	RES	CARBON	100K	+-5% 1/4W
R	34	RES	MF	4.99K	+-1% 1/4W
R	35	RES	MF	4.02K	+-1% 1/4W
R	36	RES	MF	130 OHM	+-1% 1/4W
R	37	RES	CARBON	47 OHM	+-5% 1/4W
R	38	RES	MF	19.6K	+-1% 1/4W

DESIGNATION		DESCRIPTION				
R	39	RES	CARBON	3K		+-5% 1/4W
R	40	RES	CARBON	3.3K		+-5% 1/4W
R	41	RES	CARBON	47	OHM	+-5% 1/4W
R	42	RES	CARBON	1.5K		+-5% 1/4W
R	43	RES	CARBON	47	OHM	+-5% 1/4W
R	44	RES	MF	8.45K		+-1% 1/4W
R	45	RES	MF	8.45K		+-1% 1/4W
R	46	RES	MF	9.76K		+-1% 1/4W
R	47	RES	MF	9.76K		+-1% 1/4W
R	48	RES	MF	19.6K		+-1% 1/4W
R	49	RES	MF	63.4	OHM	+-1% 1/4W
R	50	RES	MF	127	OHM	+-1% 1/4W
R	51	RES	MF	200	OHM	+-1% 1/4W
R	52	RES	MF	309	OHM	+-1% 1/4W
R	53	RES	SVR 10K	+-10%		
R	54	RES	CARBON	15K		+-5% 1/4W
R	55	RES	CARBON	820	OHM	+-5% 1/4W
R	56	RES	CARBON	390	OHM	+-5% 1/4W
R	57	RES	CARBON	100	OHM	+-5% 1/4W
R	58	RES	MF	88.7	OHM	+-1% 1/4W
R	59	RES	MF	6.81K		+-1% 1/4W
R	60	RES	MF	3.92K		+-1% 1/4W
R	61	RES	MF	402	OHM	+-1% 1/4W

DESIGNATION		DESCRIPTION			
R	62	RES	MF	3.92K	+-1% 1/4W
R	63	RES	MF	1.5K	+-1% 1/4W
R	64	RES	CARBON	2K	+-5% 1/4W
R	65	RES	CARBON	3.9K	+-5% 1/4W
R	66	RES	MF	4.02K	+-1% 1/4W
R	67	RES	CARBON	1K	+-5% 1/4W
R	68	RES	CARBON	3K	+-5% 1/4W
R	69	RES	MF	3.92K	+-1% 1/4W
R	70	RES	MF	665 OHM	+-1% 1/4W
R	71	RES	MF	432 OHM	+-1% 1/4W
R	72	RES	MF	619 OHM	+-1% 1/4W
R	73	RES	MF	1.91K	+-1% 1/4W
R	74	RES	MF	15 OHM	+-1% 1/4W
R	75	RES	MF	100 OHM	+-1% 1/4W
R	76	RES	SVR	100 OHM	+-10%
R	77	RES	MF	1.5K	+-1% 1/4W
R	78	RES	MF	4.22K	+-1% 1/4W
R	79	RES	MF	3.01K	+-1% 1/4W
R	80	RES	MF	3.01K	+-1% 1/4W
R	81	RES	MF	15K	+-1% 1/4W
R	82	RES	MF	10K	+-1% 1/4W
R	83	RES	MF	10K	+-1% 1/4W
R	84	RES	MF	2.21K	+-1% 1/4W

DESIGNATION		DESCRIPTION				
R	85	RES	CARBON	270	OHM	+-5% 1/4W
R	86	RES	CARBON	2K		+-5% 1/4W
R	87	RES	CARBON	10K		+-5% 1/4W
R	88	RES	CARBON	100k		+-5% 1/4W
R	89	RES	CARBON	10K		+-5% 1/4W
R	90	RES	CARBON	3K		+-5% 1/4W
R	91	RES	CARBON	100K		+-5% 1/4W
R	92	RES	CARBON	10K		+-5% 1/4W
R	93	RES	CARBON	10K		+-5% 1/4W
R	94	RES	CARBON	10K		+-5% 1/4W
R	95	RES	MF	1.5K		+-1% 1/4W
R	96	RES	CARBON	12K		+-5% 1/4W
R	97	RES	CARBON	1K		+-5% 1/4W
R	98	RES	CARBON	4.7K		+-5% 1/4W
R	99	RES	MF	9.09K		+-1% 1/4W
R	100	RES	CARBON	4.7K		+-5% 1/4W
R	101	RES	CARBON	3K		+-5% 1/4W
R	102	RES	CARBON	3K		+-5% 1/4W
R	103	RES	CARBON	4.7K		+-5% 1/4W
R	104	RES	MF	20K		+-1% 1/4W
R	105	RES	CARBON	3K		+-5% 1/4W
R	106	RES	CARBON	1M		+-5% 1/4W
R	107	RES	MF	499	OHM	+-1% 1/4W

DESIGNATION		DESCRIPTION				
R	108	RES	MF	499	OHM	+-1% 1/4W
R	109	RES	MF	499	OHM	+-1% 1/4W
R	110	RES	MF	499	OHM	+-1% 1/4W
R	111	RES	SVR 2.5K	+-10%		
R	112	RES	SVR 2.5K	+-10%		
R	113	RES	CARBON	3.3K		+-5% 1/4W
R	114	RES	CARBON	270	OHM	+-5% 1/4W
R	115	RES	CARBON	620	OHM	+-5% 1/4W
R	116	RES	MF	31.6K		+-1% 1/4W
R	117	RES	CARBON	620	OHM	+-5% 1/4W
R	118	RES	CARBON	1.2K		+-5% 1/4W
R	119	RES	CARBON	10	OHM	+-5% 1/4W
R	120	RES	MF	200K		+-1% 1/4W
R	121	RES	SVR 1K	+-10%		
R	122	RES	SVR 1K	+-10%		
R	123	RES	MF	21.5K		+-1% 1/4W
R	124	RES	CARBON	470	OHM	+-5% 1/4W
R	125	RES	CARBON	1K		+-5% 1/4W
R	126	RES	MF	3.01K		+-1% 1/4W
R	127	RES	CARBON	470	OHM	+-5% 1/4W
R	128	RES	CARBON	680	OHM	+-5% 1/2W
R	129	RES	CARBON	2K		+-5% 1/4W
R	130	RES	MF	2K		+-1% 1/4W

DESIGNATION		DESCRIPTION			
R	131	RES	CARBON	1K	+-5% 1/4W
R	132	RES	MF	20K	+-1% 1/4W
R	133	RES	MF	20K	+-1% 1/4W
R	134	RES	CARBON	3.9K	+-5% 1/4W
R	135	RES	MF	10K	+-1% 1/4W
R	136	RES	MF	10K	+-1% 1/4W
R	137	RES	MF	24.3K	+-1% 1/4W
R	138	RES	MF	31.6K	+-1% 1/4W
R	139	RES	MF	31.6K	+-1% 1/4W
R	140	RES	MF	34.8K	+-1% 1/4W
R	141	RES	CARBON	620 OHM	+-5% 1/4W
R	142	RES	CARBON	20 OHM	+-5% 1/4W
R	143	RES	CARBON	20 OHM	+-5% 1/4W
R	144	RES	MF	909 OHM	+-1% 1/4W
R	145	RES	SVR 10K	+-10%	
R	146	RES	MF	2K	+-1% 1/4W
R	147	RES	CARBON	1M	+-5% 1/4W
R	148	RES	CARBON	1K	+-5% 1/4W
R	149	RES	CARBON	3K	+-5% 1/4W
R	150	RES	CARBON	100 OHM	+-5% 1/4W
R	151	RES	MF	21.5K	+-1% 1/4W
R	152	RES	MF	5.62K	+-1% 1/4W
R	153	RES	MF	1K	+-1% 1/4W

DESIGNATION		DESCRIPTION			
R	154	RES	MF	1K	+-1% 1/4W
R	155	RES	MF	1K	+-1% 1/4W
R	156	RES	CARBON	2.7K	+-5% 1/4W
R	157	RES	MF	2K	+-1% 1/4W
R	158	RES	MF	1.91K	+-1% 1/4W
R	159	RES	MF	2K	+-1% 1/4W
R	160	RES	MF	1.5K	+-1% 1/4W
R	161	RES	CARBON	27K	+-5% 1/4W
R	162	RES	MF	249K	+-1% 1/4W
R	163	RES	MF	1.5K	+-1% 1/4W
R	164	RES	MF	124K	+-1% 1/4W
R	165	RES	CARBON	2.2K	+-5% 1/4W
R	166	RES	CARBON	470 OHM	+-5% 1/4W
R	167	RES	CARBON	2K	+-5% 1/4W
R	168	RES	CARBON	12K	+-5% 1/4W
R	169	RES	MF	619K	+-1% 1/4W
R	170	RES	MF	442 OHM	+-1% 1/4W
R	171	RES	CARBON	2.7K	+-5% 1/4W
R	172	RES	SVR	10K	+-10%
R	173	RES	SVR	100 OHM	+-10%
R	174	RES	SVR	2.5K	+-10%
R	175	RES	SVR	500 OHM	+-10%
R	176	RES	SVR	1K	+-10%

DESIGNATION		DESCRIPTION		
R	177	RES	SVR	1K +-10%
R	178	RES	SVR	250 OHM +-10%
R	179	RES	SVR	1K +-10%
R	180	RES	SVR	1K +-10%
R	181	RES	SVR	10K +-10%
R	182	RES	SVR	10K +-10%
R	183	RES	VR	1KB WITH SW
R	184	RES	VR	1KB
R	185	RES	VR	1KB
R	186	RES	VR	10KB 2PORT WITH SW
R	187	RES	VR	10KB 2PORT WITH SW
R	188	RES	VR	5KB
R	189	RES	VR	5KB
U	1	IC	LM710	
U	2	IC	CA3140	
U	3	IC	TL081CP	
U	4	IC	SN7400	
U	5	IC	LM710	
U	6	IC	CA3140	
U	7	IC	UA741	
U	8	IC	CA3096AE	
U	9	IC	LM78L05	

DESIGNATION		DESCRIPTION			
(600046002)					
C	200	CAP	ELEC(T)	4700UF	16V +80%-20%
C	201	CAP	ELEC	4.7UF	50V +80%-20%
C	202	CAP	ELEC	100UF	25V +80%-20%
C	203	CAP	CER	.1UF	50V +-10%
C	204	CAP	ELEC	100UF	25V +80%-20%
C	205	CAP	CER	.1UF	50V +-10%
C	206	CAP	ELEC	100UF	25V +80%-20%
C	207	CAP	CER	.1UF	50V +-10%
C	208	CAP	ELEC(T)	1000UF	63V +80%-20%
C	209	CAP	ELEC(T)	1000UF	63V +80%-20%
C	210	CAP	ELEC	4.7UF	50V +80%-20%
C	211	CAP	ELEC	4.7UF	50V +80%-20%
C	212	CAP	CER	.047UF	500V +-10%
C	213	CAP	CER	100PF	50V +-10%
C	214	CAP	CER	3PF	50V +-10%
C	215	CAP	CER	22PF	50V +-10%
C	216	CAP	CER	100PF	50V +-10%
C	217	CAP	ELEC	100UF	25V +80%-20%
C	218	CAP	CER	.1UF	50V +-10%
C	219	CAP	SVC	10PF	+-10%

DESIGNATION		DESCRIPTION				
C	220	CAP	CER	.01UF	50V	+-10%
C	221	CAP	CER	.01UF	50V	+-10%
C	222	CAP	ELEC	4.7UF	50V	+80%-20%
C	223	CAP	ELEC	10UF	25V	+80%-20%
C	224	CAP	CER NPO	15PF	50V	+-10%
C	225	CAP	CER NPO	8PF	50V	+-10%
C	226	CAP	CER NPO	33PF	50V	+-10%
C	227	CAP	CER	.1UF	50V	+-10%
C	228	CAP	ELEC	100UF	25V	+80%-20%
C	229	CAP	CER	.1UF	50V	+-10%
C	230	CAP	MF	10UF	100V	+-5%
C	231	CAP	MF	1UF	100V	+-5%
C	232	CAP	MF	.1UF	100V	+-5%
C	233	CAP	MF	.01UF	100V	+-5%
C	234	CAP	PF	910UF	50V	
C	235	CAP	CER SVC	8-50PF		
C	236	CAP	CER	.01UF	50V	+-10%
C	237	CAP	CER	.01UF	50V	+-10%
C	238	CAP	CER	.01UF	50V	+-10%
C	239	CAP	CER	.01UF	50V	+-10%
C	240	CAP	CER	.01UF	50V	+-10%
CR	201	DIODE	1N4002	100V	1A	

DESIGNATION	DESCRIPTION
CR 202	DIODE 1N4002 100V 1A
CR 203	DIODE 1N4002 100V 1A
CR 204	DIODE 1N4002 100V 1A
CR 205	DIODE 1N4002 100V 1A
CR 206	DIODE 1N4002 100V 1A
CR 207	DIODE 1N4148
CR 208	DIODE 1N4148
CR 209	DIODE 1N4148
CR 210	DIODE 1N4148
CR 211	DIODE 1N4148
CR 212	DIODE 1N4148
CR 213	DIODE 1N4148
CR 214	DIODE 1N4148
CR 215	DIODE 1N4148
CR 216	DIODE 1N4148
CR 217	DIODE 1N4148
CR 218	DIODE 1N4148
CR 219	DIODE 1N4148
CR 220	DIODE 1N4148
CR 221	DIODE 1N4148
CR 226	DIODE 1N4148
K 1	RELAY S1A21

DESIGNATION		DESCRIPTION
K	2	RELAY S1A21
K	3	RELAY S1A21
K	4	RELAY S1A21
K	5	RELAY S1A21
K	6	RELAY S1A21
K	7	RELAY S1A21
K	8	RELAY MZ-9HS-TYPE 9V
L	201	INDUCTOR (T) 4.3UH
L	202	INDUCTOR (T) 4.3UH
Q	201	TRANS 2SK192 (FET)
Q	202	TRANS BFT-95
Q	203	TRANS 2N3906
Q	204	TRANS 2N3906
Q	205	TRANS 2N3904
Q	206	TRANS 2N3906
Q	207	TRANS 2N3906
Q	208	TRANS 2N3906
Q	209	TRANS 2N3906
Q	210	TRANS 2N3904
Q	211	TRANS 2N3904
Q	212	TRANS 2N3906

DESIGNATION		DESCRIPTION				
R	201	RES	CARBON	4.7K		+-5% 1/4W
R	202	RES	CARBON	4.7K		+-5% 1/4W
R	203	RES	CARBON	1K		+-5% 1/4W
R	204	RES	CARBON	10	OHM	+-5% 1/4W
R	205	RES	MF	900K		+-1% 1/2W
R	206	RES	MF	111K		+-1% 1/4W
R	207	RES	CARBON	100K		+-5% 1/4W
R	208	RES	CARBON	1M		+-5% 1/4W
R	209	RES	CARBON	220	OHM	+-5% 1/4W
R	210	RES	CARBON	470	OHM	+-5% 1/4W
R	211	RES	CARBON	470	OHM	+-5% 1/4W
R	212	RES	CARBON	470	OHM	+-5% 1/4W
R	213	RES	CARBON	330	OHM	+-5% 1/4W
R	214	RES	CARBON	470	OHM	+-5% 1/4W
R	215	RES	CARBON	330	OHM	+-5% 1/4W
R	216	RES	CARBON	470	OHM	+-5% 1/4W
R	217	RES	CARBON	470	OHM	+-5% 1/4W
R	218	RES	CARBON	330	OHM	+-5% 1/4W
R	219	RES	CARBON	220	OHM	+-5% 1/4W
R	220	RES	CARBON	470	OHM	+-5% 1/4W
R	221	RES	CARBON	470	OHM	+-5% 1/4W
R	222	RES	CARBON	22	OHM	+-5% 1/4W

DESIGNATION		DESCRIPTION				
R	223	RES	CARBON	75	OHM	+-5% 1/4W
R	224	RES	CARBON	470	OHM	+-5% 1/4W
R	225	RES	CARBON	470	OHM	+-5% 1/4W
R	226	RES	CARBON	470K		+-5% 1/4W
R	227	RES	CARBON	470K		+-5% 1/4W
R	228	RES	CARBON	100K		+-5% 1/4W
R	229	RES	CARBON	2.2K		+-5% 1/4W
R	230	RES	CARBON	10K		+-5% 1/4W
R	231	RES	CARBON	10K		+-5% 1/4W
R	232	RES	CARBON	10K		+-5% 1/4W
R	233	RES	CARBON	10K		+-5% 1/4W
R	234	RES	CARBON	33K		+-5% 1/4W
R	235	RES	CARBON	4.7K		+-5% 1/4W
R	236	RES	CARBON	10K		+-5% 1/4W
R	237	RES	CARBON	330	OHM	+-5% 1/4W
R	238	RES	CARBON	10K		+-5% 1/4W
R	239	RES	CARBON	4.7K		+-5% 1/4W
R	240	RES	CARBON	330	OHM	+-5% 1/4W
R	241	RES	CARBON	22M		+-5% 1/2W
R	242	RES	CARBON	10K		+-5% 1/4W
R	243	RES	CARBON	10K		+-5% 1/4W
R	244	RES	CARBON	470	OHM	+-5% 1/4W
R	245	RES	CARBON	1K		+-5% 1/4W

DESIGNATION		DESCRIPTION				
R	246	RES	CARBON	330	OHM	+-5% 1/4W
R	247	RES	CARBON	330	OHM	+-5% 1/4W
R	248	RES	CARBON	4.7K		+-5% 1/4W
R	249	RES	CARBON	4.7K		+-5% 1/4W
R	250	RES	CARBON	2.2K		+-5% 1/4W
R	251	RES	CARBON	4.7K		+-5% 1/4W
R	252	RES	CARBON	2.2K		+-5% 1/4W
R	253	RES	SVR 1K	+-10%		+-5% 1/4W
U	201	IC	UA7805			
U	202	IC	MC10116L			
U	203	IC	MC14093			
U	204	IC	SN74LS193			
U	205	IC	MC14093			
U	206	IC	SN74LS138			
U	207	IC	MC14051B			
U	208	IC	MC14051B			
U	209	IC	ICM7216D			
U	210	IC	SN74S196			
U	211	IC	SN74S02			
U	212	IC	7812CP			
U	213	IC	MC7912CP			

DESIGNATION	DESCRIPTION
X 201	CRYSTAL 10MHz
F 201	FUSE 0.5A
S 201	SLIDE SWITCH 115V/230V PCB-TYPE
T 201	TRANSFORMER

(600046003)

CR 222	LED 3.0Ø	RED SQUARE
CR 223	LED 3.0Ø	RED SQUARE
CR 224	LED 3.0Ø	RED SQUARE
CR 225	LED 3.0Ø	RED SQUARE
CR 227	DISPLAY	5082-7740
CR 228	DISPLAY	5082-7740
CR 229	DISPLAY	5082-7740
CR 230	DISPLAY	5082-7740
CR 231	DISPLAY	5082-7740

14	IC SOCKET 14PIN
1	IC SOCKET 16PIN
1	IC SOCKET 28PIN

DESIGNATION	DESCRIPTION
2	FUSE HOUSING PCB-TYPE
1	POWER AC CORD
1	PUSH SWITCH
6	BNC
2	HEAT SINK
8	KNOB (IVORY)
5	KNOB (GRAY)
7	KNOB (BLACK) PN-37
1	CONNECTOR 8PIN PITCH=3.96mm
1	CONNECTOR 5PIN PITCH=3.96mm
1	CONNECTOR 4PIN PITCH=3.96
1	CONNECTOR 4PIN PITCH=2.54mm L=165mm
1	CONNECTOR 9PIN PITCH=2.54mm L=100mm
1	CONNECTOR 10PIN PITCH=2.54mm L=115mm
1	CONNECTOR 5PIN PITCH=3.96mm