FUNCTION GENERATOR
MODEL: GFG-8015G

SAFETY TERMS AND SYMBOLS

These terms may appear in this manual or on the product:

WARNING. Warning statements identify condition or practices that could result in injury or loss of life.

CAUTION. Caution statements identify conditions or practices that could result in damage to this product or other property.

The following symbols may appear in this manual or on the product:

DANGER High Voltage	DANGER Hot Surface	ATTENTION refer to Manual	Protective Conductor Terminal	Earth(ground) Terminal

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LIST OF TABLE

NOTE

⚠ WARNING. For continued fire protection. Replace fuse only with 250V fuse of the specified type and rating, and disconnect the power cord before replacing fuse.

⚠ WARNING. To avoid electrical shock, the power cord protective grounding conductor must be connected to ground.

⚠ CAUTION. To avoid damaging the instrument, don't use it in a place where ambient temperature exceeds 40℃.

⚠ CAUTION . To avoid damaging the instrument, V.C.F. (V.C.G.) do not input more than DC15V.

SECTION 1 GENERAL DESCRIPTION

INTRODUCTION

The Function Generator provides square, triangle, sine, ramp and pulse waveforms over a frequency range of 0.2Hz to 2MHz, puls a VCF (voltage controlled frequency) input, variable DC Offset and TTL Pulse output.

MECHANICAL DESCRIPTION

Case/Top and Bottom Covers

The instrument case is made of lightweight plastic. The top and bottom covers are made of ABS plastic for extreme ruggedness and flexibility. Front and rear panels are made of ABS plastic for maximum strength and rigifity. The instrument requires no ventilation holes because of its low power consumption.

Front Panel

The main output and all controls are located on the front panel. They are: the pushbutton POWER switch, power ON indicator, seven frequency RANGE pushbutton switches, three pushbutton FUNCTION switches, INVERT pushbutton switch, ATTENUATION pushbutton switch, frequency MULTIPLIER (variable), DUTY potentiometer, DC OFFSET control, output AMPLITUDE control, OUTPUT, VCF (voltage controlled frequency) input, TTL pulse output.

Printed Circuit Boards

MAIN GENERATOR: All circuity and the power supply are contained on the main P.C. board. All controls, the POWER switch and ON indicator are also contained on the main P.C. board

ELECTRICAL DESCRIPTION

The FUNCTION GENERATOR utilize two constant current sources of opposite polarity for charging and discharging a timing capacitor to produce the triangular waveform.

A diode shaping bridge netwrok shapes the triangle to produce the low-distoriton sine wave. The level detector senses the voltage on the timing capacitor and connects and disconnects the current sources alternately. The square wave produced by the level detector is utilized to produce the output square wave.

ENVIRONMENT CONDITION

Operation Environment	Indoor use Altitude up to 2000m Ambient Temperature 0℃ to 40℃ Relative Humidity 80% (maximum) Installation Category II Pollution Degree 2
Storage Temperature & Humidity	-10℃ to 70℃ 70% (maximum)

SPECIFICATIONS

Specifications are listed below in table 1-1. Test procedures for verification of specification are given in Section 3.

Table 1-1 Specifications

Main Generator:	
Frequency Range :	0.2Hz to 2MHz (7 ranges)
Frequency Accuracy:	±5% of full scale
VCF (Voltage Controlled Frequency):	Approx. 0 to 10V (±1V) input for 1000 : 1 (3 decades) frequency ratio. Input impedance – Approx.10KΩ

Main Output (50Ω))	Waveforms - Since, triangle, square, pulse and ramp Amplitude - >20Vpp open circuit >10Vpp into 50Ω Attenuation - 20db continuously variable plus 20db for the output DC Offset - (variable) +10 to −10 volts open circuit +5 to −5 volts into 50Ω NOTE: DC offset plus signal cannot exceed maximum peak voltage or clipping will occur. Sine Distortion - <1% 0 2Hz to 200KHz typically <.5% −20db 200KHz to 2MHz (all harmonics) measured at full output, between 0.2 and 2.0 on the dial. Sine Frequency Response - <0.1db 0.1Hz to 200KHz <0.5db 200KHz to 2MHz Square Wave - Rise Time - <100nsec Abberations - <5% max pp ampl!tude
Pulse Output: TTL Compatable:	Amplitude Fixed - >+3V open circuit. <25nsec rise time will sink 5 TTL loads.

Power Requirements:	100V, 120V, 220V, 230V AC ± 10%, 50/60 Hz. Approx. 5 watts.
Physical Characteristics:	245 wide x 95 high x 280 deep. Weight— Approx. 1.5Kg.
Accessories:	Accessories: Test leads 1 ea
	NOTE: (unless otherwise stated). Specifications apply 10% to maximum output voltage, terminated into 50Ω, between 0.2 and 2 Multiplier settings. Specifications are valid at 25°C±5°C after 1 hr. warmup time.

SECTION 2 INSTALLATION AND OPERATION

UNPACKING AND INSPECTION

The FUNCTION GENERATOR are packaged to absorb any reasonable shock encountered during shipping.
Carefully remove the instrument from the shipping container and inspect for shipping damage. If damage is found, notify the carrier immediately.

AC POWER REQUIREMENTS

The function generator operate on line voltages of either 220V or 230 VAC ± 10% 50 - 60Hz. Power dissipation is typically 5 watts.
Unless specifically ordered otherwise, the instrument will be wired for 120 VAC.

If it is necessary to operate the instrument at a different line voltage, it is necessary to change one jumper located on the P.C. board. Perform the following steps.

A. Remove the top and bottom covers as described under dissassembly steps section 5.

B, From figure 5-2 select the jumper or jumpers corresponding to the desired line voltage of operation.

C. Remove the jumper or jumpers previously installed in the P.C. board (fig. 5-2).

D. Install the jumper or jumpers corresponding to the desired line voltage.

WARNING

Be sure to insulate jumpers to prevent shock hazard.

FUSE REPLACEMENT

If for some reason the fuse blows, first try to determine the cause of the failure and remedy if possible.
NOTE: Replace with the proper size fuse ONLY to prevent damage to the instrument.

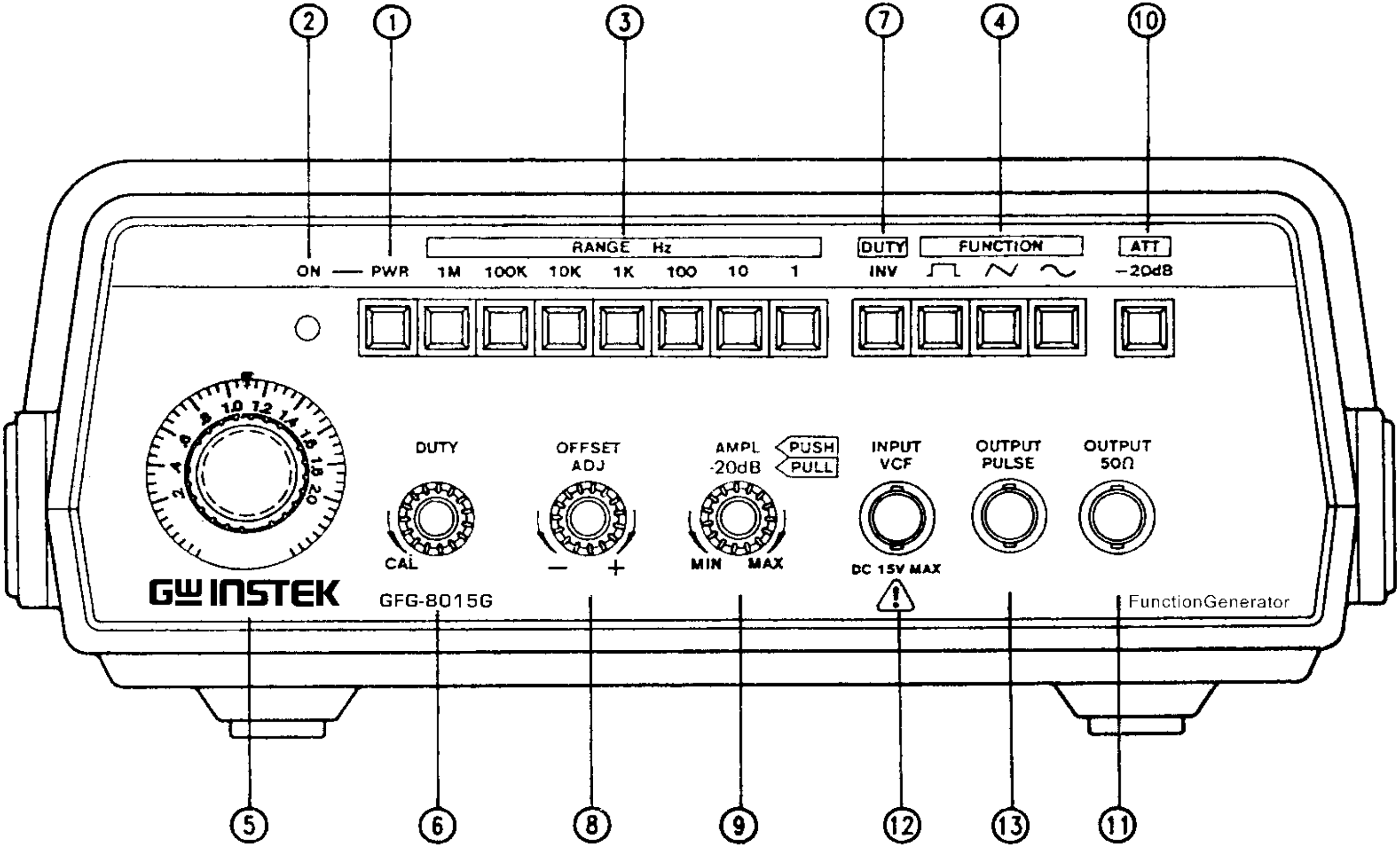


Fig. 2-1 Controls and Indicators

CONTROLS AND INDICATORS (Fig. 2-1)

1 POWER Switch

The power switch applies power to the function generator.

2 Power On Indicator

A light emitting diode (LED) is used to indicate when power is applied to the function generator. Because the LED is a solid-state device, its life expectancy, like most other solid-state devices, is indefinite.

3 RANGE Switch

Seven fixed decades of frequency are provided by the RANGE pushbutton switch. Each of the seven pushbutton RANGE switches is interlocked. Pressing one pushbutton will release all others.

4 FUNCTION Switch

Three interlocking pushbutton switches provide selection of the desired output waveform. Depressing one switch will release the switch previously depressed. Square, triangle, and sine waveforms are provided, satisfying most applications.

5 MULTIPLIER

The MULTIPLIER is a variable potentiometer allowing frequency settings between fixed ranges. Although the dial skirt is calibrated from .2 to 2.0, the dynamic range of the MULTIPLIER dial is 1000:1 (three decades). For example, this allows frequency settings between 200KHz and 200Hz without changing ranges. NOTE: This is necessary when sweeping up in frequency over a three decade range 1000:1. For further information concerning sweeping refer to Section 4, (Summing Amplifier).

6 DUTY CONTROL

Time symmetry of the OUTPUT waveforms, as well as the TTL PULSE output, is controlled by the DUTY potentiometer.

When this control is set to the CAL position, the time symmetry of the output waveforms is 50/50 or approximately 100% symmetrical.

The variable symmetry allows the time period of onehalf the waveform to be changed while the other half remains fixed as determined by RANGE and MULTIPLIER settings. This unique feature provides ramp waveforms, variable pulse width and variable duty cycle pulses, and skewed sine waves.

7 RAMP/PULSE INVERT

A pushbutton switch is provided to invert the time symmetry set by the DUTY control.

Table 2-1 illustrates the effect of the INVERT switch and DUTY control.

NOTE: The time symmetry as illustrated below is for reference only. Any desired time symmetry ratio may be set as desired within the limits as described in Section 4, DUTY.

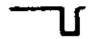
Ramp/Pulse Invert Switch	Duty Control	Square	MAIN OUTPUT Triangle	Sine	Pulse Output
Out	Cal				
In	Cal				
In	Max CW				
Out	Max CW				

Table 2-1 DUTY Control

8 DC OFFSET (PULL ADJ)

A DC OFFSET control is provided to allow the DC level of the OUTPUT waveforms to be set as desired.

NOTE: The amount of offset plus the amplitude setting cannot exceed the maximum P-P amplitude or clipping will occur.

Table 2-2 below illustrates the effect of the DC OFFSET con trol. The clipped waveform is caused by too much amplitude and too much offset.

Offset	Amplitude	Output
O	Max	+10V +10V
Max CW	Max	+10V 0V
Max CCW	Max	0V 10V
Mid CW	Max	+10V 10V
Mid CCW	Max	+10V +10V

Table 2-2 D.C. Offset Control

9 AMPLITUDE

The AMPLITUDE control provides 20db of attenuation of the output waveform selected by the FUNCTION switch.

10 ATT

When the switch is push, in additior to 20db provided by amplitude control, a maximum of 40db of attenuation, at the outout.

11 OUTPUT

Square, triangle, sine, ramp and pulse waveforms are provided at up to 20V P-P amplitude (open circuit) at the OUTPUT. (When ATT pushbutton switch is pull).

The VCF input and PULSE outputs, utilize BNC connectors

12 VCF INPUT

A VCF (voltage-controlled frequency) input is provided for externally sweeping the frequency. Approximately +10V applied at the VCF input will sweep the generator frequency down three decades or 1000:1. The generator may also be swept up in frequency by applying a negative voltage at the VCF input.

13 PULSE OUTPUT

The PULSE OUTPUT is a TTL output signal suitable for driving TTL logic. The rise and fall time of the PULSE output is typically 10ns. The pulse width and repetition rate may be set as desired, utilizing the RANGE and MULTIPLIER and DUTY control. The symmetry of the PULSE output is controlled in the same manner as the output waveforms described in Table 2-1.

FIRST TIME OPERATION PROCEDURE

NOTE: Before applying power to the MODEL GFG–8015F FUNCTION GENERATOR , be sure the proper line voltage is available.

Plug the power cord into the proper source of 120V AC 50-60 Hz. All instruments are wired for 120V AC unless otherwise ordered made. The proper procedure for change jumper wire is described in Section2. (AC Power Requirements).
Set the FUNCTION GENERATOR control as follows:

RANGE-HZ	10K
MULTIPLIER	2.0
FUNCTION	
DUTY	CAL
AMPLITUDE	MAX
OFFSET	'O'
ATTENUATOR	0db

MAIN OUTPUT

Connect an oscilloscope to the output.

Observe a 20V P-P 20K Hz triangle wave.

FUNCTION SWITCH

Select and observe a 20V P-P square wave and sine wave.

AMPLITUDE CONTROL

Rotate the AMPLITUDE vernier from maximum to minimum and observe greater than 30db of attenuation.

ATTENUATION

Connect the oscilloscope to the OUTPUT and push the ATT pushbutton switch that the signal is attenuated by a factor of 20db.

DC OFFSET

Reconnect the oscilloscope to the OUTPUT and select the triangle waveform. Rotate the DC OFFSET control and observe the peaks of the triangle waveform will "clip" when the DC OFFSET plus the peak amplitude exceeds ±10V.

Reduce the output amplitude and observe the amount of DC OFFSET may be increased by the same amount the peak amplitude has been decreased.

Return the DC OFFSET to "0" and the AMPLITUDE to maximum.

DUTY CONTROL

While observing the triangle waveform on the oscilloscope, rotate the DUTY control CW from the CAL position.

Observe one slope of the triangle remains constant while the other slope is variable over typically a 20:1 range, producing a ramp waveform.

INVERT SWITCH

Depress the INVERT pushbutton switch and observe the positive and negative slopes of the ramp waveform reverse (invert).

By selecting the Square wave and repeating the same procedure, the FUNCTION GENERATOR become very versatile pulse generators. The pulse width may be determined by the following formula:
PULSE WIDTH the reciprocal of 2 x freq. setting.

In other words, the pulse width equals one-half the time period of the frequency set by the RANGE and MULTIPLIER controls.

The time symmetry of the Sine wave may be set in the same manner, providing additional versatility.

NOTE: The DUTY control and INVERT switch provide the same flexibility for the PULSE output.

PULSE OUTPUT

Connect the oscilloscope to the PULSE output. By adjusting the generator frequency, the DUTY control and the INVERT switch, the high-speed TTL pulse may be utilized as a very versatile pulse generator. With the INVERT switch in the NORM position (out), the pulse width "on time" is determined by the RANGE and MULTIPLIER setting and the repetition rate "off time" is set by the DUTY control.

NOTE: When the INVERT switch is set to INVERT, the pulse "off time" is determined by the RANGE and MULTIPLIER setting and the pulse "on time" is set with the DUTY control.

SECTION 3 SPECIFICATION VERIFICATION

GENERAL

This procedure is designed to ensure that the instrument is operating properly and within its specifications. If any of the readings is not within tolerance, refer to the Calibration Procedure.

If the instrument fails to operate properly, refer to the Troubleshooting Procedure.

PREPARATION

Allow at least 30 minutes warm-up time before checking specifications or attempting to re-calibrate.

EQUIPMENT

Table 3-1 is a list of test equipment necessary for complete specification verification or calibration of the FUNCTION GENERATOR.

PROCEDURE

Connect the test equipment as shown in the table for each accuracy check. Set all controls as indicated in each table and perform the measurements as called out in each case.

Table 3-1 Required Test and Calibration Equipment

EQUIP	REQUIRED SPECS	TYPE
Oscilloscope	Bandwidth >20MHz Rise Time <10ns Vert. Accuracy ±3% Horzi. Accuracy ±5%	Good Will Type GOS-642 or Equivalent
Frequency Counter	Freq. Accuracy ±.1% Freq. Response >10MHz	Good Will Type GFC-8130G or Equivalent
Voltage Source	>10V Output (Variable) Well Regulated	Good Will Type GPR-1830 or Equivalent
Distortion Analyzer	Freq. Response >100KHz Residual Distortion <.1%	H.P. Type 333A or Equivalent

Set controls as indicated below for all accuracy checks unless indicated otherwise in each table.

POWER	ON
RANGE	REFER TO TABLES
MULT.	REFER TO TABLES
INVERT	NORM (OUT)
FUNCTION	
DUTY	CAL (MAX CCW)
DC OFFSET	'O'
AMPLITUDE	MAX (MAX CW)

Table 3-2 Frequency Accuracy

Range	Mult.	Frequency Reading	Frequency Tolerance	Time Period Reading	Time Period Tolerance
IM		2.0000MHz	2.1000 to 1.9000MHz	0.5000 μsec	52632 to .47619 μsec
100K		200.00KHz	210.00 to 190.00KHz	5.0000 μsec	5.2632 to 4.7619 μsec
10K	2.0	20.000KHz	21.000 to 19.000KHz	50.000 μsec	52.632 to 47.619 μsec
1K		2.0000KHz	2.1000 to 1.9000KHz	0.5000 ms	52632 to .47619 ms
100		200.000Hz	210.00 to 190.00Hz	5.0000 ms	5.2632 to 4.7619 ms
10		20.000Hz	21.000 to 19.000Hz	50.000 ms	52.632 to 47.619 ms
1		2.0000Hz	2.1000 to 1.9000Hz	0.5000 sec	52632 to .47619 sec
IM		200.00KHz	300.00 to 100.00KHz	5.0000 μsec	3.3333 to 10.000 μsec
100K		20.000KHz	30.000 to 10.000KHz	50.000 μsec	33.333 to 100.00 μsec
10K		2.0000KHz	3.0000 to 1.0000KHz	0.5000 ms	33333 to 1.0000 ms
1K	2 0	200.00Hz	300.00 to 100.00Hz	5.0000 ms	3.3333 to 10.000 ms
100		20.000Hz	30.000 to 10.000Hz	50.000 ms	33.333 to 100.00 ms
10		2.0000Hz	3.0000 to 1.0000Hz	0.5000 sec	33333 to 1.0000 sec
1		.20000Hz	30000 to .10000Hz	5.0000 sec	3.3333 to 10.000 sec

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Table 3-2 Frequency Accraoy (Continued)

Range	MULT'	Frequency Reading	Frequency Tolerance	Time Period Reading	Time Period Tolerance
IM	1.0	1000.00KHz	1100.0 to 900.00KHz	1.0000 μsec	1.1111 to .90909 μsec
100K		100.000KHz	110.00 to 90.000KHz	10.000 μsec	11.111 to 9.0909 μsec
10K		10.0000KHz	11.000 to 9.0000KHz	100.00 μsec	111.11 to 90.909 μsec
1K		1000.00Hz	1100.00 to 900.00Hz	1.0000 ms	1.1111 to .90909 ms
100		100.000Hz	110.00 to 90.000Hz	10.000 ms	11.111 to 9.0909 ms
10		10.0000Hz	11.000 to 9.0000Hz	100.00 ms	111.11 to 90.909 ms
1		1.00000Hz	1.1000 to .90000Hz	1.0000 sec	1.1111 to .90909 sec

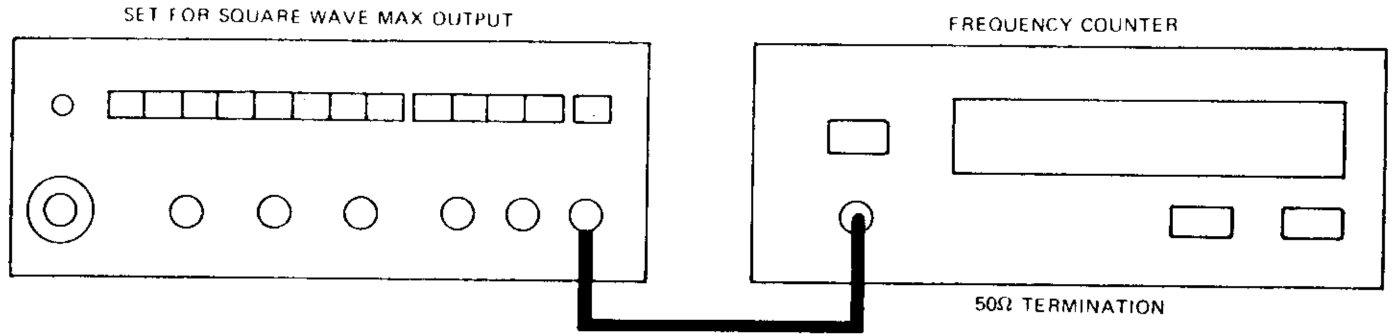

Table 3-3 Frequency Range

Range	Multiplier	Frequency Tolerance	Time Period Tolerance
1M	Max CW	>2.000 MHz	<5000 μsec
1	<20	<2000 Hz	>5.000 sec

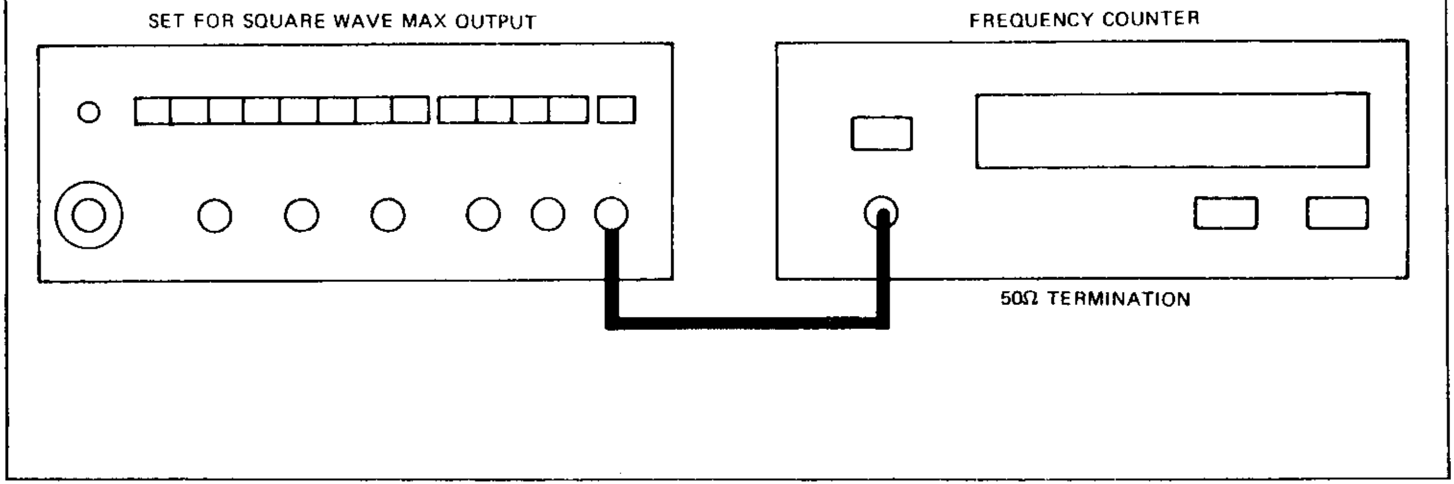

Table 3-4 VCF (Voltage Controlled Frequency)

Range	Mult	VCF Input Voltage	Voltage Tolerance	Frequency Reading	Time Period Reading
100K	2.0	0V	±250MV	200KHz±5%	5.0 μsec ±5%
100K	2.0	See Note: +10VDC	±1VDC	200Hz±5%	5.0 ms ±5%

Note: Apply pos voltage at VCF input (Approx + 10VDC) until Frequency Reading of 200Hz ± 5% is obtained.

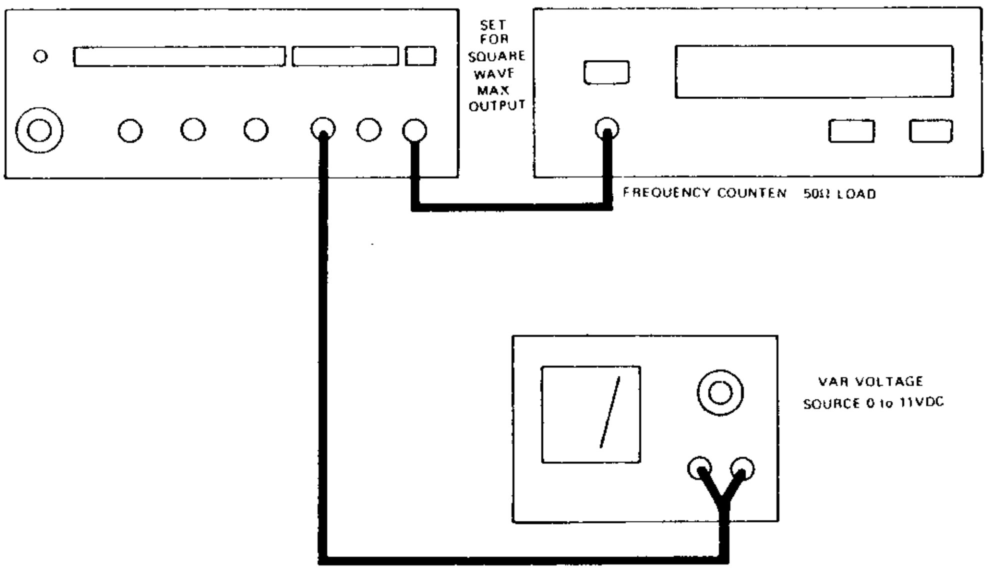

Table 3-5 Main Output Amplitude

Range	Mult	Function	Amplitude	pp Voltage Tolerance	Output Load
1K	2.0	⎍	Max (CW)	>20 Vpp	Open Ckt
		△		>20 Vpp	
		∿		>20 Vpp	
		⎍	Min (CW)	<632 mv pp	
		△		<632 mv pp	
		∿		<632 mv pp	

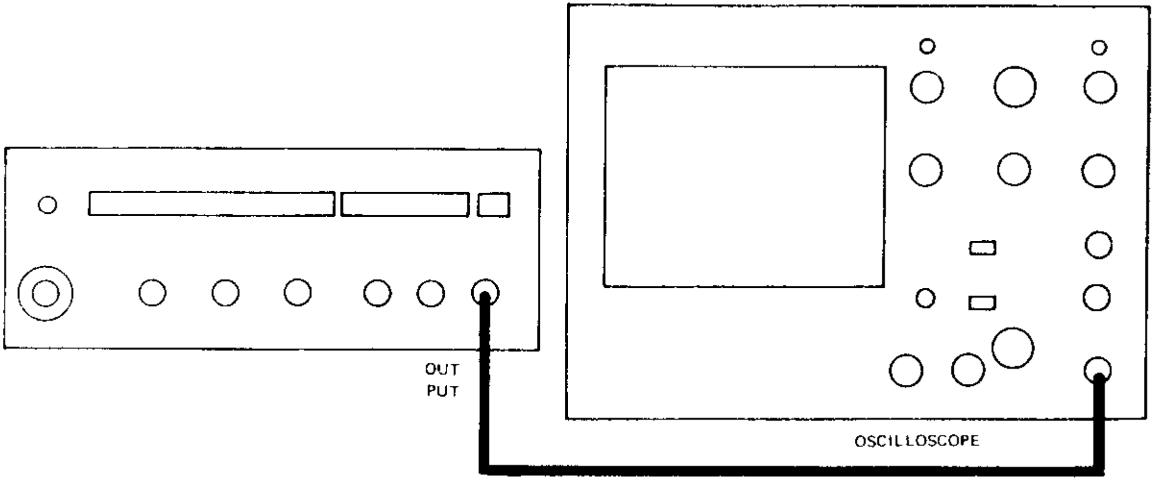

Table 3-6 D.C. Offset (Main Output)

Range	Mult	Function	Amplitude	DC Offset	Oulput Voltage Tolerance
1K	2.0	∿	Min (CCW)	Max CW +	>10 VDC Open Ckt
				Max CCW –	>–10VDC Open Ckt
				Max CW +	>–5VDC into 50Ω Load
				Max CCW –	>–5VDC into 50Ω Load

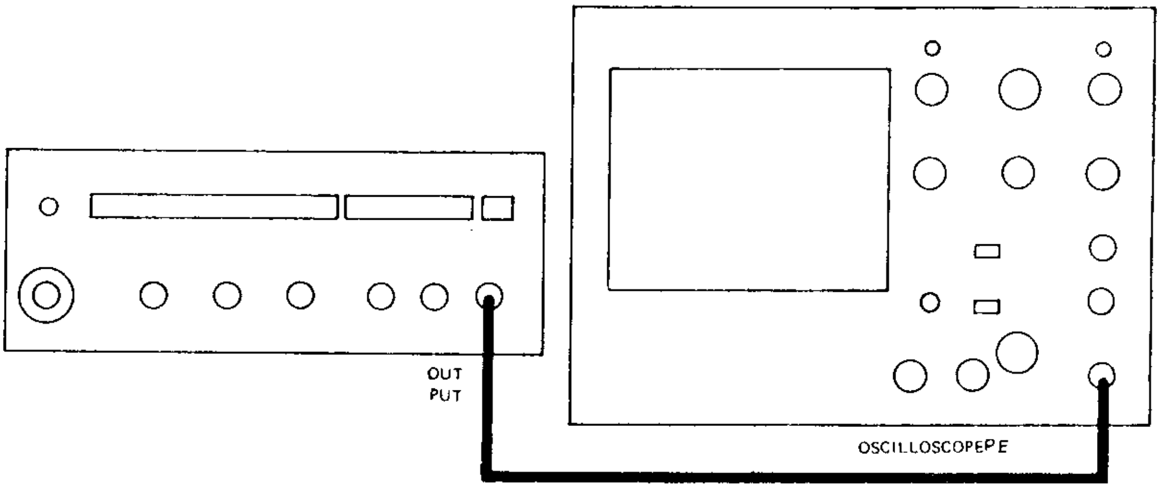

Table 3-7 Sine Distortion

Range	Mult	Function	Sine Distortion Tolerance
100K	2.0	~	<1% Sine Distortion
	.20		
10K	2.0		
	.20		
1K	2.0		
	.20		
100	2.0		
	.20		
10	2.0		
	.20		
1	2.0		
	.20		
1M	2.0		All Harmonics >30db down Note: Disconnect Distortion Analyzer Before Connecting Spectrum Analyzer
	.20		

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Table 3-7 Sine Distortion (Continued)

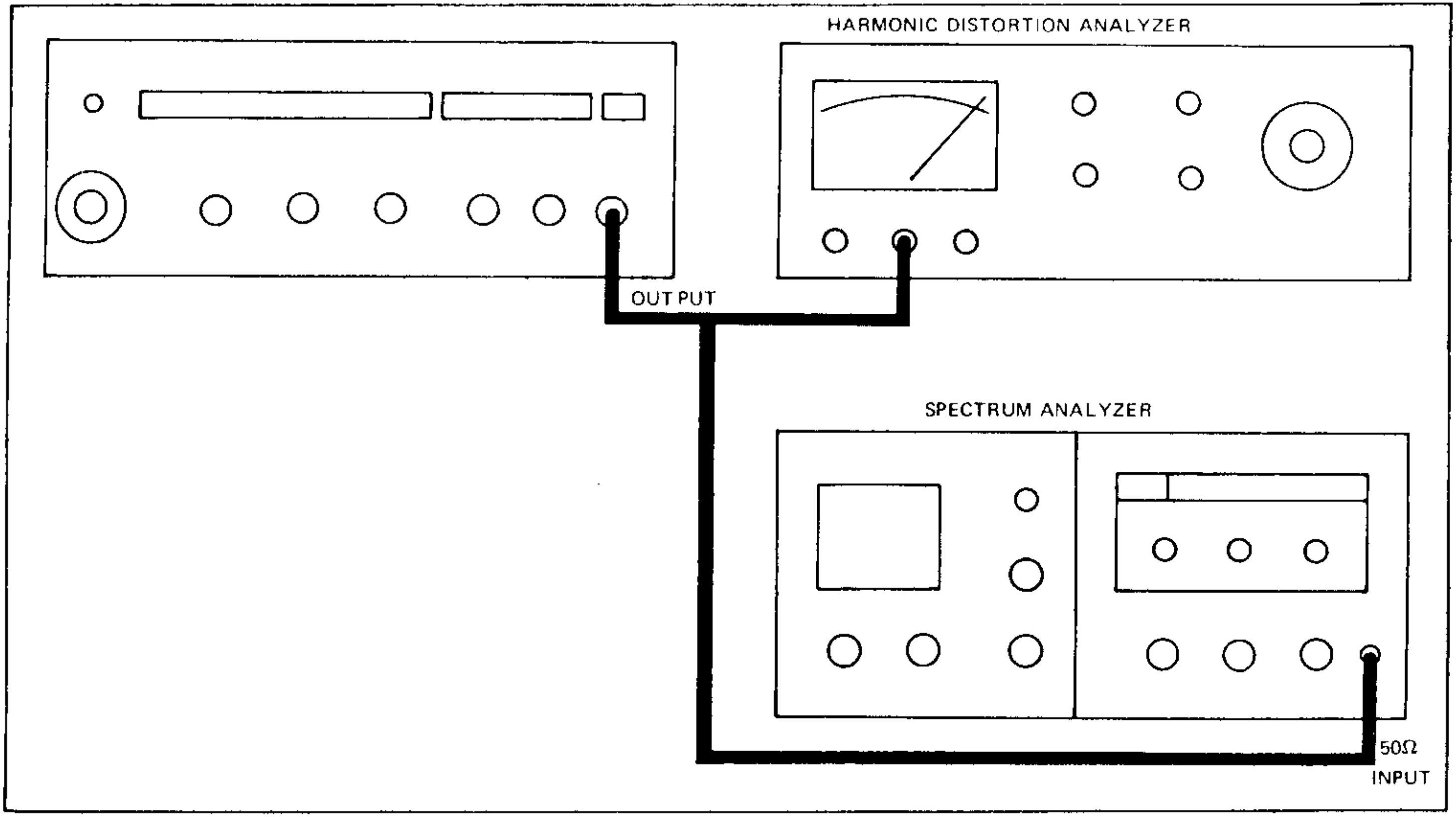


Table 3-8 Sine Frequency Response

Range	Mult	Amplitude	Sine Amplitude	Tolerance
10K	2.0	Max CW	Measured Value	
100K				Measured Value ± .1db (±1.15%)
1M				Measured Value ± .5db (±5.92%)

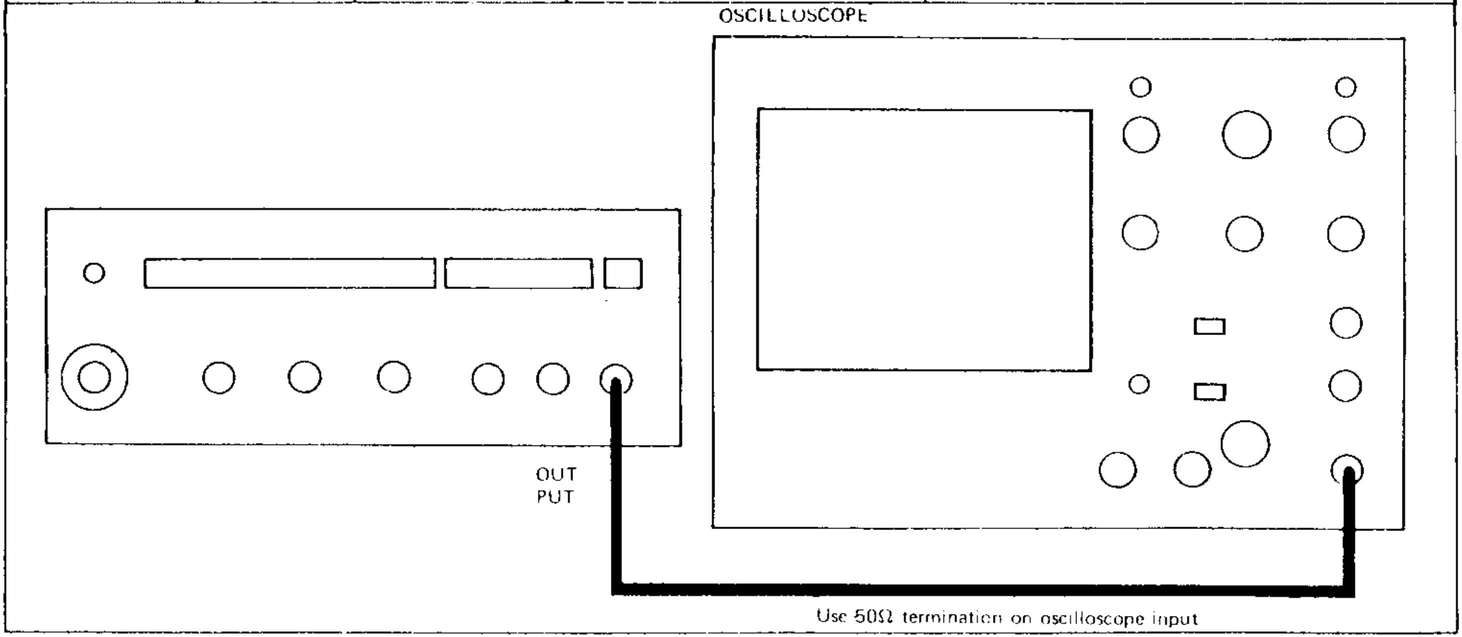


Table 3-9 Square Wave Rise and Fall Time

Range	Mult	Amplitude	Function	Rise Time	Fall Time	Square Aberrations
100K	2.0	10V pp	⌐L	<100ns	<100ns	<±5% of pp Amp or ±0.5

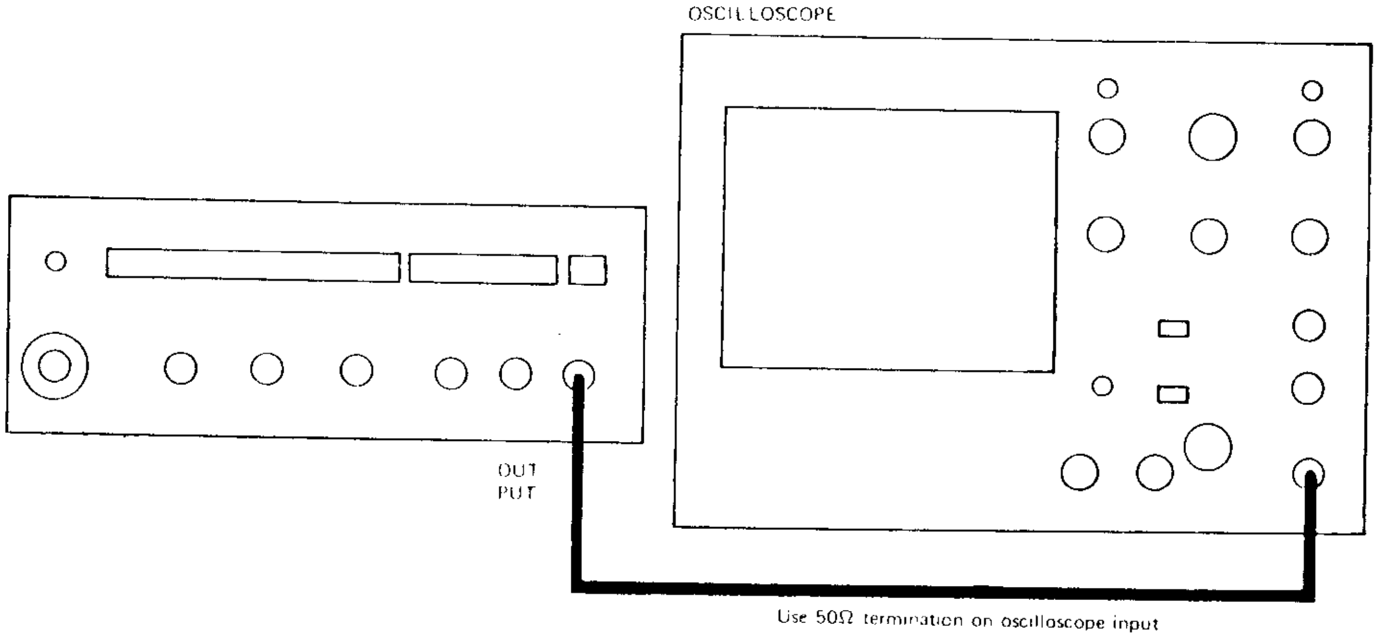
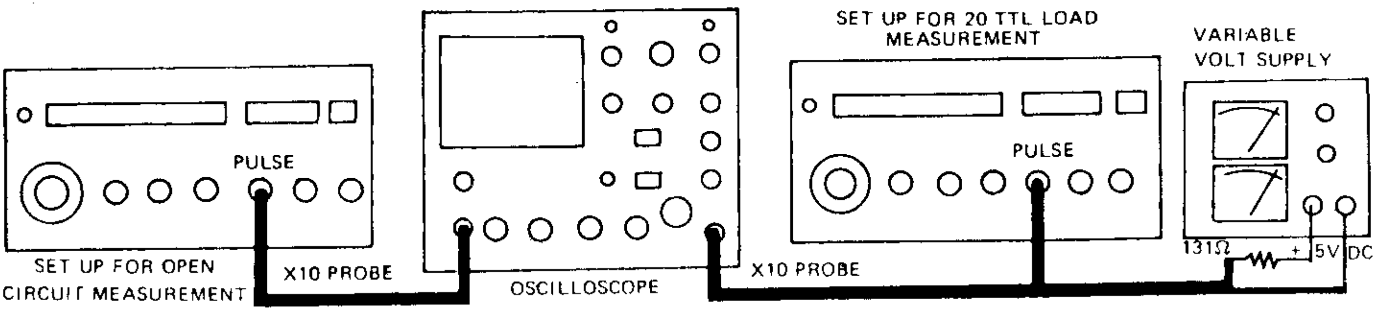


Table 3-10 Pulse Output

Range	Mult	Nominal	Pulse Amplitude	Rise Time / Fall Time Tolerance	Pulse Output load	Nominal Rise Time/Fall Time
100K	2.0	+3.5V 0V	>+3V <.8V	<25ns	Open Circuit	10ns
		+5V 7V	>2.0V <.8V	<25ns	5 TTL Loads 131Ω Res From Pulse Output to +5.0 VDC	15ns

Note: pulse outputs are on rear panel.

MODEL GFG-8015G



GENERAL

This section describes the operation of FUNCTION GENERATOR in detail as well as a brief description relating to the Block Diagram. (See Section 6). The drawings contained in this Section are included to aid in the description as well as to supplement the schematics in Section 6.

MAIN GENERATOR:

A DC voltage from the MULTIPLIER potentiometer is connected to the Summing Amplifier U201 and Q201. The output of the Summing Amplifier drives the Positive Current Source U203, Q203 and the Inverter U202, Q202. The Inverter in turn drives the Negative Current Source U204 and Q204.

Two constant current sources of opposite polarity charge and discharge a timing capacitor producing the triangle waveform, figure 4-1.

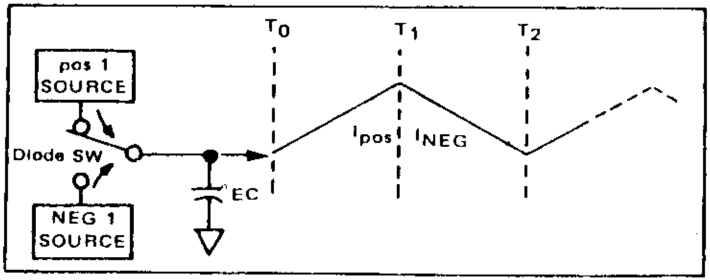


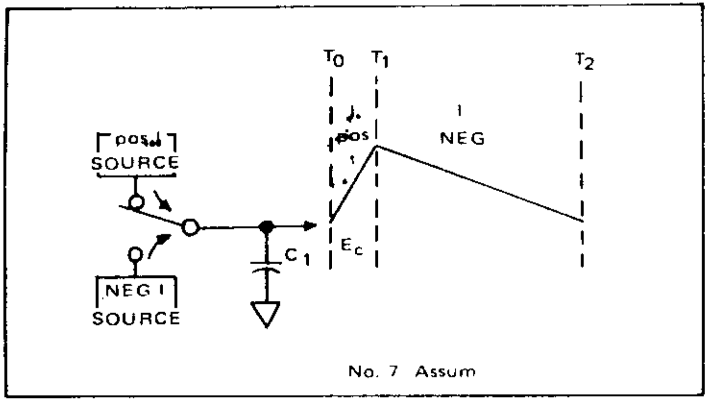
Fig. 4-1 Triangle Waveform

The Positive Current Source charges the timing capacitc during the time period T_0 - T causing the voltage on the timing capacitor to increase from T_0 to T lineraly. At time T the Diode Switch disconnects the Positive Current Source from the timing capacitor and connects the Negative Current Source at time T . The voltage on the timing capacitor will now discharge or decrease linearly until time T_2 when the Diode Switch will disconnect the Negative Current Source and connect the Positive Current Source, etc.

Rs_1 and Rs_2, Figure 6-1 are equal in value and determine the positive and negative voltage at the Positive and Negative Current Source. The DUTY potentiometer varies the voltage and thus the current of the Positive or Negative Current Source depending upon the position of the INVERT switch.

By varying the current from one current source and not the other, the timing capacitor will charge and discharge at different rates causing an unsymmetrical triangle waveform (Ramp) Figure 4-2.

Fig. 4-2 Unsymmetrical Triangle (Ramp) Waveform



The RANGE switch selects different timing resistors and timing capacitors which determine the frequency of the generator. A high input impedance BUFFER Q301, U301 A and B is necessary to prevent loading of the timing capacitor at small timing currents. The triangle waveform is connected to the LEVEL DETECTOR U301, C, D, E, Q302 and Q303. The LEVEL DETECTOR switches when the voltage at its input reaches a pre-determined level. The output from the LEVEL DETECTOR causes the CURRENT SOURCE Diode Bridge to switch, disconnecting one current source and connecting the other. By connecting and disconnecting and current sources at the proper level of voltage on the timing capacitor the triangle waveform is produced. The square wave from the LEVEL DETECTOR drives another diode switch producing a symmetrical square wave for use at the OUTPUT AMPLIFIER.

A TTL GATE is also driven by the square wave from the LEVEL DETECTOR. The output of the TTL GATE provides a TTL pulse at the PULSE output connector.

A diode shaping bridge network uses the log curve of silicon diodes to simulate a sinusoidal curve. Figure 4-3

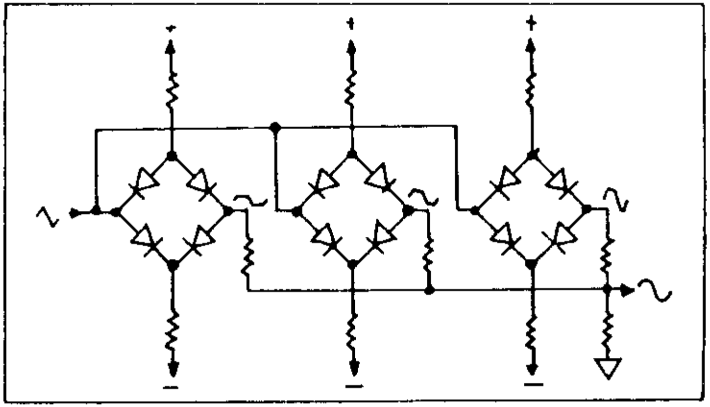


Fig. 4-3 Diode Shaping Bridge

Sine amplifier U401, boosts the amplitude of the sine wave to the proper level for the OUTPUT AMPLIFIER.

A square, triangle or sine wave may be selected by the FUNCTION switch. The desired waveform is connected to the AMPLITUDE potentiometer. OUTPUT AMPLIFIER Q501 thru Q500 is a non inverting amplifier which supplies the necessary output amplitudes of the desired waveforms as selected by the FUNCTION switch and AMPLITUDE control.

CIRCUIT DESCRIPTION (Main Generator)

The power supply shown in the Block Diagram, figure 6-1, consists of a full wave unregulated ±20V supply and a regulated ±15.5V supply.

Note: Unregulated ±20V supply: Refer to the schematic diagram figure 6-3.

Line voltage is applied to transformer T101 through power switch S101. The Power On indicator (D101) is an LED. The LED is connected to the −15.5V DC supply through S101 in the On position.

Jumpers wire provide for line voltages selected of 110, 220 and 240VAC 50-60Hz. NOTE: If it is necessary to change the wiring on the transformer primary to accept other line voltages, refer to section 2 (AC Power Requirements) for the proper procedure. The proper wiring, jumpers and fuse data for different line voltages are indicated on the power supply schematic.

BD101 is a full wave rectifier which converts the line voltage to approximately ±20V DC across filter capacitors C101 to C104.

U101, Q101, and U102, Q102 are dual regulator supply ±15.5V DC

SVR101 and SVR102 are Adjust balances the ±15.5V supplies. This small smount of adjustment (approximately ±1V) helps adjust the waveform symmetry for minimum sine distortion.

Summing Amplifier

U201 is an operational amplifier. Q201 is an emitter follower buffer used in conjunction with the operational amplifier. U201 and Q201 are connected as a summing amplifier with a closed loop gain of−1 (inverting).

The MULTIPLIER, (VR201) supplies a negative voltage to the summing amplifier input (pin 2) through summing resistor R204. The negative voltage of approximately −2V to 0V is inverted by the summing amplifier and appears as +2V to 0V at Q201 emitter.

Main Timing potentiometer SVR201 adjusts the voltage on the MULTIPLIER for frequency calibration. The frequency is dependent upon the voltage of the summing amplifier output. (Q201 emitter).

The frequency may be swept (adjusted) over a three decade range (1000:1) by the MULTIPLIER or by applying the proper AC or DC voltage at the VCF input. With the MULTIPLIER set at 2.0, the voltage at the summing resistor R204 is approximately 2V. By applying approximately +10V DC at the VCF input, approximately +2V is applied at summing resistor R202. The −2V from the MULTIPLIER and the +2V at the VCF input add to provide 0V at the summing amplifier output. This will cause the frequency to decrease approximately three decades or 1000:1. If it is desirable to sweep up in frequency rather than down, set the MULTIPLIER at maximum counter-clockwise (approximately 0V at the summing amplifier output). This will set the frequency approximately three decades below the selected frequency RANGE. By applying approximately 10V at the VCF input, the summing amplifier output will be forced to +2V causing the frequency to increase three decades or to the maximum frequency indicated on the selected frequency RANGE. By setting the MULTIPLIER at the desired start frequency and applying the proper AC or DC voltage at the VCF input, the frequency may be swept as desired over a three-decade range.

NOTE: The maximum frequency and minimum frequency limits on any selected frequency RANGE are between .002 and 2.0 (1000:1) on the MULTIPLIER dial.

Q201 provides a voltage-to-current conversion for driving the positive current source. Q201 converts the voltage at Q201 emitter to a constant current through R214A. Assume DUTY control is in the CAL position. By varying the MULTIPLIER the voltage on R208A varies, causing the current through R214 to vary. The current through R208A and R214A are equal except for a small amount of base current for Q201 and bias current for U202.

Inverter

The INVERTER (U202, Q202) inverts the voltage at the summing amplifier output (Q201 emitter) and appears across R209A which is equal in value to R208A. U202 is an operational amplifier connected for a closed-loop gain of −1 (inverting). The +2V at Q201 emitter is inverted and becomes −2V at conjunction with the operational amplifier U202. The voltage across R209B is equal to the voltage across R208B, therefore: the current through R214B is equal to the current through R214A (assuming VR202 is in the Cal position). Q202, like Q201, provides a voltage-to-current conversion.

Positive and Negative Current Source

The positive and negative current sources provide a constant current for charging and discharging the timing capacitors.

U203 and Q203 form a voltage follower. U203 is an operational amplifier with very low input bias currents necessary to prevent timing current errors. Q203 is an emitter follower providing the voltage-to-current conversion for the current source.

U204 and Q204 perform the same function for the negative current source. Equal voltages appear at the current source inputs and outputs dependent upon the MULTIPLIER setting as previously explained.

Since the current rhough R214A and R214B are equal the voltage at U203 and U204 inputs is equal and opposite in polarity. The voltage appearing at Q203 and Q204 emitters is also equal and opposite in polarity.
The timing current is determined by the voltage across the timing resistors (R216 to R219 and R220 to R223).

The RANGE pushbutton switches select the proper timing resistors and capacitors according to the frequency range selected.

DUTY

S202 INVERT switch and VR202 VAR DUTY control are utilized to obtain pulse and ramp waveforms. When the VAR DUTY control VR202 is in the CAL position. R208A and R208B are both connected to ground in either position of the DUTY switch S202.

As long as R208A and R208B are grounded, the current thus R208A and R028B is equal as previously explained. When the INVERT switch is in the NORM position (out), R208A is grounded directly and R208B is grounded through VR202, the through R214B, R208B, R214A and R208A are equal; therefore the voltages at Q203 and Q204 are equal and opposite in polarity. A triangle waveform is produced across the timing capacitor when the DUTY control is in the CAL position. When VR202 is not set to the CAL position, the resistance from Q202 emitter to ground is variable from 1Kohm to approximately 20K ohms. The voltage at Q202 emitter remains constant determined by the MULTIPLIER setting. This causes the current thus R208B to vary over approximately a 20:1 range, approx. 2ma in the CAL position (1K) and approximately. 1ma in the CW position (20K). Current thus R208A remains constant while current thus R208B is variable. The positive current source voltage remains fixed and the negative current source voltage is variable by the DUTY control. A variable slope ramp waveform is produced in this manner. The slope of the ramp is adjusted as desired over approximately a 20:1 range. When the INVERT switch (S202) is set to the INVERT position, the positive current source becomes variable and the negative current source remains fixed reversing the slopes of the ramp waveform. NOTE: When VR202 is in the CAL position, the position of S202 has no effect because R208A and R208B are both grounded in either position of S202.

Current Source Diode Switch

A diode switch is utilized for connecting and disconnecting the current sources. One output from the level detector sinks the current from either the positive or negative current source When the input to the switching brideg is positive, the level detector sinks the current from the negative current source thru diodes D205 and D206. This positive input signal reverse biases D201 and D202. The positive current source now charges the timing capacitor positive. When the voltage on the timing capacitor reaches approximately +1V, the level detector switches and the diode bridge input switches negative. This negative voltage at the input to the switching bridge sinks the current from the positive current source thru D201 and D202. This negative voltage reverse biases D205 and D206. The negative current source now discharges the timing capacitor. When the voltage on the timing capacitor reaches approximately −1V, the level detector switches and the timing capacitor charges positive again, etc.

Buffer

Q301 and U301A and B form the high input impedance buffer. Q301 is an FET with a very high input impedance. U301B is used as a current source supplying bias current for Q301. The ZERO BAL adjust SVR301 sets the bias current thru the FET (Q301) to the proper level to obtain a gate to source voltage equal to the base emitter drop of U301A. The gate to source voltage of the N-channel FET Q301 is opposite in polarity to that of the emitter follower U301A. The input to output error is adjusted to 0V in this manner The emitter follower output (pin 10) provides the necessary current to drive the level detector and associated circuitry.

Level Detector

The level detector senses the voltage on the timing capacitor from the buffer output and switches the diode switch at the proper level producing the triangle waveform. U301C and D forms a differential amplifier with current source U301E. Q302 and Q303 form a second differential amplifier driven from the input differential amplifier U301C and D. Positive feedback is applied to U301D base the thus the reference switching bridge D304 thus D307. This positive feedback and high open loop gain provide very fast switching times for the level detector. Q302 collector drives the reference switching bridge providing the positive and negative reference current thru R311. When Q302 is on, the collector holds the input to the reference bridge positive. Q302 sinks the current from the ence voltage of approximately +.5V at U301D base. Q302 R311, D304, SVR302 and R312 establishes the positive reference voltage of approximately +.5V at IC301D base. Q302 collector is also connected to the current source switching bridey at D201 and D206 junction. This positive signal allows the timing capacitor to charge in the positive direction as explained in Section 4, (Theory of Operation).

The input to the level detector is a voltage divider consisting of R304 and R305 +1V at R304 input equals approximately +.5V at U301C base. When the voltage at U301C base rises above the reference voltage at U301D (+.5V), the level detector will switch. Q302 will turn off, causing the voltage at the reference bridge (D304 to D307) and the current source switching bridge (D201 to D204 and D205 to D208) to switch negative. This negative voltage will cause the reference voltage at U301D to switch negative and cause the timing capacitor to begin charging negative (discharge). When the timing capacitor has charged to approximately −1V, the signal at U301 C will become more negative than the reference voltage at U301D (now approximately −.5V) and the level detector will switch again etc. Q303 collector supplies the square wave signal to drive the Square Diode Switch and the TTL Gate U302.

TTL Gate

U302 is a Dual 4 Input Positive Nand gate providing the TTL PULSE OUTPUT. D320, D321 and D322 provide the necessary level shifting of the square wave at Q303 collector for driving the TTL GATE inputs (pin 1 and 9). ZD301 is a zener diode providing approximately a +5V power supply for the TTL GATE. The outputs of the two nand gates (pin 6 and 8) are paralled to provide the capability of sinking 20 TTL Gates.
Output levels of the TTL GATE are approximately +3V and 0V open circuit at typically 10ns rise and fall time. The PULSE out is a square wave as long as the DUTY control is in the CAL position. A variable pulse width and variable duty cycle pulse are easily set up utilizing the DUTY control and INVERT switch as shown in Section 2, Table 2-1.

Square Wave Diode Switch

The square wave diode switch D323 to D326 provides a clean square wave of approximately ±1V amplitude from the ±2V signal at Q303 collector. The signal from Q303 collector is routed thru S500C to the diode switch. The diode switch is activated only when the square wave is selected by S502 the FUNCTION switch. The positive signal sinks the current thru D323 and R318. The positive portion of the square wave is developed across the amplitude potentiometer (VR501) thru SVR304, D326 and R317. The negative portion of the square wave is developed across VR501 thru SVR304, D326 and

R318, when the square wave at Q303 collector reverses polarity SVR304 provides a small amount of adjustment for calibration of the square wave amplitude.

Sine Shaper

Three diode bridges are utilized to produce a sine wave from the triangle waveform. D401, D402 and D403 are three matched diode sets of 4 diodes in each set. The triangle waveform from the buffer output is connected to these three diode bridges thru R401. As the triangle voltage rises above 0V, the current thru R404 increases exponentially in the positive direction thru BD401B and R402 while the current thru BD401D and R403 is being shunted thru BD401C as the triangle voltage rises toward its positive peak. When the triangle has reached its positive peak, the current thru R404 to the +15V supply has reached a maximum. The current now decreases exponentially as the triangle rises toward its negative peak. When the triangle has reached approximately 0V, the current thru R404 is nearly zero because an equal current is passing thru BD401D and BD401B. As the triangle increases in the negative direction, current increases thru BD401D and R404 exponentially, as the triangle rises toward its negative peak. Current thru R402 is now being shunted thru BD401A as the triangle rises toward its negative peak. The current thru R404, R407 and R410 increase in the positive and negative direction exponentially thru each of the three bridges in the same manner. The current thru each bridge is determined by the resistors in each bridge. By summing or adding the exponential currents of the three bridges across R412, a sine wave is produced. By proper selection of resistor values in each bridge, a low distortion sine wave of typically <.5% is produced.

Sine Amplifier

U401 is an operational amplifier which boosts the small sine wave at R412 to approximately 2V pp. The operational amplifier is connected as an inverting amplifier with a closed loop gain of approximately −6, SVR401 allows adjustment of the feedback resistor to adjust the sine wave amplitude during calibration. The sine wave is connected to the AMPLITUDE control VR501 when the sine wave is selected by the FUNCTION switch S501.

Output Amplifier

±20V P-P waveforms are produced by the output amplifier. Square wave rise and fall times <100ns are possible with this amplifiers 200V/μsec slew rate. Q501 and Q502 is the input differential amplifier. Feedback for this non-inverting amplifier is thru R507; R507 and R506 form a voltage divider at Q502 (the inverting input) establishing a closed loop gain of approximately 10. Q503 and &504 are two constant current sources driving bias diodes Q507 and Q508. R512, R512 and R514 is a voltage divider providing the bias voltage for Q503 and Q504. R511 sets the current for Q504 a few milliamps less than the current available at Q503 current source. Q502 supplies a current equal to the difference in current between Q503 and Q504 current source. Q505 and Q506 form a complementary output emitter follower. A positive going signal at Q501 base will cuase Q501 collector current to increase and Q502 collector current to decrease. A decrease in curr rent from Q502 causes excess current from Q503 current source to raise the voltage at Q505 and Q506 base Negative feedback from the output emitter followers thru R507 to the base of Q502 maintains an output signal approximately 10 times the input signal. As the input signal becomes negative. Q501 collector current decreases and Q502 collector current increases. As Q502 collector current increases, the current from Q503 collector becomes less than the current from Q504 and the output follows the input negative. Negative feedback maintains the output at approximately 10 times the input signal as previously explained. R519 and R520 provide 50Ω output impedance and short circuit protection for the output.

−20dB Output

R521 to R522 make up the output attenuator switch S502 for the −20dB output.

DISASSEMBLY FOR CALIBRATION

(a) Remove the four retaining screws located on the bottom cover which secure the bottom cover, figure.5-1.
(b) Push up on the four tabs from which the retaining screws were removed to loosen the cover. Lift the bottom cover away from the side bezel, and Pull the cover away from the side bezel.

Access to all calibration adjustments is now possible.

DISASSEMBLY FOR PARTS REPLACEMENT

Remove the top and bottom cover using the same procedure as described under disassembly for calibration. With the top and bottom covers removed, both sides of the printed circuit board are accessable for parts replacement or troubleshooting if either becomes necessary.

REASSEMBLY

The top and bottom covers are reassembled simply by reversing the procedure for disassembly.

CALIBRATION

The calibration procedure is included to maintain the Generator operating within its published specifications if recalibration becomes necessary.

Required Equipment

The equipment required for calibration is listed in table 3-1

Preparation For Calibration

Perform the steps of disassembly for calibration. Section 5 (Disassembly for Calibration).

Apply power to the Generator and allow a minimum of 30 minutes warm up time.

All adjustments are silk screened on the top of the PC boards to aid in locating the proper adjustments. Refer to Fig. 5-2

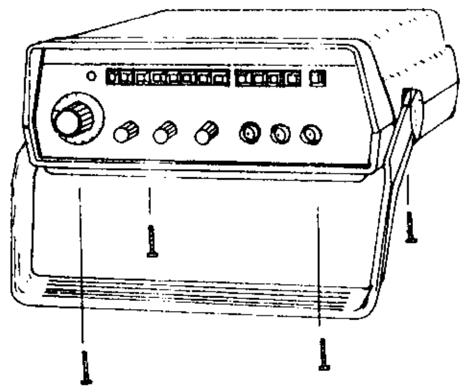


Fig. 5-1 Retaining screw Removal and top cover removal

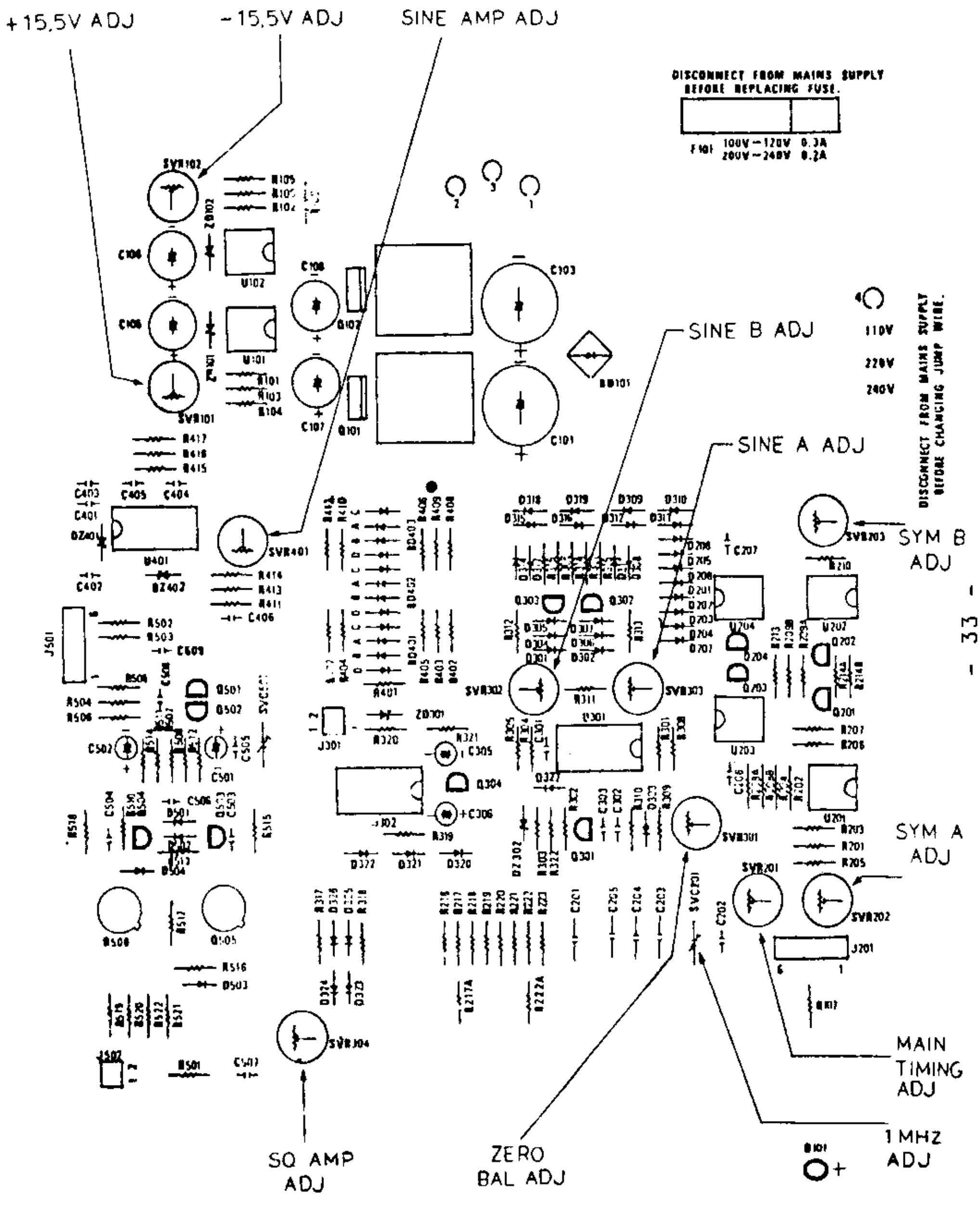


Fig 5-2 Adjustment Locations

Procedure

Set all controls as follows unless otherwise indicated:

POWER	ON
Range-Hz	1K
MULTIPLIER	2.0
INVERT	NORM(OUT)
FUNCTION	∿
DUTY	CAL
DC OFFSET	'0'
AMPLITUDE	MAX(CW)

±15.5V DC Adjust

Adjust the voltage balances SVR101, SVR102 for regulator supply to obtain±15.50V.

Zero Bal

Connect a jumper from the main output ground to the jumper marked SJ (summing junction) on the PC board, figure 5-4. Using a voltmeter, DVM or oscilloscope, adjust the ZERO BAL adjust to obtain 0V ±25mv at U301 pin 10. figure 5-4. Remove the jumper lead and proceed with the next step.

Sine Distortion

Connect a distortion analyzer to the main OUTPUT and monitor the harmonic distortion.

Adjust Sine A, B adjust to obtain minimum sine distortion. Typically <.5%.

1000:1 Symmetry Adjust

Set the MULTIPLIER to the MAX CCW end of rotation. Select the 100KHz RANGE and select the Triangle waveform. Observe the triangle waveform on an oscilloscope connected to the main OUTPUT. Set the horizontal sweep rate of the oscilloscope to 0.5ms cm.

Adjust SYM A and SYM B to obtain one complete symmetrical triangle across the CRT (10cm).

NOTE: 5ms = 200Hz (1000:1)

Main Timing

(a) Connect a frequency counter to the PULSE output and monitor the frequency.

With the MULTIPLIER set at 2.0 and the 1K RANGE selected, adjust the MAIN TIMING to obtain 2KHz ±1%. NOTE: Be sure the DUTY DONTROL is in the CAL position.

(b) Set the MULTIPLIER to .20 and observe 200Hz ±10% on the frequency counter. NOTE: If the frequency at the .2 end of the MULTIPLIER is out of tolerance, or it becomes necessary to re-set the MULTIPLIER knob because of replacement or other reasons: refer to Section 5 (multiplier alignment procedure) for the proper procedure to re-align the MULTIPLIER know with the potentiometer shaft.

(c) Select the 1M RANGE and set the MULTIPLIER to 2.0 Adjust the 2MHz trimmer capacitor to obtain 2MHz ±1%.

Output Amplitude

Select the 1K RANGE. Connect an oscilloscope to the main OUTPUT and observe a Triangle waveform 20V P-P open circuit.

Select the Sine waveform and adjust the SINE AMPLITUDE for 20V P-P amplitude.
Select the Square waveform and adjust the SQ AMP adjust to obtain 20V P-P amplitude.

NOTE: A small amount of DC offset may exist from one waveform to another, the DC OFFSET control allows the DC level of all waveforms to be set as desired.

TROUBLESHOOTING

A troubleshooting chart of symptoms and probable causes is provided, Table 5-1.

The table indicates the circuit most liekly at fault and test points to check for proper operating voltage and waveforms. The paragraph numbers of the theory section describing the circuit operation is also indicated.

NOTE: The data provided in the troubleshooting chart is with the controls set as follows:

POWER	ON
RANGE	1K
MULTIPLIER	2.0
INVERT	NORM(OUT)
FUNCTION	∿
DUTY	CAL(MAX CCW)
DC OFFSETQ	'0'
AMPLITUDE	MAX

Procedure

(a) Determine the exact nature and extent of the problem by performing the SPECIFICATION VERIFICATION PROCEDURE Section 3 and note which instrument operations fail to perform properly.

(b) With power removed, perform the disassembly procedure described in Section 5, (Disassembly for Calibration).

(c) According to the information obtained in step (a) refer to the symptoms of table 5-1 which most nearly describe the problem observed and perform the appropriate troubleshooting operations.

Table 5-1 Troubleshooting Procedure

Symptom	Probable Cause	Circuit	Test Point	Signal	Reference Page No.
No Power On Indication	No Power	Power Supply	+ 20V	+20V ± 5V	24
			− 20V	−20V ± 5V	
			+15V	+15V ± 1V	
			−15V	−15V ±1V	
No Output	Faulty Component	Output Amplifier	Q501 Base	∿ 1VPP	28
			Q503 Emitter	+12.8 VDC	
			Q504 Emitter	−13 VDC	
			Q505 Collector	+14.9 VDC	
			Q506 Collector	−14.9 VDC	

(Continued on Next Page)

Table 5-1 Troubleshooting Procedure (Continued)

Symptom	Probable Cause	Circuit	Test Point	Signal	Reference Page No.
No output Cont'd	Generator Loop Not Running	Current Sources Buffer and Level Detector	Q203 Emitter	+9 VDC	25
			Q204 Emitter.	−9 VDC	
			Q201 Collector	+9 VDC	25
			Q202 Collector	−9 VDC	
			Q201 Emitter	+ 2.2 VDC	
			Q202 Gate SJ	∿ ± 1V	26
			U301A Emitter	∿ ± 1V	
			U 301C & D Collector	+4.35 VDC	27
			U301 C&D Emitter	−.5 VDC	
			Q302, Q203 Emitter	+4.78 VDC	
Output Waveforms Clipped	Excessive DC Offset	Output Amplifier	R502 Slider	OV ± .5VDC	28
			Q502 Base	∿ ±.5V	
			Q501 Base	∿ ± 1V	
	Low Voltage	Power Supply	See Power Supply		

(Continued on Next Page)

Symptom	Probable Cause	Circuit	Test Point	Signal	Reference Page No
No Sine wave, Triangle & Square Ok	Faulty Comp	Sine Amplifier	R417	∿ 2Vpp	28 29
			R412	∿ 150mv pp	
			U401 pin 3 & 4	0V ± 250mv	
			R401	Λ 2Vpp	
	Intermitted Function SW	S501	S501A NO S501A arm	∿ 2Vpp ∿ 2Vpp	28
No Square Wave Triangle & Sine OK	Faulty Component	SO Wave Diode Switch	D325 Cathode	⊓ 4Vpp	
			D326 Cathode	⊓ 2Vpp	
	Intermitted Function SW	S501	501D Arm	⊓ 4Vpp	
			501D N.O.	⊓ 4Vpp	
			501C N.O.	⊓ 2Vpp	
			501C Arm	⊓ 2Vpp	
No Pulse Output	Faulty Comp	Pulse Output	D 320 Cathode	⊓ ±2V	27
			U 302 Pin 1 & 9	⊓ ±1.6V 0V	
			U302 Pin 14	+5V ± .5V	
			U302 pin 6&8	⊓ +3V 0V	

(Continued on Next Page)

MULTIPLIER ALIGNMENT PROCEDURE

If it becomes necessary to re-align the MULTIPLIER knob with the potentiometer shaft for any reason, perform the following procedure.
Set the front panel controls as follows:

POWER	ON
RANGE	10K
VAR DUTY	CAL
DC OFFSET	'0'

(a) Connect a frequency counter to the PULSE output and monitor the frequency.

(b) Remove the knob cover and loosen the one nut in the MULTIPLIER knob and dial skirt assembly from the MULTIPLIER potentiometer shaft. Figure 5-3.

(c) Rotate the potentiometer shaft CCW until a frequency of 2KHz ±1% is obtained.

(d) Place the MULTIPLIER knob and dial skirt on the shaft with 2.0 on the dial skirt directly in line with the index mark on the front panel. Figure 5-4.

(e) Tighten one nut while holding the dial skirt in alignment with the index mark. NOTE: Be sure the frequency counter reads 2KHz ±1% before tightening the nut.

(f) Set the MULTIPLIER to 2.0 and adjust the MAIN TIMING to obtain 2KHz ±1% if necessary.

(g) In some cases if may be necessary to repeat steps (b) thru (f) until both ends of the MULTIPLIER dial read correctly.

(h) Tighten the remaining set nut and press the knob cover to complete the MULTIPLIER alignment procedure.

Fig. 5-3 Removal of Multiplier Knob

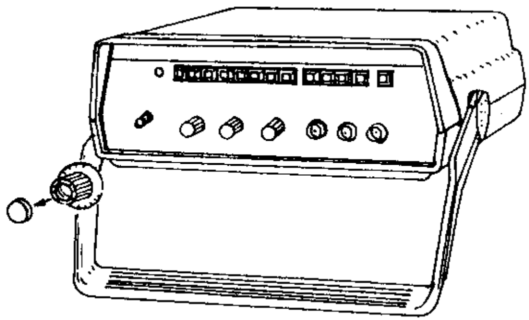
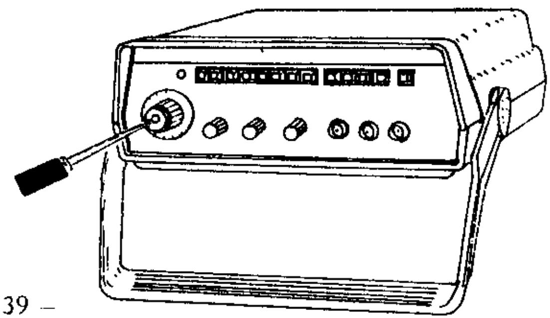


Fig. 5-4 Alignment of Multiplier Knob



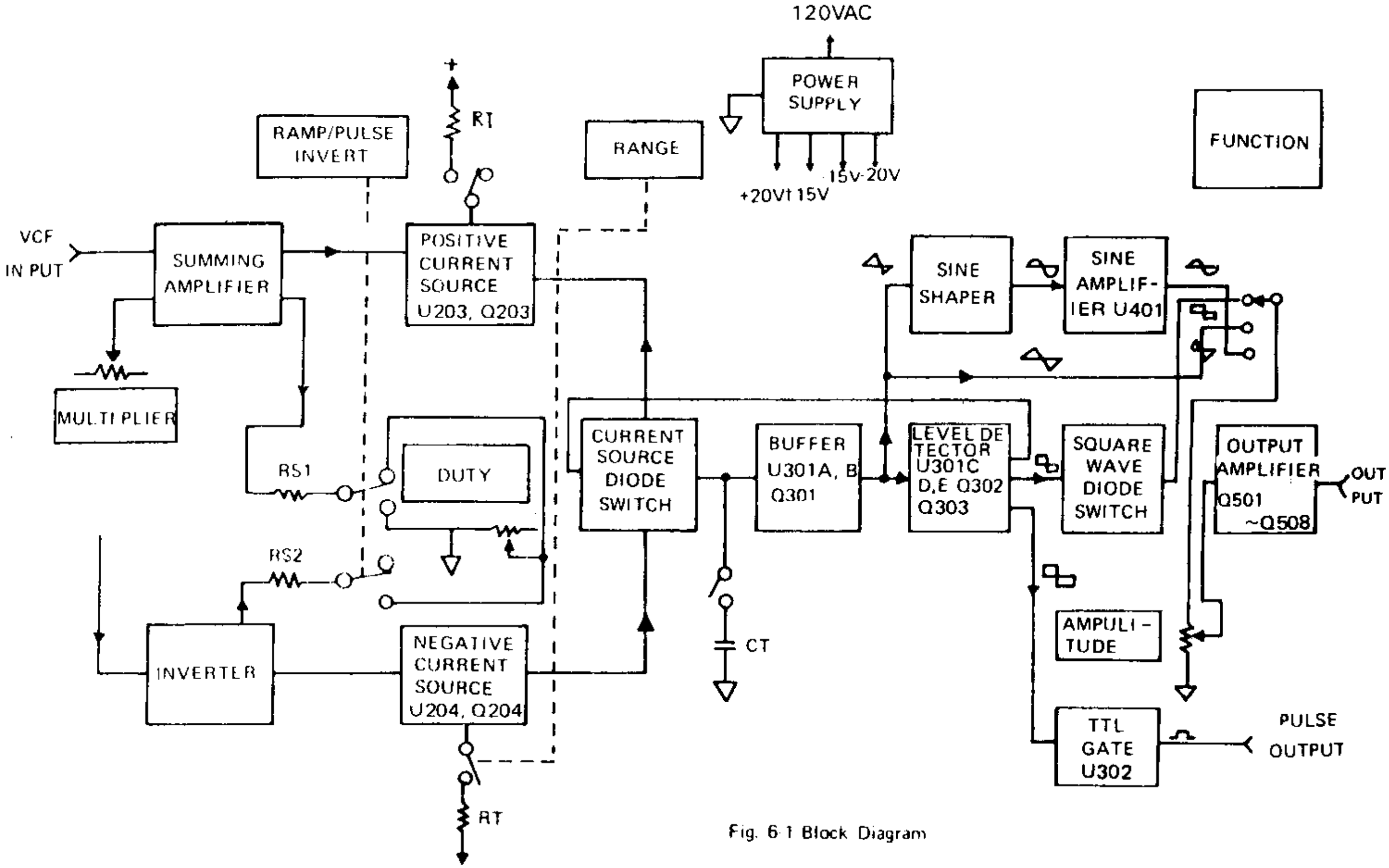
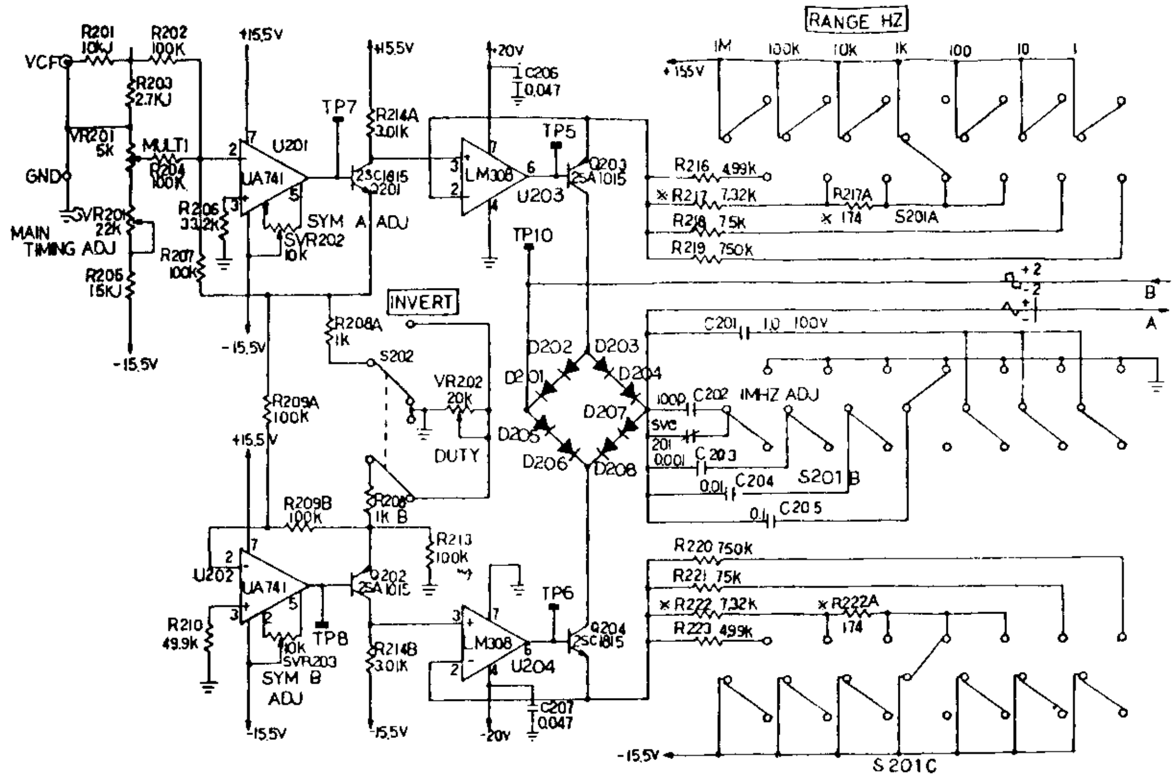


Fig. 6-1 Block Diagram

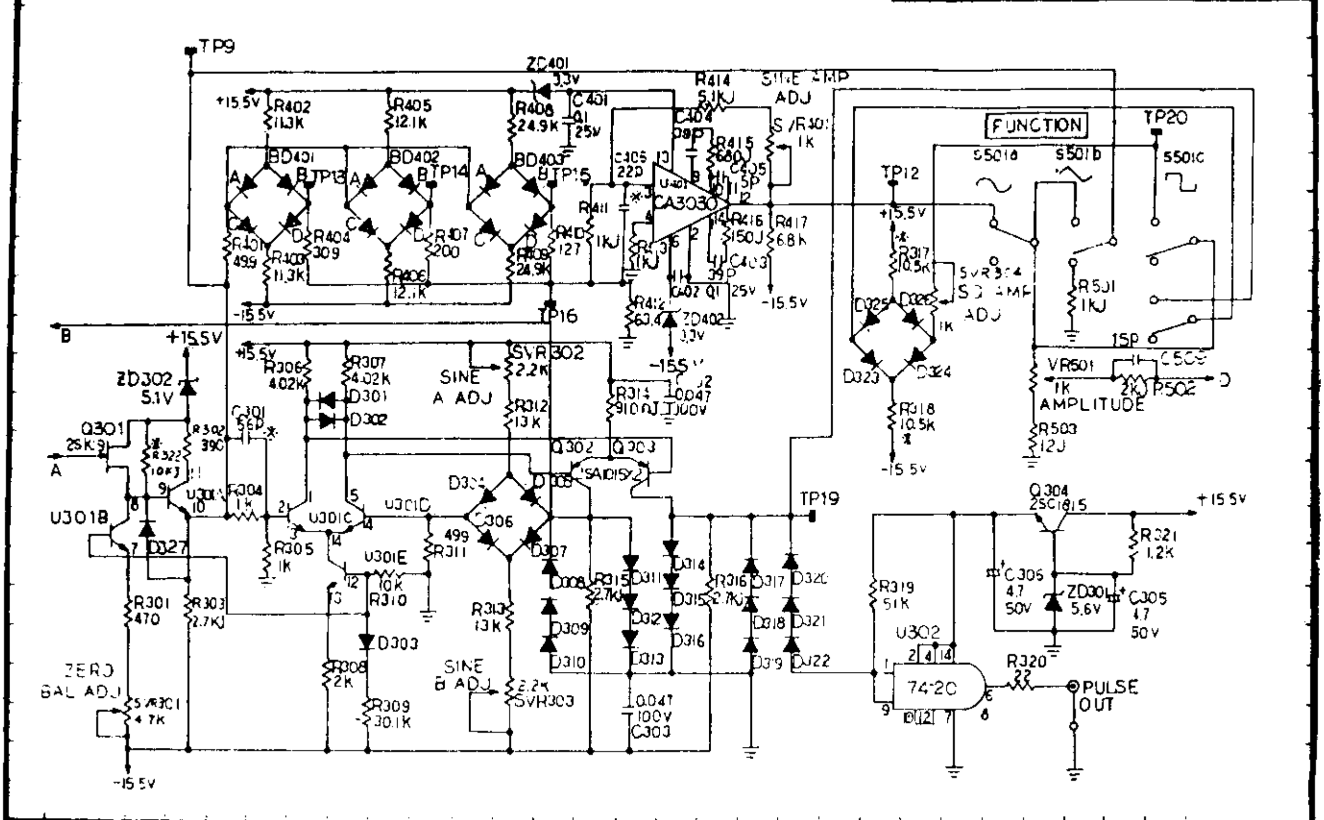
CIRCUIT DIAGRAM



1 ※ ADJUSTED IN FACTORY
2 CIRCUITRY ARE SUBJECT TO CHANGE WITHOUT NOTICE FOR FUTHER IMPROVEMENT
3 RESISTANCE VALUES IN Ω ¼ WATT AND CAPACITANCE IN μF UNLESS OTHERWISE SPECIFIED

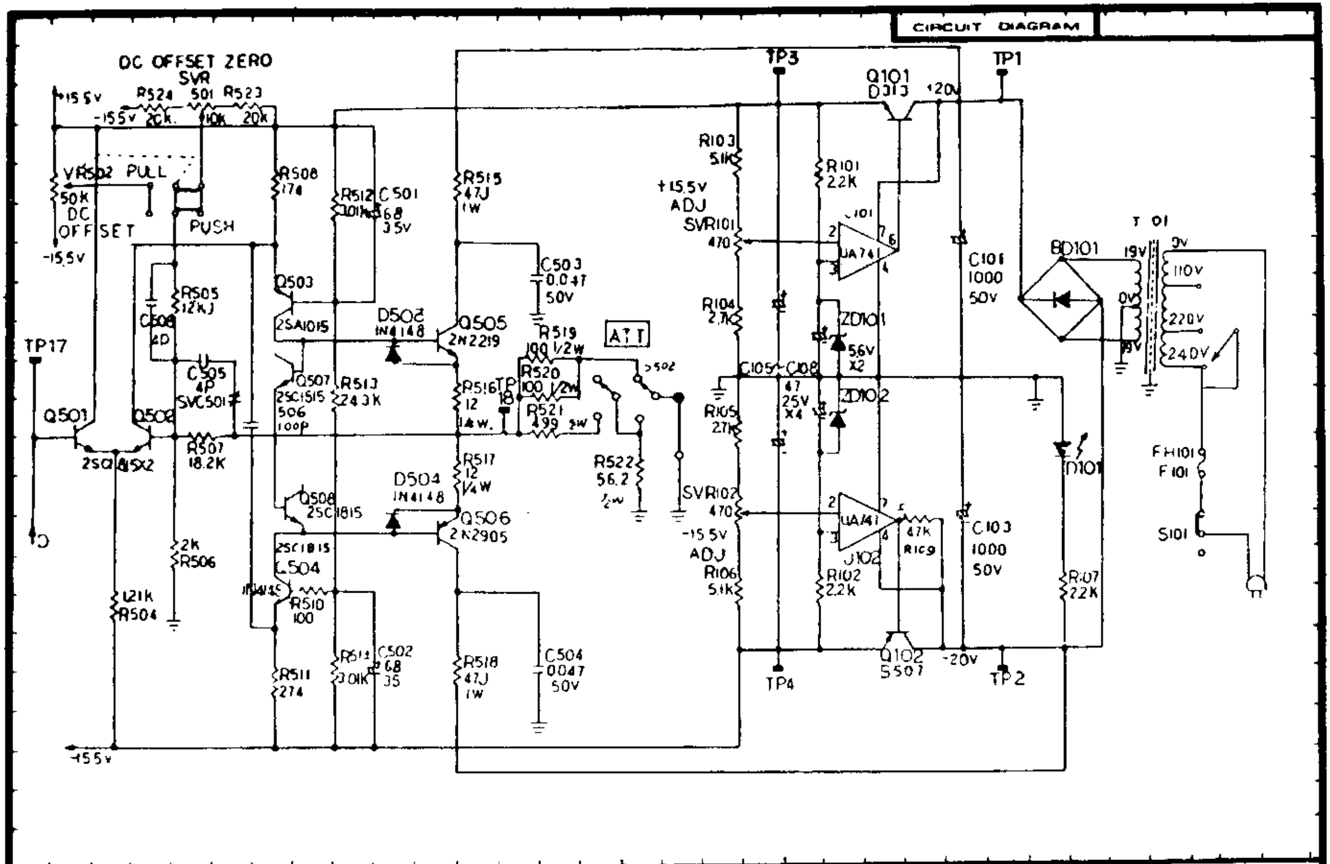
DRAWN BY	CHECKED BY	APPROVED BY	NAME	
			DESCRIPTION	FUNCTION GENERATOR
			DRAWING NO	

CIRCUIT DIAGRAM



1 ✱ ADJUSTED IN FACTORY
2 CIRCUITRY ARE SUBJECT TO CHANGE WITHOUT NOTICE FOR FUTHER IMPROVEMENT
3 RESISTANCE VALUES IN Ω ¼ WATT AND CAPACITANCE IN µF UNLESS OTHERWISE SPECIFIED

DRAWN BY	CHECKED BY	APPROVED BY	NAME	
			DESCRIPTION	FUNCTION GENERATOR
			DRAWING NO	



1 ● ADJUSTED IN FACTORY
2 CIRCUITRY ARE SUBJECT TO CHANGE WITHOUT NOTICE FOR FUTHER IMPROVEMENT
3 RESISTANCE VALUES IN Ω ½ WATT AND CAPACITANCE IN μF UNLESS OTHERWISE SPECIFIED

DRAWN BY	CHECKED BY	APPROVED BY	NAME	
			DESCRIPTION	Function Generator
			DRAWING NO	

MAINTENANCE

The following instructuions are use for by qualified only. To avoid electrical shock, do not perform any servicing other than contained in the operating instructions unless you are qualified to do so.

1. FUSE Replacement:
   If the fuse bolws, the FUNCTION GENERATOR will not operate. Try to determine and correct the cause of the blown fuse, then replace only with a fuse of the correct rating and type, as shown below.

MODEL	FUSE Rating and Type		Rating Input	
	100V-120V	220V-230V	Watts	VA
GFG-8015G	T 0.315A 250V	T 0.2A 250V	11	16

2. Cleaning:
   To keep the instrument clean, wipe the case with a damp cloth and detergent. Do not use abrasives or solvents.

FOR UNITED KINGDOM ONLY

NOTE

This lead/appliance must only Be wired by competent persons

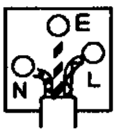
WARNING

THIS APPLIANCE MUST BE EARTHED

IMPORTANT

The wires in this lead are coloured in accordance with the following code:

Green/ Yellow: Earth
Blue: Neutral
Brown: Live(Phase)



As the colours of the wires in main leads may not correspond with the colours marking identified in your plug/ appliance, proceed as follows:

The wire which is coloured Green & Yellow must be connected to the Earth terminal marked with the letter E or by the earth symbol ⏚ or coloured Green or Green & Yellow.

The wire which is coloured Blue must be connected to the terminal which is marked with the letter N or coloured Blue or Black.

The wire which is coloured Brown must be connected to the terminal marked with the letter L or P or coloured Brown or Red.

If in doubt, consult the instructions provided with the equipment or contact the supplier.

This cable/appliance should be protected by a suitably rated and approved HBC mains fuse :refer to the rating information on the equipment and/or user instructions for details.

As a guide, cable of $0.75mm^2$ should be protected by a 3A or 5A fuse. Large conductors would normally require 13A types, depending on the connection method used.

Any moulded mains connector that requires removal/replacement must be destroyed by removal of any fuse & fuse carrier and disposed immediately, as a plug with bared wires is hazardous if a engaged in live socket.

Any re-wiring must be carried out in accordance with the information detailed on this label

EC Declaration of Conformity

We

GOOD WILL INSTRUMENT CO., LTD.
(1) NO.7-1, Jhongsing Road, Tucheng City, Taipei County 236, Taiwan
(2) NO.69,Lu Shan Rd.,New District,Suzhou City,P.R.C.
declare under sole responsibility that

GFG-8015G

Are herewith confirmed to comply with the requirements set out in the Council Directive on the Approximation of the Law of Member States relating to Electromagnetic Compatibility (89/336/EEC,92/31/EEC, 93/68/EEC) and Low Voltage Equipment Directive (73/23/EEC).

For the evaluation regarding the Electromagnetic Compatibility and Low Voltage Equipment Directive,the following standards were applied:

EN 61326-1:Electrical equipment for measurement,control and laboratory use-EMC requirements (1997+A1:1998)					
Conducted Emission	EN 55022 class B (1994)		Electrostatic Discharge	IEC 1000-4-2	(1995)
Radiated Emission	EN 55011 class B (1991)		Radiated Immunity	EN 61000-4-3	(1996)
Current Harmonics	EN 61000-3-2	(1996)	Electrical Fast Transients	IEC 1000-4-4	(1995)
Voltage Fluctuations	EN 61000-3-3	(1995)	Surge Immunity	IEC 1000-4-5	(1995)
			Conducted Susceptibility	EN 61000-4-6	(1996)
			Power Frequency Magnetic field	EN 61000-4-8	(1993)
			Voltage Dip/Interruption	EN 61000-4-11	(1994)

Low Voltage Equipment Directive 73/23/EEC	
Low Voltage Directive	EN 61010-1:1993