

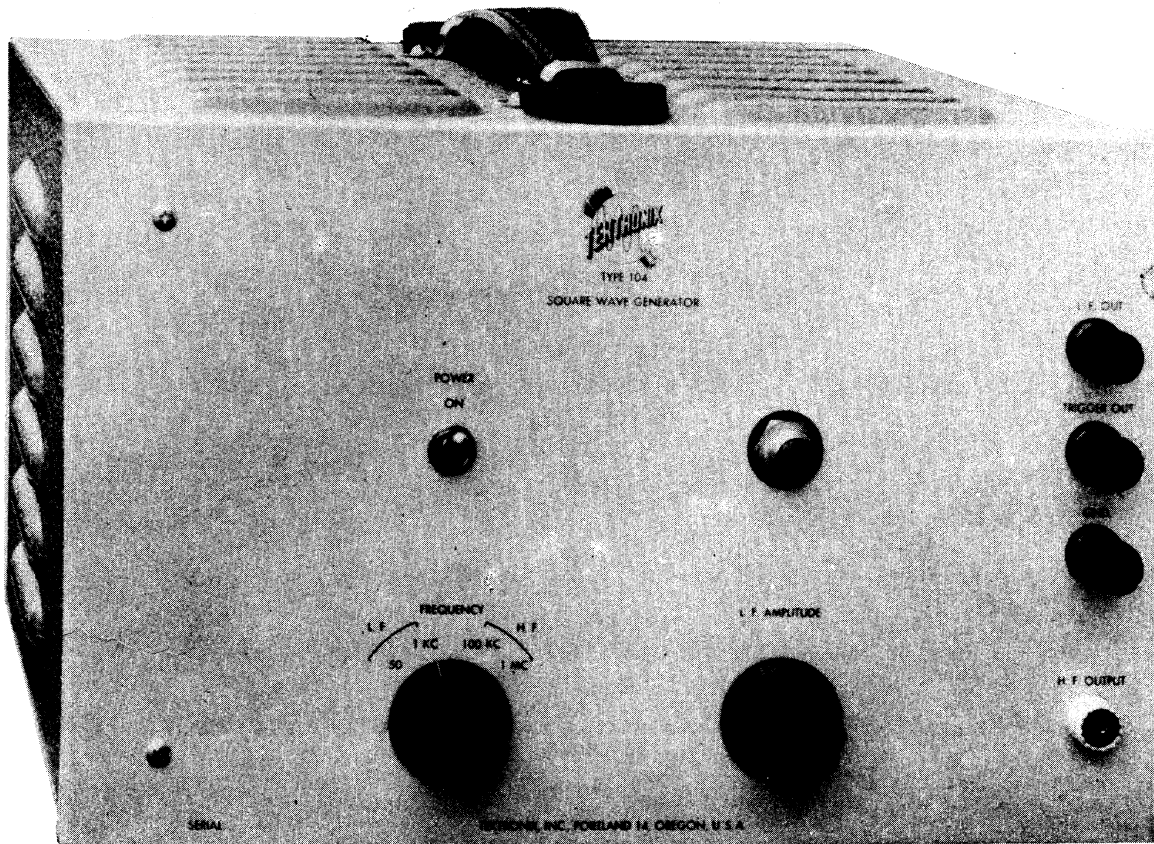


TEKTRONIX, INC.

712 SOUTHEAST HAWTHORNE BOULEVARD, PORTLAND 14, OREGON, U.S.A.

TEKTRONIX

TYPE 104
SQUARE WAVE GENERATOR



Manufacturers of Cathode-Ray and Video Test Instruments

712 S.E. Hawthorne Blvd. Portland 14, Oregon - EAst 6197 - Cables: Tektronix

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GENERAL DESCRIPTION

The Tektronix Type 104 Square Wave Generator is a compact, portable instrument, providing precision square waves at four frequencies. It is well adapted to production testing and general laboratory use.

CHARACTERISTICS

Frequencies: Four fixed; 50 cycles, 1 kc., 100 kc., 1 mc.

Rise Time: For 10% to 90% of peak amplitude—

Low Frequencies—less than 3 microseconds.

High Frequencies—less than .015 microseconds.

Amplitude:

Low Frequencies—continuously variable 0 to 50 volts.

High Frequencies—continuously variable 0 to 5 volts.

Output Impedance:

Low Frequencies—0 to 20,000 ohms.

High Frequencies—0 to 93 ohms, depending on attenuator settings.

Trigger Output: Approximately 2.5 volts, all frequencies.

Power Input: 105-125 or 210-250 volts 50-60 cycles. 115 watts at 117 or 234 volts.

OPERATING INSTRUCTIONS

Connect the Type 104 to a 105-125 or 210-250 volt, 50-60 cycle supply, using the cord supplied. **CAUTION! Do not operate on 210-250 volts before reading the adjustment and maintenance section of this manual.**

The two lower frequency signals are available at the binding post marked "Low Frequency Output". While it is intended that ordinary test leads be used for these two signals, their length should be kept as short as possible in order not to alter the wave shape because of the relatively short rise time. Since a shielded lead will affect the rise time, its use should be avoided.

Due to the much faster rise time of the two higher frequency signals, a matched coaxial cable is provided for their output. The cable supplied (RG62U) is of 93 ohms characteristic impedance and is terminated by a 93 ohm potentiometer, which is the high frequency attenuator as well as the plate load for the 6AG7 output amplifier. The attenuator end of this cable will plug in directly to the input connection of both the Tektronix Type 511-A and 512 Oscilloscopes. A special adapter is required for use with the early Tektronix Type 511 Oscilloscopes and will be supplied upon request from the factory. An adapter is furnished employing two quite short clip leads to provide connection of the Type 104 to equipment not having the proper fittings. In case additional length is required on these clip leads, care should be taken to keep their length to a minimum, as additional lead length at this point will introduce serious distortion in the wave shape, depending upon the bandwidth of the amplifier being tested.

If the high frequency output cable is removed and a single wire substituted with no external attenuator, an output of approximately 125 volts is available with rather poor rise time characteristic because of the circuit ca-

capacity's effect on the relatively high impedance left in the plate circuit. Since the output amplitude will vary in direct proportion to the effective load resistance from zero for zero resistance up to 125 volts for an infinite external resistance, the optimum compromise between output amplitude and rapid rise time may be selected for any given application by choice of the right external load. With relatively short leads and an external load resistance which is small compared to the 2470 ohm internal load resistance but larger than the 93 ohm attenuator, a quite usable output signal is available with higher amplitude.

CIRCUIT DESCRIPTION

HIGH FREQUENCY CIRCUITS

The high frequency square waves are generated by a multivibrator using two 6AG7 tubes, V1 and V2. Variable condensers C1 and C2 permit balancing the duration of the positive and negative portions of the output. Frequency in the 1 mc. position is controlled by varying potentiometer R5. Series resistors R23 and R24, in conjunction with potentiometer R6, provide the proper frequency range in the 100 kc. position.

The multivibrator output is taken from the cathode of V2 and applied to the grid of the 6AG7 limiter, V3, via a parasitic suppressor, R26. The signal at this point is a square wave with a "spike" on the top of its leading edge. Its amplitude is sufficient to reduce the plate current of V3 to cut-off well before maximum negative grid swing is reached, thus producing a waveform at the plate which is similar except amplified, inverted and having a flat top.

This signal is impressed on the grid of the 6AG7 output amplifier V4, and appears at the plate as a clean square wave, the top being at plate current cut-off, and the bottom an inverted replica of the flat top of the grid waveform.

A potentiometer shunted to 93 ohms, R45, is used as output load resistor and attenuator.

Short rise time is obtained by the use of small load resistors, thus requiring relatively large plate currents in all the 6AG7 tubes. Shunt compensation by means of L15 permits a sufficiently large load resistor to be used in the plate of V3 so that enough output is available to swing the grid of V4 from full conduction to cut-off.

To provide a synchronizing signal, a portion of the high frequency output is fed to one grid of the 6J6 cathode follower V5. This circuit isolates the trigger output connection.

LOW FREQUENCY CIRCUITS

The low frequencies are generated by a separate multivibrator using a type 12AU7 tube, V6. In the 1 kc. position, frequency is controlled by varying potentiometer R63. R61 and R62, in conjunction with potentiometer R64, control the 50 cycle frequency. Compromise balance between 1 kc. and 50 cycle operation is obtained by proper choice of R49.

The multivibrator output is fed to the grid of the output cathode follower, one section of V7, (12AU7), via C21 and R65. A divider, R51 and R66, maintains the signal at proper operating level for the diode connected limiter section of V7. Maximum positive amplitude is determined by the divider R67 and R68. The output is square, as the top is limited by the diode and the bottom at ground by current cut-off in the cathode follower.

A synchronizing trigger signal is obtained from the divider R69 and R70 and applied to the cathode follower, V5.

POWER SUPPLY

Rectified current for the 200 volt supply is provided by V8, a 5V4G.

An electronic regulator is employed to eliminate the effects of load changes, and line voltage fluctuations over the range of 105 to 125 volts. This circuit reduces 120 cycle ripple to below .1 volt.

The cathode of V10, (6AU6) is maintained at a fixed voltage by V11, (VR105) reference tube. Any fluctuations in the 200 volt supply are impressed on the grid of V10, amplified, and applied to the grid of V9, (6Y6G) series regulator. This varies the plate resistance of V9, stabilizing the 200 volt supply.

Additional current required for high frequency operation is supplied by a shunt resistor, R71.

ADJUSTMENTS AND MAINTENANCE

200 VOLT REGULATED SUPPLY:

Connect an accurate voltmeter to the cathode (pin 8) of V9, (6Y6G) and adjust potentiometer R88 for 200 volts. This reading should remain nearly constant at line voltages of 105 to 125.

FREQUENCY

Adjustment of frequency is accomplished by observing the output waveform of the Type 104 on an accurately calibrated oscilloscope, such as the Tektronix Type 511-A or Type 512, and adjusting R5, R6, R63 and R64 until proper frequencies are indicated on the oscilloscope. As this adjustment does not affect rise time, it is not critical for most square wave applications. If the range of high frequency adjustment is not adequate, it may be changed by varying C1 and C2.

HIGH FREQUENCY BALANCE

Set the frequency selector at 1 mc. and adjust C1 and C2 until the positive and negative portions of the output observed on the oscilloscope are equal in duration. A setting between 2/3 and maximum capacity is recommended. Replace V1 and/or V2 if balance cannot be obtained within this range. The balance at 100 kc. should now be substantially correct. A compromise setting of C1 and C2 for 1 mc. and 100 kc. may be desirable.

HIGH FREQUENCY COMPENSATION

L15 is factory adjusted for best waveform and should not require resetting. Adjustment in the field is not recommended, as oscilloscopes with sufficiently good transient response are not generally available.

OPERATION ON 210-250 VOLT 50-60 CYCLE LINE

The Type 104 power transformer is wound with two 117 volt primaries. These windings are ordinarily connected in parallel at the factory for 117 volt operation. If 234 volt operation is desired, remove the jumpers connecting terminals 1 to 2 and 3 to 4. Connect terminal 2 directly to terminal 3. With the line still connected to terminals 1 and 4, the instrument is now ready for 234 volt operation.

TEKTRONIX TYPE 104 SQUARE WAVE

GENERATOR — PARTS LIST

ABBREVIATIONS

Cer.—Ceramic	PM—Paper, Molded
Comp.—Composition	PMC—Paper, Metal Cased
EBT—Electrolytic, Bathtub	PT—Paper, Tubular
EMC—Electrolytic, Metal Cased	Prec.—Precision
PBT—Paper, Bathtub	Var.—Variable
	WW—Wire Wound

CONDENSERS

				WVDC
C1	Var.	Cer.	7-45 mmf.	500
C2	Var.	Cer.	7-45 mmf.	500
C3a, b	Fixed	EMC	2x20 mf. —20%+50%	450
C5	Fixed	PT	.01 mf. —20%+50%	400
C6	Fixed	PMC	.025 mf. —20%+50%	400
C7	Fixed	PT	.01 mf. —20%+50%	400
C8	Fixed	PT	.1 mf. —20%+50%	400
C9	Fixed	PT	.5 mf. —20%+50%	400
C19	Fixed	Mica	.001 mf. —10%+10%	500
C20	Fixed	Mica	.001 mf. —10%+10%	500
C21	Fixed	PT	.1 mf. —20%+50%	400
C22	Fixed	PBT	1 mf. —20%+50%	400
C23	Fixed	EMC	40 mf. —20%+50%	450
C24	Fixed	PT	.01 mf. —20%+50%	400
C25	Fixed	PT	.01 mf. —20%+50%	400

SWITCHES

S1	SPST ON-OFF	3A	125 v.	toggle
S2a,b,c,d,e,f	6P4T		frequency selector,	rotary

FUSE

4AG	2 amp.	250 volt
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RESISTORS

R1	Fixed	Comp.	2 w.	27 k	±10%
R2	Fixed	Comp.	2 w.	680	±10%
R3	Fixed	Comp.	2 w.	680	±10%
R4	Fixed	Comp.	1 w.	330	±10%
R5	Var.	Comp.	1 w.	50 k	±20%
R6	Var.	Comp.	1 w.	50 k	±20%
R7	Fixed	Comp.	2 w.	10 k	±10%
R8	Fixed	Comp.	2 w.	680	±10%
R9	Fixed	Comp.	2 w.	680	±10%
R21	Fixed	Comp.	½ w.	22 k	±10%
R22	Fixed	Comp.	½ w.	22 k	±10%
R23	Fixed	Comp.	½ w.	330 k	±10%
R24	Fixed	Comp.	½ w.	330 k	±10%
R25	Fixed	Comp.	1 w.	330	±10%
R26	Fixed	Comp.	½ w.	47	±10%
R27	Fixed	Comp.	½ w.	220	±10%
R28	Fixed	Comp.	1 w.	470	±10%

R29	Fixed	Comp.	2 w.	10 k	±10%
R30	Fixed	Comp.	½ w.	470 k	±10%
R39	Fixed	Comp.	½ w.	22 meg.	±10%
R40	Fixed	Comp.	2 w.	4.7 k	±10%
R41	Fixed	WW	10 w.	2 k.	±10%
R42	Fixed	Comp.	2 w.	470	±10%
R43	Fixed	Comp.	½ w.	1 meg.	±10%
R44	Fixed	Comp.	1 w.	2.2 k	±10%
R45	Var.	Comp.	1 w.	93	±5%
R46	Fixed	Comp.	1 w.	100 k	±10%
R47	Fixed	Comp.	2 w.	22 k	±10%
R48	Fixed	Comp.	½ w.	470 k	±10%
R49	Fixed	Comp.	½ w.	330 k	±10%
R50	Fixed	Comp.	½ w.	220 k	±10%
R51	Fixed	Comp.	½ w.	2.2 meg.	±10%
R61	Fixed	Comp.	½ w.	5.6 meg.	±10%
R62	Fixed	Comp.	½ w.	5.6 meg.	±10%
R63	Var.	Comp.	1 w.	50 k	±20%
R64	Var.	Comp.	1 w.	50 k	±20%
R65	Fixed	Comp.	½ w.	220 k	±10%
R66	Fixed	Comp.	½ w.	1.5 meg.	±10%
R67	Fixed	Comp.	1 w.	56 k	±10%
R68	Fixed	Comp.	½ w.	18 k	±10%
R69	Fixed	Comp.	½ w.	100 k	±10%
R70	Fixed	Comp.	½ w.	18 k	±10%
R71	Fixed	WW	25 w.	1.5 k	±5%
R81	Var.	Comp.	1 w.	20 k	±20%
R82	Fixed	Comp.	½ w.	47	±10%
R83	Fixed	Comp.	½ w.	1 meg.	±10%
R84	Fixed	Comp.	1 w.	6.8 k	±10%
R85	Fixed	Comp.	½ w.	680 k	±10%
R86	Fixed	Comp.	1 w.	6.8 k	±10%
R87	Fixed	Comp.	½ w.	220 k	±10%
R88	Var.	Comp.	1 w.	500 k	±20%
R89	Fixed	Comp.	½ w.	680 k	±10%

INDUCTORS

L15	Var.	H.F. Compensating	.1-15 microhenries
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TRANSFORMERS

T1	Primary	117-234 volt, 50-60 cycle
	Secondaries	275-0-275 volt, 135 ma.
		5 volt 3A. insulated for 350 volts
		6.3 volt 1.25A. insulated for 200 volts
		6.3 volt 4A.

TUBE COMPLEMENT

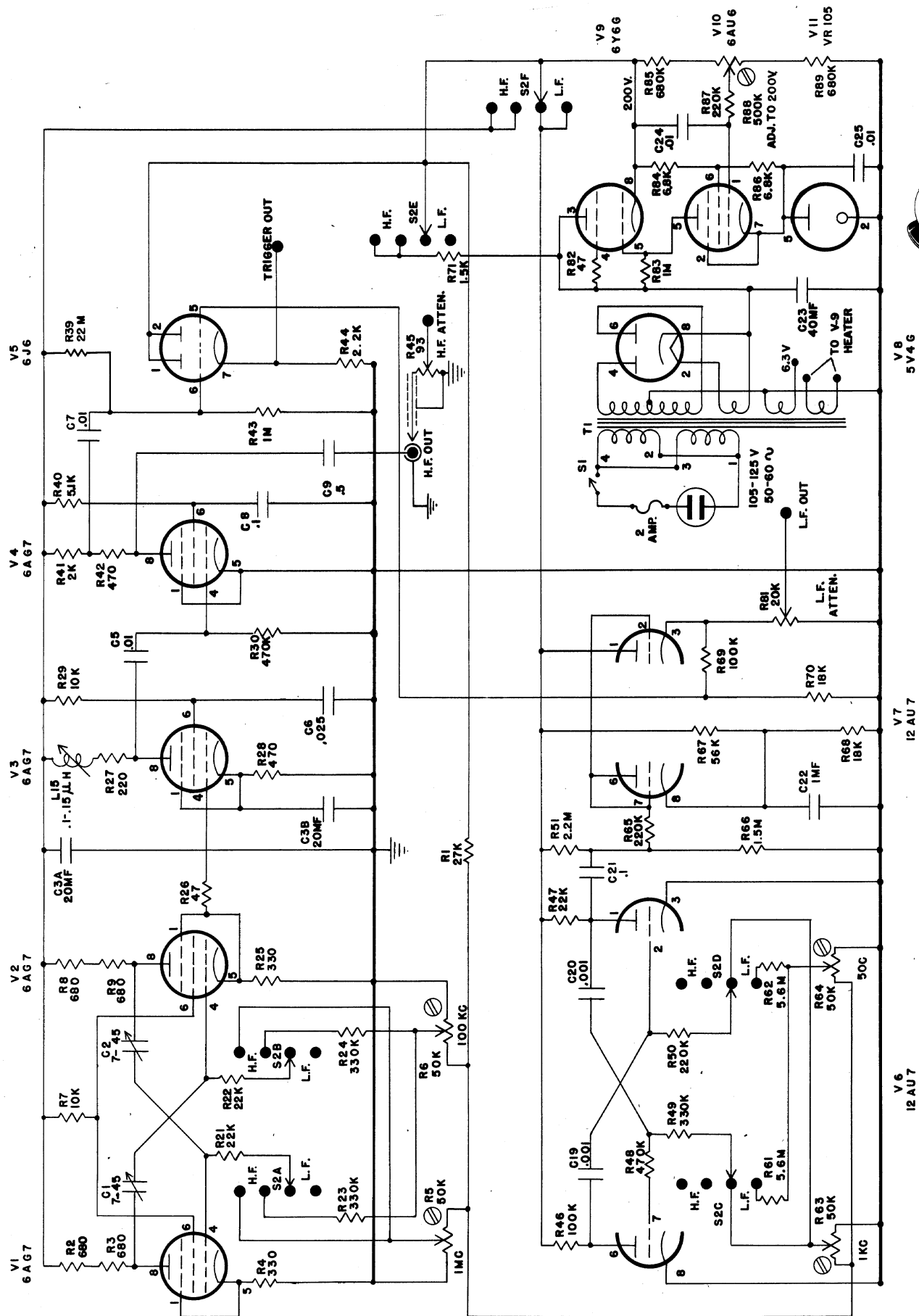
V1	6AG7	H.F. Multivibrator
V2	6AG7	H.F. Multivibrator
V3	6AG7	H.F. Limiter
V4	6AG7	H.F. Output Amplifier
V5	6J6	Trigger Out. Cathode Follower
V6	12AU7	L.F. Multivibrator
V7	12AU7	L.F. Limiter and Cathode Follower
V8	5V4G	Power Supply Rectifier
V9	6Y6G	Series Regulator
V10	6AU6	Regulator Amplifier
V11	VR105	Voltage Reference

WARRANTY

This instrument is guaranteed to the original user to be free from defects in material and workmanship for a period of one year from date of purchase. Our responsibility under this warranty is limited to the repair or replacement of the instrument, or any part thereof, failure of which is not due to abuse. For warranty service, the instrument should be sent to the factory, with transportation charges prepaid, together with all details regarding the failure in operation. If the instrument is defective under the terms of this warranty, the faults will be corrected at no charge and returned to the owner. If, however, the fault is found to be due to misuse, the owner will be billed at cost for repairing and return shipping charges.

IMPORTANT

If necessary to write to the factory regarding this instrument, PLEASE MENTION SERIAL NUMBER.



TYPE 104 SQUARE WAVE GENERATOR

CONDENSER VALUES LESS THAN 1 ARE MF.
VALUES 1 AND GREATER ARE MMF, UNLESS
OTHERWISE MARKED.



