

**TENMA<sup>®</sup>**

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**TENMA<sup>®</sup>**  
**TEST EQUIPMENT**  
405 Pioneer Blvd.  
Springboro, Ohio 45066

**72-6858**  
*2MHz FUNCTION GENERATOR WITH COUNTER*

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**INSTRUCTION MANUAL**

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## Introduction

This function generator is a general purpose signal source capable of producing sine, square, triangle and TTL waveforms between 0.2Hz and 2MHz, with an amplitude of up to 20V p-p. The switched attenuator and rotary amplitude control allows control of the output amplitude down to mV levels. Frequency control is by seven switched decade ranges and a 10:1 rotary vernier with frequency setting shown on a 4 digit LED display. Versatility is enhanced by the provision of separate 50Ω and 600Ω outputs, a fully variable ±10V offset control with centre off position, a variable symmetry control and an external sweep input.

The generator utilises a microprocessor based reciprocal frequency counter that gives a 4-digit display, with the measurement being updated approximately every 1s. This avoids the need for long gate times or period measurements. Constant resolution is also obtained, independent of the input frequency. An external frequency input is also provided for other frequency measurements, still enabling the signal generator to function as normal.

## Specification

### FREQUENCY

Frequency Range:	0.2Hz to 2MHz in 7 overlapping decade ranges with fine adjustment by a vernier.
Vernier Range:	>10:1 on each range.
Frequency Accuracy:	<± 0.1% of reading.

### FREQUENCY COUNTER

Frequency Range:	5Hz to 20MHz
Measurement Type:	Reciprocal, single cycle and multiple period average
Gate:	Automatic, 1s or 1 period whichever is greater
Accuracy:	± 0.01% ±1 count
Stability:	± 50ppm -10°C to +50°C
Resolution:	4 digits
Annunciators:	mHz, Hz, kHz, MHz
Display:	4 digit, 7 segment, 0.56" LED
Sensitivity:	25mV to 10MHz, 50mV to 20MHz, AC rms sinewave.
Input Impedance:	1MΩ//30pF, AC coupled; -3dB @ 5Hz
Maximum Allowable Input Voltage:	50VDC/50Vrms to 400Hz with respect to  , reducing to 1Vrms above 1MHz. Note, however, that the input will withstand an accidental short-term connection to a 50/60Hz line voltage not exceeding 250Vrms.

### SWEEP MODE (EXTERNAL)

Sweep Range:	>1000:1 1k, 10k, 100k and 1M ranges. >100:1 100Hz range. >20:1 10Hz and 1Hz ranges
Input Impedance:	9kΩ
Input Sensitivity:	10:1 sweep ~ 17.1Vpp 100:1 sweep ~ 18.8Vpp 1000:1 sweep ~ 19.0Vpp
Maximum Allowable Input Voltage:	± 20V
Maximum Slew Rate of Sweep Voltage:	0.1V/us

## OPERATING MODES

(Specifications apply for the top decade of each frequency range and output 10V peak-to-peak into 50Ω termination).

### Sine

Distortion:	<1% 0.2Hz to 200kHz; all harmonics >30dB below fundamental 200kHz to 2MHz.
Amplitude Flatness:	± 0.2dB to 200kHz; ± 2dB to 2MHz.

### Triangle

Linearity:	Typically 99% to 200kHz.
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### Squarewave

Rise and Fall Times:	<80ns
Mark/Space Ratio:	1:1 ± 1% to 200kHz.

### DC

Range:	±10V from 50Ω
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### Symmetry

Symmetry Range:	Typically variable from 1:8 to 8:1.
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## OUTPUTS

### 50Ω Main Out

Three switch-selectable ranges with >30dB vernier control within each attenuator range.

0dB Range:	<0.6V to 20V peak-to-peak from 50Ω (0.3V to 10V into 50Ω).
-20dB Range:	<60mV to 2V peak-to-peak (30mV to 1V into 50Ω)
-40dB Range:	<6mV to 0.2V peak-to-peak (3mV to 0.1V into 50Ω)
DC Offset Control Range:	±10V from 50Ω. DC offset plus signal peak limited to ±10V (± 5V into 50Ω). DC offset plus waveform attenuated proportionally in -20dB and -40dB position.

### 600Ω Main Out

Alternative output socket providing the same signal as the 50Ω MAIN OUT but from 600Ω.

### TTL

Capable of driving 20 standard TTL loads.

## GENERAL

Power:	110V-120V or 220V-240VAC ±10%, 50/60Hz, adjustable internally; 30VA max. Installation Category II.
Operating Range:	+5°C to +40°C, 20% to 80% RH.
Storage Range:	-40°C to +70°C
Environmental:	Indoor use at altitudes up to 2000m, Pollution Degree 2.
Electrical Safety:	Complies with EN61010-1
EMC:	Complies with EN61326
Size:	220(W) x 82(H) x 230(D) mm, (10.3 x 3.4 x 9.2") excluding feet.
Weight:	2.0 kg.

## Safety

This instrument is Safety Class I according to IEC classification and has been designed to meet the requirements of EN61010-1 (Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use). It is an Installation Category II instrument intended for operation from a normal single phase supply.

This instrument has been tested in accordance with EN61010-1 and has been supplied in a safe condition. This instruction manual contains some information and warnings which have to be followed by the user to ensure safe operation and to retain the instrument in a safe condition.

This instrument has been designed for indoor use in a Pollution Degree 2 environment in the temperature range 5°C to 40°C, 20% - 80% RH (non-condensing). It may occasionally be subjected to temperatures between +5°C and -10°C without degradation of its safety. Do not operate while condensation is present.

Use of this instrument in a manner not specified by these instructions may impair the safety protection provided. Do not operate the instrument outside its rated supply voltages or environmental range.

### WARNING! THIS INSTRUMENT MUST BE EARTHED

Any interruption of the mains earth conductor inside or outside the instrument will make the instrument dangerous. Intentional interruption is prohibited. The protective action must not be negated by the use of an extension cord without a protective conductor.

When the instrument is connected to its supply, terminals may be live and opening the covers or removal of parts (except those to which access can be gained by hand) is likely to expose live parts. The apparatus shall be disconnected from all voltage sources before it is opened for any adjustment, replacement, maintenance or repair.

Any adjustment, maintenance and repair of the opened instrument under voltage shall be avoided as far as possible and, if inevitable, shall be carried out only by a skilled person who is aware of the hazard involved.

If the instrument is clearly defective, has been subject to mechanical damage, excessive moisture or chemical corrosion the safety protection may be impaired and the apparatus should be withdrawn from use and returned for checking and repair.

Make sure that only fuses with the required rated current and of the specified type are used for replacement. The use of makeshift fuses and the short-circuiting of fuse holders is prohibited.

Do not wet the instrument when cleaning it.

The following symbols are used on the instrument and in this manual:-



**Caution** -refer to the accompanying documentation, incorrect operation may damage the instrument.



terminal connected to chassis ground.



mains supply OFF.



mains supply ON.



alternating current.

## EMC

This instrument has been designed to meet the requirements of the EMC Directive 89/336/EEC.

Compliance was demonstrated by meeting the test limits of the following standards:

### Emissions

EN61326 (1998) EMC product standard for Electrical Equipment for Measurement, Control and Laboratory Use. Test limits used were:

- a) Radiated: Class B
- b) Conducted: Class B
- c) Harmonics: EN61000-3-2 (2000) Class A; the instrument is Class A by product category.

### Immunity

EN61326 (1998) EMC product standard for Electrical Equipment for Measurement, Control and Laboratory Use.

Test methods, limits and performance achieved were:

- a) EN61000-4-2 (1995) Electrostatic Discharge : 4kV air, 4kV contact, Performance A.
- b) EN61000-4-3 (1997) Electromagnetic Field, 3V/m, 80% AM at 1kHz, Performance A.
- c) EN61000-4-11 (1994) Voltage Interrupt, 1 cycle, 100%, Performance A.
- d) EN61000-4-4 (1995) Fast Transient, 1kV peak (AC line), 0.5kV peak (signal lines), Performance B.
- e) EN61000-4-5 (1995) Surge, 0.5kV (line to line), 1kV (line to ground), Performance A.
- f) EN61000-4-6 (1996) Conducted RF, 3V, 80% AM at 1kHz (AC line only; signal connections <3m not tested), Performance B.

According to EN61326 the definitions of performance criteria are:

**Performance criterion A:** 'During test normal performance within the specification limits.'

**Performance criterion B:** 'During test, temporary degradation, or loss of function or performance which is self-recovering'.

**Performance criterion C:** 'During test, temporary degradation, or loss of function or performance which requires operator intervention or system reset occurs.'

Where Performance B is stated it is because the parameters of the output signal may deviate beyond Specification under the test conditions, e.g. deviation from the set frequency during the conducted RF test. However, the possible deviations are still small and unlikely to be a problem in practice.

### Cautions

To ensure continued compliance with the EMC directive the following precautions should be observed:

- a) connect the generator to other equipment using only high quality, double-screened cables.
- b) after opening the case for any reason ensure that all signal and ground connections are remade correctly before replacing the covers. Always ensure all case screws are correctly refitted and tightened.
- c) In the event of part replacement becoming necessary, only use components of an identical type, see the Service Manual.

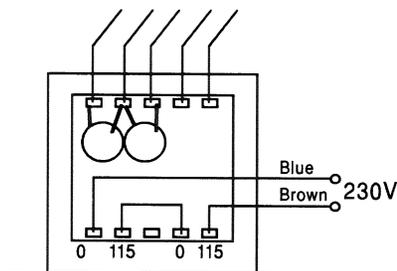
## Installation

### Mains Operating Voltage

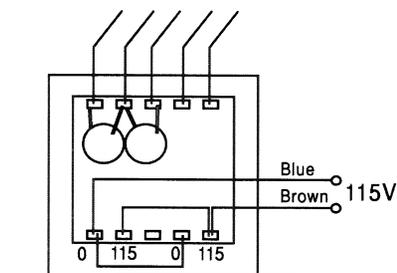
The operating voltage of the instrument is shown on the rear panel. Should it be necessary to change the operating voltage from 230V to 115V or vice-versa, proceed as follows:

1. Disconnect the instrument from all voltage sources.
2. Remove the 4 screws which hold the upper and lower case halves together and lift off the case lower.
3. Change the transformer connections following the diagrams below:

#### 230V Operation - Primaries in series



#### 115V Operation - Primaries in parallel



4. Reassemble in the reverse order.
5. To comply with safety standard requirements the operating voltage marked on the rear panel must be changed to clearly show the new voltage setting.
6. Change the fuse to suit the new operating voltage, see below.

### Fuse

The correct time-lag fuse must be fitted for the selected operating voltage.

For 230V operation use 160mA (T) 250V HBC

For 115V operation use 315mA (T) 250V HBC

Make sure that only fuses with the required rated current and of the specified type are used for replacement. The use of makeshift fuses and the short-circuiting of fuse holders are prohibited.

### Mains Lead

#### **WARNING! THIS INSTRUMENT MUST BE EARTHED**

Any interruption of the mains earth conductor inside or outside the instrument will make the instrument dangerous. Intentional interruption is prohibited.

## Operation

### Power

The AC line power switch is on the rear panel of the instrument.

### Frequency Setting

Frequency is set by pressing the appropriate FREQUENCY RANGE push button and rotating the FREQUENCY vernier. The vernier gives >10:1 adjustment, from <0.2 (at Min) to >2.0 (at Max) of the selected range; the actual frequency is shown in the 4-digit display.

The microprocessor based reciprocal frequency counter has automatic scaling and ranging. The measurement is updated every 1s or one period, whichever is the greater. Note that after range changing the update range may be longer before settling to the above times. Display resolution is always 4 digits and uses the annunciators mHz, Hz, kHz and MHz.

### Symmetry

When the SYM (f + 10) button is depressed the rotary SYMMETRY control can be used to vary the waveform symmetry over a range of approximately 1:8 to 8:1. Note that when the SYM is selected the output frequency is divided by a factor of approximately 10; the actual output frequency is correctly displayed.

### Function Selection

The output waveform shape is selected by depressing one of the three interlocking FUNCTION buttons to give sine, square or triangle. With all three switches out (accomplished by half-depressing any one) the output will be a DC level only; this is useful as it permits input threshold testing of a circuit without having to connect up an external DC supply.

### Amplitude

The amplitude of the MAIN OUT outputs is set by the AMPLITUDE control and the ATTENUATOR switches. Maximum output is 20 volts peak-to-peak open-circuit, 10 volts peak-to-peak when terminated with the output's characteristic impedance.

The AMPLITUDE control has greater than 30dB range; the ATTENUATOR switches are interlocking and permit selection of 0dB, -20dB or -40dB attenuation. Used together these controls provide a range of 20V peak-to-peak down to <6mV peak-to-peak, or 10V peak-to-peak down to <3mV peak-to-peak into the output's characteristic impedance.

The 50Ω and 600Ω outputs are both varied by the ATTENUATOR and AMPLITUDE controls but are independent; terminating one output will not affect the other.

The MAIN OUT outputs will withstand a short circuit for a period of 10 minutes at maximum output and greater periods at lower output levels.



Do not apply external voltages to these outputs.

### DC Offset

The DC OFFSET control has a range of ±10 volts from 50Ω/600Ω in all output modes; the control has a centre detent for 0 volts. DC offset plus signal peak is limited to ±10V (± 5V into the characteristic output impedance). DC offset plus waveform is attenuated proportionally in the -20dB and -40dB positions.

### TTL Output

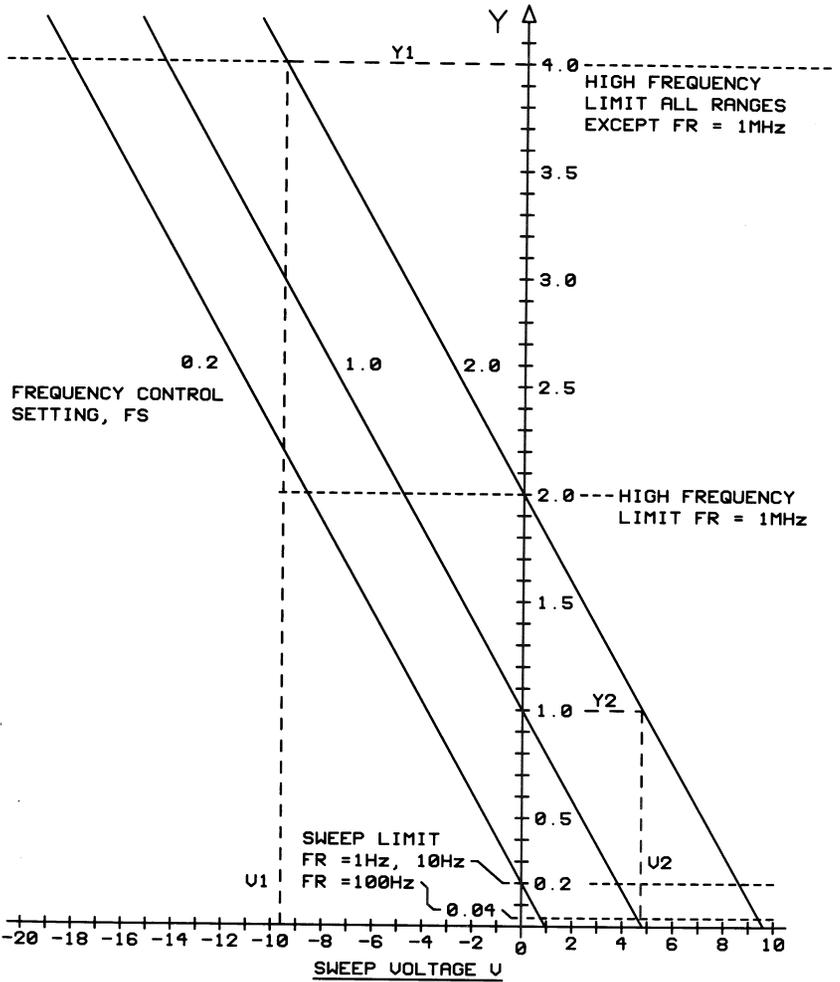
The TTL output provides a TTL pulse at the same frequency, phase and symmetry as the main outputs and is capable of driving 20 standard TTL loads.



Do not apply external voltages to this output.

**Sweep Input**

The generator input can be swept, DC programmed or modulated by a suitable control voltage applied to the SWEEP IN socket. The instrument sums the SWEEP IN voltage with the internal voltage derived from the FREQUENCY vernier to determine the operating frequency. The frequency display shows the correct resultant frequency.



The diagram provides a convenient graphical method for determining the SWEEP IN voltage swing required to achieve a particular frequency sweep.

For example, to estimate the required sweep input voltage swing to give a 4:1 sweep ratio from 10kHz to 40kHz using the 10kHz frequency range (FR) with the frequency control setting (FS) at 2.0 (Max):

- i) First calculate the Y values from the equation  $Y = F/FR$   
 $Y1 = 40kHz / 10kHz = 4.0$   
 $Y2 = 10kHz / 10kHz = 1.0$
- ii) Find the intercepts of Y1 and Y2 with FS = 2.0
- iii) Read off V1 and V2 from the sweep voltage scale:  
 $V1 = -9.6, V2 = +4.8$

- Notes:
- i) Aim to use a sweep input voltage that is approximately symmetrical about zero volts by choosing an appropriate frequency control setting (FS) for the range to be swept. This will ensure maximum linearity and minimum frequency jitter.
  - ii) the low frequency 1000:1 sweep limit is achieved when  $Y = 0.004$



Do not apply external voltages to this input exceeding ± 20V.

**External Counter**

In normal operation the rear panel COUNTER slide-switch is set to INT such that the display shows the frequency of the generator's output waveform.

If the slide-switch is set to EXT the adjacent EXT IN socket is connected to the counter and the display shows the frequency of the external signal connected to the EXT IN socket. If no external input is present the display will show zero.

Note that with the COUNTER switch in the EXT position the generator will function as normal except that the output frequency will not be displayed.

As an external frequency meter the counter has a range of 5Hz to 20MHz. Input sensitivity is given in the Specification.

**Maintenance**

For service repair and calibration please contact your local Tenma distributor or go to [www.tenma.com](http://www.tenma.com)

**Cleaning**

If the instrument requires cleaning use a cloth that is only lightly dampened with water or a mild detergent.

**WARNING! TO AVOID ELECTRIC SHOCK, OR DAMAGE TO THE INSTRUMENT, NEVER ALLOW WATER TO GET INSIDE THE CASE. TO AVOID DAMAGE TO THE CASE NEVER CLEAN WITH SOLVENTS.**