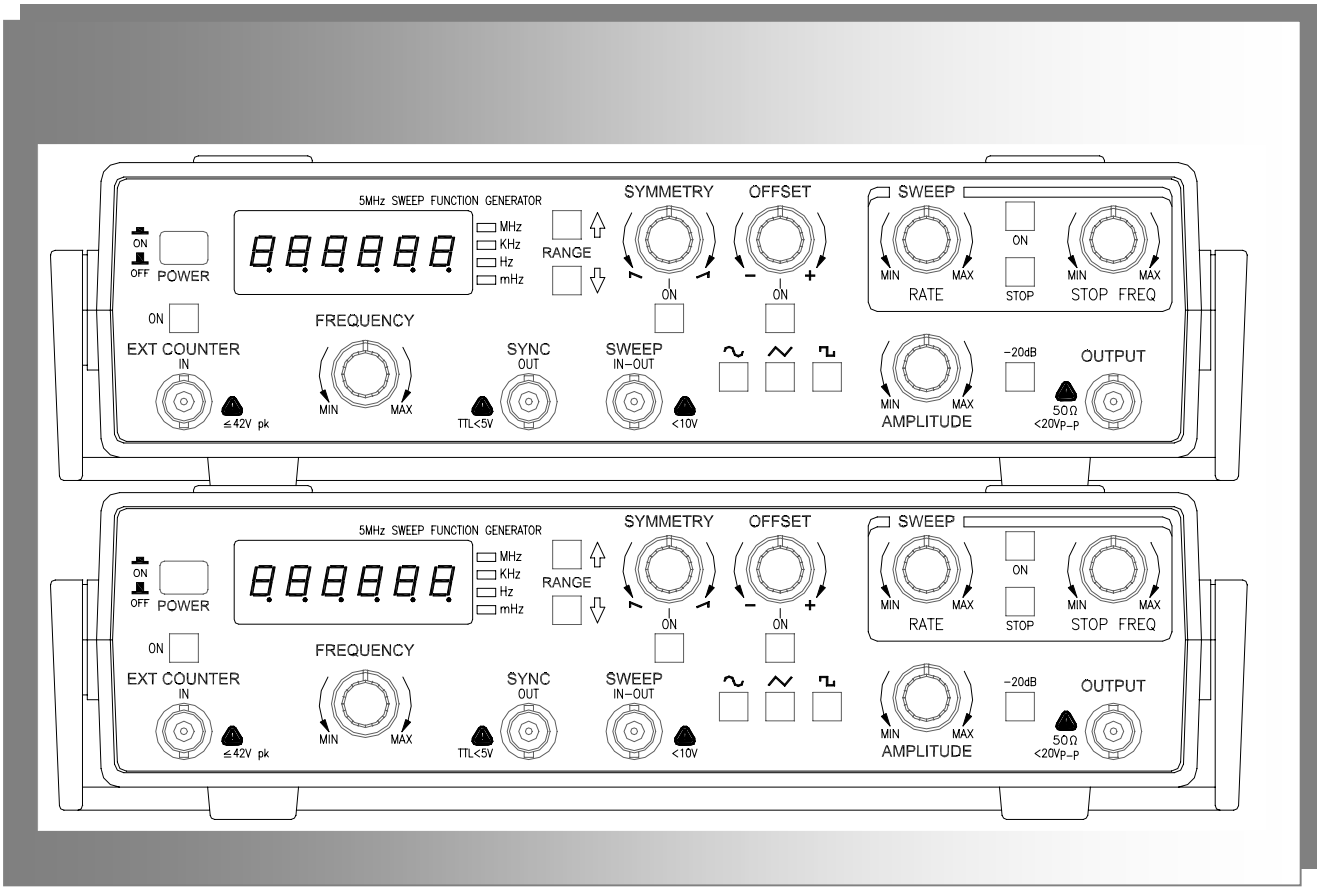
TENMA®

72-7210 5MHz FUNCTION GENERATOR

User's Manual



72-7210 5 MHZ FUNCTION GENERATOR

INSTRUCTION MANUAL

REVISION HISTORY

Version	Change Summary	Date	Author
2.2	Created	2004-05-10	LT

Copyright Statement

CONTENTS

Section-1 SAFETY

Review the following safety precautions to avoid injury and prevent damage to this instrument or any instruments connected to it.

- Read this manual carefully to ensure your personal safety and to prevent damage either to the instruments or to equipment connected to them.
- Before applying power, ensure that the line selector is in the proper position for power source being used.
- Make sure that the power cord and the fuse type / rating is specified for this product before use.
- This product is grounding through the grounding conductor of the power cord. To avoid electric shock, the grounding conductor must be connected to earth ground. Before making any connections to the input terminals of the products, ensure that the properly grounded.
- To avoid personal injury, never operate the instrument without covers or panels removed.
- To prevent product overheating, provide proper ventilation.
- Do not operate this product in wet, damp or explosive atmosphere.
- Marking on the instruments:

	Caution, referring to manual for detailed instructions.
	Protective conductor terminated.

Section-2 INTRODUCTION

This Function Generator (FG) produces low distortion combined with a 6-digit, high-resolution 50MHz counter. It is a rugged, easy to operate, excellent heat dissipation and high stability instrument. The FG range is from 0.01 Hz to 5 MHz with 8 ranges. You can also directly control amplitude and DC offset.
The sweep function makes the output signal traverse a range of frequency. The START and STOP frequency control is setting for the sweep rate and sweep width internally. The sweep function can be input from an external DC signal.

This FG has a frequency counter to count the signal frequency from 5 Hz to 50 MHz. The frequency counter features one six-digit display with automatic decimal point placement and LED indicator that show the measuring units. It provides high input impedance and good sensitivity for all specified frequency.

The symmetry function provides the user to vary the duty of frequency. When you push the switch of symmetry ON, the output waveform symmetry is adjustable. The sweep-IN function provides external voltage source to control the output frequency. The output frequency can be swept above or below the selected frequency to a maximum of 100:1, depending on the amplitude of input and the selected output frequency.

The exceptional accuracy, its portability and stackable design makes the Tenma 72-7210 Function Generator an ideal instrument for using by the electronic engineer, the communication technician, schools and laboratories.

Section-3 SPECIFICATION

General Specifications

Display	Six digits of seven-segment LED.
Output	Sine, Square, Triangle, DC, Sync and Sweep
Input	Sweep-IN, External frequency counter
Warm-up time	At least two hours
Operating Temperature	0°C~40°C (32°F to 104°F)
Storage Temperature	-10°C to 60°C
Altitude	Up to 2000 M
Relative Humidity	Up to 80% for 0°C to 28°C Up to 70% for 28°C to 40°C
Dimension	261 x 71 x 211 mm (W x H x D)
Weight	1.8Kgs approx**.**
Line Voltage	AC 100V/120V (± 10%) 50/60Hz, FUSE:0.4A/250V AC 220V/240 (± 10%) 50/60Hz, FUSE: 0.2A/250V
Power consumption	40VA maximum
Ventilation	Always keep the back of instrument far away the wall for better ventilation, and nothing at among.
Standard Accessories	User Manual in CD-ROM/ Power cord
Safety	Designed in compliance with EN61010-1 (IEC1010-1) Installation Category II, Pollution Degree 2 Environment.
EMC	Designed in compliance with EN61326.

Electrical Specification

The accuracy is given as ± (% of span + No. of least significant counts) at 23°C ± 5°C with relative humidity less than 80% R.H.

Main Output

Range (Sine/Triangle/Square Waves)

Output Range* 1		Display*2	Accuracy * 2
MIN.	MAX.	Resolution	
7mHz	500mHz	1mHz	No. Specified
0.5Hz	5 Hz	0.01Hz	±(3%+2)
5 Hz	50 Hz	0.1Hz	
50 Hz	500 Hz	1Hz	±(0.3%+1)
0.5k Hz	5k Hz	0.001kHz	±(0.03%+1)
5 kHz	50 kHz	0.01kHz	
50kHz	500 kHz	0.1kHz	
500kHz	5 MHz	0.001MHz	

Notes:

1. The specification is specified within 10% to 100% of maximum output range, and the waveform characteristics are limited to the specified range also.
2. The display resolution and accuracy is relative to the span of internal counter.

Waveform Characteristics

Triangle Wave Linearity

Frequency	Linearity
1Hz ~100KHz	> 98%
>100 KHz	No. Specified

Sine Wave Distortion

Distortion	Harmonic ratio	
10Hz ~ 100kHz	100kHz ~500kHz	0.5MHz ~5MHz
<2%	<-30dB	<-20dB

Notes:

1. The distortion isn't specified for less than 10 Hz.

Square Wave

Transition time	Aberration
< 50ns	< 5% of P-P amplitude +/- 50 mV

Output Characteristics

Amplitude

Load	MIN (CCW) Attenuator ON	MAX (CW) Attenuator OFF	Attenuator @ 1kHz	Flatness	
				<500 kHz	0.5 ~5 MHz
No Load	≦0.2Vp-p	≧20Vp-p	-20dB±1dB	±1dB	±3dB
50 Ω	≦0.1Vp-p	≧10Vp-p			

Notes:

1. Output impedance is 50Ω±10% @ 100kHz
2. The amplitude should consider additional tolerance of flatness.
3. FCCW: Full counterclockwise, FCW: Full clockwise
4. Output protection: The generator main output is non-destructively protected against short circuit to ground or to any voltage practically available in electronic laboratories.

DC Offset

Load	DC Offset Knob*1		Ripple*2
	FCCW	FCW	
No Load	< -10V	> +10V	≦10mVp-p
50Ω	< -5V	> +5V	

Notes:

1. Set the switch of DC OFFSET to ON position, and set the function switches of Sine, Triangle and Square to OFF position. Then test the DC offset.
2. Before testing ripple, set the frequency range to lowest range and turn frequency knob to MIN position. Otherwise it will induce noise around 50mVp-p based on different frequency.

Other Inputs and Outputs

Synchronous Output

Output Impedance	Output level	Transition time	Fan out *2
50 Ω typical *1	TTL level, > 3V @ open circuit	< 30 ns	Typical 20 TTL loads

Notes:

1. The output Impedance is measured at 1kΩ load or above.
2. The capability of fan out depends on different TTL logics and the level is greater than 2V

Symmetry

Range	Symmetry Knob	
	FCCW	FCW
Up to 500kHz	≦10%	≧90%

Notes:

1. Symmetry from 10% to 90% at full output amplitude terminated into 50Ω

External Sweep-IN

Impedance	Sweep Range	Sweep Ratio *1
14K Ω typical	0.2Hz~100Hz	1:100

Notes:

1. The frequency output will be proportional to the level of SWEEP-IN connector. 0–5V input for up to 100:1 frequency change approximately. To avoid damage to this instrument, ensure that the maximum voltage into this BNC is no more than ± 10 Vp.
2. Turn off the Sweep ON switch.

Internal Sweep/Sweep-OUT

Impedance	**Sweep Rate**		**Output Level*1**	
	MIN	**MAX**	**MIN**	**MAX**
600 Ω typical	>5s	<10 ms	>0.3V	<4.5

Notes:

1. The output level of SWEEP-OUT BNC is proportional to the knob of STOP FREQ.
2. The frequency knob is set to full CCW for start frequency, and Set the knob of stop frequency to full CW. The STOP switch is used to indicate stop sweep frequency. The sweep width is variable up to 100:1 frequency change approximately.

Counter Characteristics

Internal Counter

Range	**Display Resolution** *1	**Accuracy**
7mHz ~ 500 mHz	1mHz	No. Specified
0.50Hz~ 5.00Hz	0.01Hz	± (3%+2)
5.0Hz~ 50.0 Hz	0.1Hz	
1~ 999 Hz	1 Hz	± (0.3% +1)
1.000~9.999 kHz	0.001 kHz	± (0.03% +1)
10.00~99.99 kHz	0.01kHz	
100.0~999.9 kHz	0.1 kHz	
1.000~5.000 MHz	0.001MHz	

Notes:

1. The display resolution of internal counter is according to the ranges of main output setting.

External Counter

Range	Resolution	Accuracy *2	Input Sensitivity *5
5 ~ 999 Hz	1 Hz	±(Time base error +3 counts)	20mV RMS
1 ~ 999.999 kHz	0.001 kHz		
1 ~20.0000 MHz	0.0001 MHz	±(Time base error +1 count)	
>20 ~ 50 MHz	0.0001 MHz		60 mV RMS

Notes:

1. Time base: 10 MHz
2. Time base error: 10 PPM at (23 ± 5 °C)
3. Input impedance: 1MΩ typical
4. The counter display will be 0 Hz with 50Ω load on no signal input.
5. The maximum input voltage: < 42Vpk

Section-4 GETTING STARTED

Front Panel

Figure 1 shows the front-panel controls, connectors and indicators of FG.

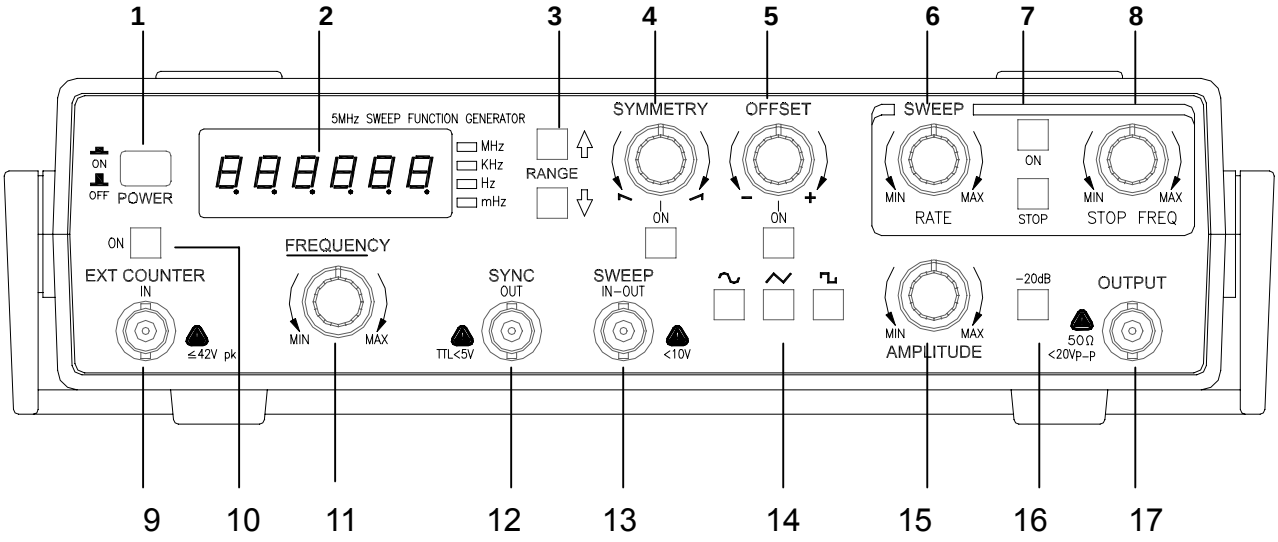


Figure 1. Front Panel.

1. POWER SWITCH: To toggle instrument power ON and OFF.

2. Counter READOUT: A six-digit display that shows frequency generator or external counter. The LED indicates the frequency units of MHz, KHz, Hz or mHz for the counter readout. The decimal point and unit is automatically placed in the appropriate position.

3. RANGE BUTTONS: Push buttons of UP/DOWN to set the frequency range of the output signal. The frequency range will be 10 times difference on each step.

4. SYMMETRY KNOB/SWITCH: The knob is used to vary either positive pulse/ramp or negative pulse/ramp. Push the symmetry switch to “ON” before rotating this knob.

5. DC OFFSET KNOB/SWITCH: The switch is set at OFF position for normal operation. The knob sets the DC level and therefore the polarity of the OUTPUT signal after the switch ON.

6. SWEEP RATE: Rotate the Knob to adjust the sweep rate. Adjusts how often the frequency sweep reiterates.

7. SWEEP SWITCHES: The ON switch is used to enable sweep function. The STOP switch is used to see the stop frequency.

8. STOP FREQ. KNOB: This knob is used to adjust the sweep width. Adjusts the range of frequency that is traversed by each sweep.

9. EXT-COUNTER INPUT: External signal input BNC. The input frequency is from 5Hz to 50MHz.

10. EXT-COUNTER SWITCH: Push the switch to ON for external counter.

11. FREQUENCY KNOB: Rotate this knob to set the desired frequency output of generator.

12. SYNC OUT BNC: This connector sends out synchronous signal of TTL level, the output frequency is same as MAIN output.

13. SWEEP IN-OUT BNC: Sweep signal output and input connector. It will be an output connector when you push the SWEEP switch ON; otherwise it is an input connector, which is voltage control frequency (VCF).

14. WAVE SELECTOR: Push the switch to select the output waveforms.

15. AMPLITUDE KNOB: Adjust the voltage within the presently selected range. Rotate this knob to adjust the voltage level of main output signal (OUTPUT BNC).

16. ATTENUATOR: Push the switch to turn attenuator ON.

17. OUTPUT BNC: Main output of function generator.

Rear Panel

In addition to line voltage selector, fuse and power cord receptacle.

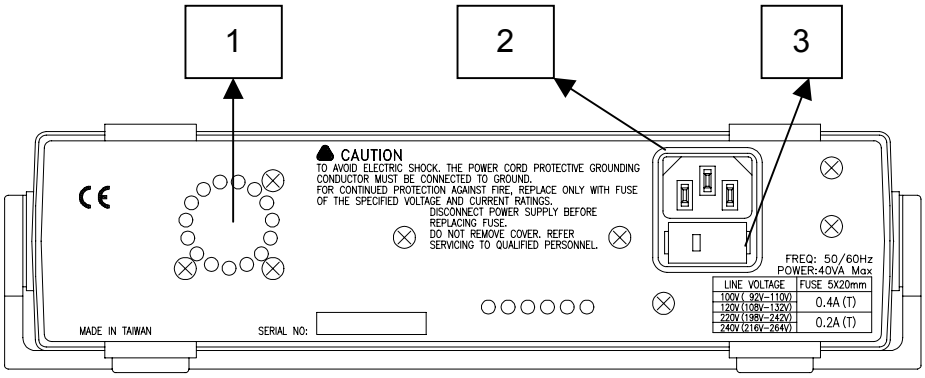


Figure-2. Rear Panel

1. VENTILATION FAN: Always keep nothing on the front of fan for better ventilation.
2. POWER CORD SOCKET
3. LINE VOLTAGE SELECTOR AND FUSE HOLDER: To select line voltage and fuse replacement.

Preparing for Use

PRECAUTIONS

In order to avoid damaging this instrument, make sure that the unit is set to the correct line voltage for your area. Also make sure that the correct fuse is used for the line voltage. These line voltages are 100V, 120V, 220V and 240V at 50/60HZ.

⚠ WARNING

To avoid damage the equipment use only specified fuse when change the power line voltage. Please refer to following table

SELECTOR	LINE VOLTAGE	FUSE
100V	92~110V 50/60Hz	0.4A
120V	108~132V 50/60Hz	0.4A
220V	198~242V 50/60Hz	0.2A
240V	216~264V 50/60Hz	0.2A

- Avoid touching the rear panel of the instrument during operation. The heat sink is nearby the rear panel, contacting it could result in skin burns.

- Avoid using the function generator in ambient temperatures above specified. Always keep sufficient air space between the rear of instrument and wall to prevent internal heat build-up.

- Although the function generator is protected against reverse polarity damage the circuit being powered may not include such protection. Always carefully observe polarity incorrect polarity may damage the equipment under test.

- Do not exceed the voltage rating of the circuit being powered.

Reference Operation

This section describes several advanced functions of the Tenma 72-7210 function generator. The variety of swept available from the function generator make it especially useful for such applications as test servo-system or amplifier response, distortion and stability. It can use for FM generator, frequency multiplication, or as a variable, beat-frequency oscillator. The synchronous and sweep outputs can be used as a source for TTL logic or to synchronize as external device, such as an oscilloscope.

Main output

1. Connect the Main output connector to the input BNC connector on an oscilloscope.
2. Switch off the external counter button.
3. Select the waveform by pushing function selector.
4. Push UP/DOWN to select a range of frequency output.
5. Turn the frequency knob to adjust the frequency output. The output value will be indicated on the display
6. Turn the amplitude knob to adjust the output level. The attenuator switch can be pushed to attenuate the output level for –20 dB if necessary.
7. Push DC offset switch to the ON position, an additional DC level will be used to shift output level. The knob of DC offset is used to adjust DC level.

Symmetry

1. Follow the operation of Main output, but with the symmetry button switched ON.
2. The frequency will be divided ten from the original frequency output around.
3. Turn the knob of symmetry to adjust duty cycle from 10% to 90 %.
4. Observe the results on the oscilloscope.

SYNC. OUTPUT

1. Connect the SYNC output connector to the input BNC connector on an oscilloscope.
2. The level and symmetry will be a constant value, but the frequency will follow the Main output. Please refer to main output for frequency change.
3. The knobs for DC offset and amplitude do not affect the output.
4. Observe the results on the oscilloscope.

Internal Sweep/ Sweep-OUT

1. Connect the Main output connector to the CH1 BNC connector on the oscilloscope.
2. Connect the SWEEP in-out BNC to the CH2 BNC connector on the oscilloscope.
3. Turn the frequency knob to set desired sweep start frequency.
4. Turn the stop frequency knob to set stop frequency. Push the STOP switch to the ON position to see the stop sweep frequency on the display. Turn off the STOP switch once you finished the setting.
5. Push the sweep switch to the ON position.
6. The main output will sweep the desired range of frequencies, and the BNC sweep is output a linear level.
7. Turn the sweep rate knob to set how often the frequency sweep reiterates.
8. Observe the results on the oscilloscope.

External Sweep-IN

1. Push the sweep switch to the OFF position.
2. Connect the Main output connector to the CH1 BNC connector on the oscilloscope.
3. Connect the SWEEP in-out BNC to another function generator.
4. Turn the frequency knob to set desired sweep start frequency.
5. The main output will sweep the desired range of frequencies according to the input level of SWEEP in-out BNC.
6. Observe the results on the oscilloscope.

Section-5 MAINTENANCE

⚠ WARNING!

To avoid electrical shock or damaging this instrument, never get water into the meter.

Cleaning

Before cleaning this instrument, make sure the power is switched in OFF position and the power cord is disconnected from the AC outlet. To clean the meter, wipe the dirty parts with gauze or soft cloth soak with diluted neutral detergent. Avoid getting the instrument too wet to prevent the detergent from penetrating into inside parts and causing damages. After cleaning, leave the instrument until it dries completely. Don't use chemicals containing benzine, benzene, toluene, xylene, acetone or similar solvents.

⚠ WARNING!

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

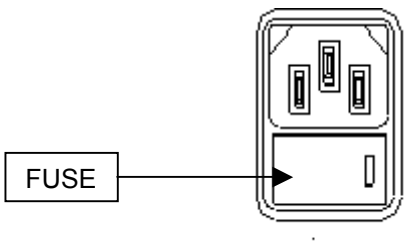
- When serving, use only specified replacement parts as described hereinafter.

- To avoid electric shock, disconnect the power cord from the unit before changing fuse or input voltage selector.

Selecting different input voltage & protection fuse replacement

1. To select different input voltage level of AC 100V, 120V 220V or 240V, simply switch to the selected voltage, so the desired voltage is displayed in the window. Please make sure that the protection fuse rating matches.

2. When replacing fuse or selecting the input voltage, please use fuse ratings as specified.



For Service and repair and calibration please contact your local Tenma distributor or go to http://www.tenma.com

Section-6 ADJUSTMENT PROCEDURES

⚠CAUTION

The Following instructions are for qualified service personnel only. To avoid electrical shock, do not perform any servicing other than contained in the operation instructions unless you are qualified to do so.

Before calibrating and adjusting, make sure that the instrument has warmed up for at least 2 hours.

Required test equipment

The following Table lists the test equipment necessary to perform the adjustments and the maintenance of this instrument. Any equipment that satisfies the critical specifications given in the table may be substituted for the recommended model.

Instrument Type	Required Specifications
Oscilloscope	100 MHz bandwidth, dual channel
DVM	4.5 digits, true RMS
Counter	100 MHz, 2 CH, time interval capability
Distortion Analyzer	10 Hz – 100 KHz, ± 0.1%
Function Generator	10 MHz frequency
Termination	Feed through termination 50 ohm
Cable Assembly	BNC-BNC, 50 ohms, RG-58
BNC Adapters	BNC to banana, BNC tees

Start to Adjust

A: Frequency Counter/ 10 MHz Oscillator Adjustments

1. Press EXT-COUNTER switch on front panel. Connect external source (sine waveform, 10MHz, amplitude of 10 mV rms). Connect a probe to TP600 and to the scope. Adjust R610 for a square wave display on the scope.
2. Remove the probe from TP600, then adjust C104 for counter reading to 10.0000~10.0002 MHz.

B: Function adjustment of Triangle wave

1. Set this FG controls as follows:

FUNCTION	TRIANGLE
AMPLITUDE	MAX
DC OFFSET	OFF
FREQUENCY	5 KHz
SYMMETRY	OFF
SWEEP	OFF

2. Adjust R225 for a symmetrical around zero waveform.

C: Function adjustment of Square wave

1. Set the FG controls as follows:

FUNCTION	SQUARE
AMPLITUDE	MAX
DC OFFSET	OFF
FREQUENCY	5 KHz
SYMMETRY	OFF

2. Adjust R340 for a symmetrical square wave around zero.

D: Frequency Adjustment

1. Connect the OUTPUT to an external counter.
2. Set the FG controls as follows:

FUNCTION	TRIANGLE
AMPLITUDE	Middle
DC OFFSET	OFF

3. Turn the FREQUENCY control knobs to full CW and select the proper RANGE for a reading of >5.2 KHz on the display.
4. Adjust R259 for a 50% symmetry waveform.
5. Turn the FREQUENCY control knob CCW and set the frequency to 100 Hz on the

display counter. It is important to stay in the same range.
6. Adjust R249 for a 50% of symmetry waveform.
7. Repeat steps 5 and 6 for best results on both ends.
8. Select the Frequency range from 5Hz to 50.0Hz.
9. Connect the output to an external counter. Turn the frequency knob to full CW position. Adjust R211 for a frequency reading to 52.0Hz on the external counter
10. Turn the frequency knob for an internal counter reading to 50.0Hz. Adjust R637 for a display of 50.0 ±0.1Hz.
11. Turn the frequency knob to 10Hz reading on the counter. Adjust R638 for a display reading of 10.0Hz ±0.1Hz.
12. Repeat steps 10 and 11 for best result on both ends.
13. Select the Frequency Range from 500KHz~5MHz. Rotate the frequency knob to full CW. Adjust C217 for a reading >5.3MHz.
14. Turn the frequency knob to full CCW, adjust R262 for a reading of 30±5 KHz.

E: Output amplitude Adjustment

1. Terminate the output in 50 ohms and connect an oscilloscope and a multi-meter to the output.
2. With all function pushbuttons out and the knob of AMPLITUDE control at full CW position, adjust R401 for output of 0V ±10 mV.
3. Set the amplitude control to full CW position and select triangle waveform. Check for a peak amplitude of >10.2V.
4. Set frequency to 5KHz and adjust R225 for a symmetrical around zero waveform.

F: Function adjustment of Sine wave.

1. Connect a distortion analyzer through a 50 ohms termination to the OUTPUT and monitor with an oscilloscope also.
2. Set the FG controls as follows:

FUNCTION	SINE
AMPLITUDE	MAX
DC OFFSET	OFF
FREQUENCY	50Hz
SYMMETRY	OFF

3. Set frequency range to 50 Hz and FREQ. Knob for 50 Hz output.
4. Adjust R320 and R309 for minimum distortion and <1.2%.
5. Set frequency range to 500kHz, and FREQ. Knob for 100k Hz output.
6. Adjust R309 for minimum distortion and <1.2%.
7. To check frequency range for 50 Hz. If the distortion > 1.2%, to adjust steps 3~ 7 again.
8. Adjust R314 for a symmetrical waveform around zero.