User's Manual

10 MHz Function Generator Module

WE7121

IM 707121-01E
3rd Edition

YOKOGAWA
Yokogawa Electric Corporation

IM 707121-01E
3rd Edition

Thank you for purchasing the 10 MHz Function Generator Module WE7121 for the PC-based measurement instruments, WE7000.

This User's Manual contains useful information about the function, connection to the measuring station, and troubleshooting of the WE7121. This manual presumes that you will use the WE7000 Control Software that is included with the measuring station.

For general information about the WE7000 (primarily the operations of the measuring station, the optical interface module, the optical interface card, and the WE7000 Control Software) see the following manual that is included with the measuring station.

Manual Title	Manual No.
WE7000 User's Manual	IM707001-01E

To ensure the correct use, please read this manual thoroughly before operation. Keep the manual in a safe place for quick reference in the event a question arises.

Notes

- **The contents of this manual describe WE7000 Control Software Ver. 4.0.2.0 and module software Ver 3.04. If you are using another version of the software, the operating procedures or the figures given in this manual may differ from the actual software.**
- The contents of this manual are subject to change without prior notice as a result of continuing improvements to the instrument's performance and functions.
- Every effort has been made in the preparation of this manual to ensure the accuracy of its contents. However, should you have any questions or find any errors, please contact your nearest YOKOGAWA dealer.
- Copying or reproducing any or all of the contents of this manual without YOKOGAWA's permission is strictly prohibited.

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Revisions

1st Edition: December 1998
2nd Edition: July 1999
3rd Edition: August 2000

Disk No. WE08
3rd Edition: August 2000 (YK)

Checking the Contents of the Package

Unpack the box and check the contents before operating the instrument. If the contents are not correct or missing or if there is physical damage, contact the dealer from which you purchased them.

Measurement Module

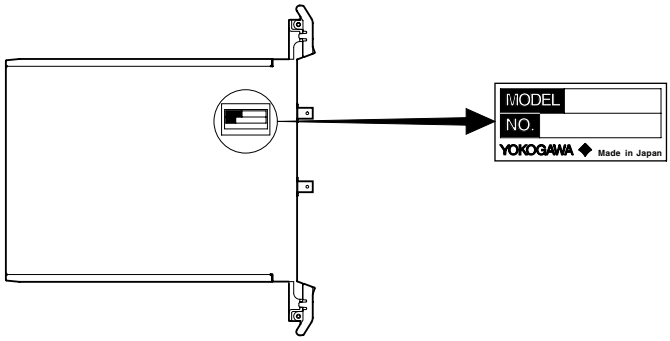
Check that the model name given on the name plate match those on the order.

MODEL

Model	Suffix Code	Description
707121		WE7121 10 MHz Function Generator Module
	/HE	English help message

NO.

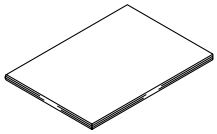
When contacting the dealer from which you purchased the instrument, please quote the instrument No.



Standard Accessories

The following standard accessories are supplied with the instrument. Make sure that all items are present and undamaged.

User's Manual (1)
IM707121-01E



How to Use This Manual

Structure of the Manual

This User's Manual consists of the following four chapters and an index.

Chapter	Title	Description
1	**Explanation of Functions**	Explains system configuration and functions.
2	**Hardware Preparation**	Explains how to install the module into the measuring station and how to connect the input.
3	**Troubleshooting and Maintenance**	Explains procedures for troubleshooting and self testing.
4	**Specifications**	Explains the specifications of the module.
Index		Index of contents.

Conventions Used in This Manual

Unit

k ..... Denotes 1000. Example: 100 kHz

K ..... Denotes 1024. Example: 720 KB

Displayed characters

Alphanumeric characters enclosed with [ ] usually refer to characters or settings that are displayed on the screen.

Symbols

The following symbol marks are used to attract the operator's attention.

Affixed to the instrument. Indicates danger to personnel or to the instrument. The operator must refer to the User's Manual. The symbol is used in the User's Manual to indicate the reference.

WARNING Describes precautions that should be observed to prevent injury or death to the user.

CAUTION Describes precautions that should be observed to prevent minor or moderate injury, or damage to the instrument.

Note Provides information that is important for operating the instrument properly.

Contents

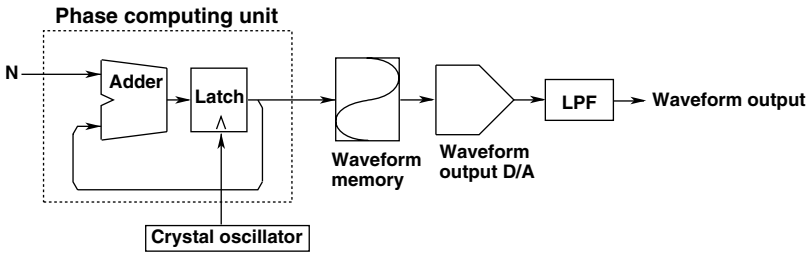
1.1 Principles of Signal Generation

Function generators can be classified into three groups according to their method of waveform generation. The common methods are analog, PLL (Phase-Locked Loop), and DDS (Direct Digital Synthesis). WE7121 is a DDS function generator.

Under the DDS method, several different sets of waveform data are stored in the memory in advance. The specified waveform data are read out using a clock signal with user selectable frequency. Then, the waveform is generated by passing the data through the D/A converter. Because everything is done digitally, this method avoids the shortcomings of the other methods such as slow frequency switching, and low frequency accuracy and stability problems.

Principles of Signal Generation with DDS

The circuit consists of a crystal oscillator that generates a standard clock, a phase computing unit, a waveform memory that stores one-cycle of waveform data, a D/A converter, and a LPF. Because the waveform memory only stores the data for one-cycle of the waveform, the address values correspond to the phase angles of the waveform.



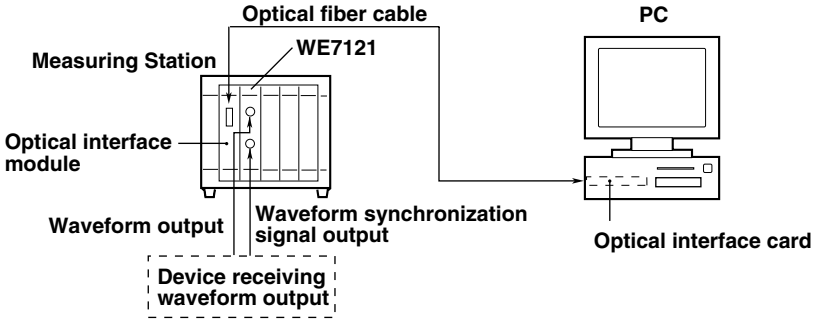
If N is one input to the adder and the other input is 0, the adder outputs N. The latching circuit outputs N in sync with the crystal oscillator clock. This value, N, will be the first address of the waveform memory. Next, the N that is output from the latching circuit is input to the adder which then outputs 2N. The latching circuit outputs 2N in sync with the next clock cycle. The result is continuously added and the phase computing unit outputs 3N, 4N, and so on, for every clock cycle. These values, N, 2N, 3N, ... become the waveform memory addresses. The data at the specified address is converted to an analog signal through the D/A converter, and high frequency components are removed with the LPF.

If the value N is applied to the input of the phase computing unit such that the specified address is three greater than the previous address, the output frequency will be increased by a factor of three if the clock frequency stays the same. Thus, the output frequency of the waveform can be adjusted by changing the value of N. Also, by changing the data in the waveform memory, the circuit can output other waveforms such as triangular and pulse waveforms.

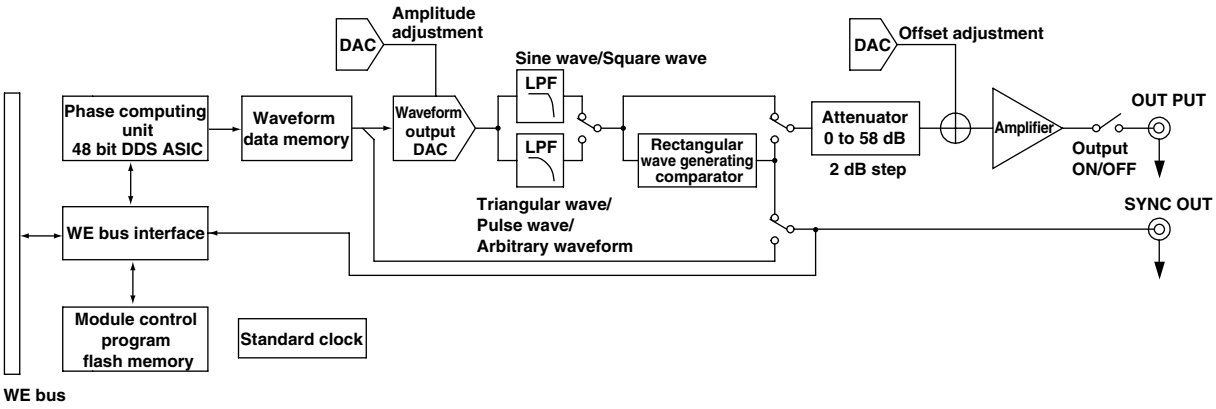
1.2 System Configuration and Block Diagram

System Configuration

The following shows an example in which a 10 MHz Function Generator Module WE7121 is installed in the measuring station and the measuring station is connected to the PC through the optical fiber cable.



Block Diagram

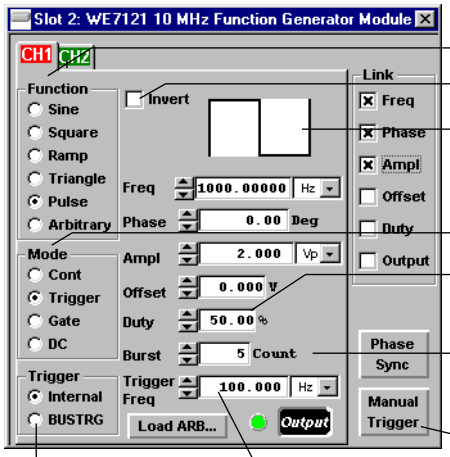


The 16-Kword Waveform data memory stores one cycle of waveform data, such as a sine wave or triangular wave, according to the instructions from the PC that are passed through the WE bus of the measuring station. The data to be summed are sent to the 48-bit phase computing unit that outputs the waveform data memory addresses. The frequency is varied by changing the data to be summed. The data that are output from the waveform data memory are converted to analog values with the 12-bit DAC and passed through an optimal filter that removes unwanted high frequency components. For creating square waves, sine waves are passed through the comparator. The amplitude of the signal is adjusted with the analog multiplier. Then, offset is added, and the signal is passed through the amplifier and output attenuator. The clock frequency of the phase computing unit in the signal generator section and DAC is 40.2107 MHz.

1.3 Operation Panel

The WE7000 Control Software that is installed in the PC is used to control the 10 MHz Function Generator Module WE7121. The WE7000 Control Software displays operation panels similar to those shown in the figure below. This User's Manual does not explain the operations of the operation panel or waveform monitor. For the operations of these items, see the on-line help that is provided with the WE7000 Control Software.

Selecting the output waveform and output mode



Select the output waveform

Invert the waveform

Output waveform display

Select the output mode

Set the duty cycle, selectable only when the output waveform is pulse wave [PULSE]

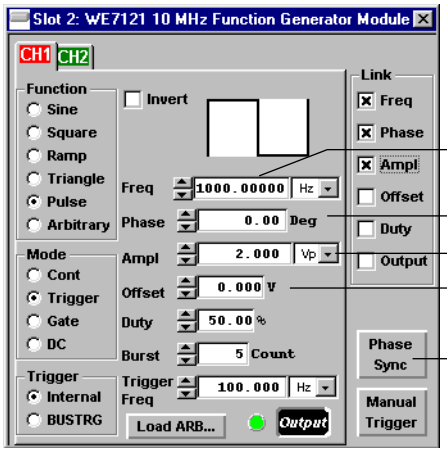
Set the burst count, selectable only when the output mode is trigger oscillation [Trigger]

Execute manual trigger

Set the trigger frequency, selectable only when the output mode is set to trigger oscillation [Trigger] and is internal [Internal]

Select the trigger source, Selectable only when the output mode is set to trigger oscillation [Trigger].

Setting output conditions and executing waveform synchronization



Set the output frequency

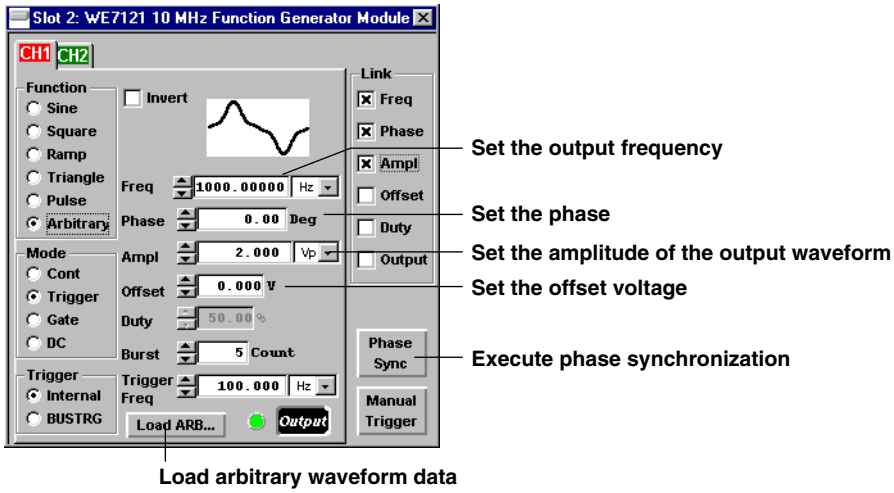
Set the phase

Set the amplitude of the output waveform

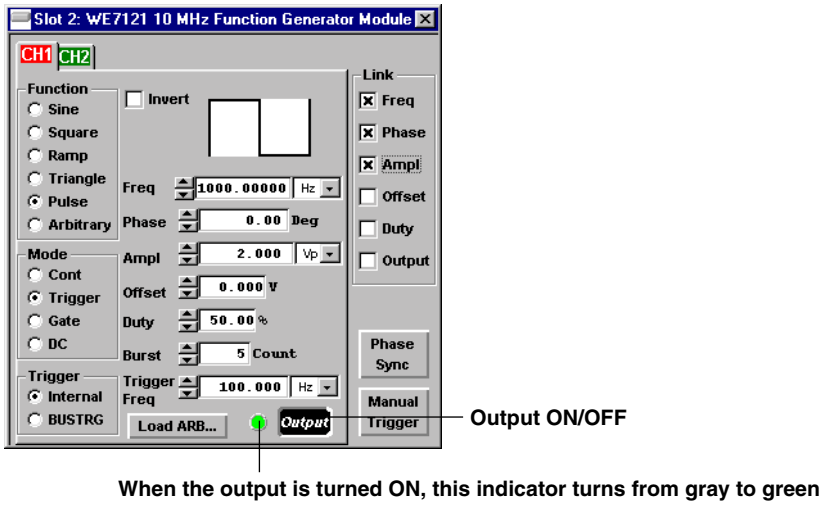
Set the offset voltage

Execute phase synchronization

Arbitrary waveform output

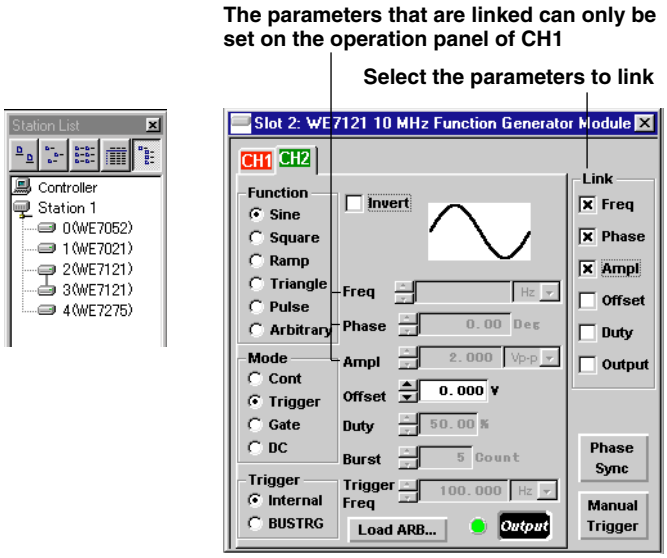


Turning ON/OFF the output



Setting up and operating multiple function generator modules simultaneously

In this example, the module installed in slot 2 is CH1 and the module installed in slot 3 is CH2.

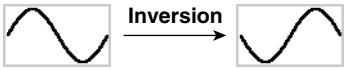


1.4 Selecting the Output Signal (Function)

Select the output waveform from the following choices. The default is [Sine].

Sine wave

Generates a sine wave with a frequency between 1 μHz and 10 MHz.



Square wave

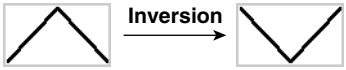
Generates a square wave with a frequency between 1 μHz and 10 MHz with a fixed duty cycle of 50%.

Ramp wave

The oscillation frequency is selectable from 1 μHz to 10 MHz, but the frequency range for high quality oscillations is 1 μHz to 200 kHz.

Triangular wave

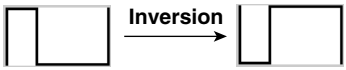
Generates a triangular wave with 50% symmetry (fixed). The selectable oscillation frequencies range from 1 μHz to 10 MHz, but the frequency range for high quality oscillations is 1 μHz to 200 kHz.



Pulse wave

The oscillation frequency is selectable from 1 μHz to 10 MHz, but the frequency range for high quality oscillations is 1 μHz to 200 kHz. You can generate a pulse wave with a duty cycle from 0 to 100%. If the function generator modules are linked*, the settings of the module with the smallest slot number can be reflected on other modules.

* If the same type of modules are linked, synchronized operation among those modules is possible. If two modules are linked, they operate like a two channel function generator.



Arbitrary waveform

An arbitrary waveform can be generated by loading the data corresponding to a desired waveform. The oscillation frequency is selectable from 1 μHz to 10 MHz, but the frequency range for high quality oscillations is 1 μHz to 200 kHz.

Setting the duty cycle

If you select pulse wave, the [Duty] entry box appears for you to enter a value. Select a value from 0 to 100% in 0.01% steps of 0.01%. The default value is 50%.

Selecting waveform inversion

If you check the [Invert] button, the polarity of the output waveform is inverted.

Note

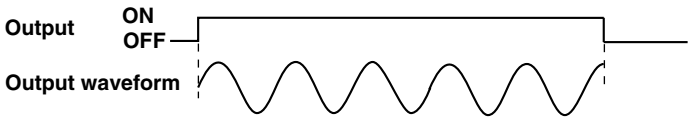
- If [DC] is selected for the output mode, you cannot select the output waveform.
- For pulse output, the waveform may not be generated, if "(1/output frequency) × duty cycle setting < 25 ns." For information on setting the output frequency, see section 1.6.

1.5 Selecting the Output Mode (Continuous/Trigger/ Gate Oscillation and DC Output)

Select from the following four output modes. The default is [Cont].

Continuous Oscillation

The waveform is generated continuously after the output is turned ON. Oscillation continues until the output is turned OFF.

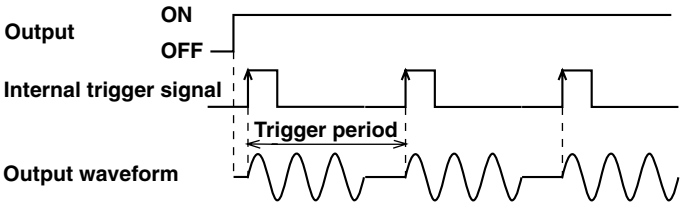


Trigger Oscillation

Oscillation starts by synchronizing to the trigger signal, and stops after the waveform is generated the number of times specified by the burst count. You can select the trigger source from internal or bus trigger source. The default is [Internal].

Internal trigger

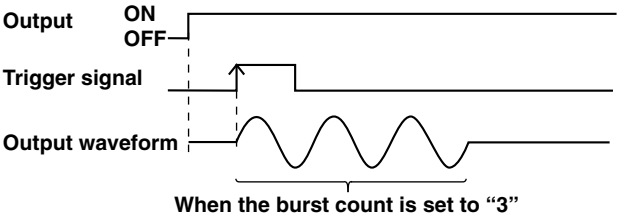
The trigger signal is periodically generated internally according to the trigger frequency (see “Setting the Trigger Frequency”) set beforehand, and is used to repetitively output the burst signal.



Bus trigger (BUSTRG)

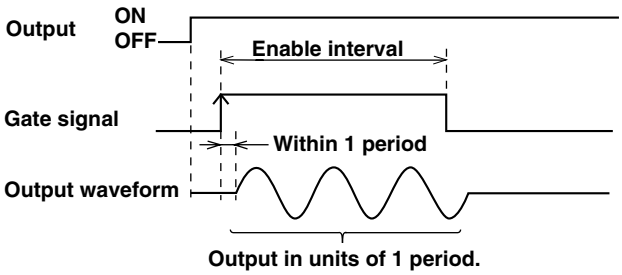
The trigger signal is generated by taking the bus trigger signal on the WE bus* or by clicking the [Manual Trigger] button on the operation panel displayed in the WE7000 Control Software.

* The trigger signal provided through the WE bus of the measuring station. For details, see the WE7000 User’s Manual (IM 7070001-01E).



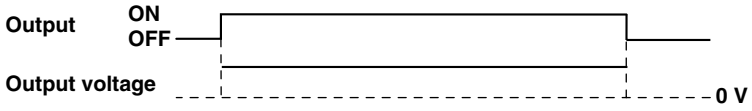
Gate Oscillation

Outputs the waveform while the gate signal is enabled. Oscillation stops when the gate signal is disabled. The waveform is generated by taking the bus trigger signal on the WE bus as the gate signal or while the [Manual Trigger] button is being pressed on the operation panel displayed in the WE7000 Control Software. The output unit of the waveform is one period.



DC Output

The DC voltage is generated continuously from the time the output is turned ON. The DC voltage is generated until the output is turned OFF. The DC output voltage is set with the offset voltage setting.



Setting the Burst Count

If you select trigger oscillation, you can enter a value in the [Burst] entry box. Enter the burst count value from 1 to 65535 in steps of 1. The default value is 5.

Setting the Trigger Frequency

If you select internal trigger for the trigger oscillation, you can enter a value in the [Trigger Freq] entry box. Enter the frequency from 1 mHz to 50 kHz in 1 mHz steps. The default value is 100 Hz.

Note

- If the output waveform is a square wave, selecting trigger or gate oscillation and “0 deg” for the phase (see the next page) will cause the initial output value to be unstable.
- When the output mode is set to DC output, the output voltage becomes the offset voltage value.

1.6 Setting Output Conditions (Output Frequency/ Voltage/Phase)

If multiple function generator modules are linked, the output frequency, the amplitude and offset voltage of the output voltage, and the phase of the module with the smallest slot number (or channel number) can be copied to other modules.

Output Frequency

You can set the output frequency in the range from 1 μHz to 10 MHz. Enter the frequency from 1 μHz to 10 MHz for all output waveforms. The default value is 1 kHz. However, the frequency range for obtaining high quality waveforms for ramp, triangular, pulse, and arbitrary waveforms is from 1 μHz to 200 kHz.

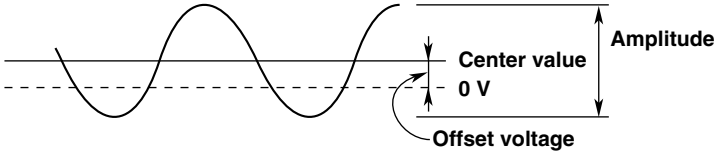
Unit and resolution

Select the setting unit from the following choices. The resolution changes depending on the unit. The maximum number of digits is nine.

Unit	Resolution	
uHz	1 μHz	
mHz	0.001 mHz	(1 μHz)
Hz	0.000001 Hz	(1 μHz)
kHz	0.00000001 kHz	(10 μHz)
MHz	0.00000001 MHz	(10 mHz)

Output Voltage

Set the amplitude and the offset voltage for the output waveform.



Setting the amplitude of the output waveform

Enter the amplitude from 20 mVp-p to 20 Vp-p for all output waveforms. If the output mode is DC, the output voltage as described in the next section is the offset voltage value and has a maximum value 10 V. The default value for the amplitude of the output voltage is 2 Vp-p.

Unit and resolution

Select the unit from the following list of choices. The resolution changes depending on the unit. Maximum number of digits is 6 digits.

Unit	Resolution
mVp-p	1 mVp-p
Vp-p	0.001 Vp-p (1 mVp-p)

Note

The output voltage is the voltage under a high impedance load.

Setting the offset voltage

Set the offset value of the output voltage. Enter the offset value from 0 to ±10 V in steps of 0.001 V for all waveforms. The default value is 0 V. If the output mode is DC, this offset voltage becomes the output voltage.

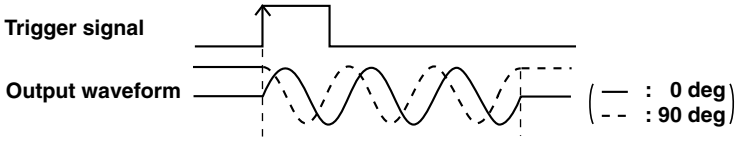
Note

You can output voltages over ±10 V by setting the amplitude of the output waveform to 20 Vp-p and setting an offset voltage, but waveforms over ±10 V may not be generated correctly.

Phase

If you wish to set the phase for each module independently (includes the case when there is one module).

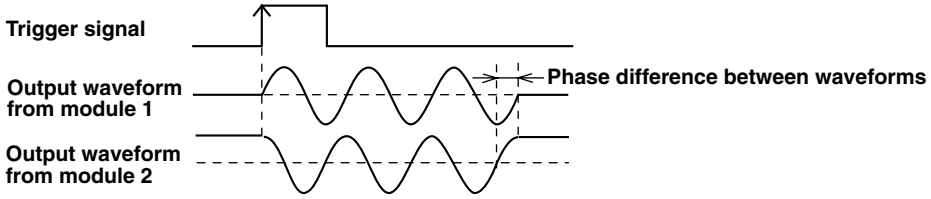
Set the start/stop phase (set the same phase for both) for the trigger/gate oscillation for each function generator module. Enter the phase from –10000 to +10000 deg in 0.01 deg steps for all output waveforms. The default value is 0 deg. The difference in the phase of the waveforms between modules will not necessarily be that which you specified. Also note that the phase is irrelevant for continuous oscillation and DC output modes.



Generating synchronized waveforms with multiple modules

When multiple function generator modules are linked together, clicking the [Phase Sync] button on the operation panel displayed in the WE7000 Control Software will make the phase difference between the waveforms of the modules the difference in phase you specified for each module.

* If the same type of modules are installed in adjacent slots, synchronized operation among those modules is possible. If two modules are linked, it operates like a two channel function generator.



Note

- If multiple modules are linked, the phase difference of the waveforms between modules will not necessarily be that which you specified between the modules. If the output waveform is anything other than a pulse waveform, the skew between the modules increases as the output frequency is lowered.
- In continuous oscillation and DC output modes, the phase setting is ignored. However, if multiple modules are linked, then the phase difference between the channels are set according to the phase setting on each module.

1.7 Arbitrary Waveform Output

Creating Arbitrary Waveform Data

Create binary data according to the following procedure.

Number of bits

16 bit (Little Endian. Effective bits are the lower 12 bits. Upper 4 bits are ignored.)

Value assignment

2048: 0 V

1: Negative side of Vp-p

4095: Positive side of Vp-p

Data length

16 Kwords (If the data are longer than the data length, only the first 16 Kword are taken. Do not create data with length under 16 Kwords.)

Extension

*.w16

Creating arbitrary waveform from ASCII data in CSV format

The ASCII data in CSV format of other modules that can save waveform data or the ASCII data in CSV format created using editing applications such as spreadsheets can be converted to the WE7121 arbitrary waveform data.

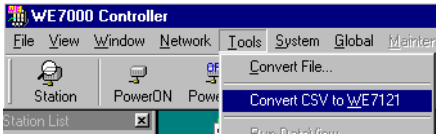
The data are converted according to the following rules.

- Amplitude: Determine the maximum and minimum values of the data and linearly scale the data in the range 1 to 4095.
- Time axis: Converts the first 16384 points.
  When creating data, enter the data from the top.
  If there are too many points, the points exceeding 16384 are ignored.
  If there are not enough points, the points are filled with 2048 (0 V).

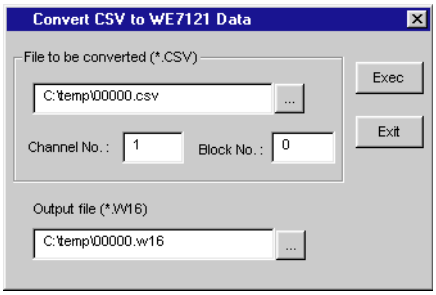
Converting ASCII data in CSV format to WE7121 arbitrary waveform data

Follow the steps below.

1. Select [Convert CSV to WE7121 Data] from the [Tools] menu of the menu bar.



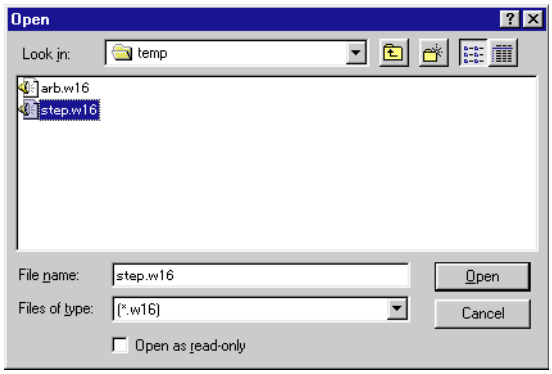
2. Select the CSV file to convert in the displayed dialog box.
   If the CSV file contains data having multiple blocks or multiple channels, enter the block number (greater than or equal to 0) and channel number (greater than or equal to 1).



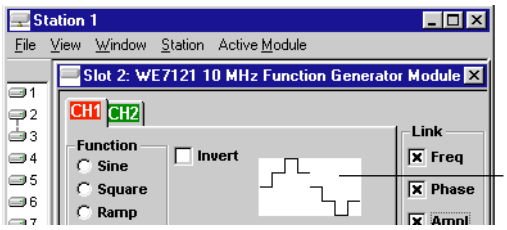
3. Enter the name for the converted file in the [Output file] entry box, and click [Exec].
   The file extension of the converted file is ".w16."

Loading Arbitrary Waveform Data

Select the file containing the arbitrary waveform data that were created according to the steps above and load them for output.
Clicking the [Load ARB] button displays a dialog box as shown in the figure below.
Select a file with a ".w16" extension and click the [Open] button to load the waveform data.
For the procedures related to converting ASCII data in CSV format to WE7121 arbitrary waveform data, see the next page.



If the waveform data are successfully loaded, the corresponding waveform is displayed by selecting [Arbitrary] in the [Function] option.



Setting Arbitrary Waveform Output

Set the output frequency, output voltage (amplitude, offset voltage), and phase.

1.8 Turning the Output ON/OFF

Output ON

Clicking the [Output] button highlights the [Output] button and the "**O**" indicator to the left of this button turns from gray to green. The waveform output is started and the OUTPUT indicator on the front panel of the module blinks.

Output OFF

Clicking the [Output] button while the waveform is being generated turns the highlighted [Output] button back to its original color and the "**O**" indicator to the left of this button turns from green to gray. The waveform output stops and the OUTPUT indicator on the front panel of the module turns off.

Note

- When the output is set to OFF, the waveform output terminal of the module is open.
- You can turn ON/OFF the output of the linked function generator modules by checking the [Output] box under [Link].

1.9 Other Functions

Setting Up and Operating Multiple Function Generator Modules Simultaneously

If multiple function generators are linked, the output frequency, phase, amplitude and offset of the output voltage, and duty cycle of the pulse signal of all linked modules can be set simultaneously to the same values. You can also turn ON/OFF the output simultaneously.

Setting the link

You can link function generator modules installed in adjacent slots in the trigger source/time base source/arming setting dialog box*. You can only link modules within the same station.

* The dialog box is displayed on the WE7000 Control Software. For the setting procedures, see section 4.6 in the WE7000 User's Manual (IM707001-01E).

Selecting the link parameters

Check the [Link] button and select the parameters you wish to simultaneously set from the following list of choices.

- Freq: Output frequency
- Phase: Phase
- Ampl: Amplitude of output voltage
- Offset: Offset voltage
- Duty: Duty cycle

Check the [Output] box to simultaneously turn ON/OFF the output of the linked function generators.

Note

If duty cycle [Duty] is selected, you can enter a value in the [Duty] entry box even if a pulse wave is not selected for the output waveform. This value is used when the pulse waveform is selected for the output waveform.

Simultaneous setting

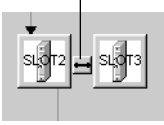
The values for the parameters to be set simultaneously are entered in the entry box of the operation panel of the lowest slot number (CH1) out of all the linked slots. All other linked slots will take on the same value. You cannot enter the values on the operation panel of the other slots.

Synchronizing Waveforms

You can synchronize waveforms that are output from function generator modules in adjacent slots. If you click the [Phase Sync] button in the trigger source/time base source/arming setting dialog box* when the function generators are linked, the phase difference between the waveforms of the modules is the difference in the phase you specified for each module.

* For the setting procedures, see the WE7000 User's Manual (IM707001-01E).

Link indication



Note

If you change the output waveform or the output frequency, the synchronization between modules will be cleared. If phase synchronization is desired, be sure to click the [Phase Sync] button every time you change the output waveform or the output frequency.

Waveform Synchronization Signal Output

The “SYNC OUT” terminal outputs a TTL level signal synchronized to the output waveform (waveform synchronization signal). The waveform synchronization signal can also be output as a bus trigger signal on the WE bus (BUSTRG1/BUSTRG2) or as a time base signal (CMNCLK).

Input/Output of Bus Trigger Signals

You can output the bus trigger signal to the two trigger signal buses (BUSTRG1/ BUSTRG2) in the measuring station by synchronizing to the waveform synchronization signal output terminal (SYNC OUT). The bus trigger signal that is output to the bus becomes “True” while the SYNC OUT signal is “High.” There is a time difference of approximately 100 ns (typical value*) between the SYNC OUT signal and the bus trigger signal.

In addition, the bus trigger signal can be used as the trigger/gate signal during trigger oscillation and gate oscillation operations. There is approximately 100 ns of delay time from the time the bus trigger signal becomes “True” to the time the trigger oscillation starts. And, there is a maximum delay of (100 ns + one cycle of the output frequency) from the time the bus trigger signal becomes “True” to the time the gate oscillation starts.

* Typical values represents typical or average values. They are not strictly guaranteed.

Output of Time Base Signal

You can output the time base signal in the module to the time base signal in the measuring station by synchronizing to the waveform synchronization signal output terminal (SYNC OUT). The time base signal becomes “True” while the SYNC OUT signal is “High.”

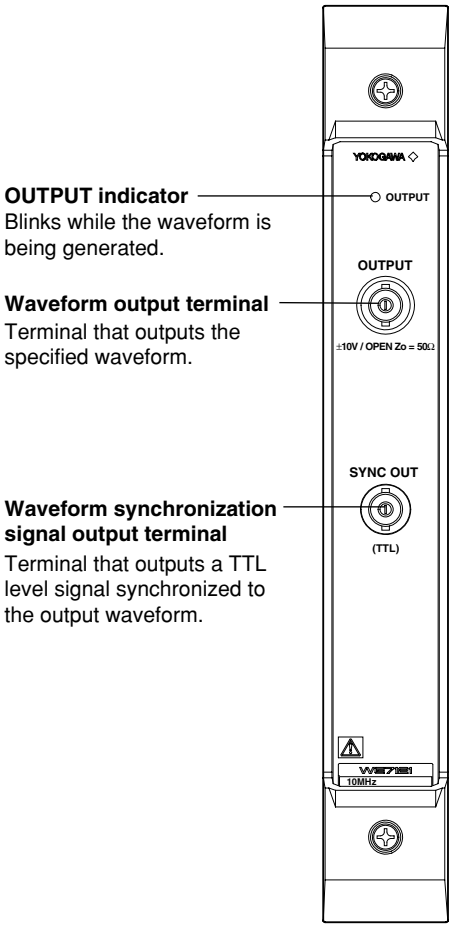
There is no function to input the time base signal.

Note

- The SYNC OUT signal is output independently from the ON/OFF condition of the output of the 10 MHz Function Generator Module WE7121. Thus, the bus trigger signal and the time base signal of the measuring station are also output independently from the ON/OFF condition of the WE7121.
- The SYNC OUT signal does not change when the oscillation is stopped during the trigger oscillation/gate oscillation mode. Furthermore, depending on the output waveform, the SYNC OUT signal becomes “High” even when the oscillation is stopped. Therefore, sometimes, “True” is continuously output to the bus trigger/time base signal bus of the measuring station.

1.10 Names and Functions of Sections

Front Panel



OUTPUT indicator
Blinks while the waveform is being generated.

Waveform output terminal
Terminal that outputs the specified waveform.

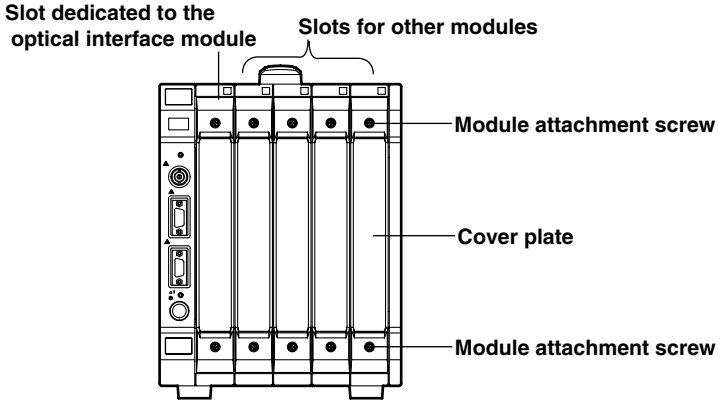
Waveform synchronization signal output terminal
Terminal that outputs a TTL level signal synchronized to the output waveform.

2.1 Installing the Module into the Measuring Station

Preparing to Install the Module

Upon purchasing the measuring station, each slot is covered with a cover plate as shown in the figure below. Verify that the power supply is not connected to the measuring station, then loosen the module attachment screws (2 locations) and remove the cover plate from the slot where the module is going to be installed. Please note that the slot on the left end is dedicated to the communication interface module and this module cannot be installed there.

* The following figure shows an example of the measuring station WE400.



Installing the Function Generator Module

WARNING

- Make sure to fasten the top and bottom attachment screws. If you connect the input signal cable without fastening the attachment screws, the protective grounding of the measuring station provided by the power cord is compromised and may cause electric shock.

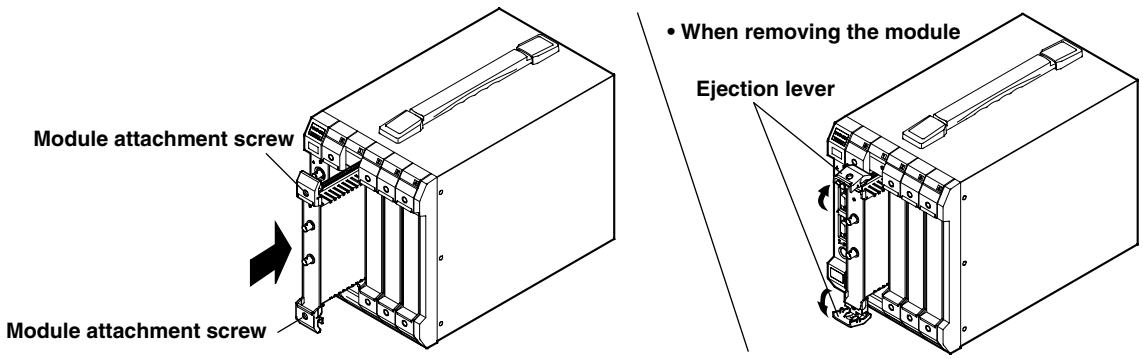
CAUTION

- To avoid damaging the instrument when installing modules, make sure to turn OFF the standby power switch of the measuring station.
- Be careful not to get your fingers caught in the ejection lever while inserting the module. In addition, do not put your hand inside the slot, because there are protrusions along the module guide. You may injure your fingers from them.
- Do not remove the cover plates from unused slots. It can cause overheating and cause malfunction. Cover plates are also needed to minimize the influence caused by electromagnetic interference.

Insert the module along the guide rail of the slot from which you removed the cover plate. Insert the module until it clicks into the connector. Be careful not to get your fingers caught in the ejection lever while inserting the module. When the module is securely inserted, fasten the module attachment screws (tightening torque: 0.6 to 0.7 N-m).

To remove the module, loosen the module attachment screws, and pull the ejection lever from the inside to the outside. This will force the module out of the slot.

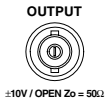
<An illustration is shown on the next page.>



Note

When synchronizing output signals from multiple function generators, install the modules in adjacent slots.

2.2 Connecting the Cable to the Waveform Output Terminal



Connect the probe (or other waveform output cables such as a BNC cable) to the output terminal (BNC terminal indicated as OUTPUT) on the front panel of the module.

- Connector type: BNC
- Number of connectors: 1
- Maximum output voltage: ±10 V, with high impedance load
- Output impedance: ±50 Ω ±1%, open when output is OFF
- Ground: Connect to case ground

CAUTION

- Do not apply voltage from the outside. Doing so may damage the module.

Note

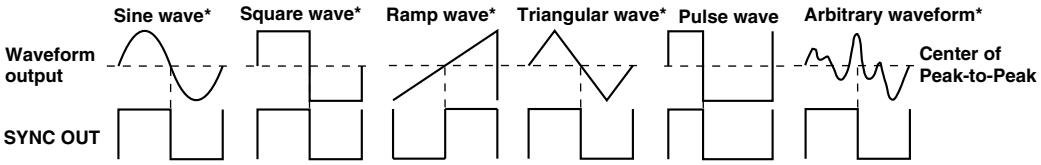
The module can output voltages over ±10 V depending on the settings, but the waveform may not retain its proper shape at this level.

2.3 Connecting the Cable to the Waveform Synchronization Signal Output Terminal

Connect the probe (or other waveform synchronization signal output cables such as a BNC cable) to the output terminal (BNC terminal indicated as SYNC OUT) on the front panel of the module.

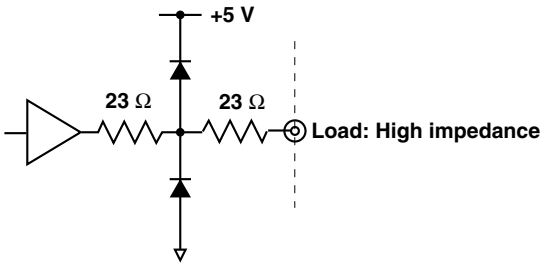
- Connector type: BNC
- Number of connectors: 1
- Output level: TTL level, with high impedance load
- Maximum output current: ±3.2 mA
- Output method: Non-isolated unbalanced output
- Output impedance: About 50 Ω
- Ground: Connect to case ground

Timing Chart



*** SYNC OUT signal of Sine wave/Square wave/Ramp wave/Triangular wave/Arbitrary waveform has a fixed duty cycle of 50%.**

Output Circuit



CAUTION

- Do not use the module with less than 1.6 kΩ of load resistance connected to the output terminal. Also, do not apply an external voltage. Doing so may damage the module.

Note

- When using the waveform synchronization signal, we recommend that you to set the output mode to continuous oscillation mode. The initial value will be unstable under the trigger and the gate oscillation modes.
- The waveform synchronization signal is constantly output regardless of the ON/OFF condition of the [Output] button of the operation panel. Therefore, the waveform synchronization signal is output to the bus trigger signal bus or the time base signal bus of the measuring station simply by selecting the trigger source or the time base source for the output of this module in the trigger source/time base source setting dialog box that appears by clicking [Station]-[Trigger Setting] in the station window.

3.1 Troubleshooting

- If servicing is necessary, or if the instrument is not operating correctly after performing the following corrective actions, contact your nearest YOKOGAWA dealer.
- To verify that the module is operating correctly, perform the self test as described on the next page.

Problem	Probable Cause/Corrective Action	Reference
Module does not operate.	Check to see that the module is installed correctly into the station. Also, install the module into another slot, and check whether it will operate there. If it operates in the other slot, the measuring station is likely to have malfunctioned. If the module is installed correctly and does not operate, the connector might be bad, or the IC may have malfunctioned. In any case, contact your nearest YOKOGAWA dealer to have it repaired.	2-1, *
There is no waveform output.	Check whether the "**O**" indicator on the left of the [Output] button is green. If the waveform is a trigger oscillation or gate oscillation or if you have specified the burst count, check that the settings are correct.	1-4, 1-12 1-6
The Output waveform is not correct.	Check to see that the output waveform setting and output conditions are correct.	1-1 to 1-9
Cannot set the waveform.	Check that the settings you are trying to enter are within the specifications.	4-1 to 4-3

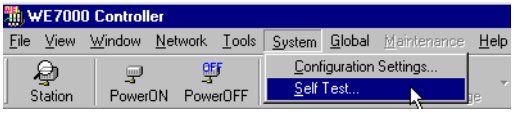
* See WE7000 User's Manual (IM 707001-01E).

3.2 Self Test

If you believe that the module is not operating correctly, perform the self test according to the following steps.

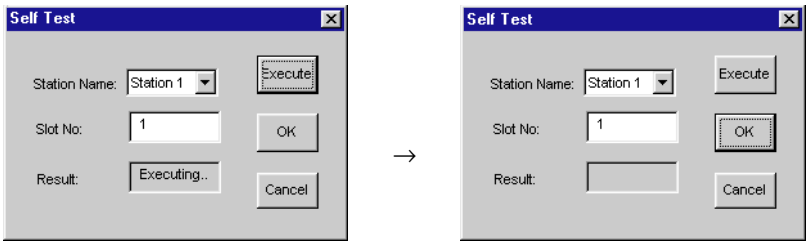
Executing Self Test

1. Disconnect the cable connected to the waveform synchronization signal output terminal (SYNC OUT).
2. Select [Self Test] from the [System] menu of the WE7000 Control Software.



3. In the [Self Test] dialog box that appears, select the station name and enter the slot number corresponding to the module, and click the [Execute] button.

   "Executing..." is displayed in the result display box.



Verifying Test Results

If a value other than "0" is displayed in the "Result" display box of the "Self Test" dialog box, the module is probably malfunctioning. Please contact your nearest YOKOGAWA dealer.

3.3 Maintenance

Maintenance of Parts

There are no parts in this module that require periodic replacement.

Calibration

We recommend that you calibrate the measurement module once a year to assure its measurement accuracy. Please contact your nearest YOKOGAWA dealer .

4.1 Performance Specifications

The following performance specifications are attained under standard operating conditions (section 4.4, “General Specifications”).

Waveform Output

Number of output channels

1 channel

Standard output waveforms

Sine wave/square wave (duty cycle fixed at 50%)/triangular wave/ramp wave/pulse wave (duty cycle variable), and inversions of each waveform

Arbitrary waveform

Output amplitude resolution: 12 bit

Memory length: 16384 points (some points are not generated when the repetitive frequency is 2.4 kHz of higher.)

Output operation

Continuous oscillation (CONT): Outputs the waveform continuously

Trigger oscillation (TRIG): Outputs the specified count (integer) of burst waveforms in sync with the trigger.

Gate oscillation (GATE): Outputs the integer count of burst waveforms while the gate is enabled.

DC output (DC): Outputs a DC voltage.

Oscillation frequency range

Sine/Square wave: 1 μHz to 10 MHz

Triangular/Pulse wave: 1 μHz to 200 kHz

Ramp wave: 1 μHz to 200 kHz

Arbitrary waveform: 1 μHz to 200 kHz

Oscillation frequency resolution

1 μHz or 9 digits maximum

Oscillation frequency accuracy

±20 ppm

Oscillation frequency stability

±20 ppm (when ambient temperature is 5 to 40°C)

Oscillation reference clock

40.2107 MHz

Output Characteristics

Maximum output voltage[*1]

±10 V

Amplitude range[*1]

20 Vp-p (resolution: 1 mVp-p)

Amplitude accuracy[*1] (for 1 kHz sine wave)

±(0.5% of the specified value + 14 mV)

Oscillation frequency characteristics[*2]

Sine wave

≤ 100 kHz ±0.1 dB

≤ 1 MHz ±0.2 dB

≤ 10 MHz ±0.5 dB

Square/Pulse wave (duty cycle 50%)

≤ 10 kHz ±2%

Triangular wave

≤ 10 kHz ±3%

Ramp wave

≤ 10 kHz ±3%

Offset voltage range*1

±10 V (resolution: 1 mV)

Offset voltage accuracy*1

±(0.3% of the specified value + 0.2% of the specified amplitude + 20 mV)

DC output range*1

±10 V (resolution: 1 mV)

DC output accuracy*1

±(0.3% of set value + 20 mV)

Output impedance

50 Ω ±1%, except open when the output is turned OFF

Maximum output current

±200 mA

Output format

Non-isolated unbalanced

Connector type

BNC

*1 Value under high impedance load.

*2 Amplitude 20 Vp-p, offset voltage 0 V, 50 Ω load, measures RMS value with 1 kHz as a reference.

Sine Wave Purity

Harmonics* (Maximum value of the 2nd to 5th order harmonic components)

100 kHz: –55 dBc or less

1 MHz: –45 dBc or less

10 MHz: –35 dBc or less

Harmonic distortion* (RMS value of 2nd to 5th order harmonic components)

100 kHz: 0.3% or less

Spurious response* (frequency range 1 kHz to 100 MHz)

100 kHz: –55 dBc or less

* Measured with 20 Vp-p amplitude, 0 V offset voltage, 50 Ω load.

Characteristics of Sine, Pulse, and Triangular Waves

Rise time*

Square wave: 30 ns or less (10% - 90%)

Pulse wave: 100 ns or less (10% - 90%)

Overshoot*

±5% or less of the output p-p value

Duty cycle setting (pulse wave only)

Selectable range: 0 to 100% (resolution: 0.01% or 25 ns)

Time accuracy (≤ 10 kHz): ±0.2% of (1/the specified frequency)

Jitter: 1 clock cycle

* Measured with 20 Vp-p amplitude, 0 V offset voltage, 50 Ω load.

Phase

Target

Start/stop phase when using trigger/gate oscillation

Selectable range

–10000 deg to +10000 deg (resolution: 0.01 deg)

Trigger/Gate

Trigger source

Internal trigger, Bus trigger (BUSTRG1/BUSTRG2) signal on WE bus

Selectable range of internal trigger frequency

1 mHz to 50 kHz (resolution: 1 mHz)

Bus trigger (BUSTRG1/BUSTRG2) signal output source

Able to output waveform synchronization output (SYNC) signal

Selectable range of burst count

1 to 65535 counts (step: 1)

Gate source

Bus trigger (BUSTRG1/BUSTRG2) signal on the WE bus

Synchronous Operation

Skew between modules (when modules are linked and outputting the pulse wave)

70 ns per module (Typical value*1)

Isolation between channels*2 (when modules are linked)

–65 dB (Typical value*1)

*1 Typical value represents a typical or average value. It is not strictly guaranteed.

*2 Output waveform: Cross talk for a 10 MHz sine wave with 20 Vp-p amplitude, 0 V offset voltage, 50 Ω load.

4.2 Specifications of the Auxiliary Output

Waveform Synchronization Signal Output (SYNC OUT)

Output level

TTL level, under high impedance load

Output impedance

Approx. 50 Ω

Maximum output current

±3.2 mA

Output format

Non-isolated unbalanced

Connector type

BNC

4.3 Default Values (Factory Default Settings)

Function (output waveform): sine
Mode (output mode): Cont
Trigger (trigger source): Internal
Freq (output frequency): 1000 Hz
Phase (phase): 0 deg
Ampl (amplitude of output voltage): 2 Vp-p
Offset (offset voltage): 0 V
Duty (duty cycle): 50 %
Burst (number of burst): 5
Trigger Freq (trigger frequency): 100 Hz
Link (link parameters): None
Invert (waveform inversion): Off

4.4 General Specifications

Safety Standards

Complies with CSA C22.2 No.1010.1 and EN61010-1, conforms to JIS C1010-1

- Overvoltage Category CAT I and II[*1]
- Pollution Degree 1 and 2[*2]

EMC Standards

Emission

Complying Standard

EN55011 Group 1 Class A

This product is a Class A (for commercial environment) product. Operation of this product in a residential area may cause radio interference in which case the user is required to correct the interference.

Immunity

Complying Standard

EN50082-2

Testing Condition

Connect with the 3 m coaxial cable (3D-2W), 50 Ω terminated.

Standard Operating Conditions

Ambient temperature: 23 ±2°C, Ambient humidity: 50 ±10% RH, Error on supply voltage/frequency: within 1% of rating, after the warm-up time has passed

Warm-up Time

At least 30 minutes

Operating Conditions

Same as that of the measuring station

Storage Conditions

Temperature: –20°C to 60°C

Humidity: 20% to 80% RH (no condensation)

Power Consumption

7 VA (Typical value at 100 V/50 Hz[*3])

External Dimensions

Approx. 33(W) × 243(H) × 232(D) mm (projections excluded)

Weight

Approx. 0.7 kg

Number of Used Slots

1

Standard Accessories

User's Manual (1)

Optional Accessories

366924 BNC cable (1 m), 366925 BNC cable (2 m), 366926 BNC alligator clip cable (1 m), 366921 Adapter (BNC plug-banana terminal jack), 366927 Adapter (BNC plug-RCA jack), 366928 Adapter (BNC jack-RCA plug)

[*1] Overvoltage Categories define transient overvoltage levels, including impulse withstand voltage levels.

Overvoltage Category I: Applies to equipment supplied with electricity from a circuit containing an overvoltage control device.

Overvoltage Category II: Applies to equipment supplied with electricity from fixed installations like a distribution board.

*2 Pollution Degree: Applies to the degree of adhesion of a solid, liquid, or gas which deteriorates withstand voltage or surface resistivity.

Pollution Degree 1: Applies to closed atmospheres (with no, or only dry, non-conductive pollution).

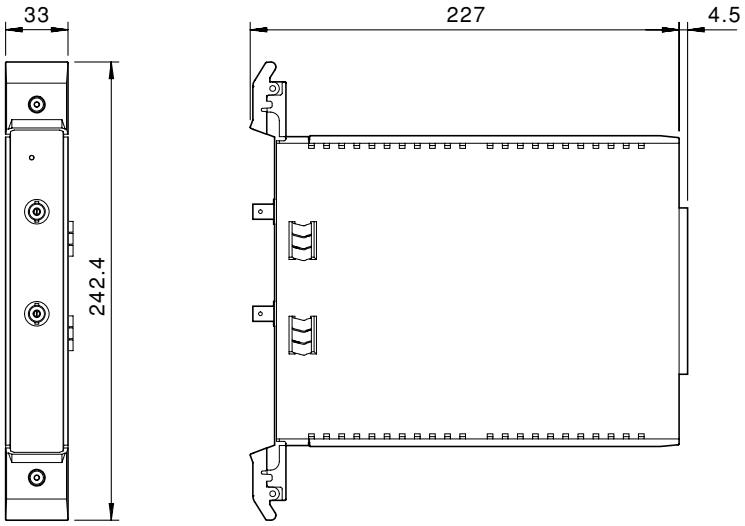
Pollution Degree 2: Applies to normal indoor atmospheres (with only non-conductive pollution).

*3 Typical value represents a typical or average value. It is not strictly guaranteed.

4.5 Dimensional Drawings

Unit: mm

10 MHz Function Generator Module (WE7121)



If not specified, the tolerance is ±3%. However, in cases of less than 10 mm, the tolerance is ±0.3 mm.

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