Tektronix PSPL1P601 & PSPL1P602 Pulse/Pattern Generators

User Manual

071-3415-00

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User Manual

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- In North America, call 1-800-833-9200.
- Worldwide, visit www.tektronix.com to find contacts in your area.

Warranty

Tektronix warrants that this product will be free from defects in materials and workmanship for a period of one (1) year from the date of shipment. If any such product proves defective during this warranty period, Tektronix, at its option, either will repair the defective product without charge for parts and labor, or will provide a replacement in exchange for the defective product. Parts, modules and replacement products used by Tektronix for warranty work may be new or reconditioned to like new performance. All replaced parts, modules and products become the property of Tektronix.

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[W2 – 15AUG04]

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Important safety information

This manual contains information and warnings that must be followed by the user for safe operation and to keep the product in a safe condition.

To safely perform service on this product, additional information is provided at the end of this section. (See page x, *Service safety summary*.)

General safety summary

Use the product only as specified. Review the following safety precautions to avoid injury and prevent damage to this product or any products connected to it. Carefully read all instructions. Retain these instructions for future reference.

Comply with local and national safety codes.

For correct and safe operation of the product, it is essential that you follow generally accepted safety procedures in addition to the safety precautions specified in this manual.

The product is designed to be used by trained personnel only.

Only qualified personnel who are aware of the hazards involved should remove the cover for repair, maintenance, or adjustment.

Before use, always check the product with a known source to be sure it is operating correctly.

This product is not intended for detection of hazardous voltages.

Use personal protective equipment to prevent shock and arc blast injury where hazardous live conductors are exposed.

While using this product, you may need to access other parts of a larger system. Read the safety sections of the other component manuals for warnings and cautions related to operating the system.

When incorporating this equipment into a system, the safety of that system is the responsibility of the assembler of the system.

To avoid fire or personal injury

Use proper power cord. Use only the power cord specified for this product and certified for the country of use.

Do not use the provided power cord for other products.

Ground the product. This product is grounded through the grounding conductor of the power cord. To avoid electric shock, the grounding conductor must be connected to earth ground. Before making connections to the input or output terminals of the product, make sure that the product is properly grounded.

Do not disable the power cord grounding connection.

Power disconnect. The power cord disconnects the product from the power source. See instructions for the location. Do not position the equipment so that it is difficult to operate the power cord; it must remain accessible to the user at all times to allow for quick disconnection if needed.

Connect and disconnect properly. Do not connect or disconnect probes or test leads while they are connected to a voltage source.

Observe all terminal ratings. To avoid fire or shock hazard, observe all ratings and markings on the product. Consult the product manual for further ratings information before making connections to the product.

Do not apply a potential to any terminal, including the common terminal, that exceeds the maximum rating of that terminal.

The measuring terminals on this product are not rated for connection to mains or Category II, III, or IV circuits.

Do not operate without covers. Do not operate this product with covers or panels removed, or with the case open. Hazardous voltage exposure is possible.

Avoid exposed circuitry. Do not touch exposed connections and components when power is present.

Do not operate with suspected failures. If you suspect that there is damage to this product, have it inspected by qualified service personnel.

Disable the product if it is damaged. Do not use the product if it is damaged or operates incorrectly. If in doubt about safety of the product, turn it off and disconnect the power cord. Clearly mark the product to prevent its further operation.

Examine the exterior of the product before you use it. Look for cracks or missing pieces.

Use only specified replacement parts.

Use proper fuse. Use only the fuse type and rating specified for this product.

Wear eye protection. Wear eye protection if exposure to high-intensity rays or laser radiation exists.

Do not operate in wet/damp conditions. Be aware that condensation may occur if a unit is moved from a cold to a warm environment.

Do not operate in an explosive atmosphere.

Keep product surfaces clean and dry. Remove the input signals before you clean the product.

Provide proper ventilation. Refer to the installation instructions in the manual for details on installing the product so it has proper ventilation.

Slots and openings are provided for ventilation and should never be covered or otherwise obstructed. Do not push objects into any of the openings.

Provide a safe working environment. Always place the product in a location convenient for viewing the display and indicators.

Avoid improper or prolonged use of keyboards, pointers, and button pads. Improper or prolonged keyboard or pointer use may result in serious injury.

Be sure your work area meets applicable ergonomic standards. Consult with an ergonomics professional to avoid stress injuries.

Use care when lifting and carrying the product.

Service safety summary

The *Service safety summary* section contains additional information required to safely perform service on the product. Only qualified personnel should perform service procedures. Read this *Service safety summary* and the *General safety summary* before performing any service procedures.

To avoid electric shock. Do not touch exposed connections.

Do not service alone. Do not perform internal service or adjustments of this product unless another person capable of rendering first aid and resuscitation is present.

Disconnect power. To avoid electric shock, switch off the product power and disconnect the power cord from the mains power before removing any covers or panels, or opening the case for servicing.

Use care when servicing with power on. Dangerous voltages or currents may exist in this product. Disconnect power, remove battery (if applicable), and disconnect test leads before removing protective panels, soldering, or replacing components.

Verify safety after repair. Always recheck ground continuity and mains dielectric strength after performing a repair.

Terms in this manual

These terms may appear in this manual:

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

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

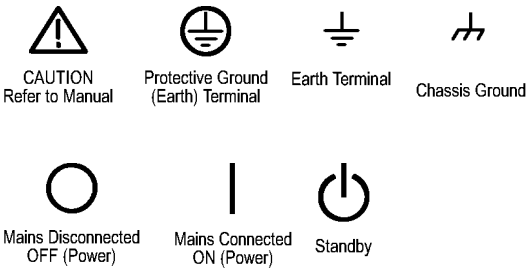
Symbols and terms on the product

These terms may appear on the product:

- DANGER indicates an injury hazard immediately accessible as you read the marking.
- WARNING indicates an injury hazard not immediately accessible as you read the marking.
- CAUTION indicates a hazard to property including the product.

When this symbol is marked on the product, be sure to consult the manual to find out the nature of the potential hazards and any actions which have to be taken to avoid them. (This symbol may also be used to refer the user to ratings in the manual.)

The following symbol(s) may appear on the product:



Preface

This document provides information for installing and using the Tektronix PSPL1P601 & PSPL1P602 Pulse/Pattern Generators.

Inspection

Your instrument was carefully inspected electrically and mechanically before shipment. After unpacking all items from the shipping carton, check for any obvious signs of physical damage that may have occurred during transit (there may be a protective film over the display lens, which can be removed). Report damage to the shipping agent immediately. Save the original packing carton for possible future shipment.

The following items are included with every instrument order:

- Pulse/Pattern Generator with line cord
- Rack mount/handle kit
- Accessories as ordered

Model summary

The Pulse/Pattern Generators give you extensive control over pulse parameters, including amplitude, offset, pulse width, and duty cycle. The PSPL1P601 is a single-channel, 1.6 GHz pulse/pattern generator; the PSPL1P602 includes a second signal output channel.

The operational flexibility and pattern generation capability of the Pulse/Pattern Generators makes them suitable for use in many different applications, including simplified simulation of serial data patterns when testing devices to characterize their performance under suboptimal conditions.

The Pulse/Pattern Generators have jitter insertion incorporated into the design. Jitter insertion allows you to introduce controlled jitter stress for the simulation of real-world signal characteristics. Refer to the *Jitter insertion* section for detailed information.

Features

- Frequency output range: 15 MHz to 1.6 GHz
- Pulse amplitude: 2.5 V (50 Ω source impedance)
- Pulse width: Programmable from 250 ps to (period - 250 ps)
- Pulse output programmable as voltage amplitude and offset
- Output channels have differential output

- Jitter insertion options: Internal or external modulation
- Four operating modes:
  - Pulse mode
  - Burst mode
  - Pattern mode
  - External Width mode
- Internal clock and period source
- Save up to nine pulse/pattern generator setups in nonvolatile memory
- IEEE-488 (GPIB) and USB 2.0 interfaces
- 2RU (Rack Unit) height, full-rack design

Model number descriptions

Models

PSPL1P601. 1.6 GHz PULSE/PAT GEN, 1 CH

PSPL1P602. 1.6 GHz PULSE/PAT GEN, 2 CH

Options

PSPL1P601 JIT. 1.6 GHz PULSE/PAT GEN, 1 CH, JITTER

PSPL1P602 JIT. 1.6 GHz PULSE/PAT GEN, 2 CH, JITTER

Getting started

Front panel controls and connectors

The front panel of the PSPL1P602 is shown in the following figure. The front panel controls and connectors for the PSPL1P601 are similar, except there is only one channel.

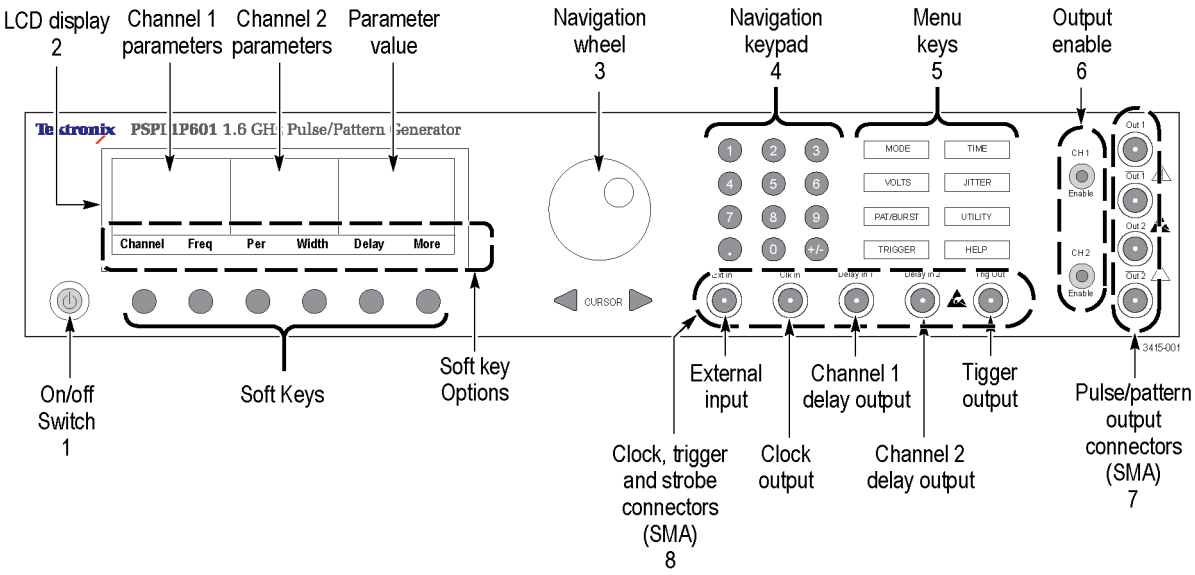


Figure 1: Front panel (PSPL1P602 shown)

1. **On/off switch:** Push this button to turn the instrument on and off. The green indicator inside the button lights up when the instrument is on. Note that the main power switch on the rear-panel power module must also be in the on position.
2. **LCD display:** The display is divided into three areas:
   - Channel 1 parameters: Displays Channel 1 parameters for the selected function.
   - Channel 2 parameters: Displays Channel 2 parameters for the selected function.
   - Parameter value: Displays the value and related information of the selected parameter.
3. **Navigation wheel:** Rotate this wheel to increase or decrease the displayed parameter value.
4. **Numeric keypad:** Use this keypad to enter parameter values. After typing in a value, available options (for example, MHz range) are displayed as soft keys.

5. **Menu select keys:** The various menus are selected using these keys. The display then shows the parameters, options, and other choices available for the selected menu.
6. **Output enable:** This button turns output enable on and off (one exists for each channel). The green indicator inside the button lights up when the output is enabled. A trigger event will then start the output.
7. **Pulse/pattern output connectors:** Output for each channel is sent to these female SMA connectors.
8. **Clock and trigger connectors:** The following input/output female SMA connectors are provided:
   - External input: Connect an external signal for external triggering.
   - Clock input: Connect an external clock.
   - Channel 1 delay input: Connect an external source for Channel 1 external jitter insertion.
   - Channel 2 delay input: Connect an external source for Channel 2 external jitter insertion.
   - Trigger output: Connect to an external unit. This connector sends a single-ended voltage pulse.
9. **Cursor keys:** Use these keys to increment or decrement parameter values.
10. **Soft keys:** Soft key options that can be selected depend upon the enabled menu. The options are positioned in the display immediately above the soft keys.

Rear panel controls and connectors

The rear panel of the instrument is shown in the following figure.

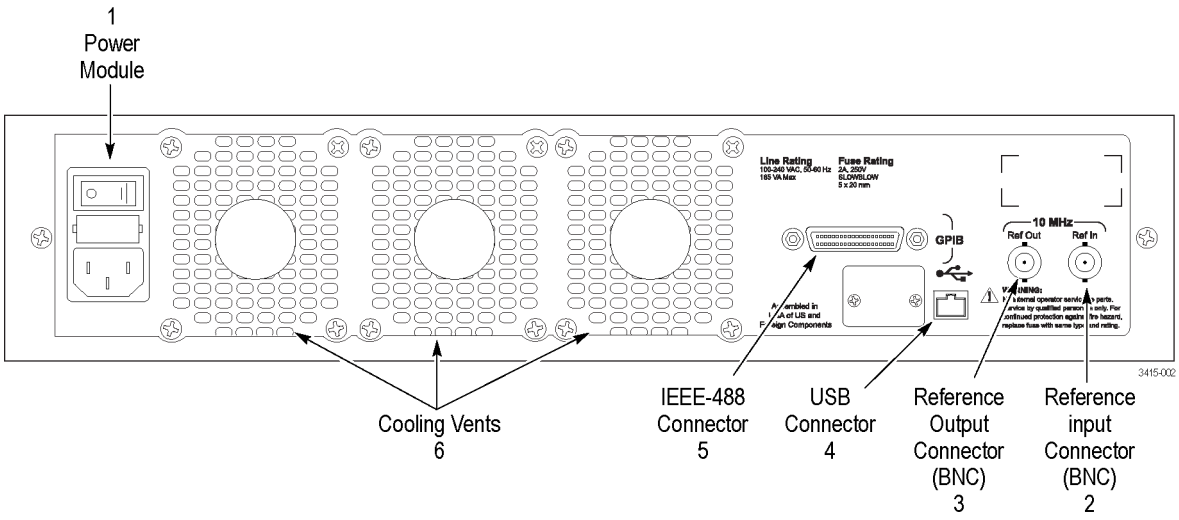


Figure 2: Rear panel

1. **Power module:** The module contains three elements:
   - AC line receptacle: Plug the instrument power cord here.
   - Power line fuse: This drawer houses two line fuses. (See page 4, *Line fuse replacement*.)
   - Power switch: This switch must be in the "1" (on) position to enable the front panel On/ Off switch.
2. **Reference input connector:** This female BNC connector accepts an external 10 MHz oscillator signal for clock reference.

NOTE. *Use the REF IN and REF OUT connectors to connect multiple instruments for the purpose of using one internal clock as the period source.*

3. **Reference output connector:** A 10 MHz signal phase-locked to the internal clock is sent through this female BNC connector.
4. **USB connector:** For USB remote operation, use a USB cable to connect to the USB interface of the remote interface.
5. I **EEE-488 connector:** For GPIB remote operation, use a shielded cable.
6. **Cooling vents:** The instrument uses a cooling fan and vents to keep it from overheating. There is also a cooling vent on each side panel of the instrument. (See page 5, *Ventilation*.)

Power up

The instrument operates from a single-phase line voltage in the range of 100 V to 240 V at a frequency of 50 Hz or 60 Hz. Line voltage and line frequency are automatically sensed; there are no switches to set. Check to ensure the operating voltage in your area is compatible.

CAUTION. *Operating the instrument on an incorrect line voltage may cause damage, possibly voiding the warranty.*

To connect the instrument to line power and turn it on:

1. Before plugging in the power cord, ensure the instrument is turned off and the rear panel power switch is in the off (0) position.
2. Connect the female end of the supplied power cord to the AC receptacle on the rear panel, and move the rear panel power switch to the on (1) position.

WARNING. *The power cord supplied with the instrument contains a separate ground for use with grounded outlets. When proper connections are made, the chassis is connected to power line ground through the ground wire in the power cord. Failure to use a grounded outlet may result in personal injury or death due to electric shock.*

3. Power up the instrument by pressing the front-panel on/off button.

Line fuse replacement

Two line fuses are located in a drawer in the Power Module above the AC receptacle. After turning the power switch off and removing the line cord, remove and inspect the fuses, and replace damaged fuses with this specific type only:

Fuse type: 2 A, 250 V, slow-blow, 5 mm x 20 mm

Ventilation

The instrument has a fan and cooling vents in the rear and side panels to keep it from overheating.

CAUTION. *Observe the following precautions to maintain proper ventilation:*

Do not block the cooling vents.

Do not position any devices adjacent to the instrument that force air (heated or unheated) into or onto the instrument's surfaces or cooling vents. This additional airflow could compromise accuracy performance.

When rack mounting the instrument, ensure there is adequate airflow around the instrument rear and sides to ensure proper cooling. Adequate airflow enables air temperatures within approximately one inch of the instrument surfaces to remain within specified limits under all operating conditions.

Setup and pulse generator settings

External instrument connections

External instrument signal connections are made at the front and rear of the instruments. All front-panel connectors are SMA; rear-panel connectors are BNC.

> ***CAUTION.*** *Instrument damage hazard. Electrostatic discharge could harm your instrument. Use approved antistatic devices when making device connections.*

Out 1 and Out 2 connections

The following figure shows how to connect the output channels of the instrument to one or two Devices Under Test (DUT).

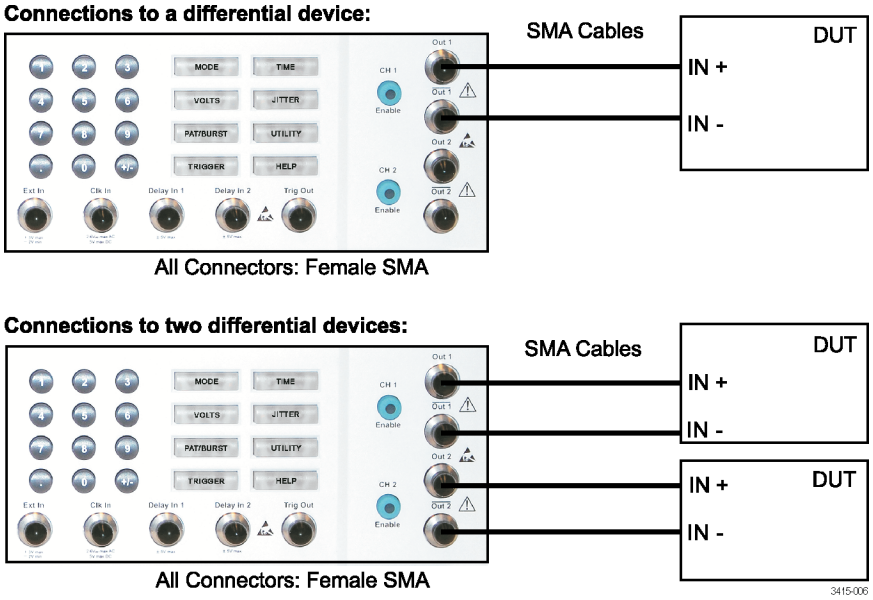


Figure 3: Out 1 and Out 2 connections

Trig Out and Ext In connections

The following figures show connections for Trigger Output (Trig Out) and the connections for External Input (Ext In). Trigger output marks each pulse or, for pattern mode, every eighth bit period. Trigger output is used to trigger an external instrument to start an operation (for example, trigger a scope to capture the waveform).

After an external instrument completes the operation (for example, waveform capture), it can send a trigger back to the Ext In of the PSPL1P601/602 to output another pulse or bit. Setting Trig Out and Ext In together allows for synchronized operation between two instruments. Refer to each operating mode under *Pulse/Pattern generator operation* for triggering details.

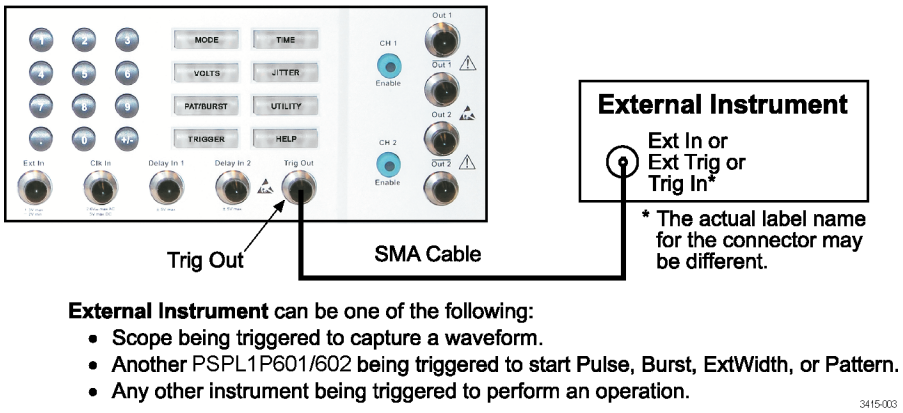


Figure 4: Trig Out connections

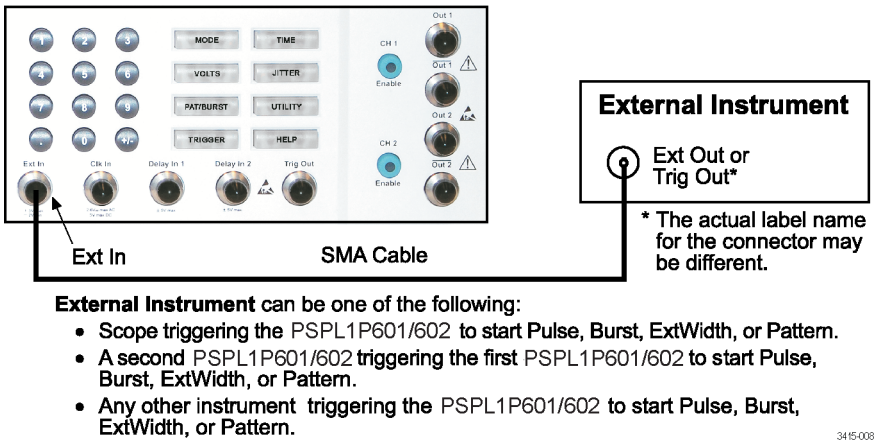


Figure 5: Ext In connections

Delay In connections

A jitter insertion source may be internal or external. The Delay In connections are used to apply external jitter to the output signal. For the Models PSPL1P601 JIT and PSPL1P602 JIT, the Delay In 1 connection applies to Channel 1, and the Delay In 2 connection applies to Channel 2.

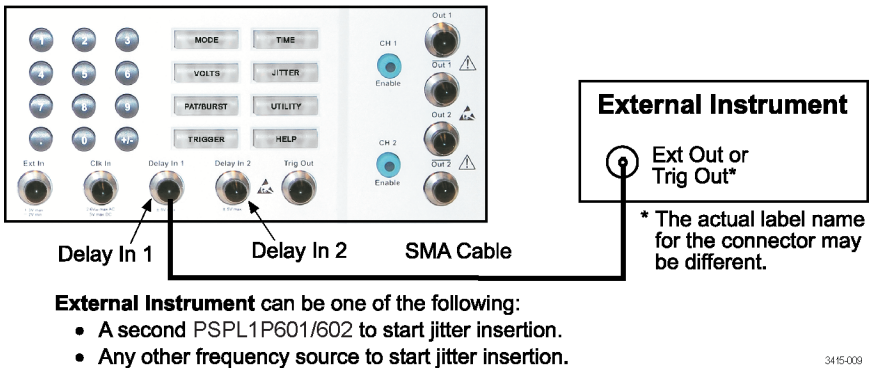


Figure 6: Delay In connections

Clk In connections

The period source can be provided by an external clock as shown in the *Power up defaults table.* (See Table 5 on page 20.) Refer to each operating mode under *Pulse/Pattern generator operation* for triggering details.

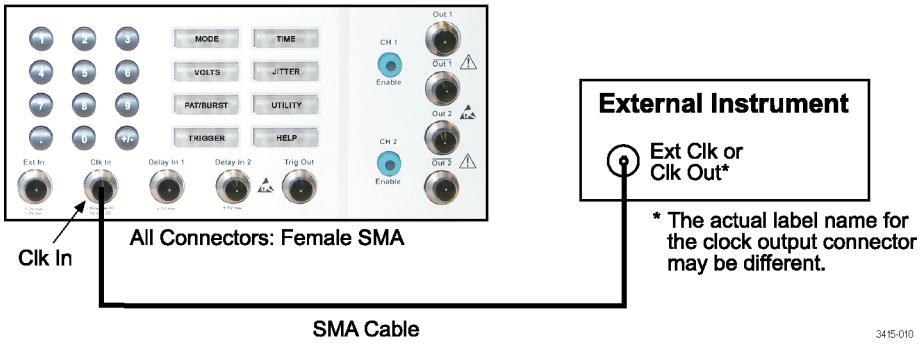


Figure 7: Clk In connections

Ref Out and Ref In connections

When using multiple instruments in a system, the internal clock reference of a single unit may be shared (made common to all units) by connecting the Reference Output (Ref Out) connector of one unit to the Reference Input (Ref In) connector of another. In any multi-unit system, the unit with the most accurate clock reference is typically used as the governing unit. When multiple units share the same internal clock reference, the frequencies of all of the units are synchronized.

The following figure shows two instruments connected together so that the second unit can use the internal clock reference of the first unit. In this configuration example, all but one instrument must be set for RefOsc = External under the Utility menu.

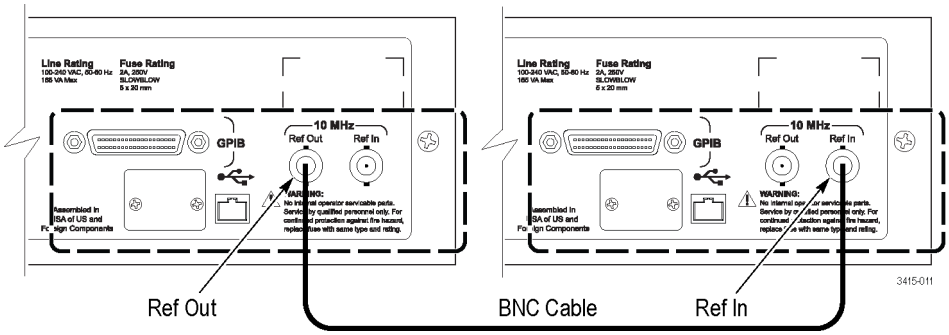


Figure 8: Ref Out and Ref In connections

Editing parameter values and settings

Display

The instrument has an LCD display to view and set the various pulse/pattern parameters. Each menu has its own set of parameters that are selected using the soft keys under each command. For example, the following figure shows display items for the VOLTS menu.

As shown, pressing the **More** soft key displays all options for the VOLTS menu. All of the menus are summarized in the *Menu summary table*. (See Table 4 on page 18.) Pressing the **Channel** soft key switches between the two channels to set parameters for the selected channel.

Power up default settings are shown in the *Power-up defaults table*. (See Table 5 on page 20.).

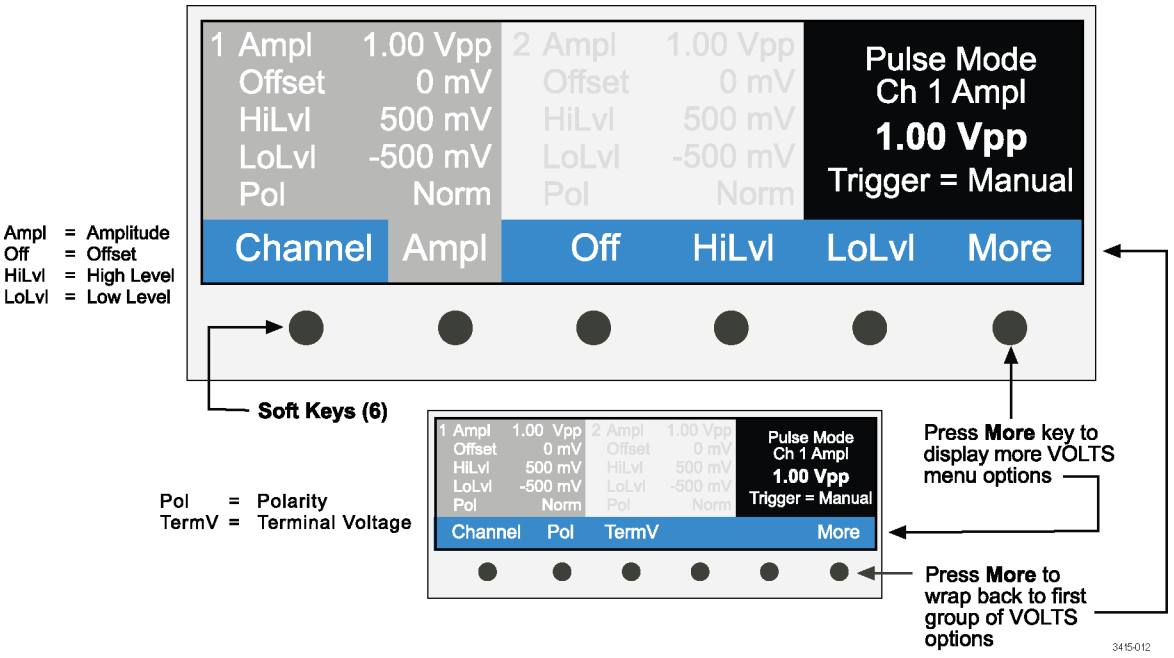


Figure 9: LCD display and soft keys (VOLTS menu shown)

To edit parameter values and settings:

1. Select a menu (VOLTS, for example). The menu keys are located next to the keypad.
2. Press the soft key of the parameter to be changed. Use the **More** key to display additional options. The parameter value or setting is displayed on the right side of the display.
3. Change a parameter value or setting as follows:
   - **Parameter value:** If the parameter is a value, it can be changed using the navigation wheel or the keypad.

     Navigation wheel: Rotating the wheel increments or decrements the value.

     Keypad: When typing in a value, the available ranges (mV or V, for example) for the value will appear at the bottom of the display. After entering in the value, press a soft key to select the range.

     CURSOR keys: Press to increment or decrement values.
   - **Parameter setting:** For a parameter setting, options may appear on the bottom of the display (for example, **Enable**, **Disable**, or **Cancel**) and can be selected by pressing a soft key.

Additional soft keys for menu navigation will display as needed:

- **Enter** soft key: Press to enter the parameter setting or value.
- **Back** soft key: Press to return to the previous menu view.
- **Cancel** soft key: Press to cancel a menu selection. The menu returns to the previous view.

Invalid entry error message

Trying to enter an invalid parameter setting will result in the following message in the upper right corner of the display:

```
Error, Press Help
```

Press the **HELP** key to display a message that explains the error. Press any key to cancel the help message.

Basic pulse parameters

The instrument is in pulse mode with continuous triggering selected when it is powered up. Once a channel is enabled, it will continuously output pulses.

The following figure shows the first two pulses of the continuous pulse output using typical settings. The parameter names in italic text correspond to the parameter names in the front panel VOLTS and TIME menus.

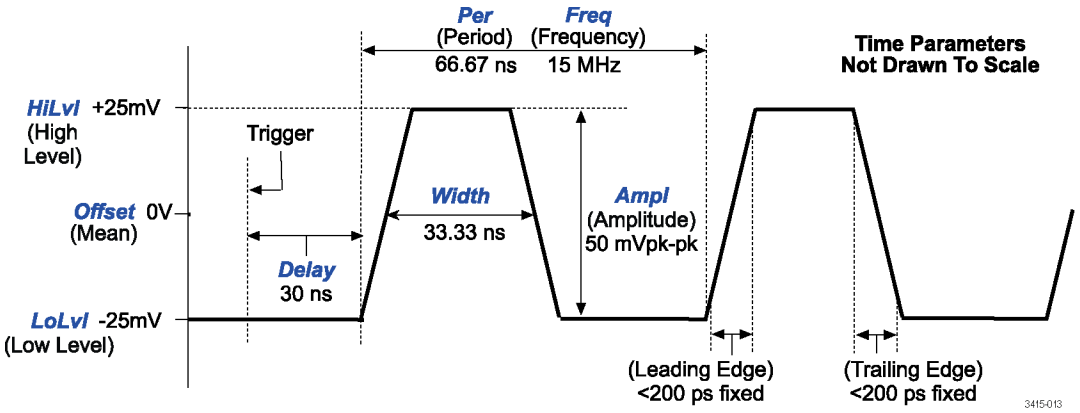


Figure 10: Typical pulse level and timing parameter settings (pulse mode, continuous triggering)

The basic pulse level, timing, and triggering parameters are summarized in the next two tables. The last column (Independent channel settings) in the two tables does not apply to single channel models.

Pulse level parameters

The following table lists the parameters found under the VOLTS menu.

Table 1: Pulse level parameters

Parameter	Description	Independent channel settings [1] (PSPL1P602 and PSPL1P602 JIT only)
High level Low level	Configure the pulse high/low levels by setting the high level and the low level within the level window (-2 V to +3.3 V). Changing the high or low level will change the amplitude and offset.	Yes
Amplitude	Amplitude is the low-to-high magnitude of the pulse. Amplitude setting: 50 mV_{p-p} to 2.5 V_{p-p}. Changing the amplitude will change the high and low levels. Offset is not affected.	Yes
Offset	Offset is the mean (average) value of the high and low levels: Offset = (high level + low level)÷2. The offset can be set to any value that allows the pulse to fit within the level window. Changing the offset will change the high and low levels. Amplitude is not affected.	Yes
Polarity	Polarity can be set to **Norm** (normal) or **Comp** (complement).	Yes
Term voltage	Enter when the DUT has non-zero termination voltage (-2 V to +3.3 V).	Yes

[1] Yes = The parameter can be independently set for each channel of the PSPL1P602 and PSPL1P602 JIT .No = The parameter setting applies to both channels.

Termination Voltage

Entering a non-zero termination voltage (**TermV**) will change the displayed values of **HiLvl**, **LoLvl** and **Offset** to be correct when the output is connected to a 50 Ω load that is not at 0 V. The following figure shows a schematic of that termination.

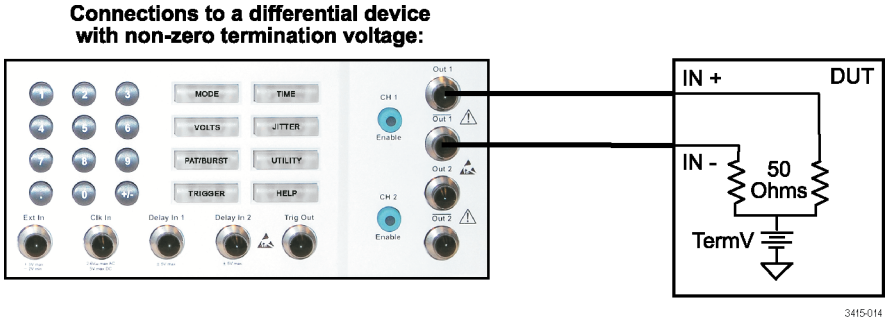


Figure 11: Out 1 connected to a DUT with non-zero termination voltage

The amplitude of the output pulse does not change, but the display shows the correct levels and offset at the DUT given its termination voltage.

Pulse timing and triggering parameters

The following table lists the parameters found under the Time menu unless otherwise noted.

Table 2: Pulse timing and triggering parameters

Parameter	Description	Independent channel settings [1] (PSPL1P602 and PSPL1P602 JIT only)
Frequency	Pulse cycle time can be set as frequency or period. Frequency can be set from 15 MHz to 1.6 GHz.	No
Period	Period can be set from 625 ps to 66.67 ns.	No
Width	Pulse width is measured at the 50% amplitude level of the pulse. Width can be set from 250 ps to (Period - 250 ps).	Yes
Delay	A delay between the trigger event and the start of each pulse can be set from 0 to Period.	Yes
Duty Cycle	The duty cycle may be set between 0.38% and 99.62%. Not applicable in NRZ format.	Yes
Crossing Point	The crossing point of NRZ data may be set between 30% and 70%.	Yes
Hold	Width or Duty Cycle is held constant as Frequency is changed.	Yes
Clock Source	The source for period generation can be Internal or an external clock input (**ClkIn**). (Under Utility menu.)	No
Trigger Source	Select the trigger source to start pulse output: Cont (continuous), ExtIn (external input), **Manual** or **Remote**. (Under Trigger menu.)	No
Trigger Type	Select the trigger type: **Edge** or **Level**. (Under Trigger menu.)	No

1 Yes = The parameter can be independently set for each channel of the PSPL1P602 and PSPL1P602 JIT .No = The parameter setting applies to both channels.

Operating modes

There are four operating modes: Pulse mode, Burst mode, Pattern mode, and External Width mode.

Pulse mode

Pulse mode delivers a single pulse to the output channel per trigger event. The basic pulse level, timing and triggering parameters are summarized in the previous two tables.

Burst mode

This mode is similar to the Pulse mode, except that each trigger event will deliver a series (burst) of n pulses. In Burst mode, 2 to 1,048,576 pulses can be delivered.

Pattern mode

Pattern mode delivers a user-configured or pre-configured bit pattern that consists of Logic 0's and 1's. The length of the bit pattern can be 8 to 16,777,216 bits. The pattern can be presented in R1 (return-to-one), RZ (return-to-zero), or NRZ (non-return-to-zero) format. In R1 and RZ modes, the duration (duty cycle) of the pattern pulse is programmable. In NRZ mode, the pattern crossing point is programmable. Logic 0 represents the low pulse level, and Logic 1 represents the high pulse level.

Pattern data formats. There are three data formats for output patterns: RZ (return-to-zero), R1 (return-to-one), and NRZ (non-return-to-zero). The following figure shows the difference between the three formats. The 8-bit pattern is the same for all three formats (11100010), and the logic levels are the same (Logic 0 = 0 V, Logic 1 = 2.5 V):

- RZ Format: For 50% duty cycle, a Logic 1 bit goes to 2.5 V for the first half of the period, and then returns to 0 V for the second half of the period (return-to-zero). A Logic 0 bit remains at 0 V for the entire period.
- R1 Format: A Logic 1 bit remains at 2.5 V for the entire period. A Logic 0 bit goes to 0 V for the first half of the period, and then returns to 2.5 V for the second half of the period (return-to one).
- NRZ Format: A Logic 1 bit goes to 2.5 V and stays at 2.5 V for the entire period (non-return-to-zero). A Logic 0 bit goes to 0 V and remains at 0 V for the entire period.

For any data format, the level for Logic 0 does not have to be 0 V. It simply must be less positive (more negative) than Logic 1.

Example 1	Example 2
Logic 1 = 2 V	Logic 1 = 0 V
Logic 0 = 1 V	Logic 0 = -2 V

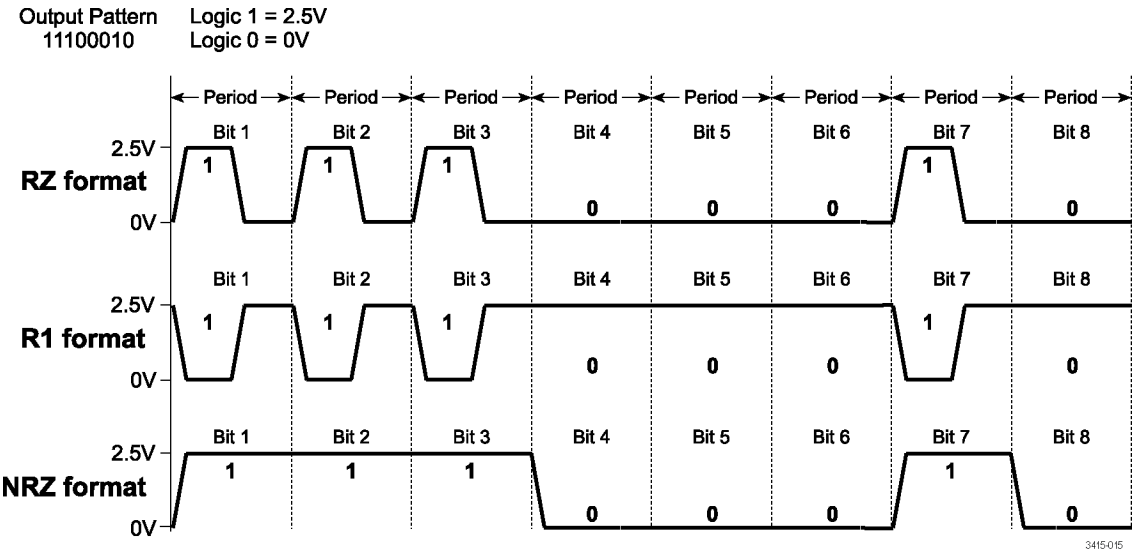


Figure 12: Example output pattern for RZ, R1, and NRZ data formats

Pseudo Random Bit Sequence (PRBS). The PRBS is used to output a pseudo random pattern for testing purposes. The number of bits for the PRBS output pattern can be set as follows:

PRBS length = 2^n-1, where n = 5 to 15, 23 or 31

The R1, RZ, or NRZ data format can be used for the PRBS pattern.

External Width mode

In this mode, the pulse output follows the edges of an external input trigger that is applied to the Ext In connector. As shown in the following figure, a rising edge causes the output to go high, while a falling edge causes the output to go low.

The maximum range of external input trigger is -2 V to +3 V.

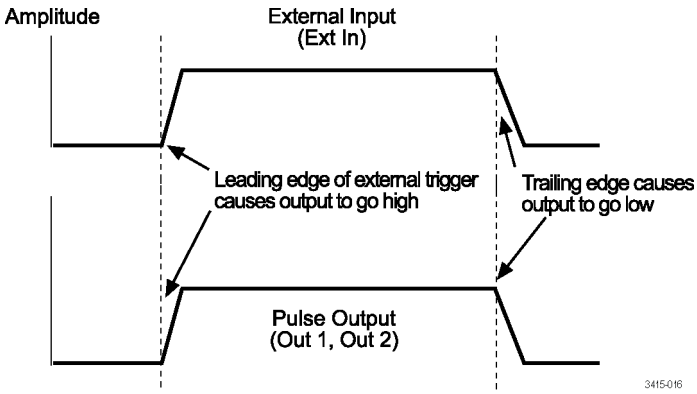


Figure 13: External Width mode

Additional pulse characteristics

The following are characteristics inherent to pulse generation and may or may not be affected by various instrument settings or load.

Duty cycle

The duty cycle is the amount of time (as a percentage of the pulse period) that the pulse is on or active (pulse width). Duty cycle (as a percentage) is calculated as follows:

Duty Cycle = (Width / Period) x 100

The following figure shows an example for duty cycle.

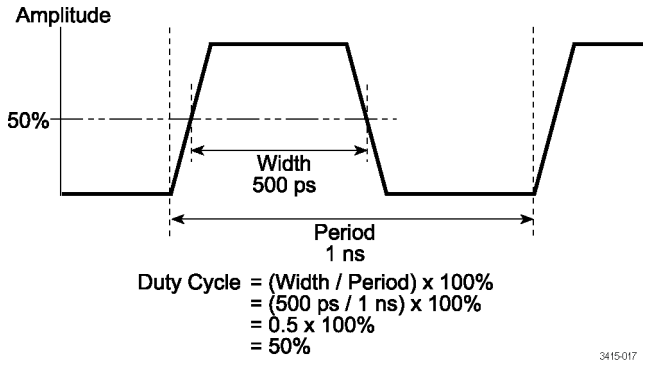


Figure 14: Example of 50% duty cycle

Jitter insertion

The PSPL1P601 JIT and PSPL1P602 JIT are equipped with jitter insertion to help accurately simulate real-world signal characteristics. Jitter is the short-term instability of one edge relative to a reference edge. Jitter is typically specified as a Root-Mean-Square (RMS) value, which is one standard deviation (or sigma).

The reference edge for period jitter is the previous leading edge. The reference edge for delay jitter is the leading edge of the trigger output. Width jitter is the stability of the trailing edge with respect to the leading edge.

Sinusoidal, deterministic, random, and external jitter can be applied in any combination.

NOTE. *The following restrictions apply to jitter insertion:*

Do Not enable SSC and Sine Jitter at the same time.

Use SSC or Sine Jitte only with Internal Clock source and Continuous Trigger Type.

Use Deterministic, Random, or External Input Jitter only with Continuous Trigger Type.

Table 3: Jitter insertion characteristics

Parameter	Specification
Jitter sources	Sinusoidal, deterministic, random, and external
Sinusoidal	Jitter by phase modulation of Clock: 10 kHz to 10 MHz
	10 kHz: 40 ns_{p-p} max.
	30 kHz: 40 ns_{p-p} max.
	3 MHz: 0.6 ns_{p-p} max.
	10 MHz: 0.6 ns_{p-p} max.
Deterministic jiter	Jitter by phase modulation of Output.
Square	1 Hz to 20 MHz, 0.45 UI_{p-p} max.

Table 3: Jitter insertion characteristics (cont.)

Parameter	Specification
Triangle	1 Hz to 4 MHz, 0.5 UI_{p-p} max.
Sine	1 Hz to 20 MHz, 0.5 UI_{p-p} max.
Random jitter	Gaussian noise, 80 MHz BW, 0.08 UI_{rms} max.
External input	80 MHz BW, 0.5 UI_{p-p} max. with 2 V_{p-p} input corresponding to 0.5 UI_{p-p} max.

Distortion

Distortion includes preshoot, overshoot, and ringing. Preshoot and overshoot are peak distortions preceding/following an edge. Ringing is the positive-peak and negative-peak distortion (excluding overshoot) on pulse top or base. Distortion for a pulse is shown in the following figure. A combined preshoot, overshoot, and ringing specification of 5% implies an overshoot and undershoot <5% of pulse amplitude.

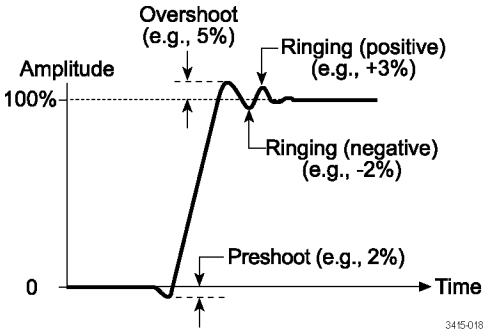


Figure 15: Distortion – Preshoot, overshoot, and ringing

Menu summary

The following table provides a brief description for each menu key.

Table 4: Menu summary

Menu key	Menu item	Description
MODE	Pulse	Select Pulse mode
	Pattern	Select Pattern mode
	Burst	Select Burst mode
	ExtWidth	External Width: Select External Width mode

Table 4: Menu summary (cont.)

Menu key	Menu item	Description
VOLTS	Channel	PSPL1P602, PSPL1P602 JIT only: Select channel
	Ampl	Amplitude: Set peak-to-peak amplitude
	Off	Offset: Set offset
	HiLvl	High Level: Set high level
	LoLvl	Low Level: Set low level
	Pol	Polarity: Set polarity: Norm (normal) or Comp (complement)
	TermV	Enter when the DUT has non-zero termination voltage
PAT/BURST	Channel	PSPL1P602, PSPL1P602 JIT only: Select output channel
	Ch1BstCt	Channel 1 Burst Count: Set burst count for channel 1 burst mode
	Ch2BstCt	Channel 2 Burst Count: Set burst count for channel 2 burst mode
	Edit	Edit: Change bit to 0 or 1 (use 0, 1 or +/- key)
	Bit#	Bit Number: Select the bit to be changed
	Length	Pattern Length: Set the number of bits of the pattern
	Type	Pattern Type: Select Data or PRBS
	Ch1Fmt	Channel 1 Format: Set channel 1 format (R1, RZ, or NRZ)
	Ch2Fmt	Channel 2 Format: Set channel 2 format (R1, RZ, or NRZ)
	PRBSLen	PRBS Length: Set the “n” in formula 2^n-1; n = 5 to 15, 23, 31
	BstPer	Burst Period: Set period in increments of 8
TRIGGER	TrgVolts	Refer to VOLTS menu above
	Source	Trigger Source: Select Continuous (Cont), External Input (ExtIn), Manual or Remote
	Type	Trigger Type: Select Edge or Level
	OutEvent	Output Event: Select Per (period) or Patt/Bur (pattern/burst)
TIME	Channel	PSPL1P602, PSPL1P602 JIT only: Select channel
	Freq	Frequency: Set the clock frequency (Hz)
	Per	Period: Set the clock period(s)
	Width	Width: Set the duration of the pulse(s)
	Delay	Delay: Set the delay period between trigger and output(s)
	DutyCyc	Duty Cycle: Set the duty cycle (%); not applicable in NRZ data format
	CrossPt	Cross Point: Set the cross point (%); only applicable in NRZ data format
	SSC	Spread Spectrum Clocking: Enable or Disable; set frequency or amplitude
	Hold	Hold: Set width or duty cycle constant (when frequency changes)
JITTER	Sin	Sine: Select sinusoidal jitter insertion
	Det	Deterministic: Select deterministic jitter insertion
	Ran	Random: Select random jitter insertion
	Ext	External Delay: Enable or Disable external delay
	Hold	Hold: Select UI or Sec (seconds) as the hold parameter

Table 4: Menu summary (cont.)

Menu key	Menu item	Description
UTILITY	ClkIn	Clock Input: Configure clock input: Termination (ClkIn Term; AC or DC), slope (ClkIn Slope; Pos or Neg) and termination voltage (ClkIn TermV; -2 V to 3 V)
	ExtIn	External Input: Configure external input: Threshold (ExtIn Threshold; -2 V to 3 V), slope (ExtIn Slope; Pos or Neg), and termination voltage (ExtIn TermV; -2 V to 3 V)
	ClkSrc	Clock Source: Select Internal or ClkIn
	RefOsc	Reference Oscillator: Select Internal or External
	System	System: Adjust display setting, select remote programming control port (IOPort: GPIB or USB), enter GPIB remote programming address (GPIB add), and enable or disable auto correct (AutoCorr; Enable or Disable)
	InstSave	Save and Recall instrument setups
	PattSave	Save and Recall patterns
HELP	N/A	Provides a brief description for the presently selected parameter (soft key). Press any menu key or soft key to cancel help.

Defaults

The power-up defaults are listed in the following table.

Table 5: Power up defaults

Menu	Parameter	Setting or value
MODE	Operating mode	Pulse
TIME	Channel	1
	Frequency	15 MHz /1.6 GHz
	Period	66.67 ns
	Width	33.33 ns
	Delay	0.0 ps
	Duty Cycle	50%
	Cross Point	50%
	Spread Spectrum Clocking	Disabled
	Hold	Duty Cycle
VOLTS	Channel	1
	Amplitude	50 mV_{p-p}
	Offset	0 mV
	High Level	25 mV
	Low Level	-25 mV
	Polarity	Normal
	Termination Voltage	0 mV

Table 5: Power up defaults (cont.)

Menu	Parameter	Setting or value
PAT/BURST	Edit	Disabled
	Bit Number	8
	Length	8 bits
	Type	Data
	Ch1 Format	NRZ
	Ch2 Format	NRZ
	PRBS Length	5
	Burst Period	8
	Ch 1 Burst Count	2
	Ch 2 Burst Count	2
UTILITY	Clock Input:	
	Termination	AC
	Termination Voltage	0 mV
	Slope	Positive
	External Input:	
	Slope	Positive
	Threshold	0 mV
	Termination Voltage	0 mV
	Clock Source	Internal
	Reference Oscillator:	Internal
	System:	
	Display:	
	Bright	8
	Contrast	6
	GPIB Address	10 [1]
	IOPort [1]	GPIB [1]
	Auto Correct	Disabled
TRIGGER	Trigger Volts:	
	Amplitude	50 mV_{p-p}
	Offset	0 mV
	Hi Level	25 mV
	Lo Level	-25 mV
	Termination Voltage	0 mV
	Source	Continuous
	Type	Edge
	Output Event	Pattern/Burst

Table 5: Power up defaults (cont.)

Menu	Parameter	Setting or value
JITTER	Sinusoidal Jitter:	
	Enable	Disabled
	Frequency	1 MHz
	A(s)	600 ps_{p-p}
	A(UI)	50 mUI_{rms}
	Deterministic Jitter:	
	Enable	Disabled
	A(s)	6.67 ns_{p-p}
	A(VI)	100 mUI_{p-p}
	Frequency	1 MHz
	Function	Sine
	Random Jitter:	
	Enable	Disabled
	A(s)	3.33 ns_{rms}
	A(VI)	50 mUI_{p-p}
	External Delay:	
	Enable	Disabled
	Hold	UI

1 At the factory, the GPIB is selected as the remote programming interface, and the address is set to 10. Changes to the interace or address are saved in Non-Volatile Memory and will be recalled on subsequent power-up. You must cycle the power after changing any communication parameters to ensure that such parameters are applied.

Pulse/Pattern/Burst/External Width operation

After making connections to the instrument, the fundamental steps to operate Pulse, Pattern, Burst, and External Width modes are as follows:

1. Select the operating mode by pressing the MODE key.
2. Configure the time and voltage parameters for the selected mode.
3. Configure triggering.
4. Enable the channel(s) and trigger the start of pulse output.
5. When finished, disable the output(s).

After selecting the operating mode, set the programmable parameters for that mode using the soft keys, navigation wheel and cursor keys, or the keypad. (See page 33, *Pulse/pattern parameters*.)

NOTE. *The Pulse/pattern parameters section contains details about all settable parameters. Each parameter is listed alphabetically by its soft key name.*

The two steps to select the operating mode are presented in the following figure.

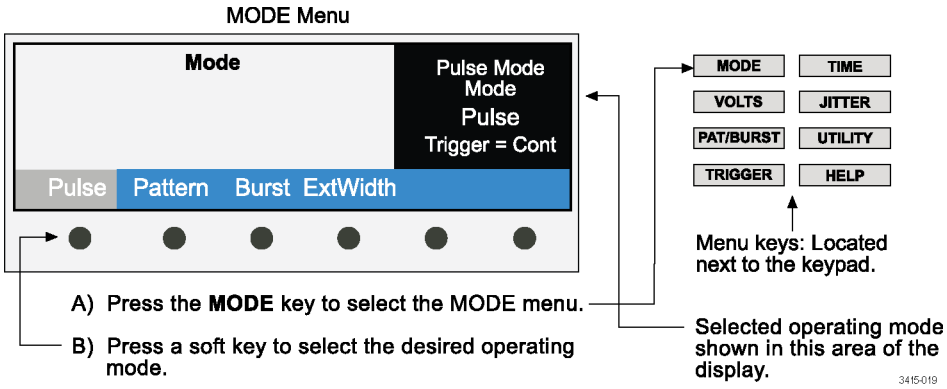


Figure 16: Select operating mode

Pulse mode

1. Select the Pulse mode as presented in the *Select operating mode* illustration.
2. Perform the steps in the following figure to access the parameters in the VOLTS and TIME menus.

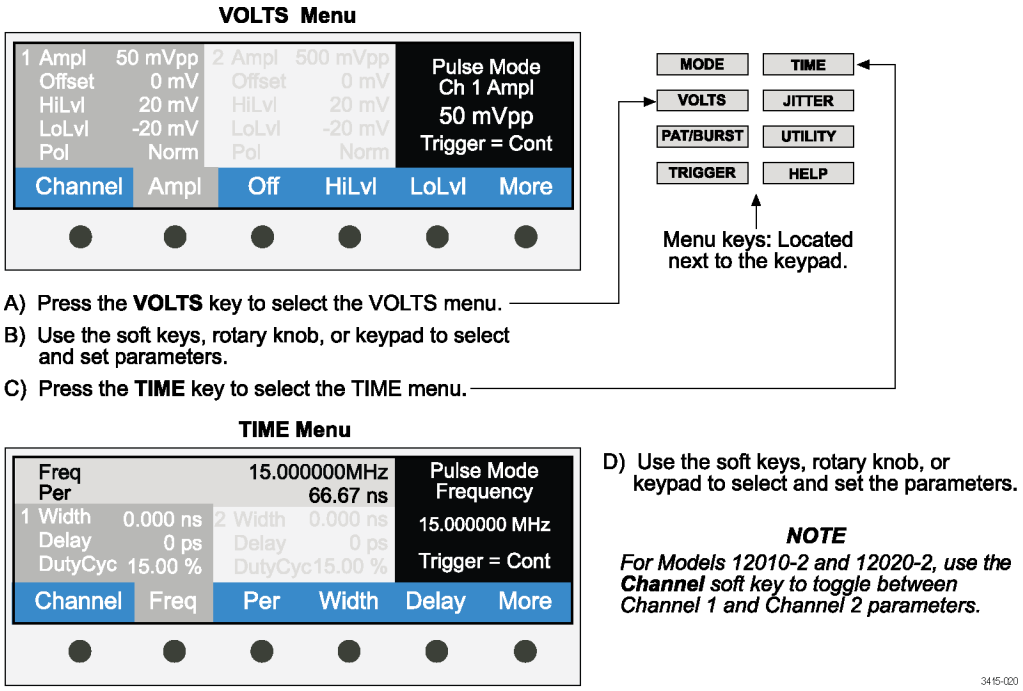


Figure 17: Configure Pulse mode parameters

3. Perform the steps in the following figure to access the triggering parameters. For additional information refer to the following table. (See Table 6 on page 25.)

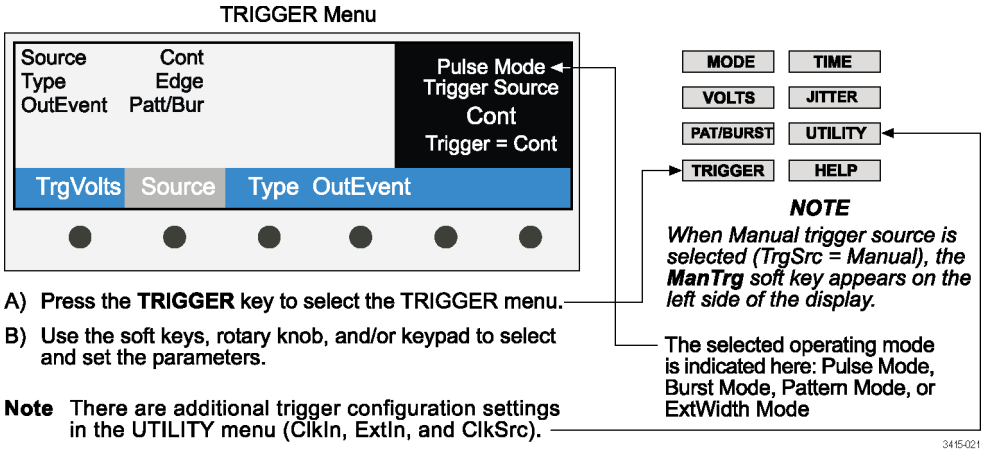


Figure 18: Configure triggering

Table 6: Pulse mode triggering parameters

Trigger source	trigger type	Pulse mode
Continuous	Edge or Level	Pulses are continually produced at the set period (Clk Src: Internal or Clk In); one output pulse for each trigger pulse.
External Input	Edge	One pulse is produced for every valid edge on the Ext In signal (Clk Src is not applicable).
	Level	During the active (high) part of the signal, pulses are continually produced at the set period (Clk Src: Internal or Clk In). During the inactive (low) part of the signal, no pulses are produced.
Manual	Edge or Level	One pulse is produced for every press of the Manual key; one output pulse for each trigger pulse.
Remote	Edge or Level	One pulse is produced for every remote trigger command; one output pulse for each trigger pulse.
Trigger Output Event: Not applicable.		

4. Press the key(s) located next to the SMA output connector(s) to enable the channel(s): CH1 Enable and CH2 Enable (two-channel instruments only). A green indicator lights up to show that the channel is enabled.

   The enabled pulse output is triggered (output sequence started) according to the trigger configuration.

5. When finished, disable the output(s) by again pressing the CH1 ENABLE and CH2 ENABLE keys (two-channel instruments only). The green indicator light(s) turns off.

Burst mode

1. Select the Pulse mode as presented in the *Select operating mode* illustration. (See Figure 16 on page 23.)
2. Perform the steps in the following figure to set the Burst count or Burst period. Burst count can be set from 2 to 1,048,576 pulse periods. Burst period length can be set from 8 to 1,048,576.

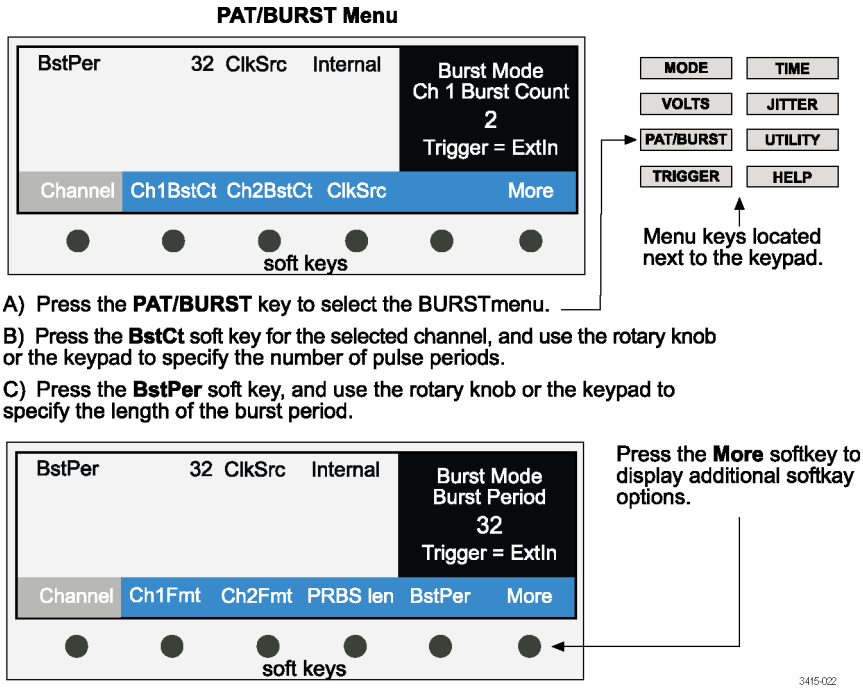


Figure 19: Setting Burst mode

3. Perform the steps in the *Configure triggering* illustration to access the triggering parameters. (See Figure 18 on page 24.) For additional information refer to the following table. (See Table 7.)

Table 7: Burst mode triggering parameters

Trigger source	trigger type	Pulse mode
Continuous	Edge or Level	Bursts are continually produced at the set period (Clk Src: Internal or Clk In).
External Input	Edge	One burst is produced for every valid edge on the Ext In signal (Clk Src: Internal or Clk In).
	Level	During the active (high) part of the signal, bursts are continually produced at the set period (Clk Src: Internal or Clk In). During the inactive (low) part of the signal, no bursts are produced.
Manual	Edge or Level	One burst is produced for every press of the Manual key (Clk Src: Internal or Clk In).
Remote	Edge or Level	One burst is produced for every remote trigger command (Clk Src: Internal or Clk In).
Trigger Output Event:		
Per - One trigger pulse for each pulse period. The number of trigger pulses per burst is equal to the burst period.		
Patt/Bur - One trigger pulse at the beginning of each burst. Trigger pulse duration is approximately four periods long.		

4. Press the key(s) located next to the SMA output connector(s) to enable the channel(s): CH1 Enable and CH2 Enable (two-channel instruments only). A green indicator lights up to show that the channel is enabled.

The enabled pulse output is triggered (output sequence started) according to the trigger configuration.

5. When finished, disable the output(s) by again pressing the CH1 ENABLE and CH2 ENABLE keys (two-channel instruments only). The green indicator light(s) turns off.

Pattern mode

1. Select the Pulse mode as presented in the *Select operating mode* illustration. (See Figure 16 on page 23.)
2. Set up the desired pattern configuration including the pattern format, pattern length, and pattern bits.
   a. Select the pattern format: NRZ, RZ, or R1

      Use the Channel soft key to move the cursor to the desired channel: Ch 1 or Ch 2 (for two-channel instruments).

      Use the Ch1Fmt soft key to select from the NRZ, RZ, or R1 pattern format for Channel 1. Do the same for Channel 2 (for two-channel instruments).

   b. Set pattern length: 8 to 16,777,216 bits

      Press the More soft key to switch menus until the Length option is shown.

      Press the Length soft key, and use the navigation wheel or keypad to enter the pattern length in multiples of 8. If using the keypad, key in the value and press the Enter soft key. All bits added to the pattern will be 0's unless the pattern was longer at a previous time, in which case the bits added will have their previous values.

      For two-channel instruments, the pattern applies to both channels.

   c. Edit pattern bits: (0 or 1)

      To change cursor position, press the Bit# soft key, and use the navigation wheel or the keypad to place the cursor on the bit to be changed.

      Press the Edit soft key, and press 0, 1 or +/- on the keypad to set the bit (the +/- key toggles the bit value). The cursor moves (right) to the next bit, which can be changed in the same manner.

NOTE. *Level and time parameters for Pattern mode are configured via the TIME and VOLTS menus. Refer to Pulse mode for details. (See page 23, Pulse mode.)*

The following figure shows the Pattern mode selections form the PAT/BURST menu.

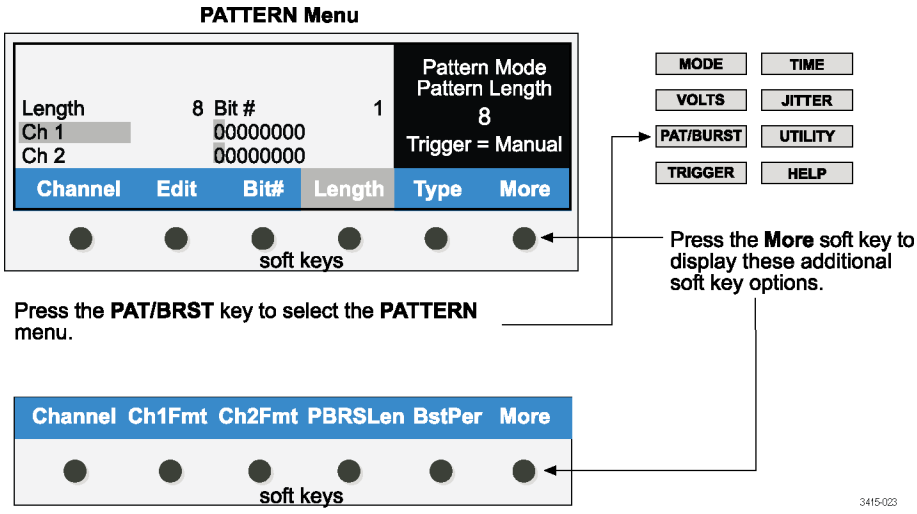


Figure 20: PATTERN menu

Pseudo random bit sequence (PRBS) length

Use PRBS to output a pseudo random pattern at the output. The bit length for the PRBS output pattern is determined by the binary sequence formula 2^n-1, where n = 5 to 15, 23, or 31. Refer to the Pattern Menu for soft key direction. (See Figure 20.)

1. Select the format (RZ, NRZ, or R1) for the output pattern.
2. Use the Type softkey to set the pattern type to PRBS.
3. Press the PRBSLen softkey.
4. Use the navigation wheel or the keypad to set "n" for PRBS. If using the keypad, press the Enter soft key after keying in the value.

   The displayed parameter value is "n" for formula 2^n-1. Note that when the Type is set to PRBS, the PRBSLen parameter sets the pattern length and the Length parameter is not in use.
5. Perform the steps in the *Configure triggering* illustration to access the triggering parameters. (See Figure 18 on page 24.) For additional information refer to the following table. (See Table 8.)

Table 8: Pattern mode triggering parameters

Trigger source	trigger type	Pulse mode
Continuous	Edge or Level	Patterns are continually produced at the set period (Clk Src: Internal or Clk In).
External Input	Edge	One pattern is produced for every valid edge on the Ext In signal (bit period: Internal or Clk In).
	Level	During the active (high) part of the signal, patterns are continually produced at the set period (bit period: Internal or Clk In). During the inactive (low) part of the signal, no patterns are produced. If the Ext In falls inactive during a pattern, the pattern will still complete.
Manual	Edge or Level	One pattern is produced for every press of the ManTrg key (bit period: Internal or Clk In).
Remote	Edge or Level	One pattern is produced for every remote trigger command (bit period: Internal or Clk In).

Trigger Output Event:

Per - One trigger pulse for each pattern. Pulse duration is half the clock period.

Patt/Bur -

Data: One trigger pulse at the beginning of each pattern. Pulse duration is approximately four periods long.

PRBS: A trigger pulse is produced at the beginning of the first pattern and every eighth pattern thereafter.

Trigger pulse duration is approximately 4 periods long.

PRBS Trigger Note: When the Type is PRBS, ”one pattern” consists of eight cycles of the PRBS sequence. Thus, for continuous trigger source, a trigger is output for every eight cycles of the PRBS sequence.

6. Press the key(s) located next to the SMA output connector(s) to enable the channel(s): CH1 Enable and CH2 Enable (two-channel instruments only). A green indicator lights up to show that the channel is enabled. The enabled pulse output is triggered (output sequence started) according to the trigger configuration.

7. When finished, disable the output(s) by again pressing the CH1 ENABLE and CH2 ENABLE keys (two-channel instruments only). The green indicator light(s) turns off.

External Width mode

In External Width mode, the rising and falling edges of an external trigger connected to the Ext In connector control the output.

1. Select the ExtWidth mode as presented in the *Select operating mode* illustration.
2. Time parameters for width, frequency, period, and delay are determined by the external trigger signal and are not programmable.
3. Triggering configuration is determined by the Ext Input and is not programmable.
4. Enable pulse output by pressing the channel enable key(s) located next to the SMA output connector(s): CH1 Enable and CH2 Enable (two-channel instruments only). A green indicator lights up to show that the channel is enabled.
5. When finished, disable the output(s) by again pressing the CH1 ENABLE and CH2 ENABLE keys (two-channel instruments only). The green indicator light(s) turns off.

Saving and recalling instrument setups

The instrument can save up to nine setups in non-volatile memory. In general, all the parameters for a setup are saved for later recall. For example, Mem1 may be a setup for Pulse mode, Mem2 may be a setup for Burst mode, Mem3 may be a setup for Pattern mode, and so on. The instrument can also be returned to the power-up default settings at any time.

Saving a setup

1. Configure the instrument for the desired pulse/pattern operation.
2. Press the UTILITY menu key.
3. Press the InstSave soft key.
4. Press the Save soft key
5. Save the setup to memory by pressing the appropriate soft key (Mem1 through Mem9).

Recalling a setup

1. Press the UTILITY menu key.
2. Press the InstSave soft key.
3. Press the Recall soft key.
4. Return the instrument to a saved setup by pressing the appropriate soft key (Mem1 through Mem9).

NOTE. *When the instrument returns to a saved or the default setup, the output(s) will disable.*

Returning to default settings

Default settings are listed in the Power-up defaults table. (See Table 5 on page 20.)

1. Press the UTILITY menu key.
2. Press the InstSave soft key.
3. Press the Recall soft key.
4. Return the instrument to the default settings by pressing the Default soft key.

Saving and recalling patterns

The instrument can save up to nine patterns in non-volatile memory.

Saving a pattern

1. Configure the instrument for the desired pattern.
2. Press the UTILITY menu key.
3. Press the PattSave soft key.
4. Press the Channel soft key to choose the pattern in Channel 1 or Channel 2 (on two-channel units only).
5. Press the Save soft key.
6. Save the pattern to memory by pressing the appropriate soft key (Mem1 through Mem9).

Recalling a pattern

1. Press the UTILITY menu key.
2. Press the PattSave soft key.
3. Press the Channel soft key to choose the destination for the pattern in Channel 1 or Channel 2 (on two-channel units only).
4. Press the Recall soft key.
5. Recall a saved pattern by pressing the appropriate soft key (Mem1 through Mem9).

Pulse/pattern parameters

In the following table, each parameter is listed alphabetically by its soft key name. Details follow the table that include applicable operating modes for the parameter and the menu where the parameter soft key is located.

Table 9: Soft key parameters

Parameter	Menu/path
A(s): Deterministic Jitter Amplitude, sec	Jitter (Det)
A(UI): Deterministic Jitter Amplitude, UI	Jitter (Det)
A(s): Random Jitter Amplitude, sec	Jitter (Ran)
A(UI): Random Jitter Amplitude, UI	Jitter (Ran)
A(s): Sine Jitter Amplitude, sec	Jitter (Sin)
A(UI): Sine Jitter Amplitude, UI	Jitter (Sin)
Ampl: Amplitude	Volts
Ampl: SSC Amplitude	Time (SSC)
AutoCorr: Auto Correct	Utility (System)
Bit #	Pattern/Burst
BstPer: Burst Period	Pattern/Burst
CH1BstCnt: Channel 1 Burst Count & CH2BstCnt: Channel 2 Burst Count	Pattern/Burst
CH1Fmt: Channel 1 Format & CH2Fmt: Channel 2 Format	Pattern/Burst
Channel	Volts
CrossPt: Cross Point	Time
ClkSrc: Clock Source	Utility
Delay	Time
Display	Utility (System)
DutyCyc: Duty Cycle	Time
Edit	Pat/Burst
Enable: Deterministic Jitter Enable	Jitter (Det)
Enable: Random Jitter Enable	Jitter (Ran)
Enable: Sine Jitter Enable	Jitter (Sine)
Enable: SSC Enable	Time (SSC)
Ext: External	Jitter
Freq: Deterministic Jitter Frequency	Jitter (Det)
Freq: Sine Jitter Frequency	Jitter (Sin)
Freq: SSC Frequency	Time (SSC)
Func: Deterministic Jitter Function	Jitter (Det)
GPIBAdd: GPIB Address	Utility (System)
HiLvl: High Level	Volts

Table 9: Soft key parameters (cont.)

Parameter	Menu/path
Hold: UI or Sec	Jitter
Hold: Hold Duty Cycle or Width	Time
InstSave: Instrument Save / Recall	Utility
IOPort: I/O Port (interface)	Utility (System)
Length	Pat/Burst
LoLvl: Low Level	Volts
Off: Offset	Volts
OutEvent: Trigger Out Event	Trigger
PattSave: Pattern Save / Recall	Utility
Per: Period	Time
Pol: Polarity	Volts
PRBSLen: Pseudo Random Bit Sequence Length	Pat/Burst
RefOsc: Reference Oscillator	Utility
Slope: ClkIn Slope	Utility (ClkIn)
Slope: ExtIn	Utility (ExtIn)
Source: Trigger Source	Trigger
Term: ClkIn Termination	Utiltiy (ClkIn)
TermV: ClkIn Termination Voltage	Utility (ClkIn)
TermV: ExtIn Termination Voltage	Utility (ExtIn)
TermV: Output Termination Voltage	Volts
Threshold: ExtIn	Utility (ExtIn)
Type: Pattern Type	Pat/Burst
Type: Trigger Type	Trigger
Width	Time

A(s): Deterministic Jitter Amplitude, sec

Operating mode:	All
Menu:	JITTER (Det) (Func
	Deterministic jitter is phase modulation of the output signal. The magnitude of the jitter may be specified in seconds or in UI. Deterministic jitter can be enabled on one or both channels. The maximum limit depends on the choice of jitter distribution. Calculate the maximum values of A(s) from the maxima listed in A(UI): Deterministic Jitter Amplitude, UI.

A(UI): Deterministic Jitter Amplitude, UI

Operating mode:	All
Menu:	JITTER (Det) (Func)
	Deterministic jitter is phase modulation of the output signal. The magnitude of the peak-to-peak jitter may be specified in seconds or in UI. Deterministic jitter can be enabled on one or both channels. The maximum limit depends on the type of jitter distribution selected. A(UI) setting: Sine: 0 UI to 0.5 UI Square: 0 UI to 0.45 UI Triangle: 0 UI to 0.5 UI

A(s): Random Jitter Amplitude, sec

Operating mode:	All
Menu:	JITTER (Ran)
	Random jitter is phase modulation of the output signal using an internal broadband white-noise source. Random jitter can be enabled on one or both channels. The magnitude (rms) of the Gaussian distribution may be specified in seconds or in UI. Calculate the maximum values of A(s) from the maxima listed in A(UI): Random Jitter Amplitude, UI.

A(UI): Random Jitter Amplitude, UI

Operating mode:	All
Menu:	JITTER (Ran)
	Random jitter is phase modulation of the output signal using an internal broadband white-noise source. Random jitter can be enabled on one or both channels. The magnitude (rms) of the Gaussian distribution may be specified in seconds or in UI. A(UI) setting: 0 UI to 0.08 UI

A(s): Sine Jitter Amplitude, sec

Operating mode:	Pulse, Pattern, or Burst
Menu:	JITTER (Sin)
	Sinusoidal jitter is phase modulation of the instrument clock using a sine function. Sinusoidal jitter is enabled on both channels. Sinusoidal Jitter and SSC can not be enabled simultaneously. The peak-to-peak jitter insertion amplitude may be specified in seconds or in UI. The following figure shows the limiting values for A(s) versus modulation frequency. Choose a combination of values below the limit line.

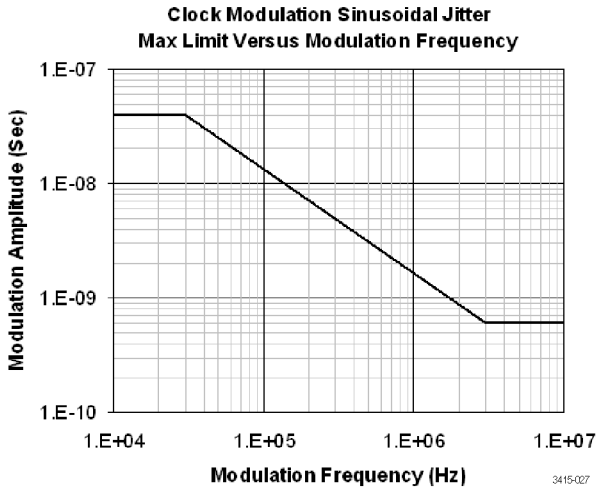


Figure 21: Limit of Modulation Amplitude versus Modulation Frequency

A(UI): Sine Jitter Amplitude, UI

Operating mode:	Pulse, Pattern, or Burst
Menu:	JITTER (Sin)
	Sinusoidal jitter is phase modulation of the instrument clock using a sine function. Sinusoidal jitter is enabled on both channels. Sinusoidal Jitter and SSC can not be enabled simultaneously. The peak-to-peak jitter insertion amplitude may be specified in seconds or in UI. Calculate the maximum values of A(s) from the previous graph. (See Figure 21.)

Ampl: Amplitude

Operating mode:	All
Menu:	VOLTS, TRIGGER (TrgVolts)
	The low-to-high magnitude is the peak-to-peak amplitude of the pulse and is calculated as follows: `Amplitude = (High Level) - (Low Level)` In the following figure, the amplitude is 50 mV: (25 mV) – (-25 mV) = 50 mV. Changing the amplitude will also change the high and low levels. Offset is not affected. For example, if the amplitude in the previous figure is changed to 500 mV_{p-p}, the high level becomes 250 mV and low level becomes -250 mV. Pulse amplitude can be independently set for each output channel and the trigger output. Ampl setting range: 50 mV_{p-p} to 2.5 V_{p-p}

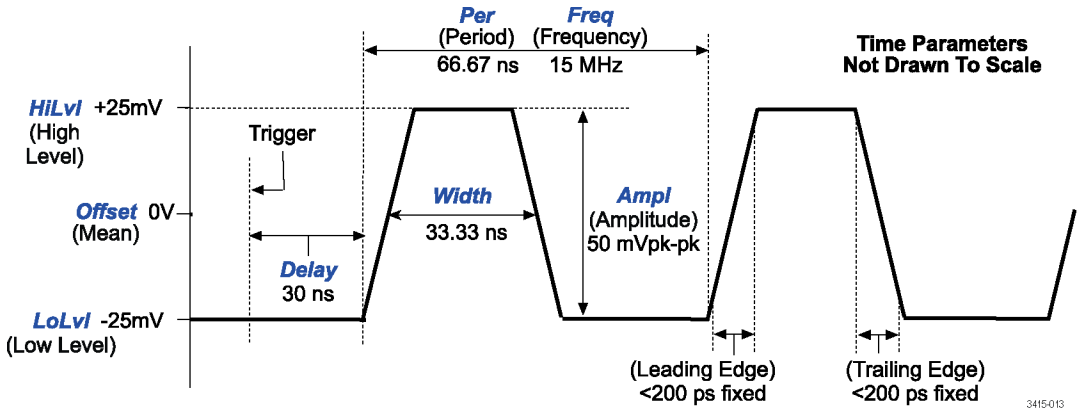


Figure 22: Example for calculating amplitude

NOTE. *Low voltage settings can be affected by the resolution specifications. For example, setting amplitude to 250 mV_{p-p} with an offset of 0 V will display HiLvl and LoLvl levels of +120 mV and -120 mV (instead of ±125 mV). This is because the setting resolution is 10 mV.*

Ampl: SSC Amplitude

Operating mode:	Pulse, Pattern, or Burst
Menu:	TIME (SSC)
	Set the Amplitude (modulation depth) of the spread spectrum modulation as a percent of the clock frequency. The modulation is below the nominal clock frequency. For instance, a SSC amplitude of 1% on a 100 MHz clock will result in the clock frequency being modulated in the range of 99 MHz to 100 MHz. Range = 0% to 2%. SSC setting range: 0% to 2%

AutoCorr: Auto Correct

Operating mode:	Pulse, Burst, and Pattern
Menu:	UTILITY
	This function enables periodic automatic correction of pulse timing (width and delay) for temperature effects. This should normally be disabled (default) because the temperature correction may result in an interruption of the output data or pulses. Enable this only if automatic temperature correction is required and data discontinuities are acceptable. Note that temperature correction of the timing is performed every time a given timing parameter is set, regardless of the AutoCorr status. AutoCorr settings: Enable or disable

Bit

Operating mode:	Pattern
Menu:	PAT/BRST
	The Bit# soft key is used to position the cursor on a bit that is to be edited. After pressing the Bit# soft key, use the navigation wheel or keypad to place the cursor on the bit to be edited. The pattern can then be edited using the Edit soft key (refer to the *Pattern mode* section for more information).

BstPer: Burst Period

Operating mode:	Burst
Menu:	PAT/BURST
	Burst period specifies the number of clock periods in the burst. Burst period can be independently set for each output channel of a two-channel instrument. BstPer setting range: 8to 1,048,576

CH1BstCnt: Channel 1 Burst Count & CH2BstCnt: Channel 2 Burst Count

Operating mode:	Burst
Menu:	PAT/BURST
	Burst Count specifies the number of pulses in a burst. It must be less than or equal to the burst period. BstCnt setting range: 2 to 1,048,576

CH1Fmt: Channel 1 Format & CH2Fmt: Channel 2 Format

Operating mode:	Pattern
Menu:	PAT/BRST
	Bit patterns can be output in the RZ, NRZ, or R1 format. The format can be individually set for each channel. In Pattern mode for the two-channel instruments, use the Ch1Fmt and Ch2Fmt soft keys to set the pattern format for each channel. Format settings: RZ, NRZ, or R1

Channel

Operating mode:	All
Menu:	VOLTS, TIME, JITTER, and PAT/BRST
	For two-channel instruments, some parameters can be independently set for each channel. The Channel soft key toggles between Channel 1 and Channel 2 for setting individual parameters. Channel settings: 1 or 2

CrossPt: Cross Point

Operating mode:	Pulse, Burst, and Pattern
Menu:	TIME
	The crossing point is the position of the crossing of the rising and falling transitions in an NRZ eye, in percent of the amplitude. The crossing point may be set anytime but has effect only when the generator is set for NRZ patterns. The crossing point is calibrated for 50% duty cycle (equal number of 1s and 0s) pattern data. Over programming in the range of 20% to 80% is allowed. CrossPt setting range: 30 to 70%

ClkSrc: Clock Source

Operating mode:	Pulse, Burst, and Pattern
Menu:	UTILITY
	Select the generator's clock source from this menu. Internal: Selects the internal clock source. ClkIn: Selects the external clock source (connected at the front panel Clk In). After selecting this option, the ClkIn frequency can be measured and the generator settings updated (MeasNow softkey). ClkSrc options: Internal and ClkIn

Delay

Operating mode:	Pulse, Burst, and Pattern
Menu:	TIME
	Delay adjusts the time from the trigger output to the pulse output. Note that there is an intrinsic delay in addition to the adjustable delay. Thus, if delay is set to 0, trigger out and pulse out are not simultaneous. The delay can be independently set for each output channel of the two-channel instruments. Delay setting range: 0 s to (Period setting)

Display

Operating mode:	All
Menu:	UTILITY (System)
	The instrument has 10 display settings each for brightness and contrast for the backlight. Bright and Contrast setting range: 1 to 10

DutyCyc: Duty Cycle

Operating mode:	Pulse
Menu:	TIME
	The duty cycle is the ratio of the pulse width to the period. The result is expressed as a percent. Duty Cycle can be adjusted anytime but has no effect when the generator is in NRZ format. DutyCyc setting range: Any value that results in an allowable width setting

Edit

Operating mode:	Pattern
Menu:	PAT/BRST
	The Edit soft key is used with the Bit# soft key to change one or more bits of a pattern: **1.** Press the Bit# soft key, and use the navigation wheel or the keypad to place the cursor on the bit to be changed. **2.** Press the Edit soft key, and then press the 0, 1, or +/- key to set the bit (+/- toggles the bit value). The cursor moves right to the next bit, which can then be edited. ***NOTE.*** *Refer to Pattern mode for details on pattern configuration.*

Enable: Deterministic Jitter Enable

Operating mode:	All
Menu:	JITTER (Det)
	Enable: Set the deterministic jitter to be enabled or disabled. Enable deterministic jitter only when the Trigger Source is Continuous. Enable settings: Enable or Disable

Enable: Random Jitter Enable

Operating mode:	All
Menu:	JITTER (Ran)
	Enable: Set the random jitter to be enabled or disabled. Enable Random Jitter only when the Trigger Source is Continuous. Enable settings: Enable or Disable

Enable: Sine Jitter Enable

Operating mode:	Pulse, Pattern, or Burst
Menu:	JITTER (Sin)
	Enable: Set the sinusoidal jitter to be enabled or disabled. Enable Sine Jitter only when the Clock Source is Internal and the Trigger Source is Continuous. Do not enable Sine Jitter and SSC simultaneously. Enable settings: Enable or Disable

Enable: SSC Enable

Operating mode:	All
Menu:	TIME (SSC)
	Enable: When SSC is enabled, the internal clock is frequency modulated with a triangle function. SSC and Sinusoidal Jitter can not be enabled simultaneously. Frequency and Amplitude may be adjusted. Enable settings: Enable or Disable

Ext: External

Operating mode:	All
Menu:	JITTER
	External jitter is phase modulation from an external source connected at Delay In 1 or Delay In 2 on the front panel. External jitter can be enabled on one or both channels. Refer to the *Jitter insertion* section for detailed range specifications. Channel: Select Channel 1 or Channel 2. Enable: Set the external jitter to be enabled or disabled. Enable external jitter only when Trigger Source is Continuous. Ext options: Enable or Disable

Freq: Deterministic Jitter Frequency

Operating mode:	Pulse, Pattern, or Burst
Menu:	JITTER (Det) Freq: Frequency
	Set the frequency of deterministic jitter in Hz. Jitter Frequency ranges: Sine: 1 Hz to 20 MHz Square: 1 Hz to 20 MHz Triangle: 1 Hz to 4 MHz

Freq: Sine Jitter Frequency

Operating mode:	Pulse, Pattern, or Burst
Menu:	JITTER (Sin)
	Sinusoidal jitter is phase modulation of the instrument clock using a sine function. Sinusoidal jitter is enabled on both channels. Sinusoidal Jitter and SSC can not be enabled simultaneously. The peak-to-peak jitter insertion amplitude may be specified in seconds or in UI. The *Limit of Modulation Amplitude versus Modulation Frequency* graph shows the limiting values for A(s) versus modulation frequency. (See Figure 21 on page 36.) Choose a combination of values below the limit line.

Freq: SSC Frequency

Operating mode:	Pulse, Pattern, or Burst
Menu:	JITTER (SSC)
	Set the modulation frequency of the spread spectrum modulation in Hz. Range = 1 kHz to 100 kHz. Freq setting range: 1 kHz to 100 kHz

Func: Deterministic Jitter Function

Operating mode:	All
Menu:	JITTER (Det)
	Func: Set the deterministic jitter function as sine, square, or triangle.

GPIBAdd: GPIB Address

Operating mode:	All
Menu:	UTILITY (System)
	The GPIB primary address can be set from 0 to 30. At the factory, the primary address is set to 10. GPIBAdd setting range: 0 to 30 ***NOTE.*** *Changes to this setting take effect only after the power is cycled.*

HiLvl: High Level

Operating mode:	All
Menu:	VOLTS, TRIGGER (TrgVolts)
	Pulse high and low levels can be set. The pulse amplitude and offset will automatically adjust to correspond to the set high/low levels (refer to *Ampl: Amplitude* and *Off: Offset*). High and low levels can be independently set for each output channel and the trigger output. High/Low Level setting range: -2 V to +3.3 V and resulting amplitude must be in allowed range.

Hold: UI or Sec

Operating mode:	Pulse, Burst, and Pattern
Menu:	JITTER
	Sets whether the jitter amplitude is held constant in UI or Seconds during changes in clock frequency. Hold settings: UI or Sec

Hold: Hold Duty Cycle or Width

Operating mode:	All
Menu:	TIME
	Sets whether the pulse width is held constant in duty cycle or width during changes in frequency. Hold settings: Width or Duty Cycle

InstSave: Instrument Save / Recall

Operating mode:	All
Menu:	UTILITY
	Saves or Recalls up to nine setups in non-volatile memory. In general, all the parameters for a setup are saved for later recall. The instrument can also be returned to the power-up default settings at any time. InstSave settings: Save Mem1 through Mem9 Recall Mem1 through Mem9 and Default

IOPort: I/O Port (interface)

Operating mode:	All
Menu:	UTILITY (System)
	Remote programming can be performed using the GPIB or USB interface. At the factory, the GPIB interface is selected. IOPort settings: GPIB or USB ***NOTE.*** *Changes to this setting take effect only after power is cycled.*

Length

Operating mode:	Pattern
Menu:	PAT/BRST
	This parameter sets the length (number of bits) of the pattern. Pattern length can be independently set for each output channel of the two-channel instruments. The pattern length setting has effect when the pattern type is Data. See PRBSLen: Pseudo Random Bit Sequence Length for length setting when the pattern type is PRBS. Length setting range: 8 to 16,777,216 in multiples of 8

LoLvl: Low Level

Operating mode:	All
Menu:	VOLTS, TRIGGER (TrgVolts)
	Refer also to *HiLvl: High Level*.

Off: Offset

Operating mode:	All
Menu:	VOLTS, TRIGGER (TrgVolts)
	Offset is the mean (average) value of the high and low pulse levels and is calculated as follows: Offset = (High Level + Low Level) / 2 Changing the offset will change the high and low levels. Amplitude is not affected. For example, assume the following levels: High Level: 1 V Low Level: -1 V Amplitude: 2 V_{p-p} (1 V) - (-1 V) = 2 V_{p-p} Offset: 0 V [(1 V) + (-1 V)] / 2 = 0 V If offset is changed to 0.5 V, amplitude will remain at 2 V_{p-p}, but the high and low levels will increase by 0.5 V. The high level becomes 1.5 V (1 V + 0.5 V), and the low level becomes -0.5 V (-1 V + 0.5 V). ***NOTE.*** *Low voltage setting may be affected by the resolution specifications of the instrument. For example, setting amplitude to 250 mV_{p-p} with an offset of 0 V will display HiLvl and LoLvl levels of +120 mV and -120 mV (instead of ±125 mV). This is because the setting resolution is 10 mV.*

OutEvent: Trigger Out Event

Operating mode:	Burst and Pattern
Menu:	TRIGGER
	This parameter sets the trigger output correlation: Period or Pattern/Burst Per - A trigger pulse is sent at the start of every pulse or bit. Patt/Bur - A trigger pulse is sent at the start of every complete pattern or burst. An exception is in Pattern mode with Type = PRBS. In this case, a trigger pulse is sent at the start of every eight cycles of the PRBS pattern. OutEvent setting range: Per or Patt/Bur

PattSave: Pattern Save / Recall

Operating mode:	Pulse, Pattern, or Burst
Menu:	UTILITY
	Saves or Recalls up to nine patterns in non-volatile memory. InstSave settings: Save: Mem1 through Mem9 Recall: Mem1 through Mem9

Per: Period

Operating mode:	Pulse, Burst, and Pattern
Menu:	TIME
	Sets the clock period. When setting the period, frequency is set according to the following calculation: `frequency = 1 / period` Refer also to *Menu: JITTER (Det) Freq: Frequency*. Per setting range: 625 ps to 66.67 ns

Pol: Polarity

Operating mode:	All
Menu:	VOLTS
	Normal polarity (Norm) results in the time specified by the pulse width or a data 1 being at a high level. Complement polarity (Comp) inverts the output signal. Refer to the following figure for visual guidance. Pol settings: Norm or Comp

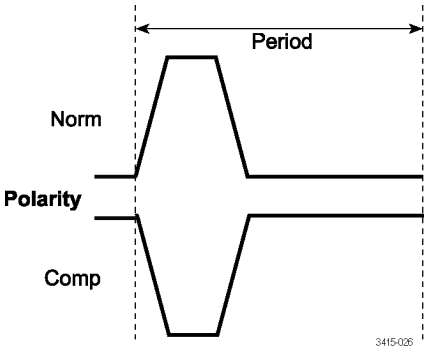


Figure 23: Polarity

PRBSLen: Pseudo Random Bit Sequence Length

Operating mode:	Pattern
Menu:	PAT/BURST
	The length (number of bits) for the pseudo random bit sequence (PRBS) is determined by "n" in the following equation: 2^n-1, where n can be set from 5 to 15, 23, or 31. PRBS bit sequence length can be independently set for each output channel. The PRBSLen setting has effect when the pattern type is PRBS. See Length for length setting when the pattern type is Data. PRBS n settings: n = 5 to 15, 23, or 31

RefOsc: Reference Oscillator

Operating mode:	All
Menu:	UTILITY
	Select the generator's reference clock from this menu. Internal: Selects the internal 10 MHz reference clock. External: Selects the external 10 MHz reference clock source (connected at the rear panel Ref In). RefOsc options: Internal and External

Slope: ClkIn Slope

Operating mode:	Pulse, Pattern, or Burst
Menu:	UTILITY (ClkIn)
	Slope: Clock input can be set to detect the positive (Pos) or negative (Neg) slope of the external clock pulses. Slope settings: Pos or Neg

Slope: ExtIn

Operating mode:	Pulse, Pattern, or Burst
Menu:	UTILITY (ExtIn)
	Slope: External input can be set to select the positive (Pos) or negative (Neg) slope of the trigger. Slope settings: Pos or Neg

Source: Trigger Source

Operating mode:	Pulse, Burst, and Pattern
Menu:	TRIGGER
	Cont: The pulse/pattern generator is always triggered; pulses, bursts, or patterns are produced continuously. ExtIn: Selects the ExtIn signal (from Ext In connector) as the Trigger Source. Manual: Selects manual triggering; a trigger is generated when the ManTrg soft key is pressed. Remote: Selects remote triggering; trigger events are provided by the GPIB or USB port. Trigger source settings: Cont, ExtIn, Manual, or Remote

Term: ClkIn Termination

Operating mode:	Pulse, Pattern, or Burst
Menu:	UTILITY (ClkIn)
	Sets the coupling for the ClkIn signal. The clock input may be set to AC or DC. TermV has an effect only when DC Termination is selected. (See Figure 24.) Term settings: AC or DC

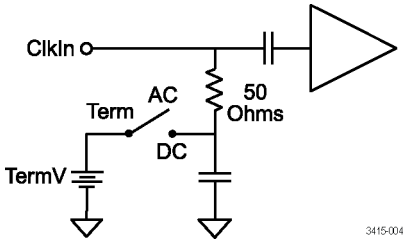


Figure 24: Clock Input schematic

TermV: ClkIn Termination Voltage

Operating mode:	Pulse, Pattern, or Burst
Menu:	UTILITY (ClkIn)
	The external clock input can be set to correctly terminate a signal that requires a non-zero termination voltage. For example, ECL logic is often terminated through 50 ohms to -2 V. This parameter has an effect only when the termination setting is DC. (See Figure 24.) TermV settings: -2V to +3V

TermV: ExtIn Termination Voltage

Operating mode:	Pulse, Pattern, or Burst
Menu:	UTILITY (ExtIn)
	A signal at the Ext In connector is terminated through 50 ohms to a zero or non-zero termination voltage in the range from -2 V to +3 V. (See Figure 25.) TermV settings: -2V to +3V

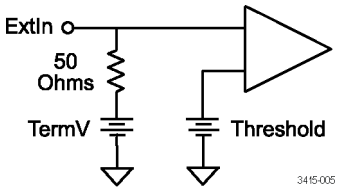


Figure 25: External Input schematic

TermV: Output Termination Voltage

Operating mode:	Pulse, Pattern, or Burst
Menu:	VOLTS
	The amplitude of the does not change when this parameter is altered. The display changes to show the correct HiLvl, LoLvl, and Offset when the output is connected to a DUT with non-zero termination voltage. TermV setting: -2 V to +3 V

Threshold: ExtIn

Operating mode:	Pulse, Pattern, or Burst
Menu:	UTILITY (ExtIn)
	This parameter sets the detection level for an external input. It sets the trigger trip voltage for a transition from low to high with positive slope selected, high to low with negative slope selected. Threshold may be in the range from -2 V to +3 V. (See Figure 25.) Threshold setting: -2 V to +3 V

Type: Pattern Type

Operating mode:	Pattern
Menu:	PAT/BURST
	This parameter sets the pattern data: PRBS or user-programmed data. **Data** – Output pattern data from the pattern memory. **PRBS** – Output a PRBS pattern. Refer to the Pseudo Random Bit Sequence (PRBS) section for details. Trigger type settings: Data or PRBS

Type: Trigger Type

Operating mode:	Pulse, Burst, and Pattern
Menu:	TRIGGER
	This parameter sets the trigger mode: Edge or Level. **Edge** – One trigger event is produced for every valid edge on the Ext In signal. **Level** – When the Ext In signal is active, the generator is always triggered - pulses, patterns, or bursts are produced continuously. When the Ext In signal is inactive, triggering stops. Trigger type settings: Edge or Level

Width

Operating mode:	Pulse, Burst, and Pattern
Menu:	TIME
	Pulse width is the interval between leading-edge and trailing-edge medians. The median is the 50% level of the amplitude. Pulse width can be independently set for each output channel Width has no effect in NRZ format. Width setting range: 250 ps to 66.42 ns

Remote interfaces

The instrument has two remote interfaces: IEEE-488 and USB (Universal Serial Bus). You can use only one interface at a time.

NOTE. *Cycle the power after selecting a different interface or making changes to the communication parameters.*

Selecting an interface

Select the interface to be used for remote operation (GPIB or USB):

1. On the front panel, press the UTILITY menu key and then the System soft key.
2. Press the IOPort soft key to display the present interface selection.
3. Press the GPIB or USB soft key.

IEEE-488 interface

The instrument can be connected to the IEEE-488 bus (also known as the GPIB or General Purpose Interface Bus) through a cable equipped with standard IEEE-488 connectors. It conforms to the IEEE-488.2 and SCPI standards (Standard Commands for Programmable Instruments). IEEE standard 488.2 defines a syntax for sending data to and from instruments, how an instrument interprets this data, what registers should exist to record the state of the instrument, and a group of common commands. The SCPI standard defines a command language protocol; it defines a standard set of commands to control every programmable aspect of an instrument.

Connections

The instrument can be connected to the IEEE-488 bus through a cable equipped with standard IEEE-488 connectors. The connector can be stacked to allow a number of parallel connections to one instrument. Two screws are located on each connector to ensure that connections remain secure.

It is recommended that you stack no more than three connectors on any one unit to avoid possible mechanical damage.

To minimize interference caused by electromagnetic radiation, use only shielded, IEEE-488 cables.

Connect the instrument to the IEEE-488 bus:

1. Line up the cable connector with the connector located on the rear panel. The connector is designed so that it will fit only one way. The following figure shows the location of the IEEE-488 connector on the instrument.

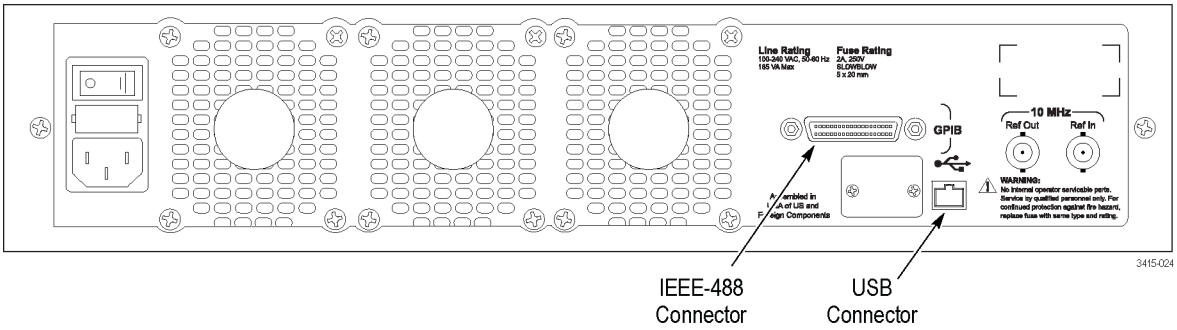


Figure 26: IEEE-488 and USB connector locations on rear panel

2. Tighten the screws securely, but do not overtighten them.
3. Add additional connectors from other instruments as required.
4. Make certain that the other end of the cable is properly connected to the controller. Most controllers are equipped with an IEEE-488-style connector, but a few may require a different type of connecting cable. Consult the instruction manual of your controller for the proper connecting method.

NOTE. *Note that the IEEE-488 bus is limited to a maximum of 15 devices, including the controller. The maximum cable length is 20 meters or two meters times the number of devices, whichever is less. Failure to observe these limits may result in erratic bus operation.*

Address selection

The default primary address is 10. The primary address can be set to any value between 0 and 30 as long as the address doesn't conflict with other instruments. Note that controllers are also given a primary address. Most frequently, controller addresses are 0 or 21, but you should consult the controller's instruction manual for details. Whatever primary address you choose, you must make certain that it corresponds with the value specified as part of the controller's programming language.

To check the present primary address or to change to a new one:

1. Press the UTILITY menu key on the front panel, and then press the System soft key.
2. Press the GPIBAdd soft key to display the current GPIB primary address.
3. Set the GPIB address to the desired value in the range of 0 to 30 using the navigation wheel and numeric keys.

NOTE. *Reboot the instrument after selecting a different interface or making changes to the communication parameters.*

USB interface

The instruments are USB TMC-class devices. Before using the USB interface, be sure to disconnect a GPIB from the instrument, as only one interface can be used at a time.

Connections

The instrument includes a type B USB socket on the rear panel. (See Figure 26 on page 52.) Typically, you will use a USB cable equipped with a type A plug on one end and a type B plug on the other end. Connect the type A plug to the type A USB socket on the host computer or USB hub. Connect the type B plug to the type B socket located on the rear panel.

USB identifiers

The Vendor ID (VID) for the PSPLIP601/602 is 0x1857.

The Product ID (PID) is 0x2EF4

Status model

The instrument has a number of status registers allowing you to monitor and manipulate the various instrument events. The status model is shown in the following figure. The core of the status model is the Status Byte Register. This register can be read by your test program to determine if a service request (SRQ) has occurred and what event caused it.

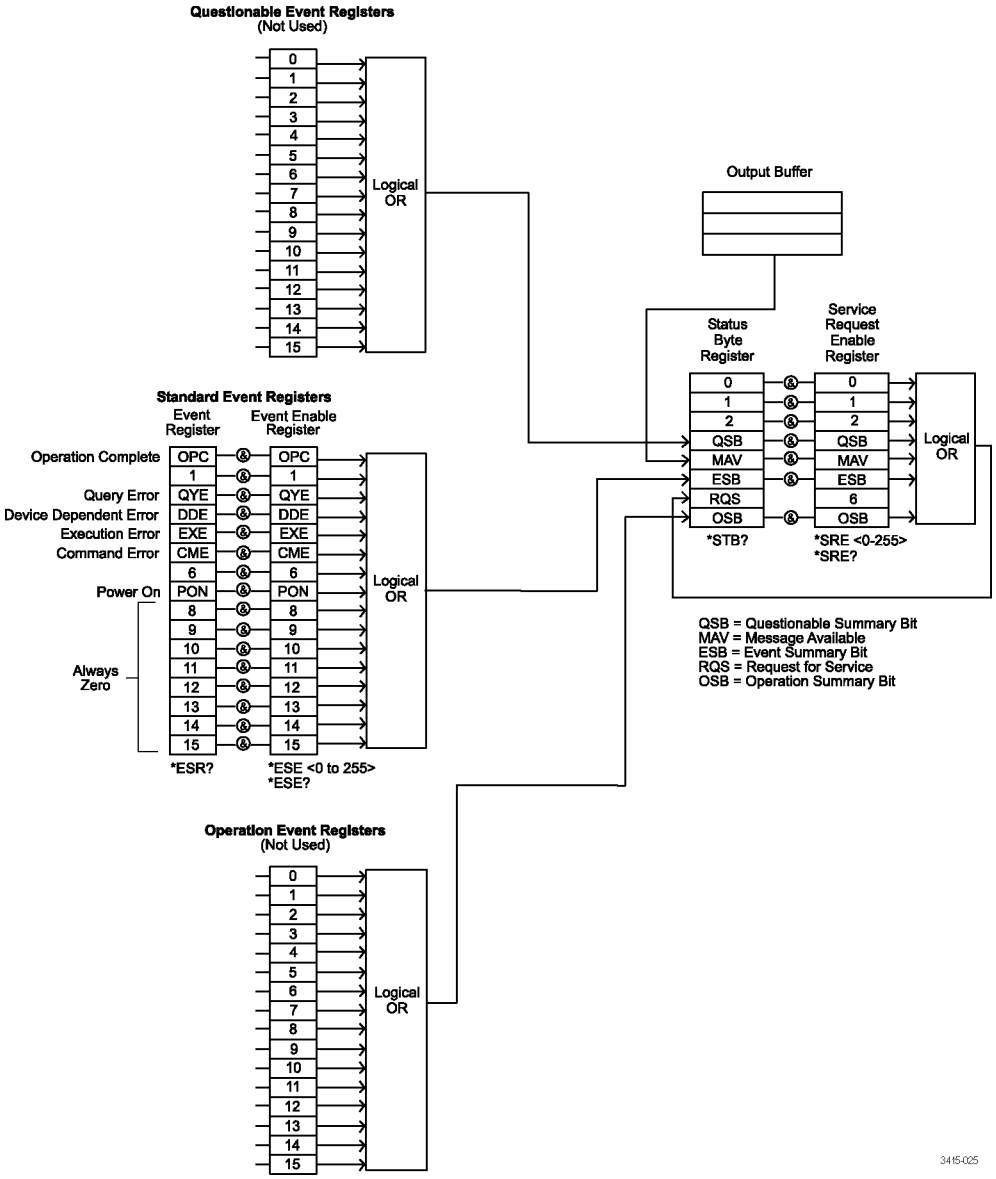


Figure 27: Status model

Status register sets

The Operation Status Register set and Questionable Status Register set are each made up of a condition register, positive and negative transition filters, an event register, and an event enable register.

NOTE. *The Operation Status group and Questionable Status group are not used by the instrument. While these registers can still be accessed with corresponding SCPI commands for compatibility with other instruments, associated status register bits are not used and are always set to 0. Refer to Command Commands for more information.*

Condition register. Contains the current status of the hardware and firmware, is continuously updated, and is not latched or buffered. Condition registers are read-only.

Event register. Latches transition events from the condition register. Event registers are cleared either by reading or with the *CLS command. Event registers are read-only, and bits are not buffered, so subsequent events are not recorded.

Enable register. Defines which bits in an event register are included in the logical OR into the summary bit. The enable register is logically ANDed with the event register and the resulting bits ORed into the summary bit. Enable registers are read-write and are not affected by *CLS or querying.

Status byte and service request (SRQ)

The Status Byte Register summarizes the information from all other status groups. The summary bit for the Status Byte Register is located in bit 6 (RQS). When RQS is set, it generates an SRQ on the IEEE-488 bus. The Status Byte Register is read using a serial poll sequence or with the *STB? query.

An SRQ is enabled by setting the associated bit in the Service Request Enable Register with the *SRE command. This register can be read using the *SRE? query.

Bits in the Status Byte Register and Service Request Enable Register are summarized in the following table.

Table 10: Status byte register and service request enable register bits

Bit	Description
0	Not used (always 0)
1	Not used (always 0)
2	Not used (always 0)
3	Questionable Status Summary Bit (not used)
4	MAV: Message available in output buffer
5	Standard Event Status Summary bit
6	RQS: Request Service
7	Operation Status Summary Bit (not used)

Standard Event Status Register

Bits in the Standard Event Status Register are summarized in the following table. Use *ESE to enable the corresponding register bit(s) and the *ESE? query to read the enable register. Use *ESR? to read the Standard Event Status Register bits.

Table 11: Standard event status register bits

Bit	Description
0	Operation Complete, set by *OPC
1	Not used (always 0)
2	Query Error
3	Device Dependent Error
4	Execution Error
5	Command Error
6	Not used (always 0)
7	Power On [1]

[1] Set bit indicates that a command/query has been sent or a front panel key has been pressed since the instrument has been turned on. Querying this bit resets it to zero, and it remains zero as long as the instrument remains on.

Operation Status group

The Operation Status group is not used by the instrument. Bits in the associated status register are not used and are always set 0. For compatibility with other instruments, associated SCPI commands can still be used. (See page 59, *SCPI command reference*.)

Questionable Status group

The Questionable Status group is not used by the instrument. Bits in the associated status register are not used and are always set 0. For compatibility with other instruments, associated SCPI commands can still be used. (See page 59, *SCPI command reference*.)

Service request programming example

To generate a service request when a Query Error occurs, send these commands:

```
*ESE 4

*SRE 32
```

Common commands

IEEE-488.2 common commands supported by the instrument are summarized in the following table. Many of these commands are associated with the status model. (See page 54, *Status model*.)

Table 12: Common commands

Command [1]	Description
*CLS	Clear status structure [2]
*ESE <0-255>	Set Standard Event Status Register mask
*ESE?	Read Standard Event Status Enable Register
*ESR?	Read Standard Event Status Event Register
*IDN?	Read Instrument's Identification string
*OPC	Set Operation Complete bit when all pending actions are completed [3]
*OPC?	Read status of the Operation Complete bit [3]
*RCL <0-9>	Recall complete instrument setting from memory
*RST	Reset instrument to standard settings
*SAV <1-9>	Save complete instrument setting to memory
*SRE <0-255>	Set Service Request Enable Mask
*SRE?	Read Service Request Enable Mask
*STB?	Read Status Byte
*TRG	Trigger instrument
*TST?	Execute instrument self-test. It will return a “0” if it boots correctly.
*WAI	Wait until all pending actions are complete [3]

1 Commands with numerics enclosed in angle brackets <> indicate parameter ranges for those commands. Commands without angle brackets have no parameters.

2 Does not clear front panel errors (only remote programming errors). Error messages will continue to be displayed until you press HELP or any other key.

3 The instrument uses sequential commands. One command must finish before the next one starts.

Table 13: Command examples

Command	Description
*ESE 4	Set Standard Event Status Register mask to decimal 4
*RCL 5	Recall instrument setting # 5 from memory
*SAV 2	Save complete instrument setting to memory location #2
*SRE 8	Set Service Request Enable Mask to decimal 8

SCPI command reference

The SCPI commands are summarized by the subsystem in the following table.

General notes:

- Square brackets ([ ]) are used to denote optional character sets. Do not use brackets in the program message.
- Angle brackets (< >) are used to indicate parameter type. Do not use angle brackets in the program message.
- Uppercase characters indicate the short-form version for each command word.
- Default - Listed parameters are the *RST defaults, unless noted otherwise.
- The command parameter to set on or off can be sent as follows:
  - ON or 1
  - OFF or 0

  The response message for the queries will be 0 or 1.

Table 14: SCPI command summary

Command	Parameter	Default	Description	Page
ARM Subsystem				
:ARM				
[:SEQuence][:LAyer]				
:Level	<numeric>	100 mV	Set/query threshold level at EXT INPUT	(See page 65.)
:SENSe	EDGE | LEVel	EDGE	Set/query trigger type	(See page 65.)
:SLOPe	POSitive | NEGative	POS	Set/query slope at EXT INPUT	(See page 65.)
:SOURce	IMMediate| MANual| EXTernal| REMote	IMM	Set/query trigger source	(See page 66.)
:TERM	<numeric>	0 V	Set/query Ext In termination voltage	(See page 66.)
DIGital subsystem				
:DIGital[:STIMulus]:PATTern				
:TYPE	DATA | PRBS	DATA	Set/query pattern type	(See page 67.)

Table 14: SCPI command summary (cont.)

Command	Parameter	Default	Description	Page
:DIGital[1|2][:STIMulus]				
:PATTern				
:LENGth	<numeric>	8	Set/query pattern length	(See page 67.)
:PLENgth	<numeric>	5	Set/query PRBS length	(See page 67.)
:RECall	<numeric>	n/a	recall pattern data from memory	
:SAVe	<numeric>	n/a	save pattern data to memory	(See page 68.)
:DATA	<numeric>, <numeric>, <arbitrary block>	1000...	Set/query pattern data	(See page 69.)
:HDATa	<numeric>, <numeric>, <arbitrary block>	1000...	Set/query pattern data in hexadecimal character format	(See page 70.)
:SIGNal				
:CROSsover				
[:VALue]	<numeric>	50%	Set/query NRZ crossing point	(See page 71.)
:FORMat	RZ|NRZ|R1	NRZ	Set/query pattern format	(See page 71.)
DISPlay subsystem				
:DISPlay				
:BRIGhtness	<numeric>	8	Set/query display brightness	(See page 72.)
:CONTrast	<numeric>	5	Set/query display contrast	(See page 72.)
MEASure subsystem				
:MEASure				
:FREQuency?	none	n/a	Query frequency applied to Clock In connector	(See page 72.)
OUTPut subsystem				
:OUTPut[0]				
:CHANnel	1|2	1	Set/query trigger out channel	(See page 73.)
:SOURce	PERiodic | BITStream	PER	Set/query trigger out event	(See page 73.)

Table 14: SCPI command summary (cont.)

Command	Parameter	Default	Description	Page
:OUTPut[1|2]				
[:STATe]	OFF | ON	OFF	Set/query channel output enable/disable status	(See page 73.)
SENSe subsystem				
:SENSe:ROSCillator				
:SOURce	INTernal | EXTernal	INT	Set/query 10 MHz reference source	(See page 74.)
SOURce subsystem				
[:SOURce]				
:FM				
[:INTernal]				
:DEViation	<numeric>	1%	Set/query SSC amplitude	(See page 74.)
:FREQuency	<numeric>	33 kHz	Set/query SSC frequency	(See page 74.)
:STATe	ON | OFF	OFF	Set/query enable/disable status of Spread Spectrum Clocking	(See page 75.)
:FREQuency				
[:CW | :FIXed]	<numeric>	15 MHz	Set/query clock frequency	(See page 75.)
:IMODe	PULSe | PATTern | BURSt | EWIDth	PULS	Set/query instrument mode	(See page 75.)
:PM				
:HOLD	UI | TIME	UI	Set/query jitter hold	(See page 76.)
:INTernal1				
[:DEViation]	<numeric>	9.0 mUI_{p-p}	Set/query sinusoidal jitter amplitude	(See page 76.)
:FREQuency	<numeric>	1 MHz	Set/query sinusoidal jitter frequency	(See page 76.)
:STATe	ON | OFF	OFF	Set/query enable/disable status of sinusoidal jitter insertion	(See page 77.)

Table 14: SCPI command summary (cont.)

Command	Parameter	Default	Description	Page
:PM [1|2]				
:EXTernal:STATe	ON | OFF	OFF	Set/query enable/disable status of sinusoidal jitter insertion	(See page 77.)
:INTernal2				
[:DEViation]	<numeric>	50 mUI_{p-p}	Set/query random jitter amplitude	(See page 77.)
:STATe	ON | OFF	OFF	Set/query enable/disable status of random jitter insertion	(See page 78.)
:INTernal3				
[:DEViation]	<numeric>	100 mUI_{p-p}	Set/query deterministic jitter amplitude	(See page 78.)
:FREQuency	<numeric>	1 MHz	Set/query deterministic jitter frequency	(See page 78.)
:STATe	ON | OFF	OFF	Set/query enable/disable status of deterministic jitter insertion	(See page 79.)
:FUNCtion[:SHAPe]	SIN | SQU | TRI	SIN	Set/query deterministic jitter waveform shape	(See page 79.)
[:PULSe]				
:BPERiod[1|2]	<numeric>	8	Set/query burst period	(See page 80.)
:COUNt[1|2]	<numeric>	2	Set/query burst count	(See page 80.)
:DCYCle[1|2]	<numeric>	50%	Set/query duty cycle	(See page 81.)
:DELay[1|2]	<numeric>	0 ns	Set/query delay	(See page 81.)
:HOLD	WIDTh | DCYCle	DCYCle	Set/query pulse width hold	(See page 81.)
:PERiod	<numeric>	66.67 ns	Set/query pulse period	(See page 82.)
:POLarity[1|2]	NORM | COMP | INV	NORM	Set/query channel polarity	(See page 82.)
:WIDTh[1|2]	<numeric>	33.33 ns	Set/query pulse width	(See page 82.)

Table 14: SCPI command summary (cont.)

Command	Parameter	Default	Description	Page
:VOLTage[0|1|2][:LEVel][:IMMediate]				
[:AMPLitude]	<numeric>	50 mV	Set/query trig/channel amplitude	(See page 83.)
:HIGH	<numeric>	25 mV	Set/query trig/channel high level	(See page 83.)
:LOW	<numeric>	-25 mV	Set/query trig/channel low level	(See page 83.)
:OFFSet	<numeric>	0 V	Set/query trig/channel offset	(See page 84.)
:TERMination	<numeric>	0 V	Set/query trig/channel termination	(See page 84.)
Status subsystem				
:STATus				
:OPERation				
:CONDition?	none	n/a	Query operation condition register	(See page 84.)
:ENABle	<numeric>	n/a	Set/query operation enable mask	(See page 85.)
[:EVENT]?	none	n/a	Query operation event register	(See page 85.)
:PRESet	none	n/a	Configure the status structure	(See page 85.)
:QUEStionable				
:CONDition?	none	n/a	Query questionable condition register	(See page 86.)
:ENABle	<numeric>	n/a	Set/query questionable enable mask	(See page 86.)
[:EVENt]?	none	n/a	Query questionable event register	(See page 86.)
System subsystem				
:SYSTem				
:ERRor[:NEXT]?	none	n/a	Query error queue	(See page 87.)
:VERSion	none	n/a	Query SCPI revision	(See page 87.)

Table 14: SCPI command summary (cont.)

Command	Parameter	Default	Description	Page
Trigger subsystem				
:TRIGger				
:SLOPe	POSitive | NEGative	POS	Set/query CLK IN slope	(See page 87.)
:SOURce	IMMediate | EXTernal	IMM	Set/query clock source	(See page 88.)
:TERM	<numeric>	0 V	Set/query CLK IN termination voltage	(See page 88.)
:STATe	AC | DC	AC	Set/query CLK IN termination type	(See page 88.)

Command descriptions

:ARM[:SEQuence][:LAYer]:LEVel

Form	Set & Query
Parameters	Numeric
Default	100 mV
Query	:ARM:LEV?
Description	Use this command to program the Ext In threshold voltage.
Example	Set Ext In threshold voltage to 1.5 V `:ARM:LEV 1.5V`

:ARM[:SEQuence][:LAYer]:SENSe

Form	Set & Query
Parameters	EDGE | LEVel
Default	EDGE
Query	:ARM:SENS?
Description	Use this command to select trigger type by choosing whether the instrument arms on the edge(s) or level of the arming signal.
Example	Set the trigger type to level `:ARM:SENS LEV`

:ARM[:SEQuence][:LAYer]:SLOPe

Form	Set & Query
Parameters	POSitive | NEGative ■ POSitive: Ext In responds to the rising edge. ■ NEGative: Ext In responds to the falling edge.
Default	POS
Query	:ARM:SLOP?
Description	Use this command to select the trigger slope for the arming signal when triggering on edges. If you are arming on levels, use this command to select whether the instrument triggers during the positive or negative cycle of the arming signal.
Example	Set the signal to be generated on the falling edge. `:ARM:SLOP NEG`

:ARM[:SEQuence][:LAYer]:SOURce

Form	Set & Query
Parameters	IMMediate | MANual | EXTernal | REMote The instrument provides the following trigger sources: ■ IMMediate. The generated signal is always triggered; pulses, bursts, or patterns are produced continuously. ■ .MANual: Manual triggering. Press the ManTrg soft key to generate one trigger event. ■ EXTernal: External triggering. Trigger events are provided by the signal applied to the Ext In port. Threshold, termination voltage, and Edge polarity of the Ext In port are adjustable. ■ REMote: Remote triggering. Trigger events are provided by the GPIB or USB port. Range coupling: Enable/Disable for: ■ SSC ■ Sinusoidal jitter ■ Delay In ■ Random jitter ■ Deterministic jitter These parameters can be enabled only if the Trigger source is set to IMMediate.
Default	IMM
Query	:ARM:SOUR?
Description	Use this command to select the triggering source of the instrument.
Example	Select manual arm source. `:ARM:SOUR MAN`

:ARM[:SEQuence][:LAYer]:TERM

Form	Set & Query
Parameters	Numeric
Suffix	V with engineering prefixes
Default	0 mV
Query	:ARM:TERM?
Description	Use this command to program the Ext In termination voltage.
Example	Set Ext In termination voltage to -1.2 V. `:ARM:TERM -1.2V`

:DIGital[:STIMulus]:PATTern:TYPE

Form	Set & Query
Parameters	DATA | PRBS
Default	DATA
Query	:DIG:PATT:TYPE?
Description	Use this command to program the pattern type. The parameter is common to both channels.
Example	Set the pattern type to PRBS. `:DIG:PATT:TYPE PRBS`

:DIGital[1|2][:STIMulus]:PATTern:LENGth

Form	Set & Query
Parameters	Numeric
Default	8
Query	:DIG1:PATT:LENG?
Description	Programs the Pattern Length. This parameter applies to each channel independently. If the channel specification portion of the command is omitted, the command applies to both channels. It should be a multiple of 8, and will be rounded to the nearest multiple of 8 if it is not. This value is only relevant if the pattern type is DATA. Maximum limit is 16,777,216.
Example	Set the pattern length for channel 1 to 56. `:DIG1:PATT:LENG 56`

:DIGital[1|2][:STIMulus]:PATTern:PLENgth

Form	Set & Query
Parameters	Numeric
Limits	5 to 15, 23 or 31
Default	5
Query	:DIG2:PATT:PLEN?
Description	Programs the Pattern PRBS Length. This parameter applies to each channel independently. If the channel specification portion of the command is omitted, the command applies to both channels. PRBS Length is 2^N-1, where N is the specified value. This value is only relevant if the pattern type is PRBS.
Example	Set the pattern length of channel 2 to (2^7-1). `:DIG2:PATT:PLEN 7`

:DIGital[1|2][:STIMulus]:PATTern:RECall

Form	Set
Parameters	Numeric
Limits	1 to 9
Default	n/a
Description	Recalls pattern data and pattern length from the memory location specified in the numeric parameter to the specified channel. Valid memory locations are integers 1 – 9. Pattern data above the recalled pattern length is unchanged.
Example	Recall the pattern data and pattern length from memory 7 to channel 2. `:DIG2:PATT:REC 7`

:DIGital[1|2][:STIMulus]:PATTern:SAVe

Form	Set
Parameters	Numeric
Limits	1 to 9
Default	n/a
Description	Saves the pattern data and pattern length from the specified channel into the memory location specified in the numeric parameter. Valid memory locations are integers 1 – 9. Pattern data up to the pattern length is saved.
Example	Save the pattern data and pattern length from channel 2 into memory 3. `:DIG2:PATT:SAV 3`

:DIGital[1|2][:STIMulus]:PATTern:DATA

Form	Set & Query
Parameters	<start address>, <bit count>, <data> ■ Start address: The numeric bit number in pattern data memory of the first bit to write. The remainder follows consecutively. ■ Bit count: The number of bits to write into pattern data memory. ■ Data: An arbitrary block of program data as defined in IEEE Standard 488.2-1992, section 7.7.6.2. This data begins with a number symbol (#) and is followed by a single digit that represents the number of characters in the length, then one to five characters specifying the length as a decimal number, then lastly, the program data.
Default	The first bit is 1, all other bits are 0
Query	:DIG[1|2]:PATT:DATA?
Description	Use this command to program the pattern data memory. Each byte of pattern data is a character (0 or 1) representing one bit of pattern data. The value (<start address> + <bit count>) must be less than or equal to 16,777,217. The bit count can be any number, 1 to 16,384. The entire pattern data memory is accessible for reading or writing, even that outside the range of the current pattern length setting. The bit count parameter and the length of the data block must match [(<start address> + <bit count>) must be less than or equal to 16,777,217].
Example	`:DIG:PATT:DATA 1,16,#2160100000101010010` This command does the following: ■ Starts loading the data into bit location 1. ■ Specifies that 16 bits of data will be loaded. ■ In the <data>: ■ #: signifies the beginning of the block ■ 2: indicates that the length of the data length is two characters ■ 16: indicates that data length is 16 bytes. (16 ASCII characters) ■ 0100000101010010: is the character representation of the data Bits 1 through 16 in the Channel 1 pattern data memory will be set to 0100000101010010. `:DIG1:PATT:DATA? 1,8` This query reads 8 bits of channel 1 pattern data starting from address 1. Given the above pattern data memory contents, the response would be "#1801000001".

:DIGital[1|2][:STIMulus]:PATTern:HDATa

Form	Set & Query
Parameters	<start address>, <bit count>, <data> ■ Start address: The numeric bit number in pattern data memory of the first bit to write. The remainder follows consecutively. ■ Bit count: The number of bits to write into pattern data memory. ■ Data: An arbitrary block of program data as defined in IEEE Standard 488.2-1992, section 7.7.6.2. This data begins with a number symbol (#) and is followed by a single digit that represents the number of characters in the length, then one to five characters specifying the length as a decimal number, then lastly, the program data.
Default	The first bit is 1, all other bits are 0
Query	:DIG[1|2]:PATT:HDAT?
Description	Use this command to program the pattern data memory using hexadecimal format. Each byte of pattern data is a hexadecimal character (0 to 9, A to F, or a to f) representing four bits of pattern data. The value (<start address> + <bit count>) must be less than or equal to 16,777,217. The bit count can be any number, 1 to 65,536. The entire pattern data memory is accessible for reading or writing, even that outside the range of the current pattern length setting. The bit count parameter must be equal to four times the length of the data block or up to three bits fewer. If it is fewer, then the extra bits in the last data byte are ignored by the instrument [(<start address> + <bit count>) must be less than or equal to 16,777,217].
Example	`:DIG1:PATT:HDAT 1,16#144152` This command does the following: ■ Starts loading the data into bit location 1. ■ Specifies that 16 bits of data will be loaded. ■ In the <data>: ■ #: signifies the beginning of the block. ■ 1: indicates the number of characters in the length. ■ 4: indicates that data length is 4 bytes. ■ 0100000101010010: is the character representation of the data Bits 1 through 16 in the Channel 1 pattern data memory will be set to 0100000101010010. `:DIG1:PATT:HDAT? 1,8` This query reads 8 bits of channel 1 pattern data starting from address 1. Given the above pattern data memory contents, the response would be #1241. ***NOTE.*** *If the query requests a number of bits that is not a multiple of four, the remaining bits in the last byte will be zero and valueless.*

:DIGital[1|2][:STIMulus]:SIGNal:CROSover:[VALue]

Form	Set & Query
Parameters	Numeric (value is%)
Default	50%
Query	:DIG[1|2]:SIGN:CROS?
Description	Use this command to adjust each channel's signal crossover point in PRBS or data mode (NRZ format only). The crossing point is accurate for 50% only. While the range of values is from 30% to 70%, over programming in the range 20% to 80% is allowed.
Example	Set Channel 1 variable crossing point to 60%. `:DIG1:SIGN:CROS 60`

:DIGital[1|2][:STIMulus]:SIGNal:FORMat

Form	Set & Query
Parameters	RZ | NRZ | R1 Range Coupling: Period, Frequency
Default	NRZ
Query	:DIG[1|2]:SIGN:FORM?
Description	Use this command to program the signal format for data and PBRS signals of Channels 1 and 2 when using Pattern mode. If you don't specify a channel number in the command, Channel 1 is assumed. RZ: Return-to-zero. ■ For a "0" bit, the signal stays low. For a "1" bit, the signal pulses from the low level to the high level and back to low. Pulse width can be specified by the pulse width or duty cycle parameters. NRZ: Non-return-to-zero. ■ For a "0" bit, the signal stays low for the entire bit period. For a "1" bit, the signal stays high for the entire bit period. Pulse width is not meaningful in this format. Crossing point may be adjusted in this format. R1: Return-to-one. ■ For a "1" bit, the signal stays high. For a "0" bit, the signal pulses from the high level to the low level and back to high. Pulse width can be specified by the pulse width or duty cycle parameters.
Example	Set Channel 2 data format to RZ `:DIG2:SIGN:FORM RZ`

:DISPlay:BRIGhtness

Form	Set & Query
Parameters	Numeric
Limits	1 to 10
Default	8
Query	:DISP:BRIG?
Description	Use this command to set the LCD display screen brightness.
Example	Set brightness to 7 `:DISP:BRIG 7`

:DISPlay:CONTrast

Form	Set & Query
Parameters	Numeric
Limits	1 to 10
Default	6
Query	::DISP:CONT?
Description	Use this command to set the LCD display screen contrast.
Example	Set contrast to 7 `:DISP:CONT 7`

:MEASure:FREQuency?

Form	Query
Parameters	None
Default	N/A
Query	:MEAS:FREQ?
Description	Use this to query the frequency at the Clk In connector. Execution of this command will also cause the generator to update the frequency parameter and any coupled parameters. If the signal at the Clk In connector is out of range, the returned value will be zero, and the frequency parameter will not be updated.
Example	Measure the frequency at the Clk In connector. `:MEAS:FREQ?`

:OUTPut[0]:CHANnel

Form	Set & Query
Parameters	1 | 2
Default	1
Query	:OUTP:CHAN?
Description	Programs which channel drives the trigger out event.
Example	Set the trigger output to be driven by the channel 2 data. `:OUTP0:CHAN 2`

:OUTPut[0]:SOURce

Form	Set & Query
Parameters	PERiodic | BITStream
Default	PERiodic
Query	:OUTP:SOUR?
Description	Use this command to program the trigger out event. ■ PERiodic: A trigger pulse will be output for each pulse or data/burst clock period. ■ BITStream: A trigger pulse will be output for each complete pattern or burst. For PRBS patterns, a trigger is output for every eighth cycle of the PRBS.
Example	Set the trigger out event to bitstream. `:OUTP0:SOUR BITS`

:OUTPut[1|2][:STATe]

Form	Set & Query
Parameters	ON | OFF
Default	OFF
Query	:OUTP[1|2]?
Description	Use this command to program the enable/disable status of the Channel 1 and 2 outputs.
Example	Enable Channel 1 output. `:OUTP1 ON`

:SENSe:ROSCillator:SOURce

Form	Set & Query
Parameters	INTernal | EXTernal
Default	INT
Query	:SENS:ROSC:SOUR?
Description	Use this command to program the 10 MHz reference source.
Example	Set the 10 MHz source to use the internal reference. `:SENS:ROSC:SOUR INT`

[:SOURce]:FM[:INTernal]:DEViation

Form	Set & Query
Parameters	Numeric (value is percent)
Default	1%
Query	:FM:DEV?
Description	Use this command to select the Spread Spectrum Clocking (SSC) amplitude.
Example	Set SSC amplitude to 1.5%. `:FM:DEV 1.5`

[:SOURce]:FM[:INTernal]:FREQuency

Form	Set & Query
Parameters	Numeric
Suffix	Hz with engineering prefixes
Default	33 kHz
Query	:FM:FREQ?
Description	Use this command to select the SSC frequency.
Example	Set SSC frequency to 40 kHz. `:FM:FREQ 40kHz`

[:SOURce]:FM:STATe

Form	Set & Query
Parameters	ON | OFF
Default	OFF
Query	:FM:STAT?
Description	Use this command to select the SSC enable/disable state. The SSC can be enabled only if the trigger source is IMMediate and the clock source is INTernal. In addition, sine jitter must be disabled.
Example	Disable SSC. `:FM:STAT OFF`

[:SOURce]:FREQuency[:CW|:FIXed]

Form	Set & Query
Parameters	Numeric Range coupling: Width, duty cycle, delay Value coupling: Period, width, duty cycle
Suffix	Hz with engineering prefixes
Default	15 MHz
Query	:FREQ?
Description	Use this command to program the internal clock frequency. This command also selects the internal clock as the time base if it is not already selected. A query returns the last known clock frequency. If the clock source is INTernal, it will be up to date. If the clock source is Clock In, the last measured frequency of Clock In is returned. Or, if no measurement has been made, the last internal setting will be returned.
Example	Set clock frequency to 1.2 GHz. `:FREQ 1.2GHz`

[:SOURce]:IMODe

Form	Set & Query
Parameters	PULSe | PATTern | BURSt | EWIDth
Default	PULS
Query	:IMOD?
Description	Use this command to program the high-level instrument operating mode. Other parameters will be relevant based on the selected mode. EWIDth means External WIDth.
Example	Set instrument to pattern mode. `:IMOD PATT`

[:SOURce]:PM:HOLD

Form	Set & Query
Parameters	UI | TIME
Default	UI
Query	:PM:HOLD?
Description	Use this command to program the jitter hold setting. This setting applies to all jitter amplitude parameters for both channels. In UI hold, if the frequency is changed, the jitter amplitudes are held to a constant UI value. In TIME hold, if the frequency is changed, the jitter amplitudes are held to a constant time value.
Example	Set jitter hold to UI. `:PM:HOLD UI`

[:SOURce]:PM:INTernal1[:DEViation]

Form	Set & Query
Parameters	Numeric [S | UI] Range coupling: Frequency, Period, and Sine jitter frequency
Default	9.0 mUI_{p-p}
Query	:PM:INT1? Query responses are always in S units.
Description	Use this command to program the sinusoidal jitter amplitude. The value is peak-to-peak. Sinusoidal jitter applies equally to both channels.
Example	Set the amplitude of sinusoidal jitter to 0.3 ns. `:PM:INT1 0.3ns`

[:SOURce]:PM:INTernal1:FREQuency

Form	Set & Query
Parameters	Numeric Range coupling: Frequency, Period, and Sine jitter amplitude
Suffix	Hz with engineering prefixes
Default	1 MHz
Query	:PM:INT1:FREQ?
Description	Use this command to program the sinusoidal jitter frequency. Sinusoidal jitter applies equally to both channels.
Example	Set the frequency of sinusoidal jitter to 1.3 MHz. `:PM:INT1:FREQ 1.3MHz`

[:SOURce]:PM:INTernal1:STATe

Form	Set & Query
Parameters	ON | OFF Range coupling: Frequency, Period, Sine jitter amplitude, and Sine jitter frequency
Default	OFF
Query	:PM:INT1:STAT?
Description	Use this command to select the sinusoidal jitter enable/disable state. Sinusoidal jitter applies equally to both channels. Sinusoidal jitter can be enabled only if the trigger source is IMMediate and the clock source is INTernal. In addition, SSC must be disabled.
Example	Enable sinusoidal jitter. `:PM:INT1:STAT ON`

[:SOURce]:PM[1|2]:EXTernal:STATe

Form	Set & Query
Parameters	ON | OFF
Default	OFF
Query	:PM[1|2]:EXT:STAT?
Description	Use this command to select the Delay In enable/disable state for Channel 1 and 2. Delay In can be enabled only if the trigger source is IMMediate.
Example	Enable Channel 2 Delay In. `:PM2:EXT:STAT ON`

[:SOURce]:PM[1|2]:INTernal2[:DEViation]

Form	Set & Query
Parameters	Numeric [S | UI] Range coupling: Frequency
Default	50 mUI_{rms}
Query	:PM[1|2]:INT2? Query responses are always in UI units
Description	Use this command to program the random jitter amplitude. The value is root mean square.
Example	Set Channel 1 random jitter amplitude to 25 mUI_{rms} `:PM1:INT2 25mUI`

[:SOURce]:PM[1|2]:INTernal2:STATe

Form	Set & Query
Parameters	ON | OFF
Default	OFF
Query	:PM[1|2]:INT2:STAT?
Description	Use this command to select the random jitter enable/disable state for Channel 1 and 2. Random jitter can be enabled only if the trigger source is IMMediate.
Example	Enable Channel 1 random jitter. `:PM1:INT2:STAT ON`

[:SOURce]:PM[1|2]:INTernal3[:DEViation]

Form	Set & Query
Parameters	Numeric [S | UI] Range coupling: Frequency and Period
Default	100 mUI_{p-p}
Query	:PM[1|2]:INT3? Query responses are always in UI units
Description	Use this command to program the deterministic jitter amplitude. The value is peak-to-peak.
Example	Query Channel 2 deterministic jitter amplitude. `:PM2:INT3:STAT ON`

[:SOURce]:PM[1|2]:INTernal3:FREQuency

Form	Set & Query
Parameters	Numeric Range coupling: Deterministic jitter function
Suffix	Hz with engineering prefixes
Default	1 MHz
Query	:PM[1|2]:INT3:FREQ?
Description	Use this command to program the deterministic jitter frequency. The maximum allowed frequency is dependent on the deterministic jitter function. See :PM:INT3:FUNC.
Example	Set the Channel 2 frequency of deterministic jitter to 2 MHz. `:PM2:INT3:FREQ 2MHz`

[:SOURce]:PM[1|2]:INTernal3:FUNCtion[:SHAPe]

Form	Set & Query
Parameters	SIN | SQU | TRI Range coupling: Deterministic jitter frequency
Default	SIN
Query	:PM[1|2]:INT3:FUNC?
Description	Use this command to select the function shape of deterministic jitter for Channel 1 and 2. There is an interaction between function shape and maximum deterministic jitter frequency: ■ Sine and square: 20 MHz ■ Triangle: 4 MHz
Example	Set Channel 1 deterministic jitter shape to square. `:PM1:INT3:FUNC SQU`

[:SOURce]:PM[1|2]:INTernal3:STATe

Form	Set & Query
Parameters	ON | OFF
Default	OFF
Query	:PM[1|2]:INT3:STAT?
Description	Use this command to select the deterministic jitter enable/disable state for Channel 1 and 2. Deterministic jitter can be enabled only if the trigger source is IMMediate.
Example	Enable Channel 2 deterministic jitter. `:PM2:INT3:STAT ON`

[:SOURce][:PULSe]:BPERiod[1|2]

Form	Set & Query
Parameters	Numeric Range coupling: Burst count
Default	8
Query	:BPER?
Description	Use this command to program the burst period (set the number of clock cycles in a burst). Burst period is common to both channels and is relevant only in burst mode. A burst consists of a number of clock cycles as set by the Burst Period. The first Burst Count of these cycles will output a pulse, the remainder do not. The burst period must be entered as a multiple of eight and must be greater than or equal to the burst count value. ***NOTE.*** *If the number entered is not a multiple of eight, the instrument will automatically round the number to the nearest multiple of eight.*
Example	Set the burst period to 32. `:BPER 32`

[:SOURce][:PULSe]:COUNt[1|2]

Form	Set & Query
Parameters	Numeric Range coupling: Burst period
Default	2
Query	:COUN[1|2]?
Description	Use this command to program the burst count (set the number of pulses in a burst) for Channel 1 or 2. Burst count is relevant only in burst mode. A burst consists of a number of clock cycles as set by the Burst Period. The first Burst Count of these cycles will output a pulse, the remainder do not. The burst period must be a minimum of 2 and cannot be greater than the burst period value.
Example	Set the Channel 2 burst count to 5. `:COUN2 5`

[:SOURce][:PULSe]:DCYCle[1|2]

Form	Set & Query
Parameters	Numeric (value is in percent) Range coupling: Frequency and period Value coupling: Width
Default	50%
Query	:DCYC[1|2]?
Description	Use this command to program the duty cycle for Channel 1 or 2. Duty cycle is not relevant when in NRZ format or Ext Width mode.
Example	Set the Channel 1 duty cycle to 41%. `:DCYC1 41`

[:SOURce][:PULSe]:DELay[1|2]

Form	Set & Query
Parameters	Numeric (value is in s) Range coupling: Frequency and period
Default	0 s
Query	:DEL[1|2]?
Description	Use this command to program the delay for Channel 1 or 2.
Example	Set the Channel 1 delay to 11 ns. `:DEL1 11ns`

[:SOURce][:PULSe]:HOLD[1|2]

Form	Set & Query
Parameters	WIDTh | DCYCle
Default	DCYCle
Query	:HOLD?
Description	Use this command to program the pulse width hold setting for Channel 1 or Channel 2. When set to WIDTh, if the frequency is changed, the pulse width is held to a constant value. When set to DCYCle, if the frequency is changed, the duty cycle is held to a constant value.
Example	Set Channel 2 pulse width hold to constant duty cycle. `:HOLD2 DCYCle`

[:SOURce][:PULSe]:PERiod

Form	Set & Query
Parameters	Numeric (value is in s) Range coupling: Width, duty cycle, and delay Value coupling: Frequency, period, width, and duty cycle
Default	66.67 ns
Query	:PER?
Description	Use this command to select the internal clock as the time base and program the internal clock period. A query returns the internal clock frequency. If the clock source is Clk In, the last measured period of Clock In is returned.
Example	Set internal clock period to 10 ns. `:PER 10ns`

[:SOURce][:PULSe]:POLarity[1|2]

Form	Set & Query
Parameters	NORMal | COMPlement | INVerted
Default	NORM
Query	:POL[1|2]?
Description	Use this command to program the polarity for Channel 1 and 2. COMP and INV are the same setting.
Example	Set Channel 1 polarity to normal. `:POL1 NORM`

[:SOURce][:PULSe]:WIDTh[1|2]

Form	Set & Query
Parameters	Numeric (value is in s) Range coupling: Frequency and period Value coupling: Duty cycle
Default	33.33 ns
Query	:WIDT[1|2]?
Description	Use this command to program the pulse width for Channel 1 and 2.
Example	Set Channel 2 pulse width to 5.2 ns. `:WIDT2 5.2ns`

[:SOURce]:VOLTage[0|1|2][:LEVel][:IMMediate][:AMPLitude]

Form	Set & Query
Parameters	Numeric (value is in V) Value coupling: High level = offset + amplitude/2; Low level = offset – amplitude/2 Range coupling: Offset, high level, and low level
Default	50 mV
Query	:VOLT[1|2]?
Description	This command programs the amplitude of the signal for the trigger output and channels 1 and 2. For this command, the trigger output is treated as channel 0.
Example	Set Channel 1 amplitude to 2 V. `:VOLT1 2V`

[:SOURce]:VOLTage[0|1|2][:LEVel][:IMMediate]:HIGH

Form	Set & Query
Parameters	Numeric (value is in V) Value coupling: Amplitude = high level - low level; Offset = (high level + low level)/2 Range coupling: Low level, amplitude, and Offset
Default	25 mV
Query	:VOLT[1|2]:HIGH?
Description	This command programs the high level of the signal for the trigger output and channels 1 and 2. For this command, the trigger output is treated as channel 0.
Example	Set Channel 1 high level voltage to 2 V. `:VOLT1:HIGH 2V`

[:SOURce]:VOLTage[0|1|2][:LEVel][:IMMediate]:LOW

Form	Set & Query
Parameters	Numeric (value is in V) Value coupling: Amplitude = high level - low level; Offset = (high level + low level)/2 Range coupling: High level, amplitude, and Offset
Default	-25 mV
Query	:VOLT[1|2]:LOW?
Description	This command programs the low level of the signal for the trigger output and channels 1 and 2. For this command, the trigger output is treated as channel 0.
Example	Set Channel 1 low level voltage to 2 V. `:VOLT1:LOW 2V`

[:SOURce]:VOLTage[0|1|2][:LEVel][:IMMediate]:OFFSet

Form	Set & Query
Parameters	Numeric (value is in V) Value coupling: High level = offset + (amplitude/2); Low level = offset - (amplitude/2) Range coupling: Amplitude, high level, and low level
Default	0 mV
Query	:VOLT[1|2]:OFFS?
Description	This command programs the offset of the signal for the trigger output and channels 1 and 2. For this command, the trigger output is treated as channel 0.
Example	Set Channel 1 offset voltage to -0.5 V. `:VOLT1:OFFS -0.5 V`

[:SOURce]:VOLTage[0|1|2][:LEVel][:IMMediate]:TERMination

Form	Set & Query
Parameters	Numeric (value is in V) Range coupling: High level, low level, amplitude, and offset Value coupling: High level, low level, and offset
Default	0 V
Query	:VOLT[1|2]:TERM?
Description	This command programs the user-supplied termination voltage. This setting results in the high level, low level, and offset values being updated to reflect the correct levels at the load given its termination voltage.
Example	Set Channel 2 termination voltage to -1.0 V. `:VOLT2:TERM -1.0V`

:STATus:OPERation:CONDition?

Form	Query
Parameters	None
Default	N/A
Query	:STAT:OPER:COND?
Description	Queries the operation condition register. This register is not used; the query always returns 0.
Example	Query the operation condition register. `:STAT:OPER:COND?`

:STATus:OPERation:ENABle

Form	Set & Query
Parameters	None
Default	N/A
Query	:STAT:OPER:ENAB?
Description	Programs operation enable mask. This register is not used; the command form does nothing; the query always returns 0.
Example	Query the operation enable mask. :STAT:OPER:ENAB?

:STATus:OPERation[:EVENt]?

Form	Query
Parameters	None
Default	N/A
Query	:STAT:OPER[:ENEV]?
Description	Queries the operation event register. This register is not used; the query always returns 0.
Example	Query the operation event register. :STAT:OPER?

:STATus:PRESet

Form	Set
Parameters	None
Default	N/A
Description	Presets the status structure. The registers this command impacts are not used; this command has no effect.
Example	Preset the status structure. :STAT:PRES

:STATus:QUEStionable:CONDition?

Form	Query
Parameters	None
Default	N/A
Query	:STAT:QUES:COND?
Description	Queries the questionable condition register. This register is not used; the query always returns 0.
Example	Query the questionable condition register. :STAT:QUES:COND?

:STATus:QUEStionable:ENABle

Form	Set & Query
Parameters	None
Default	N/A
Query	STAT:QUES:ENAB?
Description	Programs questionable enable mask. This register is not used; the command form does nothing; the query always returns 0.
Example	Query the questionable enable mask. :STAT:QUES:ENAB?

:STATus:QUEStionable[:EVENt]?

Form	Query
Parameters	None
Default	N/A
Query	:STAT:QUES[:EVEN]?
Description	Queries the questionable event register. This register is not used; the query always returns 0.
Example	Query the questionable event register. :STAT:QUES?

:SYSTem:ERRor[:NEXT]?

Form	Query
Parameters	None
Default	N/A
Query	:SYST:ERR[:NEXT]?
Description	Queries the system error queue. Returns an integer representing the error number and a string in double quotes containing the error description. The integer and string are separated by a comma. The error queue may have multiple items that can be retrieved using multiple queries. If the queue is empty, the response will be: +0,"No error".
Example	Query the error queue. `:SYST:ERR?`

:SYSTem:VERSion?

Form	Query
Parameters	None
Default	N/A
Query	:SYST:VERS?
Description	Queries the SCPI version to which this instrument complies.
Example	Query the SCPI version. `:SYST:VERS?`

:TRIGger:SLOPe

Form	Set & Query
Parameters	POSitive | NEGative
Default	POS
Query	:TRIG:SLOP?
Description	This command programs the Clk In slope and commands whether the signal is generated at the rising (POSitive) or falling (NEGative) edge of the external clock input.
Example	Set the slope of the clock input to NEGative. `:TRIG:SLOP NEG`

:TRIGger:SOURce

Form	Set & Query
Parameters	IMMediate | EXTernal
Default	IMM
Query	:TRIG:SOUR?
Description	This command programs the clock source. IMM: ■ The internal oscillator is the clock source. ■ EXT: The clock source is provided by the signal at the Clk In connector. The frequency at the Clk In connector can be measured using the command: MEAS:FREQ?
Example	Select the clock source to the internal oscillator. `:TRIG:SOUR IMM`

:TRIGger:TERM

Form	Set & Query
Parameters	Numeric [mV | V]
Default	0 V
Query	:TRIG:TERM?
Description	This command programs the termination voltage for the external Clock In. This voltage is applied only if DC-coupled termination is enabled.
Example	Sets the termination voltage of the signal applied to the external clock input to 1 V. `:TRIG:TERM 1V`

:TRIGger:TERM:STATe

Form	Set & Query
Parameters	AC | DC
Default	AC
Query	:TRIG:TERM:STAT?
Description	This command programs the termination type as AC or DC for the external Clock In.
Example	Set the coupling of the external clock input connector to DC. `:TRIG:TERM:STAT DC`

Compliance information

This section lists the safety and environmental standards with which the instrument complies.

Safety compliance

This section lists the safety compliance information.

Equipment type Test and measuring equipment.

Safety class Class 1 – grounded product.

Pollution degree descriptions A measure of the contaminants that could occur in the environment around and within a product. Typically the internal environment inside a product is considered to be the same as the external. Products should be used only in the environment for which they are rated.

- Pollution degree 1. No pollution or only dry, nonconductive pollution occurs. Products in this category are generally encapsulated, hermetically sealed, or located in clean rooms.
- Pollution degree 2. Normally only dry, nonconductive pollution occurs. Occasionally a temporary conductivity that is caused by condensation must be expected. This location is a typical office/home environment. Temporary condensation occurs only when the product is out of service.
- Pollution degree 3. Conductive pollution, or dry, nonconductive pollution that becomes conductive due to condensation. These are sheltered locations where neither temperature nor humidity is controlled. The area is protected from direct sunshine, rain, or direct wind.
- Pollution degree 4. Pollution that generates persistent conductivity through conductive dust, rain, or snow. Typical outdoor locations.

Pollution degree rating Pollution degree 2 (as defined in IEC 61010-1). Rated for indoor, dry location use only.

Measurement and overvoltage category descriptions

Measurement terminals on this product may be rated for measuring mains voltages from one or more of the following categories (see specific ratings marked on the product and in the manual).

- Category II. Circuits directly connected to the building wiring at utilization points (socket outlets and similar points).
- Category III. In the building wiring and distribution system.
- Category IV. At the source of the electrical supply to the building.

NOTE. *Only mains power supply circuits have an overvoltage category rating. Only measurement circuits have a measurement category rating. Other circuits within the product do not have either rating.*

Mains overvoltage category rating

Overvoltage category II (as defined in IEC 61010-1).

Environmental considerations

This section provides information about the environmental impact of the product.

Product end-of-life handling

Observe the following guidelines when recycling an instrument or component:

Equipment recycling. Production of this equipment required the extraction and use of natural resources. The equipment may contain substances that could be harmful to the environment or human health if improperly handled at the product's end of life. To avoid release of such substances into the environment and to reduce the use of natural resources, we encourage you to recycle this product in an appropriate system that will ensure that most of the materials are reused or recycled appropriately.

Mercury notification. This product uses an LCD backlight lamp that contains mercury. Disposal may be regulated due to environmental considerations. Please contact your local authorities or, within the United States, refer to the E-cycling Central Web page (www.eiae.org) for disposal or recycling information.