Tektronix®

Tektronix PPG1251
PatternPro® Programmable Pattern Generator

User Manual

077-1091-01

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www.tek.com

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Contacting Tektronix

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For product information, sales, service, and technical support:
- In North America, call 1-800-833-9200.
- Worldwide, visit www.tek.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.

In order to obtain service under this warranty, Customer must notify Tektronix of the defect before the expiration of the warranty period and make suitable arrangements for the performance of service. Customer shall be responsible for packaging and shipping the defective product to the service center designated by Tektronix, with shipping charges prepaid. Tektronix shall pay for the return of the product to Customer if the shipment is to a location within the country in which the Tektronix service center is located. Customer shall be responsible for paying all shipping charges, duties, taxes, and any other charges for products returned to any other locations.

This warranty shall not apply to any defect, failure or damage caused by improper use or improper or inadequate maintenance and care. Tektronix shall not be obligated to furnish service under this warranty a) to repair damage resulting from attempts by personnel other than Tektronix representatives to install, repair or service the product; b) to repair damage resulting from improper use or connection to incompatible equipment; c) to repair any damage or malfunction caused by the use of non-Tektronix supplies; or d) to service a product that has been modified or integrated with other products when the effect of such modification or integration increases the time or difficulty of servicing the product.

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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 vii, *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.

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.

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. This product is provided with handles for lifting and carrying.

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:

CAUTION
Refer to Manual

Protective Ground
(Earth) Terminal

Preface

The Tektronix PPG1251 PatternPro® Programmable Pattern Generator gives you extensive control over operating parameters such as amplitude, offset, and crossing point.

The operational flexibility and pattern generation capability makes this unit suitable for use in many different applications, including creating stressed serial data patterns for receiver testing and characterization.

Features

The PPG1251 Pattern Generators provides serial data and clock outputs with the following features:

- Touch screen and USB interface
- 50 Ω source impedance
- Adjustable voltage amplitude
  - 250 mV to 2.0 V single ended
  - 500 mV to 4.0 V differential
- Pulse output programmable as voltage amplitude and offset
- Internal clock source
- External clock input
- Full rate clock output
- Pattern trigger or clock/n output
- Jitter insertion (option):
  - Built-in sinusoidal modulation source
  - Built-in random modulation source
  - External modulation input
- Save up to twenty-five user patterns in nonvolatile memory
- Save up to twenty-five generator setups in nonvolatile memory
- 3RU height, full-rack design

Documentation

The following documentation is available:

- This PPG1251 PatternPro® Programmable Pattern Generator User Manual
- Product datasheets (PDF versions only, downloadable from the Tektronix Web Site)

Check the Tektronix Web Site for additional product documentation at www.Tektronix.com.

Getting started

Installation

The pattern generator is 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 might be a protective film over the display, which can be removed). Report damage to the shipping agent immediately. Save the original packing carton for possible future shipment.

Accessories

The following items are included with every order:

- Pattern generator
- Power cord
- Rack mount ears on the front of the instrument
- PPG/PED Installation & Safety instructions
- Accessories as ordered

Power requirements

CAUTION. *Operating the instrument on an incorrect line voltage can cause damage, possibly voiding the warranty. To avoid this, operate the instrument with the correct line voltage.*

The instrument operates from a single-phase line voltage listed in the following table. 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.

Table 1: Power requirements

Item	Description
Voltage	100 V to 240 V
Frequency	50 Hz to 60 Hz
Power	360 W, maximum
Power fuse	T 2A 250V

The power cord supplied with the instrument contains a separate ground for use with grounded outlets. When proper connections are made, the instrument chassis is connected to power line ground through the ground wire in the power cord providing protection against electric shock.

Ventilation

The unit has fans in the rear, as well as cooling vents on the bottom and side panels to keep it from overheating.

CAUTION. *Inadequate ventilation can damage the instrument; to avoid damaging the instrument, observe the following precautions:*

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 surfaces or cooling vents. This additional airflow could compromise performance.

When rack mounting the instrument, ensure there is adequate airflow around the instrument rear, sides, and bottom 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.

Environmental considerations

The following table describes the maximum operating environmental ratings for your instrument.

Table 2: Maximum operating environmental considerations

Feature	Description
Temperature	40 °C (104 °F)
Humidity	80% for temperatures up to 31 °C (88 °F) decreasing linearly to 50% at 40 °C (104 °F)
Altitude	2000 m (6562 ft.)

Controls and connectors

The following illustration and table describe the front panel controls and connectors.

NOTE. *The exact location and spacing of the Data Out connectors may be different depending on the output options ordered with the instrument.*

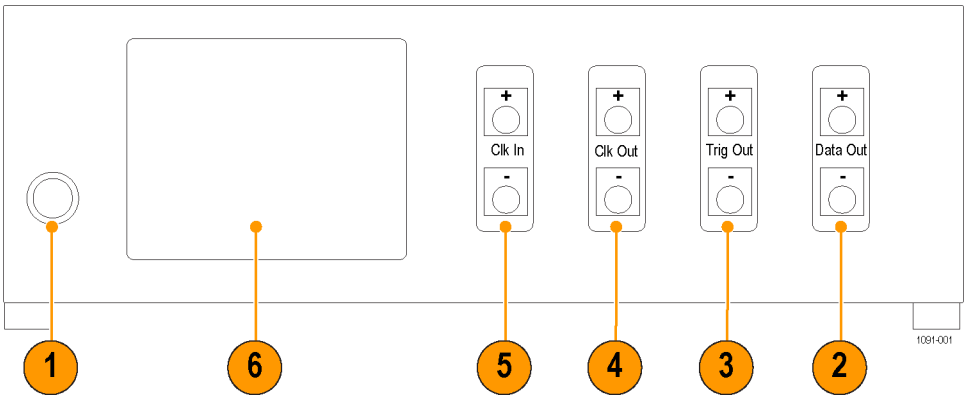

Figure 1: Front panel controls and connectors

Table 3: Front panel controls and connectors

Item		Description
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.
2	Data Out connectors	SMA + and – data output connectors; can be used single-ended. Amplitudes can be set independently.
3	Trig Out connectors	SMA differential trigger output connectors; can be used single-ended.
4	Clk Out connectors	SMA differential clock output connectors, can be used single-ended.
5	Clk In connectors	SMA differential clock input connectors; can be used single-ended. Used for an external clock signal.
6	Display	The display is a touch screen graphical user interface.

The following illustration and table describe the rear panel connectors.

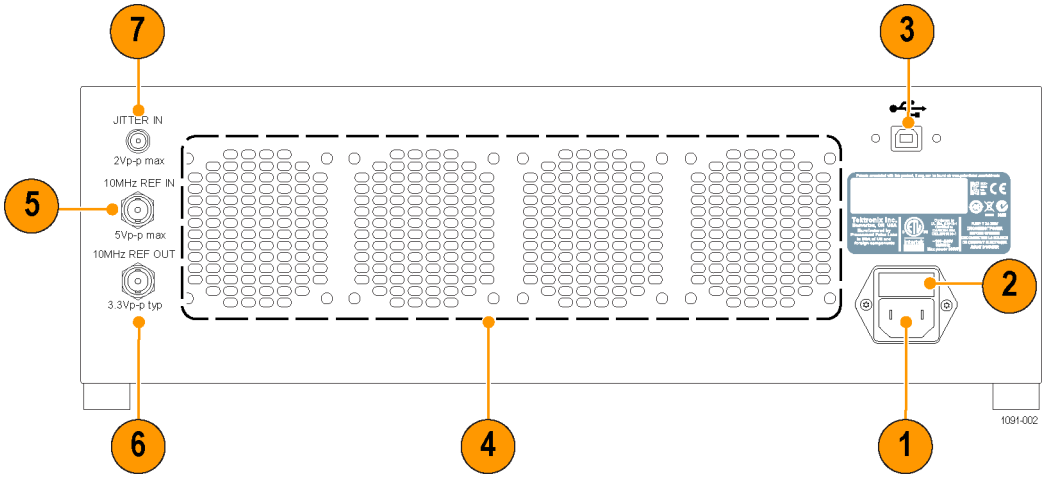

Figure 2: Rear panel connectors

Table 4: Rear panel connectors

Item		Description
1	AC line receptacle	Connect the appropriate power cord here.
2	Fuse holder	Line fuse, 5 X 20 mm, 2 A, 250 V, SLO BLO
3	USB connection	Connect the USB cable here to control the instrument from an external computer.
4	Fans	Fans and cooling vents
5	10 MHz REF IN	BNC input for external frequency reference
6	10 MHz REF OUT	BNC output for buffered version of the frequency reference (internal or external)
7	JITTER IN	SMA input for external jitter insertion (Option HFJIT)

Functional verification

Instrument setup

A typical setup for verifying the pattern generator operation is shown in the following figure. The diagram uses only the + side of all differential connections, the - side can be tested in the same manner. Use a DSA8300 Digital Serial Analyzer Sampling Oscilloscope or similar for functional verification.

CAUTION. *Damage to the pattern generator and/or associated equipment can occur if the input and output voltage ratings are exceeded. Check the input and output voltage ratings for your equipment. The following illustration shows electrical attenuators where voltage ratings are commonly exceeded.*

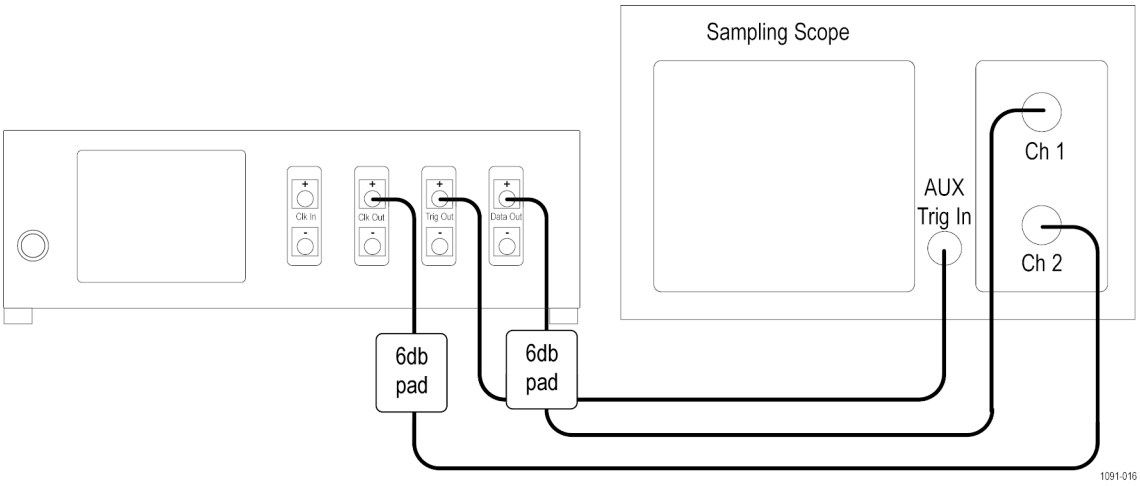

Figure 3: Verification setup

Power on and verify instrument operation

The following steps assume the unit is connected as shown in the verification setup.

NOTE. *Note: The generator is internally temperature compensated for timing and output level continuously and automatically. Internal timing calibration will also take place whenever the frequency is set (either manually or through remote programming). Setting the frequency (or resetting the frequency to its current value) is recommended after an initial 20-minute warm-up, or if a significant change in ambient temperature has occurred during operation.*

1. Push front panel on/off switch.
   - The green light on the switch turns on.
   - The instrument goes through the start-up sequence.
   - The Main menu displays on the touch screen.
2. Select **UTILITY** by touching the on-screen button.
3. Select **SAVE**.
4. Select **RECALL DEFAULTS** (The instrument loads all the default settings).
5. Select **BACK**.
6. Select **MAIN**.
7. Turn **OUTPUT ON**.
8. Use the **AUTO SCALE** function on the oscilloscope to identify and display signals.
9. Adjust the oscilloscope voltage, timing and display settings as needed.
   - Channel 1 shows a square wave at the default clock rate.
   - Channel 2 shows PRBS data with pattern trigger.
   - The output should be similar to the following figure (the displayed data pattern may differ).

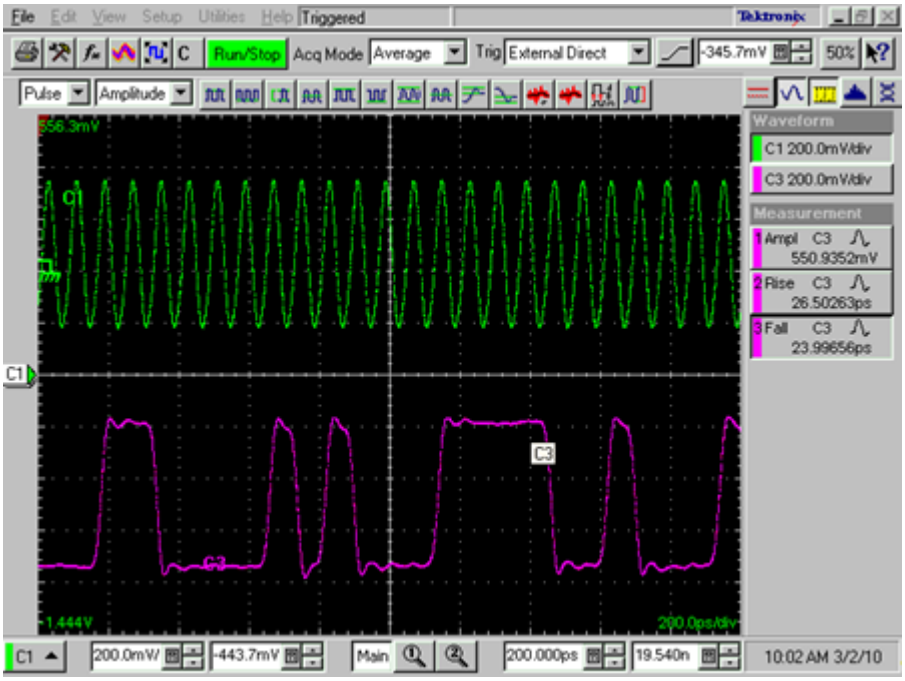

Figure 4: Clock (top) and data (bottom) waveforms

Verify the eye diagram

1. Select **UTILITY**.
2. Select **TRIGGER**.
3. Select **TRIGGER TYPE = CLK/N**.
4. Set **N DIVISOR** to **8** (check the frequency capability for your oscilloscope).
5. Turn off the display on the oscilloscope channel 1 (clock signal).
6. Adjust the sampling oscilloscope amplitude, timing and display as needed. Output should be similar to the following figure.

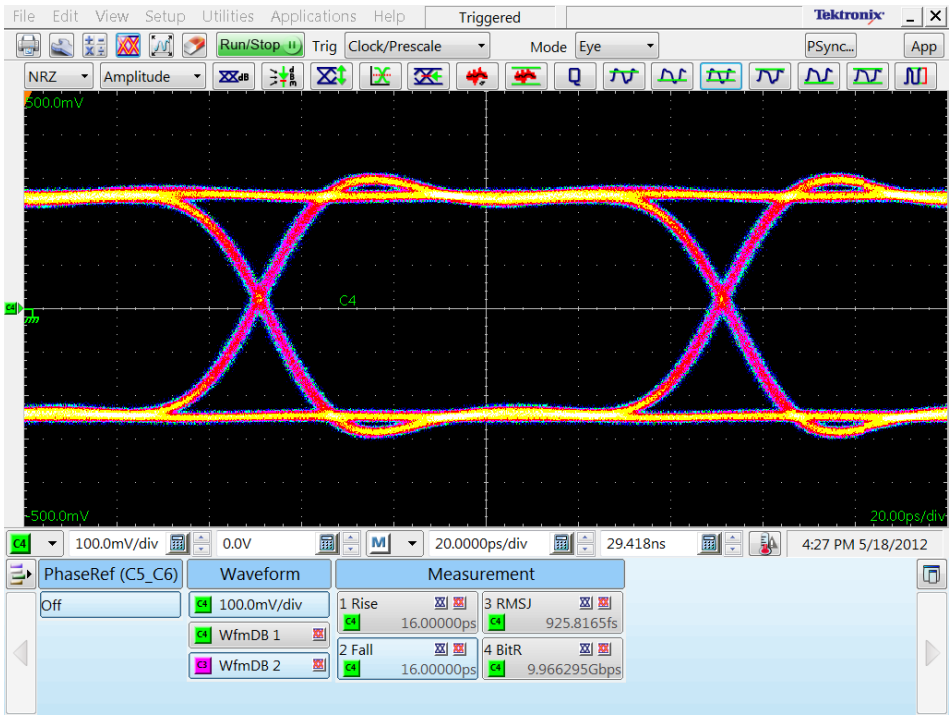

Figure 5: Typical eye diagram example

Check other settings

Access the remaining menus to experiment with other settings.

Data and clock output instructions

Treat the outputs with care as they are static sensitive.

Input and output descriptions

Overview

RF connectors

Data and Clock front panel RF connectors are SMA.

Connector torque specifications

Minimum:	2 in-lbs (0.226 N-m)
Recommended:	7-10 in-lbs (0.791-1.130 N-m)
Maximum:	15 in-lb (1.695 N-m)

NOTE. *Please note the special termination instructions.* *(See page 8, Data and clock output instructions.)*

Data out and /Data out

These are the primary outputs from the unit. The outputs can be used single-ended or differentially. Data pattern and timing can be controlled manually or remotely.

Trig out and /Trig out

These differential outputs provide a timing reference for viewing the data signals. The output amplitudes are fixed. Trigger options are PATTERN or CLOCK/N.

When using a pattern trigger, one pulse is produced at the beginning of each pattern. The trigger output has variable width depending on pattern length. This optimizes the pulse width seen at the oscilloscope trigger input (refer to the following table for details). The pattern trigger mode can be used with user-defined or PRBS data.

Table 5: Trigger output recipe (pattern trigger)

Pattern length (# of bits)	Number of ones in trigger output
2 - 3	1
4 - 7	2
8 - 15	4
16 - 31	8
32 - 63	16
64 - maximum	32

For the CLOCK/N trigger mode, the clock frequency is reduced by a factor of ‘N’. By selecting an odd-numbered divisor, a proper eye diagram can be displayed even if the pattern length is an even number.

Clk Out and /Clk Out

These clock outputs reflect the data rate; there is one full clock cycle per bit of data. The clock frequency can be generated internally or externally. For internal generation the duty cycle is 50%. For external generation the clock outputs mimic the input signal. Outputs are AC coupled and the amplitude is fixed.

Triggering on the clock output is useful for producing an eye diagram; however most sampling oscilloscopes are unable to trigger at the full data rate. Use the Trig Out connections with CLOCK/N trigger mode to overcome this problem.

Clk In and /Clk In

These are the inputs for external clocking. The clock frequency is restricted to a range of one half the data rate to the full data rate

These inputs can be used single-ended or differentially. The unused input can be left open for single-ended operation. Sine or square wave inputs can be used.

Functional block diagram

The basic functional blocks are shown in the following figure.

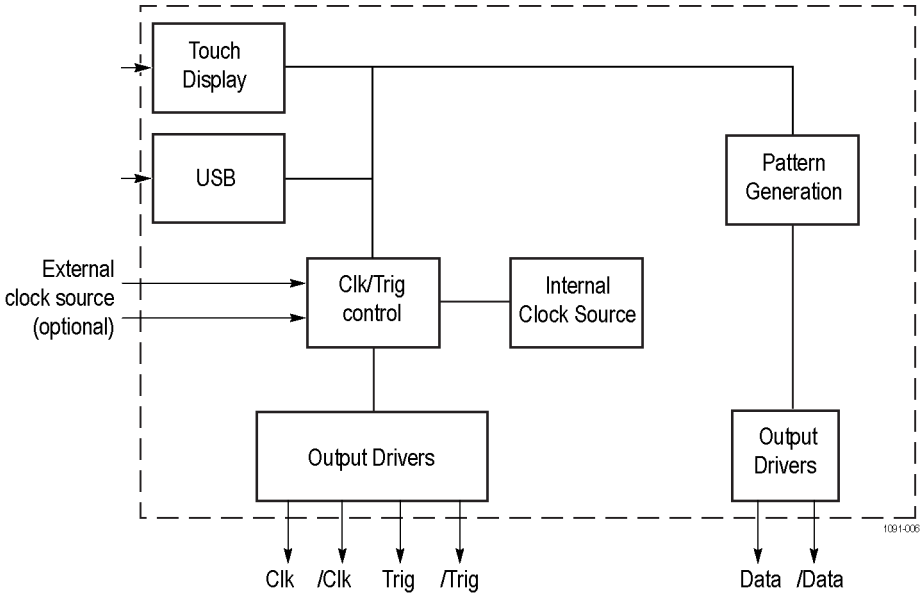

Figure 6: Block diagram

Data outputs

Output range

The instrument is designed to drive a 50 Ω load. The voltages into 50 Ω have a maximum range from -2 to +3 V. The output voltage is determined by settings for Offset, Amplitude, and Termination Voltage.

WARNING. *To ensure proper operation, never load the output with less than 50 Ω.*

Termination voltage

This setting is used in cases where the load being driven is terminated at a level other than zero volts. The affect of the Termination voltages on the output is shown in the following figure.

WARNING. *To ensure proper operation, never load the output with a Termination voltage less than Voh – 3 V.*

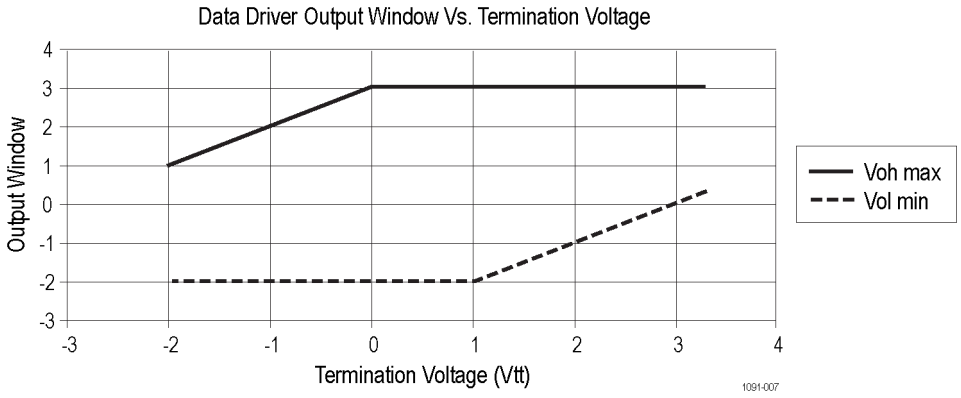

Figure 7: Available output range

Graphical user interface (GUI)

Touch screen

The instrument is equipped with touch screen controls. The instrument has the following primary menus:

- MAIN
- VOLT
- TIMING
- PATTERN
- UTILITY

Touch the screen at the rectangular buttons to open the menu. All manual settings are accessed through the user interface. An example of the user interface is shown in the following figure.

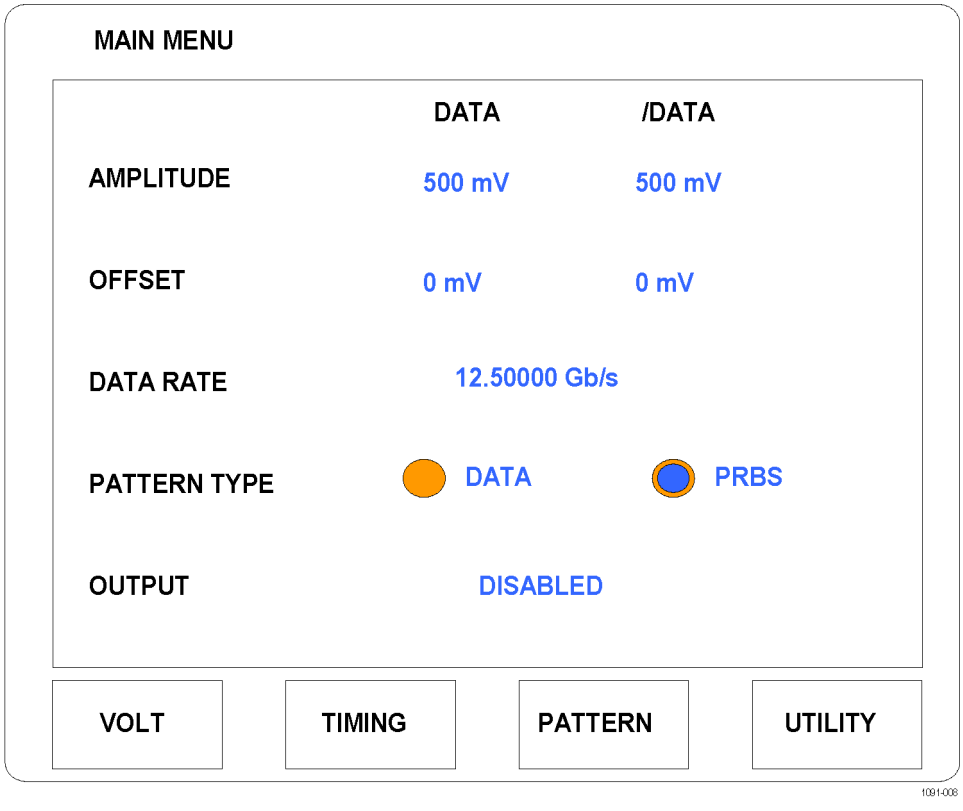

Figure 8: Main menu

Use the following table to find various parameter within the menu structure.

Table 6: Parameter lookup table

Parameter	Found in menu(s)
Amplitude	MAIN, VOLT
Crossing Point	VOLT
Data Rate	MAIN, TIMING
External Clock Enable	TIMING
Jitter Enable	TIMING
Offset Voltage	MAIN, VOLT
Pattern Length	PATTERN
Pattern Type	MAIN, PATTERN
Pattern (user defined)	PATTERN [DATA]
PRBS Length	PATTERN
Output ON / OFF	MAIN, VOLT
Recall Pattern	PATTERN [SAVE] [RECALL]
Recall Setup	UTILITY [SAVE] [RECALL]
Save Pattern	PATTERN [SAVE] [STORE]
Save Setup	UTILITY [SAVE] [STORE]
Termination Voltage	VOLT
Trigger Options	UTILITY [TRIGGER]

Menu structure

The following figures show the menu structure and the default settings. The primary menu selections are broken out into additional options. Most menu selections are self-explanatory; additional comments are provided where needed.

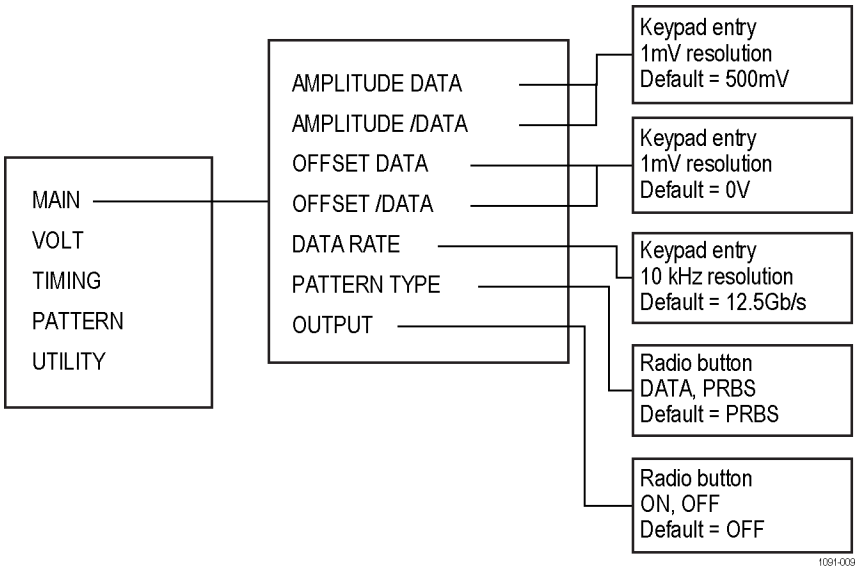

Figure 9: MAIN menu tree

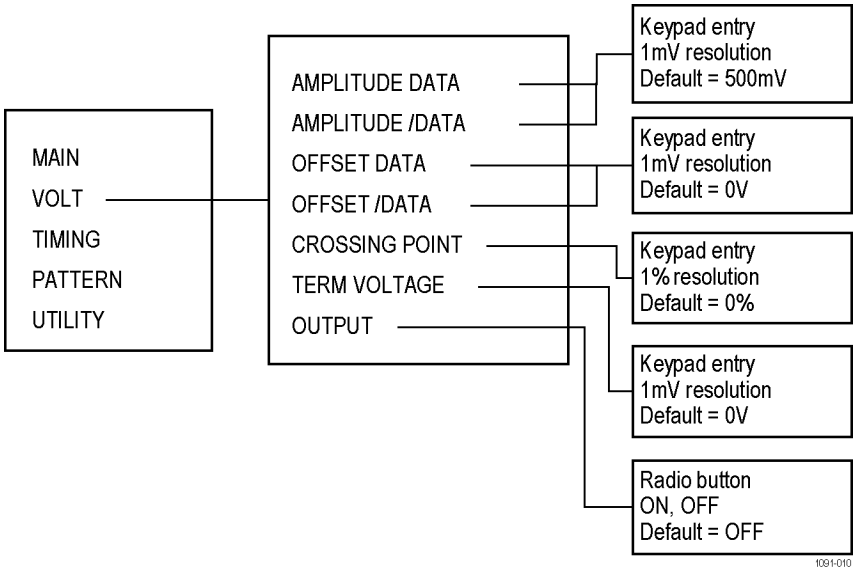

Figure 10: VOLT menu tree

The jitter functionality in the TIMING menu is optional and is not included on all units..

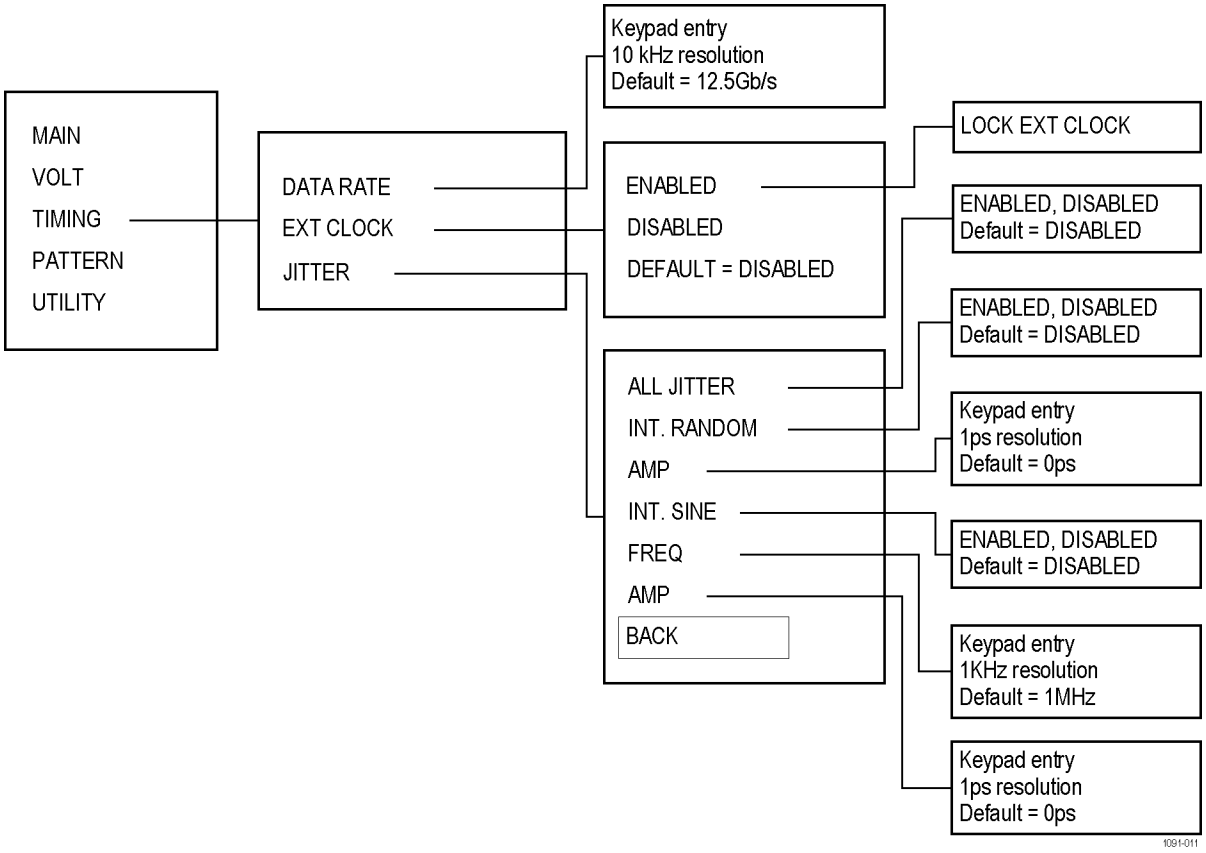

Figure 11: TIMING menu tree

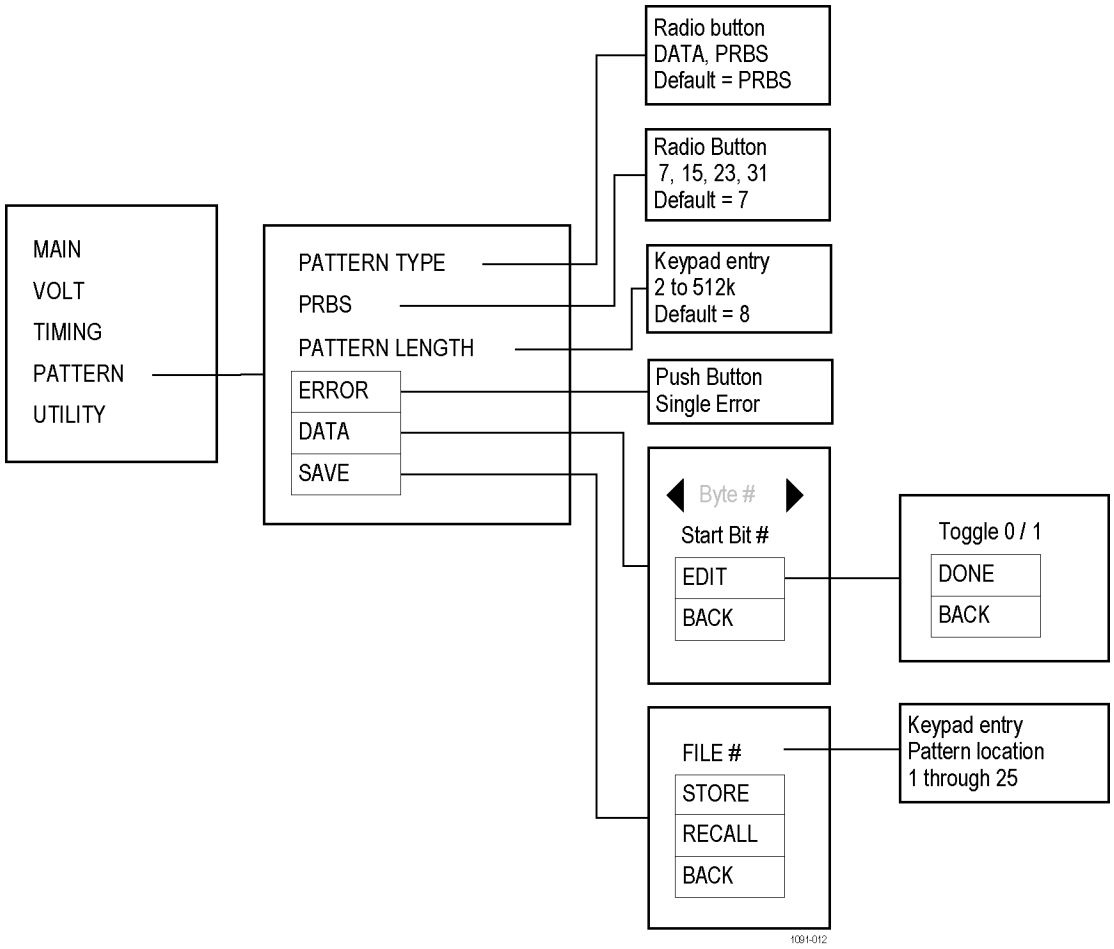

Figure 12: PATTERN menu tree

The ERROR button injects a single error into the output stream (flips a bit from 0 to 1 or from 1 to 0).

The DATA is displayed 8 bits at a time for editing. Use the right and left arrows to navigate through the entire pattern length. Touch EDIT to change the displayed 8 bits. Touching a 0 or a 1 on the screen will flip the bit. Press DONE when editing is complete.

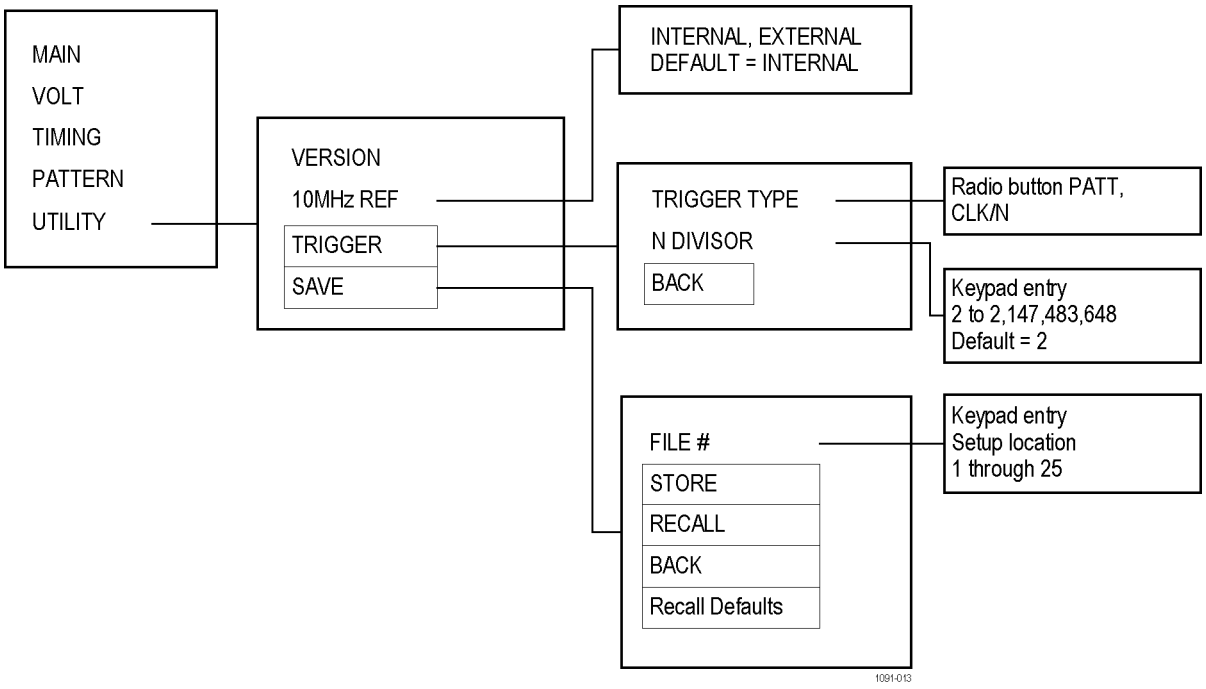

Figure 13: UTILITY menu tree

The N DIVISOR works as a divider when using the trigger in CLK/N mode (some sampling oscilloscopes are typically unable to trigger at the full data rate). By selecting an odd-numbered divisor, a proper eye diagram can be displayed even if the pattern length is an even number.

Operation

Default settings

The instrument retains all PATTERN, TIMING, and VOLTAGE settings when the power is turned off. The default settings can be quickly loaded to start from a known point.

1. Select **UTILITY**.
2. Select **SAVE**.
3. Select **RECALL DEFAULTS**.

User-defined Pattern entry (DATA)

1. Select **PATTERN**.
2. Select **PATTERN TYPE** (DATA).
3. Enter the PATTERN LENGTH (2 to 512k).
4. Select **DATA**.
5. Touch the left or right arrow to display additional bits.

6. Select **EDIT** (the data bits are shown in groups of 8).
7. Touch individual bits to toggle between 1 and 0.
8. Select **DONE** to exit the Edit mode.

User-defined pattern entry (PRBS)

1. Select **PATTERN**.
2. Select **PATTERN TYPE** (PRBS).
3. Choose one of the PRBS patterns (PRBS 7, 15, 23,31).

NOTE. *Data patterns and instrument setups are stored numerically; text descriptions are not supported. It is up to the user to document which pattern or instrument setup is stored at a given location.*

Save a data pattern

1. Select **PATTERN**.
2. Select **SAVE**.
3. Enter the FILE # (the pattern memory location, valid values are from 1 to 25).
4. Select **STORE**.

Recall a data pattern

1. Select **PATTERN**.
2. Select **SAVE**.
3. Enter the FILE # (the previously saved pattern number, valid values are from 1 to 25).
4. Select **RECALL**.

Save an instrument setup

1. Select **UTILITY**.
2. Select **SAVE**.
3. Enter the FILE # (the setup memory location, valid values are from 1 to 25).
4. Select **STORE**.

Recall an instrument setup

1. Select **UTILITY**.
2. Select **RECALL**.
3. Enter the FILE # (the previously saved setup number, valid values are from 1 to 25).
4. Select **RECALL**.

Jitter insertion (optional feature)

The PPG1251 JIT Pattern Generator has the built-in jitter insertion option. (See page 23, *Jitter insertion option (PPG1251 JIT)*.)This option contains built-in random and sine sources as well as an external modulation input. The ease of use and flexibility of this option enable a number of different types of jitter generation and make it useful for a wide range of jitter tolerance testing.

Jitter sources

Built-in high-frequency sinusoidal modulation source

- Programmable frequency from 5 kHz to 200 MHz
- Programmable amplitude up to 200 ps_{P-P}

Built-in random noise modulation source

- Programmable amplitude up to 25 ps_{RMS}

External modulation source

- Jitter amplitude up to 200 ps_{P-P}

External modulation input (Jitter In)

- 1 V_{P-P} maximum input (AC coupled)
- Frequency range: 1 kHz to 900 MHz
- Any waveform (or random)

Specifications

Data outputs

Amplitude Differential/complimentary output, Positive and negative differential outputs are independently programmable.

Single-ended. 250 mV to 2.0 V

Differential. 500 mV to 4.0 V

Rise/fall time Scope bandwidth can impact the measured signal rise time.

20 to 80%. 17 ps, typical

10 to 90%. 25 ps, typical

Offset -2.0 V to +3.0 V window, programmable/adjustable

Crossing point range 35% to 65% typical

Data output jitter 600 fs, RMS RJ typical at 12.5 Gb/s using PRBS2^7-1 pattern

Output impedance **50 Ω.** Single-ended

100 Ω. Differential

Termination voltage -2.0 to +3.3 V, programmable/adjustable

Connector type SMA

Clock outputs

Full rate clock output

AC coupled, single-ended

Amplitude. 400 mV_{p-p}, typical

Trigger output

Programmed as pattern trigger or clock/n

Amplitude. -600 mV to 0 V, DC coupled

Connector type

SMA

Data patterns

Pattern type

Data (from memory) or PRBS

Data rate

Programmable/adjustable

Range. 800 Mbs to 12.5 Gb/s

Resolution. 10 kb/s

Accuracy. ±5 ppm

PRBS pattern lengths

2^7 -1 bits. Polynomial = $X^7 + X^6 + 1$

2^{15} -1 bits. Polynomial = $X^{15} + X^{14} + 1$

2^{23} -1 bits. Polynomial = $X^{23} + X^{18} + 1$

2^{31} -1 bits. Polynomial = $X^{31} + X^{28} + 1$

Data pattern depth

512 kbit

Programmable error insertion

Single bit

Jitter insertion option (PPG1251 JIT)

High frequency jitter insertion

Peak-to-peak range for all sources combined.

Amplitude range. 0 to 200 ps_{p-p}

Built-in sine source

Programmable from either the front panel touch screen or remote control.

Frequency range. 5 kHz to 200 MHz

Amplitude range. 0 to 200 ps_{p-p}

Built-in random noise source

Programmable from either the front panel touch screen or remote control.

Amplitude range. 0 to 25_{RMS}

Low frequency sine/periodic jitter

Programmable from either the front panel touch screen or remote control.

Frequency range. 10 Hz to 1 MHz

Maximum amplitude. 100 UI @ 0 to 10 kHz, 10 UI @ 100 kHz, 1 UI @ 1 MHz

Accuracy. ±10%, typical

SSC Modulation

Programmable from either the front panel touch screen or remote control.

Modulation frequency. 28 kHz to 34 kHz

Frequency deviation. 0 to 0.5% peak-to-peak

Modulation type. Down/center/up spread

Modulation waveform. Triangular

External modulation input

Frequency range. Frequency range 1 kHz to 900 MHz, AC coupled, 3 dB bandwidths

Amplitude range. 0 to 200 psp-p

Maximum input. 2 Vp-p

Connector type. SMA

External clock inputs

Frequency range 6.25 GHz to 12.5 GHz

Input signal 400 mV_{p-p}, typical, AC coupled

Maximum input signal 1 V_{p-p}

Input impedance 50 Ω, AC-coupled

Reference clock

Input frequency range. 10 MHz ±10 ppm

Input signal. 1 Vp-p, typical, 50% duty square wave

Maximum input signal. 6 Vp-p, ±10 V DC, damage threshold

Input impedance. 50 Ω, AC-coupled

Output signal. 1.2 Vp-p, typical, square wave

Connector type. BNC

Control interfaces

Front panel touchscreen GUI Yes, edit all instrument settings

Computer programmable interface USB TMC, program all instrument settings

Physical characteristics

Front panel width (with mounting tabs)	48.3 cm (19.0 in)
Height	13.3 cm (5.25 in)
Width	45.1 cm (17.75 in)
Depth (rack mount)	35.1 cm (13.8 in)
Weight	11.1 kg (24.5 lbs)
Operating temperature	0 °C to 40 °C (32 °F to 104 °F)

Remote programming

USB interface

All automated programming is accomplished through a USB TMC interface.

Command information

Sequential vs. overlapped

All commands are sequential commands. Sequential commands complete before the next is executed. This means that completion of any command can be verified by following it with any query. When the query response is received, the previous command is certain to be complete.

Long and short form

Commands have both a long and short form. In command descriptions, the long form is the entire command while the short form is the part in capital letters. Commands must be either the exact long form or the exact short form, other combinations will create an error.

Common commands

Summary

Command	Description
*IDN?	Read Instrument's Identification string
*RCL <1-25>	Recall complete instrument setting from memory
*RST	Reset instrument to default settings
*SAV <1-25>	Save complete instrument setting to memory

Reference

***IDN?** Read the instrument's identification string.

The returned string has the following format:

"`Tektronix Inc.,Model code,SN,FWREV`" Where:

- SN = serial number
- Model code = 12050
- FWREV = firmware revision

***RCL <1-25>** Recall the instrument state from memory. The instrument state includes all settings except output enable, pattern length, and pattern data. Outputs are always disabled after *RCL is executed. The argument specifies one of 25 memory locations.

***RST** Resets the instrument to default settings. This sets all parameters to their default values, including output enable, pattern length, and pattern data.

***SAV <1-25>** Save the instrument state to memory. The instrument state includes all settings except output enable, pattern length, and pattern data. The argument specifies one of 25 memory locations.

Regular commands

Summary

The following table provides a summary of the remote control commands.

Command	Parameters	Default	Description	
DIGITAL subsystem				
:DIGital				
:PATTern				
:LENGth	<numeric>	8	set/query Pattern Length	(See page 33.)
:TYPE	DATA | PRBS	PRBS	set/query Pattern type	(See page 33.)
:PLENgth	<numeric>	7	set/query PRBS length	(See page 34.)
:DATA	<numeric>, <numeric>, <arbitrary block>	1000…	set/query Pattern Data	(See page 35.)
:HDATa	<numeric>, <numeric>, <arbitrary block>	1000…	set/query Pattern Data in hexadecimal character format	(See page 36.)
:SERRor	none	n/a	insert a single error into the data output	(See page 37.)
:LOAD	<numeric>	n/a	loads pattern data and length from the specified memory	(See page 37.)
:SAVE	<numeric>	n/a	saves pattern data and length to the specified memory	(See page 37.)
:SIGNal [:POS|:NEG]:CROSsover				
[:VALue]	<numeric>	50%	set/query crossing point	(See page 38.)
Memory subsystem				
:STORe				
:PDATa	<string>	n/a	store pattern data in system memory	(See page 38.)
:STATe	<string>	n/a	store instrument settings in system memory	(See page 39.)
:LOAD				
:PDATa	<string>	n/a	recall pattern data from system memory	(See page 39.)
:STATe	<string>	n/a	recall instrument settings from system memory	(See page 39.)

Command	Parameters	Default	Description	
:MOVE				
:PDATa	<string>, <string>	n/a	rename existing pattern data file in system memory	(See page 40.)
:STATe	<string>, <string>	n/a	rename existing instrument settings file in system memory	(See page 40.)
:DELete				
:PDATa	<string>	n/a	delete stored pattern data file in system memory	(See page 40.)
:STATe	<string>	n/a	delete instrument settings file in system memory	(See page 41.)
:CATalog				
:PDATa	n/a	n/a	get list of stored pattern data files in system memory	(See page 41.)
:STATe	n/a	n/a	get list of instrument settings files in system memory	(See page 41.)
Output subsystem				
:OUTPut0				
:SOURce	PERiodic | BITStream	BITS	set/query trigger out event	(See page 42.)
:DIVider	<numeric>	2	set/query trigger divider	(See page 42.)
:OUTPut				
[:STATe]	OFF | ON	OFF	set/query data output enable/disable status	(See page 43.)
Sense subsystem				
:SENSe:ROSCillator				
:SOURce	INTernal | EXTernal	INT	set/query 10 MHz reference source	(See page 43.)

Command	Parameters	Default	Description	
Source subsystem				
[:SOURce]				
FM				
:INTernal1[:DEViation]	<numeric>	0.5%	set/query SSC amplitude	(See page 44.)
:INTernal1:DIRection	DOWN | CENTER | UP	DOWN	set/query SSC direction	(See page 44.)
:INTernal1:FREQuency	<numeric>	33 kHz	set/query SSC frequency	(See page 44.)
:INTernal1:[:STATe]	OFF | ON	OFF	set/query enable/disable status of SSC	(See page 45.)
:FREQuency[:CW|:FIXed]	<numeric>	12.5 GHz	set/query clock frequency	(See page 45.)
:PM				
[:HF]				
[:STATe]	OFF | ON	OFF	set/query overall jitter insertion enable/disable status	(See page 45.)
:INTernal1[:DEViation]	<numeric>	0 ps	set/query internal sine jitter amplitude	(See page 46.)
:INTernal1:FREQuency	<numeric>	1 MHz	set/query internal sine jitter frequency	(See page 46.)
:INTernal1:STATe	OFF | ON	OFF	set/query internal sine jitter enable/disable status	(See page 46.)
:INTernal2[:DEViation]	<numeric>	0 ps	set/query internal random jitter amplitude	(See page 47.)
:INTernal2:STATe	OFF | ON	OFF	set/query internal random jitter enable/disable status	(See page 47.)
:LF				
:INTernal3[:DEViation]	<numeric>	0 UI	set/query internal LF sine jitter amplitude	(See page 47.)
:INTernal3:FREQuency	<numeric>	10 kHz	set/query internal LF sine jitter frequency	(See page 48.)
:INTernal3:[:STATe]	OFF | ON	OFF	set/query internal LF sine jitter enable/disable status	(See page 48.)

Command	Parameters	Default	Description	
:VOLTage[:POS|:NEG][:LEVel][:IMMediate]				
[:AMPLitude]	<numeric>	500 mV	set/query data amplitude	(See page 48.)
:OFFSet	<numeric>	0 V	set/query data offset	(See page 49.)
:TERMination	<numeric>	0 V	set/query data term	(See page 49.)
System subsystem				
:SYSTem:ERRor[:NEXT]?	none	n/a	query error queue	(See page 50.)
Trigger subsystem				
:TRIGger				
:SOURce	IMMediate | EXTernal	IMM	set/query clock source	(See page 50.)
:LOCK	none	n/a	initiate lock to external clock	(See page 51.)

Reference

:DIGital:PATTern:LENGth

Form	Set & Query
Parameters	Numeric
Value Coupling	None
Range Coupling	None
Default	8
Description	Programs the Pattern Length. This value is only relevant if the pattern type is DATA. The length can be any integer from 2 through 524,288.

Example	Set pattern length to 56
	`:DIG:PATT:LENG 56`
	Query pattern length
	`:DIG:PATT:LENG?`

:DIGital:PATTern:TYPE

Form	Set & Query
Parameters	DATA | PRBS
Value Coupling	None
Range Coupling	None
Default	PRBS
Description	Programs the Pattern Type.

Example	Set the pattern type to PRBS
	`:DIG:PATT:TYPE PRBS`
	Query pattern type
	`:DIG:PATT:TYPE?`

:DIGital:PATTern:PLENgth

Form	Set & Query
Parameters	7 | 15 | 23 | 31
Value Coupling	None
Range Coupling	None
Default	7
Description	Programs the Pattern PRBS Length. PRBS Length is specified as 2^N-1, where N is the specified value. This value is only relevant if the pattern type is PRBS.

Example	Set the PRBS length to (2^7-1)
	`:DIG:PATT:PLEN 7`
	Query PRBS length
	`:DIG:PATT:PLEN?`

:DIGital:PATTern:DATA

Form	Set & Query
Parameters	<start address>,<bit count>,<data> <start address> is numeric and is the bit number in pattern data memory of the first bit to write; the remainder follow consecutively. <bit count> is the number of bits to write into pattern data memory. <data> is an arbitrary block of program data as defined in IEEE-488.2-1992, section 7.7.6.2. It starts with a "#" character, followed by a single character representing the length of the length, then 1 to 5 characters specifying the length as a decimal number, then the program data.
Value Coupling	None
Range Coupling	None
Default	Default data is a 1 in position 1, all other bits are 0.
Description	Programs the pattern data memory. Each byte of pattern data is a character (0 or 1) representing one bit of pattern data. The start address can be any bit location, 1 – <max address>. <max address> is > is 524,288. The bit count can be any number 1 – 1024. The entire pattern data memory is accessible for reads or writes, even 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 ≤ (<max address> + 1).

Example	`:DIG:PATT:DATA 1,16,#2160100000101010010`
	This command does the following:
	Starts loading the Ch 1 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
	Thus, bits 1 through 16 in the channel 1 pattern data memory will be set to 0100000101010010.
	`:DIG: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:PATTern:HDATa

Form	Set & Query
Parameters	<start address>,<bit count>,<data> <start address> is numeric, and is the bit number in pattern data memory of the first bit to write. The remainder follow consecutively. <bit count> is the number of bits to write into pattern data memory. <data> is an arbitrary block of program data as defined in IEEE-488.2-1992, section 7.7.6.2. It starts with a "#" character, followed by a single character representing the length of the length, then 1 to 5 characters specifying the length as a decimal number, then the program data.
Value Coupling	None
Range Coupling	None
Default	Default data is a 1 in position 1, all other bits are 0.
Description	Programs the pattern data memory using hexadecimal character format. Each byte of pattern data is a hexadecimal character (0-9, A-F or a-f) representing four bits of pattern data. The start address can be any bit location, 1 – <max address>. <max address> is 524,288. The bit count can be any number 1 – 4096. The entire pattern data memory is accessible for reads or writes, even outside the range of the current pattern length setting. The bit count parameter must be equal to 4 times the length of the data block or up to 3 bits fewer. If it is fewer, then the extra bits in the last data byte are ignored. (<start address> + <bit count>) must be ≤ (<max address> + 1).

Example	`:DIG:PATT:HDAT 1,16,#144152`
	This command does the following:
	Starts loading 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 that the length of the data length is one character
	4: indicates that data length is 4 bytes. (4 ASCII characters)
	4152: is the character representation of the data
	Thus, bits 1 through 16 in the channel 1 pattern data memory will be set to 0100000101010010.
	`:DIG: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 that if the query requests a number of bits that is not a multiple of 4, some bits in the last byte will not be meaningful, and will be 0.

:DIGital:PATTern:SERRor

Form	Set
Parameters	None
Value Coupling	None
Range Coupling	None
Default	n/a
Description	Inserts a single error into the data output. Error insertion works for either data patterns or PRBS patterns. If there is no pattern currently being output, for instance if the outputs are disabled, the command has no effect.
Example	Insert one error into the data output. `:DIG:PATT:SERROR`

:DIGital:PATTern:LOAD

Form	Set
Parameters	Numeric Integer, 1 through 25
Value Coupling	Pattern Data and Length
Range Coupling	None
Default	n/a
Description	Loads the pattern data and pattern length from the specified memory number. Pattern data is loaded into bit position 1 up to through the stored pattern length. Pattern memory above the stored pattern length will remain unchanged.
Example	Load the pattern data and length from memory 12. `:DIG:PATT:LOAD 12`

:DIGital:PATTern:SAVE

Form	Set
Parameters	Numeric Integer, 1 through 25
Value Coupling	None
Range Coupling	None
Default	n/a
Description	Saves the pattern data and pattern length to the specified memory number. Pattern data from bit 1 up to the pattern length is saved.
Example	Save the pattern data and length to memory 5. `:DIG:PATT:SAVE 5`

:DIGital:SIGNal[:POS|:NEG]:CROSsover:[VALue]

Form	Set & Query
Parameters	Numeric [no units, value is in %]
Value Coupling	None
Range Coupling	None
Default	50%
Description	Programs the NRZ signal crossing point. Positive and negative outputs have independent crossing point adjustment, specified by [:POS | :NEG]. Note: to maintain normal complement behavior, if the POS output crossing point is set to 50+X, then the NEG should be set to 50-X. For example, if the POS were set to 57%, the NEG would be set to 43%.

Example	Set negative output crossing point to 45 %.
	`:DIG:SIGN:NEG:CROS 45`
	Query negative output crossing point?
	`:DIG:SIGN:NEG:CROS?`

:MMEMory:STORe:PDATa

Form	Set
Parameters	String
Value Coupling	None
Range Coupling	None
Default	N/A
Description	Store the current pattern data into the system memory. The pattern length and all pattern data up to the pattern length are stored. The filename can be up to 8 characters long and is not case-sensitive. Filenames must consist of only alphanumeric characters.
Example	Store the pattern data in system memory. `:MMEM:STOR:PDAT "PATT1011"`

:MMEMory:STORe:STATe

Form	Set
Parameters	String
Value Coupling	None
Range Coupling	None
Default	N/A
Description	Store the instrument setting into the system memory. Every parameter of the instrument is stored except for pattern data, pattern length and output enable status. The filename can be up to 8 characters long and is not case-sensitive. Filenames must consist of only alphanumeric characters.
Example	Store the parameters in system memory. `:MMEM:STOR:STAT "PARAM22"`

:MMEMory:LOAD:PDATa

Form	Set
Parameters	String
Value Coupling	None
Range Coupling	None
Default	N/A
Description	Recalls the pattern data from a saved file in system memory. The pattern length and all data up to the pattern length are recalled. Pattern memory addresses above the pattern length are not changed. The filename can be up to 8 characters long and is not case-sensitive. Filenames must consist of only alphanumeric characters.
Example	Recall the pattern data from file "PATT1011". `MMEM:LOAD:PDAT "PATT1011"`

:MMEMory:LOAD:STATe

Form	Set
Parameters	String
Value Coupling	None
Range Coupling	None
Default	N/A
Description	Recalls the instrument setting from a saved file in system memory. Every parameter of the instrument is recalled except for pattern data, pattern length and output enable status. The filename can be up to 8 characters long and is not case-sensitive. Filenames must consist of only alphanumeric characters.
Example	Recall the instrument settings from file "PARAM22". `:MMEM:LOAD:STAT "PARAM22"`

:MMEMory:MOVE:PDATa

Form	Set
Parameters	String
Value Coupling	None
Range Coupling	None
Default	N/A
Description	Rename the existing saved pattern data file in system memory. The filename can be up to 8 characters long and is not case-sensitive. Filenames must consist of only alphanumeric characters.
Example	Rename the pattern data file PATT1011 to PATT0101. `:MMEM:MOVE:PDAT "PATT1011", "PATT0101"`

:MMEMory:MOVE:STATe

Form	Set
Parameters	String
Value Coupling	None
Range Coupling	None
Default	N/A
Description	Rename the existing saved instrument settings file in system memory. The filename can be up to 8 characters long and is not case-sensitive. Filenames must consist of only alphanumeric characters.
Example	Rename the instrument settings file PARAM22 to PARAM. `:MMEM:MOVE:STAT "PARAM22", "PARAM"`

:MMEMory:DELete:PDATa

Form	Set
Parameters	String
Value Coupling	None
Range Coupling	None
Default	N/A
Description	Deletes an existing saved pattern data file in system memory. The filename can be up to 8 characters long and is not case-sensitive. Filenames must consist of only alphanumeric characters.
Example	Delete the existing pattern data file PATT0101. `:MMEM:DEL:PDAT "PATT0101"`

:MMEMory:DELete:STATe

Form	Set
Parameters	String
Value Coupling	None
Range Coupling	None
Default	N/A
Description	Deletes an existing saved instrument settings file in system memory. The filename can be up to 8 characters long and is not case-sensitive. Filenames must consist of only alphanumeric characters.
Example	Delete the existing instrument settings file PARAM. :MMEM:DEL:STAT "PARAM"

:MMEMory:CATalog:PDATa?

Form	Query
Parameters	None
Value Coupling	None
Range Coupling	None
Default	N/A
Description	Get the list of pattern data files stored in system memory. All the filenames stored in the system memory are returned as capital letters.
Example	Get the list of pattern data files stored in system memory. :MMEM:CAT:PDAT?

:MMEMory:CATalog:STATe?

Form	Query
Parameters	None
Value Coupling	None
Range Coupling	None
Default	N/A
Description	Get the list of instrument settings files stored in system memory. All the filenames stored in the system memory are returned as capital letters.
Example	Get the list of instrument settings files stored in system memory. :MMEM:CAT:STAT?

:OUTPut0:SOURce

Form	Set & Query
Parameters	PERiodic | BITStream
Value Coupling	None
Range Coupling	None
Default	PERiodic
Description	Programs the trigger out event. PERiodic means the trigger will output a signal whose frequency is the clock rate divided by N, where N is the trigger divider setting. BITStream means a trigger pulse will be output for each complete pattern.
Example	Set the trigger out event to bit stream. `:OUTP0:SOUR BITSTREAM`

:OUTPut0:DIVider

Form	Set & Query
Parameters	Numeric
Value Coupling	None
Range Coupling	None
Default	2
Description	Programs the trigger divider. This is meaningful only if the trigger output event is set to `periodic`.
Example	Set the trigger divider to 128. `:OUTP0:DIV 128`

:OUTPut[:STATe]

Form	Set & Query
Parameters	OFF | ON
Value Coupling	None
Range Coupling	None
Default	OFF
Description	Programs the enable/disable status of the channel outputs.
Example	Disable the output. `:OUTP OFF`

:SENSe:ROSCillator:SOURce

Form	Set & Query
Parameters	INTernal | EXTernal
Value Coupling	None
Range Coupling	None
Default	INT
Description	Programs the 10 MHz reference source.
Example	Set the 10 MHz reference source to use the internal reference. `:SENSE:ROSCILLATOR:SOURCE INTERNAL`

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

Form	Set & Query
Parameters	Numeric (no units, value is in %)
Value Coupling	None
Range Coupling	None
Default	0.5%
Description	Set/Query Spread Spectrum Clocking Amplitude. This value sets the peak-to-peak frequency deviation, in % of the clock frequency. SSC is common to all channels.
Example	Set the SSC amplitude to 0.7%. `:FM:DEV 0.7`

[:SOURce]:FM[:INTernal]:DIRection

Form	Set & Query
Parameters	DOWN | CENTER | UP
Value Coupling	None
Range Coupling	None
Default	DOWN
Description	Set/Query Spread Spectrum Clocking direction. This value selects whether the SSC frequency deviation is below, centered on, or above the clock frequency. SSC is common to all channels.
Example	Set the SSC direction for down-spread. `:SOUR:FM:INT:DIR DOWN`

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

Form	Set & Query
Parameters	Numeric [Hz]
Value Coupling	None
Range Coupling	None
Default	33 kHz
Description	Set/Query Spread Spectrum Clocking frequency. SSC is common to all channels.
Example	Set the SSC frequency to 32 kHz. `:FM:FREQUENCY 32kHz`

[:SOURce]:FM[:INTernal]:STATe

Form	Set & Query
Parameters	OFF | ON
Value Coupling	LF Sine Jitter State
Range Coupling	None
Default	OFF
Description	Set/Query Spread Spectrum Clocking enable/disable state. SSC and LF sine jitter may not be enabled at the same time. SSC is common to all channels.
Example	Enable SSC. `FM:STATE ON`

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

Form	Set & Query
Parameters	Numeric [Hz]
Value Coupling	None
Range Coupling	None
Default	12.5 GHz
Description	Programs the internal clock frequency, and also selects the internal clock as clock source if it is not already selected.
Example	Set frequency to 1.2 GHz. `:FREQ 1.2e9`

[:SOURce]:PM[:HF][:STATe]

Form	Set & Query
Parameters	OFF | ON
Value Coupling	None
Range Coupling	None
Default	OFF
Description	Programs the overall HF jitter insertion enable/disable status. The HF sources are HF sine, random and external. If enabled, the external jitter source is enabled and the internal sources are set according to their individual controls.
Example	Enable overall HF jitter insertion. `:PM ON`

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

Form	Set & Query
Parameters	Numeric [S]
Value Coupling	None
Range Coupling	None
Default	0 ps
Description	Programs the peak-to-peak amplitude of the channel internal HF sine jitter source. Units are in seconds.
Example	Set the internal HF sine jitter source to 11 ps peak-to-peak. `:PM:INT1 11ps`

[:SOURce]:PM[:HF]:INTernal1:FREQuency

Form	Set & Query
Parameters	Numeric [Hz]
Value Coupling	None
Range Coupling	None
Default	1 MHz
Description	Programs the frequency of the channel internal HF sine jitter source. Units are Hz.
Example	Set the HF sinusoidal jitter frequency to 1.3 MHz. `:PM:INT1:FREQ 1.3MHz`

[:SOURce]:PM[:HF]:INTernal1:STATe

Form	Set & Query
Parameters	OFF | ON
Value Coupling	None
Range Coupling	None
Default	OFF
Description	Programs the channel internal HF sine jitter source enable/disable status. Both this setting and [:SOURce]:PM[:HF][:STATe] for a given channel must be on for HF sine jitter to be applied.
Example	Enable the internal HF sine jitter source. `:PM1:INTERNAL1:STATE ON`

[:SOURce]:PM[:HF]:INTernal2[:DEViation]

Form	Set & Query
Parameters	Numeric [S]
Value Coupling	None
Range Coupling	None
Default	0 ps
Description	Programs the rms amplitude of the channel internal random jitter source. Units are in seconds.
Example	Set the internal random jitter source to 7 ps rms. `:PM:INT2 7ps`

[:SOURce]:PM[:HF]:INTernal2:STATe

Form	Set & Query
Parameters	OFF | ON
Value Coupling	None
Range Coupling	None
Default	OFF
Description	Programs the channel internal random jitter source enable/disable status. Both this setting and [:SOURce]:PM[:HF][:STATe] must be on for random jitter to be applied.
Example	Disable the internal random jitter source. `:PM:INTERNAL2:STATE OFF`

[:SOURce]:PM:LF[:INTernal3][:DEViation]

Form	Set & Query
Parameters	Numeric [UI]
Value Coupling	None
Range Coupling	LF Sine Jitter Frequency
Default	0 UI
Description	Programs the peak-to-peak amplitude of the internal LF sine jitter source. Units are UI. Maximum allowed value depends on LF Sine Jitter Frequency.
Example	Set the internal LF sine jitter source to 7.3 UI peak-to-peak. `:PM:LF:INT3:DEV 7.3`

[:SOURce]:PM:LF[:INTernal3]:FREQuency

Form	Set & Query
Parameters	Numeric [Hz]
Value Coupling	None
Range Coupling	LF Sine Jitter Amplitude
Default	10 kHz
Description	Programs the frequency of the internal LF sine jitter source. Units are Hz. Allowed range depends on LF Sine Jitter Amplitude.
Example	SSet the LF sinusoidal jitter frequency to 21 kHz. `:PM:LF:FREQ 21kHz`

[:SOURce]:PM:LF[:INTernal3]:STATe

Form	Set & Query
Parameters	OFF | ON
Value Coupling	SSC State
Range Coupling	None
Default	OFF
Description	Programs the internal LF sine jitter source enable/disable status. The LF sine jitter and the SSC sources may not be enabled at the same time.
Example	Enable the internal LF sine jitter source. `:PM:LF:STATE ON`

[:SOURce]:VOLTage[:POS|:NEG][:LEVel][:IMMediate]:[:AMPLitude]

Form	Set & Query
Parameters	Numeric [V]
Value Coupling	N/A
Range Coupling	Offset
Default	250 mV
Description	Programs the amplitude of the output signal for the positive or negative data outputs.

Example	Set positive data amplitude to 1 V.
	`:VOLT:POS 1V`
	Query the positive data amplitude.
	`:VOLT:POS?`

[:SOURce]:VOLTage[:POS|:NEG][:LEVel][:IMMediate]:OFFSet

Form	Set & Query
Parameters	Numeric [V]
Value Coupling	N/A
Range Coupling	Amplitude
Default	0 V
Description	Programs the offset of the output signal for the positive or negative data outputs.

Example	Set negative data offset to –0.5 V.
	`:VOLT:NEG:OFFS –0.5V`
	Query the negative data offset.
	`:VOLT:NEG:OFFS?`

[:SOURce]:VOLTage[:POS|:NEG][:LEVel][:IMMediate]:TERMination

Form	Set & Query
Parameters	Numeric [V]
Value Coupling	Offset
Range Coupling	Amplitude, Offset
Default	0 V
Description	Programs the user-supplied external termination voltage for the positive or negative data outputs.

Example	Set positive term voltage to –1.0 V.
	`:VOLT:POS:TERM –1.0V`
	Query the positive voltage..
	`:VOLT:POS:TERM?`

:SYSTem:ERRor[:NEXT]?

Form	Query
Parameters	None
Value Coupling	N/A
Range Coupling	N/A
Default	N/A
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 can have multiple items that can be retrieved using multiple queries. If the queue is empty, the response will be: +0,"No error". If the queue receives more errors than it can hold, the extra errors will be discarded.
Example	Query the error queue. `:SYST:ERR?`

:TRIGger:SOURce

Form	Set and Query
Parameters	IMMediate | EXTernal
Value Coupling	N/A
Range Coupling	N/A
Default	IMMediate
Description	Programs the clock source. IMMediate means the internal clock source provides the clock. Clock frequency is set by the [:SOURce]:FREQuency[:CW|:FIXed] command. EXTernal means the signal at the Ext Clock connector provides the clock source. Clock frequency is equal to the frequency of the external signal. After changing to external clock source the generator must be locked to the clock. If external clock source is in use, the generator must be re-locked to the clock after any interruption or change in frequency of the clock. The lock process must be successfully completed for the generator to function properly. See the :TRIGger:LOCK command. (See page 51, *:TRIGger:LOCK*.)
Example	Set the clock source to internal. `:TRIG:SOUR IMM`

:TRIGger:LOCK

Form	Set
Parameters	None
Value Coupling	N/A
Range Coupling	N/A
Default	N/A
Description	Initiates the process of locking the generator to the external clock. After changing to external clock source the generator must be locked to the clock. If external clock source is in use, the generator must be re-locked to the clock after any interruption or change in frequency of the clock. The lock process must be successfully completed for the generator to function properly.
Example	Lock the generator to the external clock. `:TRIG:LOCK`

User service

This section describes high-level service information and procedures for your instrument.

Service offerings

Tektronix provides service to cover repair under warranty and other services that are designed to meet your specific service needs.

Whether providing warranty repair service or any of the other services listed below, Tektronix service technicians are well equipped to service your instruments. Services are provided at Tektronix Service Centers and on-site at your facility, depending on your location.

Warranty repair service

Tektronix warrants this product as described in the warranty statements at the front of this manual. Tektronix technicians provide warranty service at most Tektronix service locations worldwide. The Tektronix product catalog lists all service locations worldwide.

Calibration and repair service

In addition to warranty repair, Tektronix Service offers calibration and other services that provide cost-effective solutions to your service needs and quality standards compliance requirements. Tektronix instruments are supported worldwide by the leading-edge design, manufacturing, and service resources of Tektronix to provide the best possible service.

General care

Protect the instrument from adverse weather conditions. The instrument is not waterproof. Do not store or leave the instrument where the display will be exposed to direct sunlight for long periods of time.

CAUTION. *To avoid damage to the instrument, do not expose it to sprays, liquids, or solvents.*

Preventive maintenance

Preventive maintenance mainly consists of periodic cleaning. Periodic cleaning reduces instrument breakdown and increases reliability. Clean the instrument as needed, based on the operating environment. Dirty conditions may require more frequent cleaning than computer room conditions.

Clean the flat panel display

The flat panel display is a soft plastic display and must be treated with care during cleaning.

CAUTION. *Improper cleaning agents or methods can damage the flat panel display.*

- Do not use abrasive cleaners or commercial glass cleaners to clean the display surface.
- Do not spray liquids directly on the display surface.
- Do not scrub the display with excessive force.
- Avoid getting moisture inside the instrument while cleaning the display; use only enough solution to dampen the wipe.
- Clean the flat panel display surface by gently rubbing the display with a cleanroom wipe (such as Wypall Medium Duty Wipes, #05701, available from Kimberly-Clark Corporation).
- If the display is very dirty, moisten the wipe with distilled water or a 75% isopropyl alcohol solution and gently rub the display surface. Avoid using excess force or you may damage the plastic display surface.

Clean the exterior surfaces

Clean the exterior surfaces with a dry, lint-free cloth or a soft-bristle brush. If dirt remains, use a cloth or swab dampened with a 75% isopropyl alcohol solution. A swab is useful for cleaning in narrow spaces around the controls and connectors. Do not use abrasive compounds on any part of the instrument.

To avoid damaging the instrument follow these precautions:

- Avoid getting moisture inside the instrument during external cleaning and use only enough solution to dampen the cloth or swab.
- Do not wash the front-panel power switch. Cover the switch while washing the instrument.
- Use only deionized water when cleaning. Use a 75% isopropyl alcohol solution as a cleanser and rinse with deionized water.
- Do not use chemical cleaning agents; they may damage the instrument. Avoid chemicals that contain benzene, toluene, xylene, acetone, or similar solvents.

Battery information

The coin cell battery on the instrument computer motherboard is not a user replaceable part. The coin cell battery is not rechargeable. Under no circumstances attempt to recharge the battery.

Fuse replacement

The instrument is protected by a fuse placed in series with the power line input. The fuse is conservatively rated and should never open through the life of the instrument. A blown fuse would generally indicate a problem with the instrument which requires factory service. It is recommended that you arrange to have the instrument serviced if you experience a blown fuse.

Repack the instrument for shipment

If the instrument is to be shipped to a Tektronix service center for repair, attach a tag showing the following information:

- Name of the product owner
- Address of the owner
- Instrument serial number
- A description of the problems encountered and/or service required

When packing an instrument for shipment, use the original packaging. If it is unavailable or not fit for use, contact your Tektronix representative to obtain new packaging.

Compliance information

This section lists the EMC (electromagnetic compliance), safety, and environmental standards with which the instrument complies.

EMC compliance

EC Declaration of Conformity – EMC

Meets intent of Directive 2004/108/EC for Electromagnetic Compatibility. Compliance was demonstrated to the following specifications as listed in the Official Journal of the European Communities:

EN 61326-1. EMC requirements for electrical equipment for measurement, control, and laboratory use. [1] [2] [3]

- CISPR 11. Radiated and conducted emissions, Group 1, Class A
- IEC 61000-4-2. Electrostatic discharge immunity
- IEC 61000-4-3. RF electromagnetic field immunity
- IEC 61000-4-4. Electrical fast transient / burst immunity
- IEC 61000-4-5. Power line surge immunity
- IEC 61000-4-6. Conducted RF immunity
- IEC 61000-4-11. Voltage dips and interruptions immunity

EN 61000-3-2. AC power line harmonic emissions

EN 61000-3-3. Voltage changes, fluctuations, and flicker

European contact.

Tektronix UK, Ltd.
Western Peninsula
Western Road
Bracknell, RG12 1RF
United Kingdom

1 This product is intended for use in nonresidential areas only. Use in residential areas may cause electromagnetic interference.

2 Emissions which exceed the levels required by this standard may occur when this equipment is connected to a test object.

3 For compliance with the EMC standards listed here, high quality shielded interface cables should be used.

Australia / New Zealand Declaration of Conformity – EMC

Complies with the EMC provision of the Radiocommunications Act per the following standard, in accordance with ACMA:

- CISPR 11. Radiated and Conducted Emissions, Group 1, Class A, in accordance with EN 61326-1.

Australia / New Zealand contact.

Baker & McKenzie
Level 27, AMP Centre
50 Bridge Street
Sydney NSW 2000, Australia

Safety compliance

This section lists the safety standards with which the product complies and other safety compliance information.

EU declaration of conformity – low voltage

Compliance was demonstrated to the following specification as listed in the Official Journal of the European Union:

Low Voltage Directive 2006/95/EC.

- EN 61010-1. Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 1: General Requirements.

U.S. nationally recognized testing laboratory listing

- UL 61010-1. Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 1: General Requirements.

Canadian certification

- CAN/CSA-C22.2 No. 61010-1. Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 1: General Requirements.

Additional compliances

- IEC 61010-1. Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 1: General Requirements.

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.

This symbol indicates that this product complies with the applicable European Union requirements according to Directives 2012/19/EU and 2006/66/EC on waste electrical and electronic equipment (WEEE) and batteries. For information about recycling options, check the Support/Service section of the Tektronix Web site (www.tektronix.com).

Restriction of hazardous substances

This product is classified as an industrial monitoring and control instrument, and is not required to comply with the substance restrictions of the recast RoHS Directive 2011/65/EU until July 22, 2017.

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