Tektronix®

3 Series MDO
Mixed Domain Oscilloscope

Specifications and Performance Verification

077-1499-06

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Mixed Domain Oscilloscope
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Warning.

The servicing instructions are for use by qualified personnel only. To avoid personal injury, do not perform any servicing unless you are qualified to do so. Refer to all safety summaries prior to performing service.

Revision A. Released March 4th, 2022. Supports product firmware V1.0 and above.

Register now!
Click the following link to protect your product.
tek.com/register

077-1499-06 August 2023

Contacting Tektronix

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USA

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.

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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, see the *Service safety summary* that follows the *General 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.

This product shall be used in accordance with local and national 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.

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, ensure 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. Use only insulated voltage probes, test leads, and adapters supplied with the product, or indicated by Tektronix to be suitable for the product.
Observe all terminal ratings	To avoid fire or shock hazard, observe all rating and markings on the product. Consult the product manual for further ratings information before making connections to the product. Do not exceed the Measurement Category (CAT) rating and voltage or current rating of the lowest rated individual component of a product, probe, or accessory. Use caution when using 1:1 test leads because the probe tip voltage is directly transmitted to the product. Do not apply a potential to any terminal, including the common terminal, that exceeds the maximum rating of that terminal.
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.

Before use, inspect voltage probes, test leads, and accessories for mechanical damage and replace when damaged. Do not use probes or test leads if they are damaged, if there is exposed metal, or if a wear indicator shows.

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

Use only specified replacement parts.

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 a handle or handles for lifting and carrying.

⚠ **WARNING:** The product is heavy. To reduce the risk of personal injury or damage to the device get help when lifting or carrying the product.

Use only the Tektronix rackmount hardware specified for this product.

Probes and test leads

Before connecting probes or test leads, connect the power cord from the power connector to a properly grounded power outlet.

Keep fingers behind the protective barrier, protective finger guard, or tactile indicator on the probes.

Remove all probes, test leads and accessories that are not in use.

Use only correct Measurement Category (CAT), voltage, temperature, altitude, and amperage rated probes, test leads, and adapters for any measurement.

Terms in the 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.

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.

Symbols on 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 symbols may appear on the product:

Specifications

This chapter contains specifications for the 3 Series MDO oscilloscopes. All specifications are guaranteed unless noted as "typical." Typical specifications are provided for your convenience but are not guaranteed. Specifications that are marked with the ✓ symbol have associated procedures listed in the *Performance Verification* section.

All specifications apply to all 3 Series MDO models unless noted otherwise. To meet specifications, the following conditions must first be met:

- This instrument must have been calibrated/adjusted at an ambient temperature between +18 °C and +28 °C.
- The instrument must be in an environment with temperature, altitude, humidity, and vibration within the operating limits described in this section.
- The instrument must be powered from a source maintaining voltage and frequency within the limits described in this section.
- The instrument must have had its signal-path-compensation routine last executed after at least a 20-minute warm-up period at an ambient temperature within ±5 °C of the current ambient temperature.
- The instrument must have had a warm up period of at least 10 minutes.

Model overview

MDO32 and MDO34										
Analog channel bandwidth	100 MHz	100 MHz	200 MHz	200 MHz	350 MHz	350 MHz	500 MHz	500 MHz	1 GHz	1 GHz
Analog channels	2	4	2	4	2	4	2	4	2	4
Rise time (typical, calculated) *(10 mV/div setting with 50 Ω input termination)*	3.5 ns	3.5 ns	2 ns	2 ns	1.14 ns	1.14 ns	800 ps	800 ps	400 ps	400 ps
Sample rate (1 ch)	2.5 GS/s	2.5 GS/s	2.5 GS/s	2.5 GS/s	2.5 GS/s	2.5 GS/s	2.5 GS/s	2.5 GS/s	5 GS/s	5 GS/s
Sample rate (2 ch)	2.5 GS/s	2.5 GS/s	2.5 GS/s	2.5 GS/s	2.5 GS/s	2.5 GS/s	2.5 GS/s	2.5 GS/s	5 GS/s	5 GS/s
Sample rate (4 ch)	-	2.5 GS/s	-	2.5 GS/s	-	2.5 GS/s	-	2.5 GS/s	-	2.5 GS/s
Record length (1 ch)	10 M	10 M	10 M	10 M	10 M	10 M	10 M	10 M	10 M	10 M
Record length (2 ch)	10 M	10 M	10 M	10 M	10 M	10 M	10 M	10 M	10 M	10 M
Record length (4 ch)	-	10 M	-	10 M	-	10 M	-	10 M	-	10 M
Digital channels with 3-MSO option	16	16	16	16	16	16	16	16	16	16
Arbitrary Function Generator outputs with 3-AFG option	1	1	1	1	1	1	1	1	1	1
Spectrum analyzer channels	1	1	1	1	1	1	1	1	1	1
Standard spectrum analyzer frequency range	9 kHz - 1 GHz	9 kHz - 1 GHz	9 kHz - 1 GHz	9 kHz - 1 GHz	9 kHz - 1 GHz	9 kHz - 1 GHz	9 kHz - 1 GHz	9 kHz - 1 GHz	9 kHz - 1 GHz	9 kHz - 1 GHz
Optional spectrum analyzer frequency range with 3-SA3 option	9 kHz - 3 GHz	9 kHz - 3 GHz	9 kHz - 3 GHz	9 kHz - 3 GHz	9 kHz - 3 GHz	9 kHz - 3 GHz	9 kHz - 3 GHz	9 kHz - 3 GHz	9 kHz - 3 GHz	9 kHz - 3 GHz

Analog channel input and vertical specifications

Number of input channels

MDO34	4 analog, BNC, digitized simultaneously
MDO32	2 analog, BNC, digitized simultaneously

Input coupling AC, DC

Input termination selection 1 MΩ or 50 Ω

✓ Input termination 1 MΩ DC-coupled 1 MΩ, ±1%

✓ Input termination, 50 Ω, DC-coupled 50 Ω ± 1%

Input capacitance 1 MΩ, typical 13 pF ± 2 pF

Input VSWR, 50 Ω, DC-coupled, typical

Bandwidth	VSWR
For instruments with 1 GHz bandwidth	≤ 1.5:1 from DC to 1 GHz, typical
For instruments with 500 MHz bandwidth	≤ 1.5:1 from DC to 500 MHz, typical
For instruments with 350 MHz bandwidth	≤ 1.5:1 from DC to 350 MHz, typical
For instruments with 200 MHz bandwidth	≤ 1.5:1 from DC to 200 MHz, typical
For instruments with 100 MHz bandwidth	≤ 1.5:1 from DC to 100 MHz, typical

Maximum input voltage (50 Ω) 5 V_{RMS} with peaks ≤ ±20 V, (DF ≤ 6.25%)

There is an over-voltage trip circuit, intended to protect against overloads that might damage termination resistors. A sufficiently large impulse can cause damage regardless of the over-voltage protection circuitry, due to the finite time required to detect the over-voltage condition and respond to it.

Maximum input voltage (1 MΩ, DC coupled) The maximum input voltage at the BNC, 300 V_{RMS}.

Installation Category II.

De-rate at 20 dB/decade between 4.5 MHz and 45 MHz, De-rate 14 db between 45 MHz and 450 MHz. Above 450 MHz, 5 V_{RMS}

Maximum peak input voltage at the BNC, ±424 V

✓ DC balance

0.2 div with the input DC-50Ω coupled and 50 Ω terminated
0.25 div at 2 mV/div with the input DC-50 Ω coupled and 50 Ω terminated
0.5 div at 1 mV/div with the input DC-50 Ω coupled and 50 Ω terminated
0.2 div with the input DC-1 MΩ coupled and 50 Ω terminated
0.3 div at 1 mV/div with the input DC-1 MΩ coupled and 50 Ω terminated
All the above specifications are increased by 0.01 divisions per °C above 40 °C.

Number of digitized bits 8 bits

Displayed vertically with 25 digitization levels (DL) per division, 10.24 divisions dynamic range

"DL" is the abbreviation for "digitization level." A DL is the smallest voltage level change that can be resolved by an 8-bit A-D Converter. This value is also known as the LSB (least significant bit).

Sensitivity range (coarse)

1 M Ω 1 mV/div to 10 V/div in a 1-2-5 sequence

50 Ω 1 mV/div to 1 V/div in a 1-2-5 sequence

Sensitivity range (fine) Allows continuous adjustment from 1 mV/div to 10 V/div, 1 MΩ

Allows continuous adjustment from 1 mV/div to 1 V/div, 50 Ω

Sensitivity resolution (fine), typical ≤ 1% of current setting

✓ **DC gain accuracy** ±2.5% for 1 mV/Div, derated at 0.100%/°C above 30 °C

±2.0% for 2 mV/Div, derated at 0.100%/°C above 30 °C

±1.5% for 5 mV/Div and above, derated at 0.100%/°C above 30 °C

±3.0% Variable Gain, derated at 0.100%/°C above 30 °C

Offset ranges Input Signal cannot exceed Max Input Voltage for the 50 Ω input path.

Volts/div setting	Offset range	
	1 MΩ input	50 Ω input
1 mV/div - 50 mV/div	±1 V	±1 V
50.5 mV/div - 99.5 mV/div	±1 V	±1 V
100 mV/div - 500 mV/div	±10 V	±5 V
505 mV/div - 995 mV/div	±5 V	±5 V
1 V/div - 10 V/div[1]	±100 V	±5 V

Position range ±5 divisions

✓ **Offset accuracy** ±[0.005 X | offset - position | + DC Balance]

⚠ **Note:** Both the position and constant offset term must be converted to volts by multiplying by the appropriate volts/div term.

Number of waveforms for average acquisition mode 2 to 512 waveforms, Default of 16 waveforms

DC voltage measurement accuracy

Average acquisition mode

⚠ **Note:** Offset, position and the constant offset term must be converted to volts by multiplying by the appropriate volts/div term.

1 For 50Ω path, 1V/div is the maximum vertical setting.

Measurement Type	DC Accuracy (In Volts)
Average of ≥ 16 waveforms	±((DC Gain Accuracy) X |reading - (offset - position)| + Offset Accuracy + 0.1 div)
Delta Volts between any two averages of 16 waveforms acquired with the same setup and ambient conditions	±(DC Gain Accuracy X |reading| + 0.05 div)

The basic accuracy specification applies directly to any sample and to the following measurements: High, Low, Max, Min, Mean, Cycle Mean, RMS, and Cycle RMS. The delta volt accuracy specification applies to subtractive calculations involving two of these measurements.

The delta volts (difference voltage) accuracy specification applies directly to the following measurements; Positive Overshoot, Negative Overshoot, Pk-Pk, and Amplitude.

Sample acquisition mode, typical

⚠ **Note:** Offset, position and the constant offset term must be converted to volts by multiplying by the appropriate volts/div term.

Measurement Type	DC Accuracy (In Volts)
Any Sample	±(DC Gain Accuracy X |reading - (offset - position)| + Offset Accuracy + 0.15 div + 0.6 mV)
Delta Volts between any two samples acquired with the same setup and ambient conditions	±(DC Gain Accuracy X |reading| + 0.15 div + 1.2 mV)

Analog bandwidth limit filter selections

For instruments with 1 GHz, 500 MHz or 350 MHz analog bandwidth: 20 MHz, 250 MHz, and Full

For instruments with 200 MHz and 100 MHz analog bandwidth: 20 MHz and Full

✓ Analog bandwidth, 50 Ω, DC coupled

1 GHz instruments:

Volts/Div setting	Bandwidth
10 mV/div - 1 V/div	DC - 1.00 GHz
5 mV/div - 9.98 mV/div	DC - 500 MHz
2 mV/div - 4.98 mV/div	DC - 350 MHz
1 mV/div - 1.99 mV/div	DC - 150 MHz

500 MHz instruments:

Volts/Div setting	Bandwidth
5 mV/div - 1 V/div	DC - 500 MHz
2 mV/div - 4.98 mV/div	DC - 350 MHz
1 mV/div - 1.99 mV/div	DC - 150 MHz

350 MHz instruments:

Volts/Div setting	Bandwidth
5 mV/div - 1 V/div	DC - 350 MHz
2 mV/div - 4.98 mV/div	DC - 350 MHz

Table continued…

Volts/Div setting	Bandwidth
1 mV/div - 1.99 mV/div	DC - 150 MHz

200 MHz instruments:

Volts/Div setting	Bandwidth
2 mV/div - 1 V/div	DC - 200 MHz
1 mV/div - 1.99 mV/div	DC - 150 MHz

100 MHz instruments:

Volts/Div setting	Bandwidth
1 mV/div - 1 V/div	DC - 100 MHz

Analog bandwidth, 1 MΩ input termination, typical

1 GHz, 500 MHz, and 350 MHz instruments

The limits are for ambient temperature of ≤ 30 °C and the bandwidth selection set to FULL. Reduce the upper bandwidth frequency by 1% for each °C above 30 °C.

Volts/Div	Bandwidth
2 mV/div - 10 V/div	DC - 350 MHz
1 mV/div - 1.99 V/div	DC - 150 MHz

200 MHz instruments

Volts/Div	Bandwidth
2 mV/div - 10 V/div	DC - 200 MHz
1 mV/div - 1.99 V/div	DC - 150 MHz

100 MHz instruments

Volts/Div	Bandwidth
1 mV/div - 10 V/div	DC - 100 MHz

Analog Bandwidth, 1 MΩ with standard probe, typical

1 GHz instruments:

The limits are for ambient temperature of ≤ 30 °C and the bandwidth selection set to FULL. Reduce the upper bandwidth frequency by 1% for each °C above 30 °C.

Volts/Div setting	Bandwidth
100 mV/div - 100 V/div	DC - 1.00 GHz
50 mV/div - 99.8mV/div	DC - 400 MHz
20 mV/div - 49.8 mV/div	DC - 250 MHz
10 mV/div - 19.9 mV/div	DC - 150 MHz

500 MHz instruments:

Volts/Div setting	Bandwidth
100 mV/div - 100 V/div	DC - 500 MHz

Table continued…

Volts/Div setting	Bandwidth
50 mV/div - 99.8mV/div	DC - 400 MHz
20 mV/div - 49.8 mV/div	DC - 250 MHz
10 mV/div - 19.9 mV/div	DC - 150 MHz

350 MHz instruments:

Volts/Div setting	Bandwidth
50 mV/div - 100 V/div	DC - 350 MHz
20 mV/div - 49.8 mV/div	DC - 250 MHz
10 mV/div - 19.9 mV/div	DC - 150 MHz

200 MHz instruments:

Volts/Div setting	Bandwidth
20 mV/div - 100 V/div	DC - 200 MHz
10 mV/div - 19.9 mV/div	DC - 150 MHz

100 MHz instruments:

Volts/Div setting	Bandwidth
10 mV/div - 100 V/div	DC - 100 MHz

Calculated rise time, typical

50 Ω

Calculated Rise Time (10% to 90%) equals 0.35/BW. The formula accounts for the rise time contribution of the oscilloscope independent of the rise time of the signal source.

All values in the table are in ps.

Instrument bandwidth	Volts per division			
	1 mV-1.99 mV	2 mV-4.99 mV	5 mV-9.98 mV	10 mV-1 V
1 GHz	2666	1333	800	400
500 MHz	2666	1333	800	800
350 MHz	2666	1333	1143	1143
200 MHz	2666	2000	2000	2000
100 MHz	3500	3500	3500	3500

TPPxxx0 Probe

All values in the table are in ps. 1 GHz BW models assume the TPP1000 probe. 500 MHz and 350 MHz models assume the TPP0500B probe. 200 MHz and 100 MHz models assume the TPP0250 probe.

Instrument bandwidth	Volts per division			
	1 mV-1.99 mV	2 mV-4.99 mV	5 mV-9.98 mV	10 mV-1 V
1 GHz	2666	1600	1000	400
500 MHz	2666	1600	1000	800
350 MHz	2666	1600	1143	1143
200 MHz	2666	2000	2000	2000

Table continued…

Instrument bandwidth	Volts per division			
	1 mV-1.99 mV	**2 mV-4.99 mV**	**5 mV-9.98 mV**	**10 mV-1 V**
100 MHz	3500	3500	3500	3500

Measurements made using the scopes automated measurement feature may read slower rise time values than those determined by the above equation. This is because the automated measurements do not take interpolation into account. Measuring using cursors on the interpolated waveform gives a more accurate result.

Lower frequency limit, AC coupled, typical

< 10 Hz when AC to 1 MΩ coupled

The AC coupled lower frequency limits are reduced by a factor of 10 when 10X passive probes are used.

Upper frequency limit, 250 MHz bandwidth limit filter, typical

250 MHz, +25%, and –25% (all models, except 100 MHz and 200 MHz)

Upper frequency limit, 20 MHz bandwidth limit filter, typical

50 Ω and 1 MΩ, DC coupled: 20 MHz, ±25% (all models)

Pulse response, peak detect, or envelope mode, typical

Instrument bandwidth	Minimum Pulse Width
1 GHz	> 1.5 ns
500 MHz	> 2.0 ns
350 MHz	> 3.0 ns
200 MHz	> 5.0 ns
100 MHz	> 7.0 ns

✓ Random noise, sample acquisition mode, 50 Ω termination setting, full bandwidth, typical

For detailed guaranteed specifications see the Specifications and Performance Verification manual.

	1 mV/div	100 mV/div	1 V/div
1 GHz	-	1.98 mV	17.07 mV
500 MHz	-	1.54 mV	13.47 mV
350 MHz	-	1.7 mV	12.7 mV
200 MHz	111 µV	1.6 mV	15.19 mV
100 MHz	98 µV	1.38 mV	15.87 mV

✓ Random noise, sample acquisition mode, 50 Ω termination setting, full bandwidth, guaranteed

Note: Specifications with an asterisk (*) apply to oscilloscopes with the following serial numbers:

- B013600 and above
- C035000 and above
- MYVJ0001060 and above

	1 GHz	500 MHz	350 MHz	200 MHz	100 MHz
1 mV, Full BW	0.13	0.13	0.157	0.162	0.125

Table continued…

	1 GHz	500 MHz	350 MHz	200 MHz	100 MHz
1 mV, Full BW*	0.13	0.13	0.17	0.162	0.125
2 mV, Full BW	0.24	0.15	0.14	0.143	0.11
2 mV, Full BW*	0.28	0.165	0.14	0.143	0.12
5 mV, Full BW	0.36	0.2	0.18	0.16	0.15
5 mV, Full BW*	0.4	0.215	0.19	0.19	0.165
10 mV, Full BW	0.39	0.29	0.3	0.3	0.3
20 mV, Full BW	0.58	0.53	0.7	0.57	0.55
50 mV, Full BW	1.5	1.4	1.6	1.5	1.4
100 mV, Full BW	3.1	3.1	3.3	3.25	2.85
200 mV, Full BW	6.2	5.5	6.7	6.75	5.5
500 mV, Full BW	15.5	14.5	15.4	16.4	17
1 V, Full BW	31	25.8	25	30.5	35
1 mV, 250 MHz BW	0.13	0.162	0.162	-	-
2 mV, 250 MHz BW	0.126	0.12	0.12	-	-
5 mV, 250 MHz BW	0.165	0.155	0.155	-	-
5 mV, 250 MHz BW*	0.175	0.165	0.165	-	-
10 mV, 250 MHz BW	0.3	0.3	0.3	-	-
20 mV, 250 MHz BW	0.63	0.7	0.7	-	-
50 mV, 250 MHz BW	1.6	1.58	1.58	-	-
100 mV, 250 MHz BW	3.4	3.3	3.3	-	-
200 mV, 250 MHz BW	6.5	6.5	6.5	-	-
500 mV, 250 MHz BW	16	16	16	-	-
1 V, 250 MHz BW	30	30	30	-	-
1 mV, 20 MHz BW	0.078	0.078	0.078	0.078	0.078
2 mV, 20 MHz BW	0.084	0.086	0.086	0.086	0.086
5 mV, 20 MHz BW	0.16	0.17	0.17	0.17	0.17
10 mV, 20 MHz BW	0.32	0.3	0.3	0.3	0.3
20 mV, 20 MHz BW	0.63	0.55	0.55	0.55	0.55
50 mV, 20 MHz BW	1.6	1.5	1.5	1.5	1.5
100 mV, 20 MHz BW	3.4	3.25	3.25	3.25	3.25
200 mV, 20 MHz BW	6.4	6	6	6	6
500 mV, 20 MHz BW	17	15	15	15	15
1 V, 20 MHz BW	30	28	28	28	28

Delay between channels, full bandwidth, typical

≤ 500 ps between any two channels with input termination set to 50 Ω, DC coupling

⚠ **Note:** All settings in the instrument can be manually time aligned using the Probe Deskew function

Deskew range –125 ns to +125 ns

Digital-to-Analog skew 1 ns

Crosstalk (channel isolation), typical

	≤100 MHz	>100 MHz
1 MΩ	100:1	30:1
50 Ω	100:1	30:1

TekVPI Interface The probe interface allows installing, powering, compensating, and controlling a wide range of probes offering a variety of features.

The interface is available on CH1-CH4 front panel inputs. Aux In is available on the front of two-channel instrument only and is fully VPI compliant. Four-channel instruments have no Aux In input.

Digital channel acquisition specifications

Number of input channels 16 Digital Inputs

Input resistance, typical 101 KΩ to ground

Input capacitance, typical 8 pF

Specified at the input to the P6316 probe with all 8 ground inputs connected to the user's ground.
Use of leadsets, grabber clips, ground extenders, or other connection accessories may compromise this specification.

Minimum input signal swing, typical 500mV peak-to-peak

Specified at the input to the P6316 probe with all 8 ground inputs connected to the user's ground.
Use of leadsets, grabber clips, ground extenders, or other connection accessories may compromise this specification.

Maximum input signal swing, typical +30 V, -20 V

DC input voltage range +30 V, -20 V

Maximum input dynamic range 50 V_{pp} (threshold setting dependent)

Channel to channel skew (typical) 500 ps

Digital Channel to Digital Channel only

This is the propagation path skew, and ignores skew contributions due to bandpass distortion, threshold inaccuracies (see Threshold Accuracy), and sample binning (see Digital Channel Timing Resolution).

Threshold voltage range –15 V to +25 V

Digital channel timing resolution Minimum: 2 ns

✓ Threshold accuracy ± [130 mV + 3% of threshold setting after calibration]. Requires valid SPC.

Minimum detectable pulse 2.0 ns

Specified at the input to the P6316 probe with all eight ground inputs connected to the user's ground. Use of lead sets, grabber clips, ground extenders, or other connection accessories may compromise this specification.

Horizontal specifications

Sample Rate Range

Table 1: Sample rate range with 3 or 4 channels enabled

<table>
<tr><th>Characteristic</th><th colspan="7">Description</th></tr>
<tr><td rowspan="25">Sample rate range (Analog Channels)</td><td>Time/Div</td><td>10 M record</td><td>5 M record</td><td>1 M record</td><td>100 K record</td><td>10 K record</td><td>1 K record</td></tr>
<tr><td>1 ns</td><td colspan="6">2.5 GS/s</td></tr>
<tr><td>2 ns</td><td colspan="6">2.5 GS/s</td></tr>
<tr><td>4 ns</td><td colspan="6">2.5 GS/s</td></tr>
<tr><td>10 ns</td><td colspan="6">2.5 GS/s</td></tr>
<tr><td>20 ns</td><td colspan="6">2.5 GS/s</td></tr>
<tr><td>40 ns</td><td colspan="6">2.5 GS/s</td></tr>
<tr><td>80 ns</td><td colspan="5"></td><td>1.25 GS/s</td></tr>
<tr><td>100 ns</td><td colspan="5">2.5 GS/s</td><td></td></tr>
<tr><td>200 ns</td><td colspan="5">2.5 GS/s</td><td>500 MS/s</td></tr>
<tr><td>400 ns</td><td colspan="5">2.5 GS/s</td><td>250 MS/s</td></tr>
<tr><td>800 ns</td><td colspan="4"></td><td>1.25 GS/s</td><td></td></tr>
<tr><td>1 µs</td><td colspan="4">2.5 GS/s</td><td></td><td>100 MS/s</td></tr>
<tr><td>2 µs</td><td colspan="4">2.5 GS/s</td><td>500 MS/s</td><td>50 MS/s</td></tr>
<tr><td>4 µs</td><td colspan="4">2.5 GS/s</td><td>250 MS/s</td><td>25 MS/s</td></tr>
<tr><td>8 µs</td><td colspan="3"></td><td>1.25 GS/s</td><td colspan="2"></td></tr>
<tr><td>10 µs</td><td colspan="3">2.5 GS/s</td><td></td><td>100 MS/s</td><td>10 MS/s</td></tr>
<tr><td>20 µs</td><td colspan="3">2.5 GS/s</td><td>500 MS/s</td><td>50 MS/s</td><td>5 MS/s</td></tr>
<tr><td>40 µs</td><td colspan="3">2.5 GS/s</td><td>250 MS/s</td><td>25 MS/s</td><td>2.5 MS/s</td></tr>
<tr><td>80 µs</td><td colspan="2"></td><td>1.25 GS/s</td><td colspan="3"></td></tr>
<tr><td>100 µs</td><td colspan="2">2.5 GS/s</td><td></td><td>100 MS/s</td><td>10 MS/s</td><td>1 MS/s</td></tr>
<tr><td>200 µs</td><td colspan="2">2.5 GS/s</td><td>500 MS/s</td><td>50 MS/s</td><td>5 MS/s</td><td>500 KS/s</td></tr>
<tr><td>400 µs</td><td>2.5 GS/s</td><td>1.25 GS/s</td><td>250 MS/s</td><td>25 MS/s</td><td>2.5 MS/s</td><td>250 KS/s</td></tr>
<tr><td>800 µs</td><td>1.25 GS/s</td><td>625 MS/s</td><td colspan="4"></td></tr>
</table>

Table continued…

Characteristic	Description						
Sample rate range (Analog Channels) (Cont.)	**Time/Div**	**10 M record**	**5 M record**	**1 M record**	**100 K record**	**10 K record**	**1 K record**
	1 ms			100 MS/s	10 MS/s	1 MS/s	100 KS/s
	2 ms	500 MS/s	250 MS/s	50 MS/s	5 MS/s	500 KS/s	50 KS/s
	4 ms	250 MS/s	125 MS/s	25 MS/s	2.5 MS/s	250 KS/s	25 KS/s
	10 ms	100 MS/s	50 MS/s	10 MS/s	1 MS/s	100 KS/s	10 KS/s
	20 ms	50 MS/s	25 MS/s	5 MS/s	500 KS/s	50 KS/s	5 KS/s
	40 ms	25 MS/s	12.5 MS/s	2.5 MS/s	250 KS/s	25 KS/s	2.5 KS/s
	100 ms	10 MS/s	5 MS/s	1 MS/s	100 KS/s	10 KS/s	1 KS/s
	200 ms	5 MS/s	2.5 MS/s	500 KS/s	50 KS/s	5 KS/s	500 S/s
	400 ms	2.5 MS/s	1.25 MS/s	250 KS/s	25 KS/s	2.5 KS/s	250 S/s
	1 s	1 MS/s	500 KS/s	100 KS/s	10 KS/s	1 KS/s	100 S/s
	2 s	500 KS/s	250 KS/s	50 KS/s	5 KS/s	500 S/s	50 S/s
	4 s	250 KS/s	125 KS/s	25 KS/s	2.5 KS/s	250 S/s	25 S/s
	10 s	100 KS/s	50 KS/s	10 KS/s	1 KS/s	100 S/s	10 S/s
	20 s	50 KS/s	25 KS/s	5 KS/s	500 S/s	50 S/s	5 S/s
	40 s	25 KS/s	12.5 KS/s	2.5 KS/s	250 S/s	25 S/s	2.5 S/s
	100 s	10 KS/s	5 KS/s	1 KS/s	100 S/s	10 S/s	
	200 s	5 KS/s	2.5 KS/s	500 S/s	50 S/s	5 S/s	
	400 s	2.5 KS/s	1.25 KS/s	250 S/s	25 S/s	2.5 S/s	
	1000 s	1 KS/s	500 S/s	100 S/s	10 S/s		

Table 2: Sample rate range with 1 or 2 channels enabled

Characteristic	Description						
Sample rate range (Analog Channels)	**Time/Div**	**10 M record**	**5 M record**	**1 M record**	**100 K record**	**10 K record**	**1 K record**
	400 ps	5 GS/s					
	1 ns	5 GS/s					
	2 ns	5 GS/s					
	4 ns	5 GS/s					
	10 ns	5 GS/s					
	20 ns	5 GS/s					
	40 ns	5 GS/s					2.5 GS/s
	100 ns	5 GS/s					1 GS/s
	200 ns	5 GS/s					500 MS/s
	400 ns	5 GS/s				2.5 GS/s	250 MS/s
	1 µs	5 GS/s				1 GS/s	100 MS/s
	2 µs	5 GS/s				500 MS/s	50 MS/s
	4 µs	5 GS/s			2.5 GS/s	250 MS/s	25 MS/s
	10 µs	5 GS/s			1 GS/s	100 MS/s	10 MS/s
	20 µs	5 GS/s			500 MS/s	50 MS/s	5 MS/s
	40 µs	5 GS/s		2.5 GS/s	250 MS/s	25 MS/s	2.5 MS/s
	100 µs	5 GS/s		1 GS/s	100 MS/s	10 MS/s	1 MS/s
	200 µs	5 GS/s	2.5 GS/s	500 MS/s	50 MS/s	5 MS/s	500 KS/s
	400 µs	2.5 GS/s	1.25 GS/s	250 MS/s	25 MS/s	2.5 MS/s	250 KS/s

Table continued…

Characteristic	Description						
Sample rate range (Analog Channels) (Cont.)	**Time/Div**	**10 M record**	**5 M record**	**1 M record**	**100 K record**	**10 K record**	**1 K record**
	1 ms	1 GS/s	500 MS/s	100 MS/s	10 MS/s	1 MS/s	100 KS/s
	2 ms	500 MS/s	250 MS/s	50 MS/s	5 MS/s	500 KS/s	50 KS/s
	4 ms	250 MS/s	125 MS/s	25 MS/s	2.5 MS/s	250 KS/s	25 KS/s
	10 ms	100 MS/s	50 MS/s	10 MS/s	1 MS/s	100 KS/s	10 KS/s
	20 ms	50 MS/s	25 MS/s	5 MS/s	500 KS/s	50 KS/s	5 KS/s
	40 ms	25 MS/s	12.5 MS/s	2.5 MS/s	250 KS/s	25 KS/s	2.5 KS/s
	100 ms	10 MS/s	5 MS/s	1 MS/s	100 KS/s	10 KS/s	1 KS/s
	200 ms	5 MS/s	2.5 MS/s	500 KS/s	50 KS/s	5 KS/s	500 S/s
	400 ms	2.5 MS/s	1.25 MS/s	250 KS/s	25 KS/s	2.5 KS/s	250 S/s
	1 s	1 MS/s	500 KS/s	100 KS/s	10 KS/s	1 KS/s	100 S/s
	2 s	500 KS/s	250 KS/s	50 KS/s	5 KS/s	500 S/s	50 S/s
	4 s	250 KS/s	125 KS/s	25 KS/s	2.5 KS/s	250 S/s	25 S/s
	10 s	100 KS/s	50 KS/s	10 KS/s	1 KS/s	100 S/s	10 S/s
	20 s	50 KS/s	25 KS/s	5 KS/s	500 S/s	50 S/s	5 S/s
	40 s	25 KS/s	12.5 KS/s	2.5 KS/s	250 S/s	25 S/s	2.5 S/s
	100 s	10 KS/s	5 KS/s	1 KS/s	100 S/s	10 S/s	
	200 s	5 KS/s	2.5 KS/s	500 S/s	50 S/s	5 S/s	
	400 s	2.5 KS/s	1.25 KS/s	250 S/s	25 S/s	2.5 S/s	
	1000 s	1 KS/s	500 S/s	100 S/s	10 S/s		

Record length range

1K, 10K, 100K, 1M, 5M, 10M

Seconds/division range

<1 GHz instruments MDO30XX models: 1 ns/div to 1000 sec/div

1 GHz instruments MDO310X models: 400 ps/div to 1000 sec/div

Maximum triggered acquisition rate

Bandwidth	1 and 2 channels		3 and 4 channels	
	FastAcq	DPO	FastAcq	DPO
1 GHz	> 280,000 wfm/sec	> 60,000 wfm/sec	> 230,000 wfm/sec	> 50,000 wfm/sec
< 1 GHz	> 230,000 wfm/sec	> 50,000 wfm/sec	> 230,000 wfm/sec	> 50,000 wfm/sec

Aperture uncertainty, typical (also called "sample rate jitter")

≤ (5 ps + 1 × 10^{-6} x record duration)RMS, for records having duration ≤ 1 minute
Record duration = (Record Length) / (Sample Rate)

Long-term sample rate and delay time accuracy

±10 ppm over any ≥ 1 ms time interval

Timebase delay time range

-10 divisions to 5000 s

Delta time measurement accuracy

The formula to calculate delta-time measurement accuracy (DTA) for a given instrument setting and input signal is given below (assumes insignificant signal content above Nyquist).

SR1 = Slew Rate (1st Edge) around the 1st point in the measurement

SR2 = Slew Rate (2nd Edge) around the 2nd point in the measurement

N = input-referred noise (voltsrms, refer to the Random Noise, Sample acquisition mode specification)

t_{sr} = 1 / (Sample Rate)

TBA = timebase accuracy (refer to the Long-term sample rate and delay time accuracy specification)

t_p = delta-time measurement duration

RD = (Record Length) / (Sample Rate)

$$DTA_{pp} = \pm 5\sqrt{2\left(\frac{N}{SR_1}\right)^2 + 2\left(\frac{N}{SR_2}\right)^2 + \left(5ps + 1x10^{-6} xRD\right)^2} + 2t_{sr} + TBA\ xt_p$$

$$DTA_{rms} = \sqrt{2\left(\frac{N}{SR_1}\right)^2 + 2\left(\frac{N}{SR_2}\right)^2 + \left(5ps + 1x10^{-6} xRD\right)^2 + \left(\frac{2t_{sr}}{\sqrt{12}}\right)^2} + TBA\ xt_p$$

Assumes that error due to aliasing is insignificant.

The term under the square-root sign is the stability, and is related to the TIE (Time Interval Error). The errors from this term occur throughout a single-shot measurement. The second term is a result of both the absolute center-frequency accuracy and the center-frequency stability of the timebase, and varies between multiple single-shot measurements over the observation interval (the amount of time from the first single-shot measurement to the final single-shot measurement).

Frequency response tolerance, typical

±0.5 dB from DC to 80% of nominal bandwidth

Trigger specifications

Aux In

Number of channels

MDO32 - 2 channel instruments: One (1) channel

MDO34 - 4 channel instruments: Zero (0) channels

Input impedance, typical

1 MΩ ±1% in parallel with 13 pF ± 2 pF.

Maximum input voltage

300 V RMS, Installation Category II; derate at 20 dB/decade above 3 MHz to 30 V RMS at 30 MHz; 10 dB/decade above 30 MHz.

Based upon sinusoidal or DC input signal. Excursion above 300 V should be less than 100 ms duration and the duty factor is limited to < 44%. RMS signal level must be limited to 300 V. If these values are exceeded, damage to the instrument may result.

Bandwidth, typical

> 250 MHz

Trigger bandwidth, edge, pulse, and logic, typical

Instrument bandwidth	Trigger bandwidth
1 GHz	≥1 GHz
500 MHz	≥500 MHz
350 MHz	≥500 MHz
200 MHz	≥200 MHz

Table continued…

Instrument bandwidth	Trigger bandwidth
100 MHz	≥200 MHz

Edge trigger sensitivity, typical

Edge trigger, DC coupled

Trigger source	Sensitivity
Any Analog Channel	1 mV/div to 4.98 mV/div: 0.75 div from DC to 50 MHz, increasing to 1.3 div at instrument bandwidth. ≥ 5 mV/div: 0.40 divisions from DC to 50 MHz, increasing to 1 div at instrument bandwidth.
Aux In (External)	200 mV from DC to 50 MHz, increasing to 500 mV at 200 MHz
Line	The line trigger level is fixed at about 50% of the line voltage.

Edge trigger, not DC coupled

Trigger coupling	Sensitivity
AC	1.5 times the DC Coupled limits for frequencies above 10 Hz. Attenuates signals below 10 Hz.
Noise Rej	2.5 times the DC Coupled limits
HF Reject	1.5 times the DC Coupled limits from DC to 50 kHz. Attenuates signals above 50 kHz.
LF Reject	1.5 times the DC Coupled limits for frequencies above 50 kHz. Attenuates signals below 50 kHz

Trigger modes

Auto, Normal, and Single

Trigger types

Edge, sequence (B trigger), pulse width, timeout, runt, logic, setup & hold, rise/fall time, video, and bus (serial or parallel).

Video trigger

Formats and field rates

Triggers from negative sync composite video, field 1 or field 2 for interlaced systems, any field, specific line, or any line for interlaced or non-interlaced systems. Supported systems include NTSC, PAL, SECAM.

Standard Video formats are: Trigger on 480p/60, 576p/50, 720p/30, 720p/50, 720p/60, 875i/60, 1080i/50, 1080i/60, 1080p/24, 1080p/24sF, 1080p/25, 1080p/30, 1080p/50, 1080p/60, and custom bi-level and tri-level sync video standards.

Sensitivity, typical

Source	Sensitivity
Any Analog Input Channel	0.6 to 2.5 divisions of video sync tip
Aux In (External)	Video not supported through Aux In (External) input.

Lowest frequency for successful set level to 50%, typical 45 Hz

Logic, logic-qualified, and Delay-by-events sensitivities, DC coupled, typical ≥1.0 division, from DC to maximum bandwidth.

Pulse width trigger sensitivity, typical ≥1.0 division, from DC to maximum bandwidth.

Runt trigger sensitivity, typical ≥1.0 division, from DC to maximum bandwidth.

Logic trigger minimum logic or rearm time, typical

Triggering type	Pulse width	Rearm time	Time between channels [2]
Logic	Not applicable	2 ns	2 ns
Time qualified logic	4 ns	2 ns	2 ns

Setup/Hold violation trigger, typical

Minimum clock pulse width, typical

Minimum pulse width, clock active[2]	Minimum pulse width, clock inactive[2]
User's hold time +2.5 ns[1]	2 ns

Time ranges

Feature	Minimum	Maximum
Setup time	-0.5 ns	1.024 ms
Hold time	1 ns	1.024 ms
Setup + hold time	0.5 ns	2.048 ms

Minimum pulse width, rearm time, and transition time

Pulse Class	Minimum Pulse Width	Minimum Rearm Time
Glitch	4 ns	2 ns + 5% of glitch width setting
Runt	4 ns	2 ns
Time-Qualified Runt	4 ns	8.5 ns + 5% of width setting
Width	4 ns	2 ns + 5% of width upper limit setting
Slew Rate	4 ns	8.5 ns + 5% of delta time setting

Rise/Fall time, delta time range 4 ns to 8 seconds

Desired Time	Time Resolution (Fine)	Time Resolution (Coarse)
<10 µs	0.8 ns	8 ns

Table continued…

2 For Logic, time between channels refers to the length of time a logic state derived from more than one channel must exist to be recognized. For Events, the time is the minimum time between a main and delayed event that will be recognized if more than one channel is used.

Desired Time	Time Resolution (Fine)	Time Resolution (Coarse)
≥10 μs and <100 μs	0.1 μs	1 μs
≥100 μs and <1 ms	1 μs	10 μs
≥1 ms and <10 ms	10 μs	100 μs
≥10 ms and <100 ms	100 μs	1 ms
≥100 ms and <1 s	1 ms	10 ms
≥1 s	10 ms	100 ms

Pulse width or time-qualified runt trigger time range

4 ns to 8 s

Desired Time	Time Resolution (Fine)	Time Resolution (Coarse)
<10 μs	0.8 ns	8 ns
≥10 μs and <100 μs	0.1 μs	1 μs
≥100 μs and <1 ms	1 μs	10 μs
≥1 ms and <10 ms	10 μs	100 μs
≥10 ms and <100 ms	100 μs	1 ms
≥100 ms and <1 s	1 s	10 ms
≥1 s	10 ms	100 ms

Pulse width time accuracy

Time Range	Accuracy
1 ns to 500 ns	±(20% of setting + 0.5 ns)
520 ns to 1 s	±(0.01% of setting + 100 ns)

B trigger

Minimum pulse width, typical 1/(2 * [Rated instrument bandwidth])

Maximum event frequency, typical Rated instrument bandwidth or 500 MHz, whichever is lower

Minimum time between arm and trigger 9.2 ns

For B trigger after time, this is the time between the A trigger and the B trigger

For B trigger after events, this is the time between the A trigger and the first qualifying B trigger event

Trigger after time, time range 8 ns to 8 seconds

Trigger after events, event range 1 to 4,000,000 events

Trigger level ranges

Any input channel ±8 divs from center of screen

±8 divs from 0 V when vertical LF Reject trigger coupling is selected

Aux In (external) ±8 V

Line Line trigger level is fixed at about 50% of the line voltage

Trigger level accuracy, DC coupled, typical

Source	Range
Any input channel	±0.20 div
Aux In (external)	± (10% of setting + 25 mV)
Line	N/A

Trigger holdoff range 20 ns to 8 s

Maximum serial trigger bits 128 bits

I^2C triggering, optional

Address Triggering: 7 & 10 bits of user-specified addresses supported, as well as General Call, START byte, HS-mode, EEPROM, and CBUS

Data Trigger: 1 - 5 bytes of user-specified data

Trigger on: Start, Repeated Start, Stop, Missing Ack, Address, Data, or Address & Data

Maximum Data Rate: 10 Mb/s

SPI triggering, optional

Data Trigger: 1 - 16 bytes of user-specified data

Trigger on: SS Active, MOSI, MISO, or MOSI & MISO

Maximum Data Rate: 10 Mb/s

CAN triggering, optional

Data Trigger: 1 - 8 bytes of user-specified data, including qualifiers of equal to (=), not equal to <>, less than (<), greater than (>), less than or equal to (≤), greater than or equal to (≥)

Trigger on: Start of Frame, Type of Frame, Identifier, Data, Identifier & Data, End of Frame, Missing Ack, or Bit Stuffing Error

Frame Type: Data, Remote, Error, Overload

Identifier: Standard (11 bit) and Extended (29 bit) identifiers

Maximum Data Rate: 1 Mb/s

RS232/422/485/UART triggering

Data Trigger: Tx Data, Rx Data

Trigger On: Tx Start Bit, Rx Start Bit, Tx End of Packet, Rx End of Packet, Tx Data, Rx Data, Tx Parity Error, or Rx Parity Error

Maximum Data Rate: 10 Mb/s

LIN triggering, optional

Data Trigger: 1 - 8 bytes of user-specified data, including qualifiers of equal to (=), not equal to <>, less than (<), greater than (>), less than, or equal to (≤), greater than or equal to (≥)

Trigger On: Sync, Identifier, Data, Identifier & Data, Wakeup Frame, Sleep Frame, or Error

Maximum Data Rate: 1 Mb/s (by LIN definition, 20 kbit/s)

Flexray triggering, optional

Indicator Bits: Normal Frame, Payload Frame, Null Frame, Sync Frame, Startup Frame

Identifier Trigger: 11 bits of user-specified data, equal to (=), not equal to <>, less than (<), greater than (>), less than or equal to (<=), greater than or equal to (>=), Inside Range, or Outside Range

Cycle Count Trigger: 6 bits of user-specified data, equal to (≤), greater than or equal to (≥), Inside Range, Outside Range

Header Fields Trigger: 40 bits of user-specified data comprising Indicator Bits, Identifier, Payload Length, Header CRC, and Cycle Count, equal to (=)

Data Trigger: 1 - 16 bytes of user-specified data, with 0 to 253, or don't care bytes of data offset, including qualifiers of equal to (=), not equal to <>, less than (<), greater than (>), less than or equal to (≤), greater than or equal to (≥), Inside Range, and Outside Range.

End Of Frame: User-chosen types Static, Dynamic (DTS), and All

Error: Header CRC, Trailer CRC, Null Frame-static, Null Frame-dynamic, Sync Frame, Startup frame

Trigger on: Start of Frame, Indicator Bits, Identifier, Cycle Count, Header Fields, Data, Identifier & Data, End of Frame, or Error

I^{2}S triggering, optional

Data Trigger: 32 bits of user-specified data in a left word, right word, or either, including qualifiers of equal to (=), not equal to <>, less than (<), greater than (>), less than or equal to (≤), greater than or equal to (≥), inside range, outside range

Trigger on: SS Word Select or Data

Maximum Data Rate: 12.5 Mb/s

Left Justified triggering, optional

Data Trigger: 32 bits of user-specified data in a left word, right word, or either, including qualifiers of equal to (=), not equal to <>, less than (<), greater than (>), less than or equal to (≤), greater than or equal to (≥), inside range, and outside range

Trigger on: Word Select or Data

Maximum Data Rate: 12.5 Mb/s

Right Justified triggering, optional

Data Trigger: 32 bits of user-specified data in a left word, right word, or either, including qualifiers of equal to (=), not equal to <>, less than (<), greater than (>), less than or equal to (≤), greater than or equal to (≥), inside range, outside range

Trigger on: Word Select and Data

Maximum Data Rate: 12.5 Mb/s

MIL-STD-1553 triggering, optional

For MIL-STD-1553, trigger selection of Command Word will trigger on Command and ambiguous Command/Status words. Trigger selection of Status Word will trigger on Status and ambiguous Command/Status words.

Bit Rate: 1 Mb/s

Trigger on: Sync

Word Type (Command, Status, and Data)

Command Word (set RT Address (=, ≠, <, >, ≤, ≥, inside range, outside range), T/R, Sub-address/Mode, Data Word Count/Mode Code, and Parity individually)

Status Word (set RT Address (=, ≠, <, >, ≤, ≥, inside range, outside range), Message Error, Instrumentation, Service Request Bit, Broadcast Command Received, Busy, Subsystem Flag, Dynamic Bus Control Acceptance (DBCA), Terminal Flag, and Parity individually)

Data Word (user-specified 16-bit data value),

Error (Sync, Parity, Manchester, Non-contiguous data), Idle Time (minimum time selectable from 2 µs to 100 µs; maximum time selectable from 2 µs to 100 µs; trigger on < minimum, > maximum, inside range, and outside range)

TDM triggering, optional

Data Trigger:	32 bits of user-specified data in a channel 0-7, including qualifiers of equal to (=), not equal to <>, less than (<), greater than (>), less than or equal to (≤), greater than or equal to (≥), inside range, outside range.
Trigger On:	Frame Sync or Data
Maximum Data Rate:	25 Mb/s

USB triggering, optional

Data Rates Supported:	Full: 12 Mbs, Low: 1.5 Mbs
Trigger On:	Sync, Reset, Suspend, Resume, End of Packet, Token (Address) Packet, Data Packet, Handshake Packet, Special Packet, or Error

Display specifications

Display

Type	Display Area - 256.32 mm (H) x 144.18 mm (V), 29 cm (11.6 inch) diagonal TFT active matrix, liquid crystal display (LCD) with capacitive touch. eDP, 2 lanes 2.7 Gbps
Resolution	1920 (H) x 1080 (V) pixels
Luminance, typical	450 cd/m² Display luminance is specified for a new display set at full brightness
Color Support	16,777,216 (8-bit RGB) colors

Input/Output port specifications

Ethernet interface	An 8-pin RJ-45 connector that supports 10/100 Mb/s
GPIB interface	Available as an optional accessory that connects to USB Device and USB Host port, with the TEK-USB-488 GPIB to USB Adapter Control interface is incorporated in the instrument user interface
HDMI connector	An 19-pin, HDMI type connector
USB interface	Two USB host ports on the front of the instrument: two USB 2.0 High Speed ports. One USB host port on the rear of the instrument: USB 2.0 High Speed port. One USB 2.0 High Speed device port on the rear of the instrument providing USBTMC support. Also Supports Full Speed and Slow Speed modes

Probe compensator output voltage and frequency, typical

Output voltage:	0 to 2.5 V amplitude
Source Impedance:	1 KΩ
Frequency	1 kHz

Auxiliary output (AUX OUT)

Selectable Output:	Main Trigger, Event, or AFG
Main Trigger:	HIGH to LOW transition indicates the trigger occurred
Event Out:	The instrument will output a negative edge during a specified trigger event in a test application. A falling edge occurs when there is a specified event in a test application (i.e. the waveform crosses the violation threshold in the limit / mask test application). A rising edge occurs when the trigger system begins waiting for the next test application event.
AFG:	The trigger output signal from the AFG.

Data storage specifications

Nonvolatile memory retention time, typical	No time limit for front-panel settings, saved waveforms, setups, and calibration constants
Real-time clock	A programmable clock providing time in years, months, days, hours, minutes, and seconds

Memory capacity

Front panel	A 64 Kbit EEPROM on the LED board that stores the USB vendor ID and device ID for the internal front panel controller
Analog board	The PMU includes 64 KB of nonvolatile memory for storage of its own binary executable
Probe interface	A microcontroller is used to manage probe communication as well as power state for the instrument
Main acquisition	Two eMMC 4 GB ISSI devices contain the U-Boot, kernel, CAL constants, scope application, and user data storage
Mass storage device	Linux: ≥4 GB. Form factor is an embedded eMMC BGA. Provides storage for saved customer data, all calibration constants and the Linux operating system. Not customer serviceable. Partition on the device, with a nominal capacity of 4 GB, is available for storage of saved customer data.
Host processor system	4 Gb of DDR3-1600 DRAM. The host processor utilizes two matched DDR3 non-ECC embedded modules

Power source specifications

Power consumption	130 W maximum
Source voltage	100 V to 240 V ±10%
Source frequency	100 V to 240 V: 50/60 Hz 115 V: 400 Hz ±10%
Fuse rating	T3.15 A, 250 V The fuse is not customer replaceable.

Mechanical specifications

Weight	
Instrument	MDO34 1GHz: 11.7 lbs (5.31 kg) MDO32 1GHz: 11.6 lbs (5.26 kg)
With accessories	Protective front cover: + 1.0 lbs (0.45 kg) Pouch: + 0.2 lbs (0.09 kg) Soft case (SC3): + 4.0 lbs (1.81 kg) Instrument when packaged for shipping: 17.4 lbs (7.89 kg)
Dimensions	
Height	252 mm (9.93 in.)
Width	370 mm (14.57 in.)
Depth	148.6 mm (5.85 in.)
Clearance requirements	The clearance requirement for adequate cooling is 2.0 in (50.8 mm) on the right side (when looking at the front of the instrument) and on the rear of the instrument
Acoustic noise emission	
Sound power level	38 dBA - 40 dBA typical in accordance with ISO 9296

Environmental specifications

Temperature	
Operating	-10 °C to +55 °C (+14 °F to +131 °F)
Non-operating	–40 °C to +71 °C (–40 °F to +160 °F)
Humidity	
Operating	5% to 90% relative humidity (% RH) at up to +40 °C 5% to 60% RH above +40 °C up to +55 °C, non-condensing, and as limited by a maximum wet-bulb temperature of +39 °C
Non-operating	5% to 90% relative humidity up to +40 °C, 5% to 60% relative humidity above +40 °C up to +55 °C 5% to 40% relative humidity above +55 °C up to +71 °C, non-condensing, and as limited by a maximum wet-bulb temperature of +39 °C
Altitude	
Operating	3,000 m (9,843 feet)
Non-operating	12,000 m (39,370 feet)
Random vibration	
Non-operating:	2.46 G_{RMS}, 5-500 Hz, 10 minutes per axis, 3 axes, 30 minutes total
Operating:	0.31 G_{RMS}, 5-500 Hz, 10 minutes per axis, 3 axes, 30 minutes total

	Meets IEC60068 2-64 and MIL-PRF-28800 Class 3
Shock	
Operating:	50 G, 1/2 sine, 11 ms duration, 3 drops in each direction of each axis, total of 18 shocks Meets IEC 60068 2-27 and MIL-PRF-28800 Class 3
Non-operating	50 G, 1/2 sine, 11 ms duration, 3 drops in each direction of each axis, total of 18 shocks Exceeds MIL-PRF-28800F

RF input specifications

Center frequency range	9 kHz to 3.0 GHz (with 3-SA3 installed) 9 kHz to 1.0 GHz (Any model without 3-SA3 installed)
Resolution bandwidth range	20 Hz – 150 MHz
Resolution bandwidth range for Windowing functions	Kaiser (default): 30 Hz – 150 MHz Rectangular: 20 Hz – 150 MHz Hamming: 20 Hz – 150 MHz Hanning: 20 Hz – 150 MHz Blackman-Harris: 30 Hz – 150 MHz Flat-Top: 50 Hz – 150 MHz Adjusted in 1-2-3-5 sequence
Kaiser RBW Shape Factor	60 db/3 db Shape factor ≤ 4:1
Reference frequency error, cumulative	$\pm 10 \times 10^{-6}$
✓ **Reference frequency error, cumulative**	Cumulative Error: $\pm 10 \times 10^{-6}$ Includes allowances for aging per year, reference frequency calibration accuracy, and temperature stability. Valid over the recommended 1 year calibration interval, from –10 °C to +55 °C . ⚠ **Note:** The RF and analog channels share the same reference frequency. Reference frequency accuracy is tested by the Long-term Sample Rate and Delay Time Accuracy checks.
Marker frequency measurement accuracy	±(([Reference Frequency Error] x [Marker Frequency]) + (span / 750 + 2)) Hz Reference Frequency Error = 10 ppm (10 Hz/MHz) Example, assuming the span is set to 10 kHz and the marker is at 1,500 MHz, this would result in a Frequency Measurement Accuracy of ±((10 Hz/1 MHz x 1,500 MHz) + (10 kHz / 750 + 2)) = ±15.015 kHz Marker Frequency with Span/RBW ≤ 1000:1 Reference Frequency Error with Marker level to displayed noise level > 30 dB
Phase noise from 1 GHz CW	
10 kHz	< -81 dBc/Hz, < -85 dBc/Hz (typical)
100 kHz	< -97 dBc/Hz, < -101 dBc/Hz (typical)
1 MHz	< -118 dBc/Hz, < -122 dBc/Hz (typical)
✓ **Displayed average noise level (DANL)**	

9 kHz - 50 kHz	< -109 dBm/Hz (< -113 dBm/Hz typical)
50 kHz – 5 MHz	< -126 dBm/Hz (< -130 dBm/Hz typical)
5 MHz - 2 GHz	< -136 dBm/Hz (< -140 dBm/Hz typical)
2 GHz – 3 GHz	< -126 dBm/Hz (< -130 dBm/Hz typical)
Vertical range	20 dB/div to DANL
Attenuation range	Attenuator Settings from 10 to 30 dB, in 5 dB steps
Spectrum trace length (points)	751 points
Spurious response	
2nd harmonic distortion	>100 MHz: < -55 dBc (< -60 dBc typical) 9 kHz to 100 MHz: < -55 dBc
3rd harmonic distortion	>100 MHz: < -53 dBc (< -58 dBc typical) 9 kHz to 100 MHz: < -55 dBc (< -60 dBc typical)
2nd order intermodulation distortion	>15 MHz: < -55 dBc (< -60 dBc typical) 9 kHz to 15 MHz, < -47 dBc (< -52 dBc typical)
3rd order intermodulation distortion ()	>15 MHz: < -55 dBc (< -60 dBc typical) 9 kHz to 15 MHz: < -55 dBc (< -60 dBc typical)

Residual spurious response

< -78 dBm (< -84 dBm typical, ≤ -15 dBm reference level and RF input terminated with 50 Ω)

At 2.5 GHz	< -62 dBm (< -73 dBm typical)
At 1.25 GHz	< -76 dBm (< -82 dBm typical)
Adjacent channel power ratio dynamic range, typical	-58 dBc
Frequency measurement resolution	1 Hz
Span	Span adjustable in 1-2-5 sequence Variable Resolution = 1% of the next span setting
Level display range	Log scale and units: dBm, dBmV, dBμV, dBμW, dBmA, dBμA Measurement points: 1,000 Marker level readout resolution: log scale: 0.1 dB Maximum number of RF traces: 4 Trace functions: Maximum Hold; Average; Minimum Hold; Normal; Spectrogram Slice (Uses normal trace) Detectors: Positive-Peak, negative-peak, sample, average
Reference level	-140 dBm to +20 dBm in steps of 5 dBm
Vertical position	±100 divisions (displayed in dB)
Maximum operating input level	

Average continuous power +20 dBm (0.1 W)

DC maximum before damage ±40 V DC

Maximum power before damage (CW) +33 dBm (2 W)

Maximum power before damage (pulse) +45 dBm (32 W) (<10 µs pulse width, <1% duty cycle, and reference level of ≥ +10 dBm)

Resolution bandwidth accuracy

Maximum RBW % Error = ((0.5/(25 x WF)) * 100

WF represents the Window Factor and is set by the window method being used.

Method	WF	RBW error
Rectangular	0.89	2.25%
Hamming	1.30	1.54%
Hanning	1.44	1.39%
Blackman-Harris	1.90	1.05%
Kaiser	2.23	0.90%
Flat-Top	3.77	0.53%

Level measurement uncertainty

Reference level 10 dBm to -15 dBm. Input level ranging from reference level to 40 dB below reference level. Specifications exclude mismatch error.

18 °C to 28 °C

9 kHz-1.5 GHz < ±1 dBm (<±0.4 dBm typical)

1.5 GHz-2.5 GHz < ±1.3 dBm (<±0.6 dBm typical)

2.5 GHz-3 GHz < ±1.5 dBm (<±0.7 dBm typical)

Over operating range < ±2.0 dBm

Crosstalk to RF from analog channels, typical

< -60 dB from reference level (≤800 MHz instrument input frequencies)

< -40 dB from reference level (>800 MHz - 2 GHz instrument input frequencies)

Full scale amplitude with 50 Ω input and 100 mV/div vertical setting with direct input (no probes).

Arbitrary function generator characteristics

Function types Arbitrary, Sine, Square, Pulse, Ramp, Triangle, DC Level, Gaussian, Lorentz, Exponential Rise/Fall, Sine(x)/x, Random Noise, Haversine, Cardiac

Amplitude range Software selectable load impedance of 50 Ω or High Z. With 50 Ω, selected maximum amplitude is ±2.5 V. With High-Z, selected maximum amplitude is ±5 V.

Amplitude range Values are peak-to-peak voltages

Waveform	50 Ω	1 MΩ
Arbitrary	10 mV to 2.5 V	20 mV to 5 V
Sine	10 mV to 2.5 V	20 mV to 5 V

Table continued…

Waveform	50 Ω	1 MΩ
Square	10 mV to 2.5 V	20 mV to 5 V
Pulse	10 mV to 2.5 V	20 mV to 5 V
Ramp	10 mV to 2.5 V	20 mV to 5 V
Triangle	10 mV to 2.5 V	20 mV to 5 V
Gaussian	10 mV to 1.25 V	20 mV to 2.5 V
Lorentz	10 mV to 1.2 V	20 mV to 2.4 V
Exponential rise	10 mV to 1.25 V	20 mV to 2.5 V
Exponential fall	10 mV to 1.25 V	20 mV to 2.5 V
Sine(x)/x	10 mV to 1.5 V	20 mV to 3.0 V
Random noise	10 mV to 2.5 V	20 mV to 5 V
Haversine	10 mV to 1.25 V	20 mV to 2.5 V
Cardiac	10 mV to 2.5 V	20 mV to 5 V

Maximum sample rate 250 MS/s

Arbitrary Function record length 128 k samples

Sine waveform

- **Frequency range** 0.1 Hz to 50 MHz
- **Frequency setting resolution** 0.1 Hz
- **Amplitude range** 20 mV_{p-p} to 5 V_{p-p} into Hi-Z; 10 mV_{p-p} to 2.5 V_{p-p} into 50 Ω
- **Amplitude flatness (typical)** ±0.5 dB at 1 kHz (±1.5 dB for <20 mV_{p-p} amplitudes)
- **Total harmonic distortion (typical)** 1% into 50 Ω
  2% for amplitude < 50 mV and frequencies > 10 MHz
  3% for amplitude < 20 mV and frequencies > 10 MHz
- **Spurious free dynamic range (SFDR) (typical)** 40 dBc (V_{p-p} ≥ 0.1 V); 30 dBc (V_{p-p} ≤ 0.02 V), 50 Ω load

Square/Pulse waveform

- **Frequency range** 0.1 Hz to 25 MHz
- **Frequency setting resolution** 0.1 Hz
- **Amplitude range** 20 mV_{p-p} to 5 V_{p-p} into Hi-Z; 10 mV_{p-p} to 2.5 V_{p-p} into 50 Ω
- **Duty cycle** 10% to 90% or 10 ns minimum pulse, whichever is larger cycle
- **Duty cycle resolution** 0.1%
- **Pulse width minimum (typical)** 10 ns

Rise/fall time (typical)	5 ns (10% - 90%)
Pulse width resolution	100 ps
Overshoot (typical)	< 4% for signal steps greater than 100 mV_{pp}
Asymmetry	±1% ±5 ns, at 50% duty cycle
Jitter (TIE RMS) (typical)	< 500 ps 60 ps TIE RMS, ≥100 mV_{pp} amplitude, 40%-60% duty cycle

Ramp/Triangle waveform

Frequency range	0.1 Hz to 500 kHz
Frequency setting resolution	0.1 Hz
Variable symmetry	0% to 100%
Symmetry resolution	0.1%
DC level range, typical	±2.5 V in to Hi-Z; ±1.25 V into 50 Ω
Gaussian Pulse, Lorentz Pulse, Haversine maximum frequency	5 MHz
Exponential Rise/Fall maximum frequency	5 MHz
Sine(X)/X maximum frequency	2 MHz
Random noise amplitude range	20 mV_{p-p} to 5 V_{p-p} into Hi-Z; 10 mV_{p-p} to 2.5 V_{p-p} into 50 Ω
✓ **Sine and ramp frequency accuracy**	130 ppm (frequency ≤10 kHz); 50ppm (frequency >10 kHz)
✓ **Square and pulse frequency accuracy**	130 ppm (frequency ≤10 kHz); 50ppm (frequency >10 kHz)
Signal amplitude resolution	500 uV (50 Ω) 1 mV (Hi-Z)
✓ **Signal amplitude accuracy**	±[(1.5% of peak-to-peak amplitude setting) + (1.5% of absolute DC offset setting) + 1 mV] (frequency = 1 kHz)
DC Offset Range	±2.5 V into Hi-Z ±1.25 V into 50 Ω
DC offset resolution	500 uV (50 Ω) 1 mV (Hi-Z)
✓ **DC Offset Accuracy**	±[(1.5% of absolute offset voltage setting) + 1 mV] Add 3 mV of uncertainty per 10 °C change from 25 °C ambient
Cardiac maximum frequency	500 kHz

Random noise waveform

Amplitude range	20 mV_{p-p} to 5 V_{p-p} in to Hi-Z; 10 mV_{p-p} to 2.5 V_{p-p} into 50 Ω
Amplitude resolution	0% to 100% in 1% increments

✓ **Sine and ramp frequency accuracy**	130 ppm (frequency ≤10 kHz); 50 ppm (frequency > 10 kHz)
✓ **Square and pulse frequency accuracy**	130 ppm (frequency ≤10 kHz); 50 ppm (frequency > 10 kHz)
Signal amplitude resolution	500 µV (50 Ω) 1 mV (Hi-Z)
✓ **Signal amplitude accuracy**	±[(1.5% of peak-to-peak amplitude setting) + (1.5% of DC offset setting) + 1 mV] (frequency = 1 kHz)

DC offset

DC offset range	±2.5 V into Hi-Z; ±1.25 V into 50 Ω
DC offset resolution	1 mV into Hi-Z; 500 uV into 50 Ω
DC offset accuracy	±[(1.5% of absolute offset voltage setting) + 1 mV] Add 3 mV for every 10 °C change from 25 °C

AM/FM Modulation characteristics

Carrier Waveform	All except Pulse, Noise, DC, and Cardiac
Internal modulating waveform	Sine, Square, Triangle, Down Ramp, Up Ramp, Noise
Internal modulating frequency	100 mHz to 50 kHz
AM modulation depth	0.0% to 100.0%
Min FM peak deviation	DC
Max FM peak deviation	

Output Function	Max Deviation Frequency
ARB	12.5 MHz
Sine	25 MHz
Square	12.5 MHz
Ramp	250 kHz
Sinc	1 MHz
Other	2.5 MHz

Digital voltmeter and counter

Measurement types — AC_{rms}, DC_{rms}, $AC+DC_{rms}$ (reads out in volts or amps); frequency count

✓ **Voltage accuracy**

DC

±(2 mV + [(((4 * (Vertical scale voltage)) / (Absolute input voltage)) + 1)% of Absolute input voltage] + (0.5% of Absolute offset voltage))

Example: an input channel set up with +2 V offset and 1 V/div measuring a –5 V signal would have ±(2 mV + [(((4 * 1) / 5) + 1)% of 5 V] + [0.5% of 2 V]) = ±(2 mV + [1.8% of 5 V] + [0.5% of 2 V]) = ±(2 mV + 90 mV + 10 mV) = ±102 mV. This is roughly ±2% of the input voltage.

AC	±2% (40 Hz to 1 kHz) ±2% (20 Hz to 10 kHz) typical For AC measurements, the input channel vertical settings must allow the V_{pp} input signal to cover between 4 and 8 divisions.
Resolution	Voltage: 4 digits Frequency: 5 digits
✓ **Frequency accuracy**	±(10 µHz/Hz + 1 count)
Frequency counter maximum input frequency	100 MHz for 100 MHz models 150 MHz for all other models Trigger Sensitivity limits must be observed for reliable frequency measurements.

Performance verification

This chapter contains performance verification procedures for the specifications marked with the ✓ symbol. The following equipment, or a suitable equivalent, is required to complete these procedures.

Table 3: Required equipment

Description	Minimum requirements	Examples
DC voltage source	3 mV to 100 V, ±0.1% accuracy	Fluke 9500B Oscilloscope Calibrator with a 9530 Output Module An appropriate BNC-to-0.1 inch pin adapter between the Fluke 9530 and P6316 probe
Leveled sine wave generator	9 kHz to 3,000 MHz, ±4% amplitude accuracy	
Time mark generator	80 ms period, ±1 ppm accuracy, rise time < 50 ns	
50 Ω BNC cable	Male-to-male connectors	Tektronix part number 012-0057-01 (43 inch)
BNC feed-through termination	50 Ω	Tektronix part number 011-0049-02
RF signal generator	9 kHz to 3 GHz, –20 dBm to +10 dBm	Anritsu MG3690C series with options 2, 3, 4, 15, 22
Power meter	Use with Power sensor	Rhode & Schwarz NRX
Power sensor	–30 dBm to +10 dBm	Rhode & Schwarz NRP-Z98
Frequency counter	0.1 Hz to 50 MHz, 5 ppm accuracy	Tektronix FCA3000
DMM	DC Voltage: 0.1% accuracy AC RMS Voltage: 0.2% accuracy	Tektronix DMM4040

You may need additional cables and adapters, depending on the actual test equipment you use.

These procedures cover all 3 Series MDO models. Please disregard any checks that do not apply to the specific model you are testing.

Print the test record on the following pages and use it to record the performance test results for your oscilloscope.

⚠ **Note:** Completion of the performance verification procedure does not update the stored time and date of the latest successful adjustment. The date and time are updated only when the adjustment procedures in the service manual are successfully completed.

The performance verification procedures verify the performance of your instrument. They do not adjust your instrument. If your instrument fails any of the performance verification tests, you should consult the factory adjustment procedures described in the *3 Series MDO Service Manual*.

Upgrade the Firmware

For the best functionality, you can upgrade the oscilloscope firmware.

To upgrade the firmware of the oscilloscope:

1. Open up a Web browser and go to www.tektronix.com/software/downloads. Proceed to the software finder. Download the latest firmware for your oscilloscope on your PC.
2. Unzip the files and copy the firmware.img file into the root folder of a USB flash drive or USB hard drive.
3. Power off your oscilloscope.

4. Insert the USB flash or hard drive into the USB port on the front panel of your oscilloscope.
5. Power on the oscilloscope. The instrument automatically recognizes the replacement firmware and installs it.

   ⚠ **Note:** Do not power off the oscilloscope or remove the USB drive until the oscilloscope finishes installing the firmware.

   If the instrument does not install the firmware, rerun the procedure. If the problem continues, try a different model of USB flash or hard drive. Finally, if needed, contact qualified service personnel.
6. When the upgrade is complete, power off the oscilloscope and remove the USB flash or hard drive.
7. Power on the oscilloscope.
8. Tap **Help** and select **About**. The oscilloscope displays the firmware version number.
9. Confirm that the version number matches that of the new firmware.

Test Record

Print this section for use during the Performance Verification.

Model number	Serial number	Procedure performed by	Date

Test	Passed	Failed
Self Test		

Input Termination Tests

Input Termination Tests

Input Impedance				
Performance checks	Vertical scale	Low limit	Test result	High limit
Channel 1				
Channel 1 Input Impedance, 1 MΩ	10 mV/div	990 kΩ		1.01 MΩ
	100 mV/div	990 kΩ		1.01 MΩ
Channel 1 Input Impedance, 50 Ω	10 mV/div	49.5 Ω		50.5 Ω
	100 mV/div	49.5 Ω		50.5 Ω
Channel 2				
Channel 2 Input Impedance, 1 MΩ	10 mV/div	990 kΩ		1.01 MΩ
	100 mV/div	990 kΩ		1.01 MΩ

Table continued…

Input Impedance				
Performance checks	Vertical scale	Low limit	Test result	High limit
Channel 2 Input Impedance, 50 Ω	10 mV/div	49.5 Ω		50.5 Ω
	100 mV/div	49.5 Ω		50.5 Ω
Channel 3 [3]				
Channel 3 Input Impedance, 1 MΩ	10 mV/div	990 kΩ		1.01 MΩ
	100 mV/div	990 kΩ		1.01 MΩ
Channel 3 Input Impedance, 50 Ω	10 mV/div	49.5 Ω		50.5 Ω
	100 mV/div	49.5 Ω		50.5 Ω
Channel 4 [3]				
Channel 4 Input Impedance, 1 MΩ	10 mV/div	990 kΩ		1.01 MΩ
	100 mV/div	990 kΩ		1.01 MΩ
Channel 4, Input Impedance, 50 Ω	10 mV/div	49.5 Ω		50.5 Ω
	100 mV/div	49.5 Ω		50.5 Ω

DC Balance Tests

DC Balance Tests				
Performance checks	Vertical scale	Low limit (div)	Test result	High limit (div)
Channel 1				
Channel 1 DC Balance, 50 Ω, 20 MHz BW	1 mV/div	–0.500		0.500
	2 mV/div	–0.250		0.250
	10 mV/div	–0.200		0.200
	100 mV/div	–0.200		0.200
	1 V/div	–0.200		0.200

Table continued…

3 Channels 3 and 4 are only on four-channel oscilloscopes.

DC Balance Tests				
Performance checks	Vertical scale	Low limit (div)	Test result	High limit (div)
Channel 1 DC Balance, 1 MΩ, 20 MHz BW	1 mV/div	–0.300		0.300
	2 mV/div	–0.200		0.200
	10 mV/div	–0.200		0.200
	100 mV/div	–0.200		0.200
	1 V/div	–0.200		0.200
Channel 1 DC Balance, 50 Ω, 250 MHz BW	1 mV/div	–0.500		0.500
	2 mV/div	–0.250		0.250
	10 mV/div	–0.200		0.200
	100 mV/div	–0.200		0.200
	1 V/div	–0.200		0.200
Channel 1 DC Balance, 1 MΩ, 250 MHz BW	1 mV/div	–0.300		0.300
	2 mV/div	–0.200		0.200
	10 mV/div	–0.200		0.200
	100 mV/div	–0.200		0.200
	1 V/div	–0.200		0.200
Channel 1 DC Balance, 50 Ω, Full BW	1 mV/div	–0.500		0.500
	2 mV/div	–0.250		0.250
	10 mV/div	–0.200		0.200
	100 mV/div	–0.200		0.200
	1 V/div	–0.200		0.200

Table continued…

DC Balance Tests				
Performance checks	Vertical scale	Low limit (div)	Test result	High limit (div)
Channel 1 DC Balance, 1 MΩ, Full BW	1 mV/div	–0.300		0.300
	2 mV/div	–0.200		0.200
	10 mV/div	–0.200		0.200
	100 mV/div	–0.200		0.200
	1 V/div	–0.200		0.200
Channel 2				
Channel 2 DC Balance, 50 Ω, 20 MHz BW	1 mV/div	–0.500		0.500
	2 mV/div	–0.250		0.250
	10 mV/div	–0.200		0.200
	100 mV/div	–0.200		0.200
	1 V/div	–0.200		0.200
Channel 2 DC Balance, 1 MΩ, 20 MHz BW	1 mV/div	–0.300		0.300
	2 mV/div	–0.200		0.200
	10 mV/div	–0.200		0.200
	100 mV/div	–0.200		0.200
	1 V/div	–0.200		0.200
Channel 2 DC Balance, 50 Ω, 250 MHz BW	1 mV/div	–0.500		0.500
	2 mV/div	–0.250		0.250
	10 mV/div	–0.200		0.200
	100 mV/div	–0.200		0.200
	1 V/div	–0.200		0.200

Table continued…

DC Balance Tests				
Performance checks	Vertical scale	Low limit (div)	Test result	High limit (div)
Channel 2 DC Balance 1 MΩ, 250 MHz BW	1 mV/div	–0.300		0.300
	2 mV/div	–0.2000		0.200
	10 mV/div	–0.200		0.200
	100 mV/div	–0.200		0.200
	1 V/div	–0.200		0.200
Channel 2 DC Balance, 50 Ω, Full BW	1 mV/div	–0.500		0.500
	2 mV/div	–0.250		0.250
	10 mV/div	–0.200		0.200
	100 mV/div	–0.200		0.200
	1 V/div	–0.200		0.200
Channel 2 DC Balance, 1 MΩ, Full BW	1 mV/div	–0.300		0.300
	2 mV/div	–0.200		0.200
	10 mV/div	–0.200		0.200
	100 mV/div	–0.200		0.200
	1 V/div	–0.200		0.200
Channel 3 [3]				
Channel 3 DC Balance, 50 Ω, 20 MHz BW	1 mV/div	–0.500		0.500
	2 mV/div	–0.250		0.250
	10 mV/div	–0.200		0.200
	100 mV/div	–0.200		0.200
	1 V/div	–0.200		0.200

Table continued…

DC Balance Tests				
Performance checks	Vertical scale	Low limit (div)	Test result	High limit (div)
Channel 3 DC Balance, 1 MΩ, 20 MHz BW	1 mV/div	–0.300		0.300
	2 mV/div	–0.200		0.200
	10 mV/div	–0.200		0.200
	100 mV/div	–0.200		0.200
	1 V/div	–0.200		0.200
Channel 3 DC Balance, 50 Ω, 250 MHz BW	1 mV/div	–0.500		0.500
	2 mV/div	–0.250		0.250
	10 mV/div	–0.200		0.200
	100 mV/div	–0.200		0.200
	1 V/div	–0.200		0.200
Channel 3 DC Balance, 1 MΩ, 250 MHz BW	1 mV/div	–0.300		0.300
	2 mV/div	–0.200		0.200
	10 mV/div	–0.200		0.200
	100 mV/div	–0.200		0.200
	1 V/div	–0.200		0.200
Channel 3 DC Balance, 50 Ω, Full BW	1 mV/div	–0.500		0.500
	2 mV/div	–0.250		0.250
	10 mV/div	–0.200		0.200
	100 mV/div	–0.200		0.200
	1 V/div	–0.200		0.200

Table continued…

DC Balance Tests				
Performance checks	Vertical scale	Low limit (div)	Test result	High limit (div)
Channel 3 DC Balance, 1 MΩ, Full BW	1 mV/div	–0.300		0.300
	2 mV/div	–0.200		0.200
	10 mV/div	–0.200		0.200
	100 mV/div	–0.200		0.200
	1 V/div	–0.200		0.200
Channel 4 [3]				
Channel 4 DC Balance, 50 Ω, 20 MHz BW	1 mV/div	–0.500		0.500
	2 mV/div	–0.250		0.250
	10 mV/div	–0.200		0.200
	100 mV/div	–0.200		0.200
	1 V/div	–0.200		0.200
Channel 4 DC Balance, 1 MΩ, 20 MHz BW	1 mV/div	–0.300		0.300
	2 mV/div	–0.200		0.200
	10 mV/div	–0.200		0.200
	100 mV/div	–0.200		0.200
	1 V/div	–0.200		0.200
Channel 4 DC Balance, 50 Ω, 250 MHz BW	1 mV/div	–0.500		0.500
	2 mV/div	–0.250		0.250
	10 mV/div	–0.200		0.200
	100 mV/div	–0.200		0.200
	1 V/div	–0.200		0.200

Table continued…

DC Balance Tests				
Performance checks	Vertical scale	Low limit (div)	Test result	High limit (div)
Channel 4 DC Balance, 1 MΩ, 250 MHz BW	1 mV/div	–0.300		0.300
	2 mV/div	–0.2000		0.200
	10 mV/div	–0.200		0.200
	100 mV/div	–0.200		0.200
	1 V/div	–0.200		0.200
Channel 4 DC Balance, 50 Ω, Full BW	1 mV/div	–0.500		0.500
	2 mV/div	–0.250		0.250
	10 mV/div	–0.200		0.200
	100 mV/div	–0.200		0.200
	1 V/div	–0.200		0.200
Channel 4 DC Balance, 1 MΩ, Full BW	1 mV/div	–0.300		0.300
	2 mV/div	–0.200		0.200
	10 mV/div	–0.200		0.200
	100 mV/div	–0.200		0.200
	1 V/div	–0.200		0.200

Analog Bandwidth Tests 50

Analog Bandwidth 50 Ω						
Bandwidth at Channel	Termination	Vertical scale	V_{in-pp}	V_{bw-pp}	Limit	Test result *Gain* = $V_{bw\text{--}pp}/V_{in\text{--}pp}$
1	50 Ω	10 mV/div			≥ 0.707	
	50 Ω	5 mV/div			≥ 0.707	
	50 Ω	2 mV/div			≥ 0.707	
	50 Ω	1 mV/div			≥ 0.707	

Table continued…

Analog Bandwidth 50 Ω						
Bandwidth at Channel	Termination	Vertical scale	V_{in-pp}	V_{bw-pp}	Limit	Test result *Gain* = *V* $_{bw--pp}$/V_{in--pp}
2	50 Ω	10 mV/div			≥ 0.707	
	50 Ω	5 mV/div			≥ 0.707	
	50 Ω	2 mV/div			≥ 0.707	
	50 Ω	1 mV/div			≥ 0.707	
3 [3]	50 Ω	10 mV/div			≥ 0.707	
	50 Ω	5 mV/div			≥ 0.707	
	50 Ω	2 mV/div			≥ 0.707	
	50 Ω	1 mV/div			≥ 0.707	
4 [3]	50 Ω	10 mV/div			≥ 0.707	
	50 Ω	5 mV/div			≥ 0.707	
	50 Ω	2 mV/div			≥ 0.707	
	50 Ω	1 mV/div			≥ 0.707	

DC Gain Accuracy Tests

DC Gain Accuracy				
Performance checks	Vertical scale	Low limit	Test result	High limit
Channel 1 0 V offset, 0 V vertical position, 20 MHz BW, 1 MΩ	1 mV/div	–2.5%		2.5%
	2 mV/div	–2.0%		2.0%
	4.98 mV/div	–3.0%		3.0%
	5 mV/div	–1.5%		1.5%
	10 mV/div	–1.5%		1.5%
	20 mV/div	–1.5%		1.5%
	49.8 mV	–3.0%		3.0%
	50 mV/div	–1.5%		1.5%
	100 mV/div	–1.5%		1.5%
	200 mV/div	–1.5%		1.5%
	500 mV/div	–1.5%		1.5%
	1 V/div	–1.5%		1.5%

Table continued…

DC Gain Accuracy				
Performance checks	Vertical scale	Low limit	Test result	High limit
Channel 2 0 V offset, 0 V vertical position, 20 MHz BW, 1 MΩ	1 mV/div	–2.5%		2.5%
	2 mV/div	–2.0%		2.0%
	4.98 mV/div	–3.0%		3.0%
	5 mV/div	–1.5%		1.5%
	10 mV/div	–1.5%		1.5%
	20 mV/div	–1.5%		1.5%
	49.8 mV	–3.0%		3.0%
	50 mV/div	–1.5%		1.5%
	100 mV/div	–1.5%		1.5%
	200 mV/div	–1.5%		1.5%
	500 mV/div	–1.5%		1.5%
	1 V/div	–1.5%		1.5%
Channel 3 [3] 0 V offset, 0 V vertical position, 20 MHz BW, 1 MΩ	1 mV/div	–2.5%		2.5%
	2 mV/div	–2.0%		2.0%
	4.98 mV/div	–3.0%		3.0%
	5 mV/div	–1.5%		1.5%
	10 mV/div	–1.5%		1.5%
	20 mV/div	–1.5%		1.5%
	49.8 mV	–3.0%		3.0%
	50 mV/div	–1.5%		1.5%
	100 mV/div	–1.5%		1.5%
	200 mV/div	–1.5%		1.5%
	500 mV/div	–1.5%		1.5%
	1 V/div	–1.5%		1.5%

Table continued…

DC Gain Accuracy				
Performance checks	Vertical scale	Low limit	Test result	High limit
Channel 4 [3] 0 V offset, 0 V vertical position, 20 MHz BW, 1 MΩ	1 mV/div	–2.5%		2.5%
	2 mV/div	–2.0%		2.0%
	4.98 mV/div	–3.0%		3.0%
	5 mV/div	–1.5%		1.5%
	10 mV/div	–1.5%		1.5%
	20 mV/div	–1.5%		1.5%
	49.8 mV	–3.0%		3.0%
	50 mV/div	–1.5%		1.5%
	100 mV/div	–1.5%		1.5%
	200 mV/div	–1.5%		1.5%
	500 mV/div	–1.5%		1.5%
	1 V/div	–1.5%		1.5%

DC Offset Accuracy Tests

DC Offset Accuracy					
Performance checks	Vertical scale	Vertical offset	Low limit	Test result	High limit
All models					

Table continued…

DC Offset Accuracy					
Performance checks	Vertical scale	Vertical offset	Low limit	Test result	High limit
Channel 1 20 MHz BW, 1 MΩ	1 mV/div	700 mV	696.2 mV		703.8 mV
	1 mV/div	–700 mV	–703.8 mV		–696.2 mV
	2 mV/div	700 m	696.1 mV		703.9 mV
	2 mV/div	–700 mV	–703.9 mV		–696.1 mV
	10 mV/div	1 V	993 mV		1007 mV
	10 mV/div	–1 V	–1007 mV		–993 mV
	100 mV/div	10.0 V	9.930 V		10.07 V
	100 mV/div	–10.0 V	–10.07 V		–9.930 V
	1 V/div	100 V	99.30 V		100.7 V
	1 V/div	–100 V	–100.7 V		–99.30 V
	1.01 V/div	100 V	99.30 V		100.7 V
	1.01 V/div	–100 V	–100.7 V		–99.30 V
Channel 2 20 MHz BW, 1 MΩ	1 mV/div	700 mV	696.2 mV		703.8 mV
	1 mV/div	–700 mV	–703.8 mV		–696.2 mV
	2 mV/div	700 mV	696.1 mV		703.9 mV
	2 mV/div	–700 mV	–703.9 mV		–696.1 mV
	10 mV/div	1 V	993 mV		1007 mV
	10 mV/div	–1 V	–1007 mV		–993 mV
	100 mV/div	10.0 V	9.930 V		10.07 V
	100 mV/div	–10.0 V	–10.07 V		–9.930 V
	1 V/div	100 V	99.30 V		100.7 V
	1 V/div	–100 V	–100.7 V		–99.30 V
	1.01 V/div	100 V	99.30 V		100.7 V
	1.01 V/div	–100 V	–100.7 V		–99.30 V

Table continued…

DC Offset Accuracy					
Performance checks	Vertical scale	Vertical offset	Low limit	Test result	High limit
Channel 3 [3] 20 MHz BW, 1 MΩ	1 mV/div	700 mV	696.2 mV		703.8 mV
	1 mV/div	–700 mV	-703.8 mV		–696.2 mV
	2 mV/div	700 mV	696.1 mV		703.9 mV
	2 mV/div	–700 mV	–703.9 mV		–696.1 mV
	10 mV/div	1 V	993 mV		1007 mV
	10 mV/div	–1 V	–1007 mV		–993 mV
	100 mV/div	10.0 V	9.930 V		10.07 V
	100 mV/div	–10.0 V	–10.07 V		–9.930 V
	1 V/div	100 V	99.30 V		100.7 V
	1 V/div	–100 V	–100.7 V		–99.30 V
	1.01 V/div	100 V	99.30 V		100.7 V
	1.01 V/div	–100 V	–100.7 V		–99.30 V
Channel 4 [3] 20 MHz BW, 1 MΩ	1 mV/div	700 mV	696.2 mV		703.8 mV
	1 mV/div	–700 mV	–703.8 mV		–696.2 mV
	2 mV/div	700 mV	696.1 mV		703.9 mV
	2 mV/div	–700 mV	–703.9 mV		–696.1 mV
	10 mV/div	1 V	993 mV		1007 mV
	10 mV/div	–1 V	–1007 mV		–993 mV
	100 mV/div	10.0 V	9.930 V		10.07 V
	100 mV/div	–10.0 V	–10.07 V		–9.930 V
	1 V/div	100 V	99.30 V		100.7 V
	1 V/div	–100 V	–100.7 V		–99.30 V
	1.01 V/div	100 V	99.30 V		100.7 V
	1.01 V/div	–100 V	–100.7 V		–99.30 V

Sample Rate and Delay Time Accuracy

Sample Rate and Delay Time Accuracy			
Performance checks	Low limit	Test result	High limit
Sample Rate and Delay Time Accuracy	–2 division		+2 division

Random Noise, Sample Acquisition Mode Tests

Random Noise, Sample Acquisition Mode		Bandwidth Selection	Test result	High limit
For 1 GHz bandwidth instruments at 100 mV/div	Channel 1	Full		3.1 mV
		250 MHz		3.4 mV
		20 MHz		3.4 mV
	Channel 2	Full		3.1 mV
		250 MHz		3.4 mV
		20 MHz		3.4 mV
	Channel 3 [3]	Full		3.1 mV
		250 MHz		3.4 mV
		20 MHz		3.4 mV
	Channel 4 [3]	Full		3.4 mV
		250 MHz		3.4 mV
		20 MHz		3.4 mV

Table continued…

Random Noise, Sample Acquisition Mode		Bandwidth Selection	Test result	High limit
For 500 MHz bandwidth instruments 100 mV/div at 100 mV/div	Channel 1	Full		3.1 mV
		250 MHz		3.3 mV
		20 MHz		3.25 mV
	Channel 2	Full		3.1 mV
		250 MHz		3.3 mV
		20 MHz		3.25 mV
	Channel 3 [3]	Full		3.1 mV
		250 MHz		3.3 mV
		20 MHz		3.25 mV
	Channel 4 [3]	Full		3.1 mV
		250 MHz		3.3 mV
		20 MHz		3.25 mV
For 350 MHz bandwidth instruments at 100 mV/div	Channel 1	Full		3.3 mV
		250 MHz		3.3 mV
		20 MHz		3.25 mV
	Channel 2	Full		3.3 mV
		250 MHz		3.3 mV
		20 MHz		3.25 mV
	Channel 3 [3]	Full		3.3 mV
		250 MHz		3.3 mV
		20 MHz		3.25 mV
	Channel 4 [3]	Full		3.3 mV
		250 MHz		3.3 mV
		20 MHz		3.25 mV

Table continued…

Random Noise, Sample Acquisition Mode		Bandwidth Selection	Test result	High limit
For 200 MHz bandwidth instruments at 100 mV/div	Channel 1	Full		3.25 mV
		20 MHz		3.25 mV
	Channel 2	Full		3.25 mV
		20 MHz		3.25 mV
	Channel 3	Full		3.25 mV
		20 MHz		3.25 mV
	Channel 4	Full		3.25 mV
		20 MHz		3.25 mV
For 100 MHz bandwidth instruments at 100 mV/div	Channel 1	Full		2.85 mV
		20 MHz		3.25 mV
	Channel 2	Full		2.85 mV
		20 MHz		3.25 mV
	Channel 3 [3]	Full		2.85 mV
		20 MHz		3.25 mV
	Channel 4 [3]	Full		2.85 mV
		20 MHz		3.25 mV

Delta Time Measurement Accuracy Tests

Delta Time Measurement Accuracy, < 1 GHz instruments				
Channel 1				
	MDO = 4 ns/Div, Source frequency = 240 MHz (does not apply to 100 and 200 MHz models)			
	MDO V/Div	**Source V pp**	**Test Result**	**High Limit**
	100 mV	800 mV		233 ps
	500 mV	4 V		233 ps
	1 V	4 V		237 ps

Table continued…

Delta Time Measurement Accuracy, < 1 GHz instruments				
	MDO = 40 ns/Div, Source frequency = 24 MHz			
	MDO V/Div	**Source V pp**	**Test Result**	**High Limit**
	5 mV	40 mV		435 ps
	100 mV	800 mV		359 ps
	500 mV	4 V		356 ps
	1 V	4 V		583 ps
	MDO = 400 ns/Div, Source frequency = 2.4 MHz			
	MDO V/Div	**Source V pp**	**Test Result**	**High Limit**
	5 mV	40 mV		3.69 ns
	100 mV	800 mV		2.75 ns
	500 mV	4 V		2.71 ns
	1 V	4 V		5.36 ns
	MDO = 4 μs/Div, Source frequency = 240 kHz			
	MDO V/Div	**Source V pp**	**Test Result**	**High Limit**
	5 mV	40 mV		36.8 ns
	100 mV	800 mV		27.4 ns
	500 mV	4 V		27.0 ns
	1 V	4 V		53.5 ns
	MDO = 40 μs/Div, Source frequency = 24 kHz			
	MDO V/Div	**Source V pp**	**Test Result**	**High Limit**
	5 mV	40 mV		368 ns
	100 mV	800 mV		274 ns
	500 mV	4 V		270 ns
	1 V	4 V		535 ns
	MDO = 400 μs/Div, Source frequency = 2.4 kHz			

Table continued…

Delta Time Measurement Accuracy, < 1 GHz instruments				
	MDO V/Div	**Source V pp**	**Test Result**	**High Limit**
	5 mV	40 mV		3.68 µs
	100 mV	800 mV		2.74 µs
	500 mV	4 V		2.70 µs
	1 V	4 V		5.35 µs
Channel 2				
	MDO = 4 ns/Div, Source frequency = 240 MHz (does not apply to 100 and 200 MHz models)			
	MDO V/Div	**Source V pp**	**Test Result**	**High Limit**
	100 mV	800 mV		233 ps
	500 mV	4 V		233 ps
	1 V	4 V		237 ps
	MDO = 40 ns/Div, Source frequency = 24 MHz			
	MDO V/Div	**Source V pp**	**Test Result**	**High Limit**
	5 mV	40 mV		435 ps
	100 mV	800 mV		359 ps
	500 mV	4 V		356 ps
	1 V	4 V		583 ps
	MDO = 400 ns/Div, Source frequency = 2.4 MHz			
	MDO V/Div	**Source V pp**	**Test Result**	**High Limit**
	5 mV	40 mV		3.69 ns
	100 mV	800 mV		2.75 ns
	500 mV	4 V		2.71 ns
	1 V	4 V		5.36 ns
	MDO = 4 µs/Div, Source frequency = 240 kHz			
	MDO V/Div	**Source V pp**	**Test Result**	**High Limit**

Table continued…

Delta Time Measurement Accuracy, < 1 GHz instruments				
	5 mV	40 mV		36.8 ns
	100 mV	800 mV		27.4 ns
	500 mV	4 V		27.0 ns
	1 V	4 V		53.5 ns
	MDO = 40 µs/Div, Source frequency = 24 kHz			
	MDO V/Div	**Source V pp**	**Test Result**	**High Limit**
	5 mV	40 mV		368 ns
	100 mV	800 mV		274 ns
	500 mV	4 V		270 ns
	1 V	4 V		535 ns
	MDO = 400 µs/Div, Source frequency = 2.4 kHz			
	MDO V/Div	**Source V pp**	**Test Result**	**High Limit**
	5 mV	40 mV		3.68 µs
	100 mV	800 mV		2.74 µs
	500 mV	4 V		2.70 µs
	1 V	4 V		5.35 µs
Channel 3 [3]				
	MDO = 4 ns/Div, Source frequency = 240 MHz (does not apply to 100 and 200 MHz models)			
	MDO V/Div	**Source V pp**	**Test Result**	**High Limit**
	100 mV	800 mV		233 ps
	500 mV	4 V		233 ps
	1 V	4 V		237 ps
	MDO = 40 ns/Div, Source frequency = 24 MHz			
	MDO V/Div	**Source V pp**	**Test Result**	**High Limit**
	5 mV	40 mV		435 ps

Table continued…

Delta Time Measurement Accuracy, < 1 GHz instruments				
	100 mV	800 mV		359 ps
	500 mV	4 V		356 ps
	1 V	4 V		583 ps
	MDO = 400 ns/Div, Source frequency = 2.4 MHz			
	MDO V/Div	**Source V pp**	**Test Result**	**High Limit**
	5 mV	40 mV		3.69 ns
	100 mV	800 mV		2.75 ns
	500 mV	4 V		2.71 ns
	1 V	4 V		5.36 ns
	MDO = 4 µs/Div, Source frequency = 240 kHz			
	MDO V/Div	**Source V pp**	**Test Result**	**High Limit**
	5 mV	40 mV		36.8 ns
	100 mV	800 mV		27.4 ns
	500 mV	4 V		27.0 ns
	1 V	4 V		53.5 ns
	MDO = 40 µs/Div, Source frequency = 24 kHz			
	MDO V/Div	**Source V pp**	**Test Result**	**High Limit**
	5 mV	40 mV		368 ns
	100 mV	800 mV		274 ns
	500 mV	4 V		270 ns
	1 V	4 V		535 ns
	MDO = 400 µs/Div, Source frequency = 2.4 kHz			
	MDO V/Div	**Source V pp**	**Test Result**	**High Limit**
	5 mV	40 mV		3.68 µs
	100 mV	800 mV		2.74 µs

Table continued…

Delta Time Measurement Accuracy, < 1 GHz instruments				
	500 mV	4 V		2.70 μs
	1 V	4 V		5.35 μs
Channel 4 [3]				
	MDO = 4 ns/Div, Source frequency = 240 MHz (does not apply to 100 and 200 MHz models)			
	MDO V/Div	**Source V pp**	**Test Result**	**High Limit**
	100 mV	800 mV		233 ps
	500 mV	4 V		233 ps
	1 V	4 V		237 ps
	MDO = 40 ns/Div, Source frequency = 24 MHz			
	MDO V/Div	**Source V pp**	**Test Result**	**High Limit**
	5 mV	40 mV		435 ps
	100 mV	800 mV		359 ps
	500 mV	4 V		356 ps
	1 V	4 V		583 ps
	MDO = 400 ns/Div, Source frequency = 2.4 MHz			
	MDO V/Div	**Source V pp**	**Test Result**	**High Limit**
	5 mV	40 mV		3.69 ns
	100 mV	800 mV		2.75 ns
	500 mV	4 V		2.71 ns
	1 V	4 V		5.36 ns
	MDO = 4 μs/Div, Source frequency = 240 kHz			
	MDO V/Div	**Source V pp**	**Test Result**	**High Limit**
	5 mV	40 mV		36.8 ns
	100 mV	800 mV		27.4 ns
	500 mV	4 V		27.0 ns

Table continued…

Delta Time Measurement Accuracy, < 1 GHz instruments				
	1 V	4 V		53.5 ns
	MDO = 40 µs/Div, Source frequency = 24 kHz			
	MDO V/Div	**Source V pp**	**Test Result**	**High Limit**
	5 mV	40 mV		368 ns
	100 mV	800 mV		274 ns
	500 mV	4 V		270 ns
	1 V	4 V		535 ns
	MDO = 400 µs/Div, Source frequency = 2.4 kHz			
	MDO V/Div	**Source V pp**	**Test Result**	**High Limit**
	5 mV	40 mV		3.68 µs
	100 mV	800 mV		2.74 µs
	500 mV	4 V		2.70 µs
	1 V	4 V		5.35 µs

Delta Time Measurement Accuracy Tests

Delta Time Measurement Accuracy, 1 GHz instruments				
Channel 1				
	MDO = 4 ns/Div, Source frequency = 240 MHz			
	MDO V/Div	**Source V pp**	**Test Result**	**High Limit**
	100 mV	800 mV		119 ps
	500 mV	4 V		119 ps
	1 V	4 V		128 ps
	MDO = 40 ns/Div, Source frequency = 24 MHz			
	MDO V/Div	**Source V pp**	**Test Result**	**High Limit**
	5 mV	40 mV		386 ps

Table continued…

Delta Time Measurement Accuracy, 1 GHz instruments				
	100 mV	800 mV		298 ps
	500 mV	4 V		294 ps
	1 V	4 V		584 ps
	MDO = 400 ns/Div, Source frequency = 2.4 MHz			
	MDO V/Div	**Source V pp**	**Test Result**	**High Limit**
	5 mV	40 mV		3.69 ns
	100 mV	800 mV		2.75 ns
	500 mV	4 V		2.71 ns
	1 V	4 V		5.36 ns
	MDO = 4 µs/Div, Source frequency = 240 kHz			
	MDO V/Div	**Source V pp**	**Test Result**	**High Limit**
	5 mV	40 mV		36.8 ns
	100 mV	800 mV		27.4 ns
	500 mV	4 V		27.0 ns
	1 V	4 V		53.5 ns
	MDO = 40 µs/Div, Source frequency = 24 kHz			
	MDO V/Div	**Source V pp**	**Test Result**	**High Limit**
	5 mV	40 mV		368 ns
	100 mV	800 mV		274 ns
	500 mV	4 V		270 ns
	1 V	4 V		535 ns
	MDO = 400 µs/Div, Source frequency = 2.4 kHz			
	MDO V/Div	**Source V pp**	**Test Result**	**High Limit**
	5 mV	40 mV		3.68 µs
	100 mV	800 mV		2.74 µs

Table continued…

Delta Time Measurement Accuracy, 1 GHz instruments				
	500 mV	4 V		2.70 µs
	1 V	4 V		5.35 µs
Channel 2				
	MDO = 4 ns/Div, Source frequency = 240 MHz			
	MDO V/Div	**Source V pp**	**Test Result**	**High Limit**
	100 mV	800 mV		119 ps
	500 mV	4 V		119 ps
	1 V	4 V		128 ps
	MDO = 40 ns/Div, Source frequency = 24 MHz			
	MDO V/Div	**Source V pp**	**Test Result**	**High Limit**
	5 mV	40 mV		386 ps
	100 mV	800 mV		298 ps
	500 mV	4 V		294 ps
	1 V	4 V		584 ps
	MDO = 400 ns/Div, Source frequency = 2.4 MHz			
	MDO V/Div	**Source V pp**	**Test Result**	**High Limit**
	5 mV	40 mV		3.69 ns
	100 mV	800 mV		2.75 ns
	500 mV	4 V		2.71 ns
	1 V	4 V		5.36 ns
	MDO = 4 µs/Div, Source frequency = 240 kHz			
	MDO V/Div	**Source V pp**	**Test Result**	**High Limit**
	5 mV	40 mV		36.8 ns
	100 mV	800 mV		27.4 ns
	500 mV	4 V		27.0 ns

Table continued…

Delta Time Measurement Accuracy, 1 GHz instruments				
	1 V	4 V		53.5 ns
	MDO = 40 µs/Div, Source frequency = 24 kHz			
	MDO V/Div	**Source V pp**	**Test Result**	**High Limit**
	5 mV	40 mV		368 ns
	100 mV	800 mV		274 ns
	500 mV	4 V		270 ns
	1 V	4 V		535 ns
	MDO = 400 µs/Div, Source frequency = 2.4 kHz			
	MDO V/Div	**Source V pp**	**Test Result**	**High Limit**
	5 mV	40 mV		3.68 µs
	100 mV	800 mV		2.74 µs
	500 mV	4 V		2.70 µs
	1 V	4 V		5.35 µs
Channel 3 [3]				
	MDO = 4 ns/Div, Source frequency = 240 MHz			
	MDO V/Div	**Source V pp**	**Test Result**	**High Limit**
	100 mV	800 mV		119 ps
	500 mV	4 V		119 ps
	1 V	4 V		128 ps
	MDO = 40 ns/Div, Source frequency = 24 MHz			
	MDO V/Div	**Source V pp**	**Test Result**	**High Limit**
	5 mV	40 mV		386 ps
	100 mV	800 mV		298 ps
	500 mV	4 V		294 ps
	1 V	4 V		584 ps

Table continued…

Delta Time Measurement Accuracy, 1 GHz instruments				
	MDO = 400 ns/Div, Source frequency = 2.4 MHz			
	MDO V/Div	**Source V pp**	**Test Result**	**High Limit**
	5 mV	40 mV		3.69 ns
	100 mV	800 mV		2.75 ns
	500 mV	4 V		2.71 ns
	1 V	4 V		5.36 ns
	MDO = 4 µs/Div, Source frequency = 240 kHz			
	MDO V/Div	**Source V pp**	**Test Result**	**High Limit**
	5 mV	40 mV		36.8 ns
	100 mV	800 mV		27.4 ns
	500 mV	4 V		27.0 ns
	1 V	4 V		53.5 ns
	MDO = 40 µs/Div, Source frequency = 24 kHz			
	MDO V/Div	**Source V pp**	**Test Result**	**High Limit**
	5 mV	40 mV		368 ns
	100 mV	800 mV		274 ns
	500 mV	4 V		270 ns
	1 V	4 V		535 ns
	MDO = 400 µs/Div, Source frequency = 2.4 kHz			
	MDO V/Div	**Source V pp**	**Test Result**	**High Limit**
	5 mV	40 mV		3.68 µs
	100 mV	800 mV		2.74 µs
	500 mV	4 V		2.70 µs
	1 V	4 V		5.35 µs
Channel 4 [3]				

Table continued…

Delta Time Measurement Accuracy, 1 GHz instruments				
	MDO = 4 ns/Div, Source frequency = 240 MHz			
	MDO V/Div	**Source V pp**	**Test Result**	**High Limit**
	100 mV	800 mV		119 ps
	500 mV	4 V		119 ps
	1 V	4 V		128 ps
	MDO = 40 ns/Div, Source frequency = 24 MHz			
	MDO V/Div	**Source V pp**	**Test Result**	**High Limit**
	5 mV	40 mV		386 ps
	100 mV	800 mV		298 ps
	500 mV	4 V		294 ps
	1 V	4 V		584 ps
	MDO = 400 ns/Div, Source frequency = 2.4 MHz			
	MDO V/Div	**Source V pp**	**Test Result**	**High Limit**
	5 mV	40 mV		3.69 ns
	100 mV	800 mV		2.75 ns
	500 mV	4 V		2.71 ns
	1 V	4 V		5.36 ns
	MDO = 4 µs/Div, Source frequency = 240 kHz			
	MDO V/Div	**Source V pp**	**Test Result**	**High Limit**
	5 mV	40 mV		36.8 ns
	100 mV	800 mV		27.4 ns
	500 mV	4 V		27.0 ns
	1 V	4 V		53.5 ns
	MDO = 40 µs/Div, Source frequency = 24 kHz			
	MDO V/Div	**Source V pp**	**Test Result**	**High Limit**

Table continued…

Delta Time Measurement Accuracy, 1 GHz instruments				
	5 mV	40 mV		368 ns
	100 mV	800 mV		274 ns
	500 mV	4 V		270 ns
	1 V	4 V		535 ns
	MDO = 400 µs/Div, Source frequency = 2.4 kHz			
	MDO V/Div	**Source V pp**	**Test Result**	**High Limit**
	5 mV	40 mV		3.68 µs
	100 mV	800 mV		2.74 µs
	500 mV	4 V		2.70 µs
	1 V	4 V		5.35 µs

Digital Threshold Accuracy Tests (with 3-MSO option)

Digital Threshold Accuracy (with 3-MSO option)						
Digital channel	Threshold	V_{s-}	V_{s+}	Low limit	Test result $V_{sAvg} = (V_{s--} + V_{s+})/2$	High limit
D0	0 V			-0.1 V		0.1 V
	4 V			3.78 V		4.22 V
D1	0 V			-0.1 V		0.1 V
	4 V			3.78 V		4.22 V
D2	0 V			-0.1 V		0.1 V
	4 V			3.78 V		4.22 V
D3	0 V			-0.1 V		0.1 V
	4 V			3.78 V		4.22 V
D4	0 V			-0.1 V		0.1 V
	4 V			3.78 V		4.22 V

Table continued…

Digital Threshold Accuracy (with 3-MSO option)						
Digital channel	Threshold	V_{s-}	V_{s+}	Low limit	Test result $V_{sAvg} = (V_{s--} + V_{s+})/2$	High limit
D5	0 V			-0.1 V		0.1 V
	4 V			3.78 V		4.22 V
D6	0 V			-0.1 V		0.1 V
	4 V			3.78 V		4.22 V
D7	0 V			-0.1 V		0.1 V
	4 V			3.78 V		4.22 V
D8	0 V			-0.1 V		0.1 V
	4 V			3.78 V		4.22 V
D9	0 V			-0.1 V		0.1 V
	4 V			3.78 V		4.22 V
D10	0 V			-0.1 V		0.1 V
	4 V			3.78 V		4.22 V
D11	0 V			-0.1 V		0.1 V
	4 V			3.78 V		4.22 V
D12	0 V			-0.1 V		0.1 V
	4 V			3.78 V		4.22 V
D13	0 V			-0.1 V		0.1 V
	4 V			3.78 V		4.22 V
D14	0 V			-0.1 V		0.1 V
	4 V			3.78 V		4.22 V
D15	0 V			-0.1 V		0.1 V
	4 V			3.78 V		4.22 V

Displayed Average Noise Level Tests (DANL)

Displayed Average Noise Level (DANL)				
Performance checks		**Low limit**	**Test result**	**High limit**
All models	9 kHz – 50 kHz	N/A		–109 dBm/Hz
	50 kHz – 5 MHz	N/A		–126 dBm/Hz
	5 MHz – 1 GHz (3-SA3 not installed)	N/A		–136 dBm/Hz
	5 MHz – 2 GHz (3-SA3 installed)	N/A		–136 dBm/Hz
	2 GHz – 3 GHz (3-SA3 installed)	N/A		–126 dBm/Hz

Residual Spurious Response Tests

Residual Spurious Response				
Performance checks		**Low limit**	**Test result**	**High limit**
All models	9 kHz to 50 kHz	N/A		–78 dBm
	50 kHz to 5 MHz	N/A		–78 dBm
	5 MHz to 2 GHz (not 1.25 GHz)	N/A		–78 dBm
	1.25 GHz (3-SA3 installed)	N/A		–76 dBm
	2 GHz to 3 GHz (not 2.5 GHz) (3-SA3 installed)	N/A		–78 dBm
	2.5 GHz (3-SA3 installed)	N/A		–69 dBm

Level Measurement Uncertainty Tests

Level Measurement Uncertainty			
Performance checks	**Low limit**	**Test result**	**High limit**

Table continued…

Level Measurement Uncertainty				
+10 dBm	All models	9 kHz	–1.2 dB	+1.2 dB
		50 kHz	–1.2 dB	+1.2 dB
		100 kHz – 900 kHz	–1.2 dB	+1.2 dB
		1 MHz – 9 MHz	–1.2 dB	+1.2 dB
		10 MHz - 90 MHz	–1.2 dB	+1.2 dB
		100 MHz – BW	–1.2 dB	+1.2 dB
0 dBm	All models	9 kHz	–1.2 dB	+1.2 dB
		50 kHz	–1.2 dB	+1.2 dB
		100 kHz – 900 kHz	–1.2 dB	+1.2 dB
		1 MHz – 9 MHz	–1.2 dB	+1.2 dB
		10 MHz - 90 MHz	–1.2 dB	+1.2 dB
		100 MHz – BW	–1.2 dB	+1.2 dB
–15 dBm	All models	9 kHz	–1.2 dB	+1.2 dB
		50 kHz	–1.2 dB	+1.2 dB
		100 kHz – 900 kHz	–1.2 dB	+1.2 dB
		1 MHz – 9 MHz	–1.2 dB	+1.2 dB
		10 MHz – 90 MHz	–1.2 dB	+1.2 dB
		100 MHz – BW	–1.2 dB	+1.2 dB

Functional check with a TPA-N-PRE Preamp Attached

Functional check with a TPA-N-PRE Preamp attached			
Performance checks		**Limit**	**Test result**
All models	1.7 GHz	≤ 1.5 dB	
	2.9 GHz	≤ 1.5 dB	

Displayed Average Noise Level (DANL) with a TPA-N-PRE Preamp Attached

Displayed Average Noise Level (DANL) with a TPA-N-PRE Preamp Attached				
Performance checks		**Low limit**	**Test result**	**High limit**
All models	9 kHz - 50 kHz	N/A		–117 dBm/Hz
	50 kHz - 5 MHz	N/A		–138 dBm/Hz
	50 kHz - 1 GHz (3-SA3 not installed)	N/A		–148 dBm/Hz
	5 MHz - 2 GHz (3-SA3 installed)	N/A		–148 dBm/Hz
	2 GHz - 3 GHz (-3SA3 installed)	N/A		–138 dBm/Hz

Auxiliary (Trigger) Output Tests

Auxiliary (Trigger) Output Tests				
Performance checks		**Low limit**	**Test result**	**High limit**
Trigger Output	High 1 MΩ	≥ 2.25 V		—
	Low 1 MΩ	—		≤ 0.7 V
	High 50 Ω	≥ 0.9 V		—
	Low 50 Ω	—		≤ 0.25 V

AFG Sine and Ramp Frequency Accuracy Tests

AFG Sine and Ramp Frequency Accuracy				
Performance checks		**Low limit**	**Test result**	**High limit**
All models	Sine Wave at 10 kHz, 2.5 V, 50 Ω	9.9987 kHz		10.0013 kHz
	Sine Wave at 50 MHz, 2.5 V, 50 Ω	49.9975 MHz		50.0025 MHz

AFG Square and Pulse Frequency Accuracy Tests

AFG Square and Pulse Frequency Accuracy				
Performance checks		**Low limit**	**Test result**	**High limit**
All models	Square Wave at 25 kHz, 2.5 V, 50 Ω	24.99875 kHz		25.00125 kHz
	Square Wave at 25 MHz, 2.5 V, 50 Ω	24.99875 MHz		25.00125 MHz

AFG Signal Amplitude Accuracy Tests

AFG Signal Amplitude Accuracy				
Performance checks		**Low limit**	**Test result**	**High limit**
All models	Square Wave 20 mV_{pp} @ 1 kHz, 50 Ω, 0 V Offset	9.35 mV		10.65 mV
	Square Wave 1 V_{pp} @ 1 kHz, 50 Ω, 0.2 V Offset	490.5 mV		509.5 mV

AFG DC Offset Accuracy Tests

AFG DC Offset Accuracy				
Performance checks		**Low limit**	**Test result**	**High limit**
All models	20 mV DC offset @ 50 Ω	18.7 mV		21.3 mV
	1 V DC offset @ 50 Ω	984 mV		1.016 V
	- 1 V DC offset @ 50 Ω	-1.016 V		-984 mV

DVM Voltage Accuracy Tests (DC)

DVM Voltage Accuracy Tests (DC)					
Channel 1					
Vertical Scale	**Input Voltage**	**Offset Voltage**	**Low Limit**	**Test Result**	**High Limit**
1	–5	–5	–5.117		–4.883
0.5	–2	–2	–2.052		–1.948
0.5	–1	–0.5	–1.0345		–0.9655
0.2	–0.5	–0.5	–0.5175		–0.4825

Table continued…

DVM Voltage Accuracy Tests (DC)					
0.01	0.002	0	0.00042		0.00442
0.2	0.5	0.5	0.4825		0.5175
0.5	1	0.5	0.9655		1.0345
0.5	2	2	1.948		2.052
1	5	5	4.883		5.117
Channel 2					
Vertical Scale	**Input Voltage**	**Offset Voltage**	**Low Limit**	**Test Result**	**High Limit**
1	–5	–5	–5.117		–4.883
0.5	–2	–2	–2.052		–1.948
0.5	–1	–0.5	–1.0345		–0.9655
0.2	–0.5	–0.5	–0.5175		–0.4825
0.01	0.002	0	0.00042		0.00442
0.2	0.5	0.5	0.4825		0.5175
0.5	1	0.5	0.9655		1.0345
0.5	2	2	1.948		2.052
1	5	5	4.883		5.117
Channel 3 [3]					
Vertical Scale	**Input Voltage**	**Offset Voltage**	**Low Limit**	**Test Result**	**High Limit**
1	–5	–5	–5.117		–4.883
0.5	–2	–2	–2.052		–1.948
0.5	–1	–0.5	–1.0345		–0.9655
0.2	–0.5	–0.5	–0.5175		–0.4825
0.01	0.002	0	0.00042		0.00442
0.2	0.5	0.5	0.4825		0.5175
0.5	1	0.5	0.9655		1.0345

Table continued…

DVM Voltage Accuracy Tests (DC)					
0.5	2	2	1.948		2.052
1	5	5	4.883		5.117
Channel 4 [3]					
Vertical Scale	**Input Voltage**	**Offset Voltage**	**Low Limit**	**Test Result**	**High Limit**
1	–5	–5	–5.117		–4.883
0.5	–2	–2	–2.052		–1.948
0.5	–1	–0.5	–1.0345		–0.9655
0.2	–0.5	–0.5	–0.5175		–0.4825
0.01	0.002	0	0.00042		0.00442
0.2	0.5	0.5	0.4825		0.5175
0.5	1	0.5	0.9655		1.0345
0.5	2	2	1.948		2.052
1	5	5	4.883		5.117

DVM Voltage Accuracy Tests (AC)

DVM Voltage Accuracy Tests (AC)				
Channel 1				
Vertical Scale	**Input Signal**	**Low Limit**	**Test Result**	**High Limit**
5 mV	20 mV_{pp} at 1 kHz	9.800 mV		10.200 mV
10 mV	50 mV_{pp} at 1 kHz	24.5 mV		25.500 mV
100 mV	0.5 V_{pp} at 1 kHz	245.000 mV		255.000 mV
200 mV	1 V_{pp} at 1 kHz	490.000 mV		510.000 mV
1 V	5 V_{pp} at 1 kHz	2.450 mV		2.550 mV
Channel 2				
Vertical Scale	**Input Signal**	**Low Limit**	**Test Result**	**High Limit**

Table continued…

DVM Voltage Accuracy Tests (AC)				
5 mV	20 mV_{pp} at 1 kHz	9.800 mV		10.200 mV
10 mV	50 mV_{pp} at 1 kHz	24.5 mV		25.500 mV
100 mV	0.5 V_{pp} at 1 kHz	245.000 mV		255.000 mV
200 mV	1 V_{pp} at 1 kHz	490.000 mV		510.000 mV
1 V	5 V_{pp} at 1 kHz	2.450 mV		2.550 mV
Channel 3 [3]				
Vertical Scale	**Input Signal**	**Low Limit**	**Test Result**	**High Limit**
5 mV	20 mV_{pp} at 1 kHz	9.800 mV		10.200 mV
10 mV	50 mV_{pp} at 1 kHz	24.5 mV		25.500 mV
100 mV	0.5 V_{pp} at 1 kHz	245.000 mV		255.000 mV
200 mV	1 V_{pp} at 1 kHz	490.000 mV		510.000 mV
1 V	5 V_{pp} at 1 kHz	2.450 mV		2.550 mV
Channel 4 [3]				
Vertical Scale	**Input Signal**	**Low Limit**	**Test Result**	**High Limit**
5 mV	20 mV_{pp} at 1 kHz	9.800 mV		10.200 mV
10 mV	50 mV_{pp} at 1 kHz	24.5 mV		25.500 mV
100 mV	0.5 V_{pp} at 1 kHz	245.000 mV		255.000 mV
200 mV	1 V_{pp} at 1 kHz	490.000 mV		510.000 mV
1 V	5 V_{pp} at 1 kHz	2.450 mV		2.550 mV

DVM Frequency Accuracy Tests and Maximum Input Frequency

DVM Frequency Accuracy Tests and Maximum Input Frequency				
Channel 1				
	Nominal	**Low Limit**	**Test Result**	**High Limit**

Table continued…

DVM Frequency Accuracy Tests and Maximum Input Frequency				
	9.0000 Hz	8.9998 Hz		9.0002 Hz
	99.000 Hz	98.998 Hz		99.002 Hz
	999.00 Hz	998.98 Hz		999.02 Hz
	99.000 kHz	98.998 kHz		99.002 kHz
	999.00 kHz	998.98 kHz		999.02 kHz
	150 MHz [4]	149.99 MHz		150.01 MHz
Channel 2				
	9.0000 Hz	8.9998 Hz		9.0002 Hz
	99.000 Hz	98.998 Hz		99.002 Hz
	999.00 Hz	998.98 Hz		999.02 Hz
	99.000 kHz	98.998 kHz		99.002 kHz
	999.00 kHz	998.98 kHz		999.02 kHz
	150 MHz [4]	149.99 MHz		150.01 MHz
Channel 3 [3]				
	9.0000 Hz	8.9998 Hz		9.0002 Hz
	99.000 Hz	98.998 Hz		99.002 Hz
	999.00 Hz	998.98 Hz		999.02 Hz
	99.000 kHz	98.998 kHz		99.002 kHz
	999.00 kHz	998.98 kHz		999.02 kHz
	150 MHz [4]	149.99 MHz		150.01 MHz
Channel 4 [3]				
	9.0000 Hz	8.9998 Hz		9.0002 Hz
	99.000 Hz	98.998 Hz		99.002 Hz
	999.00 Hz	998.98 Hz		999.02 Hz

Table continued…

4 Verifies the maximum frequency.

DVM Frequency Accuracy Tests and Maximum Input Frequency				
	99.000 kHz	98.998 kHz		99.002 kHz
	999.00 kHz	998.98 kHz		999.02 kHz
	150 MHz [4]	149.99 MHz		150.01 MHz

Performance Verification Procedures

The following three conditions must be met prior to performing these procedures:

1. The oscilloscope must have been operating continuously for ten (10) minutes in an environment that meets the operating range specifications for temperature and humidity.
2. You must perform a signal path compensation (SPC). (See *Self Tests — System Diagnostics and Signal Path Compensation* section below.) If the operating temperature changes by more than 5 °C (41 °F), you must perform the signal path compensation again.
3. You must connect the oscilloscope and the test equipment to the same AC power circuit. Connect the oscilloscope and test instruments into a common power strip if you are unsure of the AC power circuit distribution. Connecting the oscilloscope and test instruments into separate AC power circuits can result in offset voltages between the equipment, which can invalidate the performance verification procedure.

The time required to complete all the procedures is approximately one hour.

⚠ **WARNING:** Some procedures use hazardous voltages. To prevent electrical shock, always set voltage source outputs to 0 V before making or changing any interconnections.

Self Tests, System Diagnostics, and Signal Path Compensation

These procedures use internal routines to verify that the oscilloscope functions and passes its internal self tests. No test equipment or hookups are required. Start the self test with these steps:

Run the System Diagnostics (may take several minutes):

1. Disconnect all probes and cables from the oscilloscope inputs.
2. Push **Default Setup** on the front-panel to set the instrument to the factory default settings.
3. Tap **Utility > Self Test**. This displays the **Self Test** configuration menu.
4. Tap the **Run Self Test** button.
5. Wait while the self test runs. When the self test completes, a dialog box displays the results of the self test.
6. Verify that the status of all tests is **Passed**.
7. Cycle the oscilloscope power off and back on before proceeding.

⚠ **Note:** Remember to cycle the oscilloscope power off and back on before proceeding.

Run the signal-path compensation routine (may take 5 to 15 minutes per channel):

1. Push **Default Setup** on the front panel.
2. Tap **Utility > Calibration**. This displays the **Calibration** configuration menu.
3. Tap the **Run SPC** button to start the routine.
4. Signal-path compensation may take 5 to 15 minutes to run per channel.

5. Verify that the **SPC Status** is **Passed.**
6. Return to regular service: Tap anywhere outside the menu to exit the **Calibration** menu.

   The self test procedures are completed. If any of the above tests failed, run the tests again. If there are still failures, contact Tektronix Customer Support.

   Note: You cannot run the remaining performance tests until the self tests pass and the SPC has successfully run.

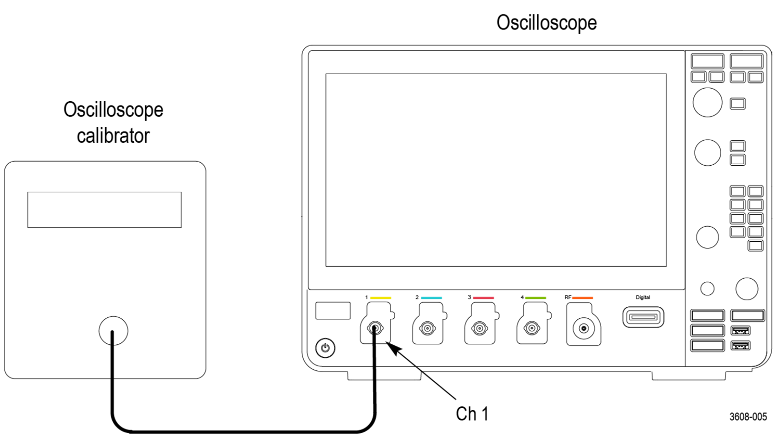
Check Input Termination DC Coupled (Resistance)

This test checks the Input Termination for 1 MΩ or 50 Ω settings.

1. Connect the output of the oscilloscope calibrator (for example, Fluke 9500) to the oscilloscope channel 1 input, as shown below.

   WARNING: Be sure to set the generator to Off or 0 volts before connecting, disconnecting, and/or moving the test hookup during the performance of this procedure. The generator is capable of providing dangerous voltages.

   Note: Impedance measuring equipment that produces a voltage across the channel that exceeds the measurement range of the instrument may report erroneous impedance results. A measurement voltage exceeds the measurement range of the instrument when the resulting trace is not visible on the graticule.



2. Push **Default Setup** on the front panel to set the instrument to the factory default settings.
3. Push the channel button on the front panel for the oscilloscope channel that you are testing, as shown in the test record (for example, **1**, **2**, **3**, or **4**).
4. Confirm that the oscilloscope termination and calibrator impedance are both set to 1 MΩ.
5. Turn the **Vertical Scale** knob to set the vertical scale, as shown in the test record (for example, 10 mV/div, 100 mV/div). See *Input Termination Tests* on page 41.
6. Measure the input resistance of the oscilloscope with the calibrator. Record this value in the test record.
7. Repeat steps 5 and 6 for each volt/division setting in the test record.
8. Change the oscilloscope termination to 50 Ω and repeat steps 5 through 7.
9. Repeat steps 4 through 9 for each channel listed in the test record and relevant to the model of oscilloscope that you are testing, as shown in the test record (for example, **2**, **3**, or **4**).

   This completes the procedure.

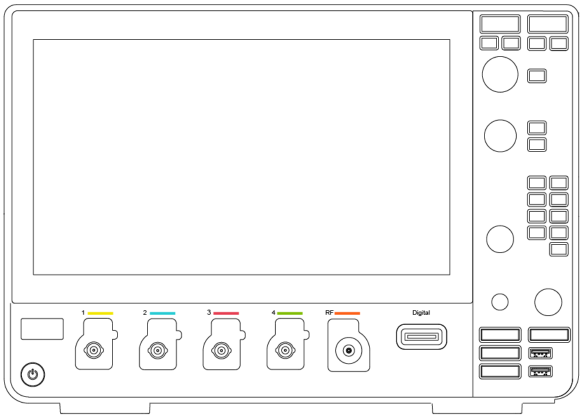
Check DC Balance

This test checks the DC balance.

You do not need to connect the oscilloscope to any equipment to run this test. The only piece of equipment needed is a BNC feed-through 50 Ω terminator.

1. For 50 Ω coupling, attach a 50 Ω terminator to the channel input of the oscilloscope being tested.

Oscilloscope



3608-006

2. Push **Default Setup** on the front panel to set the instrument to the factory default settings.
3. Double-tap the **Horizontal** badge on the Settings bar and set the **Horizontal Scale** to **1 ms/div**.
4. Tap the channel 1 button on the oscilloscope Settings bar to display a channel badge.
5. Double tap the Ch 1 badge to open its menu.
6. Set the **Vertical Scale** to **1 mV/div**.
7. Set the channel **Termination** to **50 Ω**.
8. Tap **Bandwidth Limit** and select **20 MHz**, **150 MHz**, or **Full**, as given in the test record.
9. Tap outside the menu to close it.
10. Double-tap the **Acquisition** badge and set the **Acquisition Mode** to **Average.**
11. Set the **Number of Waveforms** to **16**.
12. Tap outside the menu to close it.
13. Double-tap the **Trigger** badge and set the **Source** to **AC line**. You do not need to connect an external signal to the oscilloscope for this DC Balance test.
14. Tap outside the menu to close it.
15. Add a Mean amplitude measurement for channel 1 to the Results bar:
    a. Tap the **Add New... Measure** button to open the **Add Measurements** menu.
    b. Set the **Source** to **Ch 1**.
    c. In the **Amplitude Measurements** panel, double-tap the **Mean** button to add the **Mean** measurement badge to the Results bar.
16. View the mean measurement value in the display and enter that mean value as the test result in the test record. See *DC Balance Tests* on page 42.

    Note: Translate the mean value into divisions for use in the test record. To do this, divide the voltage value by the vertical scale value. (e.g. 0.2 V / (1 V / division) = 0.2 divisions)
17. Repeat step *6* on page 81 and step *16* on page 81 for each volts/division value listed in the results table.
18. Repeat step *6* on page 81 and step *17* on page 81 for each bandwidth setting in the test record table.
19. Repeat the channel tests at 1 MΩ impedance as follows:
    a. Double-tap the channel 1 badge.
    b. Set the **Termination** to **1 MΩ**.

c. Repeat steps *7* on page 81 through *18* on page 81.

20. Repeat the procedure for all remaining channels as follows:

a. Move the 50 Ω terminator to the next channel input to be tested.

b. Double-tap the channel badge of the channel that you have finished testing and set **Display** to **Off.**

c. Tap the channel button on the Settings bar of the next channel to test.

d. Starting from step *6* on page 81, repeat the procedures until all channels have been tested. To change the source for the Mean measurement for each channel test:

i. Double-tap the **Mean** measurement badge.

ii. Tap the **Configure** panel.

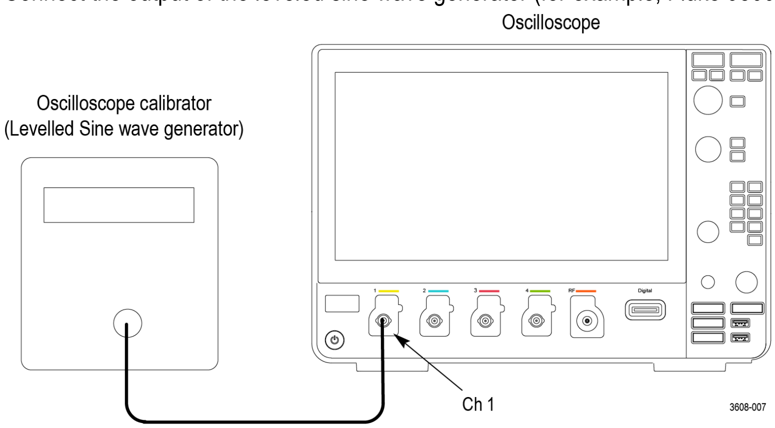
iii. Tap the **Source 1** field and select the next channel to test.

21. Tap outside the menu to close it.

Check Analog Bandwidth

This test checks the bandwidth for each channel.

1. Connect the output of the leveled sine wave generator (for example, Fluke 9500) to the oscilloscope channel 1 input as shown below.



2. Push **Default Setup** on the front panel to set the instrument to the factory default settings.

3. Double-tap the **Acquisition** badge and set the Acquisition mode to **Sample.**

4. Tap outside the menu to close it.

5. Add the peak-to-peak measurement as follows:

a. Tap the **Measure** button.

b. Set the **Source** to the channel under test.

c. In the **Amplitude Measurements** panel, tap the **Peak-to-Peak** measurement button and then tap the **Add** button to add the measurement badge to the Results bar.

d. Tap outside the menu to close it.

6. Set the channel under test settings:

a. Double-tap the badge of the channel under test to open its configuration menu.

b. Set **Vertical Scale** to **1 mV/div**.

c. Set **Termination** to **50 Ω**.

d. Tap outside the menu to close it.

7. Adjust the leveled sine wave signal source to display a waveform of 8 vertical divisions at the selected vertical scale with a set frequency of **10 MHz**. For example, at 5 mV/div, use a ≥40 mV_{p-p} signal; at 2 mV/div, use a ≥16 mV_{p-p} signal.

Note: At some V/div settings, the generator may not provide 8 vertical divisions of signal. Set the generator output to obtain as many vertical divisions of signal as possible.

8. Double-tap the **Horizontal** badge in the Settings bar.
9. Set the **Horizontal Scale** to **1 ms/division**.
10. Tap outside the menu to close it.
11. Record the **Peak-to-Peak** measurement in the $\mathbf{V_{in\text{-}pp}}$ entry of the test record.
12. Double-tap the **Horizontal** badge in the Settings bar.
13. Set the **Horizontal Scale** to **4 ns/division**.
14. Adjust the signal source to the maximum bandwidth frequency for the bandwidth and model being tested.
15. Record the peak-to-peak measurement as follows:

    Record the **Peak-to-Peak** measurement at the new frequency in the $\mathbf{V_{bw\text{-}pp}}$ entry of the test record.

Table 4: Maximum Bandwidth Frequency worksheet

Termination	Vertical Scale	Maximum Bandwidth Frequency
For instruments with **1 GHz bandwidth**		
50 Ω	10 mV/div	1 GHz
50 Ω	5 mV/div	500 MHz
50 Ω	2 mV/div	350 MHz
50 Ω	1 mV/div	150 MHz
For instruments with **500 MHz bandwidth**		
50 Ω	5 mV/div	500 MHz
50 Ω	2 mV/div	350 MHz
50 Ω	1 mV/div	150 MHz
For instruments with **350 MHz bandwidth**		
50Ω	5 mV/div	350 MHz
50Ω	2 mV/div	350 MHz
50Ω	1 mV/div	150 MHz
For instruments with **200 MHz bandwidth**		
50 Ω	2 mV/div	200 MHz
50 Ω	1 mV/div	150 MHz
50 Ω	1 mV/div	100 MHz
For instruments with **100 MHz bandwidth**		
50 Ω	1 mV/div	100 MHz

16. Use the values of *V bw-pp* and *V in-pp* recorded in the test record, and the following equation, to calculate the *Gain* at bandwidth:

    Gain = V bw-pp /V in-pp.
17. To pass the performance measurement test, Gain should be ≥ 0.707. Enter *Gain* in the test record.
18. Repeat steps *6* on page 82 through *16* on page 83 for all combinations of Vertical Scale and Horizontal Scale settings listed in the test record.

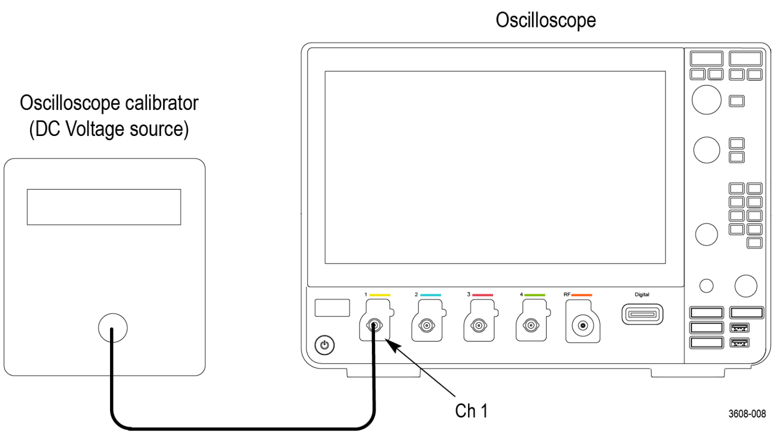
19. Repeat the test for all remaining channels as follows:
    a. Set the calibrator to **0** volts and **50 Ω** output impedance.
    b. Move the calibrator output to the next channel input to be tested.
    c. Press the channel button of the channel that you have finished testing to turn the channel off.
    d. Tap the channel button on the oscilloscope Settings bar of the next channel to test.
    e. Double-tap the **Peak-to-Peak** measurement badge.
    f. Tap the **Configure** panel.
    g. Tap the **Source 1** field and select the next channel to test.
    h. Starting from step *6* on page 82, repeat the procedure until all channels have been tested.

    This completes the procedure.

Check DC Gain Accuracy

This test checks the DC gain accuracy.

1. Connect the oscilloscope to a DC voltage source. If using the Fluke 9500 calibrator, connect the calibrator head to the oscilloscope channel to test.



2. Push **Default Setup** on the front panel to set the instrument to the factory default settings.
3. Double-tap the **Acquisition** badge and set **Acquisition Mode** to **Average.**
4. Set the **Number of Waveforms** to **16**.
5. Tap outside the menu to close the menu.
6. Double-tap the **Trigger** badge and set the trigger **Source** to **AC line**.
7. Tap outside the menu to close the menu.
8. Add the Mean measurement to the Results bar:
    a. Tap the **Measure** button to open the **Add Measurements** menu.
    b. Set the **Source** to **Ch 1**.
    c. In the **Amplitude Measurements** panel, tap the **Mean** button and then tap the **Add** button to add the Mean measurement badge to the Results bar.
9. Tap the channel button of the channel to test, to add the channel badge to the Settings bar.
10. Double tap the channel to test badge to open its menu and set the channel settings:
    a. Set **Vertical Scale** to **1 mV/div**.
    b. Set **Termination** to **50 Ω**.

c. Tap **Bandwidth Limit** and set to **20 MHz**.
d. Tap outside the menu to close it.

11. Record the negative-measured and positive-measured mean readings in the Gain expected worksheet as follows:
   a. On the calibrator, set the DC Voltage Source to the $V_{negative}$ value as listed in the 1 mV row of the worksheet.
   b. Double-tap the **Acquisition** badge and tap **Clear** to reset the measurement statistics.
   c. Enter the **Mean** reading in the worksheet as $V_{negative\text{-}measured}$.
   d. On the calibrator, set the DC Voltage Source to $V_{positive}$ value as listed in the 1 mV row of the worksheet.
   e. Double-tap the **Acquisition** badge (if not open) and tap **Clear**.
   f. Enter the Mean reading in the worksheet as $V_{positive\text{-}measured}$.

Table 5: Gain Expected worksheet - channel 1

Oscilloscope Vertical Scale Setting	$V_{diffExpected}$	$V_{negative}$	$V_{positive}$	$V_{negative\text{-}measured}$	$V_{positive\text{-}measured}$	V_{diff}	Test Result(Gain Accuracy)
1 mV/div	7 mV	–3.5 mV	+3.5 mV				
2 mV/div	14 mV	–7 mV	+7 mV				
4.98 mV	34.86 mV	–17.43 mV	+17.43 mV				
5 mV	35 mV	–17.5 mV	+17.5 mV				
10 mV	70 mV	–35 mV	+35 mV				
20 mV	140 mV	–70 mV	+70 mV				
49.8 mV	348.6 mV	–174.3 mV	+174.3 mV				
50 mV	350 mV	–175 mV	+175 mV				
100 mV	700 mV	–350 mV	+350 mV				
200 mV	1400 mV	–700 mV	+700 mV				
500 mV	3500 mV	–1750 mV	+1750 mV				
1.0 V	7000 mV	–3500 mV	+3500 mV				

Table 6: Gain Expected worksheet - channel 2

Oscilloscope Vertical Scale Setting	$V_{diffExpected}$	$V_{negative}$	$V_{positive}$	$V_{negative\text{-}measured}$	$V_{positive\text{-}measured}$	V_{diff}	Test Result(Gain Accuracy)
1 mV/div	7 mV	–3.5 mV	+3.5 mV				

Table continued…

Oscilloscope Vertical Scale Setting	$V_{diffExpected}$	$V_{negative}$	$V_{positive}$	$V_{negative-measured}$	$V_{positive-measured}$	V_{diff}	Test Result(Gain Accuracy)
2 mV/div	14 mV	–7 mV	+7 mV				
4.98 mV	34.86 mV	–17.43 mV	+17.43 mV				
5 mV	35 mV	–17.5 mV	+17.5 mV				
10 mV	70 mV	–35 mV	+35 mV				
20 mV	140 mV	–70 mV	+70 mV				
49.8 mV	348.6 mV	–174.3 mV	+174.3 mV				
50 mV	350 mV	–175 mV	+175 mV				
100 mV	700 mV	–350 mV	+350 mV				
200 mV	1400 mV	–700 mV	+700 mV				
500 mV	3500 mV	–1750 mV	+1750 mV				
1.0 V	7000 mV	–3500 mV	+3500 mV				

Table 7: Gain Expected worksheet - channel 3

Oscilloscope Vertical Scale Setting	$V_{diffExpected}$	$V_{negative}$	$V_{positive}$	$V_{negative-measured}$	$V_{positive-measured}$	V_{diff}	Test Result(Gain Accuracy)
1 mV/div	7 mV	–3.5 mV	+3.5 mV				
2 mV/div	14 mV	–7 mV	+7 mV				
4.98 mV	34.86 mV	–17.43 mV	+17.43 mV				
5 mV	35 mV	–17.5 mV	+17.5 mV				
10 mV	70 mV	–35 mV	+35 mV				
20 mV	140 mV	–70 mV	+70 mV				
49.8 mV	348.6 mV	–174.3 mV	+174.3 mV				
50 mV	350 mV	–175 mV	+175 mV				
100 mV	700 mV	–350 mV	+350 mV				

Table continued…

Oscilloscope Vertical Scale Setting	$V_{diffExpected}$	$V_{negative}$	$V_{positive}$	$V_{negative-measured}$	$V_{positive-measured}$	V_{diff}	Test Result(Gain Accuracy)
200 mV	1400 mV	–700 mV	+700 mV				
500 mV	3500 mV	–1750 mV	+1750 mV				
1.0 V	7000 mV	–3500 mV	+3500 mV				

Table 8: Gain Expected worksheet - channel 4

Oscilloscope Vertical Scale Setting	$V_{diffExpected}$	$V_{negative}$	$V_{positive}$	$V_{negative-measured}$	$V_{positive-measured}$	V_{diff}	Test Result(Gain Accuracy)
1 mV/div	7 mV	–3.5 mV	+3.5 mV				
2 mV/div	14 mV	–7 mV	+7 mV				
4.98 mV	34.86 mV	–17.43 mV	+17.43 mV				
5 mV	35 mV	–17.5 mV	+17.5 mV				
10 mV	70 mV	–35 mV	+35 mV				
20 mV	140 mV	–70 mV	+70 mV				
49.8 mV	348.6 mV	–174.3 mV	+174.3 mV				
50 mV	350 mV	–175 mV	+175 mV				
100 mV	700 mV	–350 mV	+350 mV				
200 mV	1400 mV	–700 mV	+700 mV				
500 mV	3500 mV	–1750 mV	+1750 mV				
1.0 V	7000 mV	–3500 mV	+3500 mV				

12. Calculate Gain Accuracy as follows:

a. Calculate V_{diff} as follows: $V_{diff} = | V_{negative-measured} - V_{positive-measured} |$

b. Enter V_{diff} in the worksheet.

c. Calculate Gain Accuracy as follows: Gain Accuracy = $((V_{diff} - V_{diffExpected})/V_{diffExpected}) \times 100\%$

d. Enter the Gain Accuracy value in the worksheet and in the test record.

13. Repeat steps *10* on page 84 through *12* on page 87 for all vertical scale settings in the work sheet and the test record.

14. Repeat tests at 1 MΩ impedance as follows:

a. Set the calibrator to **0** volts and **1 MΩ** output impedance.

b. Double-tap the badge of the channel being tested.

c. Set the **Termination** to **1 MΩ**

d. Repeat steps *10* on page 84 through *13* on page 87 for all vertical scale settings in the test record.

15. Repeat the procedure for all remaining channels:

a. Set the calibrator to **0** volts and **50 Ω** output impedance.

b. Move the calibrator output to the next channel input to be tested.

c. Press the channel button of the channel that you have finished testing to turn off the channel.

d. Double-tap the **Mean** measurement badge.

e. Tap the **Configure** panel.

f. Tap the **Source 1** field and select the next channel to test.

g. Starting from step *10* on page 84, set the values from the test record for the channel under test, and repeat the above steps until all channels have been tested.

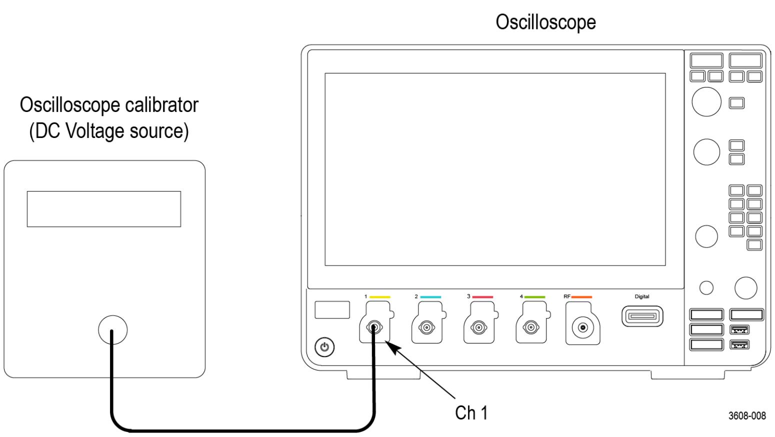
16. Touch outside a menu to close the menu.

This completes the procedure.

Check Offset Accuracy

This test checks the offset accuracy.

1. Connect the oscilloscope to a DC voltage source to run this test. If using the Fluke 9500 calibrator as the DC voltage source, connect the calibrator head to the oscilloscope channel to test.



WARNING: Set the generator output to Off or 0 volts before connecting, disconnecting, or moving the test hookup during the performance of this procedure. The generator is capable of providing dangerous voltages.

2. Push **Default Setup** on the front panel to set the instrument to the factory default settings.

3. Double-tap the **Acquisition** badge and set **Acquisition Mode** to **Average**.

4. Set the **Number of Waveforms** to **16**.

5. Tap outside the menu to close the menu.

6. Double-tap the **Trigger** badge and set the trigger **Source** to **AC line**.

7. Double-tap the **Horizontal** badge and set **Horizontal Scale** to **20 ms/div**.

8. Add the **Mean** measurement to the Results bar:

a. Tap the **Measure** button to open the **Add Measurements** menu.

b. Set the **Source** to **Ch 1**.

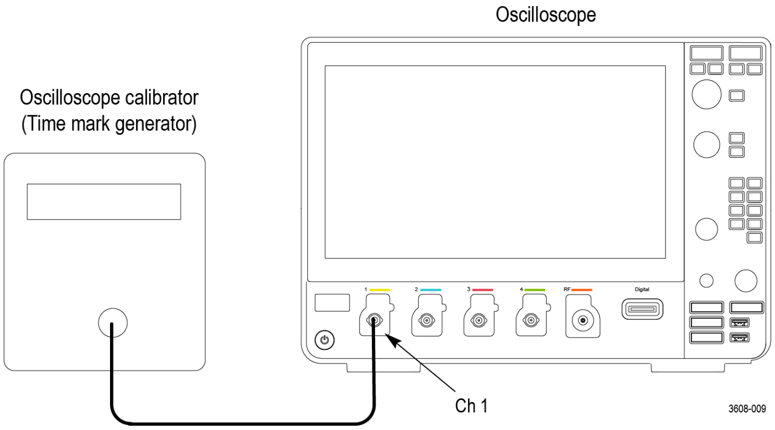
c. In the **Amplitude Measurements** panel, tap the **Mean** button and then tap the **Add** button to add the Mean measurement badge to the Results bar.

9. Tap the channel button (starting with channel 1) on the Settings bar to add the channel under test to the Settings bar.
10. Double-tap the channel under test badge to open its configuration menu and change the vertical settings:
    a. Set **Vertical Scale** to **1 mV/div**.
    b. Set **Offset** to **900 mV**.
    c. Set **Position** to 0 by tapping **Set to 0**.
    d. Set **Termination** to **1 MΩ**.
    e. Tap **Bandwidth Limit** and set to **20 MHz**.
    f. Tap outside the menu to close it.
11. Set the calibrator output to **+900 mV**, as shown in the test record, and turn the calibrator output On.
12. Enter the Mean measurement value in the test record.
13. Double-tap the channel under test badge to open its configuration menu and change the **Offset** to **-900 mV**.
14. Set the calibrator output to **-900 mV**, as shown in the test record.
15. Enter the Mean measurement value in the test record.
16. Repeat step *10* on page 89 through *15* on page 89, changing the channel vertical settings and the calibrator output as listed in the test record for the channel under test.
17. Repeat the procedure for all remaining channels as follows:
    a. Double-tap the **Mean** measurement badge.
    b. Tap the **Configure** panel.
    c. Tap the **Source 1** field and select the next channel to test.
    d. Set the calibrator to **0** volts and **1 MΩ** output impedance.
    e. Move the calibrator output to the next channel input to test.
    f. Press the channel button of the channel that you have finished testing to turn the channel off.
    g. Tap the channel button on the oscilloscope Settings bar of the next channel to test.
    h. Starting from step *2* on page 88, repeat the procedure until all channels have been tested.
18. This completes the procedure.

Check Long-term Sample Rate and Delay Time Accuracy

This test checks the sample rate and delay time accuracy (time base).

1. Push **Default Setup** on the oscilloscope front panel to set the instrument to the factory default settings.
2. Connect the output of the time mark generator to the oscilloscope channel 1 input using a 50 Ω cable. Use the time mark generator with a 50 Ω source with the oscilloscope set for internal 50 Ω termination.



3. Set the time mark generator to 80 ms. Use a time mark waveform with a fast rising edge.
4. Set the mark amplitude to 1 V_{pp}.
5. Set the channel under test settings:
   a. Double-tap the Channel 1 badge to open its configuration menu.
   b. Set **Vertical Scale** to **500 mV/div.**
   c. Set **Termination** to **50 Ω**.
   d. Tap outside the menu to close it.
6. Double-tap the **Horizontal** badge in the Settings bar.
7. Set the **Horizontal Scale** to **20 ms/div**.
8. Double-tap the **Trigger** badge in the Settings bar.
9. Adjust the **Trigger Level** for a triggered display.
10. Adjust the vertical **Position** knob to center the time mark on center screen.
11. Adjust the **Horizontal Position** knob counterclockwise to set the delay to exactly 80 ms.
12. Set the **Horizontal Scale** to **400 ns/div**.
13. Compare the rising edge of the marker to the center horizontal graticule. The rising edge should be within ±2 divisions of the center graticule. Enter the deviation in the test record. See *Sample Rate and Delay Time Accuracy* on page 55.

   Note: One division of displacement from graticule center corresponds to a 5 ppm time base error.

   This completes the procedure.

Check Random Noise Sample Acquisition Mode

This test checks random noise. You do not need to connect any test equipment to the oscilloscope for this test.

1. Disconnect everything connected to the oscilloscope inputs.
2. Push **Default Setup** on the front panel to set the instrument to the factory default settings. This sets the oscilloscope to Channel 1, Full Bandwidth, 1 MΩ input termination, 100 mV/div, and 4.00 μs/div.
3. Double-tap the **Horizontal** settings badge.
4. Set **Horizontal Scale** to **10 ms/div**.
5. Double-tap the Channel badge of the channel being tested.
6. Set **Termination** to 50 Ω.
7. Set the **Bandwidth Limit** to the desired bandwidth.

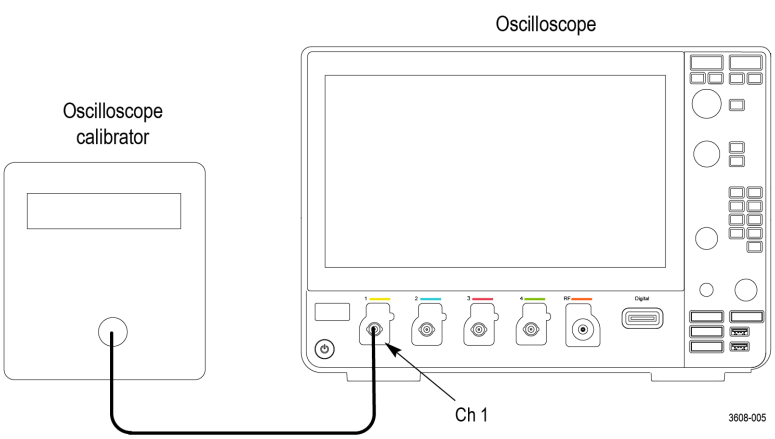
8. Add the **AC RMS** measurement:
   a. Tap the **Measure** button.
   b. Set the **Source** to the channel being tested.
   c. In the **Amplitude Measurements** panel, tap the **AC RMS** measurement button and then tap the **Add** button to add the measurement badge to the Results bar.
   d. Double-tap the **AC RMS** measurement badge and tap **Show Statistics in Badge** to display statistics in the measurement badge.
   e. Tap outside the menu to close it.
9. Add the **Mean** measurement:
   a. Tap the **Measure** button.
   b. Set the **Source** to the channel being tested.
   c. In the **Amplitude Measurements** panel, tap the **Mean** measurement button and then tap the **Add** button to add the measurement badge to the Results bar.
   d. Double-tap the **Mean** measurement badge and tap **Show Statistics in Badge** to display statistics in the measurement badge.
   e. Tap outside the menu to close it.
10. Record the measurements.
11. Calculate RMS noise voltage = Square root of (RMS^2 – $Mean^2$), and record the result.
12. The calculated RMS noise voltage from step *11* on page 91. should be less than the high limit in the test record (the calculated maximum RMS noise).
13. Repeat the above test for the other bandwidths listed in the test record.
14. Repeat the above test for all other input channels. Channels 3 and 4 are only available on four channel oscilloscopes.

This completes the procedure.

Check Delta Time Measurement Accuracy

This test checks the Delta time measurement accuracy (DTA) for a given instrument setting and input signal.

1. Set the sine wave generator output impedance to 50 Ω.
2. Connect a 50 Ω coaxial cable from the signal source to the oscilloscope channel being tested.



WARNING: Set the generator output to Off or 0 volts before connecting, disconnecting, or moving the test hookup during the performance of this procedure. The generator is capable of providing dangerous voltages.

3. Push the oscilloscope front-panel **Default Setup** button.
4. Double-tap the badge of the channel under test to open its configuration menu.

5. Set **Termination** to **50 Ω**.
6. Set the **Vertical Scale** to a value in the test record being tested.
7. Tap outside the menu to close it.
8. Double-tap the **Trigger** badge, and then, if necessary, set the **Trigger Source** to the channel being tested:
9. Tap outside the menu to close it.
10. Double-tap the **Horizontal** badge.
11. Set the **Horizontal Scale** to a value in the test record being tested.
12. Tap outside the menu to close it.
13. Add a **Burst Width** measurement for the channel under test:
    a. Tap the **Measure** button.
    b. Tap the **Time Measurements** panel.
    c. Tap the **Burst Width** measurement and then tap the **Add** button to add the measurement badge to the Results bar.
    d. Tap outside the menu to close it.
14. Double-tap the **Burst Width** results badge to open the measurement configuration menu.
15. Tap **Show Statistics in Badge** to display the measurement statistics in the results badge.
16. Tap outside the menu to close it.
17. Refer to the Test Record *Delta Time Measurement Accuracy* table. See *Delta Time Measurement Accuracy Tests* on page 63. Set the oscilloscope and the signal source as directed there.
18. Push **More** on the lower menu to select **Statistics**, and then push **Reset Statistics.** Wait five or 10 seconds for the oscilloscope to acquire all the samples before taking the reading.
19. Verify that the **Std Dev** is less than the upper limit shown for each setting, and note the reading in the Test Record.
20. Repeat steps *4* on page 91 through *19* on page 92 for each setting combination shown in the Test Record for the channel being tested.
21. Push the channel button on the front panel for the current channel to shut off the channel. Push the channel button for the next channel to be tested, and move the coaxial cable to the appropriate input on the oscilloscope. Only the channel being tested should be enabled
22. Repeat steps *4* on page 91 through *21* on page 92 until all channels have been tested.

    ⚠ **Note:** For this test, enable only one channel at a time. If additional channels are enabled at the same time, the maximum sample rate is reduced and the limits in the Test Record are no longer valid.

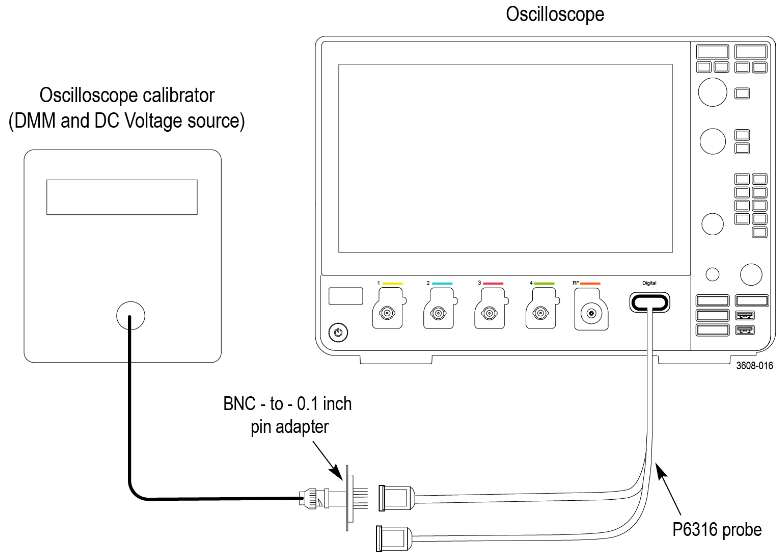
    This completes the procedure.

Check Digital Threshold Accuracy (with 3-MSO option)

For models with the 3-MSO option only, this test checks the threshold accuracy of the digital channels. This procedure applies to digital channels D0 through D15, and to channel threshold values of 0 V and +4 V.

1. Connect the P6316 digital probe to the instrument.
2. Connect the P6316 Group 1 pod to the DC voltage source to run this test. You will need a BNC-to-0.1 inch pin adapter to complete the connection.

    ⚠ **Note:** If using the Fluke 9500 calibrator as the DC voltage source, connect the calibrator head to the P6316 Group 1 pod. You will need a BNC-to-0.1 inch pin adapter to complete the connection.



3. Push **Default Setup** on the front panel to set the instrument to the factory default settings.
4. Display the digital channels and set the thresholds as follows:
   a. Tap the **D15-D0** button on the Settings bar.
   b. Double-tap the **D15-D0** badge on the Settings bar.
   c. Tap the **D15-D8 Turn All On** button to turn all bits on.
   d. Tap the **D7-D0 Turn All On** button to turn all bits on.
   e. Tap the D15-D8 **Thresholds** field at the bottom of the menu and set the value to **0 V**.
   f. Tap the D7-D0 **Thresholds** field at the bottom of the menu and set the value to **0 V**. The thresholds are set for the 0 V threshold check.
   g. Tap outside the menu to close it.
5. You need to record the test values in the test record row for 0 V for each digital channel. See *Digital Threshold Accuracy Tests (with 3-MSO option)* on page 69.
6. Double-tap the **Trigger** badge.
7. Tap **Slope** and change the slope to rising edge.
8. Set the **Source** to the appropriate channel, such as D0.

   By default, the Type is set to Edge, Coupling is set to DC, Slope is set to Rising, Mode is set to Auto, and Level is set to match the threshold of the channel being tested.
9. Tap outside the menu to close it.
10. Set the DC voltage source (Vs) to -400 mV. Wait 3 seconds. Check the logic level of the corresponding digital channel in the display.

    If the channel is a static logic level high (green), change the DC voltage source Vs to -500 mV.
11. Increment Vs by +20 mV. Wait 3 seconds and check the logic level of the corresponding digital channel in the display. If the channel is at a static logic level high (green), record the Vs value as in the 0 V row of the test record.

    If the channel is a logic level low (blue) or is alternating between high and low, repeat this step (increment Vs by 20 mV, wait 3 seconds, and check for a static logic high). Continue until a value for **Vs-** is found.

    ⚠ **Note:** In this procedure, the channel might not change state until after you pass the set threshold level.
12. Double-tap the **Trigger** badge.
13. Tap **Slope** and change the slope to falling edge.
14. Tap outside the menu to close it.

15. Set the DC voltage source (Vs) to +400 mV. Wait 3 seconds. Check the logic level of the corresponding digital channel in the display.

    If the channel is a static logic level low (blue), change the DC voltage source Vs to +500 mV.

16. Decrement Vs by -20 mV. Wait 3 seconds and check the logic level of the corresponding digital channel in the display. If the channel is at a static logic level low, record the Vs value as **Vs+** in the 0 V row of the test record.

    If the channel is a logic level high (green) or is alternating between high and low, repeat this step (decrement Vs by 20 mV, wait 3 seconds, and check for a static logic low). Continue until a value for **Vs+** is found.

17. Find the average, V_{sAvg} = (Vs- + Vs+)/2. Record the average as the test result in the test record.

    Compare the test result to the limits. If the result is between the limits, continue with the procedure to test the channel at the +4 V threshold value.

18. Repeat the procedure starting with step *6* on page 93 for each remaining digital channel.
19. Double-tap the **Trigger** badge.
20. Set the **Source** to the appropriate channel, such as D0.
21. Tap **Slope** and change the slope to falling edge.
22. The remaining part of this procedure is for the +4 V threshold test.

    a. Double-tap the **D15-D0** badge on the Settings bar.
    b. Tap the **D15-D8 Turn All On** button to turn all bits on.
    c. Tap the **D7-D0 Turn All On** button to turn all bits on.
    d. Tap the D15-D8 **Thresholds** field at the bottom of the menu and set the value to **4.00 V**.
    e. Tap the D7-D0 **Thresholds** field at the bottom of the menu and set the value to **4.00 V**.
    f. Tap outside the menu to close it.

23. Set the DC voltage source (Vs) to +4.4 V. Wait 3 seconds. Check the logic level of the corresponding digital channel in the display.

    If the channel is a static logic level low (blue), change the DC voltage source Vs to +4.5 V.

24. Decrement Vs by -20 mV. Wait 3 seconds and check the logic level of the corresponding digital channel in the display. If the channel is at a static logic level low, record the Vs value as **Vs+** in the 4 V row of the test record.

    If the channel is a logic level high (green) or is alternating between high and low, repeat this step (decrement Vs by 20 mV, wait 3 seconds, and check for a static logic low). Continue until a value for **Vs+** is found.

25. Double-tap the **Trigger** badge.
26. Tap **Slope** and change the slope to rising edge.
27. Tap outside the menu to close it.
28. Set the DC voltage source (Vs) to +3.6 V. Wait 3 seconds. Check the logic level of the corresponding digital channel in the display.

    If the channel is a static logic level high (green), change the DC voltage source Vs to +3.5 V.

29. Increment Vs by +20 mV. Wait 3 seconds and check the logic level of the corresponding digital channel in the display. If the channel is at a static logic level high, record the Vs value as in the 4 V row of the test record.

    If the channel is a logic level low (blue) or is alternating between high and low, repeat this step (increment Vs by 20 mV, wait 3 seconds, and check for a static logic high). Continue until a value for **Vs-** is found.

30. Find the average, V_{sAvg} = (Vs- + Vs+)/2. Record the average as the test result in the test record.

    Compare the test result to the limits. If the result is between the limits, the channel passes the test.

31. Repeat the procedure starting with step *19* on page 94 for each digital channel.

    This completes the procedure.

Check Displayed Average Noise Level (DANL)

This test does not require an input signal.

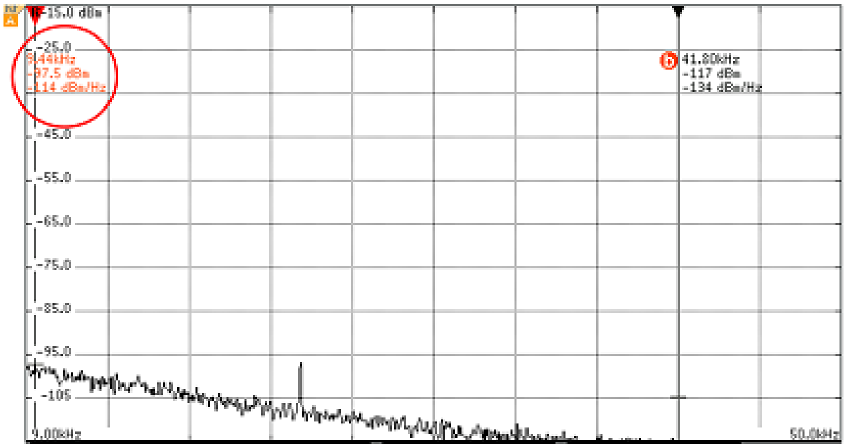
The test measures the average internal noise level of the instrument, ignoring residual spurs.

It checks these ranges:

- 9 kHz to 50 kHz
- 50 kHz to 5 MHz
- 5 MHz to 1GHz
- 5 MHz to 2 GHz (3-SA3 installed)
- 2 GHz to 3 GHz (3-SA3 installed)

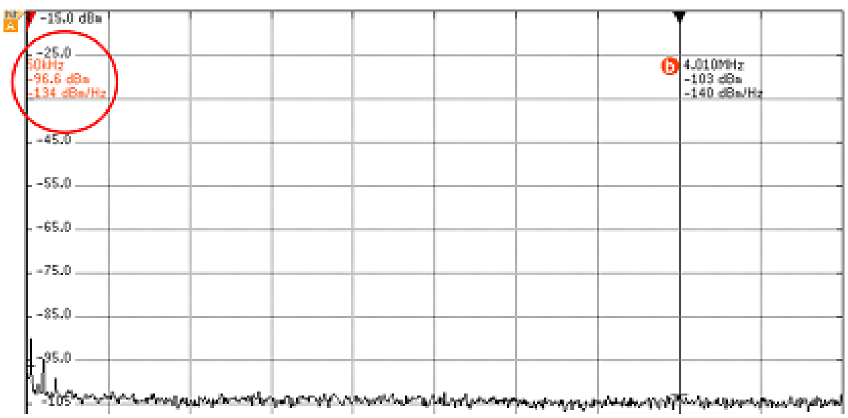
Note: If the specific measurement frequency results in measuring a residual spur that is visible above the noise level, the DANL specification applies not to the spur but to the noise level on either side of the spur. Please refer to the Spurious Response specifications.

1. *Initial oscilloscope setup:*
   a. Terminate the RF input in 50 Ω with no input signal applied.
   b. Push the **Default Setup** button on the front panel.
   c. Tap the **RF** button to turn on the RF channel.
   d. *Turn on the average trace as follows:*
      i. Double-tap the **RF** badge to open the RF VERTICAL SETTINGS configuration menu.
      ii. Tap **TRACES** to open the TRACES panel.
      iii. Tap Spectrum Traces **Normal** to turn off Normal.
      iv. Tap Spectrum Traces **Average** to turn on Average.
   e. *Turn on the average detection as follows:*
      i. Tap the Detection Method **Manual** button.
      ii. For the Average Spectrum Trace touch **Detection Type** and select **Average** from the drop-down list.
   f. *Set the reference level to –15 dBm as follows:*
      i. Tap **Vertical Settings** to open the Vertical Settings panel.
      ii. Tap **Reference Level** and set the Ref Level to **–15.0 dBm**.
   g. *Set the start and stop frequency as follows:*
      i. Double-tap the **Horizontal** badge.
      ii. Tap **Start Frequency** and set the start frequency to **9 kHz**.
      iii. Tap **Stop Frequency** and set the stop frequency to **50 kHz**.
2. *Check from 9 kHz to 50 kHz:*
   a. Set Manual Marker (a) at the frequency with the highest noise level as follows: Tap the **Cursors** button. Turn Multipurpose knob **a** to move the marker to the frequency at the noise threshold (highest point of noise), ignoring any spurs. For this span, it should be near 9 kHz on the far left of the screen. See the following figure.



   b. Record the noise threshold value (in dBm/Hz) in the test record and compare it to the instrument specification.

3. In the test record, enter the result at this frequency (9 kHz).
4. *Check from 50 kHz to 5 MHz:*
   a. Double-tap the **Horizontal** badge.
   b. Tap **Stop Frequency** and set the stop frequency to **5 MHz**.
   c. Tap **Start Frequency** and set the start frequency to **50 kHz**.
   d. Tap **Span** and set the Span to **10 MHz**.
   e. Set marker (a) at the frequency of the highest noise, ignoring any spurs.
   f. Tap **Center Frequency** and set the frequency to **2.525 MHz**.
   a. Record the highest noise value (in dBm/Hz) in the test record and compare it to the instrument specification.



5. In the test record, enter the result at this frequency (50 kHz).
6. *Check from 5 MHz to 1 GHz (3-SA3 not installed):*
   a. Set the **Stop Frequency** to **1 GHz**.
   b. Set the **Start Frequency** to **5 MHz**.
   c. Set marker (a) at the frequency of the highest noise, ignoring any spurs.
   d. Tap **Center Frequency** and set the frequency to half the maximum bandwidth.
   e. *Set the span to 10 MHz as follows:* Tap **Span** and set the Span to **10 MHz**.
   f. Record the highest noise value (in dBm/Hz) in the test record and compare it to the instrument specification.
7. *Check from 5 MHz to 2 GHz (3-SA3 installed).*
   a. Set the **Stop Frequency** to **2 GHz**.

b. Set the **Start Frequency** to **5 MHz**.
c. Set marker (a) at the frequency of the highest noise, ignoring any spurs.
d. Tap **Center Frequency** and set the frequency to **1 GHz**.
e. *Set the span to 10 MHz as follows:* Tap **Span** and set the Span to **10 MHz**.
f. Record the highest noise value (in dBm/Hz) in the test record and compare it to the instrument specification.

8. *Check from 2 GHz to 3 GHz (3-SA3 installed).*
   a. Set the **Stop Frequency** to **3 GHz**.
   b. Set the **Start Frequency** to **2 GHz**.
   c. Set marker (a) at the frequency of the highest noise, ignoring any spurs.
   d. Tap the **Center Frequency** and set the frequency to**1.5 GHz**.
   e. *Set the span to 10 MHz as follows:* Tap **Span** and set the Span to **10 MHz**.
   f. Record the highest noise value (in dBm/Hz) in the test record and compare it to the instrument specification.

This completes the procedure.

Check Residual Spurious Response

This check verifies that the oscilloscope meets the specification for residual spurious response. This check does not require an input signal.

1. *Initial Setup:*
   a. Terminate the oscilloscope RF input in 50 Ω with no input signal applied.
   b. Push **Default Setup**.
   c. Tap **RF**. Double-tap the **RF** badge.
   d. Tap **TRACES** to open the Traces panel
   e. Tap Spectrum Traces **Average** to select **Average**. Tap Spectrum Traces **Normal** to turn off Normal.
   f. Tap **VERTICAL SETTINGS** to open the panel.
   g. Tap **Reference Level** and set **Ref Level** to **–15 dBm**.
2. *Check in the range of 9 kHz to 50 kHz (all models).*
   a. Double-tap the **Horizontal** badge.
   b. Tap **Start Frequency** and set the start frequency to **9 kHz**.
   c. Tap **Stop Frequency** and set the stop frequency to **50 kHz**.
   d. Observe any spurs above –78 dBm and note them in the test record.
3. *Check in the range of 50 kHz to 5 MHz .*
   a. Set **Stop Frequency** to **5 MHz**.
   b. Set **Start Frequency** to **50 kHz**.
   c. Observe any spurs above –78 dBm and note them in the test record.
4. *Check in the range of 5 MHz to 1GHz (3-SA3 not installed):*
   a. Set **Stop Frequency** to **1 GHz**.
   b. Set **Start Frequency** to **5 MHz**.
   c. Set **RBW** to **100 kHz**.
   d. Observe any spurs above –78 dBm and note them in the test record.
5. *Check in the range of 5 MHz to 2 GHz (3-SA3 installed):*

a. Set **Stop Frequency** to **2 GHz**.
b. Set **Start Frequency** to **5 MHz**.
c. Set **RBW** to **100 kHz**.
d. Check the spur level at 1.25 GHz, if present. Turn the **Multipurpose a** knob to line up the marker on the 1.25 GHz spur, if it is present. Adjust the marker until the horizontal dash on the marker sits on top of the spur. Note the spur level in the test record.
e. Observe any spurs above –78 dBm in the rest of the span, and note them in the test record.

6. *Check in the range of 2 GHz to 3 GHz (3-SA3 installed):*

a. Set **Stop Frequency** to the **3 GHz**.
b. Set **Start Frequency** to **2 GH**z.
c. Set **RBW** to **100 kHz**.
d. Check the spur level at 2.5 GHz, if present. Turn the **Multipurpose a** knob to line up the marker on the 2.5 GHz spur, if it is present. Adjust the marker until the horizontal dash on the marker sits on top of the spur. Note the spur level in the test record.
e. Observe any spurs above –78 dBm in the rest of the span, and note them in the test record.

This completes the procedure.

Check Level Measurement Uncertainty

This test checks the level measurement uncertainty at three reference levels: +10 dBm, 0 dBm, and –15 dBm. This check uses the generator to step frequencies across four spans to verify that the instrument meets the specification.

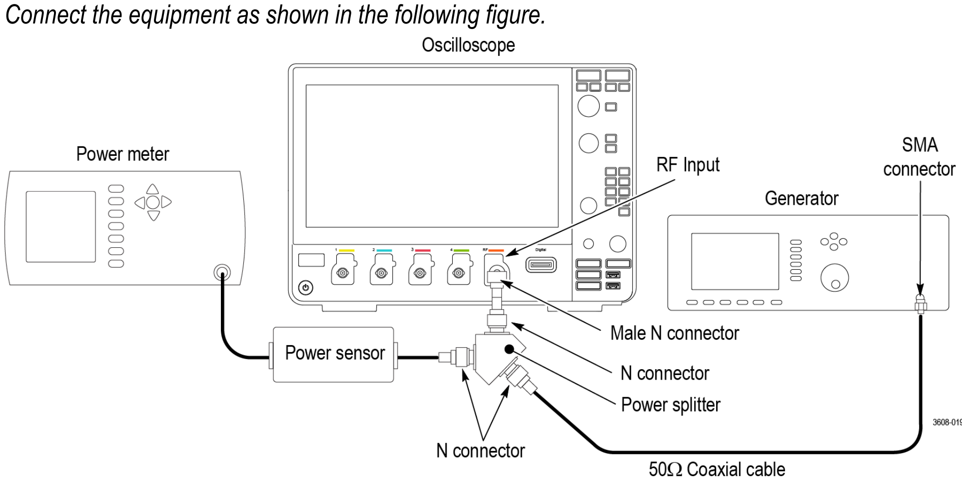
For this check, you will need the following equipment, which is described in the Required Equipment table. See *Table 3* on page 40.

- RF signal generator
- Power meter
- Power sensor
- Power splitter
- Adapters and cables as shown in the following figure.

WARNING: The generator is capable of providing dangerous voltages. Be sure to set the generator to off or 0 volts before connecting, disconnecting, and/or moving the test hookup during the performance of this procedure.

Note: Use an SMA connector with the RF signal generator. Equipment damage will result if an N connector is used.

1. *Connect the equipment as shown in the following figure.*



2. *Initial oscilloscope setup:*

a. Push the **Default Setup** button on the front panel.

b. Tap **RF** to turn on the RF channel.

3. *Check at +10 dBm:*

a. Double-tap the **RF** badge.

b. Set the reference level to +10 dBm as follows: Tap **Reference Level** and set the Reference Level to **+10 dBm**.

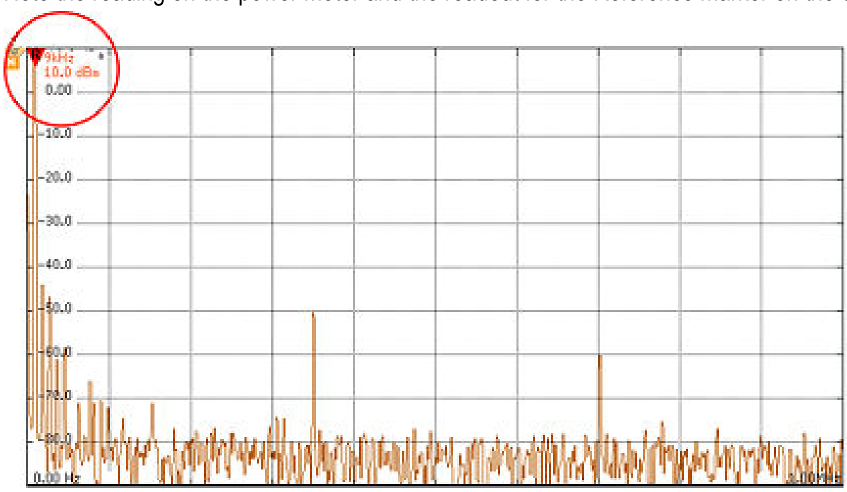
c. *Set the frequency range as follows:*

- Double-tap the **Horizontal** badge.
- Tap **Start Frequency** and set the Start Frequency to **0 Hz**.
- Tap **Stop Frequency** ans set the stop frequency to **1 MHz**.

d. Set the generator to provide a **9 kHz**, **+10 dBm** signal.

e. At 9 kHz, determine the test result as follows:

- Note the reading on the power meter and the readout for the Reference marker on the oscilloscope. See the following figure.



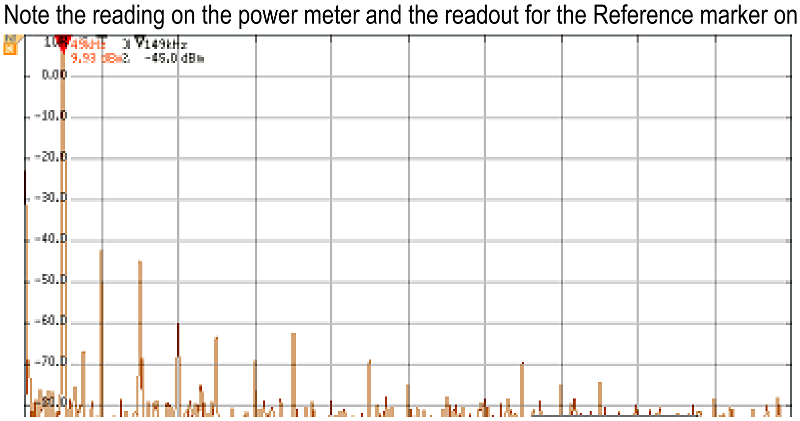
- Calculate the difference between the two readings. This is the test result.

f. In the test record, enter the result at this frequency (9 kHz).

g. Set the generator to provide a **50 kHz**, **+10 dBm** signal.

h. At 50 kHz, determine the test result as follows:

- Note the reading on the power meter and the readout for the Reference marker on the oscilloscope. See the following figure.



- Calculate the difference between the two readings. This is the test result.

i. In the test record, enter the result at this frequency (50 kHz).

j. Step the generator, in 100 kHz intervals, through frequencies from 100 kHz to 900 kHz. At each interval, determine the test result as follows:

- Note the reading on the power meter and the readout for the Reference marker on the oscilloscope.
- Calculate the difference between the two readings. This is the test result.

k. In the test record, enter the greatest result determined within this frequency range (100 kHz – 900 kHz).

l. *Change the frequency range as follows:*

- Change the stop frequency to **9.2 MHz**.
- Change the start frequency to **980 kHz**.

m. Set the generator to provide a **1 MHz**, **+10 dBm** signal.

n. Step the generator, in 1 MHz intervals, through frequencies from 1 MHz to 9 MHz. At each interval, determine the test result as follows:

- Note the reading on the power meter and the readout for the Reference marker on the oscilloscope.
- Calculate the difference between the two readings. This is the test result.

o. In the test record, enter the greatest result determined within this frequency range (1 MHz to 9 MHz).

p. *Change the frequency range as follows:*

- Change the **Stop Frequency** to **92 MHz**.
- Change the **Start Frequency** to **9.8 MHz**.

q. Set the generator to provide a **10 MHz**, **+10 dBm** signal.

r. Step the generator, in 10 MHz intervals, through frequencies from 10 MHz to 90 MHz. At each interval, determine the test result as follows:

- Note the reading on the power meter and the readout for the Reference marker on the oscilloscope.
- Calculate the difference between the two readings. This is the test result.

s. In the test record, enter the greatest result determined within this frequency range (10 MHz to 90 MHz).

For all models without the 3-SA3 3 GHz option (See steps *3.t* on page 100 through *3.w* on page 100.)

t. *Change the frequency range as follows:*

- Change the **Stop Frequency** to the maximum bandwidth.
- Change the **Start Frequency** to **99 MHz**.

u. Set the generator to provide a **100 MHz**, **+10 dBm** signal.

v. Step the generator, in 100 MHz intervals, through frequencies from 100 MHz to the maximum bandwidth. At each interval, determine the test result as follows:

- Note the reading on the power meter and the readout for the Reference marker on the oscilloscope.
- Calculate the difference between the two readings. This is the test result.

w. In the test record, enter the greatest result determined within this frequency range (100 MHz to 3 GHz).

For models with the 3-SA3 3 GHz option (See steps *3.x* on page 100 through *3.aa* on page 101.)

x. *Change the frequency range as follows:*

- Change the **Stop Frequency** to **3 GHz**.
- Change the **Start Frequency** to **99 MHz**.

y. Set the generator to provide a **100 MHz**, **+10 dBm** signal.

z. *Step the generator, in 100 MHz intervals, through frequencies from 100 MHz to 3 GHz. At each interval, determine the test result as follows:*

- Note the reading on the power meter and the readout for the Reference marker on the oscilloscope.
- Calculate the difference between the two readings. This is the test result.

aa. In the test record, enter the greatest result determined within this frequency range (100 MHz to 3 GHz).

4. *Repeat the previous step with these changes:*

a. Set the **Reference Level** to **0 dBm**.

b. Set the generator level to **0 dBm**.

5. *Repeat the previous step with these changes:*

a. Set the **Reference Level** to **–15 dBm**.

b. Set the generator level to **–15 dBm**.

Functional check of the 3 Series MDO with a TPA-N-PRE attached to its RF Input

The following instructions apply to situations where the 3 Series MDO has a TPA-N-PRE preamplifier attached to its RF input

Perform the following functional check to ensure proper operation of the TPA-N-PRE/3 Series MDO system.

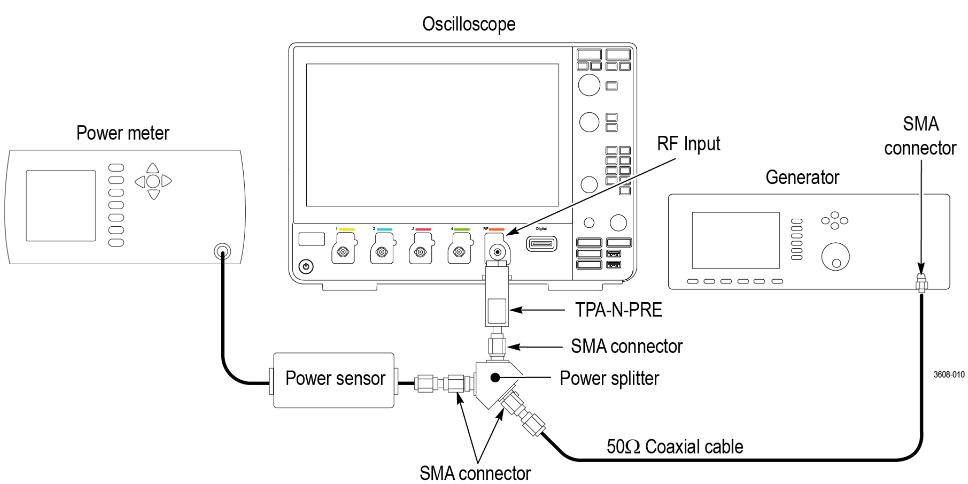
For this check, you will need the following equipment, which is described in the Required Equipment table. See *Table 3* on page 40.

- RF signal generator
- Power meter
- Power sensor
- Power splitter
- Adapters and cables as shown in the following figure.

WARNING: The generator is capable of providing dangerous voltages. Be sure to set the generator to off or 0 volts before connecting, disconnecting, and/or moving the test hookup during the performance of this procedure.

Note: Use an SMA connector with the RF signal generator. Equipment damage will result if an N connector is used.

1. *Connect the equipment as shown in the following figure.*



2. *Initial oscilloscope setup:*

a. Push the front-panel **Default Setup** button.

b. Tap **RF** to turn on the RF channel.

c. Double-tap the **RF** badge.

d. Tap **TRACES** to open the panel.

e. Push the Menu button on the TPA-N-PRE preamplifier. On the 3 Series MDO, verify that the **Detection Method** is set to **Auto**.

3. Check at 1.7 GHz

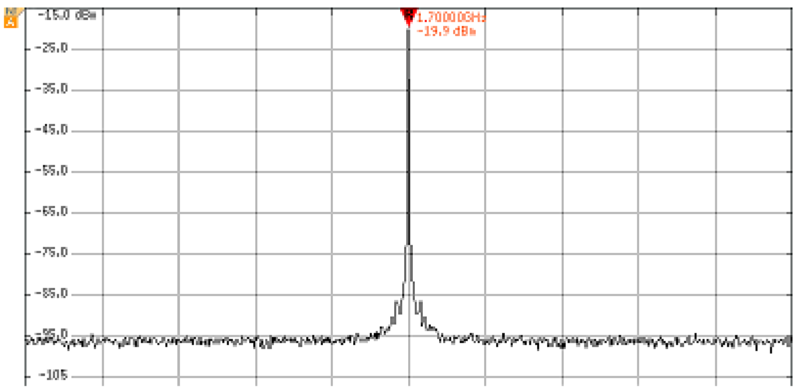
   a. Set the reference level to –15 dBm as follows: Tap **VERTICAL SETTINGS** to open the panel. Tap **Reference Level** and set the Reference Level to **–15 dBm**.

   b. *Set the frequency range as follows:*

      - Double-tap the **Horizontal** badge.
      - Tap **Center Frequency** and set the center frequency to **1.7 GHz**.
      - Tap **Span** and set the span to **50 MHz**.

   a. Set the generator to provide a **1.7 GHz**, **–20 dBm** signal.

   b. Note the reading on the power meter and the readout for the Reference marker on the oscilloscope. See the following figure:



   c. The absolute difference between the two readings should be small (~ 1.5 dB or less). If the 3 Series MDO reading is too low, tighten the preamp more firmly to the oscilloscope by hand and check the reading again.

   d. Check at the –30 dBm reference level.

      - Set the generator to provide a **1.7 GHz**, **–35 dBm** signal.
      - Double-tap the **RF** badge. Tap **Reference Level** and set the reference level to **–30 dBm**.
      - Compare the oscilloscope and the power meter readings as before. The absolute difference between the readings should be ~1.5 dB or less. If the oscilloscope reading is too low, tighten the preamp more firmly to the oscilloscope by hand and check the reading again.

4. Check at 2.9 GHz

   a. Double-tap the **RF** badge. Tap **Reference Level** and set the reference level to **–15 dBm**.

   b. *Set the frequency range as follows:*

      - Double-tap the **Horizontal** badge.
      - Tap **Center Frequency** and set the center frequency to **2.9 GHz**.
      - Tap **Span** and set the span to **50 MHz**.

   c. Set the generator to provide a **2.9 GHz**, **–20 dBm** signal.

   d. Note the reading on the power meter and the readout for the Reference marker on the oscilloscope.

   e. The absolute difference between the two readings should be small (~ 1.5 dB or less). If the oscilloscope reading is too low, tighten the preamp more firmly to the oscilloscope by hand and check the reading again.

   f. Check at the –30 dBm reference level.

      - Set the generator to provide a **2.9 GHz**, **–35 dBm** signal.
      - Double-tap the **RF** badge. Tap **Reference Level** and set the reference level to **–30 dBm**.
      - Compare the oscilloscope and the power meter readings as before. The absolute difference between the readings should be ~1.5 dB or less. If the oscilloscope reading is too low, tighten the preamp more firmly to the oscilloscope by hand and check the reading again.

This completes the procedure.

Check Displayed Average Noise Level (DANL) with a TPA-N-PRE Attached:

This test does not require an input signal.

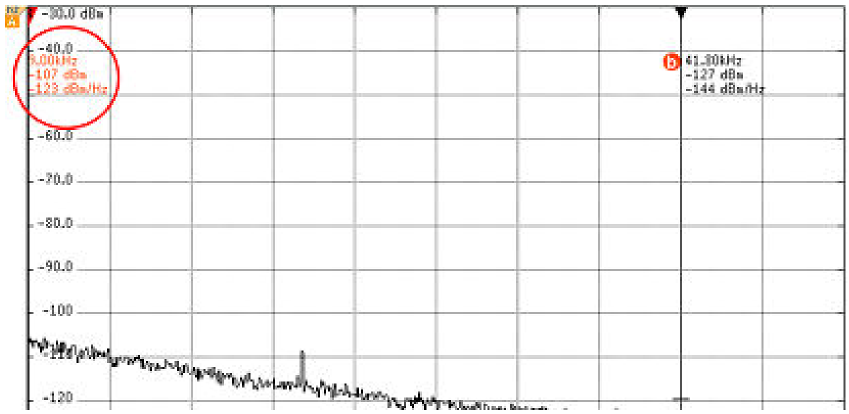
The test measures the average internal noise level of the instrument, ignoring residual spurs.

It checks these ranges:

- 9 kHz to 50 kHz
- 50 kHz to 5 MHz
- 5 MHz to 1GHz (3-SA3 not installed)
- 5 MHz to 2 GHz (3-SA3 installed)
- 2 GHz to 3 GHz (3-SA3 installed)

Note: If the specific measurement frequency results in measuring a residual spur that is visible above the noise level, the DANL specification applies not to the spur but to the noise level on either side of the spur. Please refer to the Spurious Response specifications. See on page 0

1. *Initial oscilloscope setup:*
   - **a.** Terminate the TPA-N-PRE preamp input in 50 Ω and make sure that no input signal is applied.
   - **b.** Push the front-panel **Default Setup** button.
   - **c.** Tap **RF** to turn on the RF channel.
   - **d.** Double-tap the **RF** badge.
   - **e.** *Turn on the average trace as follows:*
     - Tap **TRACES** to open the panel.
     - Tap the Spectrum Traces **Average** button to set average trace to **On**.
     - Tap the Spectrum Traces **Normal** button to set normal trace to **Off**.
   - **f.** *Turn on average detection as follows:*
     - Tap Detection Method **Manual** button.
     - Tap Detection Type and select **Average** from the drop down list.
   - **g.** Push the **Menu** button on the TPA-N-PRE preamplifier.
   - **h.** Double-tap the **Horizontal** badge. On the oscilloscope, verify that the **RBW Mode** is set to **Auto**.
   - **i.** *Set the reference level to –30.0 dBm as follows:*
     - Double-tap the **RF** badge.
     - Tap the **Reference Level** button and set the Reference Level to **–30.0 dBm**.
2. *Check from 9 kHz to 50 kHz (all models):*
   - **a.** *Set the stop and start frequencies as follows:*
     - Double-tap the **Spectrum** badge.
     - Tap **Stop Frequency** button and set the stop frequency to **50 kHz**.
     - Tap **Start Frequency** button and set the start frequency to **9 kHz**.
     - Wait 60 seconds. Due to the low RBW for this span, it takes a little while for the instrument to compute a valid average.
   - **b.** Set Marker (a) at the frequency with the highest noise level as follows:
     - Turn Multipurpose knob **a** to move the marker to the frequency at the noise threshold (highest point of noise), ignoring any spurs. See the following figure.



c. Record the highest noise value (in dBm/Hz) in the test record and compare it to the instrument specification.

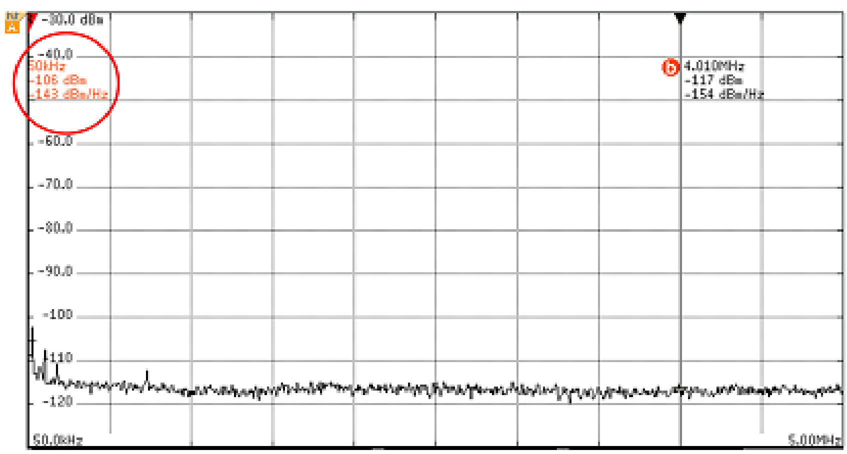
3. *Check from 50 kHz to 5 MHz (all models):*

a. *Set the start and stop frequency as follows:*

- Tap **Stop Frequency** button and set the stop frequency to **5 MHz**.
- Tap **Start Frequency** button and set the start frequency to **50 kHz**.

b. *Set Marker (**a**) at the frequency with the highest noise level as follows:*

- Turn Multipurpose knob **a** to move the marker to the frequency at the noise threshold (highest point of noise), ignoring any spurs. See the following figure.



c. Record the noise threshold value (in dBm/Hz) in the test record and compare it to the instrument specification.

4. *Check from 5 MHz to 1 GHz (3-SA3 not installed)*

a. Tap **Stop Frequency** and set the stop frequency to **1 GHz**.

b. Tap **Start Frequency** and set the start frequency to **5 MHz**.

c. Set Marker (**a**) at the frequency of the highest noise, ignoring any spurs.

d. *Tap **Center Frequency** and set the frequency to the center frequency:*

e. Tap **Span** and set the Span to **10 MHz**.

a. Record the highest noise value (in dBm/Hz) in the test record and compare it to the instrument specification.

5. *Check from 5 MHz to 2 GHz (3-SA3 installed)*

a. Tap **Stop Frequency** and set the stop frequency to **2 GHz**.

b. Tap **Start Frequency** and set the start frequency to **5 MHz**.

c. Set Marker (**a**) at the frequency of the highest noise, ignoring any spurs.

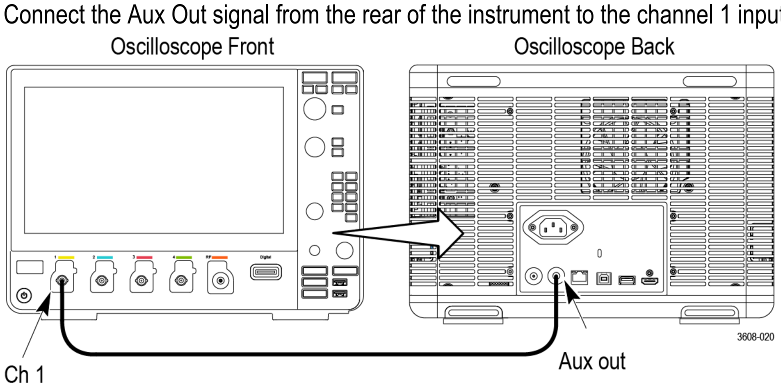
   - d. Tap **Center Frequency** and set the frequency to the center frequency.
   - e. Tap **Span** and set the Span to **10 MHz**.
   - f. Record the highest noise value (in dBm/Hz) in the test record and compare it to the instrument specification.
6. *Check from 2 GHz to 3 GHz (3-SA3 installed):*
   - a. Tap **Stop Frequency** and set the stop frequency to **3 GHz**.
   - b. Tap **Start Frequency** and set the start frequency to **2 GHz**.
   - c. Set Marker (**a**) at the frequency of the highest noise, ignoring any spurs.
   - d. Tap **Center Frequency** and set the frequency to the center frequency.
   - e. Tap **Span** and set the span to **10 MHz**.
   - f. Record the highest noise value (in dBm/Hz) in the test record and compare it to the instrument specification.

This completes the procedure.

Check Auxiliary Output

This test checks the Auxiliary Output.

1. Connect the Aux Out signal from the rear of the instrument to the channel 1 input using a 50 Ω cable.



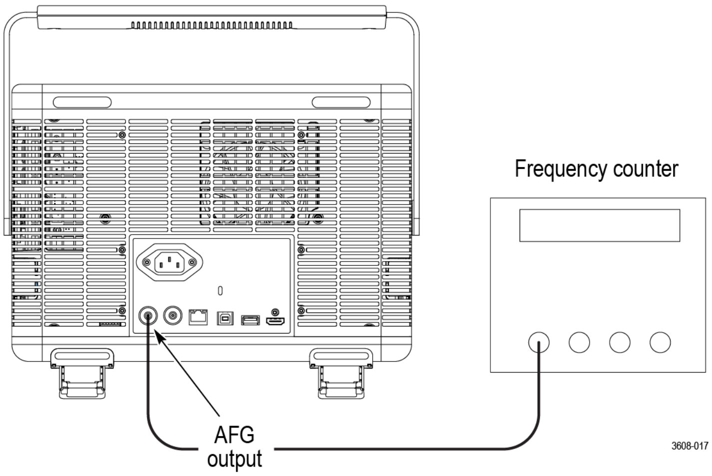
2. Push the **Default Setup** button on the front panel to set the instrument to the factory default settings.
3. Double-tap the **Ch 1** badge.
4. Set the oscilloscope termination to 1 MΩ. The default **Termination** setting is **1M Ω**.
5. Set the horizontal to 4 us/div and the vertical to 1 V/div.
6. Tap the **Measure** button.
7. Tap **Low** in the Amplitude Measurements panel, and then tap **Add**.
8. Tap **High** in the Amplitude Measurements panel, and then tap **Add**.
9. Tap outside the **Add Measurements** panel to close the menu.
10. Record the high and low measurements in the test record (for example, low = 200 mV and high = 3.52 V). See *Auxiliary (Trigger) Output Tests* on page 73.
11. Repeat the procedure, using **50 Ω** instead of **1 MΩ** in step 4.

    This completes the procedure.

Check AFG Sine and Ramp Frequency

This test checks the AFG Sine and Ramp Frequency.

1. Connect AFG output to the frequency counter.

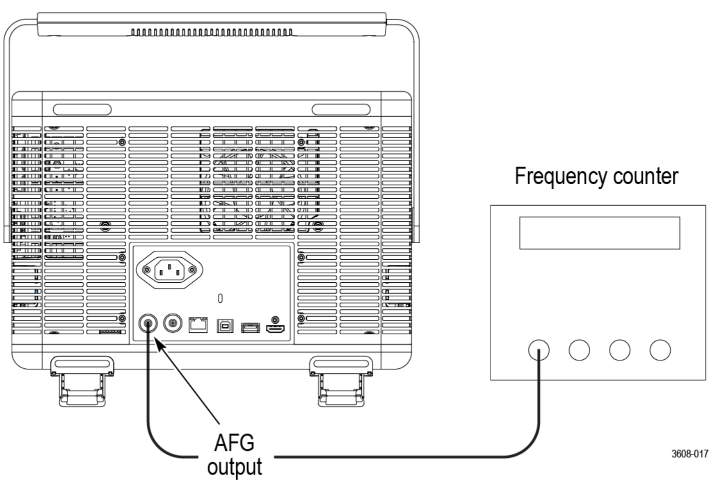


2. Push the **Default Setup** button on the oscilloscope front panel.
3. Tap the **AFG** button.
4. Tap **Waveform Type** and select **Sine** wave (or Ramp) from the drop down list.
5. Tap **Amplitude** and set the amplitude to the value shown in the test record.
6. Tap **Frequency** and the frequency to the value shown in the test record.
7. Tap **Load Impedance** and select **50 Ω**.
8. Measure frequency in the frequency counter. Compare results to the limits in the test record.
9. Repeat steps *3* on page 106 - *8* on page 106 above for all rows in the test record.

   This completes the procedure.

Check AFG Square and Pulse Frequency Accuracy

This test checks the AFG Square and Pulse Frequency Accuracy.



1. Connect the AFG output to the frequency counter.
2. Push the **Default Setup** button on the oscilloscope front panel.
3. Tap the **AFG** button.
4. Tap **Waveform Type** and select **Square** wave (or Pulse) from the list.
5. Tap **Amplitude**, set the Amplitude to the value shown in the test record.

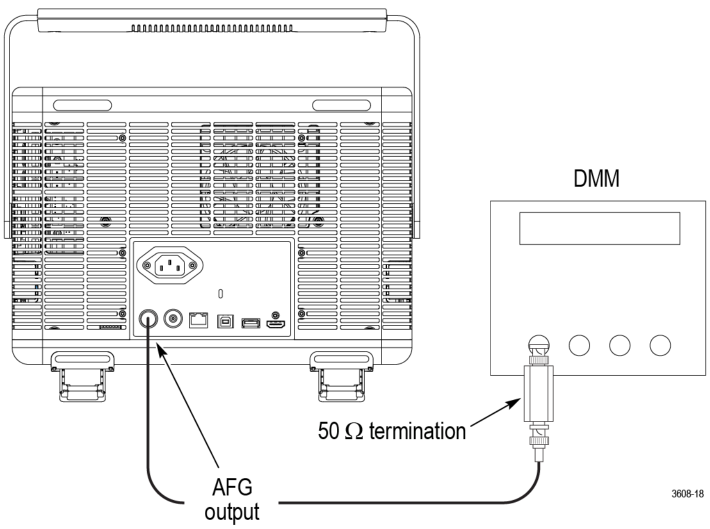
6. Tap **Frequency**, set the frequency to the value shown in the test record.
7. Tap **Load Impedance** and select **50 Ω**.
8. Measure frequency in the frequency counter. Compare results to the limits in the test record.
9. Repeat steps *3* on page 106 - *8* on page 107 for all rows in the test record.

   This completes the procedure.

Check AFG Signal Amplitude Accuracy

This test checks the AFG Signal Amplitude Accuracy.

1. Connect the AFG output to the DMM through a 50 Ω termination.



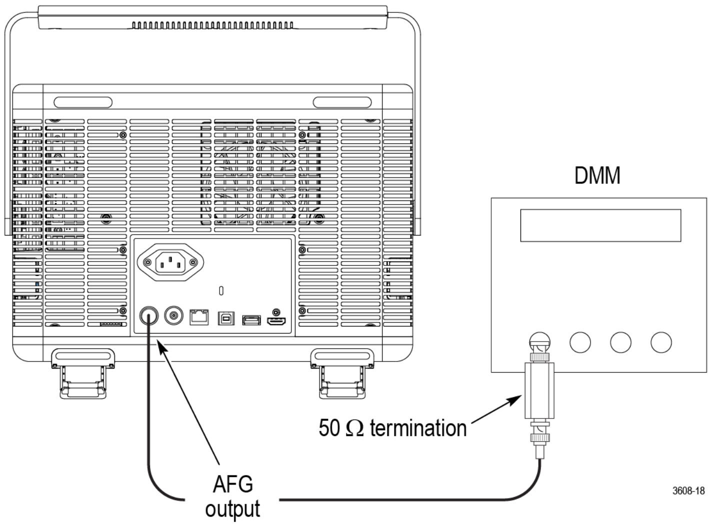
2. Push the **Default Setup** button on the oscilloscope front panel.
3. Tap the **AFG** button.
4. Tap **Waveform Type** and select **Square** from the list.
5. Tap **Amplitude** and set amplitude to the value shown in the test record.
6. Tap **Frequency** and set frequency to the value shown in the test record.
7. Tap **Load Impedance** and select **50 Ω**.
8. Set DMM to measure ACRMS Voltage.
9. Measure voltage on the DMM. Compare the result to the limits in the test record.
10. Repeat steps *3* on page 107 - *9* on page 107 above for all rows in the test record.

    This completes the procedure.

Check AFG DC Offset Accuracy

This test checks the AFG DC Offset Accuracy.

1. Connect the AFG output to the DMM through a 50 Ω termination.



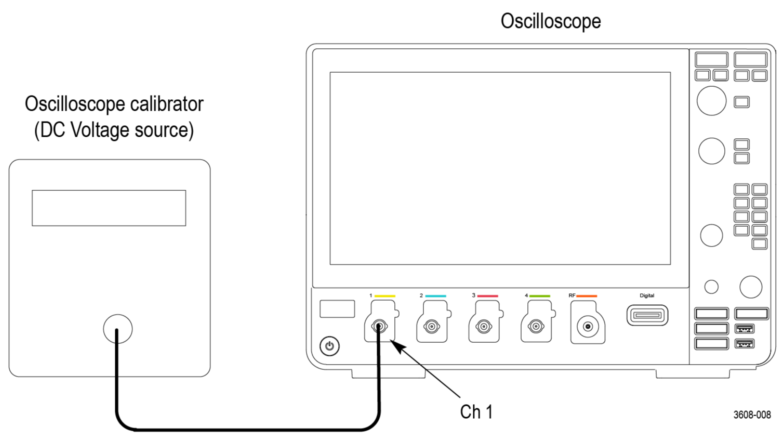
2. Push the **Default Setup** button on the oscilloscope front panel.
3. Tap the **AFG** button.
4. Tap **Waveform Type** and select **DC** from the list.
5. Tap **Amplitude** and set Amplitude to the value shown in the test record.
6. Tap **Load Impedance** and select **50 Ω**.
7. Set DMM to measure DC Voltage.
8. Measure voltage on the DMM. Compare the result to the limits in the test record.
9. Repeat steps *3* on page 108 - *8* on page 108 above for each line in the test record.

   This completes the procedure.

Check DVM Voltage Accuracy (DC)

This test checks the DVM voltage accuracy (DC).

1. Connect the oscilloscope to a DC voltage source to run this test. If using the Fluke 9500 calibrator as the DC voltage source, connect the calibrator head to the oscilloscope channel to test.



2. Push the **Default Setup** button on the front panel to set the instrument to the factory default settings.
3. Set the channel settings:

   a. Double tap the badge of the channel under test to open its menu.

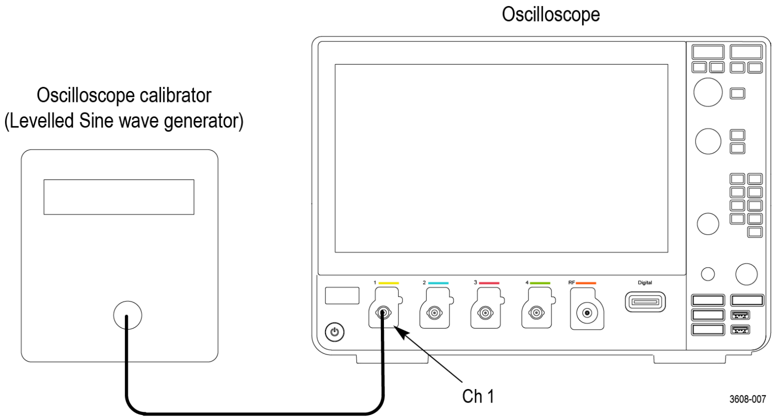
   b. Check that Position is set to 0 divs. If not, set the position to 0 divisions.
   c. Confirm that Termination is set to 1 MΩ.
   d. Set the **Bandwidth Limit** to **20 MHz**.
4. Set the calibrator impedance to 1 MΩ.
5. Turn the Horizontal **Scale** knob to 1 ms/div.
6. Double-tap the **Acquisition** badge.
7. Tap **Acquisition Mode** and select **Average** from the list. Use the default number of averages (16).
8. Tap outside the menu to close it.
9. Double-tap the **Trigger** badge.
10. Tap **Source** and select **AC Line** as the trigger source.
11. Tap outside the menu to close it.
12. Tap the **DVM** button to add the DVM badge to the Results bar.
13. Double-tap the **DVM** badge.
14. In the **DVM** menu, set **Source** to the channel to be tested.
15. Tap the Mode **DC** button to select DC mode.
16. Tap outside the menu to close it.
17. Set the calibrator to the input voltage shown in the test record (for example, –5 V for a 1 V/div setting).
18. In the channel under test menu, set the **Offset** value to that shown in the test record (for example, –5 V for –5 V input and 1 V/div setting).
19. Turn the vertical **Scale** knob to match the value in the test record (for example, 1 V/division).
20. Enter the measured value on the DVM badge in the test record. See *DVM Voltage Accuracy Tests (DC)* on page 74.
21. Repeat the procedure (steps *17* on page 109 - *20* on page 109) for each volts/division setting shown in the test record.
22. Repeat all steps, starting with step *3* on page 108, for each oscilloscope channel you want to check. To set the next channel to test:
   a. Double-tap the badge of the channel under test to open its menu
   b. Set **Display** to **Off**.
   c. Tap the channel button in the Settings bar of the next channel to test to add that channel badge and signal to the display.
23. This completes the procedure.

Check DVM Voltage Accuracy (AC)

This test checks the DVM voltage accuracy (AC).

1. Connect the output of the leveled sine wave generator (for example, Fluke 9500) to the oscilloscope channel 1 input as shown below.

   ⚠ **WARNING:** Set the generator output to Off or 0 volts before connecting, disconnecting, or moving the test hookup during the performance of this procedure. The generator is capable of providing dangerous voltages.

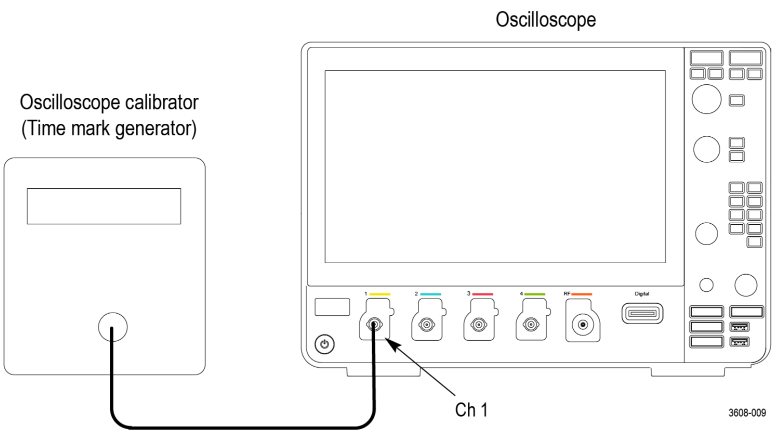


2. Set the generator to 50 Ω output impedance (50 Ω source impedance).
3. Set the generator to produce a square wave of the amplitude and frequency listed in the test record (for example, 20 mV_{pp} and 1 kHz).
4. Push **Default Setup** on the front panel to set the instrument to the factory default settings.
5. Tap **DVM** button to add the DVM badge to the Results bar.
6. Double-tap **DVM** badge.
7. Set the DVM **Mode** to **AC RMS**.
8. Set the DVM **Source** to the input channel being tested.
9. Double-tap the channel badge of the channel being tested to open its configuration menu.
10. Set the oscilloscope **Termination** to **50 Ω**.
11. Turn the vertical scale knob so that the signal covers between 4 and 8 vertical divisions on screen.
12. Enter the measured value in the test record.
13. Repeat steps *11* on page 110 and *12* on page 110 for each voltage and frequency combination shown in the test record.
14. Repeat all steps for each oscilloscope channel. To set the next channel to test:
    a. Double-tap the badge of the channel under test to open its menu.
    b. Set **Display** to **Off**.
    c. Tap the channel button in the Settings bar of the next channel to test to add that channel badge and signal to the display.
15. This completes the procedure.

Check DVM Frequency Accuracy and Maximum Input Frequency

This test checks DVM Frequency Accuracy.

1. Push **Default Setup** on the oscilloscope front panel to set the instrument to the factory default settings.
2. Connect the output of the time mark generator to the oscilloscope channel 1 input using a 50 Ω cable. Use the time mark generator with a 50 Ω source with the oscilloscope set for internal 50 Ω termination.



3. Set the time mark generator to the value shown in the test record. For example, use 9 Hz. Use a time mark waveform with a fast rising edge (square wave), except at 150 MHz use a sine wave.
4. Set the mark amplitude to 1 V_{pp}.
5. Set the oscilloscope vertical **Scale** to 200 mV/div.
6. Set the **Horizontal Scale** to 20 ms/div.
7. Adjust the **Trigger Level** for a triggered display.
8. Adjust the vertical **Position** knob to center the time mark on center screen.
9. Double-tap the **Trigger** badge.
10. Tap **MODE & HOLDOFF** to display the Mode and Holdoff panel.
11. Tap **Trigger Frequency Counter** to toggle the counter on.
12. Enter the measured value in the test record.
13. Repeat this procedure for each frequency setting shown in the record. (Keep the same vertical and horizontal scales as set in steps *5* on page 111 and *6* on page 111.)
14. Repeat all these steps for each oscilloscope channel.

    This completes the procedure.

This completes the Performance Verification procedures