



4GS/s 8 Bit Digital Storage Oscilloscope Calibration Manual

M-Class Oscilloscope
ZT4610 Series
Models ZT4611, ZT4612

User's Manual: 0004-000063
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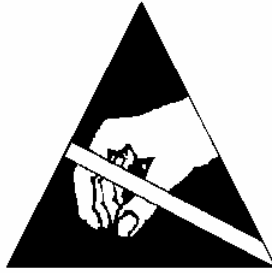
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Handling Precautions for Electronic Devices Subject to Damage by Static Electricity

This instrument is susceptible to Electronic Static Discharge (ESD) damage. When transporting, place the instrument or module in conductive (anti-static) envelopes or carriers. Open only at an ESD-approved work surface. An ESD safe work surface is defined as follows:

- The work surface must be conductive and reliably connected to an earth ground with a safety resistance of approximately 250 kilo Ohms.
- The surface must NOT be metal. A resistance of 30–300 kilo Ohms per square inch is suggested.

Ground the frame of any line-powered equipment, chassis, test instruments, lamps, soldering irons, etc., directly to the earth ground. To avoid shorting out the safety resistance, ensure that the grounded equipment has rubber feet or other means of insulation from the work surface.

Avoid placing tools or electrical parts on insulators. Do NOT use any hand tool that can generate a static charge, such as a non-conductive plunger-type solder sucker. Use a conductive strap or cable with a wrist cuff to reliably ground to the work surface. The cuff must make electrical contact directly with the skin; do NOT wear it over clothing.

Note: Resistance between the skin and the work surface is typically 250 kilo Ohms to 1 mega Ohm using a commercially-available personnel grounding device.

Avoid circumstances that are likely to produce static charges, such as wearing clothes of synthetic material, sitting on a plastic-covered stool (especially when wearing woolen material), combing the hair, or making extensive pencil erasures. These circumstances are most significant when the air is dry.

When testing static sensitive devices, ensure DC power is ON before, during, and after application of test signals. Ensure all pertinent voltages are switched OFF while circuit boards or components are removed or inserted.

Revision History

Rev	Date	Section	Description
1	July 31, 2007	All	Initial Release
1A	Sept. 10, 2007	All	Updated for ZT4612VXI models
1B	Dec. 10, 2007	ALL	Updated for all ZT4612 models

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Performance Testing



Test Environment

Operating Conditions	
Ambient temperature	0°C to 40°C
Humidity	10 to 90%, non-condensing, up to +40 °C
Warm up time	30 minutes

Table 1: Operating conditions

Recommended Equipment

All equipment should be properly calibrated prior to running any of the validation tests described in this document.

Test Equipment
Digital Multimeter
DC Source Measurement Unit
4 Wire Sense Mode
200V Range
Accuracy: $\pm 0.02\%$
AC Voltage Source
Frequency Range 1Hz to 1.2GHz
Output Power -127dBm to +13dBm
Harmonics: less than -35dBc

Table 2: Recommended Validation Equipment

Validation Tests

These tests will validate the performance of the instrument. The tests can be performed in any order.

Impedance Validation

Specification: 50 Ohm \pm 1% (Channels 1-4)
 1 MOhm \pm 1% (Channels 1-4)
 \pm 2% (External Input)

Procedure:

1. Reset the instrument.
2. Set the instrument channel, impedance, and range to the value specified by the experiment table below.
3. Use a digital multimeter to measure impedance on the input connector.
4. Verify that the measured value is within the tolerance specified by the experiment table.

Experiment Table:

Channel	Impedance Setting (Ohms)	Range Setting (Vpp)	Minimum Acceptable Impedance (Ohms)	Maximum Acceptable Impedance (Ohms)
1 - 4	50	0.05	49.5	50.5
		0.1		
		0.25		
		0.5		
		1		
		2		
		5		
		10		
	1M	1	9.90E+05	1.01E+06
		100		
External Input	50	NA	49	51
	1M		9.80E+05	1.02E+06

Table 3: Impedance Test Setup and Tolerances

DC Range Validation

Specification: $\pm 1\%$ of full scale range

Procedure:

1. Disconnect all cables from the instrument.
2. Reset the instrument.
3. Run an automatic calibration of the instrument.
4. Disable the instrument channels which will not be tested.
5. Connect a 10MHz clock to the external input of the instrument.
6. Enter the following settings for each test.

Setup Item	Setting
Acquisition Type	Average
Number of Acquisitions	64
Trigger Mode	Normal
Trigger Source	External Input
Trigger Level	0.0
Trigger Polarity	Rising Edge
Sample Points	100k
Offset	0
Coupling	DC
Attenuation	1.0

Table 4: DC Range Validation Settings

7. Use the experiment table below to determine the remaining instrument settings.
8. Use a voltage source to apply the voltage specified by the experiment table below.
9. Capture a waveform. Measure the average value of the waveform.
10. Verify that the measured value is within the tolerance specified by the experiment table.

Experiment Table:

Chan	Sample Rate (GS/s)	Time / Div	Offset Time	Filter	Imped (Ohm)	Range (V)	Applied Voltage(V)	Min. Average Value (V)	Max. Average Value (V)
1 - 4	4	2.5us	0.0000125	Off	50	0.05	0.02	0.0198	0.0202
							-0.02	-0.0198	-0.0202
						0.10	0.04	0.0396	0.0404
							-0.04	-0.0396	-0.0404
						0.25	0.10	0.0990	0.101
							-0.10	-0.0990	-0.101
						0.50	0.20	0.1980	0.202
							-0.20	-0.1980	-0.202
						1.00	0.40	0.3960	0.404

Chan	Sample Rate (GS/s)	Time / Div	Offset Time	Filter	Imped (Ohm)	Range (V)	Applied Voltage(V)	Min. Average Value (V)	Max. Average Value (V)	
	2	5us	0.000025				-0.40	-0.3960	-0.404	
						2.00	0.80	0.7920	0.808	
							-0.80	-0.7920	-0.808	
						5.00	2.00	1.9800	2.02	
							-2.00	-1.9800	-2.02	
						10.00	4.00	3.9600	4.04	
							-4.00	-3.9600	-4.04	
						0.05	0.02	0.0198	0.0202	
							-0.02	-0.0198	-0.0202	
						0.10	0.04	0.0396	0.0404	
							-0.04	-0.0396	-0.0404	
						0.25	0.10	0.0990	0.101	
							-0.10	-0.0990	-0.101	
						0.50	0.20	0.1980	0.202	
	-0.20	-0.1980	-0.202							
	1.00	0.40	0.3960	0.404						
		-0.40	-0.3960	-0.404						
	2.00	0.80	0.7920	0.808						
		-0.80	-0.7920	-0.808						
	5.00	2.00	1.9800	2.02						
		-2.00	-1.9800	-2.02						
	10.00	4.00	3.9600	4.04						
		-4.00	-3.9600	-4.04						
	4	2.5us	0.0000125			1M	0.05	0.02	0.0198	0.0202
								-0.02	-0.0198	-0.0202
							0.10	0.04	0.0396	0.0404
								-0.04	-0.0396	-0.0404
							0.25	0.10	0.0990	0.101
-0.10								-0.0990	-0.101	
0.50							0.20	0.1980	0.202	
							-0.20	-0.1980	-0.202	
1.00							0.40	0.3960	0.404	
							-0.40	-0.3960	-0.404	

Chan	Sample Rate (GS/s)	Time / Div	Offset Time	Filter	Imped (Ohm)	Range (V)	Applied Voltage(V)	Min. Average Value (V)	Max. Average Value (V)						
						2.00	0.80	0.7920	0.808						
							-0.80	-0.7920	-0.808						
						5.00	2.00	1.9800	2.02						
							-2.00	-1.9800	-2.02						
						10.00	4.00	3.9600	4.04						
							-4.00	-3.9600	-4.04						
						20.00	8.00	7.9200	8.08						
							-8.00	-7.9200	-8.08						
						40.00	16.00	15.8400	16.16						
							-16.00	-15.8400	-16.16						
						100.0	40.00	39.6000	40.4						
							-40.00	-39.6000	-40.4						
						2	5us	0.000025				0.05	0.02	0.0198	0.0202
													-0.02	-0.0198	-0.0202
	0.10	0.04	0.0396	0.0404											
		-0.04	-0.0396	-0.0404											
	0.25	0.10	0.0990	0.101											
		-0.10	-0.0990	-0.101											
	0.50	0.20	0.1980	0.202											
		-0.20	-0.1980	-0.202											
	1.00	0.40	0.3960	0.404											
		-0.40	-0.3960	-0.404											
	2.00	0.80	0.7920	0.808											
		-0.80	-0.7920	-0.808											
	5.00	2.00	1.9800	2.02											
		-2.00	-1.9800	-2.02											
	10.00	4.00	3.9600	4.04											
		-4.00	-3.9600	-4.04											
20.00	8.00	7.9200	8.08												
	-8.00	-7.9200	-8.08												
40.00	16.00	15.8400	16.16												
	-16.00	-15.8400	-16.16												
100.0	40.00	39.6000	40.4												

Chan	Sample Rate (GS/s)	Time / Div	Offset Time	Filter	Imped (Ohm)	Range (V)	Applied Voltage(V)	Min. Average Value (V)	Max. Average Value (V)					
							-40.00	-39.6000	-40.4					
	4	2.5us	0.0000125	On	50	0.05	0.02	0.0198	0.0202					
							-0.02	-0.0198	-0.0202					
						0.10	0.04	0.0396	0.0404					
							-0.04	-0.0396	-0.0404					
						0.25	0.10	0.0990	0.101					
							-0.10	-0.0990	-0.101					
						0.50	0.20	0.1980	0.202					
							-0.20	-0.1980	-0.202					
						1.00	0.40	0.3960	0.404					
							-0.40	-0.3960	-0.404					
						2.00	0.80	0.7920	0.808					
							-0.80	-0.7920	-0.808					
						5.00	2.00	1.9800	2.02					
							-2.00	-1.9800	-2.02					
						10.00	4.00	3.9600	4.04					
							-4.00	-3.9600	-4.04					
						2	5us	0.000025		50	0.05	0.02	0.0198	0.0202
												-0.02	-0.0198	-0.0202
	0.10	0.04	0.0396	0.0404										
		-0.04	-0.0396	-0.0404										
	0.25	0.10	0.0990	0.101										
		-0.10	-0.0990	-0.101										
	0.50	0.20	0.1980	0.202										
		-0.20	-0.1980	-0.202										
	1.00	0.40	0.3960	0.404										
		-0.40	-0.3960	-0.404										
	2.00	0.80	0.7920	0.808										
		-0.80	-0.7920	-0.808										
	5.00	2.00	1.9800	2.02										
		-2.00	-1.9800	-2.02										
	10.00	4.00	3.9600	4.04										
		-4.00	-3.9600	-4.04										

Chan	Sample Rate (GS/s)	Time / Div	Offset Time	Filter	Imped (Ohm)	Range (V)	Applied Voltage(V)	Min. Average Value (V)	Max. Average Value (V)	
	4	2.5us	0.0000125		1M	0.05	0.02	0.0198	0.0202	
							-0.02	-0.0198	-0.0202	
						0.10	0.04	0.0396	0.0404	
							-0.04	-0.0396	-0.0404	
						0.25	0.10	0.0990	0.101	
							-0.10	-0.0990	-0.101	
						0.50	0.20	0.1980	0.202	
							-0.20	-0.1980	-0.202	
						1.00	0.40	0.3960	0.404	
							-0.40	-0.3960	-0.404	
						2.00	0.80	0.7920	0.808	
							-0.80	-0.7920	-0.808	
	5.00	2.00	1.9800	2.02						
		-2.00	-1.9800	-2.02						
	10.00	4.00	3.9600	4.04						
		-4.00	-3.9600	-4.04						
	20.00	8.00	7.9200	8.08						
		-8.00	-7.9200	-8.08						
	40.00	16.00	15.8400	16.16						
		-16.00	-15.8400	-16.16						
	100.0	40.00	39.6000	40.4						
		-40.00	-39.6000	-40.4						
	2	5us	0.000025			1M	0.05	0.02	0.0198	0.0202
								-0.02	-0.0198	-0.0202
0.10							0.04	0.0396	0.0404	
							-0.04	-0.0396	-0.0404	
0.25							0.10	0.0990	0.101	
							-0.10	-0.0990	-0.101	
0.50							0.20	0.1980	0.202	
							-0.20	-0.1980	-0.202	
1.00							0.40	0.3960	0.404	
							-0.40	-0.3960	-0.404	
2.00							0.80	0.7920	0.808	

Chan	Sample Rate (GS/s)	Time / Div	Offset Time	Filter	Imped (Ohm)	Range (V)	Applied Voltage(V)	Min. Average Value (V)	Max. Average Value (V)
							-0.80	-0.7920	-0.808
						5.00	2.00	1.9800	2.02
							-2.00	-1.9800	-2.02
						10.00	4.00	3.9600	4.04
							-4.00	-3.9600	-4.04
						20.00	8.00	7.9200	8.08
							-8.00	-7.9200	-8.08
						40.00	16.00	15.8400	16.16
							-16.00	-15.8400	-16.16
						100.0	40.00	39.6000	40.4
							-40.00	-39.6000	-40.4

Table 5: DC Range Setup and Tolerances Settings

Zero Offset Validation

Specification: $< \pm(1\% \text{ full scale range} + 1 \text{ mV}) @ +25 \text{ }^\circ\text{C} (50 \ \Omega)$
 $< \pm(1\% \text{ full scale range} + 5 \text{ mV}) @ +25 \text{ }^\circ\text{C} (1 \text{ M}\Omega)$

Procedure:

1. Disconnect all cables from the input channels.
2. Reset the instrument.
3. Run an automatic calibration of the instrument.
4. Disable all channels which are not being tested.
5. Connect a 10MHz clock to the external input of the instrument.
6. Enter the following settings for each test.

Setup Item	Setting
Acquisition Type	Average
Number of Acquisitions	64
Trigger Mode	Normal
Trigger Source	External Input
Trigger Level	0.0
Trigger Polarity	Rising Edge
Sample Points	100k
Time/Div	2.5us
Offset Time	0.0
Offset	0.0
Coupling	DC
Attenuation	1.0

Table 6: Zero Offset Validation Settings

7. Use the experiment table below to determine the remaining instrument settings.
8. Capture a waveform. Measure the average value of the waveform.
9. Verify that the measurement is within the tolerances specified below by the experiment table.

Experiment Table:

Channel	Filter	Impedance (Ohm)	Range (V)	Min. Average Value (V)	Max. Average Value (V)
1 - 4	Off	50	0.05	-0.0015	0.0015
			0.10	-0.0020	0.0020
			0.25	-0.0035	0.0035
			0.50	-0.0060	0.0060
			1.00	-0.0110	0.0110
			2.00	-0.0210	0.0210
			5.00	-0.0510	0.0510

Channel	Filter	Impedance (Ohm)	Range (V)	Min. Average Value (V)	Max. Average Value (V)
			10.00	-0.1010	0.1010
		1M	0.05	-0.0055	0.0055
			0.10	-0.0060	0.0060
			0.25	-0.0075	0.0075
			0.50	-0.0100	0.0100
			1.00	-0.0150	0.0150
			2.00	-0.0250	0.0250
			5.00	-0.0550	0.0550
			10.00	-0.1050	0.1050
			20.00	-0.2050	0.2050
			40.00	-0.4050	0.4050
			100.00	-1.0050	1.0050
			On	50	0.05
	0.10	-0.0020			0.0020
	0.25	-0.0035			0.0035
	0.50	-0.0060			0.0060
	1.00	-0.0110			0.0110
	2.00	-0.0210			0.0210
	5.00	-0.0510			0.0510
	10.00	-0.1010			0.1010
	1M	0.05		-0.0055	0.0055
		0.10		-0.0060	0.0060
		0.25		-0.0075	0.0075
		0.50		-0.0100	0.0100
		1.00		-0.0150	0.0150
		2.00		-0.0250	0.0250
		5.00		-0.0550	0.0550
		10.00		-0.1050	0.1050
		20.00		-0.2050	0.2050
	40.00	-0.4050	0.4050		
100.00	-1.0050	1.0050			

Table 7: Zero Offset Setup and Tolerances

Offset Validation

Specification: $< \pm(1\% \text{ full scale range} + 1\% \text{ offset} + 1 \text{ mV}) @ +25 \text{ }^\circ\text{C} (50 \ \Omega)$
 $< \pm(1\% \text{ full scale range} + 1\% \text{ offset} + 5 \text{ mV}) @ +25 \text{ }^\circ\text{C} (1 \ \text{M}\Omega)$

Procedure:

1. Disconnect all cables from the input channels.
2. Reset the instrument.
3. Run an automatic calibration of the instrument.
4. Disable all channels that are not being tested.
5. Connect a 10MHz clock to the external input of the instrument
6. Enter the following settings for each test.

Setup Item	Setting
Acquisition Type	Average
Number of Acquisitions	64
Trigger Mode	Normal
Trigger Source	External Input
Trigger Level	0.0
Trigger Polarity	Rising Edge
Sample Points	100k
Time/Div	2.5us
Offset Time	0.0
Coupling	DC
Attenuation	1.0

Table 8: Offset Validation Settings

7. Use the experiment table below to determine the remaining settings of the instrument.
8. Capture a waveform. Measure the average value of the waveform.
9. Verify that the measurement is within the tolerances specified below by the experiment table.

Experiment Table:

Channel	Filter	Impedance (Ohm)	Range (V)	Offset Value (V)	Min. Average Value (V)	Max. Average Value (V)
1 - 4	Off	50	0.05	0.02	-0.0017	0.0017
				-0.02		
			0.10	0.04	-0.0024	0.0024
				-0.04		
			0.25	0.10	-0.0045	0.0045
				-0.10		
			0.50	0.20	-0.0080	0.0080
				-0.20		

Channel	Filter	Impedance (Ohm)	Range (V)	Offset Value (V)	Min. Average Value (V)	Max. Average Value (V)	
			1.00	0.40	-0.0150	0.0150	
				-0.40			
			2.00	0.80	-0.0290	0.0290	
				-0.80			
			5.00	2.00	-0.0710	0.0710	
				-2.00			
			10.00	0.00	-0.1010	0.1010	
				0.00			
			1M	0.05	0.02	-0.0017	0.0017
					-0.02		
		0.10		0.04	-0.0024	0.0024	
				-0.04			
		0.25		0.10	-0.0045	0.0045	
				-0.10			
		0.50		0.20	-0.0080	0.0080	
				-0.20			
		1.00		0.40	-0.0150	0.0150	
				-0.40			
		2.00	0.80	-0.0290	0.0290		
			-0.80				
	5.00	2.00	-0.0710	0.0710			
		-2.00					
	10.00	4.00	-0.1410	0.1410			
		-4.00					
	20.00	8.00	-0.2810	0.2810			
		-8.00					
	40.00	16.00	-0.5610	0.5610			
		-16.00					
100.00	40.00	-1.4010	1.4010				
	-40.00						
On	50	0.05	0.02	-0.0017	0.0017		
			-0.02				
	0.10	0.04	-0.0024	0.0024			
		-0.04					

Channel	Filter	Impedance (Ohm)	Range (V)	Offset Value (V)	Min. Average Value (V)	Max. Average Value (V)	
			0.25	0.10	-0.0045	0.0045	
				-0.10			
			0.50	0.20	-0.0080	0.0080	
				-0.20			
			1.00	0.40	-0.0150	0.0150	
				-0.40			
			2.00	0.80	-0.0290	0.0290	
				-0.80			
			5.00	2.00	-0.0710	0.0710	
				-2.00			
			10.00	0.00	-0.1010	0.1010	
				0.00			
			1M	0.05	0.02	-0.0017	0.0017
					-0.02		
		0.10		0.04	-0.0024	0.0024	
				-0.04			
		0.25		0.10	-0.0045	0.0045	
				-0.10			
		0.50		0.20	-0.0080	0.0080	
				-0.20			
		1.00		0.40	-0.0150	0.0150	
				-0.40			
		2.00		0.80	-0.0290	0.0290	
				-0.80			
		5.00		2.00	-0.0710	0.0710	
				-2.00			
		10.00	4.00	-0.1410	0.1410		
			-4.00				

Table 9: Offset Setup and Tolerances

Zero Bias Validation

Specification: $\leq \pm 10\mu\text{A}$ (50 Ohm)
 $\leq \pm 1\text{nA}$ (1 MOhm)

Procedure:

1. Disconnect all cables from the input channels.
2. Reset the instrument.
3. Perform an automatic calibration of the instrument.
4. Use the experiment table below to determine the settings of the instrument.
5. Use a digital multimeter to measure the current at the input connector.
6. Verify that the measurement is within the tolerances specified below by the experiment table.

Note: Bias current measurements will be limited by the accuracy of the digital multimeter.

Experiment Table:

Channel	Impedance (Ohm)	Range (V)	Min. Measured Value (Amp)	Max. Measured Value (Amp)
1 - 4	50	0.05	-1.00E-05	1.00E-05
		0.25	-1.00E-05	1.00E-05
		1.00	-1.00E-05	1.00E-05
	1M	0.10	-1.00E-09	1.00E-09
		5.00	-1.00E-09	1.00E-09

Table 10: Zero Bias Setup and Tolerances

Noise Validation

Specification: $\leq (0.5\% \text{ of full scale range} + 350 \mu\text{V})$ (50 Ω Full Bandwidth)
 $\leq (0.5\% \text{ of full scale range} + 350 \mu\text{V})$ (50 Ω + 20 MHz Filter)
 $\leq (0.5\% \text{ of full scale range} + 700 \mu\text{V})$ (1M Ω Full Bandwidth)
 $\leq (0.5\% \text{ of full scale range} + 350 \mu\text{V})$ (1M Ω + 20 MHz Filter)

Procedure:

1. Reset the instrument.
2. Connect a 10MHz clock to the external input of the instrument.
3. Enter the following settings for each test.

Setup Item	Setting
Acquisition Type	Normal
Trigger Mode	Automatic
Trigger Source	External Input
Trigger Level	0.0
Trigger Polarity	Rising Edge
Sample Points	1M
Time/Div	50us
Offset Time	0.0
Coupling	DC
Attenuation	1.0
Offset	0.0

Table 11: Noise Validation Settings

4. Use the experiment table below to determine the settings of the instrument.
5. Capture a waveform. Measure the AC RMS of the waveform.
6. Verify that the measurement is within the tolerances specified below by the experiment table.

Experiment Table:

Channel	Filter	Impedance (Ohm)	Range (V)	Min. Measured Value (V)	Max. Measured Value (V)
1 - 4	Off	50	0.05	-0.00060	0.00060
			0.10	-0.00085	0.00085
			0.25	-0.00160	0.00160
			0.50	-0.00285	0.00285
			1.00	-0.00535	0.00535
			2.00	-0.01035	0.01035
			5.00	-0.02535	0.02535
			10.00	-0.05035	0.05035

Channel	Filter	Impedance (Ohm)	Range (V)	Min. Measured Value (V)	Max. Measured Value (V)			
		1M	0.05	-0.00095	0.00095			
			0.10	-0.00120	0.00120			
			0.25	-0.00195	0.00195			
			0.50	-0.00320	0.00320			
			1.00	-0.00570	0.00570			
			2.00	-0.01070	0.01070			
			5.00	-0.02570	0.02570			
			10.00	-0.05070	0.05070			
			20.00	-0.10070	0.10070			
			40.00	-0.20070	0.20070			
			100.00	-0.50070	0.50070			
			On	50		0.05	-0.00025	0.00025
						0.10	-0.00050	0.00050
						0.25	-0.00125	0.00125
						0.50	-0.00250	0.00250
	1.00	-0.00500				0.00500		
	2.00	-0.01000				0.01000		
	5.00	-0.02500				0.02500		
	10.00	-0.05000				0.05000		
	1M				0.05	-0.00060	0.00060	
					0.10	-0.00085	0.00085	
					0.25	-0.00160	0.00160	
					0.50	-0.00285	0.00285	
					1.00	-0.00535	0.00535	
					2.00	-0.01035	0.01035	
					5.00	-0.02535	0.02535	
	10.00	-0.05035	0.05035					
	20.00	-0.10035	0.10035					
	40.00	-0.20035	0.20035					
	100.00	-0.50035	0.50035					

Table 12: Noise Setup and Tolerances

External Input Trigger Level Validation

Specification: $\pm 20\text{mV}$

Procedure:

1. Reset the instrument.
2. Enter the following settings for each test.

Setup Item	Setting
Acquisition Type	Normal
Trigger Mode	Automatic

Table 13: External Input Validation Settings

3. Use a voltage source to apply the voltage indicated in the experiment table below to the external input.
4. Capture a waveform. Measure the average value of the waveform.
5. Verify that the measurement is within the tolerances specified below by the experiment table.

Experiment Table:

Channel	Applied Voltage (V)	Min. Measured Value (V)	Max. Measured Value (V)
External Input	1.00	0.98	1.02
	-1.00	-1.02	-0.98

Table 14: External Input Setup and Tolerances

Internal 10MHz Clock Validation

Specification: $\pm 2.5\text{ppm}$ accuracy

Procedure:

1. Connect a precision 10MHz clock to channel 1 of the instrument.
2. Reset the instrument.
3. Enter the following settings for the test.

Setup Item	Setting
Acquisition Type	Normal
Trigger Mode	Automatic
Sample Points	10k
Time/Div	20ms
Offset Time	100ms
Trigger Source	Channel 1
Trigger Level	1.0
Trigger Polarity	Rising Edge
Channel 1	Enabled
Channel 1 Range	5.0Vpp
Channel 1 Offset	0
Channel 1 Coupling	DC
Channel 1 Impedance	50 Ohm
Channel 1 Filter	Off
Channel 1 Attenuation	1.0
External Output	Enabled
External Output Source	Reference Event
External Output Polarity	Positive

Table 15: 10MHz Clock Validation Settings

4. Capture a waveform. Measure the frequency of the waveform.
5. Verify that the measurement is within the tolerances specified below by the experiment table.

Experiment Table:

Channel	Min. Measured Value (Hz)	Max. Measured Value (Hz)
External Output	0	25

Table 16: 10MHz Clock Validation Tolerances

Sample Rate Validation

Specification: $\pm 0.5\%$

Procedure:

1. Reset the instrument.
2. Enter the following settings for each test.

Setup Item	Setting
Acquisition Type	Normal
Trigger Mode	Automatic
Sample Points	10k
Offset Time	0.0
Trigger Level	0.0
Trigger Polarity	Rising Edge
Range	2Vpp
Offset	0.0
Coupling	DC
Impedance	50 Ohm
Filter	Off
Attenuation	1.0
Measure Method	Entire Waveform
Measure Edge	1

Table 17: Sample Rate Validation Settings

3. Use the experiment table below to determine the remaining instrument settings.
4. Use an AC voltage source to apply a +8dBm signal to the channel being tested at the frequency indicated by the experiment table below.
5. Capture a waveform. Measure the frequency of the waveform.
6. Verify that the measurement is within the tolerances specified below by the experiment table.

Experiment Table:

Trigger & Capture Channel	Sample Rate (S/s)	Time/Div	Signal Frequency (Hz)	Minimum Measured Frequency (Hz)	Maximum Measured Frequency (Hz)
1 - 4	2.0000E+09	0.5us	1.0100E+06	1.0050E+06	1.0151E+06
	5.0000E+07	20us	2.5100E+04	2.4975E+04	2.5226E+04

Table 18: Sample Rate Setup and Tolerances

AC Coupling Validation

Specification: 200kHz High Pass (50 Ohm)
10kHz High Pass (1 MOhm)

Procedure:

1. Reset the instrument.
2. Enter the following settings for each test.

Setup Item	Setting
Acquisition Type	Normal
Trigger Mode	Automatic
Sample Points	10k
Offset Time	0.0
Range	2Vpp
Offset	0.0
Coupling	AC
Impedance	50 Ohm
Filter	Off
Attenuation	1.0
Measure Method	Entire Waveform
Measure Edge	1

Table 19: AC Coupling Validation Settings

3. Use the experiment table below to determine the remaining instrument settings.
4. Use an AC voltage source to apply a +8dBm signal to the channel being tested at the frequency indicated by the experiment table below.
5. Capture a waveform. Measure the AC RMS of the waveform.
6. Verify that the measurement is within the tolerances specified below by the experiment table.

Experiment Table:

Channel	Sample Rate (S/s)	Time/Div	Signal Frequency (Hz)	Minimum Measured Value (V)	Maximum Measured Value (V)
1 - 4	2.0000E+08	5us	1.0000E+06	0.5457	0.5781
	2.0000E+07	50us	1.0000E+05	0.3544	0.4092
	2.0000E+06	0.5ms	1.0000E+04	0.0000	0.0562

Table 20: AC Coupling Setup and Tolerances

Trigger Level Validation

Specification: \pm (2% full scale range + 5mV + offset accuracy)

Procedure:

1. Reset the instrument.
2. Disable all channels not being tested.
3. Enter the following settings for each test.

Setup Item	Setting
Acquisition Type	Average
Number of Acquisitions	32
Trigger Mode	Normal
Sample Points	100
Time/Div	2.5ns
Offset Time	12.5ns
Range	2Vpp
Impedance	50 Ohms
Offset	0.0
Coupling	DC
Filter	Off
Attenuation	1.0
Measure Method	Entire Waveform
Measure Edge	1

Table 21: Trigger Level Validation Settings

4. Use the experiment table below to determine the remaining instrument settings.
5. Use an AC voltage source to apply a 100Hz signal at the voltage indicated in the experiment table to the channel being tested.
6. Capture a waveform. Measure the average value of the waveform.
7. Verify that the measurement is within the tolerances specified below by the experiment table.

Experiment Table:

Channel	Signal Power (dB)	Trigger Polarity	Trigger Level	Minimum Average Value (V)	Maximum Average Value (V)
1 - 4	10	Falling Edge	0.7071	0.641107	0.773107
		Rising Edge	-0.7071	-0.773107	-0.641107

Table 22: Trigger Level Setup and Tolerances

Trigger Bandwidth Validation

Specification: DC to 500MHz minimum

Procedure:

1. Reset the instrument.
2. Disable all channels not being tested.
3. Enter the following settings for each test.

Setup Item	Setting
Acquisition Type	Normal
Trigger Mode	Normal
Sample Points	1000
Offset Time	0
Range	5Vpp
Offset	0.0
Coupling	DC
Impedance	50 Ohm
Filter	Off
Attenuation	1.0
Trigger Polarity	Rising Edge

Table 23: Trigger Bandwidth Validation Settings

4. Use the experiment table below to determine the remaining instrument settings.
5. Set the instrument to trigger on the channel under test.
6. Use an AC voltage source to apply the signal specified in the experiment table to the channel being tested.
7. Set the instrument to capture a waveform asynchronously.
8. Verify that the instrument captures a waveform.

Experiment Table:

Channel	Time/ Div	Trigger Level (V)	Signal Frequency (Hz)	Signal Magnitude (dB)
1 - 4	50ns	0.25	1.00E+07	5.0
			1.00E+08	5.0
			5.00E+08	6.0
External Input	1us	0.1	1.00E+07	5.0
			1.00E+08	6.0
			5.00E+08	8.0

Table 24: Trigger Bandwidth Setup

Range Bandwidth Validation

Specification: 50Ohm: DC to 1000MHz typical, 900MHz minimum (-3dB)
 50mVpp and 100mVpp ranges 500MHz (-3dB) 900MHz (-6dB)
 1MOhm: DC to 400MHz typical, 300MHz minimum

Procedure:

1. Reset the instrument.
2. Disable all channels not being tested.
3. Enter the following settings for each test.

Setup Item	Setting
Acquisition Type	Normal
Trigger Mode	Automatic
Sample Points	100k
Time/Div	100us
Offset Time	0
Offset	0.0
Coupling	DC
Filter	Off
Attenuation	1.0
Measure Method	Entire Waveform
Measure Edge	1

Table 25: Range Bandwidth Validation Settings

4. Use the experiment table below to determine the remaining instrument settings.
5. Use an AC voltage source to apply the signal specified in the experiment table to the channel being tested.
6. Capture a waveform. Measure the AC RMS of the waveform.
7. Verify that the measurement is within the tolerances specified below by the experiment table.

Experiment Table:

Chan	Imped (Ohm)	Range (Vpp)	Signal Volt (mVrms)	Signal Freq. (Hz)	Min. Measured Value (V)	Max. Measured Value (V)
1 - 4	50	10	999	9.010E+08	0.7071	1.1210
		5	999	9.010E+08	0.7071	1.1210
		2	500	9.010E+08	0.3540	0.5610
		1	200	9.010E+08	0.1416	0.2244
		0.5	100	9.010E+08	0.07079	0.1122
		0.25	50	9.010E+08	0.03544	0.05617
		0.1	25	5.010E+08	0.01776	0.02582
				9.010E+08	0.01411	0.02582
0.05	10	5.010E+08	0.007071	0.01028		

Chan	Imped (Ohm)	Range (Vpp)	Signal Volt (mVrms)	Signal Freq. (Hz)	Min. Measured Value (V)	Max. Measured Value (V)
				9.010E+08	0.005617	0.01028
	1M	0.5	200	3.010E+08	0.1413	0.2113
		5	999	3.010E+08	0.7079	1.0590

Table 26: Range Bandwidth Setup and Tolerances

Filter Bandwidth Validation

Specification: Stopband rejection approx. 3dB at 20 MHz

Procedure:

1. Reset the instrument.
2. Disable all channels not being tested.
3. Enter the following settings for each test.

Setup Item	Setting
Acquisition Type	Normal
Trigger Mode	Automatic
Sample Points	100k
Sample Rate	500MHz
Time/Div	20us
Offset Time	0
Range	2Vpp
Offset	0.0
Coupling	DC
Impedance	50 Ohm
Filter	On
Attenuation	1.0
Measure Method	Entire Waveform
Measure Edge	1

Table 27: Filter Bandwidth Validation Settings

4. Use an AC voltage source to apply the signal specified in the experiment table to the channel being tested.
5. Capture a waveform. Measure the AC RMS of the waveform.
6. Verify that the measurement is within the tolerances specified below by the experiment table.

Experiment Table:

Channel	Signal Voltage (mVrms)	Signal Frequency (Hz)	Minimum Measured Value (V)	Maximum Measured Value (V)
1 – 4	500	2.0100E+07	0.31590	0.37540

Table 28: Filter Bandwidth Setup and Tolerances

Harmonics & Distortion Validation

Specification: Typical results

Input Range & Signal Frequency	Signal-to-Noise Ratio (SNR)	Total Harmonic Distortion (THD)	Signal-to-Noise + Distortion (SINAD)
10Vpp, 10.7MHz	46.6 dBc	-53.0 dBc	45.7 dBc
1Vpp, 10.7MHz	47.9 dBc	-56.8 dBc	47.4 dBc
0.1Vpp, 10.7MHz	34.0 dBc	-56.8 dBc	34.0 dBc
10Vpp, 60.1MHz	39.5 dBc	-45.0 dBc	38.4 dBc
1Vpp, 60.1MHz	41.3 dBc	-46.9 dBc	40.2 dBc
0.1Vpp, 60.1MHz	34.0 dBc	-48.0 dBc	33.8 dBc

Table 29: Dynamic Range Specifications

Procedure:

1. Reset the instrument.
2. Disable all channels not being tested.
3. Enter the following settings for each test.

Setup Item	Setting
Acquisition Type	Normal
Trigger Mode	Normal
Sample Points	100k
Range	2Vpp
Offset	0.0
Coupling	DC
Impedance	50 Ohm
Filter	Off
Attenuation	1.0

Table 30: Harmonics and Distortion Validation Settings

4. Use the experiment table below to determine the remaining instrument settings.
5. Use an AC voltage source to apply +9dB 10.7MHz signal to the channel being tested. ZTEC suggest filtering the signal at the input to the instrument in order to eliminate any noise from the AC source.
6. Capture a waveform.
7. Enable calculation channel 1. Set calculation channel 1 to perform an FFT of the captured waveform using a Hanning window.
8. Measure the SNR and THD of the FFT in calculation channel 1.
9. Verify that the measurement meets the minimum requirements specified by the experiment table below.

Experiment Table:

Channel	Sample Rate(Hz)	Time/Div	Offset Time (s)	Measurement	Minimum Measured Value (dB)
1 & 3	4.00E+09	2.5us	1.2500E-05	SNR	40.0
				THD	-40.0
2 & 4	2.00E+09	5us	2.5000E-05	SNR	40.0
				THD	-40.0

Table 31: Harmonics & Distortion Setup and Tolerances



ZTEC Instruments