



Hantek



DPO7000 series

Digital oscilloscope

Performance Verification Guide

202304

Warranties and Declarations

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Product certification

Hantek certified DPO series oscilloscope to meet China's national industry standards and has passed the CE certification.

Contact us

If you have any questions when using the products of Qingdao Hantek Electronics Co., LTD., you can obtain service and support through the following ways:

Email: service@hantek.com, support@hantek.com

Website: <http://www.hantek.com>

1 Safety requirement

1.1 Summary of general security issues

Read the following safety precautions carefully to avoid injury and to prevent damage to this product or any product connected. To avoid possible dangers, please use this product in accordance with the regulations.

- **Only professionally authorized personnel can perform repairs.**

- **Use the right power cable.**

Use the power cable approved by the country in which the product is used only.

- **Connect and disconnect correctly.**

Before connecting the probe to the circuit being measured, please connect the probe to the oscilloscope first. Before disconnecting the probe from the oscilloscope, please disconnect the probe and the circuit under test first.

- **Ground the product.**

To avoid electric shocks, the product is grounded through a grounding conductor of the power cable. The grounding conductor must be connected to the ground before connecting the input or output terminals of the product. Ensure that the product is properly grounded.

- **Connect the probe properly.**

The ground wire of the probe is the same as the ground potential. Do not connect the ground wire to high voltage.

- **View all terminal rating values.**

To avoid fire or excessive current, please check all rating values and signs on the product. Please consult the product manual for details of the rating values before connecting the product.

- **Do not operate with the cover open.**

Do not run the product with the cover or panel open.

- **Avoid circuit exposure.**

Do not touch exposed connectors and components after power is switched on.

- **Do not operate if the product is suspected to be faulty.**

If you suspect that the product has been damaged, please ask qualified maintenance personnel to check it.

- Maintain proper ventilation.
- Do not operate in a humid environment.
- Do not operate in inflammable or explosive environment.
- Please keep the product surface clean and dry.

**Warning:**

Equipment that meets Class A requirements may not provide adequate protection for broadcast services in residential environments.

1.2 Security terms and signs

Security terms in this manual:

**Warning:**

Indicates that the operation may not cause immediate damage to you.

**Note:**

Indicates that the operation may cause damage to the product or other property.

Safety terms on products:

Warning:

Indicates a potential hazard may be caused to you if you do not perform this operation.

Safety signs on the product:

Hazardous
Voltage



Safety
Warning



2 Document overview

This document describes how to quickly understand the front and back panels, user interfaces, and basic operation methods of the DPO7000 series digital oscilloscopes.



Tip:

The latest version of this manual can be downloaded at (<http://www.hantek.com>).

Document number:


202304

Software version:

Software upgrade may change or increase product functionalities, please pay attention to Hantek website for the latest version.

Document format conventions:

1 Virtual keys and main interface icons

Use **[name]** to represent virtual keys and main interface icons. For example, **[Utility]** is for .

2 Menu

Use "menu text (bold) + color" to represent a label or a menu option. For example, **I/O** means to click the "I/O" option on the current operation interface to enter the function configuration menu of "I/O".

3 Operation steps

Use "->" to represent the next step. For example, **[Utility]** -> **Language** means click **Utility** label before clicking **Language** menu.

Document content conventions:

DPO7000 series tablet oscilloscope consists of the following models. Unless otherwise specified, this manual uses DPO7504E as an example to describe the DPO7000 series and basic operations.

Model	Bandwidth	Channel	Signal source	Digital Channels
DPO7104E	100MHz	4	1	16
DPO7102E	100 MHz	2	1	16
DPO7104C	100 MHz	4	-	-

Model	Bandwidth	Channel	Signal source	Digital Channels
DPO7102C	100 MHz	2	-	-
DPO7204E	200 MHz	4	1	16
DPO7202E	200 MHz	2	1	16
DPO7204C	200 MHz	4	-	-
DPO7202C	200 MHz	2	-	-
DPO7354E	350 MHz	4	1	16
DPO7352E	350 MHz	2	1	16
DPO7354C	350 MHz	4	-	-
DPO7352C	350 MHz	2	-	-
DPO7504E	500 MHz	4	1	16
DPO7502E	500 MHz	2	1	16
DPO7504C	500 MHz	4	-	-
DPO7502C	500 MHz	2	-	-

3 Overview

3.1 Preparation before testing

Before conducting testing, users need to first prepare as follows:

1. Power on
2. Warm up (run the oscilloscope for at least 30 minutes)
3. Self correction

Power on

When the oscilloscope is powered on, press the power button in the lower left corner of the front panel to start the oscilloscope. During the startup process, the oscilloscope performs a series of self checks, and the startup screen appears after the self check is completed.

If the oscilloscope cannot start normally, please refer to the "Troubleshooting" section in the "DPO7000 User Manual" to identify and resolve the cause, and then perform self calibration and performance testing.

Preheat

Turn on or run the oscilloscope for at least 30 minutes.

Self correction

Before calibration, please ensure that the oscilloscope has been preheated or operated for more than 30 minutes.

1. Firstly, confirm to disconnect all input channels.
2. Enter the oscilloscope function, click on **[Utility]** -> **More** -> **System** -> **SelfCal** menu and follow the instructions on the display screen to perform calibration. Calibration takes approximately 2-3 minutes.
3. Under the oscilloscope function, click on the **[Acquire]** -> **Acquisition** method menu, set the acquisition mode to average, and set the average number of times to 16.
4. Set the vertical gear of each channel to 2 mV/div and check the offset degree of each channel waveform. If the deviation is greater than 0.5 div, recheck the surrounding area for interference signals, etc., and perform calibration again after checking for errors.

3.2 Record of test results

When executing each test, the test results can be recorded and retained in the test record table after each test item. In addition, the appendix section of this manual also provides additional test result record forms. This table lists various tests and their corresponding performance indicator limits, and provides spaces for users to record test results.

Hantek suggests that you prepare a separate test record form before each test. This ensures that the tables in this document can be reused.

3.3 Technical Parameter

In Chapter 4 of this manual, corresponding indicators are provided for each test. If you need other technical parameters, please refer to the "DPO7000 Data Manual" (available for download from the Hantek website at www.hantek.com).



Tips:

All indicators are valid when the oscilloscope is preheated for more than 30 minutes.

4 Performance verification Test

This chapter takes the DPO7504E machine as an example to introduce the performance verification and testing methods and processes of the DPO7000 series digital oscilloscope. The testing equipment used in this manual is FLUKE5000.

Note:

1. Before performing performance verification tests, please ensure that the oscilloscope passes self check and self calibration.
2. Before performing each performance verification test below, please ensure that the oscilloscope has been preheated for at least 30 minutes.
3. Before or at the end of each performance verification test below, please set the oscilloscope to the default settings.

4.1 Impedance Test

4.1.1 Index

Input impedance	
Analog channel	1M Ω : 0.99M Ω 至 1.01M Ω

4.1.2 Test Connection Diagram



4.1.3 Test Procedure

1. Connect the active signal probe of Fluke5000 to the CH1 channel of the oscilloscope, as shown in the above figure.
2. Configure oscilloscope:
 - Click on **[CH1]** in the button area to open the CH1 channel.
 - Set the vertical gear of CH1 to 100 mV/div.
3. Open Fluke5000, set its impedance to 1 M Ω , select the resistance measurement function, read and record the measured resistance value.

4. Adjust the vertical gear of oscilloscope CH1 to 500 mV/div, read and record the resistance measurement again.
5. Close CH1. Measure the impedance of CH2, CH3, and CH4 in sequence using the above method and record the measurement results.

4.1.4 Test Record Form

Channel	Vertical gear	Test Result	Test Scope	Passed or not
CH1	100mv/div		0.99 MΩ to 1.01 MΩ	
	500mv/div			
CH2	100mv/div			
	500mv/div			
CH3	100mv/div			
	500mv/div			
CH4	100mv/div			
	500mv/div			

4.2 DC Gain Accuracy Test

4.2.1 Index

DC Gain Accuracy	
Index	± 3% × Fullscale

Full scale=8 * Current vertical gear

4.2.2 Test Connection Diagram



4.2.3 Test Procedure

1. Connect the active signal probe of Fluke5000 to the CH1 channel of the oscilloscope, as shown in the above figure.
2. Set the impedance of Fluke5000 to 1 M Ω .
3. Output a DC signal with a voltage V1 of +3mVDC through Fluke5000.
4. Configure oscilloscope:
 - Open the CH1 channel on the oscilloscope interface.
 - Click on the **Attenuation** menu and set the probe attenuation ratio to 1X, with a default value of 1X.
 - Set the vertical gear to 1mV/div.
 - Set the horizontal time base to 1 μ s/div.
 - Set the vertical offset to 0.
5. Click on **[Acquire]** -> **Acquisition** -> **Average**, and then click on the **Averages** menu button to set the average frequency to 32.
6. Adjust the trigger level to prevent the signal from being mistakenly triggered.
7. Click on **[Meas]**, select the data source as CH1, select the measurement item as the average value, and set the read average value to Vavg1.
8. Adjust Fluke5000 to output a DC signal with a voltage V2 of -3mVDC.
9. Turn on the average measurement function, read and record Vavg2.
10. Calculate the relative error of the vertical gear: $| (V_{avg1} - V_{avg2}) - (V1 - V2) | / \text{full scale} \times 100\%$.
11. Keep the other settings of the oscilloscope unchanged:
12. Set the vertical gears to 500uV/div, 2 mV/div, 5 mV/div, 10 mV/div, 20 mV/div, 50 mV/div, 100 mV/div, 200 mV/div, 500 mV/div, 1 V/div, 2 V/div, 5 V/div, and 10 V/div.
13. Adjust the output voltage of Fluke5000 to 3 times and -3 times the current vertical gear in sequence.
14. Repeat steps 3 to 7 above and record the test results.
15. Calculate the relative error of each vertical gear: $| (V_{avg1} - V_{avg2}) - (V1 - V2) | / \text{full scale} \times 100\%$.
16. Close CH1. Test the relative errors of CH2, CH3, and CH4 gears in sequence using the above method and record the test results.

4.2.4 Test Record Form

Channel	Vertical gear	Test Result			Test Scope	Passed or not
		Vavg1	Vavg2	Calculated value		
CH1	500 uV/div				± 3% × Fullscale	
	1 mV/div					
	2 mV/div					
	5 mV/div					
	10 mV/div					
	20 mV/div					
	50 mV/div					
	100 mV/div					
	200 mV/div					
	500 mV/div					
	1V/div					
	2V/div					
	5V/div					
	10V/div					
CH2	500 uV/div				± 3% ×Fullscale	
	1 mV/div					
	2 mV/div					

	5 mV/div					
	10 mV/div					
	20 mV/div					
	50 mV/div					
	100 mV/div					
	200 mV/div					
	500 mV/div					
	1V/div					
	2V/div					
	5V/div					
	10V/div					
CH3	500 uV/div				± 3% xFullscale	
	1 mV/div					
	2 mV/div					
	5 mV/div					
	10 mV/div					
	20 mV/div					
	50 mV/div					
	100 mV/div					
	200 mV/div					
	500 mV/div					

	1V/div				± 3% xFullscale
	2V/div				
	5V/div				
	10V/div				
CH4	500 uV/div				
	1 mV/div				
	2 mV/div				
	5 mV/div				
	10 mV/div				
	20 mV/div				
	50 mV/div				
	100 mV/div				
	200 mV/div				
	500 mV/div				
	1V/div				
	2V/div				
5V/div					
10V/div					

4.3 Bandwidth Test

The bandwidth test verifies the bandwidth performance of the oscilloscope by testing its amplitude loss at full bandwidth.

4.3.1 Index

Index		
Bandwidth	100MHz	$\pm 3\text{dB}$
	200MHz	$\pm 3\text{dB}$
	350MHz	$\pm 3\text{dB}$
	500MHz	$\pm 3\text{dB}$

4.3.2 Test Connection Diagram



4.3.3 Test Procedure

1. Connect the active signal probe of Fluke5000 to the CH1 channel of the oscilloscope and follow the test connection diagram.
2. Open Fluke5000 and set its impedance to 1 M Ω .
3. Configure oscilloscope:
 - Click **[CH1]** in the button area to open the CH1 menu.
 - Click on the **Attenuation** menu and set the probe attenuation ratio to 1X, with a default value of 1X.
 - Add a 50 ohm adapter at the CH1 channel connection.
 - Set the horizontal time base to 500 ns/div.
 - Set the vertical gear to 100 mV/div.
 - Set both horizontal and vertical offsets to 0.
 - Set the trigger level to 0 V.
4. Output a sine signal with a frequency of 1 MHz and an amplitude of 600 mVpp (V) through Fluke5000.
5. Click on the **[Meas]** menu, select the data source as CH1, select the measurement item as amplitude, read and record V1.

6. Once again, output a sinusoidal signal with an amplitude of 600 mVpp at other frequencies (not greater than 250MHz. The maximum frequency setting here varies depending on the model of the oscilloscope being tested) through Fluke5000.
7. Set the corresponding horizontal time base according to different frequencies.
8. Turn on the effective value measurement function, read and record the value (V1).
9. Calculate amplitude loss: Amplitude loss (dB)=20 × lg (V1/V).
10. Keep the other settings of the oscilloscope in step 3 unchanged and set the vertical gear to 200 mV/div.
11. Output a sine signal with a frequency of 1 MHz and an amplitude of 1.2 Vpp through Fluke5000.
12. Repeat steps 5-9.
13. Keep the other settings of the oscilloscope in step 3 unchanged and set the vertical gear to 2V/div.
14. Output a sine signal with a frequency of 1 MHz and an amplitude of 5.5 Vpp through Fluke5000.
15. Repeat steps 5-9.
16. Close CH1. Test CH2, CH3, and CH4 in sequence according to the above testing method and record the test results.

4.3.4 Test Record Form

Voltage Range	Fluke Amp	Fluke Freq	Meas Result	Range	Passed or not
100mV/div	600mV	1MHz		-3dB to 3dB	
		10MHz			
		20MHz			
		50MHz			
		100MHz			
		200MHz			
		250MHz			

200mV/div	1.2V	1MHz		-3dB to 3dB	
		10MHz			
		20MHz			
		50MHz			
		100MHz			
		200MHz			
		250MHz			
2V/div	5.5V	1MHz		-3dB to 3dB	
		10MHz			
		20MHz			
		50MHz			
		100MHz			
		200MHz			
		250MHz			
		10MHz			
		20MHz			
		50MHz			
		110MHz			

5 Test Record Form

Impedance Test

Channel	Vertical gear	Test Result	Test Scope	Passed or not
CH1	100mv/div		0.99 MΩ to 1.01 MΩ	
	500mv/div			
CH2	100mv/div			
	500mv/div			
CH3	100mv/div			
	500mv/div			
CH4	100mv/div			
	500mv/div			

DC Gain Accuracy Test

Channel	Vertical gear	Test Result			Test Scope	Passed or not
		Vavg1	Vavg2	Calculated value		
CH1	500 uV/div				± 3% × Fullscale	
	1 mV/div					
	2 mV/div					
	5 mV/div					
	10 mV/div					
	20 mV/div					
	50 mV/div					
	100 mV/div					
	200 mV/div					

	500 mV/div					
	1V/div					
	2V/div					
	5V/div					
	10V/div					
CH2	500 uV/div				± 3% xFullscale	
	1 mV/div					
	2 mV/div					
	5 mV/div					
	10 mV/div					
	20 mV/div					
	50 mV/div					
	100 mV/div					
	200 mV/div					
	500 mV/div					
	1V/div					
	2V/div					
	5V/div					
	10V/div					
CH3	500 uV/div				± 3%	
	1 mV/div				xFullscale	

	2 mV/div					
	5 mV/div					
	10 mV/div					
	20 mV/div					
	50 mV/div					
	100 mV/div					
	200 mV/div					
	500 mV/div					
	1V/div					
	2V/div					
	5V/div					
	10V/div					
CH4	500 uV/div				± 3%	×Fullscale
	1 mV/div					
	2 mV/div					
	5 mV/div					
	10 mV/div					
	20 mV/div					
	50 mV/div					
	100 mV/div					
	200 mV/div					
	500 mV/div					

	1V/div					
	2V/div					
	5V/div					
	10V/div					

Bandwidth Test

Voltage Range	Fluke Amp	Fluke Freq	Meas Result	Range	Passed or not
100mV/div	600mV	1MHz		-3dB to 3dB	
		10MHz			
		20MHz			
		50MHz			
		100MHz			
		200MHz			
		250MHz			
200mV/div	1.2V	1MHz		-3dB to 3dB	
		10MHz			
		20MHz			
		50MHz			
		100MHz			
		200MHz			
		250MHz			

2V/div	5.5V	1MHz		-3dB to 3dB	
		10MHz			
		20MHz			
		50MHz			
		100MHz			
		200MHz			
		250MHz			
		10MHz			
		20MHz			
		50MHz			
		110MHz			



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