RIGOL

Calibration Guide

DS4000 Series Digital Oscilloscope

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RIGOL Technologies, Inc.

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Document Overview

This document mainly introduces how to calibrate the **RIGOL** DS4000 oscilloscope in its project mode. It is assumed that readers of this document are familiar with the front and rear panels and the operation method of DS4000. DS4000 includes dual-channel and four-channel models and in this manual the four-channel model is taken as an example for the illustration.

Chapter 1   Calibration Notices

Calibration Preparations

- **RIGOL** DS4000 oscilloscope
- **RIGOL** DG5000 signal generator
- A BNC cable (Figure 1)
- A BNC one-to-five cable (Figure 2)

Note: make sure the instrument has been warmed up for 30 minutes before calibrating.

Figure 1   Figure 2

Project Mode

1. Start the oscilloscope.

2. Press MENU in the **TRIGGER** control area at the lower-right corner of the front panel and then set the trigger **Type** to "Edge".

3. Press **F7**, **F6**, **F7** and Utility (**F7** and **F6** are defined as shown in Figure 3) successively to enter the project mode and select the second-page menu (Figure 4). (Repeating step 2 and 3 can return back to the normal mode).

   Note: by default, the oscilloscope enters the normal mode after restart.

Figure 3

Figure 4

Calibration Sequence

The calibration sequence is as shown in the figure below. It is recommended to calibrate the instrument following the **Self-Calibration**, **Equivalent Calibration**, **Delay Calibration** sequence, wherein, equivalent calibration and delay calibration must be performed in project mode.

```
        ┌─────────────────┐
        ╱  At Least 30-    ╲
        ╲  minute Warm-up  ╱
         └────────┬───────┘
                  │
                  ▼
        ┌─────────────────┐
        │  Self-Calibration │
        └────────┬────────┘
                 │
                 ▼
        ┌─────────────────────┐
        │ Equivalent Calibration │
        └──────────┬──────────┘
                   │
                   ▼
        ┌─────────────────┐
        │  Delay Calibration │
        └────────┬────────┘
                 │
                 ▼
           (   Finish   )
```
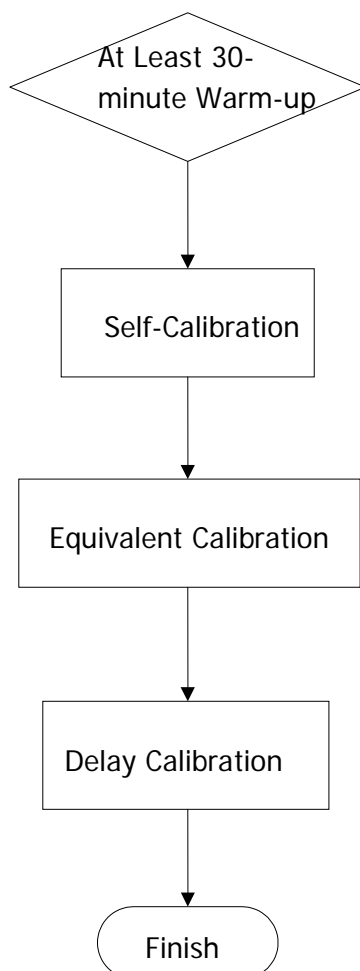
Figure 5

To Resume Calibration

Select **ResumeCal** to restore the oscilloscope to its default parameters when the calibration fails or the oscilloscope fails to save the parameters.

Chapter 2   Calibration Procedures

Self-Calibration (Vertical Calibration)

Make sure the oscilloscope has been warmed up for 30 minutes before performing self-calibration. Then, follow the steps below to calibrate the instrument.

1. Connect all the input channels and external trigger channel of the oscilloscope to the **[Trig Out/Calibration]** connector at the rear panel using the **BNC One-to-Five Cable**.

2. Press **Utility** at the front panel and select **Self-Cal** in the first-page menu.

3. Press **Start** to perform self-calibration (as shown in Figure 6).

4. The self-calibration would last for about 30 minutes (20 minutes for dual-channel models). Restart the oscilloscope when "Calibration finished, please restart the oscilloscope!" is displayed.

5. Press **Acquire**, set the **Acquisition** to "Average" and the **Averages** to 16.

6. Disconnect the input signals of all the channels to view the offset of the waveform of each channel at 2mV/div scale. Calibrate again if the offset exceeds 0.5div.
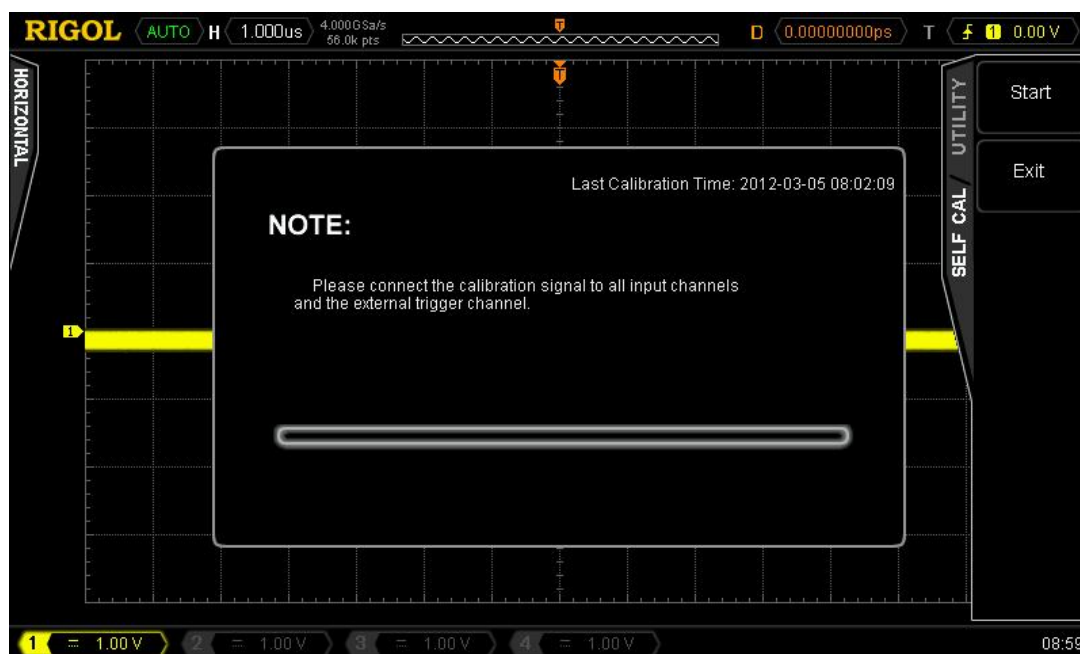

Figure 6

Equivalent Calibration

Make sure the oscilloscope has been warmed up for 30 minutes before performing equivalent calibration. Then, follow the steps below to calibrate the instrument.

1. Disconnect all the channels as well as the external trigger channel. Enter the project mode and select **EqualCal** (**Figure 4**) to start the calibration.

2. The equivalent calibration would last for about 1 minute. Restart the oscilloscope when "Calibration finished, please restart the oscilloscope!" is displayed.

3. Connect CH1 of the oscilloscope to the **[Trig Out/Calibration]** connector at the rear panel using the BNC Cable.

4. Press **Utility**, enter the second-page menu and press **AuxOutput** to select "Fast".

5. Press **CH1** and set the input impedance of CH1 to 50 Ω and the vertical scale to 200 mV/div. Adjust the trigger level to get stable waveform. Adjust the vertical position of CH1 to display the waveform within the screen range.

6. Observe whether jitter occurs at the signal trigger position at 10 ns and 2 ns horizontal scales respectively. If yes, calibrate again. The normal calibration waveform should be as shown in Figure 7.
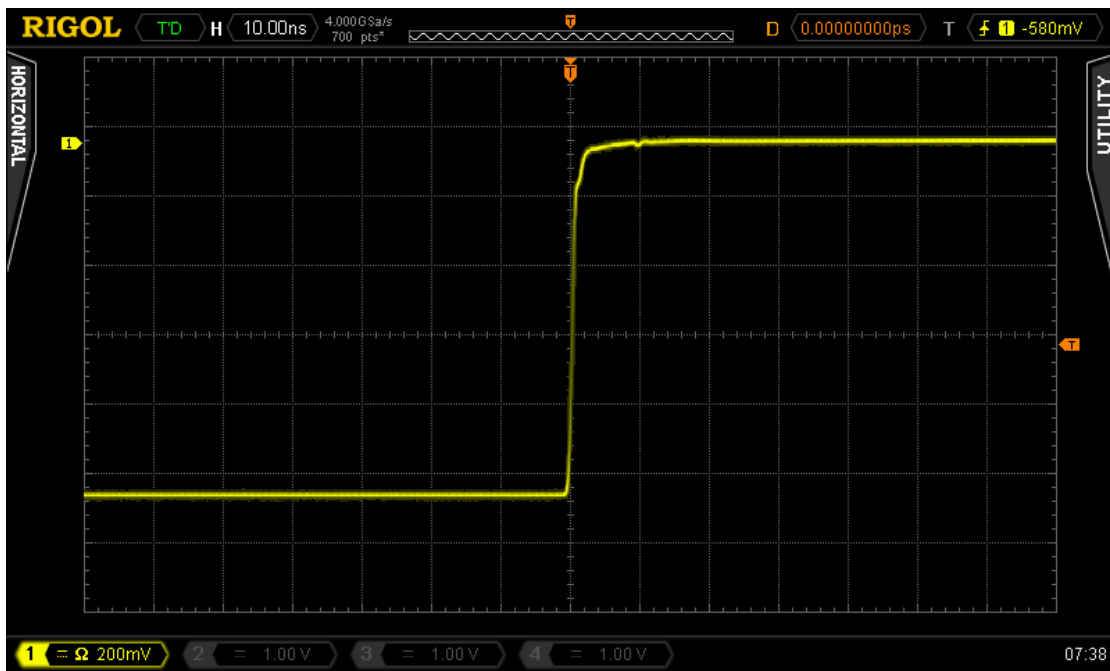

Figure 7

Delay Calibration

Make sure the oscilloscope has been warmed up for 30 minutes before performing delay calibration. Then, follow the steps below to calibrate the instrument.

1. Output a square waveform with 100 kHz frequency, 4 Vpp amplitude and 50 Ω impedance from the signal generator.

2. Connect the above-mentioned signal to all the input channels (except the external trigger channel) of the oscilloscope using the **BNC One-to-Five Cable**.

3. Enter the second-page menu (**Figure 4**) of the project mode and select **DelayCal** to start the calibration.

4. The delay calibration would last for about 2 minutes. Restart the oscilloscope when the "Calibration finished, please restart the oscilloscope!" message is displayed.

5. Set the time base to the minimum scale (500MHz oscilloscope: 1ns scale; 350 MHz and 200 MHz oscilloscopes: 2 ns scale; 100MHz oscilloscope: 5 ns scale) and set the vertical scale and input impedance of each channel to 500 mV/div and 50Ω respectively to view whether offset to the zero point of the waveform of each channel occurs. If yes, calibrate again. The failed waveform is as shown in Figure 8.

6. Keep the time base setting unchanged. Turn all the channels on, then turn any of the channels off and view whether other channels are affected and whether the waveforms jump. If yes, perform delay calibration again. The normal waveform should be as shown in Figure 9.
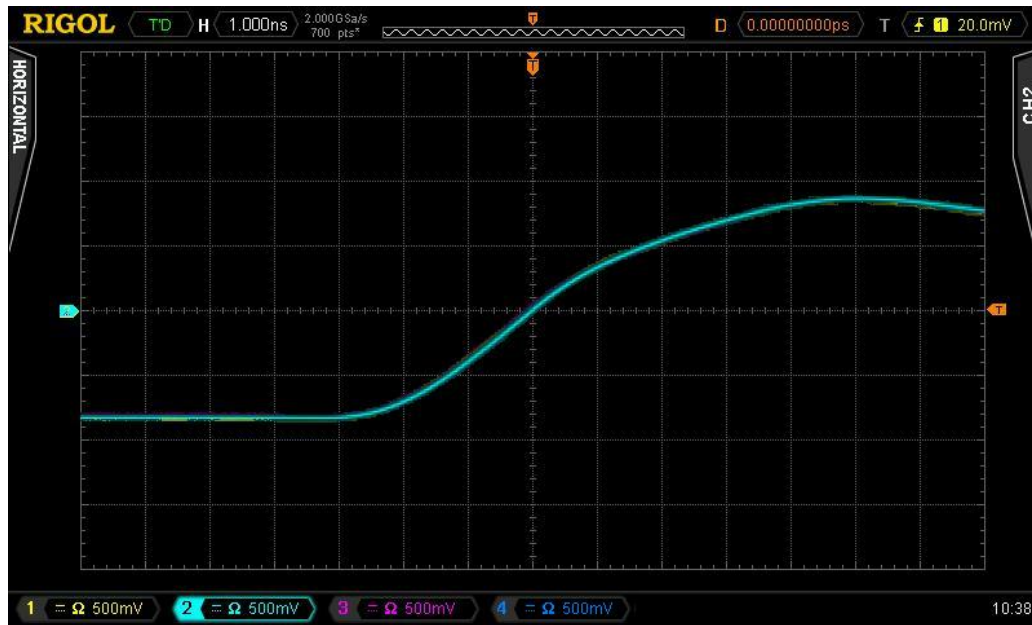

Figure 8

Figure 9

By now, the calibration finishes.