Oscilloscope MSO-X 2002A

InfiniiVision 2000 X-Series Oscilloscopes—At a Glance
Oscilloscope MSO-X 2002A
Oscilloscope MSO-X 2002A

1. Power cord connector
2. Kensington lock hole
3. Module slot
4. TRIG OUT connector
5. Calibration protect button
6. EXT TRIG IN connector
7. USB Host port
8. USB Device port
Oscilloscope MSO-X 2002A
Oscilloscope MSO-X 2002A (Models)

<table>
<thead>
<tr>
<th>Bandwidth</th>
<th>70 MHz</th>
<th>100 MHz</th>
<th>200 MHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-Channel + 8 Logic Channels MSO</td>
<td>MSO-X 2002A</td>
<td>MSO-X 2012A</td>
<td>MSO-X 2022A</td>
</tr>
<tr>
<td>4-Channel + 8 Logic Channels MSO</td>
<td>MSO-X 2004A</td>
<td>MSO-X 2014A</td>
<td>MSO-X 2024A</td>
</tr>
<tr>
<td>2-Channel DSO</td>
<td>DSO-X 2002A</td>
<td>DSO-X 2012A</td>
<td>DSO-X 2022A</td>
</tr>
<tr>
<td>4-Channel DSO</td>
<td>DSO-X 2004A</td>
<td>DSO-X 2014A</td>
<td>DSO-X 2024A</td>
</tr>
</tbody>
</table>
Oscilloscope MSO-X 2002A

Acessories

Documentation CD

Power cord (Based on country of origin)

N2862B probes (Qty 2 or 4)

Digital Probe Kit* (MSO models only)

*N6450-60001 Digital Probe Kit contains:
- N6459-61601 8-channel cable (qty 1)
- 01650-82103 2-inch probe ground leads (qty 3)
- 5090-4832 Grabber (qty 10)

Digital probe replacement parts are listed in the "Digital Channels" chapter.
Figure 1  Interpreting the oscilloscope display
Oscilloscope MSO-X 2002A
Oscilloscope MSO-X 2002A
Connect Probes to the Oscilloscope

1. Connect the oscilloscope probe to an oscilloscope channel BNC connector.

2. Connect the probe's retractable hook tip to the point of interest on the circuit or device under test. Be sure to connect the probe ground lead to a ground point on the circuit.
Oscilloscope MSO-X 2002A

Input a Waveform

The first signal to input to the oscilloscope is the Demo 2, Probe Comp signal. This signal is used for compensating probes.

1. Connect an oscilloscope probe from channel 1 to the **Demo 2** (Probe Comp) terminal on the front panel.

2. Connect the probe's ground lead to the ground terminal (next to the **Demo 2** terminal).
Recall the Default Oscilloscope Setup

To recall the default oscilloscope setup:

1. Press [Default Setup].

The default setup restores the oscilloscope's default settings. This places the oscilloscope in a known operating condition. The major default settings are:

<table>
<thead>
<tr>
<th>Table 2</th>
<th>Default Configuration Settings</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Horizontal</strong></td>
<td>Normal mode, 100 μs/div scale, 0 s delay, center time reference.</td>
</tr>
<tr>
<td><strong>Vertical (Analog)</strong></td>
<td>Channel 1 on, 5 V/div scale, DC coupling, 0 V position.</td>
</tr>
<tr>
<td><strong>Trigger</strong></td>
<td>Edge trigger, Auto trigger mode, 0 V level, channel 1 source, DC coupling, rising edge slope, 40 ns holdoff time.</td>
</tr>
<tr>
<td><strong>Display</strong></td>
<td>Persistence off, 20% grid intensity.</td>
</tr>
<tr>
<td><strong>Other</strong></td>
<td>Acquire mode normal, [Run/Stop] to Run, cursors and measurements off.</td>
</tr>
<tr>
<td><strong>Labels</strong></td>
<td>All custom labels that you have created in the Label Library are preserved (not erased), but all channel labels will be set to their original names.</td>
</tr>
</tbody>
</table>
Use Auto Scale

Use [Auto Scale] to automatically configure the oscilloscope to best display the input signals.

1. Press [Auto Scale].

You should see a waveform on the oscilloscope's display similar to this:
Oscilloscope MSO-X 2002A
Compensate Passive Probes

Each oscilloscope passive probe must be compensated to match the input characteristics of the oscilloscope channel to which it is connected. A poorly compensated probe can introduce significant measurement errors.

1. Input the Probe Comp signal (see “Input a Waveform” on page 25).
2. Press [Default Setup] to recall the default oscilloscope setup (see “Recall the Default Oscilloscope Setup” on page 25).
3. Press [Auto Scale] to automatically configure the oscilloscope for the Probe Comp signal (see “Use Auto Scale” on page 26).
4. Press the channel key to which the probe is connected ([1], [2], etc.).
5. In the Channel Menu, press Probe.
6. In the Channel Probe Menu, press Probe Check; then, follow the instructions on-screen.
If necessary, use a nonmetallic tool (supplied with the probe) to adjust the trimmer capacitor on the probe for the flattest pulse possible.

On the N2862/63/90 probes, the trimmer capacitor is the yellow adjustment on the probe tip. On other probes, the trimmer capacitor is located on the probe BNC connector.

![Waveforms](image)

7 Connect probes to all other oscilloscope channels (channel 2 of a 2-channel oscilloscope, or channels 2, 3, and 4 of a 4-channel oscilloscope).

8 Repeat the procedure for each channel.
Delay

Delay measures the time difference from the selected edge on source 1 and the selected edge on source 2 closest to the trigger reference point at the middle threshold points on the waveforms. Negative delay values indicate that the selected edge of source 1 occurred after the selected edge of source 2.
Oscilloscope MSO-X 2002A

Time Measurements

![Oscilloscope Measurement Display]
1 Press the [Meas] key to display the Measurement Menu.

2 Press the Source softkey; then turn the Entry knob to select the first analog channel source.

3 Press the Type: softkey; then, turn the Entry knob to select Delay.

4 Press the Settings softkey to select the second analog channel source and slope for the delay measurement.

   The default Delay settings measure from the rising edge of channel 1 to the rising edge of channel 2.

5 Press the Back/Up key to return to the Measurement Menu.

6 Press the Add Measurement softkey to make the measurement.
Phase

Phase is the calculated phase shift from source 1 to source 2, expressed in degrees. Negative phase shift values indicate that the rising edge of source 1 occurred after the rising edge of source 2.

\[
\text{Phase} = \frac{\text{Delay}}{\text{Source 1 Period}} \times 360
\]
Oscilloscope MSO-X 2002A

Phase Measurements
Oscilloscope MSO-X 2002A

Phase Measurements

1. Press the [Meas] key to display the Measurement Menu.
2. Press the Source softkey; then turn the Entry knob to select the first analog channel source.
3. Press the Type: softkey; then, turn the Entry knob to select Delay.
4. Press the Settings softkey to select the second analog channel source for the phase measurement.

   The default Phase settings measure from channel 1 to channel 2.

5. Press the Back/Up key to return to the Measurement Menu.
6. Press the Add Measurement softkey to make the measurement.

The example below shows a phase measurement between the channel 1 and the math d/dt function on channel 1.
1 Connect a signal to the oscilloscope and obtain a stable display.

2 Press the [Cursors] key.

The Cursors box in the right-side information area appears, indicating that cursors are "on". (Press the [Cursors] key again when you want to turn cursors off.)

3 In the Cursors Menu, press **Mode**; then, select the desired mode:
   - **Manual** – \( \Delta X \), \( 1/\Delta X \), and \( \Delta Y \) values are displayed. \( \Delta X \) is the difference between the X1 and X2 cursors and \( \Delta Y \) is the difference between the Y1 and Y2 cursors.
Filtros são circuitos elétricos contendo elementos passivos (R, L ou C) ou circuitos eletrônicos contendo elementos ativos (transistores, amplificadores operacionais) projetados para preservar sinais senoidais pertencentes a uma determinada faixa de frequência e rejeitar os sinais restantes. São, por exemplo, utilizados em sistemas de comunicações para preservar sinais elétricos de interesse e em sistemas de áudio para separar sinais utilizados por amplificadores e alto falantes (woofer, tweeter, ...).
Filtro Passivos

Fig. 3.1 - Filtro Passa-Baixa

Fig. 3.2 - Filtro Passa-Alta

Fig. 3.3 - Filtro Passa-Banda

Fig. 3.4 - Filtro Rejeita-Banda
Filtro Passivos

Woofer (filtro passa baixa)

Filtro Passa Faixa

Tweeter (filtro passa alta)

Fig. 3.6
Filtro Passivo Passa Alta
Diagrama de Bode - Amplitude
Filtro Passivo Passa Alta

Diagrama de Bode - Fase
### Tabela - Ganho e Defasagem em função da frequência (Hz)

<table>
<thead>
<tr>
<th>Frequência (Hz)</th>
<th>$V_{in}^{max}$ (V)</th>
<th>$V_{out}^{max}$ (V)</th>
<th>$G$ (dB)</th>
<th>$\Delta t$ (s)</th>
<th>$\theta$ (graus)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>60</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>80</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>100</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>120</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>200</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>400</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>600</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>800</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1200</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1600</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1850</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>