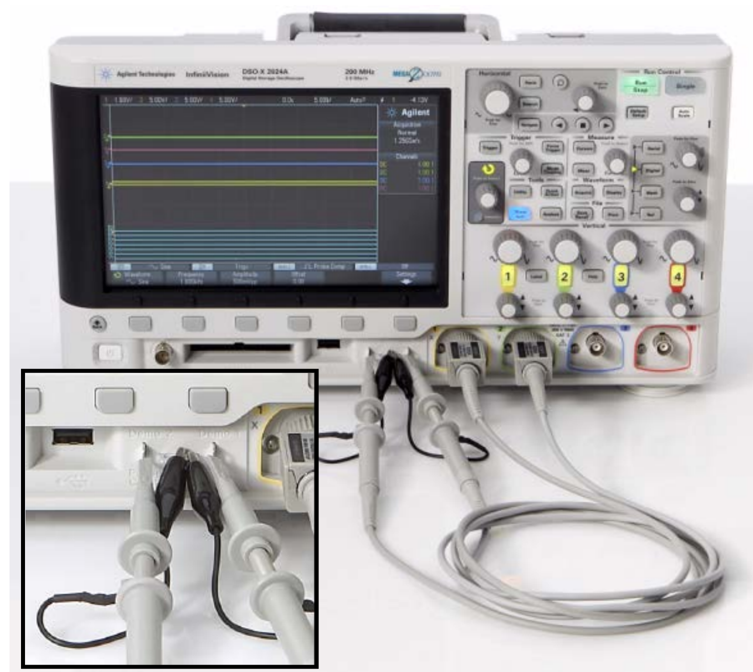
Get started with DSO-X 2014A

The oscilloscope has some built-in ”training signals”!

Connect two measurement cables with probes to the demo-connectors. Turn the oscilloscope on.



Press **Default Setup** – settings from before will be removed.

Scalefactors of the probes

The probes will attenuate the signals 10:1, this fact must be known by the oscilloscope in order for it to present correct values.

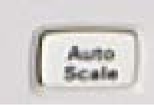
Chose the menu for Channel1, the yellow chan
and then press the Softkey **Probe**.
Choose **Probe** and turn the Entry-knob to
Ratio 10.0:1 and press it.

Do the same with Channel2, the green channel.

Measurements of a sinus-voltage

Press the button **Help** to display the soft-menu with the training signals.

Choose Softkey **Training Signals**. Turn and choose **Sine** with the Entry-knob.

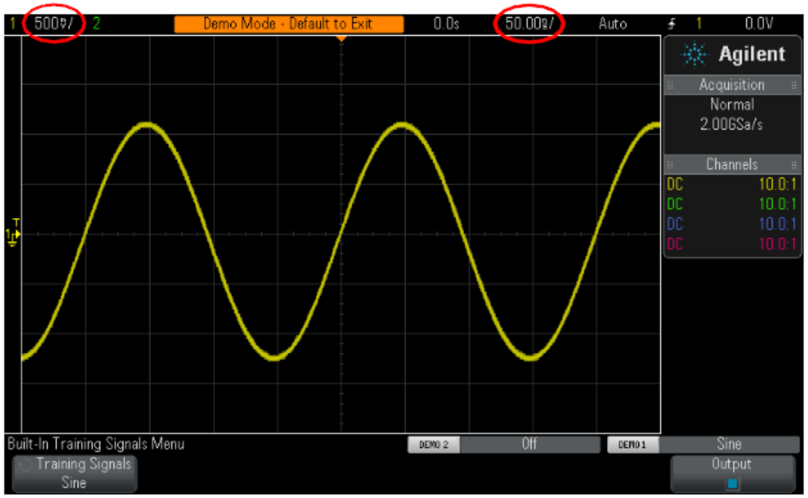


Press the button **Auto Scale**, this is a ”fix it-button” that often will find suitable settings to start your measurements with. Channel1 shows the sinus-voltage, and Channel2 a DC-voltage.

A better picture

Set s/div (Horizontal) at **50** ns/div

Set Channel1 V/div (Vertical) **500** mV/div



Close Channel2 by pressing the button twice.

Settings are shown on top of the screen.

Peak-Peak Period Frequency

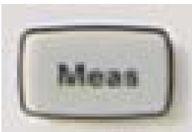
Use the **grid** to estimate the Peak-Peak value (Pk-Pk), the Period, and the Frequency.
You can move the curve with the knobs for Horisontal and Vertikal position. (500 mV/div, 50 ns/div)

$$T = \qquad\qquad [\text{ns}]$$

$$f = \frac{1}{T} = \qquad\qquad [\text{kHz}]$$

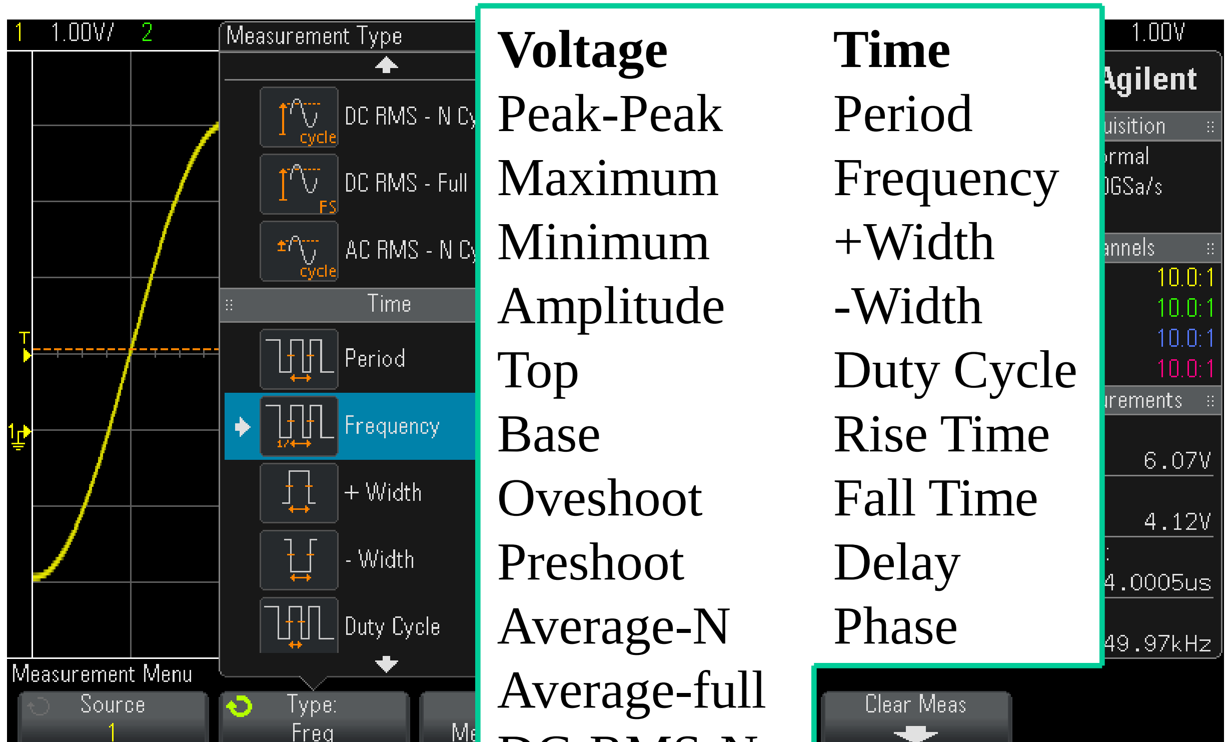
$$\hat{V}_{P-P} = \qquad\qquad [\text{V}]$$

Automatical measurmets



Press **Meas**. As default values for **Freq** and **Pk-Pk** are shown.

Are the values the same as your estimate?



Voltage	**Time**
Peak-Peak	Period
Maximum	Frequency
Minimum	+Width
Amplitude	-Width
Top	Duty Cycle
Base	Rise Time
Oveshoot	Fall Time
Preshoot	Delay
Average-N	Phase
Average-full	
DC-RMS-N	
DC-RMS-full	
AC-RMS-N	
AC-RMS-full	

In the softmenu **Type** you can also chose to calculate/measure **AC-RMS-N** or **DC-RMS-N** or **Average-N**

Automatical measurements compared to a DMM

V⎓ U_{DC} **DC-component** *average*

V~ U_{AC} **AC-component** *rms-average*

V⎓ V~ U_{ACDC} **Total** *rms-average*

Average-N

AC-RMS-N

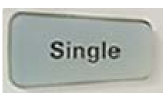
DC-RMS-N

$$U_{\text{ACDC}} = \sqrt{U_{\text{DC}}^2 + U_{\text{AC}}^2}$$

$$U_{\text{DC-RMS}} = \sqrt{U_{\text{Average}}^2 + U_{AC-RMS}^2}$$

Auto Scale’s limitations

The ”fixitall-key” **Auto Scale**, can’t handle everything! In order to study complex signals one must use the advanced triggering-functions.

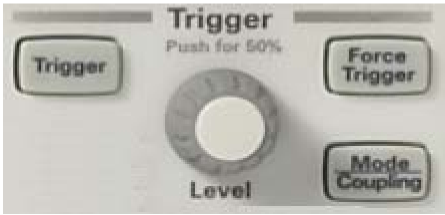


You could always run a single sweep and display a steady curve, but it could be tidesome to try out how to display a certain part of the curve. That’s the reason for the need of the trigger-functionerns.

Press **Help** to reach the softkeymenu with the training signals.

Chose Softkey **Training Signals**. Twist and choose **Sine** with the Entry-knob.

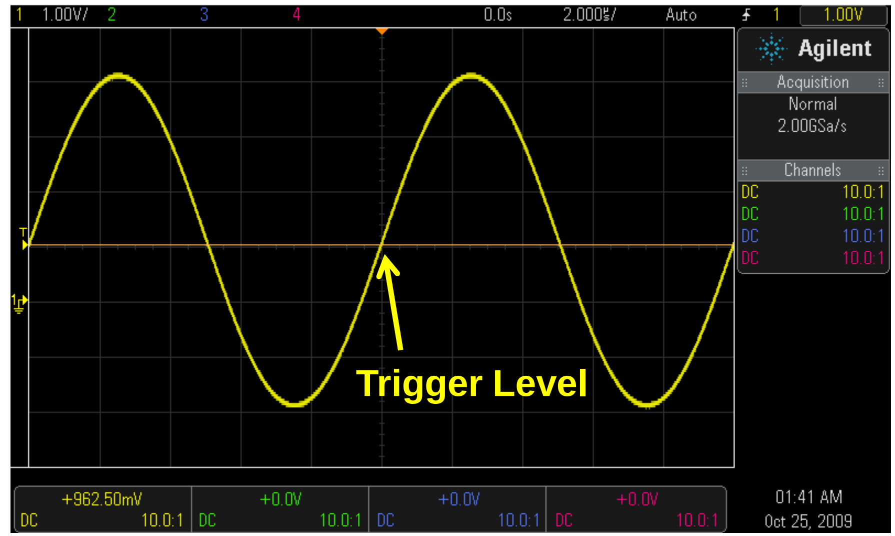
Trigg-menu



- Twist the knob **Level** and study how the curve moves around the triggeringpoint (in the middle of the screen).

- What will happen if you sets a trigger level outside the curve?

- Press the key **Trigger** to choose from the alternatives under **Source** or **Slope** in the trigger-menu. Try different settings. Wich ones will dispay a steady signal? Try to explain what happens.

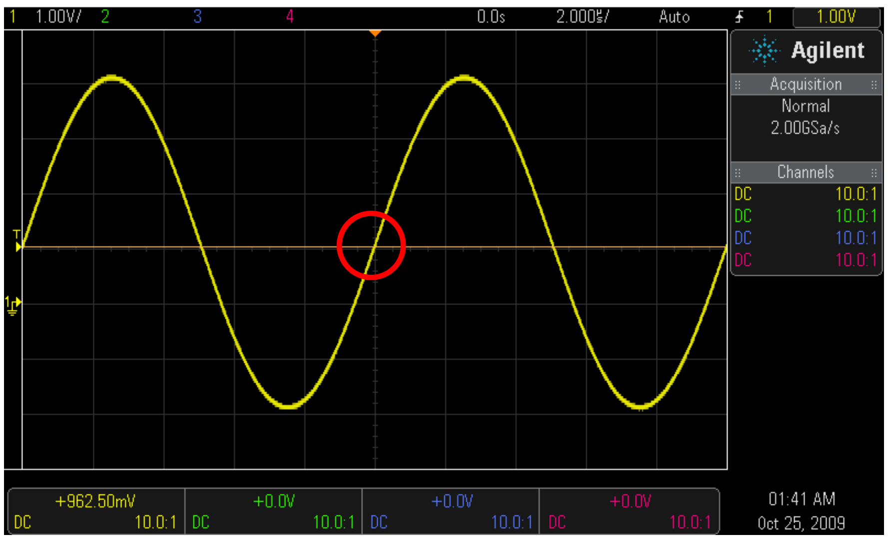


Source
1
2
3
4
External
Line

Slope
(Rising)
(Falling)
(Alternating)
(Either)

Auto Scale

Press **Auto Scale** and find out wich settings the autoscale function does for this signal?



Source
- 1
- 2
- 3
- 4
- External
- Line

Slope
- (Rising)
- (Falling)
- (Alternating)
- (Either)

With this pure sine-signal **Auto Scale** performed good!

Noisy sine-voltage?

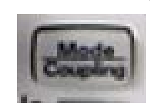
Press **Default Setup** and then **Help**. Choose **Training Signal**, **Sine with Noice**.

With **Auto Scale the** noisy sine-signal will show up. You can close Channel2.

If you *change* the atenuation there will no longer be a steady display of the curve. To change the trigger-level will not help. It’s hard to synchronise with to noisy signal.

Filter the trig-signal.

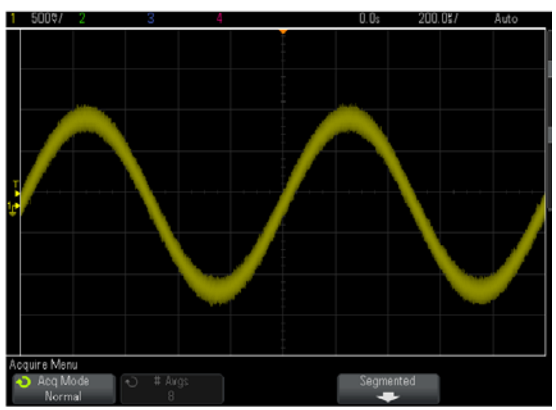
Solution: **Mode Coupling**, **Noise Rej**.

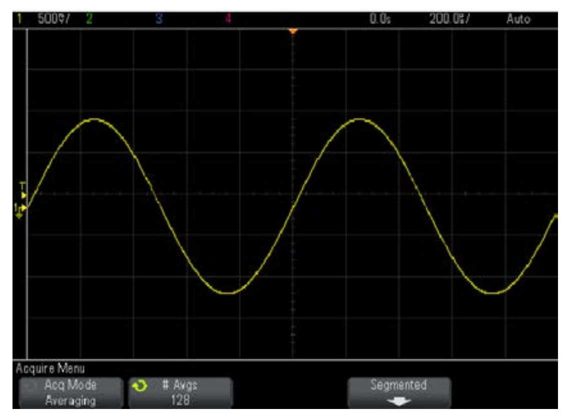


Waveform averaging

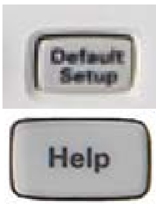
The noisy sine-signal can be ”clean” if one presents an ”average-curve” out of many curves!

Press the button **Acquire**, and then **Acq Mode and** choose **Averaging**. **# Avgs 8** is the amount of curves *N* that is ”averaged together”. Noise will be attenuated in proportion of the squareroot of *N*.



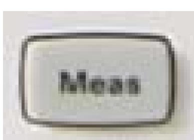


Phasemeasurement



Press **Default Setup** and then **Help**. Choose **Training Signal**, **Phase Shifted Sine**. Choose **Phase** and set the value fo eg. **45°**.

With **Auto Scale** traces of two sine-voltages are shown. If channel1 is the reference you can see that Channel2 is later in time (lagging in phase).

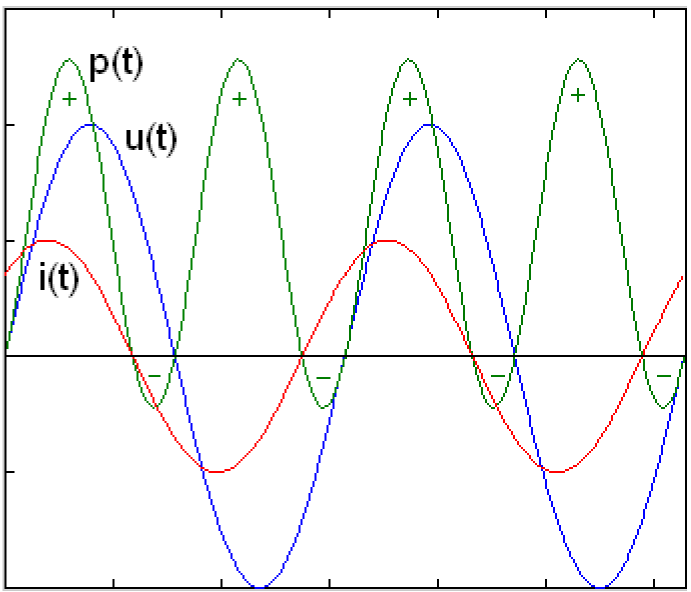


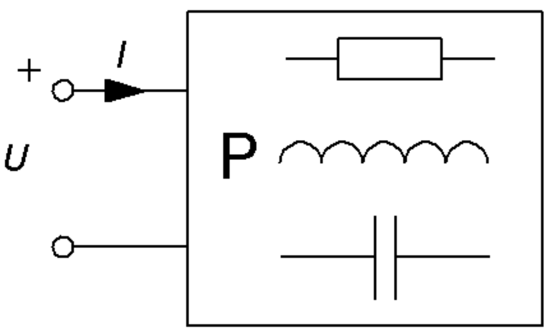
Press **Meas** and choose **Type**, **Phase**.

The measured value will be **`Phase(1→2): 45°`**

Power measurement

Suppose the two sine-traces represents current and voltage to a load. The product between a voltage and a current then represents *instantaneous power* to the load.



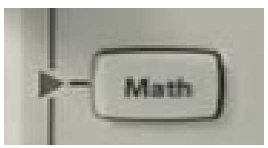


Power measurement

Press **Default Setup**.

Press Channel1 menu and choose **Coupling AC**.

Do the same with Channel2.



Press **Math** and choose **Operator** ×.

Press **Help**. Choose **Training Signal**, **Phase Shifted Sine**. Choose **Phase** and set to **45°**.

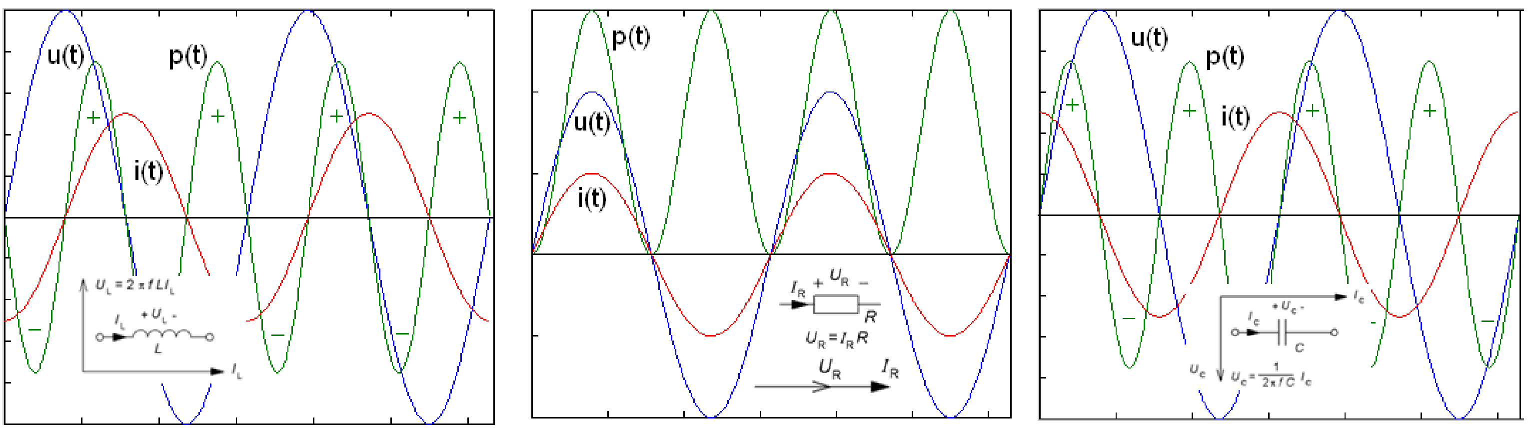
Do ***not*** press **Auto Scale**! Set the traces manualy with Horisontal and Vertical sensitivity – we want to be able to continnue to set the phase and don’t want to lose this menu.

Instantaneous power

Study the power-curve at **different phase** between voltage and current.

$$u = U\sqrt{2}\sin(\omega t + \varphi) \qquad i = I\sqrt{2}\sin(\omega t)$$

$$p = u \cdot i = U\sqrt{2}\sin(\omega t + \varphi) \cdot I\sqrt{2}\sin(\omega t) = UI\left(\cos(\varphi) - \cos(2\omega t + \varphi)\right)$$



- Why has the power-curve the double frequency compared to current and voltage?
- At which phaseangles will the power be an symetric sine (with the average 0)?