

5. Performance Verification

5.1 Introduction

This chapter contains procedures suitable for determining if the WaveSurfer 400 Series of Digital Storage Oscilloscope performs correctly and as warranted. They check all the characteristics listed in subsection 5.1.1.

In the absence of the computer automated calibration system based on LeCroy Calibration Software (Calsoft), this manual performance verification procedure can be followed to establish a traceable calibration. It is the calibrating entities' responsibility to ensure that all laboratory standards used to perform this procedure are operating within their specifications and traceable to required standards if a traceable calibration certificate is to be issued for the WaveSurfer 400 series Digital Storage Oscilloscope.

5.1.1 List of Tested Characteristics

This subsection lists the characteristics that are tested in terms of quantifiable performance limits.

- Input Impedance
- Leakage Current
- Peak to Peak noise level
- Positive and Negative DC accuracy
- Positive and Negative Offset
- Bandwidth
- Trigger Accuracy
- Time Base Accuracy

5.1.2 Calibration Cycle

The WaveSurfer 400 series Digital Storage Oscilloscope requires periodic verification of performance. Under normal use (2,000 hours of use per year) and environmental conditions, this instruments calibration cycle is 12 months.



5.2 Test Equipment Required

These procedures use external, traceable signal generators, DC precision power supply and digital multi-meter, to directly check specifications.

Instrument	Specifications	Recommended
Signal Generator Radio Frequency	Frequency : .5 MHz to 1 GHz Frequency Accuracy : 1 PPM	HP 8648B or C or Fluke 9500
Signal Generator Audio Frequency	Frequency : 0 to 5 kHz Amplitude : 8 V peak to peak	HP 33120A
Voltage Generator DC Power Supply	Range of 0 to 20 V, in steps of no more than 15 mV	HP 6633A
Power Meter + Sensor	Accuracy ± 1 %	HP437B + 8482A or equivalent
Digital Multimeter Volt & Ohm	Voltmeter Accuracy : 0.1 % Ohmmeter Accuracy : 0.1 %	Keithley 2000, Fluke 9500 or 5820 Oscilloscope Calibrator
Coaxial Cable, 5 ns	50 Ω , BNC, length 100 cm,	
Coaxial Cable, 5 ns	50 Ω , SMA, length 100 cm,	
2 Attenuators, 20 dB	50 Ω , BNC, 1 % accuracy	
T adapter	50 Ω , BNC T adapter	

Table 5-1 : Test Equipment

5.2.1 Test Records

The last pages of this chapter contain the WaveSurfer 400 series test records in the format of tables. Keep them as masters and use a photocopy for each calibration.

5.3 Turn On

If you are not familiar with operating the WaveSurfer 400, refer to the operator's manual.

- Switch on the power using the power switch.
- Wait for about 20 minutes for the scope to reach a stable operating temperature:
- To provide for quicker setup of the scope for each test, a CD containing panel setups has been included with this manual. An external USB CD ROM drive will need to be connected if you wish to use these. Detailed set up information is contained in the text and the panel setups are not needed if a CD ROM drive is not available.

5.4 Input Impedance

Specifications

DC $50\Omega \pm 1.0\%$
EXT DC $50\Omega \pm 1.0\%$
DC $1M\Omega \pm 1.0\%$
EXT $1M\Omega \pm 1.0\%$
AC $1.2M\Omega \pm 1.0\%$

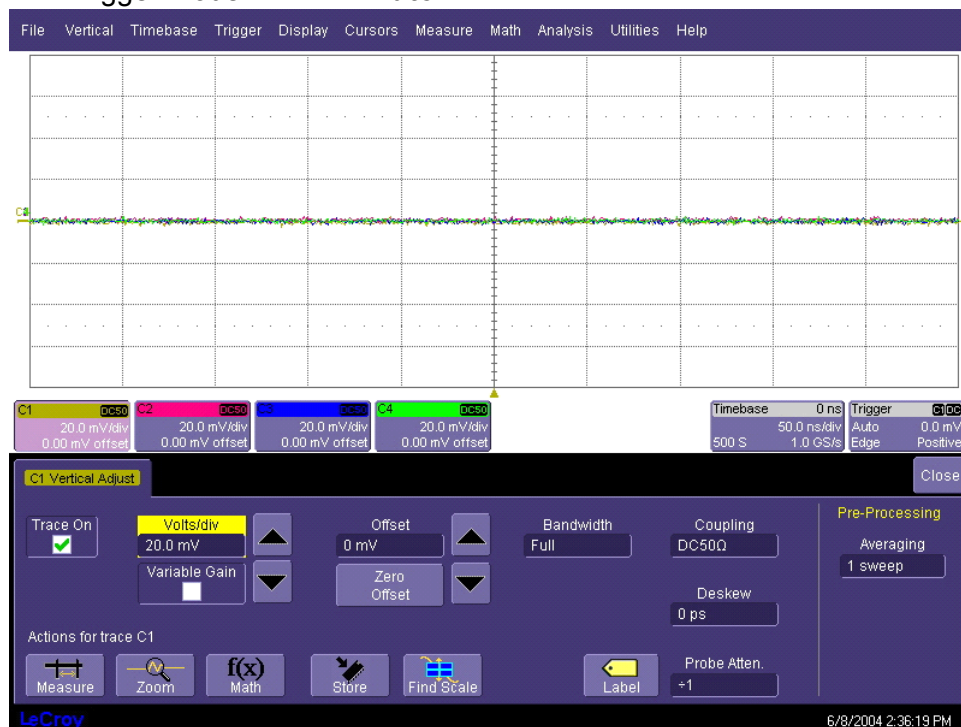
The impedance values for 50Ω coupling are measured with a high precision digital multimeter. The DMM is connected to the DSO in 4 wire configuration (input and sense), allowing for accurate measurements.

5.4.1 Channel Input Impedance

a. DC 50Ω

- Recall **Input Impedance - 50 ohm x1.lss** or configure the DSO :

Panel Setups	:	Recall FROM DEFAULT SETUP
Channels Trace ON	:	Channel 1, Channel 2, Channel 3 & Channel 4
Input Coupling	:	DC 50Ω on all 4 Channels
Input gain	:	20 mV/div. on all 4 Channels
Time base	:	50 ηsec/div.
Trigger mode	:	Auto





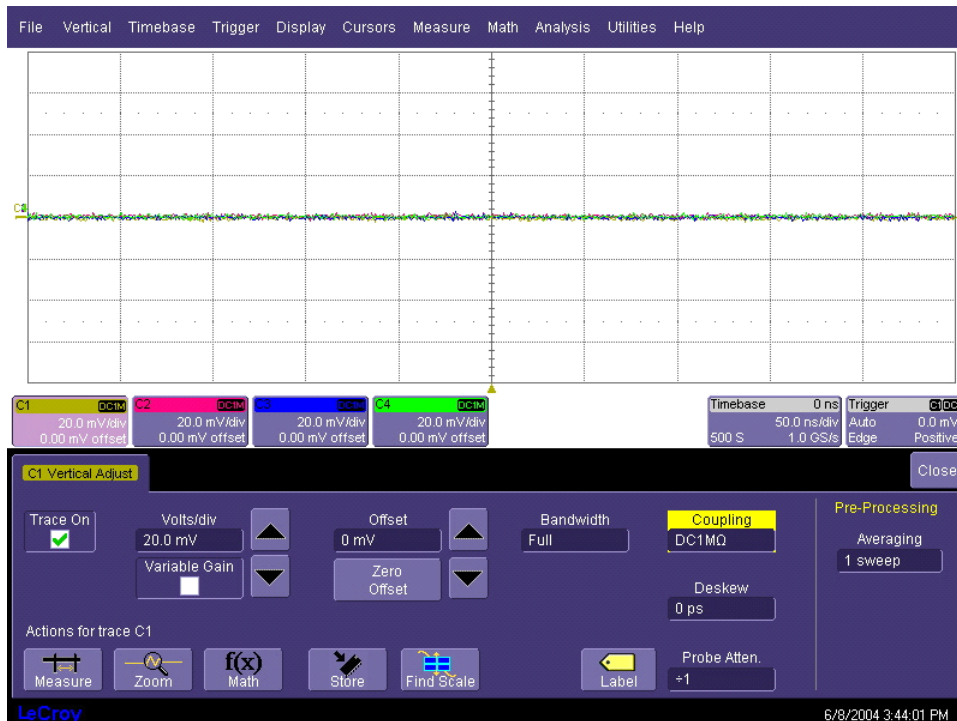
- Set the DMM with **Ohms and Ohms sense** to provide a 4 wire measurement.
- Connect it to Channel 1.
- Measure the **input impedance**, reverse the meter leads and measure the input impedance.
- **Average** these two numbers and record it in Table 2, and compare it to the limits.
- Repeat the above test for all input channels.
- Recall **Input Impedance - 50 ohm x10.lss** or Set Input gain to **200 mV/div.** on all 4 Channels
- Repeat the test for all input channels.
- Record the measurements in Table 2, and compare the test results to the limits in the test record.
- Recall **Input Impedance - 50 ohm x1.lss** or Set Input gain to **2 V/div.** on all 4 Channels
- Repeat the test for all input channels.
- Record the measurements in Table 2, and compare the test results to the limits in the test record.

b. DC 1MΩ

- Recall **Input Impedance - 1 Mohm DC x1.lss** or configure the DSO :

Panel Setups	:	Recall FROM DEFAULT SETUP
Channels Trace ON	:	Channel 1, Channel 2, Channel 3 & Channel 4
Input Coupling	:	DC 1MΩ on all 4 Channels
Input gain	:	20 mV/div. on all 4 Channels
Time base	:	50 ns/div.

Trigger mode : **Auto**



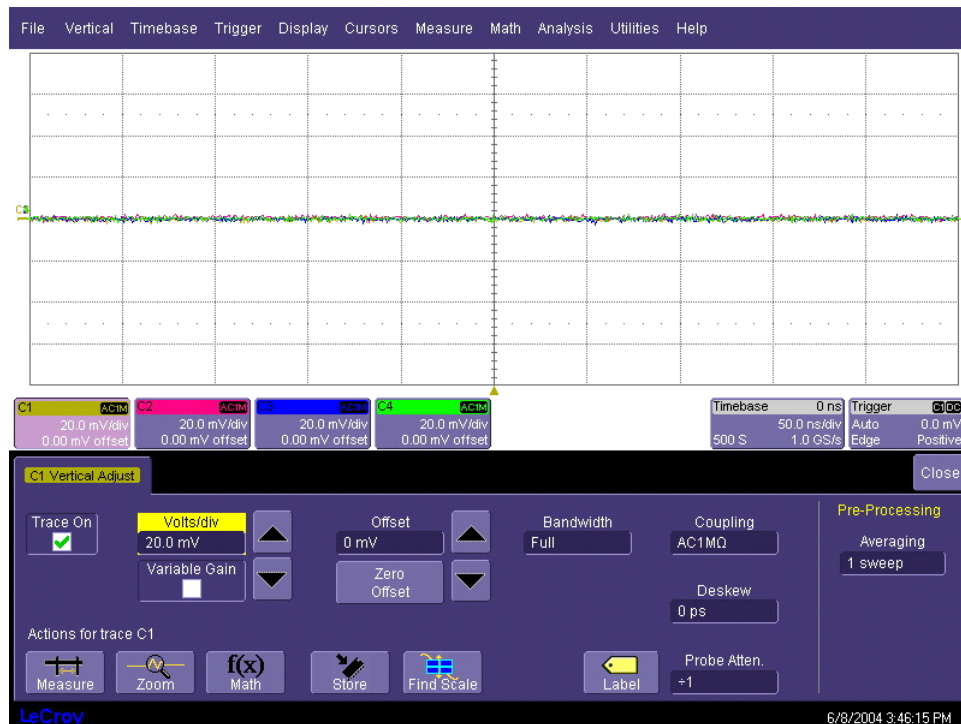
- Set the DMM with **Ohms** and **Ohms sense** to provide a 4 wire measurement.
- Connect it to Channel 1.
- Measure the **input impedance**, reverse the meter leads and measure the input impedance.
- **Average** these two numbers and record it in Table 2, and compare it to the limits.
- Repeat the above test for all input channels.
- Recall **Input Impedance - 1 Mohm DC x10.Iss** or Set Input gain to **200 mV/div.** on all 4 Channels
- Repeat the test for all input channels.
- Record the measurements in Table 2, and compare the test results to the limits in the test record.
- Recall **Input Impedance - 1 Mohm DC x1.Iss** or Set Input gain to **2 V/div.** on all 4 Channels
- Repeat the test for all input channels.
- Record the measurements in Table 2, and compare the test results to the limits in the test record.



c. AC 1M Ω

- Recall **Input Impedance - 1 Mohm AC x1.lss** or configure the DSO :

Panel Setups : **Recall FROM DEFAULT SETUP**
Channels Trace ON : **Channel 1, Channel 2, Channel 3 & Channel 4**
Input Coupling : **AC 1M Ω on all 4 Channels**
Input gain : **20 mV/div. on all 4 Channels**
Time base : **50 η sec/div.**
Trigger mode : **Auto**



- Set the DMM with **Ohms and Ohms sense** to provide a 4 wire measurement.
- Connect it to Channel 1.
- Measure the **input impedance**.
- Record the measurements in Table 2, and compare the test results to the limits in the test record.
- Repeat the above test for all input channels.

5.4.2 External Trigger Input Impedance

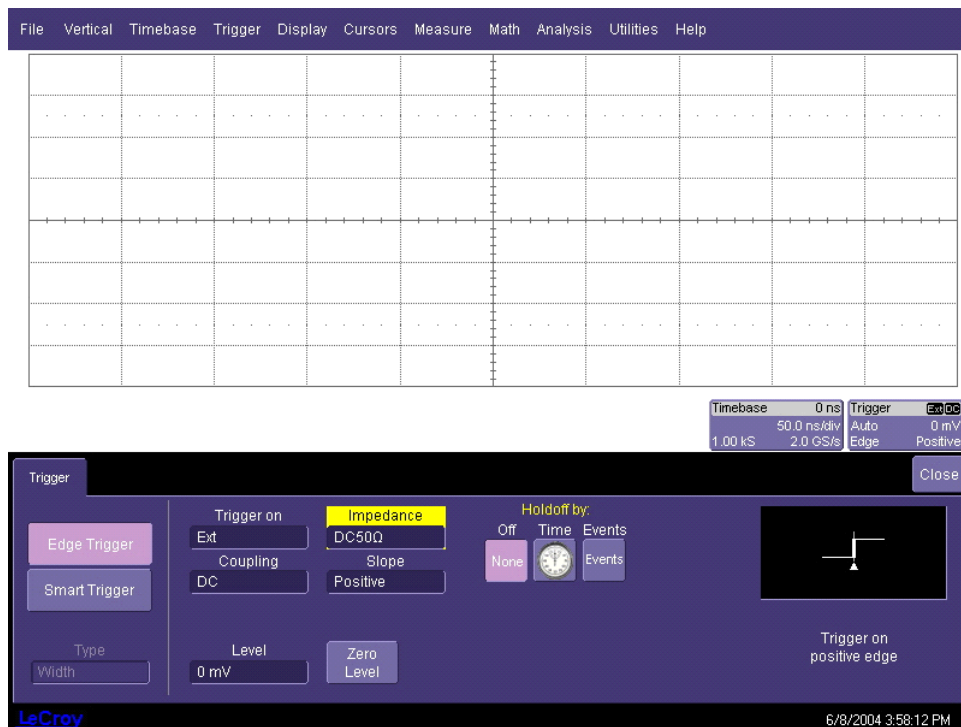
a. DC 50Ω

- Recall **Input Impedance - 50 ohm ext x1.1ss** or configure the DSO :

Select Setup trigger

Trigger on : **EXT**

Impedance : **DC 50Ω**



- Connect the DMM to External, and measure the **input impedance**, reverse the meter leads and measure the input impedance.
- Average** these two numbers and record the input impedance in Table 2, and compare the result to the limit in the test record.
- Recall **Input Impedance - 50 ohm ext x10.1ss** or Set Trigger Source to **Ext/10**.
- Repeat the test.
- Record the measurements in Table 2, and compare the test results to the limits in the test record.



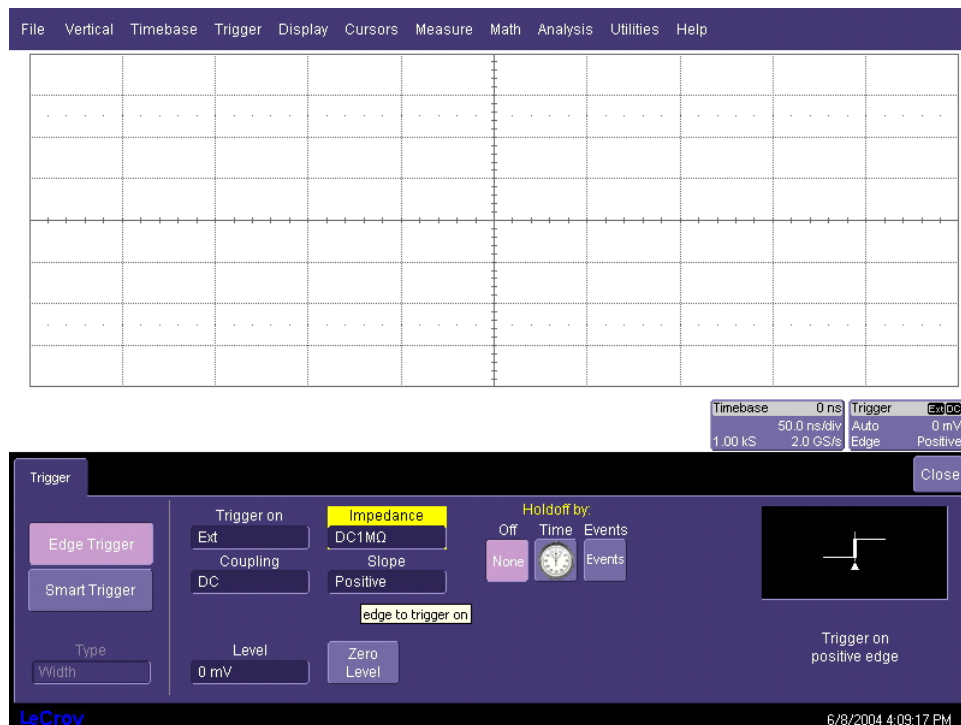
b. Ext DC 1MΩ Input Impedance

- Recall **Input Impedance - 1 Mohm DC Ext x1.Iss** or configure the DSO :

Select Setup trigger

Trigger on : **EXT**

Impedance : **DC 1MΩ**



- Connect the DMM to External, and measure the **input impedance**.
- Record** the input impedance in Table 2, and compare the result to the limit in the test record.
- Recall **Input Impedance - 1 Mohm DC Ext x10.Iss** or Set Trigger Source to **Ext/10**.
- Repeat the test for all input channels.
- Record the measurements in Table 2, and compare the test results to the limits in the test record.

5.5 Leakage Current

Specifications

DC 50 Ω , EXT DC 50 Ω : ± 0.5 mV

DC 1M Ω , EXT DC 1M Ω : ± 1.0 mV

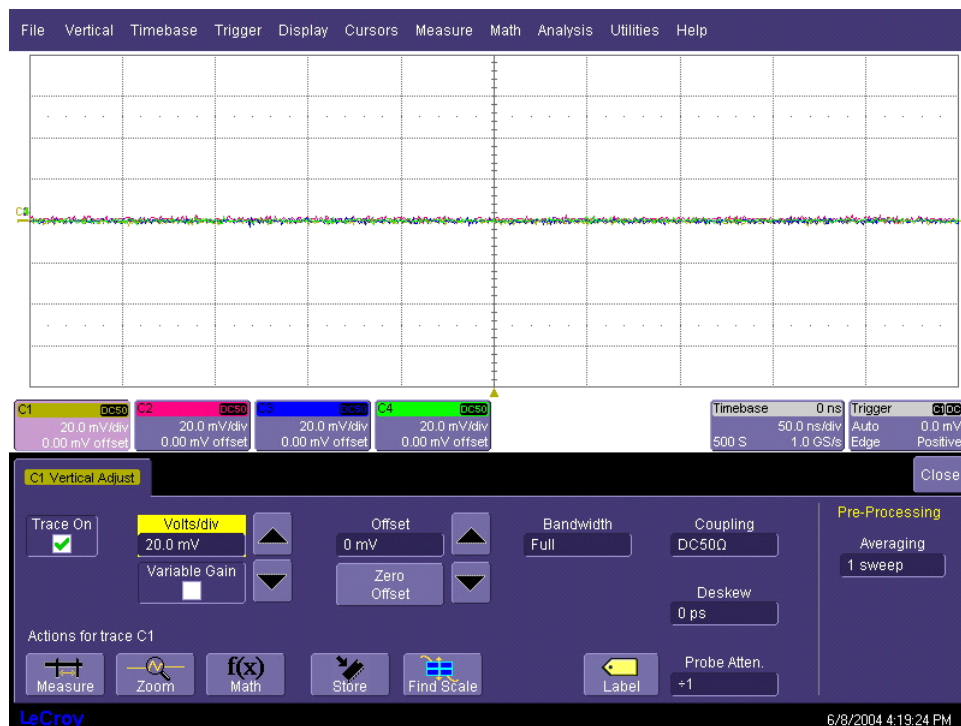
The leakage current is tested by measuring the voltage across the input channel.

5.5.1 Channel Leakage Current

a. DC 50 Ω

- Recall **Leakage - 50 ohm x1.lss** or configure the DSO :

Panel Setups	:	Recall FROM DEFAULT SETUP
Channels Trace ON	:	Channel 1, Channel 2, Channel 3 & Channel 4
Input Coupling	:	DC 50Ω on all 4 Channels
Input gain	:	20 mV/div. on all 4 Channels
Trigger mode	:	Auto
Time base	:	50 nsec/div.



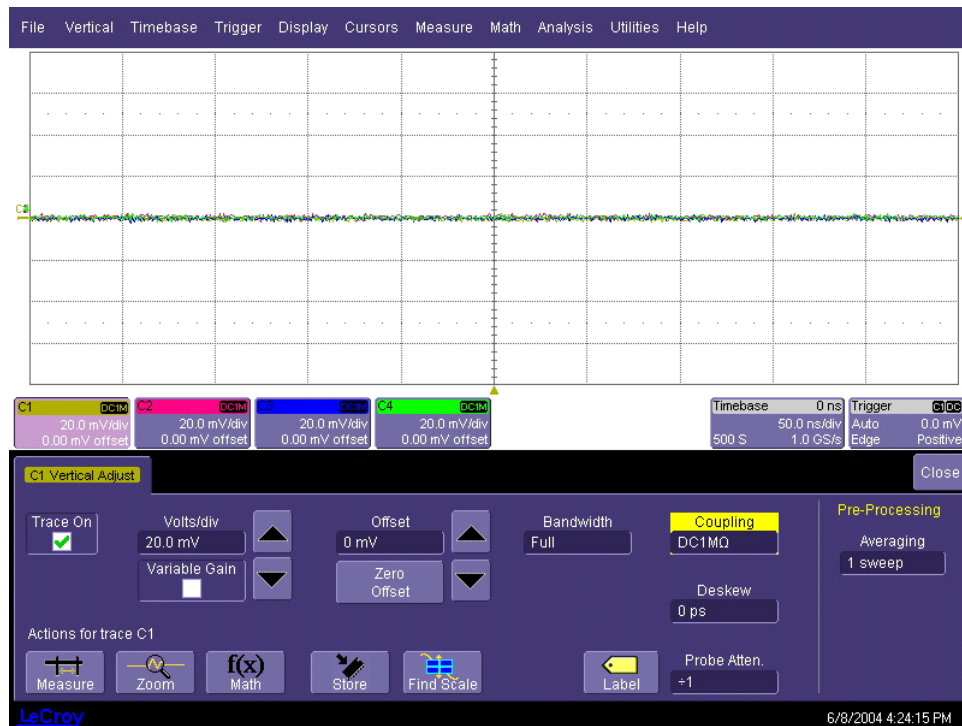


- Set the DMM to measure Volts, and connect it to Channel 1.
- Measure the **voltage** and enter it in Table 3. Compare it to the limits.
- Repeat the test for all input channels.
- Recall **Leakage - 50 ohm x10.lss** or set Input gain to **200 mV/div.** on all 4 Channels
- Repeat the test for all input channels. Record the measurements in Table 3, and compare the results to the limits in the test record.
- Recall **Leakage - 50 ohm x100.lss** or set Input gain to **2 V/div.** on all 4 Channels
- Repeat the test for all input channels. Record the measurements in Table 3, and compare the results to the limits in the test record.

b. DC 1M Ω

- Recall **Leakage - 1 Mohm x1.lss** or configure the DSO :

Panel Setups	:	Recall FROM DEFAULT SETUP
Channels Trace ON	:	Channel 1, Channel 2, Channel 3 & Channel 4
Input Coupling	:	DC 1MΩ on all 4 Channels
Input gain	:	20 mV/div. on all 4 Channels
Trigger mode	:	Auto
Time base	:	50 nsec/div.
- Set the DMM to measure Volts, and connect it to Channel 1.
- Measure the **voltage** and enter it in Table 3. Compare it to the limits.



- Repeat the test for all input channels.
- Recall **Leakage - 1 Mohm x10.Iss** or set Input gain to **200 mV/div.** on all 4 Channels
- Repeat the test for all input channels. Record the measurements in Table 3, and compare the results to the limits in the test record.
- Recall **Leakage - 1 Mohm x1.Iss** or set Input gain to **2 V/div.** on all 4 Channels
- Repeat the test for all input channels. Record the measurements in Table 3, and compare the results to the limits in the test record.



5.5.2 External Trigger Leakage Current

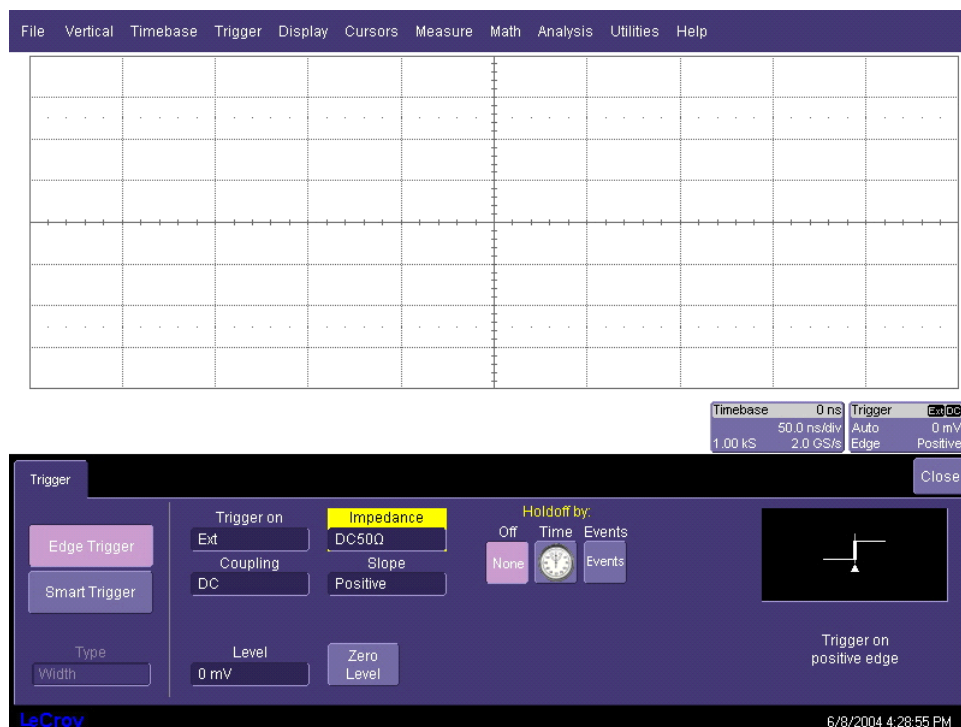
a. DC 50 Ω

- Recall **Leakage - 50 ohm ext x1.lss** or configure the DSO:

Panel Setups : **Recall FROM DEFAULT SETUP**
 Channels Trace OFF **Channel 1, Channel 2, Channel 3 & Channel 4**

Select Setup trigger
 Set Trigger on : **EXT**

Impedance : **DC 50 Ω**



- Connect the DMM to External.
- Measure the **voltage** and enter it in Table 3. Compare it to the limits.
- Recall **Leakage - 50 ohm ext x10.lss** or Set Trigger Source to **Ext/10**.
- Repeat the test.
- Record the measurements in Table 3, and compare the test results to the limits in the test record.

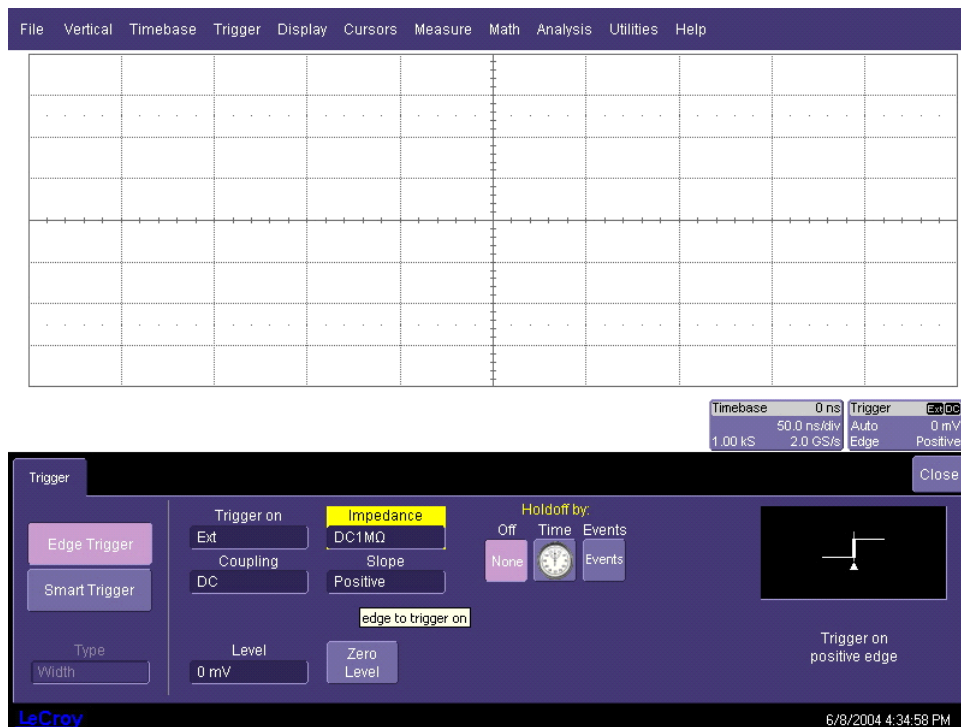
b. DC 1MΩ

- Recall **Leakage – 1 Mohm ext x1.lss** or configure the DSO as shown in 5.5.2.a and make the following changes:

Select Setup trigger

Set Trigger on : **EXT**

External : **DC 1MΩ**



- Connect the DMM to External.
- Measure the **voltage** and enter it in Table 3. Compare it to the limits.
- Recall **Leakage - 1 Mohm ext x10.lss** or Set Trigger Source to **Ext/10**.
- Repeat the test.
- Record the measurements in Table 3, and compare the test results to the limits in the test record.



5.6 Peak-Peak Noise Level

Description

Noise tests with open inputs are executed on all channels with 1 M Ω input coupling, 0 mV offset, at a gain setting of 2 mV/div and 10 mV/div. The scope parameters functions are used to measure the Peak to Peak amplitude of the noise.

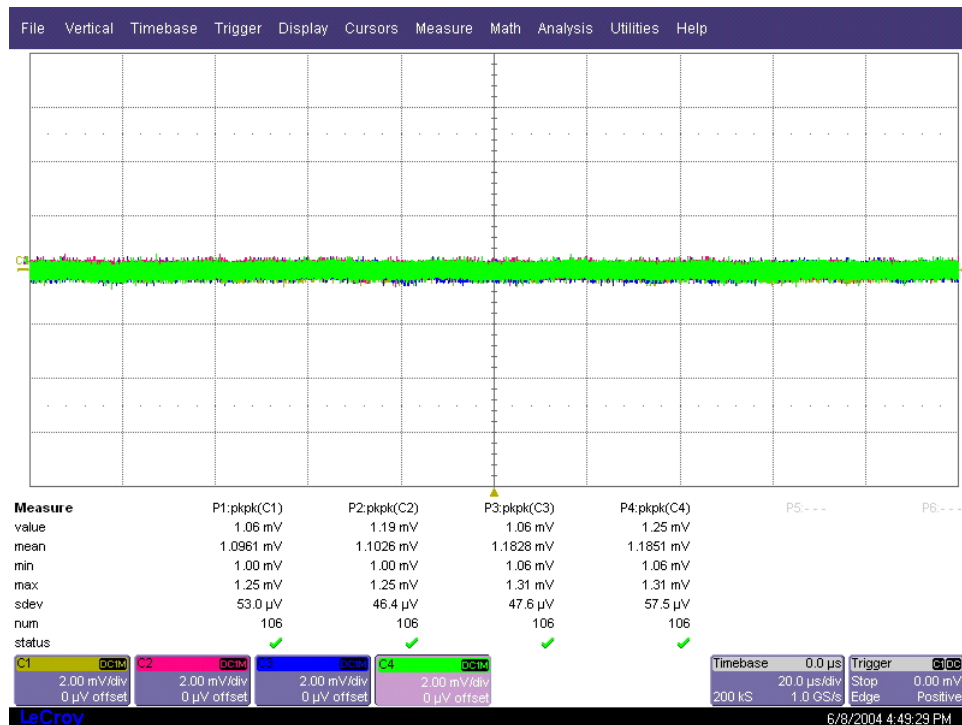
Specifications

1.6 mV Peak-Peak at 2 mV/div.
3.8 mV Peak-Peak at 10 mV/div.

With no signal connected to the inputs

- Recall **Noise - 2mv.lss** or configure the DSO :

Panel Setups	:	Recall FROM DEFAULT SETUP	
Channels Trace ON	:	Channel 1, Channel 2, Channel 3 & Channel 4	
Input Coupling	:	DC 1M0Ω on all 4 Channels	
Input gain	:	2 mV/div. on all 4 Channels	
Input offset	:	0.0 mV on all 4 Channels	
Trigger setup	:	Edge	
Trigger on	:	Line	
Trigger Mode	:	Auto	
Time base	:	20 μsec/div.	
Press	:	Measure, Measure Setup	
Statistics	:	On	
P1	:	Mean	C1
P2	:	Mean	C2
P3	:	Mean	C3
P4	:	Mean	C4



- Press **Clear Sweeps**.
- Measure for at least **50 sweeps**, and then press **Stop** to halt the acquisition.
- Record the four **mean** parameter values in Table 4, and compare the test results to the limits in the test record.
- Recall **Noise - 10mv.lss** or set Input gain to **10 mV/div.** on all 4 Channels
- Record the measurements (**mean** of 1,2,3,4) in Table 4, and compare the results to the limits in the test record.



5.7 DC Accuracy

Specification

$\leq \pm 1.5\%$ of reading + 1.0% of FS + 1mV full scale with 0 mV offset.

Description

This test measures the DC Accuracy within the gain range specified. It requires a DC source with a voltage range of 0 V to 6 V adjustable in steps of no more than 15 mV, and a calibrated DMM that can measure voltage to 0.1 %. Measurements are made using voltage values applied by the external voltage reference source, measured by the DMM, and in the oscilloscope using the parameters Mean. For each known input voltage, the deviation is checked against the tolerance.

5.7.1 Positive DC Accuracy

Procedure

- Recall **DC accuracy - 50 ohm 2mv.lss** or configure the DSO :

Panel Setups	:	Recall FROM DEFAULT SETUP
Channels Trace ON	:	Channel 1, Channel 2, Channel 3 & Channel 4
Input Coupling	:	DC 50Ω or DC 1MΩ (see Table 5) on all 4 Ch
Input offset	:	0.0 mV on all 4 Channels
Input gain	:	from 1mV/div to 2 V/div (10V/div 1MΩ) . (see Table 5)
C1 Averaging	:	10 sweeps
C2 Averaging	:	10 sweeps
C3 Averaging	:	10 sweeps
C4 Averaging	:	10 sweeps
Trigger	:	Edge Trigger
Trigger on	:	Line
Mode	:	Auto
Time base	:	1 μsec/div.

Change parameters

P1	:	Measure mean of C1
P2	:	Measure mean of C2
P3	:	Measure mean of C3
P4	:	Measure mean of C4

- Connect the test equipment as shown in Figure 5-2.

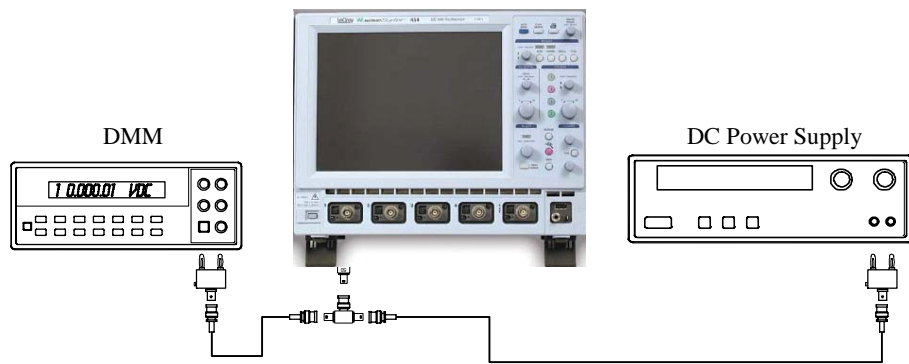


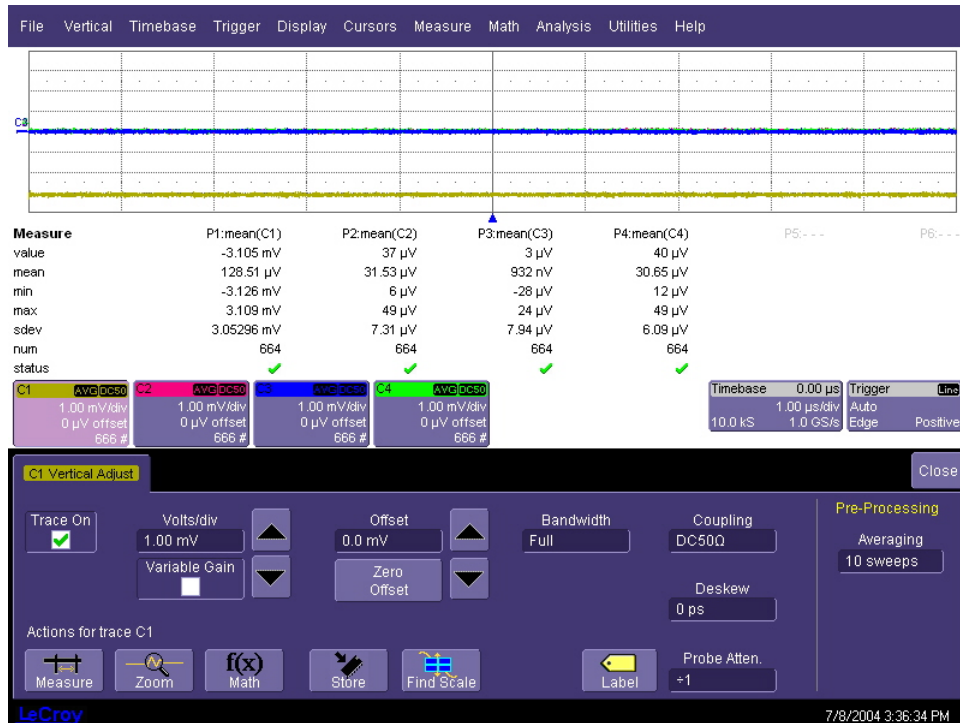
Figure 5-2 : DC Accuracy Equipment Setup

- For each **DSO Volts/div**, set the output of the external **DC voltage reference source** as shown in Table 5, column **PS output**.
 - 1) Connect the DMM and record the **voltage reading** in Table 5, column **DMM**.
 - 2) Disconnect the DMM from the BNC T connector.
 - 3) Press **Clear Sweeps**
 - 4) After 100 sweeps, read off the **DSO mean parameter**, and record the measurement in Table 5, column **Mean**.
- For each DC voltage applied to the DSO input, repeat parts 1), 2), 3) and 4).
- Calculate the **Difference (Δ)** by subtracting the **DMM voltage** reading from the **DSO mean** voltage reading. Record the test result in Table 5, and compare the **Difference (Δ)** to the corresponding limit in the test record.
- Repeat step 5.7.1.a. for the other channels, substituting channel controls and Input connector.



5.7.2 Negative DC Accuracy

- Recall **DC accuracy - 50 ohm 2mv.lss** or configure the DSO as shown in 5.7.1.
- Connect the test equipment as shown in Figure 5-2.
- For each **DSO Volts/div**, set the output of the external **DC voltage reference source** as shown in Table 6, column PS output. (if a banana-BNC adapter is being used it can simply be turned to get the opposite polarity)



- 1) Connect the DMM and record the **voltage reading** in Table 6, column **DMM**.
 - 2) Disconnect the DMM from the BNC T connector.
 - 3) Press **Clear Sweeps**
 - 4) After 100 sweeps, read off the **DSO mean parameter**, and record the measurement in Table 6, column **Mean**.
- For each DC voltage applied to the DSO input, repeat parts 1), 2), 3) and 4).
 - Calculate the **Difference (Δ)** by subtracting the **DMM voltage** reading from the **DSO mean** voltage reading. Record the test result in Table 6, and compare the **Difference (Δ)** to the corresponding limit in the test record.
 - Repeat step 5.7.2. for the other channels, substituting channel controls and input connector.



5.8 Offset Accuracy

Specifications

$\pm(1.0\% \text{ of offset} + .5\% \text{ of FS} + 1\text{mv})$

Description

The offset test is done at 50 mV/div, with a signal of ± 0.750 Volt cancelled by an offset of the opposite polarity.

5.8.1 Positive Offset Accuracy

Procedure

- Recall **Offset - Positive.Iss** or configure the DSO:

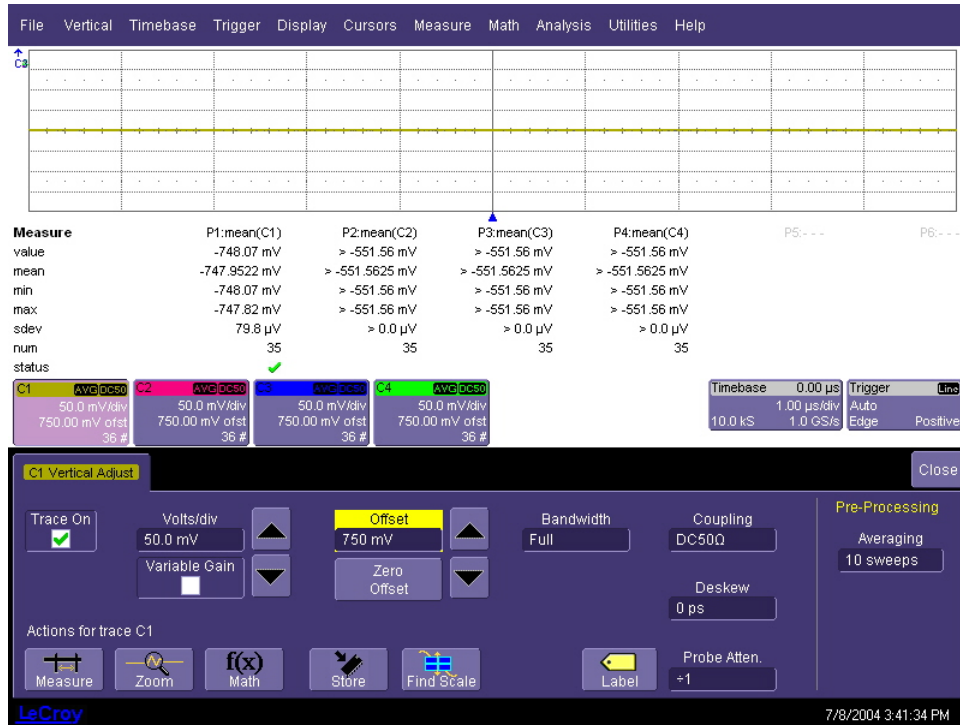
Panel Setups	:	Recall FROM DEFAULT SETUP
Channels Trace ON	:	Channel 1, Channel 2, Channel 3 & Channel 4
Input Coupling	:	DC 50Ω on all 4 Channels
Input gain	:	50mV/div on all 4 Channels
Input offset	:	+0.750 Volt on all 4 Channels
C1 Averaging	:	10 sweeps
C2 Averaging	:	10 sweeps
C3 Averaging	:	10 sweeps
C4 Averaging	:	10 sweeps
Trigger setup	:	Edge
Trigger on	:	Line
Mode	:	Auto
Time base	:	1 μsec/div.
Statistics	:	on
Change parameters	:	
P1	:	Measure mean of C1
P2	:	Measure mean of C2
P3	:	Measure mean of C3
P4	:	Measure mean of C4

- Connect the test equipment as shown in Figure 5-2.
- Set the output of the external **DC voltage reference source until the DVM measures -0.750 Volt.**
 - Verify that the displayed trace A : Average (1) is on the screen, near the center horizontal graticule line. If the trace is not visible, modify the **DC voltage reference source output** until the trace is within ± 2 divisions of center.
 - Connect the DMM and record the **voltage reading** in Table 7, column **DMM**.
 - Disconnect the DMM from the BNC T connector.

4) Press **Clear Sweeps**

5) After 100 sweeps, Read off the DSO Mean parameter voltage, and record the measurement in Table 7, column Mean.

- Repeat the test for the other channels, substituting channel controls and input connector. Record the measurements in Table 7.



- Calculate the **Difference (Δ)** by subtracting the **DMM voltage** reading from the **DSO mean voltage** reading.
- Record the test result in Table 7, and compare the **Difference (Δ)** to the corresponding limit in the test record.



5.8.2 Negative Offset Accuracy

Procedure

- Recall **Offset - Negative.Iss** or configure the DSO as shown in 5.8.1 and for each channel make the following change :

Input offset : **-0.750 Volt** on all 4 Channels

- Connect the test equipment as shown in Figure 5-2.
- Set the output of the external **DC voltage** reference source until the DMM measures +0.750 Volt.
 - 1) Verify that the displayed trace A : Average (1) is on the screen, near the center horizontal graticule line. If the trace is not visible, modify the **DC voltage reference source output** until the trace is within ± 2 divisions of center.
 - 2) Connect the DMM and record the **voltage reading** in Table 8, column **DMM**.
 - 3) Disconnect the DMM from the BNC T connector.
 - 4) Press **Clear Sweeps**
 - 5) After 100 sweeps, Read off the **DSO Mean parameter** voltage, and record the measurement in Table 8, column **Mean**.
- Repeat the test for the other channels, substituting channel controls and input connector. Record the measurements in Table 8.
- Calculate the **Difference (Δ)** by subtracting the **DMM voltage** reading from the **DSO mean** voltage reading. Record the test result in Table 8, and compare the **Difference (Δ)** to the corresponding limit in the test record.

5.9 Bandwidth

5.9.1 Description

The purpose of this test is to ensure that the entire system has a bandwidth of at least 500 MHz for a WaveSurfer 45x, 350 MHz for a WaveSurfer 43x and 200 MHz for a WaveSurfer 42x. An external source is used as the reference to provide a signal where amplitude and frequency are well controlled.

The amplitude of the generator and cable as a function of frequency and power is calibrated using a HP8482A power sensor, and HP437B power meter or equivalent. Note: If a leveled generator is used then the corrections needed by using the power meter may not be necessary.

Specifications

WaveSurfer 45x

50 Ω : DC to at least 500 MHz (-3 dB)

WaveSurfer 43x

50 Ω : DC to at least 350 MHz (-3 dB)

WaveSurfer 42x

50 Ω : DC to at least 200 MHz (-3 dB)



- Recall **Bandwidth - CH1 10mv.lss** or configure the DSO:

Panel Setups	:	Recall FROM DEFAULT SETUP
Channels Trace ON	:	Channel 1
Input Coupling	:	DC 50Ω on all 4 Channels
Input gain	:	10 mV/div on all 4 Channels
Input offset	:	0 mV on all 4 Channels
Trigger setup	:	Edge
Trigger on	:	Line
Mode	:	Auto
Time base	:	50 ns/div.
Change parameters	:	
P1	:	PK-PK of C1
P2	:	Freq of C1

- Connect the HP8482A power sensor to the power meter.
- Zero and **calibrate** the HP8482A power sensor using the power meter **Power Ref output**.
- Connect a **BNC adapter** to the HP8482A power sensor.
- Connect a 50Ω SMA cable to the **RF output** of the HP8648B generator and then through the necessary adapters to the power sensor. It is very important that the same cable/generator be used throughout this BW procedure and that the SMA connectors are torqued at all their mating locations.

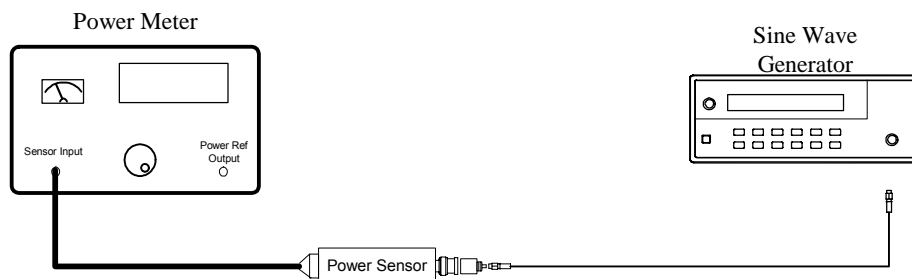


Figure 5-3 : Power Meter Equipment Setup

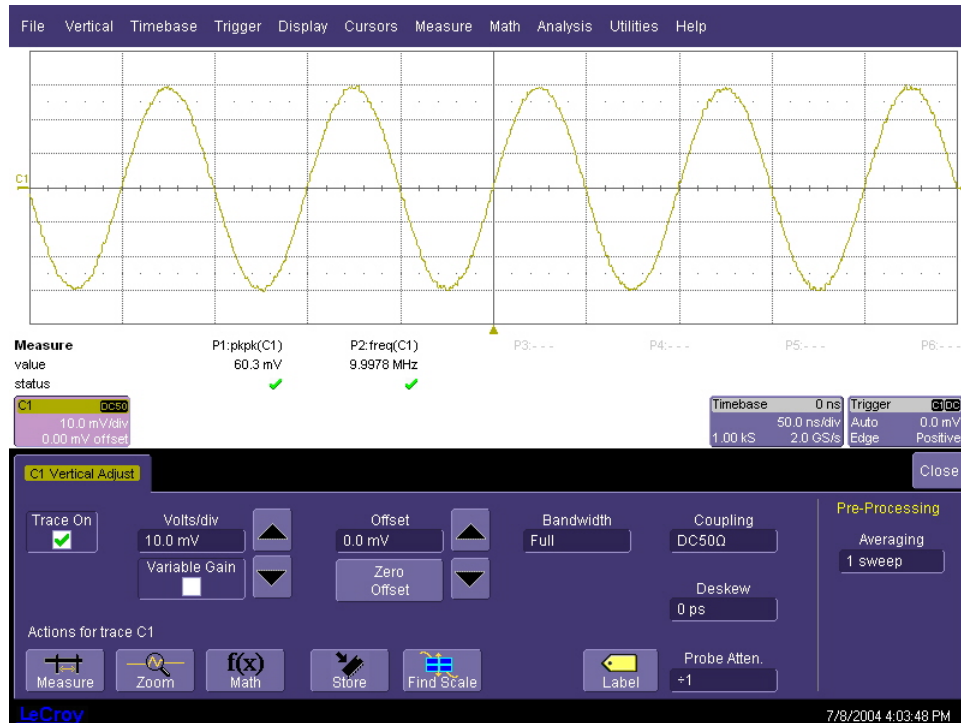
- Set the generator frequency to **10 MHz**
- Set the generator amplitude to measure **8 μW** on the power meter.
- Read the displayed **generator output amplitude**, and record it in the third column of Table 9.

- Repeat the above measurement for the model under test either, **200.1 350.1 MHz & 500.1 MHz**. Record the generator output amplitude readout in the third column of Table 9.
- Disconnect the **RF output** of the HP8648B generator from the power sensor.
- Connect the **RF output** of the HP8648B generator through the same cable that was calibrated in the previous step into Channel 1 and connect any attenuators as listed in the table.

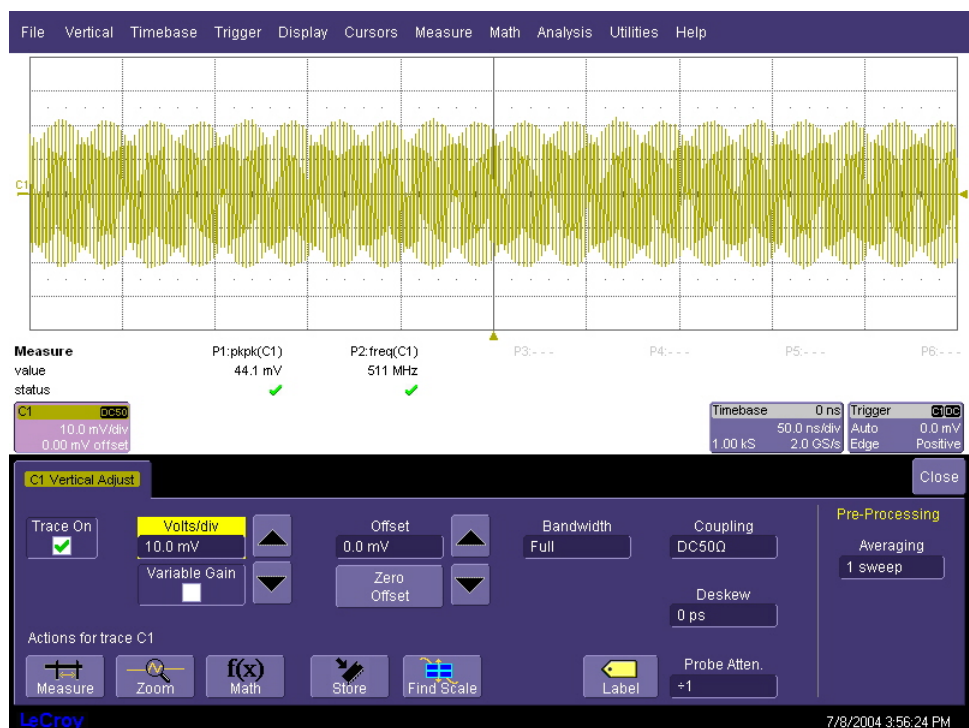


Figure 5-4 : 50Ω Bandwidth Equipment Setup

- Set the generator frequency to **10 MHz**.
- From the generator, apply the **recorded generator signal amplitude** to Channel 1.
- Measure the value of **pkpk(1)** in Table 9.



- Increase the frequency of the generator to the maximum input frequency for that model, adjusting the amplitude so that the power remains constant and measure the value of pk-pk. Record in Table 9.
- Repeat the above 3 steps for Channel 2, (**Bandwidth – CH2 10mv.lss s**) Channel 3 (**Bandwidth – CH3 10mv.lss**) & Channel 4 (**Bandwidth – CH4 10mv.lss**) substituting channel controls and input connector. Record the measurements in Table 9.



- Calculate the ratio to 10 MHz for each channel, $\text{pk-pk}_{500.1}/\text{pk-pk}_{10}$ (for WaveSurfer 45X), $\text{pk-pk}_{350.1}/\text{pk-pk}_{10}$ (for WaveSurfer 43X), or $\text{pk-pk}_{200.1}/\text{pk-pk}_{10}$ (for WaveSurfer 42X) and compare the results to the limits in the test record.
- Repeat the above steps for V/div setting of 50 mV, 100 mV, and 500 mV, using the appropriate **Bandwidth - CHx vvmv.lss** (where x is channel and yy is V/div setting) panel setup and recording your results in Tables 10 through 12. Use the power setting and attenuators as shown in the tables.



5.10 Trigger Level

Specifications

+/- (3% of Trigger Level + 20% of sensitivity)

5.10.1 Description

The trigger capabilities are tested for several cases of the standard edge trigger:

- Channel (internal), and External Trigger sources
- Three DC levels: -2.5, 0, +2.5 major screen divisions
- Positive and negative slopes

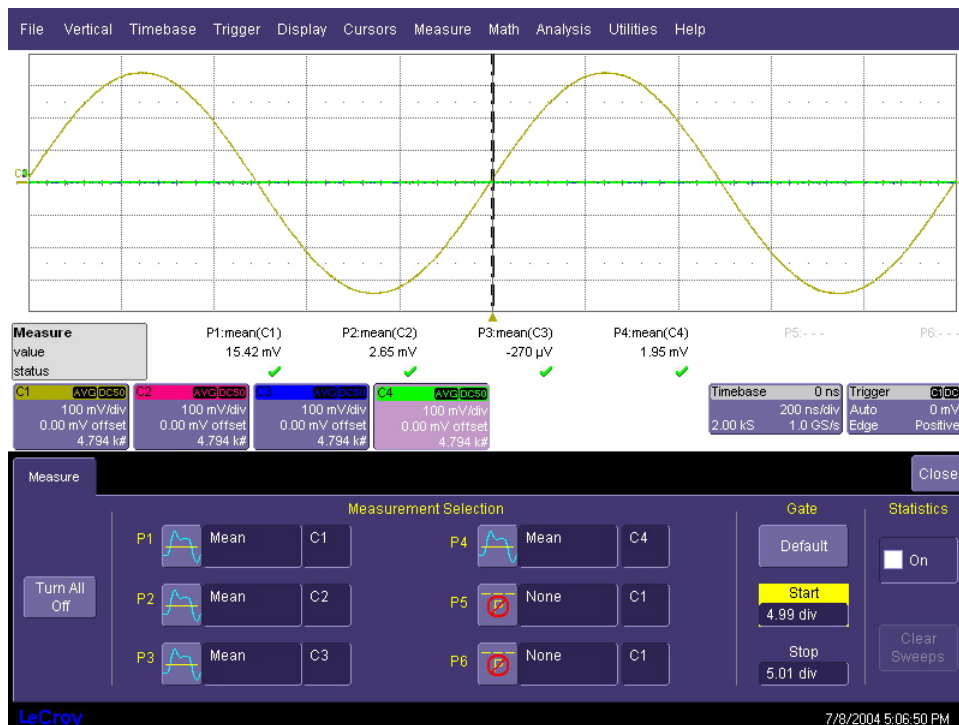
5.10.2 Channel Trigger at 0 Division Threshold

Recall **Trigger - CH1 0 div pos slope.lss** or configure the DSO:

Panel Setups	:	Recall FROM DEFAULT SETUP
Channels Trace ON	:	Channel 1, Channel 2, Channel 3 & Channel 4
Input Coupling	:	DC 50Ω on all 4 Channels
Input gain	:	100 mV/div. on all 4 Channels
Input offset	:	0 mV on all 4 Channels (use show status to verify)
Trigger setup	:	Edge
Trigger on	:	C1
Slope	:	Pos
Mode	:	Auto
Set Trigger level	:	DC 0.0 mV
Pre-Trigger Delay	:	50 %
Time base	:	200 nsec/div.
C1 Pre-Processing:	:	Averaging 10 sweeps
C2 Pre-Processing:	:	Averaging 10 sweeps
C3 Pre-Processing:	:	Averaging 10 sweeps
C4 Pre-Processing:	:	Averaging 10 sweeps
Measure P1	:	mean C1
Measure P2	:	mean C2
Measure P3	:	mean C3
Measure P4	:	mean C4
Gate Start	:	4.99 div
Gate Stop	:	5.01 div

- Set the output of the sine wave generator to **1 MHz**.

- Connect the output of the generator to Channel 1 through a 50 Ohm coaxial cable as shown in Figure 5-5 and adjust the sine wave output amplitude to get **90% of full scale**.



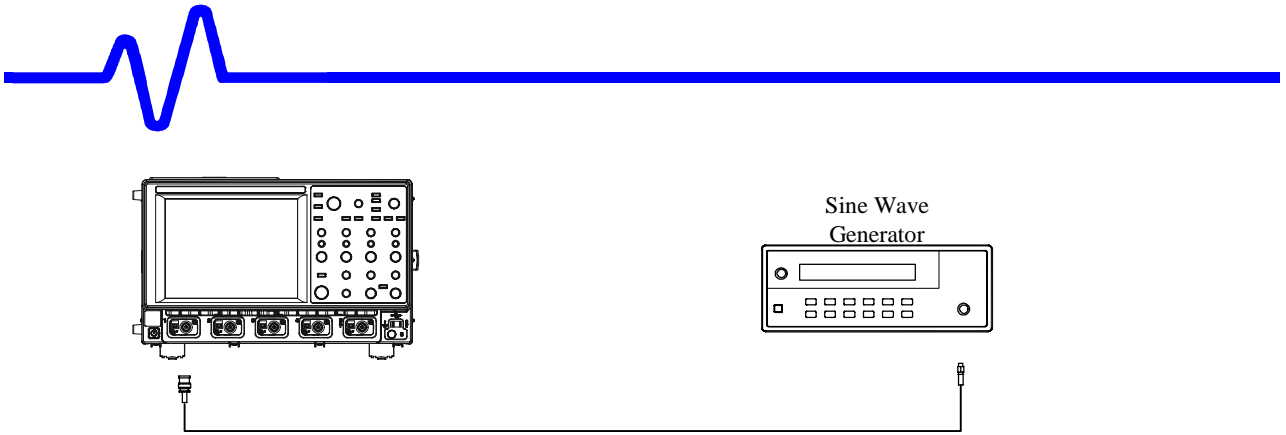
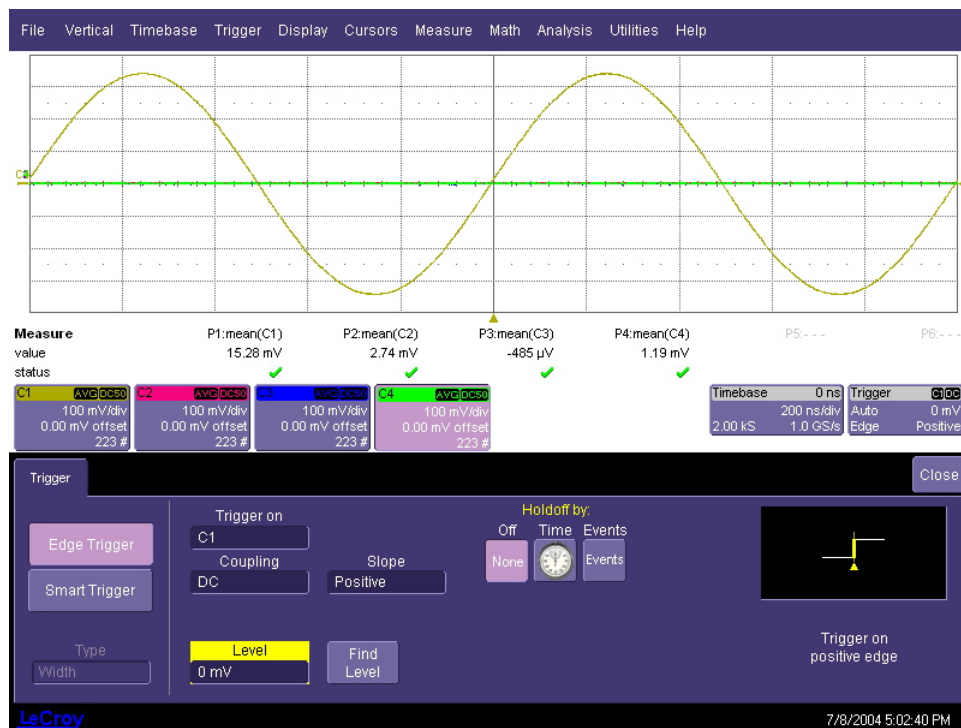
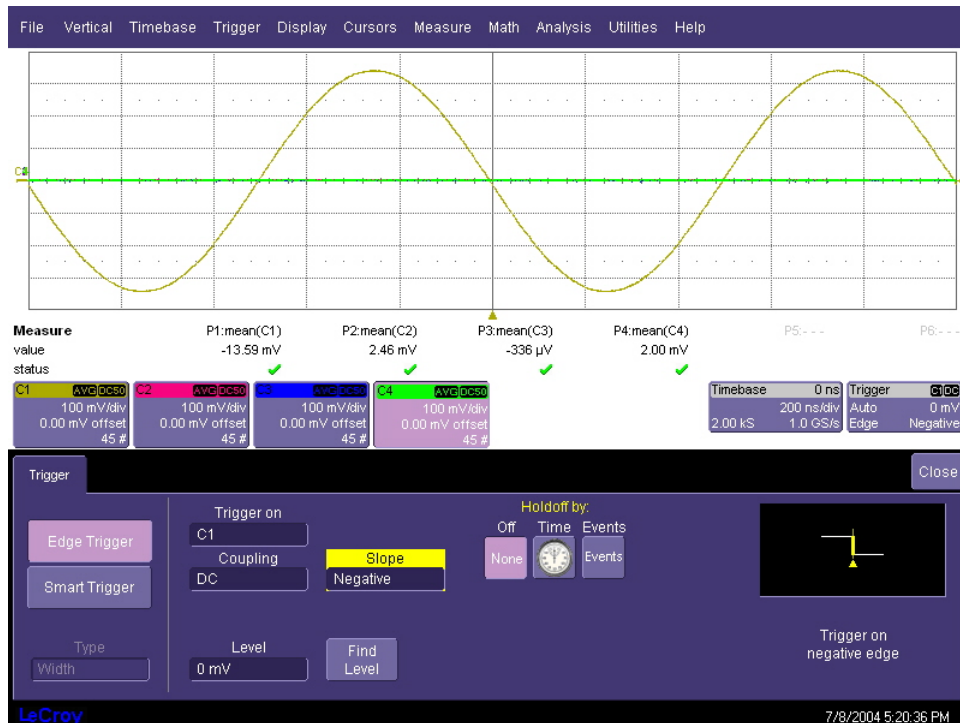


Figure 5-5 Channel Trigger Equipment Setup



- Press **Clear Sweeps**,
- Acquire 10 sweeps and record in Table 13 the **level** readout displayed below 100 mV in the icon **1**, at top left.
- Compare the test results to the corresponding limit in the test record.
- Set Trigger Slope 1 : **Neg**
- Acquire 10 sweeps and record in Table 13 the **level** readout displayed below 100 mV in the icon **1**, at top left.

- Set trigger to channels 2, 3 and 4 and for both POS and NEG slope, move input signal to appropriate channel and compare the test results to the corresponding limit in the test record.

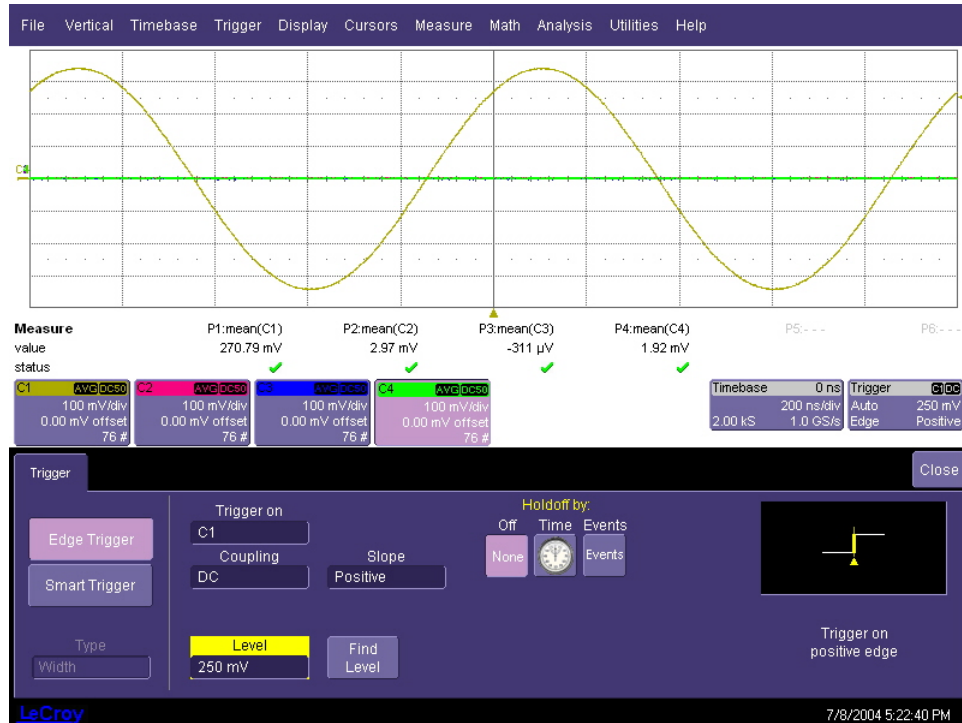


5.10.3 Channel Trigger at +2.5 Divisions Threshold

- Recall **Trigger - CH1 +2.5 div pos slope.lss** or configure the DSO as shown in 5.10.2 and for each Channel make the following change :

Set Trigger level : **DC +250 mV**
 Trigger slope : **POS**

- Connect the output of the generator to Channel 1 through a 50 Ohm coaxial cable.
- Press **Clear Sweeps**,
- Acquire 10 sweeps and record in Table 13 the **level** readout displayed below 100 mV in the icon **1**, at top left.
- Compare the test results to the corresponding limit in the test record.



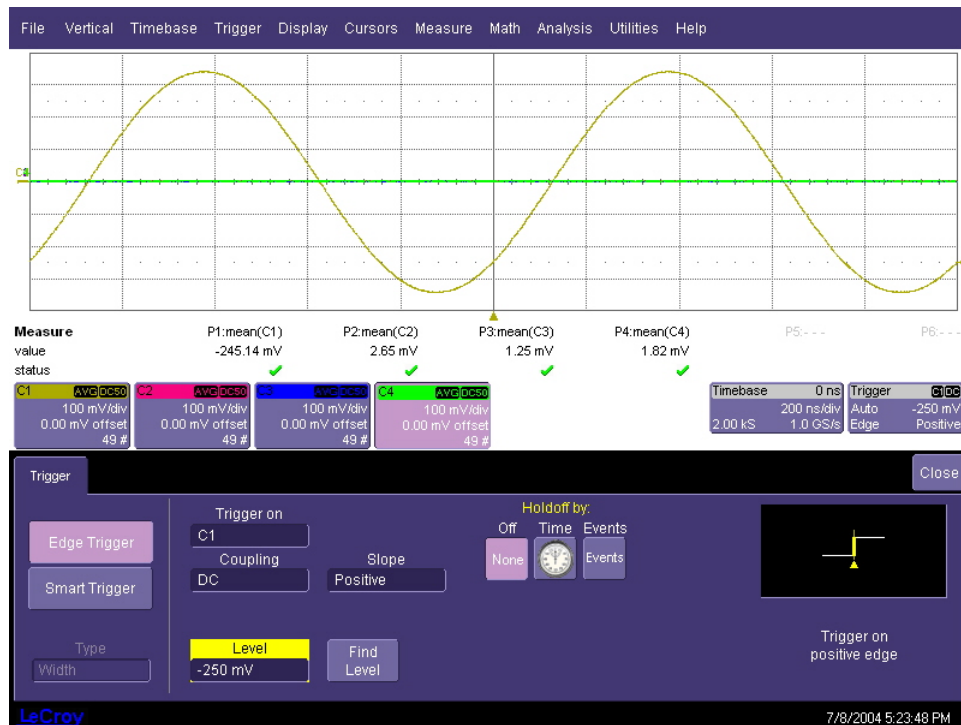
- Set Trigger Slope 1 : **Neg**
- Acquire 10 sweeps and record in Table 13 the **level** readout displayed below 100 mV in the icon **1**, at top left.
- Set trigger to channels 2, 3 and 4 and for both POS and NEG slope move input signal to appropriate channel and compare the test results to the corresponding limit in the test record.

5.10.4 Channel Trigger at **-2.5 Divisions Threshold**

- Recall **Trigger - CH1 -2.5 div pos slope.lss** or configure the DSO as shown in 5.10.2 and for each channel make the following change :

Set Trigger level : **DC -250 mV**

- Connect the output of the generator to Channel 1 through a 50 Ohm coaxial cable.
- Press **Clear Sweeps**,
- Acquire 10 sweeps and record in Table 13 the **level** readout displayed below 100 mV in the icon **1**, at top left.



- Compare the test results to the corresponding limit in the test record.
- Set Trigger Slope 1 : **Neg**
- Acquire 10 sweeps and record in Table 13 the **level** readout displayed below 100 mV in the icon **1**, at top left.
- Set trigger to channels 2, 3 and 4 and for both POS and NEG slope move input signal to appropriate channel and compare the test results to the corresponding limit in the test record.



5.11 Time Base Accuracy

5.11.1 Description

An external sine wave generator of **10.0 MHz** with frequency accuracy better than 1 PPM is used.

Specifications

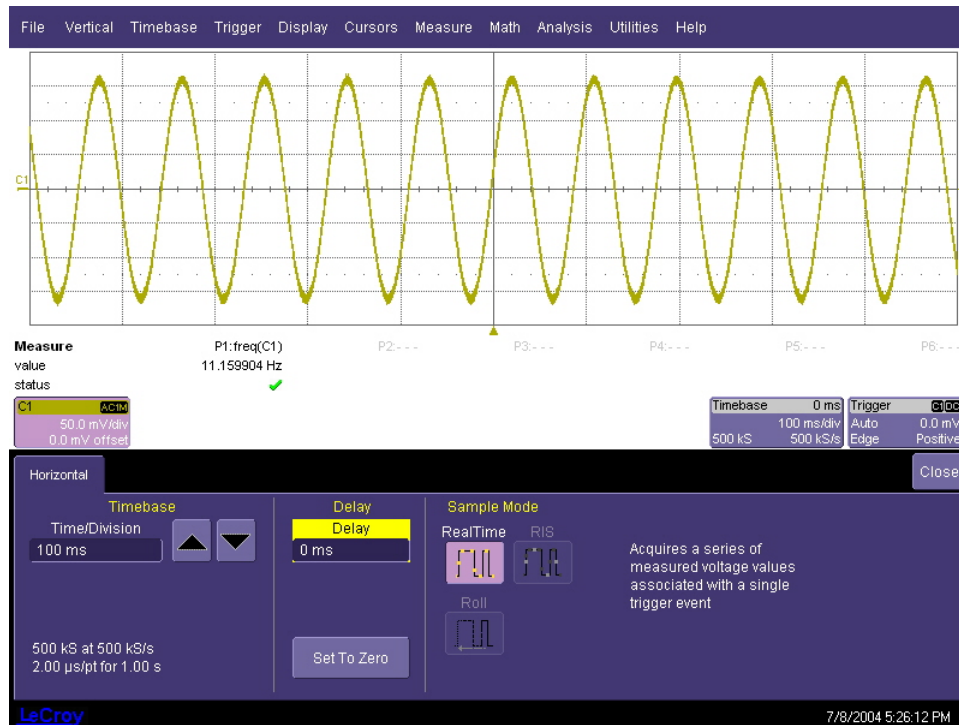
Clock : accuracy : $\leq \pm 0.001 \%$ or $\leq \pm 10 \text{ PPM}$

5.11.2 Clock Verification Procedure

- Recall **Timebase Accuracy.Iss** or configure the DSO

Panel Setups	:	Recall FROM DEFAULT SETUP
Channels trace ON	:	Channel 1
Input gain	:	.1 V/div.
Input offset	:	0 mV
Trigger setup	:	Edge
Trigger on	:	C1
Slope 1	:	Pos
Level 1	:	0 mV
Trigger mode	:	Auto
Delay	:	50 %
Time base	:	100 msec/div.
Measure	:	Parameters
P1	:	Frequency of C1

- Connect the **RF output** of the HP8648B generator through a 50 Ohm coaxial cable into Channel 1.
- Set the generator frequency to **10.0 MHz**.
- Adjust the generator output amplitude to get **6 divisions peak to peak**.
- Read of the frequency parameter (to 2 decimal places) and record the value in Table 14.
- Verify that the error is less than 100 Hz.





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