

5. Performance Verification

5.1 Introduction

This chapter contains procedures suitable for determining if the LC684D/M/L/XL Digital Storage Oscilloscope performs correctly and as warranted. They check all the characteristics listed in subsection 5.1.1.

Because they require time and suitable test equipment, you may not need to perform all of these procedures, depending on what you want to accomplish.

In the absence of the computer automated calibration system based on LeCroy Calibration Software (LeCalsoft), 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 LC684D/M/L/XL 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 and RMS Average noise level
- Positive and Negative DC linearity
- Positive and Negative Offset
- Bandwidth
- Trigger Level
- Smart Trigger
- Time Base Accuracy
- Overshoot and Rise Time –Not required for traceable calibration

5.1.2 Calibration Cycle

The LC684D/M/L/XL Digital Storage Oscilloscope requires periodic verification of performance. Under normal use (2,000 hours of use per year) and environmental conditions, this instrument should be calibrated once a year.



5.2 Test Equipment Required

These procedures use external, traceable signal generators, DC precision power supply, step generator and digital multimeter, to directly check specifications.

Instrument	Specifications	Recommended
Signal Generator Radio Frequency	Frequency : .5 MHz to 2 GHz Frequency Accuracy : 1 PPM	HP8648B or equivalent
Signal Generator Audio Frequency	Frequency : 0 to 5 kHz Amplitude : 8 V peak to peak	LeCroy LW420 or HP33120A or equivalent
Voltage Generator DC Power Supply	Range of 0 to 20 V, in steps of no more than 15 mV	HP6633A or equivalent
Power Meter + Sensor	Accuracy ± 1 %	HP437B + 8482A or equivalent
Digital Multimeter Volt & Ohm		Keithley 2000 or equivalent
Coaxial Cable, 1 ns	50 Ω , BNC, length 20 cm,	
Coaxial Cable, 5 ns	50 Ω , BNC, length 100 cm,	
2 Attenuators, 20 dB	50 Ω , BNC, 1 % accuracy	
Attenuator, 6 dB	50 Ω , BNC, 1 % accuracy	
Terminator, 2 W	50 Ω , BNC, Feed-Through	
T adapter	50 Ω , BNC T adapter	

Table 5-1 : Test Equipment

5.2.1 Test Records

The last pages of this document contain LC684D/M/L/XL test records in the format tables. Keep them as masters and use a photocopy for each calibration.

5.3 Turn On

If you are not familiar with operating the LC684D, read 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, and verify :
 - the display turns on after about 10 seconds and is stable.
 - the range of intensity and grid intensity is reasonable.



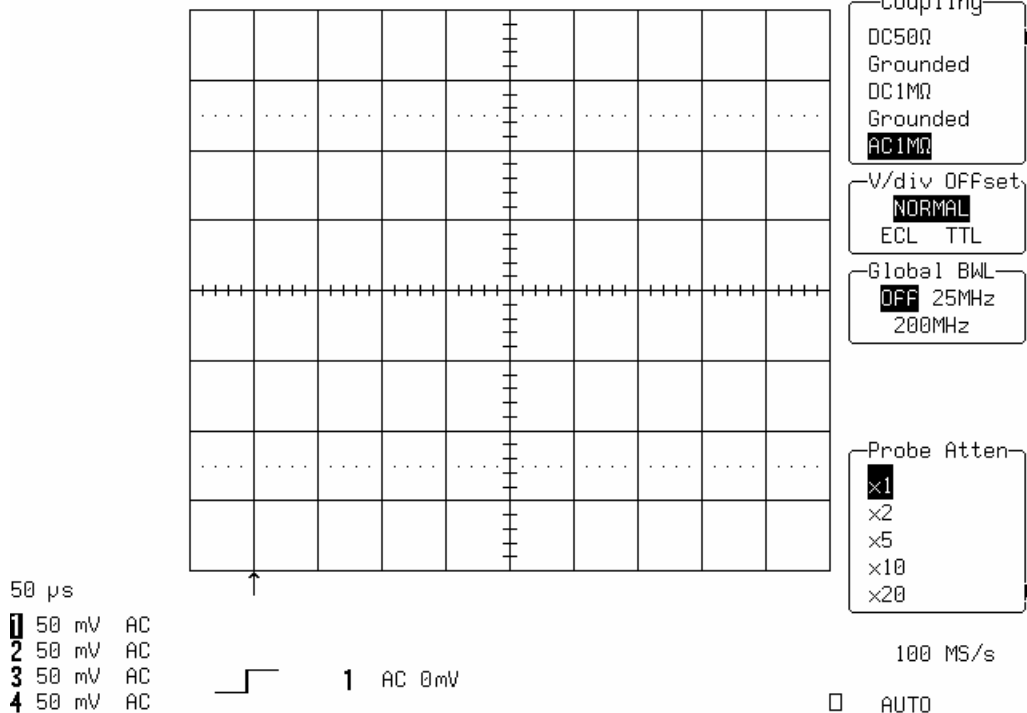
- Set the DMM with **Ohms and Ohms sense** to provide a 4 wire measurement.
- Connect it to Channel 1.
- Measure the **input impedance**. Record it in Table 2, and compare it to the limits.
- Repeat the above test for all input channels.
- Recall **LC684P002.PNL** or Set Input gain to **200 mV/div.** 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.

b. AC 1MΩ

- Recall **LC684P003.PNL** or configure the DSO as shown in 5.4.1.a, and for each Channel make the following change :

Input Coupling : **AC 1MΩ**

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15:22:13

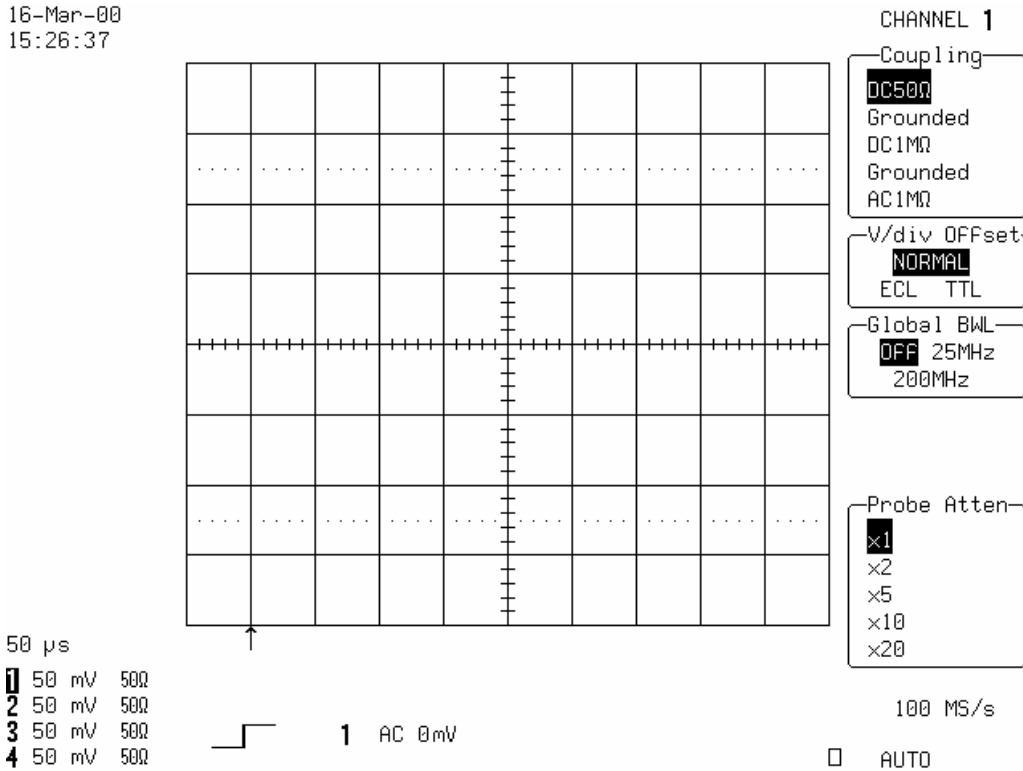


- For all input channels measure the **input impedance**.
- Record the input impedance in Table 2, and compare it to the limits.
- Recall **LC684P004.PNL** or Set Input gain to **200 mV/div** on all 4 Channels.
- Repeat the test for all input channels.
- Record the measurements in Table 2, and compare the results to the limits in the test record.

c. DC 50Ω

- Recall **LC684P005.PNL** or configure the DSO as shown in 5.4.1.a, and for each Channel make the following change:

Input Coupling : **DC 50Ω**



- For all input Channels, measure the input impedance.
- Record the **input impedance** in Table 2, and compare it to the limits.
- Recall **LC684P006.PNL** 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 results to the limits in the test record.



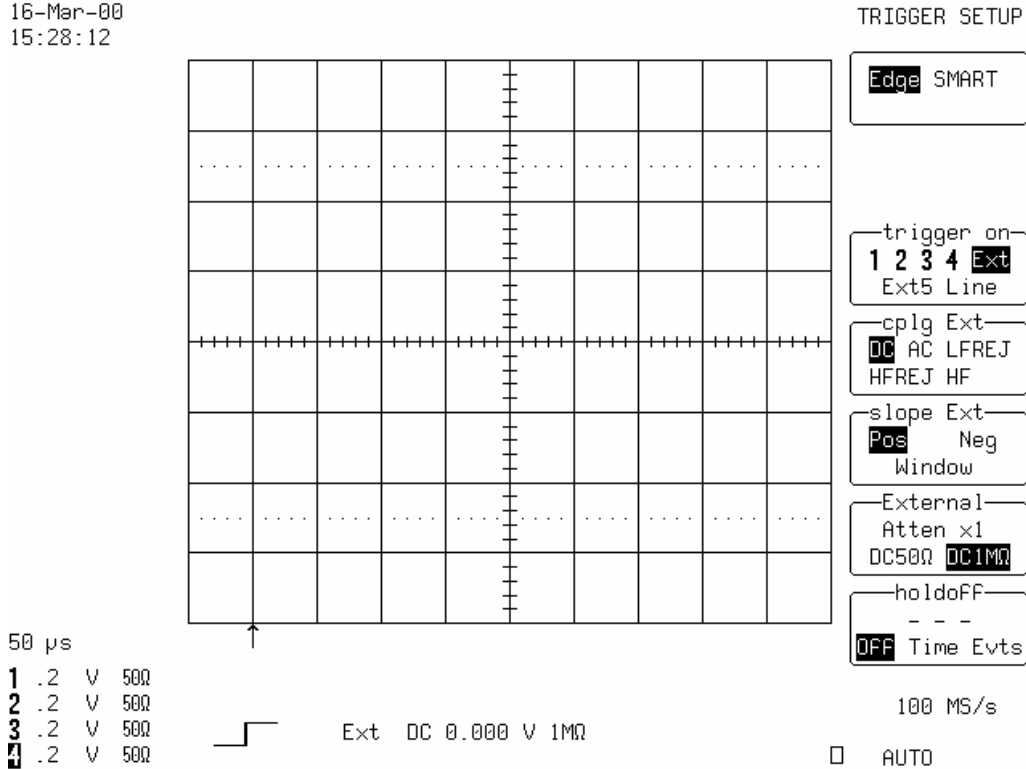
5.4.2 External Trigger Input Impedance

a. DC 1MΩ

- Recall **LC684P007.PNL** or configure the DSO :

Trigger mode : **Auto**
 Select Setup trigger
 Trigger on : **EXT**
 Cplg Ext : **DC**
 External : **DC 1MΩ**
 Time base : **50 μsec/div.**

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15:28:12



- Connect the DMM to External, and measure the input impedance.
- Record the input impedance in Table 2, and compare it to the limits.
- Recall **LC684P008.PNL** or set trigger to Ext/5
- Measure the **input impedance**.
- Record the test result in Table 2, and compare the result to the limits in the test record.

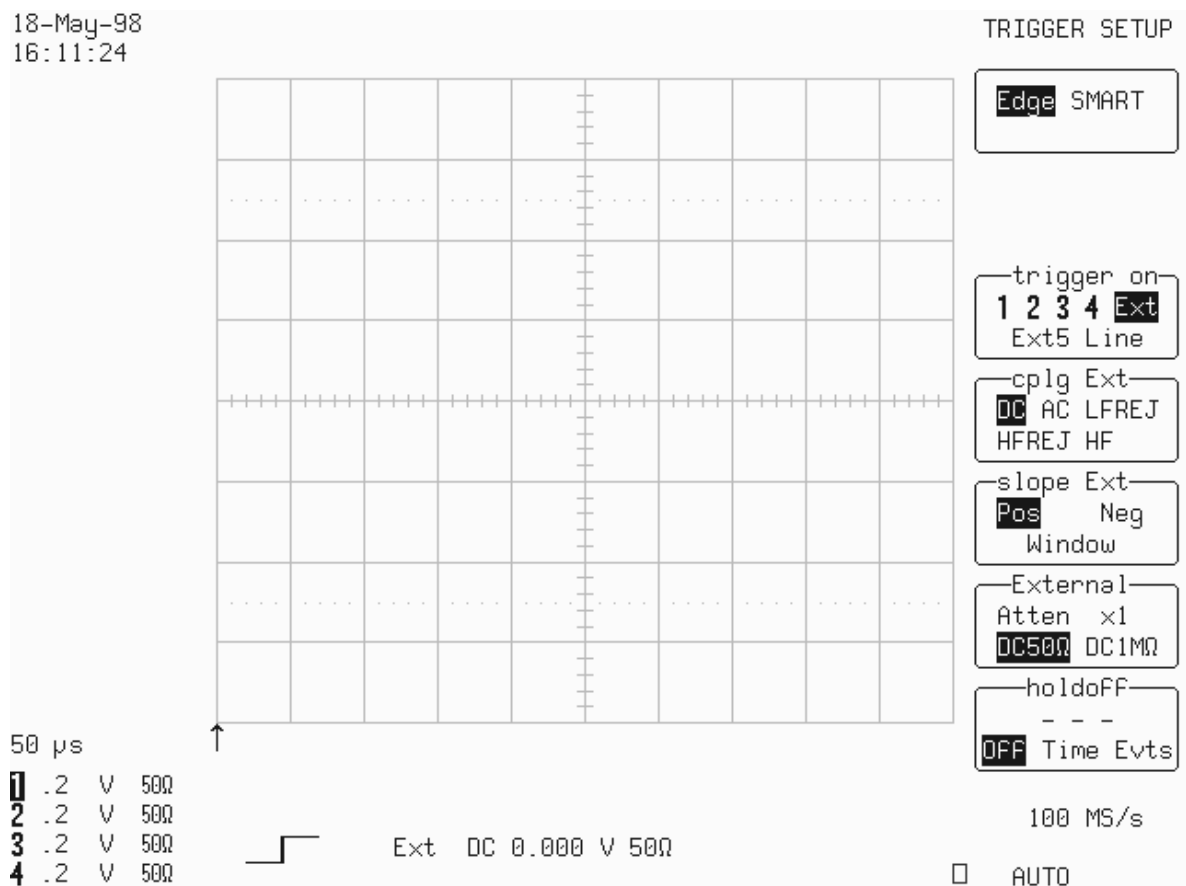
b. DC 50Ω

- Recall **LC684P009.PNL** or configure the DSO :

Select Setup trigger

Trigger on : **EXT**

External : **DC 50Ω**



- 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 **LC684P010.PNL** or configure the DSO:

Trigger on : **EXT/5**

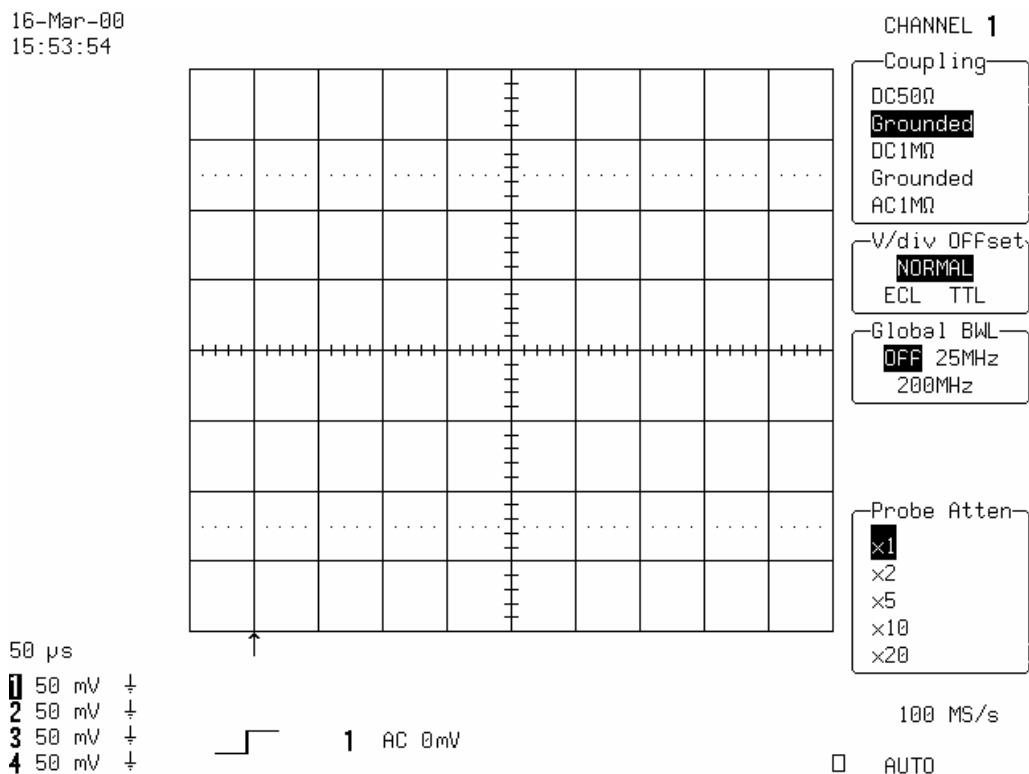


- Measure the **input impedance**.
- Record the input impedance in Table 2, and compare the result to the limit in the test record.

5.4.3 Ground

- Recall **LC684P011.PNL** or configure the DSO as shown in 5.4.1.a, and for each Channel make the following changes :

Input Coupling : **Grounded**



- Connect the DMM to Channel 1, and measure the **input impedance**.
- Record the input impedance in Table 2, and compare the result to the limit in the test record.
- Repeat the test for all input channels.
- Record the measurements in Table 2, and compare the results to the limits in the test record.

5.5 Leakage Current

Specifications

DC 1M Ω , AC 1M Ω , DC 50 Ω , EXT DC 50 Ω : ± 1 mV
EXT DC1M Ω : ± 2 mV

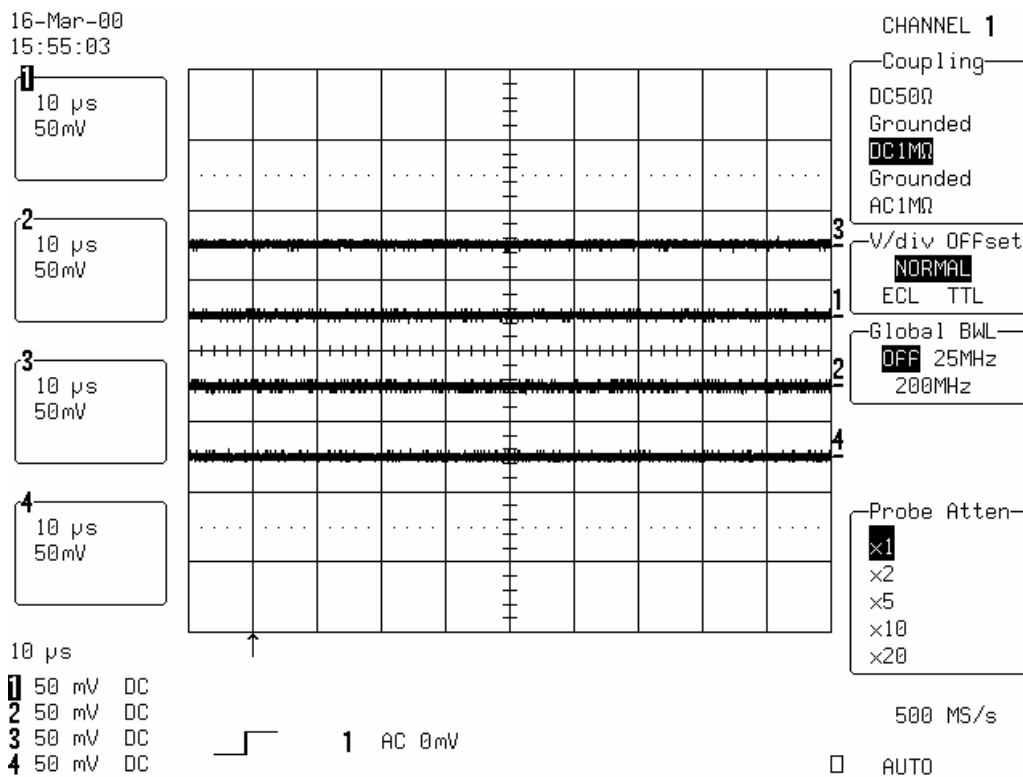
The leakage current is tested by measuring the voltage across the input channel.

5.5.1 Channel Leakage Current

a. DC 1M Ω

- Recall **LC684P012.PNL** or configure the DSO :

Panel Setups : **Recall FROM DEFAULT SETUP**
Channels Trace ON : **Channel 1, Channel 2, Channel 3 & Channel 4**
Input Coupling : **DC 1M Ω on all 4 Channels**
Input gain : **50 mV/div. on all 4 Channels**
Trigger mode : **Auto**
Time base : **10 μ sec/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 **LC684P013.PNL** 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.

b. DC 50Ω

- Recall **LC684P014.PNL** or configure the DSO as shown in 5.5.1.a and for each Channel make the following changes :
Set Input Coupling : **DC 50Ω**
- Connect the DMM to Channel 1.
- Measure the **voltage** and enter it in Table 3. Compare it to the limits.
- Recall **LC684P015.PNL** 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.

5.5.2 External Trigger Leakage Current

a. DC 50Ω

- Recall **LC684P016.PNL** or configure the DSO as shown in 5.5.1.a and make the following changes :

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

External : **DC 50Ω**

- Connect the DMM to External.
- Measure the **voltage** and enter it in Table 3. Compare it to the limits.

b. DC 50Ω EXT/5

- Recall **LC684P017.PNL** or configure the DSO as shown in 5.5.1.a and make the following changes :

Select Setup trigger
Set Trigger on : **EXT/5**

External : **DC 50Ω**

- Connect the DMM to External.
- Measure the **voltage** and enter it in Table 3. Compare it to the limits.

5.6 Average Noise Level

Description

Noise tests with open inputs are executed on all channels for both 1MΩ and 50Ω input impedance, with AC and DC input coupling, 0 mV offset, at a gain setting of 10 mV/div., and different Time base settings.

The scope parameters functions are used to measure the Peak and RMS amplitude

5.6.1 Peak to Peak Noise

Specifications

9 % of full scale or 7.2 mV Peak-Peak at 10 mV/div.

a. DC 1MΩ

With no signal connected to the inputs

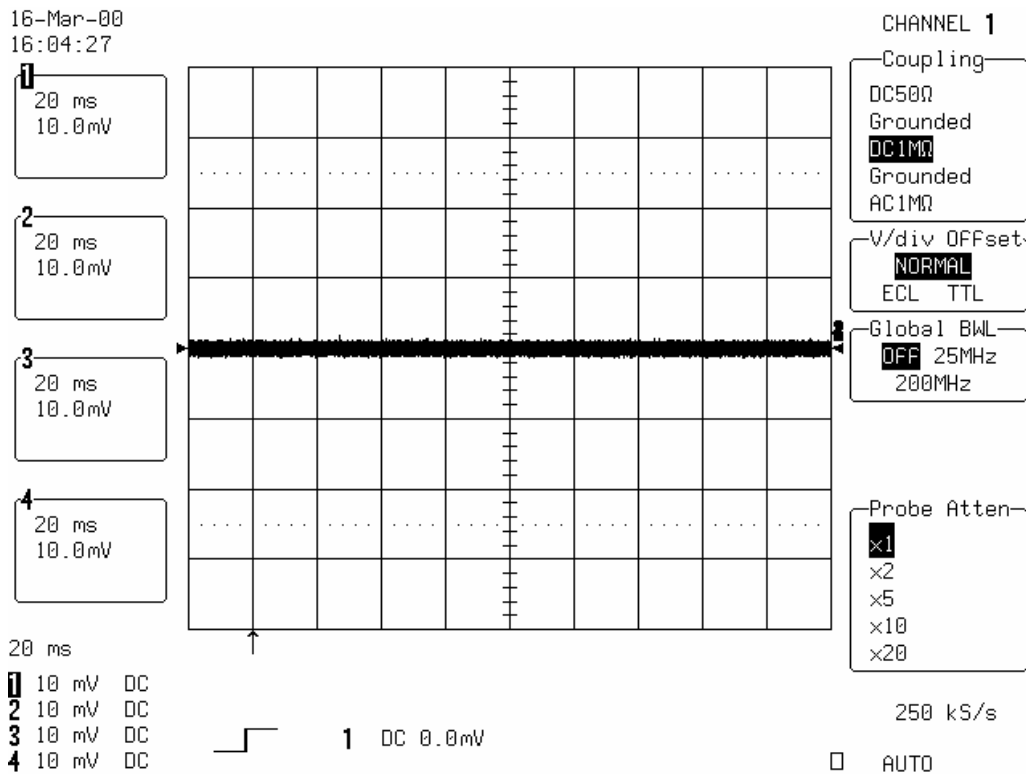
- Recall **LC684P018.PNL** or configure the DSO :

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 : **10 mV/div.** on all 4 Channels
Input offset : **0.0 mV** on all 4 Channels
Trigger setup : **Edge**
Trigger on : **1**
Coupling 1 : **DC**
Trigger Mode : **Auto**

Time base : **20 msec/div.**
Channel use : **4**



Record up to : **50 k Samples**
 Press : **Cursors/Measure**
 Measure : **Parameters**
 Mode : **Custom**
 Statistics : **On**
 Change parameters
 Category : **All**
 On line 1 : **Measure pkpk of Ch1**
 On line 2 : **Measure pkpk of Ch2**
 On line 3 : **Measure pkpk of Ch3**
 On line 4 : **Measure pkpk of Ch4**
 On line 5 : **no parameter selected for line 5**



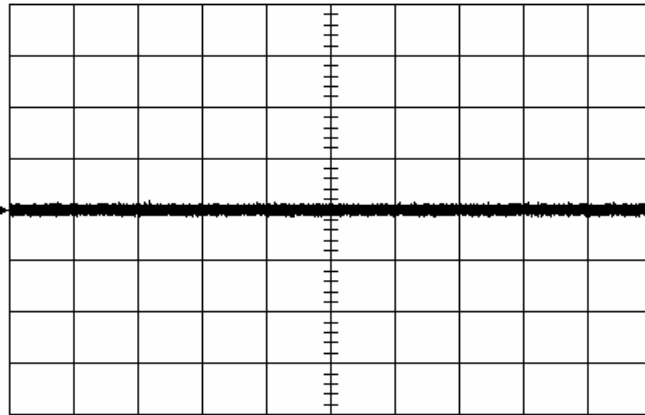
16-Mar-00
16:05:12

1 20 ms
10.0mV

2 20 ms
10.0mV

3 20 ms
10.0mV

4 20 ms
10.0mV



53 sweeps: average low high sigma

	average	low	high	sigma
pkpk (1)	3.2mV	3.1	3.7	0.2
pkpk (2)	3.0mV	2.5	3.1	0.2
pkpk (3)	3.0mV	2.8	3.4	0.2
pkpk (4)	3.1mV	2.8	3.4	0.2

20 ms

1 10 mV DC

2 10 mV DC

3 10 mV DC

4 10 mV DC

1 DC 0.0mV

MEASURE

OFF Cursors
Parameters

mode

Std Voltage
Std Time
Custom
Pass
Fail

statistics
OFF On

CHANGE
PARAMETERS

From
0.00 div
Track OFF On

to
10.00 div

250 kS/s

STOPPED

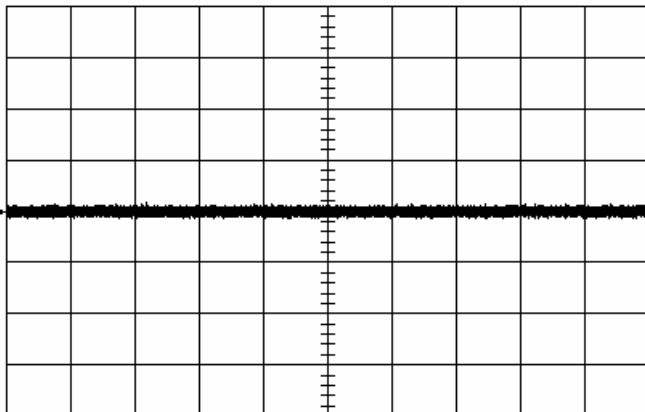
16-Mar-00
16:06:05

1 20 ms
10.0mV

2 20 ms
10.0mV

3 20 ms
10.0mV

4 20 ms
10.0mV



53 sweeps: average low high sigma

	average	low	high	sigma
pkpk (1)	3.2mV	3.1	3.7	0.2
pkpk (2)	3.0mV	2.5	3.1	0.2
pkpk (3)	3.0mV	2.8	3.4	0.2
pkpk (4)	3.1mV	2.8	3.4	0.2

20 ms

1 10 mV DC

2 10 mV DC

3 10 mV DC

4 10 mV DC

Peak to Peak
difference between maximum and
minimum data values

CHANGE PARAM

On line
1 2 3 4 5

Category
All
Cyclic
Dual
Horizontal
Misc

DELETE ALL
PARAMETERS

measure
period
phase
pkpk
pks
points

of
1 2 3 4
A B C D

250 kS/s

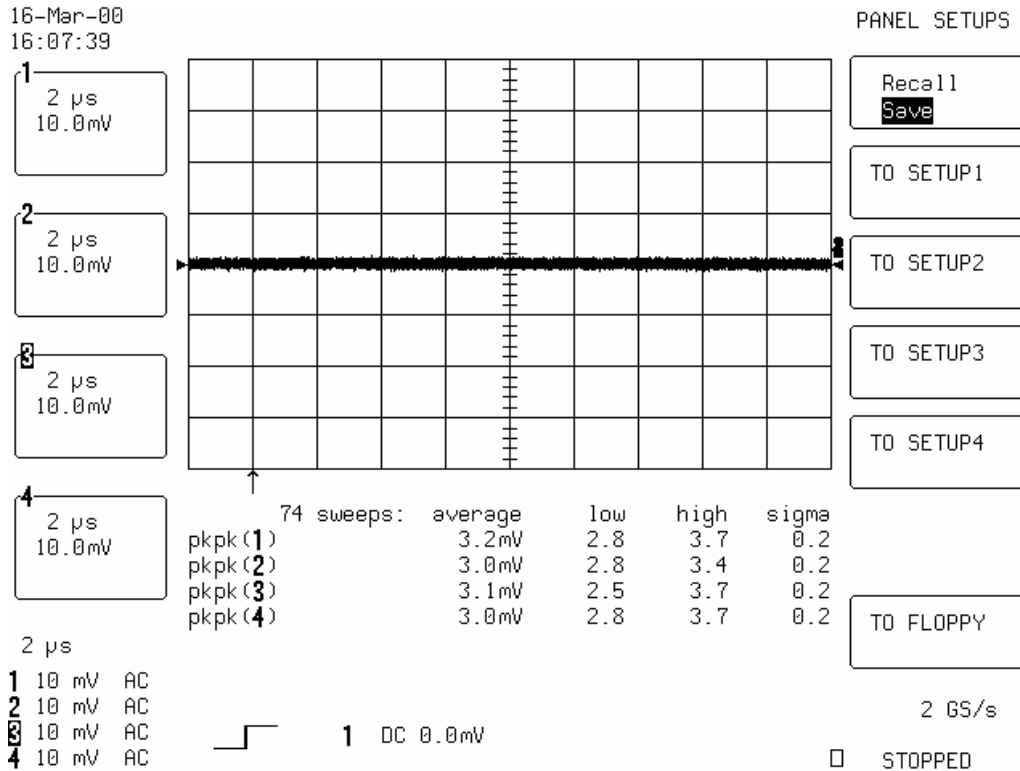
STOPPED



- Press **Clear Sweeps**.
- Measure for at least **50 sweeps**, then press **Stop** to halt the acquisition.
- Record the four **high pkpk** parameter values in Table 4, and compare the test results to the limits in the test record.
- Repeat the test for Time base : **1 msec/div**.
- Record the measurements (high pkpk of 1,2,3,4) in Table 4, and compare the results to the limits in the test record.

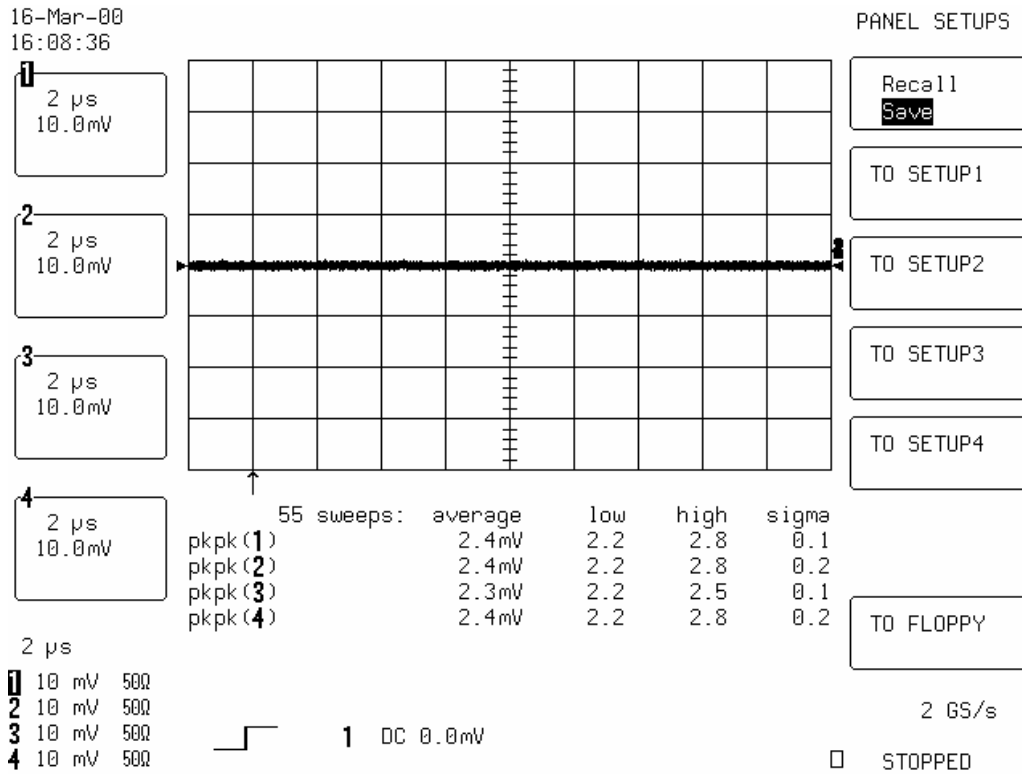
b. AC 1M Ω

- Recall **LC684P019.PNL** or configure the DSO as shown in 5.6.1.a, and for each Channel make the following changes :
 - Input Coupling : **AC 1M Ω** on all 4 Channels
 - Time base : **2 μ sec/div**
- Press **Clear Sweeps**.
- Measure for at least **50 sweeps**, then press **Stop** to halt the acquisition.
- Record the four **high pkpk** parameter values in Table 4, and compare the test results to the limits in the test record.



c. DC 50 Ω

- Recall **LC684P020.PNL** or configure the DSO as shown in 5.6.1.a, and for each Channel make the following changes :
 - Input Coupling : **DC 50 Ω** on all 4 Channels
 - Time base : **2 μ sec/div**
- Press **Clear Sweeps**.
- Measure for at least **50 sweeps**, then press **Stop** to halt the acquisition.
- Record the four **high pkpk** parameter values in Table 4, and compare the test results to the limits in the test record.
- Repeat the test for Time base : **20 μ sec/div**.
- Record the measurements (high pkpk of 1,2,3,4) in Table 4, and compare the results to the limits in the test record.



d. DC 50 Ω , 2 Channel Mode

Channel 2 & Channel 3

- Recall **LC684P021.PNL** or configure the DSO as shown in 5.6.1.a. and make the following changes :

Input Coupling : **DC 50 Ω** on all 4 Channels

Input gain : **10 mV/div.** on all 4 Channels

Channels Trace ON **Channel 2, Channel 3**

Channels Trace OFF **Channel 1, Channel 4**

Time base : **1 μ sec/div.**

Select Time base Setup

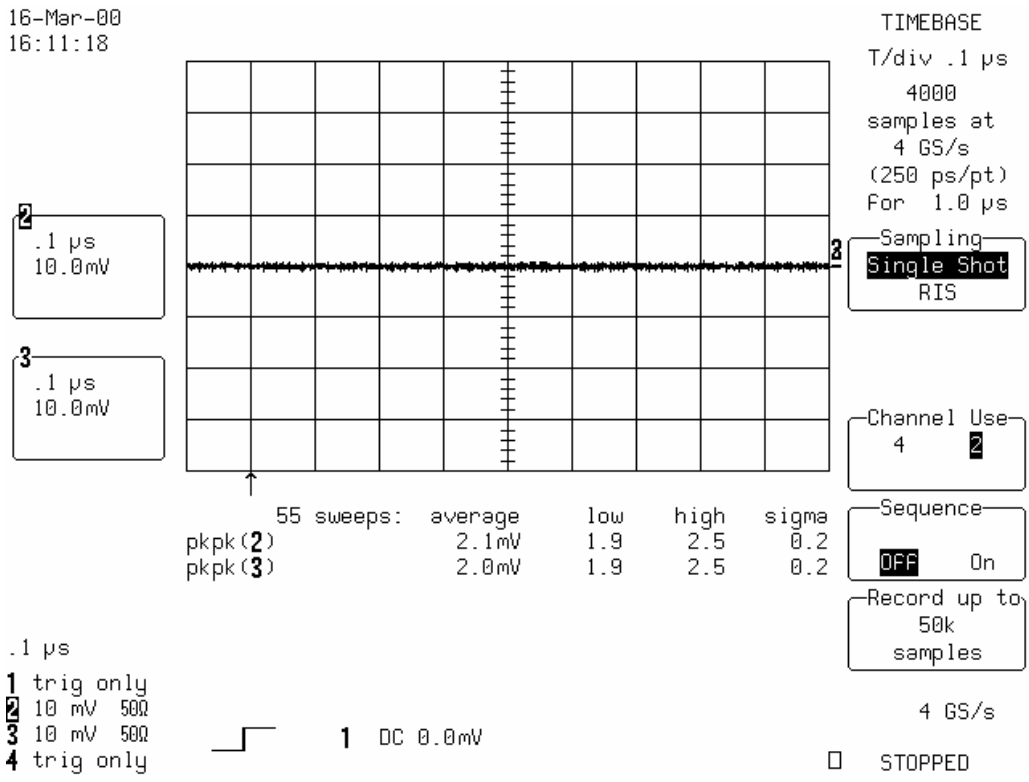
Channel use : **2**

Press : **Cursors/Measure**

Change parameters

On line 1 : **Measure pkpk of Ch2**

On line 2 : **Measure pkpk of Ch3**



- Check that the Sampling rate is **4 GS/s**
- Press **Clear Sweeps**.
- Measure for at least **50 sweeps**, then press **Stop** to halt the acquisition.
- Record the two **high pkpk of Ch2 & Ch3** in Table 4, and compare the test results to the limits in the test record.

e. LC684D, LC684DM, LC684DL & LC684DXL 1 Channel Mode

Channel 2 :

- Recall **LC684P023.PNL** or configure the DSO as shown in 5.6.1.a. and make the following changes :

Input Coupling : **DC 50 Ω** on all 4 Channels

Channels Trace ON **Channel 2**
Channels Trace OFF **Channel 1, Channel 3, Channel 4**

Time base : **0.5 μ sec/div.**

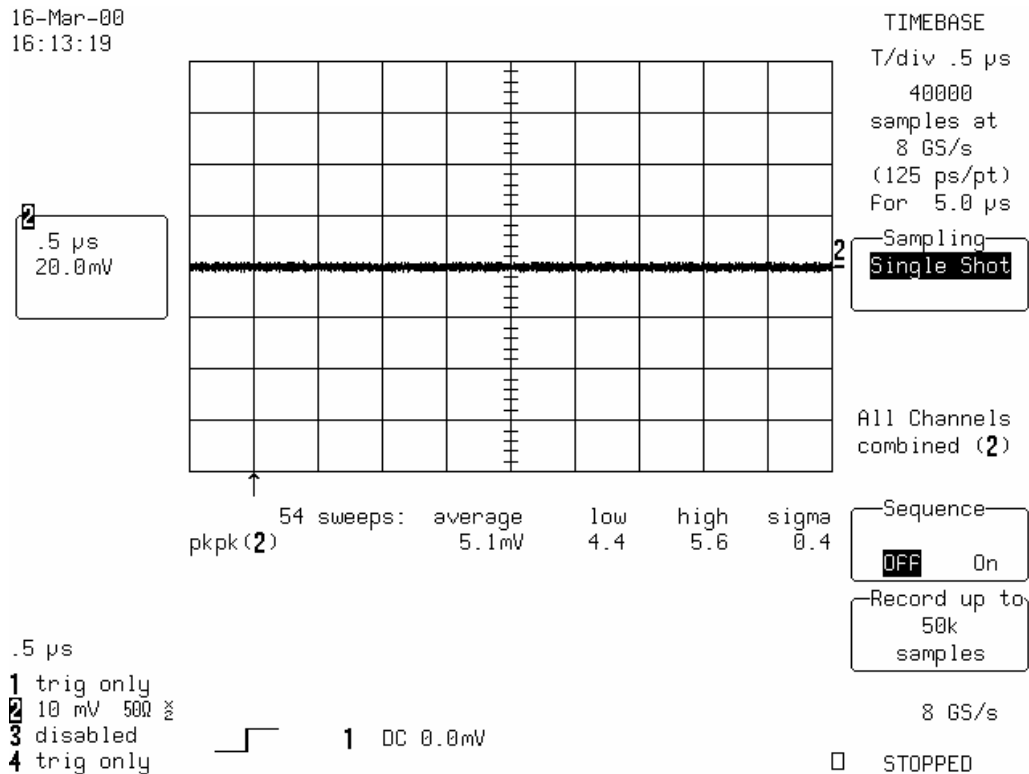
Press : **Cursors/Measure**



Change parameters

On line 1 : **Measure pkpk of Ch2**

- Connect **PP096** adapter to channel 2 & 3
- Check that the Sampling rate is **8GS/s**



- Press **Clear Sweeps**.
- Measure for at least **50 sweeps**, then press **Stop** to halt the acquisition.
- Record the **high pkpk of Ch2** in Table 4, and compare the test result to the limits in the test record.

5.6.2 Rms Noise

Specifications

0.9 % of full scale or 0.72 mV at 10 mV/div.

a. DC 1M Ω

Procedure

With no signal connected to the inputs

- Recall **LC684P024.PNL** 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	:	10 mV/div. on all 4 Channels
Input Offset	:	0mv on all 4 Channels

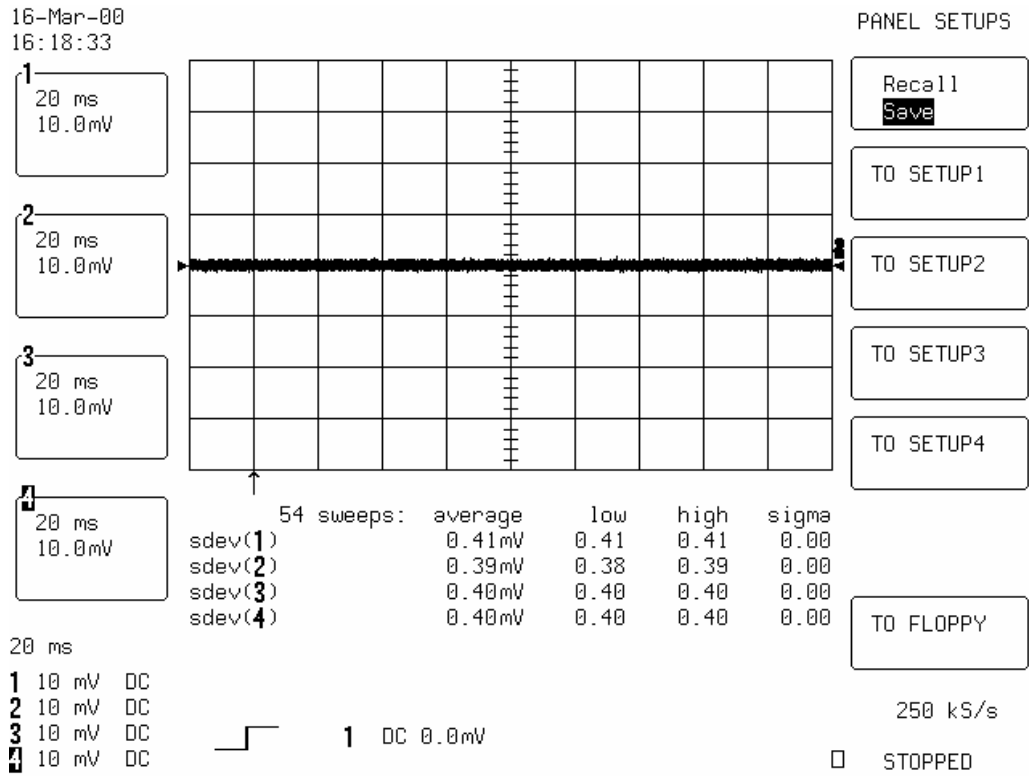
Trigger setup	:	Edge
Trigger on	:	1
Coupling 1	:	DC
Trigger Mode	:	Auto

Time base	:	20 msec/div.
Channel use	:	4
Record up to	:	50 k Samples
Press	:	Cursors/Measure
Measure	:	Parameters
Mode	:	Custom
Statistics	:	On

Change parameters

Category	:	All
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On line 1	:	Measure sdev of Ch1
On line 2	:	Measure sdev of Ch2
On line 3	:	Measure sdev of Ch3
On line 4	:	Measure sdev of Ch4
On line 5	:	no parameter selected for line 5

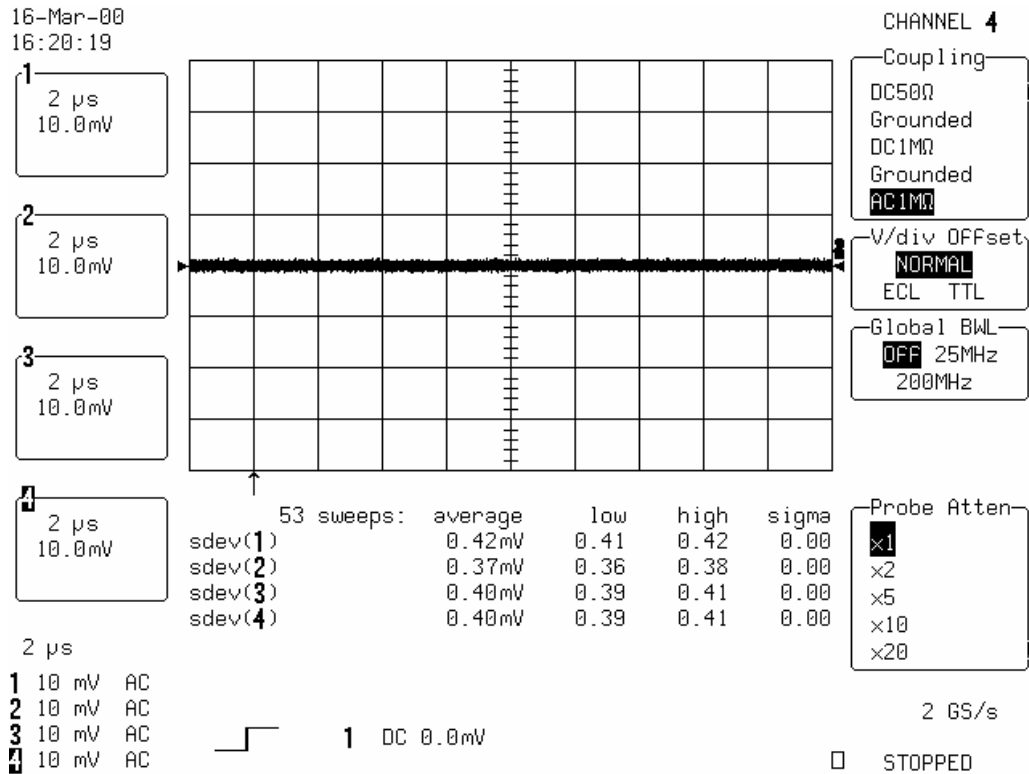


- Press **Clear Sweeps**.
- Measure for at least **50 sweeps**, then press **Stop** to halt the acquisition.
- Record the four **high sdev** parameter values in Table 5, and compare the test results to the limits in the test record.
- Repeat the test for Time base : **1 msec/div**.
- Record the measurements (high sdev of 1,2,3,4) in Table 5, and compare the results to the limits in the test record.

b. AC 1MΩ

- Recall **LC684P025.PNL** or configure the DSO as shown in 5.6.2.a. and for each Channel make the following change :
 - Input Coupling : **AC 1MΩ** on all 4 Channels
 - Time base : **2 μsec/div**.
- Press **Clear Sweeps**.
- Measure for at least **50 sweeps**, then press **Stop** to halt the acquisition.

- Record the four **high sdev** parameter values in Table 5, and compare the test results to the limits in the test record.



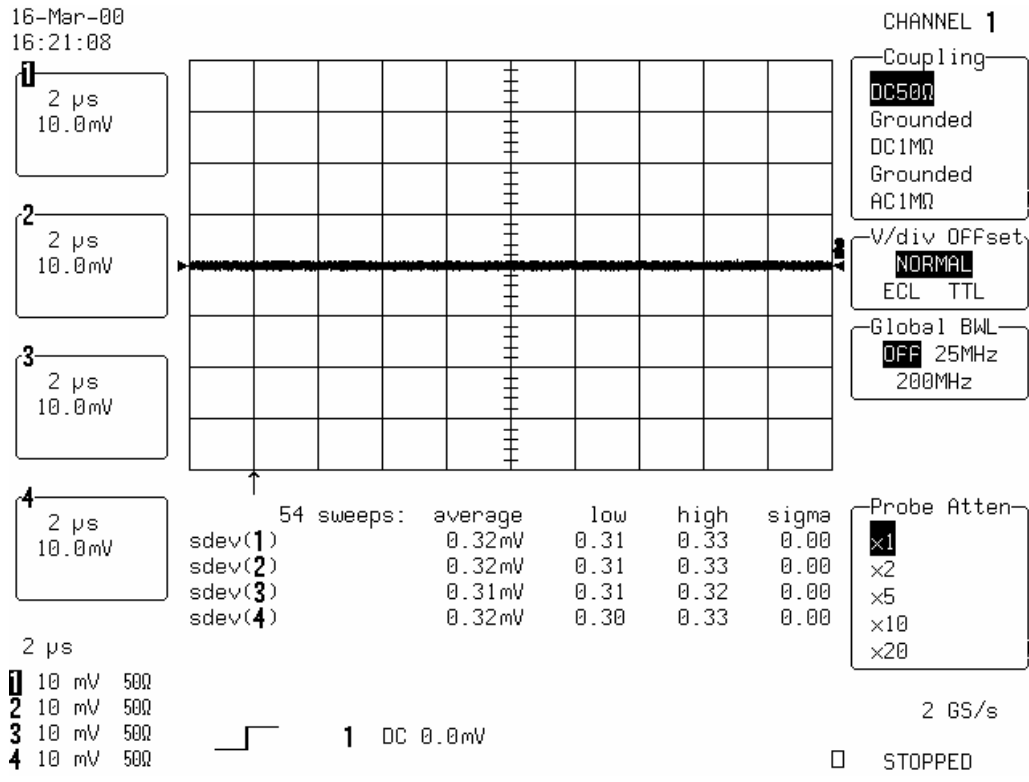
c. DC 50Ω

- Recall **LC684P026.PNL** or configure the DSO as shown in 5.6.2.a and make the following changes :

Input Coupling : **DC 50Ω** on all 4 Channels

Time base : **2 μsec/div.**

- Press **Clear Sweeps**.
- Measure for at least **50 sweeps**, then press **Stop** to halt the acquisition.



- Record the four **high sdev** parameter values in Table 5, and compare the test results to the limits in the test record.
- Repeat the test for Time base : **20 μsec/div.**
- Record the measurements (high sdev of 1,2,3,4) in Table 5, and compare the results to the limits in the test record.

d. DC 50Ω, 2 Channel Mode

Channel 2 & Channel 3

- Recall **LC684P027.PNL** or configure the DSO as shown in 5.6.2.a. and make the following changes :

Input Coupling : **DC 50Ω** on all 4 Channels

Input gain : **10 mV/div.** on all 4 Channels

Channels Trace ON **Channel 2, Channel 3**

Channels Trace OFF **Channel 1, Channel 4**

Time base : **1 μsec/div.**

Select Time base Setup

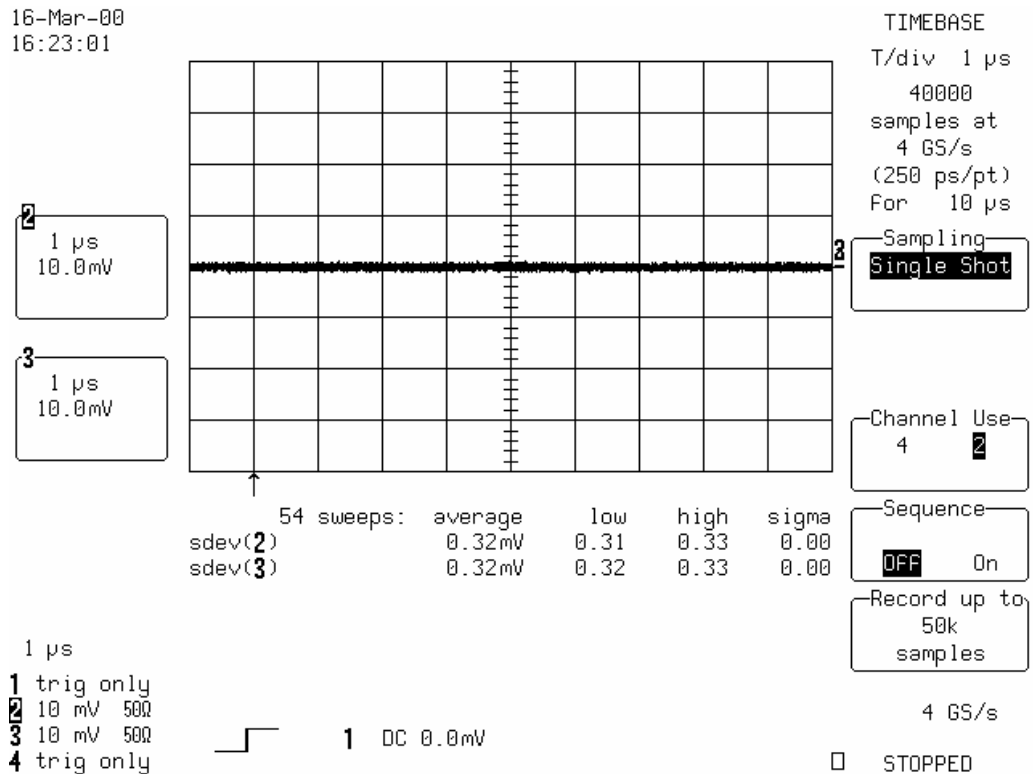
Channel use : 2

Press : **Cursors/Measure**

Change parameters

On line 1 : **Measure sdev of Ch2**

On line 2 : **Measure sdev of Ch3**



- Check that the Sampling rate is **4 GS/s**
- Press **Clear Sweeps**.
- Measure for at least **50 sweeps**, then press **Stop** to halt the acquisition.
- Record the two **high sdev of Ch2 & Ch3** in Table 5, and compare the test results to the limits in the test record.



e. LC684D, LC684DM, LC684DL & LC684DXL 1 Channel Mode

Channel 2 :

- Recall **LC684P028.PNL** or configure the DSO as shown in 5.6.2.a. and make the following changes :

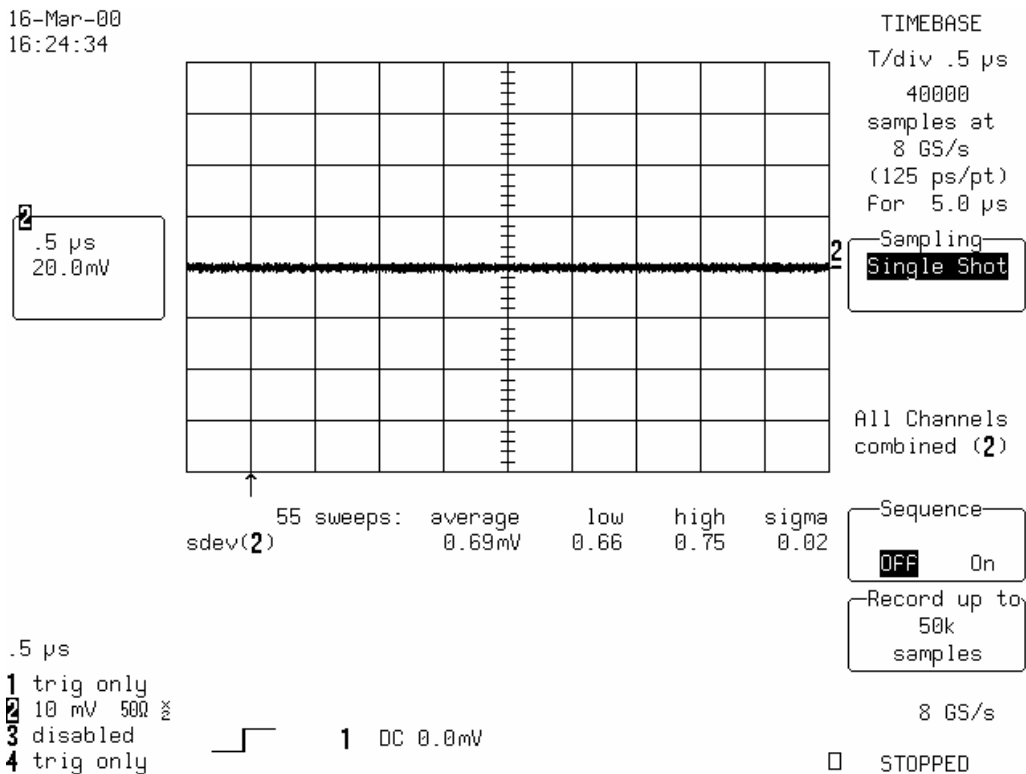
Input Coupling : **DC 50Ω** on all 4 Channels

Channels Trace ON **Channel 2**
 Channels Trace OFF **Channel 1, Channel 3, Channel 4**

Time base : **0.5 μsec/div.**

Press : **Cursors/Measure**
 Change parameters
 On line 1 : **Measure sdev of Ch1**

- Connect **PP096** to channels 2 & 3
- Check that the Sampling rate is **8GS/s**



- Press **Clear Sweeps**.
- Measure for at least **50 sweeps**, then press **Stop** to halt the acquisition.
- Record the **high sdev of Ch1** in Table 5, and compare the test result to the limits in the test record.

5.6.3 Ground Line Test

Specifications

- ±5 % of full scale at 2 mV/div.
- ±3 % of full scale at 5 mV/div.
- ±2 % of full scale at 10 mV/div. and above.

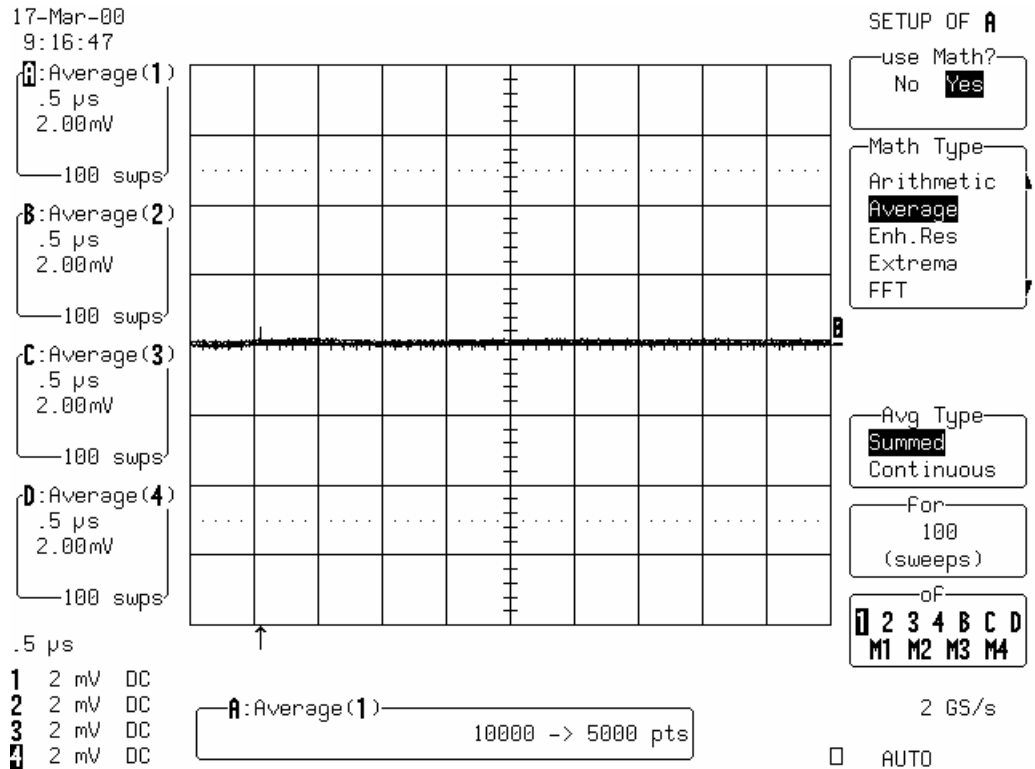
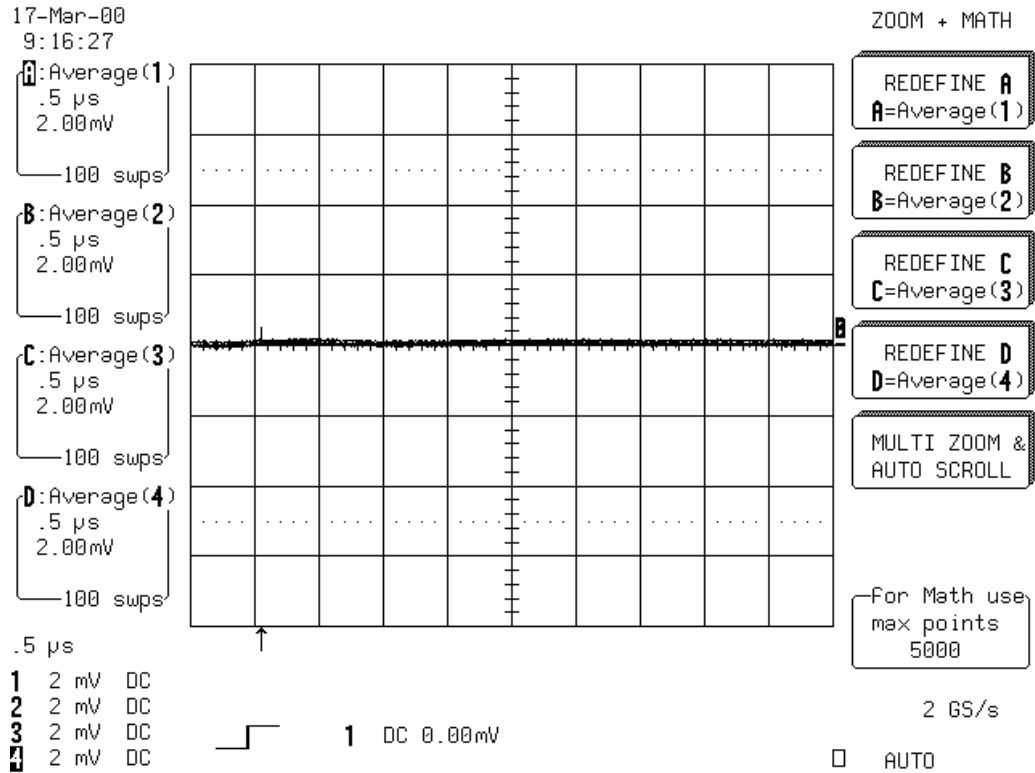
Procedure

The stability of the ground line is verified for each channel at each fixed gain. The measured average values are checked against the desired limits.

a. DC 1MΩ

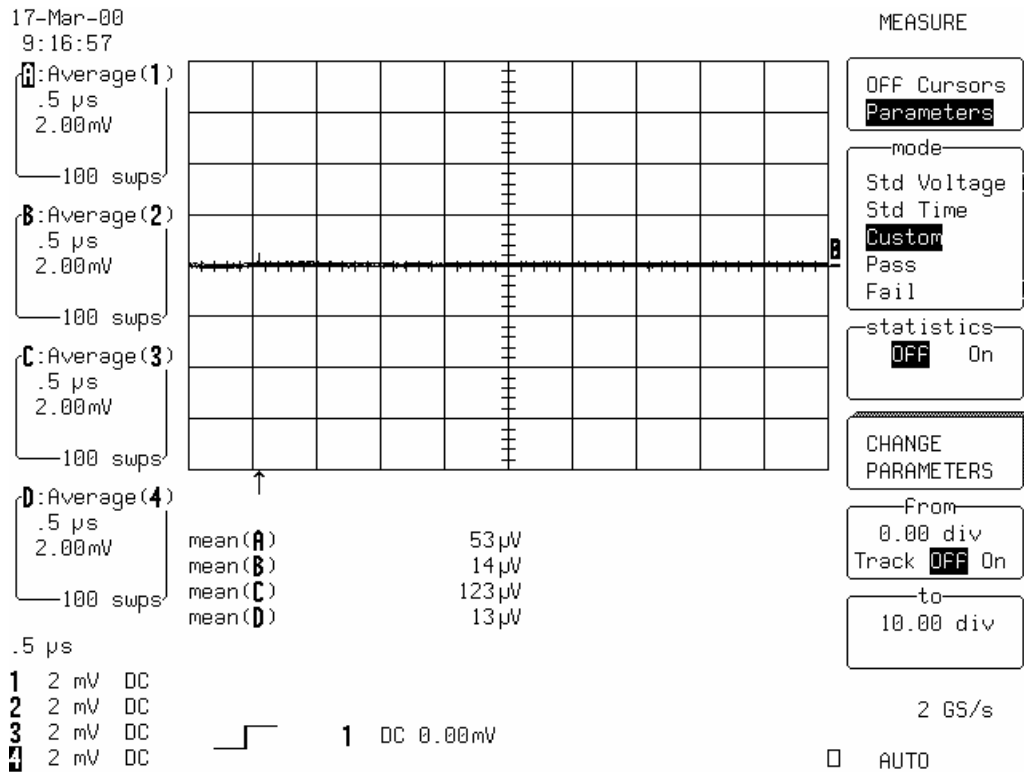
With no signal connected to the inputs

- Recall **LC684P029.PNL** or configure the DSO :
 - Channels Trace ON **Channel 1, Channel 2, Channel 3 & Channel 4**
 - Input Coupling : **DC 1MΩ** on all 4 Channels
 - Input gain : **from 2mV/div to 1 V/div. (see Table 6)** on all 4 Ch
 - Offset : **Zero** on all 4 Channels
 - Trigger on : **Channel 1, DC**
 - Trigger mode : **Auto**
 - Time base : **0.5 μsec/div.**
 - Channel use : **4**
 - Record up to : **50 k**
 - Channels Trace OFF **Channel 1, Channel 2, Channel 3 & Channel 4**
 - Zoom+Math Trace ON **A, B, C & D**
 - Select Math Setup
 - For Math : **Use at most 5000 points**
 - Redefine A, B, C, D **Channel 1, Channel 2, Channel 3 & Channel 4**
 - Use Math ? : **Yes**
 - Math Type : **Average**
 - Avg. Type : **Summed**
 - For : **100 sweeps**
 - Press : **Cursors/Measure**
 - Select : **Parameters**
 - Mode : **Custom**
 - Statistics : **off**



Change parameters

- On line 1 : **Measure mean of A**
- On line 2 : **Measure mean of B**
- On line 3 : **Measure mean of C**
- On line 4 : **Measure mean of D**



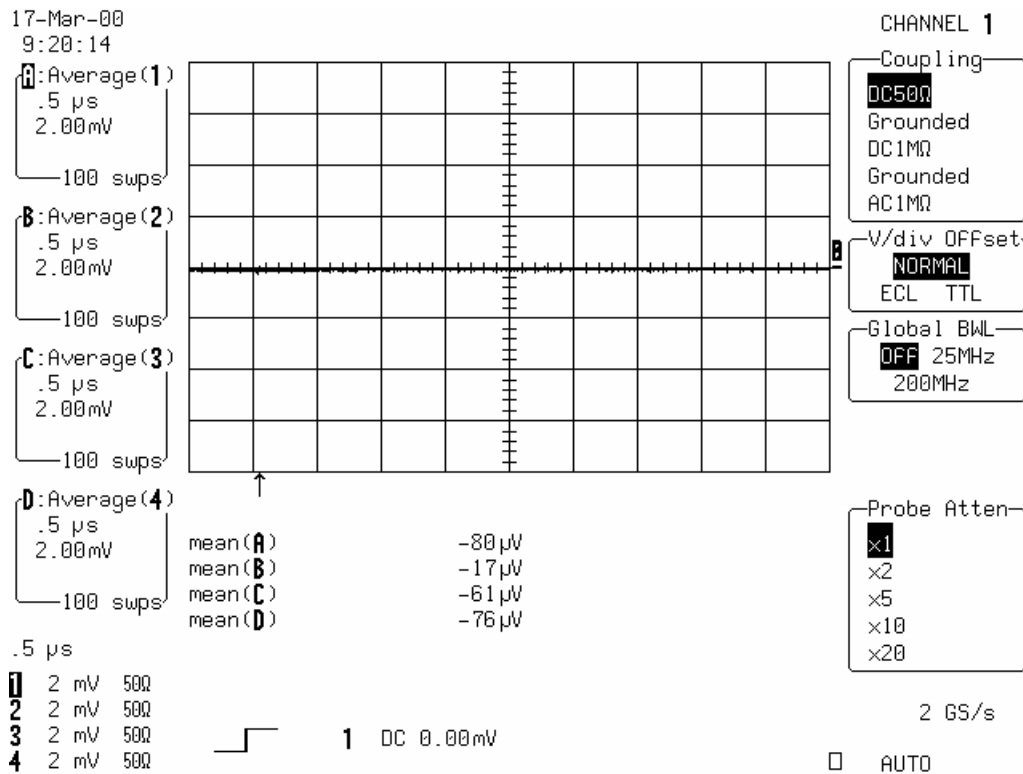
- Press **Clear Sweeps**.
- After **100 sweeps** record the **mean** value of **A, B, C & D** in Table 6, and compare the test results to the limits in the test record.
- Repeat step 5.6.3.a. for all vertical scale settings listed in Table 6, and check that the test results (mean value of A, B, C, D) are within the limits specified.
- Record the measurements in Table 6.



b. DC 50Ω

- Recall **LC684P030.PNL** or configure the DSO as shown in 5.6.3.a. and for each Channel make the following change:

Input Coupling : **DC 50Ω** on all 4 Channels
 Input gain : from **2mV/div** to **.2 V/div**. (see Table 7) on all 4 Ch



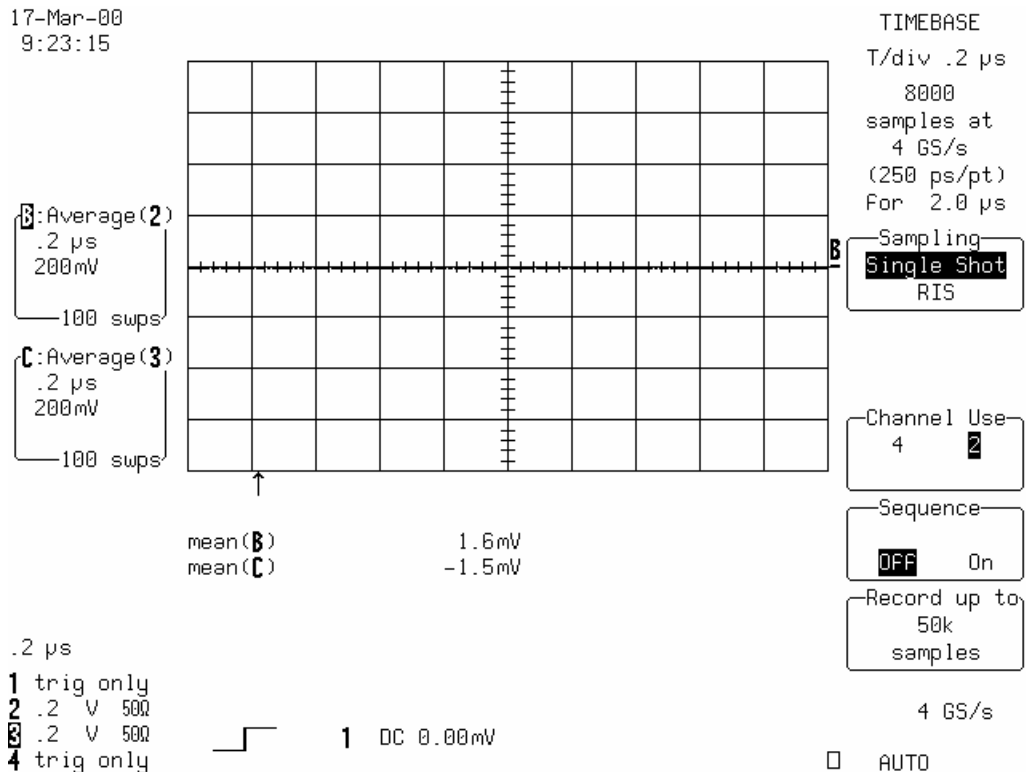
- Press **Clear Sweeps**.
- After **100 sweeps** record the **mean** value of **A, B, C & D** in Table 7, and compare the test results to the limits in the test record.
- Repeat step 5.6.3.b. for all vertical scale settings listed in Table 7, and check that the test results (mean value of A, B, C, D) are within the limits specified.
- Record the measurements in Table 7.

c. DC 50Ω, 2 Channel Mode

Channel 2 & Channel 3

- Recall **LC684P031.PNL** or configure the DSO as shown in 5.6.3.a. and make the following change :

Input Coupling : **DC 50Ω** on all 4 Channels
 Input gain : **0.2 V/div.** on all 4 Channels
 Trace ON : **A:Average of (2), C:Average of (3)**
 Trace OFF : **B:Average of (1), D:Average of (4)**
 Time base : **0.2 μsec/div.**
 Select Time base Setup
 Channel use : **2**
 Press : **Cursors/Measure**
 Change parameters
 On line 1 : **Mean of B**
 On line 2 : **Mean of C**
 On line 3, 4, 5 : **No parameter selected**



- Check that the Sampling rate is **4 GS/s**
- Press **Clear Sweeps**.
- After **100 sweeps** record the **mean** value of **B & C** in Table 7, and compare the test results to the limits in the test record.



d. LC684D, LC684DM, LC684DL & LC684DXL 1 Channel Mode

Channel 2

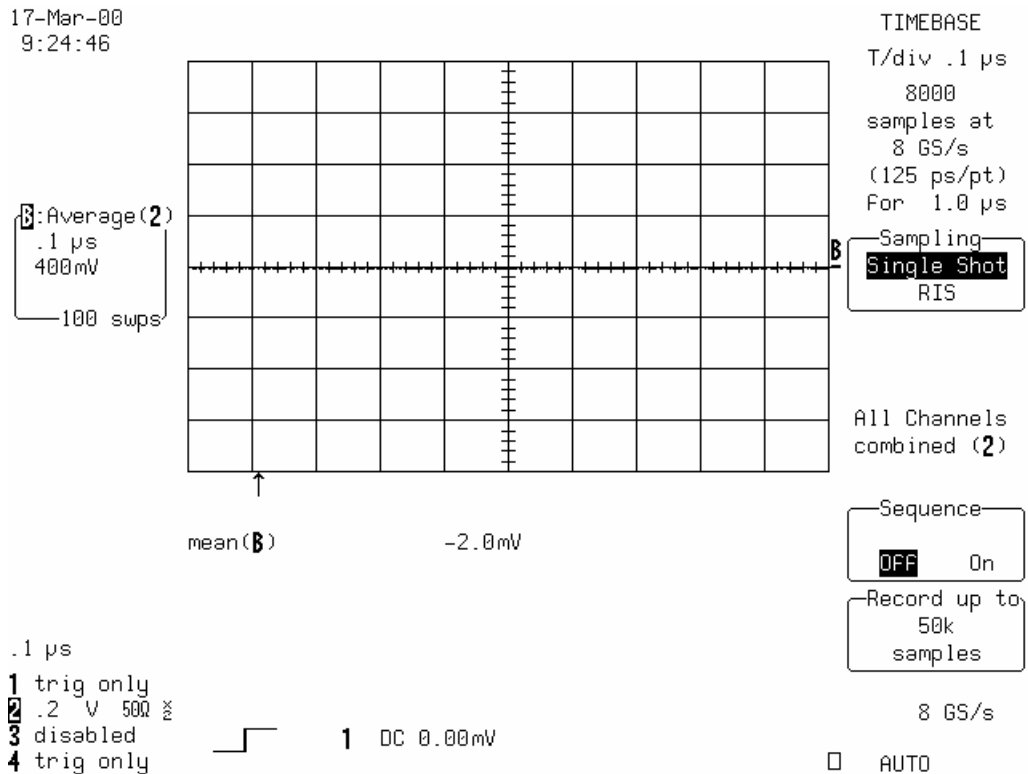
- Recall **LC684P032.PNL** or make the following changes :

Trace ON : **A:Average of (2)**
 Trace OFF : **B:Average of (1), C:Average of (3), D:Average of (4)**

Time base : **0.1 μ sec/div.**

Press : **Cursors/Measure**
 Change parameters
 On line 1 : **Measure Mean of B**
 On line 2, 3, 4, 5 : **No parameter selected**

- Connect **PP096** to channel 2 & 3
- Check that the Sampling rate is **8 GS/s**



- Press **Clear Sweeps**.
- After **100 sweeps** record the **mean** value of **A** in Table 7, and compare the test result to the limits in the test record.

5.6.4 Erroneous Read / Write Test

Specifications

±2,5 % of full scale at 50 mV/div.

Procedure

a. Channel 1, Channel 2, Channel 3 and Channel 4

- For **LC684D** recall **LC684P033.PNL**, for **LC684DM** recall **LC684P034.PNL**, for **LC684DL** recall **LC684P035.PNL** or for **LC684DXL** recall **LC684P036.PNL** or configure the DSO :

Channels Trace ON **Channel 1, Channel 2, Channel 3 & Channel 4**

Zoom+Math Trace ON **D**

Input Coupling : **DC 50Ω** on all 4 Channels

Global BWL ON : **25MHz**

Input gain : **50 mV/div.** on all 4 Channels

Offset : **Zero** on all 4 Channels

Trigger on : **Line**

Trigger mode : **Normal**

Time base : **5 μsec/div** for **LC684D**

20 μsec/div for **LC684DM**

0.1 mS for **LC684DL**

0.2 mS for **LC684DXL**

Select Setup timebase

Channel use : **4**

Record up to : **100K samples** for **LC684D**

500K samples for **LC684DM**

2.5M samples for **LC684DL**

4M samples for **LC684DXL**

Select Math Setup

For Math : **Use at most 500 points**

Redefine A : **A=1-1**

Use Math? : **Yes**

Math Type : **Arithmetic**

Difference : **1 minus 1**

Redefine B : **B=2**

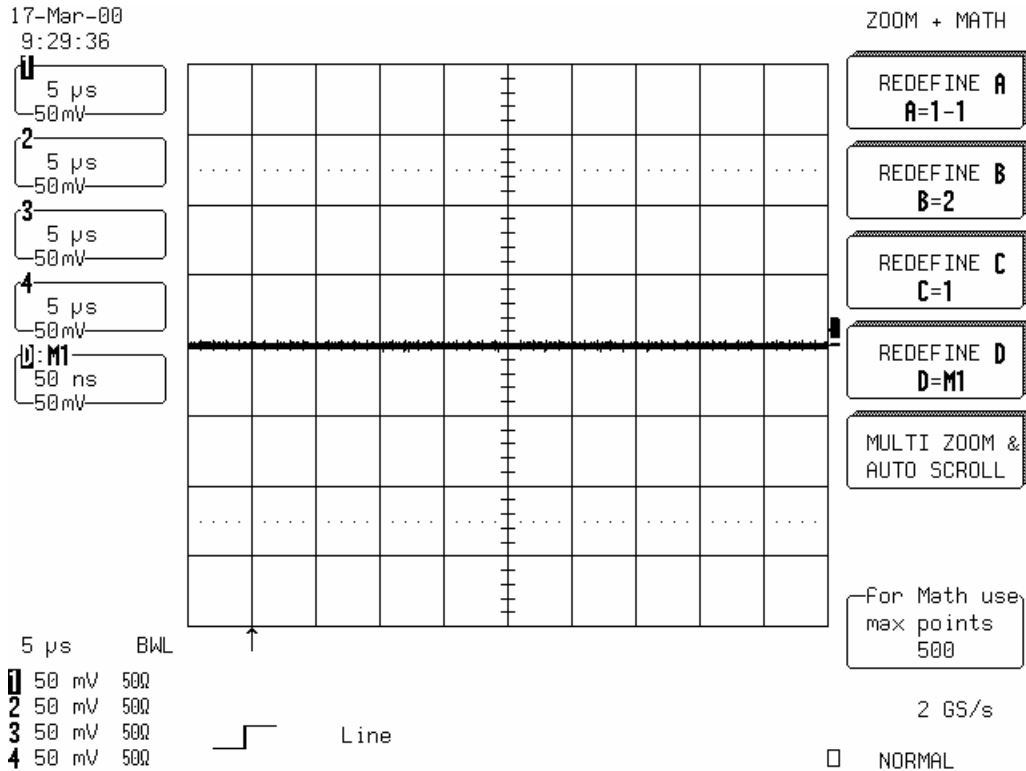
Use Math? : **No**

Trace B is Zoom of **2**

Redefine D : **D=M1**

Use Math? : **No**

Trace D is Zoom of **M1**

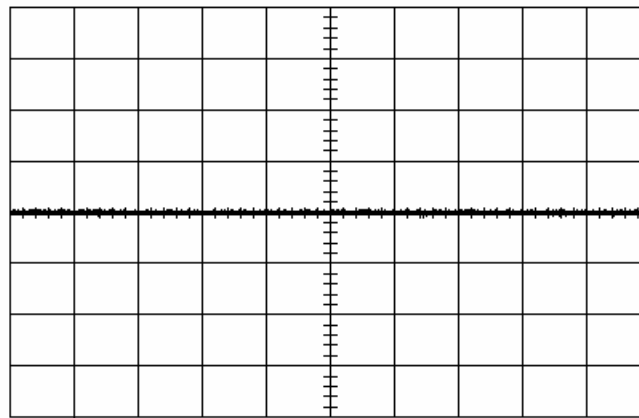


- Press **Reset Zoom+Math**
- Select **Cursors/Measure**

Measure	:	Parameters	
Mode	:	Pass	
Testing	:	On	
Select	:	Change Test Conditions	
On line	:	Action	
If	:	Fail	
Then	:	Stop Yes	
		Store No	
		Dump No	
		Beep Yes	
		Pulse No	
On line 1	:	Test on Mask	
		True if all points of 1 are inside mask D	
On line 2	:	Test on Mask	
		True if all points of 2 are inside mask D	
On line 3	:	Test on Mask	
		True if all points of 3 are inside mask D	
On line 4	:	Test on Mask	
		True if all points of 4 are inside mask D	

17-Mar-00
9:33:15

- 1 5 μ s
50mV
- 2 5 μ s
50mV
- 3 5 μ s
50mV
- 4 5 μ s
50mV
- D: M1
50 ns
50mV



0 passed of 0 sweeps Test Failed
 Pass if all points(1) inside mask(D) - - - F
 and all points(2) inside mask(D) - - - F
 and all points(3) inside mask(D) - - - F
 and all points(4) inside mask(D) - - - F

- 5 μ s BWL
- 1 50 mV 50 Ω
 - 2 50 mV 50 Ω
 - 3 50 mV 50 Ω
 - 4 50 mV 50 Ω

IF FAIL: Stop, Beep



CHANGE TEST

On line
1 2 3 4 5
Action

DELETE ALL ACTIONS

IF
Pass Fail

Then:
Stop Yes
Store No
Dump No
Beep Yes
Pulse No

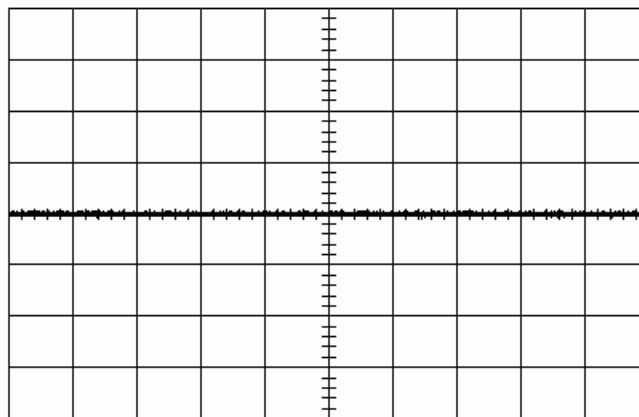
Stop
No Yes

2 GS/s

STOPPED

17-Mar-00
9:33:37

- 1 5 μ s
50mV
- 2 5 μ s
50mV
- 3 5 μ s
50mV
- 4 5 μ s
50mV
- D: M1
50 ns
50mV



0 passed of 0 sweeps Test Failed
 Pass if all points(1) inside mask(D) - - - F
 and all points(2) inside mask(D) - - - F
 and all points(3) inside mask(D) - - - F
 and all points(4) inside mask(D) - - - F

- 5 μ s BWL
- 1 50 mV 50 Ω
 - 2 50 mV 50 Ω
 - 3 50 mV 50 Ω
 - 4 50 mV 50 Ω

IF FAIL: Stop, Beep



CHANGE TEST

On line
1 2 3 4 5
Action

Test on
Param Mask
---(No Test)

MODIFY MASK

True if
all points
some points

of
1 2 3 4
A B C D

are
inside
outside

mask
A B C D

2 GS/s

STOPPED



- Select Modify Mask

From : **W'form**
 Into : **M1**
 Use W'form : **A**
 Delta V : **0.20 div**
 Delta T : **0.00 div**

17-Mar-00
9:50:24

5 μ s 50 mV
 2 5 μ s 50 mV
 3 5 μ s 50 mV
 4 5 μ s 50 mV
 M1 5 μ s 3.20 k Ω

MODIFY MASK
 From **W'Form Flpy**
 into **D=M4 M1 M2 M3 M4**
 INVERT MASK **M1**
 Use W'Form **1 2 3 4 B C D M1 M2 M3 M4**
 MAKE MASK **M1**
 delta V **0.20 div**
 delta T **0.20 div**

17567 passed of 17567 sweeps Test passed
 Pass if all points(1) inside mask(D) yes T
 and all points(2) inside mask(D) yes T
 and all points(3) inside mask(D) yes T
 and all points(4) inside mask(D) yes T

5 μ s BWL
 1 50 mV 50 Ω
 2 50 mV 50 Ω
 3 50 mV 50 Ω
 4 50 mV 50 Ω

IF FAIL: Stop, Beep

Line

2 GS/s

STOPPED

- To start the test, select **Cursors/Measure, Change Test Conditions, Modify Mask** and press **Make Mask M1**
- After **10000** sweeps for **LC684D**, or after **2500** sweeps for **LC684DM**, or after **500** sweeps for **LC684DL** or **LC684DXL** check that the number of **Passed** equals the number of **Sweeps** on all 4 Channels.
- Record the test result in Table 8.

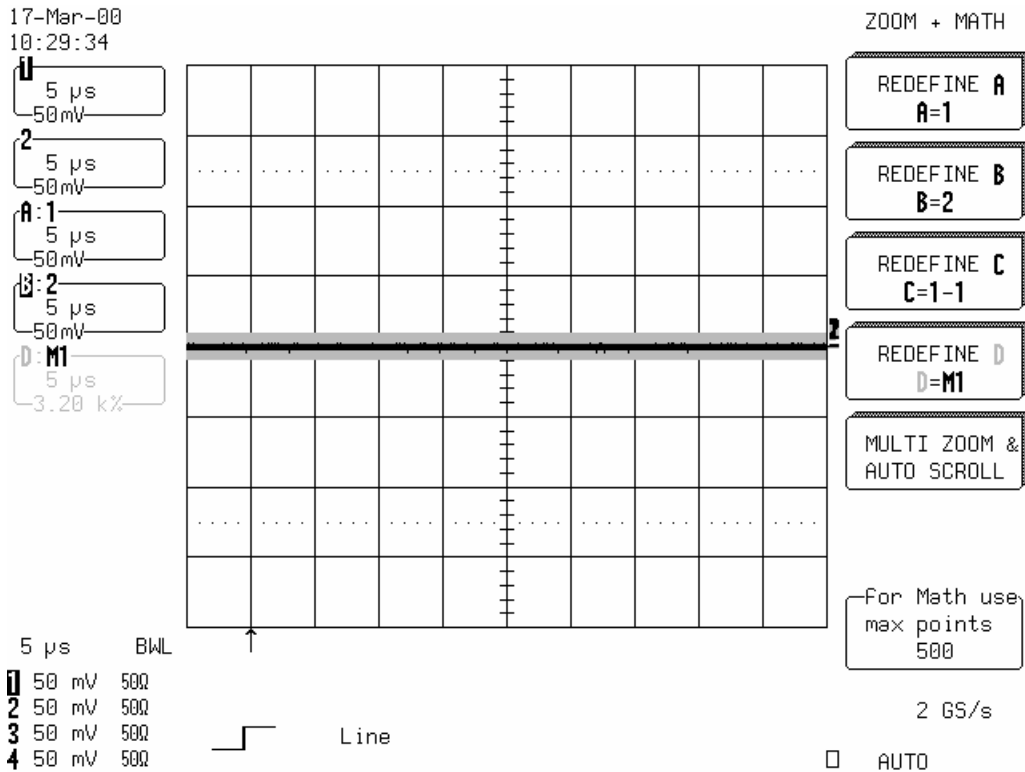
b. Channel 1, Channel 2, Expand A:1 and Expand B:2

- For **LC684D** recall **LC684P037.PNL**, for **LC684DM** recall **LC684P038.PNL**, for **LC684DL** recall **LC684P039.PNL** or for **LC684DXL** recall **LC684P040.PNL** or make the following changes :

Channels Trace ON **Channel 1, Channel 2**
 Zoom+Math Trace ON **A, B, D**

Select Math Setup
 Redefine A : **A=1**
 Use Math? : **No**
 Trace A is Zoom of **1**
 Redefine C : **C=1-1**
 Use Math? : **Yes**
 Math Type : **Arithmetic**
 Difference : **1 minus 1**

- Press **Reset Zoom+Math**



- Press **Cursors/Measure**

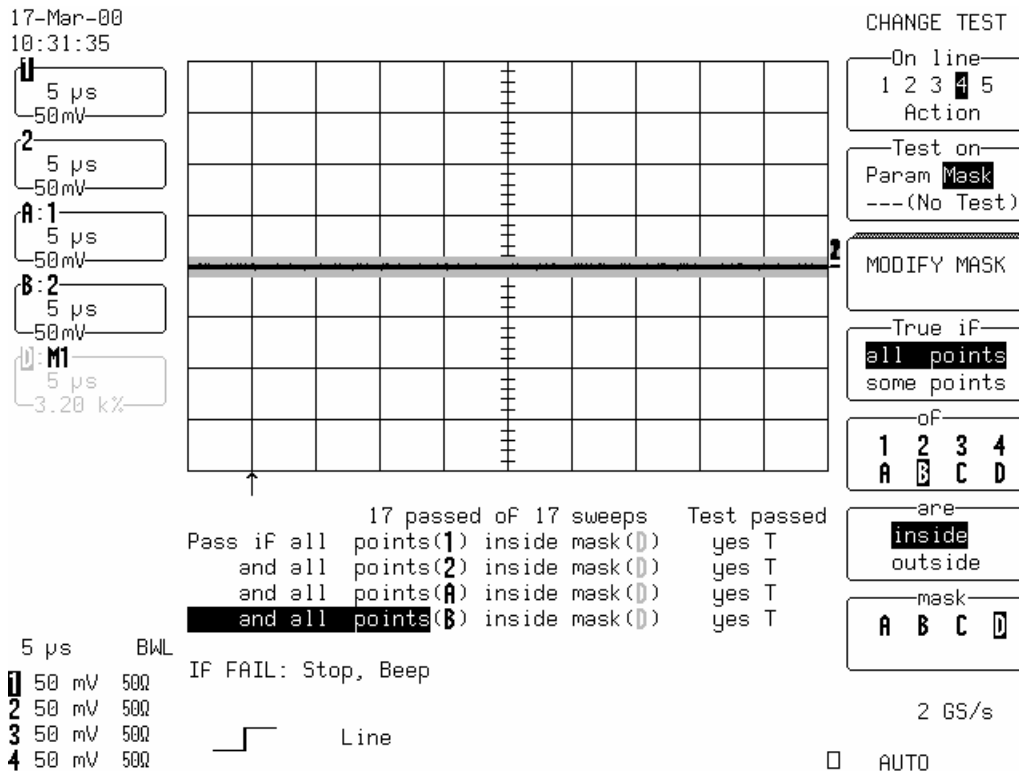
Select : **Change Test Conditions**



On line 3 : **Test on Mask**
True if all points of A are inside mask D

On line 4 : **Test on Mask**
True if all points of B are inside mask D

- Select Modify Mask
 - From : **W'form**
 - Into : **M1**
 - Use W'form : **C**



- To start the test, select **Cursors/Measure, Change Test Conditions, Modify Mask** and press **Make Mask M1**
- After **200** sweeps for **LC684D**, or after **50** sweeps for **LC684DM**, or after **10** sweeps for **LC684DL** or **LC684DXL** check that the number of **Passed** equals the number of **Sweeps** on Ch1, Ch2, A:1 and B:2.
- Record the test result in Table 8.

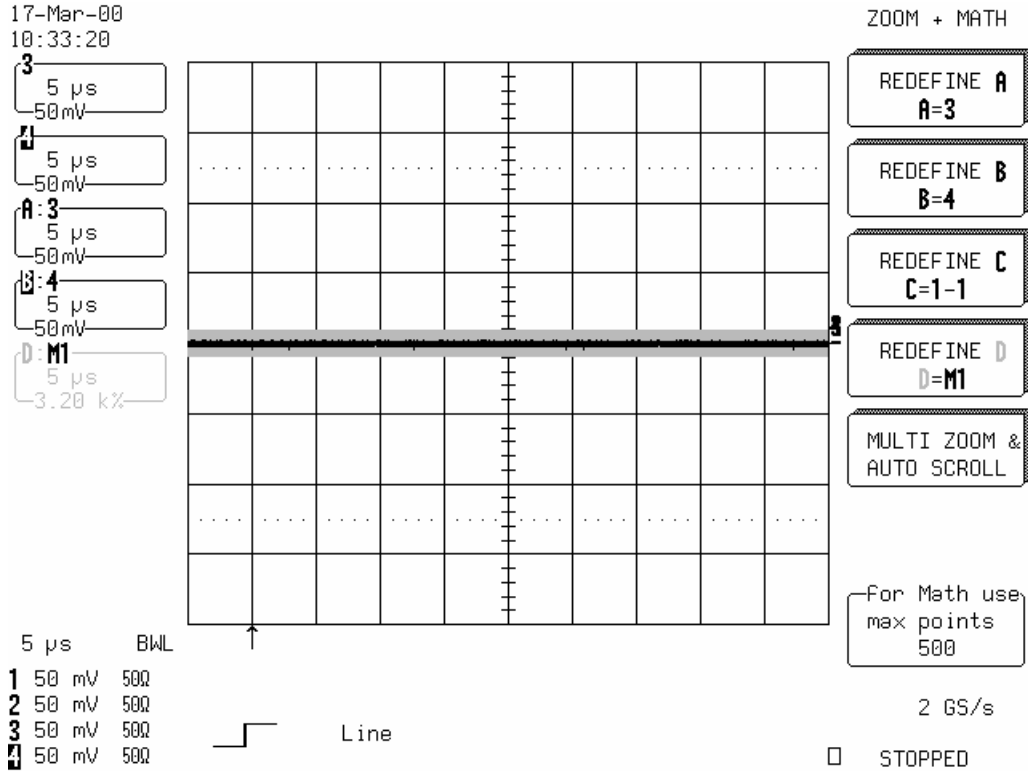
c. Channel 3, Channel 4, Expand A:3 and Expand B:4

- For **LC684D** recall **LC684P041.PNL**, for **LC684DM** recall **LC684P042.PNL**, for **LC684DL** recall **LC684P043.PNL** or for **LC684DXL** recall **LC684P044.PNL** or make the following changes :

Channels Trace ON **Channel 3, Channel 4**

Select Math Setup
 Redefine A : **A=3**
 Use Math? : **No**
 Trace A is Zoom of **3**
 Redefine B : **B=4**
 Use Math? : **No**
 Trace A is Zoom of **4**

- Press **Reset Zoom+Math**



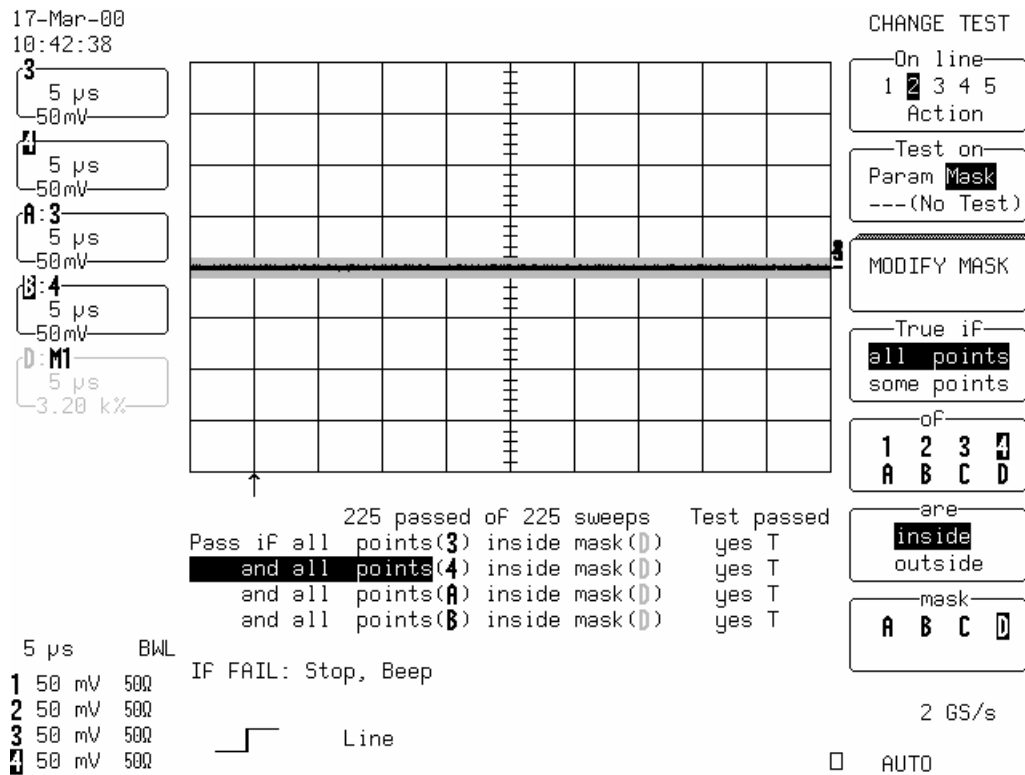
- Press **Cursors/Measure**

Select : **Change Test Conditions**



On line 1 : **Test on Mask**
True if all points of 3 are inside mask D

On line 2 : **Test on Mask**
True if all points of 4 are inside mask D



- To start the test, select **Cursors/Measure, Change Test Conditions, Modify Mask** and press **Make Mask M1**
- After **200** sweeps for **LC684D**, or after **50** sweeps for **LC684DM**, or **10** sweeps for **LC684DL** or **LC684DXL** check that the number of **Passed** equals the number of **Sweeps** on Ch3, Ch4, A:3 and B:4.
- Record the test result in Table 8.

5.7 DC Accuracy

Specification

- ≤ ±5 % of full scale at 2mV/div, with 0 mV offset.
- ≤ ±3 % of full scale at 5mV/div, with 0 mV offset.
- ≤ ±2 % of full scale at 10mV/div and above, 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 20 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 Std voltage. For each known input voltage, the deviation is checked against the tolerance.

5.7.1 Positive DC Accuracy

a. DC 50Ω

Procedure

- Recall **LC684P045.PNL** 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 offset	:	0.0 mV on all 4 Channels
Input gain	:	from 2mV/div to 1 V/div. (see Table 9) on all 4 Ch
Trigger setup	:	Edge
Trigger on	:	Line
Slope line	:	Positive
Mode	:	Auto
Time base	:	2 msec/div.
Channel use	:	4
Record up to	:	25 k
Channels Trace OFF	:	Channel 1, Channel 2, Channel 3 & Channel 4
Zoom+Math Trace ON	:	A, B, C & D
Select Math Setup	:	
For Math	:	Use at most 5000 points
Redefine A, B, C, D	:	Channel 1, Channel 2, Channel 3 & Channel 4
Use Math ?	:	Yes
Math Type	:	Average
Avg. Type	:	Summed
For	:	100 sweeps
Cursors/Measure	:	Parameters



Mode : **Custom**
Statistics : **off**

Change parameters

On line 1 : **Measure mean of A**
On line 2 : **Measure mean of B**
On line 3 : **Measure mean of C**
On line 4 : **Measure mean of D**

- For the low sensitivities: **2 mV, 5 mV, 10 mV and 20 mV/div.**, connect the test equipment as shown in Figure 5-1.

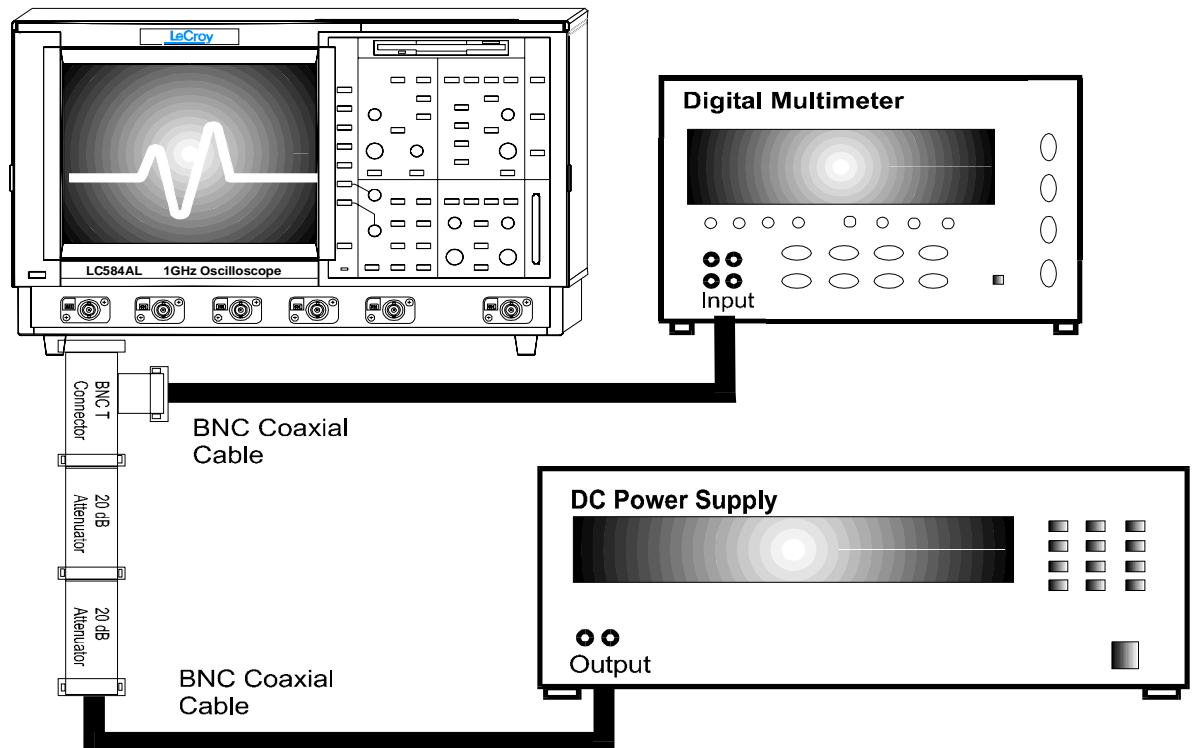


Figure 5-1 : DC 50 Ω Accuracy Equipment Setup for 2, 5, 10 and 20 mV/div

- For the sensitivities : **50 mV and 100 mV/div**, connect the test equipment as shown in Figure 5-2.
- For the range **1 V/div** no attenuator is required, connect the test equipment as shown in Figure 5-3.

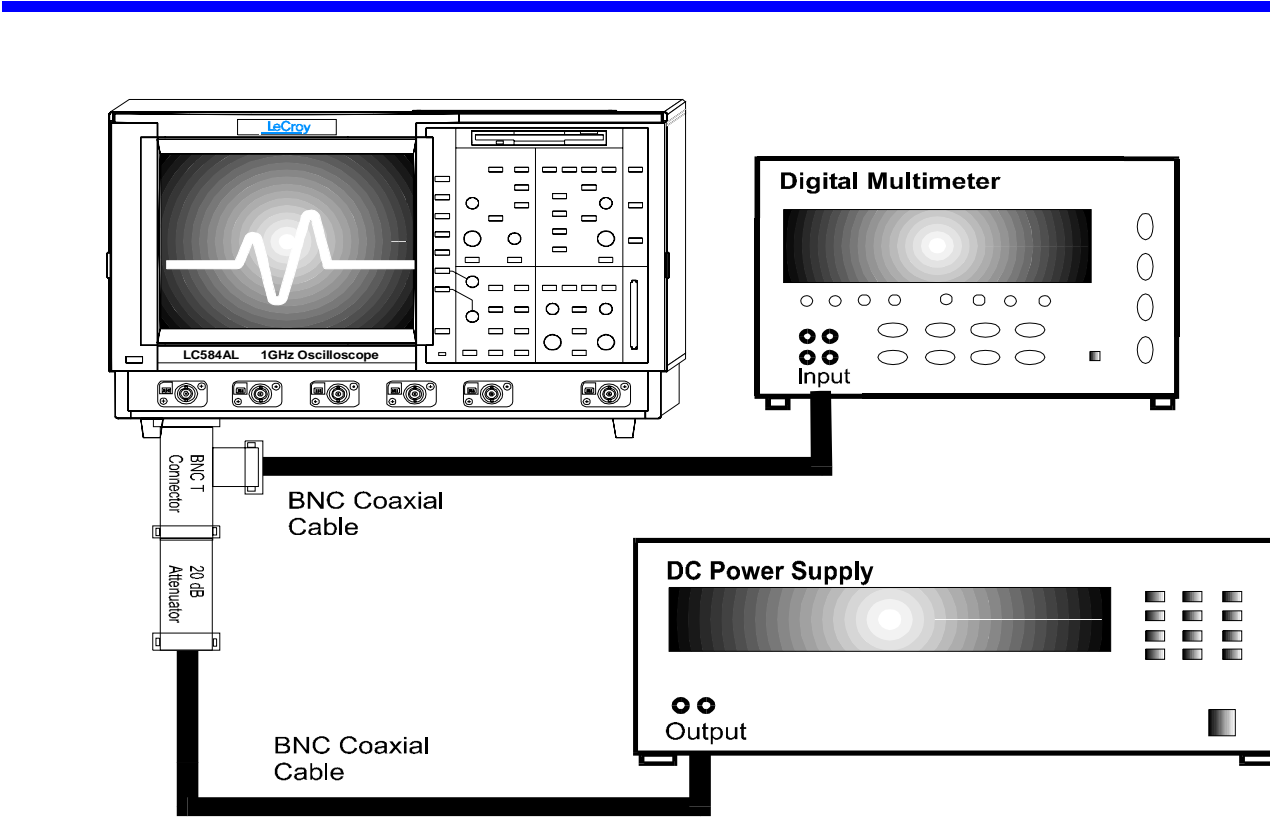


Figure 5-2 : DC 50Ω Accuracy Equipment Setup for 50 and 100 mV/div

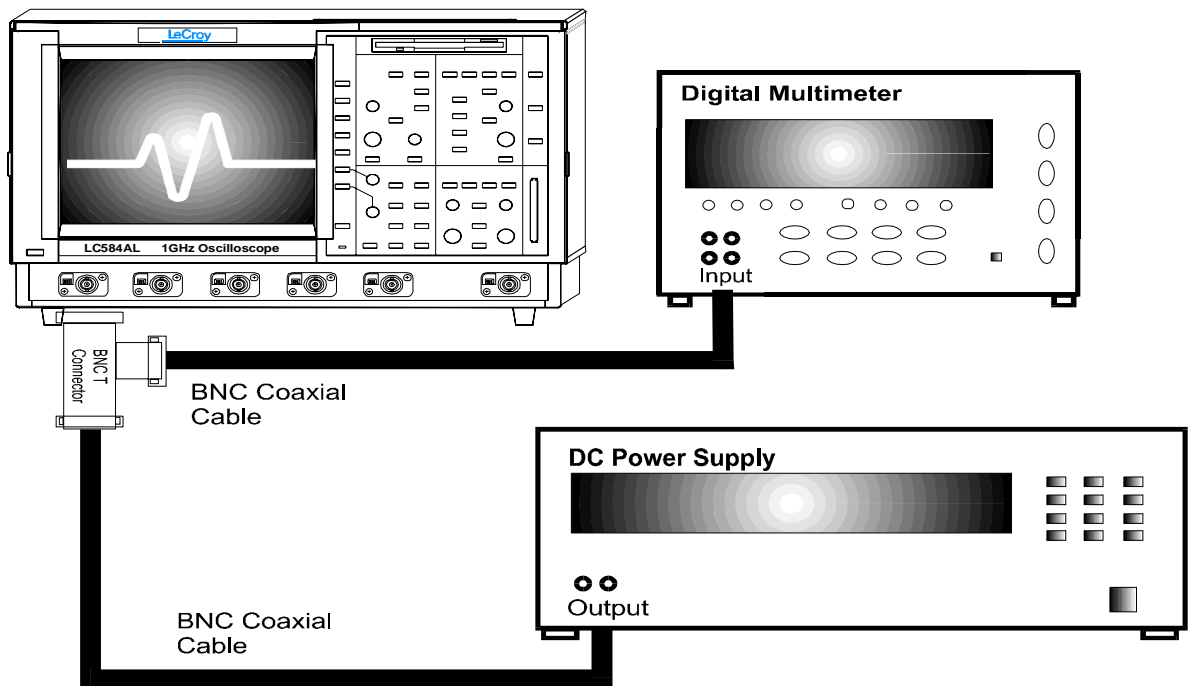
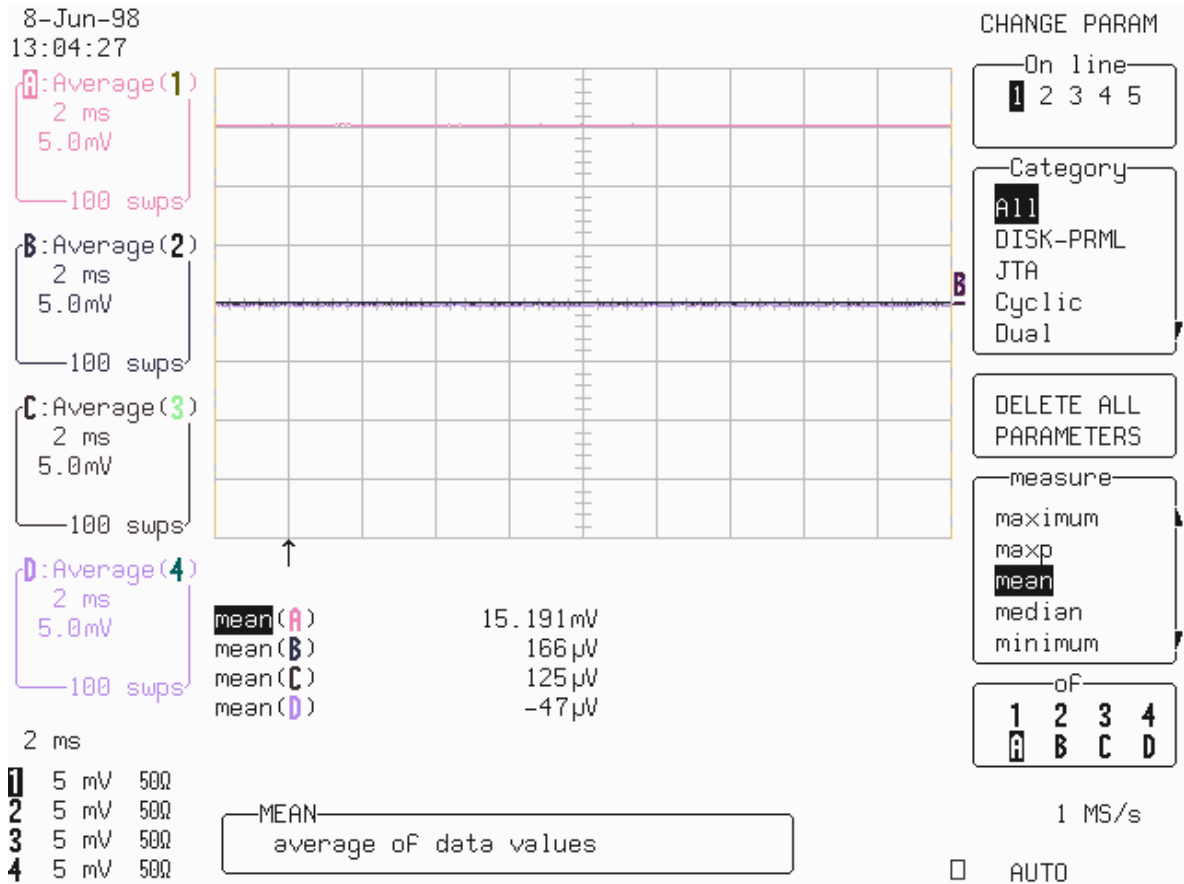


Figure 5-3 : DC 50Ω Accuracy Equipment Setup for 1 V/div.



- For each **DSO Volts/div**, set the output of the external **DC voltage reference source** as shown in Table 9, column PS output.
 - 1) Connect the DMM and record the **voltage reading** in Table 9, 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 9, 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 9, 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.



b. DC 1M Ω

Procedure

- Recall **LC684P046.PNL** or configure the DSO as shown in 5.7.1.a. and make the following change :

Input gain : **5mV/div, 0.1 V/div, and 5V/div** (see Table 10) on all 4 Ch
Input Coupling : **DC 1M Ω** on all 4 Channels

- For 5 mV/div., connect the test equipment as shown in Figure 5-4.

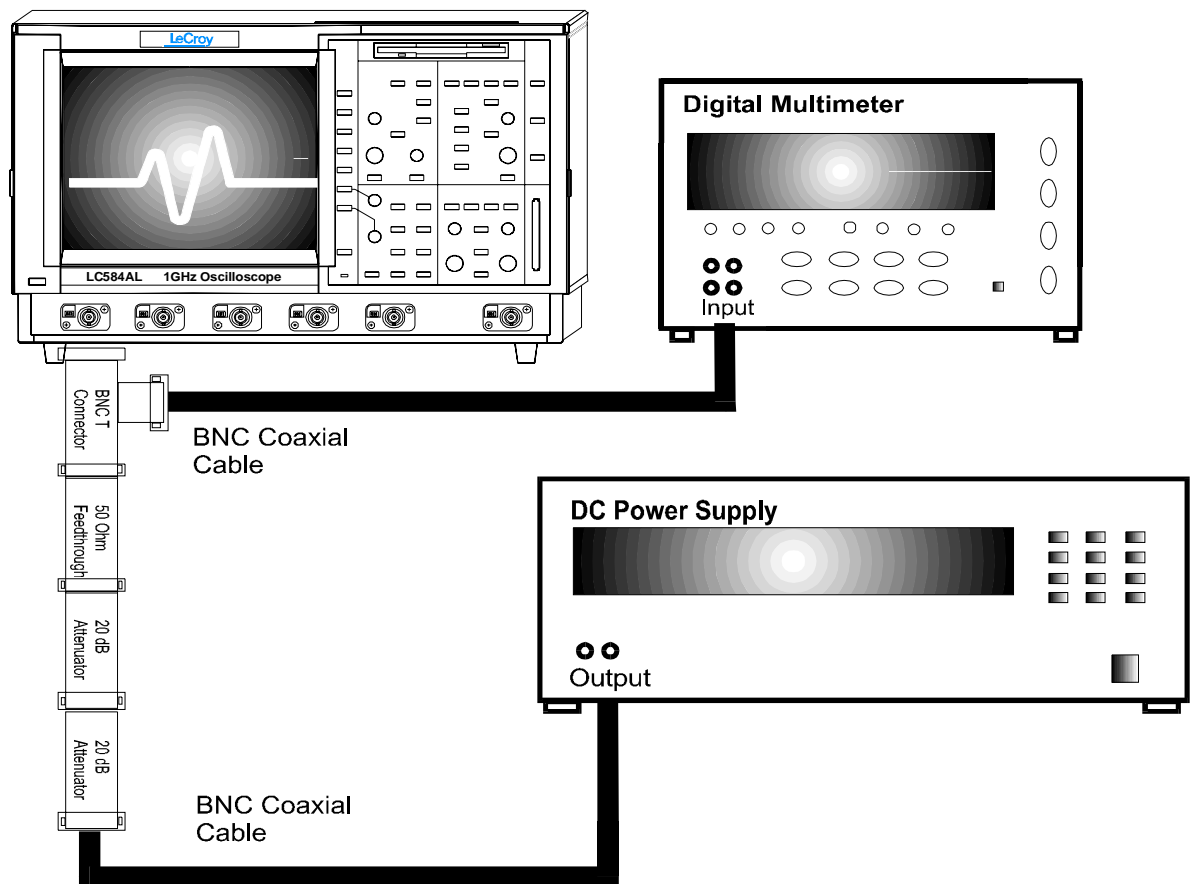


Figure 5-4: DC 1M Ω Accuracy Equipment Setup for 5 mV/div.

- For 100 mV/div, connect the test equipment as shown in Figure 5-5.
- For 5V/div no attenuator is required, connect the test equipment as shown in Figure 5-6.

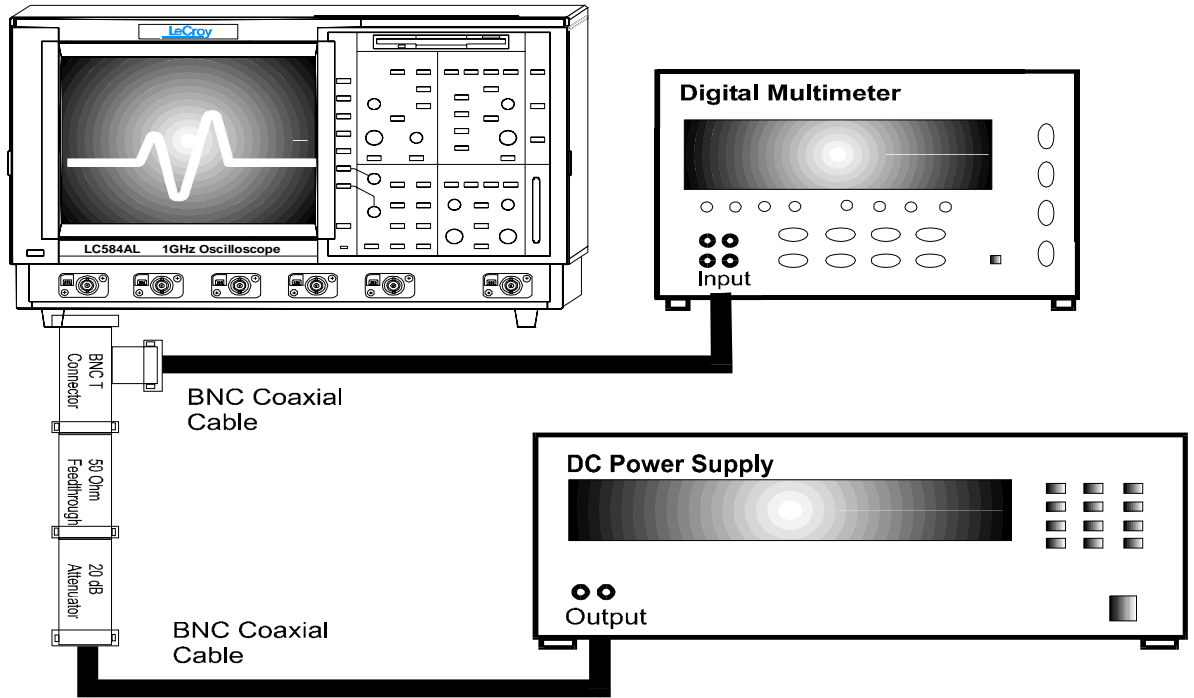


Figure 5-5 : DC 1MΩ Accuracy Equipment Setup for 100 mV/div

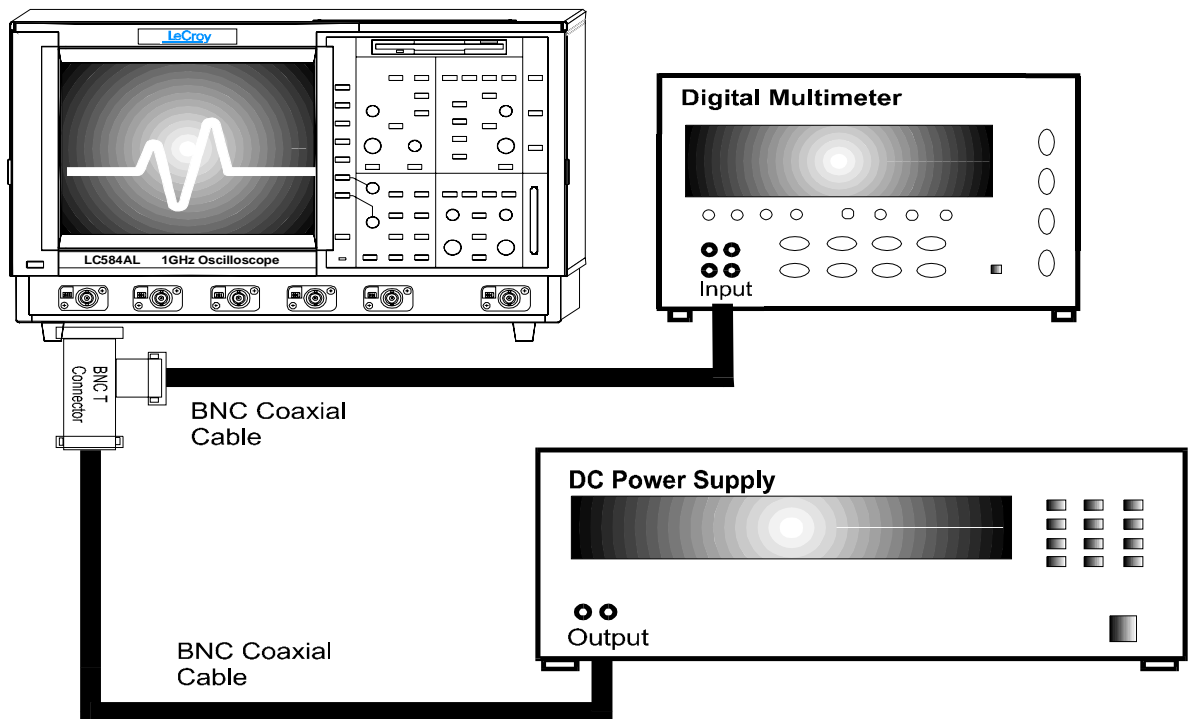
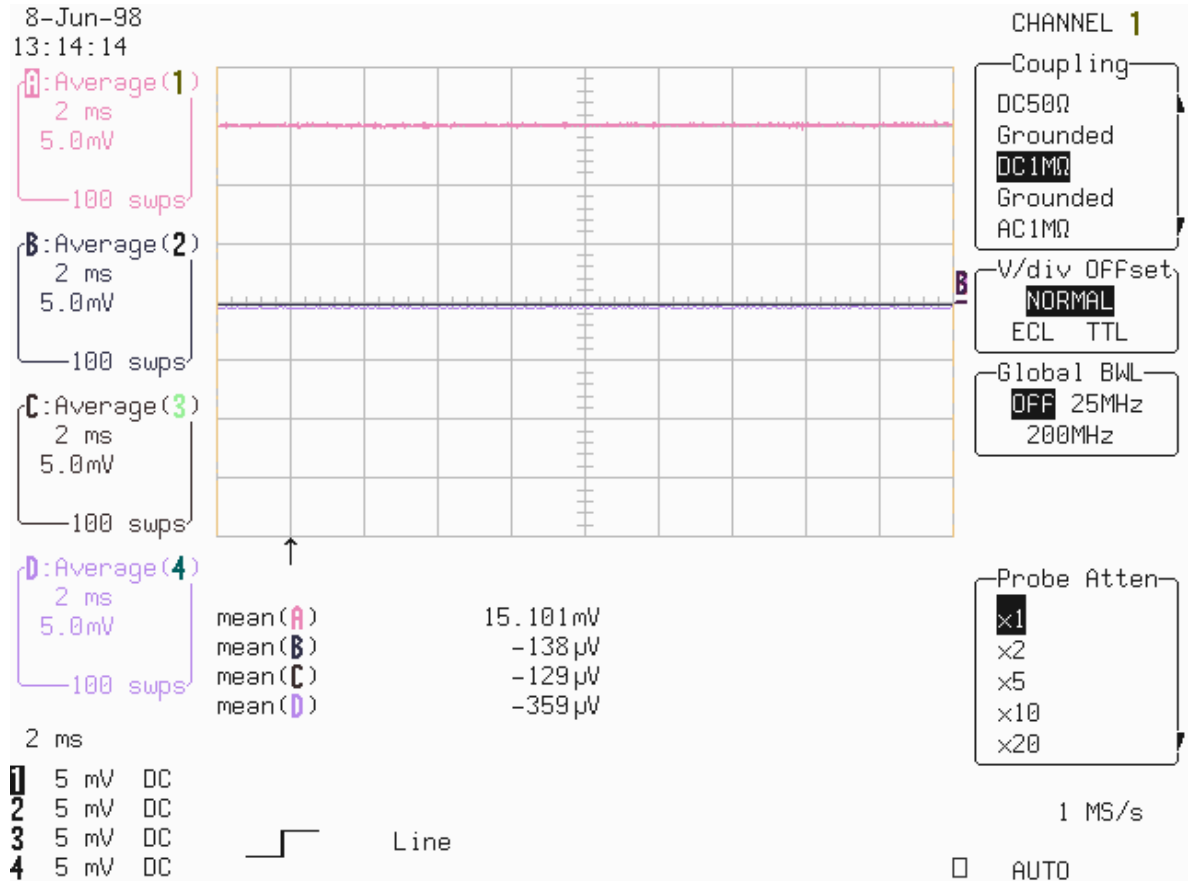


Figure 5-6 : DC 1MΩ Accuracy Equipment Setup for 5V/div.

- For each **DSO Volts/div**, set the output of the external **DC voltage reference source** as shown in Table 10, column PS output.
 - Connect the DMM and record the **voltage reading** in Table 10, column **DMM**.
 - Disconnect the DMM from the BNC T connector.
 - Press **Clear Sweeps**
 - After 100 sweeps, read off the **DSO mean parameter**, and record the measurement in Table 10, 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 10, and compare the **Difference (Δ)** to the corresponding limit in the test record.
- Repeat step 5.7.1.b. for the other channels, substituting channel controls and input connector.

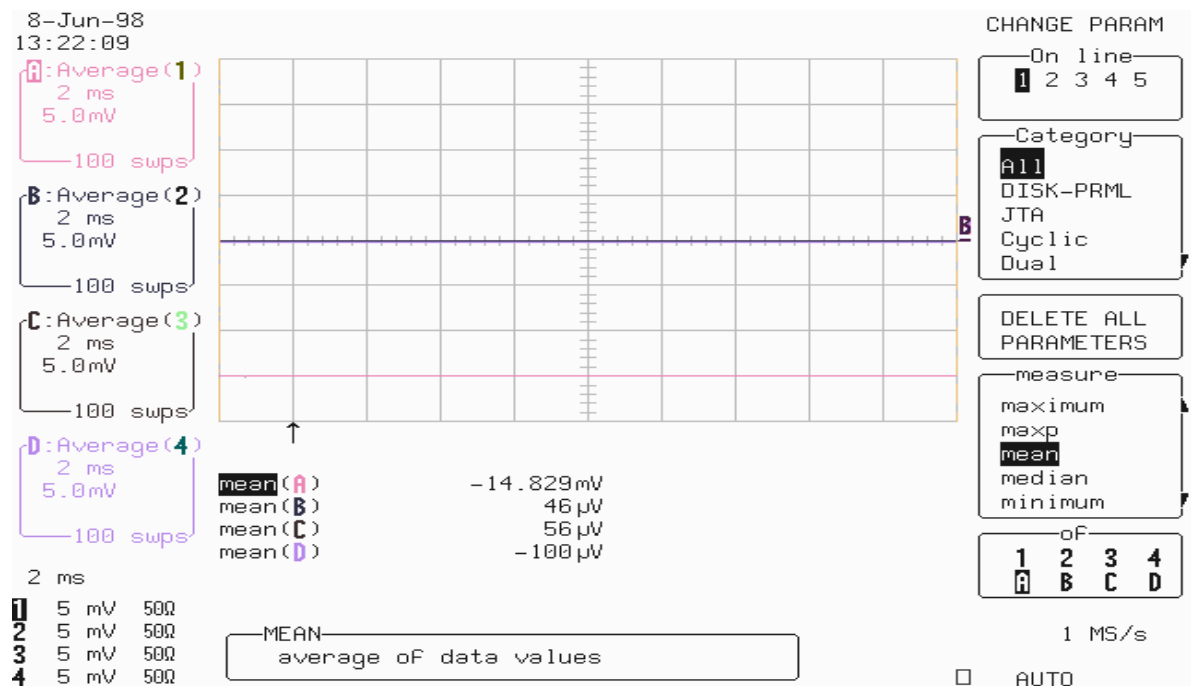




5.7.2 Negative DC Accuracy

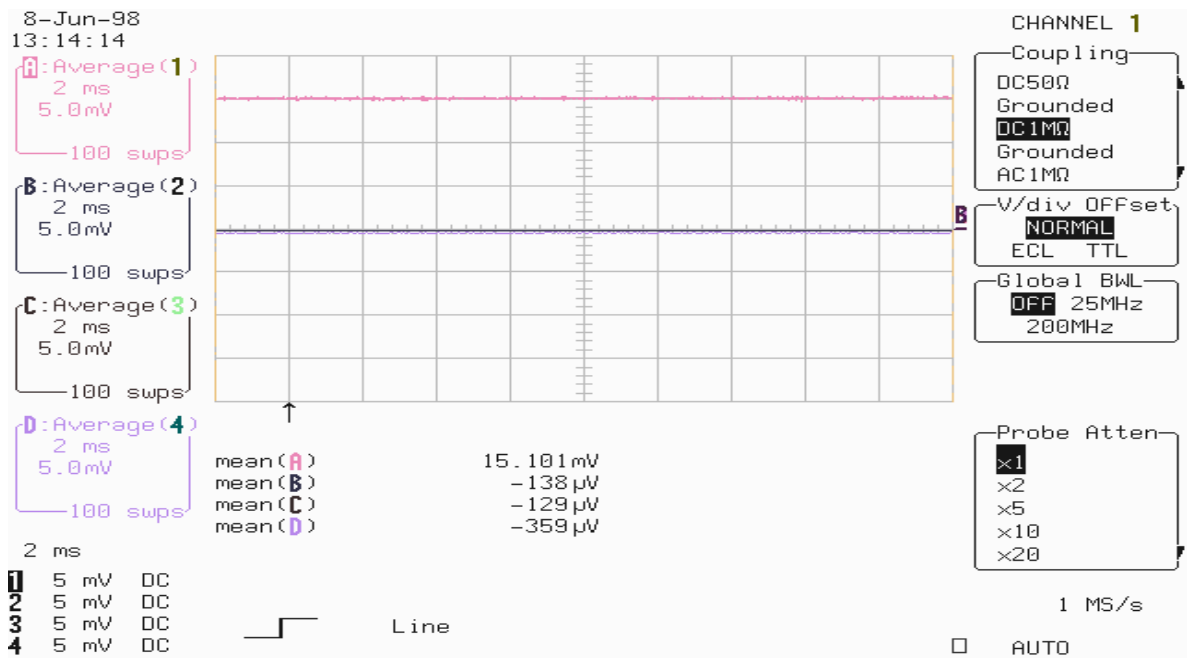
a. DC 50Ω

- Recall **LC684P045.PNL** or configure the DSO as shown in 5.7.1.a.
- Connect the test equipment as shown in either Figure 5-1 or 5-2 or 5-3.
- For each **DSO Volts/div**, set the output of the external **DC voltage reference source** as shown in Table 11, 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 11, 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 11, 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 11, and compare the **Difference (Δ)** to the corresponding limit in the test record.
- Repeat step 5.7.2.a. for the other channels, substituting channel controls and input connector.



b. DC 1 MΩ

- Recall **LC684P046.PNL** or configure the DSO as shown in 5.7.1.a. and make the following change :
 - Input gain : **5mV/div, 0.1 V/div, and 5V/dv** (see Table 12) on all 4 Ch
 - Input Coupling : **DC 1 MΩ** on all 4 Channels
- Connect the test equipment as shown in either Figure 5-4 or 5-5 or 5-6.
- For each **DSO Volts/div**, set the output of the external **DC voltage reference source** as shown in Table 12, column PS output.
 - 1) Connect the DMM and record the **voltage reading** in Table 12, 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 12, 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 12, and compare the **Difference (Δ)** to the corresponding limit in the test record.
- Repeat step 5.7.2.b. for the other channels, substituting channel controls and input connector.





5.8 Offset Accuracy

Specifications

Offset range at 2 mV/div: ± 0.4 Volt, Accuracy $\leq \pm 4.8$ mV (5% of FS + 1% of offset).
Offset range at 5 mV/div: ± 1 Volt, Accuracy $\leq \pm 11.2$ mV (3% of FS + 1% of offset).

Description

The offset test is done at 2 mV/div and 5 mV/div for 50Ω and at 5 mV/div for $1M\Omega$ coupling, with a signal of ± 0.4 Volt or ± 1 Volt cancelled by an offset of the other polarity.

5.8.1 Positive Offset Accuracy

a. DC 50Ω

Procedure

- Recall **LC684P047.PNL** 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	:	2mV/div on all 4 Channels
Input offset	:	+0.4 Volt on all 4 Channels
Trigger setup	:	Edge
Trigger on	:	Line
Coupling 1	:	DC
Mode	:	Auto
Time base	:	2 msec/div.
Channel use	:	4
Record up to	:	25 k
Channels Trace OFF	:	Channel 1, Channel 2, Channel 3 & Channel 4
Zoom+Math Trace ON	:	A, B, C & D
Select Math Setup	:	
For Math	:	Use at most 5000 points
Redefine A, B, C, D	:	Channel 1, Channel 2, Channel 3 & Channel 4
Use Math ?	:	Yes
Math Type	:	Average
Avg. Type	:	Summed
For	:	100 sweeps
Cursors/Measure	:	Parameters
Mode	:	Custom
Statistics	:	off
Change parameters	:	

- On line 1 : Measure mean of A
- On line 2 : Measure mean of B
- On line 3 : Measure mean of C
- On line 4 : Measure mean of D

- Connect the test equipment as shown in Figure 5-7.

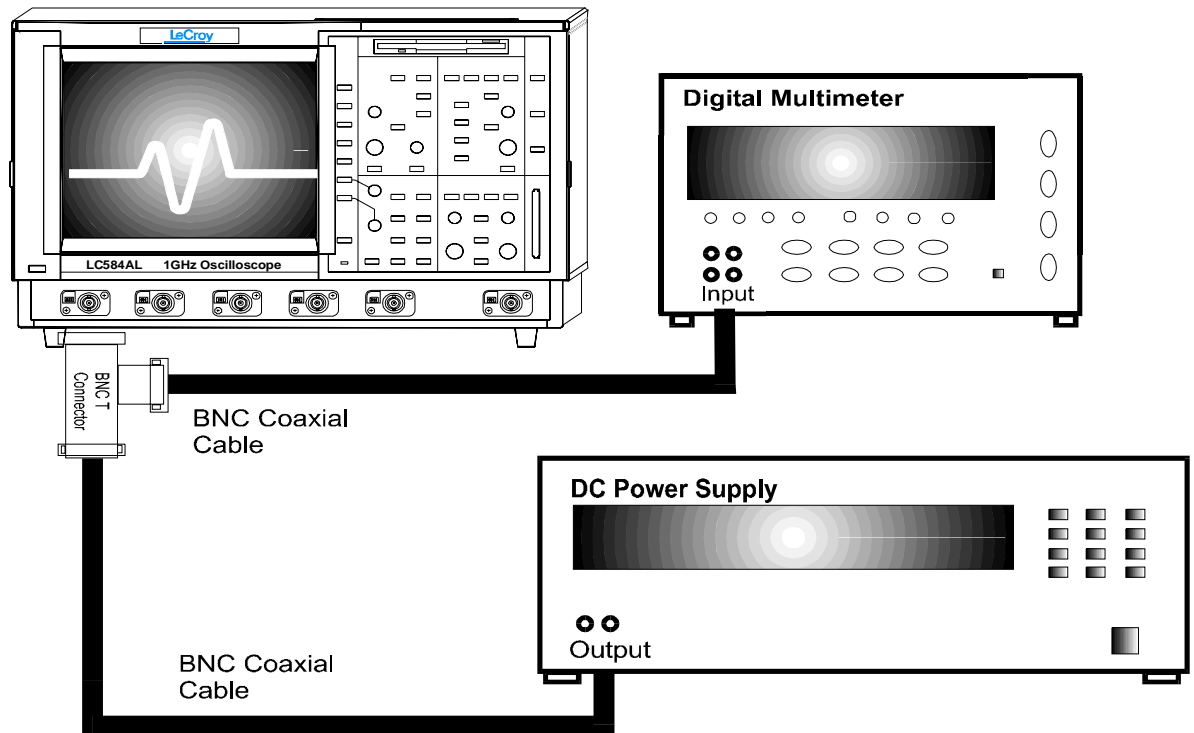
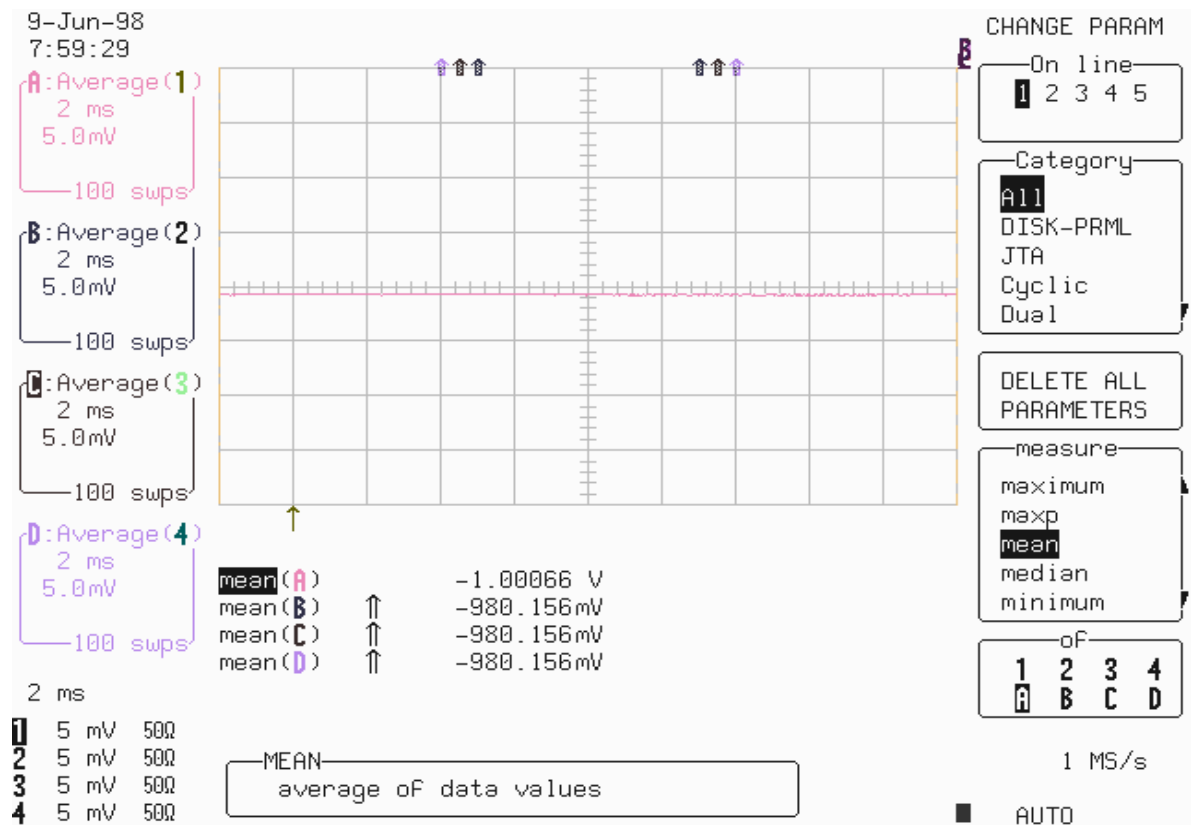


Figure 5-7 : Offset Accuracy Equipment Setup

- Set the output of the external **DC voltage reference source** to **-0.4 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 13, 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 13, column **Mean**.
- Repeat the test for the other channels, substituting channel controls and input connector. Record the measurements in Table 13.



- Set DSO input gain to **5 mv/div** and DSO Offset to **+1 Volt** on all 4 Channels.
- Set the output of the external **DC voltage reference source** to **-1 Volt**.
- Repeat steps 1), 2), 3), 4) and 5) on all 4 Channels.
- Record the measurements in Table 13.



- Calculate the **Difference (Δ)** by subtracting the **DMM voltage** reading from the **DSO mean** voltage reading.
- Record the test result in Table 13, and compare the **Difference (Δ)** to the corresponding limit in the test record.

b. DC 1M Ω

Procedure

- Recall **LC684P048.PNL** or configure the DSO as shown in 5.8.1.a. and for each Channel make the following change :
 - Input Coupling : **DC 1M Ω** on all 4 Channels
 - Input gain : **5mV/div** on all 4 Channels
 - Input offset : **+1 Volt** on all 4 Channels
- Connect the test equipment as shown in Figure 5-7.
- Set the output of the external **DC voltage reference source** to **-1 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 13, 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 13, column **Mean**.
- Repeat the test for the other channels, substituting channel controls and input connector. Record the measurements in Table 13.
- Calculate the **Difference (Δ)** by subtracting the **DMM voltage** reading from the **DSO mean** voltage reading.
- Record the test result in Table 13, and compare the **Difference (Δ)** to the corresponding limit in the test record.



5.8.2 Negative Offset Accuracy

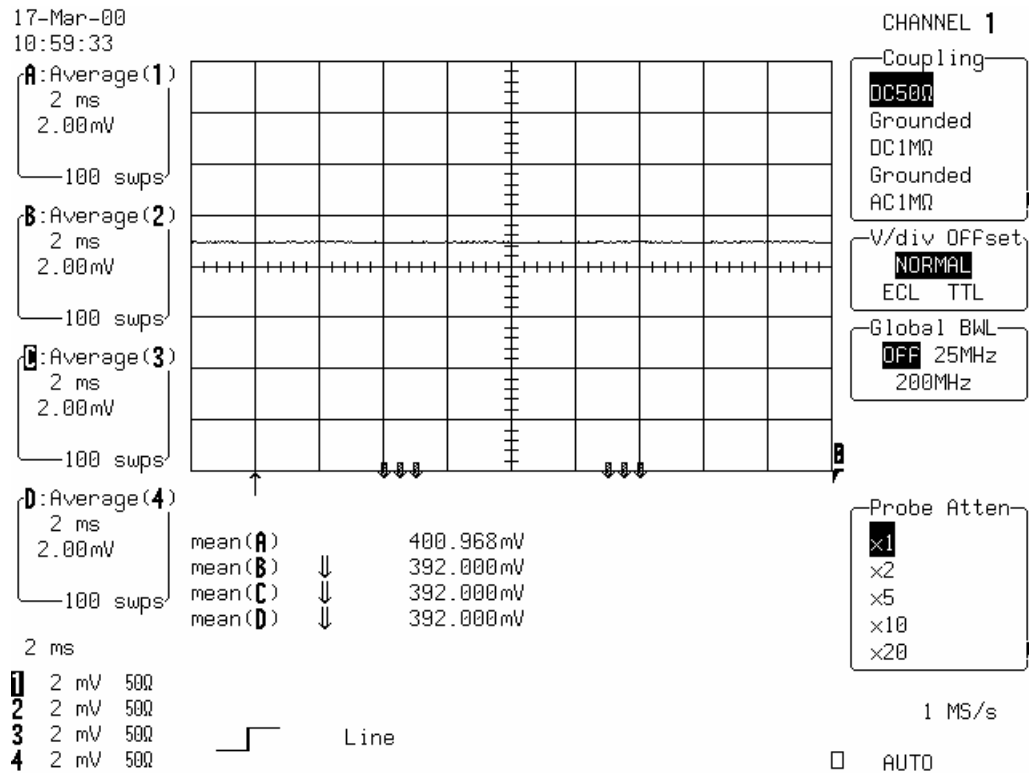
a. DC 50Ω

Procedure

- Recall **LC684P049.PNL** or configure the DSO as shown in 5.8.1.a. and for each Channel make the following change :

Input offset : **-0.4 Volt** on all 4 Channels

- Connect the test equipment as shown in Figure 5-7.
- Set the output of the external **DC voltage reference source** to **+0.4 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 14, 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 14, column **Mean**.
- Repeat the test for the other channels, substituting channel controls and input connector. Record the measurements in Table 14.
 - Set DSO input gain to **5 mV/div** and DSO Offset to **-1 Volt** on all 4 Channels.
 - Set the output of the external **DC voltage reference source** to **+1 Volt**.
 - Repeat steps 1), 2), 3), 4) and 5) on all 4 Channels.
 - Record the measurements in Table 14.
 - Calculate the **Difference (Δ)** by subtracting the **DMM voltage** reading from the **DSO mean** voltage reading. Record the test result in Table 14, and compare the **Difference (Δ)** to the corresponding limit in the test record.

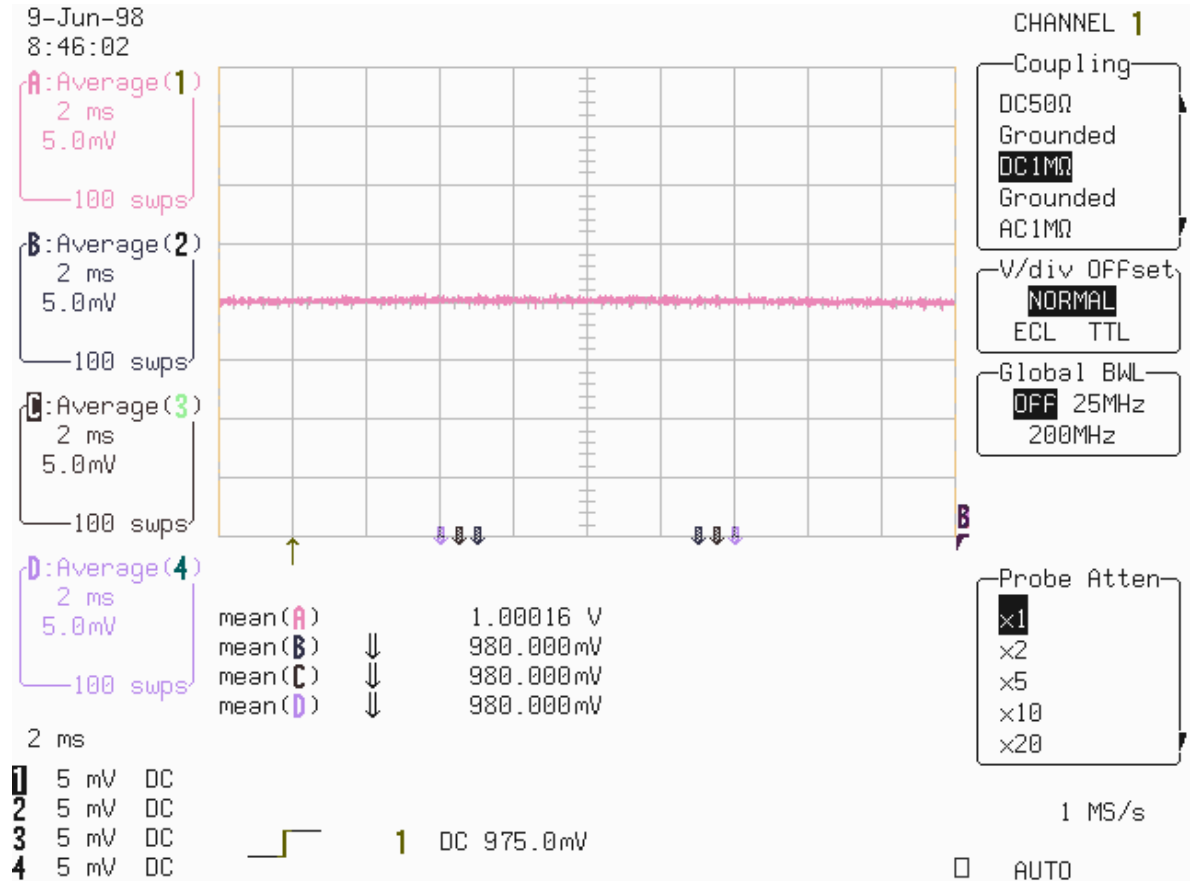
b. DC 1M Ω

- Recall **LC684P050.PNL** or configure the DSO as shown in 5.8.1.a. and for each Channel make the following changes :
 - Input Coupling : **DC 1M Ω** on all 4 Channels
 - Input Gain : **5 mV/div** on all 4 Channels
 - Input offset : **-1 Volt** on all 4 Channels
- Connect the test equipment as shown in Figure 5-7.
- Set the output of the external **DC voltage reference source** to **+1 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 14, 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 14, column **Mean**.



- Repeat the test for the other channels, substituting channel controls and input connector. Record the measurements in Table 14.
- Calculate the **Difference (Δ)** by subtracting the **DMM voltage** reading from the **DSO mean** voltage reading. Record the test result in Table 14, 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 1.5 GHz. An external source is used as the reference to provide a signal where amplitude and frequency are well controlled.

The amplitude of the generator as a function of frequency and power is calibrated using an HP8482A sensor on an HP437B power meter or equivalent.

Specifications

50Ω : DC to at least 1.5 GHz (–3 dB) at 10 mV/div. and above.

1MΩ : DC to 500 MHz typical at 100 mV/div.

a. DC 50Ω

- Recall **LC684P051.PNL** 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	:	50 mV/div on all 4 Channels
Input offset	:	0 mV on all 4 Channels
Trigger setup	:	Edge
Trigger on	:	Line
Slope line	:	Pos
Mode	:	Auto
Time base	:	1 μsec/div.
Channel use	:	4
Record up to	:	25 k
Cursors/Measure	:	Parameters
Mode	:	Custom
Statistics	:	On
Change parameters	:	
On line 1	:	Sdev of 1
On line 2	:	Sdev of 2
On line 3	:	Sdev of 3
On line 4	:	Sdev of 4

- 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 5ns 50Ω BNC cable to the **RF output** of the HP8648B generator and then through a 6dB attenuator and the necessary adapters to the power sensor.

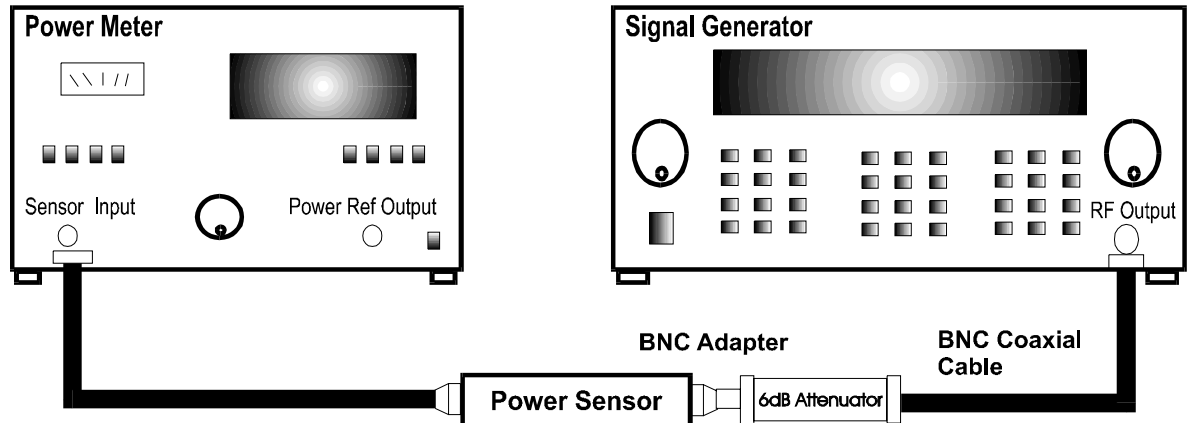


Figure 5-8 : Power Meter Equipment Setup

- Set the generator frequency to **300 kHz**
- Set the generator amplitude to measure **0.200 mW** on the power meter.
- Read the displayed **generator output amplitude**, and record it in the third column of Table 15.
- Repeat the above measurement for **1.1 MHz, 30.1 MHz, 300.1 MHz, 700.1 MHz, 1000.1 MHz, & 1500.1 MHz** Record the generator output amplitude readout in the third column of Table 15.
- Disconnect the **RF output** of the HP8648B generator from the HP8482A power sensor.
- Connect the **RF output** of the HP8648B generator through a 5ns 50 Ohm BNC cable and a 6 dB attenuator into Channel 1.
- Set the generator frequency to **300 kHz**.
- From the generator, apply the **recorded generator signal amplitude** to Channel 1.
- Press **Clear Sweeps**.

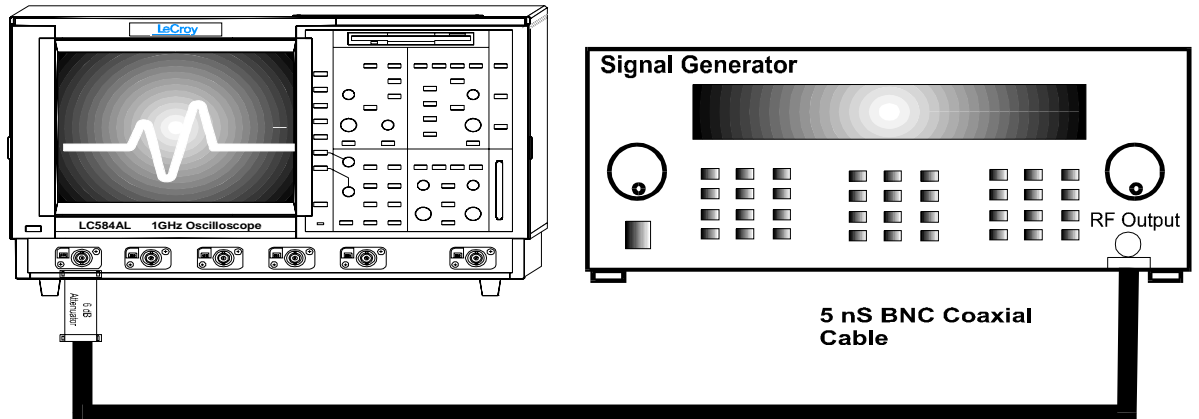
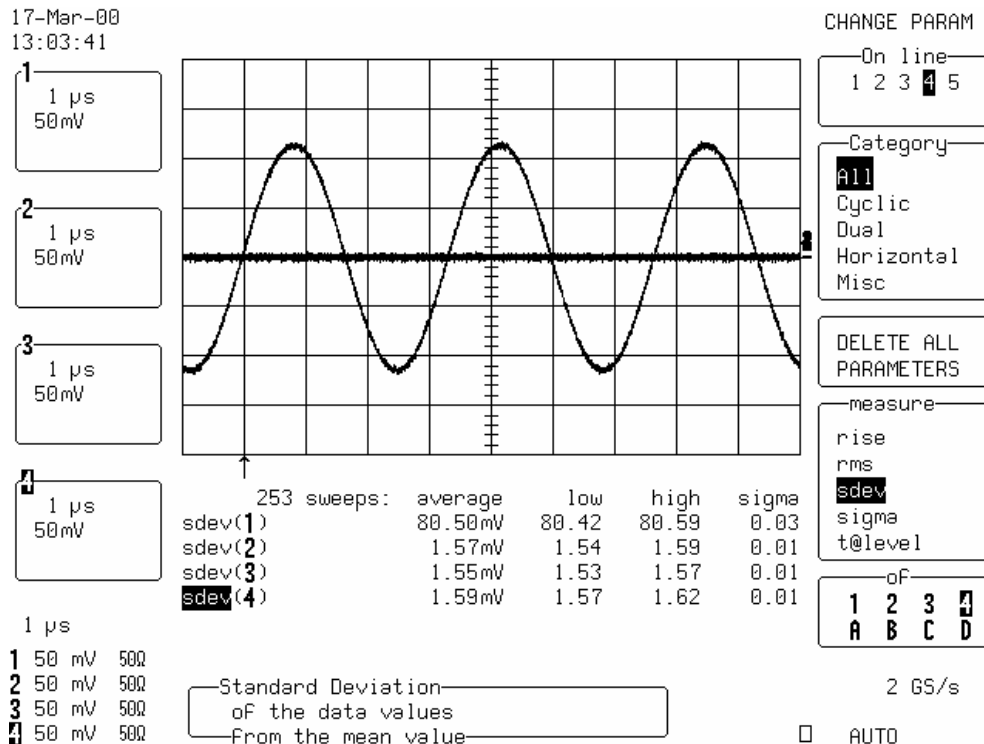


Figure 5-9 : 50Ω Bandwidth Equipment Setup

- Measure for at least 100 sweeps, record the average value of **sdev(1)** in Table 15
- Repeat the above 3 steps for Channel 2, Channel 3 & Channel 4 substituting channel controls and input connector. Record the measurements in Table 15.
- Repeat the above measurement for all channels for 1.1 MHz, 30.1 MHz, 300.1 MHz, 700.1 MHz, 1000.1 MHz and 1500.1 MHz and record the values in Table 15.
- Calculate the ratio to .3 MHz for each frequency, $sdev_{1.1}/sdev_{0.3}$, $sdev_{30.1}/sdev_{0.3}$... $sdev_{1500.1}/sdev_{0.3}$, and compare the results to the limits in the test record.





- Recall **LC684P052.PNL** or configure the DSO as shown in 5.9.1.a. and for each Channel make the following change :

 Input gain : **100mV/div**
- Connect the test equipment as shown in Figure 5-8.
- Set the generator frequency to **300 kHz**
- Set the generator amplitude to measure **0.800 mW** on the power meter.
- Read the displayed **generator output amplitude**, and record it in the third column of Table 16.
- Repeat the above measurement for **1.1 MHz, 30.1 MHz, 300.1 MHz, 700.1 MHz, 1000.1 MHz & 1500.1 MHz**. Record the generator output amplitude readout in the third column of Table 16.
- Disconnect the **RF output** of the HP8648B generator from the HP8482A power sensor.
- Connect the test equipment as shown in Figure 5-9.
- Set the generator frequency to **300 kHz**.
- From the generator, apply the **recorded generator signal amplitude** to Channel 1.
- Press **Clear Sweeps**.
- Measure for at least 100 sweeps, record the average value of **sdev(1)** in Table 16
- Repeat the above 3 steps for Channel 2, Channel 3 & Channel 4 substituting channel controls and input connector. Record the measurements in Table 16.
- Repeat the above measurement for all channels for 1.1 MHz, 30.1 MHz, 300.1 MHz, 700.1 MHz, 1000.1 MHz , 1500.1 MHz and record the values in Table 16.
- Calculate the ratio to .3 MHz for each frequency, $sdev_{1.1}/sdev_{0.3}$, $sdev_{30.1}/sdev_{0.3}$... $sdev_{1500.1}/sdev_{0.3}$, and compare the results to the limits in the test record.

b. DC 50Ω with Bandwidth Limiter On

- Recall **LC684P053.PNL** or configure the DSO

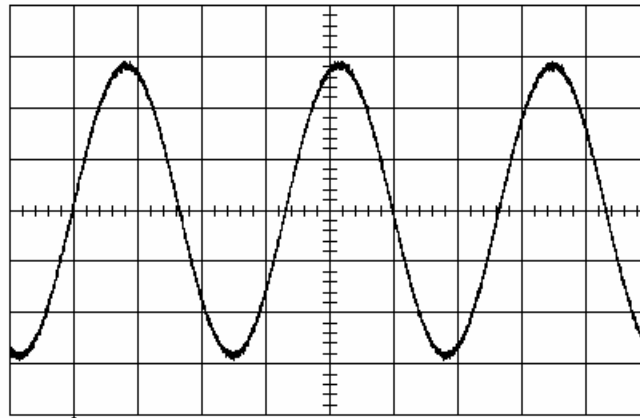
Panel Setups	:	Recall FROM DEFAULT SETUP
Channels Trace ON	:	Channel 1
Input Coupling	:	DC 50Ω
Global BWL	:	25 MHz
Input gain	:	100 mV/div.
Input offset	:	0 mV
Trigger setup	:	Edge
Trigger on	:	1
Slope line	:	Pos
Mode	:	Auto
Time base	:	1 μsec/div.
Channel use	:	4
Record up to	:	25 k
Cursors/Measure	:	Parameters
Mode	:	Custom
Statistics	:	Off
Change parameters	:	
On line 1	:	Sdev of 1
On line 2	:	Freq of 1

- Connect the test equipment as shown in Figure 5-9.
- Set the generator frequency to **300 kHz**.
- Adjust the generator signal amplitude to measure **sdev(1) = 200 mV**.
- Set Time base : **50 nsec/div.**
- Increase the generator frequency until **sdev(1) = 140 mV**. (typically 25 MHz)
- Press **Clear Sweeps**
- When **sdev(1) = 140 mV**, record Freq(1) in Table 17.
- Check that the frequency is within the limits specified in Table 17.



17-Mar-00
13:10:17

1 1 μ s
100mV



67 sweeps: average low high sigma
sdev(1) 199.9mV 199.5 200.1 0.1
Freq(1) μ 299.932 kHz 298.641 301.565 0.501

CHANNEL 1

Coupling
DC50 Ω
Grounded
DC1M Ω
Grounded
AC1M Ω

V/div OFFSET
NORMAL
ECL TTL

Global BWL
OFF 25MHz
200MHz

Probe Atten-
x1
x2
x5
x10
x20

- 1 μ s
- 1 .1 V 50 Ω
 - 2 .1 V 50 Ω
 - 3 .1 V 50 Ω
 - 4 .1 V 50 Ω

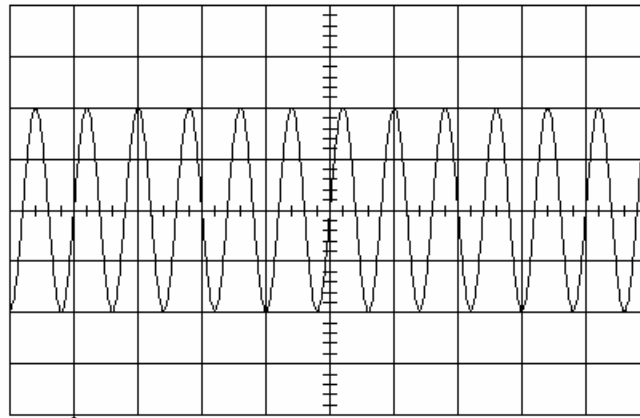
1 AC 0mV

2 GS/s

AUTO

17-Mar-00
13:11:17

1 50 ns
100mV



168 sweeps: average low high sigma
sdev(1) 139.9mV 139.4 140.3 0.1
Freq(1) μ 25.0008 MHz 24.8230 25.1572 0.0456

CHANNEL 1

Coupling
DC50 Ω
Grounded
DC1M Ω
Grounded
AC1M Ω

V/div OFFSET
NORMAL
ECL TTL

Global BWL
OFF 25MHz
200MHz

Probe Atten-
x1
x2
x5
x10
x20

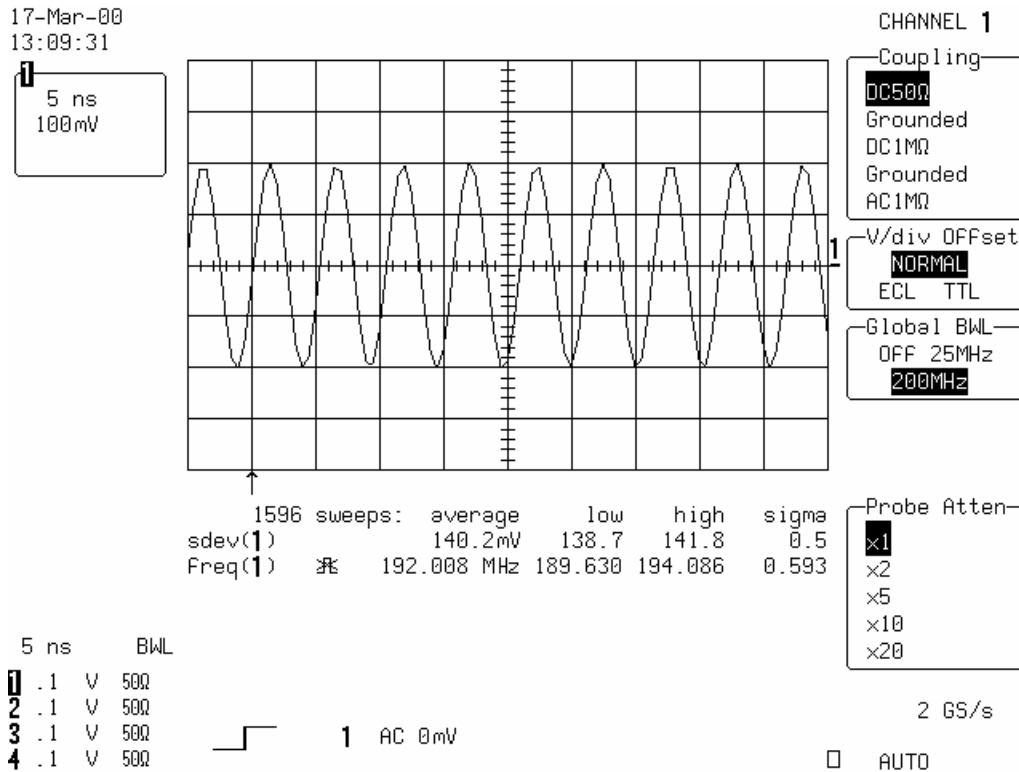
- 50 ns BWL
- 1 .1 V 50 Ω
 - 2 .1 V 50 Ω
 - 3 .1 V 50 Ω
 - 4 .1 V 50 Ω

1 AC 0mV

2 GS/s

AUTO

- Set Global BWL : **200 MHz**
- Set Timebase : **5 nsec/div.**
- Increase the generator frequency until **sdev(1) = 140 mV.** (typically 200 MHz)



- Press **Clear Sweeps**
- When **sdev(1) = 140 mV**, record **Freq(1)** in Table 17.
- Repeat the 25 MHz and 200 MHz Bandwidth limiter tests for the other channels, substituting channel controls and input connector.
- Recall **LC684P054.PNL** for Channel 2, **LC684P055.PNL** for Channel3 **LC684P056.PNL** for Channel 4, or configure the DSO as shown in 5.9.1.b. and make the necessary changes.
- Record the test results in Table 17, and compare the results to the limits.



5.9.2 DC 1MΩ

- Recall **LC684P057.PNL** 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	:	100 mV/div. on all 4 Channels
Input offset	:	0 mV on all 4 Channels
Trigger setup	:	Edge
Trigger on	:	Line
Slope line	:	Pos
Mode	:	Auto
Time base	:	1 μsec/div.
Channel use	:	4
Record up to	:	25 k
Cursors/Measure	:	Parameters
Mode	:	Custom
Statistics	:	On
Change parameters	:	
On line 1	:	Sdev of 1
On line 2	:	Sdev of 2
On line 3	:	Sdev of 3
On line 4	:	Sdev of 4

- Connect the test equipment as shown in Figure 5-10.

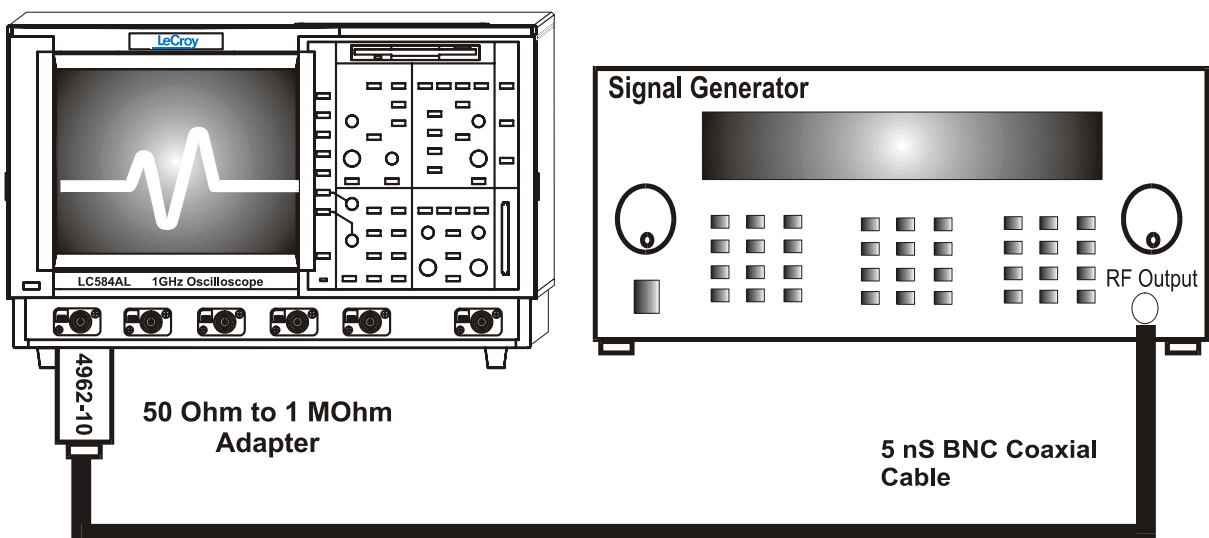
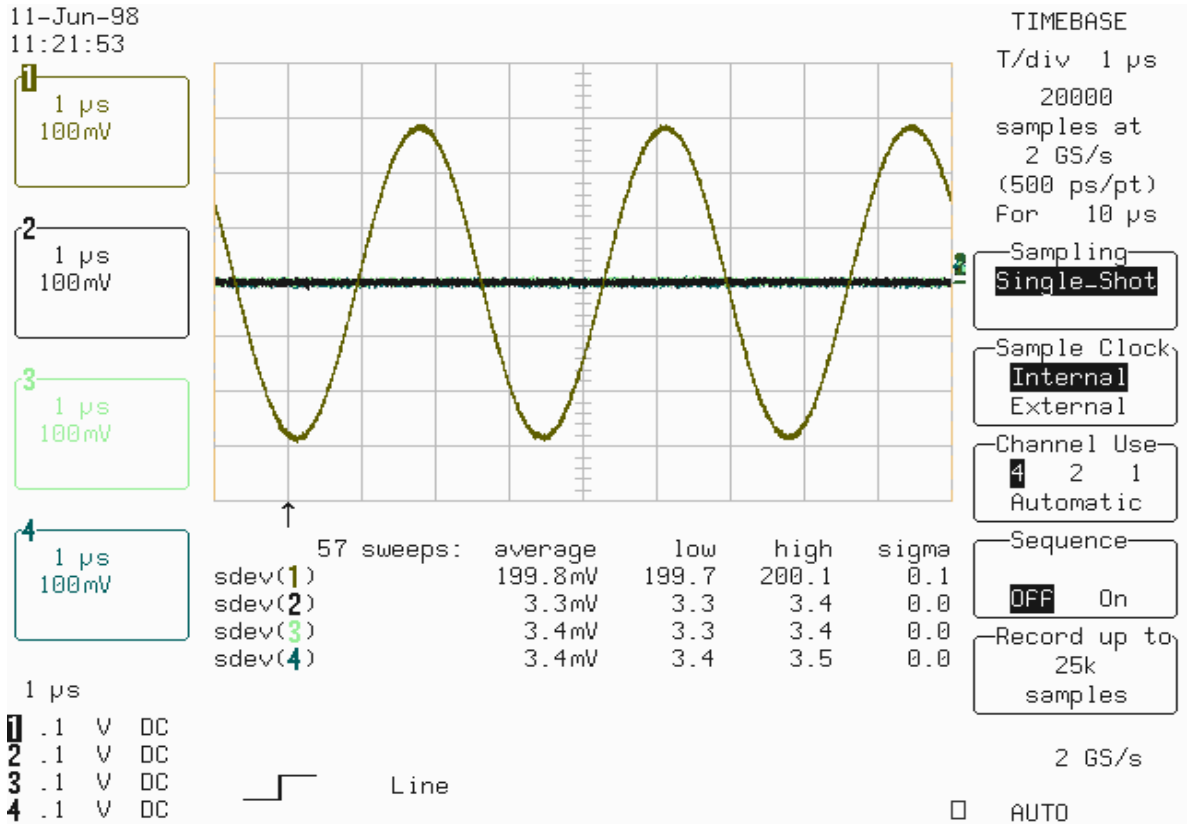


Figure 5-10 : 1MΩ Bandwidth Equipment Setup

- Set the generator frequency to **300 kHz**.

- Adjust the generator signal amplitude to measure **sdev(1) = 200 mV**.



- Disconnect the coaxial cable from the 4962-10 adapter. Connect the test equipment as shown in Figure 5-11.

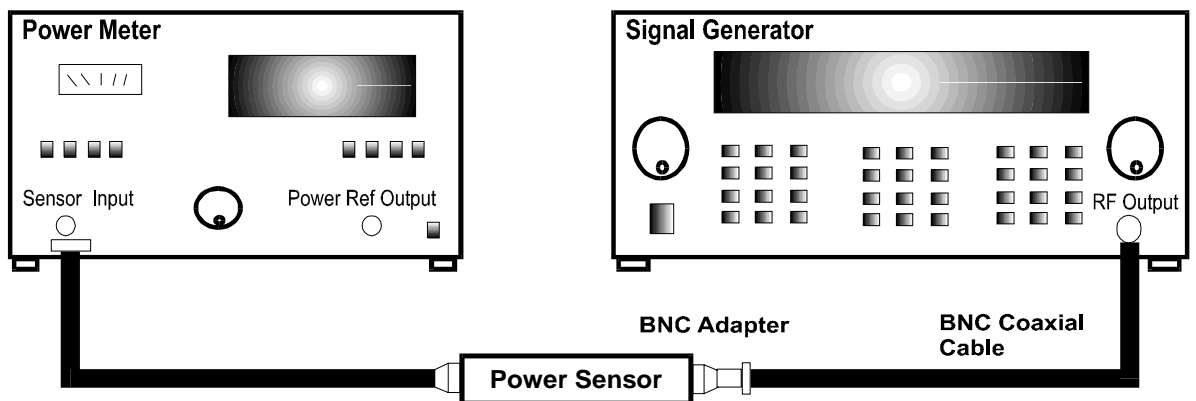
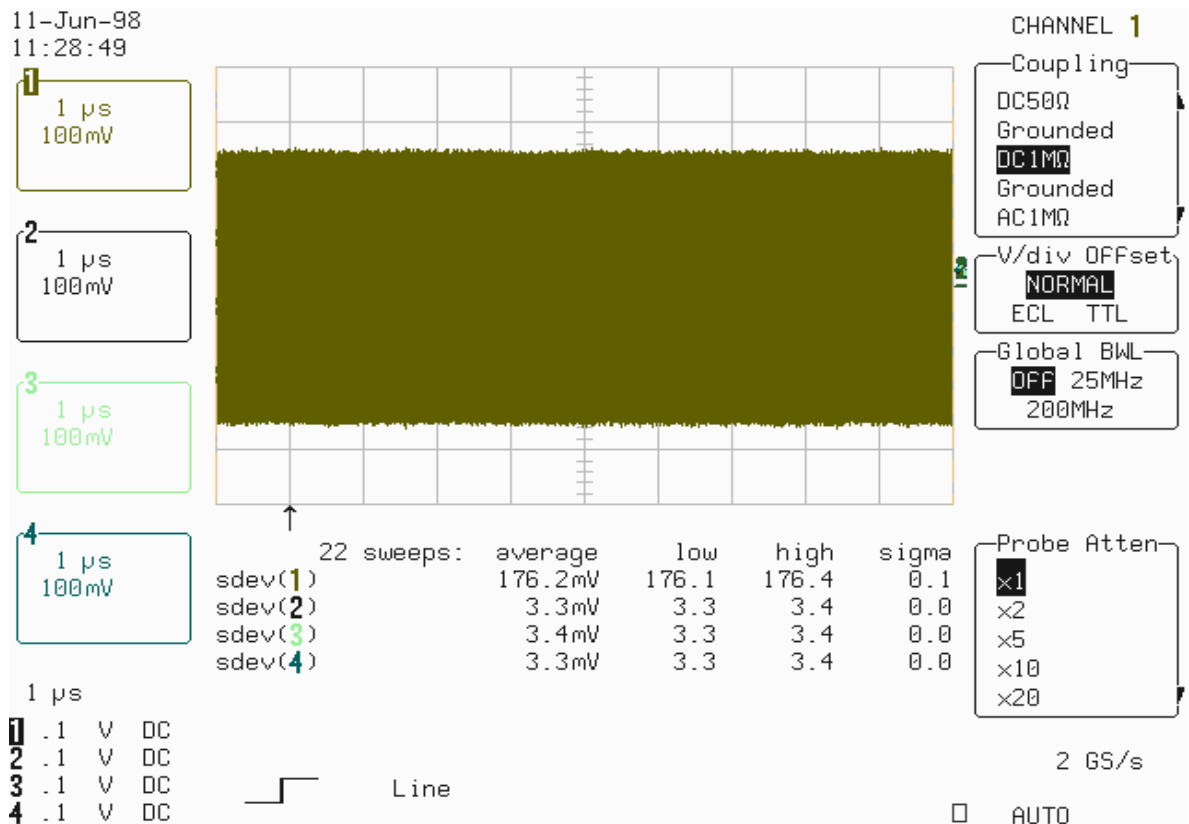


Figure 5-11 : Power Meter Equipment Setup



- Record the displayed power meter value in mW.
- Set the generator frequency to **500.1 MHz**.
- Now fine adjust the generator amplitude output until the power meter readout indicates the value measured just above at 300 kHz.
- Reconnect the signal generator to DSO Channel 1, as shown in Figure 5-10.
- Press **Clear Sweeps**.
- Measure for at least **100 sweeps**, record the average value of **sdev(1)** in Table 18.
- Repeat the above steps for Channel 2, Channel 3 & Channel 4, substituting channel controls and input connector.
- Record the sdev measurements in Table 18.
- Calculate the ratio **sdev_{500.1}/sdev_{0.3}** for each Channel, and test each value against the limits shown in the test record.



5.10 Trigger Level

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: -3, 0, +3 major screen divisions
- DC, HFREJ coupling
- Positive and negative slopes

5.10.2 Channel Trigger at 0 Division Threshold

a. DC Coupling

Recall **LC684P058.PNL** 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 : **1**
Slope 1 : **Pos**
Coupling : **DC**
Mode : **Auto**
Set Trigger level : **DC 0.0 mV**
Pre-Trigger Delay : **50 %**

Time base : **0.1 msec/div.**
Record up to : **50 k samples**

Channels Trace OFF **Channel 1, Channel 2, Channel 3 & Channel 4**

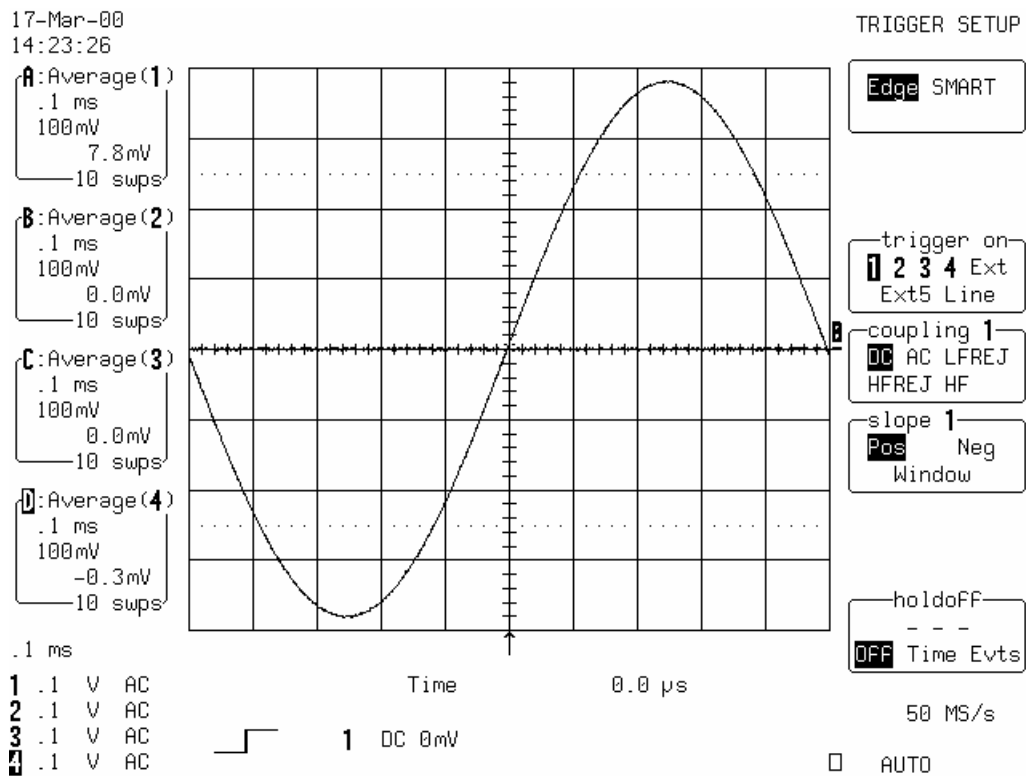
Zoom+Math Trace ON **A, B, C & D**

Select Math Setup
For Math : **Use at most 5000 points**
Redefine A, B, C, D **Channel 1, Channel 2, Channel 3 & Channel 4**
Use Math ? : **Yes**
Math Type : **Average**
Avg. Type : **Summed**
For : **10 sweeps**

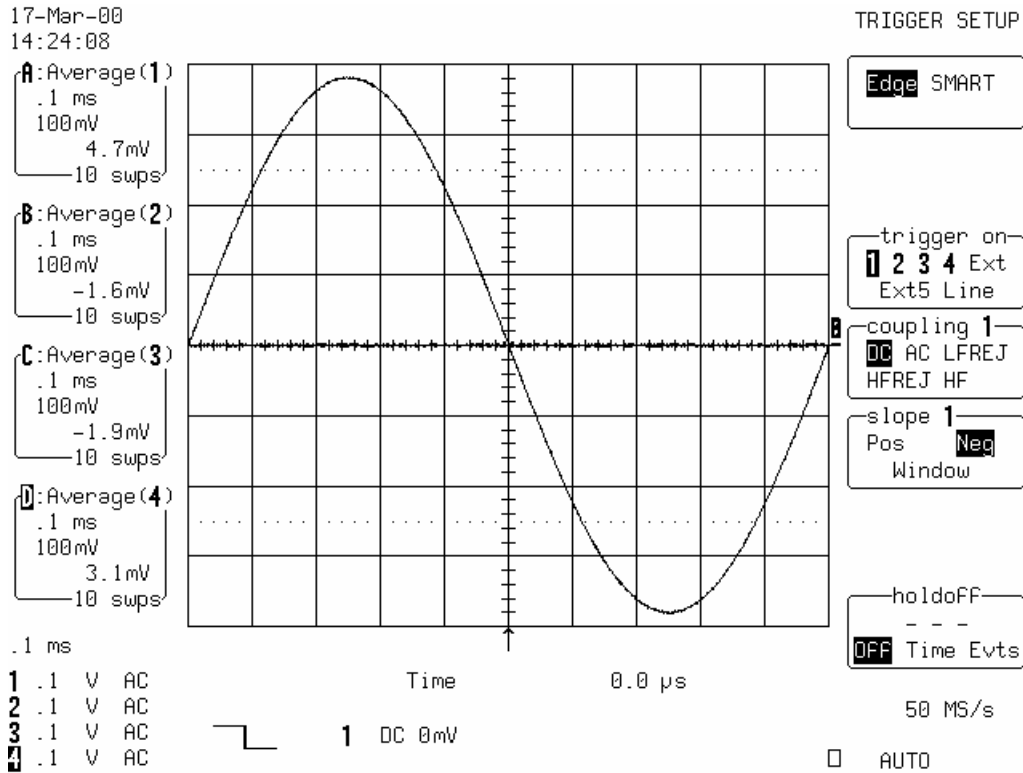
- Set the output of the LeCroy LW420 or equivalent audio frequency signal generator to **1 kHz**.



- Connect the output of the generator to Channel 1 through a 50 Ohm coaxial cable and adjust the sine wave output amplitude to get **8 divisions peak to peak** .
- Select Cursors/Measure : **Cursors, Time, Absolute**
- Use the "cursor position" knob, to move the **Time marker** at 0.0 μ s



- Press **Clear Sweeps**,
- Acquire 10 sweeps and record in Table 19 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 19 the **level** readout displayed below 100 mV in the icon **1**, at top left.



b. HFREJ Coupling

- Set Coupling : **HFREJ**
- Acquire 10 sweeps and record in Table 20 the **level** readout displayed below 100 mV in the icon **1**, at top left.
- Set Trigger Slope 1 : **Pos**
- Acquire 10 sweeps and record in Table 20 the **level** readout displayed below 100 mV in the icon **1**, at top left.
- Repeat steps 5.10.2.a. and 5.10.2.b. for all input channels, substituting channel controls (DC, HFREJ, Pos, Neg) and input connector.
Recall **LC684P059.PNL** for Channel 2, **LC684P060.PNL** for Channel 3, **LC684P061.PNL** for Channel 4, or select **Trigger on** the Channel under test.
The **Trigger level** is displayed in either the icon **2, 3 or 4**
- Record the measurements in Table 19 & 20 and compare the test results to the corresponding limits in the test record.



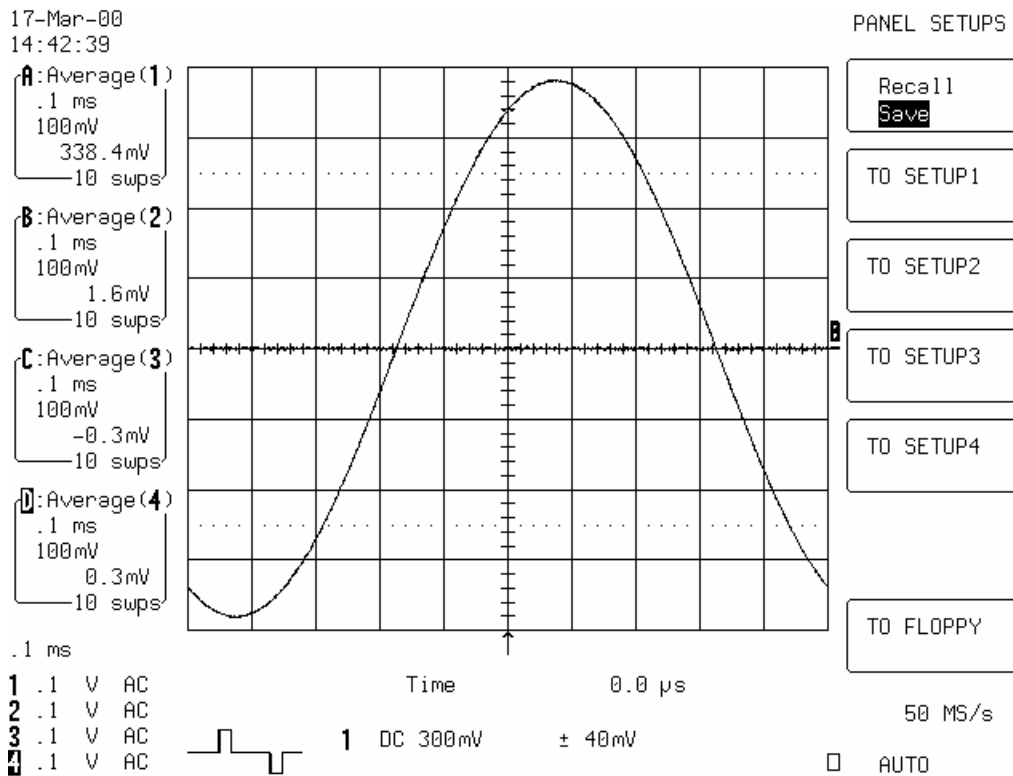
5.10.3 Channel Trigger at +3 Divisions Threshold

a. DC Coupling

- Recall **LC684P062.PNL** or configure the DSO as shown in 5.10.2.a and for each Channel make the following change :

Set Trigger level : **DC +300 mV**

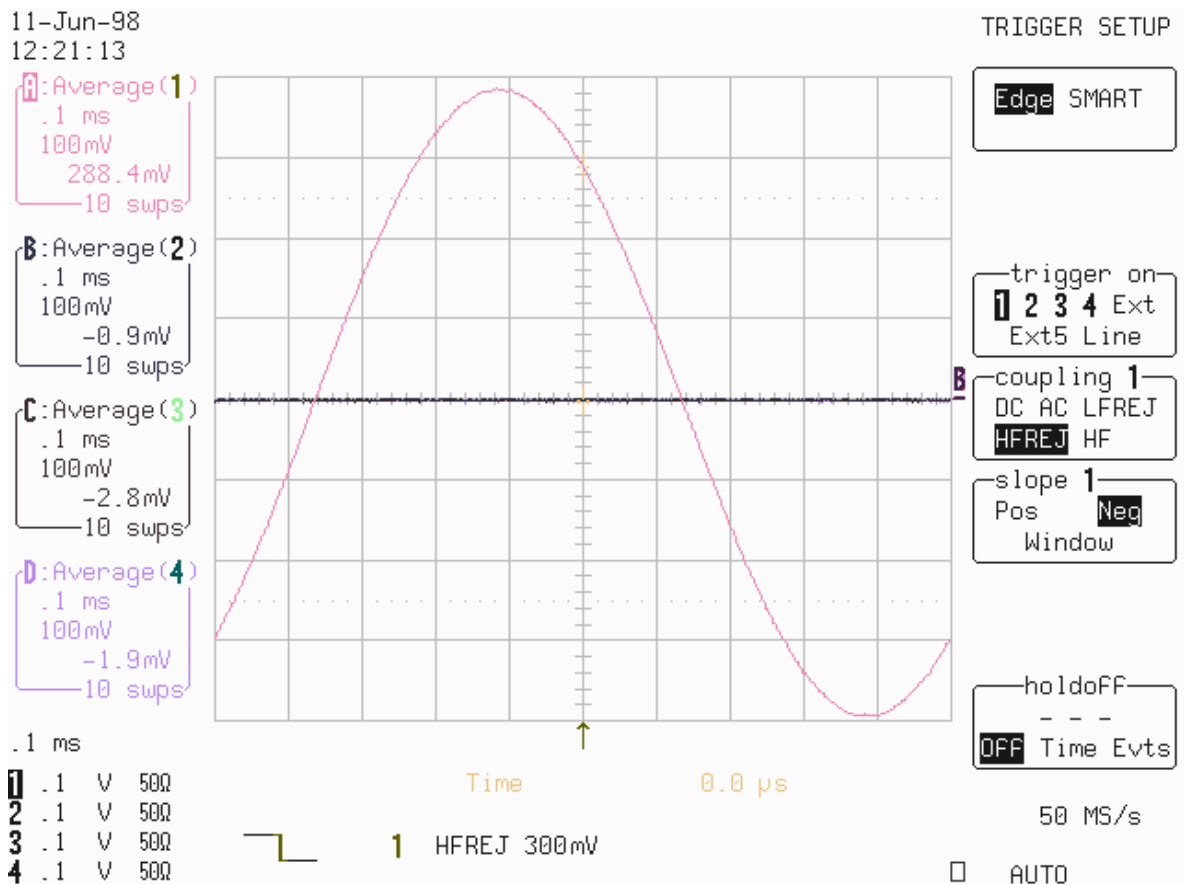
- Connect the output of the generator to Channel 1 through a 50 Ohm coaxial cable.
- Press **Clear Sweeps**,
- Acquire 10 sweeps and record in Table 19 the **level** readout displayed below 100 mV in the icon **1**, at top left.
- Compare the test results to the corresponding limit in the test record.



- Set Trigger Slope 1 : **Neg**
- Acquire 10 sweeps and record in Table 19 the **level** readout displayed below 100 mV in the icon **1**, at top left.

b. HFREJ Coupling

- Set Coupling : **HFREJ**
- Acquire 10 sweeps and record in Table 20 the **level** readout displayed below 100 mV in the icon **1**, at top left.



- Set Trigger Slope 1 : **Pos**
- Acquire 10 sweeps and record in Table 20 the **level** readout displayed below 100 mV in the icon **1**, at top left.
- Repeat steps 5.10.3.a. and 5.10.3.b. for all input channels, substituting channel controls (DC, HFREJ, Pos, Neg) and input connector. Recall **LC684P063.PNL** for Channel 2, **LC684P064.PNL** for Channel 3, **LC684P065.PNL** for Channel 4, or select **Trigger on** the Channel under test. The **Trigger level** is displayed in either the icon **2, 3 or 4**
- Record the measurements in Table 19 & 20 and compare the test results to the corresponding limits in the test record.



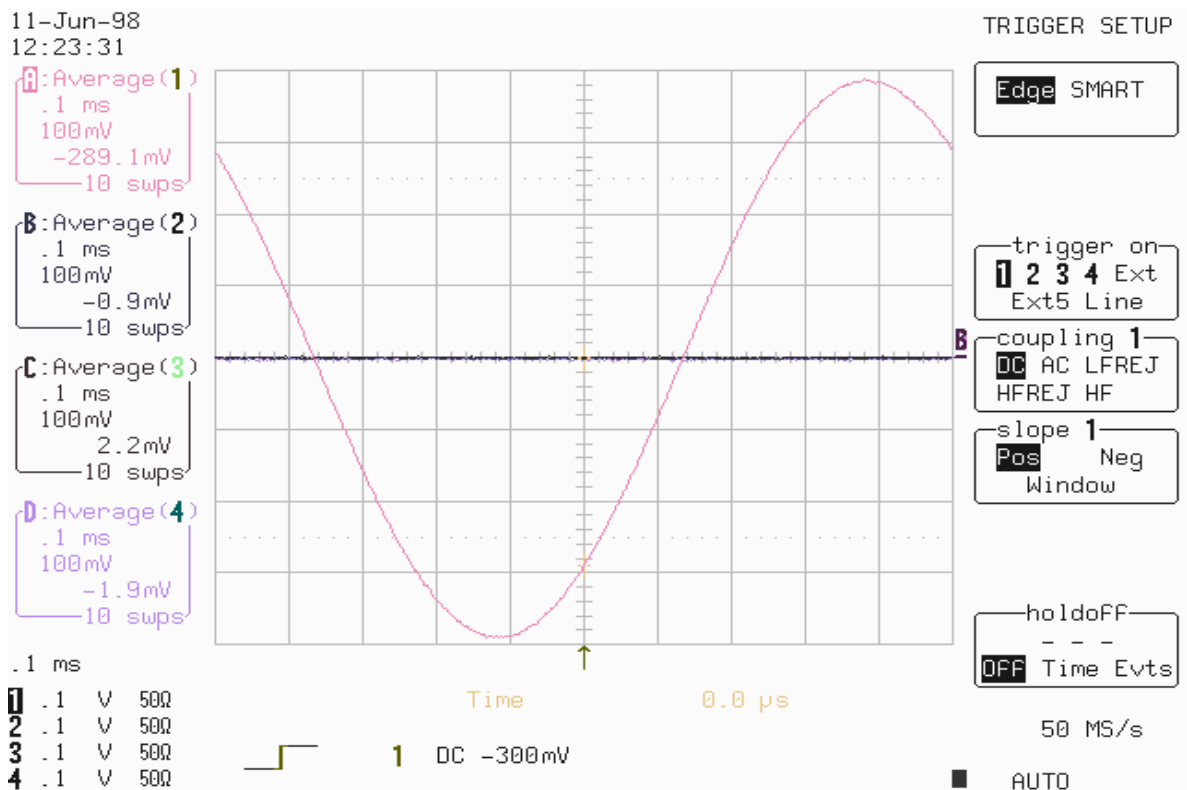
5.10.4 Channel Trigger at -3 Divisions Threshold

a. DC Coupling

- Recall **LC684P066.PNL** or configure the DSO as shown in 5.10.2.a and for each channel make the following change :

Set Trigger level : **DC -300 mV**

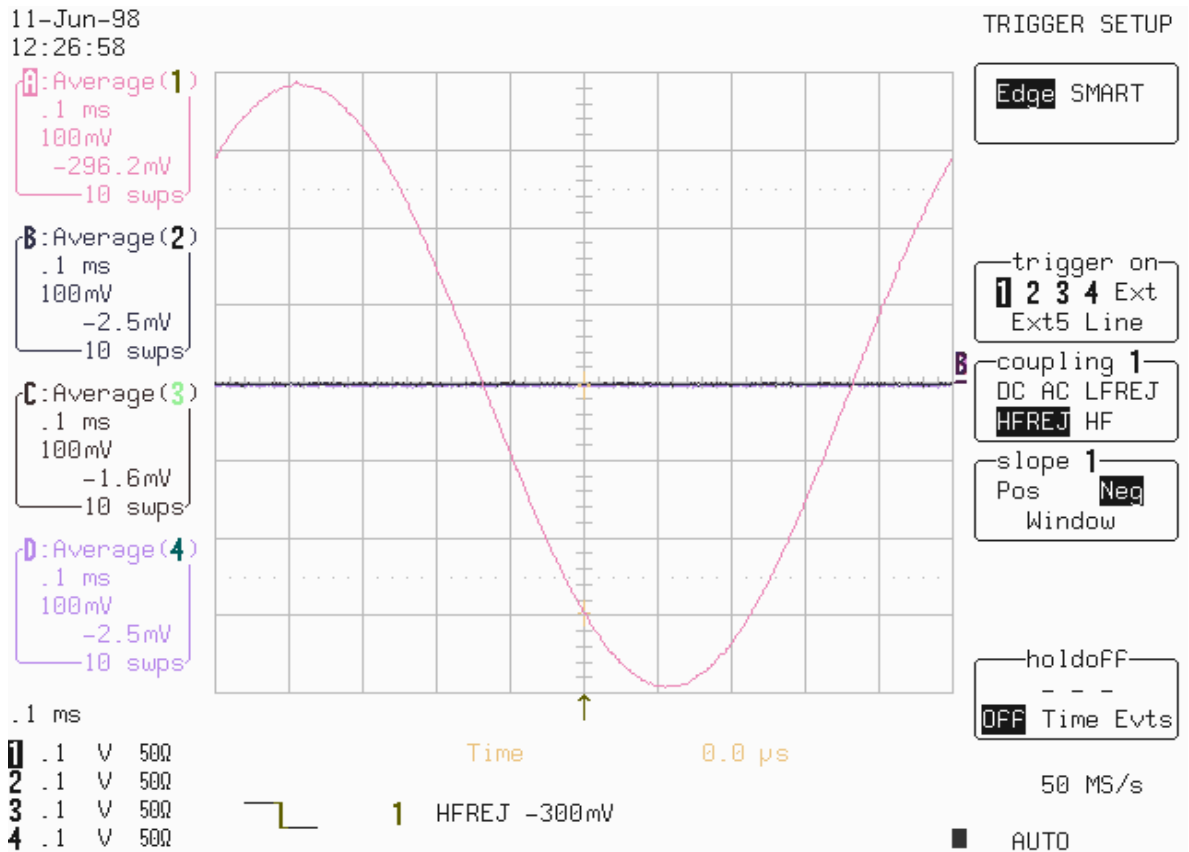
- Connect the output of the generator to Channel 1 through a 50 Ohm coaxial cable.
- Press **Clear Sweeps**,
- Acquire 10 sweeps and record in Table 19 the **level** readout displayed below 100 mV in the icon 1, at top left.
- Compare the test results to the corresponding limit in the test record.



- Set Trigger Slope 1 : **Neg**
- Acquire 10 sweeps and record in Table 19 the **level** readout displayed below 100 mV in the icon 1, at top left.

b. HFREJ Coupling

- Set Coupling : **HFREJ**
- Acquire 10 sweeps and record in Table 20 the **level** readout displayed below 100 mV in the icon 1, at top left.



- Set Trigger Slope 1 : **Pos**
- Acquire 10 sweeps and record in Table 20 the **level** readout displayed below 100 mV in the icon 1, at top left.
- Repeat steps 5.10.4.a. and 5.10.4.b. for all input channels, substituting channel controls (DC, HFREJ, Pos, Neg) and input connector. Recall **LC684P067.PNL** for Channel 2, **LC684P068.PNL** for Channel 3, **LC684P069.PNL** for Channel 4, or select **Trigger on** the Channel under test. The **Trigger level** is displayed in either the icon 2, 3 or 4
- Record the measurements in Table 19 & 20 and compare the test results to the corresponding limits in the test record.



5.10.5 External Trigger at 0 Division Threshold

a. DC Coupling

- Recall **LC684P070.PNL** or configure the DSO :

Panel Setups : **Recall FROM DEFAULT SETUP**
Channel Trace ON **Channel 2**
Input Coupling : **DC 50 Ω**
Input gain : **100 mV/div.**
Input offset : **0 mV**

Trigger setup : **Edge**
Trigger on : **Ext**
Slope Ext : **Pos**
Coupling Ext : **DC**
Set Trigger level : **0.0 mV**
External : **DC 1M Ω**
Mode : **Auto**
Pre-Trigger Delay : **50 %**
Time base : **0.1 msec/div.**
Record up to : **50 k samples**

Channel Trace OFF **Channel 2**
Zoom+Math Trace ON **B**
Select Math Setup
For Math : **Use at most 5000 points**
Redefine B : **Channel 2**
Use Math ? : **Yes**
Math Type : **Average**
Avg. Type : **Summed**
For : **10 sweeps**

- Connect the test equipment as shown in Figure 5-12.
- Set the output of the LeCroy LW420 or equivalent audio frequency signal generator to **1 kHz**.
- Adjust the sine wave output amplitude to get **8 divisions peak to peak** .
- Select Cursors/Measure : **Cursors, Time, Absolute**
- Use the "cursor position" knob, to move the **Time marker** at 0.0 μ s

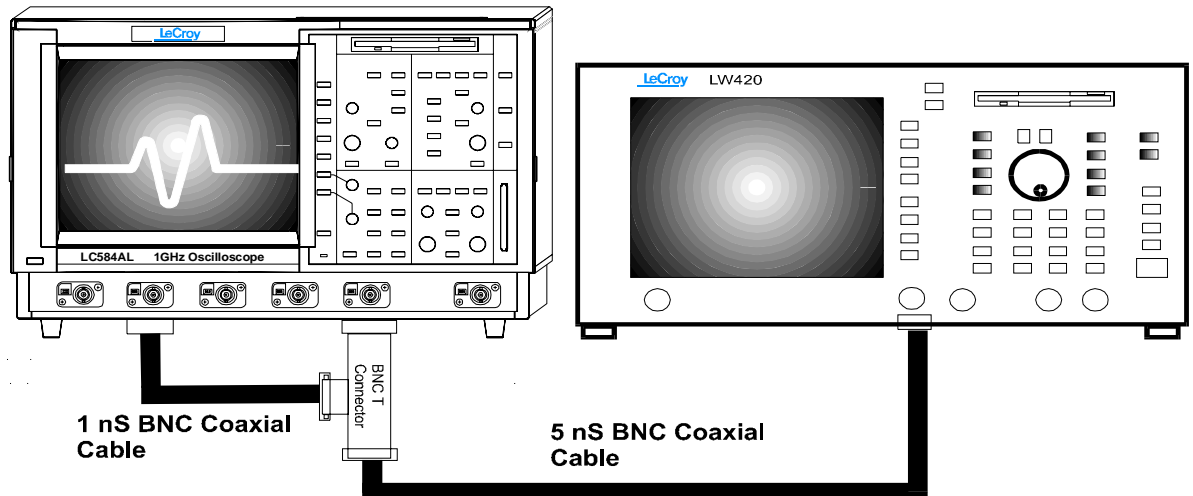
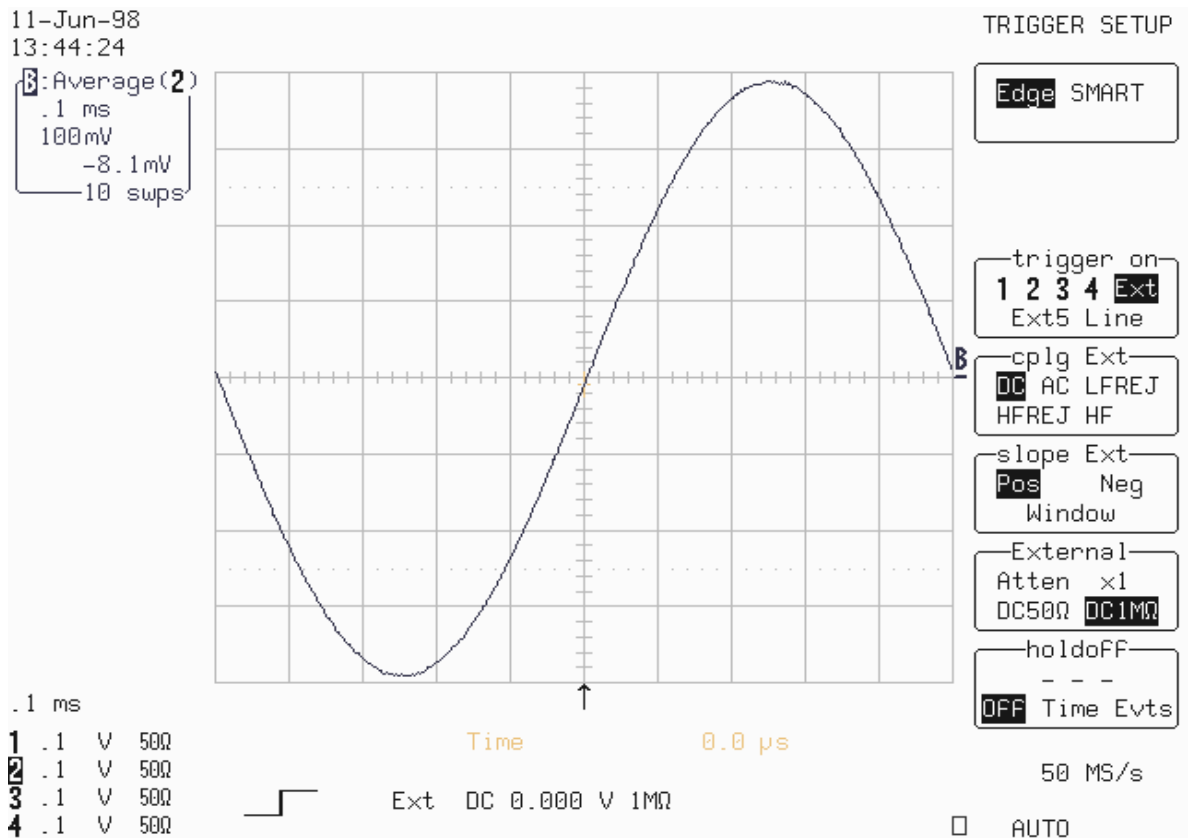


Figure 5-12 : External Trigger Equipment Setup

- Press **Clear Sweeps**
- Acquire 10 sweeps and record in Table 21 the **level** readout displayed below 100 mV in the icon **2**, at top left.

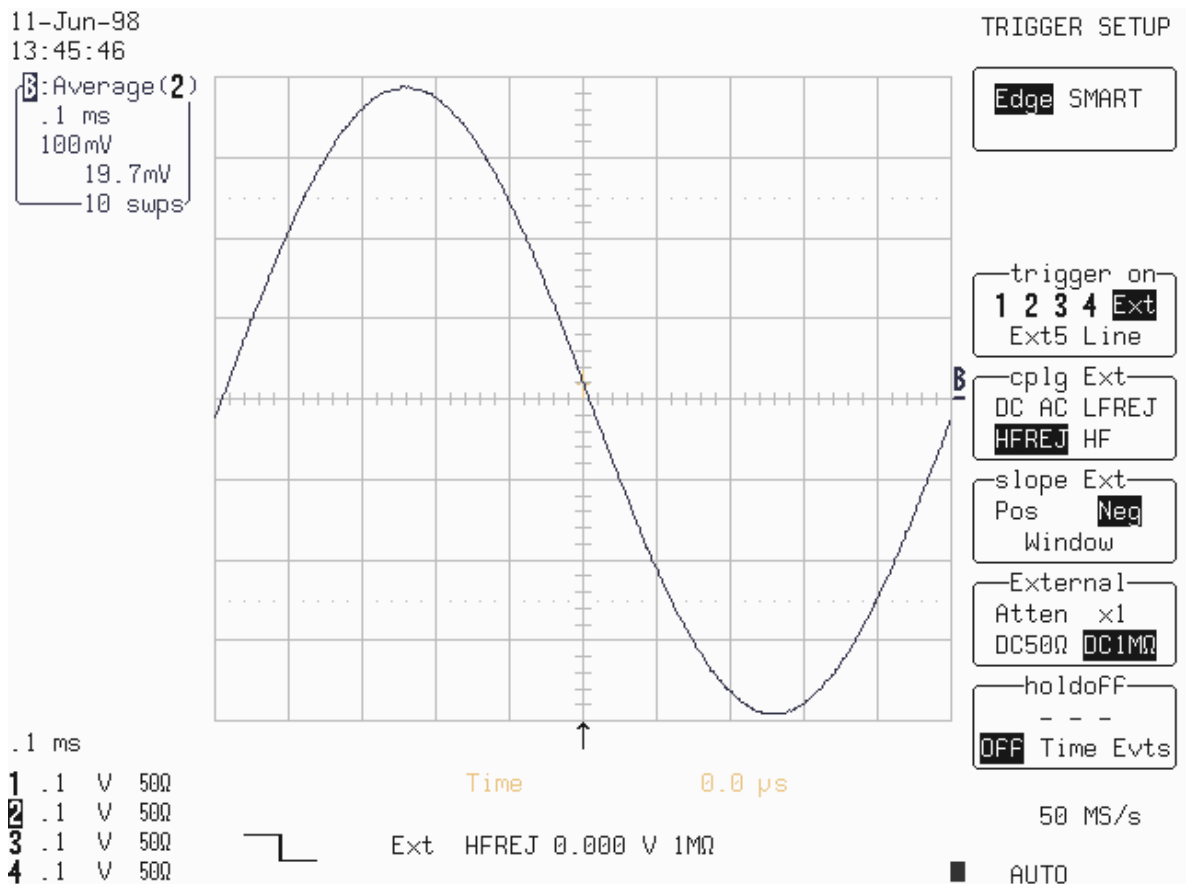




- Set Trigger Slope Ext : **Neg**
- Acquire 10 sweeps and record in Table 21 the **level** readout displayed below 100 mV in the icon **2**, at top left.
- Compare the test results to the corresponding limit in the test record.

b. HFREJ Coupling

- Set Coupling Ext : **HFREJ**
- Acquire 10 sweeps and record in Table 21 the **level** readout displayed below 100 mV in the icon **2**, at top left.



- Set Trigger Slope Ext : **Pos**
- Acquire 10 sweeps and record in Table 21 the **level** readout displayed below 100 mV in the icon **2**, at top left.
- Compare the test results to the corresponding limit in the test record.

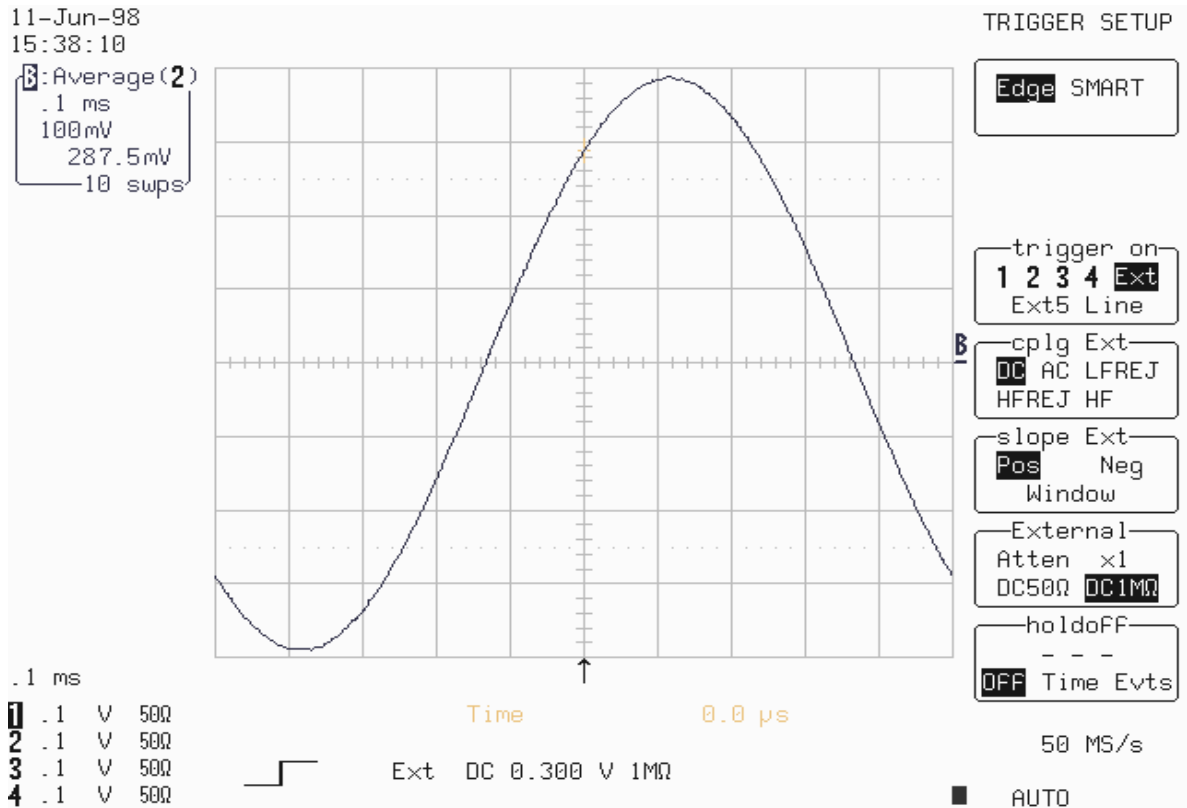
5.10.6 External Trigger at +3 Divisions Threshold

a. DC Coupling

- Recall **LC684P071.PNL** or configure the DSO as shown in 5.10.5.a and make the following change :

Set Ext Trigger level : **DC +300 mV**

- Connect the test equipment as shown in Figure 5-12.
- Press **Clear Sweeps**,
- Acquire 10 sweeps and record in Table 21 the **level** readout displayed below 100 mV in the icon **2**, at top left.
- Compare the test results to the corresponding limit in the test record.

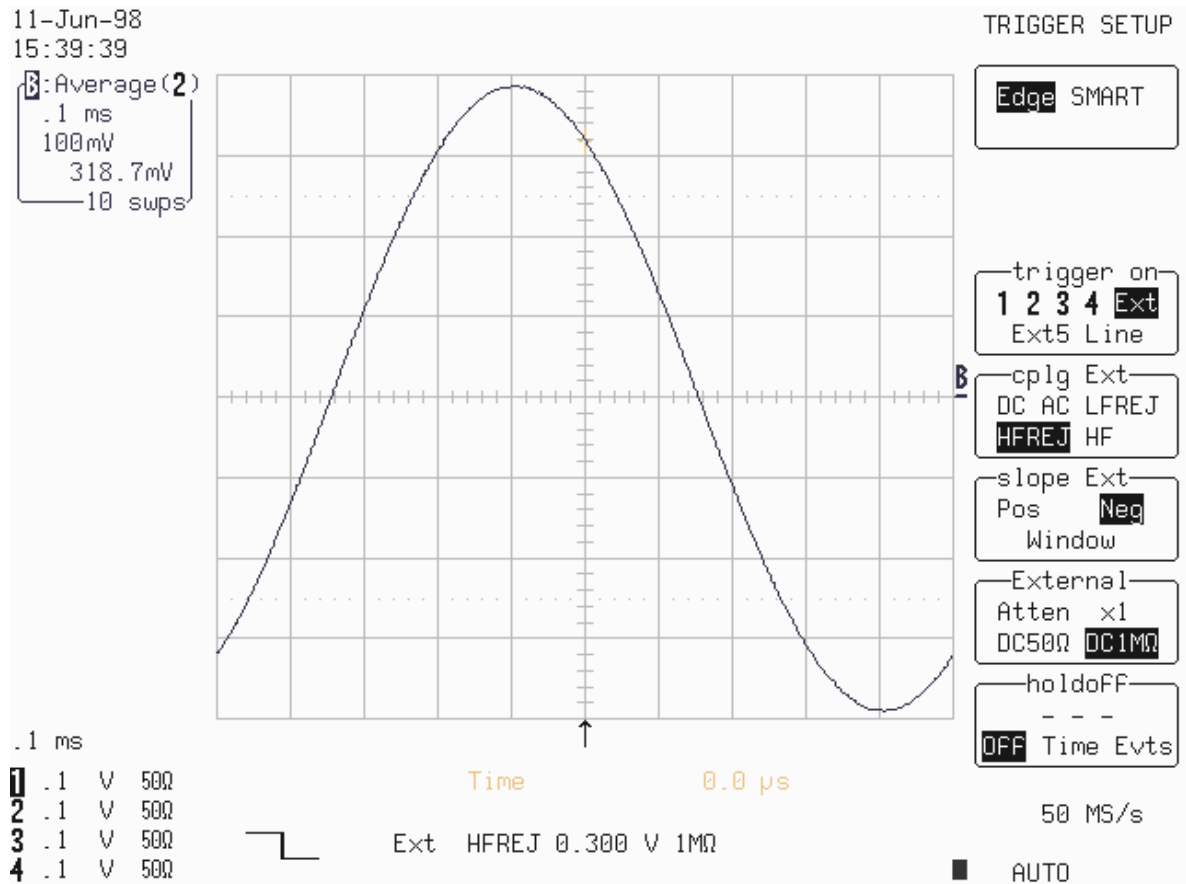


- Set Trigger Slope Ext : **Neg**
- Acquire 10 sweeps and record in Table 21 the **level** readout displayed below 100 mV in the icon **2**, at top left.



b. HFREJ Coupling

- Set Ext Coupling : **HFREJ**
- Acquire 10 sweeps and record in Table 21 the **level** readout displayed below 100 mV in the icon **2**, at top left.



- Set Trigger Slope Ext : **Pos**
- Acquire 10 sweeps and record in Table 21 the **level** readout displayed below 100 mV in the icon **2**, at top left.

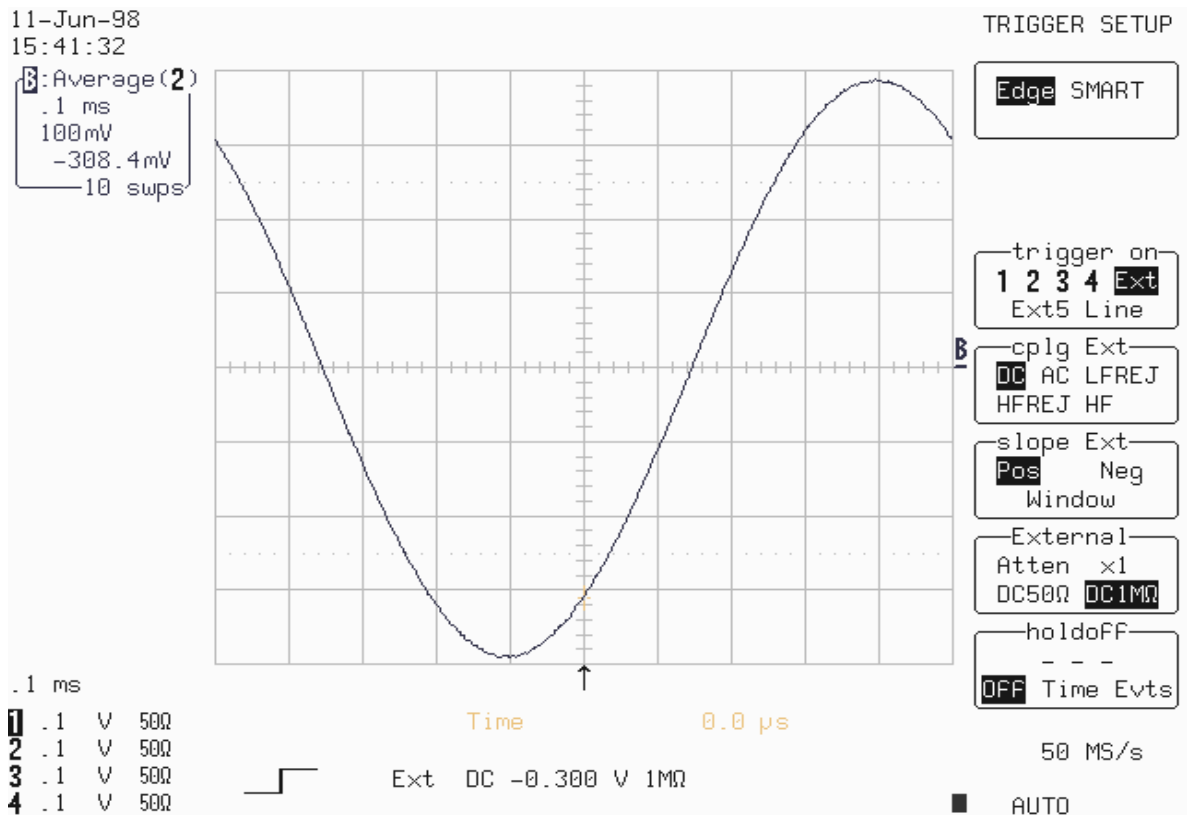
5.10.7 External Trigger at -3 Divisions Threshold

a. DC Coupling

- Recall **LC684P072.PNL** or configure the DSO as shown in 5.10.5.a and make the following change :

Set Ext Trigger level : **DC -300 mV**

- Connect the test equipment as shown in Figure 5-12.
- Press **Clear Sweeps**.
- Acquire 10 sweeps and record in Table 21 the **level** readout displayed below 100 mV in the icon **2**, at top left.
- Compare the test results to the corresponding limit in the test record.

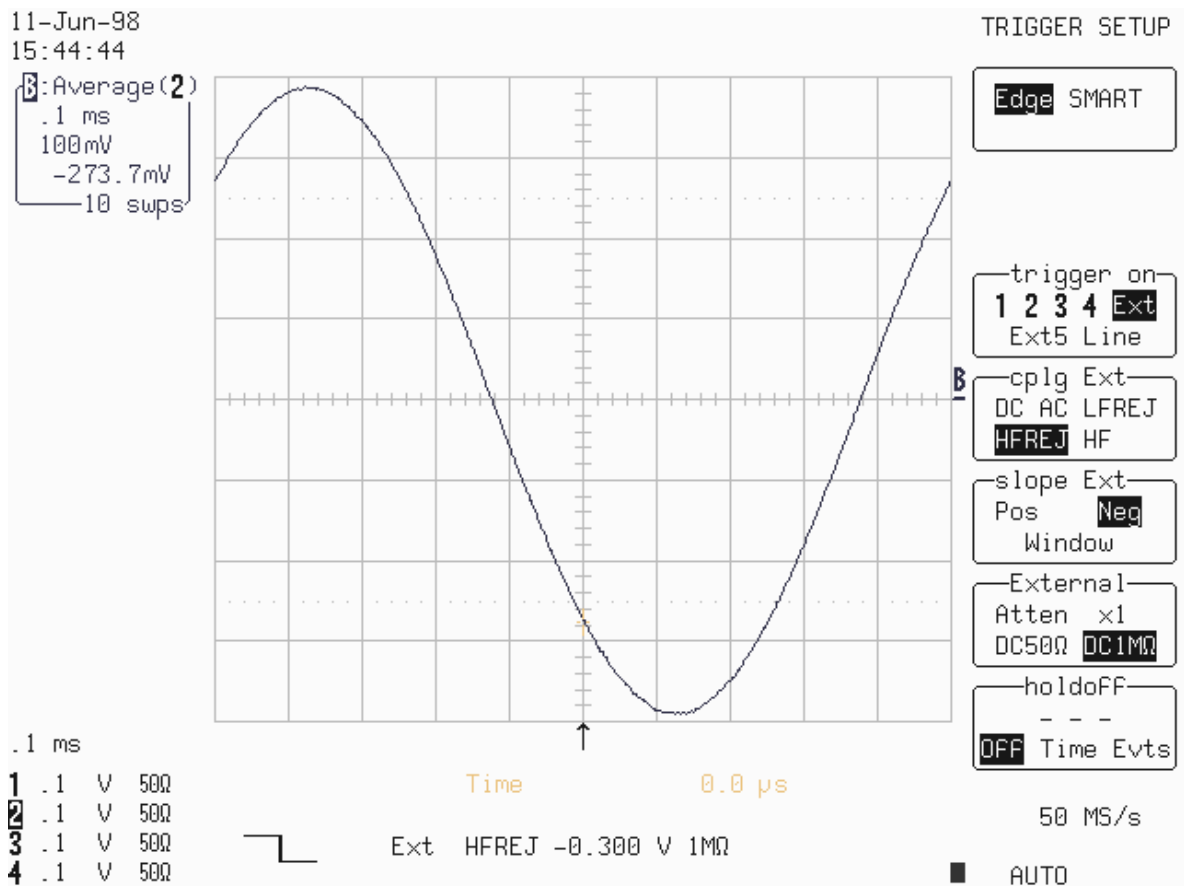


- Set Trigger Slope Ext : **Neg**
- Acquire 10 sweeps and record in Table 21 the **level** readout displayed below 100 mV in the icon **2**, at top left.



b. HFREJ Coupling

- Set Ext Coupling : **HFREJ**
- Acquire 10 sweeps and record in Table 21 the **level** readout displayed below 100 mV in the icon **2**, at top left.
- Compare the test results to the corresponding limit in the test record.



- Set Trigger Slope Ext : **Pos**
- Acquire 10 sweeps and record in Table 21 the **level** readout displayed below 100 mV in the icon **2**, at top left.
- Compare the test results to the corresponding limit in the test record.

5.10.8 External/5 Trigger at 0 Division Threshold

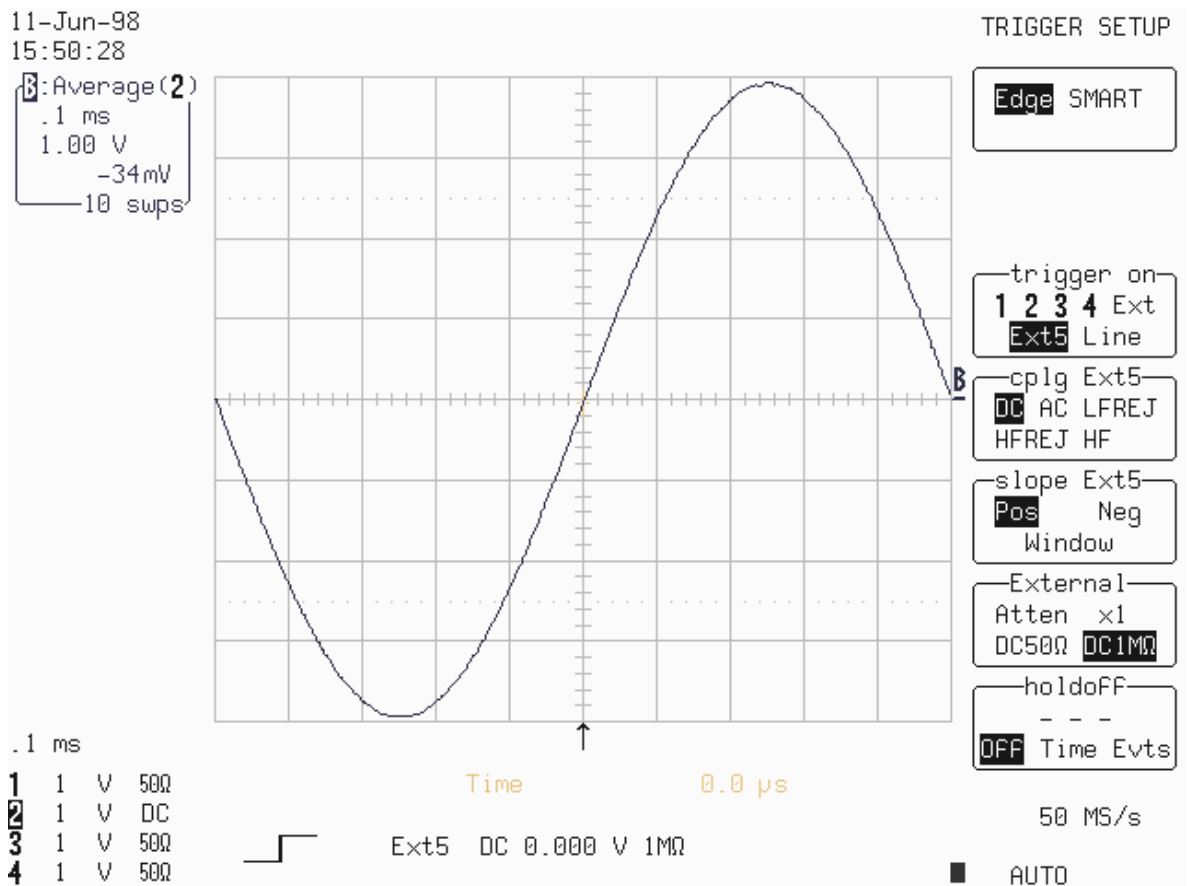
a. DC Coupling

- Recall **LC684P073.PNL** or configure the DSO :

Panel Setups : **Recall FROM DEFAULT SETUP**
Channel Trace ON **Channel 2**
Input Coupling : **DC 1M Ω**
Input gain : **1V/div**
Input offset : **0 mV**
Trigger setup : **Edge**
Trigger on : **Ext5**
Slope Ext/5 : **Pos**
Mode : **Auto**
Coupling : **DC**
Set Trigger level : **0.0 mV**
External : **DC 1M Ω**
Pre-Trigger Delay : **50 %**
Time base : **0.1 msec/div.**
Record up to : **50 k samples**

Channel Trace OFF **Channel 2**
Zoom+Math Trace ON **B**
Select Math Setup
For Math : **Use at most 5000 points**
Redefine B : **Channel 2**
Use Math ? : **Yes**
Math Type : **Average**
Avg. Type : **Summed**
For : **10 sweeps**

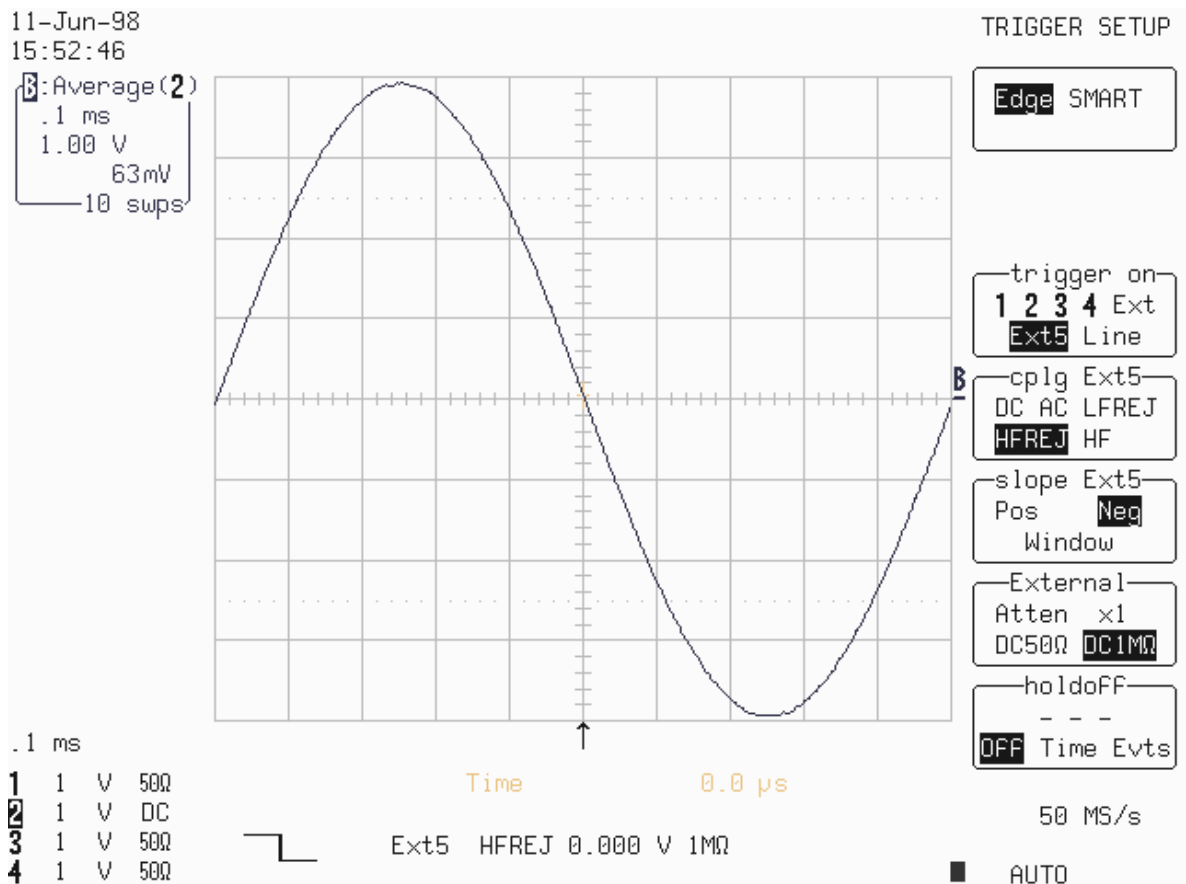
- Connect the test equipment as shown in Figure 5-12.
- Set the output of the LeCroy LW420 or equivalent audio frequency signal generator to **1 kHz**.
- Adjust the sine wave output amplitude to get **8 divisions peak to peak** .
- Select Cursors/Measure : **Cursors, Time, Absolute**
- Use the "cursor position" knob, to move the **Time marker** at 0.0 μ s
- Press **Clear Sweeps**
- Acquire 10 sweeps and record in Table 21 the **level** readout displayed below 100 mV in the icon **2**, at top left.



- Set Trigger Slope Ext5 : **Neg**
- Acquire 10 sweeps and record in Table 21 the **level** readout displayed below 100 mV in the icon **2**, at top left.
- Compare the test results to the corresponding limit in the test record.

b. HFREJ Coupling

- Set Coupling Ext5 : **HFREJ**
- Acquire 10 sweeps and record in Table 21 the **level** readout displayed below 100 mV in the icon **2**, at top left.



- Set Trigger Slope Ext5 : **Pos**
- Acquire 10 sweeps and record in Table 21 the **level** readout displayed below 100 mV in the icon **2**, at top left.
- Compare the test results to the corresponding limit in the test record.



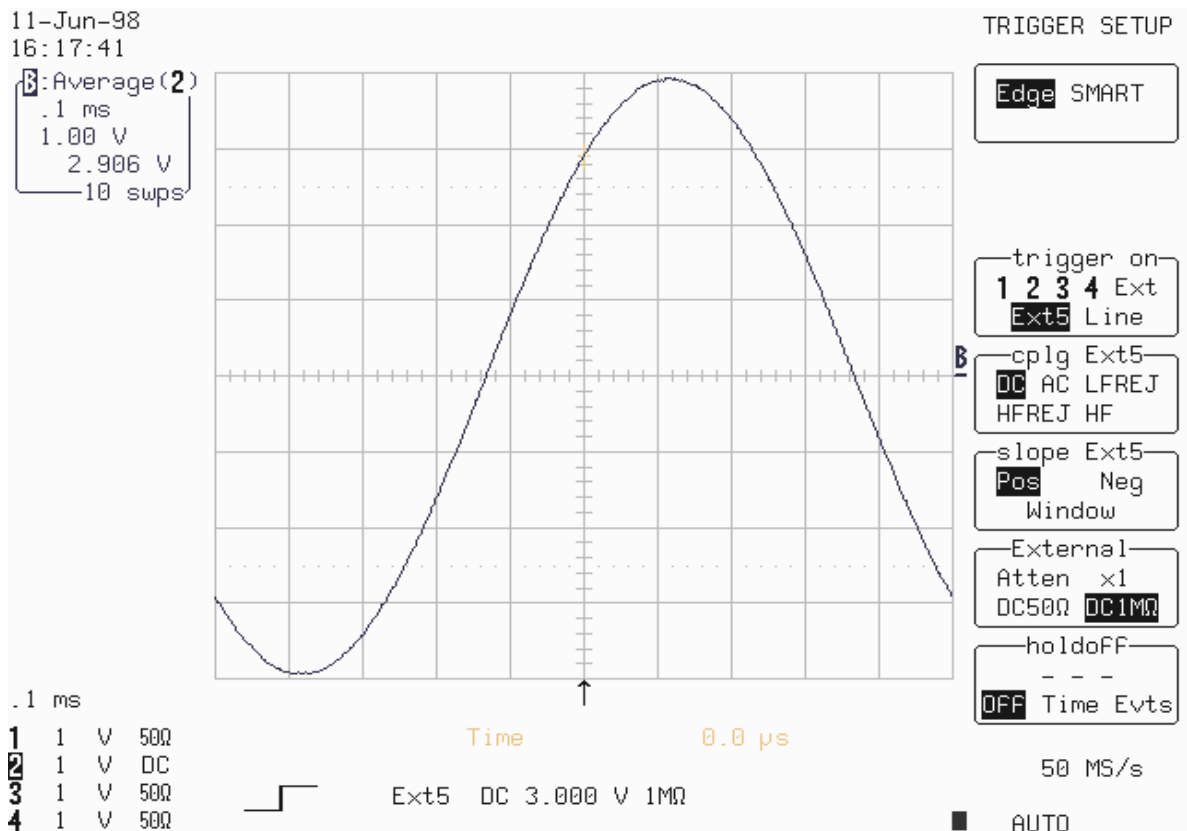
5.10.9 External/5 Trigger at +3 Divisions Threshold

a. DC Coupling

- Recall **LC684P074.PNL** or configure the DSO as shown in 5.10.8.a and make the following change :

Set Ext/5 Trigger level : **DC +3 V**

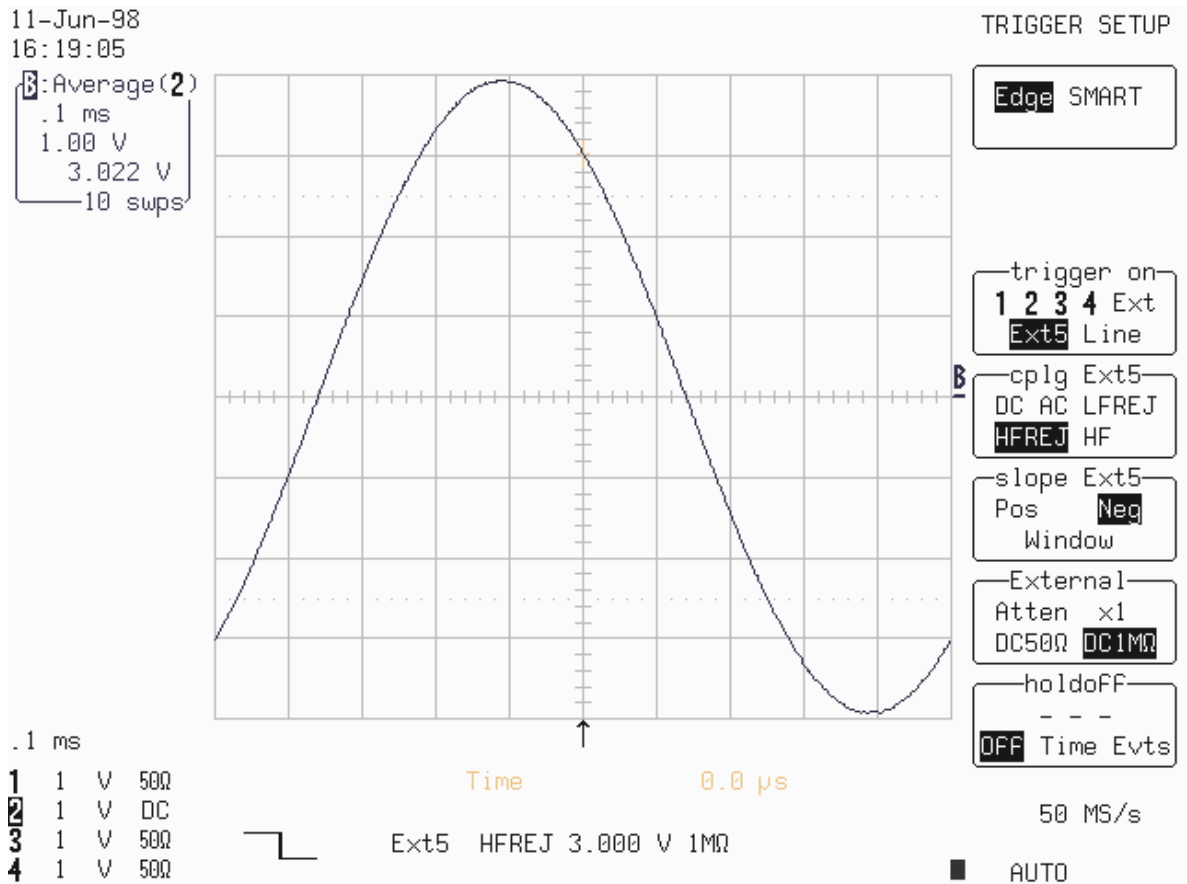
- Connect the test equipment as shown in Figure 5-12.
- Press **Clear Sweeps**,
- Acquire 10 sweeps and record in Table 21 the **level** readout displayed below 100 mV in the icon **2**, at top left.
- Compare the test results to the corresponding limit in the test record.



- Set Trigger Slope Ext/5 : **Neg**
- Acquire 10 sweeps and record in Table 21 the **level** readout displayed below 100 mV in the icon **2**, at top left.

b. HFREJ Coupling

- Set Ext/5 Coupling : **HFREJ**
- Acquire 10 sweeps and record in Table 21 the **level** readout displayed below 100 mV in the icon **2**, at top left.



- Set Trigger Slope Ext/5 :**Pos**
- Acquire 10 sweeps and record in Table 21 the **level** readout displayed below 100 mV in the icon **2**, at top left.



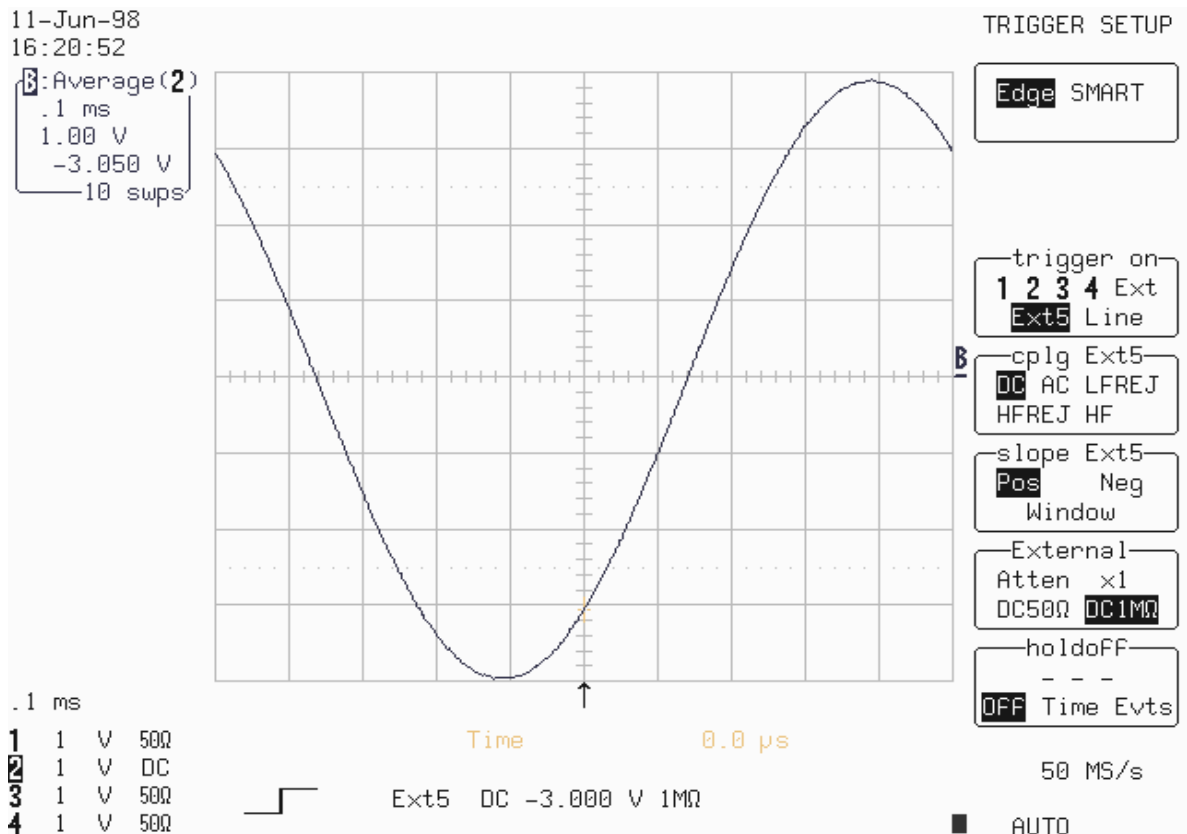
5.10.10 External/5 Trigger at -3 Divisions Threshold

a. DC Coupling

- Recall **LC684P075.PNL** or configure the DSO as shown in 5.10.5.a and make the following change :

Set Ext/5 Trigger level : **DC -3 V**

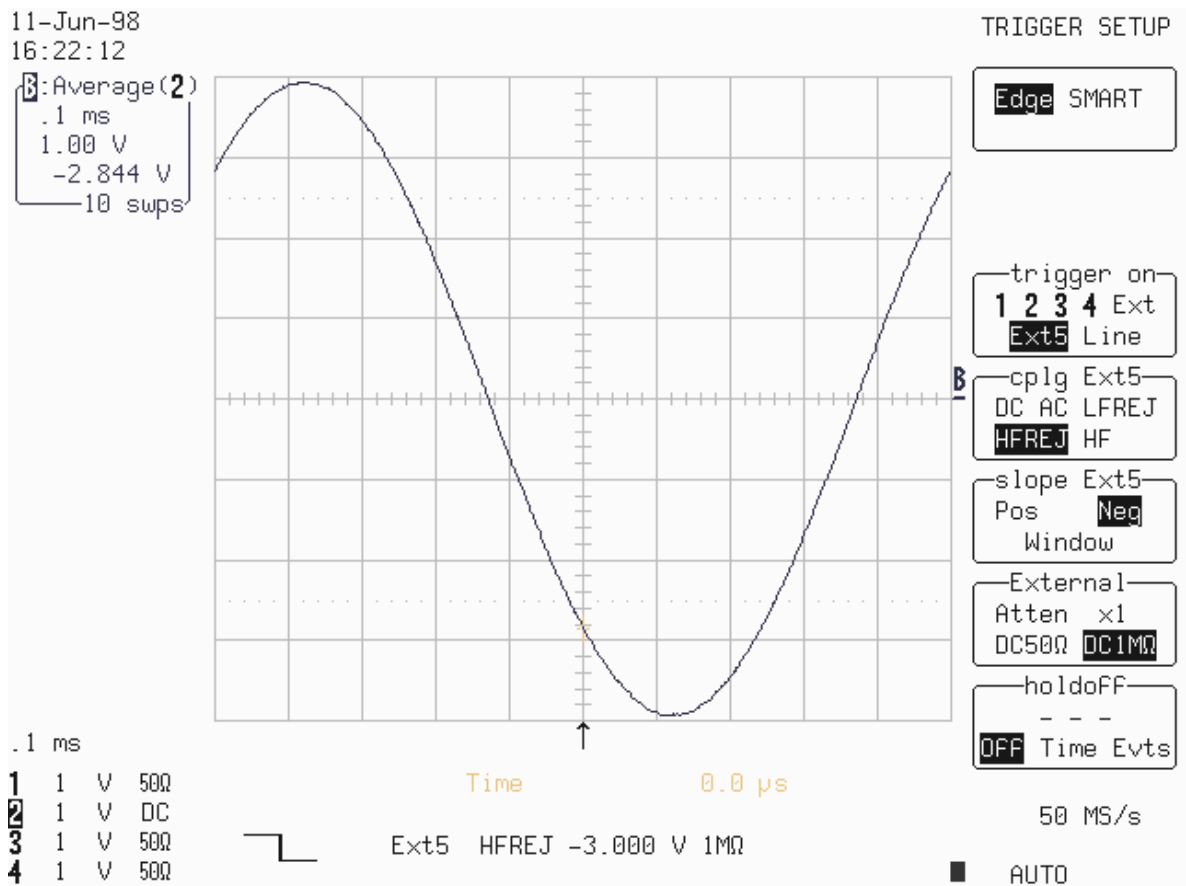
- Connect the test equipment as shown in Figure 5-12.
- Press **Clear Sweeps**.
- Acquire 10 sweeps and record in Table 21 the **level** readout displayed below 100 mV in the icon **2**, at top left.
- Compare the test results to the corresponding limit in the test record.



- Set Trigger Slope Ext/5 : **Neg**
- Acquire 10 sweeps and record in Table 21 the **level** readout displayed below 100 mV in the icon **2**, at top left.

b. HFREJ Coupling

- Set Ext/5 Coupling : **HFREJ**
- Acquire 10 sweeps and record in Table 21 the **level** readout displayed below 100 mV in the icon **2**, at top left.
- Compare the test results to the corresponding limit in the test record.



- Set Trigger Slope Ext/5 : **Pos**
- Acquire 10 sweeps and record in Table 21 the **level** readout displayed below 100 mV in the icon **2**, at top left.
- Compare the test results to the corresponding limit in the test record.



5.11 Smart Trigger

5.11.1 Trigger on Pulse Width 10 nsec

a. Pulse Width < 10 nsec

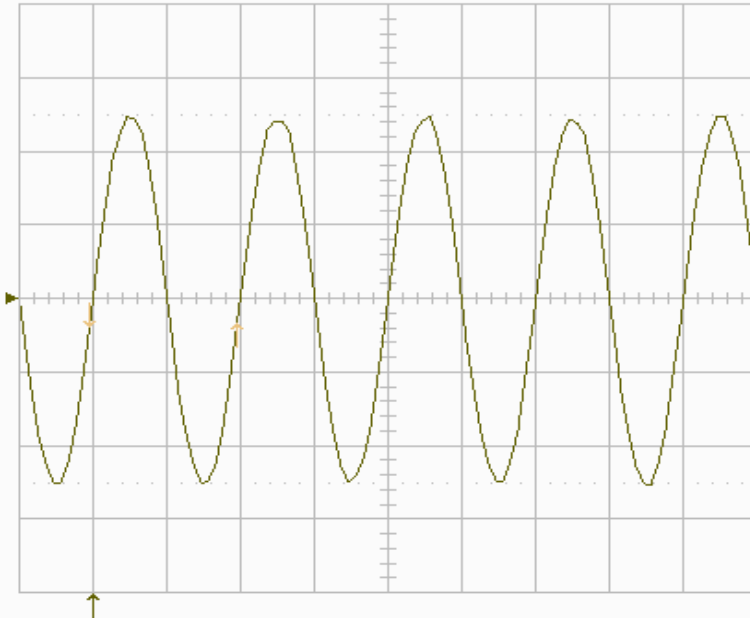
- Recall **LC684P076.PNL** or configure the DSO
 - Panel Setups : **Recall FROM DEFAULT SETUP**
 - Channels trace ON **Channel 1**
 - Input coupling : **DC 50Ω**
 - Input gain : **.5 V/div.**
 - Input offset : **0 mV**
 - Trigger setup : **Smart**
 - Setup Smart Trigger **Glitch**
 - Trigger on : **1**
 - At the end of : **Neg.**
 - Width < 10 nsec : **On**
 - Width > 10 nsec : **Off**
 - Trigger mode : **Norm**
 - Time base : **5 nsec/div.**
- Connect the **RF output** of the HP8648B generator through a 5ns 50 Ohm BNC coaxial cable into Channel 1.
- Set the generator frequency to **100 MHz**. Adjust the generator output amplitude to get **5 divisions peak to peak** .
- Check that the scope Triggers. Record the test result in Table 22.
- Set Width < 10 nsec **Off** and Width > 10 nsec **ON**
- Check that the scope **doesn't trigger** : slow trigger and no flashes in box next to normal. Record the test result in Table 22.

b. Pulse Width > 10 nsec

- Set the generator frequency to **40 MHz**.
- Set Width < 10 nsec **Off** and Width > 10 nsec **ON**
- Check that the scope Triggers. Record the test result in Table 22.
- Set Width < 10 nsec **On** and Width > 10 nsec **Off**
- Check that the scope **doesn't trigger** : slow trigger and no flashes in box. Record the test result in Table 22.

11-Jun-98
16:55:37

5 ns
0.50 V
30mV



5 ns

- 1 .5 V 50Ω
- 2 50 mV AC
- 3 50 mV AC
- 4 50 mV AC



Δt 10.000 ns $\frac{1}{2}t$ 100.00 MHz

1 DC 0.00 V
pw \leq 10.0 ns

TRIGGER SETUP

Edge SMART
(Glitch)

SETUP SMART
TRIGGER

trigger on
1 2 3 4 Ext
Ext5 Pattern

coupling 1
DC AC
LFREJ HFREJ

at end of
Neg Pos
pulse

width \leq
10.0 ns
OFF On

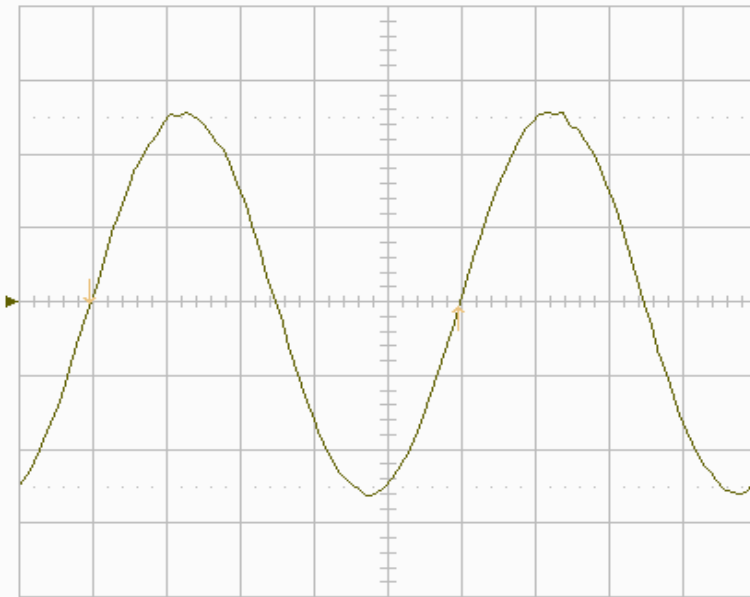
width \geq
OFF On

2 GS/s

NORMAL

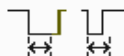
11-Jun-98
16:59:29

5 ns
0.50 V
-13mV



5 ns

- 1 .5 V 50Ω
- 2 50 mV AC
- 3 50 mV AC
- 4 50 mV AC



Δt 25.000 ns $\frac{1}{2}t$ 40.000 MHz

1 DC 0.00 V
10.0 ns \leq pw

TRIGGER SETUP

Edge SMART
(Glitch)

SETUP SMART
TRIGGER

trigger on
1 2 3 4 Ext
Ext5 Pattern

coupling 1
DC AC
LFREJ HFREJ

at end of
Neg Pos
pulse

width \leq
OFF On

width \geq
10.0 ns
OFF On

2 GS/s

NORMAL



5.11.2 Trigger on Pulse Width 100 nsec

a. Pulse Width < 100 nsec

- Recall **LC684P072.PNL** or configure the DSO as shown in 5.11.1.a and make the following changes :
 - Width < 100 nsec : **On**
 - Width > 100 nsec : **Off**
 - Time base : **20 nsec/div.**
- Set the generator frequency to **10 MHz.**
- Check that the scope Triggers. Record the test result in Table 22.
- Set Width < 100 nsec **Off** and Width > 100 nsec **ON**
- Check that the scope **doesn't trigger** : slow trigger and no flashes in box next to normal. Record the test result in Table 22.

b. Pulse Width > 100 nsec

- Set the generator frequency to **4 MHz.**
- Time base : **50 nsec/div.**
- Set Width < 100 nsec **Off** and Width > 100 nsec **ON**
- Check that the scope Triggers. Record the test result in Table 22.
- Set Width < 100 nsec **On** and Width > 100 nsec **Off**
- Check that the scope **doesn't trigger** : slow trigger and no flashes in box. Record the test result in Table 22.

5.12 Time Base Accuracy

5.12.1 Description

An external sine wave generator of **0.1 MHz** with a frequency accuracy better than 1 PPM is used.

Specifications

500 MHz clock : accuracy : $\leq \pm 0.001 \%$ or $\leq \pm 10$ PPM

5.12.2 500 MHz Clock Verification Procedure

- Recall **LC684P078.PNL** or configure the DSO

Panel Setups	:	Recall FROM DEFAULT SETUP
Channels trace ON	:	Channel 1
Input coupling	:	DC 50Ω
Input gain	:	.1 V/div.
Input offset	:	0 mV
Trigger setup	:	Edge
Trigger on	:	1
Coupling 1	:	DC
Slope 1	:	Pos
Level 1	:	100 mV
Trigger mode	:	Norm
Delay	:	0 %
Time base	:	10 μsec/div.
Channel use	:	4
Record up to	:	50 k

- Connect the **RF output** of the HP8648B generator through a 5ns 50 Ohm BNC coaxial cable into Channel 1.
- Set the generator frequency to **0.1 MHz**.
- Adjust the generator output amplitude to get **5 divisions peak to peak**.
- Store Channel 1 in Memory 1
- Recall **LC684P079.PNL** or make the following change :
- Set Post-trigger delay to **50.00 msec**
- Recall Memory **1 to A**
- Press : **Cursors/Measure**
- Measure : **Parameters**



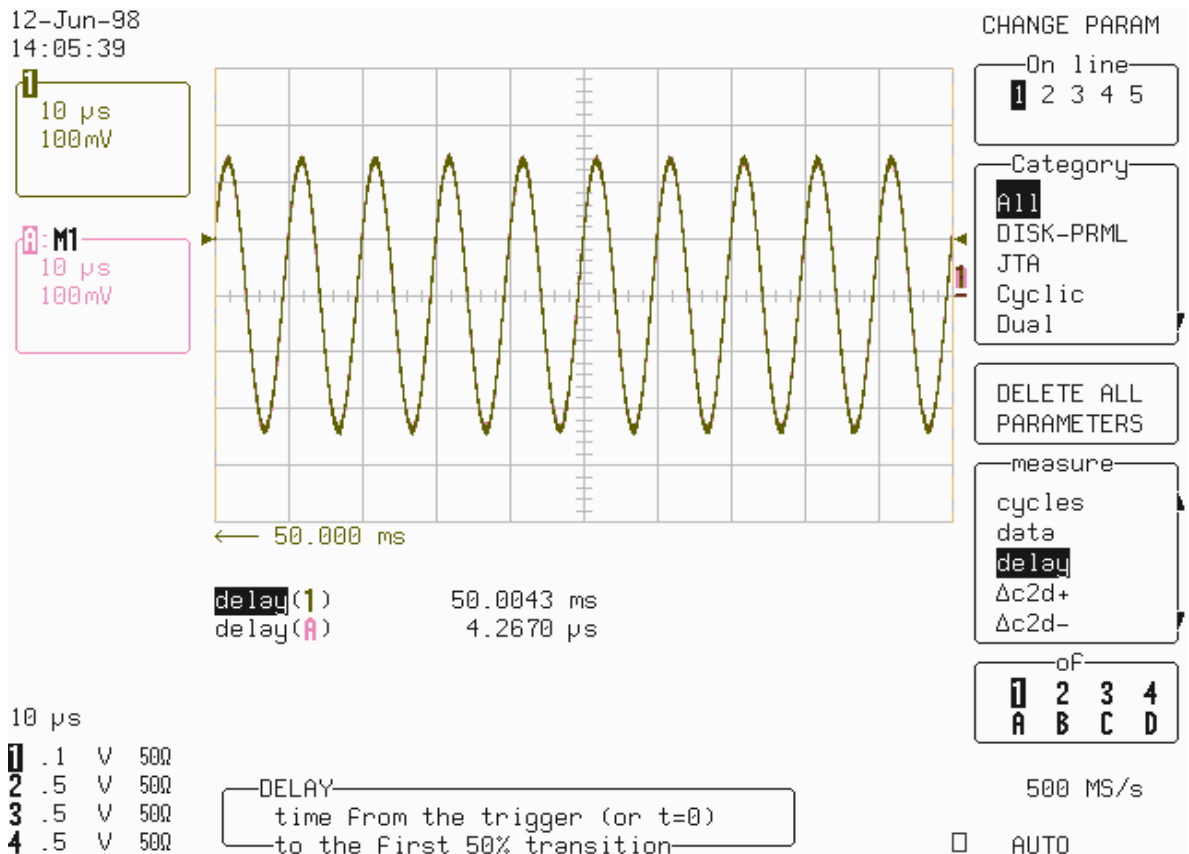
- Mode : **Custom**
- Statistics : **Off**

- Change parameters

- On line 1 : **Delay of 1**
- On line 2 : **Delay of A**

- Check that the displayed Channel 1 trace is **aligned** with the sine wave from memory 1.

- This allows the accuracy of the time base clock to be checked **5000 periods** after the trigger point. A difference of **$\pm 0.5 \mu\text{sec}$** corresponds to **$\pm 10 \text{ PPM}$** .



- Calculate the Difference **$\{[\text{delay}(A) - \text{delay}(1)] + 50 \text{ msec}\}$** .
- Record the test result in Table 23, and compare it to the limit in the test record.

5.13 Overshoot and Rise time (10 % - 90 %)

Specifications

DC 50 Ω , 50 mV/div., : overshoot < 17 %, rise time < 0.50 ns

DC 1M Ω , 100 mV/div., : overshoot < 17%, rise time < 0.90 ns

a. DC 50 Ω

- Recall **LC684P080.PNL** 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	:	0.1 V/div. on all 4 Channels
Input offset	:	-250 mV on all 4 Channels
Trigger setup	:	Edge
Trigger on	:	1
Coupling 1	:	DC
Slope 1	:	Pos
Level 1	:	250 mV
Trigger mode	:	Norm
Delay	:	30 % Pre-Trigger
Time base	:	1 nsec/div.
Channel use	:	4
Record up to	:	50 k
Turn on trace	:	A
Select Math Setup	:	
For Math	:	Use at most 1000 points
Use Math ?	:	Yes
Math Type	:	Average
Avg Type	:	Summed
Of	:	Channel 1
Sweeps	:	100
Turn off trace	:	Channel 1
Cursors/Measure	:	Parameters
Mode	:	Custom
Statistics	:	Off
Change Parameters	:	
On displayed trace:	:	A
On line 1	:	
Measure	:	Over + of A
On line 2	:	
Measure	:	Rise of A

- Connect the fast pulse generator 4969A and PB049 power adapter, or equivalent as shown in Figure 5-13.



- Set the 4969A frequency to **1 kHz**

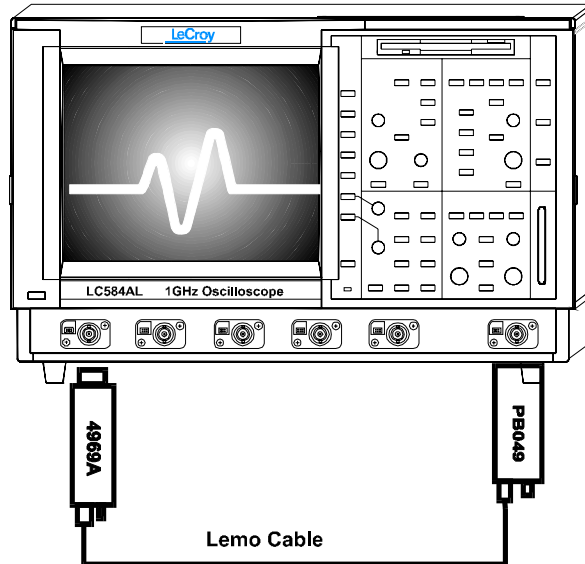
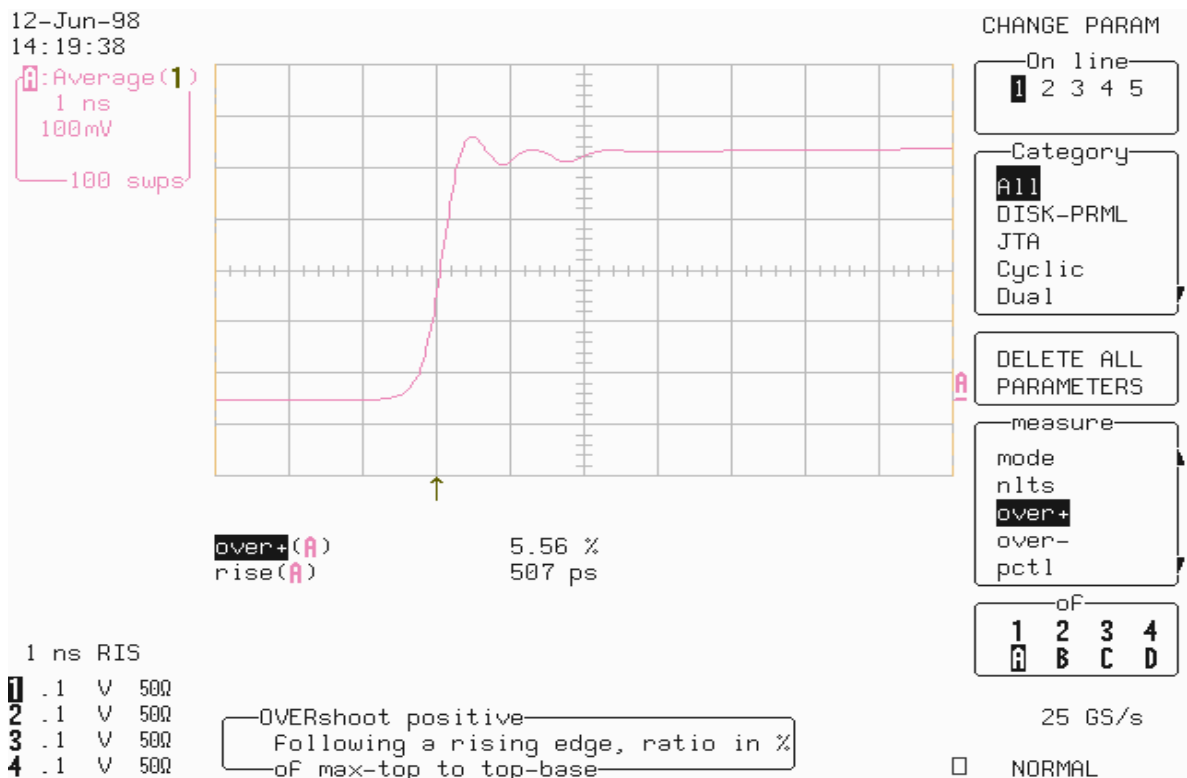


Figure 5-13: 50 Ω Overshoot & Rise time Equipment Setup

- Press **Clear Sweep**
- After 100 sweeps record **over+(A)** and **rise(A)** measurements in Table 24.
- Repeat the DC 50 Ω Overshoot and Rise time test for the other channels, substituting channel controls and input connector.
- Recall **LC684P081.PNL** for Channel 2, **LC684P082.PNL** for Channel3 **LC684P083.PNL** for Channel 4, or configure the DSO as shown in 5.13.a. and make the necessary changes.
- Record the test results in Table 24, and compare the results to the limits.



b. DC 1MΩ

- Recall **LC684P084.PNL** or configure the DSO as shown in 5.13.a. and make the following change :
 - Set Input Coupling: **DC 1MΩ** on all 4 Channels
 - Input gain : **50 mV/div.** on all 4 Channels
 - Input offset : **-150 mV** on all 4 Channels
 - Trigger Level : **75 mV**
 - Time base : **1 nsec/div.**
- Terminate the output of the 4969A Pulser with the 4962-10 adapter (50Ω to 1MΩ) as shown in Figure 5-14.
- Press **Clear Sweep**. After **100 sweeps** record **over+(A)** and **rise(A)** in Table24.
- Repeat the DC 1MΩ Overshoot and Rise time test for the other channels, substituting channel controls and input connector.
- Recall **LC684P085.PNL** for Channel 2, **LC684P086.PNL** for Channel3 **LC684P087.PNL** for Channel 4, or configure the DSO as shown in 5.13.a. and make the necessary changes.
- Record the test results in Table 24, and compare the results to the limits.

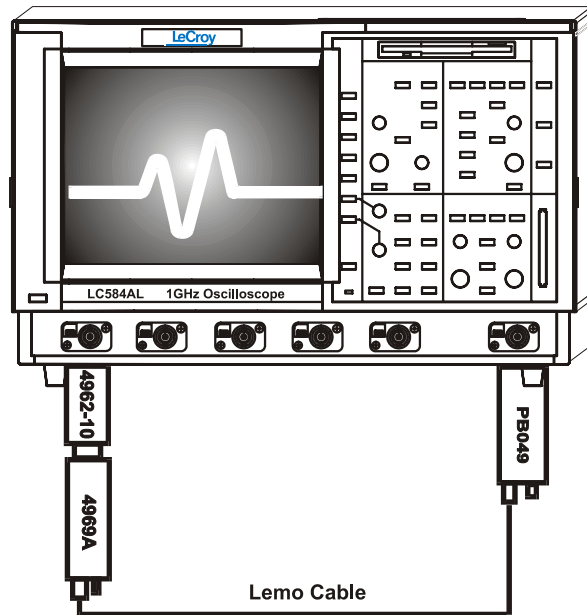


Figure 5-14 : 1MΩ Overshoot & Rise time Equipment Setup

