
1
SMC
4 DQK-701B 2
1326
3

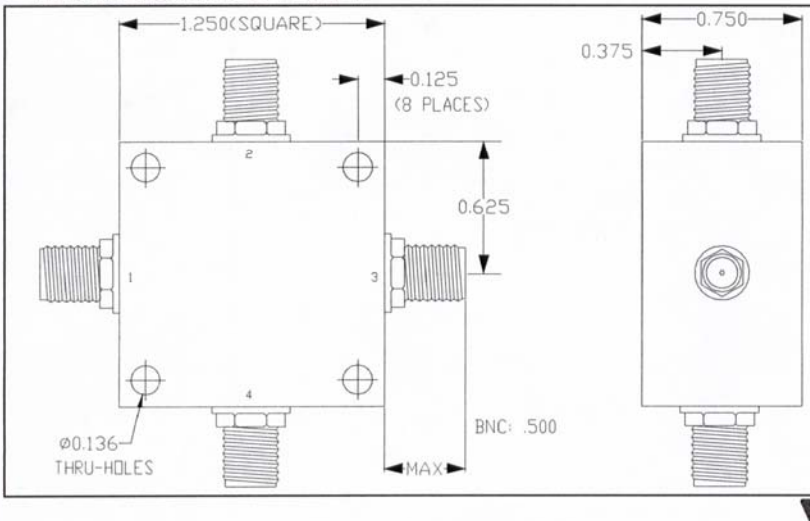
# QUADRATURE HYBRID
# MODEL DQK-701B

## OCTAVE BANDWIDTH 20 - 40 MHz

### SPECIFICATIONS:

| | |
|---|---|
| Operating Frequency: | 20 - 40 MHz |
| Insertion Loss: | 0.3 dB (Typ)<br>0.6 dB (Max) |
| Isolation: | 25 dB (Typ)<br>20 dB (Min) |
| Amplitude Unbalance: | 0.4 dB (Typ)<br>0.75 dB (Max) |
| Phase Unbalance: | 1.0° (Typ)<br>3.0°(Max) |
| Input Power Rating: | 1 Watt (Max) |
| Impedance: | 50 Ohms (Nom) |
| VSWR: | 1.1:1 (typ) |
| Operating Temperature Range: | -40°C to +85°C |

### MECHANICAL OUTLINE:




**113**

**Connector Type:**
**SMA Female**

**PIN-OUT**
INPUT - Port 1
+90° OUTPUT - Port 2
0° OUTPUT - Port 4
ISOLATED* - Port 3
* Terminate ISOLATED port with 50 ohms externally


SYNERGY MICROWAVE CORPORATION
201 McLean Boulevard * Paterson, New Jersey 07504 * Tel: (973) 881-8800 * Fax: (973) 881-8361

SYNERGY®
MICROWAVE CORPORATION

201 McLean Boulevard, Paterson, New Jersey 07504
Phone: (973) 881 - 8800 • Fax: (973) 881-8361
Website: http://www.synergymwave.com
E-mail: sales@synergymwave.com

# INVOICE - Customer

90344637

Sales Order ID : **53824**
Invoice Date : **29-Jul-2013**
Ship Date : **30-Jul-2013**
Customer PO ID : **DT062113**
Page Number : **1 of 1**

**ISO 9001 - 2008 Registered**

**AR Terms:** VISA/AMEX/ **Due Date :** 03-Aug-2013

**Bill To :**
DAVE TYPINSKI
P.O. BOX 2423
HIGH SPRINGS, FL 32655

**Ship To :**
TILE SPECIALTIES
26211 WEST US HWY. 27
ATT: DAVE TYPINSKI
HIGH SPRINGS, FL 32643

Order Date: **24-Jun-2013**
Packing Slip: **28003**
Bill of Lading :

Customer ID: **TIL100**
FOB: **Paterson, NJ**
Currency Type : **USD**
Ship Method: **UPS - COLL**

| Line Nbr | Item ID / Item Name | Est. Ship Date | Order | Shipped to Date | Back Order | Shipped Qty | Unit Price | Extended Price |
|---|---|---|---|---|---|---|---|---|
| 1 | DQK-701B<br>90 DEGREE HYBRID | 30-Jul-13 | 4 | 4 | 0 | 4.<br>0.00% | $52.50 | $210.00 |
| | | | | | | **Date Code** | | **Quantity** |
| | | | | | | 1326 | | 1 |
| | | | | | | 1331 | | 3 |
| | | **Line Item Total:** | 4 | 4 | 0 | | | $210.00 |

| | |
|---|---|
| **Total:** | $210.00 |
| **Credit Card Fee:** | $6.30 |
| **Shipping Charges:** | $0.00 |
| **Due Amount:** | $216.30 |

PAID

Net 30 upon credit approval
Money transfer is acceptable * No COD orders
$30.00 bank fee for international money transfers
VISA/MC/AMEX are acceptable forms of payment
3% surcharge on all credit card orders
$10,000 max on CC sales * Min order value is $100.00

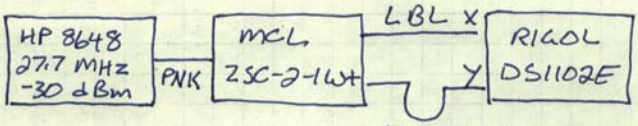
**Please make checks payable to :**

**Synergy Microwave Corporation**
**201 McLean Blvd.**
**Paterson, NJ 07504**

This Agreement shall be governed by the laws of the State of New Jersey. The parties agree that the United Nations Convention on the International Sales of Goods of 1980 shall have no application to this Agreement.

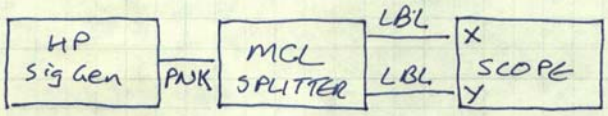
# Synergy Microwave DQK-701B 90° Hybrid

## TEST (1)

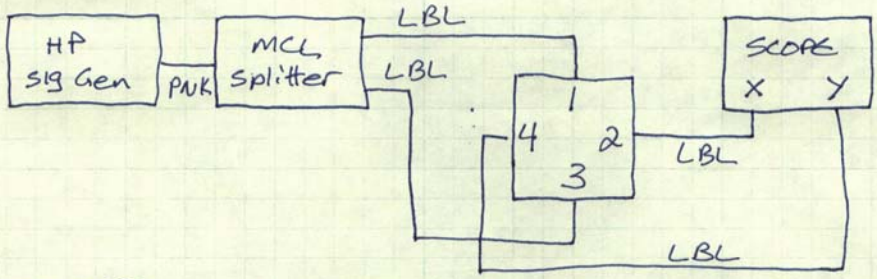



LBL + PNK → PNK = ¼λ @ 27.7 MHz

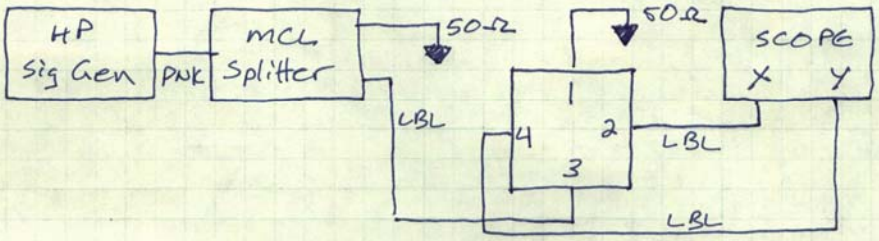
## TEST (2)



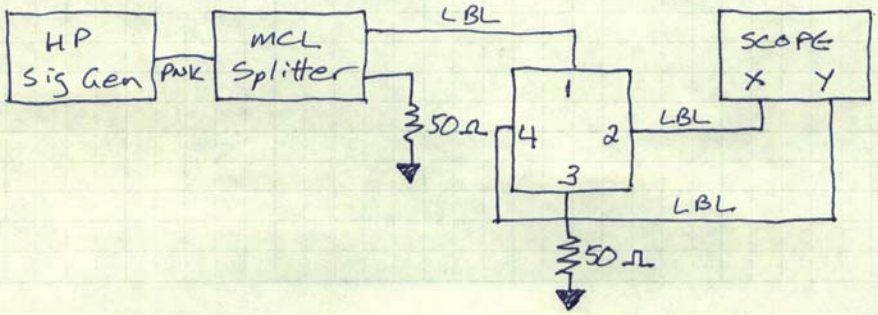

## TEST (3)



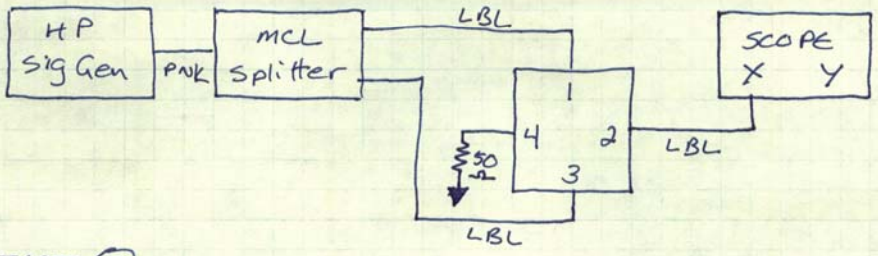

## TEST (4)



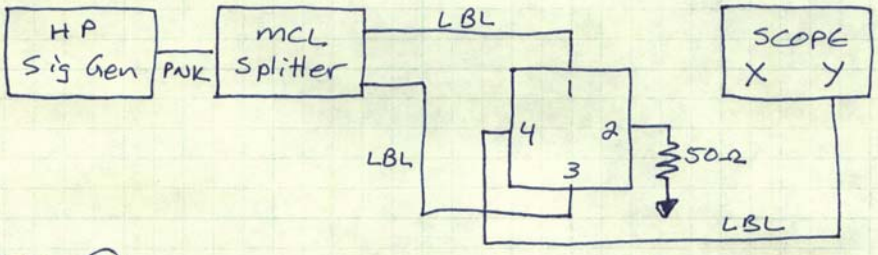

## TEST (5)



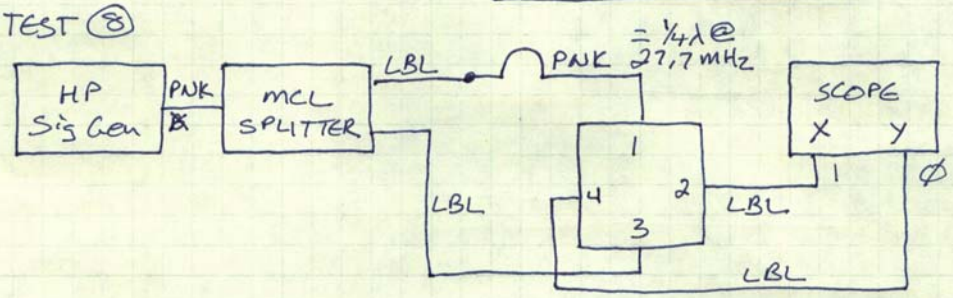
TEST (6)



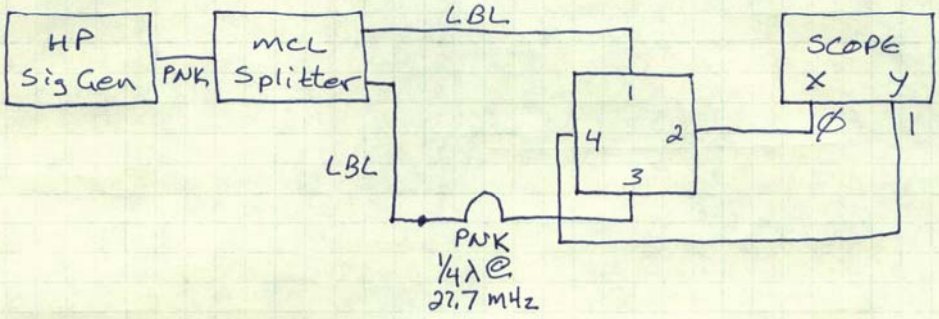

TEST (7)



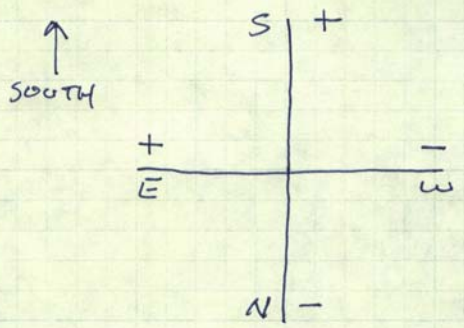

TEST (8)




TEST (9)

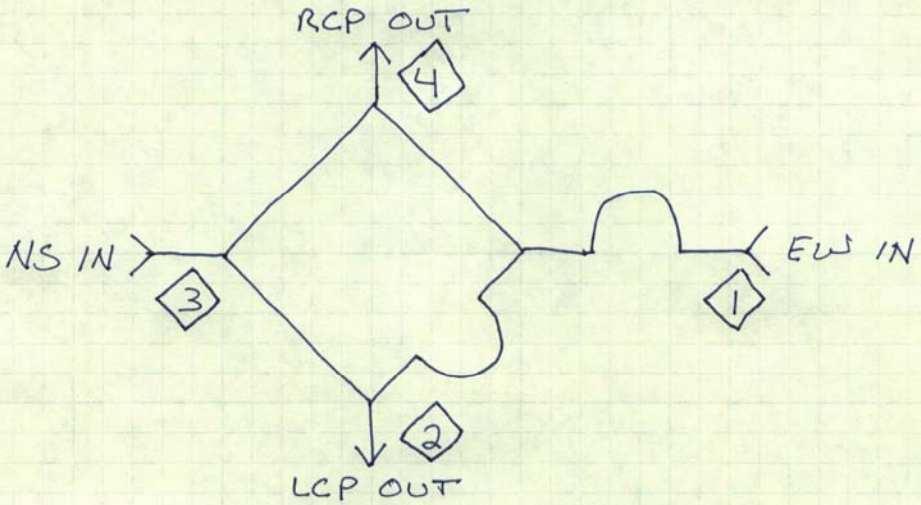


Equivalent circuit in terms of a 180° hybrid and the XTFD/STFD antenna layout.




Looking Down on Array

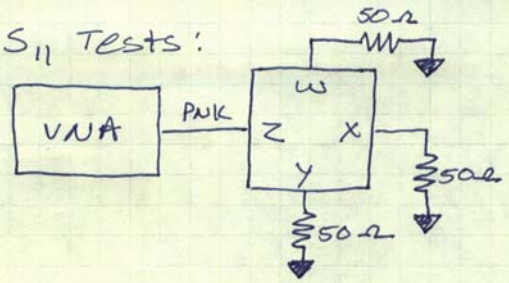
IEEE convention:
RCP $\vec{E}$ rotates CW looking <u>with</u> the direction of propagation



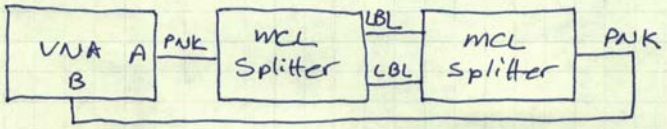

(X) = Synergy hybrid port number

HYBRID TEST CONT'D | 8/11/13 | Dave Typinski | (4)

$S_{11}$ Tests:

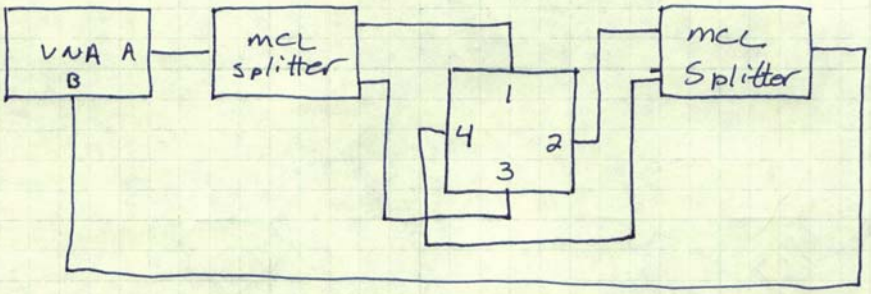



$S_{21}$ Baseline test:

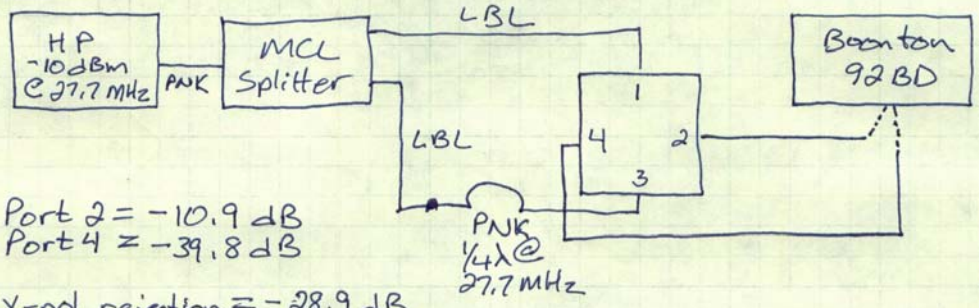



$S_{21}$ Insertion Loss Test:

**$L_{ins}$:**
**0.23 dB @ 17 MHz**
**0.34 dB @ 25 MHz**
**0.27 dB @ 33 MHz**




Cross Polarization Rejection Test:



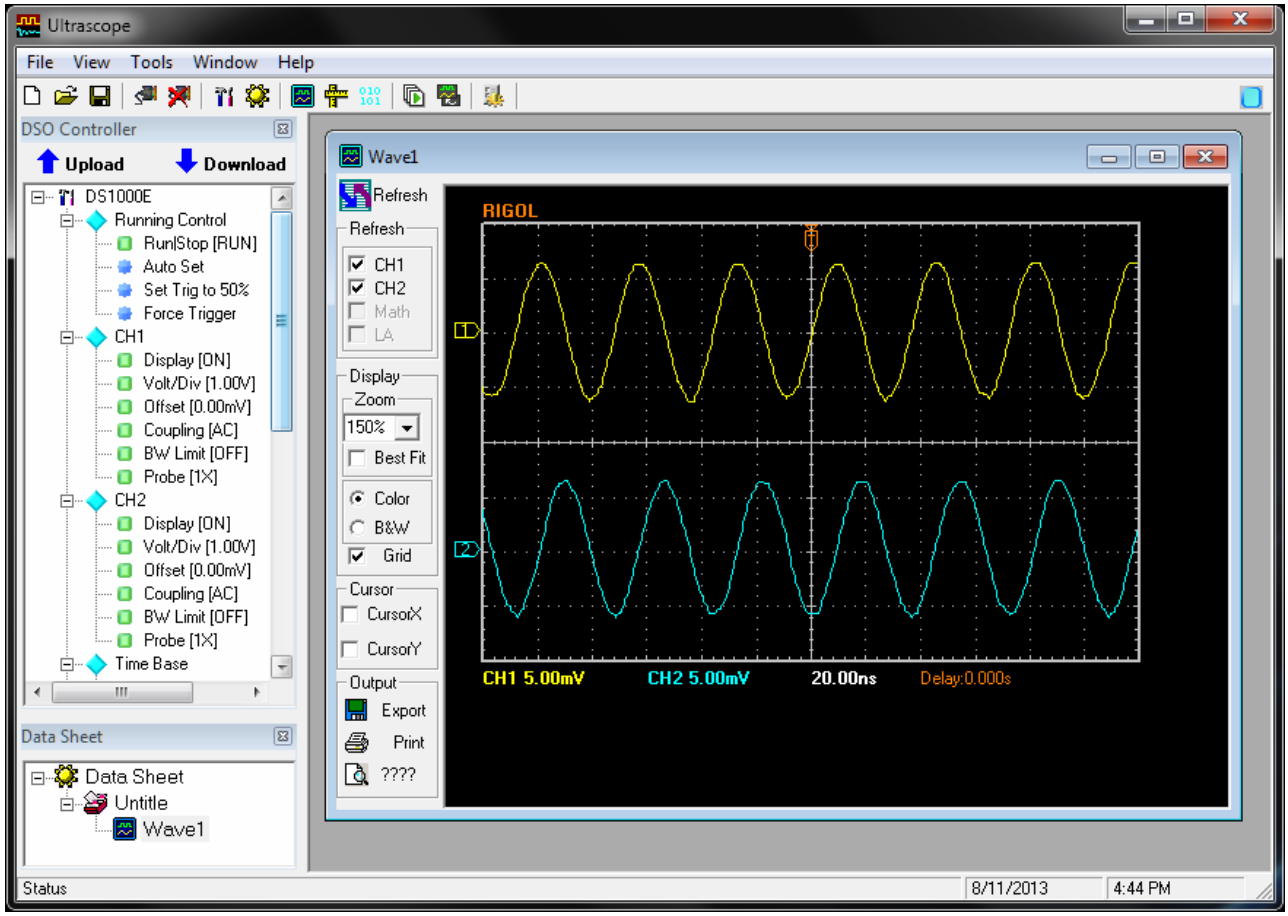

Port 2 = -10.9 dB
Port 4 = -39.8 dB

X-pol rejection = -28.9 dB

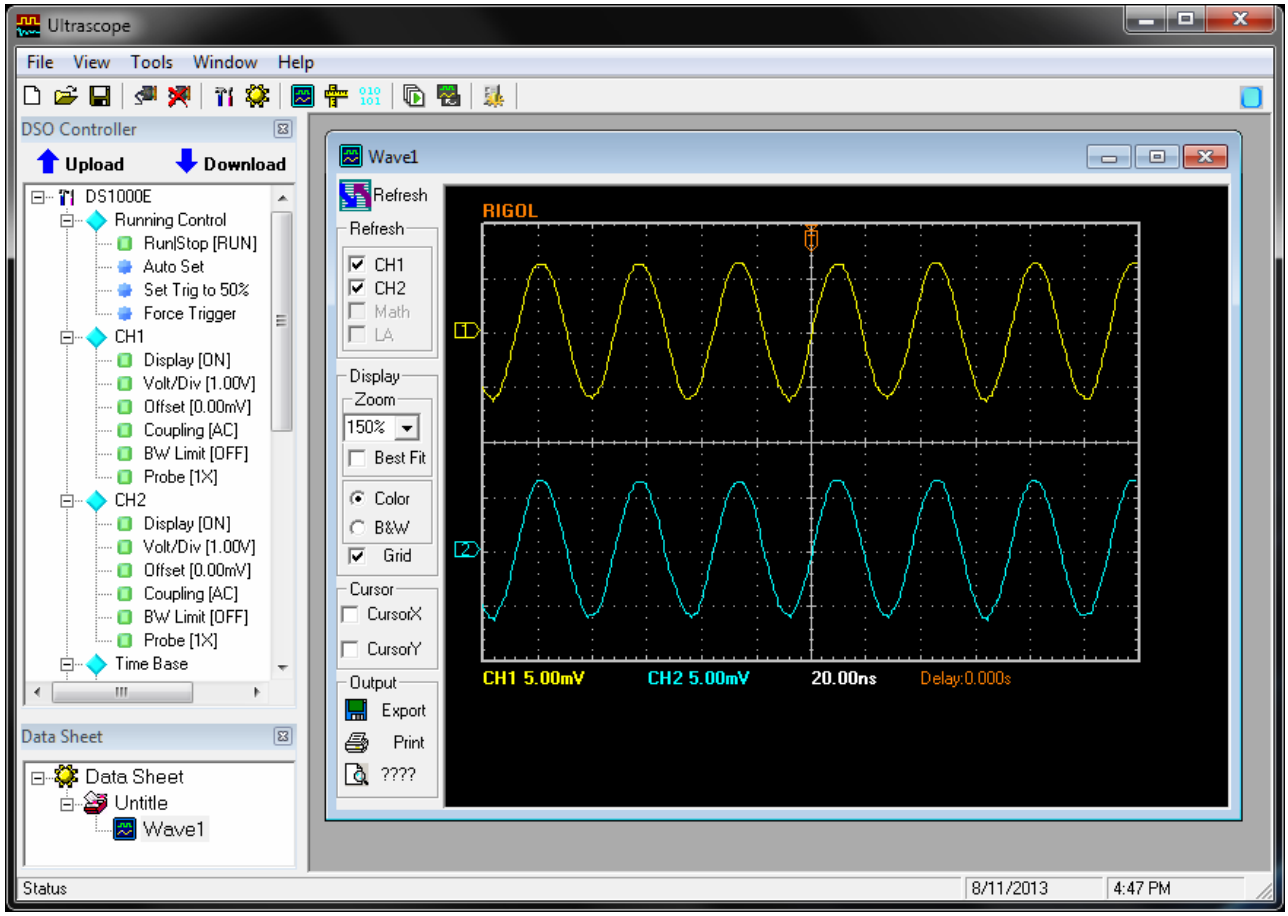
Without 1/4λ cable, both ports 1 & 2 = -13.9 dB

TOPS 35500

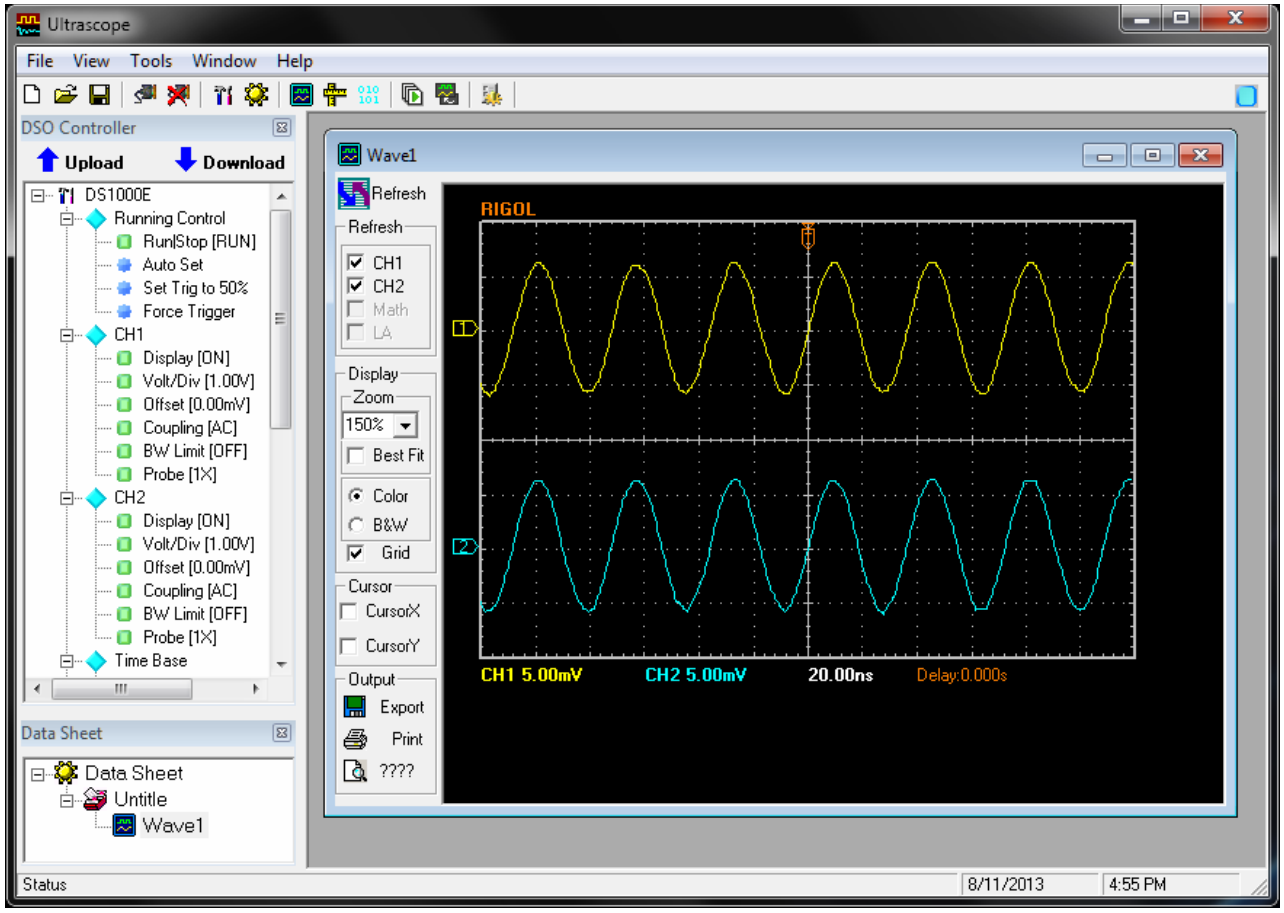
Test 1


Ultrascope
File View Tools Window Help
DSO Controller
Upload
Download
DS1000E
Running Control
RunlStop [RUN]
Auto Set
Set Trig to 50%
Force Trigger
CH1
Display [ON]
Volt/Div [1.00V]
Offset [0.00mV]
Coupling [AC]
BW Limit [OFF]
Probe [1X]
CH2
Display [ON]
Volt/Div [1.00V]
Offset [0.00mV]
Coupling [AC]
BW Limit [OFF]
Probe [1X]
Time Base
Data Sheet
Data Sheet
Untitle
Wave1
Wave1
Refresh
Refresh
CH1
CH2
Math
LA
Display
Zoom
150%
Best Fit
Color
B&W
Grid
Cursor
CursorX
CursorY
Output
Export
Print
????
RIGOL
CH1 5.00mV
CH2 5.00mV
20.00ns
Delay:0.000s
Status
8/11/2013
4:44 PM

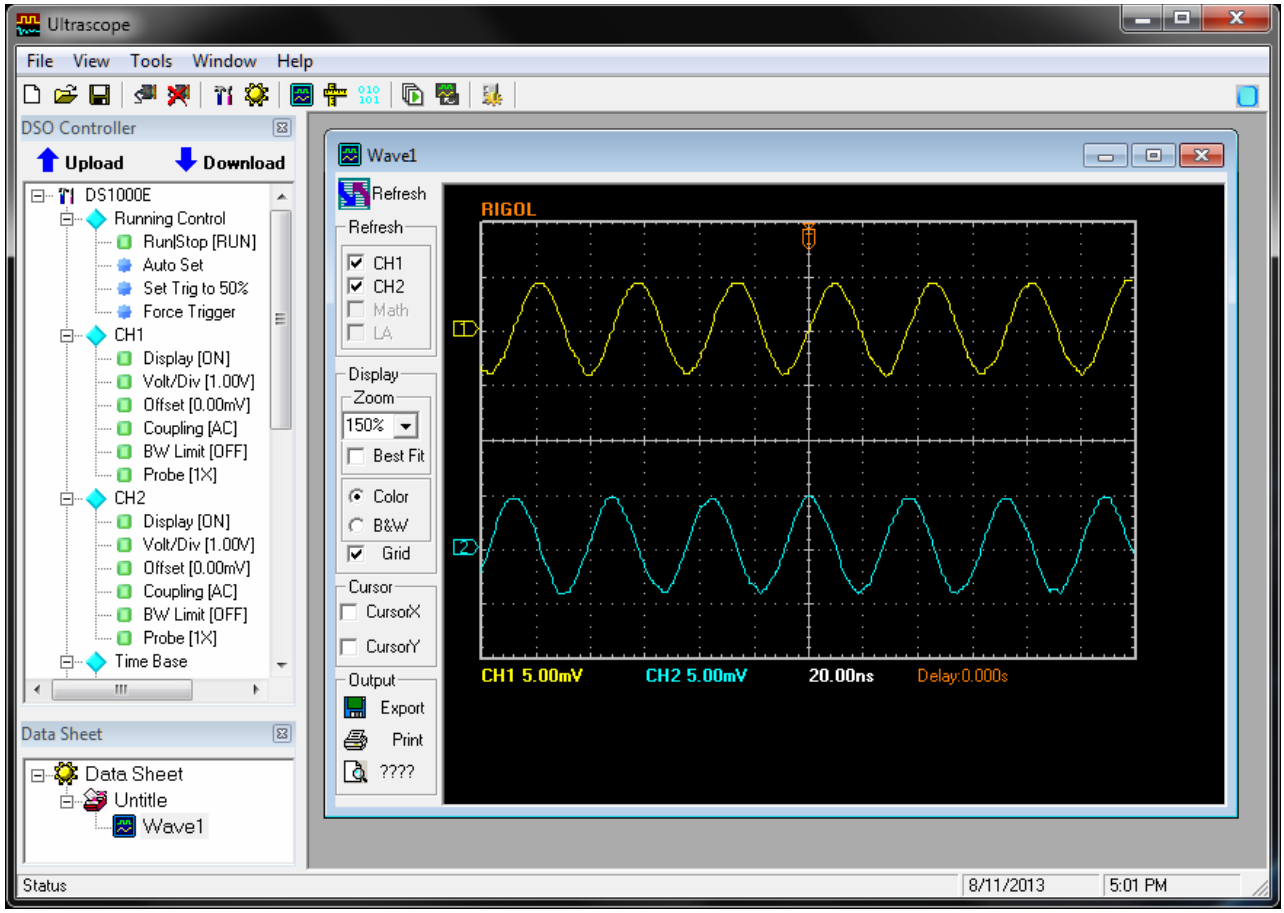
Test 2


Ultrascope
File View Tools Window Help
DSO Controller
Upload
Download
DS1000E
Running Control
RunlStop [RUN]
Auto Set
Set Trig to 50%
Force Trigger
CH1
Display [ON]
Volt/Div [1.00V]
Offset [0.00mV]
Coupling [AC]
BW Limit [OFF]
Probe [1X]
CH2
Display [ON]
Volt/Div [1.00V]
Offset [0.00mV]
Coupling [AC]
BW Limit [OFF]
Probe [1X]
Time Base
Data Sheet
Data Sheet
Untitle
Wave1
Wave1
Refresh
Refresh
CH1
CH2
Math
LA
Display
Zoom
150%
Best Fit
Color
B&W
Grid
Cursor
CursorX
CursorY
Output
Export
Print
????
RIGOL
CH1 5.00mV
CH2 5.00mV
20.00ns
Delay:0.000s
Status
8/11/2013
4:47 PM

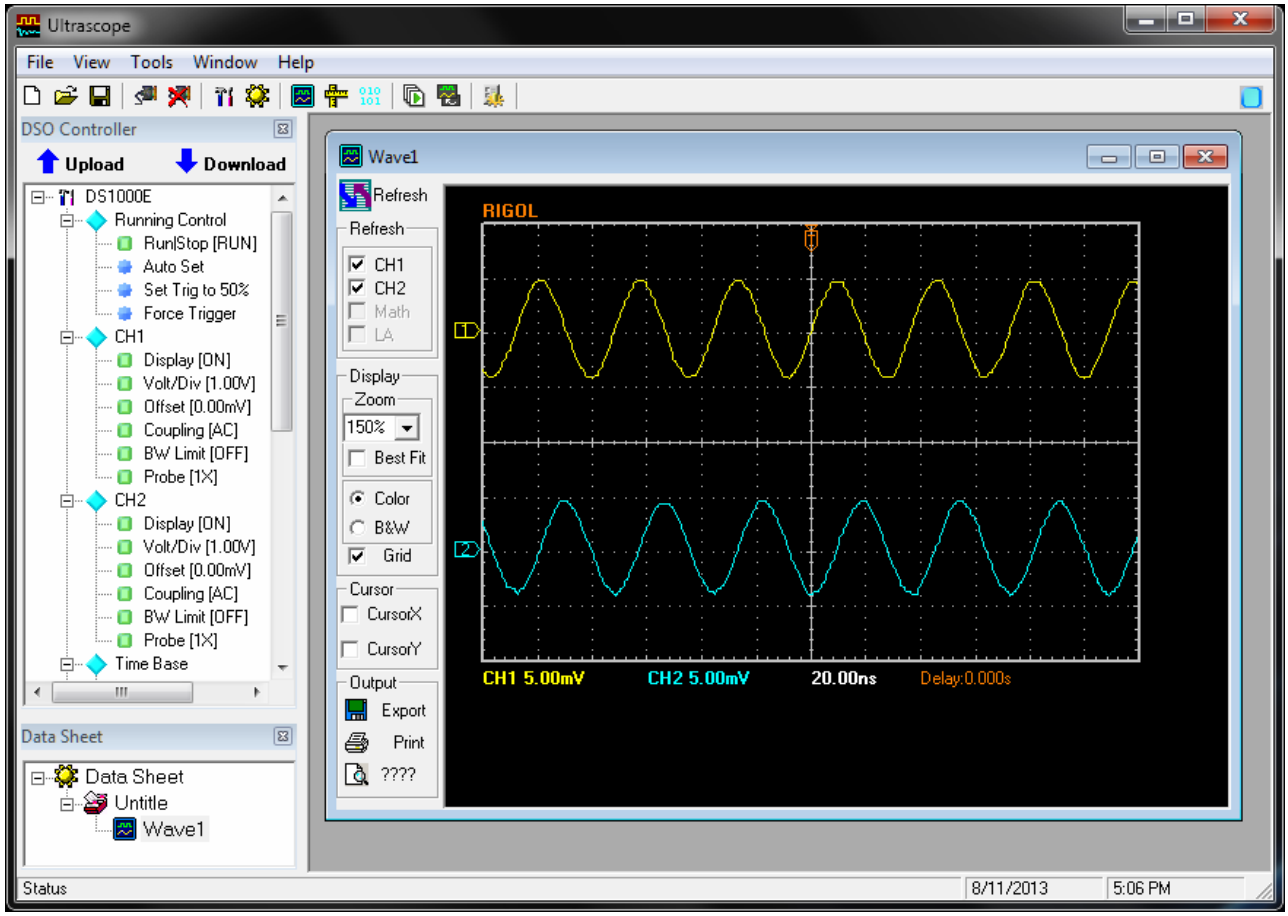
Test 3


Ultrascope
File View Tools Window Help
DSO Controller
Upload
Download
DS1000E
Running Control
RunlStop [RUN]
Auto Set
Set Trig to 50%
Force Trigger
CH1
Display [ON]
Volt/Div [1.00V]
Offset [0.00mV]
Coupling [AC]
BW Limit [OFF]
Probe [1X]
CH2
Display [ON]
Volt/Div [1.00V]
Offset [0.00mV]
Coupling [AC]
BW Limit [OFF]
Probe [1X]
Time Base
Data Sheet
Data Sheet
Untitle
Wave1
Wave1
Refresh
Refresh
CH1
CH2
Math
LA
Display
Zoom
150%
Best Fit
Color
B&W
Grid
Cursor
CursorX
CursorY
Output
Export
Print
????
RIGOL
CH1 5.00mV
CH2 5.00mV
20.00ns
Delay:0.000s
Status
8/11/2013
4:55 PM

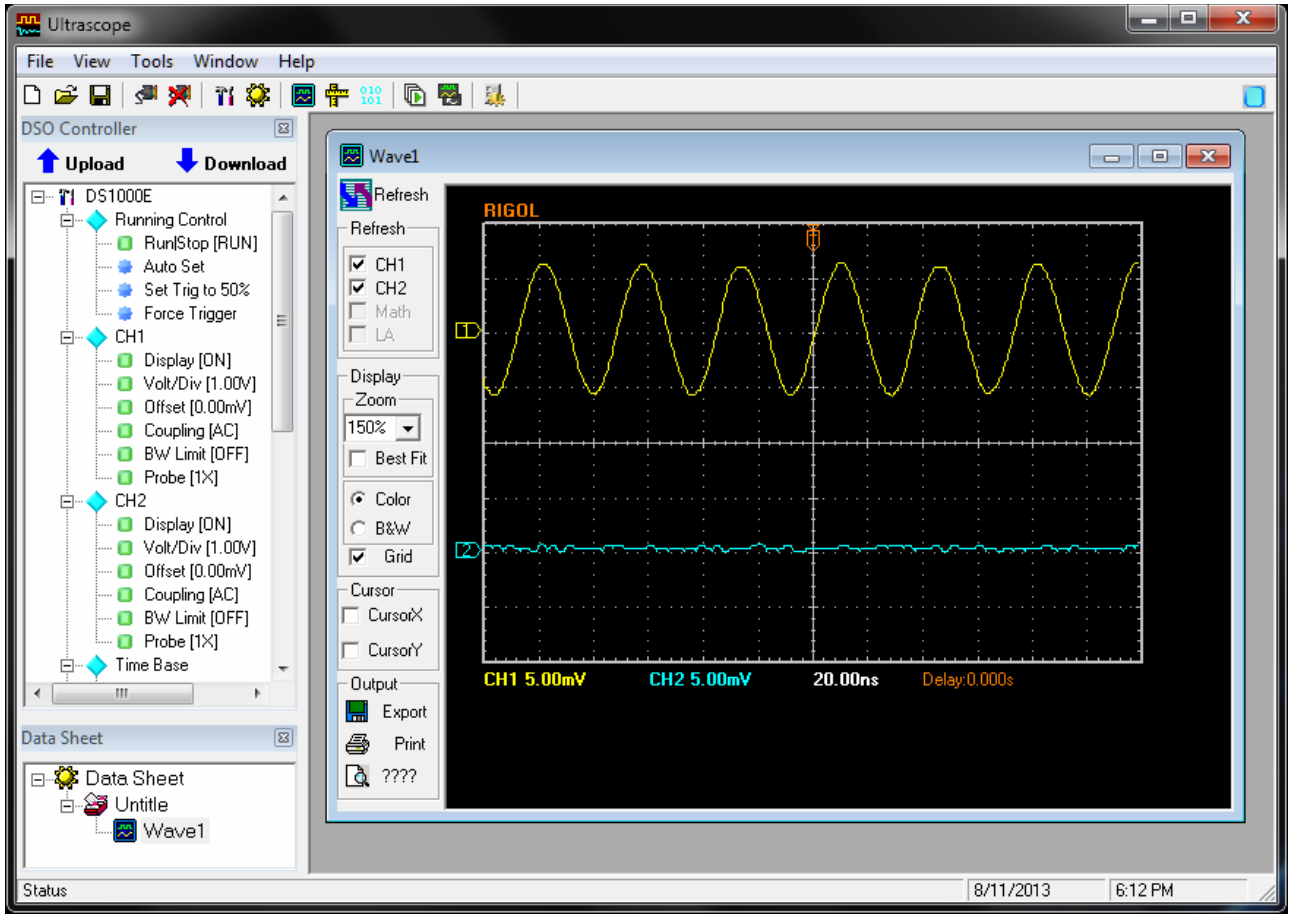
Test 4


Ultrascope
File View Tools Window Help
DSO Controller
Upload
Download
DS1000E
Running Control
RunlStop [RUN]
Auto Set
Set Trig to 50%
Force Trigger
CH1
Display [ON]
Volt/Div [1.00V]
Offset [0.00mV]
Coupling [AC]
BW Limit [OFF]
Probe [1X]
CH2
Display [ON]
Volt/Div [1.00V]
Offset [0.00mV]
Coupling [AC]
BW Limit [OFF]
Probe [1X]
Time Base
Data Sheet
Data Sheet
Untitle
Wave1
Wave1
Refresh
Refresh
CH1
CH2
Math
LA
Display
Zoom
150%
Best Fit
Color
B&W
Grid
Cursor
CursorX
CursorY
Output
Export
Print
????
RIGOL
CH1 5.00mV
CH2 5.00mV
20.00ns
Delay:0.000s
Status
8/11/2013
5:01 PM

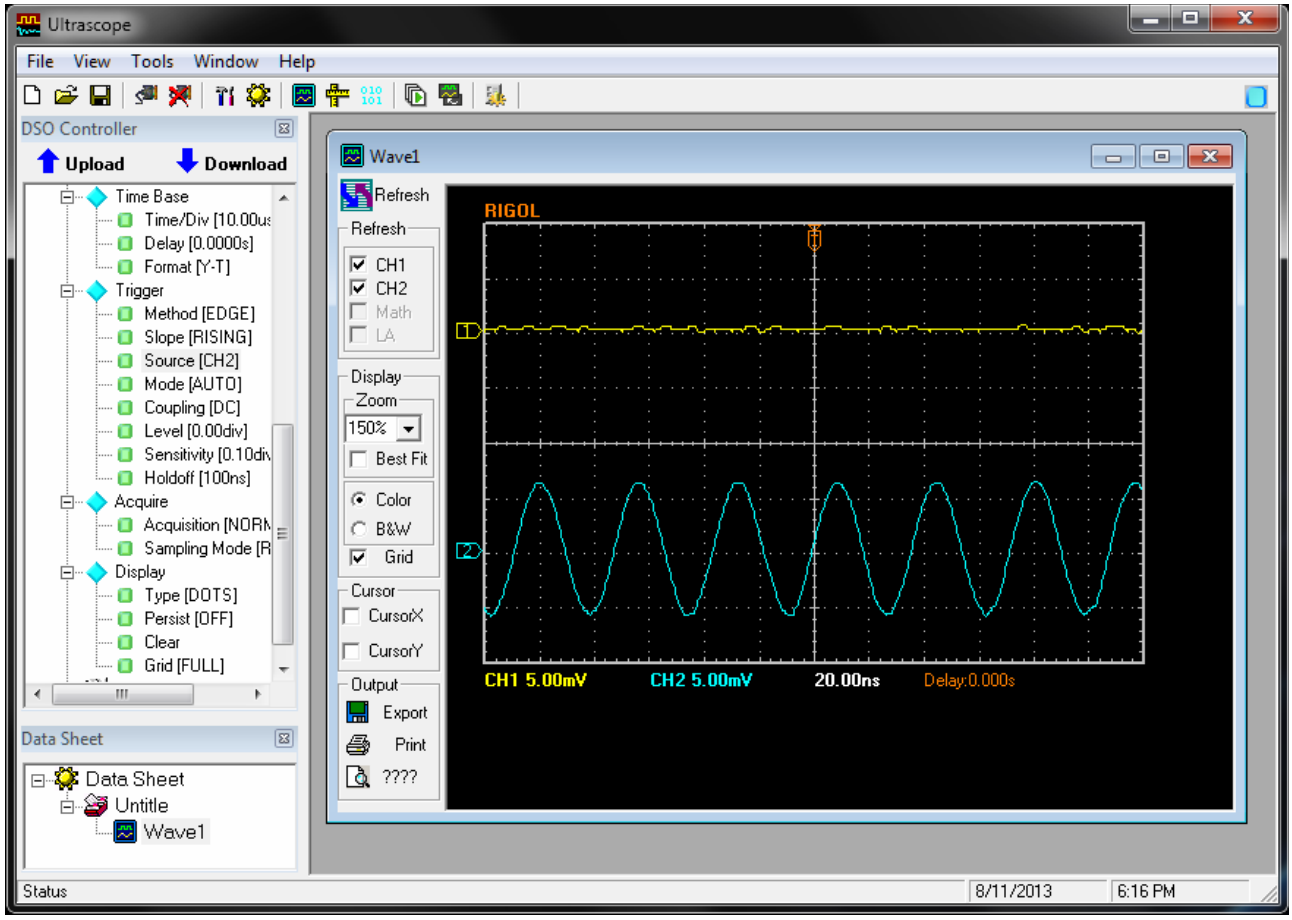
Test 5


Ultrascope
File View Tools Window Help
DSO Controller
Upload
Download
DS1000E
Running Control
Run|Stop [RUN]
Auto Set
Set Trig to 50%
Force Trigger
CH1
Display [ON]
Volt/Div [1.00V]
Offset [0.00mV]
Coupling [AC]
BW Limit [OFF]
Probe [1X]
CH2
Display [ON]
Volt/Div [1.00V]
Offset [0.00mV]
Coupling [AC]
BW Limit [OFF]
Probe [1X]
Time Base
Data Sheet
Data Sheet
Untitle
Wave1
Wave1
Refresh
Refresh
CH1
CH2
Math
LA
Display
Zoom
150%
Best Fit
Color
B&W
Grid
Cursor
CursorX
CursorY
Output
Export
Print
????
RIGOL
CH1 5.00mV
CH2 5.00mV
20.00ns
Delay:0.000s
Status
8/11/2013
5:06 PM

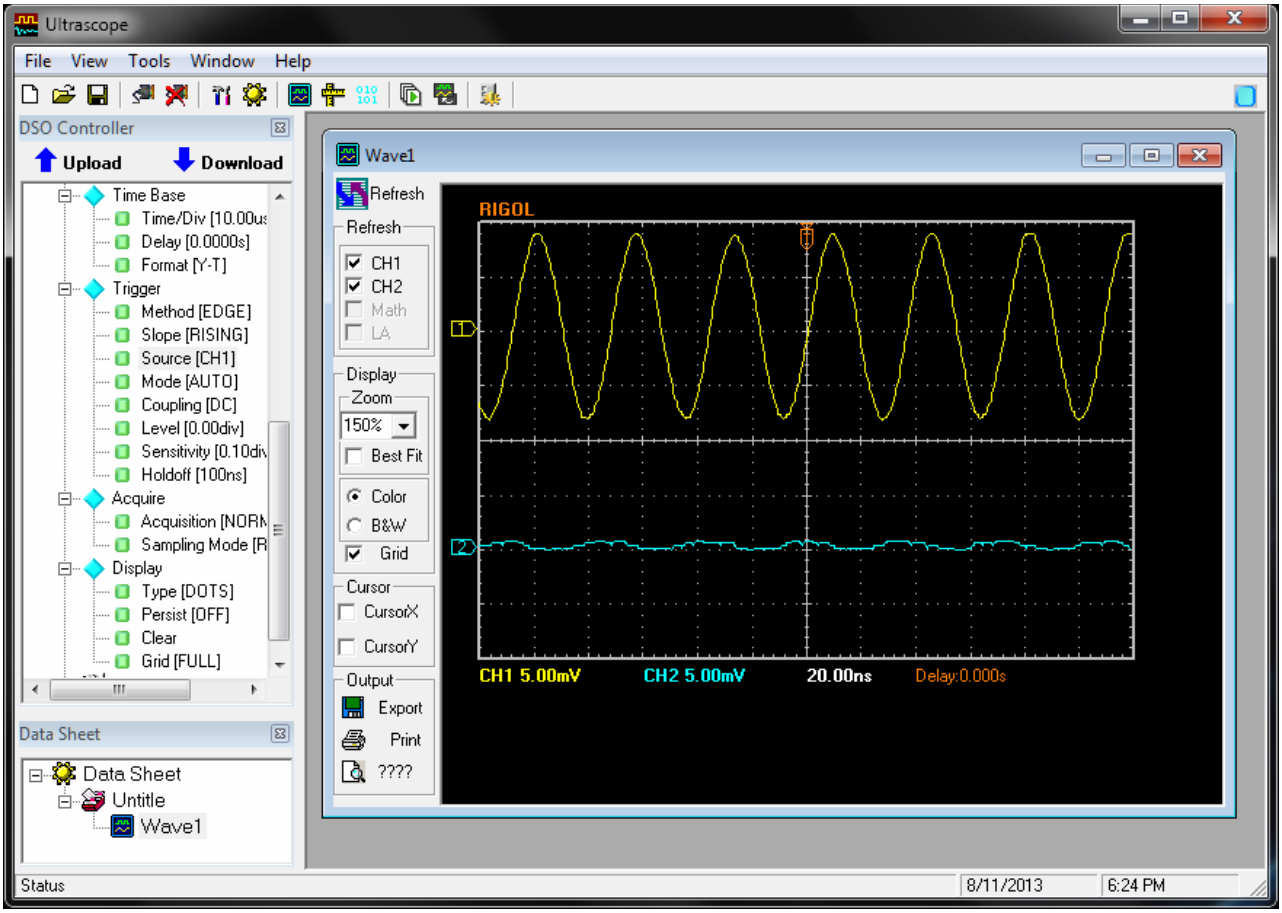
Test 6


Ultrascope
File View Tools Window Help
DSO Controller
Upload
Download
DS1000E
Running Control
Run|Stop [RUN]
Auto Set
Set Trig to 50%
Force Trigger
CH1
Display [ON]
Volt/Div [1.00V]
Offset [0.00mV]
Coupling [AC]
BW Limit [OFF]
Probe [1X]
CH2
Display [ON]
Volt/Div [1.00V]
Offset [0.00mV]
Coupling [AC]
BW Limit [OFF]
Probe [1X]
Time Base
Data Sheet
Data Sheet
Untitle
Wave1
Wave1
Refresh
Refresh
CH1
CH2
Math
LA
Display
Zoom
150%
Best Fit
Color
B&W
Grid
Cursor
CursorX
CursorY
Output
Export
Print
????
RIGOL
CH1 5.00mV
CH2 5.00mV
20.00ns
Delay:0.000s
Status
8/11/2013
6:12 PM

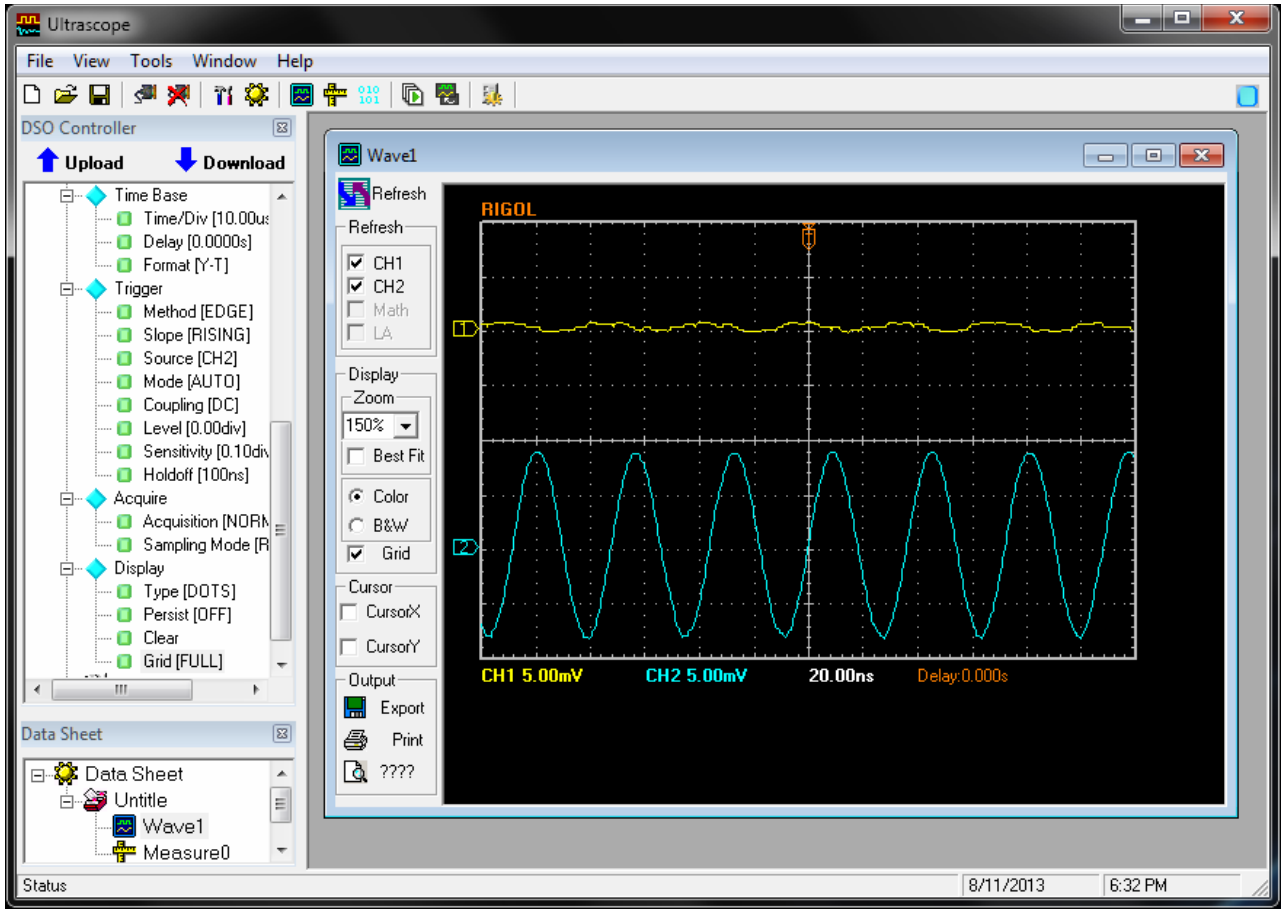
Test 7


Ultrascope
File View Tools Window Help
DSO Controller
Upload
Download
Time Base
Time/Div [10.00us
Delay [0.0000s]
Format [Y-T]
Trigger
Method [EDGE]
Slope [RISING]
Source [CH2]
Mode [AUTO]
Coupling [DC]
Level [0.00div]
Sensitivity [0.10div
Holdoff [100ns]
Acquire
Acquisition [NORM
Sampling Mode [R
Display
Type [DOTS]
Persist [OFF]
Clear
Grid [FULL]
Data Sheet
Data Sheet
Untitle
Wave1
Wave1
Refresh
Refresh
CH1
CH2
Math
LA
Display
Zoom
150%
Best Fit
Color
B&W
Grid
Cursor
CursorX
CursorY
Output
Export
Print
????
RIGOL
CH1 5.00mV
CH2 5.00mV
20.00ns
Delay:0.000s
Status
8/11/2013
6:16 PM

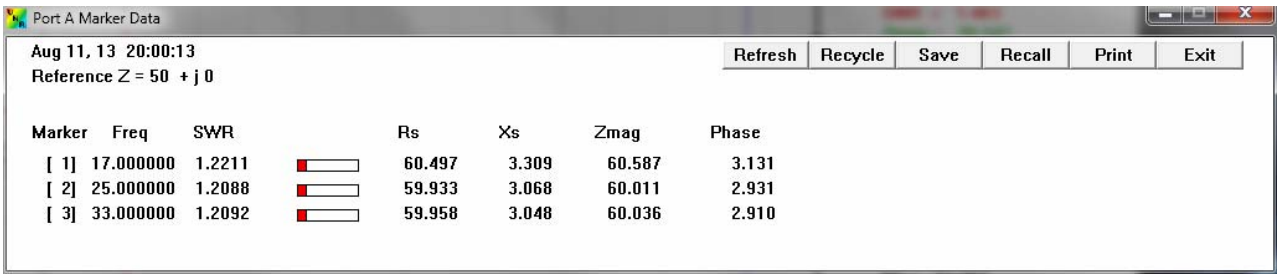
Test 8

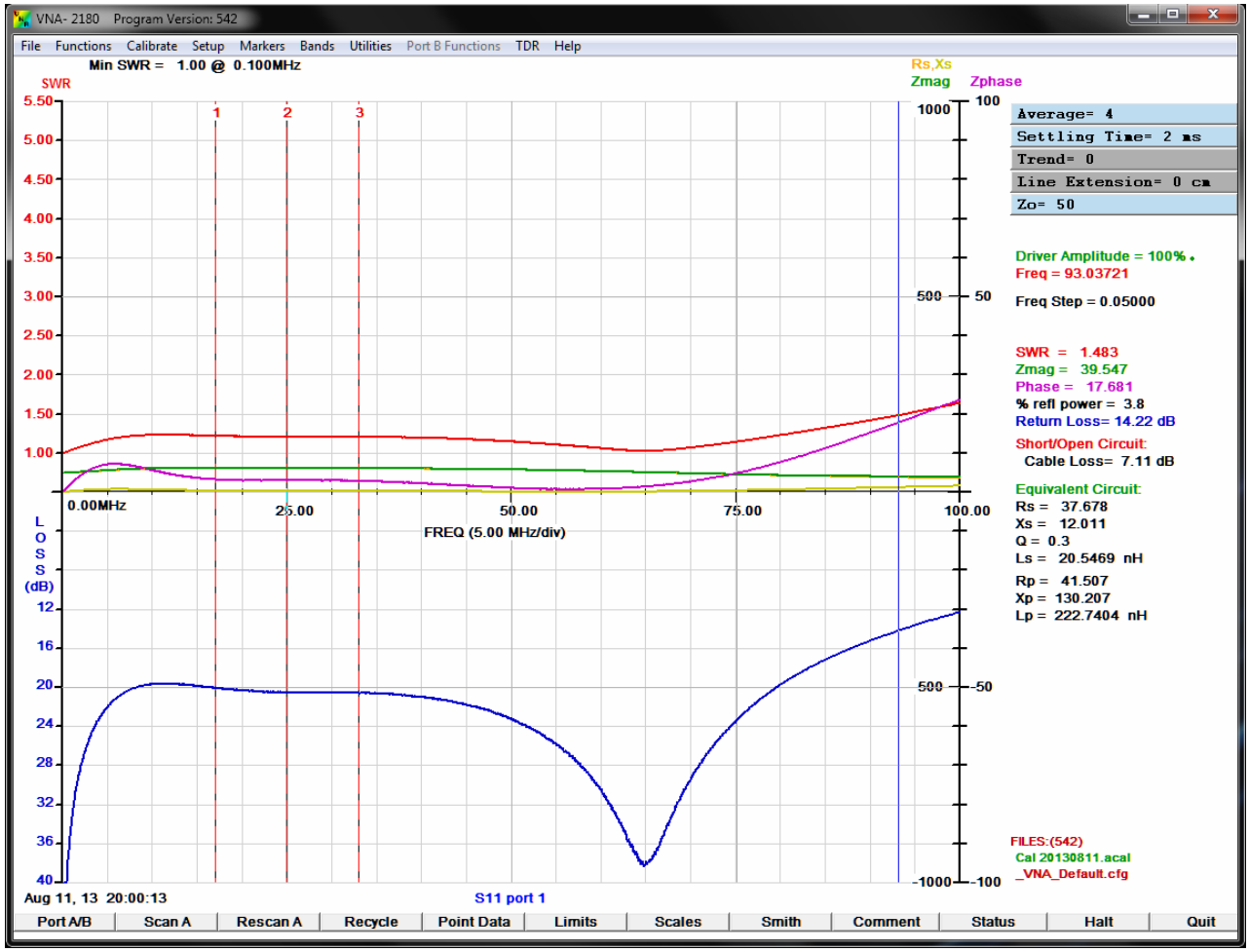

Ultrascope
File View Tools Window Help
DSO Controller
Upload
Download
Time Base
Time/Div [10.00us
Delay [0.0000s]
Format [Y-T]
Trigger
Method [EDGE]
Slope [RISING]
Source [CH1]
Mode [AUTO]
Coupling [DC]
Level [0.00div]
Sensitivity [0.10div
Holdoff [100ns]
Acquire
Acquisition [NORM
Sampling Mode [R
Display
Type [DOTS]
Persist [OFF]
Clear
Grid [FULL]
Data Sheet
Data Sheet
Untitle
Wave1
Wave1
Refresh
Refresh
CH1
CH2
Math
LA
Display
Zoom
150%
Best Fit
Color
B&W
Grid
Cursor
CursorX
CursorY
Output
Export
Print
????
RIGOL
CH1 5.00mV
CH2 5.00mV
20.00ns
Delay:0.000s
Status
8/11/2013
6:24 PM

Test 9

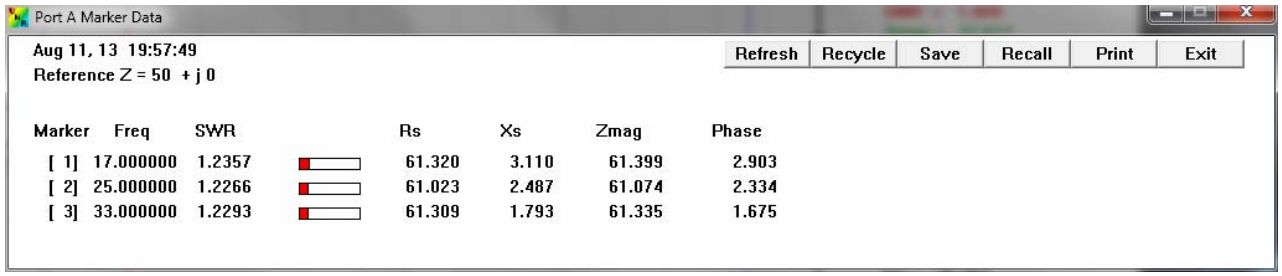

Ultrascope
File View Tools Window Help
DSO Controller
Upload
Download
Time Base
Time/Div [10.00us
Delay [0.0000s]
Format [Y-T]
Trigger
Method [EDGE]
Slope [RISING]
Source [CH2]
Mode [AUTO]
Coupling [DC]
Level [0.00div]
Sensitivity [0.10div
Holdoff [100ns]
Acquire
Acquisition [NORM
Sampling Mode [R
Display
Type [DOTS]
Persist [OFF]
Clear
Grid [FULL]
Data Sheet
Data Sheet
Untitle
Wave1
Measure0
Wave1
Refresh
Refresh
CH1
CH2
Math
LA
Display
Zoom
150%
Best Fit
Color
B&W
Grid
Cursor
CursorX
CursorY
Output
Export
Print
????
RIGOL
CH1 5.00mV
CH2 5.00mV
20.00ns
Delay:0.000s
Status
8/11/2013
6:32 PM

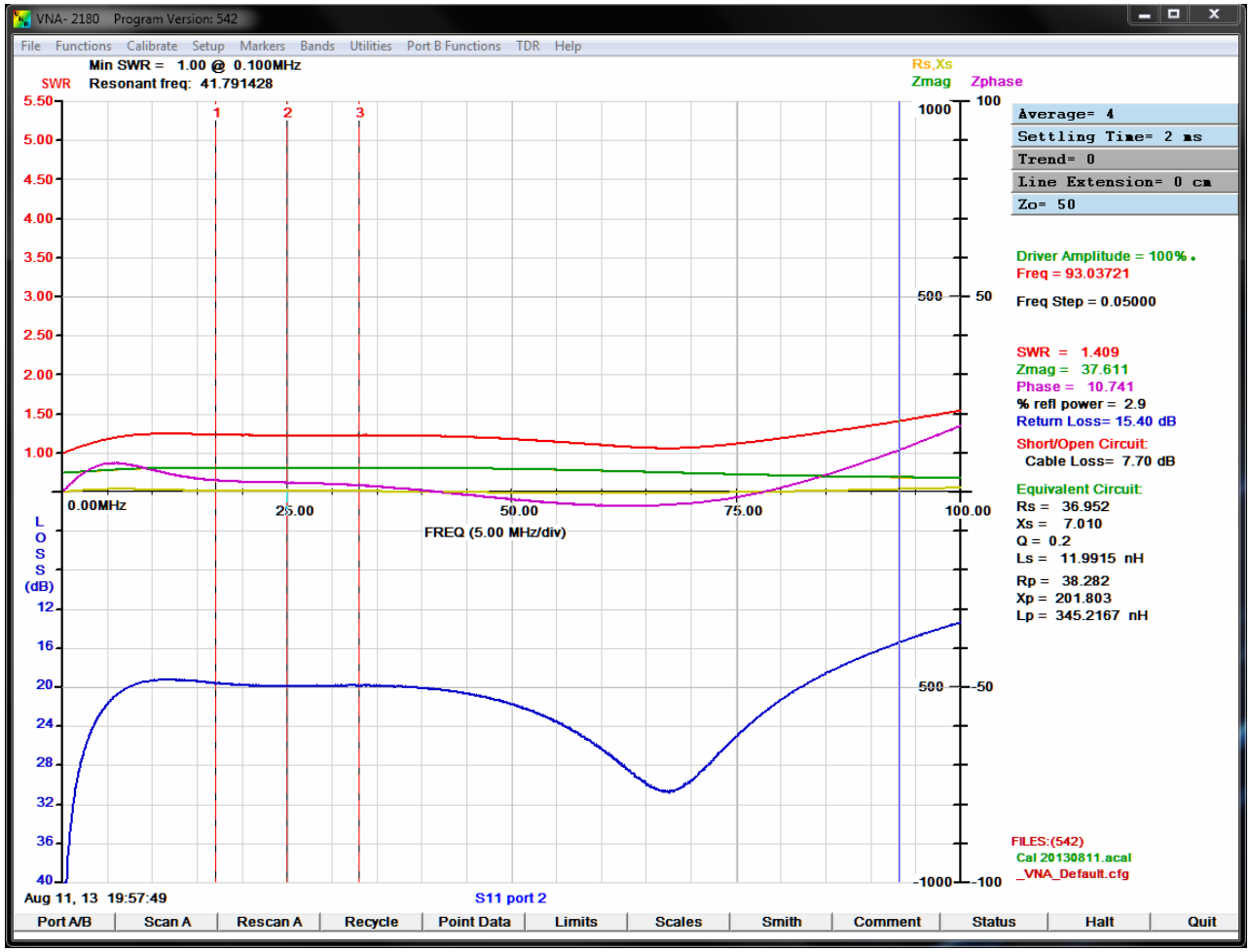
S11 port 1


Port A Marker Data
Aug 11, 13 20:00:13
Reference Z = 50 + j 0
Refresh
Recycle
Save
Recall
Print
Exit
Marker Freq SWR Rs Xs Zmag Phase
[ 1] 17.000000 1.2211 60.497 3.309 60.587 3.131
[ 2] 25.000000 1.2088 59.933 3.068 60.011 2.931
[ 3] 33.000000 1.2092 59.958 3.048 60.036 2.910

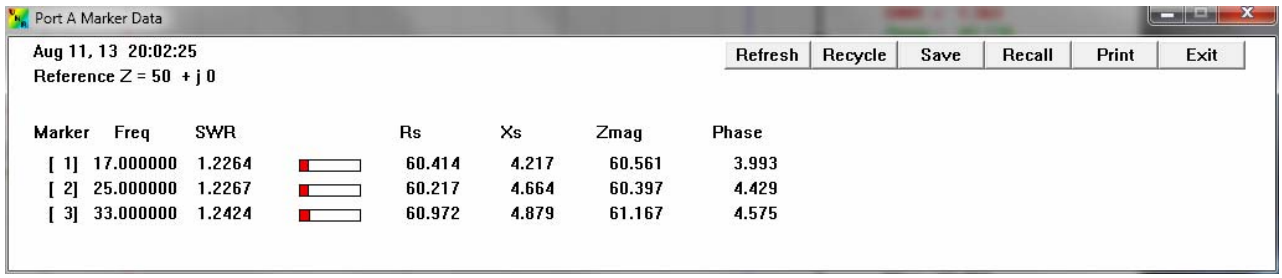

VNA- 2180 Program Version: 542
File Functions Calibrate Setup Markers Bands Utilities Port B Functions TDR Help
Min SWR = 1.00 @ 0.100MHz
SWR
Rs,Xs
Zmag Zphase
Average= 4
Settling Time= 2 ms
Trend= 0
Line Extension= 0 cm
Zo= 50
Driver Amplitude = 100%.
Freq = 93.03721
Freq Step = 0.05000
SWR = 1.483
Zmag = 39.547
Phase = 17.681
% refl power = 3.8
Return Loss= 14.22 dB
Short/Open Circuit:
Cable Loss= 7.11 dB
Equivalent Circuit:
Rs = 37.678
Xs = 12.011
Q = 0.3
Ls = 20.5469 nH
Rp = 41.507
Xp = 130.207
Lp = 222.7404 nH
FILES:(542)
Cal 20130811.acal
_VNA_Default.cfg
0.00MHz
25.00
50.00
75.00
100.00
FREQ (5.00 MHz/div)
LOSS (dB)
Aug 11, 13 20:00:13
S11 port 1
Port A/B Scan A Rescan A Recycle Point Data Limits Scales Smith Comment Status Halt Quit

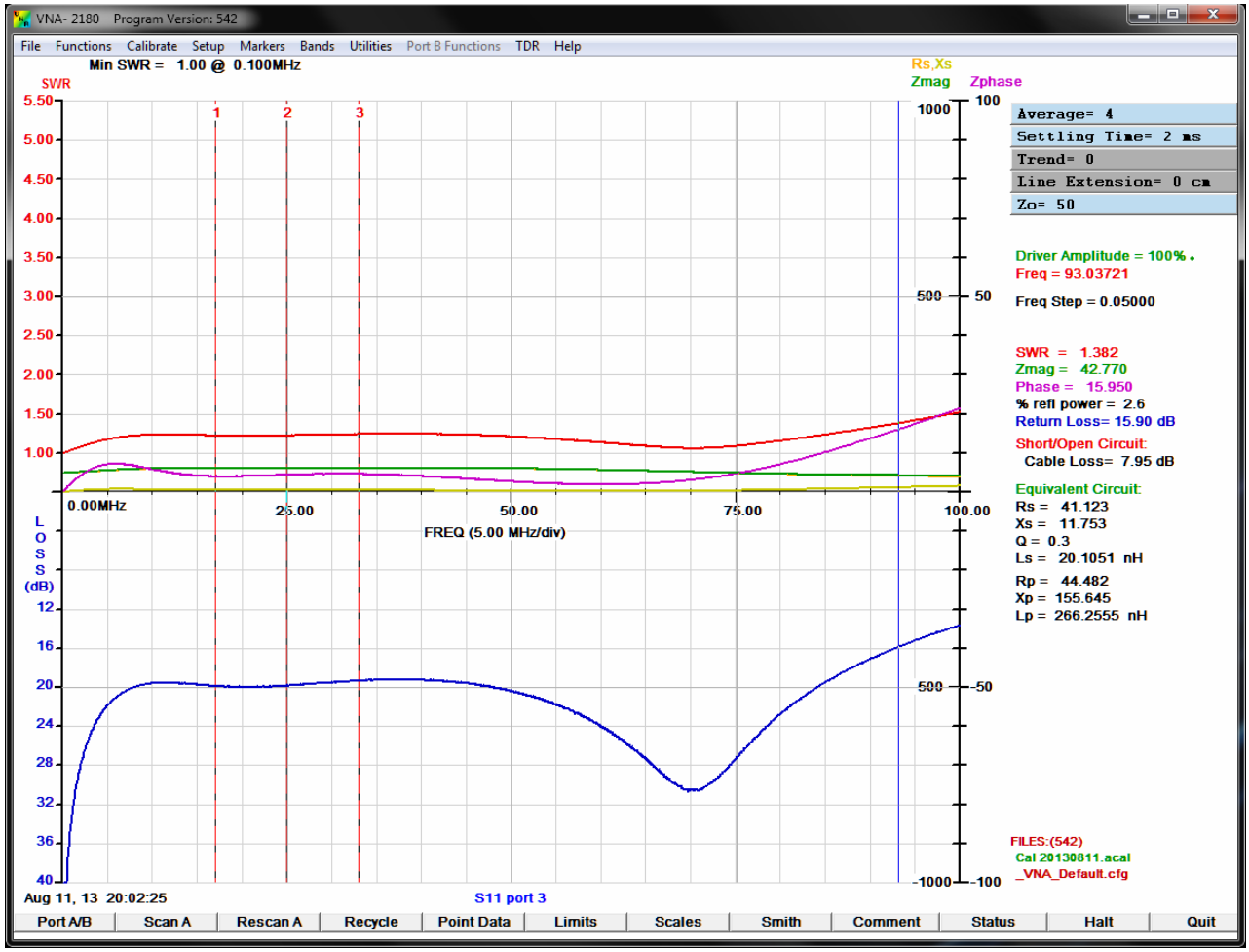
S11 port 2


Port A Marker Data
Aug 11, 13 19:57:49
Reference Z = 50 + j 0
Refresh Recycle Save Recall Print Exit
Marker Freq SWR Rs Xs Zmag Phase
[ 1] 17.000000 1.2357 61.320 3.110 61.399 2.903
[ 2] 25.000000 1.2266 61.023 2.487 61.074 2.334
[ 3] 33.000000 1.2293 61.309 1.793 61.335 1.675

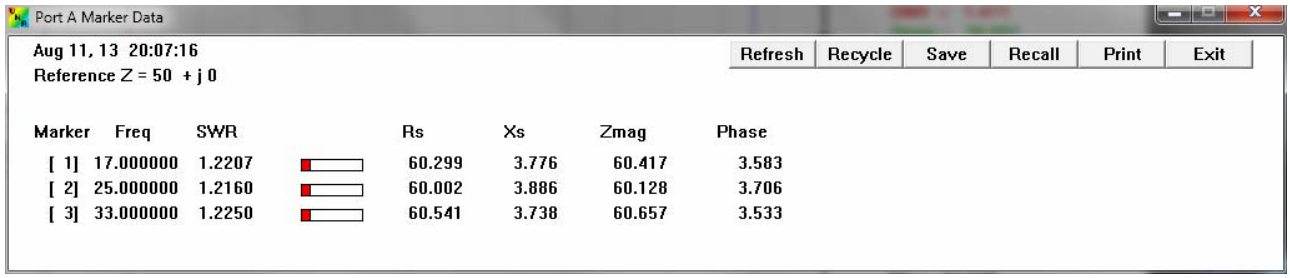

VNA- 2180 Program Version: 542
File Functions Calibrate Setup Markers Bands Utilities Port B Functions TDR Help
Min SWR = 1.00 @ 0.100MHz
SWR Resonant freq: 41.791428
Rs,Xs
Zmag Zphase
Average= 4
Settling Time= 2 ms
Trend= 0
Line Extension= 0 cm
Zo= 50
Driver Amplitude = 100%
Freq = 93.03721
Freq Step = 0.05000
SWR = 1.409
Zmag = 37.611
Phase = 10.741
% refl power = 2.9
Return Loss= 15.40 dB
Short/Open Circuit:
Cable Loss= 7.70 dB
Equivalent Circuit:
Rs = 36.952
Xs = 7.010
Q = 0.2
Ls = 11.9915 nH
Rp = 38.282
Xp = 201.803
Lp = 345.2167 nH
FILES:(542)
Cal 20130811.acal
_VNA_Default.cfg
0.00MHz
25.00
50.00
75.00
100.00
FREQ (5.00 MHz/div)
LOSS (dB)
Aug 11, 13 19:57:49
S11 port 2
Port A/B
Scan A
Rescan A
Recycle
Point Data
Limits
Scales
Smith
Comment
Status
Halt
Quit

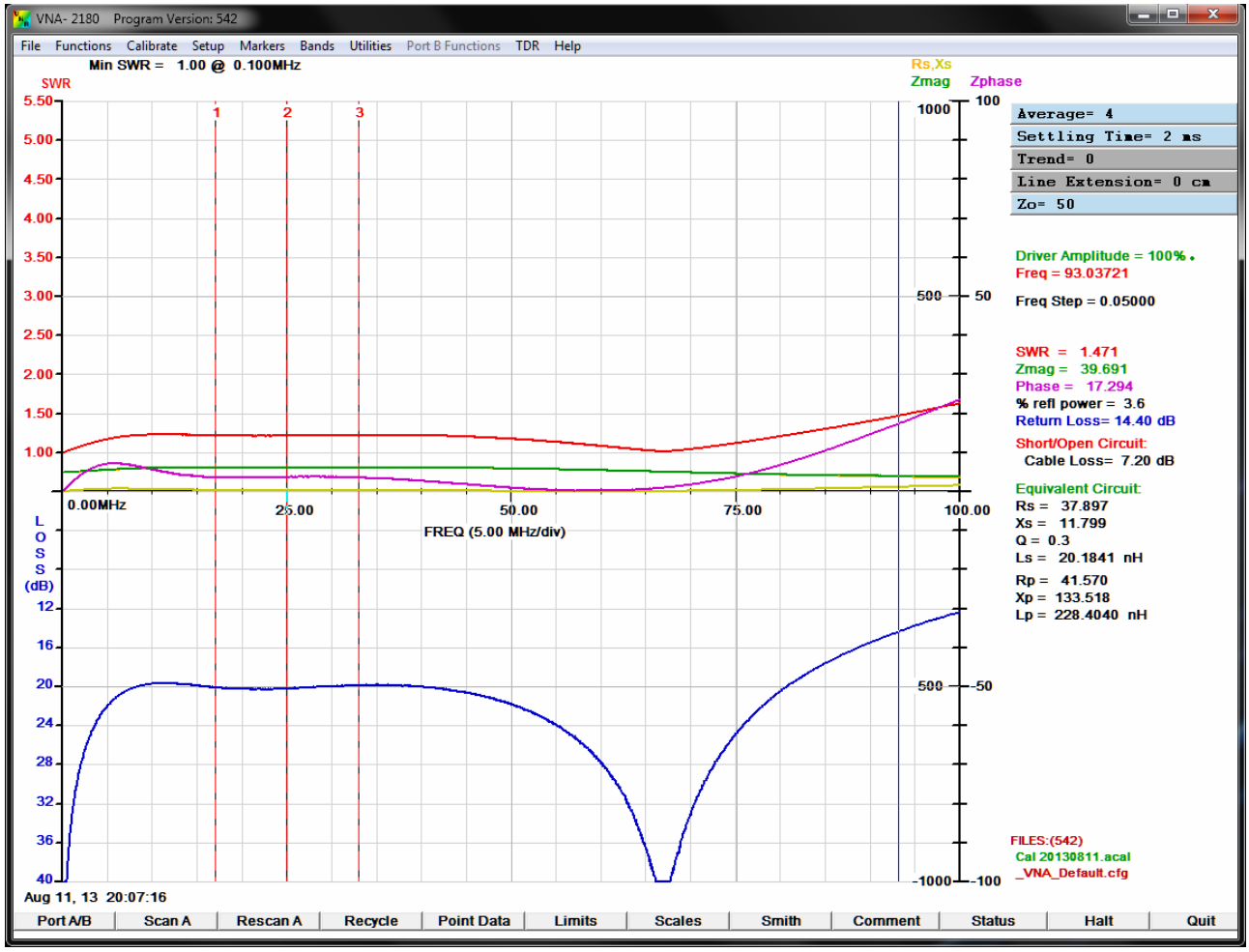
S11 port 3


Port A Marker Data
Aug 11, 13 20:02:25
Reference Z = 50 + j 0
Refresh
Recycle
Save
Recall
Print
Exit
Marker Freq SWR Rs Xs Zmag Phase
[ 1] 17.000000 1.2264 60.414 4.217 60.561 3.993
[ 2] 25.000000 1.2267 60.217 4.664 60.397 4.429
[ 3] 33.000000 1.2424 60.972 4.879 61.167 4.575

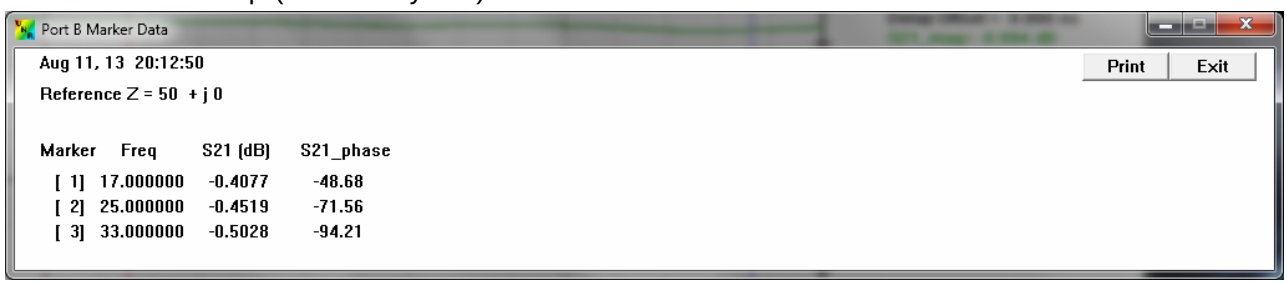

VNA- 2180 Program Version: 542
File Functions Calibrate Setup Markers Bands Utilities Port B Functions TDR Help
Min SWR = 1.00 @ 0.100MHz
SWR
Rs,Xs
Zmag Zphase
Average= 4
Settling Time= 2 ms
Trend= 0
Line Extension= 0 cm
Zo= 50
Driver Amplitude = 100%.
Freq = 93.03721
Freq Step = 0.05000
SWR = 1.382
Zmag = 42.770
Phase = 15.950
% refl power = 2.6
Return Loss= 15.90 dB
Short/Open Circuit:
Cable Loss= 7.95 dB
Equivalent Circuit:
Rs = 41.123
Xs = 11.753
Q = 0.3
Ls = 20.1051 nH
Rp = 44.482
Xp = 155.645
Lp = 266.2555 nH
FILES:(542)
Cal 20130811.acal
_VNA_Default.cfg
0.00MHz
25.00
50.00
75.00
100.00
FREQ (5.00 MHz/div)
LOSS (dB)
Aug 11, 13 20:02:25
S11 port 3
Port A/B
Scan A
Rescan A
Recycle
Point Data
Limits
Scales
Smith
Comment
Status
Halt
Quit

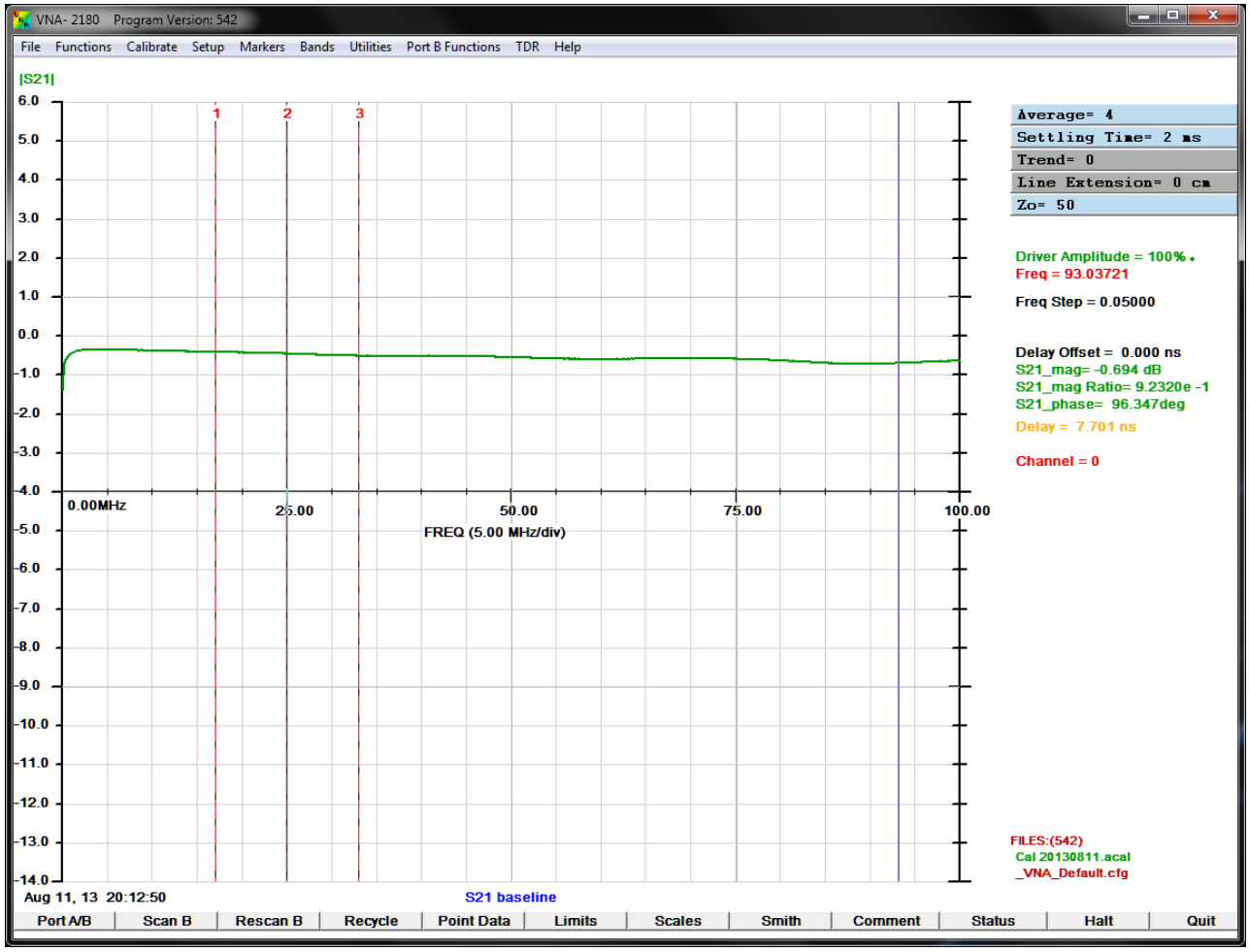
S11 port 4


Port A Marker Data
Aug 11, 13 20:07:16
Reference Z = 50 + j 0
Refresh
Recycle
Save
Recall
Print
Exit
Marker Freq SWR Rs Xs Zmag Phase
[ 1] 17.000000 1.2207 60.299 3.776 60.417 3.583
[ 2] 25.000000 1.2160 60.002 3.886 60.128 3.706
[ 3] 33.000000 1.2250 60.541 3.738 60.657 3.533

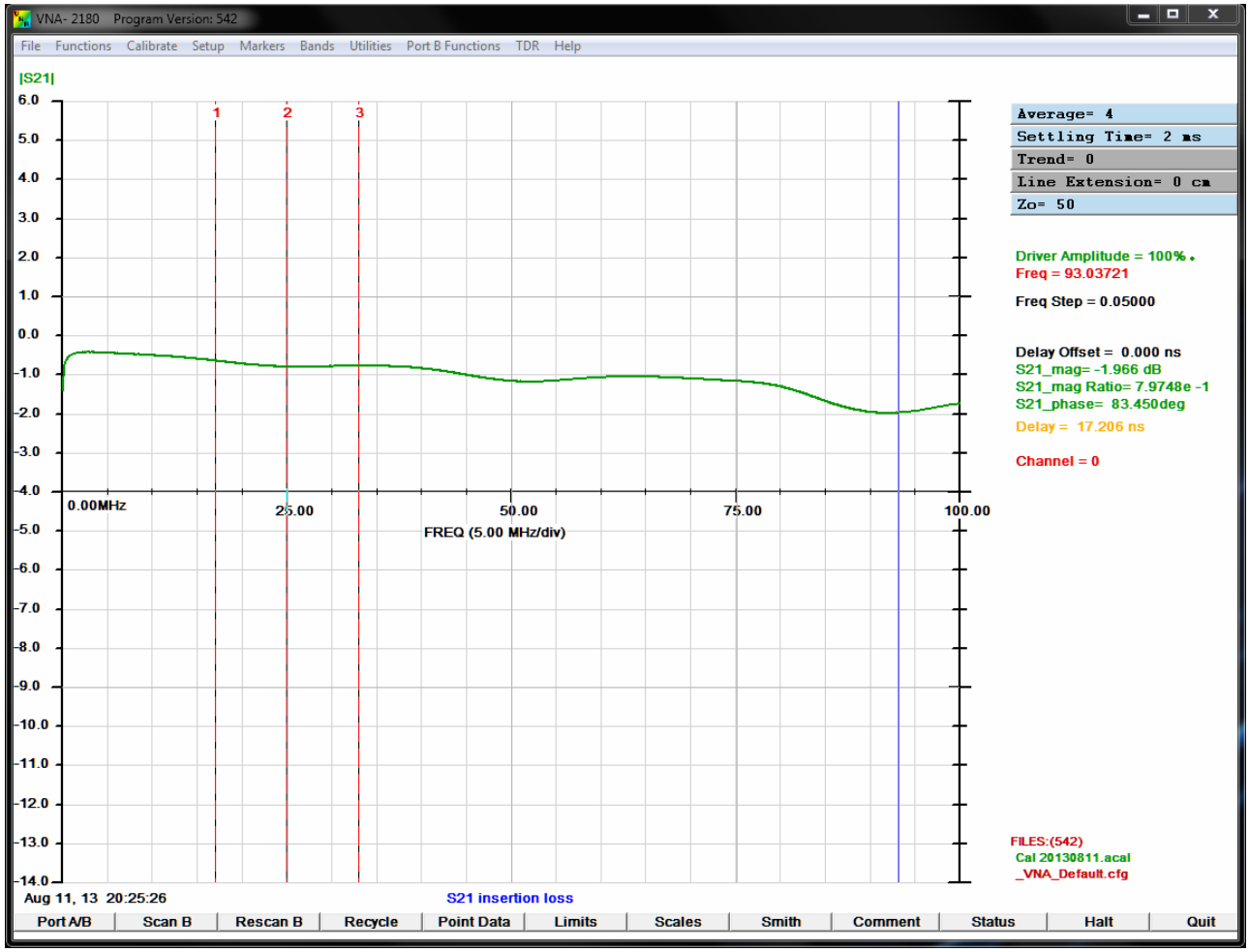



S21 baseline sweep (without hybrid)






S21 insertion loss test (with hybrid)


VNA- 2180 Program Version: 542
File Functions Calibrate Setup Markers Bands Utilities Port B Functions TDR Help
|S21|
6.0
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
-11.0
-12.0
-13.0
-14.0
1
2
3
0.00MHz
25.00
50.00
75.00
100.00
FREQ (5.00 MHz/div)
Average= 4
Settling Time= 2 ms
Trend= 0
Line Extension= 0 cm
Zo= 50
Driver Amplitude = 100%
Freq = 93.03721
Freq Step = 0.05000
Delay Offset = 0.000 ns
S21_mag= -1.966 dB
S21_mag Ratio= 7.9748e -1
S21_phase= 83.450deg
Delay = 17.206 ns
Channel = 0
FILES:(542)
Cal 20130811.acal
_VNA_Default.cfg
Aug 11, 13 20:25:26
S21 insertion loss
Port A/B
Scan B
Rescan B
Recycle
Point Data
Limits
Scales
Smith
Comment
Status
Halt
Quit