## ECE 451

## Automated Microwave Measurements Laboratory

## Copper Mountain Vector Network Analyzer (VNA) Quick guide

This short guide is meant to be a supplementary documentation for RF/microwave measurement on Copper

Mountain Technologies (CMT) VNA. From the lab computer, search for used to communicate with the CMT VNA would pop up as in Figure 1.



Figure 1: S2VNA interface

The menu bar on the right of the screen will be where most of the settings will take place. Take time to get acquaintance with it.

Similar to any other VNA software, there are some most used menu you will need to know where to find. As usual, System > Preset should be triggered before any measurement attempts.

Given a menu, for every item has the arrow and, there are sub-menus under it. Once you expand an item, it becomes the parent menu and is shown on the top of the column (as a blue button), you can click on it to go back

to upper level. For intance, clicking on \_\_\_\_\_\_ in Figure 1 will lead you to the menu bar as in Figure 2, from

which, clicking on work which, you get back to the menu bar in Figure 1.

Now, let's explore some frequently used menu.

• Stimulus: to set Frequency range, Number of points etc.



Figure 2: Stimulus menu

• Calibration: to perform calibration, add new cal. set (escpecially with self-designed TRL standards)



Figure 3: Calibration menu

Click on to pick the appropriate calibration set. In Figure 4, the Agilent 85054B N-type cal kit was selected.

🚱 CI	AT S5	5048	Netwo	ork Ar	nalyzer	20 kH	lz - 4.8 Gl	Hz N15077	008								
Trac	e/Chan	nel	Stim	ulus	Respo	nse	Display	Calibrat	ion Ma	rkers	Analysis	Save/Recall	System				Col Vit
Tr1	511 L	.og	Mag 1	0.00	) dB/	<b>0.0</b>	00 dB										85054B
50	. <sup>00</sup> [																
40	.00															1	Select
30	.00																
																	Define CTDa
20	.00																Denne STDS
10	.00																Specify CLSs
0.	000																
-10	.00																Restore Cal Kit
-20	.00																
-30	0.00																Save To File
-40	.00																and From File
																	Joad From File
-50	.00 L		5(	MOC	1	LG	1.	5G	2G	2.5	G 3	G 3.	5G 4G	i 4.5	G		
	🛾 Star	t 20	kHz				201	L	in	10	kHz	0 dBm		Stop	4.8 GHz		On-Screen
	Label			Descr	iption						Select	Predefine	d Modified	#STDs	*		Keyboard
1	85032	2F		Туре-	N 50Ω 9	GHz	Cal Kit (/	\gilent)				Yes	No	9			
2	85032	2B/E		Туре-	N 50Ω (	5GHz	Cal Kit (/	Agilent)				Yes	No	7			
3	N611/	/12/9	11/12	Туре-	·N 50Ω (	5GHz	Cal Kit, S	S/N Axx, Bx	(CMT)			Yes	No	7			
4	85054	1D		Туре-	<u>N 50Ω</u>	L8GHz	z Cal Kit	(Agilent)				Yes	No	7			
5	85054	1B		Туре-	·N 50Ω 1	L8GHz	z Cal Kit ı	with Sliding	Load (A	gilent)	•	Yes	No	9			
6	05CK	10A-:	150	Туре-	·N 50Ω 1	L8GHz	z Cal Kit (	Rosenberg	er)			Yes	No	7			
7	8850F	9/Q		Туре-	·N 50Ω 1	L8GHz	z Cal Kit	Maury Micr	rowave)			Yes	No	7			
8	88500	2		Туре-	N 50Ω 1	L8GHz	z Cal Kit	with Sliding	Load (M	laury M		Yes	No	9			
9	85033	BD/E		3.5 m	m 6GHz	:/9GH	z Cal Kit	(Agilent)				Yes	No	7			
10	85052	2B		3.5 m	m 26.5	GHz C	al Kit wi	th Sliding Lo	bad (Agile	ent)		Yes	No	11	-		
2/15	2017 1	L0:45	5		- 16 E		01 T /T'DI	7.51 1/14 / 1/2	inent)			Yee	Mea	s N1507700	BReady		

Figure 4: Cal. kit selection

- Now, go back to Calibration menu (Figure 3), click Colibrate D, and perform calibration. As same as any other VNAs, for each standard that is applicable, always specify the sex of connectors (Male or Female). After a standard was measured, it is greyed out and gets a "tick" in front. See Figure 5.

Full 2-Port Cal 85032F	Port 1 Open 85032F	Full 2-Port Cal
Port1 Open 🗅	Subclass 1	√ Port1 Open  >
Port1 Short 🛛 🖒	Subclass 2	Port1 Short
Port1 Load Broadband	Open -M-	Port1 Load Broadband
Port2 Open 🗅	Subclass 4	Port2 Open
Port2 Short 🛛 🖒	0. h de ur t	Port2 Short
Port2 Load Broadband	Subclass 5	Port2 Load Broadband
Port1-2 Thru 🛛 🖒	Subclass 7	Port1-2 Thru
Port1-2 Isol (Optional)	Subclass 7	Port1-2 Isol (Optional)
Apply		Apply
Cancel  >	шо	Cancel

Figure 5: Calibration process

• **Display:** to display measured data (Figure 6).



Figure 6: Display menu bar

- You can change **Num Of Traces** you want to observe at the same time. The highlighted trace is the active one in case we want to perform calculations on the data trace.

<i>®</i> смт	S5048	Network A	Analyzer	20 kH:	z - 4.8 GH	z N1507700	8						
Trace/Cha	annel	Stimulus	Respo	inse	Display	Calibration	n Markers	Analysis	Save/Recall	System			Num Of Traces
Tr1 511 Tr2 521 Tr3 512 Tr4 522	Log Log Log Log	Mag 10.0 Mag 10.0 Mag 10.0 Mag 10.0	00 dB/ 00 dB/ 00 dB/ 00 dB/	<ul> <li>0.00</li> <li>0.00</li> <li>0.00</li> <li>0.00</li> </ul>	00 dB 00 dB 00 dB 00 dB								4
50.00													1
40.00													2
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10.00													5
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-50.00		500M		1G	1.5	5G 2	G 2.	5G 3	G 3.	5G 4	G 4.	5G 2	
Dii Sta	art 20	KHZ	_	_	201	Lin	1	U KHZ	0 dBm		Sto	p 4.8 GHz	$\overline{\nabla}$
2/15/2017	10:40	J								j Mei	as jN150/700	Ready	

Figure 7: Multiple display

- Allocate Traces will allow you to pick a layout for all traces.

🍪 CMT S5048 Network Analyzer 20 kHz - 4.8 GHz	z N15077008	
Trace/Channel Stimulus Response Display	Calibration Markers Analysis Save/Recall System	
Tr1 S11 Log Mag 10.00 dB/ ▶0.000 dB	Tr2 S21 Log Mag 10.00 dB/ ▶0.000 dB	Allocate Traces
40.00	40.00	
30.00	30.00	×1
20.00	20.00	
10.00	10.00	×2
0.000	₫ 0.000	
-10.00	-10.00	×2
-20.00	-20.00	
-30.00	-30.00	×3
-40.00	-40.00	
-50.00 500M 1G 1.5G 2G 2.5G 3G 3.	5G 4G 4.5G -50.00 500M 1G 1.5G 2G 2.5G 3G	3.5G 4G 4.5G 2 ×3
Tr3 S12 Log Mag 10.00 dB/ ▶0.000 dB 50.00	Tr4 522 Log Mag 10.00 dB/ ▶0.000 dB	
40.00	40.00	×3
30.00	30.00	
20.00	20.00	×4
10.00	10.00	
0.000	0.000	×4 🛄
-10.00	-10.00	
-20.00	-20.00	×6
-30.00	-30.00	
-40.00	-40.00	×6
-50.00 500M 1G 1.5G 2G 2.5G 3G 3.	5G 4G 4.5G 3 -50.00 500M 1G 1.5G 2G 2.5G 3G	3.5G 4G 4.5G
Off Start 20 kHz 201	Lin 10 kHz 0 dBm	Stop 4.8 GHz 🤝
2/15/2017 10:42	Meas	N15077008 Ready

Figure 8: Multiple display with layout

- In case you prefer switching between traces, click directly on the trace name located at the top left corner. You can also change the data format in which each trace is plotted as in Figure 9.

Trace/Channel	Stimulus	Respor	nse Dis	play (	Calibration
Tr1 511 Log 50 511 51	Mag 10.00	) dB/	0.000	dв	
521 52	2				
40.00					
Trace/Cha	nnel Stim	ulus F	Response	Displa	av.
Tr1 S11	Log Mag :	10.00	dв/ ▶0.	000 de	
50.00	Log Mag				
	Phase	<u> </u>			
40.00	Delay				
	Real				
	Imag Smith(L	og)			
30.00	Smith(L Smith(R	in) e/Im)			
	Smith(R-	+jX)			
20.00	Polar (L	og)			
20.00	Polar (L Polar (R	e/Im)			

Figure 9: Multiple display with layout

• Marker: to put makers on traces. Add many markers as you want. In case you have multiple traces on the



screen, recall that the highlighted trace is active and makers will be added to it. Figure 10 shows how you can change the location of a marker.

Figure 10: Multiple display with layout

There are many other fascinating features waiting for you to explore.