Application Note FOR

SMA Calibration Kit for VNA

LCAL06A, LCAL06B, LCAL06C and LCAL09A are precision SMA calibration kits which provide accurate and reliable Short-Open-Load-Thru (SOLT) or Load-Reflect-Match (LRM) calibration of a vector network analyzer (VNA). Each calibration kit is carefully fine tuned and measured to ensure the performance factory guaranteed specifications as described in its data sheet.

LCAL06A

A female calibration kit and used for DC \sim 6.0 GHz VNA test cable with male end connector.

It includes the following items:

- 1) Short SMA Male (Part # LSHOR001). *This part needs to be used with Thru (Part # LTHRU001A) to form SMA Female Short.*
- 2) Open SMA Male (Part # LOPEN001). *This part needs to be used with Thru (Part # LTHRU001A) to form SMA Female Open.*
- 3) Load SMA Male (Part # LLOAD001M) *This part needs to be used with Thru (Part # LTHRU001A) to form SMA Female Load.*
- 4) Thru (Part # LTHRU001A) SMA Female/Female

Below is the example of a female kit LCAL06A:



LCAL06B

A male calibration kit and used for DC ~ 6.0 GHz VNA test cable with female end connector.

It includes the following items:

- 1) Short (Part # LSHOR001) SMA Male
- 2) Open (Part # LOPEN001) SMA Male
- 3) Load (Part # LLOAD001M) SMA Male
- 4) Thru (Part # LTHRU001B) SMA Male/Male

LCAL06C

A combo (female/male) calibration kit and used for DC ~ 6.0 GHz VNA test cable with either male or female end connectors.

It includes the following items:

- 1) Short (Part # LSHOR001)
 - a. SMA Male
 - b. SMA Female: *This part needs to be used with Thru (Part # LTHRU001A) to form SMA Female Short.*
- 2) Open (Part # LOPEN001)
 - a. SMA Male
 - b. SMA Female: This part needs to be used with Thru (Part # LTHRU001A) to form SMA Female Open.
- 3) Load (Part # LLOAD001M) SMA Male
 - a. SMA Male
 - b. SMA Female: *This part needs to be used with Thru (Part # LTHRU001A) to form SMA Female Load.*
- 4) Thru (Part # LTHRU001A) SMA Female/Female
- 5) Thru (Part # LTHRU001B) SMA Male/Male

LCAL09A

A female calibration kit and used for DC \sim 9.0 GHz VNA test cable with either male or female end connectors.

It includes the following items:

- Short SMA Male (Part # L022). This part needs to be used with Thru (Part # L020) to form SMA Female Short.
- 2) Open SMA Male (Part # L023).
 - This part needs to be used with Thru (Part # L020) to form SMA Female Open.
- 3) Load SMA Male (Part # L024) This part needs to be used with Thru (Part # L020) to form SMA Female Load.
- 4) Thru (Part # L020) SMA Female/Female

Connect Cal Kit to Test Cable

In order to maintain the performance of each kit and the accuracy of the calibration, a torque wrench with $5 \sim 6$ lb-Inch is *required* to connect or disconnect the kit from a test cable at the cable side SMA mating connector. Never try to turn the kits which may cause the kits to be permanently damaged.

Define the calibration kit parameters for SOLT calibration

The following instruction is used as an example

- Agilent E8357A
- A new CalKit file named "demo"
- A female Calibration Kit LCAL06A with the following measured parameters.

	Offset	C0	C1	C2	C3	Offset Loss (Gohm/S)
Short	55.7 ps (16.70 mm)					4.8
Open	55.7 ps (16.70 mm)	45	6	-2.5	0	4.8
Load	0					4.8
Thru	55.70 ps (16.70 mm)					4.8

Legend:

Yellow rounded rectangular means the user needs to select or type; Blue rounded rectangular means the user needs to pay extra attention.

1. Prep Network Analyzer

- 1) Turn on a network analyzer such as Agilent 8753 ES for at least 2 hours.
- 2) Load predefined settings like port power.
- 3) Then Select "Advanced Modify Cal Kit..."



2. Create a baseline Calibration Kit File

1) Open a factory calibration kit file such as Agilent 85052D, and select "Save As...".

dit	PNA Cal Kits		- 🗆 ×
0)pen Save A:	s Restore Defaults	
8		Installed Kits	
	Import Kit.	Save As Insert New Print to File	
ID	Kit Name	Description	
1	85032F	TypeN (50) Calibration Kit	
2	85032B/E	TypeN (50) Calibration Kit	
3	85054B	TypeN (50) with sliding load	
4	85054D	TypeN (50) Calibration Kit	
5	85036B/E	TypeN (75) Calibration Kit	
6	85039B	Type-F (75) Calibration Kit	
7	85052B	3.5 mm with sliding load	
8	85052D	3.5 mm Calibration Kit	
9	85033D7E	3.5 mm Calibration Kit	
10	85052C	3.5 mm SOLT/TRL Calibration Kit	
11	85056A	2.4 mm with sliding load	
12	85056D	2.4 mm Calibration Kit	
13	Maury 8770C	2.92 mm Sliding Load	
14	Maury 8770D	2.92 mm Broadband Load	
15	85056K	2.4 mm/2.92 mm with Broadband Load	
16	85056K01	2.4 mm/2.92 mm with Sliding Load	
17	850588 Databa	1.85 mm Precision Database Cal Kit	*
	Ec	dit Kit Delete v	
		OK Cancel	Help

2) Save to Cal Kit user directory:

Save in:	😂 user	- 🖬 😁 -	
My Recent Documents Desktop My Documents My Computer	My Recent Documents Desktop My Documents My Computer My Computer SYSTEM (C:) Program Files Agilent Network Analyzer PnaCalKits DATA (D:) RECOVERY (E:) USB DISK (F:) Shared Documents My Documents		
	My Documents	•	Save
Mu Network	Save as type: Calkit Files (*.ckt)		Cancel



A unique file name shall be used. This example uses "demo" as the file name:

- 3) Import this newly created Calkit file:
 - a. Select "Import Kit...", then "OK" button:

E dit F	PNA Cal Kits		
0	pen Save As	Restore Defaults	
_		lustallard Kits	
		Installed Kits	
	Import Kit	Save As Insert New Print to File	
ID	Kit Name	Description	
1	85032F	TypeN (50) Calibration Kit	
2	85032B/E	TypeN (50) Calibration Kit	
3	85054B	TypeN (50) with sliding load	
4	85054D	TypeN (50) Calibration Kit	
5	85036B/E	TypeN (75) Calibration Kit	
6	85039B	Type-F (75) Calibration Kit	
7	85052B	3.5 mm with sliding load	
8	85052D	3.5 mm Calibration Kit	
9	85033D7E	3.5 mm Calibration Kit	
10	85052C	3.5 mm SOLT/TRL Calibration Kit	
11	85056A	2.4 mm with sliding load	
12	85056D	2.4 mm Calibration Kit	
13	Maury 8770C	2.92 mm Sliding Load	
14	Maury 8770D	2.92 mm Broadband Load	
15	85056K	2.4 mm/2.92 mm with Broadband Load	
16	85056K01	2.4 mm/2.92 mm with Sliding Load	
17	85058B Databa	1.85 mm Precision Database Cal Kit	-
	Ed	it Kit Delete 🔶 v	
		OK Cancel	Help

b.

	-				<u>? ×</u>
Look jn:	C user		•	🗧 🔁 💣 🧱	
My Recent Documents Desktop My Documents My Computer	My Recent Desktop My Doct SYSTE SYSTE Prog As DATA ECO' Shared My Doct My Doct	t Documents uments puter ppy (A:) EM (C:) gram Files gilent Network Analyzer PnaCalKits DacalKits Color VERY (E:) VERY (E:) JSK (F:) d Documents couments			
	My Netw	ork Places			
My Network	File <u>n</u> ame:	demo.ckt		•	<u>O</u> pen
F 2000					Concol

b. Select the newly created CalKit file from "User" folder, then select "Open".

c. Select "Yes" on the warning screen:

Edit PNA Cal	Kits		- O ×	Help		
Open	Save As	Restore Defaults		op	Center	Span
[Import Kit	Installed Kits Save As Insert New Print to File		1: 2: 1: > 2:	800.000000 MHz 1.400000 GHz 800.000000 MHz 1.400000 GHz	877.81 884.90 -67.299 dB -68.376 dB
ID Kit Nam 21 85059A 22 85059A 23 85038A 24 85050B 25 85050C	e Di Databa 1.1 P Polyno 1.1 7- Af	escription D0mm Databased Precision Cal Kit D0mm (Reduced Accuracy) 16 Calibration Kit PC 7 with sliding load PC 7 TBL Calibration Kit		1:2:	800.000000 MHz 1.400000 GHz	1054.2 57.693
26 85050D 27 85031B 28 Example 29 Example 30 ×11644 31 P11644 32 K11644	sKitA 8 sKitB a A A A A	olicate Kit Name 5052D: A duplicate kit name already exists. Do nyway?	you want to in	nport	this file	
34 R11644 35 U11644 36 V11644 37 W11644	IA R- IA U- A V- 4A W	band Waveguide SOLT/TRL Calibration Kit band Waveguide SOLT/TRL Calibration Kit band Waveguide SOLT/TRL Calibration Kit -band Waveguide SOLT/TRL Calibration Kit	•		I FAIL	
	Edit Kit	Delete ^ v	Help		A 4	
Hold CH	1: 521	C. 2-Port		_	Stop	6.00000 GHz

0	pen Save As.	Restore Defaults	
0		Installed Kits	
	Import Kit	Save As Insert New Print to File	
ID	Kit Name	Description	
22	85059AP Polyno	1.00 mm (Reduced Accuracy)	
23	85038A	7-16 Calibration Kit	
24	85050B	APC 7 with sliding load	
25	85050C	APC 7 TRL Calibration Kit	
26	85050D	APC 7 Calibration Kit	
27	85031B	APC 7 Calibration Kit	
28	Example Kit A	Example Cal Kit with male and female connectors	
29	Example Kit B	Example Cal Kit with unsexed connectors	
30	X11644A	X-band Waveguide SOLT/TRL Calibration Kit	
31	P11644A	P-band Waveguide SOLT/TRL Calibration Kit	
32	K11644A	K-band Waveguide SOLT/TRL Calibration Kit	
33	Q11644A	Q-band Waveguide SOLT/TRL Calibration Kit	
34	R11644A	R-band Waveguide SOLT/TRL Calibration Kit	
35	U11644A	U-band Waveguide SOLT/TRL Calibration Kit	
36	V11644A	V-band Waveguide SOLT/TRL Calibration Kit	
37	W11644A	W-band Waveguide SOLT/TRL Calibration Kit	
38	85052D	3.5 mm Calibration Kit	
	Edi	t Kit Delete	

Now the new CalKit file is ready to be edited.

3. Edit The Cal Kit File

For a female kits, all the female components Short, Open, Load and Thru shall be modified. See the highlighted field below. For a male kit, all male components shall be modified.

Connectors Description: APC 3.5 male	Add or	Edit	Class Assignm	ents
Family: APC 3.5	Change F	Family	SOLT 🗾	Edit
D Standard	Description			
OPEN -M-	3.5 mm male op	en		
5 OPEN -F-	3.5 mm female c	pen		
SHORT -M-	3.5 mm male sho	ort		
SHURT -F-	3.5 mm remaie s	nort		
	3.5 mm temale bio	aubariu ioau voadband loar	1	
THBU	Insertable thruis	tandard	-	

1) Short: Modify the Offset Delay and Loss to the values specified in the table comes with the kit:

Freque	ncy Range		Connector	
Min	0	MHz	APC 3.5 female	•
Max	999000	MHz	-	
Short C	haracteristics		L	
LO	2.0765	H(e-12)	L2 2.1705	H(e-33)/Hz^2
L1	-108.54	H(e-24)/Hz	L3 -0.01	H(e-42)/Hz^3
Delay (Characteristics -			
Delay	55.7	pSec	Loss 4.8	Gohms/s
ZO	50	ohms		

2) **Open**: Modify the **Offset Delay, Loss** and **fringe capacitances** per the specified values in the table come with the kit.

Note: The default units for C0, C1, C2 and C3 are as shown in the screenshot below. Ensure the unit for capacitances matches your unique equipment.

Freque	ncy Range		Connector	
Min	0	MHz	APC 3.5 femal	e 🔻
Мах	999000	MHz		
Doen C	Characteristics			
CO	45	F(e-15)	C2 -2.5	F(e-36)/Hz^2
C1	6	F(e-27)/H:	2 C3 0	F(e-45)/Hz^3
Delay (Characteristics -			
Delay	55.7	pSec	Loss 4.8	Gohms/s
ZO	50	ohms		
	1			

3) Load: Modify the Offset Delay and Loss per the specified values in the table come with the kit.

requer	ncy Range —		Connector	<u> </u>
Min Max	0 999000	MHz MHz	APC 3.5 female	•
oad iy ⊙ Fix ○ Slin Pelay C	pe ed Load ding Load haracteristics	Arbitrary Impedance Offset Load	Real 50 Imag 0	Gohms/s
ZO	50 pad Definition	ohms	4.0	a chinara
maet L	First Offset	Standard THRU		2

4) Thru: Modify the Offset Delay and Loss per the specified values in the table come with the kit.

i nru L	ncu Bange	nsertable thru sta	indard		1
Min		MHz			
Max	999000	MHz			
20 Conne	ctors	onms			
Conne Port	APC 3.5 fema	le 💌	Port	APC 3.5 male	

5) Kit Name: Modify the Kit Name field to a unique identifier, and then select "OK".

Edit K Ider Kit N Kit D	it itification lumber 38 K rescription 3.5 mm Cali	Kit Name demo	×
Con Des APC Fami APC	nectors cription: 0 3.5 male lly: 0 3.5	Add or Edit	Assignments
ID 2 15 1 7 3 14 4	Standard OPEN -M- OPEN -F- SHORT -M- SHORT -F- BROADBAND LOA BROADBAND LOA THRU	Description 3.5 mm male open 3.5 mm female open 3.5 mm female short 3.5 mm female short 3.5 mm male broadband load 3.5 mm female broadband load 1.5 mm female broadband load	
	Add	Edit Delete Delete	ancel Help

6) Now the Cal Kit file is completed and ready for calibration.

dit F	PNA Cal Kits		- 🗆 ×			
Open Save As.		Restore Defaults				
1						
	Installed Kits					
Import Kit Save As Insert New Print to File						
ID	Kit Name	Description				
22	85059AP Polyno	1.00 mm (Reduced Accuracy)				
23	85038A	7-16 Calibration Kit				
24	85050B	APC 7 with sliding load				
25	85050C	APC 7 TRL Calibration Kit				
26	85050D	APC 7 Calibration Kit				
27	85031B	APC 7 Calibration Kit				
28	Example Kit A	Example Cal Kit with male and female connectors				
29	Example Kit B	Example Cal Kit with unsexed connectors				
30	X11644A	X-band Waveguide SOLT/TRL Calibration Kit				
31	P11644A	P-band Waveguide SOLT/TRL Calibration Kit				
32	K11644A	K-band Waveguide SOLT/TRL Calibration Kit				
33	Q11644A	Q-band Waveguide SOLT/TRL Calibration Kit				
34	R11644A	R-band Waveguide SOLT/TRL Calibration Kit				
35	U11644A	U-band Waveguide SOLT/TRL Calibration Kit				
36	V11644A	V-band Waveguide SOLT/TRL Calibration Kit				
37	W11644A	W-band Wavequide SOLT/TRL Calibration Kit				
38	demo	3.5 mm Calibration Kit				
	Edi	: Kit Delete ^ V				
		OK Cancel	Help			

END OF DOCUMENT