

### Add OML Waveguide Calibration Kits To Rohde & Schwarz ZVA Series Network Analyzers

OML waveguide calibration kit waveguide standard definitions are configured in Keysight \*.ckt file extension and ck\_ file extension, and in Anritsu kit\_inf.wav file extension and \*.ccf file extension. ZVA series network analyzers, however, only recognize waveguide calibration standard definitions in specific binary \*.calkit or \*.ck file extension. As such, ZVA "help" section recommends converting \*.ckt file to \*.prn file using PNA Cal Kit Editor or converting \*ckm file to \*.csv file using VNA Cal Kit Manager V.2.1.

This paper describes another method of creating OML's waveguide calibration kit standard definitions by modifying existing ZVA built-in waveguide calibration kit. The 4-Port ZVA24 network analyzer used to develop this procedure has the following installed options with firmware version 4.01. Contact manufacturer for the latest minimum options and compatible firmware version required if encountering errors in creating waveguide calibration kit standard definitions using ZVA built-in waveguide calibration kit.

Software Option - ZVA-K8 Converter Control

Hardware Option

- ZVAB-B4	- ZVA24-B22
- ZVA24-B32	- ZVA24-B23
- ZVA24-B34	- ZVA24-B24
- ZVA24-B16	- ZVA24-B31
- ZVA24-B21	- ZVA24-B33

The last section of this paper shows OML WR05 waveguide calibration kit standard and description and a cross-reference between OML waveguide calibration kit and ZV-05 waveguide calibration kit.

## **Instrumentation Configuration**

ZVA with firmware version 4.01 is used for capturing the screen displays in this procedure. Different firmware versions may have slightly different displays.

The steps below show the procedure to create OML WR05 waveguide calibration kit in ZVA network analyzer. This same procedure applies for all other OML waveguide band calibration kits.

#### Modifying Existing ZVA Built-in WR05 Waveguide Calibration Kit

1. Click "**Channel**" pull down menu with mouse. Highlight or click "**Calibration**" side-menu and then click "**CalKits**" side-menu (Figure 1).



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# 2. Click Add Kit command box once <u>Calibration Kits</u> dialog table appears (Figure 2).

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Trc3	S12 dB Mag	1 dB /	Ref0dB	Cal								Calibration
Trc4	S22 dB Mag	20 dB /	Ref 0 dB	Cal								
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CH						ОК	Can	cel		Help		
Trc1					_						_	

Figure 2 – Calibration Kits Dialogue Table

3. Click Connector Type pull down arrow and select "WR05" as Connector Type (Figure 3).

(Note: Click the check box next to "Keysight Mode" if check box is empty.

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4. Click Copy Standards from.. and highlight "ZV-WR05" (Figure 4).

(Note: "**WR05 Ideal Kit**" can also be used. It has four additional standards – Attenuation, Symmetric Network, Line 2 and Line 3.)

5. Click **OK** to complete the selection and return to previous dialogue box.

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Trc1												LOCAL

Figure 4 – "<u>Copy Standards</u>" Dialogue Box

- 6. <u>Add Calibration Kit</u> dialogue box will appear with listed Standards Short; Offset Short 1; Match; Sliding Match; Reflect; Through; Line 1.
- 7. Highlight "Short" and click View / Modify Stands.. to access "Short" standard parameter table (Figure 5).

<b>Fi</b>	e Trace	Channel	Disp	lay Sys	stem Windo	w Info	Help					_ & ×
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Trc2	<mark>S21</mark> dB	Mag 1	dB/	Ref0d	B Cal							Channel
Trc3	<mark>S12</mark> dB	Mag 1	dB/	Ref0d	B Cal							Calibration
Trc4	<mark>S22</mark> dB	Mag 20	)dB/	Ref 0 d	B Cal							Basell
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Figure 5 – List of Standards in ZV-WR05 CalKit Definition

Click Modify Offset... and change "Short" delay value to zero picoseconds "0 ps". Click OK to accept the new value and return to previous dialogue box.



	File Trace Channel Display System Window Info Help
	Trc2 S21 dB Mag 1 dB / Ref 0 dB Cal Channel
	Trc4 S22 dB Mag 20 dB / Ref 0 dB Cal
	S11 View / Modify Standard in NewKit2 (WR05)
	Type: Short Gender S-Parameters From
	A service of the
	- 20 0 GΩ/s 3
	40 + 0 E-36 r/H2 <sup>-</sup> + 0 E-24 H/Hz + 0 E-45 F/Hz <sup>∞</sup>
	3.336 ps Min Freq: 116 GHz ♥ ■
	Modify Offset Modify Load Max Freq: 230 GHz
	Trc1 File Trace Channel Display System Window Info Help
	Trc1 S11 dB Mag 20 dB / Ref 0 dB Cal 1 Set1 *
	Trc3     S12     dB Mag     1 dB / Ref 0 dB     Calibration       Trc4     S22     dB Mag     20 dB / Ref 0 dB     Cal
	S11  •Tra¢ Stat: Trc1 S11  Recall Last Cal Set
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	Short SHORT
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	+ 0 E-36 F/Hz <sup>2</sup> + 0 E-44 H/Hz + 0 E-45 F/Hz <sup>9</sup>
	+ 0 E-42 H/Hz <sup>o</sup>
	3.336 ps Min Freq: 116 GHz
	Modify Offset Modify Load Max Freq: 230 GHz
	Ch1 OK Cancel Help
	Trc1
<b>A</b> 1	Figure 0 – "Short" Standard Definition Table
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 Change "Min Freq" setting of "116 GHz" to "115.696 GHz" and "Max Freq" setting of "230 GHz" to "231.392 GHz" using the numeric keypad or keyboard. Type "SHORT" in the empty "Label" box. Figure 7 shows all the necessary changes needed for OML "Short" calkit definition.

(Note: Laminated waveguide calibration standards card in OML waveguide calibration kit box contains all the required standards value for this setup procedure.)

10.Click **OK** to return to previous dialog box.



Figure 7 – Complete Modified "Short" Standard Definition

11.Highlight "Offset Short 1" and click View / Modify Stands... to access
"Offset Short 1" standard parameter table and click Modify Offset... and modify "Offset Short 1" standard delay to "1.894 ps"\*. Click OK to return to previous dialog box (Figure 8).

(\*Note: Use the <u>1/4OS offset shim</u> delay value in the laminated card.)

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<del></del>	Connector Type: WR05		
- 40			Cal Unit
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			Label Attr A Wave Corr
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40+	Add Standard	Sliding Match	
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80+	Optimize Line Freq Ranges		
Ch1		OK Cancel	Help - More - 2/2
Trc1			
Trc1	e Trace Channel Display S S11 dB Mag 20 dB / Ref 0	System Window Info Help	】× 1 Set1 *   余
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	<mark>S22</mark> dB Mag 20 dB / Ref 0	) dB Cal	Recall
<mark>S11</mark>	S22 dB Mag 20 dB / Ref 0	) dB Cal ) dB Cal 	ac Stat: Trc1 S11 Recall Last Cal Set
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<mark>S11</mark> - 80- - 40- - 20- <b>0</b> -	S22       dB Mag       20 dB / Ref C         View / Modify Standard in Newf         Modify Offset         Offset Short 1 OFFSET SHOR         Delay:       1.894 ps         Delay of waveguide = mechanic         Z0:       varies         Offset Loss:       0 GΩ/s	AB Cal AB Cal AT A Cal Assignment Cal length / speed of light in vacuum *	Image: Stat:     Trc1 S1     Recall Last Cal Set       Image: Stat:     S-Parameters From       Image: Operative Control of Circuit Model       Image: State of Circuit Model       Image: Set of Circuit Model <t< td=""></t<>
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S11 - 80- - 401 - 201 01 201 401 801	S22       dB Mag. 20 dB / Ref C         View / Modify Standard in Newf         Modify Offset         Offset Short 1 OFFSET SHORT         Delay:       1.894 ps         Delay:       1.894 ps         Delay of waveguide = mechanic         Z0:       ∨aries         Offset Loss:       0 GΩ/s         OK       Cancel         \$5.197 ps         Modify Offset.	AB Cal AB Cal •Tr Kit2 (WR05) T Assignment al length / speed of light in vacuum * • 0 E-24 H/Hz + 0 E-23 H/Hz² + 0 E-23 H/Hz² + 0 E-24 H/Hz + 0 E-24 H/Hz² + 0 E-24 H/Hz² + 0 E-24 H/Hz² + 0 E-24 H/Hz²	Image: Calibration         Recall Last Cal Set         Image: Calibration
S11 - 80- - 40 - 20 20 20 40 80 Ch1	S22       dB Mag       20 dB / Ref C         View / Modify Standard in Newf         Modify Offset         Offset Short 1       OFFSET SHORT         Delay:       1.894 ps         Delay:       1.894 ps         Delay:       1.894 ps         Delay:       1.894 ps         Old State       0 GΩ/s         Offset Loss:       0 GΩ/s         OK       Cancel         5.197 ps       Modify Offset.	0 dB       Cal         0 dB       Cal         Kit2 (WR05)         T         Assignment         cal length / speed of light in vacuum *         Cal         + 0 E-24 H/Hz         + 0 E-24 H/Hz         + 0 E-42 H/Hz	S-Perameters From          • Circuit Model        .snp File       Read File       Vrelative permittivity       Image: State of the state of

**Figure 8 – "Offset Short 1" Standard Definition Table** 

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- 12.Change "Min Freq" setting of "116 GHz" to "115.696 GHz" and "Max Freq" setting of "230 GHz" to "231.392 GHz" using the numeric keypad or keyboard.
- 13. Type "**OFFSET SHORT**" in blank label box. Figure 9 shows all the necessary changes needed for OML "Offset Short" calkit definition.
- 14.Click **OK** to return to previous dialog box.

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Trc2	S21 dB	Mag 1	dB/	Ref0dB	Cal							Channel	×
Trc3	<mark>S12</mark> dB	Mag 1	dB/	Ref 0 dB	Cal							Calibratio	on
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Trc1													

Figure 9 – Complete Modified "Offset Short 1" Standard Definition

- 15.Highlight "**Match**" and click **View / Modify Stands..** to access "**Match**" standard parameter table. Type "**MATCH**" in blank label box (Figure 10).
- 16.Change "Min Freq" setting of "116 GHz" to "115.696 GHz" and "Max Freq" setting of "230 GHz" to "231.392 GHz" using the numeric keypad or keyboard. Figure 10 shows the changes needed for OML "Load" standard definition.

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	e Trace	Channel	Display	System Win	ndow Info	Help					_ & ×
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Figure 10 – Complete Modified "Match" Standard Definition

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💻 File Trace Channel Display System Window Info Help	_ & ×
Trc1         S11         dB Mag         20 dB /         Ref 0 dB         Cal           Trc2         S21         dB Mag         1 dB /         Ref 0 dB         Cal           Trc3         S12         dB Mag         1 dB /         Ref 0 dB         Cal           Trc4         S12         dB Mag         1 dB /         Ref 0 dB         Cal	1 Set1 - Channel Calibration
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Figure 11 – Complete Modified "Sliding Match" Standard Definition

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- 17.Click **OK** to return to previous dialog box.
- 18.Highlight "Sliding Match" and click View / Modify Stands.. to access
  "Sliding Match" standard parameter table. Type "SLIDING MATCH" in blank "Label" box (Figure 11).
- 19.Change "Min Freq" setting of "116 GHz" to "115.696 GHz" and "Max Freq" setting of "230 GHz" to "231.392 GHz" using the numeric keypad or keyboard. Figure 11 shows all the necessary changes needed for OML "Sliding Load" standard definition.
- 20.Click **OK** to return to previous dialog box.
- 21.Highlight "**Reflect**" and click View / Modify Stands... to access "**Reflect**" standard parameter table. Type "**REFLECT**" in blank label box.
- 22.Change "Min Freq" setting of "116 GHz" to "115.696 GHz" and "Max Freq" setting of "230 GHz" to "231.392 GHz" using the numeric keypad or keyboard. Figure 12 shows all the changes needed for OML "Short" standard definition.

(Note: "Flush short" or "Short" means the same as "Reflect" in ZVA TRL calibration.)

- 23.Click **OK** to return to previous dialog box.
- 24.Highlight "Through" and click View / Modify Stands.. to access
  "Through" standard parameter table and click Modify Offset.. to modify
  "Through" standard delay value to "0 ps" Click OK to return to previous dialogue box (Figure 13).
- 25.Change "Min Freq" setting of "116 GHz" to "115.696 GHz" and "Max Freq" setting of "230 GHz" to "231.392 GHz" using the numeric keypad or keyboard.
- 26. Type "**THRU**" in blank label box. Figure 14 shows all the necessary changes needed for OML "Thru" standard definition.
- 27.Click **OK** to close "**THRU**" definition table and return to previous dialogue box.



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T 4	e Trace	Channel Dis	play Sy	stem Window Ir	nfo Help			
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- 80- - 00- - 40- - 20- - 20- 0- 0- 40- 40-	View / M Type: Label	Reflect REFLECT Model 0 Impedan	n Kit I in VO5-A GΩ/s 	L-30 (WR05)	Gender:	0 E-15 F • 0 E-27 Fr • 0 E-27 Fr • 0 E-36 Fr • 0 E-45 Fr	rters From Model 18 /Hz /Hz² /Hz²	ead File
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Figure 12 – Complete Modified "Reflect" Standard Definition

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Figure 14 - Complete Modified "Through" Standard Definition

28.Highlight "Line 1" and click View / Modify Stands.. to access "Line 1" standard parameter table and click Modify Offset.." to modify "Line 1" standard delay to "1.894 ps"\* (Figure 15).

(\*Note: Enter the <u>1/4OS offset shim</u> delay value in the laminated card.)

- 29.Change "Min Freq" setting of "116 GHz" to "115.696 GHz" and "Max Freq" setting of "230 GHz" to "231.392 GHz" using the numeric keypad or keyboard.
- 30. Type "**OFFSET LINE**" in blank label box. Figure 15 shows all the necessary changes needed for OML "Thru" standard definition.
- 31.Click **OK** to close "**LINE 1**" definition table and return to previous dialogue box.
- 32. Click "OK" to return to previous dialogue box. Type OML calkit ID (for example: V05-AL-30) in the blank "**Name**" box (Figure 16).
- 33.Click **OK** to exit calkit standard definition modification and return to main **<u>Calibration Kits</u>** dialogue box.
- 34.Click **OK** to exit **Calibration Kits** and return to the main menu.

OMI Inc.



Application Note No. 41-210326, Rev 0

Release Date: 03-2021

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💻 File Trace Channel Displa	ay System Window	Info Help		_ & ×
Trc1         S11         dB Mag         20 dB / f           Trc2         S21         dB Mag         1 dB / f           Trc3         S12         dB Mag         1 dB / f           Trc4         S22         dB Mag         20 dB / f	Ref0dBCal Ref0dBCal Ref0dBCal Ref0dBCal			1 Set1 * Channel Calibration
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- 40 Name: V05-AL-30	قاً Label:			Characterize Cal Unit
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File       Trace       Channel       Displation         Trc1       S11       dB Mag       20 dB / F         Trc2       S21       dB Mag       1 dB / F         Trc3       S12       dB Mag       1 dB / F         Trc4       S22       dB Mag       20 dB / F         -40       Calibration Kits	y         System         Window           Ref 0 dB         Cal           Read bdB         Cal	Info Help •Trac Stat: Min: Max Pk-Fik: Kit Nane 1/405-05 + T-05] Ideal Kit 1/405-10 + T-10] Ideal Kit OM-1deal Kit WM-1295 Ideal Kit WM-2540 Ideal Kit WM-2032 Ideal Kit WM-2032 Ideal Kit WM-2032 Ideal Kit WM-2540 Ideal Kit WM-864 Ideal Kit ZV-WR03 V05-AL-30 WR05 Wavenuide Ideal Kit cannot be modified. Create a	Trc1 S11 -75.1882 di 32.8787 di 32.8787 di 2.8787 di 2.8787 di 32.8787 di 32.9777 di 32.9777 di 32.97777 di 32.97777 di 32.9777777777777777777777777777777777777	Set 1 * Channel Calibration Recall Last Cal Set Cal Kits Characterize Cal Unit Enhanced Wave Corr RO RO RO RO RO RO RO RO RO RO

Figure 16 - Completed Creating OML Waveguide CalKit Standard Definition

OML<sup>Inc.</sup>

### **OML WR05 Waveguide Calibration Kit (V05-AL-xx) Standard and Description**

STANDARD	Description		
Short	G Band Short [S-05]		
1/4 Wave Offset Short	G Band 1/4 Wave Offset Short [1/4OS-05 + S-05]		
Fixed Load	G Band Fixed Load [T-05]		
Sliding Load	G Band Sliding Load [AL-05]		
Offset Load	G Band Offset Load [1/4OS-05 + T-05]		
Thru	G Band Flush Thru		
1/4Wave Offset Line	G Band 1/4 Wave Offset Line [1/4OS-05]		
1" WG Line	G Band 1" WG Line [WG-05]		

### WAVEGUIDE CALIBRATION KIT STANDARD CROSS REFERENCE

STANDARD	OML V05-AL-xx	Delay (ps)	ZV-WR05	Delay (ps)
SHORT	Short	0	Short	3.336
OFFSET SHORT	1/4 Wave Offset Short	1.898*	Offset Short 1	5.197
FIXED LOAD	Fixed Load	0	Match	0
SLIDING LOAD	Sliding Load	0	Sliding Match	0
	Short	0	Reflect	3.336
THRU	Thru	0	Through	5.197
1/4 LINE	<sup>1</sup> / <sub>4</sub> Wave Offset Line	1.898*	Line 1	3.336

\* Ideal value shown. Each waveguide calibration kit ¼ wave offset line will have a unique delay time associated with its actual physical length.

