Mechanical Calibration Kit

Data Sheet

EN03B

SIGLENT TECHNOLOGIES CO., LTD.

Introduction

Mechanical calibration kit contains individual standards to characterize systematic errors, used to calibrate scalar or vector network analyzers.

SIGLENT supplies mechanical calibration kits with 2.4mm, 2.92mm, 3.5mm and Type N coaxial connectors, as well as K-band waveguide calibration kit.

Model*[1]*[2]	Frequency	Type*[3]	Connector	Impendence	Similar
F503ME	DC - 4.5 GHz	OSLT	Type N - Male	50 Ω	85032B/E
F503FE	DC - 4.5 GHz	OSLT	Type N - Female	50 Ω	85032B/E
F603ME	DC - 4.5 GHz	OSLT	3.5mm - Male	50 Ω	85033E
F603FE	DC - 4.5 GHz	OSLT	3.5mm - Female	50 Ω	85033E
F504MS	DC - 9 GHz	OSLT	Type N - Male	50 Ω	85032F
Y504MS	DC - 9 GHz	OSLT	Type N - Male	50 Ω	85032F
F504FS	DC - 9 GHz	OSLT	Type N - Female	50 Ω	85032F
Y504FS	DC - 9 GHz	OSLT	Type N - Female	50 Ω	85032F
F504TS	DC - 9 GHz	OSLT	Type N - Male AND Female	50 Ω	85032F
F604MS	DC - 9 GHz	OSLT	3.5mm - Male	50 Ω	85033E
F604FS	DC - 9 GHz	OSLT	3.5mm - Female	50 Ω	85033E
F604TS	DC - 9 GHz	OSLT	3.5mm - Male AND Female	50 Ω	85033E
F505MS	DC - 18 GHz	OSLT	Type N - Male	50 Ω	85054D
F505FS	DC - 18 GHz	OSLT	Type N - Female	50 Ω	85054D
F505TS	DC - 18 GHz	OSLT	Type N - Male AND Female	50 Ω	85054D
F606MS	DC - 26.5 GHz	OSLT	3.5mm - Male	50 Ω	85052D
Y606MS	DC - 26.5 GHz	OSLT	3.5mm - Male	50 Ω	85052D
F606FS	DC - 26.5 GHz	OSLT	3.5mm - Female	50 Ω	85052D
Y606FS	DC - 26.5 GHz	OSLT	3.5mm - Female	50 Ω	85052D
F606TS	DC - 26.5 GHz	OSLT	3.5mm - Male AND Female	50 Ω	85052D
Y707MS	DC - 40 GHz	OSLT	2.92mm - Male	50 Ω	8770D
Y707FS	DC - 40 GHz	OSLT	2.92mm - Female	50 Ω	8770D
F707TS	DC - 40 GHz	OSLT	2.92mm-Male AND Female	50 Ω	8770S
F808MS	DC - 50 GHz	OSLT	2.4mm - Male	50 Ω	85056D
Y808MS	DC - 50 GHz	OSLT	2.4mm - Male	50 Ω	85056D
F808FS	DC - 50 GHz	OSLT	2.4mm - Female	50 Ω	85056D
Y808FS	DC - 50 GHz	OSLT	2.4mm - Female	50 Ω	85056D
F808TS	DC - 50 GHz	OSLT	2.4mm - Male AND Female	50 Ω	85056D
KWR42A	18 - 26.5 GHz	Waveguide	2.92mm-Male AND Female	50 Ω	K11644A

*1: Mechanical coaxial calibration kit naming rule

F/Y	Separate/Integrated
5/6/7/8/9	N/3.5/2.92/2.4/1.85 mm
0/1	50/75 Ohm
3/4/5/6/7/8/9	4.5/9/18/26.5/40/50/67 GHz
M/F/T	Male/Female/Both
E/S	Economy/Standard

*2: Mechanical Waveguide calibration kit naming rule

Band	EIA	Version	Frequency range
W	WR10	A	75 to 110 GHz
V	WR15	A	50 to 75 GHz
U	WR19	A	40 to 60 GHz
Q	WR22	A	33 to 50 GHz
R	WR28	A	26.5 to 40 GHz
K	WR42	A	18 to 26.5 GHz
P	WR62	A	12.4 to 18 GHz
X	WR90	A	8.2 to 12.4 GHz

*3: OSLT = Open + Short + Load + Through

F503 Series

The F503ME and F503FE economy 50Ω N type coaxial mechanical calibration kit include termination loads, open circuits, short circuits, and through adapters, specified from DC to 4.5 GHz.

The F503 series performance specifications are very similar to the Keysight 85032B/E mechanical calibration kit and it can be used as an approximate replacement of 85032B/E, or use the STD of 85032B/E in network analyzers.

Figure 1 F503 series

Performance

Model	Type	Connector	Specification
F503ME	Open	N - Male	DC – 2 GHz, Phase Deviation* ≤ ± 0.65° 2 GHz – 4.5 GHz, Phase Deviation* ≤ ± 1°
	Short	N - Male	DC – 2 GHz, Phase Deviation* ≤ ± 0.65° 2 GHz – 4.5 GHz, Phase Deviation* ≤ ± 1°
	Load	N - Male	DC – 1 GHz, Return Loss ≥ 46 dB 1 GHz – 4.5 GHz, Return Loss ≥ 40 dB
	Adapter	N - Male to N - Male	DC – 4.5 GHz, SWR ≤ 1.05 (Return Loss ≥ 32.3 dB)
F503FE	Open	N - Female	DC – 2 GHz, Phase Deviation* ≤ ± 0.65° 2 GHz – 4.5 GHz, Phase Deviation* ≤ ± 1°
	Short	N - Female	DC – 2 GHz, Phase Deviation* ≤ ± 0.65° 2 GHz – 4.5 GHz, Phase Deviation* ≤ ± 1°
	Load	N - Female	DC – 1 GHz, Return Loss ≥ 46 dB 1 GHz – 4.5 GHz, Return Loss ≥ 40 dB
	Adapter	N - Female to N - Female	DC – 4.5 GHz, SWR ≤ 1.05 (Return Loss ≥ 32.3 dB)

* Phase deviation from the nominal model as defined in the standards definitions (see Appendix A)

General Specification

Impendence	50 Ω	Power	≤ 1 W
Interfaces Standard	IEC 60169-16 Grade 0	Durability	> 2000
Temperature	+ 15 °C ~ + 35 °C		

F603 Series

The F603ME and F603FE economy 50Ω 3.5mm type coaxial mechanical calibration kit include terminations loads, open circuits, short circuits, and through adapters, specified from DC to 4.5 GHz.

The F603 series performance specifications are very similar to the Keysight 85033E mechanical calibration kit and it can be used as an approximate replacement of 85033E, or use the STD of 85033E in network analyzers.

Figure 2 F603 series

Performance

Model	Type	Connector	Specification
F603ME	Open	3.5mm - Male	DC – 4.5 GHz, Phase Deviation* ≤ ± 1°
	Short	3.5mm - Male	DC – 4.5 GHz, Phase Deviation* ≤ ± 1°
	Load	3.5mm - Male	DC – 1 GHz, Return Loss ≥ 46 dB 1 GHz – 4.5 GHz, Return Loss ≥ 37.2 dB
	Adapter	3.5mm - Male to 3.5mm - Male	DC – 4.5 GHz, SWR ≤ 1.05 (Return Loss ≥ 32.3 dB)
F603FE	Open	3.5mm - Female	DC – 4.5 GHz, Phase Deviation* ≤ ± 1°
	Short	3.5mm - Female	DC – 4.5 GHz, Phase Deviation* ≤ ± 1°
	Load	3.5mm - Female	DC – 1 GHz, Return Loss ≥ 46 dB 1 GHz – 4.5 GHz, Return Loss ≥ 37.2 dB
	Adapter	3.5mm - Female to 3.5mm - Female	DC – 4.5 GHz, SWR ≤ 1.05 (Return Loss ≥ 32.3 dB)

* Phase deviation from the nominal model as defined in the standards definitions (see Appendix A)

General Specification

Impendence	50 Ω	Power	≤ 1 W
Interfaces Standard	IEEE Std 287	Durability	> 2000
Temperature	+ 15 ℃ ~ + 35 ℃		

F504 and Y504 Series

The F504MS and F504FS 50Ω N type coaxial mechanical calibration kit include termination loads, open circuits, short circuits, and through adapters, specified from DC to 9 GHz. The F504TS is a coaxial calibration kit consisting of F504MS and F504FS.

Y504MS shares the same parts and specs as F504MS, but in integrated exterior. So does Y504FS and F504FS.

The F504 and Y504 series performance specifications are very similar to the Keysight 85032F mechanical calibration kit and it can be used as an approximate replacement of 85032F, or use the STD of 85032F in network analyzers.

Figure 3 F504 series (left) and Y504 series (right)

Performance

Model		Type	Connector	Specification
F504TS	F504MS/ Y504MS	Open	N - Male	DC - 3 GHz, Phase Deviation* ≤ ± 0.65° 3 GHz - 9 GHz, Phase Deviation* ≤ ± 1°
		Short	N - Male	DC - 3 GHz, Phase Deviation* ≤ ± 0.65° 3 GHz - 9 GHz, Phase Deviation* ≤ ± 1°
		Load	N - Male	DC - 3 GHz, Return Loss ≥ 42 dB 3 GHz - 6 GHz, Return Loss ≥ 38 dB 6 GHz - 9 GHz, Return Loss ≥ 36 dB
		Adapter	N - Male to N - Male	DC - 9 GHz, SWR ≤ 1.06 (Return Loss ≥ 30.7dB)
	F504FS/ Y504FS	Open	N - Female	DC - 3 GHz, Phase Deviation* ≤ ± 0.65° 3 GHz - 9 GHz, Phase Deviation* ≤ ± 1°
		Short	N - Female	DC - 3 GHz, Phase Deviation* ≤ ± 0.65° 3 GHz - 9 GHz, Phase Deviation* ≤ ± 1°
		Load	N - Female	DC - 3 GHz, Return Loss ≥ 42 dB 3 GHz - 6 GHz, Return Loss ≥ 38 dB 6 GHz - 9 GHz, Return Loss ≥ 36 dB
		Adapter	N - Female to N - Female	DC - 9 GHz, SWR ≤ 1.06 (Return Loss ≥ 30.7dB)
	Adapter		N - Male to N - Female	DC - 9 GHz, SWR ≤ 1.06 (Return Loss ≥ 30.7dB)
	Wrench		N - 19mm	1.35 Nm

* Phase deviation from the nominal model as defined in the standards definitions (see Appendix A)

General Specification

Impendence	50 Ω	Power	≤ 1 W
Interfaces Standard	IEC 60169-16 Grade 0	Durability	> 2000
Temperature	+ 15 °C ~ + 35 °C		

F505 Series

The F505MS and F505FS 50Ω N type coaxial mechanical calibration kit include termination loads, open circuits, short circuits, and through adapters, specified from DC to 18 GHz. The F505TS is a coaxial calibration kit consisting of F505MS and F505FS.

The F505 series performance specifications are very similar to the Keysight 85054D mechanical calibration kit and it can be used as an approximate replacement of 85054D, or use the STD of 85054D in network analyzers.

Figure 4 F505 series

Performance

Model		Type	Connector	Specification
F505TS	F505MS	Open	N - Male	DC – 18 GHz, Phase Deviation* ≤ ± 1°
		Short	N - Male	DC –18 GHz, Phase Deviation* ≤ ± 1°
		Load	N - Male	DC – 18 GHz, SWR ≤ 1.048 (Return Loss ≥ 32.6 dB)
		Adapter	N - Male to N - Male	DC – 18 GHz, SWR ≤ 1.06 (Return Loss ≥ 30.7 dB)
	F505FS	Open	N - Female	DC – 18 GHz, Phase Deviation* ≤ ± 1°
		Short	N - Female	DC – 18 GHz, Phase Deviation* ≤ ± 1°
		Load	N - Female	DC – 18 GHz, SWR ≤ 1.048 (Return Loss ≥ 32.6 dB)
		Adapter	N - Female to N - Female	DC – 18 GHz, SWR ≤ 1.06 (Return Loss ≥ 30.7 dB)
	Adapter		N - Male to N - Female	DC – 18 GHz, SWR ≤ 1.06 (Return Loss ≥ -30.7 dB)
	Wrench		N - 19mm	1.35 Nm

* Phase deviation from the nominal model as defined in the standards definitions (see Appendix A)

General Specification

Impendence	50 Ω	Power	≤ 1 W
Interfaces Standard	IEC 60169-16	Durability	> 2000
Temperature	+ 15 °C ~ + 35 °C		

F604 Series

The F604MS and F604FS 50Ω 3.5mm type coaxial mechanical calibration kit include termination loads, open circuits, short circuits, and through adapters, specified from DC to 9 GHz. The F604TS is a coaxial calibration kit consisting of F604MS and F604FS.

The F604 series performance specifications are very similar to the Keysight 85033E mechanical calibration kit and it can be used as an approximate replacement of 85033E, or use the STD of 85033E in network analyzers.

Figure 5 F604 series

Performance

Model		Type	Connector	Specification
F604TS	F604MS	Open	3.5mm - Male	DC – 9 GHz, Phase Deviation* ≤ ± 1°
		Short	3.5mm - Male	DC – 9 GHz, Phase Deviation* ≤ ± 1°
		Load	3.5mm - Male	DC – 2 GHz, Return Loss ≥ 46 dB 2 GHz – 9 GHz, Return Loss ≥ 40 dB
		Adapter	3.5mm - Male to 3.5mm - Male	DC – 6 GHz, SWR ≤ 1.04 6 GHz – 9 GHz, SWR ≤ 1.06
	F604FS	Open	3.5mm - Female	DC – 9 GHz, Phase Deviation* ≤ ± 1°
		Short	3.5mm - Female	DC – 9 GHz, Phase Deviation* ≤ ± 1°
		Load	3.5mm - Female	DC – 2 GHz, Return Loss ≥ 46 dB 2 GHz – 9 GHz, Return Loss ≥ 40 dB
		Adapter	3.5mm - Female to 3.5mm - Female	DC – 6 GHz, SWR ≤ 1.04 6 GHz – 9 GHz, SWR ≤ 1.06
	Adapter		3.5mm - Male to 3.5mm - Female	DC – 6 GHz, SWR ≤ 1.04 6 GHz – 9 GHz, SWR ≤ 1.06
	Wrench		3.5mm - 8mm	0.9 Nm

* Phase deviation from the nominal model as defined in the standards definitions (see Appendix A)

General Specification

Impendence	50 Ω	Power	≤ 1 W
Interfaces Standard	IEEE Std 287	Durability	> 2000
Temperature	+ 15 °C ~ + 35 °C		

F606 and Y606 Series

The F606MS and F606FS 50Ω 3.5mm type coaxial mechanical calibration kit include termination loads, open circuits, short circuits, and through adapters, specified from DC to 26.5 GHz. The F606TS is a coaxial calibration kit consisting of F606MS and F606FS.

Y606MS shares the same parts and specs as F606MS, but in integrated exterior. So does Y606FS and F606FS.

The F606 and Y606 series performance specifications are very similar to the Keysight 85052D mechanical calibration kit and it can be used as an approximate replacement of 85052D, or use the STD of 85052D in network analyzers.

Figure 6 F606 series (left) and Y606 series (right)

Performance

Model		Type	Connector	Specification
F606TS	F606MS	Open	3.5mm - Male	DC – 3 GHz, Phase Deviation* ≤ ± 0.65° 3 GHz – 8 GHz, Phase Deviation* ≤ ± 1.2° 8 GHz – 26.5 GHz, Phase Deviation* ≤ ± 2°
		Short	3.5mm - Male	DC – 3 GHz, Phase Deviation* ≤ ± 0.65° 3 GHz – 8 GHz, Phase Deviation* ≤ ± 1° 8 GHz–26.5 GHz, Phase Deviation* ≤ ±1.75°
		Load	3.5mm - Male	DC – 8 GHz, Return Loss ≥ 38 dB 8 GHz – 20 GHz, Return Loss ≥ 36 dB 20 GHz – 26.5 GHz, Return Loss ≥ 34 dB
		Adapter	3.5mm - Male to 3.5mm - Male	DC – 26.5 GHz, SWR ≤ 1.08
	F606FS	Open	3.5mm - Female	DC – 3 GHz, Phase Deviation* ≤ ± 0.65° 3 GHz – 8 GHz, Phase Deviation* ≤ ± 1.2° 8 GHz – 26.5 GHz, Phase Deviation* ≤ ± 2°
		Short	3.5mm - Female	DC – 3 GHz, Phase Deviation* ≤ ± 0.65° 3 GHz – 8 GHz, Phase Deviation* ≤ ± 1° 8 GHz–26.5 GHz, Phase Deviation* ≤ ±1.75°
		Load	3.5mm - Female	DC – 8 GHz, Return Loss ≥ 38 dB 8 GHz – 20 GHz, Return Loss ≥ 36 dB 20 GHz – 26.5 GHz, Return Loss ≥ 34 dB
		Adapter	3.5mm - Female to 3.5mm - Female	DC – 26.5 GHz, SWR ≤ 1.08
	Adapter		3.5mm - Male to 3.5mm - Female	DC – 26.5 GHz, SWR ≤ 1.08
	Wrench		3.5mm - 8mm	0.9 Nm

* Phase deviation from the nominal model as defined in the standards definitions (see Appendix A)

Model	Type	Connector	Specification
Y606MS	Open	3.5mm - Male	DC – 26.5 GHz, Phase Deviation* ≤ ± 3°
	Short	3.5mm - Male	DC – 26.5 GHz, Phase Deviation* ≤ ± 2.8°
	Load	3.5mm - Male	DC – 26.5 GHz, SWR ≤ 1.07
	Adapter	3.5mm - Male to 3.5mm - Male	DC – 26.5 GHz, SWR ≤ 1.12
	Wrench	3.5mm - 8mm	0.9 Nm
Y606FS	Open	3.5mm - Female	DC – 26.5 GHz, Phase Deviation* ≤ ± 3°
	Short	3.5mm - Female	DC – 26.5 GHz, Phase Deviation* ≤ ± 2.8°
	Load	3.5mm - Female	DC – 26.5 GHz, SWR ≤ 1.07
	Adapter	3.5mm - Female to 3.5mm - Female	DC – 26.5 GHz, SWR ≤ 1.12
	Wrench	3.5mm - 8mm	0.9 Nm

* Phase deviation from the nominal model as defined in the standards definitions (see Appendix A)

General Specification

Impendence	50 Ω	Power	≤ 0.5 W
Interfaces Standard	IEEE Std 287	Durability	> 2000
Temperature	+15 °C ~ + 35 °C		

F707 and Y707 Series

The F707TS 50Ω 2.92mm type coaxial mechanical calibration kit include termination loads, open circuits, short circuits and through adapters in both sexes, specified from DC to 40 GHz.

Y707MS is 2.92mm type integrated calibration kit with male connectors, Y707MS is 2.92mm type integrated calibration kit with female connectors.

The F707 series performance specifications are very similar to the Maury 8770S and the Y707 series performance specifications are very similar to the Maury 8770D, so they can be used as an approximate replacement.

Figure 7 F707 series (left) and Y707 series (right)

Performance

Model	Type	Connector	Specification
F707TS	Open	2.92mm - Male	DC – 40 GHz, Phase Deviation* ≤ ± 6°
		2.92mm - Female	
	Short	2.92mm - Male	DC – 40 GHz, Phase Deviation* ≤ ± 4.5°
		2.92mm - Female	
	Load	2.92mm - Male	DC – 40 GHz, SWR ≤ 1.052
		2.92mm - Female	
	Adapter	2.92mm - Male to 2.92mm - Male	DC – 40 GHz, SWR ≤ 1.12
		2.92mm - Female to 2.92mm - Female	
		2.92mm - Male to 2.92mm - Female	
	Wrench	8mm	0.9 Nm

* Phase deviation from the nominal model as defined in the standards definitions (see Appendix A)

Model	Type	Connector	Specification
Y707MS	Open	2.92mm - Male	DC – 40 GHz, Phase Deviation* ≤ ± 4°
	Short	2.92mm - Male	DC – 40 GHz, Phase Deviation* ≤ ± 3.5°
	Load	2.92mm - Male	DC – 40 GHz, SWR ≤ 1.11
	Adapter	2.92mm - Male to 2.92mm - Male	DC – 40 GHz, SWR ≤ 1.18
	Wrench	8mm	0.9 Nm
Y707FS	Open	2.92mm - Female	DC – 40 GHz, Phase Deviation* ≤ ± 4°
	Short	2.92mm - Female	DC – 40 GHz, Phase Deviation* ≤ ± 3.5°
	Load	2.92mm - Female	DC – 40 GHz, SWR ≤ 1.11
	Adapter	2.92mm - Female to 2.92mm - Female	DC – 40 GHz, SWR ≤ 1.18
	Wrench	8mm	0.9 Nm

* Phase deviation from the nominal model as defined in the standards definitions (see Appendix A)

General Specification

Impendence	50 Ω	Power	≤ 0.5 W
Temperature	+15 °C ~ + 35 °C	Durability	> 2000

F808 and Y808 Series

The F808MS and F808FS 50Ω 2.4mm type coaxial mechanical calibration kit include termination loads, open circuits, short circuits, and through adapters, specified from DC to 50 GHz. The F808TS is a coaxial calibration kit consisting of F808MS and F808FS.

Y808MS shares the same parts and specs as F808MS, but in integrated exterior. So does Y808FS and F808FS.

The F808 and Y808 series performance specifications are very similar to the Keysight 85056D mechanical calibration kit and it can be used as an approximate replacement of 85056D, or use the STD of 85056D in network analyzers.

Figure 8 F808 series (left) and Y808 series (right)

Performance

Model		Type	Connector	Specification
F808TS	F808MS	Open	2.4mm - Male	DC – 2 GHz, Phase Deviation* ≤ ± 0.75° 2 GHz – 20 GHz, Phase Deviation* ≤ ± 1.5° 20 GHz – 50 GHz, Phase Deviation* ≤ ± 2.5°
		Short	2.4mm - Male	DC – 2 GHz, Phase Deviation* ≤ ± 0.75° 2 GHz – 20 GHz, Phase Deviation* ≤ ± 1.5° 20 GHz – 50 GHz, Phase Deviation* ≤ ± 2.5°
		Load	2.4mm - Male	DC – 4 GHz, Return Loss ≥ 40 dB 4 GHz – 20 GHz, Return Loss ≥ 34 dB 20 GHz – 50 GHz, Return Loss ≥ 32 dB
		Adapter	2.4mm - Male to 2.4mm - Male	DC – 50 GHz, SWR ≤ 1.12
	F808FS	Open	2.4mm - Female	DC – 2 GHz, Phase Deviation* ≤ ± 0.75° 2 GHz – 20 GHz, Phase Deviation* ≤ ± 1.5° 20 GHz – 50 GHz, Phase Deviation* ≤ ± 2.5°
		Short	2.4mm - Female	DC – 2 GHz, Phase Deviation* ≤ ± 0.75° 2 GHz – 20 GHz, Phase Deviation* ≤ ± 1.5° 20 GHz – 50 GHz, Phase Deviation* ≤ ± 2.5°
		Load	2.4mm - Female	DC – 4 GHz, Return Loss ≥ 40 dB 4 GHz – 20 GHz, Return Loss ≥ 34 dB 20 GHz – 50 GHz, Return Loss ≥ 32 dB
		Adapter	2.4mm - Female to 2.4mm - Female	DC – 50 GHz, SWR ≤ 1.12
	Adapter		2.4mm - Male to 2.4mm - Female	DC – 50 GHz, SWR ≤ 1.12
	Wrench		8mm	0.9 Nm

* Phase deviation from the nominal model as defined in the standards definitions (see Appendix A)

Model	Type	Connector	Specification
Y808MS	Open	2.4mm - Male	DC – 50 GHz, Phase Deviation* ≤ ± 3.8°
	Short	2.4mm - Male	DC – 50 GHz, Phase Deviation* ≤ ± 3°
	Load	2.4mm - Male	DC – 50 GHz, SWR ≤ 1.1
	Adapter	2.4mm - Male to 2.4mm - Male	DC – 50 GHz, SWR ≤ 1.18
	Wrench	8mm	0.9 Nm
Y808FS	Open	2.4mm - Female	DC – 50 GHz, Phase Deviation* ≤ ± 3.8°
	Short	2.4mm - Female	DC – 50 GHz, Phase Deviation* ≤ ± 3°
	Load	2.4mm - Female	DC – 50 GHz, SWR ≤ 1.1
	Adapter	2.4mm - Female to 2.4mm - Female	DC – 50 GHz, SWR ≤ 1.18
	Wrench	8mm	0.9 Nm

* Phase deviation from the nominal model as defined in the standards definitions (see Appendix A)

General Specification

Impendence	50 Ω	Power	≤ 0.5 W
Temperature	+15 °C ~ + 35 °C	Durability	> 2000

KWR42A

The KWR42A precise K-band waveguide mechanical calibration kit contains K-band load, K-band short, 1/8λ waveguide line, 1/4λ waveguide line and 3/8λ waveguide line, specified from 17.6 GHz to 26.7 GHz. For measurement convenience, the KWR42A includes 2.92mm coax-to-waveguide converters and some fasteners like screws, nuts, nut collars, position bolts, etc.

The KWR42A performance specifications are very similar to the Keysight K11644A mechanical calibration kit and it can be used as an approximate replacement of K11644A, or use the STD of K11644A in network analyzers.

Figure 9 KWR42A

Performance

Model	Type	Connector	F min (MHz)	F max (MHz)	Specification
KWR42A	Short	Waveguide	14047	28094	Delay = 0, Loss = 0
	Load	Waveguide	14047	28094	Delay = 0, Loss = 0
	1/8λ Line	Waveguide	14047	28094	Delay = 0.751E-11 Sec, Loss = 2.75 Gohm/Sec
	1/4λ Line	Waveguide	14047	28094	Delay = 1.502E-11 Sec, Loss = 2.75 Gohm/Sec
	3/8λ Line	Waveguide	14047	28094	Delay = 2.253E-11 Sec, Loss = 2.75 Gohm/Sec
	Coax-to-waveguide converter	2.92mm - Female to Waveguide	14047	28094	VSWR≤1.25;IL≤0.5dB
		2.92mm - Male to Waveguide	14047	28094	VSWR≤1.25;IL≤0.5dB
	Fastener	Screw M3*12, Screw M3*16, Screw M3*20, Nut M3, Nut collar M3, Position bolt			

General Specification

Impendence	50 Ω	Power	≤ 0.5 W
Temperature	+15 °C ~ + 35 °C	Durability	> 2000

Appendix A Calibration Kit Standards Definitions

Model	Type	C0 F(e-15)	C1 F(e-27)/Hz	C2 F(e-36)/Hz^2	C3 F(e-45)/Hz^3	L0 H(e-12)	L1 H(e-24)/Hz	L2 H(e-33)/Hz^2	L3 H(e-42)/Hz^3	Delay (pSec)	Loss (GΩ/Sec)	Z0 (Ω)
F503ME	Open	62.14	-143.07	82.92	0.76					17.4	0.7	50
	Short					0	0	0	0	17.8	2.1002	50.209
	Load									0	0.7	50
	Thru									0	0.7	50
F503FE	Open	119.09	-36.955	26.258	5.5136					0	0.7	50
	Short					0	0	0	0	0.093	0.7	49.992
	Load									0	0.7	50
	Thru									0	0.7	50
F603ME	Open	49.433	-310.13	23.168	-0.15966					29.243	2.2	50
	Short					2.0765	-108.54	2.1705	-0.01	31.785	2.36	50
	Load									0	2.3	50
	Thru									0	2.3	50
F603FE	Open	49.433	-310.13	23.168	-0.15966					29.243	2.3	50
	Short					2.0765	-108.54	2.1705	-0.01	31.785	2.36	50
	Load									0	0	50
	Thru									0	2.3	50
F504MS Y504MS	Open	89.939	2536.8	-264.99	13.4					40.856	0.93	50
	Short					3.3998	-496.4808	34.8314	-0.7847	45.955	1.087	49.992
	Load									0	0	50
	Thru									0	0	50

Model	Type	C0 F(e-15)	C1 F(e-27)/Hz	C2 F(e-36)/Hz^2	C3 F(e-45)/Hz^3	L0 H(e-12)	L1 H(e-24)/Hz	L2 H(e-33)/Hz^2	L3 H(e-42)/Hz^3	Delay (pSec)	Loss (GΩ/Sec)	Z0 (Ω)
F504FS Y504FS	Open	89.939	2536.8	-264.99	13.4					41.17	0.93	50
	Short					3.3998	-496.4808	34.8314	-0.7847	45.955	1.087	49.99
	Load									0	0	50
	Thru									0	0	50
F505MS	Open	89.939	2536.7999	-264.99	13.4					57.993	0.93	50
	Short					0.7653	459.8799	-52.429	1.5846	63.078	1.1273	50
	Load									0	0	50
	Thru									0	2.2	50
F505FS	Open	104.13	-1943.4008	144.62	2.2258					22.905	0.93	50
	Short					-0.1315	606.2089	-68.405	2.0206	27.99	1.3651	50
	Load									0	0	50
	Thru									0	2.2	50
F604MS	Open	49.433	-310.13	23.168	-0.15966					29.243	2.2	50
	Short					2.0765	-108.54	2.1705	-0.01	31.785	2.36	50
	Load									0	2.3	50
	Thru									0	2.3	50
F604FS	Open	49.433	-310.13	23.168	-0.15966					29.243	2.2	50
	Short					2.0765	-108.54	2.1705	-0.01	31.785	2.36	50
	Load									0	0	50
	Thru									0	2.3	50

Model	Type	C0 F(e-15)	C1 F(e-27)/Hz	C2 F(e-36)/Hz^2	C3 F(e-45)/Hz^3	L0 H(e-12)	L1 H(e-24)/Hz	L2 H(e-33)/Hz^2	L3 H(e-42)/Hz^3	Delay (pSec)	Loss (GΩ/Sec)	Z0 (Ω)
F606MS Y606MS	Open	49.433	-310.13	23.168	-0.15966					29.243	2.2	50
	Short					2.0765	-108.54	2.1705	-0.01	31.785	2.36	50
	Load									0	0	50
	Thru									0	0	50
F606FS Y606FS	Open	49.433	-310.13	23.168	-0.15966					29.243	2.2	50
	Short					2.0765	-108.54	2.1705	-0.01	31.785	2.36	50
	Load									0	0	50
	Thru									0	0	50
F707TS	Open M	44.1578	71.4204	-0.1716	0.2048					14.8487	3.39	50
	Open F	42.9684	729.336	-31.7551	0.6628					14.8487	3.46	50
	Short M					8.7413	-1036.9	41.5223	-0.5055	16.6963	2.5639	50
	Short F					-11.2831	1910.57	-85.3145	1.0864	16.6963	2.0059	50
	Load									0	0	50
	Thru									0	0	50
Y707MS	Open	47.5	0	3.8	0.19					14.982	1.8	50.8
	Short					0	0	0	0	16.83	1.8	50
	Load									0	0	50
	Thru									0	0	50

Model	Type	C0 F(e-15)	C1 F(e-27)/Hz	C2 F(e-36)/Hz^2	C3 F(e-45)/Hz^3	L0 H(e-12)	L1 H(e-24)/Hz	L2 H(e-33)/Hz^2	L3 H(e-42)/Hz^3	Delay (pSec)	Loss (GΩ/Sec)	Z0 (Ω)
Y707FS	Open	45.5	100	0.3	0.21					14.883	1.8	50
	Short					0	0	0	0	16.73	1.8	50
	Load									0	0	50
	Thru									0	0	50
F808MS Y808MS	Open	29.722	165.78	-3.5386	0.071					20.837	3.23	50
	Short					2.1636	-146.35	4.0443	-0.0363	22.548	3.554	50
	Load									0	0	50
	Thru									0	3.554	50
F808FS Y808FS	Open	29.72	165.78	-3.5385	0.071					20.837	3.23	50
	Short					2.1636	-146.35	4.0443	-0.0363	22.548	3.554	50
	Load									0	0	50
	Thru									0	3.554	50
KWR42A	Short					0	0	0	0	0	0	1
	Load									0	0	1
	1/8λ Line									0.751	2.75	1
	1/4λ Line									1.502	2.75	1
	3/8λ Line									2.253	2.75	1

Appendix B Derivation of Coaxial Calibration Model

The model definition of coaxial mechanical calibration kit is shown in Figure 10.

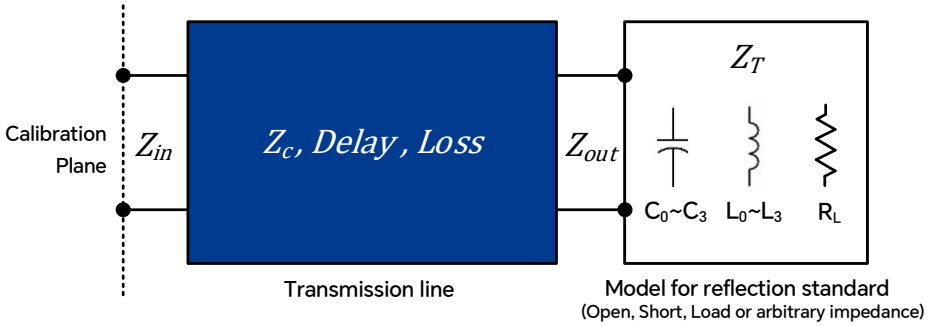

Figure 10 Model definition of coaxial mechanical calibration kit

Where:

- Z_{in} = the input impedance of transmission line
- Z_{out} = the output impedance of transmission line
- $Delay$ = the dispersion free, TEM mode, electrical delay defined by:

$$Delay = \frac{l}{v}$$

  Where l is the physical offset length of transmission line and v is the speed of light in transmission medium.

- $Loss$ = the propagation loss per unit length of transmission line at a normalization frequency of 1 GHz multiplied by the speed of light in the transmission medium, and the unit is GΩ/Sec. For coaxial mechanical calibration kit, if the log magnitude S_{11dB} of Short, Open, Load at 1GHz is obtained, or the log magnitude S_{21dB} of Through at 1GHz is obtained, $Loss$ can be estimated as:

$$Loss = -\frac{ln(10)\,S_{11dB}}{20}\left(\frac{Z_0}{Delay}\right)$$

$$Loss = -\frac{ln(10)\,S_{21dB}}{10}\left(\frac{Z_0}{Delay}\right)$$

- Z_C = the characteristic impedance of transmission line, given as:

$$Z_C = Z_0 + (1-j)\left(\frac{Loss}{4\pi f}\right)\sqrt{\frac{f}{10^9}}$$

  Where Z_0 is the lossless characteristic impedance of transmission line and f is the frequency in Hz.

- Z_T = the termination impedance. For Short and Open, there are:

$$Z_{T(Short)} = j2\pi f L_{Short} = j2\pi f(L_0 + L_1 f + L_2 f^2 + L_3 f^3)$$

$$Z_{T(Open)} = \frac{1}{j2\pi f C_{Open}} = \frac{1}{j2\pi f(C_0 + C_1 f + C_2 f^2 + C_3 f^3)}$$

- L_0~L_3 = the third order polynomial capacitance model
- C_0~C_3 = the third order polynomial inductance model
- R_L = the resistance model

According to the transmission line model, the flowgraph representation of coaxial mechanical calibration kit is shown in Figure 11.

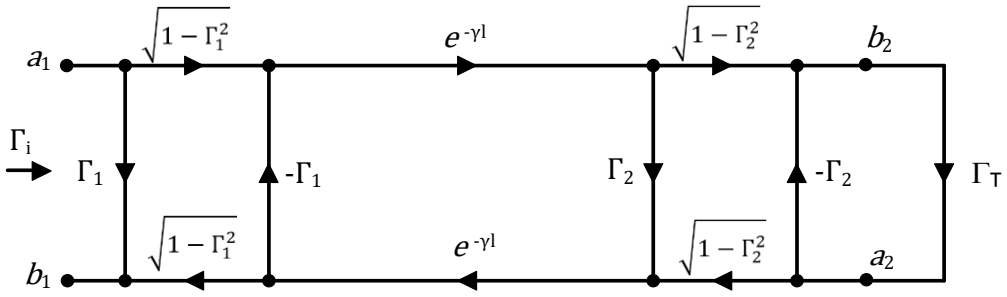

Figure 11 Flowgraph representation of coaxial mechanical calibration kit

Where:

- $\gamma =$ the propagation constant of the line, defined by:

$$\gamma = \alpha + j\beta$$

- $\alpha =$ the propagation loss constant of the line, $\beta =$ the propagation phase constant of the line, given as:

$$\alpha l = \frac{(Loss)(Delay)}{2Z_0}\sqrt{\frac{f}{10^9}}$$

$$\beta l = (2\pi f \times Delay) + \alpha l$$

- $\Gamma_1 =$ input reflection coefficient of transmission line, $\Gamma_2 =$ output reflection coefficient of transmission line, given as:

$$\Gamma_1 = \frac{Z_c - Z_{in}}{Z_c + Z_{in}}$$

$$\Gamma_2 = \frac{Z_{out} - Z_c}{Z_{out} + Z_c}$$

Let $Z_{in} = Z_{out} = Z_0$ we get:

$$\Gamma_1 = -\Gamma_2 = \frac{Z_c - Z_0}{Z_c + Z_0}$$

- $\Gamma_T =$ terminal reflection coefficient, given as:

$$\Gamma_T = \frac{Z_T - Z_0}{Z_T + Z_0}$$

Based on the flowgraph in Figure 11, the formula of the input reflection coefficient can be derived, that is, the one-port response of the coaxial mechanical calibration kit:

$$\Gamma_i = \frac{\Gamma_1(1 - e^{-2\gamma l} - \Gamma_1\Gamma_T) + \Gamma_T e^{-2\gamma l}}{1 - \Gamma_1(\Gamma_1 e^{-2\gamma l} + \Gamma_T(1 - e^{-2\gamma l}))}$$

About SIGLENT

SIGLENT is an international high-tech company, concentrating on R&D, sales, production and services of electronic test & measurement instruments.

SIGLENT first began developing digital oscilloscopes independently in 2002. After more than a decade of continuous development, SIGLENT has extended its product line to include digital oscilloscopes, isolated handheld oscilloscopes, function/arbitrary waveform generators, RF/MW signal generators, spectrum analyzers, vector network analyzers, digital multimeters, DC power supplies, electronic loads and other general purpose test instrumentation. Since its first oscilloscope was launched in 2005, SIGLENT has become the fastest growing manufacturer of digital oscilloscopes. We firmly believe that today SIGLENT is the best value in electronic test & measurement.

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