

F9651A Multi-Probe Compact Antenna Test Range (CATR) Chamber

Multi-probe millimeter-wave over-the-air chamber

Introduction

The Keysight F9651A Multi-Probe Compact Antenna Test Range (CATR) chamber in conjunction with Keysight S8705A RF/RRM DVT and Conformance Toolset fulfills the 5G FR2 RF and RRM test demands for design and verification as per 3GPP, and device acceptance as per certification bodies like GCF, PTCRB, and CTIA. It also provides a measurement environment for characterizing wireless and antenna system performance of 5G devices, at millimeter-wave (mmWave) frequencies, such as per IEEE 149 Recommended Practice for Antenna Measurements.



Overview

The Keysight F9651A Over-The-Air (OTA) Compact Antenna Test Range (CATR) chamber provides a measurement environment for characterizing wireless and antenna system performance of devices at millimeter-wave (mmWave) frequencies. Use the chamber with Keysight test and measurement equipment in a range of applications including device R&D and 3GPP / CTIA conformance tests.

Key Features

The key features of Keysight F9651A Multi-Probe CATR are:

- Shielded anechoic chamber
- 1 Primary compact antenna test range (CATR)
 - Rolled-edge parabolic reflector
 - Dual polarized feed horn assembly with roll motor
- 3 Auxiliary compact antenna test ranges (CATR)
 - Rolled-edge parabolic reflectors
 - Dual polarized feed horn assemblies
- Roll-over-azimuth DUT positioner
- Controller for feed and device under test (DUT) positioners with triggered data acquisition capability
- Probe feed options for in-band and spurious test frequency ranges
- Calibration kits for chamber validation and calibration
- LED lighting
- USB camera
- Crosshair laser guide for DUT alignment
- Chamber control software
- 3GPP FR1 and/or FR2 link antenna options
- Optional DUT and Phantom mounting fixtures
- Optional extreme temperature condition (ETC) testing
- Optional RF/RRM DVT and Conformance Toolset
- Optional Antenna Measurement Toolset

Supported Use Cases

Keysight F9651A Multi-Probe CATR supports, for example, the following use cases:

- Antenna characterization
- Signaling and non-signaling device characterization
- Used with Keysight S8705A RF/RRM DVT & Conformance Toolset for devices:
 - RF & RRM design and verification test
 - RF conformance test, in-band and spurious
 - RF demodulation
 - Radio resource management (RRM) one angle of arrival (AoA), two angles of arrival (AoA)
 - RF regulatory test, in-band and spurious
- Used with Keysight S8707A RF/RRM Carrier Acceptance Toolset for devices
- RF testing under extreme temperature condition (ETC)
- Used with S7601A Antenna Measurement Toolset
 - F7601001A Antenna Pattern Measurement

Contact Keysight for a comprehensive analysis of your custom use case(s).

System Specifications

F9651A: Anechoic chamber

Description	Specification (nominal)	Supplemental information
Construction	Not applicable	Aluminum frame and panels
Height	2190 mm	Fully assembled
Width	3450 mm	Fully assembled
Depth	2330 mm	Fully assembled
Weight	998 kg (2200 lb)	Fully assembled, no test equipment
Anechoic treatment	Pyramidal anechoic foam	
Supported frequency range	6-110 GHz	
Isolation		
0.6-7.125 GHz	>70 dB	
7.125-18 GHz	>80 dB	
18-50 GHz	>80 dB	
Supported Quiet Zone sizes	30 & 40 cm	Depends on Main in-band feed antenna
Operating voltage	110-220 V AC	
Power consumption	320 W input power	
Illumination	LED-based	
Camera	HDMI DVR output	
Ventilation	Dual intakes at the front of the chamber and dual exhausts at the top of the chamber	

F9651A-001: DUT connector panel

Description	Specification (nominal)	Supplemental information
Power ports	4 x DC power feedthroughs	100 W max. each
Connectivity ports	2 x Ethernet RJ45 4 x USB 3.0 Type A	100/1000/10 G, PoE 10 G

F9651A-002: DUT connector panel

Description	Specification (nominal)	Supplemental information
Power ports	1 x AC power 4 x DC power feedthroughs	120/220 V, 8 Amp max. 100 W max. each
Connectivity ports	1 x Ethernet RJ45 1 x USB 3.0 Type A 1 x USB 3.1 Gen 2 Type C, filtered, powered 1 x Waveguide 2 x BNC	100/1000/10 G, PoE 10 G 10 G, includes external power supply 6-Bore 44.2 GHz, 3 mm optical fiber

F9651A-0R1: RF connector panel

Description	Specification (nominal)	Supplemental information
RF connections	1 x SMA 50 Ω 18 GHz 2 x SMA 50 Ω 18 GHz 3 x 1.85 mm	Used for FR1 / LTE link antennae

F9651A-0P1: MCB connector panel

F9651A: Main reflector

Description	Specification (nominal)	Supplemental information
Frequency range	6-110 GHz	
Focal length	1.02 m	
Edge treatment	Rolled edge	
Supported Quiet Zone sizes	30 & 40 cm	Depends on Main feed antenna

F9651A-MA1: Auxiliary reflectors

Description	Specification (nominal)	Supplemental information
Frequency range	23-55 GHz	
Focal length	0.75 m	
Edge treatment	Rolled edge	
Supported Quiet Zone sizes	30 & 40 cm	Depends on Auxiliary feed antenna

F9651A-DL1: Laser guide

Description	Specification (nominal)	Supplemental information
DUT positioning	Laser-based	Two crosshair class 1 laser for exact positioning of the DUT

F9651A-P01: Motor control box for the Positioner

F9651A-PA1: DUT Positioner

Description	Specification (nominal)	Supplemental information
Azimuth Axis		
Range	$\pm 180^\circ$	
Resolution	0.01°	
Accuracy	$\pm 0.1^\circ$	
Speed	$80^\circ/\text{s}$	Requires F9629003A license
Roll Axis		
Range	$\pm 180^\circ$	
Resolution	0.01°	
Accuracy	$\pm 0.1^\circ$	
Speed	$80^\circ/\text{s}$	Non-triggered for direct move. Triggered for continuous sweep $40^\circ/\text{s}$ maximum speed at $\Rightarrow 2^\circ$ steps
DUT max weight	10 kg (22 lbs) 5.0 Nm max torque	
Communications	USB 3.0	
Power requirements	110/220 V AC	320 W input power

F9651A-AA1: FR1 Link antennae

Description	Specification (nominal)	Supplemental information
Antenna frequency range	600-5200 MHz	Includes quantity 2

F9651A-AB1: FR2 Link antenna

Description	Specification (nominal)	Supplemental information
Antenna frequency range	24-50 GHz	

F9651A-AC1: 24-42 GHz Main feed antenna

Description	Specification (nominal)	Supplemental information
Type	Corrugated dual-polarized horn	
Gain	15 dBi	Varies with frequency
Cross-polarization	30 dB	
Cable loss (to bulkhead)	~5 dB	Varies with frequency
Feed roll	-90 ° to 180 °	

F9651A-AD1: 6-110 GHz Spurious feed horn assembly with 24-42 GHz In-band feed antenna

Description	Specification (nominal)	Supplemental information
24-42 GHz Main feed antenna	Corrugated dual-polarized horn	
Gain	15 dBi	Varies with frequency
Cross-polarization	30 dB	
Cable loss (to bulkhead)	~5 dB	Varies with frequency
Feed roll	-90 ° to 180 °	
6-24 GHz Spurious feed antenna	Rectangular dual-polarized horn	
Gain	14 dBi	
40-60 GHz Spurious feed antenna	Corrugated dual-polarized horn	
Gain	13 dBi	
50-75 GHz Spurious feed antenna	Corrugated dual-polarized horn	
Gain	13 dBi	
75-110 GHz Spurious feed antenna	Corrugated dual-polarized horn	
Gain	13 dBi	

F9651A-AE1: 24-55 GHz Main feed antenna

Description	Specification (nominal)	Supplemental information
Type	Corrugated dual-polarized horn	
Gain	11.5 dBi	Varies with frequency
Cross-polarization	30 dB	
Cable loss (to bulkhead)	~5 dB	Varies with frequency
Feed roll	-90° to 180°	

F9651A-AF1: 6-110 GHz Spurious feed horn assembly with 24-55 GHz In-band feed antenna

Description	Specification (nominal)	Supplemental information
24-55 GHz Main feed antenna	Corrugated dual-polarized horn	
Gain	11.5 dBi	Varies with frequency
Cross-polarization	30 dB	
Cable loss (to bulkhead)	~5 dB	Varies with frequency
Feed roll	-90 ° to 180 °	
6-24 GHz Spurious feed antenna	Rectangular dual-polarized horn	
Gain	14 dBi	
40-60 GHz Spurious feed antenna	Corrugated dual-polarized horn	
Gain	13 dBi	
50-75 GHz Spurious feed antenna	Corrugated dual-polarized horn	
Gain	13 dBi	
75-110 GHz Spurious feed antenna	Corrugated dual-polarized horn	
Gain	13 dBi	

F9651A-AG1: 24-42 GHz Auxiliary feed antenna

Description	Specification (nominal)	Supplemental information
Type	Corrugated dual-polarized horn	
Gain	15 dBi	
Cable loss (to bulkhead)	~5 dB	Varies with frequency

F9651A-AH1: 24-55 GHz Auxiliary feed antenna

Description	Specification (nominal)	Supplemental information
Type	Corrugated dual-polarized horn	
Gain	8.5 dBi	
Cable loss (to bulkhead)	~5 dB	Varies with frequency

F9651A-AC1, F9651A-AD1, F9651A-AE1, F9651A-AF1: 30 cm Quiet Zone performance for main reflector

Description	Specification (nominal)	Supplemental information
Quiet zone dimensions	30 cm diameter	
24-42 GHz main horn maximum amplitude variation	1.2 dB at 24 GHz 1.2 dB at 32 GHz 1.3 dB at 41 GHz	Varies with frequency F9651A-AC1 (In-band feed) F9651A-AD1 (Spurious feed)
24-42 GHz main horn maximum phase variation	8° at 24 GHz 12° at 32 GHz 18° at 41 GHz	Varies with frequency F9651A-AC1 (In-band feed) F9651A-AD1 (Spurious feed)
24-42 GHz main horn path loss	45 dB at 24 GHz 47 dB at 32 GHz 52 dB at 41 GHz	OTA path loss varies with frequency F9651A-AC1 (In-band feed) F9651A-AD1 (Spurious feed)
24-55 GHz main horn maximum amplitude variation	1.5 dB at 24 GHz 1.6 dB at 32 GHz 2.3 dB at 41 GHz 2.1 dB at 49 GHz	Varies with frequency F9651A-AE1 (In-band feed) F9651A-AF1 (Spurious feed)
24-55 GHz main horn maximum phase variation	9° at 24 GHz 8.5° at 32 GHz 15° at 41 GHz 14° at 49 GHz	Varies with frequency F9651A-AE1 (In-band feed) F9651A-AF1 (Spurious feed)
24-55 GHz main horn path loss	50 dB at 24 GHz 50 dB at 32 GHz 53 dB at 41 GHz 55 dB at 49 GHz	OTA path loss varies with frequency F9651A-AE1 (In-band feed) F9651A-AF1 (Spurious feed)

F9651A-AE1, F9651A-AF1: 40 cm Quiet Zone performance for main reflector

Description	Specification (nominal)	Supplemental information
Quiet zone dimensions	40 cm diameter	
24-55 GHz main horn maximum amplitude variation	1.9 dB at 24 GHz 2.3 dB at 32 GHz 2.3 dB at 41 GHz 2.2 dB at 49 GHz	Varies with frequency F9651A-AE1 (In-band feed) F9651A-AF1 (Spurious feed)
24-55 GHz main horn maximum phase variation	11° at 24 GHz 9° at 32 GHz 17° at 41 GHz 16.5° at 49 GHz	Varies with frequency F9651A-AE1 (In-band feed) F9651A-AF1 (Spurious feed)
24-55 GHz main horn path loss	50 dB at 24 GHz 50 dB at 32 GHz 53 dB at 41 GHz 55 dB at 49 GHz	OTA path loss varies with frequency F9651A-AE1 (In-band feed) F9651A-AF1 (Spurious feed)

F9651A-AG1, F9651A-AH1: 30 cm Quiet Zone performance for auxiliary reflector

Description	Specification (nominal)	Supplemental information
Quiet zone dimensions	30 cm diameter	
Cross-polarization	30 dB	
24-42 GHz auxiliary horn maximum amplitude variation	1.9 dB at 24 GHz 1.8 dB at 32 GHz 2.5 dB at 41 GHz	Varies with frequency F9651A-AG1 (Auxiliary feed)
24-42 GHz auxiliary horn maximum phase variation	5.5° at 24 GHz 5.5° at 32 GHz 7.0° at 41 GHz	Varies with frequency F9651A-AG1 (Auxiliary feed)
24-42 GHz auxiliary horn path loss	51 dB at 24 GHz 52 dB at 32 GHz 53 dB at 41 GHz	OTA path loss varies with frequency F9651A-AG1 (Auxiliary feed)
24-55 GHz auxiliary horn maximum amplitude variation	1.6 dB at 24 GHz 1.7 dB at 32 GHz 1.8 dB at 41 GHz 2.4 dB at 49 GHz	Varies with frequency F9651A-AH1 (Auxiliary feed)
24-55 GHz auxiliary horn maximum phase variation	12° at 24 GHz 11° at 32 GHz 15° at 41 GHz 15° at 49 GHz	Varies with frequency F9651A-AH1 (Auxiliary feed)
24-55 GHz auxiliary horn path loss	53 dB at 24 GHz 56 dB at 32 GHz 60 dB at 41 GHz 61 dB at 49 GHz	OTA path loss varies with frequency F9651A-AH1 (Auxiliary feed)

F9651A-AH1: 40 cm Quiet Zone performance for auxiliary reflector

Description	Specification (nominal)	Supplemental information
Quiet zone dimensions	40 cm diameter	
Cross-polarization	30 dB	
24-55 GHz auxiliary horn maximum amplitude variation	2.0 dB at 24 GHz 2.4 dB at 32 GHz 2.7 dB at 41 GHz 3.0 dB at 49 GHz	Varies with frequency F9651A-AH1 (Auxiliary feed)
24-55 GHz auxiliary horn maximum phase variation	17° at 24 GHz 14° at 32 GHz 18° at 41 GHz 20° at 49 GHz	Varies with frequency F9651A-AH1 (Auxiliary feed)
24-55 GHz auxiliary horn path loss	53 dB at 24 GHz 56 dB at 32 GHz 60 dB at 41 GHz 61 dB at 49 GHz	OTA path loss varies with frequency F9651A-AH1 (Auxiliary feed)

F9651A-Dxx: DUT holders

Description	Specification (nominal)	Supplemental information
Alignment option	DUT type	Model option
1	Large smartphone	F9651A-D01
1	Tablet	F9651A-D02
3	Large smartphone	F9651A-D03
3	Large tablet	F9651A-D04
1	Small smartphone	F9651A-D05
1	Mobile Reference Design	F9651A-D06
1	Large Mobile Ref Design	F9651A-D07
3	Small smartphone	F9651A-D08
3	Small tablet	F9651A-D09
2	Smartphone or tablet	F9651A-D10

F9651A-DFx: Phantom fixtures for 30 cm QZ

Description	Specification (nominal)	Supplemental information
Phantom type	DUT type	Model option
Single hand / head	Smartphones	F9651A-DF0
Dual hand	Smartphones	F9651A-DF1
Single hand	Smartphones	F9651A-DF2

F9651A-M01: DUT adaptor for F9651A-PA1 Positioner

Description	Specification (nominal)	Supplemental information
DUT adaptor	For 30 cm sphere DUT holders and Phantom fixtures to be used in 45 cm sphere	Required with F9651A-PA1 Positioner

F9651A-MB1: Security brackets

Description	Specification (nominal)	Supplemental information
OTA chamber security bracket	To secure the chamber to the floor	Set of 4

F9651BA1A: 6-67 GHz Calibration kit

Description	Specification (nominal)	Supplemental information
Antenna connector	2.4 mm (f)	RF transparent holding fixture with the cable
Antenna frequency range	6-67 GHz	

F9651BB1A: 6-110 GHz Calibration kit

Description	Specification (nominal)	Supplemental information
Antenna connector	2.4 mm (f)	RF transparent holding fixture with the cable
Antenna frequency range	6-110 GHz	Requires U9361M-5CX option

F9631A: Temperature control unit

Description	Specification (nominal)	Supplemental information
Facility requirements	Clean dry air	See site preparation guide for more details
Electrical requirements	240 V / 30 A, single phase	See site preparation guide for more details
Maximum inlet air pressure to TCU	120 PSIG (8.3 BAR)	
Maximum inlet air flow to TCU	30 CFM	
Maximum outlet air flow to DUT temperature enclosure kit	24 CFM	

F9631TE1A: DUT temperature enclosure kit

Description	Specification (nominal)	Supplemental information
Enclosure size	DUT within 45 cm sphere centered on azimuth and roll axes	Polymethacrylimide (PMI) based structural foam material
Standard temperature range	-10 °C to +55 °C	Requires F9629040A license
Extended temperature range	-40 °C to +100 °C	Requires F9629041A license
Transmission loss	0.3 dB at 39 GHz	

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