



PART 1 Test Under Static Transmission Scenario

Test Report No. : 13760834H-H-R1
Applicant : Panasonic Corporation of North America
Type of EUT : Personal Computer
Model Number of EUT : FZ-G2
FCC ID : ACJ9TGFZG2
Test regulation : FCC47CFR 2.1093
Test Result : Complied (Refer to SECTION 7)
Reported SAR(1g) Value : The highest PD
Reported PD = 7.30 W/m²
Measured PD = 6.49 W/m²

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8. The opinions and the interpretations to the result of the description in this report are outside scopes where UL Japan has been accredited.
9. The information provided from the customer for this report is identified in SECTION 2.
10. This report is a revised version of 13760834H-H. 13760834H-H is replaced with this report.

Date of test(s): May 15, 2021 to July 22, 2021

Representative test operator: T. Nakagawa
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Leader



CERTIFICATE 5107.02

- ☐ The testing in which "Non-accreditation" is displayed is outside the accreditation scopes in UL Japan, Inc.
☒ There is no testing item of "Non-accreditation".

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1 Introduction

This device uses Qualcomm® Smart Transmit feature. These modem(s) is enabled in Qualcomm® Smart Transmit Feature to control and manage transmitting power in real time and to ensure at all times the averaged RF exposure is in compliance with FCC/ISED requirements.

This report (part 1) demonstrates that Qualcomm® Reference Design (QRD) complies with FCC/ISED RF exposure limits at these maximum time averaged power limits.

Note: WLAN operations are not enabled with Smart Transmit.

2 Customer information

Company Name	:	Panasonic Corporation of North America
Address	:	Two Riverfront Plaza, 9th Floor Newark, NEW JERSEY, 07102-5940, USA
Telephone Number	:	+1-201-348-7760
Facsimile Number	:	+1-201-348-7760
Contact Person	:	Ben Botros

The information provided from the customer is as follows;

- Applicant, Type of Equipment, Model No. FCC ID on the cover and other relevant pages
- Operating/Test Mode(s) (Mode(s)) on all the relevant pages
- SECTION 2: Customer information
- SECTION 3: Equipment under test (EUT) other than the Receipt Date
- SECTION 8: Tune-up tolerance information and software information

* The laboratory is exempted from liability of any test results affected from the above information in section 3.

3 Equipment under test (EUT)

3.1 Identification of EUT

Type	:	Personal Computer
Model Number	:	FZ-G2
Serial number	:	0LTSA00729
Rating	:	AC 100 V to 240 V, 50 Hz / 60 Hz
Receipt Date	:	March 30, 2021
Condition	:	Production prototype (Not for Sale: This sample is equivalent to mass-produced items.)
Modification	:	No Modification by the test lab.

3.2 Product description

Model: FZ-G2 (referred to as the EUT in this report) is a Personal Computer.

5G NR (FR2)	TDD	120 kHz	n258	Pi/2 BPSK (DFT-s-OFDM), QPSK (CP-OFDM/DFT-s-OFDM), 16QAM (CP-OFDM/DFT-s-OFDM), 64QAM (CP-OFDM/DFT-s-OFDM) MIMO Support: No
	TDD	120 kHz	n260	
	TDD	120 kHz	n261	
	-	-	-	
	-	-	-	
EN-DC(LTE-FR2 mmW) (NSA mode only)	Supported combination			*B48: not used in Canada(ISED)
	LTE Anchor Bands for NR band n258			LTE Band 2/5/7/12/66
	LTE Anchor Bands for NR band n260			LTE Band 2/5/12/13/14/48*/66
	LTE Anchor Bands for NR band n261			LTE Band 2/5/13/48*/66

Radio Module (Tested inside of Panasonic Tablet PC FZ-G2)				
Model : WW21A (FCC ID ACJ9TGW21A / ISED certification number 216H-CFWW21A)				
Wireless technologies	Dup.	Band		Mode
WCDMA	FDD		2	UMTS Rel. 99 (Data) HSDPA (Rel. 5)
	FDD		4	HSUPA (Rel. 6), HSPA+ (Rel. 7), DC-HSDPA (Rel. 8)
	FDD		5	
LTE	FDD		2	QPSK, 16QAM, 64AQM, 256QAM
	FDD		4	
	FDD		5	
	FDD		7	Downlink MIMO Support: Yes(2x2, 4x4) Supported band : B2, B4, B7, B25, B38, B41, B42, B48, B66
	FDD		12	
	FDD		13	
	FDD		14	Uplink MIMO Support: No Uplink transmission is limited to a single output stream.
	FDD		17	
	FDD		25	
	FDD		26	
	FDD(RX only)		29	
	TDD		38	
	TDD		41	
	TDD		42	
	TDD(Rx only)		46	
	TDD		48	
	FDD		66	
	FDD		71	
LTE CA	Downlink			Uplink
	Maximum 7 carriers			*B42: not used in US (FCC) / B48: not used in Canada(ISED)
				Maximum 2 carriers Supported combination: <Intra-band contiguous> 7C, 41C, 42C, 48C <Inter-band> Not supported
5G NR (FR1)	FDD	15 kHz	n2	Pi/2 BPSK (DFT-s-OFDM), QPSK (CP-OFDM/DFT-s-OFDM), 16QAM (CP-OFDM/DFT-s-OFDM), 64QAM (CP-OFDM/DFT-s-OFDM), 256QAM (CP-OFDM/DFT-s-OFDM) Downlink MIMO Support: Yes(2x2, 4x4) Supported band : n2, n41, n66, n77, n78 Uplink MIMO Support: No Uplink transmission is limited to a single output stream.
	FDD	15 kHz	n5	
	TDD	15 kHz	n41	
	FDD	15 kHz	n66	
	FDD	15 kHz	n71	
	TDD	30 kHz	n77	
	TDD	30 kHz	n78	
	-	-	-	
EN-DC(LTE-FR1 Sub6) (NSA mode only)	Supported combination			*n77, n78: not used in US (FCC)
	LTE Anchor Bands for NR band n2			LTE Band 5/12/13
	LTE Anchor Bands for NR band n5			LTE Band 2/7/66
	LTE Anchor Bands for NR band n41			LTE Band 2/25/26/66
	LTE Anchor Bands for NR band n66			LTE Band 5/12/13/14/71
	LTE Anchor Bands for NR band n71			LTE Band 2/7/66
	LTE Anchor Bands for NR band n77*			LTE Band 41
	LTE Anchor Bands for NR band n78*			LTE Band 2/5/7/12/38/66

Wireless module (Tested inside of Panasonic Tablet PC FZ-G2)				
Model : WL20B (FCC ID ACJ9TGWL20B / ISED certification number 216H-CFWL20B)				
Wireless technologies	Dup.	Band		Mode
WLAN	TDD	2.4GHz	2412-2472 for US 2412-2462 for Canada	802.11b 802.11g 802.11n(20,40) 802.11ax(20,40)
	TDD	5GHz	5180-5240 5260-5320 5500-5720 5745-5825	802.11a 802.11n(20,40) 802.11ac(20,40.80.160) 802.11ax(20,40.80.160)
Bluetooth	TDD	2.4GHz	2402-2480	BR/EDR/LE

*This report is for mmW range

3.3 mmW Antenna configuration

WWAN Antennas	5G NR(FR2)
	Tx/Rx
#0	n258, n260 and n261
#1	n258, n260 and n261
#2	n258, n260 and n261

3.4 Time averaging for SAR and PD

The Qualcomm® Smart Transmit algorithm controls and manages the instantaneous Tx power to maintain the time-averaged Tx power (in turn, time-averaged RF exposure) is in compliance with regulatory limits.

This device uses Qualcomm® Smart Transmit feature and cannot operate without RF exposure characterization at the device level, beforehand. The parameters obtained from SAR and PD characterization (char), if any, is used as input for Smart Transmit. Both SAR char and PD char will be entered via the Embedded File System (EFS) to enable the Smart Transmit feature.

4 Test standard information

4.1 Test Specification

	Title	
☒	FCC47CFR 2.1093	RF Exposure Procedures and Equipment Authorization Policies for Mobile and Portable Devices

4.2 Published RF exposure KDB procedures

	Name of documents	Title
☒	KDB447498D01(v06)	RF Exposure Procedures and Equipment Authorization Policies for Mobile and Portable Devices
☐	KDB447498D02(v02r01)	SAR Measurement Procedures for USB Dongle Transmitters
☐	KDB648474D04(v01r04)	SAR Evaluation Considerations for Wireless Handsets
☒	KDB941225D01(v03r01)	3G SAR Measurement Procedures
☒	KDB941225D05(v02r05)	SAR Evaluation Considerations for LTE Devices
☐	KDB941225D06(v02r01)	SAR Evaluation Procedures for Portable Devices with Wireless Router Capabilities
☐	KDB941225D07(v01r02)	Hot Spot SAR
☐	KDB616217D04(v01r02)	SAR Evaluation Procedures for UMPC Mini-Tablet Devices
☒	KDB865664D01(v01r04)	SAR Evaluation Considerations for Laptop, Notebook, Netbook and Tablet Computers
☐	KDB248227D01(v02r02)	SAR Measurement Requirements for 100MHz to 6 GHz

4.3 SAR Work Procedures Procedure

	Name of documents	Title or details
☒	C/N: Work Instructions- ULID-003598 Name:13-EM-W0429	UL Japan, Inc.'s SAR Work Procedures Procedure
☒	C/N: Work Instructions- ULID-003599 Name:13-EM-W0430	UL Japan, Inc.'s SAR Work Procedures Procedure
☒	C/N: Work Instructions- ULID-003619 Name: 13-EM-W0863	UL Japan, Inc.'s PD Work Procedures Procedure
☒	IEEE Std 1528-2013	IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques.
☒	IEC TR 63170 Edition 1.0	Measurement procedure for the evaluation of power density related to human exposure to radio frequency fields from wireless communication devices operating between 6 GHz and 100 GHz

4.4 Additions or deviations to standard

Other than above, no addition, exclusion nor deviation has been made from the standard.

4.5 References

SPEAG. (August 2018). *5G Module V1.2 Application Note: 5G Compliance Testing*.
SPEAG. (n.d.). *SPEAG uncertainty document (AN 15-7/AN19-17)*.

4.6 Limit

4.6.1 Below 6 GHz

(A) Limits for Occupational/Controlled Exposure (W/kg)

Spatial Average (averaged over the whole body)	Spatial Peak (averaged over any 1g of tissue)	Spatial Peak (hands/wrists/feet/ankles averaged over 10g)
0.4	8.0	20.0

(B) Limits for General population/Uncontrolled Exposure (W/kg)

Spatial Average (averaged over the whole body)	Spatial Peak (averaged over any 1g of tissue)	Spatial Peak (hands/wrists/feet/ankles averaged over 10g)
0.08	1.6	4.0

Occupational/Controlled Environments: are defined as locations where there is exposure that may be incurred by people who are aware of the potential for exposure, (i.e. because of employment or occupation).

General Population/Uncontrolled Environments: are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure.

1.6 W/kg limit is applied

4.6.2 Above 6 GHz

Frequency Range [MHz]	Power Density [mW/cm ²]	Average Time [Minutes]
(A) Limits For Occupational / Controlled Environments		
1,500 – 100,000	5	6
(B) Limits For General Population / Uncontrolled Environments		
1,500 – 100,000	1	30

Note: 1.0 mW/cm² is 10 W/m²

10 W/m² limit is applied

5 Location

UL Japan, Inc. Ise EMC Lab.
Shielded room for SAR testings
A2LA Certificate Number: 5107.02 / FCC Test Firm Registration Number: 884919
ISED SAR Lab Company Number: 2973C / CAB identifier: JP0002
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN
Telephone: +81 596 24 8999
Facsimile: +81 596 24 8124

6 Definitions, symbols, and abbreviations

6.1 Definitions

SAR_design_target	: The SAR_design_target shall be less than regulatory SAR limit (i.e., 1gSAR limit for FCC) after accounting for all device design related uncertainties.
SAR_design_target_extremity	: SAR_design_target for limbs
Tx_power_at_SAR_design_target	: Transmit level that matches SAR_design_target (P_{limit} in dBm)
Δ_{min}	: housing material influence
PD_design_target	: The design target for PD compliance. It should be less than regulatory power density limit to account for all device design related uncertainties
<i>input.power.limit</i>	: For a PD characterized wireless device, the input power level at antenna port(s) for each beam corresponding to PD_design_target.
PD char	: the table that contains input.power.limit fed to antenna port(s) for all supported beams.
N beams	: The mmW device supports total N beams, where M out of N are single beams and the rest of (N-M) are beam pairs (where 2 single beams are excited at the same time).
power density (PD) or S_{av}	: energy per unit time and unit area crossing a surface of area A characterized by the normal unit vector $\hat{\mathbf{n}}$ and averaging time.

$$S_{\text{av}} = \frac{1}{AT} \iint (\mathbf{E} \times \mathbf{H}) \cdot \hat{\mathbf{n}} dA dT$$

Specific Absorption Rate (SAR)	: The time derivative (rate) of the incremental energy (dW) absorbed by (dissipated in) an incremental mass (dm) contained in a volume element (dV) of a given density (ρ), as shown in the following equation:
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$$\text{SAR} = \frac{d}{dt} \left(\frac{dW}{dm} \right) = \frac{d}{dt} \left(\frac{dW}{\rho dV} \right)$$

Reported SAR	: Measured SAR is scaled to the maximum tune-up tolerance limit and the maximum duty by the following formulas.
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$$\begin{aligned} \text{Reported SAR [w/kg]} \\ &= \text{Measured SAR [w/kg]} \times \text{scale factor for power} \\ &\times \text{Scaled factor for duty (if needed)} \end{aligned}$$

Where

$$\text{Scaled factor for power} = \frac{\text{Maximum tune up tolerance limit [mW]}}{\text{Measured power [mW]}}$$

And

$$\text{Scaled factor for duty} = \frac{1}{\text{Duty}}$$

Maximum Tune-up tolerance limit : Tolerance power specified by customer ($P_{\max}$ or P_{limit})

6.2 Symbols

Symbol	Quantity	Unit	Dimensions
E	Electric field	volt per meter	V / m
f	Frequency	hertz	Hz
H	Magnetic field	ampere per meter	A / m
λ	Wavelength	meter	m
S	Local power density	watt per square meter	W / m ²
PD or S_{av}	Spatial-average power density	watt per square meter	W / m ² (mW / cm ²)
SAR	Specific Absorption Rate	watt per square meter	W / kg

6.3 Abbreviations

□	NOT applicable.	GPS	Global Positioning System
☒	applicable.	Hori.	Horizontal
A2LA	The American Association for Laboratory Accreditation	IEC	International Electrotechnical Commission
AC	Alternating Current	IEEE	Institute of Electrical and Electronics Engineers
AFH	Adaptive Frequency Hopping	IF	Intermediate Frequency
AM	Amplitude Modulation	ILAC	International Laboratory Accreditation Conference
Amp, AMP	Amplifier	ISED	Innovation, Science and Economic Development Canada
ANSI	American National Standards Institute	ISO	International Organization for Standardization
Ant, ANT	Antenna	KDB	Knowledge data base from Federal communication committee
AP	Access Point	LAN	Local Area Network
Atten., ATT	Attenuator	LIMS	Laboratory Information Management System
AV	Average	MCS	Modulation and Coding Scheme
BPSK	Binary Phase-Shift Keying	MRA	Mutual Recognition Arrangement
BR	Bluetooth Basic Rate	nG	n generation (e.g. 3G,4G and 5G)
BS	base station	NIST	National Institute of Standards and Technology
BT	Bluetooth	NR	New radio
BT LE	Bluetooth Low Energy	OBW	Occupied Band Width
BW	BandWidth	OFDM	Orthogonal Frequency Division Multiplexing
Cal Int	Calibration Interval	P/M	Power meter
CCK	Complementary Code Keying	PCB	Printed Circuit Board
Ch., CH	Channel	PD	Power density
CISPR	Comite International Special des Perturbations Radioelectriques	PER	Packet Error Rate
CW	Continuous Wave	PHY	Physical Layer
DBPSK	Differential BPSK	PK	Peak
DC	Direct Current	PN	Pseudo random Noise
DFS	Dynamic Frequency Selection	PRBS	Pseudo-Random Bit Sequence
DQPSK	Differential QPSK	PSD	Power Spectral Density
DSI	Device state index	QAM	Quadrature Amplitude Modulation
DSSS	Direct Sequence Spread Spectrum	QP	Quasi-Peak
DUT	Device under test	QPSK	Quadri-Phase Shift Keying
EDR	Enhanced Data Rate	RBW	Resolution Band Width
EIRP, e.i.r.p.	Equivalent Isotropically Radiated Power	RDS	Radio Data System
EMC	ElectroMagnetic Compatibility	RE	Radio Equipment
EMI	ElectroMagnetic Interference	RF	Radio Frequency
EN	European Norm	RMS	Root Mean Square
ERP, e.r.p.	Effective Radiated Power	Rx	Receiving
EU	European Union	SA, S/A	Spectrum Analyzer
EUT	Equipment Under Test	SG	Signal Generator
Fac.	Factor	S _n	Surface number
FCC	Federal Communications Commission	SVSWR	Site-Voltage Standing Wave Ratio
FHSS	Frequency Hopping Spread Spectrum	TER	Total exposure ratio
FM	Frequency Modulation	TR	Test Receiver
Freq.	Frequency	Tx	Transmitting
GFSK	Gaussian Frequency-Shift Keying	VBW	Video BandWidth
GNSS	Global Navigation Satellite System	Vert.	Vertical
EN-DC	E-UTRAN New Radio - Dual Connectivity	WLAN	Wireless LAN

7 Test result

7.1 verdict

Complied

Highest values at each band are listed next section.

7.2 Stand-alone PD result

Highest reported PD = 7.30 W/m²

Highest measured PD = 6.49 W/m²

Band	Measured PD [W/m ²]	Reported PD [W/m ²]
n258	5.55	7.30
n261	6.49	7.30
n260	5.79	7.30

Reported PD [W/m²] = $10^{(\text{device_uncert}[\text{dB}] / 10)} * PD_design_target * Duty = 10^{(0.21)} * 6 * 75 \% = 7.30$ module #0,1

Reported PD [W/m²] = $10^{(\text{device_uncert}[\text{dB}] / 10)} * PD_design_target * Duty = 10^{(0.21)} * 4 * 75 \% = 4.87$ module #2

Note that 75% factor corresponds to 3dB *reserve_power_margin*

7.3 Simultaneous transmission SAR result

5G NR FR2 n258, n260 and n261 cannot transmit simultaneously.

See section 12

7.4 Measurement Uncertainty

Error Description	Uncert. value (dB)	Probab. Distri.	Div.	(c _i)	Std. Unc. (±dB)	(v _i) v _{eff}
Uncertainty terms dependent on the measurement system						
Calibration	± 0.49	N	1	1	0.49	∞
Probe correction	± 0.00	R	√3	1	0.00	∞
Frequency response (BW ≤ 1 GHz)	± 0.20	R	√3	1	0.12	∞
Sensor cross coupling	± 0.00	R	√3	1	0.00	∞
Isotropy	± 0.50	R	√3	1	0.29	∞
Linearity	± 0.20	R	√3	1	0.12	∞
Probe scattering	± 0.00	R	√3	1	0.00	∞
Probe positioning o set	± 0.30	R	√3	1	0.17	∞
Probe positioning repeatability	± 0.04	R	√3	1	0.02	∞
Sensor mechanical o set	± 0.00	R	√3	1	0.00	∞
Probe spatial resolution	± 0.00	R	√3	1	0.00	∞
Field impedance dependance	± 0.00	R	√3	1	0.00	∞
Amplitude and phase drift	± 0.00	R	√3	1	0.00	∞
Amplitude and phase noise	± 0.04	R	√3	1	0.02	∞
Measurement area truncation	± 0.00	R	√3	1	0.00	∞
Data acquisition	± 0.03	N	1	1	0.03	∞
Sampling	± 0.00	R	√3	1	0.00	∞
Field reconstruction	± 0.95	R	√3	1	0.55	∞
Forward transformation	± 0.00	R	√3	1	0.00	∞
Power density scaling	-	R	√3	1	-	∞
Spatial averaging	0.10	R	√3	1	0.06	∞
System detection limit	± 0.04	R	√3	1	0.02	∞
Uncertainty terms dependent on the DUT and environmental factors						
Probe coupling with DUT	± 0.00	R	√3	1	0.00	∞
Modulation response	± 0.40	R	√3	1	0.23	∞
Integration time	± 0.00	R	√3	1	0.00	∞
Response time	± 0.00	R	√3	1	0.00	∞
Device holder influence	± 0.10	R	√3	1	0.06	∞
DUT alignment	± 0.00	R	√3	1	0.00	∞
RF ambient conditions	± 0.04	R	√3	1	0.02	∞
Ambient reflections	± 0.04	R	√3	1	0.02	∞
Immunity / secondary reception	± 0.00	R	√3	1	0.00	∞
Drift of the DUT	± 0.21	R	√3	1	0.12	∞
Combined Std. Uncertainty					0.87	∞
Expanded STD Uncertainty (k=2)					1.74	

8 Software information, Tune up tolerance limit, P_{limit} and input.power.limit

8.1 Software information

*The power value of the EUT was set for testing as follows (setting value might be different from product specification value);
Software: QRCT version 4.0

*This setting of software is the worst case.

The test was performed with condition that obtained the maximum average power (Burst) in pre-check.

Any conditions under the normal use do not exceed the condition of setting.

In addition, end users cannot change the settings of the output power of the product.

8.2 Input Power Limit

The input.power.limit used in this report are determined and listed in Part 0 report, details is shown also part 0.

9 PD Exposure Conditions (Test Configurations)

the PD measurement is made all channels and all applicable surfaces determined through the validated simulation approach, see Part 0 report.

The following beam selection criteria is used:

Select at least one single beam (antenna array config) per antenna type and module

The single beam containing highest number of active antenna ports. For example, the single beam with 4 active patch ports should be selected over the beam with a single active patch port

Select at least one beam pair (if applicable) per antenna module and type. The beam pair containing the highest number of active antenna ports.

If the Tx polarization diversity is supported, the selected beam pair(s) needs to be tested with Tx polarization diversity in both enabled and disabled scenario.

Table 9-1 tested configuration

Module ID	Active port #	Ant type	Test surface	
0	4	patch	Edge2	Edge1
1	4	patch	Edge4	Rear
2	4	patch	Edge1	Rear tilt edge1/Rear

10 PD System Check

10.1 Dielectric Property

Media is air so Relative Permittivity (ϵ_r) and Conductivity (σ) are 1 and 0 respectively.

10.2 System Check

System validation is required before a system is deployed for measurement

Peak and spatially averaged power density at the peak location(s) must be compared to calibrated results according to the defined test conditions

- the same spatial resolution and measurement region used in the waveguide calibration should be applied to system validation and system check
- power density distribution should also be verified, both spatially (shape) and numerically (level) through visual inspection for noticeable differences
- the measured results should be within 10% of the calibrated targets

10.3 Setting

Then create a measurement file with a test distance of 10mm for 10 GHz and 5.55mm for 30 GHz and above (the later will account for the retracted location of the horn aperture towards the top surface of a verification source). Use the scan settings defined in below table.

Grid setting

Frequency [GHz]	Grid step	Grid extent X/Y [mm]	Measurement points
10	0.25 ($\frac{\lambda}{4}$)	120/120	18 × 18
30	0.25 ($\frac{\lambda}{4}$)	60/60	26 × 26
45	0.25 ($\frac{\lambda}{4}$)	42/42	28 × 28
60	0.25 ($\frac{\lambda}{4}$)	32.5/32.5	28 × 28
90	0.25 ($\frac{\lambda}{4}$)	30/30	38 × 38

Table 10-1 PD system check result

Date	Frequency [MHz]	Temp [deg. C]	Humid [% RH]	E/H-Field Probe	Verification source	Phantom	4cm ² (S _{tot})	4cm ² (S _{norm})	(SPEAG) 4cm ² (S _{tot})	(SPEAG) 4cm ² (S _{norm})	Dev. (S _{tot}) [%]	Dev. (S _{norm}) [%]	Visual Inspection
5/17	30000	23	57	MPBm-01	MVSm-01	5G	38.4	38.0	36.1	35.5	5.99	6.58	OK
5/18	30000	23	55	MPBm-01	MVSm-01	5G	39.1	38.7	36.1	35.5	7.67	8.27	OK
5/19	30000	23	56	MPBm-01	MVSm-01	5G	39.0	38.6	36.1	35.5	7.44	8.03	OK
5/26	30000	23	42	MPBm-01	MVSm-01	5G	38.2	37.7	36.1	35.5	5.50	5.84	OK
5/28	30000	22	57	MPBm-01	MVSm-01	5G	39.1	38.7	36.1	35.5	7.67	8.27	OK
6/11	30000	21	53	MPBm-01	MVSm-01	5G	36.6	36.2	36.1	35.5	1.37	1.93	OK
7/8	30000	22	52	MPBm-01	MVSm-01	5G	36.4	36.0	36.1	35.5	0.82	1.39	OK
7/9	30000	22	58	MPBm-01	MVSm-01	5G	36.6	36.2	36.1	35.5	1.37	1.93	OK
7/13	30000	22	59	MPBm-01	MVSm-01	5G	36.4	35.9	36.1	35.5	0.82	1.11	OK
7/14	30000	23	57	MPBm-01	MVSm-01	5G	36.4	35.9	36.1	35.5	0.82	1.11	OK
7/16	30000	24	59	MPBm-01	MVSm-01	5G	36.4	35.9	36.1	35.5	0.82	1.11	OK
7/19	30000	21	56	MPBm-01	MVSm-01	5G	36.0	35.6	36.1	35.5	-0.28	0.28	OK
7/20	30000	21	56	MPBm-01	MVSm-01	5G	35.9	35.4	36.1	35.5	-0.56	-0.28	OK
7/21	30000	23	58	MPBm-01	MVSm-01	5G	36.0	35.5	36.1	35.5	-0.28	0.00	OK
7/22	30000	21	56	MPBm-01	MVSm-01	5G	36.3	35.9	36.1	35.5	0.55	1.11	OK

MPBm-01,MVSm-01 details are shown section 13.

11 PD Measurements

11.1 PD worst surface result

Worst surface

Band	Module #.	Freq. Ch	MHz	Beam ID	input.power.limit [dBm]	Mode	EUT surface	Day	S _{total} W/m ²	S _{norm} W/m ²	Power drift [dB]	Plot #	
n258	0	Low.	24300.00	36		3.4	CW	Edge2	2021/06/11	4.98	4.15	0.01	
n258	0	H-Mid.	24799.98	163		3.5	CW	Edge2	2021/05/18	5.32	3.84	-0.14	
n258	0	High.	25200.00	36	164	0.7	CW	Edge2	2021/07/08	5.55	4.79	-0.2	1
n258	1	High.	25200.00	40		2.8	CW	Edge4	2021/07/13	4.76	3.59	0.15	
n258	1	Low.	24300.00	167		3.0	CW	Edge4	2021/06/11	4.87	3.56	-0.18	
n258	1	L-Mid.	24400.00	39	167	-0.1	CW	Edge4	2021/07/09	5.13	3.91	0.02	
n258	2	High.	25200.00	33		1.2	CW	Edge1	2021/07/13	3.31	2.57	-0.17	
n258	2	Low.	24300.00	162		1.2	CW	Edge1	2021/07/13	3.91	2.63	0.08	
n258	2	Low.	24300.00	34	162	-1.7	CW	Edge1	2021/07/16	3.90	2.44	-0.02	

Band	Module #.	Freq. Ch	MHz	Beam ID	input.power.limit [dBm]	Mode	EUT surface	Day	S _{total} W/m ²	S _{norm} W/m ²	Power drift [dB]	Plot #	
n261	0	Mid.	27923.5	37		3.7	CW	Edge2	2021/05/18	6.12	4.71	-0.02	
n261	0	Mid.	27923.5	151		3.7	CW	Edge2	2021/05/18	6.49	5.33	-0.02	2
n261	0	Mid.	27923.5	23	151	0.6	CW	Edge2	2021/07/08	6.13	5.15	-0.14	
n261	1	Low.	27559.3	41		2.9	CW	Edge4	2021/07/09	5.13	3.88	-0.07	
n261	1	Mid.	27923.5	169		3.2	CW	Edge4	2021/05/18	5.38	4.51	0.06	
n261	1	Mid.	27923.5	41	169	-0.1	CW	Edge4	2021/07/09	5.00	4.31	0.07	
n261	2	Low.	27559.3	46		1.3	CW	Edge1	2021/07/13	3.68	3.22	-0.09	
n261	2	High.	28292.2	174		1.5	CW	Edge1	2021/07/14	3.76	3.07	0.03	
n261	2	High.	28292.2	32	160	-1.8	CW	Edge1	2021/07/16	3.36	2.72	0.05	

Band	Module #.	Freq. Ch	MHz	Beam ID		input.power.limit [dBm]	Mode	EUT surface	Day	S _{total} W/m ²	S _{norm} W/m ²	Power drift [dB]	Plot #
n260	0	Mid.	38498.88	36		4.4	CW	Edge2	2021/05/17	5.79	4.83	0.10	3
n260	0	Low.	37051.80	153		4.6	CW	Edge2	2021/05/17	4.00	3.08	0.21	
n260	0	High.	39949.92	25	153	1.4	CW	Edge2	2021/07/08	5.52	4.48	-0.21	
n260	1	Mid.	38498.88	30		3.6	CW	Edge4	2021/05/18	5.07	4.24	-0.01	
n260	1	Mid.	38498.88	155		3.8	CW	Edge4	2021/05/26	5.10	4.02	0.16	
n260	1	Mid.	38498.88	27	155	0.4	CW	Edge4	2021/07/09	4.59	3.54	0.04	
n260	2	Mid.	38498.88	44		1.9	CW	Edge1	2021/07/14	3.90	3.15	0.07	
n260	2	High.	39949.92	172		2.2	CW	Edge1	2021/07/14	4.17	3.32	-0.01	
n260	2	Mid.	38498.88	47	175	-1.2	CW	Edge1	2021/07/14	3.15	2.48	0.14	

12 PD simultaneous transmission consideration

12.1 Total exposure ratio (TER)

In 5G NR + LTE + WLAN + BT simultaneous transmission, 5G NR and LTE transmission are managed and controlled by Qualcomm® Smart Transmit™, while the RF exposure from WLAN and BT radios is managed using legacy approach, i.e., through a fixed power back-off if needed.

Since WLAN and BT do not employ time-averaging, 1gSAR and 10gSAR measurement for WLAN and BT need to be conducted at their corresponding rated power following current FCC test procedures to determine *reported* SAR values.

Smart Transmit current implementation assumes hotspots from all active WWAN radios are collocated. Therefore, for a total of 100% exposure margin, if primary radio uses x%, then the exposure margin left for secondary radio(s) is capped to (100-x)%. Thus, the compliance equation for simultaneous active WWAN radios, such as LTE + 5G NR, is

$$X\% * A + (100 - x)\% * B \leq 1.0$$

where, **A** is normalized time-averaged SAR from primary radio (i.e. LTE), and **A** ≤ 1.0; **B** for secondary radio (i.e. NR) is

- (for legacy radio or sub6 NR): normalized time-averaged SAR exposure
- (for mmW NR): *PD_design_target* + device uncertainty (in a normalized term),

and B ≤ 1.0.

The total RF exposure in this simultaneous transmission scenario is controlled and managed within Smart Transmit operation, and the compliance is demonstrated in Part 2 test.

Let **C** = normalized *reported* SAR exposure ratio from WLAN + WLAN or WLAN+BT, then

If there is only one active WWAN radio in Smart Transmit, then

$$A + C \leq 1.0 \text{ for compliance}$$

Else,

$$X\% * A + (100 - x)\% * B + C \leq 1.0$$

Because $x\% * A + (100-x)\% * B \leq x\% * \max(A, B) + (100-x)\% * \max(A, B)$, leading to $x\% * A + (100-x)\% * B \leq \max(A, B)$, Above equation can be rewritten as

$$X\% * A + (100 - x)\% * B + C \leq \max(A, B) + C \leq 1.0$$

if $A + C \leq 1.0$ and $B + C \leq 1.0$ can be proven, then RF exposure in simultaneous transmission meets Equation, i.e.,

$$X\% * A + (100 - x)\% * B + C \leq 1.0$$

Thus, in a case of 5G NR + LTE + WLAN + BT, simultaneous transmission analysis can be performed in two steps,

Step 1: Prove total exposure ratio (TER) of $A(\text{LTE}) + C(\text{WLAN} + \text{BT}) < 1.0$

Step 2: Prove total exposure ratio (TER) of $B(5G \text{ NR}) + C(\text{WLAN} + \text{BT}) < 1.0$

Once the above Step1 ($A + C \leq 1.0$) and Step2 ($B + C \leq 1.0$) conditions are met, the 5G NR + LTE + WLAN + BT simultaneous transmission complies with FCC requirement of TER less than 1.0.

For 5G mmW NR, compute *reported time-averaged PD* = 75% * *PD_design_target* * $10^{(\text{mmW device design uncertainty in dB})/10}$ and use this computed *reported time-averaged PD* in total exposure ratio (TER) analysis.

Note that 75% factor corresponds to 3dB *reserve_power_margin*. For other *reserve_power_margin* settings, obtain the scaling factor from Qualcomm®. Here, 75% reserve factor corresponds to Smart Transmit EFS version 15 or below. For EFS version 16 (or higher), secondary radio (5G mmW NR) can get up to 100% reserve factor irrespective of *reserve_power_margin* setting. So, in the below analysis, replace 75% with 100% reserve factor in case of EFS version 16 (or higher).

12.2 Additional surface for simultaneous transmission consideration

- S_{total} is adapted to calculation of ratio between S_{total} and $S_{norm.}$ (Ratio = 75 % * S_{total} / Limit)
- To determine worst-case PD for non-worst surfaces using simulation results, additional measurement is conducted.
- If the 75% of measured PD ratio (Ratio) with limit for the worst beams on the desired surface is higher than the computed worst-case PD (Calc. Ratio) in this step, then use 75% of the measured PD ratio (Ratio) for TER for non-worst surfaces ratio.
- Calculated ratio (Calc. Ratio in below table) is provided from customer using simulation.
- In this case, calculated ratio is used for TER for non-worst surface

Band	Module #.	Freq. Ch	MHz	Beam ID	input.power.limit [dBm]	Mode	EUT surface	Day	S_{total} W/m ²	$S_{norm.}$ W/m ²	Ratio 75%* S_{total} /Limit	Calc. Ratio	note
n258	0	Low.	24300	25	4.5	CW	Edge1	2021/05/19	0.133	0.114	0.01	0.02	worst ratio Edge1 (for 6W/m2)
n258	1	H-Mid.	24800	11 139	3.6	CW	Rear	2021/07/21	1.14	0.888	0.09	0.25	worst ratio Rear (for 6W/m2)
n258	2	I-H	25200	43 171	-1.6	CW	Rear (tilt edge1)	2021/07/19	1.18	0.967	0.09	0.43	worst ratio Rear (tilt edge1) (for 4 W/m2)
n258	2	H-Mid.	24800	12 140	1.9	CW	Rear	2021/07/20	0.845	0.651	0.06	0.31	worst ratio Rear (for 4 W/m2)

Band	Module #.	Freq. Ch	MHz	Beam ID	input.power.limit [dBm]	Mode	EUT surface	Day	S_{total} W/m ²	$S_{norm.}$ W/m ²	Ratio 75%* S_{total} /Limit	Calc. Ratio	note
n261	0	Low.	27559.3	6	7.1	CW	Edge1	2021/05/19	0.071	0.063	0.01	0.01	worst ratio Edge1 (for 6W/m2)
n261	1	Low.	27559.3	40 168	0.7	CW	Rear	2021/07/21	1.27	1.1	0.10	0.28	worst ratio Rear (for 6W/m2)
n261	2	High.	28292.2	46	1.3	CW	Rear (tilt edge1)	2021/07/19	1.34	1.21	0.10	0.41	worst ratio Rear (tilt edge1) (for 4 W/m2)
n261	2	High.	28292.2	19 147	1.0	CW	Rear	2021/07/20	0.846	0.713	0.06	0.26	worst ratio Rear (for 4 W/m2)

Band	Module #.	Freq. Ch	MHz	Beam ID	input.power.limit [dBm]	Mode	EUT surface	Day	S_{total} W/m ²	$S_{norm.}$ W/m ²	Exp. Ratio 75%* S_{total} /Limit	Calc. Ratio	note
n260	0	Low.	37051.8	22 150	1.7	CW	Edge1	2021/07/22	0.075	0.068	0.01	0.02	worst ratio Edge1 (for 6W/m2)
n260	0	High.	39949.92	144	7.6	CW	Rear	2021/05/28	2.23	1.92	0.17	0.32	worst ratio Rear (for 6W/m2)
n260	2	Low.	37051.8	46	2.6	CW	Rear (tilt edge1)	2021/07/19	1.18	1.04	0.09	0.35	worst ratio Rear (tilt edge1) (for 4 W/m2)
n260	2	Low.	37051.8	46	2.6	CW	Rear	2021/07/20	0.996	0.894	0.07	0.29	worst ratio Rear (for 4 W/m2)

12.3 PD simultaneous transmission compliance consideration

	B secondary transmitter	C WLAN	C WLAN or BT
1	5G mmW NR	WLAN 2.4 GHz	WLAN 2.4 GHz
2	5G mmW NR	WLAN 2.4 GHz	BT
3	5G mmW NR	WLAN 5 GHz (5.3/5.6/5.8G)	WLAN 5 GHz (5.3/5.6/5.8G)
4	5G mmW NR	WLAN 5 GHz (5.3/5.6/5.8G)	BT

Note that WLAN and Bluetooth SAR results are taken from the C2PC certification test report 13489132H-A-R1 for co-located module FCC ID ACJ9TGWL20B.

Module 0/1		reported time-averaged PD =7.3 W/m ²	
	Ratio to worst surface	reported exposure[W/m ²]	Ratio to limit
Edge1	0.03	0.22	0.02
Edge2	1.00	7.30	0.73
Edge3	1.00	7.30	0.73
Edge4	1.00	7.30	0.73
Rear	0.33	2.41	0.24
Rear tilt edge4	1.00	7.30	0.73
Rear tilt edge1	0.33	2.41	0.24

Module 2		reported time-averaged PD =4.87 W/m ²	
	Ratio to worst surface	reported exposure[W/m ²]	Ratio to limit
Edge1	1.00	4.87	0.49
Edge2	1.00	4.87	0.49
Edge3	1.00	4.87	0.49
Edge4	1.00	4.87	0.49
Rear	0.31	1.51	0.15
Rear tilt edge4	1.00	4.87	0.49
Rear tilt edge1	0.44	2.14	0.21

PD limit is 10 W/m²

Sample calc. Ratio = reported exposure[W/m²] / 10 [W/m²]

1.00 of "Ratio to worst surface" is used as worst case or transmission surface, other ratio is calculated in section 12.2.

Validation for the ratio for non-worst surface comparing with measurement is shown section 12.2.

"Ratio to worst surface" is round up from customer supplied value.

WLAN + WLAN

	WLAN2.4				WLAN 5.3				WLAN 5.5				WLAN5.8				Maximum ratio
	Ant1	Ant2	sum	ratio	Ant1	Ant2	sum	ratio	Ant1	Ant2	sum	ratio	Ant1	Ant2	sum	ratio	
Edge1	0.462	0.344	0.806	0.504	0.439	0.121	0.560	0.350	0.452	0.167	0.619	0.387	0.530	0.204	0.734	0.459	0.504
Edge2	0.016	0.015	0.031	0.019	0.000	0.006	0.006	0.004	0.000	0.008	0.008	0.005	0.002	0.007	0.009	0.006	0.019
Edge3	0.001	0.018	0.019	0.012	0.000	0.000	0.000	0.000	0.001	0.000	0.001	0.001	0.001	0.002	0.003	0.002	0.012
Edge4	0.084	0.010	0.094	0.059	0.029	0.000	0.029	0.018	0.018	0.000	0.018	0.011	0.023	0.000	0.023	0.014	0.059
Rear	0.120	0.852	0.972	0.608	0.122	0.546	0.668	0.418	0.198	0.582	0.780	0.488	0.244	0.585	0.829	0.518	0.608
Rear tilt edge4	0.055	0.005	0.060	0.038	0.054	0.019	0.073	0.046	0.078	0.025	0.103	0.064	0.098	0.021	0.119	0.074	0.074
Rear tilt edge1	0.240	0.938	1.178	0.736	0.238	0.830	1.068	0.668	0.313	0.808	1.121	0.701	0.336	0.729	1.065	0.666	0.736

WLAN + BT

	WLAN2.4				WLAN 5.3				WLAN 5.5				WLAN5.8				Maximum ratio
	Ant1	Ant2	sum	ratio	Ant1	Ant2	sum	ratio	Ant1	Ant2	sum	ratio	Ant1	Ant2	sum	ratio	
Edge1	0.462	0.079	0.541	0.338	0.439	0.079	0.518	0.324	0.452	0.079	0.531	0.332	0.530	0.079	0.609	0.381	0.381
Edge2	0.016	0.004	0.020	0.013	0.000	0.004	0.004	0.003	0.000	0.004	0.004	0.003	0.002	0.004	0.006	0.004	0.013
Edge3	0.001	0.002	0.003	0.002	0.000	0.002	0.002	0.001	0.001	0.002	0.003	0.002	0.001	0.002	0.003	0.002	0.002
Edge4	0.084	0.004	0.088	0.055	0.029	0.004	0.033	0.021	0.018	0.004	0.022	0.014	0.023	0.004	0.027	0.017	0.055
Rear	0.120	0.244	0.364	0.228	0.122	0.244	0.366	0.229	0.198	0.244	0.442	0.276	0.244	0.244	0.488	0.305	0.305
Rear tilt edge4	0.055	0.002	0.057	0.036	0.054	0.002	0.056	0.035	0.078	0.002	0.080	0.050	0.098	0.002	0.100	0.063	0.063
Rear tilt edge1	0.240	0.266	0.506	0.316	0.238	0.266	0.504	0.315	0.313	0.266	0.579	0.362	0.336	0.266	0.602	0.376	0.376

SAR limit is 1.6 W / kg

Sample calc. Ratio = (Ant1 SAR result + Ant2 SAR result)W/kg / 1.6 W/kg

mmW 5G + WLAN + WLAN
Module 0/1

	PD	WLAN + WLAN	TER
Edge1	0.02	0.504	0.52
Edge2	0.73	0.019	0.75
Edge3	0.73	0.012	0.74
Edge4	0.73	0.059	0.79
Rear	0.24	0.608	0.85
Rear tilt edge4	0.73	0.074	0.80
Rear tilt edge1	0.24	0.736	0.98

Module 2

	PD	WLAN + WLAN	TER
Edge1	0.49	0.504	0.99
Edge2	0.49	0.019	0.51
Edge3	0.49	0.012	0.50
Edge4	0.49	0.059	0.55
Rear	0.15	0.608	0.76
Rear tilt edge4	0.49	0.074	0.56
Rear tilt edge1	0.21	0.736	0.95

mmW 5G + WLAN + BT
Module 0/1

	PD	WLAN + BT	TER
Edge1	0.02	0.381	0.40
Edge2	0.73	0.013	0.74
Edge3	0.73	0.002	0.73
Edge4	0.73	0.055	0.78
Rear	0.24	0.305	0.55
Rear tilt edge4	0.73	0.063	0.79
Rear tilt edge1	0.24	0.376	0.62

Module 2

	PD	WLAN + BT	TER
Edge1	0.49	0.381	0.87
Edge2	0.49	0.013	0.50
Edge3	0.49	0.002	0.49
Edge4	0.49	0.055	0.54
Rear	0.15	0.305	0.46
Rear tilt edge4	0.49	0.063	0.55
Rear tilt edge1	0.21	0.376	0.59

Sample calc. TER = PD ratio to limit + other transmitter ratio to limit.

Listed only worst case.

Maximum TER = 0.99

12.4 Conclusion

PD at *input.power.limit* + SAR at P_{limit} TER is compliant whit FCC exposure limit, TER less than 1.0.

13 Test instrument

13.1 For PD measurement

Local Id	Description	Manufacturer	Model	Serial	Last Cal Date	Interval
COTS-MSAR-05	Dasy6	Schmid & Partner Engineering AG	DASY6	-	-	-
MOS-31	Thermo-Hygrometer	CUSTOM. Inc	CTH-201	3101	2021/07/08	12
MRBT-04	SAR robot	Schmid&Partner Engineering AG	TX60 Lspeag	F13/5PP1A1/A/01	2021/04/20	12
MDAE-01	Data Acquisition Electronics	Schmid&Partner Engineering AG	DAE4	509	2020/07/08	12
MDAE-01	Data Acquisition Electronics	Schmid&Partner Engineering AG	DAE4	1372	2020/08/12	12
MPB-07	Dosimetric E-Field Probe	Schmid&Partner Engineering AG	EX3DV4	3825	2020/07/16	12
MFPm-01	mmWave Phantom	Schmid & Partner Engineering AG	QD 015 025 CA	1038	-	-
MPBm-01	mmWave probe	Schmid & Partner Engineering AG	EUmmWV4	9450	2020/10/21	12
MPBmD-01	Dummy probe 5G	Schmid & Partner Engineering AG	SP DP2 002 AA	-	-	-
MDAE-03	Data Acquisition Electronics	Schmid&Partner Engineering AG	DAE4	1372	2020/08/12	12
COTS-MSARm-01	cDASY6 Module mmWave	Schmid & Partner Engineering AG	cDASY6 Module mmWave	-	-	-
MDAE-02	Data Acquisition Electronics	Schmid&Partner Engineering AG	DAE4	1369	-	-
MVSm-01	Verification Source	Schmid & Partner Engineering AG	5G Verification Source 30GHz	1053	2020/12/28	12
MDH-m01	Device Holder	Schmid & Partner Engineering AG	mmWave Device Holder V3	1130	-	-

The expiration date of the calibration is the end of the expired month.

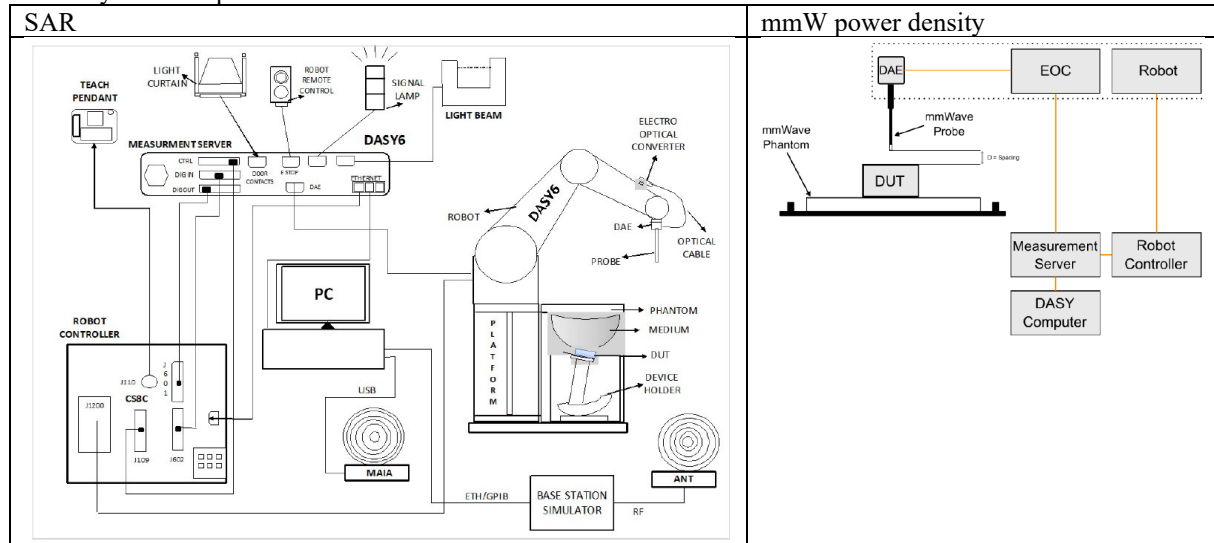
All equipment is calibrated with valid calibrations. Each measurement data is traceable to the national or international standards.

As for some calibrations performed after the tested dates, those test equipment have been controlled by means of an unbroken chains of calibrations.

SAR room is checked before every testing and ambient noise is <0.012W/kg

13.2 Test system

13.2.1 System components



13.2.2 Data Acquisition Electronics (DAE)

The data acquisition electronics (DAE4 or DAE3) consist of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16-bit AD-converter, and a command decoder with a control logic unit. Transmission to the measurement server is accomplished through an optical downlink for data and status information, as well as an optical uplink for commands and the clock.

13.2.3 Probe (mmWave)

Two dipoles optimally arranged to obtain pseudo-vector information Minimum 3 measurements/point, 120° rotated around probe axis Sensors (0.8mm length) printed on glass substrate protected by high density foam Low perturbation of the measured field Requires positioner which can do accurate probe rotation

13.2.4 EOC

The electrooptical converter (EOC), which is mounted on the robot arm. An internal data link is used from the EOC to the robot back panel. From there, a 10-meter cable connects to the measurement server DAE input.

13.2.5 Robot

The DASy6 system uses the high precision industrial robots TX60L from Stäubli SA (France).

13.2.6 Others

The SAR phantom, mmW phantom, the device holder and other accessories according to the targeted measurement.

14 Appendixes

Refer to separated files for the following appendixes.

Appendix A: DUT and SAR PD Setup Photos

Appendix B: SAR Measurement data

Appendix C: PD Measurement data

Appendix D: Repeat SAR Measurement data

Appendix E: System Check

Appendix F: System Check (PD)

Appendix G: SAR Calibration data

Appendix H: PD Calibration data

Appendix I: Antenna location

15 Revision History

Original Test Report No.: 13760834H-H

Revision	Test report No.	Date	Revision details
- (Original)	13760834H-H	December 6, 2021	-
1	13760834H-H-R1	January 5, 2022	Section 12.3 Corrected explanatory note: "Not tested WLAN and BT SAR result for simultaneous transmission considerations are quoted form 13489132H-A-R1 SAR Report." ↓ "Note that WLAN and Bluetooth SAR results are taken from the C2PC certification test report 13489132H-A-R1 for co-located module FCC ID ACJ9TGWL20B."

End of Report