PART 1 Test Under Static Transmission Scenario

Test Report No.: 14131461H-H-R1

Customer	**Panasonic Corporation of North America**
Description of EUT	**Personal Computer**
Model Number of EUT	**FZ-40**
FCC ID	**ACJ9TGFZ40**
Test Regulation	**FCC47CFR 2.1093**
Test Result	**Complied (Refer to SECTION 7)**
PD Value	**The highest PD** **Reported PD = 7.30 W/m^2** **Measured PD = 7.17 W/m^2**
Issue Date	**July 6, 2022**
Remarks	**-**

Representative test engineer	**Approved by**
Hisayoshi Sato Engineer	Takayuki Shimada 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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Contents

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
Contact Person	Ben Botros

The information provided from the customer is as follows;
- Customer, Description of EUT, 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, input power limit 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

Description	Personal Computer
Model Number	FZ-40
Serial number	1LTSA00160
Rating	AC 100 V to 240 V, 50 Hz / 60 Hz
Condition	Engineering prototype (Not for Sale: This sample is equivalent to mass-produced items.)
Modification	No Modification by the test lab.
Receipt Date	February 4, 2022
Test Date	March 8 to 16, 2022

3.2 Product description

Model: FZ-40 (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)
	TDD	120 kHz	n260	16QAM (CP-OFDM/DFT-s-OFDM),
	TDD	120 kHz	n261	64QAM (CP-OFDM/DFT-s-OFDM)
	-	-	-	
	-	-	-	MIMO Support: No
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 Personal Computer FZ-40)
Model : WW21A (FCC ID ACJ9TGWW21A / 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	Downlink MIMO Support: Yes(2x2, 4x4)
*B42: not used in US (FCC)	FDD	7	Supported band : B2, B4, B7, B25, B38, B41, B42, B48, B66
	FDD	12	
*B48: not used in	FDD	13	Uplink MIMO Support: No
Canada(ISED)	FDD	14	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 *B42: not used in US (FCC) / B48: not used in Canada(ISED)
	Maximum 7 carriers		Maximum 2 carriers Supported combination: <Inrta-band contiguous> 7C, 41C, 42C, 48C <Inter-band>2A-5A, 2A-12A, 2A-13A, 4A-5A, 4A-12A, 4A-13A, 5A-7A,5A-66A, 12A-66A, 13A-66A
5G NR (FR1)	FDD	15 kHz	n2	Pi/2 BPSK (DFT-s-OFDM),
	FDD	15 kHz	n5	QPSK (CP-OFDM/DFT-s-OFDM),
*n77, n78: not used in US	TDD	15 kHz	n41	16QAM (CP-OFDM/DFT-s-OFDM),
(FCC)	FDD	15 kHz	n66	64QAM (CP-OFDM/DFT-s-OFDM),
	FDD	15 kHz	n71	256QAM (CP-OFDM/DFT-s-OFDM)
	TDD	30 kHz	n77	Downlink MIMO Support: Yes(2x2, 4x4)
	TDD	30 kHz	n78	Supported band : n2, n41, n66, n77, n78
	-	-	-	Uplink MIMO Support: No
	-	-	-	Uplink transmission is limited to a single output stream.
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 Personal Computer FZ-40)
Model : WL20B (FCC ID ACJ9TGWL20B / ISED certification number 216H-CFWL20B)

Wireless technologies	Dup.	Band		Mode
WLAN	TDD	2.4GHz	2412-2472	802.11b
			for US	802.11g
			2412-2462	802.11n(20,40)
			for Canada	802.11ax(20,40)
	TDD	5GHz	5180-5240	802.11a
			5260-5320	802.11n(20,40)
			5500-5720	802.11ac(20,40.80.160)
			5745-5825	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 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

4.3 Additions or deviations to standard

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

4.4 References

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

4.5 Limit

4.5.1 Below 6 GHz

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

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

4.5.2 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/cm^2 is 10 W/m^2

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

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)

Δmin : 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

input.power.limit : 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 **n̂** and averaging time.

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

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:

$$SAR = \frac{d}{dt}\left(\frac{dW}{dm}\right) = \frac{d}{dt}\left(\frac{dW}{\rho dV}\right)$$

Reported SAR : Measured SAR is scaled to the maximum tune-up tolerance limit and the maximum duty by the following formulas.

$$Reported\ SAR\ [w/kg] = Measured\ SAR\ [w/kg] \times scale\ factor\ for\ power \times Scaled\ factor\ for\ duty(if\ needed)$$

Where

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

And

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

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.
☒	applicable.
A2LA	The American Association for Laboratory Accreditation
AC	Alternating Current
AFH	Adaptive Frequency Hopping
AM	Amplitude Modulation
Amp, AMP	Amplifier
ANSI	American National Standards Institute
Ant, ANT	Antenna
AP	Access Point
Atten., ATT	Attenuator
AV	Average
BPSK	Binary Phase-Shift Keying
BR	Bluetooth Basic Rate
BS	base station
BT	Bluetooth
BT LE	Bluetooth Low Energy
BW	BandWidth
Cal Int	Calibration Interval
CCK	Complementary Code Keying
Ch., CH	Channel
CISPR	Comite International Special des Perturbations Radioelectriques
CW	Continuous Wave
DBPSK	Differential BPSK
DC	Direct Current
DFS	Dynamic Frequency Selection
DQPSK	Differential QPSK
DSI	Device state index
DSSS	Direct Sequence Spread Spectrum
DUT	Device under test
EDR	Enhanced Data Rate
EIRP, e.i.r.p.	Equivalent Isotropically Radiated Power
EMC	ElectroMagnetic Compatibility
EMI	ElectroMagnetic Interference
EN	European Norm
ERP, e.r.p.	Effective Radiated Power
EU	European Union
EUT	Equipment Under Test
Fac.	Factor
FCC	Federal Communications Commission
FHSS	Frequency Hopping Spread Spectrum
FM	Frequency Modulation
Freq.	Frequency
GFSK	Gaussian Frequency-Shift Keying
GNSS	Global Navigation Satellite System
EN-DC	E-UTRAN New Radio - Dual Connectivity
GPS	Global Positioning System
Hori.	Horizontal
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
IF	Intermediate Frequency
ILAC	International Laboratory Accreditation Conference
ISED	Innovation, Science and Economic Development Canada
ISO	International Organization for Standardization
KDB	Knowledge data base from Federal communication committee
LAN	Local Area Network
LIMS	Laboratory Information Management System
MCS	Modulation and Coding Scheme
MRA	Mutual Recognition Arrangement
nG	n generation (e.g. 3G,4G and 5G)
NIST	National Institute of Standards and Technology
NR	New radio
OBW	Occupied Band Width
OFDM	Orthogonal Frequency Division Multiplexing
P/M	Power meter
PCB	Printed Circuit Board
PD	Power density
PER	Packet Error Rate
PHY	Physical Layer
PK	Peak
PN	Pseudo random Noise
PRBS	Pseudo-Random Bit Sequence
PSD	Power Spectral Density
QAM	Quadrature Amplitude Modulation
QP	Quasi-Peak
QPSK	Quadri-Phase Shift Keying
RBW	Resolution Band Width
RDS	Radio Data System
RE	Radio Equipment
RF	Radio Frequency
RMS	Root Mean Square
Rx	Receiving
SA, S/A	Spectrum Analyzer
SG	Signal Generator
S_n	Surface number
SVSWR	Site-Voltage Standing Wave Ratio
TER	Total exposure ratio
TR	Test Receiver
Tx	Transmitting
VBW	Video BandWidth
Vert.	Vertical
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/m^2
Highest measured PD = 7.17 W/m^2

Band	Measured PD [W/m^2]	Reported PD [W/m^2]
n258	7.17	7.30
n261	7.00	7.30
n260	7.01	7.30

Reported PD [W/m^2] = $10^{(\text{device uncert[dB]} / 10)}$ * *PD_design_target* * *Duty* = $10^{(0.21)}$ * 6 *75 % = 7.30 module #0,1,2
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)	(ν_i) ν_{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
1	4	patch	Keyboard
2	4	patch	Edge1

10 PD System Check

10.1 Dielectric Property

Media is air so Relative Permittivity (ϵr) 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 0.66 dB* of the calibrated targets

* Within 0.66 dB is recommended by SPEAG(Schmid & Partner Engineering AG).

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	4cm2 (Circular PDtot) [W/m2]	4cm2 (Square Pdtot) [W/m2]	(SPEAG) 4cm2 (Circular PDtot) [W/m2]	(SPEAG) 4cm2 (Square PD tot) [W/m2]	Dev. 4cm2 (Circular PDtot) [dB]	Dev. 4cm2 (Square Pdtot) [dB]	Visual Inspection
3/8	30000	23	30	MPBm-01	MVSm-01	5G	38.8	38.6	43.1	42.9	-0.46	-0.46	OK
3/9	30000	23	30	MPBm-01	MVSm-01	5G	38.8	38.7	43.1	42.9	-0.46	-0.45	OK
3/10	30000	23	30	MPBm-01	MVSm-01	5G	38.2	38.1	43.1	42.9	-0.52	-0.52	OK
3/14	30000	22	40	MPBm-01	MVSm-01	5G	37.6	37.5	43.1	42.9	-0.59	-0.58	OK
3/15	30000	24	40	MPBm-01	MVSm-01	5G	38.0	37.9	43.1	42.9	-0.55	-0.54	OK
3/16	30000	21	35	MPBm-01	MVSm-01	5G	38.6	38.5	43.1	42.9	-0.48	-0.47	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	L-Mid,	24400.00	21		2.9	CW	Edge 2	2022/3/8	5.31	4.3	0.08	
n258	0	L-Mid,	24400.00	149		3.2	CW	Edge 2	2022/3/8	5.67	4.58	-0.03	
n258	0	L-Mid,	24400.00	21	149	0.3	CW	Edge 2	2022/3/8	7.03	5.77	-0.11	
n258	1	L-Mid,	24400.00	38		3.2	CW	Keyboard	2022/3/15	7.02	5.63	-0.01	
n258	1	H-Mid,	24799.98	153		3.4	CW	Keyboard	2022/3/15	6.08	4.51	-0.02	
n258	1	L-Mid,	24400.00	26	154	0.4	CW	Keyboard	2022/3/15	***7.17***	***6.17***	-0.16	1
n258	2	L-Mid,	24400.00	45		3.8	CW	Edge1	2022/3/9	5.44	3.98	-0.05	
n258	2	High.	25200.00	162		4.2	CW	Edge1	2022/3/9	5.34	3.44	-0.17	
n258	2	High.	25200.00	32	160	1.0	CW	Edge1	2022/3/10	5.19	4.54	-0.11	

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	Low.	27559.32	21		4.5	CW	Edge 2	2022/3/8	6.62	5.44	-0.19	
n261	0	Low.	27559.32	153		4.8	CW	Edge 2	2022/3/8	***7.00***	5.63	-0.15	2
n261	0	Low.	27559.32	21	149	1.5	CW	Edge 2	2022/3/9	6.73	5.43	-0.2	
n261	1	Low.	27559.32	30		4.2	CW	Keyboard	2022/3/15	6.80	5.19	-0.15	
n261	1	Low.	27559.32	154		4.4	CW	Keyboard	2022/3/15	4.51	3.43	0.03	
n261	1	Low.	27559.32	26	154	0.9	CW	Keyboard	2022/3/15	3.93	3.43	-0.11	
n261	2	Low.	27559.32	31		5.0	CW	Edge1	2022/3/10	6.80	5.35	0.12	
n261	2	Low.	27559.32	159		4.6	CW	Edge1	2022/3/10	5.64	4.12	-0.13	
n261	2	Low.	27559.32	33	161	-0.3	CW	Edge1	2022/3/10	6.27	***6.00***	0.13	

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	37		3.8	CW	Edge 2	2022/3/9	6.23	5.04	-0.09	
n260	0	Mid.	38498.88	165		4.1	CW	Edge 2	2022/3/9	6.87	5.49	-0.04	
n260	0	Mid.	38498.88	25	153	1.0	CW	Edge 2	2022/3/9	***7.01***	***5.61***	-0.12	3
n260	1	Mid.	38498.88	42		3.8	CW	Keyboard	2022/3/14	6.08	5.03	-0.14	
n260	1	Mid.	38498.88	156		4.1	CW	Keyboard	2022/3/14	5.88	4.91	0.06	
n260	1	Mid.	38498.88	41	169	0.7	CW	Keyboard	2022/3/15	5.91	5.13	-0.06	
n260	2	Mid.	38498.88	161		4.1	CW	Edge1	2022/3/14	5.85	4.91	0.12	
n260	2	Mid.	38498.88	45		3.4	CW	Edge1	2022/3/14	5.91	5.01	-0.14	
n260	2	Mid.	38498.88	44	172	0.2	CW	Edge1	2022/3/16	5.61	4.49	-0.03	

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

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

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

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

Else,

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

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

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

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

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

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***(LTE) + ***C***(WLAN + BT) < 1.0
Step 2: Prove total exposure ratio (TER) of ***B***(5G NR) + ***C***(WLAN + BT) < 1.0

Once the above Step1 (**A** + **C** ≤ 1.0) and Step2 (**B** + **C** ≤ 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 PD simultaneous transmission compliance consideration

Tx 1	Tx 2	Tx 3
mmW 5G Maximum Reported PD: 7.30 [W/m^2]	WLAN-main Maximum Reported SAR Bottom: 0.186 [W/kg] *1 Keyboard: 0.805 [W/kg] *2	WLAN-BT Maximum ERP: 162.93 [mW] *2

*1: This is the maximum output power for the WLAN module as taken from test report HCT-SR-2112-FC005-R1 which was submitted to support a C2PC for the WLAN module (FCC ID: ACJ9TGWL20B) in the FZ-40 laptop (grant issued 23/05/2022).
*2: Results for the WLAN module are taken from test report 1413146H-B which was submitted to support a C2PC for the WWAN module (FCC ID: ACJ9TGWW21A) in the FZ-40 laptop (grant issued 06/03/2021) where extremity SAR was assessed at the keyboard position for both WLAN and WWAN modules in accordance with the test plan approved through KDB inquiry.

WLAN-main + WLAN-BT

	WLAN		
Position	WLAN-main Ratio (Maximum Reported SAR / SAR limit)	WLAN-BT Ratio (Maximum ERP / ERPth)	WLAN total ratio
Bottom	0.116	0.053	0.169
Keyboard	0.201	0.021	0.223

SAR limit for Body is 1.6 W/kg
SAR limit for Limbs is 4.0 W/kg

$$P_{th}(\text{mW}) = ERP_{20\,cm}\,(\text{mW}) = \begin{cases} 2040f & 0.3\ \text{GHz} \le f < 1.5\ \text{GHz} \\ 3060 & 1.5\ \text{GHz} \le f \le 6\ \text{GHz} \end{cases}$$

Sample calc. Ratio = WLAN Ant 1 SAR result [W/kg] / 1.6 or 4.0 [W/kg] + WLAN Ant 2 ERP [mW] / ERPth [mW]

mmW 5G + WLAN-main + WLAN-BT
Module 0/1/2

Position	Maximum PD Ratio	Maximum WLAN Ratio	TER
Bottom	0.730	0.169	0.899
Keyboard	0.730	0.223	***0.953***

Sample calc. TER = PD ratio to limit + other transmitter ratio to limit.
Listed only worst case.
Maximum TER = 0.95

12.3 Conclusion

TER is compliant with FCC exposure limit, TER less than 1.0.

13 Test instrument

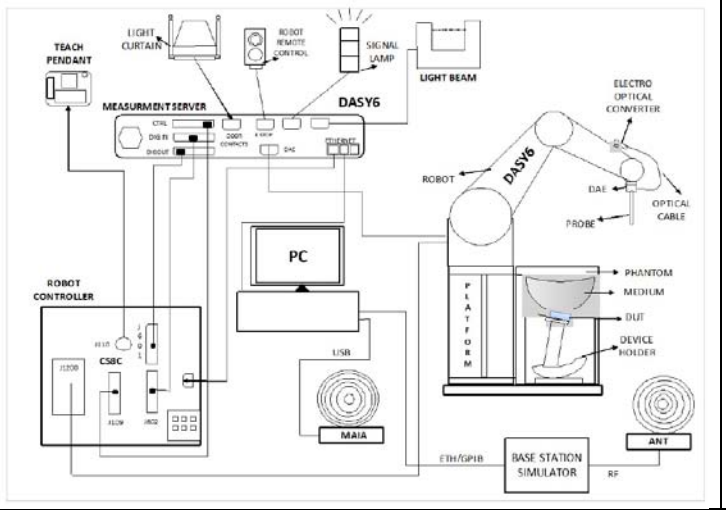
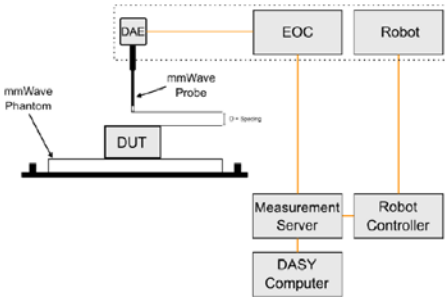
13.1 For PD measurement

Local Id	LIMS ID	Description	Manufacturer	Model	Serial	Last Cal Date	Interval
COTS-MSARm-01	186096	cDASY6 Module mmWave	Schmid & Partner Engineering AG	cDASY6 Module mmWave	-	-	-
MOS-31	141570	Thermo-Hygrometer	CUSTOM. Inc	CTH-201	3101	2021/07/08	12
MRBT-04	142249	SAR robot	Schmid&Partner Engineering AG	TX60 Lspeag	F13/5PP1A1/A	2021/04/20	12
MDAE-02	141483	Data Acquisition Electronics	Schmid&Partner Engineering AG	DAE4	1369	2021/05/11	12
MFPm-01	186095	mmWave Phantom	Schmid & Partner Engineering AG	QD 015 025 CA	1038	-	-
MPBm-01	186090	mmWave probe	Schmid & Partner Engineering AG	EUmmWV4	9450	2021/11/11	12
MPBmD-01	186091	Dummy probe 5G	Schmid & Partner Engineering AG	SP DP2 002 AA	-	-	-
MVSm-01	186093	Verification Source	Schmid & Partner Engineering AG	5G Verification Source 30 GHz	1053	2021/12/20	12

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.

13.2 Test system

13.2.1 System components

SAR	mmW power density
	

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 º rotated around probe axis Sensors (0.8 mm 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 Stuaubli 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 Setup Photos

Appendix B: PD Measurement data

Appendix C: System Check (PD)

Appendix D: Calibration data

Appendix E: Antenna location

15 Revision History

Original Test Report No.: 14131461H-H

This report is a revised version of 14131461H-H. 14131461H-H is replaced with this report.

Revision	Test Report No.	Date	Page Revised Contents
- (Original)	14131461H-H	May 9, 2022	-
1	14131461H-H-R1	July 6, 2022	Clause 12.2 Modified contents for notes *1 and *2

End of Report