

# PART 0 SAR Characterization Report

## Test Report No. 14809943H-A

<b>Customer</b>	Panasonic Corporation of North America
<b>Description of EUT</b>	Radio Module (Tested inside of Panasonic Personal Computer FZ-40)
<b>Model Number of EUT</b>	WW21A
<b>FCC ID</b>	ACJ9TGWW21A
<b>Issue Date</b>	June 16, 2023
<b>Remarks</b>	For Permissive Change

<b>Representative test engineer</b>	<b>Approved by</b>
	
Takeshi Hiyaji Engineer	Takayuki Shimada Leader

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It does not cover administrative issues such as Manual or non-SAR test related Requirements.  
(if applicable)
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## 1 Introduction

This device uses Qualcomm® Smart Transmit feature and cannot operate without specific absorption ratio (SAR) and power density (PD) characterization at the device level, beforehand. The parameters obtained from SAR and PD characterization (char) 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.

Part 0 report describes the results for the SAR char and PD char generation and evaluates them on the 5G milli wave (mmW) new radio (NR) enabled equipment under test (EUT).

This description is an overview for STx and test results may not include both sub6 (SAR) and mmW (PD).

This report is for evaluation of n77 and Downlink CA Combination only, as it was added to the EUT. For the other test, please see original application (FCC ID: ACJ9TGWW21A).

## 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

### \*Remarks:

Panasonic Connect Co., Ltd. is on behalf of the applicant: Panasonic Corporation of North America (Company incorporated abroad).

The information provided from the customer is as follows.

- Customer, Description of EUT, Model Number of EUT, 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: SAR device uncertainty, SAR design target, SAR char generation (P<sub>limit</sub> and P<sub>max</sub> (Tune up limit))

\* 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	Radio Module
Model Number	WW21A
Serial Number	1LTSA00106
Condition	Engineering prototype (Not for Sale: This sample is equivalent to mass-produced items.)
Modification	No Modification by the test lab
Receipt Date	May 22, 2023
Calculated Date	May 23, 2023

### <Information of Host device>

Type	Personal Computer FZ-40 Intel Core i7-1185G7 (1.2 GHz, Max 4.8 GHz) 14 inch LCD (1920 x 1080)
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### 3.2 Product description

#### General Specification

Rating	DC 3.0 to 3.6 V
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#### Radio Specification

Wireless technology	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 Canada(ISED)	FDD	13 Uplink MIMO Support: No
	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
	Maximum 7 carriers See Section 13.2.1 of part 1 report for supported Downlink CA combinations		*B42: not used in US (FCC) / B48: not used in Canada(ISED) Maximum 2 carriers Supported combination: <Inter-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),
	*n78: not used in US (FCC)	TDD	15 kHz n41 16QAM (CP-OFDM/DFT-s-OFDM),
	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		*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-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 2412-2462 for Canada	802.11g 802.11n(20,40) 802.11ax(20,40)
Bluetooth	TDD	2.4GHz	2402-2480	BR/EDR/LE
			5180-5240	802.11a
			5260-5320	802.11n(20,40)
			5500-5720 5745-5825	802.11ac(20,40.80.160) 802.11ax(20,40.80.160)

Host device: Personal Computer, Model: FZ-40

Wireless technologies	Dup.	Band		Mode
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)
			n260	
			n261	
			-	
	-	-	-	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	

## 4 Location

UL Japan, Inc. Ise EMC Lab.

Shielded room for SAR testings

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

## 5 References

Federal Communications Commission. (October 23, 2015). *447498 D04 Interim General RF Exposure Guidance v01*.

International Electrotechnical Commission. (2018). *IEC TR 63170:2018*.

SPEAG. (August 2018). *5G Module V1.2 Application Note: 5G Compliance Testing*.

## 6 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.

## 7 Definitions, symbols, and abbreviations

### 7.1 Definitions

SAR_design_target	: Target value to use STx and also this 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
$\Delta_{min}$	: 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 $\hat{n}$ and averaging time.

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

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 ( $\rho$ ), as shown in the following equation:
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$$SAR = \frac{d}{dt} \left( \frac{dW}{dm} \right) = \frac{d}{dt} \left( \frac{dW}{\rho dV} \right)$$

## 7.2 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
$\lambda$	Wavelength	meter	m
S	Local power density	watt per square meter	W / m <sup>2</sup>
PD or S <sub>av</sub>	Spatial-average power density	watt per square meter	W / m <sup>2</sup> (mW / cm <sup>2</sup> )
SAR	Specific Absorption Rate	watt per kilo gram	W / kg

## 7.3 Abbreviations

DSI	: device state index
KDB	: knowledge data base from Federal communication committee (FCC)
BS or BSE	: base station or base station emulator
CW	: continuous wave
DUT	: device under test
NR	: new radio
PD	: power density
RF	: radio frequency
TER	: total exposure ratio
S <sub>n</sub>	: surface number
S <sub>tot</sub> or S <sub>total</sub>	: total propagating power flux density into the phantom
S <sub>n</sub> or S <sub>norm</sub>	: surface normal propagating power flux density into the phantom or in normed vector space
Ant	: antenna
nG	: n generation (e.g. 3G,4G and 5G)
<input checked="" type="checkbox"/>	: applicable.
<input type="checkbox"/>	: NOT applicable.



## 8 SAR char generation

### 8.1 Usage scenarios in SAR evaluation and DSI determination

applicable	Scenario	Description	Position example
<input type="checkbox"/>	Head	Device positioned next to head	$SAR_{head} = \max\{SAR_{LC}, SAR_{LT}, SAR_{RC}, SAR_{RT}\}$
<input checked="" type="checkbox"/>	Body	Device positioned next to body with or without a body-worn accessory	$SAR_{body} = \max\{SAR_{s1}, SAR_{s2}, SAR_{s3}, SAR_{s4}, SAR_{s5}, SAR_{s6}\}$
<input type="checkbox"/>	Hotspot mode	Device transmitting in hotspot mode and assumed to be located next to human body	$SAR_{hotspot} = \max\{SAR_{s1}, SAR_{s2}, SAR_{s3}, SAR_{s4}, SAR_{s5}, SAR_{s6}\}$
<input checked="" type="checkbox"/>	Extremity SAR (10g)	10gSAR is evaluated for all applicable surfaces of the device against the flat phantom with 0 mm separation distance	$10gSAR_{extremity} = \max\{10gSAR_{s1}, 10gSAR_{s2}, 10gSAR_{s3}, 10gSAR_{s4}, 10gSAR_{s5}, 10gSAR_{s6}\}$

L/R: Left/Right, C/T: Cheek/Tilt, S: Surface

Table 8-A summary of Usage/Exposure Scenario for this EUT

DSI	State
0	Proximity sensor off or disable

### 8.2 SAR device uncertainty

Table 8-B device uncertainty

Item	Uncertainty dB
Total uncertainty	1.0

k=2

### 8.3 SAR design target

To account for the total uncertainty,  $SAR_{design\_target}$  needs to:

$$SAR_{design\_target} < SAR_{regulatory\_limit} \times 10^{\frac{-total\ uncertainty}{10}}$$

the  $SAR_{design\_target}$  for the EUT is determined as: < 1.27 W / kg

FCC

DSI	$SAR_{design\_target}$ [W / kg]
0	1.0 All band

## 8.4 SAR char generation

Calc. Plimit = measured power + 10log (target SAR / measured SAR value)  
ex Plimit for NR Band n77 = 23.21 + 10 log(1.00/0.476) = 26.4 dBm

Table 8-C Summary of Plimit

RAT	Band	Pmax[dBm]	Plimit
WCDMA	2	24.5	24.5
WCDMA	4	24.5	24.5
WCDMA	5	24.5	24.5
LTE	2	24.0	24.0
LTE	4	24.0	24.0
LTE	5	24.0	24.0
LTE	7	24.0	24.0
LTE	12	24.0	24.0
LTE	13	24.0	24.0
LTE	14	24.0	24.0
LTE	17	24.0	24.0
LTE	25	24.0	24.0
LTE	26	24.0	24.0
LTE	38	24.0	24.0
LTE	41	24.0	24.0
LTE	48	12.3	12.3
LTE	66	24.0	24.0
LTE	71	24.0	24.0
NR	n2	24.5	24.5
NR	n5	24.5	24.5
NR	n41	24.5	24.5
NR	n66	24.5	24.5
NR	n71	24.5	24.5
NR	n77	24.5	24.5

Limbs Plimit is also below than target SAR so same value is applied.

### For LTE B48

Uplink Downlink config (UDC)	Special sub frame (SSF)	Burst ave tune up DSI=1 [dBm]	Pmax burst ave [dBm]	Time ave DSI=1/0 [dBm]
0	0 to 7	12.3	11.09	9.4
1	0 to 7	13.8	12.66	9.4
2	0 to 7	16.6	15.57	9.4
3	0 to 7	15.3	14.10	9.4
4	0 to 7	16.8	15.69	9.4
5	0 to 7	19.7	18.56	9.4
6	0 to 7	12.9	11.64	9.4

LTE band 48 doesn't have a same burst tune up for UDC/SSF but has same time average tune up limit.

## Appendix A SAR result

### A.1 n77 (Block A)

Test Position	Dist. (mm)	Modulation	UL CH #	Freq. (MHz)	UL RB Allocation	UL RB Start	Power (dBm)		1-g SAR (W/kg)		Calc. Plimit
							Tune-up limit	Meas. Avg	Meas.	Scaled	
Bystander	25	QPSK	633332	3499.98	1	1	24.5	23.38	0.440	0.569	26.9
			633332	3499.98	135	69	24.0	23.21	<b>0.476</b>	<b>0.571</b>	<b>26.4</b>
			633332	3499.98	270	0	24.0	22.72	0.367	0.493	27.1

### A.2 n77 (Block C)

Test Position	Dist. (mm)	Modulation	UL CH #	Freq. (MHz)	UL RB Allocation	UL RB Start	Power (dBm)		1-g SAR (W/kg)		Calc. Plimit
							Tune-up limit	Meas. Avg	Meas.	Scaled	
Bystander	25	QPSK	656000	3840	1	1	24.5	23.18	<b>0.238</b>	<b>0.323</b>	<b>29.4</b>
			656000	3840	135	69	24.0	22.95	0.192	0.245	30.1
			656000	3840	270	0	24.0	22.50	0.151	0.213	30.7

## Appendix B Measurement uncertainty

### B.1 SAR measurement uncertainty

Error Description	Uncert. value	Prob. Dist.	Div.	(ci) 1g	(ci) 10g	Std. Unc. (1g)	Std.Unc. (10g)
<b>Measurement System Errors</b>							
Probe Calibration	± 14.00 %	N	2	1	1	±7.0%	±7.00%
Probe Calibration Drift	± 1.7 %	R	√3	1	1	±1.0%	±1.0%
Probe Linearity	± 4.7 %	R	√3	1	1	±2.7%	±2.7%
Broadband Signal	± 2.6 %	R	√3	1	1	±1.5%	±1.5%
Probe Isotropy	± 7.6 %	R	√3	1	1	±4.4%	±4.4%
Data Acquisition	± 0.3 %	N	1	1	1	±0.3%	±0.3%
RF Ambient	± 1.8 %	N	1	1	1	±1.8%	±1.8%
Probe Positioning	± 0.2 %	N	1	0.33	0.33	±0.1%	±0.1%
Data Processing	± 2.3 %	N	1	1	1	±2.3%	±2.3%
<b>Phantom and Device Errors</b>							
Conductivity (meas.)DAK	± 10.0 %	N	1	0.78	0.71	±7.8%	±7.1%
Conductivity (temp.)BB	± 3.4 %	R	√3	0.78	0.71	±1.5%	±1.4%
Phantom Permittivity	± 14.0 %	R	√3	0.25	0.25	±2.0%	±2.0%
Distance DUT - TSL	± 2.0 %	N	1	2	2	±4.0%	±4.0%
Device Positioning (+/- 0.5mm)	± 1.0 %	N	1	1	1	±1.0%	±1.0%
Device Holder	± 3.6 %	N	1	1	1	±3.6%	±3.6%
DUT Modulationm	± 2.4 %	R	√3	1	1	±1.4%	±1.4%
Time-average SAR	± 2.6 %	R	√3	1	1	±1.5%	±1.5%
DUT drift	± 2.5 %	N	1	1	1	±2.5%	±2.5%
Val Antenna Unc.val	± 0.0 %	N	1	1	1	±0.0%	±0.0%
Unc. Input Powerval	± 0.0 %	N	1	1	1	±0.0%	±0.0%
<b>Correction to the SAR results</b>							
Deviation to Target	± 1.9 %	N	1	1	0.84	±1.9%	±1.6%
SAR scalingp	± 0.0 %	R	√3	1	1	±0.0%	±0.0%
Combined Std. Uncertainty						±14.1%	±13.7%
<b>Expanded STD Uncertainty (κ=2)</b>						<b>±28.2%</b>	<b>±27.4%</b>

Appendix C      Revision History

**Original Test Report No. 14809943H-A**

Revision	Test report No.	Date	Page Revised Contents
- (Original)	14809943H-A	June 16, 2023	-

End of Report