RF Exposure Report

(Part 0: SAR and PD Characterization Evaluation)

FCC ID	**: A4RGLBW0**
Equipment	**: Phone**
Model Name	**: GLBW0**
Applicant	**: Google LLC 1600 Amphitheatre Parkway, Mountain View, CA, 94043 USA**
Standard	**: FCC 47 CFR Part 2 (2.1093)**

We, SPORTON INTERNATIONAL INC., would like to declare that the tested sample has been evaluated in accordance with the test procedures and has been in compliance with the applicable technical standards.

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Table of Contents

History of this test report

Report No.	Version	Description	Issued Date
FA4N0919A	01	Initial issue of report	Apr. 19, 2025
FA4N0919A	02	Update section 3.6, 3.8, 3.9	Apr. 24, 2025
FA4N0919A	03	Update section 2.1	Apr. 25, 2025
FA4N0919A	04	Update section 2.2	Jun. 05, 2025

1. Introduction

The FCC RF exposure limit is based on time-averaged RF exposure. Both SAR and PD regulatory specifications are defined over certain measurement duration allowing for time-averaging. The Samsung S.LSI proprietary Spatial Time Average SAR (S-TAS) with Non-Terrestrial Networks algorithm has been designed to meet the compliance limits over the required duration, while still allowing dynamic control of transmit power for meeting system performance.

This report shows SAR and power density characterization of sub6GHz and mmWave. The characterization is achieved by determination of Plimit. In the case of sub6GHz, power is measured by antenna connection port power and EIRP is measured for mmWave. Plimit is the power level that corresponds to the exposure design target. Design target is defined as SAR_design target for sub6GHz and PD design target respectively.

Because EIRP can vary according to beam code setting in mmWave, EIRP measured using bore-sight code at bore-sight direction is defined as Tx EIRP in this report. And same amount of antenna input power setting is used for other beams as well as bore-sight beam.

The compliance test under static transmission and simultaneous transmission are performed and summarized in Part 1 report. The validation of TAS algorithm under the dynamic transmission scenarios are reported in Part 2. Terminologies for this report are listed up in the table below.

Pmax	Maximum Tx power that can be transmitted physically from RFIC for a given RAT
SAR_FCC_limit	SAR limit specified by FCC 1.6 W/kg averaged over 1-gram, for head and body exposure
SAR_target	Target SAR level used in TAS algorithm. This SAR value should be less than FCC limit and should be determined after accounting for all uncertainties and other design considerations.
PD_FCC_limit	PD limit specified by FCC, 10 W/m2 averaged over 4 cm2
PD_target	Target PD level used in TAS algorithm. This PD value should be less than the FCC limit and should be determined accounting for all uncertainties and other design considerations.
Plimit	The time-averaged RF power that corresponds to SAR_target or PD_target.
SAR characterization	Characterization of SAR value for all sub6GHz technologies
PD characterization	Characterization of PD value for mmWave technology

2. SAR Characterization

SAR characterization must be performed to cover all radio configurations and usage scenarios that the wireless device supports for operating at 6 GHz or below. It will then be used as input for S.LSI TAS feature to control and manage RF exposure for f < 6 GHz.

2.1 SAR design target and uncertainty

The power table index 5 and 6 will be designed to meet both 1g and 10 SAR design target

Accounting for total uncertainty, SAR_design_target should meet the following condition:

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

Wireless technology	Mode	Antenna	Duty cycle	Head		Hotspot	Body-worn		Body-worn/Extremity		power tolerance (dB)
				Standalone	Simultaneous	Simultaneous	Standalone	Simultaneous	Standalone	Simultaneous	
				Index 2	Index 3	Index 4	Index 5	Index 6	Index 5	Index 6	
				1g SAR design target (W/Kg)					10g SAR design target (W/Kg)		
GSM850	GSM/GPRS 1TX	Ant0	12.50%	0.79	0.67	0.67	0.79	0.67	2.62	2.22	1.00
	GPRS 2TX		25.00%	0.83	0.7	0.7	0.83	0.7	2.74	2.32	0.80
	GPRS 3TX		37.50%	0.83	0.7	0.7	0.83	0.7	2.74	2.32	0.80
	GPRS 4TX		50.00%	0.83	0.7	0.7	0.83	0.7	2.74	2.32	0.80
	EDGE 1TX		12.50%	0.83	0.7	0.7	0.83	0.7	2.74	2.32	0.80
	EDGE 2TX		25.00%	0.83	0.7	0.7	0.83	0.7	2.74	2.32	0.80
	EDGE 3TX		37.50%	0.83	0.7	0.7	0.83	0.7	2.74	2.32	0.80
	EDGE 4TX		50.00%	0.83	0.7	0.7	0.83	0.7	2.74	2.32	0.80
GSM1900	GSM/GPRS 1TX	Ant2	12.50%	0.81	0.69	0.69	0.81	0.69	2.68	2.27	0.90
	GPRS 2TX		25.00%	0.81	0.69	0.69	0.81	0.69	2.68	2.27	0.90
	GPRS 3TX		37.50%	0.81	0.69	0.69	0.81	0.69	2.68	2.27	0.90
	GPRS 4TX		50.00%	0.81	0.69	0.69	0.81	0.69	2.68	2.27	0.90
	EDGE 1TX		12.50%	0.81	0.69	0.69	0.81	0.69	2.68	2.27	0.90
	EDGE 2TX		25.00%	0.81	0.69	0.69	0.81	0.69	2.68	2.27	0.90
	EDGE 3TX		37.50%	0.81	0.69	0.69	0.81	0.69	2.68	2.27	0.90
	EDGE 4TX		50.00%	0.81	0.69	0.69	0.81	0.69	2.68	2.27	0.90
WCDMA B2	R99/HSPA	Ant2	100.00%	0.7	0.6	0.6	0.7	0.6	2.33	1.98	1.50
WCDMA B4	R99/HSPA	Ant2	100.00%	0.7	0.6	0.6	0.7	0.6	2.33	1.98	1.50
WCDMA B5	R99/HSPA	Ant0	100.00%	0.75	0.64	0.64	0.75	0.64	2.5	2.12	1.20
LTE B7	PC3	Ant2	100.00%	0.81	0.69	0.69	0.81	0.69	2.68	2.27	0.90
LTE B12/B17	PC3	Ant0	100.00%	0.85	0.72	0.72	0.85	0.72	2.8	2.38	0.70
LTE B13	PC3	Ant0	100.00%	0.85	0.72	0.72	0.85	0.72	2.8	2.38	0.70
LTE B14	PC3	Ant0	100.00%	0.85	0.72	0.72	0.85	0.72	2.8	2.38	0.70
LTE B25/B2	PC3	Ant2	100.00%	0.79	0.67	0.67	0.79	0.67	2.62	2.22	1.00
LTE B25/B2	PC3	Ant1	100.00%	0.79	0.67	0.67	0.79	0.67	2.62	2.22	1.00
LTE B26/B5	PC3	Ant0	100.00%	0.85	0.72	0.72	0.85	0.72	2.8	2.38	0.70
LTE B30	PC3	Ant2	100.00%	0.81	0.69	0.69	0.81	0.69	2.68	2.27	0.90
LTE B41/B38	PC3	Ant2	63.30%	0.79	0.67	0.67	0.79	0.67	2.62	2.22	1.00
LTE B41/B38	PC2	Ant2	43.30%	0.81	0.69	0.69	0.81	0.69	2.68	2.27	0.90
LTE B48	PC3	Ant6	63.30%	0.79	0.67	0.67	0.79	0.67	2.62	2.22	1.00
LTE B66/B4	PC3	Ant2	100.00%	0.79	0.67	0.67	0.79	0.67	2.62	2.22	1.00
LTE B66/B4	PC3	Ant1	100.00%	0.79	0.67	0.67	0.79	0.67	2.62	2.22	1.00
LTE B71	PC3	Ant0	100.00%	0.85	0.72	0.72	0.85	0.72	2.8	2.38	0.70
FR1 n7	PC3	Ant2	100.00%	0.81	0.69	0.69	0.81	0.69	2.68	2.27	0.90
FR1 n12	PC3	Ant0	100.00%	0.85	0.72	0.72	0.85	0.72	2.8	2.38	0.70
FR1 n14	PC3	Ant0	100.00%	0.85	0.72	0.72	0.85	0.72	2.8	2.38	0.70
FR1 n25/n2	PC3	Ant2	100.00%	0.79	0.67	0.67	0.79	0.67	2.62	2.22	1.00
FR1 n25/n2	PC3	Ant1	100.00%	0.79	0.67	0.67	0.79	0.67	2.62	2.22	1.00

FR1 n26/n5	PC3	Ant0	100.00%	0.85	0.72	0.72	0.85	0.72	2.8	2.38	0.70
FR1 n30	PC3	Ant2	100.00%	0.81	0.69	0.69	0.81	0.69	2.68	2.27	0.90
FR1 n41/n38	PC3	Ant2	100.00%	0.81	0.69	0.69	0.81	0.69	2.68	2.27	0.90
FR1 n41	PC2	Ant2	50.00%	0.81	0.69	0.69	0.81	0.69	2.68	2.27	0.90
FR1 n41	PC1.5	Ant2	25.00%	0.81	0.69	0.69	0.81	0.69	2.68	2.27	0.90
FR1 n41/n38	PC3	Ant1	100.00%	0.81	0.69	0.69	0.81	0.69	2.68	2.27	0.90
FR1 n41	PC2	Ant1	50.00%	0.81	0.69	0.69	0.81	0.69	2.68	2.27	0.90
FR1 n41	PC1.5	Ant1	25.00%	0.81	0.69	0.69	0.81	0.69	2.68	2.27	0.90
FR1 n48	PC3	Ant6	100.00%	0.79	0.67	0.67	0.79	0.67	2.62	2.22	1.00
FR1 n48	PC3	Ant1	100.00%	0.79	0.67	0.67	0.79	0.67	2.62	2.22	1.00
FR1 n66	PC3	Ant2	100.00%	0.79	0.67	0.67	0.79	0.67	2.62	2.22	1.00
FR1 n66	PC3	Ant1	100.00%	0.79	0.67	0.67	0.79	0.67	2.62	2.22	1.00
FR1 n70	PC3	Ant2	100.00%	0.79	0.67	0.67	0.79	0.67	2.62	2.22	1.00
FR1 n71	PC3	Ant0	100.00%	0.85	0.72	0.72	0.85	0.72	2.8	2.38	0.70
FR1 n77/n78	PC3	Ant6	100.00%	0.79	0.67	0.67	0.79	0.67	2.62	2.22	1.00
FR1 n77/n78	PC2	Ant6	50.00%	0.79	0.67	0.67	0.79	0.67	2.62	2.22	1.00
FR1 n77	PC1.5	Ant6	25.00%	0.79	0.67	0.67	0.79	0.67	2.62	2.22	1.00
FR1 n77/n78	PC3	Ant1	100.00%	0.79	0.67	0.67	0.79	0.67	2.62	2.22	1.00
FR1 n77	PC2	Ant1	50.00%	0.79	0.67	0.67	0.79	0.67	2.62	2.22	1.00
FR1 n77	PC1.5	Ant1	25.00%	0.79	0.67	0.67	0.79	0.67	2.62	2.22	1.00
NTN B23	PC3	Ant1	83.00%	0.79	0.67	0.67	0.79	0.67	2.62	2.22	1.00
NTN B255	PC3	Ant4	83.00%	0.79	0.67	0.67	0.79	0.67	2.62	2.22	1.00

Wireless technology	Mode	Antenna	Duty cycle	Head		Hotspot	Body-worn		Body-worn/Extremity		power tolerance (dB)
				Standalone	Simultaneous	Simultaneous	Standalone	Simultaneous	Standalone	Simultaneous	
				Index 2	Index 3	Index 4	Index 5	Index 6	Index 5	Index 6	
				1g SAR design target (W/Kg)					10g SAR design target (W/Kg)		
GSM850	GSM/GPRS 1TX	Ant1	12.50%	0.81	0.69	0.69	0.81	0.69	2.68	2.27	0.90
	GPRS 2TX		25.00%	0.79	0.67	0.67	0.79	0.67	2.62	2.22	1.00
	GPRS 3TX		37.50%	0.79	0.67	0.67	0.79	0.67	2.62	2.22	1.00
	GPRS 4TX		50.00%	0.79	0.67	0.67	0.79	0.67	2.62	2.22	1.00
	EDGE 1TX		12.50%	0.81	0.69	0.69	0.81	0.69	2.68	2.27	0.90
	EDGE 2TX		25.00%	0.79	0.67	0.67	0.79	0.67	2.62	2.22	1.00
	EDGE 3TX		37.50%	0.79	0.67	0.67	0.79	0.67	2.62	2.22	1.00
	EDGE 4TX		50.00%	0.79	0.67	0.67	0.79	0.67	2.62	2.22	1.00
GSM1900	GSM/GPRS 1TX	Ant0	12.50%	0.81	0.69	0.69	0.81	0.69	2.68	2.27	0.90
	GPRS 2TX		25.00%	0.79	0.67	0.67	0.79	0.67	2.62	2.22	1.00
	GPRS 3TX		37.50%	0.79	0.67	0.67	0.79	0.67	2.62	2.22	1.00
	GPRS 4TX		50.00%	0.79	0.67	0.67	0.79	0.67	2.62	2.22	1.00
	EDGE 1TX		12.50%	0.81	0.69	0.69	0.81	0.69	2.68	2.27	0.90
	EDGE 2TX		25.00%	0.79	0.67	0.67	0.79	0.67	2.62	2.22	1.00
	EDGE 3TX		37.50%	0.79	0.67	0.67	0.79	0.67	2.62	2.22	1.00
	EDGE 4TX		50.00%	0.79	0.67	0.67	0.79	0.67	2.62	2.22	1.00
WCDMA B2	R99/HSPA	Ant0	100.00%	0.67	0.57	0.57	0.67	0.57	2.23	1.89	1.70
WCDMA B4	R99/HSPA	Ant0	100.00%	0.67	0.57	0.57	0.67	0.57	2.23	1.89	1.70
WCDMA B5	R99/HSPA	Ant1	100.00%	0.72	0.61	0.61	0.72	0.61	2.39	2.02	1.40
LTE B7	PC3	Ant0	100.00%	0.77	0.66	0.66	0.77	0.66	2.56	2.17	1.10
LTE B12/B17	PC3	Ant1	100.00%	0.81	0.69	0.69	0.81	0.69	2.68	2.27	0.90
LTE B13	PC3	Ant1	100.00%	0.81	0.69	0.69	0.81	0.69	2.68	2.27	0.90
LTE B14	PC3	Ant1	100.00%	0.81	0.69	0.69	0.81	0.69	2.68	2.27	0.90
LTE B25/B2	PC3	Ant0	100.00%	0.77	0.66	0.66	0.77	0.66	2.56	2.17	1.10
LTE B25/B2	PC3	Ant5	100.00%	0.83	0.7	0.7	0.83	0.7	2.74	2.32	0.80
LTE B26/B5	PC3	Ant1	100.00%	0.81	0.69	0.69	0.81	0.69	2.68	2.27	0.90
LTE B30	PC3	Ant0	100.00%	0.79	0.67	0.67	0.79	0.67	2.62	2.22	1.00
LTE B41/B38	PC3	Ant0	63.30%	0.75	0.64	0.64	0.75	0.64	2.5	2.12	1.20

LTE B41/B38	PC2	Ant0	43.30%	0.81	0.69	0.69	0.81	0.69	2.68	2.27	0.90
LTE B48	PC3	Ant7	63.30%	0.75	0.64	0.64	0.75	0.64	2.5	2.12	1.20
LTE B66/B4	PC3	Ant0	100.00%	0.77	0.66	0.66	0.77	0.66	2.56	2.17	1.10
LTE B66/B4	PC3	Ant5	100.00%	0.83	0.7	0.7	0.83	0.7	2.74	2.32	0.80
LTE B71	PC3	Ant1	100.00%	0.81	0.69	0.69	0.81	0.69	2.68	2.27	0.90
FR1 n7	PC3	Ant0	100.00%	0.77	0.66	0.66	0.77	0.66	2.56	2.17	1.10
FR1 n12	PC3	Ant1	100.00%	0.81	0.69	0.69	0.81	0.69	2.68	2.27	0.90
FR1 n14	PC3	Ant1	100.00%	0.81	0.69	0.69	0.81	0.69	2.68	2.27	0.90
FR1 n25/n2	PC3	Ant0	100.00%	0.77	0.66	0.66	0.77	0.66	2.56	2.17	1.10
FR1 n25/n2	PC3	Ant5	100.00%	0.75	0.64	0.64	0.75	0.64	2.5	2.12	1.20
FR1 n26/n5	PC3	Ant1	100.00%	0.81	0.69	0.69	0.81	0.69	2.68	2.27	0.90
FR1 n30	PC3	Ant0	100.00%	0.79	0.67	0.67	0.79	0.67	2.62	2.22	1.00
FR1 n41/n38	PC3	Ant0	100.00%	0.79	0.67	0.67	0.79	0.67	2.62	2.22	1.00
FR1 n41	PC2	Ant0	50.00%	0.81	0.69	0.69	0.81	0.69	2.68	2.27	0.90
FR1 n41	PC1.5	Ant0	25.00%	0.81	0.69	0.69	0.81	0.69	2.68	2.27	0.90
FR1 n41/n38	PC3	Ant5	100.00%	0.74	0.63	0.63	0.74	0.63	2.44	2.07	1.30
FR1 n41	PC2	Ant5	50.00%	0.77	0.66	0.66	0.77	0.66	2.56	2.17	1.10
FR1 n41	PC1.5	Ant5	25.00%	0.77	0.66	0.66	0.77	0.66	2.56	2.17	1.10
FR1 n48	PC3	Ant7	100.00%	0.79	0.67	0.67	0.79	0.67	2.62	2.22	1.00
FR1 n48	PC3	Ant5	100.00%	0.79	0.67	0.67	0.79	0.67	2.62	2.22	1.00
FR1 n66	PC3	Ant0	100.00%	0.77	0.66	0.66	0.77	0.66	2.56	2.17	1.10
FR1 n66	PC3	Ant5	100.00%	0.75	0.64	0.64	0.75	0.64	2.5	2.12	1.20
FR1 n70	PC3	Ant0	100.00%	0.77	0.66	0.66	0.77	0.66	2.56	2.17	1.10
FR1 n71	PC3	Ant1	100.00%	0.81	0.69	0.69	0.81	0.69	2.68	2.27	0.90
FR1 n77/n78	PC3	Ant7	100.00%	0.79	0.67	0.67	0.79	0.67	2.62	2.22	1.00
FR1 n77/n78	PC2	Ant7	50.00%	0.79	0.67	0.67	0.79	0.67	2.62	2.22	1.00
FR1 n77	PC1.5	Ant7	25.00%	0.79	0.67	0.67	0.79	0.67	2.62	2.22	1.00
FR1 n77/n78	PC3	Ant5	100.00%	0.79	0.67	0.67	0.79	0.67	2.62	2.22	1.00
FR1 n77	PC2	Ant5	50.00%	0.79	0.67	0.67	0.79	0.67	2.62	2.22	1.00
FR1 n77	PC1.5	Ant5	25.00%	0.79	0.67	0.67	0.79	0.67	2.62	2.22	1.00

2.2 SAR Characterization – Power Table

1. The Plimit values correspond to SAR_design_target.
2. GSM don't support time average feature of dynamic power varying, the power will be fixed at the static reduce power level at different exposure conditions for RF exposure compliance. For the GSM Plimit power levels in the table correspond to the burst average power levels which don't account for TX duty cycle.
3. UMTS, LTE, FR1 and NTN: Plimit power levels in the table correspond to the time-averaged power levels which accounts for TX duty cycle.
4. Maximum target power, Pmax, is configured in NV settings in EUT to limit maximum transmitting power. This power is converted into peak power in NV settings for TDD schemes.

<P_{limit} for supported technologies and bands (P_{limit} corresponding to SAR design target)>

Wireless technology (No Accounting duty cycle)	Mode	Duty cycle	Antenna	Maximum Power Condition	Head		Hotspot	Body-worn/Extremity		P Max Burst average power (dBm)
					Standalone	Simultaneous	Simultaneous	Standalone	Simultaneous	
				Index 1	Index 2	Index 3	Index 4	Index 5	Index 6	
				P limit						
				Burst average power (dBm)						
GSM850	GSM/GPRS 1TX	12.50%	Ant0	32.50	35.60	34.40	34.10	35.00	34.30	32.50
	GPRS 2TX	25.00%		31.50	32.60	31.40	31.10	32.00	31.30	31.50
	GPRS 3TX	37.50%		30.50	30.80	29.60	29.30	30.20	29.50	30.50
	GPRS 4TX	50.00%		29.50	29.60	28.40	28.10	29.00	28.30	29.50
	EDGE 1TX	12.50%		26.50	35.60	34.40	34.10	35.00	34.30	26.50
	EDGE 2TX	25.00%		25.50	32.60	31.40	31.10	32.00	31.30	25.50
	EDGE 3TX	37.50%		24.50	30.80	29.60	29.30	30.20	29.50	24.50
	EDGE 4TX	50.00%		23.50	29.60	28.40	28.10	29.00	28.30	23.50
GSM850	GSM/GPRS 1TX	12.50%	Ant1	32.20	30.30	29.60	33.10	33.80	33.10	32.20
	GPRS 2TX	25.00%		31.30	27.30	26.60	30.10	30.80	30.10	31.30
	GPRS 3TX	37.50%		30.30	25.50	24.80	28.30	29.00	28.30	30.30
	GPRS 4TX	50.00%		29.30	24.30	23.60	27.10	27.80	27.10	29.30
	EDGE 1TX	12.50%		26.20	30.30	29.60	33.10	33.80	33.10	26.20
	EDGE 2TX	25.00%		25.30	27.30	26.60	30.10	30.80	30.10	25.30
	EDGE 3TX	37.50%		24.30	25.50	24.80	28.30	29.00	28.30	24.30
	EDGE 4TX	50.00%		23.30	24.30	23.60	27.10	27.80	27.10	23.30
GSM1900	GSM/GPRS 1TX	12.50%	Ant2	29.50	34.70	34.00	31.80	32.80	32.10	29.50
	GPRS 2TX	25.00%		28.00	31.70	31.00	28.80	29.80	29.10	28.00
	GPRS 3TX	37.50%		27.50	29.90	29.20	27.00	28.00	27.30	27.50
	GPRS 4TX	50.00%		26.50	28.70	28.00	25.80	26.80	26.10	26.50
	EDGE 1TX	12.50%		25.50	34.70	34.00	31.80	32.80	32.10	25.50
	EDGE 2TX	25.00%		24.50	31.70	31.00	28.80	29.80	29.10	24.50
	EDGE 3TX	37.50%		23.50	29.90	29.20	27.00	28.00	27.30	23.50
	EDGE 4TX	50.00%		22.50	28.70	28.00	25.80	26.80	26.10	22.50
GSM1900	GSM/GPRS 1TX	12.50%	Ant0	28.70	43.80	43.10	26.40	28.40	27.70	28.70
	GPRS 2TX	25.00%		27.20	40.80	40.10	23.40	25.40	24.70	27.20
	GPRS 3TX	37.50%		26.70	39.00	38.30	21.60	23.60	22.90	26.70
	GPRS 4TX	50.00%		25.70	37.80	37.10	20.40	22.40	21.70	25.70
	EDGE 1TX	12.50%		24.70	43.80	43.10	26.40	28.40	27.70	24.70
	EDGE 2TX	25.00%		23.70	40.80	40.10	23.40	25.40	24.70	23.70
	EDGE 3TX	37.50%		22.70	39.00	38.30	21.60	23.60	22.90	22.70
	EDGE 4TX	50.00%		21.70	37.80	37.10	20.40	22.40	21.70	21.70

Wireless technology (Accounting duty cycle)	Mode	Duty cycle	Antenna	Maximum Power Condition	Head		Hotspot	Body-worn/Extremity		P Max Time-average power (dBm)
					Standalone	Simultaneous	Simultaneous	Standalone	Simultaneous	
				Index 1	Index 2	Index 3	Index 4	Index 5	Index 6	
				P limit						
				Time-average power (dBm)						
WCDMA B2	R99/HSPA	100.00%	Ant2	24.00	25.80	25.10	21.60	22.30	21.60	24.00
WCDMA B2	R99/HSPA	100.00%	Ant0	23.80	35.20	34.50	16.30	18.90	18.20	23.80
WCDMA B4	R99/HSPA	100.00%	Ant2	24.00	26.20	25.50	21.00	21.70	21.00	24.00
WCDMA B4	R99/HSPA	100.00%	Ant0	23.80	33.50	32.80	18.00	19.50	18.80	23.80
WCDMA B5	R99/HSPA	100.00%	Ant0	24.30	28.20	27.50	24.70	25.40	24.70	24.30
WCDMA B5	R99/HSPA	100.00%	Ant1	24.10	22.00	21.30	24.10	24.80	24.10	24.10
LTE B7	PC3	100.00%	Ant2	24.10	24.50	23.30	20.00	20.70	20.00	24.10
LTE B7	PC3	100.00%	Ant0	23.90	31.60	30.90	18.70	20.90	20.20	23.90
LTE B12/B17	PC3	100.00%	Ant0	24.30	30.60	29.90	26.30	27.00	26.30	24.30
LTE B12/B17	PC3	100.00%	Ant1	24.10	22.90	22.20	26.50	27.20	26.50	24.10
LTE B13	PC3	100.00%	Ant0	24.30	29.30	28.60	22.90	28.40	27.70	24.30
LTE B13	PC3	100.00%	Ant1	24.10	23.00	22.30	22.80	27.20	26.50	24.10
LTE B14	PC3	100.00%	Ant0	24.30	29.10	28.40	22.80	27.80	27.10	24.30
LTE B14	PC3	100.00%	Ant1	24.10	23.10	22.30	23.00	27.20	26.50	24.10
LTE B25/B2	PC3	100.00%	Ant2	24.00	25.90	25.20	20.10	20.80	20.10	24.00
LTE B25/B2	PC3	100.00%	Ant0	23.90	35.90	35.20	16.50	19.10	18.40	23.90
LTE B25/B2	PC3	100.00%	Ant1	24.00	17.40	16.70	20.30	21.50	20.80	24.00
LTE B25/B2	PC3	100.00%	Ant5	23.80	19.20	18.20	21.70	22.40	21.70	23.80
LTE B26/B5	PC3	100.00%	Ant0	24.30	28.40	27.70	23.80	26.20	25.50	24.30
LTE B26/B5	PC3	100.00%	Ant1	24.10	22.60	21.50	24.20	24.90	24.20	24.10
LTE B30	PC3	100.00%	Ant2	22.90	24.10	23.40	19.60	20.30	19.60	22.90
LTE B30	PC3	100.00%	Ant0	20.50	32.50	31.80	18.60	20.20	19.50	20.50
LTE B41/B38	PC3	63.30%	Ant2	22.10	22.90	21.70	19.00	19.70	19.00	22.10
LTE B41/B38	PC2	43.30%	Ant2	22.40	22.90	21.70	19.00	19.70	19.00	22.40
LTE B41/B38	PC3	63.30%	Ant0	21.90	31.50	30.80	18.60	20.90	20.20	21.90
LTE B41/B38	PC2	43.30%	Ant0	22.20	31.50	30.80	18.60	20.90	20.20	22.20
LTE B48	PC3	63.30%	Ant6	18.00	25.70	25.00	18.80	20.10	19.40	18.00
LTE B48	PC3	63.30%	Ant7	20.10	25.50	24.80	18.10	18.80	18.10	20.10
LTE B66/B4	PC3	100.00%	Ant2	24.00	25.50	24.80	21.30	22.00	21.30	24.00
LTE B66/B4	PC3	100.00%	Ant0	23.90	34.70	34.00	18.20	19.60	18.90	23.90
LTE B66/B4	PC3	100.00%	Ant1	24.00	15.70	14.50	20.50	21.20	20.50	24.00
LTE B66/B4	PC3	100.00%	Ant5	23.80	19.80	18.60	22.50	23.20	22.50	23.80
LTE B71	PC3	100.00%	Ant0	24.30	29.50	28.80	27.30	28.40	27.70	24.30
LTE B71	PC3	100.00%	Ant1	24.10	23.40	22.50	26.70	27.40	26.70	24.10
FR1 n7	PC3	100.00%	Ant2	24.10	23.40	22.20	20.60	21.90	21.20	24.10
FR1 n7	PC3	100.00%	Ant0	23.90	31.80	31.10	18.40	20.50	19.80	23.90
FR1 n12	PC3	100.00%	Ant0	24.30	29.40	28.70	23.80	26.10	25.40	24.30
FR1 n12	PC3	100.00%	Ant1	24.10	22.40	21.50	25.20	25.90	25.20	24.10
FR1 n14	PC3	100.00%	Ant0	24.30	28.90	28.20	23.00	28.20	27.50	24.30
FR1 n14	PC3	100.00%	Ant1	24.10	22.40	21.50	23.10	26.10	25.40	24.10
FR1 n25/n2	PC3	100.00%	Ant2	24.00	27.10	26.40	20.60	21.30	20.60	24.00
FR1 n25/n2	PC3	100.00%	Ant0	23.90	36.70	36.00	17.00	19.10	18.40	23.90
FR1 n25/n2	PC3	100.00%	Ant1	24.00	14.60	13.70	19.50	20.20	19.50	24.00
FR1 n25/n2	PC3	100.00%	Ant5	23.80	18.60	17.40	20.50	21.30	20.60	23.80
FR1 n26/n5	PC3	100.00%	Ant0	24.30	28.40	27.70	25.20	26.00	25.30	24.30
FR1 n26/n5	PC3	100.00%	Ant1	24.10	22.00	21.10	24.20	24.90	24.20	24.10
FR1 n30	PC3	100.00%	Ant2	22.90	24.90	24.20	19.60	20.30	19.60	22.90
FR1 n30	PC3	100.00%	Ant0	20.50	33.70	33.00	18.80	21.10	20.40	20.50
FR1 n41/n38	PC3	100.00%	Ant2	24.10	23.10	21.90	20.90	21.60	20.90	24.10
FR1 n41	PC2	50.00%	Ant2	23.00	23.10	21.90	20.90	21.60	20.90	23.00
FR1 n41	PC1.5	25.00%	Ant2	19.50	23.10	21.90	20.90	21.60	20.90	19.50

FR1 n41/n38	PC3	100.00%	Ant0	24.00	31.70	31.00	19.10	21.30	20.60	24.00
FR1 n41	PC2	50.00%	Ant0	22.80	31.70	31.00	19.10	21.30	20.60	22.80
FR1 n41	PC1.5	25.00%	Ant0	18.50	31.70	31.00	19.10	21.30	20.60	18.50
FR1 n41/n38	PC3	100.00%	Ant1	24.10	17.00	15.80	21.30	22.00	21.30	24.10
FR1 n41	PC2	50.00%	Ant1	23.00	17.00	15.80	21.30	22.00	21.30	23.00
FR1 n41	PC1.5	25.00%	Ant1	18.70	17.00	15.80	21.30	22.00	21.30	18.70
FR1 n41/n38	PC3	100.00%	Ant5	23.70	15.80	14.60	21.90	22.60	21.90	23.70
FR1 n41	PC2	50.00%	Ant5	22.60	15.80	14.60	21.90	22.60	21.90	22.60
FR1 n41	PC1.5	25.00%	Ant5	18.30	15.80	14.60	21.90	22.60	21.90	18.30
FR1 n48	PC3	100.00%	Ant6	20.00	24.90	24.20	18.40	19.30	18.60	20.00
FR1 n48	PC3	100.00%	Ant7	22.30	25.90	25.20	18.10	18.80	18.10	22.30
FR1 n48	PC3	100.00%	Ant1	20.70	13.90	13.20	17.30	19.10	18.40	20.70
FR1 n48	PC3	100.00%	Ant5	20.40	18.10	17.40	23.80	24.50	23.80	20.40
FR1 n66	PC3	100.00%	Ant2	24.00	26.70	26.00	21.30	22.00	21.30	24.00
FR1 n66	PC3	100.00%	Ant0	23.90	35.00	34.30	18.60	20.10	19.40	23.90
FR1 n66	PC3	100.00%	Ant1	24.00	15.50	14.60	20.90	21.60	20.90	24.00
FR1 n66	PC3	100.00%	Ant5	23.80	19.80	18.60	21.30	22.00	21.30	23.80
FR1 n70	PC3	100.00%	Ant2	23.70	27.30	26.60	21.40	22.10	21.40	23.70
FR1 n70	PC3	100.00%	Ant0	23.60	32.50	31.80	18.40	19.80	19.10	23.60
FR1 n71	PC3	100.00%	Ant0	24.30	30.10	29.40	26.40	28.40	27.70	24.30
FR1 n71	PC3	100.00%	Ant1	24.10	23.50	22.80	26.20	26.90	26.20	24.10
FR1 n77/n78	PC3	100.00%	Ant6	24.00	24.10	23.40	18.50	19.40	18.70	24.00
FR1 n77/n78	PC2	50.00%	Ant6	23.00	24.10	23.40	18.50	19.40	18.70	23.00
FR1 n77	PC1.5	25.00%	Ant6	19.50	24.10	23.40	18.50	19.40	18.70	19.50
FR1 n77/n78	PC3	100.00%	Ant7	23.50	23.90	22.70	18.10	18.80	18.10	23.50
FR1 n77/n78	PC2	50.00%	Ant7	22.50	23.90	22.70	18.10	18.80	18.10	22.50
FR1 n77	PC1.5	25.00%	Ant7	19.00	23.90	22.70	18.10	18.80	18.10	19.00
FR1 n77/n78	PC3	100.00%	Ant1	24.00	13.70	12.50	16.10	19.00	18.30	24.00
FR1 n77	PC2	50.00%	Ant1	23.00	13.70	12.50	16.10	19.00	18.30	23.00
FR1 n77	PC1.5	25.00%	Ant1	19.50	13.70	12.50	16.10	19.00	18.30	19.50
FR1 n77/n78	PC3	100.00%	Ant5	23.50	16.60	15.90	23.00	23.70	23.00	23.50
FR1 n77	PC2	50.00%	Ant5	22.50	16.60	15.90	23.00	23.70	23.00	22.50
FR1 n77	PC1.5	25.00%	Ant5	19.00	16.60	15.90	23.00	23.70	23.00	19.00
NTN B23	PC3	83.00%	Ant1	21.70				20.50		21.70
NTN B255	PC3	83.00%	Ant4	22.70				20.00		22.70

3. Power Density Characterization

The device with 5G mmW NR typically supports many beams and contains multiple mmW antenna arrays installed at different locations to achieve good coverage in the field. EM simulation, together with few PD measurement, is used for PD characterization for compliance

3.1 Exposure scenarios for power density evaluation

At frequency above 6GHz, power density is required to be assessed for all module and antenna configurations. The device had one antenna module on back-side of the terminal. The module has 2 patch 1x4 antenna arrays that using horizontal and vertical polarization respectively. Each polarity is denoted as H-pol and V-pol. The module has 7 beams for H-pol and V-pol respectively. And DUT use same beam index for H-pol and Vpol to support 2x2 MIMO. Therefore, total 21 beams should be assessed. (7 beams for each of SISO (H, V) and 7 beams for MIMO (H+V)).

Below procedure flow suggests PD characterization process. To validate simulation modeling, simulation results and measured PD at the certain given reference power (bore-sight Tx EIRP) are used. Antenna input power can be calculated as well if EIRP is given because array gain and antenna gain are known. Since the housing influence correlation can vary from surface to surface, the most underestimated surface should be used. The worst case housing effect is calculated by below equation.

Correlation $_{min}$= Simulation PD @ ref.power – measured PD @ ref.power

3.2 PD Characterization Process

The following steps outlines the PD char process.

1. Simulation modeling and validation
   - Correlate the simulated PD results and measured PD of beam code book for validation
2. Uncertainty consideration
   - Total device uncertainty is accounted considering worst case device to device power variation
3. Determine PD design target
   - To meet regulatory limit, PD design target is calculated accounting uncertainty budget
4. Calculate the worst case housing influence
   - Calculate below equation to estimate the worst case housing influence at given EIRP

     Correlation $_{min}$= Simulation PD @ ref.power – measured PD @ ref.power
5. PD characterization
   - Simulation results can be exploited to determine target EIRP level (and input power accordingly) after accounting for the housing influence

3.3 Beam code settings

All the beams that the DUT can support are listed up in the table below.

Band	mmWave module	Pol	Beam ID
n258	B	H	0
n258	B	H	1
n258	B	H	2
n258	B	H	3
n258	B	H	4
n258	B	H	5
n258	B	H	6
n258	B	V	0
n258	B	V	1
n258	B	V	2
n258	B	V	3
n258	B	V	4
n258	B	V	5
n258	B	V	6
n258	B	H+V	0
n258	B	H+V	1
n258	B	H+V	2
n258	B	H+V	3
n258	B	H+V	4
n258	B	H+V	5
n258	B	H+V	6

Band	mmWave module	Pol	Beam ID
n260	B	H	0
n260	B	H	1
n260	B	H	2
n260	B	H	3
n260	B	H	4
n260	B	H	5
n260	B	H	6
n260	B	V	0
n260	B	V	1
n260	B	V	2
n260	B	V	3
n260	B	V	4
n260	B	V	5
n260	B	V	6
n260	B	H+V	0
n260	B	H+V	1
n260	B	H+V	2
n260	B	H+V	3
n260	B	H+V	4
n260	B	H+V	5
n260	B	H+V	6

Band	mmWave module	Pol	Beam ID
n261	B	H	0
n261	B	H	1
n261	B	H	2
n261	B	H	3
n261	B	H	4
n261	B	H	5
n261	B	H	6
n261	B	V	0
n261	B	V	1
n261	B	V	2
n261	B	V	3
n261	B	V	4
n261	B	V	5
n261	B	V	6
n261	B	H+V	0
n261	B	H+V	1
n261	B	H+V	2
n261	B	H+V	3
n261	B	H+V	4
n261	B	H+V	5
n261	B	H+V	6

3.4 PD_design_target determination

Accounting for total uncertainty, PD_design_target should meet the criteria:

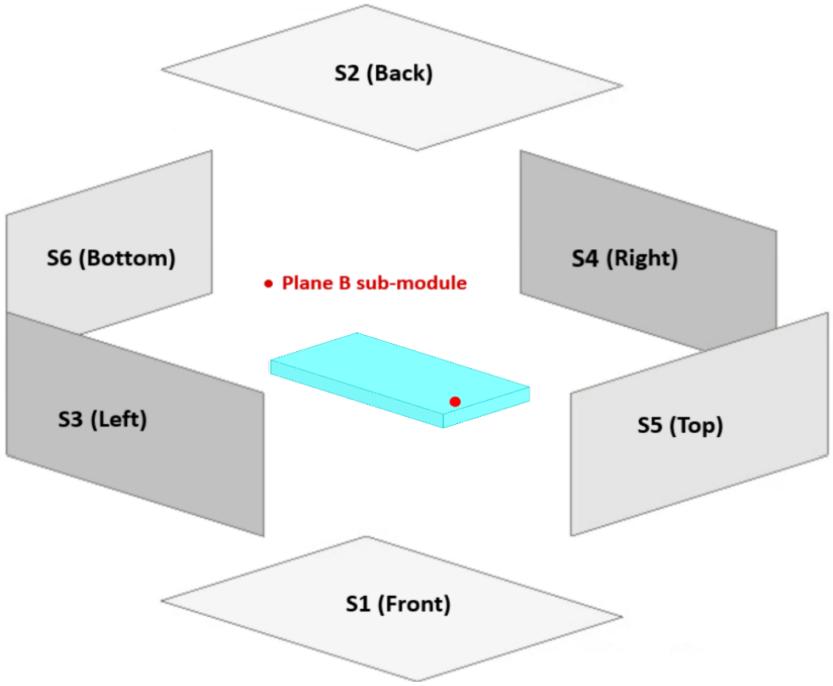
$$PD\_design\_target < PD_{regulatory\_limit} \times 10^{\frac{-totaluncertainty}{10}}$$

For this EUT, the PD design target and the uncertainty value are listed below

n258/n260/n261	PD design target	Antenna Module	W/m^2
		Plane B sub-module,	4.42

Item	Uncertainty dB (k=2)
Total uncertainty	2.3
TXAGC	1

3.5 Exposure positions for PD evaluation



Evaluation positions

Band	Antenna Module	S1 (Front)	S2 (Back)	S3 (Right)	S4 (Left)	S5 (Top)	S6 (Bottom)
n258/260/261	Plane B sub-module	✗	v	✗	✗	✗	✗

Remark:

1. The exposure positions selection is for worst-case housing influence determination. Details are illustrated in the PD simulation report.

3.6 Simulation and modeling validation

Power density simulations of all beams and surfaces were performed by the manufacturer. Details of these simulations and modeling validation can be found in the Power Density Simulation Report. Following Table includes a summary of the validation results to support worst-case housing influence quantification in power density characterization for this model With an reference power level 17 dBm for each FR2 band, PD measurements are conducted for signal beam and beam pairs per antenna type and per antenna module on worst-surface(s). PD measurements are performed at mid channel of each mmW band and with CW modulation.
PD value will be used to determine worst-case housing influence for conservative assessment.

The correlation number, after taking the TXAGC uncertainty into consideration, will be used to adjust correct the housing influence effect of the PD simulated data, as described in section 3.4

Antenna Module	Polarization		Band	Frequency (GHz)	Exposure Surface	Input Power limit	Test Separation (mm)	Modulation	4cm^2 PD (W/m^2)		Correlation Sim-Meas. (dB)
	H	V							Meas.	Sim.	
Plane B sub-module	1	-	n258	24.75	Back (S2)_Visor	17	2mm	CW	11.5	5.13	-3.51
Plane B sub-module	-	4	n258	24.75	Back (S2)_Visor	17	2mm	CW	11	6.74	-2.13
Plane B sub-module	1	1	n258	24.75	Back (S2)_Visor	17	2mm	CW	22.7	17.09	-1.23
Plane B sub-module	3	-	n260	38.5	Back (S2)_Visor	17	2mm	CW	4.08	5.28	1.12
Plane B sub-module	-	3	n260	38.5	Back (S2)_Visor	17	2mm	CW	7.06	5.45	-1.12
Plane B sub-module	3	3	n260	38.5	Back (S2)_Visor	17	2mm	CW	8.01	11.95	1.74
Plane B sub-module	3	-	n261	27.925	Back (S2)_Visor	17	2mm	CW	8.46	6.99	-0.83
Plane B sub-module	-	4	n261	27.925	Back (S2)_Visor	17	2mm	CW	7.15	7.67	0.30
Plane B sub-module	4	4	n261	27.925	Back (S2)_Visor	17	2mm	CW	13.2	16.15	0.88

3.7 Simulated Plimit to associate with design target

Perform simulation at low, mid and high channel for each mmW band supported, at a given EIRP power level (18 dBm for this product)

1. Obtain $PD_{surface}$ value (the worst PD among all identified surfaces of the device) at all three channels for all beams (1~M) specified in beam code settings.

2. According to the PD design target, determine the required worst scaling factors from the worst simulated PD values for low/middle/high channels and for all beams, to determine the worst-case scaling factor at all three channels and beams by:

$$s(f) = \frac{PD\ design\ target}{Max\ Sim\ PD}$$

Note: This scaling factor applies to the reference power at each antenna port

3. Determine the sim.power limit, for each beam by:

$$sim.\ power_{limit}.\ dBm = 10 * log(s(f)) + sim.reference.power$$

3.8 Worst-case housing influence determination

Referring to the PD simulation report for PD simulation data for all beams . Since at mmwave frequencies, the property of the material which surrounds the antenna cannot be accurately assigned for simulation, so the housing factor needs to be identified to correct the simulation data. The worst-case housing influence is determined per antenna module and per antenna type.

For this DUT, the procedure to determine worst-case housing influence, denoted as $\mathrm{Correlation}_{\mathrm{min}}$:

1. Based on PD simulation, determine one or more worst-surface(s) that contains all the highest 4cm^2-averaged PD for each of the beams, per antenna module and per antenna type in the mid channel of each band.
2. For identified worst surface(s) per antenna module and per antenna type group,
   a. Firstly determine difference between measurement and simulation for the identified worst surface(s) in Step 1 as described in section 3.6, and then follow the procedures described in Section 3.9 to derive *Plimit* corresponding to *PD_design_target* for all the beams
   b. Then for other surface(s) near-by the mmW module,
      i. From the simulation report, identify the worst beam for each surface.
      ii. Measure 4cm^2-averaged PD at *Plimit* for the identified at each non-selected surface
      iii. Demonstrate all measured 4cm^2-averaged PD values are below *PD_design_target*.
3. If any of the above surface(s) in Step (2.b.iii) have measured 4cm^2-averaged PD ≥ *PD_design_target*, then those surfaces must be included in the $\mathbf{correlation}_{min}$ determination, and follow the procedures in Section 3.6 and 3.9 to re-evaluate *Plimit*

Comparing a simulated 4cm^2-avgeraged PD and measured 4cm^2-avgeraged PD for the above identified surfaces, the worst errors introduced when using the estimated material property in the simulation per module and per antenna type (worst out of both polarizations) is highlighted in bolded numbers in section 3.6. Thus, the worst-case housing influence, denoted as $\mathbf{Correlation}_{min}$ (= minimum of (sim.PD – meas.PD) for the same antenna type of each module), is determined as:

Band	Antenna Module	Polarization	*Correlation* $_{min}$ (dB)
n258	Plane B sub-module	H	-3.51
n258	Plane B sub-module	V	-2.13
n258	Plane B sub-module	H+V	-1.23
Band	Antenna Module	Polarization	*Correlation* $_{min}$ (dB)
n260	Plane B sub-module	H	1.12
n260	Plane B sub-module	V	-1.12
n260	Plane B sub-module	H+V	1.74
Band	Antenna Module	Polarization	*Correlation* $_{min}$ (dB)
n261	Plane B sub-module	H	-0.83
n261	Plane B sub-module	V	0.30
n261	Plane B sub-module	H+V	0.88

$\mathbf{Correlation}_{min}$ represents the worst case where RF exposure is underestimated the most by simulation upon using the estimated material property for glass/plastics of the housing. For conservative assessment, the $\mathbf{Correlation}_{min}$ is used as the worst case correction and applied to each corresponding beam group to determine power limits for compliance. To ensure that condition described in Step (2.b.iii) is met, apply the correct Plimit to derive the PD simulated results for all beams, and select the worst beams for each of non-selected applicable surface(s).

The PD test results for non-selected surfaces are less than PD_design_target, and meets condition in Step (2.b.iii), the test results are illustrated in Part 1 PD report.

Simulated 4cm2-averaged PD at Plimit

Pol	Beam ID	Simulated 4cm 2 SAPD (W/m 2) corresponding to PD_design_target														
		n258 Plane B sub-module														
		Low Channel					Mid Channel					High Channel				
		S1_2mm	S2_2mm	S3_2mm	S4_2mm	S5_2mm	S1_2mm	S2_2mm	S3_2mm	S4_2mm	S5_2mm	S1_2mm	S2_2mm	S3_2mm	S4_2mm	S5_2mm
H	0	0.13	3.98	1.22	0.06	1.21	0.15	3.86	1.15	0.04	1.27	0.19	4.19	1.21	0.04	1.35
H	1	0.12	3.46	1.02	0.02	1.35	0.14	3.64	1.16	0.01	1.49	0.18	3.82	1.19	0.01	1.48
H	2	0.21	4.09	0.21	0.14	1.58	0.22	4.05	0.30	0.15	1.60	0.22	4.23	0.41	0.18	1.67
H	3	0.25	3.61	0.33	0.02	1.49	0.24	3.80	0.35	0.03	1.59	0.25	4.42	0.36	0.02	1.90
H	4	0.29	2.84	0.53	0.04	0.98	0.24	3.12	0.69	0.04	1.27	0.29	3.91	0.91	0.05	1.66
H	5	0.08	3.95	0.15	0.13	1.19	0.11	3.82	0.23	0.12	1.29	0.17	3.63	0.19	0.11	1.23
H	6	0.20	3.39	0.53	0.16	1.05	0.21	3.42	0.45	0.22	1.04	0.20	3.70	0.36	0.25	0.97
V	0	0.12	3.77	0.85	0.06	0.82	0.13	4.09	1.10	0.05	1.02	0.14	3.89	1.06	0.08	1.02
V	1	0.11	3.81	0.64	0.05	0.87	0.14	4.10	0.74	0.05	1.02	0.12	4.06	0.73	0.07	1.11
V	2	0.16	2.04	0.19	0.02	0.97	0.18	2.51	0.17	0.02	1.33	0.18	3.08	0.14	0.02	1.74
V	3	0.14	2.88	0.11	0.02	1.62	0.11	3.28	0.11	0.03	1.88	0.09	3.67	0.15	0.02	2.05
V	4	0.13	4.02	0.50	0.01	1.35	0.11	4.39	0.56	0.02	1.48	0.11	4.42	0.60	0.04	1.55
V	5	0.09	2.48	0.19	0.09	0.75	0.12	2.62	0.15	0.08	0.92	0.13	2.77	0.16	0.09	1.10
V	6	0.10	3.18	0.59	0.08	0.66	0.12	3.25	0.56	0.08	0.75	0.13	3.47	0.44	0.12	0.92
H+V	0	0.15	4.20	1.28	0.07	1.43	0.18	4.30	1.40	0.04	1.59	0.20	4.40	1.44	0.05	1.64
H+V	1	0.11	4.36	1.10	0.04	1.50	0.14	4.42	1.27	0.03	1.58	0.14	4.32	1.24	0.04	1.60
H+V	2	0.26	3.05	0.26	0.08	1.23	0.27	2.99	0.26	0.08	1.50	0.24	3.21	0.29	0.10	1.76
H+V	3	0.27	2.98	0.26	0.03	1.57	0.24	3.18	0.25	0.04	1.66	0.21	3.80	0.30	0.02	1.75
H+V	4	0.21	3.92	0.62	0.02	1.26	0.17	3.85	0.64	0.03	1.42	0.19	3.90	0.64	0.05	1.66
H+V	5	0.09	4.00	0.24	0.13	1.34	0.13	3.94	0.21	0.13	1.41	0.17	3.90	0.20	0.13	1.45
H+V	6	0.16	3.78	0.74	0.18	1.20	0.13	3.79	0.70	0.20	1.20	0.16	4.09	0.56	0.25	1.25

Pol	Beam ID	Simulated 4cm 2 SAPD (W/m 2) corresponding to PD_design_target														
		n260 Plane B sub-module														
		Low Channel					Mid Channel					High Channel				
		S1_2mm	S2_2mm	S3_2mm	S4_2mm	S5_2mm	S1_2mm	S2_2mm	S3_2mm	S4_2mm	S5_2mm	S1_2mm	S2_2mm	S3_2mm	S4_2mm	S5_2mm
H	0	0.08	3.82	0.58	0.06	1.06	0.16	3.35	0.84	0.06	0.93	0.16	3.55	0.81	0.05	1.14
H	1	0.14	3.34	0.75	0.11	1.30	0.19	3.81	1.16	0.07	1.87	0.11	3.62	0.76	0.11	1.10
H	2	0.07	3.55	0.25	0.03	1.24	0.12	3.79	0.32	0.04	1.29	0.13	4.03	0.34	0.05	1.39
H	3	0.11	3.85	0.39	0.04	1.59	0.15	3.69	0.47	0.05	1.59	0.19	4.04	0.46	0.06	1.66
H	4	0.11	3.57	0.21	0.09	1.48	0.13	3.44	0.24	0.07	1.70	0.22	3.54	0.33	0.09	1.56
H	5	0.13	4.42	0.61	0.08	0.86	0.20	3.26	0.89	0.09	0.76	0.14	3.80	0.64	0.08	1.15
H	6	0.14	4.33	1.01	0.10	0.85	0.17	4.04	1.04	0.10	0.98	0.17	3.95	0.85	0.16	0.93
V	0	0.12	3.75	0.74	0.25	1.01	0.14	3.62	0.65	0.17	0.80	0.12	3.69	0.62	0.13	1.05
V	1	0.10	3.83	0.76	0.23	0.81	0.07	3.24	0.74	0.24	0.98	0.07	2.99	0.69	0.22	1.04
V	2	0.11	3.61	0.60	0.07	1.58	0.19	3.59	0.38	0.05	1.63	0.14	3.57	0.45	0.04	1.44
V	3	0.14	3.90	0.24	0.03	1.53	0.18	3.96	0.23	0.06	1.72	0.16	4.42	0.49	0.04	1.84
V	4	0.09	3.44	0.53	0.09	1.03	0.14	3.18	0.47	0.10	1.06	0.13	3.37	0.44	0.11	1.05
V	5	0.11	3.64	0.38	0.03	1.46	0.17	3.54	0.41	0.03	1.49	0.20	3.91	0.31	0.03	1.48
V	6	0.19	3.66	0.67	0.14	1.63	0.15	3.16	0.75	0.07	1.41	0.19	3.77	0.51	0.12	1.52
H+V	0	0.09	3.53	0.80	0.19	0.99	0.16	3.37	0.90	0.12	0.87	0.18	3.79	0.81	0.10	1.12
H+V	1	0.17	3.55	0.74	0.24	1.07	0.18	3.75	1.08	0.21	1.58	0.13	3.37	0.80	0.20	1.22
H+V	2	0.13	3.89	0.47	0.05	1.56	0.23	3.67	0.44	0.05	1.56	0.19	4.00	0.40	0.06	1.48
H+V	3	0.21	3.74	0.37	0.04	1.53	0.27	3.97	0.43	0.07	1.74	0.30	4.42	0.49	0.09	1.83
H+V	4	0.14	3.48	0.42	0.10	1.27	0.20	3.27	0.44	0.10	1.41	0.23	3.57	0.42	0.15	1.35
H+V	5	0.16	3.89	0.73	0.06	1.25	0.21	3.28	0.91	0.09	1.30	0.21	3.93	0.57	0.07	1.59
H+V	6	0.17	4.23	1.09	0.12	1.19	0.13	3.47	1.06	0.11	0.96	0.13	3.89	0.84	0.18	1.47

Pol	Beam ID	Simulated 4cm 2 SAPD (W/m 2) corresponding to PD_design_target														
		n261 Plane B sub-module														
		Low Channel					Mid Channel					High Channel				
		S1_2mm	S2_2mm	S3_2mm	S4_2mm	S5_2mm	S1_2mm	S2_2mm	S3_2mm	S4_2mm	S5_2mm	S1_2mm	S2_2mm	S3_2mm	S4_2mm	S5_2mm
H	0	0.16	4.39	1.29	0.06	0.46	0.14	3.65	1.07	0.08	0.39	0.13	3.05	0.82	0.09	0.55
H	1	0.15	4.17	1.23	0.04	0.89	0.14	3.90	1.13	0.04	0.89	0.13	3.54	1.00	0.04	0.92
H	2	0.08	4.42	0.32	0.03	1.96	0.08	4.36	0.25	0.03	1.96	0.08	4.27	0.21	0.02	1.99
H	3	0.13	4.16	0.09	0.03	2.08	0.13	4.17	0.08	0.03	2.05	0.13	4.19	0.11	0.03	2.08
H	4	0.14	4.05	1.05	0.02	1.49	0.14	3.99	1.04	0.02	1.51	0.14	3.83	0.98	0.03	1.46
H	5	0.08	3.48	0.16	0.11	1.54	0.08	3.80	0.18	0.10	1.75	0.09	4.09	0.21	0.10	1.98
H	6	0.09	2.89	0.21	0.23	1.26	0.10	2.89	0.23	0.22	1.25	0.10	3.10	0.25	0.22	1.27
V	0	0.13	3.17	0.78	0.07	1.26	0.14	3.21	0.77	0.07	1.27	0.13	3.24	0.81	0.06	1.34
V	1	0.07	3.89	1.10	0.07	1.95	0.06	4.05	1.16	0.07	2.00	0.06	4.18	1.17	0.07	2.02
V	2	0.08	3.46	0.10	0.08	1.62	0.09	3.51	0.10	0.08	1.67	0.11	3.60	0.13	0.07	1.75
V	3	0.08	3.60	0.23	0.06	2.14	0.11	3.67	0.25	0.07	2.02	0.16	3.54	0.27	0.06	1.87
V	4	0.05	4.33	0.40	0.05	2.49	0.05	4.42	0.32	0.07	2.47	0.08	4.24	0.25	0.07	2.31
V	5	0.16	3.67	0.11	0.17	1.11	0.13	3.86	0.11	0.21	1.10	0.11	3.91	0.10	0.20	1.30
V	6	0.09	3.70	0.16	0.35	0.86	0.10	3.81	0.14	0.41	0.81	0.11	3.78	0.17	0.40	0.92
H+V	0	0.18	3.95	1.21	0.09	1.02	0.18	3.85	1.21	0.09	1.09	0.17	3.79	1.06	0.09	1.21
H+V	1	0.14	4.36	1.48	0.07	1.79	0.13	4.06	1.50	0.07	1.75	0.11	3.76	1.39	0.07	1.69
H+V	2	0.10	3.76	0.25	0.07	2.15	0.11	3.90	0.25	0.06	2.16	0.14	3.97	0.24	0.06	2.08
H+V	3	0.15	3.95	0.20	0.06	2.53	0.18	3.93	0.24	0.06	2.36	0.23	4.02	0.24	0.06	2.15
H+V	4	0.11	4.41	0.74	0.06	2.11	0.10	4.34	0.67	0.07	2.13	0.13	4.07	0.63	0.08	2.01
H+V	5	0.15	3.95	0.15	0.19	1.77	0.12	4.11	0.14	0.19	1.81	0.11	4.42	0.17	0.19	2.10
H+V	6	0.12	4.23	0.24	0.39	1.66	0.13	4.34	0.21	0.39	1.59	0.12	4.42	0.22	0.40	1.63

3.9 PD characterization table

Since PD_design_target derivation in Section 3.4 already accounted for power control closed loop power control error, we can allow for this uncertainty in correlation (min) calculation before applying it for reference power level adjustment, i.e., Correlation (min)= 0 if | Correlation (min) | ≤ 1dB, Correlation (min)= Correlation (min) − 1, if Correlation (min) > 1dB and Correlation (min) = Correlation (min) + 1, if Correlation (min) < −1dB

Once PD characterization is completed, for each plane and frequency band in device design we expect to have the target EIRP levels that correspond to the PD_design_target. Plimit table will be entered via NV setting to enable the TAS algorithm Feature. PD tested at Plimit is illustrated in Part 1 report to demonstrate compliance.

In dual-polarization beam operation, the Plimit value is associated with to each of single polarization beam

The Plimit is derived and listed in the table below

Band	Antenna Module	Polarization	correction (dB)	TxAGC uncertainty (dB)	FR 2 Plimit (dBm)	Input power limit(dBm)	Implemented Input power limit (dBm)
n258	Plane B	H	**-3.51**	1	17 +10* log(PD design target /Max sim PD)-2.51	11.66	9.63
		V	**-2.13**	1	17 +10* log(PD design target /Max sim PD)-1.13	12.08	9.63
		H+V	**-1.23**	1	17 +10* log(PD design target /Max sim PD)-0.23	9.63	9.63
Band	Antenna Module	Polarization	correction (dB)	TxAGC uncertainty (dB)	FR 2 Plimit (dBm)	Input power limit(dBm)	Implemented Input power limit (dBm)
n260	Plane B	H	**1.12**	1	17 +10* log(PD design target /Max sim PD)+0.12	14.29	11.49
		V	**-1.12**	1	17 +10* log(PD design target /Max sim PD)-0.12	14.02	11.49
		H+V	**1.74**	1	17 +10* log(PD design target /Max sim PD)+0.74	11.49	11.49
Band	Antenna Module	Polarization	correction (dB)	TxAGC uncertainty (dB)	FR 2 Plimit (dBm)	Input power limit(dBm)	Implemented Input power limit (dBm)
n261	Plane B	H	**-0.83**	1	17 +10* log(PD design target /Max sim PD)	13.67	10.09
		V	**0.30**	1	17 +10* log(PD design target /Max sim PD)	13.44	10.09
		H+V	**0.88**	1	17 +10* log(PD design target /Max sim PD)	10.09	10.09

Band	mmWave module	Pol	Beam ID	Input power limit (dBm)
n258	B	H	0	9.63
n258	B	H	1	9.63
n258	B	H	2	9.63
n258	B	H	3	9.63
n258	B	H	4	9.63
n258	B	H	5	9.63
n258	B	H	6	9.63
n258	B	V	0	9.63
n258	B	V	1	9.63
n258	B	V	2	9.63
n258	B	V	3	9.63
n258	B	V	4	9.63
n258	B	V	5	9.63
n258	B	V	6	9.63
n258	B	H+V	0	9.63
n258	B	H+V	1	9.63
n258	B	H+V	2	9.63
n258	B	H+V	3	9.63
n258	B	H+V	4	9.63
n258	B	H+V	5	9.63
n258	B	H+V	6	9.63

Band	mmWave module	Pol	Beam ID	Input power limit (dBm)
n260	B	H	0	11.49
n260	B	H	1	11.49
n260	B	H	2	11.49
n260	B	H	3	11.49
n260	B	H	4	11.49
n260	B	H	5	11.49
n260	B	H	6	11.49
n260	B	V	0	11.49
n260	B	V	1	11.49
n260	B	V	2	11.49
n260	B	V	3	11.49
n260	B	V	4	11.49
n260	B	V	5	11.49
n260	B	V	6	11.49
n260	B	H+V	0	11.49
n260	B	H+V	1	11.49
n260	B	H+V	2	11.49
n260	B	H+V	3	11.49
n260	B	H+V	4	11.49
n260	B	H+V	5	11.49
n260	B	H+V	6	11.49

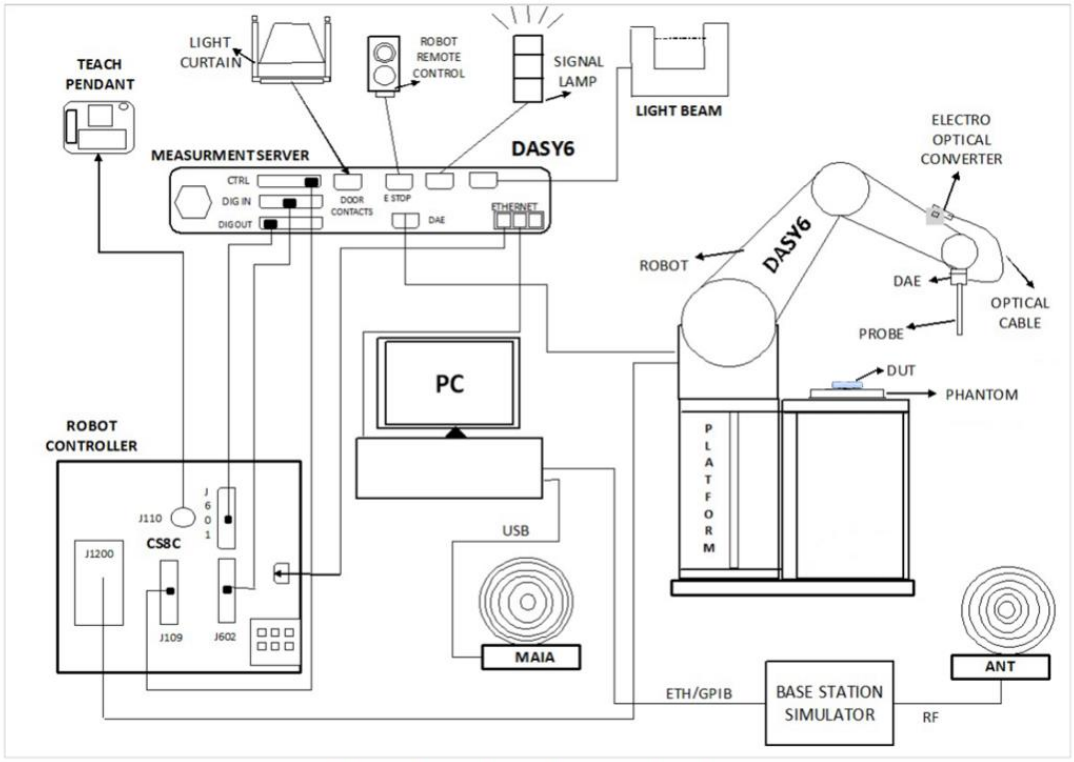
Band	mmWave module	Pol	Beam ID	Input power limit (dBm)
n261	B	H	0	10.09
n261	B	H	1	10.09
n261	B	H	2	10.09
n261	B	H	3	10.09
n261	B	H	4	10.09
n261	B	H	5	10.09
n261	B	H	6	10.09
n261	B	V	0	10.09
n261	B	V	1	10.09
n261	B	V	2	10.09
n261	B	V	3	10.09
n261	B	V	4	10.09
n261	B	V	5	10.09
n261	B	V	6	10.09
n261	B	H+V	0	10.09
n261	B	H+V	1	10.09
n261	B	H+V	2	10.09
n261	B	H+V	3	10.09
n261	B	H+V	4	10.09
n261	B	H+V	5	10.09
n261	B	H+V	6	10.09

4. PD Test Setup

4.1 PD Test – System Setup

The system to be used for the near field power density measurement

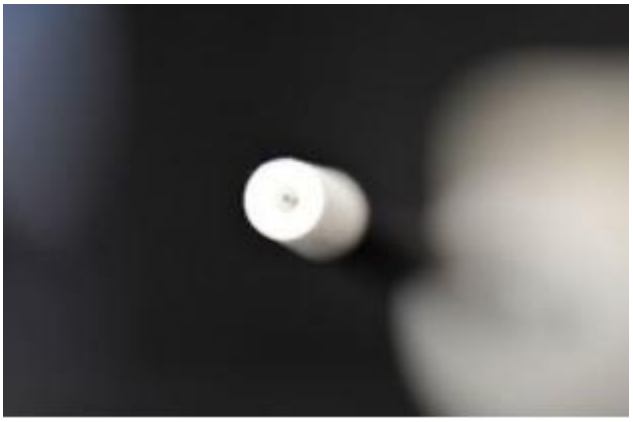
- SPEAG DASY6 system
  - SPEAG cDASY6 5G module software
  - EUmmWVx probe
- 5G Phantom cover

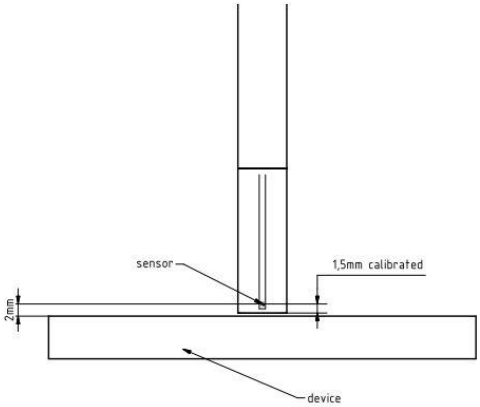


4.2 EUmmWave Probe / E-Field 5G Probe

The probe design allows measurements at distances as small as 2 mm from the sensors to the surface of the device under test (DUT). The typical sensor to probe tip distance is 1.5 mm.

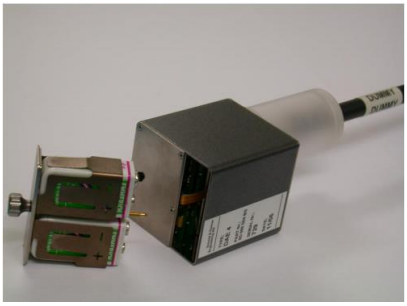
Frequency	750 MHz – 110 GHz
Probe Overall Length	320 mm
Probe Body Diameter	8.0 mm
Tip Length	23.0 mm
Tip Diameter	8.0 mm
Probe's two dipoles length	0.9 mm – Diode loaded
Dynamic Range	< 20 V/m - 10000 V/m with PRE-10 (min < 50 V/m - 3000 V/m)
Position Precision	< 0.2 mm
Distance between diode sensors and probe's tip	1.5 mm
Minimum Mechanical separation between probe tip and a Surface	0.5 mm
Applications	E-field measurements of 5G devices and other mm-wave transmitters operating above 10GHz in < 2 mm distance from device (free-space) Power density, H-field and far-field analysis using total field reconstruction.
Compatibility	cDASY6 + 5G-Module SW1.0 and higher





4.3 Data Acquisition Electronics (DAE)

The data acquisition electronics (DAE) consists 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 and 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.
The input impedance of the DAE is 200 MOhm; the inputs are symmetrical and floating. Common mode rejection is above 80 dB.



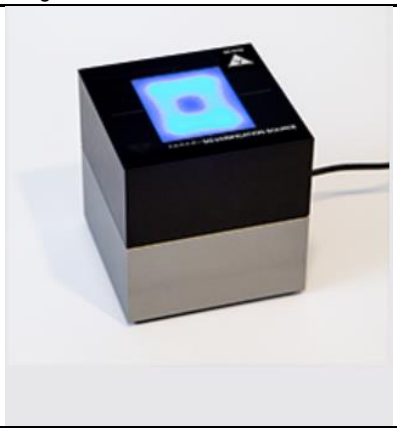
4.4 Scan configuration

Fine-resolution scans on 2 different planes are performed to reconstruct the E- and H-fields as well as the power density; the z-distance between the 2 planes is set to λ/4.
The (x, y) grid step is also set λ/4, the grid extent is set to sufficiently large to identify the field pattern and the peak.

4.5 System Verification Source

The System Verification sources at 30 GHz and above comprise horn-antennas and very stable signal generators.

Model	Ka-band horn antenna
Calibrated frequency:	30 GHz at 10mm from the case surface
Frequency accuracy	± 100 MHz
E-field polarization	linear
Harmonics	-20 dBc
Total radiated power	14 dBm
Power stability	0.05 dB
Power consumption	5 W
Size	00 x 100 x 100 mm
Weight	1 kg

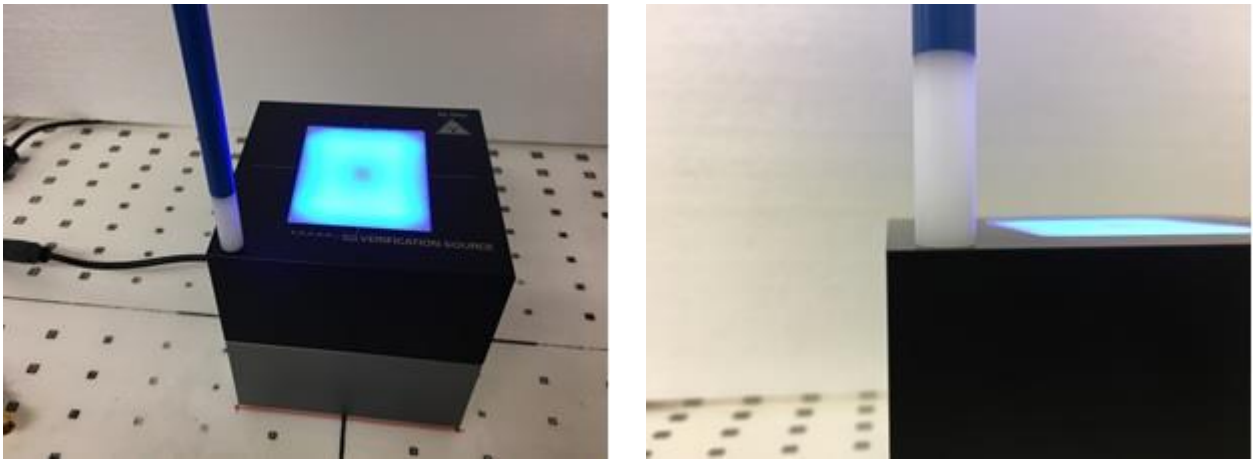


4.6 Power Density System Verification

The system performance check verifies that the system operates within its specifications.
The EUT is replaced by a calibrated source, the same spatial resolution, measurement region and the test separation used in the calibration was applied to system check. Through visual inspection into the measured power density distribution, both spatially (shape) and numerically (level) have no noticeable difference. The measured results should be within 0.66B of the calibrated targets.

Frequency [GHz]	Grid step	Grid extent X/Y [mm]	Measurement points
10	0.25 ($\frac{\lambda}{4}$)	120/120	16 × 16
30	0.25 ($\frac{\lambda}{4}$)	60/60	24 × 24
60	0.25 ($\frac{\lambda}{4}$)	32.5/32.5	26 × 26
90	0.25 ($\frac{\lambda}{4}$)	30/30	36 × 36

Settings for measurement of verification sources



Verification Setup photo

4.7 System Verification Results

Frequency (GHz)	5G Verification Source	Probe S/N	DAE S/N	Distance (mm)	Measured 4 cm^2 (W/m^2)	Targeted 4 cm^2 (W/m^2)	Deviation (dB)	Test Site	Date
30G	30GHz_1007	9441	661	5.55	41.2	42	-0.08	SAR17	2024/12/28
30G	30GHz_1007	9441	661	5.55	40.9	42	-0.12	SAR17	2025/1/10

5. Uncertainty Assessment

The budget is valid for evaluation distances > λ/2π. For specific tests and configurations, the Uncertainty could be considerably smaller.

Preliminary Module mmWave Uncertainty Budget Evaluation Distances to the Antennas > λ / 2π						
Error Description	**Uncertainty Value (± dB)**	**Probability**	**Divisor**	**(Ci)**	**Standard Uncertainty (±dB)**	**(Vi) Veff**
Measurement System						
Probe Calibration	0.49	N	1	1	0.49	∞
Hemispherical Isotropy	0.50	R	1.732	1	0.29	∞
Linearity	0.20	R	1.732	0	0.12	∞
System Detection Limits	0.04	R	1.732	1	0.02	∞
Modulation Response	0.40	R	1.732	1	0.23	∞
Readout Electronics	0.03	N	1	1	0.03	∞
Response Time	0.00	R	1.732	1	0.00	∞
Integration Time	0.00	R	1.732	1	0.00	∞
RF Ambient Noise	0.2	R	1.732	1	0.12	∞
RF Ambient Reflections	0.21	R	1.732	1	0.12	∞
Probe Positioner	0.04	R	1.732	1	0.02	∞
Probe Positioning	0.30	R	1.732	1	0.17	∞
Savg Reconstruction	0.60	R	1.732	1	0.35	∞
Test Sample Related						
Power Drift	0.2	R	1.732	1	0.12	∞
Input Power	0	N	1	0	0.00	∞
Combined Std. Uncertainty					0.76 dB	∞
Coverage Factor for 95 %					K=2	
Expanded STD Uncertainty					1.52 dB	