Appendix G. – Dipole Calibration Data

Calibration Laboratory of
Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

ilac-MRA

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Accreditation No.: SCS 0108

Client **HCT (Dymstec)** Certificate No: **D750V3-1014_May20**

CALIBRATION CERTIFICATE

Object	D750V3 - SN:1014
Calibration procedure(s)	QA CAL-05.v11 Calibration Procedure for SAR Validation Sources between 0.7-3 GHz
Calibration date:	May 19, 2020

결재	담당자	확인자
	(signature)	(signature)
직위/성명	SW / 김경석	QT / 권윤희
일자	2020 / 6.16.	2020 / 6.16

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	01-Apr-20 (No. 217-03100/03101)	Apr-21
Power sensor NRP-Z91	SN: 103244	01-Apr-20 (No. 217-03100)	Apr-21
Power sensor NRP-Z91	SN: 103245	01-Apr-20 (No. 217-03101)	Apr-21
Reference 20 dB Attenuator	SN: BH9394 (20k)	31-Mar-20 (No. 217-03106)	Apr-21
Type-N mismatch combination	SN: 310982 / 06327	31-Mar-20 (No. 217-03104)	Apr-21
Reference Probe EX3DV4	SN: 7349	31-Dec-19 (No. EX3-7349_Dec19)	Dec-20
DAE4	SN: 601	27-Dec-19 (No. DAE4-601_Dec19)	Dec-20

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB39512475	30-Oct-14 (in house check Feb-19)	In house check: Oct-20
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-18)	In house check: Oct-20
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-19)	In house check: Oct-20

	Name	Function	Signature
Calibrated by:	Jeffrey Katzman	Laboratory Technician	(signature)
Approved by:	Katja Pokovic	Technical Manager	(signature)

Issued: May 22, 2020

Calibration Laboratory of
Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

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S Swiss Calibration Service

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The Swiss Accreditation Service is one of the signatories to the EA
Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 0108

Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORM x,y,z
N/A	not applicable or not measured

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

- *Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- *Antenna Parameters with TSL:* The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- *Feed Point Impedance and Return Loss:* These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- *Electrical Delay:* One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- *SAR measured:* SAR measured at the stated antenna input power.
- *SAR normalized:* SAR as measured, normalized to an input power of 1 W at the antenna connector.
- *SAR for nominal TSL parameters:* The measured TSL parameters are used to calculate the nominal SAR result.

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

Measurement Conditions

DASY system configuration, as far as not given on page 1.

DASY Version	DASY5	V52.10.4
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	750 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	41.9	0.89 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	42.1 ± 6 %	0.91 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.13 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**8.39 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.40 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**5.53 W/kg ± 16.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.9 Ω + 3.0 jΩ
Return Loss	- 26.5 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.041 ns

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG

DASY5 Validation Report for Head TSL

Date: 19.05.2020

Test Laboratory: SPEAG, Zurich, Switzerland

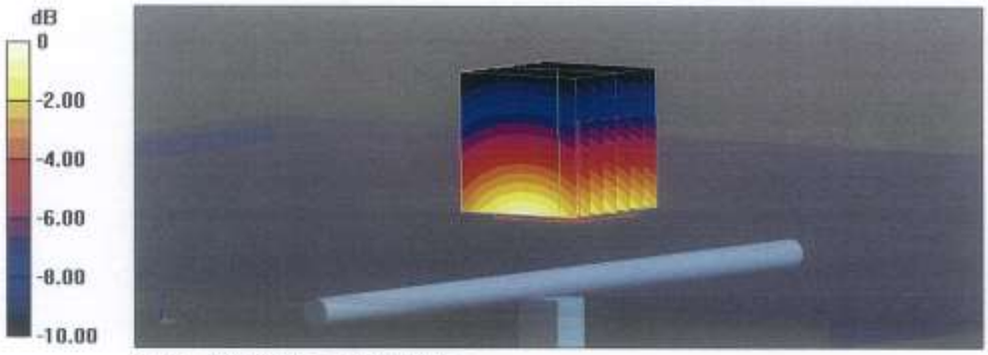
DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1014

Communication System: UID 0 - CW; Frequency: 750 MHz
Medium parameters used: f = 750 MHz; σ = 0.91 S/m; ε_r = 42.1; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(10.07, 10.07, 10.07) @ 750 MHz; Calibrated: 31.12.2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.12.2019
- Phantom: Flat Phantom 4.9 (front); Type: QD 00L P49 AA; Serial: 1001
- DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

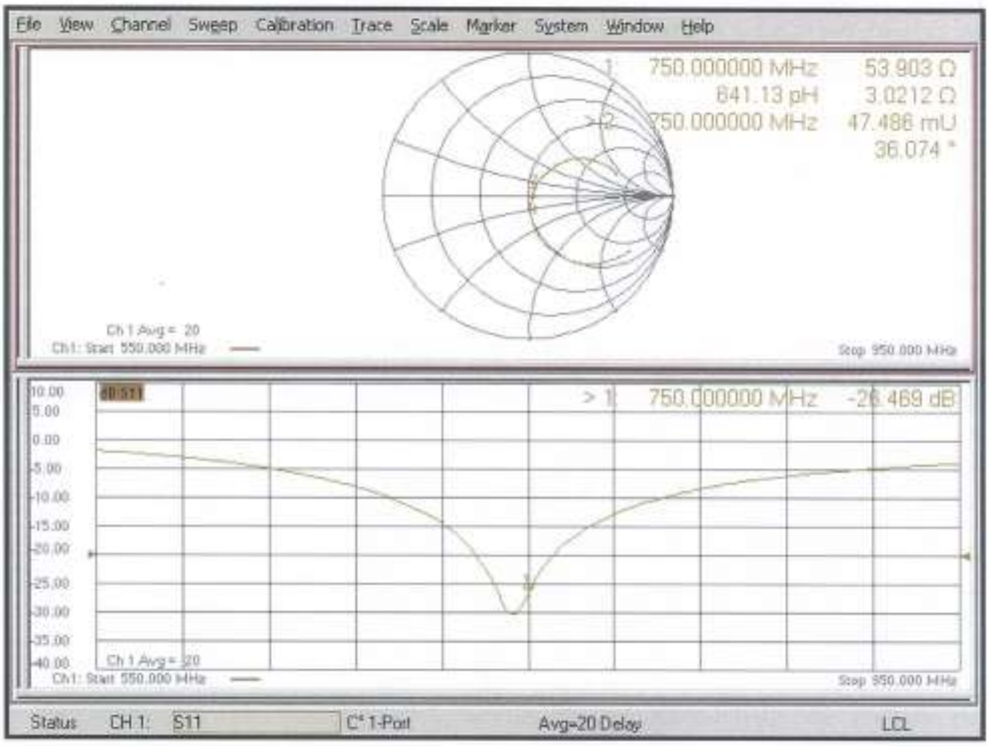
Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 58.88 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 3.18 W/kg
SAR(1 g) = 2.13 W/kg; SAR(10 g) = 1.40 W/kg
Smallest distance from peaks to all points 3 dB below = 18.4 mm
Ratio of SAR at M2 to SAR at M1 = 67.1%
Maximum value of SAR (measured) = 2.81 W/kg



0 dB = 2.81 W/kg = 4.49 dBW/kg

Certificate No: D750V3-1014_May20 Page 5 of 6

Impedance Measurement Plot for Head TSL



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Accreditation No.: **SCS 0108**

Client **HCT (Dymstec)** Certificate No: **D835V2-4d266_Aug20**

CALIBRATION CERTIFICATE

결재	담당자	확인자
이름	박상훈	박정남
일자	2020 / 10. 6	2020 / 10. 6

Object	D835V2 - SN:4d266
Calibration procedure(s)	QA CAL-05.v11 Calibration Procedure for SAR Validation Sources between 0.7-3 GHz
Calibration date:	August 27, 2020

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	01-Apr-20 (No. 217-03100/03101)	Apr-21
Power sensor NRP-Z91	SN: 103244	01-Apr-20 (No. 217-03100)	Apr-21
Power sensor NRP-Z91	SN: 103245	01-Apr-20 (No. 217-03101)	Apr-21
Reference 20 dB Attenuator	SN: BH9394 (20k)	31-Mar-20 (No. 217-03106)	Apr-21
Type-N mismatch combination	SN: 310982 / 06327	31-Mar-20 (No. 217-03104)	Apr-21
Reference Probe EX3DV4	SN: 7349	29-Jun-20 (No. EX3-7349_Jun20)	Jun-21
DAE4	SN: 601	27-Dec-19 (No. DAE4-601_Dec19)	Dec-20

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB39512475	30-Oct-14 (in house check Feb-19)	In house check: Oct-20
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-18)	In house check: Oct-20
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-19)	In house check: Oct-20

	Name	Function	Signature
Calibrated by:	Jeffrey Katzman	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: August 28, 2020

Certificate No: D835V2-4d266_Aug20 Page 1 of 7

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Zeughausstrasse 43, 8004 Zurich, Switzerland

Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORM x,y,z
N/A	not applicable or not measured

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

- *Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- *Antenna Parameters with TSL:* The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- *Feed Point Impedance and Return Loss:* These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- *Electrical Delay:* One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- *SAR measured:* SAR measured at the stated antenna input power.
- *SAR normalized:* SAR as measured, normalized to an input power of 1 W at the antenna connector.
- *SAR for nominal TSL parameters:* The measured TSL parameters are used to calculate the nominal SAR result.

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

Measurement Conditions

DASY system configuration, as far as not given on page 1.

DASY Version	DASY5	V52.10.4
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	835 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	42.2 ± 6 %	0.93 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.41 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**9.44 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.56 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**6.13 W/kg ± 16.5 % (k=2)**

Certificate No: D835V2-4d266_Aug20 Page 3 of 7

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	50.2 Ω - 2.4 jΩ
Return Loss	- 32.5 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.389 ns

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG

DASY5 Validation Report for Head TSL

Date: 27.08.2020

Test Laboratory: SPEAG, Zurich, Switzerland

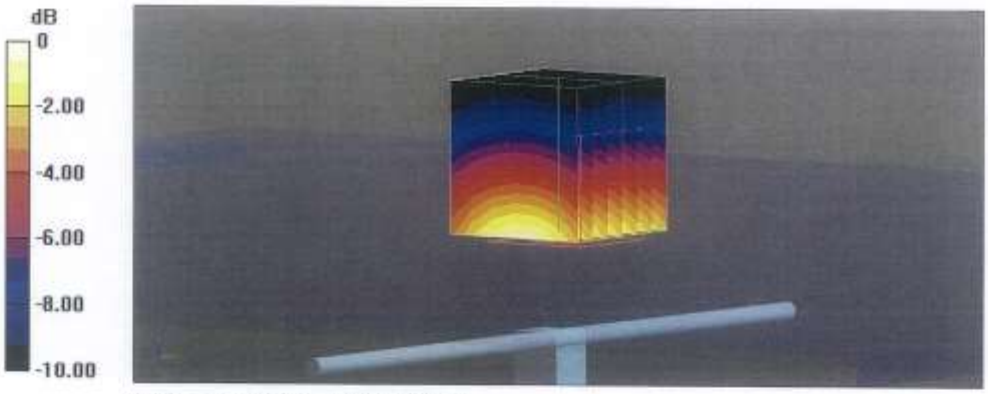
DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d266

Communication System: UID 0 - CW; Frequency: 835 MHz
Medium parameters used: f = 835 MHz; σ = 0.93 S/m; ε_r = 42.2; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

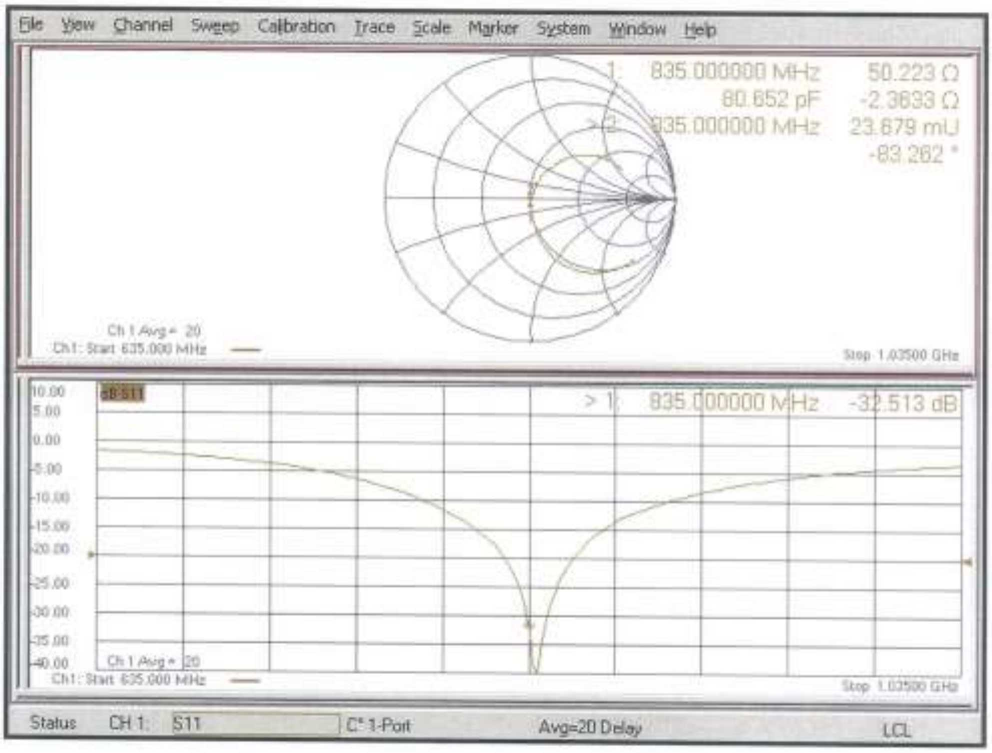
- Probe: EX3DV4 - SN7349; ConvF(9.69, 9.69, 9.69) @ 835 MHz; Calibrated: 29.06.2020
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.12.2019
- Phantom: Flat Phantom 4.9 (front); Type: QD 00L P49 AA; Serial: 1001
- DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 62.47 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 3.57 W/kg
SAR(1 g) = 2.41 W/kg; SAR(10 g) = 1.56 W/kg
Smallest distance from peaks to all points 3 dB below = 16 mm
Ratio of SAR at M2 to SAR at M1 = 67.2%
Maximum value of SAR (measured) = 3.19 W/kg



0 dB = 3.19 W/kg = 5.04 dBW/kg

Impedance Measurement Plot for Head TSL



Certificate No: D835V2-4d266_Aug20 Page 6 of 7

Appendix: Transfer Calibration at Four Validation Locations on SAM Head[1]

Evaluation Condition

Phantom	SAM Head Phantom	For usage with cSAR3DV2-R/L

SAR result with SAM Head (Top ≅ C0)

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR for nominal Head TSL parameters	normalized to 1W	8.97 W/kg ± 17.5 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR for nominal Head TSL parameters	normalized to 1W	5.93 W/kg ± 16.9 % (k=2)

SAR result with SAM Head (Mouth ≅ F90)

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR for nominal Head TSL parameters	normalized to 1W	9.42 W/kg ± 17.5 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR for nominal Head TSL parameters	normalized to 1W	6.31 W/kg ± 16.9 % (k=2)

SAR result with SAM Head (Neck ≅ H0)

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR for nominal Head TSL parameters	normalized to 1W	8.95 W/kg ± 17.5 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR for nominal Head TSL parameters	normalized to 1W	6.03 W/kg ± 16.9 % (k=2)

SAR result with SAM Head (Ear ≅ D90)

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR for nominal Head TSL parameters	normalized to 1W	7.69 W/kg ± 17.5 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR for nominal Head TSL parameters	normalized to 1W	5.17 W/kg ± 16.9 % (k=2)

[1] Additional assessments outside the current scope of SCS 0108

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Accreditation No.: **SCS 0108**

Client **HCT (Dymstec)**

Certificate No: **D1800V2-2d007_Aug20**

CALIBRATION CERTIFICATE

결재	담당자	확인자
이메일		
일자	2020 / 10. 6	2020 / 10. 6

Object: D1800V2 - SN:2d007

Calibration procedure(s): QA CAL-05.v11
Calibration Procedure for SAR Validation Sources between 0.7-3 GHz

Calibration date: August 26, 2020

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	01-Apr-20 (No. 217-03100/03101)	Apr-21
Power sensor NRP-Z91	SN: 103244	01-Apr-20 (No. 217-03100)	Apr-21
Power sensor NRP-Z91	SN: 103245	01-Apr-20 (No. 217-03101)	Apr-21
Reference 20 dB Attenuator	SN: BH9394 (20k)	31-Mar-20 (No. 217-03106)	Apr-21
Type-N mismatch combination	SN: 310982 / 06327	31-Mar-20 (No. 217-03104)	Apr-21
Reference Probe EX3DV4	SN: 7349	29-Jun-20 (No. EX3-7349_Jun20)	Jun-21
DAE4	SN: 601	27-Dec-19 (No. DAE4-601_Dec19)	Dec-20

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB39512475	30-Oct-14 (in house check Feb-19)	In house check: Oct-20
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-18)	In house check: Oct-20
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-19)	In house check: Oct-20

	Name	Function	Signature
Calibrated by:	Leif Klysner	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: August 27, 2020

This calibration certificate shall not be reproduced except in full without written approval of the laboratory.

Certificate No: D1800V2-2d007_Aug20 Page 1 of 6

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Engineering AG
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Accredited by the Swiss Accreditation Service (SAS)
The Swiss Accreditation Service is one of the signatories to the EA
Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORM x,y,z
N/A	not applicable or not measured

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

- *Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- *Antenna Parameters with TSL:* The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- *Feed Point Impedance and Return Loss:* These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- *Electrical Delay:* One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- *SAR measured:* SAR measured at the stated antenna input power.
- *SAR normalized:* SAR as measured, normalized to an input power of 1 W at the antenna connector.
- *SAR for nominal TSL parameters:* The measured TSL parameters are used to calculate the nominal SAR result.

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

Measurement Conditions

DASY system configuration, as far as not given on page 1.

DASY Version	DASY5	V52.10.4
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1800 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	40.4 ± 6 %	1.38 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.43 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**38.1 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	4.90 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**19.7 W/kg ± 16.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	46.2 Ω - 7.7 jΩ
Return Loss	- 21.0 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.204 ns

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG

DASY5 Validation Report for Head TSL

Date: 26.08.2020

Test Laboratory: SPEAG, Zurich, Switzerland

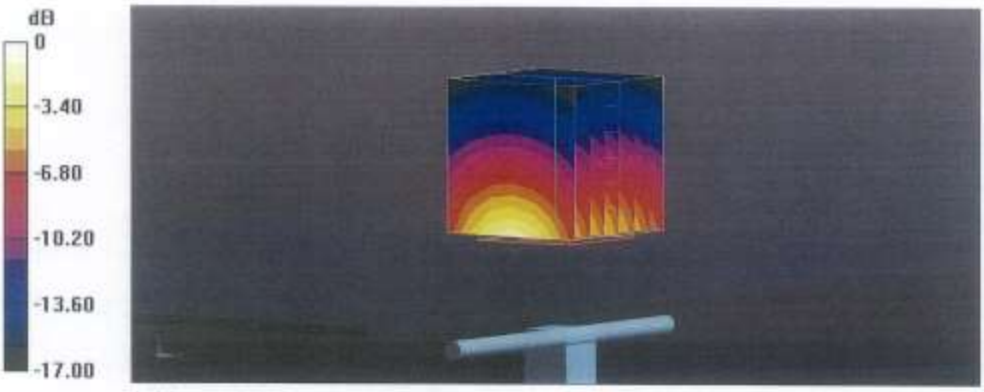
DUT: Dipole 1800 MHz; Type: D1800V2; Serial: D1800V2 - SN:2d007

Communication System: UID 0 - CW; Frequency: 1800 MHz
Medium parameters used: f = 1800 MHz; σ = 1.38 S/m; ε_r = 40.4; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

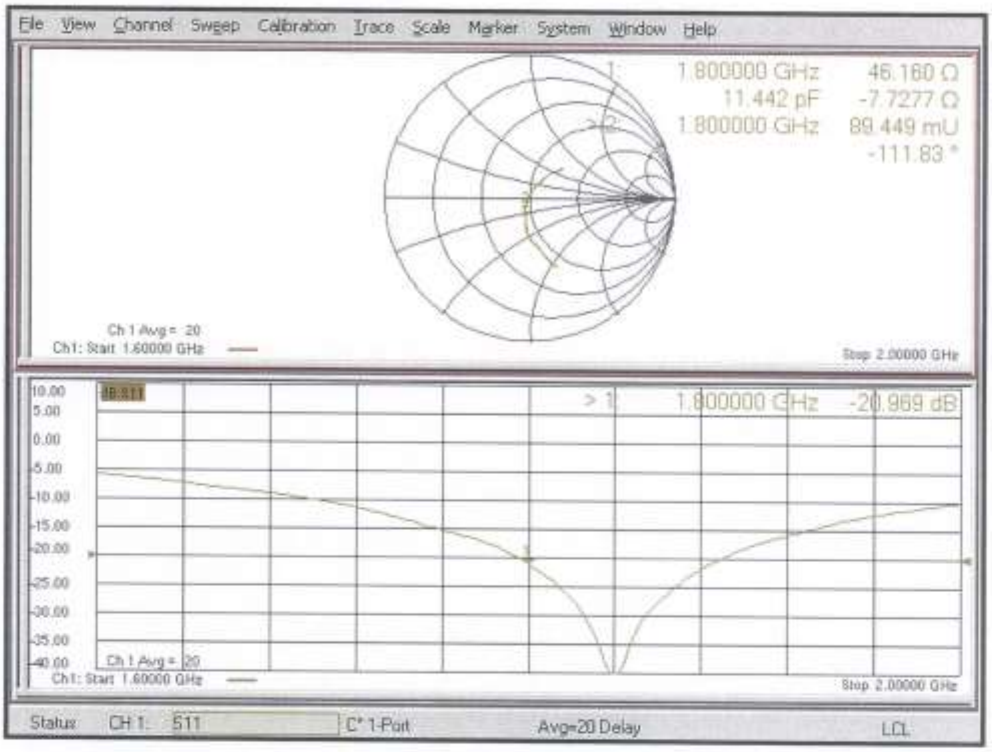
- Probe: EX3DV4 - SN7349; ConvF(8.38, 8.38, 8.38) @ 1800 MHz; Calibrated: 29.06.2020
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.12.2019
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 106.8 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 17.7 W/kg
SAR(1 g) = 9.43 W/kg; SAR(10 g) = 4.9 W/kg
Smallest distance from peaks to all points 3 dB below = 10 mm
Ratio of SAR at M2 to SAR at M1 = 53.8%
Maximum value of SAR (measured) = 14.7 W/kg



0 dB = 14.7 W/kg = 11.68 dBW/kg

Impedance Measurement Plot for Head TSL



Certificate No: D1800V2-2d007_Aug20 Page 6 of 6

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Accreditation No.: **SCS 0108**

Client **HCT (Dymstec)**

Certificate No: **D1900V2-5d032_Jan21**

CALIBRATION CERTIFICATE

결재	담당자	확인자
	2021. 02. 26	2021. 02. 08

Object	D1900V2 - SN:5d032
Calibration procedure(s)	QA CAL-05.v11 Calibration Procedure for SAR Validation Sources between 0.7-3 GHz
Calibration date:	January 28, 2021

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	01-Apr-20 (No. 217-03100/03101)	Apr-21
Power sensor NRP-Z91	SN: 103244	01-Apr-20 (No. 217-03100)	Apr-21
Power sensor NRP-Z91	SN: 103245	01-Apr-20 (No. 217-03101)	Apr-21
Reference 20 dB Attenuator	SN: BH9394 (20k)	31-Mar-20 (No. 217-03106)	Apr-21
Type-N mismatch combination	SN: 310982 / 06327	31-Mar-20 (No. 217-03104)	Apr-21
Reference Probe EX3DV4	SN: 7349	28-Dec-20 (No. EX3-7349_Dec20)	Dec-21
DAE4	SN: 601	02-Nov-20 (No. DAE4-601_Nov20)	Nov-21

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB39512475	30-Oct-14 (in house check Oct-20)	In house check: Oct-22
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-20)	In house check: Oct-22
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-20)	In house check: Oct-22
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-20)	In house check: Oct-22
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-20)	In house check: Oct-21

	Name	Function	Signature
Calibrated by:	Claudio Leubler	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: January 28, 2021

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Certificate No: D1900V2-5d032_Jan21 Page 1 of 6

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Accreditation No.: **SCS 0108**

Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORM x,y,z
N/A	not applicable or not measured

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

- *Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- *Antenna Parameters with TSL:* The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- *Feed Point Impedance and Return Loss:* These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- *Electrical Delay:* One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- *SAR measured:* SAR measured at the stated antenna input power.
- *SAR normalized:* SAR as measured, normalized to an input power of 1 W at the antenna connector.
- *SAR for nominal TSL parameters:* The measured TSL parameters are used to calculate the nominal SAR result.

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

Measurement Conditions

DASY system configuration, as far as not given on page 1.

DASY Version	DASY5	V52.10.4
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1900 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	41.2 ± 6 %	1.39 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.89 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**40.0 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.17 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**20.8 W/kg ± 16.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.4 Ω + 7.4 jΩ
Return Loss	- 22.6 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.203 ns

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG

DASY5 Validation Report for Head TSL

Date: 28.01.2021

Test Laboratory: SPEAG, Zurich, Switzerland

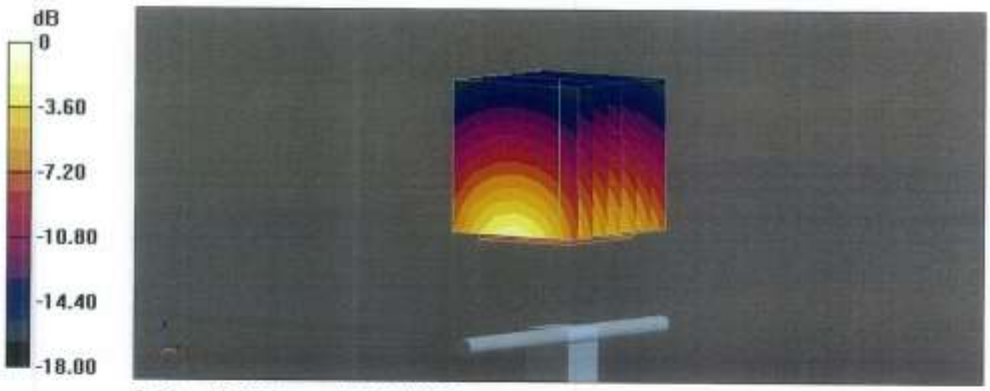
DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d032

Communication System: UID 0 - CW; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; σ = 1.39 S/m; ε_r = 41.2; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.43, 8.43, 8.43) @ 1900 MHz; Calibrated: 28.12.2020
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 02.11.2020
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

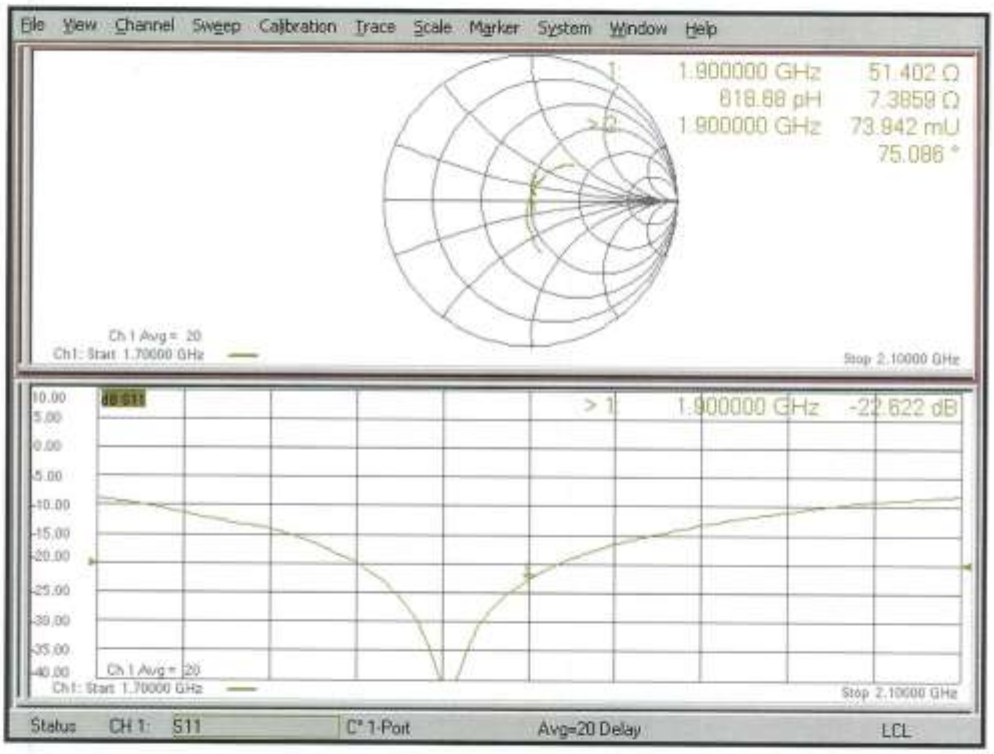
Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 109.8 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 18.2 W/kg
SAR(1 g) = 9.89 W/kg; SAR(10 g) = 5.17 W/kg
Smallest distance from peaks to all points 3 dB below = 9.5 mm
Ratio of SAR at M2 to SAR at M1 = 54.9%
Maximum value of SAR (measured) = 15.3 W/kg



0 dB = 15.3 W/kg = 11.85 dBW/kg

Certificate No: D1900V2-5d032_Jan21 Page 5 of 6

Impedance Measurement Plot for Head TSL



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Accreditation No.: **SCS 0108**

Client **HCT (Dymstec)** Certificate No: **D2450V2-1049_Aug20**

CALIBRATION CERTIFICATE

결재	담당자	확인자
	(signature)	(signature)
부서/성명	SW / 박재호	SW / 박재호
일자	2020 / 10.6	2020 / 10.6

Object: D2450V2 - SN:1049

Calibration procedure(s): QA CAL-05.v11
Calibration Procedure for SAR Validation Sources between 0.7-3 GHz

Calibration date: August 26, 2020

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	01-Apr-20 (No. 217-03100/03101)	Apr-21
Power sensor NRP-Z91	SN: 103244	01-Apr-20 (No. 217-03100)	Apr-21
Power sensor NRP-Z91	SN: 103245	01-Apr-20 (No. 217-03101)	Apr-21
Reference 20 dB Attenuator	SN: BH9394 (20k)	31-Mar-20 (No. 217-03106)	Apr-21
Type-N mismatch combination	SN: 310982 / 06327	31-Mar-20 (No. 217-03104)	Apr-21
Reference Probe EX3DV4	SN: 7349	29-Jun-20 (No. EX3-7349_Jun20)	Jun-21
DAE4	SN: 601	27-Dec-19 (No. DAE4-601_Dec19)	Dec-20

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB39512475	30-Oct-14 (in house check Feb-19)	In house check: Oct-20
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-18)	In house check: Oct-20
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-19)	In house check: Oct-20

	Name	Function	Signature
Calibrated by:	Leif Klysner	Laboratory Technician	(signature)
Approved by:	Katja Pokovic	Technical Manager	(signature)

Issued: August 31, 2020

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Certificate No: D2450V2-1049_Aug20 Page 1 of 7

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Accreditation No.: **SCS 0108**

Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORM x,y,z
N/A	not applicable or not measured

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

- *Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- *Antenna Parameters with TSL:* The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- *Feed Point Impedance and Return Loss:* These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- *Electrical Delay:* One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- *SAR measured:* SAR measured at the stated antenna input power.
- *SAR normalized:* SAR as measured, normalized to an input power of 1 W at the antenna connector.
- *SAR for nominal TSL parameters:* The measured TSL parameters are used to calculate the nominal SAR result.

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

Measurement Conditions

DASY system configuration, as far as not given on page 1.

DASY Version	DASY5	V52.10.4
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	38.9 ± 6 %	1.84 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.0 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**51.4 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.06 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**24.1 W/kg ± 16.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	49.5 Ω + 8.5 jΩ
Return Loss	- 21.4 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.161 ns

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG

DASY5 Validation Report for Head TSL

Date: 26.08.2020

Test Laboratory: SPEAG, Zurich, Switzerland

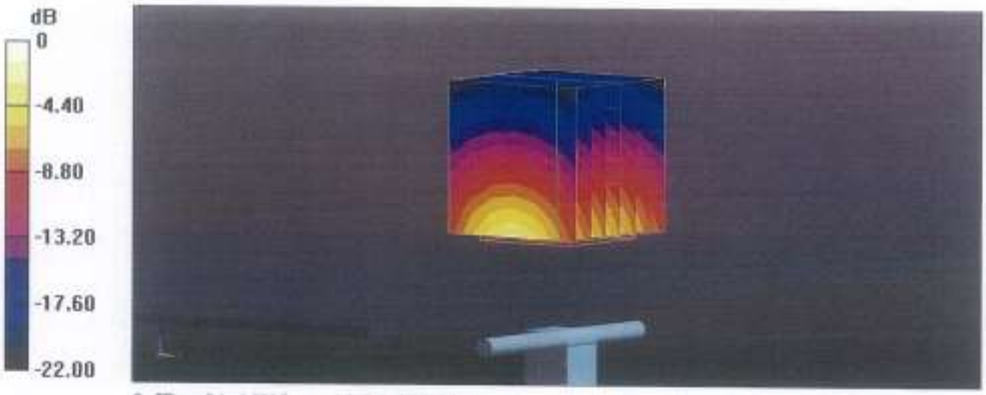
DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:1049

Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 1.84 S/m; ε_r = 38.9; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(7.74, 7.74, 7.74) @ 2450 MHz; Calibrated: 29.06.2020
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.12.2019
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

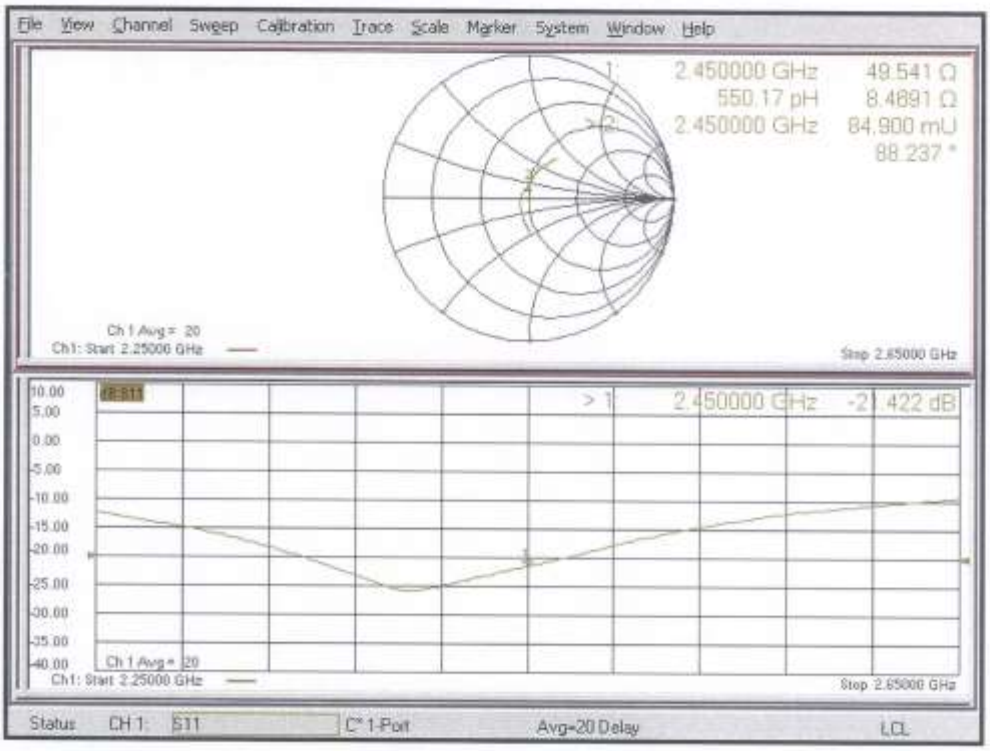
Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 115.7 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 25.5 W/kg
SAR(1 g) = 13 W/kg; SAR(10 g) = 6.06 W/kg
Smallest distance from peaks to all points 3 dB below = 9 mm
Ratio of SAR at M2 to SAR at M1 = 51.3%
Maximum value of SAR (measured) = 21.4 W/kg



0 dB = 21.4 W/kg = 13.30 dBW/kg

Certificate No: D2450V2-1049_Aug20 Page 5 of 7

Impedance Measurement Plot for Head TSL



Appendix: Transfer Calibration at Four Validation Locations on SAM Head[1]

Evaluation Condition

Phantom	SAM Head Phantom	For usage with cSAR3DV2-R/L

SAR result with SAM Head (Top ≅ C0)

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR for nominal Head TSL parameters	normalized to 1W	**54.8 W/kg ± 17.5 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR for nominal Head TSL parameters	normalized to 1W	**25.6 W/kg ± 16.9 % (k=2)**

SAR result with SAM Head (Mouth ≅ F90)

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR for nominal Head TSL parameters	normalized to 1W	**55.9 W/kg ± 17.5 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR for nominal Head TSL parameters	normalized to 1W	**26.9 W/kg ± 16.9 % (k=2)**

SAR result with SAM Head (Neck ≅ H0)

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR for nominal Head TSL parameters	normalized to 1W	**52.6 W/kg ± 17.5 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR for nominal Head TSL parameters	normalized to 1W	**24.5 W/kg ± 16.9 % (k=2)**

SAR result with SAM Head (Ear ≅ D90)

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR for nominal Head TSL parameters	normalized to 1W	**33.7 W/kg ± 17.5 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR for nominal Head TSL parameters	normalized to 1W	**17.1 W/kg ± 16.9 % (k=2)**

[1] Additional assessments outside the current scope of SCS 0108

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Accreditation No.: **SCS 0108**

Client **HCT (Dymstec)**

Certificate No: **D2600V2-1015_Aug20**

CALIBRATION CERTIFICATE

결재	담당자	확인자
직위/성명		
일자	2020 / 10. 6	2020 / 10. 6

Object	D2600V2 - SN:1015
Calibration procedure(s)	QA CAL-05.v11 Calibration Procedure for SAR Validation Sources between 0.7-3 GHz
Calibration date:	August 26, 2020

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	01-Apr-20 (No. 217-03100/03101)	Apr-21
Power sensor NRP-Z91	SN: 103244	01-Apr-20 (No. 217-03100)	Apr-21
Power sensor NRP-Z91	SN: 103245	01-Apr-20 (No. 217-03101)	Apr-21
Reference 20 dB Attenuator	SN: BH9394 (20k)	31-Mar-20 (No. 217-03106)	Apr-21
Type-N mismatch combination	SN: 310982 / 06327	31-Mar-20 (No. 217-03104)	Apr-21
Reference Probe EX3DV4	SN: 7349	29-Jun-20 (No. EX3-7349_Jun20)	Jun-21
DAE4	SN: 601	27-Dec-19 (No. DAE4-601_Dec19)	Dec-20

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB39512475	30-Oct-14 (in house check Feb-19)	In house check: Oct-20
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-18)	In house check: Oct-20
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-19)	In house check: Oct-20

	Name	Function	Signature
Calibrated by:	Leif Klysner	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: August 27, 2020

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Certificate No: D2600V2-1015_Aug20 Page 1 of 6

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Accreditation No.: **SCS 0108**

Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORM x,y,z
N/A	not applicable or not measured

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

- *Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- *Antenna Parameters with TSL:* The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- *Feed Point Impedance and Return Loss:* These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- *Electrical Delay:* One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- *SAR measured:* SAR measured at the stated antenna input power.
- *SAR normalized:* SAR as measured, normalized to an input power of 1 W at the antenna connector.
- *SAR for nominal TSL parameters:* The measured TSL parameters are used to calculate the nominal SAR result.

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

Measurement Conditions

DASY system configuration, as far as not given on page 1.

DASY Version	DASY5	V52.10.4
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2600 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.0	1.96 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	38.3 ± 6 %	2.01 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	14.4 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**56.7 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.42 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**25.4 W/kg ± 16.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	49.1 Ω - 4.0 jΩ
Return Loss	- 27.7 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.150 ns

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG

DASY5 Validation Report for Head TSL

Date: 26.08.2020

Test Laboratory: SPEAG, Zurich, Switzerland

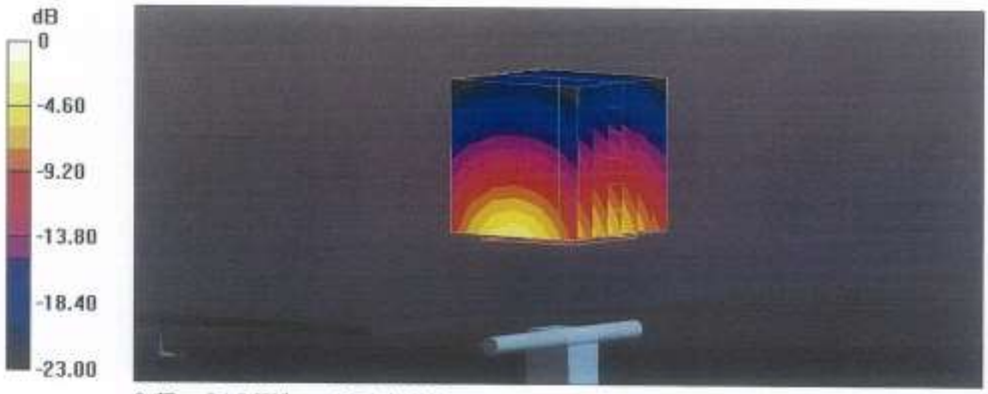
DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN:1015

Communication System: UID 0 - CW; Frequency: 2600 MHz
Medium parameters used: f = 2600 MHz; σ = 2.01 S/m; ε_r = 38.3; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

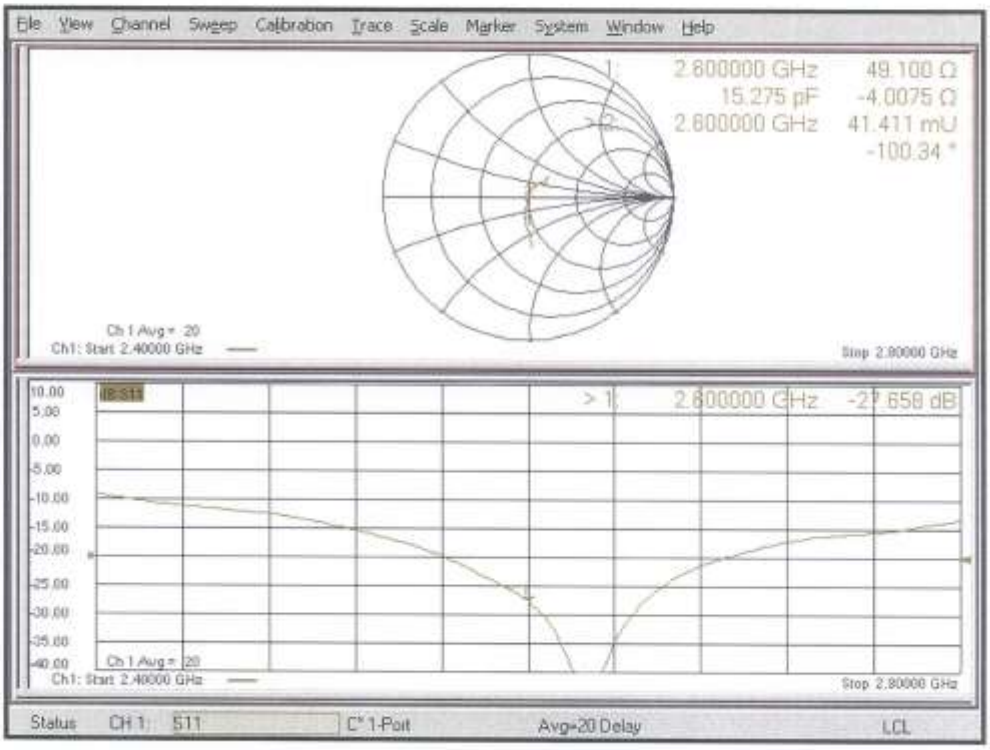
- Probe: EX3DV4 - SN7349; ConvF(7.54, 7.54, 7.54) @ 2600 MHz; Calibrated: 29.06.2020
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.12.2019
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 117.6 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 28.6 W/kg
SAR(1 g) = 14.4 W/kg; SAR(10 g) = 6.42 W/kg
Smallest distance from peaks to all points 3 dB below = 9 mm
Ratio of SAR at M2 to SAR at M1 = 50.2%
Maximum value of SAR (measured) = 24.0 W/kg



0 dB = 24.0 W/kg = 13.8 dBW/kg

Impedance Measurement Plot for Head TSL



Certificate No: D2600V2-1015_Aug20 Page 6 of 6

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Accreditation No.: **SCS 0108**

Client **HCT (Dymstec)**

Certificate No: **D5GHzV2-1253_Aug20**

CALIBRATION CERTIFICATE

결재	담당자	확인자
이름/성명	SW / 박서영	김 / 남궁
일자	2020 / 10. 6	2020 / 10. 6

Object	D5GHzV2 - SN:1253
Calibration procedure(s)	QA CAL-22.v5 Calibration Procedure for SAR Validation Sources between 3-10 GHz
Calibration date:	August 31, 2020

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	01-Apr-20 (No. 217-03100/03101)	Apr-21
Power sensor NRP-Z91	SN: 103244	01-Apr-20 (No. 217-03100)	Apr-21
Power sensor NRP-Z91	SN: 103245	01-Apr-20 (No. 217-03101)	Apr-21
Reference 20 dB Attenuator	SN: BH9394 (20k)	31-Mar-20 (No. 217-03106)	Apr-21
Type-N mismatch combination	SN: 310982 / 06327	31-Mar-20 (No. 217-03104)	Apr-21
Reference Probe EX3DV4	SN: 3503	31-Dec-19 (No. EX3-3503_Dec19)	Dec-20
DAE4	SN: 601	27-Dec-19 (No. DAE4-601_Dec19)	Dec-20

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB39512475	30-Oct-14 (in house check Feb-19)	In house check: Oct-20
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-18)	In house check: Oct-20
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-19)	In house check: Oct-20

	Name	Function	Signature
Calibrated by:	Jeton Kastrati	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: August 31, 2020

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Accreditation No.: **SCS 0108**

Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORM x,y,z
N/A	not applicable or not measured

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

- *Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- *Antenna Parameters with TSL:* The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- *Feed Point Impedance and Return Loss:* These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- *Electrical Delay:* One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- *SAR measured:* SAR measured at the stated antenna input power.
- *SAR normalized:* SAR as measured, normalized to an input power of 1 W at the antenna connector.
- *SAR for nominal TSL parameters:* The measured TSL parameters are used to calculate the nominal SAR result.

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

Measurement Conditions

DASY system configuration, as far as not given on page 1.

DASY Version	DASY5	V52.10.4
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy = 10.0 mm, dz = 10.0 mm	Graded Ratio = 1.4 (Z direction)
Frequency	5250 MHz ± 1 MHz 5600 MHz ± 1 MHz 5750 MHz ± 1 MHz	

Head TSL parameters at 5250 MHz

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	35.9	4.71 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.6 ± 6 %	4.48 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5250 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.04 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**79.7 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.31 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**22.8 W/kg ± 19.5 % (k=2)**

Head TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	35.5	5.07 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.2 ± 6 %	4.83 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5600 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.31 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**82.2 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.38 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**23.5 W/kg ± 19.5 % (k=2)**

Head TSL parameters at 5750 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.4	5.22 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.0 ± 6 %	4.98 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5750 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.04 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**79.6 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.30 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**22.7 W/kg ± 19.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL at 5250 MHz

Impedance, transformed to feed point	50.2 Ω - 4.4 jΩ
Return Loss	- 27.1 dB

Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	52.0 Ω + 1.8 jΩ
Return Loss	- 31.6 dB

Antenna Parameters with Head TSL at 5750 MHz

Impedance, transformed to feed point	55.8 Ω + 2.3 jΩ
Return Loss	- 24.6 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.195 ns

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG

DASY5 Validation Report for Head TSL

Date: 31.08.2020

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1253

Communication System: UID 0 - CW; Frequency: 5250 MHz, Frequency: 5600 MHz, Frequency: 5750 MHz
Medium parameters used: f = 5250 MHz; σ = 4.48 S/m; ε_r = 34.6; ρ = 1000 kg/m^3 ,
Medium parameters used: f = 5600 MHz; σ = 4.83 S/m; ε_r = 34.2; ρ = 1000 kg/m^3 ,
Medium parameters used: f = 5750 MHz; σ = 4.98 S/m; ε_r = 34.0; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

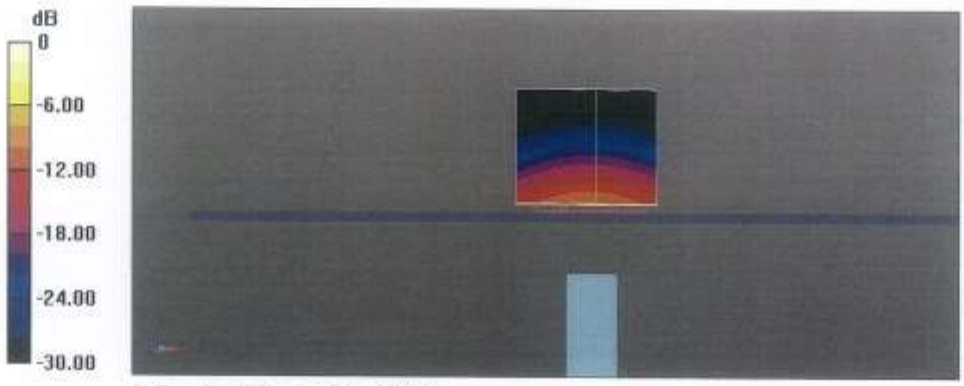
DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.5, 5.5, 5.5) @ 5250 MHz, ConvF(5.1, 5.1, 5.1) @ 5600 MHz, ConvF(5.08, 5.08, 5.08) @ 5750 MHz; Calibrated: 31.12.2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.12.2019
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5250 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 77.63 V/m; Power Drift = -0.07 dB
Peak SAR (extrapolated) = 27.8 W/kg
SAR(1 g) = 8.04 W/kg; SAR(10 g) = 2.31 W/kg
Smallest distance from peaks to all points 3 dB below = 7.4 mm
Ratio of SAR at M2 to SAR at M1 = 69.8%
Maximum value of SAR (measured) = 18.3 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 77.49 V/m; Power Drift = -0.06 dB
Peak SAR (extrapolated) = 31.3 W/kg
SAR(1 g) = 8.31 W/kg; SAR(10 g) = 2.38 W/kg
Smallest distance from peaks to all points 3 dB below = 7.4 mm
Ratio of SAR at M2 to SAR at M1 = 66.9%
Maximum value of SAR (measured) = 19.7 W/kg

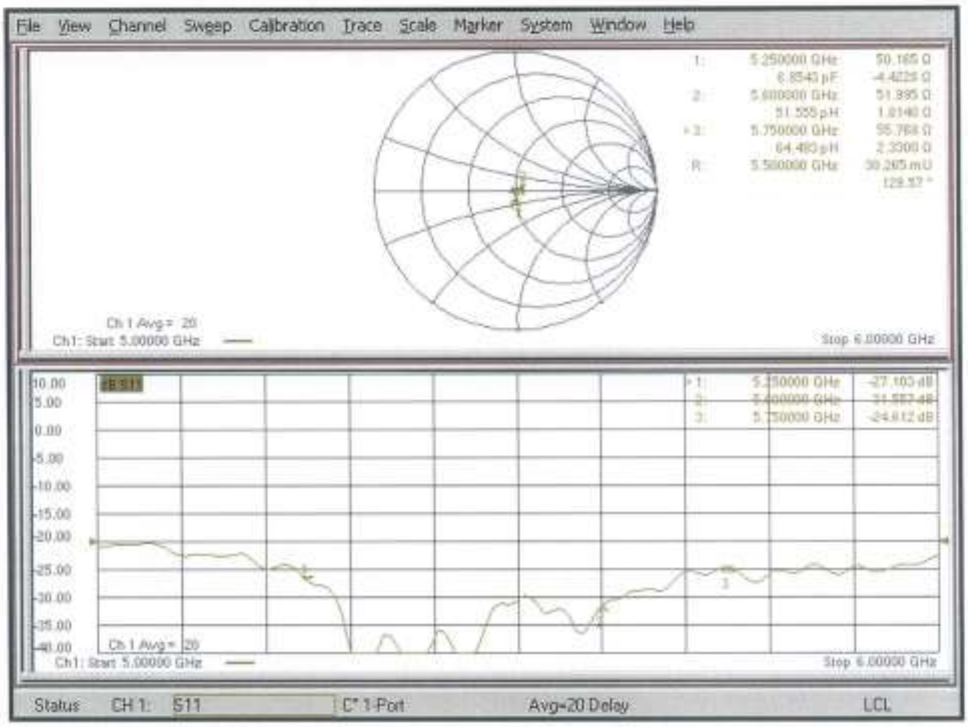
Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5750 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 75.13 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 31.8 W/kg
SAR(1 g) = 8.04 W/kg; SAR(10 g) = 2.30 W/kg
Smallest distance from peaks to all points 3 dB below = 7.4 mm
Ratio of SAR at M2 to SAR at M1 = 65.3%
Maximum value of SAR (measured) = 19.4 W/kg



0 dB = 19.7 W/kg = 12.94 dBW/kg

Certificate No: D5GHzV2-1253_Aug20 Page 7 of 8

Impedance Measurement Plot for Head TSL



Appendix H. – Power reduction verification

Per the May 2017 TCBC Workshop notes, demonstration of proper functioning of the power reduction mechanism is required to support the corresponding SAR Configurations.

The verification process was divided into two parts:

1). Evaluation of output power levels for individual triggering mechanism

2) Evaluation of the triggering distances for proximity-based sensors.

1. Power Reduction Verification for Main Bands

The Hotspot power reduction applied to this product has a higher priority than the proximity sensor, so these two conditions do not work simultaneously. and In both cases, powers were reduced to the same Power level.

All Hotspot SAR evaluations for this device were performed at the maximum allowed output Power when Hotspot is activated. FCC KDB Publication 616217D04v01r02 section 6 was used as a guideline for selection SAR test distances for this device when being used in phablet use conditions.

For detailed measurement conducted power results, please refer to the Section .11

The Power verification was performed according to the following procedure:

1. A base station simulator was used to establish a conducted RF connection and output power was monitored. The Power measurements were conformed to be within expected tolerances for all states before and after a power reduction mechanism was triggered.
2. Step 1 was repeated for all relevant modes and frequency bands for the mechanism being investigated.
3. Step 1 and 2 were repeated for all individual power reduction mechanism and combinations thereof. For the combination cases, one mechanism was switched to a “triggered” state at a time; powers were conformed to be within tolerance after each additional mechanism was activated.

Mechanism(s)	Mode/Band	Conducted Power (dBm)		
		Un-triggered (Max Power)	Triggered (Reduced Power)	Triggered (Reduced Power)
Grip	GSM/GPRS 1900 1Tx	29.15	26.74	
Grip	GSM/GPRS 1900 2Tx	27.59	24.83	
Grip	GSM/GPRS 1900 3Tx	25.81	23.33	
Grip	GSM/GPRS 1900 3Tx	23.62	21.30	
Grip	WCDMA B2	22.28	18.69	
Grip	WCDMA B4	22.80	19.80	
Grip	LTE Band 2	21.84	17.96	
Grip	LTE Band 4	23.81	19.19	
Grip	LTE Band 41(PC3)	23.99	21.77	
Grip	LTE Band 41(PC2)	25.18	22.08	
Grip	LTE Band 66	23.82	19.22	
Grip	Sub 6 Band n66	22.59	19.28	
Hotspot On	GSM/GPRS 1900 1Tx	29.15	26.54	
Hotspot On	GSM/GPRS 1900 2Tx	27.59	24.49	
Hotspot On	GSM/GPRS 1900 3Tx	25.81	22.95	
Hotspot On	GSM/GPRS 1900 3Tx	23.62	21.05	
Hotspot On	WCDMA B2	22.28	18.70	
Hotspot On	WCDMA B4	22.80	19.43	
Hotspot On	LTE Band 2	21.84	18.29	
Hotspot On	LTE Band 4	23.81	18.79	
Hotspot On	LTE Band 41(PC3)	23.99	20.51	
Hotspot On	LTE Band 41(PC2)	25.18	21.62	
Hotspot On	LTE Band 66	23.82	19.58	
Hotspot On	Sub 6 Band n66	22.59	19.21	
Hotspot On, Then Grip	GSM/GPRS 1900 1Tx	29.15	26.54	26.54
Hotspot On, Then Grip	GSM/GPRS 1900 2Tx	27.59	24.49	24.49
Hotspot On, Then Grip	GSM/GPRS 1900 3Tx	25.81	22.95	22.95
Hotspot On, Then Grip	GSM/GPRS 1900 3Tx	23.62	21.05	21.05
Hotspot On, Then Grip	WCDMA B2	22.28	18.70	18.70
Hotspot On, Then Grip	WCDMA B4	22.80	19.43	19.43
Hotspot On, Then Grip	LTE Band 2	21.84	18.29	18.29
Hotspot On, Then Grip	LTE Band 4	23.81	18.79	18.79
Hotspot On, Then Grip	LTE Band 41(PC3)	23.99	20.51	20.51
Hotspot On, Then Grip	LTE Band 41(PC2)	25.18	21.62	21.62
Hotspot On, Then Grip	LTE Band 66	23.82	19.58	19.58
Hotspot On, Then Grip	Sub 6 Band n66	22.59	19.21	19.21
Grip, then Hotspot On	GSM/GPRS 1900 1Tx	29.15	26.74	26.54
Grip, then Hotspot On	GSM/GPRS 1900 2Tx	27.59	24.83	24.49
Grip, then Hotspot On	GSM/GPRS 1900 3Tx	25.81	23.33	22.95
Grip, then Hotspot On	GSM/GPRS 1900 3Tx	23.62	21.30	21.05
Grip, then Hotspot On	WCDMA B2	22.28	18.69	18.70
Grip, then Hotspot On	WCDMA B4	22.80	19.80	19.43
Grip, then Hotspot On	LTE Band 2	21.84	17.96	18.29
Grip, then Hotspot On	LTE Band 4	23.81	19.19	18.79
Grip, then Hotspot On	LTE Band 41(PC3)	23.99	21.77	20.51
Grip, then Hotspot On	LTE Band 41(PC2)	25.18	22.08	21.62
Grip, then Hotspot On	LTE Band 66	23.82	19.22	19.58
Grip, then Hotspot On	Sub 6 Band n66	22.59	19.28	19.21

1.1. Distance Verification Procedure

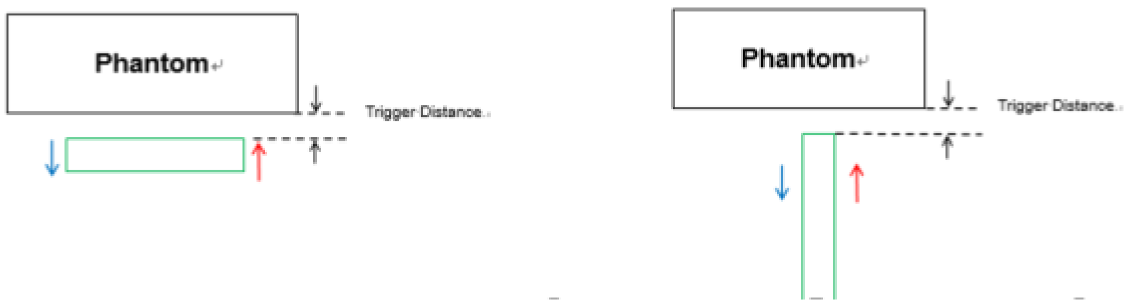
Procedures for determining proximity sensor triggering distances

(KDB 616217D04v01r02§6.2)

The distance verification procedure was performed according to the following procedure:

1. A base station simulator was used to establish an RF connection and to monitor the power levels. The device being tested was placed below the relevant section of the phantom with the relevant side or edge of the device facing toward the phantom.
2. The device was moved toward and away from the phantom to determine the distance at which the mechanism triggers and the output power is reduced, per KDB Publication 616217 D04v01r02 .Each applicable test position was evaluated. The distance were conformed to be the same or larger (more conservative) than the minimum distances provided by the manufacturer.
3. Step 1 and 2 were repeated for the relevant modes, as appropriate
4. Steps1 through 3 were repeated for all distance-based power reduction mechanisms.

For detailed measurement conducted power results, please refer to the Section .11



Proximity Sensor Trigger Distance Assessment KDB 616217 D04§6.2 (Rear / Front / Bottom side)

LEGEND

→ Direction of DUT travel for determination of power reduction triggering point

→ Direction of DUT travel for determination of full power resumption triggering point

Tissue simulating liquid	Trigger distance - Rear		Trigger distance - Front		Trigger distance - Bottom	
	Moving toward phantom [mm]	Moving away from phantom [mm]	Moving toward phantom [mm]	Moving away from phantom [mm]	Moving toward phantom [mm]	Moving away from phantom [mm]
1800MHz Tissue	9	10	7	8	14	15
1900MHz Tissue	9	10	7	8	14	15
2600 MHz Tissue	9	10	7	8	14	15

Distance Measurement verification for Proximity sensor

Rear side – EUT Moving toward (trigger) to the Phantom

Mode	Distance to DUT Output power (dBm)									
	14[mm]	13[mm]	12[mm]	11[mm]	10[mm]	9[mm]	8[mm]	7[mm]	6[mm]	5[mm]
GSM1900 /Voice	29.25	29.25	29.24	29.25	29.25	26.68	26.68	26.68	26.67	26.68
GSM1900 /GPRS 1Tx	29.15	29.15	29.15	29.15	29.15	26.75	26.74	26.76	26.75	26.74
GSM1900 /GPRS 2Tx	27.59	27.58	27.59	27.60	27.59	24.85	24.83	24.83	24.84	24.84
GSM1900 /GPRS 3Tx	25.81	25.81	25.80	25.80	25.80	23.32	23.33	23.34	23.33	23.32
GSM1900 /GPRS 4Tx	23.62	23.61	23.61	23.62	23.60	21.32	21.30	21.30	21.31	21.30
WCDMA B2	22.28	22.26	22.26	22.26	22.27	18.69	18.69	18.70	18.69	18.70
WCDMA B4	22.80	22.79	22.79	22.79	22.80	19.80	19.80	19.78	19.79	19.80
LTE Band 2	21.84	21.84	21.85	21.84	21.83	17.97	17.96	17.97	17.97	17.98
LTE Band 4	23.81	23.80	23.81	23.81	23.80	19.18	19.19	19.18	19.18	19.20
LTE Band 41(Class 3)	23.99	24.00	23.98	23.98	24.00	21.78	21.77	21.77	21.76	21.77
LTE Band 41(Class 2)	25.18	25.19	25.18	25.19	25.18	22.08	22.08	22.09	22.08	22.08
LTE Band 66	23.82	23.82	23.83	23.82	23.82	19.21	19.22	19.21	19.21	19.20
Sub 6 Band n66	22.59	22.58	22.59	22.59	22.59	19.29	19.28	19.28	19.29	19.28

Rear side – EUT Moving away (Release) from the Phantom

Mode	Distance to DUT Output power (dBm)									
	6[mm]	7[mm]	8[mm]	9[mm]	10[mm]	11[mm]	12[mm]	13[mm]	14mm]	15[mm]
GSM1900 /Voice	26.68	26.69	26.69	26.67	26.69	29.24	29.25	29.25	29.25	29.26
GSM1900 /GPRS 1Tx	26.74	26.76	26.75	26.75	26.76	29.15	29.15	29.15	29.15	29.15
GSM1900 /GPRS 2Tx	24.85	24.83	24.84	24.84	24.84	27.58	27.59	27.58	27.58	27.59
GSM1900 /GPRS 3Tx	23.33	23.33	23.33	23.34	23.33	25.80	25.82	25.81	25.81	25.81
GSM1900 /GPRS 4Tx	21.31	21.31	21.31	21.31	21.30	23.62	23.60	23.61	23.60	23.62
WCDMA B2	18.68	18.70	18.68	18.68	18.70	22.27	22.26	22.26	22.28	22.27
WCDMA B4	19.80	19.79	19.80	19.79	19.78	22.79	22.81	22.81	22.81	22.81
LTE Band 2	17.98	17.96	17.97	17.97	17.97	21.83	21.85	21.83	21.84	21.84
LTE Band 4	19.19	19.20	19.18	19.19	19.19	23.81	23.81	23.80	23.82	23.81
LTE Band 41(Class 3)	21.76	21.78	21.78	21.78	21.78	23.99	24.00	23.98	23.98	23.98
LTE Band 41(Class 2)	22.08	22.08	22.09	22.07	22.08	25.17	25.18	25.18	25.19	25.17
LTE Band 66	19.21	19.22	19.22	19.22	19.22	23.81	23.82	23.83	23.83	23.83
Sub 6 Band n66	19.29	19.29	19.29	19.28	19.29	22.59	22.58	22.59	22.59	22.59

Based on the most conservative measured triggering distance of 9mm, additional Phablet SAR measurements were required at 8mm from rear side for the above modes

Front side – EUT Moving toward (trigger) to the Phantom

Mode	Distance to DUT Output power (dBm)									
	12[mm]	11[mm]	10[mm]	9[mm]	8[mm]	7[mm]	6[mm]	5[mm]	4[mm]	3[mm]
GSM1900 /Voice	29.25	29.24	29.23	29.24	29.23	26.66	26.66	26.67	26.66	26.66
GSM1900 /GPRS 1Tx	29.14	29.13	29.13	29.14	29.14	26.73	26.72	26.75	26.74	26.73
GSM1900 /GPRS 2Tx	27.57	27.57	27.58	27.59	27.59	24.85	24.83	24.83	24.83	24.83
GSM1900 /GPRS 3Tx	25.80	25.81	25.80	25.80	25.80	23.32	23.32	23.34	23.33	23.32
GSM1900 /GPRS 4Tx	23.60	23.60	23.60	23.61	23.59	21.32	21.29	21.30	21.30	21.29
WCDMA B2	22.27	22.26	22.24	22.24	22.27	18.67	18.69	18.69	18.67	18.68
WCDMA B4	22.79	22.79	22.79	22.78	22.78	19.78	19.79	19.78	19.78	19.79
LTE Band 2	21.82	21.83	21.84	21.83	21.82	17.95	17.95	17.97	17.95	17.97
LTE Band 4	23.79	23.79	23.81	23.81	23.80	19.17	19.19	19.18	19.17	19.18
LTE Band 41(Class 3)	23.98	23.99	23.97	23.96	23.98	21.76	21.77	21.76	21.75	21.77
LTE Band 41(Class 2)	25.19	25.18	25.18	25.17	25.18	22.07	22.06	22.08	22.06	22.08
LTE Band 66	23.80	23.80	23.81	23.80	23.82	19.21	19.22	19.21	19.19	19.19
Sub 6 Band n66	22.58	22.57	22.57	22.59	22.59	19.28	19.26	19.26	19.28	19.27

Front side – EUT Moving away (Release) from the Phantom

Mode	Distance to DUT Output power (dBm)									
	4[mm]	5[mm]	6[mm]	7[mm]	8[mm]	9[mm]	10[mm]	11[mm]	12[mm]	13[mm]
GSM1900 /Voice	26.68	26.68	26.67	26.67	26.67	29.23	29.25	29.23	29.24	29.25
GSM1900 /GPRS 1Tx	26.74	26.75	26.75	26.74	26.74	29.14	29.13	29.14	29.14	29.14
GSM1900 /GPRS 2Tx	24.83	24.82	24.83	24.82	24.82	27.58	27.58	27.57	27.58	27.58
GSM1900 /GPRS 3Tx	23.31	23.31	23.31	23.33	23.33	25.79	25.81	25.80	25.81	25.80
GSM1900 /GPRS 4Tx	21.30	21.29	21.31	21.31	21.29	23.61	23.59	23.60	23.60	23.60
WCDMA B2	18.67	18.68	18.68	18.68	18.68	22.27	22.25	22.25	22.28	22.26
WCDMA B4	19.79	19.77	19.78	19.78	19.77	22.79	22.81	22.79	22.79	22.80
LTE Band 2	17.97	17.95	17.95	17.95	17.95	21.83	21.84	21.82	21.84	21.84
LTE Band 4	19.18	19.20	19.18	19.19	19.18	23.80	23.81	23.78	23.81	23.80
LTE Band 41(Class 3)	21.76	21.76	21.76	21.77	21.77	23.98	23.99	23.97	23.97	23.98
LTE Band 41(Class 2)	22.07	22.07	22.07	22.07	22.07	25.19	25.18	25.18	25.17	25.18
LTE Band 66	19.20	19.20	19.20	19.20	19.21	23.80	23.80	23.81	23.82	23.81
Sub 6 Band n2	19.29	19.28	19.29	19.27	19.27	22.58	22.56	22.57	22.58	22.59
Sub 6 Band n66	26.68	26.68	26.67	26.67	26.67	29.23	29.25	29.23	29.24	29.25

Based on the most conservative measured triggering distance of 7mm, additional Phablet SAR measurements were required at 6mm from Front side for the above modes

Bottom side – EUT Moving toward (trigger) to the Phantom

Mode	Distance to DUT Output power (dBm)									
	19[mm]	18[mm]	17[mm]	16[mm]	15[mm]	14[mm]	13[mm]	12[mm]	11[mm]	10[mm]
GSM1900 /Voice	29.24	29.22	29.21	29.24	29.23	26.65	26.66	26.65	26.66	26.64
GSM1900 /GPRS 1Tx	29.13	29.11	29.12	29.13	29.14	26.72	26.71	26.75	26.73	26.71
GSM1900 /GPRS 2Tx	27.57	27.57	27.57	27.58	27.58	24.83	24.82	24.81	24.82	24.81
GSM1900 /GPRS 3Tx	25.79	25.80	25.79	25.79	25.79	23.32	23.31	23.33	23.32	23.30
GSM1900 /GPRS 4Tx	23.60	23.60	23.59	23.60	23.58	21.30	21.29	21.28	21.29	21.29
WCDMA B2	22.26	22.25	22.23	22.23	22.26	18.67	18.68	18.67	18.65	18.67
WCDMA B4	22.79	22.77	22.78	22.76	22.77	19.77	19.79	19.76	19.77	19.78
LTE Band 2	21.82	21.81	21.82	21.83	21.81	17.95	17.93	17.97	17.95	17.97
LTE Band 4	23.78	23.78	23.79	23.80	23.80	19.17	19.19	19.18	19.17	19.17
LTE Band 41(Class 3)	23.97	23.98	23.96	23.95	23.98	21.76	21.77	21.75	21.74	21.76
LTE Band 41(Class 2)	25.19	25.18	25.16	25.17	25.18	22.05	22.06	22.08	22.05	22.07
LTE Band 66	23.79	23.79	23.79	23.79	23.81	19.19	19.22	19.20	19.18	19.17
Sub 6 Band n66	22.58	22.56	22.56	22.57	22.58	19.27	19.24	19.25	19.27	19.27

Bottom side – EUT Moving away (Release) from the Phantom

Mode	Distance to DUT Output power (dBm)									
	11[mm]	12[mm]	13[mm]	14[mm]	15[mm]	16[mm]	17[mm]	18[mm]	19[mm]	20[mm]
GSM1900 /Voice	26.66	26.68	26.67	26.66	26.66	29.23	29.25	29.21	29.23	29.24
GSM1900 /GPRS 1Tx	26.73	26.74	26.74	26.73	26.73	29.13	29.12	29.13	29.12	29.13
GSM1900 /GPRS 2Tx	24.82	24.81	24.81	24.82	24.82	27.56	27.56	27.55	27.56	27.57
GSM1900 /GPRS 3Tx	23.30	23.31	23.30	23.33	23.31	25.77	25.80	25.78	25.81	25.79
GSM1900 /GPRS 4Tx	21.30	21.29	21.29	21.31	21.29	23.60	23.59	23.59	23.59	23.60
WCDMA B2	18.67	18.68	18.67	18.68	18.67	22.26	22.23	22.24	22.26	22.26
WCDMA B4	19.78	19.77	19.77	19.76	19.76	22.77	22.80	22.77	22.77	22.80
LTE Band 2	17.95	17.94	17.95	17.94	17.93	21.82	21.84	21.82	21.84	21.83
LTE Band 4	19.17	19.19	19.17	19.17	19.17	23.78	23.80	23.78	23.79	23.80
LTE Band 41(Class 3)	21.75	21.75	21.76	21.76	21.77	23.97	23.97	23.96	23.96	23.97
LTE Band 41(Class 2)	22.05	22.06	22.05	22.05	22.07	25.18	25.17	25.19	25.16	25.17
LTE Band 66	19.19	19.20	19.20	19.19	19.20	23.80	23.80	23.80	23.82	23.80
Sub 6 Band n66	19.28	19.27	19.27	19.26	19.26	22.56	22.56	22.56	22.58	22.58

Based on the most conservative measured triggering distance of 14mm, additional Phablet SAR measurements were required at 13mm from Bottom side for the above modes

1.2 Proximity Sensor Coverage for SAR measurements

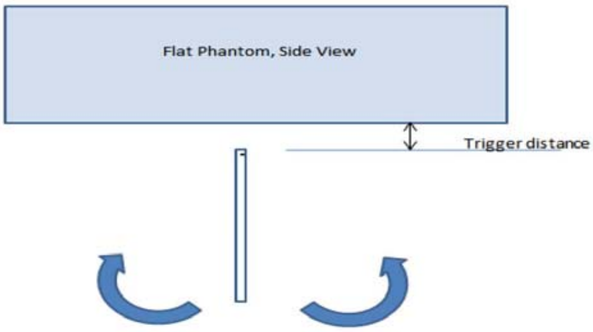
(KDB 616217 D04v01r02§6.3)

As there is no spatial offset between the antenna and the proximity sensor element, proximity sensor coverage did not need to be assessed.

1.3 Proximity Sensor Tilt Angle Assessment

(KDB 616217 D04v01r02 §6.4)

The DUT was positioned directly below the flat phantom at the minimum measured trigger distance with Bottom side parallel to the base of the flat phantom for each band. The EUT was rotated about Bottom side for angles up to ±45°. If the output power increased during the rotation the DUT was moved 1mm toward the phantom and the rotation repeated. This procedure was repeated until the power remained reduced for all angles up±45°.



Proximity sensor tilt angle assessment (Bottom side) KDB 616217 §6.4

Summary of Tablet Tilt Angle influence to Proximity Sensor Triggering (Bottom side)

Tissue	Minimumdistance atwhich power reduction was maintained over-45°	Power reduction status										
		-45°	-40°	-30°	-20°	-10°	0°	10°	20°	30°	40°	45°
1800 MHz Tissue	14mm	On	On	On	On	On	On	On	On	On	On	On
1900 MHz Tissue	14 mm	On	On	On	On	On	On	On	On	On	On	On
2600 MHz Tissue	14 mm	On	On	On	On	On	On	On	On	On	On	On

1.5 Resulting test positions for Phablet SAR measurements

Wireless technologies	Position	§6.2 Triggering Distance [mm]	§6.3 Coverage	§6.4 Tilt Angle	Worst case distance for Phablet SAR [mm]
WWAN (GSM1900 /WCDMA B2/B4 /LTEB2/B4/B41(Class3) /B41(Class2)/B66 /SUB6 n66)	Rear	9	N/A	N/A	8
	Front	7	N/A	N/A	6
	Bottom	14	N/A	N/A	13

Note:FCC KDB Publication 616217 D04v01r02 Section 6 was used as a guideline for selecting SAR test distances for this device when being used in phablet use conditions

2. Power reduction Verification for WLAN Ant

This device uses a power reduction mechanism for SAR compliance for WLAN operations during voice or VoIP held to ear scenarios.

When a user makes or receives a WLAN voice or WLAN VOIP call for WLAN Ant the audio of the call is sent through the Receiver at the top of the device will trigger the Power reduction for WLAN Ant (i.e. reducing output power for Head SAR compliance)

Detailed descriptions of the power reduction mechanism are included in the Main operational description document

Power Measurement Verification for WLAN

Condition For Power reduction	Wireless Technologies	Conducted Power[dBm]			
		Un-Triggered (Max Power)		Triggered (Reduced Power)	
		Ant1	Ant2	Ant1	Ant2
RCV-on	2.4GHz 802.11b (Exclude 12/13ch)	18.20	17.95	13.68	13.10
RCV-on	2.4GHz 802.11g (Exclude 12/13ch))	15.55	15.25	13.08	12.44
RCV-on	2.4GHz 802.11n (Exclude 12/13ch)	14.43	14.10	13.07	12.45
RCV-on	5GHz 802.11a (Exclude 100~144ch)	15.63	15.57	12.08	12.07
RCV-on	5GHz 802.11n 20MHz	15.46	15.37	12.04	12.05
RCV-on	5GHz 802.11n 40MHz	14.21	14.02	12.03	12.01
RCV-on	5GHz 802.11ac 20MHz	15.37	15.19	12.07	12.05
RCV-on	5GHz 802.11ac 40MHz	14.12	14.08	12.10	12.06
RCV-on	5GHz 802.11ac 80MHz	13.99	13.42	12.12	12.04

Appendix I. – Down-link CA Power Measurement / 5G NR Call Box Setup

1. LTE Down-link Carrier Aggregation Conducted Powers

SAR test exclusion for LTE downlink Carrier Aggregation is determined by power measurements according to the number component carriers(CCs) supported by test product implementation. For those configurations required by April 2018 TCBC Workshop notes, conducted power measurements with LTE Carrier Aggregation(CA) (downlink only) active are made in accordance to KDB Publication 941225 D05Av01r02. The RRC connection is only handled by one cell, the primary component carrier (PCC) for downlink and uplink communications. After making a data connection to the PCC, the UE device adds secondary component carrier(s)(SCC) on the downlink only.

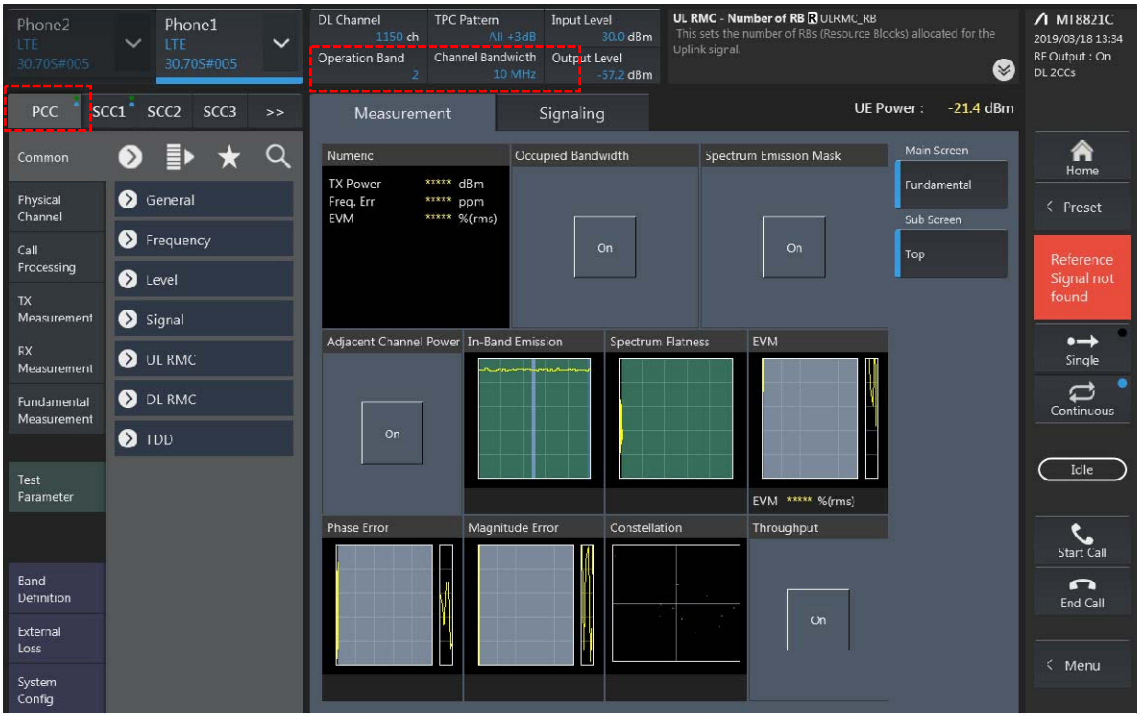
Downlink Carrier aggregation:

1. This device only supports downlink carrier aggregation. For every supported combination of downlink carrier aggregation, power measurements were performed with the downlink carrier aggregation active for the configuration with highest measured maximum conducted power with downlink carrier aggregation inactive measured among the channel bandwidth, modulation, and RB combinations in each frequency band.
2. All control and acknowledge data is sent on uplink channels that operate identical to specifications when downlink carrier aggregation is inactive.
3. Per FCC KDB publication 941225 D05A v01r02, Section C)3)b)ii), PCC uplink channel was selected at downlink carrier aggregation combinations. The downlink PCC channel was paired with the selected PCC uplink channel according to normal configurations without carrier aggregation.
4. For continuous intra-band carrier aggregation, the downlink channel spacing between the component carriers was set to multiple of 300kHz less than the nominal channel spacing defined in section 5.4.1A of 3GPP TS 36.521.
5. For non-continuous intra-band carrier aggregation, the downlink channel spacing between the component carriers was set to be larger than the nominal channel spacing and provided maximum separation between the component carriers.
6. All selected downlink channels remained fully within the downlink transmission band of the respective component carrier.

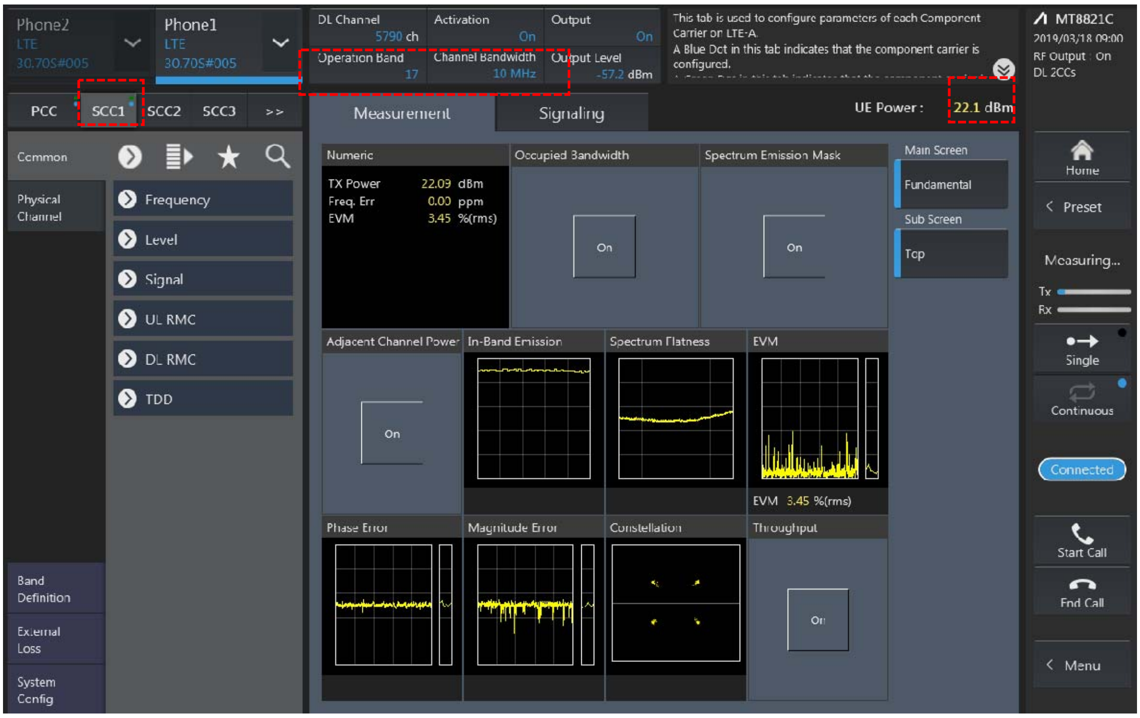
Power Measurement setup

LTE Down Link 2CA Call Setup

PCC Setting : Channel/ RB/ BW/ Modulation



SCC Setting : Channel/ RB/ BW/ Modulation and call Connection

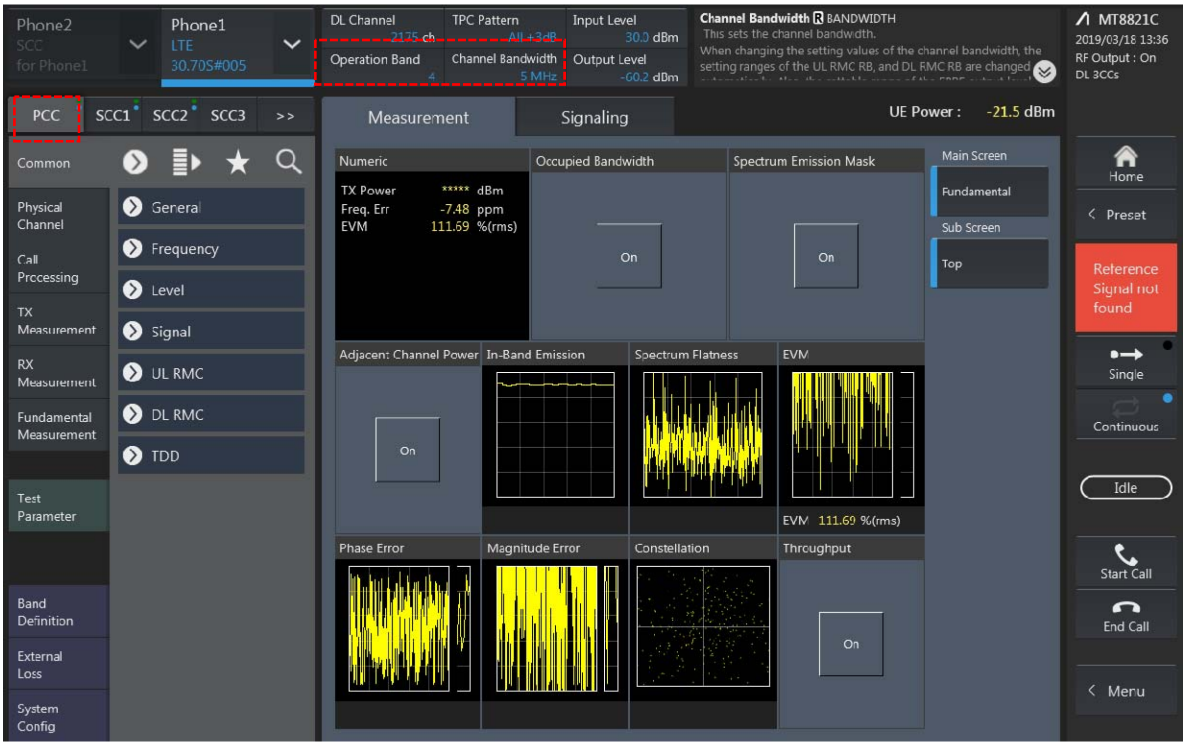


2CA Downlink Carrier aggregation Maximum conducted Powers

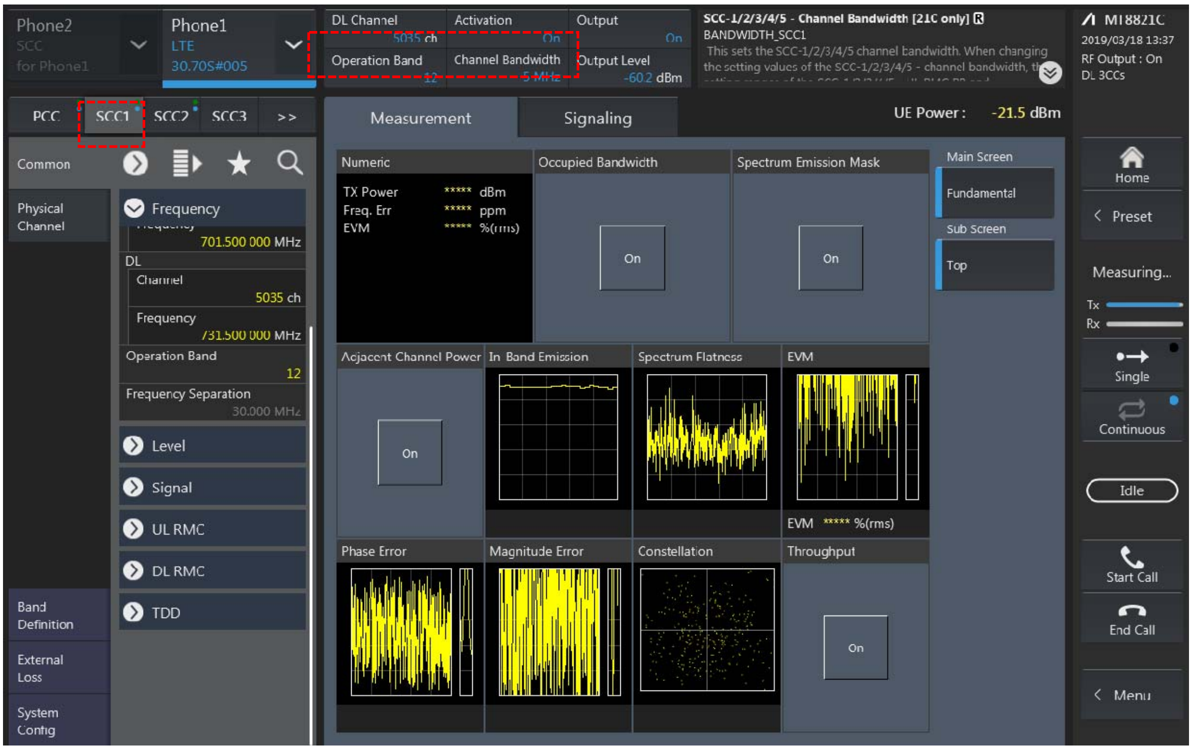
Combination	PCC									SCC				Tx Power		Deviation
	Band	BW	PCC UL Channel	PCC UL Frequency	PCC DL Channel	PCC DL Frequency	Modulation	RB	offset	Band	BW	SCC DL Channel	SCC DL Frequency	LTE Single Carrier Tx Power (dBm)	LTE Tx Power with DL CA Enabled(dBm)	
2C	2	10	19150	1905	1150	1985	QPSK	1	49	2	20	19006	1970.6	21.94	21.87	-0.07
2A-2A	2	10	19150	1905	1150	1985	QPSK	1	49	2	20	700	1940	21.94	21.87	-0.07
2A-2A	2	20	18700	1860	700	1940	QPSK	1	49	2	20	1100	1980	21.86	21.85	-0.01
2A-12A	2	10	19150	1905	1150	1985	QPSK	1	49	12	10	5230	751	21.94	21.91	-0.03
2A-12A	12	5	23155	713.5	5155	743.5	QPSK	1	12	2	20	900	1960	24.33	24.12	-0.21
2A-17A	2	10	19150	1905	1150	1985	QPSK	1	49	17	10	5790	740	21.94	21.75	-0.19
2A-17A	17	5	23790	710	5790	740	QPSK	1	12	2	10	900	1960	24.30	24.05	-0.25
4A-17A	4	5	19975	1712.5	1975	2112.5	QPSK	1	12	17	10	5790	740	23.94	23.81	-0.13
4A-17A	17	5	23790	710	5790	740	QPSK	1	12	4	10	2175	2132.5	24.30	24.15	-0.15
5A-41A	5	10	20525	836.5	2525	881.5	QPSK	1	49	41	20	40620	2593	24.35	24.15	-0.20
26A-41A	26	10	26990	844	8990	889	QPSK	1	0	41	20	41490	2680	24.67	24.28	-0.39
41A-41A	41	5	39750	2506	39675	2498.5	QPSK	1	12	41	20	41490	2680	23.55	23.31	-0.24
41A-41A	41	5	41490	2680	41490	2680	QPSK	1	0	41	20	39750	2506	23.69	23.41	-0.28
41A-41A(HPUE)	41	20	39750	2506	39675	2498.5	QPSK	1	0	41	20	41490	2680	25.05	25.10	0.05
41A-41A(HPUE)	41	5	41490	2680	41490	2680	QPSK	1	12	41	20	39750	2506	25.11	25.12	0.01
66A-2A	66	20	132022	1715	66486	2115	QPSK	1	49	2	20	900	1960	23.84	23.71	-0.13
66B	66	5	131997	1712.5	66461	2112.5	QPSK	1	12	66	15	66554	2121.8	23.84	23.75	-0.09
66C	66	20	132072	1720	66536	2120	QPSK	1	49	66	20	66734	2139.8	23.84	23.67	-0.17

LTE Down Link 3CA Call Setup

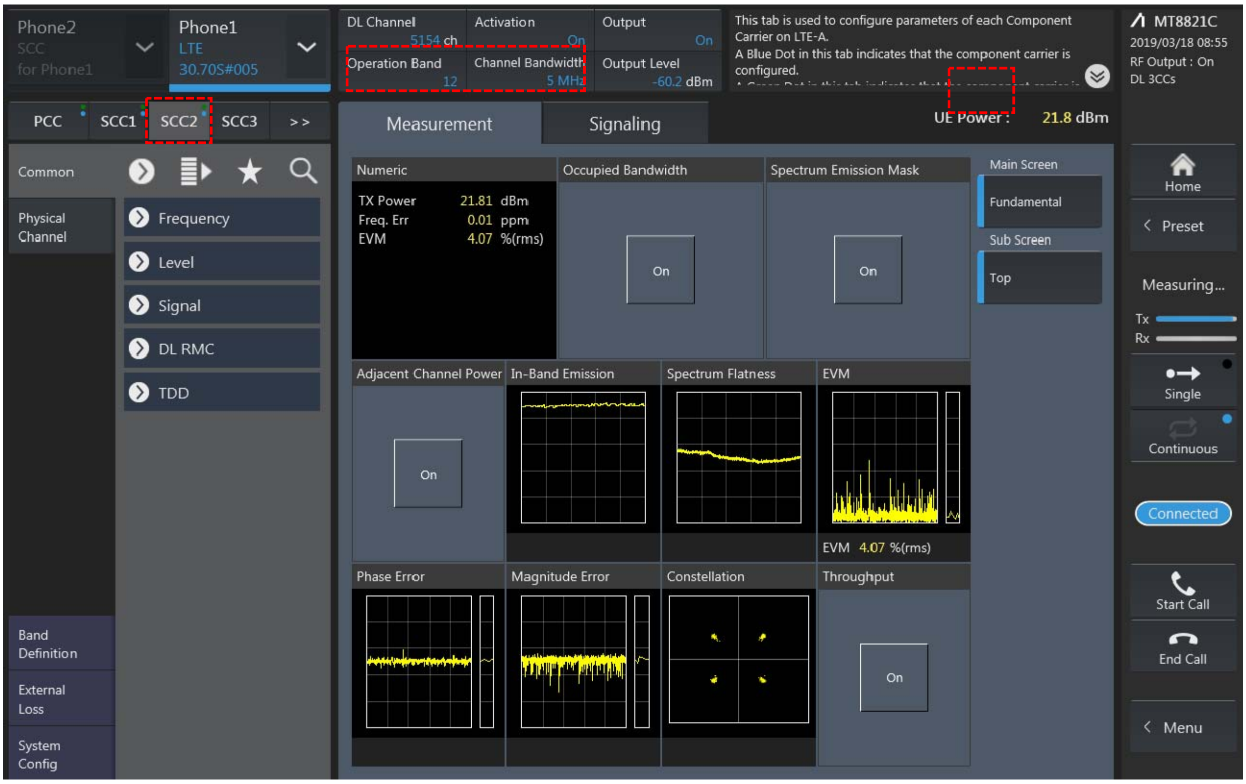
1) PCC Setting: Channel /RB/BW/Modulation



2) SCC1 Setting : Channel /RB/BW/Modulation



3) SCC2 Setting (Channel /RB/BW/Modulation)and call Connection

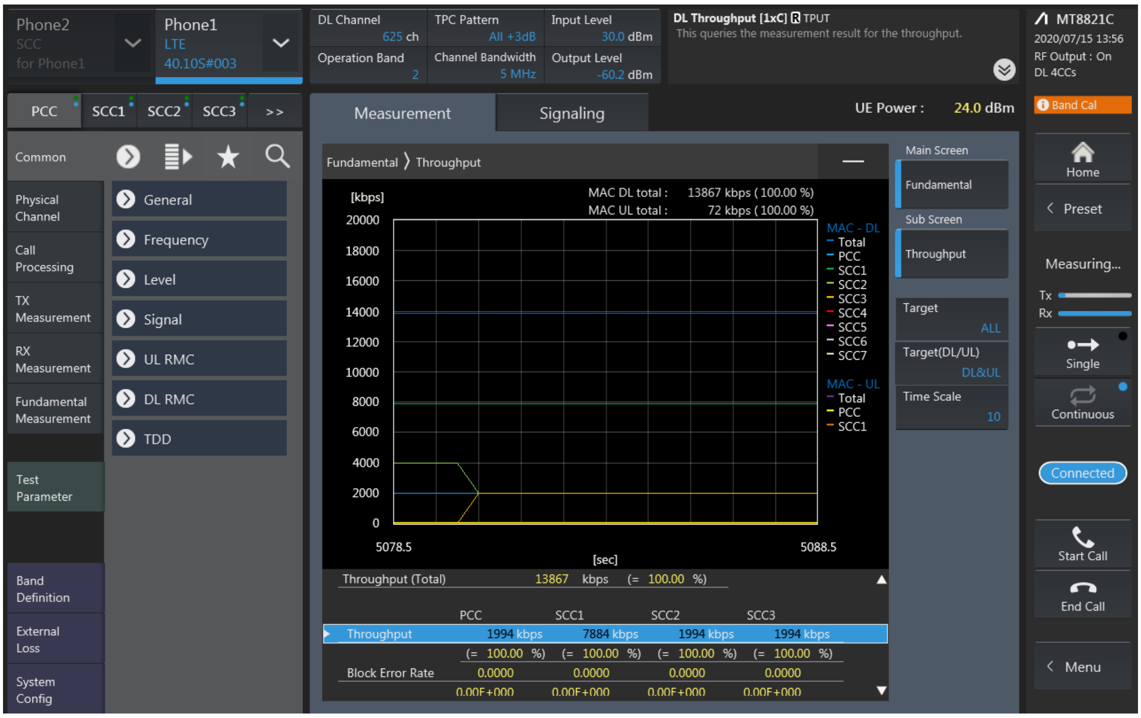


3CA Downlink Carrier aggregation Maximum conducted Powers

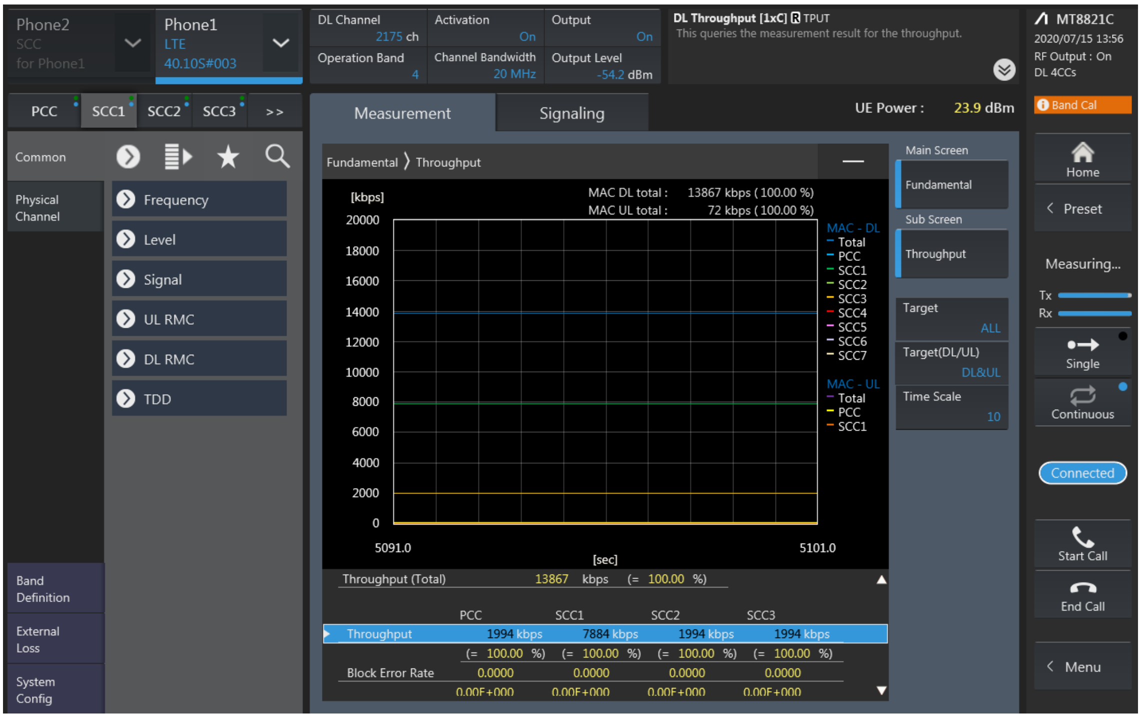
Combination	PCC									SCC				SCC				Tx Power		
	Band	BW	PCC UL Channel	PCC UL Frequency	PCC DL Channel	PCC DL Frequency	Modulation	RB	offset	Band	BW	SCC DL Channel	SCC DL Frequency	Band	BW	SCC DL Channel	SCC DL Frequency	LTE Single Carrier Tx Power (dBm)	LTE Tx Power with DL CA Enabled(dBm)	Deviation
2A-4A-5A	2	10	19150	1905	1150	1985	QPSK	1	49	4	20	2175	2132.5	5	10	2525	881.5	21.94	21.93	-0.01
2A-4A-5A	4	5	19975	1712.5	1975	2112.5	QPSK	1	12	2	20	900	1960	5	10	2525	881.5	23.94	23.53	-0.41
2A-4A-5A	5	10	20525	836.5	2525	881.5	QPSK	1	49	2	20	900	1960	4	20	2175	2133	24.35	24.11	-0.24
4A-4A-12A	4	5	19975	1712.5	1975	2112.5	QPSK	1	12	4	20	2275	2142.5	12	10	5095	737.5	23.94	23.95	0.01
4A-4A-12A	12	5	23155	713.5	5155	743.5	QPSK	1	12	4	20	2050	2120	4	20	2300	2145	24.33	24.08	-0.25
5A-66A-66A	5	10	20525	836.5	2525	881.5	QPSK	1	49	66	20	66536	2120	66	20	67036	2170	24.35	23.99	-0.36
5A-66A-66A	66	20	132072	1720	66536	2120	QPSK	1	49	66	20	67236	2190	5	10	2525	881.5	23.84	23.92	0.08
26A-41C	26	10	26990	844	8990	889	QPSK	1	0	41	20	40620	2593	41	20	40764	2607	24.67	24.37	-0.30
66A-66A-12A	66	20	132072	1720	66536	2120	QPSK	1	49	66	20	67236	2190	12	10	5095	737.5	23.84	23.91	0.07
66A-66A-12A	12	5	23155	713.5	5155	743.5	QPSK	1	12	66	20	66536	2120	66	20	67036	2170	24.33	24.13	-0.20
41A-41C	41	10	40620	2593	40620	2593	QPSK	1	24	41	20	41292	2660.2	41	20	41490	2680	24.06	23.81	-0.25
41A-41C	41	10	40620	2593	40620	2593	QPSK	1	24	41	20	40764	2607.4	41	20	39750	2506	24.06	23.79	-0.27
41D	41	10	40620	2593	40620	2593	QPSK	1	24	41	20	40476	2578.6	41	20	40764	2607	24.06	23.73	-0.33
41A-41C(HPUE)	41	10	40620	2593	40620	2593	QPSK	1	24	41	20	41292	2660.2	41	20	41490	2680	25.19	25.11	-0.08
41A-41C(HPUE)	41	10	40620	2593	40620	2593	QPSK	1	24	41	20	40764	2607.4	41	20	39750	2506	25.19	25.09	-0.10
41D(HPUE)	41	10	40620	2593	40620	2593	QPSK	1	24	41	20	40476	2578.6	41	20	40764	2607	25.19	25.21	0.02

LTE Down Link 4CA Call Setup

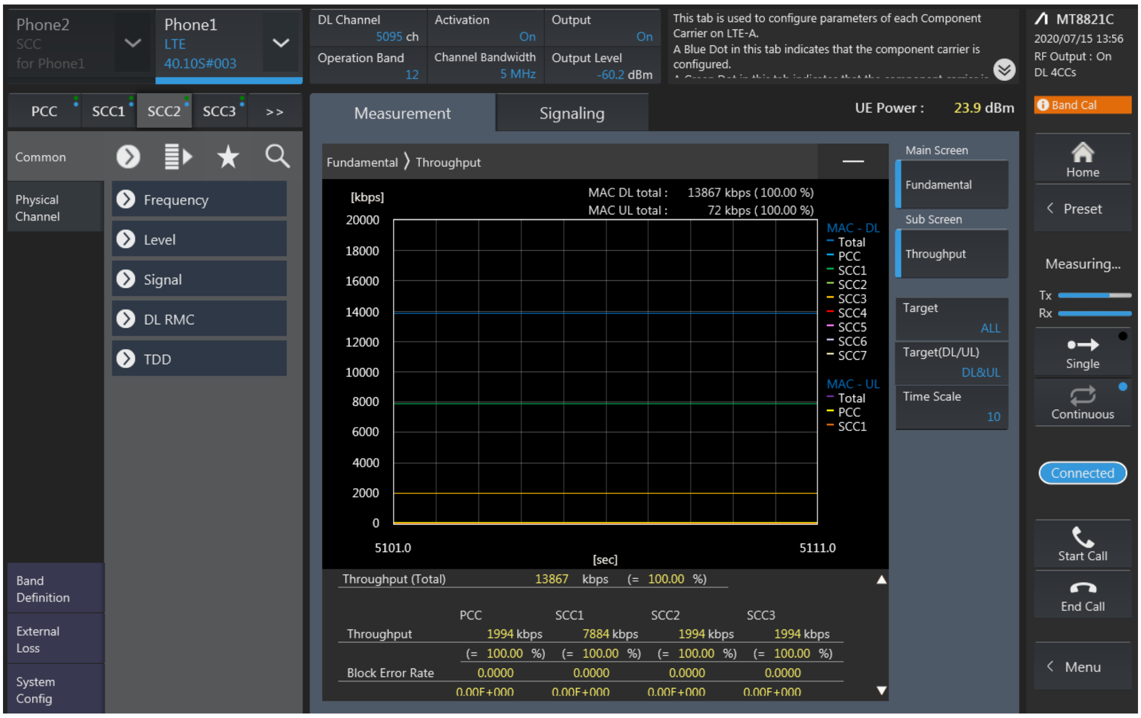
PCC Setting: Channel /RB/BW/Modulation



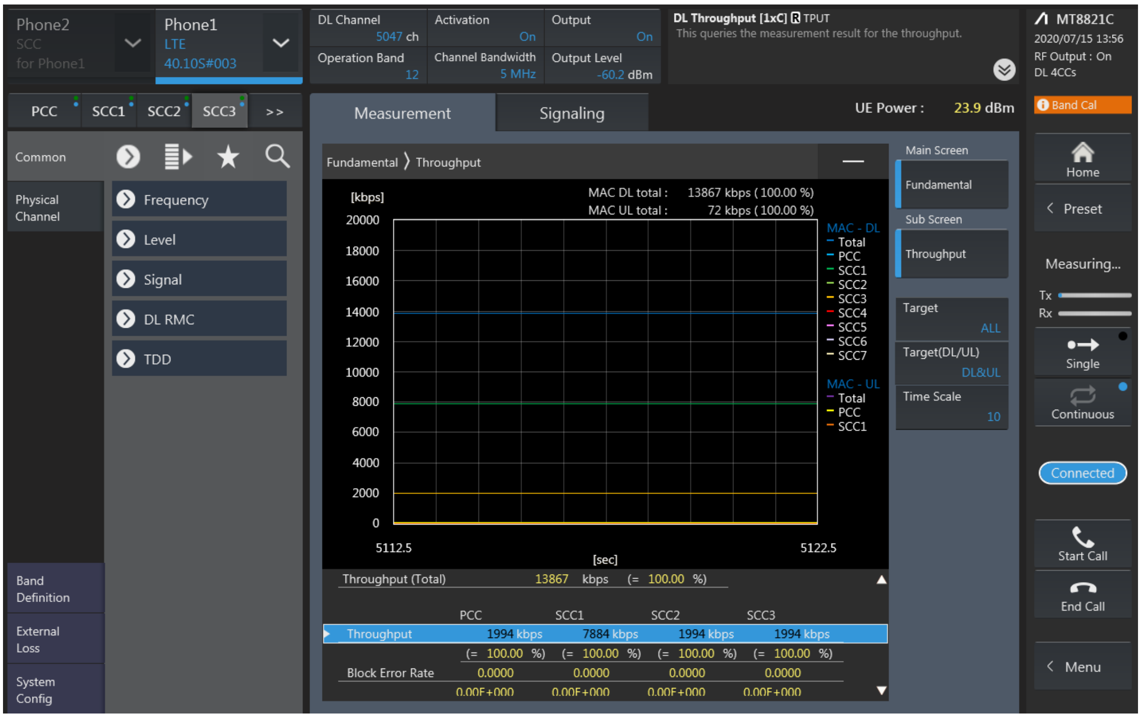
SCC1 Setting (Channel /RB/BW/Modulation)and call Connection



SCC2 Setting (Channel /RB/BW/Modulation)and call Connection



SCC3 Setting (Channel /RB/BW/Modulation)and call Connection

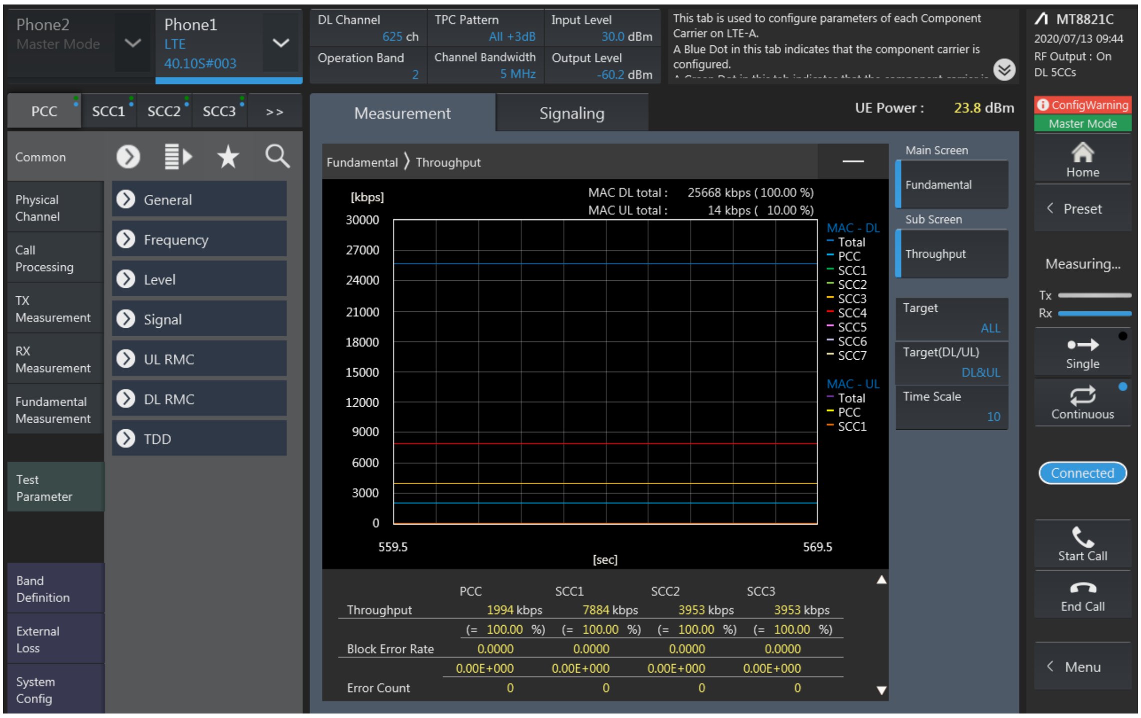


4CA Downlink Carrier aggregation Maximum conducted Powers

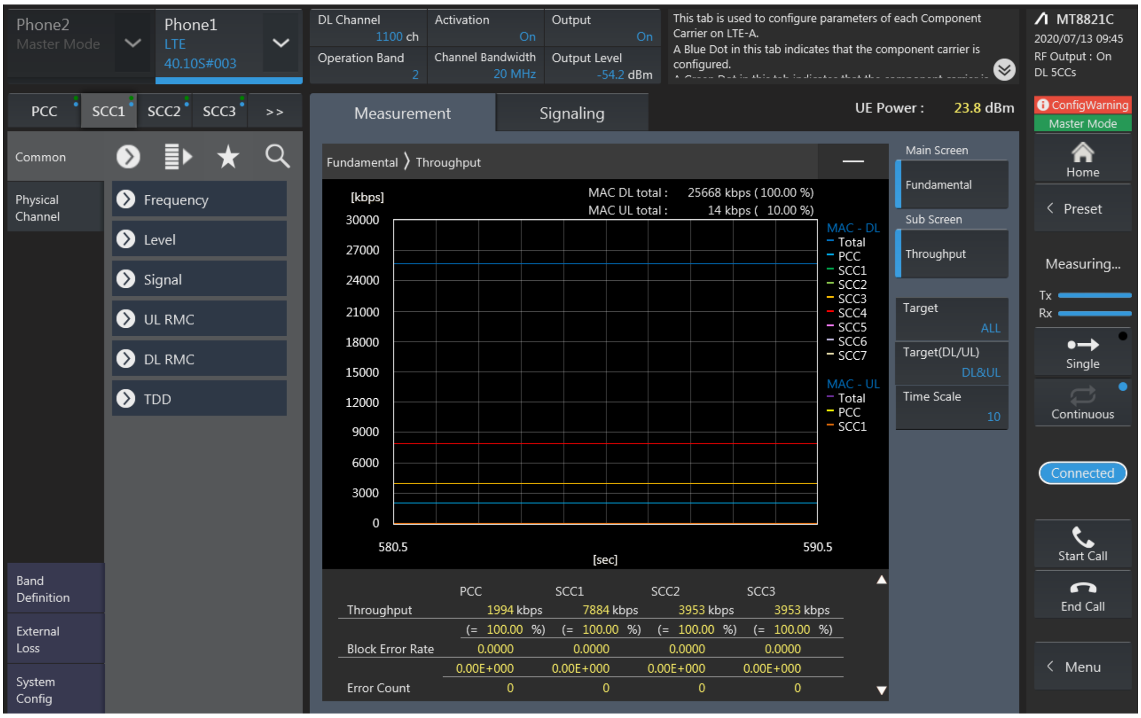
Combination	PCC									SCC				SCC				SCC				Tx Power		Deviation
	Band	BW	PCC UL Channel	PCC UL Frequency	PCC DL Channel	PCC DL Frequency	Modulation	RB	offset	Band	BW	SCC DL Channel	SCC DL Frequency	Band	BW	SCC DL Channel	SCC DL Frequency	Band	BW	SCC DL Channel	SCC DL Frequency	LTE Single Carrier Tx Power (dBm)	LTE Tx Power with DL CA Enabled(dBm)	
41A-41D	41	10	41148	2645.8	41148	2645.8	QPSK	1	24	41	20	39750	2506	41	20	41292	2660.2	41	20	41490	2680	24.06	23.77	-0.29
41C-41C	41	10	39894	2520.4	39894	2520.4	QPSK	1	24	41	20	39750	2506	41	20	41292	2660.2	41	20	41490	2680	24.06	23.92	-0.14
41C-41C	41	10	41346	2665.6	41346	2665.6	QPSK	1	24	41	20	39750	2506	41	20	39948	2525.8	41	20	41490	2680	24.06	23.76	-0.30
41D-41A	41	10	40092	2540.2	40092	2540.2	QPSK	1	24	41	20	39750	2506	41	20	39948	2525.8	41	20	41490	2680	24.06	23.75	-0.31
41A-41D(HPUE)	41	10	41148	2645.8	41148	2645.8	QPSK	1	24	41	20	39750	2506	41	20	41292	2660.2	41	20	41490	2680	25.19	25.03	-0.16
41C-41C(HPUE)	41	10	39894	2520.4	39894	2520.4	QPSK	1	24	41	20	39750	2506	41	20	41292	2660.2	41	20	41490	2680	25.19	25.11	-0.08
41C-41C(HPUE)	41	10	41346	2665.6	41346	2665.6	QPSK	1	24	41	20	39750	2506	41	20	39948	2525.8	41	20	41490	2680	25.19	25.17	-0.02
41D-41A(HPUE)	41	10	40092	2540.2	40092	2540.2	QPSK	1	24	41	20	39750	2506	41	20	39948	2525.8	41	20	41490	2680	25.19	25.21	0.02

LTE Down Link 5CA Call Setup

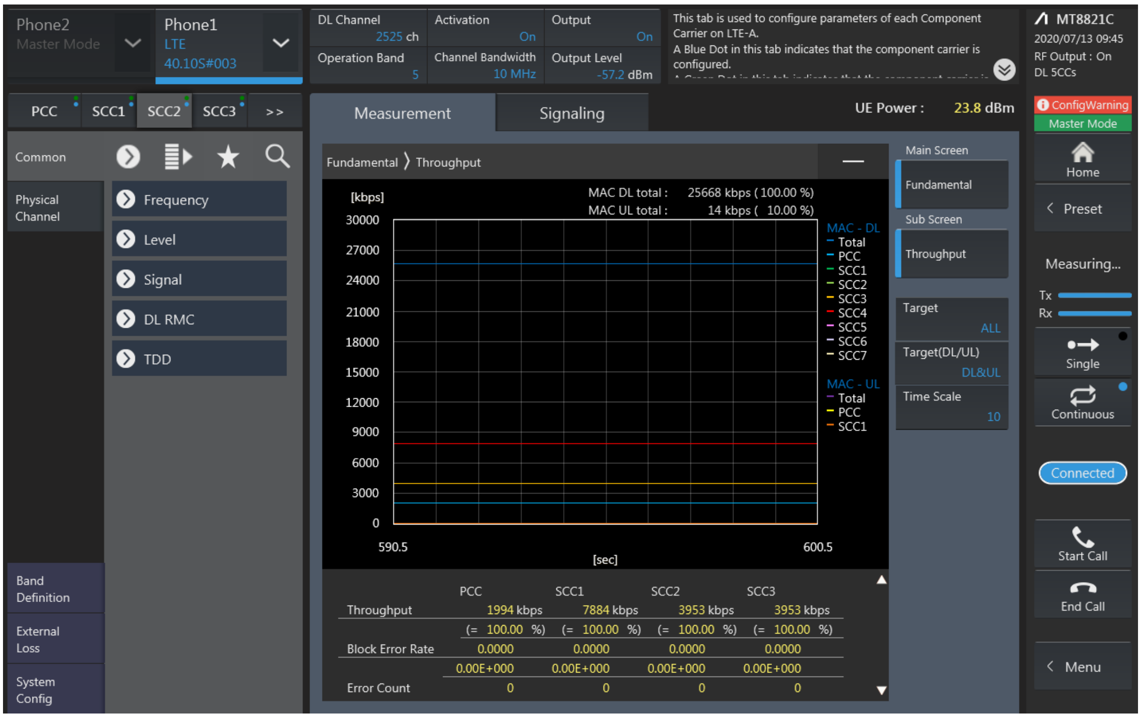
PCC Setting: Channel /RB/BW/Modulation



SCC1 Setting (Channel /RB/BW/Modulation)and call Connection

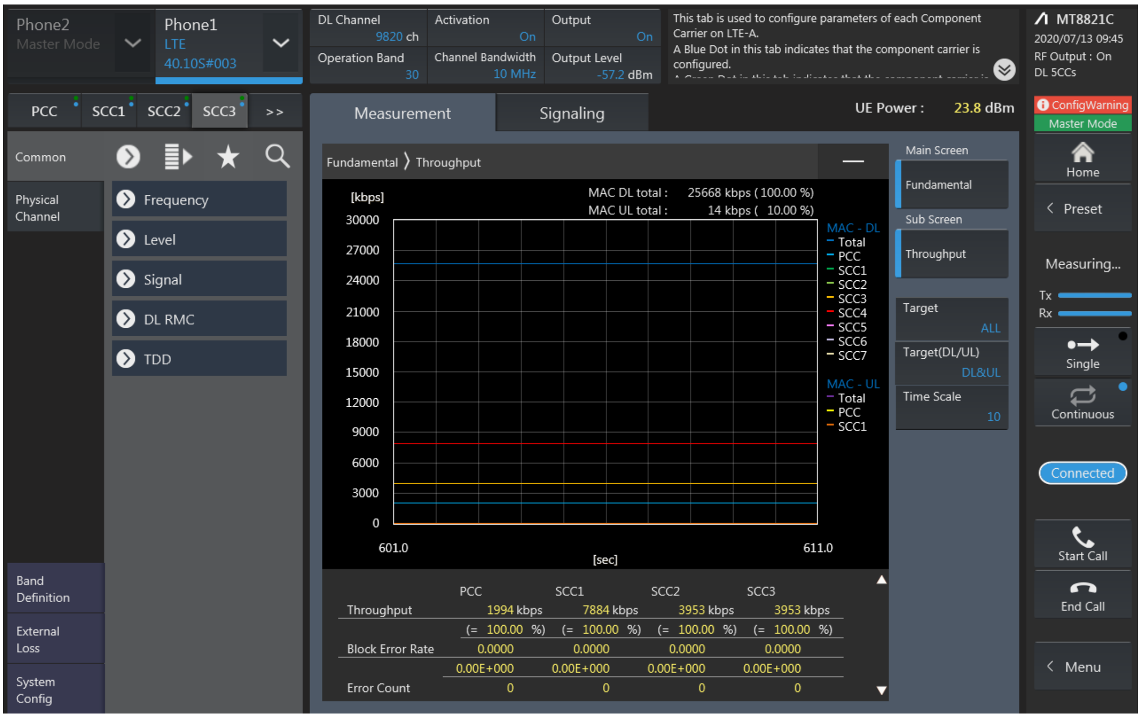


SCC2 Setting (Channel /RB/BW/Modulation)and call Connection



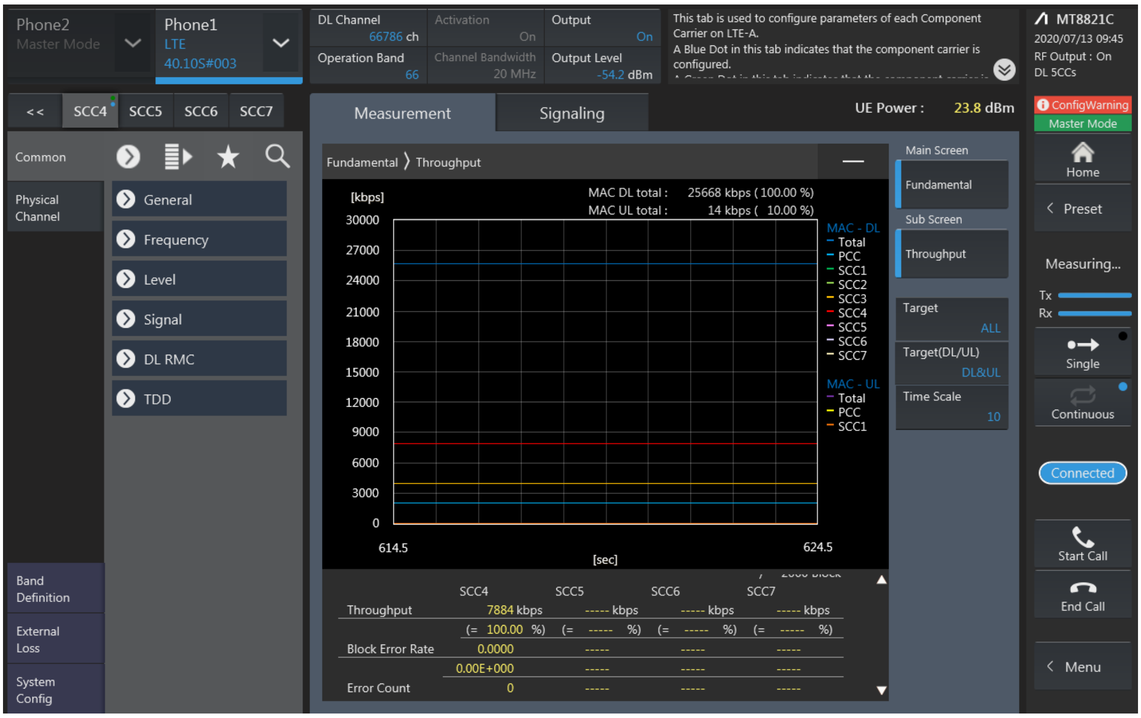
	PCC	SCC1	SCC2	SCC3
Throughput	1994 kbps	7884 kbps	3953 kbps	3953 kbps
	(= 100.00 %)	(= 100.00 %)	(= 100.00 %)	(= 100.00 %)
Block Error Rate	0.0000	0.0000	0.0000	0.0000
	0.00E+000	0.00E+000	0.00E+000	0.00E+000
Error Count	0	0	0	0

SCC3 Setting (Channel /RB/BW/Modulation)and call Connection



	PCC	SCC1	SCC2	SCC3
Throughput	1994 kbps	7884 kbps	3953 kbps	3953 kbps
	(= 100.00 %)	(= 100.00 %)	(= 100.00 %)	(= 100.00 %)
Block Error Rate	0.0000	0.0000	0.0000	0.0000
	0.00E+000	0.00E+000	0.00E+000	0.00E+000
Error Count	0	0	0	0

SCC4 Setting (Channel /RB/BW/Modulation)and call Connection



5CA Downlink Carrier aggregation Maximum conducted Powers

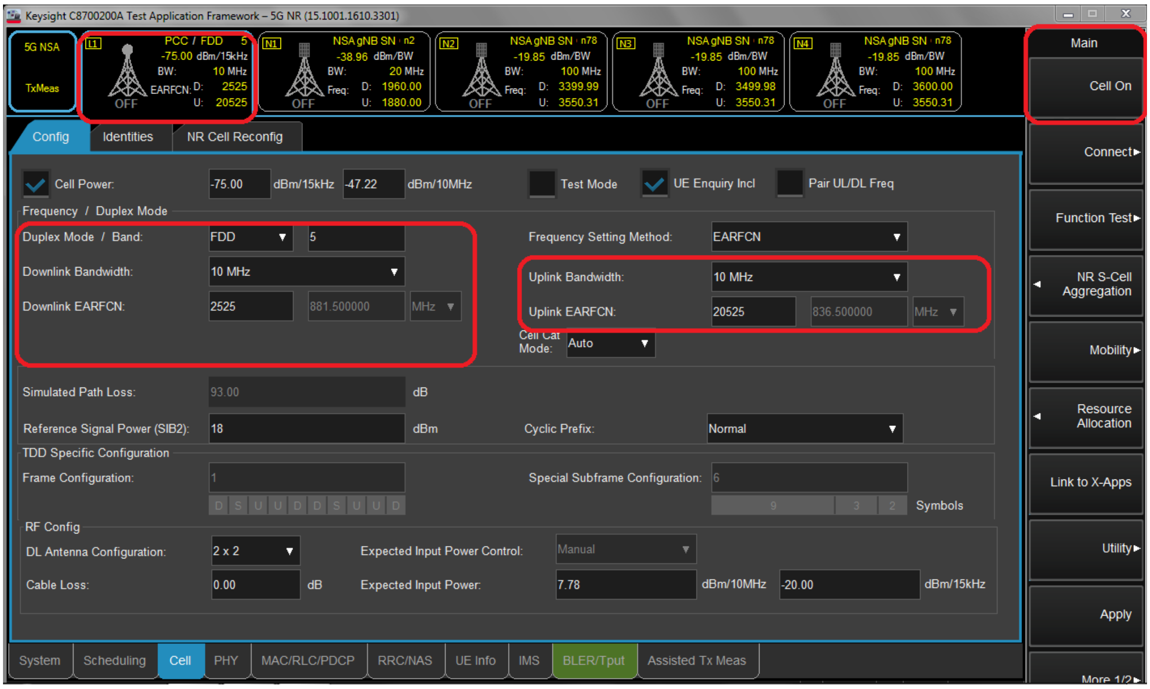
Combination	PCC									SCC				SCC				SCC				SCC				Tx Power		Deviation
	Band	BW	PCC UL Channel	PCC UL Frequency	PCC DL Channel	PCC DL Frequency	Modulation	RB	offset	Band	BW	SCC DL Channel	SCC DL Frequency	Band	BW	SCC DL Channel	SCC DL Frequency	Band	BW	SCC DL Channel	SCC DL Frequency	Band	BW	SCC DL Channel	SCC DL Frequency	LTE Single Carrier Tx Power (dBm)	LTE Tx Power with DL CA Enabled(dBm)	
41C-41D	41	10	40620	2593	40620	2593	QPSK	1	24	41	20	40764	2607.4	41	20	41094	2640.4	41	20	41292	2660.2	41	20	41490	2680	24.06	23.86	-0.20
41D-41C	41	10	40620	2593	40620	2593	QPSK	1	24	41	20	40476	2578.6	41	20	40764	2607.4	41	20	41292	2660.2	41	20	41490	2680	24.06	23.85	-0.21
41C-41D(HPUE)	41	10	40620	2593	40620	2593	QPSK	1	24	41	20	40764	2607.4	41	20	41094	2640.4	41	20	41292	2660.2	41	20	41490	2680	25.19	25.11	-0.08
41D-41C(HPUE)	41	10	40620	2593	40620	2593	QPSK	1	24	41	20	40476	2578.6	41	20	40764	2607.4	41	20	41292	2660.2	41	20	41490	2680	25.19	25.12	-0.07

2. 5G NR Call Box Setup

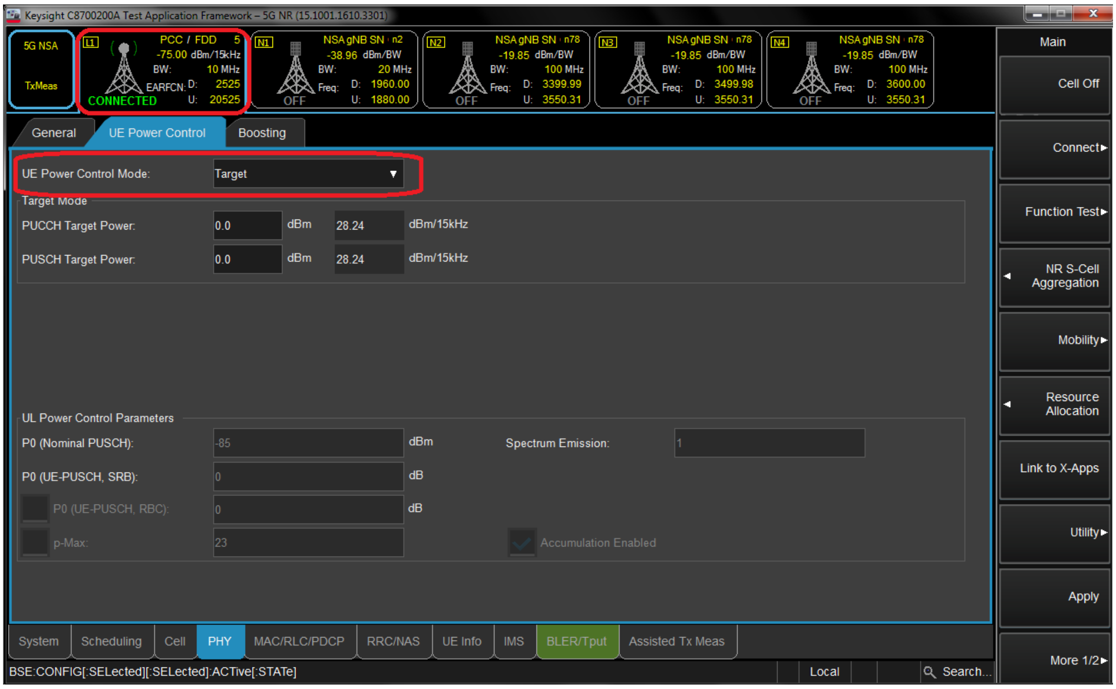
Procedure used to establish output Power measurement for NR Bands

Select operating band, BW and Channel.

- Click Cell on button in the right of Test application screen.
- Turn the LTE Cell On using "ON/OFF" Key.

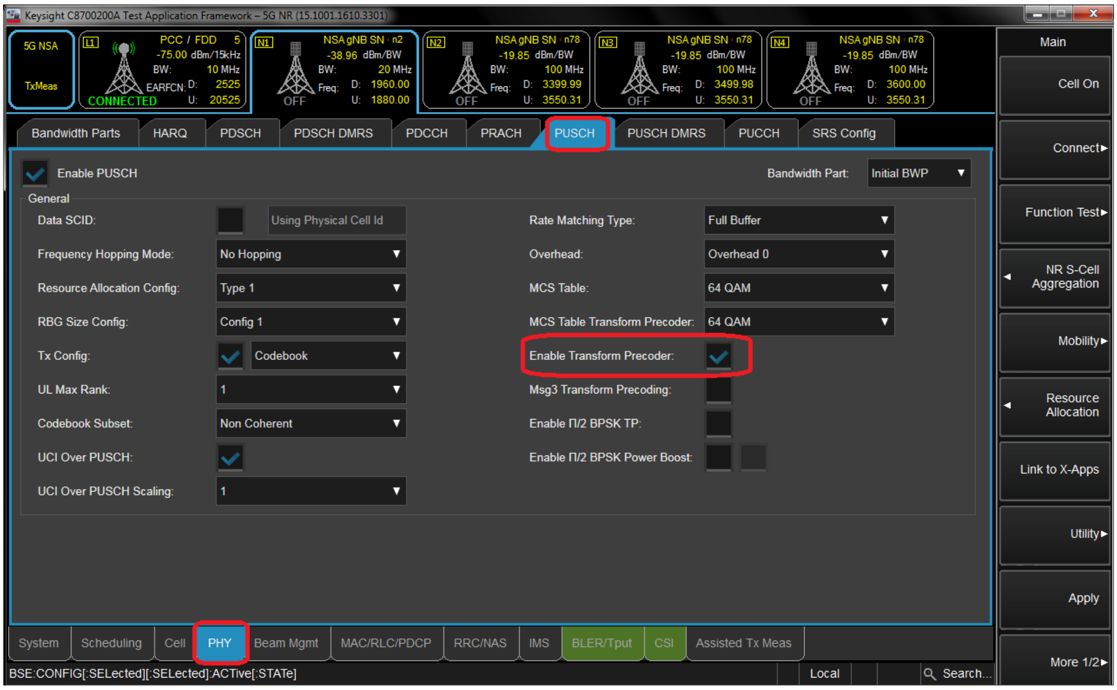


- Turn the Airplane Mode On and then turn the Airplane mode off.
- Select All down bits for UL Power control Mode in LTE.

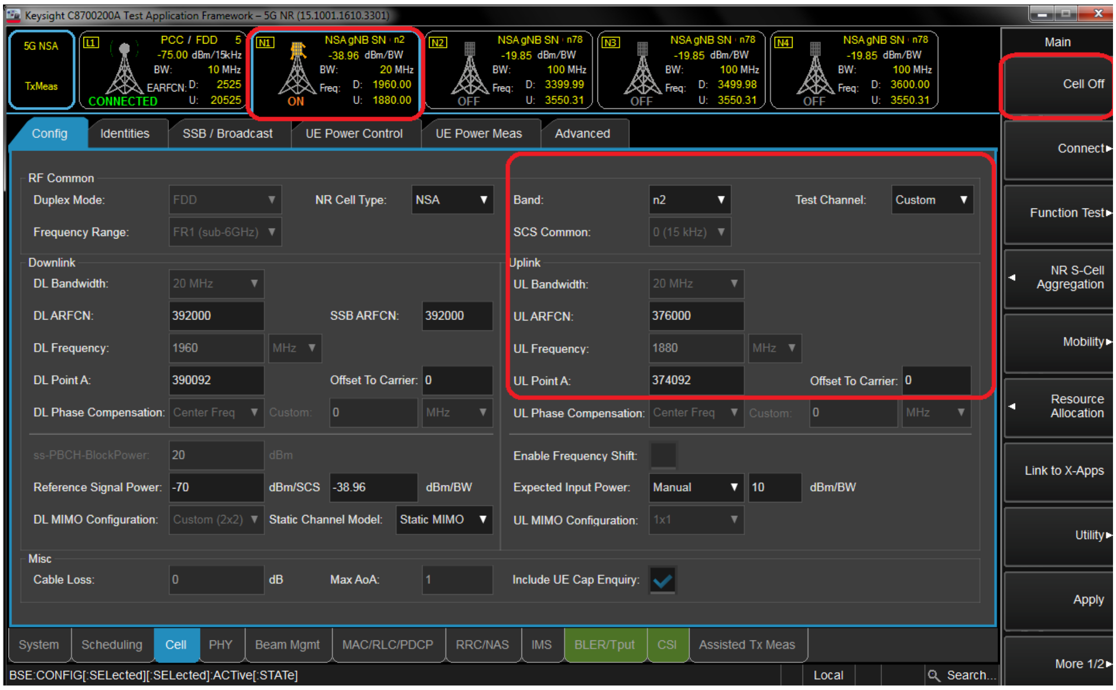


Setup for NR Band

- Select waveform for Setting NR Band (PHY->PUSCH->Enable Transform Precoder)
  - Enable : DFT-s-OFDM, Disable : CP-OFDM



- Select operating band, BW, SCS and Channel.
- Turn the NR Cell On using “ON/OFF” Key.

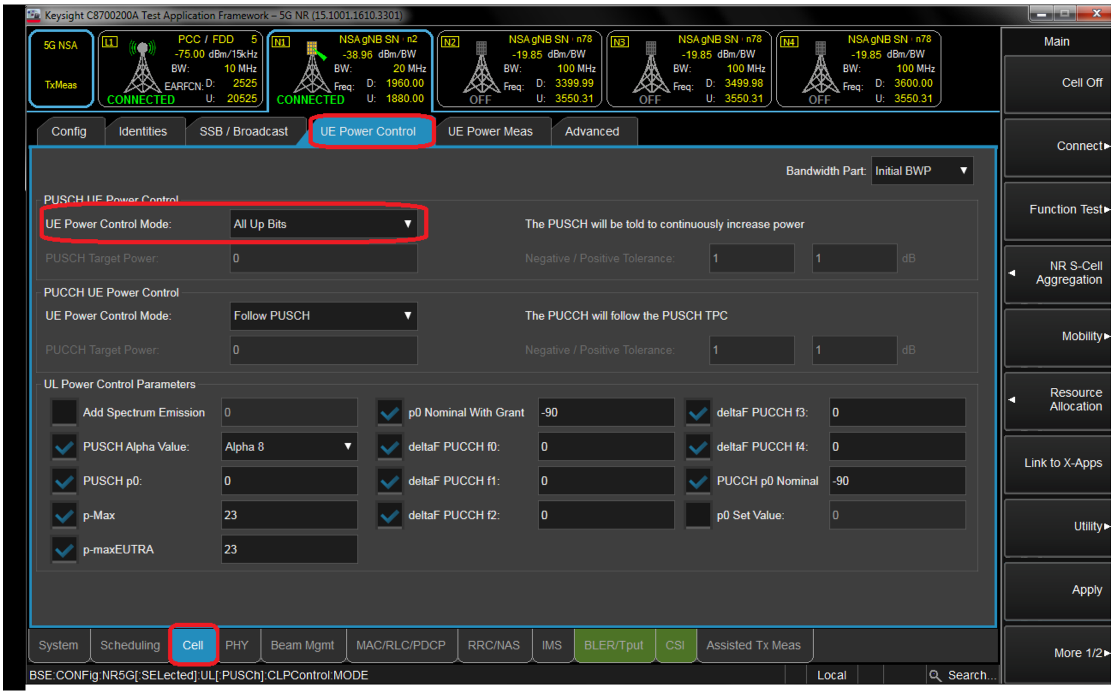


Connect NR S-Cell Aggregation

- Click NR S-Cell Aggregation
- Check the Cell 1's DL and UL box(PCC) and than Click Apply.
- Check the message summary If message shows NR Msg 5, It is connected.

Max Power setting

- Click "Cell in the bottom of screen.
- Click "UE Power control" than change UE Power control mode to All Up bits.



Selecting Start RB/Count/MCS

- Select the each test configurating (Start RB, Count, MCS).

View Tx Power

- Click "Link to X-Apps."(Please refer to Figure-7)
- Select "Channel Power".