



## **HAC T-COIL SIGNAL TEST REPORT**

**FCC 47 CFR § 20.19  
ANSI C63.19-2019**

*For*

**GSM/WCDMA/LTE/5G NR Phone + BT/BLE, DTS/UNII a/b/g/n/ac/ax and NFC**

**MODEL NUMBER : SM-A366U, SM-A366U1, SM-S366V**

**FCC ID: A3LSMA366U**

**REPORT NUMBER: S-4791547056-S3V1**

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**Testing Laboratory**

**TL-637**

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## 1. Attestation of Test Results

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                   |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|
| Applicant Name                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | SAMSUNG ELECTRONICS CO.,LTD.                                                      |
| FCC ID                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | A3LSMA366U                                                                        |
| Model Name                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | SM-A366U, SM-A366U1, SM-S366V                                                     |
| Applicable Standards                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | FCC 47 CFR § 20.19<br>ANSI C63.19-2019                                            |
| Date Tested                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 2024-11-29 to 2024-12-15                                                          |
| Test Results                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Pass                                                                              |
| <p>UL Korea, Ltd. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by UL Korea, Ltd. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.</p> <p><b>Note:</b> The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL Korea, Ltd. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Korea, Ltd. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by IAS, any agency of the Federal Government, or any agency of any government.</p> |                                                                                   |
| Approved & Released By:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Prepared By:                                                                      |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |  |
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## 2. Test Methodology

The tests documented in this report were performed in accordance with ANSI C63.19-2019 Methods of Measurement of Compatibility between Wireless Communications Devices and Hearing Aids and FCC published procedure.

KDB 285076 D01 HAC Guidance v06r04  
 KDB 285076 D02 T-Coil testing for CMRS IP v04  
 KDB 285076 D03 HAC FAQ v01r07  
 TCB workshop updates

## 3. Facilities and Accreditation

The test sites and measurement facilities used to collect data are located at

|                  |
|------------------|
| Suwon            |
| SAR 6 Room (HAC) |

UL Korea, Ltd. is accredited by IAS, Laboratory Code TL-637.

The full scope of accreditation can be viewed at <https://www.iasonline.org/wp-content/uploads/2017/05/TL-637-cert-New.pdf>

## 4. Calibration and Uncertainty

### 4.1. Measuring Instrument Calibration

The measuring equipment used to perform the tests documented in this report has been calibrated in accordance with the manufacturers' recommendations and is traceable to recognized national standards.

| Name of Equipment            | Manufacturer  | Type/Model    | Serial No.   | Cal. Due Date |
|------------------------------|---------------|---------------|--------------|---------------|
| ABM Probe                    | SPEAG         | AM1DV3        | 3140         | 2025-09-17    |
| Data Acquisition Electronics | SPEAG         | DAE4          | 1468         | 2025-08-15    |
| AMMI                         | SPEAG         | SE UMS 010 BB | 1161         | N/A           |
| Radio Communication Tester   | R & S         | CMW 500       | 150314       | 2025-07-24    |
| Wireless Test Platform       | Keysight      | E7515B        | MY57510596   | 2025-07-30    |
| Support Device               | Samsung       | SM-S921U      | R3CW80J5ERY  | N/A           |
| DAC                          | Sound Devices | USBPre 2      | HB1218172005 | N/A           |
| Thermometer                  | Lutron        | MHB-382SD     | AK.18789     | 2025-07-24    |

## 4.2. Measurement Uncertainty

### Measurement Uncertainty for Audio Band Magnetic Measurement

| Error Description                                                   | Explanation | Uncertainty value (±%) for ANSI C63.19-2019 | Probe Dist. | Divisor | (Ci) ABM1 | (Ci) ABM2 | Std. Unc.(±%) for ANSI C63.19-2019 |       |
|---------------------------------------------------------------------|-------------|---------------------------------------------|-------------|---------|-----------|-----------|------------------------------------|-------|
|                                                                     |             |                                             |             |         |           |           | ABM1                               | ABM2  |
| Probe Sensitivity                                                   |             |                                             |             |         |           |           |                                    |       |
| Reference Level                                                     | B.1         | 3.00                                        | Normal      | 1       | 1         | 1         | 3.00                               | 3.00  |
| AMCC Geometry                                                       | B.2         | 0.40                                        | Rectangular | 1.732   | 1         | 1         | 0.23                               | 0.23  |
| AMCC Current                                                        | B.3         | 1.00                                        | Rectangular | 1.732   | 1         | 1         | 0.58                               | 0.58  |
| Probe Positioning during Calibration                                | B.4         | 0.10                                        | Rectangular | 1.732   | 1         | 1         | 0.06                               | 0.06  |
| Noise Contribution                                                  | B.5         | 0.70                                        | Rectangular | 1.732   | 0.0143    | 1         | 0.01                               | 0.40  |
| Frequency Slope                                                     | B.6         | 5.90                                        | Rectangular | 1.732   | 0.1       | 1         | 0.34                               | 3.41  |
| Probe System                                                        |             |                                             |             |         |           |           |                                    |       |
| Repeatability / Drift                                               | B.7         | 1.00                                        | Rectangular | 1.732   | 1         | 1         | 0.58                               | 0.58  |
| Linearity / Dynamic Range                                           | B.8         | 0.60                                        | Rectangular | 1.732   | 1         | 1         | 0.35                               | 0.35  |
| Acoustic Noise                                                      | B.9         | 1.00                                        | Rectangular | 1.732   | 0.1       | 1         | 0.06                               | 0.58  |
| Probe Angle                                                         | B.10        | 1.00                                        | Rectangular | 1.732   | 1         | 1         | 0.58                               | 0.58  |
| Spectral Processing                                                 | B.11        | 0.90                                        | Rectangular | 1.732   | 1         | 1         | 0.52                               | 0.52  |
| Integration Time                                                    | B.12        | 0.60                                        | Normal      | 1       | 1         | 5         | 0.60                               | 3.00  |
| Field Disturbation                                                  | B.13        | 0.20                                        | Rectangular | 1.732   | 1         | 1         | 0.12                               | 0.12  |
| Test Signal                                                         |             |                                             |             |         |           |           |                                    |       |
| Ref. Signal Spectral Response                                       | B.14        | 0.60                                        | Rectangular | 1.732   | 0         | 1         | 0.00                               | 0.35  |
| Positioning                                                         |             |                                             |             |         |           |           |                                    |       |
| Probe Positioning                                                   | B.15        | 1.90                                        | Rectangular | 1.732   | 1         | 1         | 1.10                               | 1.10  |
| Phantom Thickness                                                   | B.16        | 0.90                                        | Rectangular | 1.732   | 1         | 1         | 0.52                               | 0.52  |
| DUT Positioning                                                     | B.17        | 1.90                                        | Rectangular | 1.732   | 1         | 1         | 1.10                               | 1.10  |
| External Contributions                                              |             |                                             |             |         |           |           |                                    |       |
| RF interference                                                     | B.18        | 0.00                                        | Rectangular | 1.732   | 1         | 0.3       | 0.00                               | 0.00  |
| Test Signal Varistion                                               | B.19        | 2.00                                        | Rectangular | 1.732   | 1         | 1         | 1.15                               | 1.15  |
| Combined Std, Uncertainty (ABM Field)                               |             |                                             |             |         |           |           | 3.90                               | 5.97  |
| Expanded Std. Uncertainty                                           |             |                                             |             |         |           |           | 7.80                               | 11.95 |
| Notes for table                                                     |             |                                             |             |         |           |           |                                    |       |
| 1. Ci - is te sensitivity coefficient                               |             |                                             |             |         |           |           |                                    |       |
| 2. Expanded Std. Uncertainty, Coverage Factor = 2, > 95% Confidence |             |                                             |             |         |           |           |                                    |       |

## 4.3. Decision Rule

Measurement Uncertainty is not applied when providing statements of conformity in accordance with IEC Guide 115:2023, 4.3.3.

## 5. Test Procedures for all Technologies

### 5.1. General Procedures C63.19-2019, Section 6

This subclause describes the procedures used to measure the ABM (T-Coil) performance of the WD. Measurements shall be performed over a measurement area 50 mm square in the measurement plane. The measurement area shall be scanned with a uniform measurement point spacing of  $2.0 \text{ mm} \pm 0.5 \text{ mm}$  in each X-Y axis of the plane, yielding 676 measurement points with approximately even spacing throughout the area.

Optionally, measurement point spacing may be increased to 4 mm, with interpolation employed to yield the required 676 equivalent measurement points distributed uniformly over the 50 mm square measurement area. Interpolated points shall be derived from the average of the linear representations of the field strengths of the nearest two or four equidistant measured points. The area of measurement is increased to a 52 mm square so that edge rows and columns of the required 50 mm square can be either measured or interpolated, with none extrapolated.

In addition to measuring the desired ABM signal levels, the weighted magnitude of the unintended signal shall also be determined. Weighting of the unintended and undesired ABM field shall be by the spectral and temporal weighting.

In order to assure that the required signal quality is measured, the measurement of the intended signal and the measurement of the unintended signal shall be made at the same locations. Measurements shall not include undesired influence from the WD's RF field. Pre-measurement checks should be made to avoid this possibility. All measurements shall be done with the WD operating on battery power with an appropriate normal speech audio signal input level given in Table 6.1. If the device display can be turned off during a phone call, then that may be done during the measurement as well. If tested with the display in the off state this shall be documented in the test report.

Measurements shall be performed with the probe coil oriented in the transverse direction, that is, aligned in the plane of the measurement area and perpendicular to the long dimension of the WD. A multi-stage sequence consists of first measuring the field strength of the desired T-Coil signal (desired ABM signal) that is useful to a hearing aid T-Coil at each specified measurement point. The undesired magnetic component (undesired ABM field) is then measured in the same transverse orientation at each of the same measurement points. At a single location only, taken at or near the highest desired ABM signal reading, the desired ABM signal frequency response shall be determined in a third measurement stage.

The following steps summarize the basic test flow for determining desired ABM signal and undesired ABM field. These steps assume that a sine wave or narrowband 1/3 octave signal can be used for the measurement of desired ABM signal level.

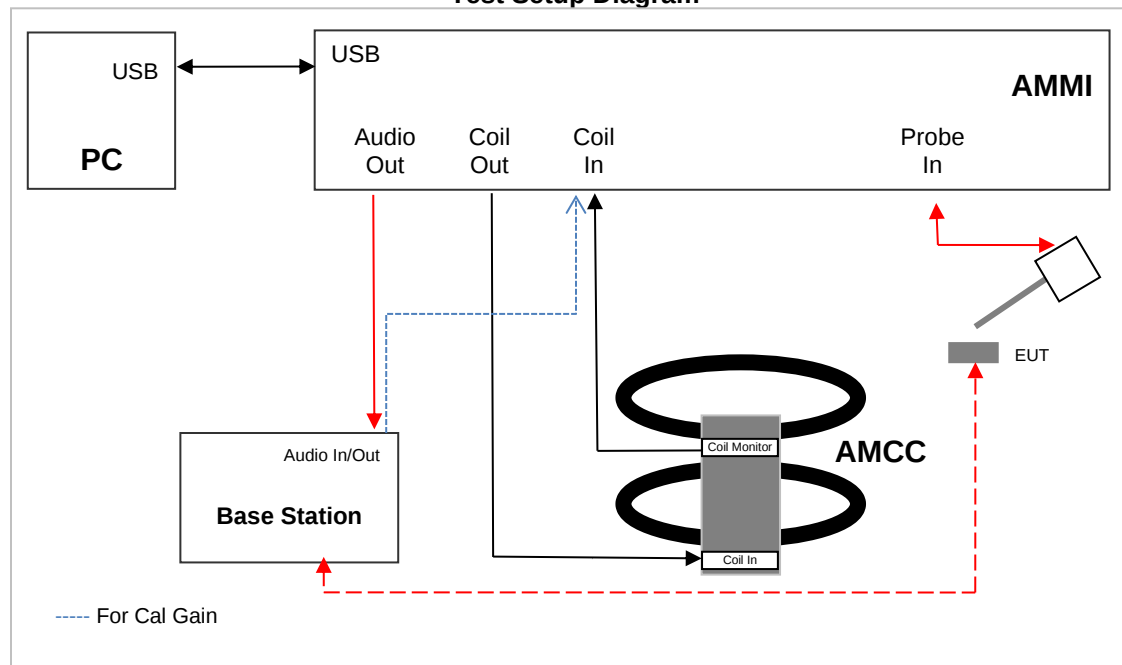
- a) A validation of the test setup and instrumentation shall be performed. This may be done using a TMFS or Helmholtz Coil. Measure the emissions and confirm that they are within tolerance of the expected values.
- b) Confirm that equipment that requires calibration has been calibrated, and that the noise level meets the requirements given in 6.3.2.
- c) Position the WD in the test setup and connect the WD RF connector to a base station simulator or a non-radiating load (if necessary to control RF interference in the measurement equipment) as shown in Figure 6.1 or Figure 6.2.
- d) The drive level to the WD is set such that the reference input level specified in Table 6.1 is input to the base station simulator (or manufacturer's test mode equivalent) in the 1 kHz, 1/3 octave band. This drive level shall be used for the T-Coil signal test (desired ABM signal) at  $f = 1 \text{ kHz}$ . Either a sine wave at 1025 Hz, or a voice-like signal, band-limited to the 1 kHz 1/3 octave, as specified in 6.4.3, shall be used for the reference audio signal. If interference is found at 1025 Hz an alternative nearby reference audio signal frequency may be used.<sup>35</sup> The same drive level will be used for the desired ABM signal frequency response measurements at each 1/3 octave band center frequency. The WD volume control may be set at any level up to maximum, provided that a signal at any frequency at maximum modulation would not result in clipping or signal overload.
- e) At each measurement location over the measurement area and in the transverse orientation, measure and record the desired 1 kHz T-Coil magnetic signal (desired ABM signal) as described in Step c).
- f) At or near a location representing a maximum in the just-measured desired ABM signal, measure and record the desired T-Coil magnetic signals (desired ABM signal at  $f_i$ ) as described in 6.4.5.2 in each individual ISO 266:1975 R10 standard 1/3 octave band. The desired audio band input frequency ( $f_i$ ) shall be centered in each 1/3 octave band maintaining the same drive level as determined in Step c), and the reading taken for that band.

Equivalent methods of determining the frequency response may also be employed, such as fast Fourier transform (FFT) analysis using noise excitation or input-output comparison using simulated speech. The full-band integrated or half-band integrated probe output, as described in D.9, may be used, as long as the

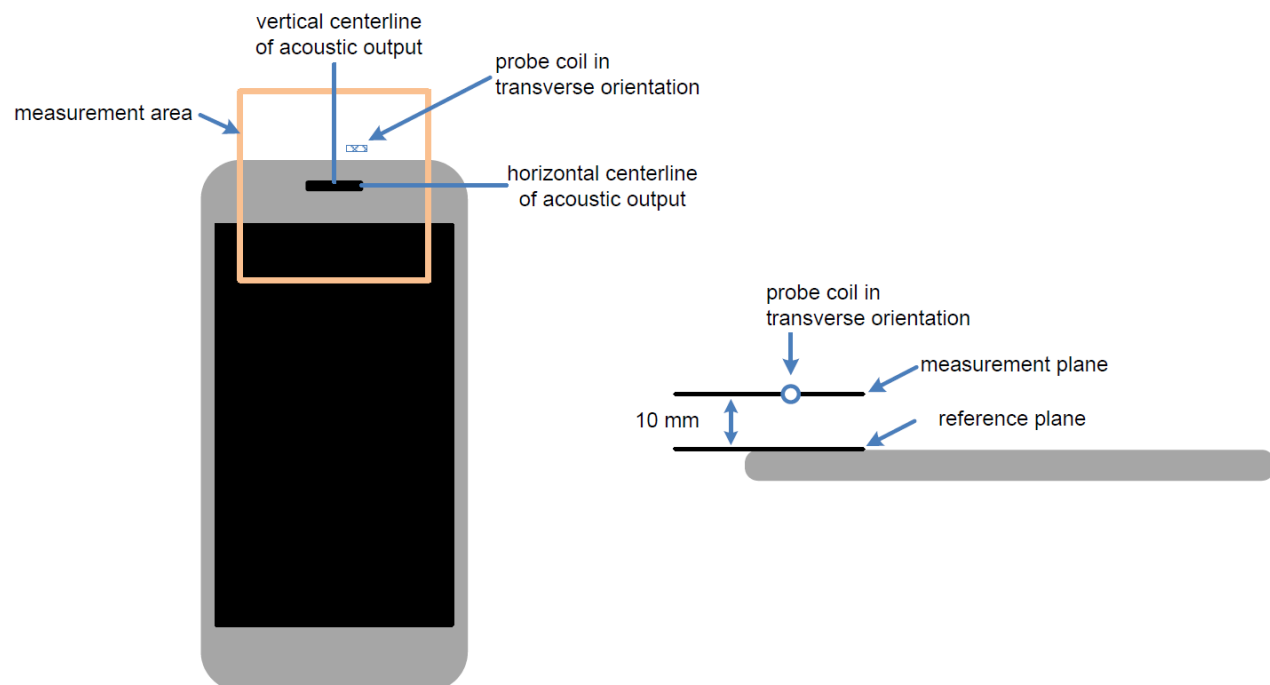
appropriate calibration curve is applied to the measured result, so as to yield an accurate measurement of the field magnitude. (The resulting measurement shall be an accurate measurement in dB(A/m).) Compare the frequency response found to the requirements of 6.6.3.

- g) At the same locations measured in Step d), measure and record the undesired broadband audio magnetic signal (undesired ABM field) with no audio signal applied (or digital zero applied, if appropriate) using the specified spectral weighting, the half-band integrator followed by the temporal weighting.
- h) Calculate and record the location and number of the measurement points that satisfy both the minimum desired ABM signal level and the maximum undesired ABM field level specified in 6.6.2. Compare this to the requirements in 6.6.4 and record the result.
- i) Calculate and record the location and number of the measurement points that satisfy the maximum undesired ABM field level and distribution requirements specified in 6.6.4.

**Test Setup Diagram**



**Measurement locations and reference plane to be used for the T-coil measurement**



## 5.2. Reference Input Level

The following reference input levels (Table 6.1) that correlate to a normal speech input level shall be used for the standard transmission protocols.

Normal speech input level -16 dBm0 is used for all testing: GSM, WCDMA, VoLTE, VoNR, VoWiFi and OTT(Google Meet).

**Table 6.1—Normal speech input levels**

| Standard                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Protocol                     | Input (dBm0) |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|--------------|
| TIA-2000                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | CDMA                         | -18          |
| TIA/EIA-136                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | TDMA (50 Hz)                 | -18          |
| J-STD-007                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | GSM (217 Hz)                 | -16          |
| T1/T1P1/3GPP<br>(See Note 1)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | UMTS (WCDMA)                 | -16          |
| iDEN®                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | TDMA (22 Hz and 11 Hz)       | -18          |
| VoIP <sup>a</sup> (See Note 2)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Voice over Internet Protocol | -16          |
| NOTE 1—For UMTS (Universal Mobile Telecommunications System), refer to 3GPP TS26.131 and TS26.132 ( <a href="http://www.3gpp.org">http://www.3gpp.org</a> ).<br>NOTE 2—VoIP is used in this table as a general term specifying a group of voice services that use -16 dBm0 as their normal acoustic level. The group includes a variety of voice services, including Voice-over-LTE (VoLTE), Voice-over-IP-multimedia-subsystem (VoIMS), Voice-over-Wi-Fi (VoWiFi) and similar services. For 3G, LTE, and WLAN terminals used for Commercial Mobile Radio Service (CMRS) based telephony, refer to 3GPP TS26.131 and TS26.132. |                              |              |

<sup>a</sup> The manufacturer shall establish that -16 dBm0 is the normal acoustic level in order to place it in this category.

For protocols not listed in Table 6.1, use the normal speech input level per the relevant specifications for that air interface.

### 5.3. AMMI Audio Output Calibration and Gain

SPEAG DASY8 HAC T-Coil Measurement system provides to calibrate and compute the gain automatically for given Input level [V full scale] and Speech level [dBm0]. The Input level using in Base Station Simulator should be set same value as setting in T-Coil Measurement system. Gain value is mostly very similar if test system has same configuration.

The audio output calibration of the AMMI is performed as described below:

- Check the **Input level [V full scale]** and **Speech level [dBm0]**.
- Connect **Audio Out** to **Coil In** on the AMMI for CMRS testing, or add the DAC between **Audio Out** and **Coil In** for OTT testing.
- Click on the **Calibrate** button.
- Click on the **Compute Gain Settings**.
- Re-establish the cabling as for regular DUT measurements.

#### AMMI Calibration

Connect Audio Out to Coil In. Then press Calibrate.

The resulting calibration factor is displayed in the log output.

Before continuing, re-establish cabling.

Calibrate

#### Base Station Simulator Settings

Specify the base station simulator settings:

- The full scale input level equivalent to 3.14 dBm0
- The codec / system delay

The codec / system delay can also be measured using the Assess Delay function

Input level [V full scale]

1

Codec delay [s]

0.16

#### Reference Input Level

Specify the desired input speech level in dBm0 as per section 6.4.3 of ANSI C63.19-2019.

Speech level [dBm0]

-16

#### Area Scan Audio Settings

|                         |                       |
|-------------------------|-----------------------|
| Audio File              | 48k_voice_1kHz_1s.wav |
| Measurement Time [s]    | 2                     |
| Peak to Full Scale [dB] | -0.37                 |
| Peak to RMS Ratio [dB]  | 15.74                 |
| BWC [dB]                | 0.07                  |
| Scaling (Gain) [dB]     | -12.45                |

#### Frequency Scan Audio Settings

|                         |                           |
|-------------------------|---------------------------|
| Audio File              | 48k_voice_300-3000_2s.wav |
| Measurement Time [s]    | 2                         |
| Peak to Full Scale [dB] | 0                         |
| Peak to RMS Ratio [dB]  | 21.57                     |
| BWC [dB]                | 10.81                     |
| Scaling (Gain) [dB]     | -6.62                     |

Compute Gain Settings

## 5.4. VoWiFi

This device supports Wi-Fi calling (aka Voice over Wi-Fi or VoWiFi) which is an extended feature of the carriers CMRS service to offload VoLTE calls onto local area networks over WI-FI via the internet and subject to HAC assessment for phones with a HAC rating.

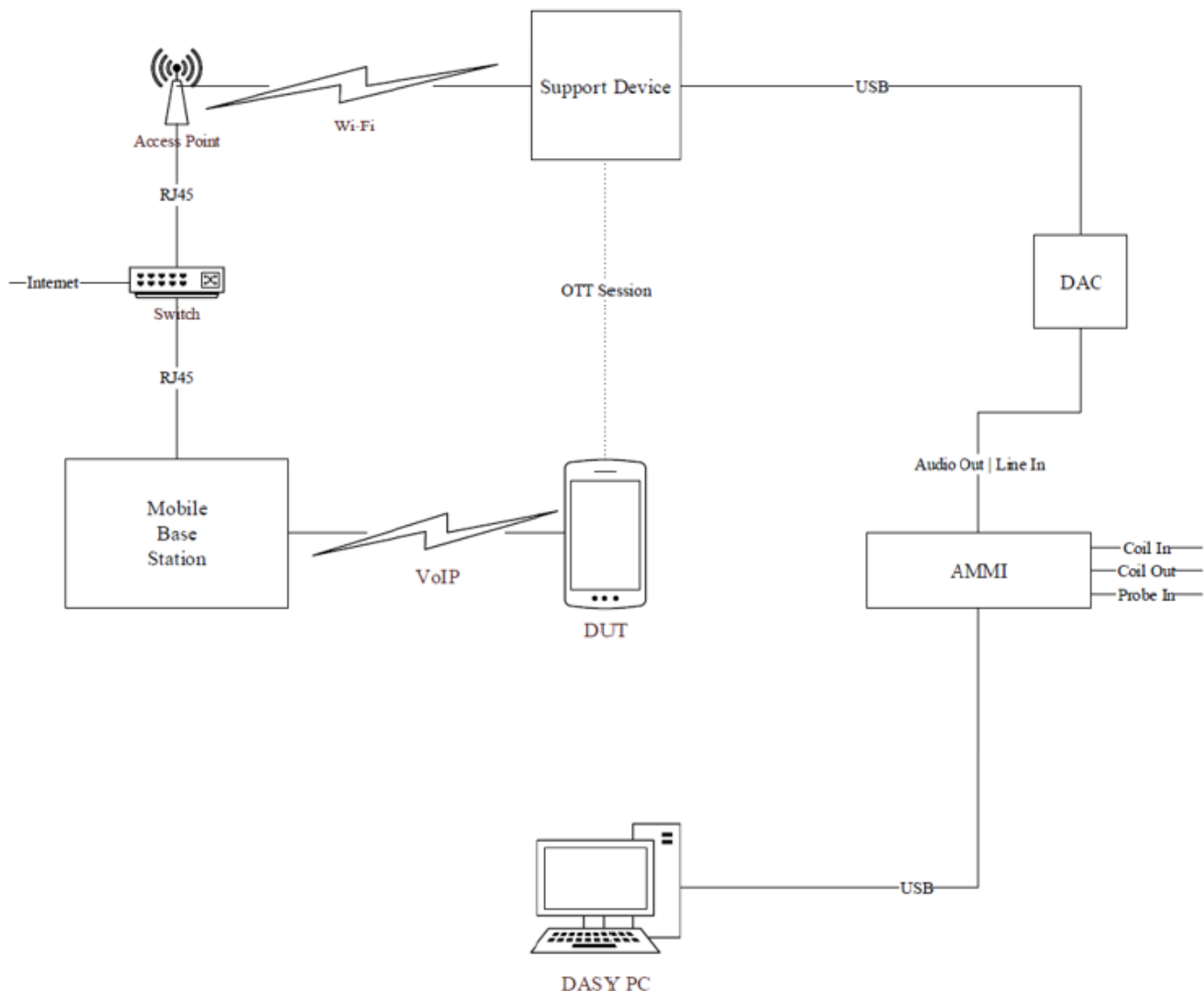
The set up for VoWiFi uses the Base station as described in section 5.1 and 5.3 and the reference level is calibrated using the standard call box calibration procedures. An investigation was performed to determine worst case codec, bit rate and air interface configuration (refer to section 9).

## 5.5. Over the Top (OTT)

This device supports VoIP via a preinstalled application that uses the **Google Meet service** and related codec “**OPUS**”. VoIP capabilities require HAC assessment when voice calls are supported over the cellular data connection via pre-installed applications.

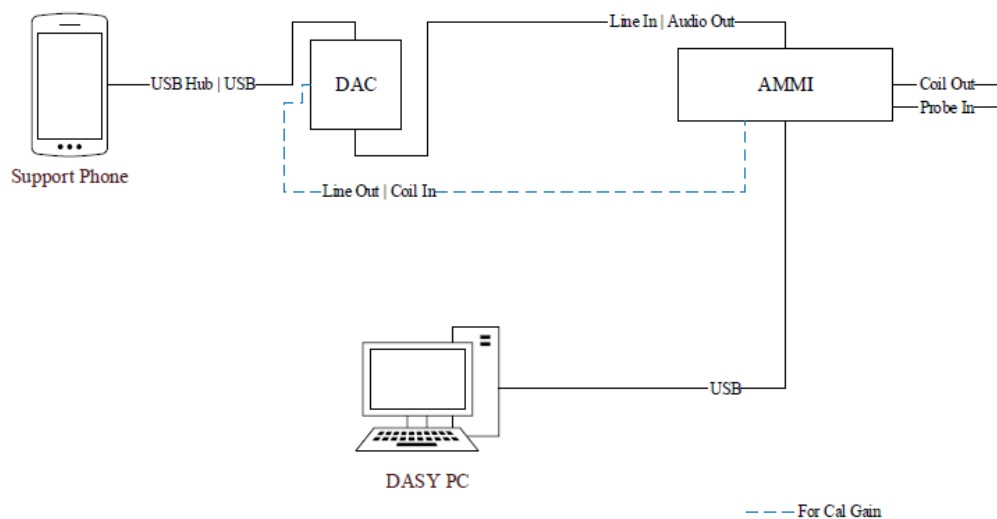
The equipment is set up as shown below with a support device used to originate the call using the IP transport. This support device includes test software that allows the codec bit rate for the IP call to be selected. The support device connects to the cloud-based Google Meet service via a Wi-Fi access point and router. The DUT connects to the VoIP service via a cellular air interface to the call box and an ethernet connection from call box to internet. The various codec bit rate and air interface configurations are evaluated to determine the worst-case configuration (refer to section 9).

Test Setup configuration for OTT Calls



For the OTT call the calibrated audio card cannot be used so the AMMI is connected to an external Digital-Analog Converter (DAC) and the DAC is connected to the Support Device via USB. The test signal is sent from the DASY PC to the AMMI, from the AMMI to the DAC, from the DAC to the Support Device, and, via the VoIP call, to the DUT.

As this test set up uses an external DAC between the AMMI's audio output and support device the appropriate gain factor for the OTT call has to be determined. This is done by connecting the DAC between the AMMI Audio output and Coil input as shown below.



## 6. Base Station Simulator – software/firmware

### 6.1. VoLTE

Refer to the below software/firmware License list for measurement VoLTE.

| Firmware          | License Keys | Software Name (CMW500) |
|-------------------|--------------|------------------------|
| V3.7.70 for LTE   | KS500        | LTE FDD R8 SIG BASIC   |
|                   | KS550        | LTE TDD R8 SIG BASIC   |
| V3.7.20 for Audio | KA100        | IP APPL ENABLING IPv4  |
|                   | KA150        | IP APPL ENABLING IPv4  |
|                   | KAA20        | IP APPL IMS BASIC      |
|                   | KM050        | DATA APPL MEAS         |
|                   | KS104        | EVS SPEECH CODEC       |

### 6.2. VoNR

Refer to the below software/firmware License list for measurement VoNR.

| License Option | Software Name (Keysight E7515B) |
|----------------|---------------------------------|
| C8700201A      | IMS-SIP Emulation               |
| C87350P1A      | 5G NR IP data                   |

### 6.3. VoWi-Fi

Refer to the below software/firmware License list for measurement VoWi-Fi.

| Firmware          | License Keys | Software Name (CMW500) |
|-------------------|--------------|------------------------|
| V3.7.50 for WLAN  | KS650        | WLAN A/B/G SIG BASIC   |
|                   | KS651        | WLAN N SIG BASIC       |
|                   | KS656        | WLAN IEEE 802.11ac     |
|                   | KS657        | WLAN IEEE 802.11ax     |
| V3.7.20 for Audio | KA100        | IP APPL ENABLING IPv4  |
|                   | KA150        | IP APPL ENABLING IPv6  |
|                   | KAA20        | IP APPL IMS BASIC      |
|                   | KM050        | DATA APPL MEAS         |
|                   | KS104        | EVS SPEECH CODEC       |

## 7. T-coil Coupling Mode Requirements

In order to comply with the requirements for T-Coil use, a WD's tested operating modes shall simultaneously meet the requirements for minimum desired ABM signal level and maximum undesired ABM field contained in this subclause at the minimum specified number of scanned locations.

### 7.1. T-Coil Coupling qualifying field strengths

When measured as specified in this standard, there are two groups of qualifying measurement points:

- **Primary group:** A qualifying measurement point shall have its T-Coil signal, desired ABM signal,  $\geq -18$  dB(A/m) at 1 kHz, in a 1/3 octave band filter. These measurements shall be made with the WD operating at a reference input level as specified. Simultaneously, the qualifying measurement point shall have its weighted magnetic noise, undesired ABM field  $\leq -38$  dB(A/m).
- **Secondary group:** A qualifying measurement point shall have its weighted magnetic noise, undesired ABM field  $\leq -38$  dB(A/m). This group inherently includes all the members of the primary group.

### 7.2. Desired ABM signal, undesired ABM field qualification requirements

#### a) Non-2G GSM operating modes

The goal of this requirement is to ensure an adequate area where desired ABM signal is sufficiently strong to be heard clearly and a larger area where undesired ABM field is sufficiently low as to avoid undue annoyance. Qualifying measurement points shall fulfill the requirements of 6.6.2; both the primary and secondary group requirements shall be met:

- The primary group shall include at least 75 measurement points.
- The secondary group shall include at least 300 contiguous measurement points.

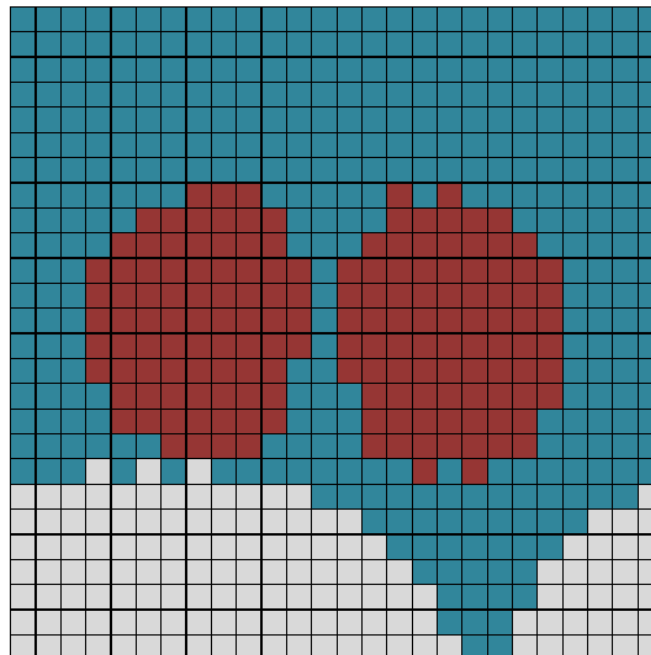
Additionally, to avoid an oddly shaped area of low noise, the secondary group shall include at least one longitudinal column of at least 10 contiguous qualifying points and at least one transverse row containing at least 15 contiguous qualifying points.

#### b) 2G GSM operating modes

If the 2G GSM operating mode(s) are selected for qualification, the qualifying measurement points shall fulfill the requirements of 6.6.2; both the primary and secondary group requirements shall be met:

- The primary group shall include at least 25 measurement points.
- The secondary group shall include at least 125 contiguous measurement points.

**An example of a qualifying desired ABM signal, undesired ABM field scan**

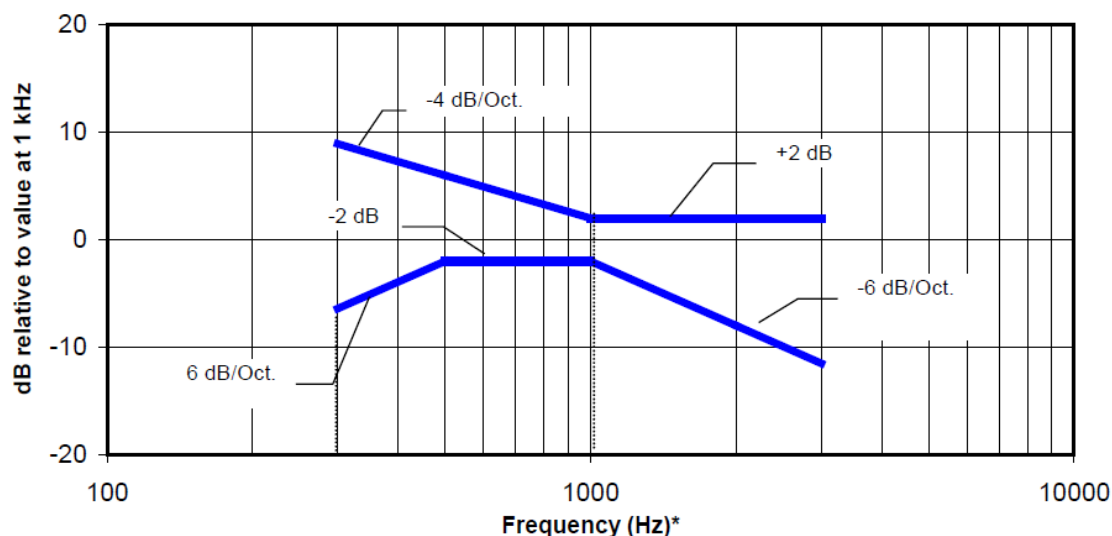


Red (primary group): AB desired ABM signal  $M1 \geq -18$  dB(A/m) and undesired ABM field  $\leq -38$  dB(A/m)  
 Blue and red (secondary group): undesired ABM field  $\leq -38$  dB(A/m)

### 7.3. Frequency Response

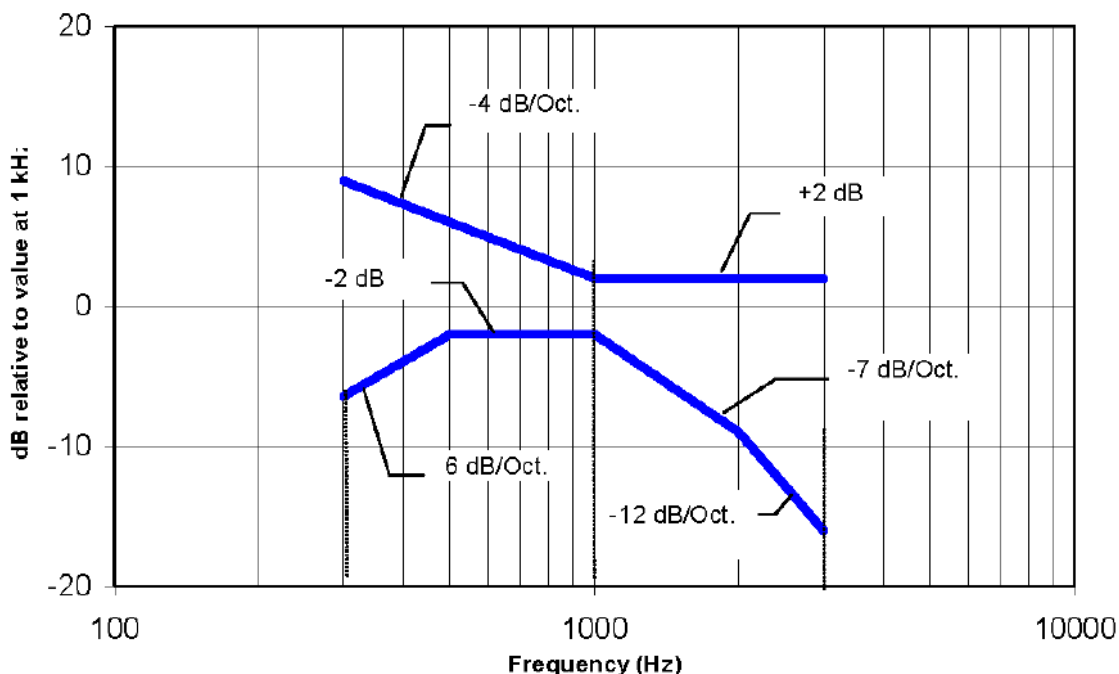
The frequency response of the magnetic field, measured in 1/3 octave bands, shall follow the response curve specified in this subclause, over the frequency range 300 Hz to 3 kHz.

Figure 6.4 and Figure 6.5 provide the boundaries for the specified frequency. These response curves are for true field strength measurements of the T-Coil signal. Thus the 6 dB/octave probe response has been corrected from the raw readings.



NOTE—Frequency response is between 300 Hz and 3 kHz.

**Figure 6.4—Magnetic field frequency response for WDs with a maximum field  $\leq -15$  dB(A/m) at 1 kHz**



NOTE—Frequency response is between 300 Hz and 3000 Hz.

**Figure 6.5—Magnetic field frequency response for WDs with a maximum field that exceeds  $-15$  dB(A/m) at 1 kHz**

8. Device Under Test

|                         |                                 |                    |
|-------------------------|---------------------------------|--------------------|
| Normal operation        | Held to head                    |                    |
| Back Cover              | The Back Cover is not removable |                    |
| Test sample information | <b>S/N</b>                      | <b>Notes</b>       |
|                         | R3CXA0QK8VZ                     | T-coil Signal Test |
|                         | R3CXA0QK8SW                     | T-coil Signal Test |

## 8.1. Air Interfaces and Operating Mode

| Air Interface | Bands (MHz)       | Type | C63.19 Tested | Simultaneous Transmitter | OTT Testing Required?<br>Name of Voice Service | Audio Codecs Evaluated       |
|---------------|-------------------|------|---------------|--------------------------|------------------------------------------------|------------------------------|
| GSM           | 850               | VO   | Yes           | Wi-Fi and BT             | CMRS                                           | FR V1, FR V2, HR V1          |
|               | 1900              |      |               |                          |                                                |                              |
|               | GPRS/EDGE         | VD   | Yes           | Wi-Fi and BT             | Yes<br>Google Meet                             | OPUS                         |
| W-CDMA (UMTS) | 850 (V)           | VO   | Yes           | Wi-Fi and BT             | CMRS                                           | AMR-NB & AMR-WB              |
|               | 1750 (IV)         |      |               |                          |                                                |                              |
|               | 1900 (II)         |      |               |                          |                                                |                              |
|               | HSPA              | VD   | Yes           | Wi-Fi and BT             | Yes<br>Google Meet                             | OPUS                         |
| LTE - FDD     | 680 (B71)         | VD   | Yes           | NR, Wi-Fi and BT         | VoLTE<br>Yes<br>Google Meet                    | AMR-NB, AMR-WB, EVS and OPUS |
|               | 700 (B12)         |      |               |                          |                                                |                              |
|               | 780 (B13)         |      |               |                          |                                                |                              |
|               | 790 (B14)         |      |               |                          |                                                |                              |
|               | 850 (B5/26)       |      |               |                          |                                                |                              |
|               | 1700 (B4/66)      |      |               |                          |                                                |                              |
|               | 1900 (B2/25)      |      |               |                          |                                                |                              |
|               | 2300 (B30)        |      |               |                          |                                                |                              |
|               | 2600 (B7)         |      |               |                          |                                                |                              |
| LTE - TDD     | 2600 (B38/41)     | VD   | Yes           | NR, Wi-Fi and BT         | VoLTE<br>Yes<br>Google Meet                    | AMR-NB, AMR-WB, EVS and OPUS |
|               | 3600 (B48)        |      |               |                          |                                                |                              |
| NR - FDD      | 680 (n71)         | VD   | Yes           | LTE, Wi-Fi and BT        | VoNR<br>Yes<br>Google Meet                     | AMR-NB, AMR-WB, EVS and OPUS |
|               | 850 (n5)          |      |               |                          |                                                |                              |
|               | 1700 (n66)        |      |               |                          |                                                |                              |
|               | 1700 (n70)        |      |               |                          |                                                |                              |
|               | 1900 (n2/25)      |      |               |                          |                                                |                              |
|               | 2300 (n30)        |      |               |                          |                                                |                              |
| NR - TDD      | 2600 (n41)        | VD   | Yes           | LTE, Wi-Fi and BT        | VoNR<br>Yes<br>Google Meet                     | AMR-NB, AMR-WB, EVS and OPUS |
|               | 3600 (n48)        |      |               |                          |                                                |                              |
|               | 3500 (n77/78 DoD) |      |               |                          |                                                |                              |
|               | 3700 (n77/78)     |      |               |                          |                                                |                              |
| Wi-Fi         | 2450              | VD   | Yes           | WWAN                     | VoWiFi<br>Yes<br>Google Meet                   | AMR-NB, AMR-WB, EVS and OPUS |
|               | 5200 (U-NII-1)    |      |               | WWAN and BT              |                                                |                              |
|               | 5300 (U-NII-2A)   |      |               |                          |                                                |                              |
|               | 5500 (U-NII-2C)   |      |               |                          |                                                |                              |
|               | 5800 (U-NII-3)    |      |               |                          |                                                |                              |
| BT            | 2450              | DT   | N/A           | WWAN and U-NII           | N/A                                            | N/A                          |

Type

Note:

VO: Legacy Cellular Voice Service

DT: Digital Transport only (no voice)

VD: IP Voice Service over Digital Transport

CMRS: Commercial Mobile Radio Service

BT: Bluetooth

### Note(s):

All tests were performed with the transmit power set to the maximum power for held-to-head conditions (RCV active). For air interfaces with a Time Averaged SAR (TAS) algorithm Pmax is considered the maximum power.

## 9. HAC (T-coil) Test Results

### 9.1. Antenna Investigation and full-scan data

An investigation was performed to determine the worst-case antenna per technology. All subsequent measurements were determined by this investigation.

Determined worst-case antenna in this section was used for single point scan of Codec/Air-interface investigations and H-max Location of below full-scan data was used for single point scan of Codec/Air-interface investigations.

| Mode / Band                     | Antenna       | Voice Codec / Codec bitrate (kbps) | Channel and Frequency    | Bandwidth | Waveform / Modulation | RB configuration (Allocation/Offset) | Ambient Noise dB(A/m) | Primary Group | Secondary Group | Frequency Response (dB) | Contiguous Longitudinal | Contiguous Transverse | H-max | H-max Location |
|---------------------------------|---------------|------------------------------------|--------------------------|-----------|-----------------------|--------------------------------------|-----------------------|---------------|-----------------|-------------------------|-------------------------|-----------------------|-------|----------------|
| WCDMA Band V                    | Main1         | AMR-NB 4.75                        | CH.4183<br>836.6 MHz     | N/A       | N/A                   | N/A                                  | -56.71                | 443           | 616             | 1.30                    | 26                      | 26                    | 12.52 | (19.0, 4.0)    |
| WCDMA Band IV                   | Main2         | AMR-NB 4.75                        | CH.4183<br>836.6 MHz     | N/A       | N/A                   | N/A                                  | -56.71                | 453           | 623             | 1.13                    | 26                      | 26                    | 12.48 | (18.0, 5.0)    |
| LTE Band 26                     | Main1         | AMR-NB 4.75                        | 26865<br>831.5 MHz       | 15 MHz    | 64QAM                 | 1/0                                  | -56.71                | 395           | 572             | 1.44                    | 26                      | 26                    | 12.72 | (18.0, 5.0)    |
| LTE Band 66                     | Main2         | AMR-NB 4.75                        | 132322<br>1745 MHz       | 20 MHz    | QPSK                  | 1/0                                  | -56.71                | 397           | 577             | 1.58                    | 26                      | 26                    | 12.41 | (18.0, 5.0)    |
| LTE Band 66                     | Sub2          | AMR-NB 4.75                        | 132322<br>1745 MHz       | 20 MHz    | QPSK                  | 1/0                                  | -56.71                | 371           | 549             | 1.20                    | 25                      | 26                    | 12.45 | (18.0, 5.0)    |
| LTE Band 41                     | Main2         | AMR-NB 4.75                        | CH.40620<br>2593 MHz     | 20 MHz    | QPSK                  | 1/0                                  | -56.78                | 309           | 482             | 1.07                    | 20                      | 26                    | 12.73 | (18.0, 4.0)    |
| LTE Band 41                     | Sub2          | AMR-NB 4.75                        | CH.40620<br>2593 MHz     | 20 MHz    | QPSK                  | 1/0                                  | -56.78                | 209           | 382             | 1.66                    | 21                      | 26                    | 13.27 | (20.0, 3.0)    |
| LTE Band 48                     | Sub3          | AMR-NB 4.75                        | CH.55773<br>3603.3 MHz   | 20 MHz    | QPSK                  | 1/0                                  | -56.78                | 251           | 427             | 1.63                    | 20                      | 26                    | 12.84 | (18.0, 5.0)    |
| NR Band n5                      | Main1         | AMR-NB 4.75                        | CH.167300<br>836.5 MHz   | 20 MHz    | DFT-s-OFDM<br>QPSK    | 1/1                                  | -56.71                | 342           | 527             | 1.62                    | 23                      | 26                    | 12.12 | (18.0, 5.0)    |
| NR Band n66                     | Main2         | AMR-NB 4.75                        | CH.349000<br>1745 MHz    | 40 MHz    | DFT-s-OFDM<br>QPSK    | 1/1                                  | -56.71                | 306           | 490             | 1.53                    | 21                      | 26                    | 11.99 | (18.0, 5.0)    |
| NR Band n66                     | Sub2          | AMR-NB 4.75                        | CH.349000<br>1745 MHz    | 40 MHz    | DFT-s-OFDM<br>QPSK    | 1/1                                  | -56.71                | 232           | 415             | 1.46                    | 20                      | 26                    | 12.05 | (18.0, 5.0)    |
| NR Band n41                     | Main2         | AMR-NB 4.75                        | CH.518598<br>2592.99 MHz | 100 MHz   | DFT-s-OFDM<br>QPSK    | 1/1                                  | -56.85                | 197           | 388             | 1.39                    | 17                      | 26                    | 11.56 | (18.0, 4.0)    |
| NR Band n41                     | Sub2          | AMR-NB 4.75                        | CH.518598<br>2592.99 MHz | 100 MHz   | DFT-s-OFDM<br>QPSK    | 1/1                                  | -56.85                | 128           | 316             | 1.17                    | 16                      | 26                    | 11.54 | (18.0, 5.0)    |
| NR Band n77                     | Sub3          | AMR-NB 4.75                        | CH.650000<br>3750 MHz    | 100 MHz   | DFT-s-OFDM<br>QPSK    | 1/1                                  | -56.85                | 165           | 357             | 1.61                    | 16                      | 26                    | 11.51 | (18.0, 5.0)    |
| WiFi 2.4GHz<br>802.11g          | MIMO          | AMR-NB 4.75                        | CH.6<br>2437 MHz         | 20 MHz    | BPSK<br>6 Mbps        | N/A                                  | -56.73                | 194           | 363             | 1.79                    | 20                      | 26                    | 12.61 | (18.0, 4.0)    |
| WiFi 2.4GHz<br>802.11g          | SISO1<br>Sub4 | AMR-NB 4.75                        | CH.6<br>2437 MHz         | 20 MHz    | BPSK<br>6 Mbps        | N/A                                  | -56.73                | 196           | 365             | 1.31                    | 19                      | 26                    | 12.76 | (18.0, 5.0)    |
| WiFi 2.4GHz<br>802.11a          | SISO2<br>Sub2 | AMR-NB 4.75                        | CH.6<br>2437 MHz         | 20 MHz    | BPSK<br>6 Mbps        | N/A                                  | -56.87                | 190           | 363             | 1.77                    | 24                      | 26                    | 12.35 | (18.0, 5.0)    |
| WiFi 5GHz<br>802.11a<br>U-NII-1 | MIMO          | AMR-NB 4.75                        | CH.40<br>5200 MHz        | 20 MHz    | BPSK<br>6 Mbps        | N/A                                  | -56.87                | 291           | 462             | 1.85                    | 25                      | 26                    | 13.06 | (18.0, 4.0)    |

#### Note(s):

- For mid-high frequency bands in LTE(B66/41) and NR(n66/41), it is observed that Sub2 is the worst-case.
- For WiFi 2.4GHz band, it is observed that Sub2 is the worst-case.

## 9.2. GSM/WCDMA/VoLTE/VoNR Codec Investigation

An investigation between the various codec configurations (Low/Mid/High bit rates for Narrowband and Wideband) and specific parameters are documented (Primary Group, Secondary Group, frequency response) to determine the worst-case bit rates for each voice service type. The table below compares the varying codec configurations.

A codec investigation was performed on one band of each GSM, W-CDMA, LTE FDD/TDD, NR FDD/TDD. The highlighted results below were determined to be the worst-case codec configuration(s) for GSM, WCDMA, LTE and NR.

| Mode / Band | Antenna | Voice Codec / Codec bitrate (kbps) | Channel and Frequency | Ambient Noise dB(A/m) | Primary Group | Secondary Group | Frequency Response (dB) | Contiguous Longitudinal | Contiguous Transverse | H-max | H-max Location |
|-------------|---------|------------------------------------|-----------------------|-----------------------|---------------|-----------------|-------------------------|-------------------------|-----------------------|-------|----------------|
| GSM 850     | Main1   | FR V1                              | CH190<br>836.6 MHz    | -56.71                | <b>190</b>    | 361             | 1.67                    | 17                      | 26                    | 12.64 | (18.0, 4.0)    |
|             |         | FR V2                              |                       | -56.71                | 194           | 361             | 1.83                    | 17                      | 26                    | 13.29 | (18.0, 5.0)    |
|             |         | HR V1                              |                       | -56.71                | 226           | 393             | 1.75                    | 18                      | 26                    | 13.47 | (18.0, 5.0)    |

### Note(s):

- For GSM, it is observed that FR V1 is the worst-case.

| Mode / Band  | Antenna | Voice Codec / Codec bitrate (kbps) | Channel and Frequency | Ambient Noise dB(A/m) | S+NMR (dB)  | Noise dB(A/m) | Frequency Response (dB) | Signal dB(A/m) | H-max Location |
|--------------|---------|------------------------------------|-----------------------|-----------------------|-------------|---------------|-------------------------|----------------|----------------|
| WCDMA Band V | Main1   | AMR-NB 4.75                        | CH.4183<br>836.6 MHz  | -56.71                | <b>49.2</b> | -36.78        | 1.82                    | 12.42          | (19.0, 4.0)    |
|              |         | AMR-NB 7.4                         |                       | -56.71                | 49.53       | -36.85        | 1.80                    | 12.68          | (19.0, 4.0)    |
|              |         | AMR-NB 12.2                        |                       | -56.71                | 49.67       | -36.84        | 1.78                    | 12.83          | (19.0, 4.0)    |
|              |         | AMR-WB 6.6                         |                       | -56.71                | 51.87       | -36.48        | 1.97                    | 15.39          | (19.0, 4.0)    |
|              |         | AMR-WB 15.85                       |                       | -56.71                | 52.39       | -36.86        | 1.27                    | 15.53          | (19.0, 4.0)    |
|              |         | AMR-WB 23.85                       |                       | -56.71                | 52.36       | -36.87        | 1.57                    | 15.49          | (19.0, 4.0)    |

### Note(s):

- For WCDMA, it is observed that AMR-NB 4.75 kbit/s is the worst-case.

| Mode / Band       | Antenna | Voice Codec / Codec bitrate (kbps) | Channel and Frequency | Bandwidth | Waveform / Modulation | RB configuration (Allocation/ Offset) | Ambient Noise dB(A/m) | S+NMR (dB)   | Noise dB(A/m) | Frequency Response (dB) | Signal dB(A/m) | H-max Location |
|-------------------|---------|------------------------------------|-----------------------|-----------|-----------------------|---------------------------------------|-----------------------|--------------|---------------|-------------------------|----------------|----------------|
| VoLTE FDD Band 66 | Sub2    | AMR-NB 4.75                        | 132322<br>1745 MHz    | 20 MHz    | QPSK                  | 1/0                                   | -56.71                | <b>46.08</b> | -33.49        | 1.43                    | 12.59          | (18.0, 5.0)    |
|                   |         | AMR-NB 7.4                         |                       |           |                       |                                       | -56.71                | 46.84        | -34.15        | 1.74                    | 12.69          | (18.0, 5.0)    |
|                   |         | AMR-NB 12.2                        |                       |           |                       |                                       | -56.71                | 47.41        | -34.60        | 1.67                    | 12.81          | (18.0, 5.0)    |
|                   |         | AMR-WB 6.6                         |                       |           |                       |                                       | -56.71                | 48.77        | -33.79        | 1.93                    | 14.98          | (18.0, 5.0)    |
|                   |         | AMR-WB 15.85                       |                       |           |                       |                                       | -56.71                | 49.09        | -33.61        | 1.80                    | 15.48          | (18.0, 5.0)    |
|                   |         | AMR-WB 23.85                       |                       |           |                       |                                       | -56.71                | 49.88        | -34.39        | 1.66                    | 15.49          | (18.0, 5.0)    |
|                   |         | EVS-nb 5.9                         |                       |           |                       |                                       | -56.71                | 46.73        | -33.67        | 1.56                    | 13.06          | (18.0, 5.0)    |
|                   |         | EVS-nb 13.2                        |                       |           |                       |                                       | -56.71                | 48.03        | -34.68        | 1.48                    | 13.35          | (18.0, 5.0)    |
|                   |         | EVS-nb 24.4                        |                       |           |                       |                                       | -56.71                | 46.83        | -33.65        | 1.50                    | 13.18          | (18.0, 5.0)    |
|                   |         | EVS-wb 5.9                         |                       |           |                       |                                       | -56.71                | 47.80        | -34.66        | 1.99                    | 13.14          | (18.0, 5.0)    |
|                   |         | EVS-wb 64                          |                       |           |                       |                                       | -56.71                | 50.19        | -34.45        | 1.40                    | 15.74          | (18.0, 5.0)    |
|                   |         | EVS-wb 128                         |                       |           |                       |                                       | -56.71                | 48.91        | -33.19        | 1.42                    | 15.72          | (18.0, 5.0)    |
|                   |         | EVS-sw b 9.6                       |                       |           |                       |                                       | -56.71                | 47.08        | -34.25        | 1.63                    | 12.83          | (18.0, 5.0)    |
|                   |         | EVS-sw b 64                        |                       |           |                       |                                       | -56.71                | 48.84        | -33.11        | 1.81                    | 15.73          | (18.0, 5.0)    |
|                   |         | EVS-sw b 128                       |                       |           |                       |                                       | -56.71                | 49.30        | -33.48        | 1.76                    | 15.82          | (18.0, 5.0)    |

| Mode / Band       | Antenna | Voice Codec / Codec bitrate (kbps) | Channel and Frequency | Bandwidth | Waveform / Modulation | RB configuration (Allocation/ Offset) | Ambient Noise dB(A/m) | Primary Group | Secondary Group | Frequency Response (dB) | Contiguous Longitudinal | Contiguous Transverse | H-max | H-max Location |
|-------------------|---------|------------------------------------|-----------------------|-----------|-----------------------|---------------------------------------|-----------------------|---------------|-----------------|-------------------------|-------------------------|-----------------------|-------|----------------|
| VoLTE TDD Band 41 | sub2    | AMR-NB 4.75                        | CH40620<br>2593 MHz   | 20 MHz    | QPSK                  | 1/0                                   | -56.78                | 209           | 382             | 1.66                    | 21                      | 26                    | 13.27 | (20.0, 3.0)    |
|                   |         | AMR-NB 7.4                         |                       |           |                       |                                       | -56.78                | <b>188</b>    | 356             | 1.66                    | 18                      | 26                    | 12.70 | (18.0, 4.0)    |
|                   |         | AMR-NB 12.2                        |                       |           |                       |                                       | -56.78                | 215           | 383             | 1.64                    | 21                      | 26                    | 12.82 | (18.0, 5.0)    |
|                   |         | AMR-WB 6.6                         |                       |           |                       |                                       | -56.78                | 248           | 385             | 1.85                    | 21                      | 26                    | 15.28 | (18.0, 4.0)    |
|                   |         | AMR-WB 15.85                       |                       |           |                       |                                       | -56.78                | 254           | 386             | 1.68                    | 21                      | 26                    | 15.64 | (18.0, 4.0)    |
|                   |         | AMR-WB 23.85                       |                       |           |                       |                                       | -56.78                | 251           | 384             | 1.70                    | 21                      | 26                    | 15.63 | (18.0, 4.0)    |
|                   |         | EVS-nb 5.9                         |                       |           |                       |                                       | -56.78                | 189           | 382             | 1.58                    | 21                      | 26                    | 11.02 | (18.0, 5.0)    |
|                   |         | EVS-nb 13.2                        |                       |           |                       |                                       | -56.78                | 218           | 383             | 1.62                    | 21                      | 26                    | 13.32 | (18.0, 4.0)    |
|                   |         | EVS-nb 24.4                        |                       |           |                       |                                       | -56.78                | 220           | 383             | 1.45                    | 21                      | 26                    | 13.38 | (18.0, 5.0)    |
|                   |         | EVS-wb 5.9                         |                       |           |                       |                                       | -56.85                | 194           | 370             | 1.91                    | 20                      | 26                    | 11.99 | (18.0, 5.0)    |
|                   |         | EVS-wb 64                          |                       |           |                       |                                       | -56.85                | 245           | 371             | 1.44                    | 20                      | 26                    | 15.88 | (19.0, 4.0)    |
|                   |         | EVS-wb 128                         |                       |           |                       |                                       | -56.85                | 252           | 379             | 1.44                    | 21                      | 26                    | 15.99 | (16.0, 5.0)    |
|                   |         | EVS-sw b 9.6                       |                       |           |                       |                                       | -56.85                | 215           | 377             | 1.18                    | 21                      | 26                    | 13.25 | (18.0, 4.0)    |
|                   |         | EVS-sw b 64                        |                       |           |                       |                                       | -56.85                | 246           | 374             | 1.38                    | 20                      | 26                    | 15.85 | (18.0, 5.0)    |
|                   |         | EVS-sw b 128                       |                       |           |                       |                                       | -56.85                | 250           | 378             | 1.43                    | 21                      | 26                    | 15.88 | (18.0, 5.0)    |

**Note(s):**

- For LTE-FDD, it is observed that AMR-NB 4.75 kbit/s is the worst-case.
- For LTE-TDD, it is observed that AMR-NB 7.4 kbit/s is the worst-case.

| Mode / Band       | Antenna | Voice Codec / Codec bitrate (kbps) | Channel and Frequency | Bandwidth | Waveform / Modulation | RB configuration (Allocation/ Offset) | Ambient Noise dB(A/m) | S+NNR (dB)   | Noise dB(A/m) | Frequency Response (dB) | Signal dB(A/m) | H-max Location |
|-------------------|---------|------------------------------------|-----------------------|-----------|-----------------------|---------------------------------------|-----------------------|--------------|---------------|-------------------------|----------------|----------------|
| VoNR FDD Band n66 | Sub2    | AMR-NB 4.75                        | CH.349000 1745 MHz    | 40 MHz    | DFT-s-OFDM QPSK       | 1/1                                   | -56.71                | <b>38.73</b> | -26.84        | 1.03                    | 11.89          | (18.0, 5.0)    |
|                   |         | AMR-NB 7.4                         |                       |           |                       |                                       | -56.71                | 39.35        | -27.28        | 1.38                    | 12.07          | (18.0, 5.0)    |
|                   |         | AMR-NB 12.2                        |                       |           |                       |                                       | -56.71                | 39.40        | -27.12        | 1.84                    | 12.28          | (18.0, 5.0)    |
|                   |         | AMR-WB 6.6                         |                       |           |                       |                                       | -56.71                | 41.17        | -26.62        | 2.00                    | 14.55          | (18.0, 5.0)    |
|                   |         | AMR-WB 15.85                       |                       |           |                       |                                       | -56.71                | 42.75        | -27.14        | 2.00                    | 15.61          | (18.0, 5.0)    |
|                   |         | AMR-WB 23.85                       |                       |           |                       |                                       | -56.71                | 42.20        | -26.93        | 1.84                    | 15.27          | (18.0, 5.0)    |
|                   |         | EVS-nb 5.9                         |                       |           |                       |                                       | -56.71                | 39.10        | -28.08        | 1.40                    | 11.02          | (18.0, 5.0)    |
|                   |         | EVS-nb 13.2                        |                       |           |                       |                                       | -56.71                | 40.08        | -27.36        | 1.36                    | 12.72          | (18.0, 5.0)    |
|                   |         | EVS-nb 24.4                        |                       |           |                       |                                       | -56.71                | 40.45        | -27.97        | 1.51                    | 12.48          | (18.0, 5.0)    |
|                   |         | EVS-wb 5.9                         |                       |           |                       |                                       | -56.71                | 39.28        | -27.74        | 1.00                    | 11.54          | (18.0, 5.0)    |
|                   |         | EVS-wb 64                          |                       |           |                       |                                       | -56.71                | 43.49        | -28.01        | 1.76                    | 15.48          | (18.0, 5.0)    |
|                   |         | EVS-wb 128                         |                       |           |                       |                                       | -56.71                | 43.28        | -27.81        | 1.79                    | 15.47          | (18.0, 5.0)    |
|                   |         | EVS-swb 9.6                        |                       |           |                       |                                       | -56.71                | 43.18        | -27.72        | 1.59                    | 15.46          | (18.0, 5.0)    |
|                   |         | EVS-swb 64                         |                       |           |                       |                                       | -56.71                | 43.09        | -27.61        | 1.91                    | 15.48          | (18.0, 5.0)    |
|                   |         | EVS-swb 128                        |                       |           |                       |                                       | -56.71                | 42.96        | -27.49        | 1.94                    | 15.47          | (18.0, 5.0)    |

| Mode / Band       | Antenna | Voice Codec / Codec bitrate (kbps) | Channel and Frequency | Bandwidth | Waveform / Modulation | RB configuration (Allocation/ Offset) | Ambient Noise dB(A/m) | Primary Group | Secondary Group | Frequency Response (dB) | Contiguous Longitudinal | Contiguous Transverse | H-max | H-max Location |
|-------------------|---------|------------------------------------|-----------------------|-----------|-----------------------|---------------------------------------|-----------------------|---------------|-----------------|-------------------------|-------------------------|-----------------------|-------|----------------|
| VoNR TDD Band n41 | Sub2    | AMR-NB 4.75                        | CH.518598 2592.99 MHz | 100 MHz   | DFT-s-OFDM QPSK       | 1/1                                   | -56.85                | <b>128</b>    | 316             | 1.17                    | 16                      | 26                    | 11.54 | (18.0, 5.0)    |
|                   |         | AMR-NB 7.4                         |                       |           |                       |                                       | -56.85                | 130           | 316             | 1.69                    | 16                      | 26                    | 11.56 | (18.0, 4.0)    |
|                   |         | AMR-NB 12.2                        |                       |           |                       |                                       | -56.85                | 134           | 317             | 1.64                    | 16                      | 26                    | 11.84 | (18.0, 4.0)    |
|                   |         | AMR-WB 6.6                         |                       |           |                       |                                       | -56.85                | 166           | 317             | 2.00                    | 16                      | 26                    | 14.03 | (17.0, 4.0)    |
|                   |         | AMR-WB 15.85                       |                       |           |                       |                                       | -56.85                | 182           | 319             | 2.00                    | 16                      | 26                    | 15.85 | (18.0, 4.0)    |
|                   |         | AMR-WB 23.85                       |                       |           |                       |                                       | -56.85                | 183           | 320             | 2.00                    | 16                      | 26                    | 15.45 | (18.0, 4.0)    |
|                   |         | EVS-nb 5.9                         |                       |           |                       |                                       | -56.85                | 130           | 321             | 1.10                    | 16                      | 26                    | 10.90 | (18.0, 4.0)    |
|                   |         | EVS-nb 13.2                        |                       |           |                       |                                       | -56.85                | 152           | 320             | 1.66                    | 16                      | 26                    | 13.12 | (18.0, 4.0)    |
|                   |         | EVS-nb 24.4                        |                       |           |                       |                                       | -56.85                | 156           | 322             | 1.50                    | 16                      | 26                    | 12.73 | (19.0, 4.0)    |
|                   |         | EVS-wb 5.9                         |                       |           |                       |                                       | -56.85                | 132           | 322             | 1.68                    | 16                      | 26                    | 11.24 | (18.0, 5.0)    |
|                   |         | EVS-wb 64                          |                       |           |                       |                                       | -56.64                | 183           | 319             | 1.85                    | 16                      | 26                    | 14.84 | (18.0, 5.0)    |
|                   |         | EVS-wb 128                         |                       |           |                       |                                       | -56.64                | 181           | 318             | 1.98                    | 16                      | 26                    | 14.79 | (18.0, 4.0)    |
|                   |         | EVS-swb 9.6                        |                       |           |                       |                                       | -56.64                | 183           | 319             | 1.49                    | 16                      | 26                    | 14.89 | (19.0, 4.0)    |
|                   |         | EVS-swb 64                         |                       |           |                       |                                       | -56.64                | 185           | 321             | 1.73                    | 16                      | 26                    | 14.78 | (17.0, 4.0)    |
|                   |         | EVS-swb 128                        |                       |           |                       |                                       | -56.64                | 182           | 319             | 1.77                    | 16                      | 26                    | 14.79 | (18.0, 5.0)    |

**Note(s):**

- For NR-FDD, it is observed that AMR-NB 4.75 kbit/s is the worst-case.
- For NR-TDD, it is observed that AMR-NB 4.75 kbit/s is the worst-case.

### 9.3. GSM/WCDMA/VoLTE/VoNR Air Interface Investigation

Using the worst-case bitrate found in Sec.9.2, a limited set of bands/channels/bandwidths were then tested to confirm that there is no effect to compliance when changing the band/channel/bandwidth.

#### GSM / W-CDMA (UMTS) Air interface Investigation:

| Mode / Band | Antenna | Voice Codec / Codec bitrate (kbps) | Channel and Frequency | Ambient Noise dB(A/m) | Primary Group | Secondary Group | Frequency Response (dB) | Contiguous Longitudinal | Contiguous Transverse | H-max | H-max Location |
|-------------|---------|------------------------------------|-----------------------|-----------------------|---------------|-----------------|-------------------------|-------------------------|-----------------------|-------|----------------|
| GSM 850     | Main1   | FR V1                              | CH128<br>824.2 MHz    | -56.71                | 213           | 384             | 1.47                    | 18                      | 26                    | 12.90 | (18.0, 4.0)    |
|             |         |                                    | CH190<br>836.6 MHz    | -56.71                | 190           | 361             | 1.67                    | 17                      | 26                    | 12.64 | (18.0, 4.0)    |
|             |         |                                    | CH251<br>848.8 MHz    | -56.71                | 173           | 345             | 1.61                    | 17                      | 26                    | 12.83 | (18.0, 5.0)    |
| GSM 1900    | Main2   | FR V1                              | CH810<br>1909.8 MHz   | -56.71                | 278           | 450             | 1.55                    | 20                      | 26                    | 12.90 | (18.0, 5.0)    |

| Mode / Band   | Antenna | Voice Codec / Codec bitrate (kbps) | Channel and Frequency | Ambient Noise dB(A/m) | S+NNR (dB) | Noise dB(A/m) | Frequency Response (dB) | Signal dB(A/m) | H-max Location |
|---------------|---------|------------------------------------|-----------------------|-----------------------|------------|---------------|-------------------------|----------------|----------------|
| WCDMA Band II | Main2   | AMR-NB 4.75                        | CH9262<br>1852.4 MHz  | -56.71                | 47.52      | -35.3         | 1.75                    | 12.22          | (19.0, 4.0)    |
| WCDMA Band IV | Main2   | AMR-NB 4.75                        | CH1312<br>1712.4 MHz  | -56.71                | 50.06      | -37.5         | 1.23                    | 12.56          | (19.0, 4.0)    |
| WCDMA Band V  | Main1   | AMR-NB 4.75                        | CH4132<br>826.4 MHz   | -56.71                | 47.45      | -35.06        | 1.68                    | 12.39          | (19.0, 4.0)    |
|               |         |                                    | CH4183<br>836.6 MHz   | -56.71                | 49.20      | -36.78        | 1.82                    | 12.42          | (19.0, 4.0)    |
|               |         |                                    | CH4233<br>846.6 MHz   | -56.71                | 48.21      | -35.74        | 1.38                    | 12.47          | (19.0, 4.0)    |

| Mode / Band  | Antenna | Voice Codec / Codec bitrate (kbps) | Channel and Frequency | Ambient Noise dB(A/m) | Primary Group | Secondary Group | Frequency Response (dB) | Contiguous Longitudinal | Contiguous Transverse | H-max | H-max Location |
|--------------|---------|------------------------------------|-----------------------|-----------------------|---------------|-----------------|-------------------------|-------------------------|-----------------------|-------|----------------|
| WCDMA Band V | Main1   | AMR-NB 4.75                        | CH4132<br>826.4 MHz   | -56.71                | 450           | 622             | 1.67                    | 26                      | 26                    | 12.43 | (18.0, 5.0)    |

**VoLTE (FDD/TDD) Air Interface Investigation:**

| Mode / Band | Antenna | Voice Codec / Codec bitrate (kbps) | Channel and Frequency | Bandwidth | Waveform / Modulation | RB configuration (Allocation/ Offset) | Ambient Noise dB(A/m) | S+NRR (dB) | Noise dB(A/m) | Frequency Response (dB) | Signal dB(A/m) | H-max Location |
|-------------|---------|------------------------------------|-----------------------|-----------|-----------------------|---------------------------------------|-----------------------|------------|---------------|-------------------------|----------------|----------------|
| LTE Band 66 | Sub2    | AMR-NB 4.75                        | 132322<br>1745 MHz    | 20 MHz    | QPSK                  | 1/0                                   | -56.71                | 46.08      | -33.49        | 1.43                    | 12.59          | (18.0, 5.0)    |
|             |         |                                    |                       |           |                       | 1/49                                  | -56.71                | 46.21      | -33.45        | 1.59                    | 12.76          | (18.0, 5.0)    |
|             |         |                                    |                       |           |                       | 1/99                                  | -56.71                | 46.12      | -33.14        | 1.75                    | 12.98          | (18.0, 5.0)    |
|             |         |                                    |                       |           |                       | 50/0                                  | -56.71                | 47.80      | -34.52        | 1.90                    | 13.28          | (18.0, 5.0)    |
|             |         |                                    |                       |           |                       | 50/24                                 | -56.71                | 47.68      | -34.89        | 1.48                    | 12.79          | (18.0, 5.0)    |
|             |         |                                    |                       |           |                       | 50/50                                 | -56.71                | 46.37      | -33.21        | 1.58                    | 13.16          | (18.0, 5.0)    |
|             |         |                                    |                       |           |                       | 100/0                                 | -56.71                | 46.09      | -32.85        | 1.26                    | 13.24          | (18.0, 5.0)    |
|             |         |                                    |                       | 15 MHz    | 64QAM                 | 1/0                                   | -56.71                | 46.86      | -33.84        | 1.45                    | 13.02          | (18.0, 5.0)    |
|             |         |                                    |                       |           |                       | 64QAM                                 | 1/0                   | -56.71     | 45.42         | 1.33                    | 12.67          | (18.0, 5.0)    |
|             |         |                                    |                       |           |                       | 256QAM                                | 1/0                   | -56.71     | 46.32         | 1.47                    | 13.00          | (18.0, 5.0)    |
|             |         |                                    |                       |           |                       | 10 MHz                                | 1/0                   | -56.71     | 47.05         | 1.91                    | 12.98          | (18.0, 5.0)    |
|             |         |                                    |                       |           |                       | 5 MHz                                 | 1/0                   | -56.71     | 45.96         | 1.54                    | 13.20          | (18.0, 5.0)    |
|             |         |                                    |                       |           |                       | 3 MHz                                 | 1/0                   | -56.71     | 47.51         | 1.77                    | 13.20          | (18.0, 5.0)    |
|             |         |                                    |                       |           |                       | 1.4 MHz                               | 1/0                   | -56.71     | 47.91         | 1.80                    | 13.22          | (18.0, 5.0)    |
|             |         |                                    | 132072<br>1720 MHz    | 20 MHz    | 64QAM                 | 1/0                                   | -56.71                | 46.45      | -33.15        | 1.57                    | 13.30          | (18.0, 5.0)    |
|             |         |                                    | 132572<br>1770 MHz    | 20 MHz    | 64QAM                 | 1/0                                   | -56.71                | 46.01      | -32.85        | 1.48                    | 13.16          | (18.0, 5.0)    |
| LTE Band 7  | Sub2    | AMR-NB 4.75                        | 21100<br>2535 MHz     | 20 MHz    | 64QAM                 | 1/0                                   | -56.71                | 45.38      | -32.87        | 1.71                    | 12.51          | (18.0, 5.0)    |
| LTE Band 12 | Main1   | AMR-NB 4.75                        | 23095<br>707.5 MHz    | 10 MHz    | 64QAM                 | 1/0                                   | -56.71                | 45.71      | -32.33        | 1.83                    | 13.38          | (18.0, 5.0)    |
| LTE Band 13 | Main1   | AMR-NB 4.75                        | 23230<br>782 MHz      | 10 MHz    | 64QAM                 | 1/0                                   | -56.71                | 47.40      | -34.15        | 1.54                    | 13.25          | (18.0, 5.0)    |
| LTE Band 14 | Main1   | AMR-NB 4.75                        | 23330<br>793 MHz      | 10 MHz    | 64QAM                 | 1/0                                   | -56.71                | 47.24      | -33.87        | 1.66                    | 13.37          | (18.0, 5.0)    |
| LTE Band 25 | Sub2    | AMR-NB 4.75                        | 26365<br>1882.5 MHz   | 20 MHz    | 64QAM                 | 1/0                                   | -56.71                | 45.04      | -32.43        | 1.76                    | 12.61          | (18.0, 5.0)    |
| LTE Band 26 | Main1   | AMR-NB 4.75                        | 26865<br>831.5 MHz    | 15 MHz    | 64QAM                 | 1/0                                   | -56.71                | 47.24      | -34.25        | 1.12                    | 12.99          | (18.0, 5.0)    |
| LTE Band 30 | Main2   | AMR-NB 4.75                        | 27710<br>2310 MHz     | 10 MHz    | 64QAM                 | 1/0                                   | -56.71                | 46.57      | -33.97        | 1.52                    | 12.60          | (18.0, 5.0)    |
| LTE Band 71 | Main1   | AMR-NB 4.75                        | 133297<br>680.5 MHz   | 20 MHz    | 64QAM                 | 1/0                                   | -56.71                | 46.87      | -34           | 1.37                    | 12.87          | (18.0, 5.0)    |

| Mode / Band | Antenna | Voice Codec / Codec bitrate (kbps) | Channel and Frequency | Bandwidth | Waveform / Modulation | RB configuration (Allocation/ Offset) | Ambient Noise dB(A/m) | Primary Group | Secondary Group | Frequency Response (dB) | Contiguous Longitudinal | Contiguous Transverse | H-max | H-max Location |
|-------------|---------|------------------------------------|-----------------------|-----------|-----------------------|---------------------------------------|-----------------------|---------------|-----------------|-------------------------|-------------------------|-----------------------|-------|----------------|
| LTE Band 25 | Sub2    | AMR-NB 4.75                        | 26365<br>1882.5 MHz   | 20 MHz    | 64QAM                 | 1/0                                   | -56.71                | 324           | 497             | 1.70                    | 26                      | 26                    | 12.67 | (18.0, 5.0)    |

| Mode / Band | Antenna | Voice Codec /<br>Codec bitrate<br>(kbps) | Channel and<br>Frequency | Bandwidth | Waveform /<br>Modulation | RB<br>configuration<br>(Allocation/<br>Offset) | Ambient Noise<br>dB(A/m) | Primary Group | Secondary<br>Group | Frequency<br>Response (dB) | Contiguous<br>Longitudinal | Contiguous<br>Transverse | H-max       | H-max Location |
|-------------|---------|------------------------------------------|--------------------------|-----------|--------------------------|------------------------------------------------|--------------------------|---------------|--------------------|----------------------------|----------------------------|--------------------------|-------------|----------------|
| LTE Band 41 | Sub2    | AMR-NB 7.4                               | CH.40620<br>2593 MHz     | 20 MHz    | QPSK                     | 1/0                                            | -56.78                   | 188           | 356                | 1.66                       | 18                         | 26                       | 12.70       | (18.0, 4.0)    |
|             |         |                                          |                          |           |                          | 1/49                                           | -56.85                   | 197           | 365                | 1.68                       | 21                         | 26                       | 12.66       | (18.0, 5.0)    |
|             |         |                                          |                          |           |                          | 1/99                                           | -56.85                   | 185           | 351                | 1.51                       | 20                         | 26                       | 12.60       | (18.0, 4.0)    |
|             |         |                                          |                          |           |                          | 50/0                                           | -56.85                   | 210           | 380                | 1.91                       | 21                         | 26                       | 12.70       | (18.0, 5.0)    |
|             |         |                                          |                          |           |                          | 50/24                                          | -56.85                   | 210           | 378                | 2.00                       | 21                         | 26                       | 12.65       | (18.0, 5.0)    |
|             |         |                                          |                          |           |                          | 50/50                                          | -56.85                   | 204           | 372                | 1.72                       | 21                         | 26                       | 12.91       | (18.0, 5.0)    |
|             |         |                                          |                          |           |                          | 100/0                                          | -56.85                   | 211           | 380                | 1.56                       | 21                         | 26                       | 12.65       | (18.0, 4.0)    |
|             |         |                                          |                          | 16QAM     | 1/99                     | -56.85                                         | 191                      | 359           | 1.69               | 20                         | 26                         | 12.69                    | (18.0, 5.0) |                |
|             |         |                                          |                          | 64QAM     | 1/99                     | -56.85                                         | 200                      | 369           | 1.94               | 20                         | 26                         | 12.71                    | (18.0, 5.0) |                |
|             |         |                                          |                          | 256QAM    | 1/99                     | -56.85                                         | 224                      | 396           | 1.64               | 21                         | 26                         | 12.83                    | (18.0, 5.0) |                |
|             |         |                                          |                          | 15 MHz    | QPSK                     | 1/74                                           | -56.85                   | 190           | 357                | 2.00                       | 20                         | 26                       | 12.69       | (18.0, 5.0)    |
|             |         |                                          |                          | 10 MHz    | QPSK                     | 1/49                                           | -56.85                   | 191           | 358                | 1.47                       | 20                         | 26                       | 12.65       | (18.0, 4.0)    |
|             |         |                                          |                          | 5 MHz     | QPSK                     | 1/24                                           | -56.85                   | 199           | 367                | 1.48                       | 21                         | 26                       | 12.60       | (18.0, 5.0)    |
|             |         |                                          | CH.39750<br>2506 MHz     | 20 MHz    | QPSK                     | 1/99                                           | -56.85                   | 197           | 365                | 1.78                       | 20                         | 26                       | 12.64       | (18.0, 4.0)    |
|             |         |                                          | CH.41490<br>2680 MHz     | 20 MHz    | QPSK                     | 1/99                                           | -56.85                   | 178           | 344                | 1.77                       | 19                         | 26                       | 12.58       | (18.0, 5.0)    |
| LTE Band 48 | Sub3    | AMR-NB 7.4                               | CH.56640<br>3690 MHz     | 20 MHz    | QPSK                     | 1/99                                           | -56.85                   | 255           | 426                | 1.30                       | 20                         | 26                       | 12.83       | (18.0, 5.0)    |

## VoNR (FDD/TDD) Air Interface Investigation:

| Mode / Band | Antenna | Voice Codec /<br>Codec bitrate<br>(kbps) | Channel and<br>Frequency | Bandwidth | Waveform /<br>Modulation | RB<br>configuration<br>(Allocation/<br>Offset) | Ambient Noise<br>dB(A/m) | S+NRR (dB) | Noise<br>dB(A/m) | Frequency<br>Response (dB) | Signal<br>dB(A/m) | H-max Location |
|-------------|---------|------------------------------------------|--------------------------|-----------|--------------------------|------------------------------------------------|--------------------------|------------|------------------|----------------------------|-------------------|----------------|
| NR Band n66 | Sub2    | AMR-NB 4.75                              | CH.349000<br>1745 MHz    | 40 MHz    | CP-OFDM<br>QPSK          | 1/1                                            | -56.71                   | 39.39      | -27.52           | 1.43                       | 11.87             | (18.0, 5.0)    |
|             |         |                                          |                          |           |                          | 1/107                                          | -56.71                   | 39.63      | -27.81           | 1.29                       | 11.82             | (18.0, 5.0)    |
|             |         |                                          |                          |           |                          | 1/214                                          | -56.71                   | 39.57      | -27.57           | 1.28                       | 12.00             | (18.0, 5.0)    |
|             |         |                                          |                          |           |                          | 108/0                                          | -56.71                   | 39.76      | -27.80           | 1.25                       | 11.96             | (18.0, 5.0)    |
|             |         |                                          |                          |           |                          | 108/54                                         | -56.71                   | 39.53      | -27.76           | 1.75                       | 11.77             | (18.0, 5.0)    |
|             |         |                                          |                          |           |                          | 108/108                                        | -56.71                   | 39.53      | -27.80           | 1.60                       | 11.73             | (18.0, 5.0)    |
|             |         |                                          |                          |           |                          | 216/0                                          | -56.71                   | 40.00      | -27.97           | 1.15                       | 12.03             | (18.0, 5.0)    |
|             |         |                                          |                          |           | CP-OFDM<br>16QAM         | 1/1                                            | -56.71                   | 39.80      | -28.00           | 1.22                       | 11.80             | (18.0, 5.0)    |
|             |         |                                          |                          |           | CP-OFDM<br>64QAM         | 1/1                                            | -56.71                   | 39.95      | -27.98           | 1.32                       | 11.97             | (18.0, 5.0)    |
|             |         |                                          |                          |           | CP-OFDM<br>256QAM        | 1/1                                            | -56.71                   | 39.73      | -27.99           | 1.77                       | 11.74             | (18.0, 5.0)    |
|             |         |                                          |                          |           | DFT-s-OFDM<br>QPSK       | 1/1                                            | -56.71                   | 38.73      | -26.84           | 1.03                       | 11.89             | (18.0, 5.0)    |
|             |         |                                          |                          |           |                          | 1/107                                          | -56.71                   | 39.76      | -27.87           | 1.58                       | 11.89             | (18.0, 5.0)    |
|             |         |                                          |                          |           |                          | 1/214                                          | -56.71                   | 39.11      | -27.21           | 1.39                       | 11.90             | (18.0, 5.0)    |
|             |         |                                          |                          |           |                          | 108/0                                          | -56.71                   | 39.53      | -27.68           | 1.94                       | 11.85             | (18.0, 5.0)    |
|             |         |                                          |                          |           |                          | 108/54                                         | -56.71                   | 38.95      | -27.21           | 1.53                       | 11.74             | (18.0, 5.0)    |
|             |         |                                          |                          |           |                          | 108/108                                        | -56.71                   | 40.02      | -28.24           | 1.31                       | 11.78             | (18.0, 5.0)    |
|             |         |                                          |                          |           |                          | 216/0                                          | -56.71                   | 39.41      | -27.41           | 1.94                       | 12.00             | (18.0, 5.0)    |
|             |         |                                          |                          |           | DFT-s-OFDM<br>pi/2 BPSK  | 1/1                                            | -56.71                   | 39.27      | -27.31           | 1.72                       | 11.96             | (18.0, 5.0)    |
|             |         |                                          |                          |           | DFT-s-OFDM<br>16QAM      | 1/1                                            | -56.71                   | 39.66      | -27.92           | 1.62                       | 11.74             | (18.0, 5.0)    |
|             |         |                                          |                          |           | DFT-s-OFDM<br>64QAM      | 1/1                                            | -56.71                   | 39.26      | -27.48           | 1.38                       | 11.78             | (18.0, 5.0)    |
|             |         |                                          |                          |           | DFT-s-OFDM<br>256QAM     | 1/1                                            | -56.71                   | 39.69      | -28.06           | 1.09                       | 11.63             | (18.0, 5.0)    |
|             |         |                                          |                          | 30 MHz    | DFT-s-OFDM<br>QPSK       | 1/1                                            | -56.71                   | 40.14      | -28.13           | 1.60                       | 12.01             | (18.0, 5.0)    |
|             |         |                                          |                          | 25 MHz    | DFT-s-OFDM<br>QPSK       | 1/1                                            | -56.71                   | 40.18      | -28.32           | 1.29                       | 11.86             | (18.0, 5.0)    |
|             |         |                                          |                          | 20 MHz    | DFT-s-OFDM<br>QPSK       | 1/1                                            | -56.71                   | 40.84      | -29.24           | 1.42                       | 11.60             | (18.0, 5.0)    |
|             |         |                                          |                          | 15 MHz    | DFT-s-OFDM<br>QPSK       | 1/1                                            | -56.71                   | 41.18      | -29.32           | 1.10                       | 11.86             | (18.0, 5.0)    |
|             |         |                                          |                          | 10 MHz    | DFT-s-OFDM<br>QPSK       | 1/1                                            | -56.71                   | 43.78      | -32.02           | 1.63                       | 11.76             | (18.0, 5.0)    |
|             |         |                                          |                          | 5 MHz     | DFT-s-OFDM<br>QPSK       | 1/1                                            | -56.71                   | 43.51      | -31.90           | 1.16                       | 11.61             | (18.0, 5.0)    |
|             |         |                                          | CH.346000<br>1730 MHz    | 40 MHz    | DFT-s-OFDM<br>QPSK       | 1/1                                            | -56.71                   | 39.35      | -27.56           | 1.45                       | 11.79             | (18.0, 5.0)    |
|             |         |                                          | CH.352000<br>1760 MHz    | 40 MHz    | DFT-s-OFDM<br>QPSK       | 1/1                                            | -56.71                   | 39.01      | -27.29           | 1.80                       | 11.72             | (18.0, 5.0)    |
| NR Band n5  | Main1   | AMR-NB 4.75                              | CH.167300<br>836.5 MHz   | 20 MHz    | DFT-s-OFDM<br>QPSK       | 1/1                                            | -56.71                   | 45.48      | -33.78           | 1.52                       | 11.70             | (18.0, 5.0)    |
| NR Band n25 | Sub2    | AMR-NB 4.75                              | CH.376520<br>1882.6 MHz  | 40 MHz    | DFT-s-OFDM<br>QPSK       | 1/1                                            | -56.71                   | 40.61      | -29.13           | 1.66                       | 11.48             | (18.0, 5.0)    |
| NR Band n30 | Main2   | AMR-NB 4.75                              | CH.462000<br>2310 MHz    | 10 MHz    | DFT-s-OFDM<br>QPSK       | 1/1                                            | -56.71                   | 43.05      | -31.09           | 1.54                       | 11.96             | (18.0, 5.0)    |
| NR Band n70 | Sub2    | AMR-NB 4.75                              | CH.340500<br>1702.5 MHz  | 15 MHz    | DFT-s-OFDM<br>QPSK       | 1/1                                            | -56.71                   | 40.95      | -28.95           | 1.56                       | 12.00             | (18.0, 5.0)    |
| NR Band n71 | Main1   | AMR-NB 4.75                              | CH.136100<br>680.5 MHz   | 20 MHz    | DFT-s-OFDM<br>QPSK       | 1/1                                            | -56.71                   | 45.52      | -33.51           | 1.27                       | 12.01             | (18.0, 5.0)    |

| Mode / Band | Antenna | Voice Codec /<br>Codec bitrate<br>(kbps) | Channel and<br>Frequency | Bandwidth | Waveform /<br>Modulation | RB<br>configuration<br>(Allocation/<br>Offset) | Ambient Noise<br>dB(A/m) | Primary Group | Secondary Group | Frequency<br>Response (dB) | Contiguous<br>Longitudinal | Contiguous<br>Transverse | H-max | H-max Location |
|-------------|---------|------------------------------------------|--------------------------|-----------|--------------------------|------------------------------------------------|--------------------------|---------------|-----------------|----------------------------|----------------------------|--------------------------|-------|----------------|
| NR Band n66 | Sub2    | AMR-NB 4.75                              | CH.349000<br>1745 MHz    | 40 MHz    | DFT-s-OFDM<br>QPSK       | 1/1                                            | -56.75                   | 222           | 405             | 1.74                       | 20                         | 26                       | 12.16 | (18.0, 5.0)    |

| Mode / Band | Antenna | Voice Codec /<br>Codec bitrate<br>(kbps) | Channel and<br>Frequency | Bandwidth | Waveform /<br>Modulation | RB<br>configuration<br>(Allocation/<br>Offset) | Ambient Noise<br>dB(A/m) | Primary Group | Secondary<br>Group | Frequency<br>Response (dB) | Contiguous<br>Longitudinal | Contiguous<br>Transverse | H-max | H-max Location |
|-------------|---------|------------------------------------------|--------------------------|-----------|--------------------------|------------------------------------------------|--------------------------|---------------|--------------------|----------------------------|----------------------------|--------------------------|-------|----------------|
| NR Band n41 | Sub2    | AMR-NB 4.75                              | CH.518598<br>2592.99 MHz | 100 MHz   | CP-OFDM<br>QPSK          | 1/1                                            | -56.64                   | 154           | 333                | 1.38                       | 16                         | 26                       | 12.18 | (18.0, 5.0)    |
|             |         |                                          |                          |           |                          | 1/136                                          | -56.64                   | 171           | 355                | 1.32                       | 17                         | 26                       | 12.06 | (18.0, 4.0)    |
|             |         |                                          |                          |           |                          | 1/271                                          | -56.64                   | 162           | 341                | 1.54                       | 17                         | 26                       | 12.00 | (18.0, 5.0)    |
|             |         |                                          |                          |           |                          | 135/0                                          | -56.64                   | 178           | 355                | 1.15                       | 16                         | 26                       | 12.36 | (18.0, 5.0)    |
|             |         |                                          |                          |           |                          | 135/69                                         | -56.64                   | 164           | 344                | 1.77                       | 17                         | 26                       | 12.10 | (18.0, 5.0)    |
|             |         |                                          |                          |           |                          | 135/138                                        | -56.64                   | 168           | 349                | 1.32                       | 16                         | 26                       | 12.08 | (18.0, 5.0)    |
|             |         |                                          |                          |           |                          | 270/0                                          | -56.64                   | 164           | 347                | 1.10                       | 17                         | 26                       | 12.20 | (18.0, 5.0)    |
|             |         |                                          |                          |           | CP-OFDM<br>16QAM         | 1/1                                            | -56.64                   | 154           | 336                | 1.27                       | 16                         | 26                       | 12.08 | (18.0, 5.0)    |
|             |         |                                          |                          |           | CP-OFDM<br>64QAM         | 1/1                                            | -56.64                   | 163           | 346                | 1.91                       | 16                         | 26                       | 12.00 | (18.0, 4.0)    |
|             |         |                                          |                          |           | CP-OFDM<br>256QAM        | 1/1                                            | -56.64                   | 180           | 361                | 1.34                       | 17                         | 26                       | 11.95 | (18.0, 5.0)    |
|             |         |                                          |                          |           | DFT-s-OFDM<br>QPSK       | 1/1                                            | -56.85                   | 128           | 316                | 1.17                       | 16                         | 26                       | 11.54 | (18.0, 5.0)    |
|             |         |                                          |                          |           |                          | 1/136                                          | -56.64                   | 158           | 338                | 1.36                       | 16                         | 26                       | 12.00 | (18.0, 5.0)    |
|             |         |                                          |                          |           |                          | 1/271                                          | -56.64                   | 131           | 337                | 1.04                       | 16                         | 26                       | 10.16 | (18.0, 5.0)    |
|             |         |                                          |                          |           |                          | 135/0                                          | -56.64                   | 133           | 337                | 1.73                       | 17                         | 26                       | 9.80  | (18.0, 4.0)    |
|             |         |                                          |                          |           |                          | 135/69                                         | -56.64                   | 160           | 341                | 1.47                       | 16                         | 26                       | 11.99 | (18.0, 5.0)    |
|             |         |                                          |                          |           |                          | 135/138                                        | -56.64                   | 152           | 331                | 1.01                       | 17                         | 26                       | 11.86 | (19.0, 4.0)    |
|             |         |                                          |                          |           |                          | 270/0                                          | -56.64                   | 156           | 333                | 1.55                       | 16                         | 26                       | 11.93 | (18.0, 4.0)    |
|             |         |                                          |                          |           | DFT-s-OFDM<br>pi/2 BPSK  | 1/1                                            | -56.64                   | 157           | 336                | 1.60                       | 16                         | 26                       | 12.08 | (18.0, 5.0)    |
|             |         |                                          |                          |           | DFT-s-OFDM<br>16QAM      | 1/1                                            | -56.64                   | 151           | 328                | 1.71                       | 16                         | 26                       | 11.88 | (19.0, 4.0)    |
|             |         |                                          |                          |           | DFT-s-OFDM<br>64QAM      | 1/1                                            | -56.64                   | 157           | 339                | 1.11                       | 16                         | 26                       | 11.91 | (18.0, 4.0)    |
|             |         |                                          |                          |           | DFT-s-OFDM<br>256QAM     | 1/1                                            | -56.64                   | 163           | 345                | 1.64                       | 17                         | 26                       | 12.04 | (18.0, 4.0)    |
|             |         |                                          |                          | 90 MHz    | DFT-s-OFDM<br>QPSK       | 1/1                                            | -56.71                   | 149           | 321                | 1.05                       | 16                         | 26                       | 11.95 | (18.0, 4.0)    |
|             |         |                                          |                          | 80 MHz    | DFT-s-OFDM<br>QPSK       | 1/1                                            | -56.71                   | 154           | 327                | 1.77                       | 17                         | 26                       | 12.11 | (18.0, 4.0)    |
|             |         |                                          |                          | 70 MHz    | DFT-s-OFDM<br>QPSK       | 1/1                                            | -56.71                   | 157           | 333                | 1.17                       | 17                         | 26                       | 12.07 | (18.0, 4.0)    |
|             |         |                                          |                          | 60 MHz    | DFT-s-OFDM<br>QPSK       | 1/1                                            | -56.71                   | 160           | 335                | 1.78                       | 18                         | 26                       | 12.06 | (18.0, 4.0)    |
|             |         |                                          |                          | 50 MHz    | DFT-s-OFDM<br>QPSK       | 1/1                                            | -56.71                   | 174           | 353                | 1.40                       | 18                         | 26                       | 12.12 | (18.0, 4.0)    |
|             |         |                                          |                          | 40 MHz    | DFT-s-OFDM<br>QPSK       | 1/1                                            | -56.71                   | 167           | 346                | 1.58                       | 17                         | 26                       | 12.16 | (18.0, 5.0)    |
|             |         |                                          |                          | 30 MHz    | DFT-s-OFDM<br>QPSK       | 1/1                                            | -56.71                   | 173           | 350                | 1.49                       | 17                         | 26                       | 12.43 | (18.0, 4.0)    |
|             |         |                                          |                          | 20 MHz    | DFT-s-OFDM<br>QPSK       | 1/1                                            | -56.71                   | 172           | 348                | 1.69                       | 16                         | 26                       | 12.21 | (18.0, 5.0)    |
|             |         |                                          |                          | 15 MHz    | DFT-s-OFDM<br>QPSK       | 1/1                                            | -56.71                   | 172           | 350                | 1.18                       | 17                         | 26                       | 12.27 | (18.0, 5.0)    |
|             |         |                                          |                          | 10 MHz    | DFT-s-OFDM<br>QPSK       | 1/1                                            | -56.71                   | 165           | 346                | 1.47                       | 17                         | 26                       | 12.25 | (18.0, 4.0)    |
| NR Band n48 | Sub3    | AMR-NB 4.75                              | CH.509202<br>2546.01 MHz | 100 MHz   | DFT-s-OFDM<br>QPSK       | 1/1                                            | -56.64                   | 146           | 324                | 1.26                       | 16                         | 26                       | 12.07 | (18.0, 5.0)    |
|             |         |                                          | CH.528000<br>2640 MHz    | 100 MHz   | DFT-s-OFDM<br>QPSK       | 1/1                                            | -56.64                   | 162           | 341                | 1.59                       | 17                         | 26                       | 12.11 | (18.0, 4.0)    |
| NR Band n48 | Sub3    | AMR-NB 4.75                              | CH.641666<br>3624.99 MHz | 40 MHz    | DFT-s-OFDM<br>QPSK       | 1/1                                            | -56.64                   | 194           | 379                | 1.60                       | 17                         | 26                       | 12.14 | (18.0, 4.0)    |
| NR Band n77 | Sub3    | AMR-NB 4.75                              | CH.650000<br>3750 MHz    | 100 MHz   | DFT-s-OFDM<br>QPSK       | 1/1                                            | -56.85                   | 165           | 357                | 1.61                       | 16                         | 26                       | 11.51 | (18.0, 5.0)    |

## 9.4. VoWi-Fi Codec Investigation

An investigation between the various codec configurations (Low/High bit rates for Narrowband and Wideband) and specific parameters are documented (Primary Group, Secondary Group, frequency response) to determine the worst-case bit rates for each voice service type. The table below compares the varying codec configurations. A codec investigation was performed for each Wi-Fi 2.4GHz and 5GHz. The highlighted results below were determined to be the worst-case codec configuration(s) for Wi-Fi 2.4GHz and 5GHz.

| Mode / Band             | Antenna    | Voice Codec / Codec bitrate (kbps) | Channel and Frequency | Bandwidth | Waveform / Modulation | Ambient Noise dB(A/m) | Primary Group | Secondary Group | Frequency Response (dB) | Contiguous Longitudinal | Contiguous Transverse | H-max | H-max Location |
|-------------------------|------------|------------------------------------|-----------------------|-----------|-----------------------|-----------------------|---------------|-----------------|-------------------------|-------------------------|-----------------------|-------|----------------|
| VoWi-Fi 2.4 GHz 802.11g | SISO2 Sub2 | AMR-NB 4.75                        | CH6 2437 MHz          | 20 MHz    | BPSK 6 Mbps           | -56.78                | 190           | 363             | 1.77                    | 24                      | 26                    | 12.35 | (18.0, 5.0)    |
|                         |            | AMR-NB 7.4                         |                       |           |                       | -56.73                | 223           | 391             | 1.53                    | 24                      | 26                    | 12.98 | (19.0, 5.0)    |
|                         |            | AMR-NB 12.2                        |                       |           |                       | -56.73                | 227           | 392             | 1.72                    | 24                      | 26                    | 13.11 | (18.0, 5.0)    |
|                         |            | AMR-WB 6.6                         |                       |           |                       | -56.73                | 223           | 358             | 2.00                    | 19                      | 26                    | 15.70 | (18.0, 5.0)    |
|                         |            | AMR-WB 15.85                       |                       |           |                       | -56.73                | 234           | 365             | 1.74                    | 19                      | 26                    | 15.67 | (18.0, 5.0)    |
|                         |            | AMR-WB 23.85                       |                       |           |                       | -56.73                | 232           | 363             | 1.50                    | 20                      | 26                    | 15.71 | (18.0, 5.0)    |
|                         |            | EVS-nb 5.9                         |                       |           |                       | -56.73                | 209           | 402             | 1.91                    | 22                      | 26                    | 11.33 | (18.0, 5.0)    |
|                         |            | EVS-nb 13.2                        |                       |           |                       | -56.73                | 238           | 401             | 1.48                    | 21                      | 26                    | 13.53 | (18.0, 5.0)    |
|                         |            | EVS-nb 24.4                        |                       |           |                       | -56.73                | 241           | 405             | 1.54                    | 22                      | 26                    | 13.65 | (18.0, 5.0)    |
|                         |            | EVS-wb 5.9                         |                       |           |                       | -56.73                | 228           | 405             | 1.57                    | 22                      | 26                    | 12.68 | (18.0, 5.0)    |
|                         |            | EVS-wb 64                          |                       |           |                       | -56.73                | 278           | 404             | 1.31                    | 22                      | 26                    | 15.97 | (18.0, 5.0)    |
|                         |            | EVS-wb 128                         |                       |           |                       | -56.73                | 283           | 409             | 1.41                    | 22                      | 26                    | 15.97 | (18.0, 5.0)    |
|                         |            | EVS-swb 9.6                        |                       |           |                       | -56.73                | 273           | 399             | 1.59                    | 21                      | 26                    | 16.08 | (18.0, 5.0)    |
|                         |            | EVS-swb 64                         |                       |           |                       | -56.78                | 299           | 425             | 1.89                    | 26                      | 26                    | 16.18 | (18.0, 5.0)    |
|                         |            | EVS-swb 128                        |                       |           |                       | -56.78                | 306           | 432             | 1.90                    | 26                      | 26                    | 16.15 | (18.0, 5.0)    |

| Mode / Band           | Antenna | Voice Codec / Codec bitrate (kbps) | Channel and Frequency | Bandwidth | Waveform / Modulation | Ambient Noise dB(A/m) | S+NMR (dB) | Noise dB(A/m) | Frequency Response (dB) | Signal dB(A/m) | H-max Location |
|-----------------------|---------|------------------------------------|-----------------------|-----------|-----------------------|-----------------------|------------|---------------|-------------------------|----------------|----------------|
| VoWi-Fi 5 GHz 802.11a | MIMO    | AMR-NB 4.75                        | CH40 5200 MHz         | 20 MHz    | 6Mbps                 | -56.87                | 44.33      | -31.21        | 1.28                    | 13.12          | (18.0, 4.0)    |
|                       |         | AMR-NB 7.4                         |                       |           |                       | -56.87                | 46.30      | -33.06        | 1.69                    | 13.24          | (18.0, 4.0)    |
|                       |         | AMR-NB 12.2                        |                       |           |                       | -56.87                | 46.39      | -33.02        | 1.73                    | 13.37          | (18.0, 4.0)    |
|                       |         | AMR-WB 6.6                         |                       |           |                       | -56.87                | 48.19      | -32.26        | 2.00                    | 15.93          | (18.0, 4.0)    |
|                       |         | AMR-WB 15.85                       |                       |           |                       | -56.87                | 50.12      | -34.05        | 1.57                    | 16.07          | (18.0, 4.0)    |
|                       |         | AMR-WB 23.85                       |                       |           |                       | -56.87                | 48.81      | -32.66        | 1.62                    | 16.15          | (18.0, 4.0)    |
|                       |         | EVS-nb 5.9                         |                       |           |                       | -56.87                | 44.78      | -34.37        | 1.40                    | 10.41          | (18.0, 4.0)    |
|                       |         | EVS-nb 13.2                        |                       |           |                       | -56.87                | 47.99      | -34.16        | 1.35                    | 13.83          | (18.0, 4.0)    |
|                       |         | EVS-nb 24.4                        |                       |           |                       | -56.87                | 47.97      | -34.19        | 1.55                    | 13.78          | (18.0, 4.0)    |
|                       |         | EVS-wb 5.9                         |                       |           |                       | -56.87                | 46.70      | -34.10        | 2.00                    | 12.60          | (18.0, 4.0)    |
|                       |         | EVS-wb 64                          |                       |           |                       | -56.87                | 49.36      | -33.03        | 1.34                    | 16.33          | (18.0, 4.0)    |
|                       |         | EVS-wb 128                         |                       |           |                       | -56.87                | 49.21      | -32.78        | 1.31                    | 16.43          | (18.0, 4.0)    |
|                       |         | EVS-swb 9.6                        |                       |           |                       | -56.87                | 50.01      | -33.52        | 1.60                    | 16.49          | (18.0, 4.0)    |
|                       |         | EVS-swb 64                         |                       |           |                       | -56.87                | 49.08      | -32.66        | 1.86                    | 16.42          | (18.0, 4.0)    |
|                       |         | EVS-swb 128                        |                       |           |                       | -56.87                | 50.54      | -34.18        | 1.87                    | 16.36          | (18.0, 4.0)    |

### Note(s):

- For Wi-Fi 2.4GHz, it is observed that AMR-NB 4.75 kbit/s is the worst-case.
- For Wi-Fi 5GHz, it is observed that AMR-NB 4.75 kbit/s is the worst-case.

## 9.5. VoWi-Fi Air Interface Investigation

Using the data from Sec.9.4, further testing was performed on the remaining 802.11 modes. The objective of these measurements is to ensure that changing the modulation, bandwidth, and data rate, whilst using the worst-case codec configuration measured in Sec.9.4, yields no unexpected variations.

### VoWi-Fi 2.4GHz Air Interface Investigation:

| Mode / Band                | Antenna    | Voice Codec / Codec bitrate (kbps) | Channel and Frequency | Bandwidth | Waveform / Modulation | Ambient Noise dB(A/m) | Primary Group | Secondary Group | Frequency Response (dB) | Contiguous Longitudinal | Contiguous Transverse | H-max | H-max Location |
|----------------------------|------------|------------------------------------|-----------------------|-----------|-----------------------|-----------------------|---------------|-----------------|-------------------------|-------------------------|-----------------------|-------|----------------|
| WiFi 2.4GHz 802.11b        | SISO2 Sub2 | AMR-NB 4.75                        | CH6 2437 MHz          | 20 MHz    | DSSS 1 Mbps           | -56.78                | 193           | 362             | 1.83                    | 21                      | 26                    | 13.01 | (18.0, 5.0)    |
|                            |            |                                    |                       |           | CCQ 5.5 Mbps          | -56.78                | 229           | 399             | 1.68                    | 26                      | 26                    | 13.17 | (18.0, 5.0)    |
|                            |            |                                    |                       |           | CCQ 11 Mbps           | -56.78                | 208           | 376             | 1.79                    | 22                      | 26                    | 12.92 | (18.0, 4.0)    |
| WiFi 2.4GHz 802.11g        | SISO2 Sub2 | AMR-NB 4.75                        | CH6 2437 MHz          | 20 MHz    | BPSK 6 Mbps           | -56.78                | 190           | 363             | 1.77                    | 24                      | 26                    | 12.35 | (18.0, 5.0)    |
| WiFi 2.4GHz 802.11n HT20   | SISO2 Sub2 | AMR-NB 4.75                        | CH6 2437 MHz          | 20 MHz    | MCS 0 6.5 Mbps        | -56.78                | 254           | 425             | 1.69                    | 26                      | 26                    | 12.98 | (18.0, 5.0)    |
| WiFi 2.4GHz 802.11ac VHT20 | SISO2 Sub2 | AMR-NB 4.75                        | CH6 2437 MHz          | 20 MHz    | MCS 0 6.5 Mbps        | -56.78                | 273           | 446             | 1.85                    | 26                      | 26                    | 12.88 | (18.0, 5.0)    |
| WiFi 2.4GHz 802.11ax HE20  | SISO2 Sub2 | AMR-NB 4.75                        | CH6 2437 MHz          | 20 MHz    | MCS 6 77 Mbps         | -56.78                | 267           | 438             | 1.40                    | 26                      | 26                    | 12.77 | (19.0, 5.0)    |
| WiFi 2.4GHz 802.11g        | SISO2 Sub2 | AMR-NB 4.75                        | CH1 2412 MHz          | 20 MHz    | BPSK 6 Mbps           | -56.78                | 229           | 393             | 1.84                    | 25                      | 26                    | 12.93 | (18.0, 5.0)    |
|                            | SISO2 Sub2 | AMR-NB 4.75                        | CH11 2462 MHz         |           |                       | -56.78                | 222           | 390             | 1.65                    | 25                      | 26                    | 12.96 | (18.0, 2.0)    |

## VoWi-Fi 5GHz Air Interface Investigation:

| Mode / Band                           | Antenna | Voice Codec / Codec bitrate (kbps) | Channel and Frequency | Bandwidth | Waveform / Modulation | Ambient Noise dB(A/m) | S+NMR (dB) | Noise dB(A/m) | Frequency Response (dB) | Signal dB(A/m) | H-max Location |
|---------------------------------------|---------|------------------------------------|-----------------------|-----------|-----------------------|-----------------------|------------|---------------|-------------------------|----------------|----------------|
| WiFi 5GHz<br>802.11a<br>U-NI-1        | MIMO    | AMR-NB 4.75                        | CH.40<br>5200 MHz     | 20 MHz    | BPSK<br>6 Mbps        | -56.87                | 44.33      | -31.21        | 1.28                    | 13.12          | (18.0, 4.0)    |
|                                       |         |                                    |                       |           | QPSK<br>18 Mbps       | -56.87                | 47.22      | -34.17        | 1.46                    | 13.05          | (18.0, 4.0)    |
|                                       |         |                                    |                       |           | 64QAM<br>54 Mbps      | -56.87                | 45.63      | -32.63        | 1.29                    | 13.00          | (18.0, 4.0)    |
| WiFi 5GHz<br>802.11n HT20<br>U-NI-1   | MIMO    | AMR-NB 4.75                        | CH.40<br>5200 MHz     | 20 MHz    | MCS 0<br>6.5 Mbps     | -56.87                | 44.57      | -31.55        | 1.60                    | 13.02          | (18.0, 4.0)    |
|                                       |         |                                    |                       |           | MCS 3<br>26 Mbps      | -56.87                | 46.32      | -33.10        | 1.52                    | 13.22          | (18.0, 4.0)    |
|                                       |         |                                    |                       |           | MCS 7<br>65 Mbps      | -56.87                | 48.10      | -34.42        | 1.62                    | 13.68          | (18.0, 4.0)    |
| WiFi 5GHz<br>802.11n HT40<br>U-NI-1   | MIMO    | AMR-NB 4.75                        | CH.38<br>5190 MHz     | 40 MHz    | MCS 0<br>13.5 Mbps    | -56.87                | 44.70      | -31.42        | 1.87                    | 13.28          | (18.0, 4.0)    |
|                                       |         |                                    |                       |           | MCS 3<br>54 Mbps      | -56.87                | 44.77      | -31.55        | 1.42                    | 13.22          | (18.0, 4.0)    |
|                                       |         |                                    |                       |           | MCS 7<br>135 Mbps     | -56.87                | 48.25      | -34.89        | 1.66                    | 13.36          | (18.0, 4.0)    |
| WiFi 5GHz<br>802.11ac VHT20<br>U-NI-1 | MIMO    | AMR-NB 4.75                        | CH.40<br>5200 MHz     | 20 MHz    | MCS 0<br>6.5 Mbps     | -56.87                | 44.34      | -30.81        | 1.97                    | 13.53          | (18.0, 4.0)    |
|                                       |         |                                    |                       |           | MCS 4<br>39 Mbps      | -56.87                | 44.94      | -31.49        | 1.74                    | 13.45          | (18.0, 4.0)    |
|                                       |         |                                    |                       |           | MCS 8<br>78 Mbps      | -56.87                | 44.35      | -31.42        | 1.71                    | 12.93          | (18.0, 4.0)    |
| WiFi 5GHz<br>802.11ac VHT40<br>U-NI-1 | MIMO    | AMR-NB 4.75                        | CH.38<br>5190 MHz     | 40 MHz    | MCS 0<br>13.5 Mbps    | -56.87                | 44.68      | -31.43        | 1.69                    | 13.25          | (18.0, 4.0)    |
|                                       |         |                                    |                       |           | MCS 4<br>108 Mbps     | -56.87                | 44.89      | -31.62        | 1.69                    | 13.27          | (18.0, 4.0)    |
|                                       |         |                                    |                       |           | MCS 9<br>180 Mbps     | -56.87                | 45.01      | -31.82        | 1.96                    | 13.19          | (18.0, 4.0)    |
| WiFi 5GHz<br>802.11ac VHT80<br>U-NI-1 | MIMO    | AMR-NB 4.75                        | CH.42<br>5210 MHz     | 80 MHz    | MCS 0<br>29.3 Mbps    | -56.87                | 46.58      | -33.31        | 1.83                    | 13.27          | (18.0, 4.0)    |
|                                       |         |                                    |                       |           | MCS 4<br>175.5 Mbps   | -56.87                | 48.08      | -34.84        | 1.83                    | 13.24          | (18.0, 4.0)    |
|                                       |         |                                    |                       |           | MCS 9<br>390 Mbps     | -56.87                | 47.82      | -34.89        | 1.91                    | 12.93          | (18.0, 4.0)    |
| WiFi 5GHz<br>802.11ax HE20<br>U-NI-1  | MIMO    | AMR-NB 4.75                        | CH.40<br>5200 MHz     | 20 MHz    | MCS 0<br>8.6 Mbps     | -56.87                | 44.38      | -30.76        | 1.57                    | 13.62          | (18.0, 4.0)    |
|                                       |         |                                    |                       |           | MCS 6<br>77 Mbps      | -56.87                | 45.35      | -32.64        | 1.94                    | 12.71          | (18.0, 4.0)    |
|                                       |         |                                    |                       |           | MCS 11<br>143 Mbps    | -56.87                | 45.62      | -32.48        | 1.91                    | 13.14          | (18.0, 4.0)    |
| WiFi 5GHz<br>802.11ax HE40<br>U-NI-1  | MIMO    | AMR-NB 4.75                        | CH.38<br>5190 MHz     | 40 MHz    | MCS 0<br>17.2 Mbps    | -56.87                | 44.75      | -31.19        | 1.49                    | 13.56          | (18.0, 4.0)    |
|                                       |         |                                    |                       |           | MCS 6<br>155 Mbps     | -56.87                | 46.34      | -32.66        | 1.36                    | 13.68          | (18.0, 4.0)    |
|                                       |         |                                    |                       |           | MCS 11<br>287 Mbps    | -56.87                | 44.66      | -31.33        | 1.76                    | 13.33          | (18.0, 4.0)    |
| WiFi 5GHz<br>802.11ax HE80<br>U-NI-1  | MIMO    | AMR-NB 4.75                        | CH.42<br>5210 MHz     | 80 MHz    | MCS 0<br>36 Mbps      | -56.87                | 44.81      | -31.40        | 1.19                    | 13.41          | (18.0, 4.0)    |
|                                       |         |                                    |                       |           | MCS 6<br>324 Mbps     | -56.87                | 48.09      | -34.76        | 1.91                    | 13.33          | (18.0, 4.0)    |
|                                       |         |                                    |                       |           | MCS 11<br>600 Mbps    | -56.87                | 46.05      | -32.57        | 1.89                    | 13.48          | (18.0, 4.0)    |
| WiFi 5GHz<br>802.11a<br>U-NI-1        | MIMO    | AMR-NB 4.75                        | CH.36<br>5180 MHz     | 20 MHz    | BPSK<br>6 Mbps        | -56.87                | 46.61      | -33.39        | 1.89                    | 13.22          | (18.0, 4.0)    |
|                                       | MIMO    | AMR-NB 4.75                        | CH.48<br>5240 MHz     | 20 MHz    | BPSK<br>6 Mbps        | -56.87                | 46.27      | -33.21        | 1.21                    | 13.06          | (18.0, 4.0)    |
| WiFi 5GHz<br>802.11a<br>U-NI-2A       | MIMO    | AMR-NB 4.75                        | CH.56<br>5280 MHz     | 20 MHz    | BPSK<br>6 Mbps        | -56.87                | 46.62      | -33.55        | 1.16                    | 13.07          | (18.0, 4.0)    |
| WiFi 5GHz<br>802.11a<br>U-NI-2C       | MIMO    | AMR-NB 4.75                        | CH.120<br>5600 MHz    | 20 MHz    | BPSK<br>6 Mbps        | -56.87                | 46.09      | -32.92        | 1.78                    | 13.17          | (18.0, 4.0)    |
| WiFi 5GHz<br>802.11a<br>U-NI-3        | MIMO    | AMR-NB 4.75                        | CH.157<br>5785 MHz    | 20 MHz    | BPSK<br>6 Mbps        | -56.87                | 45.81      | -32.80        | 1.27                    | 13.01          | (18.0, 4.0)    |

| Mode / Band                    | Antenna | Voice Codec / Codec bitrate (kbps) | Channel and Frequency | Bandwidth | Waveform / Modulation | Ambient Noise dB(A/m) | Primary Group | Secondary Group | Frequency Response (dB) | Contiguous Longitudinal | Contiguous Transverse | H-max | H-max Location |
|--------------------------------|---------|------------------------------------|-----------------------|-----------|-----------------------|-----------------------|---------------|-----------------|-------------------------|-------------------------|-----------------------|-------|----------------|
| WiFi 5GHz<br>802.11a<br>U-NI-1 | MIMO    | AMR-NB 4.75                        | CH.40<br>5200 MHz     | 20 MHz    | BPSK<br>6 Mbps        | -56.87                | 301           | 474             | 1.85                    | 25                      | 26                    | 13.04 | (18.0, 4.0)    |

## 9.6. OTT Codec Investigation and full-scan data

The DUT's nested OTT application supports range of codec bit rate 6 – 75 kbit/s, thus an investigation between the various codec configurations (6/40/75 as Low/Mid/High bit rates) and specific parameters are documented (Primary Group, Secondary Group, frequency response) to determine the worst-case bit rates for each service type. The table below compares the varying codec configurations.

H-max Location of below full-scan data was used for single point scan of Codec/Air-interface investigations.

Determined worst-case codec in this section was used for single point scan of Air-interface investigations in OTT – GSM, WCDMA, LTE FDD, LTE TDD, NR FDD, WiFi 2.4GHz and WiFi 5GHz.

| Mode / Band                 | Antenna    | Voice Codec / Codec bitrate (kbps) | Channel and Frequency | Bandwidth | Waveform / Modulation | RB configuration (Allocation/ Offset) | Ambient Noise dB(A/m) | Primary Group / S+NNR (dB) | Secondary Group / Noise dB(A/m) | Frequency Response (dB) | Contiguous Longitudinal | Contiguous Transverse | H-max / Signal dB(A/m) | H-max Location |
|-----------------------------|------------|------------------------------------|-----------------------|-----------|-----------------------|---------------------------------------|-----------------------|----------------------------|---------------------------------|-------------------------|-------------------------|-----------------------|------------------------|----------------|
| GSM850 EGPRS 2 Slots        | Main1      | OPUS 6                             | CH.251 848.8 MHz      | N/A       | N/A                   | N/A                                   | -56.82                | 262                        | 434                             | 1.30                    | 18                      | 26                    | 12.99                  | (18.0, 5.0)    |
|                             |            | OPUS 40                            |                       | N/A       | N/A                   | N/A                                   | -56.82                | 265                        | 439                             | 1.63                    | 18                      | 26                    | 13.92                  | (18.0, 3.0)    |
|                             |            | OPUS 75                            |                       | N/A       | N/A                   | N/A                                   | -56.82                | 268                        | 438                             | 1.74                    | 18                      | 26                    | 13.31                  | (18.0, 5.0)    |
| WCDMA Band V HSUPA Subtest1 | Main1      | OPUS 6                             | CH.4132 826.4 MHz     | N/A       | N/A                   | N/A                                   | -56.82                | 361                        | 535                             | 1.20                    | 26                      | 26                    | 12.32                  | (18.0, 4.0)    |
|                             |            | OPUS 6                             |                       | N/A       | N/A                   | N/A                                   | -56.82                | 44.12                      | -32.32                          | 1.01                    | N/A                     | N/A                   | 11.80                  | (18.0, 4.0)    |
|                             |            | OPUS 40                            |                       | N/A       | N/A                   | N/A                                   | -56.82                | 46.67                      | -34.72                          | 1.58                    | N/A                     | N/A                   | 11.95                  | (18.0, 4.0)    |
|                             |            | OPUS 75                            |                       | N/A       | N/A                   | N/A                                   | -56.82                | 45.24                      | -32.95                          | 1.48                    | N/A                     | N/A                   | 12.29                  | (18.0, 4.0)    |
| LTE Band 25                 | Sub2       | OPUS 6                             | 26365 1882.5 MHz      | 20 MHz    | 64QAM                 | 1/0                                   | -56.72                | 283                        | 461                             | 1.25                    | 25                      | 26                    | 13.31                  | (18.0, 4.0)    |
|                             |            | OPUS 6                             |                       |           |                       |                                       | -56.72                | 42.53                      | -30.39                          | 1.42                    | N/A                     | N/A                   | 12.14                  | (18.0, 4.0)    |
|                             |            | OPUS 40                            |                       |           |                       |                                       | -56.72                | 43.03                      | -30.41                          | 1.41                    | N/A                     | N/A                   | 12.62                  | (18.0, 4.0)    |
|                             |            | OPUS 75                            |                       |           |                       |                                       | -56.72                | 42.80                      | -30.72                          | 1.46                    | N/A                     | N/A                   | 12.08                  | (18.0, 4.0)    |
| LTE Band 41                 | Sub2       | OPUS 6                             | CH.41490 2680 MHz     | 20 MHz    | QPSK                  | 1/99                                  | -56.67                | 176                        | 340                             | 1.23                    | 19                      | 26                    | 12.02                  | (18.0, 4.0)    |
|                             |            | OPUS 40                            |                       |           |                       |                                       | -56.67                | 174                        | 337                             | 1.60                    | 18                      | 26                    | 12.78                  | (18.0, 5.0)    |
|                             |            | OPUS 75                            |                       |           |                       |                                       | -56.67                | 174                        | 338                             | 1.52                    | 19                      | 26                    | 12.50                  | (18.0, 4.0)    |
| NR Band n66                 | Sub2       | OPUS 6                             | CH.349000 1745 MHz    | 40 MHz    | DFT-s-OFDM QPSK       | 1/1                                   | -56.75                | 232                        | 408                             | 1.90                    | 20                      | 26                    | 12.35                  | (18.0, 5.0)    |
|                             |            | OPUS 6                             |                       |           |                       |                                       | -56.75                | 38.99                      | -27.53                          | 1.41                    | N/A                     | N/A                   | 11.46                  | (18.0, 5.0)    |
|                             |            | OPUS 40                            |                       |           |                       |                                       | -56.75                | 38.76                      | -26.90                          | 1.30                    | N/A                     | N/A                   | 11.86                  | (18.0, 5.0)    |
|                             |            | OPUS 75                            |                       |           |                       |                                       | -56.75                | 40.61                      | -28.22                          | 1.50                    | N/A                     | N/A                   | 12.39                  | (18.0, 5.0)    |
| NR Band n41                 | Sub2       | OPUS 6                             | CH.518598 2592.99 MHz | 100 MHz   | DFT-s-OFDM QPSK       | 1/1                                   | -56.79                | 150                        | 316                             | 1.53                    | 16                      | 26                    | 12.90                  | (17.0, 4.0)    |
|                             |            | OPUS 40                            |                       |           |                       |                                       | -56.79                | 151                        | 320                             | 1.45                    | 16                      | 26                    | 13.67                  | (18.0, 4.0)    |
|                             |            | OPUS 75                            |                       |           |                       |                                       | -56.79                | 155                        | 318                             | 1.47                    | 16                      | 26                    | 13.26                  | (18.0, 4.0)    |
| Wi-Fi 2.4 GHz 802.11g       | SISO2 Sub2 | OPUS 6                             | CH.6 2437 MHz         | 20 MHz    | BPSK 6 Mbps           | N/A                                   | -56.72                | 157                        | 343                             | 1.10                    | 19                      | 26                    | 13.20                  | (21.0, 5.0)    |
|                             |            | OPUS 40                            |                       |           |                       |                                       | -56.72                | 158                        | 319                             | 1.12                    | 17                      | 26                    | 12.95                  | (14.0, 4.0)    |
|                             |            | OPUS 75                            |                       |           |                       |                                       | -56.72                | 119                        | 324                             | 1.94                    | 17                      | 26                    | 13.65                  | (18.0, 3.0)    |
| WiFi 5GHz 802.11a U-NII-1   | MIMO       | OPUS 6                             | CH.40 5200 MHz        | 20 MHz    | BPSK 6 Mbps           | N/A                                   | -56.81                | 196                        | 362                             | 1.02                    | 22                      | 26                    | 12.89                  | (18.0, 5.0)    |
|                             |            | OPUS 40                            |                       |           |                       |                                       | -56.81                | 194                        | 352                             | 1.62                    | 22                      | 26                    | 13.36                  | (18.0, 5.0)    |
|                             |            | OPUS 75                            |                       |           |                       |                                       | -56.81                | 204                        | 365                             | 1.61                    | 21                      | 26                    | 13.32                  | (18.0, 5.0)    |

### Note(s):

A bitrate investigation was performed on the pre-install phone application to determine the worst-case bitrate;

1. For GSM, WCDMA, LTE FDD and NR TDD, it is observed that 6 kbit/s is the worst-case.
2. For LTE TDD, NR FDD and Wi-Fi 5GHz, it is observed that 40 kbit/s is the worst-case.
3. For Wi-Fi 2.4GHz, it is observed that 75 kbit/s is the worst-case.

## 9.7. OTT Air Interface Investigation

| Mode / Band                      | Antenna       | Voice Codec /<br>Codec bitrate<br>(kbps) | Channel and<br>Frequency | Bandwidth | Waveform /<br>Modulation | RB<br>configuration<br>(Allocation/<br>Offset) | Ambient Noise<br>dB(A/m) | Primary Group /<br>S+NNR (dB) | Secondary<br>Group / Noise<br>dB(A/m) | Frequency<br>Response (dB) | Contiguous<br>Longitudinal | Contiguous<br>Transverse | H-max / Signal<br>dB(A/m) | H-max Location |
|----------------------------------|---------------|------------------------------------------|--------------------------|-----------|--------------------------|------------------------------------------------|--------------------------|-------------------------------|---------------------------------------|----------------------------|----------------------------|--------------------------|---------------------------|----------------|
| GSM850<br>EGPRS 2slots           | Main1         | OPUS 6                                   | CH.251<br>848.8 MHz      | N/A       | N/A                      | N/A                                            | -56.82                   | 262                           | 434                                   | 1.30                       | 18                         | 26                       | 12.99                     | (18.0, 5.0)    |
| GSM1900<br>EGPRS 2slots          | Main2         | OPUS 6                                   | CH.810<br>1909.8 MHz     | N/A       | N/A                      | N/A                                            | -56.82                   | 293                           | 466                                   | 1.45                       | 20                         | 26                       | 12.82                     | (18.0, 5.0)    |
| WCDMA Band II<br>HSUPA Subtest1  | Main2         | OPUS 6                                   | CH.9262<br>1852.4 MHz    | N/A       | N/A                      | N/A                                            | -56.82                   | 45.03                         | -32.74                                | 1.35                       | N/A                        | N/A                      | 12.29                     | (18.0, 4.0)    |
| WCDMA Band IV<br>HSUPA Subtest1  | Main2         | OPUS 6                                   | CH.1312<br>1712.4 MHz    | N/A       | N/A                      | N/A                                            | -56.82                   | 44.16                         | -32.36                                | 1.58                       | N/A                        | N/A                      | 11.80                     | (18.0, 4.0)    |
| WCDMA Band V<br>HSUPA Subtest1   | Main1         | OPUS 6                                   | CH.4132<br>826.4 MHz     | N/A       | N/A                      | N/A                                            | -56.82                   | 44.12                         | -32.32                                | 1.01                       | N/A                        | N/A                      | 11.80                     | (18.0, 4.0)    |
| WCDMA Band V<br>HSUPA Subtest1   | Main1         | OPUS 6                                   | CH.4132<br>826.4 MHz     | N/A       | N/A                      | N/A                                            | -56.82                   | 377                           | 542                                   | 1.59                       | 26                         | 26                       | 13.18                     | (18.0, 5.0)    |
| LTE Band 7                       | Sub2          | OPUS 6                                   | 21100<br>2535 MHz        | 20 MHz    | 64QAM                    | 1/0                                            | -56.72                   | 41.54                         | -30.28                                | 1.04                       | N/A                        | N/A                      | 11.26                     | (18.0, 4.0)    |
| LTE Band 12                      | Main1         | OPUS 6                                   | 23095<br>707.5 MHz       | 10 MHz    | 64QAM                    | 1/0                                            | -56.72                   | 42.79                         | -30.99                                | 1.24                       | N/A                        | N/A                      | 11.80                     | (18.0, 4.0)    |
| LTE Band 13                      | Main1         | OPUS 6                                   | 23230<br>782 MHz         | 10 MHz    | 64QAM                    | 1/0                                            | -56.72                   | 44.02                         | -31.37                                | 1.25                       | N/A                        | N/A                      | 12.65                     | (18.0, 4.0)    |
| LTE Band 14                      | Main1         | OPUS 6                                   | 23330<br>793 MHz         | 10 MHz    | 64QAM                    | 1/0                                            | -56.72                   | 43.04                         | -30.65                                | 1.75                       | N/A                        | N/A                      | 12.39                     | (18.0, 4.0)    |
| LTE Band 25                      | Sub2          | OPUS 6                                   | 26365<br>1882.5 MHz      | 20 MHz    | 64QAM                    | 1/0                                            | -56.72                   | 42.53                         | -30.39                                | 1.42                       | N/A                        | N/A                      | 12.14                     | (18.0, 4.0)    |
| LTE Band 26                      | Main1         | OPUS 6                                   | 26865<br>831.5 MHz       | 15 MHz    | 64QAM                    | 1/0                                            | -56.72                   | 42.81                         | -30.36                                | 1.06                       | N/A                        | N/A                      | 12.45                     | (18.0, 4.0)    |
| LTE Band 30                      | Main2         | OPUS 6                                   | 27710<br>2310 MHz        | 10 MHz    | 64QAM                    | 1/0                                            | -56.72                   | 43.19                         | -30.72                                | 1.20                       | N/A                        | N/A                      | 12.47                     | (18.0, 4.0)    |
| LTE Band 66                      | Sub2          | OPUS 6                                   | 132322<br>1745 MHz       | 20 MHz    | 64QAM                    | 1/0                                            | -56.72                   | 42.70                         | -31.01                                | 1.81                       | N/A                        | N/A                      | 11.69                     | (18.0, 4.0)    |
| LTE Band 71                      | Main1         | OPUS 6                                   | 133297<br>680.5 MHz      | 20 MHz    | 64QAM                    | 1/0                                            | -56.72                   | 43.23                         | -30.93                                | 1.12                       | N/A                        | N/A                      | 12.30                     | (18.0, 4.0)    |
| LTE Band 7                       | Sub2          | OPUS 6                                   | 21100<br>2535 MHz        | 20 MHz    | 64QAM                    | 1/0                                            | -56.72                   | 323                           | 515                                   | 1.14                       | 24                         | 26                       | 12.89                     | (18.0, 4.0)    |
| LTE Band 41                      | Sub2          | OPUS 40                                  | CH.41490<br>2680 MHz     | 20 MHz    | QPSK                     | 1/99                                           | -56.67                   | 174                           | 337                                   | 1.60                       | 18                         | 26                       | 12.78                     | (18.0, 5.0)    |
| LTE Band 48                      | Sub3          | OPUS 40                                  | CH.56640<br>3690 MHz     | 20 MHz    | QPSK                     | 1/99                                           | -56.67                   | 262                           | 430                                   | 1.53                       | 20                         | 26                       | 12.98                     | (18.0, 4.0)    |
| NR Band n5                       | Main1         | OPUS 40                                  | CH.167300<br>836.5 MHz   | 20 MHz    | DFT-s-OFDM<br>QPSK       | 1/1                                            | -56.75                   | 43.21                         | -31.08                                | 1.12                       | N/A                        | N/A                      | 12.13                     | (18.0, 5.0)    |
| NR Band n25                      | Sub2          | OPUS 40                                  | CH.376520<br>1882.6 MHz  | 40 MHz    | DFT-s-OFDM<br>QPSK       | 1/1                                            | -56.75                   | 40.53                         | -28.00                                | 1.46                       | N/A                        | N/A                      | 12.53                     | (18.0, 5.0)    |
| NR Band n30                      | Main2         | OPUS 40                                  | CH.462000<br>2310 MHz    | 10 MHz    | DFT-s-OFDM<br>QPSK       | 1/1                                            | -56.75                   | 42.42                         | -30.33                                | 1.41                       | N/A                        | N/A                      | 12.09                     | (18.0, 5.0)    |
| NR Band n66                      | Sub2          | OPUS 40                                  | CH.349000<br>1745 MHz    | 40 MHz    | DFT-s-OFDM<br>QPSK       | 1/1                                            | -56.75                   | 38.76                         | -26.90                                | 1.30                       | N/A                        | N/A                      | 11.86                     | (18.0, 5.0)    |
| NR Band n70                      | Sub2          | OPUS 40                                  | CH.340500<br>1702.5 MHz  | 15 MHz    | DFT-s-OFDM<br>QPSK       | 1/1                                            | -56.75                   | 41.01                         | -29.09                                | 1.38                       | N/A                        | N/A                      | 11.92                     | (18.0, 5.0)    |
| NR Band n71                      | Main1         | OPUS 40                                  | CH.136100<br>680.5 MHz   | 20 MHz    | DFT-s-OFDM<br>QPSK       | 1/1                                            | -56.75                   | 43.66                         | -31.36                                | 1.38                       | N/A                        | N/A                      | 12.30                     | (18.0, 5.0)    |
| NR Band n66                      | Sub2          | OPUS 40                                  | CH.349000<br>1745 MHz    | 40 MHz    | DFT-s-OFDM<br>QPSK       | 1/1                                            | -56.75                   | 233                           | 405                                   | 1.50                       | 20                         | 26                       | 12.93                     | (18.0, 5.0)    |
| NR Band n41                      | Sub2          | OPUS 6                                   | CH.518598<br>2592.99 MHz | 100 MHz   | DFT-s-OFDM<br>QPSK       | 1/1                                            | -56.79                   | 150                           | 316                                   | 1.53                       | 16                         | 26                       | 12.90                     | (17.0, 4.0)    |
| NR Band n48                      | Sub3          | OPUS 6                                   | CH.641666<br>3624.99 MHz | 40 MHz    | DFT-s-OFDM<br>QPSK       | 1/1                                            | -56.75                   | 221                           | 388                                   | 1.59                       | 17                         | 26                       | 13.26                     | (18.0, 4.0)    |
| NR Band n77                      | Sub3          | OPUS 6                                   | CH.650000<br>3750 MHz    | 100 MHz   | DFT-s-OFDM<br>QPSK       | 1/1                                            | -56.75                   | 187                           | 360                                   | 1.43                       | 16                         | 26                       | 12.69                     | (19.0, 4.0)    |
| WiFi 2.4GHz<br>802.11g           | SISO2<br>Sub2 | OPUS 75                                  | CH.6<br>2437 MHz         | 20 MHz    | BPSK<br>6 Mbps           | N/A                                            | -56.72                   | 119                           | 324                                   | 1.94                       | 17                         | 26                       | 13.65                     | (18.0, 3.0)    |
| WiFi 5GHz<br>802.11a<br>U-NII-1  | MIMO          | OPUS 40                                  | CH.40<br>5200 MHz        | 20 MHz    | BPSK<br>6 Mbps           | N/A                                            | -56.81                   | 194                           | 352                                   | 1.62                       | 22                         | 26                       | 13.36                     | (18.0, 5.0)    |
| WiFi 5GHz<br>802.11a<br>U-NII-2A | MIMO          | OPUS 40                                  | CH.56<br>5280 MHz        | 20 MHz    | BPSK<br>6 Mbps           | N/A                                            | -56.82                   | 262                           | 422                                   | 1.27                       | 23                         | 26                       | 13.42                     | (18.0, 5.0)    |
| WiFi 5GHz<br>802.11a<br>U-NII-2C | MIMO          | OPUS 40                                  | CH.120<br>5600 MHz       | 20 MHz    | BPSK<br>6 Mbps           | N/A                                            | -56.82                   | 259                           | 422                                   | 1.50                       | 23                         | 26                       | 13.30                     | (18.0, 5.0)    |
| WiFi 5GHz<br>802.11a<br>U-NII-3  | MIMO          | OPUS 40                                  | CH.157<br>5785 MHz       | 20 MHz    | BPSK<br>6 Mbps           | N/A                                            | -56.82                   | 269                           | 432                                   | 1.46                       | 23                         | 26                       | 13.38                     | (18.0, 5.0)    |

## 9.8. HAC (T-coil) Test Results

### CMRS

| Mode / Band                     | Antenna       | Voice Codec /<br>Codec bitrate<br>(kbps) | Channel and<br>Frequency | Bandwidth | Waveform /<br>Modulation | RB<br>configuration<br>(Allocation/<br>Offset) | Ambient Noise<br>dB(A/m) | Primary Group /<br>S+NRR (dB) | Secondary<br>Group / Noise<br>dB(A/m) | Frequency<br>Response (dB) | Contiguous<br>Longitudinal | Contiguous<br>Transverse | H-max / Signal<br>dB(A/m) | H-max Location | Plot No. |
|---------------------------------|---------------|------------------------------------------|--------------------------|-----------|--------------------------|------------------------------------------------|--------------------------|-------------------------------|---------------------------------------|----------------------------|----------------------------|--------------------------|---------------------------|----------------|----------|
| GSM850                          | Main1         | FR V1                                    | CH.251<br>848.8 MHz      | N/A       | N/A                      | N/A                                            | -56.71                   | 173                           | 345                                   | 1.61                       | 17                         | 26                       | 12.83                     | (18.0, 5.0)    | 1,2      |
| WCDMA Band V                    | Main1         | AMR-NB 4.75                              | CH.4183<br>836.6 MHz     | N/A       | N/A                      | N/A                                            | -56.71                   | 443                           | 616                                   | 1.30                       | 26                         | 26                       | 12.52                     | (19.0, 4.0)    | 3,4      |
| LTE Band 25                     | Sub2          | AMR-NB 4.75                              | 26365<br>1882.5 MHz      | 20 MHz    | 64QAM                    | 1/0                                            | -56.71                   | 324                           | 497                                   | 1.70                       | 26                         | 26                       | 12.67                     | (18.0, 5.0)    | 5,6      |
| LTE Band 41                     | Sub2          | AMR-NB 7.4                               | CH.41490<br>2680 MHz     | 20 MHz    | QPSK                     | 1/99                                           | -56.85                   | 178                           | 344                                   | 1.77                       | 19                         | 26                       | 12.58                     | (18.0, 5.0)    | 7,8      |
| NR Band n66                     | Sub2          | AMR-NB 4.75                              | CH.349000<br>1745 MHz    | 40 MHz    | DFT-s-OFDM<br>QPSK       | 1/1                                            | -56.75                   | 222                           | 405                                   | 1.74                       | 20                         | 26                       | 12.16                     | (18.0, 5.0)    | 9,10     |
| NR Band n41                     | Sub2          | AMR-NB 4.75                              | CH.518598<br>2592.99 MHz | 100 MHz   | DFT-s-OFDM<br>QPSK       | 1/1                                            | -56.85                   | 128                           | 316                                   | 1.17                       | 16                         | 26                       | 11.54                     | (18.0, 5.0)    | 11,12    |
| Wi-Fi 2.4 GHz<br>802.11g        | SISO2<br>Sub2 | AMR-NB 4.75                              | CH.6<br>2437 MHz         | 20 MHz    | BPSK<br>6 Mbps           | N/A                                            | -56.78                   | 190                           | 363                                   | 1.77                       | 24                         | 26                       | 12.35                     | (18.0, 5.0)    | 13,14    |
| WiFi 5GHz<br>802.11a<br>U-NII-1 | MIMO          | AMR-NB 4.75                              | CH.40<br>5200 MHz        | 20 MHz    | BPSK<br>6 Mbps           | N/A                                            | -56.87                   | 291                           | 462                                   | 1.85                       | 25                         | 26                       | 13.06                     | (18.0, 4.0)    | 15,16    |

### OTT(Google Meet)

| Mode / Band                     | Antenna       | Voice Codec /<br>Codec bitrate<br>(kbps) | Channel and<br>Frequency | Bandwidth | Waveform /<br>Modulation | RB<br>configuration<br>(Allocation/<br>Offset) | Ambient Noise<br>dB(A/m) | Primary Group /<br>S+NRR (dB) | Secondary<br>Group / Noise<br>dB(A/m) | Frequency<br>Response (dB) | Contiguous<br>Longitudinal | Contiguous<br>Transverse | H-max / Signal<br>dB(A/m) | H-max Location | Plot No. |
|---------------------------------|---------------|------------------------------------------|--------------------------|-----------|--------------------------|------------------------------------------------|--------------------------|-------------------------------|---------------------------------------|----------------------------|----------------------------|--------------------------|---------------------------|----------------|----------|
| GSM850<br>EGPRS 2 Slots         | Main1         | OPUS 6                                   | CH.251<br>848.8 MHz      | N/A       | N/A                      | N/A                                            | -56.82                   | 262                           | 434                                   | 1.30                       | 18                         | 26                       | 12.99                     | (18.0, 5.0)    | 17,18    |
| WCDMA Band V<br>HSUPA Subtest1  | Main1         | OPUS 6                                   | CH.4132<br>826.4 MHz     | N/A       | N/A                      | N/A                                            | -56.82                   | 361                           | 535                                   | 1.20                       | 26                         | 26                       | 12.32                     | (18.0, 4.0)    | 19,20    |
| LTE Band 25                     | Sub2          | OPUS 6                                   | 26365<br>1882.5 MHz      | 20 MHz    | 64QAM                    | 1/0                                            | -56.72                   | 283                           | 461                                   | 1.25                       | 25                         | 26                       | 13.31                     | (18.0, 4.0)    | 21,22    |
| LTE Band 41                     | Sub2          | OPUS 40                                  | CH.41490<br>2680 MHz     | 20 MHz    | QPSK                     | 1/99                                           | -56.67                   | 174                           | 337                                   | 1.60                       | 18                         | 26                       | 12.78                     | (18.0, 5.0)    | 23,24    |
| NR Band n66                     | Sub2          | OPUS 6                                   | CH.349000<br>1745 MHz    | 40 MHz    | DFT-s-OFDM<br>QPSK       | 1/1                                            | -56.75                   | 232                           | 408                                   | 1.90                       | 20                         | 26                       | 12.35                     | (18.0, 5.0)    | 25,26    |
| NR Band n41                     | Sub2          | OPUS 6                                   | CH.518598<br>2592.99 MHz | 100 MHz   | DFT-s-OFDM<br>QPSK       | 1/1                                            | -56.79                   | 150                           | 316                                   | 1.53                       | 16                         | 26                       | 12.90                     | (17.0, 4.0)    | 27,28    |
| Wi-Fi 2.4 GHz<br>802.11g        | SISO2<br>Sub2 | OPUS 75                                  | CH.6<br>2437 MHz         | 20 MHz    | BPSK<br>6 Mbps           | N/A                                            | -56.72                   | 119                           | 324                                   | 1.94                       | 17                         | 26                       | 13.65                     | (18.0, 3.0)    | 29,30    |
| WiFi 5GHz<br>802.11a<br>U-NII-1 | MIMO          | OPUS 40                                  | CH.40<br>5200 MHz        | 20 MHz    | BPSK<br>6 Mbps           | N/A                                            | -56.81                   | 194                           | 352                                   | 1.62                       | 22                         | 26                       | 13.36                     | (18.0, 5.0)    | 31,32    |

#### Note:

The radial longitudinal (x axis), axial (z axis) measurements are no longer required per ANSI C63.19-2019. Additional tests were performed with folder opened condition using worst case in folder closed for each technology.

9.9. Worst Case T-Coil Test Plot

OTT\_WiFi 2.4GHz\_802.11g\_6 Mbps\_Sub2(SISO2)\_OPUS75\_ch.6

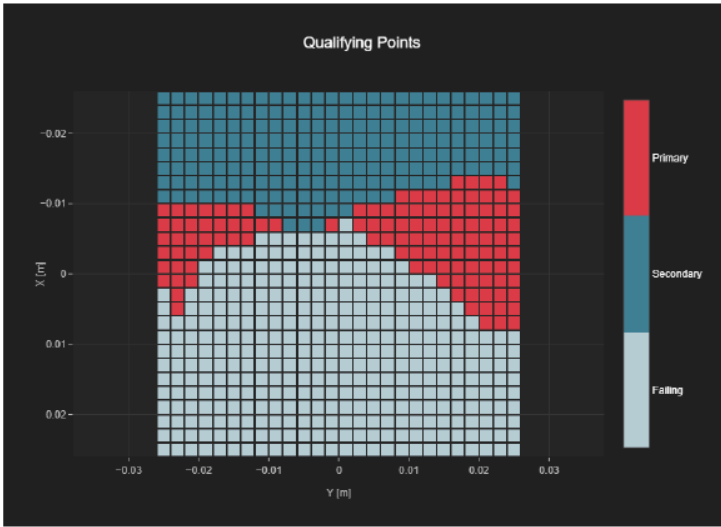
T-Coil Coupling Mode Test Report

Device Under Test

|                     |          |
|---------------------|----------|
| Manufacturer        | Model    |
| Samsung Electronics | SM-A366U |

Results

|                                      |                             |                                  |                                |
|--------------------------------------|-----------------------------|----------------------------------|--------------------------------|
| Primary Group Contiguous Point Count | Secondary Group Point Count | Secondary Group Max Longitudinal | Secondary Group Max Transverse |
| 119                                  | 324                         | 17                               | 26                             |



## **Appendix**

**Refer to separated files for the following appendixes**

**S-4791547056-S3 Appendix A\_Setup Photo**

**S-4791547056-S3 Appendix B\_Test Plots**

**S-4791547056-S3 Appendix C\_Probe Certificate**

**END OF REPORT**