

TEST REPORT

FCC HAC T-COIL Test for SM-F766U
Class II Permissive Change

APPLICANT
SAMSUNG Electronics Co., Ltd.

REPORT NO.
HCT-SR-2505-FC011

DATE OF ISSUE
May 19, 2025

Tested by
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TEST REPORT

HAC T-COIL Test
for C2PC

REPORT NO.**HCT-SR-2505-FC011****DATE OF ISSUE****May 19, 2025****FCC ID****A3LSMF766U****Applicant****SAMSUNG Electronics Co., Ltd****129, Samsung-ro, Yeongtong-gu, Suwon-Si, Gyeonggi-do, 16677, Korea****Product Name****Mobile Phone****Model Name****SM-F766U****Additional Model Name****SM-F766U1****Application Type****Class II Permissive Change****Date of Test****May 09, 2025~ May 12, 2025****Location of Test**

☒ **Permanent Testing Lab** ☐ **On Site Testing Lab**
(Address: 74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si,
Gyeonggi-do, Republic of Korea)

FCC Rule Part(s)**FCC 47 CFR § 20.19 , ANSI C63.19-2019****C63.19-2019HACResult:****PASS**

REVISION HISTORY

The revision history for this test report is shown in table.

Revision No.	Date of Issue	Description
0	May 19, 2025	Initial Release

Notice

Content

The results shown in this test report only apply to the sample(s), as received, provided by the applicant, unless otherwise stated.

The test results have only been applied with the test methods required by the standard(s).

The laboratory is not accredited for the test results marked *.

Information provided by the applicant is marked **.

Test results provided by external providers are marked ***.

When confirmation of authenticity of this test report is required, please contact www.hct.co.kr

The test results in this test report are not associated with the ((KS Q) ISO/IEC 17025) accreditation by KOLAS (Korea Laboratory Accreditation Scheme) / A2LA (American Association for Laboratory Accreditation) that are under the ILAC (International Laboratory Accreditation Cooperation) Mutual Recognition Agreement (MRA).

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1. Test Regulations

The tests were performed according to the following regulations:

Test Standard	FCC 47 CFR § 20.19, ANSI C63.19-2019
Test Method	• FCC CFR47 Part 20.19 • ANSI C63.19 2019-version • FCC KDB 285076 D01 HAC Guidance v06r04 • FCC KDB 285076 D02 T Coil testing v04 • FCC KDB 285076 D03 HAC FAQ v01r07 • TCB workshop updates

2. Test Location

2.1 Test Laboratory

Company Name	HCT Co., Ltd.
Address	74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, Republic of Korea
Telephone	031-645-6300
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2.2 Test Facilities

Our laboratories are accredited and approved by the following approval agencies according to ISO/IEC 17025.

Korea	National Radio Research Agency (Designation No. KR0032)
	KOLAS (Testing No. KT197)

3. DEVICE UNDER TEST DESCRIPTION

3.1 General Information of the EUT

Model Name	SM-F766U
Additional Model Name	SM-F766U1
Equipment Type	Mobile Phone
FCC ID	A3LSMF766U
Application Type	Class II Permissive Change
Applicant	SAMSUNG Electronics Co., Ltd.

3.2 DUT specification

Device Wireless specification overview		
Band& Mode	Operating Mode	Tx Frequency
GSM850	Voice / Data	824.2 MHz ~ 848.8 MHz
GSM1900	Voice / Data	1 850.2 MHz ~ 1 909.8 MHz
UMTS Band 2	Voice / Data	1 852.4 MHz ~ 1 907.6 MHz
UMTS Band 4	Voice / Data	1 712.4 MHz ~ 1 752.6 MHz
UMTS Band 5	Voice / Data	826.4 MHz ~ 846.6 MHz
LTE FDD Band 2 (PCS)	Voice / Data	1 850.7 MHz ~ 1 909.3 MHz
LTE FDD Band 4 (AWS)	Voice / Data	1 710.7 MHz ~ 1 754.3 MHz
LTE FDD Band 5 (Cell)	Voice / Data	824.7 MHz ~ 848.3 MHz
LTE FDD Band 7	Voice / Data	2 502.5 MHz ~ 2 567.5 MHz
LTE FDD Band 12	Voice / Data	699.7 MHz ~ 715.3 MHz
LTE FDD Band 13	Voice / Data	779.5 MHz ~ 784.5 MHz
LTE FDD Band 14	Voice / Data	790.5 MHz ~ 795.5 MHz
LTE FDD Band 25	Voice / Data	1 850.7 MHz ~ 1 914.3 MHz
LTE FDD Band 26	Voice / Data	814.7 MHz ~ 848.3 MHz
LTE FDD Band 30	Voice / Data	2 307.5 MHz ~ 2 312.5 MHz
LTE TDD Band 38	Voice / Data	2 572.5 MHz ~ 2 617.5 MHz
LTE TDD Band 41	Voice / Data	2 498.5 MHz ~ 2 687.5 MHz
LTE TDD Band 48	Voice / Data	3 552.5 MHz ~ 3 697.5 MHz
LTE FDD Band 66 (AWS)	Voice / Data	1 710.7 MHz ~ 1 779.3 MHz
LTE FDD Band 71	Voice / Data	665.5 MHz ~ 695.5 MHz
NR FDD Band n2 (PCS)	Voice / Data	1 852.5 MHz ~ 1 907.5 MHz
NR FDD Band n5	Voice / Data	826.5 MHz ~ 846.5 MHz
NR FDD Band n5	Voice / Data	2 502.5 MHz ~ 2 567.5 MHz
NR FDD Band n12	Voice / Data	701.5 MHz ~ 713.5 MHz
NR FDD Band n14	Voice / Data	790.5 MHz ~ 795.5 MHz
NR FDD Band n25 (PCS)	Voice / Data	1 852.5 MHz ~ 1 912.5 MHz
NR FDD Band n26	Voice / Data	816.5 MHz ~ 846.5 MHz
NR FDD Band n30	Voice / Data	2 307.5 MHz ~ 2 312.5 MHz
NR FDD Band n38	Voice / Data	2 575 MHz ~ 2 615 MHz
NR TDD Band n41	Voice / Data	2 501.01 MHz ~ 2 685 MHz
NR TDD Band n48	Voice / Data	3 555 MHz ~ 3 695.01 MHz
NR FDD Band n66	Voice / Data	1 712.5 MHz ~ 1 777.5 MHz
NR FDD Band n70	Voice / Data	1 697.5 MHz ~ 1 707.5 MHz
NR FDD Band n71	Voice / Data	665.5 MHz ~ 695.5 MHz
NR TDD Band n77	Voice / Data	3 705 MHz ~ 3 975 MHz
NR TDD Band n77 DoD	Voice / Data	3 445.01 MHz ~ 3 544.98 MHz
NR TDD Band n78	Voice / Data	3 705 MHz ~ 3 795 MHz
NR TDD Band n78 DoD	Voice / Data	3 455.01 MHz ~ 3 544.98 MHz
NR Band n258	Data	24 250 MHz ~ 24 450 MHz; 24 750 MHz ~ 25 250 MHz
NR Band n260	Data	37 000 MHz ~ 40 000 MHz
NR Band n261	Data	27 500 MHz ~ 28 350 MHz
U-NII-1	Voice / Data	5 180 MHz ~ 5 240 MHz
U-NII-2A	Voice / Data	5 260 MHz ~ 5 320 MHz
U-NII-2C	Voice / Data	5 500 MHz ~ 5 720 MHz
U-NII-3	Voice / Data	5 745 MHz ~ 5 825 MHz
U-NII-4	Voice / Data	5 845 MHz ~ 5 885 MHz
U-NII-5	Voice / Data	5 925 MHz ~ 6 425 MHz
U-NII-6	Voice / Data	6 425 MHz ~ 6 525 MHz
U-NII-7	Voice / Data	6 525 MHz ~ 6 865 MHz
U-NII-8	Voice / Data	6 865 MHz ~ 7 115 MHz
2.4 GHz WLAN	Voice / Data	2 412 MHz ~ 2 462 MHz
Bluetooth / LE 5.4	Data	2 402 MHz ~ 2 480 MHz
NFC	Data	13.56 MHz
WPC	Data	110 kHz ~ 148 kHz
NTN(Non-Terrestrial Networks)	Data	1 626.5 MHz ~ 1 640.4 MHz

4. 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	3049	11/14/2025
Data Acquisition Electronics	SPEAG	DAE4	1225	02/18/2026
DAC	Sound Devices	USBPre 2	HB1319212059	N/A
Radio Communication Tester	R & S	CMW 500	167916	09/11/2025
USB Audio Module	KEYSIGHT	U8903B-UAM	101006	N/A
UXM 5G Wireless Test Set	KEYSIGHT	E7515B	MY58460166	07/30/2025

5. Measurement Uncertainty

Measurement Uncertainty for Audio Band Magnetic Measurement

Error Description	Uncertainty ± %	Probability distribution	Div.	c/ ABM _d	c/ ABM _u	Std. Unc. ABM _d	Std. Unc. ABM _u
Probe Sensitivity							
Reference Level	3.00	N	1	1	1	3.00	3.00
AMCC Geometry	0.40	R	1.73	1	1	0.23	0.23
AMCC Current	1.00	R	1.73	1	1	0.58	0.58
Probe Positioning during Calibr.	0.10	R	1.73	1	1	0.06	0.06
Noise Contribution	0.70	R	1.73	0.0143	1	0.01	0.40
Frequency Slope	5.90	R	1.73	0.1	1	0.34	3.41
Probe System							
Repeatability / Drift	1.00	R	1.73	1	1	0.58	0.58
Linearity / Dynamic Range	0.60	R	1.73	1	1	0.35	0.35
Acoustic Noise	1.00	R	1.73	0.1	1	0.06	0.58
Probe Angle	1.00	R	1.73	1	1	0.58	0.58
Spectral Processing	0.90	R	1.73	1	1	0.52	0.52
Integration Time	0.60	N	1.00	1	5	0.60	3.00
Field Distribution	0.20	R	1.73	1	1	0.12	0.12
Test Signal							
Ref. Signal Spectral Response	0.60	R	1.73	0	1	0.00	0.35
Positioning							
Probe Positioning	1.90	R	1.73	1	1	1.10	1.10
Phantom Thickness	0.90	R	1.73	1	1	0.52	0.52
DUT Positioning	1.90	R	1.73	1	1	1.10	1.10
External Contributions							
RF Interference	0.00	R	1.73	1	0.3	0.00	0.00
Test Signal Variation	2.00	R	1.73	1	1	1.15	1.15
Combined Uncertainty							
Combined Std. Uncertainty	(k=1)					3.87	5.97
Expanded uncertainty	(Coverage factor for 95%, k=2)					7.74	11.94
Notes for table : N –Normal, R –Rectangular, Div. - Divisor used to obtain standard uncertainty							

6. Test Procedures for all Technologies

6.1 General Procedures C63.19-2019, Section 6

ANSI C63.19-2019, Section 6

This document describes the measurement of the baseband (audio frequency) magnetic T-Coil signal from a WD. The goal is to evaluate the size of the area where a user could position their WD relative to their hearing aid's telecoil and receive an acceptable magnetically coupled signal. Three quantities are measured and evaluated. The first is the field strength of the desired signal at the center of the audio band (desired ABM signal).³¹ The second is the frequency response of the desired signal measured across the audio band.

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, as specified in A.3. 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. 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 described in D.4 through D.6. Measurements shall not include undesired properties from the WD's RF field; therefore, use of a coaxial connection to a base station simulator or non-radiating load may be necessary. However, even then with a coaxial connection to a base station simulator or non-radiating load there may still be RF leakage from the WD, which may interfere with the desired measurement.

Measurements shall be performed with the probe coil oriented in the transverse direction, as illustrated in A.3, 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.

Test flow for T-Coil signal test

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. An alternative procedure, yielding equivalent results, using a broadband excitation is described in 6.5.

- 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 $f = 1$ 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.³⁵ 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.

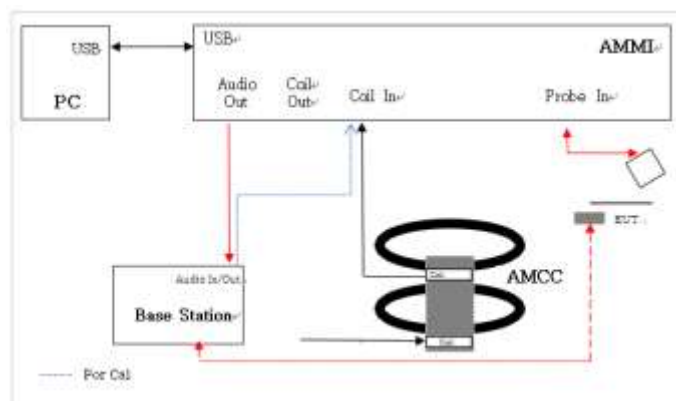
i) Calculate and record the location and number of the measurement points that satisfy the maximum undesired ABM field level and distribution requirements specified in 6.6.4.

All measurements of the desired signal shall be shown to be of the desired signal and not of an undesired signal. This may be shown by turning the desired signal ON and OFF with the probe measuring the scanned locations.

At the measurement location for each orientation, measure and record the undesired broadband audio magnetic signal (ABM2) as specified in 6.4.2 g) with no audio signal applied (or digital zero applied, if appropriate) using A-weighting and the half-band integrator. Calculate the ratio of the desired to undesired signal strength (i.e., signal quality).

Obtain the data from the postprocessor, SEMCAD, and determine the primary group, secondary group that properly the signal quality based on Table 8.

Test Setup Diagram



6.2 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.

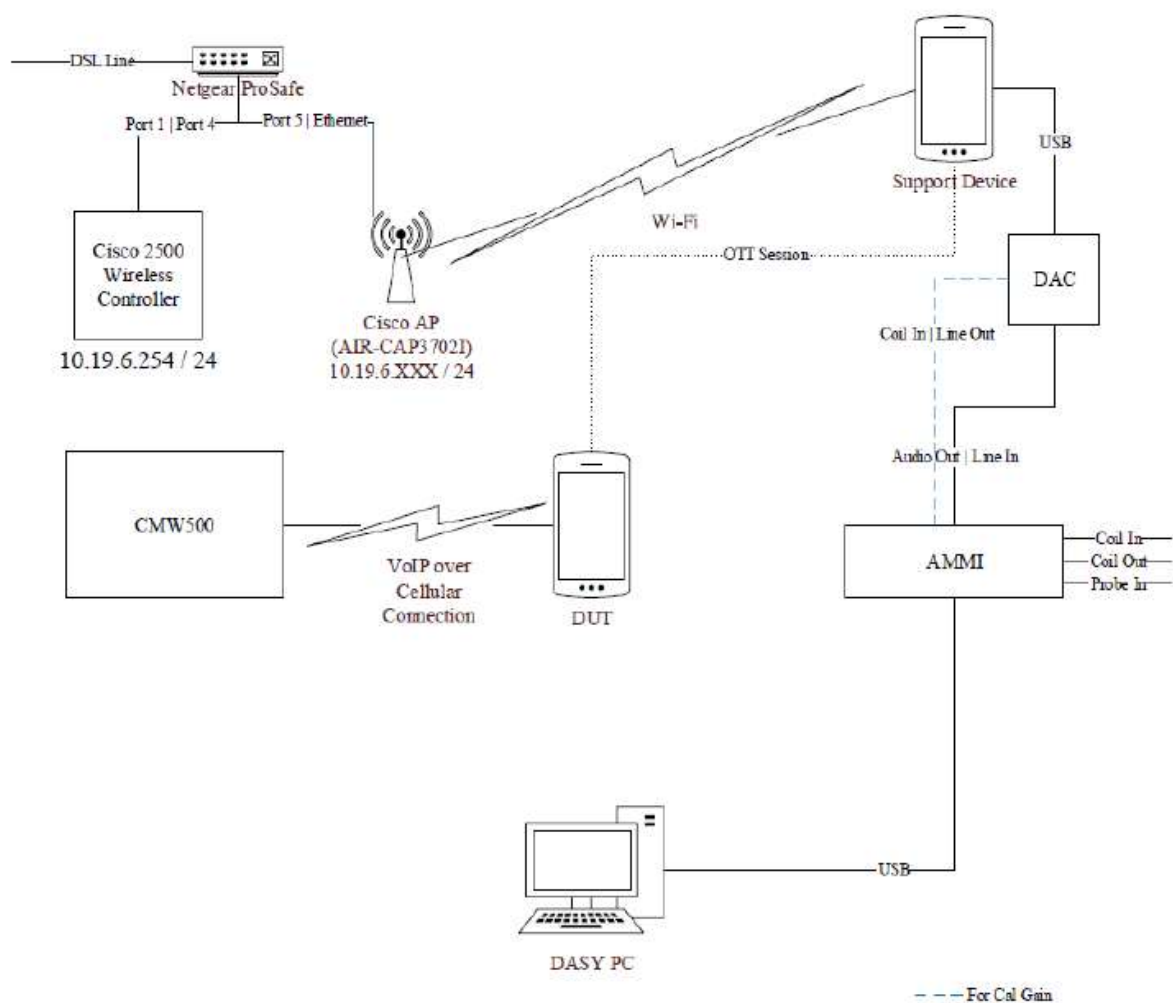
The set up for VoWiFi uses the Base station as described in section 7.1 with the exception that the reference audio level is set at -16dBm0. The reference level is calibrated using the standard call box calibration procedures with the exception of the -16dBm0 reference level being used.

An investigation was performed to determine worst case codec, bit rate and air interface configuration (refer to sections 11.3, 11.4 and 11.5).

This device supports VoIP via a preinstalled application that uses the Google Meet service, using OPUS as its only codec (refer to § 10 for air interface details and § 11.6 for codec bit rates). VoIP capabilities require HAC assessment when voice calls are supported over the cellular data connection via pre-installed VoIP applications.

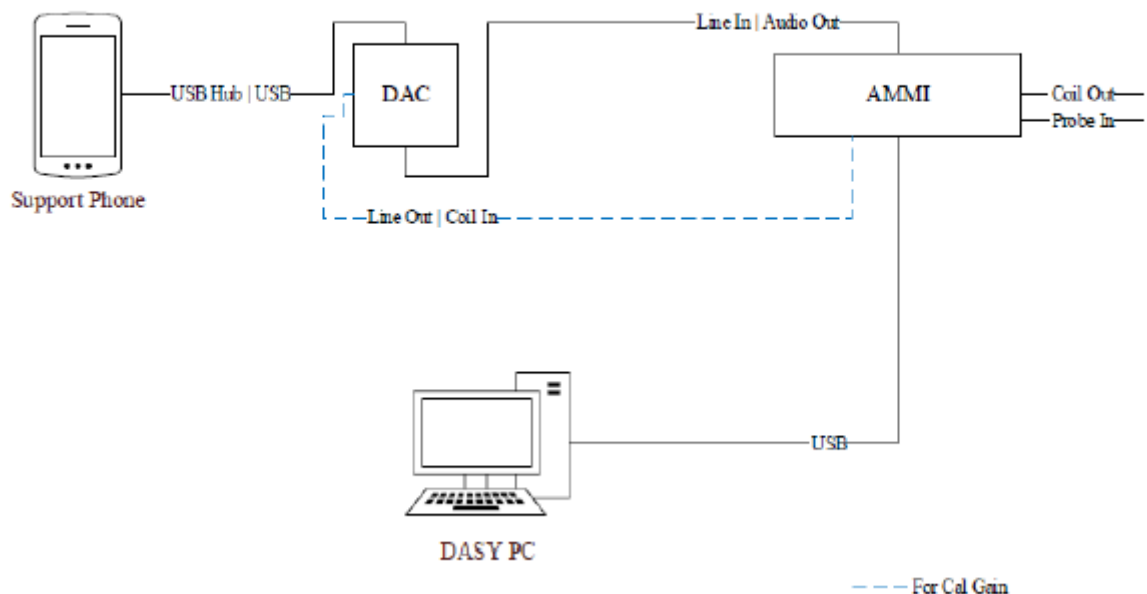
The equipment is set up as shown below with a support device used to originate the call using the IP transport. The support device connects to the cloud-based Google Meet service via Wi-Fi access point and router, or RJ45. The DUT connects to the VoIP service via a cellular/unlicensed air interface to 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 § 11.6).

Test Setup configuration for OTT calls



For the OTT call, the calibrated audio card within the CMW500 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 needs be determined. This is done by connecting the DAC between the AMMI Audio output and Coil input as shown below.



Using the metering function on the DAC, the DAC gain is adjusted until the volume reaches 0dBFS (3.14 dBm0 based on TIA/EIA 810-A).

7. Audio Level and Gain Measurements

7.1 UMTS, VoLTE, VoNR

Refer to the below table for the gains used to measure.

UMTS, VoLTE

Signal Type	Audio Level [dBm]	Peak to Full Scale [dB]	Peak to RMS Scale [dB]	BWC [dB]	Scaling [Gain]
Voice 1 kHz	-16	-0.37	15.74	0.07	-12.29
Normal Voice	-16	0	21.57	10.81	-6.46

VoNR

Signal Type	Audio Level [dBm]	Peak to Full Scale [dB]	Peak to RMS Scale [dB]	BWC [dB]	Scaling [Gain]
Voice 1 kHz	-16	-0.37	15.74	0.07	-7.49
Normal Voice	-16	0	21.57	10.81	-1.66

Refer to the below table for the gains used to measure VoLTE.

The following software/firmware was used to simulate the VoLTE server for testing:

Firmware	License Keys	Software Name
V4.0.24 for LTE	KS500	LTE FDD R8 SIG BASIC
	KS550	LTE TDD R8 SIG BASIC
V4.0.56 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

Refer to the below table for the gains used to measure VoNR of Call Box(E7515B)

The following software/firmware was used to simulate the VoNR server for testing:

Firmware	License Model	Software Name
5G NR	C8700200A	Test Application Framework
Audio	C8700201A	IMS-SIP Emulation
	C87300P1A	LTE IP data
	C87350P1A	5G NR IP data

7.2 Over the Top(OTT)

For EDGE, HSPA, LTE, NR and Wi-Fi the linear gain levels listed below were used. The results below are based on a reference input level of -16 dBm.

To calibrate the DAC (refer § 6.3), three. Way audio files (sine wave, 1 kHz voice, and 300 to 3 kHz voice) are sent from the DASY PC to the AMMI, then to the DAC. The Helmholtz resonator measures the field strength, which represents the AMMI to DAC input sensitivity. After determining the input sensitivity, the adjusted linear gain values can then be calculated.

UMTS, LTE

Signal Type	Audio Level [dBm]	Peak to Full Scale [dB]	Peak to RMS Scale [dB]	BWC [dB]	Scaling [Gain]
Voice 1 kHz	-16	-0.37	15.74	0.07	-8.70
Normal Voice	-16	0	21.57	10.81	-2.87

NR

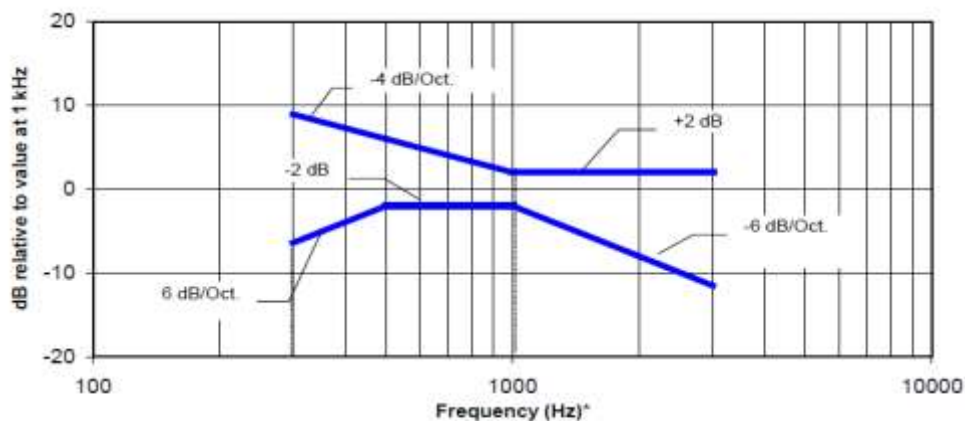
Signal Type	Audio Level [dBm]	Peak to Full Scale [dB]	Peak to RMS Scale [dB]	BWC [dB]	Scaling [Gain]
Voice 1 kHz	-16	-0.37	15.74	0.07	-8.63
Normal Voice	-16	0	21.57	10.81	-2.80

8. T-coil Measurement Criteria

8.1 Frequency Response

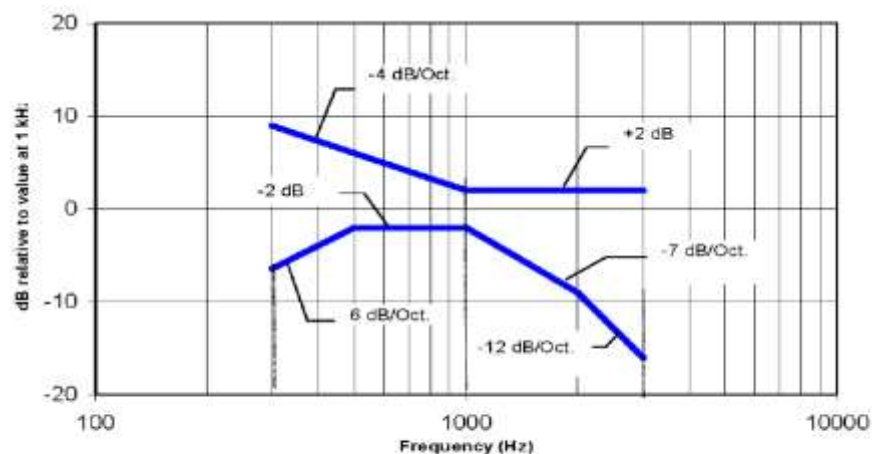
The frequency response of the axial component of the magnetic field, measured in 1/3 octave bands, shall follow the response curve, over the frequency range 300 Hz to 3000 Hz.

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 ≤ -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

8.2 Desired ABM Signal, Undesired ABM Field qualification requirements

ANSI C63.19-2019, Section 6.6.4.1

For a WD that is expected to operate primarily in radio access technologies that include 2G GSM for legacy support, the WD shall be qualified for telecoil compatibility one of two ways:

- a) The WD shall be rated for telecoil use for all other voice operating modes, exclusive of 2G GSM, according to the criteria of 6.6.4.2.
- b) If the WD is to be rated for telecoil use in its 2G GSM operating modes, these modes shall be qualified according to the criteria of 6.6.4.3.

ANSI C63.19-2019, 6.6.4.2 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.

ANSI C63.19-2019, 6.6.4.3 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.

9. Device Under Test

Normal operation	Held to head	
Back Cover	The Back Cover is not removable	
Test sample information	S/N	Notes
	YDL2327G	T-coil Test

Note : T-Coil Measurements in this report were performed by Maximum Power (Pmax) in static power condition.

10. Air Interfaces and Operating Mode

Air Interface	Bands (MHz)	Type	C63.19 Tested	Simultaneous Transmitter	Audio Codecs Evaluated
GSM	850	VO	Yes	Wi-Fi, BT	EFR ¹
	1900		Yes		
	GPRS/EDGE	VD	Yes	Wi-Fi, BT	OPUS ¹
WCDMA (UMTS)	850	VO	Yes	Wi-Fi, BT	AMR-NB &AMR-WB ¹
	1700		Yes ⁵		
	1900		Yes ⁵		
	HSPA	VD	Yes	Wi-Fi, BT	OPUS ¹
LTE - FDD	680 (B71)	VD	Yes	NR, Wi-Fi, BT	(AMR-NB, AMR- WB, EVS-NB, EVS-WB& OPUS) ¹
	700 (B12/13/14)		Yes		
	850 (B5/26)		Yes		
	1700 (B4/66)		Yes ⁵		
	1900 (B2/25)		Yes ⁵		
	2300 (B30)		Yes ⁵		
	2500 (B7)		Yes ⁵		
LTE – TDD	2600 (B38/41)	VD	Yes ⁵	NR, Wi-Fi, BT	(AMR-NB, AMR- WB, EVS-NB, EVS-WB& OPUS) ¹
	3600 (B48)		Yes		
NR -FDD	680(B71)	VD	Yes	LTE, Wi-Fi, BT	(AMR-NB, AMR- WB, EVS-NB, EVS-WB& OPUS) ¹
	700(B12/14)		Yes		
	850(B5/26)		Yes		
	1700(B66,70)		Yes ⁵		
	1900(B2/25)		Yes ⁵		
	2300(B30)		Yes ⁵		
	2500 (B7)		Yes ⁵		
NR -TDD	2600(B38,B41)	VD	Yes ^{4, 5}	LTE, Wi-Fi, BT	(AMR-NB, AMR- WB, EVS-NB, EVS-WB& OPUS) ¹
	3600 (B48)		Yes		
	3800(B77, B78)		Yes		
	25000 (n258)		No ²		
	28000 (n261)		No ²		
	39000 (n260)		No ²		
Wi-Fi	2450	VD	Yes	WWAN and BT, Wifi 5/6GHz	(AMR-NB, AMR- WB, EVS-NB, EVS-WB& OPUS) ¹
	5200 (U-NII-1)			WWAN and Wifi 2.4GHz, BT	
	5300 (U-NII-2A)				
	5500 (U-NII-2C)				
	5800 (U-NII-3)				
	5900 (U-NII-4)		Yes ³	WWAN and Wifi 2.4GHz, BT	
	6200(UNII 5)				
	6500(UNII 6)				
	6700(UNII 7)				
7000(UNII 8)	No ²				
BT	2450	DT	N/A	WWAN and Wifi 2.4GHz, Wifi 5/6GHz	N/A
NTN(Non Terrestrial Networks)	1600	DT	N/A	N/A	N/A
Type: VO: Legacy Cellular Voice Service DT: Digital Transport only(no voice) CMRS: Commercial Mobile Radio Service VD: IP Voice service over Digital Transport				Note: 1. Ref Lev in accordance with the ANSI 63.19-2019 Table 6.1 2. N258, n260,n261, Wifi 6GHz(UNII 6~8) are currently outside the scope of ANSI C63.19 and FCC HAC regulations. 3. UNII band 5 was evaluated for operations which are entirely below 6 GHz. 4. NR n41 in ANT I does not support in Head exposure scenario. 5. This report pertains to ANT I only. For full data, please refer to original test report (Test Report : HCT-SR-2504-FC002)	

11. HAC (T-coil) Test Results

11.1 Codec Investigation

An investigation between the various codec configurations (Low/High bit rates for Narrowband, Wideband) and specific parameters are documented (Primary Group, Secondary Group, longitudinal contiguous points, transverse row contiguous points, 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 UMTS, LTE FDD/TDD, NR FDD/TDD.

The highlighted results below were determined to be the worst case codec configuration(s) for UMTS and LTE, NR.

UMTS

Codec Investigation								
Codec State	AMR-NB (kbit/s)			AMR-WB (kbit/s)			Orientation	Band/ Channel
	4.75	7.4	12.2	6.6	15.85	23.85		
Freq. Response(dB)	2.00	2.00	1.96	1.97	1.77	1.91	y (Transversal)	UMTS Band 2 Rel.99 CH.9400 ANT B
Primary	395	441	428	323	345	339		
Secondary	568	615	598	526	528	520		
Contiguous Longitudinal	24	26	26	26	26	26		
Contiguous Transverse	26	26	26	26	26	26		

LTE FDD

Codec Investigation									
Codec State	AMR-NB (kbit/s)			AMR-WB (kbit/s)			Orientation	Band/ Bandwidth/ Channel	
	4.75	7.4	12.2	6.6	15.85	23.85			
Freq. Response(dB)	2.00	2.00	2.00	1.32	1.78	1.77	y (Transversal)	LTE Band25 CH.26365 20 Mhz QPSK 1RB 0offset ANT B	
Primary	334	329	345	304	321	317			
Secondary	587	590	591	534	532	529			
Contiguous Longitudinal	26	26	26	26	26	26			
Contiguous Transverse	26	26	26	26	26	26			

Codec Investigation											
Codec State	EVS-NB (kbit/s)			EVS-WB (kbit/s)			EVS-SWB (kbit/s)			Orientation	Band/ Bandwidth/ Channel
	5.9	13.2	24.4	5.9	13.2	24.4	9.6	16.4	24.4		
Freq. Response(dB)	2.00	1.91	2.00	1.30	1.91	1.86	2.00	2.00	2.00	y (Transversal)	LTE Band25 CH.26365 20 Mhz QPSK 1RB 0offset ANT B
Primary	295	345	350	306	331	328	301	429	421		
Secondary	591	587	590	590	538	536	454	581	574		
Contiguous Longitudinal	26	26	26	26	26	26	21	26	25		
Contiguous Transverse	26	26	26	26	26	26	26	26	26		

LTE TDD

Codec Investigation									
Codec State	AMR-NB (kbit/s)			AMR-WB (kbit/s)			Orientation	Band/ Bandwidth/ Channel	
	4.75	7.4	12.2	6.6	15.85	23.85			
Freq. Response(dB)	2.00	1.96	2.00	1.69	1.62	1.54	y (Transversal)	LTE Band41 CH.40620 20 Mhz QPSK 1RB 0offset ANT B	
Primary	160	160	157	163	173	170			
Secondary	376	376	372	362	361	354			
Contiguous Longitudinal	21	21	21	21	21	20			
Contiguous Transverse	26	26	26	26	26	26			

Codec Investigation											
Codec State	EVS-NB (kbit/s)			EVS-WB (kbit/s)			EVS-SWB (kbit/s)			Orientation	Band/ Bandwidth/ Channel
	5.9	13.2	24.4	5.9	13.2	24.4	9.6	16.4	24.4		
Freq. Response(dB)	2.00	2.00	2.00	1.95	1.96	1.80	1.91	2.00	2.00	y (Transversal)	LTE Band41 CH.40620 20 Mhz QPSK 1RB 0offset ANT B
Primary	134	158	157	122	169	170	216	209	216		
Secondary	359	358	357	350	350	354	358	351	360		
Contiguous Longitudinal	21	21	21	21	20	20	20	19	22		
Contiguous Transverse	26	26	26	26	26	26	26	26	26		

NR FDD

Codec Investigation								
Codec State	AMR-NB (kbit/s)			AMR-WB (kbit/s)			Orientation	Band/ Bandwidth/ Channel
	4.75	7.4	12.2	6.6	15.85	23.85		
Freq. Response(dB)	2.00	2.00	2.00	1.90	1.85	1.90	y (Transversal)	NR Band n25 CH.376500 DFT-s OFDM QPSK 40 Mhz 1RB 1offset ANT B
Primary	279	276	282	319	319	320		
Secondary	536	531	536	533	533	537		
Contiguous Longitudinal	23	26	25	22	25	26		
Contiguous Transverse	26	26	26	26	26	26		

Codec Investigation											
Codec State	EVS-NB (kbit/s)			EVS-WB (kbit/s)			EVS-SWB (kbit/s)			Orientation	Band/ Bandwidth/ Channel
	5.9	13.2	24.4	5.9	13.2	24.4	9.6	16.4	24.4		
Freq. Response(dB)	1.47	1.69	2.00	1.56	1.81	1.56	2.00	2.00	2.00	y (Transversal)	NR Band n25 CH.376500 DFT-s OFDM QPSK 40 MHz 1RB 1offset ANT B
Primary	213	293	340	253	324	335	428	383	385		
Secondary	538	537	593	538	541	550	587	541	541		
Contiguous Longitudinal	25	23	26	24	26	26	26	23	24		
Contiguous Transverse	26	26	26	26	26	26	26	26	26		

NR TDD

Codec Investigation								
Codec State	AMR-NB (kbit/s)			AMR-WB (kbit/s)			Orientation	Band/ Bandwidth/ Channel
	4.75	7.4	12.2	6.6	15.85	23.85		
Freq. Response(dB)	2.00	2.00	1.97	1.71	1.76	1.95	y (Transversal)	NR Band n41 CH.518598 DFT-s OFDM QPSK 100 Mhz 1 RB 1 offset PC2 ANT B
Primary	119	121	122	133	137	135		
Secondary	336	322	321	320	319	319		
Contiguous Longitudinal	21	21	21	21	21	21		
Contiguous Transverse	26	26	26	26	26	26		

Codec Investigation											
Codec State	EVS-NB (kbit/s)			EVS-WB (kbit/s)			EVS-SWB (kbit/s)			Orientation	Band/ Bandwidth/ Channel
	5.9	13.2	24.4	5.9	13.2	24.4	9.6	16.4	24.4		
Freq. Response(dB)	2.00	2.00	2.00	1.36	1.48	1.95	1.86	2.00	2.00	y (Transversal)	NR Band n41 CH.518598 DFT-s OFDM QPSK 100 Mhz 1 RB 1 offset PC2 ANT B
Primary	88	104	101	119	123	122	156	156	154		
Secondary	345	323	321	356	334	322	333	331	330		
Contiguous Longitudinal	20	21	20	20	20	20	20	20	20		
Contiguous Transverse	26	26	26	26	26	26	26	26	26		

11.2 Air Interface Investigation

Use the worst-case codec test and document a limited set of bands/modulations/channels/bandwidth. Observe the effect of changing the band and bandwidth to ensure that there are no unexpected variations.

11.2.1 UMTS

Original Result

Mode	Ch. Freq.	Ambient Noise dB (A/m)	Primary	Secondary	Contiguous longitudinal	Contiguous Transverse	Freq. Response(dB)	Hmax dB(A/m)	Plot No.
UMTS Band 2 AMR-WB Codec: 6.6kbit/s ANT I	CH.9400 1880.0 MHz	-52.48	325	519	26	26	2.00	14.58	
UMTS Band 4 AMR-WB Codec: 6.6kbit/s ANT I	CH.1412 1732.4 MHz	-52.48	313	510	24	26	1.85	14.70	

C2PC Result

Mode	Ch. Freq.	Ambient Noise dB (A/m)	Primary	Secondary	Contiguous longitudinal	Contiguous Transverse	Freq. Response(dB)	Hmax dB(A/m)	Plot No.
UMTS Band 4 AMR-WB Codec: 6.6kbit/s ANT I	CH.1412 1732.4 MHz	-56.82	389	633	26	26	2.00	15.25	1

11.2.2 LTE-FDD

Original Result

Mode	Ch. Freq.	BW	Mod.	RB Config.	Ambient Noise dB (A/m)	Primary	Secondary	Contiguous longitudinal	Contiguous Transverse	Freq. Response(dB)	Hmax dB (A/m)	Plot No.
LTE Band 25 ANT I Codec: EVS-NB 5.9kbit/s	CH.26365 1882.5 MHz	20 MHz	64QAM	1/0	-52.50	355	557	26	26	2.00	15.59	
LTE Band 7 ANT I Codec: EVS-NB 5.9kbit/s	CH.21100 2535 MHz	20 MHz	64QAM	1/0	-52.50	325	522	22	26	2.00	14.79	
LTE Band 30 ANT I Codec: EVS-NB 5.9kbit/s	CH.27710 2310 MHz	10 MHz	64QAM	1/0	-52.54	257	466	21	26	1.73	15.15	
LTE Band 66 ANT I Codec: EVS-NB 5.9kbit/s	CH.132322 1745 MHz	20 MHz	64QAM	1/0	-52.54	297	503	23	26	2.00	15.15	

C2PC Result

Mode	Ch. Freq.	BW	Mod.	RB Config.	Ambient Noise dB (A/m)	Primary	Secondary	Contiguous longitudinal	Contiguous Transverse	Freq. Response(dB)	Hmax dB (A/m)	Plot No.
LTE Band 30 ANT I Codec: EVS-NB 5.9kbit/s	CH.27710 2310 MHz	10 MHz	64QAM	1/0	-56.82	230	508	24	26	2.00	12.55	2

11.2.3 LTE-TDD

Original Result

Mode	Ch. Freq.	BW	Mod.	RB Config.	Ambient Noise dB (A/m)	Primary	Secondary	Contiguous longitudinal	Contiguous Transverse	Freq. Response(dB)	Hmax dB (A/m)	Plot No.
LTE Band 41 PC3 ANT I Codec: EVS-WB 5.9kbit/s	CH.40620 2593 MHz	5 MHz	QPSK	25/0	-52.39	131	374	21	26	1.57	9.74	
LTE Band 41 PC3 ANT I Codec: EVS-WB 5.9kbit/s	CH.39750 2506 MHz	5 MHz	QPSK	25/0	-52.39	144	388	21	26	1.80	9.39	
LTE Band 41 PC3 ANT I Codec: EVS-WB 5.9kbit/s	CH.40185 2549.5 MHz	5 MHz	QPSK	25/0	-52.39	130	370	21	26	2.00	10.04	
LTE Band 41 PC3 ANT I Codec: EVS-WB 5.9kbit/s	CH.41055 2636.5 MHz	5 MHz	QPSK	25/0	-52.39	133	376	21	26	1.65	10.66	
LTE Band 41 PC3 ANT I Codec: EVS-WB 5.9kbit/s	CH.41490 2680 MHz	5 MHz	QPSK	25/0	-52.39	137	372	21	26	2.00	10.26	

C2PC Result

Mode	Ch. Freq.	BW	Mod.	RB Config.	Ambient Noise dB (A/m)	Primary	Secondary	Contiguous longitudinal	Contiguous Transverse	Freq. Response(dB)	Hmax dB (A/m)	Plot No.
LTE Band 41 PC3 ANT I Codec: EVS-WB 5.9kbit/s	CH.40185 2549.5 MHz	5 MHz	QPSK	25/0	-56.82	127	378	20	26	1.79	12.47	3

11.2.4 NR-FDD

Original Result

Mode	Ch. Freq.	BW	Waveform	Mod.	RB Config.	Ambient Noise dB (A/m)	Primary	Secondary	Contiguous longitudinal	Contiguous Transverse	Freq. Response (dB)	Hmax dB (A/m)	Plot No.
NR Band n25 ANT I Codec: EVS-NB 5.9	CH.376500 1882.5 MHz	40 MHz	CP-OFDM	QPSK	1/1	-56.77	244	576	26	26	2.00	5.36	
NR Band n7 ANT I Codec: EVS-NB 5.9	CH.507000 2535 MHz	40 MHz	CP-OFDM	QPSK	1/1	-56.67	254	575	26	26	2.00	4.71	
NR Band n30 ANT I Codec: EVS-NB 5.9	CH.462000 2310 MHz	10 MHz	CP-OFDM	QPSK	1/1	-56.67	246	568	26	26	2.00	5.76	
NR Band n66 ANT I Codec: EVS-NB 5.9	CH.349000 1745 MHz	40 MHz	CP-OFDM	QPSK	1/1	-56.67	250	586	26	26	2.00	5.16	
NR Band n70 ANT I Codec: EVS-NB 5.9	CH.340500 1702.5 MHz	15 MHz	CP-OFDM	QPSK	1/1	-56.67	270	600	26	26	2.00	6.23	

C2PC Result

Mode	Ch. Freq.	BW	Waveform	Mod.	RB Config.	Ambient Noise dB (A/m)	Primary	Secondary	Contiguous longitudinal	Contiguous Transverse	Freq. Response (dB)	Hmax dB (A/m)	Plot No.
NR Band n25 ANT I Codec: EVS-NB 5.9	CH.376500 1882.5 MHz	40 MHz	CP-OFDM	QPSK	1/1	-56.83	301	589	26	26	1.85	12.87	4

11.2.5 NR-TDD

Original Result

Mode	Ch. Freq.	BW	Waveform	Mod.	RB Config.	Ambient Noise dB (A/m)	Primary	Secondary	Contiguous longitudinal	Contiguous Transverse	Freq. Response (dB)	Hmax dB (A/m)	Plot No.
NR Band n38 ANT I Codec: EVS-NB 5.9kbit/s	CH.519000 2595 MHz	40 MHz	DFT-s-OFDM	QPSK	1/1	-56.75	111	319	21	26	1.62	10.92	

C2PC Result

Mode	Ch. Freq.	BW	Waveform	Mod.	RB Config.	Ambient Noise dB (A/m)	Primary	Secondary	Contiguous longitudinal	Contiguous Transverse	Freq. Response (dB)	Hmax dB (A/m)	Plot No.
NR Band n38 ANT I Codec: EVS-NB 5.9kbit/s	CH.519000 2595 MHz	40 MHz	DFT-s-OFDM	QPSK	1/1	-56.83	113	355	21	26	1.68	12.57	5

11.3 OTT Codec Investigation

The DUT's nested OTT application supports range of codec bit rate 6 – 75 kbit/s, thus an investigation between the various codec configurations (6/75 as Low/High bit rates) and specific parameters are documented (Primary Group, Secondary Group, longitudinal contiguous points, transverse row contiguous points, Frequency Response) to determine the worst-case bit rates for each service type.

The table below compares the varying codec configurations.

Codec Investigation					
Codec State	codec bit rate (kbit/s)			Orientation	Band/ BandWidth/ Channel
	6	40	75		
Freq. Response (dB)	2.00	2.00	2.00	y(Transversal)	UMTS Band 5 HSUPA subtest 1 CH.4183 836.6 MHz ANT E
Primary	357	402	405		
Secondary	474	477	478		
Contiguous Longitudinal	21	21	21		
Contiguous Transverse	26	26	26		
Freq. Response (dB)	1.75	1.15	1.21	y(Transversal)	LTE Band 14 10 MHz 64QAM 1RB 0offset CH.23330 793 MHz ANT A
Primary	429	434	444		
Secondary	499	499	502		
Contiguous Longitudinal	21	21	22		
Contiguous Transverse	26	26	26		
Freq. Response (dB)	1.20	1.17	1.08	y(Transversal)	LTE Band 41 PC3 5 MHz QPSK 25RB 0offset CH.40185 2549.5 MHz ANT I
Primary	280	273	272		
Secondary	343	332	332		
Contiguous Longitudinal	18	18	18		
Contiguous Transverse	26	26	26		

Codec Investigation					
Codec State	codec bit rate (kbit/s)			Orientation	Band/ Bandwidth/ Channel
	6	40	75		
Freq. Response (dB)	1.35	1.88	2.00	y(Transversal)	NR Band n25 40 Mhz CP-OFDM QPSK 1RB 1offset CH.376500 1882.5 Mhz ANT B
Primary	414	428	426		
Secondary	499	508	506		
Contiguous Longitudinal	21	22	21		
Contiguous Transverse	26	26	26		
Freq. Response (dB)	1.45	2.00	2.00	y(Transversal)	NR Band n41 PC2 100 Mhz DFT-s-OFDM QPSK 1RB 1offset CH.518598 2592.99 Mhz ANT B
Primary	227	229	227		
Secondary	316	312	310		
Contiguous Longitudinal	19	19	19		
Contiguous Transverse	26	26	26		

11.4 OTT Air Interface Investigation

Original UMTS, LTE Result

Mode	Ch. Freq.	BW	Mod.	RB Config.	Ambient Noise dB (A/m)	Primary	Secondary	Contiguous longitudinal	Contiguous Transverse	Freq. Response (dB)	Hmax dB (A/m)	Plot No.
UMTS Band 2 HSUPA subtest1 Google Meet Codec: 6kbit/s ANT I	CH.9400 1880 MHz				-56.48	391	474	21	26	1.31	21.95	
UMTS Band 4 HSUPA subtest1 Google Meet Codec: 6kbit/s ANT I	CH.1412 1732.4 MHz				-56.48	390	472	20	26	1.23	22.15	
LTE Band 7 Google Meet Codec: 6kbit/s ANT I	CH.21100 2535 MHz	20 MHz	64QAM	1/0	-52.65	414	479	20	26	1.34	22.74	
LTE Band 25 Google Meet Codec: 6kbit/s ANT I	CH.26365 1882.5 MHz	20 MHz	64QAM	1/0	-52.65	424	483	20	26	2.00	23.00	
LTE Band 30 Google Meet Codec: 6kbit/s ANT I	CH.27710 2310 MHz	10 MHz	64QAM	1/0	-52.65	387	449	18	26	2.00	22.40	
LTE Band 66 Google Meet Codec: 6kbit/s ANT I	CH.132322 1745 MHz	20 MHz	64QAM	1/0	-52.65	400	465	19	26	1.87	22.78	
LTE Band 41 PC3 Google Meet Codec: 75kbit/s ANT I	CH.40185 2549.5 MHz	5 MHz	QPSK	25/0	-52.65	272	332	18	26	1.08	23.12	

C2PC UMTS, LTE Result

Mode	Ch. Freq.	BW	Mod.	RB Config.	Ambient Noise dB (A/m)	Primary	Secondary	Contiguous longitudinal	Contiguous Transverse	Freq. Response (dB)	Hmax dB (A/m)	Plot No.
UMTS Band 4 HSUPA subtest1 Google Meet Codec: 6kbit/s ANT I	CH.1412 1732.4 MHz				-56.82	373	523	23	26	1.84	20.32	6
LTE Band 30 Google Meet Codec: 6kbit/s ANT I	CH.27710 2310 MHz	10 MHz	64QAM	1/0	-56.82	359	474	19	26	1.40	22.00	7
LTE Band 41 PC3 Google Meet Codec: 75kbit/s ANT I	CH.40185 2549.5 MHz	5 MHz	QPSK	25/0	-56.82	227	336	19	26	2.00	22.00	8

Original NR Result

Mode	Ch. Freq.	BW	Wave form	Mod.	RB Config.	Ambient Noise dB (A/m)	Primary	Secondary	Contiguous longitudinal	Contiguous Transverse	Freq. Response (dB)	Hmax dB (A/m)	Plot No.
NR Band n25 Google Meet Codec: 6kbit/s ANT I	CH.376500 1882.5 MHz	40 MHz	CP-OFDM	QPSK	1/1	-56.83	413	500	20	26	1.98	21.33	
NR Band n7 Google Meet Codec: 6kbit/s ANT I	CH.507000 2535 MHz	40 MHz	CP-OFDM	QPSK	1/1	-56.83	403	491	20	26	1.90	21.09	
NR Band n30 Google Meet Codec: 6kbit/s ANT I	CH.462000 2310 MHz	10 MHz	CP-OFDM	QPSK	1/1	-56.83	407	501	21	26	1.80	20.79	
NR Band n66 Google Meet Codec: 6kbit/s ANT I	CH.349000 1745 MHz	40 MHz	CP-OFDM	QPSK	1/1	-56.83	409	489	20	26	2.00	21.35	
NR Band n70 Google Meet Codec: 6kbit/s ANT I	CH.340500 1702.5 MHz	15 MHz	CP-OFDM	QPSK	1/1	-56.83	410	500	21	26	1.99	21.17	
NR Band n38 Google Meet Codec: 75kbit/s ANT I	CH.519000 2595 MHz	40 MHz	DFT-s-OFDM	QPSK	1/1	-56.86	239	316	18	26	2.00	21.70	

C2PC NR Result

Mode	Ch. Freq.	BW	Wave form	Mod.	RB Config.	Ambient Noise dB (A/m)	Primary	Secondary	Contiguous longitudinal	Contiguous Transverse	Freq. Response (dB)	Hmax dB (A/m)	Plot No.
NR Band n7 Google Meet Codec: 6kbit/s ANT I	CH.507000 2535 MHz	40 MHz	CP-OFDM	QPSK	1/1	-56.83	391	518	22	26	2.00	21.44	9
NR Band n38 Google Meet Codec: 75kbit/s ANT I	CH.519000 2595 MHz	40 MHz	DFT-s-OFDM	QPSK	1/1	-56.83	236	349	20	26	2.00	22.44	10

Appendix 1. TEST SETUP PHOTO

Please refer to test Setup Photo file no. as follows;

Rev. No.	File No.
0	HCT-SR-2505-FC011-P

Appendix 2. HAC T-COIL Test Plots

Plot 1 UMTS Band 4 CH.1412 Voice AMR-WB Codec: 6.6kbit/s ANT I

T-Coil Signal Test Report

Hardware Setup

Probe Name	Probe Calibration Date	DAE Name	DAE Calibration Date
AM1DV3 - 3049	November 14, 2024	DAE4 Sn1225	February 18, 2025

Communication Systems

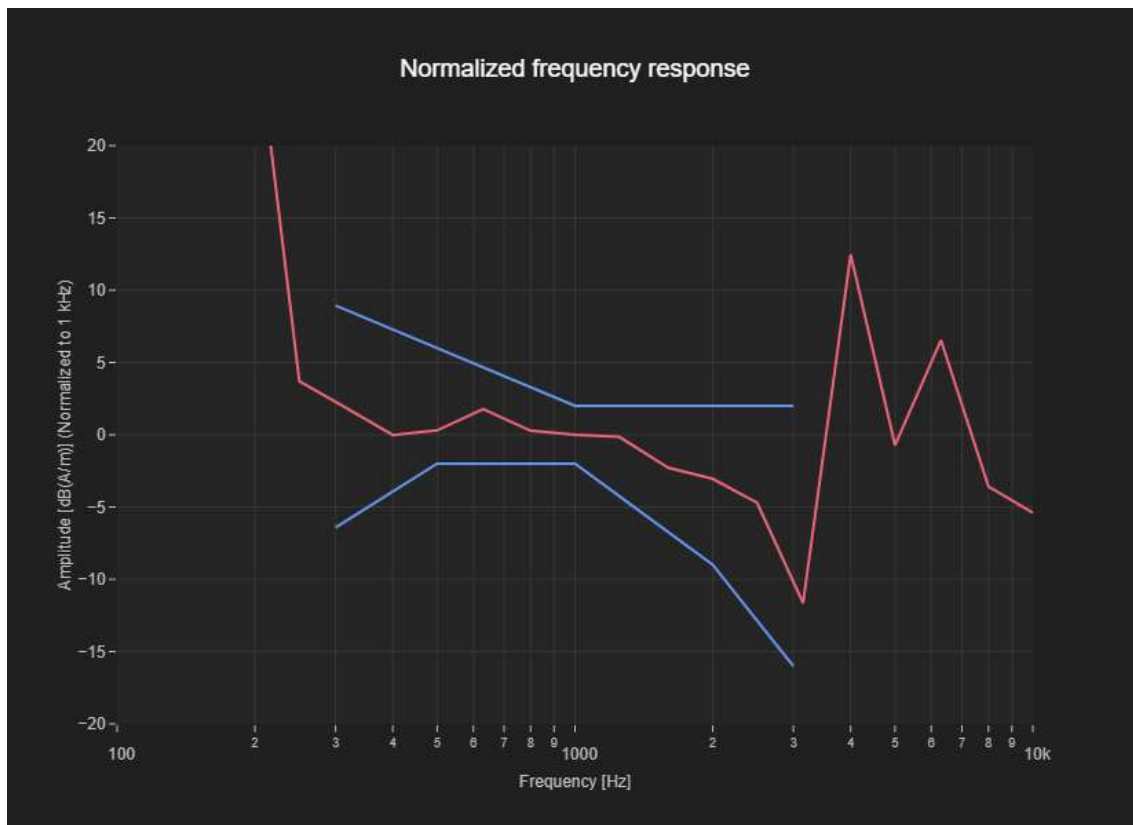
Band Name	Communication Systems Name	Channel	Frequency [MHz]
Band 4	UMTS-FDD (WCDMA)	1412	1732.4

Grid Settings

Extent X [mm]	Extent Y [mm]	Step X [mm]	Step Y [mm]	Distance [mm]
52.0	52.0	4.0	4.0	10.0

Results

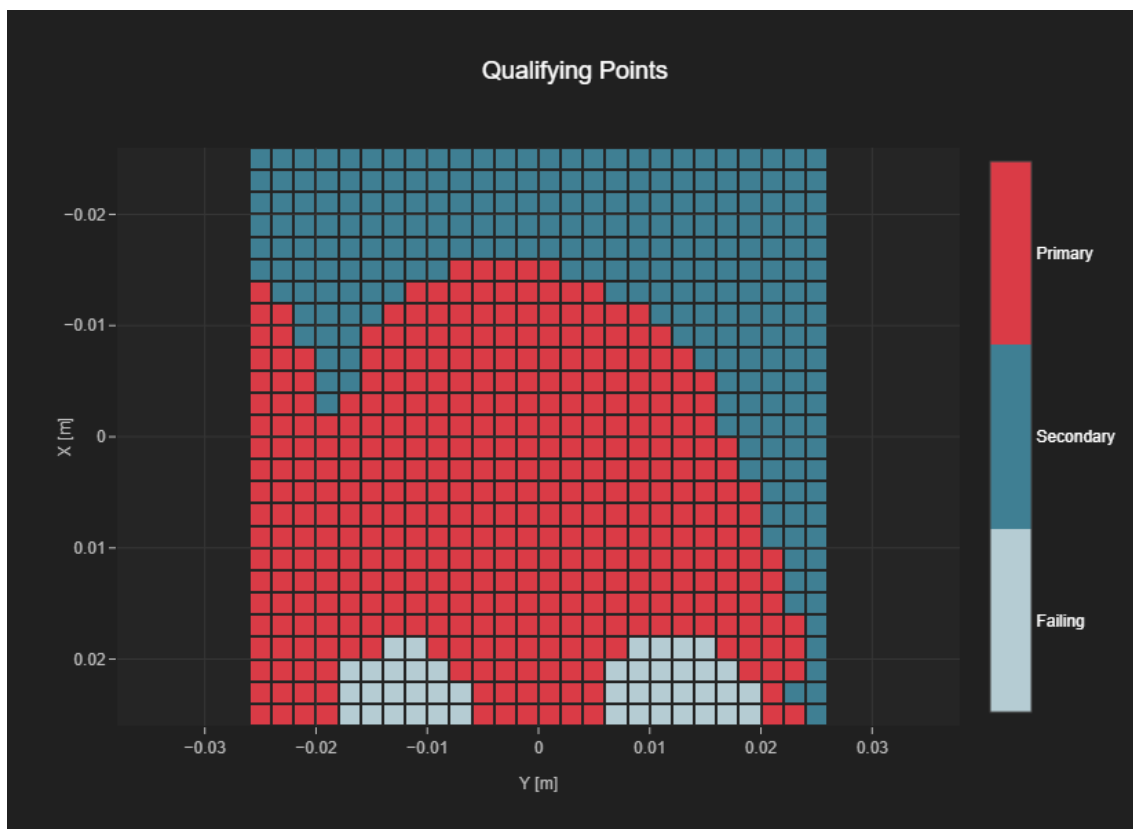
Audio File	Measurement Duration [s]	Margin Upper Bound [dB]	Margin Lower Bound [dB]
48k_voice_300-3000_2s.wav	2.0	2.0	2.0



T-Coil Coupling Mode Test Report

Results

Primary Group Contiguous Point Count	Secondary Group Point Count	Secondary Group Max Longitudinal	Secondary Group Max Transverse
389	633	26	26



**Plot 2 LTE Band 30 10MHz 64QAM 1RB 0offset CH.27710 Voice EVS-NB Codec 5.9kbit/s
ANT I****T-Coil Signal Test Report****Hardware Setup**

Name	Probe Calibration Date	DAE Name	DAE Calibration Date
AM1DV3 - 3049	November 14, 2024	DAE4 Sn1225	February 18, 2025

Communication Systems

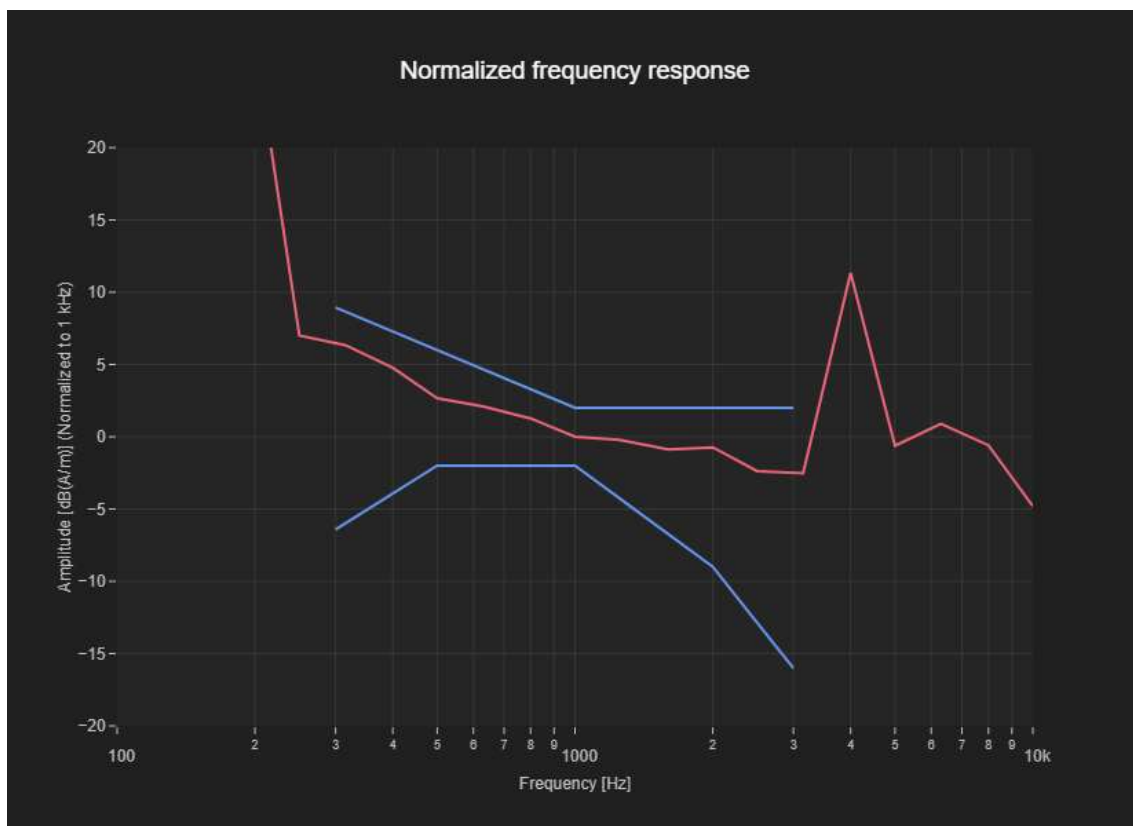
Band Name	Communication Systems Name	Channel	Frequency [MHz]
Band 30	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, 64-QAM)	27710	2310.0

Grid Settings

Extent X [mm]	Extent Y [mm]	Step X [mm]	Step Y [mm]	Distance [mm]
52.0	52.0	4.0	4.0	10.0

Results

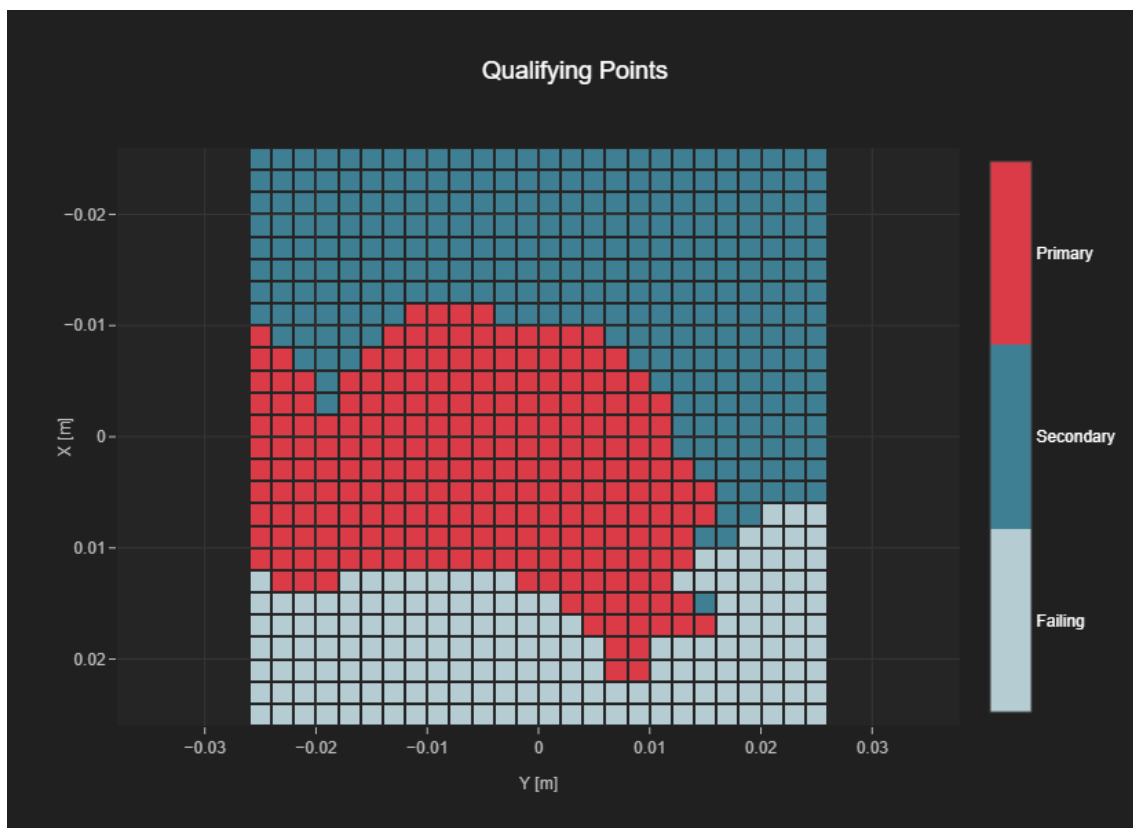
Audio File	Measurement Duration [s]	Margin Upper Bound [dB]	Margin Lower Bound [dB]
48k_voice_300-3000_2s.wav	2.0	2.0	2.0



T-Coil Coupling Mode Test Report

Results

Primary Group Contiguous Point Count	Secondary Group Point Count	Secondary Group Max Longitudinal	Secondary Group Max Transverse
230	508	24	26



Plot 3 LTE Band 41 5MHz QPSK 25RB 0offset CH.40185 Voice EVS-WB Codec: 5.9kbit/s
ANT I

T-Coil Signal Test Report

Hardware Setup

Probe Name	Probe Calibration Date	DAE Name	DAE Calibration Date
AM1DV3 - 3049	November 14, 2024	DAE4 Sn1225	February 18, 2025

Communication Systems

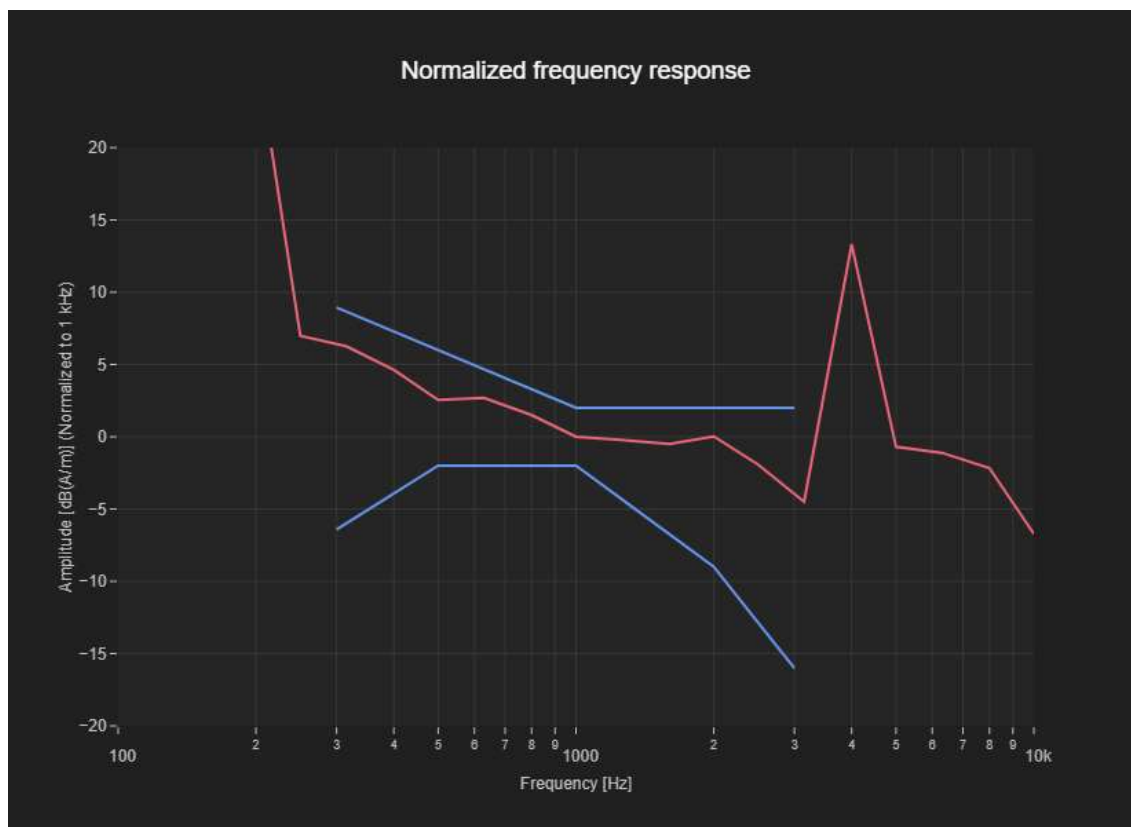
Band Name	Communication Systems Name	Channel	Frequency [MHz]
Band 41	LTE-TDD (SC-FDMA, 100 RB, 5 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	40185	2549.5

Grid Settings

Extent X [mm]	Extent Y [mm]	Step X [mm]	Step Y [mm]	Distance [mm]
52.0	52.0	4.0	4.0	10.0

Results

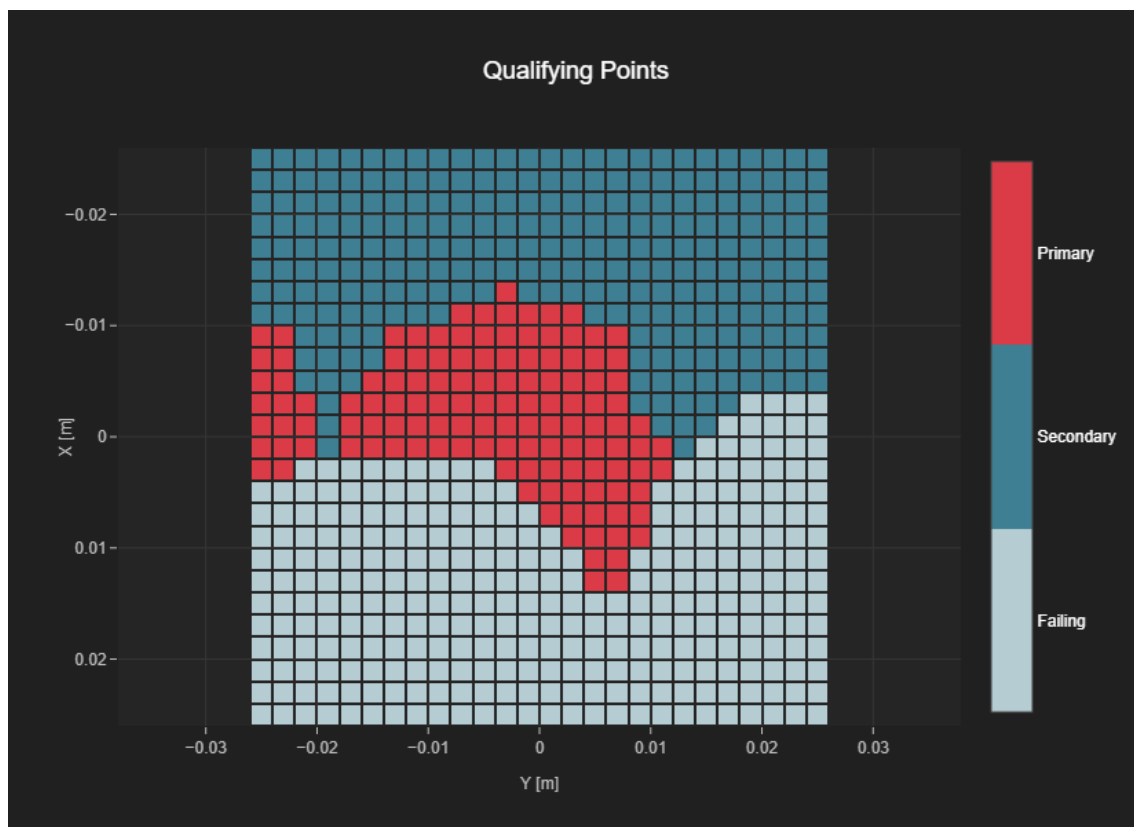
Audio File	Measurement Duration [s]	Margin Upper Bound [dB]	Margin Lower Bound [dB]
48k_voice_300-3000_2s.wav	2.0	1.79	2.0



T-Coil Coupling Mode Test Report

Results

Primary Group Contiguous Point Count	Secondary Group Point Count	Secondary Group Max Longitudinal	Secondary Group Max Transverse
127	378	20	26



Plot 4 NR Band n25 CP OFDM 40MHz QPSK 1RB 1offset CH.376500 EVS-NB Codec:
5.9kbit/s ANT I

T-Coil Signal Test Report

Hardware Setup

Probe Name	Probe Calibration Date	DAE Name	DAE Calibration Date
AM1DV3 - 3049	November 14, 2024	DAE4 Sn1225	February 18, 2025

Communication Systems

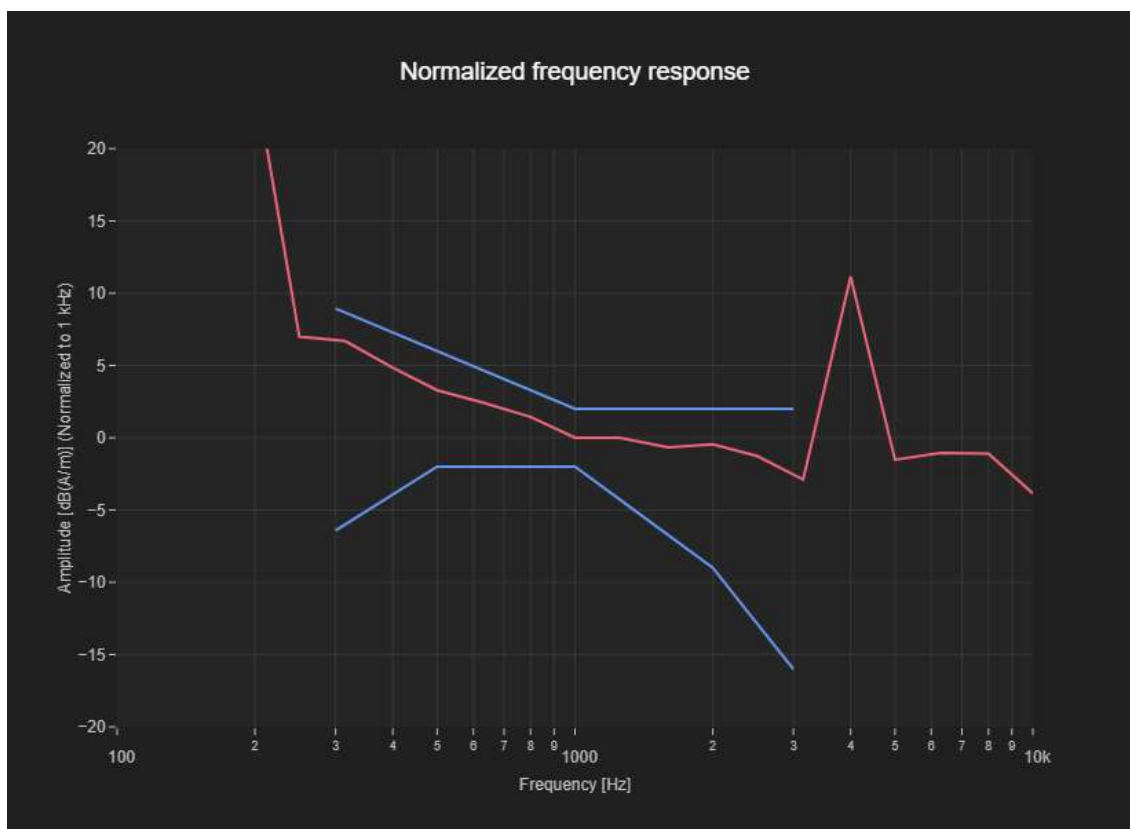
Band Name	Communication Systems Name	Channel	Frequency [MHz]
Band n25	5G NR (DFT-s-OFDM, 1 RB, 40 MHz, QPSK, 15 kHz)	376500	1882.5

Grid Settings

Extent X [mm]	Extent Y [mm]	Step X [mm]	Step Y [mm]	Distance [mm]
52.0	52.0	4.0	4.0	10.0

Results

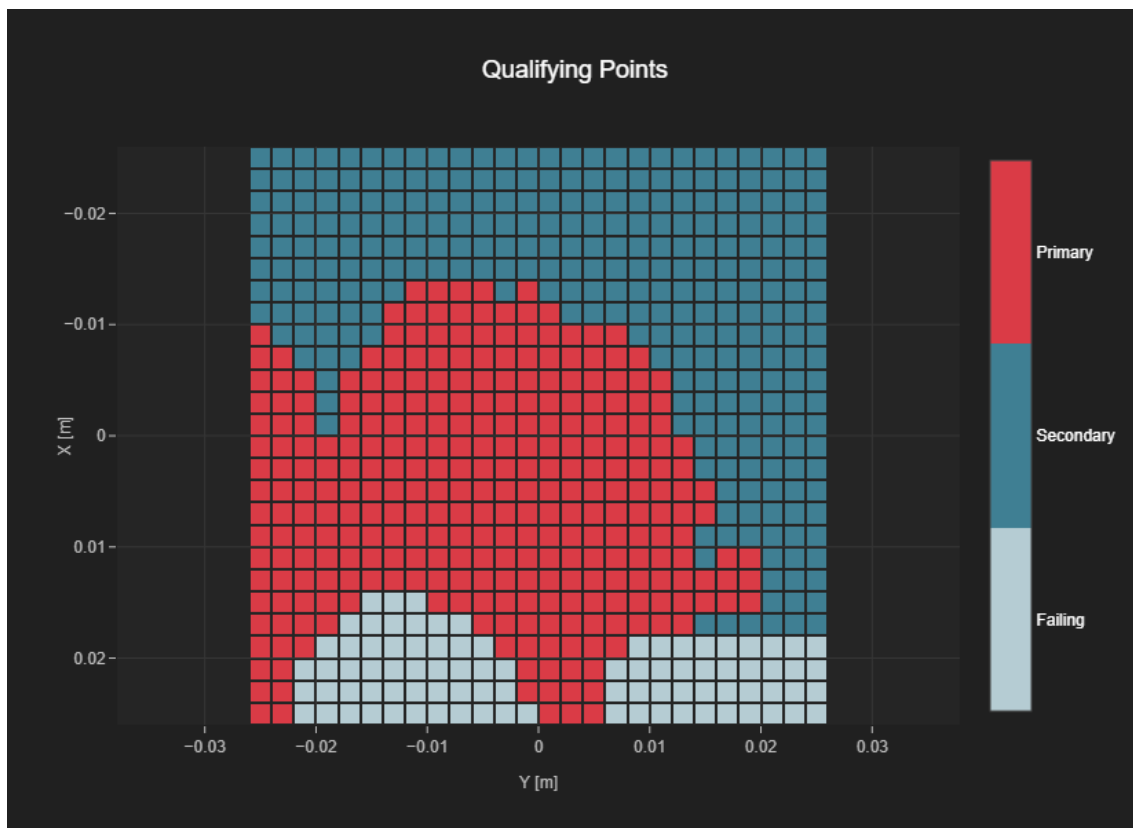
Audio File	Measurement Duration [s]	Margin Upper Bound [dB]	Margin Lower Bound [dB]
48k_voice_300-3000_2s.wav	2.0	1.85	2.0



T-Coil Coupling Mode Test Report

Results

Primary Group Contiguous Point Count	Secondary Group Point Count	Secondary Group Max Longitudinal	Secondary Group Max Transverse
301	589	26	26



Plot 5 NR Band 38 40MHz DFT-s-OFDM 1RB 1offset CH.519000 Voice EVS-NB Codec:
5.9kbit/s ANT I

T-Coil Signal Test Report

Hardware Setup

Probe Name	Probe Calibration Date	DAE Name	DAE Calibration Date
AM1DV3 - 3049	November 14, 2024	DAE4 Sn1225	February 18, 2025

Communication Systems

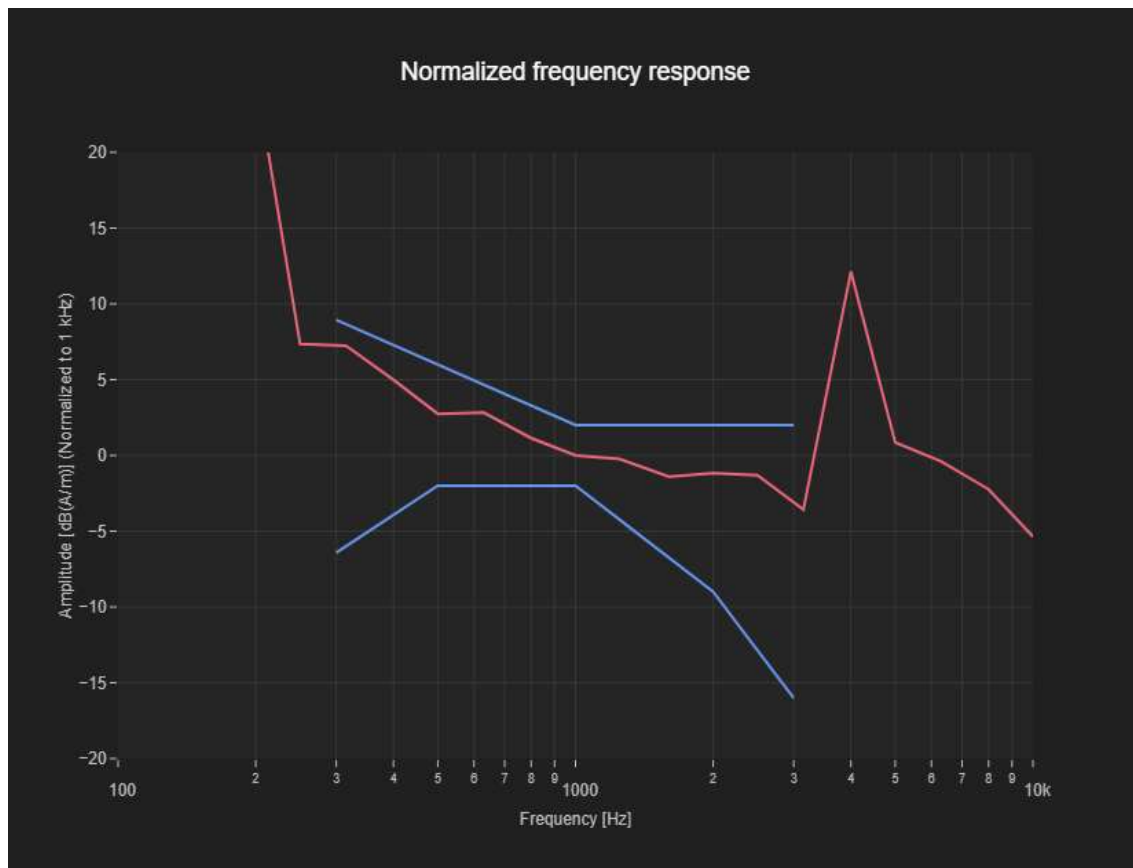
Band Name	Communication Systems Name	Channel	Frequency [MHz]
Band n38	5G NR (DFT-s-OFDM, 1 RB, 40 MHz, QPSK, 30 kHz)	519000	2595.0

Grid Settings

Extent X [mm]	Extent Y [mm]	Step X [mm]	Step Y [mm]	Distance [mm]
52.0	52.0	4.0	4.0	10.0

Results

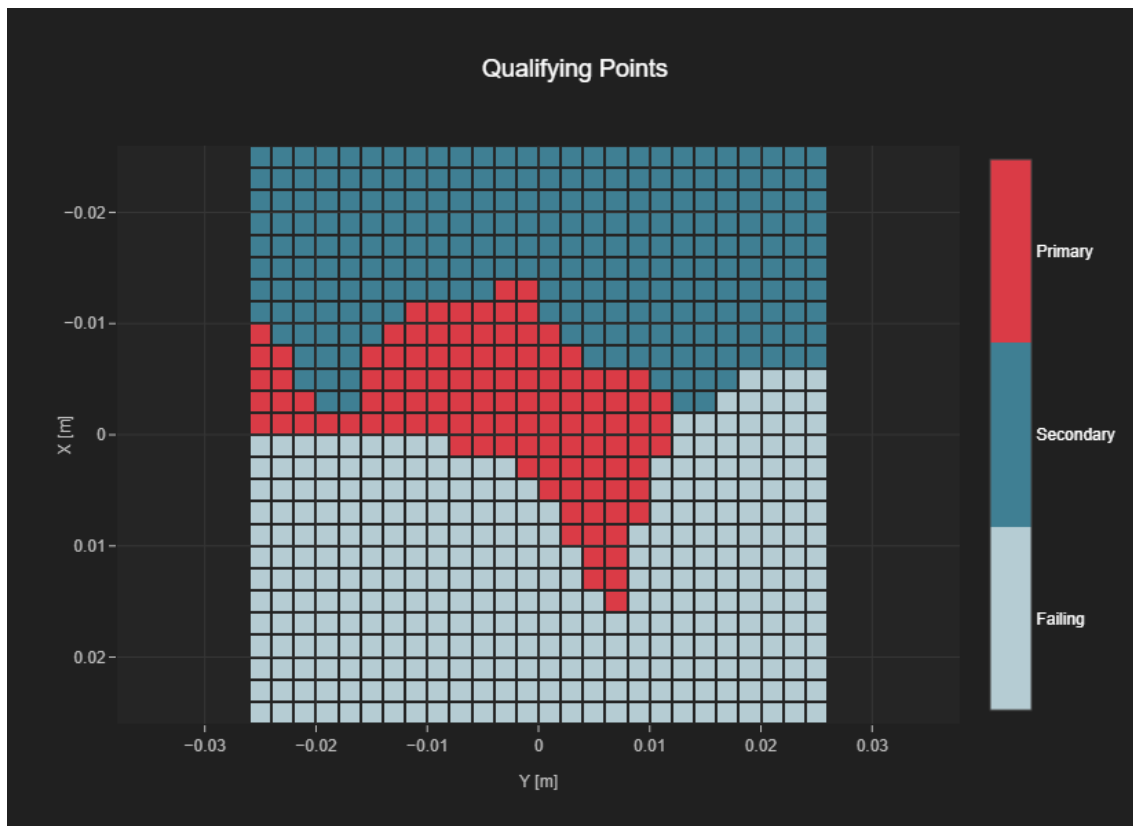
Audio File	Measurement Duration [s]	Margin Upper Bound [dB]	Margin Lower Bound [dB]
48k_voice_300-3000_2s.wav	2.0	1.68	2.0



T-Coil Coupling Mode Test Report

Results

Primary Group Contiguous Point Count	Secondary Group Point Count	Secondary Group Max Longitudinal	Secondary Group Max Transverse
113	355	21	26



Plot 6 UMTS Band 4 CH.1412 Google Meet Codec: 6 kbit/s ANT I T-Coil Signal Test Report

Hardware Setup

Probe Name	Probe Calibration Date	DAE Name	DAE Calibration Date
AM1DV3 - 3049	November 14, 2024	DAE4 Sn1225	February 18, 2025

Communication Systems

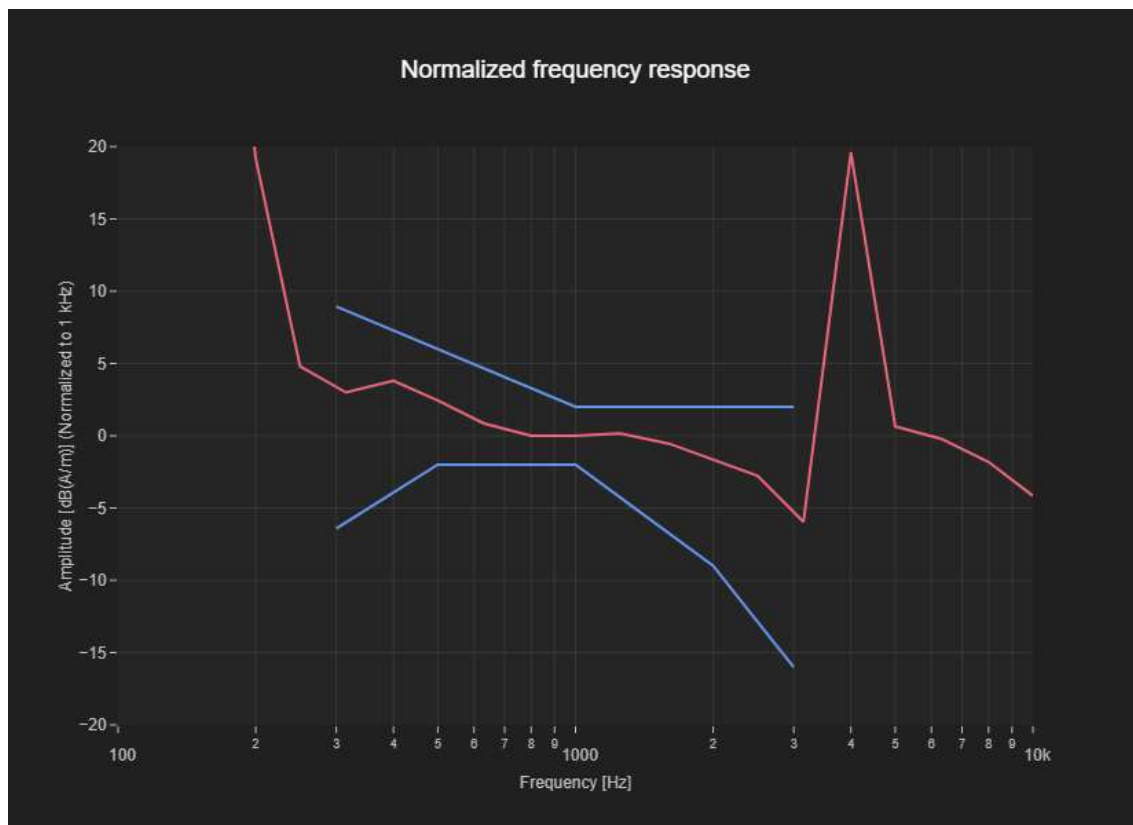
Band Name	Communication Systems Name	Channel	Frequency [MHz]
Band 4	UMTS-FDD (WCDMA)	1412	1732.4

Grid Settings

Extent X [mm]	Extent Y [mm]	Step X [mm]	Step Y [mm]	Distance [mm]
52.0	52.0	4.0	4.0	10.0

Results

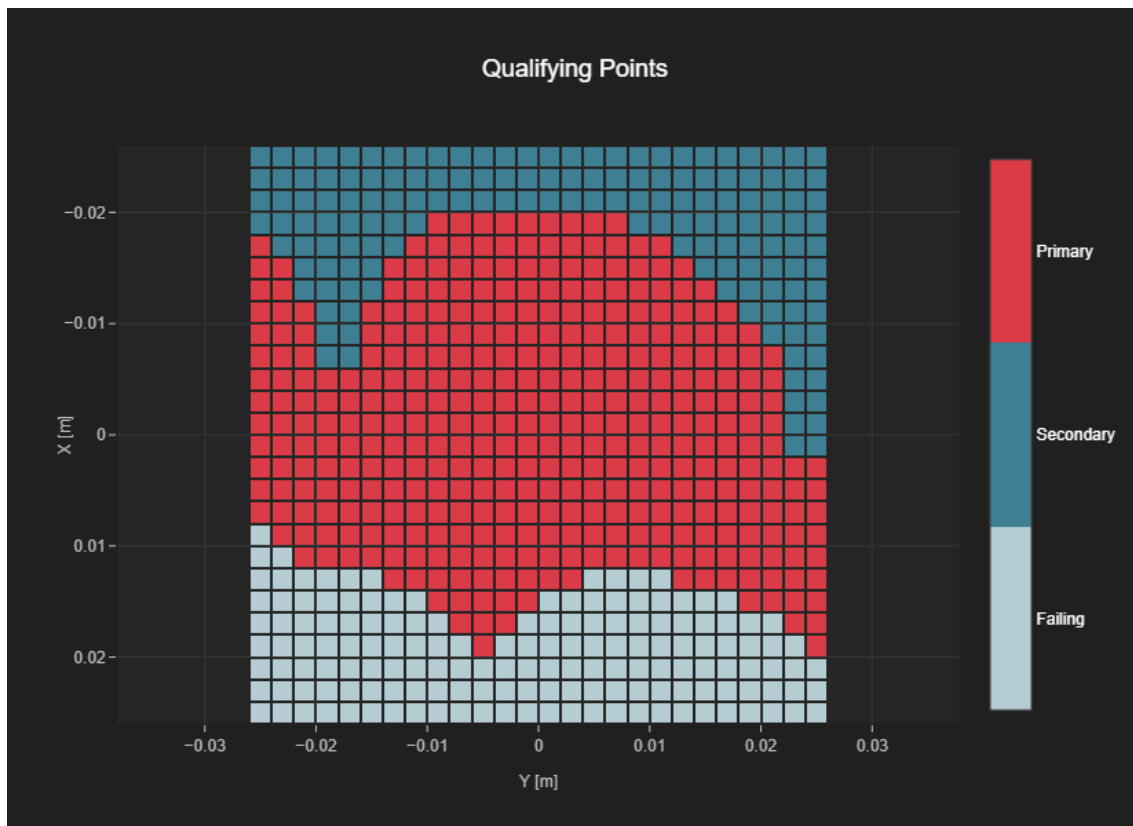
Audio File	Measurement Duration [s]	Margin Upper Bound [dB]	Margin Lower Bound [dB]
48k_voice_300-3000_2s.wav	2.0	1.84	2.0



T-Coil Coupling Mode Test Report

Results

Primary Group Contiguous Point Count	Secondary Group Point Count	Secondary Group Max Longitudinal	Secondary Group Max Transverse
373	523	23	26



Plot 7 LTE Band 30 10MHz 64QAM 1RB 0offset CH.27710

Google Meet Codec: 6 kbit/s ANT I

T-Coil Signal Test Report

Hardware Setup

Probe Name	Probe Calibration Date	DAE Name	DAE Calibration Date
AM1DV3 - 3049	November 14, 2024	DAE4 Sn1225	February 18, 2025

Communication Systems

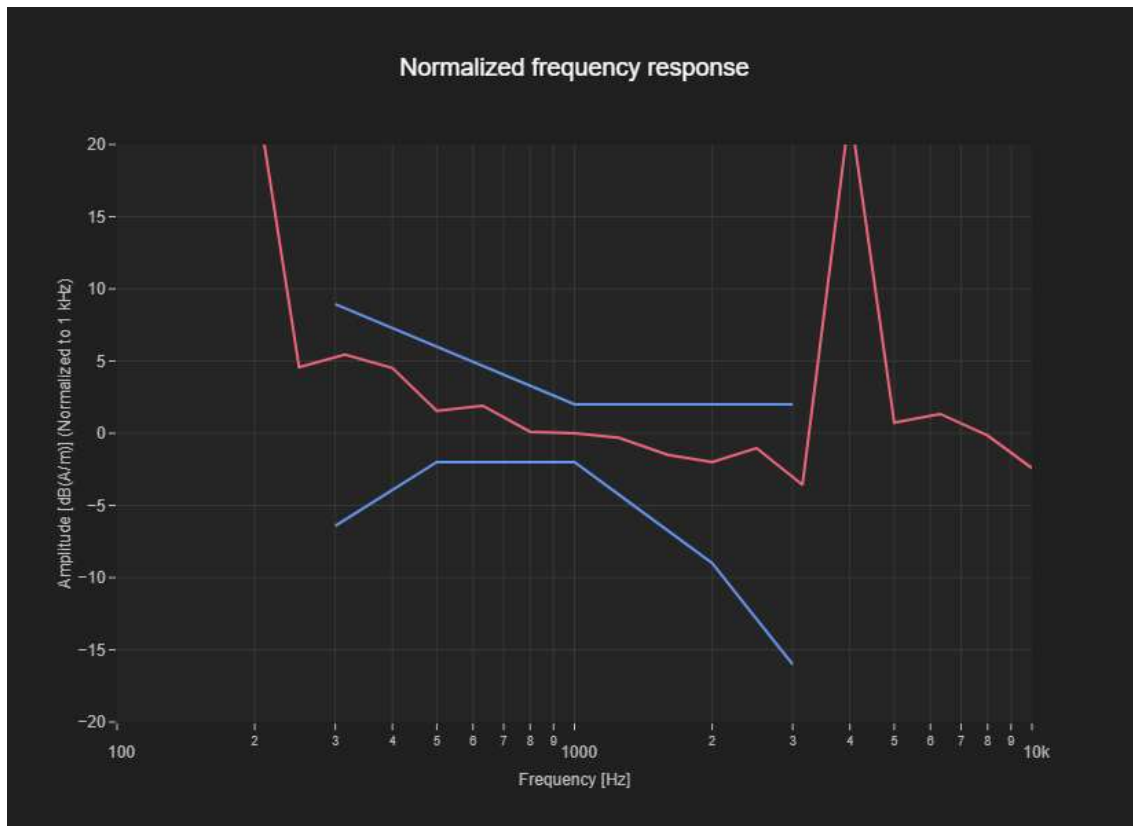
Band Name	Communication Systems Name	Channel	Frequency [MHz]
Band 30	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, 64-QAM)	27710	2310.0

Grid Settings

Extent X [mm]	Extent Y [mm]	Step X [mm]	Step Y [mm]	Distance [mm]
52.0	52.0	4.0	4.0	10.0

Results

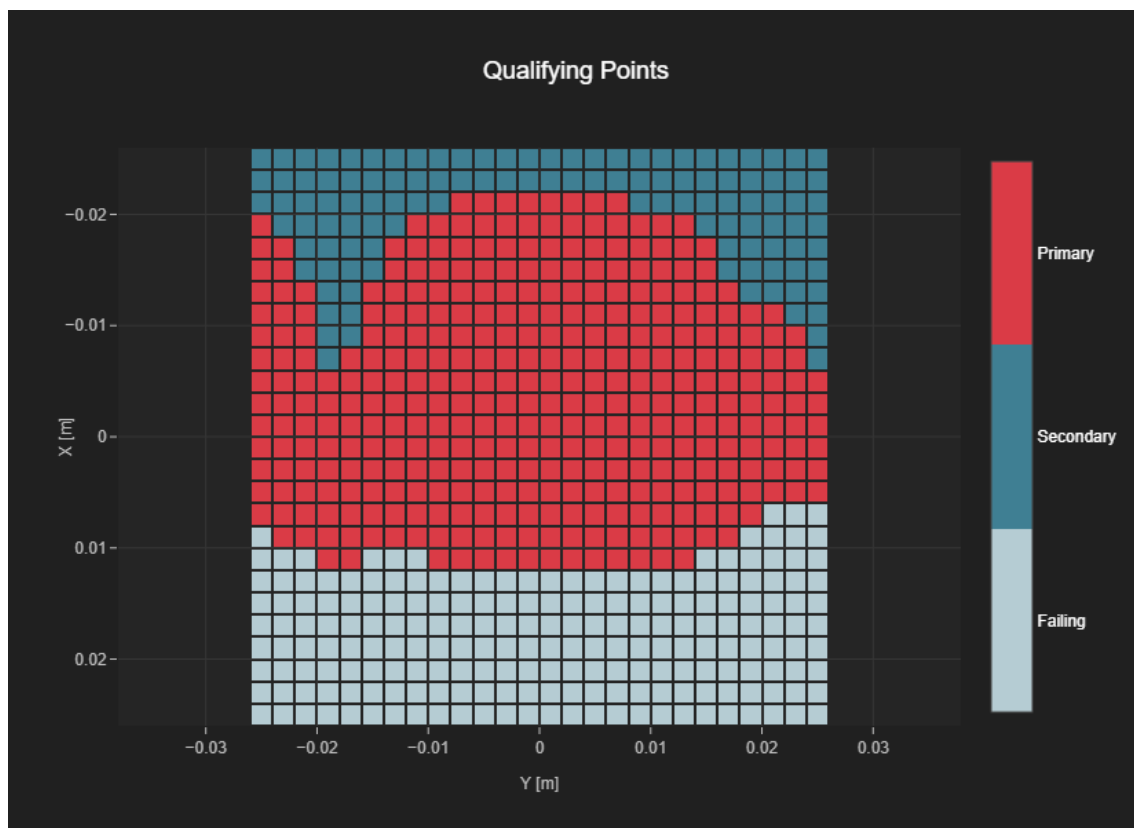
Audio File	Measurement Duration [s]	Margin Upper Bound [dB]	Margin Lower Bound [dB]
48k_voice_300-3000_2s.wav	2.0	1.86	1.4



T-Coil Coupling Mode Test Report

Results

Primary Group Contiguous Point Count	Secondary Group Point Count	Secondary Group Max Longitudinal	Secondary Group Max Transverse
359	474	19	26



Plot 8 LTE Band 41 5MHz QPSK 25RB 0offset CH.40185 PC3

Google Meet Codec: 75 kbit/s ANT I

T-Coil Signal Test Report

Hardware Setup

Probe Name	Probe Calibration Date	DAE Name	DAE Calibration Date
AM1DV3 - 3049	November 14, 2024	DAE4 Sn1225	February 18, 2025

Communication Systems

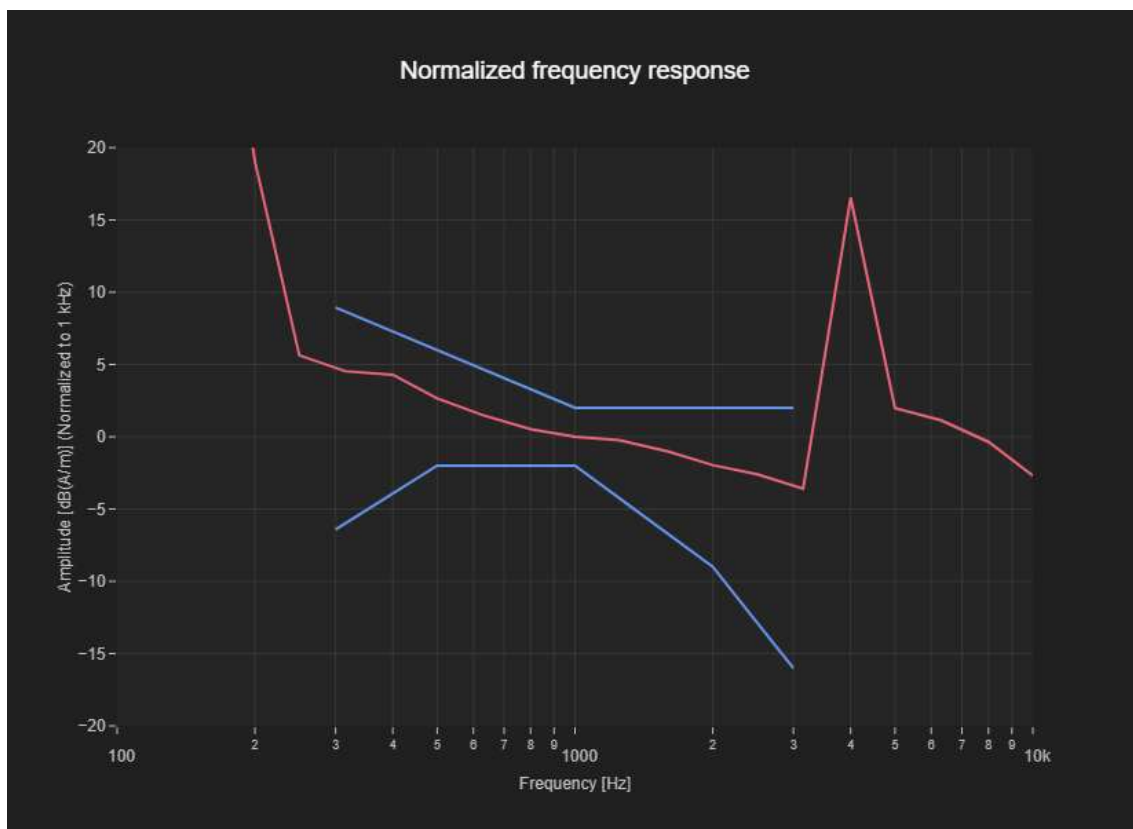
Band Name	Communication Systems Name	Channel	Frequency [MHz]
Band 41	LTE-TDD (SC-FDMA, 100% RB, 5 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	40185	2549.5

Grid Settings

Extent X [mm]	Extent Y [mm]	Step X [mm]	Step Y [mm]	Distance [mm]
52.0	52.0	4.0	4.0	10.0

Results

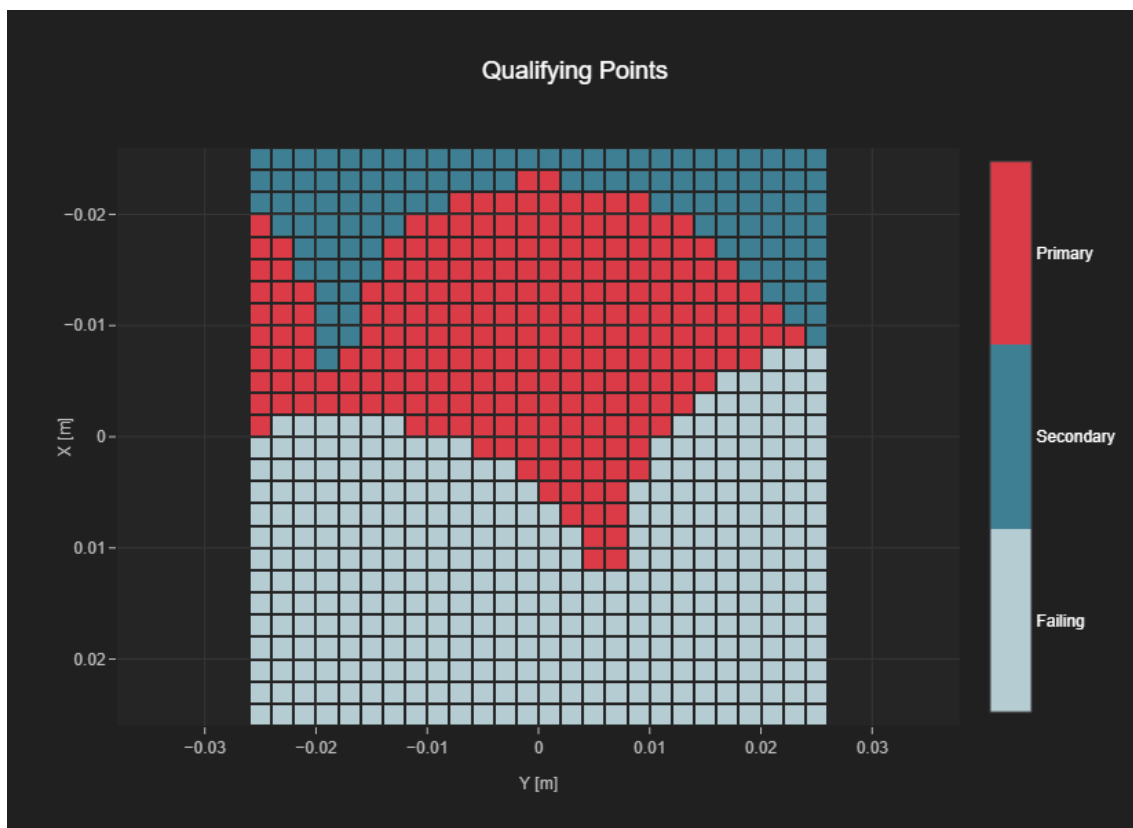
Audio File	Measurement Duration [s]	Margin Upper Bound [dB]	Margin Lower Bound [dB]
48k_voice_300-3000_2s.wav	2.0	2.0	2.0



T-Coil Coupling Mode Test Report

Results

Primary Group Contiguous Point Count	Secondary Group Point Count	Secondary Group Max Longitudinal	Secondary Group Max Transverse
227	336	19	26



Plot 9 NR Band n7 CP OFDM 40MHz QPSK 1RB 1offset CH.507000

Google Meet Codec: 6 kbit/s ANT I

T-Coil Signal Test Report

Hardware Setup

Probe Name	Probe Calibration Date	DAE Name	DAE Calibration Date
AM1DV3 - 3049	November 14, 2024	DAE4 Sn1225	February 18, 2025

Communication Systems

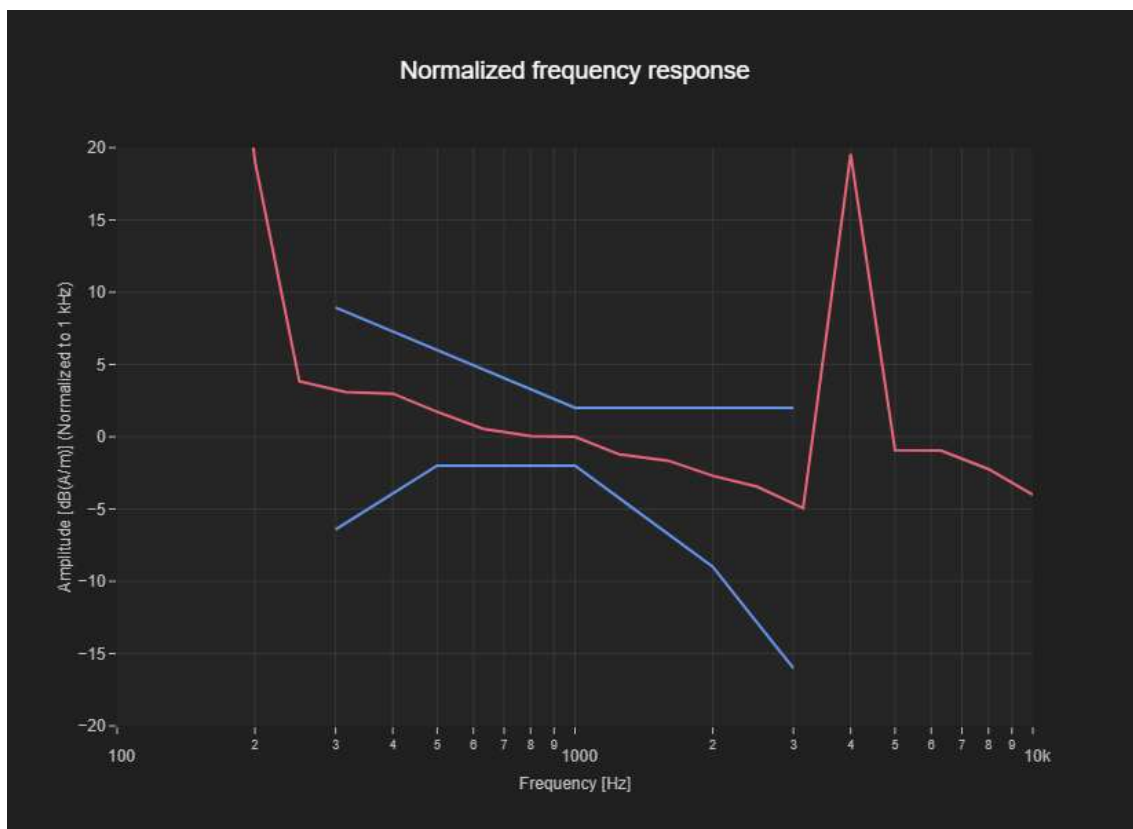
Band Name	Communication Systems Name	Channel	Frequency [MHz]
Band n7	5G NR (DFT-s-OFDM, 1 RB, 40 MHz, QPSK, 15 kHz)	507000	2535.0

Grid Settings

Extent X [mm]	Extent Y [mm]	Step X [mm]	Step Y [mm]	Distance [mm]
52.0	52.0	4.0	4.0	10.0

Results

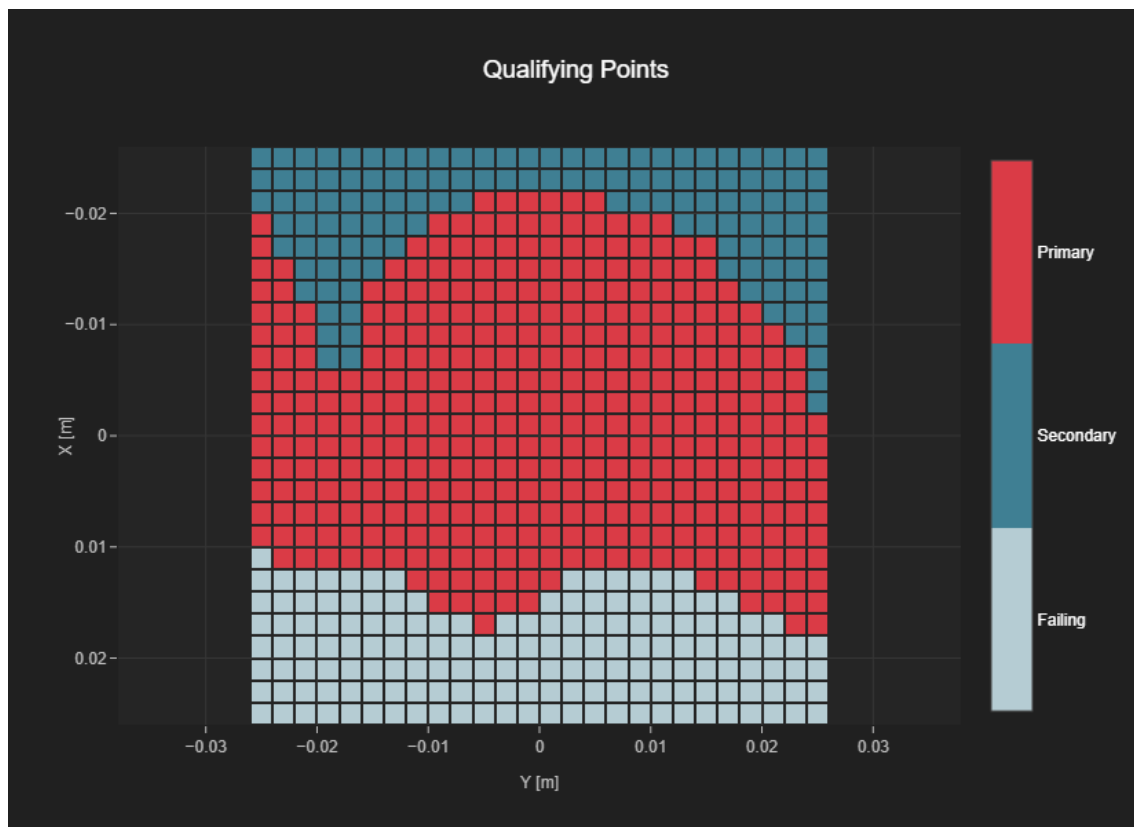
Audio File	Measurement Duration [s]	Margin Upper Bound [dB]	Margin Lower Bound [dB]
48k_voice_300-3000_2s.wav	2.0	2.0	2.0



T-Coil Coupling Mode Test Report

Results

Primary Group Contiguous Point Count	Secondary Group Point Count	Secondary Group Max Longitudinal	Secondary Group Max Transverse
391	518	22	26



Plot 10 NR Band n38 DFT-s OFDM 40MHz QPSK 1RB 1offset CH.519000

Google Meet Codec: 75 kbit/s ANT I

T-Coil Signal Test Report

Hardware Setup

Probe Name	Probe Calibration Date	DAE Name	DAE Calibration Date
AM1DV3 - 3049	November 14, 2024	DAE4 Sn1225	February 18, 2025

Communication Systems

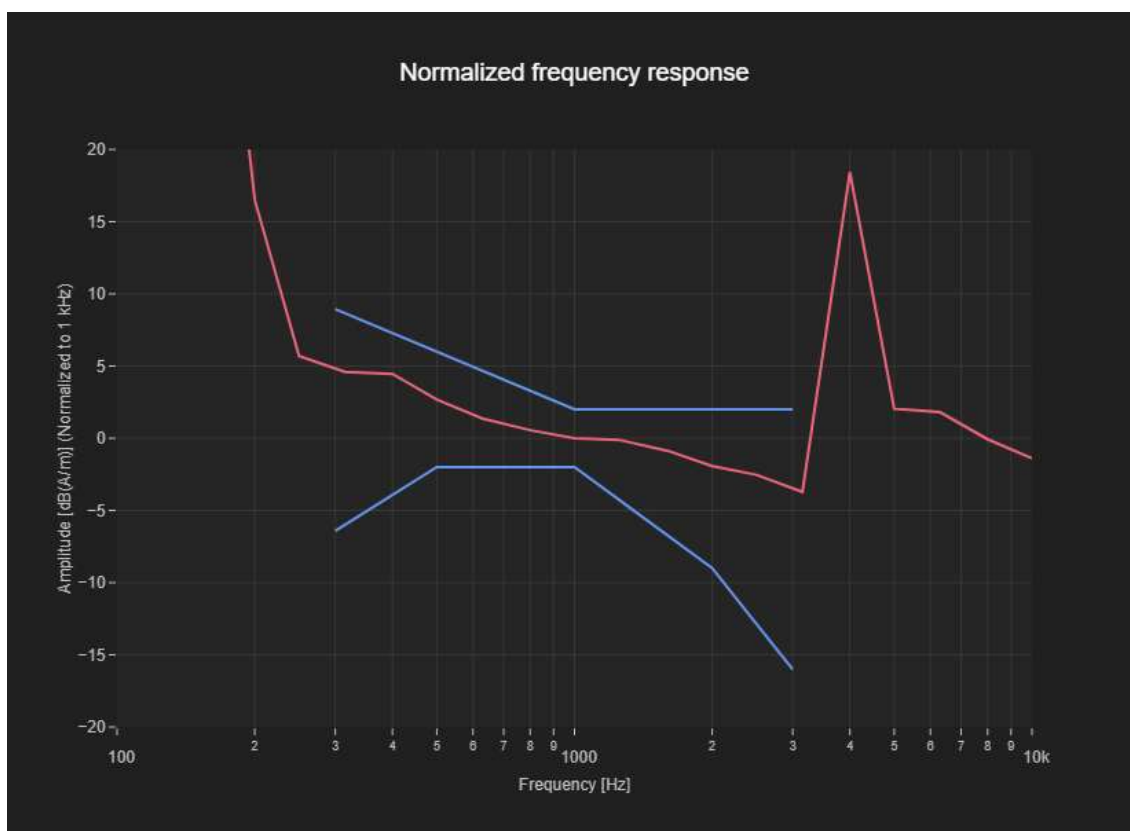
Band Name	Communication Systems Name	Channel	Frequency [MHz]
Band n38	5G NR (DFT-s-OFDM, 1 RB, 40 MHz, QPSK, 30 kHz)	519000	2595.0

Grid Settings

Extent X [mm]	Extent Y [mm]	Step X [mm]	Step Y [mm]	Distance [mm]
52.0	52.0	4.0	4.0	10.0

Results

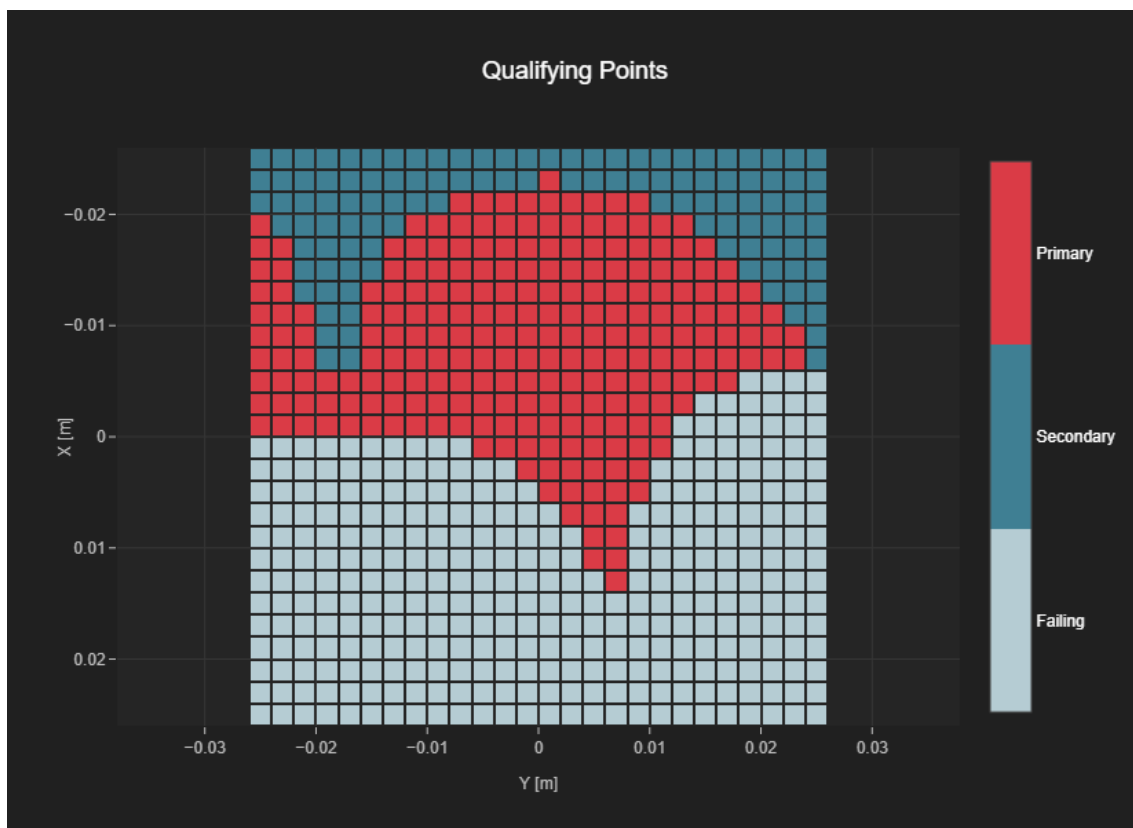
Audio File	Measurement Duration [s]	Margin Upper Bound [dB]	Margin Lower Bound [dB]
48k_voice_300-3000_2s.wav	2.0	2.0	2.0



T-Coil Coupling Mode Test Report

Results

Primary Group Contiguous Point Count	Secondary Group Point Count	Secondary Group Max Longitudinal	Secondary Group Max Transverse
236	349	20	26



Appendix 3. HAC T-Coil Probe Certificates

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



S Schweizerischer Kalibrierdienst
S Service suisse d'étalonnage
C Servizio svizzero di taratura
S Swiss Calibration Service

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

Accreditation No.: **SCS 0108**

Client **HCT**
 Gyeonggi-do, Republic of Korea

Certificate No. **AM1DV3-3049_Nov24**

CALIBRATION CERTIFICATE		제	검	정	시	확	인	서																												
Object	AM1DV3 - SN: 3049	제	7/2/3																																	
Calibration procedure(s)	QA CAL-24.v4 Calibration procedure for AM1D magnetic field probes and TMFS in the audio range	5m / V=1	2024.12.03	2024.12.03																																
Calibration date:	November 14, 2024																																			
This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate. All calibrations have been conducted in the closed laboratory facility; environment temperature $(22 \pm 3)^{\circ}\text{C}$ and humidity $< 70\%$. Calibration Equipment used (M&TE critical for calibration) <table border="1"> <thead> <tr> <th>Primary Standards</th> <th>ID #</th> <th>Cal Date (Certificate No.)</th> <th>Scheduled Calibration</th> </tr> </thead> <tbody> <tr> <td>Kethley Multimeter Type 2001</td> <td>SN: 0810278</td> <td>27-Aug-24 (No. 40547)</td> <td>Aug-25</td> </tr> <tr> <td>Reference Probe AM1DV3</td> <td>SN: 3000</td> <td>25-Sep-24 (No. AM1DV3-3000_Sep24)</td> <td>Sep-25</td> </tr> <tr> <td>DAE4</td> <td>SN: 781</td> <td>16-Feb-24 (No. DAE4-781_Feb24)</td> <td>Feb-25</td> </tr> </tbody> </table> <table border="1"> <thead> <tr> <th>Secondary Standards</th> <th>ID #</th> <th>Check Date (in house)</th> <th>Scheduled Check</th> </tr> </thead> <tbody> <tr> <td>AMCC</td> <td>SN: 1050</td> <td>01-Oct-13 (in house check Sep-24)</td> <td>Sep-25</td> </tr> <tr> <td>AMMI Audio Measuring Instrument</td> <td>SN: 1062</td> <td>26-Sep-12 (in house check Sep-24)</td> <td>Sep-25</td> </tr> </tbody> </table>									Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration	Kethley Multimeter Type 2001	SN: 0810278	27-Aug-24 (No. 40547)	Aug-25	Reference Probe AM1DV3	SN: 3000	25-Sep-24 (No. AM1DV3-3000_Sep24)	Sep-25	DAE4	SN: 781	16-Feb-24 (No. DAE4-781_Feb24)	Feb-25	Secondary Standards	ID #	Check Date (in house)	Scheduled Check	AMCC	SN: 1050	01-Oct-13 (in house check Sep-24)	Sep-25	AMMI Audio Measuring Instrument	SN: 1062	26-Sep-12 (in house check Sep-24)	Sep-25
Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration																																	
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Secondary Standards	ID #	Check Date (in house)	Scheduled Check																																	
AMCC	SN: 1050	01-Oct-13 (in house check Sep-24)	Sep-25																																	
AMMI Audio Measuring Instrument	SN: 1062	26-Sep-12 (in house check Sep-24)	Sep-25																																	
Calibrated by:	Name Claudio Leubler	Function Laboratory Technician	Signature 																																	
Approved by:	Name Sven Kühn	Function Technical Manager	Signature 																																	
This calibration certificate shall not be reproduced except in full without written approval of the laboratory. Issued: November 14, 2024																																				

Certificate No: AM1DV3-3049_Nov24

Page 1 of 3

References

- [1] ANSI-C63.19-2007
American National Standard for Methods of Measurement of Compatibility between Wireless Communications Devices and Hearing Aids.
- [2] ANSI-C63.19-2019 (ANSI-C63.19-2011)
American National Standard, Methods of Measurement of Compatibility between Wireless Communications Devices and Hearing Aids.
- [3] DASY System Handbook

Description of the AM1D probe

The AM1D Audio Magnetic Field Probe is a fully shielded magnetic field probe for the frequency range from 100 Hz to 20 kHz. The pickup coil is compliant with the dimensional requirements of [1+2]. The probe includes a symmetric low noise amplifier for the signal available at the shielded 3 pin connector at the side. Power is supplied via the same connector (phantom power supply) and monitored via the LED near the connector. The 7 pin connector at the end of the probe does not carry any signals, but determines the angle of the sensor when mounted on the DAE. The probe supports mechanical detection of the surface.

The single sensor in the probe is arranged in a tilt angle allowing measurement of 3 orthogonal field components when rotating the probe by 120° around its axis. It is aligned with the perpendicular component of the field, if the probe axis is tilted nominally 35.3° above the measurement plane, using the connector rotation and sensor angle stated below.

The probe is fully RF shielded when operated with the matching signal cable (shielded) and allows measurement of audio magnetic fields in the close vicinity of RF emitting wireless devices according to [1+2] without additional shielding.

Handling of the item

The probe is manufactured from stainless steel. In order to maintain the performance and calibration of the probe, it must not be opened. The probe is designed for operation in air and shall not be exposed to humidity or liquids. For proper operation of the surface detection and emergency stop functions in a DASY system, the probe must be operated with the special probe cup provided (larger diameter).

Methods Applied and Interpretation of Parameters

- *Coordinate System:* The AM1D probe is mounted in the DASY system for operation with a HAC Test Arch phantom with AMCC Helmholtz calibration coil according to [3], with the tip pointing to "southwest" orientation.
- *Functional Test:* The functional test preceding calibration includes test of Noise level
RF immunity (1kHz AM modulated signal). The shield of the probe cable must be well connected. Frequency response verification from 100 Hz to 10 kHz.
- *Connector Rotation:* The connector at the end of the probe does not carry any signals and is used for fixation to the DAE only. The probe is operated in the center of the AMCC Helmholtz coil using a 1 kHz magnetic field signal. Its angle is determined from the two minima at nominally +120° and -120° rotation, so the sensor in the tip of the probe is aligned to the vertical plane in z-direction, corresponding to the field maximum in the AMCC Helmholtz calibration coil.
- *Sensor Angle:* The sensor tilting in the vertical plane from the ideal vertical direction is determined from the two minima at nominally +120° and -120°. DASY system uses this angle to align the sensor for radial measurements to the x and y axis in the horizontal plane.

Sensitivity: With the probe sensor aligned to the z-field in the AMCC, the output of the probe is compared to the magnetic field in the AMCC at 1 kHz. The field in the AMCC Helmholtz coil is given by the geometry and the current through the coil, which is monitored on the precision shunt resistor of the coil.

AM1D probe identification and configuration data

Item	AM1DV3 Audio Magnetic 1D Field Probe
Type No	SP AM1 001 BA
Serial No	3049

Overall length	296 mm
Tip diameter	6.0 mm (at the tip)
Sensor offset	3.0 mm (centre of sensor from tip)
Internal Amplifier	20 dB

Manufacturer / Origin	Schmid & Partner Engineering AG, Zurich, Switzerland
-----------------------	--

Calibration data

Connector rotation angle	(in DASY system)	281.2°	+/- 3.6 ° (k=2)
Sensor angle	(in DASY system)	-0.30°	+/- 0.5 ° (k=2)
Sensitivity at 1 kHz	(in DASY system)	0.00747 V/(A/m)	+/- 2.2 % (k=2)

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