

TEST REPORT

HAC T-COIL Test for certification of SM-F741U

APPLICANT

Samsung Electronics. Co., Ltd.

REPORT NO.

HCT-SR-2404-FC001

DATE OF ISSUE

Apr. 26, 2024

Tested by

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TEST REPORT

HAC T-COIL Test
for certification

REPORT NO.

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DATE OF ISSUE

Apr. 26, 2024

FCC ID

A3LSMF741U

Applicant

SAMSUNG Electronics Co., Ltd

129, Samsung-ro, Yeongtong-gu, Suwon-Si, Gyeonggi-do, 16677, Korea

Product Name

Mobile Phone

Model Name

SM-F741U

Additional Model Name

SM-F741U1

Date of Test

Mar. 11, 2024 ~ Apr. 8, 2024

Location of Test

☒ Permanent Testing Lab ☐ On Site Testing Lab

(Address: 74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si,
Gyeonggi-do, 17383 KOREA)

FCC Rule Part(s)

FCC 47 CFR §20.19 , ANSI C63.19-2019

C63.19-2019 HAC Result:

PASS

REVISION HISTORY

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

Revision No.	Date of Issue	Description
0	Apr. 26, 2024	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 v01r06 • 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, 17383 KOREA
Telephone	031-645-6300
Fax.	031-645-6401

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-F741U
Additional Model Name	SM-F741U1
Equipment Type	Mobile Phone
FCC ID	A3LSMF741U
Application Type	Certification
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 n7	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 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 TDD 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 5.3	Data	2 402 MHz ~ 2 480 MHz
NFC	Data	13.56 MHz
WPC	Data	110 kHz ~ 148 kHz

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	3050	11/23/2024
ABM Probe	SPEAG	AM1DV3	3049	05/23/2024
Data Acquisition Electronics	SPEAG	DAE4	1254	06/02/2024
Data Acquisition Electronics	SPEAG	DAE4	1750	09/19/2024
DAC	Sound Devices	USBPre 2	HB1319212059	N/A
Radio Communication Tester	R & S	CMW 500	167916	09/21/2024
Radio Communication Tester	R & S	CMW 500	127521	04/25/2024
Radio Communication Tester	R & S	CMW 500	167918	03/20/2024
Up/Down-Converter	R & S	CMW Z800A	100218	N/A
USB Audio Module	KEYSIGHT	U8903B-UAM	101006	N/A
UXM 5G Wireless Test Set	KEYSIGHT	E7515B	MY58460166	08/01/2024
Up/Down-Converter	R & S	CMW-Z800A	100218	N/A

5. Measurement Uncertainty

Measurement Uncertainty for Audio Band Magnetic Measurement

Error Description	Uncertainty ± %	Probability distribution	Div.	<i>c</i> ABMd	<i>c</i> ABMu	Std. Unc. ABMd	Std. Unc. ABMu
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 Disturbation	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 – Nomal, 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 $f = 1 \text{ kHz}$.

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.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.

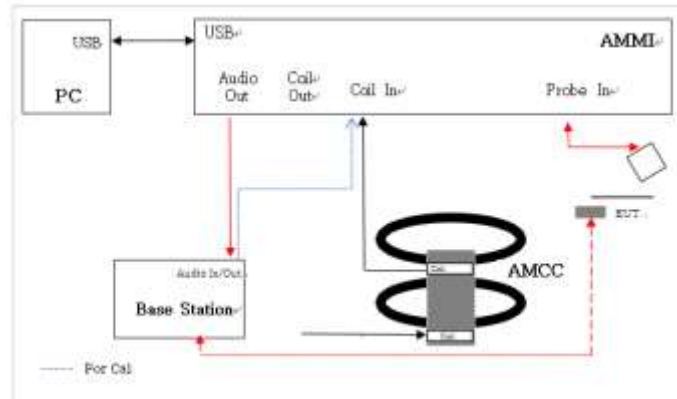
i) Calculate and record the location and number of the measurement points that satisfy the maximum undesired ABM field level and distribution requirements specified in 6.6.4.

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 (refer to section 8.4).

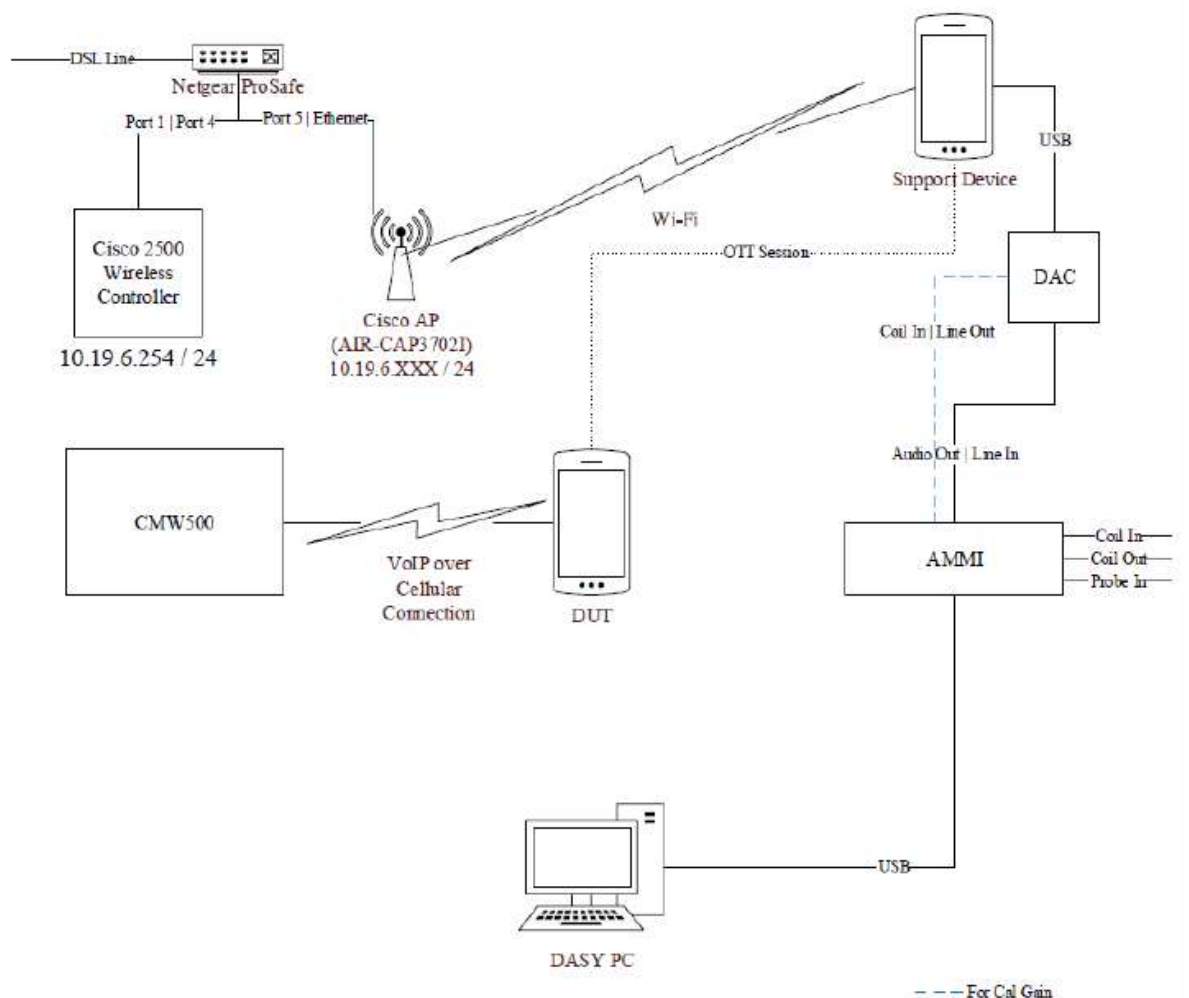
An investigation was performed to determine worst case codec, bit rate and air interface configuration (refer to sections 12.5 and 12.6).

6.3 Over the Top(OTT)

This device supports VoIP via a preinstalled application that uses the Google Meet service, using OPUS as its only codec (refer to §11 for air interface details and §12.7 for codec bit rates). VoIP capabilities require HAC assessment when voice calls are supported over the cellular data connection via pre-installed VoIP applications.

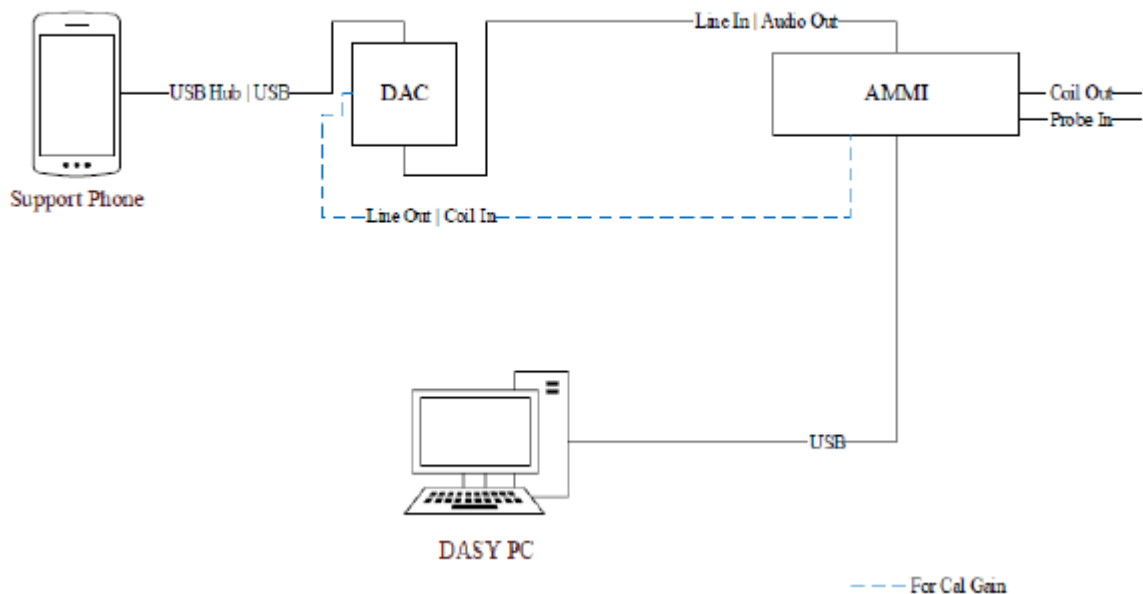
The equipment is set up as shown below with a support device used to originate the call using the IP transport. The support device connects to the cloud-based Google Meet service via Wi-Fi access point and router, or RJ45. The DUT connects to the VoIP service via a cellular/unlicensed air interface to 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 §12.7).

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 to 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 0 dBFS (3.14 dBm0 based on TIA/EIA 810-A).

7. Audio Level and Gain Measurements

7.1 GSM, UMTS, LTE, Wifi, NR

Refer to the below table for the gains used to measure

UMTS, LTE, Wifi

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	-12.26
Normal Voice	-16	0	21.57	10.81	-6.43

GSM

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	-12.24
Normal Voice	-16	0	21.57	10.81	-6.40

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	-7.8
Normal Voice	-16	0	21.57	10.81	-1.97

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
V3.7.30 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 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 VoWi-Fi.

Firmware	License Keys	Software Name
V3.7.40 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 IPv4
	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 OTT (Over the Top)

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 DASY5 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.

GSM, UMTS, LTE, Wifi

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	-8.69
Normal Voice	-16	0	21.57	10.81	-2.86

NR

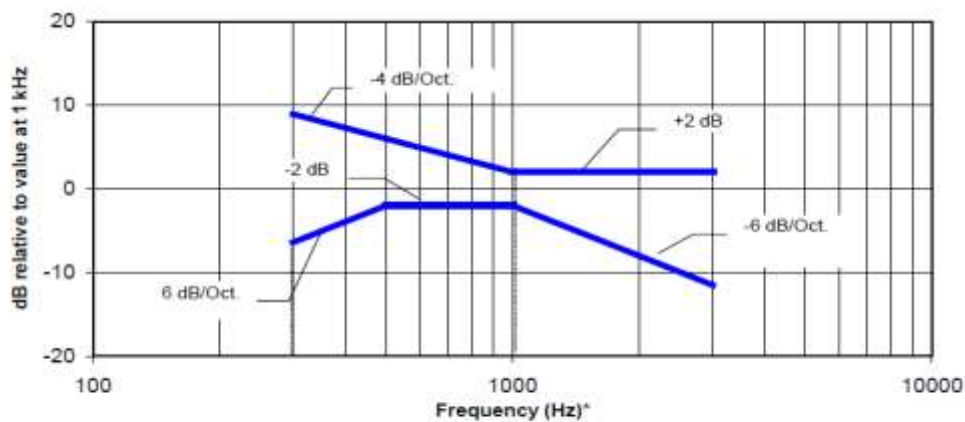
Signal Type	Audio Level [dBm]	Peak to Full Scale [dB]	Peak to RMS Scale [dB]	BWC [dB]	Scaling [Gain]
Voice 1 kHz	-16	-0.37	15.74	0.07	-8.73
Normal Voice	-16	0	21.57	10.81	-2.9

8 T-coil Measurement Criteria

8.1 Frequency Response

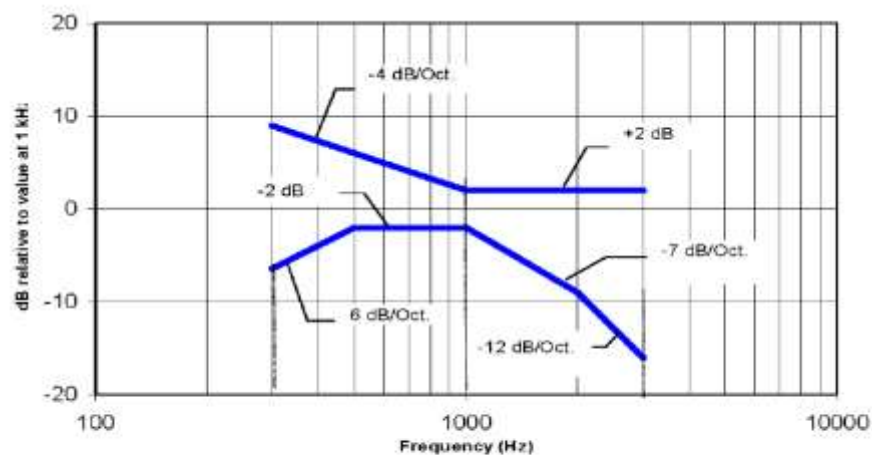
The frequency response of the axial component of the magnetic field, measured in 1/3 octave bands, shall follow the response curve, over the frequency range 300 Hz to 3000 Hz.

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
	XBK0310M	T-coil Test
	XBK0312M	T-coil Test
	XBK0313M	T-coil Test
	XCT0421M	T-coil Test

Note : T-Coil Measurements in this report were performed by Pmax in static power condition. Pmax results were referred to FCC SAR Test Report, Report No : HCT-SR-2404-FC004 Appendix J.

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				
	GPRS/EDGE	VD	Yes	Wi-Fi, BT	OPUS ¹
WCDMA (UMTS)	850	VO	Yes	Wi-Fi, BT	AMR-NB & AMR-WB ¹
	1700				
	1900				
	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)				
	850 (B5/26)				
	1700 (B4/66)				
	1900 (B2/25)				
	2300 (B30)				
	2500 (B7)				
LTE – TDD	2600 (B41(B38))	VD	Yes	NR, Wi-Fi, BT	(AMR-NB, AMR- WB, EVS-NB, EVS-WB & OPUS) ¹
	3600 (B48)				
NR -FDD	680(B71)	VD	Yes	LTE, Wi-Fi, BT	(AMR-NB, AMR- WB, EVS-NB, EVS-WB & OPUS) ¹
	700(B12)				
	850(B5/26)				
	1700(B66,B70)				
	1900(B2/25)				
	2300(B30)				
	2500 (B7)				
NR -TDD	2600(B41)	VD	Yes	LTE, Wi-Fi, BT	(AMR-NB, AMR- WB, EVS-NB, EVS-WB & OPUS) ¹
	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 5GHz	(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)		Yes ³	WWAN and Wifi 2.4GHz, BT	
	5900 (U-NII-4)				
	6200(UNII 5)		No ²	WWAN and Wifi 2.4GHz, BT	
	6500(UNII 6)				
	6700(UNII 7)				
7000(UNII 8)					
BT	2450	DT	NA	WWAN and Wifi 2.4GHz, Wifi 5GHz	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. N251, 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.	

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 GSM, UMTS, LTE FDD/TDD, NR FDD/TDD.

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

Codec Investigation				
Codec State	AMR-NB (kbit/s)		Orientation	Band/ Channel
	FR V1	HR V1		
Freq. Response(dB)	1.92	1.03	y (Transversal)	GSM 850 CH.190 ANT A
Primary	95	97		
Secondary	257	258		
Contiguous Longitudinal	15	15		
Contiguous Transverse	26	26		

Codec Investigation							
Codec State	AMR-NB (kbit/s)			AMR-WB (kbit/s)			Band/ Bandwidth/ Channel
	4.75	7.4	12.2	6.6	15.85	23.85	
Freq. Response(dB)	1.67	2	1.78	1.91	2	2	UMTS Band II Rel.99 CH.9400 ANT A
Primary	297	288	270	248	240	241	
Secondary	548	535	514	516	487	489	
Contiguous Longitudinal	26	25	25	26	25	24	
Contiguous Transverse	26	26	26	26	26	26	

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	1.94	1.81	2	2	2	y (Transversal)	LTE Band 25 CH.26365 20 MHz QPSK 1RB 0offset ANT A
Primary	282	292	297	271	273	282		
Secondary	538	545	544	541	529	544		
Contiguous Longitudinal	26	26	25	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	24.4	128	9.6	24.4	128		
Freq. Response(dB)	2	1.93	1.94	2	2	2	2	2	2	y (Transversal)	LTE Band 25 CH.26365 20 MHz QPSK 1RB 0offset ANT A
Primary	242	303	304	207	273	258	210	185	193		
Secondary	527	544	544	526	526	514	512	480	491		
Contiguous Longitudinal	26	26	26	26	26	26	26	26	26		
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	1.74	1.84	2	2	2	y (Transversal)	NR Band 25 CH.376500 DFT-s OFDM QPSK 40 MHz 1 RB 1 Offset ANT A
Primary	241	242	247	223	244	237		
Secondary	468	470	471	468	473	466		
Contiguous Longitudinal	20	20	20	20	20	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	24.4	128	9.6	24.4	128		
Freq. Response(dB)	1.83	1.88	1.99	1.75	1.7	2	2	1.8	1.98	y (Transversal)	NR Band 25 CH.376500 DFT-s OFDM QPSK 40 MHz 1 RB 1 Offset ANT A
Primary	171	249	253	164	255	246	254	254	245		
Secondary	468	466	475	472	471	473	475	472	472		
Contiguous Longitudinal	20	20	21	20	21	20	20	20	20		
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)	1.7	1.93	2	2	1.99	2	y (Transversal)	LTE Band 41 CH.40620 20 MHz QPSK 1RB 0offset PC2 ANT B
Primary	172	178	182	159	170	166		
Secondary	404	408	410	404	404	400		
Contiguous Longitudinal	17	18	18	18	18	17		
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	24.4	128	9.6	24.4	128		
Freq. Response(dB)	1.59	1.33	1.26	2	2	1.68	2	2	2	y (Transversal)	LTE Band 41 CH.40620 20 Mhz QPSK 1RB 0offset ANT B
Primary	156	193	190	127	112	122	118	155	151		
Secondary	416	416	412	404	397	397	403	412	409		
Contiguous Longitudinal	19	19	18	18	17	17	18	18	18		
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	1.96	1.89	2	2	2	y (Transversal)	NR Band 41 CH.518598 DFT-s OFDM QPSK 100 MHz 1 RB 1 offset ANT 1
Primary	157	154	161	153	153	154		
Secondary	373	361	370	368	368	369		
Contiguous Longitudinal	17	17	17	17	17	17		
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)	1.66	2	1.92	2	1.77	2	2	1.78	2	y (Transversal)	NR Band 41 CH.518598 DFT-s OFDM QPSK 100 MHz 1 RB 1 offset ANT I
Primary	98	133	129	89	132	128	147	138	130		
Secondary	370	319	317	356	320	322	337	329	326		
Contiguous Longitudinal	17	16	17	17	16	17	17	16	17		
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.

GSM / UMTS

Mode	Ch. Freq.	Ambient Noise dB (A/m)	Primary	Secondary	Contiguous longitudinal	Contiguous Transverse	Freq. Response(dB)	Plot No.
GSM 850 Codec: FR V1 ANT A	CH.128 824.2 MHz	-57.05	73	213	14	26	1.92	1
	CH.190 836.5 MHz	-57.05	95	257	14	26	1.92	2
	CH.251 848.8 MHz	-57.05	81	232	14	26	1.64	3
GSM 1900 Codec: FR V1 ANT A	CH.661 1880.0 MHz	-57.05	126	324	16	26	1.78	
UMTS Band II AMR WB Codec: 15.85kbit/s ANT A	CH.9262 1852.4 MHz	-57.05	252	500	24	26	2	4
	CH.9400 1880.0 MHz	-57.05	240	487	25	26	2	5
	CH.9538 1907.6 MHz	-57.05	277	529	26	26	1.93	6
UMTS Band IV AMR WB Codec: 15.85kbit/s ANT A	CH.1412 1732.4 MHz	-57.05	263	516	26	26	2	
UMTS Band V AMR WB Codec: 15.85kbit/s ANT A	CH.4183 836.6 MHz	-57.05	257	505	25	26	2	

Air Interface Investigation (Continued)

Mode	Ch. Freq.	BW	Modulation	RB Config.	Ambient Noise dB (A/m)	Primary	Secondary	Contiguous longitudinal	Contiguous Transverse	Freq. Response(dB)	Plot No.
LTE Band 25 ANT A Codec: EVS-SWB 24.4kbit/s	CH.26365 1882.5 MHz	20 MHz	QPSK	1/0	-56.96	185	480	26	26	2	7
				1/49	-56.96	199	500	26	26	2	
				1/99	-56.96	188	480	24	26	2	
				50/0	-56.96	201	502	26	26	2	
				50/25	-56.96	240	541	26	26	2	
				50/49	-56.96	238	537	26	26	2	
				100/0	-56.96	229	524	26	26	2	
			16QAM	1/0	-56.96	204	489	22	26	2	
			64QAM	1/0	-56.96	233	522	24	26	2	
			256QAM	1/0	-56.96	236	531	25	26	2	
		15 MHz	QPSK	1/0	-56.96	238	536	25	26	2	
		10 MHz		1/0	-56.96	232	529	26	26	2	
		5 MHz		1/0	-56.96	246	535	23	26	2	
		3 MHz		1/0	-56.96	236	537	26	26	2	
		1.4 MHz		1/0	-56.96	241	540	23	26	2	

Air Interface Investigation (Continued)

LTE-FDD

Mode	Ch. Freq.	BW	Mode	RB Config.	Ambient Noise dB (A/m)	Primary	Secondary	Contiguous longitudinal	Contiguous Transverse	Freq. Response(dB)	Plot No.
LTE Band 25 ANT.I Codec: EVS SWB 24.4kbit/s	CH.26365 1882.5 MHz	20 MHz	QPSK	1/0	-56.91	239	538	26	26	2	
LTE Band 7 ANT.B Codec: EVS SWB 24.4kbit/s	CH.21100 2535 MHz	20 MHz	QPSK	1/0	-56.91	241	536	26	26	2	
LTE Band 7 ANT.I Codec: EVS SWB 24.4kbit/s	CH.21100 2535 MHz	20 MHz	QPSK	1/0	-56.91	234	527	24	26	2	
LTE Band 12 ANT.A Codec: EVS SWB 24.4kbit/s	CH.23095 707.5 MHz	10 MHz	QPSK	1/0	-56.91	242	542	26	26	2	
LTE Band 13 ANT.A Codec: EVS SWB 24.4kbit/s	CH.23230 782 MHz	10 MHz	QPSK	1/0	-56.91	246	545	26	26	2	
LTE Band 14 ANT.A Codec: EVS SWB 24.4kbit/s	CH.23330 793 MHz	10 MHz	QPSK	1/0	-56.91	234	534	26	26	2	
LTE Band 26 ANT.A Codec: EVS SWB 24.4kbit/s	CH.26865 831.5 MHz	15 MHz	QPSK	1/0	-56.91	221	518	26	26	2	
LTE Band 30 ANT.B Codec: EVS SWB 24.4kbit/s	CH.27710 2310 MHz	10 MHz	QPSK	1/0	-56.91	233	534	26	26	2	
LTE Band 30 ANT.F Codec: EVS SWB 24.4kbit/s	CH.27710 2310 MHz	10 MHz	QPSK	1/0	-56.91	243	545	26	26	2	
LTE Band 66 ANT.A Codec: EVS SWB 24.4kbit/s	CH.132322 1745 MHz	20 MHz	QPSK	1/0	-56.91	235	532	24	26	2	
LTE Band 66 ANT.I Codec: EVS SWB 24.4kbit/s	CH.132322 1745 MHz	20 MHz	QPSK	1/0	-56.91	238	538	25	26	2	
LTE Band 71 ANT.A Codec: EVS SWB 24.4kbit/s	CH.133297 680.5 MHz	20 MHz	QPSK	1/0	-56.91	236	533	26	26	2	
LTE Band 25 ANT.A Codec: EVS SWB 24.4kbit/s	CH.26410 1860 MHz	20 MHz	QPSK	1/0	-56.91	251	549	26	26	2	8
LTE Band 25 ANT.A Codec: EVS SWB 24.4kbit/s	CH.26590 1905 MHz	20 MHz	QPSK	1/0	-56.91	245	539	25	26	2	9

NR-FDD RB/ Modulation configuration

Mode	Ch. Freq.	BW	Waveform	Modulation	RB Config.	Ambient Noise dB (A/m)	Primary	Secondary	Contiguous longitudinal	Contiguous Transverse	Freq. Response (dB)	Plot No.
NR Band 25 ANT A Codec: EVS-WB 5.9kbit/s	CH.376500 1882.5 MHz	40 MHz	CP-OFDM	QPSK	1/1	-56.94	179	473	19	26	2	
					1/108	-56.94	171	465	19	26	1.25	
					1/214	-56.94	170	465	20	26	2	
					108/0	-56.94	176	474	20	26	19.1	
					108/54	-56.94	167	469	20	26	1.76	
					108/108	-56.94	174	464	20	26	1.87	
					216/0	-56.94	171	477	20	26	1.4	
				16QAM	108/54	-56.94	167	475	20	26	2	
				64QAM	108/54	-56.94	170	472	20	26	1.85	
				256QAM	108/54	-56.94	175	480	20	26	1.43	
			DFTs-OFDM	QPSK	1/1	-56.94	164	472	20	26	1.75	
					1/108	-56.94	164	478	21	26	2	
					1/214	-56.94	190	479	20	26	1.99	
					108/0	-56.94	165	477	20	26	1.56	
					108/54	-56.94	157	470	20	26	2	10
					108/108	-56.94	172	479	20	26	2	
					216/0	-56.94	171	469	20	26	2	
				BPSK	108/54	-56.94	176	470	20	26	1.71	
				16QAM	108/54	-56.94	173	469	20	26	2	
				64QAM	108/54	-56.94	174	462	19	26	1.76	
				256QAM	108/54	-56.94	167	467	20	26	1.96	

Mode	Ch. Freq.	BW	Waveform	Modulation	RB Config.	Ambient Noise dB (A/m)	Primary	Secondary	Contiguous longitudinal	Contiguous Transverse	Freq. Response (dB)	Plot No.
NR Band 25 ANT A Codec: EVS-WB 5.9kbit/s	CH.376500 1882.5 MHz	35 MHz	DFTs-OFDM	QPSK	90/45	-57.02	161	473	20	26	1.89	
		30 MHz			80/40	-57.02	158	463	20	26	2	
		25 MHz			64/35	-57.02	170	479	21	26	1.4	
		20 MHz			50/28	-57.02	166	477	21	26	1.89	
		15 MHz			36/22	-57.02	172	483	22	26	1.96	
		10 MHz			25/14	-57.02	178	487	22	26	1.72	
		5 MHz			12/7	-57.02	173	484	22	26	2	

Mode	Ch. Freq.	BW	Waveform	Modulation	RB Config.	Ambient Noise dB (A/m)	Primary	Secondary	Contiguous longitudinal	Contiguous Transverse	Freq. Response (dB)	Plot No.
NR Band n25 ANT I Codec: EVS-WB 5.9kbit/s	CH.376500 1882.5 MHz	40 MHz	DFTs-OFDM	QPSK	108/54	-57.02	171	475	20	26	2	
NR Band n7 ANT B Codec: EVS-WB 5.9kbit/s	CH.507000 2535 MHz	40 MHz	DFTs-OFDM	QPSK	108/54	-57.02	162	470	20	26	1.93	
NR Band n7 ANT I Codec: EVS-WB 5.9kbit/s	CH.507000 2535 MHz	40 MHz	DFTs-OFDM	QPSK	108/54	-57.02	159	463	20	26	2	
NR Band n12 ANT A Codec: EVS-WB 5.9kbit/s	CH.141500 707.5 MHz	15 MHz	DFTs-OFDM	QPSK	36/22	-57.02	191	513	26	26	2	
NR Band n26 ANT A Codec: EVS-WB 5.9kbit/s	CH.166300 831.5 MHz	20 MHz	DFTs-OFDM	QPSK	50/28	-57.02	188	507	25	26	2	
NR Band n30 ANT B Codec: EVS-WB 5.9kbit/s	CH.462000 2310 MHz	10 MHz	DFTs-OFDM	QPSK	25/14	-57.02	184	494	23	26	1.96	
NR Band n30 ANT I Codec: EVS-WB 5.9kbit/s	CH.462000 2310 MHz	10 MHz	DFTs-OFDM	QPSK	25/14	-57.02	163	484	22	26	2	

Mode	Ch. Freq.	BW	Waveform	Modulation	RB Config.	Ambient Noise dB (A/m)	Primary	Secondary	Contiguous longitudinal	Contiguous Transverse	Freq. Response (dB)	Plot No.
NR Band n66 ANT A Codec: EVS-WB 5.9kbit/s	CH.349000 1745 MHz	40 MHz	DFTs-OFDM	QPSK	108/54	-57.05	165	471	20	26	2	
NR Band n66 ANT I Codec: EVS-WB 5.9kbit/s	CH.349000 1745 MHz	40 MHz	DFTs-OFDM	QPSK	108/54	-57.05	166	469	20	26	1.61	
NR Band n70 ANT A Codec: EVS-WB 5.9kbit/s	CH.340500 1702.5 MHz	15 MHz	DFTs-OFDM	QPSK	36/22	-57.05	175	487	21	26	2	
NR Band n70 ANT I Codec: EVS-WB 5.9kbit/s	CH.340500 1702.5 MHz	15 MHz	DFTs-OFDM	QPSK	36/22	-57.05	172	486	21	26	2	
NR Band n71 ANT A Codec: EVS-WB 5.9kbit/s	CH.136100 680.5 MHz	20 MHz	DFTs-OFDM	QPSK	50/28	-57.05	182	497	22	26	2	

Air Interface Investigation (Continued)

LTE-TDD

Mode	Ch. Freq.	BW	Modulation	RB Config.	Ambient Noise dB (A/m)	Primary	Secondary	Contiguous longitudinal	Contiguous Transverse	Freq. Response (dB)	Plot No.
LTEBand 41 PC2 ANT B Codec: EVS-WB 24.4kbit/s	CH.40620 2593 MHz	20 MHz	QPSK	1/0	-57.07	112	397	17	26	2	11
				1/49	-57.07	179	403	17	26	2	
				1/99	-57.07	178	403	17	26	2	
				50/0	-57.07	179	405	17	26	2	
				50/25	-57.07	198	424	19	26	2	
				50/49	-57.07	197	424	19	26	2	
				100/0	-57.07	196	423	18	26	2	
			16QAM	1/0	-57.07	187	414	18	26	2	
			64QAM	1/0	-57.07	191	420	18	26	2	
			256QAM	1/0	-57.07	207	440	19	26	2	
		15 MHz	QPSK	1/0	-57.07	175	402	18	26	2	
		10 MHz		1/0	-57.07	177	405	18	26	2	
		5 MHz		1/0	-57.07	184	413	18	26	2	
LTEBand 41 PC3 ANT B Codec: EVS-WB 24.4kbit/s	CH.40620 2593 MHz	20 MHz	QPSK	1/0	-57.07	187	418	18	26	2	
LTEBand 41 PC2 ANT I Codec: EVS-WB 24.4kbit/s	CH.40620 2593 MHz	20 MHz	QPSK	1/0	-57.07	163	381	18	26	2	
LTEBand 41 PC3 ANT I Codec: EVS-WB 24.4kbit/s	CH.40620 2593 MHz	20 MHz	QPSK	1/0	-57.07	156	370	18	26	2	
LTEBand 48 ANT F Codec: EVS-WB 24.4kbit/s	CH.55990 3625 MHz	20 MHz	QPSK	1/0	-57.07	213	450	20	26	2	
LTEBand 41 PC2 ANT B Codec: EVS-WB 24.4kbit/s	CH.39750 2506 MHz	20 MHz	QPSK	1/0	-57.07	173	397	17	26	2	12
	CH.40185 2549.5 MHz				-57.07	178	404	17	26	2	13
	CH.41055 2636.5 MHz				-57.07	188	414	18	26	2	14
	CH.41490 2680 MHz				-57.07	190	416	18	26	2	15

NR-TDD RB/ Modulation configuration

Mode	Ch. Freq.	BW	Waveform	Modulation	RB Config.	Ambient Noise dB (A/m)	Primary	Secondary	Contiguous longitudinal	Contiguous Transverse	Freq. Response (dB)	Plot No.
NR Band 41 ANT 1 Codec: EVS-WB 5.9kbit/s	CH.518598 2592.99 MHz	100 MHz	CP-OFDM	QPSK	1/1	-56.97	94	357	17	26	2	
					1/137	-56.97	100	370	17	26	2	
					1/271	-56.97	87	351	17	26	2	16
					137/0	-56.97	106	377	17	26	2	
					137/68	-56.97	103	368	17	26	1.89	
					137/136	-56.97	100	371	17	26	1.63	
					273/0	-56.97	100	372	17	26	1.6	
				16QAM	1/271	-56.97	91	351	17	26	1.6	
				64QAM	1/271	-56.97	98	369	17	26	2	
				256QAM	1/271	-56.97	100	382	17	26	2	
			DFTs-OFDM	QPSK	1/1	-56.97	89	356	17	26	2	
					1/137	-56.97	93	366	17	26	1.91	
					1/271	-56.97	87	363	17	26	1.96	
					135/0	-56.97	92	368	17	26	1.11	
					135/69	-56.97	92	359	17	26	1.51	
					135/138	-56.97	101	370	18	26	2	
					270/0	-56.97	96	371	18	26	1.86	
				BPSK	1/271	-56.97	98	366	17	26	2	
				16QAM	1/271	-56.97	92	348	17	26	1.77	
				64QAM	1/271	-56.97	93	362	17	26	2	
				256QAM	1/271	-56.97	101	379	17	26	1.58	

Mode	Ch. Freq.	BW	Waveform	Modulation	RB Config.	Ambient Noise dB (A/m)	Primary	Secondary	Contiguous longitudinal	Contiguous Transverse	Freq. Response (dB)	Plot No.
NR Band 41 ANT I Codec: EVS-WB 5.9kbit/s	CH.518598 2592.99 MHz	90 MHz	DFTs-OFDM	QPSK	1/243	-56.96	91	361	17	26	1.99	
		80 MHz			1/215	-56.96	88	352	17	26	1.29	
		70 MHz			1/188	-56.96	111	377	18	26	1.83	
		60 MHz			1/161	-56.96	110	385	18	26	1.94	
		50 MHz			1/132	-56.96	114	381	17	26	2	
		40 MHz			1/105	-56.96	116	381	17	26	1.46	
		30 MHz			1/77	-56.96	106	384	17	26	2	
		25 MHz			1/64	-56.96	112	385	17	26	1.48	
		20 MHz			1/50	-56.96	109	386	18	26	2	
		15 MHz			1/37	-56.96	127	403	18	26	2	
		10 MHz			1/23	-56.96	107	379	18	26	1.8	
NR Band 38 ANT B Codec: EVS-WB 5.9kbit/s	CH.519000 2595 MHz	40 MHz	DFTs-OFDM	QPSK	1/105	-56.96	106	372	18	26	2	
NR Band 48 ANT F Codec: EVS-WB 5.9kbit/s	CH.641666 3624.99 MHz	40 MHz	DFTs-OFDM	QPSK	1/105	-56.96	144	433	20	26	1.62	
NR Band 77 ANT F Codec: EVS-WB 5.9kbit/s	CH.650000 3750 MHz	100 MHz	DFTs-OFDM	QPSK	1/271	-56.96	128	403	18	26	2	
NR Band 77 DoD ANT F Codec: EVS-WB 5.9kbit/s	CH.633334 3500.01 MHz	100 MHz	DFTs-OFDM	QPSK	1/271	-56.96	126	411	18	26	1.77	

11.3 VoWi-Fi 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 for each Wi-Fi 2.4 GHz and 5 GHz.

The highlighted results below were determined to be the worst case codec configuration(s) for Wi-Fi 2.4 GHz and 5 GHz.

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	2	1.85	2	2	2	y (Transversal)	802.11b CH.6 2437 MHz DSSS 1 Mbps
Primary	249	247	243	229	234	233		
Secondary	495	491	485	488	480	480		
Contiguous Longitudinal	22	24	23	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	24.4	128	9.6	24.4	128		
Freq. Response(dB)	1.81	1.34	1.63	1.54	2	1.9	1.58	2	1.93	y (Transversal)	802.11b CH.6 2437 MHz DSSS 1 Mbps
Primary	264	264	256	168	155	167	145	146	151		
Secondary	504	505	497	481	466	469	463	465	469		
Contiguous Longitudinal	26	26	26	21	21	21	21	21	21		
Contiguous Transverse	26	26	26	26	26	26	26	26	26		

Codec Investigation								
Codec State	AMR-NB (kbit/s)			AMR-WB (kbit/s)			Orientation	Band/ Band width/ Channel
	4.75	7.4	12.2	6.6	15.85	23.85		
Freq. Response(dB)	2	1.68	1.54	1.73	1.39	1.38	y (Transversal)	802.11a CH.40 5200 MHz BPSK 6 Mbps
Primary	218	219	221	185	187	183		
Secondary	473	472	472	459	457	455		
Contiguous Longitudinal	21	21	21	20	20	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/ Band Width/ Channel
	5.9	13.2	24.4	5.9	24.4	128	9.6	24.4	128		
Freq. Response(dB)	1.75	1.85	1.72	1.13	1.11	1.37	2	1.84	1.89	y (Transversal)	802.11a CH.40 5200 MHz BPSK 6 Mbps
Primary	188	219	214	143	184	177	180	180	176		
Secondary	465	470	464	454	451	445	450	446	441		
Contiguous Longitudinal	21	21	21	20	20	20	20	20	20		
Contiguous Transverse	26	26	26	26	26	26	26	26	26		

11.4 VoWi-Fi Antennas Investigation

EVS-SWB 9.6 kbit/s was the worst case bit-rates for 802.11b, EVS-WB 5.9 kbit/s was the worst case bit-rates for 802.11a. The secondary antenna was investigated to determine which antennas yields a worse Primary Group. The worst case codec and bit-rate from Antenna 1 was used to determine Antenna 2, MIMO's exclusion. Since Antenna 2, MIMO yielded a better Primary Group than Antenna 1, all subsequent measurements were measured using Antenna 1.

2.4GHz Antenna Investigation					
Codec State	ANT1	ANT2	MIMO	Orientation	Band/ BandWidth/ Channel
	EVS-SWB (kbit/s)				
	9.6				
Freq. Response(dB)	1.58	2	2	y (Transversal)	802.11b CH.6 2437 MHz DSSS 1 Mbps
Primary	145	200	196		
Secondary	463	473	468		
Contiguous Longitudinal	21	20	21		
Contiguous Transverse	26	26	26		

5GHz Antenna Investigation					
Codec State	ANT1	ANT2	MIMO	Orientation	Band/ BandWidth/ Channel
	EVS-WB (kbit/s)				
	5.9				
Freq. Response(dB)	1.13	1.32	1.34	y (Transversal)	802.11a CH.40 5200 MHz BPSK 6 Mbps
Primary	143	197	199		
Secondary	454	463	469		
Contiguous Longitudinal	20	21	21		
Contiguous Transverse	26	26	26		

11.5 VoWi-Fi Air Interface Investigation

Using the data from §11.4, 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 §11.4, yields no unexpected variations.

Moe	Ch. Freq.	BW	Modulation	Ambient Noise dB (A/m)	Primary	Secondary	Contiguous longitudinal	Contiguous Transverse	Freq. Response (dB)	Plot No.
802.11b ANT1 Codec: EVS-SWB 9.6kbit/s	CH.6 2437 MHz	20 MHz	1 Mbps	-57.03	145	463	21	26	1.58	17
			5.5 Mbps	-57.03	192	467	20	26	2	
			11 Mbps	-57.03	198	470	21	26	2	
	CH.1 2412 MHz		1 Mbps	-57.03	208	484	21	26	1.97	18
	CH.11 2462 MHz		1 Mbps	-57.03	207	486	21	26	1.78	19
802.11g ANT1 Codec: EVS-SWB 9.6kbit/s	CH.6 2437 MHz	20 MHz	6 Mbps	-57.03	296	537	25	26	2	
802.11n HT20 ANT1 Codec: EVS-SWB 9.6kbit/s	CH.6 2437 MHz	20 MHz	MCS 7	-57.03	235	476	20	26	2	
802.11ax HE20 ANT1 Codec: EVS-SWB 9.6kbit/s	CH.6 2437 MHz	20 MHz	MCS 0	-57.03	227	467	21	26	2	

VoWi-Fi Air Interface Investigation (Continued)

Mode	Ch. Freq.	BW	Modulation	Ambient Noise dB (A/m)	Primary	Secondary	Contiguous longitudinal	Contiguous Transverse	Freq. Response (dB)	Plot No.
802.11a ANT1 Codec: EVS-WB 59kbit/s	CH.40 5200 MHz	20 MHz	6 Mbps	-56.92	143	454	20	26	1.13	20
			18 Mbps	-56.92	206	478	21	26	1.3	
			54 Mbps	-56.92	159	483	21	26	1.23	
802.11n HT20 ANT1 Codec: EVS-WB 59kbit/s	CH.40 5200 MHz	20 MHz	MCS 0	-56.92	160	475	21	26	1.18	
			MCS 3	-56.92	159	473	21	26	1.07	
			MCS 7	-56.92	152	462	20	26	1.39	
802.11n HT40 ANT1 Codec: EVS-WB 59kbit/s	CH.38 5190 MHz	40 MHz	MCS 0	-56.92	151	462	20	26	1.18	
			MCS 3	-56.92	172	491	21	26	1.27	
			MCS 7	-56.92	165	473	20	26	1.06	
802.11ac VHT20 ANT1 Codec: EVS-WB 59kbit/s	CH.40 5200 MHz	20 MHz	MCS 0	-56.92	155	466	20	26	1.19	
			MCS 4	-56.92	158	467	21	26	1.33	
			MCS 8	-56.92	154	473	21	26	1.64	
802.11ac VHT40 ANT1 Codec: EVS-WB 59kbit/s	CH.38 5190 MHz	40 MHz	MCS 0	-56.92	165	483	20	26	1.23	
			MCS 4	-56.92	167	486	20	26	1.15	
			MCS 9	-56.92	171	488	21	26	1.28	
802.11ac VHT80 ANT1 Codec: EVS-WB 59kbit/s	CH.42 5210 MHz	80 MHz	MCS 0	-56.92	190	461	20	26	1.34	
			MCS 4	-56.92	151	458	20	26	1.74	
			MCS 9	-56.92	157	467	21	26	1.1	

Mode	Ch. Freq.	BW	Modulation	Ambient Noise dB (A/m)	Primary	Secondary	Contiguous longitudinal	Contiguous Transverse	Freq. Response (dB)	Plot No.
802.11ac VHT160 ANT1 Codec: EVS-WB 59kbit/s	CH.50 5250 MHz	160 MHz	MCS 0	-57.04	191	459	20	26	1.33	
			MCS 4	-57.04	192	463	20	26	1.3	
			MCS 9	-57.04	186	452	20	26	1.33	
802.11ax HE20 ANT1 Codec: EVS-WB 59kbit/s	CH.40 5200 MHz	20 MHz	MCS 0	-57.04	151	464	21	26	1.27	
			MCS 6	-57.04	168	480	21	26	1.13	
			MCS 11	-57.04	164	472	21	26	1.84	
802.11ax HE40 ANT1 Codec: EVS-WB 59kbit/s	CH.38 5190 MHz	40 MHz	MCS 0	-57.04	151	470	21	26	1.37	
			MCS 6	-57.04	164	472	21	26	1.4	
			MCS 11	-57.04	145	473	21	26	1.36	
802.11ax HE80 ANT1 Codec: EVS-WB 59kbit/s	CH.42 5210 MHz	80 MHz	MCS 0	-57.04	156	472	21	26	1.56	
			MCS 6	-57.04	152	471	21	26	1.54	
			MCS 11	-57.04	154	472	21	26	1.25	
802.11ax HE160 ANT1 Codec: EVS-WB 59kbit/s	CH.50 5250 MHz	160 MHz	MCS 0	-57.04	147	451	20	26	1.5	
			MCS 6	-57.04	150	456	20	26	1.28	
			MCS 11	-57.04	148	457	20	26	1.43	
802.11ax HE20 ANT1 Codec: EVS-WB 59kbit/s	CH. 5 5975 MHz	20 MHz	MCS 0	-57.04	178	483	21	26	1.69	
802.11ax HE40 ANT1 Codec: EVS-WB 59kbit/s	CH. 7 5985 MHz	40 MHz	MCS 0	-57.04	167	472	20	26	2	
802.11a ANT1 Codec: EVS-WB 59kbit/s	CH.60 5300 MHz	20 MHz	6 Mbps	-57.04	160	476	20	26	1.12	
	CH.120 5600 MHz	20 MHz	6 Mbps	-57.04	151	468	20	26	1.54	
	CH.157 5785 MHz	20 MHz	6 Mbps	-57.04	156	477	20	26	1.18	
	CH.173 5865 MHz	20 MHz	6 Mbps	-57.04	161	481	20	26	1.58	
802.11a ANT1 Codec: EVS-WB 59kbit/s	CH.36 5180 MHz	20 MHz	6 Mbps	-57.04	180	485	21	26	1.37	21
	CH.48 5240 MHz			-57.04	176	491	21	26	1.47	22

11.6 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)	1.84	2	1.22	y(Transversal)	GSM 850 EDGE 2 slot Ch.128 824.2 MHz ANT A
Primary	184	179	198		
Secondary	347	365	416		
Contiguous Longitudinal	18	18	19		
Contiguous Transverse	26	26	26		
Freq. Response (dB)	1.32	1.92	1.57	y(Transversal)	UMTS Band II HSUPA subtest 1 CH.9400 1852.4 MHz ANT A
Primary	216	219	266		
Secondary	526	517	577		
Contiguous Longitudinal	26	24	26		
Contiguous Transverse	26	26	26		
Freq. Response (dB)	1.15	1.54	1.57	y(Transversal)	LTE Band 25 20 MHz QPSK 1RB 0offset CH.26365 1882.5 MHz ANT A
Primary	180	199	199		
Secondary	463	491	493		
Contiguous Longitudinal	19	22	22		
Contiguous Transverse	26	26	26		
Freq. Response (dB)	1.26	1.73	1.73	y(Transversal)	LTE Band 41 PC2 20 MHz QPSK 1B 0offset CH.40620 2593 MHz ANT B
Primary	123	122	122		
Secondary	391	381	372		
Contiguous Longitudinal	17	17	16		
Contiguous Transverse	26	26	26		

Codec Investigation					
Codec State	codec bit rate (kbit/s)			Orientation	Band/BandWidth/Channel
	6	40	75		
Freq. Response (dB)	1.94	2	1.78	y(Transversal)	802.11b 2.4GHz 1Mbps CH.6 2437 MHz Antenna 1
Primary	191	196	184		
Secondary	481	476	465		
Contiguous Longitudinal	21	22	20		
Contiguous Transverse	26	26	26		
Freq. Response (dB)	2	1.95	1.71	y(Transversal)	802.11a 5GHz 6Mbps CH40 5200 MHz Antenna 1
Primary	183	208	208		
Secondary	466	501	503		
Contiguous Longitudinal	19	23	25		
Contiguous Transverse	26	26	26		
Freq. Response (dB)	2	1.74	1.52	y(Transversal)	NR Band 25 40 MHz DFT-s QPSK 108RB 54offset CH.376500 1882.5 MHz ANT A
Primary	151	159	150		
Secondary	436	441	427		
Contiguous Longitudinal	21	21	19		
Contiguous Transverse	26	26	26		
Freq. Response (dB)	1.04	1.79	1.68	y(Transversal)	NR Band 41 100 MHz CP QPSK 1RB 271offset CH.518598 2592.99 MHz ANT I
Primary	101	100	100		
Secondary	344	332	343		
Contiguous Longitudinal	18	18	18		
Contiguous Transverse	26	26	26		

11.7 OTT Air Interface Investigation

Mode	Ch. Freq.	BW	Mode	RB Config.	Ambient Noise dB (A/m)	Primary	Secondary	Contiguous longitudinal	Contiguous Transverse	Freq. Response (dB)	Plot No.
GSM850 EDGE 2 slots Google Meet Codec: 40kbit/s ANT A	CH.128 824.2 MHz				-57.04	179	365	18	26	2	23
GSM1900 EDGE 2 slots Google Meet Codec: 40kbit/s ANT A	CH.661 1880 MHz				-57.04	212	403	18	26	2	
UMTS Band II HSUPA subtest1 Google Meet Codec: 6kbit/s ANT A	CH.9400 1880.0 MHz				-57.04	175	465	19	26	1.33	
UMTS Band IV HSUPA subtest1 Google Meet Codec: 6kbit/s ANT A	CH.1412 1732.4 MHz				-57.04	185	470	20	26	1.22	
UMTS Band V HSUPA subtest1 Google Meet Codec: 6kbit/s ANT A	CH.4183 836.6 MHz				-57.04	159	462	20	26	1.12	24
LTE Band 7 Google Meet Codec: 6kbit/s ANT I	CH.21100 2535 MHz	20 MHz	QPSK	1/0	-56.90	170	453	19	26	2	25
LTE Band 7 Google Meet Codec: 6kbit/s ANT B	CH.21100 2535 MHz	20 MHz	QPSK	1/0	-56.90	198	487	21	26	2	
LTE Band 12 Google Meet Codec: 6kbit/s ANT A	CH.23095 707.5 MHz	10 MHz	QPSK	1/0	-56.90	213	507	22	26	1.22	
LTE Band 13 Google Meet Codec: 6kbit/s ANT A	CH.23230 782.0 MHz	10 MHz	QPSK	1/0	-56.90	216	511	22	26	2	
LTE Band 14 Google Meet Codec: 6kbit/s ANT A	CH.23330 793 MHz	10 MHz	QPSK	1/0	-56.90	210	510	24	26	2	
LTE Band 25 Google Meet Codec: 6kbit/s ANT I	CH.26365 1882.5 MHz	20 MHz	QPSK	1/0	-56.90	186	481	21	26	1.62	
LTE Band 25 Google Meet Codec: 6kbit/s ANT A	CH.26365 1882.5 MHz	20 MHz	QPSK	1/0	-56.90	180	463	19	26	1.15	
LTE Band 26 Google Meet Codec: 6kbit/s ANT A	CH.26865 831.5 MHz	15 MHz	QPSK	1/0	-56.90	297	450	19	26	1.88	
LTE Band 30 Google Meet Codec: 6kbit/s ANT I	CH.27710 2310 MHz	10 MHz	QPSK	1/0	-56.90	195	489	21	26	1.52	
LTE Band 30 Google Meet Codec: 6kbit/s ANT A	CH.27710 2310 MHz	10 MHz	QPSK	1/0	-56.90	196	494	22	26	2	
LTE Band 66 Google Meet Codec: 6kbit/s ANT I	CH.132322 1745 MHz	20 MHz	QPSK	1/0	-56.90	195	494	21	26	2	
LTE Band 66 Google Meet Codec: 6kbit/s ANT A	CH.132322 1745 MHz	20 MHz	QPSK	1/0	-56.90	187	467	19	26	2	
LTE Band 71 Google Meet Codec: 6kbit/s ANT A	CH.133297 680.5 MHz	20 MHz	QPSK	1/0	-56.90	288	453	19	26	1.99	

Mode	Ch. Freq.	BW	Mode	RB Config.	Ambient Noise dB (A/m)	Primary	Secondary	Contiguous longitudinal	Contiguous Transverse	Freq. Response (dB)	Plot No.
LTE Band 41 Google Meet Codec: 75kbit/s PC 2 ANT B	CH.40620 2593 MHz	20 MHz	QPSK	1/0	-56.96	122	372	16	26	1.73	
LTE Band 41 Google Meet Codec: 75kbit/s PC 2 ANTI	CH.40620 2593 MHz	20 MHz	QPSK	1/0	-56.96	106	347	18	26	1.83	26
LTE Band 41 Google Meet Codec: 75kbit/s PC 3 ANT B	CH.40620 2593 MHz	20 MHz	QPSK	1/0	-56.96	134	396	17	26	1.75	
LTE Band 41 Google Meet Codec: 75kbit/s PC 3 ANT I	CH.40620 2593 MHz	20 MHz	QPSK	1/0	-56.96	120	371	17	26	1.84	
LTE Band 48 Google Meet Codec: 75kbit/s ANT F	CH.55990 3625 MHz	20 MHz	QPSK	1/0	-56.96	156	426	18	26	1.76	

Mode	Ch. Freq.	BW	Mode	RB Config.	Ambient Noise dB (A/m)	Primary	Secondary	Contiguous longitudinal	Contiguous Transverse	Freq. Response (dB)	Plot No.
Wi-Fi 2.4 GHz 802.11b Google Meet Codec: 75kbit/s	CH.6 2437 MHz	20 MHz	1 Mbps		-56.99	184	465	20	26	1.78	27
U-NII 5.2 GHz 802.11a Google Meet Codec: 6kbit/s	CH.40 5200 MHz	20 MHz	6 Mbps		-56.99	183	466	19	26	2	
U-NII 5.3 GHz 802.11a Google Meet Codec: 6kbit/s	CH.60 5300 MHz	20 MHz	6 Mbps		-56.99	198	489	21	26	1.49	
U-NII 5.6 GHz 802.11a Google Meet Codec: 6kbit/s	CH.120 5600 MHz	20 MHz	6 Mbps		-56.99	195	492	23	26	1.98	
U-NII 5.8 GHz 802.11a Google Meet Codec: 6kbit/s	CH.157 5785 MHz	20 MHz	6 Mbps		-56.99	194	485	22	26	2	
U-NII 5.8 GHz 802.11a Google Meet Codec: 6kbit/s	CH.173 5865 MHz	20 MHz	6 Mbps		-56.99	204	495	22	26	1.63	
U-NII 5.9 GHz 802.11ax Google Meet Codec: 6kbit/s	CH.5 5975 MHz	20 MHz	MCS 0		-56.99	182	462	20	26	2	28

Mode	Ch. Freq.	BW	Waveform	Modulation	RB Config.	Ambient Noise dB (A/m)	Primary	Secondary	Contiguous longitudinal	Contiguous Transverse	Freq. Response (dB)	Plot No.
NR Band n25 Google Meet Codec: 75kbit/s ANT A	CH.376500 1882.5 MHz	40 MHz	DFT-s OFDM	QPSK	108/54	-56.92	150	427	19	26	1.52	
NR Band n25 Google Meet Codec: 75kbit/s ANT I	CH.376500 1882.5 MHz	40 MHz	DFT-s OFDM	QPSK	108/54	-56.92	149	426	18	26	1.66	29
NR Band n7 Google Meet Codec: 75kbit/s ANT B	CH.50700 2535 MHz	40 MHz	DFT-s OFDM	QPSK	108/54	-56.92	152	423	18	26	1.64	
NR Band n7 Google Meet Codec: 75kbit/s ANT I	CH.50700 2535 MHz	40 MHz	DFT-s OFDM	QPSK	108/54	-56.92	149	427	18	26	1.5	
NR Band n12 Google Meet Codec: 75kbit/s ANT A	CH.142500 707.5 MHz	15 MHz	DFT-s OFDM	QPSK	36/22	-56.92	176	456	20	26	1.8	
NR Band n26 Google Meet Codec: 75kbit/s ANT A	CH.166300 831.5 MHz	20 MHz	DFT-s OFDM	QPSK	50/28	-56.92	164	445	19	26	1.67	
NR Band n30 Google Meet Codec: 75kbit/s ANT B	CH.462000 2310 MHz	10 MHz	DFT-s OFDM	QPSK	25/14	-56.92	168	452	21	26	1.71	
NR Band n30 Google Meet Codec: 75kbit/s ANT I	CH.462000 2310 MHz	10 MHz	DFT-s OFDM	QPSK	25/14	-56.92	170	456	20	26	1.62	
NR Band n66 Google Meet Codec: 75kbit/s ANT A	CH.349000 1745 MHz	40 MHz	DFT-s OFDM	QPSK	108/54	-56.92	162	445	21	26	1.67	
NR Band n66 Google Meet Codec: 75kbit/s ANT I	CH.349000 1745 MHz	40 MHz	DFT-s OFDM	QPSK	108/54	-56.92	152	428	18	26	1.54	
NR Band n70 Google Meet Codec: 75kbit/s ANT A	CH. 340500 1702.5 MHz	15 MHz	DFT-s OFDM	QPSK	36/22	-56.92	166	449	21	26	1.75	
NR Band n70 Google Meet Codec: 75kbit/s ANT I	CH.340500 1702.5 MHz	15 MHz	DFT-s OFDM	QPSK	36/22	-56.92	161	441	19	26	1.71	
NR Band n71 Google Meet Codec: 75kbit/s ANT A	CH.136100 680.5 MHz	20 MHz	DFT-s OFDM	QPSK	50/28	-56.92	173	454	19	26	1.71	

Mode	Ch. Freq.	BW	Waveform	Modulation	RB Config.	Ambient Noise dB (A/m)	Primary	Secondary	Contiguous longitudinal	Contiguous Transverse	Freq. Response (dB)	Plot No.
NR Band n38 Google Meet Codec: 40kbit/s ANT B	CH. 519000 2595 MHz	40 MHz	CP-OFDM	QPSK	1/105	-56.95	115	357	17	26	2	
NR Band n41 Google Meet Codec: 40kbit/s ANT I	CH. 518598 2592.99 MHz	100 MHz	CP-OFDM	QPSK	1/271	-56.95	100	332	18	26	1.79	30
NR Band n48 Google Meet Codec: 40kbit/s ANT F	CH. 641666 3624.99 MHz	40 MHz	CP-OFDM	QPSK	1/105	-56.95	155	434	20	26	1.68	
NR Band n77 Google Meet Codec: 40kbit/s ANT F	CH. 650000 3750 MHz	100 MHz	CP-OFDM	QPSK	1/271	-56.95	131	399	17	26	1.93	
NR Band n77 DoD Google Meet Codec: 40kbit/s ANT F	CH. 653334 3500.01 MHz	100 MHz	CP-OFDM	QPSK	1/271	-56.95	130	394	17	26	1.76	

Appendix 1. TEST SETUP PHOTO

Attachment 2. HAC T-COIL Test Plots

Plot 1 GSM 850 CH.128 Voice Coder Speech Codec: FR V1 ANT A

Hardware Setup

Probe Name	Probe Calibration Date	DAE Name	DAE Calibration Date
AM1DV3 - 3050	November 23, 2023	DAE4 Sn1254	June 02, 2023

Communication Systems

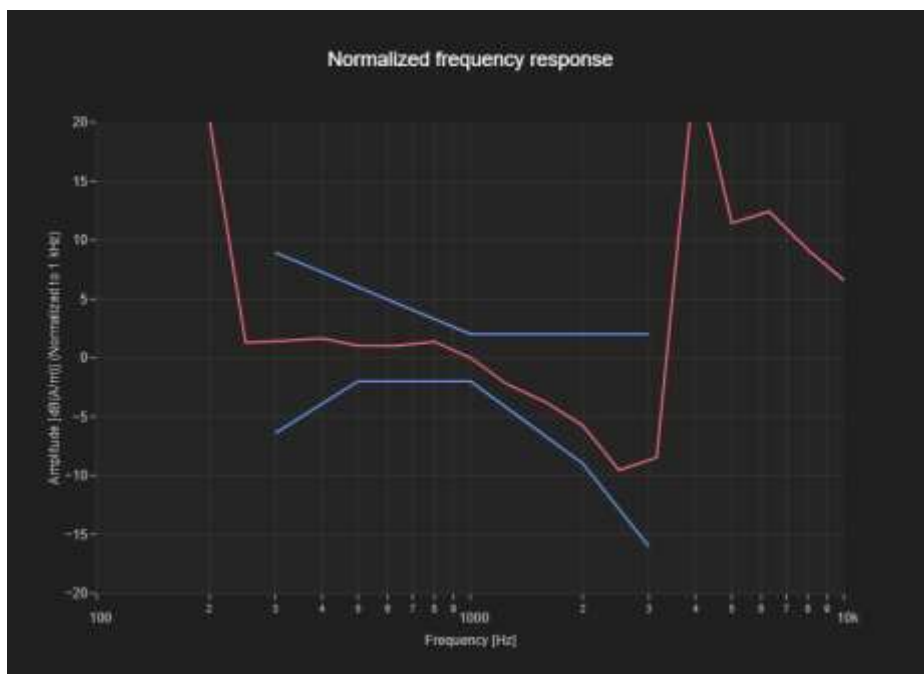
Band Name	Communication Systems Name	Channel	Frequency [MHz]
GSM 850	GSM-FDD (TDMA, GMSK)	128	824.2

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

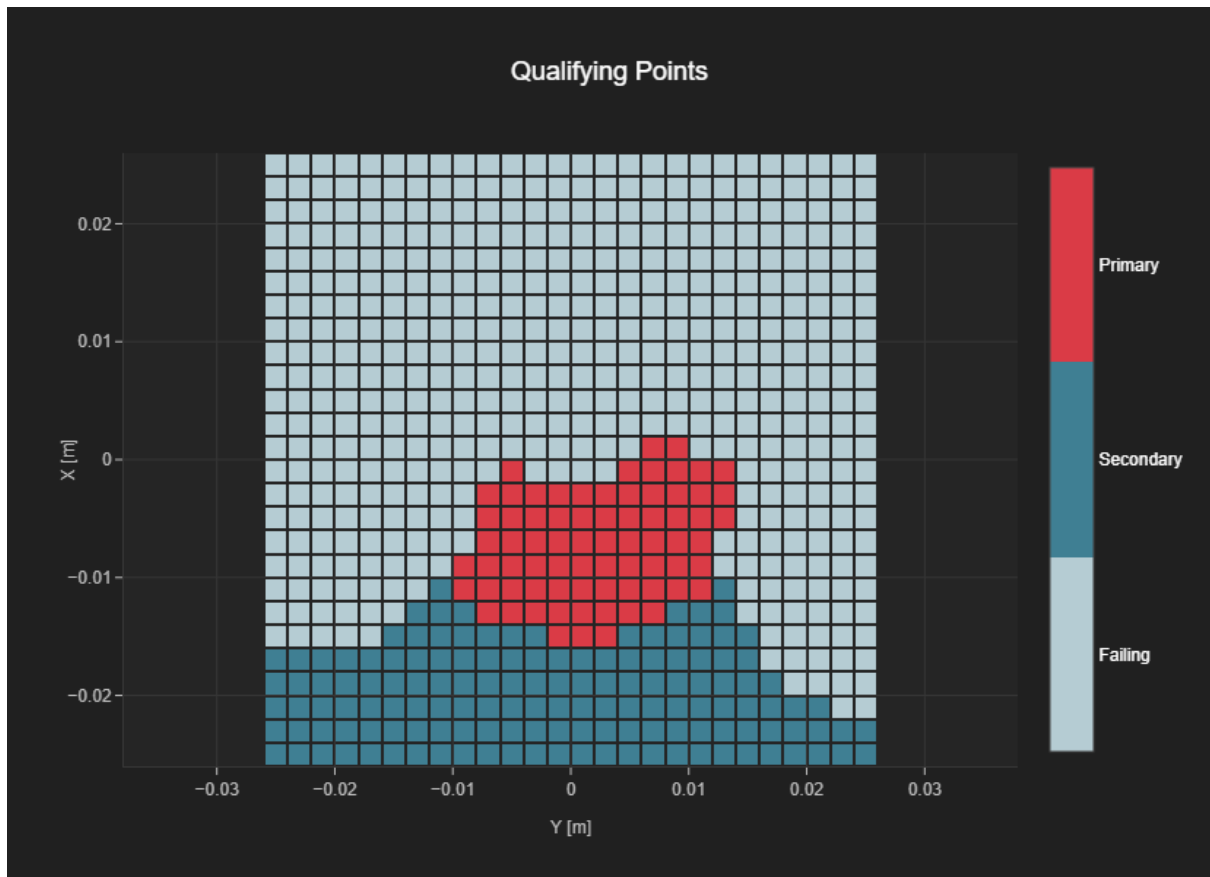
Audio File	Measurement Duration [s]	Margin Upper Bound [dB]	Margin Lower Bound [dB]
48k_voice_300-3000_2s.wav	2.0	1.92	2.0



T-Coil Coupling Mode Test Report

Results

Primary Group Contiguous Point Count	Secondary Group Point Count	Secondary Group Max Longitudinal	Secondary Group Max Transverse
73	213	14	26



Plot 2 CH.190 Voice Coder Speech Codec: FR V1 ANT A GSM 850

Hardware Setup

Probe Name	Probe Calibration Date	DAE Name	DAE Calibration Date
AM1DV3 - 3050	November 23, 2023	DAE4 Sn1254	June 02, 2023

Communication Systems

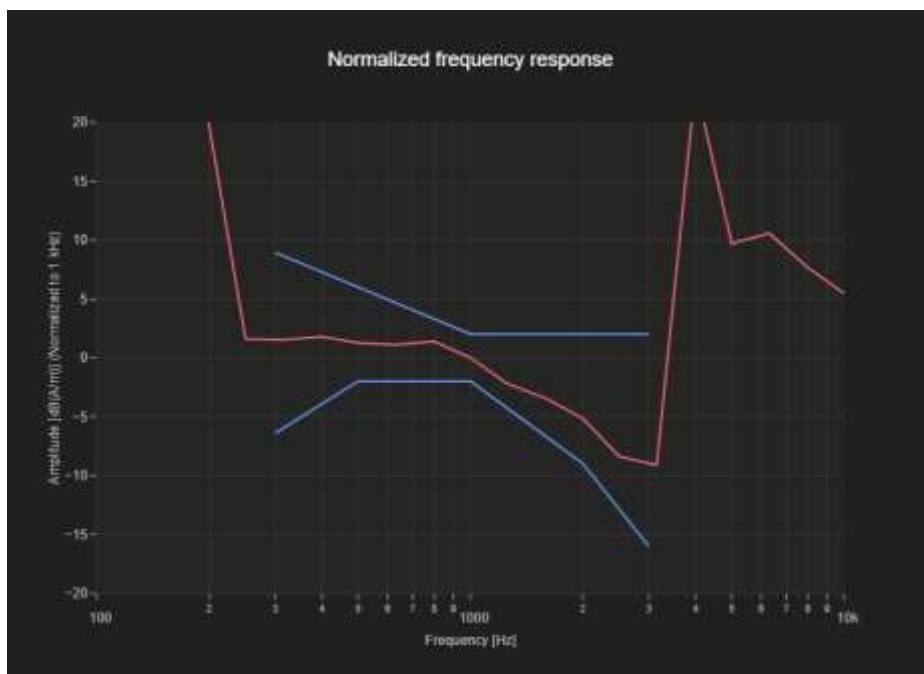
Band Name	Communication Systems Name	Channel	Frequency [MHz]
GSM 850	GSM-FDD (TDMA, GMSK)	190	836.6

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

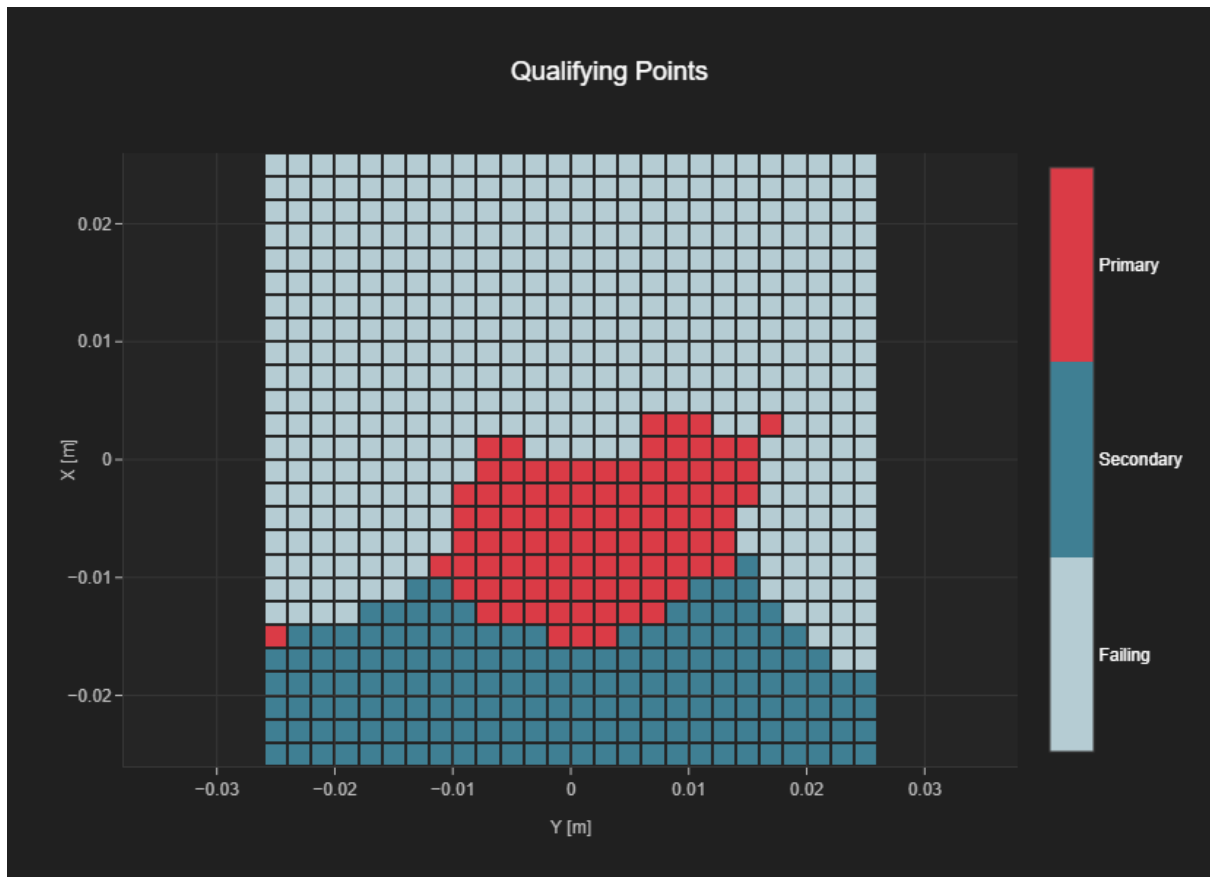
Audio File	Measurement Duration [s]	Margin Upper Bound [dB]	Margin Lower Bound [dB]
48k_voice_300-3000_2s.wav	2.0	1.92	2.0



T-Coil Coupling Mode Test Report

Results

Primary Group Contiguous Point Count	Secondary Group Point Count	Secondary Group Max Longitudinal	Secondary Group Max Transverse
95	257	15	26



Plot 3 GSM 850 CH.251 Voice Coder Speech Codec: FR V1 ANT A

Hardware Setup

Probe Name	Probe Calibration Date	DAE Name	DAE Calibration Date
AM1DV3 - 3050	November 23, 2023	DAE4 Sn1254	June 02, 2023

Communication Systems

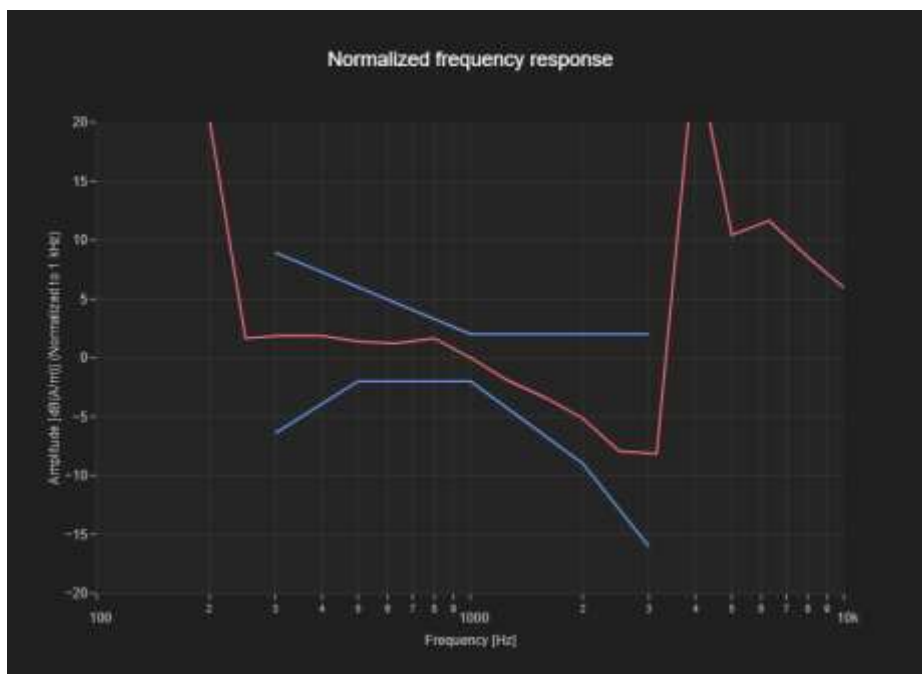
Band Name	Communication Systems Name	Channel	Frequency [MHz]
GSM 850	GSM-FDD (TDMA, GMSK)	251	848.8

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

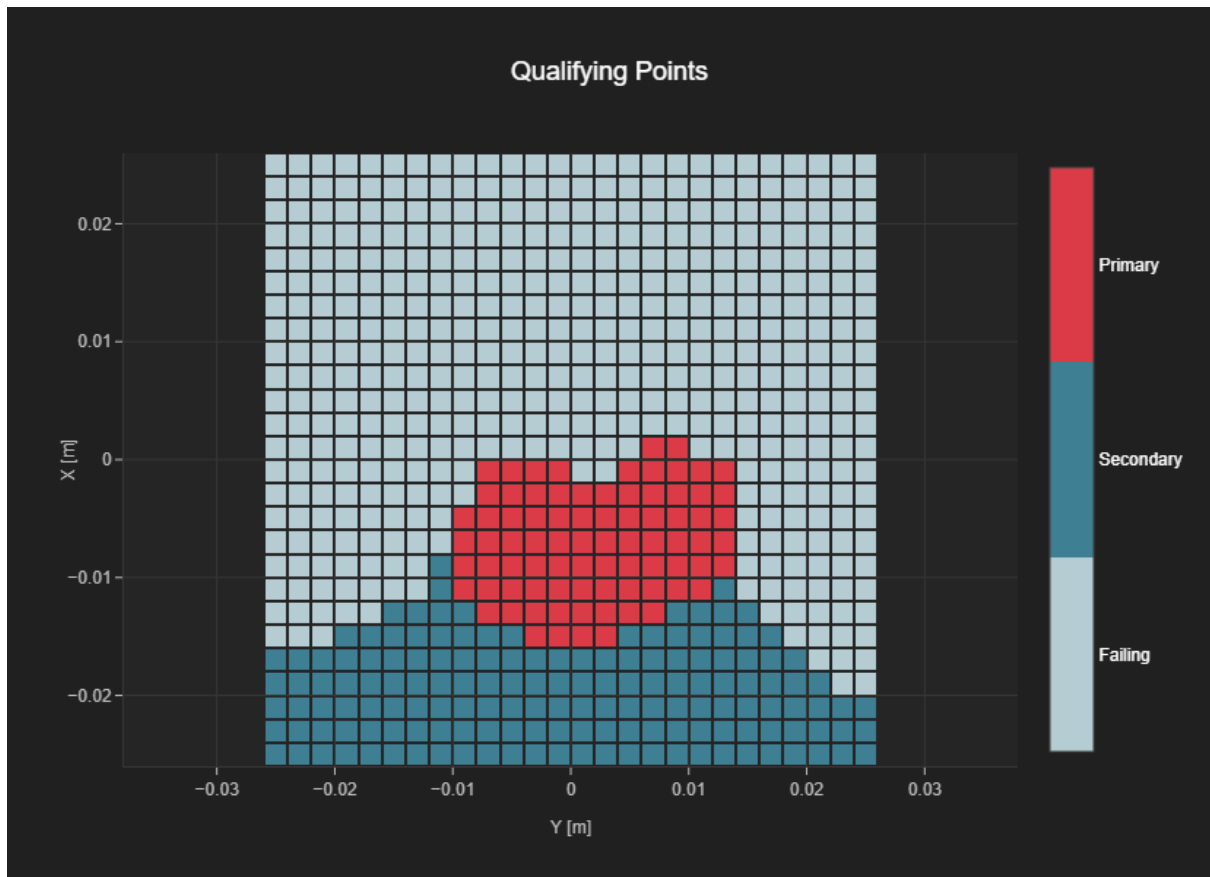
Audio File	Measurement Duration [s]	Margin Upper Bound [dB]	Margin Lower Bound [dB]
48k_voice_300-3000_2s.wav	2.0	1.64	2.0



T-Coil Coupling Mode Test Report

Results

Primary Group Contiguous Point Count	Secondary Group Point Count	Secondary Group Max Longitudinal	Secondary Group Max Transverse
81	232	14	26



Plot 4 UMTS Band II CH.9262 Voice AMR WB Codec: 15.85 kbit/s ANT A

Hardware Setup

Probe Name	Probe Calibration Date	DAE Name	DAE Calibration Date
AM1DV3 - 3049	May 23, 2023	DAE4 Sn1750	September 19, 2023

Communication Systems

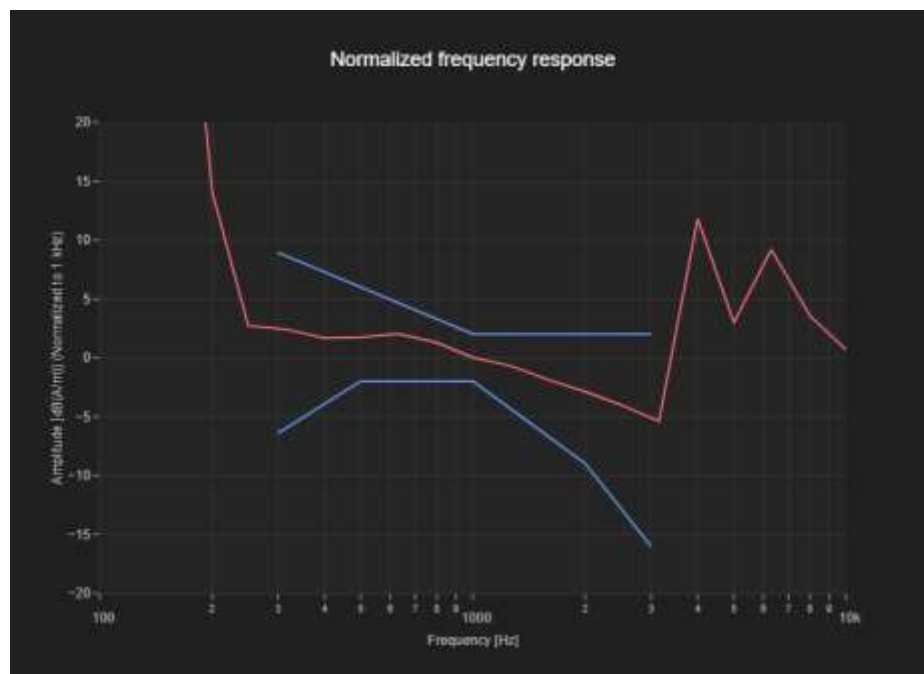
Band Name	Communication Systems Name	Channel	Frequency [MHz]
Band 2, UTRA/FDD	UMTS-FDD (WCDMA, AMR)	9262	1852.4

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

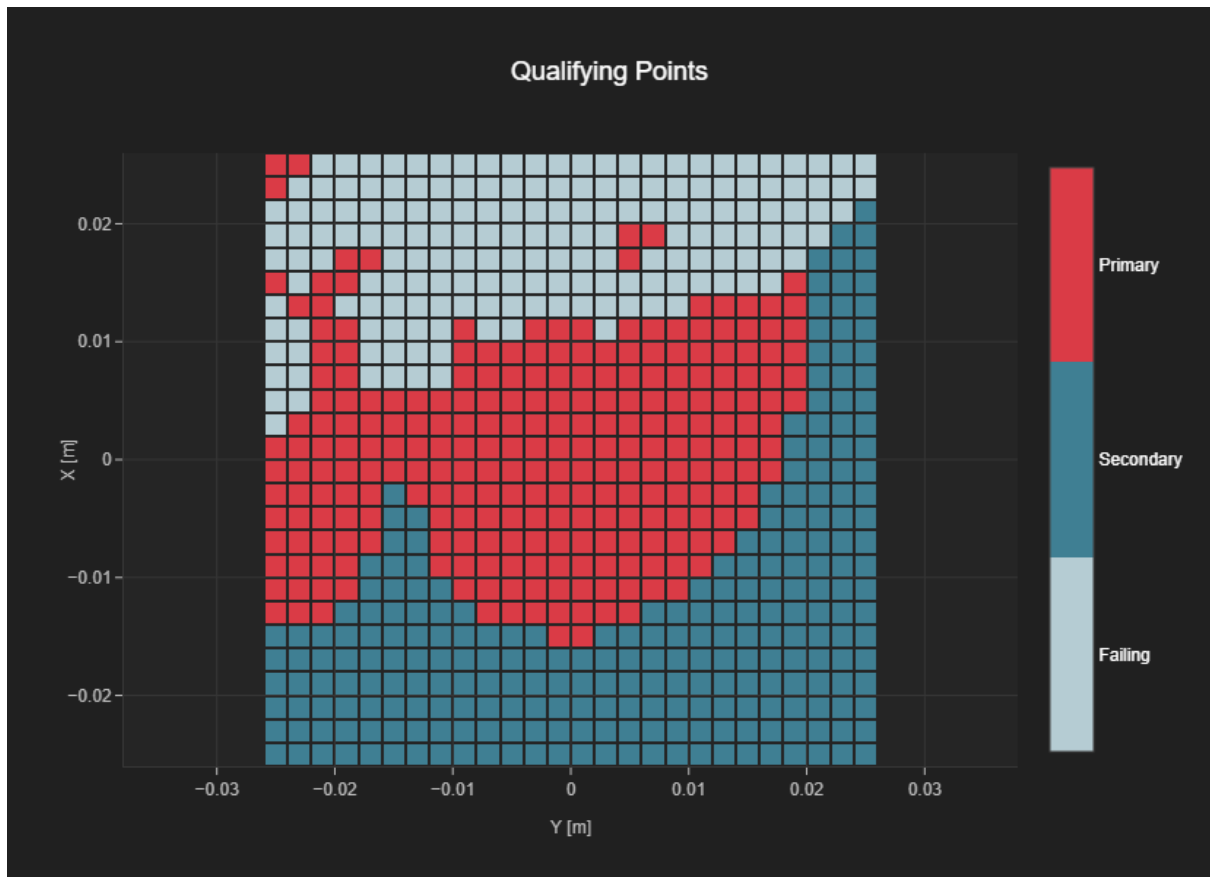
Audio File	Measurement Duration [s]	Margin Upper Bound [dB]	Margin Lower Bound [dB]
48k_voice_300-3000_2s.wav	2.0	2.0	2.0



T-Coil Coupling Mode Test Report

Results

Primary Group Contiguous Point Count	Secondary Group Point Count	Secondary Group Max Longitudinal	Secondary Group Max Transverse
252	500	24	26



Plot 5 UMTS Band II CH.9400 Voice AMR WB Codec: 15.85 kbit/s ANT A

Hardware Setup

Probe Name	Probe Calibration Date	DAE Name	DAE Calibration Date
AM1DV3 - 3049	May 23, 2023	DAE4 Sn1750	September 19, 2023

Communication Systems

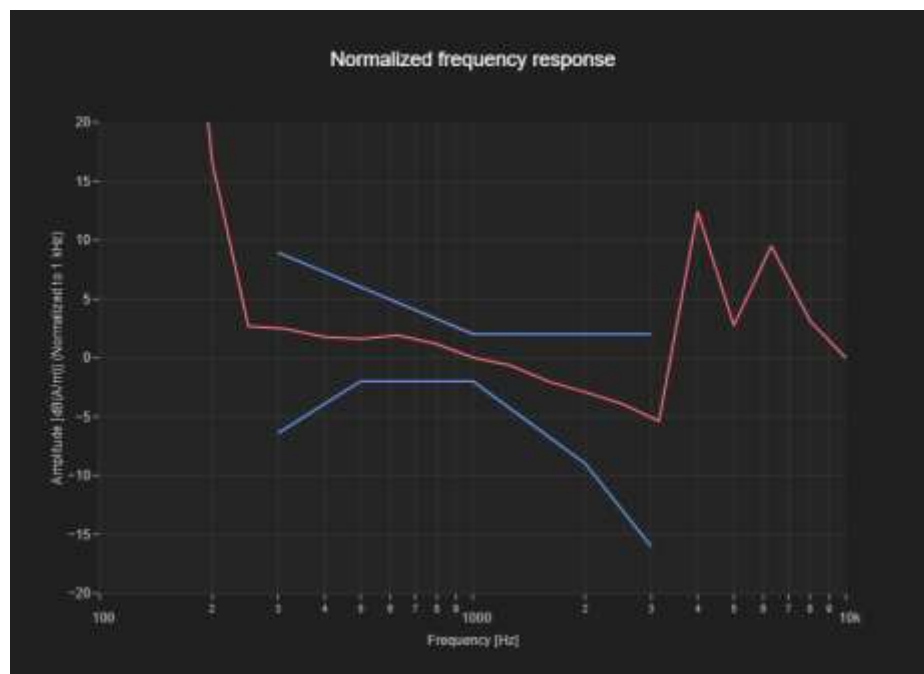
Band Name	Communication Systems Name	Channel	Frequency [MHz]
Band 2, UTRA/FDD	UMTS-FDD (WCDMA, AMR)	9400	1880.0

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

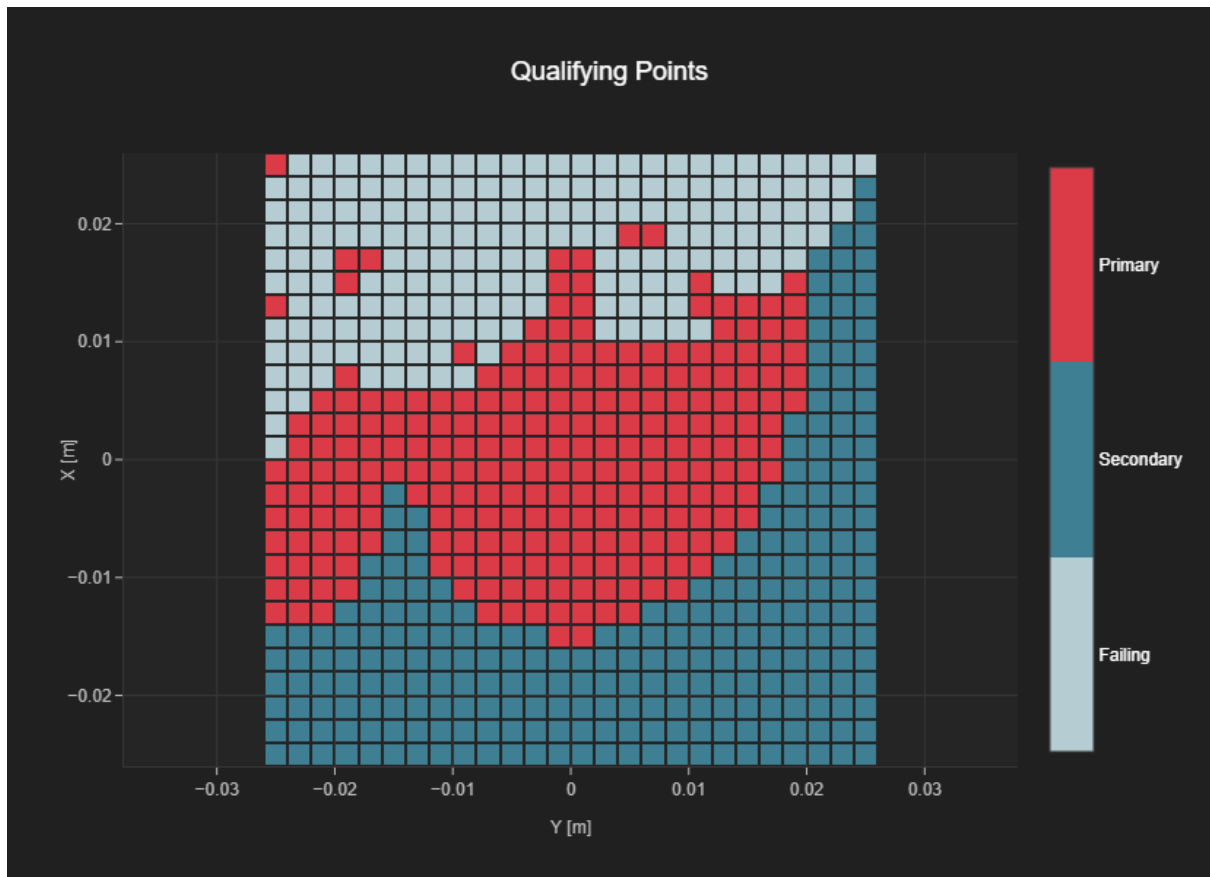
Audio File	Measurement Duration [s]	Margin Upper Bound [dB]	Margin Lower Bound [dB]
48k_voice_300-3000_2s.wav	2.0	2.0	2.0



T-Coil Coupling Mode Test Report

Results

Primary Group Contiguous Point Count	Secondary Group Point Count	Secondary Group Max Longitudinal	Secondary Group Max Transverse
240	487	25	26



Plot 6 UMTS Band II CH.9538 Voice AMR WB Codec: 15.85 kbit/s ANT A

Hardware Setup

Probe Name	Probe Calibration Date	DAE Name	DAE Calibration Date
AM1DV3 - 3049	May 23, 2023	DAE4 Sn1750	September 19, 2023

Communication Systems

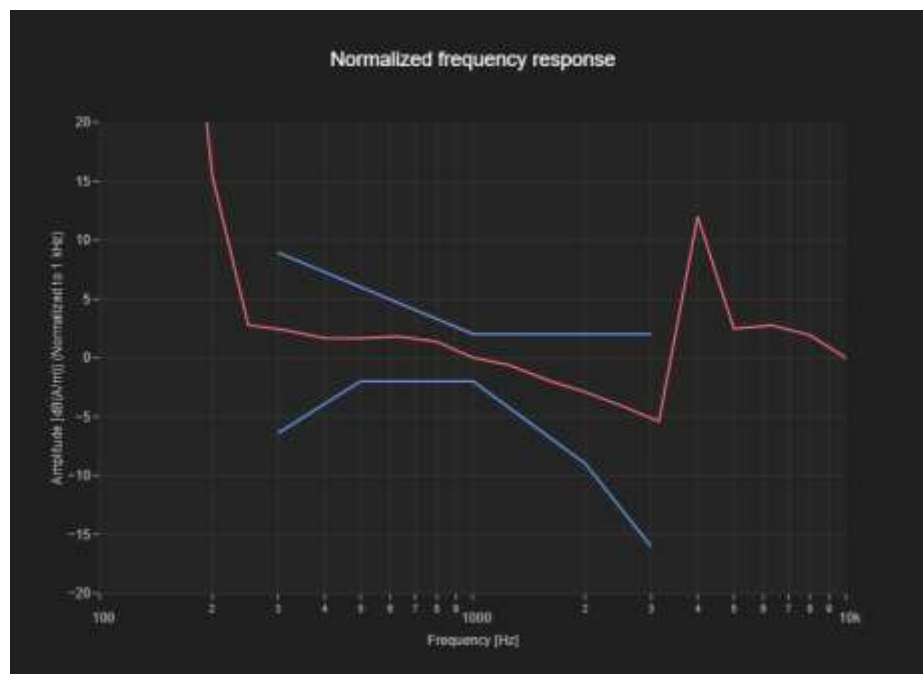
Band Name	Communication Systems Name	Channel	Frequency [MHz]
Band 2, UTRA/FDD	UMTS-FDD (WCDMA, AMR)	9538	1907.6

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

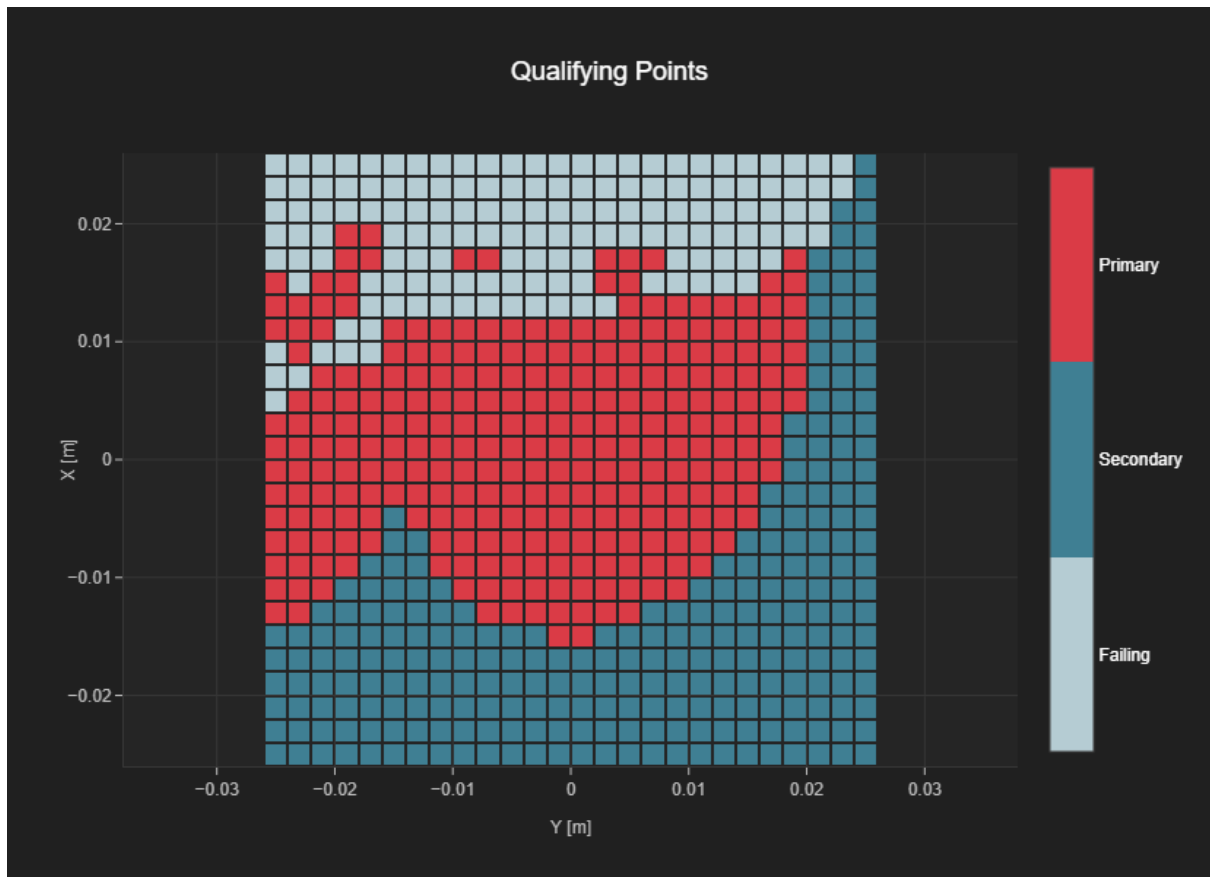
Audio File	Measurement Duration [s]	Margin Upper Bound [dB]	Margin Lower Bound [dB]
48k_voice_300-3000_2s.wav	2.0	1.93	2.0



T-Coil Coupling Mode Test Report

Results

Primary Group Contiguous Point Count	Secondary Group Point Count	Secondary Group Max Longitudinal	Secondary Group Max Transverse
277	529	26	26



Plot 7 LTE Band 25 CH.26365 Voice EVS-SWB Codec 24.4 kbit/s ANT A

Hardware Setup

Probe Name	Probe Calibration Date	DAE Name	DAE Calibration Date
AM1DV3 - 3049	May 23, 2023	DAE4 Sn1750	September 19, 2023

Communication Systems

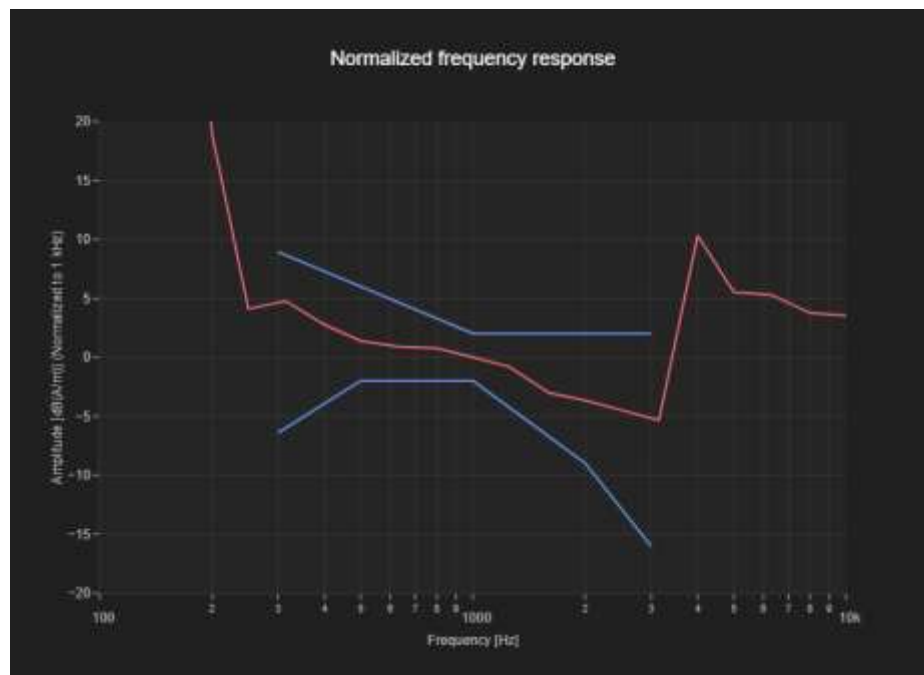
Band Name	Communication Systems Name	Channel	Frequency [MHz]
Band 25, E-UTRA/FDD	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	26365	1882.5

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

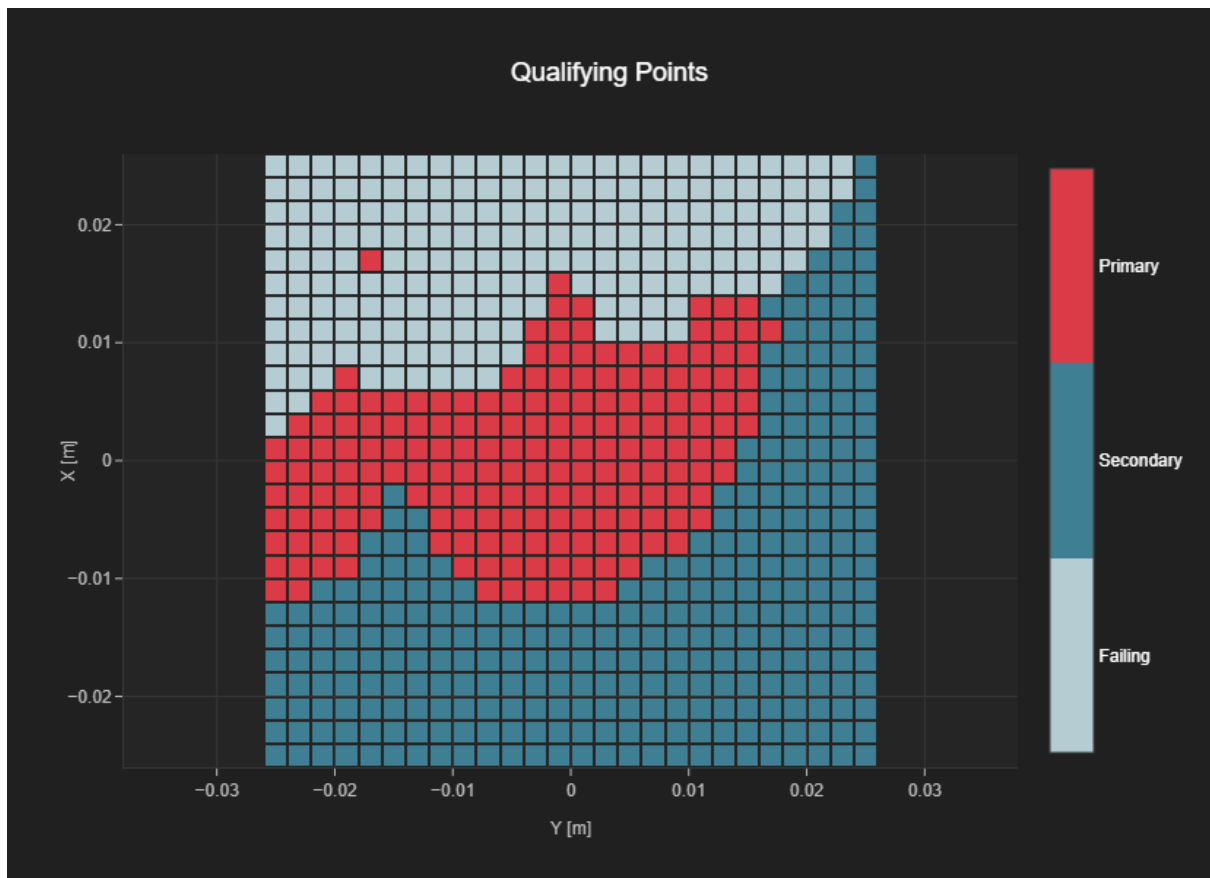
Audio File	Measurement Duration [s]	Margin Upper Bound [dB]	Margin Lower Bound [dB]
48k_voice_300-3000_2s.wav	2.0	2.0	2.0



T-Coil Coupling Mode Test Report

Results

Primary Group Contiguous Point Count	Secondary Group Point Count	Secondary Group Max Longitudinal	Secondary Group Max Transverse
185	480	26	26



Plot 8 LTE Band 25 CH.26410 Voice EVS-SWB Codec 24.4 kbit/s ANT A

Hardware Setup

Probe Name	Probe Calibration Date	DAE Name	DAE Calibration Date
AM1DV3 - 3049	May 23, 2023	DAE4 Sn1750	September 19, 2023

Communication Systems

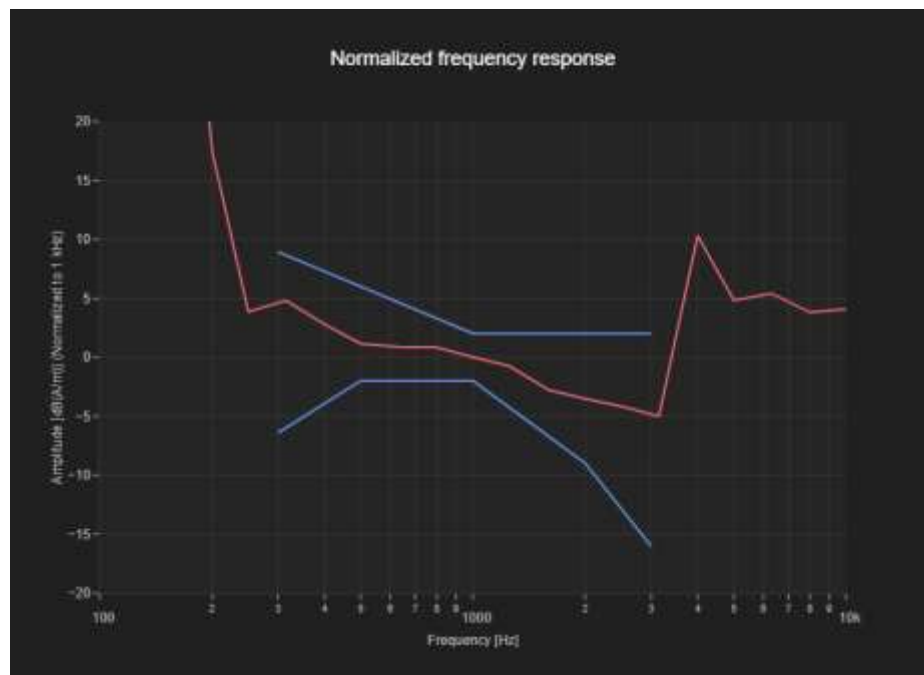
Band Name	Communication Systems Name	Channel	Frequency [MHz]
Band 25, E-UTRA/FDD	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	26140	1860.0

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

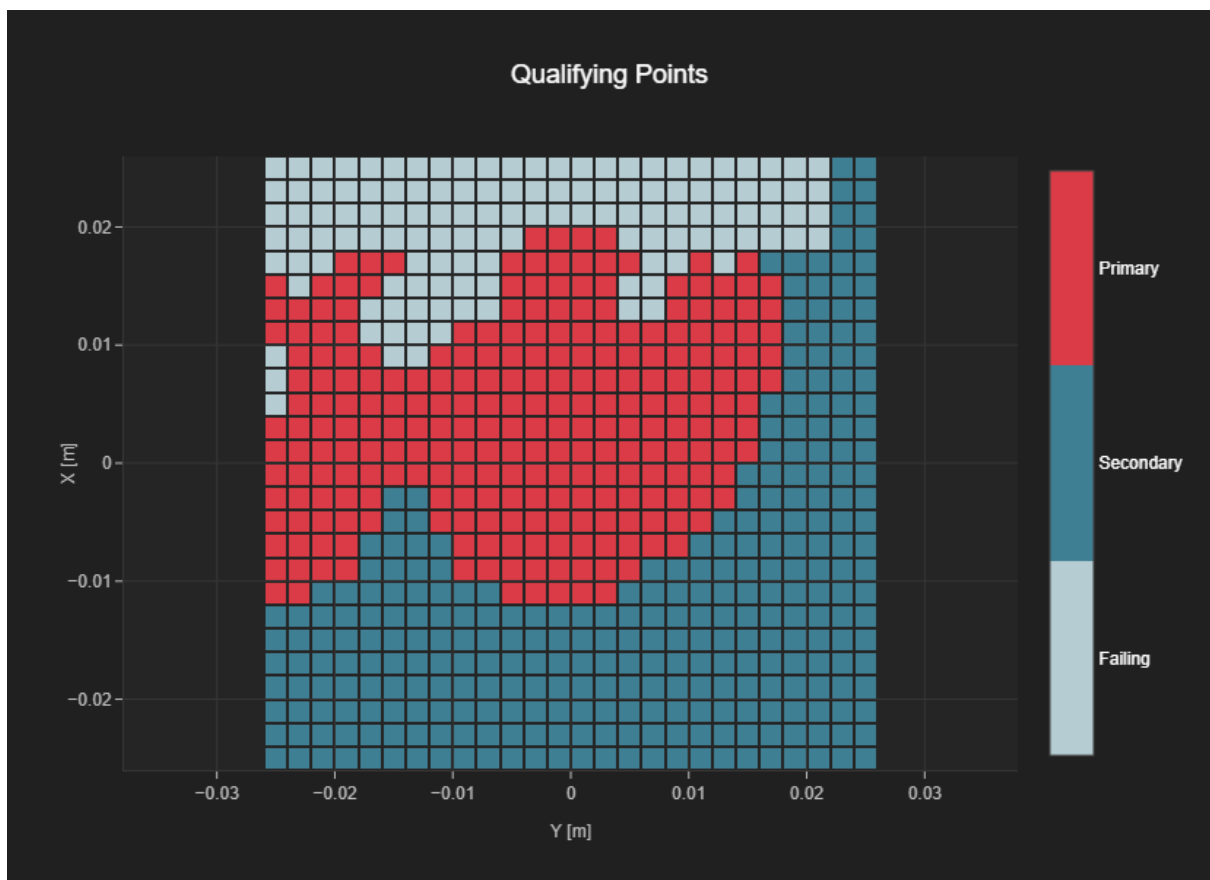
Results

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
251	549	26	26



Plot 9 LTE Band 25 CH.26590 Voice EVS-SWB Codec 24.4 kbit/s ANT A

Hardware Setup

Probe Name	Probe Calibration Date	DAE Name	DAE Calibration Date
AM1DV3 - 3049	May 23, 2023	DAE4 Sn1750	September 19, 2023

Communication Systems

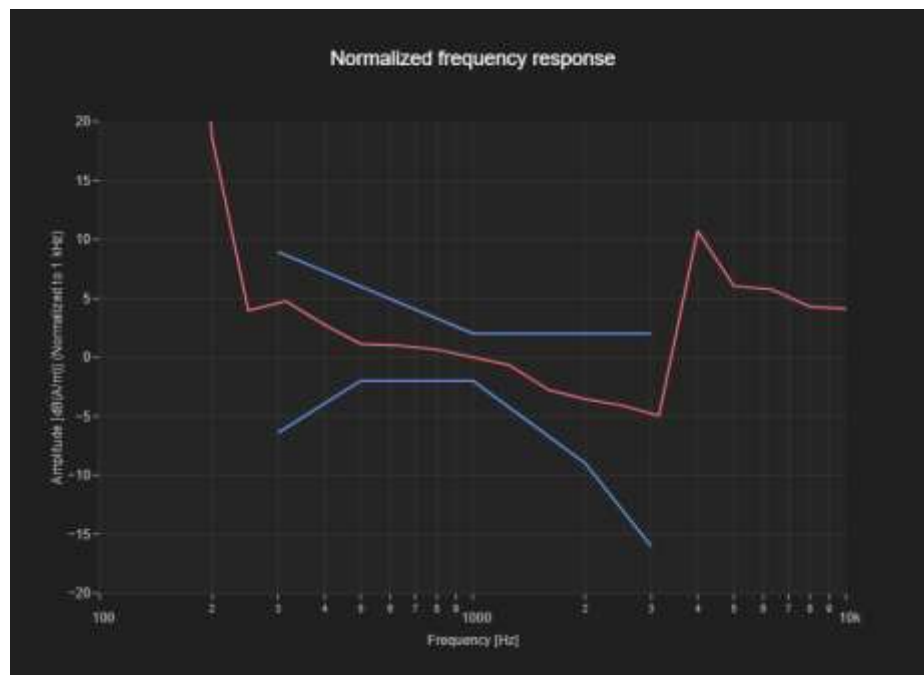
Band Name	Communication Systems Name	Channel	Frequency [MHz]
Band 25, E-UTRA/FDD	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	26590	1905.0

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

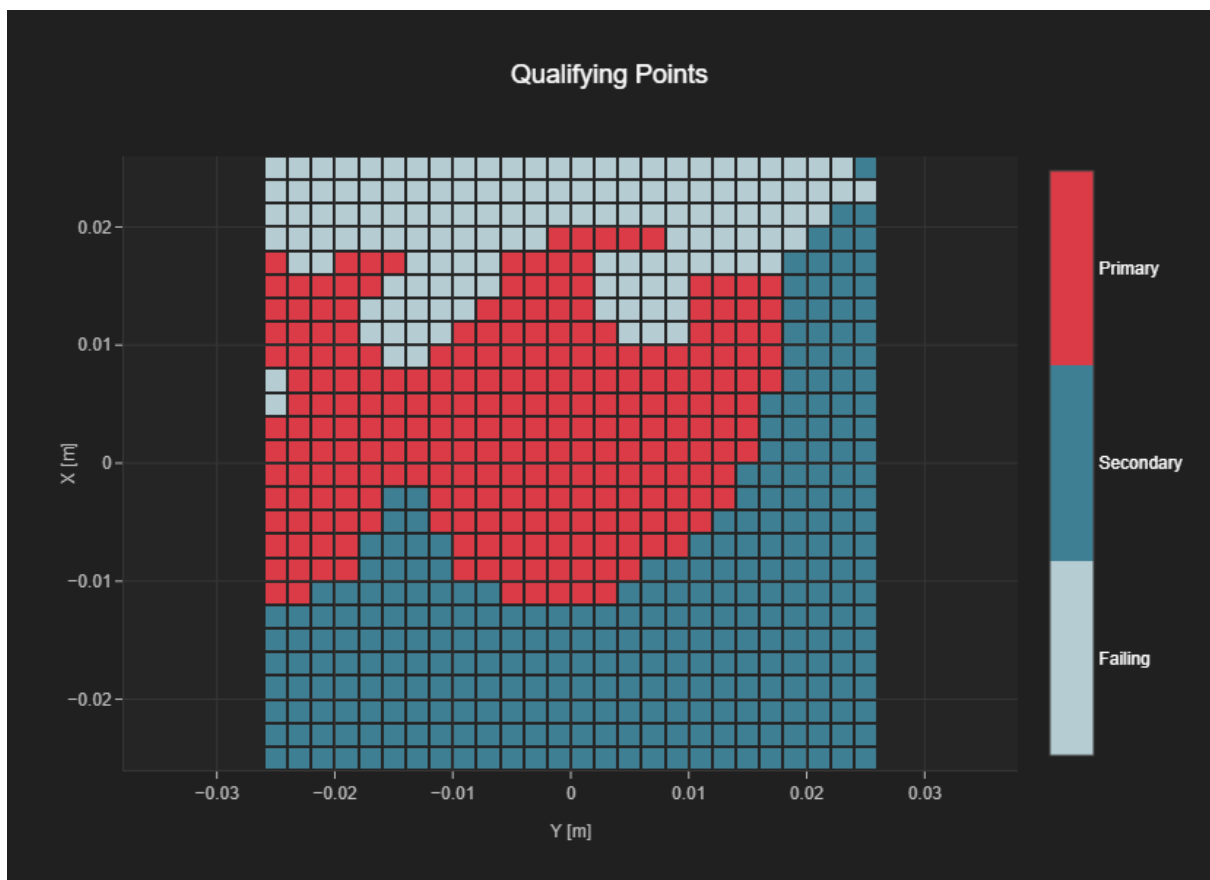
Results

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
245	539	25	26



Plot 10 NR Band n25 CH.376500 Voice EVS WB Codec: 5.9 kbit/s ANT A

Hardware Setup

Probe Name	Probe Calibration Date	DAE Name	DAE Calibration Date
AM1DV3 - 3050	November 23, 2023	DAE4 Sn1254	June 02, 2023

Communication Systems

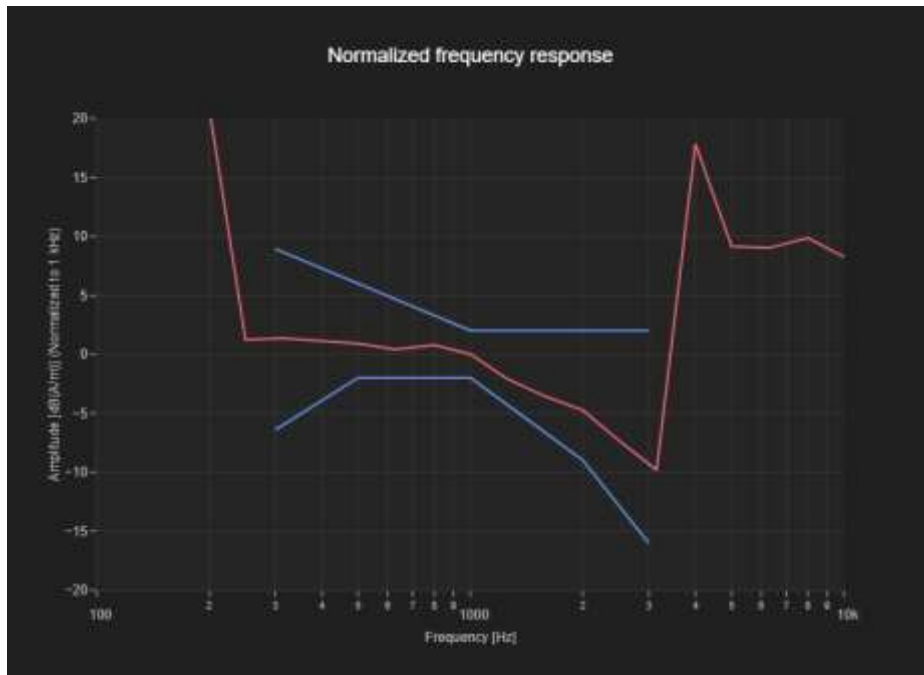
Band Name	Communication Systems Name	Channel	Frequency [MHz]
Band n25	5G NR (DFT-s-OFDM, 50% RB, 40 MHz, QPSK, 15 kHz)	376500	1882.5

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

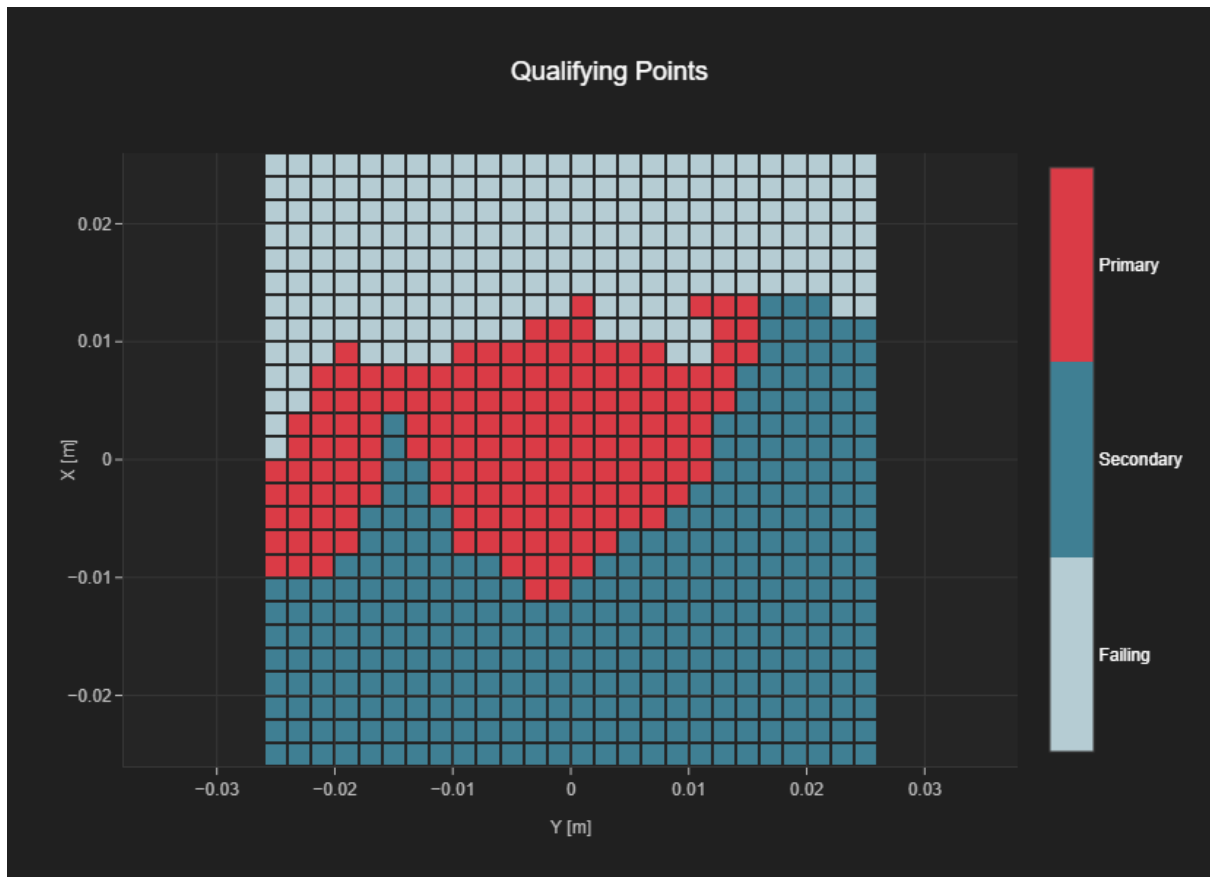
Audio File	Measurement Duration [s]	Margin Upper Bound [dB]	Margin Lower Bound [dB]
48k_voice_300-3000_2s.wav	2.0	2.0	2.0



T-Coil Coupling Mode Test Report

Results

Primary Group Contiguous Point Count	Secondary Group Point Count	Secondary Group Max Longitudinal	Secondary Group Max Transverse
157	470	20	26



Plot 11 LTE Band 41 CH.40620 Voice EVS-WB Codec: 24.4 kbit/s PC2 ANT B

Hardware Setup

Probe Name	Probe Calibration Date	DAE Name	DAE Calibration Date
AM1DV3 - 3049	May 23, 2023	DAE4 Sn1750	September 19, 2023

Communication Systems

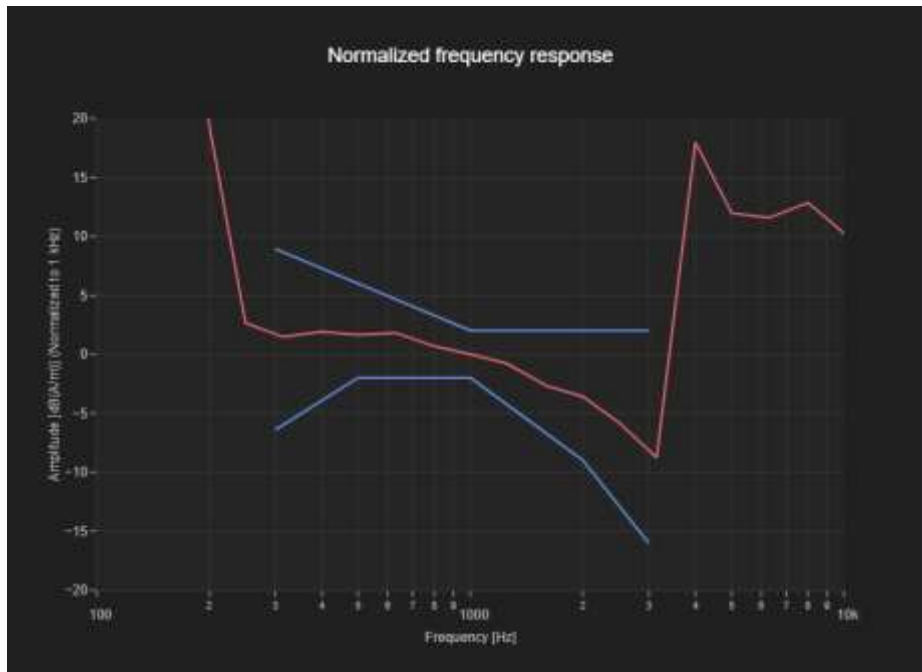
Band Name	Communication Systems Name	Channel	Frequency [MHz]
Band 41, E-UTRA/TDD	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	40620	2593.0

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

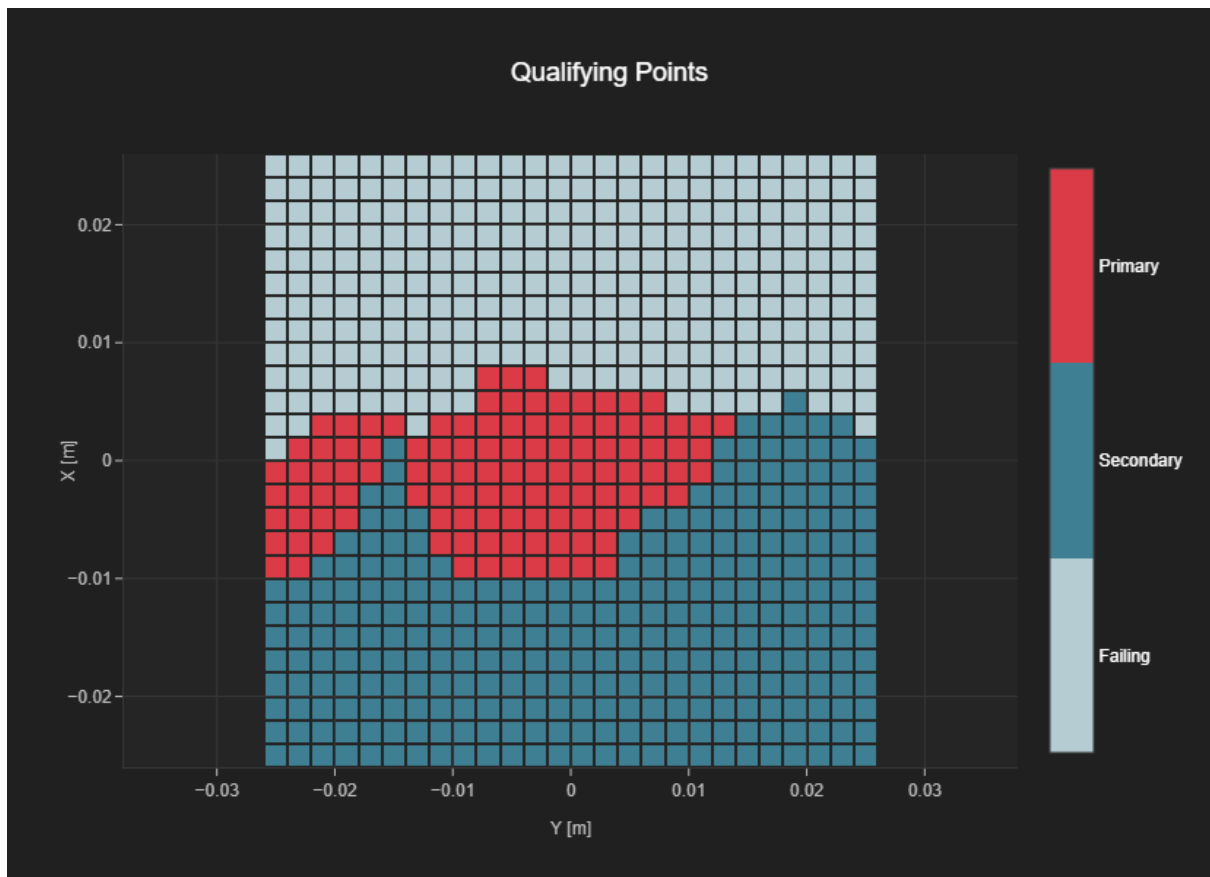
Audio File	Measurement Duration [s]	Margin Upper Bound [dB]	Margin Lower Bound [dB]
48k_voice_300-3000_2s.wav	2.0	2.0	2.0



T-Coil Coupling Mode Test Report

Results

Primary Group Contiguous Point Count	Secondary Group Point Count	Secondary Group Max Longitudinal	Secondary Group Max Transverse
112	397	17	26



Plot 12 LTE Band 41 CH.39750 Voice EVS-WB Codec: 24.4 kbit/s PC2 ANT B

Hardware Setup

Probe Name	Probe Calibration Date	DAE Name	DAE Calibration Date
AM1DV3 - 3049	May 23, 2023	DAE4 Sn1750	September 19, 2023

Communication Systems

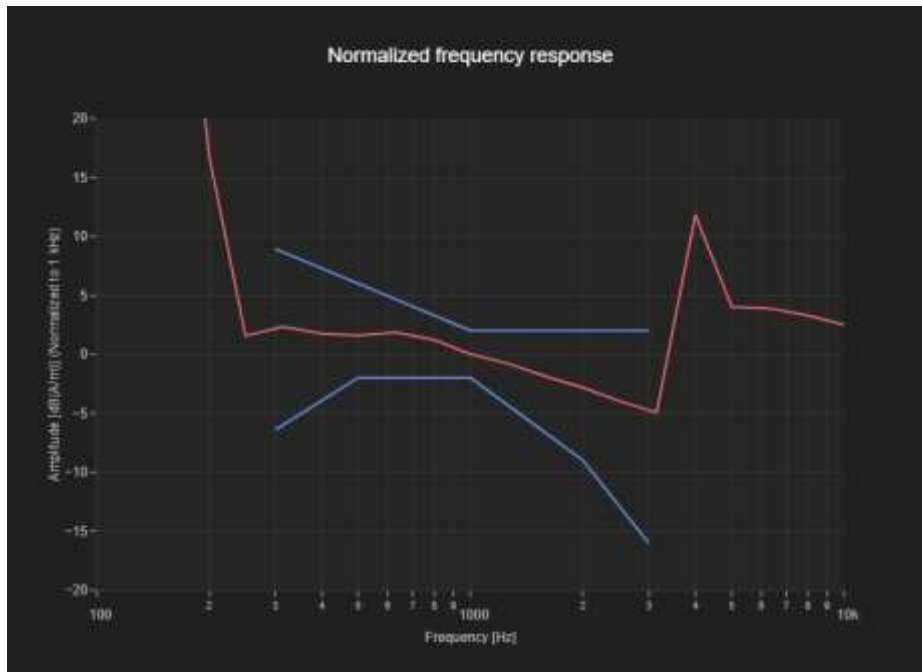
Band Name	Communication Systems Name	Channel	Frequency [MHz]
Band 41, E-UTRA/TDD	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	39750	2506.0

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

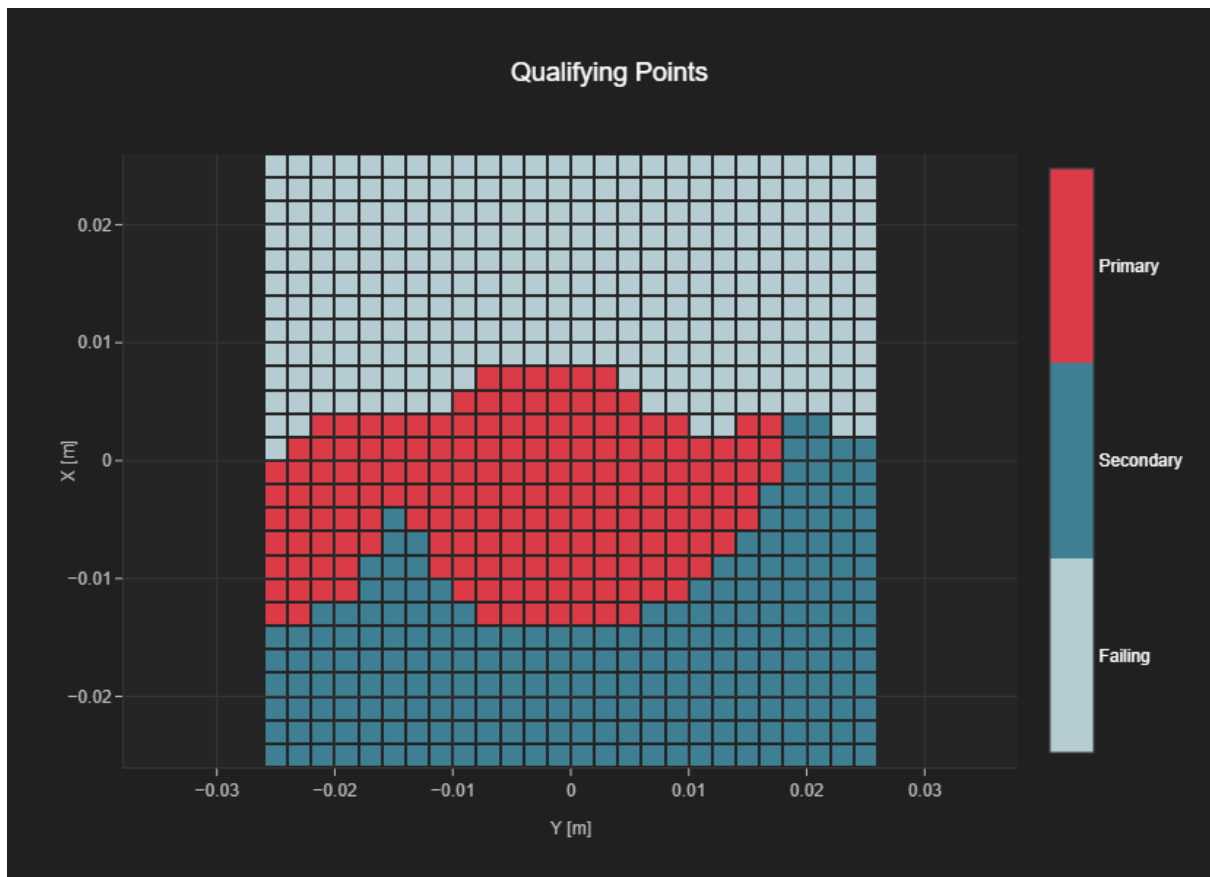
Audio File	Measurement Duration [s]	Margin Upper Bound [dB]	Margin Lower Bound [dB]
48k_voice_300-3000_2s.wav	2.0	2.0	2.0



T-Coil Coupling Mode Test Report

Results

Primary Group Contiguous Point Count	Secondary Group Point Count	Secondary Group Max Longitudinal	Secondary Group Max Transverse
173	397	17	26



Plot 13 LTE Band 41 CH.40185 Voice EVS-WB Codec: 24.4 kbit/s PC2 ANT B

Hardware Setup

Probe Name	Probe Calibration Date	DAE Name	DAE Calibration Date
AM1DV3 - 3049	May 23, 2023	DAE4 Sn1750	September 19, 2023

Communication Systems

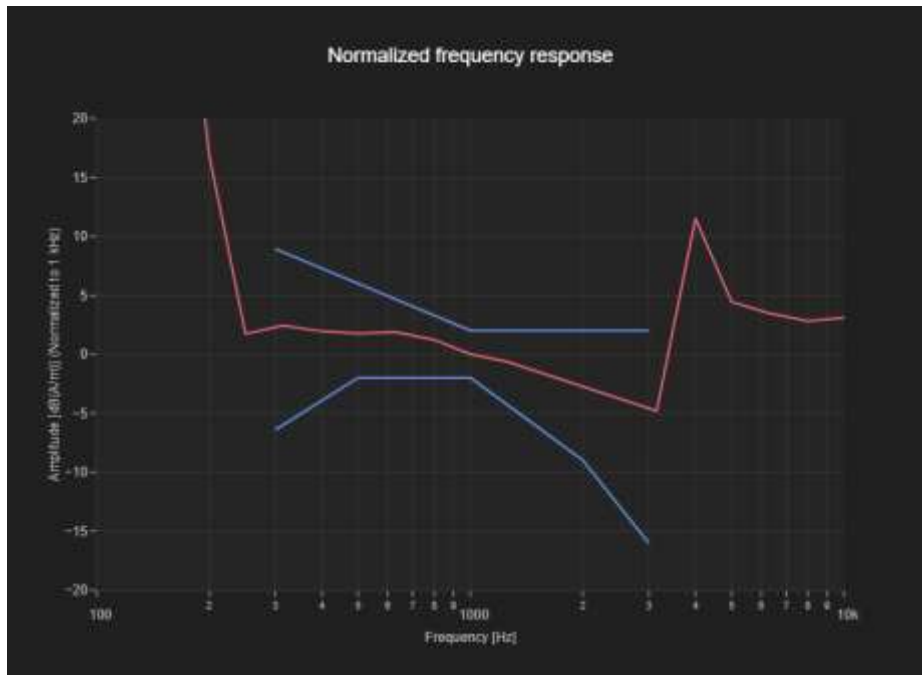
Band Name	Communication Systems Name	Channel	Frequency [MHz]
Band 41, E-UTRA/TDD	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	40185	2549.5

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

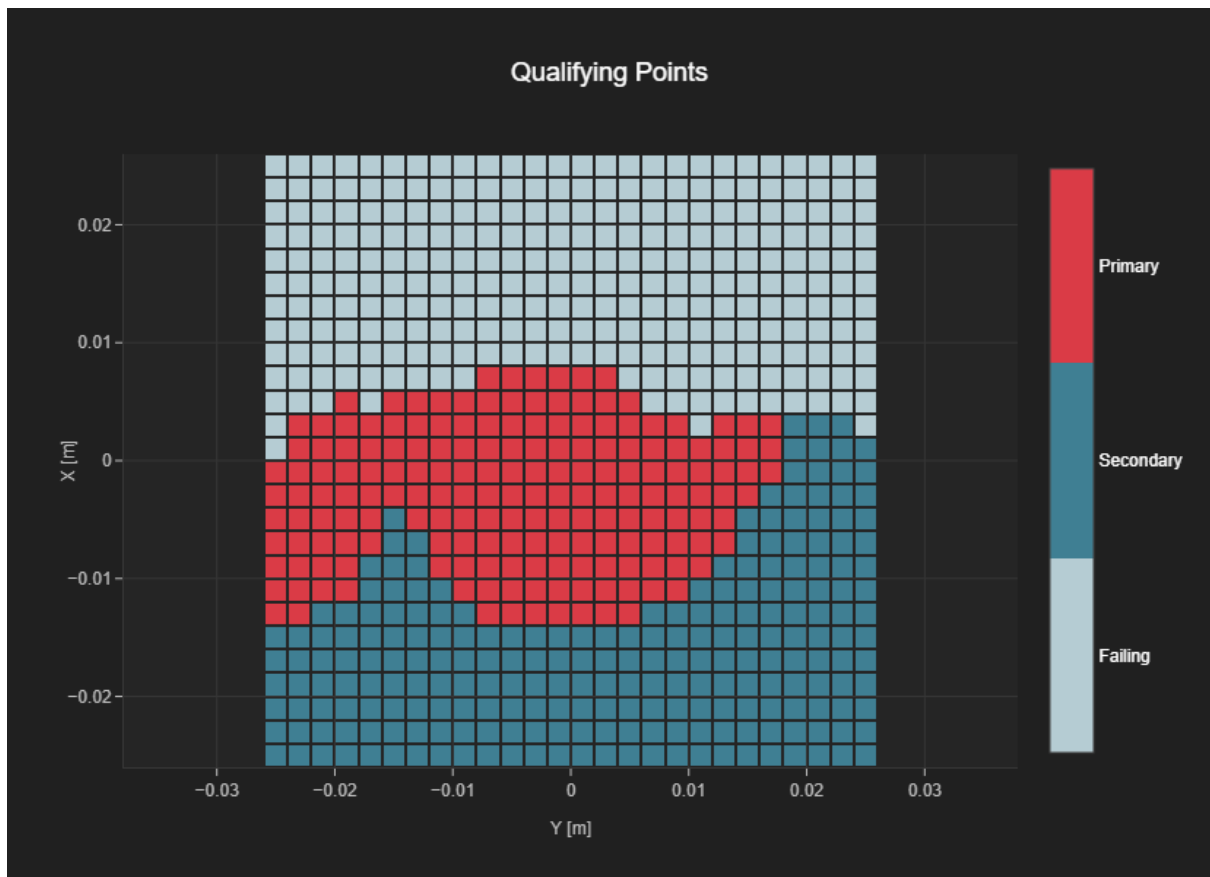
Audio File	Measurement Duration [s]	Margin Upper Bound [dB]	Margin Lower Bound [dB]
48k_voice_300-3000_2s.wav	2.0	2.0	2.0



T-Coil Coupling Mode Test Report

Results

Primary Group Contiguous Point Count	Secondary Group Point Count	Secondary Group Max Longitudinal	Secondary Group Max Transverse
178	404	17	26



Plot 14 LTE Band 41 CH.41055 Voice EVS-WB Codec: 24.4 kbit/s PC2 ANT B

Hardware Setup

Probe Name	Probe Calibration Date	DAE Name	DAE Calibration Date
AM1DV3 - 3049	May 23, 2023	DAE4 Sn1750	September 19, 2023

Communication Systems

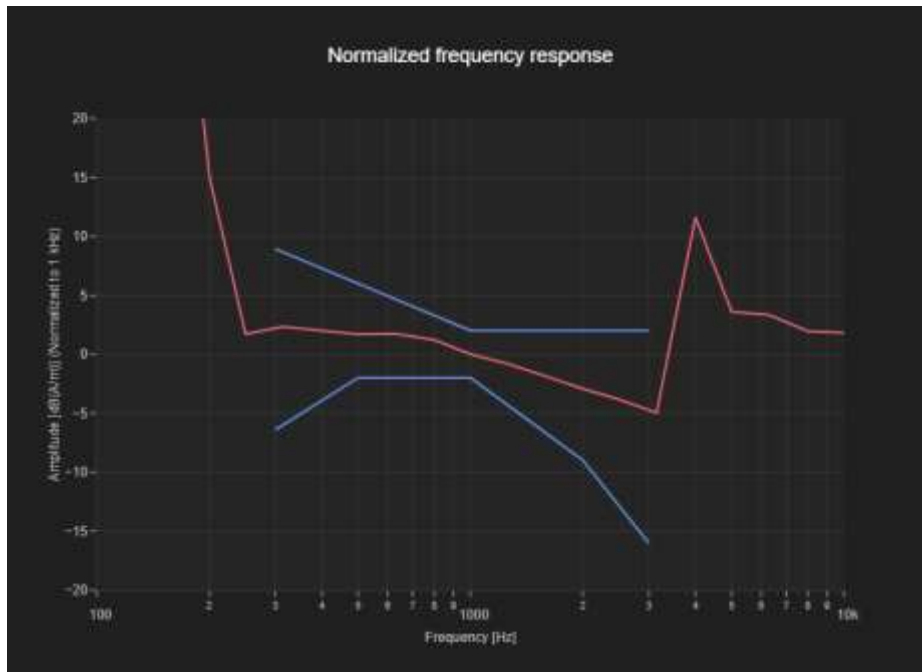
Band Name	Communication Systems Name	Channel	Frequency [MHz]
Band 41, E-UTRA/TDD	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	41055	2636.5

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

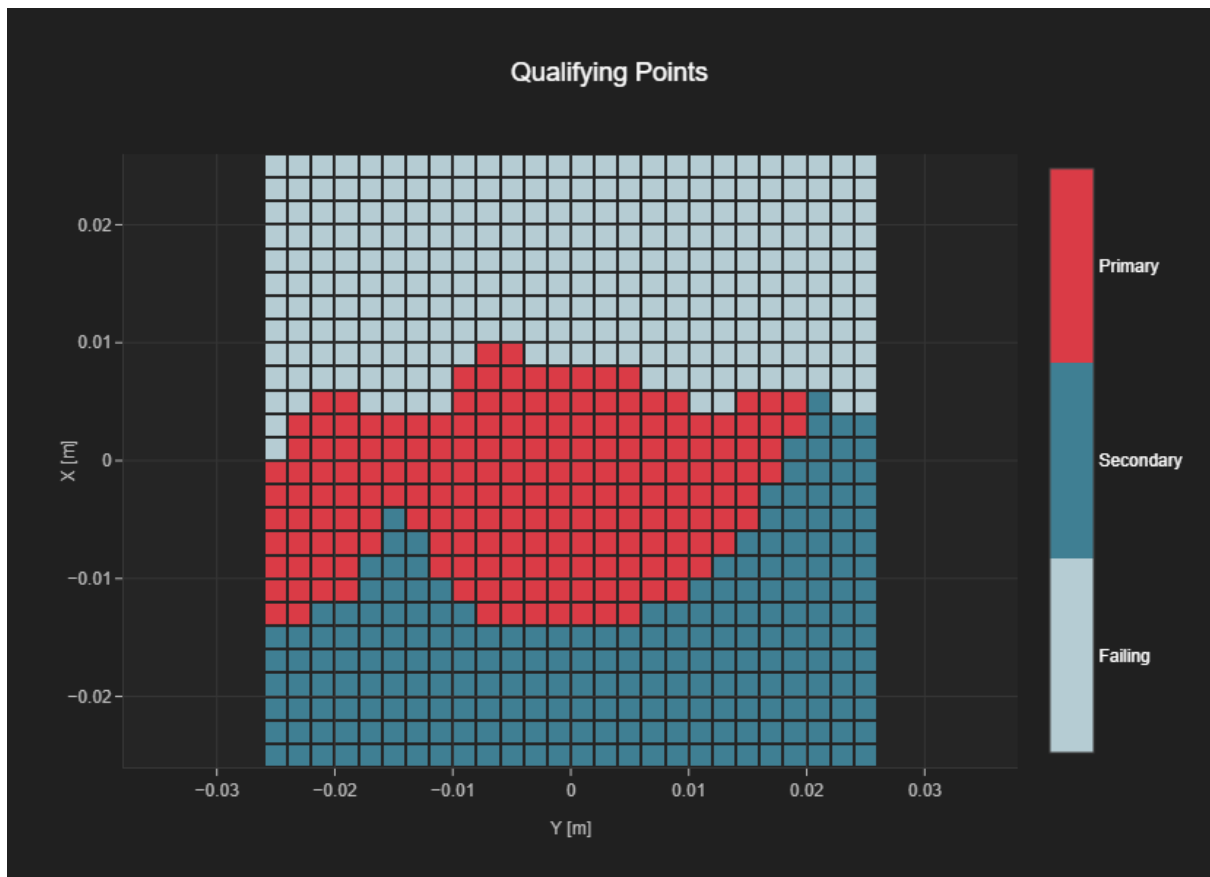
Audio File	Measurement Duration [s]	Margin Upper Bound [dB]	Margin Lower Bound [dB]
48k_voice_300-3000_2s.wav	2.0	2.0	2.0



T-Coil Coupling Mode Test Report

Results

Primary Group Contiguous Point Count	Secondary Group Point Count	Secondary Group Max Longitudinal	Secondary Group Max Transverse
188	414	18	26



Plot 15 LTE Band 41 CH.41490 Voice EVS-WB Codec: 24.4 kbit/s PC2 ANT B

Hardware Setup

Probe Name	Probe Calibration Date	DAE Name	DAE Calibration Date
AM1DV3 - 3049	May 23, 2023	DAE4 Sn1750	September 19, 2023

Communication Systems

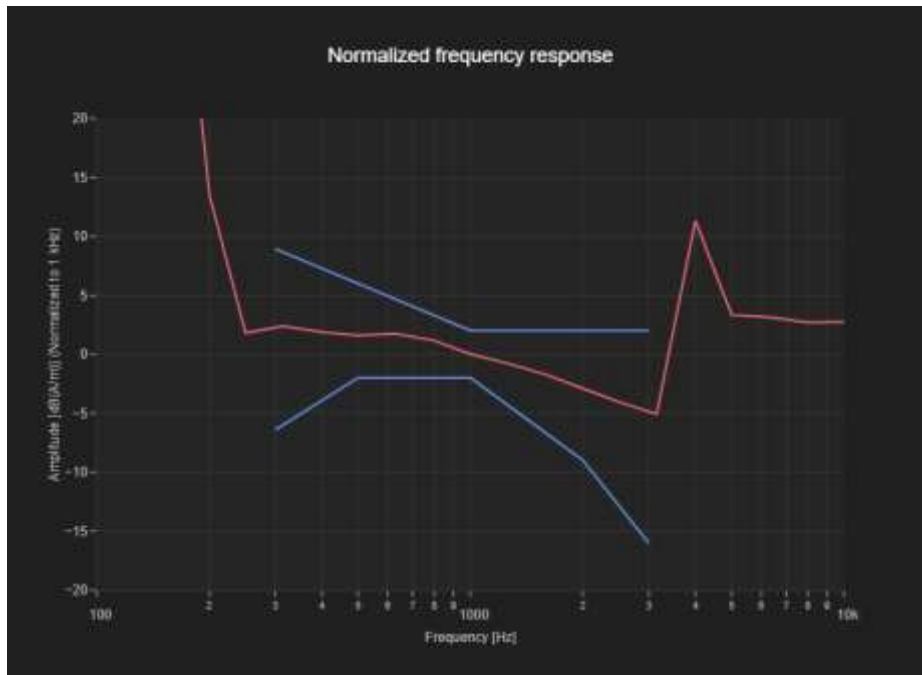
Band Name	Communication Systems Name	Channel	Frequency [MHz]
Band 41, E-UTRA/TDD	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	41490	2680.0

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

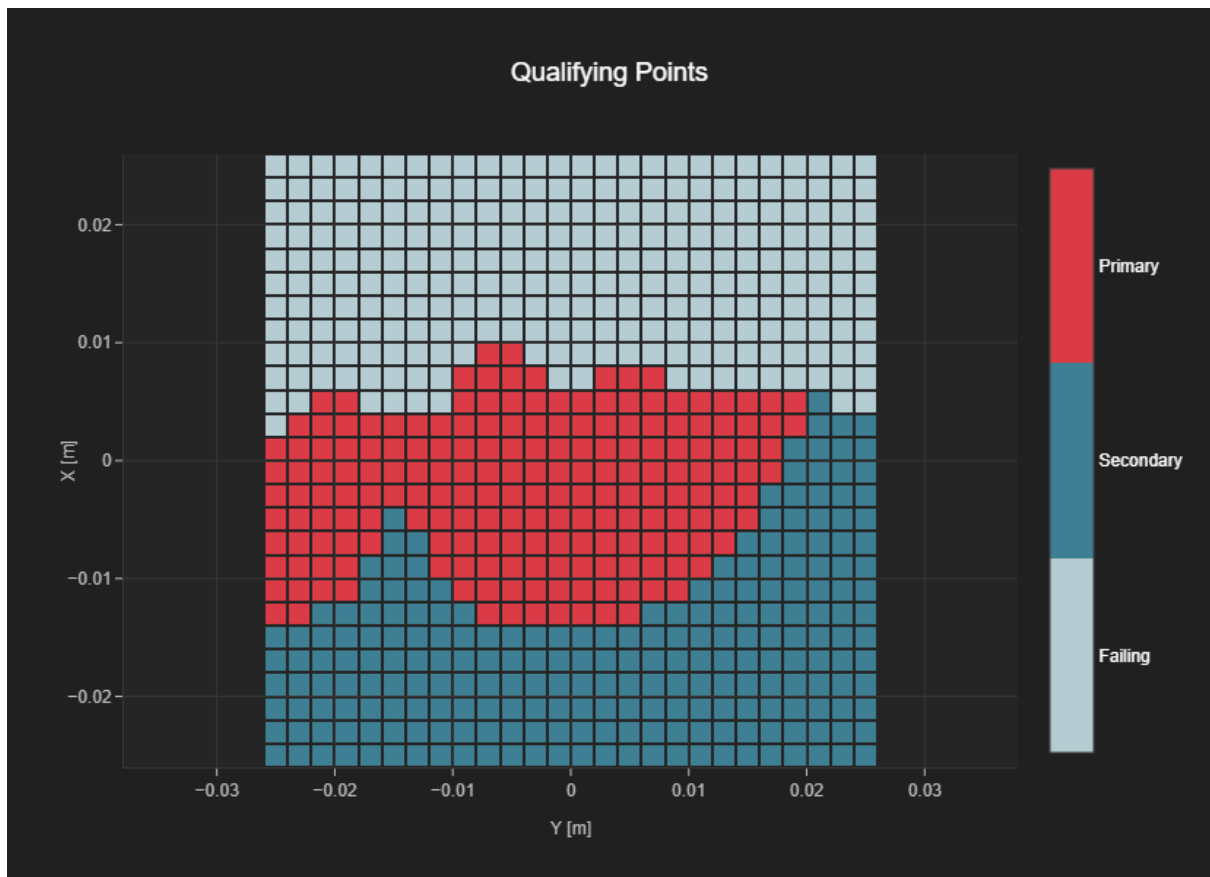
Audio File	Measurement Duration [s]	Margin Upper Bound [dB]	Margin Lower Bound [dB]
48k_voice_300-3000_2s.wav	2.0	2.0	2.0



T-Coil Coupling Mode Test Report

Results

Primary Group Contiguous Point Count	Secondary Group Point Count	Secondary Group Max Longitudinal	Secondary Group Max Transverse
190	416	18	26



Plot 16 NR Band 41 CH.518598 EVS-WB Codec: 5.9 kbit/s ANT I

Hardware Setup

Probe Name	Probe Calibration Date	DAE Name	DAE Calibration Date
AM1DV3 - 3050	November 23, 2023	DAE4 Sn1254	June 02, 2023

Communication Systems

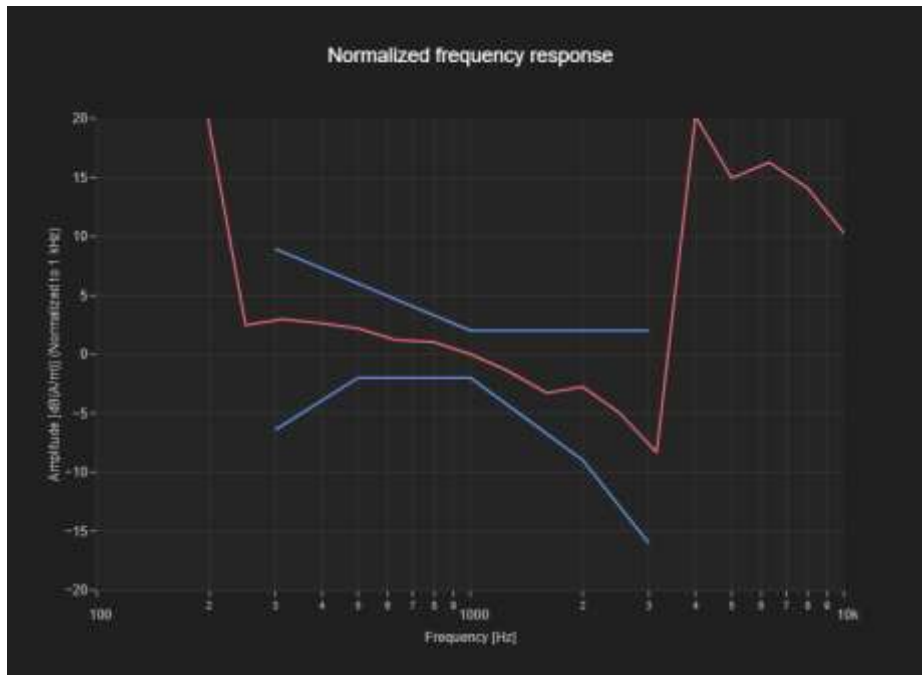
Band Name	Communication Systems Name	Channel	Frequency [MHz]
Band n41	5G NR (CP-OFDM, 1 RB, 100 MHz, QPSK, 30 kHz)	518598	2592.99

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

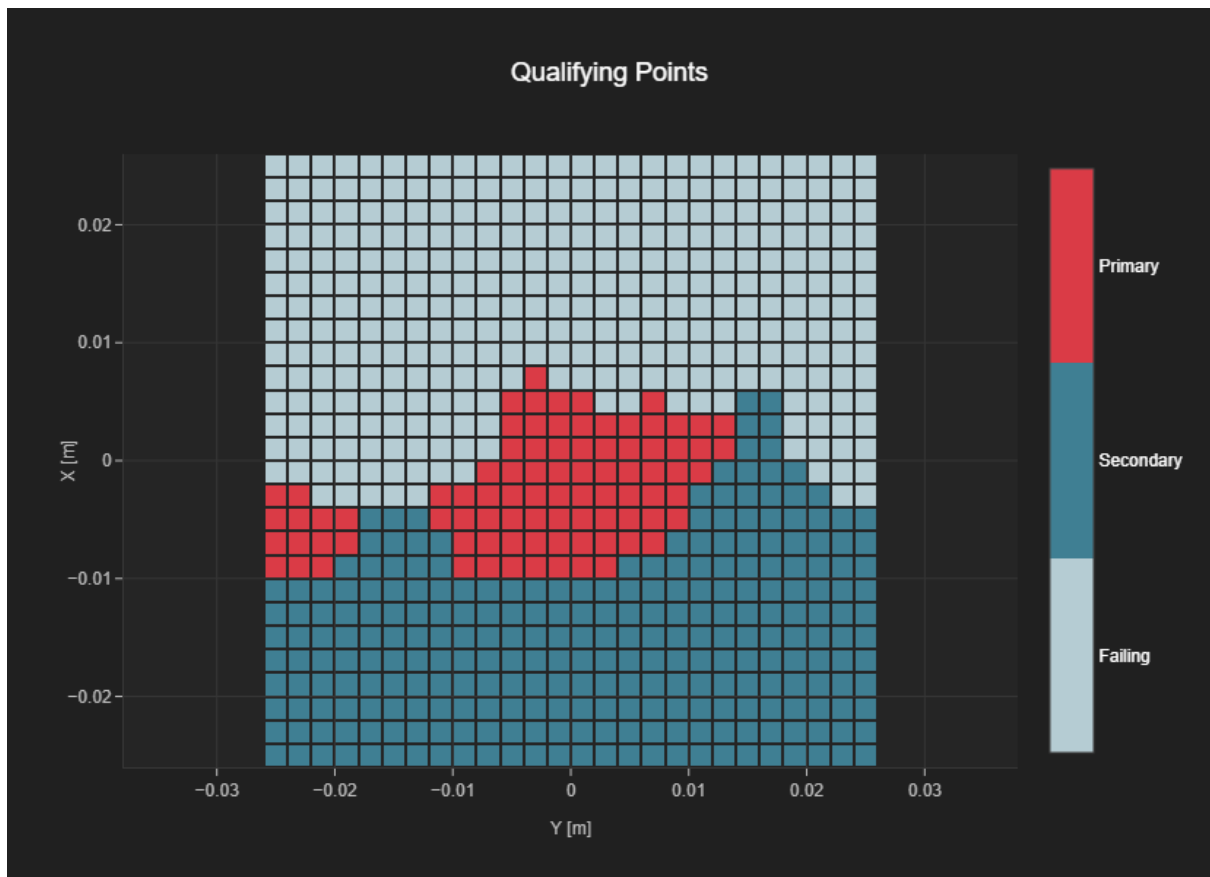
Audio File	Measurement Duration [s]	Margin Upper Bound [dB]	Margin Lower Bound [dB]
48k_voice_300-3000_2s.wav	2.0	2.0	2.0



T-Coil Coupling Mode Test Report

Results

Primary Group Contiguous Point Count	Secondary Group Point Count	Secondary Group Max Longitudinal	Secondary Group Max Transverse
87	351	17	26



Plot 17 802.11b CH.6 Voice EVS-SWB Codec: 9.6 kbit/s ANT 1

Hardware Setup

Probe Name	Probe Calibration Date	DAE Name	DAE Calibration Date
AM1DV3 - 3049	May 23, 2023	DAE4 Sn1750	September 19, 2023

Communication Systems

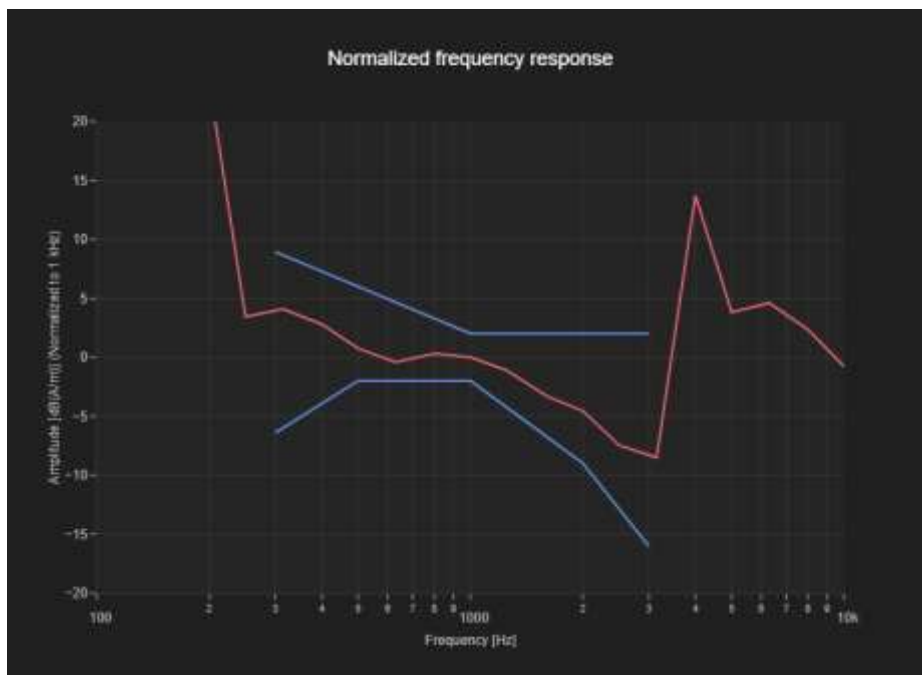
Band Name	Communication Systems Name	Channel	Frequency [MHz]
WLAN 2.4GHz	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 99pc duty cycle)	6	2437.0

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

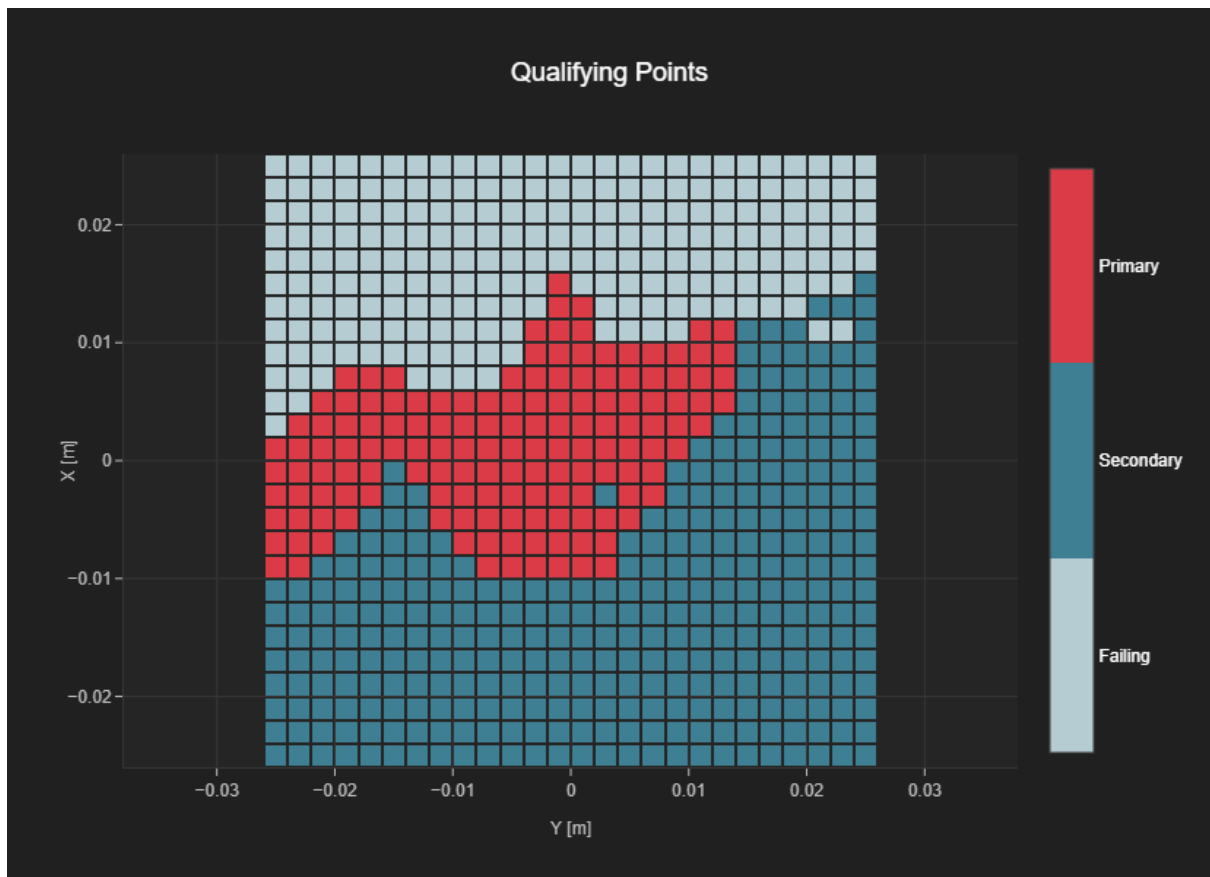
Audio File	Measurement Duration [s]	Margin Upper Bound [dB]	Margin Lower Bound [dB]
48k_voice_300-3000_2s.wav	2.0	2.0	1.58



T-Coil Coupling Mode Test Report

Results

Primary Group Contiguous Point Count	Secondary Group Point Count	Secondary Group Max Longitudinal	Secondary Group Max Transverse
145	463	21	26



Plot 18 802.11b CH.1 Voice EVS-SWB Codec: 9.6 kbit/s ANT 1

Hardware Setup

Probe Name	Probe Calibration Date	DAE Name	DAE Calibration Date
AM1DV3 - 3049	May 23, 2023	DAE4 Sn1750	September 19, 2023

Communication Systems

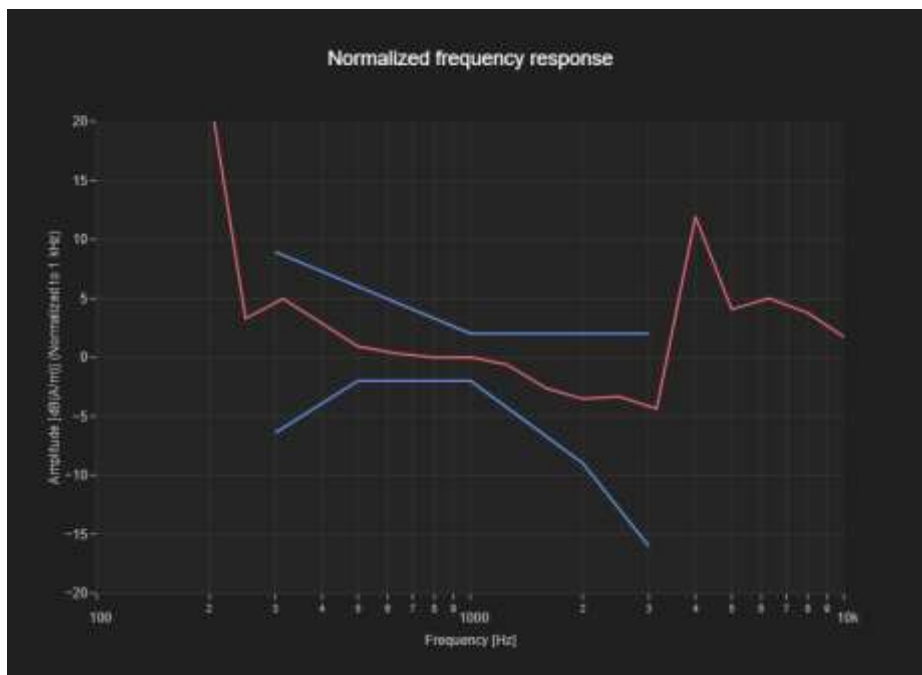
Band Name	Communication Systems Name	Channel	Frequency [MHz]
WLAN 2.4GHz	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 99pc duty cycle)	1	2412.0

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

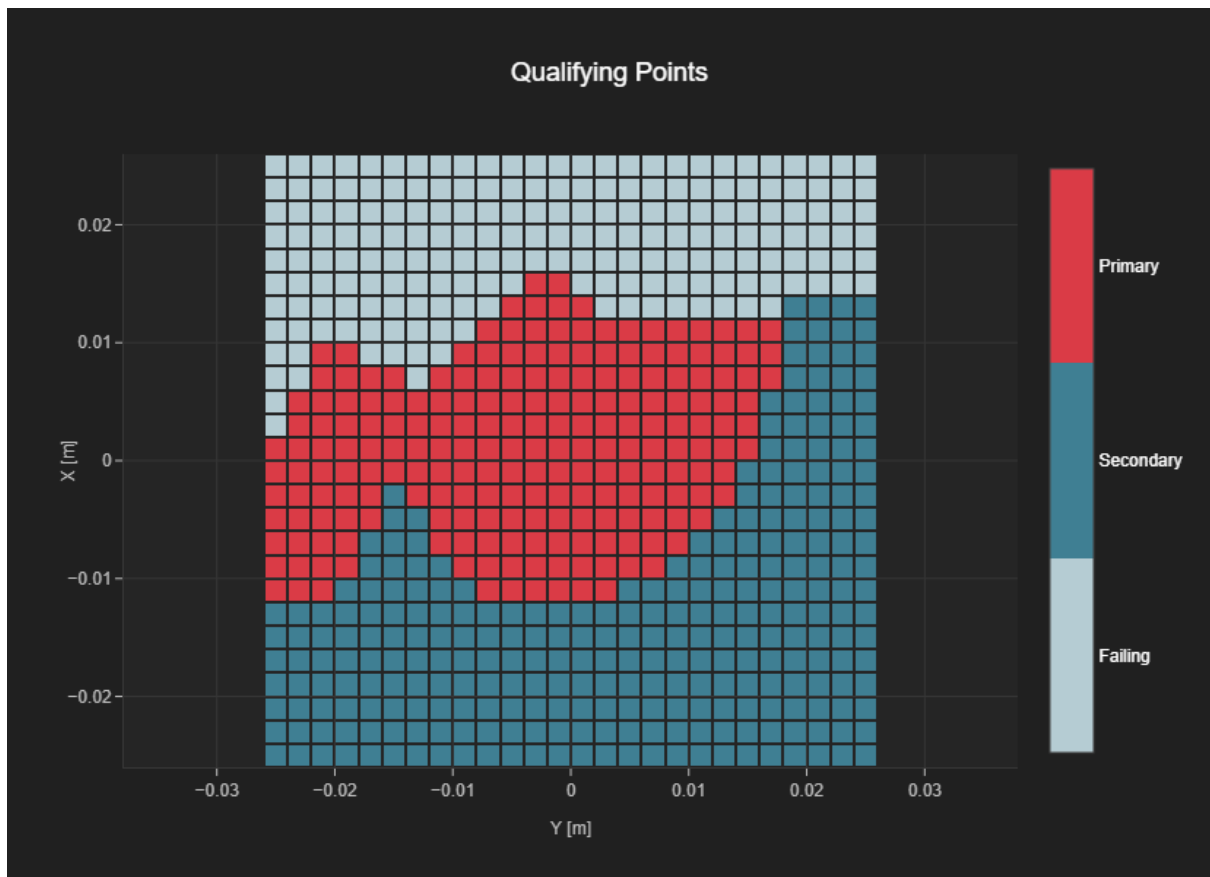
Audio File	Measurement Duration [s]	Margin Upper Bound [dB]	Margin Lower Bound [dB]
48k_voice_300-3000_2s.wav	2.0	2.0	1.97



T-Coil Coupling Mode Test Report

Results

Primary Group Contiguous Point Count	Secondary Group Point Count	Secondary Group Max Longitudinal	Secondary Group Max Transverse
208	484	21	26



Plot 19 802.11b CH.11 Voice EVS-SWB Codec: 9.6 kbit/s ANT 1

Hardware Setup

Probe Name	Probe Calibration Date	DAE Name	DAE Calibration Date
AM1DV3 - 3049	May 23, 2023	DAE4 Sn1750	September 19, 2023

Communication Systems

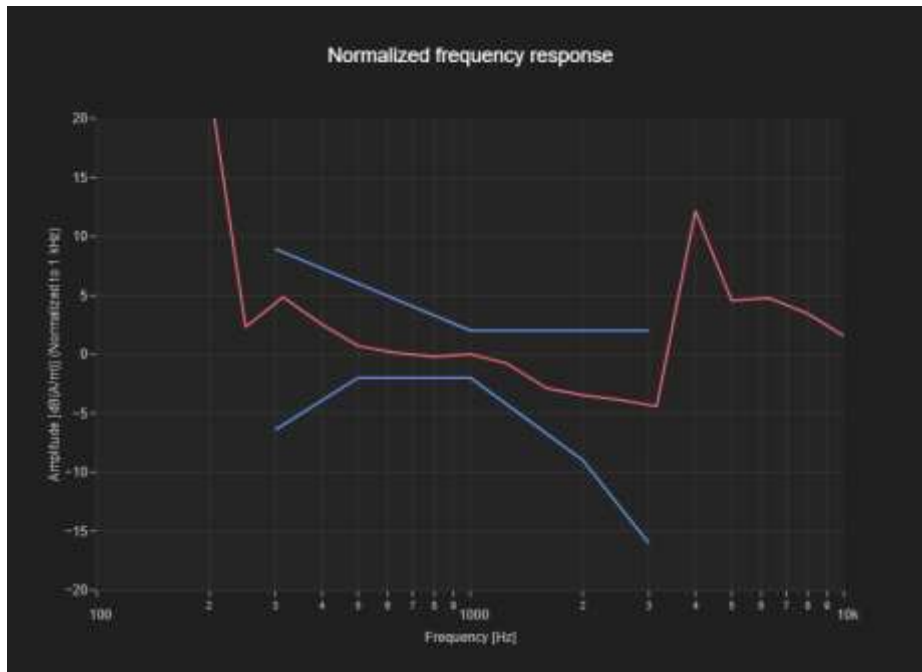
Band Name	Communication Systems Name	Channel	Frequency [MHz]
WLAN 2.4GHz	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 99pc duty cycle)	11	2462.0

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

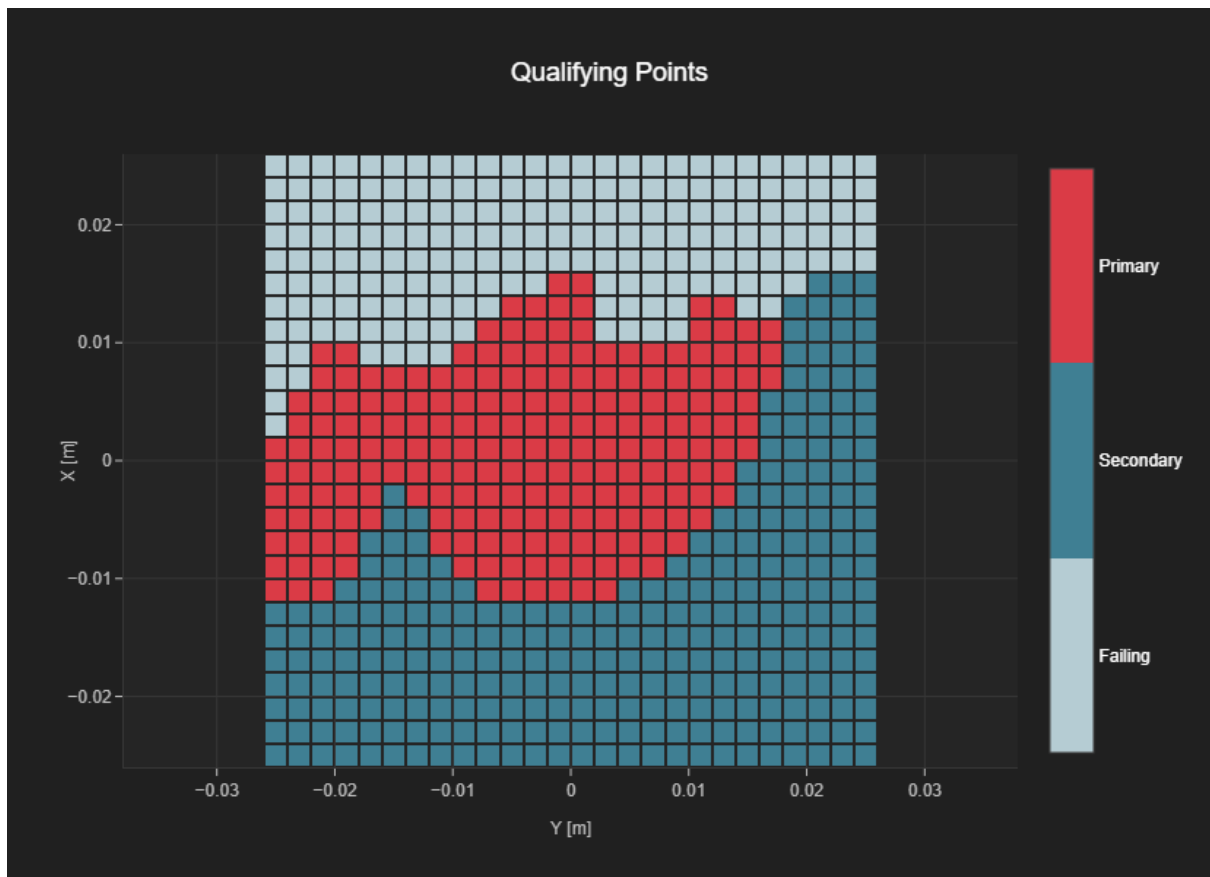
Audio File	Measurement Duration [s]	Margin Upper Bound [dB]	Margin Lower Bound [dB]
48k_voice_300-3000_2s.wav	2.0	2.0	1.78



T-Coil Coupling Mode Test Report

Results

Primary Group Contiguous Point Count	Secondary Group Point Count	Secondary Group Max Longitudinal	Secondary Group Max Transverse
207	486	21	26



Plot 20 802.11a CH.40 Voice EVS-WB Codec: 5.9 kbit/s ANT 1

Hardware Setup

Probe Name	Probe Calibration Date	DAE Name	DAE Calibration Date
AM1DV3 - 3049	May 23, 2023	DAE4 Sn1750	September 19, 2023

Communication Systems

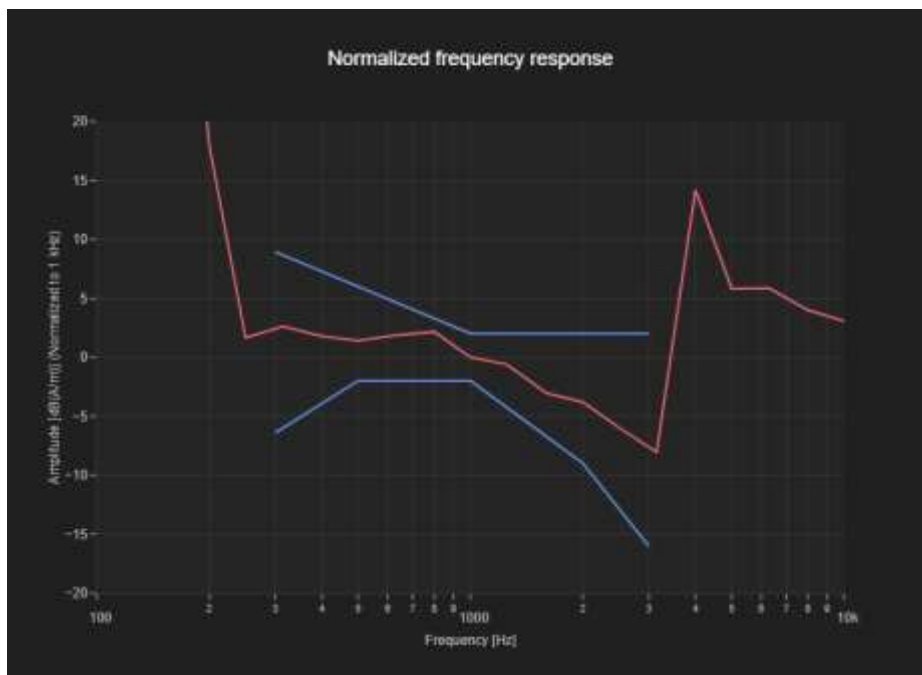
Band Name	Communication Systems Name	Channel	Frequency [MHz]
WLAN 5GHz	IEEE 802.11a/h WiFi 5 GHz (OFDM, 6 Mbps, 99pc duty cycle)	40	5200.0

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

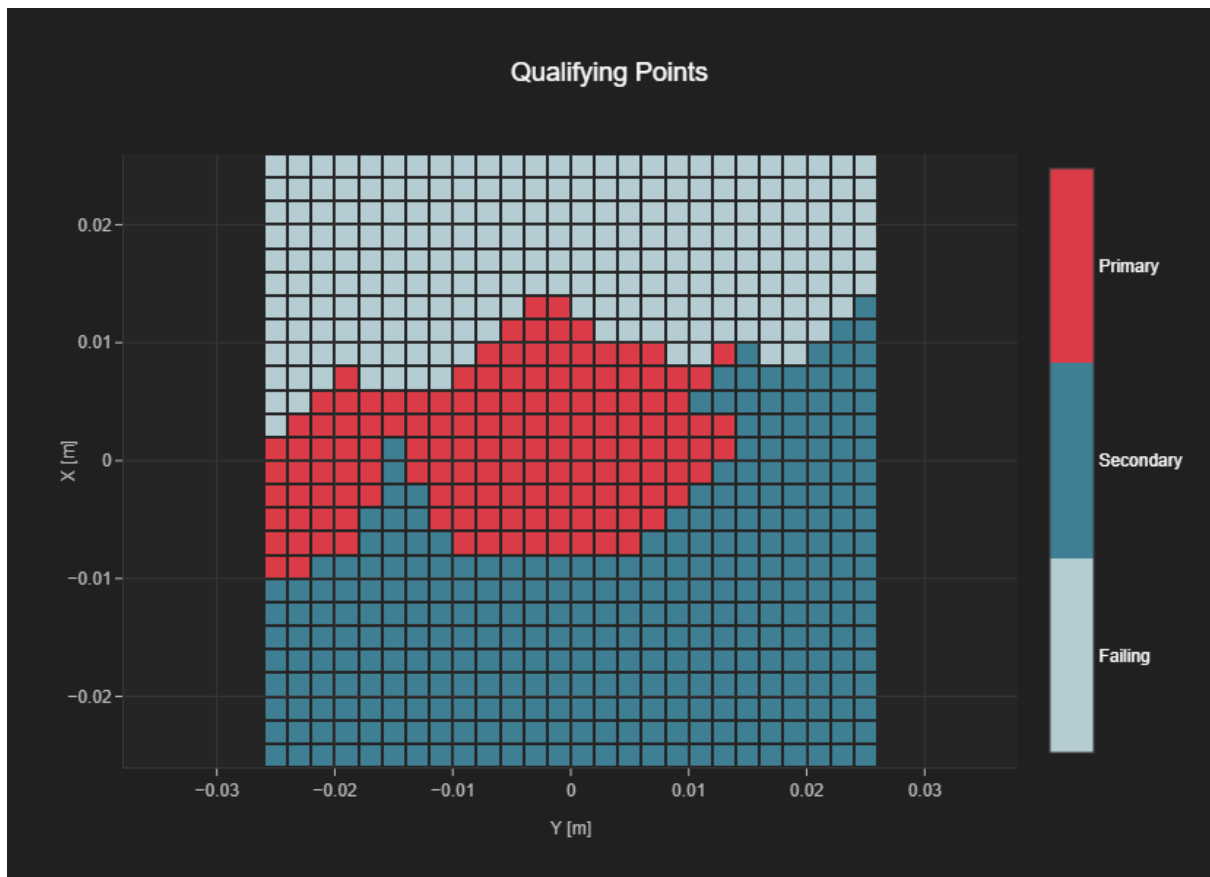
Audio File	Measurement Duration [s]	Margin Upper Bound [dB]	Margin Lower Bound [dB]
48k_voice_300-3000_2s.wav	2.0	1.13	2.0



T-Coil Coupling Mode Test Report

Results

Primary Group Contiguous Point Count	Secondary Group Point Count	Secondary Group Max Longitudinal	Secondary Group Max Transverse
143	454	20	26



Plot 21 802.11a CH.36 Voice EVS-WB Codec: 5.9 kbit/s ANT 1

Hardware Setup

Probe Name	Probe Calibration Date	DAE Name	DAE Calibration Date
AM1DV3 - 3049	May 23, 2023	DAE4 Sn1750	September 19, 2023

Communication Systems

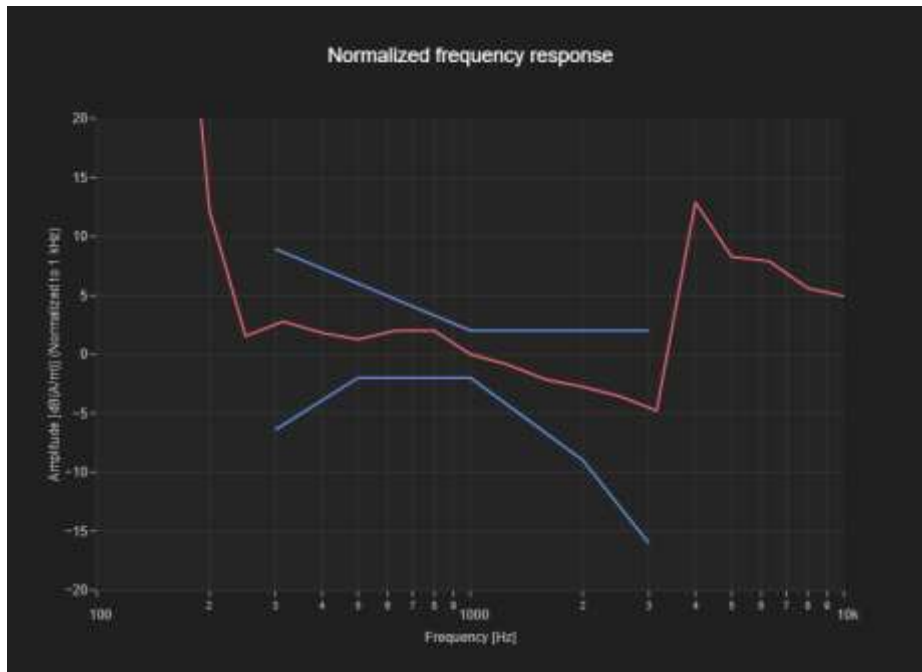
Band Name	Communication Systems Name	Channel	Frequency [MHz]
U-NII-1, U-NII-2A	IEEE 802.11a/h WiFi 5 GHz (OFDM, 6 Mbps, 99pc duty cycle)	36	5180.0

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

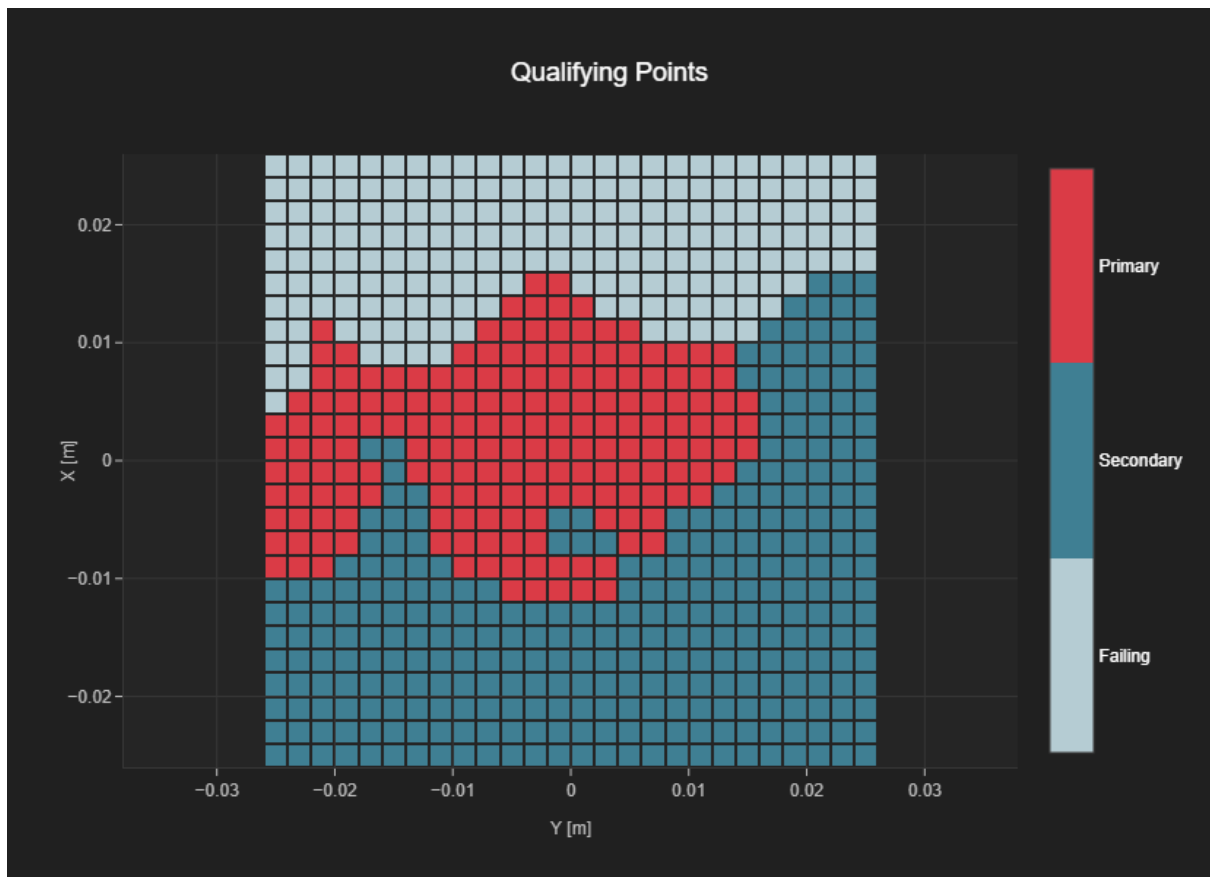
Audio File	Measurement Duration [s]	Margin Upper Bound [dB]	Margin Lower Bound [dB]
48k_voice_300-3000_2s.wav	2.0	1.37	2.0



T-Coil Coupling Mode Test Report

Results

Primary Group Contiguous Point Count	Secondary Group Point Count	Secondary Group Max Longitudinal	Secondary Group Max Transverse
180	485	21	26



Plot 22 802.11a CH.48 Voice EVS-WB Codec: 5.9 kbit/s ANT 1

Hardware Setup

Probe Name	Probe Calibration Date	DAE Name	DAE Calibration Date
AM1DV3 - 3049	May 23, 2023	DAE4 Sn1750	September 19, 2023

Communication Systems

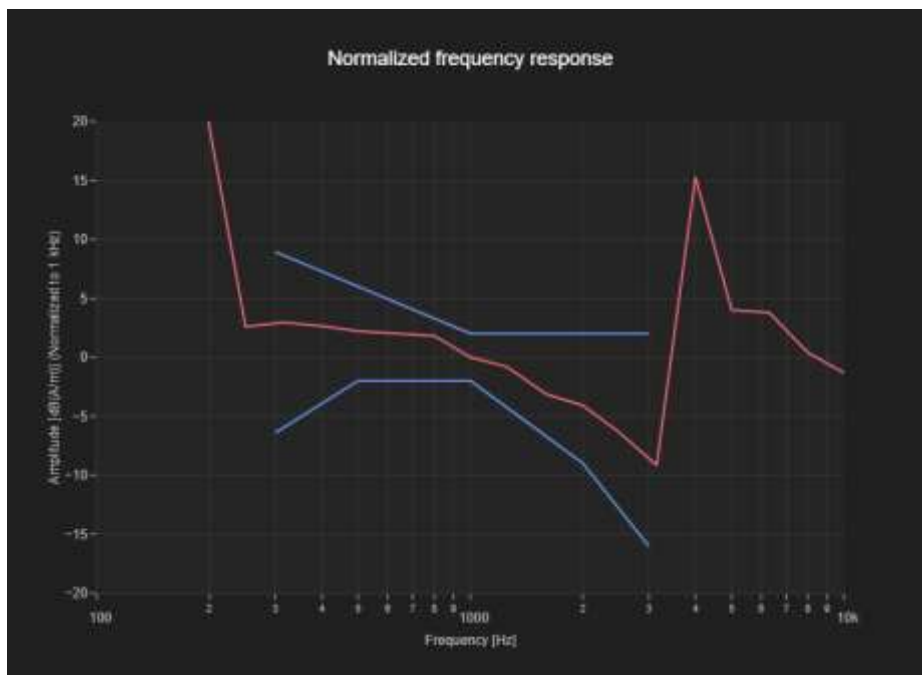
Band Name	Communication Systems Name	Channel	Frequency [MHz]
U-NII-1, U-NII-2A	IEEE 802.11a/h WiFi 5 GHz (OFDM, 6 Mbps, 99pc duty cycle)	48	5240.0

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

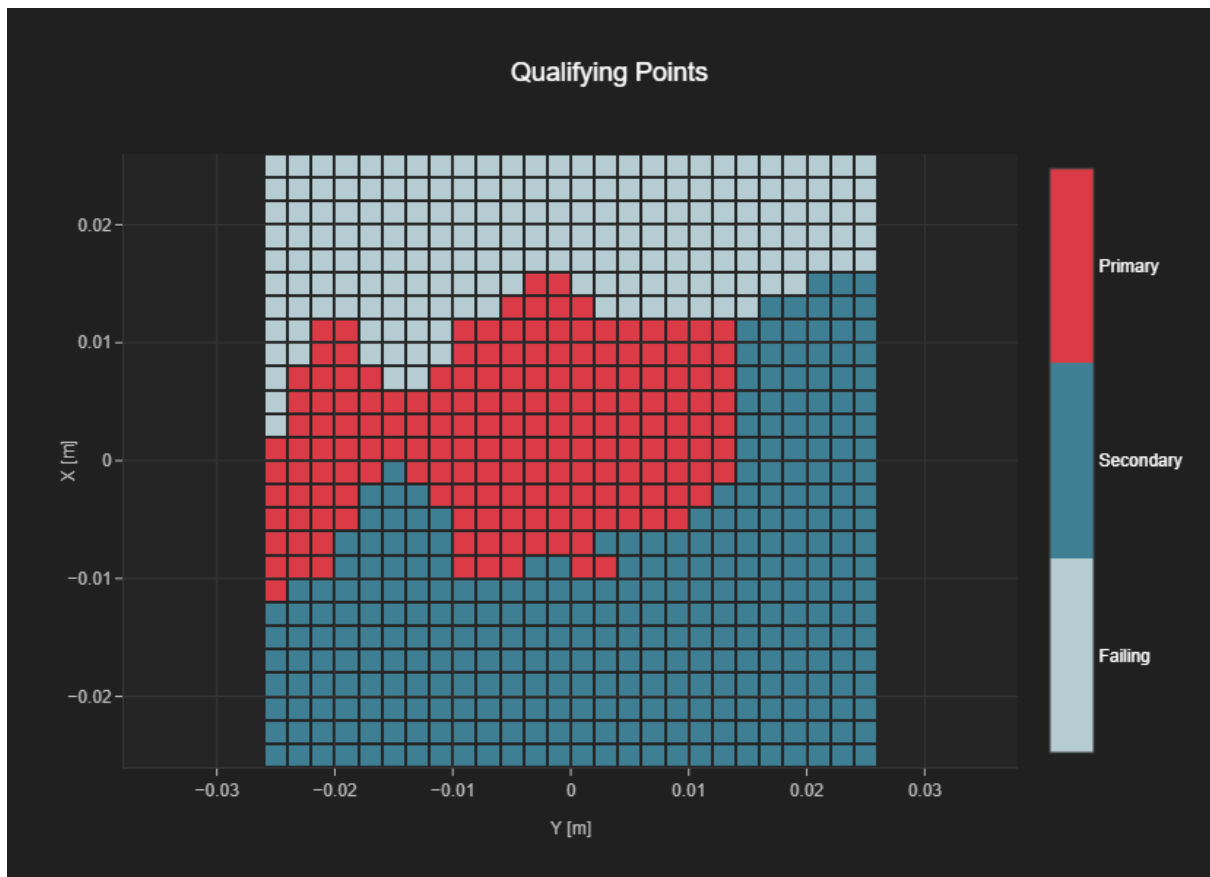
Audio File	Measurement Duration [s]	Margin Upper Bound [dB]	Margin Lower Bound [dB]
48k_voice_300-3000_2s.wav	2.0	1.47	2.0



T-Coil Coupling Mode Test Report

Results

Primary Group Contiguous Point Count	Secondary Group Point Count	Secondary Group Max Longitudinal	Secondary Group Max Transverse
176	491	21	26



Plot 23 GMS850 CH.128 EDGE 2 slots Meet Codec: 40 kbit/s ANT A

Hardware Setup

Probe Name	Probe Calibration Date	DAE Name	DAE Calibration Date
AM1DV3 - 3050	November 23, 2023	DAE4 Sn1254	June 02, 2023

Communication Systems

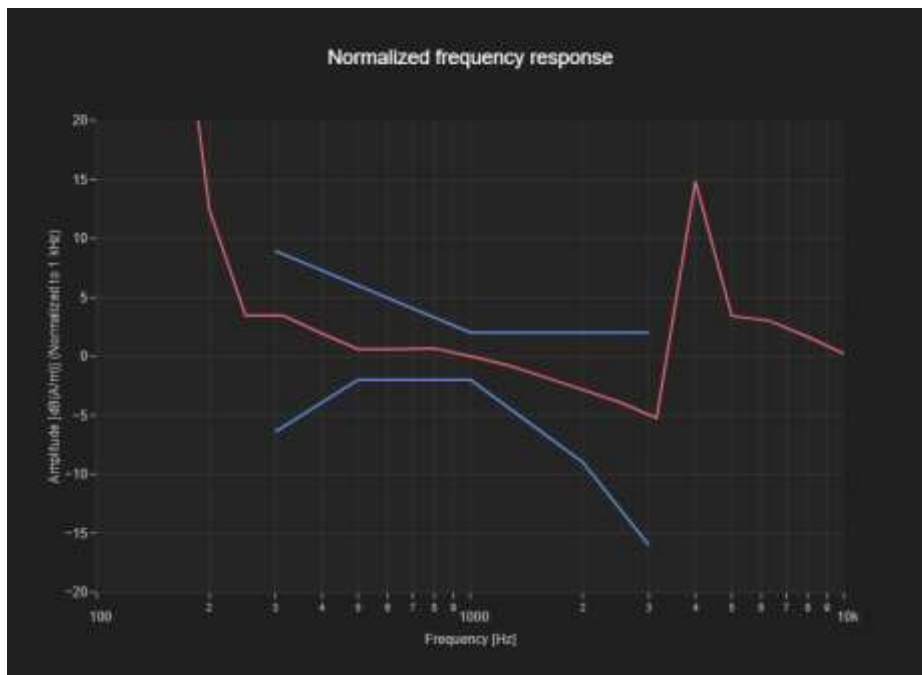
Band Name	Communication Systems Name	Channel	Frequency [MHz]
GSM 850	EDGE-FDD (TDMA, 8PSK, TN 0-1)	128	824.2

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

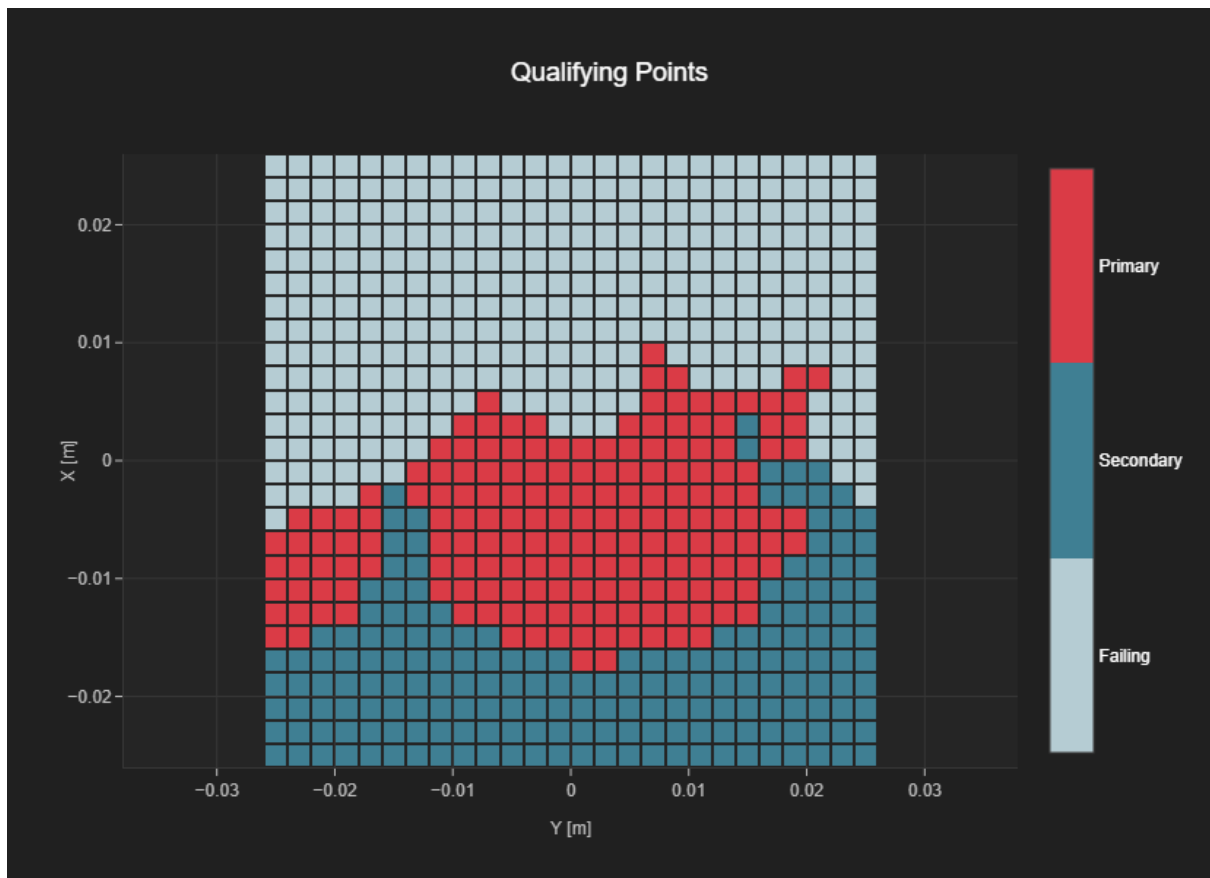
Audio File	Measurement Duration [s]	Margin Upper Bound [dB]	Margin Lower Bound [dB]
48k_voice_300-3000_2s.wav	40.0	2.0	2.0



T-Coil Coupling Mode Test Report

Results

Primary Group Contiguous Point Count	Secondary Group Point Count	Secondary Group Max Longitudinal	Secondary Group Max Transverse
179	365	18	26



Plot 24 UMTS Band v CH.4183 HSUPA subtest1 Meet Codec: 6 kbit/s ANT A

Hardware Setup

Probe Name	Probe Calibration Date	DAE Name	DAE Calibration Date
AM1DV3 - 3050	November 23, 2023	DAE4 Sn1254	June 02, 2023

Communication Systems

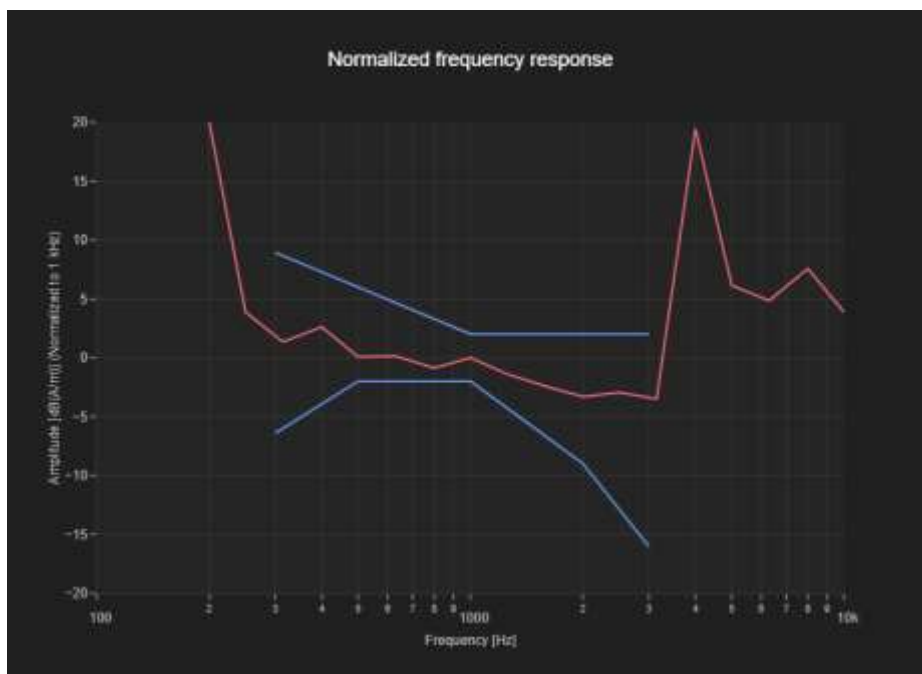
Band Name	Communication Systems Name	Channel	Frequency [MHz]
Band 5, UTRA/FDD	UMTS-FDD (HSUPA, Subtest 1)	4183	836.6

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

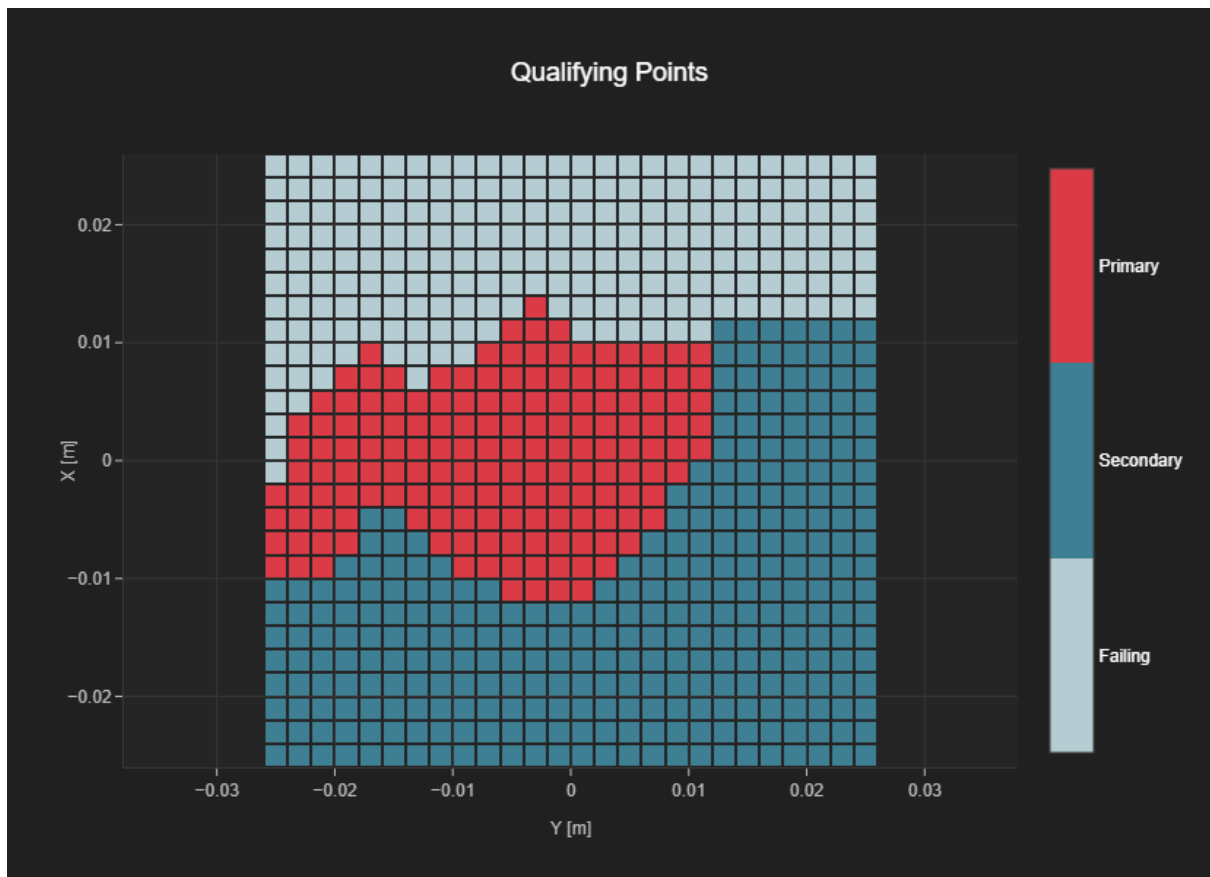
Audio File	Measurement Duration [s]	Margin Upper Bound [dB]	Margin Lower Bound [dB]
48k_voice_300-3000_2s.wav	2.0	1.82	1.12



T-Coil Coupling Mode Test Report

Results

Primary Group Contiguous Point Count	Secondary Group Point Count	Secondary Group Max Longitudinal	Secondary Group Max Transverse
159	462	20	26



Plot 25 LTE Band 7 CH.21100 Google Meet Codec: 6 kbit/s ANT I

Hardware Setup

Probe Name	Probe Calibration Date	DAE Name	DAE Calibration Date
AM1DV3 - 3050	November 23, 2023	DAE4 Sn1254	June 02, 2023

Communication Systems

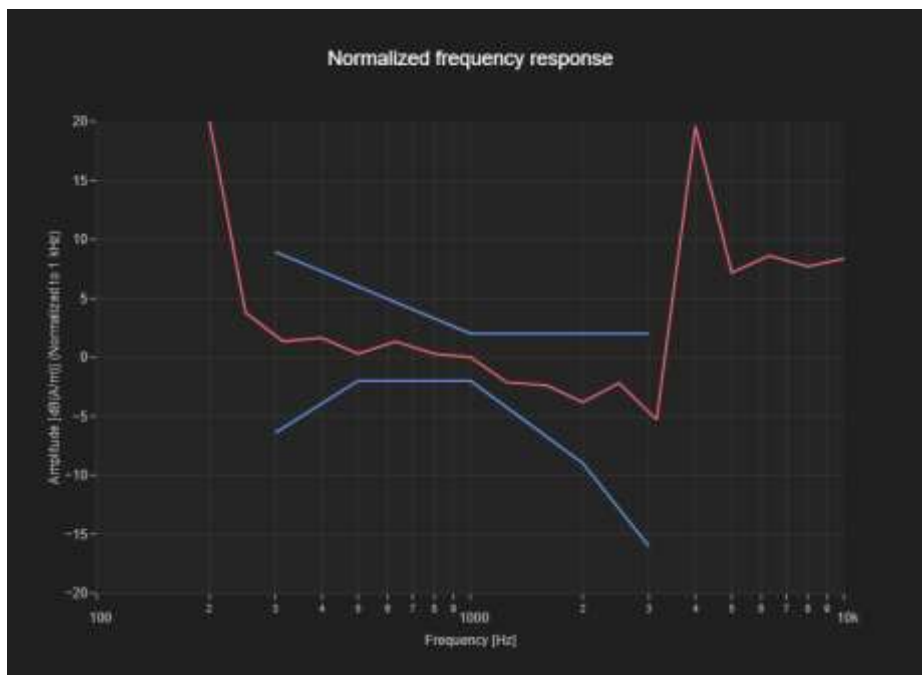
Band Name	Communication Systems Name	Channel	Frequency [MHz]
Band 7, E-UTRA/FDD	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	21100	2535.0

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

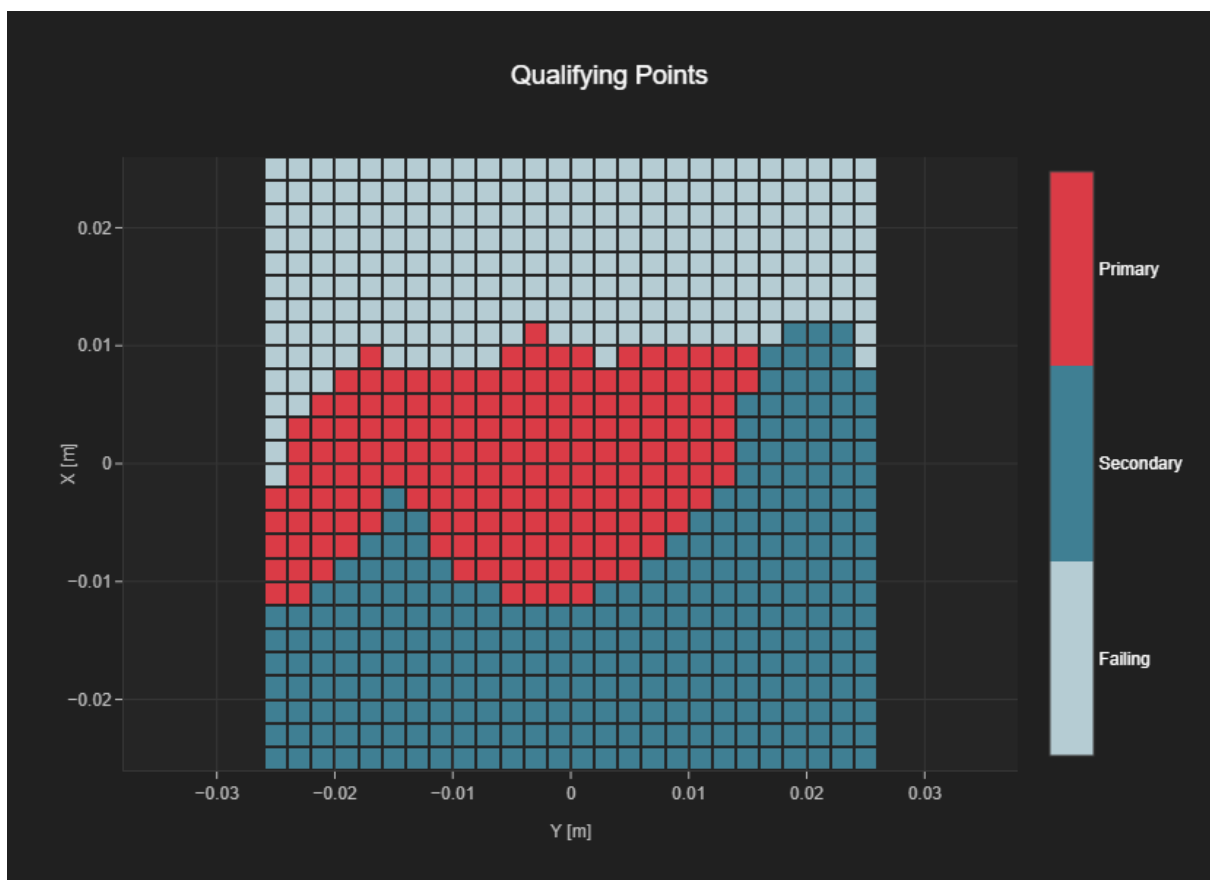
Audio File	Measurement Duration [s]	Margin Upper Bound [dB]	Margin Lower Bound [dB]
48k_voice_300-3000_2s.wav	2.0	2.0	2.0



T-Coil Coupling Mode Test Report

Results

Primary Group Contiguous Point Count	Secondary Group Point Count	Secondary Group Max Longitudinal	Secondary Group Max Transverse
170	453	19	26



Plot 26 LTE Band 41 CH.40620 Google Meet Codec: 75 kbit/s PC2 ANT I

Hardware Setup

Probe Name	Probe Calibration Date	DAE Name	DAE Calibration Date
AM1DV3 - 3050	November 23, 2023	DAE4 Sn1254	June 02, 2023

Communication Systems

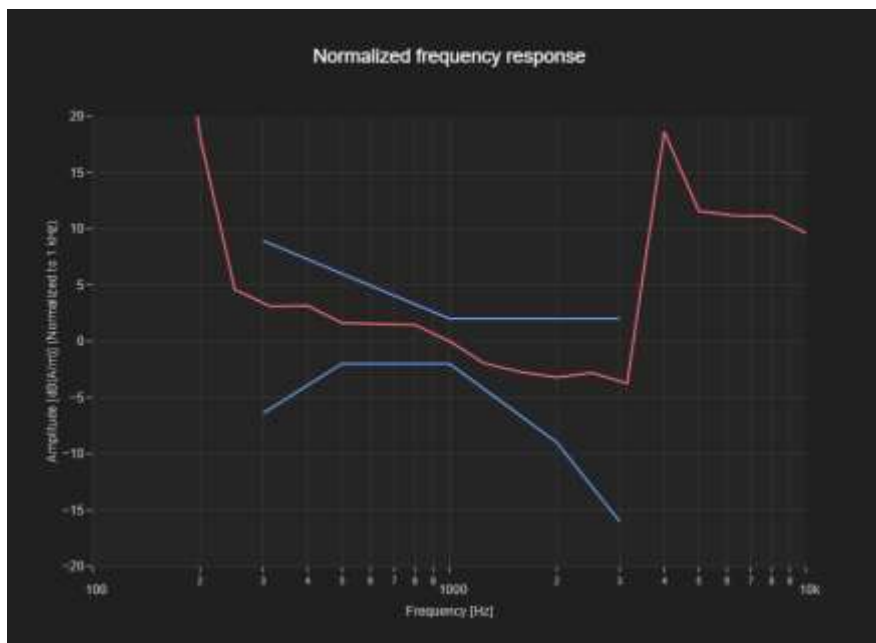
Band Name	Communication Systems Name	Channel	Frequency [MHz]
Band 41, E-UTRA/TDD	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	40620	2593.0

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

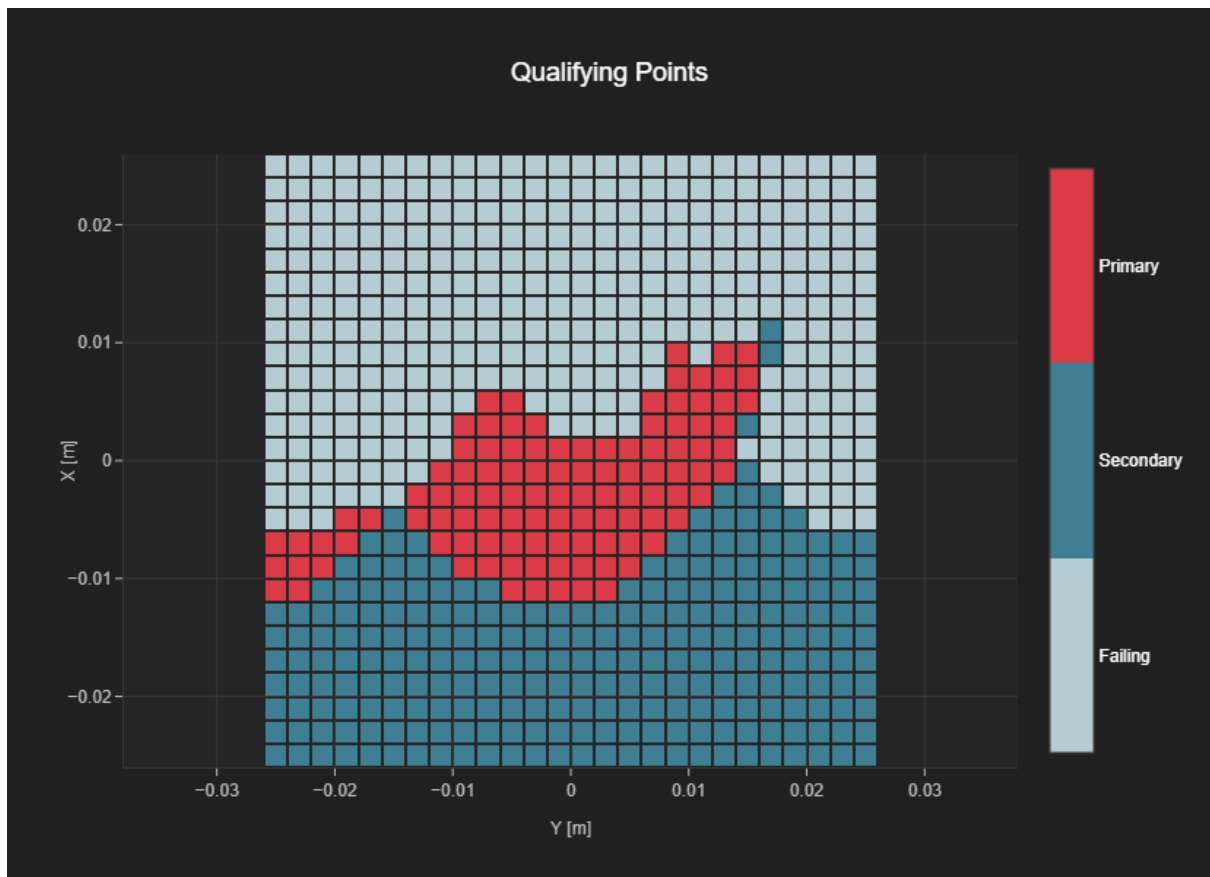
Audio File	Measurement Duration [s]	Margin Upper Bound [dB]	Margin Lower Bound [dB]
48k_voice_300-3000_2s.wav	2.0	1.83	2.0



T-Coil Coupling Mode Test Report

Results

Primary Group Contiguous Point Count	Secondary Group Point Count	Secondary Group Max Longitudinal	Secondary Group Max Transverse
106	347	18	26



Plot 27 Wi-Fi 2.4 GHz 802.11b CH.6 Google Meet Codec: 75 kbit/s ANT 1

Hardware Setup

Probe Name	Probe Calibration Date	DAE Name	DAE Calibration Date
AM1DV3 - 3050	November 23, 2023	DAE4 Sn1254	June 02, 2023

Communication Systems

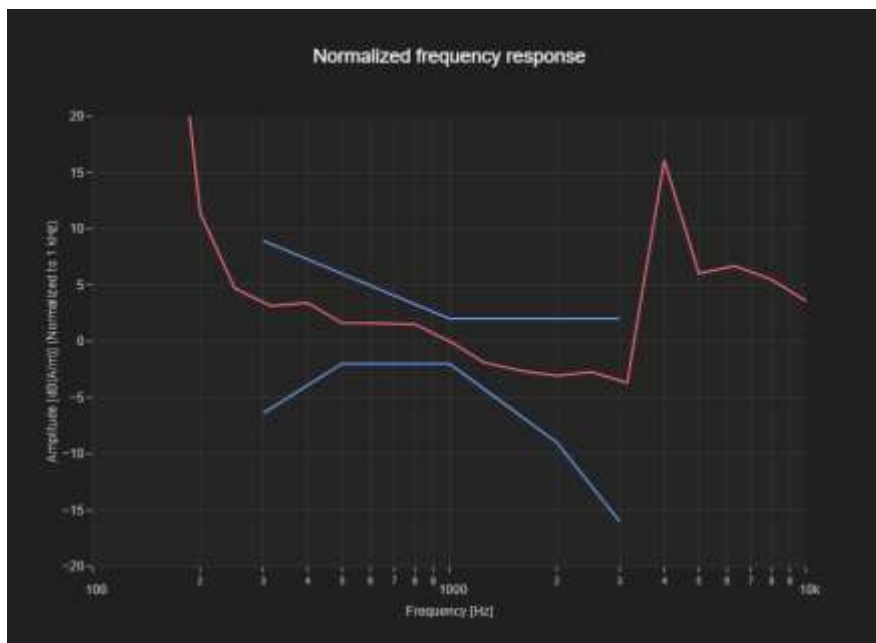
Band Name	Communication Systems Name	Channel	Frequency [MHz]
WLAN 2.4GHz	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 99pc duty cycle)	6	2437.0

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

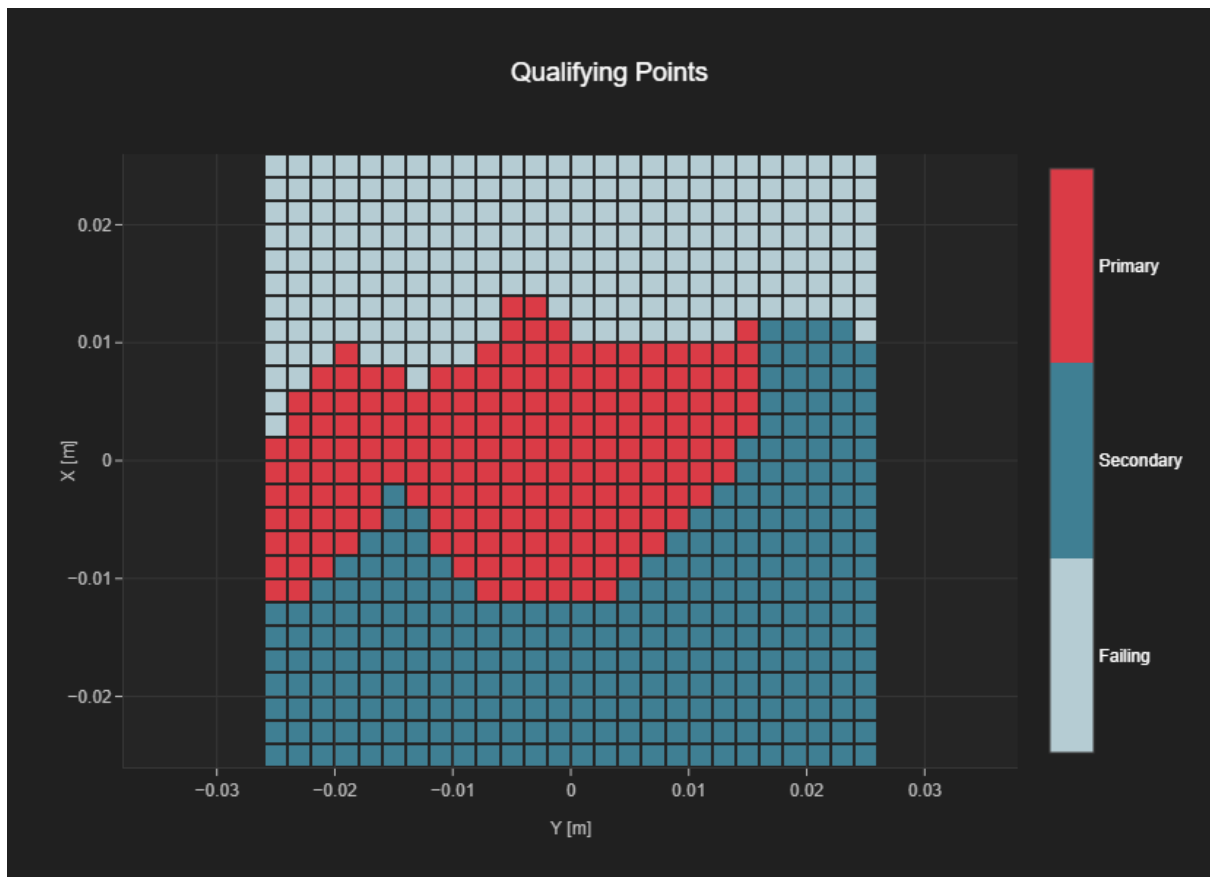
Audio File	Measurement Duration [s]	Margin Upper Bound [dB]	Margin Lower Bound [dB]
48k_voice_300-3000_2s.wav	2.0	1.78	2.0



T-Coil Coupling Mode Test Report

Results

Primary Group Contiguous Point Count	Secondary Group Point Count	Secondary Group Max Longitudinal	Secondary Group Max Transverse
184	465	20	26



Plot 28 Wi-Fi 5.9 GHz CH.5 802.11ax Google Meet Codec: 6 kbit/s ANT 1

Hardware Setup

Probe Name	Probe Calibration Date	DAE Name	DAE Calibration Date
AM1DV3 - 3050	November 23, 2023	DAE4 Sn1254	June 02, 2023

Communication Systems

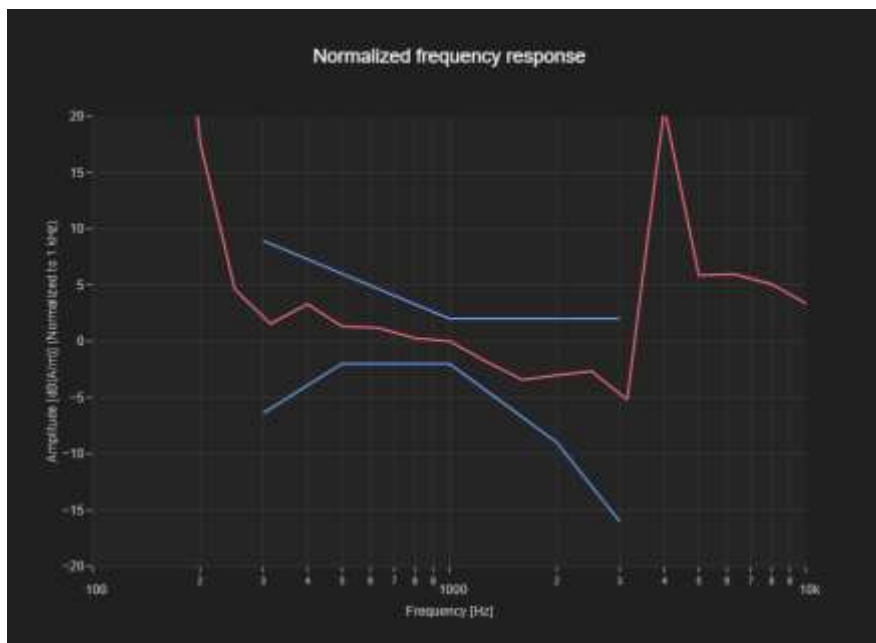
Band Name	Communication Systems Name	Channel	Frequency [MHz]
U-NII-5	IEEE 802.11ax (20MHz, MCS0, 99pc duty cycle)	5	5975.0

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

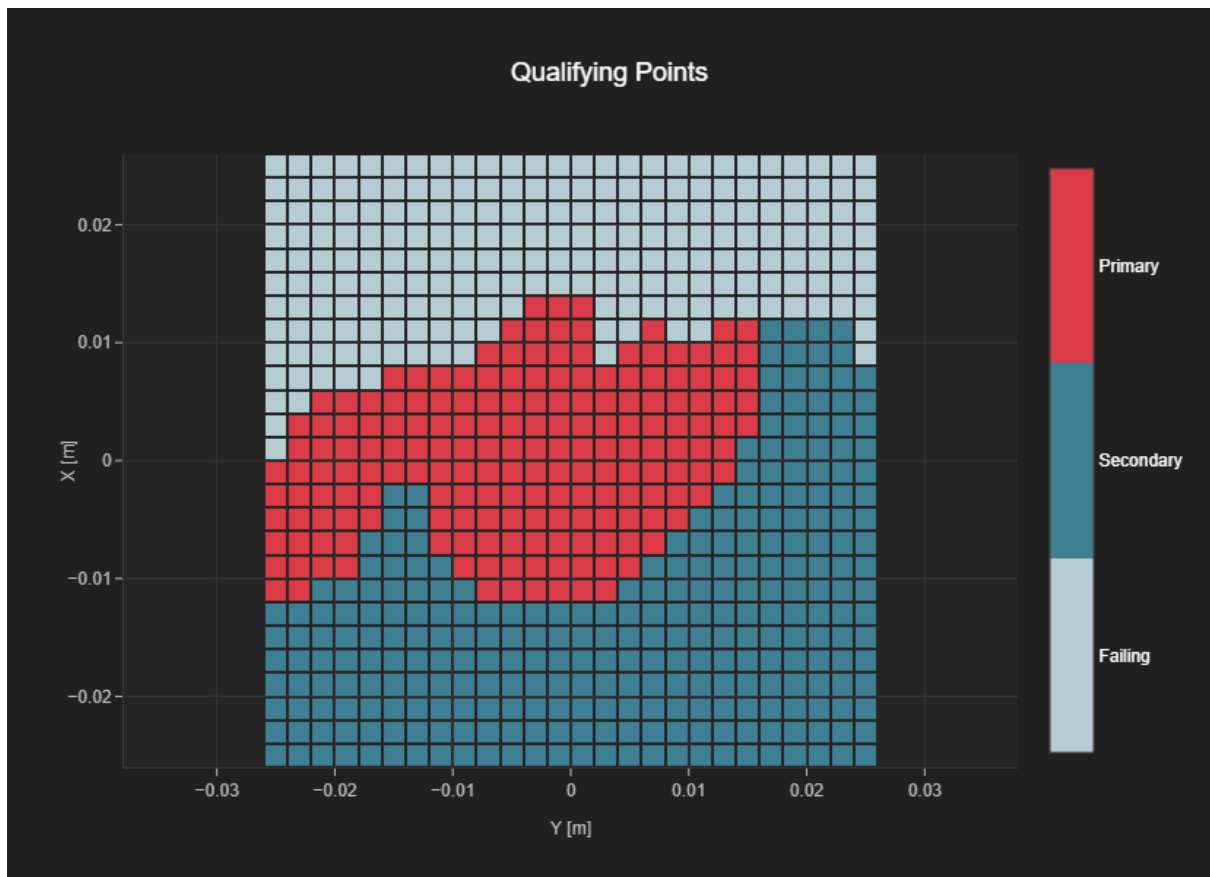
Audio File	Measurement Duration [s]	Margin Upper Bound [dB]	Margin Lower Bound [dB]
48k_voice_300-3000_2s.wav	2.0	2.0	2.0



T-Coil Coupling Mode Test Report

Results

Primary Group Contiguous Point Count	Secondary Group Point Count	Secondary Group Max Longitudinal	Secondary Group Max Transverse
182	462	20	26



Plot 29 NR Band n25 CH.376500 Google Meet Codec: 75 kbit/s ANT I

Hardware Setup

Probe Name	Probe Calibration Date	DAE Name	DAE Calibration Date
AM1DV3 - 3050	November 23, 2023	DAE4 Sn1254	June 02, 2023

Communication Systems

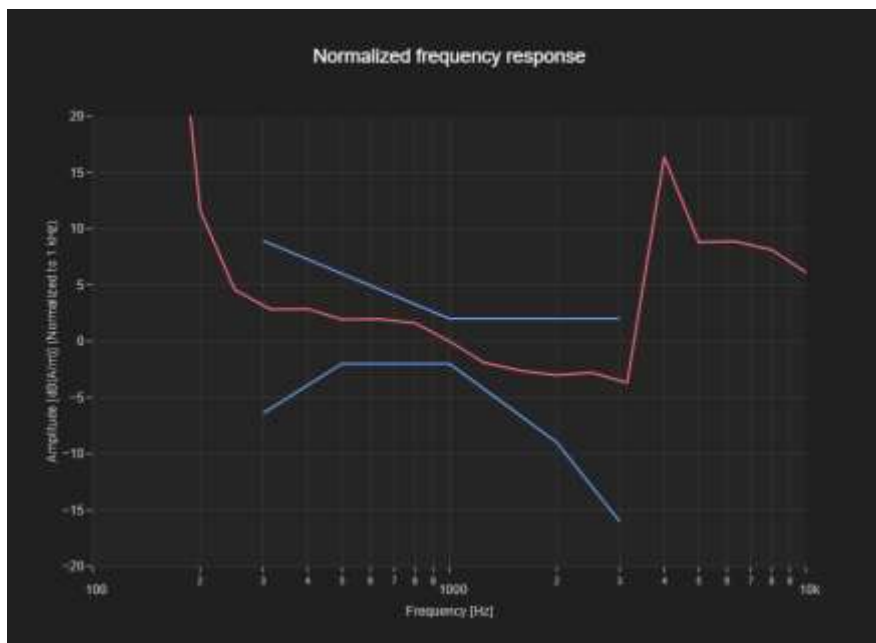
Band Name	Communication Systems Name	Channel	Frequency [MHz]
Band n25	5G NR (DFT-s-OFDM, 50% RB, 40 MHz, QPSK, 15 kHz)	376500	1882.5

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

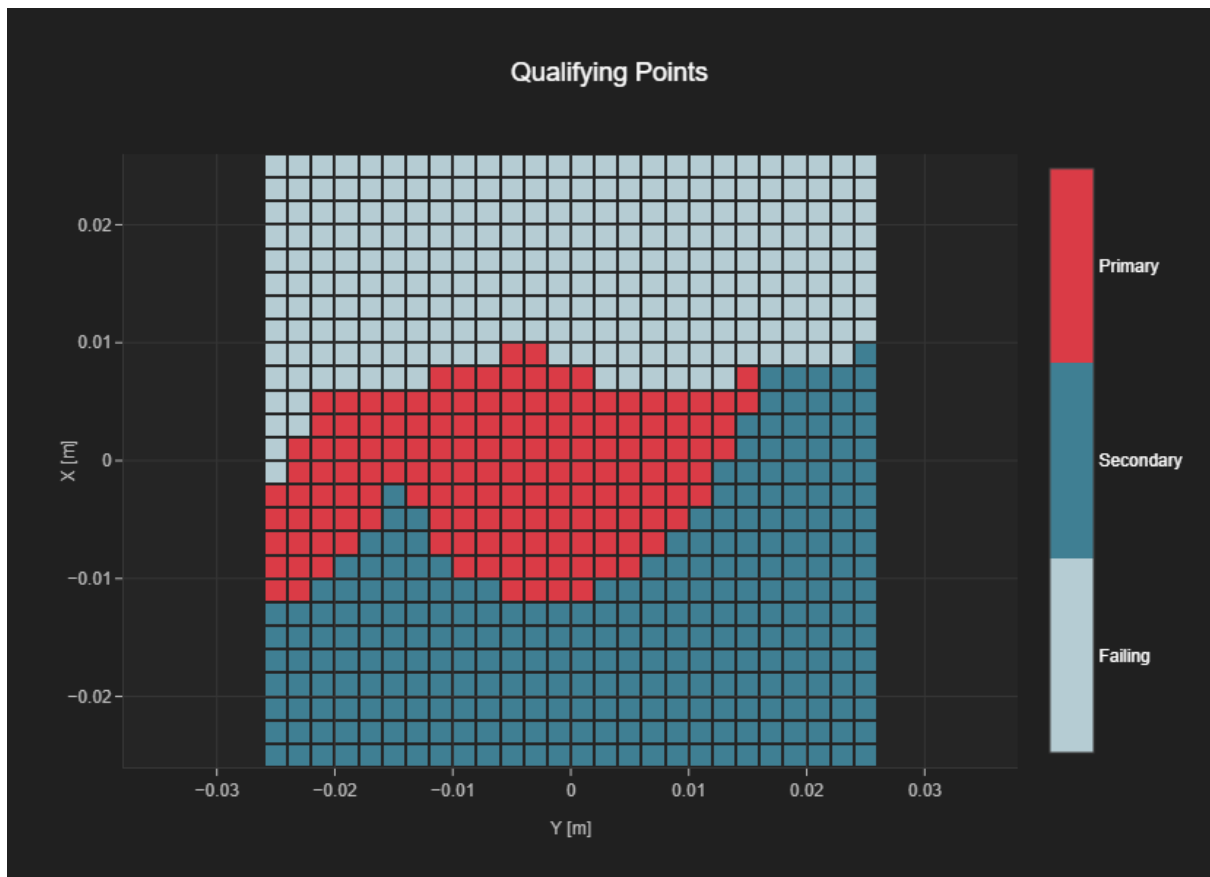
Audio File	Measurement Duration [s]	Margin Upper Bound [dB]	Margin Lower Bound [dB]
48k_voice_300-3000_2s.wav	2.0	1.66	2.0



T-Coil Coupling Mode Test Report

Results

Primary Group Contiguous Point Count	Secondary Group Point Count	Secondary Group Max Longitudinal	Secondary Group Max Transverse
149	426	18	26



Plot 30 NR Band n41 CH.518598 Google Meet Codec: 40 kbit/s ANT I

Hardware Setup

Probe Name	Probe Calibration Date	DAE Name	DAE Calibration Date
AM1DV3 - 3050	November 23, 2023	DAE4 Sn1254	June 02, 2023

Communication Systems

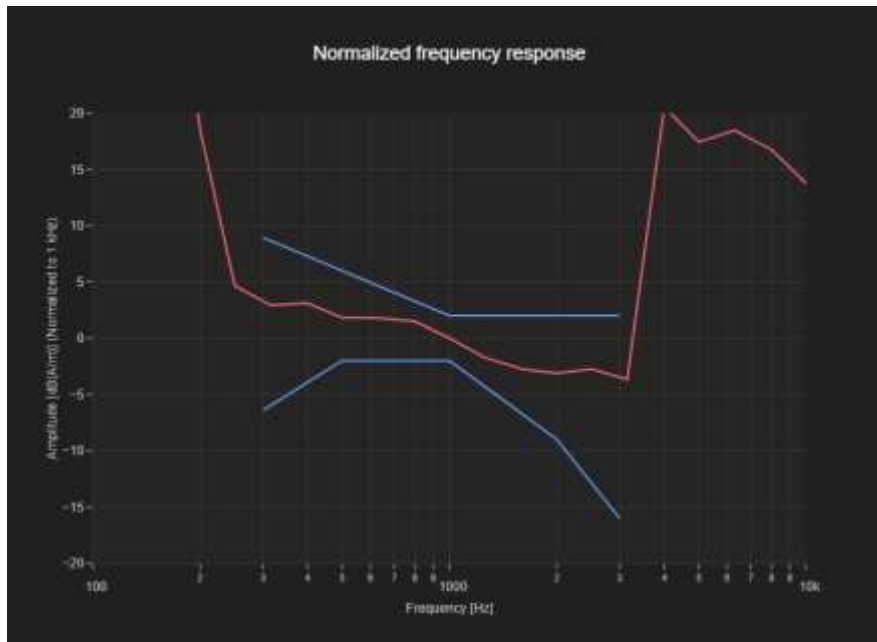
Band Name	Communication Systems Name	Channel	Frequency [MHz]
Band n41	5G NR (CP-OFDM, 1 RB, 100 MHz, QPSK, 30 kHz)	518598	2592.99

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

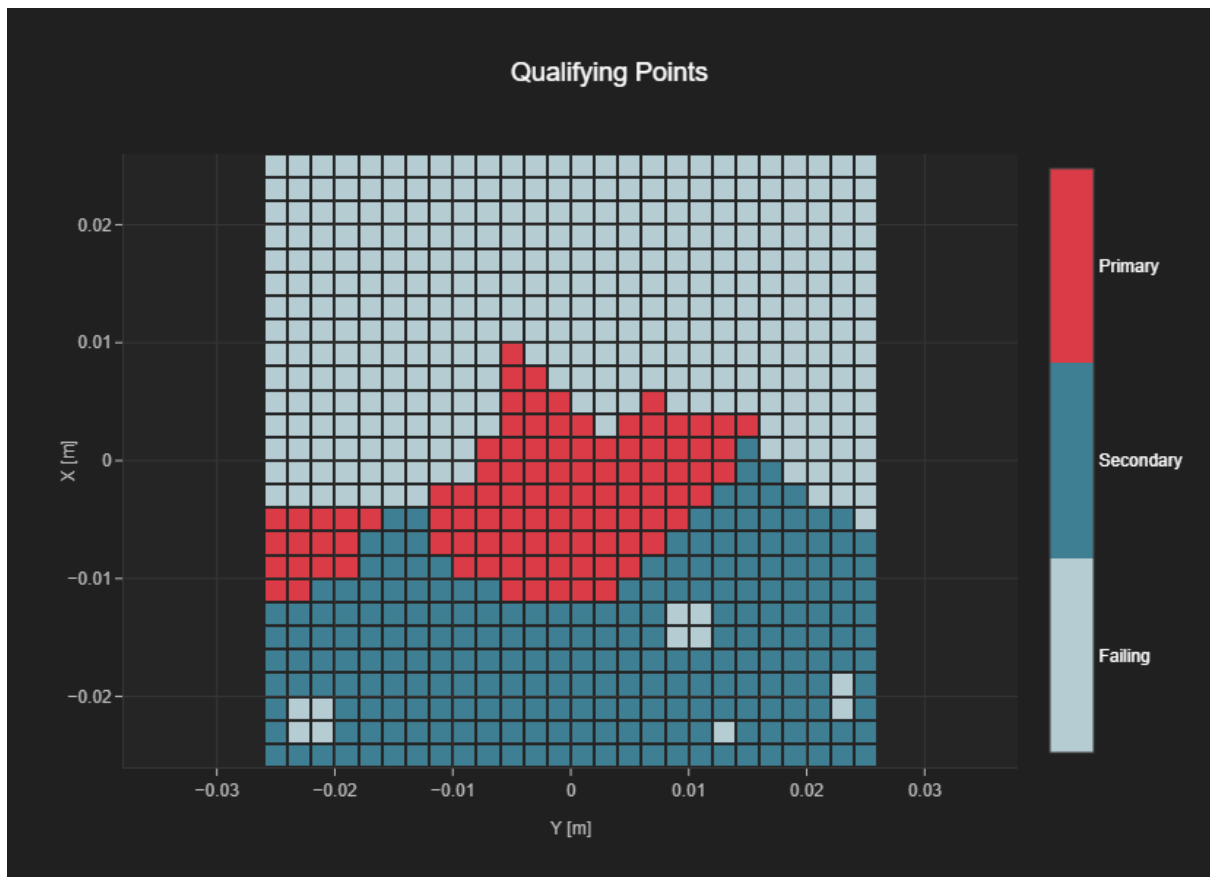
Audio File	Measurement Duration [s]	Margin Upper Bound [dB]	Margin Lower Bound [dB]
48k_voice_300-3000_2s.wav	2.0	1.79	2.0



T-Coil Coupling Mode Test Report

Results

Primary Group Contiguous Point Count	Secondary Group Point Count	Secondary Group Max Longitudinal	Secondary Group Max Transverse
100	332	18	26



Attachment 3. HAC T-Coil Probe Certificates

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



S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
S 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. **AM1DV3-3050_Nov23**

CALIBRATION CERTIFICATE

Object **AM1DV3 - SN: 3050**

Calibration procedure(s) **QA CAL-24.v4**
Calibration procedure for AM1D magnetic field probes and TMFS in
the audio range

Calibration date: **November 23, 2023**

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)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Kaithley Multimeter Type 2001	SN: 0810278	29-Aug-23 (No. 37421)	Aug-24
Reference Probe AM1DV2	SN: 1008	20-Dec-22 (No. AM1DV2-1008_Dec22)	Dec-23
DAE4	SN: 781	03-Jan-23 (No. DAE4-781_Jan23)	Jan-24
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
AMCC	SN: 1050	01-Oct-13 (in house check Sep-23)	Sep-26
AMMI Audio Measuring Instrument	SN: 1062	26-Sep-12 (in house check Sep-23)	Sep-26

Calibrated by:	Name Aldonia Georgiadou	Function Laboratory Technician	Signature
Approved by:	Sven Kühn	Technical Manager	

Issued: November 23, 2023

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

Certificate No. **AM1DV3-3050_Nov23**

Page 4 of 5

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.

Certificate No. AMF019-1950-01/02

AM1D probe identification and configuration data

Item	AM1DV3 Audio Magnetic 1D Field Probe
Type No	SP AM1 001 BA
Serial No	3050

Overall length	296 mm
Tip diameter	6.0 mm (at the tip)
Sensor offset	3.0 mm (centre of sensor from tip)
Internal Amplifier	40 dB

Manufacturer / Origin	Schmid & Partner Engineering AG, Zurich, Switzerland
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Calibration data

Connector rotation angle	(in DASY system)	215.3 °	+/- 3.6 ° (k=2)
Sensor angle	(in DASY system)	0.19 °	+/- 0.5 ° (k=2)
Sensitivity at 1 kHz	(in DASY system)	0.00752 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%.

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



S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
S 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_May23**

CALIBRATION CERTIFICATE

Object **AM1DV3 - SN: 3049**

Calibration procedure(s) **QA CAL-24.v4**
 Calibration procedure for AM1D magnetic field probes and TMFS in the audio range

Calibration date: **May 23, 2023**

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)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Keithley Multimeter Type 2001	SN: 0810278	29-Aug-22 (No. 34389)	Aug-23
Reference Probe AM1DV2	SN: 1008	20-Dec-22 (No. AM1DV2-1008_Dec22)	Dec-23
DAE4	SN: 781	03-Jan-23 (No. DAE4-781_Jan23)	Jan-24
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
AMCC	SN: 1050	01-Oct-13 (in house check Oct-20)	Oct-23
AMMI Audio Measuring Instrument	SN: 1062	26-Sep-12 (in house check Oct-20)	Oct-23

Calibrated by: **Leif Kysner** Function: **Laboratory Technician** Signature: *Leif Kysner*

Approved by: **Sven Kühn** Technical Manager Signature: *S. Kühn*

Issued: May 23, 2023

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

Certificate No: AM1DV3-3049_May23

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결	재	확인자
재	재	확인자
확인/일명	01 / 박성준	01 / 김성준
일 자	2023 / 05.22	2023 / 05.22

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
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Calibration data

Connector rotation angle	(in DASY system)	279.2 °	+/- 3.6 ° (k=2)
Sensor angle	(in DASY system)	-0.45 °	+/- 0.5 ° (k=2)
Sensitivity at 1 kHz	(in DASY system)	0.00745 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%.