Testing and Certification

TEST REPORT

HAC T-COIL Test for certification of SM-S721U

APPLICANT

Samsung Electronics. Co., Ltd.

REPORT NO.

HCT-SR-2407-FC006

DATE OF ISSUE

Jul. 19, 2024

Tested by
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FCC ID
A3LSMS721U

Applicant	**SAMSUNG Electronics Co., Ltd** **129, Samsung-ro, Yeongtong-gu, Suwon-Si, Gyeonggi-do, 16677, Korea**
Product Name	Mobile Phone
Model Name	SM-S721U
Additional Model Name	SM-S721U1
Date of Test	Jun. 10, 2024 ~ July. 14, 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	Jul. 19, 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).

CONTENTS

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-S721U
Additional Model Name	SM-S721U1
Equipment Type	Mobile Phone
FCC ID	A3LSMS721U
Application Type	Certification
Applicant	SAMSUNG Electronics Co., Ltd.

3.2 DUT specification7

Device Wireless specification overview		
Band & Mode	Operating Mode	Tx Frequency
GSM850	Voice / Data	824.2 ㎒ ~ 848.8 ㎒
GSM1900	Voice / Data	1 850.2 ㎒ ~ 1 909.8 ㎒
UMTS Band 2	Voice / Data	1 852.4 ㎒ ~ 1 907.6 ㎒
UMTS Band 4	Voice / Data	1 712.4 ㎒ ~ 1 752.6 ㎒
UMTS Band 5	Voice / Data	826.4 ㎒ ~ 846.6 ㎒
LTE FDD Band 2 (PCS)	Voice / Data	1 850.7 ㎒ ~ 1 909.3 ㎒
LTE FDD Band 4 (AWS)	Voice / Data	1 710.7 ㎒ ~ 1 754.3 ㎒
LTE FDD Band 5 (Cell)	Voice / Data	824.7 ㎒ ~ 848.3 ㎒
LTE FDD Band 7	Voice / Data	2 502.5 ㎒ ~ 2 567.5 ㎒
LTE FDD Band 12	Voice / Data	699.7 ㎒ ~ 715.3 ㎒
LTE FDD Band 13	Voice / Data	779.5 ㎒ ~ 784.5 ㎒
LTE FDD Band 14	Voice / Data	790.5 ㎒ ~ 795.5 ㎒
LTE FDD Band 25	Voice / Data	1 850.7 ㎒ ~ 1 914.3 ㎒
LTE FDD Band 26	Voice / Data	814.7 ㎒ ~ 848.3 ㎒
LTE FDD Band 30	Voice / Data	2 307.5 ㎒ ~ 2 312.5 ㎒
LTE TDD Band 38	Voice / Data	2 572.5 ㎒ ~ 2 617.5 ㎒
LTE TDD Band 41	Voice / Data	2 498.5 ㎒ ~ 2 687.5 ㎒
LTE TDD Band 48	Voice / Data	3 552.5 ㎒ ~ 3 697.5 ㎒
LTE FDD Band 66 (AWS)	Voice / Data	1 710.7 ㎒ ~ 1 779.3 ㎒
LTE FDD Band 71	Voice / Data	665.5 ㎒ ~ 695.5 ㎒
NR FDD Band n2 (PCS)	Voice / Data	1 852.5 ㎒ ~ 1 907.5 ㎒
NR FDD Band n5	Voice / Data	826.5 ㎒ ~ 846.5 ㎒
NR FDD Band n7	Voice / Data	2 502.5 ㎒ ~ 2 567.5 ㎒
NR FDD Band n12	Voice / Data	701.5 ㎒ ~ 713.5 ㎒
NR FDD Band n25 (PCS)	Voice / Data	1 852.5 ㎒ ~ 1 912.5 ㎒
NR FDD Band n26	Voice / Data	816.5 ㎒ ~ 846.5 ㎒
NR FDD Band n30	Voice / Data	2 307.5 ㎒ ~ 2 312.5 ㎒
NR TDD Band n38	Voice / Data	2 575 ㎒ ~ 2 615 ㎒
NR TDD Band n41	Voice / Data	2 501.01 ㎒ ~ 2 685 ㎒
NR TDD Band n48	Voice / Data	3 555 ㎒ ~ 3 695.01 ㎒
NR FDD Band n66	Voice / Data	1 712.5 ㎒ ~ 1 777.5 ㎒
NR FDD Band n70	Voice / Data	1 697.5 ㎒ ~ 1 707.5 ㎒
NR FDD Band n71	Voice / Data	665.5 ㎒ ~ 695.5 ㎒
NR TDD Band n77	Voice / Data	3 705 ㎒ ~ 3 975 ㎒
NR TDD Band n77 DoD	Voice / Data	3 445.01 ㎒ ~ 3 544.98 ㎒
NR TDD Band n78	Voice / Data	3 705 ㎒ ~ 3 795 ㎒
NR TDD Band n78 DoD	Voice / Data	3 455.01 ㎒ ~ 3 544.98 ㎒
NR Band n258	Data	24 250 ㎒ ~ 24 450 ㎒; 24 750 ㎒ ~ 25 250 ㎒
NR Band n260	Data	37 000 ㎒ ~ 40 000 ㎒
NR Band n261	Data	27 500 ㎒ ~ 28 350 ㎒
U-NII-1	Voice / Data	5 180 ㎒ ~ 5 240 ㎒
U-NII-2A	Voice / Data	5 260 ㎒ ~ 5 320 ㎒
U-NII-2C	Voice / Data	5 500 ㎒ ~ 5 720 ㎒
U-NII-3	Voice / Data	5 745 ㎒ ~ 5 825 ㎒
U-NII-4	Voice / Data	5 845 ㎒ ~ 5 885 ㎒
U-NII-5	Voice / Data	5 925 ㎒ – 6 425 ㎒
U-NII-6	Voice / Data	6 425 ㎒ – 6 525 ㎒
U-NII-7	Voice / Data	6 525 ㎒ – 6 865 ㎒
U-NII-8	Voice / Data	6 865 ㎒ – 7 115 ㎒
2.4 ㎓ WLAN	Voice / Data	2 412 ㎒ ~ 2 462 ㎒
Bluetooth / LE 5.3	Data	2 402 ㎒ ~ 2 480 ㎒
NFC	Data	13.56 ㎒
WPC	Data	110 ㎑ ~ 148 ㎑

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	3153	05/14/2025
Data Acquisition Electronics	SPEAG	DAE4	1254	05/16/2025
Data Acquisition Electronics	SPEAG	DAE4ip	1866	05/02/2025
DAC	Sound Devices	USB Pre 2	HB1319212059	N/A
Radio Communication Tester	R & S	CMW 500	167916	09/21/2024
Radio Communication Tester	R & S	CMW 500	127521	04/23/2025
Radio Communication Tester	R & S	CMW 500	167918	03/20/2025
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.	*ci* ABMd	*ci* 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 Distribution	0.20	R	1.73	1	1	0.12	0.12
Test Signal							
Ref. Signal Spectral Response	0.60	R	1.73	0	1	0.00	0.35
Positioning							
Probe Positioning	1.90	R	1.73	1	1	1.10	1.10
Phantom Thickness	0.90	R	1.73	1	1	0.52	0.52
DUT Positioning	1.90	R	1.73	1	1	1.10	1.10
External Contributions							
RF Interference	0.00	R	1.73	1	0.3	0.00	0.00
Test Signal Variation	2.00	R	1.73	1	1	1.15	1.15
Combined Uncertainty							
Combined Std. Uncertainty	*(k=1)*					3.87	5.97
Expanded uncertainty	*(Coverage factor for 95%, k=2)*					**7.74**	**11.94**
Notes for table : N – Normal, R – Rectangular, Div. - Divisor used to obtain standard uncertainty							

6. Test Procedures for all Technologies

6.1 General Procedures C63.19-2019, Section 6

ANSI C63.19-2019, Section 6

This document describes the measurement of the baseband (audio frequency) magnetic T-Coil signal from a WD. The goal is to evaluate the size of the area where a user could position their WD relative to their hearing aid's telecoil and receive an acceptable magnetically coupled signal. Three quantities are measured and evaluated. The first is the field strength of the desired signal at the center of the audio band (desired ABM signal).31 The second is the frequency response of the desired signal measured across the audio band.
This subclause describes the procedures used to measure the ABM (T-Coil) performance of the WD. Measurements shall be performed over a measurement area 50 mm square, in the measurement plane, as specified in A.3. The measurement area shall be scanned with a uniform measurement point spacing of 2.0 mm ± 0.5 mm in each X-Y axis of the plane, yielding 676 measurement points with approximately even spacing throughout the area. In addition to measuring the desired ABM signal levels, the weighted magnitude of the unintended signal shall also be determined. Weighting of the unintended and undesired ABM field shall be by the spectral and temporal weighting described in D.4 through D.6. Measurements shall not include undesired properties from the WD's RF field; therefore, use of a coaxial connection to a base station simulator or non-radiating load may be necessary. However, even then with a coaxial connection to a base station simulator or non-radiating load there may still be RF leakage from the WD, which may interfere with the desired measurement.
Measurements shall be performed with the probe coil oriented in the transverse direction, as illustrated in A.3, that is, aligned in the plane of the measurement area and perpendicular to the long dimension of the WD. A multi-stage sequence consists of first measuring the field strength of the desired T-Coil signal (desired ABM signal) that is useful to a hearing aid T-Coil at each specified measurement point. The undesired magnetic component (undesired ABM field) is then measured in the same transverse orientation at each of the same measurement points. At a single location only, taken at or near the highest desired ABM signal reading, the desired ABM signal frequency response shall be determined in a third measurement stage.

Test flow for T-Coil signal test

The following steps summarize the basic test flow for determining desired ABM signal and undesired ABM field. These steps assume that a sine wave or narrowband 1/3 octave signal can be used for the measurement of desired ABM signal level. An alternative procedure, yielding equivalent results, using a broadband excitation is described in 6.5.

a) A validation of the test setup and instrumentation shall be performed. This may be done using a TMFS or Helmholtz Coil. Measure the emissions and confirm that they are within tolerance of the expected values.

b) Confirm that equipment that requires calibration has been calibrated, and that the noise level meets the requirements given in 6.3.2.

c) Position the WD in the test setup and connect the WD RF connector to a base station simulator or a non-radiating load (if necessary to control RF interference in the measurement equipment) as shown in Figure 6.1 or Figure 6.2.

d) The drive level to the WD is set such that the reference input level specified in Table 6.1 is input to the base station simulator (or manufacturer's test mode equivalent) in the 1 kHz, 1/3 octave band. This drive level shall be used for the T-Coil signal test (desired ABM signal) at f = 1 kHz.
Either a sine wave at 1025 Hz, or a voice-like signal, band-limited to the 1 kHz 1/3 octave, as specified in 6.4.3, shall be used for the reference audio signal. If interference is found at 1025 Hz an alternative nearby reference audio signal frequency may be used.35 The same drive level will be used for the desired ABM signal frequency response measurements at each 1/3 octave band center frequency.

The WD volume control may be set at any level up to maximum, provided that a signal at any frequency at maximum modulation would not result in clipping or signal overload.

e) At each measurement location over the measurement area and in the transverse orientation, measure and record the desired 1 kHz T-Coil magnetic signal (desired ABM signal) as described in Step c).

f) At or near a location representing a maximum in the just-measured desired ABM signal, measure and record the desired T-Coil magnetic signals (desired ABM signal at f_i) as described in 6.4.5.2 in each individual ISO 266:1975 R10 standard 1/3 octave band. The desired audio band input frequency (f_i) shall be centered in each 1/3 octave band maintaining the same drive level as determined in Step c), and the reading taken for that band. Equivalent methods of determining the frequency response may also be employed, such as fast Fourier transform (FFT) analysis using noise excitation or input–output comparison using simulated speech. The full-band integrated or half-band integrated probe output, as described in D.9, may be used, as long as the appropriate calibration curve is applied to the measured result, so as to yield an accurate measurement of the field magnitude. (The resulting measurement shall be an accurate measurement in dB(A/m).) Compare the frequency response found to the requirements of 6.6.3.

g) At the same locations measured in Step d), measure and record the undesired broadband audio magnetic signal (undesired ABM field) with no audio signal applied (or digital zero applied, if appropriate) using the specified spectral weighting, the half-band integrator followed by the temporal weighting.

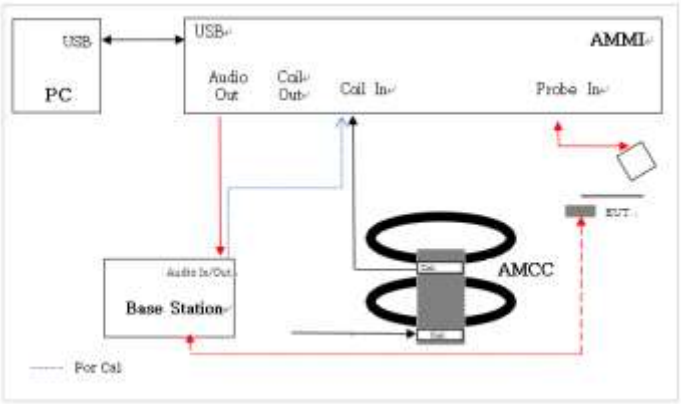
h) Calculate and record the location and number of the measurement points that satisfy both the minimum desired ABM signal level and the maximum undesired ABM field level specified in 6.6.2. Compare this to the requirements in 6.6.4 and record the result.

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

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

At the measurement location for each orientation, measure and record the undesired broadband audio magnetic signal (ABM2) as specified in 6.4.2 g) with no audio signal applied (or digital zero applied, if appropriate) using A-weighting and the half-band integrator. Calculate the ratio of the desired to undesired signal strength (i.e., signal quality).
Obtain the data from the postprocessor, SEMCAD, and determine the primary group, secondary group that properly the signal quality based on Table 8.

Test Setup Diagram



6.2 VoWiFi

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

The set up for VoWiFi uses the Base station as described in section 7.1 with the exception that the reference audio level is set at -16dBm0. The reference level is calibrated using the standard call box calibration procedures with the exception of the -16dBm0 reference level being used (refer to section 8.4).

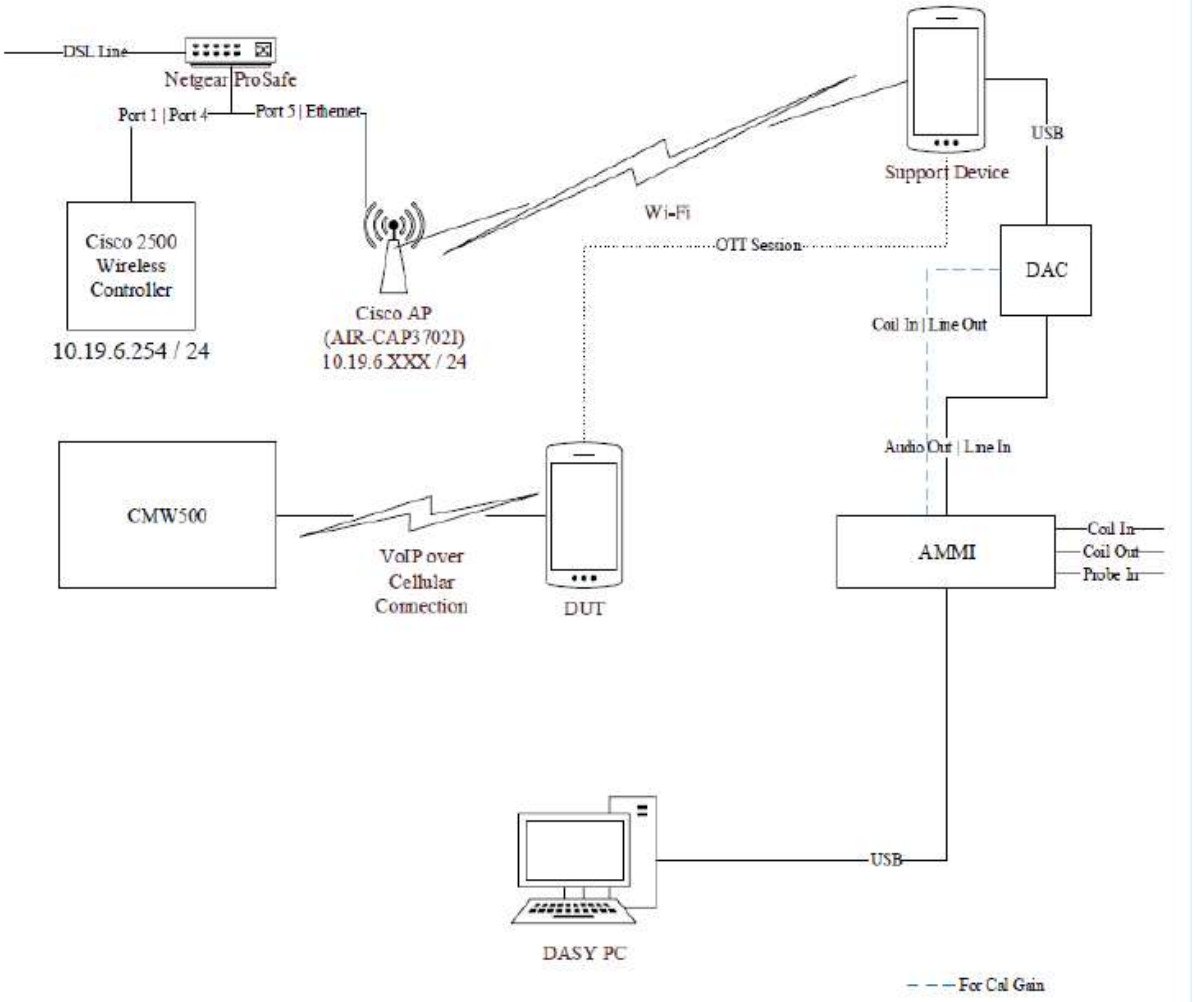
An investigation was performed to determine worst case codec, bit rate and air interface configuration (refer to sections 11.3, 11.4 and 11.5).

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 §11.7 for codec bit rates). VoIP capabilities require HAC assessment when voice calls are supported over the cellular data connection via pre-installed VoIP applications.

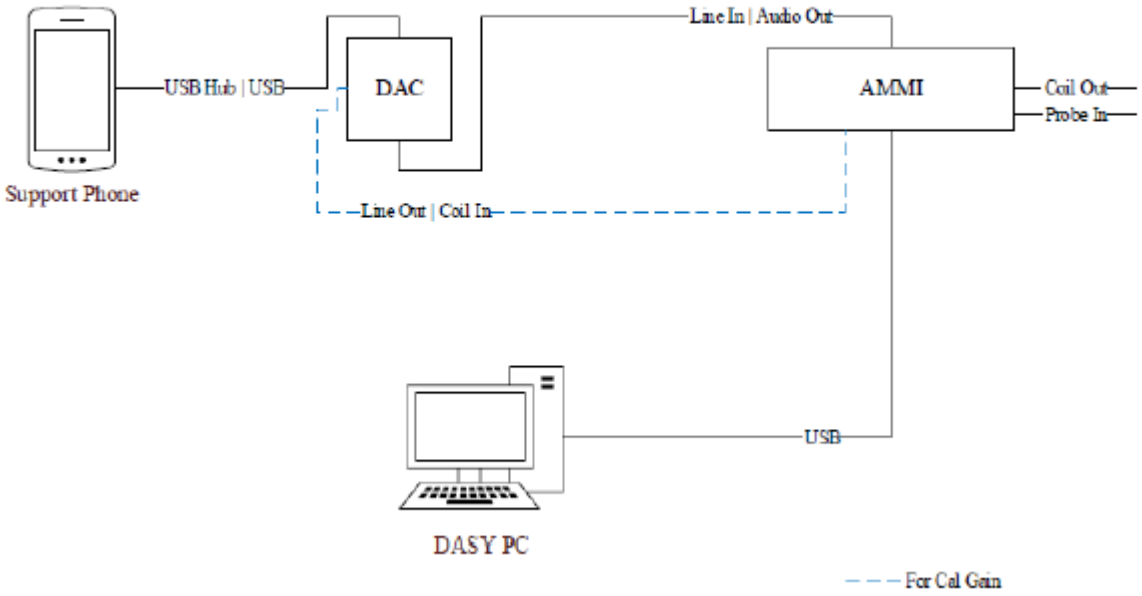
The equipment is set up as shown below with a support device used to originate the call using the IP transport. The support device connects to the cloud-based Google Meet service via Wi-Fi access point and router, or RJ45. The DUT connects to the VoIP service via a cellular/unlicensed air interface to 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 §11.7).

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 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

Signal Type	Audio Level [dBm]	Peak to Full Scale [dB]	Peak to RMS Scale [dB]	BWC [dB]	Scaling [Gain]
Voice 1 ㎑	-16	-0.37	15.74	0.07	-12.49 to -12.39
Normal Voice	-16	0	21.57	10.81	-6.66 to -6.56

GSM

Signal Type	Audio Level [dBm]	Peak to Full Scale [dB]	Peak to RMS Scale [dB]	BWC [dB]	Scaling [Gain]
Voice 1 ㎑	-16	-0.37	15.74	0.07	-12.56
Normal Voice	-16	0	21.57	10.81	-6.73

NR

Signal Type	Audio Level [dBm]	Peak to Full Scale [dB]	Peak to RMS Scale [dB]	BWC [dB]	Scaling [Gain]
Voice 1 ㎑	-16	-0.37	15.74	0.07	-7.83 to -7.67
Normal Voice	-16	0	21.57	10.81	-2.00 to -1.84

Vowifi

Signal Type	Audio Level [dBm]	Peak to Full Scale [dB]	Peak to RMS Scale [dB]	BWC [dB]	Scaling [Gain]
Voice 1 ㎑	-16	-0.37	15.74	0.07	-12.27 to -12.21
Normal Voice	-16	0	21.57	10.81	-6.44 to -6.38

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.

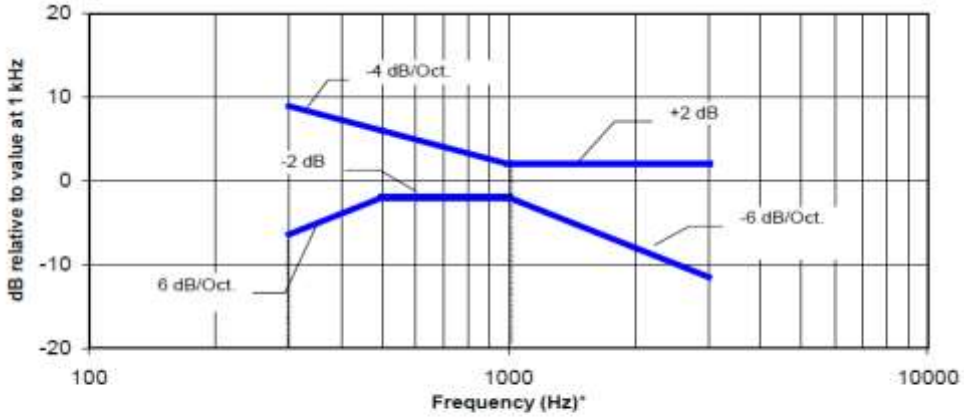
To calibrate the DAC (refer §6.3), three. Way audio files (sine wave, 1 ㎑ voice, and 300 to 3 ㎑ voice) are sent from the DASY5 PC to the AMMI, then to the DAC. The Helmholtz resonator measures the field strength, which represents the AMMI to DAC input sensitivity. After determining the input sensitivity, the adjusted linear gain values can then be calculated.

Signal Type	Audio Level [dBm]	Peak to Full Scale [dB]	Peak to RMS Scale [dB]	BWC [dB]	Scaling [Gain]
Voice 1 ㎑	-16	-0.37	15.74	0.07	-9.09 to -9.02
Normal Voice	-16	0	21.57	10.81	-3.26 to -3.19

8 T-coil Measurement Criteria

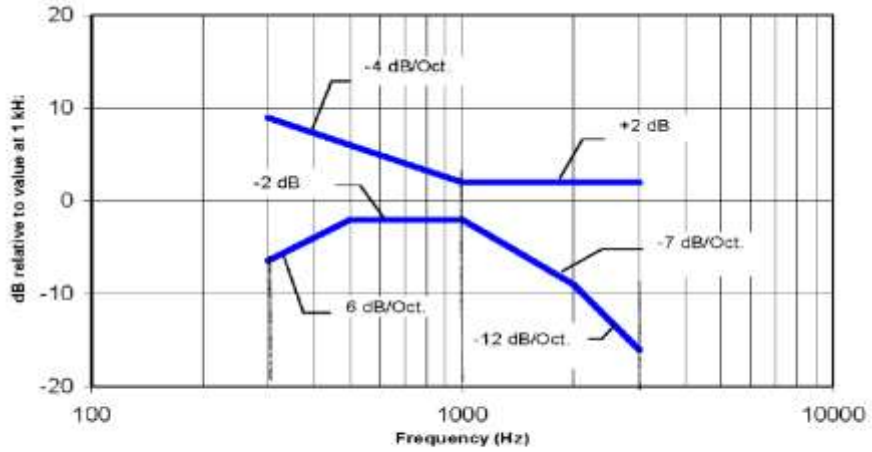
8.1 Frequency Response

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 fulfil 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
	XE01392M	T-coil Test
	XE01178M	T-coil Test
	XFD0872M	T-coil Test
	XFD0972M	T-coil Test
	XFH0560M	T-coil Test
	XFS0389M	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-2407-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(B38,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)				
	5900 (U-NII-4)				
	6200(UNII 5)		Yes[3]	WWAN and Wifi 2.4GHz, BT	
	6500(UNII 6)		No[2]		
	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. N258, n260,n261, Wifi 6GHz(UNII 6~8) are currently outside the scope of ANSI C63.19 and FCC HAC regulations.
3. UNII band 5 was evaluated for operations which are entirely below 6 GHz.

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)	2	1.91	y (Transversal)	GSM 850 CH.190 ANT A
Primary	36	53		
Secondary	323	342		
Contiguous Longitudinal	19	19		
Contiguous Transverse	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)	1.96	2	2	2	2	2	y (Transversal)	UMTS Band II Rel.99 CH.9400 ANT A
Primary	366	372	372	353	361	362		
Secondary	676	676	676	676	676	676		
Contiguous Longitudinal	26	26	26	26	26	26		
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)	1.72	2	2	2	2	2	y (Transversal)	LTE Band 25 CH.26365 20 ㎒ QPSK 1RB 0offset ANT F
Primary	364	361	364	345	348	352		
Secondary	676	673	676	676	674	676		
Contiguous Longitudinal	26	26	26	26	26	26		
Contiguous Transverse	26	26	26	26	26	26		

Codec Investigation											
Codec State	EVS-NB (kbit/s)			EVS-WB (kbit/s)			EVS-SWB (kbit/s)			Orientation	Band/ Bandwidth/ Channel
	5.9	13.2	24.4	5.9	13.2	24.4	9.6	16.4	24.4		
Freq. Response(dB)	1.82	1.08	2	2	2	2	2	2	2	y (Transversal)	LTE Band 25 CH.26365 20 ㎒ QPSK 1RB 0offset ANT F
Primary	311	368	360	332	356	356	346	370	362		
Secondary	676	676	676	647	671	671	649	676	669		
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)	1.12	2	2	1.65	1.96	2	y (Transversal)	NR Band 25 CH.376500 DFT-s OFDM QPSK 40 ㎒ 1 RB 1 Offset ANT F
Primary	359	356	369	356	356	355		
Secondary	662	664	666	676	608	663		
Contiguous Longitudinal	26	26	26	26	25	26		
Contiguous Transverse	26	26	26	26	26	26		

Codec Investigation											
Codec State	EVS-NB (kbit/s)			EVS-WB (kbit/s)			EVS-SWB (kbit/s)			Orientation	Band/ Bandwidth/ Channel
	5.9	13.2	24.4	5.9	13.2	24.4	9.6	16.4	24.4		
Freq. Response(dB)	1.85	2	2.00	1.91	2	1.95	2	2	2	y (Transversal)	NR Band 25 CH.376500 DFT-s OFDM QPSK 40 ㎒ 1 RB 1 Offset ANT F
Primary	337	364	354	331	359	359	369	370	369		
Secondary	665	658	653	668	674	674	676	676	676		
Contiguous Longitudinal	26	26	26	26	26	26	26	26	26		
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)	1.96	2	2	2	2	2	y (Transversal)	LTE Band 41 CH.40620 20 ㎒ QPSK 1RB 0offset PC2 ANT F
Primary	165	156	142	139	122	153		
Secondary	473	457	462	464	425	462		
Contiguous Longitudinal	22	21	22	22	26	21		
Contiguous Transverse	26	26	26	26	26	26		

Codec Investigation											
Codec State	EVS-NB (kbit/s)			EVS-WB (kbit/s)			EVS-SWB (kbit/s)			Orientation	Band/ BandWidth/ Channel
	5.9	13.2	24.4	5.9	13.2	24.4	9.6	16.4	24.4		
Freq. Response(dB)	2	1.58	2	2	2	2	2	2	2	y (Transversal)	LTE Band 41 CH.40620 20 ㎒ QPSK 1RB 0offset PC2 ANT F
Primary	93	158	157	97	147	153	157	157	158		
Secondary	465	457	456	460	457	463	458	457	457		
Contiguous Longitudinal	22	21	21	21	21	22	21	21	21		
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)	1.74	2	2	2	1.9	1.9	y (Transversal)	NR Band 41 CH.518598 DFT-s OFDM QPSK 100 ㎒ 1 RB 1 offset ANT B
Primary	128	128	125	107	115	114		
Secondary	433	432	428	428	428	427		
Contiguous Longitudinal	19	19	19	19	19	19		
Contiguous Transverse	26	26	26	26	26	26		

Codec Investigation											
Codec State	EVS-NB (kbit/s)			EVS-WB (kbit/s)			EVS-SWB (kbit/s)			Orientation	Band/ BandWidth/ Channel
	5.9	13.2	24.4	5.9	13.2	24.4	9.6	16.4	24.4		
Freq. Response(dB)	2	2	2	2	2	1.89	2	2	2	y (Transversal)	NR Band 41 CH.518598 DFT-s OFDM QPSK 100 ㎒ 1 RB 1 offset ANT B
Primary	116	141	144	116	131	137	134	134	136		
Secondary	445	447	447	447	443	449	436	434	434		
Contiguous Longitudinal	20	20	20	20	20	20	19	19	19		
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)	H max dB (A/m)	Plot No.
GSM 850 Codec: FR V1 ANT A	CH.128 824.2 ㎒	-56.82	40	332	19	26	2	6.13	1
	CH.190 836.5 ㎒	-56.82	36	323	19	26	2	6.27	2
	CH.251 848.8 ㎒	-56.82	33	303	18	26	2	6.34	3
GSM 1900 Codec: FR V1 ANT A	CH.661 1880.0 ㎒	-56.82	72	374	24	26	2	6.16	
UMTS Band II AMR WB Codec: 6.6kbit/s ANT A	CH.9262 1852.4 ㎒	-56.82	352	676	26	26	2	4.66	4
	CH.9400 1880.0 ㎒	-56.82	353	676	26	26	2	4.53	5
	CH.9538 1907.6 ㎒	-56.82	352	676	26	26	2	4.52	6
UMTS Band IV AMR WB Codec: 6.6kbit/s ANT A	CH.1412 1732.4 ㎒	-56.82	353	676	26	26	2	4.62	
UMTS Band V AMR WB Codec: 6.6kbit/s ANT A	CH.4183 836.6 ㎒	-56.82	354	676	26	26	2	4.68	

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)	H max dB (A/m)	Plot No.
LTE Band 25 ANT F Codec: EVS-NB 5.9kbit/s	CH.26365 1882.5 MHz	20 MHz	QPSK	1/0	-56.81	311	676	26	26	1.82	2.57	
				1/49	-56.81	297	676	26	26	2	2.48	
				1/99	-56.81	303	676	26	26	1.93	2.46	
				50/0	-56.81	304	676	26	26	2	-0.04	
				50/25	-56.81	302	676	26	26	1.73	1.9	
				50/49	-56.81	300	676	26	26	1.88	1.02	
				100/0	-56.81	308	676	26	26	1.83	1.39	
			16QAM	1/49	-56.81	298	671	26	26	2.	2.56	
			64QAM	1/49	-56.85	289	676	26	26	1.81	2.11	
			256QAM	1/49	-56.85	311	676	26	26	1.82	3.88	
		15 MHz	QPSK	1/36	-56.85	297	674	26	26	1.97	2.31	
		10 MHz		1/25	-56.85	295	676	26	26	1.97	1.57	
		5 MHz		1/12	-56.85	296	675	26	26	2	1.53	
		3 MHz		1/7	-56.85	299	674	26	26	2	2.85	
		1.4 MHz		1/3	-56.85	293	668	26	26	2	1.05	

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)	H max dB (A/m)	Plot No.
LTE Band 25 ANT.A Codec: EVS NB 5.9kbit/s	CH.26365 1882.5 MHz	20 MHz	64QAM	1/49	-56.85	284	676	26	26	1.96	2.68	7
LTE Band 7 ANT.B Codec: EVS NB 5.9kbit/s	CH.21100 2535 MHz	20 MHz	64QAM	1/49	-56.85	299	676	26	26	1.56	1.43	
LTE Band 7 ANT.F Codec: EVS NB 5.9kbit/s	CH.21100 2535 MHz	20 MHz	64QAM	1/49	-56.85	286	667	26	26	2	1.87	
LTE Band 12 ANT.A Codec: EVS NB 5.9kbit/s	CH.23095 707.5 MHz	10 MHz	64QAM	1/36	-56.85	310	676	26	26	2	1.14	
LTE Band 13 ANT.A Codec: EVS NB 5.9kbit/s	CH.23230 782 MHz	10 MHz	64QAM	1/24	-56.84	300	676	26	26	1.97	1.7	
LTE Band 14 ANT.A Codec: EVS NB 5.9kbit/s	CH.23330 793 MHz	10 MHz	64QAM	1/24	-56.84	295	676	26	26	12	2.14	
LTE Band 26 ANT.A Codec: EVS NB 5.9kbit/s	CH.26865 831.5 MHz	15 MHz	64QAM	1/36	-56.84	307	676	26	26	1.96	2.21	
LTE Band 30 ANT.A Codec: EVS NB 5.9kbit/s	CH.27710 2310 MHz	10 MHz	64QAM	1/24	-56.84	294	676	26	26	1.86	2.52	
LTE Band 30 ANT.F Codec: EVS NB 5.9kbit/s	CH.27710 2310 MHz	10 MHz	64QAM	1/24	-56.84	288	663	26	26	2	2.48	
LTE Band 66 ANT.A Codec: EVS NB 5.9kbit/s	CH.132322 1745 MHz	20 MHz	64QAM	1/49	-56.84	299	676	26	26	2	0.73	
LTE Band 66 ANT.F Codec: EVS NB 5.9kbit/s	CH.132322 1745 MHz	20 MHz	64QAM	1/49	-56.84	293	676	26	26	2	1.12	
LTE Band 71 ANT.A Codec: EVS NB 5.9kbit/s	CH.133297 680.5 MHz	20 MHz	64QAM	1/49	-56.84	295	676	26	26	1.99	2.56	
LTE Band 25 ANT.A Codec: EVS NB 5.9kbit/s	CH.26410 1860 MHz	20 MHz	64QAM	1/49	-56.84	305	676	26	26	1.73	2.68	8
LTE Band 25 ANT.A Codec: EVS NB 5.9kbit/s	CH.26590 1905 MHz	20 MHz	64QAM	1/49	-56.84	289	676	26	26	1.81	1.43	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)	H max dB (A/m)	Plot No.
NR Band 25 ANT F Codec: EVS-WB 5.9kbit/s	CH.376500 1882.5 ㎒	40 ㎒	CP-OFDM	QPSK	1/1	-53.05	339	676	26	26	2	4.71	
					1/108	-53.05	339	676	26	26	2	4.79	
					1/214	-53.05	337	676	26	26	2	4.53	
					108/0	-53.05	338	676	26	26	1.82	4.34	
					108/54	-53.05	341	676	26	26	1.91	4.51	
					108/108	-53.05	340	676	26	26	2	4.83	
					216/0	-53.05	341	676	26	26	1.92	4.77	
				16QAM	1/214	-53.05	329	668	26	26	1.55	4.87	
				64QAM	1/214	-53.05	337	676	26	26	2	4.09	
				256QAM	1/214	-53.05	338	676	26	26	2	4.52	
			DFTs-OFDM	QPSK	1/1	-53.02	331	668	26	26	1.91	4.5	
					1/108	-53.02	336	676	26	26	1.77	4.76	
					1/214	-53.02	336	674	26	26	2	4.76	
					108/0	-53.02	338	676	26	26	2	4.75	
					108/54	-53.02	336	676	26	26	1.93	4.85	
					108/108	-53.02	335	676	26	26	1.68	5.02	
					216/0	-53.02	337	676	26	26	2	4.83	
				BPSK	1/1	-53.02	345	675	26	26	1.46	5.42	
				16QAM	1/1	-53.02	343	676	26	26	1.6	5.01	
				64QAM	1/1	-53.02	347	676	26	26	2	4.77	
				256QAM	1/1	-53.02	348	676	26	26	1.82	4.73	

Mode	Ch. Freq.	BW	Waveform	Modulation	RB Config.	Ambient Noise dB (A/m)	Primary	Secondary	Contiguous longitudinal	Contiguous Transverse	Freq. Response (dB)	H max dB (A/m)	Plot No.
NR Band 25 ANT F Codec: EVS-WB 5.9kbit/s	CH.376500 1882.5 MHz	35 MHz	CP-OFDM	16QAM	1/187	-53.05	342	676	26	26	2	4.47	
		30 MHz			1/159	-53.05	338	676	26	26	2	5.10	
		25 MHz			1/132	-53.04	337	676	26	26	1.98	4.52	
		20 MHz			1/105	-53.04	338	676	26	26	2	4.66	
		15 MHz			1/78	-53.04	339	676	26	26	2	4.52	
		10 MHz			1/51	-53.04	338	676	26	26	1.57	4.77	
		5 MHz			1/24	-53.04	342	676	26	26	2	4.82	

Mode	Ch. Freq.	BW	Waveform	Modulation	RB Config.	Ambient Noise dB (A/m)	Primary	Secondary	Contiguous longitudinal	Contiguous Transverse	Freq. Response (dB)	H max dB (A/m)	Plot No.
NR Band n25 ANT A Codec: EVS-WB 5.9kbit/s	CH.376500 1882.5 MHz	40 MHz	CP-OFDM	16QAM	1/214	-53.04	338	676	26	26	1.99	4.70	
NR Band n7 ANT B Codec: EVS-WB 5.9kbit/s	CH.507000 2535 MHz	40 MHz	CP-OFDM	16QAM	1/214	-53.04	324	669	26	26	1.86	4.04	
NR Band n7 ANT F Codec: EVS-WB 5.9kbit/s	CH.507000 2535 MHz	40 MHz	CP-OFDM	16QAM	1/214	-53.04	321	668	26	26	1.99	4.17	
NR Band n12 ANT A Codec: EVS-WB 5.9kbit/s	CH.141500 707.5 MHz	15 MHz	CP-OFDM	16QAM	1/78	-53.04	338	676	26	26	2	5.13	
NR Band n26 ANT A Codec: EVS-WB 5.9kbit/s	CH.166300 831.5 MHz	20 MHz	CP-OFDM	16QAM	1/105	-53.04	337	676	26	26	2	4.54	
NR Band n30 ANT A Codec: EVS-WB 5.9kbit/s	CH.462000 2310 MHz	10 MHz	CP-OFDM	16QAM	1/51	-53.04	334	676	26	26	2	4.45	
NR Band n30 ANT F Codec: EVS-WB 5.9kbit/s	CH.462000 2310 MHz	10 MHz	CP-OFDM	16QAM	1/51	-53.04	306	643	26	26	2	4.50	10

Mode	Ch. Freq.	BW	Waveform	Modulation	RB Config.	Ambient Noise dB (A/m)	Primary	Secondary	Contiguous longitudinal	Contiguous Transverse	Freq. Response (dB)	H max dB (A/m)	Plot No.
NR Band n66 ANT A Codec: EVS-WB 5.9kbit/s	CH.349000 1745 MHz	40 MHz	CP-OFDM	16QAM	1/214	-53.04	339	676	26	26	2	4.78	
NR Band n66 ANT F Codec: EVS-WB 5.9kbit/s	CH.349000 1745 MHz	40 MHz	CP-OFDM	16QAM	1/214	-53.04	338	672	26	26	1.61	462	
NR Band n70 ANT A Codec: EVS-WB 5.9kbit/s	CH.340500 1702.5 MHz	15 MHz	CP-OFDM	16QAM	1/78	-53.04	338	676	26	26	2	4.38	
NR Band n71 ANT A Codec: EVS-WB 5.9kbit/s	CH.136100 680.5 MHz	20 MHz	CP-OFDM	16QAM	1/105	-53.04	340	676	26	26	2	4.51	

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)	H max dB (A/m)	Plot No.
LTEBand 41 PC2 ANT F Codec: EVS-NB 5.9kbit/s	CH.40620 2593 ㎒	20 ㎒	QPSK	1/0	-56.81	93	465	22	26	2	2.29	
				1/49	-56.81	97	470	22	26	2	1.06	
				1/99	-56.81	86	456	21	26	2	-0.05	11
				50/0	-56.81	102	478	21	26	2	4.49	
				50/25	-56.81	107	467	22	26	2	0.83	
				50/49	-56.81	96	463	22	26	2	2.18	
				100/0	-56.81	102	466	22	26	1.98	3.50	
			16QAM	1/0	-56.81	92	457	21	26	2	1.22	
			64QAM	1/0	-56.81	117	480	22	26	2	3.94	
			256QAM	1/0	-56.81	159	537	25	26	2	1.71	
		15 ㎒	QPSK	1/74	-56.81	96	461	21	26	1.77	2.91	
		10 ㎒		1/49	-56.81	91	460	21	26	2	2.88	
		5 ㎒		1/24	-56.75	100	458	21	28	2	2.11	
LTEBand 41 PC3 ANT F Codec: EVS-NB 5.9kbit/s	CH.40620 2593 ㎒	20 ㎒	QPSK	1/99	-56.75	109	475	22	26	2	2.56	
LTEBand 41 PC2 ANT B Codec: EVS-NB 5.9kbit/s	CH.40620 2593 ㎒	20 ㎒	QPSK	1/99	-56.75	93	442	26	26	1.67	1.55	
LTEBand 41 PC3 ANT B Codec: EVS-NB 5.9kbit/s	CH.40620 2593 ㎒	20 ㎒	QPSK	1/99	-56.75	111	481	26	26	2	2.55	
LTEBand 48 ANT F Codec: EVS-NB 5.9kbit/s	CH.55990 3625 ㎒	20 ㎒	QPSK	1/99	-56.75	165	836	26	26	2	1.66	
LTEBand 41 PC2 ANT F Codec: EVS-NB 5.9kbit/s	CH.39750 2506 ㎒	20 ㎒	QPSK	1/99	-56.75	93	465	22	26	2	2.11	12
	CH.40185 2549.5 ㎒				-56.75	102	463	21	26	1.86	1.68	13
	CH.41055 2636.5 ㎒				-56.82	94	450	21	26	1.85	2.54	14
	CH.41490 2680 ㎒				-56.82	88	435	20	26	2	0.65	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)	H max dB (A/m)	Plot No.
NR Band 41 ANT B Codec: AMR-WB 6.6kbit/s	CH.518598 2592.99 ㎒	100 ㎒	CP-OFDM	QPSK	1/1	-52.85	118	439	21	26	2	6.01	
					1/137	-52.85	121	442	20	26	2	5.72	
					1/271	-52.85	104	425	19	20	2	5.75	
					137/0	-52.85	172	494	21	26	2	6.42	
					137/68	-52.85	141	462	20	26	2	6.23	
					137/136	-52.85	154	476	21	26	2	6.01	
					273/0	-52.85	161	482	21	26	2	6.15	
				16QAM	1/271	-52.85	132	454	20	26	2	6.14	
				64QAM	1/271	-52.85	159	479	21	26	2	6.02	
				256QAM	1/271	-52.85	224	544	23	26	2	6.19	
			DFTs-OFDM	QPSK	1/1	-52.85	107	428	19	26	2	5.38	
					1/137	-52.85	113	432	20	26	2	5.38	
					1/271	-52.85	116	440	20	26	2	5.36	
					135/0	-52.85	129	445	20	26	2	5.41	
					135/69	-52.85	101	422	19	26	2	5.49	
					135/138	-52.85	103	423	19	26	2	5.59	
					270/0	-52.85	112	433	20	26	1.84	6.06	
				BPSK	135/69	-52.85	94	416	21	26	2	5.93	
				16QAM	135/69	-52.85	87	438	20	26	2	5.80	16
				64QAM	135/69	-52.85	144	464	21	26	2	5.75	
				256QAM	135/69	-52.85	183	504	22	26	2	5.86	

Mode	Ch. Freq.	BW	Waveform	Modulation	RB Config.	Ambient Noise dB (A/m)	Primary	Secondary	Contiguous longitudinal	Contiguous Transverse	Freq. Response (dB)	H max dB (A/m)	Plot No.
NR Band 41 ANT B Codec: AMR-WB 6.6kbit/s	CH.518598 2592.99 MHz	90 MHz	DFTs-OFDM	16QAM	120/63	-52.88	127	448	20	26	1.96	6.11	
		80 MHz			108/55	-52.88	127	444	20	26	1.93	5.95	
		70 MHz			90/50	-52.88	127	446	20	26	2	6.01	
		60 MHz			81/41	-52.88	124	445	20	26	2	6.01	
		50 MHz			64/35	-52.88	122	444	20	26	2	6.12	
		40 MHz			50/28	-52.88	124	444	20	26	1.96	6.05	
		30 MHz			36/21	-52.88	122	442	20	26	2	6.05	
		25 MHz			32/17	-52.88	120	441	20	26	2	6.13	
		20 MHz			25/13	-52.88	122	442	20	26	2	6.08	
		15 MHz			18/9	-52.88	126	445	20	26	2	6.16	
		10 MHz			12/6	-52.88	122	441	20	26	2	6.10	
NR Band 38 ANT B Codec: AMR-WB 6.6kbit/s	CH.519000 2595 MHz	40 MHz	DFTs-OFDM	16QAM	50/28	-52.89	222	521	25	26	2	7.93	
NR Band 48 ANT F Codec: AMR-WB 6.6kbit/s	CH.641666 3624.99 MHz	40 MHz	DFTs-OFDM	16QAM	50/28	-52.89	238	555	25	26	2	5.68	
NR Band 77 ANT F Codec: AMR-WB 6.6kbit/s	CH.650000 3750 MHz	100 MHz	DFTs-OFDM	16QAM	135/69	-52.89	141	461	24	26	2	5.28	
NR Band 77 DoD ANT F Codec: AMR-WB 6.6kbit/s	CH.633334 3500.01 MHz	100 MHz	DFTs-OFDM	16QAM	135/69	-52.89	117	438	24	26	2	545	

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	2	2	2	2	y (Transversal)	802.11b CH.6 2437 MHz DSSS 1 Mbps ANT1
Primary	145	153	151	141	151	151		
Secondary	458	463	461	462	464	163		
Contiguous Longitudinal	25	26	26	26	26	26		
Contiguous Transverse	26	26	26	26	26	26		

Codec Investigation											
Codec State	EVS-NB (kbit/s)			EVS-WB (kbit/s)			EVS-SWB (kbit/s)			Orientation	Band/ BandWidth/ Channel
	5.9	13.2	24.4	5.9	13.2	24.4	9.6	16.4	24.4		
Freq. Response(dB)	2	2	2	2	2	2	2	2	2	y (Transversal)	802.11b CH.6 2437 MHz DSSS 1 Mbps ANT1
Primary	131	154	159	112	152	149	163	171	169		
Secondary	462	462	466	461	462	458	462	471	469		
Contiguous Longitudinal	26	26	26	26	26	26	25	26	26		
Contiguous Transverse	26	26	26	26	26	26	29	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	2	2	2	2	2	y (Transversal)	802.11a CH.40 5200 ㎒ BPSK 6 Mbps MIMO
Primary	169	169	170	156	169	167		
Secondary	475	470	466	475	481	479		
Contiguous Longitudinal	26	25	25	25	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/ Band Width/ Channel
	5.9	13.2	24.4	5.9	13.2	24.4	9.6	16.4	24.4		
Freq. Response(dB)	1.97	2	2	2	2	2	2	2	1.95	y (Transversal)	802.11a CH.40 5200 ㎒ BPSK 6 Mbps MIMO
Primary	152	165	171	123	165	165	173	190	153		
Secondary	468	461	467	470	474	474	472	468	457		
Contiguous Longitudinal	24	24	24	24	25	26	26	25	24		
Contiguous Transverse	26	26	26	26	26	26	26	26	26		

11.4 VoWi-Fi Antennas Investigation

EVS-WB 5.9 kbit/s was the worst case bit-rates for 2.4GHz 802.11b, 2.4GHz 802.11n, EVS-WB 5.9 kbit/s was the worst case bit-rates for 5GHz 802.11a. The secondary antenna was investigated to determine which antennas yields a worse Primary Group. The worst case codec and bit-rate from 802.11b 2.4GHz Antenna 1 was used to determine Antenna 2 exclusion.

2.4GHz Antenna Investigation				
Codec State	ANT1	ANT2	Orientation	Band/ Bandwidth/ Channel
	EVS-WB (kbit/s)			
	5.9			
Freq. Response(dB)	2	1.79	y (Transversal)	802.11b CH.6 2437 ㎒ 1 Mbps
Primary	112	268		
Secondary	461	620		
Contiguous Longitudinal	26	26		
Contiguous Transverse	26	26		

The worst case codec and bit-rate from 802.11n 2.4GHz Antenna MIMO was used to determine Antenna 1, Antenna 2's exclusion.

2.4GHz Antenna Investigation					
Codec State	ANT1	ANT2	MIMO	Orientation	Band/ Bandwidth/ Channel
	EVS-WB (kbit/s)				
	5.9				
Freq. Response(dB)	2	2	2	y (Transversal)	802.11g CH.6 2437 ㎒ 6 Mbps
Primary	267	298	119		
Secondary	621	656	471		
Contiguous Longitudinal	26	26	25		
Contiguous Transverse	26	26	26		

Since 5GHz Antenna 1, 2 yielded a better Primary Group than Antenna MIMO, all subsequent measurements were measured using Antenna MIMO.

5GHz Antenna Investigation					
Codec State	ANT1	ANT2	MIMO	Orientation	Band/ BandWidth/ Channel
	EVS-WB (kbit/s)				
	5.9				
Freq. Response(dB)	2	2	2	y (Transversal)	802.11a CH.40 5200 ㎒ 6 Mbps
Primary	225	207	123		
Secondary	582	562	470		
Contiguous Longitudinal	26	26	24		
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 §11.3, §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)	H max dB (A/m)	Plot No.
802.11b ANT1 Codec: EVS-WB 5.9kbit/s	CH.6 2437 ㎒	20 ㎒	1 Mbps	-52.96	112	461	26	26	2	10.09	17
			5.5 Mbps	-52.96	228	568	26	26	1.73	9.04	
			11 Mbps	-52.96	236	582	26	26	1.78	8.91	
	CH.1 2412 ㎒		1 Mbps	-52.96	215	578	26	26	2	5.9	18
	CH.11 2462 ㎒		1 Mbps	-52.96	220	577	26	26	2	5.51	19
802.11g MIMO Codec: EVS-WB 5.9kbit/s	CH.6 2437 ㎒	20 ㎒	6 Mbps	-52.96	204	556	26	26	2	5.79	
802.11n HT20 MIMO Codec: EVS-WB 5.9kbit/s	CH.6 2437 ㎒	20 ㎒	MCS 0	-52.96	119	471	25	26	2	5.54	
802.11ac VHT20 MIMO Codec: EVS-WB 5.9kbit/s	CH.6 2437 ㎒	20 ㎒	MCS 0	-52.96	116	472	25	26	2	6.98	
802.11ax HE20 MIMO Codec: EVS-WB 5.9kbit/s	CH.6 2437 ㎒	20 ㎒	MCS 0	-52.96	298	661	26	26	2	6.39	

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)	H max dB (A/m)	Plot No.
802.11a MIMO Codec: EVS-WB 5.9kbit/s	CH.40 5200 MHz	20 MHz	6 Mbps	-52.98	123	470	23	26	2	3.06	
			18 Mbps	-52.98	143	504	26	26	2	3.15	
			54 Mbps	-52.98	183	552	26	26	2	3.19	
802.11n HT20 MIMO Codec: EVS-WB 5.9kbit/s	CH.40 5200 MHz	20 MHz	MCS 0	-52.98	104	466	24	26	2	3.24	20
			MCS 3	-52.98	120	488	25	26	2	2.96	
			MCS 7	-52.98	227	535	26	26	2	7.34	
802.11n HT40 MIMO Codec: EVS-WB 5.9kbit/s	CH.38 5190 MHz	40 MHz	MCS 0	-52.98	132	496	26	26	2	2.86	
			MCS 3	-52.98	146	520	26	26	2	3.36	
			MCS 7	-52.98	225	590	26	26	2	3.13	
802.11ac VHT20 MIMO Codec: EVS-WB 5.9kbit/s	CH.40 5200 MHz	20 MHz	MCS 0	-53.03	141	451	23	26	2	7.44	
			MCS 4	-53.03	235	544	26	26	2	7.39	
			MCS 8	-53.03	185	496	26	26	2	7.28	
802.11ac VHT40 MIMO Codec: EVS-WB 5.9kbit/s	CH.38 5190 MHz	40 MHz	MCS 0	-53.03	167	469	25	26	2	7.40	
			MCS 4	-53.03	293	593	26	26	2	7.47	
			MCS 9	-53.03	237	567	26	26	1.96	6.06	
802.11ac VHT80 MIMO Codec: EVS-WB 5.9kbit/s	CH.42 5210 MHz	80 MHz	MCS 0	-53.03	123	468	24	26	2	4.47	
			MCS 4	-53.03	171	521	26	26	2	4.69	
			MCS 9	-53.03	195	544	26	26	1.98	2.53	

Mode	Ch. Freq.	BW	Modulation	Ambient Noise dB (A/m)	Primary	Secondary	Contiguous longitudinal	Contiguous Transverse	Freq. Response (dB)	H max dB (A/m)	Plot No.
802.11ac VHT160 MIMO Codec: EVS-WB 5.9kbit/s	CH.50 5250 MHz	160 MHz	MCS 0	-53.03	152	498	26	26	2	4.33	
			MCS 4	-53.03	201	553	26	26	2	4.15	
			MCS 9	-53.03	197	557	26	26	2	3.04	
802.11ax HE20 MIMO Codec: EVS-WB 5.9kbit/s	CH.40 5200 MHz	20 MHz	MCS 0	-53.00	138	495	26	26	2	3.85	
			MCS 6	-53.00	192	554	26	26	2	3.16	
			MCS 11	-53.00	251	610	26	26	1.56	3.92	
802.11ax HE40 MIMO Codec: EVS-WB 5.9kbit/s	CH.38 5190 MHz	40 MHz	MCS 0	-53.00	229	5897	26	26	2	3.58	
			MCS 6	-53.00	258	610	26	26	2	3.32	
			MCS 11	-53.00	234	600	26	26	2	3.22	
802.11ax HE80 MIMO Codec: EVS-WB 5.9kbit/s	CH.42 5210 MHz	80 MHz	MCS 0	-53.00	170	525	26	26	2	3.11	
			MCS 6	-53.00	180	542	26	26	2	3.37	
			MCS 11	-53.00	184	540	26	26	2	2.95	
802.11ax HE160 MIMO Codec: EVS-WB 5.9kbit/s	CH.50 5250 MHz	160 MHz	MCS 0	-53.00	174	531	26	26	2	3.13	
			MCS 6	-53.00	181	538	26	26	1.99	3.34	
			MCS 11	-53.00	203	560	26	26	2	3.20	
802.11ax HE20 MIMO Codec: EVS-WB 5.9kbit/s	CH. 5 5975 MHz	20 MHz	MCS 0	-52.92	197	555	26	26	2	3.58	
802.11ax HE40 MIMO Codec: EVS-WB 5.9kbit/s	CH. 7 5985 MHz	40 MHz	MCS 0	-52.92	154	512	26	26	2	3.55	
802.11n20 MIMO Codec: EVS-WB 5.9kbit/s	CH.60 5300 MHz	20 MHz	MCS 0	-52.92	141	481	25	26	2	4.76	
	CH.120 5600 MHz	20 MHz	MCS 0	-52.92	137	480	25	26	2	4.86	
	CH.157 5785 MHz	20 MHz	MCS 0	-52.92	120	465	24	26	1.89	4.42	
	CH.173 5865 MHz	20 MHz	MCS 0	-52.92	123	465	24	26	1.68	4.69	
802.11n20 MIMO Codec: EVS-WB 5.9kbit/s	CH.36 5180 MHz	20 MHz	MCS 0	-52.92	123	467	24	26	2	4.01	21
	CH.48 5240 MHz			-52.92	122	464	24	26	2	4.81	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)	2	1.71	1.49	y(Transversal)	GSM 850 EDGE 2 slot Ch.251 848.8 MHz ANT A
Primary	63	70	113		
Secondary	386	403	422		
Contiguous Longitudinal	21	21	20		
Contiguous Transverse	26	26	26		
Freq. Response (dB)	1.69	1.55	1.73	y(Transversal)	UMTS Band II HSUPA subtest 1 CH.9538 1907.6 ㎒ ANT A
Primary	298	322	319		
Secondary	606	617	626		
Contiguous Longitudinal	26	26	26		
Contiguous Transverse	26	26	26		
Freq. Response (dB)	1.14	1.66	2	y(Transversal)	LTE Band 25 20 ㎒ 64QAM 1RB 49offset CH.26365 1882.5 ㎒ ANT A
Primary	323	335	376		
Secondary	622	640	669		
Contiguous Longitudinal	26	26	26		
Contiguous Transverse	26	26	26		
Freq. Response (dB)	1.5	1.84	1.76	y(Transversal)	LTE Band 41 PC2 20 ㎒ QPSK 1B 99offset CH.40620 2593 ㎒ ANT F
Primary	143	146	153		
Secondary	443	440	454		
Contiguous Longitudinal	21	20	21		
Contiguous Transverse	26	26	26		

Codec Investigation					
Codec State	codec bit rate (kbit/s)			Orientation	Band/Bandwidth/Channel
	6	40	75		
Freq. Response (dB)	1.64	2	1.91	y(Transversal)	802.11b 2.4GHz 1Mbps CH.6 2437 ㎒ Antenna 1
Primary	128	134	136		
Secondary	443	445	448		
Contiguous Longitudinal	24	24	24		
Contiguous Transverse	26	26	26		
Freq. Response (dB)	1.36	2	2	y(Transversal)	802.11n20 5GHz MCS0 CH40 5200 ㎒ Antenna MIMO
Primary	165	159	163		
Secondary	489	481	485		
Contiguous Longitudinal	25	25	25		
Contiguous Transverse	26	26	26		
Freq. Response (dB)	1.1	2	1.9	y(Transversal)	NR Band 30 10 ㎒ CP-OFDM 16QAM 1RB 51offset CH.462000 2310 ㎒ ANT F
Primary	350	338	349		
Secondary	641	628	638		
Contiguous Longitudinal	26	26	26		
Contiguous Transverse	26	26	26		
Freq. Response (dB)	1.38	1.59	1.69	y(Transversal)	NR Band 41 100 ㎒ DFT-s 16QAM 135RB 69offset CH.518598 2592.99 ㎒ ANT B
Primary	209	202	202		
Secondary	507	504	495		
Contiguous Longitudinal	24	22	23		
Contiguous Transverse	36	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)	H max dB (A/m)	Plot No.
GSM850 EDGE 2 slots Google Meet Codec: 6kbit/s ANT A	CH.128 824.2 MHz				-53.00	75	407	21	26	1.51	4.31	23
GSM850 EDGE 2 slots Google Meet Codec: 6kbit/s ANT A	CH.190 836.6 MHz				-53.00	51	379	20	26	1.73	5.42	24
GSM850 EDGE 2 slots Google Meet Codec: 6kbit/s ANT A	CH.251 848.8 MHz				-53.00	63	386	21	26	2	4.48	25
GSM1900 EDGE 2 slots Google Meet Codec: 40kbit/s ANT A	CH.661 1880 MHz				-53.00	98	431	22	26	1.15	3.92	
UMTS Band II HSUPA subtest1 Google Meet Codec: 6kbit/s ANT A	CH.9538 1907.6 MHz				-53.00	298	606	26	26	1.69	7.22	**26**
UMTS Band IV HSUPA subtest1 Google Meet Codec: 6kbit/s ANT A	CH.1412 1732.4 MHz				-53.00	310	645	26	26	1.36	4.65	
UMTS Band V HSUPA subtest1 Google Meet Codec: 6kbit/s ANT A	CH.4183 836.6 MHz				-53.00	342	651	26	26	1.10	7.31	
LTE Band 7 Google Meet Codec: 6kbit/s ANT B	CH.21100 2535 MHz	20 MHz	64QAM	1/49	-52.91	358	664	26	26	1.51	7.41	
LTE Band 7 Google Meet Codec: 6kbit/s ANT F	CH.21100 2535 MHz	20 MHz	64QAM	1/49	-52.91	313	618	26	26	1.46	7.32	**27**
LTE Band 12 Google Meet Codec: 6kbit/s ANT A	CH.23095 707.5 MHz	10 MHz	64QAM	1/24	-52.91	338	642	26	26	1.41	7.65	
LTE Band 13 Google Meet Codec: 6kbit/s ANT A	CH.23230 782.0 MHz	10 MHz	64QAM	1/24	-52.91	350	654	26	26	1.79	7.53	
LTE Band 14 Google Meet Codec: 6kbit/s ANT A	CH.23330 793 MHz	10 MHz	64QAM	1/24	-52.91	343	647	26	26	2	7.51	
LTE Band 25 Google Meet Codec: 6kbit/s ANT A	CH.26365 1882.5 MHz	20 MHz	64QAM	1/49	-52.91	323	622	26	26	1.14	7.57	
LTE Band 25 Google Meet Codec: 6kbit/s ANT F	CH.26365 1882.5 MHz	20 MHz	64QAM	1/49	-52.91	345	651	26	26	1.94	7.58	
LTE Band 26 Google Meet Codec: 6kbit/s ANT A	CH.26865 831.5 MHz	15 MHz	64QAM	1/36	-52.91	326	632	26	26	1.88	7.28	
LTE Band 30 Google Meet Codec: 6kbit/s ANT A	CH.27710 2310 MHz	10 MHz	64QAM	1/24	-52.91	319	625	26	26	2	7.64	
LTE Band 30 Google Meet Codec: 6kbit/s ANT F	CH.27710 2310 MHz	10 MHz	64QAM	1/24	-52.91	317	622	26	26	1.48	7.76	
LTE Band 66 Google Meet Codec: 6kbit/s ANT A	CH.132322 1745 MHz	20 MHz	64QAM	1/49	-52.91	369	672	26	26	1.45	7.64	
LTE Band 66 Google Meet Codec: 6kbit/s ANT F	CH.132322 1745 MHz	20 MHz	64QAM	1/49	-52.91	332	636	26	26	1.59	7.51	
LTE Band 71 Google Meet Codec: 6kbit/s ANT A	CH.133297 680.5 MHz	20 MHz	64QAM	1/49	-52.91	336	640	26	26	1.84	7.51	

Mode	Ch. Freq.	BW	Mode	RB Config.	Ambient Noise dB (A/m)	Primary	Secondary	Contiguous longitudinal	Contiguous Transverse	Freq. Response (dB)	H max dB (A/m)	Plot No.
LTE Band 41 Google Meet Codec: 6kbit/s PC 2 ANT F	CH.40620 2593 ㎒	20 ㎒	QPSK	1/99	-52.91	143	443	21	26	1.50	7.93	
LTE Band 41 Google Meet Codec: 6kbit/s PC 2 ANTB	CH.40620 2593 ㎒	20 ㎒	QPSK	1/99	-52.91	110	414	22	26	1.49	7.71	28
LTE Band 41 Google Meet Codec: 6kbit/s PC 3 ANT F	CH.40620 2593 ㎒	20 ㎒	QPSK	1/99	-52.91	203	507	22	26	1.39	7.00	
LTE Band 41 Google Meet Codec: 6kbit/s PC 3 ANT B	CH.40620 2593 ㎒	20 ㎒	QPSK	1/99	-52.91	153	454	24	26	1.54	7.71	
LTE Band 48 Google Meet Codec: 6kbit/s ANT F	CH.55990 3625 ㎒	20 ㎒	QPSK	1/99	-52.91	185	489	23	26	1.79	8.07	

Mode	Ch. Freq.	BW	Mode	RB Config.	Ambient Noise dB (A/m)	Primary	Secondary	Contiguous longitudinal	Contiguous Transverse	Freq. Response (dB)	H max dB (A/m)	Plot No.
Wi-Fi 2.4 GHz 802.11b Ant1 Google Meet Codec: 6kbit/s	CH.6 2437 MHz	20 MHz	1 Mbps		-52.96	128	443	24	26	1.64	8.40	**29**
U-NII 5.2 GHz 802.11n MIMO Google Meet Codec: 40kbit/s	CH.40 5200 MHz	20 MHz	MCS 0		-52.92	159	481	25	26	2	9.32	
U-NII 5.3 802.11n MIMO Google Meet Codec: 40kbit/s	CH.60 5300 MHz	20 MHz	MCS 0		-52.92	157	448	22	26	1.69	8.5	
U-NII 5.6 GHz 802.11n MIMO Google Meet Codec: 40kbit/s	CH.120 5600 MHz	20 MHz	MCS 0		-52.92	134	424	20	26	1.86	8.65	**30**
U-NII 5.8 GHz 802.11n MIMO Google Meet Codec: 40kbit/s	CH.157 5785 MHz	20 MHz	MCS 0		-52.92	139	424	22	26	1.74	9.16	
U-NII 5.8 GHz 802.11n MIMO Google Meet Codec: 40kbit/s	CH.173 5865 MHz	20 MHz	MCS 0		-52.92	154	445	23	26	1.68	8.52	
U-NII 5.9 GHz 802.11ax MIMO Google Meet Codec: 40kbit/s	CH.5 5975 MHz	20 MHz	MCS 0		-52.92	266	557	26	26	1.83	8.88	

Mode	Ch. Freq.	BW	Waveform	Modulation	RB Config.	Ambient Noise dB (A/m)	Primary	Secondary	Contiguous longitudinal	Contiguous Transverse	Freq. Response (dB)	H max dB (A/m)	Plot No.
NR Band n25 Google Meet Codec: 40kbit/s ANT A	CH.376500 1882.5 MHz	40 MHz	CP-OFDM	16QAM	1/214	-52.89	342	638	26	26	1.97	8.05	
NR Band n25 Google Meet Codec: 40kbit/s ANT F	CH.376500 1882.5 MHz	40 MHz	CP-OFDM	16QAM	1/214	-52.89	339	636	26	26	1.77	7.55	
NR Band n7 Google Meet Codec: 40kbit/s ANT B	CH.50700 2535 MHz	40 MHz	CP-OFDM	16QAM	1/214	-52.89	336	632	26	26	1.74	8.17	
NR Band n7 Google Meet Codec: 40kbit/s ANT F	CH.50700 2535 MHz	40 MHz	CP-OFDM	16QAM	1/214	-52.89	335	639	26	26	2	7.54	
NR Band n12 Google Meet Codec: 40kbit/s ANT A	CH.142500 707.5 MHz	15 MHz	CP-OFDM	16QAM	1/78	-52.89	342	641	26	26	1.89	8.49	
NR Band n26 Google Meet Codec: 40kbit/s ANT A	CH.166300 831.5 MHz	20 MHz	CP-OFDM	16QAM	1/214	-52.89	333	630	26	26	1.74	8.40	
NR Band n30 Google Meet Codec: 40kbit/s ANT A	CH.462000 2310 MHz	10 MHz	CP-OFDM	16QAM	1/51	-52.89	325	625	26	26	1.73	7.78	
NR Band n30 Google Meet Codec: 40kbit/s ANT F	CH.462000 2310 MHz	10 MHz	CP-OFDM	16QAM	1/51	-52.89	338	628	26	2	2	8.97	
NR Band n66 Google Meet Codec: 40kbit/s ANT A	CH.349000 1745 MHz	40 MHz	CP-OFDM	16QAM	1/214	-52.89	339	636	26	26	1.78	7.96	
NR Band n66 Google Meet Codec: 40kbit/s ANT F	CH.349000 1745 MHz	40 MHz	CP-OFDM	16QAM	1/214	-52.89	337	632	26	26	1.80	7.53	
NR Band n70 Google Meet Codec: 40kbit/s ANT A	CH. 340500 1702.5 MHz	15 MHz	CP-OFDM	16QAM	1/78	-52.89	342	638	26	26	1.80	7.98	
NR Band n71 Google Meet Codec: 40kbit/s ANT A	CH.136100 680.5 MHz	20 MHz	CP-OFDM	16QAM	1/105	-52.89	331	629	26	26	1.63	8.52	31

Mode	Ch. Freq.	BW	Waveform	Modulation	RB Config.	Ambient Noise dB (A/m)	Primary	Secondary	Contiguous longitudinal	Contiguous Transverse	Freq. Response (dB)	H max dB (A/m)	Plot No.
NR Band n38 Google Meet Codec: 75kbit/s ANT B	CH. 519000 2595 MHz	40 MHz	DFTs OFDM	16QAM	50/28	-53.00	230	522	25	26	2	8.87	
NR Band n41 Google Meet Codec: 75kbit/s ANT B	CH. 518598 2592.99 MHz	100 MHz	DFTs OFDM	16QAM	135/69	-53.00	202	495	23	26	1.69	8.43	
NR Band n48 Google Meet Codec: 75kbit/s ANT F	CH. 641666 3624.99 MHz	40 MHz	DFTs OFDM	16QAM	50/28	-53.00	207	505	23	26	1.61	8.40	
NR Band n77 Google Meet Codec: 75kbit/s ANT F	CH. 650000 3750 MHz	100 MHz	DFTs OFDM	16QAM	135/69	-53.00	196	493	23	26	1.60	8.48	32
NR Band n77 DoD Google Meet Codec: 75kbit/s ANT F	CH. 653334 3500.01 MHz	100 MHz	DFTs OFDM	16QAM	135/69	-53.00	209	507	22	26	1.57	8.50	

Appendix 1. TEST SETUP PHOTO

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

Rev. No.	File No.
0	HCT-SR-2407-FC006-P

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 - 3153	May 14, 2024	DAE4 Sn1254	May 16, 2024

Communication Systems

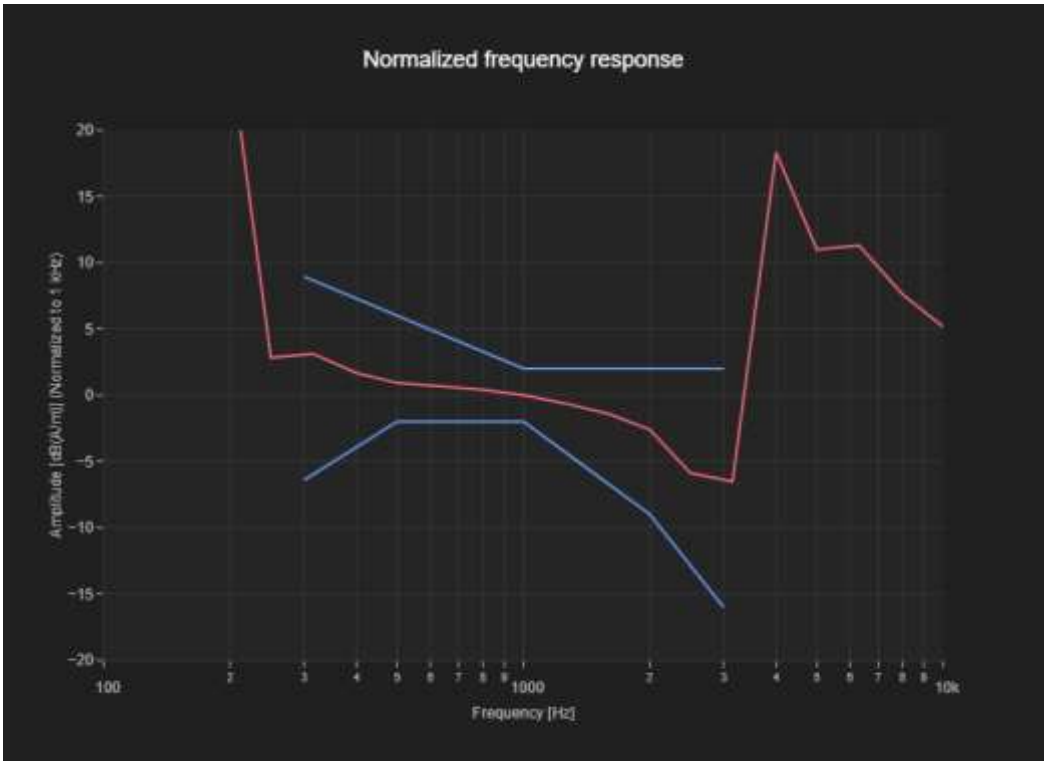
Band Name	Communication Systems Name	Channel	Frequency [MHz]
GSM 850	GSM-FDD (TDMA, GMSK)	128	824.2

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	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
40	332	19	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 - 3153	May 14, 2024	DAE4 Sn1254	May 16, 2024

Communication Systems

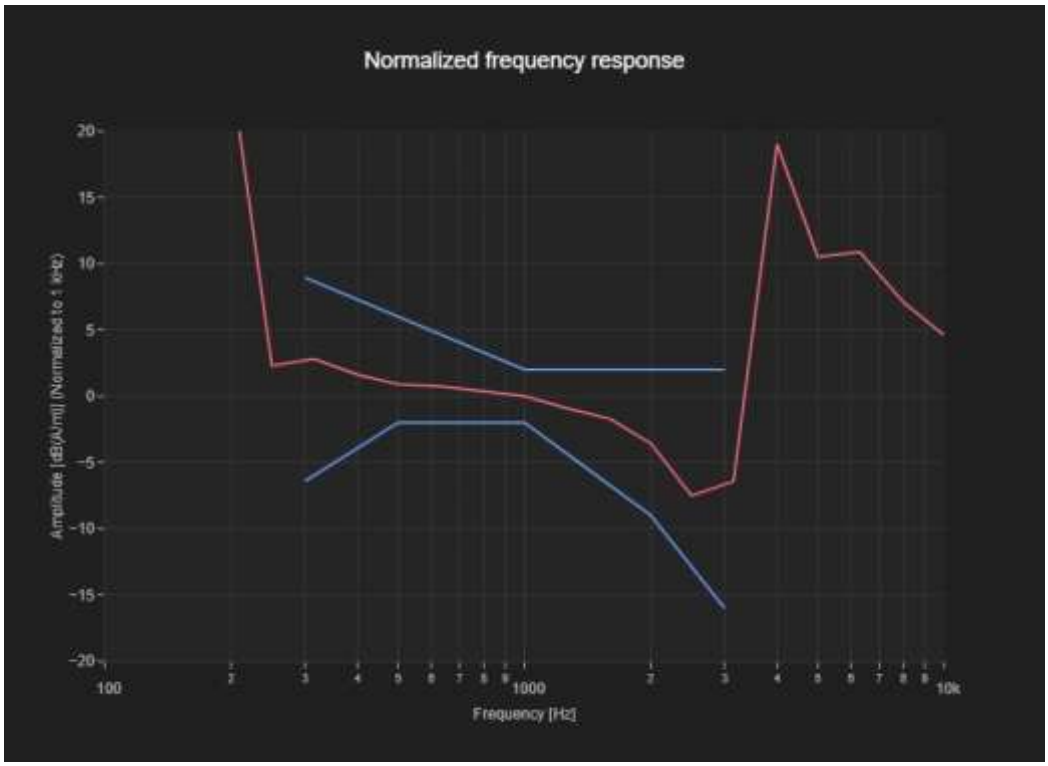
Band Name	Communication Systems Name	Channel	Frequency [MHz]
GSM 850	GSM-FDD (TDMA, GMSK)	190	836.6

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	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
36	323	19	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 - 3153	May 14, 2024	DAE4 Sn1254	May 16, 2024

Communication Systems

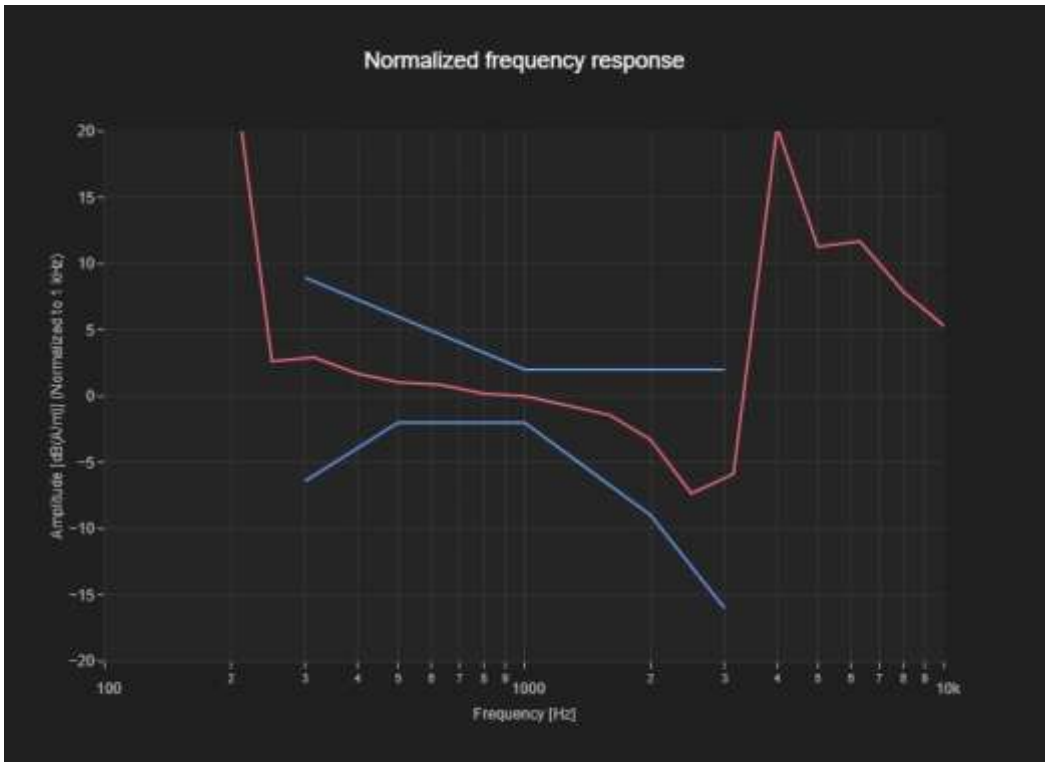
Band Name	Communication Systems Name	Channel	Frequency [MHz]
GSM 850	GSM-FDD (TDMA, GMSK)	251	848.8

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	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
33	303	18	26

Plot 4 UMTS Band II CH.9262 Voice AMR WB Codec: 6.6 kbit/s ANT A

Hardware Setup

Probe Name	Probe Calibration Date	DAE Name	DAE Calibration Date
AM1DV3 - 3153	May 14, 2024	DAE4 Sn1254	May 16, 2024

Communication Systems

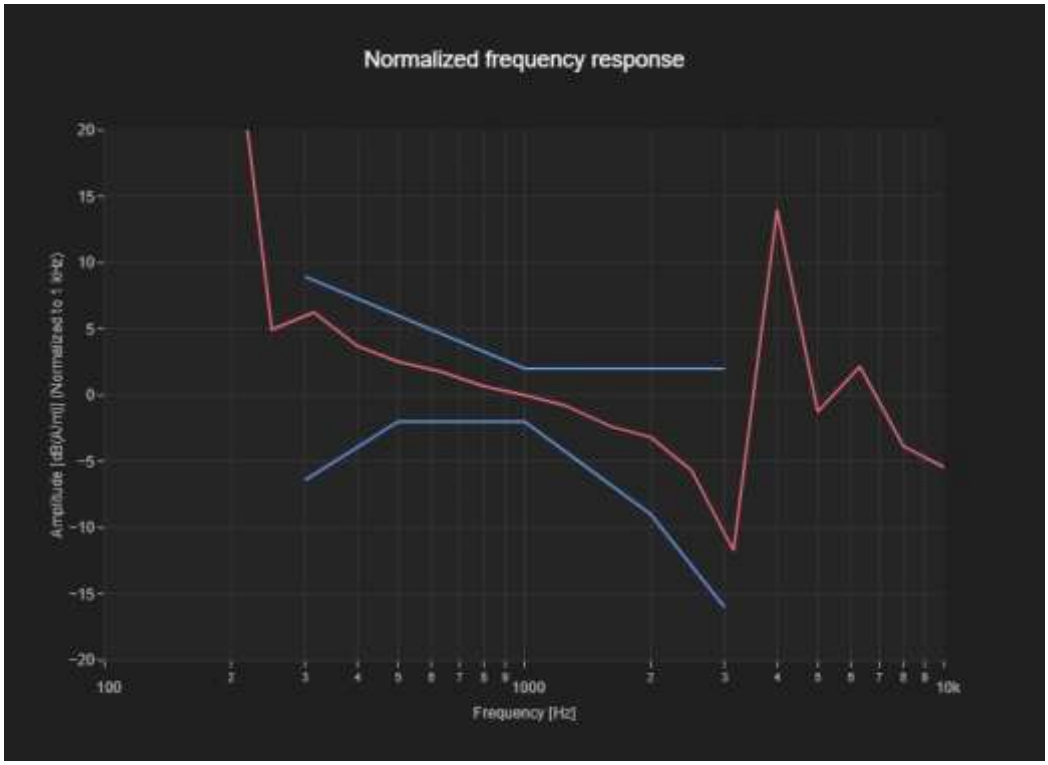
Band Name	Communication Systems Name	Channel	Frequency [MHz]
Band 2, UTRA/FDD	UMTS-FDD (WCDMA, AMR)	9262	1852.4

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
352	676	26	26

Plot 5 UMTS Band II CH.9400 Voice AMR WB Codec: 6.6 kbit/s ANT A

Hardware Setup

Probe Name	Probe Calibration Date	DAE Name	DAE Calibration Date
AM1DV3 - 3153	May 14, 2024	DAE4 Sn1254	May 16, 2024

Communication Systems

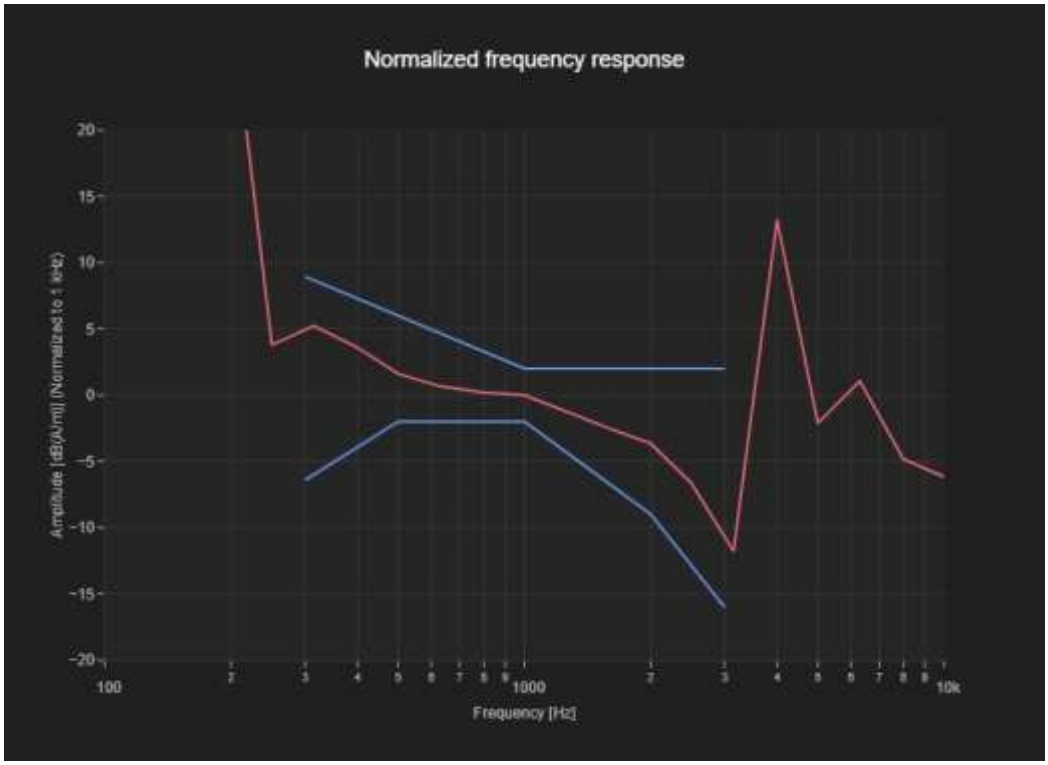
Band Name	Communication Systems Name	Channel	Frequency [MHz]
Band 2, UTRA/FDD	UMTS-FDD (WCDMA, AMR)	9400	1880.0

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
353	676	26	26

Plot 6 UMTS Band II CH.9538 Voice AMR WB Codec: 6.6 kbit/s ANT A

Hardware Setup

Probe Name	Probe Calibration Date	DAE Name	DAE Calibration Date
AM1DV3 - 3153	May 14, 2024	DAE4 Sn1254	May 16, 2024

Communication Systems

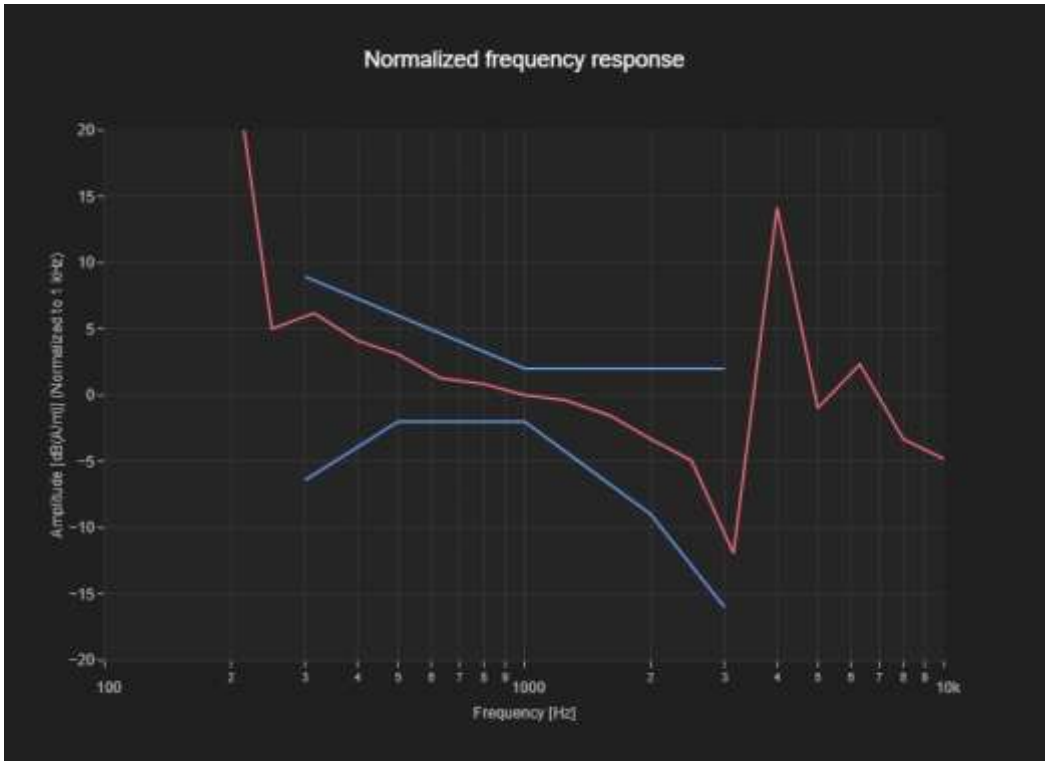
Band Name	Communication Systems Name	Channel	Frequency [MHz]
Band 2, UTRA/FDD	UMTS-FDD (WCDMA, AMR)	9538	1907.6

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	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
352	676	26	26

Plot 7 LTE Band 25 CH.26365 Voice EVS-NB Codec 5.9 kbit/s ANT A

Hardware Setup

Probe Name	Probe Calibration Date	DAE Name	DAE Calibration Date
AM1DV3 - 3153	May 14, 2024	DAE4 Sn1254	May 16, 2024

Communication Systems

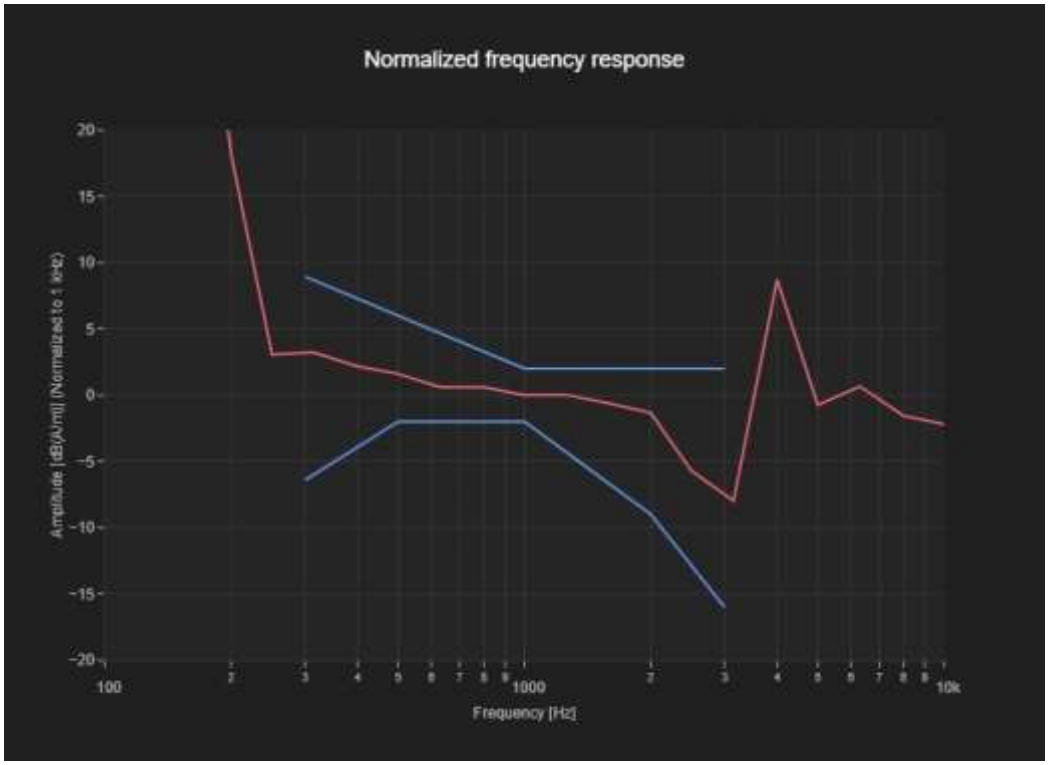
Band Name	Communication Systems Name	Channel	Frequency [MHz]
Band 25, E-UTRA/FDD	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, 64-QAM)	26365	1882.5

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	1.96	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
284	676	26	26

Plot 8 LTE Band 25 CH.26410 Voice EVS-NB Codec 5.9 kbit/s ANT A

Hardware Setup

Probe Name	Probe Calibration Date	DAE Name	DAE Calibration Date
AM1DV3 - 3153	May 14, 2024	DAE4 Sn1254	May 16, 2024

Communication Systems

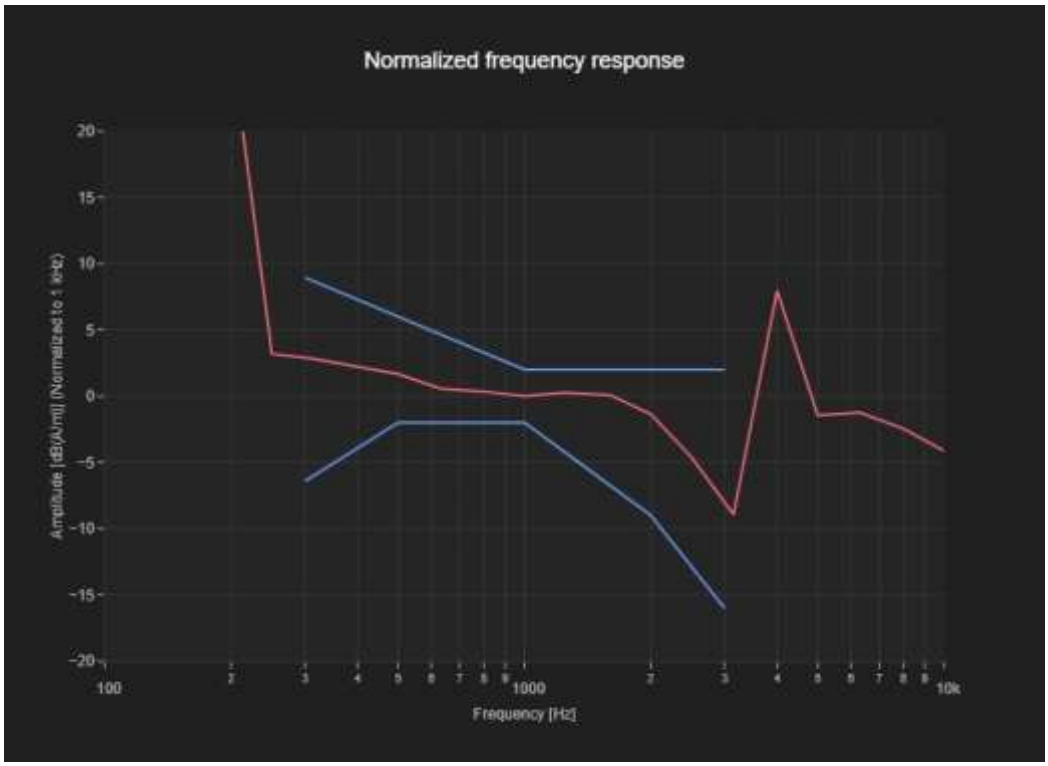
Band Name	Communication Systems Name	Channel	Frequency [MHz]
Band 25, E-UTRA/FDD	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, 64-QAM)	26140	1860.0

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	1.73	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
305	676	26	26

Plot 9 LTE Band 25 CH.26590 Voice EVS-NB Codec 5.9 kbit/s ANT A

Hardware Setup

Probe Name	Probe Calibration Date	DAE Name	DAE Calibration Date
AM1DV3 - 3153	May 14, 2024	DAE4 Sn1254	May 16, 2024

Communication Systems

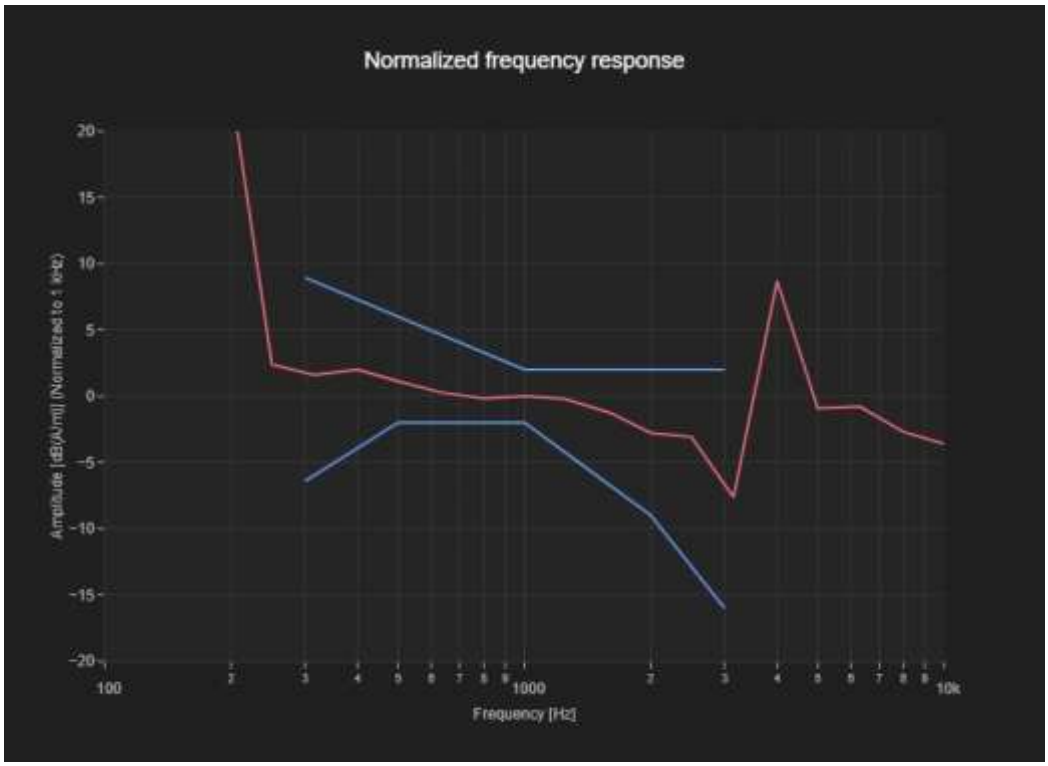
Band Name	Communication Systems Name	Channel	Frequency [MHz]
Band 25, E-UTRA/FDD	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, 64-QAM)	26590	1905.0

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	1.81



T-Coil Coupling Mode Test Report

Results

Primary Group Contiguous Point Count	Secondary Group Point Count	Secondary Group Max Longitudinal	Secondary Group Max Transverse
289	676	26	26

Plot 10 NR Band n30 CH.462000 Voice EVS WB Codec: 5.9 kbit/s ANT F

Hardware Setup

Probe Name	Probe Calibration Date	DAE Name	DAE Calibration Date
AM1DV3 - 3050	November 23, 2023	DAE4ip Sn1866	May 02, 2024

Communication Systems

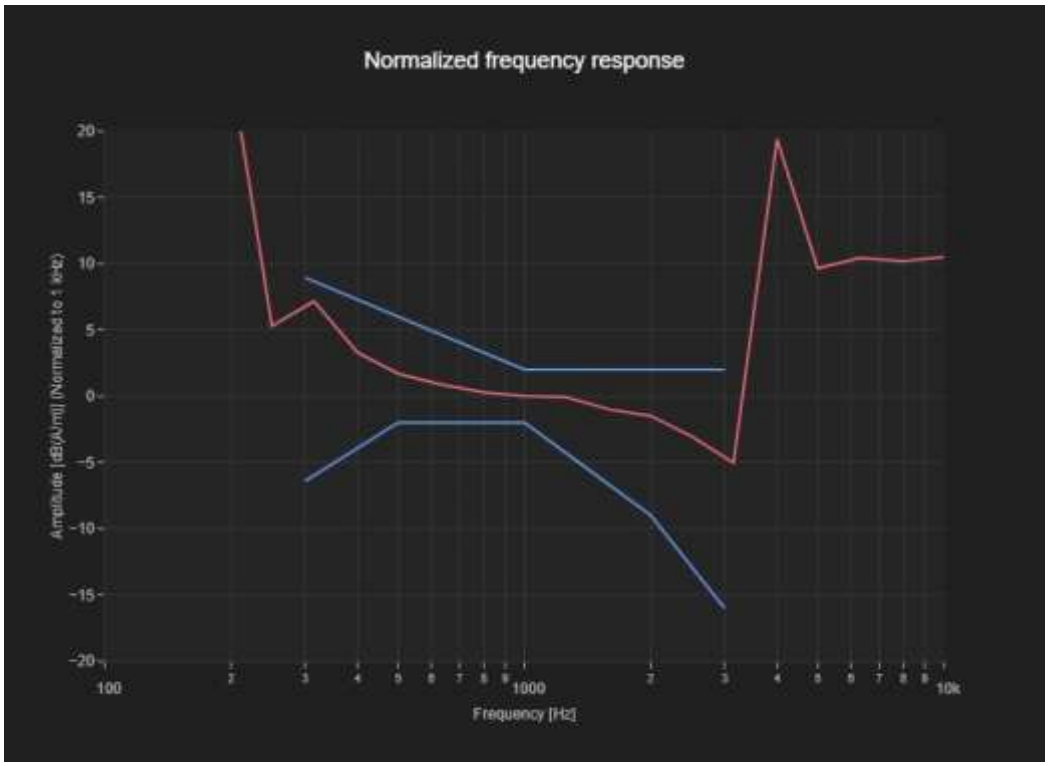
Band Name	Communication Systems Name	Channel	Frequency [MHz]
Band n30	5G NR (DFT-s-OFDM, 1 RB, 10 MHz, QPSK, 15 kHz)	462000	2310.0

Grid Settings

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

Results

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



T-Coil Coupling Mode Test Report

Results

Primary Group Contiguous Point Count	Secondary Group Point Count	Secondary Group Max Longitudinal	Secondary Group Max Transverse
306	643	26	26

Plot 11 LTE Band 41 CH.40620 Voice EVS-NB Codec: 5.9 kbit/s PC2 ANT F

Hardware Setup

Probe Name	Probe Calibration Date	DAE Name	DAE Calibration Date
AM1DV3 - 3153	May 14, 2024	DAE4 Sn1254	May 16, 2024

Communication Systems

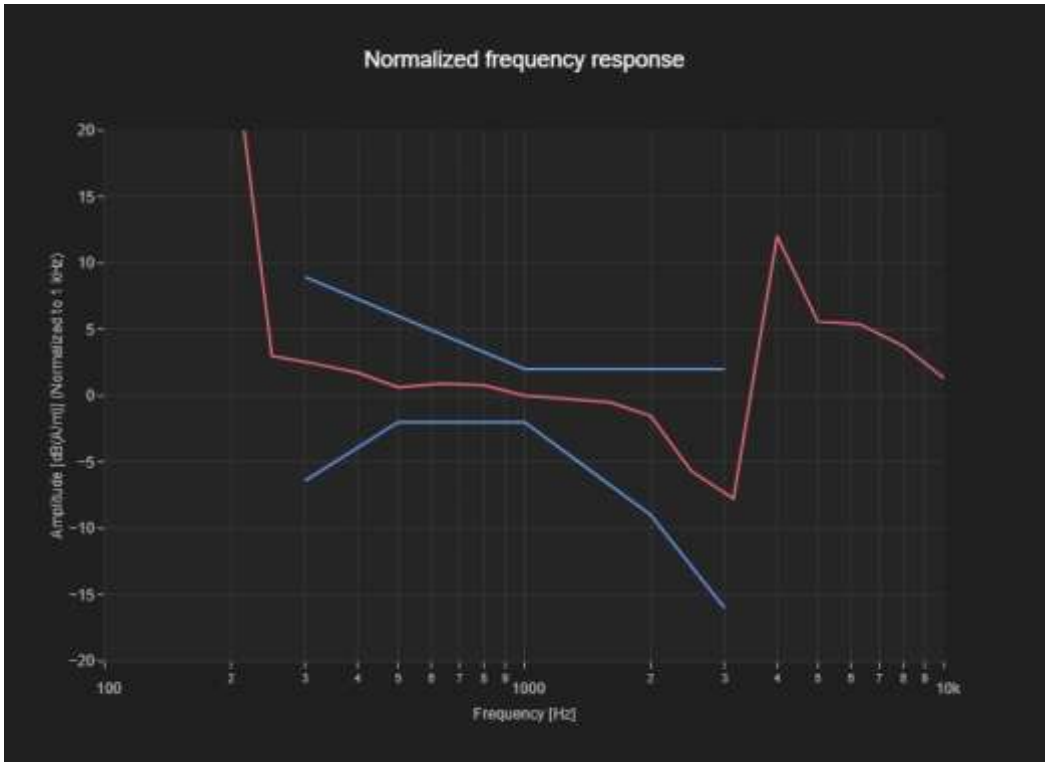
Band Name	Communication Systems Name	Channel	Frequency [MHz]
Band 41, E-UTRA/TDD	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	40620	2593.0

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
86	456	21	26

Plot 12 LTE Band 41 CH.39750 Voice EVS-NB Codec: 5.9 kbit/s PC2 ANT F

Hardware Setup

Probe Name	Probe Calibration Date	DAE Name	DAE Calibration Date
AM1DV3 - 3153	May 14, 2024	DAE4 Sn1254	May 16, 2024

Communication Systems

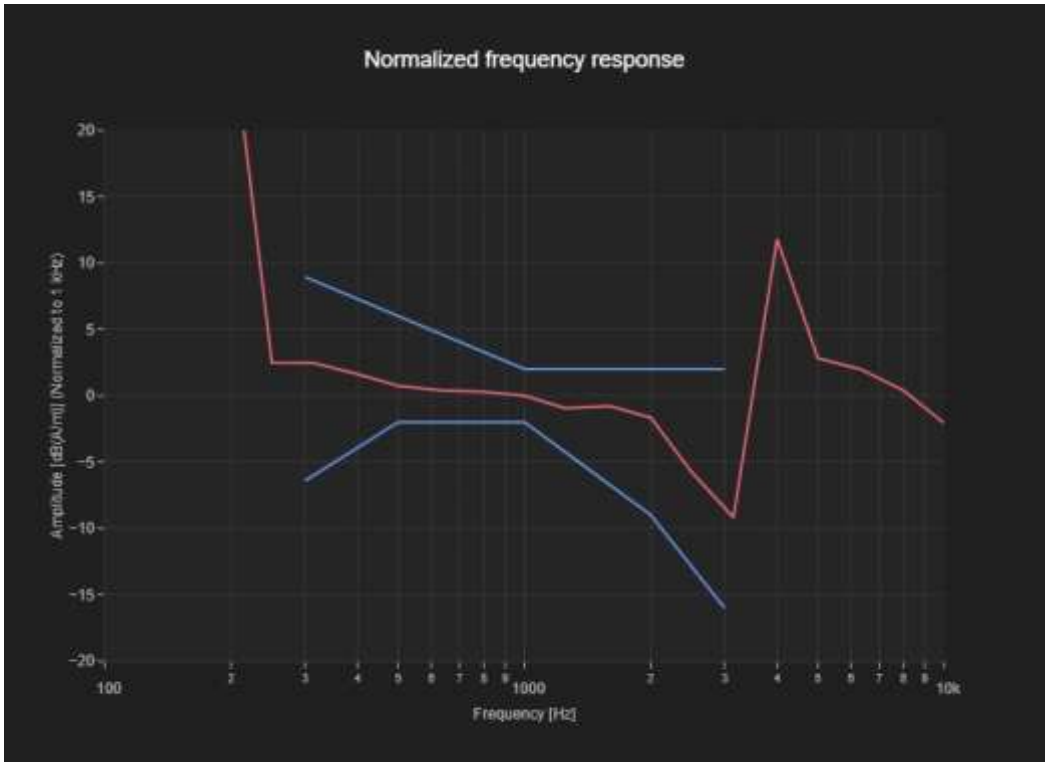
Band Name	Communication Systems Name	Channel	Frequency [MHz]
Band 41, E-UTRA/TDD	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	39750	2506.0

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
93	465	22	26

Plot 13 LTE Band 41 CH.40185 Voice EVS-NB Codec: 5.9 kbit/s PC2 ANT F

Hardware Setup

Probe Name	Probe Calibration Date	DAE Name	DAE Calibration Date
AM1DV3 - 3153	May 14, 2024	DAE4 Sn1254	May 16, 2024

Communication Systems

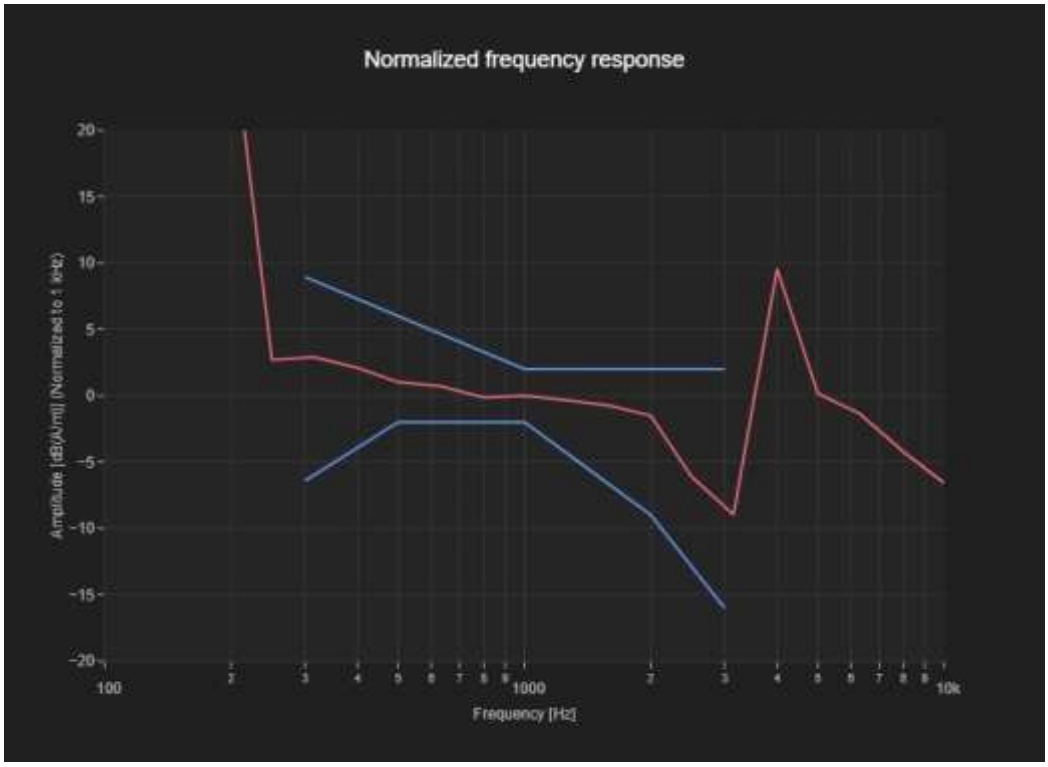
Band Name	Communication Systems Name	Channel	Frequency [MHz]
Band 41, E-UTRA/TDD	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	40185	2549.5

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	1.86



T-Coil Coupling Mode Test Report

Results

Primary Group Contiguous Point Count	Secondary Group Point Count	Secondary Group Max Longitudinal	Secondary Group Max Transverse
102	463	21	26

Plot 14 LTE Band 41 CH.41055 Voice EVS-NB Codec: 5.9 kbit/s PC2 ANT F

Hardware Setup

Probe Name	Probe Calibration Date	DAE Name	DAE Calibration Date
AM1DV3 - 3153	May 14, 2024	DAE4 Sn1254	May 16, 2024

Communication Systems

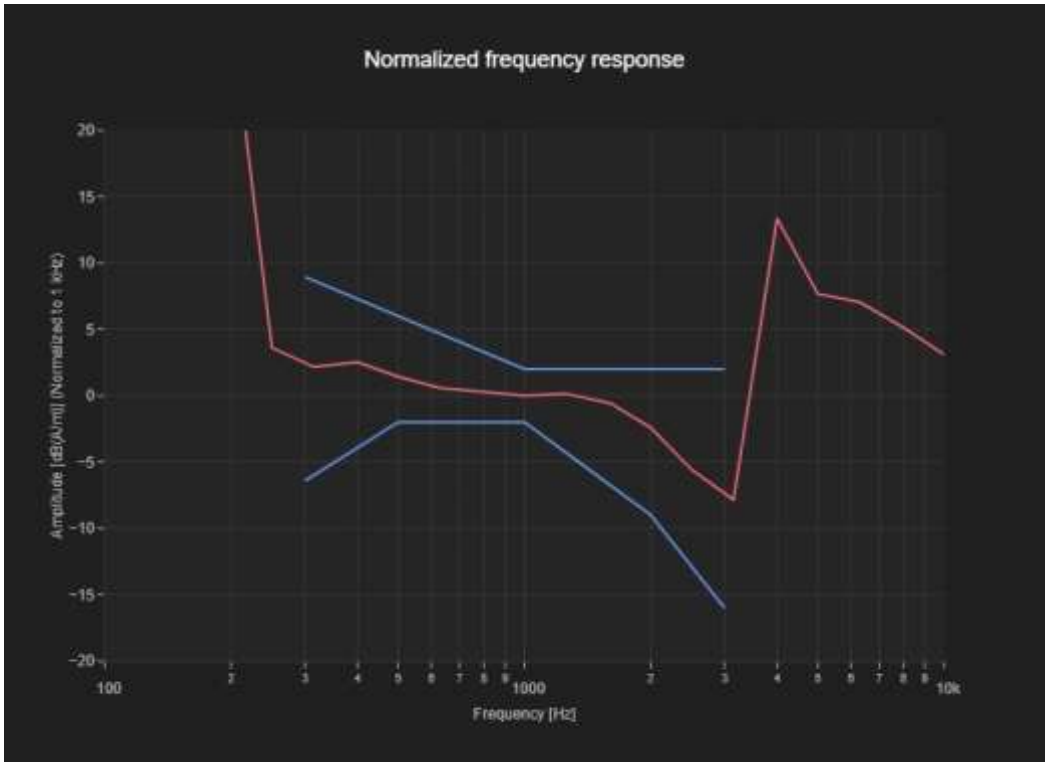
Band Name	Communication Systems Name	Channel	Frequency [MHz]
Band 41, E-UTRA/TDD	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	41055	2636.5

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	1.85	2.0



T-Coil Coupling Mode Test Report

Results

Primary Group Contiguous Point Count	Secondary Group Point Count	Secondary Group Max Longitudinal	Secondary Group Max Transverse
94	450	21	26

Plot 15 LTE Band 41 CH.41490 Voice EVS-NB Codec: 5.9 kbit/s PC2 ANT F

Hardware Setup

Probe Name	Probe Calibration Date	DAE Name	DAE Calibration Date
AM1DV3 - 3153	May 14, 2024	DAE4 Sn1254	May 16, 2024

Communication Systems

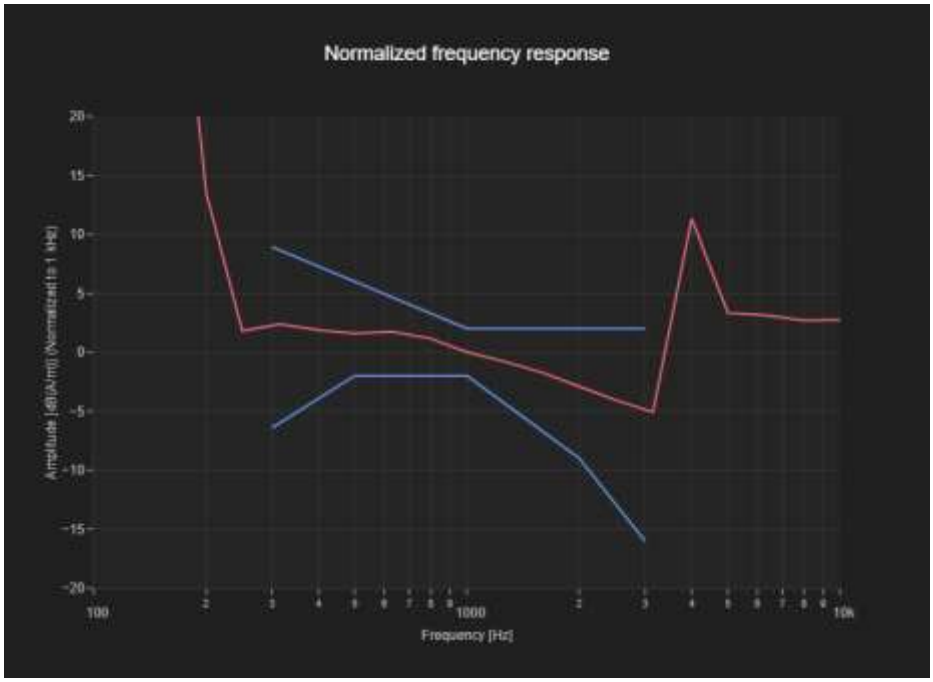
Band Name	Communication Systems Name	Channel	Frequency [MHz]
Band 41, E-UTRA/TDD	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	41490	2680.0

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
88	435	20	26

Plot 16 NR Band 41 100MHz DFTs OFDM 16QAM 135RB 69offset CH.518598 AMR-WB Codec: 6.6 kbit/s ANT B

Hardware Setup

Probe Name	Probe Calibration Date	DAE Name	DAE Calibration Date
AM1DV3 - 3050	November 23, 2023	DAE4ip Sn1866	May 02, 2024

Communication Systems

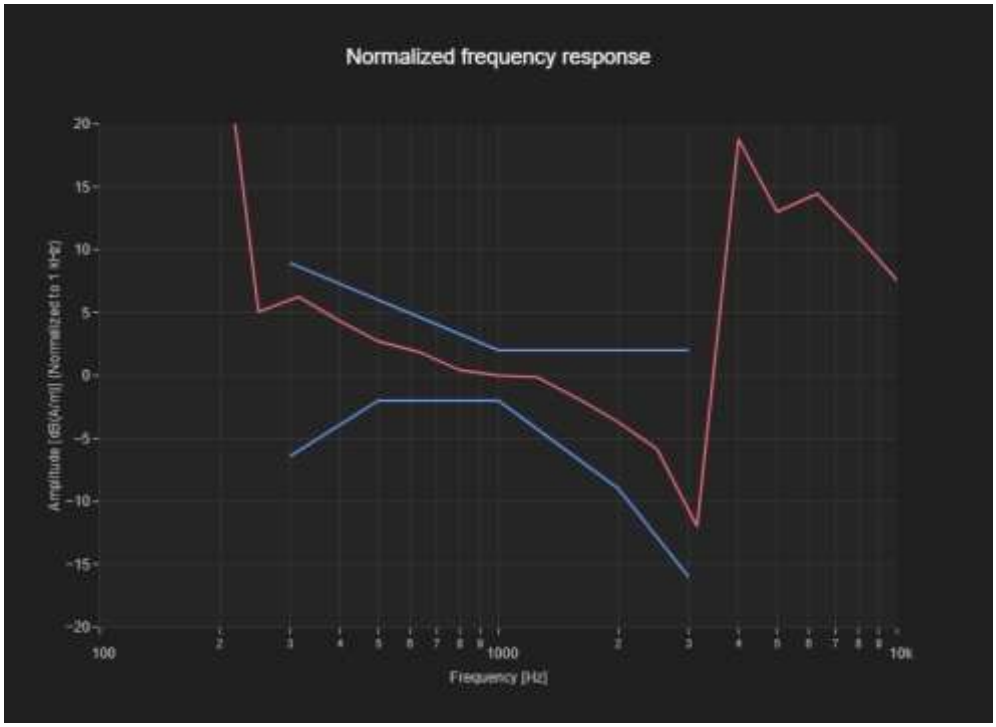
Band Name	Communication Systems Name	Channel	Frequency [MHz]
Band n41	5G NR (DFT-s-OFDM, 50% RB, 100 MHz, QPSK, 30 kHz)	518598	2592.99

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	438	20	26

Plot 17 802.11b CH.6 Voice EVS-WB Codec: 5.9 kbit/s ANT 1

Hardware Setup

Probe Name	Probe Calibration Date	DAE Name	DAE Calibration Date
AM1DV3 - 3050	November 23, 2023	DAE4ip Sn1866	May 02, 2024

Communication Systems

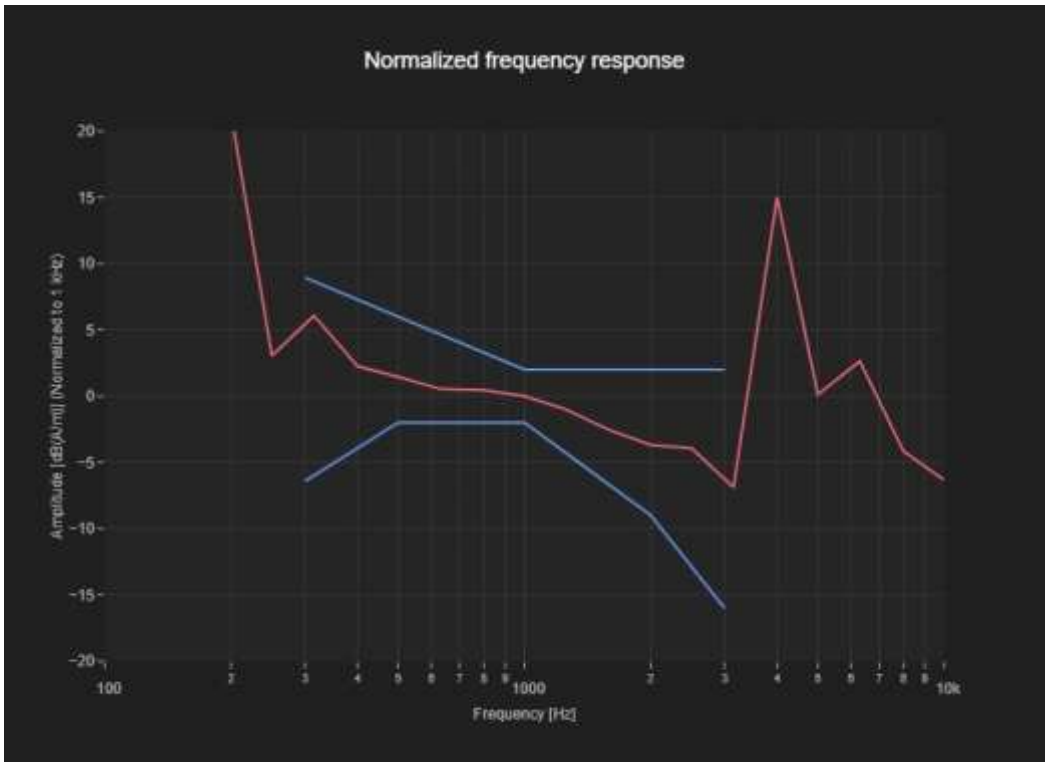
Band Name	Communication Systems Name	Channel	Frequency [MHz]
WLAN 2.4GHz	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 99pc duty cycle)	6	2437.0

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	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	461	26	26

Plot 18 802.11b CH.1 Voice EVS-WB Codec: 5.9 kbit/s ANT 1

Hardware Setup

Probe Name	Probe Calibration Date	DAE Name	DAE Calibration Date
AM1DV3 - 3050	November 23, 2023	DAE4ip Sn1866	May 02, 2024

Communication Systems

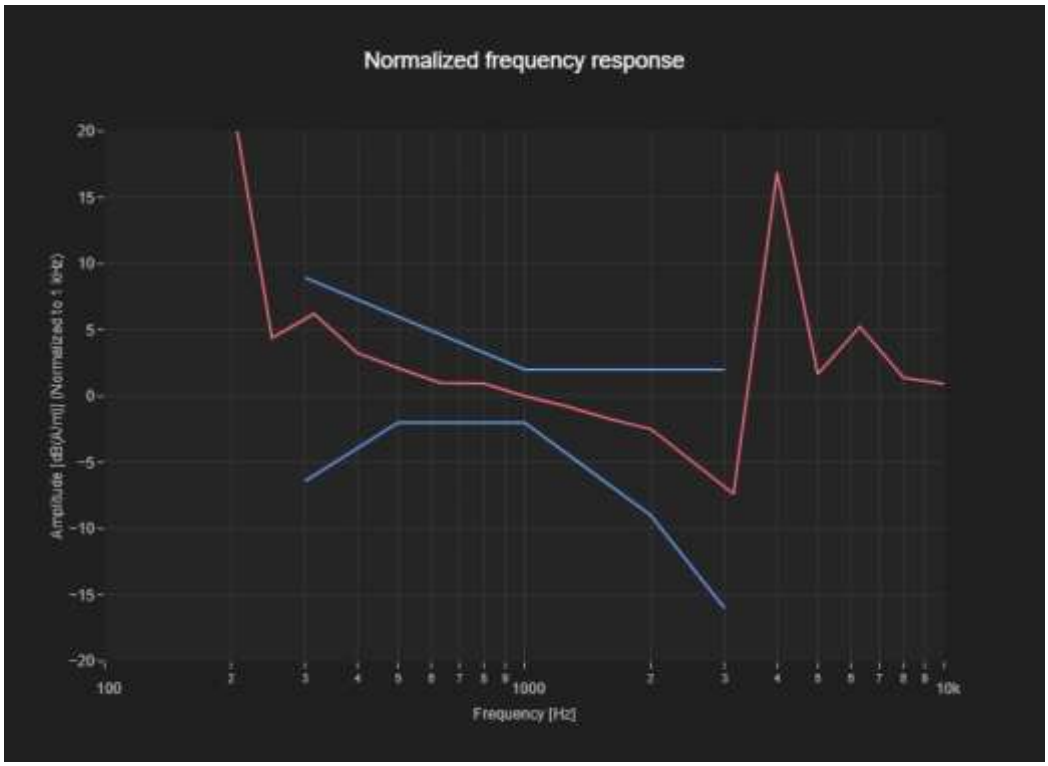
Band Name	Communication Systems Name	Channel	Frequency [MHz]
WLAN 2.4GHz	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 99pc duty cycle)	1	2412.0

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	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
215	578	26	26

Plot 19 802.11b CH.11 Voice EVS-WB Codec: 5.9 kbit/s ANT 1

Hardware Setup

Probe Name	Probe Calibration Date	DAE Name	DAE Calibration Date
AM1DV3 - 3050	November 23, 2023	DAE4ip Sn1866	May 02, 2024

Communication Systems

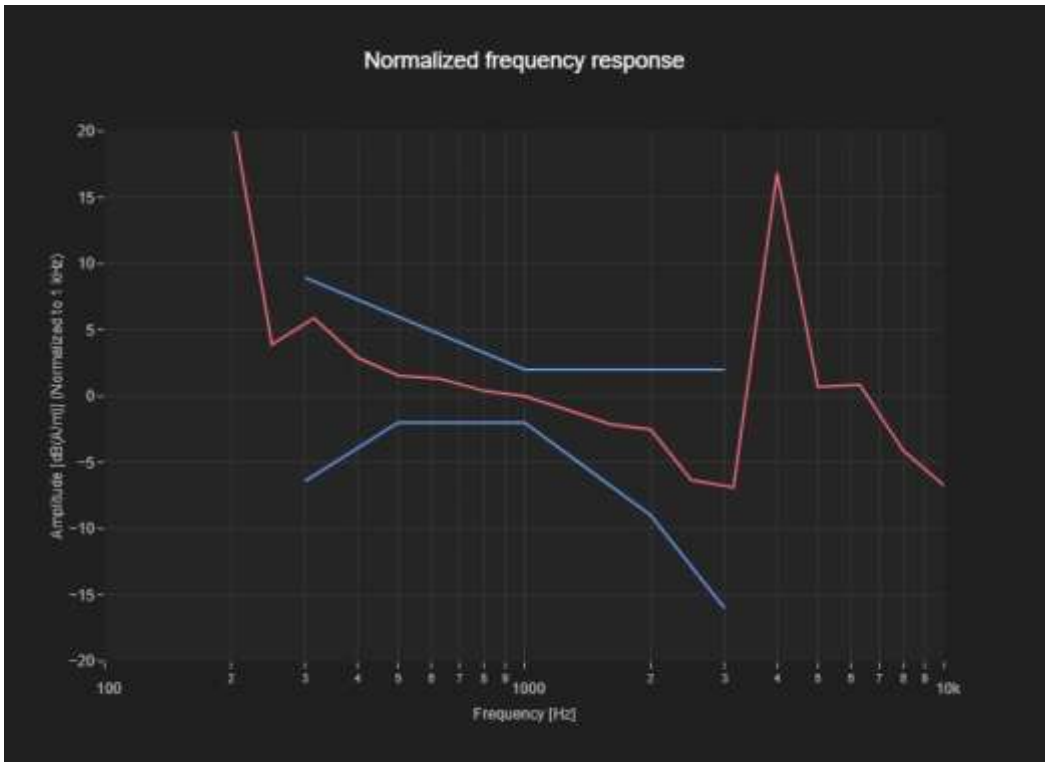
Band Name	Communication Systems Name	Channel	Frequency [MHz]
WLAN 2.4GHz	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 99pc duty cycle)	11	2462.0

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	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
220	577	26	26

Plot 20 802.11n20 CH.40 Voice EVS-WB Codec: 5.9 kbit/s MIMO

Hardware Setup

Probe Name	Probe Calibration Date	DAE Name	DAE Calibration Date
AM1DV3 - 3050	November 23, 2023	DAE4ip Sn1866	May 02, 2024

Communication Systems

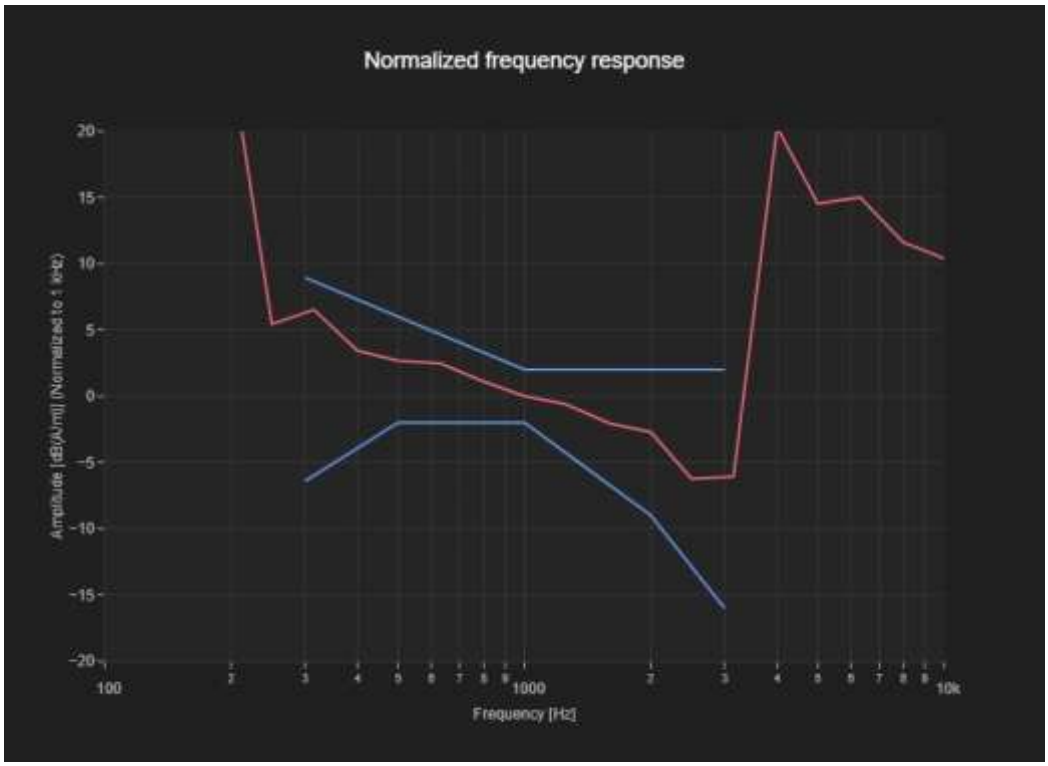
Band Name	Communication Systems Name	Channel	Frequency [MHz]
U-NII-2C, U-NII-3	IEEE 802.11n (HT Mixed, 20MHz, MCS0, 90pc duty cycle)	40	5200.0

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	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
104	466	24	26

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

Hardware Setup

Probe Name	Probe Calibration Date	DAE Name	DAE Calibration Date
AM1DV3 - 3050	November 23, 2023	DAE4ip Sn1866	May 02, 2024

Communication Systems

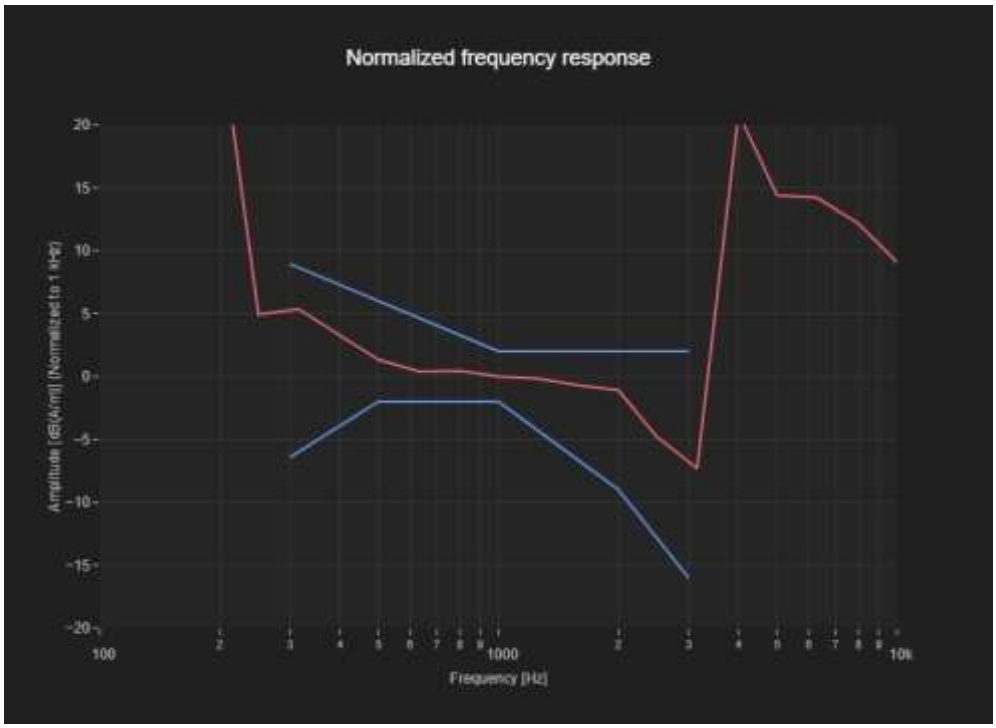
Band Name	Communication Systems Name	Channel	Frequency [MHz]
U-NII-1, U-NII-2A	IEEE 802.11n (HT Mixed, 20MHz, MCS0, 90pc duty cycle)	36	5180.0

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	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
123	467	24	26

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

Hardware Setup

Probe Name	Probe Calibration Date	DAE Name	DAE Calibration Date
AM1DV3 - 3050	November 23, 2023	DAE4ip Sn1866	May 02, 2024

Communication Systems

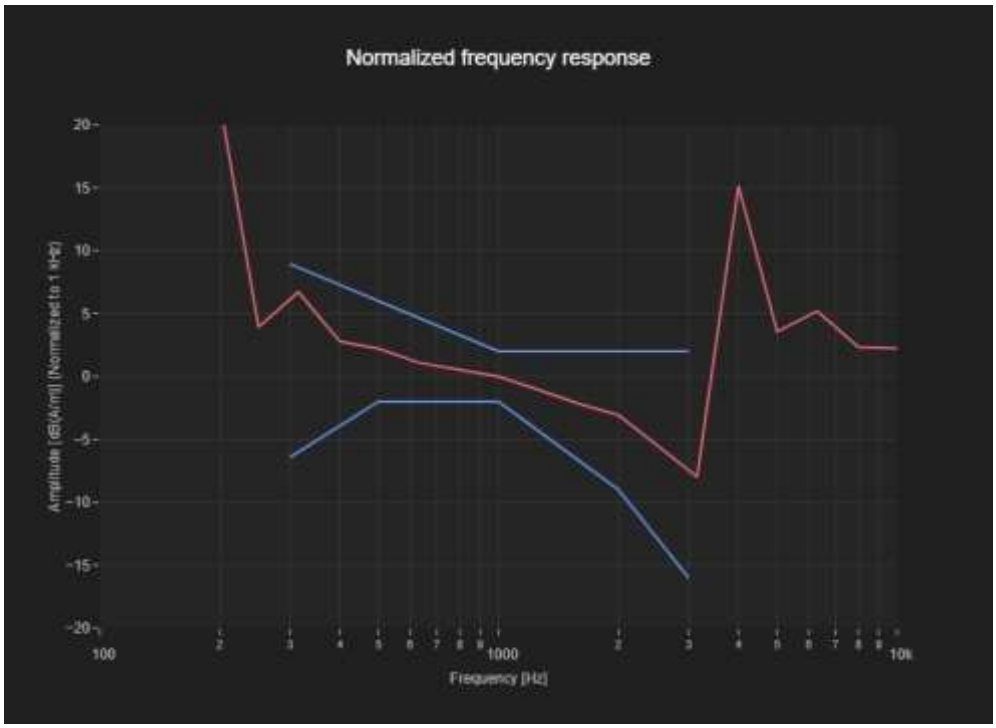
Band Name	Communication Systems Name	Channel	Frequency [MHz]
U-NII-1, U-NII-2A	IEEE 802.11n (HT Mixed, 20MHz, MCS0, 90pc duty cycle)	48	5240.0

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	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
122	464	24	26

Plot 23 GMS850 CH.128 EDGE 2 slots Meet Codec: 6 kbit/s ANT A

Hardware Setup

Probe Name	Probe Calibration Date	DAE Name	DAE Calibration Date
AM1DV3 - 3050	November 23, 2023	DAE4ip Sn1866	May 02, 2024

Communication Systems

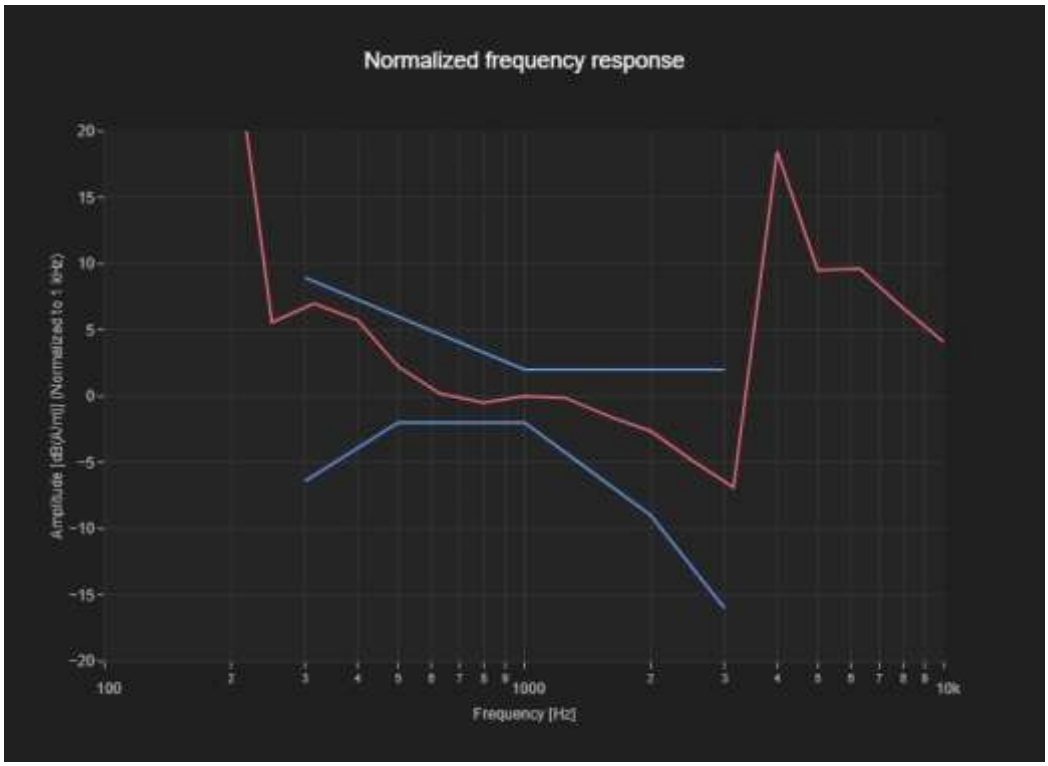
Band Name	Communication Systems Name	Channel	Frequency [MHz]
GSM 850	EDGE-FDD (TDMA, 8PSK, TN 0-1)	128	824.2

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

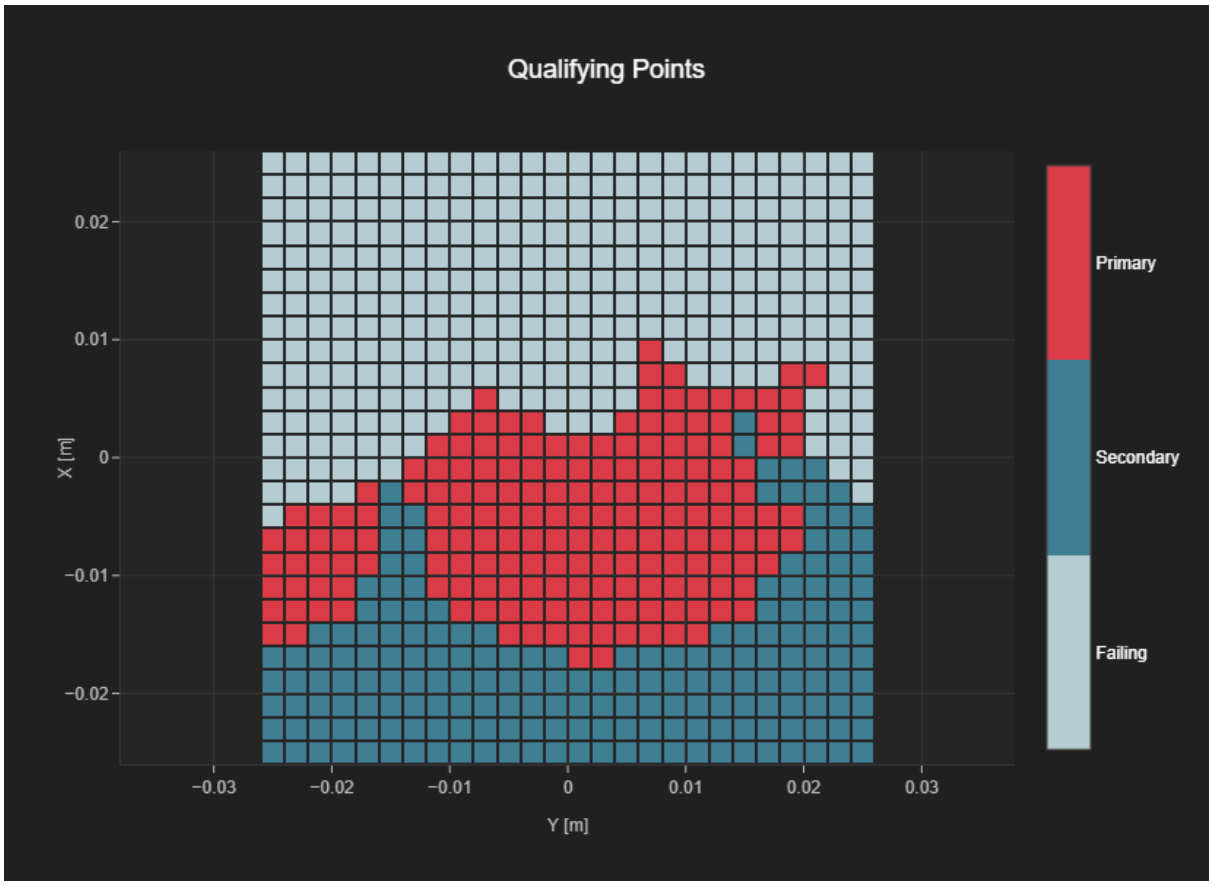
Audio File	Measurement Duration [s]	Margin Upper Bound [dB]	Margin Lower Bound [dB]
48k_voice_300-3000_2s.wav	2.0	1.55	1.51



T-Coil Coupling Mode Test Report

Results

Primary Group Contiguous Point Count	Secondary Group Point Count	Secondary Group Max Longitudinal	Secondary Group Max Transverse
75	407	21	26



Plot 24 GMS850 CH.190 EDGE 2 slots Meet Codec: 6 kbit/s ANT A

Hardware Setup

Probe Name	Probe Calibration Date	DAE Name	DAE Calibration Date
AM1DV3 - 3050	November 23, 2023	DAE4ip Sn1866	May 02, 2024

Communication Systems

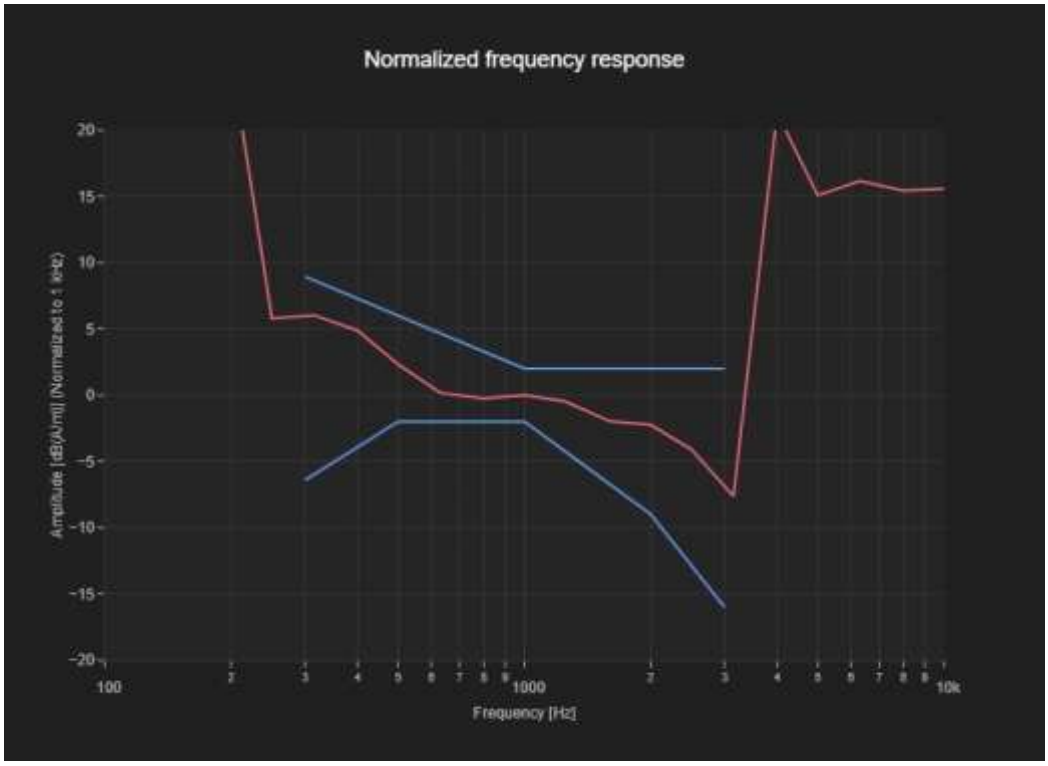
Band Name	Communication Systems Name	Channel	Frequency [MHz]
GSM 850	EDGE-FDD (TDMA, 8PSK, TN 0-1)	190	836.6

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	2.0	1.73



T-Coil Coupling Mode Test Report

Results

Primary Group Contiguous Point Count	Secondary Group Point Count	Secondary Group Max Longitudinal	Secondary Group Max Transverse
51	379	20	26

Plot 25 GMS850 CH.251 EDGE 2 slots Meet Codec: 6 kbit/s ANT A

Hardware Setup

Probe Name	Probe Calibration Date	DAE Name	DAE Calibration Date
AM1DV3 - 3050	November 23, 2023	DAE4ip Sn1866	May 02, 2024

Communication Systems

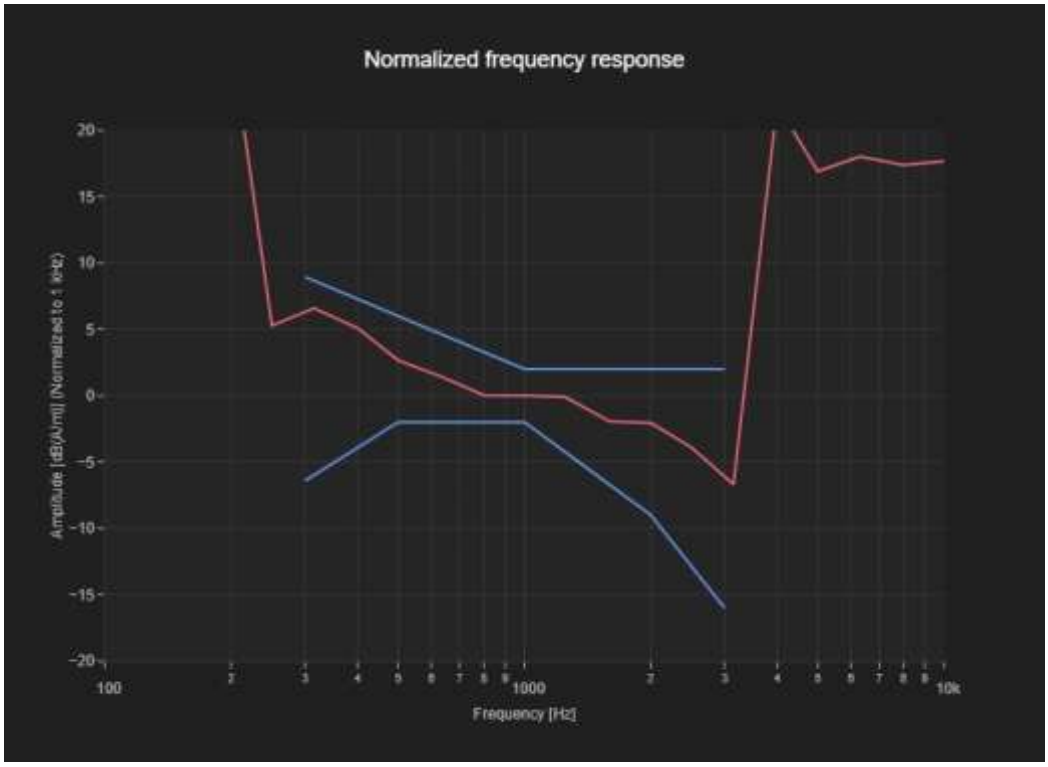
Band Name	Communication Systems Name	Channel	Frequency [MHz]
GSM 850	EDGE-FDD (TDMA, 8PSK, TN 0-1)	251	848.8

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

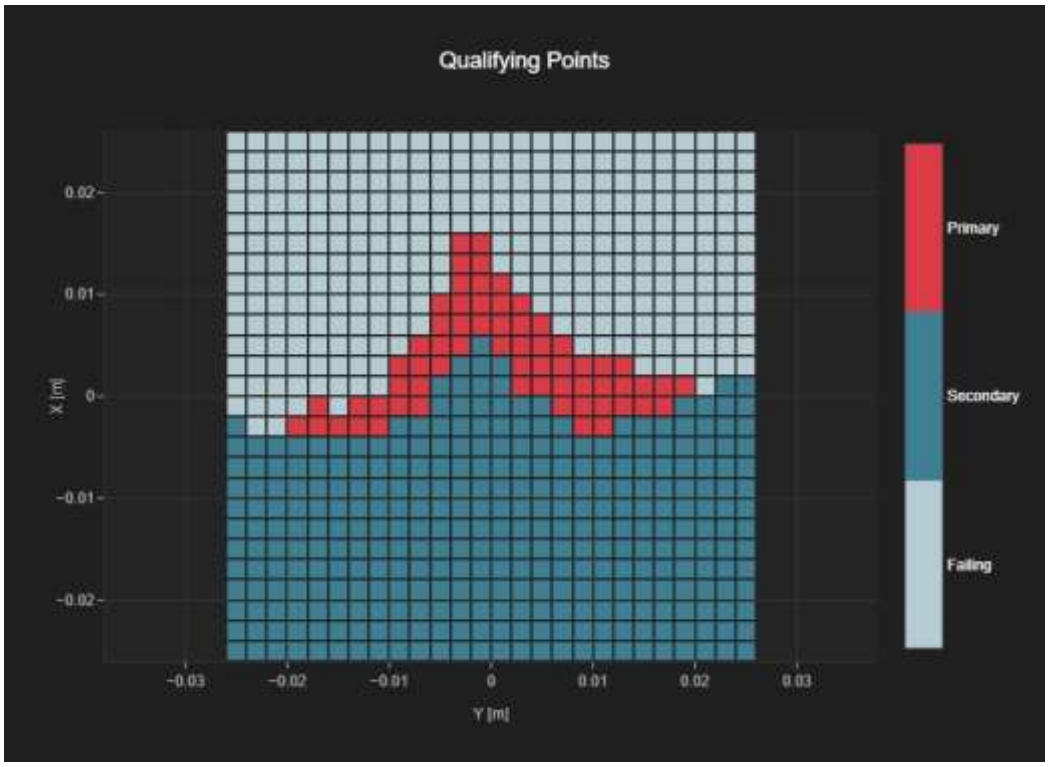
Audio File	Measurement Duration [s]	Margin Upper Bound [dB]	Margin Lower Bound [dB]
48k_voice_300-3000_2s.wav	2.0	2.0	2.0



T-Coil Coupling Mode Test Report

Results

Primary Group Contiguous Point Count	Secondary Group Point Count	Secondary Group Max Longitudinal	Secondary Group Max Transverse
63	386	21	26



Plot 26 UMTS Band 2 CH.9538 Google Meet Codec: 6 kbit/s ANT A

Hardware Setup

Probe Name	Probe Calibration Date	DAE Name	DAE Calibration Date
AM1DV3 - 3050	November 23, 2023	DAE4ip Sn1866	May 02, 2024

Communication Systems

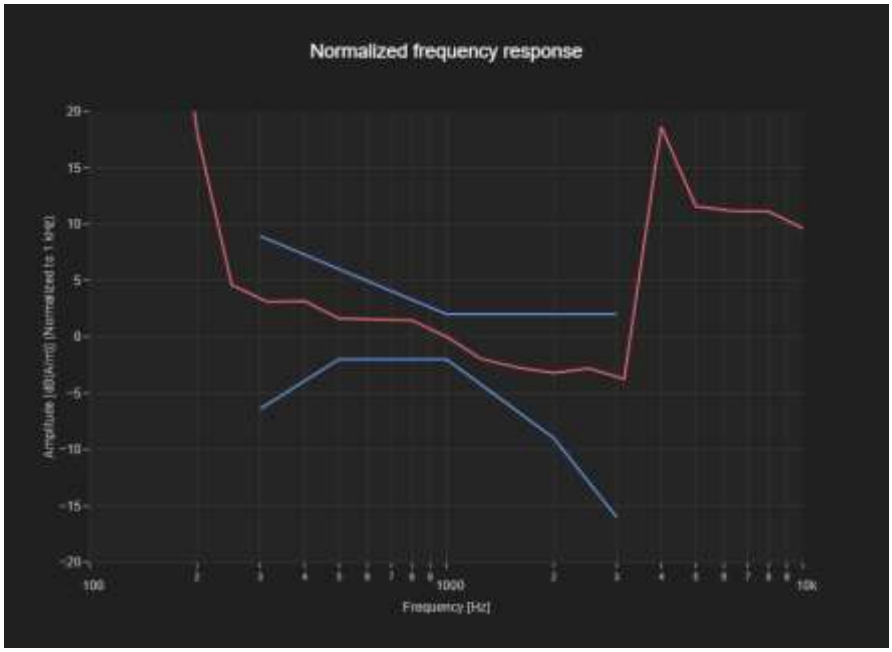
Band Name	Communication Systems Name	Channel	Frequency [MHz]
Band 2, UTRA/FDD	UMTS-FDD (HSUPA, Subtest 1)	9538	1907.6

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	2.0	1.69



T-Coil Coupling Mode Test Report

Results

Primary Group Contiguous Point Count	Secondary Group Point Count	Secondary Group Max Longitudinal	Secondary Group Max Transverse
298	606	26	26

Plot 27 LTE Band 7 20MHz 64QAM 1RB 49offset CH.21100
Google Meet Codec: 6 kbit/s ANT B

Hardware Setup

Probe Name	Probe Calibration Date	DAE Name	DAE Calibration Date
AM1DV3 - 3050	November 23, 2023	DAE4ip Sn1866	May 02, 2024

Communication Systems

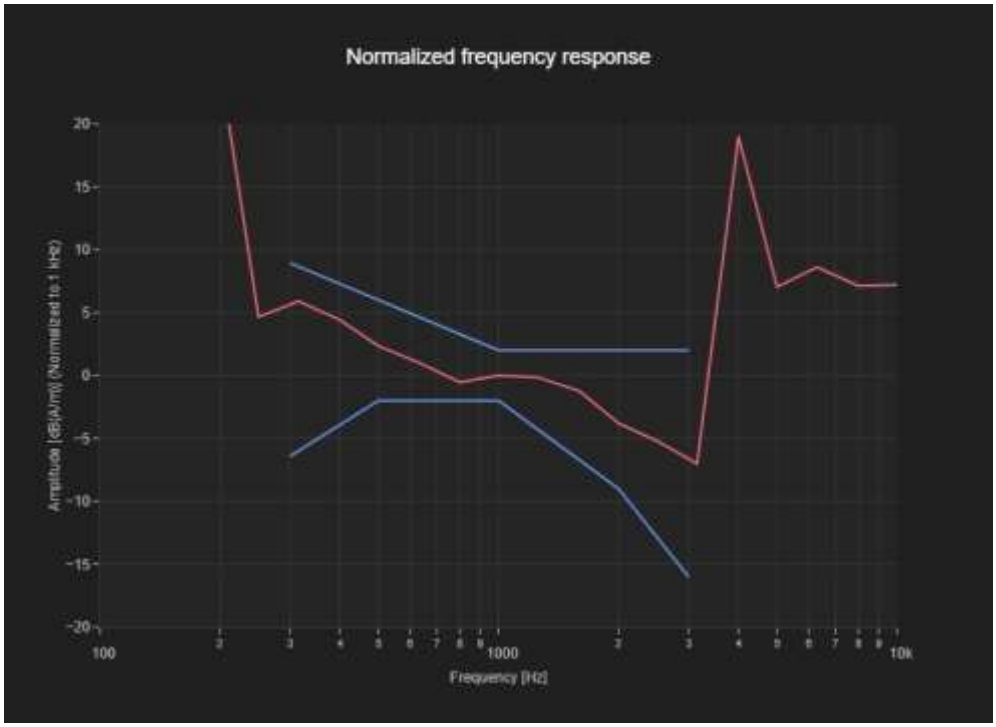
Band Name	Communication Systems Name	Channel	Frequency [MHz]
Band 7, E-UTRA/FDD	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, 64-QAM)	21100	2535.0

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	1.46



T-Coil Coupling Mode Test Report

Results

Primary Group Contiguous Point Count	Secondary Group Point Count	Secondary Group Max Longitudinal	Secondary Group Max Transverse
313	618	26	26

Plot 28 LTE Band 41 20MHz QPSK 1RB 99offset CH.40620 PC2 Google Meet Codec: 6 kbit/s ANT B

Hardware Setup

Probe Name	Probe Calibration Date	DAE Name	DAE Calibration Date
AM1DV3 - 3050	November 23, 2023	DAE4ip Sn1866	May 02, 2024

Communication Systems

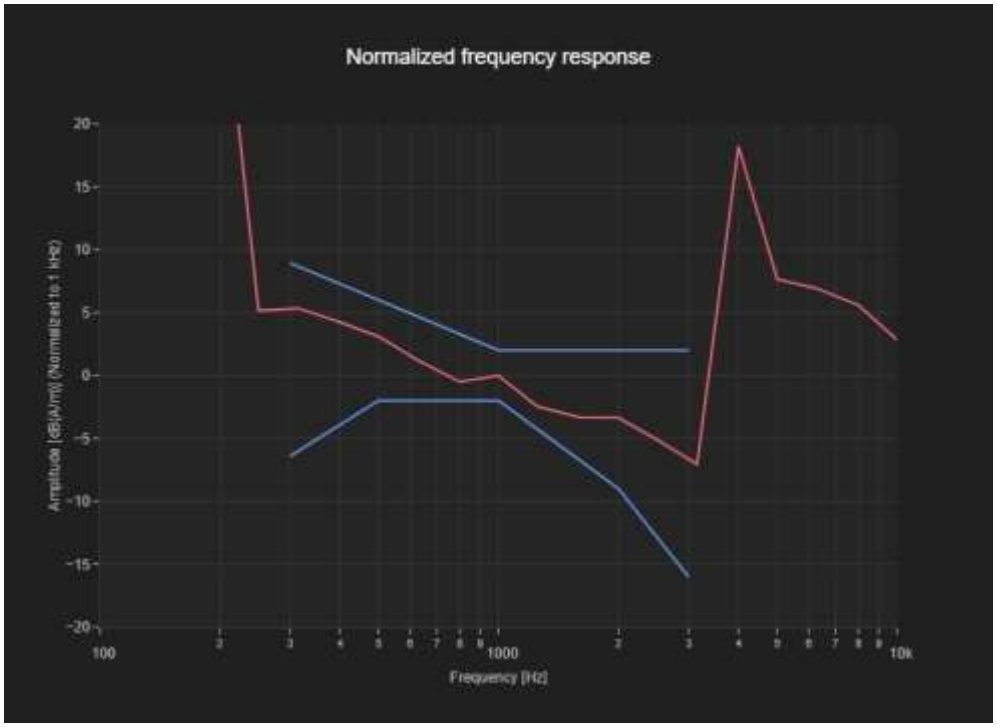
Band Name	Communication Systems Name	Channel	Frequency [MHz]
Band 41, E-UTRA/TDD	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	40620	2593.0

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	1.49



T-Coil Coupling Mode Test Report

Results

Primary Group Contiguous Point Count	Secondary Group Point Count	Secondary Group Max Longitudinal	Secondary Group Max Transverse
110	414	22	26

Plot 29 Wi-Fi 2.4 GHz 802.11b 1Mbps CH.6 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	DAE4ip Sn1866	May 02, 2024

Communication Systems

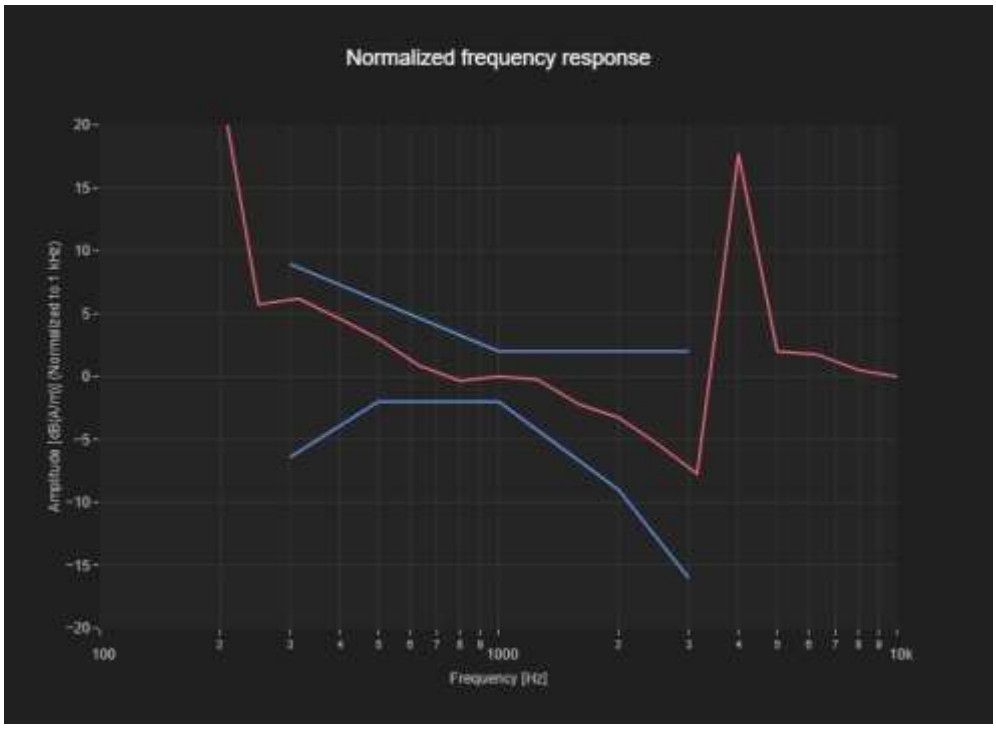
Band Name	Communication Systems Name	Channel	Frequency [MHz]
WLAN 2.4GHz	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 99pc duty cycle)	6	2437.0

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	1.64



T-Coil Coupling Mode Test Report

Results

Primary Group Contiguous Point Count	Secondary Group Point Count	Secondary Group Max Longitudinal	Secondary Group Max Transverse
128	443	24	26

Plot 30 Wi-Fi 5.6 GHz 802.11n20 MCS 0 CH.120 Google Meet Codec: 40 kbit/s MIMO

Hardware Setup

Probe Name	Probe Calibration Date	DAE Name	DAE Calibration Date
AM1DV3 - 3050	November 23, 2023	DAE4ip Sn1866	May 02, 2024

Communication Systems

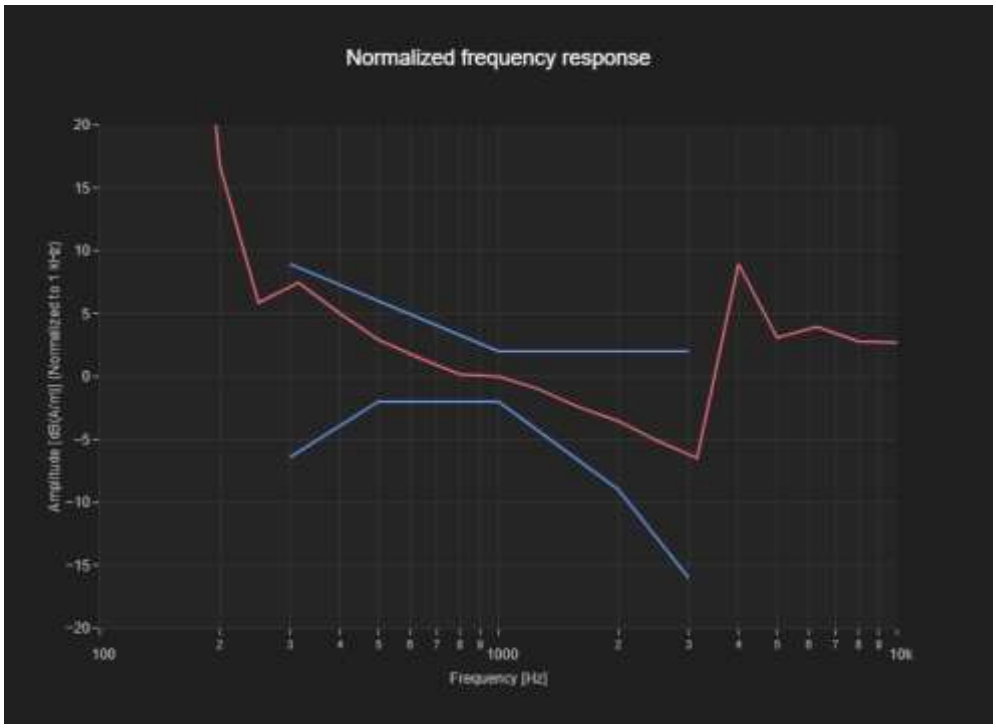
Band Name	Communication Systems Name	Channel	Frequency [MHz]
WLAN 5GHz	IEEE 802.11n (HT Mixed, 20MHz, MCS0, 90pc duty cycle)	120	5600.0

Grid Settings

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

Results

Audio File	Measurement Duration [s]	Margin Upper Bound [dB]	Margin Lower Bound [dB]
48k_voice_300-3000_2s.wav	2.0	1.86	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
134	424	20	26

Plot 31 NR Band n71 CP-OFDM 20MHz 16QAM 1RB 105offset CH.136100 Google Meet Codec: 40 kbit/s ANT A

Hardware Setup

Probe Name	Probe Calibration Date	DAE Name	DAE Calibration Date
AM1DV3 - 3050	November 23, 2023	DAE4ip Sn1866	May 02, 2024

Communication Systems

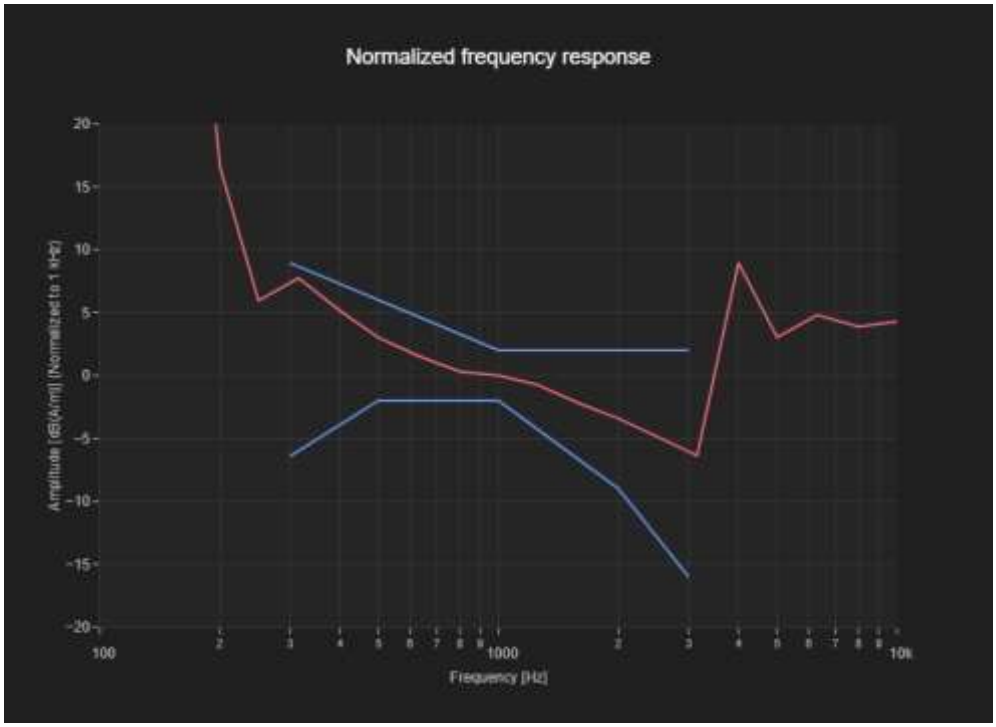
Band Name	Communication Systems Name	Channel	Frequency [MHz]
Band n71	5G NR (DFT-s-OFDM, 1 RB, 20 MHz, QPSK, 15 kHz)	136100	680.5

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	1.63	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
331	629	26	26

Plot 32 NR Band n77 DFTs-OFDM 100MHz 16QAM 135RB 69offset CH.650000 Google Meet Codec: 75 kbit/s ANT F

Hardware Setup

Probe Name	Probe Calibration Date	DAE Name	DAE Calibration Date
AM1DV3 - 3050	November 23, 2023	DAE4ip Sn1866	May 02, 2024

Communication Systems

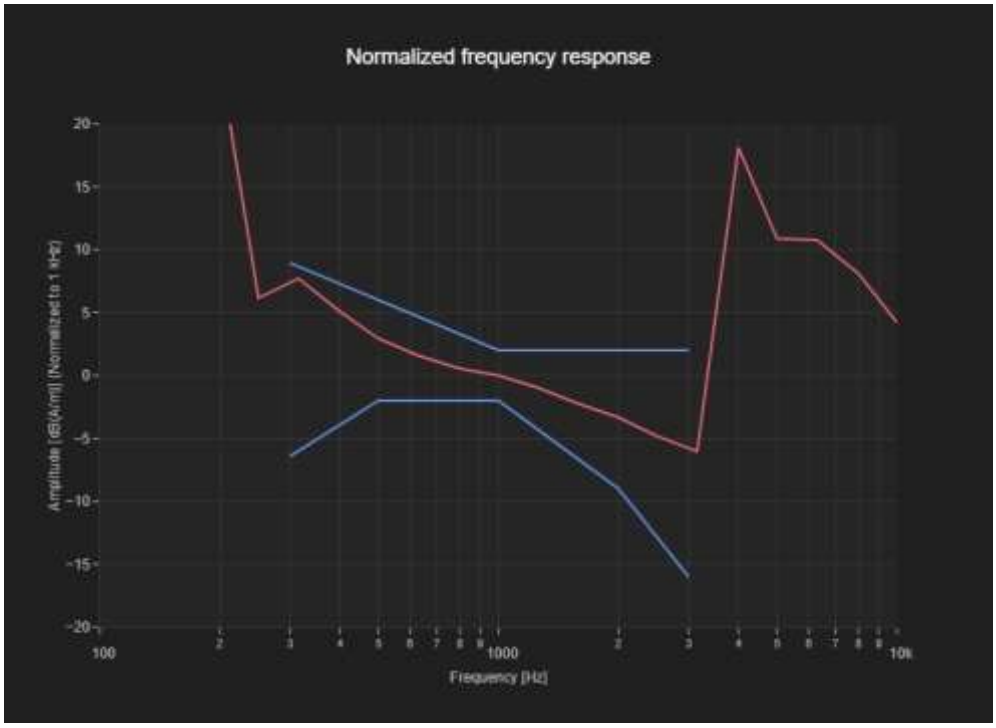
Band Name	Communication Systems Name	Channel	Frequency [MHz]
Band n77	5G NR (DFT-s-OFDM, 50% RB, 100 MHz, QPSK, 30 kHz)	650000	3750.0

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	1.60	2.0

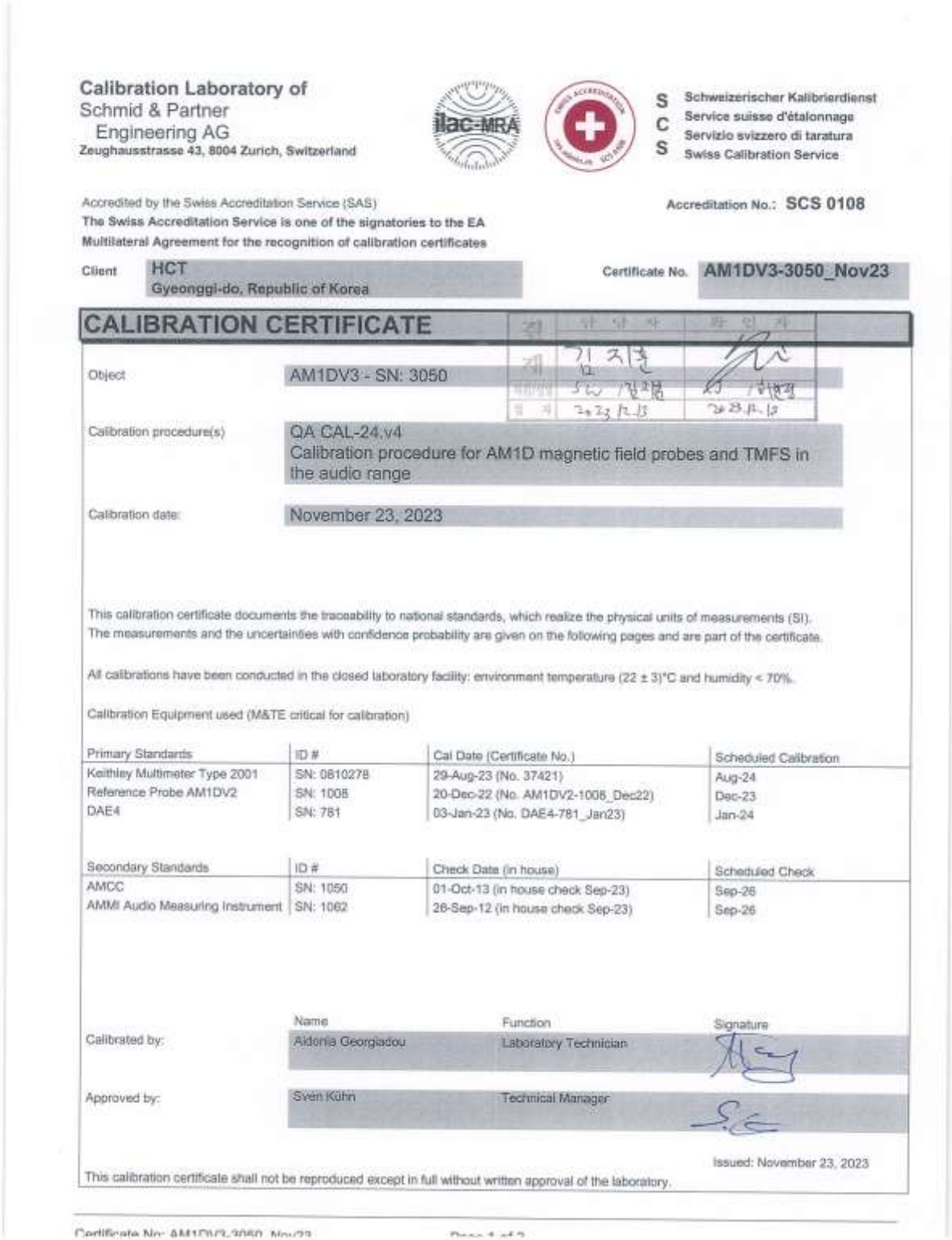


T-Coil Coupling Mode Test Report

Results

Primary Group Contiguous Point Count	Secondary Group Point Count	Secondary Group Max Longitudinal	Secondary Group Max Transverse
196	493	23	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 ± 3)°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-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

	Name	Function	Signature
Calibrated by:	Aidonia Georgiadou	Laboratory Technician	
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 1 of 2

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	**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

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. AM1DV3-3153_May24

CALIBRATION CERTIFICATE

검	작 성 자	확 인 자
재		
확인날짜	SW 2024.06.05	CJ 2024.06.05

Object AM1DV3 - SN: 3153

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

Calibration date: May 14, 2024

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

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°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-23 (No. 37421)	Aug-24
Reference Probe AM1DV3	SN: 3000	09-Oct-23 (No. AM1DV3-3000_Oct23)	Oct-24
DAE4	SN: 781	16-Feb-24 (No. DAE4-781_Feb24)	Feb-25

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
AMCC	SN: 1050	01-Oct-13 (in house check Sep-23)	Sep-26
AMMI Audio Measuring Instrument	SN: 1062	26-Sep-12 (in house check Sep-23)	Sep-26

	Name	Function	Signature
Calibrated by:	Leif Klysner	Laboratory Technician	
Approved by:	Sven Kühn	Technical Manager	

Issued: May 15, 2024

[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)
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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

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- *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	**3153**

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

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

Calibration data

Connector rotation angle	(in DASY system)	**236.6** °	+/- 3.6 ° (k=2)
Sensor angle	(in DASY system)	**0.81** °	+/- 0.5 ° (k=2)
Sensitivity at 1 kHz	(in DASY system)	**0.00737 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%.

Certificate No: AM1DV3-3153_May24 Page 3 of 3