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HAC RF Emission Test Report

Applicant Name: **SAMSUNG Electronics Co., Ltd.** 129, Samsung-ro, Yeongtong-gu, Suwon-Si, Gyeonggi-do, 16677 Rep. of Korea	**Date of Issue:** Jul 28, 2022 **Test Report No.:** HCT-SR-2207-FC013-R2 **Test Site: HCT CO., LTD.**

FCC ID	**A3LSMG990U**
Equipment Type:	**Mobile Phone**
Application Type	**Class II Permissive Change**
FCC Rule Part(s):	**CFR §20.19 , ANSI C63.19-2011**
Model Name:	**SM-G990U**
Additional Model Name:	**SM-G990U1/DS, SM-G990U1**
Date of Test:	**N/A**

C63.19-2011 HAC Category	**M4 (RF EMISSION CATEGORY, NR n48 Only)**

This wireless portable device has been shown to be hearing-aid compatible under the above rated category, specified in ANSI/IEEE Std. C63.19-2011 and had been tested in accordance with the specified measurement procedures. Hearing-Aid Compatibility is based on the assumption that all production units will be designed electrically identical to the device tested in this report.
I attest to the accuracy of data. All measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

Tested by

Hui-Jun, Yun
Test Engineer
SAR Team
Certification Division

Technical Manager

Yun Jeang, Heo
Technical Manager
SAR Team
Certification Division

REVISION HISTORY

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

Revision No.	Date of Issue	Description
0	Jul 14, 2022	Initial Release
1	Jul. 20, 2022	Revised Page 19
2	Jul. 28, 2022	Revised Page 16

This test results were applied only to the test methods required by the standard.

The above Test Report is not related to the accredited test result by (KS Q) ISO/IEC 17025 and KOLAS(Korea Laboratory Accreditation Scheme), which signed the ILAC-MRA.

Table of Contents

1. Test Regulations

The tests were performed according to the following regulations:

Test Standard	FCC 47 CFR §20.19 ANSI C63.19-2011
Test Method	· KDB 285076 D01 HAC Guidance v06 · KDB 285076 D03 HAC FAQ v01r05 · TCB workshop updates

2. Attestation of test Result of Device Under Test

Test Laboratory	
Company Name:	HCT Co., LTD
Address:	74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383, Rep. of Korea
Telephone:	+82 31 645 6300
Fax.:	+82 31 645 6401

Attestation of SAR test result	
Applicant Name:	SAMSUNG Electronics Co., Ltd.
Model Name	SM-G990U
Additional Model Name:	SM-G990U1/DS, SM-G990U1
EUT Type:	Mobile Phone
Application Type:	**Class II Permissive Change**

2.1 Test Methodology

The Tests document in this report were performed in accordance with ANSI C63.19-2011 method of Measurement of Compatibility between Wireless Communication Devices and Hearing Aids, FCC published KDB 285076 D01 HAC Guidance v06, FCC Published KDB285076 D03 HAC FAQ v01r05 and TCB Workshop updates .

3. Device Under Test Description

3.1 DUT specification

Device Wireless specification overview		
Band & Mode	**Operating Mode**	**Tx Frequency**
CDMA/EVDO BC10	Voice / Data	817.90 ㎒ ~ 823.10 ㎒
CDMA/EVDO BC0	Voice / Data	824.70 ㎒ ~ 848.31 ㎒
CDMA/EVDO BC1	Voice / Data	1 851.25 ㎒ ~ 1 908.75 ㎒
GSM850	Voice / Data	824.2 ㎒ ~ 848.8 ㎒
GSM1900	Voice / Data	1 850.2 ㎒ ~ 1 909.8 ㎒
UMTS 850	Voice / Data	826.4 ㎒ ~ 846.6 ㎒
UMTS 1700	Voice / Data	1 712.4 ㎒ ~ 1 752.6 ㎒
UMTS 1900	Voice / Data	1 852.4 ㎒ ~ 1 907.6 ㎒
LTE Band 2 (PCS)	Voice / Data	1 850.7 ㎒ ~ 1 909.3 ㎒
LTE Band 4 (AWS)	Voice / Data	1 710.7 ㎒ ~ 1 754.3 ㎒
LTE Band 5 (Cell)	Voice / Data	824.7 ㎒ ~ 848.3 ㎒
LTE Band 7	Voice / Data	2 502.5 ㎒ ~ 2 567.5 ㎒
LTE Band 12	Voice / Data	699.7 ㎒ ~ 715.3 ㎒
LTE Band 13	Voice / Data	779.5 ㎒ ~ 784.5 ㎒
LTE Band 14	Voice / Data	790.5 ㎒ ~ 795.5 ㎒
LTE Band 25	Voice / Data	1 850.7 ㎒ ~ 1 914.3 ㎒
LTE Band 26	Voice / Data	814.7 ㎒ ~ 848.3 ㎒
LTE 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 40	Voice / Data	2 302.5 ㎒ ~ 2 397.5 ㎒
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 Band 66 (AWS)	Voice / Data	1 710.7 ㎒ ~ 1 779.3 ㎒
LTE Band 71	Voice / Data	665.5 ㎒ ~ 695.5 ㎒
NR Band n2 (PCS)	Data	1 852.5 ㎒ ~ 1 907.5 ㎒
NR Band n5 (Cell)	Data	826.5 ㎒ ~ 846.5 ㎒
NR Band n12	Data	701.5 ㎒ ~ 713.5 ㎒
NR Band n25	Data	1852.5 ㎒ ~ 1912.5 ㎒
NR Band n30	Data	2 307.5 ㎒ ~ 2 312.5 ㎒
NR Band n41	Data	2 506.02 ㎒ ~ 2 679.99 ㎒
NR Band n48	Data	3 560.01 ㎒ ~ 3 690 ㎒
NR Band n66	Data	1 712.5 ㎒ ~ 1 777.5 ㎒
NR Band n71	Data	665.5 ㎒ - 695.5 ㎒
NR Band n77 DoD	Data	3460.02 ㎒ ~ 3 540 ㎒
NR Band n77	Data	3 710 ㎒ ~ 3 969.99 ㎒
NR Band n260	Data	37000 - 40000 MHz
NR Band n261	Data	27500 - 28350 MHz
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 ㎒
2.4 ㎓ WLAN	Voice / Data	2 412 ㎒ ~ 2 462 ㎒
Bluetooth / LE 5.0	Data	2 402 ㎒ ~ 2 480 ㎒
NFC	Data	13.56 ㎒

3.2 Device Under Test

Normal operation	Held to head
Back Cover	The Back Cover is not removable

4. HAC Measurement Set-Up

These measurements are performed using the DASY5 automated dosimetric assessment system.
It is made by Schmid & Partner Engineering AG (SPEAG) in Zurich, Switzerland. It consists of high precision robotics system (Staubli), robot controller, Pentium IV computer, near-field probe, probe alignment sensor. The robot is a six-axis industrial robot performing precise movements.

A cell controller system contains the power supply, robot controller, teach pendant (Joystick), and remote control, is used to drive the robot motors. The PC consists of the HP Pentium IV 3.0 GHz computer with Windows XP system and HAC Measurement Software DASY5, A/D interface card, monitor, mouse, and keyboard. The Staubli Robot is connected to the cell controller to allow software manipulation of the robot. A data acquisition electronic (DAE) circuit performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. is connected to the Electro-optical coupler (EOC). The EOC performs the conversion from the optical into digital electric signal of the DAE and transfers data to the PC plug-in card.

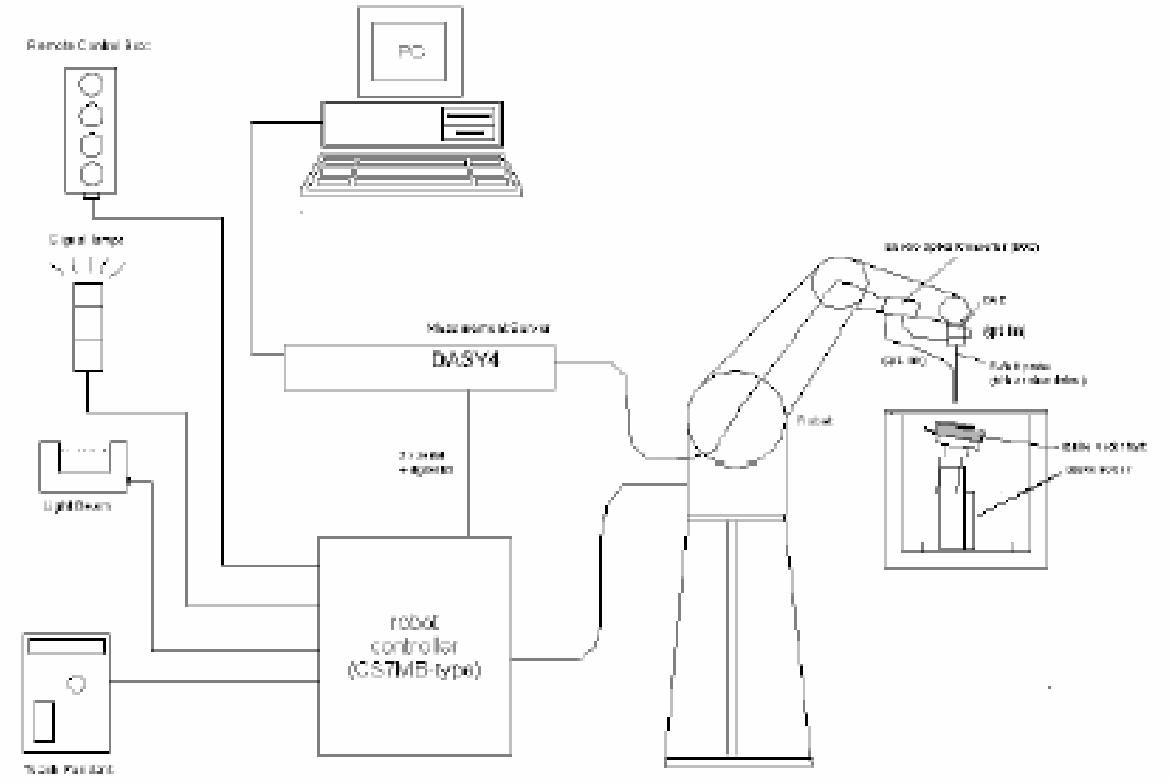


Figure 1. HAC Test Measurement Set-up

The DAE4 consists of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD-converter and a command decoder and control logic unit. Transmission to the PC-card is accomplished through an optical downlink for data and status information and an optical uplink for commands and clock lines.
The mechanical probe mounting device includes two different sensor systems for frontal and sidewise probe contacts. They are also used for mechanical surface detection and probe collision detection.
The robot uses its own controller with a built in VME-bus computer.

5. System Specifications

5.1 Probe

E-Field Probe Description

Construction	One dipole parallel, two dipoles normal to probe axis Built-in shielding against static charges	 [E-Field Probe]
Calibration	In air from 100 ㎒ to 3.0 GHz (absolute accuracy ± 6.0 %, *k* = 2)	
Frequency	100 ㎒ to > 6 GHz; Linearity: ± 0.2 dB (100 ㎒ to 3 GHz)	
Directivity	± 0.2 dB in air (rotation around probe axis) ± 0.4 dB in air (rotation normal to probe axis)	
Dynamic Range	2 V/m to > 1000 V/m (M3 or better device readings fall well below diode compression point)	
Linearity	± 0.2 dB	
Dimensions	Overall length: 337 mm (Tip: 20 mm) Tip diameter: 3.9 mm (Body: 12 mm) Distance from probe tip to dipole centers: 1.5 mm	

5.2 Phantom & Device Holder

Figure 2. HAC Phantom & Device Holder

The Test Arch phantom should be positioned horizontally on a stable surface. Reference markings on the Phantom allow the complete setup of all predefined phantom positions and measurement grids by manually teaching three points in the robot.

The devices can be easily, accurately, and repeatable positioned according to the FCC specifications.

5.3 Robotic System Specifications

Specifications	
POSITIONER:	Stäubli Unimation Corp. Robot Model: TX90 XLspeag
Repeatability:	0.02 mm
No. of axis:	6
Data Acquisition Electronic (DAE) System	
Cell Controller	
Processor:	Core i7
Clock Speed:	3.0 GHz
Operating System:	Windows 7
Data Card:	DASY5 PC-Board
Data Converter	
Features:	Signal Amplifier, multiplexer, A/D converter, and control logic
Software:	DASY5 software
Connecting Lines:	Optical downlink for data and status info. Optical uplink for commands and clock
PC Interface Card	
Function:	24 bit (64 MHz) DSP for real time processing Link to DAE 16 bit A/D converter for surface detection system serial link to robot direct emergency stop output for robot

6. HAC RF Emmissions Test Procedure

The following are step-by-step test procedures.

a) Confirm proper operation of the field probe, probe measurement system and other instrumentation and the positioning system.

b) Position the WD in its intended test position.

c) Set the WD to transmit a fixed and repeatable combination of signal power and modulation characteristic that is representative of the worst case (highest interference potential) encountered in normal use. Transiently occurring start-up, changeover, or termination conditions, or other operations likely to occur less than 1% of the time during normal operation, may be excluded from consideration.

d) The center sub-grid shall be centered on the T-Coil mode perpendicular measurement point or the acoustic output, as appropriate. Locate the field probe at the initial test position in the 50 mm by 50 mm grid, which is contained in the measurement plane, refer to illustrated in Figure 1. If the field alignment method is used, align the probe for maximum field reception.

e) Record the reading at the output of the measurement system.

f) Scan the entire 50 mm by 50 mm region in equally spaced increments and record the reading at each measurement point. The distance between measurement points shall be sufficient to assure the identification of the maximum reading.

g) Identify the five contiguous sub-grids around the center sub-grid whose maximum reading is the lowest of all available choices. This eliminates the three sub-grids with the maximum readings. Thus, the six areas to be used to determine the WD's highest emissions are identified.

h) Identify the maximum reading within the non-excluded sub-grids identified in step g).

i) Convert the highest field reading within identified in step h) to RF audio interference level, in V/m, by taking the square root of the reading and then dividing it by the measurement system transfer function, established in 5.5.1.1 Convert this result to dB(V/m) by taking the base-10 logarithm and multiplying by 20. Indirect measurement method Replacing step i), the RF audio interference level in dB (V/m) is obtained by adding the MIF (in dB) to the maximum steady-state rms field-strength reading, in dB (V/m), from step h). Use this result to determine the category rating.

j) Compare this RF audio interference level with the categories in Clause 8 (ANSI C63.19) and record the resulting WD category rating.

Otherwise, repeat step a) through step i), with the grid shifted so that it is centered on the perpendicular measurement point. Record the WD category rating.

Figure 3. WD reference and plane for RF emission measurements

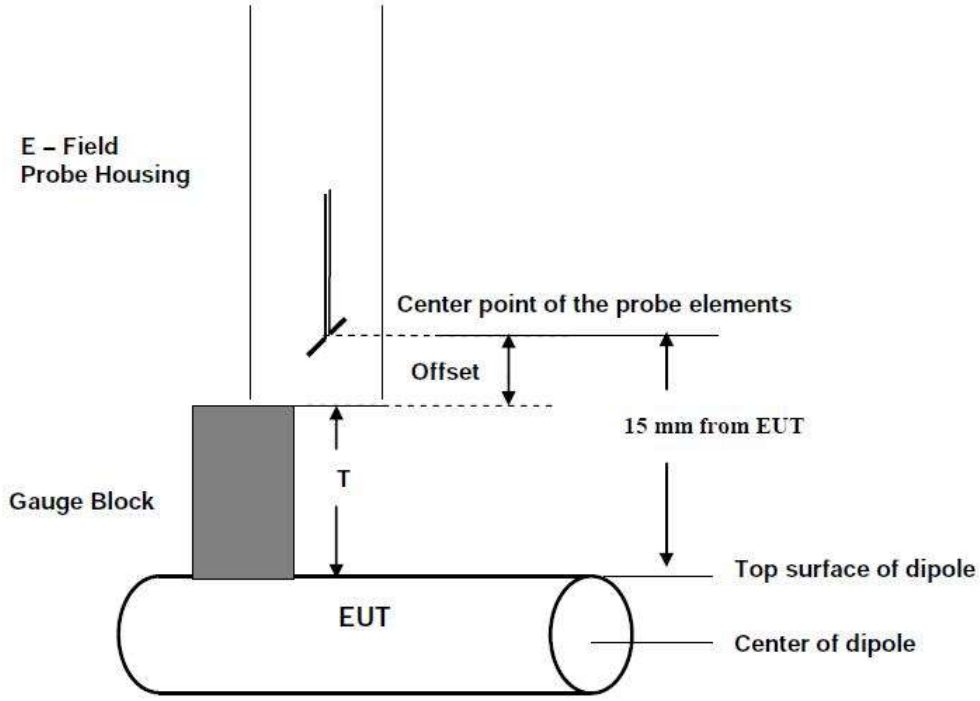


Figure 4. Gauge Block with E-Field Probe

7. System Specifications

E-field measurements are performed using the DASY52 automated dosimetric assessment system. The DASY52 is made by Schmid & Partner Engineering AG (SPEAG) in Zurich, Switzerland.

The DASY52 HAC Extension consists of the following parts:

Test Arch Phantom

The specially designed Test Arch allows high precision positioning of both the device and any of the validation dipoles.

EF3DV3 Isotropic E-Field Probe

Construction:	One dipole parallel, two dipoles normal to probe axis Interleaved sensors Built-in shielding against static charges PEEK enclosure material
Calibration:	In air from 100 MHz to 3.0 GHz(absolute accuracy ±6.0%, k=2) ISO/IEC 17025 calibration service available.
Frequency:	40 MHz – >6 GHz (can be extended to < 20 MHz); Linearity: ±0.2 dB (100 MHz – 3 GHz)
Directivity:	± 0.2 dB in air (rotation around probe axis) ± 0.4 dB in air (rotation normal to probe axis)
Dynamic Range:	2 V/m to > 1000 V/m; Linearity: ± 0.2 dB
Dimensions:	Overall length: 337 mm (Tip: 20 mm) Tip diameter: 3.9 mm (Body: 12 mm) Distance from probe tip to dipole centers: 1.5 mm Sensor displacement to probe's calibration point: <0.7 mm
Application:	General near-field measurements up to 6 GHz HAC measurements up to 6 GHz Field component measurements Fast automatic scanning in phantoms

8. System Validation

The test setup was validated when first configured and verified periodically thereafter to ensure proper function. The procedure provided in this section is a validation procedure using dipole antennas for which the field levels were computed by numeric modeling.

Procedure:

Place a dipole antenna meeting the requirements given in ANSI C63.19 in the normally occupied by the WD.

The dipole antenna serves as a known source for an electrical and magnetic output. Position the E-field probe so that the following occurs:

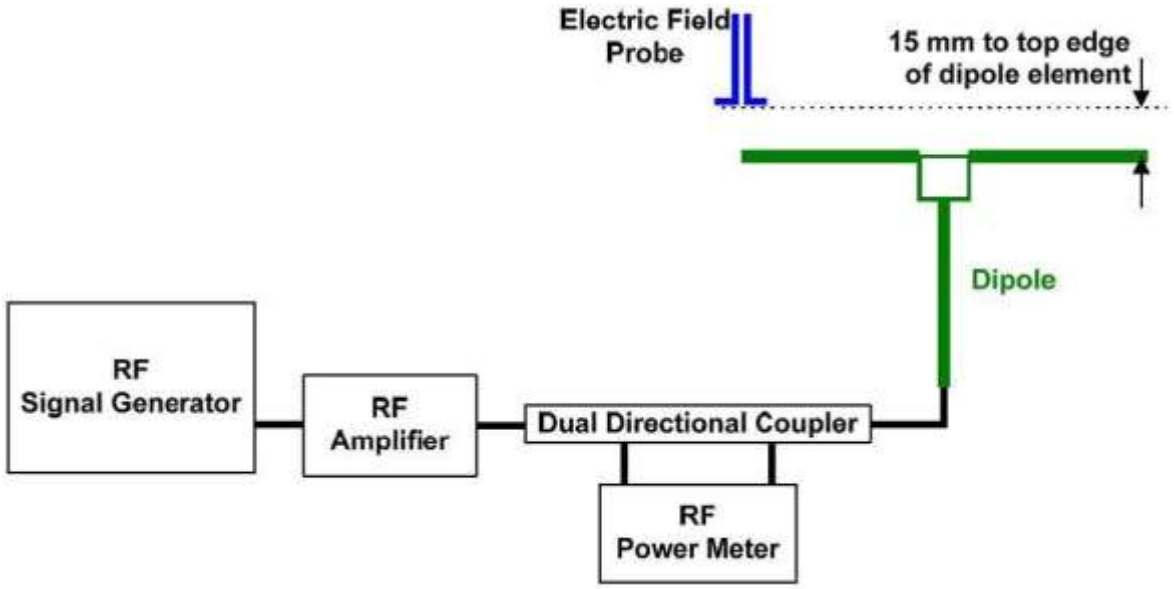
- The probes and their cables are parallel to the coaxial feed of the dipole antenna

- The probe cables and the coaxial feed of the dipole antenna approach the measurement area from opposite directions

- The center point of the probe element(s) is 15 mm from the closest surface of the dipole elements.

Scan the length of the dipole with the E-field probe and record the two maximum values found near the dipole ends. Average the two readings and compare the reading to the expected value in the calibration certificate or the expected value in this standard.

Setup diagram



9. Modulation Interference Factor (MIF)

The HAC Standard ANSI C63.19 defines a new scaling using the Modulation Interference Factor (MIF) which replaces the need for the Articulation Weighting Factor (AWF) during the evaluation and is applicable to any modulation scheme.

The Modulation Interference factor (MIF, in dB) is added to the measured average E-field (in dBV/m) and converts it to the RF Audio Interference level (in dBV/m). This level considers the audible amplitude modulation components in the RF E-field. CW fields without amplitude modulation are assumed to not interfere with the hearing aid electronics. Modulations without time slots and low fluctuations at low frequencies have low MIF values, TDMA modulations with narrow transmission and repetition rates of few 100 Hz have high MIF values and give similar classifications as ANSI C63.19.

Definitions

E-field probes have a bandwidth <10 kHz and can therefore not evaluate the RF envelope in the full audio band. DASY52 is therefore using the “indirect” measurement method according to ANSI C63.19 which is the primary method. These near field probes read the averaged E-field measurement. Especially for the new high peak-to- average (PAR) signal types, the probes shall be linearized by probe modulation response (PMR) calibration in order to not overestimate the field reading.

The evaluation method or the MIF is defined in ANSI C63.19 section D.7. An RMS demodulated RF signal is fed to a spectral filter (similar to an A weighting filter) and forwarded to a temporal filter acting as a quasi-peak detector. The averaged output of these filtering is called to a 1 kHz 80% AM signal as reference. MIF measurement requires additional instrumentation and is not well suited for evaluation by the end user with reasonable uncertainty It may alternatively be determined through analysis and simulation, because it is constraint and characteristic for a communication signal. DASY52 uses well defined signals for PMR calibration. The MIF of these signals has been determined by simulation and is automatically applied.

MIF values were not tested by a probe or as specified in the standards but are based on analysis provided by SPEAG for all the air interfaces (CDMA, GSM, WCDMA, LTE, and Wi-Fi). The data included in this report are for the worst case operating modes. The UIDs used are listed below:

A PMR calibrated probe is linearized for the selected waveform over the full dynamic range within the uncertainty specified in its calibration certificate. E-field probes have a bandwidth <10 kHz and can therefore not evaluate the RF envelope in the full audio band. DASY52 is therefore using the \indirect" measurement method according to ANSI C63.19 which is the primary method. These near field probes read the averaged E-field measurement. Especially for the new high peak-to-average (PAR) signal types, the probes shall be linearized by PMR calibration in order to not overestimate the field reading.

The MIF measurement uncertainty is estimated as follows, for modulation frequencies from slotted waveforms with fundamental frequency and at least 2 harmonics within 10 kHz:

- *0.2 dB for MIF -7 to +5 dB,*
- *0.5 dB for MIF -13 to +11 dB*
- *1 dB for MIF > -20 dB*

UID	Communication System Name	MIF (dB)
10295-AAB	CDMA2000, RC1, SO3, 1/8th Rate 25 fr.	3.26
10021-DAC	GSM-FDD (TDMA, GMSK)	3.63
10460-AAA	UMTS-FDD (WCDMA,AMR)	-25.43
10170-CAE	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, 16-QAM)	-9.76
10182-CAE	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, 16-QAM)	-9.76
10176-CAG	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, 16-QAM)	-9.76
10173-CAG	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, 16-QAM)	-1.44
10061-CAB	IEEE 802.11b WiFi 2.4 GHz (DSSS, 11 Mbps)	-2.02
10077-CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 54 Mbps)	0.12
10591-AAC	IEEE 802.11n (HT Mixed, 20MHz, MCS0, 90pc duty cycle)	-5.59
10069-CAD	IEEE 802.11a/n WiFi 5 GHz (OFDM, 54 Mbps)	-3.15
10616-AAC	IEEE 802.11ac WiFi (40MHz, MCS0, 90pc duty cycle)	-5.57
10671-AAC	IEEE 802.11ax (20MHz, MCS0, 90pc duty cycle)	-5.58
10743-AAC	IEEE 802.11ax (160MHz, MCS0, 90pc duty cycle)	-6.60
10030-CAA	IEEE 802.15.1 Bluetooth (GFSK, DH1)	1.02
10933-AAC	5G NR-FDD (DFT-s-OFDM, 1RB, 30 MHz, QPSK, 15 kHz)	-15.06
10972-AAB	5G NR TDD (CP-OFDM, 1 RB, 20 MHz, QPSK, 15 kHz)	-1.65
10973-AAB	5G NR TDD (DFT-s-OFDM, 1 RB, 100 MHz, QPSK, 30 kHz)	-1.64
10974-AAB	5G NR TDD (CP-OFDM, 100% RB, 100 MHz, 256-QAM, 30 kHz)	-3.48

10. Analysis of RF Air interface Technologies

An analysis was performed, following the guidance of 4.3 and 4.4 of the ANSI standard, of the RF air interface technologies being evaluated. The factors that will affect the RF interference Potential were evaluated, and the worst case operating modes were identified and used in the evaluation. A WD's interference potential is a function both of the WD's average near-field field strength and of the signal's audio-frequency amplitude modulation characteristics. Per 4.4, RF air interface technologies that have low power have been found to produce sufficiently low RF interference potential, so it is possible to exempt them from the product testing specified in Clause 5 of the ANSI standard. An RF air interface technology of a device is exempt from testing

When its average antenna input power plus its MIF is ≤ 17dBm for all of its operating modes.

The worst case MIF plus the worst case average antenna input power for all modes are investigated below to determine the testing requirements for this device.

10.1 Air Interfaces and Operating Mode

Air-Interface	Band (㎒)	Type	HAC Tested	Simultaneous Transmissions Note: Not to be tested	Name of Voice service	Power Reduction
GSM	850	VO	No[1]	Yes: BT, WLAN	CMRS Voice	N/A
	1900					
	GPRS/EDGE	VD	N/A	Yes: BT, WLAN	google Duo	N/A
WCDMA	850	VO	No[1]	Yes: BT, WLAN	CMRS Voice	N/A
	1700					
	1900					
	HSPA	VD	N/A	Yes: BT, WLAN	google Duo	N/A
CDMA	850	VO	No[1]	Yes: BT, WLAN	CMRS Voice	N/A
	1900			Yes: BT, WLAN		
	1xEvDO	VD	No[1]	Yes: BT, WLAN	google Duo	N/A
LTE (FDD)	680(B71)	VD	No[1]	Yes: BT, WLAN	VOLTE,google Duo	N/A
	700 (B12)					
	780 (B13)					
	790 (B14)					
	850 (B5,B26)					
	1700 (B4,B66)					
	1900 (B2,B25)					
	2300(B30)					
	2500(B7)					
LTE (TDD)	2300 (B40)	VD	No[1]	Yes: BT, WLAN	VOLTE,google Duo	N/A
	2600 (B38)		No[1]			
	2600 (B41)		No[1]			
	3500 (B48)		No[1]			Yes
NR(FDD)	700(B12)	VD	No[1]	Yes: BT, WLAN	google Duo	N/A
	680(B71)					
	850(B5)					
	1700(B66)					
	1900(B2, B25)					
	2300(B30)					
NR(TDD)	2600(B41)	VD	No[1]	Yes: BT, WLAN	google Duo	N/A
	3500(B48)		No[1]			Yes
	3800(B77)		No[1]			
	28000 (n261)		No[2]			N/A
	39000 (n260)		No[2]			
WLAN	2450	VD	No[1]	Yes: WWAN, Wifi 5GHz	VoWIFI, google Duo	Yes
	5200(UNII 1)		No[1]	Yes: WWAN, Wifi 2,4GHz and BT		
	5300(UNII 2A)		No[1]			
	5500(UNII 2C)		No[1]			
	5800(UNII 3)		No[1]			
BT	2450	DT	N/A	Yes: WWAN and Wifi 5GHz	N/A	N/A

Type Transport
VO = CMRS Voice Service
DT = Digital Transport
VD = CMRS IP Voice Service and Digital Transport

Note:
[1]. Evaluated for MIF and low power exemption.
[2]. n260,n261 are currently outside the scope of ANSI C63.19 and FCC HAC regulations.
This report pertains to NR n48 only. For full data, please refer to original test report (Test Report : HCT-SR-2105-FC006-R2, HCT-SR-2106-FC001)

10.2 Individual Mode Evaluations

Max. Average Power + MIF calculations for Low Power Exemptions

Air Interface	Maximum Average Power	Worst case MIF	Total (Power + MIF)	C63.19 Testing Required
	[dBm]	[dBm]	[dBm]	
NR Band 48	17.0*	-1.65	15.35	No

Note(s):

1. Max tune-up limit.
2. Band NR n48 was applied RCV-On Back-off during the Voice call mode.

*. ANSI C63.19-2011 Sec. 4.4 footnot 20 indicates the use of a long averaging time for measuring the antenna input power when using this method of exclusion. Therefore, the frame averaged power was calculated for these modes in this investigation.

10.3 Low-Power Exemption Conclusions

Per ANSI C63.19-2011, All applicable air interfaces are exempt.

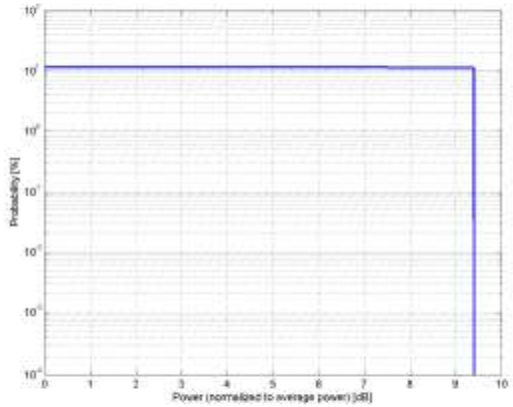
23. Appendix A. UID Specifications

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

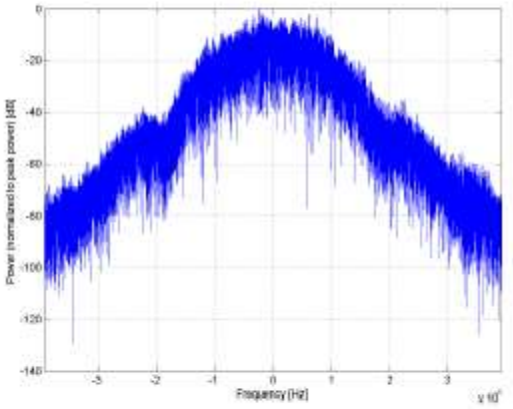
Name:	GSM-FDD (TDMA, GMSK)
Group:	GSM
UID:	10021-DAC
PAR: [1]	9.39 dB
MIF: [2]	3.63 dB
Standard Reference:	ETSI TS 100 909 V8.9.0 (2005-01) FCC OET KDB 941225, D03 and D04
Category:	Periodic pulsed modulation
Modulation:	GMSK
Frequency Band:	GSM 450 (450.4 - 457.6 MHz) GSM 480 (478.8 - 486.0 MHz) GSM 710 (698.0 - 716.0 MHz) GSM 750 (747.0 - 763.0 MHz) GSM 850 (824.0 - 849.0 MHz) P-GSM 900 (890.0 - 915.0 MHz) E-GSM 900 (880.0 - 915.0 MHz) R-GSM 900 (876.0 - 915.0 MHz) DCS 1800 (1710.0 - 1785.0 MHz) PCS 1900 (1850.0 - 1910.0 MHz) ER-GSM 900 (873.0 - 915.0 MHz) Validation band (0.0 - 6000.0 MHz)
Detailed Specification:	Active Slot: TN0 Data: PN9 continuous Frame: composed out of 8 Slots Multiframe: 26th (IDLE) Frame set blank Slottype & -timing: Normal burst for GMSK
Bandwidth:	0.2 MHz
Integration Time:	120.0 ms

[1] PAR (0.1%) in accordance with FCC KDB 971168, Section 6.0 "Measurement of the Peak-to-Average Power Ratio (PAPR)"
[2] Modulation Interference Factor (MIF) value valid only in conjunction with advanced probe response linearization calibration for the same communication system (same UID and version).

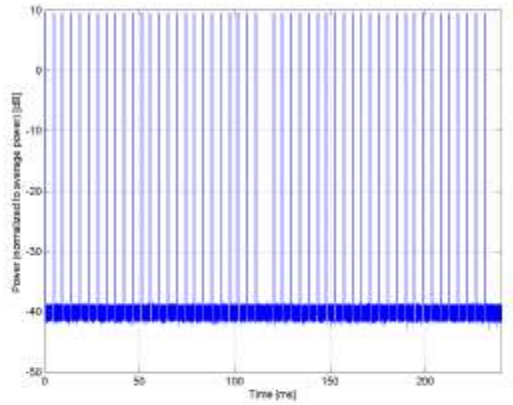
Calibration Laboratory of
Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland



Complementary Cumulative Distribution Function (CCDF)



Frequency Domain



Time Domain

UID Specification Sheet UID 10021-DAC page 2/2 16.11.2016

Calibration Laboratory of
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Name:	**UMTS-FDD (WCDMA, AMR)**
Group:	WCDMA
UID:	10460-AAA
PAR: [1]	**2.39 dB**
MIF: [2]	**-25.43 dB**
Standard Reference:	FCC OET KDB 941225 D01 SAR test for 3G devices v03
Category:	Random amplitude modulation
Modulation:	QPSK
Frequency Band:	Band 1, UTRA/FDD (1920.0-1980.0 MHz, 20000) Band 2, UTRA/FDD (1850.0-1910.0 MHz, 20001) Band 3, UTRA/FDD (1710.0-1785.0 MHz, 20002) Band 4, UTRA/FDD (1710.0-1755.0 MHz, 20003) Band 5, UTRA/FDD (824.0-849.0 MHz, 20004) Band 6, UTRA/FDD (830.0-840.0 MHz, 20005) Band 7, UTRA/FDD (2500.0-2570.0 MHz, 20006) Band 8, UTRA/FDD (880.0-915.0 MHz, 20007) Band 9, UTRA/FDD (1749.9-1784.9 MHz, 20008) Band 10, UTRA/FDD (1710.0-1770.0 MHz, 20009) Band 11, UTRA/FDD (1427.9-1452.9 MHz, 20010) Band 12, UTRA/FDD (698.0-716.0 MHz, 20011) Band 13, UTRA/FDD (777.0-787.0 MHz, 20012) Band 14, UTRA/FDD (788.0-798.0 MHz, 20013) Band 19, UTRA/FDD (830.0-845.0 MHz, 20130) Band 20, UTRA/FDD (832.0-862.0 MHz, 20131) Band 21, UTRA/FDD (1447.9-1462.9 MHz, 20132) Band 22, UTRA/FDD (3410.0-3490.0 MHz, 20217) Band 25, UTRA/FDD (1850.0-1915.0 MHz, 20218) Band 26, UTRA/FDD (814.0-849.0 MHz, 20219)
Detailed Specification:	Dedicated Channel Type: 12.2 kbps AMR 3.4 kbps SRB
Bandwidth:	5.0 MHz
Integration Time:	100.0 ms

[1] PAR (0.1%) in accordance with FCC KDB 971168, Section 6.0 "Measurement of the Peak-to-Average Power Ratio (PAPR)"
[2] Modulation Interference Factor (MIF) value valid only in conjunction with advanced probe response linearization calibration for the same communication system (same UID and version).

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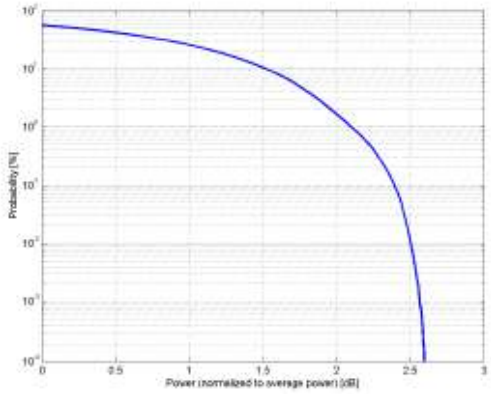
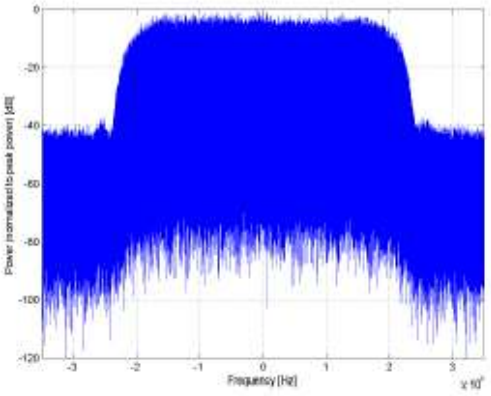
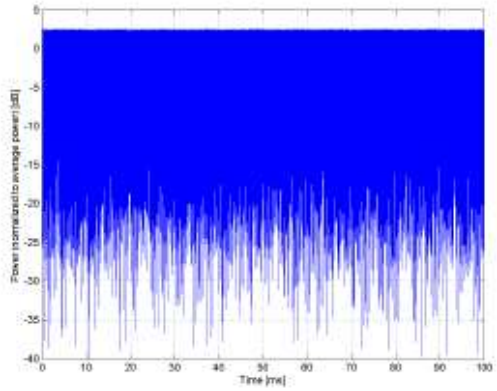


Complementary Cumulative Distribution Function (CCDF)



Frequency Domain



Time Domain

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Name:	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, 16-QAM)
Group:	LTE-FDD
UID:	10170-CAE
PAR: [1]	6.52 dB
MIF: [2]	-9.76 dB
Standard Reference:	3GPP / ETSI TS 136.101 V8.4.0 3GPP / ETSI TS 136.213 V8.4.0 FCC OET KDB 941225 D05 SAR for LTE Devices v01
Category:	Random amplitude modulation
Modulation:	16-QAM
Frequency Band:	Band 1, E-UTRA/FDD (1920.0 - 1980.0 MHz) Band 2, E-UTRA/FDD (1850.0 - 1910.0 MHz) Band 3, E-UTRA/FDD (1710.0 - 1785.0 MHz) Band 4, E-UTRA/FDD (1710.0 - 1755.0 MHz) Band 7, E-UTRA/FDD (2500.0 - 2570.0 MHz) Band 9, E-UTRA/FDD (1749.9 - 1784.9 MHz) Band 10, E-UTRA/FDD (1710.0 - 1770.0 MHz) Band 20, E-UTRA/FDD (832.0 - 862.0 MHz) Band 22, E-UTRA/FDD (3410.0 - 3490.0 MHz) Band 23, E-UTRA/FDD (2000.0 - 2020.0 MHz) Band 25, E-UTRA/FDD (1850.0 - 1915.0 MHz) Band 28 E-UTRA/FDD (703.0 - 748.0 MHz) Band 65, E-UTRA/FDD (1920.0 - 2010.0 MHz) Band 66, E-UTRA/FDD (1710.0 - 1780.0 MHz) Band 70, E-UTRA/FDD (1695.0 - 1710.0 MHz) Band 71, E-UTRA/FDD (663.0 - 698.0 MHz) Band 74, E-UTRA/FDD (1427.0 - 1470.0 MHz) Validation band (0.0 - 6000.0 MHz)
Detailed Specification:	Modulation Scheme: SC-FDMA Number of PUSCHs: 1 Settings for Subframe #0 to #9: Modulation Scheme: 16QAM Data Type: UL-SCH Number RB: 1 Transport Block Size: 256 TBS Index: 14 MCS Index: 15 Data Type: PN9
Bandwidth:	20.0 MHz
Integration Time:	10.0 ms

[1] PAR (0.1%) in accordance with FCC KDB 971168, Section 6.0 "Measurement of the Peak-to-Average Power Ratio (PAPR)"
[2] Modulation Interference Factor (MIF) value valid only in conjunction with advanced probe response linearization calibration for the same communication system (same UID and version).

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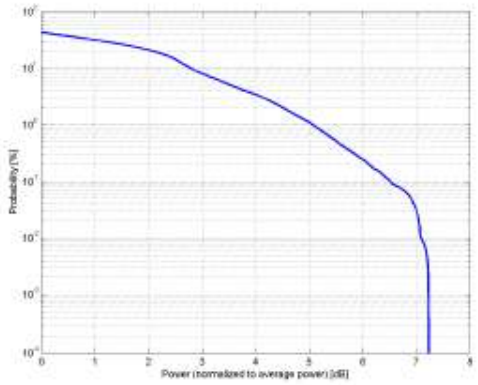
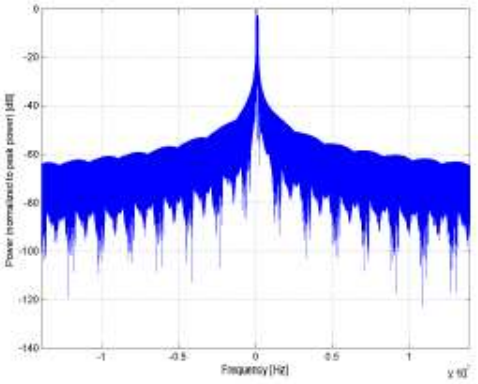
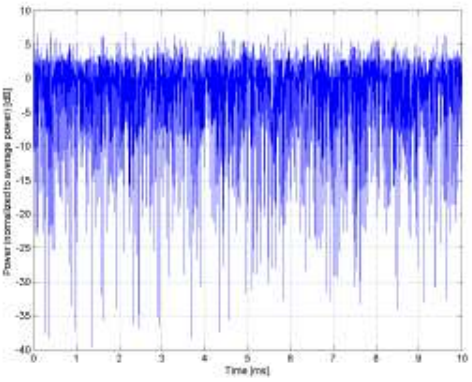


Complementary Cumulative Distribution Function (CCDF)



Frequency Domain



Time Domain

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Name:	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, 16-QAM)
Group:	LTE-FDD
UID:	10182-CAE
PAR: [1]	6.52 dB
MIF: [2]	-9.76 dB
Standard Reference:	3GPP / ETSI TS 136.101 V8.4.0 3GPP / ETSI TS 136.213 V8.4.0 FCC OET KDB 941225 D05 SAR for LTE Devices v01
Category:	Random amplitude modulation
Modulation:	16-QAM
Frequency Band:	Band 1, E-UTRA/FDD (1920.0 - 1980.0 MHz) Band 2, E-UTRA/FDD (1850.0 - 1910.0 MHz) Band 3, E-UTRA/FDD (1710.0 - 1785.0 MHz) Band 4, E-UTRA/FDD (1710.0 - 1755.0 MHz) Band 7, E-UTRA/FDD (2500.0 - 2570.0 MHz) Band 9, E-UTRA/FDD (1749.9 - 1784.9 MHz) Band 10, E-UTRA/FDD (1710.0 - 1770.0 MHz) Band 18, E-UTRA/FDD (815.0 - 830.0 MHz) Band 19, E-UTRA/FDD (830.0 - 845.0 MHz) Band 20, E-UTRA/FDD (832.0 - 862.0 MHz) Band 21, E-UTRA/FDD (1447.9 - 1462.9 MHz) Band 22, E-UTRA/FDD (3410.0 - 3490.0 MHz) Band 23, E-UTRA/FDD (2000.0 - 2020.0 MHz) Band 25, E-UTRA/FDD (1850.0 - 1915.0 MHz) Band 26 E-UTRA/FDD (814.0 - 849.0 MHz) Band 28 E-UTRA/FDD (703.0 - 748.0 MHz) Band 65, E-UTRA/FDD (1920.0 - 2010.0 MHz) Band 66, E-UTRA/FDD (1710.0 - 1780.0 MHz) Band 68, E-UTRA/FDD (698.0 - 728.0 MHz) Band 70, E-UTRA/FDD (1695.0 - 1710.0 MHz) Band 71, E-UTRA/FDD (663.0 - 698.0 MHz) Band 74, E-UTRA/FDD (1427.0 - 1470.0 MHz) Validation band (0.0 - 6000.0 MHz)
Detailed Specification:	Modulation Scheme: SC-FDMA Number of PUSCHs: 1 Settings for Subframe #0 to #9: Modulation Scheme: 16QAM Data Type: UL-SCH Number RB: 1 Transport Block Size: 256 TBS Index: 14 MCS Index: 15 Data Type: PN9
Bandwidth:	15.0 MHz
Integration Time:	10.0 ms

[1] PAR (0.1%) in accordance with FCC KDB 971168, Section 6.0 "Measurement of the Peak-to-Average Power Ratio (PAPR)"
[2] Modulation Interference Factor (MIF) value valid only in conjunction with advanced probe response linearization calibration for the same communication system (same UID and version).

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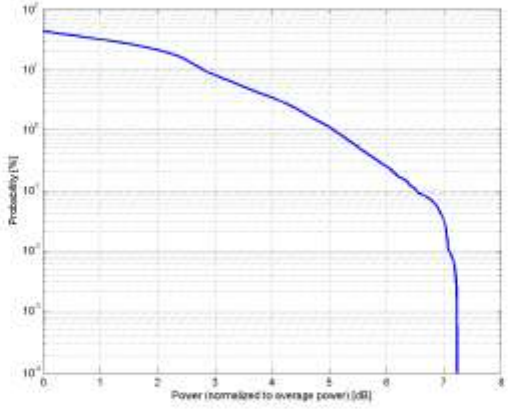
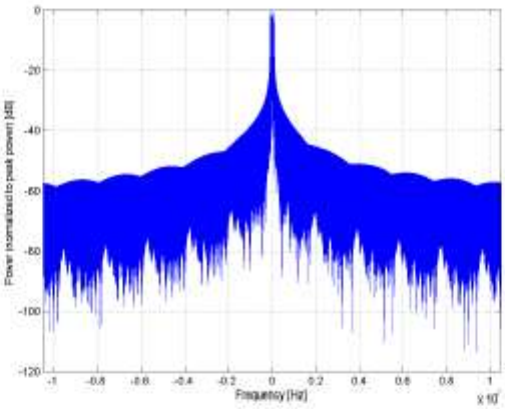
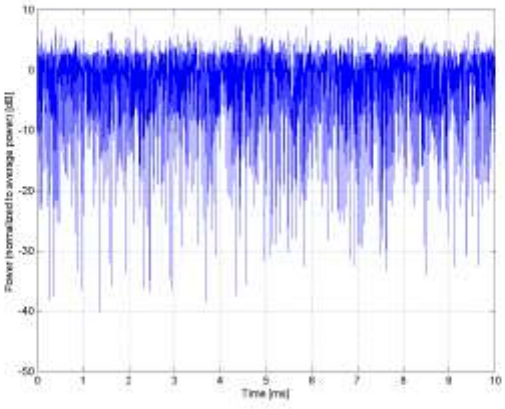


Complementary Cumulative Distribution Function (CCDF)



Frequency Domain



Time Domain

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Name:	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, 16-QAM)
Group:	LTE-FDD
UID:	10176-CAG
PAR: [1]	6.52 dB
MIF: [2]	-9.76 dB
Standard Reference:	3GPP / ETSI TS 136.101 V8.4.0 3GPP / ETSI TS 136.213 V8.4.0 FCC OET KDB 941225 D05 SAR for LTE Devices v01
Category:	Random amplitude modulation
Modulation:	16-QAM
Frequency Band:	Band 1, E-UTRA/FDD (1920.0 - 1980.0 MHz) Band 2, E-UTRA/FDD (1850.0 - 1910.0 MHz) Band 3, E-UTRA/FDD (1710.0 - 1785.0 MHz) Band 4, E-UTRA/FDD (1710.0 - 1755.0 MHz) Band 5, E-UTRA/FDD (824.0 - 849.0 MHz) Band 6, E-UTRA/FDD (830.0 - 840.0 MHz) Band 7, E-UTRA/FDD (2500.0 - 2570.0 MHz) Band 8, E-UTRA/FDD (880.0 - 915.0 MHz) Band 9, E-UTRA/FDD (1749.9 - 1784.9 MHz) Band 10, E-UTRA/FDD (1710.0 - 1770.0 MHz) Band 11, E-UTRA/FDD (1427.9 - 1447.9 MHz) Band 12, E-UTRA/FDD (699.0 - 716.0 MHz) Band 13, E-UTRA/FDD (777.0 - 787.0 MHz) Band 14, E-UTRA/FDD (788.0 - 798.0 MHz) Band 17, E-UTRA/FDD (704.0 - 716.0 MHz) Band 18, E-UTRA/FDD (815.0 - 830.0 MHz) Band 19, E-UTRA/FDD (830.0 - 845.0 MHz) Band 20, E-UTRA/FDD (832.0 - 862.0 MHz) Band 21, E-UTRA/FDD (1447.9 - 1462.9 MHz) Band 22, E-UTRA/FDD (3410.0 - 3490.0 MHz) Band 23, E-UTRA/FDD (2000.0 - 2020.0 MHz) Band 24, E-UTRA/FDD (1626.5 - 1660.5 MHz) Band 25, E-UTRA/FDD (1850.0 - 1915.0 MHz) Band 26 E-UTRA/FDD (814.0 - 849.0 MHz) Band 27 E-UTRA/FDD (807.0 - 824.0 MHz) Band 28 E-UTRA/FDD (703.0 - 748.0 MHz) Band 30, E-UTRA/FDD (2305.0 - 2315.0 MHz) Band 65, E-UTRA/FDD (1920.0 - 2010.0 MHz) Band 66, E-UTRA/FDD (1710.0 - 1780.0 MHz) Band 68, E-UTRA/FDD (698.0 - 728.0 MHz) Band 70, E-UTRA/FDD (1695.0 - 1710.0 MHz) Band 71, E-UTRA/FDD (663.0 - 698.0 MHz) Band 74, E-UTRA/FDD (1427.0 - 1470.0 MHz) Band 85, E-UTRA/FDD (698.0 - 716.0 MHz) Validation band (0.0 - 6000.0 MHz)
Detailed Specification:	Modulation Scheme: SC-FDMA Number of PUSCHs: 1 Settings for Subframe #0 to #9: Modulation Scheme: QPSK Data Type: UL-SCH Number RB: 1 Transport Block Size: 256 TBS Index: 14 MCS Index: 15 Data Type: PN9
Bandwidth:	10.0 MHz
Integration Time:	10.0 ms

1 PAR (0.1%) in accordance with FCC KDB 971168, Section 6.0 "Measurement of the Peak-to-Average Power Ratio (PAPR)"
2 Modulation Interference Factor (MIF) value valid only in conjunction with advanced probe response linearization calibration for the same communication system (same UID and version).

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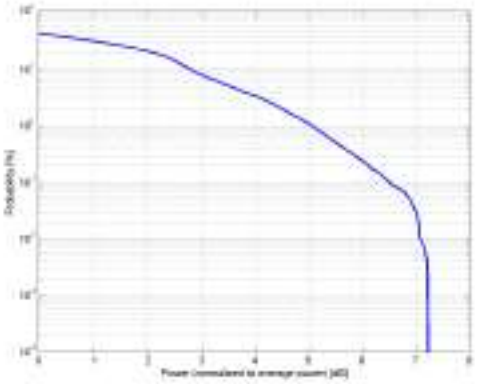
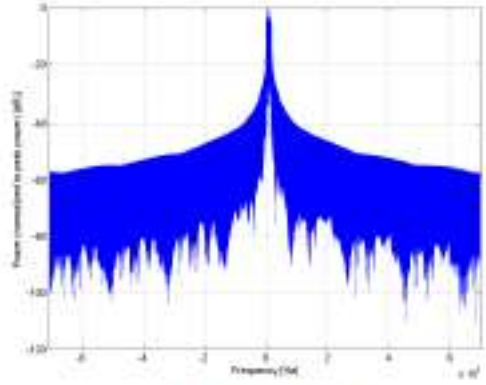
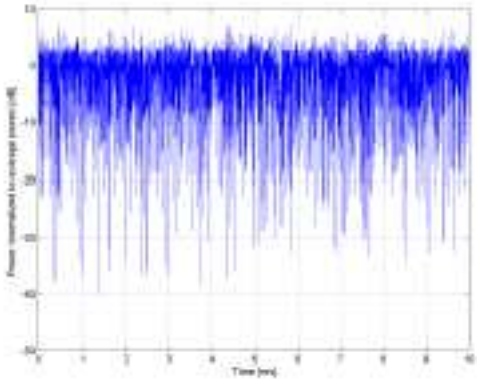


Complementary Cumulative Distribution Function (CCDF)



Frequency Domain



Time Domain

Calibration Laboratory of
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Name:	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, 16-QAM)
Group:	LTE-TDD
UID:	10173-CAG
PAR: [1]	9.48 dB
MIF: [2]	-1.44 dB
Standard Reference:	3GPP / ETSI TS 136.101 V8.4.0 3GPP / ETSI TS 136.213 V8.4.0 FCC OET KDB 941225 D05 SAR for LTE Devices v02
Category:	Random amplitude modulation
Modulation:	16-QAM
Frequency Band:	Band 33, E-UTRA/TDD (1900.0 - 1920.0 MHz) Band 35, E-UTRA/TDD (1850.0 - 1910.0 MHz) Band 36, E-UTRA/TDD (1930.0 - 1990.0 MHz) Band 37, E-UTRA/TDD (1910.0 - 1930.0 MHz) Band 38, E-UTRA/TDD (2570.0 - 2620.0 MHz) Band 39, E-UTRA/TDD (1880.0 - 1920.0 MHz) Band 40, E-UTRA/TDD (2300.0 - 2400.0 MHz) Band 41, E-UTRA/TDD (2496.0 - 2690.0 MHz) Band 42, E-UTRA/TDD (3400.0 - 3600.0 MHz) Band 43, E-UTRA/TDD (3600.0 - 3800.0 MHz) Band 44, E-UTRA/TDD (703.0 - 803.0 MHz) Band 45, E-UTRA/FDD (1447.0 - 1467.0 MHz) Band 46, E-UTRA/FDD (5150.0 - 5925.0 MHz) Band 47, E-UTRA/TDD (5855.0 - 5925.0 MHz) Band 48, E-UTRA/TDD (3550.0 - 3700.0 MHz) Band 49, E-UTRA/TDD (3550.0 - 3700.0 MHz) Band 50, E-UTRA/TDD (1432.0 - 1517.0 MHz) Band 76, E-UTRA/FDD (3300.0 - 3400.0 MHz) Validation band (0.0 - 6000.0 MHz)
Detailed Specification:	Modulation Scheme: SC-FDMA Uplink-downlink configuration: 1 Special Subframe configuration: 4 Number of Frames: 1 Settings for UL Subframe 2,3,7,8: Number of PUSCHs: 1 Modulation Scheme: 16QAM Allocated RB: 1 Start Number of RB: 50 Data Type: PN9fix
Bandwidth:	20.0 MHz
Integration Time:	6.0 ms

[1] PAR (0.1%) in accordance with FCC KDB 971168, Section 6.0 "Measurement of the Peak-to-Average Power Ratio (PAPR)"
[2] Modulation Interference Factor (MIF) value valid only in conjunction with advanced probe response linearization calibration for the same communication system (same UID and version).

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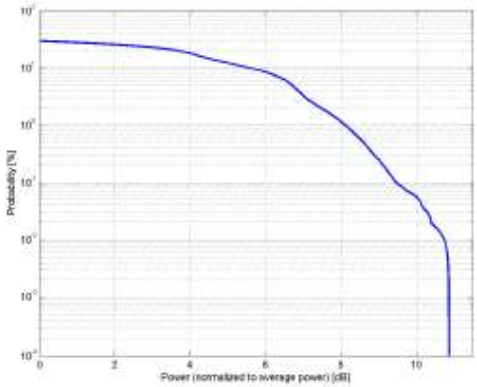
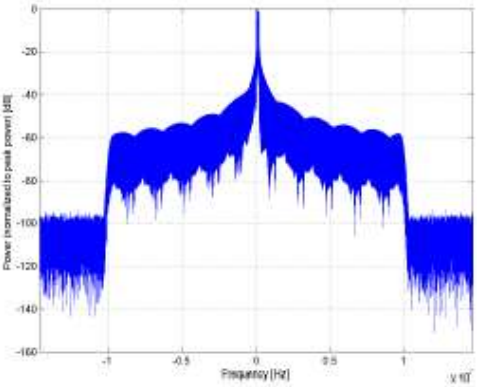
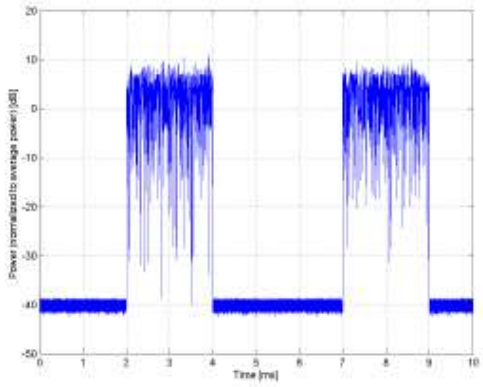


Complementary Cumulative Distribution Function (CCDF)



Frequency Domain



Time Domain

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Name:	**IEEE 802.11b WiFi 2.4 GHz (DSSS, 11 Mbps)**
Group:	WLAN
UID:	10061-CAB
PAR: [1]	**3.60 dB**
MIF: [2]	**-2.02 dB**
Standard Reference:	IEEE 802.11b-1999 , Part 11, FCC SAR meas for 802 11 a b g v01r02 (248227 D01)
Category:	Random amplitude modulation
Modulation:	DQPSK
Frequency Band:	WLAN 2.4GHz (2412.0-2484.0 MHz, 20230)
Detailed Specification:	Data Rate: 11 Mbps Spreading, Coding: CCK PPDU format: Long Preamble & Heading PSDU Length: 1024 PSDU Data: PN9
Bandwidth:	20.0 MHz
Integration Time:	1.5 ms

1 PAR (0.1%) in accordance with FCC KDB 971168, Section 6.0 "Measurement of the Peak-to-Average Power Ratio (PAPR)"
2 Modulation Interference Factor (MIF) value valid only in conjunction with advanced probe response linearization calibration for the same communication system (same UID and version).

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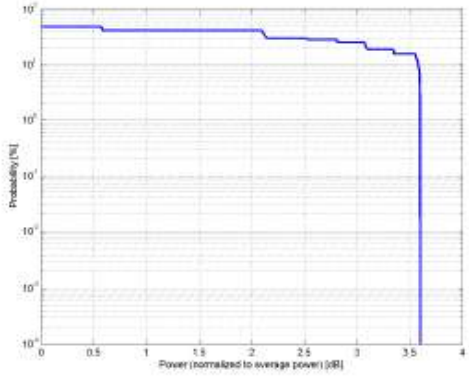
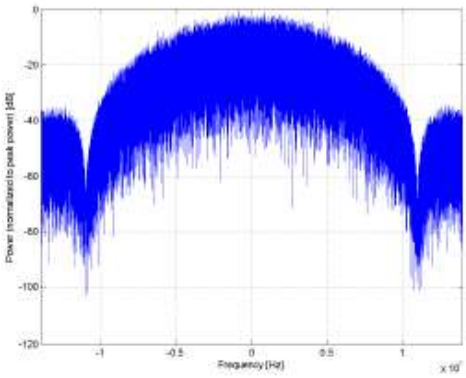
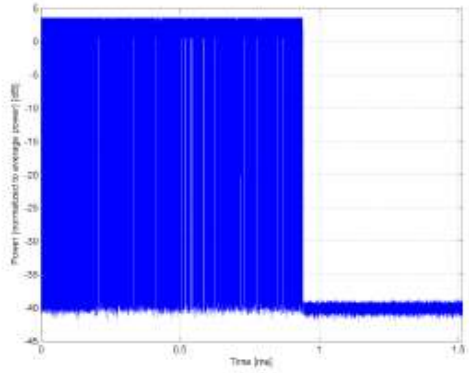


Complementary Cumulative Distribution Function (CCDF)



Frequency Domain



Time Domain

Calibration Laboratory of
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Name:	**IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 54 Mbps)**
Group:	WLAN
UID:	10077-CAB
PAR: [1]	**11.00 dB**
MIF: [2]	**0.12 dB**
Standard Reference:	IEEE 802.11g-2003 , Part 11
	FCC SAR meas for 802 11 a b g v01r02 (248227 D01)
Category:	Random amplitude modulation
Modulation:	64-QAM
Frequency Band:	WLAN 2.4GHz (2412.0-2484.0 MHz, 20230)
Detailed Specification:	Data Rate: 54 Mbps
	Coding Rate: 3/4
	Coded bits per subcarrier: 6
	Coded bits per OFDM symbol: 288
	Data bits per OFDM symbol: 216
	PSDU Length: 1000 Bytes
	PSDU Data: PN9
Bandwidth:	20.0 MHz
Integration Time:	0.9 ms

1 PAR (0.1%) in accordance with FCC KDB 971168, Section 6.0 "Measurement of the Peak-to-Average Power Ratio (PAPR)"
2 Modulation Interference Factor (MIF) value valid only in conjunction with advanced probe response linearization calibration for the same communication system (same UID and version).

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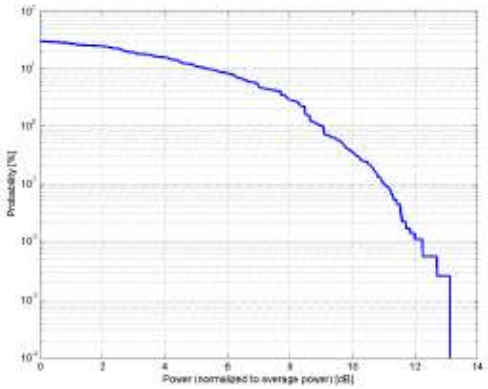
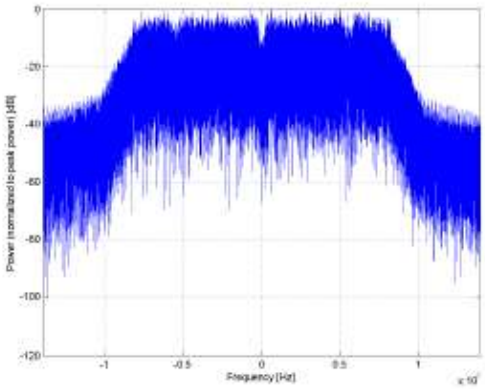
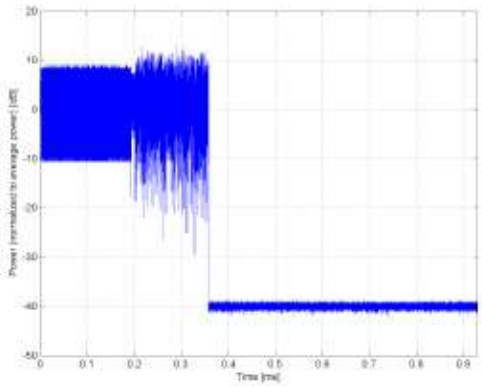


Complementary Cumulative Distribution Function (CCDF)



Frequency Domain



Time Domain

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Name:	IEEE 802.11n (HT Mixed, 20MHz, MCS0, 90pc duty cycle)
Group:	WLAN
UID:	10591-AAC
PAR: [1]	8.63 dB
MIF: [2]	-5.59 dB
Standard Reference:	IEEE 802.11-2012 FCC OET KDB 248227 D01 802.11 Wi-Fi SAR v02r01
Category:	Random amplitude modulation
Modulation:	BPSK
Frequency Band:	WLAN 2.4GHz (2412.0 - 2484.0 MHz) WLAN 5GHz (4915.0 - 5825.0 MHz) U-NII-1, U-NII-2A (5170 - 5330 MHz) U-NII-2C Standalone (5490 - 5710 MHz) U-NII-2C <5.65 GHz (5490 - 5650 MHz) U-NII-3 Standalone (5735 - 5835 MHz) U-NII-2C, U-NII-3 (5650 - 5835 MHz) U-NII-4 (5.825 - 5.925 MHz) Validation band (0.0 - 6000.0 MHz)
Detailed Specification:	Duty cycle: 90% MPDU length: 4096 bytes MCS: 0 Guard interval: long
Bandwidth:	20.0MHz
Integration Time:	5.6 ms

[1] PAR (0.1%) in accordance with FCC KDB 971168, Section 6.0 "Measurement of the Peak-to-Average Power Ratio (PAPR)"
[2] Modulation Interference Factor (MIF) value valid only in conjunction with advanced probe response linearization calibration for the same communication system (same UID and version).

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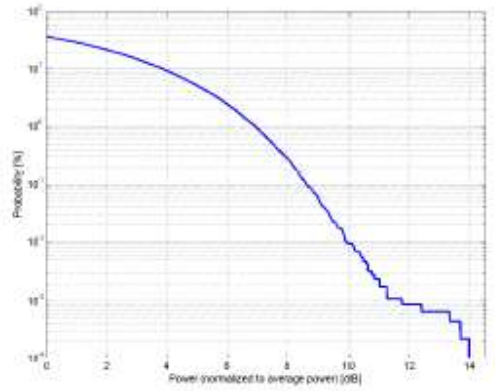
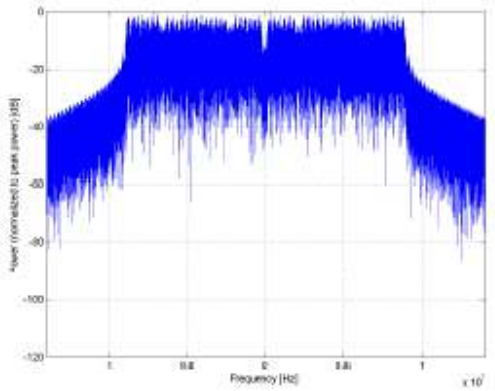
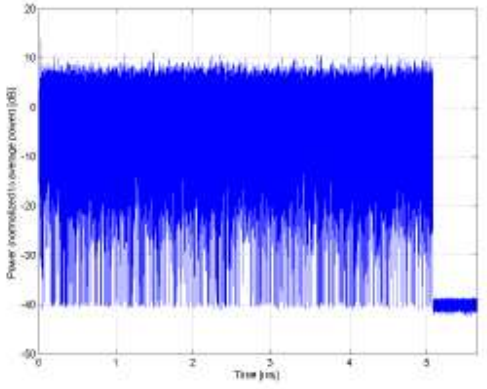


Complementary Cumulative Distribution Function (CCDF)



Frequency Domain



Time Domain

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Name:	IEEE 802.11a/h WiFi 5 GHz (OFDM, 54 Mbps)
Group:	WLAN
UID:	10069-CAD
PAR: [1]	10.56 dB
MIF: [2]	-3.15 dB
Standard Reference:	IEEE 802.11a-1999 (R2003) , Part 11 IEEE 802.11h-2003 , Part 11 FCC SAR meas for 802 11 a b g v01r02 (248227 D01)
Category:	Random amplitude modulation
Modulation:	64-QAM
Frequency Band:	WLAN 5GHz (4915.0 - 5825.0 MHz) U-NII-1, U-NII-2A (5170 - 5330 MHz) U-NII-2C Standalone (5490 - 5710 MHz) U-NII-2C <5.65 GHz (5490 - 5650 MHz) U-NII-3 Standalone (5735 - 5835 MHz) U-NII-2C, U-NII-3 (5650 - 5835 MHz) U-NII-4 (5.825 - 5.925 MHz) Validation band (0.0 - 6000.0 MHz)
Detailed Specification:	Data Rate: 54 Mbps Coding Rate: 3/4 Coded bits per subcarrier: 6 Coded bits per OFDM symbol: 288 Data bits per OFDM symbol: 216 PSDU Length: 1000 Bytes PSDU Data: PN9
Bandwidth:	20.0 MHz
Integration Time:	0.3 ms

1 PAR (0.1%) in accordance with FCC KDB 971168, Section 6.0 "Measurement of the Peak-to-Average Power Ratio (PAPR)"
2 Modulation Interference Factor (MIF) value valid only in conjunction with advanced probe response linearization calibration for the same communication system (same UID and version).

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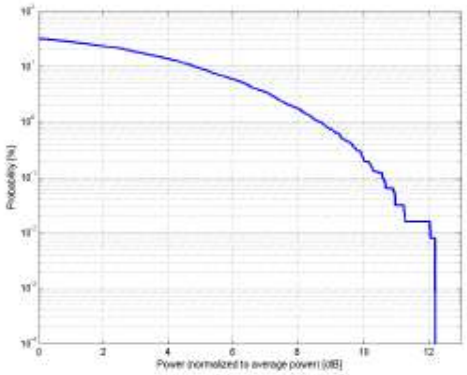
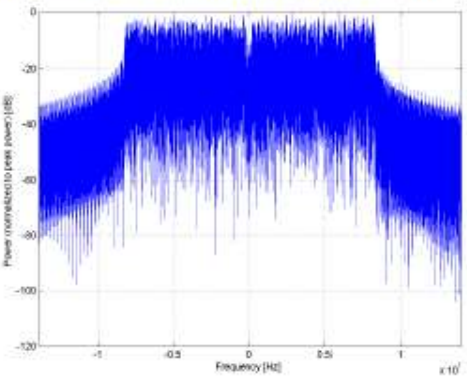
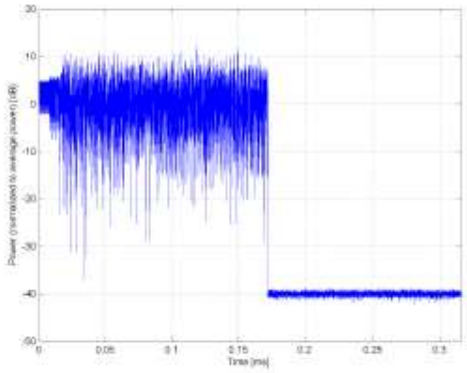


Complementary Cumulative Distribution Function (CCDF)



Frequency Domain



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Name:	IEEE 802.11ac WiFi (40MHz, MCS0, 90pc duty cycle)
Group:	WLAN
UID:	10616-AAC
PAR: [1]	8.82 dB
MIF: [2]	-5.57 dB
Standard Reference:	IEEE 802.11-2013 FCC OET KDB 248227 D01 802.11 Wi-Fi SAR v02r01
Category:	Random amplitude modulation
Modulation:	BPSK
Frequency Band:	WLAN 2.4GHz (2412.0 - 2484.0 MHz) WLAN 5GHz (4915.0 - 5825.0 MHz) U-NII-1, U-NII-2A (5170 - 5330 MHz) U-NII-2C Standalone (5490 - 5710 MHz) U-NII-2C <5.65 GHz (5490 - 5650 MHz) U-NII-3 Standalone (5735 - 5835 MHz) U-NII-2C, U-NII-3 (5650 - 5835 MHz) U-NII-4 (5.825 - 5.925 MHz) Validation band (0.0 - 6000.0 MHz)
Detailed Specification:	Bandwidth: 40MHz Duty cycle: 90% MCS: 0 Number of spatial streams: 1 MPDU length: 8192
Bandwidth:	40.0 MHz
Integration Time:	5.4 ms

1 PAR (0.1%) in accordance with FCC KDB 971168, Section 6.0 "Measurement of the Peak-to-Average Power Ratio (PAPR)"
2 Modulation Interference Factor (MIF) value valid only in conjunction with advanced probe response linearization calibration for the same communication system (same UID and version).

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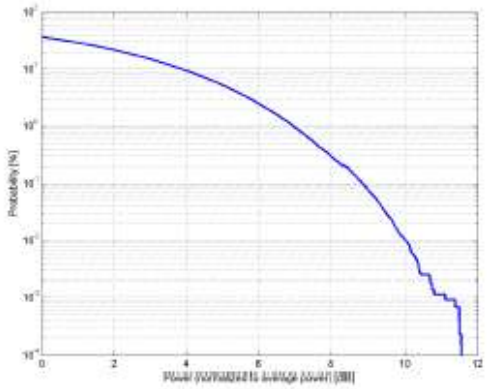
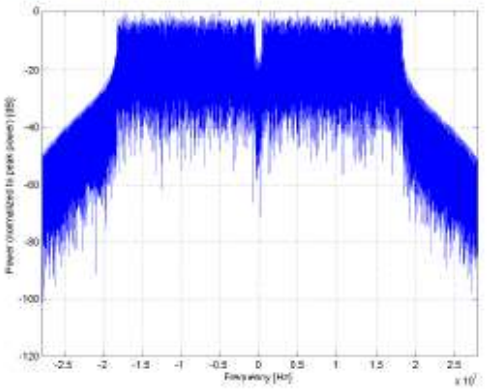
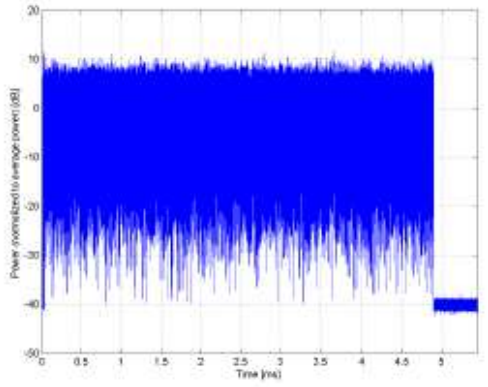


Complementary Cumulative Distribution Function (CCDF)



Frequency Domain



Time Domain

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Name:	IEEE 802.11ax (20MHz, MCS0, 90pc duty cycle)
Group:	WLAN
UID:	10671-AAC
PAR: [1]	9.09 dB
MIF: [2]	-5.58 dB
Standard Reference:	SPEAG
Category:	Random amplitude modulation
Modulation:	BPSK
Frequency Band:	WLAN 2.4GHz (2412.0 - 2484.0 MHz) WLAN 5GHz (4915.0 - 5825.0 MHz) U-NII-1, U-NII-2A (5170 - 5330 MHz) U-NII-2C Standalone (5490 - 5710 MHz) U-NII-2C <5.65 GHz (5490 - 5650 MHz) U-NII-3 Standalone (5735 - 5835 MHz) U-NII-2C, U-NII-3 (5650 - 5835 MHz) U-NII-5 (5925 - 6425 MHz) U-NII-6 (6425 - 6525 MHz) U-NII-7 (6525 - 6875 MHz) U-NII-8 (6875 - 7125 MHz) U-NII-4 (5.825 - 5.925 MHz) Validation band (0.0 - 6000.0 MHz)
Detailed Specification:	Bandwidth: 20MHz Duty Cycle: 90% Number of spatial stream: 1
Bandwidth:	20.0 MHz
Integration Time:	5.0 ms

[1] PAR (0.1%) in accordance with FCC KDB 971168, Section 6.0 "Measurement of the Peak-to-Average Power Ratio (PAPR)"
[2] Modulation Interference Factor (MIF) value valid only in conjunction with advanced probe response linearization calibration for the same communication system (same UID and version).

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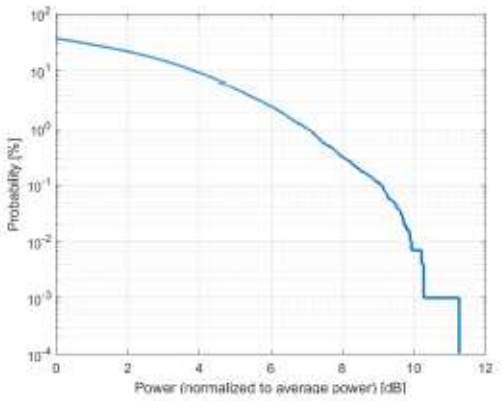
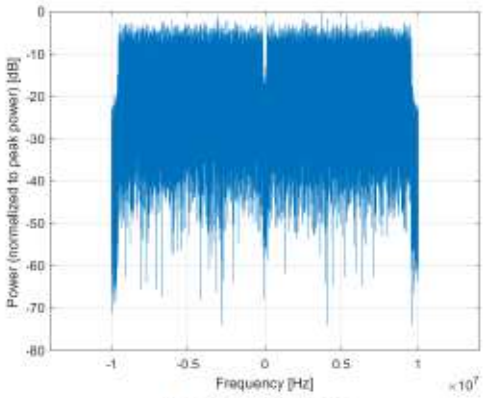
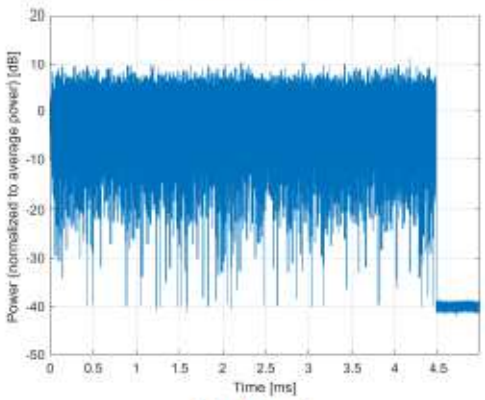


Complementary Cumulative Distribution Function (CCDF)



Frequency Domain



Time Domain

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Name:	**IEEE 802.11ax (160MHz, MCS0, 90pc duty cycle)**
Group:	WLAN
UID:	10743-AAC
PAR: [1]	**8.94 dB**
MIF: [2]	**-6.60 dB**
Standard Reference:	SPEAG
Category:	Random amplitude modulation
Modulation:	BPSK
Frequency Band:	WLAN 2.4GHz (2412.0 - 2484.0 MHz) WLAN 5GHz (4915.0 - 5825.0 MHz) U-NII-1, U-NII-2A (5170 - 5330 MHz) U-NII-2C Standalone (5490 - 5710 MHz) U-NII-2C <5.65 GHz (5490 - 5650 MHz) U-NII-3 Standalone (5735 - 5835 MHz) U-NII-2C, U-NII-3 (5650 - 5835 MHz) U-NII-5 (5925 - 6425 MHz) U-NII-6 (6425 - 6525 MHz) U-NII-7 (6525 - 6875 MHz) U-NII-8 (6875 - 7125 MHz) U-NII-4 (5.825 - 5.925 MHz) Validation band (0.0 - 6000.0 MHz)
Detailed Specification:	Bandwidth: 160MHz Duty Cycle: 90% Number of spatial stream: 1
Bandwidth:	160.0 MHz
Integration Time:	0.9 ms

[1] PAR (0.1%) in accordance with FCC KDB 971168, Section 6.0 "Measurement of the Peak-to-Average Power Ratio (PAPR)"
[2] Modulation Interference Factor (MIF) value valid only in conjunction with advanced probe response linearization calibration for the same communication system (same UID and version).

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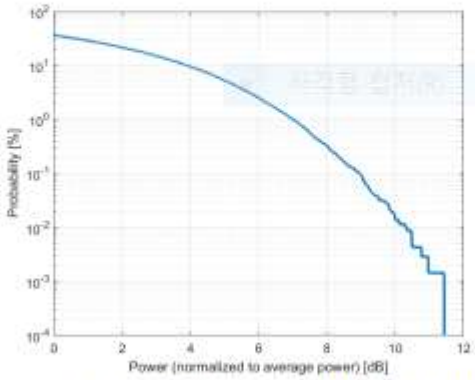
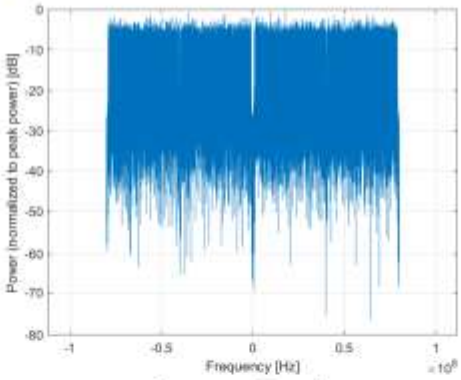
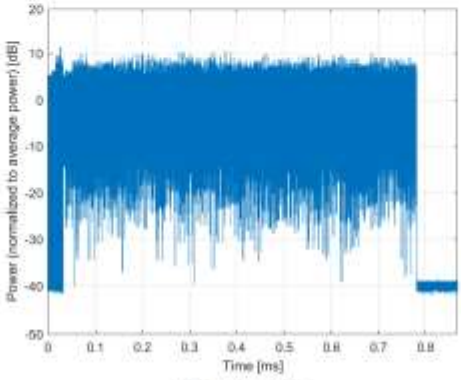


Complementary Cumulative Distribution Function (CCDF)



Frequency Domain



Time Domain

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Name:	**IEEE 802.15.1 Bluetooth (GFSK, DH1)**
Group:	Bluetooth
UID:	10030-CAA
PAR: [1]	**5.30 dB**
MIF: [2]	**1.02 dB**
Standard Reference:	Bluetooth 1.2 (IEEE Standard 802.15.1-2005)
Category:	Periodic pulsed modulation
Modulation:	GFSK
Frequency Band:	ISM 2.4 GHz Band (2400.0-2483.5 MHz, 20052)
Detailed Specification:	Basic Rate, 1 Slot active Data Rate: 1 Mbps Packet Type: DH1 Payload Body: 27 Bytes PN9 data is inserted into the payload body Modulation for Payload: GFSK Modulation Index: 0.32
Bandwidth:	1.4 MHz
Integration Time:	2.5 ms

1 PAR (0.1%) in accordance with FCC KDB 971168, Section 6.0 "Measurement of the Peak-to-Average Power Ratio (PAPR)"
2 Modulation Interference Factor (MIF) value valid only in conjunction with advanced probe response linearization calibration for the same communication system (same UID and version).

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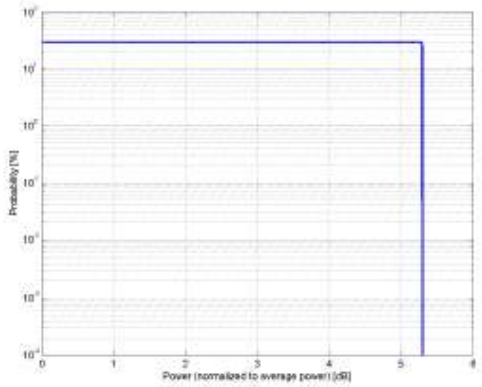
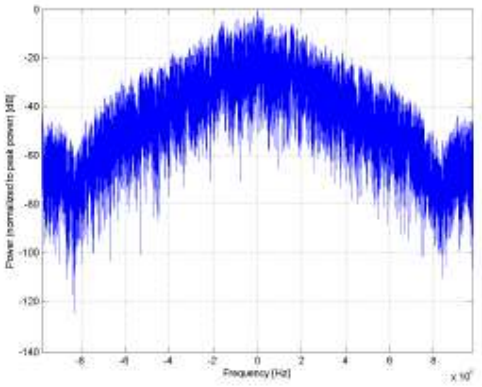
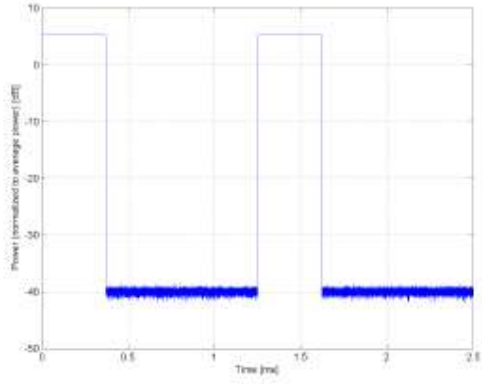


Complementary Cumulative Distribution Function (CCDF)



Frequency Domain



Time Domain

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Name:	5G NR (DFT-s-OFDM, 1 RB, 30 MHz, QPSK, 15 kHz)
Group:	5G NR FR1 FDD
UID:	10933-AAC
PAR: [1]	5.51 dB
MIF: [2]	-15.06 dB
Standard Reference:	SPEAG
Category:	Random amplitude modulation
Modulation:	QPSK
Frequency Band:	Band n25 (1850 - 1915 MHz) Band n66 (1710 - 1780 MHz) Band n1 (1920 - 1980 MHz) Band n3 (1710 - 1785 MHz) Band n7 (2500 - 2570 MHz) Band n28 (703 - 748 MHz) Band n80 (1710 - 1785 MHz) Band n97 (2300 - 2400 MHz) Band n98 (1880 - 1920 MHz) Validation band (0.0 - 6000.0 MHz)
Detailed Specification:	Multiplexing Scheme: DFT-s-OFDM Modulation Scheme: QPSK Subcarrier Spacing: 15 kHz Number RBs: 1 Data Type: PN9
Bandwidth:	30.0 MHz
Integration Time:	10.0 ms

1 PAR (0.1%) in accordance with FCC KDB 971168, Section 6.0 "Measurement of the Peak-to-Average Power Ratio (PAPR)"
2 Modulation Interference Factor (MIF) value valid only in conjunction with advanced probe response linearization calibration for the same communication system (same UID and version).

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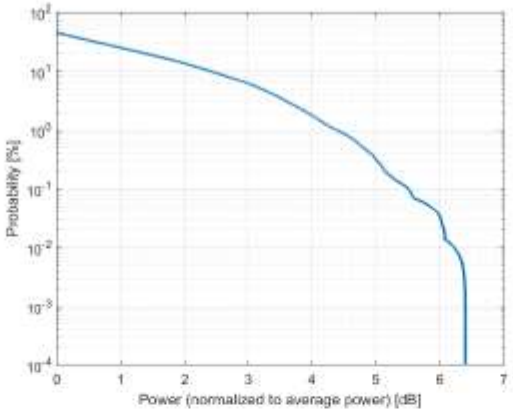
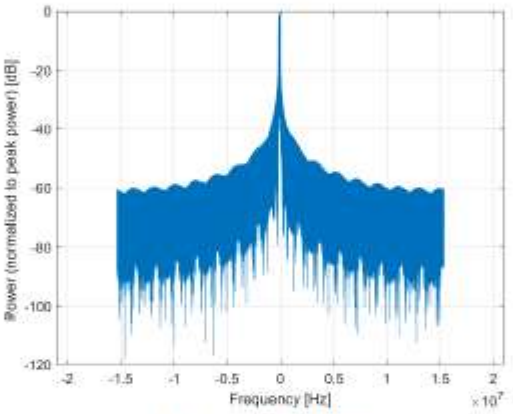
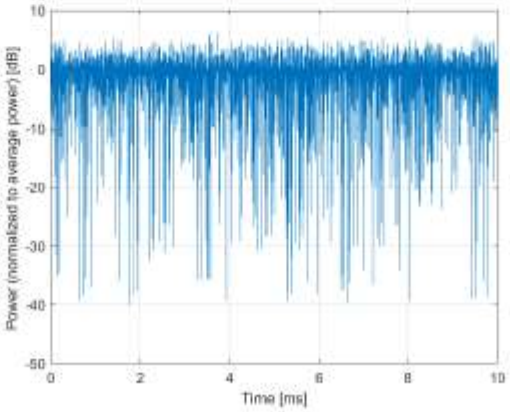


Complementary Cumulative Distribution Function (CCDF)



Frequency Domain



Time Domain

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Name:	**5G NR (CP-OFDM, 1 RB, 20 MHz, QPSK, 15 kHz)**
Group:	5G NR FR1 TDD
UID:	10972-AAB
PAR: [1]	**11.59 dB**
MIF: [2]	**-1.65 dB**
Standard Reference:	SPEAG
Category:	Random amplitude modulation
Modulation:	QPSK
Frequency Band:	Band n38 (2570 - 2620 MHz) Band n39 (1880 - 1920 MHz) Band n40 (2300 - 2400 MHz) Band n41 (2496 - 2690 MHz) Band n48 (3550 - 3700 MHz) Band n50 (1432 - 1517 MHz) Band n77 (3300 - 4200 MHz) Band n78 (3300 - 3800 MHz) Band n90 (2496 - 2690 MHz) Band n47 (5855 - 5925 MHz) Validation band (0.0 - 6000.0 MHz)
Detailed Specification:	Multiplexing Scheme: CP-OFDM Modulation Scheme: QPSK Subcarrier Spacing: 15 kHz Number RBs: 1 Slot Format Index: - Data Type: PN9
Bandwidth:	20.0 MHz
Integration Time:	10.0 ms

[1] PAR (0.1%) in accordance with FCC KDB 971168, Section 6.0 "Measurement of the Peak-to-Average Power Ratio (PAPR)"
[2] Modulation Interference Factor (MIF) value valid only in conjunction with advanced probe response linearization calibration for the same communication system (same UID and version).

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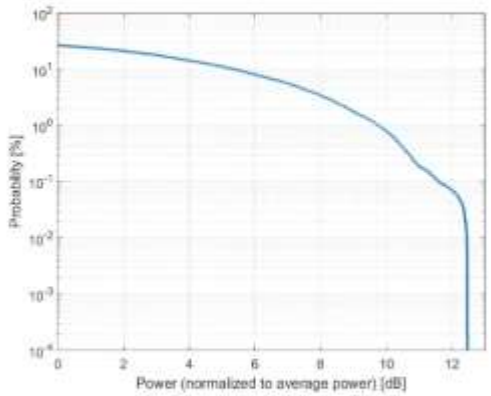
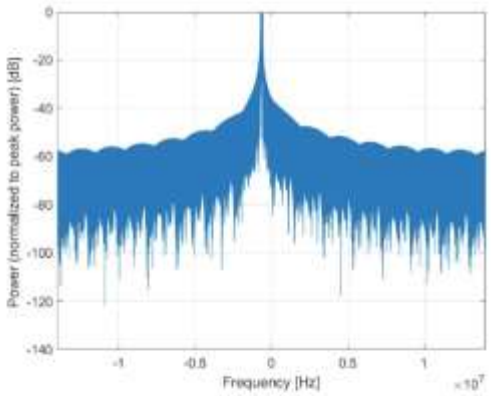
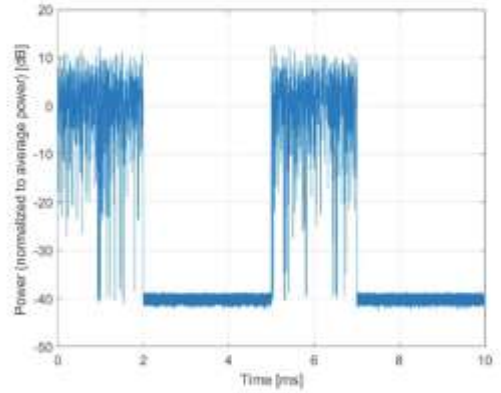


Complementary Cumulative Distribution Function (CCDF)



Frequency Domain



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Name:	**5G NR (DFT-s-OFDM, 1 RB, 100 MHz, QPSK, 30 kHz)**
Group:	5G NR FR1 TDD
UID:	10973-AAB
PAR: [1]	**9.05 dB**
MIF: [2]	**-1.64 dB**
Standard Reference:	SPEAG
Category:	Random amplitude modulation
Modulation:	QPSK
Frequency Band:	Band n41 (2496 - 2690 MHz) Band n48 (3550 - 3700 MHz) Band n77 (3300 - 4200 MHz) Band n78 (3300 - 3800 MHz) Band n79 (4400 - 5000 MHz) Band n90 (2496 - 2690 MHz) Validation band (0.0 - 6000.0 MHz)
Detailed Specification:	Multiplexing Scheme: DFT-s-OFDM Modulation Scheme: QPSK Subcarrier Spacing: 30 kHz Number RBs: 1 Slot Format Index: - Data Type: PN9
Bandwidth:	100.0 MHz
Integration Time:	10.0 ms

[1] PAR (0.1%) in accordance with FCC KDB 971168, Section 6.0 "Measurement of the Peak-to-Average Power Ratio (PAPR)"
[2] Modulation Interference Factor (MIF) value valid only in conjunction with advanced probe response linearization calibration for the same communication system (same UID and version).

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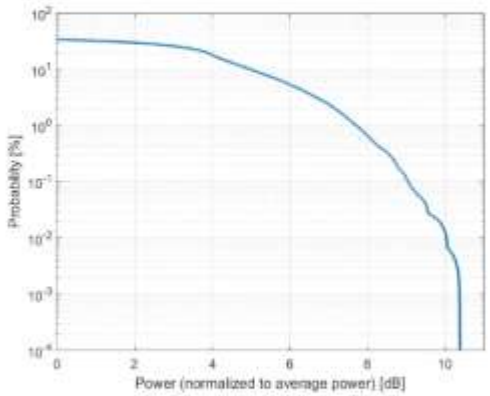
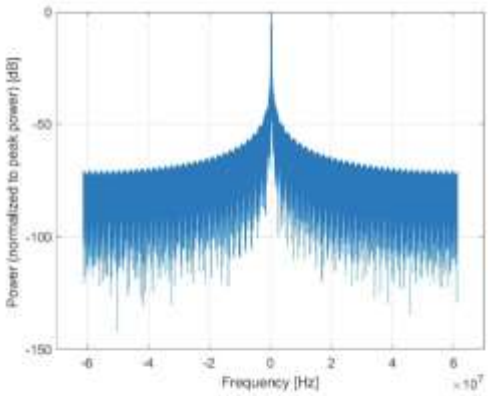
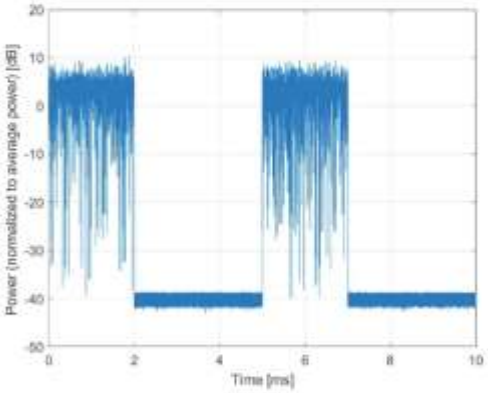


Complementary Cumulative Distribution Function (CCDF)



Frequency Domain



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Engineering AG
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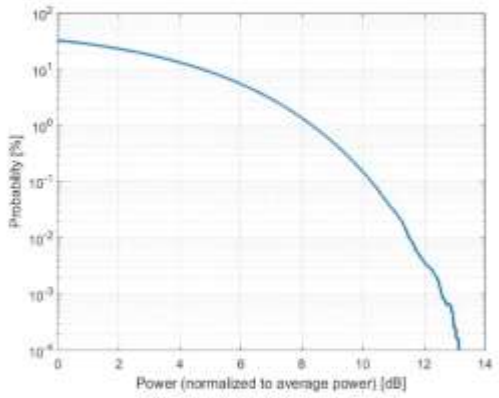
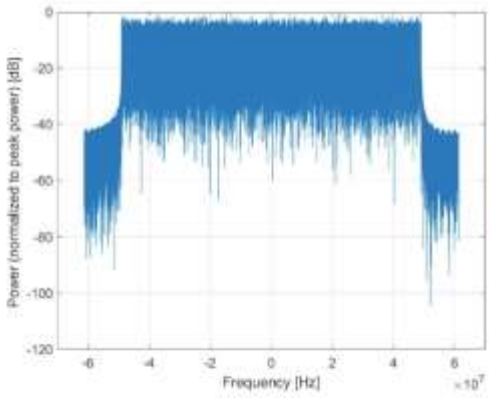
Name:	**5G NR (CP-OFDM, 100% RB, 100 MHz, 256-QAM, 30 kHz)**
Group:	5G NR FR1 TDD
UID:	10974-AAB
PAR: [1]	**10.28 dB**
MIF: [2]	**-3.48 dB**
Standard Reference:	SPEAG
Category:	Random amplitude modulation
Modulation:	256-QAM
Frequency Band:	Band n41 (2496 - 2690 MHz) Band n48 (3550 - 3700 MHz) Band n77 (3300 - 4200 MHz) Band n78 (3300 - 3800 MHz) Band n79 (4400 - 5000 MHz) Band n90 (2496 - 2690 MHz) Validation band (0.0 - 6000.0 MHz)
Detailed Specification:	Multiplexing Scheme: CP-OFDM Modulation Scheme: 256-QAM Subcarrier Spacing: 30 kHz Number RBs: 273 Slot Format Index: - Data Type: PN9
Bandwidth:	100.0 MHz
Integration Time:	10.0 ms

[1] PAR (0.1%) in accordance with FCC KDB 971168, Section 6.0 "Measurement of the Peak-to-Average Power Ratio (PAPR)"
[2] Modulation Interference Factor (MIF) value valid only in conjunction with advanced probe response linearization calibration for the same communication system (same UID and version).

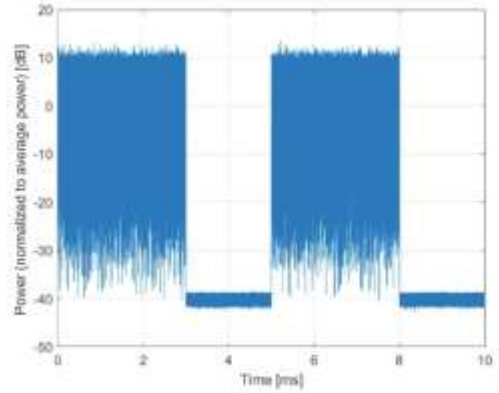
Calibration Laboratory of
Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland



Complementary Cumulative Distribution Function (CCDF)



Frequency Domain



Time Domain