SRD RADIO TEST REPORT

TEST STANDARD(S)	:	ETSI EN 300 220-1 V3.1.1 (2017-02) ETSI EN 300 220-2 V3.1.1 (2017-02)
CLIENT / APPLICANT	:	WeBill (Pty) Ltd.
CLIENT ADDRESS	:	147 North Reef Road, Bedfordview, Germiston, 1401
EUT DESCRIPTION	:	Sigfox Electricity Meter
EUT MODEL No	:	M190RSF
EUT MODEL SERIAL No	:	19000001
UNTESTED VARIANTS	:	None
REPORT TYPE	:	Delta
REPORT NUMBER	:	TRR01235-1-21
DATE ISSUED	:	6 September 2021
REVISION	:	1.0

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This report was prepared by: **Name:** *HE Olivier*
Title: *Junior RF Engineer*

This report was approved by: ***Name:*** *RM van den Berg*
Title: *Technical Signatory (RF)*

T0812

This test report is issued in accordance with SANAS accreditation requirements. SANAS is a signatory to the ILAC Mutual Recognition arrangement for the mutual recognition of the equivalence of testing and calibration reports

DOCUMENT CONTROL

Version	Date	Author	Change Proposal
1.0	2021/09/06	HE Olivier	First release

TEST LABORATORY INFORMATION

Established in 2017, iSERT (Pty) Ltd. Provides EMC, RF & Safety testing services by our skilled Engineers. Our services employ a wide variety of advanced cutting-edge test equipment with one of the widest ranges of accredited standards in the country.

The site and apparatus are constructed in conformance with the requirements of CISPR 16-1-4, EN 50147-1 and other equivalent standards. The laboratory is compliant with the requirements of ISO/IEC 17025. ISERT (PTY) LTD has been accredited to ISO/IEC 17025 by SANAS (Lab code: T0812).

The company's definite objective is to institute long term, trust-based associations with its clients. The expectation set up with the clients are based on outstanding service, practical expertise and devotion to a certified value structure. The company has a passion to grant their clients with the best EMC, RF & Safety services by knowledgeable and accommodating staff.

Our test site is located at 129 Khai-Apple street, Montana, Pretoria, South Africa 0182.

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ACRONYMS AND ABBREVIATIONS

AVE	Average
ARFCN	Absolute Radio Frequency Channel Number
C	Circular
CSE	Conducted Spurious Emissions
CSIR	Council for Scientific and Industrial Research
DCS	Digital Cellular System
E-Fields	Electric Fields
EIRP	Effective isotropic radiated power
ERP	Effective radiated power
EFT	Electrical Fast Transients
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
ESD	Electrostatic Discharge
EUT	Equipment Under Test
FW	Firmware
GPRS	General packet radio service
GSM	Global System for Mobile Communications
HW	Hardware
MS	Mobile Station
NIST	National Institute of Science and Technology
N/A	Not Applicable
OATS	Open Area Test Site
PC	Personal Computer
PK	Peak
Pol	Polarized
QP	Quasi-Peak
RSE	Radiated Spurious Emissions
RED	Radio Equipment Directive
RCSE	Receiver Conducted Spurious Emissions (idle mode)
RMS	Root Mean Square
RRSE	Receiver Radiated Spurious Emissions (idle mode)
RSE	Radiated Spurious Emissions
RF	Radio Frequency
R&TTE	Radio and telecommunications terminal equipment
SANAS	South African National Accreditation System
SRD	Short Range Equipment
TCSE	Transmitted conducted Spurious Emissions (allocated mode)
TRSE	Transmitted Radiated Spurious Emissions (allocated mode)
VH	Voltage High (Maximum
VL	Voltage Low (minimum)
VN	Voltage Normal
TH	Temperature High (maximum)
TN	Temperature Normal
TL	Temperature Low (Minimum)

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1. INTRODUCTION

This report details the results of tests performed on the M190RSF, henceforth referred to as Equipment Under Test (**EUT**). The EUT was tested according to the following standards and methods:

- ETSI EN 300 220-1 V3.1.1 (2017-02) *'Short Range Devices (SRD) operating in the frequency range 25 MHz to 1 000 MHz; Part 1: Technical characteristics and methods of measurement'*
- ETSI EN 300 220-2 V3.1.1 (2017-02) *'Short Range Devices (SRD) operating in the frequency range 25 MHz to 1 000 MHz; Part 2: Harmonised Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU for non-specific radio equipment'*

The assessment was carried out at iSERT laboratory Facility.

Test Engineer	Start date	End date
HE Olivier	2021/07/31	2021/08/13

2. SUMMARY OF TEST RESULTS

2.1 MODULAR TEST RESULTS

The EUT contains a RF module that was fully tested according to the essential requirements of Directive 2014/53/EU, see table below.

Table 1: Modular RF reports

Standard	Laboratory	Report No
EN 300 220-2 V3.11	HCT CO.LTD	HCT-R-1706-C011-3

2.2 DELTA TEST RESULTS

Additional tests on the final product were performed after the module was integrated into the final product to ensure that the final product complies to the essential requirements of EN 300 220-2.

Table 2: Results

Harmonised Standard ETSI EN 300 220-2 V3.1.1 (2017-02)			
Parameter to be tested	**Sub clause**	**Notes**	**Result**
Operating frequency	4.2.1	1	✓
Unwanted emissions in the spurious domain	4.2.2		✓
TX effective radiated power	4.3.1		✓

Note 1: Manufacturer declaration

Test case verdicts:

- N/A Test case does not apply to EUT
- N/T Test was not performed on EUT
- ✓ Test passed the minimum requirement
- ✓ Test passed but with a margin less than the uncertainty budget
- ✗ Test did not pass the minimum requirement

3. CONCLUSION

Based on the results of our investigation, we have concluded that the EUT (in the configuration tested) **complies** with the requirements of the standard(s) indicated above. The results obtained in this test report are only valid for the item(s) tested. iSERT (Pty) Ltd. does not make any claims of compliance for samples or variants which were not tested.

If levels measured are within ISERT's uncertainty budget, there is a possibility that this unit, or a similar unit selected out of production may not meet the required limit specification if tested by another agency.

4. EQUIPMENT DESCRIPTION

The details below as declared and provided by the manufacturer.

Table 3: Equipment under test details

Description	Customer declaration		
Radio type	✓	Module	
		Chipset	
		Discrete	
Radio information	SFM10R1		
Transmitter Frequency (s)	868.055 MHz to 868.205 MHz		
Receiver Frequency (s)	869.525 MHz		
Operating channel width	100 Hz		
Antenna type	Location	Internal	
	Type	PCB trace	
	Gain	0dBi	
TX max. Power Output	14 dBm (ERP)		
Worst case modulation	DBPSK		
Duty Cycle	≤1%		
Receiver Category		1	High performance level of receiver
		1.5	Improved standard performance receiver
	✓	2	Standard performance level of receiver
		3	Low performance level of receiver *
Spectrum Access Mechanism	✓	Duty Cycle	
		Polite Spectrum Access	
		ALOHA	
Adaptive Frequency Agility	N/A		
FHSS equipment	N/A		
Power Source	AC mains		
Build Status	✓	Production	
		Pre-production	
		Prototype	
Build Revision	Hardware:	1.1	
	Software:	Not provided	

The following variant models were not tested as part of this evaluation but have been identified by the manufacturer as being electrically identical, depopulated or with reasonable similarity to the model tested. iSERT (Pty) Ltd. does not make any claims of compliance for variants that were not tested.

Table 4: List of untested variants

Model	Variant difference from EUT
--	--

5. TEST MEASUREMENT INSTRUMENTS

The test equipment below was used during this assessment:

Table 5: List of measurement equipment

Instrument	Manufacturer	Model	Serial number	Next Cal date
Signal Analyzer	Keysight	N9020A	MY50510250	May 2022
Horn antenna	AH systems	SAS-571	1129	May 2022
Combilog antenna	Com-power	AC220	061128	May 2022
Pre-Amplifier	Adv Microwave	WLA652B	135	November 2021
Band Reject Filter	Wainwright	WRCJV8	SN1	August 2021
Coaxial Cable	AH Systems	SAC-26G-2	2584-2	August 2021
Coaxial Cable	AH Systems	SAC-18G-4	1763	August 2021
Multimeter	Fluke	115	34511488WS	November 2021
Laboratory Power Supply	Manson	HCS-3202	G071710100	Verify before use
Temperature Hygrometer	Flus	ET-951W	2015106449	November 2021
Environmental chamber	Jeiotech	PBV-012	1B097018	January 2022

6. MEASUREMENT OF UNCERTAINTY

For the test methods in the present document the uncertainty figures were calculated according to the methods described in the TR 100 028 [2] and corresponds to an expansion factor (coverage factor) k = 2 (which provide confidence levels of 95,45 % in case where the distributions characterizing the actual measurement uncertainties are normal (Gaussian)).

Table 6: Measurement uncertainty

Parameter	Range	Test Uncertainty
Radio frequency	9kHz to 26.5GHz	±22.8Hz
Total RF power conducted	400MHz to 6GHz	±0.47dB
Effective radiated power	400MHz to 1GHz	±2.18dB
Equivalent Isotopically Radiated Power	1GHz to 3GHz	±3.42dB
RF emissions radiated	30MHz to 200MHz	±5.16dB
	200MHz to 1GHz	±4.44dB
	1GHz to 18GHz	±4.15dB
	18GHz to 26.5GHz	±4.34dB
RF emissions conducted	9kHz to 10MHz	±1.78dB
	10MHz to 1GHz	±1.56dB
	1GHz to 18GHz	±2.76dB
	18GHz to 26.5GHz	±2.83dB
Transmitter maximum output power	700MHz to 3GHz	±0.47dB
DC voltages	10mV to 600V	±0.7%
Temperature	-20°C to +85°C	±0.9%
Humidity	10% to 75%	±5.0%

7. TEST SETUP DETAILS

7.1 RADIATED MEASUREMENTS

All radiated measurements were performed in a CISPR-16 fully anechoic shielded chamber at an antenna-to-EUT distance as indicated in the table below:

Frequency Range (MHz)	EUT - to - receiver antenna distance (meter)
30 – 18 000	3

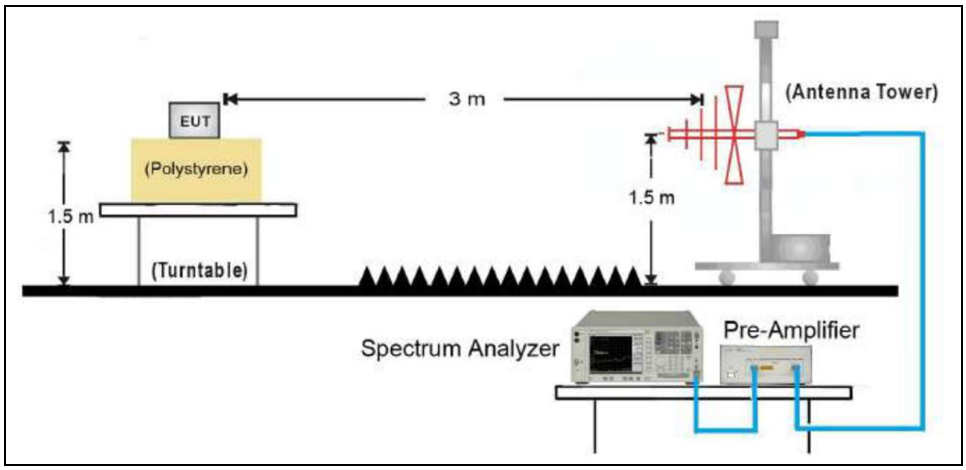


Figure 1: FAR layout below 1GHz

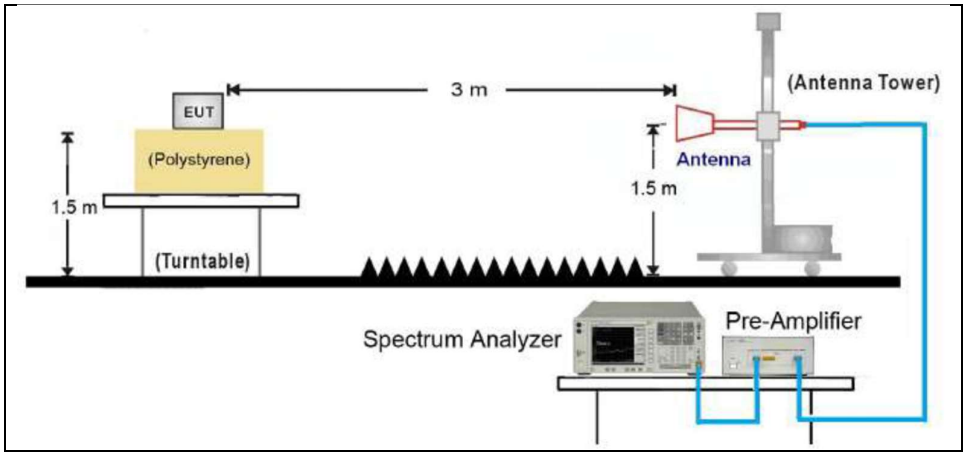


Figure 2: FAR layout above 1GHz

7.2 EUT PLACEMENT IN FAR

The EUT was placed in the FAR as illustrated in the following figure.

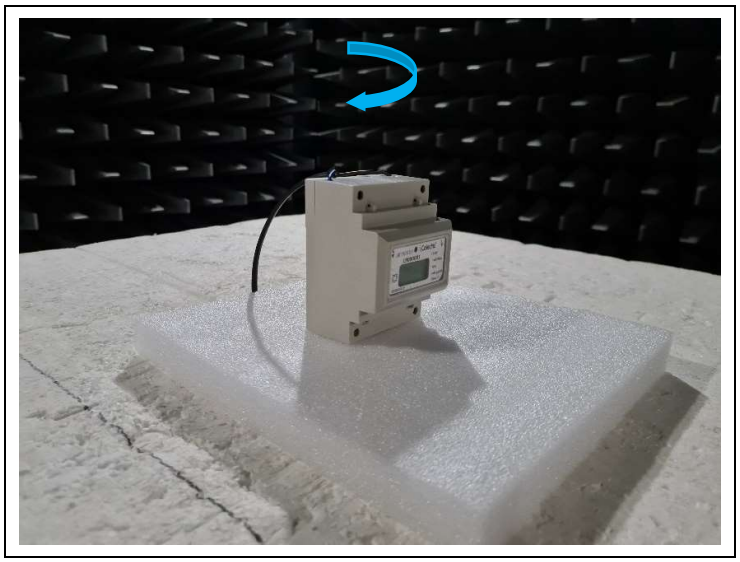


Figure 3: EUT placement during assessment

Notes:

1. *If applicable the above equipment/cables were placed in the worst-case configuration to maximize the emissions during the test.*
2. *When applicable grounding was established in accordance with the manufacturer's requirements and conditions for the intended use.*

7.3 TEMPERATURE CONDITIONS

For normal conditions, all measurements were taken under conditions of temperature and humidity in the table below.

Table 7: Normal environmental conditions

Condition	Value
Temperature	+20°C to +23°C
Relative Humidity	38% to 44%

8. EUT TEST CONFIGURATION

The EUT test configuration was declared by the manufacturer.

8.1 HARDWARE IDENTIFICATION

Figure 4: External angle view of EUT

8.2 OPERATING CHANNELS

Table 8: List of operating channels

EUT Channel Number	Frequency (MHz)	Test allocation
N/A	868.130	Middle

8.3 EUT TEST MODES

According to EN 300 220-1 v3.1.1 clause 4.3.1, the EUT should be capable of generating the following test signals in the table below.

Table 9: Test Signals

Test signal	Description
D-M1	A test signal consisting of an unmodulated carrier. This test signal is optional but helps to simplify some tests.
D-M2	A test signal consisting of a modulated carrier representative of normal operation and generating the greatest occupied RF bandwidth. The preferred test signal consists of a pseudo-random bit sequence of at least 511 bits in accordance with Recommendation ITU-T .153 [1]. This sequence shall be continuously repeated.
D-M2a	A test signal as described in D-M2 but generated intermittently. The generated RF signals shall be the same for each transmission except for the data sequence, occur regularly in time, be accurately repeatable and their timing duration shall represent normal operation of the EUT except for compliance with a duty cycle limit.
D-M3	A test signal representative of normal operation of the EUT. This signal shall be agreed between the test laboratory and the manufacturer in case selective messages are used and are generated or decoded within the equipment. The agreed test signal may be formatted and may contain error detection and correction.

8.4 EUT SETUP CONFIGURATION

Parameter to be tested	EUT Mode	Power Source	RF Port
Unwanted emissions in the spurious domain	D-M2	Internal	Radiated
TX effective radiated power	D-M1	Internal	Radiated

8.5 POWER SUPPLY

The supply in the table below were supplied by the customer to power the EUT.

Source Location	Source Type	Source Description	Power source range (V)		
			VL	VN	VH
Internal	--	--	--	--	--
External	AC	Grid supply	(1)	230	(1)

(1) The RF module/Card in the EUT was already assessed with an extreme power source through an accredited test lab so no further tests under extreme conditions are required.

8.6 INPUT/OUTPUT CABLES

The cables in the table below were connected to the EUT, auxiliary equipment and support equipment.

Table 10: List of external I/O cables

Cable Description	Length (m)	From Port	To
-	-	-	-

8.7 ANCILLARY/AUXILIARY EQUIPMENT

The EUT has been tested as an independent unit with Ancillary/auxiliary equipment. The following equipment/accessories were used to form a representative test configuration during this assessment.

Table 11: List of ancillary/auxiliary equipment

Type/description	Manufacturer	Model	Serial number
-	-	-	-

8.8 SPECIAL ACCESSORIES

No special accessories.

8.9 SUPPORT EQUIPMENT

The support equipment below was used during this assessment:

Table 12: List of support equipment

Instrument	Manufacturer	Model	Serial number
-	-	-	-

8.10 MODIFICATION RECORD TO EUT

Table 13: Modifications made to the EUT

Modification		Description
✓	None	No modification was made to the EUT during this assessment.

8.11 DEVIATIONS FROM THE STANDARD

None.

9. TEST DETAIL

9.1 OPERATING FREQUENCY

9.1.1 Applicable Standard

According to ETSI EN 300 220-1 V3.1.1 (2017-02) clause 5.1.1, the nominal operating frequency is the center of a channel of width OCW. The manufacturer may declare either one or more operating frequencies or operating channels.

9.1.2 Limit

Operating channel(s) shall be entirely within operational frequency bands allowed in ETSI EN 300 220-1 V3.1.1 (2017-02) annexes B, C or any National Radio Interface. For the purpose of this document the limits in the table below were used to determine compliance.

Table 14: ETSI limits

Frequency band		Maximum ERP (dBm)	Channel access	Maximum OBW
Allocation	(MHz)			
H	433.04 - 434.79	10	<0.1& duty cycle	whole band
I	433.04 - 434.79	0, -13dBm/10kHz PSD	No requirement	whole band
J	433.04 - 434.79	10	No requirement	25 kHz
K	863.0 – 865.0	14	≤ 0,1 % duty cycle or polite spectrum access	whole band
L	865.0 – 868.0	14, +6.2dBm/100kHz PSD	≤ 1 % duty cycle or polite spectrum access	whole band
M	868.0 - 868.6	14	≤ 1 % duty cycle or polite spectrum access	whole band
N	868.7 - 869.2	14	≤ 0.1 % duty cycle or polite spectrum access	whole band
P	869.4 - 869.65	27	≤ 10 % duty cycle or polite spectrum access	whole band
Q	869.7 - 870.0	7	No requirement	whole band

9.1.3 Results

Table 15: Results of operating frequency band

Operating frequency (MHz)	Mode of operation	Operating frequency band (MHz)	Result
868.055 to 868.205	Transmit	868.0 to 868.6	Pass
869.525	Receive	869.4 to 869.65	Pass

9.2 UNWANTED EMISSIONS IN THE SPURIOUS DOMAIN

9.2.1 Applicable Standard

According to EN 300 220-1 V3.1.1 clause 5.9.1.1, Spurious emissions are unwanted emissions in the spurious domain at frequencies other than those of the Operating Channel and it's Out-Of-Band Domain. Spurious radiations from the EUT are components, at any frequency, radiated by the equipment and antenna. The relevant spurious domain is shown in the figure below.

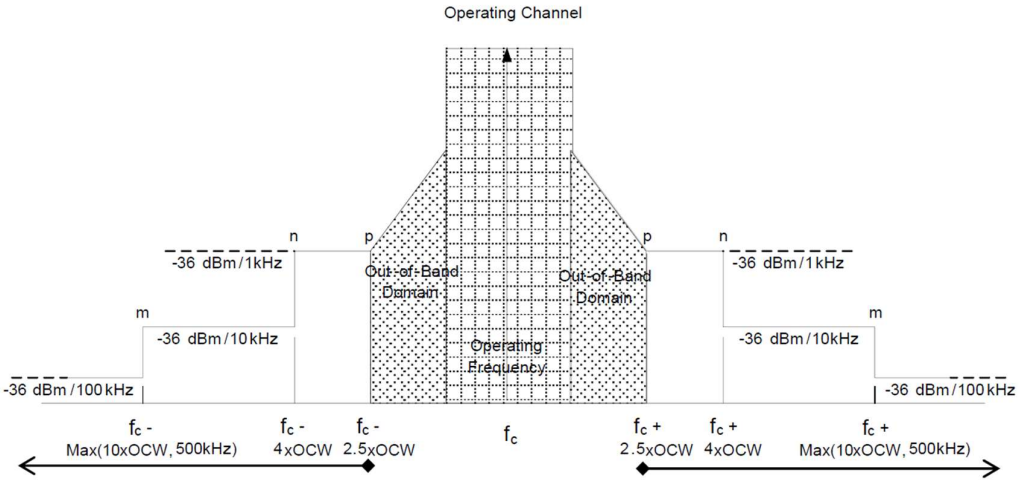


Figure 5: Spectrum mask of unwanted emissions in the spurious domain

9.2.2 Limits

The power of any unwanted emission in the spurious domain shall not exceed the values given in the table below.

Table 16: Limits for unwanted emissions in the spurious domain

Frequency / State	47 MHz to 74 MHz 87.5 MHz to 118 MHz 174 MHz to 230 MHz 470 MHz to 790 MHz	Other frequencies below 1000 MHz	Frequencies above 1000 MHz
TX mode	-54 dBm	-36 dBm	-30 dBm
RX and all other modes	-57 dBm	-57 dBm	-47 dBm

9.2.3 Test results

Table 17: Transmitter radiated SE from 25 MHz to 6 GHz

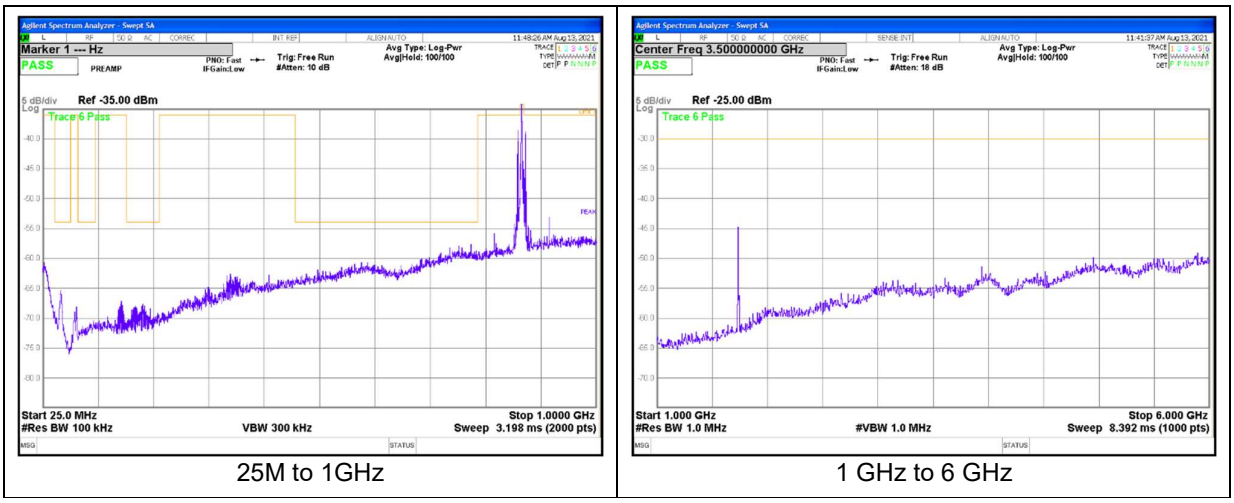
Frequency (MHz)	Level (dBm)	Receive Antenna Polarization	Receiver RBW (kHz)	Detector Used	Limit (dBm)	Margin (dB)	Test Result
57.2	-65.4	H	100	PK	-54	-11.4	Pass
84.5	-68.1	H	100	PK	-36	-32.1	Pass
120.1	-62.2	V	100	PK	-36	-26.2	Pass
160.6	-63.4	V	100	PK	-36	-27.4	Pass
163.0	-67.2	H	100	PK	-36	-31.2	Pass
163.0	-61.7	V	100	PK	-36	-25.7	Pass
164.0	-67.2	H	100	PK	-36	-31.2	Pass
164.0	-61.2	V	100	PK	-36	-25.2	Pass
165.5	-62.3	V	100	PK	-36	-26.3	Pass
167.4	-63.5	V	100	PK	-36	-27.5	Pass
168.4	-63.4	V	100	PK	-36	-27.4	Pass

170.8	-64.2	V	100	PK	-36	-28.2	Pass
208.4	-63.5	V	100	PK	-54	-9.5	Pass
209.4	-62.8	V	100	PK	-54	-8.8	Pass
211.8	-62.4	V	100	PK	-54	-8.4	Pass
216.2	-62.4	V	100	PK	-54	-8.4	Pass
218.6	-62.6	V	100	PK	-54	-8.6	Pass
220.6	-63.2	V	100	PK	-54	-9.2	Pass
861.5	-48.9	H	100	RMS	-36	-12.9	Pass
861.5	-50.3	V	100	RMS	-36	-14.3	Pass
862.5	-52.0	H	100	RMS	-36	-16.0	Pass
862.5	-50.7	V	100	RMS	-36	-14.7	Pass
870.3	-51.9	V	100	RMS	-36	-15.9	Pass
871.7	-45.2	H	100	PK	-36	-9.2	Pass
873.7	-46.6	H	100	PK	-36	-10.6	Pass
873.7	-53.6	V	100	RMS	-36	-17.6	Pass
875.1	-48.0	H	100	RMS	-36	-12.0	Pass
875.1	-46.2	V	100	RMS	-36	-10.2	Pass
876.1	-63.0	H	100	RMS	-36	-27.0	Pass
916.1	-53.1	H	100	PK	-36	-17.1	Pass
1736.0	-44.7	H	1000	PK	-30	-14.7	Pass
1736.0	-41.8	V	1000	PK	-30	-11.8	Pass

Table 18: Receiver radiated SE from 25 MHz to 6 GHz

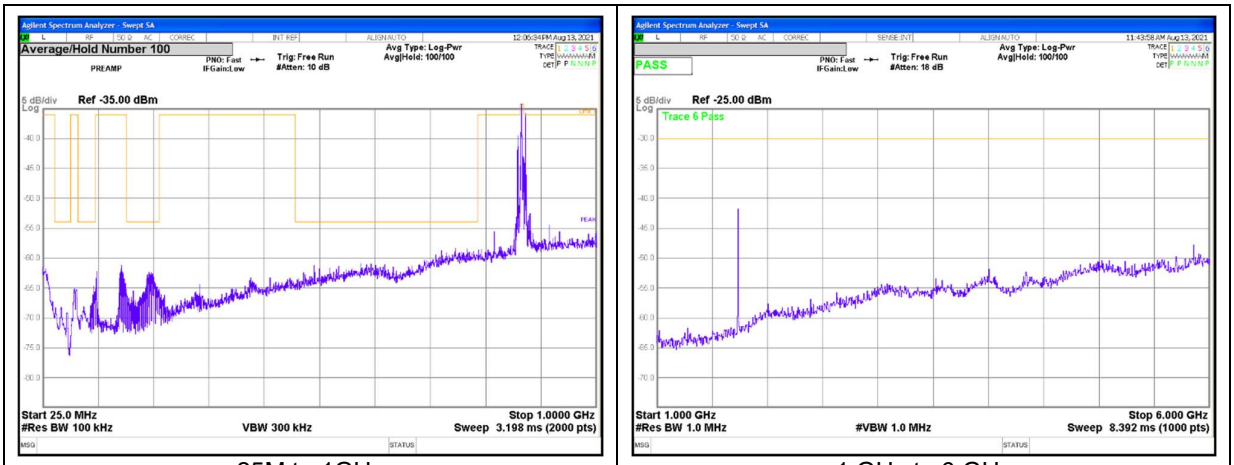
Frequency (MHz)	Level (dBm)	Receive Antenna Polarization	Receiver RBW (kHz)	Detector Used	Limit (dBm)	Margin (dB)	Test Result
57.2	-67.7	H	100	PK	-57	-10.7	Pass
57.2	-71.3	V	100	PK	-57	-14.3	Pass
68.9	-70.9	V	100	PK	-57	-13.9	Pass
84.5	-66.0	V	100	PK	-57	-9.0	Pass
85.5	-70.5	H	100	PK	-57	-13.5	Pass
111.9	-65.0	V	100	PK	-57	-8.0	Pass
113.8	-73.8	H	100	PK	-57	-16.8	Pass
167.5	-66.8	H	100	PK	-57	-9.8	Pass
168.5	-65.7	V	100	PK	-57	-8.7	Pass
216.3	-71.6	H	100	PK	-57	-14.6	Pass
219.2	-67.3	V	100	PK	-57	-10.3	Pass
295.3	-69.0	V	100	PK	-57	-12.0	Pass
364.6	-66.1	H	100	PK	-57	-9.1	Pass
395.9	-68.4	V	100	PK	-57	-11.4	Pass
433.9	-69.5	H	100	PK	-57	-12.5	Pass

9.2.4 Pre-scan results



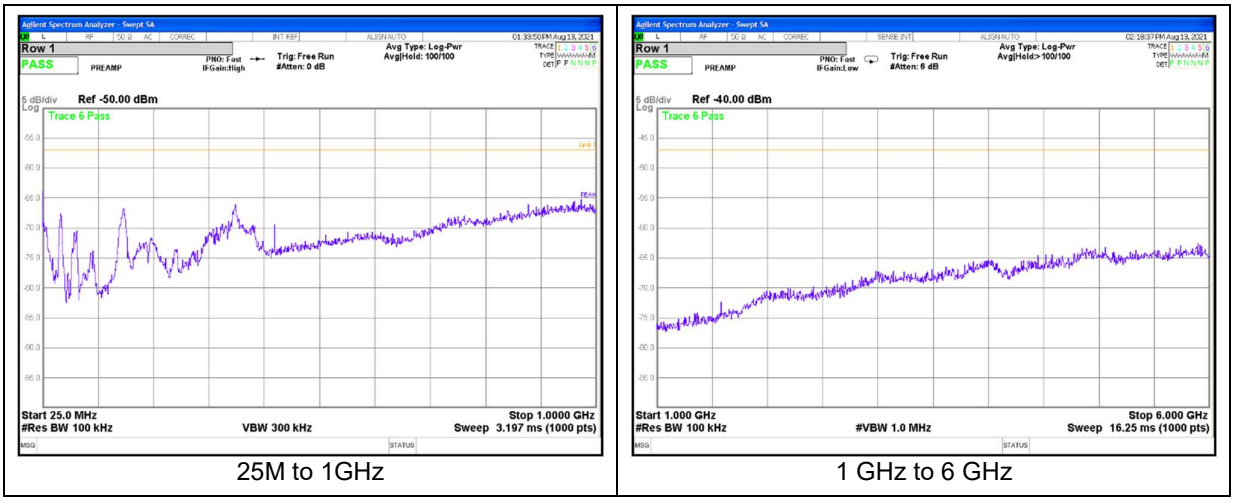
25M to 1GHz | 1 GHz to 6 GHz

Figure 6: Transmitter radiated SE HP



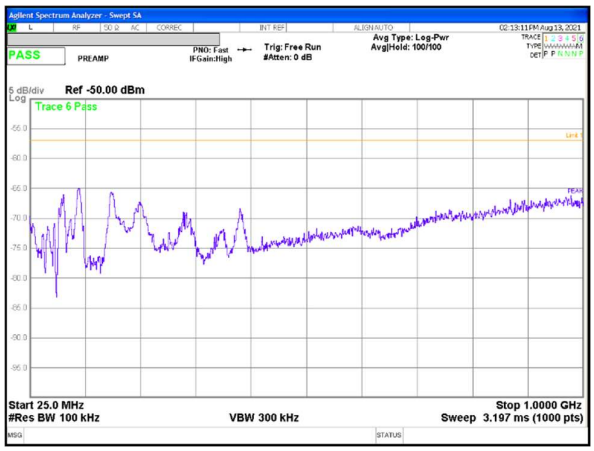
25M to 1GHz | 1 GHz to 6 GHz

Figure 7: Transmitter radiated SE VP

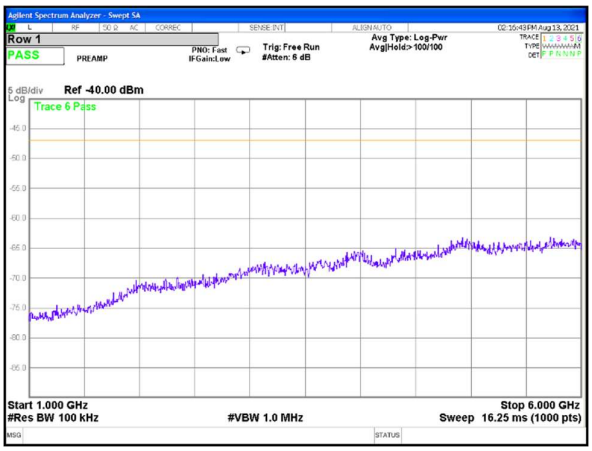


25M to 1GHz | 1 GHz to 6 GHz

Figure 8: Receiver radiated SE HP



25M to 1GHz



1 GHz to 6 GHz

Figure 9: Receiver radiated SE VP

9.3 TX EFFECTIVE RADIATED POWER

9.3.1 Applicable Standard

According to ETSI EN 300 220-1 V3.1.1 (2017-02) clause 5.2.1, the effective radiated power (E.R.P.) is the power radiated in the direction of the maximum radiated power under specified conditions of measurements for any condition of modulation. For equipment with a permanent or temporary antenna connection it may be taken as the power delivered from that connector considering the antenna gain.

9.3.2 Limit

The maximum ERP shall not be greater than the value allowed in ETSI EN 300 220-2 V3.1.1 (2017-02) annexes B, C or any National Radio Interface.

Table 19: ETSI limits

Frequency band		Maximum ERP (dBm)
Allocation	(MHz)	
H	433.04 - 434.79	10
I	433.04 - 434.79	0, -13dBm/10kHz PSD
J	433.04 - 434.79	10
K	863.0 – 865.0	14
L	865.0 – 868.0	14, +6.2dBm/100kHz PSD
M	868.0 - 868.6	14
N	868.7 - 869.2	14
P	869.4 - 869.65	27
Q	869.7 - 870.0	7

9.3.3 Test results

Table 20: Effective radiated power measured

Test Condition		Frequency (MHz)	ERP Level (dBm)	ERP Limit (dBm)	Margin (dB)	Test Result
Temperature	Voltage					
TN	VN	868.13	8.2	14	-5.8	Pass

10. PHOTOGRAPHS

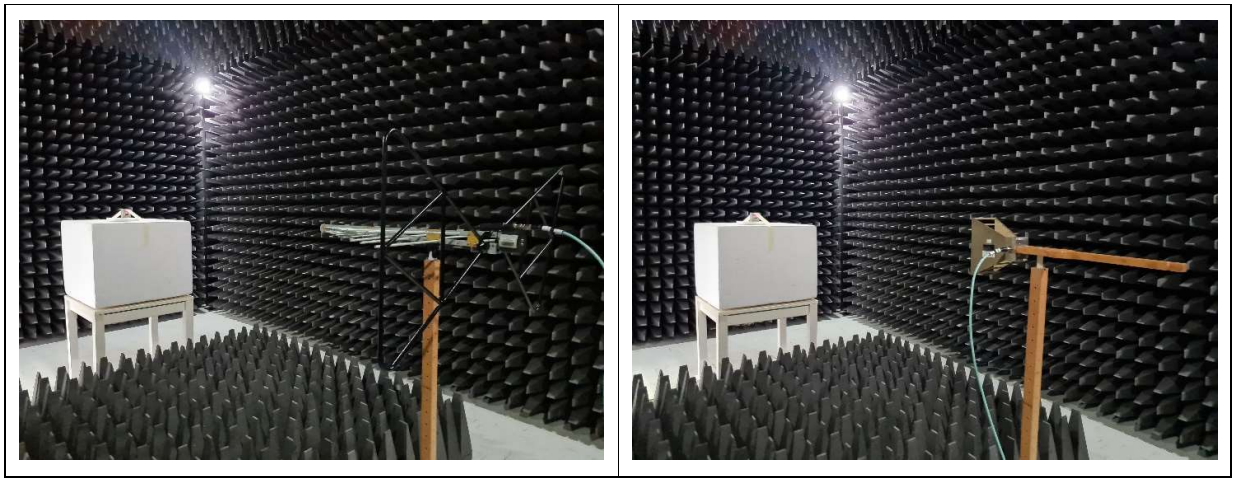


Figure 10: EUT in anechoic chamber undergoing RE tests with combi-log and horn antenna

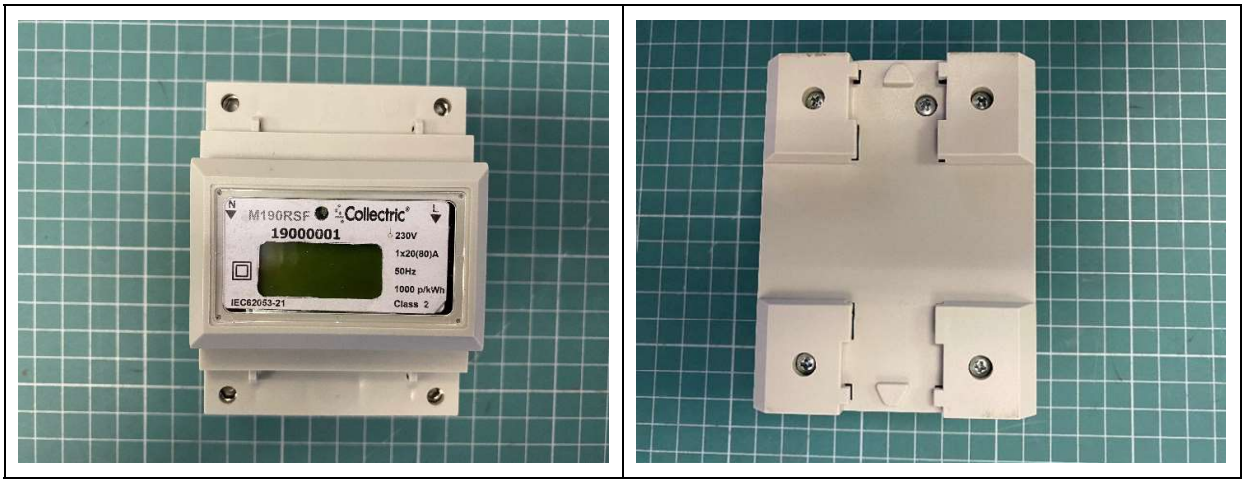


Figure 11: External Top and Bottom view of EUT

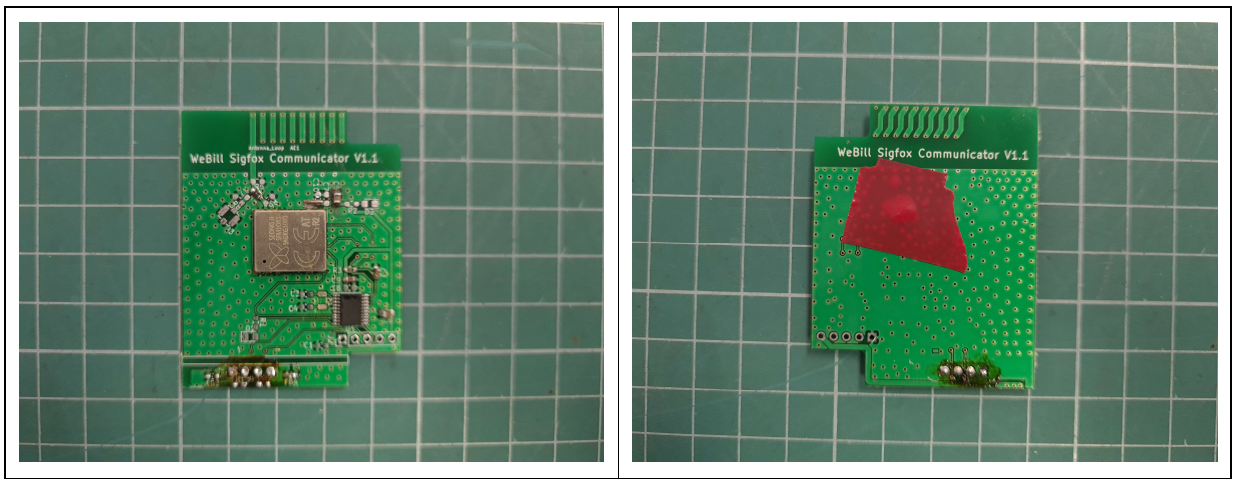


Figure 12: Internal Top and Bottom View of EUT

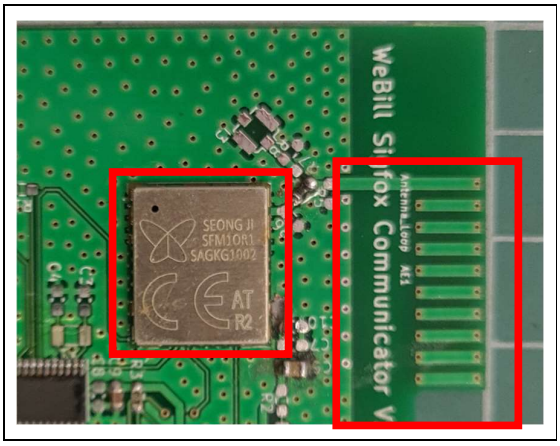


Figure 13: 868 MHz RF module plus antenna

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