RADIO TEST REPORT
FCC ID: WA5WN51E

Product： Soil Moisture sensor

Trade Mark： N/A

Model Name： WN51E

Family Model： WH31SM

Report No.： S20042202608001

Prepared for

Shenzhen Fine Offset Electronics Co., Ltd.

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Prepared by

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TEST RESULT CERTIFICATION

Applicant's name	:	Shenzhen Fine Offset Electronics Co., Ltd.
Address	:	2/F., Building no.3, Ping Shan Minqi Industrial Park, Xili Town, Nanshan District, Shenzhen City, China
Manufacturer's Name	:	Shenzhen Fine Offset Electronics Co., Ltd.
Address	:	2/F., Building no.3, Ping Shan Minqi Industrial Park, Xili Town, Nanshan District, Shenzhen City, China

Product description

Product name	:	Soil Moisture sensor
Model and/or type reference	:	WN51E
Family Model		WH31SM
Standards	:	FCC Part15.249
Test procedure		ANSI C63.10-2013

This device described above has been tested by NTEK, and the test results show that the equipment under test (EUT) is in compliance with the FCC requirements. And it is applicable only to the tested sample identified in the report.

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Date of Test	:	
Date (s) of performance of tests	:	23 Apr. 2020 ~ 18 May. 2020
Date of Issue	:	20 May. 2020
Test Result	:	**Pass**

Testing Engineer : Jerry Xie
(Jerry Xie)

Technical Manager : Jason chen
(Jason Chen)

Authorized Signatory : Sam . Chen
(Sam Chen)

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1. SUMMARY OF TEST RESULTS

Test procedures according to the technical standards:

FCC Part15, Subpart C (15.249)			
Standard Section	Test Item	Judgment	Remark
15.207	Conducted Emission	N/A	
15.203	Antenna Requirement	Pass	
15.249 15.209	Radiated Spurious Emission	Pass	
15.249b(2)	Frequency Tolerance	N/A	
15.249(a)	Fundamental Measurement	Pass	
15.205	Band Edge Emission	Pass	
15.215	Occupied Bandwidth	Pass	

Note: “N/A” denotes test is not applicable in this Test Report.

1.1 FACILITIES AND ACCREDITATIONS

FACILITIES

All measurement facilities used to collect the measurement data are located at
1/F, Building E, Fenda Science Park Sanwei, Xixiang, Bao'an District
Shenzhen, Guangdong, China

The sites are constructed in conformance with the requirements of ANSI C63.7, ANSI C63.10 and CISPR Publication 22.

1.2 LABORATORY ACCREDITATIONS AND LISTINGS

Site Description

CNAS-Lab.	:	The Laboratory has been assessed and proved to be in compliance with CNAS-CL01:2006 (identical to ISO/IEC 17025:2005) The Certificate Registration Number is L5516.
IC-Registration		The Certificate Registration Number is 9270A. CAB identifier:CN0074
FCC- Accredited		Test Firm Registration Number: 463705. Designation Number: CN1184
A2LA-Lab.		The Certificate Registration Number is 4298.01 This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005 General requirements for the competence of testing and calibration laboratories. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated 8 January 2009).
Name of Firm	:	Shenzhen NTEK Testing Technology Co., Ltd.
Site Location	:	1/F, Building E, Fenda Science Park Sanwei, Xixiang, Bao'an District Shenzhen, Guangdong, China

1.3 MEASUREMENT UNCERTAINTY

The reported uncertainty of measurement y±U, where expended uncertainty U is based on a standard uncertainty multiplied by a coverage factor of k=2, providing a level of confidence of approximately 95 %.

No.	Item	Uncertainty
1	Conducted Emission Test	±2.80dB
2	RF power, conducted	±0.16dB
3	Spurious emissions, conducted	±0.21dB
4	All emissions, radiated(30MHz~1GHz)	±2.64dB
5	All emissions, radiated(1GHz~6GHz)	±2.40dB
6	All emissions, radiated(＞6GHz)	±2.52dB
7	Temperature	±0.5°C
8	Humidity	±2%

2. GENERAL INFORMATION

2.1 GENERAL DESCRIPTION OF EUT

Equipment	Soil Moisture sensor
Trade Mark	N/A
Model Name	WN51E
Family Model	WH31SM
Model Difference	All models are the same circuit and RF module, except the model name.
Product Description	The EUT is a Soil Moisture sensor Operation Frequency: 915MHz Modulation Type: FSK Antenna Designation: Iron plate antenna Antenna Gain(Peak) 2.15dBi Based on the application, features, or specification exhibited in User's Manual. More details of EUT technical specification, please refer to the User's Manual.
Channel List	Please refer to the Note 2.
Adapter	N/A
Battery	DC 1.5V From Battery
Hardware version	N/A
Firmware version	N/A
Software version	N/A

Note:

1. For a more detailed features description, please refer to the manufacturer's specifications or the User's Manual.

2.

Channel	Frequency(MHz)
01	915

3.

Table for Filed Antenna

Ant.	Brand	Model Name	Antenna Type	Connector	Gain (dBi)	NOTE
1	N/A	N/A	Iron plate antenna	N/A	2.15	Antenna

Note:The device does not support simultaneous transmission

2.2 DESCRIPTION OF TEST MODES

To investigate the maximum EMI emission characteristics generates from EUT, the test system was pre-scanning tested base on the consideration of following EUT operation mode or test configuration mode which possible have effect on EMI emission level. Each of these EUT operation mode(s) or test configuration mode(s) mentioned above was evaluated respectively.

Pretest Mode	Description
Mode 1	CH01 TX

For Radiated Spurious Emission	
Pretest Mode	Description
Mode 1	CH01 TX

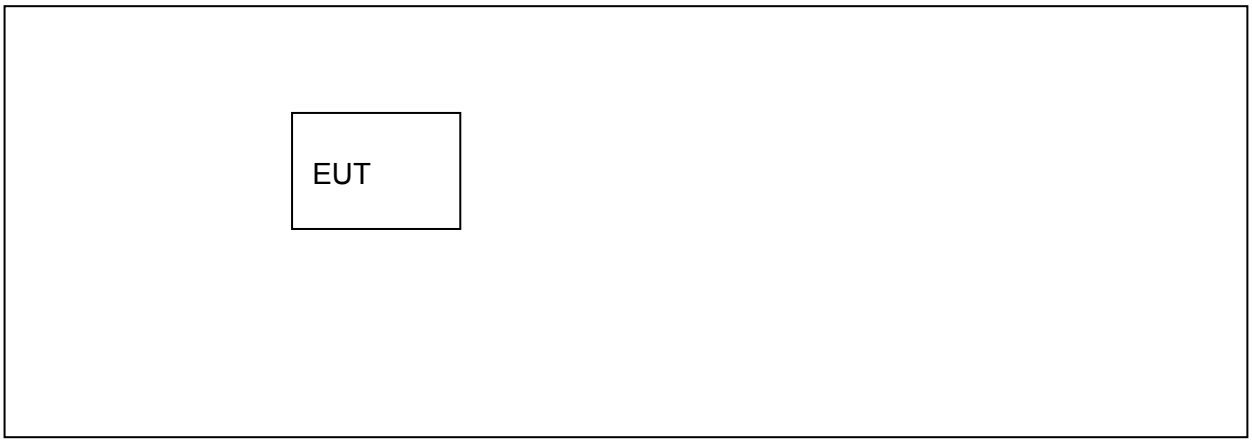
For Conducted Emission	
Final Test Mode	Description
Mode 1	CH01 TX

Note:

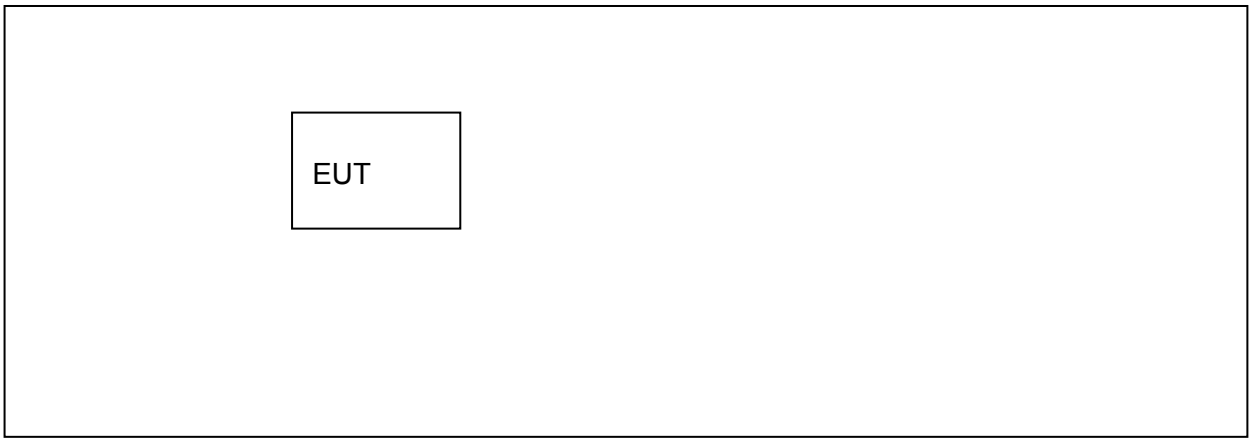
(1) The measurements are performed at the highest, middle, lowest available channels.

2.3 BLOCK DIGRAM SHOWING THE CONFIGURATION OF SYSTEM TESTED

Conducted Emission Mode



Radiated Spurious Emission Test



2.4 DESCRIPTION OF SUPPORT UNITS (CONDUCTED MODE)

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

Item	Equipment	Mfr/Brand	Model/Type No.	Series No.	Note

Item	Cable Type	Shielded Type	Ferrite Core	Length	Note

Note:

(1) The support equipment was authorized by Declaration of Confirmation.
(2) For detachable type I/O cable should be specified the length in cm in『Length』column.

2.5 EQUIPMENTS LIST FOR ALL TEST ITEMS

Radiation Test equipment

Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Last calibration	Calibrated until	Calibration period
1	Spectrum Analyzer	Aglient	E4407B	MY45108040	2019.05.13	2020.05.12	1 year
					2020.05.11	2021.05.10	
2	Spectrum Analyzer	Agilent	N9020A	MY49100060	2019.08.28	2020.08.27	1 year
3	EMI Test Receiver	Agilent	N9038A	MY53227146	2019.08.28	2020.08.27	1 year
4	Test Receiver	R&S	ESPI	101310	2019.05.13	2020.05.12	1 year
5	Bilog Antenna	TESEQ	CBL6111D	31216	2020.04.11	2021.04.10	1 year
6	50Ω Coaxial Switch	Anritsu	MP59B	6200983705	2018.05.19	2020.05.18	2 year
					2020.05.11	2023.05.10	3 year
7	Horn Antenna	EM	EM-AH-10180	2011071402	2019.05.13	2020.05.12	1 year
					2020.05.11	2021.05.10	
8	Horn Ant	Schwarzbeck	BBHA 9170	9170-181	2019.11.03	2020.11.02	1 year
9	Amplifier	EMC	EMC051835 SE	980246	2019.08.06	2020.08.05	1 year
10	Amplifier	MITEQ	TTA1840-35-HG	177156	2019.11.03	2020.11.02	1 year
11	Loop Antenna	ARA	PLA-1030/B	1029	2019.08.06	2020.08.05	1 year
12	Power Meter	DARE	RPR3006W	15I00041SNO84	2019.08.05	2020.08.04	3 year
13	Test Cable (9KHz-30MHz)	N/A	R-01	N/A	2018.04.21	2021.04.20	3 year
14	Test Cable (30MHz-1GHz)	N/A	R-02	N/A	2018.04.21	2021.04.20	3 year
15	High Test Cable(1G-40GHz)	N/A	R-03	N/A	2018.04.21	2021.04.20	3 year
16	High Test Cable(1G-40GHz)	N/A	R-04	N/A	2018.04.21	2021.04.20	3 year
17	temporary antenna connector (Note)	NTS	R001	N/A	N/A	N/A	N/A

Note:
The temporary antenna connector is soldered on the PCB board in order to perform conducted tests and this temporary antenna connector is listed in the equipment list.

Conduction Test equipment

Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Last calibration	Calibrated until	Calibration period
1	Test Receiver	R&S	ESCI	101160	2019.05.13	2020.05.12	1 year
					2020.05.11	2021.05.10	
2	LISN	R&S	ENV216	101313	2019.05.13	2020.05.12	1 year
					2020.05.11	2021.05.10	
3	LISN	SCHWARZBECK	NNLK 8129	8129245	2019.05.13	2020.05.12	1 year
					2020.05.11	2021.05.10	
4	50Ω Coaxial Switch	ANRITSU CORP	MP59B	6200983704	2018.05.19	2020.05.18	2 year
					2020.05.11	2023.05.10	3 year
5	Test Cable (9KHz-30MHz)	N/A	C01	N/A	2018.04.21	2021.04.20	3 year
6	Test Cable (9KHz-30MHz)	N/A	C02	N/A	2018.04.21	2021.04.20	3 year
7	Test Cable (9KHz-30MHz)	N/A	C03	N/A	2018.04.21	2021.04.20	3 year

Note: Each piece of equipment is scheduled for calibration once a year except the Test Cable which is scheduled for calibration every 3 years.

3. ANTENNA REQUIREMENT

3.1 STANDARD REQUIREMENT

15.203 requirement: For intentional device, according to 15.203: an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

3.2 EUT ANTENNA

The EUT antenna is permanent attached Iron plate antenna (Gain: 2.15dBi). It comply with the standard requirement.

3.3 CONDUCTED EMISSION MEASUREMENT

3.3.1 POWER LINE CONDUCTED EMISSION Limits (Frequency Range 150KHz-30MHz)

FREQUENCY (MHz)	Class A (dBuV)		Class B (dBuV)		Standard
	Quasi-peak	Average	Quasi-peak	Average	
0.15 -0.5			66 - 56 *	56 - 46 *	CISPR
0.50 -5.0			56.00	46.00	CISPR
5.0 -30.0			60.00	50.00	CISPR

0.15 -0.5			66 - 56 *	56 - 46 *	LP002.
0.50 -5.0			56.00	46.00	LP002.
5.0 -30.0			60.00	50.00	LP002.

Note:

(1) The tighter limit applies at the band edges.

(2) The limit of " * " marked band means the limitation decreases linearly with the logarithm of the frequency in the range.

The following table is the setting of the receiver

Receiver Parameters	Setting
Attenuation	10 dB
Start Frequency	0.15 MHz
Stop Frequency	30 MHz
IF Bandwidth	9 kHz

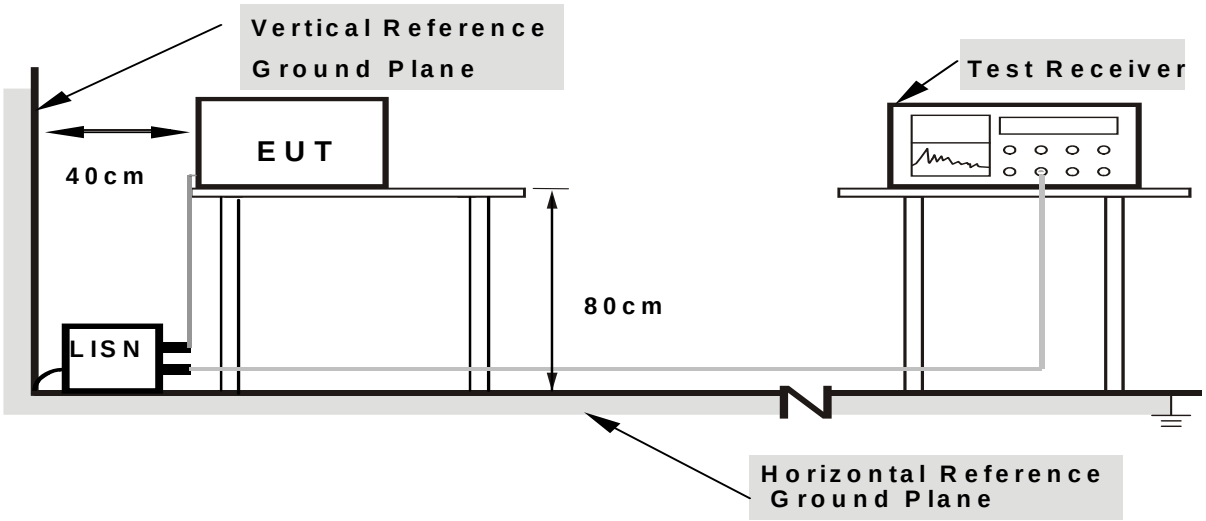
3.3.2 TEST PROCEDURE

a. The EUT was placed 0.4 meters from the horizontal ground plane with EUT being connected to the power mains through a line impedance stabilization network (LISN). All other support equipments powered from additional LISN(s). The LISN provide 50 Ohm/ 50uH of coupling impedance for the measuring instrument.
b. Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 to 40 cm long.
c. I/O cables that are not connected to a peripheral shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. The overall length shall not exceed 1 m.
d. LISN at least 80 cm from nearest part of EUT chassis.
e. For the actual test configuration, please refer to the related Item –EUT Test Photos.

3.3.3 DEVIATION FROM TEST STANDARD

No deviation

3.3.4 TEST SETUP



Note: 1.Support units were connected to second LISN.
2.Both of LISNs (AMN) are 80 cm from EUT and at least 80 from other units and other metal planes

3.2.5 TEST RESULT

EUT：	Soil Moisture sensor	Model Name. ：	WN51E
Temperature：	25 ℃	Relative Humidity：	55%
Pressure：	1010hPa	Phase：	N/A
Test Voltage ：	N/A	Test Mode：	N/A

Note: Not applicable

3.4 RADIATED EMISSION MEASUREMENT

3.4.1 Radiated Emission Limits (FCC 15.209)

Frequencies (MHz)	Field Strength (micorvolts/meter)	Measurement Distance (meters)
0.009~0.490	2400/F(KHz)	300
0.490~1.705	24000/F(KHz)	30
1.705~30.0	30	30
Frequency (MHz)	Limit (dBuV)	
30~88	40	3
88~216	43.5	3
216~960	46	3
960 -10000	54.00	3
902-928	94	3

Note:

(1) The tighter limit applies at the band edges.

(2) Emission level (dBuV/m)=20log Emission level (uV/m).

(3) *Note: This is the limit for the fundamental frequency.

LIMITS OF RADIATED EMISSION MEASUREMENT (FCC 15.249)

Frequency of Emission (MHz)	Field Strength of fundamental (millivolts /meter)	Field Strength of Harmonics (microvolts/meter)
902-928	50	500

Notes:

(1) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in Section 15.209, whichever is the lesser attenuation.

Spectrum Parameter	Setting
Attenuation	Auto
Start Frequency	1000 MHz
Stop Frequency	10th carrier harmonic
RB / VB (emission in restricted band)	1MHz / 1MHz for Peak

Receiver Parameter	Setting
Attenuation	Auto
Start ~ Stop Frequency	9kHz~150kHz / RB 200Hz for QP
Start ~ Stop Frequency	150kHz~30MHz / RB 9kHz for QP
Start ~ Stop Frequency	30MHz~1000MHz / RB 120kHz for QP

3.4.2 TEST PROCEDURE

a. The measuring distance of at 3 m shall be used for measurements at frequency up to 1GHz. For frequencies above 1GHz, any suitable measuring distance may be used.
b. The EUT was placed on the top of a rotating table 0.8 m for below 1GHz and 1.5m for above 1GHz the ground at a 3 meter. The table was rotated 360 degrees to determine the position of the highest radiation.
c. The height of the equipment or of the substitution antenna shall be 0.8 m for below 1GHz and 1.5m for above 1GHz; the height of the test antenna shall vary between 1 m to 4 m. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
d. The initial step in collecting conducted emission data is a spectrum analyzer peak detector mode pre-scanning the measurement frequency range. Significant peaks are then marked and then Quasi Peak detector mode re-measured.
e. If the Peak Mode measured value compliance with and lower than Quasi Peak Mode Limit, the EUT shall be deemed to meet QP Limits and then no additional QP Mode measurement performed.
f. For the actual test configuration, please refer to the related Item –EUT Test Photos.

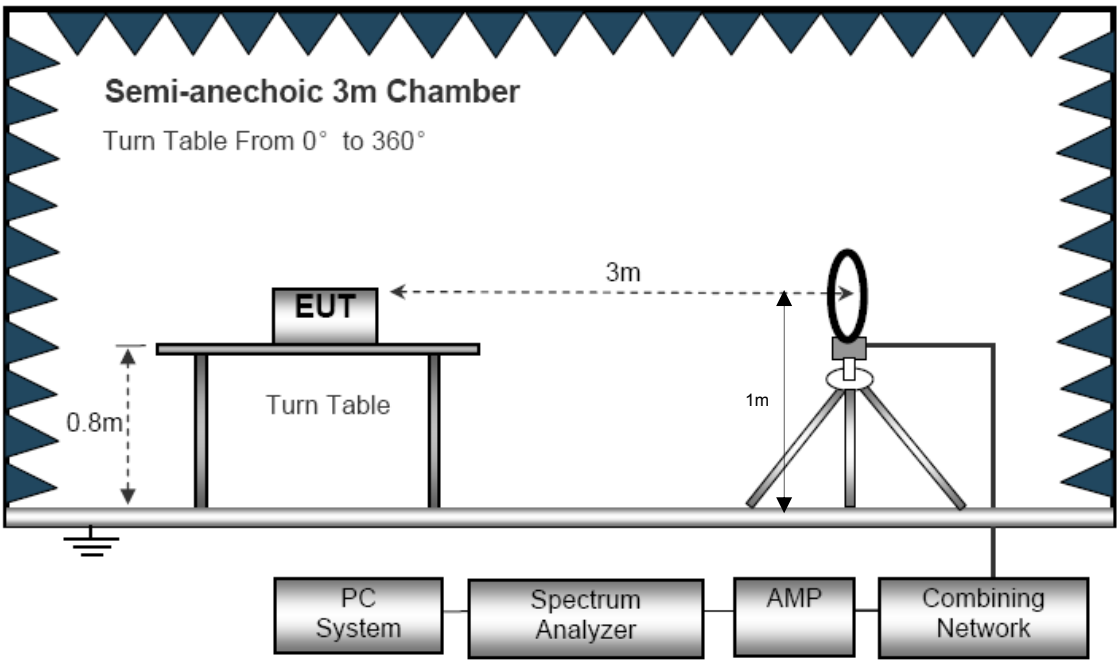
Note:

Both horizontal and vertical antenna polarities were tested
and performed pretest to three orthogonal axis. The worst case emissions were reported

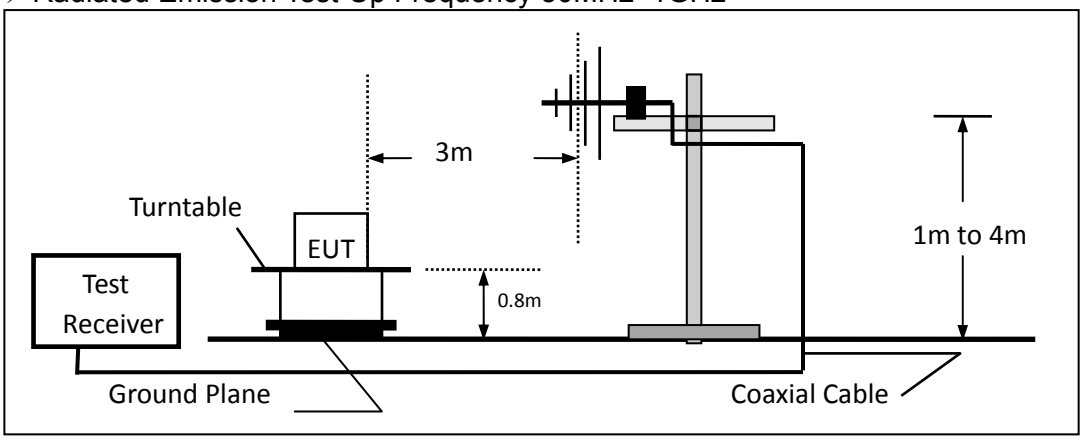
3.4.3 DEVIATION FROM TEST STANDARD

No deviation

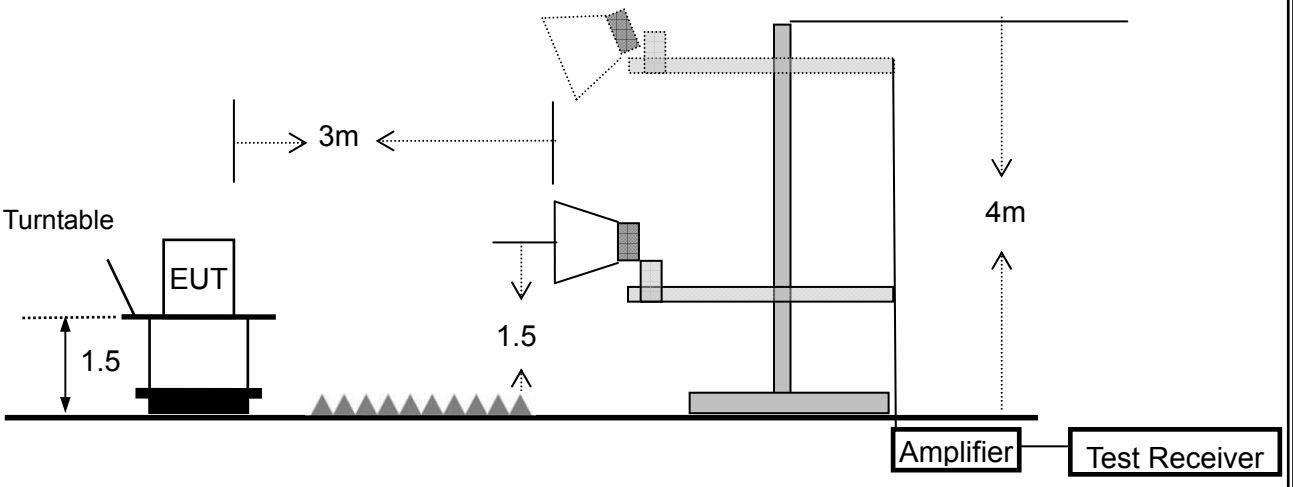
（A）Radiated Emission Test-Up Frequency Below 30MHz



（B）Radiated Emission Test-Up Frequency 30MHz~1GHz



（C）Radiated Emission Test-Up Frequency Above 1GHz



3.4.4 TEST RESULTS (BELOW 30MHz)

EUT：	Soil Moisture sensor	Model Name. ：	WN51E
Temperature：	20 ℃	Relative Humidtity：	48%
Pressure：	1010 hPa	Test Voltage ：	DC 1.5V
Test Mode ：	TX	Polarization :	--

Freq.	Reading	Limit	Margin	State
(MHz)	(dBuV/m)	(dBuV/m)	(dB)	P/F
--	--	--	--	PASS
--	--	--	--	PASS

NOTE:

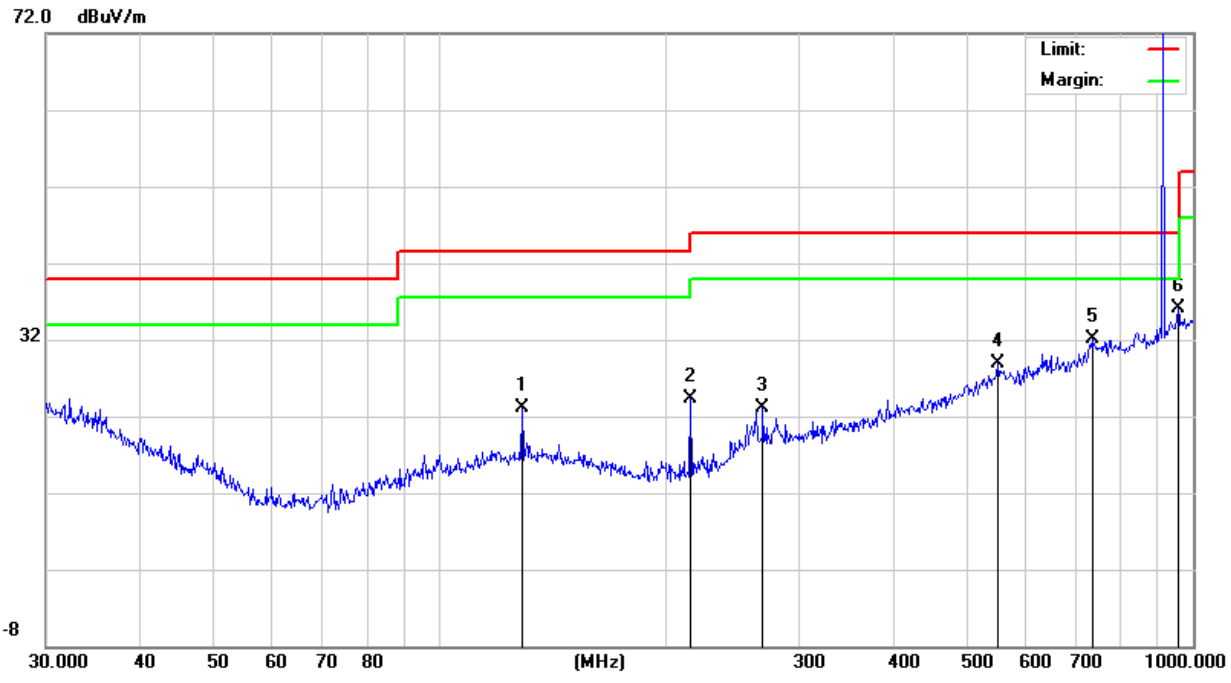
The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.
Distance extrapolation factor =20 log (specific distance/test distance)(dB);
Limit line = specific limits(dBuv) + distance extrapolation factor.

3.4.5 TEST RESULTS (BELOW 1000 MHz)

EUT：	Soil Moisture sensor	Model Name ：	WN51E
Temperature：	25 ℃	Relative Humidity：	51%
Pressure：	1010 hPa	Test Voltage ：	DC 1.5V
Test Mode ：	Mode 1	Polarization：	Vertical

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
128.5629	10.67	12.44	23.11	43.50	-20.39	QP
215.2675	14.45	9.91	24.36	43.50	-19.14	QP
268.4852	8.84	14.32	23.16	46.00	-22.84	QP
550.9479	6.22	22.60	28.82	46.00	-17.18	QP
734.4913	7.04	25.15	32.19	46.00	-13.81	QP
955.4379	7.69	28.41	36.10	46.00	-9.90	QP

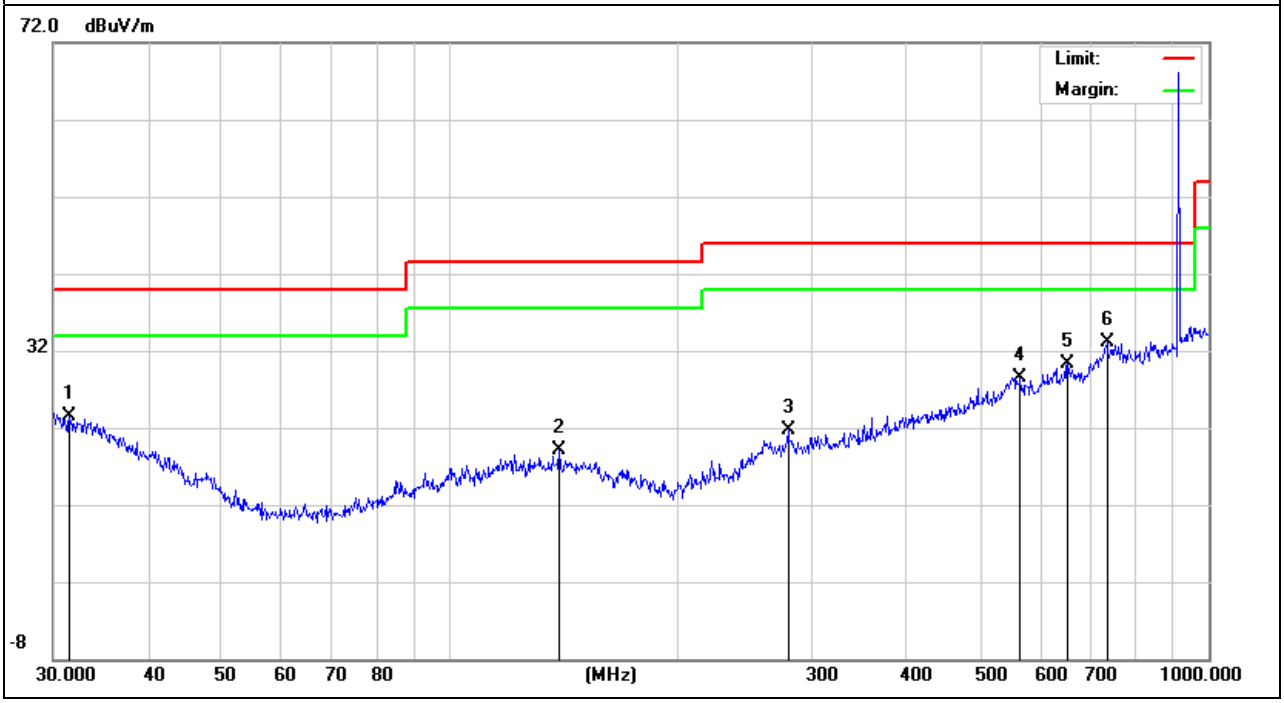
Remark:
1. Factor = Antenna Factor + Cable Loss – Pre-amplifier.



EUT：	Soil Moisture sensor	Model Name ：	WN51E
Temperature：	25 ℃	Relative Humidity：	51%
Pressure：	1010 hPa	Test Voltage ：	DC 1.5V
Test Mode ：	Mode 1	Polarization：	Horizontal

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
31.5092	5.41	18.04	23.45	40.00	-16.55	QP
139.3611	6.69	12.43	19.12	43.50	-24.38	QP
279.0436	5.98	15.72	21.70	46.00	-24.30	QP
564.6389	6.43	22.12	28.55	46.00	-17.45	QP
651.9415	7.60	22.67	30.27	46.00	-15.73	QP
734.4913	7.89	25.15	33.04	46.00	-12.96	QP

Remark:
1. Factor = Antenna Factor + Cable Loss – Pre-amplifier.

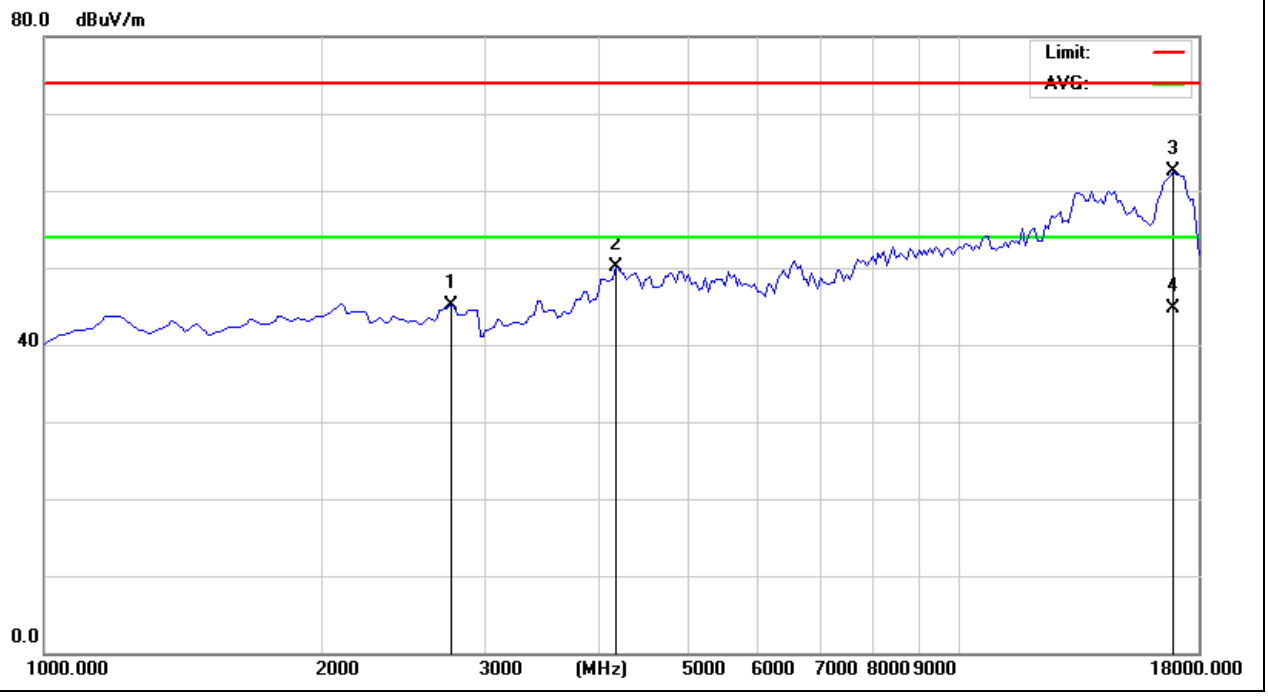


3.4.6 TEST RESULTS (ABOVE 1000 MHZ)

EUT：	Soil Moisture sensor	Model Name ：	WN51E
Temperature：	25 ℃	Relative Humidity：	51%
Pressure：	1010 hPa	Test Voltage ：	DC 1.5V
Test Mode ：	Mode 1	Polarization：	Horizontal

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
2785.000	39.09	5.96	45.05	74.00	-28.95	peak
4187.500	38.75	11.36	50.11	74.00	-23.89	peak
16937.500	34.81	27.76	62.57	74.00	-11.43	peak
16937.500	16.94	27.76	44.70	54.00	-9.30	AVG

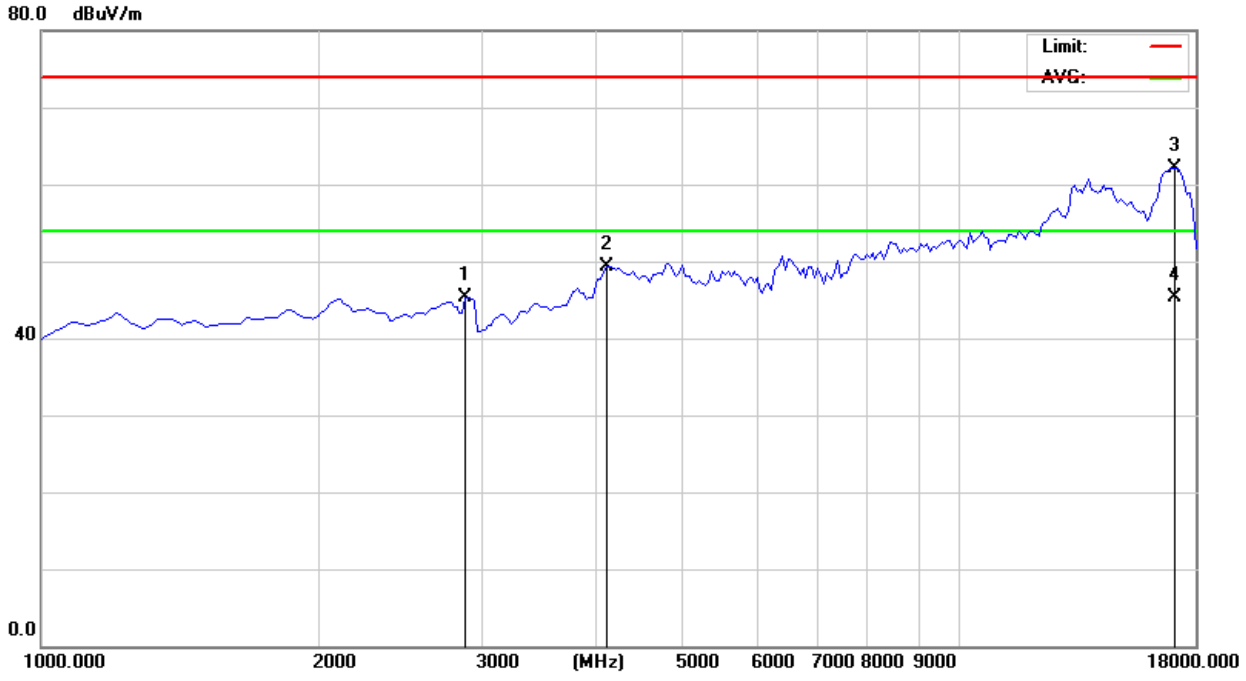
Remark:
Factor = Antenna Factor + Cable Loss – Pre-amplifier.



EUT：	Soil Moisture sensor	Model Name ：	WN51E
Temperature：	25 ℃	Relative Humidity：	51%
Pressure：	1010 hPa	Test Voltage ：	DC 1.5V
Test Mode ：	Mode 1	Polarization：	Vertical

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
2912.500	39.18	6.04	45.22	74.00	-28.78	peak
4145.000	38.01	11.32	49.33	74.00	-24.67	peak
17150.000	33.87	28.30	62.17	74.00	-11.83	peak
17150.000	17.06	28.30	45.36	54.00	-8.64	AVG

Remark:
Factor = Antenna Factor + Cable Loss – Pre-amplifier.



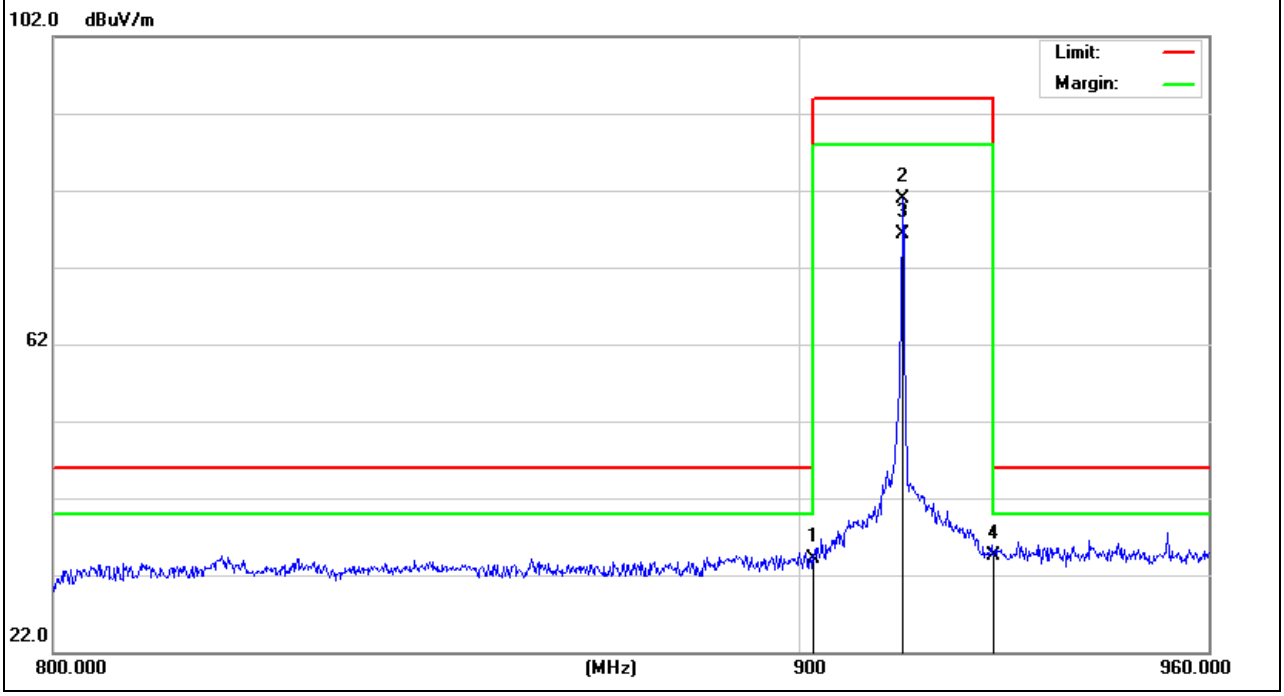
Note: EUT Pre-scan X/Y/Z orientation, only worst case is presented in the report(X orientation).

3.4.7 TEST RESULTS (RESTRICTED BANDS REQUIREMENTS)

EUT：	Soil Moisture sensor	Model Name ：	WN51E
Temperature：	25 ℃	Relative Humidity：	51%
Pressure：	1010 hPa	Test Voltage ：	DC 1.5V
Test Mode ：	TX-915MHz	Polarization：	Horizontal

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
902.0000	7.81	26.23	34.04	46.00	-11.96	peak
914.8799	53.91	26.93	80.84	94.00	-13.16	peak
914.8799	49.43	26.93	76.36	94.00	-17.64	QP
928.0000	6.88	27.64	34.52	46.00	-11.48	peak

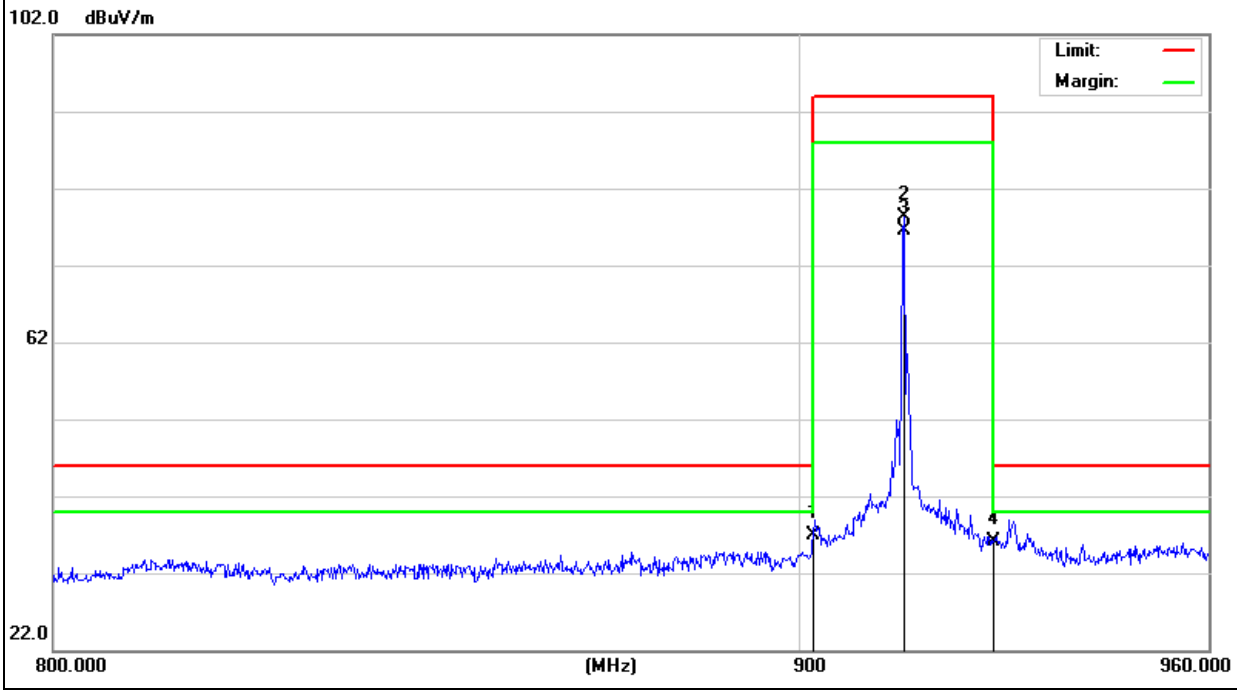
Remark:
Factor = Antenna Factor + Cable Loss – Pre-amplifier.



EUT：	Soil Moisture sensor	Model Name ：	WN51E
Temperature：	25 ℃	Relative Humidity：	51%
Pressure：	1010 hPa	Test Voltage ：	DC 1.5V
Test Mode ：	TX-915MHz	Polarization：	Vertical

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
902.0000	10.61	26.23	36.84	46.00	-9.16	peak
915.0398	51.39	26.94	78.33	94.00	-15.67	peak
915.0398	49.66	26.94	76.60	94.00	-17.40	QP
928.0000	8.44	27.64	36.08	46.00	-9.92	peak

Remark:
Factor = Antenna Factor + Cable Loss – Pre-amplifier.



4. BANDWIDTH TEST

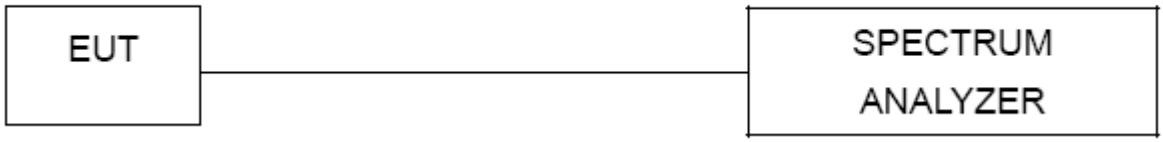
4.1 TEST PROCEDURE

a. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below,
b. Spectrum Setting : The resolution bandwidth (RBW) shall be in the range of 1% to 5% of the actual occupied / x dB bandwidth and the video bandwidth (VBW) shall not be smaller than three times the RBW value., Sweep time = Auto.

4.2 DEVIATION FROM STANDARD

No deviation.

4.3 TEST SETUP



4.4. TEST RESULTS

EUT：	Soil Moisture sensor	Model Name ：	WN51E
Temperature：	26 ℃	Relative Humidity：	53%
Pressure：	1020 hPa	Test Power ：	DC 1.5V
Test Mode ：	Mode 1		

Test Channel	Frequency (MHz)	20 dBc Bandwidth (MHz)
CH01	915	0.151

915 MHz

END OF REPORT