TEST REPORT

KCTL Inc.
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1. Applicant

Name:	SAM JIN CO., LTD.
Address:	(Anyang-dong) 81, Anyangcheonseo-ro, Manan-gu Anyang-si, Gyeonggi-do, Korea

2. Sample Description:

FCC ID:	2AF4S-STS-WTR-250
IC ID:	20753-STSWTR250
Type of equipment:	Water Leak Sensor
Basic Model:	STS-WTR-250

3. Date of Test: July 1 ~ July 4, 2016

4. Test standard used: FCC Part 15 Subpart C, 15.247
RSS-247 Issue 1 May 2015
RSS GEN Issue 4 November 2014

5. Test Results

Test Item:	Refer to page 7
Result:	Complied (Refer to page 8 ~ page 16)
Measurement Uncertainty:	Refer to page 7

This result shown in this report refer only to the sample(s) tested unless otherwise stated.

Affirmation	Tested by Name: TAEK YONG, NAM	Technical Manager Name: MIN GI, SON

2016. 07. 12

KCTL Inc.

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1. Client information

Applicant:	SAM JIN CO., LTD.
Address:	(Anyang-dong) 81, Anyangcheonseo-ro, Manan-gu Anyang-si, Gyeonggi-do, Korea
Telephone number:	+82-31-467-5949
Facsimile number:	+82-31-469-3115
Contact person:	Jung Woo Kim / jungwoo@samjin.com

Manufacturer:	SAM JIN CO., LTD.
Address:	(Anyang-dong) 81, Anyangcheonseo-ro, Manan-gu Anyang-si, Gyeonggi-do, Korea

2. Laboratory information

Address

KCTL Inc.
65 Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, Korea
Telephone Number: 82-70-5008-1016 Facsimile Number: 82-505-299-8311

Certificate

KOLAS No.: KT231
FCC Site Designation No.: KR0040
FCC Site Registration No.: 687132
VCCI Site Registration No.: R-3327, G-198, C-3706, T-1849
IC Site Registration No.:8035A-2

SITE MAP

3. Description of E.U.T.

3.1 Basic description

Applicant:	SAM JIN CO., LTD.
Address of Applicant	(Anyang-dong) 81, Anyangcheonseo-ro, Manan-gu Anyang-si, Gyeonggi-do, Korea
Manufacturer	SAM JIN CO., LTD.
Address of Manufacturer	(Anyang-dong) 81, Anyangcheonseo-ro, Manan-gu Anyang-si, Gyeonggi-do, Korea
Type of equipment	Water Leak Sensor
Basic Model	STS-WTR-250
Serial number	N/A

3.2 General description

Frequency Range	2 405 ㎒ ~ 2 470 ㎒
Type of Modulation	O-QPSK
Number of Channels	14 ch
Type of Antenna	PCB Pattern Antenna
Antenna Gain	1.9 dBi
Transmit Power	17.69 dBm
Power supply	DC 3 V
H/W Version	1.0
S/W version	1.0
Test SW Version	Teraterm_version 2.3
RF power setting in TEST SW	-6

Note : The above EUT information was declared by the manufacturer.

3.3 Test frequency

	Frequency
Lowest frequency	2 405 ㎒
Middle frequency	2 440 ㎒
Highest frequency	2 470 ㎒

3.4 Test Voltage

Mode	Voltage
Nominal Voltage	DC 3.0 Ⅴ

4. Summary of test results

4.1 Standards & results

FCC Rule Reference	IC Rule Reference	Parameter	Report Section	Test Result
15.203, 15.247(b)(4)	-	Antenna Requirement	5.1	C
15.247(b)(3)	RSS-247, 5.4(4)	Maximum Peak Output Power	5.2	NT1)
15.247(e)	RSS-247, 5.2(2)	Peak Power Spectral Density	5.3	NT1)
15.247(a)(2)	RSS-247, 5.2(1)	6 dB Channel Bandwidth	5.4	NT1)
-	RSS-GEN, 6.6	Occupied Bandwidth	5.4	NT1)
15.247(d), 15.205(a), 15.209(a)	RSS-247, 5.5 RSS-GEN, 8.9, 10	Spurious Emission, Band Edge and Restricted bands	5.5	C
15.207(a)	RSS-GEN, 8.8	Conducted Emissions	5.6	NA1)

Note: C = complies
NC = Not complies
NT = Not tested
NA = Not Applicable
NA1) : Since the device doesn't use rechargeable battery, this test is not applicable.
NT1) : Since this is C2PC evaluation due to PCB art-work, only spurious emission test has done. Please refer to original test report # KCTL15-FR0086(2).

Note: The general test methods used to test this device is ANSI C63.10:2013

4.2 Uncertainty

Measurement Item	Expanded Uncertainty U = *k*Uc (*k* = 2)	
Conducted RF power	1.44 dB	
Conducted Spurious Emissions	1.52 dB	
Radiated Spurious Emissions	30 MHz ~ 300 MHz:	+ 4.94 dB, - 5.06 dB
		+ 4.93 dB, - 5.05 dB
	300 MHz ~ 1 000 MHz:	+ 4.97 dB, - 5.08 dB
		+ 4.84 dB, - 4.96 dB
	1 GHz ~ 25 GHz:	+ 6.03 dB, - 6.05 dB

5. Test results

5.1 Antenna Requirement

5.1.1 Regulation

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. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

And according to §15.247(b)(4), the conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBI. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

5.1.2 Result

- Complied

The transmitter has a PCB Pattern antenna attaching on PCB permanently and the directional peak gain is 1.9 dBi.

5.5 Spurious Emission, Band Edge, and Restricted bands

5.5.1 Regulation

According to §15.247(d), in any 100 ㎑ bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 ㏈ below that in the 100 ㎑ bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 ㏈ instead of 20 ㏈. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

According to §15.209(a), Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall notexceed the field strength levels specified in the following table:

Frequency (㎒)	Field strength (㎶/m)	Measurement distance (m)
0.009 - 0.490	2 400/F(㎑)	300
0.490 - 1.705	24 000/F(㎑)	30
1.705 - 30	30	30
30 - 88	100**	3
88 - 216	150**	3
216 - 960	200**	3
Above 960	500	3

**Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54–72 ㎒, 76–88 ㎒, 174–216 ㎒ or 470–806 ㎒. However, operation within these frequency bands is permItted under other sections of this part, e.g., §§15.231 and 15.241.

According to § 15.205(a) and (b), only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.009 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
0.495 - 0.505	16.694 75 - 16.695 25	608 - 614	5.35 - 5.46
2.173 5 - 2.190 5	16.804 25 - 16.804 75	960 – 1 240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1 300 – 1 427	8.025 - 8.5
4.177 25 - 4.177 75	37.5 - 38.25	1 435 – 1 626.5	9.0 - 9.2
4.207 25 - 4.207 75	73 - 74.6	1 645.5 – 1 646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1 660 – 1 710	10.6 - 12.7
6.267 75 - 6.268 25	108 - 121.94	1 718.8 – 1 722.2	13.25 - 13.4
6.311 75 - 6.312 25	123 - 138	2 200 – 2 300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2 310 – 2 390	15.35 - 16.2
8.362 - 8.366	156.524 75 - 156.525 25	2 483.5 – 2 500	17.7 - 21.4
8.376 25 - 8.386 75	156.7 - 156.9	2 690 – 2 900	22.01 - 23.12
8.414 25 - 8.414 75	162.012 5 - 167.17	3 260 – 3 267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3 332 – 3 339	31.2 - 31.8
12.519 75 - 12.520 25	240 - 285	3 345.8 – 3 358	36.43 - 36.5
12.576 75 - 12.577 25	322 - 335.4	3 600 – 4 400	Above 38.6
13.36 - 13.41			

The field strength of emissions appearing within these frequency bands shall not exceed the limits shown in §15.209. At frequencies equal to or less than 1 000 MHz, compliance with the limits in §15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1 000 MHz, compliance with the emission limits in §15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in §15.35 apply to these measurements.

5.5.2Measurement Procedure

5.5.2.1 Band-edge Compliance of RF Conducted Emissions

5.5.2.1.1 Reference Level Measurement

Establish a reference level by using the following procedure:

1) Set instrument center frequency to DTS channel center frequency.
2) Set the span to ≥ 1.5 times the DTS bandwidth.
3) Set the RBW = 100 ㎑.
4) Set the VBW ≥ 3 x RBW.
5) Detector = peak.
6) Sweep time = auto couple.
7) Trace mode = max hold.
8) Allow trace to fully stabilize.
9) Use the peak marker function to determine the maximum PSD level.

5.5.2.1.2 Emissions Level Measurement

1) Set the center frequency and span to encompass frequency range to be measured.
2) Set the RBW = 100 ㎑.
3) Set the VBW ≥ 3 x RBW.
4) Detector = peak.
5) Ensure that the number of measurement points ≥ span/RBW
6) Sweep time = auto couple.
7) Trace mode = max hold.
8) Allow trace to fully stabilize.
9) Use the peak marker function to determine the maximum amplitude level.

Ensure that the amplitude of all unwanted emissions outside of the authorized frequency band (excluding restricted frequency bands) are attenuated by at least the minimum requirements specified in 11.1 a) or 11.1 b). Report the three highest emissions relative to the limit.

5.5.2.2 Conducted Spurious Emissions

Set the spectrum analyzer as follows:

1) Span = wide enough to capture the peak level of the in-band emission and all spurious emissions (e.g., harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic. Typically, several plots are required to cover this entire span.
2) RBW = 100 ㎑
3) VBW ≥ RBW
4) Sweep = auto
5) Detector function = peak
6) Trace = max hold
7) Allow the trace to stabilize. Set the marker on the peak of any spurious emission recorded.
8) Each frequency found during preliminary measurements was re-examined and investigated. The test-receiver system was set up to average, peak and quasi-peak detector function with specified bandwidth.

5.5.2.3 Radiated Spurious Emissions

1) The preliminary and final radiated measurements were performed to determine the frequency producing the maximum emissions in at a 10m anechoic chamber. The EUT was tested at a distance 3 meters.
2) The EUT was placed on the top of the 0.8-meter height, 1 × 1.5 meter non-metallic table. To find the maximum emission levels, the height of a measuring antenna was changed and the turntable was rotated 360°.
3) The antenna polarization was also changed from vertical to horizontal. The spectrum was scanned from 9 ㎑ to 30 ㎒ using the loop antenna, and from 30 to 1 000 ㎒ using the TRILOG broadband antenna, and from 1 000 ㎒ to 26 500 ㎒ using the horn antenna.
4) Each frequency found during preliminary measurements was re-examined and investigated. The test-receiver system was set up to average, peak, and quasi-peak detector function with specified bandwidth.

Note

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 ㎑ for Peak detection (PK) and Quasi-peak detection (QP) at frequency below 1 ㎓.
2. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 1 ㎒ for Peak detection and frequency above 1 ㎓.
   The resolution bandwidth of test receiver/spectrum analyzer is 1 ㎒ and the video bandwidth is 1 ㎑(≥1/T) for Average detection (AV) at frequency above 1 ㎓. **(**where T = pulse width)

5.5.3 Test Result

- Complied

1. Conducted Spurious Emissions was shown in figure 3.
   Note: We took the insertion loss of the cable into consideration within the measuring instrument.
2. Measured value of the Field strength of spurious Emissions (Radiated)
3. It tested x,y and z – 3 axis each, mentioned only worst case data at this report.

- 9 ㎑ ~ 1 ㎓ (worst-case)

Highest channel (2 470 ㎒)

Frequency [㎒]	Receiver Bandwidth [㎑]	Pol. [V/H]	Reading [dB(㎶)]	Factor [dB]	Result [dB(㎶/m)]	Limit [dB(㎶/m)]	Margin [dB]
Quasi-Peak DATA. Emissions below 30 ㎒							
Below 30.00	**Not Detected**	-	-	-	-	-	-
Quasi-Peak DATA. Emissions below 1 ㎓							
85.41	120	V	26.30	-16.20	10.10	40.00	29.90
Above 100.00	**Not Detected**	-	-	-	-	-	-

- 1 ㎓ ~ 26.5 ㎓ data

Lowest channel (2 405 ㎒)

Frequency [㎒]	Receiver Bandwidth [㎑]	Pol. [V/H]	Reading [dB(㎶)]	Factor [dB]	Result [dB(㎶/m)]	Limit [dB(㎶/m)]	Margin [dB]
Peak DATA. Emissions above 1 ㎓							
2 389.50[1)]	1 000	H	53.70	3.50	57.20	74.00	16.80
3 735.00	1 000	H	35.40	6.80	42.20	74.00	31.80
4 809.38[2)]	1 000	H	51.00	9.50	60.50	74.00	13.50
5 983.13	1 000	H	34.80	12.20	47.00	74.00	27.00
7 216.88[2)]	1 000	H	37.60	14.30	51.90	74.00	22.10
9 616.87[2)]	1 000	V	41.30	16.30	57.60	74.00	16.40
Above 10 000.00	Not Detected	-	-	-	-	-	-
Average DATA. Emissions above 1 ㎓							
2 389.50[1)]	1 000	H	41.70	3.50	45.20	54.00	8.80
3 735.00	1 000	H	23.90	6.80	30.70	54.00	23.30
4 809.38[2)]	1 000	H	40.70	9.50	50.20	54.00	3.80
5 983.13	1 000	H	23.20	12.20	35.40	54.00	18.60
7 216.88[2)]	1 000	H	27.90	14.30	42.20	54.00	11.80
9 616.87[2)]	1 000	V	28.30	16.30	44.60	54.00	9.40
Above 10 000.00	Not Detected	-	-	-	-	-	-

[1)] Restricted band.

[2)] Harmonic components.

Middle channel (2 440 ㎒)

Frequency [㎒]	Receiver Bandwidth [㎑]	Pol. [V/H]	Reading [dB(㎶)]	Factor [dB]	Result [dB(㎶/m)]	Limit [dB(㎶/m)]	Margin [dB]
Peak DATA. Emissions above 1 ㎓							
3 956.25	1 000	H	35.50	6.60	42.10	74.00	31.90
4 880.63[1)]	1 000	H	49.40	9.10	58.50	74.00	15.50
6 613.13	1 000	V	37.30	12.90	50.20	74.00	23.80
8 199.38	1 000	H	32.60	15.40	48.00	74.00	26.00
9 761.25[1)]	1 000	V	39.40	16.80	56.20	74.00	17.80
Above 10 000.00	Not Detected	-	-	-	-	-	-
Average DATA. Emissions above 1 ㎓							
3 956.25	1 000	H	25.00	6.60	31.60	54.00	22.40
4 880.63[1)]	1 000	H	40.90	9.10	50.00	54.00	4.00
6 613.13	1 000	V	24.10	12.90	37.00	54.00	17.00
8 199.38	1 000	H	22.20	15.40	37.60	54.00	16.40
9 761.25[1)]	1 000	V	29.90	16.80	46.70	54.00	7.30
Above 10 000.00	Not Detected	-	-	-	-	-	-

[1)] Harmonic components.

Highest channel (2 470 ㎒)

Frequency [㎒]	Receiver Bandwidth [㎑]	Pol. [V/H]	Reading [dB(㎶)]	Factor [dB]	Result [dB(㎶/m)]	Limit [dB(㎶/m)]	Margin [dB]
Peak DATA. Emissions above 1 ㎓							
2 483.75[1)]	1 000	H	53.80	3.60	57.40	74.00	16.60
3 421.88	1 000	H	35.50	5.70	41.20	74.00	32.80
4 940.63[2)]	1 000	H	54.00	9.20	63.20	74.00	10.80
6 461.25	1 000	H	33.70	12.70	46.40	74.00	27.60
8 021.25	1 000	H	30.30	15.10	45.40	74.00	28.60
9 877.50[2)]	1 000	V	40.70	17.10	57.80	74.00	16.20
Above 10 000.00	Not Detected	-	-	-	-	-	-
Average DATA. Emissions above 1 ㎓							
2 483.75[1)]	1 000	H	42.30	3.60	45.90	54.00	8.10
3 421.88	1 000	H	24.60	5.70	30.30	54.00	23.70
4 940.63[2)]	1 000	H	42.80	9.20	52.00	54.00	2.00
6 461.25	1 000	H	23.90	12.70	36.60	54.00	17.40
8 021.25	1 000	H	22.70	15.10	37.80	54.00	16.20
9 877.50[2)]	1 000	V	32.00	17.10	49.10	54.00	4.90
Above 10 000.00	Not Detected	-	-	-	-	-	-

[1)] Restricted band.
[2)] Harmonic components.

6. Test equipment used for test

	Description	Manufacturer	Model No.	Serial No.	Next Cal Date.
■	Test Receiver	R & S	ESR7	101078	17.02.26
■	Bi-Log Antenna	SCHWARZBECK	VULB 9168	583	18.06.10
■	Amplifier	SONOMA INSTRUMENT	310N	188280	17.04.07
■	ATTENUATOR	HP	8497B-003	2408A18758	16.09.01
■	Turn Table	MATURO	CO2000-SOFT	-	-
■	Antenna Mast	MATURO	AM4.0	079/3440509	-
■	Broadband Preamplifier	SCHWARZBECK	BBV9718	9718-233	17.01.09
■	LOOP Antenna	R & S	HFH2-Z2	100355	18.03.03
■	Horn antenna	ETS.lindgren	3116	86632	16.11.05
■	Horn antenna	ETS.lindgren	3117	00155787	16.11.25
■	Broadband Preamplifier	SCHWARZBECK	BBV9721	2	17.05.03
■	DC POWER SUPPLY	AGILENT	E3632A	KR73001026	17.01.07
■	SPECTRUM ANALYZER	R & S	FSV30	101437	16.11.03
■	VECTOR SIGNAL GENERATOR	R & S	SMBV100A	257566	17.01.07
■	SIGNAL GENERATOR	R & S	SMB100A	176206	17.03.14
■	WIDEBAND POWER SENSOR	R & S	NRP-Z81	102398	17.02.11
■	Highpass Filter	Wainwright Instruments GmbH	WHKX3.0/ 18G-12SS	44	17.02.01
■	CABLE Assembly	HUER+SUHNER	SUCOFLEX 102	MY3565/2	-
■	CABLE Assembly	JUNFLON	MWX221 DMSMNS	J1012214	-
■	ATTENUATOR	HP	8491A	18591	17.05.03