Report No.: GTS201904000035E03

SPECTRUM REPORT (GNSS)

Applicant:	Dragino Technology Co., Limited
Address of Applicant:	Room 202, Block B, BCT Incubation Bases (BaoChengTai), No.8 CaiYunRoad LongCheng Street, LongGang District ; Shenzhen 518116,China
Manufacturer/Factory:	Dragino Technology Co., Limited
Address of Manufacturer/Factory:	Room 202, Block B, BCT Incubation Bases (BaoChengTai), No.8 CaiYunRoad LongCheng Street, LongGang District ; Shenzhen 518116,China

Equipment Under Test (EUT)

Product Name:	LoRaWAN GPS Tracker
Model No.:	LGT-92
Trade Mark:	Dragino
Applicable standards:	ETSI EN 303 413 V1.1.1 (2017-06)
Date of sample receipt:	April 03, 2019
Date of Test:	April 04-22, 2019
Date of report issue:	April 22, 2019
Test Result :	PASS *

* In the configuration tested, the EUT detailed in this report complied with the standards specified above.

The CE mark as shown below can be used, under the responsibility of the manufacturer, after completion of an EC Declaration of Conformity and compliance with all relevant EC Directives. The protection requirements with respect to electromagnetic compatibility contained in Directive 2014/53/EU are considered.

Robinson Lo
Laboratory Manager

2 Version

Version No.	Date	Description
00	*April 22, 2019*	*Original*

Prepared By: Bill. Yuan ***Date:*** *April 22, 2019*

Project Engineer

Check By: ***Date:*** *April 22, 2019*

Reviewer

3 Contents

4 Test Summary

Radio Spectrum Matter (RSM) Part Rx					
Test	**Test Requirement**	**Test method**	**Limit/Severity**	**Uncertainty**	**Result**
GUE adjacent frequency band selectivity performance	Clause 4.2.1	Clause 5.4.3& Clause 5.4.4	Table 4-2& Table 4-3	±6	PASS
Spurious emissions	Clause 4.2.2	Clause 5.5.2	Table 4-5	±6	PASS

Remark:

Rx: In this whole report Rx (or rx) means Receiver.

Temperature (Uncertainty): ±1°C Humidity(Uncertainty): ±5%

Uncertainty: ± 3%(for DC and low frequency voltages)

5 General Information

5.1 General Description of EUT

Product Name:	LoRaWAN GPS Tracker
Model No.:	LGT-92
Receiver Frequency:	1575.42MHz
Antenna Type:	Integral antenna
Antenna Gain:	0dBi(Declared by applicant)
Power Supply:	Battery: DC 3.7V, 1000mAh Charge: DC 5V

5.2 Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

● **FCC —Registration No.: 381383**

Global United Technology Services Co., Ltd., Shenzhen EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in files. Registration 381383.

● **Industry Canada (IC) —Registration No.: 9079A-2**

The 3m Semi-anechoic chamber of Global United Technology Services Co., Ltd. has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 9079A-2.

● **NVLAP (LAB CODE:600179-0)**

Global United Technology Services Co., Ltd., is accredited by the National Voluntary Laboratory Accreditation Program (NVLAP). LAB CODE:600179-0

5.3 Test Location

GUE adjacent frequency band selectivity performance tests were performed at:

Dongguan Dongdian Testing Service Co., Ltd

Add: No. 17, Zongbu Road 2, Songshan Lake Sci&Tech, Industry Park, Dongguan City, Guangdong Province, China, 523808 Tel: +86-0769-22891499

Spurious emission test was performed at:

Global United Technology Services Co., Ltd.

Address: No. 123-128, Tower A, Jinyuan Business Building, No.2, Laodong Industrial Zone, Xixiang Road, Baoan District, Shenzhen, Guangdong, China

Tel: 0755-27798480; Fax: 0755-27798960

5.4 Description of Support Units

The EUT has been tested as an independent unit.

5.5 Deviation from Standards

None.

5.6 Abnormalities from Standard Conditions

None.

5.7 Other Information Requested by the Customer

None.

6 Test Instruments List

Radiated Emission:						
Item	**Test Equipment**	**Manufacturer**	**Model No.**	**Inventory No.**	**Cal.Date (mm-dd-yy)**	**Cal.Due date (mm-dd-yy)**
1	3m Semi- Anechoic Chamber	ZhongYu Electron	9.2(L)*6.2(W)* 6.4(H)	GTS250	July. 03 2015	July. 02 2020
2	Control Room	ZhongYu Electron	6.2(L)*2.5(W)* 2.4(H)	GTS251	N/A	N/A
3	EMI Test Receiver	Rohde & Schwarz	ESU26	GTS203	June. 27 2018	June. 26 2019
4	BiConiLog Antenna	SCHWARZBECK MESS-ELEKTRONIK	VULB9163	GTS214	June. 27 2018	June. 26 2019
5	Double -ridged waveguide horn	SCHWARZBECK MESS-ELEKTRONIK	BBHA 9120 D	GTS208	June. 27 2018	June. 26 2019
6	Horn Antenna	ETS-LINDGREN	3160	GTS217	June. 27 2018	June. 26 2019
7	EMI Test Software	AUDIX	E3	N/A	N/A	N/A
8	Coaxial Cable	GTS	N/A	GTS213	June. 27 2018	June. 26 2019
9	Coaxial Cable	GTS	N/A	GTS211	June. 27 2018	June. 26 2019
10	Coaxial cable	GTS	N/A	GTS210	June. 27 2018	June. 26 2019
11	Coaxial Cable	GTS	N/A	GTS212	June. 27 2018	June. 26 2019
12	Amplifier(100kHz-3GHz)	HP	8347A	GTS204	June. 27 2018	June. 26 2019
13	Amplifier(2GHz-20GHz)	HP	84722A	GTS206	June. 27 2018	June. 26 2019
14	Amplifier (18-26GHz)	Rohde & Schwarz	AFS33-18002 650-30-8P-44	GTS218	June. 27 2018	June. 26 2019
15	Band filter	Amindeon	82346	GTS219	June. 27 2018	June. 26 2019
16	Power Meter	Anritsu	ML2495A	GTS540	June. 27 2018	June. 26 2019
17	Power Sensor	Anritsu	MA2411B	GTS541	June. 27 2018	June. 26 2019
18	Wideband Radio Communication Tester	Rohde & Schwarz	CMW500	GTS575	June. 27 2018	June. 26 2019
19	Splitter	Agilent	11636B	GTS237	June. 27 2018	June. 26 2019
20	Loop Antenna	ZHINAN	ZN30900A	GTS534	June. 27 2018	June. 26 2019
21	Breitband hornantenne	SCHWARZBECK	BBHA 9170	GTS579	Oct. 20 2018	Oct. 19 2019
22	Amplifier	TDK	PA-02-02	GTS574	Oct. 20 2018	Oct. 19 2019
23	Amplifier	TDK	PA-02-03	GTS576	Oct. 20 2018	Oct. 19 2019
24	PSA Series Spectrum Analyzer	Rohde & Schwarz	FSP	GTS578	June. 27 2018	June. 26 2019

Adjacent signal selectivity test						
Item	**Test Equipment**	**Manufacturer**	**Model No.**	**Inventory No.**	**Cal.Date (mm-dd-yy)**	**Cal.Due date (mm-dd-yy)**
1	MXG Vector Generator	Agilent	N5182A	MY47420276	Oct. 08, 2018	Oct. 09, 2019
2	MXG Vector Generator	Agilent	N5182A	MY48180737	Jun. 16, 2018	Jun. 15, 2019
3	PSA Series Spectrum analyzer	Agilent	E4447A	MY50180031	Jun. 16, 2018	Jun. 15, 2019
4	Power divider	Mini-Circuits	ZFRSC-183-S+	SF601301339	Jun. 16, 2018	Jun. 15, 2019
5	Double Ridged Horn Antenna	R&S	HF907	100276	Oct. 10, 2018	Oct. 09, 2019
6	RF Cable	HUBSER	CP-X2	W11.03	Oct. 14, 2018	Oct. 13, 2019
7	RF Cable	HUBSER	CP-X1	W11.02	Oct. 14, 2018	Oct. 13, 2019
8	MI Cable	HUBSER	C10-01-01-1M	1091629	Oct. 14, 2018	Oct. 13, 2019

General used equipment:						
Item	**Test Equipment**	**Manufacturer**	**Model No.**	**Inventory No.**	**Cal.Date (mm-dd-yy)**	**Cal.Due date (mm-dd-yy)**
1	Humidity/ Temperature Indicator	KTJ	TA328	GTS243	June. 27 2018	June. 26 2019
2	Barometer	ChangChun	DYM3	GTS255	June. 27 2018	June. 26 2019

7 Radio Technical Specification in ETSI EN 303 413

7.1 Test Environment and Mode

Test mode:	
GPS mode	Keep the EUT in communicating mode on GPS function.
Operating Environment:	
Item	**Normal condition**
Temperature	+25ºC
Humidity	20%-95%
Atmospheric Pressure:	1008 mbar

7.1.1 GUE Adjacent Frequency Band Selectivity Performance

Test Requirement:	ETSI EN 303 413 clause 4.2.1
Test Method:	ETSI EN 303 413 clause 5.4.3& clause 5.4.4
Limit:	Δ C/N_0≤ 1dB
Adjacent frequency signal:	See below
Parameters:	See below
Test setup:	See below
Test procedure:	1) Configure the GNSS signal generator to simulate those GNSS and GNSS signals from table 4-1 declared as supported by the GUE, with power levels and other details as specified in clause B.2.

Adjacent frequency signal:

Parameter	Value	Comments
Frequency	See table 4-2 and table 4-3	
Power level	See table 4-2 and table 4-3	
Bandwidth	1 MHz	See clause B.1 for details
Format	AWGN	

Parameters:

Table 4-1: GNSS, GNSS signals and RNSS frequency bands

GNSS	GNSS Signal Designations	RNSS Frequency Band (MHz)
BDS	B1I	1 559 to 1 610
Galileo	E1	1 559 to 1 610
	E5a	1 164 to 1 215
	E5b	1 164 to 1 215
	E6	1 215 to 1 300
GLONASS	G1	1 559 to 1 610
	G2	1 215 to 1 300
GPS	L1	1 559 to 1 610
	L2	1 215 to 1 300
	L5	1 164 to 1 215
SBAS	L1	1 559 to 1 610
	L5	1 164 to 1 215

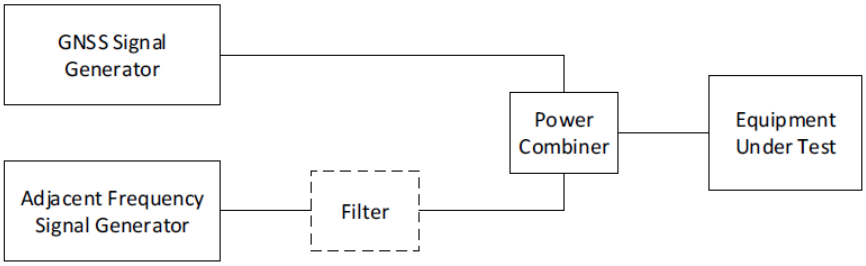
Table 4-2: Frequency bands, adjacent frequency signal test point centre frequencies and power levels for the 1 559 MHz to 1 610 MHz RNSS band

Frequency band (MHz)	Test point centre frequency (MHz)	Adjacent frequency signal power level (dBm)	Comments
1 518 to 1 525	1 524	-65	MSS (space-to-Earth) band
1 525 to 1 549	1 548	-95	MSS (space-to-Earth) band
1 549 to 1 559	1 554	-105	MSS (space-to-Earth) band
1 559 to 1 610	GUE RNSS band under test		
1 610 to 1 626	1 615	-105	MSS (Earth-to-space) band
1 626 to 1 640	1 627	-85	MSS (Earth-to-space) band

Table 4-3: Frequency bands, adjacent frequency signal test point centre frequencies and power levels for the 1 164 MHz to 1 300 MHz RNSS band

Frequency band (MHz)	Test point centre frequency (MHz)	Adjacent frequency signal power level (dBm)	Comments
960 to 1 164	1 154	-75	AM(R)S, ARNS band
1 164 to 1 215	GUE RNSS band under test		
1 215 to 1 260	GUE RNSS band under test		
1 260 to 1 300	GUE RNSS band under test		
1 300 to 1 350	1 310	-85	Radiolocation, ARNS, RNSS (Earth-to-space) band

Test setup:

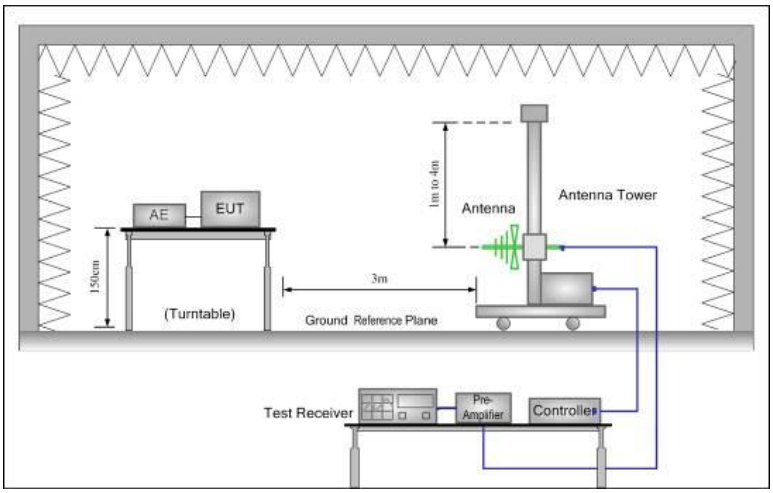
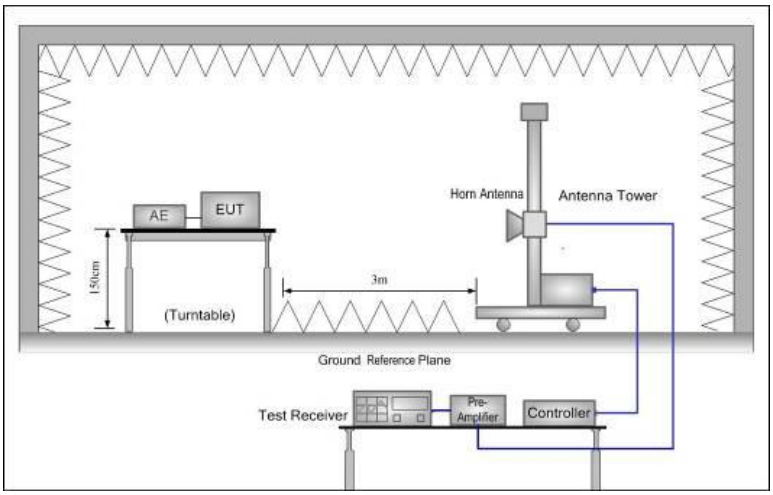


	2) With the adjacent frequency signal switched off, the EUT shall be given sufficient time to acquire all simulated satellites from the declared GNSS system(s). 3) Record the baseline C/N_0 value(s) reported by the EUT. Sufficient filtering shall be used to obtain a stable value. C/N_0 may be averaged across all the satellites in view for each GNSS constellation. However, C/N_0 shall not be averaged across satellite signals in different GNSS constellations. For a multi-GNSS EUT, there shall be a separate C/N_0 value recorded for each GNSS constellation and each GNSS signal supported. 4) The adjacent frequency signal generator shall be configured to generate the signal defined in table 4-4, at the first test point centre frequency and signal power level as specified in table 4-2. 5) The adjacent frequency signal shall be switched on, and the EUT's C/N_0 value(s) recorded as in step 3) to measure the degradation with respect to the baseline value(s) recorded in step 3). 6) Test point Pass/Fail Criteria: If the C/N_0 degradation from step 5) does not exceed the value in equation 4-1, then this test point is set to "pass". If the C/N_0 degradation exceeds the value in equation 4-1, then this test point is set to "fail." For a multi-GNSS and multi-signal EUT, there shall be a separate pass/fail determination for each GNSS and for each GNSS signal supported. If the C/N_0 degradation exceeds the value in equation 4-1 for any supported GNSS or supported GNSS signal, then this test point is set to "fail". 7) Step 1) through step 6) shall be repeated for all test point centre frequencies (and associated signal power level) specified in table 4-2. If the EUT passes the C/N_0 degradation test for all test points for all GNSS constellations and all GNSS signals declared as supported from table 4-1, the EUT shall be deemed to "pass". If the C/N_0 degradation test fails for any GNSS constellation or GNSS signal at any of the test points, the EUT shall be deemed to "fail".
Measurement Record:	Uncertainty: ± 6dB
Test Instruments:	See section 6.0
Test mode:	Refer to section 7.1

Measurement Data

Mode: GPS ☒ L1 ☐ L2 ☐ L5						
Frequency band (MHz)	**Test point centre frequency (MHz)**	**Adjacent frequency signal power level (dBm)**	**Measured C/N0 (dB-Hz)**			
	From table 4-2	**From table 4-2**	**No interfering signal**	**With interfering signal**	**Decrease of C/N0**	**Result**
1 518 to 1 525	1524	-65	51	51	0	Pass
1 525 to 1 549	1548	-95	51	51	0	Pass
1 549 to 1 559	1554	-105	51	51	0	Pass
1 610 to 1 626	1615	-105	51	51	0	Pass
1 626 to 1 640	1627	-85	51	51	0	Pass
Limit: $\Delta C/N_0 \leqslant 1dB$						

7.1.2 Spurious Emissions

Test Requirement:	ETSI EN 303 413 clause 4.2.2
Test Method:	ETSI EN 303 413 clause 5.5.2
Limit:	**Frequency range** / **Maximum power** / **Bandwidth** 30 MHz to 1 GHz / -57 dBm / 100 kHz 1 GHz to 8,3 GHz / -47 dBm / 1 MHz
Test setup:	Below 1GHz  Above 1GHz 
Test procedure:	The procedure in step 1) to step 4) below shall be used to identify potential unwanted emissions of the EUT: 1) The sensitivity of the spectrum analyser should be such that the noise floor is at least 12 dB below the limits given in table 4-5. 2) The emissions over the range 30 MHz to 1 000 MHz shall be identified. Spectrum analyser settings: • Resolution bandwidth: 100 kHz • Video bandwidth: 300 kHz

	• Filter type: 3 dB (Gaussian) • Detector mode: Peak • Trace Mode: Max Hold • Sweep Points: ≥ 19 400 (for spectrum analysers not supporting this high number of sweep points, the frequency band may be segmented) • Sweep time: Auto Wait for the trace to stabilize. Any emissions identified during the sweeps above and that fall within the 6 dB range below the applicable limit or above, shall be individually measured using the procedure in clause 5.5.2.1.3 and compared to the limits given in table 4-5. 3) The emissions over the range 1 GHz to 8,3 GHz shall be identified. Spectrum analyser settings: • Resolution bandwidth: 1 MHz • Video bandwidth: 3 MHz • Filter type: 3 dB (Gaussian) • Detector mode: Peak • Trace Mode: Max Hold • Sweep Points: ≥ 14 600 (for spectrum analysers not supporting this high number of sweep points, the frequency band may be segmented) • Sweep time: Auto Wait for the trace to stabilize. Any emissions identified during the sweeps above that fall within the 6 dB range below the applicable limit or above, shall be individually measured using the procedure in clause 5.5.2.1.3 and compared to the limits given in table 4-5. 4) In case of conducted measurements on smart antenna systems (equipment with multiple receive chains),step 2) and step 3) shall be repeated for each of the active receive chains, A_{ch}. The limits used to identify emissions during this pre-scan shall be reduced by $10 \times \log_{10}(A_{ch})$. **5.5.2.1.3 Measurement of the emissions identified during the pre-scan** The procedure in step 1) to step 4) below shall be used to accurately measure the individual unwanted emissions identified during the pre-scan measurements above. This method assumes the spectrum analyser has a Time Domain Power function. 1) The level of the emissions shall be measured using the following spectrum analyser settings: - Measurement Mode: Time Domain Power. - Centre Frequency: Frequency of the emission identified during the pre-scan. - Resolution Bandwidth: 100 kHz (< 1 GHz) / 1 MHz (> 1 GHz). - Video Bandwidth: 300 kHz (< 1 GHz) / 3 MHz (> 1 GHz).

	- Frequency Span: Zero Span. - Sweep mode: Single Sweep. - Sweep time: 30 ms. - Sweep points: ≥ 30 000. - Trigger: Video (for burst signals) or Manual (for continuous signals). - Detector: RMS. 2) Set a window where the start and stop indicators match the start and end of the burst with the highest level and record the RMS value of the power measured within this window. If the spurious emission to be measured is a continuous transmission, the measurement window shall be set to the start and stop times of the sweep. 3) In case of conducted measurements on smart antenna systems (equipment with multiple receive chains), step 2) shall be repeated for each of the active receive chains, Ach. Sum the measured power (within the observed window) for each of the active receive chains. 4) The value defined in step 3) shall be compared to the limits defined in table 4-5.
Measurement Record:	Uncertainty: ±6dB
Test Instruments:	See section 6.0
Test mode:	Receiving mode

Measurement Data

Frequency (MHz)	Spurious Emission		Limit (dBm)	Test Result
	polarization	Level(dBm)		
45.71	Vertical	-78.66	-57dBm below 1GHz, -47dBm above 1GHz.	Pass
357.63	V	-78.41		
1126.45	V	-57.20		
2780.25	V	-57.75		
4371.18	V	-56.39		
5912.42	V	-55.71		
107.45	Horizontal	-77.72		
479.63	H	-78.11		
1720.38	H	-56.91		
2835.14	H	-58.50		
3756.70	H	-57.27		
4636.81	H	-56.12		

8 Test Setup Photo

Reference to the **appendix I** for details.

9 EUT Constructional Details

Reference to the **appendix II** for details.

------End------