RADIO TEST REPORT

(EN 301 511)

Applicant:	Particle Industries,Inc
Address:	126 Post St,4th floor, San Francisco,CA 94108 USA

Manufacturer or Supplier:	Particle Industries,Inc
Address:	126 Post St,4th floor, San Francisco,CA 94108 USA
Product:	Tracker SoM LTE CAT1/3G/2G
Brand Name:	Particle
Model Name:	T523M/T524M
Date of tests:	May. 21, 2020 ~ Jun. 08, 2020
The tests have been carried out according to the requirements of the following standard:	
☒ **ETSI EN 301 511 V12.5.1 (2017-03)**	
CONCLUSION: The submitted sample was found to COMPLY with the test requirement	

Prepared by Alex Chen Engineer / Mobile Department	Approved by Luke Lu Manager / Mobile Department
Alex Date: Jun. 09, 2020	Luke Lu Date: Jun. 09, 2020

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RELEASE CONTROL RECORD

ISSUE NO.	REASON FOR CHANGE	DATE ISSUED
RE200520W002-1	Original release	Jun. 09, 2020

BV 7Layers Communications Technology (Shenzhen) Co. Ltd

No.B102, Dazu Chuangxin Mansion, North of Beihuan Avenue, North Area, Hi-Tech Industrial Park, Nanshan District, Shenzhen51800, China

Tel: +86 755 8869 6566
Fax: +86 755 8869 6577
Email: customerservice.sw@bureauveritas.com

1 SUMMARY OF TEST RESULTS

The EUT has been tested according to the following specifications:

HARMONIZED STANDARD EN 301 511				TS 151 010-1 clause
TEST CASE	TEST DESCRIPTION	VERDICT		
		GSM 900	GSM 1800	
4.2.16	Radiated spurious emissions - MS allocated channel.	PASS	PASS	12.2.1
	Normal Temperature / Normal Voltage	NA	NA	
	Normal Temperature / Low Voltage	NA	NA	
	Normal Temperature / High Voltage	NA	NA	
4.2.17	Radiated spurious emissions - MS in idle mode.	PASS	PASS	12.2.2
	Normal Temperature / Normal Voltage	NA	NA	
	Normal Temperature / Low Voltage	NA	NA	
	Normal Temperature / High Voltage	NA	NA	

Note：The detail information of the data please refer to the FTA report：R1906A0310-R1

1.1 TEST INSTRUMENTS

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
Signal Pre-Amplifier	EMSI	EMC 02325	980224	Jun. 24,19	Jun. 23,20
Signal Pre-Amplifier	EMSI	EMC 012645B	980258	Jun. 24,19	Jun. 23,20
3m Fully-anechoic Chamber	ETS-LINDGREN	10m*5m*5m	Euroshieldpn-CT0001143-1217	May. 19,20	May. 18,23
RS Antenna_LF	Rohde&Schwarz	R&S® HL046E	HL064E	NA	NA
Horn Antenna	ETS-LINDGREN	3117	00168692	Nov. 24,19	Nov. 23,20
EXA Signal Analyzer	KEYSIGHT	N9010A-544	MY54510355	Jun. 24,19	Jun. 23,20
Radio Communication Analyzer	ANRITSU	MT8820C	6201465425	Mar. 10,20	Mar. 09,21

NOTE:

1. The calibration interval of the above test instruments is 12 months or 36 months and the calibrations are traceable to CEPREI/CHINA, GRGT/CHINA and NIM/CHINA.
2. The test was performed in 3m Fully-anechoic Chamber.
3. The horn antenna is used only for the measurement of emission frequency above 1GHz if tested.

1.2 MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT:

PARAMETER	UNCERTAINTY
Radiated emissions (30MHz~1GHz)	±2.90dB
Radiated emissions (1GHz~18GHz)	±3.02dB
DC and low frequency voltages	±2%

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

2 GENERAL INFORMATION

2.1 GENERAL DESCRIPTION OF EUT

PRODUCT	Tracker SoM LTE CAT1/3G/2G
BRAND NAME	Particle
MODEL NAME	T523M/T524M
NOMINAL VOLTAGE	Li+ PIN: DC +3.3V--4.3V or Vusb PIN: DC +4.35V--5.5V or Vin PIN: DC +3.9V--17V
MODULATION TYPE	**GSM, GPRS, EDGE:** GMSK, 8PSK
OPERATING FREQUENCY	GSM 900 Tx: 880.2MHz ~ 914.8MHz Rx: 925.2MHz ~ 959.8MHz DCS 1800 Tx: 1710.2MHz ~ 1784.8MHz Rx: 1805.2MHz ~ 1879.8MHz
ANTENNA TYPE	External Antenna
MAX. ANTENNA GAIN	**GSM 900:** 1.42dBi
	PCS 1800: 3.77dBi
HW VERSION	V1.0
SW VERSION	V1.5.4
I/O PORTS	Refer to user's manual
CABLE SUPPLIED	N/A

NOTE:

1. For a more detailed features description, please refer to the manufacturer's specifications or the user's manual.
2. The schematic and PCB of the two models T523M and T524M used by our company for the Certification is completely the same ,and the HW&SW used is the same. Because the product is sold in different market using different models eSIM, different models are named. the differences are as follows:T523M uses eSIM of Kore.T524M uses eSIM of Twilio.
3. For the test results, the EUT had been tested with all conditions. But only the worst case was shown in test report.

2.2 CONDUCTED POWER

GSM900 & GSM1800

Band	GSM900			GSM1800		
Channel	975	38	124	512	699	885
Frequency	880.2	897.6	914.8	1710.2	1747.6	1784.8
GPRS (GMSK, 1Tx-slot)	32.08	**32.25**	32.16	28.67	28.95	**29.04**
GPRS (GMSK, 2Tx-slot)	31.34	31.46	31.63	28.34	28.56	28.69
GPRS (GMSK, 3Tx-slot)	29.63	29.29	29.66	26.42	26.67	26.89
GPRS (GMSK, 4Tx-slot)	27.98	28.04	28.26	25.26	25.55	25.67
EDGE (8PSK, 1Tx-slot)	25.37	25.24	25.23	25.04	25.24	25.36
EDGE (8PSK, 2Tx-slot)	24.66	24.59	24.71	23.98	23.26	24.27
EDGE (8PSK, 3Tx-slot)	23.58	23.55	23.64	21.86	22.14	22.26
EDGE (8PSK, 4Tx-slot)	22.44	22.29	22.38	20.75	20.96	20.95

2.3 DESCRIPTION OF TEST MODES

✧ The EUT was tested under following conditions:

✧ BAND	OPERATING CONDITIONS	AXIS
GSM 900	Linking / Idle mode (CH 38)	X-Plane
DCS 1800	Linking / Idle mode (CH 699)	X-Plane

NOTE:

Since the EUT is considered a portable unit, it was pre-tested on the positioned of each 3 axis. Only the worst case was present in this report positioned. Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture), although the BT&WIFI can simultaneously transmit, but has no effect on the RF signal level in spurious emissions test.

✧ The applicant defined the working voltage as follows:

NORMAL VOLTAGE (NV):	5V
MAXIMUM VOLTAGE (NV):	17V
MINIMUM VOLTAGE (NV):	3.9V

2.4 GENERAL DESCRIPTION OF APPLIED STANDARDS

The EUT is a RF product. According to the specifications of the manufacturer, it must comply with the requirements of the following standard:

EN 301 511 V12.5.1 (2017-03)

All tests have been performed and recorded as per the above standard.

2.5 DESCRIPTION OF SUPPORT UNITS

The EUT has been tested as an independent unit together without any other necessary accessories or support units.

For test

NO.	PRODUCT	BRAND	MODEL NO.	SERIAL NO.	FCC ID
1	N/A	N/A	N/A	N/A	N/A

NO.	DESCRIPTION OF THE ABOVE SUPPORT UNITS
1	N/A

2.6 CONFIGURATION OF SYSTEM UNDER TEST

Please see section 5 photograph of the test configuration for reference.

3 TEST TYPES AND RESULTS

3.1 RADIATED SPURIOUS EMISSIONS – MS ALLOCATED A CHANNEL

3.1.1 LIMIT OF RADIATED SPURIOUS EMISSIONS – MS ALLOCATED A CHANNEL

FOR GSM 900

FREQUENCY RANGE	Power level in dBm
30MHz ~ 1GHz	-36
1GHz ~ 4GHz	-30

FOR DCS 1800

FREQUENCY RANGE	Power level in dBm
30MHz ~ 1GHz	-36
1GHz ~ 1710MHz	-30
1710MHz ~ 1785MHz	-36
1785MHz ~ 4GHz	-30

3.1.2 TEST PROCEDURES

Refer to TS 151 010-1, clause 12.2.1.4.

3.1.3 TEST SETUP

For the actual test configuration, please refer to the related Item in this test report (Photographs of the Test Configuration).

3.1.4 DEVIATION FROM TEST STANDARD

No deviation.

3.1.5 TEST RESULTS

Note: For higher frequency, the emission is too low to be detected.

LINKING MODE AT MIDDLE CHANNEL GSM900 (CH 38)

FREQUENCY RANGE	30MHz ~ 4GHz	**TEST VOLTAGE**	230Vac, 50Hz
ENVIRONMENTAL CONDITIONS	23deg.C, 60%RH	**TESTED BY**	Star Le
OPERATING CONDITIONS	Linking mode at middle channel (CH 38)		

SPURIOUS EMISSION LEVEL				
Frequency (MHz)	**Antenna Polarization**	**Level (dBm)**	**Limit (dBm)**	**Margin (dB)**
34.85	H	-74.04	-36.00	-38.04
71.71	H	-75.94	-36.00	-39.94
184.23	H	-88.37	-36.00	-52.37
286.08	H	-86.02	-36.00	-50.02
523.73	H	-86.27	-36.00	-50.27
850.62	H	-83.31	-36.00	-47.31
1795.04	H	-40.51	-30.00	-10.51
2692.02	H	-45.89	-30.00	-15.89
SPURIOUS EMISSION LEVEL				
Frequency (MHz)	**Antenna Polarization**	**Level (dBm)**	**Limit (dBm)**	**Margin (dB)**
49.4	V	-72.8	-36.00	-36.8
74.62	V	-77.6	-36.00	-41.6
159.98	V	-86.33	-36.00	-50.33
291.9	V	-86.77	-36.00	-50.77
532.46	V	-85.31	-36.00	-49.31
850.62	V	-82.81	-36.00	-46.81
1795.5	V	-44.23	-30.00	-14.23
2693.2	V	-51.69	-30.00	-21.69

LINKING MODE AT MIDDLE CHANNEL DCS1800 (CH 699)

FREQUENCY RANGE	30MHz ~ 4GHz	**TEST VOLTAGE**	230Vac, 50Hz
ENVIRONMENTAL CONDITIONS	23deg.C, 60%RH	**TESTED BY**	Star Le
OPERATING CONDITIONS	Linking mode at middle channel (CH 699)		

SPURIOUS EMISSION LEVEL				
Frequency (MHz)	**Antenna Polarization**	**Level (dBm)**	**Limit (dBm)**	**Margin (dB)**
35.82	H	-75.19	-36.00	-39.19
162.89	H	-88.18	-36.00	-52.18
345.25	H	-90.1	-36.00	-54.1
487.84	H	-85.73	-36.00	-49.73
655.65	H	-85.31	-36.00	-49.31
869.05	H	-82.29	-36.00	-46.29
1304.5	H	-58.96	-30.00	-28.96
2638	H	-54.55	-30.00	-24.55
3495.36	H	-41.92	-30.00	-11.92
SPURIOUS EMISSION LEVEL				
Frequency (MHz)	**Antenna Polarization**	**Level (dBm)**	**Limit (dBm)**	**Margin (dB)**
47.46	V	-72.17	-36.00	-36.17
202.66	V	-85.31	-36.00	-49.31
385.02	V	-88.55	-36.00	-52.55
524.7	V	-85.82	-36.00	-49.82
625.58	V	-84.14	-36.00	-48.14
868.08	V	-82.3	-36.00	-46.3
1403.2	V	-59	-30.00	-29
2749.3	V	-53.78	-30.00	-23.78
3495.58	V	-43.6	-30.00	-13.6

3.2 RADIATED SPURIOUS EMISSIONS – MS IN IDLE MODE

3.2.1 LIMIT OF RADIATED SPURIOUS EMISSIONS – MS IN IDLE MODE

FOR GSM 900 & DCS 1800

Frequency Range	Power level in dBm
30MHz ~ 880MHz	-57
880MHz ~ 915MHz	-59
915MHz ~ 1000MHz	-57
1GHz ~ 1710MHz	-47
1710MHz ~ 1785MHz	-53
1785MHz ~ 4GHz	-47

3.2.2 TEST PROCEDURES

Refer to TS 151 010-1 [2], clause 12.2.2.4.

3.2.3 TEST SETUP

For the actual test configuration, please refer to the related Item in this test report (Photographs of the Test Configuration).

3.2.4 DEVIATION FROM TEST STANDARD

No deviation.

3.2.5 TEST RESULTS

Note: For higher frequency, the emission is too low to be detected.

IDLE MODE AT MIDDLE CHANNEL GSM900 (CH 38)

FREQUENCY RANGE	30MHz ~ 4GHz	**TEST VOLTAGE**	230Vac, 50Hz
ENVIRONMENTAL CONDITIONS	23deg.C, 60%RH	**TESTED BY**	Star Le
OPERATING CONDITIONS	Idle mode at middle channel (CH 38)		

SPURIOUS EMISSION LEVEL				
Frequency (MHz)	**Antenna Polarization**	**Level (dBm)**	**Limit (dBm)**	**Margin (dB)**
33.88	H	-75.63	-57.00	-18.63
69.77	H	-77.34	-57.00	-20.34
182.29	H	-86.63	-57.00	-29.63
295.78	H	-87.96	-57.00	-30.96
520.82	H	-85.77	-57.00	-28.77
732.28	H	-85.01	-57.00	-28.01
1945	H	-72.13	-47.00	-25.13
2905	H	-70.25	-47.00	-23.25
SPURIOUS EMISSION LEVEL				
Frequency (MHz)	**Antenna Polarization**	**Level (dBm)**	**Limit (dBm)**	**Margin (dB)**
35.82	V	-73.63	-57.00	-16.63
67.83	V	-82.19	-57.00	-25.19
206.54	V	-87.18	-57.00	-30.18
507.24	V	-86.05	-57.00	-29.05
624.61	V	-84.28	-57.00	-27.28
850.62	V	-82.74	-57.00	-25.74
2215	V	-71.21	-47.00	-24.21
3004	V	-68.42	-47.00	-21.42

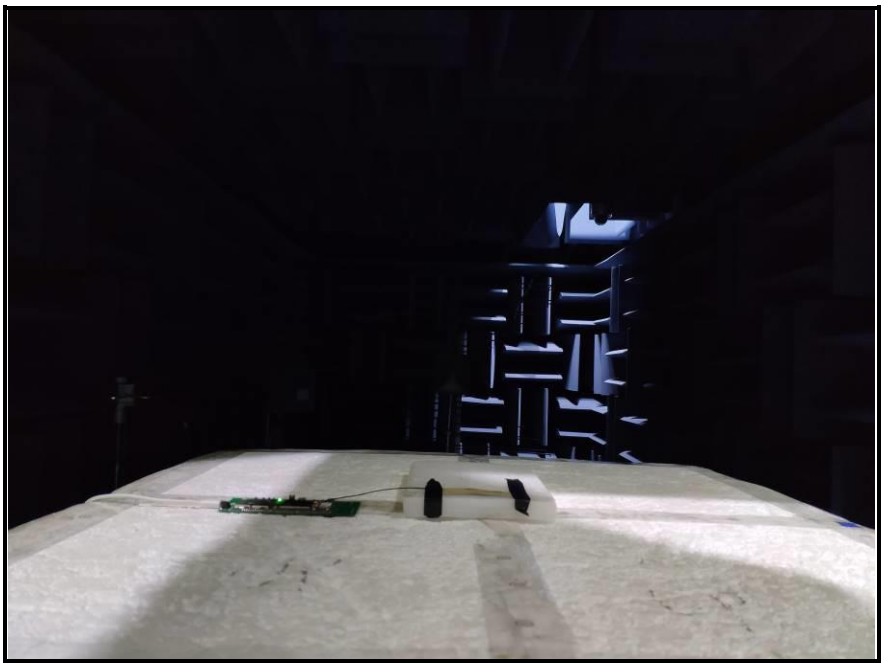
IDLE MODE AT MIDDLE CHANNEL DCS1800 (CH 699)

FREQUENCY RANGE	30MHz ~ 4GHz	**TEST VOLTAGE**	230Vac, 50Hz
ENVIRONMENTAL CONDITIONS	23deg.C, 60%RH	**TESTED BY**	Star Le
OPERATING CONDITIONS	Idle mode at middle channel (CH 699)		

SPURIOUS EMISSION LEVEL				
Frequency (MHz)	**Antenna Polarization**	**Level (dBm)**	**Limit (dBm)**	**Margin (dB)**
35.82	H	-76.3	-57.00	-19.3
73.65	H	-81.49	-57.00	-24.49
190.05	H	-88.39	-57.00	-31.39
310.33	H	-90.44	-57.00	-33.44
564.47	H	-85.81	-57.00	-28.81
750.71	H	-85.15	-57.00	-28.15
2203	H	-71.14	-47.00	-24.14
2929	H	-69.87	-47.00	-22.87
SPURIOUS EMISSION LEVEL				
Frequency (MHz)	**Antenna Polarization**	**Level (dBm)**	**Limit (dBm)**	**Margin (dB)**
47.46	V	-72.99	-57.00	-15.99
75.59	V	-77.18	-57.00	-20.18
160.95	V	-90.7	-57.00	-33.7
351.07	V	-89.29	-57.00	-32.29
507.24	V	-85.91	-57.00	-28.91
710.94	V	-84.54	-57.00	-27.54
2113	V	-71.09	-47.00	-24.09
3109	V	-70.29	-47.00	-23.29

4 PHOTOGRAPHS OF THE TEST CONFIGURATION

TX AND RX SPURIOUS EMISSION（BELOW 1G）



TX AND RX SPURIOUS EMISSION（ABOVE 1G）

5 APPENDIX A – MODIFICATIONS RECORDERS FOR ENGINEERING CHANGES TO THE EUT BY THE LAB

No any modifications were made to the EUT by the lab during the test.

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