

Seven Mile INVESTMENTS DBA ELECTRONIC PRECEPTS

TEST REPORT

SCOPE OF WORK
FCC TESTING-BLE BEACON

REPORT NUMBER
180131007SZN-001

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Seven Mile investments dba Electronic Precepts

Application
For
Certification

FCC ID: 2AO3I-EPBEAC**Bluetooth Low Energy Device****Model: BLE Beacon**

2.4GHz Transceiver

Report No.: 180131007SZN-001

We hereby certify that the sample of the above item is considered to comply with the requirements of FCC Part 15, Subpart C for Intentional Radiator, mention 47 CFR [10-1-16]

Prepared and Checked by:

Approved by:

Sign on file

Surel Guo
Engineer

Kidd Yang
Technical Supervisor
Date: February 12, 2018

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MEASUREMENT/TECHNICAL REPORT**Seven Mile investments dba Electronic Precepts****MODEL: BLE Beacon****Brand Name: ST BlueNRG-1****FCC ID: 2AO3I-EPBEAC**

This report concerns (check one): Original Grant Class II Change

Equipment Type: DXX - Part 15 Low Power Communication Device Transmitter

Deferred grant requested per 47 CFR 0.457(d)(1)(ii)? Yes No

If yes, defer until: _____
date

Company Name agrees to notify the Commission by: _____
date

of the intended date of announcement of the product so that the grant can be issued on that date.

Transition Rules Request per 15.37? Yes No

If no, assumed Part 15, Subpart C for intentional radiator – the new 47 CFR [10-1-16 Edition] provision.

Report prepared by:

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Exhibit type	File Description	Filename
Test Report	Test Report	report.pdf
Test Setup Photo	Radiated Emission	radiated photos.pdf
Test Report	Bandedge Plot	bandedge.pdf
Test Report	20dB BW Plot	bw.pdf
External Photo	External Photo	external photos.pdf
Internal Photo	Internal Photo	internal photos.pdf
Block Diagram	Block Diagram	block.pdf
Schematics	Circuit Diagram	circuit.pdf
Operation Description	Technical Description	descri.pdf
ID Label/Location	Label Artwork and Location	label.pdf
User Manual	User Manual	manual.pdf
Cover Letter	Confidentiality Letter	request.pdf
Cover Letter	Letter of Agency	agency.pdf



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EXHIBIT 1

GENERAL DESCRIPTION

1.0 General Description

1.1 Product Description

The equipment under test (EUT) is a Bluetooth Low Energy Device with Bluetooth function operated at 2.4GHz band. The EUT is powered by DC 3V button battery. For more detail information pls. refer to the user manual.

Bluetooth Version: 4.0 BLE (single mode)

Antenna Type: Integral antenna

Antenna Gain: 5dBi Max

Modulation Type: GFSK

For electronic filing, the brief circuit description is saved with filename: descri.pdf.

1.2 Related Submittal(s) Grants

This is an application for certification of a transceiver for the Bluetooth Low Energy Device BT 4.0 BLE.

1.3 Test Methodology

Radiated emission measurements were performed according to the procedures in ANSI C63.10 (2013). Radiated Emission measurement was performed in a Semi-anechoic chamber. Preliminary scans were performed in the Semi-anechoic chamber only to determine worst case modes. All Radiated tests were performed at an antenna to EUT distance of 3 meters, unless stated otherwise in the "**Justification Section**" of this Application.

1.4 Test Facility

The Semi-anechoic chamber used to collect the radiated data is **Intertek Testing Services Shenzhen Ltd. Longhua Branch** and located at Building B, QiaoAn Scientific Technology Park, Shangkeng Community, GuanHu Subdistrict, Longhua District, Shenzhen, P. R. China. This test facility and site measurement data have been fully placed on file with the FCC (Registration Number: CN1188).

EXHIBIT 2**SYSTEM TEST CONFIGURATION**

2.0 System Test Configuration

2.1 Justification

The system was configured for testing in a typical fashion (as a customer would normally use it), and in the confines as outlined in ANSI C63.10 (2013).

The EUT was powered by DC 3V button battery during the test. Only the worst case data was reported.

For maximizing emissions below 30 MHz, the EUT was rotated through 360°, the centre of the loop antenna was placed 1 meter above the ground, and the antenna polarization was changed. For maximizing emission at and above 30 MHz, the EUT was rotated through 360°, the antenna height was varied from 1 meter to 4 meters above the ground plane, and the antenna polarization was changed. This step by step procedure for maximizing emissions led to the data report in Exhibit 3.0.

The unit was operated standalone and placed in the centre of the turntable.

The equipment under test (EUT) was configured for testing in a typical fashion (as a customer would normally use it). The EUT was mounted to a plastic stand if necessary and placed on the styrene turntable, which enabled the engineer to maximize emissions through its placement in the three orthogonal axes.

2.2 EUT Exercising Software

The EUT exercise program (provided by client) used during testing was designed to exercise the various system components in a manner similar to a typical use.

2.3 Special Accessories

No special accessories used.

2.4 Equipment Modification

Any modifications installed previous to testing by Seven Mile investments dba Electronic Precepts will be incorporated in each production model sold / leased in the United States.

No modifications were installed by Intertek Testing Services Shenzhen Ltd Longhua Branch.

2.5 Measurement Uncertainty

When determining the test conclusion, the Measurement Uncertainty of test has been considered.

2.6 Support Equipment List and Description

Description	Manufacturer	Model No.
iPod (Provided by Intertek)	Apple	A1446



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Test Report

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EXHIBIT 3

EMISSION RESULTS

3.0 Emission Results

Data is included worst-case configuration (the configuration which resulted in the highest emission levels).

3.1 Radiated Test Results

A sample calculation, configuration photographs and data tables of the emissions are included.

3.1.1 Field Strength Calculation

The field strength is calculated by adding the reading on the Spectrum Analyzer to the factors associated with preamplifiers (if any), antennas, cables, pulse desensitization and average factors (when specified limit is in average and measurements are made with peak detectors). A sample calculation is included below.

$$FS = RA + AF + CF - AG$$

Where

FS = Field Strength in $\text{dB}\mu\text{V}/\text{m}$

RA = Receiver Amplitude (including preamplifier) in $\text{dB}\mu\text{V}$

CF = Cable Attenuation Factor in dB

AF = Antenna Factor in dB

AG = Amplifier Gain in dB

In the radiated emission table which follows, the reading shown on the data table may reflect the preamplifier gain. An example of the calculations, where the reading does not reflect the preamplifier gain, follows:

$$FS = RA + AF + CF - AG$$

Assume a receiver reading of 62.0 $\text{dB}\mu\text{V}$ is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted. The net field strength for comparison to the appropriate emission limit is 42 $\text{dB}\mu\text{V}/\text{m}$. This value in $\text{dB}\mu\text{V}/\text{m}$ was converted to its corresponding level in $\mu\text{V}/\text{m}$.

$$RA = 62.0 \text{ dB}\mu\text{V}$$

$$AF = 7.4 \text{ dB}$$

$$CF = 1.6 \text{ dB}$$

$$AG = 29.0 \text{ dB}$$

$$FS = 62 + 7.4 + 1.6 - 29 + 0 = 42 \text{ dB}\mu\text{V}/\text{m}$$

$$\text{Level in } \mu\text{V}/\text{m} = \text{Common Antilogarithm } [(42 \text{ dB}\mu\text{V}/\text{m})/20] = 125.9 \mu\text{V}/\text{m}$$

3.1.2 Radiated Emission Configuration Photograph

For electronic filing, the worst case radiated emission configuration photograph is saved with filename: radiated photos. pdf.

3.1.3 Radiated Emissions

The data on the following page lists the significant emission frequencies, the limit and the margin of compliance. Numbers with a minus sign are below the limit.

Worst Case Radiated Emission
at
31.000 MHz

Judgement: Passed by 16.3 dB

TEST PERSONNEL:

Sign on file

Surel Guo, Engineer
Typed/Printed Name

February 3, 2018
Date

Applicant: Seven Mile investments dba Electronic Precepts
Date of Test: February 3, 2018 Model: BLE Beacon
Worst Case Operating Mode: BT Link

Table 1

Radiated Emissions

Polarization	Frequency (MHz)	Reading (dB μ V)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dB μ V/m)	Limit at 3m (dB μ V/m)	Margin (dB)
Horizontal	32.000	24.2	20.0	16.8	21.0	40.0	-19.0
Horizontal	296.000	23.8	20.0	15.3	19.1	46.0	-26.9
Horizontal	530.000	24.1	20.0	21.9	26.0	46.0	-20.0
Vertical	31.000	26.4	20.0	17.3	23.7	40.0	-16.3
Vertical	37.000	26.1	20.0	14.3	20.4	40.0	-19.6
Vertical	40.000	26.9	20.0	12.8	19.7	40.0	-20.3

NOTES: 1. Quasi-Peak detector is used except for others stated.

2. All measurements were made at 3 meters. Harmonic emissions not detected at the 3-meter distances were measured at 0.3-meter and an inverse proportional extrapolation was performed to compare the signal level to the 3-meter limit. No other harmonic emissions than those reported were detected at a test distance of 0.3-meter.

3. Negative value in the margin column shows emission below limit.

4. All emissions are below the QP limit.

3.1.4 Transmitter Spurious Emissions (Radiated)

Worst Case Radiated Emission
at
2480.000 MHz

For electronic filing, the worst case radiated emission configuration photograph is saved with filename: radiated photos. pdf.

The data on the following page lists the significant emission frequencies, the limit and the margin of compliance. Numbers with a minus sign are below the limit.

Judgement: Passed by 1.7 dB

TEST PERSONNEL:

Sign on file

Surel Guo, Engineer
Typed/Printed Name

February 3, 2018
Date

Applicant: Seven Mile investments dba Electronic Precepts
Date of Test: February 3, 2018 Model: BLE Beacon
Worst Case Operating Mode: Transmitting

Table 2

Radiated Emissions

(2402MHz)

Polarization	Frequency (MHz)	Reading (dB μ V)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dB μ V/m)	Peak Limit at 3m (dB μ V/m)	Margin (dB)
Horizontal	2402.000	101.4	36.7	28.1	92.8	114.0	-21.2
Horizontal	4804.000	54.7	36.7	35.5	53.5	74.0	-20.5
Horizontal	7206.000	54.3	36.1	36.5	54.7	74.0	-19.3
Horizontal	9608.000	55.5	36.2	37.0	56.3	74.0	-17.7

Polarization	Frequency (MHz)	Reading (dB μ V)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dB μ V/m)	Average Limit at 3m (dB μ V/m)	Margin (dB)
Horizontal	2402.000	99.4	36.7	28.1	90.8	94.0	-3.2
Horizontal	4804.000	42.2	36.7	35.5	41.0	54.0	-13.0
Horizontal	7206.000	41.2	36.1	36.5	41.6	54.0	-12.4
Horizontal	9608.000	41.6	36.2	37.0	42.4	54.0	-11.6

Notes:

1. Peak detector is used for the emission measurement (RBW=1MHz / VBW=3MHz for Peak value, and RBW=1MHz / VBW=10Hz for Average value; RBW=3MHz is used for fundamental emission measurement).
2. All measurements were made at 3 meter. Harmonic emissions not detected at the 3-meter distance were measured at 0.3-meter and an inverse proportional extrapolation was performed to compare the signal level to the 3-meter limit. No other harmonic emissions than those reported were detected at a test distance of 0.3-meter.
3. Negative value in the margin column shows emission below limit.
4. Horn antenna is used for the emission over 1000MHz.

Test Engineer: Surel Guo

Applicant: Seven Mile investments dba Electronic Precepts
Date of Test: February 3, 2018 Model: BLE Beacon
Worst Case Operating Mode: Transmitting

Table 3

Radiated Emissions

(2440MHz)

Polarization	Frequency (MHz)	Reading (dB μ V)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dB μ V/m)	Peak Limit at 3m (dB μ V/m)	Margin (dB)
Horizontal	2440.000	102.1	36.7	28.1	93.5	114.0	-20.5
Horizontal	4880.000	55.0	36.7	35.5	53.8	74.0	-20.2
Horizontal	7320.000	53.0	36.1	37.2	54.1	74.0	-19.9
Horizontal	9760.000	55.6	36.2	37.0	56.4	74.0	-17.6

Polarization	Frequency (MHz)	Reading (dB μ V)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dB μ V/m)	Average Limit at 3m (dB μ V/m)	Margin (dB)
Horizontal	2440.000	99.5	36.7	28.1	90.9	94.0	-3.1
Horizontal	4880.000	42.8	36.7	35.5	41.6	54.0	-12.4
Horizontal	7320.000	40.6	36.1	37.2	41.7	54.0	-12.3
Horizontal	9760.000	41.5	36.2	37.0	42.3	54.0	-11.7

Notes:

1. Peak detector is used for the emission measurement (RBW=1MHz / VBW=3MHz for Peak value, and RBW=1MHz / VBW=10Hz for Average value; RBW=3MHz is used for fundamental emission measurement).
2. All measurements were made at 3 meter. Harmonic emissions not detected at the 3-meter distance were measured at 0.3-meter and an inverse proportional extrapolation was performed to compare the signal level to the 3-meter limit. No other harmonic emissions than those reported were detected at a test distance of 0.3-meter.
3. Negative value in the margin column shows emission below limit.
4. Horn antenna is used for the emission over 1000MHz.

Test Engineer: Surel Guo

Applicant: Seven Mile investments dba Electronic Precepts
Date of Test: February 3, 2018 Model: BLE Beacon
Worst Case Operating Mode: Transmitting

Table 4

Radiated Emissions

(2480MHz)

Polarization	Frequency (MHz)	Reading (dB μ V)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dB μ V/m)	Peak Limit at 3m (dB μ V/m)	Margin (dB)
Horizontal	2480.000	102.7	36.7	28.1	94.1	114.0	-19.9
Horizontal	4960.000	56.0	36.7	35.5	54.8	74.0	-19.2
Horizontal	7440.000	54.1	36.1	37.2	55.2	74.0	-18.8
Horizontal	9920.000	54.2	36.3	38.9	56.8	74.0	-17.2

Polarization	Frequency (MHz)	Reading (dB μ V)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dB μ V/m)	Average Limit at 3m (dB μ V/m)	Margin (dB)
Horizontal	2480.000	100.9	36.7	28.1	92.3	94.0	-1.7
Horizontal	4960.000	43.5	36.7	35.5	42.3	54.0	-11.7
Horizontal	7440.000	40.4	36.1	37.2	41.5	54.0	-12.5
Horizontal	9920.000	40.2	36.3	38.9	42.8	54.0	-11.2

Notes: 1. Peak detector is used for the emission measurement (RBW=1MHz / VBW=3MHz for Peak value, and RBW=1MHz / VBW=10Hz for Average value; RBW=3MHz is used for fundamental emission measurement).

2. All measurements were made at 3 meter. Harmonic emissions not detected at the 3-meter distance were measured at 0.3-meter and an inverse proportional extrapolation was performed to compare the signal level to the 3-meter limit. No other harmonic emissions than those reported were detected at a test distance of 0.3-meter.

3. Negative value in the margin column shows emission below limit.

4. Horn antenna is used for the emission over 1000MHz.

Test Engineer: Surel Guo

EXHIBIT 4**EQUIPMENT PHOTOGRAPHS**

4.0 Equipment Photographs

For electronic filing, the photographs of the tested EUT are saved with filename: external photos.pdf & internal photos.pdf.

EXHIBIT 5**PRODUCT LABELLING**

5.0 Product Labelling

For electronic filing, the FCC ID label artwork and the label location are saved with filename: label.pdf.



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Test Report

Intertek Report No.: 180131007SZN-001

EXHIBIT 6

TECHNICAL SPECIFICATIONS

6.0 Technical Specifications

For electronic filing, the block diagram and schematics of the tested EUT are saved with filename: block.pdf and circuit.pdf respectively.



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Test Report

Intertek Report No.: 180131007SZN-001

EXHIBIT 7

INSTRUCTION MANUAL

7.0 Instruction Manual

For electronic filing, a preliminary copy of the Instruction Manual is saved with filename: manual.pdf.

This manual will be provided to the end-user with each unit sold/leased in the United States.



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EXHIBIT 8

MISCELLANEOUS INFORMATION

8.0 Miscellaneous Information

This miscellaneous information includes details of the measured bandedge, the test procedure and calculation of factor such as pulse desensitization.

8.1 Bandedge Plot

For electronic filing, the plot shows the fundamental emission when modulated is saved with filename: bandedge.pdf. From the plot, the field strength of any emissions outside of the specified frequency band are attenuated to the general radiated emission limits in section 15.209. It fulfills the requirement of 15.249(d).

Peak Measurement

Bandedge compliance is determined by applying marker-delta method, i.e (Bandedge Plot).

(i) Lower channel 2402MHz:

Peak Resultant field strength = Fundamental emissions (peak value) – delta from the bandedge plot

$$\begin{aligned} &= 92.8 \text{ dB}\mu\text{v/m} - 41.4 \text{ dB} \\ &= 51.4 \text{ dB}\mu\text{v/m} \end{aligned}$$

Average Resultant field strength = Fundamental emissions (Average value) – delta from the bandedge plot

$$\begin{aligned} &= 90.8 \text{ dB}\mu\text{v/m} - 41.4 \text{ dB} \\ &= 49.4 \text{ dB}\mu\text{v/m} \end{aligned}$$

(ii) Upper channel 2480MHz:

Peak Resultant field strength = Fundamental emissions (peak value) – delta from the bandedge plot

$$\begin{aligned} &= 94.1 \text{ dB}\mu\text{v/m} - 46.8 \text{ dB} \\ &= 47.3 \text{ dB}\mu\text{v/m} \end{aligned}$$

Average Resultant field strength = Fundamental emissions (Average value) – delta from the bandedge plot

$$\begin{aligned} &= 92.3 \text{ dB}\mu\text{v/m} - 46.8 \text{ dB} \\ &= 45.5 \text{ dB}\mu\text{v/m} \end{aligned}$$

The resultant field strength meets the general radiated emission limit in section 15.209, which does not exceed 74dB μ v/m (Peak Limit) and 54dB μ v/m (Average Limit).

8.1 Bandedge Plot (cont'd)

Pursuant to FCC part 15 Section 15.215(c), the 20dB bandwidth of the emission was contained within the frequency band designated (mentioned as above) which the EUT operated. The effects, if any, from frequency sweeping, frequency hopping, other modulation techniques and frequency stability over excepted variations in temperature and supply voltage were considered.

Figure 8.1 Bandwidth

8.2 Discussion of Pulse Desensitization

Pulse desensitivity is not applicable for this device since the transmitter transmits the RF signal continuously.

8.3 Transmitter Duty Cycle Calculation, FCC Rule 15.35(b, c)

The EUT antenna output port was connected to the input of the spectrum analyzer. The analyzer center frequency was set to EUT RF channel carrier. The SWEP function on the analyzer was set to ZERO SPAN. The Transmitter ON time was determined from the resultant time-amplitude display:

	See attached spectrum analyzer chart (s) for Transmitter timing
	See Transmitter timing diagram provided by manufacturer
x	Not applicable, duty cycle was not used.

8.4 Emissions Test Procedures

The following is a description of the test procedure used by Intertek Testing Services in the measurements of transmitters operating under Part 15, Subpart C rules.

The test set-up and procedures described below are designed to meet the requirements of ANSI C63.10 – 2013.

The transmitting equipment under test (EUT) is placed on a styrene turntable which is four feet in diameter and approximately 0.8 meter up to 1GHz and 1.5 meter above 1GHz in height above the ground plane. During the radiated emissions test, the turntable is rotated and any cables leaving the EUT are manipulated to find the configuration resulting in maximum emissions. The EUT is adjusted through all three orthogonal axes to obtain maximum emission levels. The antenna height and polarization are varied during the testing to search for maximum signal levels.

Detector function for radiated emissions is in peak mode. Average readings, when required, are taken by measuring the duty cycle of the equipment under test and subtracting the corresponding amount in dB from the measured peak readings.

The frequency range scanned is from the lowest radio frequency signal generated in the device which is greater than 9 kHz to the tenth harmonic of the highest fundamental frequency or 40 GHz, whichever is lower.

Detector function for conducted emissions is in QP & AV mode and IFBW setting is 9 kHz from the frequency band 150 kHz to 30MHz.

8.4 Emissions Test Procedures (cont'd)

The EUT is warmed up for 15 minutes prior to the test.

AC power to the unit is varied from 85% to 115% nominal and variation in the fundamental emission field strength is recorded. If battery powered, a new, fully charged battery is used.

Conducted measurements are made as described in ANSI C63.10 - 2013.

The IF bandwidth used for measurement of radiated signal strength was 10 kHz for emission below 30 MHz and 120 kHz for emission from 30 MHz to 1000 MHz. Where pulsed transmissions of short enough pulse duration warrant, a greater bandwidth is selected according to the recommendations of Hewlett Packard Application Note 150-2. Above 1000 MHz, a resolution bandwidth of 1 MHz (RBW 3MHz for fundamental emission) is used.

Transmitter measurements are normally conducted at a measurement distance of three meters. However, to assure low enough noise floor in the restricted bands and above 1 GHz, signals are acquired at a distance of one meter or less. All measurements are extrapolated to three meters using inverse scaling, but those measurements taken at a closer distance are so marked.

EXHIBIT 9**CONFIDENTIALITY REQUEST**

9.0 Confidentiality Request

For electronic filing, the confidentiality request of the tested EUT is saved with filename: request.pdf.



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Test Report

Intertek Report No.: 180131007SZN-001

EXHIBIT10

TEST EQUIPMENT LIST

10.0 Test Equipment List

Equipment No.	Equipment	Manufacturer	Model No.	Serial No.	Cal. Date	Due Date
SZ061-12	BiConiLog Antenna	ETS	3142E	00166158	20-Sep-17	20-Sep-18
SZ185-01	EMI Receiver	R&S	ESCI	100547	09-Feb-17	09-Feb-18
SZ061-07	Pyramidal Horn Antenna	ETS	3160-09	00083067	16-Mar-17	16-Mar-18
SZ061-08	Horn Antenna	ETS	3115	00092346	20-Sep-17	20-Sep-18
SZ061-06	Active Loop Antenna	Electro-Metrics	EM-6876	217	26-May-17	26-May-18
SZ056-06	Signal Analyzer	R&S	FSV 40	101101	07-Jul-17	07-Jul-18
SZ181-04	Preamplifier	Agilent	8449B	3008A02474	09-Feb-17	09-Feb-18
SZ188-01	Anechoic Chamber	ETS	RFD-F/A-100	4102	16-Jan-17	16-Jan-19
SZ062-02	RF Cable	RADIALL	RG 213U	--	10-Jan-18	10-Jul-18
SZ062-05	RF Cable	RADIALL	0.04-26.5GHz	--	11-Sep-17	11-Mar-18
SZ062-12	RF Cable	RADIALL	0.04-26.5GHz	--	11-Sep-17	11-Mar-18
SZ067-04	Notch Filter	Micro-Tronics	BRM5070 2-02	--	14-Jun-17	14-Jun-18