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TEST REPORT

Report Reference No. ..... :	**CHTW24070094**	Report verification:
Project No. ……..……:	**SHT2407005804W**	
FCC ID ..... :	**K6630653Y3D**	
Applicant's name ..... :	**YAESU MUSEN CO., LTD.**	
Address.....:	Omori Bellport D building 3F, 6-26-3 Minamioi, Shinagawa-ku, Tokyo 140-0013 Japan	
Product name ..... :	**VHF FM Marine Transceiver**	
Trade Mark .....:	Standard Horizon	
Model No. .....:	GX1410GPS	
Listed Model(s) .....:	GX1410	
Standard ..... :	**FCC CFR Title 47 Part 80**	
Date of receipt of test sample……..:	Jul.09, 2024	
Date of testing……..……:	Jul.10, 2024 - Jul.22, 2024	
Date of issue……...:	Jul.23, 2024	
Result.....……..:	**PASS**	

Compiled by (position+printed name+signature)...:	File administrators Caspar Chen	Caspar Chen
Supervised by (position+printed name+signature)...:	Project Engineer Caspar Chen	Caspar Chen
Approved by (position+printed name+signature)...:	RF Manager Xu yang	Xu Yang

Testing Laboratory Name ..... :	**Shenzhen Huatongwei International Inspection Co., Ltd.**
Address.....:	Building 7, Baiwang Idea Factory, No.1051, Songbai Road, Yangguang Community, Xili Subdistrict, Nanshan District, Shenzhen, Guangdong, China

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1. TEST STANDARDS AND REPORT VERSION

1.1. Test Standards

The tests were performed according to following standards:

FCC Rules Part 2: Frequency allocations and radio treaty matters; General rules and regulations

FCC Rules Part 80: Stations In The Maritime Services.

ANSI C63.26-2015: American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services

ANSI/TIA-603-E-2016: Land Mobile FM or PM Communications Equipment and Performance Standards

ANSI C63.4-2014: American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz

1.2. Report version information

Revision No.	Date of issue	Description
N/A	2024-07-23	Original

2. TEST DESCRIPTION

Section	Test item	Standards requirement	Result	Test Engineer
5.1	Conducted Carrier Output Power	FCC Part 80.215, FCC Part 2.1046	Pass	Xiangyu Wei
5.2	99% Occupied Bandwidth&26dB bandwidth	FCC Part 80.205, FCC Part 2.1049	Pass	Xiangyu Wei
5.3	Emission Mask	FCC Part 80.211(f), FCC Part 2.1049	Pass	Xiangyu Wei
5.4	Modulation Limit	FCC Part 80.213, FCC Part 2.1047(b)	Pass	Xiangyu Wei
5.5	Audio Frequency Response	FCC Part 2.1047(a)	Pass	Xiangyu Wei
5.6	Audio Low Pass Filter Response	FCC Part 80.213, Part 2.1047(a)	Pass	Xiangyu Wei
5.7	Frequency Stability V.S. Temperature	FCC Part 80.209, Part 2.1055	Pass	Xiangyu Wei
5.8	Frequency Stability V.S. Voltage	FCC Part 80.209, Part 2.1055	Pass	Xiangyu Wei
5.9	Transmit Conducted Spurious Emission	FCC Part 80. 211(f)(3), FCC Part 2.1051	Pass	Xiangyu Wei
5.10	Transmitter Radiated Spurious Emission	FCC Part 80. 211(f)(3), FCC Part 2.1053	Pass	Yifan Wang

Note:

The measurement uncertainty is not included in the test result.

3. SUMMARY

3.1. Client information

Applicant:	YAESU MUSEN CO., LTD.
Address:	Omori Bellport D building 3F, 6-26-3 Minamioi, Shinagawa-ku, Tokyo 140-0013 Japan
Manufacturer:	YAESU MUSEN CO.,LTD.
Address:	43 Utsuroda, Morijuku, Sukagawa-shi,Fukushima 962-0001 Japan

3.2. Product description

Main unit information:	
Name of EUT:	VHF FM Marine Transceiver
Trade mark:	Standard Horizon
Mode No.:	GX1410GPS
Listed Model(s):	GX1410
Power supply:	DC 13.8V
Hardware Version:	N/A
Software Version:	N/A

3.3. Radio Specification Description *1

Device type:	☐ Portable ☒ Mobile
Operation Frequency Range:	TX:156.025MHz to 157.425MHz RX:156.050MHz to 162.000MHz
Support type:	Analog
Modulation type:	FM
Channel Separation:	25kHz
Emission Designator*2:	16K0G3E
Rated power class:	☒ High Power: 25W ☒ Low Power: 1W

Note:

(1) *1 This information is provided by this applicant.

(2) *2 According to FCC Part 2.202 requirements, the Necessary Bandwidth is calculated as follows:

- For PM Voice Modulation

  Channel Spacing = 25 KHz, D = 5 KHz max, K = 1, M = 3 KHz

  Bn = 2M + 2DK = 2*3 + 2*5*1 = **16 KHz**

  Emission designation: 16K0G3E

3.4. Testing laboratory information

Laboratory Name	Shenzhen Huatongwei International Inspection Co., Ltd.	
Laboratory Location	Building 7, Baiwang Idea Factory, No.1051, Songbai Road, Yangguang Community, Xili Subdistrict, Nanshan District, Shenzhen, Guangdong, China	
Connect information:	Tel: 86-755-26715499 E-mail: cs@szhtw.com.cn http://www.szhtw.com.cn	
Qualifications	Type	Accreditation Number
	FCC Registration Number	762235
	FCC Designation Number	CN1181

4. TEST CONFIGURATION

4.1. Test frequency list

According to ANSI C63.26 section 5.1.2.1:

Measurements of transmitters shall be performed and, if required, reported for each frequency band in which the EUT can be operated with the device transmitting at the number of frequencies in each band specified in Table 2.

Frequency range over which EUT operates	Number of frequencies	Location in frequency range of operation
1 MHz or less	1	Middle
1 MHz to 10 MHz	2	1 near top and 1 near bottom
More than 10 MHz	3	1 near top, 1 near middle, and 1 near bottom

Mode	Modulation	Operation Frequency Range	Test Frequency (MHz)	
Analog	FM	Tx: 156.025MHz to 157.425MHz Rx: 156.050MHz to 162.000MHz	CH_L	Tx: 156.025(CH60) Rx: 156.050(CH1001)
			CH_M	Tx: 156.800(CH16) Rx: 156.800(CH16)
			CH_H	Tx: 157.425(CH88) Rx: 162.000(CH28)

4.2. EUT operation mode

Test mode	Transmitting	Power level	
		High	Low
TX-AWH	√	√	
TX-AWL	√		√

√: is operation mode.

Modulation Type	Description
UM	Un-modulation
AM2	Apply a 1000 Hz tone and adjust the audio frequency generator to produce 20% of the rated system deviation.
AM6	Apply a 1000 Hz modulating signal to the transmitter from the audio frequency generator, and adjust the level to obtain 60% of full rated system deviation, then increase the level from the audio generator by 20 dB
AM5	Modulate the transmitter with a 2500 Hz sine wave at an input level 16 dB greater than that necessary to produce 50% of rated system deviation.
DM	A 511 bit binary pseudo-random bit sequence based on ITU-T Rec. O.153

Pre-scan above all test mode, found below test mode which it was worse case mode, so only show the test data for worse case mode on the test report.

Test item	Modulation Type	Test mode (Worse case mode)
Conducted Output Power	UM	TX-AWH, TX-AWL
99% Occupied Bandwidth & 26dB bandwidth	AM6, DM	TX-AWH, TX-AWL
Emission Mask	AM5, DM	TX-AWH, TX-AWL
Modulation Limit	AM6	TX-AWH
Audio Frequency Response	AM2	TX-AWH
Audio Frequency Response	AM2	TX-AWH

Frequency Stability VS Temperature	UM	TX-AWH, TX-AWL
Frequency Stability VS Voltage	UM	TX-AWH, TX-AWL
Transmit Conducted Spurious Emission	AM5, DM	TX-AWH
Transmit Radiated Spurious Emission	AM5, DM	TX-AWH

4.3. Support unit used in test configuration and system

The EUT has been associated with peripherals and configuration operated in a manner tended to maximize its emission characteristics in a typical application.

The following peripheral devices and interface cables were connected during the measurement:

Whether support unit is used?			
✓ No			
Item	Equipment	Trade Name	Model No.
1			
2			

4.4. Environmental conditions

Type	Requirement	Actual
Temperature:	15~35°C	25°C
Relative Humidity:	25~75%	50%
Air Pressure:	860~1060mbar	1000mbar
Test voltage:	Normal voltage:	DC 13.8V
	Extreme lower voltage:	DC 10.8V
	Extreme upper voltage:	DC 15.6V

4.5. Measurement uncertainty

Test Item	Measurement Uncertainty
Frequency stability	25 Hz
Carrier output power (ERP)	2.20 dB
Occupied Bandwidth	35 Hz
Modulation Limiting	0.42 %
FM deviation	25 Hz
Audio level	0.62 dB
Radiated Spurious Emission 30~1000MHz	4.65 dB
Radiated Spurious Emission 1~18GHz	5.16 dB

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=1.96.

4.6. Equipments Used during the Test

● RF Conducted test item							
Used	Test Equipment	Manufacturer	Equipment No.	Model No.	Serial No.	Last Cal. Date (YY-MM-DD)	Next Cal. Date (YY-MM-DD)
●	Spectrum Analyzer	Agilent	HTWE0286	N9020A	MY50510187	2023/08/22	2024/08/21
●	Signal & Spectrum Analyzer	R&S	HTWE0262	FSW26	103440	2023/08/22	2024/08/21
●	RF Communication Test Set	HP	HTWE0038	8920A	3813A10206	2023/08/22	2024/08/21
●	Digital intercom communication tester	Aeroflex	HTWE0255	3920B	1001682041	2023/08/22	2024/08/21
●	RF Control Unit	Tonscend	HTWE0294	JS0806-2	N/A	2023/08/22	2024/08/21
●	Filter-VHF	Microwave	HTWE0309	N26460M1	498702	2023/08/22	2024/08/21
●	Filter-UHF	Microwave	HTWE0311	N25155M2	498704	2023/08/22	2024/08/21
●	Attenuator	JFW	HTWE0292	50FH-030-100	N/A	2024/03/26	2025/03/25
●	Attenuator	Eastsheep	HTWE0387	NCP-20-3-100W	/	2024/03/26	2025/03/25
●	Attenuator	Eastsheep	HTWE0388	NCP-10-3-100W	/	2024/03/26	2025/03/25
●	High Pass Filter	RFSYS	HTWE0390-05	RFSYS-GTA10	200615-1-04	2024/03/26	2025/03/25
●	Filter-UHF	Microwave	HTWE0310	N26460M1	498703 DC1808	2024/01/23	2025/01/22
●	Filter-VHF	Microwave	HTWE0312	N25155M2	498704 DC1808	2024/01/23	2025/01/22
●	Test software	HTW	N/A	Radio ATE	N/A	N/A	N/A

● Auxiliary Equipment							
Used	Test Equipment	Manufacturer	Equipment No.	Model No.	Serial No.	Last Cal. Date (YY-MM-DD)	Next Cal. Date (YY-MM-DD)
●	Climate chamber	ESPEC	HTWS0715	GPL-2	N/A	2023/08/21	2024/08/20
●	DC Power Supply	Gwinstek	HTWE0274	SPS-2415	GER835793	N/A	N/A

● Radiated Spurious Emission							
Used	Test Equipment	Manufacturer	Equipment No.	Model No.	Serial No.	Last Cal. Date (YY-MM-DD)	Next Cal. Date (YY-MM-DD)
●	Semi-Anechoic Chamber	Albatross projects	HTWE0122	SAC-3m-01	C11121	2023/04/17	2026/04/16
●	Spectrum Analyzer	R&S	HTWE0098	FSP40	100597	2023/08/22	2024/08/21
●	Spectrum Analyzer	R&S	HTWE0385	N9020A	MY54486658	2023/08/22	2024/08/21
●	Ultra-Broadband Antenna	SCHWARZBECK	HTWE0123	VULB9163	538	2024/04/08	2027/04/07
●	Horn Antenna	SCHWARZBECK	HTWE0126	BBHA 9120D	1011	2023/02/14	2026/02/13
●	Pre-Amplifer	CD	HTWE0071	PAP-0102	12004	2024/6/6	2025/6/5
●	Broadband Pre-amplifier	SCHWARZBECK	HTWE0551	SCU18F	100855	2024/6/6	2025/6/5
●	Test Software	Audix	N/A	E3	N/A	N/A	N/A

● Auxiliary Equipment							
Used	Test Equipment	Manufacturer	Equipment No.	Model No.	Serial No.	Last Cal. Date (YY-MM-DD)	Next Cal. Date (YY-MM-DD)
●	High pass filter	Wainwright	HTWE0297	WHKX3.0/18G-10SS	38	2024/03/26	2025/03/25
○	Band Stop filter	-	HTWE0039	N/A	N/A	2024/01/23	2025/01/22

5. TEST CONDITIONS AND RESULTS

5.1. Conducted Carrier Output Power

LIMIT

FCC Part 80.215(c)

(c) Coast station frequencies above 27500kHz. The maximum power must not exceed the values listed below. Maximum authorized power at the input terminals of the station antenna

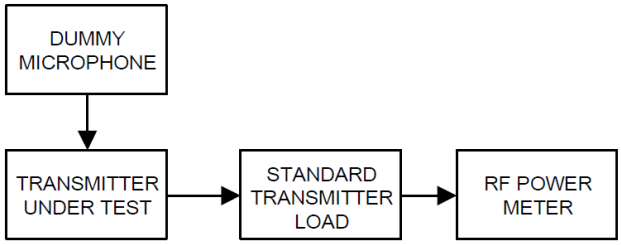
(1) Coast stations:

156-162MHz-50W

(2) Marine utility stations:

156-162MHz—10W

TEST CONFIGURATION



TEST PROCEDURE

(1) Connect the equipment as illustrated

(2) Correct for all losses in the RF path

(3) Measure the transmitter output power

(4) If the power output is adjustable, measurements shall be made for the highest and lowest power levels.

TEST MODE

Refer to the section 4.2

TEST RESULT

☒ **Passed** ☐ **Not Applicable**

TEST DATA

Refer to the appendix report on section 8

5.2. 99% Occupied Bandwidth & 26dB Bandwidth

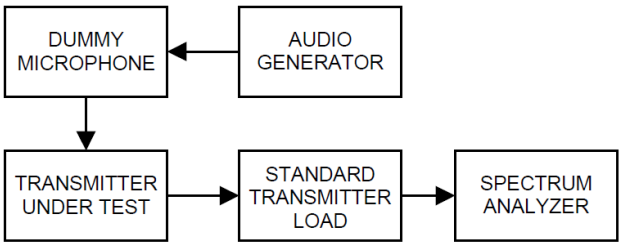
LIMIT

FCC Part 80.205

(a) An emission designator shows the necessary bandwidth for each class of emission of a station except that in ship earth stations it shows the occupied or necessary bandwidth, whichever is greater. The following table gives the class of emission and corresponding emission designator and authorized bandwidth:

Class of emission	Emission designator	Authorized bandwidth (kHz)
A1A	160HA1A	0.4
A1B[1]	160HA1B	0.4
A1D[12]	16K0A1D	20.0
A2A	2K66A2A	2.8
A2B[1]	2K66A2B	2.8
A2D[12]	16K0A2D	20.0
A3E	6K00A3E	8.0
A3N[2]	2K66A3N	2.8
A3X[3]	3K20A3X	25.0
F1B[4]	280HF1B	0.3
F1B[5]	300HF1B	0.5
F1B[6]	16KOF1B	20.0
F1C	2K80F1C	3.0
F1D[12]	16K0F1D	20.0
F2B[6]	16KOF2B	20.0
F2C[7]	16KOF2C	20.0
F2D[12]	16K0F2D	20.0
F3C	2K80F3C	3.0
F3C[7]	16KOF3C	20.0
F3E[8]	16KOF3E	20.0
F3N[9]	20MOF3N	20,000.0
G1D[12]	16K0G1D	20.0
G2D[12]	16K0G2D	20.0
G3D[10]	16KOG3D	20.0
G3E[8]	16KOG3E	20.0
G3N[3 13]	16KOG3N	20.0
H2A	1K40H2A	2.8
H2B[1]	1K40H2B	2.8
H3E[11]	2K80H3E	3.0
H3N	2K66H3N	2.8
J2A	160HJ2A	0.4
J2B[4]	280HJ2B	0.3
J2B[5]	300HJ2B	0.5
J2B	2K80J2B	3.0
J2C	2K80J2C	3.0
J2D[14]	2K80J2D	3.0
J3C	2K80J3C	3.0
J3E[11]	2K80J3E	3.0
J3N	160HJ3N	0.4
NON	NON	0.4
PON	([12])	([12])
R3E[11]	2K80R3E	3.0

TEST CONFIGURATION



TEST PROCEDURE

(1) Connect the equipment as illustrated

(2) Spectrum set as follow:

Centre frequency = the nominal EUT channel center frequency,

The frequency span for the spectrum analyzer shall be set wide enough to capture all modulation products including the emission skirts (typically a span of 1.5 × OBW is sufficient)

RBW = 1% to 5% of the anticipated OBW, VBW ≥ 3 × RBW, Sweep = auto,

Detector function = peak, Trace = max hold

(3) Set 99% Occupied Bandwidth and 26dB Bandwidth

(4) Measure and record the results in the test report.

TEST MODE

Refer to the section 4.2

TEST RESULT

☒ **Passed** ☐ **Not Applicable**

TEST DATA

Refer to the appendix report on section 8

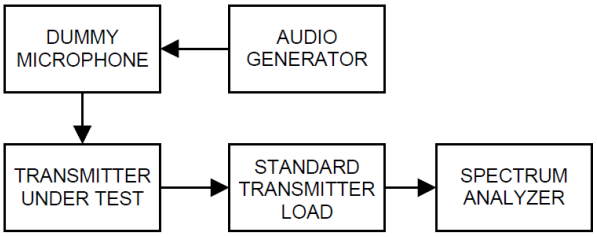
5.3. Emission Mask

LIMIT

FCC Part 80.211

(f) The mean power when using emissions other than those in paragraphs (a), (b), (c) and (d) of this section:
(1) On any frequency removed from the assigned frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth: At least 25 dB;
(2) On any frequency removed from the assigned frequency by more than 100 percent up to and including 250 percent of the authorized bandwidth: At least 35 dB; and
(3) On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43 plus 10log10 (mean power in watts) dB.

TEST CONFIGURATION



TEST PROCEDURE

1) Connect the equipment as illustrated.
2) Spectrum set as follow:
   Centre frequency= fundamental frequency,span=120kHz ,RBW=300Hz,VBW=1000Hz,Sweep= auto, Detector function=peak,Trace=max hold.
3) Key the transmitter, and set the level of the unmodulated carrier to a full scale reference line. This is the 0dB reference for the measurement.
4) Apply Input Modulation Signal to EUT according to Section 3.4
5) Measure and record the results in the test report.

TEST MODE

Refer to the section 4.2

TEST RESULT

☒ **Passed** ☐ **Not Applicable**

TEST DATA

Refer to the appendix report on section 8

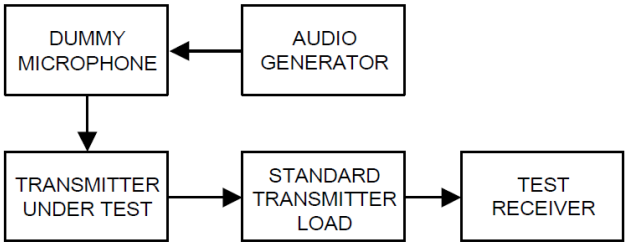
5.4. Modulation Limit

LIMIT

FCC Part 2.1047(b),FCC Part 80.213(d)

Ship and coast station transmitters operating in the 156-162 MHz and 216-220 bands must be capable of proper operation with a frequency deviation that does not exceed ±5 kHz when using any emission authorized by §80.207.

TEST CONFIGURATION



TEST PROCEDURE

1) Connect the equipment as illustrated.
2) Adjust the transmitter per the manufacturer's procedure for full rated system deviation.
3) Set the test receiver to measure peak positive deviation. Set the audio bandwidth for ≤0.25 Hz to ≥15,000 Hz. Turn the de-emphasis function off.
4) Apply Input Modulation Signal to EUT according to Section 3.4 and vary the input level from –20 to +20dB.
5) Measure both the instantaneous and steady-state deviation at and after the time of increasing the audio input level
6) Repeat step 4-5 with input frequency changing to 300Hz,1004Hz,1500Hz and 2500Hz in sequence.

TEST MODE

Refer to the section 4.2

TEST RESULT

☒ **Passed** ☐ **Not Applicable**

TEST DATA

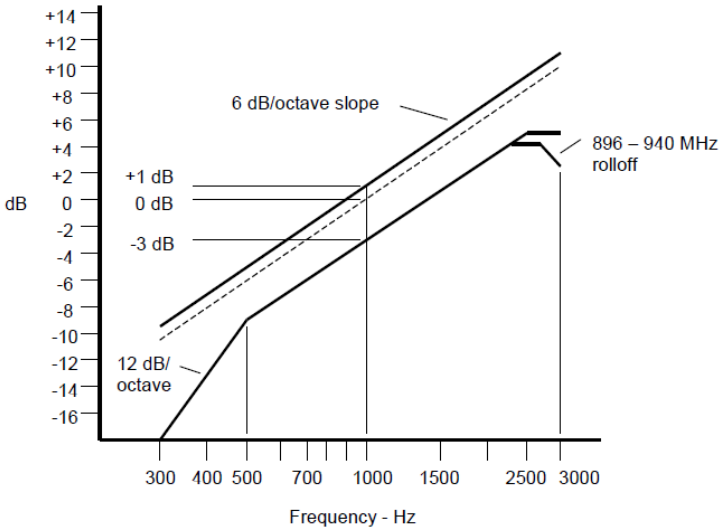
Refer to the appendix report on section 8

5.5. Audio Frequency Response

LIMIT

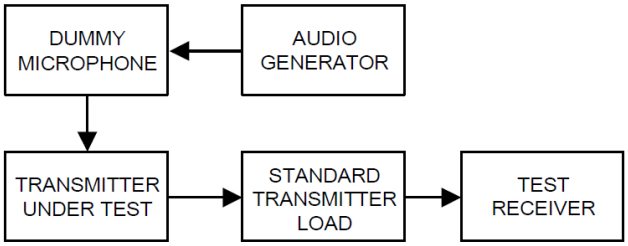
FCC Part 2.1047(a):

Voice modulated communication equipment. A curve or equivalent data showing the frequency response of the audio modulating circuit over a range of 100 to 5000 Hz shall be submitted. For equipment required to have an audio low-pass filter, a curve showing the frequency response of the filter or of all circuitry installed between the modulation limiter and the modulated stage shall be submitted.



An additional 6 dB per octave attenuation is allowed from 2500 Hz to 3000 Hz in equipment operating in the 25 MHz to 869 MHz range.

TEST CONFIGURATION



TEST PROCEDURE

1) Connect the equipment as illustrated.
2) Set the test receiver to measure peak positive deviation. Set the audio bandwidth for 50 Hz to 15,000 Hz. Turn the de-emphasis function off.
3) Set the DMM to measure rms voltage.
4) Adjust the transmitter per the manufacturer's procedure for full rated system deviation.
5) Apply Input Modulation Signal to EUT according to Section 3.4
6) Set the test receiver to measure rms deviation and record the deviation reading.
7) Record the DMM reading as V_{REF} .
8) Set the audio frequency generator to the desired test frequency between 300 Hz and 3000 Hz.
9) Vary the audio frequency generator output level until the deviation reading that was recorded in step 6) is obtained.
10) Record the DMM reading as V_{FREQ}
11) Calculate the audio frequency response at the present frequency as:
audio frequency response=$20\log_{10}$ (V_{FREQ}/V_{REF}).
12) Repeat steps 8) through 11) for all the desired test frequencies

TEST MODE

Refer to the section 4.2

TEST RESULT

☒ **Passed** ☐ **Not Applicable**

TEST DATA

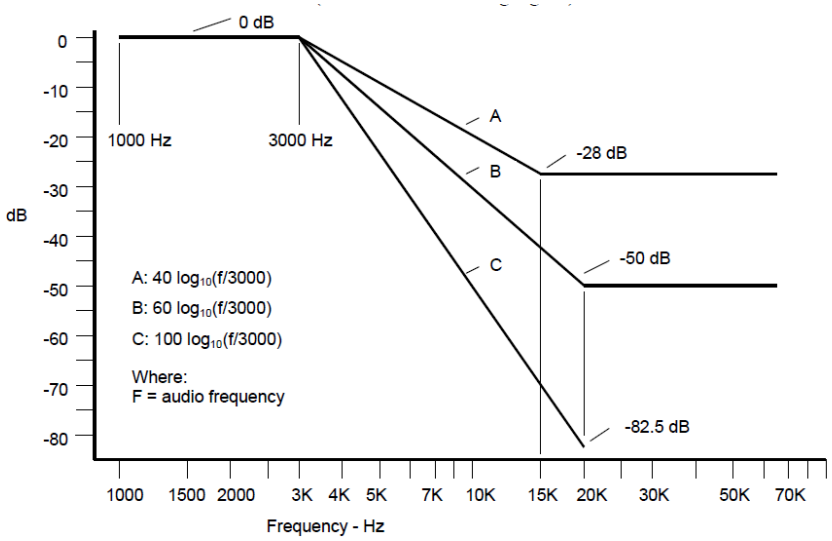
Refer to the appendix report on section 8

5.6. Audio Low Pass Filter Response

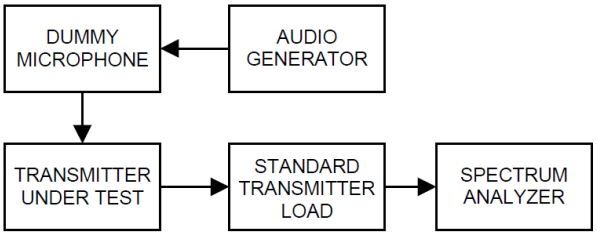
LIMIT

FCC Part 2.1047(b),FCC Part 80.213(e)

Coast station transmitters operated in the 156-162 MHz band must be equipped with an audio low-pass filter. The filter must be installed between the modulation limiter and the modulated radio frequency stage. At frequencies between 3 kHz and 20 kHz it must have an attenuation greater than at 1 kHz by at least 60log10(f/3) dB where “f” is the audio frequency in kilohertz. At frequencies above 20 kHz the attenuation must be at least 50 dB greater than at 1 kHz.



TEST CONFIGURATION



TEST PROCEDURE

1) Configure the EUT as shown in figure .
2) Apply a 1000 Hz tone from the audio signal generator and adjust the level per manufacturer’s specifications. Record the dB level of the 1000 Hz tone as LEV_{REF}.
3) Set the audio signal generator to the desired test frequency between 3000 Hz and the upper low pass filter limit. Record the dB level at the test frequency as $LEV_{FREQ.}$
4) Calculate the audio frequency response at the test frequency as:
   low pass filter response = LEV_{FREQ} - LEV_{REF}

TEST MODE

Refer to the section 4.2

TEST RESULT

☒ **Passed** ☐ **Not Applicable**

TEST DATA

Refer to the appendix report on section 8

5.7. Frequency stability VS Temperature

LIMIT

FCC Part 80.209(a):

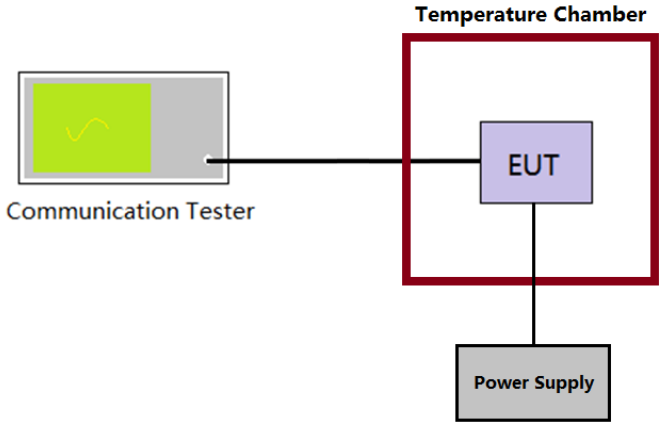
The frequency tolerance requirements applicable to transmitters in the maritime services are shown in the following table. Tolerances are given as parts in 10^6 unless shown in Hz.

Frequency bands and categories of stations	Tolerances[1]
(5) Band 156-162 MHz:	
(i) Coast stations:	
For carriers licensed to operate with a carrier power:	
Below 3 watts	10.
3 to 100 watts	5.[7]
(ii) Ship stations	10.[4]
(iii) Survival craft stations operating on 121.500 MHz	50.
(iv) EPIRBs:	
Operating on 121.500 and 243.000 MHz	50.
Operating on 156.750 and 156.800 MHz.[6]	10.
(6) Band 216-220 MHz:	
(i) Coast stations:	
For all emissions	5.
(ii) Ship stations:	
For all emissions	5.
(7) Band 400-466 MHz:	
(i) EPIRBs operating on 406-406.1 MHz	5.
(ii) On-board stations	5.
(iii) Radiolocation and telecommand stations.	5.
(8) Band 1626.5-1646.5 MHz:	
(i) Ship earth stations	5.

[4]For transmitters in the radiolocation and associated telecommand service operating on 154.584 MHz, 159.480 MHz, 160.725 MHz and 160.785 MHz the frequency tolerance is 15 parts in 10^6.

[7]For transmitters operated at private coast stations with antenna heights less than 6 meters (20 feet) above ground and output power of 25 watts or less the frequency tolerance is 10 parts in 10^6.

TEST CONFIGURATION



TEST PROCEDURE

1. The EUT output port was connected to communication tester.
2. The EUT was placed inside the temperature chamber.
3. Turn EUT off and set the chamber temperature to –30°C. After the temperature stabilized for approximately 30 minutes recorded the frequency as MCF_{MHz}.
4. Calculate the ppm frequency error by the following:
   ppm error=$(MCF_{MHZ}/ACF_{MHZ}-1)*10^6$
   where
   MCF_{MHz} is the Measured Carrier Frequency in MHz
   ACF_{MHz} is the Assigned Carrier Frequency in MHz
5. Repeat step 3 measure with 10°C increased per stage until the highest temperature of +50°C reached.

TEST MODE

Refer to the section 4.2

TEST RESULT

☒ **Passed** ☐ **Not Applicable**

TEST DATA

Refer to the appendix report on section 8

5.8. Frequency stability VS Voltage

LIMIT

FCC Part 80.209(a):

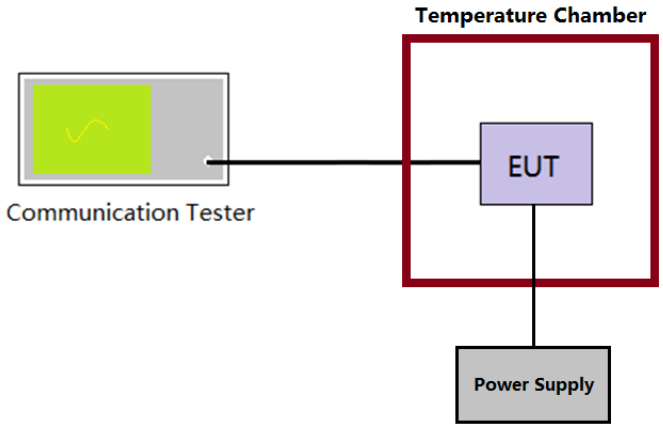
The frequency tolerance requirements applicable to transmitters in the maritime services are shown in the following table. Tolerances are given as parts in 10^6 unless shown in Hz.

Frequency bands and categories of stations	Tolerances[1]
(5) Band 156-162 MHz:	
(i) Coast stations:	
For carriers licensed to operate with a carrier power:	
Below 3 watts	10.
3 to 100 watts	5.[7]
(ii) Ship stations	10.[4]
(iii) Survival craft stations operating on 121.500 MHz	50.
(iv) EPIRBs:	
Operating on 121.500 and 243.000 MHz	50.
Operating on 156.750 and 156.800 MHz.[6]	10.
(6) Band 216-220 MHz:	
(i) Coast stations:	
For all emissions	5.
(ii) Ship stations:	
For all emissions	5.
(7) Band 400-466 MHz:	
(i) EPIRBs operating on 406-406.1 MHz	5.
(ii) On-board stations	5.
(iii) Radiolocation and telecommand stations.	5.
(8) Band 1626.5-1646.5 MHz:	
(i) Ship earth stations	5.

[4]For transmitters in the radiolocation and associated telecommand service operating on 154.584 MHz, 159.480 MHz, 160.725 MHz and 160.785 MHz the frequency tolerance is 15 parts in 10^6.

[7]For transmitters operated at private coast stations with antenna heights less than 6 meters (20 feet) above ground and output power of 25 watts or less the frequency tolerance is 10 parts in 10^6.

TEST CONFIGURATION



TEST PROCEDURE

1) The EUT output port was connected to communication tester.
2) The EUT was placed inside the temperature chamber at 25°C
3) Record the carrier frequency of the transmitter as MCF_{MHZ}
4) Calculate the ppm frequency error by the following:
   ppm error=$(MCF_{MHz}/ACF_{MHz}-1)*10^6$
   where
   MCF_{MHz} is the Measured Carrier Frequency in MHz
   ACF_{MHz} is the Assigned Carrier Frequency in MHz
5) Repeat step 3 measure with varied ±15% of the nominal value measured at the input to the EUT

TEST MODE

Refer to the section 4.2

TEST RESULT

☒ **Passed** ☐ **Not Applicable**

TEST DATA

Refer to the appendix report on section 8

5.9. Transmit Conducted Spurious Emission

LIMIT

FCC Part 80.211(f)(3)

On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43 plus 10log10 (mean power in watts) dB.

Note: In general, the worse case attenuation requirement shown above was applied.

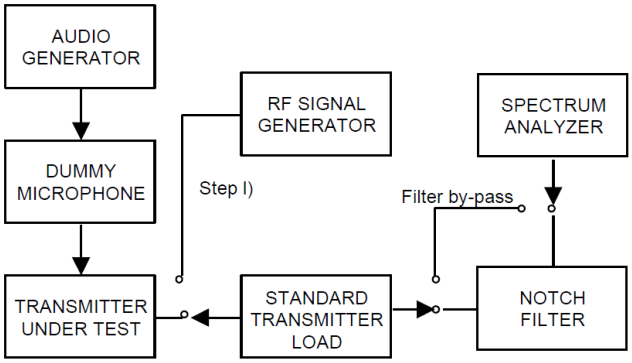
Calculation: Limit (dBm) =EL-43-10log10 (TP)

EL is the emission level of the Output Power expressed in dBm,

In this application, the EL is P(dBm)

Limit (dBm) = P(dBm)-43-10 log (Pwatts) = -13dBm

TEST CONFIGURATION



TEST PROCEDURE

1) Connect the equipment as illustrated, with the notch filter by-passed.
2) Apply Input Modulation Signal to EUT according to Section 3.4
3) Adjust the spectrum analyzer for the following settings:
   Below 1GHz: RBW=100kHz, VBW=300kHz,Above 1GHz: RBW=1MHz, VBW=3MHz
   Detector=Peak, Sweep time=Auto, Trace=Max hold
4) Scan frequency range up to 10th harmonic.
5) Record the frequencies and levels of spurious emissions.

TEST MODE

Refer to the section 4.2

TEST RESULT

☒ **Passed** ☐ **Not Applicable**

TEST DATA

Refer to the appendix report on section 8

5.10. Transmitter Radiated Spurious Emission

LIMIT

FCC Part 80.211(f)(3)

On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43 plus 10log10 (mean power in watts) dB.

Note: In general, the worse case attenuation requirement shown above was applied.

Calculation: Limit (dBm) =EL-43-10log10 (TP)

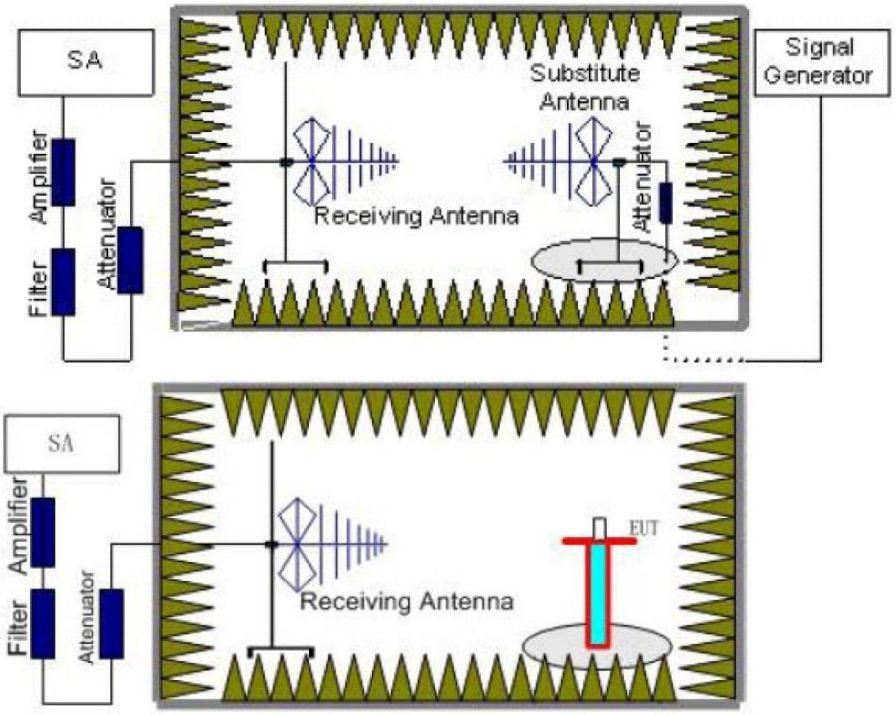
EL is the emission level of the Output Power expressed in dBm,

In this application, the EL is P(dBm)

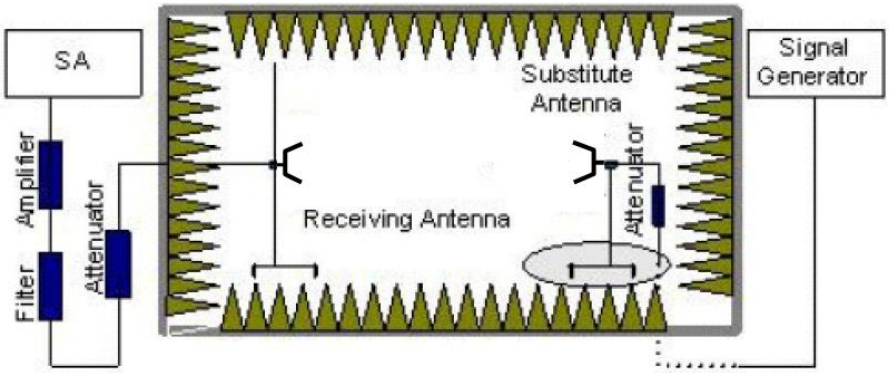
Limit (dBm) = P(dBm)-43-10 log (Pwatts) = -13dBm

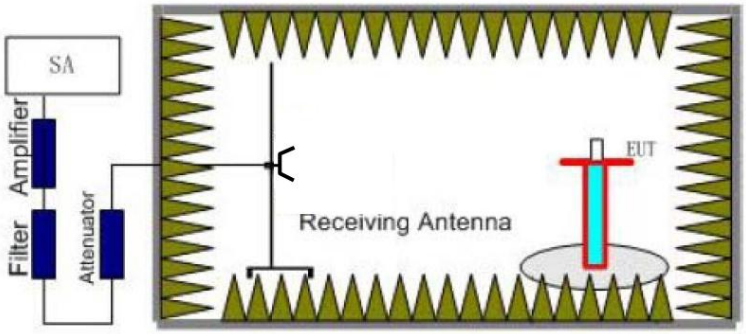
TEST CONFIGURATION

Below 1GHz:



Above 1GHz:





TEST PROCEDURE

1. Place the EUT in the center of the turntable.
   a) For radiated emissions measurements performed at frequencies less than or equal to 1 GHz, the EUT shall be placed on a RF-transparent table at a nominal height of 80 cm above the reference ground plane
   b) For radiated measurements performed at frequencies above 1 GHz, the EUT shall be placed on an RF transparent table at a nominal height of 1.5 m above the ground plane.
2. Unless the EUT uses an integral antenna, the EUT shall be terminated with a non-radiating transmitter load. In cases where the EUT uses an adjustable antenna, the antenna shall be adjusted through typical positions and lengths to maximize emissions levels.
3. The EUT shall be tested while operating on the frequency per manufacturer specification. Set the transmitter to operate in continuous transmit mode.
4. Receiver or Spectrum set as follow:
   Below 1GHz, RBW=100kHz, VBW=300kHz, Detector=Peak, Sweep time=Auto
   Above 1GHz, RBW=1MHz, VBW=3MHz, Detector=Peck, Sweep time=Auto
5. Each emission under consideration shall be evaluated:
   a) Raise and lower the measurement antenna from 1 m to 4 m, as necessary to enable detection of the maximum emission amplitude relative to measurement antenna height.
   b) Rotate the EUT through 360° to determine the maximum emission level relative to the axial position.
   c) Return the turntable to the azimuth where the highest emission amplitude level was observed.
   d) Vary the measurement antenna height again through 1 m to 4 m again to find the height associated with the maximum emission amplitude.
   e) Record the measured emission amplitude level and frequency
6. Repeat step 5 for each emission frequency with the measurement antenna oriented in both the horizontal and vertical polarizations to determine the orientation that gives the maximum emissions amplitude.
7. Set-up the substitution measurement with the reference point of the substitution antenna located as near as possible to where the center of the EUT radiating element was located during the initial EUT measurement.
8. Maintain the previous measurement instrument settings and test set-up, with the exception that the EUT is removed and replaced by the substitution antenna.
9. Connect a signal generator to the substitution antenna; locate the signal generator so as to minimize any potential influences on the measurement results. Set the signal generator to the frequency where emissions are detected, and set an output power level such that the radiated signal can be detected by the measurement instrument, with sufficient dynamic range relative to the noise floor.
10. For each emission that was detected and measured in the initial test
    a) Vary the measurement antenna height between 1 m to 4 m to maximize the received (measured) signal amplitude.
    b) Adjust the signal generator output power level until the amplitude detected by the measurement instrument equals the amplitude level of the emission previously measured directly in step 5 and step 6.
    c) Record the output power level of the signal generator when equivalence is achieved in step b).
11. Repeat step 8 through step 10 with the measurement antenna oriented in the opposite polarization.
12. Calculate the emission power in dBm referenced to a half-wave dipole using the following equation:
    Pe = Ps(dBm) − cable loss (dB) + antenna gain (dBd)
    where
    Pe = equivalent emission power in dBm
    Ps = source (signal generator) power in dBm
    NOTE—dBd refers to the measured antenna gain in decibels relative to a half-wave dipole.
13. Correct the antenna gain of the substitution antenna if necessary to reference the emission power to a half-wave dipole. When using measurement antennas with the gain specified in dBi, the equivalent dipole-referenced gain can be determined from:

gain (dBd) = gain (dBi) − 2.15 dB.
If necessary, the antenna gain can be calculated from calibrated antenna factor information

14. Provide the complete measurement results as a part of the test report.

TEST MODE

Refer to the section 4.2

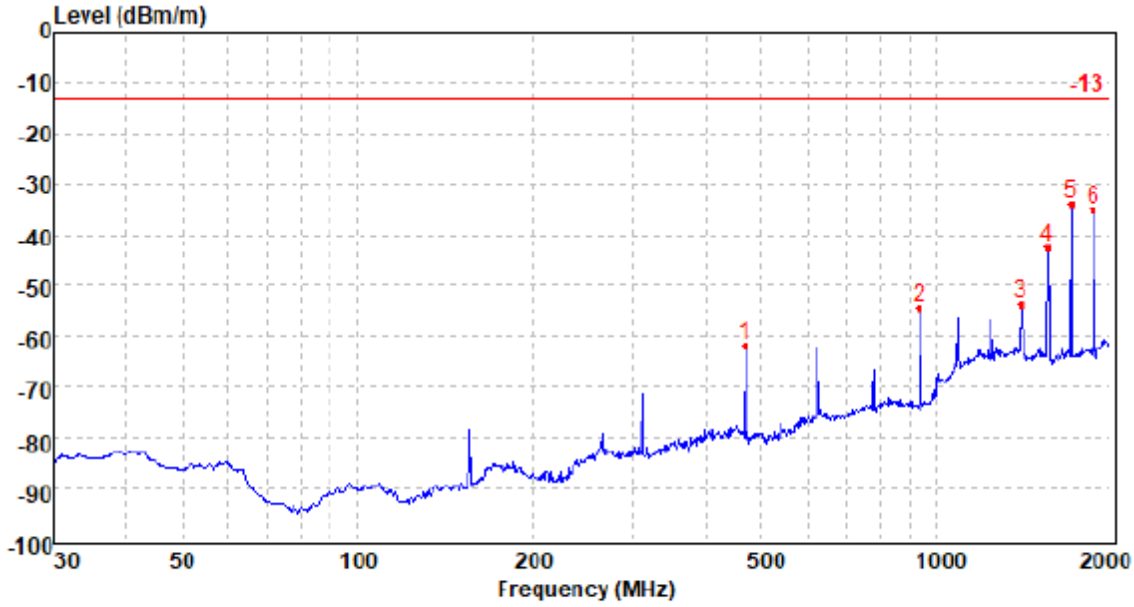
TEST RESULT

☒ **Passed** ☐ **Not Applicable**

TEST DATA

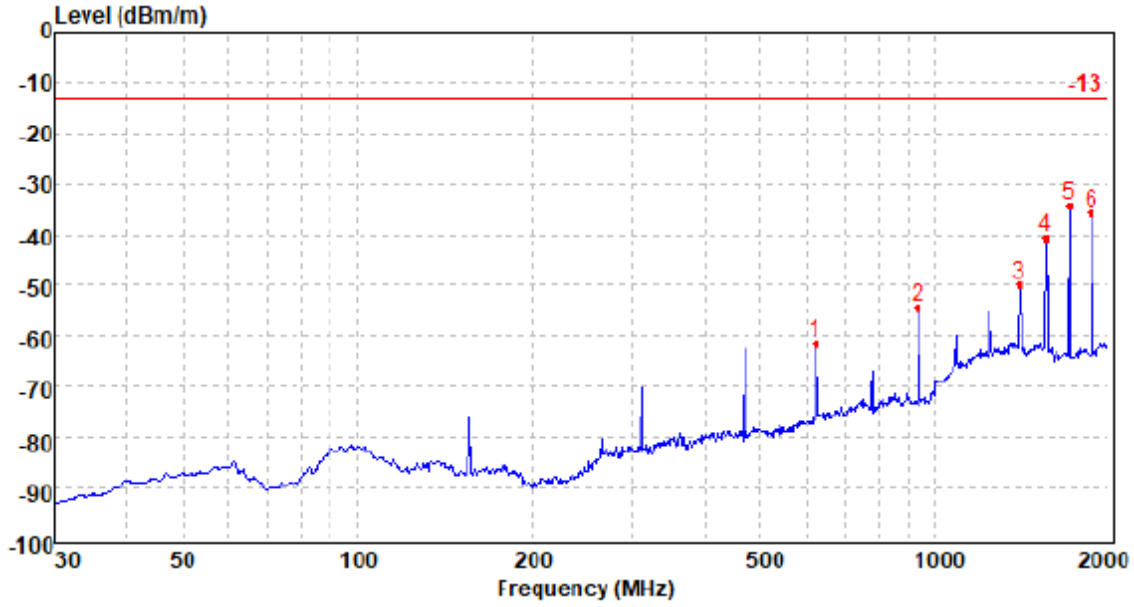
Refer to the below test data

TX-AWH			
Test Frequency:	CH_L	Polarity:	Horizontal



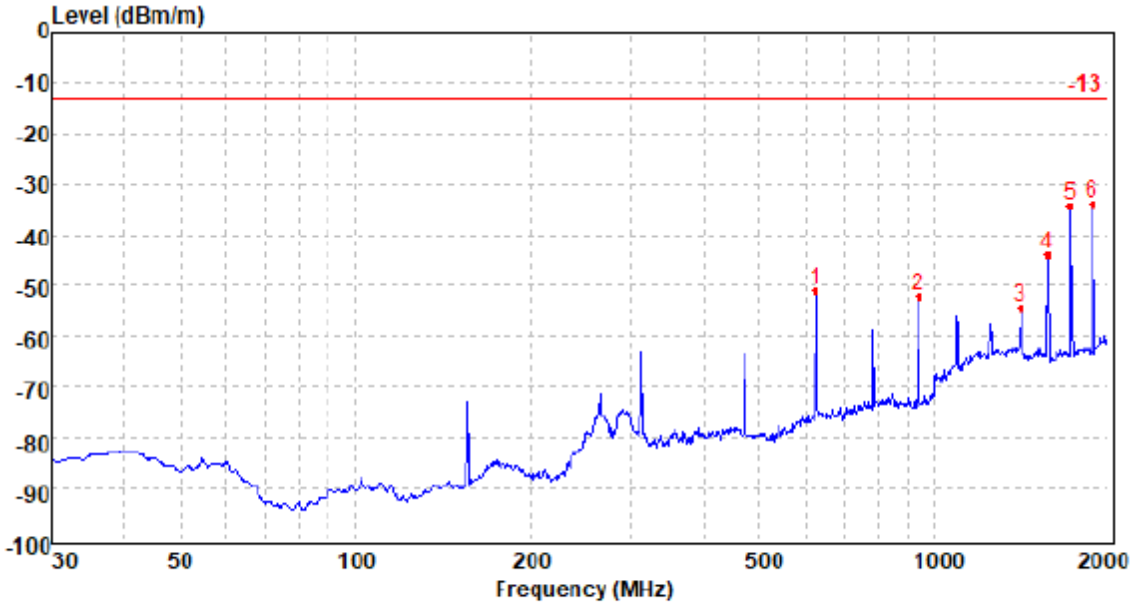
Mark	Frequency MHz	Reading dBm	Antenna dB	Cable dB	Preamp dB	Level dBm	Limit dBm	Over limit	Remark
1	467.59	-61.70	25.59	4.28	29.82	-61.65	-13.00	-48.65	Peak
2	938.10	-60.65	29.22	6.31	29.24	-54.36	-13.00	-41.36	Peak
3	1404.45	-51.76	37.13	3.08	42.00	-53.55	-13.00	-40.55	Peak
4	1560.49	-39.66	36.18	3.19	42.20	-42.49	-13.00	-29.49	Peak
5	1717.13	-31.32	36.42	3.40	42.19	-33.69	-13.00	-20.69	Peak
6	1872.55	-33.99	37.62	3.59	42.01	-34.79	-13.00	-21.79	Peak

Test Frequency:	CH_L	Polarity:	Vertical



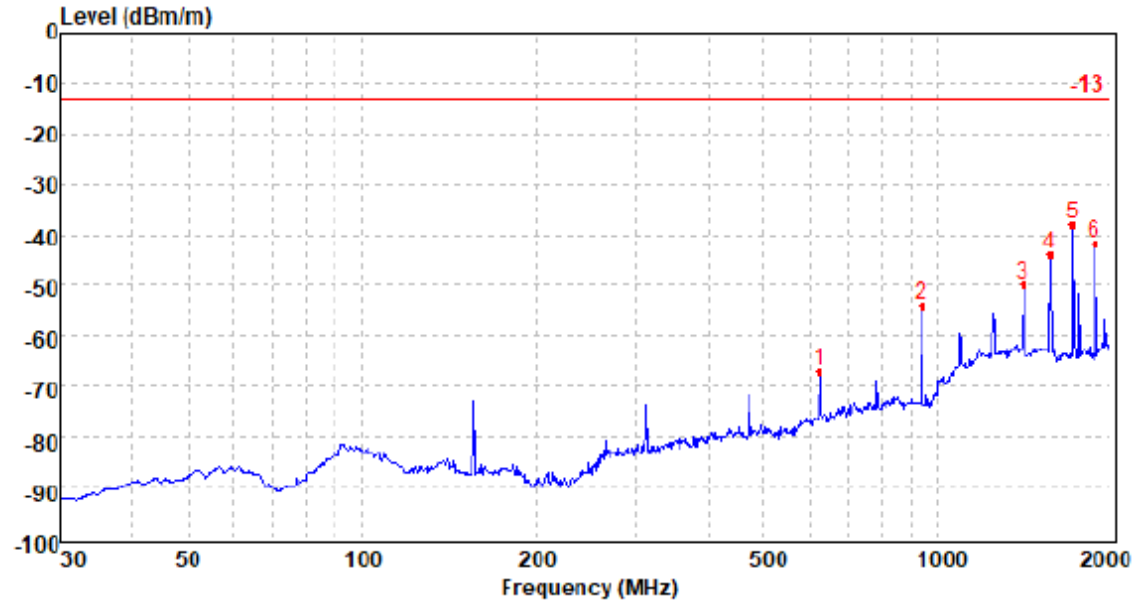
Mark	Frequency MHz	Reading dBm	Antenna dB	Cable dB	Preamp dB	Level dBm	Limit dBm	Over limit	Remark
1	623.87	-64.29	27.93	5.02	29.90	-61.24	-13.00	-48.24	Peak
2	938.10	-60.33	28.99	6.31	29.24	-54.27	-13.00	-41.27	Peak
3	1404.45	-48.64	37.76	3.08	42.00	-49.80	-13.00	-36.80	Peak
4	1560.49	-39.44	37.76	3.19	42.20	-40.69	-13.00	-27.69	Peak
5	1717.13	-31.76	36.28	3.40	42.19	-34.27	-13.00	-21.27	Peak
6	1872.55	-34.43	37.16	3.59	42.01	-35.69	-13.00	-22.69	Peak

TX-AWH			
Test Frequency:	CH_M	Polarity:	Horizontal



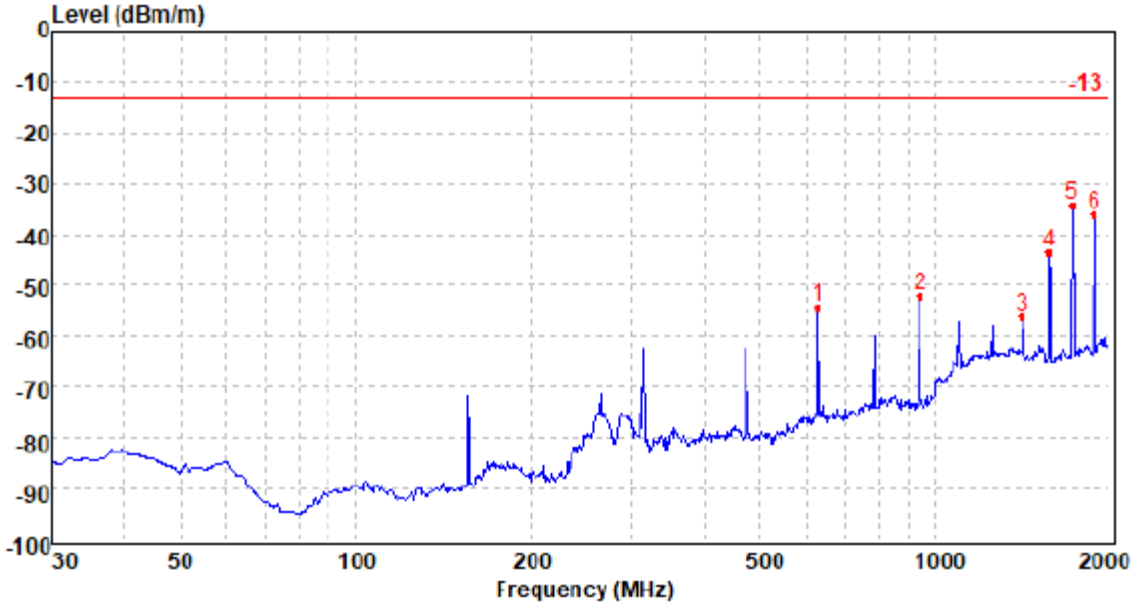
Mark	Frequency MHz	Reading dBm	Antenna dB	Cable dB	Preamp dB	Level dBm	Limit dBm	Over limit	Remark
1	626.07	-54.80	28.51	5.03	29.84	-51.10	-13.00	-38.10	Peak
2	941.41	-58.53	29.26	6.32	29.25	-52.20	-13.00	-39.20	Peak
3	1411.28	-52.34	37.09	3.09	42.01	-54.17	-13.00	-41.17	Peak
4	1568.08	-40.85	36.14	3.21	42.20	-43.70	-13.00	-30.70	Peak
5	1725.48	-32.07	36.45	3.43	42.18	-34.37	-13.00	-21.37	Peak
6	1881.65	-32.98	37.73	3.58	42.00	-33.67	-13.00	-20.67	Peak

Test Frequency:	CH_M	Polarity:	Vertical



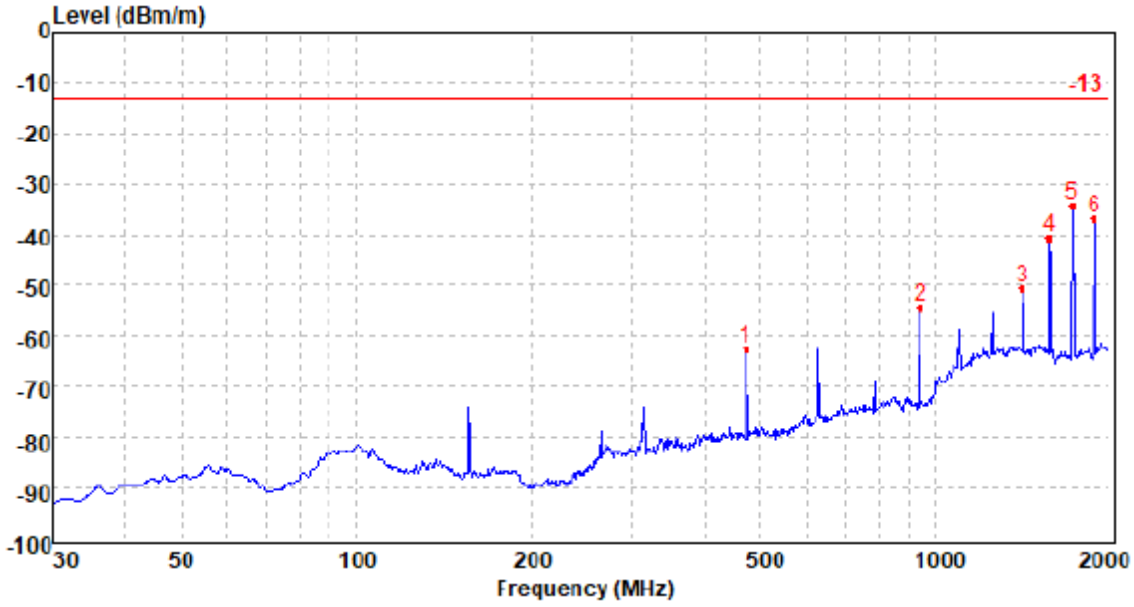
Mark	Frequency MHz	Reading dBm	Antenna dB	Cable dB	Preamp dB	Level dBm	Limit dBm	Over limit	Remark
1	626.07	-70.11	28.00	5.03	29.84	-66.92	-13.00	-53.92	Peak
2	941.41	-59.94	28.96	6.32	29.25	-53.91	-13.00	-40.91	Peak
3	1411.28	-48.54	37.76	3.09	42.01	-49.70	-13.00	-36.70	Peak
4	1568.08	-42.79	37.76	3.21	42.20	-44.02	-13.00	-31.02	Peak
5	1725.48	-35.45	36.30	3.43	42.18	-37.90	-13.00	-24.90	Peak
6	1881.65	-40.35	37.24	3.58	42.00	-41.53	-13.00	-28.53	Peak

TX-AWH			
Test Frequency:	CH_H	Polarity:	Horizontal



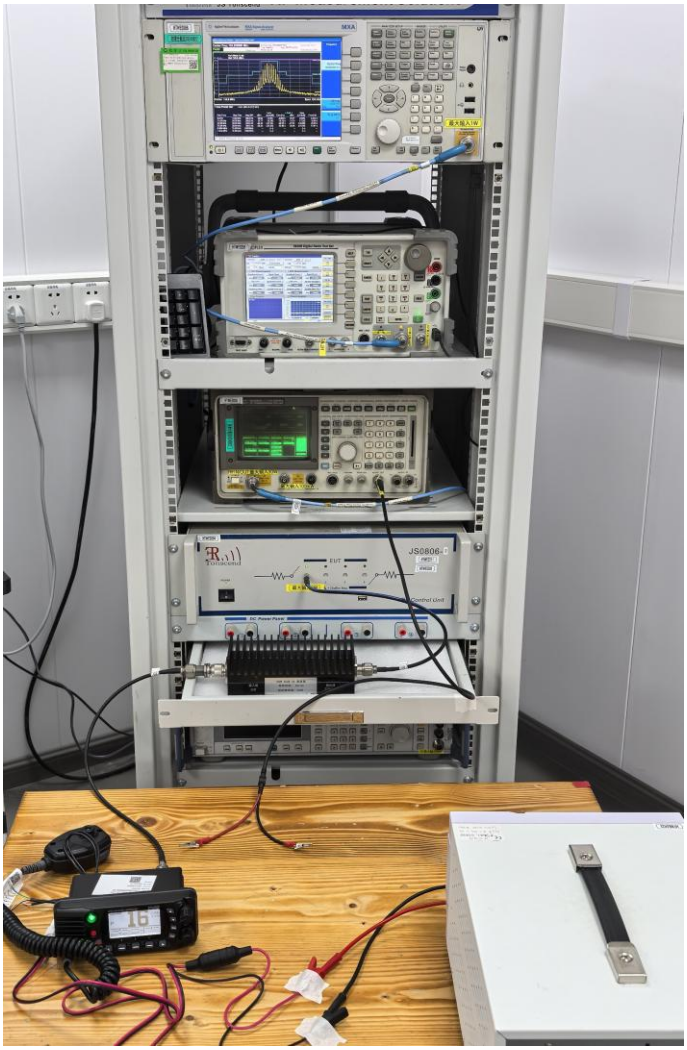
Mark	Frequency MHz	Reading dBm	Antenna dB	Cable dB	Preamp dB	Level dBm	Limit dBm	Over limit	Remark
1	630.49	-58.24	28.68	5.04	29.75	-54.27	-13.00	-41.27	Peak
2	944.72	-58.34	29.33	6.34	29.26	-51.93	-13.00	-38.93	Peak
3	1417.16	-54.32	37.05	3.10	42.03	-56.20	-13.00	-43.20	Peak
4	1574.62	-40.79	36.10	3.24	42.20	-43.65	-13.00	-30.65	Peak
5	1732.67	-32.01	36.47	3.46	42.17	-34.25	-13.00	-21.25	Peak
6	1889.49	-35.48	37.82	3.58	42.00	-36.08	-13.00	-23.08	Peak

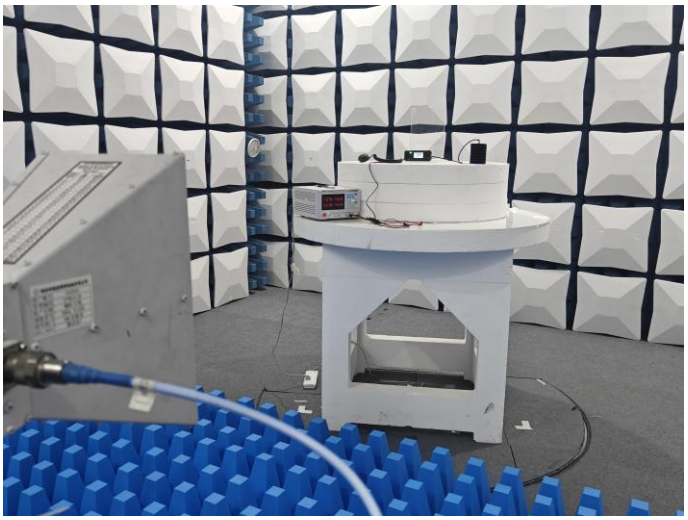
Test Frequency:	CH_H	Polarity:	Vertical



Mark	Frequency MHz	Reading dBm	Antenna dB	Cable dB	Preamp dB	Level dBm	Limit dBm	Over limit	Remark
1	472.55	-62.49	25.45	4.31	29.82	-62.55	-13.00	-49.55	Peak
2	944.72	-60.44	29.05	6.34	29.26	-54.31	-13.00	-41.31	Peak
3	1417.16	-49.23	37.76	3.10	42.03	-50.40	-13.00	-37.40	Peak
4	1574.62	-39.28	37.76	3.24	42.20	-40.48	-13.00	-27.48	Peak
5	1732.67	-31.66	36.31	3.46	42.17	-34.06	-13.00	-21.06	Peak
6	1889.49	-35.85	37.32	3.58	42.00	-36.95	-13.00	-23.95	Peak

6. TEST SETUP PHOTOS

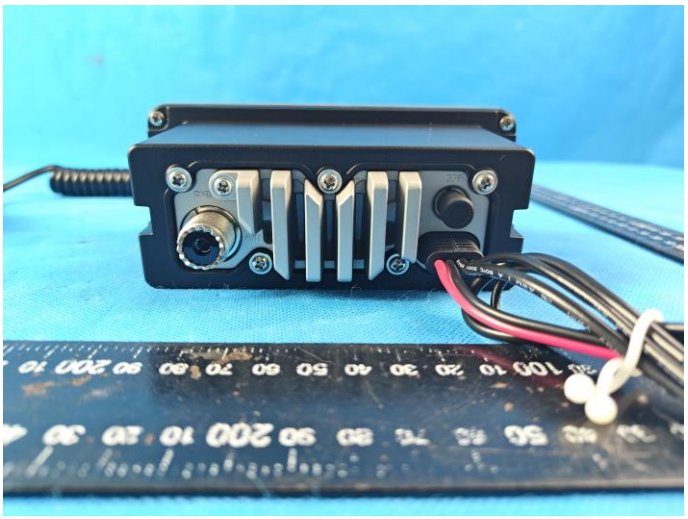




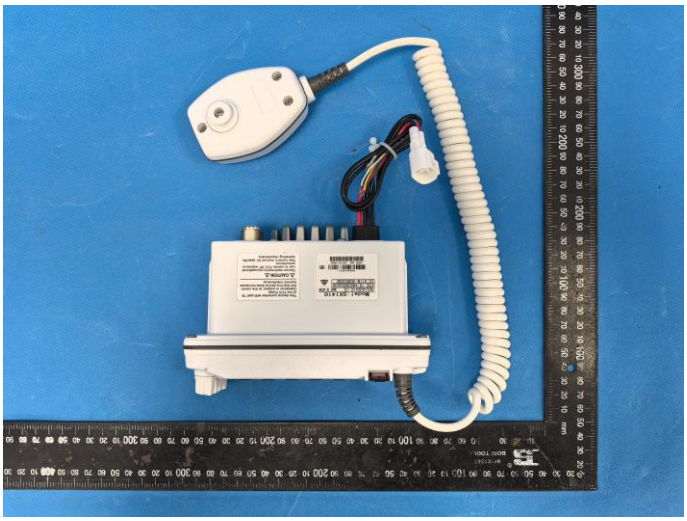
7. EXTERNAL AND INTERNAL PHOTOS

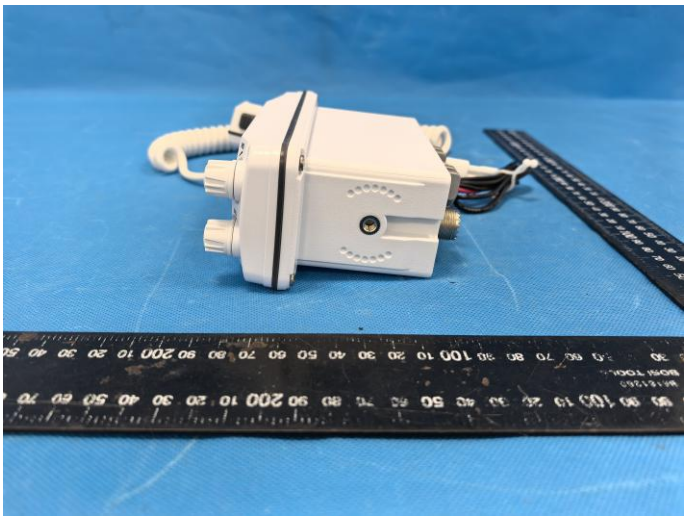
7.1. External Photos

GX1410GPS

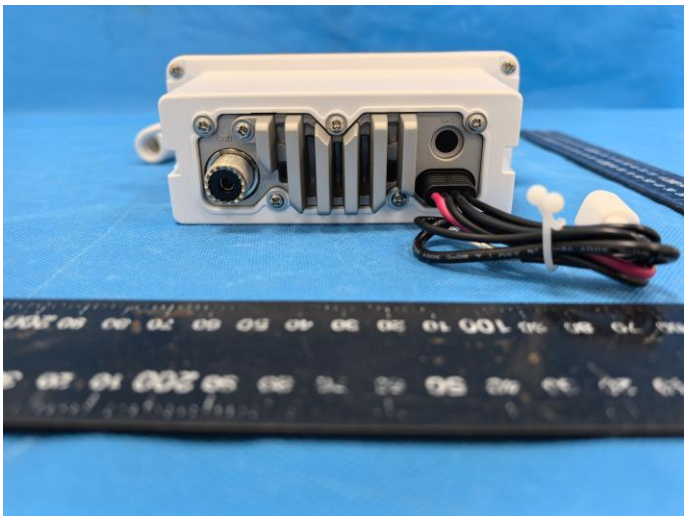


GX1410



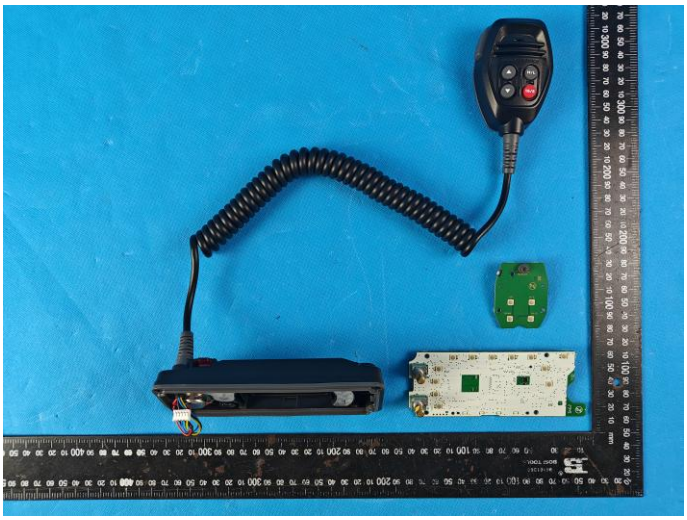


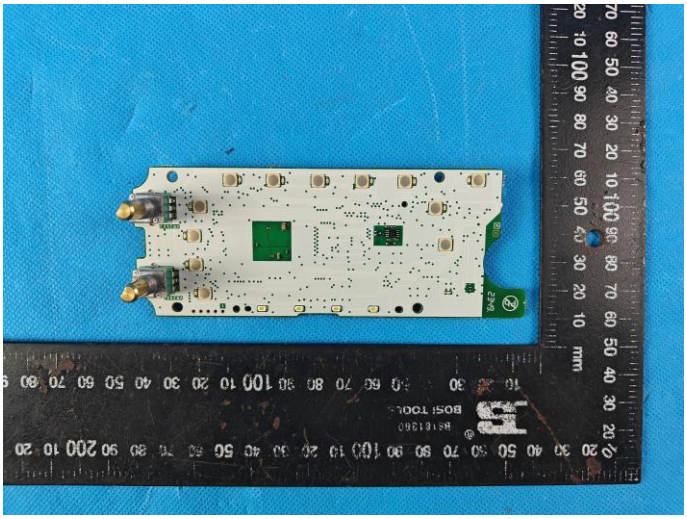

STANDARD HORIZON
ECLIPSE

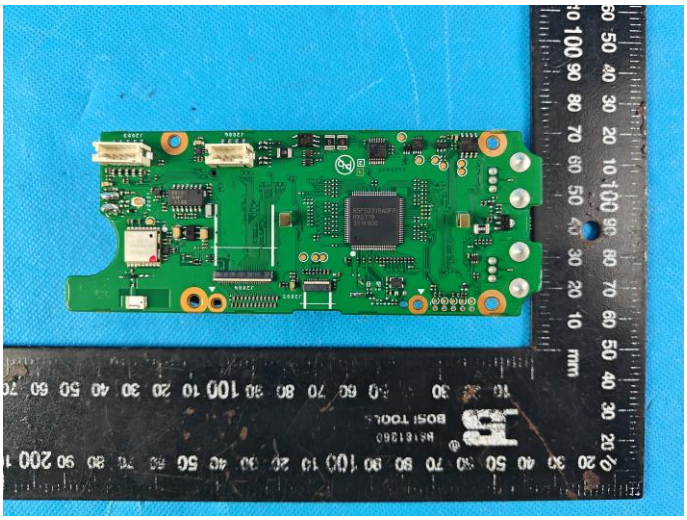


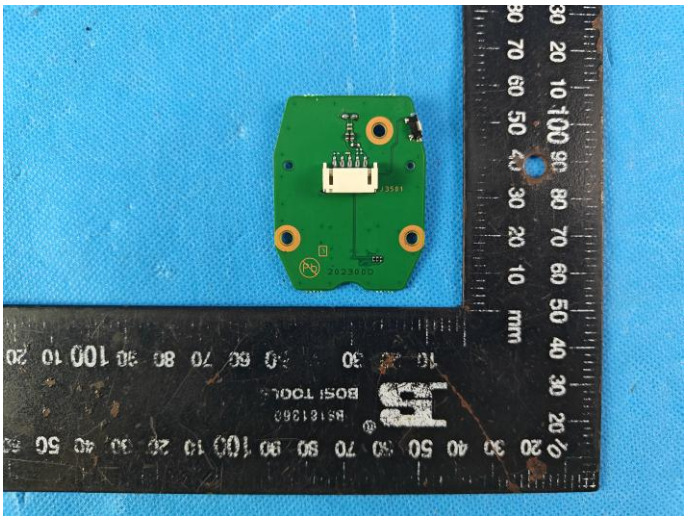
7.2. Internal Photos

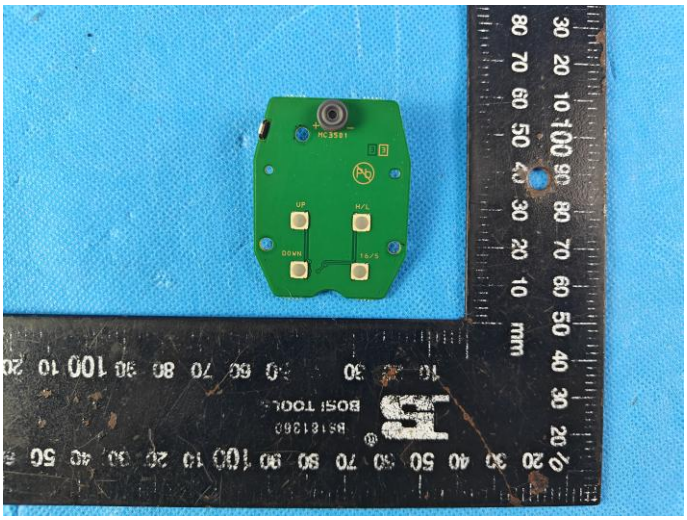
GX1410GPS

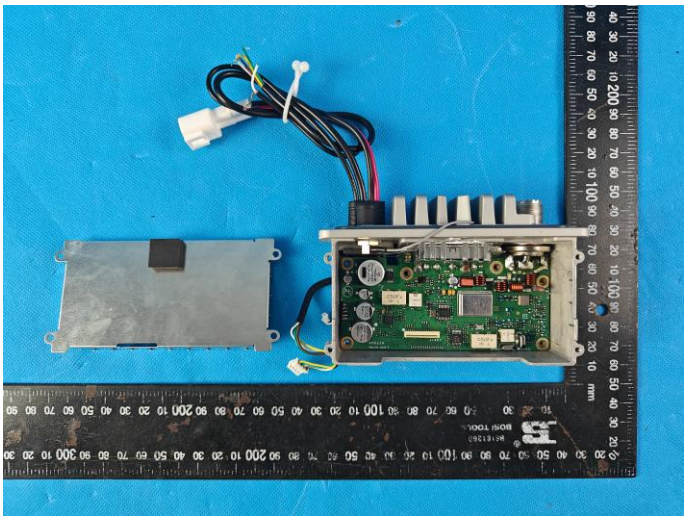


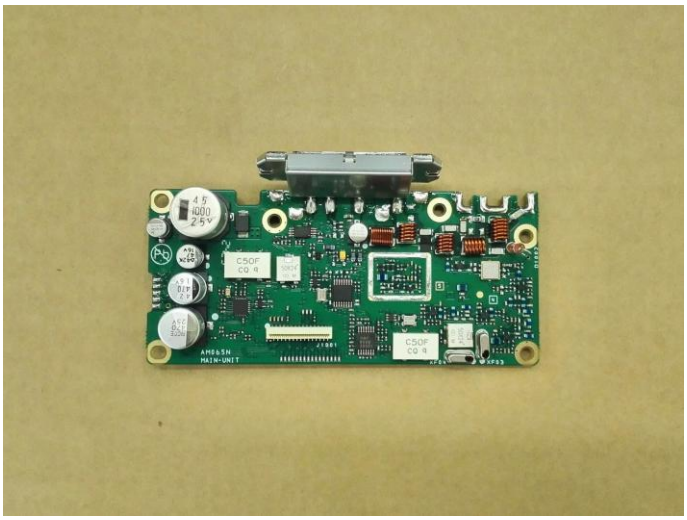


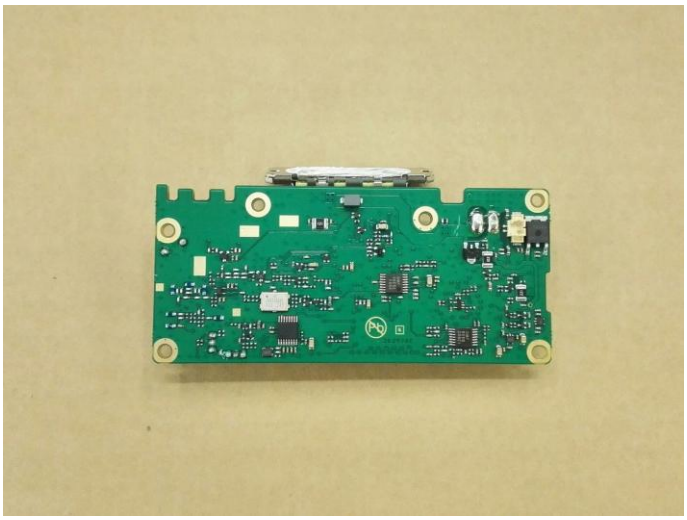




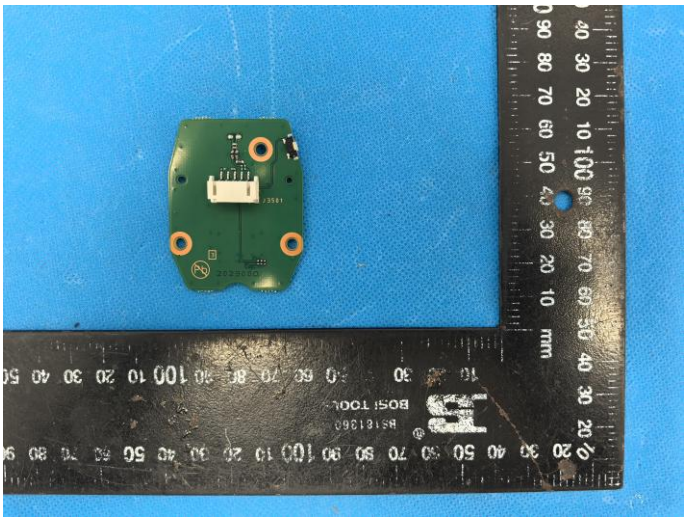


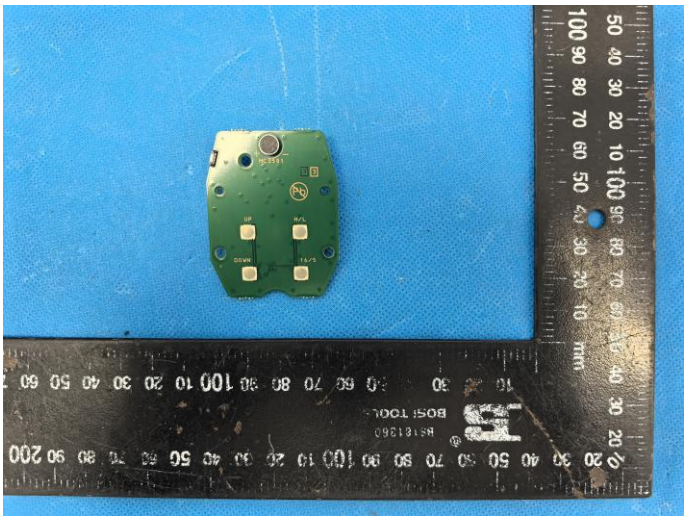


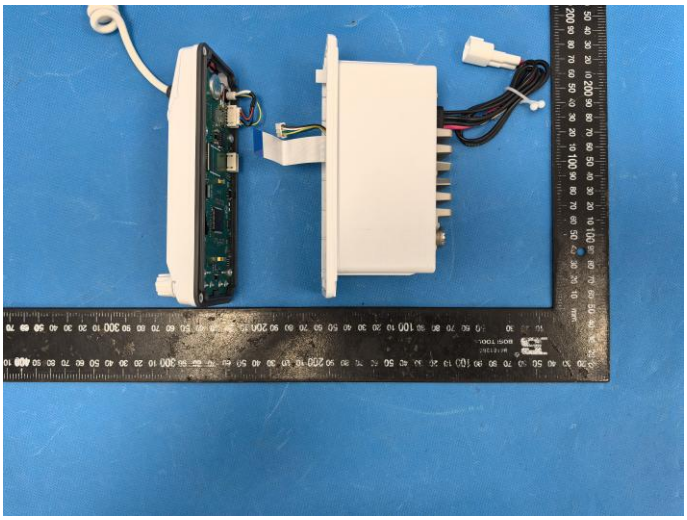


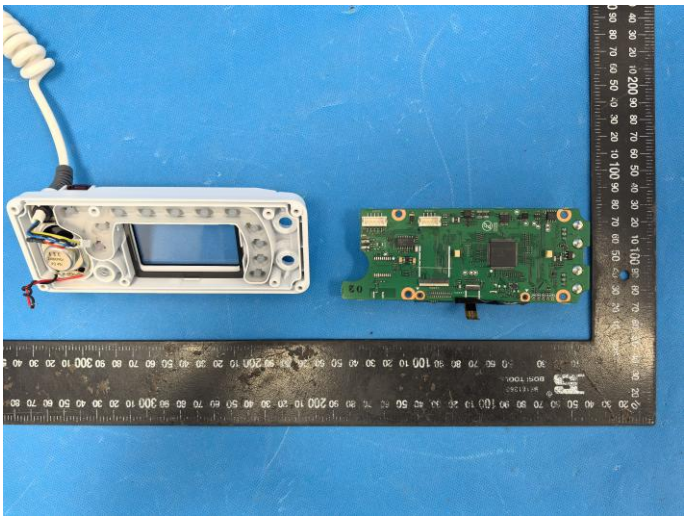


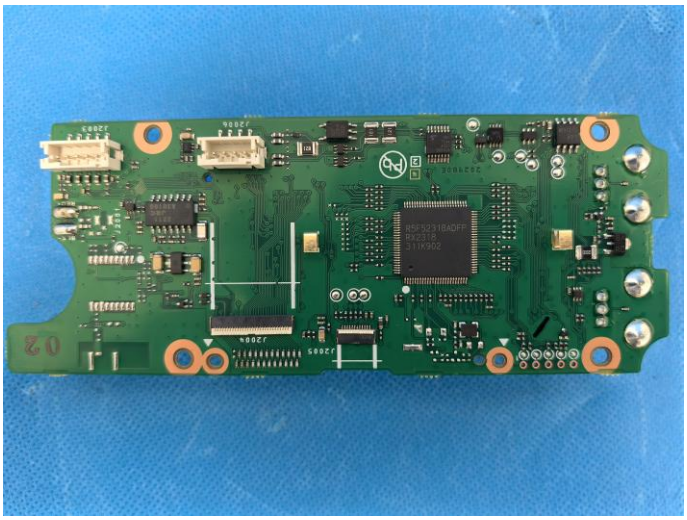
GX1410

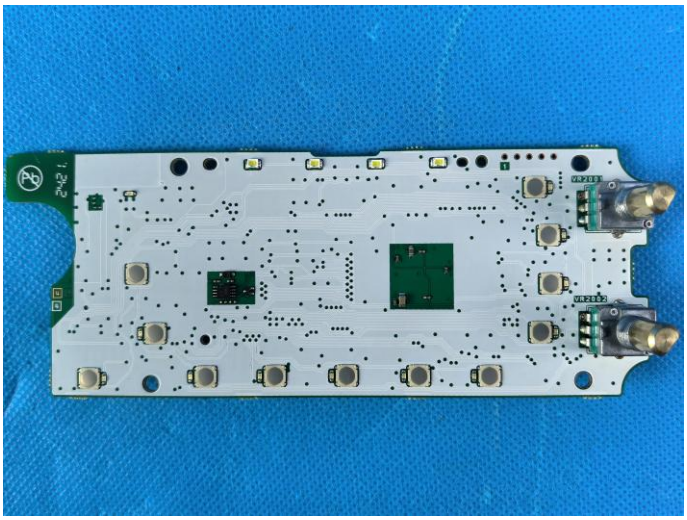


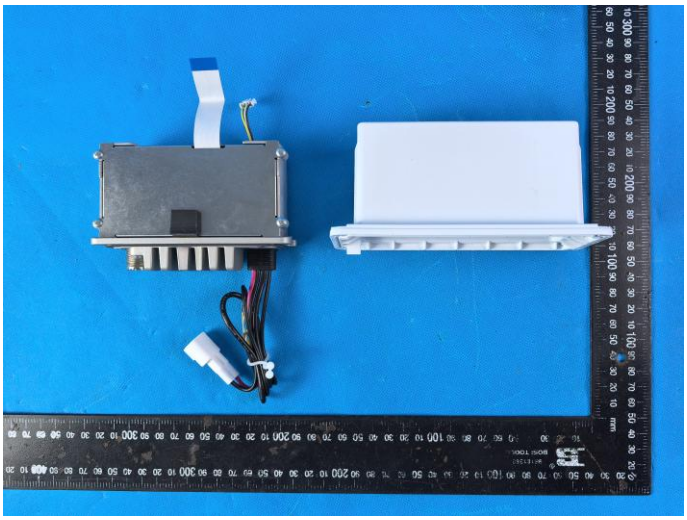


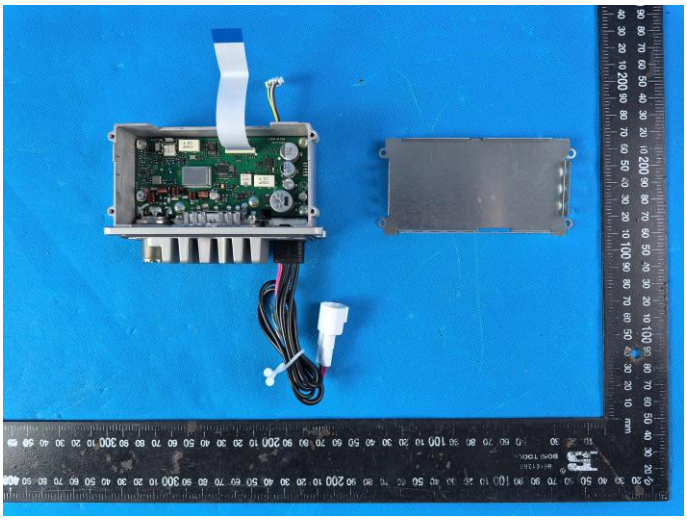


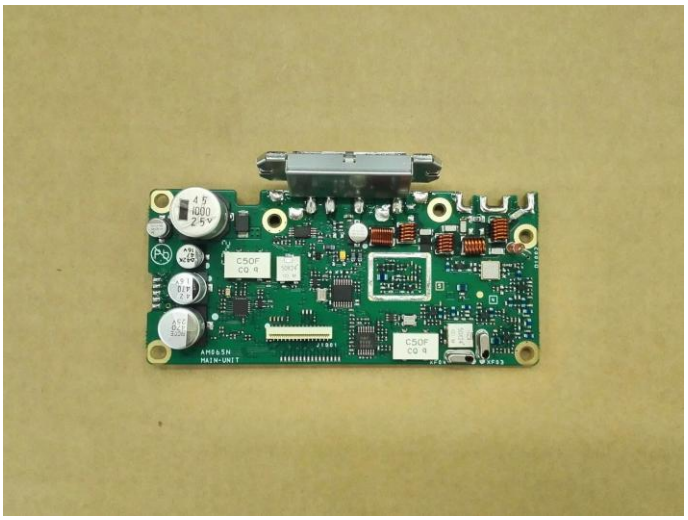


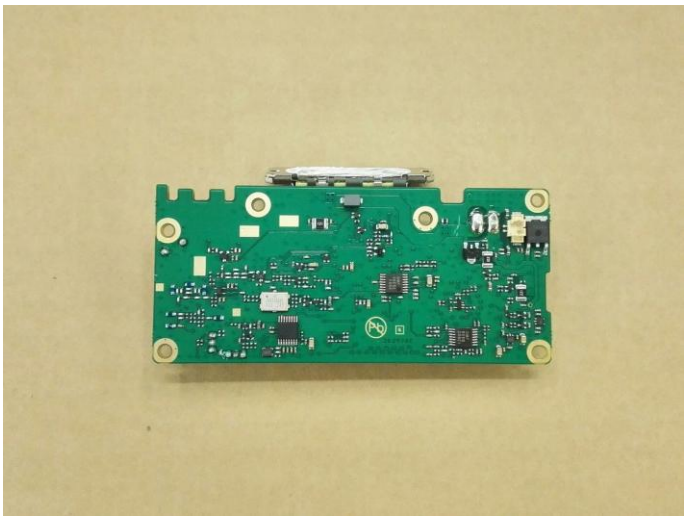












8. APPENDIX REPORT