

IEC 62238 TEST REPORT

For

Raymarine UK Limited

Raymarine UK Limited, Marine House, Cartwright Drive, Fareham,
Hampshire, PO15 5RJ, England

Model: RAY60

Report Type: Original Report	Product Type: Class D Digital Selective Calling device
Test Engineer: Candy Li	<i>Candy Li</i>
Report Number: RSZ141105006-01	
Report Date: 2015-01-26	
Reviewed By: Jimmy Xiao RF Engineer	<i>Jimmy Xiao</i>
Prepared By: Bay Area Compliance Laboratories Corp. (Shenzhen) 6/F, the 3rd Phase of WanLi Industrial Building, ShiHua Road, FuTian Free Trade Zone Shenzhen, Guangdong, China Tel: +86-755-33320018 Fax: +86-755-33320008 www.baclcorp.com.cn	

Note: This test report is prepared for the customer shown above and for the equipment described herein. It may not be duplicated or used in part without prior written consent from Bay Area Compliance Laboratories Corp. This report is valid only with a valid digital signature. The digital signature may be available only under the Adobe software above version 7.0.

TABLE OF CONTENTS

GENERAL INFORMATION.....	4
PRODUCT DESCRIPTION FOR EQUIPMENT UNDER TEST (EUT)	4
OBJECTIVE	4
RELATED SUBMITTAL(S)/GRANT(S).....	4
TEST METHODOLOGY	4
TEST FACILITY	4
SYSTEM TEST CONFIGURATION.....	5
DESCRIPTION OF TEST CONFIGURATION	5
EQUIPMENT MODIFICATIONS	5
SUPPORT EQUIPMENT LIST AND DETAILS	5
SUMMARY OF TEST RESULTS	6
§7.4 VIBRATION TEST	7
APPLICABLE STANDARD	7
TEST EQUIPMENT LIST AND DETAILS.....	7
TEST DATA	7
§7.5 TEMPERATURE TEST.....	8
APPLICABLE STANDARD	8
TEST EQUIPMENT LIST AND DETAILS.....	8
TEST DATA	8
§8.14 TEST OF GENNERATED CALL SEQUENCES	9
APPLICABLE STANDARD	9
TEST EQUIPMENT LIST AND DETAILS.....	9
TEST DATA	9
§9.13 MULTIPLE WATCH CHARACTERISTICS.....	11
APPLICABLE STANDARD	11
TEST EQUIPMENT LIST AND DETAILS.....	11
TEST DATA	11
§10.3 DSC RECEIVER ADJACENT CHANNEL SELECTIVITY.....	13
APPLICABLE STANDARD	13
TEST EQUIPMENT LIST AND DETAILS.....	13
TEST DATA	13
§10.5 DSC RECEIVER INTERMODULATION RESPONSE	15
APPLICABLE STANDARD	15
TEST EQUIPMENT LIST AND DETAILS.....	15
TEST DATA	15
§10.8 VERIFICATION OF CORRECT DECODING OF VARIOUS TYPES OF DSC CALLS.....	16
APPLICABLE STANDARD	16
TEST EQUIPMENT LIST AND DETAILS.....	16
TEST DATA	16
§10.9 REACTION TO VTS AND AIS CHANNEL MANAGEMENT DSC TRANSMISSIONS	18
APPLICABLE STANDARD	18
TEST EQUIPMENT LIST AND DETAILS.....	18
TEST DATA	18

§10.10 SIMULTANEOUS RECEPTION	20
APPLICABLE STANDARD	20
TEST EQUIPMENT LIST AND DETAILS.....	20
TEST DATA	20
EXHIBIT A- EUT PHOTOGRAPHS.....	21
EUT – ALL VIEW	21
EUT – FRONT VIEW	21
EUT – REAR VIEW	22
EUT – TOP VIEW	22
EUT – BOTTOM VIEW	23
EUT – LEFT SIDE VIEW	23
EUT – RIGHT SIDE VIEW	24
EUT – COVER OFF VIEW	24
EUT – MAIN BOARD 1 TOP VIEW	25
EUT – MAIN BOARD 1 TOP SHIELDING OFF VIEW	25
EUT – MAIN BOARD 1 BOTTOM VIEW.....	26
EUT – MAIN BOARD 1 BOTTOM SHIELDING OFF VIEW.....	26
EUT – MAIN BOARD 2 TOP VIEW	27
EUT – MAIN BOARD 2 TOP SHIELDING OFF VIEW	27
EUT – MAIN BOARD 2 BOTTOM VIEW.....	28
EUT – MAIN BOARD 3 TOP VIEW	28
EUT – MAIN BOARD 3 BOTTOM VIEW.....	29
EUT – CONNECT BOARD TOP VIEW	29
EUT –CONNECT BOARD BOTTOM VIEW.....	30
EUT – LCD SCREEN TOP VIEW	30
EUT – LCD SCREEN BOTTOM VIEW.....	31
EUT – SPEAKER VIEW	31
EUT – FRONT VIEW	32
EUT – REAR VIEW.....	32
EUT – TOP VIEW	33
EUT – BOTTOM VIEW	33
EUT – LEFT SIDE VIEW	34
EUT – RIGHT SIDE VIEW	34
EUT – COVER OFF VIEW.....	35
EUT – MAIN BOARD TOP VIEW	35
EUT – MAIN BOARD TOP SHIELDING OFF VIEW.....	36
EUT – MAIN BOARD BOTTOM VIEW	36
EUT – LCD SCREEN TOP VIEW	37
EUT – LCD SCREEN BOTTOM VIEW.....	37
EUT – SPEAKER VIEW	38
EUT – FRONT VIEW.....	38
EUT – REAR VIEW.....	39
EUT – TOP VIEW	39
EUT – BOTTOM VIEW.....	40
EUT – LEFT SIDE VIEW	40
EUT – RIGHT SIDE VIEW	41
EUT – COVER OFF VIEW.....	41
EUT – MAIN BOAR TOP VIEW	42
EUT – MAIN BOARD BOTTOM VIEW	42
EUT – SPEAKER VIEW	43
EUT – LABEL VIEW	43
EXHIBIT B - TEST SETUP PHOTOGRAPHS	44

GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

The *Raymarine UK Limited*'s product, model number: *RAY60* or the "EUT" in this report was a *RAY60 DSC Class D VHF Radio*, which was measured approximately: 199mm (L) x 175.5mm (W) x 98.5mm(H), rated with input voltage: DC 12.0V battery.

** All measurement and test data in this report was gathered from production sample serial number: 1411024 (Assigned by Shenzhen BACL). The EUT supplied by the applicant was received on 2014-11-05.*

Objective

This test report is prepared on behalf of *Raymarine UK Limited* in accordance with IEC 62238.

Related Submittal(s)/Grant(s)

No related submittal(s)

Test Methodology

All tests and measurements indicated in this document were performed in accordance with the IEC 62238 First edition 2003-03, Maritime navigation and radiocommunication equipment and systems-VHF radiotelephone equipment incorporating Class "D" Digital Selective Calling (DSC)-Methods of testing and required test results.

Test Facility

The test site used by Bay Area Compliance Laboratories Corp. (Shenzhen) to collect test data is located on the 6/F, the 3rd Phase of WanLi Industrial Building, ShiHua Road, FuTian Free Trade Zone Shenzhen, Guangdong, China.

Test site at Bay Area Compliance Laboratories Corp. (Shenzhen) has been fully described in reports submitted to the Federal Communication Commission (FCC). The details of these reports have been found to be in compliance with the requirements of Section 2.948 of the FCC Rules on December 06, 2010. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.4-2009.

The Federal Communications Commission has the reports on file and is listed under FCC Registration No.: 382179. The test site has been approved by the FCC for public use and is listed in the FCC Public Access Link (PAL) database.

SYSTEM TEST CONFIGURATION

Description of Test Configuration

The system was configured for testing in a DSC mode in accordance with IEC 62238.

Equipment Modifications

No modification was made to the EUT tested.

Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
DC Power Supply	MEAN WELL	SP-320	N/A

SUMMARY OF TEST RESULTS

IEC 62238 Rules	Description of Test	Results
§7.4	Vibration Test	Compliance
§7.5	Temperature Tests	Compliance
§8.14	Test of Generated Call Sequences	Compliance
§9.13	Multiple Watch Characteristics	Compliance
§10.3	DSC Receiver Adjacent Channel Selectivity	Compliance
§10.5	DSC Receiver Intermodulation Response	Compliance
§10.8	Verification of Correct Decoding of Various Types of DSC Calls	Compliance
§10.9	Reaction to VTS and AIS Channel Management DSC Transmissions	Compliance
§10.10	Simultaneous Reception	Compliance

Note: a brief summary of the tests carried out in accordance with IEC 62238 standards.

§7.4 VIBRATION TEST

Applicable Standard

According to IEC 62238, Clause 7.4

Limit:

The requirement of the performance check shall be met.

Test Equipment List and Details

Manufacturer	Description	Model	Calibration Date	Calibration Due Date
H&P	RF Communication Test Set	8921A	2014-05-16	2015-05-16
CMI	Vibration Tester	ACT2000-S06L	2014-06-03	2015-06-03

Test Data

Environmental Conditions

External Temperature:	25 °C
Relative Humidity:	50 %
ATM Pressure:	101.0 kPa

The testing was performed on 2015-01-24

Test Levels:

- 2Hz to 5Hz and up to 13.2Hz with and excursion of $\pm 1.43\text{mm} \pm 10\%$ (9.8m/s^2 maximum acceleration at 13.2Hz)
- Above 13.2Hz and up to 600Hz with a constant acceleration of 1g
- Nominal test voltage = +12Vdc

Endurance Test for 2 hour sat each resonant frequency or frequency with a g level ≥ 5 times the drive g level. If no resonant frequencies or frequency with a g level ≥ 5 times the drive g level are found endurance test shall be performed at 30Hz.

Test Result: Compliance.

§7.5 TEMPERATURE TEST

Applicable Standard

According to IEC 62238, Clause 7.5

Limit:

The requirement of the performance check shall be met.

Test Equipment List and Details

Manufacturer	Description	Model	Calibration Date	Calibration Due Date
H&P	RF Communication Test Set	8921A	2014-05-16	2015-05-16
ESPEC	Temperature & Humidity Chamber	ESL-04KA	2014-12-14	2015-12-14

Test Data

Environmental Conditions

External Temperature:	25 °C
Relative Humidity:	50 %
ATM Pressure:	101.0 kPa

The testing was performed from 2015-01-22 to 2015-01-26

Test Result: Compliance. Please refer to following table.

Environmental Conditions		Temperature	Voltage (V _{DC})	Test Period(Hour)	Results
Dry Heat	Storage Test	70±1°C	-	15	Compliance
	Functional Test	55±1°C	15.6	15	Compliance
			12.0	15	Compliance
			10.8	15	Compliance

§8.14 TEST OF GENNERATED CALL SEQUENCES

Applicable Standard

According to IEC 62238, Clause 8.14

Limit:

The requirement of ITU-R Recommendation M.493-10 regarding message composition and content shall be met.

The generated call shall be analysed with the calibrated apparatus for correct configuration of the signal format, including time diversity.

It shall be verified that, after transmission of a DSC call, the transmitter re-tunes to the original channel. However, in the case of a distress call, the transmitter shall tune to channel 16 and automatically select the maximum power.

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
H&P	Modulation Analyzer	8901B	3438A05208	2014-06-03	2015-06-03
Agilent	RF Communication test set	8920A	3325U00859	2014-06-03	2015-06-03
Agilent	MXG X-Series Signal Generators	N5182B	N/A	2014-06-03	2015-06-03
Agilent	Universal Frequency Center	53220A	N/A	2014-10-09	2015-10-08
Aeroflex	Digital Radio Test Set	3920	1000003253	2014-09-06	2015-09-05
Agilent	Signal Generator	E4422B	T-08-RM137	2014-01-22	2015-01-21

Test Data

Environmental Conditions

Temperature:	25 °C
Relative Humidity:	50 %
ATM Pressure:	101.0 kPa

The testing was performed by Candy Li on 2015-01-13

Test Result: Compliance. Please refer to following table.

Format specifier	Category	1 st telecommand (symbol No.)	2 st telecommand (symbol No.)
Distress	-	100	126
All Ships	Distress	100	126
All Ships	Urgency	100	126
All Ships	Safety	100	126
Individual	Urgency	100	126
Individual	Safety	100	126
Individual	Routine	100	126
Group	Routine	100	126

§9.13 MULTIPLE WATCH CHARACTERISTICS

Applicable Standard

According to IEC 62238, Clause 9.13

Limit:

Test Project	Requirement
Scanning Period	$\leq 2s$
Dwell Time (Priority Channel)	$\leq 150ms$
Dwell Time (Additional Channel)	Between 850 ms and 2s

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
H&P	Modulation Analyzer	8901B	3438A05208	2014-06-03	2015-06-03
Agilent	RF Communication test set	8920A	3325U00859	2014-06-03	2015-06-03
Agilent	MXG X-Series Signal Generators	N5182B	N/A	2014-06-03	2015-06-03
Agilent	Universal Frequency Center	53220A	N/A	2014-10-09	2015-10-08
Aeroflex	Digital Radio Test Set	3920	1000003253	2014-09-06	2015-09-05
ESPEC	Temperature & Humidity Chamber	EL-10KA	09107726	2014-11-01	2015-11-01

Test Data

Environmental Conditions

Temperature:	25 °C
Relative Humidity:	50 %
ATM Pressure:	101.0 kPa

The testing was performed by Candy Li on 2015-01-13.

Test Result: Compliance. Please refer to following table.

Test Conditions		Scanning Time(s)	Dwell on Priority (ms)	Dwell on Additional (s)
Temperature(°C)	Voltage (V _{DC})			
-15	15.6	1.635	80.5	1.621
-15	12.0	1.636	80.6	1.613
-15	10.8	1.639	80.1	1.620
+25	12.0	1.642	80.2	1.618
+55	15.6	1.645	80.5	1.624
+55	12.0	1.639	80.4	1.618
+55	10.8	1.629	80.3	1.619

§10.3 DSC RECEIVER ADJACENT CHANNEL SELECTIVITY**Applicable Standard**

According to IEC 62238, Clause 10.3

Limit:

The bit error ratio shall be less than 10^{-2}

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
H&P	Modulation Analyzer	8901B	3438A05208	2014-06-03	2015-06-03
Agilent	RF Communication test set	8920A	3325U00859	2014-06-03	2015-06-03
Agilent	MXG X-Series Signal Generators	N5182B	N/A	2014-06-03	2015-06-03
Agilent	Universal Frequency Center	53220A	N/A	2014-10-09	2015-10-08
Aeroflex	Digital Radio Test Set	3920	1000003253	2014-09-06	2015-09-05
ESPEC	Temperature & Humidity Chamber	EL-10KA	09107726	2014-11-01	2015-11-01
Hyetra	DSC Decoder/Encoder	N/A	N/A	NCR	NCR

Test Data**Environmental Conditions**

Temperature:	25 °C
Relative Humidity:	50 %
ATM Pressure:	101.0 kPa

The testing was performed by Candy Li on 2015-01-13.

Test Result: Compliance. Please refer to following table.

Test Conditions		Bit Error Ratio	
Temperature(°C)	Temperature(°C)	156.525MHz	
		+25 kHz	-25 kHz
-15	-15	Less than 10^{-2}	Less than 10^{-2}
-15	-15		
-15	-15		
+25	+25		
+55	+55		
+55	+55		
+55	+55		

Measurement uncertainty: ± 1.6 dB

§10.5 DSC RECEIVER INTERMODULATION RESPONSE

Applicable Standard

According to IEC 62238, Clause 10.5

Limit:

The BER shall not exceed 10^{-2}

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
H&P	Modulation Analyzer	8901B	3438A05208	2014-06-03	2015-06-03
Agilent	RF Communication test set	8920A	3325U00859	2014-06-03	2015-06-03
Agilent	MXG X-Series Signal Generators	N5182B	N/A	2014-06-03	2015-06-03
Agilent	Universal Frequency Center	53220A	N/A	2014-10-09	2015-10-08
Aeroflex	Digital Radio Test Set	3920	1000003253	2014-09-06	2015-09-05
ESPEC	Temperature & Humidity Chamber	EL-10KA	09107726	2014-11-01	2015-11-01

Test Data

Environmental Conditions

Temperature:	23 °C
Relative Humidity:	43 %
ATM Pressure:	101.0 kPa

The testing was performed by Candy Li on 2015-01-13.

Test Result: Compliance. Please refer to following table.

Frequency Increments of Unwanted Signals	Bit Error Rate
	156.525 MHz
+50/100 kHz	Less than 10^{-2}
-50/100 kHz	Less than 10^{-2}

Measurement uncertainty: ± 1.5 dB

§10.8 VERIFICATION OF CORRECT DECODING OF VARIOUS TYPES OF DSC CALLS

Applicable Standard

According to IEC 62238, Clause 10.8

Limit:

The requirement of ITU-R Recommendation M.493.13(5) regarding message composition and content shall be met.

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
H&P	Modulation Analyzer	8901B	3438A05208	2014-06-03	2015-06-03
Agilent	RF Communication test set	8920A	3325U00859	2014-06-03	2015-06-03
Agilent	MXG X-Series Signal Generators	N5182B	N/A	2014-06-03	2015-06-03
Agilent	Universal Frequency Center	53220A	N/A	2014-10-09	2015-10-08
Aeroflex	Digital Radio Test Set	3920	1000003253	2014-09-06	2015-09-05

Test Data

Environmental Conditions

Temperature:	23 °C
Relative Humidity:	43 %
ATM Pressure:	101.0 kPa

The testing was performed by Candy Li on 2015-01-13.

Test Result: Compliance. Please refer to following tables.

Format specifier	Category	1 st telecommand (symbol No.)	2 st telecommand (symbol No.)
Distress	-	100	126
All Ships	Distress	100	126
All Ships	Urgency	100	126
All Ships	Safety	100	126
Individual	Urgency	100	126
Individual	Safety	100	126
Individual	Routine	100	126
Group	Routine	100	126

	Confirm (Y or N)
Confirm that the decoded call sequences at the output of the receiver have been examined for correct technical format, including error check characteristics:	Y
Error found:	N
Confirm that the checks have been made to ensure accordance between printer output and display:	Y
Error found:	N
It has been verified that the equipment is capable of switching to a channel identified in the DSC call:	Y

§10.9 REACTION TO VTS AND AIS CHANNEL MANAGEMENT DSC TRANSMISSIONS

Applicable Standard

According to IEC 62238, Clause 10.9

Limit:

The equipment shall not sound an alarm, display a message (an accurate, informative display is permissible but not required), transmit a message a reponse or suggest a transmitted response, lock up, or require operator intervention.

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
H&P	Modulation Analyzer	8901B	3438A05208	2014-06-03	2015-06-03
Agilent	RF Communication test set	8920A	3325U00859	2014-06-03	2015-06-03
Agilent	MXG X-Series Signal Generators	N5182B	N/A	2014-06-03	2015-06-03
Agilent	Universal Frequency Center	53220A	N/A	2014-10-09	2015-10-08
Aeroflex	Digital Radio Test Set	3920	1000003253	2014-09-06	2015-09-05

Test Data

Environmental Conditions

Temperature:	23 °C
Relative Humidity:	43 %
ATM Pressure:	101.0 kPa

The testing was performed by Candy Li on 2015-01-13.

Test Result: Compliance. Please refer to following table.

	Confirm (Y or N)
Not sound an alarm	Y
Not display a message (An accurate informative display is permissible but not required)	Y
Not transmit a response	Y
Not suggest a transmitted response	Y
Not lock up	Y
Not require operator intervention	Y

§10.10 SIMULTANEOUS RECEPTION

Applicable Standard

According to IEC 62238, Clause 10.10

Limit:

Test Project	Requirement
SINAD Ratio (dB)	≥ 20 dB in presence of DSC Signal
Bit Error Rate	$\leq 10^{-2}$

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
H&P	Modulation Analyzer	8901B	3438A05208	2014-06-03	2015-06-03
Agilent	RF Communication test set	8920A	3325U00859	2014-06-03	2015-06-03
Agilent	MXG X-Series Signal Generators	N5182B	N/A	2014-06-03	2015-06-03
Agilent	Universal Frequency Center	53220A	N/A	2014-10-09	2015-10-08
Aeroflex	Digital Radio Test Set	3920	1000003253	2014-09-06	2015-09-05
ESPEC	Temperature & Humidity Chamber	EL-10KA	09107726	2014-11-01	2015-11-01
Hyetra	DSC Decoder/Encoder	N/A	N/A	NCR	NCR

Test Data

Environmental Conditions

Temperature:	23 °C
Relative Humidity:	47 %
ATM Pressure:	100.0 kPa

The testing was performed by Candy Li on 2014-12-16

Test Mode: Transmitting

Test Result: Compliance. Please refer to following table.

SINAD (dB) No DSC Signal	SINAD (dB) DSC Signal Applied	Bit Error Rate
45.6	45.8	Less than 10^{-2}

Measurement uncertainty: ± 1.6 dB

EXHIBIT A- EUT PHOTOGRAPHS

Base:

EUT – All View



EUT – Front View



EUT – Rear View



EUT – Top View



EUT – Bottom View



EUT – Left Side View



EUT – Right Side View



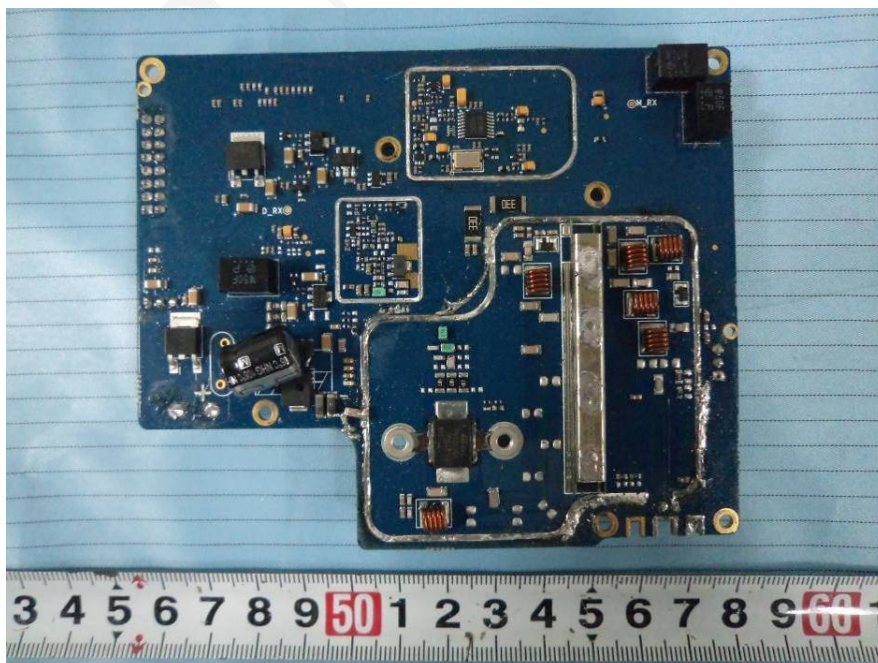
EUT – Cover off View



EUT – Main Board 1 Top View



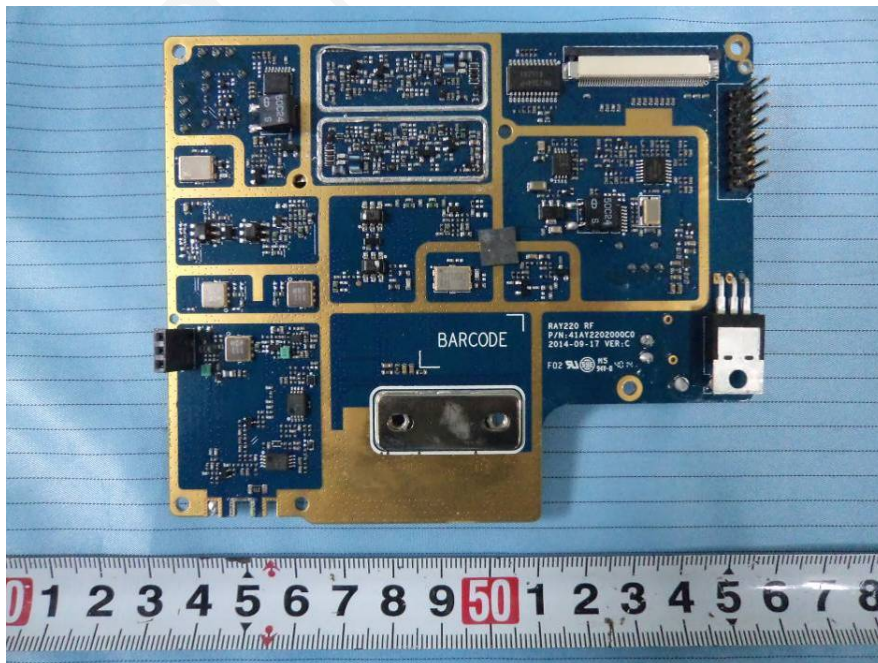
EUT – Main Board 1 Top Shielding off View



EUT – Main Board 1 Bottom View



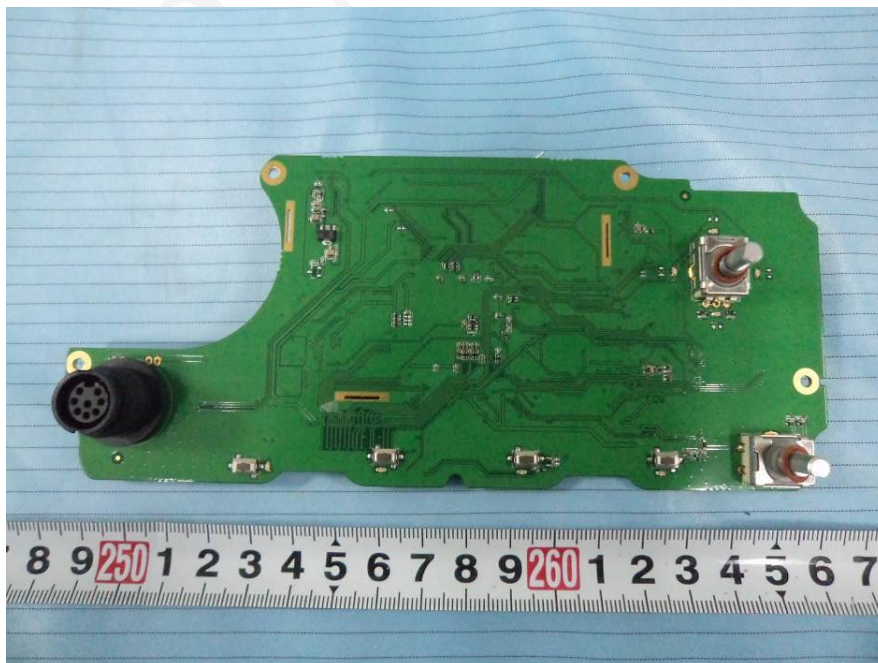
EUT – Main Board 1 Bottom Shielding off View



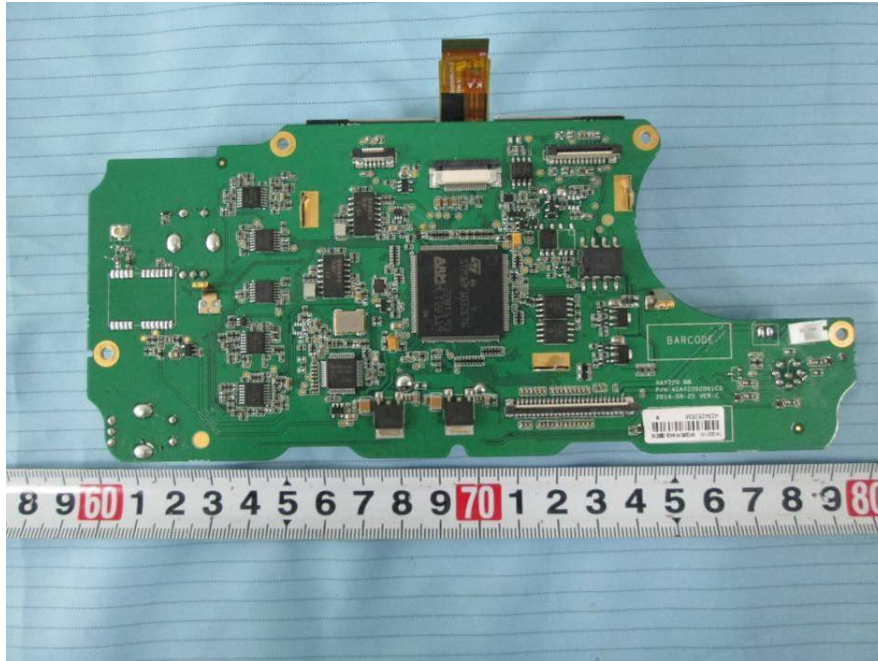
EUT – Main Board 2 Top View



EUT – Main Board 2 Top Shielding off View



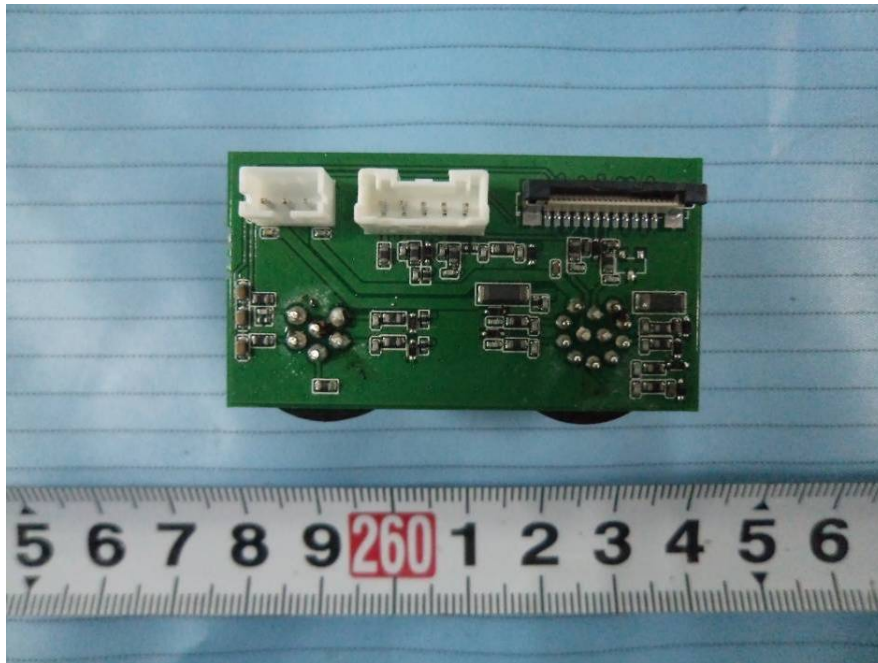
EUT – Main Board 2 Bottom View



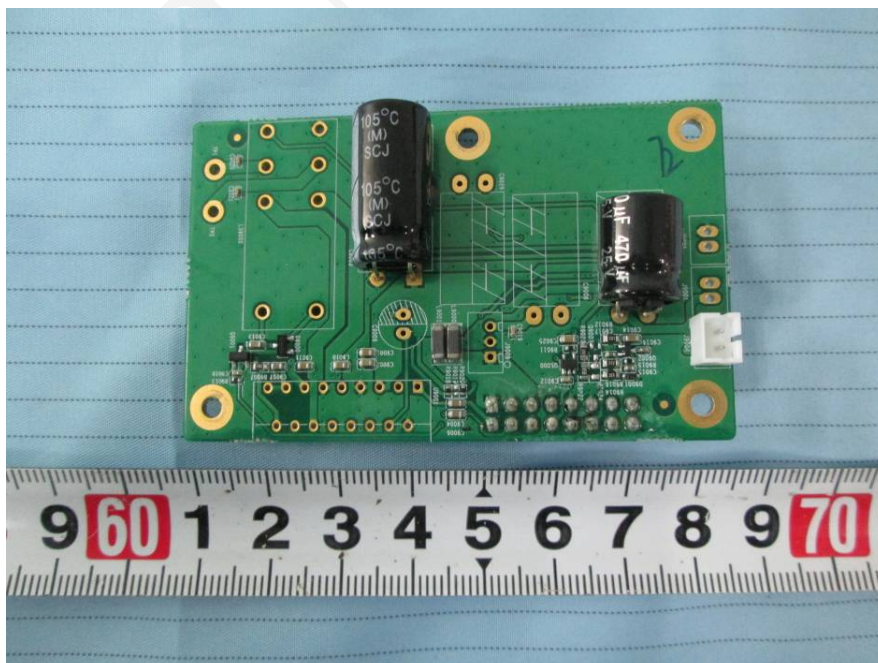
EUT – Main Board 3 Top View



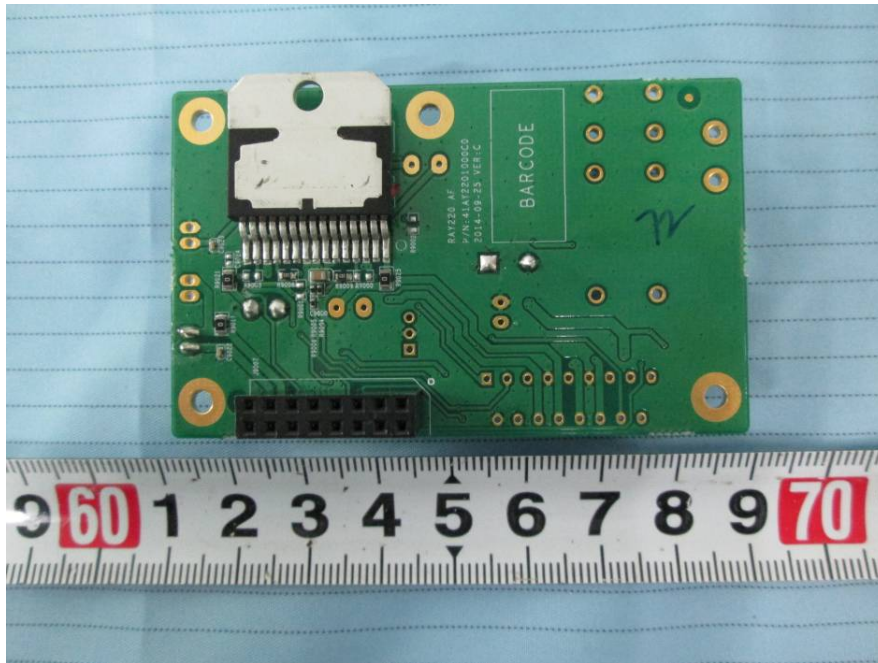
EUT – Main Board 3 Bottom View



EUT – Connect Board Top View



EUT –Connect Board Bottom View



EUT – LCD Screen Top View



EUT – LCD Screen Bottom View



EUT – Speaker View



Handset:

EUT – Front View



EUT – Rear View



EUT – Top View



EUT – Bottom View



EUT – Left Side View



EUT – Right Side View



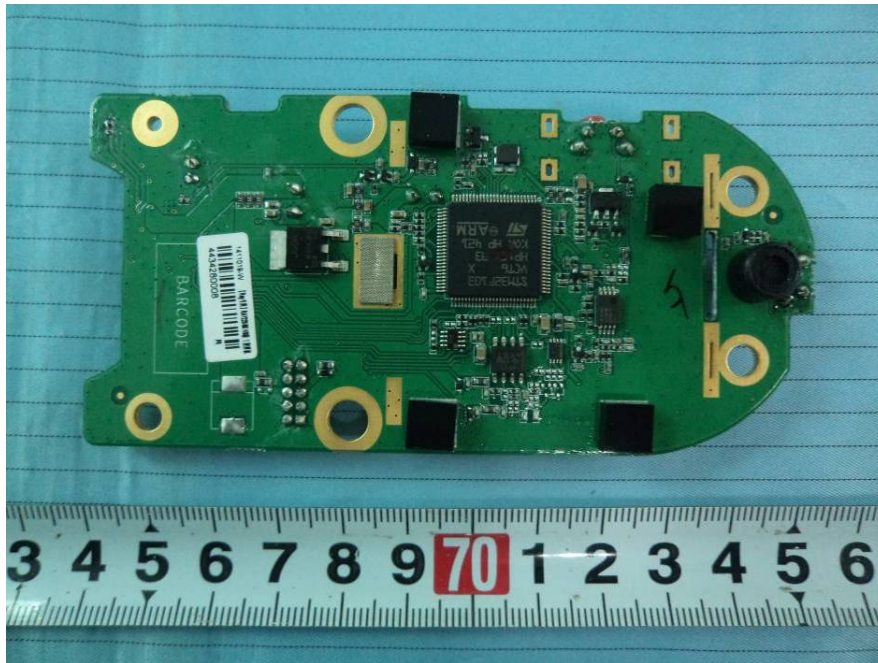
EUT – Cover off View



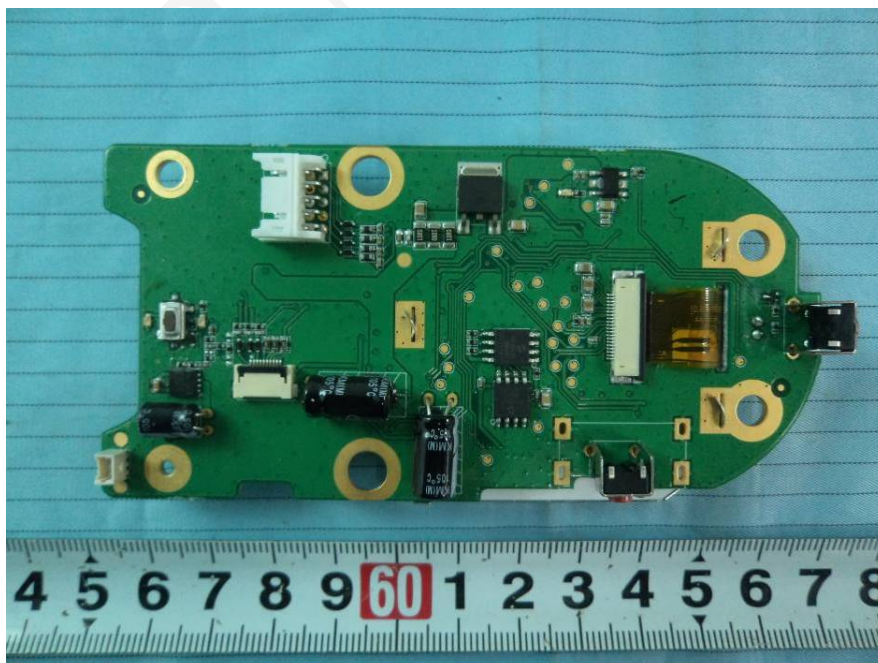
EUT – Main Board Top View



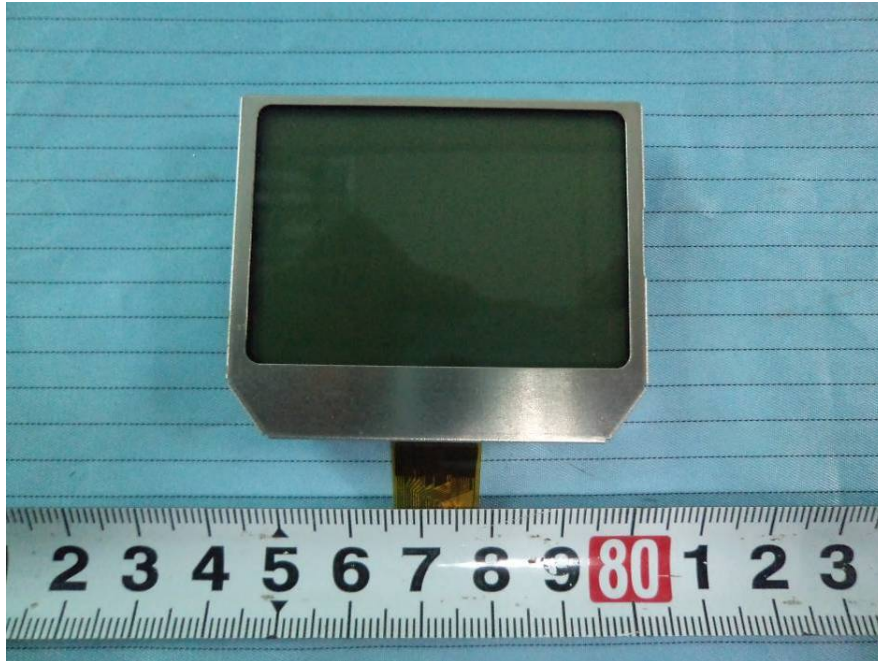
EUT – Main Board Top Shielding off View



EUT – Main Board Bottom View



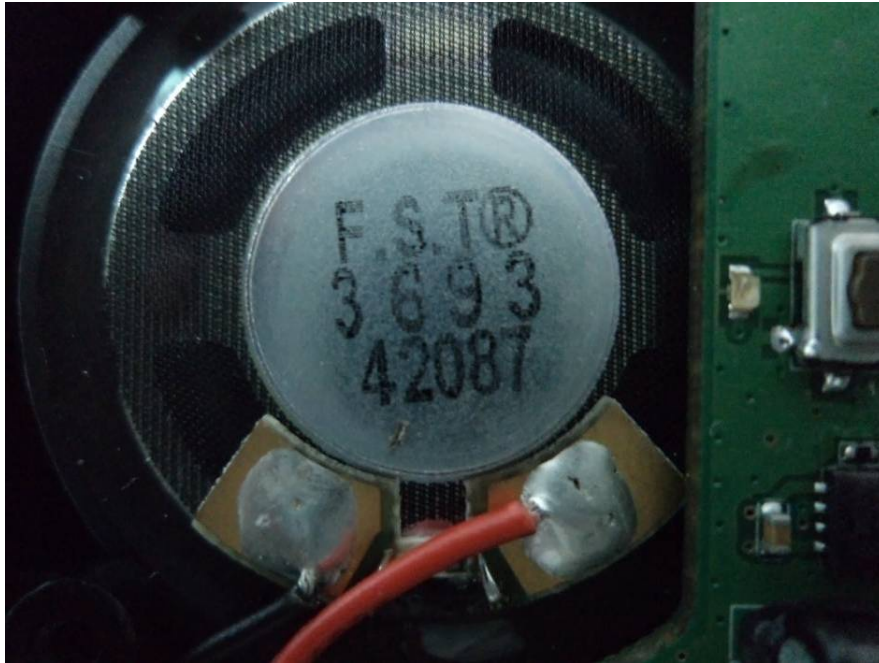
EUT – LCD Screen Top View



EUT – LCD Screen Bottom View



EUT – Speaker View



MIC:

EUT – Front View



EUT – Rear View



EUT – Top View



EUT – Bottom View



EUT – Left Side View



EUT – Right Side View



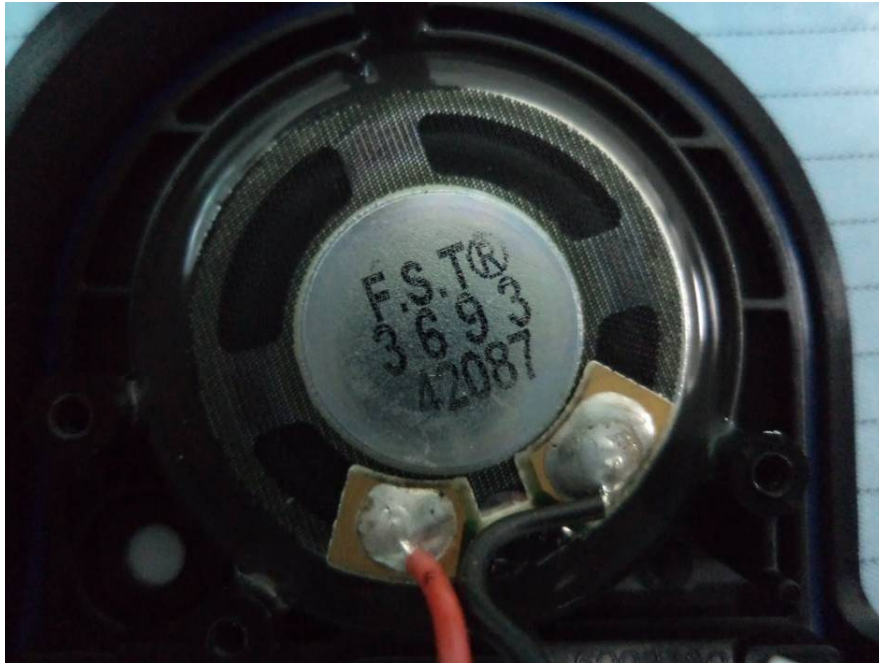
EUT – Cover off View



The image shows a green PCB component with the following details:

- Text on PCB:**
 - RAY2C F1STMIC
 - REV. B0
 - P/M-41009001167B0
 - BARCODE
- Components:**
 - A white multi-pin connector labeled 'C1'.
 - A small black component labeled 'SPK'.
 - A small black component labeled 'E2'.
 - A small black component labeled 'M'.
- Barcode:**
 - Barcode number: 69277862 810001 167B01
 - Barcode label: M
- Scale:** A ruler is placed below the PCB, showing measurements in centimeters. The ruler is marked from 0 to 10 cm, with the number '70' highlighted in red.

EUT – Speaker View



EUT – Label View



EXHIBIT B - TEST SETUP PHOTOGRAPHS





*******END OF REPORT *******