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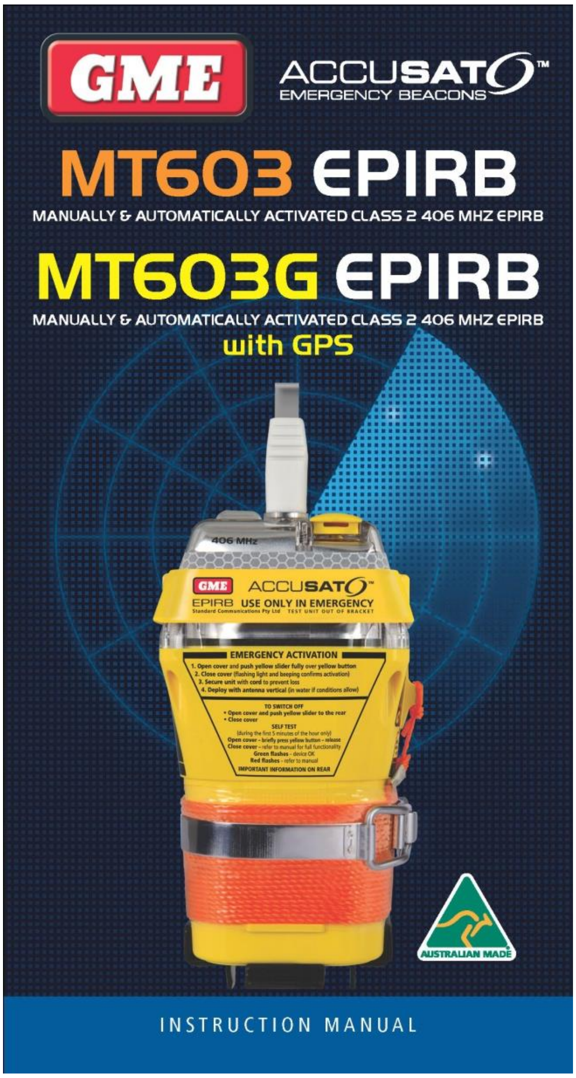
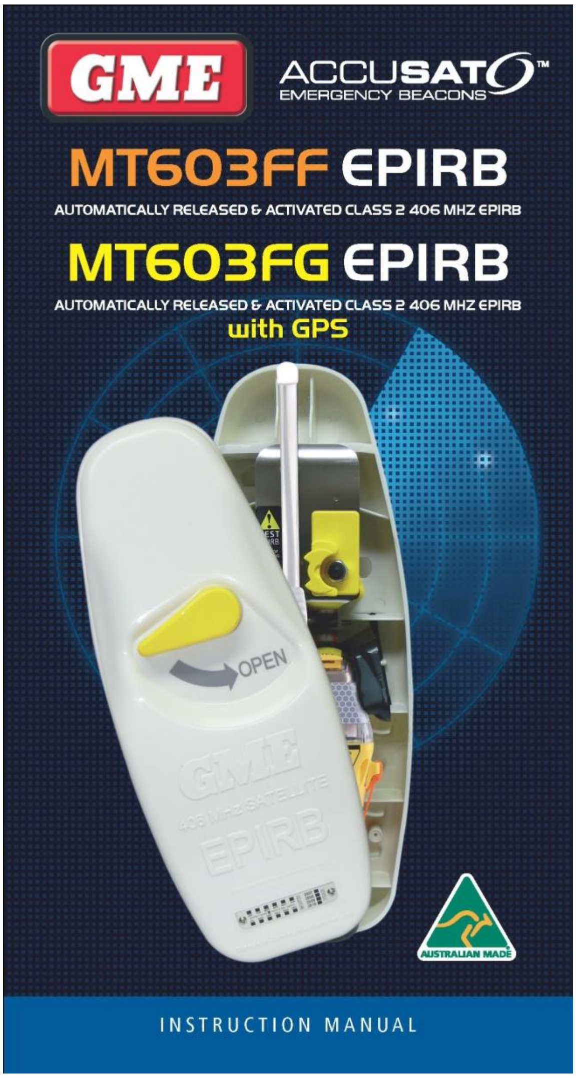
MT603G - Description of model differences.

The GME EPIRB Model MT603G is available in two variants;

Model MT603G is designed to stowed in a Manual Release Only Bracket. Model MT603FG is designed to be stowed in an Automatic Release Housing with optional Manual Release. Both variants are electrically identical.





The MT603FG is fitted with a buoyancy-neutral extension (“ boot”) to prevent incorrect insertion into the housing and to increase the size of the fitting such that users may not attempt to fit a non float-free model into the housing.

Date. 30/03/2016 Signed Kevan Wilson-Elswood
Technical Compliance Manager

Outside and the inside look of the extension “boot”

The bottom of the MT603G EPIRB with the grooves for the extension “boot” mounting

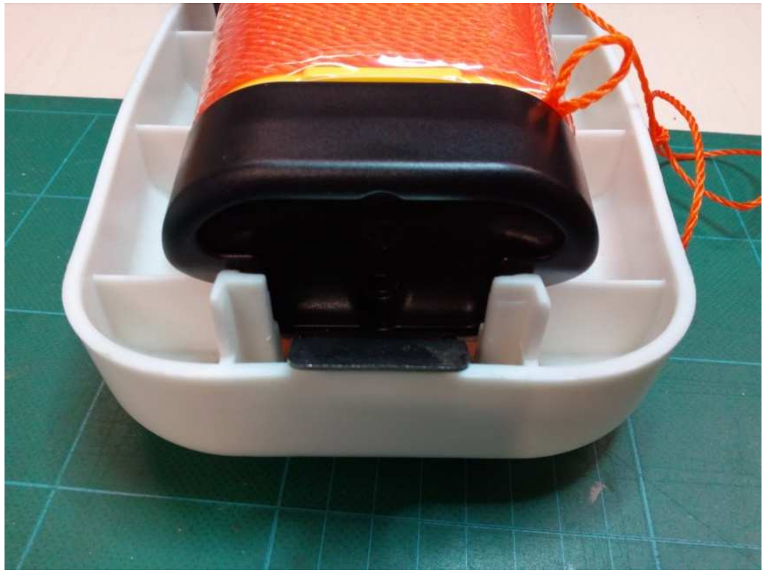
The extension “boot” and MT603G – before connecting

Fitting the extension “boot” to the EPIRB housing

Securing the “boot” with the stainless screws to the bottom of the EPIRB housing

Different angles of the MT603G with the "boot" attached to the bottom of the EPIRB housing

Fitting the MT603G (with the "boot" attached) into a Float-free housing -MT603FG-



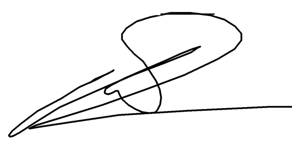
A complete check-list of technical information provided in support of the type-approval

APPENDIX F TO ANNEX F

Table F-F.l: Check-List of Technical Data Provided by Beacon Manufacturer

Tick (V) to indicate submissio	Applicable C/S T.007 requirement	Description of technical information item	File name, title of document, page, section, where the item is located
X	5(a)	Application Form (Annex G)	MT603G_Annex G_2016v2.pdf
N/A	6.2	Change Notice Form (Annex H)	
X	5(m)	Quality Assurance Plan (Annex L)	MT603G Annex L.pdf
X	5(b)	Photos of the beacon in all operational configurations	
X	5(c)	Pre-test discharge data and analysis, table F-E.2	MT603G_Appendix_E_to_Annex_F-7yrs+1.pdf
X	5(d)	List and analysis of operating modes, Table F-E.l	MT603G_Appendix_E_to_Annex_F-7yrs+1.pdf
X	5(e)	Beacon manuals	48807-A_MT603FG Instruction_Manual.pdf
X	5(e)	Beacon technical Data sheet	48807-A_MT603FG Instruction_Manual.pdf
X	5(f)	Marketing brochure	MT603 Brochure.pdf
X	5(g)	Battery cell technical data sheet	Battery Data Sheet_LO26SX.pdf
X	5(g)	Electrical diagramme of the battery pack	MT603G__Battery_Pack.pdf
X	5(h)	Beacon labels and markings	42719-1_MT403Fx-MT603Fx Bulkhead Instruction placard.pdf 42867-7_ MT401Fx_MT403Fx_MT603Fx Float Free Housing -HRU Expiry Plate.pdf 45730_1 MT603 FaceB.pdf 45731_1 MT603 FaceC.pdf 45732_1 MT603 FaceD.pdf 45733-1_MT603_FaceE.pdf 47424-2_MT600_Bulhhead Instruction Placard.pdf MT600G_Cap_45740-1.pdf MT600_Cap_45739-1.pdf
X	5(i-i)	Reference oscillator type and specification	Deaclaration of TCXO installation - MT603G.pdf
X	5(i-ii)	Long-term frequency stability (LTS)	2012_137 E5344LFT MTS 10-year prediction.pdf
X	5(i-iii)	Technical data for TCXO/MCXOs	TCXO Data Sheet E5344LF(T) .pdf
X	5(i-iv)	Report on oscillator ageing	2010_029 E5344LFT MTS 5-year prediction.pdf
X	5(i-v)	Serial Number and temperature gradient results (graph, summary and Excel file)	MT603FG_1410407582_E5344_NK 9508
X	5(j-i)	Design: protection against continuous transmission	MT603 Family_Continuous Transmit Inhibit_5_j_i.pdf

X	5(j-ii)	Design: frequency 5-year frequency stability	MT603G_MT603 5 year stabillity statement_ 5_j_ii.pdf
X	5(j-iii)	Design: protection against repetitive self-test	MT603G Protection from Repetitive_self_test 5_j_iii.pdf
X	5(j-iv)	Design: self-test default values	MT603G Default Location 5_j_iv.pdf
X	5(j-v)	Design: protection against GNSS receiver faulty operation	MT603G Erroneous location 5_j_v.pdf
X	5(k)	Matching network	Matching Network-46798-2.pdf
N/A	5(1)	Antenna cable type and maximum RF-losses	
X	5(n)	GNSS receiver operating cycle and battery current	MT603G Modes of Operation-Antenova.pdf
X	5(n)	Internal GNSS receiver and antenna data sheets	GNSS Receiver Data sheet -M10478-A2_12MD-0050-1-PS.pdf
N/A	5(o)	Interface with external navigation device	
N/A	5(p-i)	External ancillary devices: technical data sheets	
N/A	5(p-ii)	External ancillary devices: details of electrical	
X	5(q)	Description of differences between beacon model variants	MT603G_Description of Differences
X	5(r)	Check-list	MT603G-Appendix_F to Annex F
X	5(s)	Statement on worst-case operating temperature	MT603G_MT603_Minimum operational life temp.pdf
X	5(t)	Statement on known non-compliances	MT603G_MT603_Statement of Non-Compliance.pdf
X	A.3.8.7	Position Data Encoding: Tables F-C.1,F-C.2,F-C3	MT603G_Manufacturers_ Test_Report-Appendix_G to Annex F v1.pdf
	A.2.8	Beacon Coding Software: Tables F-D.l , F-D.2 and F-D.3	
		Other	



22/3/2016 MT603G Kevan Wilson-Elswood, Technical Compliance Manager, kelswood@gme.net.au

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Statement on worst-case operating temperature

GME Kingray

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Within the C/S T.001 Class 2 operational temperature range, the MT603G and MT603 will attain minimum operational lifetime at a temperature of -20°C.

Date. 30/03/2016 Signed Kevan Wilson-Elswood

Technical Compliance Manager

Statement on known non-compliances

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Statement of Non-Compliance to C/S T.001 Issue 3, Revision 16 (Dec 2015)

The GME EPIRB Model MT603G and MT603 are fully compliant to C/S T.001 Issue 3, Revision 16(Dec 2015) as applicable to type.

Date. 30/03/2016 Signed Kevan Wilson-Elswood
Technical Compliance Manager

Manufacturer's position data encoding test results

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APPENDIX G TO ANNEX F

Standard Communication Pty Ltd

Report On

Cospas-Sarsat 406 MHz Emergency Beacon Testing
of the GME EPIRB “MT603G”
in accordance with C/S T.007

(Drawing No. 48887 Issue 1)

Test facility: Standard Communications Pty Ltd
17 Gibbon Road, Winston Hills, NSW 2153, Australia
Ph: +61 (2) 8867 6000
www: www.gme.net.au
Contact : Kevan Wilson-Elswood
Email : kelswood@gme.net.au

Report on: GME EPIRB Model MT603G

Prepared by: Kevan Wilson-Elswood

Date of Issue: 29th March2016

History of the report Issue/revisions:

Report No. – Issue No.	Date of Issue	Reason for re-issue
Dwg. 48887 Issue 1	29/03/2016	Initial Release

Section Contents Page

1. Scope

   This report describes the limited testing performed and results produced by the GME EPIRB model MT603G when tested by Standard Communications.
   The purpose of testing is to verify that the MT603G Model and variants comply with Navigational requirements of C/S T.001 as tested according to C/S T.007 section A.3.8.7

2. Reference Documents

   Specification for COSPAS-SARSAT 406 MHz Distress Beacons C/S T.001 Issue 3 – Revision 16 December 2015.
   COSPAS-SARSAT 406 MHz Beacon Type Approval Standard, C/S T.007 Issue 4 – Revision 10 December 2015.

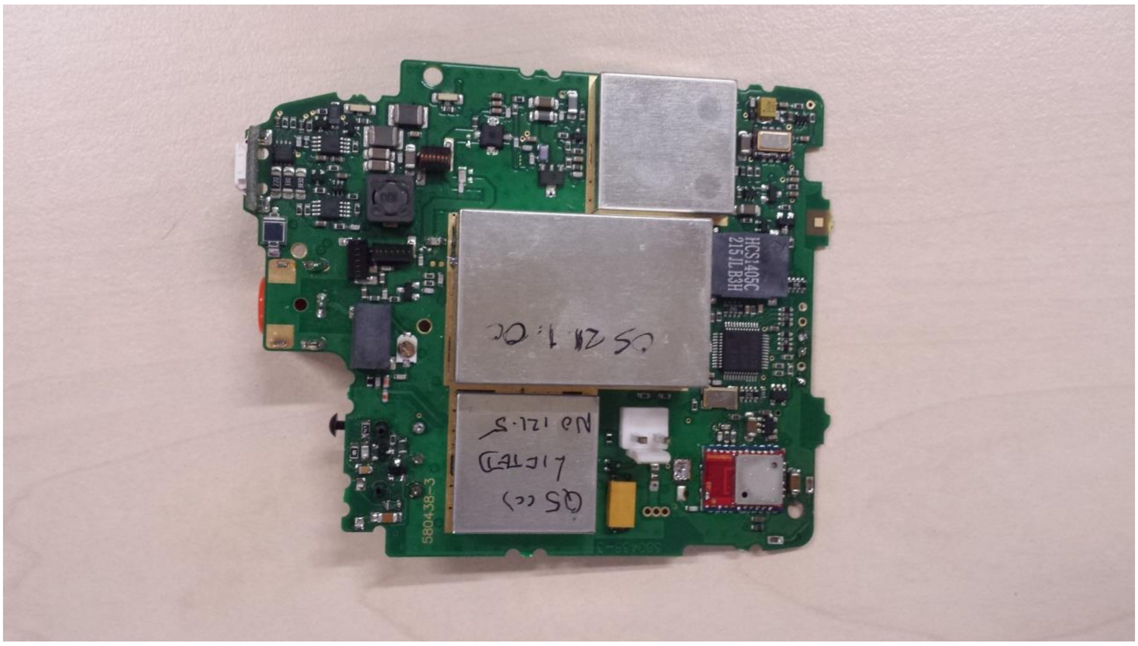
3. Details of Test samples

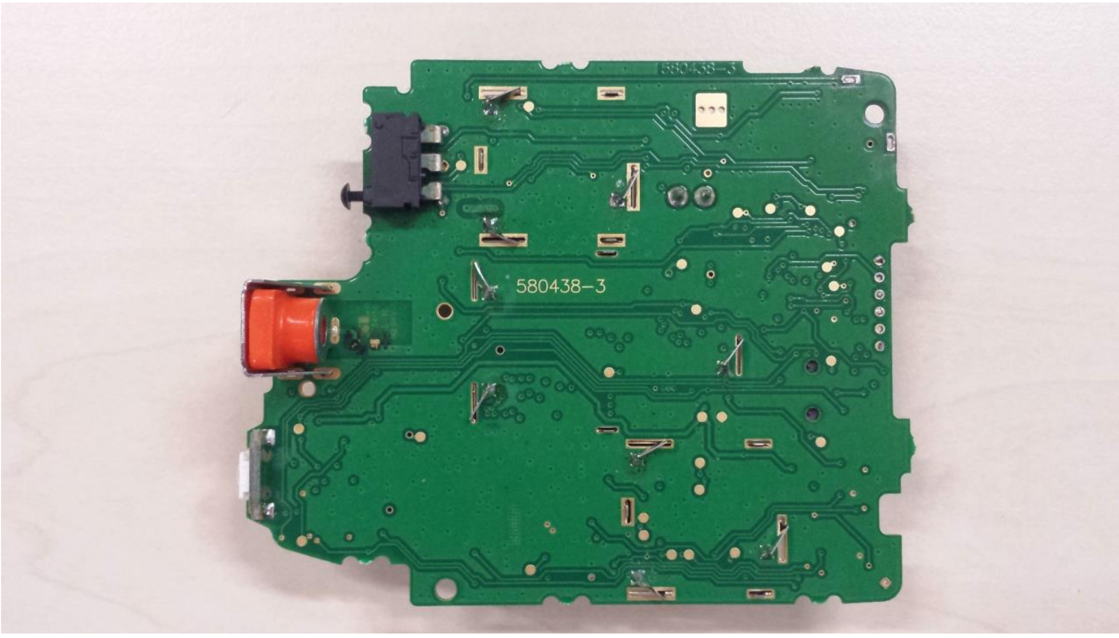
- Model MT603G
- Serial Number : 99
- Circuit Board Number 580438 v 3; Firmware OS0021 Version 1.00 (8/12/2014)
- The equipment under test (EUT) was an isolated circuit board of the MT603G.

  For GNSS testing, the 406MHz transmitter was connected to the 5W input of a WS Technologies Beacon Tester Model BT100S and this device used for decoding.
  A serial Data interface was connected to the circuit board to facilitate simulation of the GNSS NMEA sentences.
  The circuit board was powered with a standard MT603G battery pack.

- Equipment used during Test;
  WS Technologies Beacon Tester Model BT100S,
  Windows 7 Professional PC with serial interface.
  GME Beacon Programmer MT400DPK with software version DS0023.6.11

- Photographs of the EUT under test;





4. Type approval testing

- Applicable C/S standards

  C/S T.001 Issue 3 – Revision 16 December 2015.
  C/S T.007 Issue 4 – Revision 10 December 2015.

- Deviations
  Testing of Standard Location Protocol per. A-3.8.7 was performed with the EUT coded with Serial Number 9999.

- EUT Modifications during TA testing

Modification State (Mod State)	Date of Implementation	Reasons for modification	Description of modification, HW/FW P/Ns,SW version/release after modification
0	1 March 2015	Initial Version	-

- The EUT was operated in all normal modes and Self-Test modes during testing.

5. Test Results

5.1 Test Results Summary Table

Parameters to be Measured	Range of Specification	Units	Test Results			Comments
27/3/2016, MT603G ,S/N 99, Mod State 1 **Position Data Encoding (A.3.8.7)**	correct					Standard Location Protocol was tested with serial number 9999. **PASS** See decoded transmissions pp 9-10. Tables F-C.1 F-C.2 F-C.3

5.2 Position Data Encoding

Date of Test	27-03-2016,28-03-2016
Specification	C/S T.007 – section A.2.5
Beacon Model	MT603G
EUT Mod State	1
Serial Number	99
EUT system configuration during the test, including antenna, external ancillary devices and modes of their operation	The EUT was fitted with a 50 Ohm attenuator to the 406.04MHz transmitter via coaxial cable which was then connected to a WS Technologies BT100S Beacon Tester. The 121 MHz Transmitter was disabled.
Performed by	K Wilson-Elswood
Environmental conditions	Ambient Temperature 22C
Deviations from standard test procedures	Standard Location Protocol as tested with Serial number 9999
Non-compliances noticed	No non-compliances

Test Method.

The MT603G has an auxiliary communications port used for testing only.
Upon Power ON, the GNSS Receiver immediately produces NMEA sentences which are monitored and parsed by the microprocessor navigation routines.
If data is detected on the auxiliary communications port, the microprocessor treats this as a priority, ignores data from GNSS Receiver and the data from the auxiliary port is parsed by the navigation routines
Immediately a valid location is derived, the GNSS receiver is switched to 'Sleep'
The auxiliary communications port is only monitored while GNSS Receiver is ON. After an initial location is derived the GNSS Receiver is switched ON for 6mins.every 30mins.
To Test Navigation Scripts, T.007 Annex D, a terminal program is used that has internal Pascal scripting functions.
Packets of 8 NMEA sentences are sent to the auxiliary Port. After the first location, the second packet is delayed 33mins. to ensure NMEA sentences are sent in the centre of the GNSS ON window. Thereafter, NMEA packets are sent approximately every 30mins.

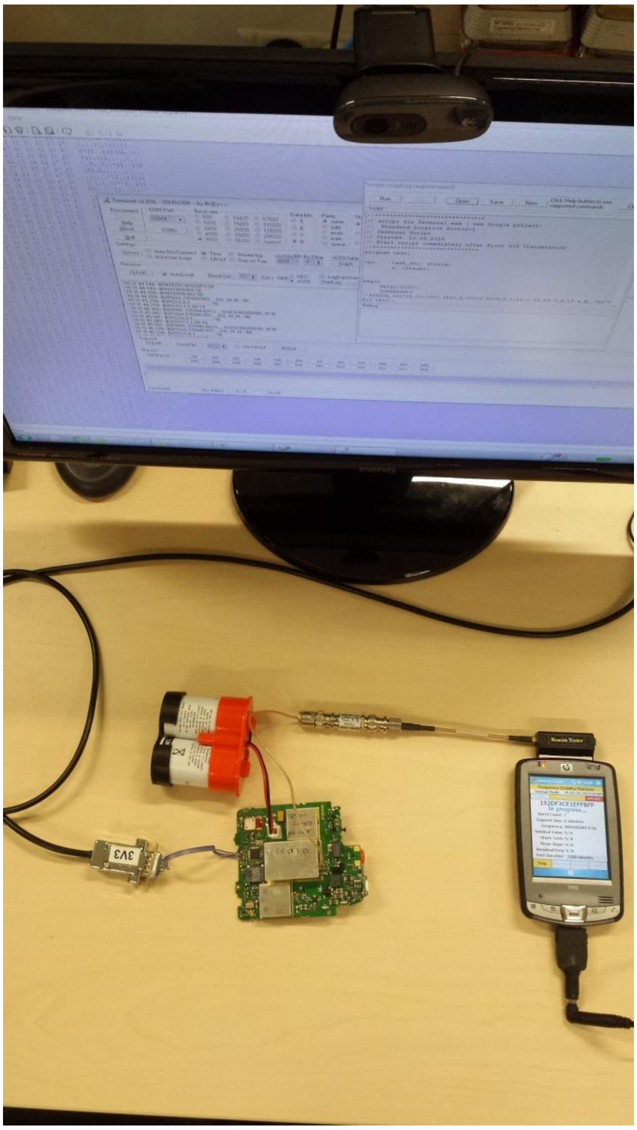
To verify timing, a separate 'Port Monitor' program is used.
This monitor program shows 'request' / 'answer' messages.
Note - 'Request' entries represent data sent from the Terminal (emulator) program.
At no time does the microprocessor ever send data to the GNSS device or to the Terminal Emulator

During Self-test routines, two different Terminal Pascal scripts are used. One script sends 41 identical packets (as per first section of example shown below) with 100msec delay between packets. The second script sends 41 identical packets (as per first section of example shown below) with 1 sec delay between packets. This process ensures that a valid NMEA sentence is continuously “presented” to the microprocessor whilst performing the self-test routines.

Transmissions are logged by a WS Technologies BT100S Beacon Tester used in Stability mode. This mode generates a CSV file including complete message for decoding.

Encoding of the BCH fields was verified for each transmission using the Beacon Decoding Utility provided on the Cospas-Sarsat Website.

Test Configuration for Navigation / Coding tests



Extract of Pascal Script generating NMEA sentences (first two GNSS On periods only shown);

Standard Location

```
program test;

var     test_str: string;
        a: integer;


begin
   Delay(3000);
   ComSendstr('$GPGGA,061706.00,0000.9833,S,00000.9500,W,1,11,0.86,59.9,M,19.4,M,,*6F'+#13 +#10);
   ComSendstr('$GPGSA,A,3,03,06,5,18,2122,14,1909,27,16,,.45,0.861.16*07'+#13 +#10);
   ComSendstr('$GPGSV,4,1,1,03,38,24,45,06,5,259,48,09,16,092,44,14,37,350,48*7F'+#13 +#10);
   ComSendstr('$GPGSV,4,2,16,15,21,136,40,16,09,288,28,18,62,156,46,19,17,221,41*7E'+#13 +#10);
   ComSendstr('$GPGSV,4,3,1,21,51,085,46,22,61,249,48,27,15,103,43,29,03,022,42*7F'+#13 +#10);
   ComSendstr('$GPGSV,4,4,1,30,03,310,,42,49,340,42,48,03,082,37,50,50,349,44*79'+#13 +#10);
   ComSendstr('$GPRMC,061706.00,A,3349.19882,S,15107.20563,E,0.003,,310511,,,A*68'+#13 +#10);
   ComSendstr('$GPGGA,061706.00,0000.9833,S,00000.9500,W,1,11,0.86,59.9,M,19.4,M,,*6F'+#13 +#10);
   Delay(1980000);
   ComSendstr('$GPGGA,061706.00,0000.8833,N,00000.8500,E,1,11,0.86,59.9,M,19.4,M,,*60'+#13 +#10);
   ComSendstr('$GPGSA,A,3,03,06,5,18,2122,14,1909,27,16,,.45,0.861.16*07'+#13 +#10);
   ComSendstr('$GPGSV,4,1,1,03,38,24,45,06,5,259,48,09,16,092,44,14,37,350,48*7F'+#13 +#10);
   ComSendstr('$GPGSV,4,2,16,15,21,136,40,16,09,288,28,18,62,156,46,19,17,221,41*7E'+#13 +#10);
   ComSendstr('$GPGSV,4,3,1,21,51,085,46,22,61,249,48,27,15,103,43,29,03,022,42*7F'+#13 +#10);
   ComSendstr('$GPGSV,4,4,1,30,03,310,,42,49,340,42,48,03,082,37,50,50,349,44*79'+#13 +#10);
```

```
ComSendstr('$GPRMC,061706.00,A,3349.19882,S,15107.20563,E,0.003,,310511,,,A*68'+#13 +#10);
ComSendstr('$GPGGA,061706.00,0000.8833,N,00000.8500,E,1,11,0.86,59.9,M,19.4,M,,*60'+#13 +#10);
Delay(1800000);
```

……….continues…..

Extract of the table generated from BT100S exported csv file.

File:	MT603G	SLP–74	(Caution! INT REF used.)			TEST STAGE			
Date	Time		Burst	UIN	Full Hex		Bits 65~85	Bits 113~132	
27/03/2016	7:50:36	AM	0	0					
27/03/2016	7:51:19	AM	1	192DF3CE1EFFBFF	FFFE2F8C96F9E70F7FDFFB53F5F783E0F66C	1	FFBFF	83E0F	
27/03/2016	7:52:08	AM	2	192DF3CE1EFFBFF	FFFE2F8C96F9E70F80200223E5B78420EDF0	2	100400	8420E	Request: 27/03/2016 7:51:26 AM
27/03/2016	7:52:59	AM	3	192DF3CE1EFFBFF	FFFE2F8C96F9E70F80200223E5B78420EDF0				
27/03/2016	7:53:50	AM	4	192DF3CE1EFFBFF	FFFE2F8C96F9E70F80200223E5B78420EDF0				
27/03/2016	7:54:40	AM	5	192DF3CE1EFFBFF	FFFE2F8C96F9E70F80200223E5B78420EDF0				
27/03/2016	7:55:29	AM	6	192DF3CE1EFFBFF	FFFE2F8C96F9E70F80200223E5B78420EDF0				
27/03/2016	7:56:19	AM	7	192DF3CE1EFFBFF	FFFE2F8C96F9E70F80200223E5B78420EDF0				
27/03/2016	7:57:09	AM	8	192DF3CE1EFFBFF	FFFE2F8C96F9E70F80200223E5B78420EDF0				
27/03/2016	7:58:00	AM	9	192DF3CE1EFFBFF	FFFE2F8C96F9E70F80200223E5B78420EDF0				
27/03/2016	7:58:48	AM	10	192DF3CE1EFFBFF	FFFE2F8C96F9E70F80200223E5B78420EDF0				
27/03/2016	7:59:39	AM	11	192DF3CE1EFFBFF	FFFE2F8C96F9E70F80200223E5B78420EDF0				
27/03/2016	8:00:30	AM	12	192DF3CE1EFFBFF	FFFE2F8C96F9E70F80200223E5B78420EDF0				
27/03/2016	8:01:20	AM	13	192DF3CE1EFFBFF	FFFE2F8C96F9E70F80200223E5B78420EDF0				
27/03/2016	8:02:09	AM	14	192DF3CE1EFFBFF	FFFE2F8C96F9E70F80200223E5B78420EDF0				
27/03/2016	8:02:58	AM	15	192DF3CE1EFFBFF	FFFE2F8C96F9E70F80200223E5B78420EDF0				
27/03/2016	8:03:46	AM	16	192DF3CE1EFFBFF	FFFE2F8C96F9E70F80200223E5B78420EDF0				
27/03/2016	8:04:38	AM	17	192DF3CE1EFFBFF	FFFE2F8C96F9E70F80200223E5B78420EDF0				
27/03/2016	8:05:28	AM	18	192DF3CE1EFFBFF	FFFE2F8C96F9E70F80200223E5B78420EDF0				
27/03/2016	8:06:18	AM	19	192DF3CE1EFFBFF	FFFE2F8C96F9E70F80200223E5B78420EDF0				
27/03/2016	8:07:08	AM	20	192DF3CE1EFFBFF	FFFE2F8C96F9E70F80200223E5B78420EDF0				
27/03/2016	8:07:56	AM	21	192DF3CE1EFFBFF	FFFE2F8C96F9E70F80200223E5B78420EDF0				
27/03/2016	8:08:47	AM	22	192DF3CE1EFFBFF	FFFE2F8C96F9E70F80200223E5B78420EDF0				
27/03/2016	8:09:39	AM	23	192DF3CE1EFFBFF	FFFE2F8C96F9E70F80200223E5B78420EDF0				
27/03/2016	8:10:31	AM	24	192DF3CE1EFFBFF	FFFE2F8C96F9E70F80200223E5B78420EDF0				
27/03/2016	8:11:21	AM	25	192DF3CE1EFFBFF	FFFE2F8C96F9E70F80200223E5B78420EDF0				
27/03/2016	8:12:11	AM	26	192DF3CE1EFFBFF	FFFE2F8C96F9E70F80200223E5B78420EDF0				
27/03/2016	8:13:03	AM	27	192DF3CE1EFFBFF	FFFE2F8C96F9E70F80200223E5B78420EDF0				
27/03/2016	8:13:52	AM	28	192DF3CE1EFFBFF	FFFE2F8C96F9E70F80200223E5B78420EDF0				
27/03/2016	8:14:42	AM	29	192DF3CE1EFFBFF	FFFE2F8C96F9E70F80200223E5B78420EDF0				
27/03/2016	8:15:34	AM	30	192DF3CE1EFFBFF	FFFE2F8C96F9E70F80200223E5B78420EDF0				
27/03/2016	8:16:25	AM	31	192DF3CE1EFFBFF	FFFE2F8C96F9E70F80200223E5B78420EDF0				
27/03/2016	8:17:14	AM	32	192DF3CE1EFFBFF	FFFE2F8C96F9E70F80200223E5B78420EDF0				
27/03/2016	8:18:02	AM	33	192DF3CE1EFFBFF	FFFE2F8C96F9E70F80200223E5B78420EDF0				
27/03/2016	8:18:51	AM	34	192DF3CE1EFFBFF	FFFE2F8C96F9E70F80200223E5B78420EDF0				
27/03/2016	8:19:38	AM	35	192DF3CE1EFFBFF	FFFE2F8C96F9E70F80200223E5B78420EDF0				
27/03/2016	8:20:26	AM	36	192DF3CE1EFFBFF	FFFE2F8C96F9E70F80200223E5B78420EDF0				
27/03/2016	8:21:14	AM	37	192DF3CE1EFFBFF	FFFE2F8C96F9E70F80200223E5B78420EDF0				
27/03/2016	8:22:03	AM	38	192DF3CE1EFFBFF	FFFE2F8C96F9E70F80200223E5B78420EDF0				
27/03/2016	8:22:55	AM	39	192DF3CE1EFFBFF	FFFE2F8C96F9E70F80200223E5B78420EDF0				
27/03/2016	8:23:45	AM	40	192DF3CE1EFFBFF	FFFE2F8C96F9E70F80200223E5B78420EDF0				
27/03/2016	8:24:38	AM	41	192DF3CE1EFFBFF	FFFE2F8C96F9E70F0000071BB4B78360D373	3	000000	8360D	Request: 27/03/2016 8:24:26 AM
27/03/2016	8:25:25	AM	42	192DF3CE1EFFBFF	FFFE2F8C96F9E70F0000071BB4B78360D373				
27/03/2016	8:26:17	AM	43	192DF3CE1EFFBFF	FFFE2F8C96F9E70F0000071BB4B78360D373				
27/03/2016	8:27:08	AM	44	192DF3CE1EFFBFF	FFFE2F8C96F9E70F0000071BB4B78360D373				
27/03/2016	8:27:59	AM	45	192DF3CE1EFFBFF	FFFE2F8C96F9E70F0000071BB4B78360D373				
27/03/2016	8:28:51	AM	46	192DF3CE1EFFBFF	FFFE2F8C96F9E70F0000071BB4B78360D373				
27/03/2016	8:29:42	AM	47	192DF3CE1EFFBFF	FFFE2F8C96F9E70F0000071BB4B78360D373				

…..continues…..

Shown below are tables as per. above for each protocol with intermediary transmissions removed;

User Location Protocol

File:	MT603G	ULP– —1	(Caution! INT REF used.)						
Date	Time		Burst	UIN	Full Hex	TEST STAGE	Bit 108	Bits 109~132	
27/03/2016	6:20:42	PM	0	0					
27/03/2016	6:21:49	PM	1	992E40018C00F9D	FFFE2FCC972000C6007CEB7FB16FE0FF0146	1	0	FE0FF0	
27/03/2016	6:22:37	PM	2	992E40018C00F9D	FFFE2FCC972000C6007CEB7FB1700100084B	2	1	001000	Request: 27/03/2016 6:22:03 PM
27/03/2016	6:55:07	PM	41	992E40018C00F9D	FFFE2FCC972000C6007CEB7FB16000000E27	3	0	000000	Request: 27/03/2016 6:55:03 PM
27/03/2016	7:25:57	PM	78	992E40018C00F9D	FFFE2FCC972000C6007CEB7FB16006B3C2F3	4	0	006B3C	Request: 27/03/2016 7:25:04 PM
27/03/2016	7:55:51	PM	114	992E40018C00F9D	FFFE2FCC972000C6007CEB7FB17007B3C49F	5	1	007B3C	Request: 27/03/2016 7:55:04 PM
27/03/2016	8:25:56	PM	150	992E40018C00F9D	FFFE2FCC972000C6007CEB7FB17B28590C48	6	1	B28590	Request: 27/03/2016 8:25:05 PM
27/03/2016	8:55:48	PM	186	992E40018C00F9D	FFFE2FCC972000C6007CEB7FB17B295907AB	7	1	B29590	Request: 27/03/2016 8:55:05 PM
27/03/2016	9:25:46	PM	222	992E40018C00F9D	FFFE2FCC972000C6007CEB7FB16B41B400FA	8	0	B41B40	Request: 27/03/2016 9:25:06 PM
27/03/2016	9:55:42	PM	258	992E40018C00F9D	FFFE2FCC972000C6007CEB7FB16B3CB4095C	9	0	B3CB40	Request: 27/03/2016 9:55:06 PM
27/03/2016	10:25:41	PM	294	992E40018C00F9D	FFFE2FCC972000C6007CEB7FB174918A7EF2	10	1	4918A7	Request: 27/03/2016 10:25:07 PM
SELF-TEST									
27/03/2016	11:02:11	PM	336	992E40018C00F9D	FFFED0CC972000C6007CEB7FB16FE0FF0146	11	0	FE0FF0	
27/03/2016	11:02:32	PM	337	992E40018C00F9D	FFFED0CC972000C6007CEB7FB16FE0FF0146	12	0	FE0FF0	Initial Request: 27/03/2016 11:02:18 PM
27/03/2016	11:04:08	PM	338	992E40018C00F9D	FFFED0CC972000C6007CEB7FB16FE0FF0146	12	0	FE0FF0	Initial Request: 27/03/2016 11:04:05 PM

Standard Location Protocol

File:	MT603G	SLP–74	(Caution! INT REF used.)			TEST STAGE			
Date	Time		Burst	UIN	Full Hex		Bits 65~85	Bits 113~132	
27/03/2016	7:50:36	AM	0	0					
27/03/2016	7:51:19	AM	1	192DF3CE1EFFBFF	FFFE2F8C96F9E70F7FDFFB53F5F783E0F66C	1	0FFBFF	83E0F	
27/03/2016	7:52:08	AM	2	192DF3CE1EFFBFF	FFFE2F8C96F9E70F80200223E5B78420EDF0	2	100400	8420E	Request: 27/03/2016 7:51:26 AM
27/03/2016	8:24:38	AM	41	192DF3CE1EFFBFF	FFFE2F8C96F9E70F0000071BB4B78360D373	3	000000	8360D	Request: 27/03/2016 8:24:26 AM
27/03/2016	8:54:35	AM	77	192DF3CE1EFFBFF	FFFE2F8C96F9E70F00567E420FB70F2220AE	4	000ACF	0F222	Request: 27/03/2016 8:54:27 AM
27/03/2016	9:24:34	AM	113	192DF3CE1EFFBFF	FFFE2F8C96F9E70F009675D5C03793A602AA	5	0012CE	93A60	Request: 27/03/2016 9:24:27 AM
27/03/2016	9:54:36	AM	149	192DF3CE1EFFBFF	FFFE2F8C96F9E70F80767B7A5EB70FA10C2D	6	100ECF	0FA10	Request: 27/03/2016 9:54:28 AM
27/03/2016	10:24:31	AM	185	192DF3CE1EFFBFF	FFFE2F8C96F9E70FD94B228DAC7780A00F76	7	1B2964	80A00	Request: 27/03/2016 10:24:21 AM
27/03/2016	10:55:16	AM	222	192DF3CE1EFFBFF	FFFE2F8C96F9E70FD96B26A6D97784E007A2	8	1B2D64	84E00	Request: 27/03/2016 10:54:29 AM
27/03/2016	11:25:13	AM	258	192DF3CE1EFFBFF	FFFE2F8C96F9E70F5A36843A13B7038016F7	9	0B46D0	03801	Request: 27/03/2016 11:24:29 AM
27/03/2016	11:55:11	AM	294	192DF3CE1EFFBFF	FFFE2F8C96F9E70F5A16801166B7080098C0	10	0B42D0	08009	Request: 27/03/2016 11:54:30 AM
27/03/2016	12:25:10	PM	330	192DF3CE1EFFBFF	FFFE2F8C96F9E70FA4B1537353378020001B	11	14962A	80200	Request: 27/03/2016 12:24:30 PM
SELF-TEST									
27/03/2016	12:28:23	PM	334	192DF3CE1EFFBFF	FFFED08C96F9E70F7FDFFB53F5F783E0F66C	12	0FFBFF	83E0F	
27/03/2016	12:29:11	PM	335	192DF3CE1EFFBFF	FFFED08C96F9E70F7FDFFB53F5F783E0F66C	13	0FFBFF	83E0F	Initial Request: 27/03/2016 12:29:05 PM
27/03/2016	12:29:34	PM	336	192DF3CE1EFFBFF	FFFED08C96F9E70F7FDFFB53F5F783E0F66C	13	0FFBFF	83E0F	Additional S/T during above Data stream
27/03/2016	12:30:35	PM	337	192DF3CE1EFFBFF	FFFED08C96F9E70F7FDFFB53F5F783E0F66C	13	0FFBFF	83E0F	Initial Request: 27/03/2016 12:30:32 PM

National Location Protocol

File:	MT603G	NLP– –2	(Caution! INT REF used.)						
Date	Time		Burst	UIN	Full Hex	TEST STAGE	Bits 59~85	Bits 113~126	
27/03/2016	1:06:41	PM	0	0					
27/03/2016	1:08:03	PM	1	1934E08CBF81FE0	FFFE2F8C9A70465FC0FF07A3F4379F3C0010	1	3F81FE0	27CF	
27/03/2016	1:08:51	PM	2	1934E08CBF81FE0	FFFE2F8C9A704660010004140D77A1380347	2	4002000	284E	Request: 27/03/2016 1:08:09 PM
27/03/2016	1:41:21	PM	41	1934E08CBF81FE0	FFFE2F8C9A7046400000035AF8B79B340105	3	0000000	26CD	Request: 27/03/2016 1:41:10 PM
27/03/2016	2:11:18	PM	77	1934E08CBF81FE0	FFFE2F8C9A7046400CB3C25121B718340B28	4	0019678	060D	Request: 27/03/2016 2:11:10 PM
27/03/2016	2:41:17	PM	113	1934E08CBF81FE0	FFFE2F8C9A7046400AB3D35C9BB79C400767	5	001567A	2710	Request: 27/03/2016 2:41:11 PM
27/03/2016	3:11:19	PM	149	1934E08CBF81FE0	FFFE2F8C9A7046600DB3BD1900F71D00029F	6	401B677	0740	Request: 27/03/2016 3:11:11 PM
27/03/2016	3:41:14	PM	185	1934E08CBF81FE0	FFFE2F8C9A70467650590366E4B71B00059E	7	6CA0B20	06C0	Request: 27/03/2016 3:41:12 PM
27/03/2016	4:12:00	PM	222	1934E08CBF81FE0	FFFE2F8C9A704676515904E4AFB787000A6C	8	6CA2B20	21C0	Request: 27/03/2016 4:11:12 PM
27/03/2016	4:41:56	PM	258	1934E08CBF81FE0	FFFE2F8C9A70465681B405B484B71C040195	9	2D03680	0701	Request: 27/03/2016 4:41:13 PM
27/03/2016	5:11:55	PM	294	1934E08CBF81FE0	FFFE2F8C9A7046567AB4056908B7802408F2	10	2CF5680	2009	Request: 27/03/2016 5:11:13 PM
27/03/2016	5:41:53	PM	330	1934E08CBF81FE0	FFFE2F8C9A7046691F8A7A07D0F781000D6D	11	523F14F	2040	Request: 27/03/2016 5:41:14 PM
SELF-TEST									
27/03/2016	5:55:29	PM	346	1934E08CBF81FE0	FFFED08C9A70465FC0FF07A3F4379F3C0010	12	3F81FE0	27CF	
27/03/2016	5:56:11	PM	347	1934E08CBF81FE0	FFFED08C9A70465FC0FF07A3F4379F3C0010	13	3F81FE0	27CF	Initial Request: 27/03/2016 5:56:03 PM
27/03/2016	5:56:34	PM	348	1934E08CBF81FE0	FFFED08C9A70465FC0FF07A3F4379F3C0010	13	3F81FE0	27CF	Additional S/T during above Data stream
27/03/2016	5:57:44	PM	349	1934E08CBF81FE0	FFFED08C9A70465FC0FF07A3F4379F3C0010	13	3F81FE0	27CF	Initial Request: 27/03/2016 5:57:40 PM
27/03/2016	5:58:05	PM	350	1934E08CBF81FE0	FFFED08C9A70465FC0FF07A3F4379F3C0010	13	3F81FE0	27CF	Additional S/T during above Data stream

5.3

APPENDIX C TO ANNEX F
NAVIGATION SYSTEM TEST RESULTS

Table F-C.1: Position Data Encoding Results User-Location Protocol

Script Reference (See Table D.1)	Value of Encoded Location Bits Transmitted by Beacon	Confirmation that BCH Correct (✓)
1	Bits 108-132= **0FE0FF0**	✓
2	Bits 108-132= **1001000** Number of seconds after providing navigation data that beacon transmitted the above encoded location information: **34**	✓
3	Bits 108-132= **0000000**	✓
4	Bits 108-132= **0006B3C**	✓
5	Bits 108-132= **1007B3C**	✓
6	Bits 108-132= **1B28590**	✓
7	Bits 108-132= **1B29590**	✓
8	Bits 108-132= **0B41B40**	✓
9	Bits 108-132= **0B3CB40**	✓
10	Bits 108-132= **14918A7**	✓
11	Bits 108-132= **0FE0FF0**	✓
12	Bits 108-132= **0FE0FF0**	✓

Table F-C.2: Position Data Encoding Results Standard Location Protocol

Script Reference (See Table D.2)	Value of Encoded Location Bits Transmitted by Beacon	Confirmation that BCH Correct (✓)
1	Bits 65-85= **0FFBFF** Bits 113-132= **83E0F**	✓
2	Bits 65-85= **100400** Bits 113-132= **8420E** Number of seconds after providing navigation data that beacon transmitted the above encoded location information: **42**	✓
3	Bits 65-85= **000000** Bits 113-132= **8360D**	✓
4	Bits 65-85= **000ACF** Bits 113-132= **0F222**	✓
5	Bits 65-85= **0012CE** Bits 113-132= **93A60**	✓
6	Bits 65-85= **100ECF** Bits 113-132= **0FA10**	✓
7	Bits 65-85= **1B2964** Bits 113-132= **80A00**	✓
8	Bits 65-85= **1B2D64** Bits 113-132= **84E00**	✓
9	Bits 65-85= **0B46D0** Bits 113-132=**03801**	✓
10	Bits 65-85= **0B42D0** Bits 113-132= **08009**	✓
11	Bits 65-85= **14962A** Bits 113-132= **80200**	✓
12	Bits 65-85= **0FFBFF** Bits 113-132= **83E0F**	✓
13	Bits 65-85= **0FFBFF** Bits 113-132= **83E0F**	✓

Table F-C.3: Position Data Encoding Results National Location Protocol

Script Reference (See Table D.3)	Value of Encoded Location Bits Transmitted by Beacon	Confirmation that BCH Correct (✓)
1	Bits 59-85= **3F81FE0** Bits 113-126= **27CF**	✓
2	Bits 59-85= **4002000** Bits 113-126= **284E** Number of seconds after providing navigation data that beacon transmitted the above encoded location information: **42**	✓
3	Bits 59-85= **0000000** Bits 113-126= **26CD**	✓
4	Bits 59-85= **0019678** Bits 113-126= **060D**	✓
5	Bits 59-85= **001567A** Bits 113-126= **2710**	✓
6	Bits 59-85= **401B677** Bits 113-126= **0740**	✓
7	Bits 59-85= **6CA0B20** Bits 113-126= **06C0**	✓
8	Bits 59-85= **6CA2B20** Bits 113-126= **21C0**	✓
9	Bits 59-85= **2D03680** Bits 113-126= **0701**	✓
10	Bits 59-85= **2CF5680** Bits 113-126= **2009**	✓
11	Bits 59-85= **523F14F** Bits 113-126= **2040**	✓
12	Bits 59-85= **3F81FE0** Bits 113-126= **27CF**	✓
13	Bits 59-85= **3F81FE0** Bits 113-126= **27CF**	✓

6. Photographs

Photographs of the EUT and EUT under test are shown within sections 3 and 5.2.

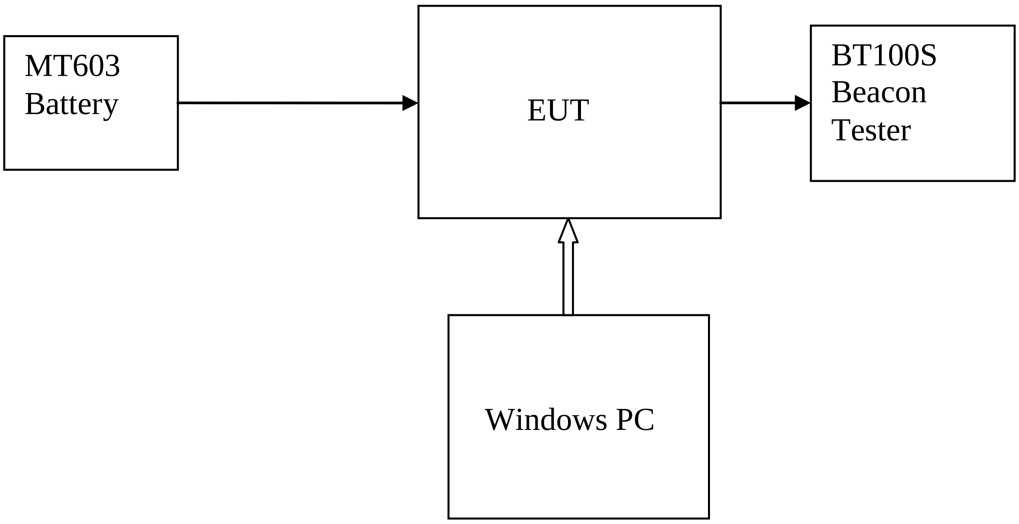
7. Test Equipment

Ref. No.	Name Of Test Equipment	Type/Model	Serial No.	Calibration Due Date
1	WS Technologies Beacon Tester	BT100S	1069	18/01/2018

Measurement Accuracies;

Parameter	Accuracy
Time	+/- 0.5sec
Temperature	+/- 2°C

Block diagram of test setup



- END OF ANNEX F -

121 MHz Power and Battery Current Measurements

EPIRB Model MT603G

IMPROVED ACCURACY OF BATTERY CURRENT MEASUREMENTS AND RF POWER MEASUREMENTS OF 121.5 MHZ SIGNAL

1. INTRODUCTION

From the previous correspondence between COSPAS-SARSAT Secretariat (CSS) and Standard Communications Pty Ltd (GME), related to MT603G type approval, the questions were raised regarding inconsistencies in RF power measurements and the battery currents measurements during 121.5 MHz signal emission, hence the battery life of the EPIRB itself. GME acknowledges and has addressed the issues raised by CSS. Accordingly, all the power and current measurements are repeated in the GME measurement & test facility.

To accurately measure the output power of 121.5 MHz signal, a 50Ω interface adaptor was re-designed to have the lowest possible impact on the accuracy and precision of these measurements across a wide temperature range (-20°C to 55°C). The adaptor influence on the accuracy and precision is not completely eliminated but it is significantly reduced characterised and further used as a correction factor for all the measurements.

To evaluate the performance of the re-designed adaptor two operation modes for 121.5 MHz signal emission were tested:

1. Idle state;
2. 30% modulation;

A temperature chamber was utilized to ensure required temperature conditions. The temperature within the chamber is regulated as follows: 22°C → -20°C → 22°C → 55°C → 22°C. For each of the temperature points a single set of measurement data is acquired: P_{max}, I_0, I_{30}.[1]

2. MEASUREMENT RESULTS

Following are the results of the EPIRBs power and battery currents measurement using two adaptors presented in a tabular form –Table 1. P_{max} values in Table 1 are obtained by adding the correction factor to the measured values of power.

[1] P_{max} – Maximum power at 121.5MHz; I_0- DC current drawn from the power source in idle state; I_{30} – DC current drawn from the power source at 30% modulation.

Table 1: The results of the power and current measurements over a wide temperature range

	MT603G Old Measurement configuration			MT603G New Measurement configuration		
	INITIAL T = 22°C					
	unit 1	unit 2	unit 3	unit 1	unit 2	unit 3
P_0 (dBm)	13.1	12.65	13.5	13.5	13.2	14.2
I_0 (mA)	19.7	19.5	20.4	19.7	19.6	20.3
I_{30} (mA)	31.6	31.8	30.9	31.5	30.9	31
	T = -20°C					
	unit 1	unit 2	unit 3	unit 1	unit 2	unit 3
P_0 (dBm)	13.7	14	14.5	13.6	13.4	14.5
I_0 (mA)	19.1	19.1	20.7	19.1	19.2	20.5
I_{30} (mA)	30.7	31	30.2	30.7	30	30.4
	Back to T = 22°C					
	unit 1	unit 2	unit 3	unit 1	unit 2	unit 3
P_0 (dBm)	12.7	12.5	13.5	13.5	13.2	14.2
I_0 (mA)	19.7	19.5	20.1	19.7	19.6	20
I_{30} (mA)	31.7	32.1	31	31.5	30.9	31.2
	T = 55°C					
	unit 1	unit 2	unit 3	unit 1	unit 2	unit 3
P_0 (dBm)	11.9	11.4	12.9	12.9	12.7	13.9
I_0 (mA)	19.9	19.7	20.4	19.8	19.7	20.3
I_{30} (mA)	32	32.1	31.7	31.9	31.3	31.7
	Back to T = 22°C					
	unit 1	unit 2	unit 3	unit 1	unit 2	unit 3
P_0 (dBm)	12.7	12.45	13.5	13.5	13.2	14.2
I_0 (mA)	19.7	19.6	20.4	19.7	19.6	20.3
I_{30} (mA)	31.5	32.1	30.9	31.5	30.9	31.1

Table 2: Relevant quantities

Quantity	Value	Description
CP_{max}	31.08dB	Correction factor (Adaptor circuit losses ± Err_{PC} ± Err_{SA}).
P_{max}		121.5 MHz max power after correction
I_0		DC current in idle state (MCU+ peripherals)
I_{30}		DC current at 30% modulation
Err_{SA}	±0.5 dB	Spectrum analyser measurement error
Err_I	0.50%	DC current measurement error
Err_{PC}	±0.5 dB	Power conversion error (including cable and connector losses).

Dummy Antenna Impedance: R = 12.7 kΩ (2x5k6+1k5); C = 6.8 pF; R and C are connected in parallel, to create the parallel equivalent of the actual antenna impedance.

3. CONCLUSIONS

It can be seen that measurement results for both power and DC currents are consistent over a wide temperature range, which isn't a case in measurements using previous versions of 50Ω interface adaptor. The new adaptor circuit provides high reliability and repeatability, further it has proven to be resilient to environmental influences, eliminating the problems the previous test adaptor had – caused by minor variations in positioning and alignment in a process of mounting the adaptor to an EPIRB under test.

The DC current consumed by the 121.5 MHz PA stage, during normal modulation, is in range of 10mA – 15mA (the difference between I_{30} and I_0), and is constant across the temperature range.

It should be noted, when the RF power drop occurs at 55°C, not at -20°C, as shown in Omega results the current actually does not drop. So, even under a hypothetical, worst case scenario of a 2 dB power increase the DC current draw would only increase by around:

$$(15\ \text{mA} \cdot 10^{0.2} - 15\ \text{mA})\ \text{mA} = 8.77\ \text{mA} \approx 9\ \text{mA}\ , \tag{1}$$

this is $9\ \text{mAh} \cdot 48\ \text{hours} = 432\ \text{mAh}$. This is around 5.5% of the available battery capacity.

Omega measurement results show EPIRB operating lifetime (T_O) to be 77 hours and 39 minutes, at minimum temperature -20°C with preliminary discharged battery. The hypothetical increase of the DC current drawn from the battery due to increase of the emitted RF power would marginally affect the beacon's operating lifetime (T'_O), thus:

$$T'_O = \frac{77.65\text{h}}{7.75\text{Ah}} \cdot (7.75\text{Ah} - 0.443\text{Ah}) = 73.32\text{h}\ . \qquad (2)$$

Nominal battery capacity:	7.75 Ah
Operating lifetime (T_O) (measured by Omega):	77.65 h
Battery discharge due to (hypothetical) RF power increase:	0.384 Ah
Recalculated operating lifetime (T'_O):	73.32 h

121.5MHz RF Power Measurement Uncertainty Estimation

Measurement uncertainty of 121.5MHz RF power measurement

WS reference: Worksheet-03 for Review of Full TA Application for Standard Communications EPIRB model MT-603FG Full Type Approval, Case **2016-02**
Matter in WS: Matter 32. – comment 3);

Executive summary:

1. Maximum 121.5 MHz RF power measured by Omega is 13.24 dBm, minimum 121.5 MHz RF power measured by Omega is 12.61 dBm [2]. After applying measurement uncertainty limits from eq.(23) it can be concluded that all the measurement results of 121.5 MHz RF power are within the limits.
2. Further, after applying measurement uncertainty to maximum measured 121.5 MHz RF power - 13.24 dBm – we are getting 14.57 dBm. GME believes that declaring “+15 dBm max”, is the safest approach of declaring max RF power for 121.5 MHz signal.

Measurand, realised quantity and corrected value:

$$P \approx Pm + Kf \tag{1}$$

$$Kf \approx La + Lc \tag{2}$$

$$P = Pm + Kf + \delta Pm + \delta Kf \tag{3}$$

$$Kf = La + Lc + \delta La + \delta Lc + \delta La_T \tag{4}$$

$$\boxed{P = Pm + La + Lc + \delta Pm + \delta La + \delta Lc + \delta La_T} \tag{5}$$

Eq.(5) which represents corrected result is viewed as the best estimate of the “true” value of the measurand, in reality it is simply the best estimate of the value of the quantity intended to be measured.

P	RF power at 121.5 MHz
Pm	Measured RF power at 121.5 MHz
Kf	RF Power-correction factor
La	Losses in 50Ω adaptor
Lc	Losses in cable
δPm	Correction of measured RF power
δKf	Correction of RF power-correction factor
δLa	Correction of adaptor losses
δLc	Correction of cable losses
δLa_T	Correction of adaptor loses due to temperature variation

*****NOTE***** Abbreviations in equations used for denotation of influential quantities are unique for this document only. Different denotation is used in official Test report.

- Quantity *Pm* is measured in Omega using the instrument of declared measurement error of ±0.5dB.
- Quantity *Kf* is indirectly measured (calculated) in GME using quantities *La* and *Lc*;
- *La* and *Lc* are measured in GME in-house laboratory. Everything is documented and included in Omega Test Report [2].

- It is pointed out that *Kf* has strong temperature dependence, hence different correction factors are provided for different temperatures.

The critical facts that have been left out of GME's originally submitted document describing 50Ω adaptor circuit are measurement uncertainties of power-correction factors and combined measurement uncertainty of 121.5MHz RF power measurement using provided antenna adaptor.

Following is detailed analysis and estimation of measurement uncertainty of 121.5MHz RF power measurement using only data provided in Omega's Test Report [2].

Measurement Uncertainty is estimated and reported according to GUM [1]: "**Evaluation of measurement data — Guide to the expression of uncertainty in measurement; JCGM 100:2008".**

Standard measurement uncertainty of influential quantities:

$$u(Pm) = \frac{\sigma(Pm)}{\sqrt{n}} = \frac{0.834}{\sqrt{14}} = 0.22dB \tag{6}$$

$$u(La) = 0 \tag{7}$$

$$u(Lc) = 0 \tag{8}$$

$$u(\delta Pm) = \frac{\Delta Pm}{\sqrt{3}} = \frac{0.5}{\sqrt{3}} = 0.29dB \tag{9}$$

$$u(\delta La) = \frac{\Delta La}{\sqrt{3}} = \frac{0.5}{\sqrt{3}} = 0.29dB \tag{10}$$

$$u(\delta Lc) = \frac{\Delta Lc}{\sqrt{3}} = \frac{0.5}{\sqrt{3}} = 0.29dB \tag{11}$$

$$u(\delta La_T) = \frac{\Delta La_T}{\sqrt{3}} = \frac{0.65}{\sqrt{3}} = 0.375dB \tag{12}$$

Standard measurement uncertainty of measured 121.5MHz RF power - $u(Pm)$ is measurement uncertainty type A. It is estimated from *n* repeated measurements of 121.5MHz RF power performed in Omega laboratory during Type Approval testing. It is expressed as a standard deviation of *n* repeated measurements $\sigma(Pm)$ divided by $\sqrt{n}$ - assuming Normal (Gaussian) distribution of results – eq.(6).

Standard measurement uncertainties (type A) for the adaptor losses La and the cable losses Lc, are **optimistically** estimated to be $u(La) = 0$ and $u(Lc) = 0$; This is the best estimation taking into account we don't have enough information on repeated measurements, hence no information on number of the measurements and corresponding standard deviation – eq.(7) and eq.(8).

Standard measurement uncertainty $u(\delta Pm)$ (type B) of the Measured RF power correction factor – δPm - due to measurement equipment declared accuracy (error) of ±0.5dB – is estimated under assumption of Uniform distribution of measurement error. Therefore, it is estimated as declared measurement error (0.5dB) divided by $\sqrt{3}$ - corresponds to Uniform distribution – eq.(9).

Standard measurement uncertainty $u(\delta La)$ (type B) of the Correction of adaptor losses – δLa - due to measurement equipment declared accuracy (error) of ±0.5dB – is estimated under assumption of Uniform distribution of measurement error. Therefore, it is estimated as declared measurement error (0.5dB) divided by $\sqrt{3}$ - corresponds to Uniform distribution – eq.(10).

Standard measurement uncertainty $u(\delta Lc)$ (type B) of the Correction of cable losses – δLc - due to measurement equipment declared accuracy (error) of ±0.5dB – is estimated under assumption of Uniform distribution of measurement error. Therefore, it is estimated as declared measurement error (0.5dB) divided by $\sqrt{3}$ - corresponds to Uniform distribution – eq.(11).

Standard measurement uncertainty $u(\delta La_T)$ (type B) of the Correction of adaptor loses due to temperature variation – δLa_T – is estimated based on data provided by GME and included into official Test report [2]. Experimental data from Test report [2], indicate variation of measured adaptor losses from -1.1dB to +0.2dB over the temperature range of (-20°C to 55°C). A valid approximation (according to [1]) of the range -1.1dB to +0.2dB is ±0.65dB under assumption of Uniform distribution. Therefore, it is estimated as declared variation (0.65dB) divided by $\sqrt{3}$ - corresponds to Uniform distribution – eq.(12).

Combined measurement uncertainty of 121.5MHz RF power:

Combined measurement uncertainty squared is calculated (per [1]) as a sum of standard measurement uncertainties squared multiplied by corresponding sensitivity coefficient squared. Eq. (13) shows the general formula for calculation of combined measurement uncertainty.

$$u_c^2(y) = \sum_{i=1}^{N} c_i^2 u_i^2(x_i) \Rightarrow u_c(y) = \sqrt{\sum_{i=1}^{N} c_i^2 u_i^2(x_i)} \quad (13)$$

Sensitivity coefficients of influential quantities:

Sensitivity coefficient of influential quantity, calculated as per [1], represents a partial derivative of the measured quantity eq.(5) per corresponding influential quantity.

$$c_{Pm} = \frac{\partial P}{\partial Pm} = 1 \quad (14)$$

$$c_{La} = \frac{\partial P}{\partial La} = 1 \quad (15)$$

$$c_{Lc} = \frac{\partial P}{\partial Lc} = 1 \quad (16)$$

$$c_{\delta Pm} = \frac{\partial P}{\partial(\delta Pm)} = 1 \quad (17)$$

$$c_{\delta La} = \frac{\partial P}{\partial(\delta La)} = 1 \quad (18)$$

$$c_{\delta Lc} = \frac{\partial P}{\partial(\delta Lc)} = 1 \quad (19)$$

$$c_{\delta La_T} = \frac{\partial P}{\partial(\delta La_T)} = 1 \quad (20)$$

In this particular case, uncertainty model comprises of the additive elements only, hence all partial derivatives (sensitivity coefficients) are equal to 1. The combined measurement uncertainty depends only on standard measurement uncertainties of influential quantities.

$$u_c(P) = \sqrt{c_{Pm}^2 u^2(Pm) + c_{La}^2 u^2(La) + c_{Lc}^2 u^2(Lc) + c_{\delta Pm}^2 u^2(\delta Pm) + c_{\delta La}^2 u^2(\delta La) + c_{\delta Lc}^2 u^2(\delta Lc) + c_{\delta La_T}^2 u^2(\delta La_T)}$$

$$u_c(P) = \sqrt{u^2(Pm) + u^2(La) + u^2(Lc) + u^2(\delta Pm) + u^2(\delta La) + u^2(\delta Lc) + u^2(\delta La_T)} \quad (21)$$

$$u_c(P) = \sqrt{0.22^2 + 0^2 + 0^2 + 0.29^2 + 0.29^2 + 0.29^2 + 0.375^2} = \sqrt{0.4413}$$

$$u_c(P) = 0.664\ dB$$

Expanded measurement uncertainty of 121.5MHz RF power:

As a standard and commonly used format for expression of the measurement uncertainty is expanded measurement uncertainty. It is calculated as combined measurement uncertainty - eq.(21) multiplied by **coverage factor** – *k*, for required **level of confidence**. The best practice is to use 95% level of confidence, which guaranties that 95% of the measurement results will fit into limits defined by Expanded Measurement Uncertainty [1]. This level of confidence corresponds to coverage factor of *k*=2. Therefore, expanded measurement uncertainty of 121.5MHz RF power measurement is:

$$U(P) = k \cdot u_c(P) = 2 \cdot 0.664 = 1.328 \cong 1.33\ dB \quad (22)$$

Now we can safely (with 95% confidence) return to eq.(1) and claim that 121.5MHz RF power is:

$$P = (Pm + Kf)dB \pm U(P)dB = (Pm + Kf)dB \pm 1.33dB \quad (23)$$

Conclusion:

1. Maximum 121.5 MHz RF power measured by Omega is 13.24 dBm, minimum 121.5 MHz RF power measured by Omega is 12.61 dBm [2]. After applying measurement uncertainty limits from eq.(23) it can be concluded that all the measurement results of 121.5 MHz RF power are within the limits.
2. Further, after applying measurement uncertainty to maximum measured 121.5 MHz RF power - 13.24 dBm – we are getting 14.57 dBm. GME believes that declaring “+15 dBm max”, is the safest approach of declaring max RF power for 121.5 MHz signal.

   However, if C/S Secretariat has different value to suggest for 121.5 MHz max. RF power, please do so, GME will gladly accept?

3. Furthermore, as we understand, the original C/S concern related to RF power differences of (1dB) between GPS version and non-GPS version of MT603 EPIRB, are also covered by the same measurement uncertainty limits.

4. Due to temperature and other influences on the 50Ω test adaptor it appears that RF power vary. That is not the case with current draw from the battery. Very accurate measurements indicate that current draw from battery is stable across the temperature range.

   Extensive measurements and analysis cover all details including a **hypothetical** increase of RF power of 2dB. However, battery current draw measurements and the analysis of the impact on battery life of the EPIRB is the subject of separate document. The document was included in form of the attachment in our latest submission.

References:

[1] JCGM 100:2008,“Evaluation of measurement data — Guide to the expression of uncertainty in measurement”; also available on official ISO webpage in html form: http://www.iso.org/sites/JCGM/GUM-introduction.htm

[2] TESTING CENTER «OMEGA», “Report on COSPAS-SARSAT 406 MHz Emergency Beacon Testing of the Standard Communications Pty Ltd Emergency Position Indicating Radio Beacon (EPIRB) model MT603FG in accordance with C/S T.007”, Report Nr: 16/116, Issue 3.

Impact of Ground Plane Shift on the Antenna Performace

Differences in float line height of Float free and Non-Float free MT603G series EPIRB units

-impact on EPIRB performance-

WS reference: Worksheet-03 for Review of Full TA Application for Standard Communications EPIRB model MT-603FG Full Type Approval, Case **2016-02**
Matter in WS: Matter 18. – comment 2)

Executive summary:

1. Differences in float line height due to added weight:	Δh = 0.92mm
2. Maximum difference in antenna gain due to Δh at 406MHz:	ΔG_A = -0.043dB
3. Difference in 406MHz antenna impedance due to Δh:	ΔZ_{406} = (1.5 +0.5j) Ω
4. Difference in 121.5MHz antenna impedance due to Δh:	ΔZ_{121} = (-0.01+0j) Ω

Side-by-side measurements

For the purpose of comparative analysis, two units of MT603G were placed side-by-side in a water tank with seawater, one of them equipped with the extension boot (FF model) and the other without (non-FF) – Fig 1 and Fig 2. The measured difference in the float line height between a MT603G and MT603FG is not greater than 1mm. The reference point (plane) for the height measurement is a joint plane between the cover and the bottle. The float line of MT603G is exactly h_1 =14.33mm up from the chassis joint plane. Due to the added weight of Δm = 32.4g, MT603FG sits exactly Δh = 0.92mm lower in water, therefore float line is exactly h_2 = 15.25mm up from chassis joint plane.

Figure 1 MT603G (left) and MT603FG (right) side-by-side in a water tank – zoomed in

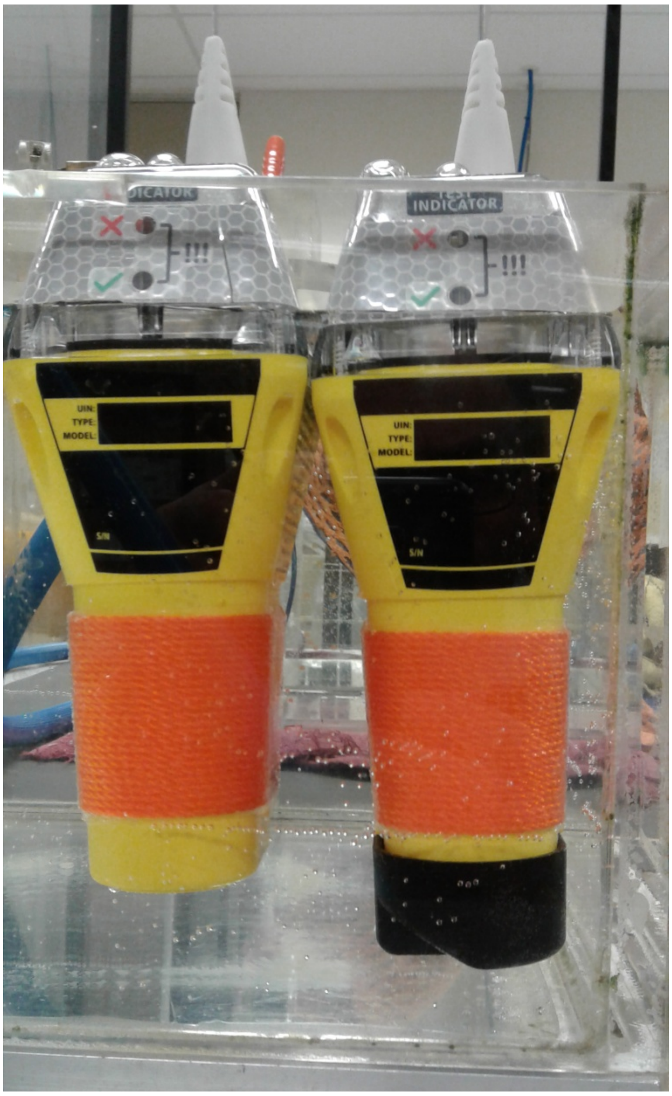


Figure 2 MT603G (left) and MT603FG (right) side-by-side in a water tank

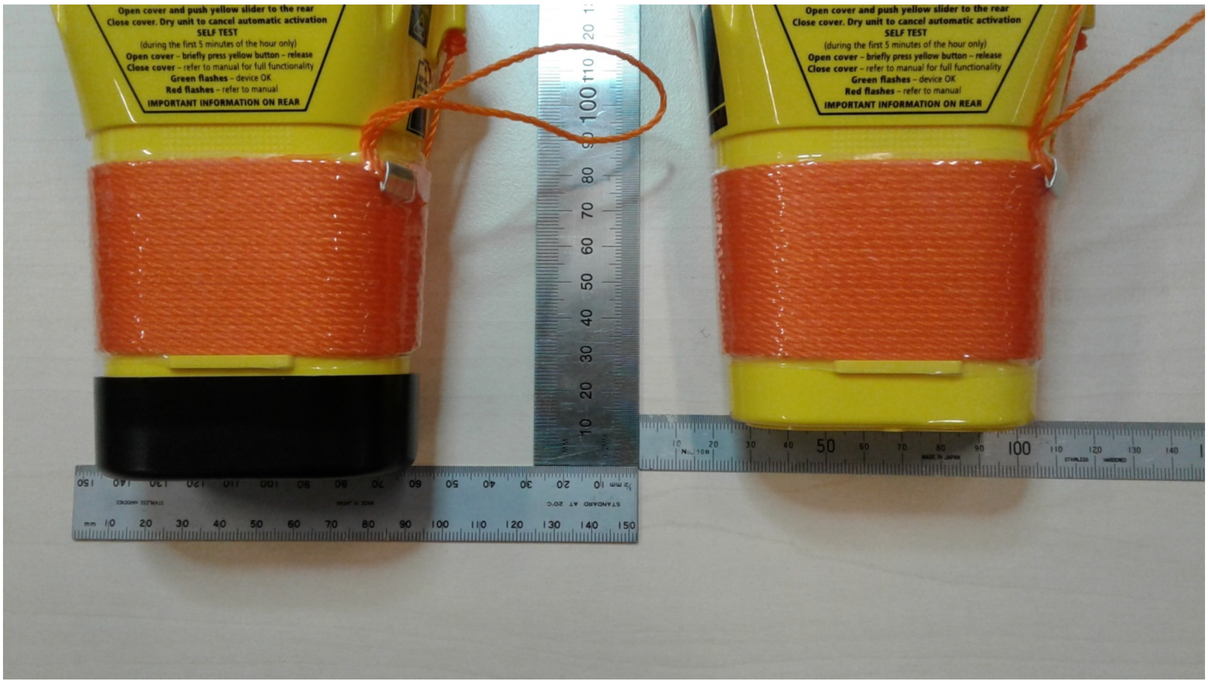


Figure 3 MT603FG (left) and MT603G (right) against the ruler in side-by-side dimension comparison – zoomed in

Figure 4 MT603FG (left) and MT603G (right) against the ruler in side-by-side dimension comparison

Figure 5 MT603FG (left) and MT603G (right) against the ruler in side-by-side dimension comparison – alternative angle

Effects of ground plane shift on the EPIRB antenna performance - simulations

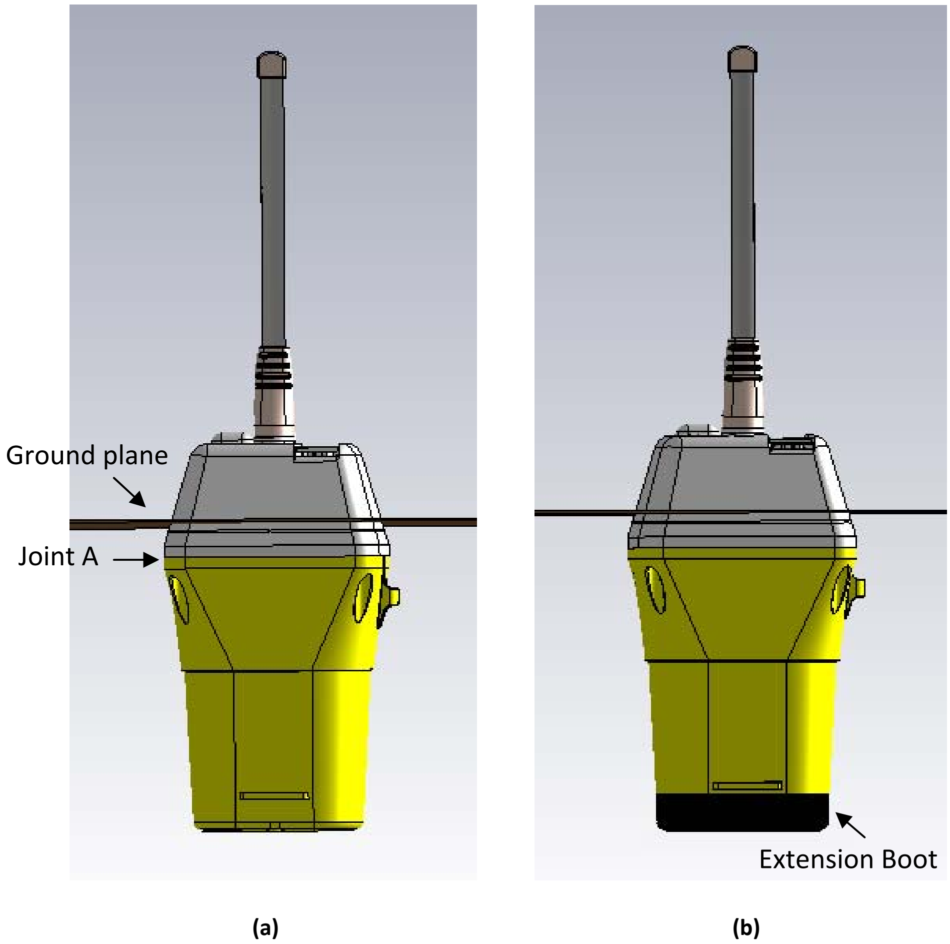


Figure 6: EPIRB Antenna simulated in CST Studio Suite with changes in ground plane (with radius 125cm) height according to test configurations for "EPIRB-like" Devices in Figure B.4 of C/S T.007 (a) 14.33mm from joint A (b) 15.25 mm from Joint A with the extension boot fitted to the EPIRB

Table 1: Change in EIRP and antenna gain (dB) with ground plane shifted from 14.33mm to 15.25mm as shown in Fig 6 (a) and (b) above

Azimuth Angle (Degrees)	Elevation Angle (Degrees)				
	10	20	30	40	50
0	-0.00197	-0.00733	-0.00546	-0.00067	-0.00422
30	0.006805	0.003826	-0.00058	-0.00934	-0.03418
60	0.011305	0.011445	0.009783	0.005891	-0.00702
90	0.008317	0.008114	0.006966	0.001872	-0.01663
120	-0.00026	-0.00597	-0.01062	-0.01919	-0.04309
150	0.015872	0.017526	0.019374	0.013578	-0.03109
180	-0.00377	-0.01186	-0.01185	-0.005	-0.00598
210	0.002694	-5.7E-05	0.003566	0.007904	-0.01008
240	0.011563	0.010236	0.004414	-0.00483	-0.02743
270	0.022226	0.02723	0.024962	0.015899	-0.00565
300	0.002266	-0.00448	-0.00717	-0.00351	-0.00193
330	0.001278	-0.0059	-0.01041	-0.01026	-0.00812

It is clearly visible that the antenna gain and EIRP slightly change with the increase of ground plane height from 14.33mmm to 15.25mm. However, the change is still within the limits of experimental accuracy.

<u>Impact of Δ*h* on the antenna impedance at 406MHz and 121.5MHz</u>

An insignificant change in impedance is observed in simulation with a shift of antenna ground plane from 14.33mm to 15.25mm.

406 MHz: $\Delta Z_{406} = (1.5 + 0.5j)\ \Omega$

121.5MHz: $\Delta Z_{121} = (-0.01 + 0j)\ \Omega$

<u>Conclusions</u>

The above measurements, calculations and simulation results indicate measurably small differences in the antenna performance and the antenna impedance due to the ground plane shift for Δh = 0.92mm, caused by added weight to the Float-Free EPIRB units – MT603FG.

The differences in the antenna gain - ΔG_A and antenna impedance at 406MHz and 121.5MHz - ΔZ_{406} and ΔZ_{121} respectively – are well within measurement error limits. Therefore, in our opinion additional measurements and testing should not be necessary.

NUP Protocol Clarification

National User Protocol (NUP) issue

WS reference: Worksheet-03 for Review of Full TA Application for Standard Communications EPIRB model MT-603FG Full Type Approval, Case **2016-02**
Matter in WS: Matter 1. – comment 2); Matter 23. ; and Matter 38.

Executive summary: We do not provide any means of user input in our MT603G EPIRB. Therefore, all bits in the Digital message remain unchanged during beacon operation.

After careful reading of our response in current Worksheet and C-S Secretariat's comment on NUP matter, it came to our attention that our response could be misleading. In our great desire to show that we have good mechanism to preserve the integrity of the digital message (regardless of Protocol used), it sounded like we are using NUP for encoding position data and updating message bits per GPS coordinates changes.

In fact we do not use NUP for encoding GPS position data. NUP is used only as intended (per T.001 C/S standard). Our MT603 EPIRB supports option of NUP bits programming at point of sale – aligned with specific country regulations.

The first 106 bits of the message always remain unchanged during the beacon operation. Although the standard allows bits from 107 onwards to change during beacon operation (min. interval of 20mins update) those bits remain unchanged in our beacon. Simple reason those bits remain unchanged is a fact that we don't support any means of "user data input" in our beacons.

Worth mentioning is that bit 108 is set to "1", which designates water + manual activation options – and it does not change during beacon operation;

We do not provide any means of user input; hence there are no changes in an entire Digital message. Bits in the Digital message remain the same from the moment of programming to the very end (or beacon reprogramming by authorised personnel).

The mechanism explained in the Worksheet, for keeping the integrity of Digital message is used to ensure that all bits remain unchanged:

NUP bits (the whole digital message) are stored in the MCU Data Flash area (non-volatile storage). At startup, the bits are read from Data Flash to internal RAM and used as the actual information payload. If for any reason the MCU experiences a disturbance on the supply line that might in other circumstances cause RAM corruption ("brown out"), this is detected by the brown out reset circuit in the MCU silicon causing a beacon restart. At this point the Initial NUP message bits are copied from Data Flash to RAM again.

Position of 50Ω Point on PCB (121.5 MHz)

Schematics of the 121.5MHz module