REPORT ON

Testing of the McMurdo Limited G5 Smartfind Plus 406 GPS EPIRB
in accordance with
Cospas-Sarsat 406 MHz Distress Beacon Type Approval Standard
T.007 Issue 4 November 2005

Report No RM614667/01 Issue 3 **July 2006**

Product Service

Product Service

Competence. Certainty. Quality.

TUV Product Service Ltd, Octagon House, Concorde Way, Segensworth North,
Fareham, Hampshire, United Kingdom, PO15 5RL
Tel: +44 (0) 1489 558100. Website: www.tuvps.co.uk; www.babt.com

REPORT ON

Testing of the McMurdo Limited G5 Smartfind Plus 406 GPS EPIRB in accordance with Cospas Sarsat 406 MHz Distress Beacon Type Approval Standard T.007 Issue 4 November 2005

Report No RM614667/01 Issue 3

July 2006

PREPARED FOR

McMurdo Limited
Silverpoint
Airport Service Road
Portsmouth
Hilsea
PO3 5PB

PREPARED BY

J Plummer
Technical Author

APPROVED BY

M Jenkins
Authorised Signatory

DATED

18th July 2006

CONTENTS

SECTION 1

REPORT SUMMARY

Testing of the McMurdo Limited G5 Smartfind Plus 406 GPS EPIRB
in accordance with
Cospas-Sarsat 406 MHz Distress Beacon Type Approval Standard
T.007 Issue 4 November 2005

1.1 STATUS

Manufacturer	McMurdo Limited
Type Designation	G5 Smartfind Plus 406 GPS EPIRB
Serial No(s)	9D1CD34D34D74D1
Number of Samples Tested	One
Test Specification	Cospas-Sarsat T.007 Issue 4 November 2005
Date of Receipt of Test Sample	1st February 2006
Start of Test	16th February 2006
Finish of Test	1st June 2006
Test Engineer(s)	R Henley J Holding R Hampton

1.2 BRIEF SUMMARY OF RESULTS

A brief summary of the tests carried out is shown below.

Section	Spec Clause	Test Description	Result	Levels/Comments
	-	Table of Test Results	N/A	
2.1	A3.2.2	Transmitted Power Output	Pass	
-	A3.1.4	Digital Message Coding	Pass	
-	A3.1	Digital Message Generator	Pass	
-	A3.2.3	Data Encoding and Modulation	Pass	
-	A3.2.1	406MHz Transmitted Frequency	Pass	
2.2	A3.2.2.4	Spurious Emissions	Pass	
2.3	A3.3	406MHz VSWR Check – Decoded Message	Pass	
2.4	A3.6	Self Test Mode – Decoded Message	Pass	
2.5	A2.2	Thermal Shock	Pass	
2.6	A2.3	Operating Lifetime at Minimum Temperature	Pass	
2.7	A2.4	Frequency Stability with Temperature Gradient	Pass	
-	A3.5	Long Term Frequency Stability	Pass	
-	A3.4	Protection Against Continuous Transmission	Pass	
2.8	A2.5	Satellite Qualitative Test	Pass	
2.9	A2.6	Antenna Characteristics	Pass	
2.10	C2/16	Beacon Coding Software	Pass	
2.11	-	Navigation System	Pass	
2.11.1	A3.8	National Location Protocol 1	Pass	
2.11.2	A3.8	Standard Location Protocol 1	Pass	
2.11.3	A3.8	User Location Protocol 1	Pass	

1.3 APPLICATION FORM

1.3.1 Applicant Details

Company Name	McMurdo Limited		
Address	Silver Point Airport Service Road Portsmouth Hilsea PO3 5PB United Kingdom		
Category of Applicant	[✓] Manufacturer [ ] Distributor	[ ] Importer [ ] Agent	
Contact Name	Neil Jordan	Telephone	02392 623934
Email	neiljordan@mcmurdo.co.uk	Fax	02392 623997

1.3.2 Manufacturer Details

Company Name	Same as above		
Address			
Contact Name		Telephone	
Email		Fax	

1.3 APPLICATION FORM

1.3.3 Beacon Details

Beacon Model: G5 Smartfind Plus 406 GPS EPIRB
Name & Location of Test Facility: BABT, Hampshire, United Kingdom

Beacon Type:	[ ] Aviation	[ ] Land	[✓] Maritime
Operating Temperature Range:	[ ] Class 1: -40ºC to +55ºC		[✓] Class 2: -20ºC to +55ºC
Specified Operating Lifetime:	[ ] 24 hrs	[✓] 48 hrs	[ ] Other [hrs]

Beacon Battery Type:

Chemistry:	Lithium Manganese Dioxide	
Manufacturer & Model No:	Varta CR2/3 AH	
Size & number of cells:	3 x 3 2/3AH	
Voltage:	9V nominal	6.4V end-point

Beacon Oscillator:

Type:	TCXO
Manufacturer & Model No:	CMAC E3279

<u>Ancillary Devices & Features:</u>

	No	Yes	Details
Self Test Mode:	[ ]	[✓]	See in Self Test Characteristics below
Auxiliary Radio-Locating Device:	[ ]	[✓]	Frequency: 121.5 MHz Power: 17 dBm for 48 hours Tx. Duty Cycle: Continuous
Encoded Position Data:	[ ]	[✓]	Nav. Device: Internal Type: GPS Manufacturer: EAZIX Model: EZGPM01
Long Message (144 bits):	[ ]	[✓]	
Short Message (112 bits):	[ ]	[ ]	
Automatic Activation:	[ ]	[✓]	
Strobe Light:	[ ]	[✓]	Intensity: >0.75cd Flash Rate 21 flashes per minute
Voice Communications (PTT):	[✓]	[ ]	
Other:	[✓]	[ ]	Specify:

<u>Protocols Supported:</u>

User Location Protocol	[ ]	[✓]
Standard Location Protocol	[ ]	[✓]
Standard Short Location Protocol	[✓]	[ ]
National Location Protocol	[ ]	[✓]
National Short Location Protocol	[✓]	[ ]

1.3 APPLICATION FORM

1.3.3 Beacon Details

Self Test Characteristics

	Yes	No
Does self-test have a separate switch positions?	[✓]	[ ]
Does self-test switch automatically return to normal position when released?	[✓]	[ ]
If not, how long until the first 'distress' message is emitted?		
Does self-test transmit a 406MHz signal?	[✓]	[ ]
Unmodulated signal only?	[ ]	[✓]
Normal data, but with inverted frame synchronisation pattern?	[✓]	[ ]
1 burst only?	[✓]	[ ]
Does self-test transmit a 121.5MHz signal?	[✓]	[ ]
For less than 1 second?	[ ]	[✓]
Continually while self-test is activated?	[ ]	[✓]
☒ Other period (specify): 15		
Does self-test transmit on any other frequency (e.g. 243MHz)	[ ]	[✓]
Result of self test is indicated by:		
Pass fail indicator light	[✓]	[ ]
Strobe light flash	[✓]	[ ]
[ ] Other (specify):		
Can the self-test be performed without removing the beacon from mounting bracket?	[✓]	[ ]
What parameters are internally tested by the self-test?		
Battery voltage	[✓]	[ ]
RF power at 406MHz	[✓]	[ ]
RF power at 121.5MHz	[✓]	[ ]
Approximate RF frequency	[ ]	[✓]
Phase locked loop	[✓]	[ ]
[ ] Other (specify):		
Number of self tests per year	[12]	
Duration of self test	[9 seconds]	
Do the above characteristics apply for all countries where beacon sold?	[✓]	[ ]
If No, please specify:		
Do the above characteristics apply for all production serial numbers?	[✓]	[ ]
If No, please specify:		

Battery Data

Battery replacement interval	[6 years]
Battery capacity	[3.06 Ah]
Battery self drain (i.e. when the battery is stored out of the beacon)	[1% per yr]

1.3 APPLICATION FORM

1.3.4 Declaration of Build Status

Hardware Version: Issue C

Software Version: 1.2.186

1.3.5 Declarations

	Yes	No
Are the equipments submitted representative production models?	[✓]	[ ]
If No re the equipments pre-production models?	[ ]	[ ]
If pre-production, will final equipments be identical in ALL respects?	[✓]	[ ]
If No supply full details:		
Is the Test report to be used as part of a Cospas-Sarsat Type Approval Application?	[✓]	[ ]
If Yes, has the product, any direct engineering predecessor, or variant ever been granted Type Approval in any EEC member country?	[ ]	[✓]
If Yes, supply full details:		
Will the labeling of the equipment comply with the requirements of C/S T.007 Issue 4?	[✓]	[ ]

ITU Class of Emission: 121.5MHz = 3K20A3X
406.028MHz = 16K0G1D

Applicant's Declaration

I hereby declare that I am entitled to sign on the behalf of the applicant and that the information supplied is correct and complete.

Signed: (when not emailing)
Name: Neil Jordan

Position Held: Electronics Engineer

Date:

Test Facility Declaration

I hereby confirm that the 406MHz beacon described above has been successfully tested in accordance with the Cospas-Sarsat Type Approval Standard (C/S T.007) and complies with the Cospas-Sarsat Specification (C/S T.001) as demonstrated in the attached report. *

Signed:
Name: M Jenkins
Position Held: Telecom Group Leader

Date: 18th July 2006

*** with the exception of failures in Section 2.9 of this report.**

1.4 MODIFICATIONS

No modifications were made to the test sample during testing.

1.5 REPORT MODIFICATION RECORD

Issue 1 – First Issue

SECTION 2

TEST DETAILS

Testing of the McMurdo Limited G5 Smartfind Plus 406 GPS EPIRB
in accordance with
Cospas-Sarsat 406 MHz Distress Beacon Type Approval Standard
T.007 Issue 4 November 2005

TABLE OF TEST RESULTS

Parameter	Limits	Units	Test Results			Comments
			T_{min} (ºC)	T_{amb} (ºC)	T_{max} (ºC)	
			-20	23	+55	
1. Power Output Test C2.1 Clause A3.2.2						Test sample: 01 Build state: 0 **Result: Pass**
Transmitter power output	35 to 39	dBm	36.15	37.18	37.65	
Power output rise time	< 5	ms	0.04	0.08	0.104	
Power output 1ms before burst	< -10	dBm	-22.61	-24.50	-29.85	
2. Digital Message Coding Test C2.2 Clause A3.1.4						Test sample: 01 Build state: 0 **Result: Pass**
Bit sync Bits 1 – 15	111111111111111	P / F	P	P	P	Decoded messages: Page 17
Frame Sync 16 – 24	000101111	P / F	P	P	P	
Format Flag 25	1 bit	data	1	1	1	
Protocol Flag 26	1 bit	data	1	1	1	
Identification / position data 27 – 85	59 bits	P / F	P	P	P	
BCH code 86 – 106	21 bits	P / F	P	P	P	
Emerg. code/nat. use/supplem. data 107 – 112	6 bits	data	101111	101111	101111	
Additional Data / BCH (if applicable) 112 – 144	32 bits	P / F	P	P	P	
Position Error (If applicable)	< 5	km	N/A	N/A	N/A	
3. Digital Message Generator Test C2.3 Clause A3.1						Test sample: 01 Build state: 0 **Result: Pass**
Repetition rate T_R						
Average T_R	48.5 to 51.5	seconds	50.504	50.184	49.62	
Minimum T_R	$47.5 \leq T_R \leq 48$	seconds	47.51	47.51	47.80	
Maximum T_R	$52 \leq T_R \leq 52.5$	seconds	52.29	52.29	52.39	
Standard deviation	0.5 to 2.0	seconds	1.347	1.431	1.311	
Bit rate						
Minimum f_b	≥ 396	bits/sec	400.242	400.346	400.464	
Maximum f_b	≤ 404	bits/sec	400.245	400.451	400.480	
Total transmission time						
Short message	435.6 – 444.4	ms	N/A	N/A	N/A	
Long message	514.8 - 525.2	ms	521.434	521.254	521.337	
Unmodulated carrier						
Minimum T_1	≥ 158.4	ms	161.159	161.120	161.152	
Maximum T_1	≤ 161.6	ms	161.160	161.121	161.166	
First burst delay	>47.5	seconds	51.0	51.1	50.5	

TABLE OF TEST RESULTS

Parameter	Limits	Units	Test Results T_{min} (ºC) -20	T_{amb} (ºC) 23	T_{max} (ºC) +55	Comments
4. Modulation Test C2.4 Clause A3.2.3						Test sample: 01 Build state: 0 **Result: Pass**
Biphase L Rise time Fall Time Phase deviation: positive Phase deviation: negative Symmetry measurement	P / F 50 - 250 50 - 250 + (1.0 to 1.2) - (1.0 to 1.2) <= 0.05	P / F µs µs radians radians radians	P 131.56 142.44 1.09 -1.13 0.0046	P 117.56 138.44 1.09 -1.13 0.0032	P 126.44 135.23 1.16 -1.14 0.0171	
5. 406 MHz Transmitted Frequency Test C2.5 Clause A3.2.1						Test sample: 01 Build state: 0 **Result: Pass**
Nominal value Short term stability Medium term stability Slope Residual frequency variation	IAW T.001 / T.007 $<= 2x10^{-9}$ $(-1 \text{ to } +1)x10^{-9}$ $<= 3x10^{-9}$	MHz /100 ms /minute 	406.027949 $1.767x10^{-10}$ $2.111x10^{-10}$ $5.515x10^{-10}$	406.027986 $2.536x10^{-10}$ $-5.741x10^{-11}$ $2.475x10^{-10}$	406.027963 $1.437x10^{-10}$ $6.494x10^{-11}$ $4.360x10^{-10}$	
6. Spurious Emissions Test C2.6 Clause A3.2.2.4						Test sample: 01 Build state: 0 **Result: Pass**
In band (406.0 – 406.1 MHz)	IAW mask	P / F	P	P	P	Spectrum plots: Pages 20 Note: The ambient result passes within measurement uncertainty.
7. 406MHz VSWR Check Test C2.7 Clause A3.3						Test sample: 01 Build state: 0 **Result: Pass**
Nominal transmitted frequency Modulation Rise time Fall Time Phase deviation: positive Phase deviation: negative Symmetry measurement Digital Message	IAW T.001 / T.007 50 - 250 50 - 250 + (1.0 to 1.2) - (1.0 to 1.2) <= 0.05 Must be correct	MHz µs µs radians radians radians P / F	406.027943 127.56 140.43 1.10 -1.16 0.0089 P	406.027992 128.23 135.77 1.11 -1.15 0.0089 P	406.027962 134.66 139.30 1.11 -1.04 0.0171 P	Decoded message: Page 23
8. Self Test Mode Test C2.8 Clause A3.6						Test sample: 01 Build state: 0 **Result: Pass**
Frame sync Format flag Single radiated burst Default position data (if applicable) Description provided Data on protections against repetitive transmission Single burst verification Provides for beacon 15 Hex ID	011010000 0 or 1 440 / 520 ± 1% Must be correct Y / N Y / N 1 burst Must be correct	P / F 1 / 0 ms P / F P / F P / F	P 1 521.8536 P P P	P 1 521.0212 P P P	P 1 520.8296 P P P	Decoded message: Page 24 Applicant's data: Page 24

TABLE OF TEST RESULTS

Parameter	Limits	Units	Test Results				Comments
9. Thermal Shock Test C2.9 Clause A2.2							Test sample: 01 Build state: 0 **Result: Pass**
Soak Temperature		ºC	22.3				
Measurement Temperature		ºC	-8.0				
Meet within 15 minutes, maintained for 2 hours:							
Transmitted frequency							Test data: Page 25
Nominal value	IAW T.007 / T.012	MHz	Max	406.027962	Min	406.027956	
Short term stability	$\leq 2x10^{-9}$	/100ms	Max	$1.865x10^{-10}$	Min	$8.712x10^{-11}$	
Medium term stability							
Slope	$(-2 \text{ to } +2)x10^{-9}$	/minute	Max	$-1.526x10^{-09}$	Min	$7.805x10^{-11}$	
Residual frequency variation	$\leq 3x10^{-9}$		Max	$1.389x10^{-09}$	Min	$1.676x10^{-10}$	
Transmitter output power	35 – 39	dBm	Max	37.28	Min	36.56	
Digital Message	Must be correct	P / F	P				Decoded message: Page 30
10. Operating Lifetime at Minimum Temperature Test C2.10 Clause A2.3							Test sample: 01 Build state: 0 **Result: Pass**
Duration	>24		48				Quiescent battery current: Page 37
Transmitted frequency							Test data: Page 31
Nominal value	IAW T.007 / T.012	MHz	Max	406.027949	Min	406.027944	
Short term stability	$\leq 2x10^{-9}$	/100ms	Max	$2.325X10^{-10}$	Min	$5.716X10^{-11}$	Note: GPS was never allowed to obtain a fix to maximize consumption.
Medium term stability							
Slope	$(-1 \text{ to } +1)x10^{-9}$	/minute	Max	$2.469x10^{-10}$	Min	$-2.948x10^{-10}$	
Residual frequency variation	$\leq 3x10^{-9}$		Max	$1.185x10^{-09}$	Min	$1.143x10^{-10}$	
Transmitter output power	35 – 39	dBm	Max	37.43	Min	37.19	
Digital Message	Must be correct	P / F	P				Decoded message: Page 36
11. Frequency Stability with Temperature Gradient Test C2.11 Clause A2.4							Test sample: 01 Build state: 0 **Result: Pass**
Transmitted frequency							Test data: Page 43
Nominal value	IAW T.007 / T.012	MHz	Max	406.027991	Min	406.027944	
Short term stability	$\leq 2x10^{-9}$	/100ms	Max	$3.874x10^{-10}$	Min	$7.536x10^{-11}$	
Medium term stability							
Slope (A to B, C+15 to D, E+15 to F)	$(-1 \text{ to } +1)x10^{-9}$	/minute	Max	$5.184x10^{-10}$	Min	$-6.038x10^{-10}$	
Slope (B to C+15, D to E+15)	$(-2 \text{ to } +2)x10^{-9}$	/minute	Max		Min		
Residual frequency variation	$\leq 3x10^{-9}$		Max	$1.144x10^{-09}$	Min	$8.975x10^{-11}$	
Transmitter output power	35 – 39	dBm	Max	37.75	Min	37.50	
Digital Message	Must be correct	P / F	P				Decoded message: Page 47
12. Long Term Frequency Stability Test C2.12 Clause A3.5							Test sample: N/A Build state: N/A **Result: Pass**
Data on long term stability	Y / N		Y				Applicant's data: Page A.2

TABLE OF TEST RESULTS

Parameter	Limits	Units	Test Results			Comments
13. Protection Against Continuous Transmission Test C2.13 Clause A3.4						Test sample: N/A Build state: N/A **Result: Pass**
Description provided	Y / N		Y			Applicant's data: Page A.2
14. Satellite Qualitative Tests Test C2.14 Clause A2.5			Configuration			Test sample: 01 Build state: 0 **Result: Pass**
			T.007 Fig B.4	T.007 Fig B5	In Salt Water	
Results provided	Y / N		Y	Y	Y	Test data: Page 48
LEOLUT Hex ID solution for all passes $(1^{0}<CTA<21^{0})$	Must be correct	P / F	P	P	P	
Position error	>=80% of results <=5 km	km	100%	100%	96.0 %	
15 Antenna Characteristics Test C2.15 Clause A2.6			Configuration B4	Configuration B5		Test sample: 01 Build state: 0 **Result: Pass**
Polarisation	Linear / RHCP		P			Test data: Page 51
VSWR	≤1.5		N/A	N/A		
$EIRP_{maxEOL}$	≤20	Watts	15.17	7.60		
$EIRP_{minEOL}$	≥1.6	Watts	1.4	1.1		Pass within measurement uncertainty
Azimuth gain variation at 40º elevation angle	≤3	dB	1.19	0.47		
16. Beacon Coding Software Test C2.16						Test sample: 01 Build state: 0 **Result: Pass**
Sample message for each coding option	Must be correct	P/ F	P			Decoded Messages: Page 53
Sample self-test message for each coding option	Must be correct	P/ F	P			
17. Navigation System Test C.17 Clause A3.8			Location Protocol			Test sample: 01 Build state: 0 **Result: Pass**
			National	Standard	User	Test data: Page 56
Position data default values	Must be correct	P/ F	P	P	P	
Position acquisition time	<30/1 minutes	P/ F	P	P	P	
	<0.5/5.25 km	P/ F	P	P	P	
Encoded position data update interval	>20	minutes: seconds	20.51	22:27	21:06	
Position data update interval	20/1	minutes	N/A	N/A	N/A	
Last valid position retained after navigation input lost	240 +/- 5	minutes	240	239	241	
Position Clearance after deactivation	Must be cleared	P / F	P	P	P	
Position Data Encoding	Must be correct	P / F	P	P	P	
Design data on protection due to navigation failure	No degradation	P / F				Applicant's data: Page 56

2.1 DIGITAL MESSAGE CODING

Digital Message at Ambient Temperature

Beacon Id Format......... 30 Hex Id, Long Message, Bits 25-144
15 Hex (Bits 26- 85) = 9D1CD34D34D74D1 9D1CD34D34D74D1 Default_Id
30 Hex (Bits 25-144) = CE8E69A69A6BA68E3888AFE0FF0146

```
26   30   34   38   42   46   50   54   58   62   66   70   74   78   82
|    |    |    |    |    |    |    |    |    |    |    |    |    |    |
1001 1101 0001 1100 1101 0011 0100 1101 0011 0100 1101 0111 0100 1101 0001
1100 0111 0001 0001 0001 0101 1111 1100 0001 1111 1110 0000 0010 1000 110
|    |    |    |    |    |    |    |    |    |    |    |    |    |    |
86   90   94   98   102  106  110  114  118  122  126  130  134  138  142
```

Field Name	Bit Pos	Value	Decode	Bits
----------	-------	-----	------	----
Format Flag	25	1	Long Message	1
Protocol Flag	26	1	User	1
MID	27- 36	232	G_BRITAIN	0011 1010 00
User Protocol	37- 39	7	Test	111
Spare	40- 63			0011 0100 1101 0011 0100 1101
Spare	64- 83			0011 0101 1101 0011 0100
Homing	84- 85	1	121.5	01
BCH Encoded	86-106		Errors=0	1100 0111 0001 0001 0001 0
BCH Generated	86-106			1100 0111 0001 0001 0001 0
Spare	107-126			1011 1111 1000 0011 1111
Spare	127-144			1100 0000 0101 0001 10

2.1 DIGITAL MESSAGE CODING

Digital Message at Minimum Temperature

Beacon Id Format......... 30 Hex Id, Long Message, Bits 25-144
15 Hex (Bits 26- 85) = 9D1CD34D34D74D1 9D1CD34D34D74D1 Default_Id
30 Hex (Bits 25-144) = CE8E69A69A6BA68E3888AFE0FF0146

```
26    30    34    38    42    46    50    54    58    62    66    70    74    78    82
|     |     |     |     |     |     |     |     |     |     |     |     |     |     |
1     1001  1101  0001  1100  1101  0011  0100  1101  0011  0100  1101  0111  0100  1101  0001
1100  0111  0001  0001  0001  0101  1111  1100  0001  1111  1110  0000  0010  1000  110
|     |     |     |     |     |     |     |     |     |     |     |     |     |     |
86    90    94    98    102   106   110   114   118   122   126   130   134   138   142
```

Field Name	Bit Pos	Value	Decode	Bits
Format Flag	25	1	Long Message	1
Protocol Flag	26	1	User	1
MID	27- 36	232	G_BRITAIN	0011 1010 00
User Protocol	37- 39	7	Test	111
Spare	40- 63			0011 0100 1101 0011 0100 1101
Spare	64- 83			0011 0101 1101 0011 0100
Homing	84- 85	1	121.5	01
BCH Encoded	86-106		Errors=0	1100 0111 0001 0001 0001 0
BCH Generated	86-106			1100 0111 0001 0001 0001 0
Spare	107-126			1011 1111 1000 0011 1111
Spare	127-144			1100 0000 0101 0001 10

2.1 DIGITAL MESSAGE CODING

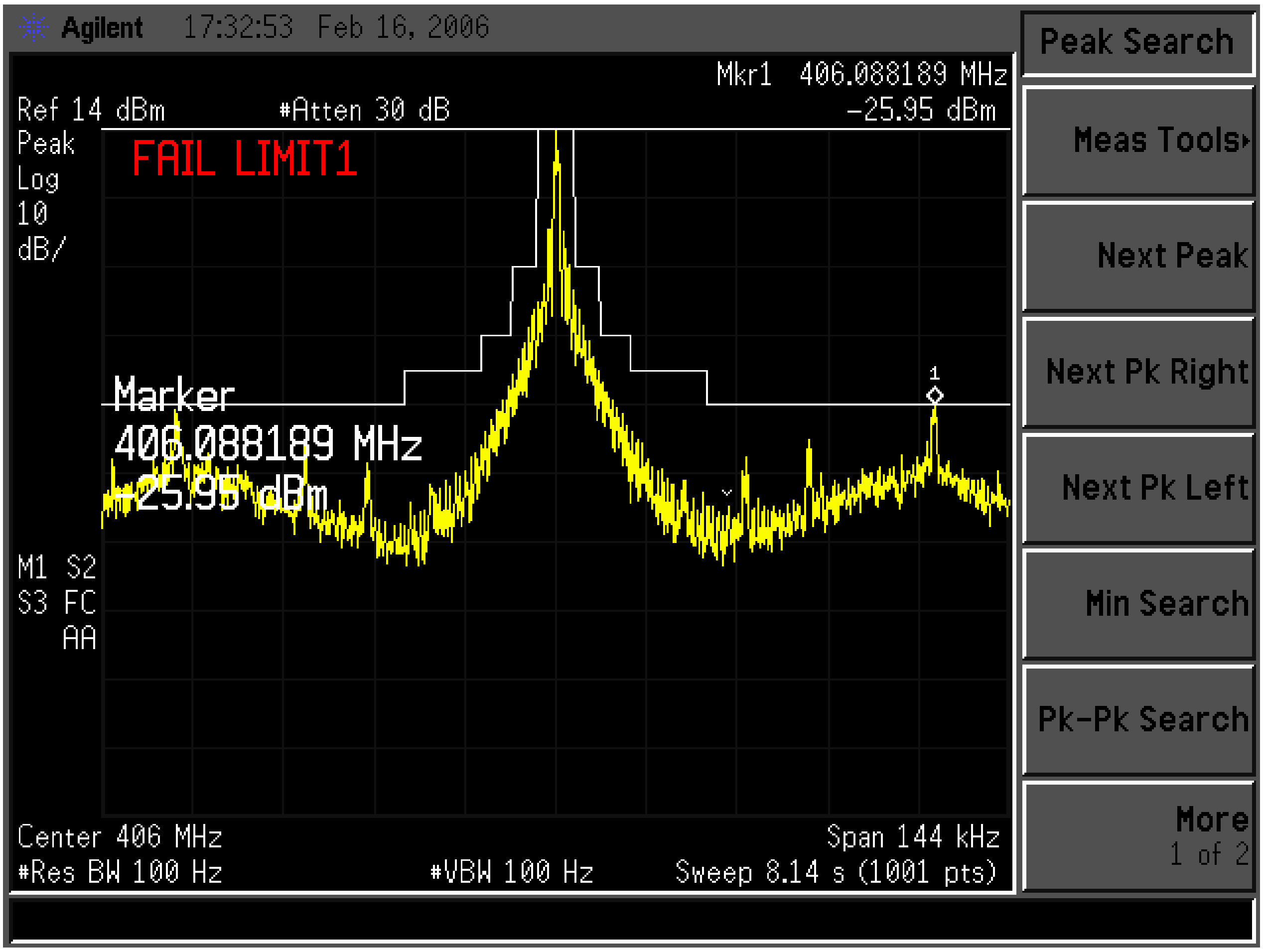
Digital Message at Maximum Temperature

Beacon Id Format......... 30 Hex Id, Long Message, Bits 25-144
15 Hex (Bits 26- 85) = 9D1CD34D34D74D1 9D1CD34D34D74D1 Default_Id
30 Hex (Bits 25-144) = CE8E69A69A6BA68E3888AFE0FF0146

```
26   30   34   38   42   46   50   54   58   62   66   70   74   78   82
|    |    |    |    |    |    |    |    |    |    |    |    |    |
1001 1101 0001 1100 1101 0011 0100 1101 0011 0100 1101 0111 0100 1101 0001
1100 0111 0001 0001 0001 0101 1111 1100 0001 1111 1110 0000 0010 1000 110
|    |    |    |    |    |    |    |    |    |    |    |    |    |    |
86   90   94   98   102  106  110  114  118  122  126  130  134  138  142
```

Field Name	Bit Pos	Value	Decode	Bits
----------	-------	-----	------	----
Format Flag	25	1	Long Message	1
Protocol Flag	26	1	User	1
MID	7- 36	232	G_BRITAIN	0011 1010 00
User Protocol	37- 39	7	Test	111
Spare	40- 63			0011 0100 1101 0011 0100 1101
Spare	64- 83			0011 0101 1101 0011 0100
Homing	84- 85	1	121.5	01
BCH Encoded	86-106		Errors=0	1100 0111 0001 0001 0001 0
BCH Generated	86-106			1100 0111 0001 0001 0001 0
Spare	107-126			1011 1111 1000 0011 1111
Spare	127-144			1100 0000 0101 0001 10

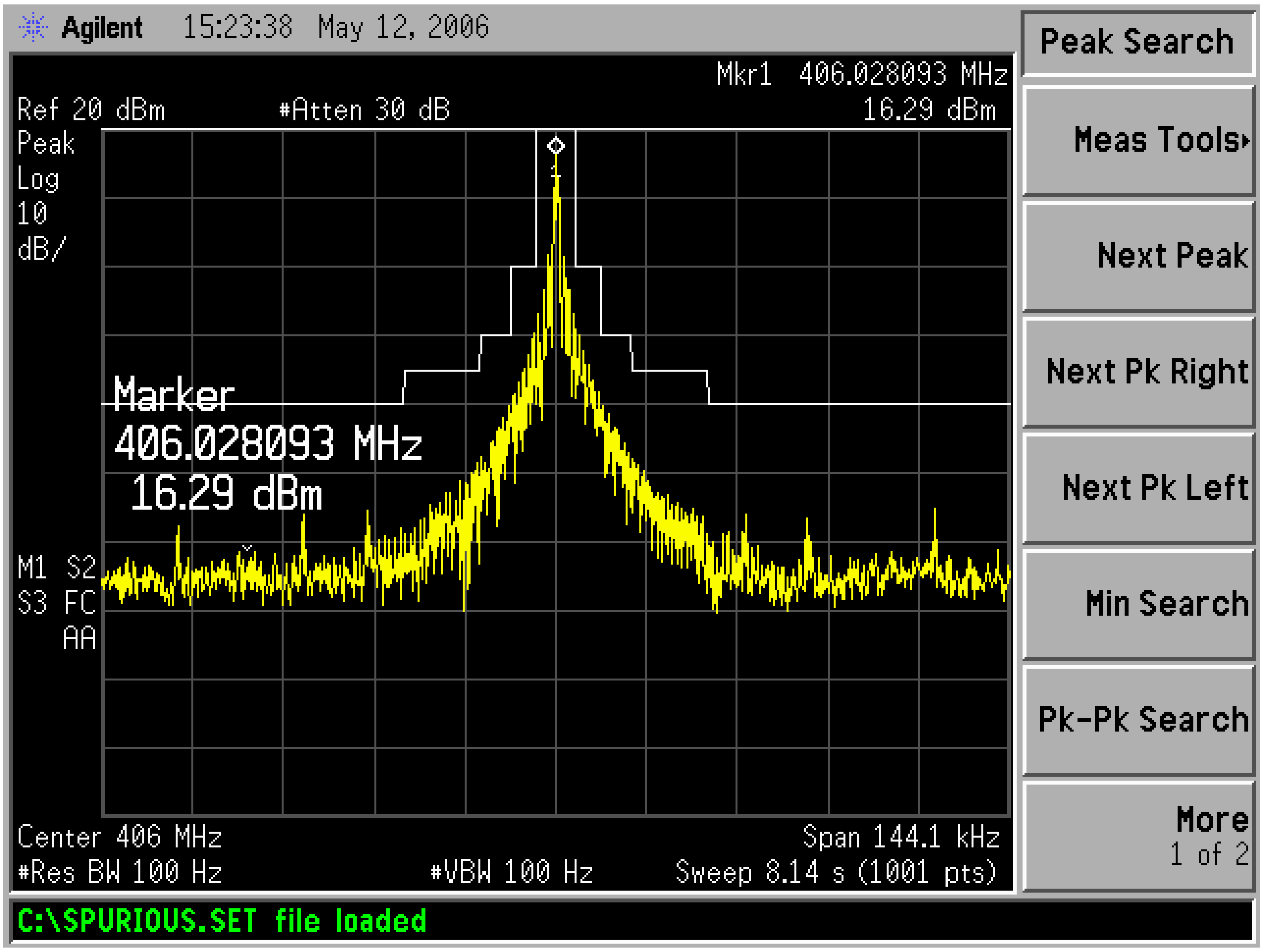
2.2 SPURIOUS EMISSIONS



Spurious Emissions at Ambient Temperature

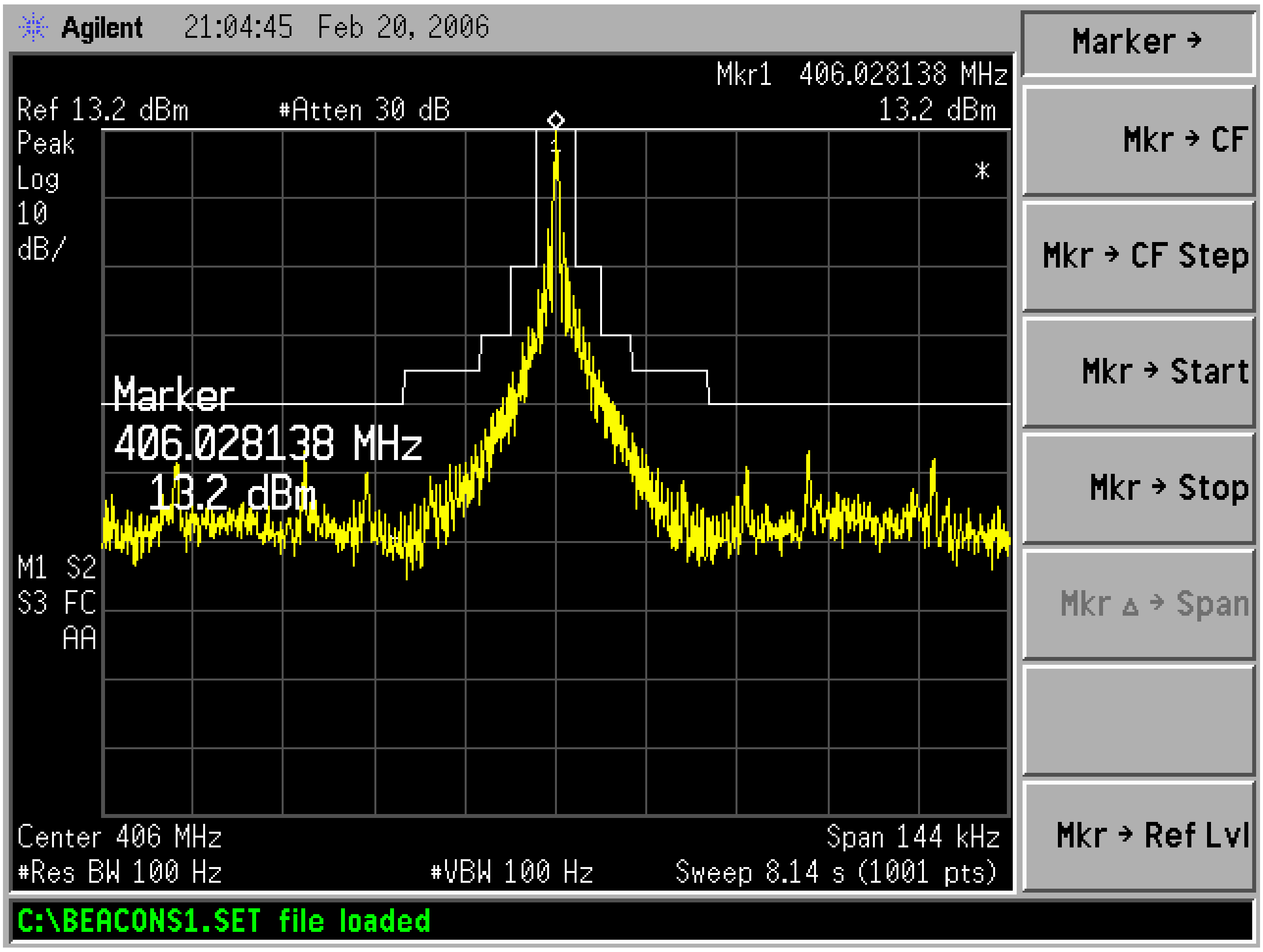
Note: From the reference level (peak power) of +14.00 dBm, the relative limit of -40.00 dBc occurring at 406.088189 MHz gives an equivalent limit of -26.00 dBm, the recorded level of -25.95 is a pass within measurement uncertainty

2.2 SPURIOUS EMISSIONS



Spurious Emissions at Minimum Temperature

2.2 SPURIOUS EMISSIONS



Spurious Emissions at Maximum Temperature

2.3 406 MHZ VSWR CHECK - DECODED MESSAGE

Beacon Id Format......... 30 Hex Id, Long Message, Bits 25-144
15 Hex (Bits 26- 85) = 9D1CD34D34D74D1 9D1CD34D34D74D1 Default_Id
30 Hex (Bits 25-144) = CE8E69A69A6BA68E3888AFE0FF0146

	26	30	34	38	42	46	50	54	58	62	66	70	74	78	82
	|	|	|	|	|	|	|	|	|	|	|	|	|	|	|
1	1001	1101	0001	1100	1101	0011	0100	1101	0011	0100	1101	0111	0100	1101	0001
	1100	0111	0001	0001	0001	0101	1111	1100	0001	1111	1110	0000	0010	1000	110
	|	|	|	|	|	|	|	|	|	|	|	|	|	|	|
	86	90	94	98	102	106	110	114	118	122	126	130	134	138	142

Field Name	Bit Pos	Value	Decode	Bits
----------	------	-----	------	----
Format Flag	25	1	Long Message	1
Protocol Flag	26	1	User	1
MID	27- 36	232	G_BRITAIN	0011 1010 00
User Protocol	37- 39	7	Test	111
Spare	40- 63			0011 0100 1101 0011 0100 1101
Spare	64- 83			0011 0101 1101 0011 0100
Homing	84- 85	1	121.5	01
BCH Encoded	86-106		Errors=0	1100 0111 0001 0001 0001 0
BCH Generated	86-106			1100 0111 0001 0001 0001 0
Spare	107-126			1011 1111 1000 0011 1111
Spare	127-144			1100 0000 0101 0001 10

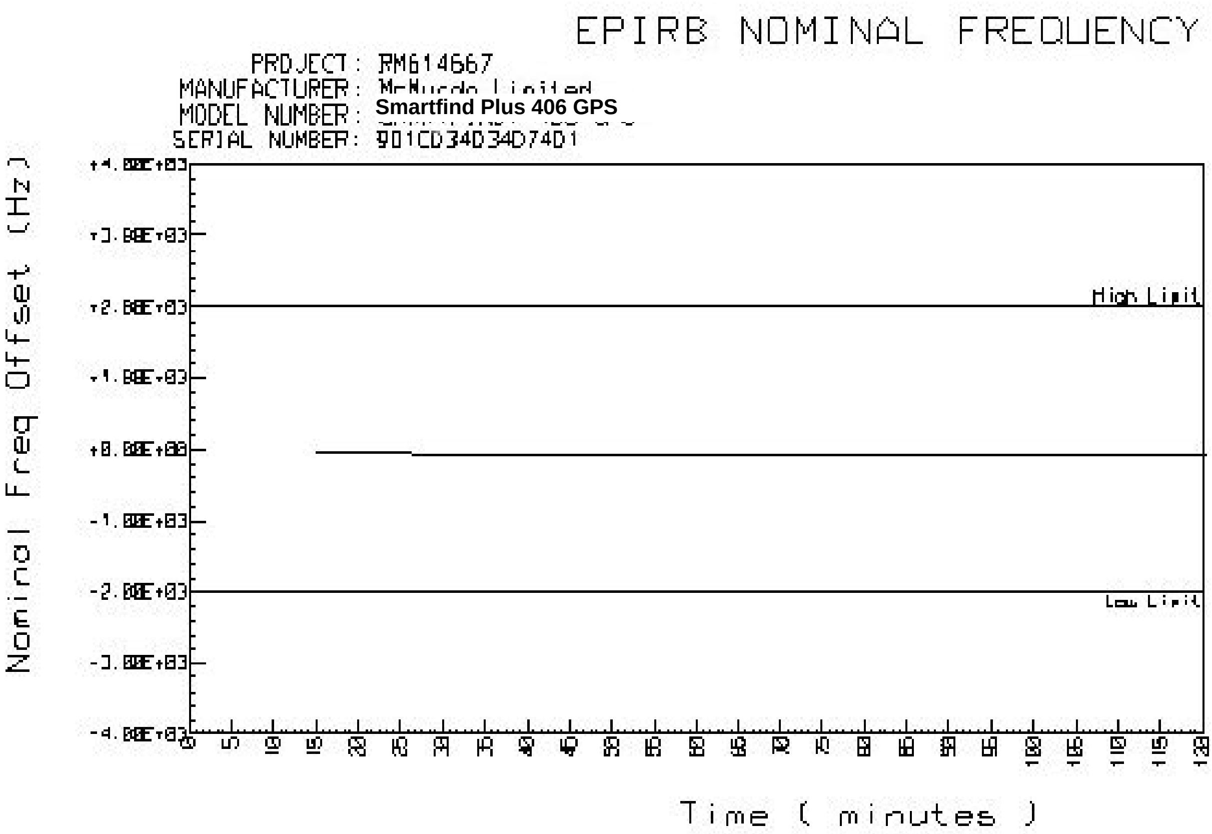
2.4 SELF TEST MODE - DECODED MESSAGE

BEACON ID FORMAT......... 30 HEX ID, LONG MESSAGE, BITS 25-144
15 HEX (BITS 26- 85) = 9D1CD34D34D74D1 9D1CD34D34D74D1 DEFAULT_ID
30 HEX (BITS 25-144) = CE8E69A69A6BA68E3888AFE0FF0146

```
        26   30   34   38   42   46   50   54   58   62   66   70   74   78   82
        |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
1       1001 1101 0001 1100 1101 0011 0100 1101 0011 0100 1101 0111 0100 1101 0001
        1100 0111 0001 0001 0001 0101 1111 1100 0001 1111 1110 0000 0010 1000 110
        |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
        86   90   94   98   102  106  110  114  118  122  126  130  134  138  142
```

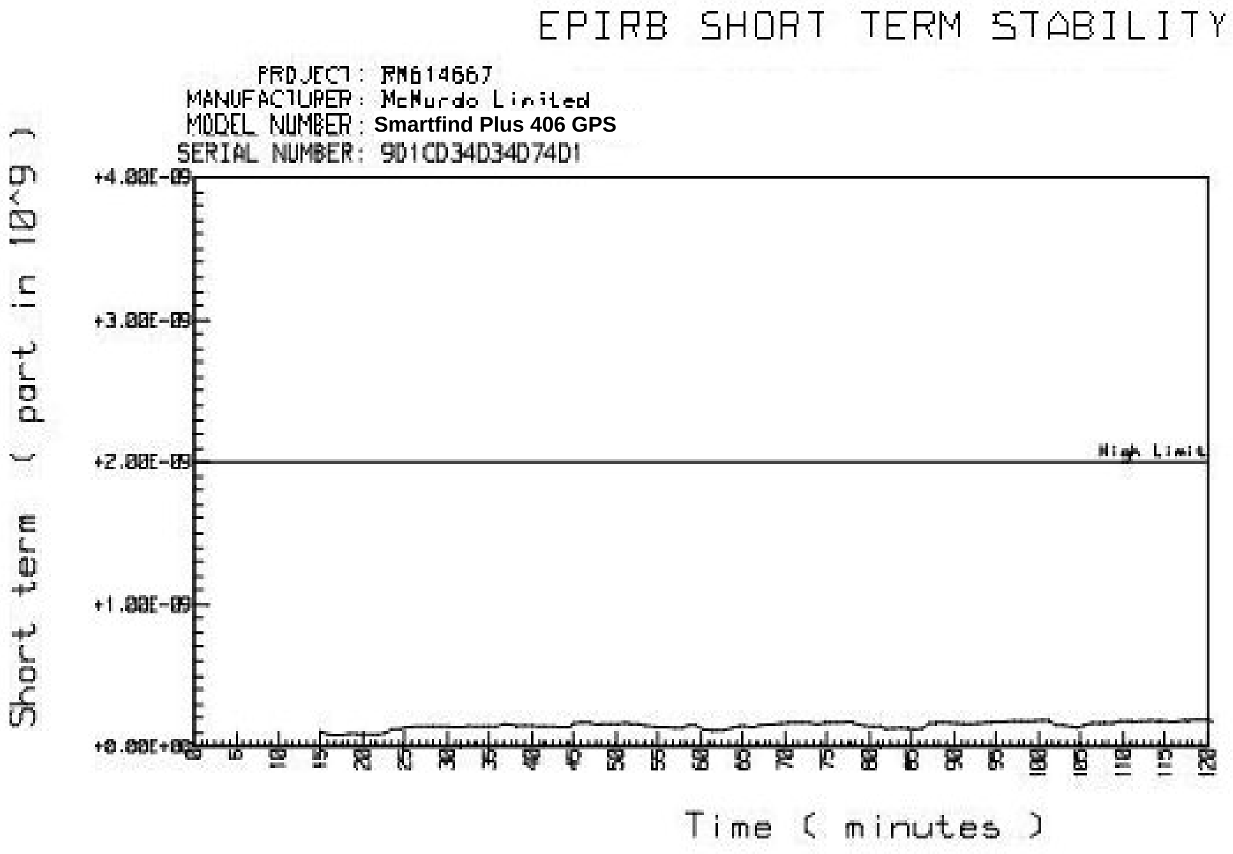
FIELD NAME	BIT POS	VALUE	DECODE	BITS
----------	-------	-----	------	----
FORMAT FLAG	25	1	LONG MESSAGE	1
PROTOCOL FLAG	26	1	USER	1
MID	27- 36	232	G_BRITAIN	0011 1010 00
USER PROTOCOL	37- 39	7	TEST	111
SPARE	40- 63			0011 0100 1101 0011 0100 1101
SPARE	64- 83			0011 0101 1101 0011 0100
HOMING	84- 85	1	121.5	01
BCH ENCODED	86-106		ERRORS=0	1100 0111 0001 0001 0001 0
BCH GENERATED	86-106			1100 0111 0001 0001 0001 0
SPARE	107-126			1011 1111 1000 0011 1111
SPARE	127-144			1100 0000 0101 0001 10

2.5 THERMAL SHOCK



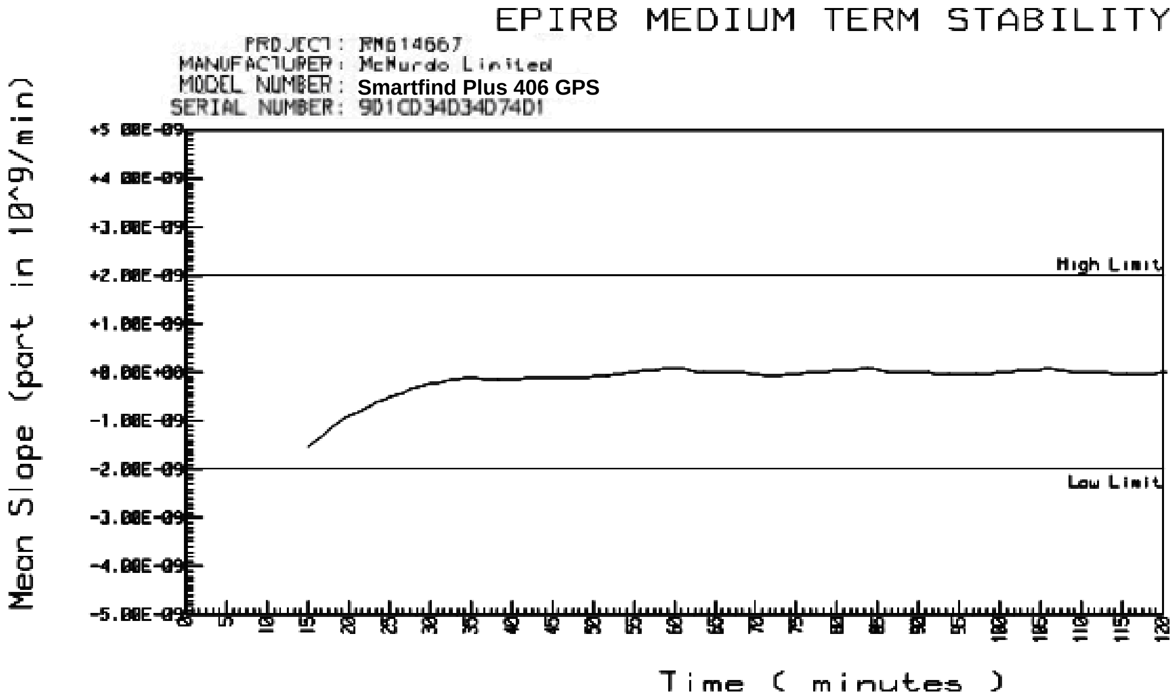
Thermal Shock - Nominal Frequency

2.5 THERMAL SHOCK



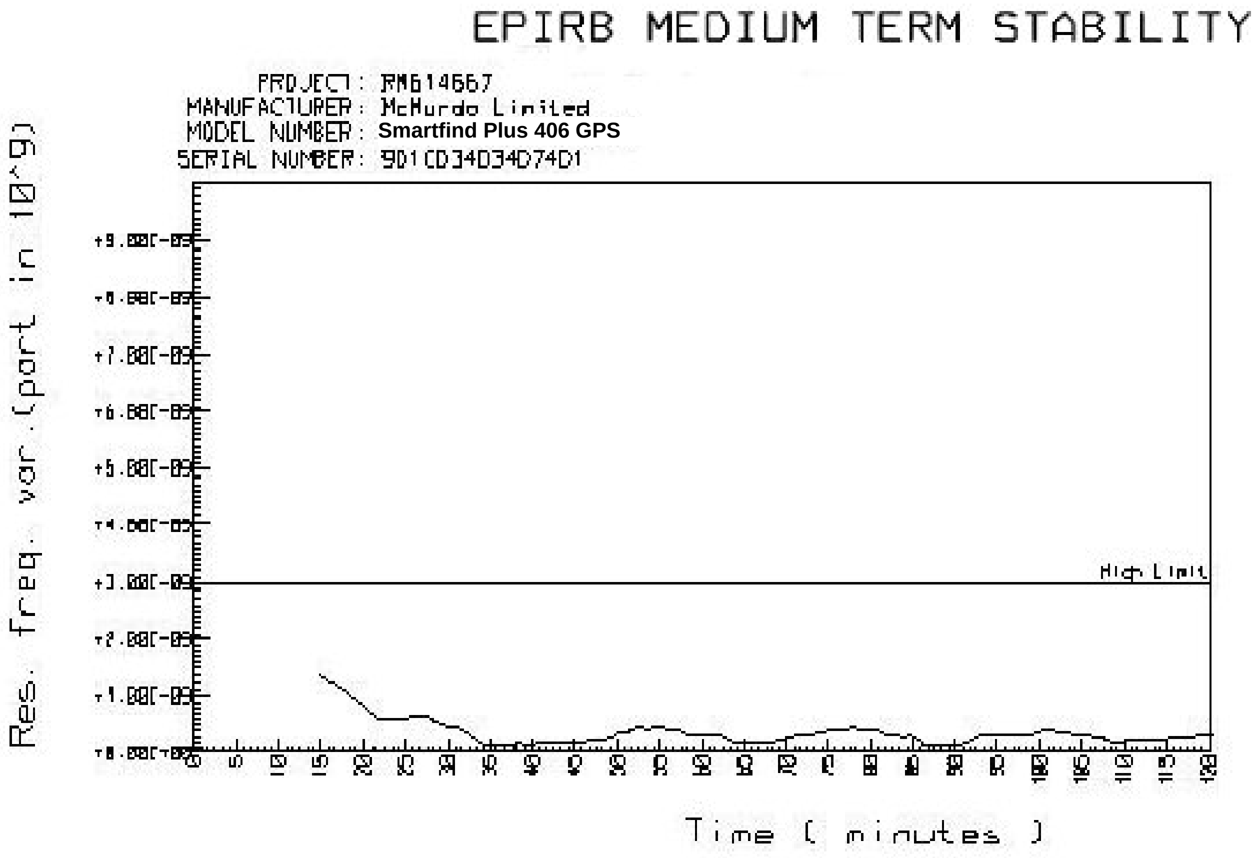
Thermal Shock - Short Term Stability

2.5 THERMAL SHOCK



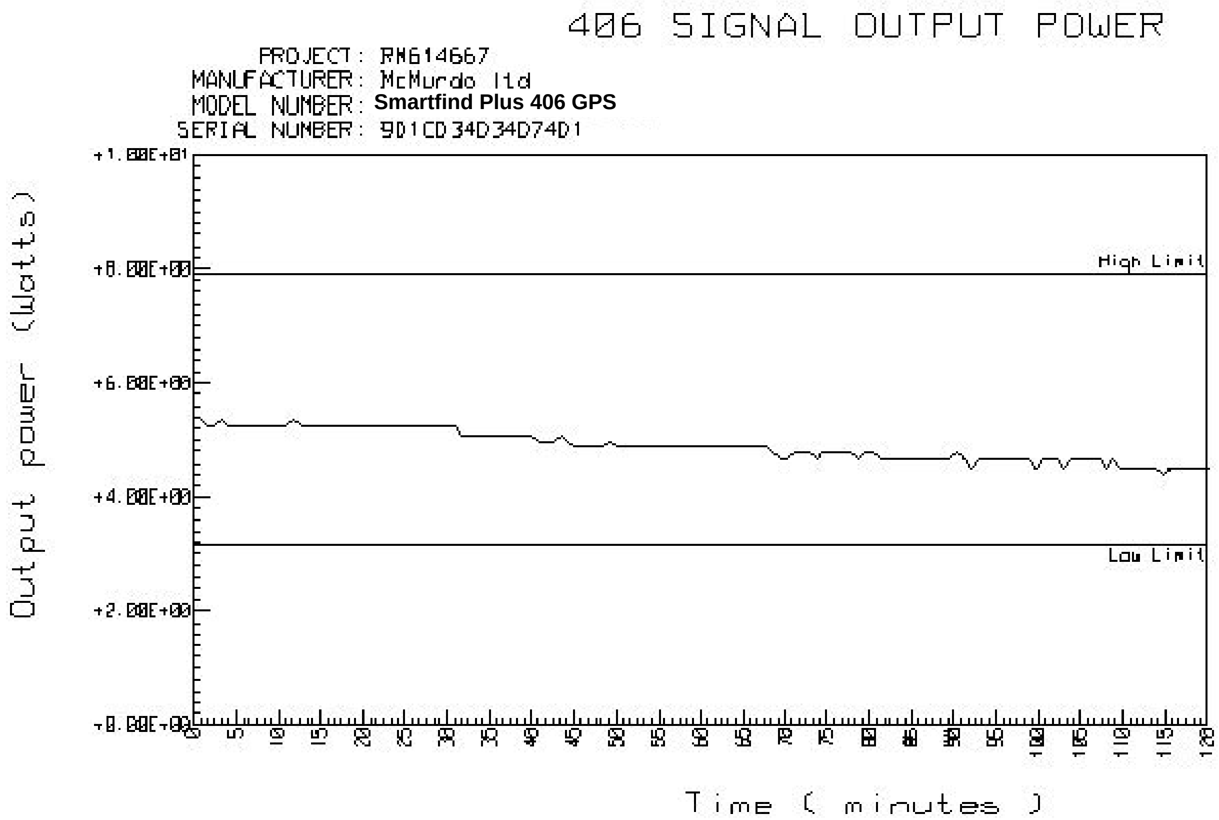
Thermal Shock - Medium Term Stability, Mean Slope

2.5 THERMAL SHOCK



Thermal Shock - Medium Term Stability, Residual Frequency Variation

2.5 THERMAL SHOCK



Thermal Shock - Output Power

2.5 THERMAL SHOCK

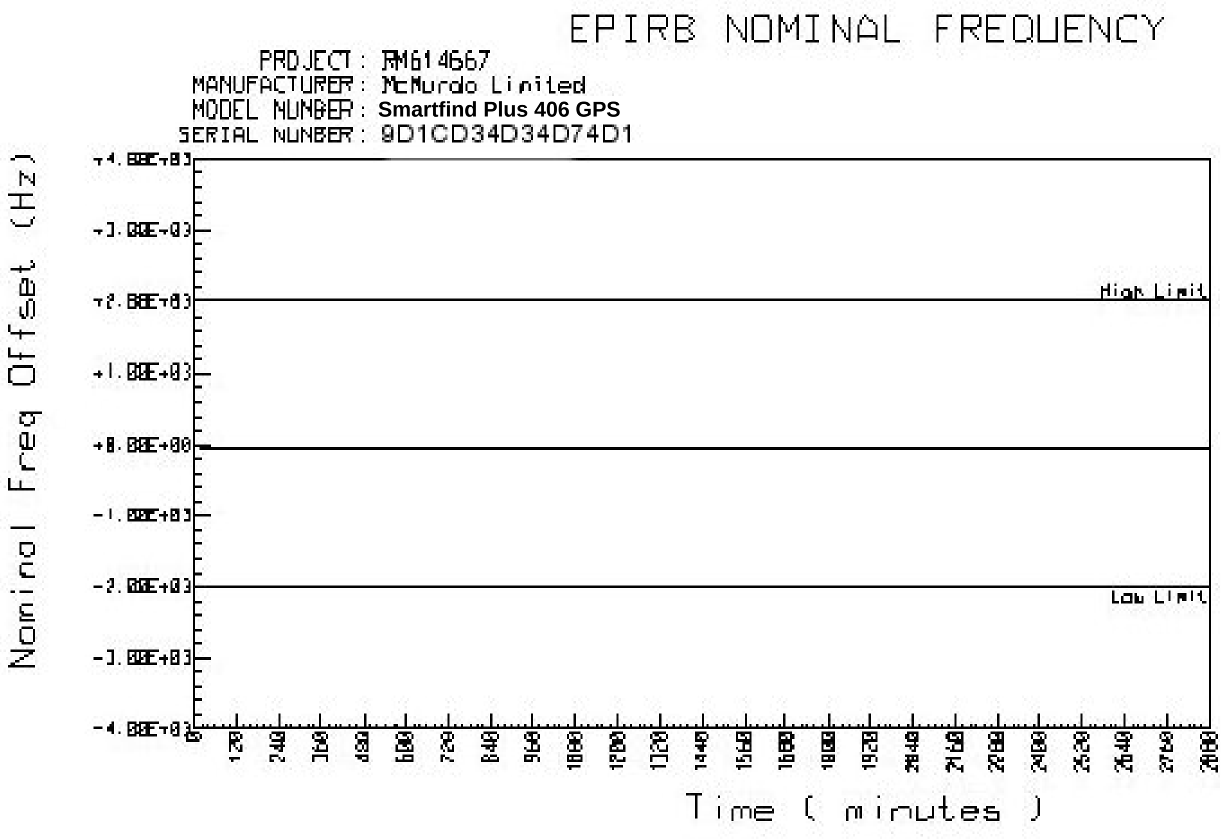
Thermal Shock - Digital Message

Beacon Id Format......... 30 Hex Id, Long Message, Bits 25-144
15 Hex (Bits 26- 85) = 9D1CD34D34D74D1 9D1CD34D34D74D1 Default_Id
30 Hex (Bits 25-144) = CE8E69A69A6BA68E3888AFE0FF0146

```
       26   30   34   38   42   46   50   54   58   62   66   70   74   78   82
       |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
1      1001 1101 0001 1100 1101 0011 0100 1101 0011 0100 1101 0111 0100 1101 0001
       1100 0111 0001 0001 0001 0101 1111 1100 0001 1111 1110 0000 0010 1000 110
       |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
       86   90   94   98   102  106  110  114  118  122  126  130  134  138  142
```

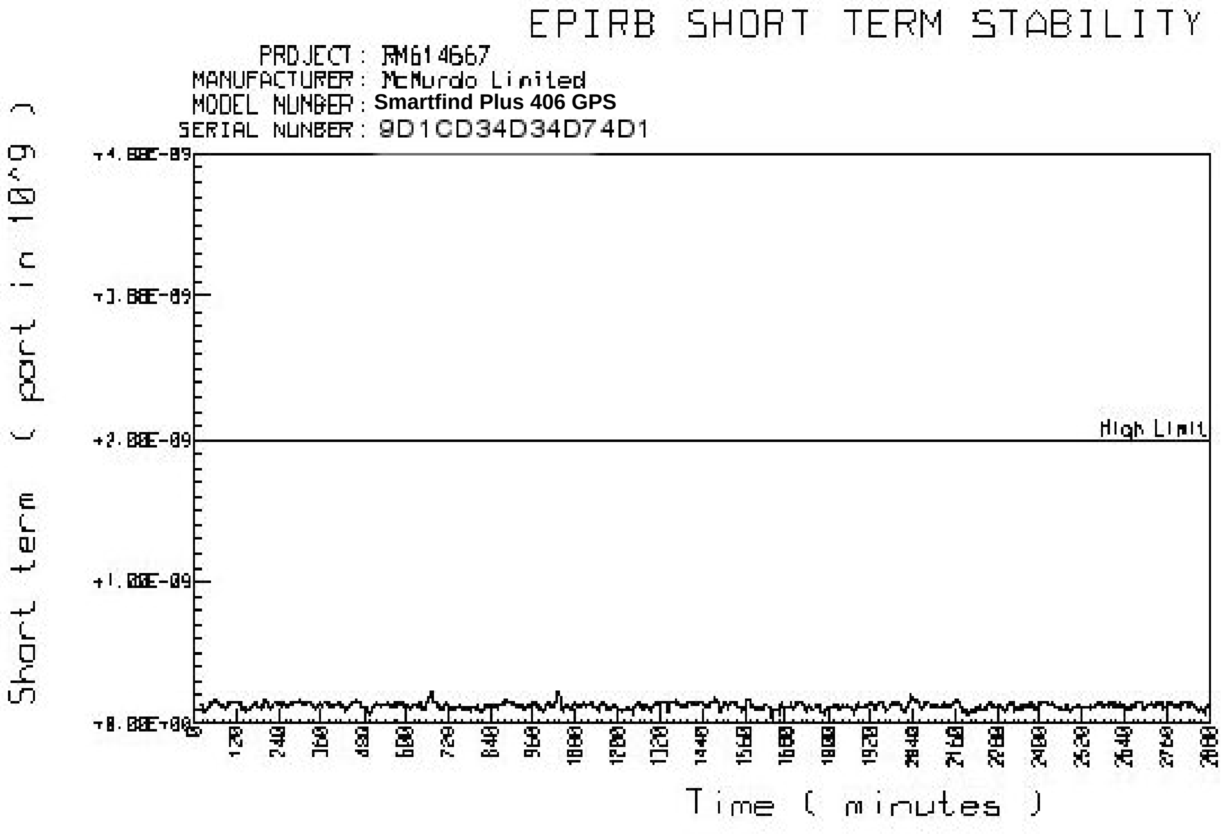
Field Name	Bit Pos	Value	Decode	Bits
----------	-------	-----	------	----
Format Flag	25	1	Long Message	1
Protocol Flag	26	1	User	1
MID	27- 36	232	G_BRITAIN	0011 1010 00
User Protocol	37- 39	7	Test	111
Spare	40- 63			0011 0100 1101 0011 0100 1101
Spare	64- 83			0011 0101 1101 0011 0100
Homing	84- 85	1	121.5	01
BCH Encoded	86-106		Errors=0	1100 0111 0001 0001 0001 0
BCH Generated	86-106			1100 0111 0001 0001 0001 0
Spare	107-126			1011 1111 1000 0011 1111
Spare	127-144			1100 0000 0101 0001 10

2.6 OPERATING LIFETIME AT MINIMUM TEMPERATURE



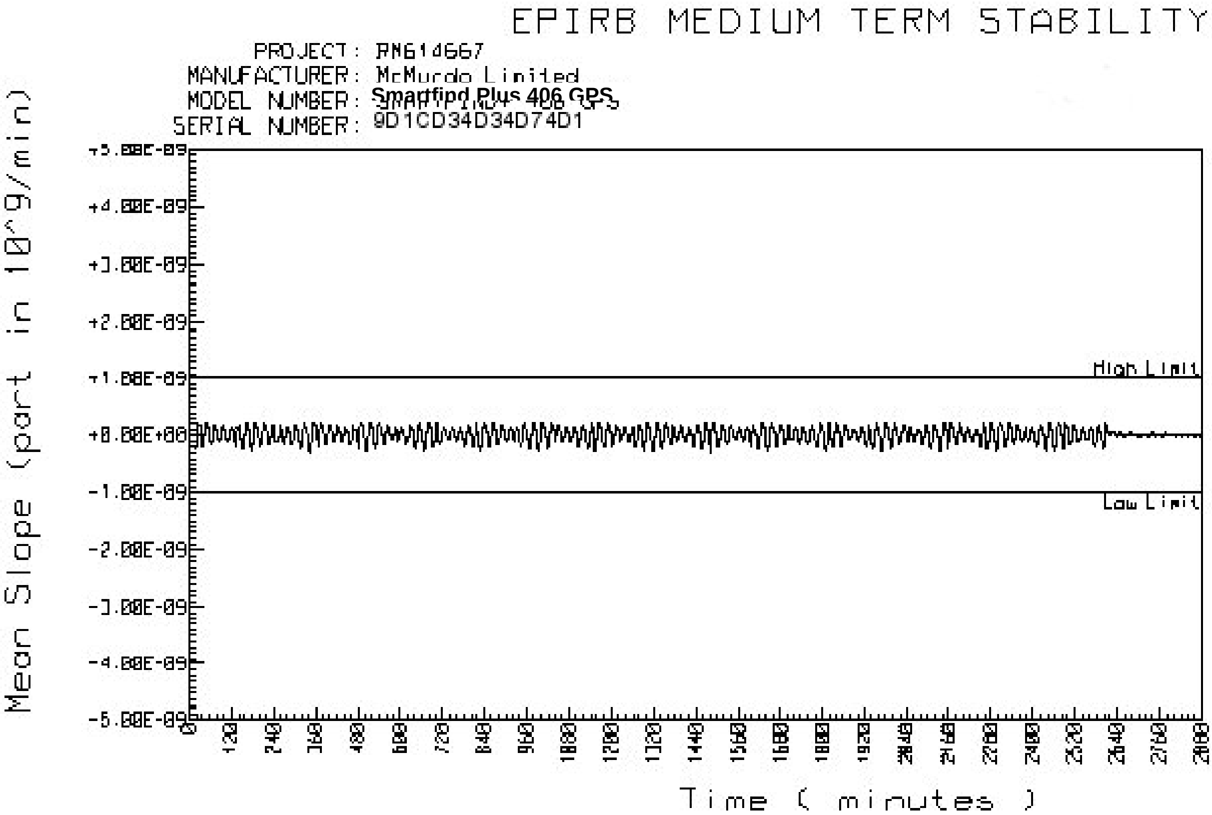
Operating Lifetime at Minimum Temperature - Nominal Frequency

2.6 OPERATING LIFETIME AT MINIMUM TEMPERATURE



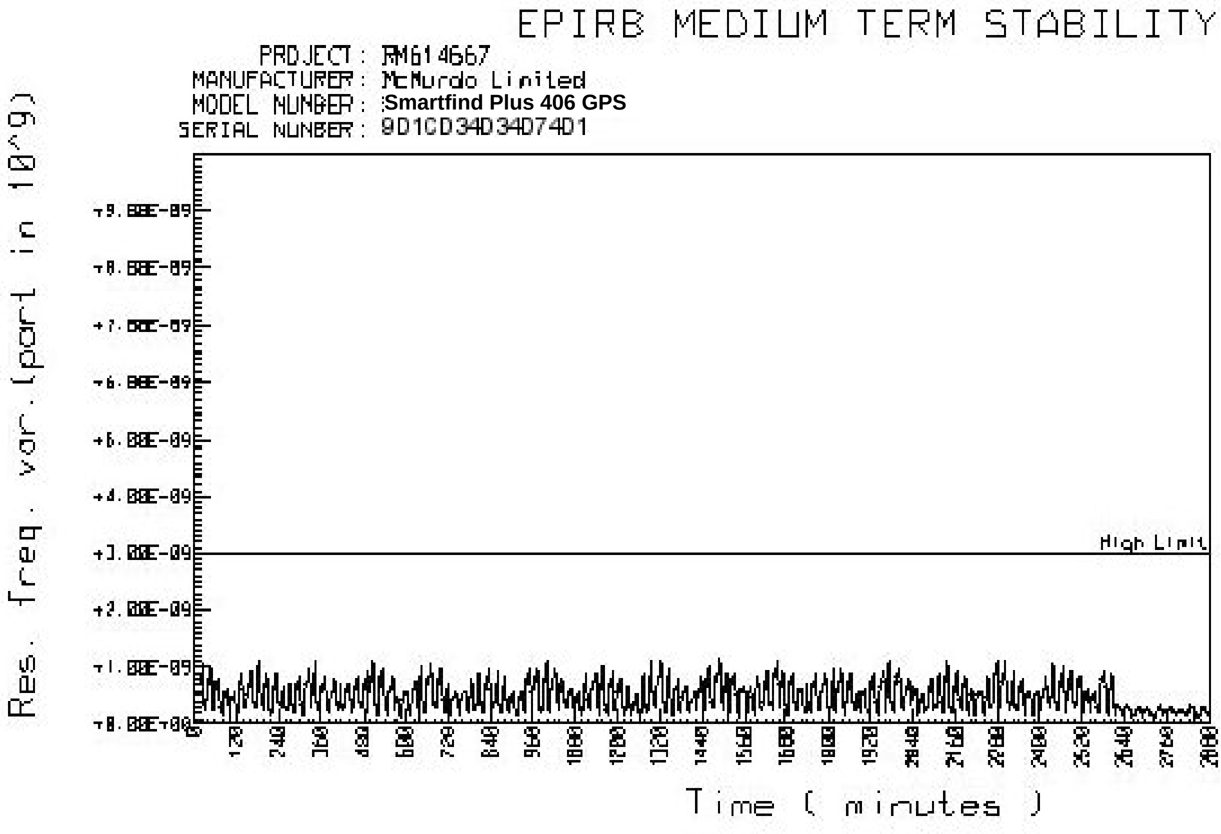
Operating Lifetime at Minimum Temperature - Short Term Stability

2.6 OPERATING LIFETIME AT MINIMUM TEMPERATURE



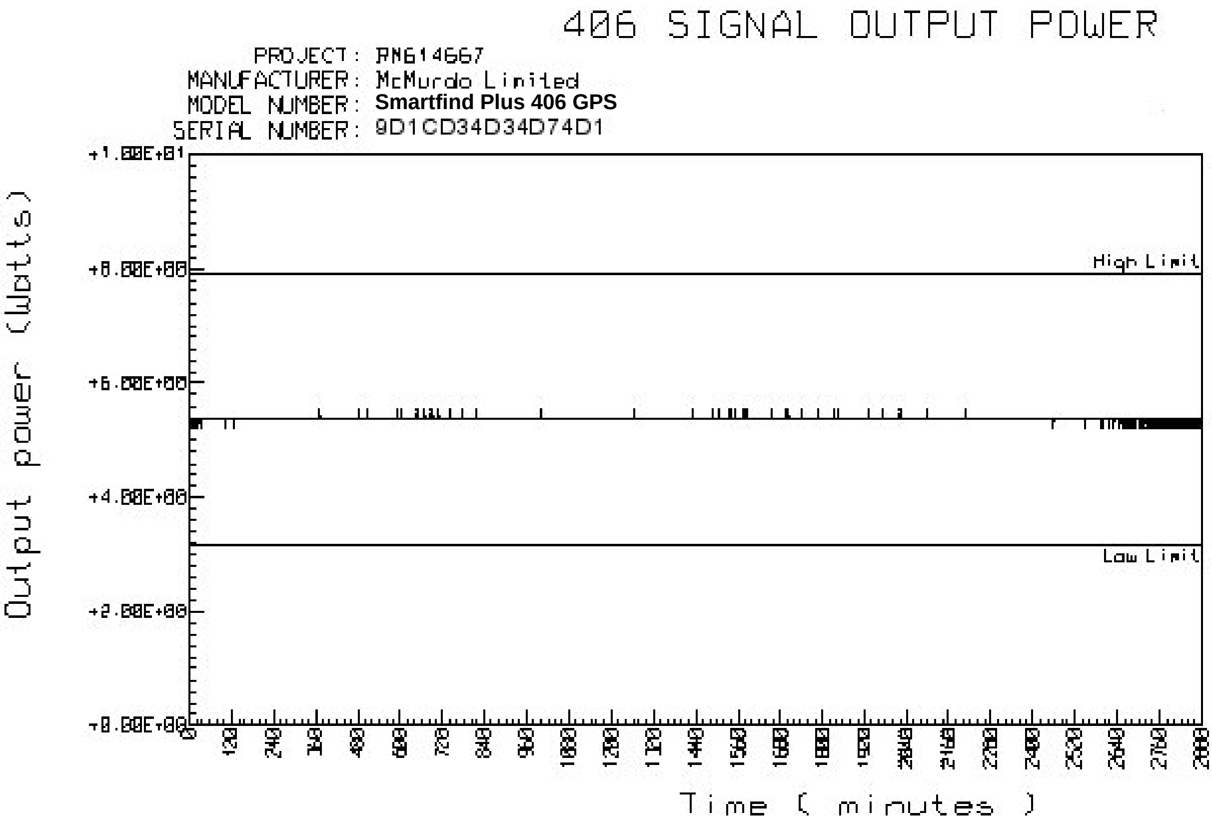
Operating Lifetime at Minimum Temperature - Medium Term Stability, Mean Slope

2.6 OPERATING LIFETIME AT MINIMUM TEMPERATURE



Operating Lifetime at Minimum Temperature - Medium Term Stability, Residual Frequency Variation

2.6 OPERATING LIFETIME AT MINIMUM TEMPERATURE



Operating Lifetime at Minimum Temperature - Output Power

2.6 OPERATING LIFETIME AT MINIMUM TEMPERATURE

Beacon Id Format......... 30 Hex Id, Long Message, Bits 25-144
15 Hex (Bits 26- 85) = 9D1CD34D34D74D1 9D1CD34D34D74D1 Default_Id
30 Hex (Bits 25-144) = CE8E69A69A6BA68E3888AFE0FF0146

	26	30	34	38	42	46	50	54	58	62	66	70	74	78	82
	|	|	|	|	|	|	|	|	|	|	|	|	|	|	|
1	1001	1101	0001	1100	1101	0011	0100	1101	0011	0100	1101	0111	0100	1101	0001
	1100	0111	0001	0001	0001	0101	1111	1100	0001	1111	1110	0000	0010	1000	110
	|	|	|	|	|	|	|	|	|	|	|	|	|	|	|
	86	90	94	98	102	106	110	114	118	122	126	130	134	138	142

Field Name	Bit Pos	Value	Decode	Bits
Format Flag	25	1	Long Message	1
Protocol Flag	26	1	User	1
MID	27- 36	232	G_BRITAIN	0011 1010 00
User Protocol	37- 39	7	Test	111
Spare	40- 63			0011 0100 1101 0011 0100 1101
Spare	64- 83			0011 0101 1101 0011 0100
Homing	84- 85	1	121.5	01
BCH Encoded	86-106		Errors=0	1100 0111 0001 0001 0001 0
BCH Generated	86-106			1100 0111 0001 0001 0001 0
Spare	107-126			1011 1111 1000 0011 1111
Spare	127-144			1100 0000 0101 0001 10

2.6 OPERATING LIFETIME AT MINIMUM TEMPERATURE

2.6.1 Battery Current Measurement Results

Battery Discharge Current

The discharge current for the batteries was measured for each of the following beacon states.
- Beacon in the Off or Standby State, "Standby Current"
- Beacon performing a Self-test, "Self-test Current" and a GPS self-test, "GPS test Current"
- Beacon activated and transmitting, "Operating Current"

The individual tests were conducted for the following durations:

Standby Current	:	30 minutes	(1799950 ms)
Self-test Current	:	15 seconds	(14990 ms)
GPS test Current	:	15 minutes	(899950 ms)
Operating Current	:	30 minutes	(1799950 ms)

Assumptions / Supplied Data

Battery Replacement Interval	: 6 years
Battery Capacity	: 3.06 Ah
Battery Self Drain	: 1.00 % per year
Self-test Interval	: 12 tests per year
GPS Tests limited to	: 10 tests per battery

Test Results

Mode Current	=	Accumulated Charge / Time			
Standby Current	=	39797225 pC / 1799950 ms	=	22.11	nA
Self-test Current	=	1153936.8 uC / 14990 ms	=	76.98	mA
GPS test Current	=	53756125 uC / 899950 ms	=	59.73	mA
Operating Current	=	129613346 uC / 1799950 ms	=	72.01	mA

Battery Preconditioning / Discharge Time Calculations

Battery Self Drain = Capacity - [(100% - Self Drain/Year%)$^{\text{Replacement Interval}}$ x Capacity]
= 3.06- ((1- 0.0100)^{6} x 3.06) = 0.1791 Ah

Standby Drain = Hours per year x Battery Replacement Interval x Standby Current
= 365 x 24 x 6 x 22.11 x 10^{-9} = 0.0012 Ah

Worst Case = 1.65 x 0.0012 Ah = 0.0019 Ah

Self-test Drain = Self-tests per battery x Self-test Current x Self-test duration (in hours)
= 12 x 6 x 76.98 x 10^{-3} x (15 / 3600) = 0.0231 Ah

Worst Case = 1.65 x 0.0231 Ah = 0.0381 Ah

GPS Test Drain = GPS Tests per battery x GPS test Current x GPS test duration (in hours)
= 10 x 59.73 x 10^{-3} x (15 / 60) = 0.1493 Ah

Worst Case = 1.65 x 0.1493 Ah = 0.2464 Ah

Total Drain = Self Drain + Standby Drain* + Self-test Drain* + GPS Test Drain*
= 0.1791 + 0.0019 + 0.0381 + 0.2464 = 0.4655 Ah

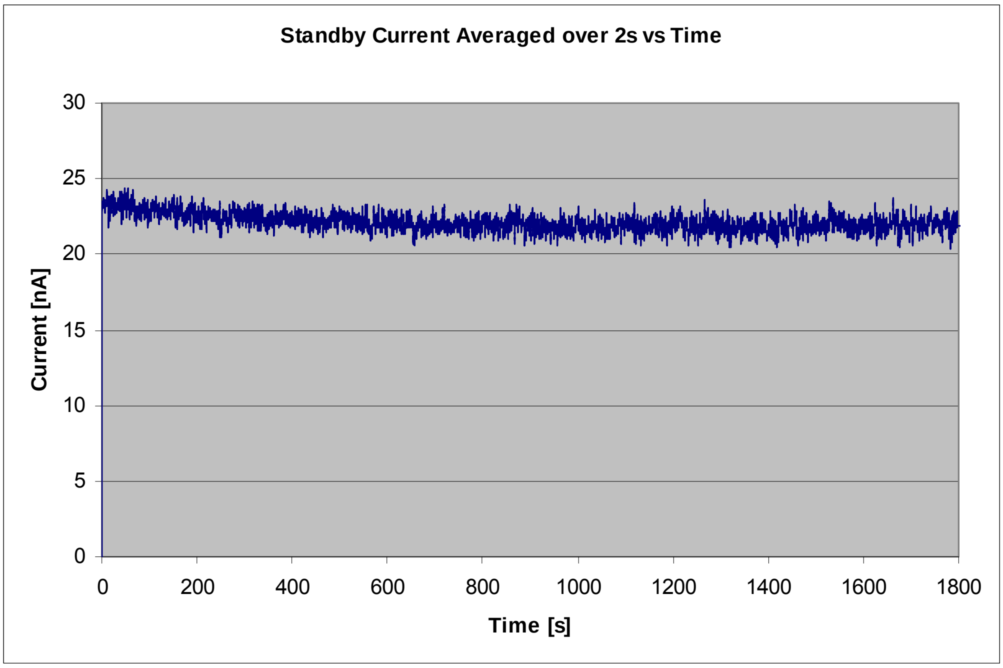
(* = Worst Case)

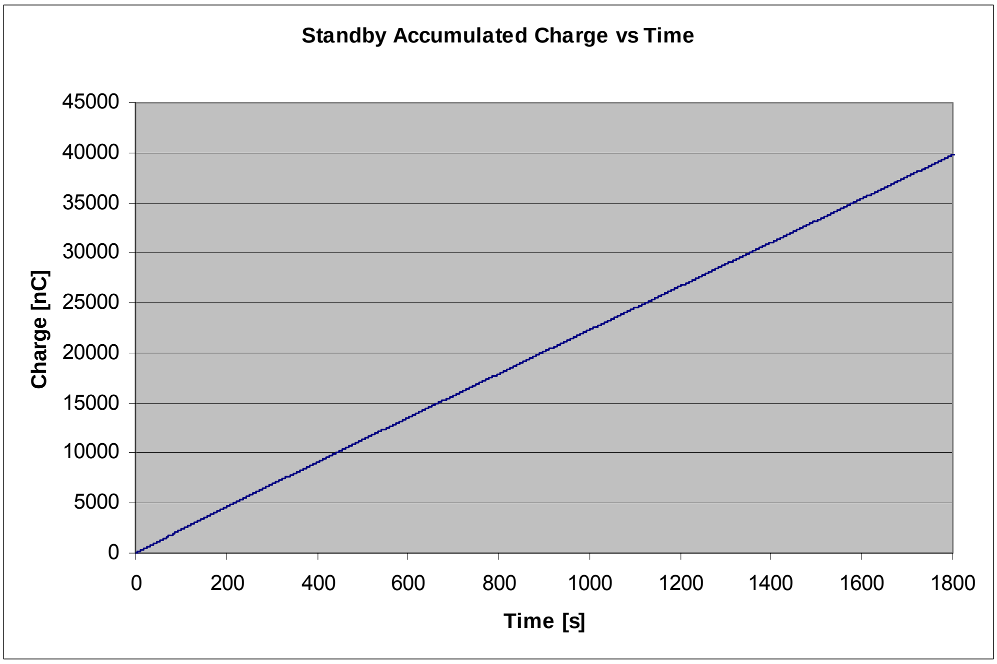
Battery Preconditioning / Discharge Time = Worst Case drain / Operational Current
= 0.4655 / (72.01 x 10^{-3})
= 6.46 hours

2.6 OPERATING LIFETIME AT MINIMUM TEMPERATURE

2.6.1 Battery Current Measurement Results

Battery Current Measurement Results (continued) - Standby Mode

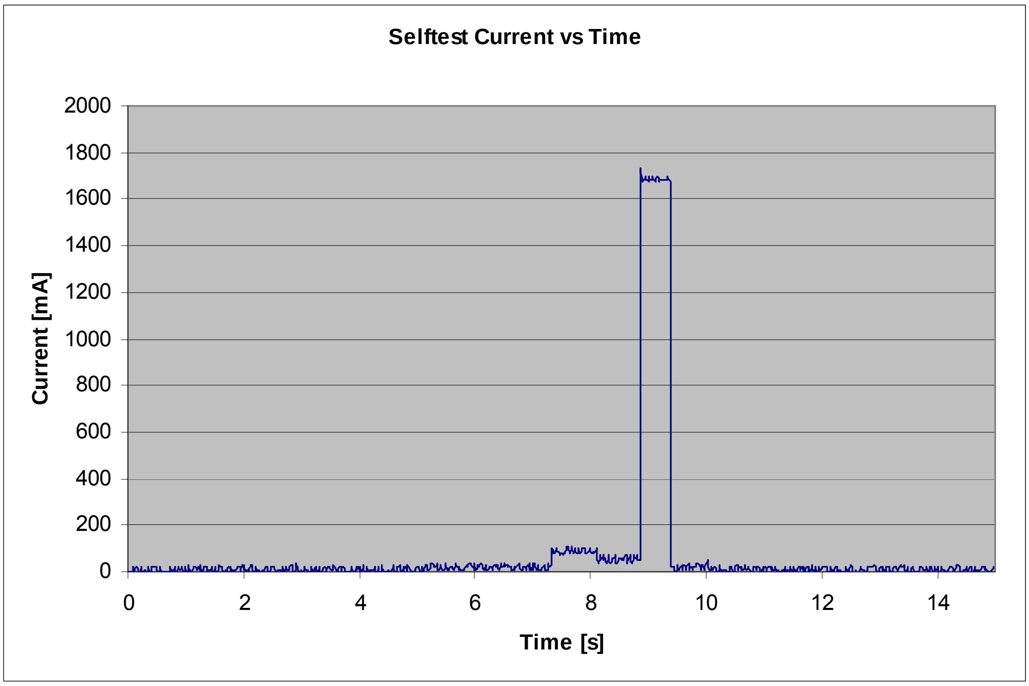


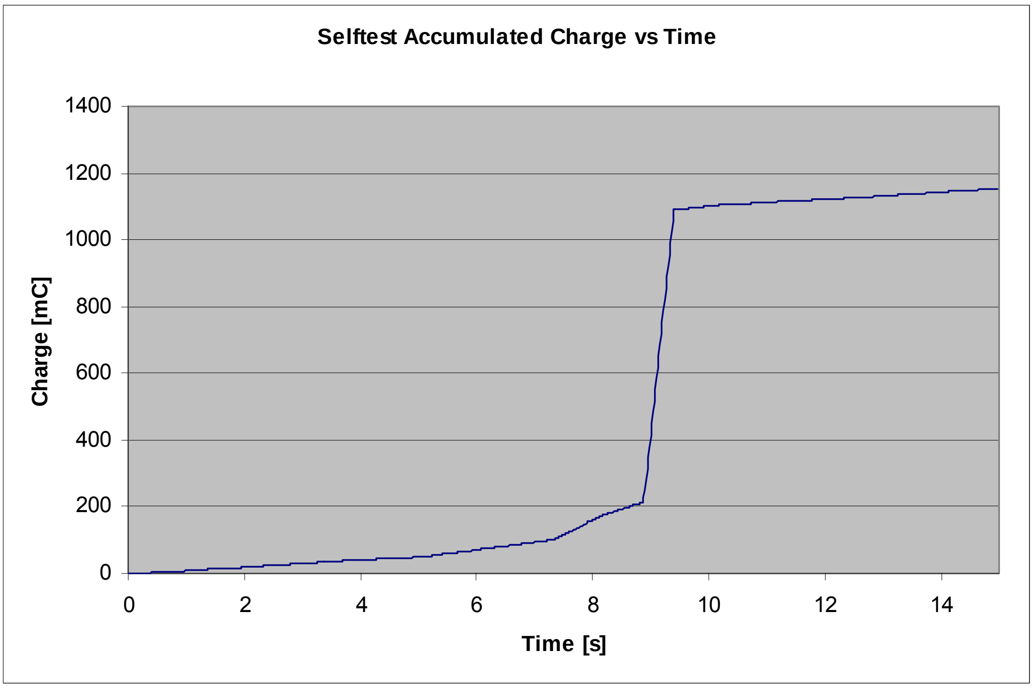


2.6 OPERATING LIFETIME AT MINIMUM TEMPERATURE

2.6.1 Battery Current Measurement Results

Battery Current Measurement Results (continued) - Selftest Mode

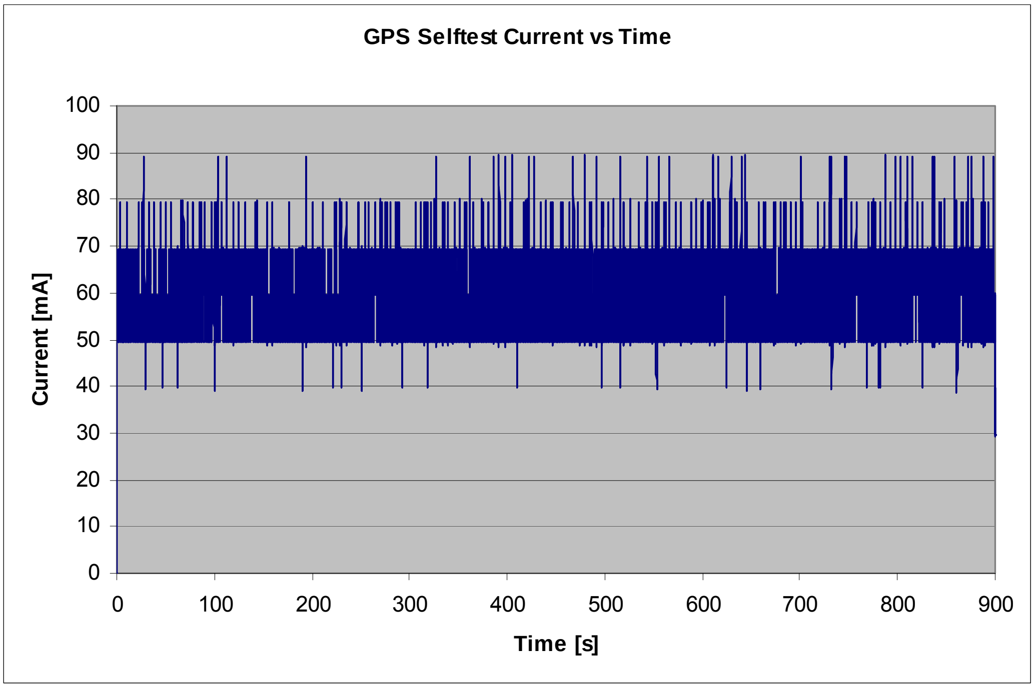


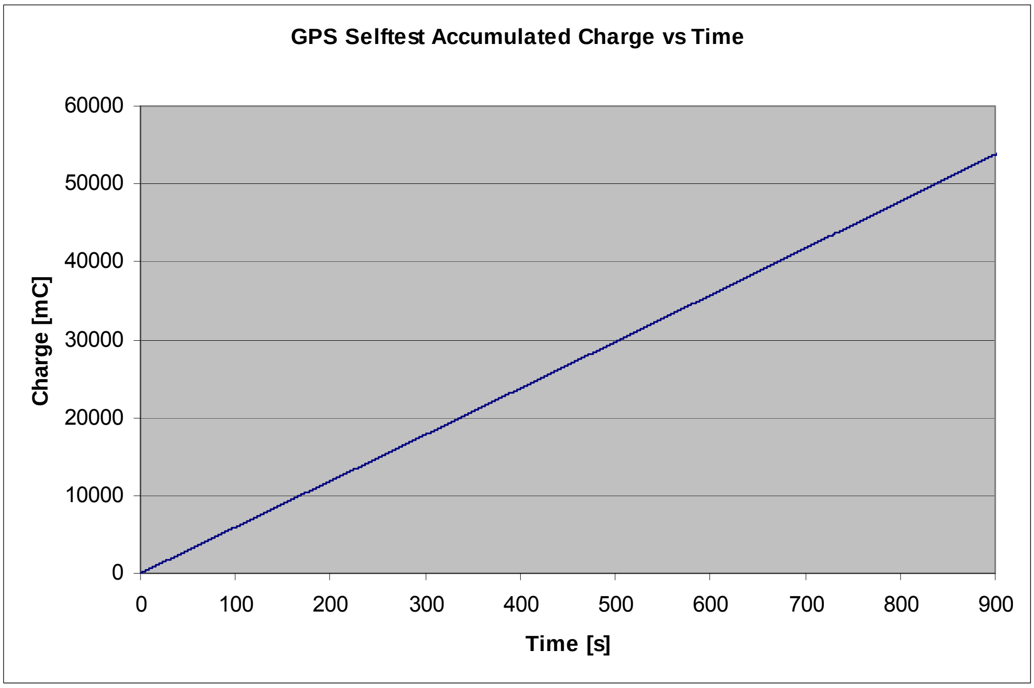


2.6 OPERATING LIFETIME AT MINIMUM TEMPERATURE

2.6.1 Battery Current Measurement Results

<u>Battery Current Measurement Results (continued) – GPS Test Mode</u>

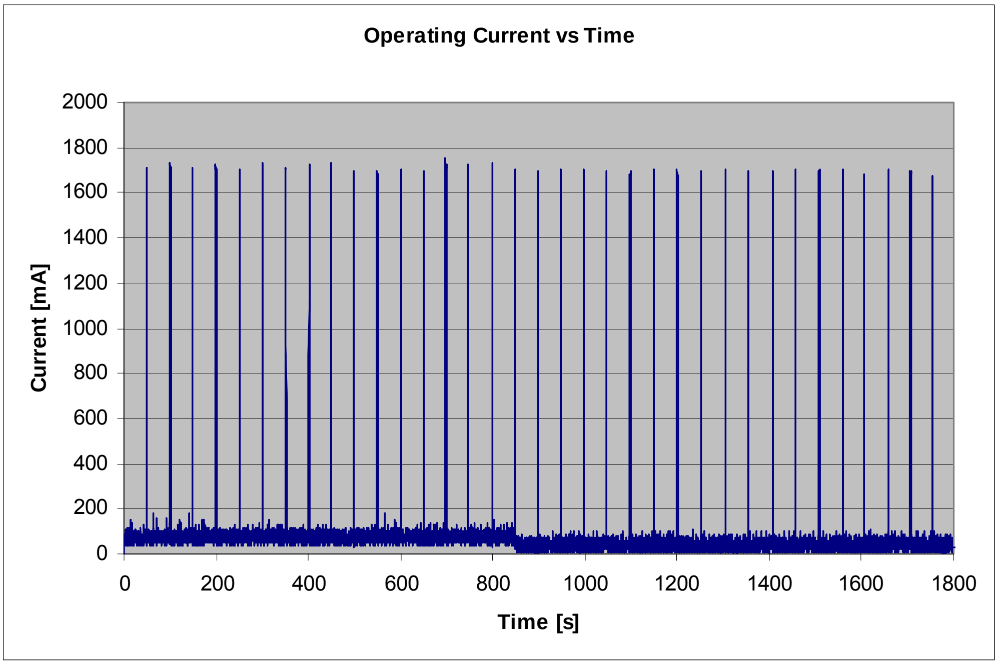


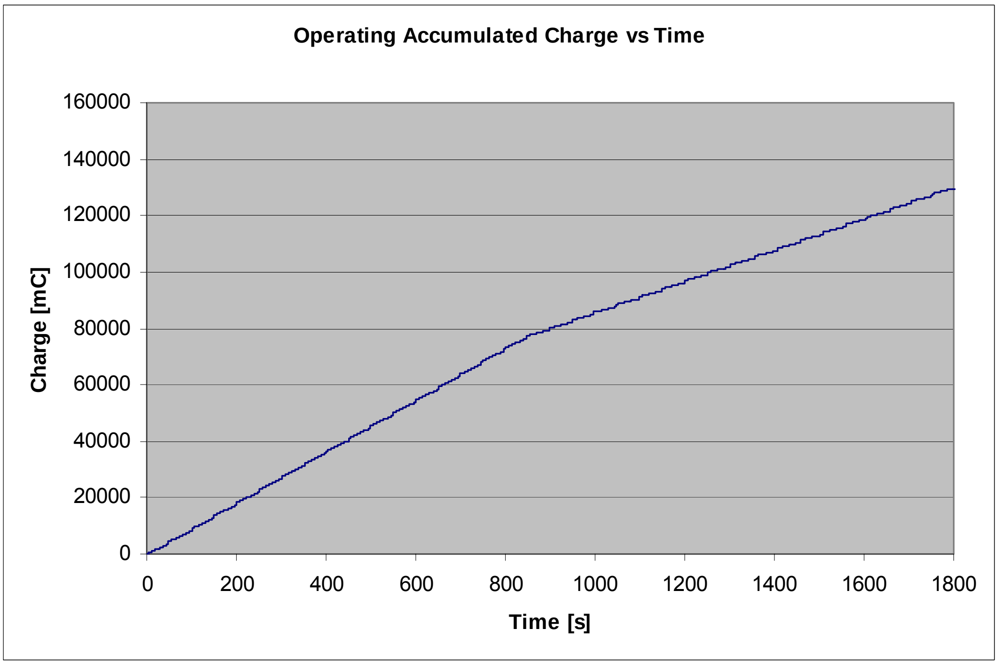


2.6 OPERATING LIFETIME AT MINIMUM TEMPERATURE

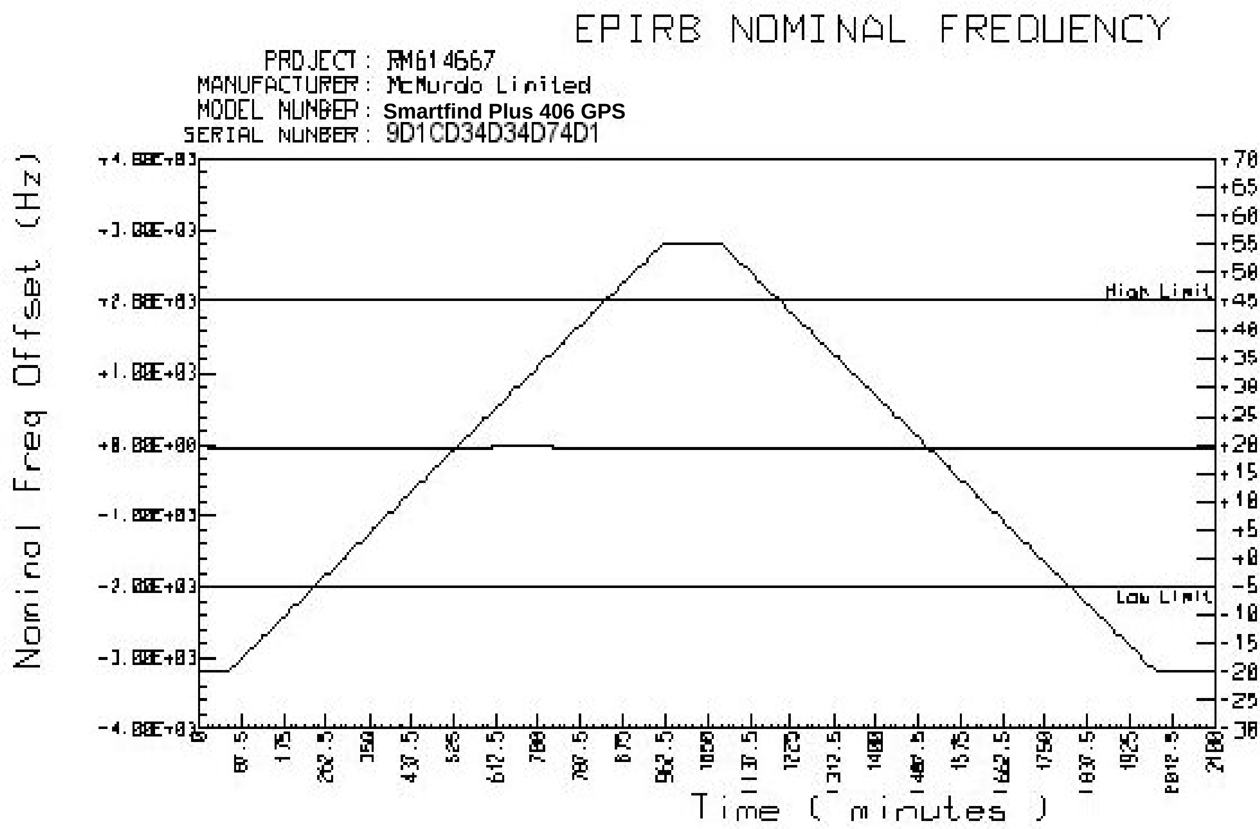
2.6.1 Battery Current Measurement Results

Battery Current Measurement Results (continued) - Operational Mode



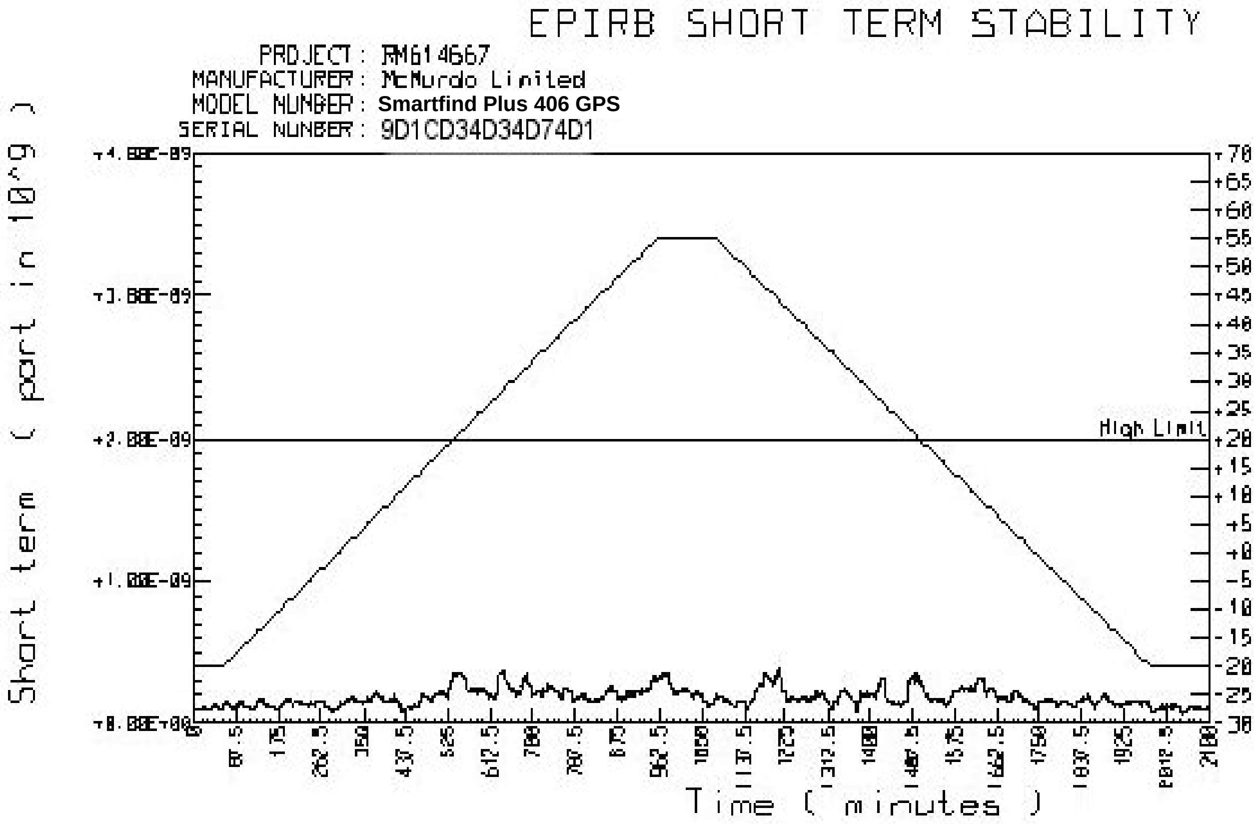


2.7 FREQUENCY STABILITY WITH TEMPERATURE GRADIENT



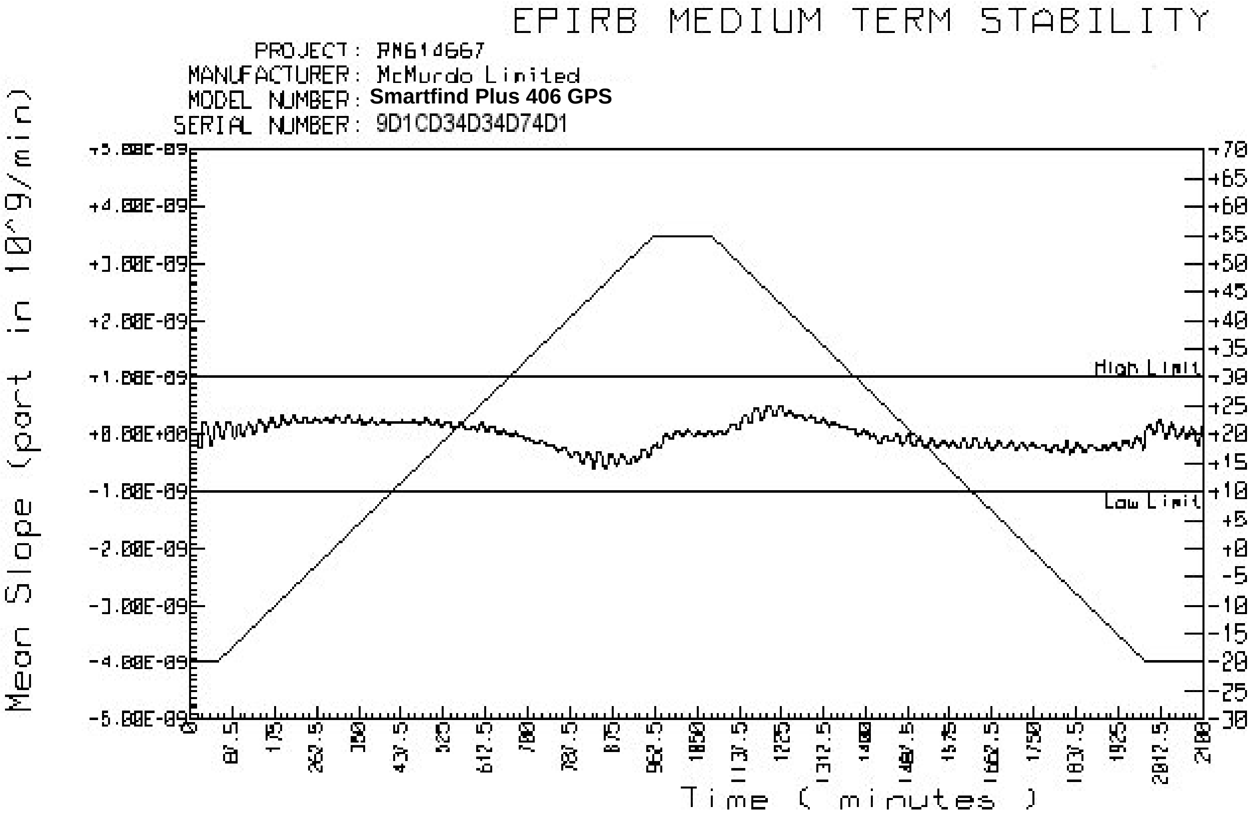
Temperature Gradient - Nominal Frequency

2.7 FREQUENCY STABILITY WITH TEMPERATURE GRADIENT



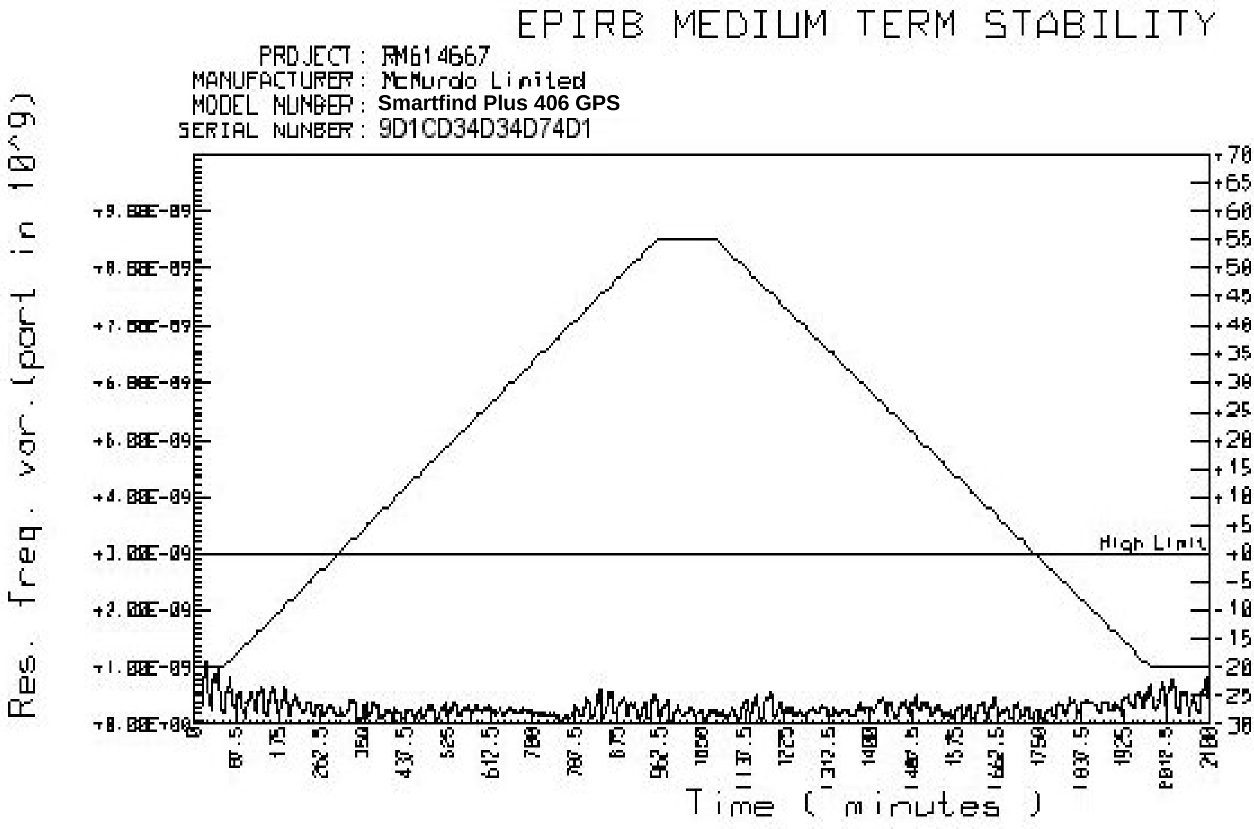
Temperature Gradient - Short Term Stability

2.7 FREQUENCY STABILITY WITH TEMPERATURE GRADIENT



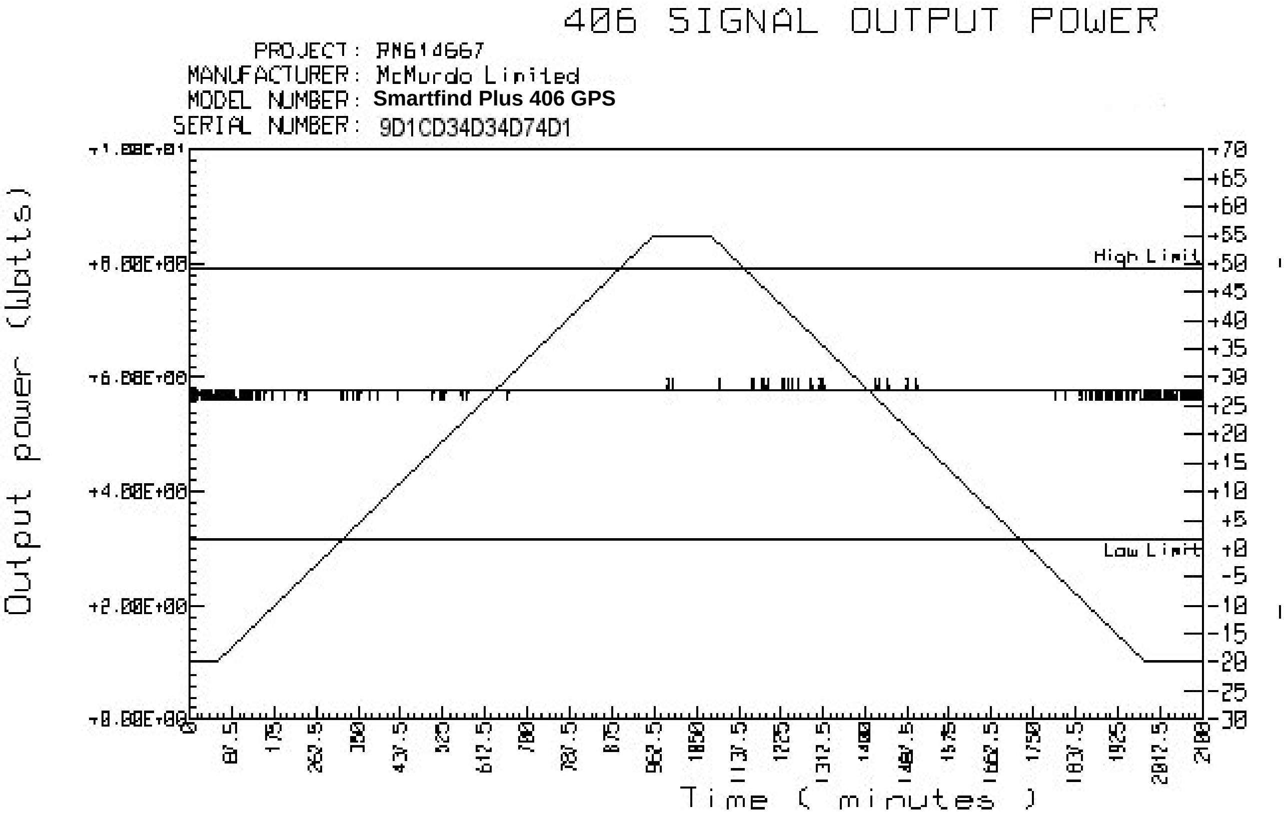
Temperature Gradient - Medium Term Stability, Mean Slope

2.7 FREQUENCY STABILITY WITH TEMPERATURE GRADIENT



Temperature Gradient – Medium Term Stability, Residual Frequency Variation

2.7 FREQUENCY STABILITY WITH TEMPERATURE GRADIENT



Temperature Gradient – Output Power

2.7 FREQUENCY STABILITY WITH TEMPERATURE GRADIENT

Beacon Id Format......... 30 Hex Id, Long Message, Bits 25-144
15 Hex (Bits 26- 85) = 9D1CD34D34D74D1 9D1CD34D34D74D1 Default_Id
30 Hex (Bits 25-144) = CE8E69A69A6BA68E3888AFE0FF0146

```
26   30   34   38   42   46   50   54   58   62   66   70   74   78   82
|    |    |    |    |    |    |    |    |    |    |    |    |    |    |
1001 1101 0001 1100 1101 0011 0100 1101 0011 0100 1101 0111 0100 1101 0001
1100 0111 0001 0001 0001 0101 1111 1100 0001 1111 1110 0000 0010 1000 110
|    |    |    |    |    |    |    |    |    |    |    |    |    |    |
86   90   94   98   102  106  110  114  118  122  126  130  134  138  142
```

Field Name	Bit Pos	Value	Decode	Bits
----------	-------	-----	------	----
Format Flag	25	1	Long Message	1
Protocol Flag	26	1	User	1
MID	27- 36	232	G_BRITAIN	0011 1010 00
User Protocol	37- 39	7	Test	111
Spare	40- 63			0011 0100 1101 0011 0100 1101
Spare	64- 83			0011 0101 1101 0011 0100
Homing	84- 85	1	121.5	01
BCH Encoded	86-106		Errors=0	1100 0111 0001 0001 0001 0
BCH Generated	86-106			1100 0111 0001 0001 0001 0
Spare	107-126			1011 1111 1000 0011 1111
Spare	127-144			1100 0000 0101 0001 10

Temperature Gradient – Digital Message Check

2.8 SATELLITE QUALITATIVE TESTS – T.007 Configuration B.4

Date of the Test:	29th and 30th May
Time of the Test:	20:00 to 10:55
Beacon Model:	Smartfind Plus 406 GPS
Beacon 15 Hex ID:	993C3 0C30C 30CD1
Actual location of the test beacon:	Latitude: 050° 49.091´ N Longitude: 001° 11.870´W
Beacon test configuration (e.g. on dry ground floating in water etc):	C/S T.007 Figure B.4

Satellite ID	Satellite Pass Number	15 Hex ID Provided by LUT	Doppler Latitude	Doppler Longitude	Mean Rx Power (dBm)	TCA	CTA (deg)	Location Error (km)
S7	41818	993C3 0C30C 30CD1	50.81870	-1.20255	-125.88	08:20:46	16.026	0.336
S7	41817	993C3 0C30C 30CD1	50.81592	-1.18609	-121.22	06:41:43	1.990	0.862
S7	41816	993C3 0C30C 30CD1	50.81752	-1.20038	-118.04	05:01:16	-13.778	0.193
S8	29304	993C3 0C30C 30CD1	50.81582	-1.19873	-124.86	05:53:59	15.420	0.270
S8	29303	993C3 0C30C 30CD1	50.81421	-1.18234	-115.69	04:14:05	1.268	1.174
S10	5283	993C3 0C30C 30CD1	50.81457	-1.19257	-122.01	03:34:30	9.087	0.546
S8	29302	993C3 0C30C 30CD1	50.81091	-1.19839	-126.35	02:32:46	-14.637	0.809
S10	5282	993C3 0C30C 30CD1	50.81753	-1.19906	-123.64	01:53:49	-6.186	0.113
S9	20418	993C3 0C30C 30CD1	50.82344	-1.19201	-125.05	23:30:40	-16.960	0.713
S9	20417	993C3 0C30C 30CD1	50.83253	-1.16504	-121.94	21:49:52	-1.090	2.800
S9	20416	993C3 0C30C 30CD1	50.82344	-1.20588	-124.65	20:10:30	13.455	0.813

$$\text{Ratio of Successful Solutions} = \frac{\text{number of Doppler solutions within 5km with } 1^\circ<\text{CTA}<21^\circ}{\text{number of satellite passes over test duration with } 1^\circ<\text{CTA}<21^\circ}$$

$$= \frac{11}{11} = 100\ \%$$

2.8 SATELLITE QUALITATIVE TESTS – T.007 Configuration B.5

Date of the Test:	1st and 2nd June
Time of the Test:	17:04 to 06:22
Beacon Model:	Smartfind Plus 406 GPS
Beacon 15 Hex ID:	1D1C0 00002 FFBFF
Actual location of the test beacon:	Latitude: 052° 14.447´ N Longitude: 001° 43.917´W
Beacon test configuration (e.g. on dry ground floating in water etc):	C/S T.007 Figure B.5

Satellite ID	Satellite Pass Number	15 Hex ID Provided by LUT	Doppler Latitude	Doppler Longitude	Mean Rx Power (dBm)	TCA	CTA (deg)	Location Error (km)
S7	41860	1D1C0 00002 FFBFF	52.23556	-1.71643	-125.67	07:09:57	5.424	1.258
S7	41859	1D1C0 00002 FFBFF	52.24102	-1.71900	-123.07	05:29:50	-9.593	0.942
S8	29346	1D1C0 00002 FFBFF	52.23677	-1.72241	-128.06	05:19:12	9.766	0.838
S10	5326	1D1C0 00002 FFBFF	52.23517	-1.72814	-132.07	04:43:23	17.018	0.701
S8	29345	1D1C0 00002 FFBFF	52.23703	-1.72007	-127.39	03:38:44	-4.800	0.963
S8	29344	1D1C0 00002 FFBFF	52.23960	-1.72104	-123.47	01:56:48	-20.385	0.813
S10	5325	1D1C0 00002 FFBFF	52.23867	-1.71713	-126.60	03:03:35	3.797	1.094
S10	5324	1D1C0 00002 FFBFF	52.23456	-1.72268	-125.63	01:22:23	-11.473	0.978
S6	58891	1D1C0 00002 FFBFF	52.25350	-1.72939	-137.70	22:48:57	-19.199	1.432
S9	20460	1D1C0 00002 FFBFF	52.24432	-1.71720	-125.53	22:21:26	-5.852	1.134
S6	58890	1D1C0 00002 FFBFF	52.25391	-1.76306	-131.92	21:07:14	-3.627	2.521
S9	20459	1D1C0 00002 FFBFF	52.25257	-1.73928	-125.45	20:41:37	8.804	1.381
S9	20458	1D1C0 00002 FFBFF	52.24036	-1.72860	-127.14	19:03:09	20.795	0.292
S6	58889	1D1C0 00002 FFBFF	52.26216	-1.72512	-133.57	19:26:58	10.746	2.433
S7	41853	1D1C0 00002 FFBFF	52.24116	-1.71871	-132.39	19:01:19	-17.849	0.962
S7	41852	1D1C0 00002 FFBFF	52.24416	-1.71164	-126.98	17:20:26	-2.425	1.490

$$\text{Ratio of Successful Solutions} = \frac{\text{number of Doppler solutions within 5km with } 1^\circ<\text{CTA}<21^\circ}{\text{number of satellite passes over test duration with } 1^\circ<\text{CTA}<21^\circ}$$

$$= \frac{16}{16} = 100\ \%$$

2.8 SATELLITE QUALITATIVE TESTS – Floating in Salt Water Configuration

Date of the Test:	15th and 16th May
Time of the Test:	11:58 to 09:59
Beacon Model:	G5 Smartfind Plus 406 GPS
Beacon 15 Hex ID:	993C3 0C30C 30CD1
Actual location of the test beacon:	Latitude: 050° 49.091´ N Longitude: 001° 11.870´W
Beacon test configuration (e.g. on dry ground floating in water etc):	Floating in Salt water 5% by mass

Satellite ID	Satellite Pass Number	15 Hex ID Provided by LUT	Doppler Latitude	Doppler Longitude	Mean Rx Power (dBm)	TCA	CTA (deg)	Location Error (km)
S7	41618	993C3 0C30C 30CD1	50.82016	-1.19729	-119.26	07:14:22	6.740	0.223
S7	41619	993C3 0C30C 30CD1	50.81800	-1.19967	-130.13	08:52:59	19.837	0.131
S6	58656	993C3 0C30C 30CD1	50.82594	-1.18996	-135.03	08:00:01	-20.589	1.024
S7	41617	993C3 0C30C 30CD1	50.81522	-1.19972	-117.08	05:34:22	-8.668	0.355
S8	29106	993C3 0C30C 30CD1	50.81526	-1.19338	-126.02	05:16:00	10.544	0.451
S10	5086	993C3 0C30C 30CD1	50.81392	-1.19500	-126.83	04:16:46	14.808	0.514
S8	29105	993C3 0C30C 30CD1	50.81643	-1.19874	-123.47	03:35:36	-4.474	0.205
S8	29104	993C3 0C30C 30CD1	50.81727	-1.19971	-120.88	01:53:43	-20.549	0.166
S10	5084	993C3 0C30C 30CD1	50.81535	-1.19495	-119.24	00:55:09	-15.534	0.374
S9	20219	993C3 0C30C 30CD1	50.81631	-1.18486	-129.17	23:52:38	-20.361	0.934
S9	20218	993C3 0C30C 30CD1	50.82170	-1.18266	-123.89	22:11:31	-4.412	1.135
S6	58650	993C3 0C30C 30CD1	50.83813	-1.21600	-130.09	21:25:55	-6.926	2.557
S9	20217	993C3 0C30C 30CD1	50.82472	-1.21183	-125.65	20:31:52	10.565	1.222
S6	58649	993C3 0C30C 30CD1	50.83894	-1.21179	-131.65	19:45:23	8.345	2.506
S7	41611	993C3 0C30C 30CD1	50.82375	-1.19244	-129.05	19:05:04	-18.822	0.725
S6	58648	993C3 0C30C 30CD1	50.83999	-1.22654	-135.53	18:06:15	20.984	3.152
S7	41610	993C3 0C30C 30CD1	50.82427	-1.18521	-121.85	17:24:09	-2.901	1.115
S7	41609	993C3 0C30C 30CD1	50.82362	-1.20973	-124.49	15:44:40	11.896	1.031
S8	29098	993C3 0C30C 30CD1	50.82128	-1.19123	-124.17	15:18:58	-6.927	0.577
S10	5078	993C3 0C30C 30CD1	50.82503	-1.19009	-126.12	14:19:31	-11.403	0.935
S9	20212	993C3 0C30C 30CD1	50.81823	-1.19702	-120.75	12:24:54	11.261	0.057
S8	29097	993C3 0C30C 30CD1	50.82126	-1.20334	-124.87	13:38:20	8.373	0.516
S10	5077	993C3 0C30C 30CD1	50.82275	-1.20492	-121.48	12:38:22	4.339	0.711
S6	58644	993C3 0C30C 30CD1	50.82919	-1.20128	-131.21	11:34:57	12.241	1.247
S10	5076	993C3 0C30C 30CD1	50.79417	-1.27465	-128.51	10:58:39	18.042	6.018*

* Location error(s) ≥ 5km

$$\text{Ratio of Successful Solutions} = \frac{\text{number of Doppler solutions within 5km with } 1^\circ<\text{CTA}<21^\circ}{\text{number of satellite passes over test duration with } 1^\circ<\text{CTA}<21^\circ}$$

$$= \frac{24}{25} = 96.0\ \%$$

2.9 ANTENNA CHARACTERISTICS B4 Configuration

Antenna Model Integral

	Elevation Angle (degrees)									
	10		20		30		40		50	
Azimuth Angle (Degrees)	EIRP dBm	Ant dBi	EIRP dBm	Ant dBi	EIRP dBm	Ant dBi	EIRP dBm	Ant dBi	EIRP dBm	Ant dBi
0	37.5	0.27	40.4	3.26	41.9	4.67	36.9	-0.27	~~30.2~~	-6.98
30	37.9	0.76	40.4	3.27	41.7	4.47	36.6	-0.58	~~30.5~~	-6.66
60	37.8	0.66	40.6	3.45	41.7	4.56	36.4	-0.74	~~31.2~~	-6.00
90	38.2	1.06	40.5	3.36	41.5	4.36	36.3	-0.88	**31.6**	-5.56
120	38.2	1.06	40.9	3.75	41.6	4.47	36.0	-1.14	32.3	-4.91
150	38.0	0.86	41.0	3.85	41.7	4.57	35.8	-1.37	32.3	-4.85
180	38.3	1.07	40.9	3.75	41.8	4.67	35.7	-1.47	32.4	-4.74
210	38.2	0.97	40.6	3.46	41.8	4.58	35.9	-1.26	**31.7**	-5.44
240	37.9	0.77	40.9	3.68	41.7	4.51	36.1	-1.12	**31.5**	-5.69
270	38.0	0.78	40.7	3.57	41.5	4.29	36.3	-0.92	~~31.1~~	-6.09
300	37.6	0.46	40.7	3.48	41.7	4.50	36.8	-0.34	~~30.5~~	-6.63
330	37.7	0.56	40.2	2.98	41.4	4.19	36.8	-0.37	~~30.7~~	-6.50
Gain Variation	0.80		0.87		0.49		1.19		0.05	

	Elevation Angle (degrees)									
	10		20		30		40		50	
Azimuth Angle (Degrees)	Vv	Vh	Vv	Vh	Vv	Vh	Vv	Vh	Vv	Vh
0	108.80	89.30	111.40	90.40	112.10	90.80	106.10	82.70	97.80	81.00
30	109.30	88.30	111.40	90.70	111.90	90.40	105.80	80.30	98.20	70.20
60	109.20	88.00	111.60	88.00	112.00	88.60	105.60	86.60	98.80	80.90
90	109.60	89.30	111.50	89.90	111.80	89.20	105.50	81.70	99.30	71.70
120	109.60	88.40	111.90	88.00	111.90	90.10	105.20	86.30	99.90	81.00
150	109.40	89.10	112.00	88.80	112.00	89.90	105.00	83.10	100.00	77.50
180	109.60	90.20	111.90	88.60	112.10	90.20	104.90	83.10	100.10	79.10
210	109.50	90.00	111.60	90.60	112.00	91.90	105.10	84.40	99.30	84.00
240	109.30	89.20	111.80	92.40	111.90	93.70	105.20	87.30	98.90	87.20
270	109.30	90.50	111.70	91.30	111.70	92.40	105.40	87.60	98.50	86.70
300	109.00	88.30	111.60	92.40	111.90	93.10	106.00	86.90	97.90	87.00
330	109.10	88.60	111.10	91.60	111.60	91.80	106.00	84.00	98.20	84.10
Min (Vv-Vh)	18.80		19.20		18.20		17.80		10.90	

* Denotes results outside of specification limit.

$EIRP_{LOSS} = Pt_{ambient} - Pt_{EOL}$ = (37.18 – 37.19) = -0.01dB

$EIRP_{max\ EOL}$ = MAX [$EIRP_{max}$, ($EIRP_{max}$ - $EIRP_{LOSS}$)] = MAX (41.8 , 41.81) = 41.81dBm = 15.17w

$EIRP_{min\ EOL}$ = MIN [$EIRP_{min}$, ($EIRP_{min}$ - $EIRP_{LOSS}$)] = MIN (31.5 , 31.51) = 31.51 = 1.4w

2.9 ANTENNA CHARACTERISTICS B5 Configuration

Antenna Model Integral

	Elevation Angle (degrees)									
	10		20		30		40		50	
Azimuth Angle (Degrees)	EIRP dBm	Ant dBi	EIRP dBm	Ant dBi	EIRP dBm	Ant dBi	EIRP dBm	Ant dBi	EIRP dBm	Ant dBi
0	38.2	1.03	38.6	1.46	35.4	-1.74	~~30.0~~	-7.17	~~24.6*~~	-12.59
90	38.4	1.18	38.8	1.63	35.8	-1.33	30.4	-6.76	~~29.0*~~	-8.21
180	38.3	1.13	38.8	1.64	36.1	-1.04	30.9	-6.29	~~30.3~~	-6.92
270	38.3	1.08	38.7	1.50	35.9	-1.32	30.6	-6.56	31.8	-5.34
Gain Variation	0.15		0.18		0.70		0.47		7.25	

	Elevation Angle (degrees)									
	10		20		30		40		50	
Azimuth Angle (Degrees)	Vv	Vh	Vv	Vh	Vv	Vh	Vv	Vh	Vv	Vh
0	109.60	77.10	109.60	87.50	105.70	82.70	99.20	77.30	91.60	83.90
90	109.70	90.80	109.80	59.90	106.10	83.90	99.40	86.80	94.50	92.60
180	109.70	83.00	109.80	81.70	106.40	83.30	100.10	69.50	97.40	88.70
270	109.60	90.90	109.60	91.80	106.10	85.80	99.60	87.10	99.50	77.20
Min (Vv-Vh)	18.70		17.80		20.30		12.50		1.90	

* Denotes results outside of specification limit.

$EIRP_{LOSS} = Pt_{ambient} - Pt_{EOL} = (37.18 – 37.19) = -0.01dB$

$EIRP_{max\ EOL} = MAX\ [\ EIRP_{max}\ ,\ (EIRP_{max} - EIRP_{LOSS})\ ] = MAX\ (38.8\ ,\ 38.81) = 38.81dBm = 7.6W$

$EIRP_{min\ EOL} = MIN\ [\ EIRP_{min}\ ,\ (EIRP_{min} - EIRP_{LOSS})\ ] = MIN\ (30.4,\ 30.41) = 30.41\ dBm = 1.1W$

2.10 BEACON CODING SOFTWARE

Examples of Location Protocol Beacon Messages

2.10 BEACON CODING SOFTWARE

Examples of Location Protocol Beacon Messages

Table F-D.2: Examples of Location Protocol Beacon Messages
(Examples required for each protocol requested for inclusion on the type approval certificate)

Protocol	Operational Message (in hexadecimal including bit and frame synchronisation bits)		Self-Test Message (in hexadecimal including bit and frame synchronisation bits)
	Location "A"[1]	Location "B"[1]	
Standard Location: EPIRB with MMSI	FFFE2F8C92F423F033 A03DDC83F71DA4D4D0	FFFE2F8C92F423F032 E0320822F78EA76951	FFFED08C92F423F07F DFFB2BF03783E0F66C
Standard Location: EPIRB with Serial Number	FFFE2F8C96F9C06333 A03F659CF71DA4D4D0	FFFE2F8C96F9C06332 E030B13DF78EA76951	FFFED08C96F9C0637F DFF992EF3783E0F66C
Standard Location: ELT with 24-bit Address			
Standard Location: ELT with Serial Number			
Standard Location: ELT with Aircraft Operator Designator			
Standard Location: PLB with Serial Number			
National Location: EPIRB	FFFE2F8C9A0018CCD7 01CE0ABA779208025B	FFFE2F8C9A0018CCB1 019BCFE5B794240FCD	FFFED08C9A0018DFC0 FF02AD44779F3C0010
National Location: ELT			
National Location: PLB			
User-Location[2]	FFFE2FCC9418618618 6689DE52A66D01C026	FFFE2FCC9418618618 6689DE52A65901967F	FFFED0CC9418618618 6689DE52AFE0FF0146

- END OF ANNEX F -

[1] Location "A" and location "B" must be separated by at least 500 metres for the Standard and National location protocols, and by at least 10 km for the User-Location protocol.

[2] Conformance of User-Location protocol demonstrated by a single example of "A", "B", and self-test messages provided in Table F-D.2 supplemented by Table F-D.1 completed with the specific User protocol variations requested.

2.10 BEACON CODING SOFTWARE

Examples of Location Protocol Beacon Messages

T7NOV05 F - D - 1 C/S T.007 - Issue 4
November 2005

ADDITIONAL RESULTS FOR USER LOCATION PROTOCOL TESTS

APPENDIX D TO ANNEX F

BEACON CODING SOFTWARE RESULTS

Table F-D.1: Examples of User Protocol Beacon Messages
(Examples required for each protocol requested for inclusion on the type approval certificate)

Protocol	Operational Message (in hexadecimal including bit and frame synchronisation bits)	Self-Test Message (in hexadecimal including bit and frame synchronisation bits)
Maritime User Protocol with MMSI	A FFFE2FCC94186186186689DE52A6 6D01C026 B FFFE2FCC94186186186689DE52A6 5901967F	FFFED0CC9418618618 6689DE52AFE0FF0146
Maritime User Protocol with Radio Call Sign	A FFFE2FCC9526F6F06B268F9F3226 6D01C026 B FFFE2FCC9526F6F06B268F9F3226 5901967F	FFFED0CC9526F6F06B 268F9F322FE0FF0146
Radio Call Sign User Protocol	A FFFE2FCC9DBDBC1A55468ED9F626 6D01C026 B FFFE2FCC9DBDBC1A55468ED9F626 5901967F	FFFED0CC9DBDBC1A55 468ED9F62FE0FF0146
Serial User: Float-Free EPIRB with Serial Number	A FFFE2FCC96A000C6007CEEBD42E6 6D01C026 B FFFE2FCC96A000C6007CEEBD42E6 5901967F	FFFED0CC96A000C600 7CEEBD42EFE0FF0146
Serial User: Non Float-Free EPIRB with Serial Number	A FFFE2FCC972000C6007CEB7FB166 6D01C026 B FFFE2FCC972000C6007CEB7FB166 5901967F	FFFED0CC972000C600 7CEB7FB16FE0FF0146
Aviation User Protocol		
Serial User: ELT with Serial Number		
Serial User: ELT with Aircraft Operator Designator & Serial Number		
Serial User: ELT with Aircraft 24-bit address		
Serial User: PLB with Serial Number		
National User (Short)		
National User (Long)		

2.11 NAVIGATION SYSTEM

2.11.1 NATIONAL LOCATION PROTOCOL 1

Position Data Default Values

The beacon was activated without receiving GPS signals and operated for 30 minutes. Message content was checked for all bursts during this period.

Hex 30 Message	Message Count
8C9F0018DFC0FF04F9E4379F3C0010	37

Position Acquisition Time and Position Accuracy

A3.8.2.1: Location: 50^0 52.163' N 1^0 14.607' W①

A3.8.2.2: Location: 51^0 22.583' N 1^0 49.833' W②

① Measured using Garmin Etrex hand held GPS receiver
② Input from navigation simulator

Operation Configuration	C/S T.007 Section A3.8.2.1		C/S T.007 Section A.3.8.2.2	
	Time to Acquire Position (sec)	Location Error in metres	Time to Acquire Position (sec)	Location Error in metres
Floating in Water				
Resting on Dry Ground	1min 40 secs	62	51 secs	49.2
Other (specify)				

Positional accuracy was estimated using the Haversine Formula, earth's radius taken as 6367Km.

Encoded Position Data Update Interval – Retest

Location: 51^0 22.583' N 1^0 49.833' W①		
Time from activation to 1st message	52s	
First Message Acquired at	11:00:54	8C9F0018CCD701C85E1A37920C0AB2
Data Acquired at	11:00:54	8C9F0018CCD701C85E1A37920C0AB2
Location: 50^0 48.683' N 1^0 37.417' W①		
First Message Acquired at	11:02:34	8C9F0018CCD701C85E1A37920C0AB2
Data Updated at	11:21:45	8C9F0018CCB1019D9B45F794240FCD
Data Update Interval	20m 51s	Pass

① Input from navigation simulator

Note: Initial test failed, test repeated 5 times, 3:5 Pass:Fail ratio.
The Data Update Interval for the tests not shown were as follows: Original: 19m 58s, Retest 2: 19m 58s, Retest 3: 19m 58s, Retest 4: 20m 5s, Retest 5: 20m 01s.

2.11 NAVIGATION SYSTEM

2.11.1 NATIONAL LOCATION PROTOCOL

Position Clearance After Deactivation

The beacon was activated and a position acquired, moved and a new position acquired, (See "Encoded Position Data Update Interval", above). The beacon was then deactivated and reactivated without receiving GPS signals.

Data Present at	11:01:37	8C9F0018CCB1019D9B45F794240FCD
Deactivated at	11:02	
Time from re-activation to 1st message	51s	
Default data present	11:03:50	8C9F0018DFC0FF04F9E4379F3C0010

① Input from Encoded Position Data Update Interval test, above.

Last Valid Position

Location: 50^0 48.683' N 1^0 37.417' W①		
Time from activation to 1st message	51s	
First Message Acquired at	11:40:26	8C9F0018CCB1019D9B45F794240FCD
Data Present at	11:40:26	8C9F0018CCB1019D9B45F794240FCD
GPS Signal Removed	11:40:40	
Last Message with Positional Data	15:39:54	8C9F0018CCB1019D9B45F794240FCD
First Message with Default Data	15:40:43	8C9F0018DFC0FF04F9E4379F3C0010
Last Valid Position Held	240m	

① Input from navigation simulator

2.11 NAVIGATION SYSTEM

2.11.1 NATIONAL LOCATION PROTOCOL 1

Coarse Position and Delta Offset as per Table F.C.3

Note: Information in the following table has been provided by the manufacturer as permitted by C/S T.007 Section A.3.8.7 paragraph 2.

Script Reference (See Table D.3 of C/S T.007 – Issue 4 November 2005)	Value of Encoded Location Bits Transmitted by Beacon (Hexadecimal)	Confirmation that BCH Correct (✓)
1	Bits 59-85= 3F81FE0 Bits 113-126= 27CF	✓
2	Bits 59-85= A8A0C2 Bits 113-126= 2489 Number of seconds after providing navigation data that beacon transmitted the above encoded location information: 52	✓
3	Bits 59-85= A8A0C2 Bits 113-126= 3F09	✓
4	Bits 59-85= D8A0C2 Bits 113-126= 2189	✓
5	Bits 59-85= D8A0C2 Bits 113-126= B09	✓
6	Bits 59-85=C8B67D Bits 113-126= 749	✓
7	Bits 59-85= C8B67D Bits 113-126= 77E	✓
8	Bits 59-85= C8967C Bits 113-126= 702	✓
9	Bits 59-85= C8967C Bits 113-126= 77E	✓
10	Bits 59-85= C8B67D Bits 113-126= 749	✓

① Input from navigation simulator

2.11 NAVIGATION SYSTEM

2.11.2 STANDARD LOCATION PROTOCOL 1

Position Data Default Values

The beacon was activated without receiving GPS signals and operated for 30 minutes. Message content was checked for all bursts during this period.

Hex 30 Message	Message Count
8C9EF9C0637FDFF83D15B783E0F66C	37

Position Acquisition Time and Position Accuracy

A3.8.2.1: Location: 50^0 52.163' N 1^0 14.607' W①

A3.8.2.2: Location: 51^0 22.417' N 1^0 50.067' W②

① Measured using Garmin Etrex hand held GPS receiver
② Input from navigation simulator

Operation Configuration	C/S T.007 Section A3.8.2.1		C/S T.007 Section A.3.8.2.2	
	Time to Acquire Position (sec)	Location Error in metres	Time to Acquire Position (sec)	Location Error in metres
Floating in Water	52	68.8	51	52.9
Resting on Dry Ground	51	113	52	32
Other (specify)				

Positional accuracy was estimated using the Haversine Formula, earth's radius taken as 6367Km.

Encoded Position Data Update Interval

Location: 51^0 22.583' N 1^0 49.833' W①		
Time from activation to 1st message	51s	
First Message Acquired at	15:51:56	8C9EF9C0637FDFF83D15B783E0F66C
Data Acquired at	15:53:38	8C9EF9C06333A03ECA66771DA4C1E9
Location: 50^0 48.683' N 1^0 37.417' W①		
First Message Acquired at	15:54:29	8C9EF9C06333A03ECA66771DA4C1E9
Data Updated at	16:16:05	8C9EF9C06332E0311EC7778EA76951
Data Update Interval	22m 27s	

① Input from navigation simulator

2.11 NAVIGATION SYSTEM

2.11.2 STANDARD LOCATION PROTOCOL 1

Position Clearance After Deactivation

The beacon was activated and a position acquired, moved and a new position acquired, (See "Encoded Position Data Update Interval", above). The beacon was then deactivated and reactivated without receiving GPS signals.

Data Present at ➀	13-Apr-06 16:16:56	8C9EF9C06332E0311EC7778EA76951
Deactivated at	13-Apr-06 17:00	
Time from re-activation to 1st message	51s	
Default data present	18-Apr-06 10:57:36	8C9EF9C0637FDFF83D15B783E0F66C

➀ Input from Encoded Position Data Update Interval test, above.

Last Valid Position

Location: 51^0 22.583' N 1^0 49.833' W➀		
Time from activation to 1st message	51s	
First Message Acquired at	12:13:30	8C9EF9C0637FDFF83D15B783E0F66C
Data Present at	12:16:03	8C9EF9C06333A03ECA66771DA4D4D0
GPS Signal Removed	12:16:19	
Last Message with Positional Data	16:14:25	8C9EF9C06333A03ECA66771DA4D4D0
First Message with Default Data	16:15:17	8C9EF9C0637FDFF83D15B783E0F66C
Last Valid Position Held	239m	

➀ Input from navigation simulator

2.11 NAVIGATION SYSTEM

2.11.2 STANDARD LOCATION PROTOCOL 1

<u>Coarse Position and Delta Offset as per Table F.C. 2</u>

Script Reference (See Table D.2 of C/S T.007 – Issue 4 November 2005)	Value of Encoded Location Bits Transmitted by Beacon (Hexadecimal)	Confirmation that BCH Correct (✓)
1	Bits 65-85= FFBFF Bits 113-132= 83E0F	✓
2	Bits 65-85= 2404 Bits 113-132= 8E227 Number of seconds after providing navigation data that beacon transmitted the above encoded location information: 52s	✓
3	Bits 65-85= 2404 Bits 113-132= F8227	✓
4	Bits 65-85= 3404 Bits 113-132= 88227	✓
5	Bits 65-85= 3404 Bits 113-132= 74627	✓
6	Bits 65-85= 2404 Bits 113-132= 8227	✓
7	Bits 65-85= 2404 Bits 113-132= 83D7	✓
8	Bits 65-85= 2406 Bits 113-132= 8227	✓
9	Bits 65-85= 2406 Bits 113-132= 81B8	✓
10	Bits 65-85= 2402 Bits 113-132= 8206	✓

2.11 NAVIGATION SYSTEM

2.11.3 USER LOCATION PROTOCOL 1

Position Data Default Values

The beacon was activated without providing navigation data and operated for 30 minutes. Message content was checked for all bursts during this period.

Hex 30 Message	Message Count
CE8E69A69A6BA68E3888AFE0FF0146	37

Position Acquisition Time and Position Accuracy

A3.8.2.1: Location: 50^0 52.163' N 1^0 14.607' W①

A3.8.2.2: Location: 1^0 3.500' N 1^0 2.500' W②

① Measured using Garmin Etrex hand held GPS receiver
② Input from navigation simulator

Operation Configuration	C/S T.007 Section A3.8.2.1		C/S T.007 Section A.3.8.2.2	
	Time to Acquire Position (sec)	Location Error in metres	Time to Acquire Position (sec)	Location Error in metres
Floating in Water				
Resting on Dry Ground	1 min 44 secs	1656	2 mins 38 secs	2928
Other (specify)				

Positional accuracy was estimated using the Haversine Formula, earth's radius taken as 6367Km.

Encoded Position Data Update Interval

Location: 1^0 3.500' N 1^0 2.500' W①		
Time from activation to 1st message	52s	
First Message Acquired at	14:50:23	CE8E69A69A6BA68E3888AFE0FF0146
Data Acquired at	14:52:04	CE8E69A69A6BA68E3888A0230110F4
Location: 3^0 23.500' N 5^0 6.250' W①		
First Message Acquired at	14:53:40	CE8E69A69A6BA68E3888A0230110F4
Data Updated at	15:13:10	CE8E69A69A6BA68E3888A06D0520AF
Data Update Interval	21 min 6 sec	

① Input from navigation simulator

2.11 NAVIGATION SYSTEM

2.11.3 USER LOCATION PROTOCOL 1

Position Clearance After Deactivation

The beacon was activated and a position acquired, moved and a new position acquired, (See "Position Acquisition Time", above). The beacon was then deactivated and reactivated without receiving GPS signals.

Data Present at ①	11:56:51	CE8E69A69A6BA68E3888A0230110F4
Deactivated at	11:57	
Time from re-activation to 1st message	52s	
Default data present	12:23:28	CE8E69A69A6BA68E3888AFE0FF0146

① Input from Encoded Position Data Update Interval test, above.

Last Valid Position

Location: 50^0 52.163' N 1^0 14.607' W①		
Time from activation to 1st message	51s	
First Message Acquired at	09:12:29	CE8E69A69A6BA68E3888A65B0143DE
Data Present at	09:12:29	CE8E69A69A6BA68E3888A65B0143DE
GPS Signal Removed	09:13:00	
Last Message with Positional Data	13:14:25	CE8E69A69A6BA68E3888A65B0143DE
First Message with Default Data	13:14:19	CE8E69A69A6BA68E3888AFE0FF0146
Last Valid Position Held	241m	

① Measured using Garmin Etrex hand held GPS receiver

Coarse Position as per Table F.C.1

Script Reference (See Table D.1 of C/S T.007 – Issue 4 November 2005)	Value of Encoded Location Bits Transmitted by Beacon (Hexadecimal)	Confirmation that BCH Correct (✓)
1	Bits 108-132 = FE0FF0	✓
2	Bits 108 – 132 = 23011 Number of seconds after providing navigation data that beacon transmitted the above encoded location information: 52	✓
3	Bits 108-132 = 6D052	✓

SECTION 3

TEST EQUIPMENT

3.1 TEST EQUIPMENT

List of absolute measuring and other principal items of test equipment.

Instrument	Manufacturer	Type No	TE Number	Calibration Due
Section 2.9 Beacons - Antenna Characteristics				
Antenna (Dipole, 30MHz-300MHz)	Schwarzbeck	VHAP	27	08/09/2007
Signal Generator	Rohde & Schwarz	SMS-2/28	1431	19/04/2007
Spectrum Analyser	Hewlett Packard	8568A	1666	24/06/2006
Quasi-Peak Adaptor	Hewlett Packard	85650A	1667	07/06/2006
RF Preselector	Hewlett Packard	85685A	1668	07/06/2006
Antenna Mast	EMCO	1050	1707	TU
Turntable Controller	Various	RH253	1708	TU
Roberts Antenna 406MHz	Compliance Design	-	1860	21/02/2007
Sections 2.1 to 2.4 Beacons - Constant Temperature Tests				
Climatic Chamber	Heraeus Votsch	VMT 04/30	40	O/P Mon
Power Meter	Hewlett Packard	436A	47	16/06/2006
Climatic Chamber	Heraeus Votsch	VM 04/100	85	O/P Mon
Frequency -Time Analyser	Hewlett Packard	5372A	93	27/07/2006
Signal Generator	Hewlett Packard	8644A	96	17/12/2006
Beacon RF Unit	TUV		97	TU
Logic Analyser	Hewlett Packard	1631D	155	04/08/2006
Time Interval Analyser	Yokogawa	TA720	181	17/11/2006
Oscilloscope	Gould	840	182	31/01/2007
Signal Generator	Hewlett Packard	8644A	199	17/12/2006
Digital Temperature Indicator	Fluke	51	412	21/09/2006
Attenuator 10dB/10W)	Texscan	HFP-50N	454	05/08/2006
Attenuator (3dB,10W)	Texscan	HFP-50N	475	05/08/2006
Attenuator: 6dB/10W	Texscan	HFP-50N	476	11/07/2006
Attenuator: 10dB/20W	Narda	766-10	480	21/12/2006
Attenuator (10dB)	Weinschel	47-10-34	481	21/12/2006
Oscilloscope	Lecroy	9370M	612	14/09/2006

3.1 TEST EQUIPMENT

List of absolute measuring and other principal items of test equipment.

Instrument	Manufacturer	Type No	TE Number	Calibration Due
Sections 2.1 to 2.4 Beacons - Constant Temperature Tests				
Signal Generator	Hewlett Packard	8644A	199	17/12/2006
Digital Temperature Indicator	Fluke	51	412	21/09/2006
Attenuator 10dB/10W)	Texscan	HFP-50N	454	05/08/2006
Attenuator (3dB,10W)	Texscan	HFP-50N	475	05/08/2006
Attenuator: 6dB/10W	Texscan	HFP-50N	476	11/07/2006
Attenuator: 10dB/20W	Narda	766-10	480	21/12/2006
Attenuator (10dB)	Weinschel	47-10-34	481	21/12/2006
Oscilloscope	Lecroy	9370M	612	14/09/2006
Spectrum Analyser	Hewlett Packard	E4407B	1154	19/04/2006
Signal Generator	Hewlett Packard	8663A	1172	23/08/2006
Power Sensor	Hewlett Packard	8482A	1341	19/09/2006
Attenuator:10dB/10W	Texscan	HFP-50N	1377	11/07/2006
Spectrum Analyser	Hewlett Packard	8568A	1666	24/05/2006
Quasi-Peak Adaptor	Hewlett Packard	85650A	1667	07/06/2006
RF Preselector	Hewlett Packard	85685A	1668	07/06/2006
Antenna Mast	EMCO	1050	1707	TU
Turntable Controller	Various	RH253	1708	TU
Roberts Antenna 406MHz	Compliance Design	-	1860	21/02/2007
Broadband Filter	Texscan	8BC-372-186-BB	2281	TU
1m N(m) -N(m) Cable	Reynolds	269-0088-1000	2396	21/07/2006
3m N(m) - N(m) RF Cable	Reynolds	269-008803000	2413	21/07/2006
Termination 50ohm/15W	Radio Spares	612-192	2425	26/07/2006
Distress Beacon RF Unit	TUV	-	2445	TU
Stop Clock	R.S Components	RS328 061	2674	28/03/2006
Frequency and Time Interval Analyser	Hewlett Packard	5372A	2756	15/06/2006
Logic Analyser	Hewlett Packard	1631D	2757	28/06/2006
20dB/20W Attenuator	JFW	50FHC-020-20	2774	TU

3.1 TEST EQUIPMENT

Instrument	Manufacturer	Type No	TE Number	Calibration Due
Sections 2.1 to 2.4 Beacons - Constant Temperature Tests				
Beacon RF Unit	TUV	N/A	3066	TU
50ohm / 6W Termination	Micronde	R404613	3074	18/02/2007
3dB/2W Attenuator	Hewlett Packard	HP8491B	3075	TU
20dB/75W Attenuator	Bird	8308-200	3076	TU
1m N(m)-N(m) RF Cable	Reynolds	269-0088-1000 0201	3078	TU
50ohm/2W Termination	Omni-Spectra	3001-6100	3081	Class 1 (Int)
3dB/2W Attenuator	Hewlett Packard	HP8491B	3082	28/07/2006
Section 2.11 Beacons - Navigation System				
Beacon Tester	WS Technologies	BT 100S	87	TU
Stop Clock	R.S Components	RS328 061	2674	TU
Section 2.16 Beacons - Operating Lifetime				
Climatic Chamber	Heraeus Votsch	VMT 04/30	40	O/P Mon
Power Meter	Hewlett Packard	436A	47	16/06/2006
Climatic Chamber	Heraeus Votsch	VM 04/100	85	O/P Mon
Frequency -Time Analyser	Hewlett Packard	5372A	93	27/07/2006
Signal Generator	Hewlett Packard	8644A	96	17/12/2006
Time Interval Analyser	Yokogawa	TA720	181	17/11/2006
Oscilloscope	Gould	840	182	31/01/2007
Digital Temperature Indicator	Fluke	51	412	21/09/2006
Attenuator 10dB/10W)	Texscan	HFP-50N	454	05/08/2006
Attenuator: 10dB/20W	Narda	766-10	480	21/12/2006
Attenuator (10dB)	Weinschel	47-10-34	481	21/12/2006
Signal Generator	Hewlett Packard	8663A	1172	23/08/2006
Broad Band Filter	Texscan	8BC-372-186-BB	1246	TU
Power Sensor	Hewlett Packard	8482A	1341	19/09/2006
Attenuator:10dB/10W	Texscan	HFP-50N	1377	11/07/2006
Broadband Filter	Texscan	8BC-372-186-BB	2281	TU
Data Logger	Pico Technology Ltd	ADC-42	2395	21/09/2006

3.1 TEST EQUIPMENT

Instrument	Manufacturer	Type No	TE Number	Calibration Due
Section 2.6 Beacons - Operating Lifetime				
1m N(m) -N(m) Cable	Reynolds	269-0088-1000	2396	21/07/2006
3m N(m) - N(m) RF Cable	Reynolds	269-008803000	2413	21/07/2006
TERMINATION: 50ohm/15W	Radio Spares	612-192	2425	26/07/2006
Distress Beacon RF Unit	TUV	-	2445	TU
Logic Analyser	Hewlett Packard	1631D	2757	28/06/2006
20dB/20W Attenuator	JFW	50FHC-020-20	2774	18/02/2007
Beacon RF Unit	TUV	N/A	3066	TU
50ohm / 6W Termination	Micronde	R404613	3074	18/02/2007
3dB/2W Attenuator	Hewlett Packard	HP8491B	3075	18/02/2007
Attenuator: 3dB/2W	Hewlett Packard	HP8491B	3077	18/02/2007
1m N(m)-N(m) RF Cable	Reynolds	269-0088-1000 0201	3078	TU
50ohm/ 1W Termination	Suhner	-	3080	18/02/2007
3dB/2W Attenuator	Hewlett Packard	HP8491B	3082	28/07/2006
Section 2.2 Beacons - Spurious Emissions				
Attenuator (3dB,10W)	Texscan	HFP-50N	475	05/08/2006
Spectrum Analyser	Hewlett Packard	E4407B	1154	19/04/2006
20dB/20W Attenuator	JFW	50FHC-020-20	2774	O/P Mon

3.1 TEST EQUIPMENT

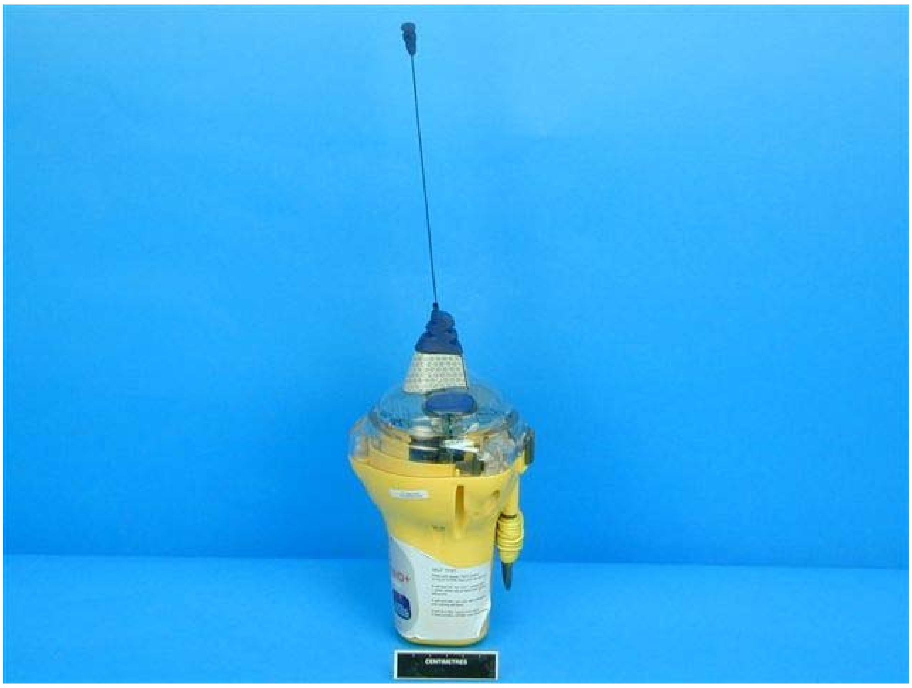
Instrument	Manufacturer	Type No	TE Number	Calibration Due
Section 2.7 Beacons - Temperature Gradient				
Power Meter	Hewlett Packard	436A	47	16/06/2006
Climatic Chamber	Heraeus Votsch	VM 04/100	85	O/P Mon
Frequency -Time Analyser	Hewlett Packard	5372A	93	27/07/2006
Digital Temperature Indicator	Fluke	51	412	21/09/2006
Signal Generator	Hewlett Packard	8663A	1172	23/08/2006
Broad Band Filter	Texscan	8BC-372-186-BB	1246	TU
Power Sensor	Hewlett Packard	8482A	1341	19/09/2006
Distress Beacon RF Unit	TUV	-	2445	TU
Logic Analyser	Hewlett Packard	1631D	2757	28/06/2006
20dB/20W Attenuator	JFW	50FHC-020-20	2774	18/02/2007
1m N(m)-N(m) RF Cable	Reynolds	269-0088-1000 0201	3078	TU
3dB/2W Attenuator	Hewlett Packard	HP8491B	3082	28/07/2006
50ohm/15W Termination	Diamond Antenna	DL-30N	3098	09/03/2007
Section 2.5 Beacons - Thermal Shock				
Signal Generator	Hewlett Packard	8644A	96	17/12/2006
Beacon RF Unit	TUV	-	97	TU
Logic Analyser	Hewlett Packard	1631D	155	04/08/2006
Attenuator: 10dB/20W	Narda	766-10	480	21/12/2006
Attenuator (10dB)	Weinschel	47-10-34	481	21/12/2006
Frequency and Time Interval Analyser	Hewlett Packard	5372A	2756	15/06/2006
1m N(m)-N(m) RF Cable	Reynolds	269-0088-1000 0201	3078	TU
3dB/2W Attenuator	Hewlett Packard	HP8491B	3082	28/07/2006

Some test equipment shown is out of calibration prior to the end of the test programme. However the item was in calibration at the time of test.

SECTION 4

PHOTOGRAPHS

4.1 PHOTOGRAPHS OF EQUIPMENT UNDER TEST (EUT)

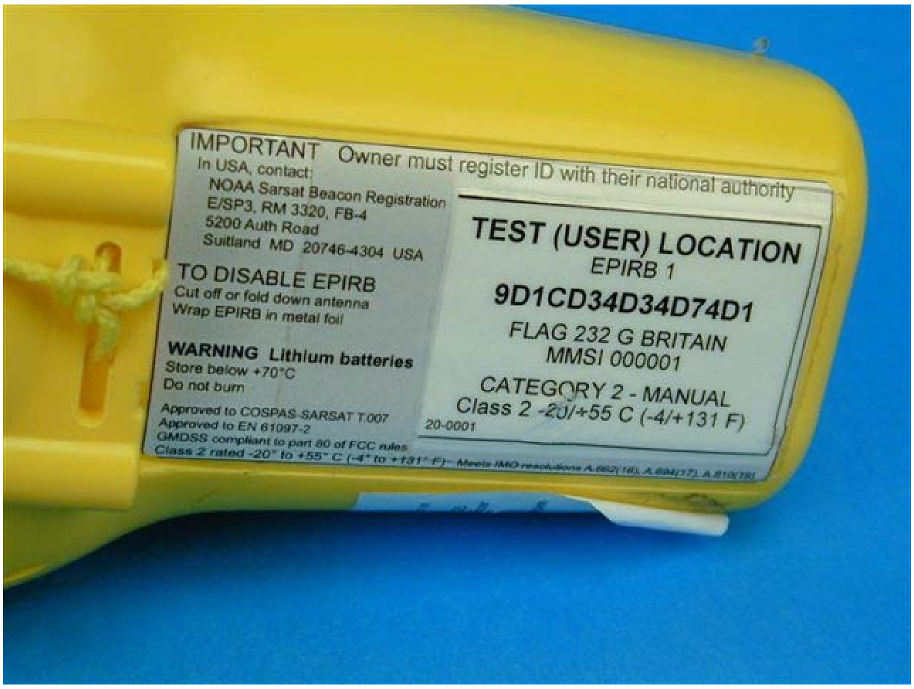


Photograph of EUT with Antenna

Photograph of EUT with Antenna

4.1 PHOTOGRAPHS OF EQUIPMENT UNDER TEST (EUT)

Photograph of EUT with Antenna



Photograph of EUT Label

4.1 PHOTOGRAPHS OF EQUIPMENT UNDER TEST (EUT)

Photograph of EUT with Conducting Link

Photograph of EUT with Conducting Link

4.1 PHOTOGRAPHS OF EQUIPMENT UNDER TEST (EUT)

Photograph of EUT with Conducting Link

SECTION 5

ACCREDITATION, DISCLAIMERS AND COPYRIGHT

5.1 ACCREDITATION, DISCLAIMER AND COPYRIGHT

0141
Group

This report relates only to the actual item/items tested.

Our UKAS Accreditation does not cover opinions and interpretations and any expressed are outside the scope of our UKAS Accreditation.

Results of tests not covered by our UKAS Accreditation Schedule are marked NUA (Not UKAS Accredited).

ANNEX A

APPLICANTS SUPPLIED INFORMATION

Protection against continuous transmission

The McMurdo Smartfind EPIRB is designed to limit any inadvertent 406.028MHz transmission to a maximum of 3 seconds under the worst case conditions.
Figure 1 is an extract from the Smartfind circuit diagram 82-830C issue 1. The PA_ON line provides gate bias to the 406 PA FET Q6 via resistive network R32, R33 and R59, and also enables the PA regulator (not shown). This regulator supplies power to the drain of Q6 (Vpa).
The PA_ON line also supplies voltage to the gate of Q4 via the time constant R43 and C48. If the 406 PA is on for longer than a few seconds sufficient voltage will be developed across C48 to switch Q4 on. This will result in all the PA_ON voltage being dropped across R44 and therefore removing the DC gate bias to Q6 and the shutting down the PA regulator (Vpa).

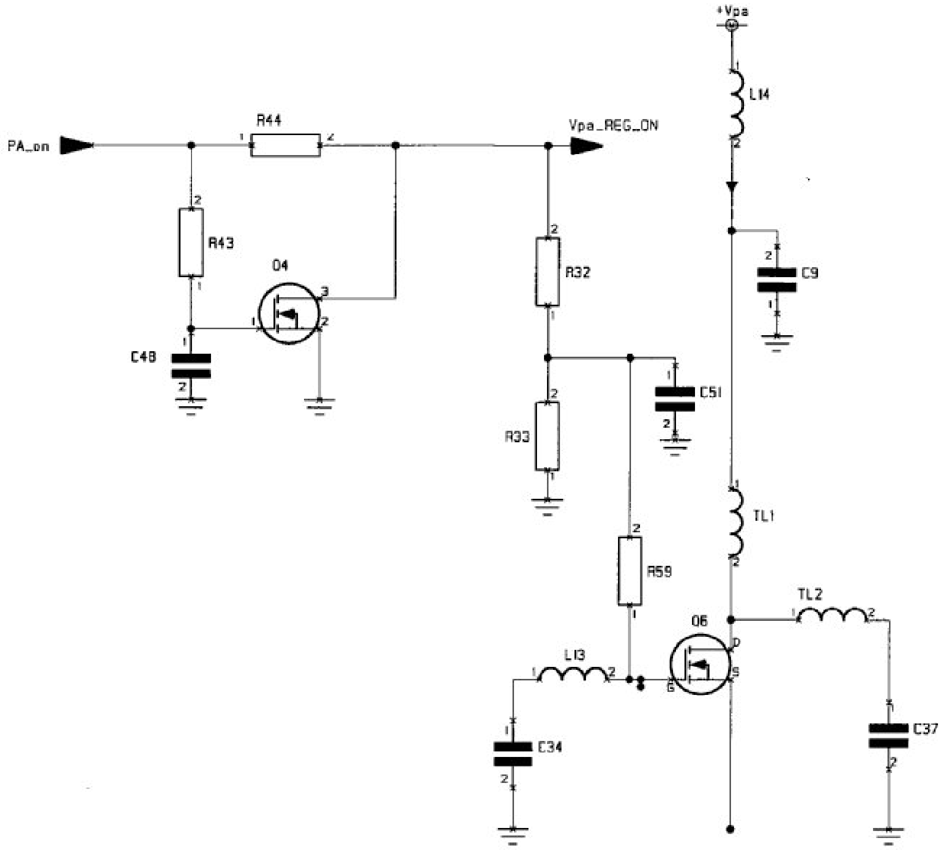


Figure 1

Neil Jordan
Electronics Engineer
8-5-06

Statement on protection against beacon degradation
due to internal navigation device failure

The internal GPS navigation device is an EZGPM01 12-channel module made by Eazix in the Philippines.

Software protection:
The positional data is sent from the GPS module in serial NMEA format. This data is checked for validity by examining the message field quality bit and calculated HDOP (Horizontal dilution of precision) figure. The quality bit is calculated by the GPS module to determine the quality of the position fix and requires three or more satellites with good signal to noise ratios. The HDOP figure is calculated from the relative geometry of the satellites used to determine the position fix. The smaller the figure the better the positional accuracy. The software rejects position fixes with a HDOP figure greater than 20.
With these checks in place it is considered unlikely that false position data could be encoded in the 406MHz message.
If no valid GPS data is available, the beacon will revert to transmitting default position data.

Hardware protection:
The serial NMEA data is input to the micro-controller, this input is only connected to the GPS module. If the Eazix GPS module fails in such a way to output incorrect logic levels, this input is protected by diodes from excessive voltage on the input.
The GPS module is not continuously powered in order to comply with the maximum positional update rate defined in C/S T.001. Hence in any one hour, at least 64 406MHz transmissions are made with the GPS module in-active.
The GPS module is supplied by P-channel logic level FET, which is enabled or disabled by a discrete control line from the microprocessor.

Neil Jordan
Electronics Engineer
15-5-06

G5 / Smartfind Plus EPIRB

Statement on self-test

Standard self-test

The G5 is a 406.028MHz EPIRB operating with the Cospas-Sarsat satellite system. The G5 has a press and release self-test facility, which operates as follows.

a) Power up the micro-controller, the CMAC oscillator and the GPS module.

b) Generate one short CW burst at 121.5MHz, check the antenna RF level is above threshold.

c) Activate the 406.028MHz PLL and check that it is locked.

d) Generate an inverted frame 406.028MHz transmission. Check the antenna RF level is above threshold. (This also confirms the battery is capable of high current loads).

e) Confirm the GPS receiver has output normal NMEA sentences. (do not wait for a fix).

The self-test completes within 9s. If all of the above checks prove true then the sounder will sound; the LED strobe light and also the RED and GREEN LEDs will all flash simultaneously. The number of flashes actually depends on the total accumulated battery use, as follows -

Accumulated Battery Hours	Strobe / LED Flash Count Sounder Beep Count
0 to 4	3
5 to 6	2
6+	1

Additional GPS long self-test

This feature can only be accessed at the end of a successful self-test operation. If the beacon's self-test button is held down for more than 15s after the LEDs begin flashing, the GPS long self-test mode will be entered. Holding the button for such a long time deliberately makes this test hard to initiate.
If the user attempts a GPS long self-test following a failed normal self-test, the software will not initiate the long self-test. In this case the software will release the power latch and sit idling until the user releases the self-test button. The time during which the button is held down will be accumulated by the battery lifetime timer and stored in non-volatile memory.
The long GPS test takes 15 minutes to complete. When the GPS reports a valid position, the green LED will be lit and the sounder will 'beep'. The strobe LED will flash a number of times to indicate how many unused GPS long self-tests remain in the unit. For example 9 flashes indicate there are 9 more long GPS tests remaining (a maximum of 10 are allowed).
The long GPS test can be exited by holding down the test button continuously for 5s.

Battery life counter

The accumulated runtime of the beacon (both live and self-tests) is recorded by the micro-controller, thus giving an accurate indication of remaining battery life.

Repetitive self-test protection

Self tests are controlled by firmware which monitors the duration of TEST button presses, looking for firm and lengthy self test requests, thus avoiding accidental repetition of self tests.

Neil Jordan
Electronics Engineer
8-5-06

C-MAC Frequency Products

Sadler Road, Lincoln
LN6 3RS, United Kingdom

Tel.: + 44 (0) 1522 883528
Fax: + 44 (0) 1522 823535
E-mail: DavidWoodall@cmac.com

C-MAC Quartz Crystals Ltd.

PRODUCT EVALUATION REPORT

REPORT No.: **2006-016**

Date: 16th May 2006

Product type: Temperature Compensated, Voltage Controlled Crystal Oscillator (TC/VCXO)

Construction: 1) Surface Mount (7 x 5 mm)
2) "Pluto" ASIC

Generic Type: "Cospas Sarsat" Beacon Oscillator

Long Term Performance Verification

This document sets out the steps taken by C-MAC to address the requirements for long term assurance of performance with respect to short and medium term stability. Specifically with respect to the short and medium term stability addressed in the second paragraph of the specification requirement:

Cospas-Sarsat type approval standard T.007 Issue 4 Nov 2005.
Section A.3.5 Oscillator Aging:

Long-term frequency stability shall be demonstrated by data (e.g. oscillator manufacturer's test data) provided by the beacon manufacturer to the test facility.

For oscillators which require compensation over the operating temperature range, measurement results and a technical analysis shall also be provided to substantiate that short and medium-term stability would remain within specification after five years.

The long-term frequency stability or oscillator aging requirement is industry standard and has established procedures both company specific and as laid out by international standards, for example as referenced in MIL-PRF-55310 section 4.8.35. However the long term verification of the short and in particular the medium term stability requirements has no directly established procedure. The 100ms short term stability is not associated with the temperature compensation part of the oscillator and so should not be degraded by the use of a TCXO as opposed to an OCXO type oscillator. The short term stability also forms part of the medium term stability in respect of the residual error requirements, and so it should only be necessary to study the medium term stability to cover both of these requirements.

For oscillators which include a frequency adjustment or trim component for either initial calibration in the beacon or for correction of aging during lifetime then there is a recognised degradation process called trim effect. This is where the compensation can be degraded when the oscillator is tuned away from its nominal or compensated condition. This effect can be tested for by measurement of the frequency temperature characteristics at the frequency adjustment limits as well as the nominal condition during for example production verification. Whether the oscillator is adjustable or not should be clearly stated in any beacon qualification so this point can be addressed.

This however is not the case for the oscillators addressed in this document as they have no frequency adjustment available after manufacture. As such we have usually stated in respect of the above requirement:

' For C-MAC TCXO’s the type of compensation used to correct the frequency of the oscillator for temperature changes within the TCXO remains constant with the individual characterisation set in non-volatile memory. No adjustment is required, or available, to correct for aging for the life of the device, so this characterisation is not perturbed. There is no known mechanism to suggest any change or ageing effect to the Medium or Short term stability exists.'

The medium term stability requirements for the beacon are difficult to achieve with temperature compensation techniques and were until recently not achievable. Therefore the long term verification of performance to this required level was not specifically available, although no degradation was expected from either extrapolation of less precise data on comparable oscillators or from analysis of any possible aging mechanism.

With aging verification it is standard practice to use data from accelerated aging conditions, ie aging at high temperature. Data taken during this time is then fitted and extrapolated with established procedures, for example as MIL-PRF-55310. Also standard acceleration factors are often applied for example “30 days at 85C is roughly equivalent to 1 year at room”. For the medium term stability requirement, no established procedures or acceleration factors exist and continuous or periodic measurement is not possible. Therefore real data over a reasonable period of time with significant numbers of oscillators was studied.

Two studies are presented. One batch of devices were measured before and after an 8 month period (measurements in August 2005 and April 2006) and a second set of devices was measured after a period of approximately 1 year.

Batch 1 results:

The histograms show the results for August 2005 in red and April 2006 in blue
The average change for frequency stability vs. temperature over the batch is –0.0007 ppm, effectively zero or

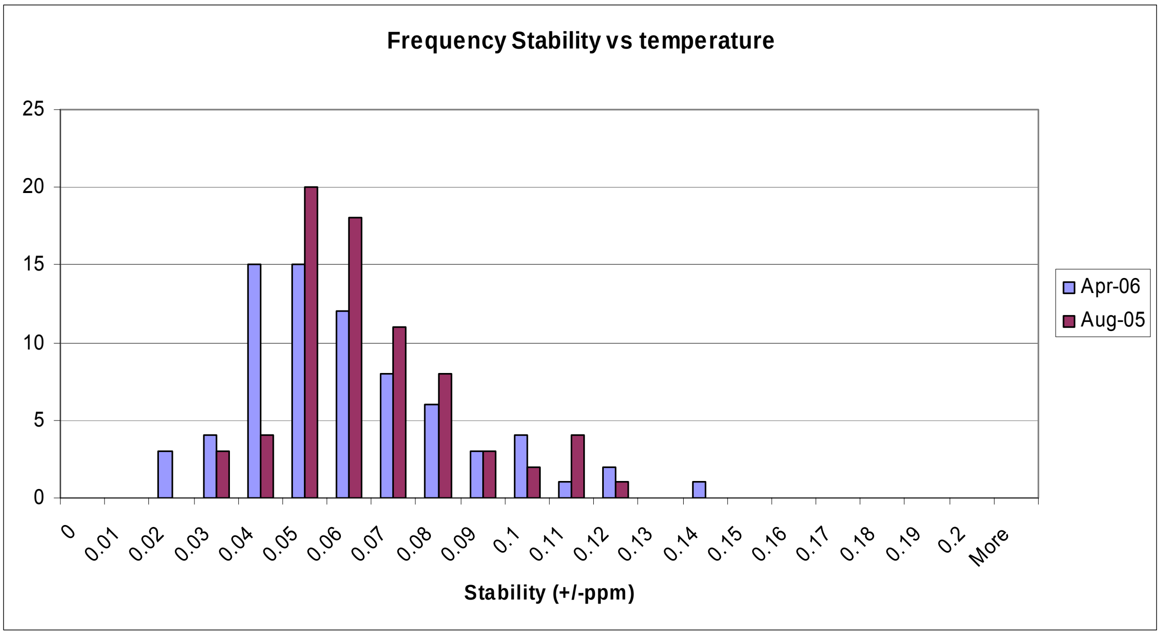


Figure 1 Frequency Stability vs. Temperature

an extremely small improvement.
The average change for nominal frequency over the batch is –0.10 ppm, considerably inside the aging

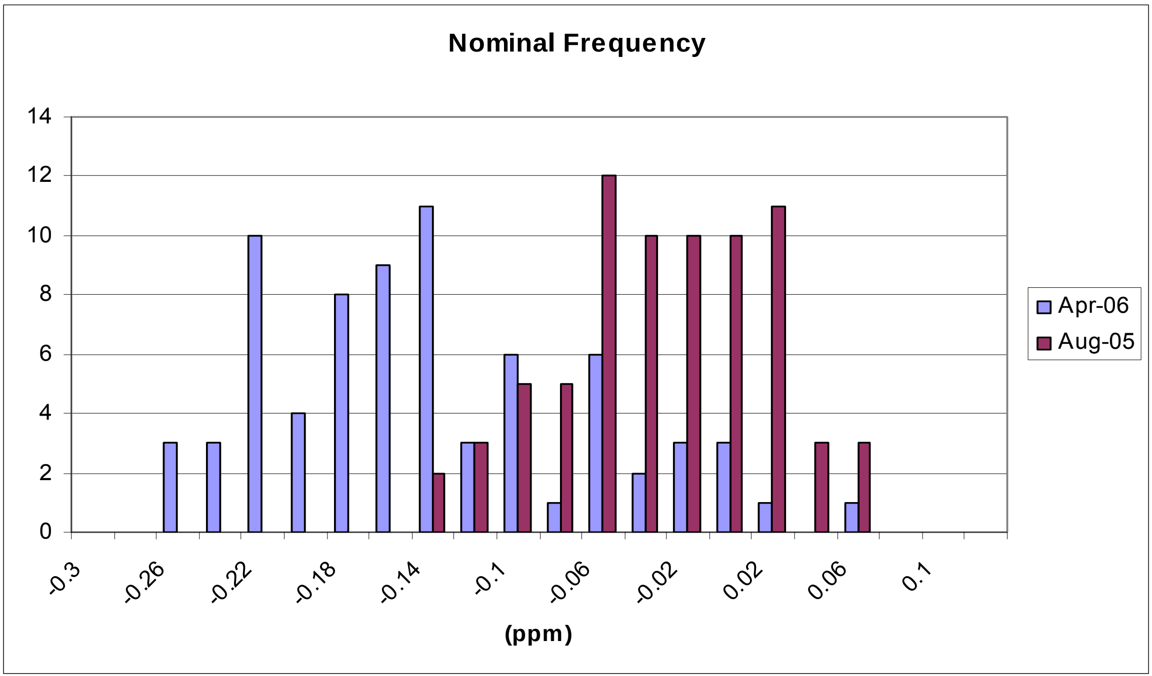


Figure 2 Nominal frequency

requirements for nominal frequency.

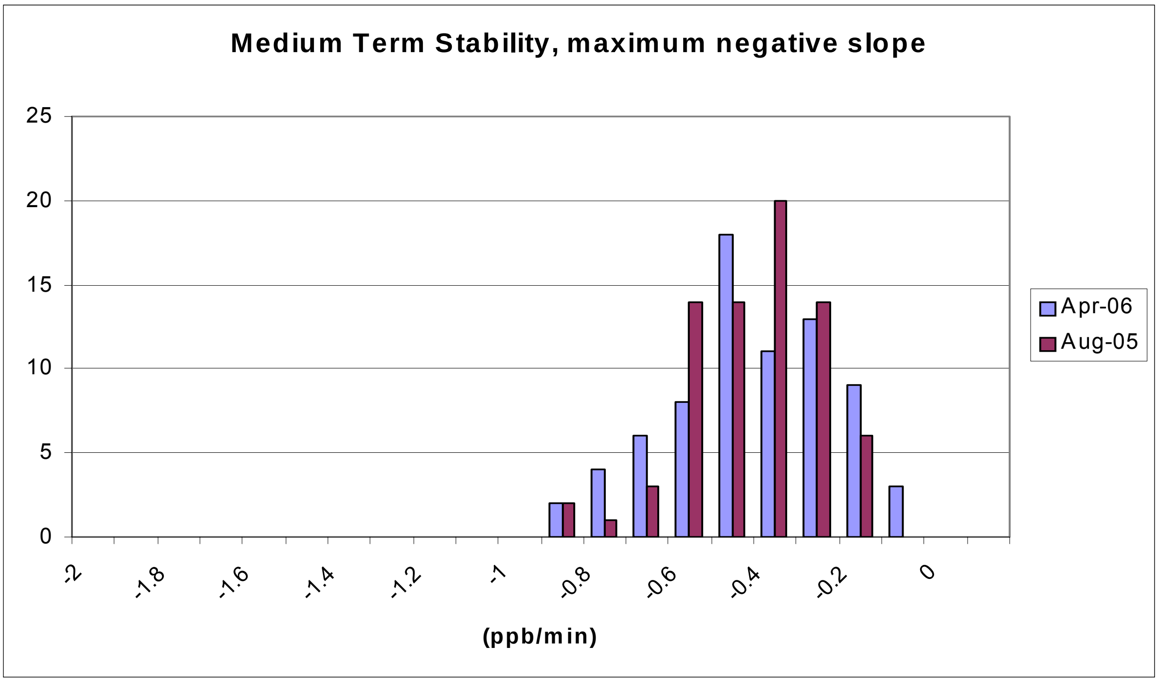


Figure 3 Medium term stability, Slope

The average change over the batch for maximum negative slope for 8 months is +0.004ppb/min and for the maximum positive slope –0.0011ppb/min. This again effectively shows no change or very small improvement within the measurement uncertainties involved.

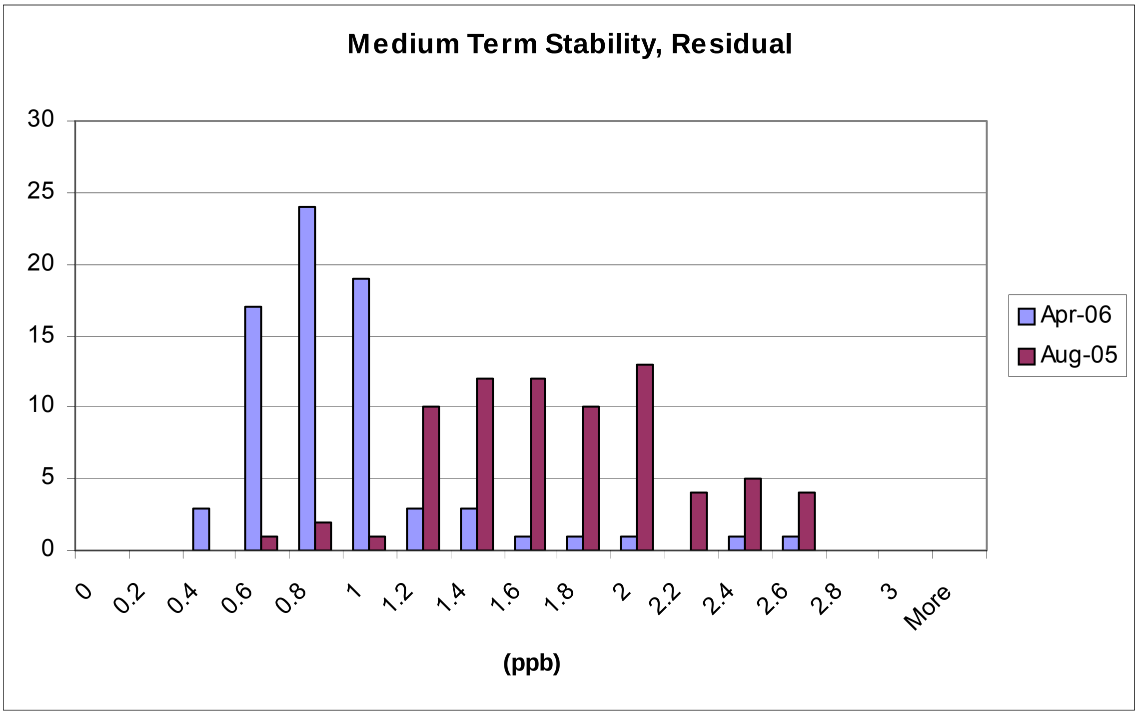
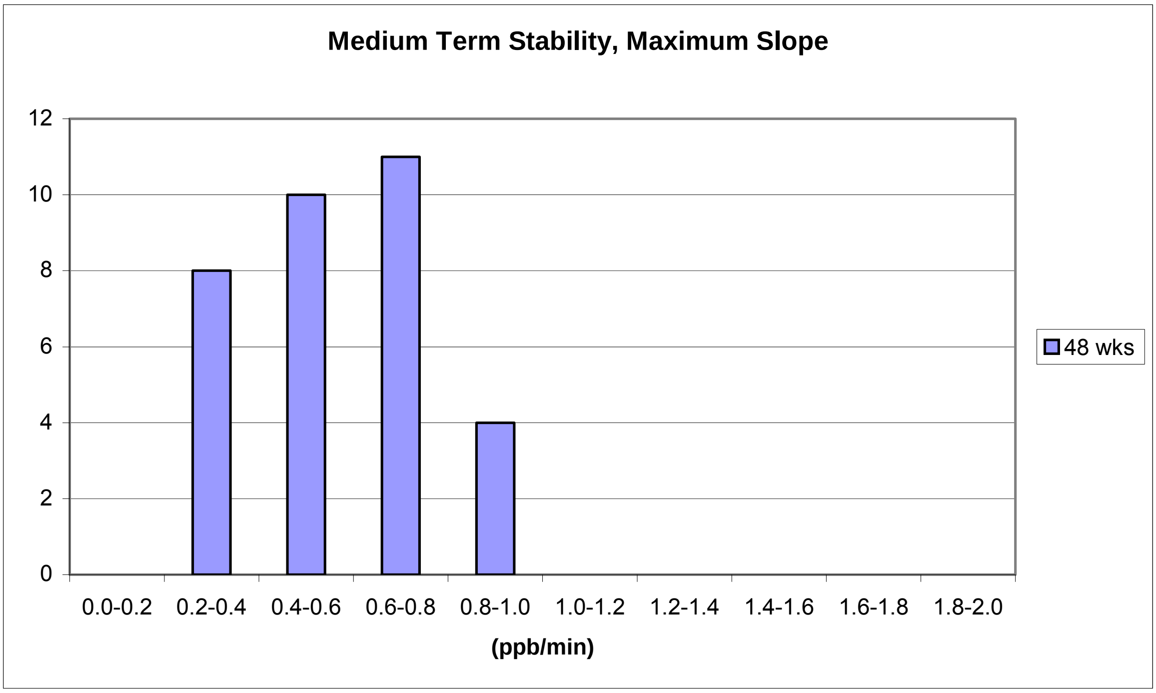


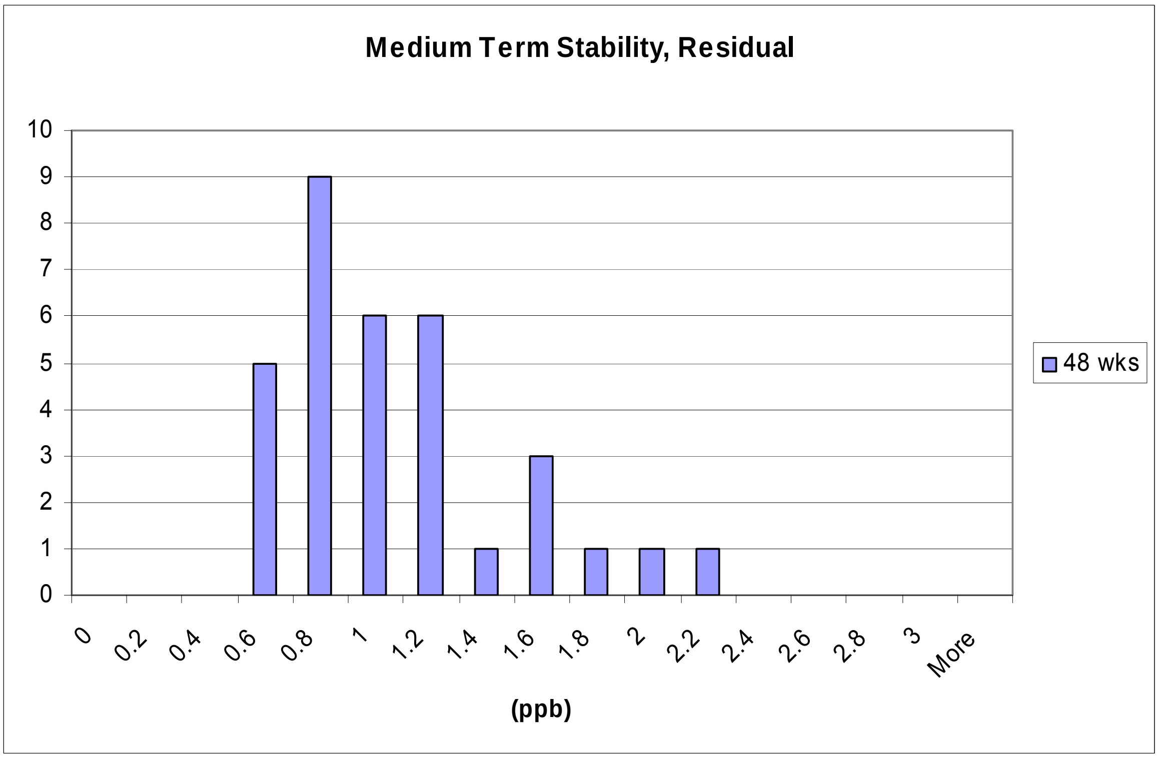
Figure 4 Medium term stability, Residual

The average change over the batch for medium term stability residual error shows an apparent improvement of -0.78 ppb. However this improvement is due in the main part to improvements in the measurement system noise floor and not to any improvement in the oscillator performance over this period.

Batch 2 results:

These devices were re-measured after a period of between 44 and 52 weeks after manufacture and initial testing. Results after an average of 48 wks are shown below.





Conclusion:

In conclusion, no noticeable degradation in temperature compensation performance was observed and all devices stayed with specification. Therefore, we conclude the requirement to provide measurement and technical analysis for long-term conformance has been demonstrated for these oscillators.

N. D. Hardy

Dr Nigel D Hardy
Principal Design Engineer
For and on behalf of
C-MAC Quartz Crystals Limited
Antell House, Windsor Place
Harlow, Essex. CM20 2GQ
England

16 May 2006

C-MAC
Frequency Products

Sadler Road, Lincoln
LN6 3RS, UK

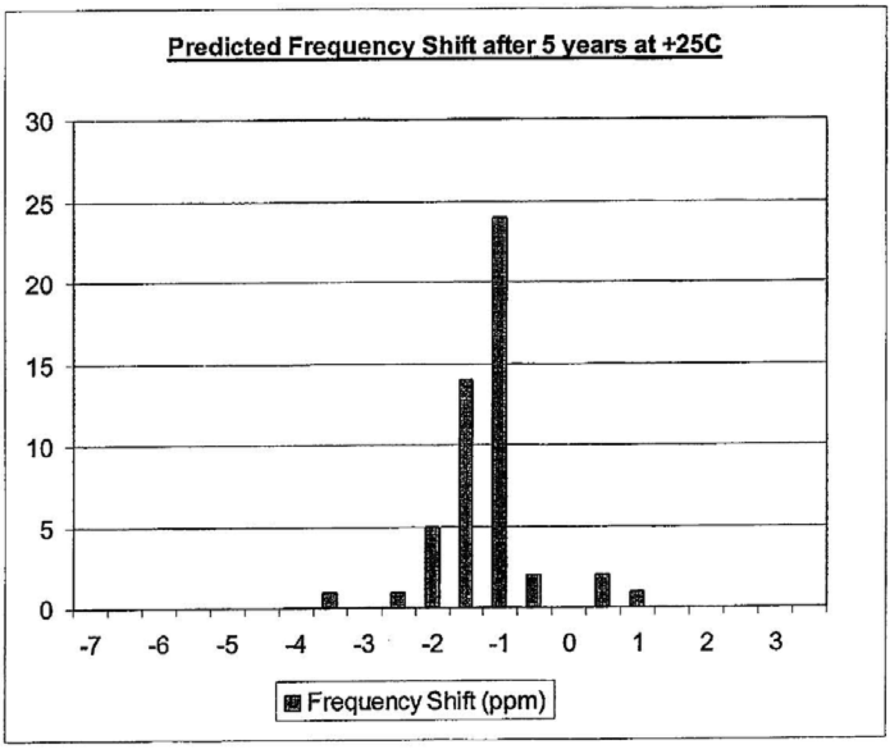
Tel.: + 44 (0) 1522 883528
Fax: + 44 (0) 1522 823535
E-mail:
DavidWoodall@cmac.com

C-MAC Quartz Crystals Ltd

TEST SUMMARY

REPORT No :	**2005-009**		
Date:	22nd June 2005		
Product type:	Crystal unit		
Construction:	SMD packaged Strip resonator		
Output Frequency:	12.688375 MHz		
C-MAC Part No :	C7825		
Number Tested:	50		
Test Performed:	Accelerated Ageing (Frequency drift with time)		
Test Duration:	936 hours		
Test Temperature:	+105°C		
Measurement System:	P.R.A.		
SARSAT Requirement:	Frequency drift over 5-years at +25°C	+3.0 / -10.0 ppm max.	
Process Capability:	Using a MIL model (ref. MIL-PRF-55310)		
	1-year at +25°C	Mean ΔF	- 0.548 ppm
	5-year requirement at +25°C	Mean ΔF	- 1.012 ppm
		Std Dev	0.619
		Cp	3.50
		Cpk	2.16

Figure 1



Prepared by: David R Woodall
Quality Manager