ANNEX III

MANUFACTURER DOCUMENTATION

SafeLink DOC09060 Indice B

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SafeLink

Technical data

EVOLUTIONS

Ref.	Date	Modifications descriptions
A	11/05/2009	Original document
B	16/09/2009	Photos

CONTENTS

1 Introduction.

The new KANNAD SafeLink beacon is an EPIRB designed for the professional and the leisure market.
This beacon can be installed with an automatic release container (SafeLink AUTO) or with a mounting bracket (SafeLink MANUAL+).

This beacon transmits the unique ID and positioning of the distress via the COSPAS-SARSAT satellites for instant alert to the SAR operations.

Main characteristics	***SafeLink***
Dimensions max	250x80x105mm (antenna deployed)
Weight	627g
Antenna	Integrated
Autonomy	Mini 48 hours at -20°C
Battery	9 CR123 cells
Oscillator	TCXO E4217LF
PCB	I583
GPS module	Fastrax UC322

This beacon has been tested in accordance with COSPAS-SARSAT CS/T 001 and CS/T 007 standards.

2 Application form for a COSPAS-SARSAT 406 MHz Beacon type approval certificate (Annex G).

Beacon Manufacturer and Beacon Model

Beacon manufacturer	KANNAD
Beacon model	SafeLink

Beacon type and operational configurations

Beacon type	Beacon used while	Tick where appropriate
EPIRB	Floating in water or on deck or in a safety raft	X
PLB	On ground and above ground	
	On ground and above ground and floating in water	
ELT survival	On ground and above ground	
	On ground and above ground and floating in water	
ELT auto fixed	Fixed ELT with aircraft external antenna	
ELT auto portable	In aircraft with an external antenna	
	On ground, above ground, or in a safety raft with an integrated antenna	
ELT auto deployable	Deployable ELT with attached antenna	
Other (specify)		

Beacon characteristics

Characteristic	Specification
Operating temperature range	-20 °C / +55°C
Operating lifetime	48 hours
Battery chemistry	Lithium
Battery cell size and number of cells	CR123 / 9
Battery manufacturer	PANASONIC
Battery pack manufacturer and part number	Williamson / P/N=0146030
Oscillator type (e.g. OCXO, MCXO, TCXO)	TCXO (see § 10)
Oscillator manufacturer	RAKON (see § 10)
Oscillator part name and number	E4217LF
Oscillator satisfies long-term frequency stability requirements (Yes or No)	YES (see § 10)
Antenna type (Integrated or External)	Integrated
Antenna manufacturer	KANNAD
Antenna part name and number	Antenna printed on the PCB I583
Navigation device type (Internal, external or none)	Internal
Features in beacon that prevent degradation to 406 MHz signal or beacon lifetime resulting from a failure of navigation device or failure to acquire position data (Yes, No, or N/A)	YES (see § 2.4.3)
Features in beacon that ensures erroneous position data is not encoded into the beacon message (Yes, No or N/A)	NO
Navigation device capable of supporting global coverage (Yes, No or N/A)	YES
For internal navigation devices - geodetic reference system (WGS84 or GTRF) - GNSS receiver cold start forced at every beacon activation (Yes or No) - Navigation device manufacturer - Navigation device model name and part number - GNSS system supported (e.g. GPS, GLONASS, Galileo)	See § 2.4 WGS84 YES FASTRAX UC322 GPS

For external navigation devices - Data protocol for GNSS receiver to beacon interface - Physical interface for beacon to navigation device - Electrical interface for beacon to navigation device - Navigation device model and manufacturer (if beacon designed to use specific devices)	NOT APPLICABLE
Self-test mode characteristics - self-test has separate switch position (Yes or No) - Self-test switch automatically returns to normal position when released (Yes or No) - Self-test activation can cause an operational mode transmission (Yes or No) - Self-test causes a single beacon self-test message burst only regardless of how long the self-test activation mechanism applied (Yes or No) - Results of self-test indicated by (e.g. Pass / Fail indicator Light, Strobe light, etc.) - Self-test can be activated from beacon remote activation points (Yes or No) - Self-test performs an internal check and indicates that RF power emitted at 406 MHz and 121.5 MHz if beacon includes a 121.5 MHz homer (Yes or No) - Self-test transmits a signal(s) other than at 406 MHz (Yes & details or No) - Self-test can be activated directly at beacon (Yes or No) - List of items checked by self-test - Self-test transmission burst duration (440 or 520 ms) - Self-test format bit (“0” or “1”)	 YES YES NO YES Pass / fail indicator light NO YES NO YES Battery voltage RF power at 406 MHz Phase locked loop 520ms 1
Beacon includes a homer transmitter (if yes identify frequency of transmission) - Homer transmit power - Homer duty cycle - Duty cycle of homer swept tone	121.5 MHz ±3kHz 50mW ± 3dB PERP 95 % 34 %
Beacon includes a strobe light (Yes or No) - Strobe light intensity - Strobe light flash rate	YES As specified in the IEC61097-2 23 / minute
Beacon transmission repetition period satisfies C/S T.001 requirement that two beacon’s repetition periods are not synchronised closer than a few seconds over 5 minute period, and the time intervals between transmissions are randomly distributer on the interval 47.5 to 52.5 seconds (Yes or No)	YES (see § 11.5)
Other ancillary devices (e.g. voice transceiver). List details on a separate sheet if insufficient space to describe	NO
Beacon includes automatic activation mechanism (Yes or No)	YES

2.1 List of operational configurations supported.

2.1.1 Antenna test configuration requirements.

Beacon version	Configuration 1 "water ground plane"	Configuration 2 "Antenna fixed to ground plane"	Configuration 3 "Beacon sitting on ground plane"	Configuration 4 "beacon above ground plane"
SafeLink	X			X

2.1.2 Satellite qualitative test and position acquisition time and position accuracy test configuration requirements.

Beacon version	Configuration 5 "water ground plane"	Configuration 6 "Antenna fixed to ground plane"	Configuration 7 "Beacon on ground plane"	Configuration 8 "beacon above ground plane"
SafeLink	X		X	X

2.2 Details of the beacon battery and battery pack.

The battery is made of 3 packs connected in parallel, each of them made of 3 cells CR123 size connected in series. In order to prevent destruction if a short-circuit occurs, a re-triggerable switch (SPR200) is integrated (see §8 for more details).

Battery chemistry	Lithium (LiMnO2)
Battery cell size and number of cells	CR123 / 9
Battery manufacturer	PANASONIC
Battery pack manufacturer and part number	Williamson / P/N=0146030

2.3 Details on the special features of the beacon.

2.3.1 Homer.

- Frequency : 121.5 MHz ±3kHz
- Homer transmit power : 50mW ± 3dB PERP
- Homer duty cycle : 95 %
- Duty cycle of homer swept tone : 34 %

2.4 Beacon navigation system.

2.4.1 GPS module datasheet.

Fastrax UC322

Revolutionary antenna solution for PND applications!

NEW!

Actual size

Miniature GPS receiver with chip antenna for PND´s.

The Fastrax UC322 is an OEM GPS receiver module, which uses the state of the art SiRF single chip receiver GSC3LT with high navigation sensitivity (-159dBm). The UC322 receiver is equipped with an on-board chip antenna that enables thinner PND design than ever before. The receiver provides low power consumption (90mW) and very fast TTFF together with weak signal acquisition and tracking capability to meet even the most demanding performance expectations.

Impossible to fit in a good antenna?

The module provides complete signal processing from embedded GPS antenna to serial data output in NMEA (or SiRF binary) messages. The embedded chip antenna has good radiation gain, which leads to solid GPS signal levels. The antenna operation is optimized for 50-110mm ground plane width.

Mother Board PCB = GPS Antenna Ground Plane

Fastrax UC322 enables extremely high navigation performance even for applications with very tight requirements for size. The antenna does not need a separate ground plane. Instead it utilizes the application's own PCB for gaining the best antenna signal.

Ultimate GPS receiver module

SiRF GSC3LT chipset with the sensitivity of -159 dBm joined by this revolutionary antenna solution, enables navigation in urban canyons, where many others would fail in acquiring and reading the signal from satellites.

Key Features:

- SiRF GSC3LT single chip
- 20 channels
- Revolutionary antenna solution
- Size: 10.4 x 30.0 x 2.9mm
- Sensitivity: -159 dBm (tracking)
- Power consumption: 90 mW @ 3.3V
- Full SMT mounting
- Operating temp: -30°C...+85°C
- One power supply, no battery back-up

NOTE: For detailed firmware configuration alternatives, see page 30.

Table 1 General Specifications

Receiver	GPS L1 C/A-code, SPS
Chip set & Sensitivity	SiRF GSC3LT -159dBm
Channels	20 physical (limited to 12 tracking by firmware)
Update rate	1 Hz default (fix rate configurable)
Supply voltage, VDD	+3.25V…+5.5 V
Supply voltage, VDD ripple max	300mVpp @ f<10kHz & 3mVpp @ f>100kHz
Power consumption, VDD	90 mW typical @ 3.3V
Power consumption, VDD	65 uW typical @ 3.3V (during Hibernate state)
Operating temperature range	-30°C…+85°C (1)
Serial port protocol (default)	NMEA 3.01 (switchable to SiRF binary)
Serial data format	8 bits, no parity, 1 stop bit
Serial data speed (default)	4800 baud (configurable)
I/O signal levels	CMOS VCC=1.8V compatible: low state 0.0…0.25xVCC; high state 0.75…1.0xVCC
I/O sink/source capability	+/- 2 mA max.
Embedded antenna gain	2.8dBi (linear pol.) @ 80mm ground plane width
PPS output accuracy	+/- 1us

Note (1): Operation at the temperature range -40…+85C is accepted but the TTFF and other GPS performance may degrade.

2.4.2 GPS functioning.

The GPS functioning is based on the future RTCM specification "RTCM Paper 083-2009-SC110-535":

- In the first 60 minutes the navigation device shall make at least 3 attempts to obtain an initial location and shall be on for a cumulative total of at least 30 minutes. If the navigation device fails to obtain an initial location within the first 60 minutes then it shall continue to make at least one attempt every 15 minutes thereafter for the next 1 hour of operation (2 hours total time) until an initial valid fix is obtained. Attempts at obtaining an initial location shall require the navigation device to be powered up for a period of at least 5 minutes each time. Once an initial valid location (fix) has been encoded into the beacon message, or after 2 hours, the navigation device shall attempt location updates following the regime set out below:
- In the first 6 hours the navigation device shall attempt at least one fix / location update every 30 minutes.
- Between 6 hours and [24] hours a fix / location update shall be attempted at least every 2 hours.
- Between [24] hours and [44] hours a fix / location update shall be attempted at least every 4 hours

So :
In the first 60 minutes, $T_{GPS\ ON\ Max}$ = 1h
In the second hour, $T_{GPS\ ON\ Max}$ = 5min every 15 min = 20min
Between 2 hours ans 6 hours, $T_{GPS\ ON\ Max}$ = 4 x 5min every 30 min = 40min
Between 6 hours ans 24 hours, $T_{GPS\ ON\ Max}$ = 18 x 5min every 2 hours = 45min
Between 24 hours ans 48 hours, $T_{GPS\ ON\ Max}$ = 24 x 5min every 6 hours = 20min

⇨ TOTAL : $T_{GPS\ ON\ Max}$ = 3h 05min

2.4.3 406 MHz signal versus GPS failure.

The GPS module is completely independent of the 406 MHz signal.
If we detect a GPS failure, we shut down the power of the GPS module and the beacon is used as a version beacon without GPS (the only difference is that the message sent is not a short message as for the version without GPS but a long message with default position).

2.4.4 Position clearance after deactivation.

After deactivation and reactivation of the beacon, there is a GPS "cold start".
The previous position stored in the beacon memory has been cleared and the correct default values are encoded in the message.

2.5 Self test mode characteristics.

- self-test has separate switch position (Yes or No)	YES
- Self-test switch automatically returns to normal position when released (Yes or No)	YES
- Self-test activation can cause an operational mode transmission (Yes or No)	NO
- Self-test causes a single beacon self-test message burst only regardless of how long the self-test activation mechanism applied (Yes or No)	YES
- Results of self-test indicated by (e.g. Pass / Fail indicator Light, Strobe light, etc.)	Pass / fail indicator light
- Self-test can be activated from beacon remote activation points (Yes or No)	NO
- Self-test performs an internal check and indicates that RF power emitted at 406 MHz and 121.5 MHz if beacon includes a 121.5 MHz homer (Yes or No)	YES
- Self-test transmits a signal(s) other than at 406 MHz (Yes & details or No)	NO
- Self-test can be activated directly at beacon (Yes or No)	YES
- List of items checked by self-test	Battery voltage RF power at 406 MHz Phase locked loop
- Self-test transmission burst duration (440 or 520 ms)	520ms
- Self-test format bit (“0” or “1”)	1

3 Summary of the beacon antenna test results.

3.1 Satellite qualitative test results.

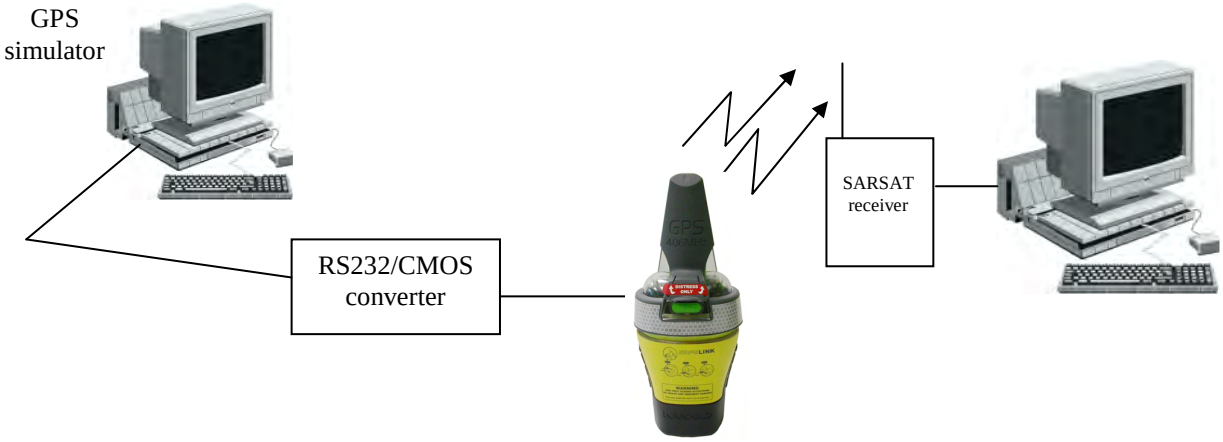
Test performed at INTESPACE.

3.2 Beacon antenna test results.

Test performed at INTESPACE.

3.3 Navigation system test results as per Appendix C to annex F.

To do these tests, we used a NMEA simulation software to send NMEA frames. To decode SARSAT messages, we used the decoder software available on the COSPAS-SARSAT web site.
A RS232/CMOS converter has been used to convert serial link beacon signals to RS232 format.



Different protocols were tested :

- Standard location - EPIRB WITH MMSI
- Standard TEST - EPIRB WITH MMSI
- Standard location - EPIRB WITH SERIAL NUMBER
- NATIONAL location EPIRB
- NATIONAL TEST
- maritime user with MMSI
- maritime user with RADIO CALL SIGN
- RADIO CALL SIGN USER PROTOCOL
- serial user FF EPIRB
- serial user NON FF EPIRB

3.3.1 Standard Location : EPIRB with MMSI

3.3.1.1 Coding values for the message.

Data element	Value
Country code	201
MMSI	999999
Specific beacon	1
121.5 MHz Homer	0

3.3.1.2 Position data encoding results.

Script	Message	Value of Encoded Location Bits Transmitted by Beacon	Required Value of Encoded Location Bits	BCH Correct?
1. Turn on beacon ensuring that navigation is not provided to the beacon. Record the value of encoded location bits.	FFFE2F8C92F423F17FDFF90DB83683E0F00E	Bits 65-85= 01111111101111111111 b 0FFBFF Hex Bits 113-132= 10000111111000001111 b 83E0F Hex	Bits 65-85= 0FFBFF Bits 113-132= 83E0F	√
2. Keeping the beacon active, apply the following navigation data to the beacon: 0° 0 min 59 sec South, 0° 0 min 57 sec West. When the beacon transmitted message changes, record the new encoded location bits and the duration of time the beacon took to update.	FFFE2F8C92F423F18020007DA8768420EB92	Bits 65-85= 10000000010000000000 100400hex Bits 113-132= 10000100001000001110 8420E hex Number of seconds after providing navigation data that beacon transmitted the above encoded location information: _____	Bits 65-85= 100400 Bits 113-132= 8420E Response time for beacon to transmit correct encoded location must be less than 52.5 Sec.	√
3. Keeping the beacon active, change the navigation input to the beacon to: 0° 0 min 53 sec North, 0° 0 min 51 sec East. When the beacon transmitted message changes, record the new encoded location bits.	FFFE2F8C92F423F100000545F9768360D511	Bits 65-85= 00000000000000000000 b 000000 hex Bits 113-132= 10000011011000001101 8360D hex	Bits 65-85= 000000 Bits 113-132= 8360D	√
4. Keeping the beacon active, change the navigation input to the beacon to: 0° 11 min 10 sec North, 179° 47 min 7 sec East. When the beacon transmitted message changes, record the new encoded location bits.	FFFE2F8C92F423F100567C1C42760F622BE6	Bits 65-85= 00000000010101100111 1 000ACF Hex Bits 113-132= 00001111011000100010 0F622 Hex	Bits 65-85= 000ACF Bits 113-132= 0F222 or 0F622	√
5. Keeping the beacon active, change the navigation input to the beacon to: 0° 34 min 55 sec North, 179° 35 min 59 sec East. When the beacon transmitted message changes, record the new encoded location bits.	FFFE2F8C92F423F10096778B8DF693A604C8	Bits 65-85= 00000000100101100111 10 0012CE Hex Bits 113-132= 10010011101001100000 93A60 Hex	Bits 65-85= 0012CE Bits 113-132= 93A60	√
6. Keeping the beacon active, change the navigation input to the beacon to: 0° 11 min 3 sec South, 179° 46 min 0 sec West. When the beacon transmitted message changes, record the new encoded location bits.	FFFE2F8C92F423F18076792413760FA10A4F	Bits 65-85= 10000000011101100111 1 100ECF Hex Bits 113-132= 00001111010000100000 0FA10 Hex	*Bits 65-85= 100ECF Bits 113-132= 0FA10*	√
7. Keeping the beacon active, change the navigation input to the beacon to: 89° 15 min 8 sec South,	FFFE2F8C92F423F1D94B20D3E1B680A00914	Bits 65-85= 11011001010010110010 0 1B2964 Hex Bits 113-132=	Bits 65-85= 1B2964 Bits 113-132= 80A00 or 80800	√

89° 0 min 1 sec East. When the beacon transmitted message changes, record the new encoded location bits.		1000000101000000000 80A00 Hex		
8. Keeping the beacon active, change the navigation input to the beacon to: 89° 16 min 10 sec South, 89° 0 min 1 sec West. When the beacon transmitted message changes, record the encoded location bits	FFFE2F8C92F423F1D96B24F894B684E001C0	Bits 65-85= 11011001011010110010 0 1B2D64 Hex Bits 113-132= 1000010011100000000 84E00 Hex	Bits 65-85= 1B2D64 Bits 113-132= 84E00 or 84C00	√
9. Keeping the beacon active, change the navigation input to the beacon to: 89° 59 min 4 sec North, 179° 59 min 54 sec West. When the beacon transmitted message changes, record the new encoded location bits.	FFFE2F8C92F423F15A3686645E7603802FDE	Bits 65-85= 01011010001101101000 0 0B46D0 Hex Bits 113-132= 00000011100000000010 b 03802 Hex	Bits 65-85= 0B46D0 Bits 113-132= 03801 or 03802	√
10. Keeping the beacon active, change the navigation input to the beacon to: 89° 57 min 59 sec North, 179° 59 min 24 sec East. When the beacon transmitted message changes, record the new encoded location bits.	FFFE2F8C92F423F15A16824F2B7608009EA2	Bits 65-85= 01011010000101101000 0 b 0B42D0 Hex Bits 113-132= 00001000000000001001 08009 Hex	Bits 65-85= 0B42D0 Bits 113-132= 08009	√
11. Keeping the beacon active, change the navigation input to the beacon to: 36° 30 min 0 sec South, 138° 29 min 59 sec West. When the beacon transmitted message changes, record the new encoded location bits.	FFFE2F8C92F423F1A4B1512D1EF6800000EC	Bits 65-85= 10100100101100010101 0 b 14962A Hex Bits 113-132= 10000000000000000000 80000 Hex	Bits 65-85= 14962A Bits 113-132= 80200 or 00200 or 80000 or 00000	√

3.3.1.3 First message decoded.

ITEM	BITS	VALUE
Message format: long format	**25**	**1**
Protocol: Location Protocol	**26**	**0**
Country code: 201	**27-36**	**0011001001**
Type of location protocol: Standard Location - EPIRB (MMSI)	**37-40**	**0010**
MID: 999999	**41-60**	**11110100001000111111**
Specific Beacon: 1	**61-64**	**0001**
Latitude Sign: default	**65**	**0**
Latitude Degrees: default	**66-72**	**1111111**
Latitude Minutes: default	**73-74**	**11**
Longitude Sign: default	**75**	**0**
Longitude Degrees: default	**76-83**	**11111111**
Longitude Minutes: default	**84-85**	**11**
BCH 1 Encoded:	**86-106**	**00100001101101100000**
BCH 1 Calculated:	**N/A**	**00100001101101100000**
Fixed bits (1101): Pass	**107-110**	**1101**
Position Data: Encoded Position Data Source From Internal Navigation Device	**111**	**1**
Aux Device: No 121.5 MHz homer	**112**	**0**
Latitude Offset Sign: default	**113**	**1**
Latitude Offset Minutes: default	**114-118**	**00000**
Latitude Offset Seconds: default	**119-122**	**1111**
Longitude Offset Sign: default	**123**	**1**
Longitude Offset Minutes: default	**124-128**	**00000**
Longitude Offset Seconds: default	**129-132**	**1111**
BCH 2 Encoded:	**133-144**	**000000001110**
BCH 2 Calculated:	**N/A**	**000000001110**
Composite Latitude: default	**N/A**	**Composite Longitude: default**
15 Hex ID:	**N/A**	**1925E847E2FFBFF**

3.3.2 Standard Location : EPIRB with serial number

3.3.2.1 Coding values for the message.

Data element	Value
Country code	201
C/S TAC number	999
Beacon serialised number	99
121.5 MHz Homer	0

3.3.2.2 Position data encoding results.

Script	Message	Value of Encoded Location Bits Transmitted by Beacon	Required Value of Encoded Location Bits	BCH Correct?
1. Turn on beacon ensuring that navigation is not provided to the beacon. Record the value of encoded location bits.	FFFE2F8C96F9C0637FDFF992EF3683E0F00E	Bits 65-85= 01111111101111111111 0FFBFF Bits 113-132= 10000011111000001111 83E0F	Bits 65-85= 0FFBFF Bits 113-132= 83E0F	√
2. Keeping the beacon active, apply the following navigation data to the beacon: 0° 0 min 59 sec South, 0° 0 min 57 sec West. When the beacon transmitted message changes, record the new encoded location bits and the duration of time the beacon took to update.	FFFE2F8C96F9C063802000E2FF768420EB92	Bits 65-85= 10000000010000000000 100400hex Bits 113-132= 10000100001000001110 8420E hex Number of seconds after providing navigation data that beacon transmitted the above encoded location information: _____	Bits 65-85= 100400 Bits 113-132= 8420E Response time for beacon to transmit correct encoded location must be less than 52.5 Sec.	√
3. Keeping the beacon active, change the navigation input to the beacon to: 0° 0 min 53 sec North, 0° 0 min 51 sec East. When the beacon transmitted message changes, record the new encoded location bits.	FFFE2F8C96F9C063000005DAAE768360D511	Bits 65-85= 00000000000000000000 b 000000 hex Bits 113-132= 10000011011000001101 8360D hex	Bits 65-85= 000000 Bits 113-132= 8360D	√
4. Keeping the beacon active, change the navigation input to the beacon to: 0° 11 min 10 sec North, 179° 47 min 7 sec East. When the beacon transmitted message changes, record the new encoded location bits.	FFFE2F8C96F9C06300567C8315760F622BE6	Bits 65-85= 00000000010101100111 1 000ACF Hex Bits 113-132= 00001111011000100010 0F622 Hex	Bits 65-85= 000ACF Bits 113-132= 0F222 or 0F622	√
5. Keeping the beacon active, change the navigation input to the beacon to: 0° 34 min 55 sec North, 179° 35 min 59 sec East. When the beacon transmitted message changes, record the new encoded location bits.	FFFE2F8C96F9C06300967714DAF693A604C8	Bits 65-85= 00000000101011001110 0012CE hex Bits 113-132= 10010011101001100000 93A60 hex	Bits 65-85= 0012CE Bits 113-132= 93A60	√
6. Keeping the beacon active, change the navigation input to the beacon to: 0° 11 min 3 sec South, 179° 46 min 0 sec West. When the beacon transmitted message changes, record the new encoded location bits.	FFFE2F8C96F9C063807679BB44760FA10A4F	Bits 65-85= 10000000111011001111 100ECF hex Bits 113-132= 00001111101000010000 0FA10 hex	*Bits 65-85= 100ECF* *Bits 113-132= 0FA10*	√
7. Keeping the beacon active, change the navigation input to the beacon to: 89° 15 min 8 sec South,	FFFE2F8C96F9C063D94B204CB6B680A00914	Bits 65-85= 11011001010010110 0100 1B2964 Hex Bits 113-132=	Bits 65-85= 1B2964 Bits 113-132= ~~80A00 or 80800~~	√

89° 0 min 1 sec East. When the beacon transmitted message changes, record the new encoded location bits.		1000000101000000000 80A00 Hex		
8. Keeping the beacon active, change the navigation input to the beacon to: 89° 16 min 10 sec South, 89° 0 min 1 sec West. When the beacon transmitted message changes, record the encoded location bits	FFFE2F8C96F9C063D96B2467C3B684E001C0	Bits 65-85= 11011001011010110010 0 1B2D64 Hex Bits 113-132= 10000100111000000000 84E00 Hex	Bits 65-85= 1B2D64 Bits 113-132= 84E00 or 84C00	√
9. Keeping the beacon active, change the navigation input to the beacon to: 89° 59 min 4 sec North, 179° 59 min 54 sec West. When the beacon transmitted message changes, record the new encoded location bits.	FFFE2F8C96F9C0635A3686FB097603802FDE	Bits 65-85= 01011010001101101000 0 B46D0 Hex Bits 113-132= 00000011100000000010 b 03802 Hex	Bits 65-85= 0B46D0 Bits 113-132= 03801 or 03802	√
10. Keeping the beacon active, change the navigation input to the beacon to: 89° 57 min 59 sec North, 179° 59 min 24 sec East. When the beacon transmitted message changes, record the new encoded location bits.	FFFE2F8C96F9C0635A1682D07C7608009EA2	Bits 65-85= 01011010000101101000 0 b 0B42D0 Hex Bits 113-132= 00001000000000001001 08009 Hex	Bits 65-85= 0B42D0 Bits 113-132= 08009	√
11. Keeping the beacon active, change the navigation input to the beacon to: 36° 30 min 0 sec South, 138° 29 min 59 sec West. When the beacon transmitted message changes, record the new encoded location bits.	FFFE2F8C96F9C063A4B151B249F6800000EC	Bits 65-85= 10100100101100010101 0 b 14962A Hex Bits 113-132= 10000000000000000000 80000 Hex	Bits 65-85= 14962A Bits 113-132= 80200 or 00200 or 80000 or 00000	√

3.3.2.3 First message decoded.

ITEM	BITS	VALUE
Message format: long format	**25**	**1**
Protocol: Location Protocol	**26**	**0**
Country code: 201	**27-36**	**0011001001**
Type of location protocol: Standard Location - EPIRB (Serial)	**37-40**	**0110**
Cospas-Sarsat #: 999	**41-50**	**1111100111**
Serial Number: 99	**51-64**	**00000001100011**
Latitude Sign: default	**65**	**0**
Latitude Degrees: default	**66-72**	**1111111**
Latitude Minutes: default	**73-74**	**11**
Longitude Sign: default	**75**	**0**
Longitude Degrees: default	**76-83**	**11111111**
Longitude Minutes: default	**84-85**	**11**
BCH 1 Encoded:	**86-106**	**00110010010111011100**
BCH 1 Calculated:	**N/A**	**00110010010111011100**
Fixed bits (1101): Pass	**107-110**	**1101**
Position Data: Encoded Position Data Source From Internal Navigation Device	**111**	**1**
Aux Device: No 121.5 MHz homer	**112**	**0**
Latitude Offset Sign: default	**113**	**1**
Latitude Offset Minutes: default	**114-118**	**00000**
Latitude Offset Seconds: default	**119-122**	**1111**
Longitude Offset Sign: default	**123**	**1**
Longitude Offset Minutes: default	**124-128**	**00000**
Longitude Offset Seconds: default	**129-132**	**1111**
BCH 2 Encoded:	**133-144**	**000000001110**
BCH 2 Calculated:	**N/A**	**000000001110**
Composite Latitude: default	**N/A**	**Composite Longitude: default**
15 Hex ID:	**N/A**	**192DF380C6FFBFF**

3.3.3 National Location : EPIRB

3.3.3.1 Coding values for the message.

Data element	Value
Country code	201
Beacon serialised number	99
121.5 MHz Homer	0

3.3.3.2 Position data encoding results.

Script	Message	Value of Encoded Location Bits Transmitted by Beacon	Required Value of Encoded Location Bits	BCH Correct?
1. Turn on beacon ensuring that navigation is not provided to the beacon. Record the value of encoded location bits.	FFFE2F8C9A0018DFC0FF02AD44769F3C0672	Bits 59-85= 011111110000001111111100000 b 3F81FE0 Hex Bits 113-126= 10011111001111 b 27CF Hex	Bits 59-85= 3F81FE0 Bits 113-126= 27CF	√
2. Keeping the beacon active, apply the following navigation data to the beacon: 0° 0 min 59 sec South, 0° 0 min 57 sec West. When the beacon transmitted message changes, record the new encoded location bits and the duration of time the beacon took to update.	FFFE2F8C9A0018E00100011ABD36A1380525	Bits 59-85= 100000000000010000000000000 b 4002000 Hex Bits 113-126= 10100001001110 b 284E Hex Number of seconds after providing navigation data that beacon transmitted the above encoded location information: _____	Bits 59-85= 4002000 Bits 113-126= 284E Response time for beacon to transmit correct encoded location must be less than 52.5 Sec.	√
3. Keeping the beacon active, change the navigation input to the beacon to: 0° 0 min 53 sec North, 0° 0 min 51 sec East. When the beacon transmitted message changes, record the new encoded location bits.	FFFE2F8C9A0018C00000065448F69B340767	Bits 59-85= 00000000000000000000000000000 b 0000000 hex Bits 113-126= 10011011001101 b 26CD Hex	Bits 59-85= 0000000 Bits 113-126= 26CD	√
4. Keeping the beacon active, change the navigation input to the beacon to: 0° 11 min 10 sec North, 179° 47 min 7 sec East. When the beacon transmitted message changes, record the new encoded location bits.	FFFE2F8C9A0018C00CB3C75F91F61A340FB5	Bits 59-85= 000000000011001011001111000 b 0019678 Hex Bits 113-126= 00011010001101 b 068D Hex	Bits 59-85= 0019678 Bits 113-126= 060D or 068D	√
5. Keeping the beacon active, change the navigation input to the beacon to: 0° 10 min 55 sec North, 179° 51 min 1 sec East. When the beacon transmitted message changes, record the new encoded location bits.	FFFE2F8C9A0018C00AB3D6522BF69C400105	Bits 59-85= 000000000010101011001111010 b 001567A Hex Bits 113-126= 10011100010000 b 2710 Hex	Bits 59-85= 001567A Bits 113-126= 2710	√
6. Keeping the beacon active, change the navigation input to the beacon to: 0° 11 min 3 sec South, 179° 46 min 0 sec West. When the beacon transmitted message changes, record the new encoded location bits.	FFFE2F8C9A0018E00DB3B817B0B61D0004FD	Bits 59-85= 100000000011011011001110111 b 401B677 Hex Bits 113-126= 00011101000000 b 0740 Hex	Bits 59-85= 401B677 Bits 113-126= 0740 or 0700	√
7. Keeping the beacon active, change the navigation input to the beacon to: 89° 15 min 8 sec South, 89° 0 min 1 sec East.	FFFE2F8C9A0018F65059066854F61B0003FC	Bits 59-85= 110110010100000101100100000 b 6CA0B20 Hex Bits 113-126= 00011011000000 b	Bits 59-85= 6CA0B20 Bits 113-126= 06C0 or 0680	√

When the beacon transmitted message changes, record the new encoded location bits.		06C0 Hex		
8. Keeping the beacon active, change the navigation input to the beacon to: 89° 16 min 10 sec South, 89° 0 min 1 sec West. When the beacon transmitted message changes, record the encoded location bits	FFFE2F8C9A0018F6515901EA1FF687000C0E	Bits 59-85= 1101100101000101011001000000 b 6CA2B20 Hex Bits 113-126= 10000111000000 b 21C0 Hex	Bits 59-85= 6CA2B20 Bits 113-126= 21C0 or 2180	√
9. Keeping the beacon active, change the navigation input to the beacon to: 89° 59 min 4 sec North, 179° 59 min 54 sec West. When the beacon transmitted message changes, record the new encoded location bits.	FFFE2F8C9A0018D681B400BA34F61C080BF5	Bits 59-85= 0101101000000110110100000000 b 2D03680 Hex Bits 113-126= 00011100000010 b 0701 Hex	Bits 59-85= 2D03680 Bits 113-126= 0701 or 0702	√
10. Keeping the beacon active, change the navigation input to the beacon to: 89° 57 min 59 sec North, 179° 59 min 24 sec East. When the beacon transmitted message changes, record the new encoded location bits.	FFFE2F8C9A0018D67AB40067B8F600240DA1	Bits 59-85= 0101100111101010110100000000 b 2CF5680 Hex Bits 113-126= 00000000001001 b 0009 Hex	Bits 59-85= 2CF5680 Bits 113-126= 2009 or 0009	√
11. Keeping the beacon active, change the navigation input to the beacon to: 36° 30 min 0 sec South, 138° 29 min 59 sec West. When the beacon transmitted message changes, record the new encoded location bits.	FFFE2F8C9A0018E91F8A7F0960B6800000EC	Bits 59-85= 1010010001111110001010011111 b 523F14F Hex Bits 113-126= 10000000000000 b 2000 Hex	Bits 59-85= 523F14F Bits 113-126= 2040 or 2000 or 0040 or 0000	√

3.3.3.3 First message decoded.

ITEM	BITS	VALUE
Message format: long format	**25**	**1**
Protocol: Location Protocol	**26**	**0**
Country code: 201	**27-36**	**0011001001**
Type of location protocol: National Location - EPIRB	**37-40**	**1010**
Serial Number: 99	**41-58**	**000000000001100011**
Latitude Flag: default	**59**	**0**
Latitude (Degrees): default	**60-66**	**1111111**
Latitude (Minutes): default	**67-71**	**00000**
Longitude Flag: default	**72**	**0**
Longitude (Degrees): default	**73-80**	**11111111**
Longitude (Minutes): default	**81-85**	**00000**
BCH 1 Encoded:	**86-106**	**01010101101010001000 1**
BCH 1 Calculated:	**86-106**	**01010101101010001000 1**
Fixed bits (110): Pass	**107-109**	**110**
Bits 113 - 132 provides offset data location	**110**	**1**
Position Data: Encoded Position Data Source From Internal Navigation Device	**111**	**1**
Aux Loc. Device: No 121.5 MHz homer	**112**	**0**
Latitude Offset Sign: default	**113**	**1**
Latitude Offset Minutes: default	**114-115**	**00**
Latitude Offset Seconds: default	**116-119**	**1111**
Longitude Offset Sign: default	**120**	**1**
Longitude Offset Minutes: default	**121-122**	**00**
Longitude Offset Seconds: default	**123-126**	**1111**
Additional Id (Nat Use)	**127-132**	**000000**
BCH 2 Encoded:	**133-144**	**011001110010**
BCH 2 Calculated:	**N/A**	**011001110010**
Composite Latitude: default	**N/A**	**Composite Longitude: default**
15 Hex ID:	**N/A**	**19340031BF81FE0**

3.3.4 Maritime User Protocol with MMSI

3.3.4.1 Coding values for the message.

Data element	Value
Country code	201
MMSI	999999
Specific beacon	1
121.5 MHz Homer	0

3.3.4.2 Position data encoding results.

Script	Message	Value of Encoded Location Bits Transmitted by Beacon	Required Value of Encoded Location Bits	BCH Correct?
1. Turn on beacon ensuring that navigation is not provided to the beacon. Record the value of encoded location bits.	FFFED0CC94186186186E8162F72FE0FF0146	Bits 108-132= 011111110000011111110000 b 0FE0FF0 Hex	Bits 108-132= 0FE0FF0	√
2. Keeping the beacon active, apply the following navigation data to the beacon: 0° 0 min 59 sec South, 0° 0 min 57 sec West. When the beacon transmitted message changes, record the new encoded location bits and the duration of time the beacon took to update.	FFFE2FCC94186186186E8162F7300100084B	Bits 108 – 132= 100000000000100000000000 b 1001000 Hex Number of seconds after providing navigation data that beacon transmitted the above encoded location information: 20sec	Bits 108-132= 1001000 Response time for beacon to transmit correct encoded location must be less than 52.5 sec.	√
3. Keeping the beacon active, change the navigation input to the beacon to: 0° 0min 53 sec North, 0° 0min 51 sec East. When the beacon transmitted message changes, record the new encoded location bits.	FFFE2FCC94186186186E8162F72000000E27	Bits 108-132= 000000000000000000000000b 0000000 Hex	Bits 108-132= 0000000	√
4. change the navigation input to the beacon to: 0° 11min 10 sec North, 179° 47min 7 sec East. When the beacon transmitted message changes, record the new encoded location bits.	FFFE2FCC94186186186E8162F72006B3C2F3	Bits 108-132= 000000000011010110011110 0b 0006B3C Hex	Bits 108-132= 0006B3C	√
5. Keeping the beacon active, change the navigation input to the beacon to: 0° 11min 3 sec South, 179° 46min 0 sec West. When the beacon transmitted message changes, record the new encoded location bits.	FFFE2FCC94186186186E8162F73007B3C49F	Bits 108-132= 100000000011110110011110 0b 1007B3C Hex	Bits 108-132= 1007B3C	√
6. Keeping the beacon active, change the navigation input to the beacon to: 89° 15min 8 sec South, 89° 0min 1 sec East. When the beacon transmitted message changes, record the new encoded location bits.	FFFE2FCC94186186186E8162F73B28590C48	Bits 108-132= 110110010100001011001 0000 b 1B28590 Hex	Bits 108-132= 1B28590	√
7. Keeping the beacon active, change the navigation input to the beacon to: 89° 16min 10 sec South, 89° 0min 1 sec West. When the beacon transmitted	FFFE2FCC94186186186E8162F73B295907AB	Bits 108-132= 110110010100101011001 0000b 1B29590 Hex	Bits 108-132= 1B29590	√

message changes, record the new encoded location bits.				
8. Keeping the beacon active, change the navigation input to the beacon to: 89° 59min 4 sec North, 179° 59min 54 sec West. When the beacon transmitted message changes, record the new encoded location bits.	FFFE2FCC94186186186E8162F72B41B400FA	Bits 108-132= 01011010000011011010000 0 b 0B41B40 Hex	Bits 108-132= 0B41B40	√
9. Keeping the beacon active, change the navigation input to the beacon to: 89° 57min 59 sec North, 179° 59min 24 sec East. When the beacon transmitted message changes, record the new encoded location bits.	FFFE2FCC94186186186E8162F72B3CB4095C	Bits 108-132= 01011001111001011010000000b 0B3CB40 Hex	Bits 108-132= 0B3CB40	√
10. Keeping the beacon active, change the navigation input to the beacon to: 36° 30min 0 sec South, 138° 29min 59 sec West. When the beacon transmitted message changes, record the new encoded location bits.	FFFE2FCC94186186186E8162F734918A7EF2	Bits 108-132= 10100100100011000101001 11b 14918A7 Hex	Bits 108-132= 14918A7	√

3.3.4.3 First message decoded.

ITEM	BITS	VALUE
Message format: long format	**25**	**1**
Protocol: User	**26**	**1**
Country code: 201	**27-36**	**0011001001**
User type: Maritime User	**37-39**	**010**
Maritime MMSI (6 digits): 999999	**40-75**	**0000110000110000110000110000110000011**
Specific bcn: 1	**76-81**	**011101**
Spare	**82-83**	**00**
Aux radio device: No Auxiliary Radio-locating Device	**84-85**	**00**
Encoded BCH 1:	**86-106**	**00101100010111101 1100**
Calculated BCH 1:	**N/A**	**00101100010111101 1100**
Encoded Position Data Source From Internal Navigation Device	**107**	**1**
default	**108**	**0**
Latitude (degrees): default	**109-115**	**1111111**
Latitude (minutes): default	**116-119**	**0000**
default	**120**	**0**
Longitude (degrees): default	**121-128**	**11111111**
Longitude (minutes): default	**129-132**	**0000**
Encoded BCH 2:	**133-144**	**000101000110**
Calculated BCH 2:	**N/A**	**000101000110**
15 Hex ID:	**N/A**	**992830C30C30DD0**

3.3.5 Maritime User Protocol with Radio Call Sign

3.3.5.1 Coding values for the message.

Data element	Value
Country code	201
Radio call sign	XPA02
Specific beacon	1
121.5 MHz Homer	0

3.3.5.2 Position data encoding results.

Script	Message	Value of Encoded Location Bits Transmitted by Beacon	Required Value of Encoded Location Bits	BCH Correct?
1. Turn on beacon ensuring that navigation is not provided to the beacon. Record the value of encoded location bits.	FFFE2FCC9526F6F06B2E872397AFE0FF0146	Bits 108-132= 01111111000001111111110000b 0FE0FF0 Hex	Bits 108-132= 0FE0FF0	√
2. Keeping the beacon active, apply the following navigation data to the beacon: 0° 0 min 59 sec South, 0° 0 min 57 sec West. When the beacon transmitted message changes, record the new encoded location bits and the duration of time the beacon took to update.	FFFE2FCC9526F6F06B2E872397B00100084B	Bits 108 – 132= 100000000000010000000000000 b 1001000 Hex Number of seconds after providing navigation data that beacon transmitted the above encoded location information: 4sec	Bits 108-132= 1001000 Response time for beacon to transmit correct encoded location must be less than 52.5 sec.	√
3. Keeping the beacon active, change the navigation input to the beacon to: 0° 0min 53 sec North, 0° 0min 51 sec East. When the beacon transmitted message changes, record the new encoded location bits.	FFFE2FCC9526F6F06B2E872397A000000E27	Bits 108-132= 00000000000000000000000000b 0000000 Hex	Bits 108-132= 0000000	√
4. change the navigation input to the beacon to: 0° 11min 10 sec North, 179° 47min 7 sec East. When the beacon transmitted message changes, record the new encoded location bits.	FFFE2FCC9526F6F06B2E872397A006B3C2F3	Bits 108-132= 00000000001101011001111100b 0006B3C Hex	Bits 108-132= 0006B3C	√
5. Keeping the beacon active, change the navigation input to the beacon to: 0° 11min 3 sec South, 179° 46min 0 sec West. When the beacon transmitted message changes, record the new encoded location bits.	FFFE2FCC9526F6F06B2E872397B007B3C49F	Bits 108-132= 10000000001111011001111100b 1007B3C Hex	Bits 108-132= 1007B3C	√
6. Keeping the beacon active, change the navigation input to the beacon to: 89° 15min 8 sec South, 89° 0min 1 sec East. When the beacon transmitted message changes, record the new encoded location bits.	FFFE2FCC9526F6F06B2E872397BB28590C48	Bits 108-132= 11011001010000010110010000 b 1B28590 Hex	Bits 108-132= 1B28590	√
7. Keeping the beacon active, change the navigation input to the beacon to: 89° 16min 10 sec South, 89° 0min 1 sec West. When the beacon transmitted	FFFE2FCC9526F6F06B2E872397BB295907AB	Bits 108-132= 11011001010010101100100000b 1B29590 Hex	Bits 108-132= 1B29590	√

message changes, record the new encoded location bits.				
8. Keeping the beacon active, change the navigation input to the beacon to: 89° 59min 4 sec North, 179° 59min 54 sec West. When the beacon transmitted message changes, record the new encoded location bits.	FFFE2FCC9526F6F06B2E872397AB41B400FA	Bits 108-132= 01011010000011011010000000b 0B41B40 Hex	Bits 108-132= 0B41B40	√
9. Keeping the beacon active, change the navigation input to the beacon to: 89° 57min 59 sec North, 179° 59min 24 sec East. When the beacon transmitted message changes, record the new encoded location bits.	FFFE2FCC9526F6F06B2E872397AB3CB4095C	Bits 108-132= 01011001111001011010000000b 0B3CB40 Hex	Bits 108-132= 0B3CB40	√
10. Keeping the beacon active, change the navigation input to the beacon to: 36° 30min 0 sec South, 138° 29min 59 sec West. When the beacon transmitted message changes, record the new encoded location bits.	FFFE2FCC9526F6F06B2E872397B4918A7EF2	Bits 108-132= 10100100100011000100100111b 14918A7 Hex	Bits 108-132= 14918A7	√

3.3.5.3 First message decoded.

ITEM	BITS	VALUE
Message format: long format	**25**	**1**
Protocol: User	**26**	**1**
Country code: 201	**27-36**	**0011001001**
User type: Maritime User	**37-39**	**010**
Radio Call Sign (6 digits): XPA02	**40-75**	**1001001101111011011110000011010111001**
Specific bcn: 1	**76-81**	**011101**
Spare	**82-83**	**00**
Aux radio device: No Auxiliary Radio-locating Device	**84-85**	**00**
Encoded BCH 1:	**86-106**	**11100100011100101111 0**
Calculated BCH 1:	**N/A**	**11100100011100101111 0**
Encoded Position Data Source From Internal Navigation Device	**107**	**1**
default	**108**	**0**
Latitude (degrees): default	**109-115**	**1111111**
Latitude (minutes): default	**116-119**	**0000**
default	**120**	**0**
Longitude (degrees): default	**121-128**	**11111111**
Longitude (minutes): default	**129-132**	**0000**
Encoded BCH 2:	**133-144**	**000101000110**
Calculated BCH 2:	**N/A**	**000101000110**
15 Hex ID:	**N/A**	**992A4DEDE0D65D0**

3.3.6 Radio Call Sign User Protocol

3.3.6.1 Coding values for the message.

Data element	Value
Country code	201
Radio call sign	XPA02
Specific beacon	1
121.5 MHz Homer	0

3.3.6.2 Position data encoding results.

Script	Message	Value of Encoded Location Bits Transmitted by Beacon	Required Value of Encoded Location Bits	BCH Correct?
1. Turn on beacon ensuring that navigation is not provided to the beacon. Record the value of encoded location bits.	FFFE2FCC9DBDBC1A554E866553AFE0FF0146	Bits 108-132= 011111110000111111110000b 0FE0FF0 Hex	Bits 108-132= 0FE0FF0	√
2. Keeping the beacon active, apply the following navigation data to the beacon: 0° 0 min 59 sec South, 0° 0 min 57 sec West. When the beacon transmitted message changes, record the new encoded location bits and the duration of time the beacon took to update.	FFFE2FCC9DBDBC1A554E866553B00100084B	Bits 108 – 132= 100000000000010000000000 b 1001000 Hex Number of seconds after providing navigation data that beacon transmitted the above encoded location information: 4sec	Bits 108-132= 1001000 Response time for beacon to transmit correct encoded location must be less than 52.5 sec.	√
3. Keeping the beacon active, change the navigation input to the beacon to: 0° 0min 53 sec North, 0° 0min 51 sec East. When the beacon transmitted message changes, record the new encoded location bits.	FFFE2FCC9DBDBC1A554E866553A000000E27	Bits 108-132= 000000000000000000000000 b 0000000 Hex	Bits 108-132= 0000000	√
4. change the navigation input to the beacon to: 0° 11min 10 sec North, 179° 47min 7 sec East. When the beacon transmitted message changes, record the new encoded location bits.	FFFE2FCC9DBDBC1A554E866553A006B3C2F3	Bits 108-132= 000000000011010110011110 0 b 0006B3CHex	Bits 108-132= 0006B3C	√
5. Keeping the beacon active, change the navigation input to the beacon to: 0° 11min 3 sec South, 179° 46min 0 sec West. When the beacon transmitted message changes, record the new encoded location bits.	FFFE2FCC9DBDBC1A554E866553B007B3C49F	Bits 108-132= 100000000011110110011110 0 b 1007B3C Hex	Bits 108-132= 1007B3C	√
6. Keeping the beacon active, change the navigation input to the beacon to: 89° 15min 8 sec South, 89° 0min 1 sec East. When the beacon transmitted message changes, record the new encoded location bits.	FFFE2FCC9DBDBC1A554E866553BB28590C48	Bits 108-132= 110110010100001011001000 0 b 1B28590 Hex	Bits 108-132= 1B28590	√
7. Keeping the beacon active, change the navigation input to the beacon to: 89° 16min 10 sec South, 89° 0min 1 sec West.	FFFE2FCC9DBDBC1A554E866553BB295907AB	Bits 108-132= 110110010100101011001000 0 b 1B29590 Hex	Bits 108-132= 1B29590	√

When the beacon transmitted message changes, record the new encoded location bits.				
8. Keeping the beacon active, change the navigation input to the beacon to: 89° 59min 4 sec North, 179° 59min 54 sec West. When the beacon transmitted message changes, record the new encoded location bits.	FFFE2FCC9DBDBC1A554E866553AB41B400FA	Bits 108-132= 010110100000110110100000 0 b 0B41B40 Hex	Bits 108-132= 0B41B40	√
9. Keeping the beacon active, change the navigation input to the beacon to: 89° 57min 59 sec North, 179° 59min 24 sec East. When the beacon transmitted message changes, record the new encoded location bits.	FFFE2FCC9DBDBC1A554E866553AB3CB4095C	Bits 108-132= 010110011110010110100000 0 b 0B3CB40 Hex	Bits 108-132= 0B3CB40	√
10. Keeping the beacon active, change the navigation input to the beacon to: 36° 30min 0 sec South, 138° 29min 59 sec West. When the beacon transmitted message changes, record the new encoded location bits.	FFFE2FCC9DBDBC1A554E866553B4918A7EF2	Bits 108-132= 101001001000110001010011 1 b 14918A7 Hex	Bits 108-132= 14918A7	√

3.3.6.3 First message decoded.

ITEM	BITS	VALUE
Message format: long format	**25**	**1**
Protocol: User	**26**	**1**
Country code: 201	**27-36**	**0011001001**
User type: Radio Call Sign	**37-39**	**110**
Radio Call Sign Identification: XPA02	**40-75**	**1101111011011110000011010010101010 10**
Specific bcn: 1	**76-81**	**011101**
Spare	**82-83**	**00**
Aux radio device: No Auxiliary Radio-locating Device	**84-85**	**00**
Encoded BCH 1:	**86-106**	**11001100101010100111 0**
Calculated BCH 1:	**N/A**	**11001100101010100111 0**
Encoded Position Data Source From Internal Navigation Device	**107**	**1**
default	**108**	**0**
Latitude (degrees): default	**109-115**	**1111111**
Latitude (minutes): default	**116-119**	**0000**
default	**120**	**0**
Longitude (degrees): default	**121-128**	**11111111**
Longitude (minutes): default	**129-132**	**0000**
Encoded BCH 2:	**133-144**	**000101000110**
Calculated BCH 2:	**N/A**	**000101000110**
15 Hex ID:	**N/A**	**993B7B7834AA9D0**

3.3.7 Serial user - FF EPIRB

3.3.7.1 Coding values for the message.

Data element	Value
Country code	201
C/S TAC number	999
Beacon serialised number	99
121.5 MHz Homer	0

3.3.7.2 Position data encoding results.

Script	Message	Value of Encoded Location Bits Transmitted by Beacon	Required Value of Encoded Location Bits	BCH Correct?
1. Turn on beacon ensuring that navigation is not provided to the beacon. Record the value of encoded location bits.	FFFE2FCC96A000C6007CE70B3A2FE0FF0146	Bits 108-132= 011111110000011111111110000b 0FE0FF0 HEX	Bits 108-132= 0FE0FF0	√
2. Keeping the beacon active, apply the following navigation data to the beacon: 0° 0 min 59 sec South, 0° 0 min 57 sec West. When the beacon transmitted message changes, record the new encoded location bits and the duration of time the beacon took to update.	FFFE2FCC96A000C6007CE70B3A300100084B	Bits 108 – 132= 100000000000010000000000000 b 1001000 Hex Number of seconds after providing navigation data that beacon transmitted the above encoded location information: 4sec	Bits 108-132= 1001000 Response time for beacon to transmit correct encoded location must be less than 52.5 sec.	√
3. Keeping the beacon active, change the navigation input to the beacon to: 0° 0min 53 sec North, 0° 0min 51 sec East. When the beacon transmitted message changes, record the new encoded location bits.	FFFE2FCC96A000C6007CE70B3A2000000E27	Bits 108-132= 000000000000000000000000000b 0000000 Hex	Bits 108-132= 0000000	√
4. change the navigation input to the beacon to: 0° 11min 10 sec North, 179° 47min 7 sec East. When the beacon transmitted message changes, record the new encoded location bits.	FFFE2FCC96A000C6007CE70B3A2006B3C2F3	Bits 108-132= 000000000011010110011110 0b 0006B3C Hex	Bits 108-132= 0006B3C	√
5. Keeping the beacon active, change the navigation input to the beacon to: 0° 11min 3 sec South, 179° 46min 0 sec West. When the beacon transmitted message changes, record the new encoded location bits.	FFFE2FCC96A000C6007CE70B3A3007B3C49F	Bits 108-132= 100000000011110110011110 0b 1007B3C Hex	Bits 108-132= 1007B3C	√
6. Keeping the beacon active, change the navigation input to the beacon to: 89° 15min 8 sec South, 89° 0min 1 sec East. When the beacon transmitted message changes, record the new encoded location bits.	FFFE2FCC96A000C6007CE70B3A3B28590C48	Bits 108-132= 110110010100001011001000 0 b 1B28590 Hex	Bits 108-132= 1B28590	√
7. Keeping the beacon active, change the navigation input to the beacon to: 89° 16min 10 sec South, 89° 0min 1 sec West. When the beacon transmitted	FFFE2FCC96A000C6007CE70B3A3B295907AB	Bits 108-132= 110110010100101011001000 0b 1B29590 Hex	Bits 108-132= 1B29590	√

message changes, record the new encoded location bits.				
8. Keeping the beacon active, change the navigation input to the beacon to: 89° 59min 4 sec North, 179° 59min 54 sec West. When the beacon transmitted message changes, record the new encoded location bits.	FFFE2FCC96A000C6007CE70B3A2B41B400FA	Bits 108-132= 01011010000011011010000000b 0B41B40 Hex	Bits 108-132= 0B41B40	√
9. Keeping the beacon active, change the navigation input to the beacon to: 89° 57min 59 sec North, 179° 59min 24 sec East. When the beacon transmitted message changes, record the new encoded location bits.	FFFE2FCC96A000C6007CE70B3A2B3CB4095C	Bits 108-132= 01011001111001011010000000b 0B3CB40 Hex	Bits 108-132= 0B3CB40	√
10. Keeping the beacon active, change the navigation input to the beacon to: 36° 30min 0 sec South, 138° 29min 59 sec West. When the beacon transmitted message changes, record the new encoded location bits.	FFFE2FCC96A000C6007CE70B3A34918A7EF2	Bits 108-132= 10100100100011000100100111b 14918A7 Hex	Bits 108-132= 14918A7	√

3.3.7.3 First message decoded.

ITEM	BITS	VALUE
Message format: long format	**25**	**1**
Protocol: User	**26**	**1**
Country code: 201	**27-36**	**0011001001**
User type: Serial User	**37-39**	**011**
Serial Type: Float Free EPIRB with Serial Identification Number	**40-42**	**010**
Cospas-Sarsat Certificate Number in bits 74-83: Yes	**43**	**1**
Serial Number: 99	**44-63**	**00000000000001100011**
All 0s or National Use	**64-73**	**0000000000**
C/S Number or National Use (bit 43 refers): 999	**74-83**	**1111100111**
Aux radio device: No Auxiliary Radio-locating Device	**84-85**	**00**
Encoded BCH 1:	**86-106**	**11100001011001101000**
Calculated BCH 1:	**N/A**	**11100001011001101000**
Encoded Position Data Source From Internal Navigation Device	**107**	**1**
default	**108**	**0**
Latitude (degrees): default	**109-115**	**1111111**
Latitude (minutes): default	**116-119**	**0000**
default	**120**	**0**
Longitude (degrees): default	**121-128**	**11111111**
Longitude (minutes): default	**129-132**	**0000**
Encoded BCH 2:	**133-144**	**000101000110**
Calculated BCH 2:	**N/A**	**000101000110**
15 Hex ID:	**N/A**	**992D40018C00F9C**

3.3.8 Serial user – NON FF EPIRB

3.3.8.1 Coding values for the message.

Data element	Value
Country code	201
C/S TAC number	999
Beacon serialised number	99
121.5 MHz Homer	0

3.3.8.2 Position data encoding results.

Script	Message	Value of Encoded Location Bits Transmitted by Beacon	Required Value of Encoded Location Bits	BCH Correct?
1. Turn on beacon ensuring that navigation is not provided to the beacon. Record the value of encoded location bits.	FFFE2FCC972000C6007CE2C9C9AFE0FF0146	Bits 108-132= 011111110000011111110000b 0FE0FF0 HEX	Bits 108-132= 0FE0FF0	√
2. Keeping the beacon active, apply the following navigation data to the beacon: 0° 0 min 59 sec South, 0° 0 min 57 sec West. When the beacon transmitted message changes, record the new encoded location bits and the duration of time the beacon took to update.	FFFE2FCC972000C6007CE2C9C9B00100084B	Bits 108 – 132= 100000000000100000000000 b 1001000 Hex Number of seconds after providing navigation data that beacon transmitted the above encoded location information: 4sec	Bits 108-132= 1001000 Response time for beacon to transmit correct encoded location must be less than 52.5 sec.	√
3. Keeping the beacon active, change the navigation input to the beacon to: 0° 0min 53 sec North, 0° 0min 51 sec East. When the beacon transmitted message changes, record the new encoded location bits.	FFFE2FCC972000C6007CE2C9C9A000000E27	Bits 108-132= 000000000000000000000000b 0000000 Hex	Bits 108-132= 0000000	√
4. change the navigation input to the beacon to: 0° 11min 10 sec North, 179° 47min 7 sec East. When the beacon transmitted message changes, record the new encoded location bits.	FFFE2FCC972000C6007CE2C9C9A006B3C2F3	Bits 108-132= 000000000011010110011111 00b 0006B3C Hex	Bits 108-132= 0006B3C	√
5. Keeping the beacon active, change the navigation input to the beacon to: 0° 11min 3 sec South, 179° 46min 0 sec West. When the beacon transmitted message changes, record the new encoded location bits.	FFFE2FCC972000C6007CE2C9C9B007B3C49F	Bits 108-132= 100000000011110110011111 00b 1007B3C Hex	Bits 108-132= 1007B3C	√
6. Keeping the beacon active, change the navigation input to the beacon to: 89° 15min 8 sec South, 89° 0min 1 sec East. When the beacon transmitted message changes, record the new encoded location bits.	FFFE2FCC972000C6007CE2C9C9BB28590C48	Bits 108-132= 110110010100001011001000 0 b 1B28590 Hex	Bits 108-132= 1B28590	√
7. Keeping the beacon active, change the navigation input to the beacon to: 89° 16min 10 sec South, 89° 0min 1 sec West. When the beacon transmitted	FFFE2FCC972000C6007CE2C9C9BB295907AB	Bits 108-132= 110110010100101100100000b 1B29590 Hex	Bits 108-132= 1B29590	√

message changes, record the new encoded location bits.				
8. Keeping the beacon active, change the navigation input to the beacon to: 89° 59min 4 sec North, 179° 59min 54 sec West. When the beacon transmitted message changes, record the new encoded location bits.	FFFE2FCC972000C6007CE2C9C9AB41B400FA	Bits 108-132= 0101101000001101101000000b 0B41B40 Hex	Bits 108-132= 0B41B40	√
9. Keeping the beacon active, change the navigation input to the beacon to: 89° 57min 59 sec North, 179° 59min 24 sec East. When the beacon transmitted message changes, record the new encoded location bits.	FFFE2FCC972000C6007CE2C9C9AB3CB4095C	Bits 108-132= 0101100111100101101000000b 0B3CB40 Hex	Bits 108-132= 0B3CB40	√
10. Keeping the beacon active, change the navigation input to the beacon to: 36° 30min 0 sec South, 138° 29min 59 sec West. When the beacon transmitted message changes, record the new encoded location bits.	FFFE2FCC972000C6007CE2C9C9B4918A7EF2	Bits 108-132= 1010010010001100010100111b 14918A7 Hex	Bits 108-132= 14918A7	√

3.3.8.3 First message decoded.

ITEM	BITS	VALUE
Message format: long format	**25**	**1**
Protocol: User	**26**	**1**
Country code: 201	**27-36**	**0011001001**
User type: Serial User	**37-39**	**011**
Serial Type: Non Float Free EPIRB with Serial Identification	**40-42**	**100**
Cospas-Sarsat Certificate Number in bits 74-83: Yes	**43**	**1**
Serial Number: 99	**44-63**	**00000000000001100011**
All 0s or National Use	**64-73**	**0000000000**
C/S Number or National Use (bit 43 refers): 999	**74-83**	**1111100111**
Aux radio device: No Auxiliary Radio-locating Device	**84-85**	**00**
Encoded BCH 1:	**86-106**	**01011001001110010011O**
Calculated BCH 1:	**N/A**	**01011001001110010011O**
Encoded Position Data Source From Internal Navigation Device	**107**	**1**
default	**108**	**0**
Latitude (degrees): default	**109-115**	**1111111**
Latitude (minutes): default	**116-119**	**0000**
default	**120**	**0**
Longitude (degrees): default	**121-128**	**11111111**
Longitude (minutes): default	**129-132**	**0000**
Encoded BCH 2:	**133-144**	**000101000110**
Calculated BCH 2:	**N/A**	**000101000110**
15 Hex ID:	**N/A**	**992E40018C00F9C**

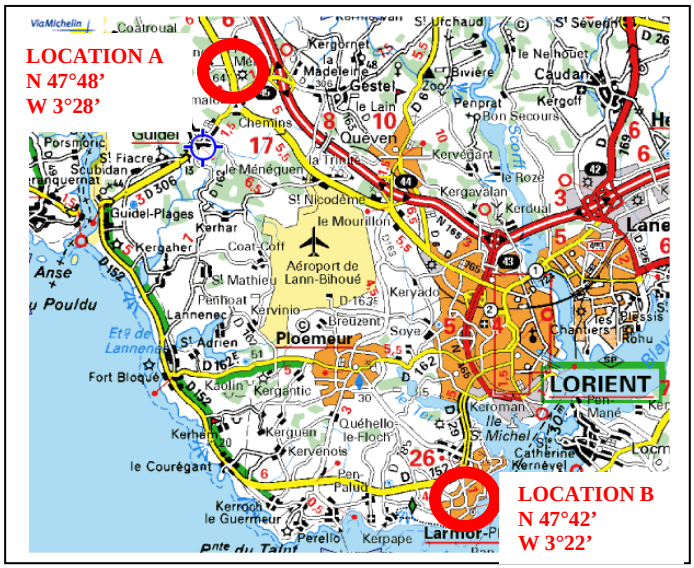
3.4 Sample messages generated by the beacon coding software.

3.4.1 List of all protocols.

Standard location protocols	EPIRB with MMSI
	EPIRB with Serial Number
National location protocols	EPIRB
User location protocols	Maritime User Protocol with MMSI
	Maritime Usr Protocol with Radio Call Sign
	Radio Call Sign User Protocol
	Serial user FF EPIRB
	Serial user NON FF EPIRB

3.4.2 Location Protocol Beacon Messages.

The KANNAD SafeLink is switched on at each test point (see road map below).
The SARSAT message is received via the SARSAT decoder , transmitted to the laptop and stored in a text file.
Then, the KANNAD SafeLink is switched off and the same test is done at another test point.



Protocol	Operational message		Self-test message
	Location "A"	Location "B"	
Standard Location : EPIRB with MMSI	FFFE2F8C92F423F12FE077496CB68C020006	FFFE2F8C92F423F12FE077496CB60C080934	FFFED08C92F423F17FDFF90DB83683E0F00E
Standard Location : EPIRB with Serial Number	FFFE2F8C96F9C0632FE077D63BB68C020006	FFFE2F8C96F9C0632FE077D63BB60C080934	FFFED08C96F9C0637FDFF992EF3683E0F00E
National Location : EPIRB	FFFE2F8C9A0018CBF1037020C23681000B0F	FFFE2F8C9A0018CBEB0359CEE1F681000B0F	FFFED08C9A0018DFC0FF02AD44769F3C0672
Maritime User Protocol with MMSI	FFFE2FCC94186186186E8162F725F9037C97	FFFE2FCC94186186186E8162F725F7036553	FFFED0CC94186186186E8162F72FE0FF0146
Maritime Usr Protocol with Radio Call Sign	FFFE2FCC9526F6F06B2E872397A5F9037C97	FFFE2FCC9526F6F06B2E872397A5F7036553	FFFED0CC9526F6F06B2E872397AFE0FF0146
Radio Call Sign User Protocol	FFFE2FCC9DBDBC1A554E866553A5F9037C97	FFFE2FCC9DBDBC1A554E866553A5F7036553	FFFED0CC9DBDBC1A554E866553AFE0FF0146
Serial user FF EPIRB	FFFE2FCC96A000C6007CE70B3A25F9037C97	FFFE2FCC96A000C6007CE70B3A25F7036553	FFFED0CC96A000C6007CE70B3A2FE0FF0146
Serial user NON FF EPIRB	FFFE2FCC972000C6007CE2C9C9A5F9037C97	FFFE2FCC972000C6007CE2C9C9A5F7036553	FFFED0CC972000C6007CE2C9C9AFE0FF0146

4 Analysis and calculations that support the pre-test battery discharge.

Battery discharge calculation (see § 8.7 for calculation details)

Depletion in battery power		**216,48**	**mAh**	(1)
Requested energy for 7 years constant operation prior to activation		6,13	mAh	(2)
With correction coefficient 1,65	(2) * 1,65	**10,12**	**mAh**	(3)
Requested energy for a 7 years monthly test		37,02	mAh	(4)
Correction coefficient 1,65	(4) * 1,65	**61,08**	**mAh**	(5)
TOTAL :	(1) + (3) + (5)	287,68	mAh	(6)
Normal consumption at +20°C :		69,30	mA	(7)
Previous time of battery discharge	(6) / (7)	**4,15**	**Hours (4h09')**	(8)

5 Multiple modes of operation

5.1 Operating mode that draws the maximum battery energy.

Theoretical consumption calculation :

TEST CONSUMPTION

	I instant (mA)	Ton (s)	
406 test burst	1670	0,52	0,241 mA
121,5 test burst	34	0,1	0,001 mA
logic, led and oscillator consumption	2	21	0,012 mA
Flash (7 during self-test)	421	0,7	0,082 mA
GPS (ON during self-test)	18	21	0,105 mA
		total for 1 test	0,441 mA
		total for 7 years with 1 test per month	37,018 mAh
		with correction coefficient of 1,65	**61,080 mAh**

AVERAGE CONSUMPTION PRIOR TO ACTIVATION BEACON

	I instant (mA)	Ton (s)	
Consumption	0,0001	3600	0,0001 mA
		Total for 7 years	6,132 mAh
		with correction coefficient of 1,65	**10,118 mAh**

NORMAL CONSUMPTION (at +20°C)

	I instant (mA)	Ton (s)	Toff		
406 test burst	1670	0,52	50	17,361	mA
Logic, led and oscillator	2	1	0	2,000	mA
121,5 MHz	34	48	2	32,640	mA
GPS receiver	18	11100	161700	1,156	mA
Flash	421	0,1	2,5	16,138	mA
			Total	69,296	mA
		after 48h 406 MHz + 48h 121,5 MHz		**3326,191**	**mAh**

NORMAL CONSUMPTION (at -20°C)

	I instant (mA)	Ton (s)	Toff		
406 test burst	1670	0,52	50	17,361	mA
Logic, led and oscillator	3	1	0	3,000	mA
121,5 MHz	36	48	2	34,560	mA
GPS receiver	21	11100	161700	1,349	mA
Flash	307	0,1	2,5	11,768	mA
			Total	68,038	mA
		after 48h 406 MHz + 48h 121,5 MHz		**3265,841**	**mAh**

5.2 Operating modes that have pulse loads greater than above.

There is no mode that have pulse loads greater than the operating mode described above.

6 Beacon operating instructions and technical data sheet.

6.1 Beacon operating instructions.

All instructions are described on the beacon labels (see § 9) and in the beacon manual as described below.

1- To test the beacon, press on the TEST button.

2- To stop the beacon after an activation, press the TEST button.

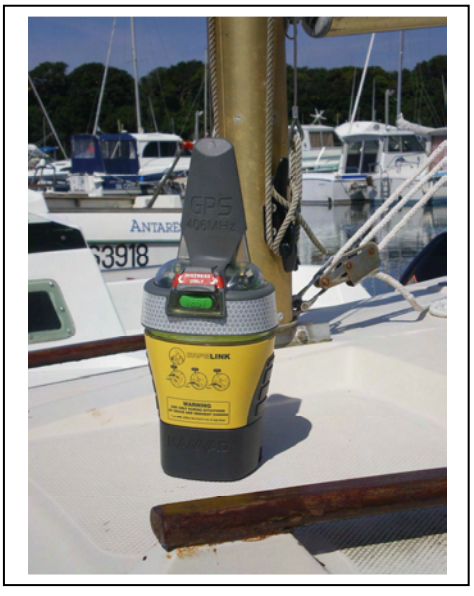
3- To activate the beacon :

A- Manual activation :

- Break the seal :

- Press ON :

- Place the beacon in horizontal position in clear area, with the antenna in the vertical position :



B- Automatic activation (with water switch sensor)

- Throw the beacon to the water :

6.2 Manual Instructions.

KANNAD DOC09028A

2. DESCRIPTION

SafeLink beacons are Emergency Positionning Radio Beacons (EPIRB) Float Free version category 1 or non Float Free version category 2. Both versions are fitted with a built-in GPS.

- An automatic container protects the SafeLink category 1 and enables the release of the EPIRB for automatic activation when submerged in water.
- The SafeLink category 2 is supplied with a mounting bracket design to install the beacon on board.

ENGLISH

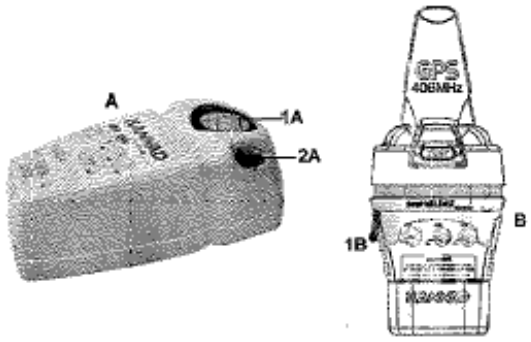
2.1. Container and mounting bracket description

The beacon is supplied either in an automatic container (A) for the Float Free version category 1, or with a wall mounting bracket for the Non Float Free version category.

The container (A) is designed to protect the beacon and to ensure its automatic release in the event of a ship wreck thanks to the HAMMAR H20 release system (1A). This container is also fitted witha locking pin (2A).

It is mounted either in horizontal position on the wheel house or deck of the vessel, or in vertical position against a bulkhead or any vertical and flat surface (*§ 6.2.1. Installation du conteneur*).

The wall mounting bracket (B) is designed to be mounted vertically against a bulkhead or any vertical flat surface. When installed in its mounting bracket, a magnet avoids beacon activation (water, moisture).



2.2. Beacon description

(1) Tamper proof seal
- to prove the beacon has been intentionally activated.

(2) Locking system
- to avoid unintentional activation of the beacon.

(3) TEST pushbutton:
- to perform a self-test;
- to stop the beacon transmission if required by authorities.

(4) ON button:
- to activate manually beacon.

(5) Strobe lights:
- to improve or help visual localization of the beacon by the SAR operations.

(6) Beacon control lamp:
- to check good operation when activating the beacon;
- to check good operation when performing a self-test;

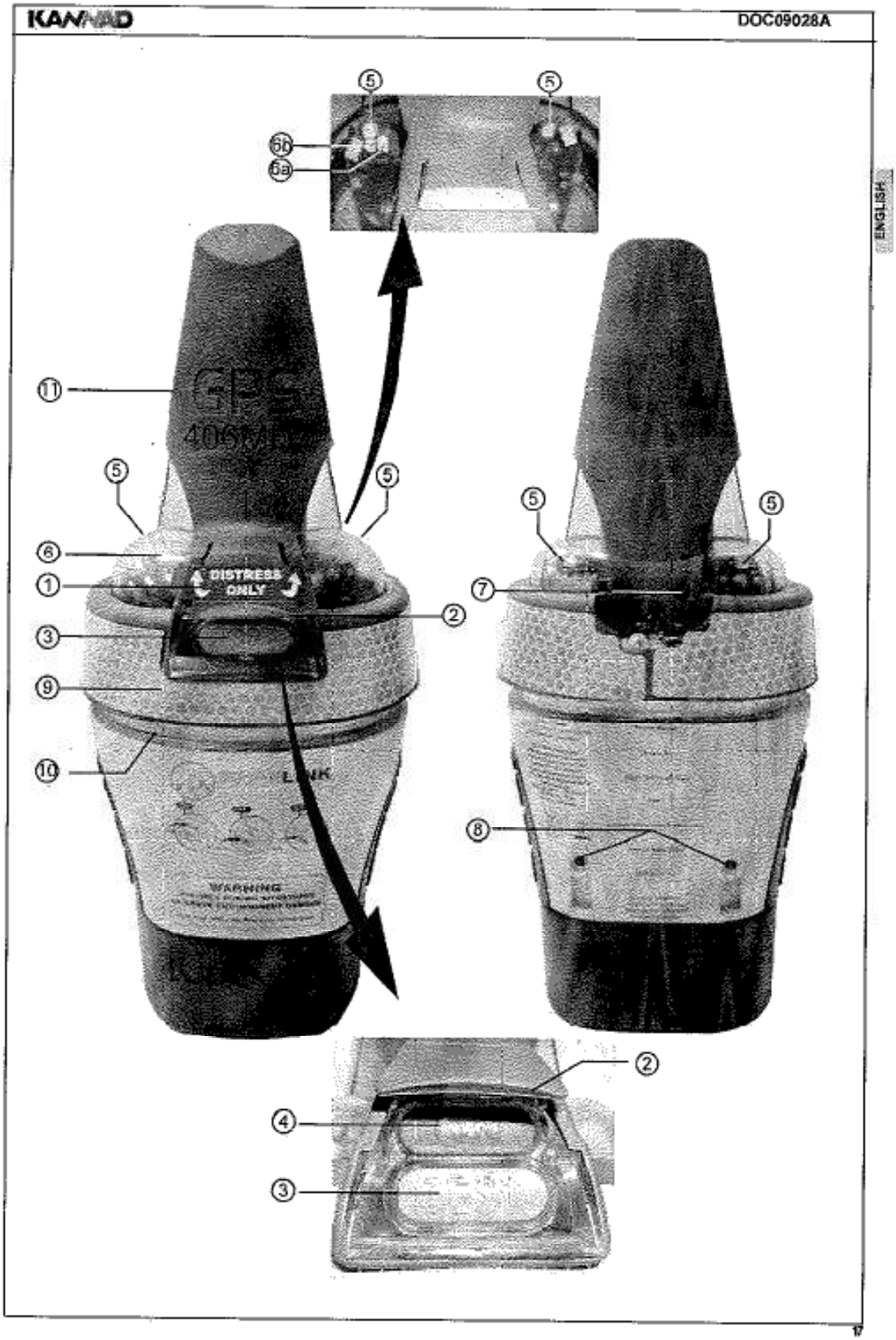
(7) Programming led
- to program the beacon (by manufacturer or authorized programming stations).

(8) Water switch contact:
- to activate automatically the beacon when submerged in water.

(9) Retroreflective tape.

(10) Tether line:
- to secure beacon to a liferaft, life jacket, boat, etc.
  Important: The tether line is use to tie the EPIRB to the liferaft when floating in the water. The tether line must not be used to tie the EPIRb to the ship.

(11) 406 / 121.5 MHz antenna.



ENGLISH

3. TEST INSTRUCTIONS

Test of 406 / 121.5 MHz frequencies

(1) Press TEST / READY push button (3) for 2 seconds.

(2) Strobe lightd (5) and programming led (7) blink during the test, the buzzer transmits an audible signal.

(3) At the end of the test, the result is displayed by green (6a) or red (6b) leds:

- Green led (6a), 1 flash indicates the system is operational;
- Red led (6b), 1 flash indicates the test has failed.

Repeat 3 times to confirm failure before contacting agent.

4. INSTRUCTIONS FOR USE

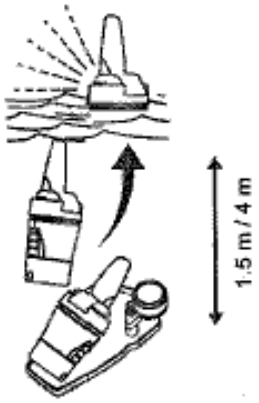
WARNING: It is unlawful to transmit a distress signal unless an emergency exists.
Do not operate inside liferaft or under any similar cover of canopy.

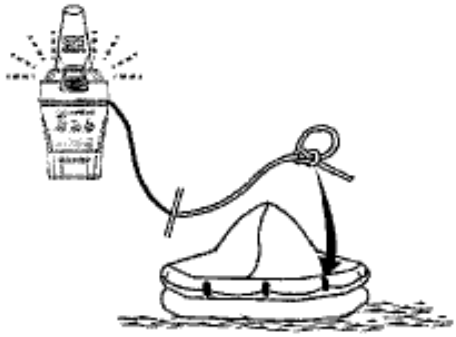
4.1. Automatic activation

IMPORTANT: Only for SafeLink Float Free version, category 1.

If the vessel sinks, the release system ejects the cover to enable the beacon to rise to the surface. The beacon is automatically activated when submerged in water and out of its container.

The beacon should be recovered and tied to a liferaft to locate the survivors and not the wreck location.





4.2. Manual activation

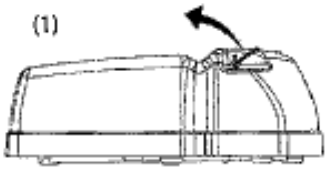
<u>SafeLink category 1 (Float Free)</u>

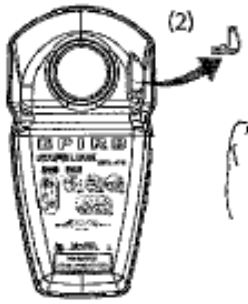
Remove the beacon from its container:

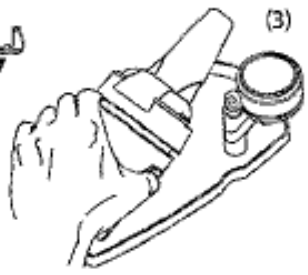
(1) Lift up the red locking pin of container;

(2) Remove the locking pin;

(3) Remove the cover of the container and extract the beacon.



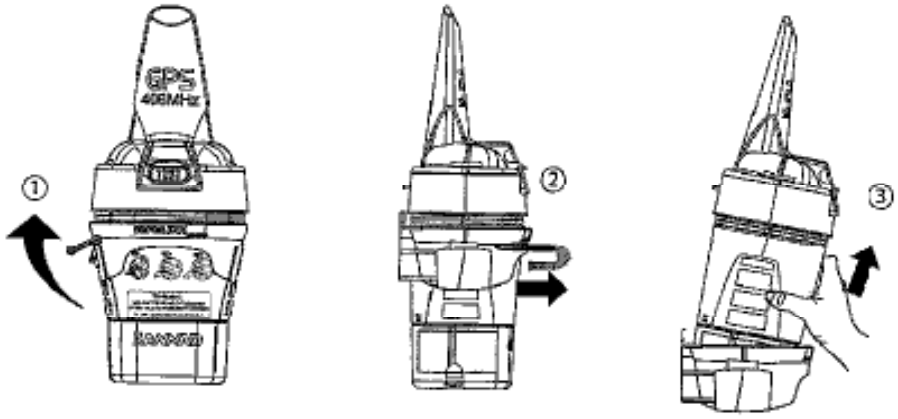




Safel ink category 2 (Non Float Free)

Remove the beacon from its mounting bracket:

(1) Lift up the red locking pin;
(2) Pull and remove the red locking pin to unlock the bracket;
(3) Extract the beacon from the mounting bracket.



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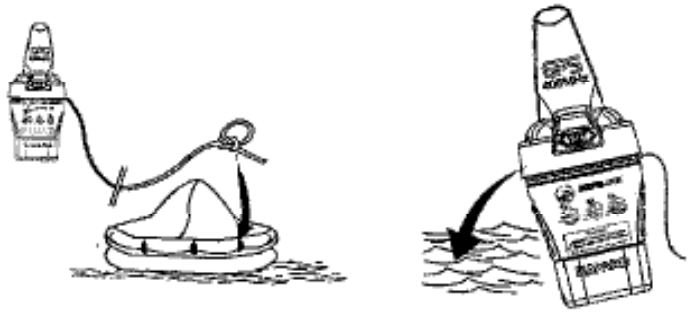
4.2.1. Activation by water switch sensor

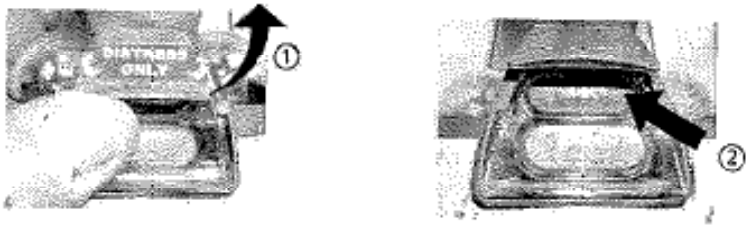
Tie the beacon with lanyard before throwing overboard.



The beacon will start to transmit as soon as submerged (water switch sensor activation).

TO STOP BEACON: remove the beacon from water.

4.2.2 Manual Activation by pushbutton



(1) Break the seal by pushing the locking system up.
(2) Press ON pushbutton.
(3) The buzzer transmits an audible signal every second.
(4) The beacon performs a self-test.
(5) After the self-test, only the white strobe lights blink 3 seconds. The buzzer continues to transmit every second.
(6) Tie the beacon with the lanyard to the boat or a liferaft and throw it overboard.
Important: If beacon is activated by the ON pushbutton, it must operate in water for optimal condition.

TO STOP BEACON: press TEST pushbutton.

6.3 Technical data sheet.

Operating temperature range		: -20℃ to +55℃.	
Storage temperature		: -30℃ to +70℃.	
Lithium manganese batteries		: High energy LiMnO2.	
➢ Battery life		: 7 years from date of manufacturing.	
Operating life		: 48 heures mini. at -20℃.	
Watertight at 1 bar.			
Dimensions	Beacon + bracket	: 250 x 111 x 91 mm	
	Container	: 287.6 x 147.5 x 96.7 mm	
Weight	Beacon	Beacon with bracket	Beacon with container
	627 g.	679 g.	1280 g.

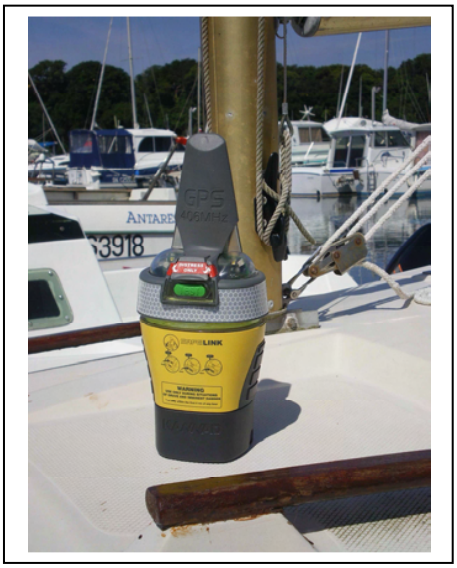
406 MHz SATELLITE TRANSMISSION

Frequency	: 406.037 MHz ± 0.001 MHz
UHF output power	: 5W nominal (37dBm ± 2 dB)
Phase modulation	: 16K0G1D, Biphase L ± 1.1 ± 0.1 radians
Repetition period	: 50 sec. ± 5%
Transmission time	: 520 msec. ± 1%

121.5 MHz HOMING TRANSMITTER

Frequency	: 121.5 MHz ± 0.006 MHz
Power	: 50 mW (17dBm ± 3 dB)
Modulation	: AM audio sweep
Modulation format	: 3K20A3X
Transmission	: Continuous (except during 2sec with 406 transmission)
STROBE LIGHTS	: Super LEDs - 0.75 Candela - 23 flashes / mn
GPS	: FASTRAX UC322

7 Photographs of the beacon.



8 Battery.

8.1 Battery features.

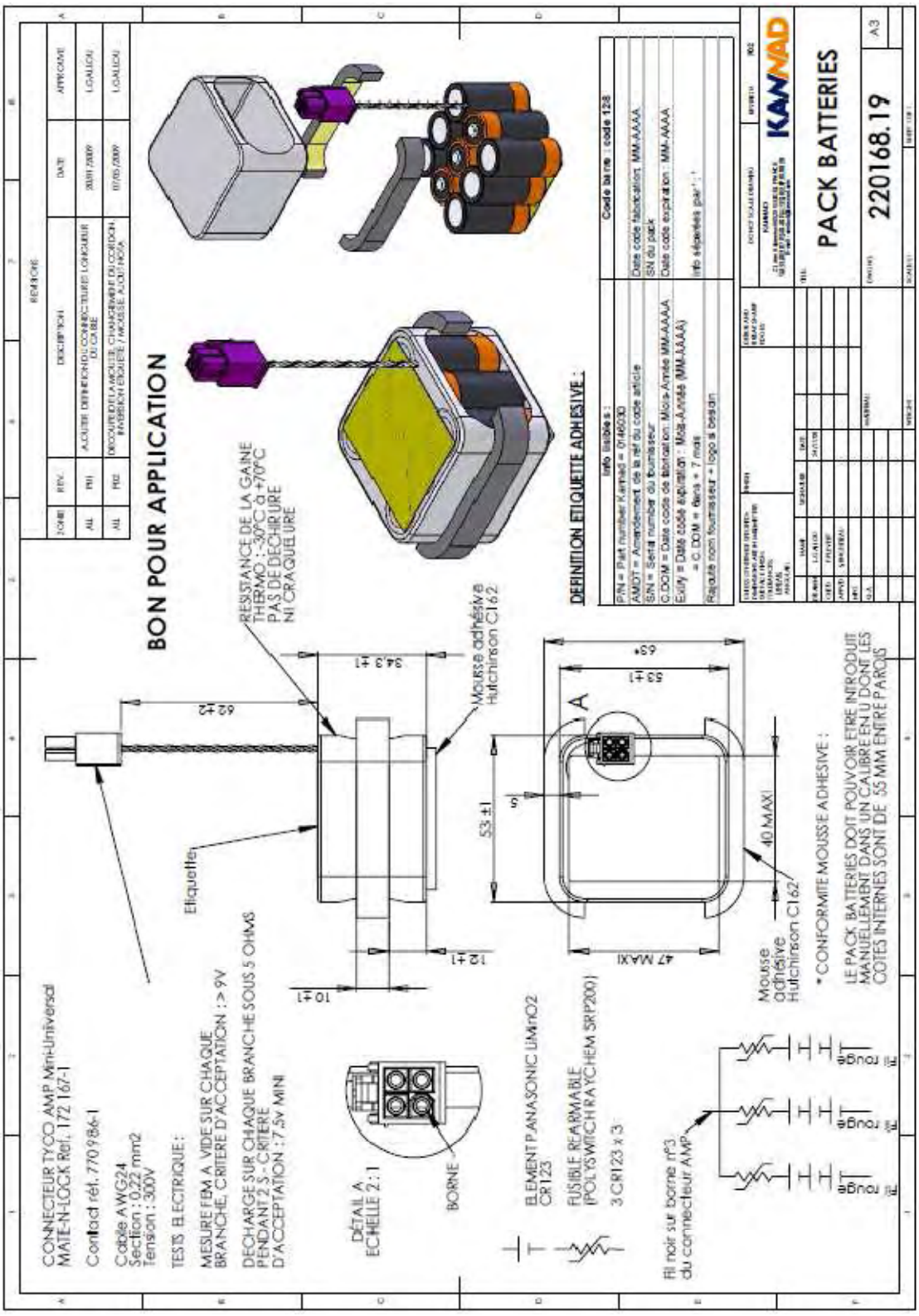
The battery is made of 3 packs connected in parallel, each of them made of 3 cells CR123 size connected in series. In order to prevent destruction if a short-circuit occurs, a re-triggerable switch (SRP200) is integrated in the battery pack.

8.2 Cell characteristics.

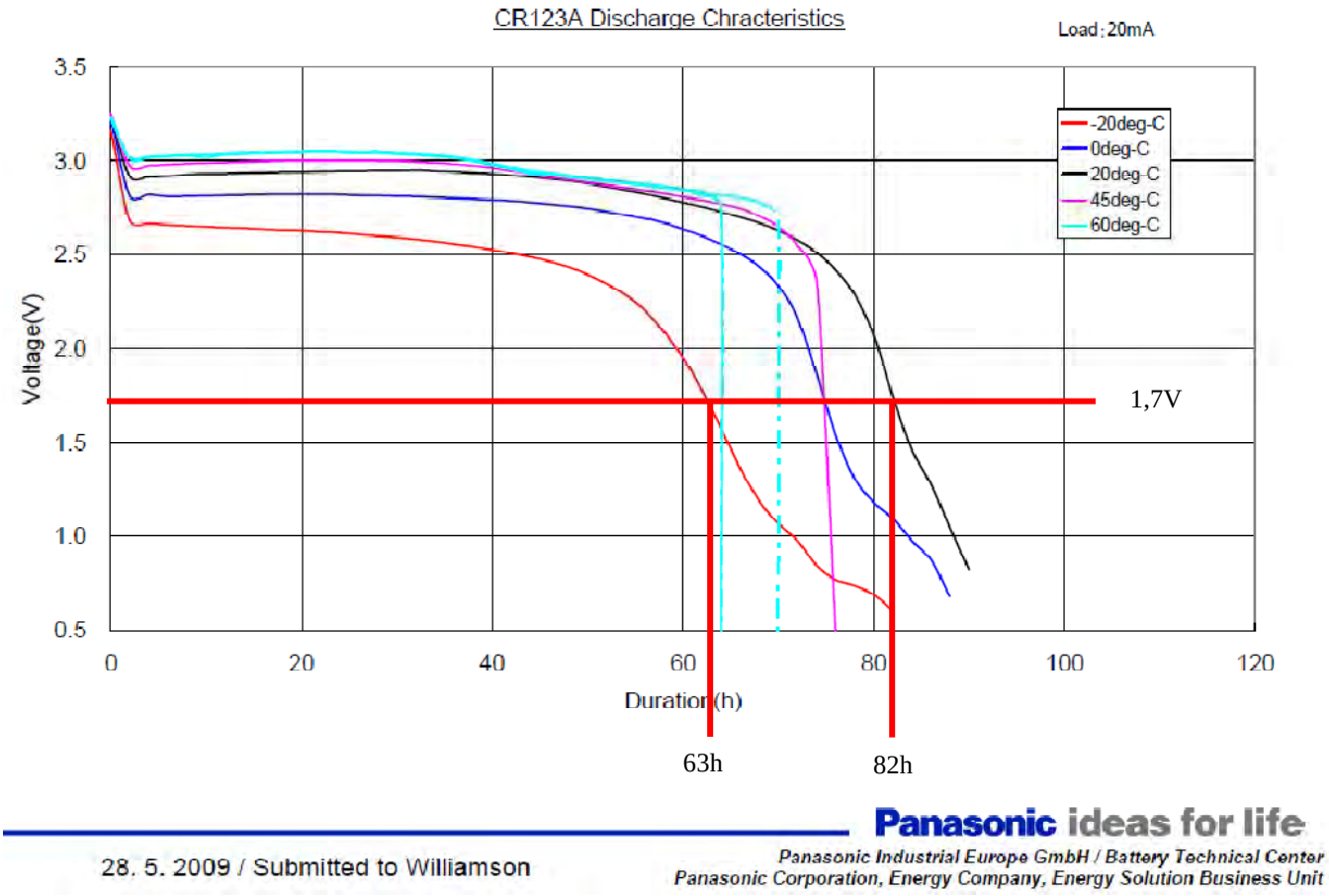
Lithium Type CR123 – 3 volts :

Characteristics	
Nominal voltage	3 V
Weight	17g
Operating temperature	-40°C to +60°C

8.3 Battery pack.



8.4 Estimated capacity at 20℃ and at -20℃.



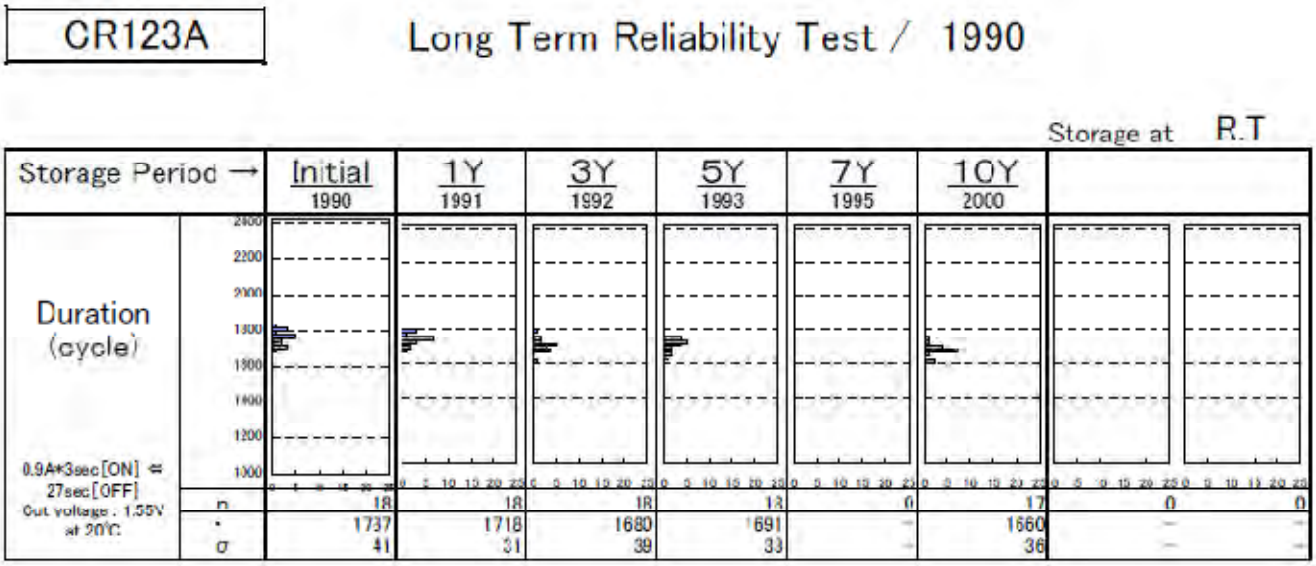
The stop voltage of the beacon to be sure to obtain the C/S characteristics is 5V DC.
The battery pack is composed with 3 serial cells so the stop voltage for each cell is 1,66V DC.
The average continuous discharge current for the all battery pack is less than 40mA (121.5 MHz power + logic power).
The battery pack is composed with 3 parallel batteries so, the average continuous discharge current for each element is less than 14mA (we used the discharge characteristics curve at 20mA)

As shown on the figure above :

- At -20°C, the duration for a 20mA load, the duration is 63h. The capacity is : 63hx20mA=1260mAh
- At 20°C, the duration for a 20mA load, the duration is 82h. The capacity is : 82hx20mA=1640mAh
- So, the derating at -20°C is : 23%

8.5 Self-discharge at ambient temperature.

Find hereafter a chart from PANASONIC :



The derating at 20°C after 5 years is 2,6% : (1737-1691) /1737
The derating at 20°C after 10 yeras is 4,4% : (1737-1660) /1737

For the theoretical calculation after 7 years, we used 4,4% for the derating (derating equivalent after 10 years).

8.6 Batteries time on shelf prior to integration into beacons.

The manufacturer guarantees less than 2 years for the battery time on shelf prior to integration.

The margin calculated is 235 mAh and the self-discharge is less than 1% per year (4920 * 1% = 49 mA per year)
So, the margin is equivalent to 4,8 years which is comfortable

8.7 Battery discharge calculation.

TEST CONSUMPTION

	I instant (mA)	Ton (s)		
406 test burst	1670	0,52	0,241	mA
121,5 test burst	34	0,1	0,001	mA
logic, led and oscillator consumption	2	21	0,012	mA
Flash (7 during self-test)	421	0,7	0,082	mA
GPS (ON during self-test)	18	21	0,105	mA
		total for 1 test	0,441	mA
		total for 7 years with 1 test per month	37,018	mAh
		with correction coefficient of 1,65	**61,080**	**mAh**

AVERAGE CONSUMPTION PRIOR TO ACTIVATION BEACON

	I instant (mA)	Ton (s)		
Consumption	0,0001	3600	0,0001	mA
		Total for 7 years	6,132	mAh
		with correction coefficient of 1,65	**10,118**	**mAh**

NORMAL CONSUMPTION (at +20°C)

	I instant (mA)	Ton (s)	Toff		
406 test burst	1670	0,52	50	17,361	mA
Logic, led and oscillator	2	1	0	2,000	mA
121,5 MHz	34	48	2	32,640	mA
GPS receiver	18	11100	161700	1,156	mA
Flash	421	0,1	2,5	16,138	mA
			Total	69,296	mA
		after 48h 406 MHz + 48h 121,5 MHz		**3326,191**	**mAh**

NORMAL CONSUMPTION (at -20°C)

	I instant (mA)	Ton (s)	Toff		
406 test burst	1670	0,52	50	17,361	mA
Logic, led and oscillator	3	1	0	3,000	mA
121,5 MHz	36	48	2	34,560	mA
GPS receiver	21	11100	161700	1,349	mA
Flash	307	0,1	2,5	11,768	mA
			Total	68,038	mA
		after 48h 406 MHz + 48h 121,5 MHz		**3265,841**	**mAh**

ENERGY MARGIN

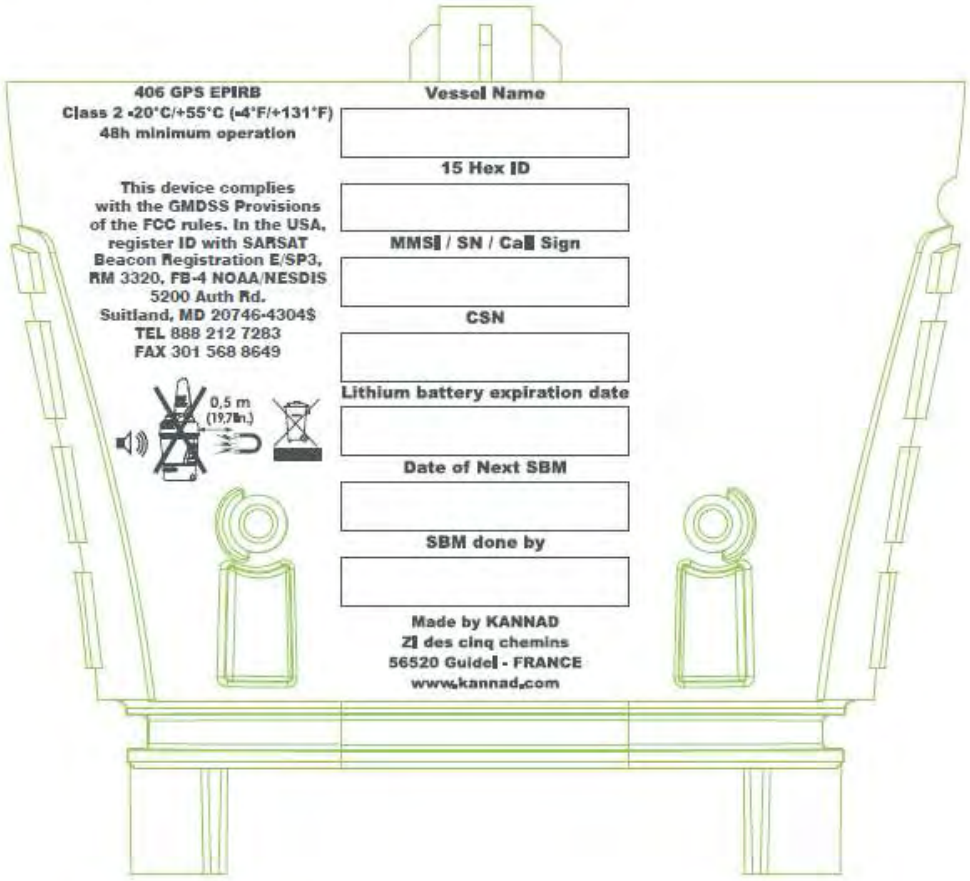
	Derating		
Fresh battery capacity at +20°C	100%	4920	mAh
Derating for battery capacity at -20°C	23	1131,6	mAh
7 years weekly test		61,080	mAh
self discharge after 7 years at +20°C	4,4	216,48	mAh
Requested energy for 7 years constant operation prior to activation		10,118	mAh
Requested energy for total operations		3265,841	mAh

Margin	**234,881**	**mAh**
Or	4,8	%

PREVIOUS TIME OF BATTERY DISCHARGE

Battery capacity loss after 7 years at +20°C	287,678	mAh
Previous time of battery discharge	**4,15**	**heures**

9 Beacon labels.



10 Reference oscillator.

10.1 Oscillator datasheet.

RAKON TCXO, device E4217LF / Batch L28081, presents the general specifications on the pages below.

CFPT-9000 Series

ISSUE 10 ; 3 FEBRUARY 2006

Recommended for New Designs

Delivery Options

- Please contact our sales office for current leadtimes

Description

- A series of surface mountable 7.0 × 5.0mm temperature compensated voltage controlled crystal oscillators (TCVCXOs) for medium to high volume applications where small size and high performance are pre-requisites. This oscillator uses C-MAC's latest custom ASIC "Pluto", a single chip oscillator and analogue compensation circuit, capable of sub 1 ppm performance over an extended temperature range. Its ability to function down to a supply voltage of 2.4V and low power consumption make it particularly suitable for mobile applications

RoHS compliance

- Parts with the suffix 'LF' on the ordering code and part number are fully compliant with the European Union directive 2002/95/EC on the restriction of the use of certain hazardous substances in electrical and electronic equipment. Note: The RoHS compliant parts are suitable for assembly using both Lead-free solders (see Lead-free Reflow soldering profile) and Tin / Lead solders (see Tin / Lead Reflow soldering profile).

Standard Frequencies

- 3.2, 5.0, 6.4, 8.192, 9.6, 12.688375, 10.0, 12.8, 13.0, 14.4, 14.85, 16.384, 16.367, 16.8, 19.2, 19.44, 19.8, 20.0, 24.5535, 32.768, 38.88, 40.0MHz

Output Waveform

- Square HCMOS 15pF load
- Square ACMOS 50pF max. load (available on request, contact sales office)
- Sinewave 10kΩ // 10pF, AC-coupled
- Clipped sinewave 10kΩ // 10pF, AC-coupled

Supply Voltage

- Operating range 2.4 to 6.0V, see table

Current Consumption

- HCMOS Typically ≈ 1+Frequency(MHz)*Supply(V)*{Load(pF)+15}*10^{-3} mA e. g. 20MHz, 5V, 15pF ≈ 4mA
- Sinewave, ≤ 8mA
- Clipped Sinewave Typically ≈ 1+Frequency(MHz)*1.2*{Load(pF)+30}*10^{-3}mA

Package Outline

- 7.0 x 5.0 x 2.0mm SMD Ceramic Carrier

Ageing

- ±1ppm maximum in first year, frequency ≤ 20MHz
- ±2ppm maximum in first year, frequency > 20MHz
- ±3ppm maximum for 10 years (including the first year), frequency ≤ 20MHz
- ±5ppm maximum for 10 years (includng the first year), frequency > 20MHz
- ±1ppm maximum after reflow

Frequency Stability

- Temperature: see table
- Typical Supply Voltage Variation ±10% ≤ ±0.2 ppm*
- Typical Load Coefficient 15pF ±5pF ≤ ±0.2 ppm*

*Dependent on frequency and output type

Frequency Adjustment

- Three options with external Voltage Control applied to pad 10:

  A - Ageing adjustment: ≥ ±5ppm, frequency ≤ 20MHz (Standard Option)
  ≥ ±7ppm, frequency > 20MHz

  B - No frequency adjustment initial calibration @ 25°C ≤ ±1.0 ppm

  C - High Pulling ±10ppm to ±50ppm can be available depending on frequency and stability options. Please consult our sales office

- Linearity ≤ 1%
- Slope Positive
- Input resistance > 100kΩ
- Modulation bandwidth > 2kHz
- Standard voltage control ranges:

  Without reference voltage - Vs=5.0V 2.5V±1V
  Without reference voltage - Vs=3.3V 1.65V±1V
  With reference voltage - Vc=0V to Vref

Reference Voltage, Vref

- Optional reference voltage output on pad 1, suitable for potentiometer supply or DAC reference.

  1. No output (standard option)
  2. 2.2V, for Min. Vs>2.4V
  3. 2.7V, for Min. Vs>3.0V
  4. 4.2V, for Min. Vs>4.5V

  Maximum load current (mA) = Vref/10

For manual frequency adjustment connect an external 50kΩ potentiometer between pad 1 (Reference Voltage) and pad 4 (GND) with wiper connected to pad 10 (Voltage Control). Please specify reference voltage as part of the ordering code

Tri-state

- Pad 8 open circuit or >0.6Vs output enabled
- < 0.2Vs Tri-state
- When Tri-stated, the output stage is disabled for all output options, but the oscillator and compensation circuit are still active (current consumption <1mA)

Storage Temperature Range

- –55 to 125°C

Environmental Specification

- Vibration: IEC 60068-2-6 Test Fc Procedure B4, 10-60Hz 1.5mm displacement, 60 –2000Hz at 10gn, 30 minutes in each of three mutually perpendicular axes at 1 octave per minute
- Shock: IEC 60068-2-27 Test Ea, 1500gn acceleration for 0.5ms duration, half sine pulse, 3 shocks in each direction along three mutually perpendicular axes
- Soldering: SMD product suitable for Convection Reflow soldering. See recommended reflow profiles
- Solderabiltiy: MIL-STD-202, Method 208, Category 3
- Marking: Laser Marked

Marking Includes

- C-MAC
- Manufacturing identifier (xx)
- Pad 1 / Static sensitivity identifier (Triangle)
- Part Number (Four digits)
- Device date code (YW)

C-MAC xx
Δ 0000 YW

Minimum Order Information Required

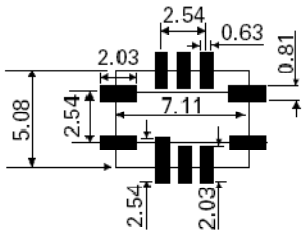
- Frequency + Model Number + Frequency Stability Vs Operating Temperature Range Code + Reference Voltage Code + Frequency Adjustment Code + RoHS compliance code 'LF'

OR

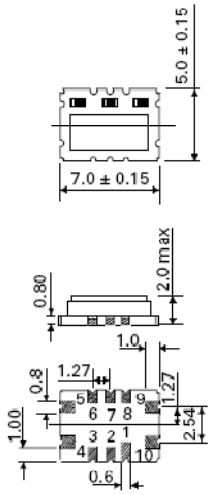
- Discrete part number for repeat orders (Discrete part numbers suitable for Lead-free soldering include the RoHS compinace code 'LF' as a suffix, e.g. E2747LF)

Please supply full information for non-standard options, if required.

Solder pad layout



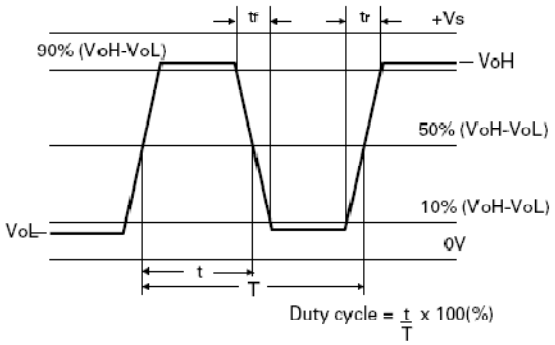
Outline in mm



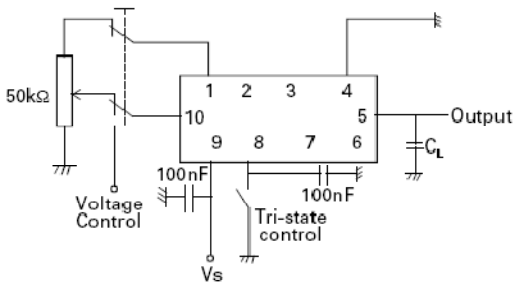
Pad Connections
1. V ref
2. N/C
3. DC Coupled Output (do not connect)
4. GND
5. Output
6. N/C
7. N/C
8. Tri-state Control (Enable)*
9. +Vs
10. Voltage Control*

*leave unconnected if not required.

Output Waveform - HCMOS

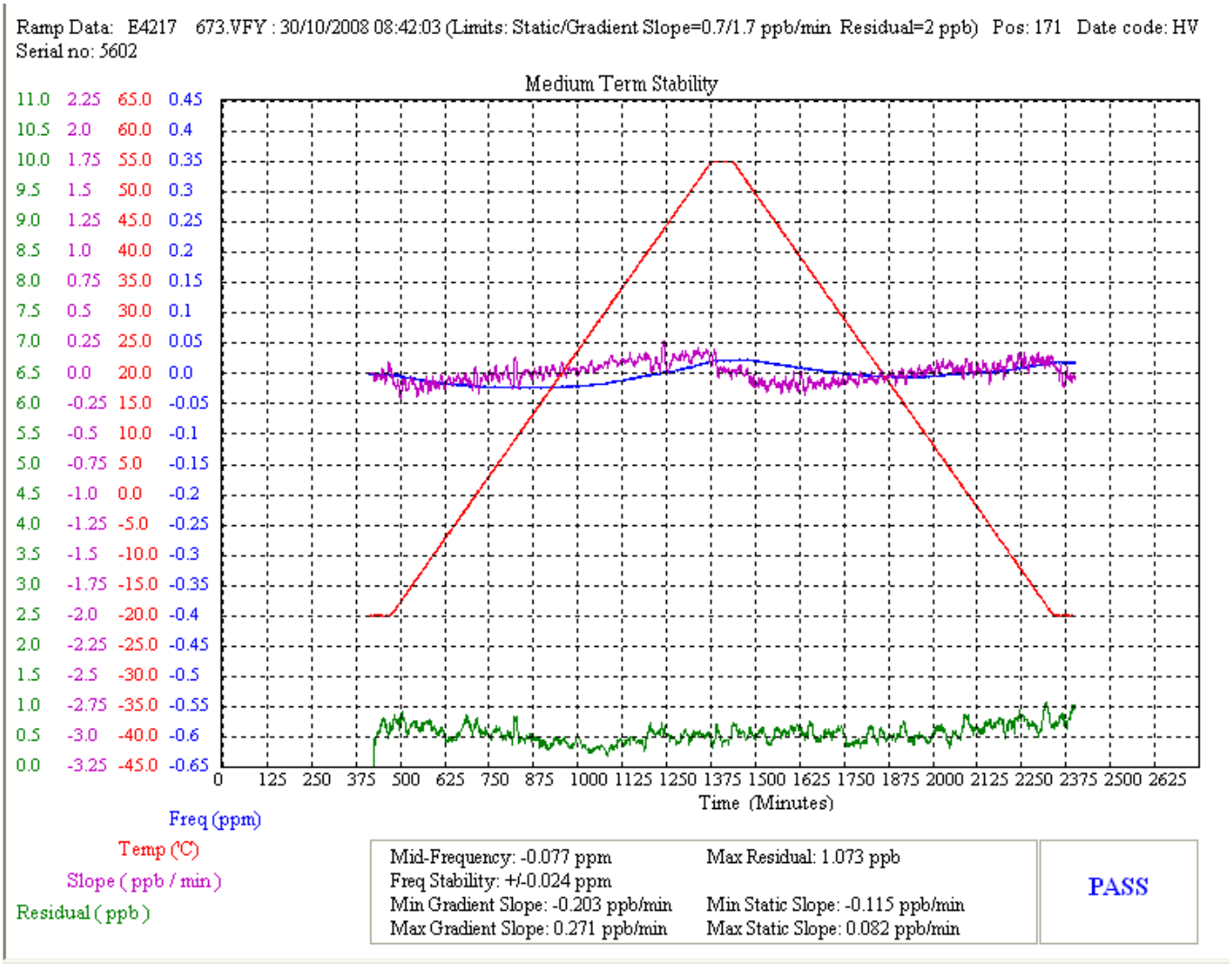


Test Circuit



SURFACE MOUNT TCXOs

10.2 Oscillator medium term frequency stability.



10.3 Oscillator long term frequency stability.

C-MAC
Frequency Products

C-MAC Quartz Crystals Ltd.

Sadler Road, Lincoln
LN6 3RS, United Kingdom

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

PRODUCT EVALUATION REPORT

REPORT No.: **2006-016A**

Date: 17th July 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

Parts Tested: Batch 1 - p/no. E3357 (12.551630 MHz)
Batch 2 - p/no. E3233 (12.688375 MHz)

Applicable to:

This report is applicable to the following part numbers all of which are identical to the parts tested with respect to materials used, including the same crystal, construction, manufacture and test. And are to the same or a looser internal specification.

12.551630 MHz - E3356 & E3357
12.688375 MHz - E3233, E3261, E3279, E3499 & E4495

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 100ns 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 frecuency 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 a 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

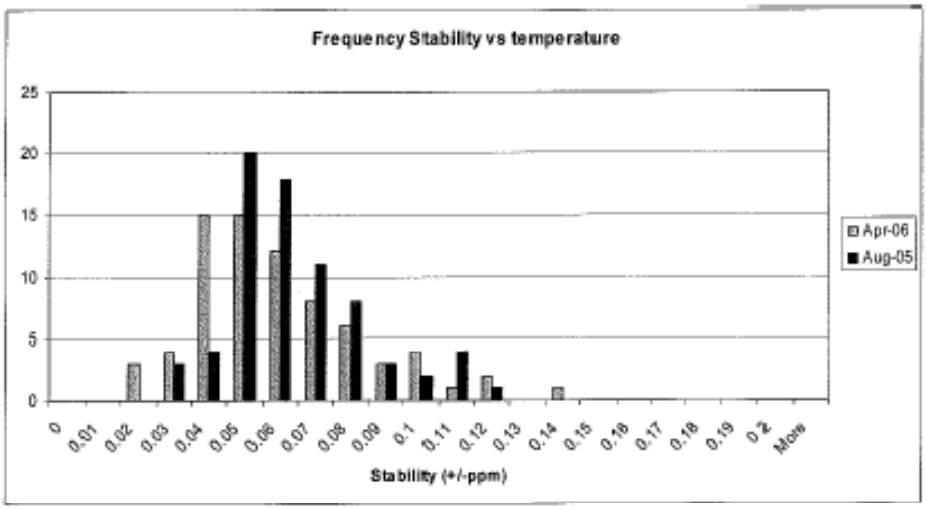


Figure 1 Frequency Stability vs. Temperature

2006 in blue
The average change for frequency stability vs. temperature over the batch is -0.0007 ppm, effectively zero or a extremely small improvement.
The average change for nominal frequency over the batch is -0.10 ppm, considerably inside the aging requirements for nominal frequency.

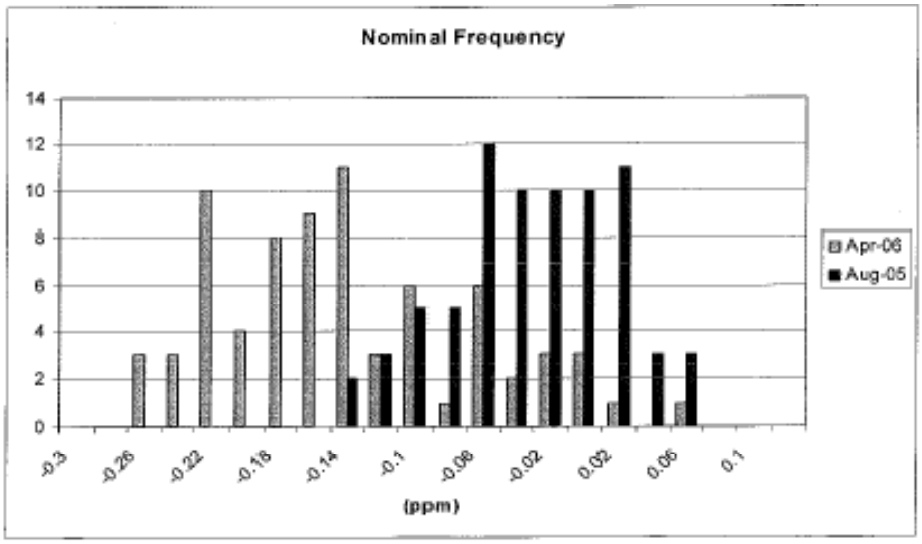


Figure 2 Nominal frequency

The average change over the batch for maximum negative slope for

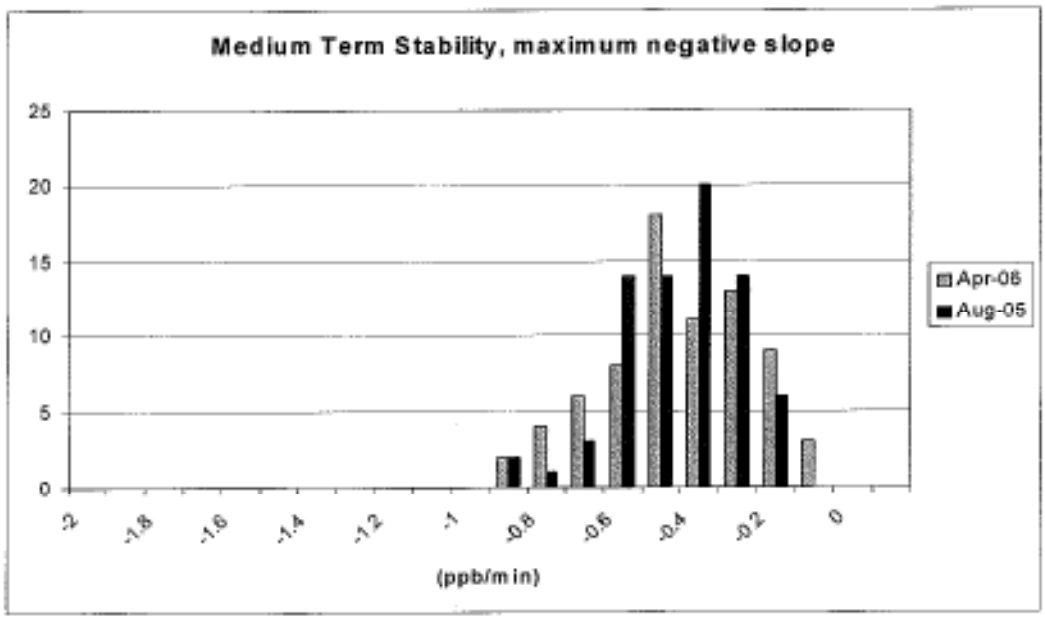


Figure 3 Medium term stability, Slope

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.

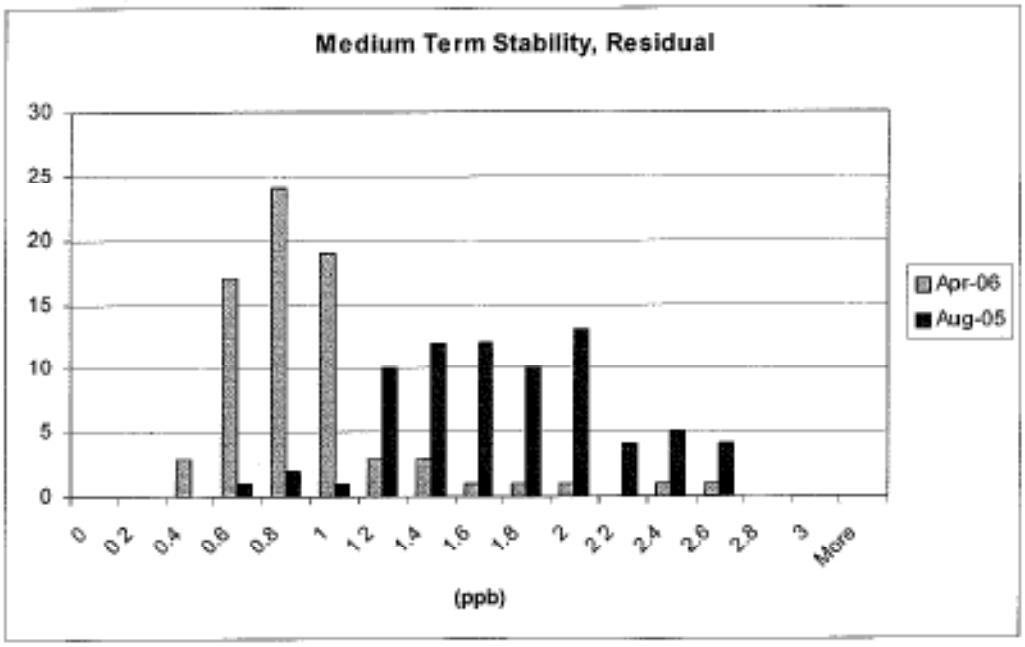
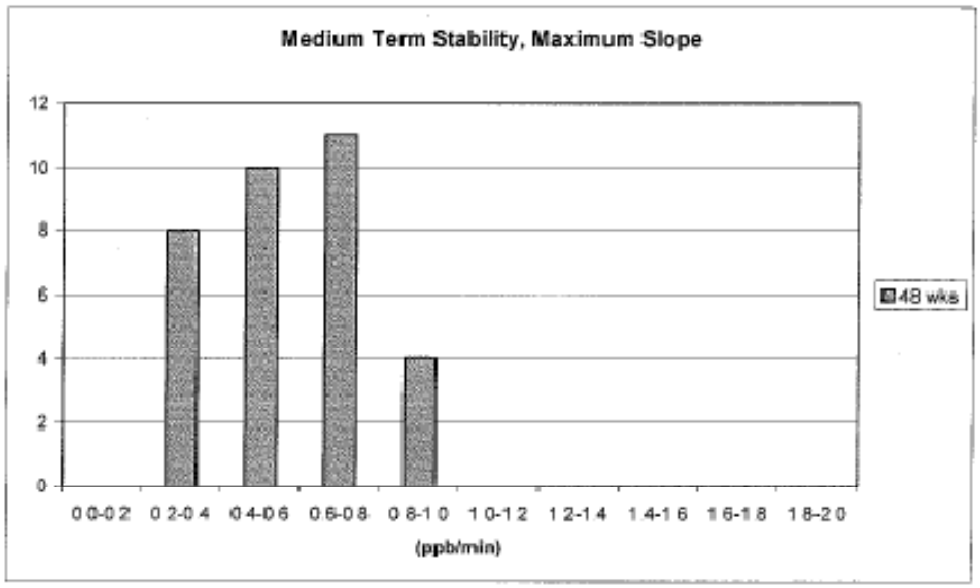
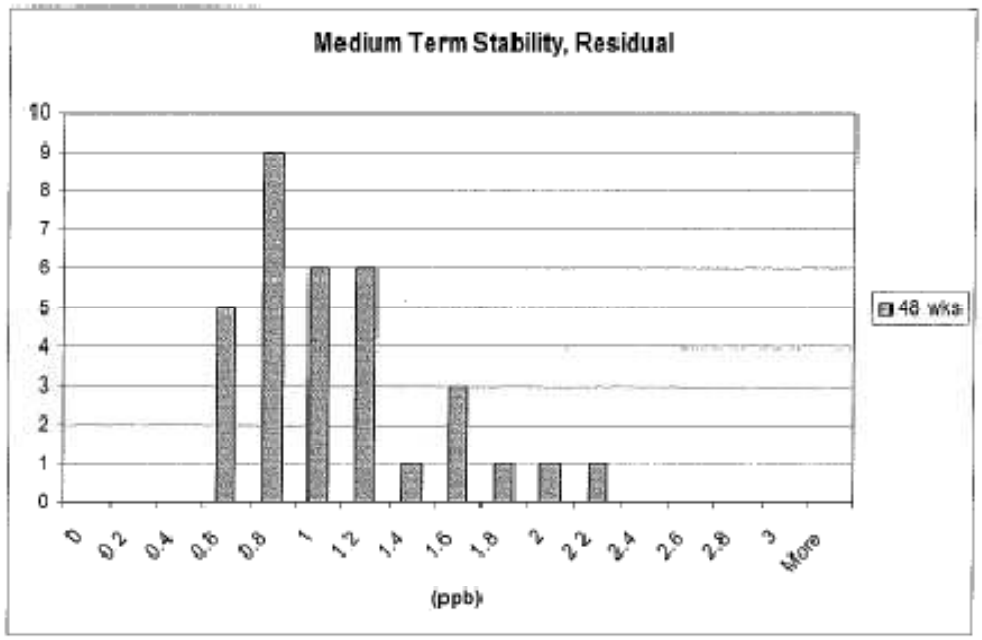


Figure 4 Medium term stability, Residual

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.

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

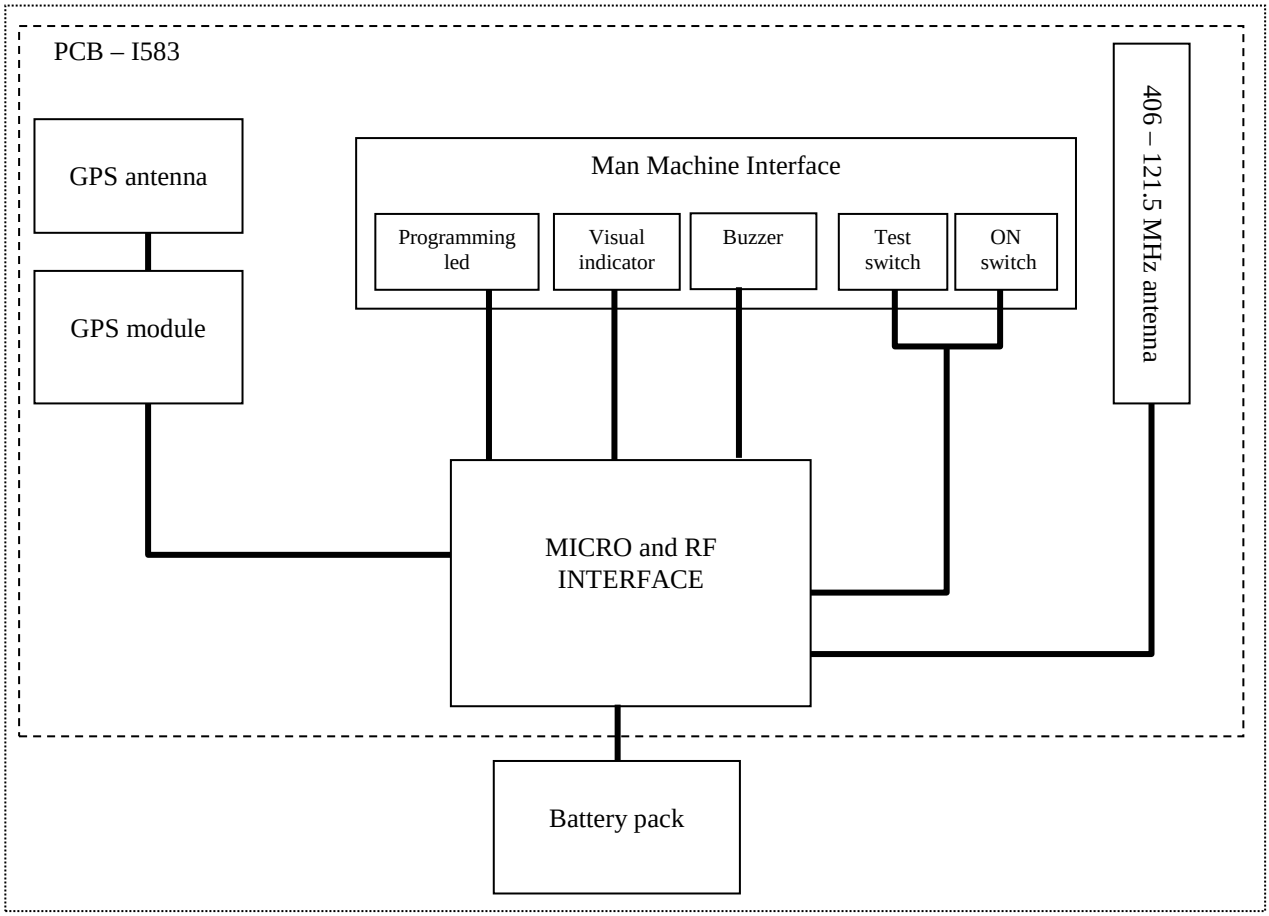
16 May 2006

This information, issued in July 2006, do not precise the 16.384MHz frequency. Nevertheless RAKON explains that this information is applicable to the 16.384 MHz E4217LF (see information below).

> Please find attached a report containing data that demonstrates the long
> term stability of Rakon UK beacon oscillators. Please note that since
> this report was issued in July 2006 the company has changed its name from
> C-MAC Quartz Crystals Limited (identified in the report) to Rakon UK
> Limited. Also the number of variants of this oscillator being offered
has
> increased. Although not identified in the report, I can confirm that the
> report is applicable to the 16.384 MHz E4217LF. If you have any queries
> concerning the report we will be pleased to assist.
>
> Regards
>
> David R Woodall
> Rakon UK Limited

11 Design description.

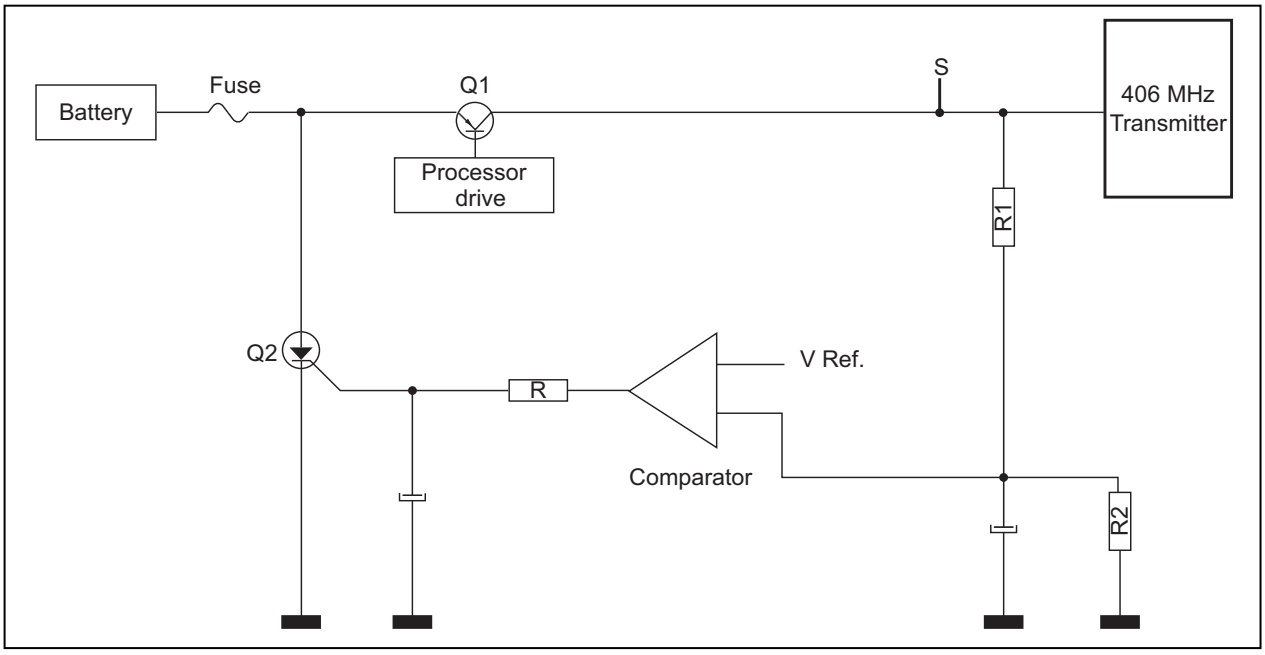
11.1 Technical diagram.



11.2 Protection against continuous transmission.

The 406 MHz transmission duration is 440 ms every 50 seconds. Should the transmission be unusually too long, a protective circuit stops the beacon: the power supply fuse is blown after 10 or 17 seconds (depending of battery voltage) of uninterrupted transmission without involving the microprocessor.
The theoretical arithmetic gives 10 seconds (1/RC=10sec) and we performed some practical tests that show that the fuse blew at less than 17 seconds.

Protective device against permanent transmission :



11.3 Frequency stability requirements over 5 years.

See reference oscillator (§ 10.3).

11.4 Protection against repetitive self-test mode transmissions.

Self test sequence is activated by pushing a specific button. A new self test cannot be initiated before the end of the whole sequence.
The microprocessor takes into consideration a pushing of the test button only on a falling edge and not on a low level.
Therefore, if the test button is held unintentionally in press position, there is no new self test.

11.5 Transmission repetition period.

The repetition period is controlled by the microprocessor thanks to the « rand() » function. This function is called each time to calculate the period of the next burst.
This function returns a pseudo-random number in the range from 0 to 32767. This is generated by an algorithm that returns a series of non-related numbers each time it is called. This algorithm is initialised to different starting points (by using « srand() function) to generate more realistic random numbers. Each starting point is calculated using the serial number of the beacon. Therefore, the algorithm starting point of any 2 beacons, and all the more the Tr sequence, are different.
This pseudo-random number (PRNb) is used to calculate a period between 0 and 5 seconds which is added to a fixed period of 47.5 seconds. The result, a pseudo-random number in the range from 47.5 to 52.5 seconds, is used for the repetition period.

The formula used to calculate the repetition period is :

$$Tr = 47.5\text{sec} + (PRNb\%66) * \frac{5\text{sec}}{66}$$

(PRNb%66) is a pseudo-random number between 0 and 66.

So, the probability to obtain a specific Tr for 1 beacon is : $P = \frac{1}{66}$

Or, when 2 events are independent (which is the case for two beacons), the probability of the intersection is :

$$P(A \cap B) = P(A) \bullet P(B)$$

For our application, the probability to obtain a specific Tr for 1 beacon is : $P(Beacon1) = \frac{1}{66}$

So, the probability of any two beacons having an identical Tr is :

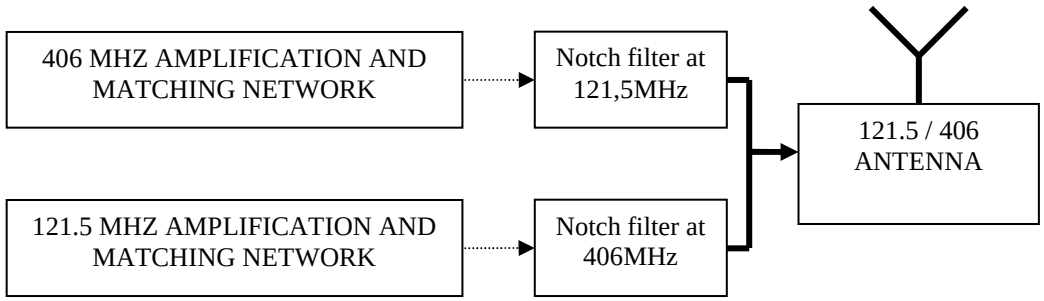
$$P(Beacon1 \cap Beacon2) = P(Beacon1) \bullet P(Beacon2)$$

$$P(Beacon1 \cap Beacon2) = \frac{1}{66} \bullet \frac{1}{66}$$

$$\boxed{P(Beacon1 \cap Beacon2) = \frac{1}{4356}}$$

12 Technical description and analysis of the matching network.

The synoptic of the beacon power amplification and matching is as follows :



13 Beacon quality assurance plan.

ANNEX L

BEACON QUALITY ASSURANCE PLAN

We, manufacturer of Cospas-Sarsat 406 MHz beacons (Manufacturer name and address)

KANNAD
ZI des Cinq Chemins
56520 GUIDEL – France

Confirm that ALL PRODUCTION UNITS of the following beacon model(s),

SAFELINK, P/N= 5106419
(Model, part number)

will meet the Cospas-Sarsat specification and technical requirements in a similar manner to the units subjected for type approval testing. To this effect all production units will be subjected to following tests at ambient temperature:

- Digital message
- Bit rate
- Rise and fall times of the modulation waveform
- Modulation Index (positive / negative)
- Output power
- Frequency stability (short, medium)*

Note* : Beacon manufacturer shall provide technical data on the beacon frequency generation to demonstrate that the frequency stability tests at ambient temperature are sufficient for ensuring that each production beacon will exhibit frequency stability performance similar to the beacon submitted for type approval over the complete operating temperature range. If such assurance of adequate performance over the complete operating temperature range cannot be deduced from the technical data provided and the frequency stability test results at ambient temperature, a thermal gradient test shall be performed on all production units.

- Other tests :
  - *121.5 MHz transmitter control (frequency / power / modulation / consumption)*
  - *Global spectrum control (406 MHz and 121.5 MHz)*

We confirm that the above tests will be performed as appropriate to ensure that the complete beacon satisfies Cospas-Sarsat requirements, as demonstrated by the test unit submitted for type approval.

We agree to keep the test result sheet of every production beacon for inspection by Cospas-Sarsat, if required, for a minimum of 10 years.

We confirm that Cospas-Sarsat representative(s) have the right to visit our premises to witness the production and testing process of the above-mentioned beacons. We understand that the cost related to the visit is to be borne by Cospas-Sarsat.

We also accept that, upon official notification of Cospas-Sarsat, we may be required to resubmit a unit of the above beacon model selected by Cospas-Sarsat for the testing of parameters chosen at Cospas-Sarsat discretion at a Cospas-Sarsat accepted test facility selected by the Cospas-Sarsat. We understand that the cost of the testing shall be borne by Cospas-Sarsat.

We understand that the Cospas-Sarsat Type Approval Certificate is subjected to revocation should the beacon type for which it was issued, or its modifications, cease to meet the Cospas-Sarsat specifications, or Cospas-Sarsat has determined that this quality assurance plan is not implemented in a satisfactory manner.

Dated : 29/05/2009 Signed : Stéphane JINCHELEAU, Technical Manager LP SAR marine
(Name, Position and signature of Beacon Manufacturer Representative)

KANNAD
SAS au capital de 2.000.000 €
ZI des Cinq Chemins - 56520 GUIDEL (France)
BP 23
Tél. : 02 97 02 49 49
Fax : 02 97 65 60 20
RCS Lorient 500 055 744
TVA FR 07 500 055 744
SIRET 500 055 744 00014 - APE 2790 Z

- END OF ANNEX L -

14 Nomenclatures and diagrams.