Technical report

Rev.Date (YYYY-MM-DD)	Rev.	File name
2019-11-07	Rev A	TRON 40VDR RTCM manufacture test results_revA.docx
Prepared by: Øystein Bjørgum		Approved by: Per Kolbjørn Soglo

RTCM 11000.4 Manufacturer documentation for Jotron Tron 40VDR

AIM:

This test report provides test results of the verification by manufacture Jotron for paragraphs in RTCM 11000.4.

Revision history:

Rev	Date	Change	By
A	07.Nov.2019	First rev	ØB
B			

Equipment:

- Tektronix TDS3014B, Oscilloscope
- Tektronix DPO3014, Oscilloscope
- Sense Resistor; 0.05 Ohm
- ATT DY250, Climate chamber
- Tinius Olsen 5ST, Tension machine

Conditions:

Operational temperatures:

- Minimum temperature: - 20°C
- Ambient temperature: + 20 to +23°C
- Maximum temperature: + 55°C

Contents

2.3.3 ERGONOMICS

RTCM 11000.4: 2.3.*3 "This section shall replace the Ergonomics requirements of IEC 61097-2 Ed3.0 Paragraph 3.3.8…"*

Comments:

TÜV SÜD have performed this test in October 2019, see TÜVSÜD report, doc nr: 75946712-01.

2.2.4.2 INTERNAL NAVIGATION DEVICE PERFORMANCE

RTCM 11000.4: 2.2.4.2 *"Self-check features shall prevent position data from being encoded into the beacon message unless minimum performance criteria are met. The manufacturer shall include details of how this is achieved in the provided test documentation…"*

Comments:

If Internal navigation devices fails or does not have the required precision, it will not give a Valid flag to the controller (uC). The controller will then use the default position into the message. If the controller receives a Valid flag from the GNSS module, it will then exchange the default position with the valid position into the message. The checksum of the message is then checked before the message is sent, if this fails the default message is sent. This is a software-controlled limitation and is not affected by temperature or other external conditions. Therefore, it is not possible for a message with not valid position or wrong checksum to be sent. See flowchart below.

Tron 40VDR are using the GNSS module; MAX-7Q from u-blox, which is graded as a Standard Precision GNSS (meter level) module (SPG). The module is using a Position Dilution Of Precision (PDOP, 3 coordinates) with value = 2.5. This will guarantee that a valid position (Valid flag set) from the GNSS module has an accuracy better than 500 meters.

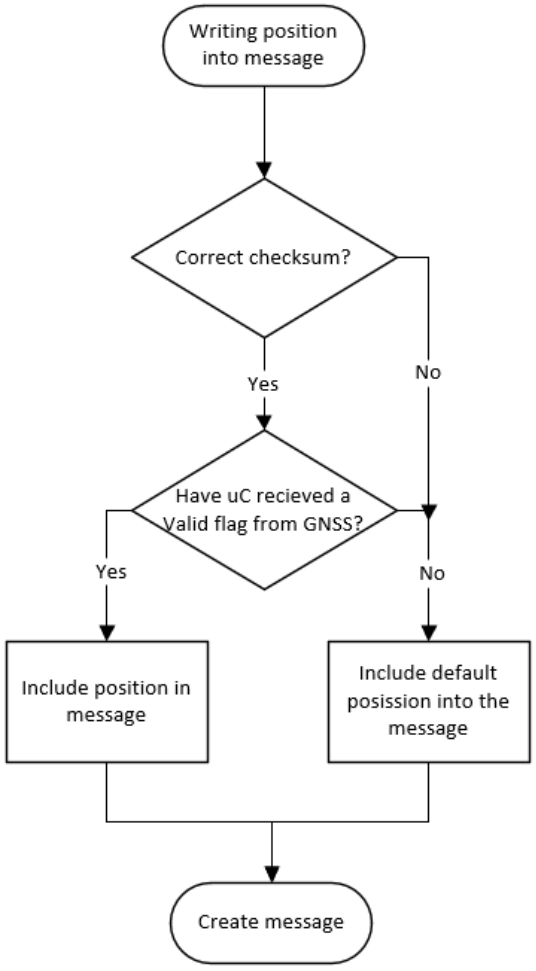

Figure 1: Writing GNSS position into the message

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Conformity:

Verdict:	PASS
Test engineer:	Øystein Bjørgum

A.1 A) FULL-LOAD CURRENT DRAIN DURING SELF-TEST

RTCM 11000.4: A.1 *"a) The EPIRB battery experiences full-load current drain during the Self-test."*

Procedure:

Voltage is measured over a sense resistor at minimum, ambient and maximum operation temperatures.
Sense Resistor = 0.05 Ohm.

Comments:

TÜVSÜD Cospas-Sarsat report "75941540 report 01 Issue 5" has measured the Peak current to be 1611 mA during activation:

SCOMM Results as per C/S T.007 Table F-E.1:

Beacon Operating Modes	Mode: Manually selectable or Automatic	Measurement interval, sec	Average Current, mA	Peak Current, mA
A1	A	599.9	0.0006692	0.0006818
B1	M	599.9	0.00001724	0.00004205
A2	M	2097.0	44.04	1611
B2	M	2099.0	43.42	1592
A3	M	417.2	41.57	1595
B3	M	415.1	40.12	1528
A4	M	2093.0	43.74	1555
A5	M	420.1	39.30	1537
A6	M	16.47	68.15	1512
B6	M	16.47	67.81	1464
A7	M	128.8	28.48	31.24
B7	M	126.7	29.07	31.24
A8	M	44.9	38.36	1486
B8	M	47.8	40.32	1501

Figure 2: Current during Activation stated in Cospas-Sarsat report

Results:

Measured current during Self-test:

Temperature	Average Current	Peak Current
Minimum	1.528 A	1.592 A
Ambient	1.568 A	1.616 A
Maximum	1.568 A	1.600 A

During our Self-test we are measuring the same current as TÜVSÜD have measured for peak current during 406MHz transmission (within measurement tolerances). Therefore, it shows that our product experience full-load current during Self-test.
Below are pictures of the current at different temperatures:

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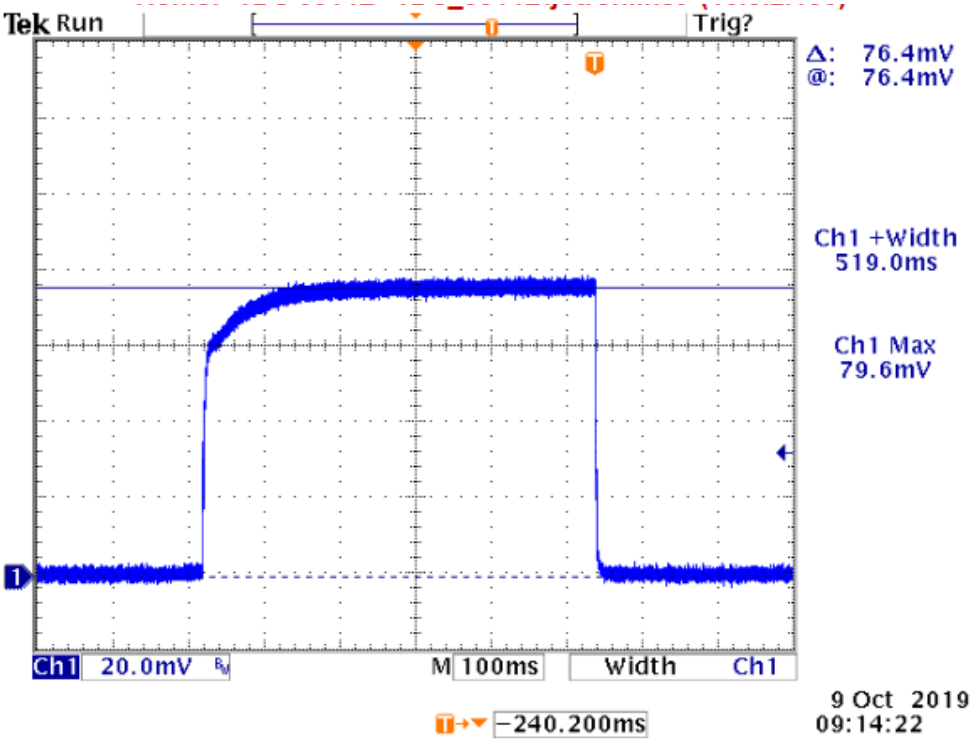

Figure 3: Current drain during Self-test at minimum temperature

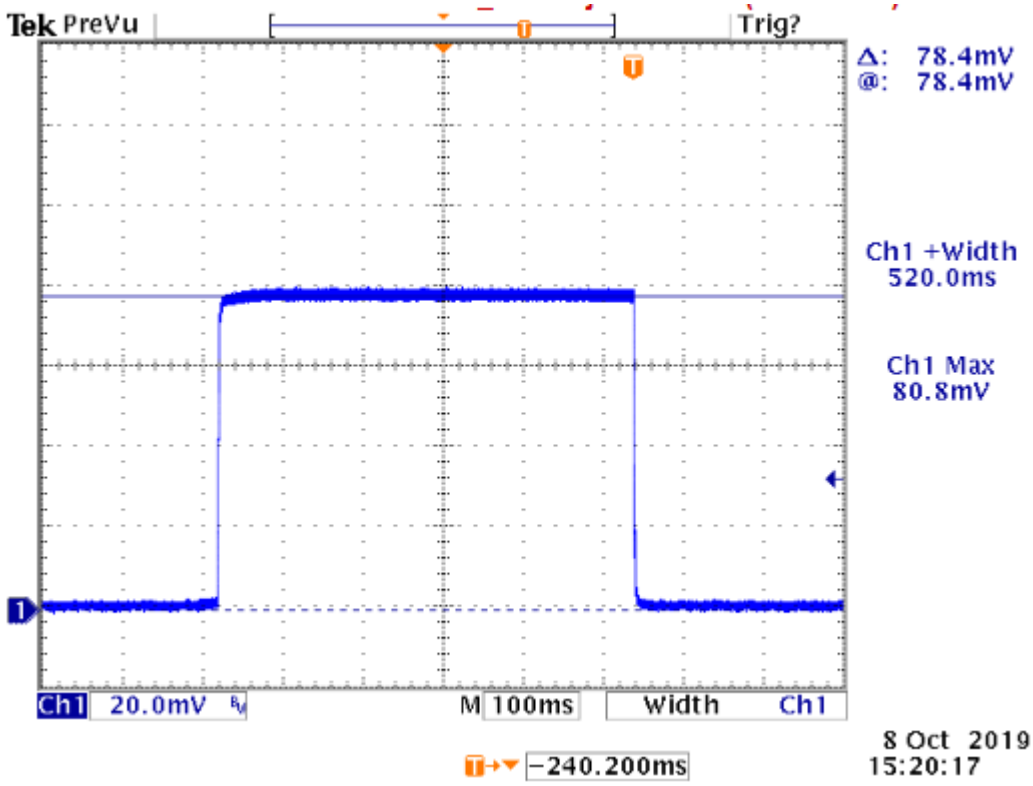

Figure 4: Current drain during Self-test at ambient temperature

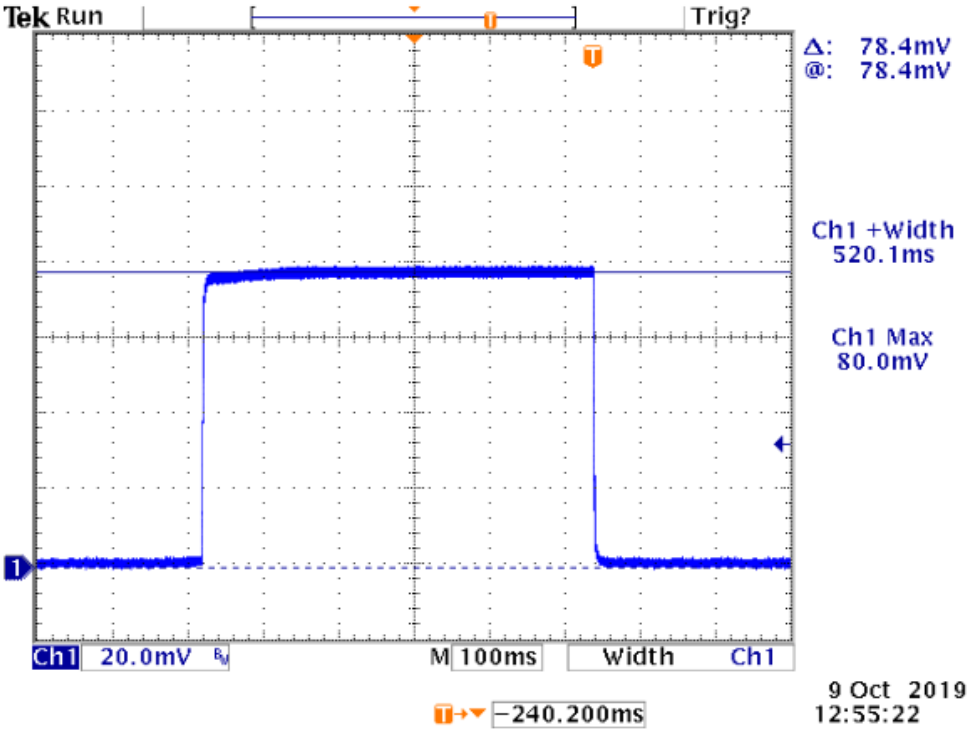

Figure 5: Current drain during maximum temperature

Conformity:

Verdict:	PASS
Test engineer:	Øystein Bjørgum

A.1 B) SELF-TEST PASS/FAIL INDICATION DURING INDUCTION OF FAILURE

RTCM 11000.4: A.1 *"b) Each self-test pass/fail indicator correctly identifies a fail condition when a failure in the monitored function has been induced."*

Procedure:

There are induced errors, according the table below, to the unit before a Self-test is performed. The unit is then observed and recording the indications given from the unit.

Comments:

Below is the overview of the EPRIB error messages given in the manual:

6.3 EPIRB SELF-TEST INDICATION

If the self-test detects a fault in the EPIRB module, one or more of the following indications are shown:

Number of flashes:	Indication:
1	Test OK
2	Low power on 406 MHz transmitter
3	Low battery voltage
4	Low power on 121.5 MHz transmitter
5	PLL on 406 MHz transmitter out of lock
6	PLL on 121.5 MHz transmitter out of lock
7	EPIRB module not programmed or programming not complete

Figure 6: Error messages from User manual

Results:

Conditions	Indication	Verdict
406 MHz transmitter faulty	2 flashes	PASS
Too low voltage on battery	3 flashes	PASS
121,5 MHz transmitter faulty	4 flashes	PASS
Failure on PLL on 406 MHz transmitter	5 flashes	PASS
Failure on PLL on 121,5 MHz transmitter	6 flashes	PASS
Not programmed unit	7 flashes	PASS

Conformity:

Verdict:	PASS
Test engineer:	Øystein Bjørgum

A.1 C) TRANSMISSION IN SELF-TEST IS LIMITED TO ONE BURST

RTCM 11000.4: A.1 *"c) Any transmission in either self-test mode is limited to one burst, or in the case of AIS transmissions a single pulse."*

Procedure:

The beacon is put into self-test mode and it is observed that only one burst is transmitted. This is checked by measuring the current the unit is using.

Comments:

In self-test, the beacon is powered by a separate test switch, and a TEST signal will activate the self-test mode. The software self-test routine sends only one burst in the transmission. After the microcontroller has performed the self-test routine, the microcontroller turns off all electrical circuits. Then the program runs in a wait loop until the TEST switch is released. This is a software-controlled limitation and is not affected by temperature or other external conditions.
Please see figure below:

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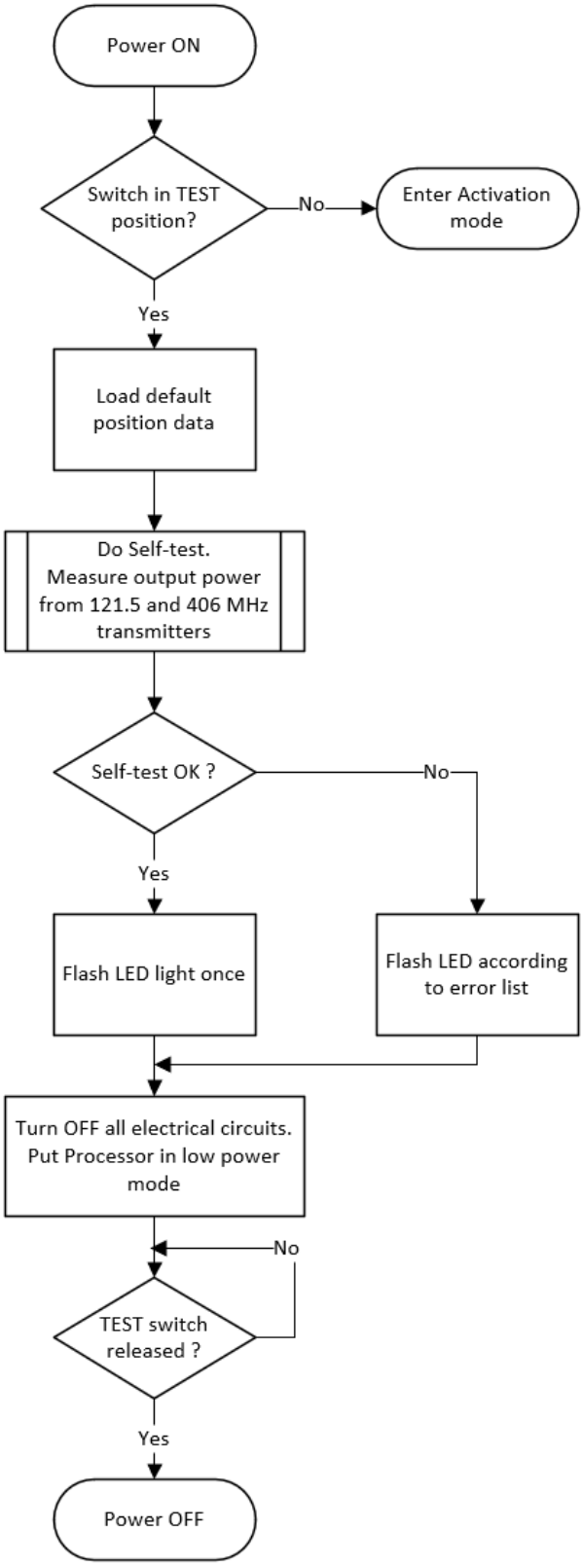

Figure 7: Self-test flowchart

Results:

Current measuring while the beacon is put into Self-test mode, the measurement is run for 16 minutes (top frame) and the window is zoomed to the first 3 seconds:

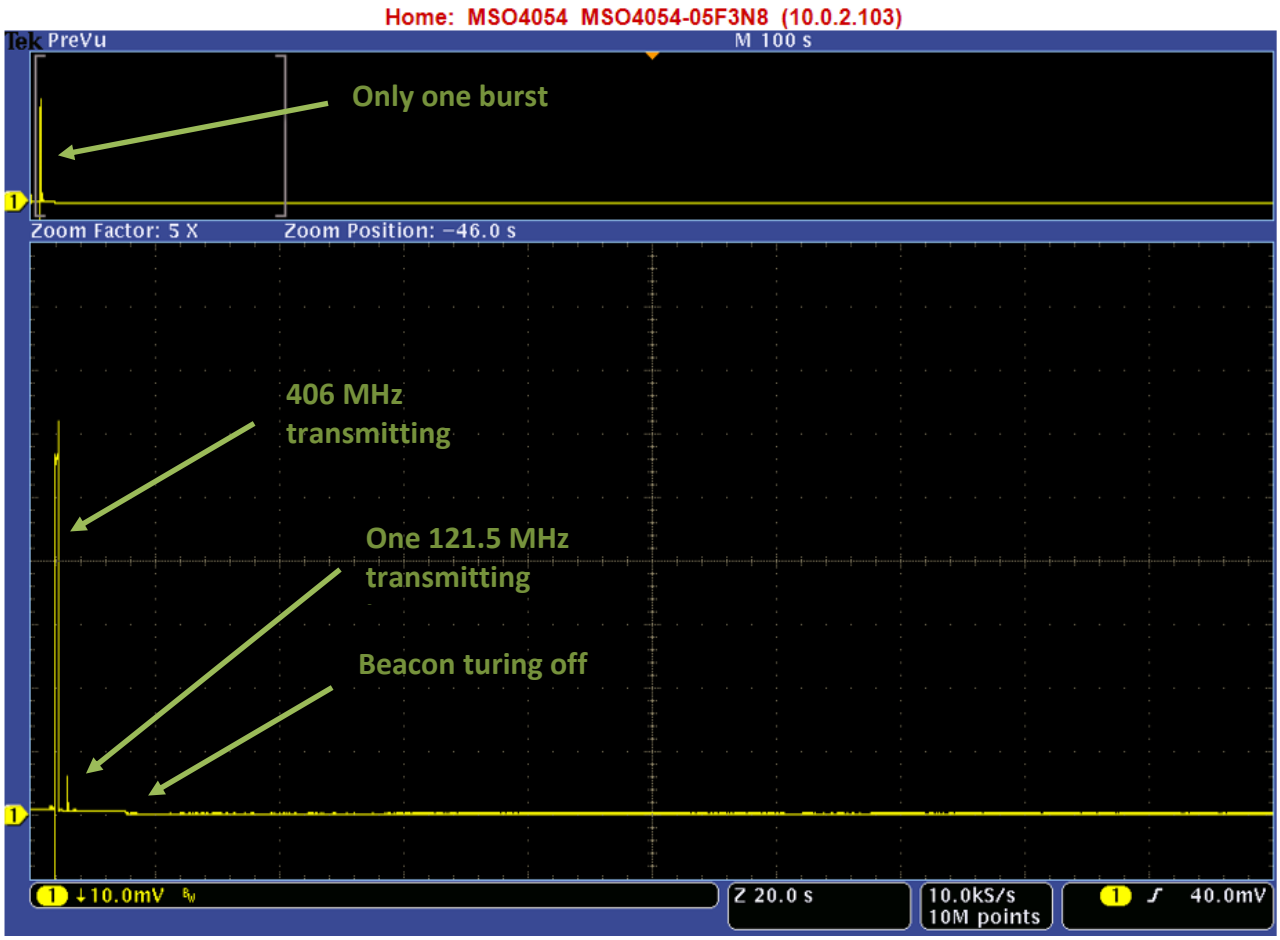

Figure 8: Only one burst sent from the unit in 16 minutes.

Conformity:

Verdict:	PASS
Test engineer:	Øystein Bjørgum

A.1 D) GNSS SELF-TEST LIMITATIONS

RTCM 11000.4: A.1 *"d) That the GNSS Self-Test mode is tested to verify that under worst case conditions (no GNSS reception or input) it is* ***limited in duration*** *and number"*

Comments:

See also the TÜVSÜD Cospas-Sarsat report "75941540 Report 01 Issue 5", chapter "Self-test Modes" on page 31, which also have tested those criteria's in accordance to T.007.

Description:

GNSS Self-Test is activated by moving the switch to TEST-position twice within 3 seconds and released back to READY position. The unit counts the total started GNSS Self-tests, the allowed number is 60. If more than allowed GNSS Self-tests are tried executed, this will be announced by 10 beeps to the user and the EPIRB will power off. This is a software-controlled limitation and is not affected by temperature or other external conditions.

If the unit have performed less than 60 GNSS Self-tests it will start the GNSS Self-test mode. It also starts a 120 seconds timer. If a valid position is received before the timer ends, one normal Self-test is executed, and the position is transmitted in the 406 MHz message. After the self-test is performed, the unit will turn itself off.
In case of no position within the 120 seconds timer, this will be announced by 5 beep's and the EPIRB will power off.

Please see figure below.

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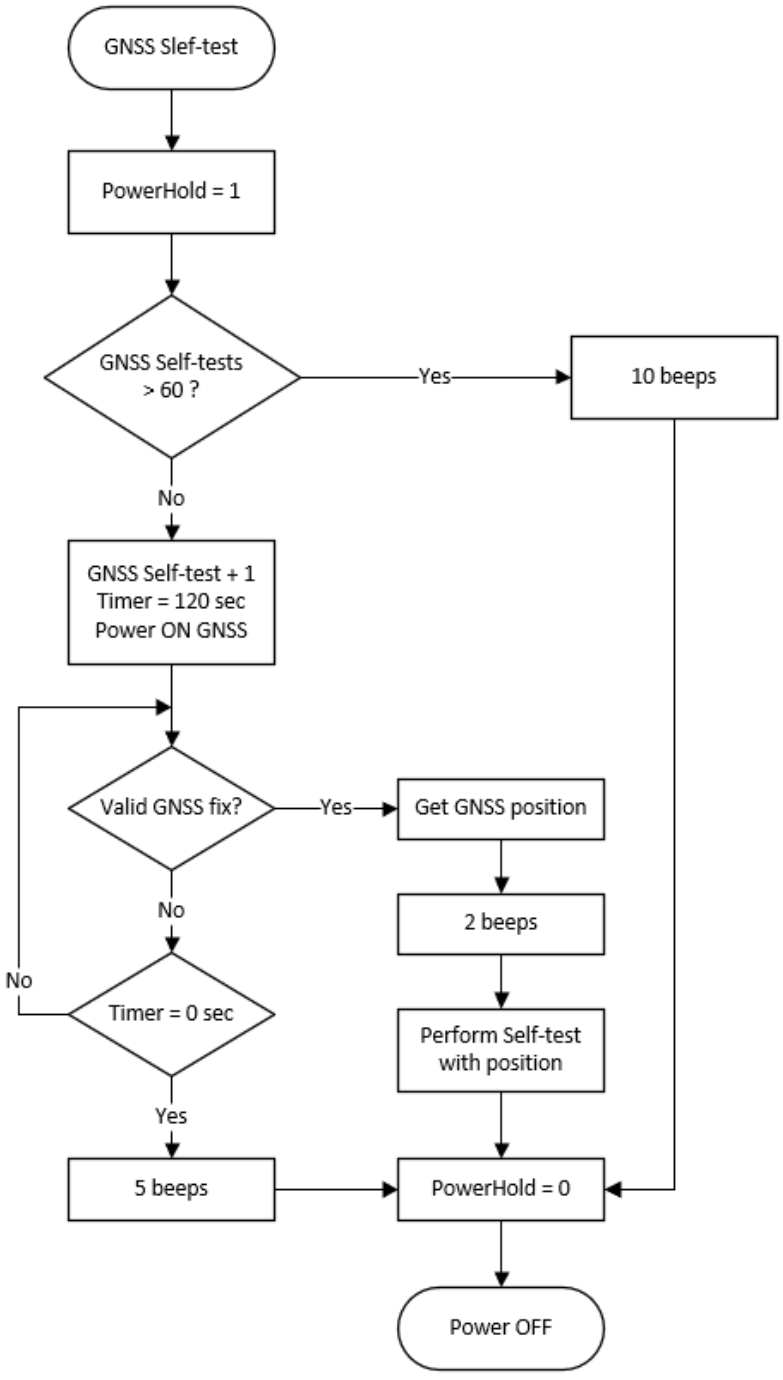

Figure 9: GNSS Self-test flowchart

Procedure:

The unit is programmed to have done 59 GNSS Self-tests before this test is started. The unit is then tested the 60th time, which is allowed. The test is done once more time, which is the 61th time where the unit shall indicate to the user and not perform a self-test.
The duration of a performed GNSS Self-test is recorded and measured.

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Manual indications of GNSS self-test indications:

GPS-test sound indication :

Number of beeps:	Indication:
2	Test OK
5	Did not acquire GPS position
10	Number of GPS TEST above limit (>60)

Figure 10: GNSS Self-test indications, listed in User Manual

Results:

Indications of the beacon during GNSS Self-test around number of limits:

Test conditions	Temp.	Indication	Comment	Verdict
60th test time	Min.	5 beeps	Did not acquire GPS position	Pass
61th test time	Min.	10 beeps	Number of GPS tests above limit (>60)	Pass
60th test time	Ambient	5 beeps	Did not acquire GPS position	Pass
61th test time	Ambient	10 beeps	Number of GPS tests above limit (>60)	Pass
60th test time	Max.	5 beeps	Did not acquire GPS position	Pass
61th test time	Max.	10 beeps	Number of GPS tests above limit (>60)	Pass

The transmission time is observed during a GNSS Self-test, to verify the length of the duration:

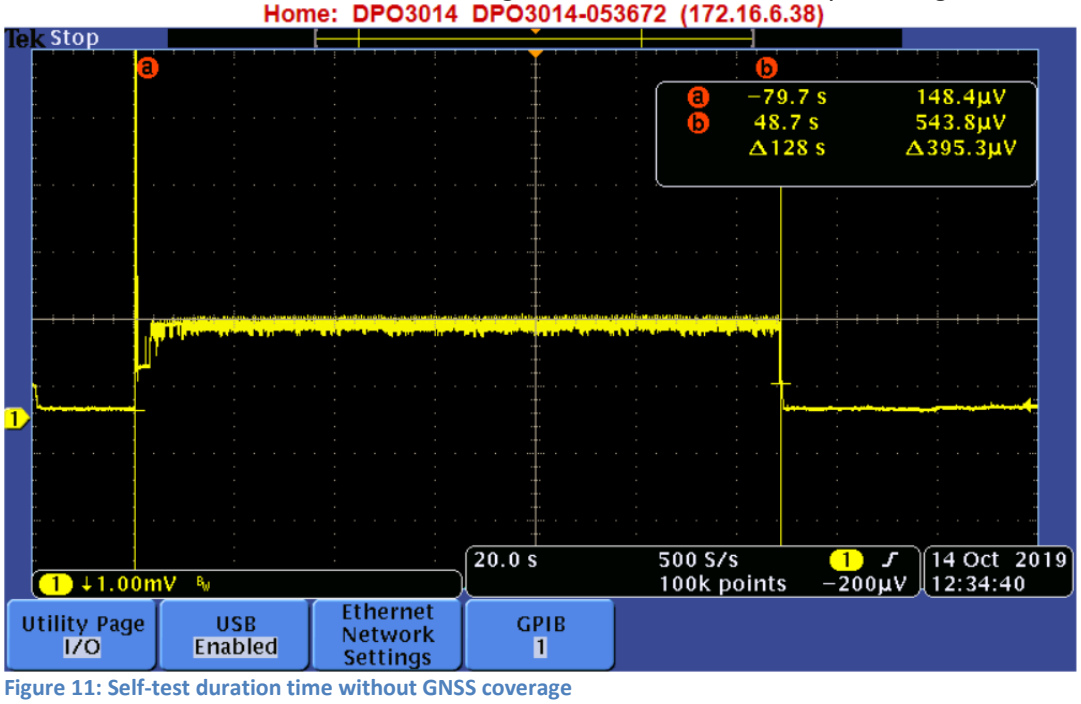

Figure 11: Self-test duration time without GNSS coverage

Conformity:

Verdict:	PASS
Test engineer:	Øystein Bjørgum

A.1 E) GNSS SELF-TEST; PREVENTS INADVERTENT ACTIVATION

RTCM 11000.4: A.1 *"e) That the GNSS Self-Test mode prevents inadvertent activation."*

Comments:

This issue is maintained by mechanical and software design:

Tron 40VDR is using a sliding switch, that can be pushed in two different directions (clockwise for activation or anti-clockwise for test). It is therefore not possible to activate both test and activation at the same time.

The GNSS Self-test (Extended Test) is started by pushing the switch to the Test position twice within three seconds.

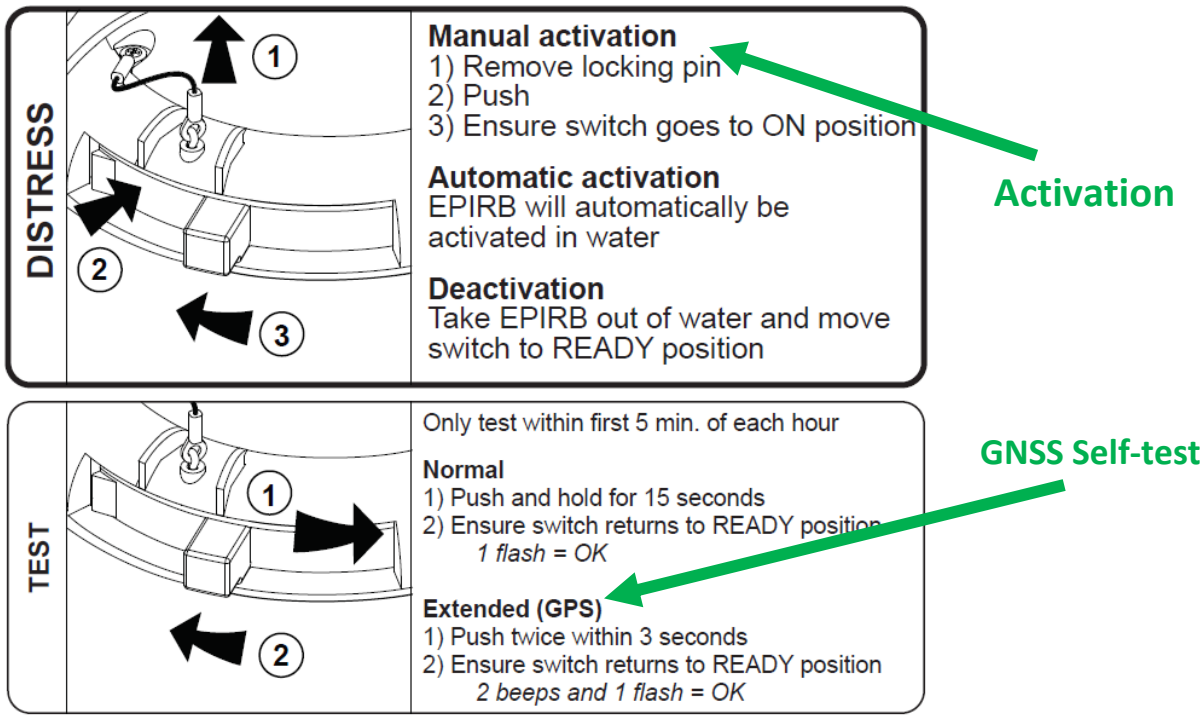

Figure 12: Activation instructions for beacon

The microcontroller starts up when the unit is powered up. It will then follow the flowchart below to decide what mode it shall start:

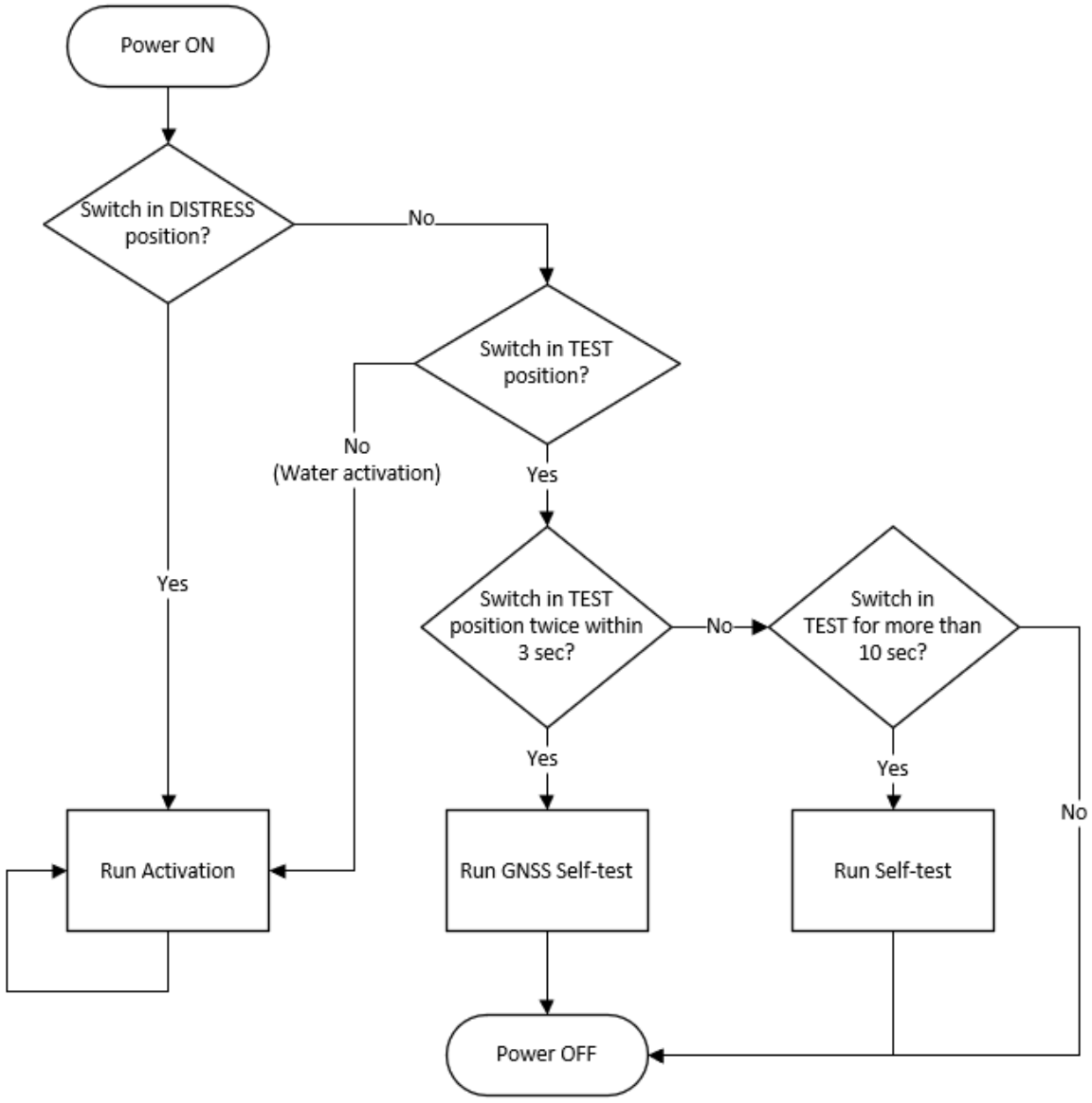

Figure 13: uC activation flowchart

Conformity:

Verdict:	PASS
Test engineer:	Øystein Bjørgum

A.1 F) GNSS SELF-TEST; PASS/FAIL CORRECT INDICATION

RTCM 11000.4: A.1 *" f) That the GNSS Self-Test mode provides correct indication of the correct operation of the GNSS Self-Test pass/fail indicator(s)"*

Procedure:

The unit is tested, after user manual procedure (pushing the switch to Test mode twice within 2 seconds), in both GNSS coverage and no-coverage.

Comments:

Error messages indicated in User manual:

GPS-test sound indication :

Number of beeps:	Indication:
2	Test OK
5	Did not acquire GPS position
10	Number of GPS TEST above limit (>60)

Figure 14: GNSS Self-test error messages stated in User manual

10 beeps are tested earlier in this report in chapter "A.1 d) GNSS self-test limitations".

Results:

Pass / Fail indication of the unit.

Test conditions	Temp.	Indication	Comment	Verdict
GNSS Coverage	Min.	2 beeps + 1 flash	GNSS Self-test = OK	Pass
No GNSS coverage	Min.	5 beeps + No flash	Did not acquire GPS position	Pass
GNSS Coverage	Ambient	2 beeps + 1 flash	GNSS Self-test = OK	Pass
No GNSS Coverage	Ambient	5 beeps + No flash	Did not acquire GPS position	Pass
GNSS Coverage	Max.	2 beeps + 1 flash	GNSS Self-test = OK	Pass
No GNSS Coverage	Max.	5 beeps + No flash	Did not acquire GPS position	Pass

Conformity:

Verdict:	PASS
Test engineer:	Øystein Bjørgum

A.3 E) HANDS-FREE RETENTION BREAKING FORCE

RTCM 11000.4: A.3 *"e) the lanyard can be deployed…. The minimum breaking force of any hands-free retention means shall be demonstrated by the inspection of evidence submitted by the manufacturer that it meets the specified requirements."*

Procedure:

The hands-free retention is attached to the fastening point on the beacon in this test. The fastening point and the end or the hands-free retention is attached to the tension machine.
The tensile testing will then stretch and test the whole hands-free retention mechanism.

Tensile testing has been carried out to verify that the hands-free retention meets the requirement of 245 N without breaking.

Results:

Test	Results
Hands-free retention mounted on beacon can handle > 245 N without breaking.	Pass, the hands-free retention did not break.

Conformity:

Verdict:	PASS
Test engineer:	Stian Jensen