Racon Variable sensitivity and side lobe suppression Report

LW26-70118918

Issue: 1
Classification: Commercial in Confidence
Dated: 03/11/20

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Approval:

Name	Project Role	Signature
N Sparling	Technical Authority	
I Duke	Quality Assurance	

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1 Overview

This document details tests that are in addition to those previously carried out to confirm compliance of the Phalcon-NT to various aspects of FCC part 80. The results of these tests are also contained within this document.

Two tests have been carried out on a representative unit currently available.

- A variable sensitivity test where the sensitivity of the unit is reduced such that the unit no longer responds to signals at -10dBm
- A full sensitivity test where side lobes are present on the synthesised radar signal in order to demonstrate the racon's automatic suppression of responses to a radar side lobes.

2 Hardware

Phalcon-NT Serial number: 0042

3 Software/Firmware

Micro Controller Code 5.0

FPGA Code 5.12

Uploader code 2.0

Note : All earlier code versions would operate in the same manner as both tested functions have been a core requirement since the first release.

4 Variable sensitivity test

4.1 Variable sensitivity to -10dBm signals

4.1.1 Requirement

Demonstrate the sensitivity of the unit can be adjusted such that it no longer responds to signals at -10dBm

4.1.2 Test

With the power supply set to +12V and racon responding to a lab synthesised radar signal, confirm that output pulses are present when receiving a -10dBm signal, adjust the sensitivity until the racon stops responding to -10dBm signals and then adjust the sensitivity back to maximum and confirm that the output pulses are present when receiving a -50dBm signal (S band) and -45dBm (X band).

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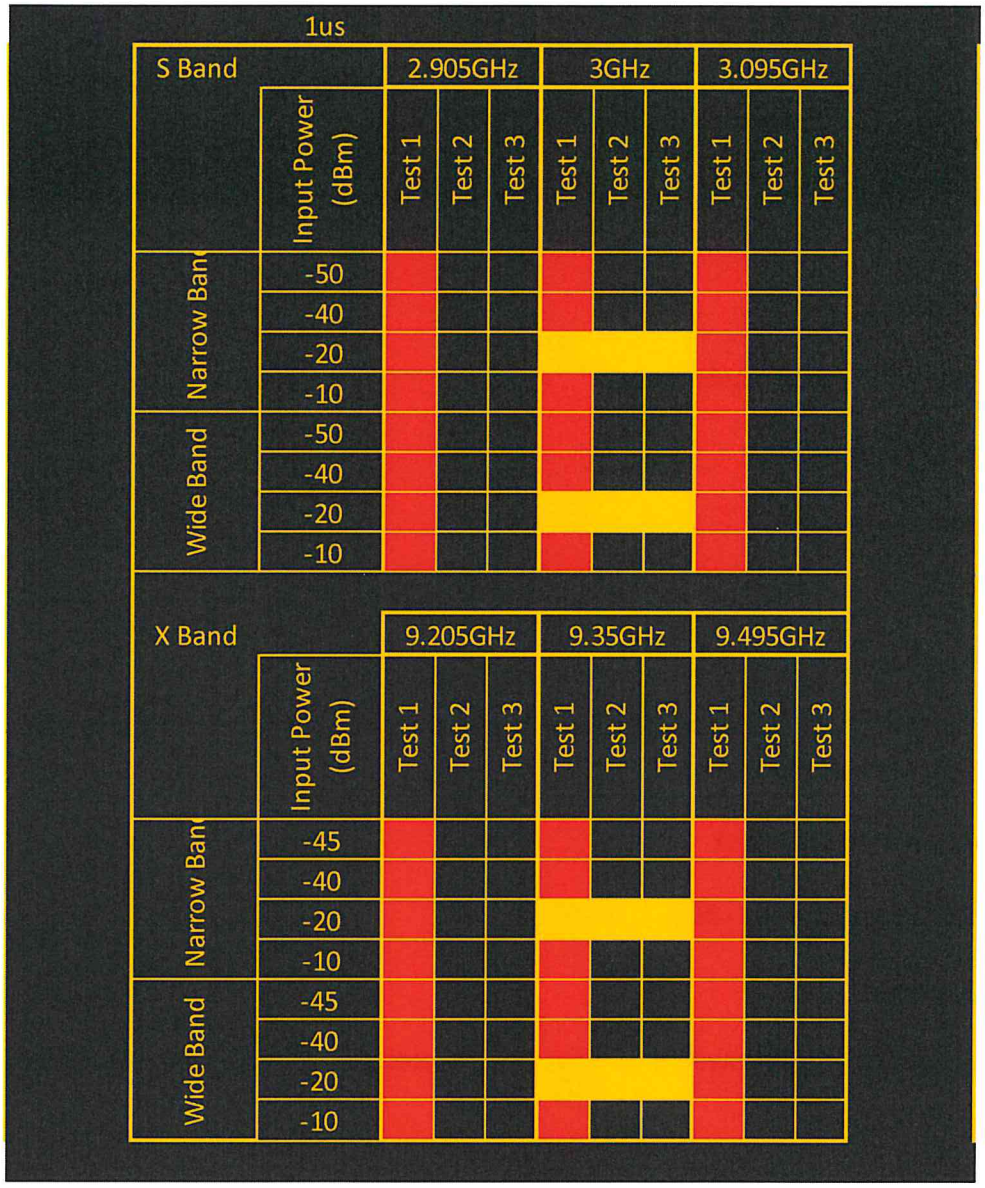
The test setup utilised is a dedicated automated site which transmits RF pulses into the racon with calibrated configurable frequency, power and pulse durations. The output pulse train is additionally amplitude modulated to represent a radar transmission that sweeps over the racon every 2.5 seconds. A 1us duration pulse at centre band was selected for the test.



ATE available selection options for a 1us pulse. Narrow band tests for a single Morse response. Wideband, not utilised for this test, tests for a train of Morse responses.

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4.1.3 Results

Initial sensitivity settings:

```
VERSION   : 5.00, DEV, Dec  5 2019 10:55:38
IMAGE     : FPGA     : Type=3,VER=5.120,LEN=3891628,CRC_H=0x669d9f45,CRC_I=0x6ec65a9f
IMAGE     : MAIN     : Type=2,VER=5.00,LEN=92488,CRC_H=0xbb636c5b,CRC_I=0xca7722d6
IMAGE     : UPLOADER: Type=7,VER=2.00,LEN=81812,CRC_H=0x91a0937,CRC_I=0xd9284599
HEADER CONFIGURATION : TRANAPP_USER_SET
MORSE CODE INDEX     : 2
MORSE BIT LENGTH     : 8
TX SPOKES            : 3
TX TIME DELAY        : 0
SLEEP TIME           : 4
SLEEP TIME AFTER RUN : 4
SLEEP TIME RX        : 4
SLEEP PULSE WAKE CNT : 0
SLEEP WAKE RX THRESH : 145
X BAND               : ON
S BAND               : ON
MODE                 : RUNNING
AUTO MORSE LEN       : OFF
RADAR RESPONSES      : 8
BEACON ID            : BEACON 0042
SERIAL NUMBER        : 0042
BATTERY THRESHOLD    : 238
Serial Number B      : UNASSIGNED
Serial Number C      : UNASSIGNED
Serial Number D      : SD01846000032
FPGA LEDS            : OFF
S BAND RX THRESH     : 1365
X BAND RX THRESH     : 1265
S BAND RX HSYT       : 335
X BAND RX HSYT       : 435
TX TRIGGER LEVEL     : 300
DE-INT DELTA         : 100
TX FPGA DELAY        : 0
SWEEP PEAK REDUCTION : 15
System Mode Bits     : 0x7ffffff
System Mode Bits     : FT=1 SC=1 OR=1
Set Baud Rate        : 115200
Max Baud Rate        : 600000
SYSTEM LEDS          : OFF
DEINT MIN DIST UPDATE: 110
DEINT MERGE WEIGHT   : 50
DEINT SWP DIFF       : 1750
DEINT SWP WEIGHT     : 12
HEADER CRC           : 0x89a06409
HEADER SIZE          : 180
HEADER UPDATE LEVEL  : 4
```


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S band test at full sensitivity:

MC indicates a Morse character has been transmitted and detected by the ATE

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Reduced S band sensitivity settings:

```
VERSION   : 5.00, DEV, Dec  5 2019 10:55:38
IMAGE     : FPGA     : Type=3,VER=5.120,LEN=3891628,CRC_H=0x669d9f45,CRC_I=0x6ec65a9f
IMAGE     : MAIN     : Type=2,VER=5.00,LEN=92488,CRC_H=0xbb636c5b,CRC_I=0xca7722d6
IMAGE     : UPLOADER: Type=7,VER=2.00,LEN=81812,CRC_H=0x91a0937,CRC_I=0xd9284599
HEADER CONFIGURATION : TRANAPP_USER_SET
MORSE CODE INDEX     : 2
MORSE BIT LENGTH     : 8
TX SPOKES            : 3
TX TIME DELAY        : 0
SLEEP TIME           : 4
SLEEP TIME AFTER RUN : 4
SLEEP TIME RX        : 4
SLEEP PULSE WAKE CNT : 0
SLEEP WAKE RX THRESH : 145
X BAND               : ON
S BAND               : ON
MODE                 : RUNNING
AUTO MORSE LEN       : OFF
RADAR RESPONSES      : 8
BEACON ID            : BEACON 0042
SERIAL NUMBER        : 0042
BATTERY THRESHOLD    : 238
Serial Number B      : UNASSIGNED
Serial Number C      : UNASSIGNED
Serial Number D      : SD01846000032
FPGA LEDS            : OFF
S BAND RX THRESH     : 3365
X BAND RX THRESH     : 1265
S BAND RX HSYT       : 335
X BAND RX HSYT       : 435
TX TRIGGER LEVEL     : 300
DE-INT DELTA         : 100
TX FPGA DELAY        : 0
SWEEP PEAK REDUCTION : 15
System Mode Bits     : 0x7ffffff
System Mode Bits     : FT=1 SC=1 OR=1
Set Baud Rate        : 115200
Max Baud Rate        : 600000
SYSTEM LEDS          : OFF
DEINT MIN DIST UPDATE: 110
DEINT MERGE WEIGHT   : 50
DEINT SWP DIFF       : 1750
DEINT SWP WEIGHT     : 12
HEADER CRC           : 0x5940e0b8
HEADER SIZE          : 180
HEADER UPDATE LEVEL  : 4
```


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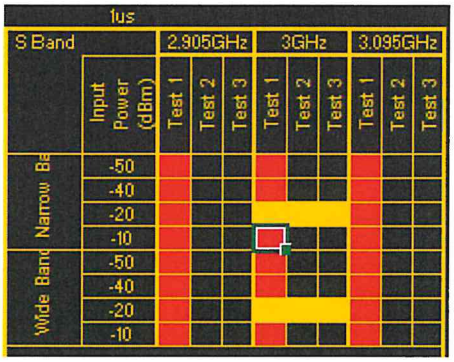
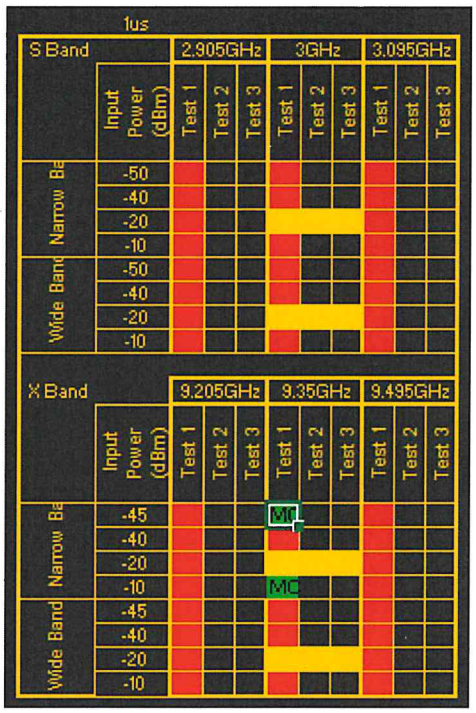
S band test at reduced sensitivity:



MC flag has been cleared indicating no Morse character has been transmitted

X band test at full sensitivity:



MC indicates a Morse character has been transmitted and detected by the ATE

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Reduced X band sensitivity settings:

```
VERSION   : 5.00, DEV, Dec  5 2019 10:55:38
IMAGE     : FPGA     : Type=3,VER=5.120,LEN=3891628,CRC_H=0x669d9f45,CRC_I=0x6ec65a9f
IMAGE     : MAIN     : Type=2,VER=5.00,LEN=92488,CRC_H=0xbb636c5b,CRC_I=0xca7722d6
IMAGE     : UPLOADER: Type=7,VER=2.00,LEN=81812,CRC_H=0x91a0937,CRC_I=0xd9284599
HEADER CONFIGURATION : TRANAPP_USER_SET
MORSE CODE INDEX     : 2
MORSE BIT LENGTH     : 8
TX SPOKES            : 3
TX TIME DELAY        : 0
SLEEP TIME           : 4
SLEEP TIME AFTER RUN : 4
SLEEP TIME RX        : 4
SLEEP PULSE WAKE CNT : 0
SLEEP WAKE RX THRESH : 145
X BAND               : ON
S BAND               : ON
MODE                 : RUNNING
AUTO MORSE LEN       : OFF
RADAR RESPONSES      : 8
BEACON ID            : BEACON 0042
SERIAL NUMBER        : 0042
BATTERY THRESHOLD    : 238
Serial Number B      : UNASSIGNED
Serial Number C      : UNASSIGNED
Serial Number D      : SD01846000032
FPGA LEDS            : OFF
S BAND RX THRESH     : 1365
X BAND RX THRESH     : 3265
S BAND RX HSYT       : 335
X BAND RX HSYT       : 435
TX TRIGGER LEVEL     : 300
DE-INT DELTA         : 100
TX FPGA DELAY        : 0
SWEEP PEAK REDUCTION : 15
System Mode Bits     : 0x7ffffff
System Mode Bits     : FT=1 SC=1 OR=1
Set Baud Rate        : 115200
Max Baud Rate        : 600000
SYSTEM LEDS          : OFF
DEINT MIN DIST UPDATE: 110
DEINT MERGE WEIGHT   : 50
DEINT SWP DIFF       : 1750
DEINT SWP WEIGHT     : 12
HEADER CRC           : 0xff76fccf
HEADER SIZE          : 180
HEADER UPDATE LEVEL  : 4
```


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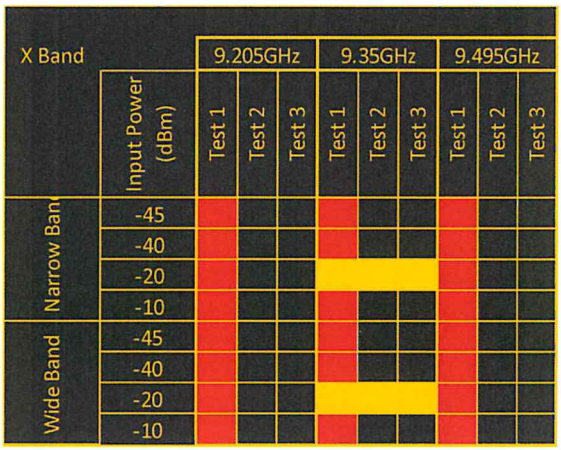
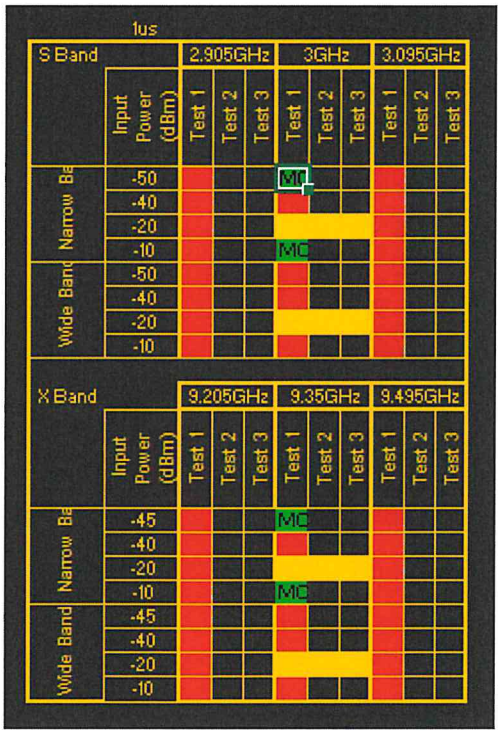
X band test at reduced sensitivity:



MC flag has been cleared indicating no Morse character has been transmitted

S and X band tests at full sensitivity:



MC indicates a Morse character has been transmitted and detected by the ATE

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5 Sidelobe Test

5.1 Transmission into main lobe rejecting other lobes

5.1.1 Requirement

Transmit full power into main lobe and with no transmission into any present side lobes

5.1.2 Test

With the power supply set to +12V and system responding to a lab synthesised radar signal, confirm that the output pulses are present during the main lobe and not present during the side lobes.

5.1.3 Results

Operation showing a burst of pulses in yellow being output as the synthesised radar signal, the modulated signal for the synthesiser in blue which is required to be inverted to peak the synthesisers response, crosses the set triggering threshold.

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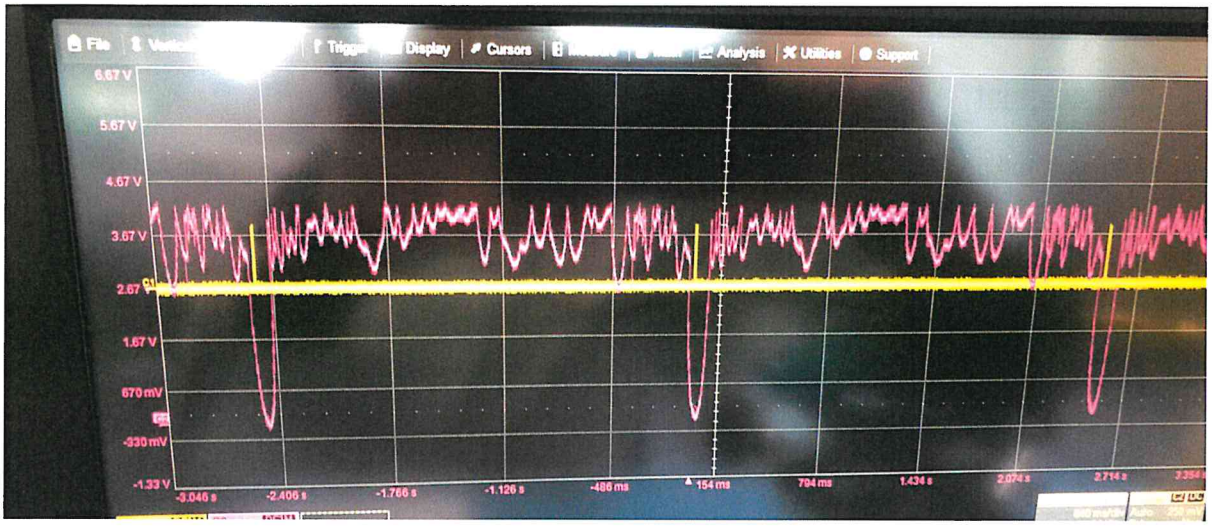

Operation showing multiple bursts of pulses in yellow being output as the synthesised radar signal crosses the set triggering threshold. The synthesised radar signal here is generated from a real world capture of a radar RF environment.

6 Test Equipment Used

Item	Type	Serial Number	Calibration Due
Arbitrary Waveform Generator	GW Instek QFG-2112	1234	NORC
Synthesiser	Agilent 83732B	0442	NORC
Spectrum analyser	E4407B	0186	22/07/21
Oscilloscope	Teledyne Lecroy	1169	25/09/21
DMM	Fluke 115	1068	NORC
Power Supply	TTi EX354D	0090	NORC

NORC - Not on routine calibration. Referenced against calibrated equipment

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