

# Test Report

Report Number:

**F211774E1**

Equipment under Test (EUT):

**AIS Class A transponder  
R6 Supreme**

Applicant:

**Saab TransponderTech AB**

Manufacturer:

**Saab TransponderTech AB**



Deutsche  
Akkreditierungsstelle  
D-PL-17186-01-01  
D-PL-17186-01-02  
D-PL-17186-01-03

## References

### [1] IEC 61993-2 Edition 3: 2018-07:

Maritime navigation and radiocommunication equipment and systems –  
Automatic Identification Systems (AIS) -  
Part 2: Class A shipborne equipment of the automatic identification system (AIS) -  
Operational and performance requirements, methods of test and required test results

## Test result

The requirements of the tests performed as shown in the overview (clause 4) were fulfilled by the equipment under test. The complete test results are presented in the following.

“Passed” indicates that the equipment under test conforms with the relevant limits of the testing standard AND the expanded measurement uncertainty ( $k = 2$  for approximately 95 % coverage probability) of the laboratory is not larger in magnitude than the measurement uncertainty requirements defined in clause 9.5 of IEC 61993-2 Edition 3: 2018-07.

Tested and  
written by:

Signature

Reviewed and  
approved by:

Signature

**This test report is only valid in its original form.**

Any reproduction of its contents in extracts without written permission of the accredited test laboratory PHOENIX TESTLAB GmbH is prohibited.

The test results herein refer only to the tested sample. PHOENIX TESTLAB GmbH is not responsible for any generalisations or conclusions drawn from these test results concerning further samples. Any modification of the tested samples is prohibited and leads to the invalidity of this test report. Each page necessarily contains the PHOENIX TESTLAB Logo and the TEST REPORT NUMBER.

This test report is valid in hardcopy form as well as in electronic form.

<b>Contents:</b>	<b>Page</b>
1 Identification.....	4
1.1 Applicant.....	4
1.2 Manufacturer .....	4
1.3 Test laboratory.....	4
1.4 EUT (Equipment Under Test).....	5
1.5 Dates .....	6
2 Operational states.....	6
3 Additional information .....	6
4 Test overview.....	7
5 Transmitter Requirements .....	8
5.1 Frequency error Subclause 15.1.1 [1].....	8
5.2 Carrier power (conducted) Subclause 15.1.2 [1].....	9
5.3 Slotted transmission spectrum Subclause 15.1.3 [1] .....	10
5.4 Modulation accuracy Subclause 15.1.4 [1].....	13
5.5 Transmitter output power characteristics Subclause 15.1.5 [1] .....	20
6 Receiver requirements.....	26
6.1 TDMA receiver sensitivity Subclause 15.2.1 [1].....	26
6.2 TDMA receiver error behaviour at high input levels Subclause 15.2.2 [1].....	27
6.3 TDMA receiver co-channel rejection Subclause 15.2.3 [1] .....	28
6.4 TDMA receiver adjacent channel selectivity Subclause 15.2.4 [1] .....	29
6.5 TDMA receiver spurious response rejection Subclause 15.2.5 [1] .....	30
6.6 TDMA receiver intermodulation response rejection and blocking Subclause 15.2.6 [1].....	32
6.7 TDMA receiver transmit to receive switching time Subclause 15.2.7 [1] .....	33
6.8 TDMA receiver immunity to out-of-band energy Subclause 15.2.8 [1] .....	34
7 Conducted spurious emissions.....	35
7.1 Spurious emissions from the transmitter Subclause 15.3.1 [1].....	35
7.2 Spurious emissions from the receiver Subclause 15.3.2 / C.2.8 [1] .....	37
8 Results of the DSC receiver tests.....	38
8.1 DSC receiver maximum sensitivity Subclause C.2.1 [1] .....	38
8.2 DSC receiver error behaviour at high input levels Subclause C.2.2 [1] .....	39
8.3 DSC receiver co-channel rejection Subclause C.2.3 [1] .....	40
8.4 DSC receiver adjacent channel sensitivity Subclause C.2.4 [1] .....	41
8.5 DSC receiver spurious response rejection Subclause C.2.5 [1] .....	42
8.6 DSC receiver intermodulation response rejection Subclause C.2.6 [1] .....	43
8.7 DSC receiver blocking or desensitisation Subclause C.2.7 [1] .....	44
9 Test equipment and ancillaries used for tests .....	45
10 Measurement uncertainties .....	46
11 Report history .....	46
12 List of annexes.....	46

## 1 Identification

### 1.1 Applicant

Name:	Saab AB TransponderTech
Address:	Låsblecksgatan 3 SE-589 41 Linköping
Country:	Sweden
Name for contact purposes:	Johan LINDBORG
Phone:	+46 13 18 94 90
Fax:	+46-13-182377
eMail Address:	johan.lindborg@saabroup.com
Applicant represented during the test by the following person:	---

### 1.2 Manufacturer

Name:	Saab AB TransponderTech
Address:	Låsblecksgatan 3 SE-589 41 Linköping
Country:	Sweden
Name for contact purposes:	Johan LINDBORG
Phone:	+46 13 18 94 90
Fax:	+46-13-182377
eMail Address:	johan.lindborg@saabroup.com
Manufacturer represented during the test by the following person:	---

### 1.3 Test laboratory

The tests were carried out at: **PHOENIX TESTLAB GmbH**  
**Königswinkel 10**  
**32825 Blomberg**  
**Germany**

accredited by DGA Deutsche Akkreditierungsstelle GmbH (DAkkS) in compliance with  
DIN EN ISO/IEC 17025 under Reg. No. D-PL-17186-01-02.

## 1.4 EUT (Equipment Under Test)

Type: *	AIS Class A Transponder		
Type designation: *	R6 Supreme		
Product Number: *	7000 121-100		
Alignment range: *	156.025 MHz to 162.025 MHz		
Switching range: *	156.025 MHz to 162.025 MHz		
Channel separation: *	25 kHz		
Rated RF output power: *	Nominal low power: 1.0 W / 30 dBm Nominal high power: 12.5 W / 41 dBm		
Supply voltage: *	U <sub>nom</sub> = 24.0 V <sub>DC</sub>	U <sub>min</sub> = 10.8 V <sub>DC</sub>	U <sub>max</sub> = 31.2 V <sub>DC</sub>
Temperature range: *	-15 °C to +55 °C		
Ancillary used for test:	Laptop PC (supplied by the applicant)		

	EUT number		
	1	2	3
Serial number: *	000001	000002	-
PCB identifier: *	7000 121-110, P6A1	7000 121-110, P6A1	-
Hardware version: *	7000 121-100, P2A1	7000 121-100, P2A1	-
Software version: *	0.4.1	0.4.1	-

\* Declared by the applicant

### Ports/Connectors

Identification	Connector type		Length *1
	EUT	Ancillary	
DC-power-supply	4 Pin ConXall Mini-Con-X	Banana plug	3 m *2 (2 m *1)
GPS-antenna	TNC-female	-	10 m *2 (5 m *1)
VHF-antenna	BNC-female	BNC-Connector	3 m *2 (0.3 m *1)
NMEA	26 Pin, HD-SUB	9 pole D-Sub	3 m *2 (2 m *1)
RS422	9 pole DSub	9 pole DSub	*3
Ethernet1	RJ45	RJ45	30 m *2 (2 m *1)
Ethernet2	RJ45	RJ45	30 m *2, *3

\*1: Length during test

\*2: Length specified by the applicant

\*3: Not used during test

## 1.5 Dates

Date of receipt of test sample:	04.10.2021
Start of test:	06.10.2021
End of test:	24.11.2021

## 2 Operational states

### General:

The EUT is a AIS class A transceiver and a DSC receiver, which could operate from 156.025 MHz to 162.025 MHz. It contains three receivers - two for AIS and one for DSC. Full AIS tests were carried out at 156.025 MHz and 162.025 MHz.

DSC receiver tests were carried out on 156.525 MHz.

The EUT was powered by an external DC power supply. During all tests the EUT was connected to the laptop PC via the Ethernet port 1. All operation modes were set via the EUTs WEB interface with the help of the internet explorer.

All wanted signals for receiver tests were generated either by a vector signal generator or a AIS tester from PHOENIX TESTLAB. The test signals for transmitter tests could be set via the EUTs WEB interface and were generated by the transmitter itself and were checked with the help of a spectrum analyser or the AIS tester.

The spurious emission measurement was performed once because all 3 receivers are able to operate simultaneous. The two AIS receivers were set to one AIS channel each (156.025 MHz and 162.025 MHz) and the DSC receiver was set to the DSC channel (156.525 MHz).

### Test-signal overview:

Test-signal:	Mode:	Bit pattern:
1	DSC	010101 (dotting pattern, refer to ITU-R M.825)
2	AIS (TDMA)	01010101 (defined in part 10.2 [1])
3	AIS (TDMA)	00001111 (defined in part 10.3 [1])
4	AIS (PRBS)	Pseudo Random Bit Sequence (defined in part 10.4 [1])
5	AIS (PRBS)	Pseudo Random Bit Sequence (defined in part 10.5 [1])

### Unwanted signal:

All unwanted signals were generated by the RF generators from PHOENIX TESTLAB.

## 3 Additional information

The tested samples were not labelled as required.

## 4 Test overview

Subclause	Test parameter	Remark	Test result	Used test sample	Refer page
<b>15.1 [1]</b>	<b>TDMA Transmitter</b>				
15.1.1 [1]	Frequency error	Applicable	Passed	2	8
15.1.2 [1]	Carrier power	Applicable	Passed	2	9
15.1.3 [1]	Slotted transmission spectrum	Applicable	Passed	2	10 et seq.
15.1.4 [1]	Modulation accuracy	Applicable	Passed	2	13 et seq.
15.1.5 [1]	Transmitter output power characteristic	Applicable	Passed	2	19 et seq.
<b>15.2 [1]</b>	<b>TDMA Receiver</b>				
15.2.1 [1]	Sensitivity	Applicable	Passed	1	26
15.2.2 [1]	Error behaviour at high input level	Applicable	Passed	1	27
15.2.3 [1]	Co-channel rejection	Applicable	Passed	1	28
15.2.4 [1]	Adjacent channel selectivity	Applicable	Passed	1	29
15.2.5 [1]	Spurious response rejection	Applicable	Passed	1	30
15.2.6 [1]	Intermodulation response rejection and blocking	Applicable	Passed	1	32
15.2.7 [1]	Transmit to receive switching time	Applicable	Passed	2	33
15.2.8 [1]	Immunity to out-of-band energy	Applicable	Passed	1	34
<b>15.3 [1]</b>	<b>Conducted spurious emissions</b>				
15.3.1 [1]	Spurious Emissions from the Transmitter	Applicable	Passed	1	35 et seq.
15.3.2 [1]	Spurious Emissions from the Receiver	Applicable	Passed	1	37
<b>C.2 [1]</b>	<b>DSC Receiver Test</b>				
C.2.1 [1]	Maximum sensitivity	Applicable	Passed	1	38
C.2.2 [1]	Error behaviour at high input level	Applicable	Passed	1	39
C.2.3 [1]	Co-channel rejection	Applicable	Passed	1	40
C.2.4 [1]	Adjacent channel selectivity	Applicable	Passed	1	41
C.2.5 [1]	Spurious response rejection	Applicable	Passed	1	42
C.2.6 [1]	Intermodulation response rejection	Applicable	Passed	1	43
C.2.7 [1]	Blocking or Desensitisation	Applicable	Passed	1	44
C.2.8 [1]	Conducted spurious emission from the receiver	Applicable	Passed	1	37

## 5 Transmitter Requirements

### 5.1 Frequency error

Subclause 15.1.1 [1]

Ambient temperature:	22 °C
Relative humidity:	38 %

Date:	13.10.2021
Tested by:	Thomas KÜHN

Operation mode: Continuous transmission on 156.025 MHz without modulation, high power

Test conditions		Frequency	Frequency error	Limit	Test result
Temperature	Voltage				
T <sub>nom</sub> (+20 °C)	U <sub>nom</sub> (24.0 V <sub>DC</sub> )	156.025904 MHz	-96 Hz	±0.5 kHz	Passed
T <sub>min</sub> (-15 °C)	U <sub>min</sub> (10.8 V <sub>DC</sub> )	156.024916 MHz	-84 Hz	±1 kHz	Passed
	U <sub>max</sub> (31.2 V <sub>DC</sub> )	156.024916 MHz	-84 Hz	±1 kHz	Passed
T <sub>max</sub> (+55 °C)	U <sub>min</sub> (10.8 V <sub>DC</sub> )	156.024868 MHz	-132 Hz	±1 kHz	Passed
	U <sub>max</sub> (31.2 V <sub>DC</sub> )	156.024868 MHz	-132 Hz	±1 kHz	Passed

Operation mode: Continuous transmission on 162.025 MHz without modulation, high power

Test conditions		Frequency	Frequency error	Limit	Test result
Temperature	Voltage				
T <sub>nom</sub> (+20 °C)	U <sub>nom</sub> (24.0 V <sub>DC</sub> )	162.024904 MHz	-96 Hz	±0.5 kHz	Passed
T <sub>min</sub> (-15 °C)	U <sub>min</sub> (10.8 V <sub>DC</sub> )	162.024912 MHz	-88 Hz	±1 kHz	Passed
	U <sub>max</sub> (31.2 V <sub>DC</sub> )	162.024912 MHz	-88 Hz	±1 kHz	Passed
T <sub>max</sub> (+55 °C)	U <sub>min</sub> (10.8 V <sub>DC</sub> )	162.024868 MHz	-132 Hz	±1 kHz	Passed
	U <sub>max</sub> (31.2 V <sub>DC</sub> )	162.024888 MHz	-112 Hz	±1 kHz	Passed

Limit: Subclause 15.1.1.3 [1]

The frequency error shall not exceed ±0.5 kHz under normal and ±1 kHz under extreme conditions.
---

Test equipment (please refer to chapter 9 for details)
1 - 5



## 5.2 Carrier power (conducted)

Subclause 15.1.2 [1]

Ambient temperature:	22 °C
Relative humidity:	38 %

Date:	13.10.2021
Tested by:	Thomas KÜHN

Operation mode: Continuous transmission on 156.025 MHz without modulation

Test conditions		Carrier power (Conducted)				Limit	Test result
		P <sub>nom</sub> = 30.0 dBm		P <sub>nom</sub> = 41.0 dBm			
		Measured value	Diff. to rated value	Measured value	Diff. to rated value		
T <sub>nom</sub> (+20 °C)	U <sub>nom</sub> (24.0 V <sub>DC</sub> )	30.4 dBm	+0.4 dB	40.6 dBm	-0.4 dB	±1.5 dB	Passed
T <sub>max</sub> (-15 °C)	U <sub>min</sub> (10.8 V <sub>DC</sub> )	29.9 dBm	-0.1 dB	41.1 dBm	+0.1 dB	±3.0 dB	Passed
	U <sub>max</sub> (31.2 V <sub>DC</sub> )	29.8 dBm	-0.2 dB	41.0 dBm	0.0 dB	±3.0 dB	Passed
T <sub>max</sub> (+55 °C)	U <sub>min</sub> (10.8 V <sub>DC</sub> )	30.4 dBm	+0.4 dB	40.2 dBm	-0.8 dB	±3.0 dB	Passed
	U <sub>max</sub> (31.2 V <sub>DC</sub> )	30.4 dBm	+0.4 dB	40.3 dBm	-0.7 dB	±3.0 dB	Passed

Operation mode: Continuous transmission on 162.025 MHz without modulation

Test conditions		Carrier power (Conducted)				Limit	Test result
		P <sub>nom</sub> = 30.0 dBm		P <sub>nom</sub> = 41.0 dBm			
		Measured value	Diff. to rated value	Measured value	Diff. to rated value		
T <sub>nom</sub> (+20 °C)	U <sub>nom</sub> (24.0 V <sub>DC</sub> )	30.3 dBm	+0.3 dB	40.5 dBm	-0.5 dB	±1.5 dB	Passed
T <sub>max</sub> (-15 °C)	U <sub>min</sub> (10.8 V <sub>DC</sub> )	29.8 dBm	-0.2 dB	41.0 dBm	0.0 dB	±3.0 dB	Passed
	U <sub>max</sub> (31.2 V <sub>DC</sub> )	29.9 dBm	-0.1 dB	41.1 dBm	+0.1 dB	±3.0 dB	Passed
T <sub>max</sub> (+55 °C)	U <sub>min</sub> (10.8 V <sub>DC</sub> )	30.1 dBm	+0.1 dB	40.1 dBm	-0.9 dB	±3.0 dB	Passed
	U <sub>max</sub> (31.2 V <sub>DC</sub> )	30.3 dBm	+0.3 dB	40.1 dBm	-0.9 dB	±3.0 dB	Passed

Limit: Subclause 15.1.2.3 [1]

At all test frequencies, the carrier output power shall be ±1.5 dB of its nominal power levels under normal test conditions.

At all test frequencies, the carrier output power shall be ±3.0 dB of its nominal power levels under extreme test conditions.

Test equipment (please refer to chapter 9 for details)

2 - 5, 27, 28

### 5.3 Slotted transmission spectrum

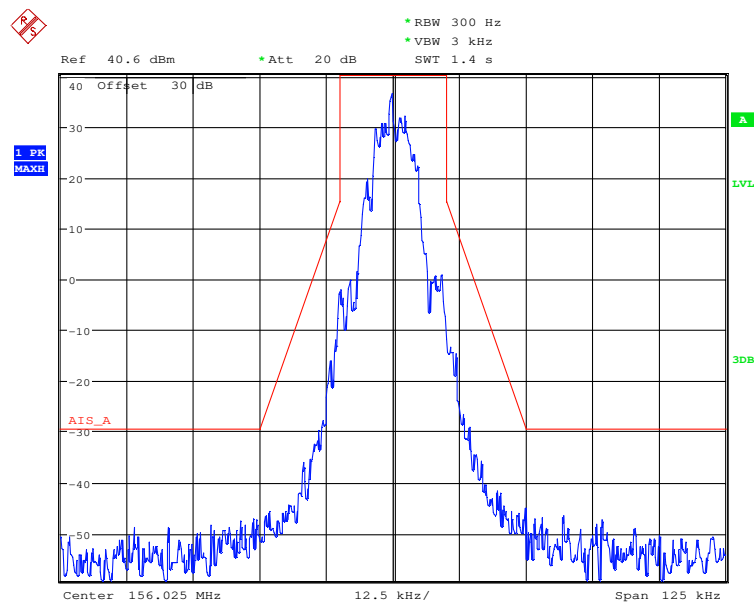
Subclause 15.1.3 [1]

Ambient temperature:	23 °C
Relative humidity:	45 %

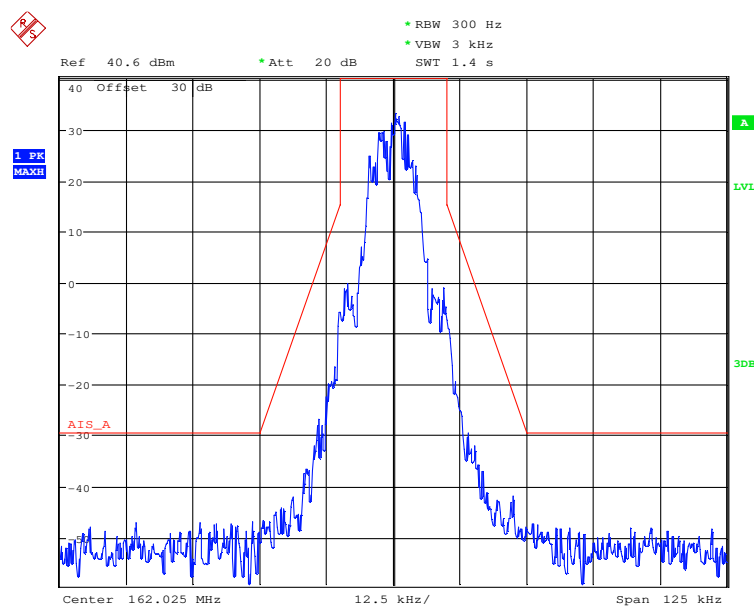
Date:	12.10.2021
Tested by:	Thomas KÜHN

Operation mode: Transmit in AIS-mode (test signal number 4)

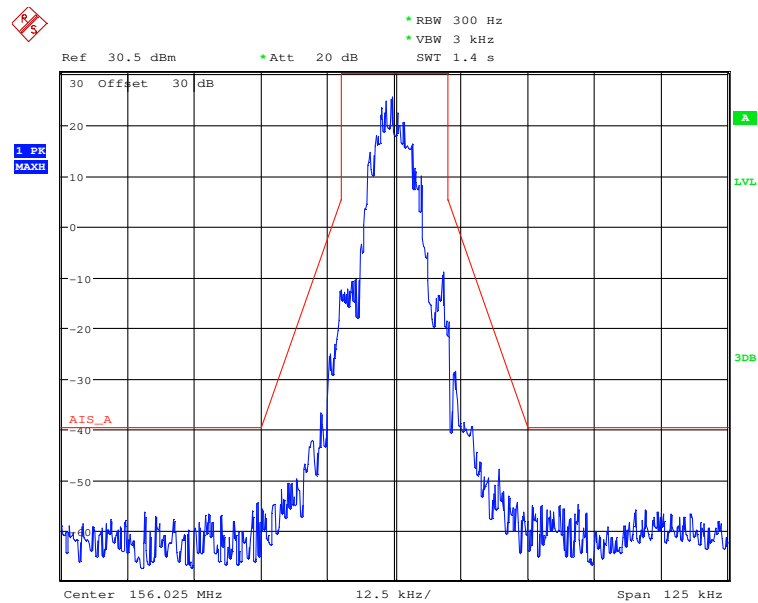
211774\_62.wmf: Transmission spectrum, transmit on 156.025 MHz, high power:



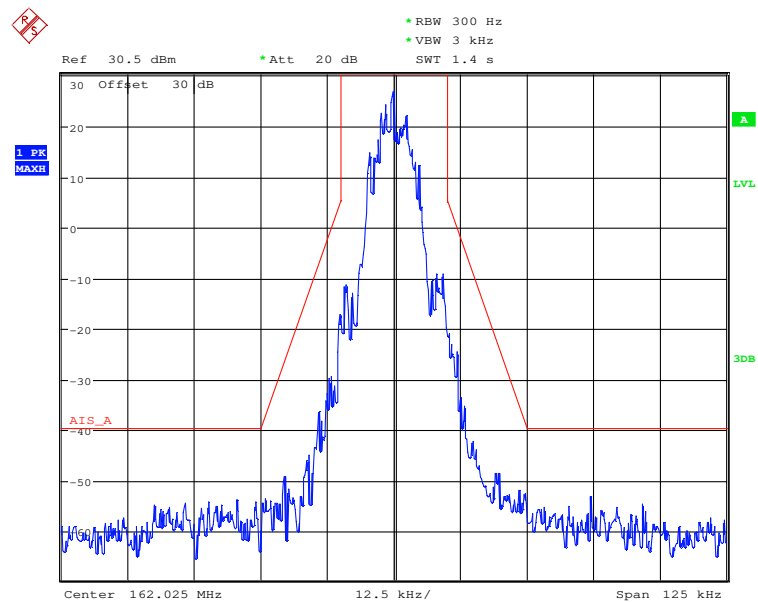
211774\_063.wmf: Transmission spectrum, transmit on 162.025 MHz, high power:



211774\_065.wmf: Transmission spectrum, transmit on 156.025 MHz, low power:



211774\_064.wmf: Transmission spectrum, transmit on 162.025 MHz, low power:



Limit: Subclause 15.1.3.3 [1]

In the region between the carrier and  $\pm 10$  kHz removed from the carrier, the modulation and transient sidebands shall be below 0 dBc.

At  $\pm 10$  kHz removed from the carrier, the modulation and transient sideband shall be below - 25 dBc.

At  $\pm 25$  kHz to  $\pm 62.5$  kHz removed from the carrier, the modulation and transient sideband shall be below the lower value of -70 dBc.

In the region  $\pm 10$  kHz and  $\pm 25$  kHz removed from the carrier, the modulation and transients sidebands shall be below a line specified between these two points.

Test equipment (please refer to chapter 9 for details)

1 – 4

## 5.4 Modulation accuracy

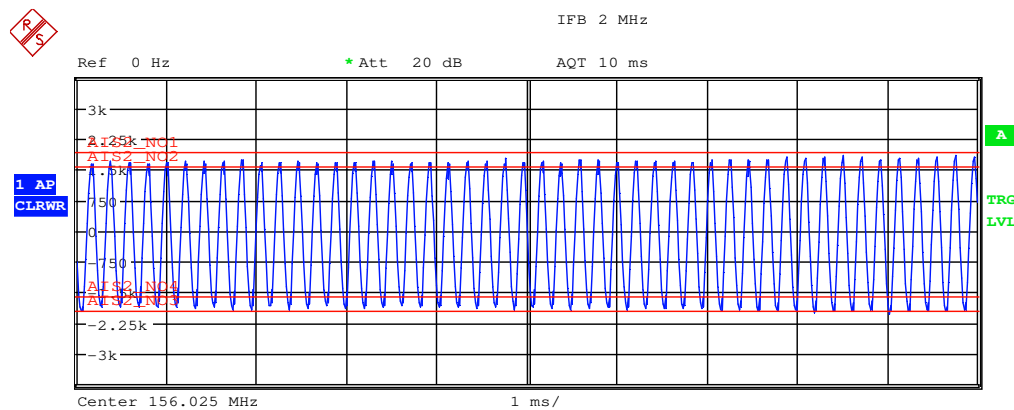
Subclause 15.1.4 [1]

Ambient temperature:	22 °C
Relative humidity:	38 %

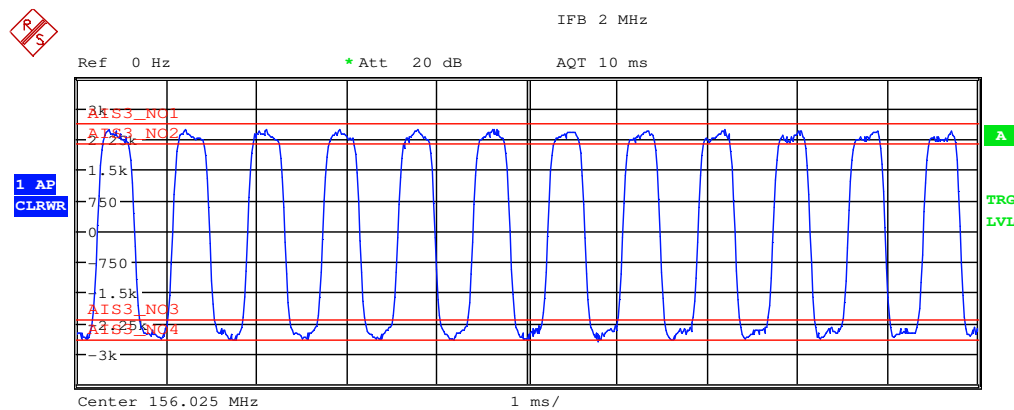
Date:	13.10.2021
Tested by:	Thomas KÜHN

Operation mode: Transmit in AIS-mode (test signal number 2 and 3)

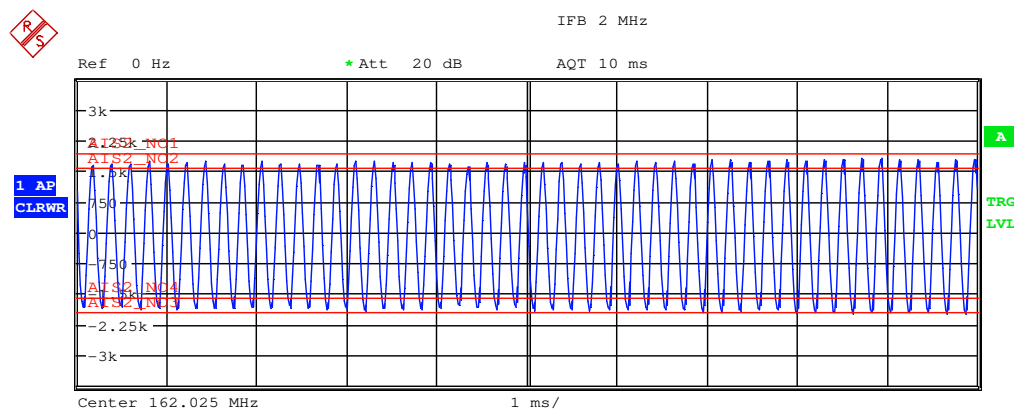
211774 67.wmf: Modulation accuracy, transmit on 156.025 MHz with test signal 2; U = 24.0 V DC; T = 20 °C:



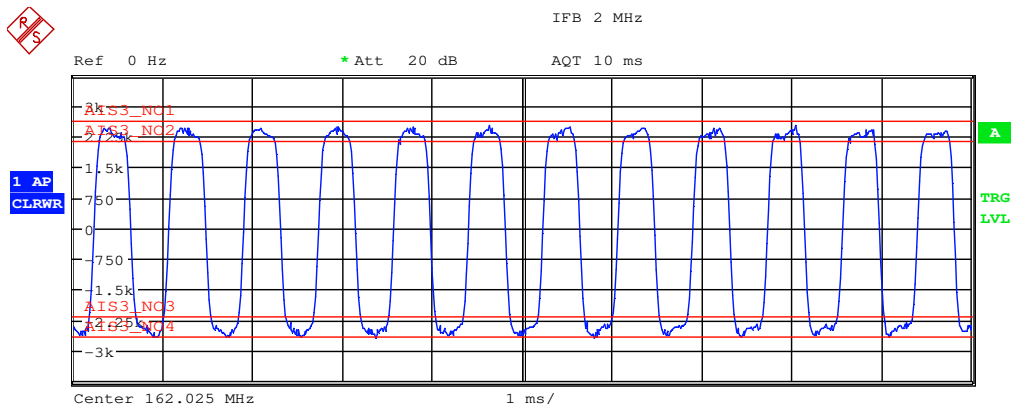
211774 68.wmf: Modulation accuracy, transmit on 156.025 MHz with test signal 3; U = 24.0V DC; T = 20 °C:



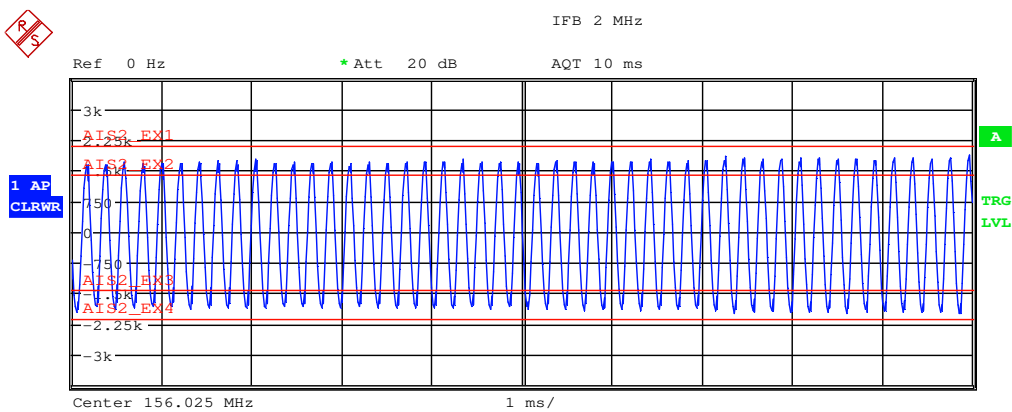
211774 66.wmf: Modulation accuracy, transmit on 162.025 MHz with test signal 2; U = 24.0 V<sub>DC</sub>; T = 20 °C:



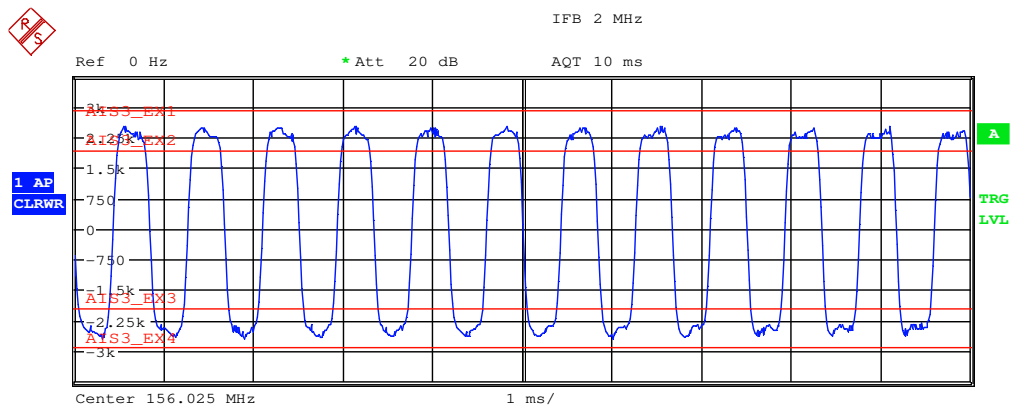
211774\_69.wmf: Modulation accuracy, transmit on 162.025 MHz with test signal 3; U = 24.0 V<sub>DC</sub>; T = 20 °C:



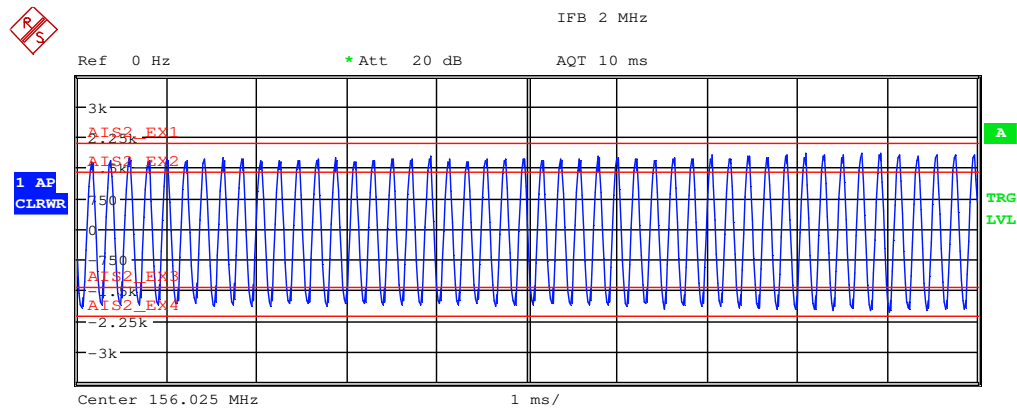
211774\_082.wmf: Modulation accuracy, transmit on 156.025 MHz with test signal 2; U = 10.8 V<sub>DC</sub>; T = -15 °C:



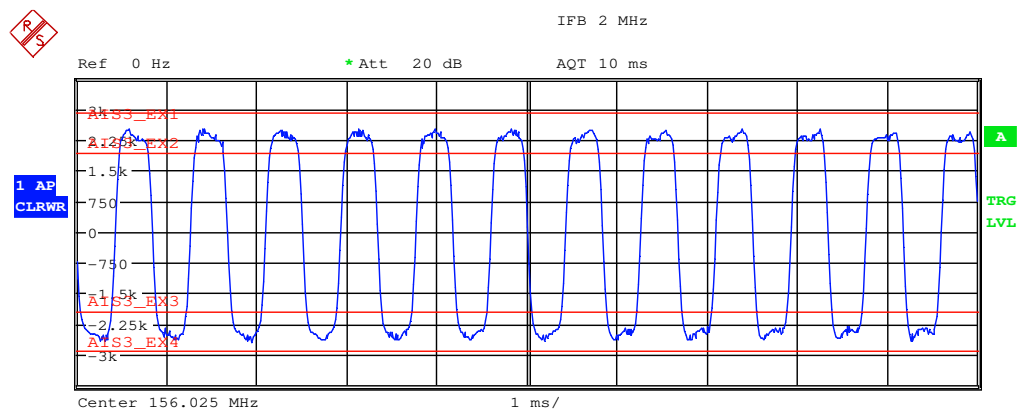
211774\_081.wmf: Modulation accuracy, transmit on 156.025 MHz with test signal 3; U = 10.8 V<sub>DC</sub>; T = -15 °C:



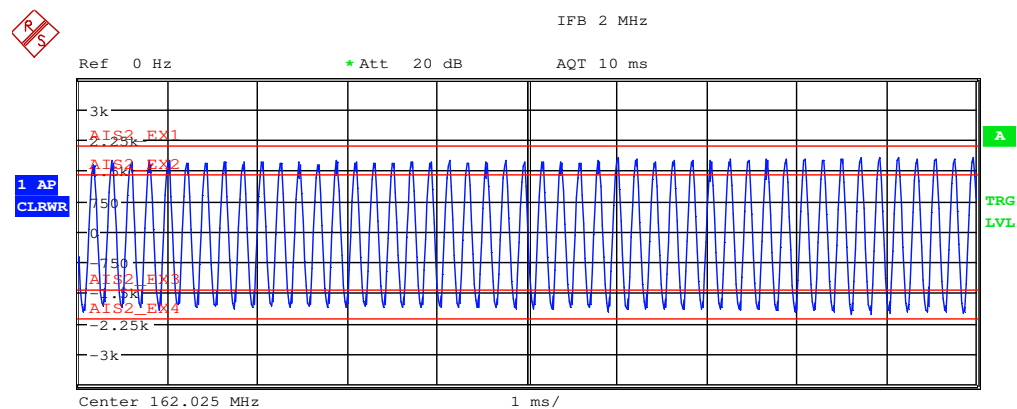
211774\_085.wmf: Modulation accuracy, transmit on 156.025 MHz with test signal 2; U = 31.2 V<sub>DC</sub>; T = -15 °C:



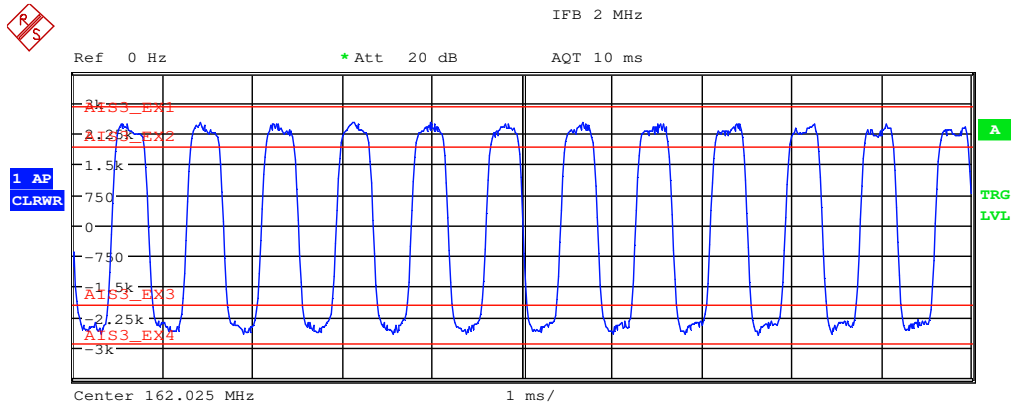
211774\_078.wmf: Modulation accuracy, transmit on 156.025 MHz with test signal 3; U = 31.2 V<sub>DC</sub>; T = -15 °C:



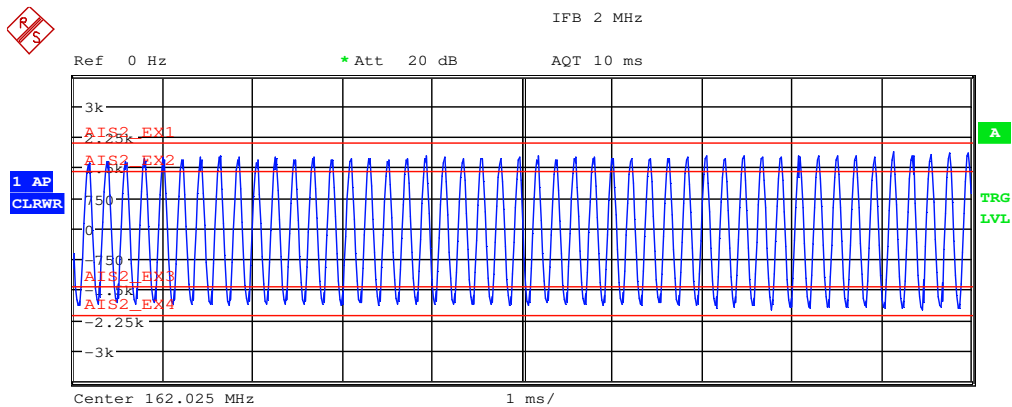
211774\_083.wmf: Modulation accuracy, transmit on 162.025 MHz with test signal 2; U = 10.8 V<sub>DC</sub>; T = -15 °C:



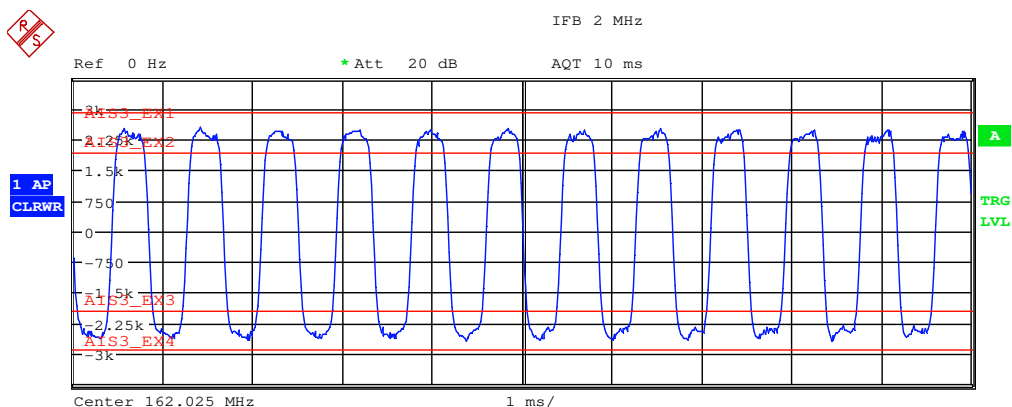
211774\_080.wmf: Modulation accuracy, transmit on 162.025 MHz with test signal 3; U = 10.8 V<sub>DC</sub>; T = -15 °C:



211774\_084.wmf: Modulation accuracy, transmit on 162.025 MHz with test signal 2; U = 31.2 V<sub>DC</sub>; T = -15 °C:

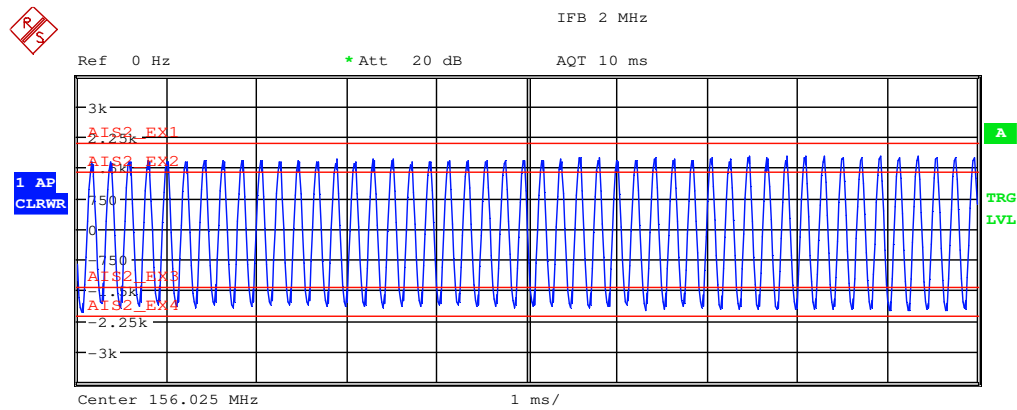


211774\_079.wmf: Modulation accuracy, transmit on 162.025 MHz with test signal 3; U = 31.2 V<sub>DC</sub>; T = -15 °C:

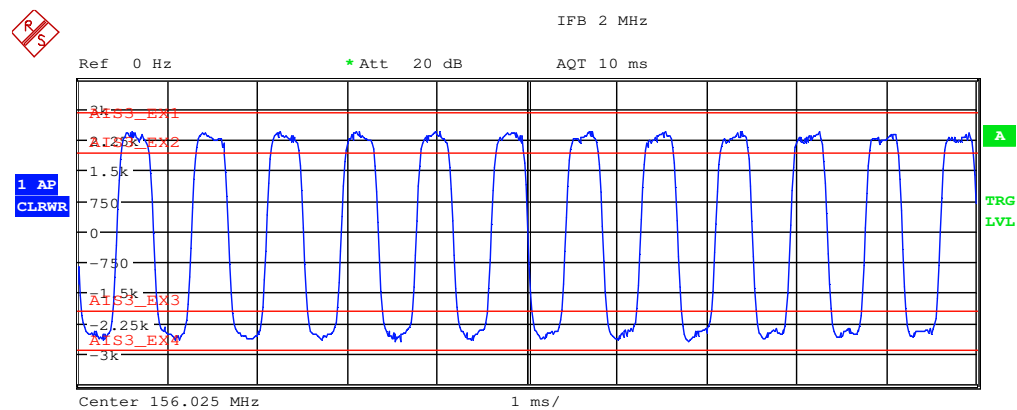




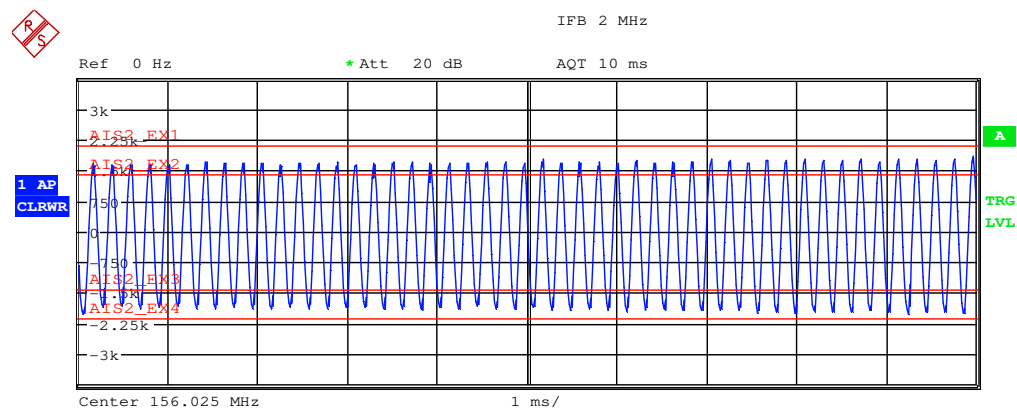
211774\_073.wmf: Modulation accuracy, transmit on 156.025 Hz with test signal 2;  $U = 10.8 \text{ V}_{\text{DC}}$ ;  $T = 55 \text{ }^{\circ}\text{C}$ :



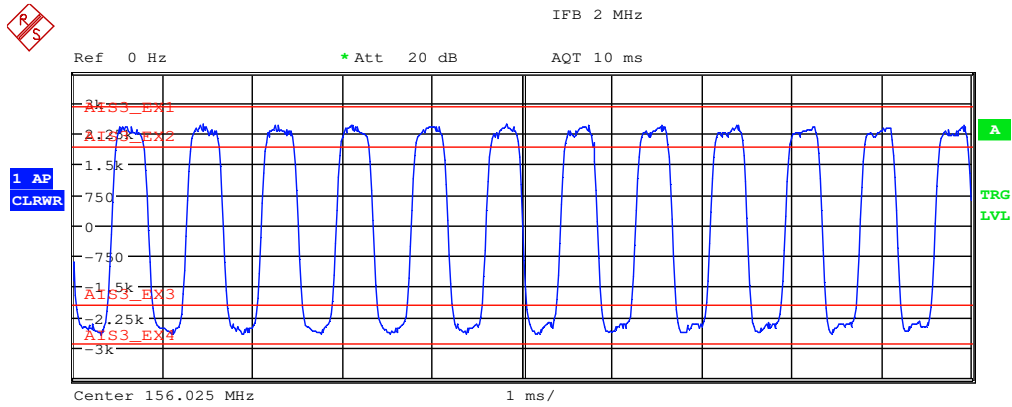
211774\_074.wmf: Modulation accuracy, transmit on 156.025 MHz with test signal 3;  $U = 10.8 \text{ V}_{\text{DC}}$ ;  $T = 55 \text{ }^{\circ}\text{C}$ :



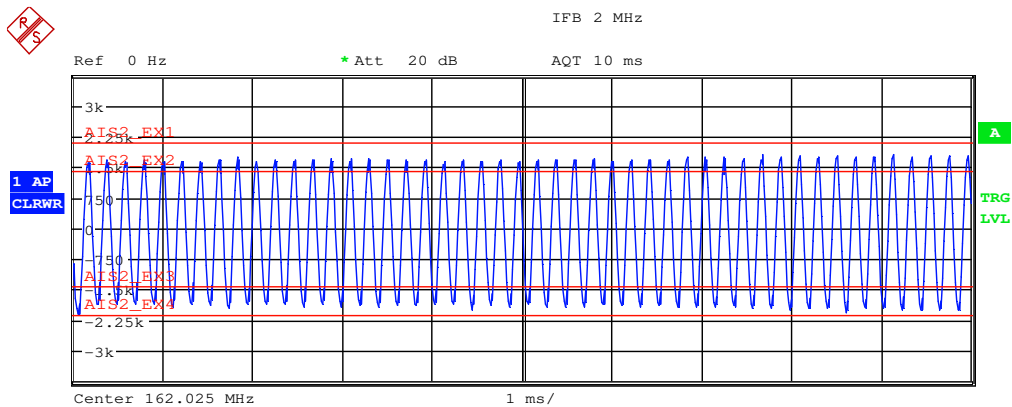
211774\_070.wmf: Modulation accuracy, transmit on 156.025 MHz with test signal 2;  $U = 31.2 \text{ V}_{\text{DC}}$ ;  $T = 55 \text{ }^{\circ}\text{C}$ :



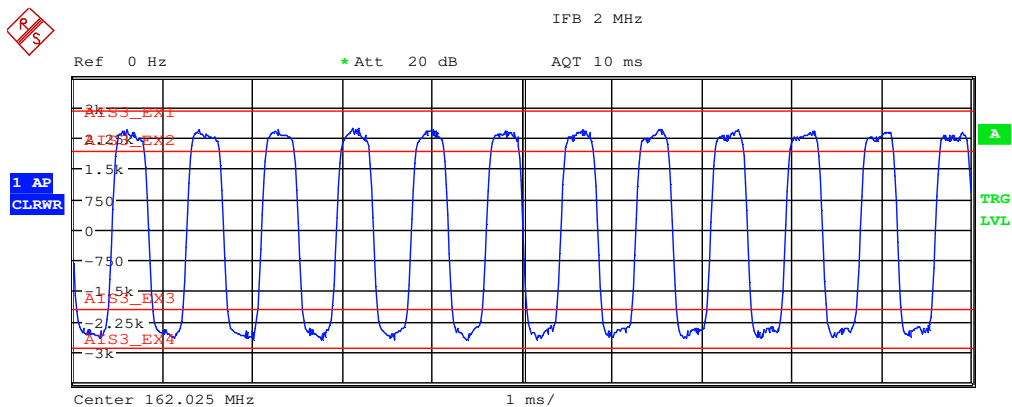
211774\_077.wmf: Modulation accuracy, transmit on 156.025 MHz with test signal 3; U = 31.2 V<sub>DC</sub>; T = 55 °C:



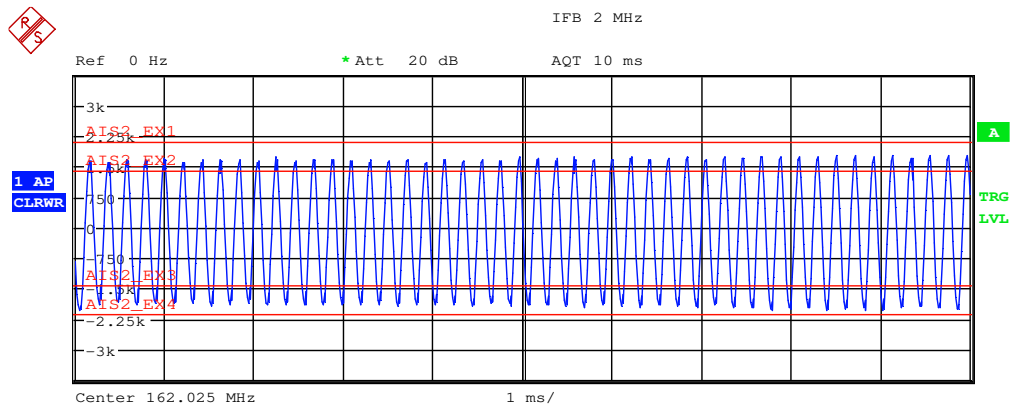
211774\_072.wmf: Modulation accuracy, transmit on 162.025 MHz with test signal 2; U = 10.8 V<sub>DC</sub>; T = 55 °C:



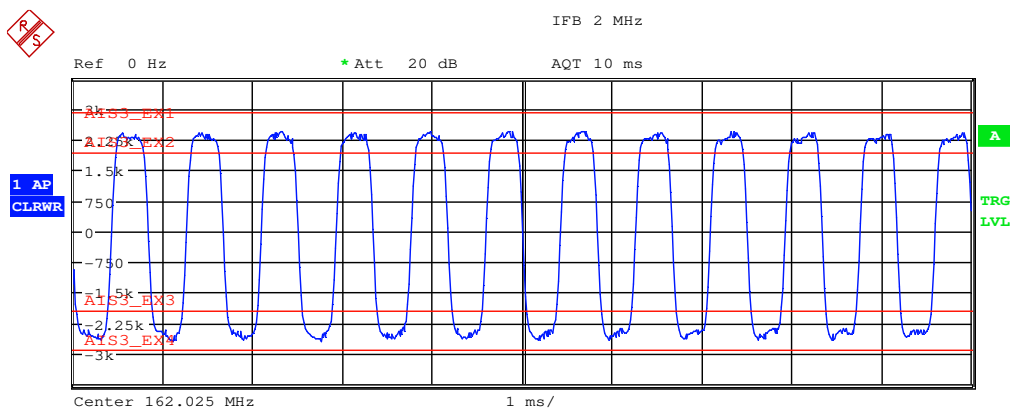
211774\_075.wmf: Modulation accuracy, transmit on 162.025 MHz with test signal 3; U = 10.8 V<sub>DC</sub>; T = 55 °C:



211774\_071.wmf: Modulation accuracy, transmit on 162.025 MHz with test signal 2; U = 31.2 V<sub>DC</sub>; T = 55 °C:



211774\_076.wmf: Modulation accuracy, transmit on 162.025 MHz with test signal 3; U = 31.2 V<sub>DC</sub>; T = 55 °C:



#### Additional Information:

Pretests have shown that the modulation accuracy is not depending on the output power. Therefore, only the “high-power-plots” are stated in this report.

Limit: Subclause 15.1.4.3 [1]

Test signal 2		Test signal 3	
Normal	Extreme	Normal	Extreme
1740 Hz ± 175 Hz	1740 Hz ± 350 Hz	2400 Hz ± 240 Hz	2400 Hz ± 480 Hz

Test equipment (please refer to chapter 9 for details)
1 – 5

## 5.5 Transmitter output power characteristics

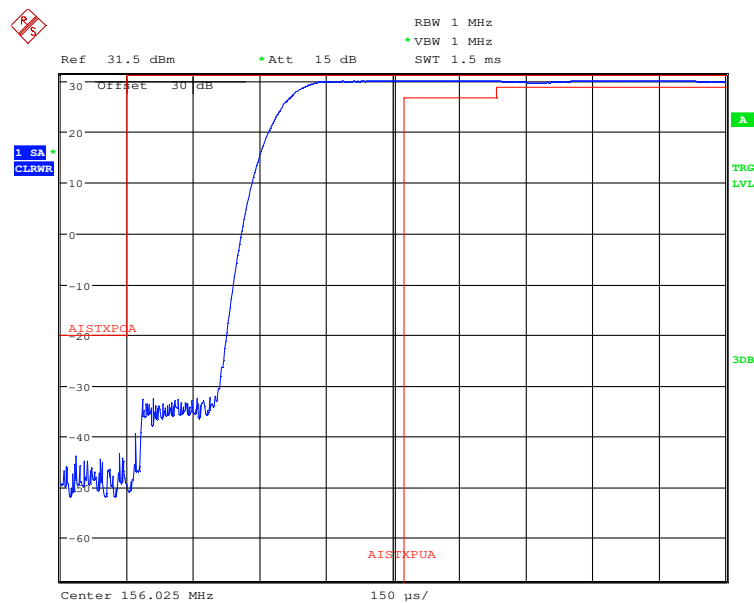
Subclause 15.1.5 [1]

Ambient temperature:	23 °C
Relative humidity:	45 %

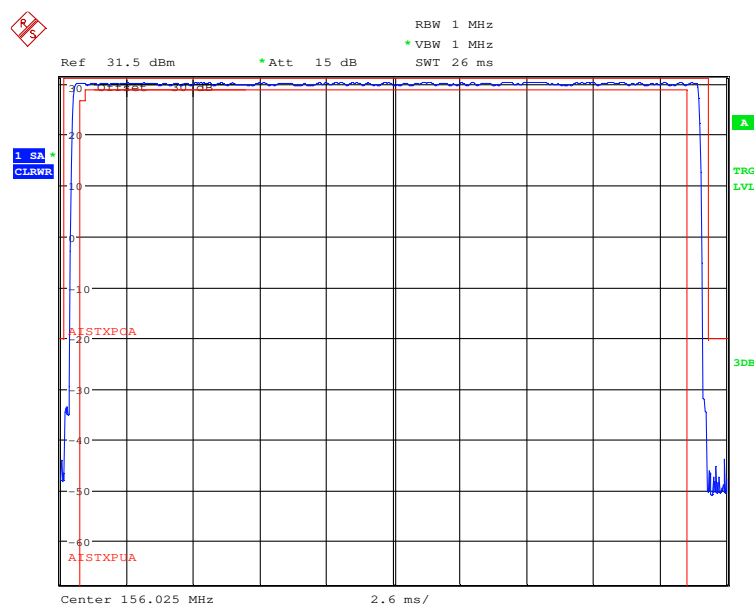
Date:	12.10.2021
Tested by:	Thomas KÜHN

Operation mode: Transmit in AIS-mode (test signal number 2)

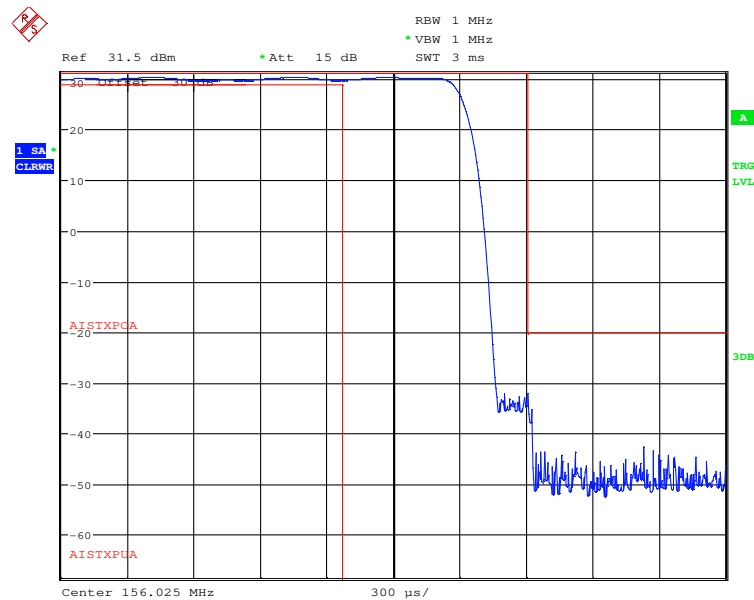
211774 54.wmf: Transmitter power versus time characteristics, transmit on 156.025 MHz, low power:



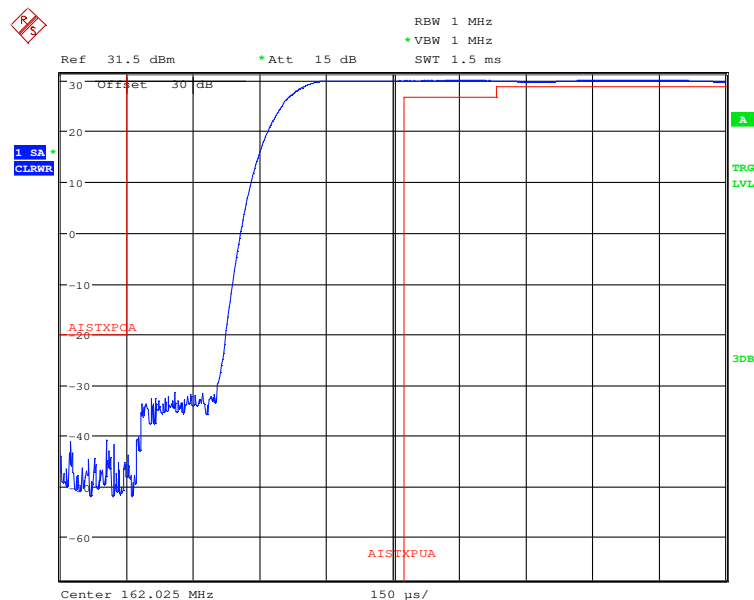
211774 55.wmf: Transmitter power versus time characteristics, transmit on 156.025 MHz, low power:



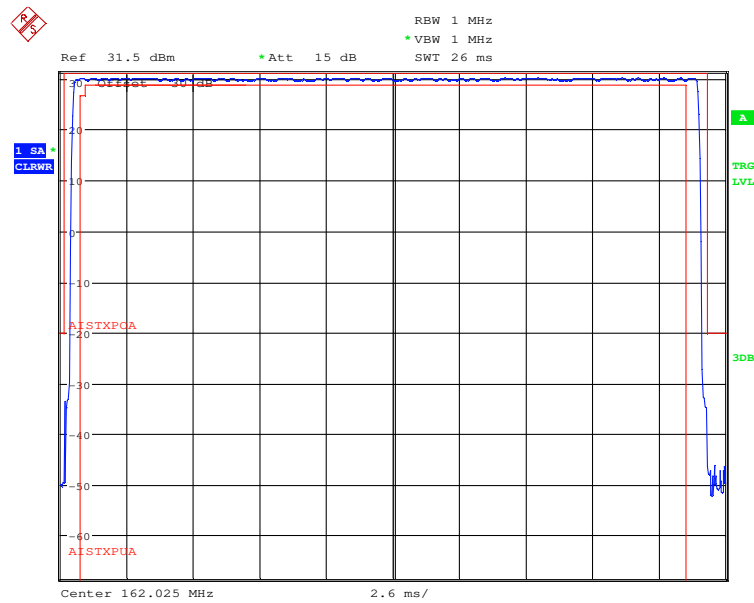
211774\_53.wmf: Transmitter power versus time characteristics, transmit on 156.025 MHz, low power:



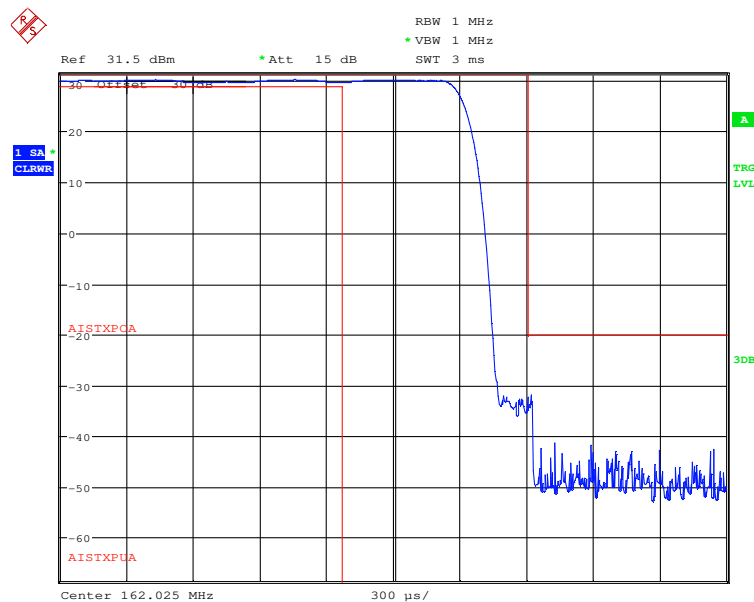
211774\_050.wmf: Transmitter power versus time characteristics, transmit on 162.025 MHz, low power:



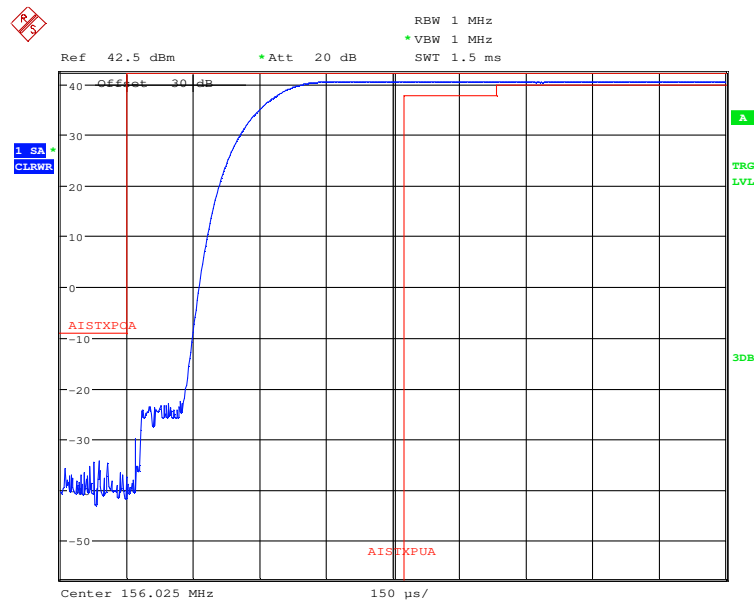
211774\_051.wmf: Transmitter power versus time characteristics, transmit on 162.025 MHz, low power:



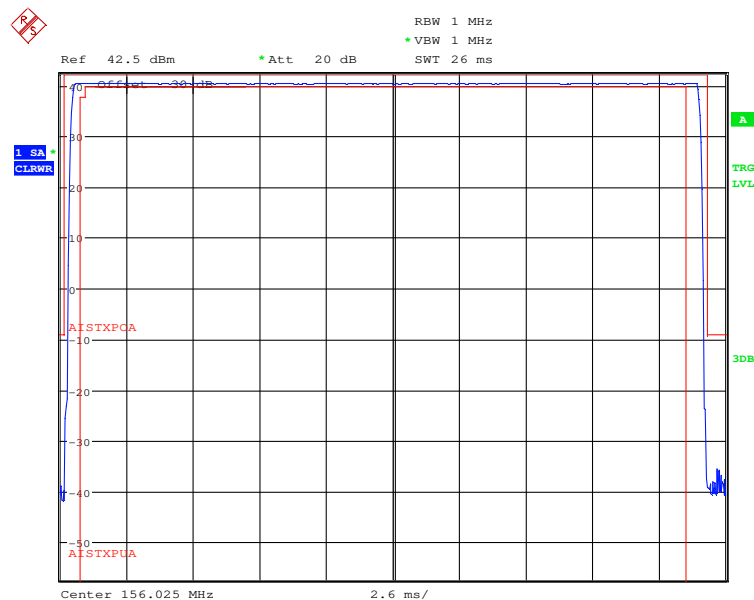
211774\_052.wmf: Transmitter power versus time characteristics, transmit on 162.025 MHz, low power:



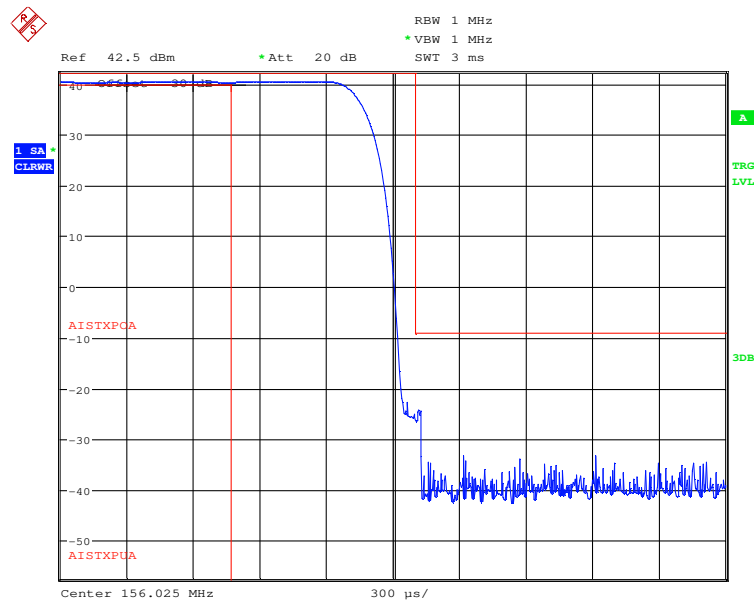
211774\_060.wmf: Transmitter power versus time characteristics, transmit on 156.025 MHz, high power:



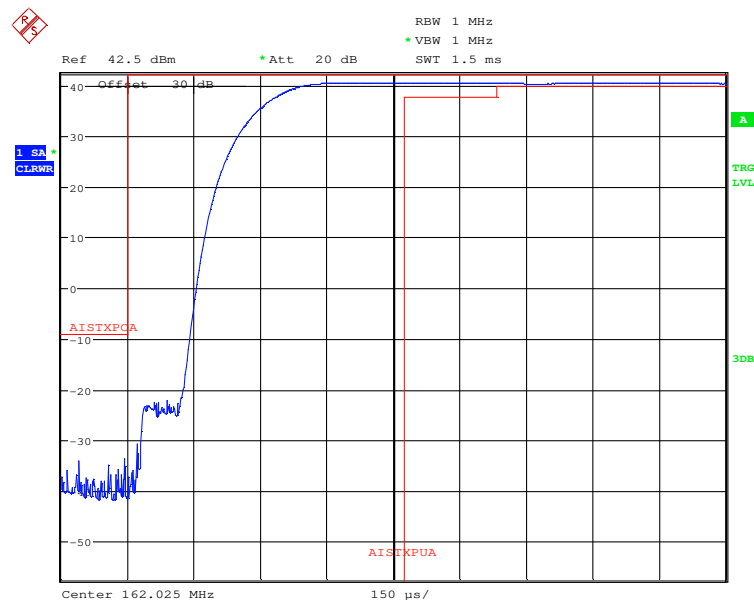
211774\_056.wmf: Transmitter power versus time characteristics, transmit on 156.025 MHz high power:



211774\_059.wmf: Transmitter power versus time characteristics, transmit on 156.025 MHz, high power:

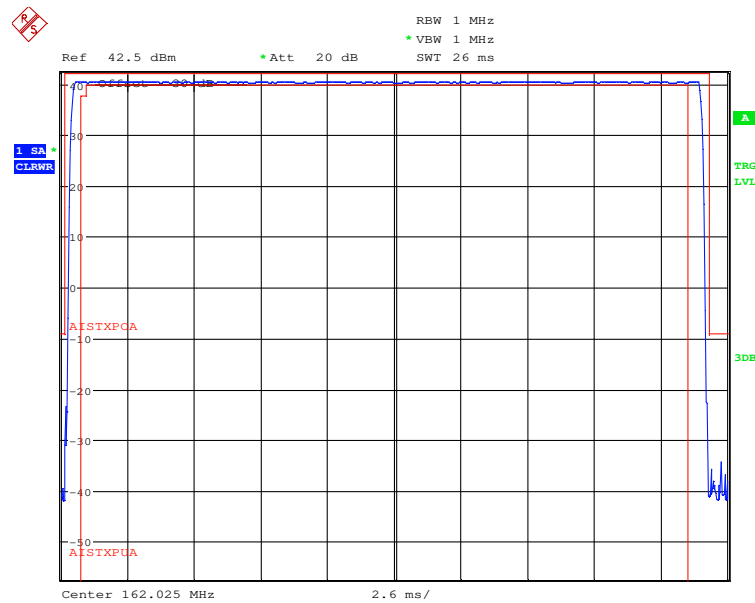


211774\_061.wmf: Transmitter power versus time characteristics, transmit on 162.025 MHz high power:

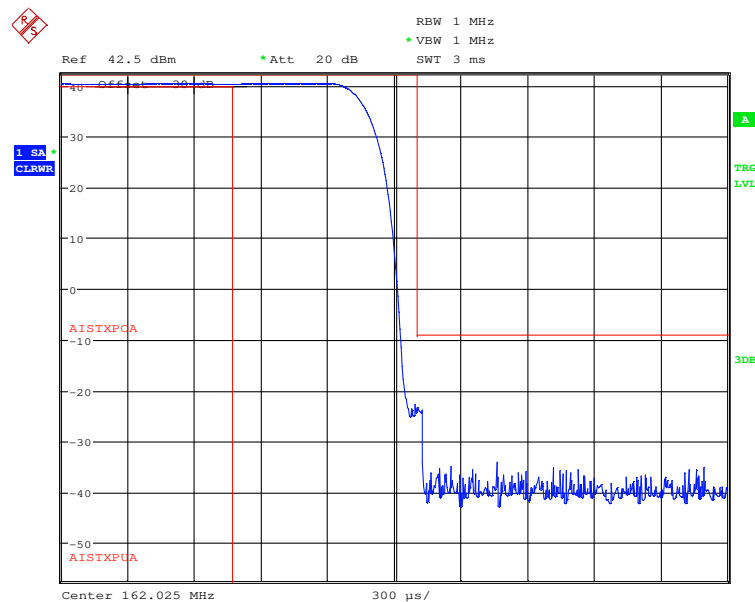




211774\_057.wmf: Transmitter power versus time characteristics, transmit on 162.025 MHz, high power:



211774\_058.wmf: Transmitter power versus time characteristics, transmit on 162.025 MHz high power:



Limit: Subclause 15.1.5.3 [1]

See table 10 [1].

Test equipment (please refer to chapter 9 for details)

1 - 4

## 6 Receiver requirements

### 6.1 TDMA receiver sensitivity

Subclause 15.2.1 [1]

Ambient temperature:	22 °C
Relative humidity:	38 %

Date:	11.10.2021
Tested by:	Thomas KÜHN

Operation mode: Receive on 156.025 MHz (-107 dBm (normal) / 104 dBm (normal  $\pm 500$  Hz) /  
-101 dBm (extreme) conditions)

Wanted signal: Test signal 5

Measurement conditions		Frequency	PER	Limit	Test result	20 % limit reached at *
Temperature	Voltage					
T <sub>nom</sub> (+ 20 °C)	U <sub>nom</sub> (24.0 V <sub>DC</sub> )	156.0245 MHz	0 %	20 %	Passed	-119 dBm
		156.025 MHz	0 %	20 %	Passed	-119 dBm
		156.0255 MHz	0 %	20 %	Passed	-119 dBm
T <sub>min</sub> (-15 °C)	U <sub>min</sub> (10.8 V <sub>DC</sub> )	156.025 MHz	0 %	20 %	Passed	-119 dBm
	U <sub>max</sub> (31.2 V <sub>DC</sub> )	156.025 MHz	0 %	20 %	Passed	-119 dBm
T <sub>max</sub> (55 °C)	U <sub>min</sub> (10.8 V <sub>DC</sub> )	156.025 MHz	0 %	20 %	Passed	-119 dBm
	U <sub>max</sub> (31.2 V <sub>DC</sub> )	156.025 MHz	0 %	20 %	Passed	-118 dBm

\*: Applicant requests this test, no limits defined in the standard.

Operation mode: Receive on 162.025 MHz (-107 dBm (normal) / 104 dBm (normal  $\pm 500$  Hz) /  
-101 dBm (extreme) conditions)

Wanted signal: Test signal 5

Measurement conditions		Frequency	PER	Limit	Test result	20 % limit reached at *
Temperature	Voltage					
T <sub>nom</sub> (+ 20 °C)	U <sub>nom</sub> (24.0 V <sub>DC</sub> )	162.0245 MHz	0 %	20 %	Passed	-119 dBm
		162.025 MHz	0 %	20 %	Passed	-119 dBm
		162.0255 MHz	0 %	20 %	Passed	-119 dBm
T <sub>min</sub> (-15 °C)	U <sub>min</sub> (10.8 V <sub>DC</sub> )	162.025 MHz	0 %	20 %	Passed	-119 dBm
	U <sub>max</sub> (31.2 V <sub>DC</sub> )	162.025 MHz	0 %	20 %	Passed	-118 dBm
T <sub>max</sub> (55 °C)	U <sub>min</sub> (10.8 V <sub>DC</sub> )	162.025 MHz	0 %	20 %	Passed	-119 dBm
	U <sub>max</sub> (31.2 V <sub>DC</sub> )	162.025 MHz	0 %	20 %	Passed	-118 dBm

\*: Applicant requests this test, no limits defined in the standard.

Limit: Subclause 15.2.1.3 [1]

The PER shall not exceed 20 %.

Test equipment (please refer to chapter 9 for details)

3 - 6

## 6.2 TDMA receiver error behaviour at high input levels

Subclause 15.2.2 [1]

Ambient temperature:	22 °C
Relative humidity:	48 %

Date:	07.10.2021
Tested by:	Thomas KÜHN

Operation mode: Receive in AIS-mode on 156.025 MHz  
Wanted signal: Test signal 5

RF-input signal level	PER	Limit	Test result
- 77 dBm	0 %	1 %	Passed
- 7 dBm	0 %	1 %	Passed

Operation mode: Receive in AIS-mode on 162.025 MHz  
Wanted signal: Test signal 5

RF-INPUT signal level	PER	Limit	Test result
- 77 dBm	0 %	1 %	Passed
- 7 dBm	0 %	1 %	Passed

Limit: Subclause 15.2.2.3 [1]

The PER shall not exceed 1 %.
-------------------------------

Test equipment (please refer to chapter 9 for details)
3, 4, 6

### 6.3 TDMA receiver co-channel rejection

Subclause 15.2.3 [1]

Ambient temperature:	22 °C
Relative humidity:	37 %

Date:	11.10.2021
Tested by:	Thomas KÜHN

Operation mode: Receive in AIS-mode on 156.025 MHz

Wanted signal: Test-signal 5

Unwanted signal: Test signal 4 continuously (without ramping)

Unwanted signal frequency	Wanted signal level	Unwanted signal level	Signal ratio	PER	Limit	Test result
156.024 MHz	-104 dBm	-114 dBm	10 dB	0 %	20 %	Passed
156.025 MHz	-104 dBm	-114 dBm	10 dB	0 %	20 %	Passed
156.026 MHz	-104 dBm	-114 dBm	10 dB	0 %	20 %	Passed

Operation mode: Receive in AIS-mode on 162.025 MHz

Wanted signal: Test-signal 5, P = -104 dBm

Unwanted signal: Test signal 4 continuously (without ramping)

Unwanted signal frequency	Wanted signal level	Unwanted signal level	Signal ratio	PER	Limit	Test result
162.024 MHz	-104 dBm	-114 dBm	10 dB	0 %	20 %	Passed
162.025 MHz	-104 dBm	-114 dBm	10 dB	0 %	20 %	Passed
162.026 MHz	-104 dBm	-114 dBm	10 dB	0 %	20 %	Passed

Limit: Subclause 15.2.3.3 [1]

The maximum PER shall not exceed 20 %.

Test equipment (please refer to chapter 9 for details)

3, 4, 6 - 9

## 6.4 TDMA receiver adjacent channel selectivity

Subclause 15.2.4 [1]

Ambient temperature:	22 °C
Relative humidity:	38 %

Date:	11.10.2021
Tested by:	Thomas KÜHN

Operation mode: Receive in AIS mode  
 Wanted signal: Test-signal, 5 P = -104 dBm (normal conditions) / -98 dBm (extreme conditions)  
 Unwanted signal: Modulated with 400 Hz / 3 kHz deviation,  
 P = -34 dBm (normal conditions) / -38 dBm (extreme conditions)

Test conditions		Wanted signal	Unwanted signal	Signal ratio	PER	Limit	Test result
Temperature	Voltage						
T <sub>nom</sub> (+20 °C)	U <sub>nom</sub> (24.0 V <sub>DC</sub> )	156.025 MHz	156.000 MHz	70 dB	0 %	20 %	Passed
			156.050 MHz	70 dB	0 %	20 %	Passed
		162.025 MHz	162.000 MHz	70 dB	0 %	20 %	Passed
			162.050 MHz	70 dB	0 %	20 %	Passed
T <sub>min</sub> (-15 °C)	U <sub>min</sub> (10.8 V <sub>DC</sub> )	156.025 MHz	156.000 MHz	60 dB	0 %	20 %	Passed
			156.050 MHz	60 dB	0 %	20 %	Passed
	U <sub>max</sub> (31.2 V <sub>DC</sub> )	156.025 MHz	156.000 MHz	60 dB	0 %	20 %	Passed
			156.050 MHz	60 dB	0 %	20 %	Passed
	U <sub>min</sub> (10.8 V <sub>DC</sub> )	162.025 MHz	162.000 MHz	60 dB	0 %	20 %	Passed
			162.050 MHz	60 dB	0 %	20 %	Passed
	U <sub>max</sub> (31.2 V <sub>DC</sub> )	162.025 MHz	162.000 MHz	60 dB	0 %	20 %	Passed
			162.050 MHz	60 dB	0 %	20 %	Passed
T <sub>max</sub> (+55 °C)	U <sub>min</sub> (10.8 V <sub>DC</sub> )	156.025 MHz	156.000 MHz	60 dB	0 %	20 %	Passed
			156.050 MHz	60 dB	0 %	20 %	Passed
	U <sub>max</sub> (31.2 V <sub>DC</sub> )	156.025 MHz	156.000 MHz	60 dB	0 %	20 %	Passed
			156.050 MHz	60 dB	0 %	20 %	Passed
	U <sub>min</sub> (10.8 V <sub>DC</sub> )	162.025 MHz	162.000 MHz	60 dB	0 %	20 %	Passed
			162.050 MHz	60 dB	0 %	20 %	Passed
	U <sub>max</sub> (31.2 V <sub>DC</sub> )	162.025 MHz	162.000 MHz	60 dB	0 %	20 %	Passed
			162.050 MHz	60 dB	0 %	20 %	Passed

Limit: Subclause 15.2.4.3 [1]

The PER shall not exceed 20 %.

Test equipment (please refer to chapter 9 for details)

3 - 8

## 6.5 TDMA receiver spurious response rejection

Subclause 15.2.5 [1]

Ambient temperature:	22 °C
Relative humidity:	38 %

Date:	08.10.2021
Tested by:	Thomas KÜHN

Operation mode: Receive in AIS-mode on 156.025 MHz,  
 $f_{ADC} = 98.304$  MHz, no IF,  
 Wanted signal: Test-signal 1, P = -104 dBm  
 Unwanted signal: Unmodulated, P = -34 dBm

Results of the measurement of specific frequencies of interest				
Definition	Unwanted frequency	PER	Limit	Test result
Nyquist band 1	40.583 MHz	0 %	20 %	Passed
Nyquist band 2	57.721 MHz	0 %	20 %	Passed
Nyquist band 3	138.887 MHz	0 %	20 %	Passed
Nyquist band 4	156.025 MHz	No test, wanted signal	20 %	-
Nyquist band 5	237.191 MHz	0 %	20 %	Passed
Nyquist band 6	254.329 MHz	0 %	20 %	Passed
Nyquist band 7	335.495 MHz	0 %	20 %	Passed
Nyquist band 8	352.633 MHz	0 %	20 %	Passed
Nyquist band 9	433.799 MHz	0 %	20 %	Passed
Nyquist band 10	450.937 MHz	0 %	20 %	Passed
Nyquist band 11	532.103 MHz	0 %	20 %	Passed
Nyquist band 12	549.241 MHz	0 %	20 %	Passed

The following settings were used for the searching over the limited frequency range:  
 Because the receiver has no IF, the range was calculated with the receiver switching range  $\pm 3$  MHz  
 Limited frequency range: 153.025 MHz to 166.025 MHz (stepped with 5 kHz).  
 Operation mode: Receive in AIS mode on 156.025 MHz  
 Wanted signal: 156.025 MHz with P = -104 dBm.  
 Unwanted signal: Modulated with 400 Hz / 3 kHz deviation, P = -24 dBm.

Result for searching over the limited frequency range: No frequencies with an influence were found.

Continued next page:

Continued:

Operation mode: Receive in AIS-mode on 162.025 MHz,  
 $f_{ADC} = 98.304$  MHz, no IF,  
 Wanted signal: Test-signal 1, P = -104 dBm  
 Unwanted signal: Unmodulated, P = -34 dBm

Results of the measurement of specific frequencies of interest				
Definition	Unwanted frequency	PER	Limit	Test result
Nyquist band 1	34.583 MHz	0 %	20 %	Passed
Nyquist band 2	63.721 MHz	0 %	20 %	Passed
Nyquist band 3	132.887 MHz	0 %	20 %	Passed
Nyquist band 4	162.025 MHz	No test, wanted signal	20 %	-
Nyquist band 5	231.191 MHz	0 %	20 %	Passed
Nyquist band 6	260.329 MHz	0 %	20 %	Passed
Nyquist band 7	329.495 MHz	0 %	20 %	Passed
Nyquist band 8	358.633 MHz	0 %	20 %	Passed
Nyquist band 9	427.799 MHz	0 %	20 %	Passed
Nyquist band 10	456.937 MHz	0 %	20 %	Passed
Nyquist band 11	526.103 MHz	0 %	20 %	Passed
Nyquist band 12	555.241 MHz	0 %	20 %	Passed

The following settings were used for the searching over the limited frequency range:  
 Because the receiver has no IF, the range was calculated with the receiver switching range  $\pm 3$  MHz  
 Limited frequency range: 153.025 MHz to 166.025 MHz (stepped with 5 kHz).  
 Operation mode: Receive in AIS mode on 162.025 MHz  
 Wanted signal: 156.025 MHz with P = -104 dBm.  
 Unwanted signal: Modulated with 400 Hz / 3 kHz deviation,  
 P = -31 dBm (measurement) / -24 dBm (searching over the limited frequency range).

Results of the measurement over the limited frequency range			
Definition	Unwanted frequency	PER	Test result
Search result	159.995 MHz	0.0 %	Passed

Limit: Subclause 15.2.5.6 [1]

At any frequency separated from the nominal frequency of the receiver by two channels or more, the spurious responses shall not result in a PER of greater than 20 %.

Test equipment (please refer to chapter 9 for details)
3, 4, 6 - 8

## 6.6 TDMA receiver intermodulation response rejection and blocking

Subclause 15.2.6 [1]

Ambient temperature:	22 °C
Relative humidity:	38 %

Date:	08.10.2021
Tested by:	Thomas KÜHN

Wanted signal A: Test-signal 5, P = -101 dBm  
 Unwanted signal B: Modulated 400 Hz / 3 kHz, RF-level -27 dBm  
 Unwanted signal C: Unmodulated, P = -27 dBm  
 Unwanted signal D: Unmodulated, P = -15 dBm

Operation mode: Receive in AIS-mode on 156.025 MHz

Frequencies of the unwanted signals			PER	Limit	Test result
Generator B	Generator C	Generator D			
156.525 MHz	157.025 MHz	161.750 MHz	0 %	20 %	Passed

Operation mode: Receive in AIS-mode on 162.025 MHz

Frequencies of the unwanted signals			PER	Limit	Test result
Generator B	Generator C	Generator D			
161.525 MHz	161.025 MHz	156.300 MHz	2 %	20 %	Passed

Limit: Subclause 15.2.6.3 [1]

The packet error rate shall not exceed 20 %.
--

Test equipment (please refer to chapter 9 for details)
3, 4, 6, 8, 10 - 16



## 6.7 TDMA receiver transmit to receive switching time

Subclause 15.2.7 [1]

Ambient temperature:	22 °C
Relative humidity:	42 %

Date:	15.10.2021
Tested by:	Thomas KÜHN

Wanted signal: Test-signal 5

Operation mode: Receive in the time slot after transmission on 156.025 MHz

Operation mode	Receiver sensitivity	PER	Limit	Test result
Receive in time slot after transmission	-107 dBm	0 %	20 %	Passed

Operation mode: Receive in the time slot after transmission on 162.025 MHz

Operation mode	Receiver sensitivity	PER	Limit	Test result
Receive in time slot after transmission	-107 dBm	0 %	20 %	Passed

Limit: Subclause 15.2.7.3 [1]

The PER shall not exceed 20 %.
--------------------------------

Test equipment (please refer to chapter 9 for details)
2 - 4, 17 - 21

## 6.8 TDMA receiver immunity to out-of-band energy

Subclause 15.2.8 [1]

Ambient temperature:	22 °C
Relative humidity:	37 %

Date:	11.10.2021
Tested by:	Thomas KÜHN

Wanted signal A: Test-signal 5  
Unwanted signal B: Unmodulated

Operation mode: Receive in AIS-mode on 156.025 MHz  
Wanted signal: P = -101 dBm

Generator B frequency	Signal level	PER	Limit	Test result
174.000 MHz	-5 dBm	0 %	20 %	Passed

Operation mode: Receive in AIS-mode on 162.025 MHz  
Wanted signal: P = -101 dBm

Generator B frequency	Signal level	PER	Limit	Test result
174.000 MHz	-5 dBm	0 %	20 %	Passed

Limit: Subclause 15.2.8.3 [1]

The packet error rate shall not exceed 20 %.
--

Test equipment (please refer to chapter 9 for details)
3, 4, 6 - 8

## 7 Conducted spurious emissions

### 7.1 Spurious emissions from the transmitter

Subclause 15.3.1 [1]

Ambient temperature:	22 °C
Relative humidity:	35 %

Date:	24.11.2021
Tested by:	Thomas KÜHN

Operation mode: Transmit in AIS-mode (without modulation)

Spurious emissions level (conducted), transmitter operates on 156.025 MHz, P = 30 dBm					
f [MHz]	Level [dBm]	Bandwidth [kHz]	Limit [dBm]	Margin [dB]	Result
65.238	-53.4	100	-36.0	17.4	Passed
155.521	-47.9	10	-36.0	11.9	Passed
155.835	-43.3	20	-36.0	7.3	Passed
156.260	-42.8	20	-36.0	6.8	Passed
156.525	-47.2	10	-36.0	11.2	Passed
312.050	-60.8	1	-36.0	24.8	Passed

Spurious emissions level (conducted), transmitter operates on 156.025 MHz, P = 41 dBm					
f [MHz]	Level [dBm]	Bandwidth [kHz]	Limit [dBm]	Margin [dB]	Result
60.283	-53.2	100	-36.0	17.2	Passed
149.880	-46.7	50	-36.0	10.7	Passed
154.247	-48.8	10	-36.0	12.8	Passed
155.161	-43.2	10	-36.0	7.2	Passed
155.391	-39.2	20	-36.0	3.2	Passed
156.659	-40.3	20	-36.0	4.3	Passed
156.914	-42.4	10	-36.0	6.4	Passed
157.798	-48.4	10	-36.0	12.4	Passed
162.160	-46.8	50	-36.0	10.8	Passed
312.050	-38.6	1	-36.0	2.6	Passed

Continued next page

Continued

Spurious emissions level (conducted), transmitter operates on 162.025 MHz, P = 30 dBm					
f [MHz]	Level [dBm]	Bandwidth [kHz]	Limit [dBm]	Margin [dB]	Result
61.759	-52.5	100	-36.0	16.5	Passed
155.807	-48.2	100	-36.0	12.2	Passed
161.640	-47.7	20	-36.0	11.7	Passed
161.825	-43.4	20	-36.0	7.4	Passed
162.222	-43.5	20	-36.0	7.5	Passed
162.525	-46.6	20	-36.0	10.6	Passed
168.294	-50.9	100	-36.0	14.9	Passed
324.050	-59.3	1	-36.0	23.3	Passed

Spurious emissions level (conducted), transmitter operates on 162.025 MHz, P = 41 dBm					
f [MHz]	Level [dBm]	Bandwidth [kHz]	Limit [dBm]	Margin [dB]	Result
58.465	-51.9	100	-36.0	15.9	Passed
121.995	-53.5	100	-36.0	17.5	-36.0
155.877	-38.6	100	-36.0	2.6	-36.0
160.201	-48.7	20	-36.0	12.7	-36.0
161.291	-42.3	20	-36.0	6.3	-36.0
161.655	-41.6	20	-36.0	5.6	-36.0
162.390	-41.7	20	-36.0	5.7	-36.0
161.689	-40.1	20	-36.0	4.1	-36.0
163.848	-49.1	20	-36.0	13.1	-36.0
168.166	-41.0	100	-36.0	5.0	-36.0
324.050	-38.6	1	-36.0	2.6	-36.0

Limit: Subclause 15.3.1.3 [1]

The power of any spurious emission on any discrete frequency shall not exceed 0,25  $\mu$ W (-36 dBm) in the frequency range 9 kHz to 1 GHz and 1  $\mu$ W (-30 dBm) in the frequency range 1 GHz to 4 GHz.

Test equipment (please refer to chapter 9 for details)

18, 19, 22 - 25

## 7.2 Spurious emissions from the receiver

Subclause 15.3.2 / C.2.8 [1]

Ambient temperature:	22 °C
Relative humidity:	44 %

Date:	06.10.2021
Tested by:	Thomas KÜHN

Operation mode: Receiver 1: f = 156.025 MHz, AIS-mode  
 Receiver 2: f = 162.025 MHz, AIS-mode  
 Receiver 3: f = 156.525 MHz, DSC-mode

Spurious emissions level (conducted)					
f [MHz]	Level [dBm]	Bandwidth [kHz]	Limit [dBm]	Margin [dB]	Result
0.024045	-98.9	0.200	-57.0	41.9	Passed
19.870	-90.4	10	-57.0	33.4	Passed
98.304	-85.6	100	-57.0	28.6	Passed
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-

Remark: This measurement includes the spurious emission results of all 3 integrated receivers (AIS1: 156.025 MHz, AIS2:162.025 MHz and DSC: 156.525 MHz).

Limit: Subclause 15.3.2.3 [1] / C2.8.3

The power of any spurious emission in the specified range at the antenna terminal shall not exceed -57 dBm (2 nW) in the frequency range 9 kHz to 1 GHz and -47 dBm (20 nW) in the frequency range 1 GHz to 4 GHz.

Test equipment (please refer to chapter 9 for details)

1, 3, 4, 26

## 8 Results of the DSC receiver tests

### 8.1 DSC receiver maximum sensitivity

Subclause C.2.1 [1]

Ambient temperature:	22 °C
Relative humidity:	38 %

Date:	11.10.2021
Tested by:	Thomas KÜHN

Operation mode: Receive on 156.525 MHz (-107 dBm (normal) / -101 dBm (extreme) conditions)  
 Wanted signal: Test-signal 1 (0101010...)

Measurement conditions		Frequency	BER	Limit	Test result	1 % limit reached at *
Temperature	Voltage					
T <sub>nom</sub> (+ 20 °C)	U <sub>nom</sub> (24.0 V DC)	156.5235 MHz	0 %	1 %	Passed	-119 dBm
		156.525 MHz	0 %	1 %	Passed	-121 dBm
		156.5265 MHz	0 %	1 %	Passed	-119 dBm
T <sub>min</sub> (-15 °C)	U <sub>min</sub> (10.8 V DC)	156.525 MHz	0 %	1 %	Passed	-121 dBm
	U <sub>max</sub> (31.2 V DC)	156.525 MHz	0 %	1 %	Passed	-121 dBm
T <sub>max</sub> (55 °C)	U <sub>min</sub> (10.8 V DC)	156.525 MHz	0 %	1 %	Passed	-121 dBm
	U <sub>max</sub> (31.2 V DC)	156.525 MHz	0 %	1 %	Passed	-121 dBm

\*: Applicant requests this test, no limits defined in the standard.

Limit: Subclause C.2.1.3 [1]

The BER shall not exceed 1 %.

Test equipment (please refer to chapter 9 for details)

3 - 6

## 8.2 DSC receiver error behaviour at high input levels

Subclause C.2.2 [1]

Ambient temperature:	22 °C
Relative humidity:	48 %

Date:	07.10.2021
Tested by:	Thomas KÜHN

Operation mode: Receive in DSC-mode on 156.525 MHz  
Wanted signal: Test-signal 1 (0101010...)

RF-input signal level	BER	Limit	Test result
-7 dBm	0 %	1 %	Passed

Limit: Subclause C.2.2.3 [1]

The BER shall not exceed 1 %.
-------------------------------

Test equipment (please refer to chapter 9 for details)
3, 4, 6

### 8.3 DSC receiver co-channel rejection

Subclause C.2.3 [1]

Ambient temperature:	22 °C
Relative humidity:	48 %

Date:	07.10.2021
Tested by:	Thomas KÜHN

Operation mode: Receive in DSC-mode on 156.525 MHz  
 Wanted signal: Test-signal 1 (0101010...)  
 Unwanted signal: Modulated with 400 Hz / 3 kHz deviation

Unwanted signal frequency	Wanted signal level	Unwanted signal level	Signal ratio	BER	Limit	Test result
156.522 MHz	-104 dBm	-114 dBm	-10 dB	0 %	1 %	Passed
156.525 MHz	-104 dBm	-114 dBm	-10 dB	0 %	1 %	Passed
156.528 MHz	-104 dBm	-114 dBm	-10 dB	0 %	1 %	Passed

Limit: Subclause C.2.3.3 [1]

The BER shall not exceed  $10^{-2}$ .

Test equipment (please refer to chapter 9 for details)

3, 4, 6 - 8



## 8.4 DSC receiver adjacent channel sensitivity

Subclause C.2.4 [1]

Ambient temperature:	22 °C
Relative humidity:	38 %

Date:	11.10.2021
Tested by:	Thomas KÜHN

Operation mode: Receive in DSC-mode  
 Wanted signal: Test-signal 1, P = - 104 dBm (normal) / -98 dBm (extreme conditions)  
 Unwanted signal: Modulated with 400 Hz / 3 kHz deviation,  
 P = -34 dBm (normal conditions) / -38 dBm (extreme conditions)

Test conditions		Wanted signal	Unwanted signal	Signal ratio	BER	Limit	Test result	
Temperature	Voltage							
T <sub>nom</sub> (+20 °C)	U <sub>nom</sub> (24.0 V <sub>DC</sub> )	156.525 MHz	156.500 MHz	70 dB	0 %	1 %	Passed	
			156.550 MHz	70 dB	0 %	1 %	Passed	
T <sub>min</sub> (-15 °C)	U <sub>min</sub> (10.8 V <sub>DC</sub> )		156.500 MHz	60 dB	0 %	1 %	Passed	
			156.550 MHz	60 dB	0 %	1 %	Passed	
	U <sub>max</sub> (31.2 V <sub>DC</sub> )		156.500 MHz	60 dB	0 %	1 %	Passed	
			156.550 MHz	60 dB	0 %	1 %	Passed	
T <sub>max</sub> (+55 °C)	U <sub>min</sub> (10.8 V <sub>DC</sub> )		156.500 MHz	60 dB	0 %	1 %	Passed	
			156.550 MHz	60 dB	0 %	1 %	Passed	
	U <sub>max</sub> (31.2 V <sub>DC</sub> )		156.500 MHz	60 dB	0 %	1 %	Passed	
			156.550 MHz	60 dB	0 %	1 %	Passed	

Limit: Subclause C.2.4.3 [1]

The BER shall not exceed 10<sup>-2</sup>.

Test equipment (please refer to chapter 9 for details)

3 - 8

## 8.5 DSC receiver spurious response rejection

Subclause C.2.5 [1]

Ambient temperature:	22 °C
Relative humidity:	38 %

Date:	08.10.2021
Tested by:	Thomas KÜHN

Operation mode: Receive in DSC-mode on 156.525 MHz,  
 $f_{ADC} = 98.304$  MHz, no IF,  
 Wanted signal: Test-signal 1, P = -104 dBm  
 Unwanted signal: Unmodulated, P = -34 dBm

Results of the measurement of specific frequencies of interest				
Definition	Unwanted frequency	BER	Limit	Test result
Nyquist band 1	40.083 MHz	0 %	1 %	Passed
Nyquist band 2	58.221 MHz	0 %	1 %	Passed
Nyquist band 3	138.387 MHz	0 %	1 %	Passed
Nyquist band 4	156.525 MHz	No test, wanted signal	1 %	-
Nyquist band 5	236.691 MHz	0 %	1 %	Passed
Nyquist band 6	254.829 MHz	0 %	1 %	Passed
Nyquist band 7	334.995 MHz	0 %	1 %	Passed
Nyquist band 8	353.133 MHz	0 %	1 %	Passed
Nyquist band 9	433.299 MHz	0 %	1 %	Passed
Nyquist band 10	451.437 MHz	0 %	1 %	Passed
Nyquist band 11	531.603 MHz	0 %	1 %	Passed
Nyquist band 12	549.741 MHz	0 %	1 %	Passed

The following settings were used for the searching over the limited frequency range:  
 Because the receiver has no IF, the range was calculated with the receiver switching range  $\pm 3$  MHz  
 Limited frequency range: 153.025 MHz to 166.025 MHz (stepped with 5 kHz).  
 Operation mode: Receive in DSC mode  
 Wanted signal: 156.525 MHz with P = -104 dBm.  
 Unwanted signal: Modulated with 400 Hz / 3 kHz deviation, P = -24 dBm.

Result for searching over the limited frequency range: No frequencies with an influence were found.

Limit: Subclause C.2.5.5 [1]

At any frequency separated from the nominal frequency of the receiver by two channels or more, the BER shall not exceed  $10^{-2}$ .

Test equipment (please refer to chapter 9 for details)

3, 4, 6 - 8

## 8.6 DSC receiver intermodulation response rejection

Subclause C.2.6 [1]

Ambient temperature:	22 °C
Relative humidity:	48 %

Date:	07.10.2021
Tested by:	Thomas KÜHN

Operation mode: Receive in DSC-mode on 156.525 MHz  
 Wanted signal A: Test-signal 1 on 156.525 MHz, P = -104 dBm  
 Unwanted signal B: Unmodulated, P = -39 dBm  
 Unwanted signal C: Modulated with 400 Hz and 3 kHz deviation, P = -39 dBm

Frequencies of the unwanted signals		BER	Limit	Test result
Generator B	Generator C			
156.575 MHz	156.625 MHz	0 %	1 %	Passed
156.475 MHz	156.425 MHz	0 %	1 %	Passed

Limit: Subclause C.2.6.3 [1]

The BER shall not exceed  $10^{-2}$ .

Test equipment (please refer to chapter 9 for details)

3, 4, 6 - 8, 11, 13 - 15, 25

## 8.7 DSC receiver blocking or desensitisation

Subclause C.2.7 [1]

Ambient temperature:	22 °C
Relative humidity:	48 %

Date:	07.10.2021
Tested by:	Thomas KÜHN

Wanted signal A: Test-signal 1 on 156.525 MHz, P = -104 dBm

Unwanted signal B: Unmodulated, P = -20 dBm

Frequencies of the unwanted signal		BER	Limit	Test result
-10 MHz	146.525 MHz	0 %	1 %	Passed
-5 MHz	151.525 MHz	0 %	1 %	Passed
-2 MHz	154.525 MHz	0 %	1 %	Passed
-1 MHz	155.525 MHz	0 %	1 %	Passed
+1 MHz	157.525 MHz	0 %	1 %	Passed
+2 MHz	158.525 MHz	0 %	1 %	Passed
+5 MHz	161.525 MHz	0 %	1 %	Passed
+10 MHz	166.525 MHz	0 %	1 %	Passed

Limit: Subclause C.2.7.3 [1]

The BER shall not exceed  $10^{-2}$ .

Test equipment (please refer to chapter 9 for details)

3, 4, 6 - 8

## 9 Test equipment and ancillaries used for tests

No.	Test equipment	Type	Manufacturer	Serial No.	PM. No.	Cal. Date	Cal. due
1	Spectrum Analyser	FSU	Rohde & Schwarz	200125	480956	25.02.2021	02.2022
2	30 dB Attenuator	8498A	Hewlett Packard	3318A06321	481817	Calibration not necessary	
3	Power supply	TOE8952-40	Toellner	87702	482589	Calibration not necessary	
4	Multimeter	971A	Hewlett Packard	JP39009358	480721	17.02.2021	02.2022
5	Temperature chamber	MK 240	Binder	05-79022	480462	10.12.2020	12.2022
6	Signal generator	SMBV100A	Rohde & Schwarz	255092	481326	25.02.2021	02.2022
7	Power divider	ZFSC-2-11	Mini-Circuits	-	410169	Calibration not necessary	
8	Signal generator	SMHU 58	Rohde & Schwarz	844170/017	480266	14.02.2021	02.2022
9	AIS Test Unit	MK II	Attingimus	AA06PA	481422	Calibration not necessary	
10	Signal generator	SML 03	Rohde & Schwarz	101360	480421	11.02.2020	02.2022
11	Signal generator	SMG	Rohde & Schwarz	833449/030	480013	11.02.2020	02.2022
12	Power divider	ZFSC-4-1	Mini-Circuits	-	410171	Calibration not necessary	
13	Circulator	156 – 162 MHz	Dirk Fischer	1	410162	Calibration not necessary	
14	Circulator	156 – 162 MHz	Dirk Fischer	2	410163	Calibration not necessary	
15	Circulator	156 – 162 MHz	Dirk Fischer	3	410164	Calibration not necessary	
16	Circulator	156 – 162 MHz	Dirk Fischer	4	410165	Calibration not necessary	
17	Power supply	TOE8852 (DC)	Toellner	51704	480591	Calibration not necessary	
18	Spectrum Analyser	FSW43	Rohde & Schwarz	100586 & 100926	481720	19.11.2021	11.2022
19	20 dB Attenuator	WA8 / 18-20-34	Weinschel	-	481451	Calibration not necessary	
20	Variable attenuator	8494B	Hewlett Packard	3308A38264	480264	Calibration not necessary	
21	Variable attenuator	8496B	Hewlett Packard	626	480265	Calibration not necessary	
22	High pass filter	WHJ9-167-200-2000-60EF	Wainwright	1	481811	Calibration not necessary	
23	High pass filter	WHJS1000C11/60EF	Wainwright	1	480413	Calibration not necessary	
24	Tunable notch filter	WTRCD5-150-165-0.05-0.61-40EEK	Wainwright	1	481810	Calibration not necessary	
25	Power divider	ZFSC-2-11	Mini-Circuits	-	410170	Calibration not necessary	
26	10 dB Attenuator	WA8-10	Weinschel	1	410112	Calibration not necessary	
27	Power meter	NRVD	Rohde & Schwarz	833697/030	480589	23.02.2021	02.2022
28	Peak power sensor	NRV-Z32	Rohde & Schwarz	849745/016	480551	22.02.2021	02.2022

## 10 Measurement uncertainties

Measurement uncertainties according to clause 9.5 [1]			
Test case of [1]	Description	Limit	U <sub>Lab</sub>
15.1.1	RF frequency	$\pm 1 \times 10^{-7}$	$\pm 4.5 \times 10^{-8}$
15.1.2	RF power	$\pm 0.75$ dB	+0.66 dB / -0.72 dB
15.1.4	Modulation accuracy	No requirement	$\pm 3,9\%$
15.1.3, 15.3.1	Conducted spurious emissions of transmitter	$\pm 4$ dB	$\pm 2.3$ dB
15.3.2, C.2.8	Conducted spurious emissions of receiver	$\pm 3$ dB	$\pm 2.3$ dB
15.2.1, 15.2.2, 15.2.7, C.2.1, C.2.2,	One signal measurement	No requirement	$\pm 1.1$ dB
15.2.3, 15.2.4, 15.2.5, 15.2.8, C.2.3, C.2.4, C.2.5, C.2.7	Two signal measurement	$\pm 4$ dB	$\pm 1.2$ dB
C.2.6	Three signal measurement	$\pm 3$ dB	$\pm 1.3$ dB
15.2.6	Four signal measurement	No requirement	$\pm 1.4$ dB
15.1.5 [1]	Transmitter attack and release time	$\pm 20$ %	$\pm 10$ %

## 11 Report history

Report Number	Date	Comment
F211774E1	25.03.2022	Document created
-	-	-
-	-	-

## 12 List of annexes

Annex A	Test Setup Photos	4 pages
Annex B	Measurement results	14 pages