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# TEST REPORT

## **IEC 61993-2: 2001-12 MARITIME NAVIGATION AND RADIOCOMMUNICATION EQUIPMENT AND SYSTEMS**

**Automatic Identification systems (AIS)**

**Part 2: Class A shipborne installation of the  
Universal Automatic Identification system (AIS)-  
Operational and performance requirements,  
Methods of test and required test results**

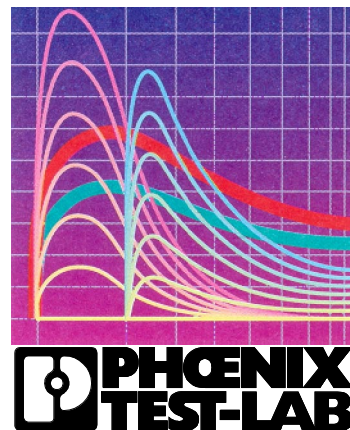
**Test Report Reference: R20608 Edition 3**

**Equipment under Test: AIS-Transponder X-Pack DS**

**Serial Number: -**

**Applicant: Nauticast Schiffsnavigationssysteme AG**

**Manufacturer: Nauticast Schiffsnavigationssysteme AG**



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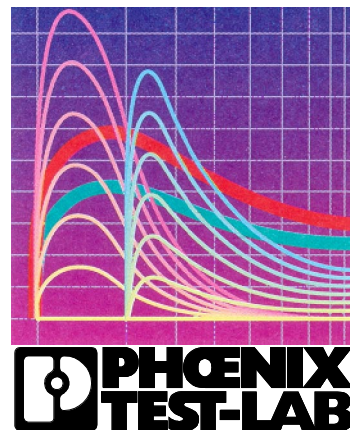
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## 1 IDENTIFICATION

### 1.1 APPLICANT

Name:	Nauticast Schiffsnavigationssysteme AG
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Country:	Austria
Name for contact purposes:	Mr. Florian Gruber
Tel:	0043-1-5-237-237-0
Fax:	0043-1-5-237-237-150
e-mail address:	florian.gruber@nauticast.com

### 1.2 MANUFACTURER

Name:	Nauticast Schiffsnavigationssysteme AG
Address:	Mariahilfer Straße 50/2/11 1070 Vienna
Country:	Austria
Name for contact purposes:	Mr. Florian Gruber
Tel:	0043-1-5-237-237-0
Fax:	0043-1-5-237-237-150
e-mail address:	florian.gruber@nauticast.com

### 1.3 DATES

Date of Receipt of Test Sample:	26. August 2002
Start of test:	26. August 2002
Finish of test:	25 October 2002



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## 1.4 TEST LABORATORY

The tests were carried out at:

**PHOENIX TEST-LAB GmbH**  
**Königswinkel 10**  
**D-32825 Blomberg**  
**Germany**

**Tel: +49 (0) 52 35 / 95 00-0**  
**Fax: +49 (0) 52 35 / 95 00-10**

accredited by DATech e.V. in compliance with DIN EN ISO/IEC 17025 under Reg. No. TTI-P-G071/94-11.

Test engineer:

Raimund Blask

29. October 2002

name

signature

date

Test report checked:

Bernd Steiner

29. October 2002

name

signature

date

**Phoenix TEST-LAB GmbH**  
**Königswinkel 10**  
**32825 Blomberg**  
**Tel. 0 52 35 / 95 00-0**  
**Fax 0 52 35 / 95 00-10**

stamp

## 1.5 RESERVATION

This test report is only valid in the original form.

Any reproduction of it's contents without written permission of the accredited test laboratory PHOENIX TEST-LAB GmbH is prohibited.

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



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## 2 TECHNICAL DATA OF EQUIPMENT

see also Annex B

Type:	AIS Transponder		
Type designation:	-		
Serial No.:	-		
Alignment range:	156.025 to 162.025 MHz		
Switching range:	156.025 to 162.025 MHz		
Channel separation:	12.5 kHz / 25 kHz		
Rated RF output power:	Nominal low power: 2.0 W / 33 dBm Nominal high power: 12.5 W / 41 dBm		
Supply Voltage:	U <sub>nom</sub> = 24.0 V DC	U <sub>min</sub> = 21.6 V DC	U <sub>max</sub> = 31.2 V DC
Printed circuit designation:	C98451-D6127-P10-3-86		
Software:	VHF evaluation SW 2.0		

### Ports/Connectors

Identification	Connector		Length
	EUT	Ancillary	
DC-power-supply	D-SUB	Not specified	3 m
GPS-antenna	D-SUB	TNC	15 m
VHF-antenna	D-SUB	BNC	15 m
RS 422-Display	D-SUB	D-SUB	3 m
RS 422-Sensor	D-SUB	D-SUB	3 m



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### 3 ADDITIONAL INFORMATION

#### General:

The EUT was classified in the category AR1 according to EN 300 793 V1.1.1 (1998-02).

For this reason, full tests were carried out at 156.025 MHz and 162.025 MHz.

The EUT was powered by an external 24 V-DC-power-supply, connected to the AIS-Transponder.

#### Wanted signal:

The test-signals 1 (DSC-mode), 2 and 3 (AIS-mode) were generated by a second EUT using the terminal software of the manufacturer. The rf-signal was attenuated by an external attenuator to generate the necessary test levels (according to the standard).

#### Test-signal overview:

Test-signal:	Mode:	Bit pattern:
1	DSC	DSC-call (defined in part 10.4.1 of IEC 61993-2)
2	AIS	010101... (defined in part 10.4.2 of IEC 61993-2)
3	AIS	001100... (defined in part 10.4.3 of IEC 61993-2)

#### Unwanted signal:

The unwanted-signals were generated by the rf-generators from Phoenix Test-Lab.

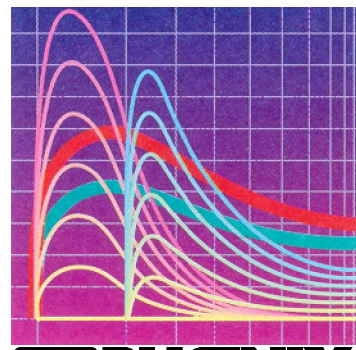


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## 4 TEST OVERVIEW

Part 15	<b>Physical tests</b>	
	<b>Transmitter requirements</b>	
<b>15.1</b>	<b>TDMA Transmitter</b>	
15.1.1	Frequency error	Applicable
15.1.2	Carrier power (conducted)	Applicable
15.1.3	Modulation Spectrum 25 kHz Channel mode	Applicable
15.1.4	Modulation Spectrum 12.5 kHz Channel mode	Applicable
15.1.5	Transmitter attack time	Applicable
15.1.6	Transmitter release time	Applicable
<b>15.2</b>	<b>DSC Transmission</b>	
15.2.1	Frequency error of the DSC Transmission	Applicable
15.2.2	Modulation Rate	Applicable
	<b>Receiver requirements</b>	
<b>15.3</b>	<b>TDMA Receiver</b>	
15.3.1	Sensitivity - 25 kHz Operation	Applicable
15.3.2	Sensitivity - 12.5 kHz Operation	Applicable
15.3.3	Error behaviour at high input level	Applicable
15.3.4	Co-channel rejection - 25 kHz operation	Applicable
15.3.5	Co-channel rejection - 12.5 kHz operation	Applicable
15.3.6	Adjacent channel selectivity - 25 kHz operation	Applicable
15.3.7	Adjacent channel selectivity - 12.5 kHz operation	Applicable
15.3.8	Spurious response rejection	Applicable
15.3.9	Intermodulation response rejection and blocking	Applicable
15.3.10	Transmit to receive switching time	Applicable
<b>15.4</b>	<b>DSC Receiver</b>	
15.4.1	Maximum sensitivity	Applicable
15.4.2	Error behaviour at high input level	Applicable
15.4.3	Co-channel rejection	Applicable
15.4.4	Adjacent channel selectivity - 25 kHz operation	Applicable
15.4.5	Spurious response rejection	Applicable
15.4.6	Intermodulation response rejection	Applicable
15.4.7	Blocking or Desensitisation	Applicable
<b>15.5</b>	<b>Conducted Spurious Emissions conveyed to the antenna</b>	
15.5.1	Spurious Emissions from the Receiver	Applicable
15.5.2	Spurious Emissions from the Transmitter	Applicable

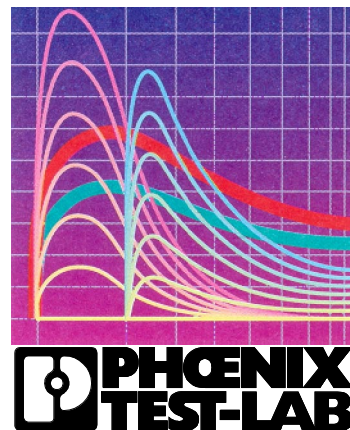




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## 5 TRANSMITTER REQUIREMENTS



TEST REPORT REFERENCE: R20608 Edition 3

## 5.1 FREQUENCY ERROR

### SUBCLAUSE 15.1.1

Ambient temperature	20 °C	Relative humidity	55 %
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Operation mode: Continuous transmission without modulation,  $f = 156.025 \text{ MHz}$

TEST CONDITIONS		FREQUENCY	FREQUENCY ERROR
Temperature	Voltage		
$T_{\text{nom}}$ (+ 20 °C)	$U_{\text{nom}}$ (24.0 V DC)	156.02509 MHz	+ 90 Hz
$T_{\text{min}}$ (- 15 °C)	$U_{\text{min}}$ (21.6 V DC)	156.02491 MHz	- 90 Hz
	$U_{\text{max}}$ (31.2 V DC)	156.02492 MHz	- 80 Hz
$T_{\text{max}}$ (+ 55 °C)	$U_{\text{min}}$ (21.6 V DC)	156.02500 MHz	0 Hz
	$U_{\text{max}}$ (31.2 V DC)	156.02500 MHz	0 Hz
Maximum frequency error		$\pm 90 \text{ Hz}$	
Measurement uncertainty		$\pm 10 \text{ Hz}$	

Operation mode: Continuous transmission without modulation,  $f = 157.4125 \text{ MHz}$

TEST CONDITIONS		FREQUENCY	FREQUENCY ERROR
Temperature	Voltage		
$T_{\text{nom}}$ (+ 20 °C)	$U_{\text{nom}}$ (24.0 V DC)	157.41259 MHz	+ 90 Hz
$T_{\text{min}}$ (- 15 °C)	$U_{\text{min}}$ (21.6 V DC)	157.41241 MHz	- 90 Hz
	$U_{\text{max}}$ (31.2 V DC)	157.41241 MHz	- 90 Hz
$T_{\text{max}}$ (+ 55 °C)	$U_{\text{min}}$ (21.6 V DC)	157.41249 MHz	- 10 Hz
	$U_{\text{max}}$ (31.2 V DC)	157.41250 MHz	+ 0 Hz
Maximum frequency error		$\pm 90 \text{ Hz}$	
Measurement uncertainty		$\pm 10 \text{ Hz}$	

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TEST REPORT REFERENCE: R20608 Edition 3

Continued:

Operation mode: Continuous transmission without modulation,  $f = 160.6375 \text{ MHz}$

TEST CONDITIONS		FREQUENCY	FREQUENCY ERROR
Temperature	Voltage		
$T_{\text{nom}}$ (+ 20 °C)	$U_{\text{nom}}$ (24.0 V DC)	160.63758 MHz	+ 80 Hz
$T_{\text{min}}$ (- 15 °C)	$U_{\text{min}}$ (21.6 V DC)	160.63740 MHz	- 100 Hz
	$U_{\text{max}}$ (31.2 V DC)	160.63741 MHz	- 90 Hz
$T_{\text{max}}$ (+ 55 °C)	$U_{\text{min}}$ (21.6 V DC)	160.63748 MHz	- 20 Hz
	$U_{\text{max}}$ (31.2 V DC)	160.63748 MHz	- 20 Hz
Maximum frequency error		- 100 Hz	
Measurement uncertainty		$\pm 10 \text{ Hz}$	

Operation mode: Continuous transmission without modulation,  $f = 162.025 \text{ MHz}$

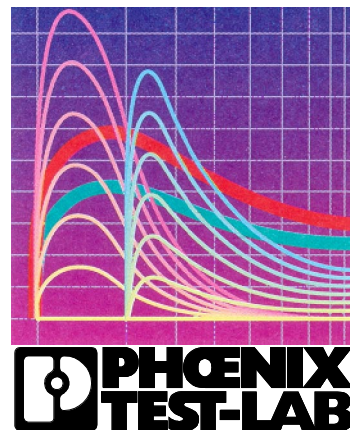
TEST CONDITIONS		FREQUENCY	FREQUENCY ERROR
Temperature	Voltage		
$T_{\text{nom}}$ (+ 20 °C)	$U_{\text{nom}}$ (24.0 V DC)	162.02508 MHz	+ 80 Hz
$T_{\text{min}}$ (- 15 °C)	$U_{\text{min}}$ (21.6 V DC)	162.02495 MHz	- 50 Hz
	$U_{\text{max}}$ (31.2 V DC)	162.02498 MHz	- 20 Hz
$T_{\text{max}}$ (+ 55 °C)	$U_{\text{min}}$ (21.6 V DC)	162.02497 MHz	- 30 Hz
	$U_{\text{max}}$ (31.2 V DC)	162.02498 MHz	- 20 Hz
Maximum frequency error		+ 80 Hz	
Measurement uncertainty		$\pm 10 \text{ Hz}$	

LIMITS: SUBCLAUSE 15.1.1

The frequency error shall not exceed  $\pm 0.5 \text{ kHz}$  under normal and  $\pm 1 \text{ kHz}$  under extreme conditions.

TEST EQUIPMENT USED:

29, 42, 51, 97



TEST REPORT REFERENCE: R20608 Edition 3

## 5.2 CARRIER POWER (CONDUCTED)

### SUBCLAUSE 15.1.2

Ambient temperature	20 °C	Relative humidity	60 %
---------------------	-------	-------------------	------

Operation mode: Continuous transmission without modulation,  $f = 156.025$  MHz

Test conditions		Carrier power (Conducted)	
		At nominal low power: 33 dBm	At nominal high power: 41 dBm
$T_{nom}$ (+ 20 °C)	$U_{nom}$ (24.0 V DC)	33.3 dBm	40.0 dBm
$T_{max}$ (-15 °C)	$U_{min}$ (21.6 V DC)	32.5 dBm	40.8 dBm
	$U_{max}$ (31.2 V DC)	32.6 dBm	40.4 dBm
$T_{max}$ (+ 55 °C)	$U_{min}$ (21.6 V DC)	33.0 dBm	41.5 dBm
	$U_{max}$ (31.2 V DC)	34.0 dBm	42.0 dBm
Maximum difference to rated power		+ 1 dB	+ 1 dB
Measurement uncertainty		+ 0.66 dB / - 0.72 dB	

Operation mode: Continuous transmission without modulation,  $f = 162.025$  MHz

Test conditions		Carrier power (Conducted)	
		At nominal low power: 33 dBm	At nominal high power: 41 dBm
$T_{nom}$ (+ 20 °C)	$U_{nom}$ (24.0 V DC)	32.9 dBm	41.2 dBm
$T_{max}$ (-15 °C)	$U_{min}$ (21.6 V DC)	33.3 dBm	40.9 dBm
	$U_{max}$ (31.2 V DC)	33.5 dBm	41.8 dBm
$T_{max}$ (+ 55 °C)	$U_{min}$ (21.6 V DC)	32.5 dBm	42.0 dBm
	$U_{max}$ (31.2 V DC)	34.0 dBm	41.8 dBm
Maximum difference to rated power		+ 1 dB	+ 0.8 dB
Measurement uncertainty		+ 0.66 dB / - 0.72 dB	

#### LIMITS: SUBCLAUSE 15.1.2

The carrier output power (conducted) under normal test conditions shall be within  $\pm 1.50$  dB of the rated output power. The carrier output power (conducted) under extreme test conditions shall be within + 2.0 dB and - 3.0 dB of the rated output power.

#### TEST EQUIPMENT USED:

29, 42, 51, 97



TEST REPORT REFERENCE: R20608 Edition 3

### 5.3 MODULATION SPECTRUM 25 KHZ CHANNEL MODE

### SUBCLAUSE 15.1.3

Ambient temperature	20 °C	Relative humidity	55 %
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Operation mode: Transmit in DSC-mode,  $f = 156.525$  MHz

Centre frequency:	$f = 156.525$ MHz:	Test-signal 1	
Upper side band:	$f + 25$ kHz	79 dBc	
	$f + 10$ kHz	50 dBc	
Lower side band:	$f - 10$ kHz	50 dBc	
	$f - 25$ kHz	78 dBc	
Maximum adjacent channel power( $\pm 25$ kHz)		78 dBc	
Measurement uncertainty		+ 1.8 dB / -2.5 dB	

Remark: For detailed information about the transmitter modulation spectrum see plot "608\_25c1" of "Annex C: Measuring results to the test report R 20608 Edition 1", page 11 of 20.

Operation mode: Transmit in AIS-mode,  $f = 156.025$  MHz

Centre frequency	$f = 156.025$ MHz	Test-signal 2	Test-signal 3
Upper side band:	$f + 25$ kHz	77 dBc	81 dBc
	$f + 10$ kHz	45 dBc	39 dBc
Lower side band:	$f - 10$ kHz	46 dBc	43 dBc
	$f - 25$ kHz	80 dBc	82 dBc
Maximum adjacent channel power ( $\pm 25$ kHz)		77 dBc	
Measurement uncertainty		+ 1.8 dB / -2.5 dB	

Remark: For detailed information about the transmitter modulation spectrum see plot "608\_25a" and "608\_25b" of "Annex C: Measuring results to the test report R 20608 Edition 1", page 11 of 20.

Continued next page:



TEST REPORT REFERENCE: R20608 Edition 3

Continued:

Operation mode: Transmit in AIS-mode,  $f = 162.025$  MHz

Centre frequency	$f = 162.025$ MHz	Test-signal 2	Test-signal 3
Upper side band:	$f + 25$ kHz	81 dBc	80 dBc
	$f + 10$ kHz	40 dBc	47 dBc
Lower side band:	$f - 10$ kHz	47 dBc	48 dBc
	$f - 25$ kHz	81 dBc	78 dBc
Maximum adjacent channel power ( $\pm 25$ kHz)		78 dBc	
Measurement uncertainty		+ 1.8 dB / -2.5 dB	

Remark: For detailed information about the transmitter modulation spectrum see plot "608\_25a1" and "608\_25b1" of "Annex C: Measuring results to the test report R 20608 Edition 1", page 11 of 20.

LIMITS: SUBCLAUSE 15.1.3

At  $\pm 10$  kHz removed from the carrier, the modulation sideband is below - 25 dBc.

At  $\pm 25$  kHz removed from the carrier, the modulation sideband is below - 70 dBc, without any need to be below  $0.25 \mu\text{W}$ .

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

TEST EQUIPMENT USED:

07, 42, 51, 66, 67, 81, 85, 100, 101



TEST REPORT REFERENCE: R20608 Edition 3

## 5.4 MODULATION SPECTRUM 12.5 KHZ CHANNEL MODE SUBCLAUSE 15.1.4

Ambient temperature	20 °C	Relative humidity	55 %
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Operation mode: Transmit in AIS-mode,  $f = 156.025$  MHz

Centre frequency	$f = 156.025$ MHz	Test-signal 2	Test-signal 3
Upper side band:	$f + 12.5$ kHz	60 dBc	60 dBc
Lower side band:	$f - 12.5$ kHz	60 dBc	60 dBc
Maximum adjacent channel power ( $\pm 12.5$ kHz)	60 dBc		
Measurement uncertainty	+ 1.8 dB / - 2.5 dB		

Remark: For detailed information about the transmitter modulation spectrum see plot "608\_12a" and "608\_12b" of "Annex C: Measuring results to the test report R 20608 Edition 1", page 11 of 20.

Operation mode: Transmit in AIS-mode,  $f = 162.025$  MHz

Centre frequency	$f = 162.025$ MHz	Test-signal 2	Test-signal 3
Upper side band:	$f + 12.5$ kHz	61 dBc	62 dBc
Lower side band:	$f - 12.5$ kHz	61 dBc	61 dBc
Maximum adjacent channel power ( $\pm 12.5$ kHz)	61 dBc		
Measurement uncertainty	+ 1.8 dB / - 2.5 dB		

Remark: For detailed information about the transmitter modulation spectrum see plot "608\_12a1" and "608\_12b1" of "Annex C: Measuring results to the test report R 20608 Edition 1", page 11 of 20.

LIMITS: SUBCLAUSE 15.1.4

At  $\pm 12.5$  kHz removed from the carrier, the modulation sideband is below - 60 dBc.

In the region  $\pm 2.5$  kHz and 12.5 kHz removed the carrier the modulation sideband is below a line starting at 0 dBc /  $\pm 2.5$  kHz and ending at - 60 dBc /  $\pm 12.5$  kHz without any need to be below 0.25  $\mu$ W.

TEST EQUIPMENT USED:

07, 42, 51, 66, 67, 81, 85, 100, 101





TEST REPORT REFERENCE: R20608 Edition 3

## 5.5 TRANSMITTER ATTACK TIME

## SUBCLAUSE 15.1.5

Ambient temperature	20 °C	Relative humidity	55 %
---------------------	-------	-------------------	------

Operation mode: Transmit without modulation,  $f = 156.025$  MHz

Time when the output power has reached a level of 1dB below or 1.5 dB above the steady state power P and maintains a level within + 1.5 dB / - 1 dB from P thereafter as seen in the plot (see annex)	0.4 ms
The moment after which the frequency of the carrier always remains within $\pm 1$ kHz of its steady state frequency F, as seen in the plot (see annex)	< 1 ms
Measurement uncertainty	< 20 %

Operation mode: Transmit without modulation,  $f = 162.025$  MHz

Time when the output power has reached a level of 1dB below or 1.5 dB above the steady state power P and maintains a level within + 1.5 dB / - 1 dB from P thereafter as seen in the plot (see annex)	0.4 ms
The moment after which the frequency of the carrier always remains within $\pm 1$ kHz of its steady state frequency F, as seen in the plot (see annex)	< 1 ms
Measurement uncertainty	< 20 %

LIMITS: SUBCLAUSE 15.1.5

The transmitter attack time shall not exceed 1 ms, and the transient power level shall not exceed + 1.5 dB of its final value at any time. The carrier frequency shall not exceed  $\pm 1$  kHz of its required values after 1ms.

TEST EQUIPMENT USED:

07, 29, 31, 33, 42, 66, 67, 81, 85, 100, 101, 102, 103





TEST REPORT REFERENCE: R20608 Edition 3

## 5.6 TRANSMITTER RELEASE TIME

### SUBCLAUSE 15.1.6

Ambient temperature	20 °C	Relative humidity	55 %
---------------------	-------	-------------------	------

Operation mode: Transmit without modulation,  $f = 156.025$  MHz

Time which elapses between the initiation of the "transmitter off" function and the moment when the transmitter output power has reduced to a level 50 dB below the steady state power and remains below this level thereafter as seen in the plot (see annex).	< 0.4 ms
Measurement uncertainty	< 20 %

Operation mode: Transmit without modulation,  $f = 162.025$  MHz

Time which elapses between the initiation of the "transmitter off" function and the moment when the transmitter output power has reduced to a level 50 dB below the steady state power and remains below this level thereafter as seen in the plot (see annex).	< 0.4 ms
Measurement uncertainty	< 20 %

LIMITS: SUBCLAUSE 15.1.6

The transmitter attack time shall not exceed 1 ms.
--

#### TEST EQUIPMENT USED:

07, 29, 31, 33, 42, 66, 67, 81, 85, 100, 101, 102, 103
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## 5.7 FREQUENCY ERROR OF THE DSC-SIGNAL

## SUBCLAUSE 15.2.1

Ambient temperature	20 °C	Relative humidity	55 %
---------------------	-------	-------------------	------

Operation mode: Transmit in DSC-mode (B = 2100 Hz and Y = 1300 Hz as nominal values)

		Measured frequency of the DSC-Signal			
Test conditions		B		Y	
		Frequency	Freq.-Error	Frequency	Freq.-Error
T <sub>nom</sub> (+ 20 °C)	U <sub>nom</sub> (24.0 V DC)	2099.3 Hz	- 0.3 Hz	1300.2 Hz	+ 0.2 Hz
T <sub>min</sub> (- 15 °C)	U <sub>min</sub> (21.6 V DC)	2097.1 Hz	- 2.9 Hz	1300.6 Hz	+ 0.6 Hz
	U <sub>max</sub> (31.2 V DC)	2098.9 Hz	- 1.1 Hz	1300.5 Hz	+ 0.5 Hz
T <sub>max</sub> (+ 55 °C)	U <sub>min</sub> (21.6 V DC)	2099.3 Hz	- 0.7 Hz	1300.8 Hz	+ 0.8 Hz
	U <sub>max</sub> (31.2 V DC)	2099.5 Hz	- 0.5 Hz	1300.7 Hz	+ 0.7 Hz
Maximum frequency error		- 2.9 Hz		+ 0.8 Hz	
Measurement uncertainty		± 17 mHz			

LIMITS: SUBCLAUSE 15.2.1

The B and the Y state frequency for both normal and extreme test conditions shall be within ± 1%

TEST EQUIPMENT USED:

42, 90, 118



TEST REPORT REFERENCE: R20608 Edition 3

## 5.8 MODULATION RATE

## SUBCLAUSE 15.2.2

Ambient temperature	20 °C	Relative humidity	55 %
---------------------	-------	-------------------	------

Operation mode: Transmit in DSC-mode (1200 bit/s as nominal value).

	Results:
Nominal bit rate:	1200.000000 bit/s
Measured bit rate:	1200.027875 bit/s
Relative difference:	+ 23.2 ppm

\* Remark:

The bit rate was calculated by measuring the 9600 Hz oscillator frequency of the FSK-modulator.

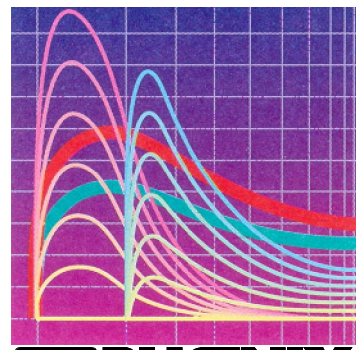
Nominal oscillator frequency:	9600.000 Hz
Measured oscillator frequency:	9600.223 Hz
Absolute difference	+ 223 Hz
Relative difference	+ 23.2 ppm
Nominal bit rate:	1200 bit/s
+ Relative difference	+ 23.2 ppm
Calculated bit rate	1200.027875 bit/s

LIMITS: SUBCLAUSE 15.2.2

The baud rate shall be 1200 bits/sec $\pm$ 30 ppm
---

TEST EQUIPMENT USED:

42, 90, 118
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TEST REPORT REFERENCE: R20608 Edition 3

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## 6 RECEIVER REQUIREMENTS



TEST REPORT REFERENCE: R20608 Edition 3

## 6.1 SENSITIVITY - 25 KHZ OPERATION

## SUBCLAUSE 15.3.1

Ambient temperature	20 °C	Relative humidity	55 %
---------------------	-------	-------------------	------

Operation mode: Receive in AIS-mode,  $f = 156.025$  MHz

Wanted signal: Test signal 2 and 3 in alternating mode

TEMPERATURE	VOLTAGE	PACKET ERROR RATE	RECEIVER SENSITIVITY
$T_{\text{nom}}$ (+ 20 °C)	$U_{\text{nom}}$ (24.0 V DC)	4.1 %	- 107 dBm
$T_{\text{min}}$ (- 15 °C)	$U_{\text{min}}$ (21.6 V DC)	2.5 %	- 101 dBm
	$U_{\text{max}}$ (31.2 V DC)	5.0 %	- 101 dBm
$T_{\text{max}}$ (+ 55 °C)	$U_{\text{min}}$ (21.6 V DC)	5.0 %	- 101 dBm
	$U_{\text{max}}$ (31.2 V DC)	4.0 %	- 101 dBm
Measurement uncertainty		< 3 dB	

Operation mode: Receive in AIS-mode,  $f = 162.025$  MHz

Wanted signal: Test signal 2 and 3 in alternating mode

TEMPERATURE	VOLTAGE	PACKET ERROR RATE	RECEIVER SENSITIVITY
$T_{\text{nom}}$ (+ 20 °C)	$U_{\text{nom}}$ (24.0 V DC)	16.0 %	- 107 dBm
$T_{\text{min}}$ (- 15 °C)	$U_{\text{min}}$ (21.6 V DC)	8.0 %	- 101 dBm
	$U_{\text{max}}$ (31.2 V DC)	10.0 %	- 101 dBm
$T_{\text{max}}$ (+ 55 °C)	$U_{\text{min}}$ (21.6 V DC)	4.0 %	- 101 dBm
	$U_{\text{max}}$ (31.2 V DC)	2.0 %	- 101 dBm
Measurement uncertainty		< 3 dB	

LIMITS: SUBCLAUSE 15.3.1

The sensitivity shall be - 107 dBm under normal test conditions, and - 101 dBm under extreme test conditions, when operating on a 25 kHz channel with a PER of 20%.

TEST EQUIPMENT USED:

25, 42, 51, 81, 100, 101, 102, 103, 113



TEST REPORT REFERENCE: R20608 Edition 3

## 6.2 SENSITIVITY - 12.5 KHZ OPERATION

## SUBCLAUSE 15.3.2

Ambient temperature	20 °C	Relative humidity	55 %
---------------------	-------	-------------------	------

Operation mode: Receive in AIS-mode,  $f = 160.6375$  MHz

Wanted signal: Packet type 2 and 3 in alternating mode.

TEMPERATURE	VOLTAGE	PACKET ERROR RATE	RECEIVER SENSITIVITY
$T_{nom}$ (+ 20 °C)	$U_{nom}$ (24.0 V DC)	7.0 %	- 98 dBm
$T_{min}$ (- 15 °C)	$U_{min}$ (21.6 V DC)	5.0 %	- 92 dBm
	$U_{max}$ (31.2 V DC)	4.0 %	- 92 dBm
$T_{max}$ (+ 55 °C)	$U_{min}$ (21.6 V DC)	4.0 %	- 92 dBm
	$U_{max}$ (31.2 V DC)	6.0 %	- 92 dBm
Measurement uncertainty		< 3 dB	

Operation mode: Receive in AIS-mode,  $f = 157.4125$  MHz

Wanted signal: Packet type 2 and 3 in alternating mode.

TEMPERATURE	VOLTAGE	PACKET ERROR RATE	RECEIVER SENSITIVITY
$T_{nom}$ (+ 20 °C)	$U_{nom}$ (24.0 V DC)	6.0 %	- 98 dBm
$T_{min}$ (- 15 °C)	$U_{min}$ (21.6 V DC)	5.0 %	- 92 dBm
	$U_{max}$ (31.2 V DC)	4.0 %	- 92 dBm
$T_{max}$ (+ 55 °C)	$U_{min}$ (21.6 V DC)	1.0 %	- 92 dBm
	$U_{max}$ (31.2 V DC)	3.0 %	- 92 dBm
Measurement uncertainty		< 3 dB	

LIMITS: SUBCLAUSE 15.3.2

The sensitivity shall be - 98 dBm under normal test conditions, and - 92 dBm under extreme test conditions, when operating on a 12.5 kHz channel with a PER of 20%.

TEST EQUIPMENT USED:

25, 42, 51, 81, 100, 101, 102, 103, 113



TEST REPORT REFERENCE: R20608 Edition 3

### 6.3 ERROR BEHAVIOUR AT HIGH INPUT LEVELS

### SUBCLAUSE 15.3.3

Ambient temperature	20 °C	Relative humidity	55 %
---------------------	-------	-------------------	------

Operation mode: Receive in AIS-mode,  $f = 162.025$  MHz

Wanted signal: Test signal 2 and 3 in alternating mode

RF-INPUT SIGNAL LEVEL	NUMBER OF MESSAGES NOT SUCCESSFULLY RECORDED
- 77 dBm	13.0 %
- 7 dBm	14.0 %

Operation mode: Receive in AIS-mode,  $f = 156.025$  MHz

Wanted signal: Test signal 2 and 3 in alternating mode

RF-INPUT SIGNAL LEVEL	NUMBER OF MESSAGES NOT SUCCESSFULLY RECORDED
- 77 dBm	1.0 %
- 7 dBm	0.0 %

LIMITS: SUBCLAUSE 15.3.3

The number of messages not correctly received (lost or corrupted) at - 7 dBm shall not differ by more than 1% from the recorded at - 77 dBm.

TEST EQUIPMENT USED:

25, 42, 81, 100, 101, 102, 103, 113



TEST REPORT REFERENCE: R20608 Edition 3

## 6.4 CO-CHANNEL REJECTION - 25 KHZ OPERATION

## SUBCLAUSE 15.3.4

Ambient temperature	20 °C	Relative humidity	55 %
---------------------	-------	-------------------	------

Operation mode: Receive in AIS-mode,  $f = 156.025$  MHz  
 Wanted signal: Test-signal 2 and 3 in alternating mode,  $P = -104$  dBm  
 Unwanted signal: Modulated with 400 Hz / 3 kHz deviation

Unwanted signal frequency:	Unwanted signal level:	Signal ratio:	Packet error rate:
156.022 MHz	-110 dBm	- 6 dB	1 %
156.025 MHz	-110 dBm	- 6 dB	1 %
156.028 MHz	-110 dBm	- 6 dB	0 %
Measurement uncertainty		< 3 dB	

Operation mode: Receive in AIS-mode,  $f = 162.025$  MHz  
 Wanted signal: Test-signal 2 and 3 in alternating mode,  $P = -104$  dBm  
 Unwanted signal: Modulated with 400 Hz / 3 kHz deviation

Unwanted signal frequency:	Unwanted signal level:	Signal ratio:	Packet error rate:
162.022 MHz	-110 dBm	- 6 dB	0 %
162.025 MHz	-110 dBm	- 6 dB	0 %
162.028 MHz	-110 dBm	- 6 dB	1 %
Measurement uncertainty		< 3 dB	

LIMITS: SUBCLAUSE 15.3.4

The value of the co-channel rejection ratio, expressed in dB, at the signal displacements given in the method of measurements, shall be between  $-10.0$  dB and  $0$  dB. Any positive value is also acceptable.

TEST EQUIPMENT USED:

25, 27, 33, 42, 81, 100, 101, 102, 103, 113





TEST REPORT REFERENCE: R20608 Edition 3

## 6.5 CO-CHANNEL REJECTION – 12.5 KHZ OPERATION

## SUBCLAUSE 15.3.5

Ambient temperature	20 °C	Relative humidity	55 %
---------------------	-------	-------------------	------

Operation mode: Receive in AIS-mode,  $f = 156.025$  MHz  
 Wanted signal: Test-signal 2 and 3 in alternating mode,  $P = -95$  dBm  
 Unwanted signal: Modulated with 400 Hz / 1.5 kHz deviation

Unwanted signal frequency:	Unwanted signal level:	Signal ratio:	Packet error rate:
156.0235 MHz	-110 dBm	- 15 dB	1 %
156.0250 MHz	-110 dBm	- 15 dB	0 %
156.0265 MHz	-110 dBm	- 15 dB	1 %
Measurement uncertainty		< 3 dB	

Operation mode: Receive in AIS-mode,  $f = 162.025$  MHz  
 Wanted signal: Test-signal 2 and 3 in alternating mode,  $P = -95$  dBm  
 Unwanted signal: Modulated with 400 Hz / 1.5 kHz deviation

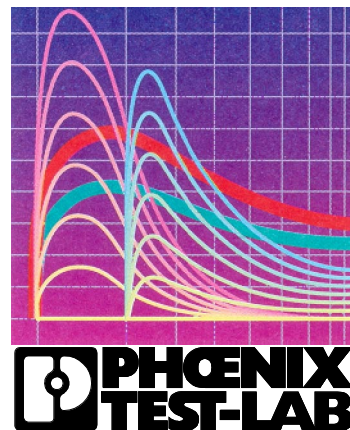
Unwanted signal frequency:	Unwanted signal level:	Signal ratio:	Packet error rate:
162.0235 MHz	-110 dBm	- 15 dB	1 %
162.0250 MHz	-110 dBm	- 15 dB	1 %
162.0265 MHz	-110 dBm	- 15 dB	0 %
Measurement uncertainty		< 3 dB	

LIMITS: SUBCLAUSE 15.3.5

The value of the co-channel rejection ratio, expressed in dB, at the signal displacements given in the method of measurements, shall be between  $-18.0$  dB and  $0$  dB. Any positive value is also acceptable.

### TEST EQUIPMENT USED:

25, 27, 33, 42, 81, 100, 101, 102, 103, 113



TEST REPORT REFERENCE: R20608 Edition 3

## 6.6 ADJACENT CHANNEL SELECTIVITY – 25 KHZ OPERATION SUBCLAUSE 15.3.6

Ambient temperature	20 °C	Relative humidity	55 %
---------------------	-------	-------------------	------

Operation mode: Receive in AIS mode  
 Wanted signal: Test-signal 2 and 3 in alternating mode,  
 P = -104 dBm (normal conditions) / -98 dBm (extreme conditions)  
 Unwanted signal: Modulated with 400 Hz / 3 kHz deviation

TEMPERATURE	VOLTAGE	WANTED SIGNAL	UNWANTED SIGNAL	SIGNAL RATIO	PACKET ERROR RATE
T <sub>nom</sub> ( + 20 °C)	U <sub>nom</sub> (24.0 V DC)	156.025 MHz	156.000 MHz	65 dB	18 %
			156.050 MHz	63 dB	18 %
	U <sub>nom</sub> (24.0 V DC)	162.025 MHz	162.000 MHz	63 dB	19 %
			162.050 MHz	60 dB	18 %
T <sub>min</sub> ( - 15 °C)	U <sub>min</sub> (21.6 V DC)	156.025 MHz	156.000 MHz	60 dB	1 %
			156.050 MHz	60 dB	1 %
	U <sub>max</sub> (31.2 V DC)	156.025 MHz	156.000 MHz	60 dB	2 %
			156.050 MHz	60 dB	2 %
	U <sub>min</sub> (21.6 V DC)	162.025 MHz	162.000 MHz	60 dB	1 %
			162.050 MHz	60 dB	0 %
	U <sub>max</sub> (31.2 V DC)	162.025 MHz	162.000 MHz	60 dB	3 %
			162.050 MHz	60 dB	1 %
T <sub>max</sub> ( + 55 °C)	U <sub>min</sub> (21.6 V DC)	156.025 MHz	156.000 MHz	63 dB	6 %
			156.050 MHz	63 dB	4 %
	U <sub>max</sub> (31.2 V DC)	156.025 MHz	156.000 MHz	63 dB	5 %
			156.050 MHz	63 dB	5 %
	U <sub>min</sub> (21.6 V DC)	162.025 MHz	162.000 MHz	63 dB	6 %
			162.050 MHz	63 dB	4 %
	U <sub>max</sub> (31.2 V DC)	162.025 MHz	162.000 MHz	63 dB	3 %
			162.050 MHz	63 dB	3 %
Measurement uncertainty				< 3 dB	

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TEST REPORT REFERENCE: R20608 Edition 3

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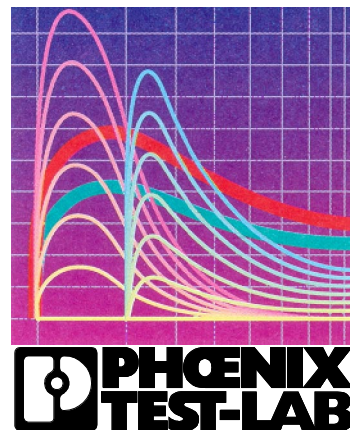
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LIMITS: SUBCLAUSE 15.3.6

Conditions	Limits of adjacent channel selectivity
Normal test conditions	70 dB
Extreme test conditions	60 dB

TEST EQUIPMENT USED:

25, 27, 33, 42, 51, 81, 100, 101, 102, 103, 113



TEST REPORT REFERENCE: R20608 Edition 3

## 6.7 ADJACENT CHANNEL SELECTIVITY -12.5 KHZ OPERATION SUBCLAUSE 15.3.7

Ambient temperature	20°C	Relative humidity	55 %
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Operation mode: Receive in AIS mode  
 Wanted signal: Test-signal 2 and 3 in alternating mode,  
 P = -95 dBm (normal conditions) / -89 dBm (extreme conditions)  
 Unwanted signal: Modulated with 400 Hz / 1.5 kHz deviation

TEMPERATURE	VOLTAGE	WANTED SIGNAL	UNWANTED SIGNAL	SIGNAL RATIO	PACKET ERROR RATE
T <sub>nom</sub> ( + 20 °C)	U <sub>nom</sub> (24.0 V DC)	156.025 MHz	156.000 MHz	50 dB	13 %
			156.050 MHz	50 dB	18 %
	U <sub>nom</sub> (24.0 V DC)	162.025 MHz	162.000 MHz	50 dB	9 %
			162.050 MHz	50 dB	10 %
T <sub>min</sub> ( - 15 °C)	U <sub>min</sub> (21.6 V DC)	156.025 MHz	156.000 MHz	50 dB	11 %
			156.050 MHz	50 dB	9 %
	U <sub>max</sub> (31.2 V DC)	156.025 MHz	156.000 MHz	50 dB	12 %
			156.050 MHz	50 dB	15 %
	U <sub>min</sub> (21.6 V DC)	162.025 MHz	162.000 MHz	50 dB	11 %
			162.050 MHz	50 dB	9 %
	U <sub>max</sub> (31.2 V DC)	162.025 MHz	162.000 MHz	50 dB	14 %
			162.050 MHz	50 dB	12 %
T <sub>max</sub> ( + 55 °C)	U <sub>min</sub> (21.6 V DC)	156.025 MHz	156.000 MHz	56 dB	11 %
			156.050 MHz	56 dB	11 %
	U <sub>max</sub> (31.2 V DC)	156.025 MHz	156.000 MHz	56 dB	3 %
			156.050 MHz	56 dB	4 %
	U <sub>min</sub> (21.6 V DC)	162.025 MHz	162.000 MHz	56 dB	5 %
			162.050 MHz	56 dB	5 %
	U <sub>max</sub> (31.2 V DC)	162.025 MHz	162.000 MHz	52 dB	12 %
			162.050 MHz	52 dB	11 %
Measurement uncertainty				< 3 dB	

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TEST REPORT REFERENCE: R20608 Edition 3

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Continued:

LIMITS: SUBCLAUSE 15.3.6

Conditions	Limits of adjacent channel selectivity
Normal test conditions	50 dB
Extreme test conditions	50 dB

TEST EQUIPMENT USED:

25, 27, 33, 42, 51, 81, 100, 101, 102, 103, 113



TEST REPORT REFERENCE: R20608 Edition 3

## 6.8 SPURIOUS RESPONSE REJECTION

## SUBCLAUSE 15.3.8

Ambient temperature	20 °C	Relative humidity	55 %
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Operation mode: Receive in AIS-mode,  $f = 156.025$  MHz  
 Wanted signal: Test-signal 2 and 3 in alternating mode,  $P = -104$  dBm  
 Unwanted signal: Modulated with 400 Hz / 3 kHz deviation

DEFINITION	UNWANTED FREQUENCY	RATIO
1st LO-Freq. - IF	246.025 MHz	> 80 dB
2 x 1st LO-Freq. - IF	357.050 MHz	> 80 dB
2 x 1st LO-Freq. + IF	447.050 MHz	> 80 dB
3 x 1st LO-Freq. - IF	558.075 MHz	> 80 dB
3 x 1st LO-Freq. + IF	648.075 MHz	> 80 dB
4 x 1st LO-Freq. - IF	759.100 MHz	> 80 dB
4 x 1st LO-Freq. + IF	849.100 MHz	> 80 dB
No other spurious response rejection frequencies found		
Measurement uncertainty		
		< 3 dB

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TEST REPORT REFERENCE: R20608 Edition 3

Continued:

Operation mode: Receive in AIS-mode,  $f = 162.025$  MHz  
 Wanted signal: Test-signal 2 and 3 in alternating mode,  $P = -104$  dBm  
 Unwanted signal: Modulated with 400 Hz / 3 kHz deviation

DEFINITION	UNWANTED FREQUENCY	RATIO
1st LO-Freq. - IF	252.025 MHz	> 80 dB
2 x 1st LO-Freq. - IF	369.050 MHz	> 80 dB
2 x 1st LO-Freq. + IF	459.050 MHz	> 80 dB
3 x 1st LO-Freq. - IF	576.075 MHz	> 80 dB
3 x 1st LO-Freq. + IF	666.075 MHz	> 80 dB
4 x 1st LO-Freq. - IF	783.100 MHz	> 80 dB
4 x 1st LO-Freq. + IF	873.100 MHz	> 80 dB
No other spurious response rejection frequencies found		
Measurement uncertainty		
		< 3 dB

LIMITS: SUBCLAUSE 15.3.8

At any frequency separated from the nominal frequency of the receiver by two channels or more, the spurious response rejection ratio shall not be less than 70 dB.

TEST EQUIPMENT USED:

25, 27, 33, 42, 81, 100, 101, 102, 103, 113



TEST REPORT REFERENCE: R20608 Edition 3

## 6.9 INTERMODULATION RESPONSE REJECTION AND BLOCKING

### SUBCLAUSE 15.3.9

Ambient temperature	21 °C	Relative humidity	60 %
---------------------	-------	-------------------	------

Operation mode: Receive in AIS-mode,  $f = 156.025$  MHz  
 Wanted signal A: Test-signal 2 and 3 in alternating mode,  $P = -101$  dBm  
 Unwanted signal B: Modulated 400 Hz / 3 kHz, RF-level -39 dBm (Remark 1)  
 Unwanted signal C: Unmodulated, RF-level -39 dBm (Remark 1)  
 Unwanted signal D: Unmodulated, RF-level -15 dBm

FREQUENCIES OF THE UNWANTED SIGNALS			PACKET ERROR RATE
Generator B	Generator C	Generator D	
+ 500 kHz: 156.525 MHz	+ 1000 kHz: 157.025 MHz	+ 5725 kHz: 161.750 MHz	< 20 % Remark 1
Measurement uncertainty			< 3 dB

Remark 1:  
 To fulfil the limits of the subclause 15.3.9, the signal levels of the unwanted signal B and C were reduced from - 31 dBm to - 39 dBm.

Operation mode: Receive in AIS-mode,  $f = 162.025$  MHz  
 Wanted signal A: Test-signal 2 and 3 in alternating mode,  $P = -101$  dBm  
 Unwanted signal B: Modulated 400 Hz / 3 kHz, RF-level -41 dBm (Remark 2)  
 Unwanted signal C: Unmodulated, RF-level -41 dBm (Remark 2)  
 Unwanted signal D: Unmodulated, RF-level -15 dBm

FREQUENCIES OF THE UNWANTED SIGNALS			PACKET ERROR RATE
Generator B	Generator C	Generator D	
- 500 kHz: 161.525 MHz	- 1000 kHz: 161.025 MHz	- 5725 kHz: 156.300 MHz	< 20 % Remark 2
Measurement uncertainty			< 3 dB

Remark 2:  
 To fulfil the limits of the subclause 15.3.9, the signal levels of the unwanted signal B and C were reduced from - 31 dBm to - 39 dBm.

LIMITS: SUBCLAUSE 15.3.9

The packet error rate, with the output of signal generators B, C and D switched on, shall be 20 % or less.

TEST EQUIPMENT USED:

25, 27, 33, 42, 81, 100, 101, 102, 103, 113





TEST REPORT REFERENCE: R20608 Edition 3

## 6.10 TRANSMIT TO RECEIVE SWITCHING TIME

## SUBCLAUSE 15.3.10

Ambient temperature	20 °C	Relative humidity	55 %
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Operation mode: Transmit, receive in the following time slot

### Test procedure:

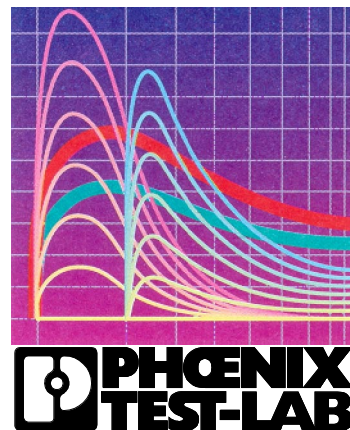
The trigger signal of the transmitter of the EUT was connected to channel 1 of a storage oscilloscope. The output signal of the receiver demodulator stage was connected to channel 2 of the same oscilloscope. A rf-signal with a level of - 107 dBm (modulated with a sinusoidal signal) was fed to the receiver. The plot "transmit to receive switching time" in "Annex C" of this test-report shows the demodulated sinusoidal signal immediately after the trigger signal of the transmitter switches from transmit to receive.

LIMITS: SUBCLAUSE 15.3.10

The sensitivity shall be -107 dBm with a PER of at most 20% under normal conditions.
--

### TEST EQUIPMENT USED:

25, 31, 42, 81, 84, 100
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TEST REPORT REFERENCE: R20608 Edition 3

## 6.11 MAXIMUM SENSITIVITY

## SUBCLAUSE 15.4.1

Ambient temperature	20 °C
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Relative humidity	55 %
-------------------	------

Operation mode: Receive in DSC-mode,  $f = 156.525 \text{ MHz}$

Wanted signal: Test-signal 1

TEMPERATURE	VOLTAGE	BIT ERROR RATE	RECEIVER SENSITIVITY
$T_{\text{nom}}$ (+ 20 °C)	$U_{\text{nom}}$ (24.0 V DC)	0 %	- 107 dBm
$T_{\text{min}}$ (- 15 °C)	$U_{\text{min}}$ (21.6 V DC)	0 %	- 101 dBm
	$U_{\text{min}}$ (31.2 V DC)	0 %	- 101 dBm
$T_{\text{max}}$ (+ 55 °C)	$U_{\text{min}}$ (21.6 V DC)	0 %	- 101 dBm
	$U_{\text{min}}$ (31.2 V DC)	0 %	- 101 dBm
Measurement uncertainty		< 3 dB	

Operation mode: Receive in DSC-mode,  $f = 156.525 \text{ MHz} + 1.5 \text{ kHz}$

Wanted signal: Test-signal 1

TEMPERATURE	VOLTAGE	BIT ERROR RATE	RECEIVER SENSITIVITY
$T_{\text{nom}}$ (+ 20 °C)	$U_{\text{nom}}$ (24.0 V DC)		
$T_{\text{min}}$ (- 15 °C)	$U_{\text{min}}$ (21.6 V DC)	<div style="border: 1px solid black; padding: 5px;">                     The wanted signal was generated by using a second AIS Transponder X-Pack DS. The synthesizer with a channel spacing of 12.5 kHz was not able to generate a wanted signal at <math>156.525 \text{ MHz} + 1.5 \text{ kHz}</math>.                 </div>	
	$U_{\text{min}}$ (31.2 V DC)		
$T_{\text{max}}$ (+ 55 °C)	$U_{\text{min}}$ (21.6 V DC)		
	$U_{\text{min}}$ (31.2 V DC)		
Measurement uncertainty		< 3 dB	

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TEST REPORT REFERENCE: R20608 Edition 3

Continued:

Operation mode: Receive in DSC-mode,  $f = 156.525 \text{ MHz} - 1.5 \text{ kHz}$

Wanted signal: Test-signal 1

TEMPERATURE	VOLTAGE	BIT ERROR RATE	RECEIVER SENSITIVITY
$T_{\text{nom}}$ (+ 20 °C)	$U_{\text{nom}}$ (24.0 V DC)	<div style="border: 1px solid black; padding: 5px;">                     The wanted signal was generated by using a second AIS Transponder X-Pack DS. The synthesizer with a channel spacing of 12.5 kHz was not able to generate a wanted signal at 156.525 MHz - 1.5 kHz.                 </div>	
$T_{\text{min}}$ (- 15 °C)	$U_{\text{min}}$ (21.6 V DC)		
	$U_{\text{min}}$ (31.2 V DC)		
$T_{\text{max}}$ (+ 55 °C)	$U_{\text{min}}$ (21.6 V DC)		
	$U_{\text{min}}$ (31.2 V DC)		
Measurement uncertainty		< 3 dB	

LIMITS: SUBCLAUSE 15.4.1

The maximum usable sensitivity shall not be less sensitive than - 107 dBm under normal test conditions, and - 101 dBm under extreme test conditions. The test shall be repeated at the nominal carrier frequency  $(156.525 \text{ MHz}) \pm 1.5 \text{ kHz}$ .

TEST EQUIPMENT USED:

25, 27, 33, 42, 51, 81, 100, 101, 102, 103, 113



TEST REPORT REFERENCE: R20608 Edition 3

## 6.12 ERROR BEHAVIOUR AT HIGH INPUT LEVELS

### SUBCLAUSE 15.4.2

Ambient temperature	20 °C	Relative humidity	55 %
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Operation mode: Receive in DSC-mode,  $f = 156.525$  MHz

Wanted signal: Test-signal 1

RF-INPUT SIGNAL LEVEL	NUMBER OF MESSAGES NOT SUCCESSFULLY RECORDED (NORMAL TEST SIGNAL TRANSMITTED 1000 TIMES)
- 77 dBm	1 %
- 7 dBm	1 %

LIMITS: SUBCLAUSE 15.4.2

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

#### TEST EQUIPMENT USED:

25, 27, 33, 42, 81, 100, 101, 102, 103, 113



TEST REPORT REFERENCE: R20608 Edition 3

## 6.13 CO-CHANNEL REJECTION

## SUBCLAUSE 15.4.3

Ambient temperature	20 °C	Relative humidity	55 %
---------------------	-------	-------------------	------

Operation mode: Receive in DSC-mode,  $f = 156.525$  MHz  
Wanted signal: Test-signal 1,  $P = -104$  dBm  
Unwanted signal: Modulated with 400 Hz / 3 kHz deviation

Unwanted signal frequency:	Unwanted signal level:	Signal ratio:	Bit error rate:
156.522 MHz	-114 dBm	-10 dB	0 %
156.525 MHz	-112 dBm	-8 dB	0 %
156.528 MHz	-114 dBm	-10 dB	1 %
Measurement uncertainty		< 3 dB	

LIMITS: SUBCLAUSE 15.4.3

The value of the co-channel rejection ratio, expressed in dB, at the signal displacements given in the method of measurements, shall be between  $-10.0$  dB and 0 dB. Any positive value is also acceptable. The BER shall not exceed 1%.

## TEST EQUIPMENT USED:

25, 27, 33, 42, 81, 100, 101, 102, 103, 113



TEST REPORT REFERENCE: R20608 Edition 3

## 6.14 ADJACENT CHANNEL SENSITIVITY

## SUBCLAUSE 15.4.4

Ambient temperature	20 °C	Relative humidity	55 %
---------------------	-------	-------------------	------

Operation mode: Receive in DSC-mode,  $f = 156.525$  MHz  
 Wanted signal: Test-signal 1,  $P = -104$  dBm  
 Unwanted signal:  $f = 156.550$  MHz, modulated with 400 Hz and a deviation of 3 kHz.

TEMPERATURE	VOLTAGE	SIGNAL RATIO	BIT ERROR RATE
$T_{\text{nom}}$ (+ 20 °C)	$U_{\text{nom}}$ (24.0 V)	70 dB	0 %
$T_{\text{min}}$ (- 15 °C)	$U_{\text{min}}$ (21.6 V)	60 dB	0 %
	$U_{\text{max}}$ (31.2 V)	60 dB	0 %
$T_{\text{max}}$ (+ 55 °C)	$U_{\text{min}}$ (21.6 V)	60 dB	1 %
	$U_{\text{max}}$ (31.2 V)	60 dB	1 %
Measurement uncertainty		< 3 dB	

Operation mode: Receive in DSC-mode,  $f = 156.525$  MHz  
 Wanted signal: Test-signal 1,  $P = -104$  dBm  
 Unwanted signal:  $f = 156.500$  MHz, modulated with 400 Hz and a deviation of 3 kHz.

TEMPERATURE	VOLTAGE	SIGNAL RATIO	BIT ERROR RATE
$T_{\text{nom}}$ (+ 20 °C)	$U_{\text{nom}}$ (24.0 V)	70 dB	0 %
$T_{\text{min}}$ (- 15 °C)	$U_{\text{min}}$ (21.6 V)	60 dB	0 %
	$U_{\text{max}}$ (31.2 V)	60 dB	0 %
$T_{\text{max}}$ (+ 55 °C)	$U_{\text{min}}$ (21.6 V)	60 dB	0 %
	$U_{\text{max}}$ (31.2 V)	60 dB	0 %
Measurement uncertainty		< 3 dB	

LIMITS: SUBCLAUSE 15.4.4

Normal test conditions:	70 dB
Extreme test conditions:	60 dB
The BER shall not exceed 1%.	

TEST EQUIPMENT USED:

25, 27, 33, 42, 51, 81, 100, 101, 102, 103, 113



TEST REPORT REFERENCE: R20608 Edition 3

## 6.15 SPURIOUS RESPONSE REJECTION

## SUBCLAUSE 15.4.5

Ambient temperature	20 °C	Relative humidity	55 %
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Operation mode: Receive in DSC-mode,  $f = 156.525$  MHz  
 Wanted signal: Test-signal 1,  $P = -104$  dBm  
 Unwanted signal: Modulated with 400 Hz and a deviation of 3 kHz

DEFINITION	UNWANTED FREQUENCY	RATIO
1st LO-Freq. - IF	246.525 MHz	75 dB
2 x 1st LO-Freq. - IF	358.050 MHz	> 80 dB
2 x 1st LO-Freq. + IF	448.050 MHz	> 80 dB
3 x 1st LO-Freq. - IF	559.575 MHz	> 80 dB
3 x 1st LO-Freq. + IF	649.575 MHz	> 80 dB
4 x 1st LO-Freq. - IF	761.100 MHz	> 80 dB
4 x 1st LO-Freq. + IF	851.100 MHz	> 80 dB
No other spurious response rejection frequencies found		
Measurement uncertainty		
		< 3 dB

LIMITS: SUBCLAUSE 15.4.5

At any frequency separated from the nominal frequency of the receiver by two channels or more, the spurious response rejection ratio shall not be less than 70 dB.

TEST EQUIPMENT USED:

25, 27, 33, 42, 81, 100, 101, 102, 103, 113



TEST REPORT REFERENCE: R20608 Edition 3

## 6.16 INTERMODULATION RESPONSE REJECTION

## SUBCLAUSE 15.4.6

Ambient temperature	20 °C	Relative humidity	55 %
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Operation mode: Receive in DSC-mode,  $f = 156.525$  MHz  
 Wanted signal A: Test-signal 1,  $P = -104$  dBm  
 Unwanted signal B: Unmodulated,  $P = -52$  dBm (Remark 3)  
 Unwanted signal C: Modulated with 400 Hz and 3 kHz deviation,  $P = -52$  dBm (Remark 3)

FREQUENCIES OF THE UNWANTED SIGNALS		SIGNAL RATIO	BIT ERROR RATE
Generator B	Generator C		
+ 50 kHz	+ 100 kHz	52 dB (Remark 3)	0.8 %
- 50 kHz	- 100 kHz	52 dB (Remark 3)	0.9 %
Measurement uncertainty		< 3 dB	

Remark 3:  
 To fulfil the limits of the subclause 15.4.6, the signal levels of the unwanted signal B and C were reduced from - 39 dBm to - 52 dBm.

LIMITS: SUBCLAUSE 15.4.6

The intermodulation response rejection ratio shall not be less than 65 dB.  
 The BER shall not exceed 1%.

### TEST EQUIPMENT USED:

25, 27, 33, 42, 51, 81, 100, 101, 102, 103, 113





TEST REPORT REFERENCE: R20608 Edition 3

## 6.17 BLOCKING OR DESENSITISATION

### SUBCLAUSE 15.4.7

Ambient temperature	20 °C	Relative humidity	55 %
---------------------	-------	-------------------	------

Operation mode: Receive in DSC-mode,  $f = 156.525$  MHz  
Wanted signal A: Test-signal 1,  $P = -104$  dBm  
Unwanted signal B: Unmodulated,  $P = -20$  dBm

FREQUENCIES OF THE UNWANTED SIGNALS	BIT ERROR RATE BER
157.525 MHz	< 1 %
155.525 MHz	< 1 %
158.525 MHz	0 %
154.525 MHz	0 %
161.525 MHz	0 %
151.525 MHz	0 %
166.525 MHz	0 %
146.525 MHz	0 %
Measurement uncertainty	< 3 dB

LIMITS: SUBCLAUSE 15.4.7

The blocking ratio for any frequency within the specified ranges shall not be less than 84 dB, except at frequencies on which spurious responses are found.  
The BER shall not exceed 1%.

TEST EQUIPMENT USED:

25, 27, 33, 42, 51, 81, 100, 101, 102, 103, 113





TEST REPORT REFERENCE: R20608 Edition 3

## 6.19 SPURIOUS EMISSIONS FROM THE TRANSMITTER

## SUBCLAUSE 15.5.2

Ambient temperature	20 °C	Relative humidity	55 %
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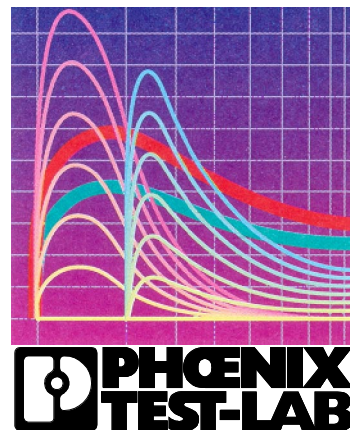
Operation mode: Continuous transmission without modulation,  $f = 156.025$  MHz,  $P = 33$  dBm

SPURIOUS EMISSIONS LEVEL (CONDUCTED)					
f	Level	Bandwidth	f	Level	Bandwidth
312.050 MHz	- 49 dBm	100 kHz	-	-	-
468.075 MHz	- 60 dBm	100 kHz	-	-	-
-	-	-	-	-	-
Measurement uncertainty		+ 0.66 dB / - 0.72 dB			

Operation mode: Continuous transmission without modulation,  $f = 156.025$  MHz,  $P = 41$  dBm

SPURIOUS EMISSIONS LEVEL (CONDUCTED)					
f	Level	Bandwidth	f	Level	Bandwidth
312.050 MHz	- 42 dBm	100 kHz	-	-	-
468.075 MHz	- 41 dBm	100 kHz	-	-	-
-	-	-	-	-	-
Measurement uncertainty		+ 0.66 dB / - 0.72 dB			

Continued next page:



TEST REPORT REFERENCE: R20608 Edition 3

Continued:

Operation mode: Continuous transmission without modulation,  $f = 162.025$  MHz,  $P = 33$  dBm

SPURIOUS EMISSIONS LEVEL (CONDUCTED)					
f	Level	Bandwidth	f	Level	Bandwidth
324.050 MHz	- 48 dBm	100 kHz	-	-	-
486.075 MHz	- 62 dBm	100 kHz	-	-	-
-	-	-	-	-	-
Measurement uncertainty		+ 0.66 dB / - 0.72 dB			

Operation mode: Continuous transmission without modulation,  $f = 162.025$  MHz,  $P = 41$  dBm

SPURIOUS EMISSIONS LEVEL (CONDUCTED)					
f	Level	Bandwidth	f	Level	Bandwidth
324.050 MHz	- 41 dBm	100 kHz	-	-	-
486.075 MHz	- 43 dBm	100 kHz	-	-	-
-	-	-	-	-	-
Measurement uncertainty		+ 0.66 dB / - 0.72 dB			

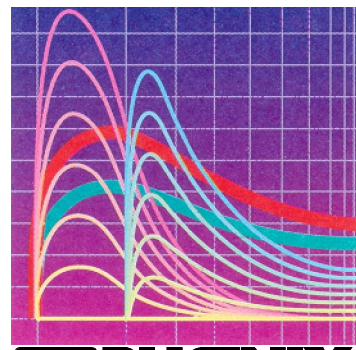
LIMITS: SUBCLAUSE 15.5.1

Conducted emissions:

Frequency range	150 kHz to 1 GHz	1 to 2 GHz
TX operating	0.25 $\mu$ W (- 36 dBm)	1 $\mu$ W (- 30 dBm)

TEST EQUIPMENT USED:

07, 42, 63, 81, 100, 101



TEST REPORT REFERENCE: R20608 Edition 3

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## 7 TEST EQUIPMENT



TEST REPORT REFERENCE: R20608 Edition 3

No.	Test equipment	Type	Manufacturer	Serial No.	PM-No
01	Fully anechoic chamber M8	-	Siemens Matsushita	B83117-E7019-T231	480190
02	Fully anechoic chamber M20	-	Albatross Projects	B83107-E2439-T232	480303
03	Open area test site	-	Phoenix Test-Lab	-	480085
04	Outdoor test site	-	Phoenix Test-Lab	-	480293
05	Measuring receiver	ESAI	Rohde & Schwarz	831953/001 833181/018	480025 480026
06	Measuring receiver	ESMI	Rohde & Schwarz	843977/001 843530/018	480179 480180
07	Measuring receiver	ESI 40	Rohde & Schwarz	837808/007	480334
08	Measuring receiver	ESCS 30	Rohde & Schwarz	828985/014	480270
09	Spectrum analyser	R2361C	Advantest	51720469	480144
10	Loop antenna	HFH2-Z2	Rohde & Schwarz	832609/014	480059
11	BILOG Antenna	CBL6112 A	Chase	2034	480185
12	BILOG Antenna	CBL6112 B	Chase	2688	480328
13	Bikon Antenna	HK 116	Rohde & Schwarz	833599/008	480071
14	Bikon Antenna	HK 116	Rohde & Schwarz	836891/012	480122
15	Log-Per Antenna	HL 223	Rohde & Schwarz	835556/014	480123
16	Log-Per Antenna	HL 223	Rohde & Schwarz	833335/005	480072
17	Horn Antenna	3115 A	EMCO	9609-4918	480183
18	Horn Antenna	3115 B	EMCO	9609-4922	480184
19	Precision Dipole	HZ 12	Rohde & Schwarz	831781/02	480061
20	Precision Dipole	HZ 13	Rohde & Schwarz	831782/02	480062
21	Shorted Dipole	VHAA 9110	Schwarzbeck	143	480166
22	Power amplifier	25A100	AR	12610	480023
23	Loop Antenna $\varnothing = 110$ mm	-	Phoenix Test-Lab	-	410084
24	Signal generator	SMP 03	Rohde & Schwarz	848986/004	480245
25	Signal generator	SMHU	Rohde & Schwarz	844170/017	480266
26	Signal generator	SME 06	Rohde & Schwarz	844530/008	480174
27	Signal generator	SMG	Rohde & Schwarz	8334497/030	480013
28	Signal generator	83650L	Agilent	3844A00554	480333



TEST REPORT REFERENCE: R20608 Edition 3

No.	Test equipment	Type	Manufacturer	Serial No.	PM-No
29	Radio communication analyser	CMTA 54	Rohde & Schwarz	841904/011	480169
30	Oscilloscope 4channel	54540A	Hewlett Packard	3339A00192	480001
31	Oscilloscope 2 channel	54520A	Hewlett Packard	3344A00390	480007
32	Signal generator	TOE 7704	TOELLNER	39385	480008
33	Combiner	ZFSC-2-11	Mini Circuits	-	410089
34	Combiner	ZFSC-2-11	Mini Circuits	-	410090
35	Power splitter	11850C	Hewlett Packard	01052	410069
36	Power splitter	-	Suhner	-	410070
37	Symmetrical transformer	-	Phoenix Test Lab	-	410086
38	Feeding bridge A	-	Phoenix Test Lab	-	410087
39	Feeding bridge A	-	Phoenix Test Lab	-	410088
40	Regulating transformer	BR802	Block	-	480094
41	Regulating transformer	BR802	Block	-	480095
42	Power supply	TOE 8752	Toellner	31566	480010
43	Power supply	TOE 8852	Toellner	51712	480233
44	Power supply	TOE 8752	Toellner	31569	480009
46	Power supply	TOE 8852	Toellner	51786	490001
47	Climatic chamber	KS600/75L	RS-Simulatoren	19002901	490065
48	Climatic chamber	KS600/75	RS-Simulatoren	19004201	490070
49	Climatic chamber	ST2K220/75	RS-Simulatoren	9803901	490020
50	Climatic chamber	ST2K220/75	RS-Simulatoren	2002701	490072
51	Climatic chamber	GTS500.40	GTS	1660	490073
52	Double circulator	-	Motorola	-	-
53	Directional coupler	ZFDC-2O-5	Mini Circuits	-	410092
54	Directional coupler	4001B-20	Narda Microwave	02010	410150
55	Directional coupler	774D	Hewlett Packard	06375	410149
56	Impedance matching unit	-	Phoenix-Test-Lab	-	410091
57	High Pass Filter	HP-350	Dirk Fischer Elektronik	-	410151
58	High Pass Filter	HP-450	Dirk Fischer Elektronik	-	410152
59	High Pass Filter	HP-1000	Dirk Fischer Elektronik	-	410147
60	IF-Filter 20kHz/25kHz	MQF 10.7-	Telefilter	0043	480323





TEST REPORT REFERENCE: R20608 Edition 3

No.	Test equipment	Type	Manufacturer	Serial No.	PM-No
		1400/11			
61	IF-Filter 12.5kHz	MQF 10.7-0850/11	Telefilter	0043	480324
62	Notch Filter	TTR 375-3EE	TELONIC Berkeley	-	480330
63	Notch Filter	TTR 190-3EE	TELONIC Berkeley	97284-6	480331
64	Notch Filter	TTR 95-3EE	TELONIC Berkeley	00104-2	480332
65	Mixer	ZP-1	Mini Circuits	15542	410148
66	Variable Attenuator / 0-11 dB	8494B	Hewlett Packard	3308A38264	480264
67	Variable Attenuator 0 - 110 dB	8496B	Hewlett Packard	3308A71365	480265
68	Attenuator / 3 dB / 5 W	WA2-3	Weinschel	8250	410115
69	Attenuator / 3 dB / 5 W	WA2-3	Weinschel	8251	410116
70	Attenuator / 3 dB / 5 W	WA2-3	Weinschel	8252	410117
71	Attenuator / 3 dB / 50 W	33-3-34	Weinschel	BH 5062	410131
72	Attenuator / 6 dB / 5 W	WA2-6	Weinschel	8253	410118
73	Attenuator / 6 dB / 5 W	WA2-6	Weinschel	8254	410119
74	Attenuator / 6 dB / 5 W	WA2-6	Weinschel	8255	410120
75	Attenuator / 6 dB / 25 W	33-6-34	Weinschel	BH 5536	410128
76	Attenuator / 10 dB / 1 W	6810.17A	Huber + Suhner	-	410067
77	Attenuator / 10 dB / 5 W	WA2-10	Weinschel	8259	410121
78	Attenuator / 10 dB / 5 W	WA2-10	Weinschel	8260	410122
79	Attenuator / 10 dB / 5 W	WA2-10	Weinschel	8261	410123
80	Attenuator / 10 dB / 10 W	WA8-10	Weinschel	7538	410112
81	Attenuator / 10 dB / 25 W	33-10-34	Weinschel	BH 4878	410129
82	Attenuator / 10 dB / 25 W	33-10-34	Weinschel	BH 4856	410130
83	Attenuator / 10 dB / 100 W	BN 745353	Spinner	20262	480274
84	Attenuator / 20 dB / 1 W	6820.17A	Huber + Suhner	-	410068
85	Attenuator / 20 dB / 5 W	WA2-20	Weinschel	8256	410124
86	Attenuator / 20 dB / 5 W	WA2-20	Weinschel	8257	410125
87	Attenuator / 20 dB / 5 W	WA2-20	Weinschel	8258	410126
88	Attenuator / 20 dB / 10 W	WA8-20	Weinschel	7539	410113





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No.	Test equipment	Type	Manufacturer	Serial No.	PM-No
89	Attenuator / 30 dB / 200 W	BN 745395	Spinner	29971	480232
90	Termination / 50 $\Omega$ / 15 W	6515.17.A	Huber + Suhner	-	410078
91	Termination / 50 $\Omega$ / 0.5 W	6500.17.A	Huber + Suhner	-	410074
92	Termination / 50 $\Omega$ / 0.5 W	6500.17.A	Huber + Suhner	-	410075
93	RF-cable No. 1	RTK 081	Rosenberger	-	410093
94	RF-cable No. 2	RTK 081	Rosenberger	-	410094
95	RF-cable No. 3	RTK 081	Rosenberger	-	410095
96	RF-cable No. 4	RTK 081	Rosenberger	-	410096
97	RF-cable No. 5	RTK 081	Rosenberger	-	410097
98	RF-cable No. 6	RTK 081	Rosenberger	-	410098
99	RF-cable No. 7	Sucoflex	Huber + Suhner	-	410099
100	RF-cable No. 8	RG223	Phoenix-Test-Lab	-	410100
101	RF-cable No. 9	RG223	Phoenix-Test-Lab	-	410101
102	RF-cable No. 10	RG223	Phoenix-Test-Lab	-	410102
103	RF-cable No. 11	RG223	Phoenix-Test-Lab	-	410103
104	RF-cable No. 12	RG223	Phoenix-Test-Lab	-	410104
105	RF-cable No. 13	RG223	Phoenix-Test-Lab	-	410105
106	RF-cable No. 14	RG223	Phoenix-Test-Lab	-	410106
107	RF-cable No. 15	RG223	Phoenix-Test-Lab	-	410107
108	RF-cable No. 16	RG223	Phoenix-Test-Lab	-	410108
109	RF-cable No. 17	RG223	Phoenix-Test-Lab	-	410109
110	RF-cable No. 18	RG58	Phoenix-Test-Lab	-	410110
111	RF-cable No. 30	RTK 081	Rosenberger	-	410141
112	RF-cable No. 31	RTK 081	Rosenberger	-	410142
113	Oscilloscope	HM	HAMEG	-	480160
114	Probe	HM	HAMEG	-	410057
115	Power-Amplifier	AR 100	Amplifier Research	-	480022
116	Directional coupler	3060-20	Narda	-	480351
117	Signal generator	SMY 01	Rohde & Schwarz	-	580010
118	225 MHz Universal counter	53131 A	Hewlett & Packard	-	480134



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	X-Pack DS, main board, front view (with display and gps)	20608eut14.jpg
	X-Pack DS, main board, rear view (with connection port)	20608eut15.jpg
	X-Pack DS, power supply, front view	20608eut7.jpg
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