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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**

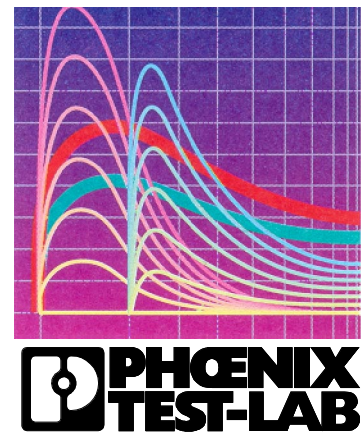
Test Report Reference: R20273 Edition 4

Equipment under Test: AIS-Transponder DEBEG 3400

Serial Number: -

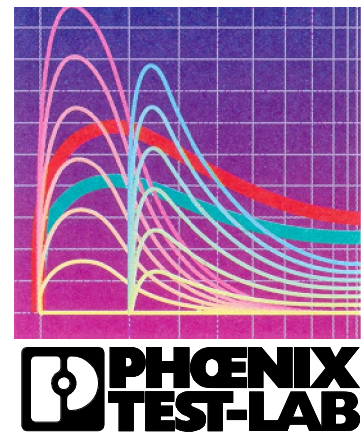
Applicant: STN ATLAS Marine Electronics GmbH

Manufacturer: STN ATLAS Marine Electronics GmbH



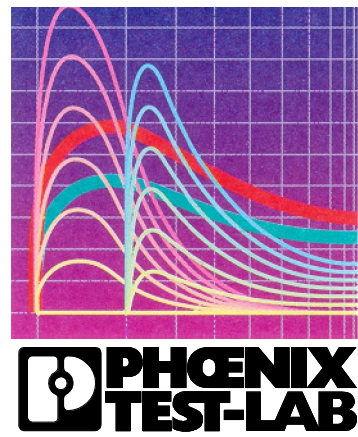
TEST REPORT REFERENCE: R20273 Edition 4

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1 IDENTIFICATION

1.1 APPLICANT

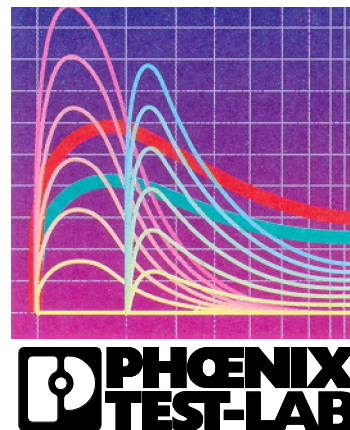
Name:	STN ATLAS Marine Electronics GmbH Systems Navigation / Communication
Address:	Behringstrasse 120 D-22763 Hamburg
Country:	Germany
Name for contact purposes:	Dr. Volker Köhler
Tel:	+49-(0)40-8825-3535
Fax:	+49-(0)40-8825-4105
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1.2 MANUFACTURER

Name:	STN ATLAS Marine Electronics GmbH Systems Navigation / Communication
Address:	Behringstrasse 120 D-22763 Hamburg
Country:	Germany
Name for contact purposes:	Dr. Volker Köhler
Tel:	+49-(0)40-8825-3535
Fax:	+49-(0)40-8825-4105
e-mail address:	volker.koehler@sam-electronic.de

1.3 DATES

Date of Receipt of Test Sample:	29 April 2002
Start of test:	29 April 2002
Finish of test:	02 Sept. 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

19. Sept. 2002

name

signature

date

Test report checked: Bernd Steiner

19. Sept. 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

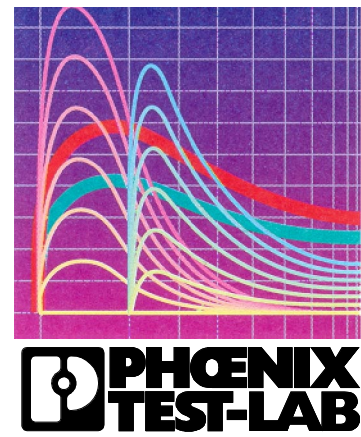
stamp

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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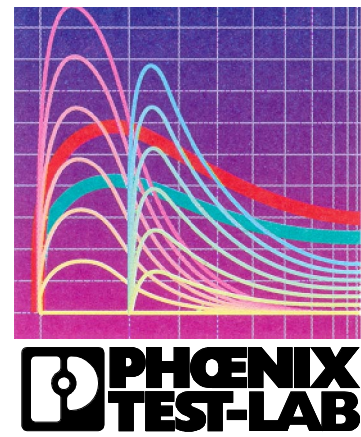
2 TECHNICAL DATA OF EQUIPMENT

see also Annex B

Type:	AIS Transponder				
Type designation:	DEBEG 3400				
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:					
AIS-Transponder:	$U_{nom}=$	24.0 V DC	$U_{min}=$	21.6 V DC	$U_{max}=$ 31.2 V DC
RF-Part:	$U_{nom}=$	15.0 V DC	$U_{min}=$	-	$U_{max}=$ -
Printed circuit designation:	HF-Bd. 0051				
Software:	TR 29.rom				

Ports/Connectors

Identification	Connector		Length
	EUT	Ancillary	
DC-power-supply	fixed	Not specified	Not specified
RS 422 data communication	fixed	D-Sub	Not specified
GPS-antenna	TNC	TNC	Not specified
VHF-antenna	BNC	BNC	Not specified
Ethernet 10-Base-T	BNC	BNC	Not specified



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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.

Some test were carried out by using a 15 V-DC-power-supply, connected directly to the rf-part of the EUT.

Wanted signal:

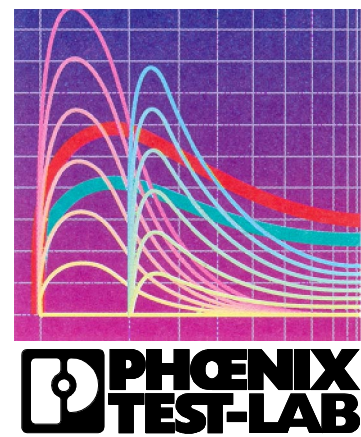
The test-signals 1 (DSC-mode), 2 and 3 (AIS-mode) were generated by a second EUT using the terminal software of the manufacturer. The modulation signal output was connected to the modulation signal input of a rf-generator, transmitting on 156.025 MHz or 162.025 MHz (if no others given in the standard) with the necessary signal levels.

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:

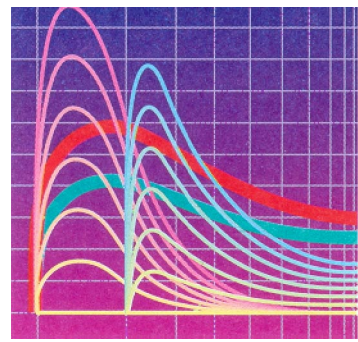
The unwanted-signals were generated by the rf-generators from Phoenix Test-Lab.



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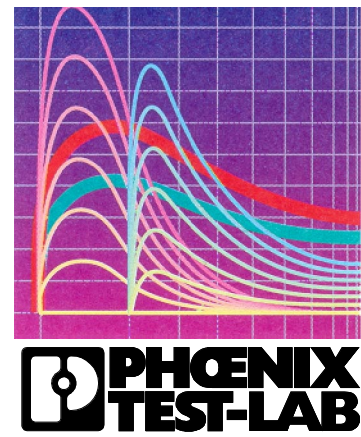
4 TEST OVERVIEW

Part 15	Physical tests	
	Transmitter requirements	
15.1	TDMA Transmitter	
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
15.2	DSC Transmission	
15.2.1	Frequency error of the DSC Transmission	Applicable
15.2.2	Modulation Rate	Applicable
	Receiver requirements	
15.3	TDMA Receiver	
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
15.4	DSC Receiver	
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
15.5	Conducted Spurious Emissions conveyed to the antenna	
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: R20273 Edition 4

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_{nom} (+ 20 °C)	U_{nom} (24.0 V DC)	156.02493 MHz	- 70 Hz
T_{min} (- 15 °C)	U_{nom} (15.0 V DC)*	156.02499 MHz	- 10 Hz
T_{max} (+ 55 °C)	U_{min} (21.6 V DC)	156.02590 MHz	+ 900 Hz
	U_{max} (31.2 V DC)	156.02591 MHz	+ 910 Hz
Maximum frequency error		+ 910 Hz	
Measurement uncertainty		$\pm 10 \text{ Hz}$	

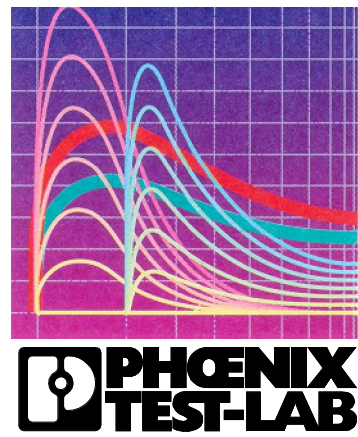
Operation mode: Continuous transmission without modulation, $f = 157.4125 \text{ MHz}$

TEST CONDITIONS		FREQUENCY	FREQUENCY ERROR
Temperature	Voltage		
T_{nom} (+ 20 °C)	U_{nom} (24.0 V DC)	157.41242 MHz	- 80 Hz
T_{min} (- 15 °C)	U_{nom} (15.0 V DC)*	157.41251 MHz	+ 10 Hz
T_{max} (+ 55 °C)	U_{min} (21.6 V DC)	157.41349 MHz	+ 99 Hz
	U_{max} (31.2 V DC)	157.41341 MHz	+ 91 Hz
Maximum frequency error		+ 99 Hz	
Measurement uncertainty		$\pm 10 \text{ Hz}$	

Remark:

* The rf-part of the transceiver is powered by 15 V DC using an inbuilt DC / DC-converter working with an input voltages from 21 to 32 V DC. The regulator stage delivers a stabilized 15 V DC-Voltages to the transceiver. For this reason some tests were carried out by using 15 V DC supplied directly to the rf-part of the EUT.

Continued next page:



TEST REPORT REFERENCE: R20273 Edition 4

Continued:

Operation mode: Continuous transmission without modulation, $f = 160.6375$ MHz

TEST CONDITIONS		FREQUENCY	FREQUENCY ERROR
Temperature	Voltage		
T_{nom} (+ 20 °C)	U_{nom} (24.0 V DC)	160.63742 MHz	- 80 Hz
T_{min} (- 15 °C)	U_{nom} (15.0 V DC)*	160.63749 MHz	- 10 Hz
T_{max} (+ 55 °C)	U_{min} (21.6 V DC)	160.63847 MHz	+ 970 Hz
	U_{max} (31.2 V DC)	160.63835 MHz	+ 850 Hz
Maximum frequency error		+ 970 Hz	
Measurement uncertainty		± 10 Hz	

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

TEST CONDITIONS		FREQUENCY	FREQUENCY ERROR
Temperature	Voltage		
T_{nom} (+ 20 °C)	U_{nom} (24.0 V DC)	162.02492 MHz	- 80 Hz
T_{min} (- 15 °C)	U_{nom} (15.0 V DC)*	162.02482 MHz	- 180 Hz
T_{max} (+ 55 °C)	U_{min} (21.6 V DC)	162.02597 MHz	+ 970 Hz
	U_{max} (31.2 V DC)	162.02598 MHz	+ 980 Hz
Maximum frequency error		+ 980 Hz	
Measurement uncertainty		± 10 Hz	

Remark:

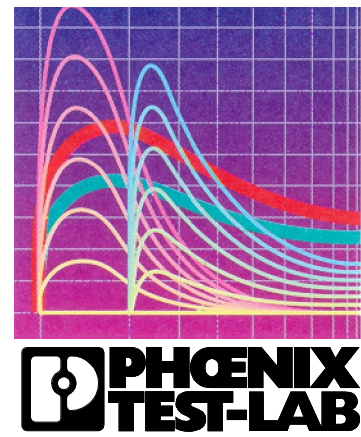
* The rf-part of the transceiver is powered by 15 V DC using an inbuilt DC / DC-converter working with an input voltages from 21 to 32 V DC. The regulator stage delivers a stabilized 15 V DC-Voltages to the transceiver. For this reason some tests were carried out by using 15 V DC supplied directly to the rf-part of the EUT.

LIMITS: SUBCLAUSE 15.1.1

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

TEST EQUIPMENT USED:

29, 42, 51, 93



TEST REPORT REFERENCE: R20273 Edition 4

5.2 CARRIER POWER (CONDUCTED)

SUBCLAUSE 15.1.2

Ambient temperature	20 °C	Relative humidity	55 %
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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)	33.0 dBm	40.2 dBm
T_{min} (- 15 °C)	U_{nom} (15.0 V DC)*	33.5 dBm	41.0 dBm
T_{max} (+ 55 °C)	U_{min} (21.6 V DC)	33.0 dBm	39.3 dBm
	U_{max} (31.2 V DC)	33.0 dBm	39.2 dBm
Maximum difference to rated power		+ 0.5 dB / - 0 dB	+ 0 dB / - 1.8 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)	33.0 dBm	40.0 dBm
T_{min} (- 15 °C)	U_{nom} (15.0 V DC)*	33.1 dBm	40.6 dBm
T_{max} (+ 55 °C)	U_{min} (21.6 V DC)	33.3 dBm	39.0 dBm
	U_{max} (31.2 V DC)	33.2 dBm	38.9 dBm
Maximum difference to rated power		+ 0.3 dB / - 0 dB	+ 0 dB / - 2.1 dB
Measurement uncertainty		+ 0.66 dB / - 0.72 dB	

Remark:

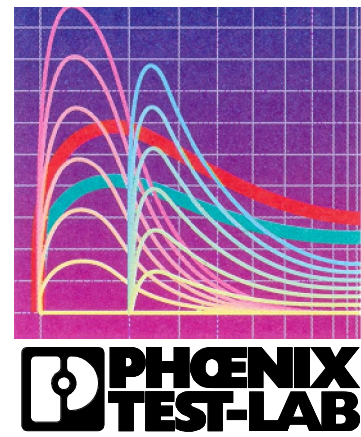
* The rf-part of the transceiver is powered by 15 V DC using an inbuilt DC / DC-converter working with an input voltages from 21 to 32 V DC. The regulator stage delivers a stabilized 15 V DC-Voltages to the transceiver. For this reason some tests were carried out by using 15 V DC supplied directly to the rf-part of the EUT.

LIMITS: SUBCLAUSE 15.1.2

The carrier output power (conducted) under normal test conditions shall be within ± 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, 93



TEST REPORT REFERENCE: R20273 Edition 4

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:	$f + 10$ kHz	- 44 dBc	
	$f + 25$ kHz	- 73 dBc	
Lower side band:	$f - 10$ kHz	- 43 dBc	
	$f - 25$ kHz	- 75 dBc	
Maximum adjacent channel power(± 25 kHz)		-73 dBc	
Measurement uncertainty		+ 1.8 dB / -2.5 dB	

Operation mode: Transmit in AIS-mode, $f = 156.525$ MHz

Centre frequency	$f = 156.525$ MHz	Test-signal 2	Test-signal 3
Upper side band:	$f + 10$ kHz	- 41 dBc	- 44 dBc
	$f + 25$ kHz	- 82 dBc	- 84 dBc
Lower side band:	$f - 10$ kHz	- 41 dBc	- 42 dBc
	$f - 25$ kHz	- 83 dBc	- 82 dBc
Maximum adjacent channel power (± 25 kHz)		-82 dBc	
Measurement uncertainty		+ 1.8 dB / -2.5 dB	

LIMITS: SUBCLAUSE 15.1.3

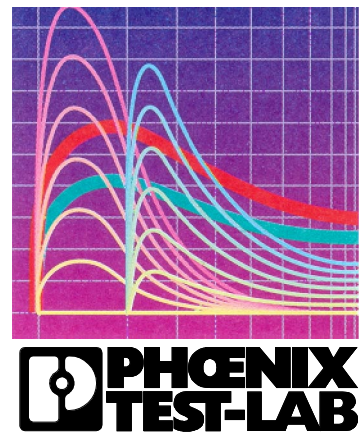
At ± 10 kHz removed from the carrier, the modulation sideband is below - 25 dBc.

At ± 25 kHz removed from the carrier, the modulation sideband is below - 70 dBc, without any need to be below 0.25 μ W.

In the region ± 10 kHz and ± 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: R20273 Edition 4

5.4 MODULATION SPECTRUM 12.5 KHZ CHANNEL MODE

SUBCLAUSE 15.1.4

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

Operation mode: Transmit in AIS-mode, $f = 156.525$ MHz

Centre frequency	$f = 156.525$ MHz	Test-signal 2	Test-signal 3
Upper side band:	$f + 2.5$ kHz	- 52 dBc	- 13 dBc
	$f + 12.5$ kHz	- 75 dBc	- 62 dBc
Lower side band:	$f - 2.5$ kHz	- 53 dBc	- 13 dBc
	$f - 12.5$ kHz	- 75 dBc	- 63 dBc
Maximum adjacent channel power (± 12.5 kHz)		-62 dBc	
Measurement uncertainty		+ 1.8 dB / -2.5 dB	

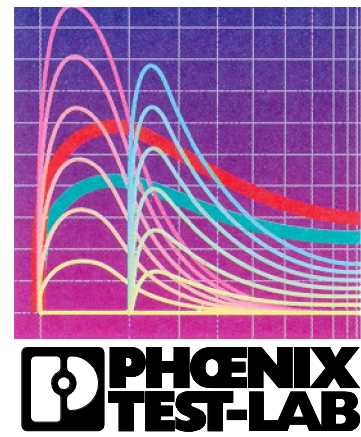
LIMITS: SUBCLAUSE 15.1.4

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

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

TEST EQUIPMENT USED:

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



TEST REPORT REFERENCE: R20273 Edition 4

5.5 TRANSMITTER ATTACK TIME

SUBCLAUSE 15.1.5

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

Operation mode: Transmit without modulation, $f = 156.525$ MHz, $P = 33$ dBm

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)	< 1 ms
The moment after which the frequency of the carrier always remains within ± 1 kHz of its steady state frequency F , as seen in the plot (see annex)	< 0.5 ms
Measurement uncertainty	< 20 %

Operation mode: Transmit without modulation, $f = 156.525$ MHz, $P = 41$ dBm

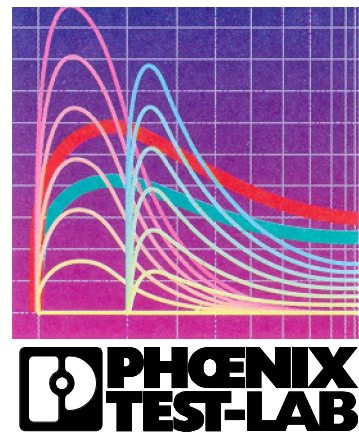
Time when the output power has reached a level of 1dB below or 1.5 dB above the steady state power P and maintains a level within $+ 1.5$ dB / $- 1$ dB from P thereafter as seen in the plot (see annex)	< 1 ms
The moment after which the frequency of the carrier always remains within ± 1 kHz of its steady state frequency F , as seen in the plot (see annex)	< 0.5 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 ± 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: R20273 Edition 4

5.6 TRANSMITTER RELEASE TIME

SUBCLAUSE 15.1.6

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

Operation mode: Transmit without modulation, $f = 156.525$ MHz, $P = 33$ dBm

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).	< 0.5 ms
Measurement uncertainty	< 20 %

Operation mode: Transmit without modulation, $f = 156.525$ MHz, $P = 41$ dBm

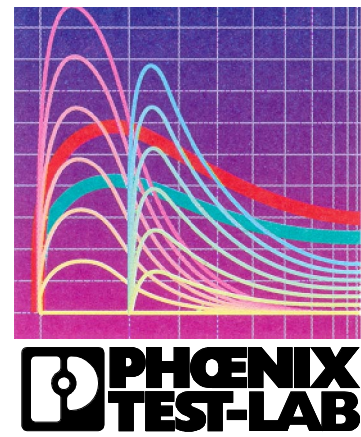
Time which elapses between the initiation of the "transmitter off" function and the moment when the transmitter output power has reduced to a level 50 dB below the steady state power and remains below this level thereafter as seen in the plot (see annex).	< 0.5 ms
Measurement uncertainty	< 20 %

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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TEST REPORT REFERENCE: R20273 Edition 4

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 _{nom} (+ 20 °C)	U _{nom} (24.0 V DC)	2099 Hz	- 1 Hz	1300 Hz	+ 0 Hz
T _{min} (- 15 °C)	U _{nom} (15.0 V DC)*	2100 Hz	+ 0 Hz	1299 Hz	- 1 Hz
T _{max} (+ 55 °C)	U _{min} (21.6 V DC)	2101 Hz	+ 1 Hz	1298 Hz	- 2 Hz
	U _{max} (31.2 V DC)	2103 Hz	+ 3 Hz	1299 Hz	- 1 Hz
Maximum frequency error		+ 3 Hz		- 2 Hz	
Measurement uncertainty		± 17 mHz			

Remark:

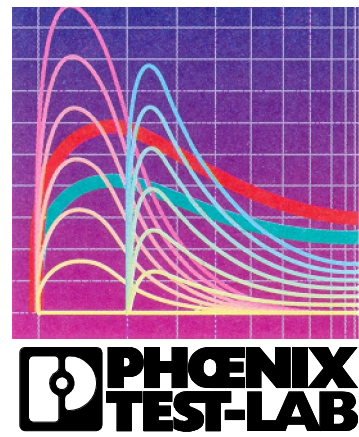
* The rf-part of the transceiver is powered by 15 V DC using an inbuilt DC / DC-converter working with an input voltages from 21 to 32 V DC. The regulator stage delivers a stabilized 15 V DC-Voltages to the transceiver. For this reason some tests were carried out by using 15 V DC supplied directly to the rf-part of the EUT.

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: R20273 Edition 4

5.8 MODULATION RATE

SUBCLAUSE 15.2.2

Ambient temperature	20 °C	Relative humidity	55 %
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Operation mode: Transmit in DSC-mode (1200 bit/s as nominal value).

	Results:
Nominal bit rate:	1200.000000 bit/s
Calculated bit rate:	1200.006625 bit/s *
Relative difference:	+ 5.5 ppm

* Remark:

Calculated bit rate by using the 48 MHz oscillator clock-frequency of the Digital Signal Processors DSP.

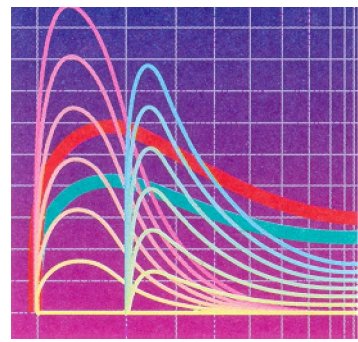
Nominal DSP clock frequency:	48000000 Hz
Measured DSP clock frequency:	48000264 Hz
Absolute difference	+ 264 Hz
Relative difference	+ 5.5 ppm
Nominal bit rate:	1200 bit/s
+ Relative difference	+ 5.5 ppm
Calculated bit rate	1200.006625 bit/s

LIMITS: SUBCLAUSE 15.2.2

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

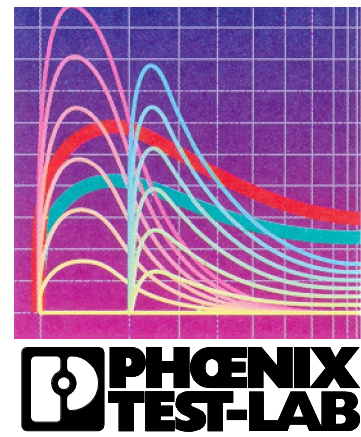
TEST EQUIPMENT USED:

42, 90, 118



TEST REPORT REFERENCE: R20273 Edition 4

6 RECEIVER REQUIREMENTS



TEST REPORT REFERENCE: R20273 Edition 4

6.1 SENSITIVITY - 25 KHZ OPERATION

SUBCLAUSE 15.3.1

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

TEMPERATURE	VOLTAGE	PACKET ERROR RATE	RECEIVER SENSITIVITY
T_{nom} (+ 20 °C)	U_{nom} (24.0 V DC)	6.3 %	-109 dBm
T_{min} (- 15 °C)	U_{nom} (15.0 V DC)*	10.0 %	-102 dBm
T_{max} (+ 55 °C)	U_{min} (21.6 V DC)	19.4 %	-102 dBm
	U_{max} (31.2 V DC)	18.4 %	-102 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_{nom} (+ 20 °C)	U_{nom} (24.0 V DC)	6.3 %	- 109 dBm
T_{min} (- 15 °C)	U_{nom} (15.0 V DC)*	10.0 %	-102 dBm
T_{max} (+ 55 °C)	U_{min} (21.6 V DC)	9.0 %	-102 dBm
	U_{max} (31.2 V DC)	17.9 %	-102 dBm
Measurement uncertainty		< 3 dB	

Remark:

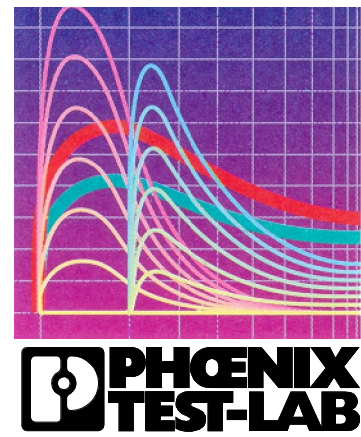
* The rf-part of the transceiver is powered by 15 V DC using an inbuilt DC / DC-converter working with an input voltages from 21 to 32 V DC. The regulator stage delivers a stabilized 15 V DC-Voltages to the transceiver. For this reason some tests were carried out by using 15 V DC supplied directly to the rf-part of the EUT.

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: R20273 Edition 4

6.2 SENSITIVITY - 12.5 KHZ OPERATION

SUBCLAUSE 15.3.2

Ambient temperature	20 °C	Relative humidity	55 %
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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)	2.4 %	- 102 dBm
T_{min} (- 15 °C)	U_{nom} (15.0 V DC)*	8.0 %	- 92 dBm
T_{max} (+ 55 °C)	U_{min} (21.6 V DC)	2.2 %	- 92 dBm
	U_{max} (31.2 V DC)	5.3 %	- 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)	4.1 %	- 102 dBm
T_{min} (- 15 °C)	U_{nom} (15.0 V DC)*	9.0 %	- 92 dBm
T_{max} (+ 55 °C)	U_{min} (21.6 V DC)	8.7 %	-92 dBm
	U_{max} (31.2 V DC)	4.4 %	-92 dBm
Measurement uncertainty		< 3 dB	

Remark:

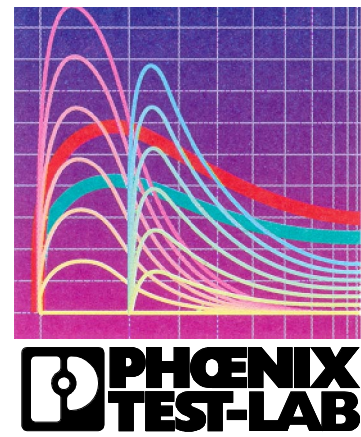
* The rf-part of the transceiver is powered by 15 V DC using an inbuilt DC / DC-converter working with an input voltages from 21 to 32 V DC. The regulator stage delivers a stabilized 15 V DC-Voltages to the transceiver. For this reason some tests were carried out by using 15 V DC supplied directly to the rf-part of the EUT.

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: R20273 Edition 4

6.3 ERROR BEHAVIOUR AT HIGH INPUT LEVELS

SUBCLAUSE 15.3.3

Ambient temperature	20 °C	Relative humidity	55 %
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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	0%
- 7 dBm	0%

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

Wanted signal: Test signal 2 and 3 in alternating mode

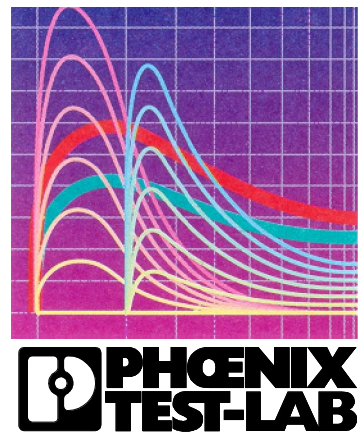
RF-INPUT SIGNAL LEVEL	NUMBER OF MESSAGES NOT SUCCESSFULLY RECORDED
- 77 dBm	0%
- 7 dBm	0%

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: R20273 Edition 4

6.4 CO-CHANNEL REJECTION - 25 KHZ OPERATION

SUBCLAUSE 15.3.4

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

Unwanted signal frequency:	Unwanted signal level:	Signal ratio:	Packet error rate:
156.022 MHz	-114 dBm	-10 dB	17.6%
156.025 MHz	-114 dBm	-10 dB	16.6%
156.028 MHz	-114 dBm	-10 dB	12.5%
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

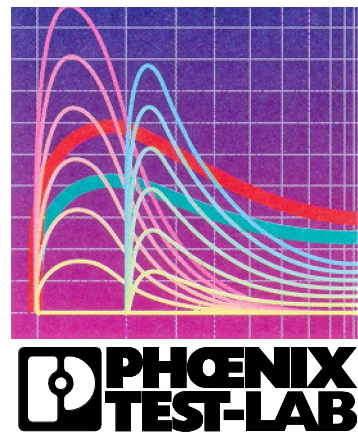
Unwanted signal frequency:	Unwanted signal level:	Signal ratio:	Packet error rate:
162.022 MHz	-114 dBm	-10 dB	10.7%
162.025 MHz	-114 dBm	-10 dB	16.6%
162.028 MHz	-114 dBm	-10 dB	12.5%
Measurement uncertainty		< 3 dB	

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: R20273 Edition 4

6.5 CO-CHANNEL REJECTION – 12.5 KHZ OPERATION

SUBCLAUSE 15.3.5

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, $P = -95$ 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	-113 dBm	-18 dB	4.0%
156.0250 MHz	-113 dBm	-18 dB	1.7%
156.0265 MHz	-113 dBm	-18 dB	0.7%
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

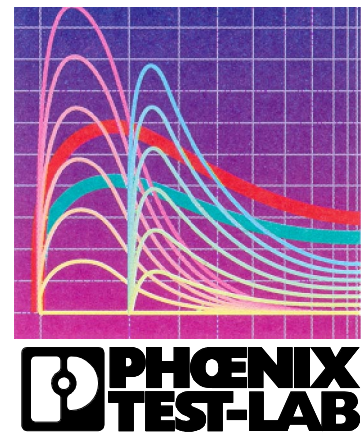
Unwanted signal frequency:	Unwanted signal level:	Signal ratio:	Packet error rate:
162.0235 MHz	-113 dBm	-18 dB	1.0%
162.0250 MHz	-113 dBm	-18 dB	4.5%
162.0265 MHz	-113 dBm	-18 dB	1.5%
Measurement uncertainty		< 3 dB	

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: R20273 Edition 4

6.6 ADJACENT CHANNEL SELECTIVITY – 25 KHZ OPERATION SUBCLAUSE 15.3.6

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 = -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 _{nom} (+ 20 °C)	U _{nom} (15.0 V DC)*	156.025 MHz	156.000 MHz	-70 dB	17.6%
			156.050 MHz	-70 dB	17.2%
	U _{nom} (15.0 V DC)*	162.025 MHz	162.000 MHz	-70 dB	15.8%
			162.050 MHz	-70 dB	20.0%
T _{min} (- 15 °C)	U _{nom} (15.0 V DC)*	156.025 MHz	156.000 MHz	-66 dB	2.0%
			156.050 MHz	-65 dB	10.3%
	U _{nom} (15.0 V DC)*	162.025 MHz	162.000 MHz	-65 dB	10.2%
			162.050 MHz	-65 dB	5.5%
T _{max} (+ 55 °C)	U _{nom} (15.0 V DC)*	156.025 MHz	156.000 MHz	-60 dB	2.8%
			156.050 MHz	-60 dB	1.6%
	U _{nom} (15.0 V DC)*	162.025 MHz	162.000 MHz	-60 dB	0.6%
			162.050 MHz	-60 dB	1.3%
Measurement uncertainty				< 3 dB	

Remark:

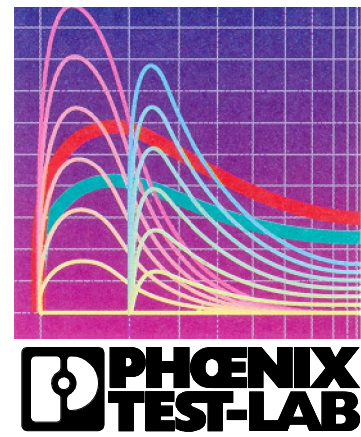
* The rf-part of the transceiver is powered by 15 V DC using an inbuilt DC / DC-converter working with an input voltages from 21 to 32 V DC. The regulator stage delivers a stabilized 15 V DC-Voltages to the transceiver. For this reason some tests were carried out by using 15 V DC supplied directly to the rf-part of the EUT.

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: R20273 Edition 4

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 _{nom} (+ 20 °C)	U _{nom} (15.0 V DC)*	156.025 MHz	156.0125 MHz	-50 dB	2.3%
			156.0375 MHz	-50 dB	1.8%
	U _{nom} (15.0 V DC)*	162.025 MHz	162.0125 MHz	-50 dB	1.8%
			162.0375 MHz	-50 dB	1.2%
T _{min} (- 15 °C)	U _{nom} (15.0 V DC)*	156.025 MHz	156.0125 MHz	-50 dB	16.0%
			156.0375 MHz	-50 dB	15.7%
	U _{nom} (15.0 V DC)*	162.025 MHz	162.0125 MHz	-50 dB	16.2%
			162.0375 MHz	-50 dB	3.0%
T _{max} (+ 55 °C)	U _{nom} (15.0 V DC)*	156.025 MHz	156.0125 MHz	-50 dB	1.8%
			156.0375 MHz	-50 dB	1.1%
	U _{nom} (15.0 V DC)*	162.025 MHz	162.0125 MHz	-50 dB	2.7%
			162.0375 MHz	-50 dB	0.6%
Measurement uncertainty				< 3 dB	

Remark:

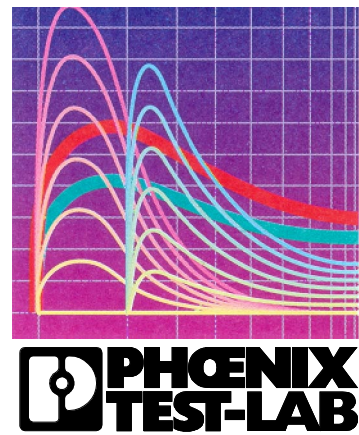
* The rf-part of the transceiver is powered by 15 V DC using an inbuilt DC / DC-converter working with an input voltages from 21 to 32 V DC. The regulator stage delivers a stabilized 15 V DC-Voltages to the transceiver. For this reason some tests were carried out by using 15 V DC supplied directly to the rf-part of the EUT.

LIMITS: SUBCLAUSE 15.3.7

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: R20273 Edition 4

6.8 SPURIOUS RESPONSE REJECTION

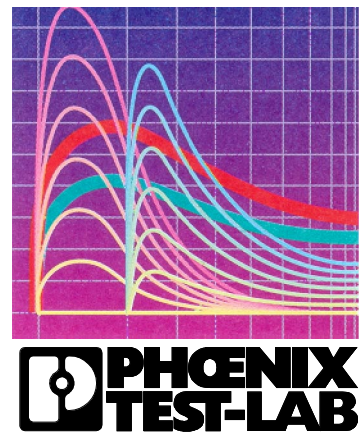
SUBCLAUSE 15.3.8

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, $P = -101$ dBm
 Unwanted signal: Modulated with 400 Hz / 3 kHz deviation

DEFINITION	UNWANTED FREQUENCY	RATIO
1st LO-Freq. - IF	134.515 MHz	90 dB
2 x 1st LO-Freq. - IF	279.785 MHz	90 dB
2 x 1st LO-Freq. + IF	301.295 MHz	90 dB
3 x 1st LO-Freq. - IF	425.055 MHz	80 dB
3 x 1st LO-Freq. + IF	446.565 MHz	80 dB
4 x 1st LO-Freq. - IF	570.325 MHz	90 dB
4 x 1st LO-Freq. + IF	591.835 MHz	90 dB
No other spurious response rejection frequencies found.		
Measurement uncertainty		< 3 dB

Continued next page:



TEST REPORT REFERENCE: R20273 Edition 4

Continued:

Operation mode: Receive in AIS-mode, $f = 162.025$ MHz
 Wanted signal: Test-signal 2 and 3 in alternating mode, $P = -101$ dBm
 Unwanted signal: Modulated with 400 Hz / 3 kHz deviation

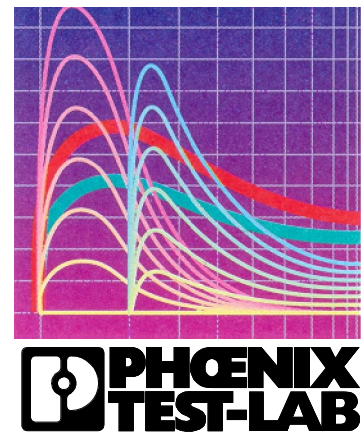
DEFINITION	UNWANTED FREQUENCY	RATIO
1st LO-Freq. - IF	140.515 MHz	90 dB
2 x 1st LO-Freq. - IF	291.785 MHz	90 dB
2 x 1st LO-Freq. + IF	313.295 MHz	90 dB
3 x 1st LO-Freq. - IF	443.055 MHz	90 dB
3 x 1st LO-Freq. + IF	464.565 MHz	90 dB
4 x 1st LO-Freq. - IF	594.325 MHz	90 dB
4 x 1st LO-Freq. + IF	615.835 MHz	90 dB
No other spurious response rejection frequencies found.		
Measurement uncertainty		

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: R20273 Edition 4

6.9 INTERMODULATION RESPONSE REJECTION AND BLOCKING

SUBCLAUSE 15.3.9

Ambient temperature	21 °C	Relative humidity	60 %
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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 -31 dBm
 Unwanted signal C: Unmodulated, RF-level -31 dBm
 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	18.2 %
Measurement uncertainty			< 3 dB

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 -31 dBm
 Unwanted signal C: Unmodulated, RF-level -31 dBm
 Unwanted signal D: Unmodulated, RF-level -15 dBm

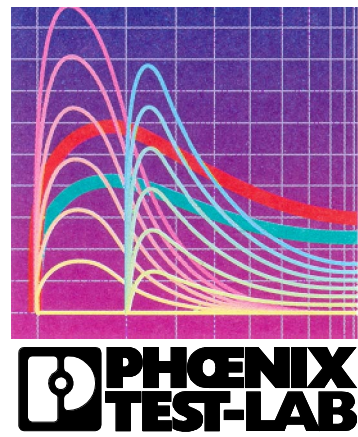
FREQUENCIES OF THE UNWANTED SIGNALS			PACKET ERROR RATE
Generator B	Generator C	Generator D	
- 500 kHz: 161.525 MHz	- 1000 kHz: 161.025 MHz	- 5725 kHz: 156.300 MHz	14.3 %
Measurement uncertainty			< 3 dB

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, 117



TEST REPORT REFERENCE: R20273 Edition 4

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:

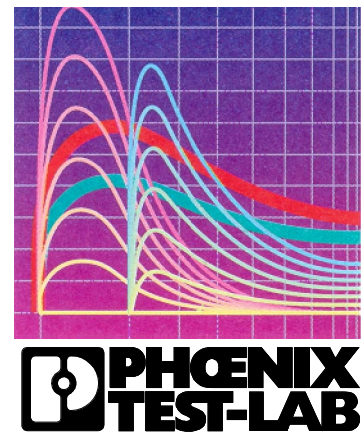
The trigger signal of the transmitter of the EUT was connected to channel 1 of a storage oscilloscope. The output signal of the receiver demodulator stage was connected to channel 2 of the same oscilloscope. A rf-signal with a level of -107 dBm (modulated with a sinusoidal signal) was fed to the receiver. 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



TEST REPORT REFERENCE: R20273 Edition 4

6.11 MAXIMUM SENSITIVITY

SUBCLAUSE 15.4.1

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

Wanted signal: Test-signal 1

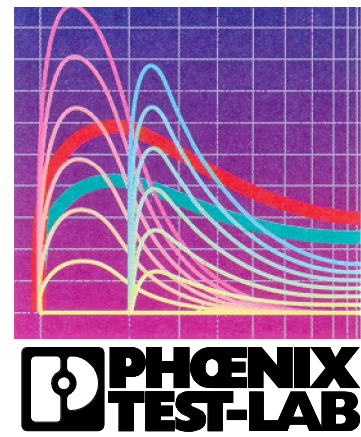
TEMPERATURE	VOLTAGE	BIT ERROR RATE	RECEIVER SENSITIVITY
T_{nom} (+ 20 °C)	U_{nom} (24.0 V DC)	0.32 %	-109 dBm
T_{min} (- 15 °C)	U_{nom} (15.0 V DC)*	0 %	-101 dBm
T_{max} (+ 55 °C)	U_{nom} (15.0 V DC)*	0%	-101 dBm
Measurement uncertainty		< 3 dB	

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_{nom} (+ 20 °C)	U_{nom} (24.0 V DC)	0.68 %	-109 dBm
T_{min} (- 15 °C)	U_{nom} (15.0 V DC)*	0 %	-101 dBm
T_{max} (+ 55 °C)	U_{nom} (15.0 V DC)*	0 %	-101 dBm
Measurement uncertainty		< 3 dB	

Continued next page:



TEST REPORT REFERENCE: R20273 Edition 4

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_{nom} (+ 20 °C)	U_{nom} (24.0 V DC)	0.68 %	-109 dBm
T_{min} (- 15 °C)	U_{nom} (15.0 V DC)*	0.04 %	-101 dBm
T_{max} (+ 55 °C)	U_{nom} (15.0 V DC)*	0.20 %	-101 dBm
Measurement uncertainty		< 3 dB	

Remark:

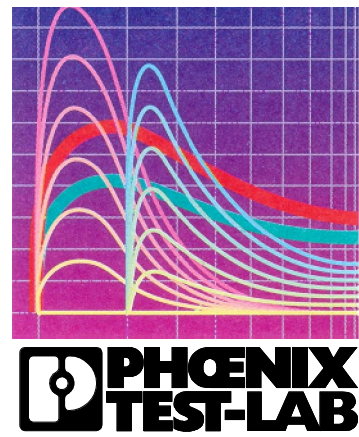
* The rf-part of the transceiver is powered by 15 V DC using an inbuilt DC / DC-converter working with an input voltages from 21 to 32 V DC. The regulator stage delivers a stabilized 15 V DC-Voltages to the transceiver. For this reason some tests were carried out by using 15 V DC supplied directly to the rf-part of the EUT.

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 MHz) $\pm 1.5 \text{ kHz}$.

TEST EQUIPMENT USED:

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



TEST REPORT REFERENCE: R20273 Edition 4

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

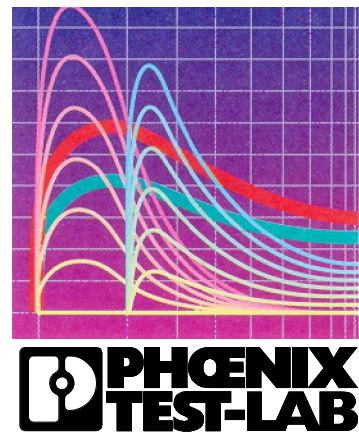
RF-INPUT SIGNAL LEVEL	NUMBER OF MESSAGES NOT SUCCESSFULLY RECORDED (NORMAL TEST SIGNAL TRANSMITTED 1000 TIMES)
- 77 dBm	0%
- 7 dBm	0%

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: R20273 Edition 4

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

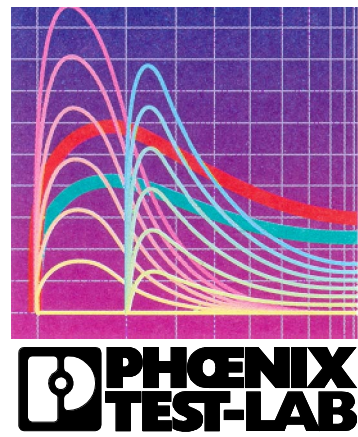
Unwanted signal frequency:	Unwanted signal level:	Signal ratio:	Bit error rate:
156.522 MHz	-114 dBm	-10 dB	0.6%
156.525 MHz	-112 dBm	-8 dB	0.17%
156.528 MHz	-114 dBm	-10 dB	0.2%
Measurement uncertainty		< 3 dB	

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: R20273 Edition 4

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, $P = -98$ dBm
 Unwanted signal: $f = 156.550$ MHz, modulated with 400 Hz and a deviation of 3 kHz.

TEMPERATURE	VOLTAGE	SIGNAL RATIO	BIT ERROR RATE
$T_{nom} (+ 20\text{ °C})$	$U_{nom} (15\text{ V})^*$	70 dB	0.80%
$T_{min} (- 15\text{ °C})$	$U_{nom} (15\text{ V})^*$	60 dB	0.94%
$T_{max} (+ 55\text{ °C})$	$U_{nom} (15\text{ V})^*$	60 dB	0.85%
Measurement uncertainty		< 3 dB	

Operation mode: Receive in DSC-mode, $f = 156.525$ MHz
 Wanted signal: Test-signal 1, $P = -98$ dBm
 Unwanted signal: $f = 156.500$ MHz, modulated with 400 Hz and a deviation of 3 kHz.

TEMPERATURE	VOLTAGE	SIGNAL RATIO	BIT ERROR RATE
$T_{nom} (+ 20\text{ °C})$	$U_{nom} (15\text{ V})^*$	70 dB	0.95%
$T_{min} (- 15\text{ °C})$	$U_{nom} (15\text{ V})^*$	60 dB	0.87%
$T_{max} (+ 55\text{ °C})$	$U_{nom} (15\text{ V})^*$	60 dB	0.13%
Measurement uncertainty		< 3 dB	

Remark:

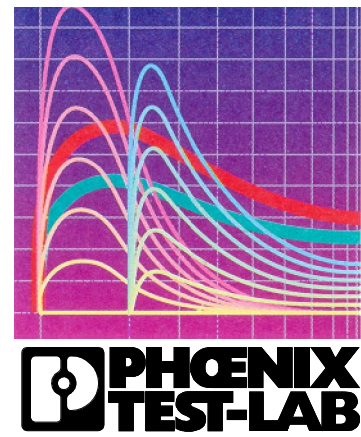
* The rf-part of the transceiver is powered by 15 V DC using an inbuilt DC / DC-converter working with an input voltages from 21 to 32 V DC. The regulator stage delivers a stabilized 15 V DC-Voltages to the transceiver. For this reason some tests were carried out by using 15 V DC supplied directly to the rf-part of the EUT.

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: R20273 Edition 4

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

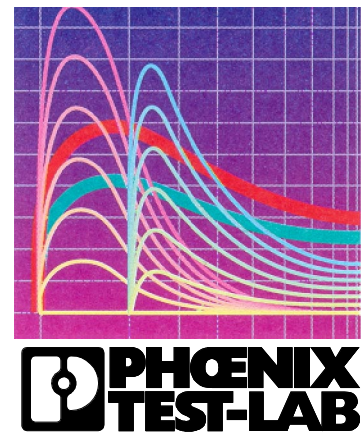
DEFINITION	UNWANTED FREQUENCY	RATIO
1st LO-Freq. - IF	135.015 MHz	90 dB
2 x 1st LO-Freq. - IF	280.785 MHz	90 dB
2 x 1st LO-Freq. + IF	302.295 MHz	90 dB
3 x 1st LO-Freq. - IF	426.555 MHz	80 dB
3 x 1st LO-Freq. + IF	448.065 MHz	80 dB
4 x 1st LO-Freq. - IF	572.325 MHz	90 dB
4 x 1st LO-Freq. + IF	593.835 MHz	90 dB
No other spurious response 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: R20273 Edition 4

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, $P = -39$ dBm
Unwanted signal C: Modulated with 400 Hz and 3 kHz deviation, $P = -39$ dBm

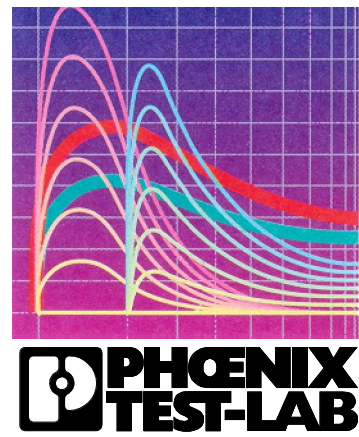
FREQUENCIES OF THE UNWANTED SIGNALS		SIGNAL RATIO	BIT ERROR RATE
Generator B	Generator C		
+ 50 kHz	+ 100 kHz	63 dB	0.98%
- 50 kHz	- 100 kHz	62 dB	0.98%
Measurement uncertainty		< 3 dB	

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: R20273 Edition 4

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

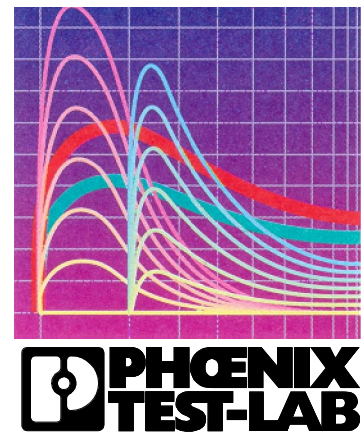
FREQUENCIES OF THE UNWANTED SIGNALS	BIT ERROR RATE BER
157.525 MHz	0.8 %
155.525 MHz	0.8 %
158.525 MHz	0.7 %
154.525 MHz	0.7 %
161.525 MHz	0.8 %
151.525 MHz	0.8 %
166.525 MHz	0.6 %
146.525 MHz	0.6 %
Measurement uncertainty	< 3 dB

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: R20273 Edition 4

6.18 SPURIOUS EMISSIONS FROM THE RECEIVER

SUBCLAUSE 15.5.1

Ambient temperature	19 °C	Relative humidity	55 %
---------------------	-------	-------------------	------

Operation mode: Receive, f = 156.025 MHz

SPURIOUS EMISSIONS LEVEL (CONDUCTED)					
f (MHz)	Level (dBm)	Bandwidth (kHz)	f (MHz)	Level (dBm)	Bandwidth (kHz)
		No spurious radiation found			
Measurement uncertainty		+ 0.66 dB / - 0.72 dB			

Operation mode: Receive, f = 162.025 MHz

SPURIOUS EMISSIONS LEVEL (CONDUCTED)					
f (MHz)	Level (dBm)	Bandwidth (kHz)	f (MHz)	Level (dBm)	Bandwidth (kHz)
		No spurious radiation found			
Measurement uncertainty		+ 0.66 dB / - 0.72 dB			

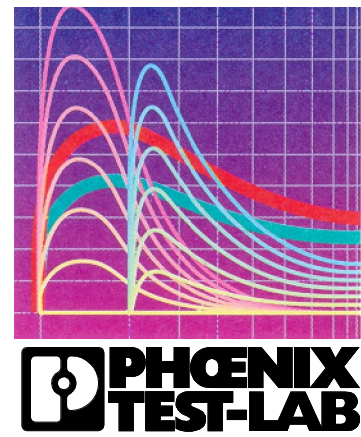
LIMITS: SUBCLAUSE 15.5.1

Conducted emissions:

Frequency range	150 kHz to 1 GHz	1 to 2 GHz
Rx operating	2 nW (- 57 dBm)	20 nW (- 47 dBm)

TEST EQUIPMENT USED:

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



TEST REPORT REFERENCE: R20273 Edition 4

6.19 SPURIOUS EMISSIONS FROM THE TRANSMITTER

SUBCLAUSE 15.5.2

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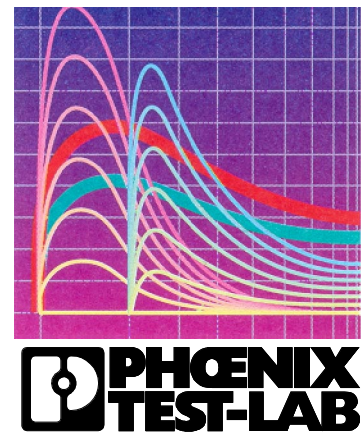
Operation mode: Continuous transmission without modulation, $f = 156.025$ MHz, $P = 33$ dBm

SPURIOUS EMISSIONS LEVEL (CONDUCTED)					
f	Level	Bandwidth	f	Level	Bandwidth
132.025 MHz	-42 dBm	120 kHz	624.100 MHz	-49 dBm	120 kHz
180.025 MHz	-43 dBm	120 kHz	780.125 MHz	-51 dBm	120 kHz
312.050 MHz	-49 dBm	120 kHz	936.150 MHz	-49 dBm	120 kHz
468.075 MHz	-39 dBm	120 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 (MHz)	Level (dBm)	Bandwidth (kHz)	f (MHz)	Level (dBm)	Bandwidth (kHz)
132.025 MHz	-47 dBm	120 kHz	624.100 MHz	-44 dBm	120 kHz
180.025 MHz	-46 dBm	120 kHz	780.125 MHz	-45 dBm	120 kHz
312.050 MHz	-49 dBm	120 kHz	936.150 MHz	-46 dBm	120 kHz
468.075 MHz	-37 dBm	120 kHz	-	-	-
Measurement uncertainty		+ 0.66 dB / - 0.72 dB			

Continued next page:



TEST REPORT REFERENCE: R20273 Edition 4

Continued:

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

SPURIOUS EMISSIONS LEVEL (CONDUCTED)					
f (MHz)	Level (dBm)	Bandwidth (kHz)	f (MHz)	Level (dBm)	Bandwidth (kHz)
138.025 MHz	-42 dBm	120 kHz	648.100 MHz	-49 dBm	120 kHz
186.025 MHz	-43 dBm	120 kHz	810.125 MHz	-51 dBm	120 kHz
324.050 MHz	-49 dBm	120 kHz	972.150 MHz	-49 dBm	120 kHz
486.075 MHz	-39 dBm	120 kHz	-	-	-
Measurement uncertainty		+ 0.66 dB / - 0.72 dB			

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

SPURIOUS EMISSIONS LEVEL (CONDUCTED)					
f (MHz)	Level (dBm)	Bandwidth (kHz)	f (MHz)	Level (dBm)	Bandwidth (kHz)
138.025 MHz	-43 dBm	120 kHz	648.100 MHz	-45 dBm	120 kHz
186.025 MHz	-46 dBm	120 kHz	810.125 MHz	-48 dBm	120 kHz
324.050 MHz	-41 dBm	120 kHz	972.150 MHz	-49 dBm	120 kHz
486.075 MHz	-43 dBm	120 kHz	2592.425 MHz	-40 dBm	1 MHz
Measurement uncertainty		+ 0.66 dB / - 0.72 dB			

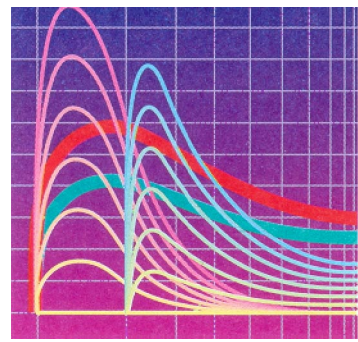
LIMITS: SUBCLAUSE 15.5.1

Conducted emissions:

Frequency range	150 kHz to 1 GHz	1 to 2 GHz
TX operating	0.25 μW (- 36 dBm)	1 μW (- 30 dBm)

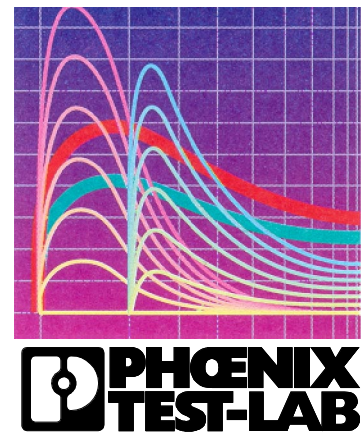
TEST EQUIPMENT USED:

07, 42, 63, 81, 100, 101



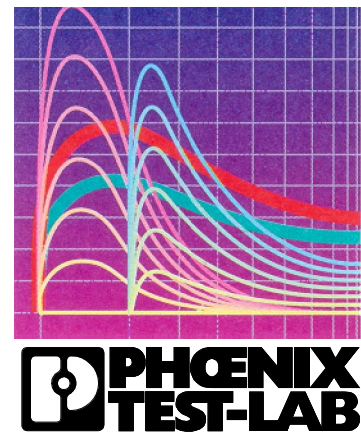
TEST REPORT REFERENCE: R20273 Edition 4

7 TEST EQUIPMENT



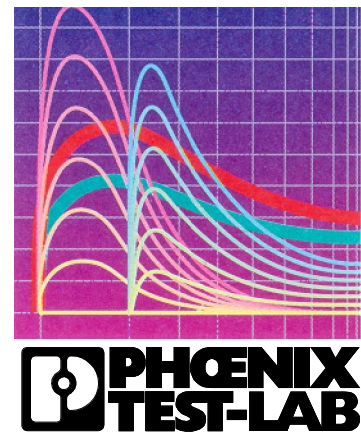
TEST REPORT REFERENCE: R20273 Edition 4

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



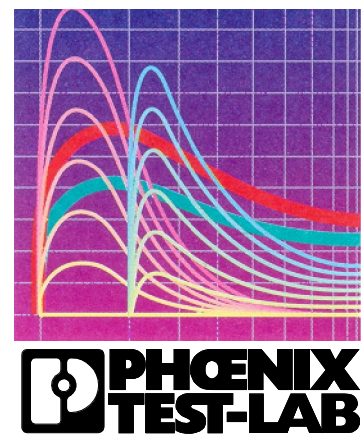
TEST REPORT REFERENCE: R20273 Edition 4

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-20-5	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



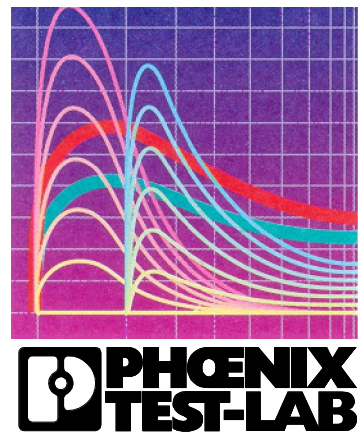
TEST REPORT REFERENCE: R20273 Edition 4

No.	Test equipment	Type	Manufacturer	Serial No.	PM-No
60	IF-Filter 20kHz/25kHz	MQF 10.7-1400/11	Telefilter	0043	480323
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



TEST REPORT REFERENCE: R20273 Edition 4

No.	Test equipment	Type	Manufacturer	Serial No.	PM-No
88	Attenuator / 20 dB / 10 W	WA8-20	Weinschel	7539	410113
89	Attenuator / 30 dB / 200 W	BN 745395	Spinner	29971	480232
90	Termination / 50 Ω / 15 W	6515.17.A	Huber + Suhner	-	410078
91	Termination / 50 Ω / 0.5 W	6500.17.A	Huber + Suhner	-	410074
92	Termination / 50 Ω / 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



TEST REPORT REFERENCE: R20273 Edition 4

8 LIST OF ANNEXES

ANNEX A	PHOTOGRAPHS	8 pages
	PHOTOGRAPHS OF THE TEST SAMPLE	
	DEBEG 3400, radio part, PCB, front view	20273eut8.jpg
	DEBEG 3400, radio part, PCB, rear view	20273eut9.jpg
	DEBEG 3400, radio part, PCB, RF-power-amplifier	20273eut12.jpg
	DEBEG 3400, radio part, PCB, receiver part	20273eut16.jpg
	DEBEG 3400, microcontroller part	20273eut20.jpg
	DEBEG 3400, radio part, PCB, baseband-unit	20273eut15.jpg
	DEBEG 3400, radio part, PCB, RF-filter-unit	20273eut19.jpg
	PHOTOGRAPHS OF THE TEST SET-UP	
	DEBEG 3400, test set-up climatic chamber	20273clima3.jpg
ANNEX C	MEASUREMENT RESULTS	24 pages