PHOENIX TESTLAB

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TEST REPORT

on

IEC 62287-1: Edition 1.0 (2006-03)

Maritime Navigation and
Radiocommunication Equipment and Systems:
Class B shipborne equipment of the Automatic Identification System (AIS)
Part 1: Carrier sense division multiple access (CSTDMA) techniques

Test Report Reference: F092025E3

Equipment under Test:

AMEC Camino-101 Class B AIS

Serial Number: -

Applicant: Alltek Marine Electronics Corp.

Manufacturer: Alltek Marine Electronics Corp.

1 IDENTIFICATION

1.1 APPLICANT

Name:	Alltek Marine Electronics Corp.
Address:	9F-1, No. 360, Ruei Guang Rd., Neihu 114 Taipei
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1.2 MANUFACTURER

Name:	Alltek Marine Electronics Corp.
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1.3 DATES

Date of Receipt of Test Sample:	10 August 2009
Start of test:	12 August 2009
Finish of test:	20 November 2009

1.4 TEST LABORATORY

The tests were carried out at: **PHOENIX TESTLAB GmbH**
Königswinkel 10
D-32825 Blomberg **Tel: +49 (0) 52 35 / 95 00-0**
Germany **Fax: +49 (0) 52 35 / 95 00-10**

Test engineer:	Raimund BLASK		15 February 2010
	Name		Date
Test report checked by:	Bernd STEINER		16 February 2010
	Name		Date

1.5 RESERVATION

This test report is only valid in the original form.

The test results herein refer only to the tested sample. PHOENIX TESTLAB 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 TESTLAB Logo and the TEST REPORT REFERENCE.

1.6 REFERENCES

[1] IEC 62287-1: Edition 1.0 (2006-03): Maritime Navigation and Radiocommunication Equipment and Systems: Class B shipborne equipment of the Automatic Identification System (AIS)
Part 1: Carrier sense division multiple access (CSTDMA) techniques

2 TECHNICAL DATA OF EQUIPMENT

Type:	AIS Class B Transponder
Type designation:	Camino-101 Class B AIS
Serial No.:	-
Alignment range:	156.025 to 162.025 MHz
Switching range:	156.025 to 162.025 MHz
Channel separation:	25 kHz
Rated RF output power:	2 W / 33 dBm
Supply Voltage :	U_{nom}= 24.0 V DC U_{min}= 12.0 V DC U_{max}= 30.0 V DC
Printed circuit designation:	M-PCB-AISPF03P51
Software:	Version 1.0

Ports/Connectors

Identification	Connector		Length
	EUT	Ancillary	
DC-power-supply	DC-Plug	none	3 m
GPS-antenna	TNC	TNC	3 m
VHF-antenna	SO-239	N-Connector	3 m
NMEA0813	8-pole-Connector	D-Sub	3 m
RS-232	D-Sub	D-Sub	3 m

3 ADDITIONAL INFORMATION

General:
Full tests were carried out at 156.025 MHz and 162.025 MHz, unless otherwise stated.
The EUT was powered by an external 24 V-DC-power-Supply.

Wanted signal:

AIS-Mode (wanted signals):
The Test-Signals were generated by the AIS-Simulator “Programmable Modulation Waveform Generator” (Manufacturer “SINE QUA NONE”). For the Receiver-Tests the Output-Signal of the Simulator was used to modulate a calibrated RF-Generator from Phoenix TESTLAB. The received Data-Telegrams were compared transmitted Data-Telegrams. A number of 200 Packets (unless otherwise stated) were used to calculate the Packet Error Rate PER.

Unwanted signal:
All unwanted-signals were generated by the RF-Generators from Phoenix Test-Lab.

4 TEST OVERVIEW

Part 11	PHYSICAL TESTS		
11.1	**TDMA Transmitter**		
11.1.1	Frequency error	Applicable	Passed
11.1.2	Carrier power	Applicable	Passed
11.1.3	Transmission spectrum	Applicable	Passed
11.1.4	Modulation accuracy	Applicable	Passed
11.1.5	Transmitter output power versus time function	Applicable	Passed
11.2	**TDMA Receiver**		
11.2.1	Sensitivity	Applicable	Passed
11.2.2	Error behaviour at high input level	Applicable	Passed
11.2.3	Co-channel rejection	Applicable	Passed
11.2.4	Adjacent channel selectivity	Applicable	Passed
11.2.5	Spurious response rejection	Applicable	Passed
11.2.6	Intermodulation response rejection	Applicable	Passed
11.2.7	Blocking and desensitisation	Applicable	Passed
11.3	Conducted spurious emissions		
11.3.1	Spurious emissions from the receiver	Applicable	Passed
11.3.2	Spurious emissions from the transmitter	Applicable	Passed
C.4	**DSC Receiver Tests**		
C.4.1	Maximum sensitivity	Applicable	Passed
C.4.2	Error behaviour at high input levels	Applicable	Passed
C.4.3	Co-channel rejection	Applicable	Passed
C.4.4	Adjacent channel selectivity	Applicable	Passed
C.4.5	Spurious response rejection	Applicable	Passed
C.4.6	Intermodulation response rejection	Applicable	Passed
C.4.7	Blocking and desensitisation	Applicable	Passed

5 TRANSMITTER REQUIREMENTS

5.1 FREQUENCY ERROR — SUBCLAUSE 11.1.1

Ambient temperature	20 °C	Relative humidity	45 %

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

TEST CONDITIONS		FREQUENCY	FREQUENCY ERROR
Temperature	Voltage		
T_{nom} (+20°C)	U_{nom} (24.0 V DC)	156.024835 MHz	-165 Hz
T_{min} (-20°C)	U_{min} (12.0 V DC)	156.025285 MHz	+285 Hz
	U_{max} (30.0 V DC)	156.025320 MHz	+320 Hz
T_{max} (+55°C)	U_{min} (12.0 V DC)	156.025136 MHz	+136 Hz
	U_{max} (30.0 V DC)	156.025085 MHz	+85 Hz
Maximum frequency error		+ 320 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)	162.024828 MHz	-172 Hz
T_{min} (-20°C)	U_{min} (12.0 V DC)	162.025012 MHz	+12 Hz
	U_{max} (30.0 V DC)	162.025195 MHz	+195 Hz
T_{max} (+55°C)	U_{min} (12.0 V DC)	162.024519 MHz	-481 Hz
	U_{max} (30.0 V DC)	162.024823 MHz	-177 Hz
Maximum frequency error		- 481 Hz	
Measurement uncertainty		± 10 Hz	

LIMITS: SUBCLAUSE 1.1.1.3

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

TEST EQUIPMENT USED:

06, 42, 51, 82, 86

5.2 CARRIER POWER (CONDUCTED) SUBCLAUSE 11.1.2

Ambient temperature	20 °C	Relative humidity	45 %

Operation mode: Continuous transmission with test-signal 4, f = 156.025 MHz

Test conditions		Carrier power (Conducted)
T_{nom} (+20°C)	U_{nom} (24.0 V DC)	33.6 dBm / 2.3 W
T_{min} (-20°C)	U_{min} (12.0 V DC)	33.6 dBm / 2.3 W
	U_{max} (30.0 V DC)	33.4 dBm / 2.2 W
T_{max} (+55°C)	U_{min} (12.0 V DC)	31.0 dBm / 1.3 W
	U_{max} (30.0 V DC)	32.4 dBm / 1.7 W
Measurement uncertainty		+ 0.66 dB / - 0.72 dB

Operation mode: Continuous transmission with test-signal 4, f = 162.025 MHz

Test conditions		Carrier power (Conducted)
T_{nom} (+20°C)	U_{nom} (24.0 V DC)	34.1 dBm / 2.6 W
T_{min} (-20°C)	U_{min} (12.0 V DC)	34.6 dBm / 2.9 W
	U_{max} (30.0 V DC)	33.5 dBm / 2.2 W
T_{max} (+55°C)	U_{min} (12.0 V DC)	31.8 dBm / 1.5 W
	U_{max} (30.0 V DC)	33.8 dBm / 2.4 W
Measurement uncertainty		+ 0.66 dB / - 0.72 dB

LIMITS: SUBCLAUSE 11.1.2.3

The carrier output power (conducted) shall be 33 dBm ± 1.5 dB under normal test conditions and 33 dBm ± 3 dB under extreme test conditions.

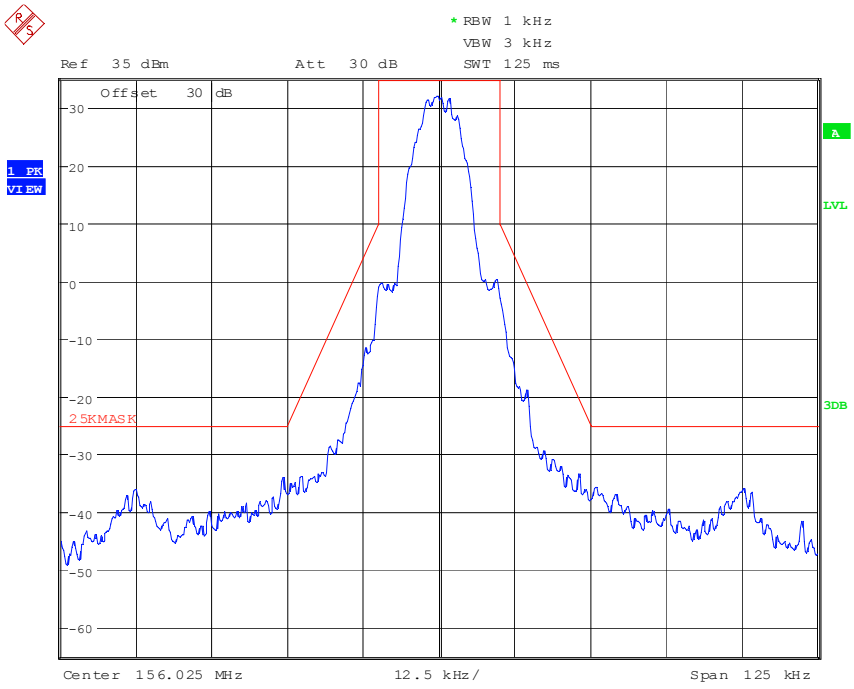
TEST EQUIPMENT USED:

06, 42, 51, 82, 86

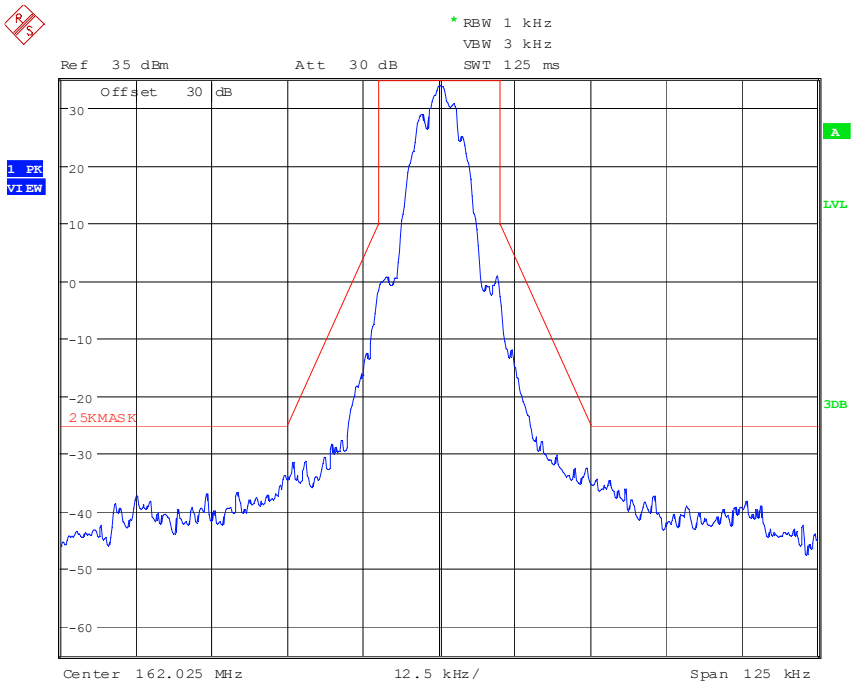
5.3 MODULATION SPECTRUM 25 KHZ CHANNEL MODE SUBCLAUSE 11.1.3

Ambient temperature	20 °C	Relative humidity	45 %

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



92025mask156: 156.025 MHz



92025mask162: 162.025 MHz

LIMITS: SUBCLAUSE 11.1.3.3

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 - 60 dBc or -30 dBm. In the region ± 10 kHz and ± 25 kHz removed from the carrier, the modulation sideband is below a line specified between these two points.

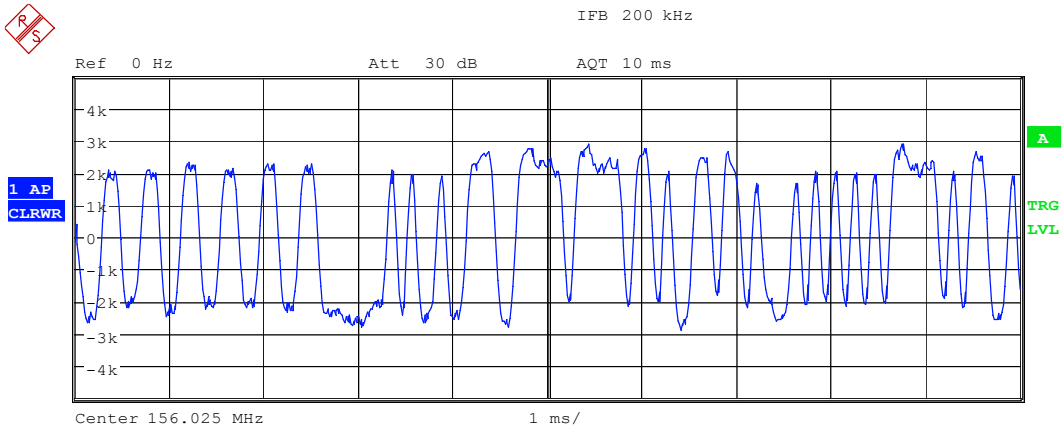
TEST EQUIPMENT USED:

06, 42, 82, 86

5.4 TRANSMITTER TEST SEQUENCE AND MODULATION ACCURACY SUBCLAUSE 11.1.4

Ambient temperature	20 °C	Relative humidity	55 %

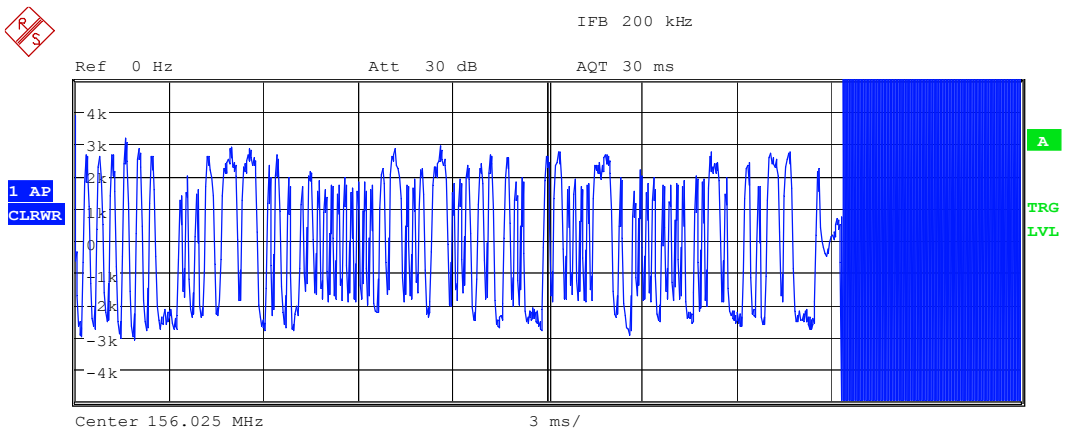
Operation mode: Transmit at 156.025 MHz



Frequency Modulation Summary

Coupling	DC		Carrier Offset	329.80 Hz
Deviation	+peak	2.873 kHz	Carrier Power	33.24 dBm
	-peak	-2.916 kHz	Modulation Frequency	--- Hz
	⇧peak/2	2.895 kHz	Sampling Rate	250 kHz
	RMS	1.874 kHz	Record Length	2501
			Demod Bandwidth	200 kHz

92025modacc156: 156.025 MHz, detailed view

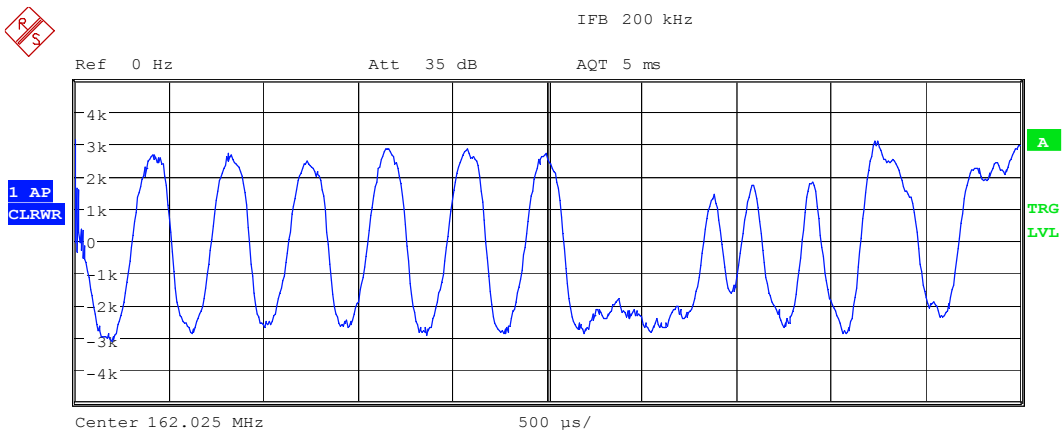


Frequency Modulation Summary

Coupling	DC		Carrier Offset	32.239 Hz
Deviation	+peak	195.2 kHz	Carrier Power	33.21 dBm
	-peak	-195.4 kHz	Modulation Frequency	--- Hz
	⇧peak/2	195.3 kHz	Sampling Rate	250 kHz
	RMS	30.57 kHz	Record Length	7501
			Demod Bandwidth	200 kHz

92025modacc156a: 156.025 MHz, complete pulse train

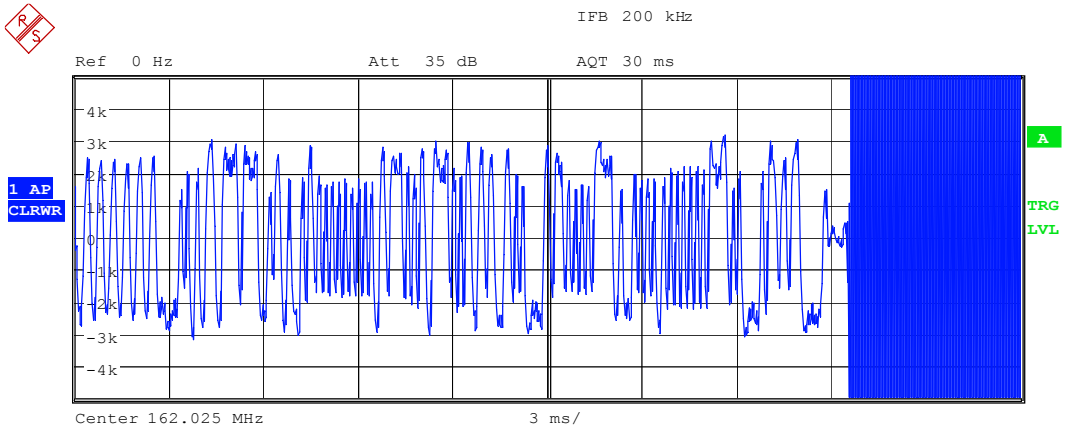
Operation mode: Transmit at 162.025 MHz



Frequency Modulation Summary

Coupling	DC		Carrier Offset	-693.40 Hz
Deviation	+peak	3.117 kHz	Carrier Power	34.03 dBm
	-peak	-3.122 kHz	Modulation Frequency	--- Hz
	⇧peak/2	3.120 kHz	Sampling Rate	250 kHz
	RMS	2.034 kHz	Record Length	1251
			Demod Bandwidth	200 kHz

92025modacc162 162.025 MHz, detailed view



Frequency Modulation Summary

Coupling	DC		Carrier Offset	82.657 Hz
Deviation	+peak	200.8 kHz	Carrier Power	33.96 dBm
	-peak	-191.1 kHz	Modulation Frequency	--- Hz
	⇧peak/2	195.9 kHz	Sampling Rate	250 kHz
	RMS	29.60 kHz	Record Length	7501
			Demod Bandwidth	200 kHz

92025modacc162a: 162.025 MHz, complete pulse train

Additional Information:

Due to the fact that the measurement results under extreme test conditions are equal to the results under normal test-conditions the additional plots from the measurement under extreme conditions are not documented in this test-report.

LIMITS: SUBCLAUSE 11.1.4.3

See table 22.

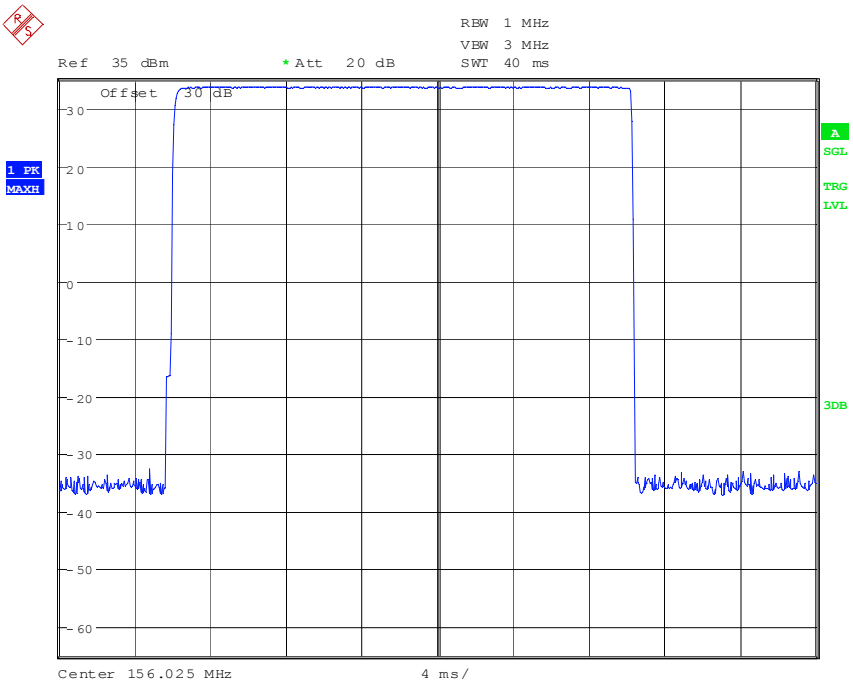
TEST EQUIPMENT USED:

06, 42, 82, 86

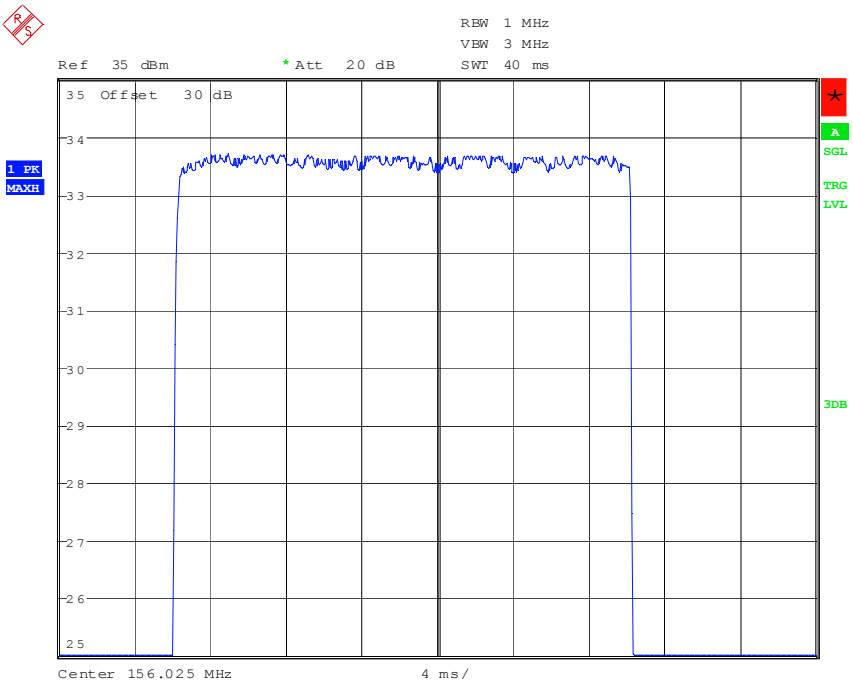
5.5 TRANSMITTER OUTPUT POWER VERSUS TIME FUNCTION SUBCLAUSE 11.1.5

Ambient temperature	20 °C	Relative humidity	55 %

Operation mode: Transmit with test signal 2, f = 156.025 MHz

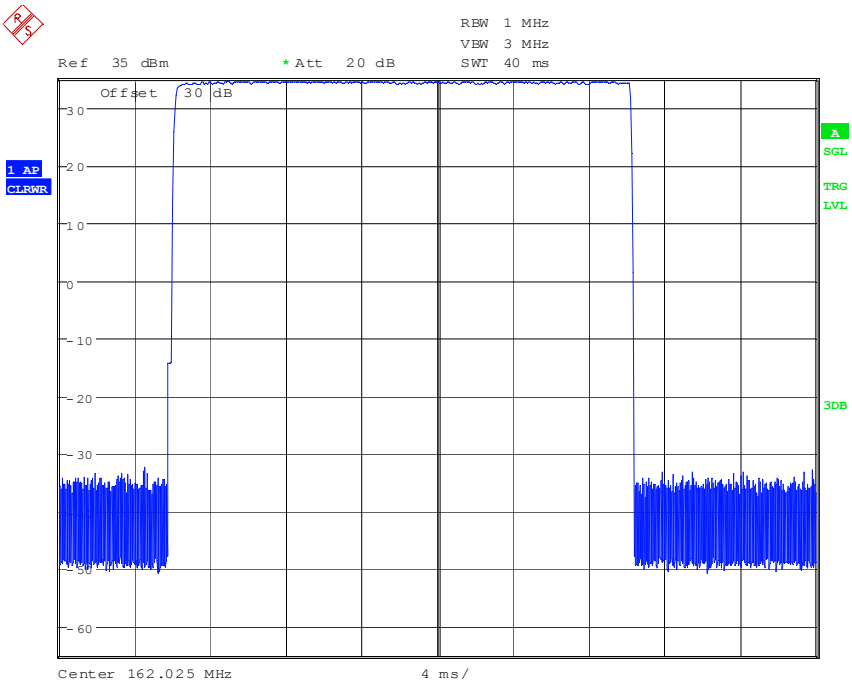


92025_156burst: 156.025 MHz

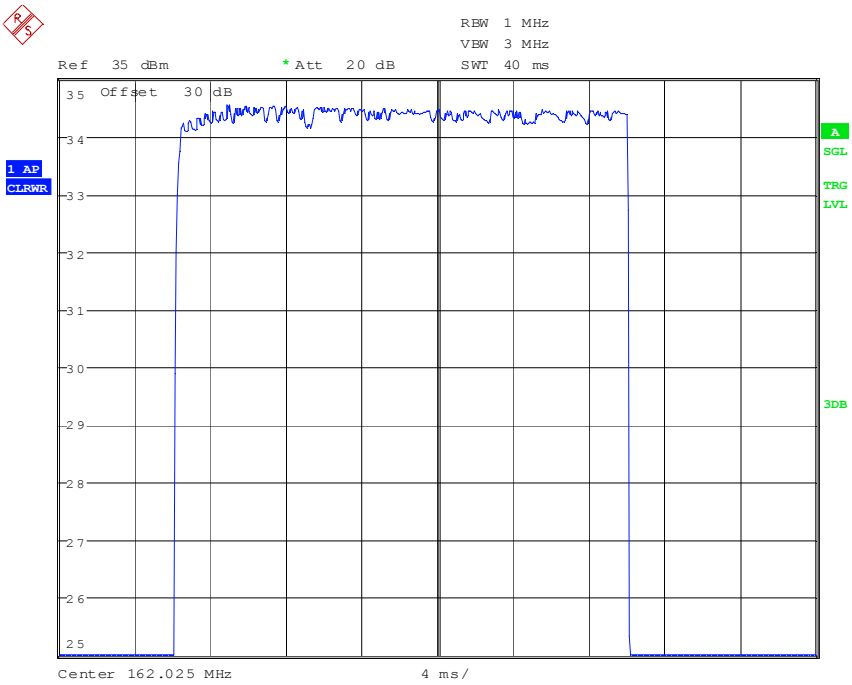


92025_156burst1: 156.025 MHz

Operation mode: Transmit with test signal 2, f = 162.025 MHz



92025_162burst1: 162.025 MHz



92025_162burst1: 162.025 MHz,

LIMITS: SUBCLAUSE 11.1.5.3

See table 6 [1].

Result: Passed

TEST EQUIPMENT USED:

06, 42, 82, 86

6 RECEIVER REQUIREMENTS

6.1 TDMA-RECEIVER SENSITIVITY SUBCLAUSE 11.2.1

Ambient temperature	20 °C	Relative humidity	45 %

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

MEASUREMENT CONDITIONS		MEASURED PACKET ERROR RATE PER	
TEMPERATURE	VOLTAGE	Frequency:	PER:
T_{nom} (+ 20°C)	U_{nom} (24.0 V DC)	156.024500 MHz*	0.5%
		156.025000 MHz	1.0%
		156.025500 MHz*	0.5%
T_{min} (- 20°C)*	U_{min} (12.0 V DC)	156.025000 MHz*	0.0%
	U_{max} (30.0 V DC)	156.025000 MHz*	0.0%
T_{max} (+ 55°C)	U_{min} (12.0 V DC)	156.025000 MHz*	1.5%
	U_{max} (30.0 V DC)	156.025000 MHz*	2.5%
Limit		< 20%	
Measurement uncertainty		+ 0.9 dB / - 1.0 dB	

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

MEASUREMENT CONDITIONS		MEASURED PACKET ERROR RATE PER	
TEMPERATURE	VOLTAGE	Frequency:	PER:
T_{nom} (+ 20°C)	U_{nom} (24.0 V DC)	162.024500 MHz*	0.0%
		162.025000 MHz	0.0%
		162.025500 MHz*	0.5%
T_{min} (- 20°C)*	U_{min} (12.0 V DC)	162.025000 MHz*	0.5%
	U_{max} (30.0 V DC)	162.025000 MHz*	0.0%
T_{max} (+ 55°C)	U_{min} (12.0 V DC)	162.025000 MHz*	2.0%
	U_{max} (30.0 V DC)	162.025000 MHz*	1.5%
Limit		< 20%	
Measurement uncertainty		+ 0.9 dB / - 1.0 dB	

* These tests were also done with -107 dBm RF-Level.

LIMITS: SUBCLAUSE 11.2.1.3

The PER shall not exceed 20%.

TEST EQUIPMENT USED:

25, 42, 51

6.2 ERROR BEHAVIOUR AT HIGH INPUT LEVELS SUBCLAUSE 11.2.2

Ambient temperature	20 °C	Relative humidity	45 %

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

RF-INPUT SIGNAL LEVEL	NUMBER OF MESSAGES NOT SUCCESSFULLY RECORDED
- 77 dBm	0.0%
- 7 dBm	0.0%
Measurement uncertainty	+ 0.9 dB / - 1.0 dB

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

RF-INPUT SIGNAL LEVEL	NUMBER OF MESSAGES NOT SUCCESSFULLY RECORDED
- 77 dBm	0.0%
- 7 dBm	0.5%
Measurement uncertainty	+ 0.9 dB / - 1.0 dB

LIMITS: SUBCLAUSE 11.2.2.3

The maximum PER shall not exceed 2% at -77 dBm and 10% at -7 dBm.

TEST EQUIPMENT USED:

25, 42

6.3 CO-CHANNEL REJECTION SUBCLAUSE 11.2.3

Ambient temperature	20 °C	Relative humidity	45 %

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

Unwanted signal frequency:	Unwanted signal level:	Signal ratio:	Packet error rate:
156.024 MHz	-111 dBm	10 dB	19%
156.025 MHz	-111 dBm	10 dB	13%
156.026 MHz	-111 dBm	10 dB	0%
Measurement uncertainty		+ 0.8 dB / - 0.9 dB	

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

Unwanted signal frequency:	Unwanted signal level:	Signal ratio:	Packet error rate:
162.024 MHz	-111 dBm	10 dB	10%
162.025 MHz	-111 dBm	10 dB	6%
162.026 MHz	-111 dBm	10 dB	11%
Measurement uncertainty		+ 0.8 dB / - 0.9 dB	

LIMITS: SUBCLAUSE 11.2.3.3

The maximum PER shall not exceed 20%.

TEST EQUIPMENT USED:

25, 29, 33, 42

6.4 ADJACENT CHANNEL SELECTIVITY SUBCLAUSE 11.2.4

Ambient temperature	20 °C	Relative humidity	45 %

Operation mode: Receive in AIS mode
Wanted signal: P = -101 dBm
Unwanted signal: Modulated with 400 Hz / 3 kHz deviation, P = -31 dBm

TEMPERATURE	VOLTAGE	WANTED SIGNAL	UNWANTED SIGNAL	SIGNAL RATIO	PACKET ERROR RATE
T_{nom} (+20°C)	U_{nom} (24.0 V DC)	156.025 MHz	156.000 MHz	70 dB	19%
			156.050 MHz	70 dB	12%
		162.025 MHz	162.000 MHz	70 dB	5%
			162.050 MHz	70 dB	6%
Measurement uncertainty				+ 0.8 dB / - 0.9 dB	

LIMITS: SUBCLAUSE 11.2.4.3

The maximum PER shall not exceed 20%.

TEST EQUIPMENT USED:

25, 29, 33, 42

6.5 SPURIOUS RESPONSE REJECTION SUBCLAUSE 11.2.5

Ambient temperature	20 °C	Relative humidity	45 %

Operation mode: Receive in AIS-mode, Channel A = 156.025 MHz
Wanted signal: P = -101 dBm
Unwanted signal: Modulated with 400 Hz / 3 kHz deviation, P = -27 dBm

DEFINITION IF	UNWANTED FREQUENCY	MEASSURED PACKET ERROR RATE
1st IF	21.400 MHz	0.5%
1st LO-Freq. - IF	113.225 MHz	0.5%
2 x 1st LO-Freq. – IF	247.850 MHz	0.0%
2 x 1st LO-Freq. + IF	269.250 MHz	0.0%
3 x 1st LO-Freq. – IF	382.475 MHz	0.0%
3 x 1st LO-Freq. + IF	403.875 MHz	0.0%
-	No other spurious response rejection frequencies found	-
-		-
-		-
Measurement uncertainty		+ 0.8 dB / - 0.9 dB

Continued next page:

Continued:

Operation mode: Receive in AIS-mode, Channel B = 162.025 MHz
Wanted signal: P = -101 dBm
Unwanted signal: Modulated with 400 Hz / 3 kHz deviation, P = -27 dBm

DEFINITION IF	UNWANTED FREQUENCY	MEASSURED PACKET ERROR RATE
1st IF	38,855 MHz	0.0%
1st LO-Freq. - IF	84.315 MHz	1.0%
2 x 1st LO-Freq. – IF	207.485 MHz	0.0%
2 x 1st LO-Freq. + IF	246.340 MHz	0.0%
3 x 1st LO-Freq. – IF	330.655 MHz	0.0%
3 x 1st LO-Freq. + IF	369.510 MHz	0.0%
-	No other spurious response rejection frequencies found	-
-		-
-		-
Measurement uncertainty		+ 0.8 dB / - 0.9 dB

LIMITS: SUBCLAUSE 11.2.5.6

At any frequency separated from the specified frequency of the receiver by 50 kHz or more, the PER shall not exceed 20%.

TEST EQUIPMENT USED:

25, 29, 33, 42

6.6 INTERMODULATION RESPONSE REJECTION SUBCLAUSE 11.2.6

Ambient temperature	20 °C	Relative humidity	45 %

Wanted signal A: P = -101 dBm
Unwanted signal B: Unmodulated, P = -36 dBm
Unwanted signal C: Modulated with 400 Hz / 3 kHz-deviation, P = -36 dBm

FREQUENCIES OF THE UNWANTED SIGNALS			PACKET ERROR RATE
Generator A	Generator B	Generator C	
162.025 MHz	162.075 MHz	162.125 MHz	18.5%
	161.975 MHz	161.925 MHz	3.5%
Limit:			20%
Measurement uncertainty:			+ 0.8 dB / - 0.9 dB

Wanted signal A: P = -101 dBm
Unwanted signal B: Unmodulated, P = -36 dBm
Unwanted signal C: Modulated with 400 Hz / 3 kHz-deviation, P = -36 dBm

FREQUENCIES OF THE UNWANTED SIGNALS			PACKET ERROR RATE
Generator A	Generator B	Generator C	
156.025 MHz	156.075 MHz	156.125 MHz	7%
	155.975 MHz	155.925 MHz	6%
Limit:			20%
Measurement uncertainty:			+ 0.8 dB / - 0.9 dB

LIMITS: SUBCLAUSE 11.2.6.3

The PER shall not exceed 20 %.

TEST EQUIPMENT USED:

25, 27, 29, 33, 34, 42

6.7 BLOCKING OR DESENSITISATION SUBCLAUSE 11.2.7

Ambient temperature	20 °C	Relative humidity	45 %

Operation mode: Receive in AIS-mode: f = 156.025 MHz
Wanted signal A: P = -101 dBm
Unwanted signal B: Unmodulated, P = -23 dBm / -15 dBm*

FREQUENCIES OF THE UNWANTED SIGNALS		PACKET ERROR RATE PER
-10 MHz	146.025 MHz	0%
-5 MHz	151.025 MHz	0%
-2 MHz	154.025 MHz*	0%
-1 MHz	155.025 MHz*	0%
-500 kHz	155.525 MHz*	0%
+500 kHz	156.525 MHz*	0%
+1 MHz	157.025 MHz*	0%
+2 MHz	158.025 MHz*	0%
+5 MHz	161.025 MHz	0%
+10 MHz	166.025 MHz	0%
Limit:		20%
Measurement uncertainty		+ 0.8 dB / - 0.9 dB

Operation mode: Receive in AIS-mode: f = 162.025 MHz
Wanted signal A: P = -101 dBm
Unwanted signal B: Unmodulated, P = -23 dBm / -15 dBm*

FREQUENCIES OF THE UNWANTED SIGNALS		PACKET ERROR RATE PER
-10 MHz	152.025 MHz	0%
-5 MHz	157.025 MHz	0%
-2 MHz	160.025 MHz*	0%
-1 MHz	161.025 MHz*	0%
-500 kHz	161.525 MHz*	0%
+500 kHz	162.525 MHz*	0%
+1 MHz	163.025 MHz*	0%
+2 MHz	164.025 MHz*	0%
+5 MHz	167.025 MHz	0%
+10 MHz	172.025 MHz	0%
Limit:		20%
Measurement uncertainty		+ 0.8 dB / - 0.9 dB

LIMITS: SUBCLAUSE 11.2.7.3

The PER shall not exceed 20%.

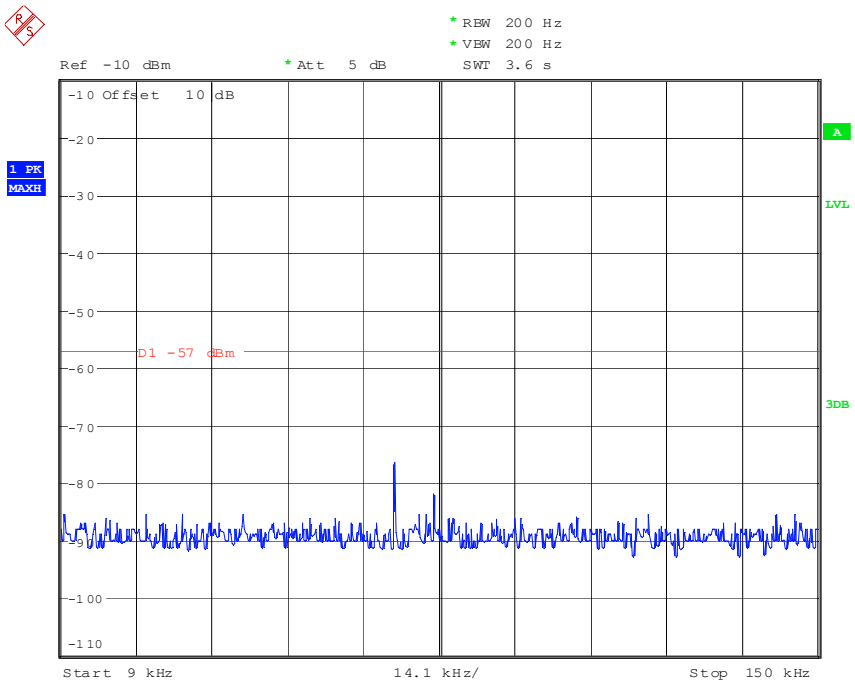
TEST EQUIPMENT USED:

25, 29, 33, 42

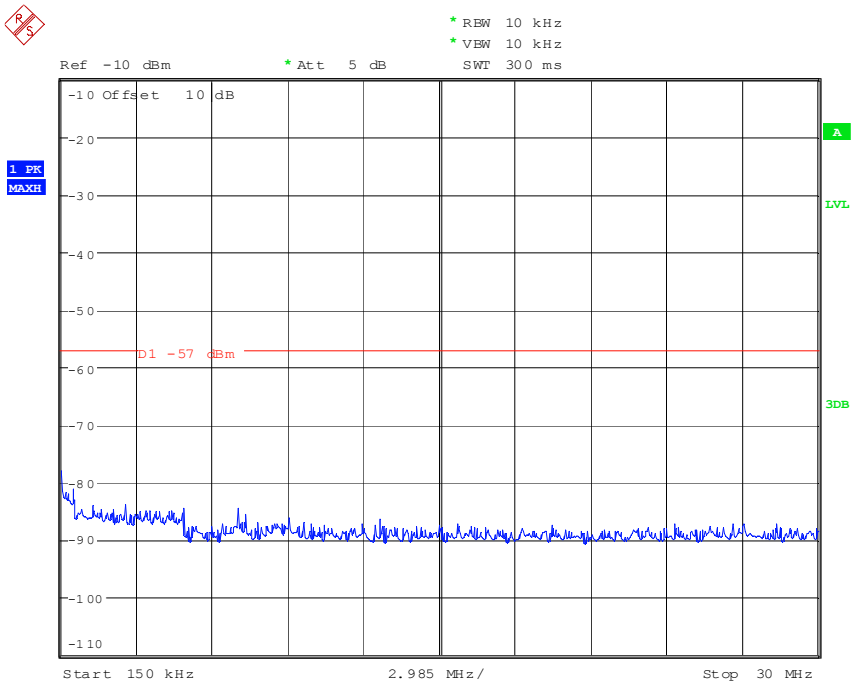
6.8 SPURIOUS EMISSIONS FROM THE RECEIVER SUBCLAUSE 11.3.1

Ambient temperature	20 °C	Relative humidity	45 %

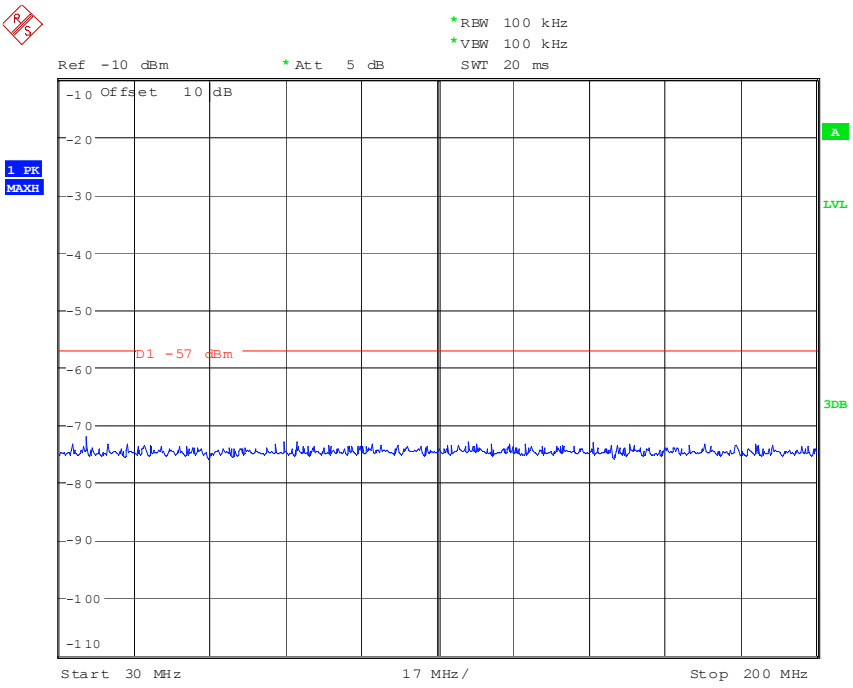
Operation mode: Receiver 1: f = 156.025 MHz, AIS-mode
Receiver 2: f = 162.025 MHz, AIS-mode



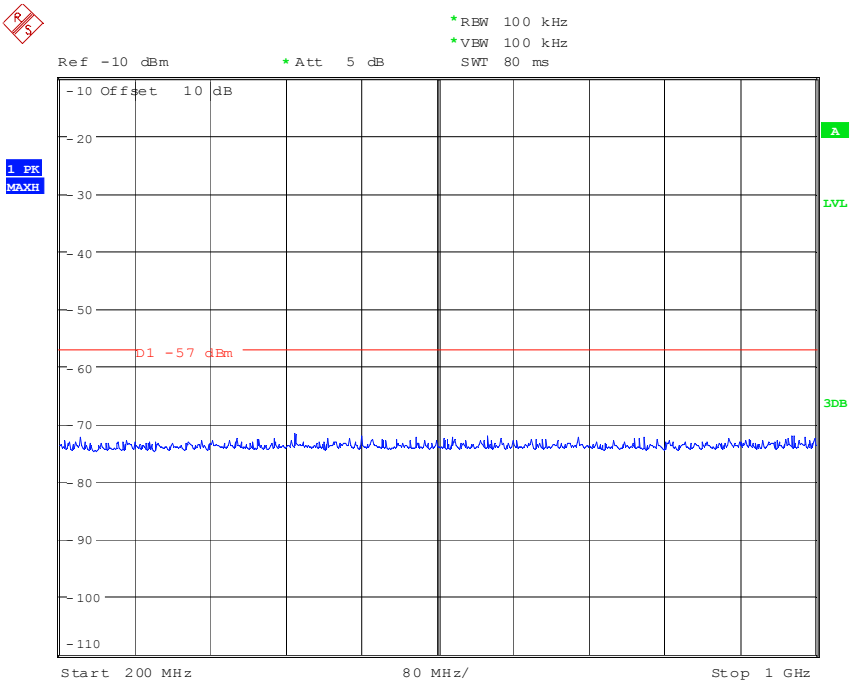
92025emi_rx1: 9 kHz to 150 kHz



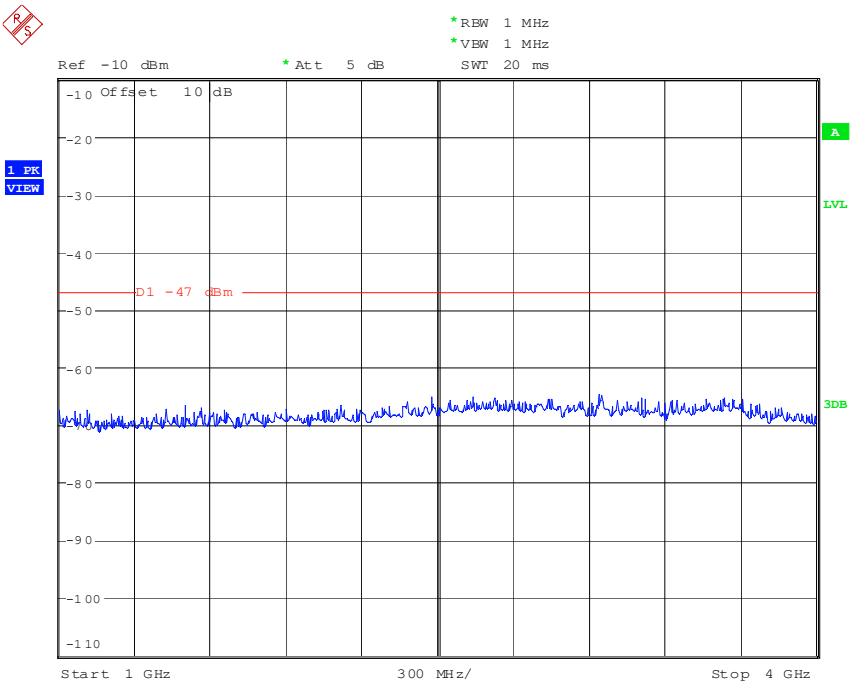
92025emi_rx2: 150 kHz to 30 MHz



92025emi_rx3: 30 MHz to 200 MHz



92025emi_rx4: 200 MHz to 1000 MHz



92025emi_rx5: 1 GHz to 4 GHz

SPURIOUS EMISSIONS LEVEL			
Frequency:	Measured level:	Limit:	Margin:
-	No significant spurious emissions found.		-
-			-
-	-	-	-
Measurement uncertainty	+0.66 dB / -0.72 dB		

LIMITS: SUBCLAUSE 11.3.1.3

Frequency range	9 kHz to 1 GHz	1 to 4 GHz
Rx operating	2 nW (- 57 dBm)	20 nW (- 47 dBm)

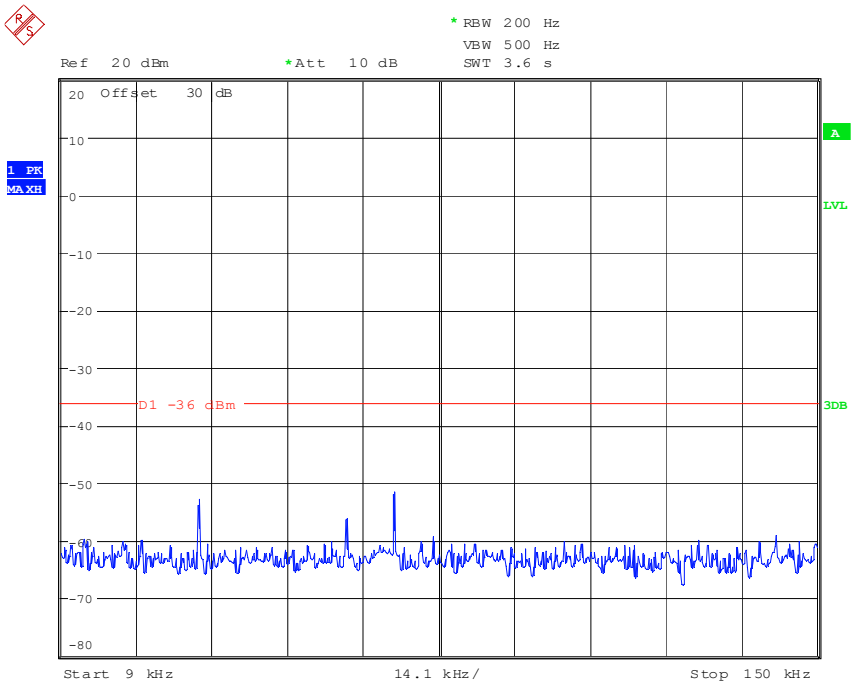
TEST EQUIPMENT USED:

06, 42, 76

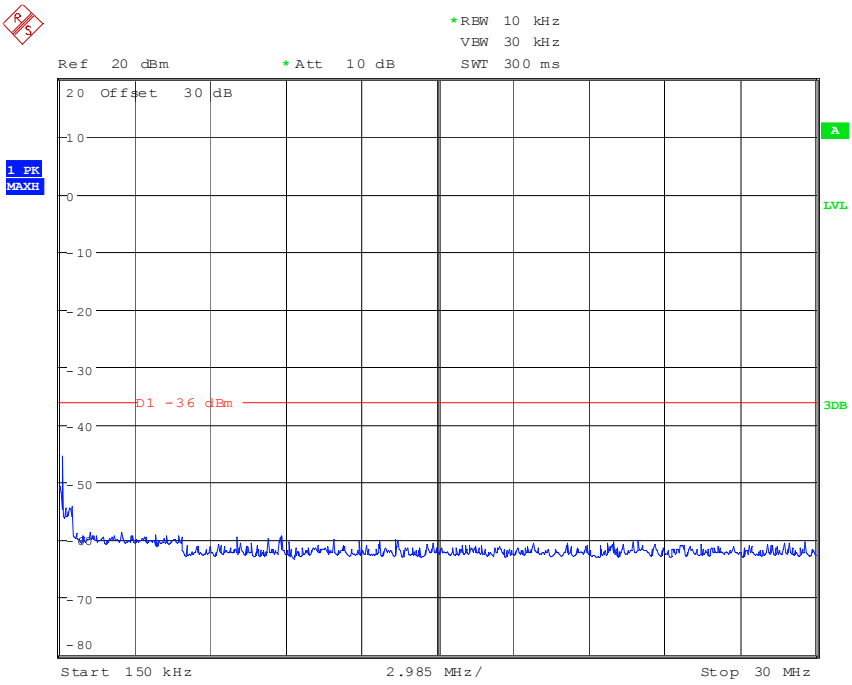
6.9 SPURIOUS EMISSIONS FROM THE TRANSMITTER SUBCLAUSE 11.3.2

Ambient temperature	20 °C	Relative humidity	45 %

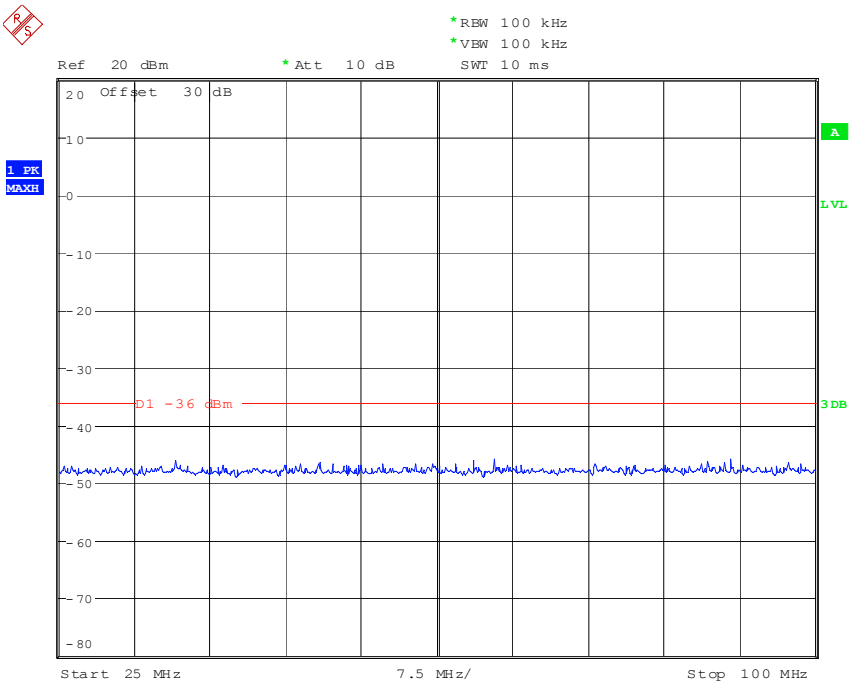
Operation mode: Continuous transmission, f = 156.025 MHz



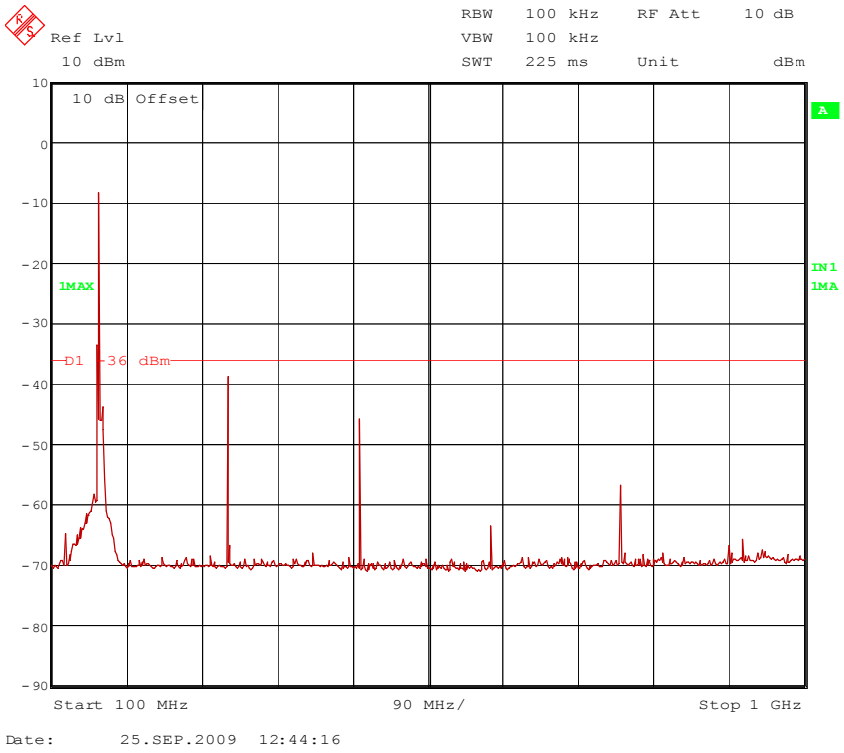
92025tx156_1: 9 kHz to 150 kHz



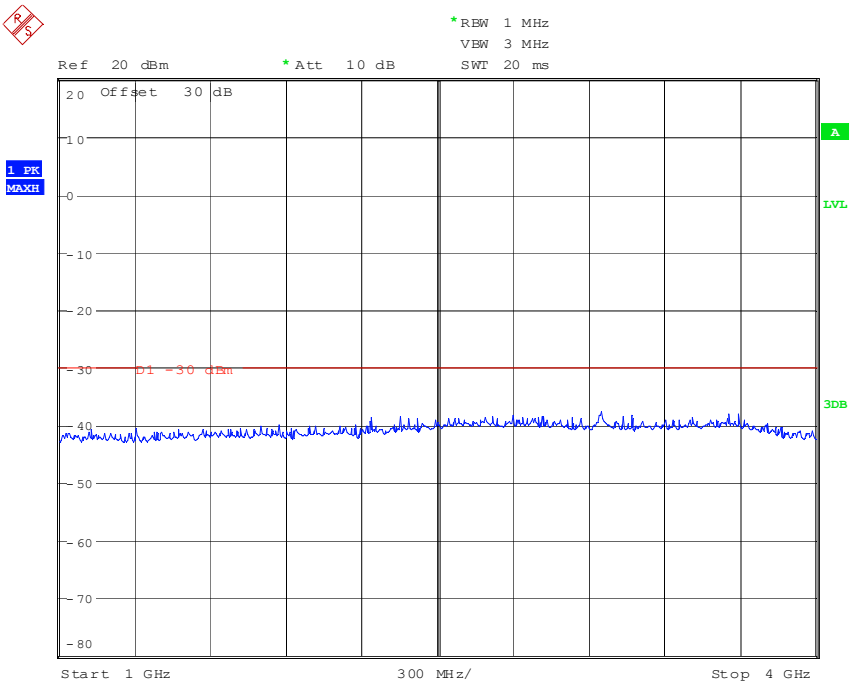
92025tx156_2: 150 kHz to 30 MHz



92025tx156_3: 25 MHz to 100 MHz



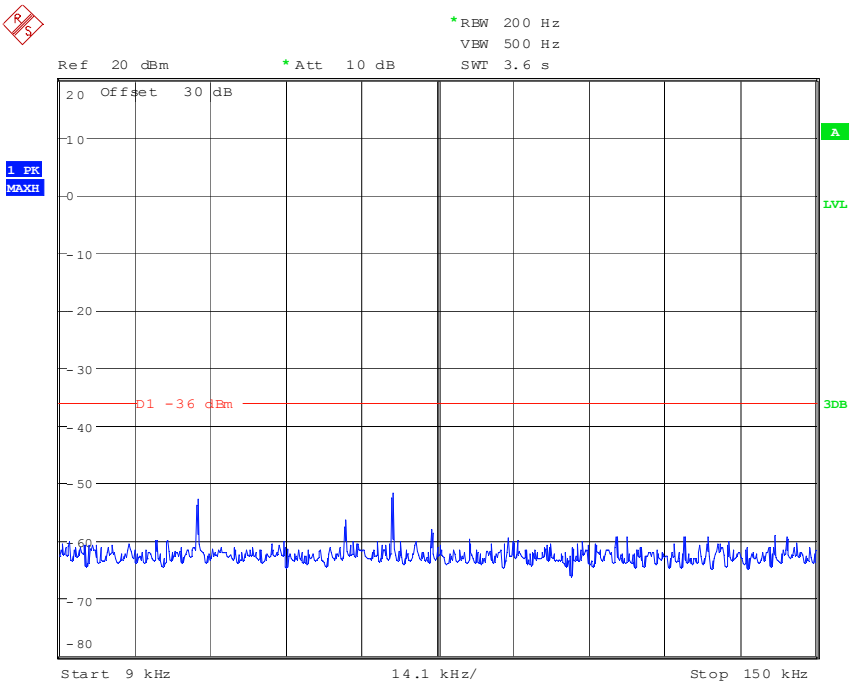
92025tx156_4: 100 MHz to 1000 MHz (with Notchfilter)



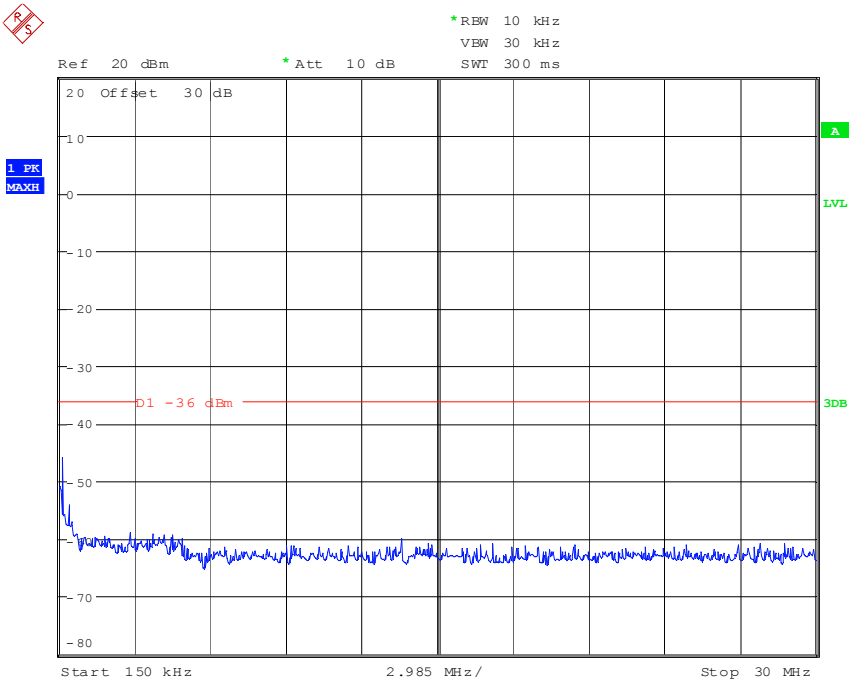
92025tx156_5: 1 GHz to 4 GHz

SPURIOUS EMISSIONS LEVEL (CONDUCTED)					
f	Level	Bandwidth	Limit	Margin	Result
312.025 MHz	-38.5 dBm	100 kHz	-36 dBm	2.5 dB	Passed
468.075 MHz	-47.0 dBm	100 kHz	-36 dBm	11.0 dB	Passed
780.125 MHz	-57.0 dBm	100 kHz	-36 dBm	21.0 dB	Passed
Measurement uncertainty		+ 0.66 dB / - 0.72 dB			

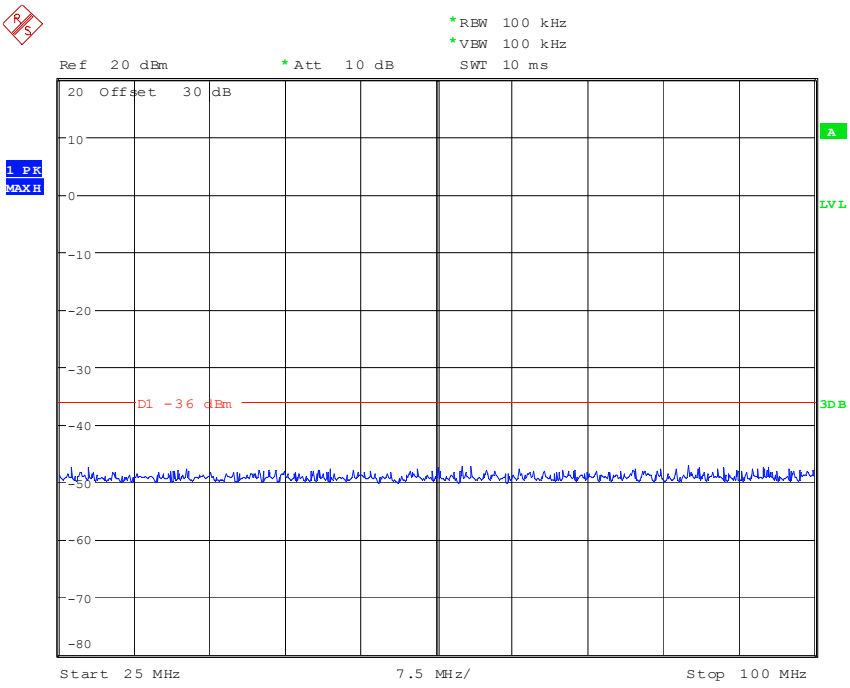
Operation mode: Continuous transmission, f = 162.025 MHz



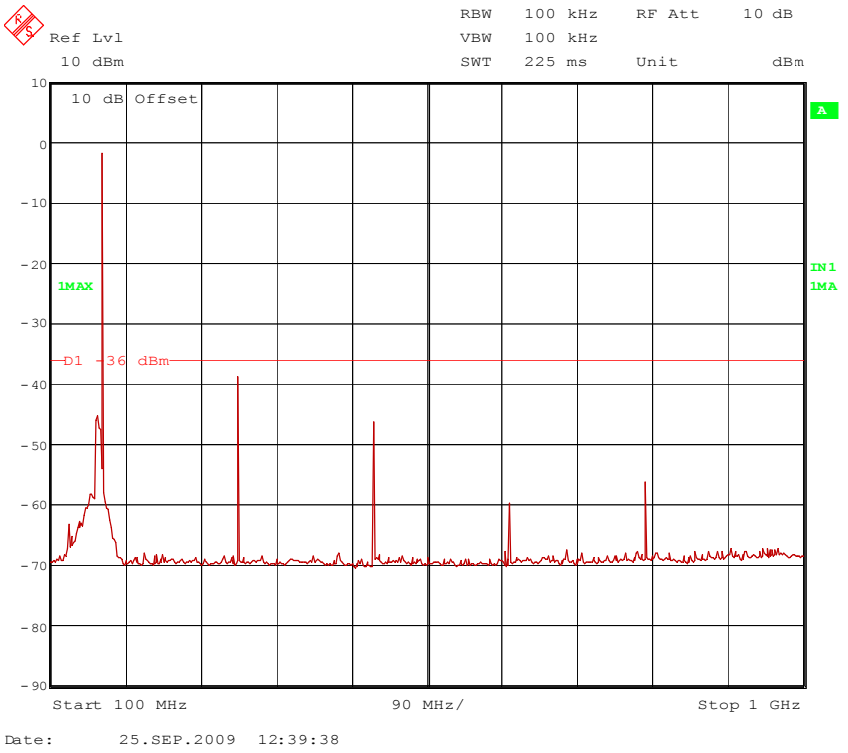
92025tx162_1: 9 kHz to 150 kHz



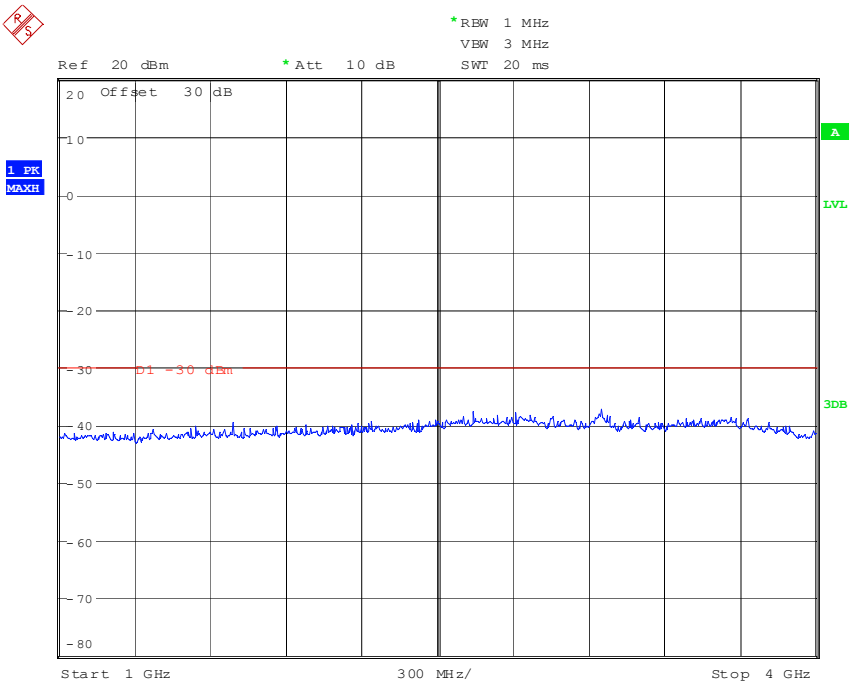
92025tx162_2: 150 kHz to 30 MHz



92025tx162_3: 25 MHz to 100 MHz



92025tx162_4: 100 MHz to 1000 MHz (with Notchfilter)



92025tx162_5: 1 GHz to 4 GHz

SPURIOUS EMISSIONS LEVEL (CONDUCTED)					
f	Level	Bandwidth	Limit	Margin	Result
324.050 MHz	-39.0 dBm	100 kHz	-36 dBm	3.0 dB	Passed
486.075 MHz	-47.0 dBm	100 kHz	-36 dBm	11.0 dB	Passed
810.125 MHz	-56.0 dBm	100 kHz	-36 dBm	20.0 dB	Passed
Measurement uncertainty		+ 0.66 dB / - 0.72 dB			

LIMITS: SUBCLAUSE 11.3.2.3

Conducted emissions:

Frequency range	150 kHz to 1 GHz	1 to 4 GHz
TX operating	0.25 µW (- 36 dBm)	1 µW (- 30 dBm)

TEST EQUIPMENT USED:

06, 07, 42, 63, 82, 86

6.10 MAXIMUM SENSITIVITY

SUBCLAUSE C.4

Ambient temperature	20 °C

Relative humidity	45 %

Operation mode: Receive in DSC-mode, f = 156.525 MHz
Wanted signal: Test-signal 1 (0101010…)

TEMPERATURE	VOLTAGE	DSC-FREQUENCY	RECEIVER SENSITIVITY
T_{nom} (+20°C)	U_{nom} (24.0 V DC)	156.523500 MHz 156.525000 MHz 156.526500 MHz	-110 dBm -112 dBm -111 dBm
T_{min} (- 20°C)	U_{min} (12.0 V DC)	156.523500 MHz 156.525000 MHz 156.526500 MHz	-110 dBm -111 dBm -110 dBm
	U_{max} (30.0 V DC)	156.523500 MHz 156.525000 MHz 156.526500 MHz	-109 dBm -110 dBm -110 dBm
T_{max} (+ 55°C)	U_{min} (12.0 V DC)	156.523500 MHz 156.525000 MHz 156.526500 MHz	-107 dBm -109 dBm -108 dBm
	U_{max} (30.0 V DC)	156.523500 MHz 156.525000 MHz 156.526500 MHz	-108 dBm -109 dBm -108 dBm
Measurement uncertainty		< 3 dB	

LIMITS: SUBCLAUSE C.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) ± 1.5 kHz.

TEST EQUIPMENT USED:

29, 42, 51

6.11 ERROR BEHAVIOUR AT HIGH INPUT LEVELS SUBCLAUSE C.4.2

Ambient temperature	20 °C

Relative humidity	45 %

Operation mode: Receive in DSC-mode, f = 156.525 MHz
Wanted signal: Test-signal 1 (0101010…)

RF-INPUT SIGNAL LEVEL	NUMBER OF MESSAGES NOT SUCCESSFULLY RECORDED
- 7 dBm	DSC BER = 0%

LIMITS: SUBCLAUSE C.4.2

The BER shall not exceed 1%.

TEST EQUIPMENT USED:

29, 42

6.12 CO-CHANNEL REJECTION SUBCLAUSE C.4.3

Ambient temperature	20 °C	Relative humidity	45 %

Operation mode: Receive in DSC-mode, f = 156.525 MHz
Wanted signal: Test-signal 1 (0101010…), 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	0.1%
156.525 MHz	-114 dBm	-10 dB	0.7%
156.528 MHz	-114 dBm	-10 dB	0.1%
Measurement uncertainty		< 3 dB	

LIMITS: SUBCLAUSE C.4.3

The BER shall not exceed 1%.

TEST EQUIPMENT USED:

29, 42

6.13 ADJACENT CHANNEL SENSITIVITY SUBCLAUSE C.4.4

Ambient temperature	20 °C	Relative humidity	45 %

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	UNWANTED SIGNAL LEVEL	BIT ERROR RATE
T_{nom} (+ 20 °C)	U_{nom} (24.0 V)	-34 dBm	0.5%
T_{min} (- 15 °C)	U_{min} (12.0 V DC)	-44 dBm	1%
	U_{max} (30.0 V DC)		
T_{max} (+ 55 °C)	U_{min} (12.0 V DC)	-44 dBm	1%
	U_{max} (30.0 V DC)		
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 = 156.550 MHz, modulated with 400 Hz and a deviation of 3 kHz.

TEMPERATURE	VOLTAGE	UNWANTED SIGNAL LEVEL	BIT ERROR RATE
T_{nom} (+ 20 °C)	U_{nom} (24.0 V)	-34 dBm	0.2%
T_{min} (- 15 °C)	U_{min} (12.0 V DC)	-44 dBm	1%
	U_{max} (30.0 V DC)		
T_{max} (+ 55 °C)	U_{min} (12.0 V DC)	-44 dBm	1%
	U_{max} (30.0 V DC)		
Measurement uncertainty		< 3 dB	

LIMITS: SUBCLAUSE C.4.4

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

TEST EQUIPMENT USED:

25, 29, 33, 42, 51

6.14 SPURIOUS RESPONSE REJECTION SUBCLAUSE C.4.5

Ambient temperature	20 °C	Relative humidity	45 %

Operation mode: Receive in AIS-mode, Channel A = 156.525 MHz
Wanted signal: Test-signal 1, P = -104 dBm
Unwanted signal: Unmodulated, P = -34 dBm

DEFINITION	UNWANTED FREQUENCY	MEASSURED BIT EROR RATE BER
1st IF (Receiver A)	21.400 MHz	0%
1st LO-Freq. - IF	113.725 MHz	0%
2 x 1st LO-Freq. – IF	248.850 MHz	0.2%
2 x 1st LO-Freq. + IF	291.650 MHz	0%
3 x 1st LO-Freq. – IF	383.975 MHz	0%
3 x 1st LO-Freq. + IF	426.775 MHz	0%
-	No other spurious response rejection frequencies found	
-		
Measurement uncertainty		

DEFINITION	UNWANTED FREQUENCY	MEASSURED BIT EROR RATE BER
1st IF (Receiver B)	38.855 MHz	0%
1st LO-Freq. - IF	78.815 MHz	0%
2 x 1st LO-Freq. – IF	196.485 MHz	0%
2 x 1st LO-Freq. + IF	274.195 MHz	0.1%
3 x 1st LO-Freq. – IF	314.155 MHz	0%
3 x 1st LO-Freq. + IF	391.865 MHz	0%
-	No other spurious response rejection frequencies found	
-		
Measurement uncertainty		

LIMITS: SUBCLAUSE C.4.5

The BER shall not exceed 1%.

TEST EQUIPMENT USED:

25, 29, 33, 42

6.15 INTERMODULATION RESPONSE REJECTION SUBCLAUSE C.4.6

Ambient temperature	20 °C	Relative humidity	45 %

Wanted signal A: P = -104 dBm
Unwanted signal B: Unmodulated, P = -39 dBm
Unwanted signal C: Modulated with 400 Hz / 3 kHz-deviation, P = -39 dBm

FREQUENCIES OF THE UNWANTED SIGNALS			MEASSURED BIT EROR RATE BER
Generator A	Generator B	Generator C	
156.525 MHz	156.475 MHz	156.425 MHz	0.5%
	156.575 MHz	156.625 MHz	0.7%
Limit:			1%
Measurement uncertainty:			

LIMITS: SUBCLAUSE C.4.6

The BER shall not exceed 1%.

TEST EQUIPMENT USED:

25, 27, 29, 33, , 34, 42

6.16 BLOCKING OR DESENSITISATION SUBCLAUSE C.4.7

Ambient temperature	20 °C	Relative humidity	45 %

Wanted signal A: P = -104 dBm
Unwanted signal B: Unmodulated, P = -20 dBm

FREQUENCIES OF THE UNWANTED SIGNALS		MEASSURED BIT EROR RATE BER
-10 MHz	146.525 MHz	0%
-5 MHz	151.525 MHz	0%
-2 MHz	154.525 MHz	0%
-1 MHz	155.525 MHz	0.5%
+1 MHz	157.525 MHz	0.7%
+2 MHz	158.525 MHz	0%
+5 MHz	161.525 MHz	0%
+10 MHz	166.525 MHz	0%
Limit:		1%
Measurement uncertainty		

LIMITS: SUBCLAUSE C.4.7

The PER shall not exceed 1%.

TEST EQUIPMENT USED:

25, 29, 33, 42

7 TEST EQUIPMENT

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	Spectrum Analyser	FSU	Rohde & Schwarz	200125	480956
07	Measuring receiver	ESI 40	Rohde & Schwarz	837808/007	480335
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 ∅ = 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
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

No.	Test equipment	Type	Manufacturer	Serial No.	PM-No
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	-	Binder	-	480462
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 10.7-1400/11	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

No.	Test equipment	Type	Manufacturer	Serial No.	PM-No
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
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

No.	Test equipment	Type	Manufacturer	Serial No.	PM-No
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	AR25A250A	Amplifier Research	18647	480154
116	Combiner	ZFSC-2-11	Mini Circuits	-	410169
117	Signal generator	SMY 01	Rohde & Schwarz	-	580010
118	225 MHz Universal counter	53131 A	Hewlett & Packard	-	480134
128	Zirkulator	156-162MHz	DFE	-	410162
129	Zirkulator	156-162MHz	DFE	-	410163
130	Zirkulator	156-162MHz	DFE	-	410164
131	Zirkulator	156-162MHz	DFE	-	410165

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	EUT, internal-view	92025eut3.jpg
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