

TEST REPORT

on

IEC 62320-2: Edition 1.0 2008-03

**MARITIME NAVIGATION AND
RADIOCOMMUNICATION EQUIPMENT
AND SYSTEMS-AUTOMATIC IDENTIFICATION SYSTEM (AIS)
Part 2: AIS AtoN Stations-Operational and
Performance Requirements,
Methods of test and required test results**

Test Report Reference: F110939E1 2nd Version

Equipment under Test:

MANDO-303/301 AIS AtoN

Serial Number: -

Applicant: Alltek Marine Electronics Corp

Manufacturer: Alltek Marine Electronics Corp

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2 IDENTIFICATION

2.1 APPLICANT

Name:	Alltek Marine Electronics Corp
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2.2 MANUFACTURER

Name:	Alltek Marine Electronics Corp
Address:	7F, No.605, Ruei-Guang Rd., Neihu, Taipei
Country:	Taiwan, R.O.C.
Name for contact purposes:	Y.Y. Chiou
Tel:	+886 2 2627 1599 ext.109
Fax:	+886 2 2627 1600
e-mail address:	yychiou@alltekmarine.com

2.3 DATES

Date of Receipt of Test Sample:	7. November 2011
Start of test:	4. January 2012
Finish of test:	4. January 2012

TEST REPORT REFERENCE: F110939E1 2nd version

2.4 TEST LABORATORY

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

accredited by Deutsche Gesellschaft für Akkreditierung mbH (DGA) in compliance with DIN EN ISO/IEC 17025 under Reg. No. DGA-PL-105/99-22

Test engineer:	Raimund BLASK		5 January 2012
	_____ Name	_____ Signature	_____ Date
Authorized reviewer:	Bernd STEINER		5 January 2012
	_____ Name	_____ Signature	_____ Date

2.5 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 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.

2.6 REFERENCES

[1] IEC 62320-2: Edition 1.0 2008-03: Maritime Navigation and Radio Communication Equipment and Systems- Automatic Identification System (AIS);
Part 2: AIS AtoN Stations-Operational and performance requirements, Methods of test and required test results.

TEST REPORT REFERENCE: F110939E1 2nd version

3 TECHNICAL DATA OF EQUIPMENT

Type:	AIS AtoN Navigation System		
Type designation:	MANDO-303/301 AIS AtoN		
Serial No.:	MANDO-303: A1K310903 MANDO-301: A1K310901		
Alignment range:	156.025 to 162.025 MHz		
Switching range:	156.025 to 162.025 MHz		
Channel separation:	25 kHz		
Rated RF output power:	2W / 5W / 12.5 W (programmable)		
Supply Voltage:	U _{nom} = 12.0 V DC	U _{min} = 9.6 V DC	U _{max} = 15.6 V DC
Temperature range:	-20°C to +55°C		
Printed circuit designation:	M-PCB-CTLN3, M-PCB-RFNR2		
Hardware:	M-PCB-CTLN3, M-PCB-RFNR2		
Software:	Version 1.4.3		

Ports/Connectors

Identification	Connector		Length
	EUT	Ancillary	
DC-power-supply	Customized	-	3 m
GPS-antenna	TNC	TNC	10 m
VHF-antenna	SO-239 (M-Type)	N-Male	3 m
RS 232-Display	Customized	Customized	5 m
RS 422-Sensor	Customized	Customized	5 m

TEST REPORT REFERENCE: F110939E1 2nd version

4 ADDITIONAL INFORMATION

General:

Full tests were carried out at 156.025 MHz and 162.025 MHz.

The EUT was powered by an external 12 V-DC-Power-Supply.

All Tests were carried out with the MANDO-303. The MANDO-301 is using the same Hard- and Software, only the Receivers are not integrated (as declared by the applicant).

Wanted signal:

AIS-Mode (wanted signals):

The Test-Signals were generated by the AIS-Simulator "Attingimus".

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.

Test Report History:

Test Report Number:	Date of issue:	Report Status:
F110939E1	9 November 2011	First issue
F110939E1 2 nd version	4 January 2012	- Transmitter Trainings-Sequence-Plots added on page 21 and 22 to show that the Trainings-Sequence starts with "0". - Typing error (spurious response rejection frequencies) corrected on page 37.
-	-	-

TEST REPORT REFERENCE: F110939E1 2nd version

5 TEST OVERVIEW

Part 7	AIS AtoN stations		
7.1	RF-Tests (receiver and transmitter)		
7.1.1	TDMA Transmitter		
7.1.1.1	Frequency error	Applicable	Passed
7.1.1.2	Carrier power (conducted)	Applicable	Passed
7.1.1.3	Modulation spectrum slotted transmission	Applicable	Passed
7.1.1.4	Transmitter test sequence and modulation accuracy	Applicable	Passed
7.1.1.5	Transmitter output power versus time function	Applicable	Passed
7.1.2	TDMA Receiver		
7.1.2.1	Sensitivity	Applicable	Passed
7.1.2.2	Error behaviour at high input level	Applicable	Passed
7.1.2.3	Co-channel rejection	Applicable	Passed
7.1.2.4	Adjacent channel selectivity	Applicable	Passed
7.1.2.5	Spurious response rejection	Applicable	Passed
7.1.2.6	Intermodulation response rejection	Applicable	Passed
7.1.2.7	Blocking and desensitisation	Applicable	Passed
7.1.3	Conducted spurious emissions at the antenna		
7.1.3.1	Spurious emissions from the receiver	Applicable	Passed
7.1.3.2	Spurious emissions from the transmitter	Applicable	Passed

TEST REPORT REFERENCE: F110939E1 2nd version

6 TRANSMITTER REQUIREMENTS

TEST REPORT REFERENCE: F110939E1 2nd version

6.1 FREQUENCY ERROR

SUBCLAUSE 7.1.1.1

Ambient temperature	20 °C	Relative humidity	45 %
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Operation mode: Continuous transmission without modulation, f = 156.025 MHz

TEST CONDITIONS		FREQUENCY	FREQUENCY ERROR
Temperature	Voltage		
T _{nom} (+20°C)	U _{nom} (12.0 V DC)	156.024620 MHz	-380 Hz
T _{min} (-20°C)	U _{min} (9.6 V DC)	156.024920 MHz	-80 Hz
	U _{max} (15.6 V DC)	156.024950 MHz	-50 Hz
T _{max} (+55°C)	U _{min} (9.6 V DC)	156.024920 MHz	-80 Hz
	U _{max} (15.6 V DC)	156.024890 MHz	-110 Hz
Maximum frequency error		-110 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} (12.0 V DC)	162.024598 MHz	-402 Hz
T _{min} (-20°C)	U _{min} (9.6 V DC)	162.024910 MHz	-90 Hz
	U _{max} (15.6 V DC)	162.024940 MHz	-60 Hz
T _{max} (+55°C)	U _{min} (9.6 V DC)	162.024910 MHz	-90 Hz
	U _{max} (15.6 V DC)	162.024885 MHz	-115 Hz
Maximum frequency error		-402 Hz	
Measurement uncertainty		± 10 Hz	

LIMITS: SUBCLAUSE 7.1.1.1.3

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

TEST EQUIPMENT USED:

29, 42, 51

TEST REPORT REFERENCE: F110939E1 2nd version

6.2 CARRIER POWER (CONDUCTED)

SUBCLAUSE 7.1.1.2

Ambient temperature	20 °C	Relative humidity	45 %
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Operation mode: Transmit mode, f = 156.025 MHz

Test conditions		Carrier Power (conducted)		
		2W / +33dBm	5W / +37dBm	12.5W / +41dBm
T _{nom} (+20°C)	U _{nom} (12.0 V DC)	33.5 dBm	36.8 dBm	40.8 dBm
T _{min} (-20°C)	U _{min} (9.6 V DC)	32.7 dBm	36.7 dBm	40.6 dBm
	U _{max} (15.6 V DC)	32.9 dBm	37.1 dBm	40.7 dBm
T _{max} (+55°C)	U _{min} (9.6 V DC)	33.2 dBm	37.2 dBm	40.7 dBm
	U _{max} (15.6 V DC)	33.5 dBm	37.0 dBm	40.9 dBm
Measurement uncertainty		+ 0.66 dB / - 0.72 dB		

Operation mode: Transmit mode, f = 162.025 MHz

Test conditions		Carrier Power (conducted)		
		2W / +33dBm	5W / +37dBm	12.5W / +41dBm
T _{nom} (+20°C)	U _{nom} (12.0 V DC)	33.8 dBm	37.5 dBm	41.2 dBm
T _{min} (-20°C)	U _{min} (9.6 V DC)	33.5 dBm	37.7 dBm	41.8 dBm
	U _{max} (15.6 V DC)	33.2 dBm	37.3 dBm	41.7 dBm
T _{max} (+55°C)	U _{min} (9.6 V DC)	33.7 dBm	37.2 dBm	41.7 dBm
	U _{max} (15.6 V DC)	33.8 dBm	37.5 dBm	41.5 dBm
Measurement uncertainty		+ 0.66 dB / - 0.72 dB		

LIMITS: SUBCLAUSE 7.1.1.2.3

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 ± 3.0 dB of the rated output power.

TEST EQUIPMENT USED:

29, 42, 51

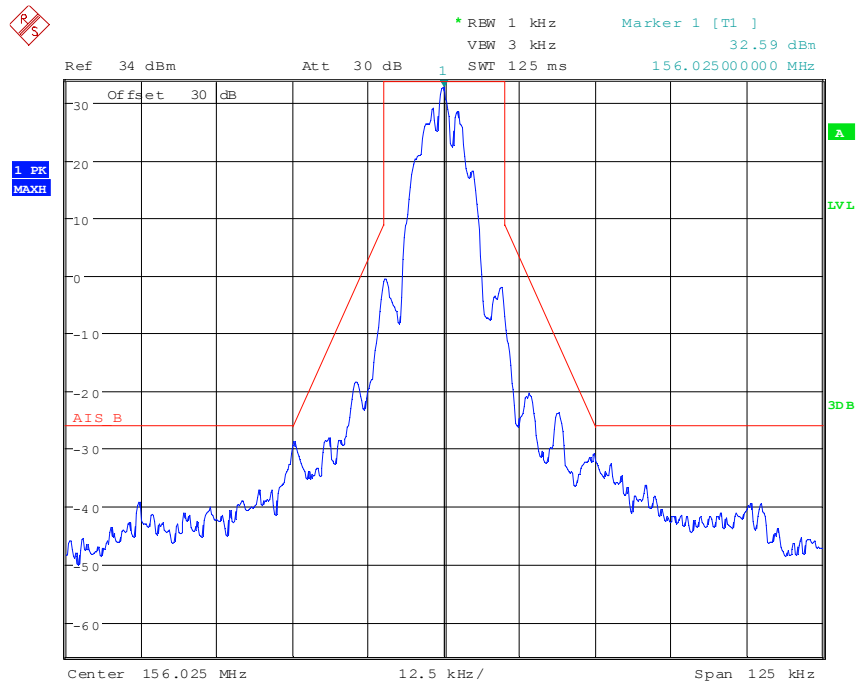
TEST REPORT REFERENCE: F110939E1 2nd version

6.3 MODULATION SPECTRUM SLOTTED SPECTRUM

SUBCLAUSE 7.1.1.3

Ambient temperature	20 °C	Relative humidity	45 %
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Operation mode: Transmit mode

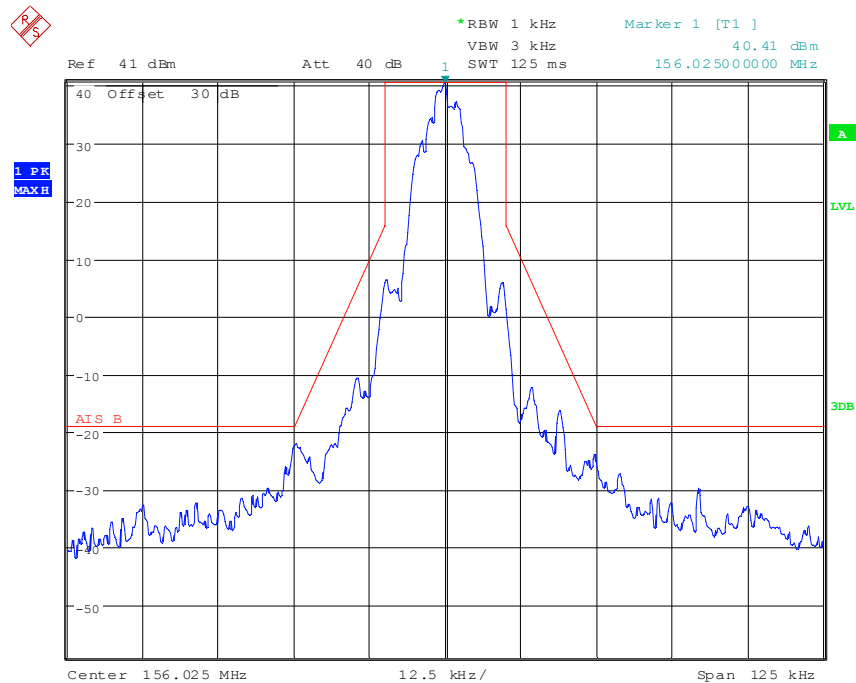


156I Mod: Transmit 156.025 MHz / 2W



156m Mod: Transmit 156.025 MHz / 5W

TEST REPORT REFERENCE: F110939E1 2nd version

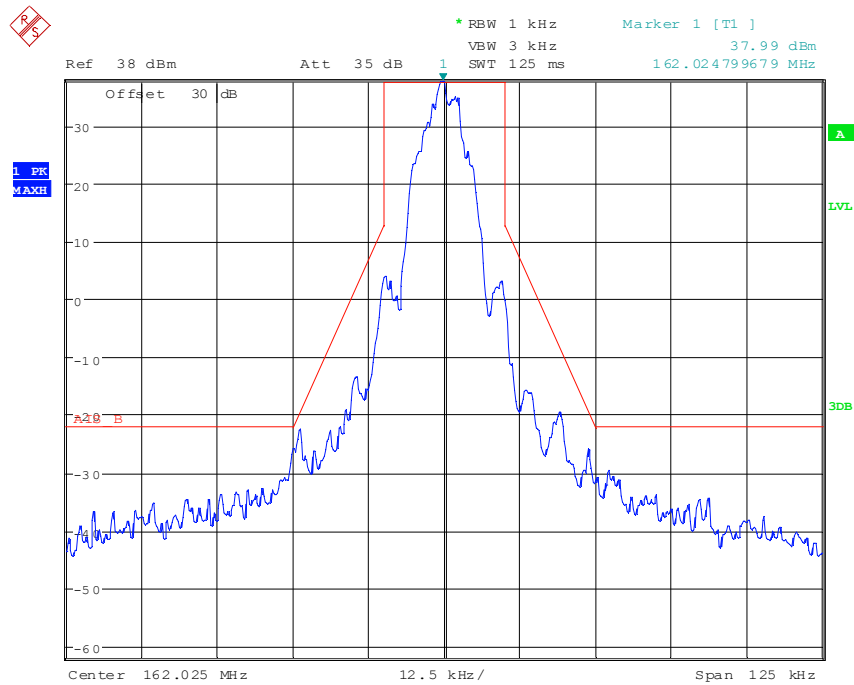


156hMod: Transmit 156.025 MHz / 12.5W

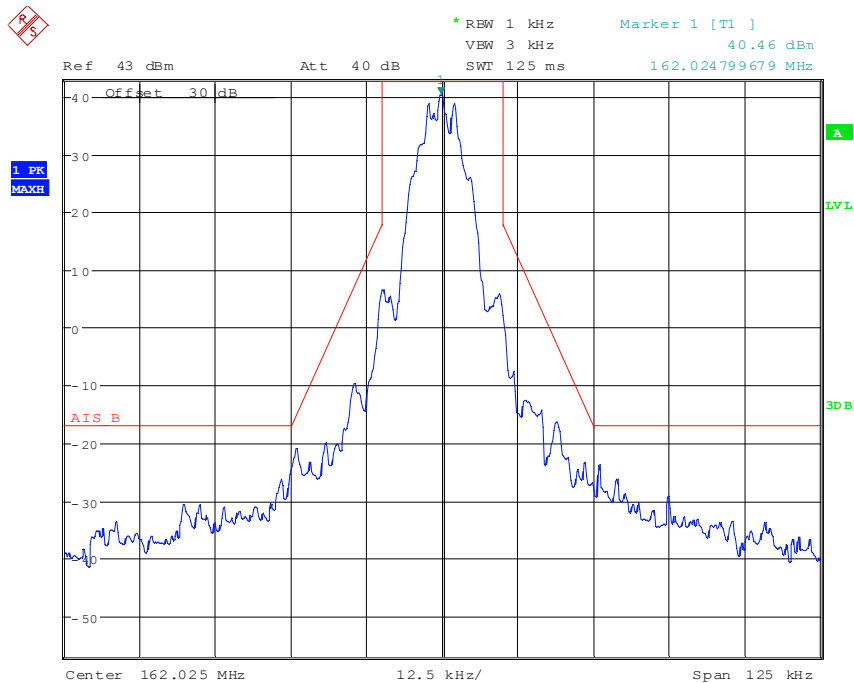


162IMod: Transmit 162.025 MHz / 2W

TEST REPORT REFERENCE: F110939E1 2nd version



156mMod: Transmit 162.025 MHz / 5W



156hMod: Transmit 162.025 MHz / 12.5W

TEST REPORT REFERENCE: F110939E1 2nd version

LIMITS: SUBCLAUSE 7.1.1.3.3

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

At ± 25 kHz to ± 62.5 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 and transient sideband is below a line specified between these two points.

TEST EQUIPMENT USED:

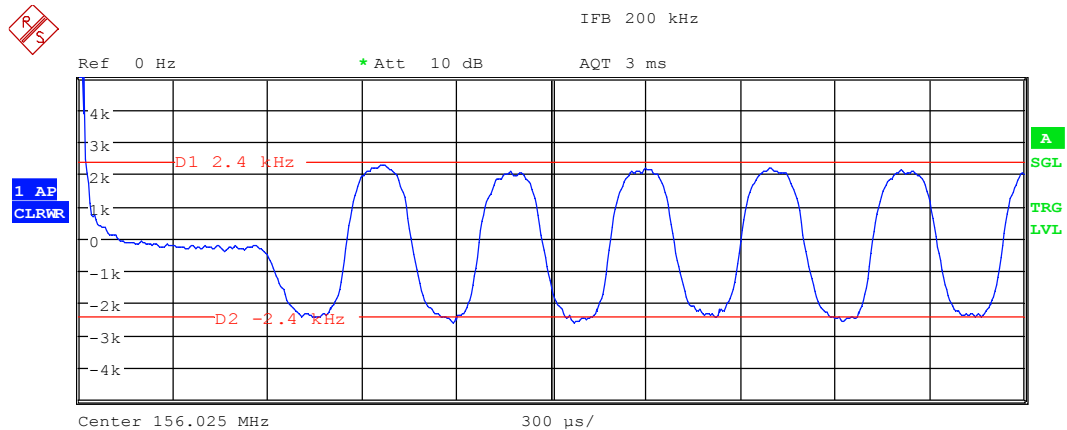
06, 42, 79-81, 100-102

TEST REPORT REFERENCE: F110939E1 2nd version

6.4 TRANSMITTER TEST SEQUENCE AND MODULATION ACCURACY

SUBCLAUSE 7.1.1.4

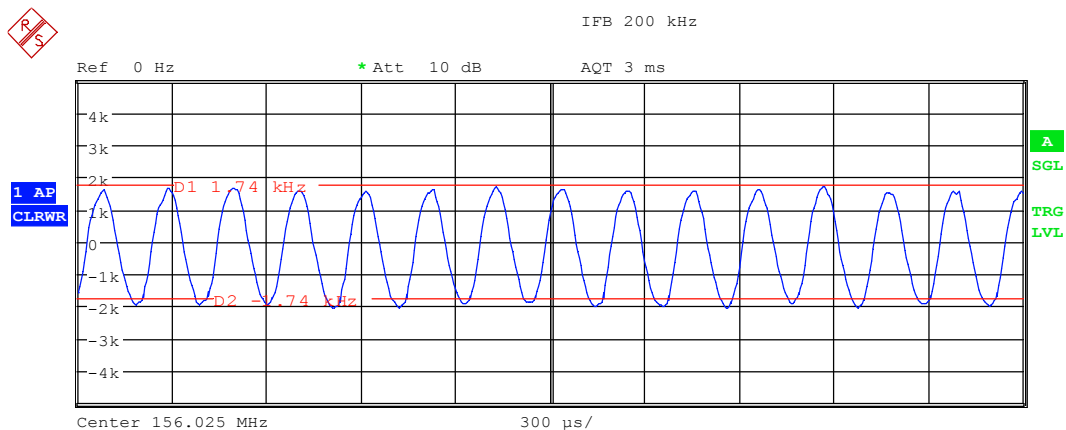
Ambient temperature	20 °C	Relative humidity	55 %
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Frequency Modulation Summary

Coupling	DC	Carrier Offset	-223.22 Hz
Deviation	+peak 6.522 kHz	Carrier Power	32.82 dBm
	-peak -2.631 kHz	Modulation Frequency	---
	f _{peak/2} 4.576 kHz	Sampling Rate	125 kHz
	RMS 1.760 kHz	Record Length	376
		Demod Bandwidth	100 kHz

156modL1: 156.025 MHz / 2W

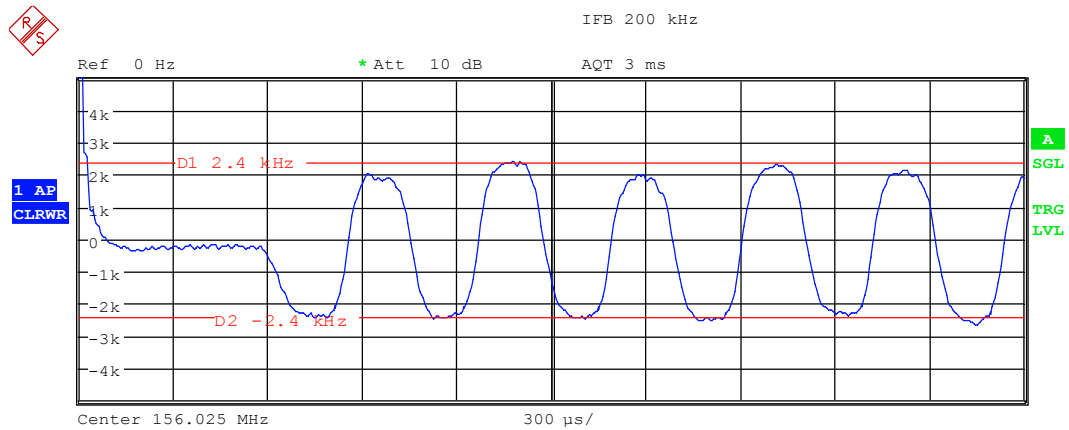


Frequency Modulation Summary

Coupling	DC	Carrier Offset	-178.64 Hz
Deviation	+peak 1.703 kHz	Carrier Power	32.81 dBm
	-peak -2.067 kHz	Modulation Frequency	4.80082 kHz
	f _{peak/2} 1.885 kHz	Sampling Rate	125 kHz
	RMS 1.313 kHz	Record Length	376
		Demod Bandwidth	100 kHz

156modL2: 156.025 MHz / 2W

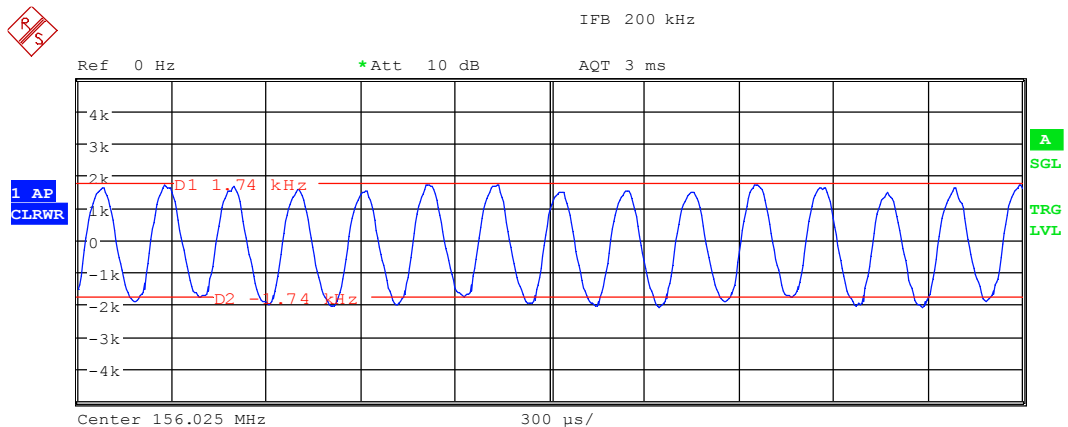
TEST REPORT REFERENCE: F110939E1 2nd version



Frequency Modulation Summary

Coupling	DC	Carrier Offset	-200.81 Hz
Deviation	+peak 8.096 kHz	Carrier Power	37.18 dBm
	-peak -2.669 kHz	Modulation Frequency	---
	$\uparrow$ peak/2 5.382 kHz	Sampling Rate	125 kHz
	RMS 1.779 kHz	Record Length	376
		Demod Bandwidth	100 kHz

156modM1: 156.025 MHz / 5W

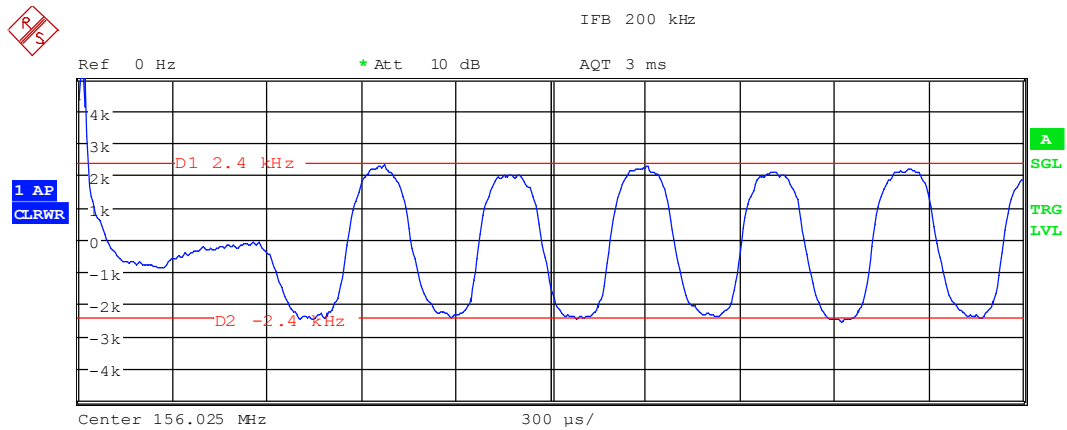


Frequency Modulation Summary

Coupling	DC	Carrier Offset	-172.83 Hz
Deviation	+peak 1.708 kHz	Carrier Power	37.14 dBm
	-peak -2.109 kHz	Modulation Frequency	4.80080 kHz
	$\uparrow$ peak/2 1.908 kHz	Sampling Rate	125 kHz
	RMS 1.307 kHz	Record Length	376
		Demod Bandwidth	100 kHz

156modM2: 156.025 MHz / 5W

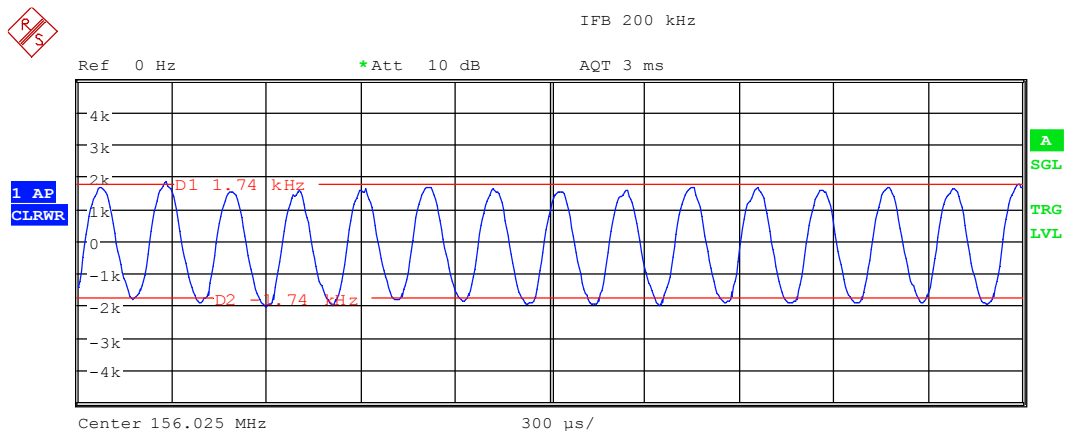
TEST REPORT REFERENCE: F110939E1 2nd version



Frequency Modulation Summary

Coupling	DC	Carrier Offset	-203.87 Hz
Deviation	+peak 6.868 kHz	Carrier Power	40.82 dBm
	-peak -2.567 kHz	Modulation Frequency	---
	$\uparrow$ peak/2 4.717 kHz	Sampling Rate	125 kHz
	RMS 1.765 kHz	Record Length	376
		Demod Bandwidth	100 kHz

156modH1: 156.025 MHz / 12.5W

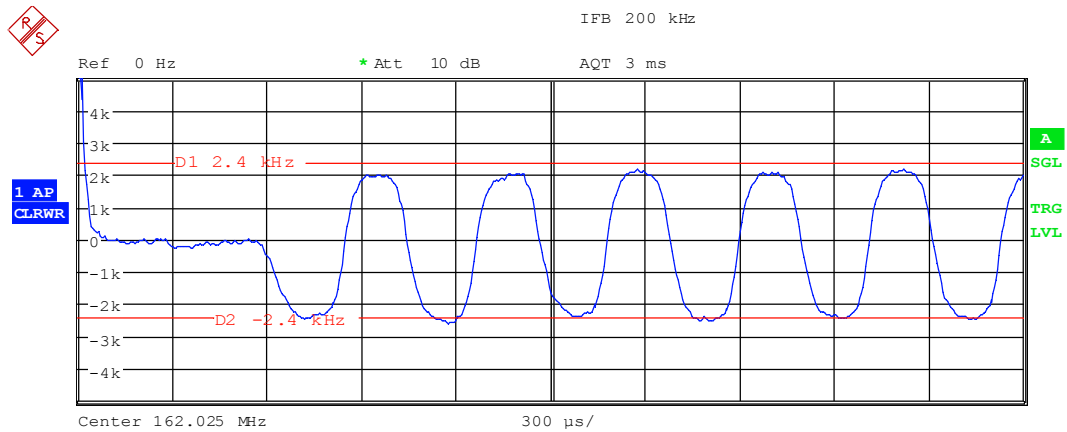


Frequency Modulation Summary

Coupling	DC	Carrier Offset	-162.68 Hz
Deviation	+peak 1.838 kHz	Carrier Power	40.81 dBm
	-peak -2.052 kHz	Modulation Frequency	4.80122 kHz
	$\uparrow$ peak/2 1.945 kHz	Sampling Rate	125 kHz
	RMS 1.305 kHz	Record Length	376
		Demod Bandwidth	100 kHz

156modH2: 156.025 MHz / 12.5W

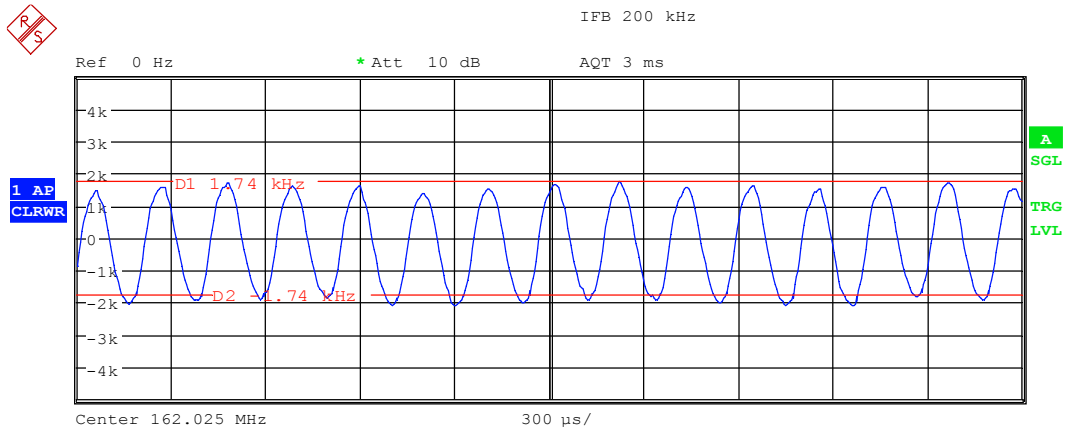
TEST REPORT REFERENCE: F110939E1 2nd version



Frequency Modulation Summary

Coupling	DC	Carrier Offset	-229.98 Hz	
Deviation	+peak	7.123 kHz	Carrier Power	32.41 dBm
	-peak	-2.625 kHz	Modulation Frequency	-- Hz
	↑peak/2	4.874 kHz	Sampling Rate	125 kHz
	RMS	1.741 kHz	Record Length	376
		Demod Bandwidth	100 kHz	

162modL1: 162.025 MHz / 2W

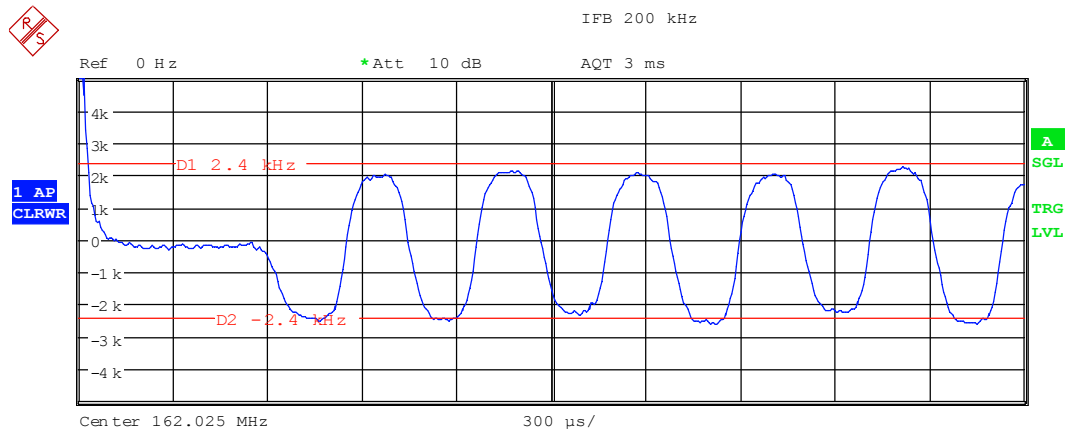


Frequency Modulation Summary

Coupling	DC	Carrier Offset	-192.12 Hz	
Deviation	+peak	1.718 kHz	Carrier Power	32.40 dBm
	-peak	-2.113 kHz	Modulation Frequency	4.80447 kHz
	↑peak/2	1.916 kHz	Sampling Rate	125 kHz
	RMS	1.302 kHz	Record Length	376
		Demod Bandwidth	100 kHz	

162modL2: 162.025 MHz / 2W

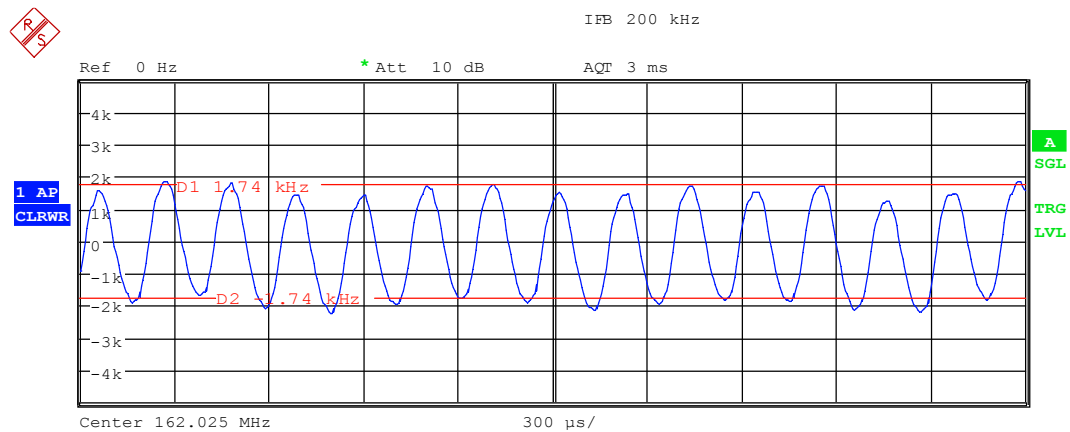
TEST REPORT REFERENCE: F110939E1 2nd version



Frequency Modulation Summary

Coupling	DC	Carrier Offset	-214.05 Hz
Deviation	+peak 6.829 kHz	Carrier Power	37.23 dBm
	-peak -2.618 kHz	Modulation Frequency	---
	$\uparrow$ peak/2 4.723 kHz	Sampling Rate	125 kHz
	RMS 1.754 kHz	Record Length	376
		Demod Bandwidth	100 kHz

162modM1: 162.025 MHz / 5W

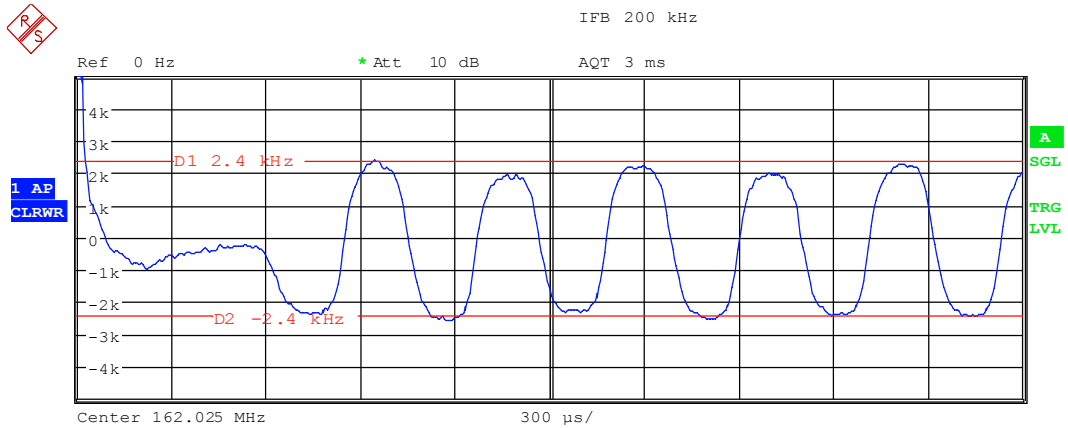


Frequency Modulation Summary

Coupling	DC	Carrier Offset	-178.04 Hz
Deviation	+peak 1.839 kHz	Carrier Power	37.07 dBm
	-peak -2.240 kHz	Modulation Frequency	4.80980 kHz
	$\uparrow$ peak/2 2.040 kHz	Sampling Rate	125 kHz
	RMS 1.309 kHz	Record Length	376
		Demod Bandwidth	100 kHz

162modM2: 162.025 MHz / 5W

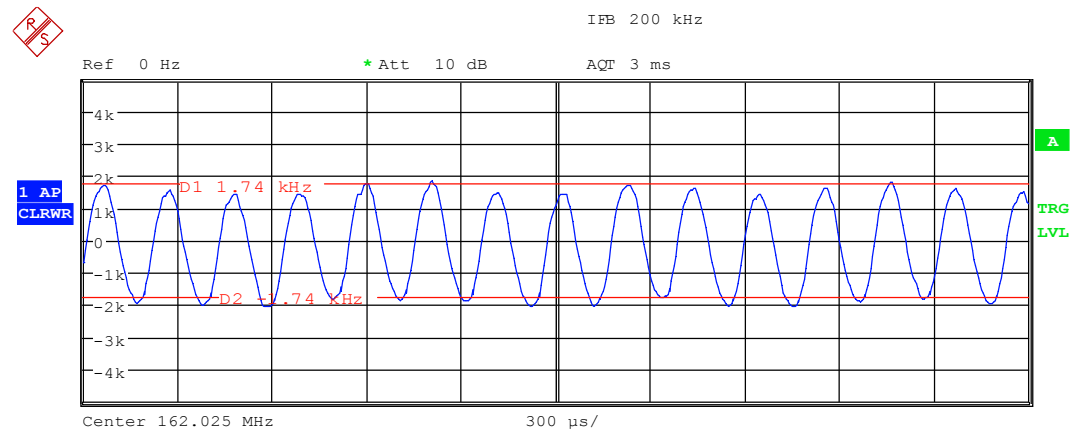
TEST REPORT REFERENCE: F110939E1 2nd version



Frequency Modulation Summary

Coupling	DC	Carrier Offset	-217.73 Hz
Deviation	+peak 8.280 kHz	Carrier Power	40.55 dBm
	-peak -2.603 kHz	Modulation Frequency	---
	$\uparrow$ peak/2 5.442 kHz	Sampling Rate	125 kHz
	RMS 1.796 kHz	Record Length	376
		Demod Bandwidth	100 kHz

162modH1: 162.025 MHz / 12.5W



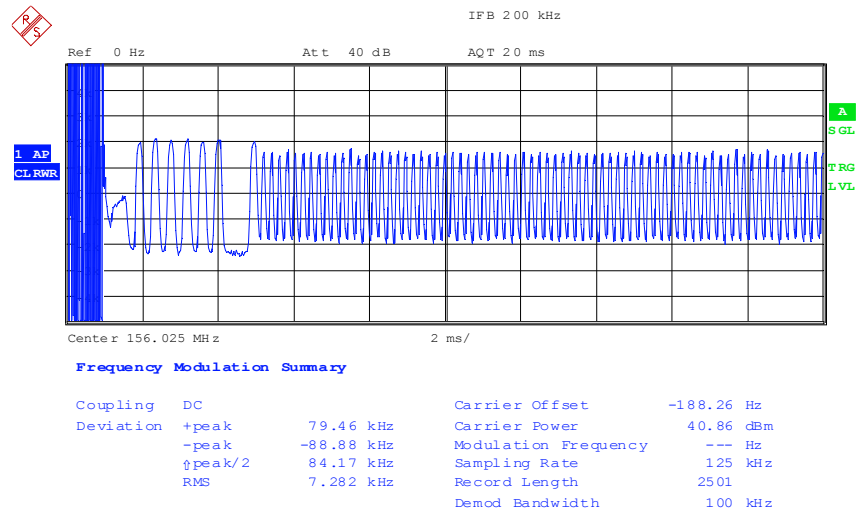
Frequency Modulation Summary

Coupling	DC	Carrier Offset	-171.22 Hz
Deviation	+peak 1.810 kHz	Carrier Power	40.53 dBm
	-peak -2.081 kHz	Modulation Frequency	4.79177 kHz
	$\uparrow$ peak/2 1.946 kHz	Sampling Rate	125 kHz
	RMS 1.299 kHz	Record Length	376
		Demod Bandwidth	100 kHz

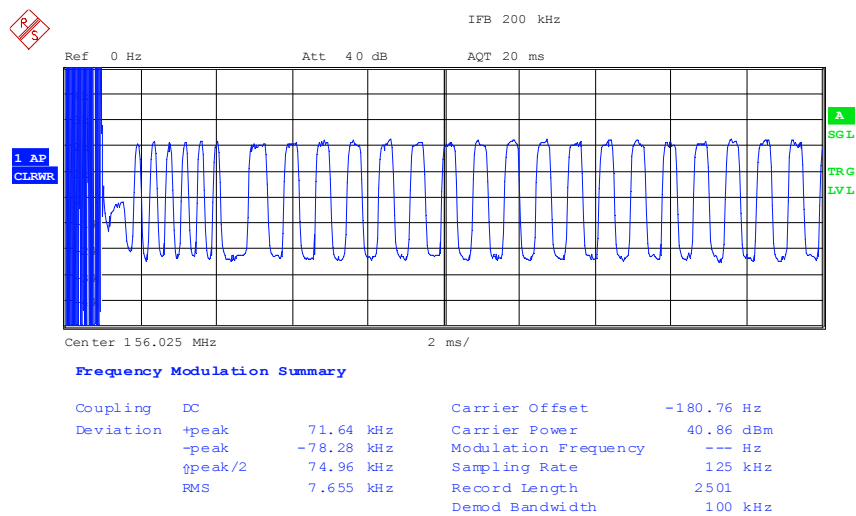
162modH2: 162.025 MHz / 12.5W

TEST REPORT REFERENCE: F110939E1 2nd version

Transmitter Trainings-Sequence:

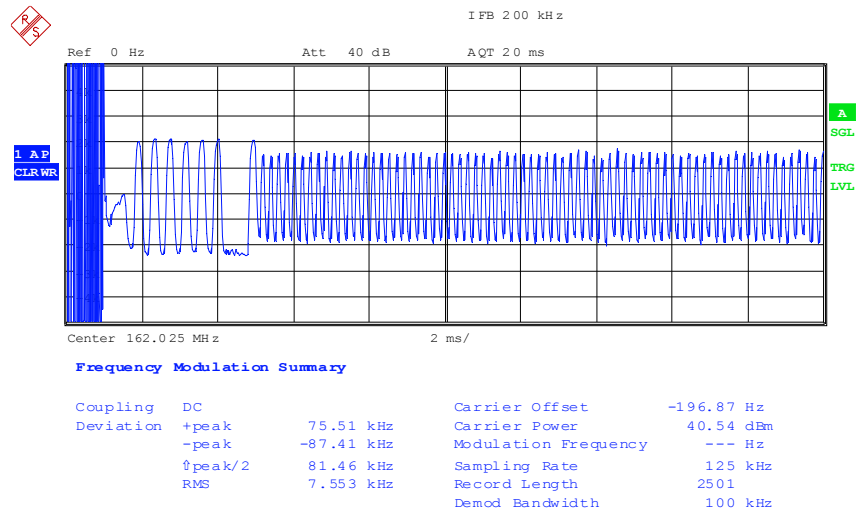


156tx1.wmf: 156.025 MHz, modulated with Test-Signal 1

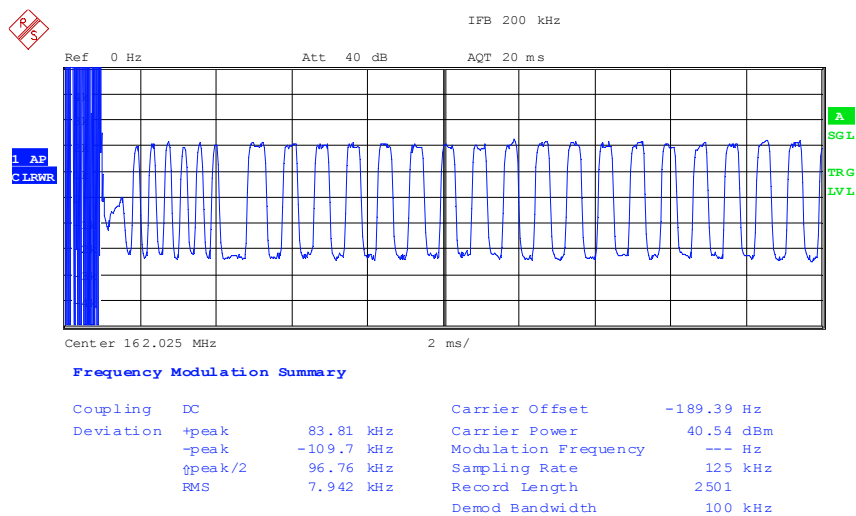


156tx2.wmf: 156.025 MHz, modulated with Test-Signal 2

TEST REPORT REFERENCE: F110939E1 2nd version



162tx1.wmf: 162.025 MHz, modulated with Test-Signal 1



162tx2.wmf: 162.025 MHz, modulated with Test-Signal 2

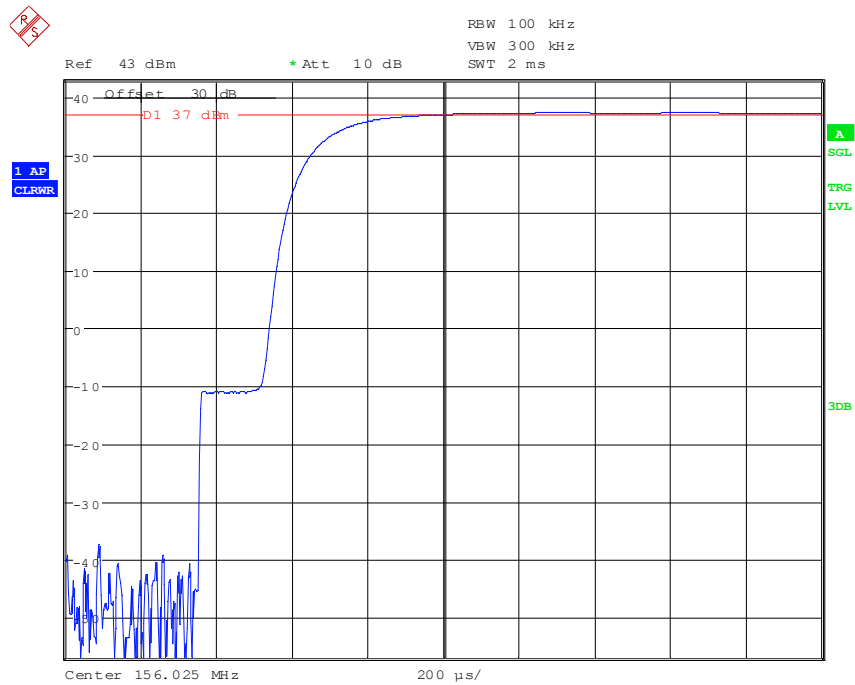
LIMITS: SUBCLAUSE 7.1.1.5.3

See table 18.

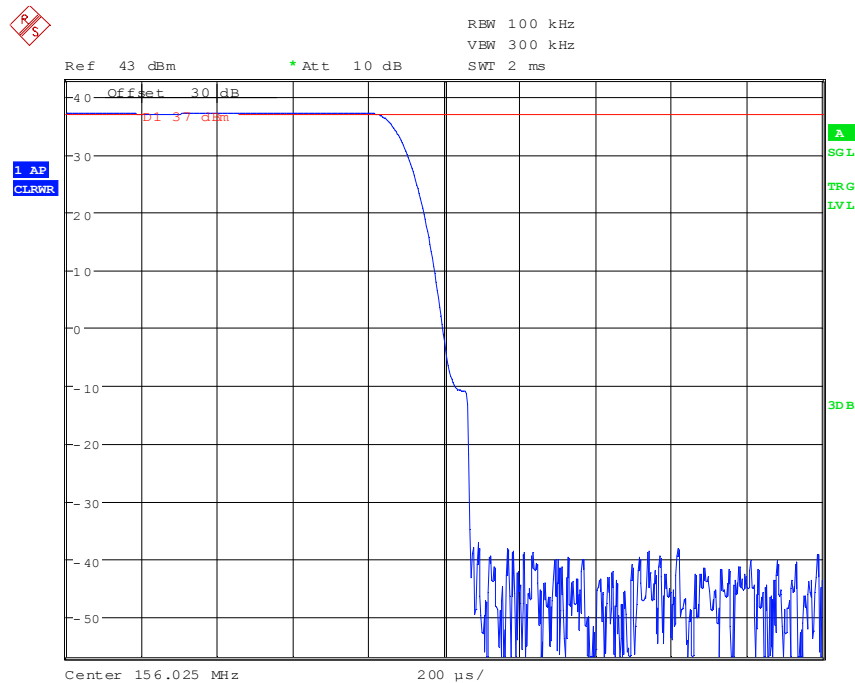
TEST EQUIPMENT USED:

06, 42, 79-81, 100-102

TEST REPORT REFERENCE: F110939E1 2nd version

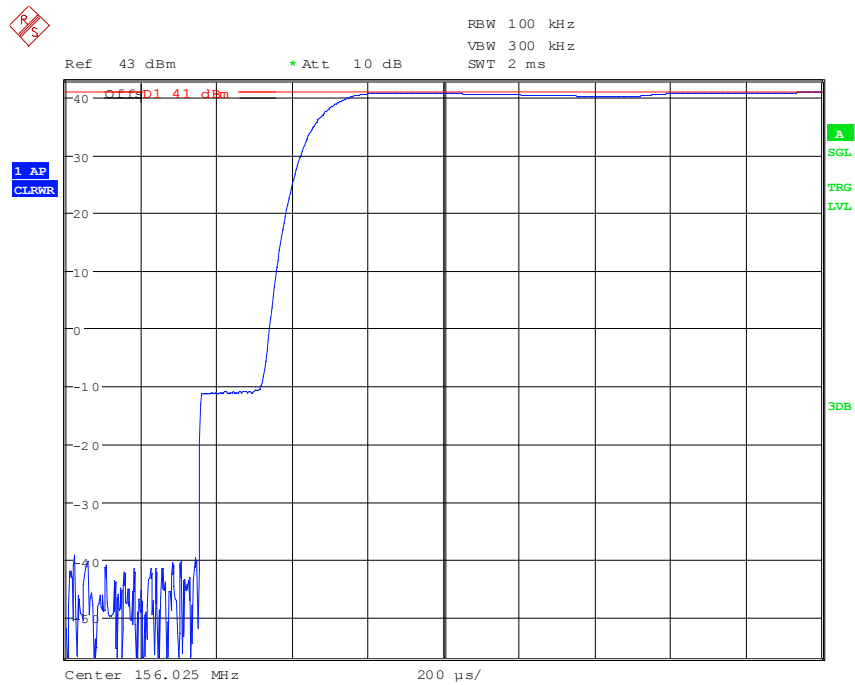


onM1: 156.025 MHz / 5W, Power-Ramp-up

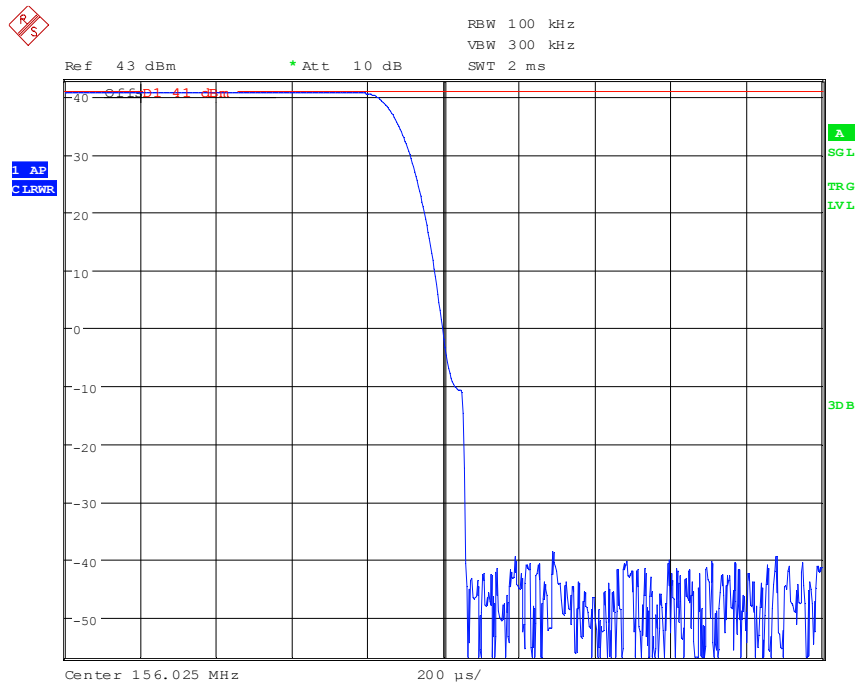


offM1: 156.025 MHz / 5W, Power-Ramp-down

TEST REPORT REFERENCE: F110939E1 2nd version



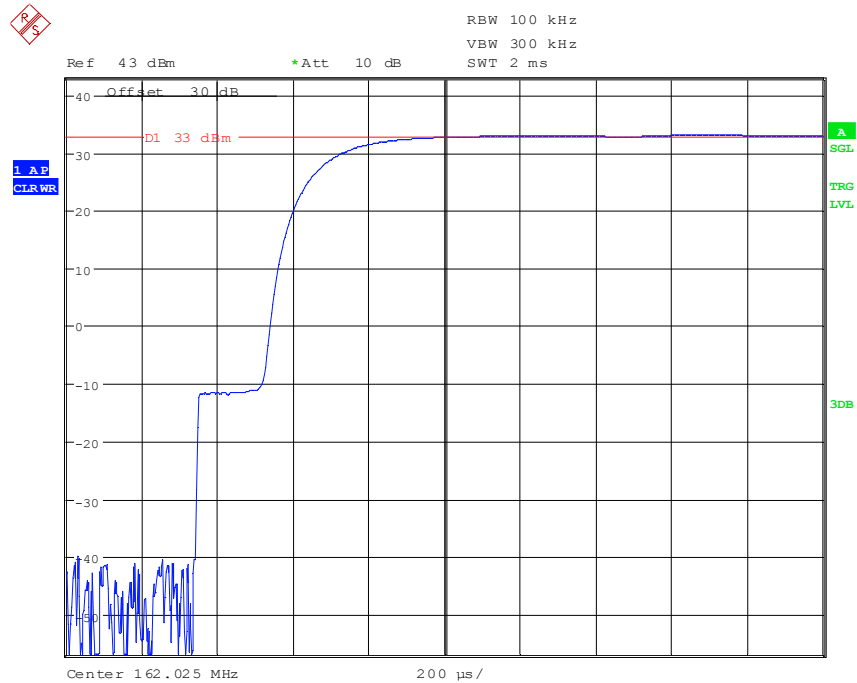
onH1: 156.025 MHz / 12.5W, Power-Ramp-up



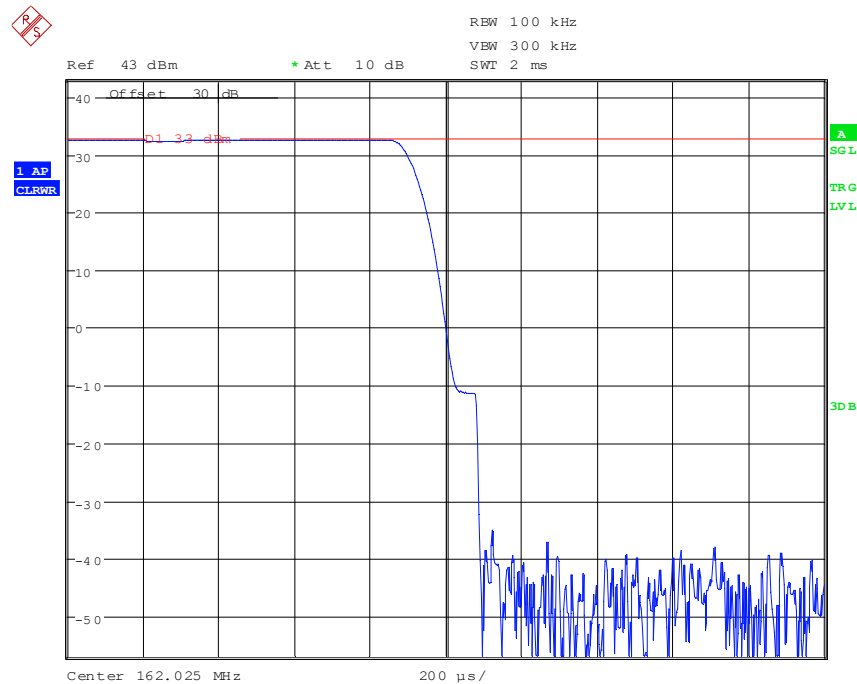
offH1: 156.025 MHz / 12.5W, Power-Ramp-down

TEST REPORT REFERENCE: F110939E1 2nd version

Operation mode: Transmit, $f = 162.025$ MHz

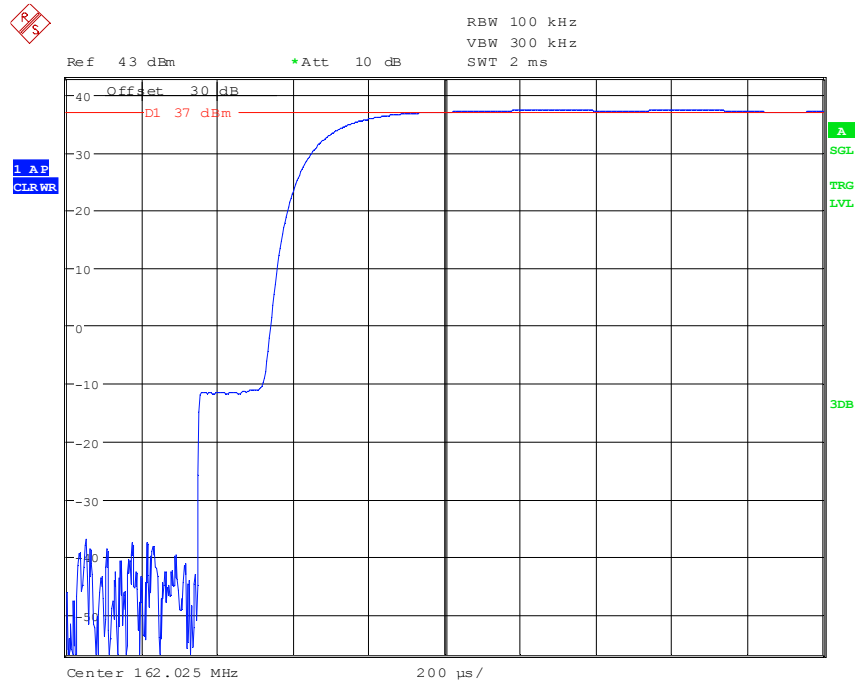


onL1: 162.025 MHz / 2W, Power-Ramp-up

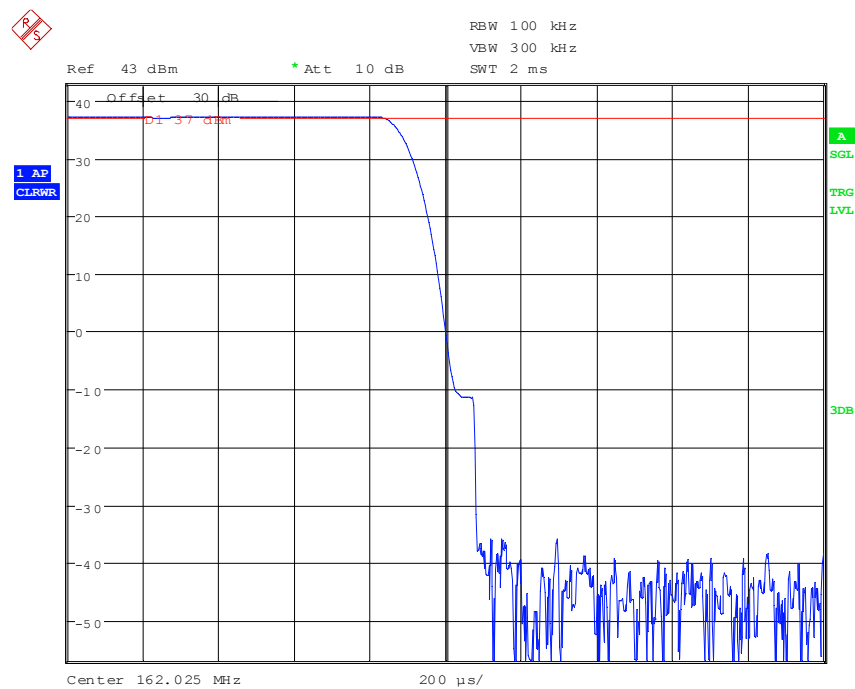


offL1: 162.025 MHz / 2W, Power-Ramp-down

TEST REPORT REFERENCE: F110939E1 2nd version

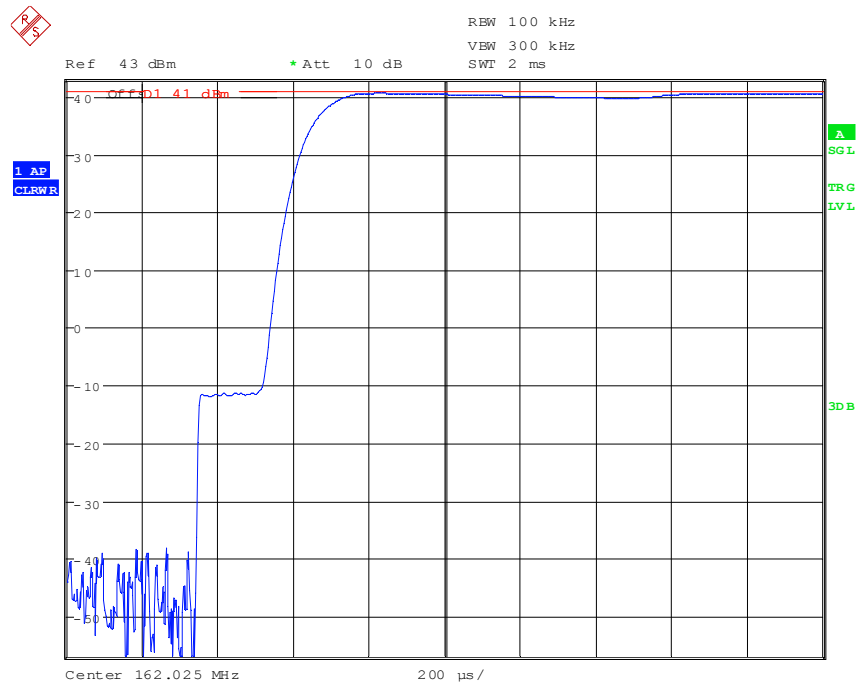


onM1: 162.025 MHz / 5W, Power-Ramp-up

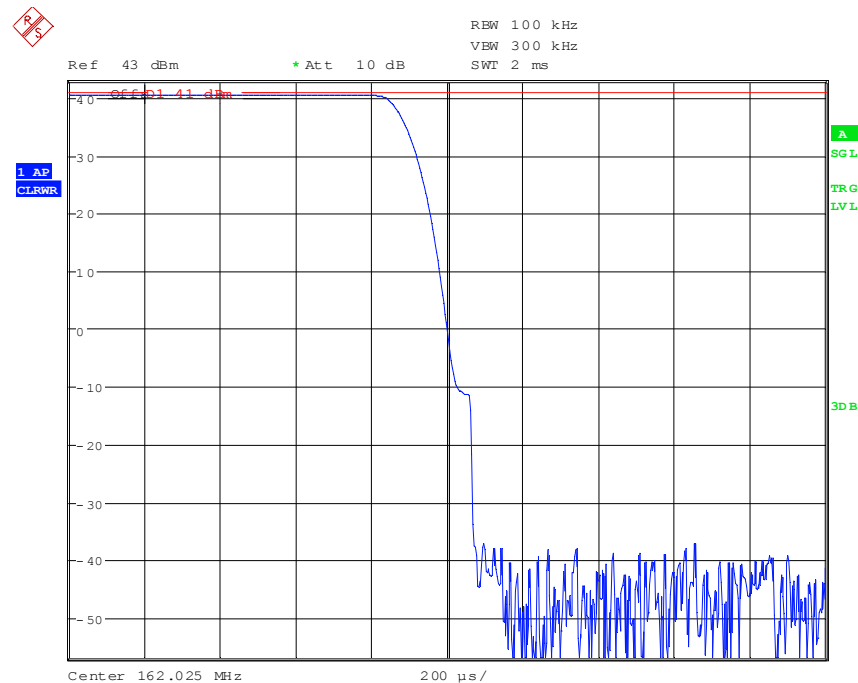


offM1: 162.025 MHz / 5W, Power-Ramp-down

TEST REPORT REFERENCE: F110939E1 2nd version



onH1: 162.025 MHz / 12.5W, Power-Ramp-up



offH1: 162.025 MHz / 12.5W, Power-Ramp-down

TEST REPORT REFERENCE: F110939E1 2nd version

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 7.1.1.4.3

See table 17.

TEST EQUIPMENT USED:

06, 42, 79-81, 100-102

TEST REPORT REFERENCE: F110939E1 2nd version

7 RECEIVER REQUIREMENTS

7.1 TDMA-RECEIVER SENSITIVITY

SUBCLAUSE 7.1.2.1

Ambient temperature	20 °C	Relative humidity	45 %
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Operation mode: Receive in AIS-mode, f = 156.025 MHz

Wanted signal: Test signal 4 (-107 dBm / -101 dBm under extreme conditions)

MEASUREMENT CONDITIONS		RECEIVER SENSITIVITY at PER < 20%	
TEMPERATURE	VOLTAGE	Frequency:	Test signal 4
T _{nom} (+20°C)	U _{nom} (12.0 V DC)	156.024500 MHz	1.8%
		156.025000 MHz	1.2% @ -107dBm
			1.7% @ -112dBm
		156.025500 MHz	2.0%
T _{min} (-20°C)	U _{min} (9.6 V DC)	156.024500 MHz	1.0%*
		156.025000 MHz	1.0%*
		156.025500 MHz	1.5%*
	U _{max} (15.6 V DC)	156.024500 MHz	0.6%*
		156.025000 MHz	0.7%*
		156.025500 MHz	0.6%*
T _{min} (+55°C)	U _{min} (9.6 V DC)	156.024500 MHz	11.0%*
		156.025000 MHz	11.0%*
		156.025500 MHz	11.0%*
	U _{max} (15.6 V DC)	156.024500 MHz	8.9%*
		156.025000 MHz	8.9%*
		156.025500 MHz	8.9%*
Limit		< 20%	
Measurement uncertainty		+ 0.66 dB / - 0.72 dB	

*Remark: These Tests were also carried out with -107dBm-Signal-Level (wanted signal).

TEST REPORT REFERENCE: F110939E1 2nd version

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

Wanted signal: Test signal 4 (-107 dBm / -101 dBm under extreme conditions)

MEASUREMENT CONDITIONS		RECEIVER SENSITIVITY at PER < 20%	
TEMPERATURE	VOLTAGE	Frequency:	Test signal 4
T _{nom} (+20°C)	U _{nom} (12.0 V DC)	162.024500 MHz	1.8%
		162.025000 MHz	2.0% @ -107dBm
			9.6% @ -112dBm
		162.025500 MHz	1.8%
T _{min} (-20°C)	U _{min} (9.6 V DC)	162.024500 MHz	1.1%*
		162.025000 MHz	1.1%*
		162.025500 MHz	1.1%*
	U _{max} (15.6 V DC)	162.024500 MHz	1.7%*
		162.025000 MHz	1.7%*
		162.025500 MHz	1.7%*
T _{min} (+55°C)	U _{min} (9.6 V DC)	162.024500 MHz	13.3%*
		162.025000 MHz	13.3%*
		162.025500 MHz	13.3%*
	U _{max} (15.6 V DC)	162.024500 MHz	10.6%*
		162.025000 MHz	10.6%*
		162.025500 MHz	10.6%*
Limit		< 20%	
Measurement uncertainty		+ 0.66 dB / - 0.72 dB	

*Remark: These Tests were also carried out with -107dBm-Signal-Level (wanted signal).

LIMITS: SUBCLAUSE 7.1.2.1.3

The maximum PER shall be not more than 20%.

TEST EQUIPMENT USED:

29, 42, 51, 81, 100

TEST REPORT REFERENCE: F110939E1 2nd version

7.2 ERROR BEHAVIOUR AT HIGH INPUT LEVELS

SUBCLAUSE 7.1.2.2

Ambient temperature	20 °C	Relative humidity	45 %
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Operation mode: Receive in AIS-mode, f = 156.025 MHz
Wanted signal: Test signal 4

RF-INPUT SIGNAL LEVEL	NUMBER OF MESSAGES NOT SUCCESSFULLY RECORDED
- 77 dBm	1.0%
- 7 dBm	3.2%

Operation mode: Receive in AIS-mode, f = 162.025 MHz
Wanted signal: Test signal 4

RF-INPUT SIGNAL LEVEL	NUMBER OF MESSAGES NOT SUCCESSFULLY RECORDED
- 77 dBm	1.0%
- 7 dBm	2.8%

LIMITS: SUBCLAUSE 7.1.2.2.3

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

TEST EQUIPMENT USED:

29, 42, 51, 81, 100

TEST REPORT REFERENCE: F110939E1 2nd version

7.3 CO-CHANNEL REJECTION

SUBCLAUSE 7.1.2.3

Ambient temperature	20 °C	Relative humidity	45 %
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Operation mode: Receive in AIS-mode, f = 156.025 MHz
 Wanted signal: Test-signal 4, P = -101 dBm
 Unwanted signal: Modulated with 400 Hz / 3 kHz deviation

Unwanted signal frequency:	Unwanted signal level:	Signal ratio:	Packet error rate:
156.024 MHz	-111 dBm	10 dB	5%
156.025 MHz	-111 dBm	10 dB	3%
156.026 MHz	-111 dBm	10 dB	7%
Measurement uncertainty		+ 0.66 dB / - 0.72 dB	

Operation mode: Receive in AIS-mode, f = 162.025 MHz
 Wanted signal: Test-signal 4, P = -101 dBm
 Unwanted signal: Modulated

Unwanted signal frequency:	Unwanted signal level:	Signal ratio:	Packet error rate:
162.024 MHz	-111 dBm	10 dB	6%
162.025 MHz	-111 dBm	10 dB	5%
162.026 MHz	-111 dBm	10 dB	3%
Measurement uncertainty		+ 0.66 dB / - 0.72 dB	

LIMITS: SUBCLAUSE 7.1.2.3.3

The maximum PER shall not exceed 20%.

TEST EQUIPMENT USED:

27, 29, 33, 42, 81, 100-102

TEST REPORT REFERENCE: F110939E1 2nd version

7.4 ADJACENT CHANNEL SELECTIVITY

SUBCLAUSE 7.1.2.4

Ambient temperature	20 °C	Relative humidity	45 %
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Operation mode: Receive in AIS mode
 Wanted signal: Test-signal 4; P = -101 dBm
 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} (12.0 V DC)	156.025 MHz	156.000 MHz	70 dB	7%
			156.050 MHz	70 dB	4%
		162.025 MHz	162.000 MHz	70 dB	1%
			162.050 MHz	70 dB	3%
T _{min} (-20°C)	U _{min} (9.6 V DC)	156.025 MHz	156.000 MHz	70 dB	9.8%
			156.050 MHz	70 dB	11.5%
	U _{max} (15.6 V DC)		156.000 MHz	70 dB	8.9%
			156.050 MHz	70 dB	13.3%
	U _{min} (9.6 V DC)	162.025 MHz	162.000 MHz	70 dB	9.3%
			162.050 MHz	70 dB	10.6%
	U _{max} (15.6 V DC)		162.000 MHz	70 dB	11.0%
			162.050 MHz	70 dB	10.2%
T _{max} (+55°C)	U _{min} (9.6 V DC)	156.025 MHz	156.000 MHz	70 dB	15.5%
			156.050 MHz	70 dB	14.4%
	U _{max} (15.6 V DC)		156.000 MHz	70 dB	12.6%
			156.050 MHz	70 dB	13.5%
	U _{min} (9.6 V DC)	162.025 MHz	162.000 MHz	70 dB	12.0%
			162.050 MHz	70 dB	12.8%
	U _{max} (15.6 V DC)		162.000 MHz	70 dB	13.1%
			162.050 MHz	70 dB	12.0%
Measurement uncertainty				+ 0.66 dB / - 0.72 dB	

LIMITS: SUBCLAUSE 7.1.2.4.3

The maximum PER shall not exceed 20%.

TEST EQUIPMENT USED:

27, 29, 33, 42, 51, 81, 100-102

TEST REPORT REFERENCE: F110939E1 2nd version

7.5 SPURIOUS RESPONSE REJECTION

SUBCLAUSE 7.1.2.5

Ambient temperature	20 °C	Relative humidity	45 %
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Operation mode: Receive in AIS-mode, $f = 162.025$ MHz (1st-IF RX1: 21.4 MHz)
 Wanted signal: Test-signal 4, $P = -101$ dBm
 Unwanted signal: Modulated with 400 Hz / 3 kHz deviation / -31dBm

DEFINITION	UNWANTED FREQUENCY	MEASURED PACKET ERROR RATE
IF		
1 st - IF	21.4 MHz	1.7%
1 st LO-Freq. - IF	119.225 MHz	0.7%
2 x 1 st LO-Freq. – IF	259.850 MHz	0.9%
2 x 1 st LO-Freq. + IF	302.650 MHz	1.1%
3 x 1 st LO-Freq. – IF	400.475 MHz	1.1%
3 x 1 st LO-Freq. + IF	443.275 MHz	0.2%
4 x 1 st LO-Freq. – IF	541.100 MHz	1.1%
4 x 1 st LO-Freq. + IF	583.900 MHz	0.9%
-	No other spurious response rejection frequencies found	-
-		-
-		-
Measurement uncertainty		+ 0.66 dB / - 0.72 dB

Continued next page:

TEST REPORT REFERENCE: F110939E1 2nd version

Continued:

Operation mode: Receive in AIS-mode, f = 156.025 MHz (1st-IF RX2: 38.855 MHz)
 Wanted signal: Test-signal 4, P = -101 dBm
 Unwanted signal: Modulated with 400 Hz / 3 kHz deviation / -31dBm

DEFINITION	UNWANTED FREQUENCY	MEASSURED PACKET EROR RATE
IF		
1 st - IF	38.855 MHz	3.0%
1 st LO-Freq. - IF	78.315 MHz	2.0%
2 x 1 st LO-Freq. – IF	195.485 MHz	1.5%
2 x 1 st LO-Freq. + IF	273.195 MHz	2.6%
3 x 1 st LO-Freq. – IF	312.655 MHz	4.6%
3 x 1 st LO-Freq. + IF	390.365 MHz	4.6%
4 x 1 st LO-Freq. – IF	429.825 MHz	3.3%
4 x 1 st LO-Freq. + IF	507.535 MHz	4.6%
-	No other spurious response rejection frequencies found	-
-		-
-		-
Measurement uncertainty		+ 0.66 dB / - 0.72 dB

LIMITS: SUBCLAUSE 7.1.2.5.8

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:

27, 29, 33, 42, 81, 100-102

TEST REPORT REFERENCE: F110939E1 2nd version

7.6 INTERMODULATION RESPONSE REJECTION

SUBCLAUSE 7.1.2.6

Ambient temperature	20 °C	Relative humidity	45 %
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Wanted signal A: Test-signal 3, P = -101 dBm
 Unwanted signal B: Unmodulated
 Unwanted signal C: Modulated with 400 Hz / 3 kHz-deviation

FREQUENCIES OF THE UNWANTED SIGNALS			PACKET ERROR RATE
Generator A	Generator B	Generator C	
162.025 MHz	161.525 MHz	161.025 MHz	2.7%
Limit:			20%
Measurement uncertainty:			+ 0.66 dB / - 0.72 dB

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

FREQUENCIES OF THE UNWANTED SIGNALS			PACKET ERROR RATE
Generator A	Generator B	Generator C	
156.025 MHz	156.525 MHz	157.025 MHz	4.4%
Limit:			20%
Measurement uncertainty:			+ 0.66 dB / - 0.72 dB

LIMITS: SUBCLAUSE 7.1.2.6.3

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

TEST EQUIPMENT USED:

25, 27, 29, 33, 34, 42, 81, 100-102, 119-121
--

TEST REPORT REFERENCE: F110939E1 2nd version

7.7 BLOCKING OR DESENSITISATION

SUBCLAUSE 7.1.2.7

Ambient temperature	20 °C	Relative humidity	45 %
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Operation mode: Receive in AIS-mode: f = 156.025 MHz
 Wanted signal A: Test-signal 3, P = -101 dBm
 Unwanted signal B: Unmodulated, P = -15 dBm / -23 dBm

FREQUENCIES OF THE UNWANTED SIGNALS		PACKET ERROR RATE PER
-10 MHz	146.025 MHz	0.6%
-5 MHz	151.025 MHz	1.3%
-2 MHz	154.025 MHz*	2.6%
-1 MHz	155.025 MHz*	1.3%
-500 kHz	155.525 MHz*	1.3%
+500 kHz	156.525 MHz*	4.0%
+1 MHz	157.025 MHz*	3.3%
+2 MHz	158.025 MHz*	5.3%
+5 MHz	161.025 MHz	2.6%
+10 MHz	166.025 MHz	0.6%
Limit:		20%
Measurement uncertainty		+ 0.66 dB / - 0.72 dB

*Remark: These Tests were done with -15 dBm unwanted signal level too.

TEST REPORT REFERENCE: F110939E1 2nd version

Operation mode: Receive in AIS-mode: f = 162.025 MHz
 Wanted signal A: Test-signal 3, P = -101 dBm
 Unwanted signal B: Unmodulated, P = -15 dBm / -23 dBm

FREQUENCIES OF THE UNWANTED SIGNALS		PACKET ERROR RATE PER
-10 MHz	152.025 MHz	0.7%
-5 MHz	157.025 MHz	2.0%
-2 MHz	160.025 MHz*	6.2%
-1 MHz	161.025 MHz*	5.8%
-500 kHz	161.525 MHz*	6.7%
+500 kHz	162.525 MHz*	6.2%
+1 MHz	163.025 MHz*	5.3%
+2 MHz	164.025 MHz*	4.0%
+5 MHz	167.025 MHz	2.0%
+10 MHz	172.025 MHz	0.0%
Limit:		20%
Measurement uncertainty		+ 0.66 dB / - 0.72 dB

*Remark: These tests were done with -15 dBm unwanted signal level too.

LIMITS: SUBCLAUSE 7.1.2.7.3

The PER shall not exceed 20%.

TEST EQUIPMENT USED:

27, 29, 33, 42, 81, 100-102

TEST REPORT REFERENCE: F110939E1 2nd version

7.8 SPURIOUS EMISSIONS FROM THE RECEIVER

SUBCLAUSE 7.1.3.1

Ambient temperature	20 °C	Relative humidity	45 %
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Operation mode: Receive-mode, AIS 1 = 156.025 MHz / AIS 2 = 162.025 MHz

SPURIOUS EMISSIONS LEVEL							
f (MHz)	Polarisation	Level (dBm)	Bandwidth*	f (MHz)	Polarisation	Level (dBm)	Bandwidth*
No significant spurious emissions caused by the receiver found.							
Measurement uncertainty			+2.2 dB / -3.6 dB				

* the measuring receiver bandwidth

LIMITS: SUBCLAUSE 7.1.3.1.3

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, 81, 111

TEST REPORT REFERENCE: F110939E1 2nd version

7.9 SPURIOUS EMISSIONS FROM THE TRANSMITTER

SUBCLAUSE 7.1.3.2

Ambient temperature	20 °C	Relative humidity	45 %
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Operation mode: Transmit, f = 156.025 MHz / 12.5W

SPURIOUS EMISSIONS LEVEL (CONDUCTED)					
f	Level	Bandwidth	Limit	Margin	Result
312.050 MHz	-38.3 dBm	100 kHz	-36 dBm	2.3 dB	passed
468.075 MHz	-48.2 dBm	100 kHz	-36 dBm	12.2 dB	passed
-	-	-	-	-	-
Measurement uncertainty		+ 0.66 dB / - 0.72 dB			

Operation mode: Transmit, f = 156.025 MHz / 5W

SPURIOUS EMISSIONS LEVEL (CONDUCTED)					
f	Level	Bandwidth	Limit	Margin	Result
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-
Measurement uncertainty		+ 0.66 dB / - 0.72 dB			

Operation mode: Transmit, f = 156.025 MHz / 2W

SPURIOUS EMISSIONS LEVEL (CONDUCTED)					
f	Level	Bandwidth	Limit	Margin	Result
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-
Measurement uncertainty		+ 0.66 dB / - 0.72 dB			

TEST REPORT REFERENCE: F110939E1 2nd version

Operation mode: Transmit, f = 162.025 MHz / 12.5W

SPURIOUS EMISSIONS LEVEL (CONDUCTED)					
f	Level	Bandwidth	Limit	Margin	Result
324.050 MHz	-41.5 dBm	100 kHz	-36 dBm	5.5 dB	passed
486.075 MHz	-40.5 dBm	100 kHz	-36 dBm	4.5 dB	passed
-	-	-	-	-	-
Measurement uncertainty		+ 0.66 dB / - 0.72 dB			

Operation mode: Transmit, f = 162.025 MHz / 5W

SPURIOUS EMISSIONS LEVEL (CONDUCTED)					
f	Level	Bandwidth	Limit	Margin	Result
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-
Measurement uncertainty		+ 0.66 dB / - 0.72 dB			

Operation mode: Transmit, f = 162.025 MHz / 2W

SPURIOUS EMISSIONS LEVEL (CONDUCTED)					
f	Level	Bandwidth	Limit	Margin	Result
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-
Measurement uncertainty		+ 0.66 dB / - 0.72 dB			

LIMITS: SUBCLAUSE 7.1.3.2.3

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:

07, 42, 79-81, 111, 112

TEST REPORT REFERENCE: F110939E1 2nd version

8 TEST EQUIPMENT

TEST REPORT REFERENCE: F110939E1 2nd version

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
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 $\varnothing = 110$ 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
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

TEST REPORT REFERENCE: F110939E1 2nd version

No.	Test equipment	Type	Manufacturer	Serial No.	PM-No
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 8872	Toellner	61005	480833
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-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
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

TEST REPORT REFERENCE: F110939E1 2nd version

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

TEST REPORT REFERENCE: F110939E1 2nd version

No.	Test equipment	Type	Manufacturer	Serial No.	PM-No
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
119	Zirkulator	156-162MHz	DFE	-	410162
120	Zirkulator	156-162MHz	DFE	-	410163
121	Zirkulator	156-162MHz	DFE	-	410164
122	Zirkulator	156-162MHz	DFE	-	410165

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