

Radio Test report

99320430

based on:
EN 61993-2

Maritime AIS Transceiver
MDS
AIMS MIV

Contents

MAIN MODULE	3
1 Introduction	3
2 Product	4
3 Test schedule	4
4 Product documentation	5
5 Observations and comments	5
6 Summary	5
7 Conclusions	6
TEST RESULTS MODULE	7
1 Summary	8
2 Test results	9
2.1 4.1.4 Transmitter shutdown	9
2.2 4.4 Marking & identification	9
2.3 14.8 Transceiver protection	9
2.4 15.1 TDMA Transmitter	10
2.4.1 15.1.1 Frequency Error	10
2.4.2 15.1.2 Carrier Power	11
2.4.3 15.1.3 Modulation Spectrum 25 kHz channel mode	12
2.4.4 15.1.4 Modulation Spectrum 12.5 kHz channel mode	15
2.4.5 15.1.5 Transmitter Attack Time	17
2.4.6 15.1.6 Transmitter Release Time	19
2.5 15.2 DSC Transmissions	20
2.5.1 15.2.1 Frequency error of the DSC Signal	20
2.5.2 15.2.2 Modulation Rate	21
2.6 15.3 TDMA Receivers	22
2.6.1 15.3.1 Sensitivity - 25 kHz Operation	22
2.6.2 15.3.2 Sensitivity - 12.5 kHz Operation	23
2.6.3 15.3.3 Error Behaviour at High Input Levels	24
2.6.4 15.3.4 Co-channel Rejection - 25 kHz Operation	25
2.6.5 15.3.5 Co-channel Rejection - 12.5 kHz Operation	26
2.6.6 15.3.6 Adjacent Channel selectivity - 25 kHz Operation	27
2.6.7 15.3.7 Adjacent Channel selectivity - 12.5 kHz Operation	28
2.6.8 15.3.8 Spurious Response Rejection	29
2.6.9 15.3.9 Intermodulation response rejection and blocking	30
2.6.10 15.3.10 Transmit to receive switching time	31
2.7 15.4 DSC Receiver	32
2.7.1 15.4.1 Maximum sensitivity	32
2.7.2 15.4.2 Error Behaviour at High Input Levels	33
2.7.3 15.4.3 Co-Channel Rejection	34
2.7.4 15.4.4 Adjacent Channel selectivity	35
2.7.5 15.4.5 Spurious Response Rejection	36
2.7.6 15.4.6 Intermodulation response Rejection	37
2.7.7 15.4.7 Blocking or Desensitisation	38
2.8 15.5 Conducted Spurious Emissions conveyed to the antenna	39
2.8.1 15.5.1 Spurious Emissions from the Receiver	39
2.8.2 15.5.2 Spurious Emissions from the Transmitter	40
USED TEST EQUIPMENT MODULE	42
PHOTOGRAPHS MODULE	44
ADDITIONAL INFORMATION MODULE	52

This report comprises of five modules. The total number of pages is: 52

Main module

1 Introduction

This report contains the result of tests performed by:

Telefication bv
Edisonstraat 12a
6902 PK Zevenaar
The Netherlands

Telefication bv complies with the accreditation criteria for laboratories as described in the STERLAB Criteria which contains all of the criteria from EN 45001 and ISO/IEC guide 25 and the relevant criteria from ISO 9001. The accreditation covers the quality system of the laboratory as well as the specified activities described in the accreditation certificate bearing the accreditation number L021 and is granted on 30 November 1990 by the Dutch Council For Accreditation (RvA: Raad voor Accreditatie). An extended procedure for performing tests outside their permanent premises has been accepted by the board of STERLAB for accreditation. Telefication bv is thereby allowed to conduct tests on any suitable site by regular telefication bv staff, using suitable equipment that is property of Telefication bv or of a second party.

Ordering party:

Company name	:	Marine Data Systems
Address	:	580 Kyalami Boulevard, Kyalami Business Park
Zipcode	:	--
City/town	:	Kyalami, Midrand
Country	:	South Africa
Date of order	:	12 April 2002

2 Product

A sample of the following product was submitted for testing:

Product category	:	Universal Automatic Identification System
Manufacturer	:	Marine Data Systems
Trade mark	:	MDS
Type designation	:	AIMS MIV
Hardware version	:	Ver 0
Software version	:	Ver 1.18
Serial number	:	020002642

3 Test schedule

Tests were carried out in accordance with the specification detailed in chapter 6 "Summary" of this report.

Tests were carried out at the following location:

- Marine Data Systems, Kayalami, South Africa

Tests were carried out between:

- 15 May 2002 and 6 June 2002
-

4 Product documentation

For production of this report the following product documentation was used:

Description	Identification	Date
Physical qualification acceptance test report AIMS mobile data transceiver (AMDT) Rev. 01	1101-0010AA-01-PQATR-01	April 2002
Technical documentation AIMS MIV Rev 07	1101-0010-AA-01-TM	May 2002

The above mentioned documentation will be filed at Telefication bv for a period of 10 years following the issue of this report.

5 Observations and comments

For Packet Error Rate tests the wanted signal modulation used was as described in clause 15.3.1., i.e. two packets alternating with 10101010 and 11001100 bits in the data field.

6 Summary

The product is intended for use in the following application area:

Universal Automatic Identification System

The sample was tested according to the following specifications:

IEC 61993-2: (2001-12),	Clause 4.1.4	Transmitter Shutdown
	Clause 4.4	Marking & Identification
	Clause 14.8	Transmitter Protection
	Clause 15	Physical Tests.

7 Conclusions

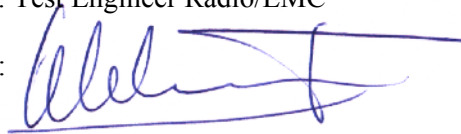
The results of the tests as stated in this report, are exclusively applicable to the product item as identified in this report. Telefication bv does not accept any responsibility for the results stated in this report, with respect to the properties of product items not involved in these tests.

All tests are performed by:

name : H.H. Lodewijk

function : Test Engineer Radio/EMC

signature :

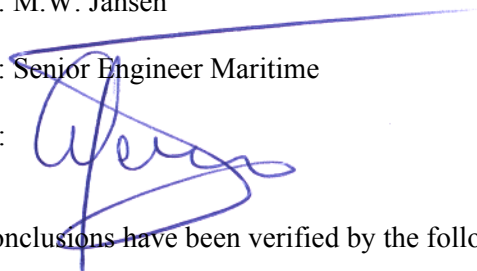


Review of test methods and report by:

name : M.W. Jansen

function : Senior Engineer Maritime

signature :



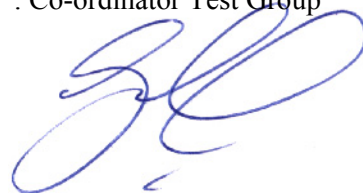
The above conclusions have been verified by the following signatory:

date : 12 July 2002

name : J.P. van de Poll

function : Co-ordinator Test Group

signature :



Test results module

1 Summary

LIST OF VERIFICATION

The list of measured or checked parameters called for in IEC 61993-2 Clause 15 is given below.

IEC 61993-2 Clause	GENERAL REQUIREMENTS	Performed verification (yes/no/n.a)
15 Physical Tests		
15.1 TDMA Transmitter		
15.1.1	Frequency Error	yes
15.1.2	Carrier Power	yes
15.1.3	Modulation Spectrum 25 kHz channel mode	yes
15.1.4	Modulation Spectrum 12.5 kHz channel mode	yes
15.1.5	Transmitter Attack Time	yes
15.1.6	Transmitter Release Time	yes
15.2 DSC Transmissions		
15.2.1	Frequency error of the DSC Signal	yes
15.2.2	Modulation Rate	yes
15.3 TDMA Receivers		
15.3.1	Sensitivity - 25 kHz Operation	yes
15.3.2	Sensitivity - 12.5 kHz Operation	yes
15.3.3	Error Behaviour at High Input Levels	yes
15.3.4	Co-Channel Rejection - 25 kHz Operation	yes
15.3.5	Co-Channel Rejection - 12.5 kHz Operation	yes
15.3.6	Adjacent Channel selectivity - 25 kHz Operation	yes
15.3.7	Adjacent Channel selectivity - 12.5 kHz Operation	yes
15.3.8	Spurious Response Rejection	yes
15.3.9	Intermodulation response rejection and blocking	yes
15.3.10	Transmit to receive switching time	yes
15.4 DSC Receiver		
15.4.1	Maximum sensitivity	yes
15.4.2	Error Behaviour at High Input Levels	yes
15.4.3	Co-Channel Rejection	yes
15.4.4	Adjacent Channel selectivity	yes
15.4.5	Spurious Response Rejection	yes
15.4.6	Intermodulation response Rejection	yes
15.4.7	Blocking or Desensitisation	yes
15.5 Conducted Spurious Emissions conveyed to the antenna		
15.5.1	Spurious Emissions from the Receiver	yes
15.5.2	Spurious Emissions from the Transmitter	yes

2 Test results

2.1 4.1.4 Transmitter shutdown

Transmitter shutdown	Result
Shutdown within 1 second of end transmission slot	Pass

Remark: Test was carried out by modifying digital circuitry for continuous transmission.

2.2 4.4 Marking & identification

Marking and identification	Result
Information power supply and battery replacement	Pass

Remark: Marking can be found on photographs.

2.3 14.8 Transceiver protection

Transceiver protection	Result
Open and short circuit VHF-antenna terminal 60 seconds	Pass

Remark: EUT operative within 2 minutes after refitting antenna.

2.4 15.1 TDMA Transmitter

2.4.1 15.1.1 Frequency Error

Date of test: 15 May 2002	Ambient temp.: 28.2 °C	R.H.: 33.4 %
Date of test: 20 May 2002	Ambient temp.: 25.4 °C	R.H.: 34.8 %
Date of test: 21 May 2002	Ambient temp.: 27.4 °C	R.H.: 36.2 %

TEST CONDITIONS		FREQUENCY ERROR (Hz)			
Temperature	Voltage	156.025 kHz	157.4125 kHz	160.6375 kHz	162.025 kHz
T_{nom} (+15 – 35 °C)	V_{nom} (24.0 V)	+ 130	+ 140	+150	+ 140
T_{min} (-15 °C)	V_{min} (21.6 V)	+ 502	+ 538	+ 527	+ 280
T_{max} (+55 °C)	V_{max} (31.2 V)	- 495	- 495	- 498	- 500
Measurement uncertainty		±15 Hz			
Limits		$\leq \pm 0.5$ kHz under normal conditions, $\leq \pm 1$ kHz under extreme conditions.			

2.4.2 15.1.2 Carrier Power

Date of test: 15 May 2002 Ambient temp.: 28.2 °C R.H.: 33.4 %
 Date of test: 20 May 2002 Ambient temp.: 25.4 °C R.H.: 34.8 %
 Date of test: 21 May 2002 Ambient temp.: 27.4 °C R.H.: 36.2 %

Rated output carrier power: H.P. : 12.5 W
 L.P. : 2.0 W

TEST CONDITIONS		CARRIER POWER (W)							
		156.025 kHz		157.4125 kHz		160.6375 kHz		162.025 kHz	
Temperature	Voltage	H.P.	L.P.	H.P.	L.P.	H.P.	L.P.	H.P.	L.P.
T_{nom} (+15 – 35 °C)	V_{nom} (24.0 V)	11.7	2.7	11.9	2.7	12.8	2.7	13.1	2.7
T_{min} (-15 °C)	V_{min} (21.6 V)	9.5	2.8	9.7	2.8	9.7	2.8	8.3	2.8
T_{max} (+55 °C)	V_{max} (31.2 V)	12.5	2.9	12.6	2.8	13.4	2.8	13.4	2.8
Measurement uncertainty		0.5 dB							
Limits		<u>Normal test conditions:</u> => H.P.: - between 8.8 and 17.7 W => L.P.: - between 1.4 and 2.8 W - within ± 1.5 dB of the rated carrier power <u>Extreme test conditions:</u> => H.P.: - between 6.3 and 19.8 W => L.P.: - between 1.0 and 3.2 W - within +2.0 & -3.0 dB of the rated carrier power							

H.P. = Output carrier power set at its nominal High: 12.5 W

L.P. = Output carrier power set at its nominal Low: 2 W

2.4.3 15.1.3 Modulation Spectrum 25 kHz channel mode

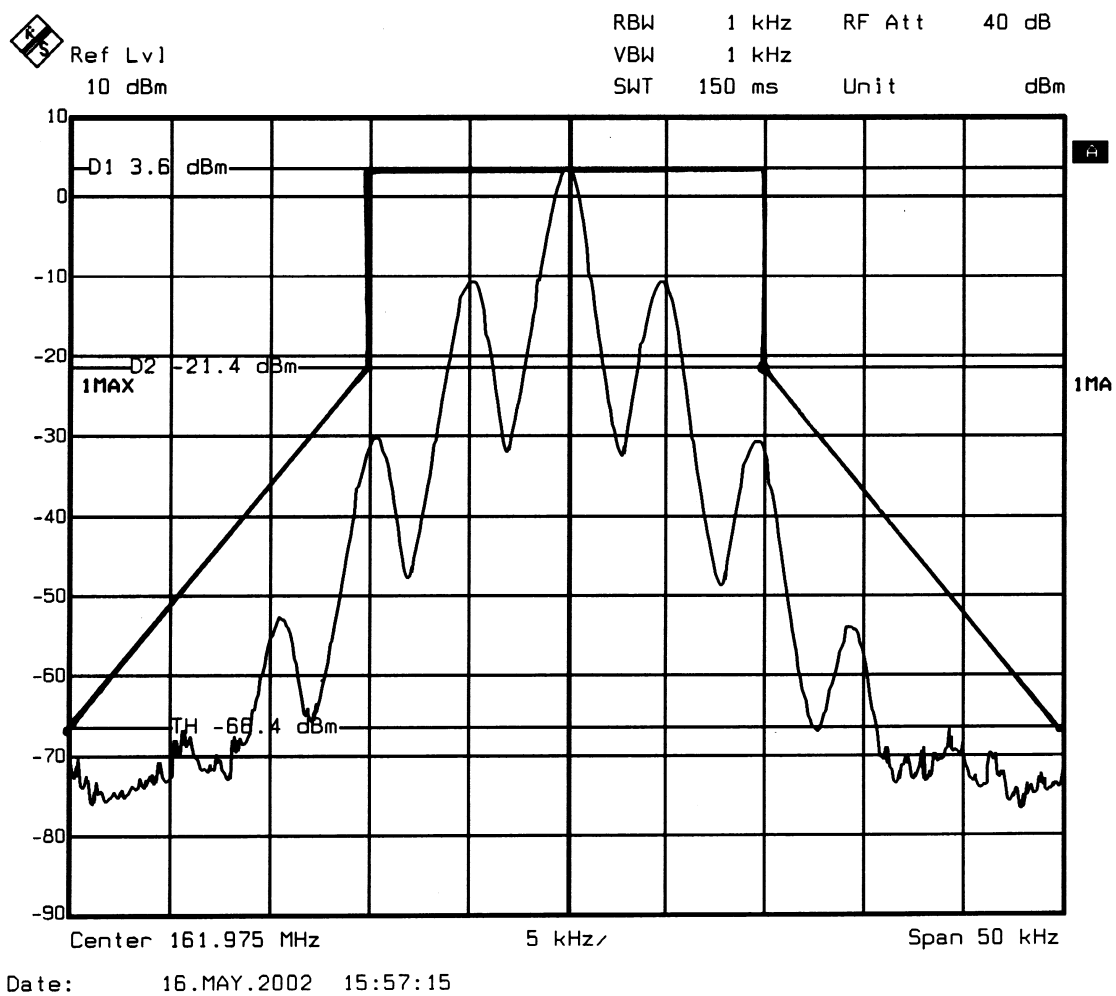
Date of test: 16 May 2002

Ambient temp.: 28.6 °C

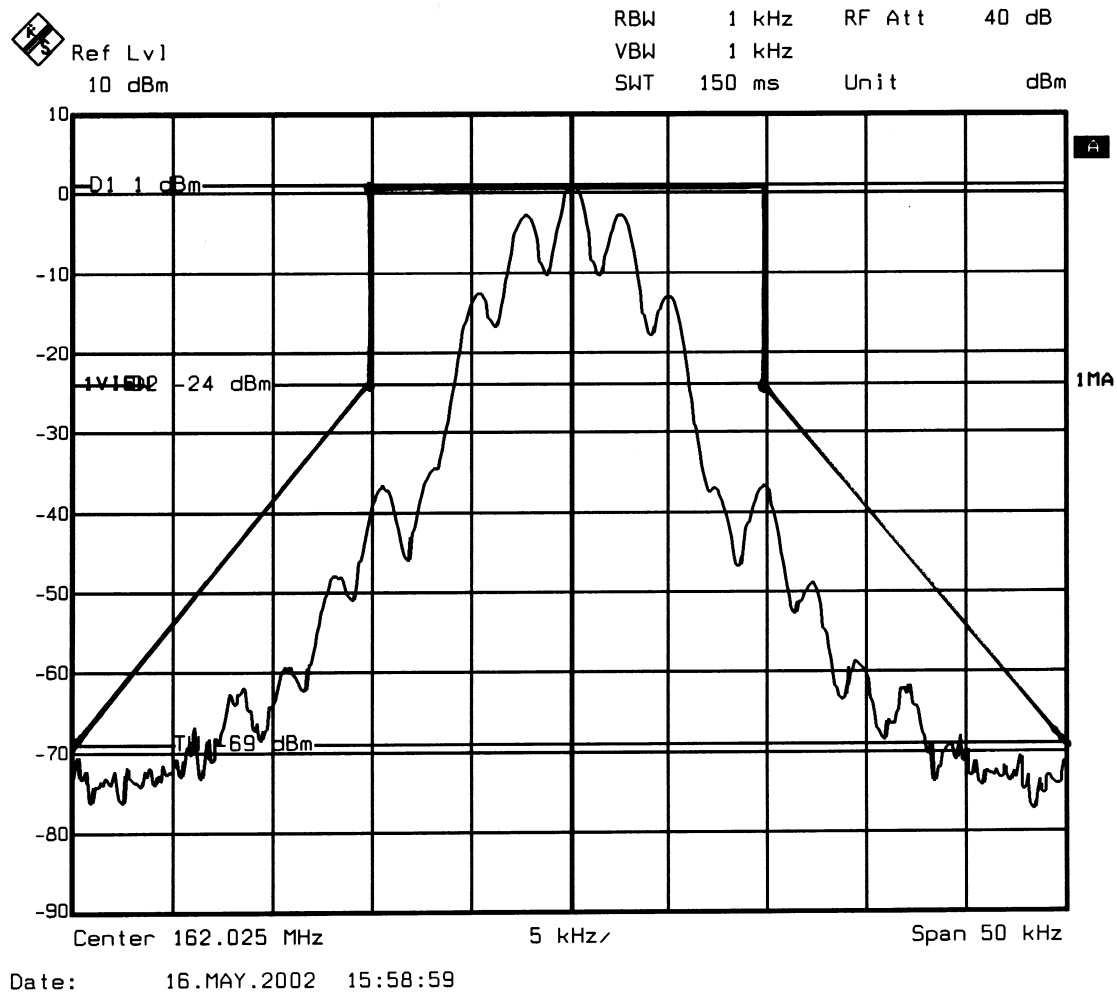
R.H.: 32.2 %

TX freq.: 159.025 MHz Carrier power: H. P.

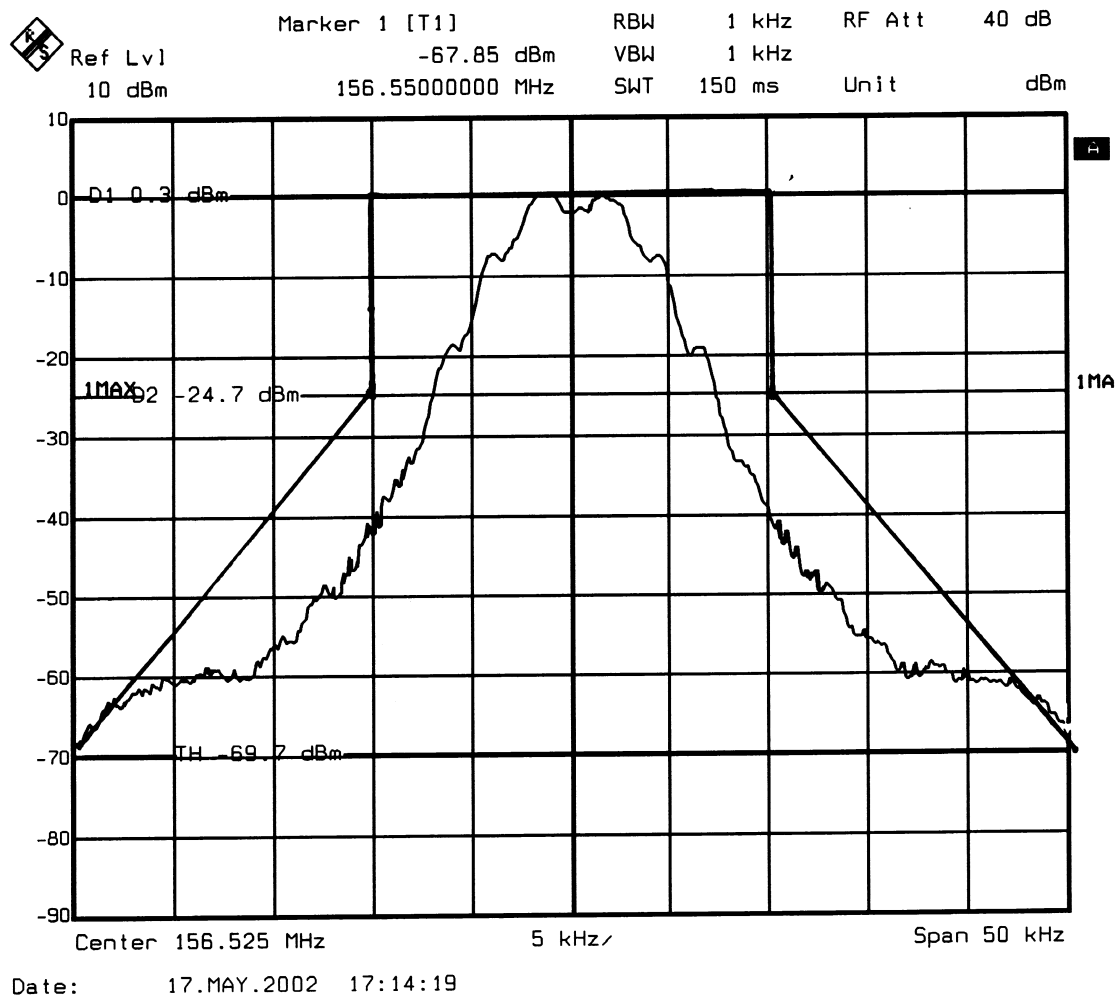
(1) TDMA Type 1 mode (Standard Test Signal Number 2):



(2) TDMA Type 2 ((Standard Test Signal Number 3):



- (3) DSC mode (standard Test Signal Number 1):
 TX freq.: 156.525 MHz Carrier power: H.P



Limit : within the mask specified in figure 4, Clause 15.1.3, IEC 61993-2.

(Emission mask):

- At ± 10 kHz removed from the carrier, the modulation sidebands is below -25 dBc.
- At ± 25 kHz removed from the carrier, the modulation sidebands is below -70 dBc, without any need to be below 0.25 μ W.

In the region between ± 10 kHz and ± 25 kHz removed from the carrier, the modulation sidebands is below a line specified between these two points.

2.4.4 15.1.4 Modulation Spectrum 12.5 kHz channel mode

Date of test: 16 May 2002

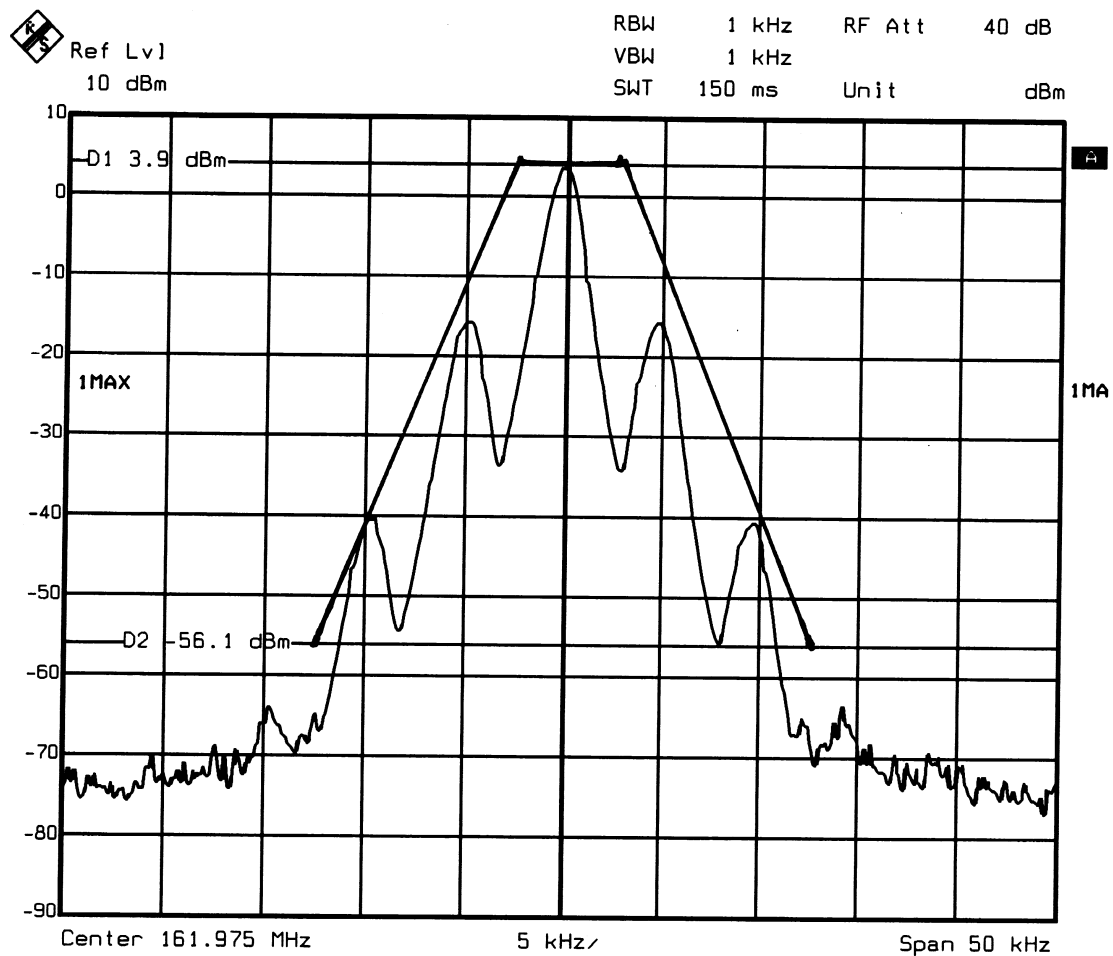
Ambient temp.: 28.6 °C

R.H.: 32.2 %

TX freq.: 157.4125 MHz

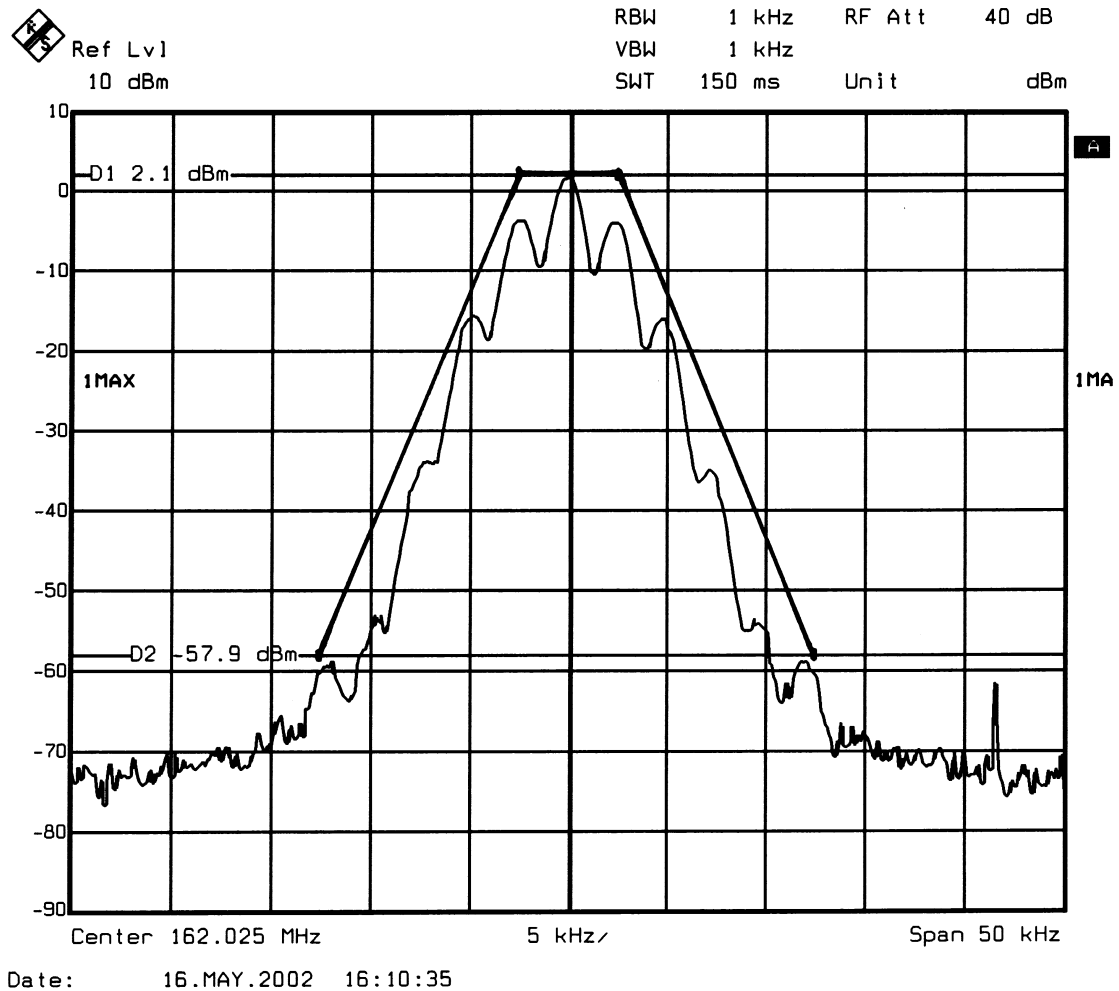
Carrier power: H. P.

(1) TDMA Type 1 mode (Standard Test Signal Number 2):



Date: 16.MAY.2002 16:06:45

(2) TDMA Type 2 (Standard Test Signal Number 3):



Limit: within the mask specified in figure 5, Clause 15.1.4, IEC 61993-2.

(Emission mask):

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

In the region between ± 2.5 kHz and ± 12.5 kHz removed from the carrier, the modulation sidebands 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.

2.4.5 15.1.5 Transmitter Attack Time

Date of test: 16 May 2002

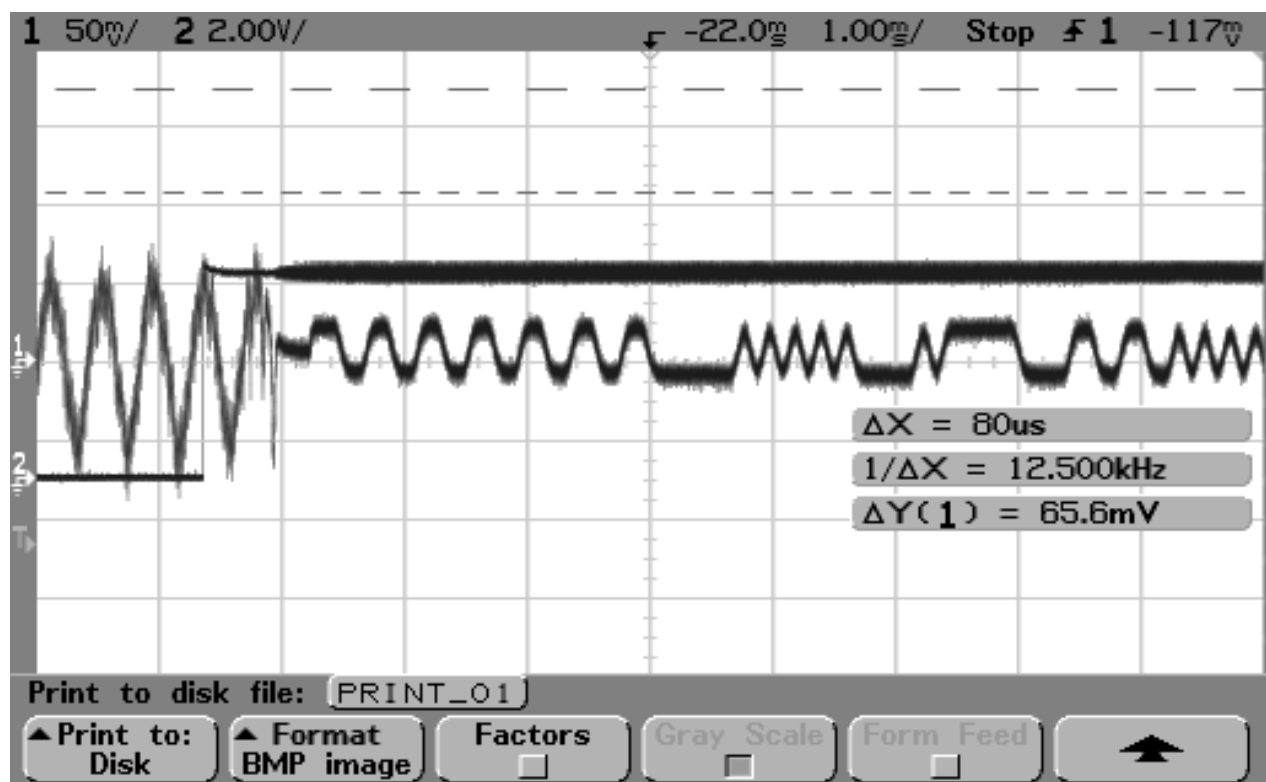
Ambient temp.: 28.6 °C

R.H.: 32.2 %

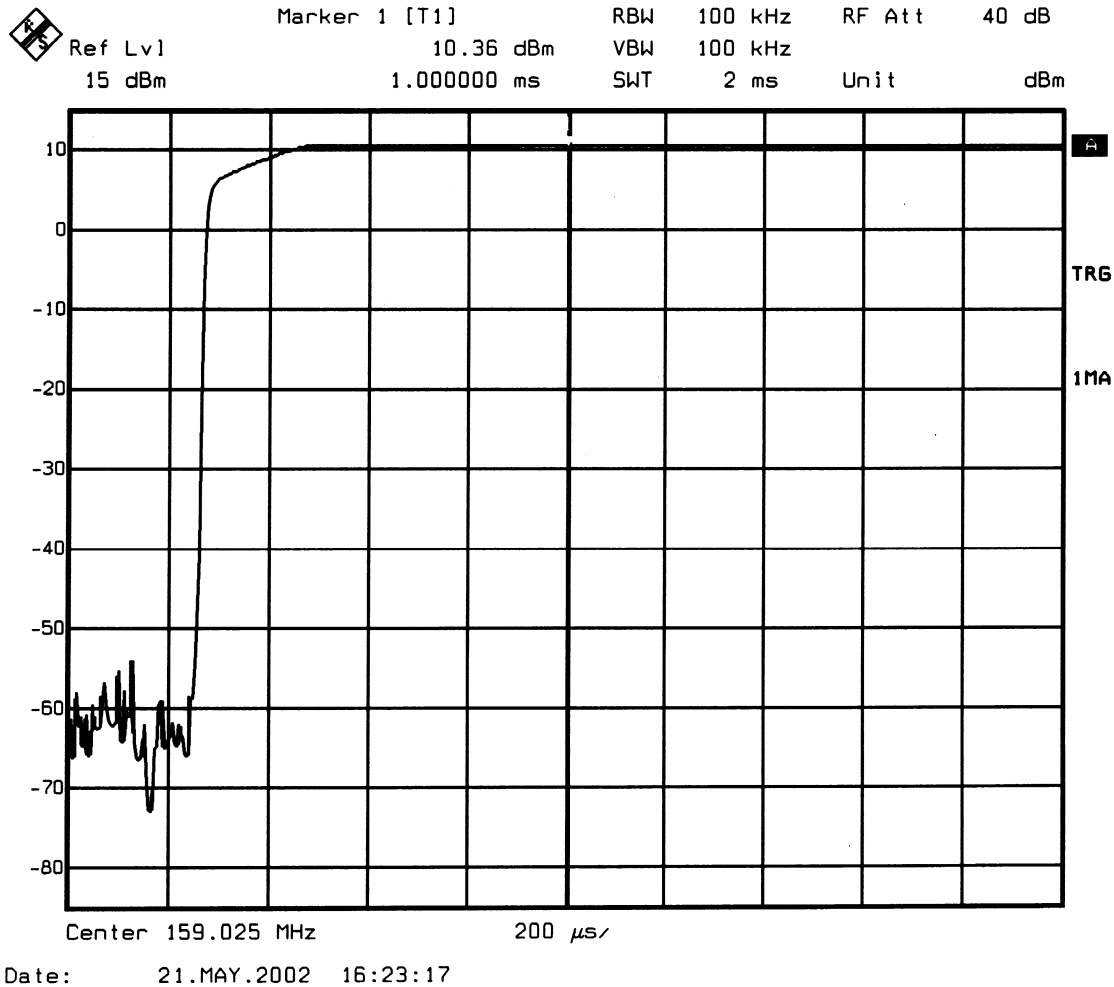
TX freq.: 159.025 MHz

Carrier power: H. P.

PLOT OF FREQUENCY BEHAVIOUR



PLOT OF RF POWER BEHAVIOUR



Measurement Uncertainty: $\pm 2\%$

Limit:

- Transmitter attack time T_0 : within 1 ms,
- Transient power level: within ± 1.5 dB of its final value at any time,
- Carrier frequency F_c : within ± 1 kHz of its required value after 1 ms.

2.4.6 15.1.6 Transmitter Release Time

Date of test: 16 May 2002

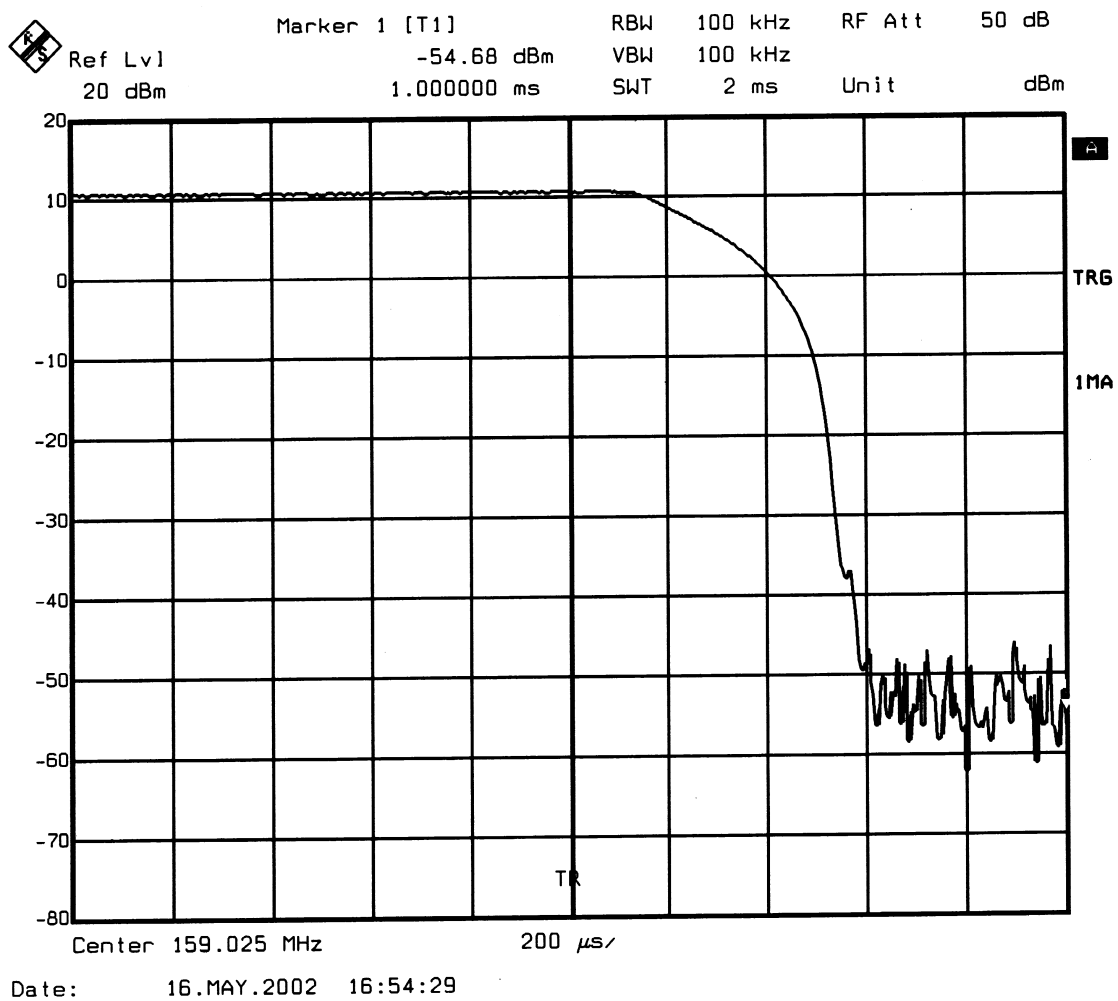
Ambient temp.: 28.6 °C

R.H.: 32.2 %

TX freq.: 159.025 MHz

Carrier power: H. P.

PLOT OF RF POWER BEHAVIOUR


Measurement Uncertainty: $\pm 2\%$

Limit:

Transmitter release time T_r : within 1 ms,

2.5 15.2 DSC Transmissions

2.5.1 15.2.1 Frequency error of the DSC Signal

Date of test: 16 May 2002	Ambient temp.: 28.6 °C	R.H.: 32.2 %
Date of test: 20 May 2002	Ambient temp.: 25.4 °C	R.H.: 34.8 %
Date of test: 21 May 2002	Ambient temp.: 27.4 °C	R.H.: 36.2 %

CHANNEL 70

Fn = 156.525 MHz

TEST CONDITIONS		FREQUENCY ERROR (Hz)	
Temperature	Voltage	B-STATE (2100 Hz)	Y-STATE (1300Hz)
<i>T_{nom}</i> (+15 – 35 °C)	<i>V_{nom}</i> (24.0 V)	+ 0.63	- 0.56
<i>T_{min}</i> (-15 °C)	<i>V_{min}</i> (21.6 V)	+ 0.63	- 0.56
<i>T_{max}</i> (+55 °C)	<i>V_{max}</i> (31.2 V)	+ 0.63	- 0.56
Limits		≤ ±1%	

2.5.2 15.2.2 Modulation Rate

Date of test: 17 May 2002

Ambient temp.: 28.2 °C

R.H.: 30.1%

CHANNEL 70

Fn = 156.525 MHz

TEST CONDITIONS		Modulation Rate (ppm)
Temperature	Voltage	
T_{nom} (+20 °C)	V_{nom} (24.0 V)	1200.013
Limit		1200 bit/s $\pm$ 30 ppm ($\pm$ 0.036 bits/s).

2.6 15.3 TDMA Receivers

2.6.1 15.3.1 Sensitivity - 25 kHz Operation

Date of test: 15 May 2002

Ambient temp.: 28.2 °C

R.H.: 33.4 %

Date of test: 20 May 2002

Ambient temp.: 25.4 °C

R.H.: 34.8 %

Date of test: 21 May 2002

Ambient temp.: 27.4 °C

R.H.: 36.2 %

TEST CONDITIONS		SENSITIVITY LEVEL	
		Fn: 156.025 MHz	Fn: 162.025 MHz
Temperature	Voltage	RF level (dBm)	RF level (dBm)
T_{nom} (+15 – 35 °C)	V_{nom} (24.0 V)	-107 dBm at 2.9% PER	-107 dBm at 4.4% PER
T_{min} (-15 °C)	V_{min} (21.6 V)	- 101 dBm at 0.8% PER	- 101 dBm at 0.4% PER
T_{max} (+55 °C)	V_{max} (31.2 V)	- 101 dBm at 1.0% PER	- 101 dBm at 1.5% PER
Measurement uncertainty		±1.2 dB	
Limits		$\leq$ - 107 dBm with a PER of 20% under normal test conditions, $\leq$ - 101 dBm with a PER of 20% under extreme test conditions,	

2.6.2 15.3.2 Sensitivity - 12.5 kHz Operation

Date of test: 15 May 2002	Ambient temp.: 28.2 °C	R.H.: 33.4 %
Date of test: 20 May 2002	Ambient temp.: 25.4 °C	R.H.: 34.8 %
Date of test: 21 May 2002	Ambient temp.: 27.4 °C	R.H.: 36.2 %

TEST CONDITIONS		SENSITIVITY LEVEL	
		Fn: 157.4125 MHz	Fn: 160.6375 MHz
Temperature	Voltage	RF level (dBm)	RF level (dBm)
T_{nom} (+15 – 35 °C)	V_{nom} (24.0 V)	- 98 dBm at 14.1% PER	- 98 dBm at 13.8% PER
T_{min} (-15 °C)	V_{min} (21.6 V)	- 92 dBm at 4.9% PER	- 92 dBm at 3.0% PER
T_{max} (+55 °C)	V_{max} (31.2 V)	- 92 dBm at 1.1% PER	- 92 dBm at 7.3% PER
Measurement uncertainty		±1.2 dB	
Limits		$\leq$ - 98 dBm with a PER of 20% under normal test conditions, $\leq$ - 92 dBm with a PER of 20% under extreme test conditions,	

2.6.3 15.3.3 Error Behaviour at High Input Levels

Date of test: 15 May 2002

Ambient temp.: 28.2 °C

R.H.: 33.4 %

TEST CONDITIONS		Packet Error Rate (%)	
		Fn = 156.025 MHz (CH 60)	
Standard Test Signal		as described in clause 15.3.1	
Input signal (dBm)		-77	-7
Temperature	Voltage		
T_{nom} (+15 – 35 °C)	V_{nom} (24.0 V)	0.7	0.3
Measurement uncertainty		±1.2 dB	
Limits		Difference < 1%	

2.6.4 15.3.4 Co-channel Rejection - 25 kHz Operation

Date of test: 16 May 2002

Ambient temp.: 28.6 °C

R.H.: 32.2 %

TEST CONDITIONS		CO-CHANNEL REJECTION RATIO (dB)	
Temperature	Voltage	Fn = 159.025 MHz	
<i>Tnom</i> (+15 – 35 °C)	<i>Vnom</i> (24.0 V)	Fn +3 kHz	-13 dB at 16.2% PER
		Fn	-14 dB at 17.0% PER
		Fn –3 kHz	-15 dB at 19.7% PER
Measurement uncertainty		±1.2 dB	
Limits		Between -10.0 dB and 0 dB. Any positive value is also acceptable.	

Remark: Unwanted signal modulated with 400Hz / 3kHz deviation

TEST CONDITIONS		CO-CHANNEL REJECTION RATIO (dB)	
Temperature	Voltage	Fn = 159.025 MHz	
<i>Tnom</i> (+15 – 35 °C)	<i>Vnom</i> (24.0 V)	Fn +3 kHz	-15 dB at 19.8% PER
		Fn	-12 dB at 17.9% PER
		Fn –3 kHz	-15 dB at 18.9% PER
Measurement uncertainty		±1.2 dB	
Limits		Between -10.0 dB and 0 dB. Any positive value is also acceptable.	

Remark: Unwanted signal modulated with GMSK test signal #2, 2.4 kHz deviation, BT 0.4

2.6.5 15.3.5 Co-channel Rejection - 12.5 kHz Operation

Date of test: 16 May 2002

Ambient temp.: 28.6 °C

R.H.: 32.2 %

TEST CONDITIONS		CO-CHANNEL REJECTION RATIO (dB)	
Temperature	Voltage	Fn = 159.025 MHz	
T_{nom} (+15 – 35 °C)	V_{nom} (24.0 V)	Fn +1.5 kHz	-21 dB at 18.9% PER
		Fn	-16 dB at 18.4% PER
		Fn –1.5 kHz	-21 dB at 19.9% PER
Measurement uncertainty		±1.2 dB	
Limits		Between -18.0 dB and 0 dB. Any positive value is also acceptable.	

Remark: Unwanted signal modulated with 400Hz / 1.5 kHz deviation

TEST CONDITIONS		CO-CHANNEL REJECTION RATIO (dB)	
Temperature	Voltage	Fn = 159.025 MHz	
T_{nom} (+15 – 35 °C)	V_{nom} (24.0 V)	Fn +1.5 kHz	-18 dB at 17.4% PER
		Fn	-12 dB at 13.2% PER
		Fn –1.5 kHz	-17 dB at 19.1% PER
Measurement uncertainty		±1.2 dB	
Limits		Between -18.0 dB and 0 dB. Any positive value is also acceptable.	

Remark: Unwanted signal modulated with GFSK, test signal #2, 1.2 kHz deviation, BT 0.3

2.6.6 15.3.6 Adjacent Channel selectivity - 25 kHz Operation

Date of test: 17 May 2002	Ambient temp.: 27.2 °C	R.H.: 32.7 %
Date of test: 20 May 2002	Ambient temp.: 25.4 °C	R.H.: 34.8 %
Date of test: 21 May 2002	Ambient temp.: 27.4 °C	R.H.: 36.2 %

TEST CONDITIONS		ADJACENT CHANNEL SELECTIVITY (dB)	
		Fn: 159.025 (MHz)	
Temp.	Voltage	Unwanted signal – 25 kHz	Unwanted signal + 25 kHz
T_{nom} (+15 – 35 °C)	V_{nom} (24.0V)	70dB at 3.7% PER	70d B at 10% PER
T_{min} (-15 °C)	V_{min} (21.6 V)	63 dB at 1.0% PER	63 dB at 1.0% PER
T_{max} (+55 °C)	V_{max} (31.2 V)	63 dB at 0.5% PER	63 dB at 0.6% PER
Measurement uncertainty		±1.2 dB	
Limits		> 70.0 dB @ ≤20% PER under normal test conditions, > 60.0 dB @ ≤20% PER under extreme test conditions.	

2.6.7 15.3.7 Adjacent Channel selectivity - 12.5 kHz Operation

Date of test: 17 May 2002	Ambient temp.: 27.2 °C	R.H.: 32.7 %
Date of test: 20 May 2002	Ambient temp.: 25.4 °C	R.H.: 34.8 %
Date of test: 21 May 2002	Ambient temp.: 27.4 °C	R.H.: 36.2 %

TEST CONDITIONS		ADJACENT CHANNEL SELECTIVITY (dB)	
		Fn = 159.025 MHz	
Temp.	Voltage	Unwanted signal – 12.5 kHz	Unwanted signal + 12.5 kHz
<i>T_{nom}</i> (+15 – 35 °C)	<i>V_{nom}</i> (24.0V)	50 dB at 15.2% PER	50 dB at 12.2% PER
<i>T_{min}</i> (-15 °C)	<i>V_{min}</i> (21.6 V)	53 dB at 15.8% PER	53 dB at 19.5% PER
<i>T_{max}</i> (+55 °C)	<i>V_{max}</i> (31.2 V)	50 dB at 6.7% PER	53 dB at 11.4% PER
Measurement uncertainty		±1.2 dB	
Limits		> 50.0 dB @ ≤20% PER under normal test conditions, > 50.0 dB @ ≤20% PER under extreme test conditions.	

2.6.8 15.3.8 Spurious Response Rejection

Date of test: 16 May 2002

Ambient temp.: 28.6 °C

R.H.: 32.2 %

Tested frequency : 159.025 MHz

Funw (MHz)	SPURIOUS RESPONSE REJECTION RATIO (dB)
*	--
*	--
*	--
*	--

Funw = unwanted frequency

* : Rejection on all spurious responses was >77 dB.

(1) Frequency of the Receiver (f_R): 159.025 MHz

(2) Frequency of the local oscillator signal applied to the 1st mixer of the Receiver (f_{LO}): 204.125 MHz

(3) Intermediate frequencies (f_{I1} , f_{I2} , f_{I3}): f_{I1} = 45.1 MHz, f_{I2} = 10.7 MHz, f_{I3} = 455 kHz

(4) Switching range of the Receiver (sr): 156.025 to 162.025 MHz

2.6.9 15.3.9 Intermodulation response rejection and blocking

Date of test: 16 May 2002

Ambient temp.: 28.6 °C

R.H.: 32.2 %

TEST CONDITIONS		PACKET ERROR RATE (%)	
		Fn = 156.025 MHz	Fn = 162.025 MHz
Temperature	Voltage	Test #1	Test #2
T_{nom} (+15 – 35 °C)	V_{nom} (24.0 V)	5.0	6.7
Measurement uncertainty		±1.2 dB	
Limits		≤20% PER	

Remark: test configuration

	Generator A wanted –101 dbm	Generator B unwanted –27 dbm Mod. 400Hz / 3 kHz	Generator C unwanted –27 dbm unmodulated	Generator D unwanted –15 dbm unmodulated
Test #1	159.025MHz (Fn)	Fn + 500 kHz	Fn + 1000 kHz	Fn + 5.725
Test #2	162.025MHz (Fn)	Fn - 500 kHz	Fn - 1000 kHz	Fn - 5.725

2.6.10 15.3.10 Transmit to receive switching time

Date of test: 16 May 2002

Ambient temp.: 28.6 °C

R.H.: 32.2 %

TEST CONDITIONS		PACKET ERROR RATE (%)
Temperature	Voltage	F _n = 159.025 MHz
<i>T_{nom}</i> (+15 – 35 °C)	<i>V_{nom}</i> (24.0 V)	8.4
Limits		≤20% PER

Remark: The wanted signal level was -107 dBm

2.7 15.4 DSC Receiver

2.7.1 15.4.1 Maximum sensitivity

Date of test: 16 May 2002	Ambient temp.: 28.6 °C	R.H.: 32.2 %
Date of test: 20 May 2002	Ambient temp.: 25.4 °C	R.H.: 34.8 %
Date of test: 21 May 2002	Ambient temp.: 27.4 °C	R.H.: 36.2 %

TEST CONDITIONS		SENSITIVITY LEVEL (dBm)		
		Fn: 156.525 MHz (CH 70)		
Temperature	Voltage	Fn	Fn - 1.5 kHz	Fn + 1.5 kHz
<i>T_{nom}</i> (+15 – 35 °C)	<i>V_{nom}</i> (24.0 V)	- 110 dBm at 0 % BER	- 110 dBm at 0 % BER	- 110 dBm at 0 % BER
<i>T_{min}</i> (-15 °C)	<i>V_{min}</i> (21.6 V)	- 104 dBm at 0 % BER	- 104 dBm at 0 % BER	- 104 dBm at 0 % BER
<i>T_{max}</i> (+55 °C)	<i>V_{max}</i> (31.2 V)	- 104 dBm at 0 % BER	- 104 dBm at 0 % BER	- 104 dBm at 0 % BER
Measurement uncertainty		±1.2 dB		
Limits		≤ - 107 dBm with a BER of 1% under normal test conditions, ≤ - 101 dBm with a BER of 1% under extreme test conditions,		

2.7.2 15.4.2 Error Behaviour at High Input Levels

Date of test: 16 May 2002

Ambient temp.: 28.6 °C

R.H.: 32.2 %

CHANNEL 70: Fn: 156.525 MHz

TEST CONDITIONS		BIT ERROR RATE (%)
Temperature	Voltage	RF input -7 dBm / Standard Test Signal #1
T_{nom} (+15 – 35 °C)	V_{nom} (24.0 V)	0.0
Measurement uncertainty		±1.2 dB
Limits		BER <1%

2.7.3 15.4.3 Co-Channel Rejection

Date of test: 17 May 2002

Ambient temp.: 28.1 °C

R.H.: 30.7 %

CHANNEL 70: Fn: 156.525 MHz

TEST CONDITIONS		CO-CHANNEL REJECTION RATIO (dB)	
		Standard Test Signal #1/ -104 dBm	
		Unwanted signal (Fn: 156.525 MHz)	
Temperature	Voltage	Unwanted signal	
<i>T_{nom}</i> (+15 – 35 °C)	<i>V_{nom}</i> (24.0 V)	Fn + 3 kHz	- 10 dB at 0.9 % BER
		Fn	- 10 dB at 0.0 % BER
		Fn - 3 kHz	- 10 dB at 0.0 % BER
Measurement uncertainty		±1.2 dB	
Limits		Between -10.0 dB and 0 dB @ BER < 1%	

2.7.4 15.4.4 Adjacent Channel selectivity

Date of test: 17 May 2002	Ambient temp.: 28.1 °C	R.H.: 30.7 %
Date of test: 20 May 2002	Ambient temp.: 25.4 °C	R.H.: 34.8 %
Date of test: 21 May 2002	Ambient temp.: 27.4 °C	R.H.: 36.2 %

TEST CONDITIONS		ADJACENT CHANNEL SELECTIVITY (dB)
Temp.	Voltage	$F_n = 156.525 \text{ MHz (CH 70)}$
T_{nom} (+15 – 35 °C)	V_{nom} (24.0V)	73 dB at 0.0% BER
T_{min} (-15 °C)	V_{min} (21.6 V)	63 dB at 0.0% BER
T_{max} (+55 °C)	V_{max} (31.2 V)	63 dB at 0.0% BER
Measurement uncertainty		$\pm 1.2 \text{ dB}$
Limits		$\geq 70.0 \text{ dB @ BER} < 1\%$ under normal test conditions, $\geq 60.0 \text{ dB @ BER} < 1\%$ under extreme test conditions.

2.7.5 15.4.5 Spurious Response Rejection

Date of test: 17 May 2002

Ambient temp.: 28.1 °C

R.H.: 30.7 %

CHANNEL 70: Fn: 156.525 MHz

Funw (MHz)	SPURIOUS RESPONSE REJECTION RATIO (dB)
179.075	80 dB @ 1.0 % BER
*	--
--	--
Measurement uncertainty	±1.2 dB
Limit	≥ 70 dB @ BER < 1%

Funw = unwanted frequency

* : Rejection on other spurious responses was > 80 dB.

- (1) Frequency of the Receiver (f_R): 156.525 MHz
- (2) Frequency of the local oscillator signal applied to the 1st mixer of the Receiver (f_{LO}): 201.125 MHz
- (3) Intermediate frequencies (f_{I1} , f_{I2} , f_{I3}): f_{I1} = 45.1 MHz, f_{I2} = 10.7 MHz, f_{I3} = 455 kHz
- (4) Switching range of the Receiver (sr): 156.025 to 162.025 MHz

2.7.6 15.4.6 Intermodulation response Rejection

Date of test: 17 May 2002

Ambient temp.: 28.1 °C

R.H.: 30.7 %

CHANNEL 70: Fn: 156.525 MHz

TEST CONDITIONS		Intermodulation response rejection ratio (dB)
Temperature	Voltage	65 dB at 0% BER
T_{nom} (+20 °C)	V_{nom} (24.0 V)	
Measurement uncertainty		±1.2 dB
Limits		65.0 dB at BER < 1%

2.7.7 15.4.7 Blocking or Desensitisation

Date of test: 17 May 2002

Ambient temp.: 28.1 °C

R.H.: 30.7 %

CHANNEL 70: Fn: 156.525 MHz

Unwanted frequency (MHz)	BER (%)
Fn -10	0.0
Fn - 9	0.0
Fn - 8	0.0
Fn - 7	0.0
Fn - 6	0.0
Fn - 5	0.0
Fn - 4	0.0
Fn - 3	0.0
Fn - 2	0.0
Fn - 1	0.0
Fn + 1	0.0
Fn + 2	0.0
Fn + 3	0.0
Fn + 4	0.0
Fn + 5	0.0
Fn + 6	0.0
Fn + 7	0.0
Fn + 8	0.0
Fn + 9	0.0
Fn + 10	0.0
Measurement uncertainty	±1.2 dB
Limit	≥ 84 dB @ BER < 1% except at spurious response frequencies

2.8 15.5 Conducted Spurious Emissions conveyed to the antenna

2.8.1 15.5.1 Spurious Emissions from the Receiver

Date of test: 16 May 2002

Ambient temp.: 28.6 °C

R.H.: 32.2 %

TDMA Receivers and DSC Receiver

Fn = 156.025, 162.025 MHz and 156.525 MHz

SPURIOUS EMISSIONS POWER LEVEL	
Spurious frequency (MHz)	Power level (dBm)
*	All emissions more than 10 dB below the limit
*	--
Measurement uncertainty	±1.2 dB
Limit (150 kHz - 2 GHz)	≤ -57 dBm (2 nW) for 150 kHz - 1 GHz, ≤ -47 dBm (20 nW) for 1 GHz - 2 GHz.

2.8.2 15.5.2 Spurious Emissions from the Transmitter

Date of test: 21 May. 2002

Ambient temp.: 27.4 °C

R.H.: 36.2 %

Fn = 156.025 MHz

SPURIOUS EMISSIONS POWER LEVEL	
Spurious frequency (MHz)	Power level (dBm)
123.847	- 45.0
126.052	- 48.8
154.108	- 41.2
154.779	- 36.8
154.746	- 37.1
158.116	- 38.6
158.517	- 44.2
312.024	-39.6
*	All other spurious emissions more than 10 dB below the limit
Measurement uncertainty	±1.2 dB
Limit (150 kHz - 2 GHz)	$\leq$ - 36 dBm (0.25 μ W) for 150 kHz - 1 GHz, $\leq$ - 30 dBm (1 μ W) for 1 GHz - 2 GHz.

$F_n = 162.025 \text{ MHz}$

SPURIOUS EMISSIONS POWER LEVEL	
Spurious frequency (MHz)	Power level (dBm)
129.860	- 42.3
132.064	- 46.7
158.317	-45.6
160.120	-43.3
160.777	-36.5
160.747	-36.7
164.128	-44.3
165.730	-40.9
324.048	-39.5
Measurement uncertainty	$\pm 1.2 \text{ dB}$
Limit (150 kHz - 2 GHz)	$\leq - 36 \text{ dBm (0.25 } \mu\text{W) for 150 kHz - 1 GHz,}$ $\leq - 30 \text{ dBm (1 } \mu\text{W) for 1 GHz - 2 GHz.}$

Remark: Test was carried out on high and low power.

Used test equipment module

This module contains the total list of test equipment used.

3.2 Test Equipment / Test Software

3.2.1 Test Equipment

A reference number to the hardware is given in the first column to be used as a reference in this document.

Reference Number	Serial Number	Part Number	System	Version	Calibrated (Yes/No) - Date of next calibration
[HW 11.]	836529/02	Q/s FSEA 30	Spectrum Analyser	—	Yes - 27/07/2002
[HW 12.]	0091170	GPC-300-E	Power Supply	—	—
[HW 13.]	0091168	GPC-300-E	Auxiliary Power Supply	—	—
[HW 14.]	01/850/5008	I60	Environmental Test Chamber	—	—
[HW 15.]	—	SOFHC-030-15	30 dB Power Attenuator	—	—
[HW 16.]	GB410 50517	E4416A	Power Meter which includes a Peak Power Sensor (50MHz→6GHz, BW: 300kHz, -65dBm→120dBm)	—	Yes - 18/07/2002
[HW 17.]	—	—	Standard Test PC	—	—
[HW 18.]	—	—	Printer	—	—
[HW 19.]	V13727800	50001221-01	RS232 USB HUB	—	—
[HW 20.]	—	—	AC/DC Adapter (1.5V→12V)	—	—
[HW 21.]	78140195	77411	Multimeter	—	Yes - 13/05/2003
[HW 22.]	US4005456	E4430B	Signal Generator A	—	Yes - 23/01/2003
[HW 23.]	US39236080	E4434B	Signal Generator B	—	Yes - 27/02/2003
[HW 24.]	US3926064	E4434B	Signal Generator C	—	Yes - 23/01/2003
[HW 25.]	US3926020	E4434B	Signal Generator D	—	Yes - 01/03/2003
[HW 26.]	US4450633	S4622D	Oscilloscope	—	Yes - 25/06/2002
[HW 27.]	80310129	SOS	Thermometer	—	Yes - 13/05/2003
[HW 28.]	058833	SDK-200 (Atmel AVR)	External Trigger Device - Transmit-Receive Switching Time	—	—
[HW 29.]	M44001629	S3181A	Frequency Counter	—	Yes - 21/06/2002
[HW 30.]	50249	SDK-200 (Atmel AVR)	External Trigger Device	—	—
[HW 31.]	—	1902-0066	4-way RF Combiner	00-01	—
[HW 32.]	—	1902-0090	FSK Modulator	00-01	—
[HW 33.]	—	—	TNC Male to BNC female adapter	—	—
[HW 34.]	161	3TUF-100/200-K/N	Tunable Bandreject Filter	—	Aligned with Network Analyser E753ES; SW US39173185 Calibrated Next Cal 14/02/2002
[HW 35.]	020002660	MI V	Test Target 1	—	—
[HW 36.]	020002651	MI V	Test Target 2	—	—
[HW 37.]	020002622	MI V	Test Target 3	—	—
[HW 38.]	020002639	MI V	Test Target 4	—	—
[HW 39.]	020000526	MI V	Test Target 5	—	—
[HW 40.]	636570003	KDU 2000	KDU 1	—	—
[HW 41.]	636570003	KDU 1805	KDU 2	—	—
[HW 42.]	—	—	KDU 3	—	—
[HW 43.]	—	—	KDU 4	—	—
[HW 44.]	—	—	KDU 5	—	—

Table 3: Additional Equipment – Hardware

Photographs module

List of Photographs

Photograph 1: <i>Assembled view</i>	45
Photograph 2: <i>Connections-1</i>	46
Photograph 3: <i>Connections-2</i>	47
Photograph 4: <i>Label</i>	48
Photograph 5: <i>Front view with leds</i>	49
Photograph 6: <i>Internal view side-1</i>	50
Photograph 7: <i>Internal view side-2</i>	51

Photograph 1: *Assembled view*



Photograph 2: *Connections-1*



Photograph 3: *Connections-2*



Photograph 4: *Label*



Photograph 5: *Front view with leds*



Photograph 6: *Internal view side-1*



Photograph 7: *Internal view side-2*



Additional information module

This module contains **no** pages of information provided by the applicant.

The pages in this module are not included in the total number of pages of this report.