TEST REPORT # EMCC-880104KC, 2007-01-26

EQUIPMENT UNDER TEST:

Trade Name:	Transceiver Module
Model:	TM2.4-1 (integral antenna), TM2.4-2 (external antenna)
Article No:	1350.9905162 (integral antenna), 1350.9905161 (external antenna)
Serial No:	00017 (integral antenna), 00016 (external antenna)
Equipment Category:	Transceiver
Manufacturer:	Sasse Elektronik GmbH
Address:	Mühlenstrasse 4 91126 Schwabach Germany
Phone:	+49-9122-978-126
Fax:	+49-9122-978-133
	drechsel@sasse-elektronik.de

RELEVANT STANDARD: 47 CFR Part 15.249

MEASUREMENT PROCEDURE USED:

☒ ANSI C63.4-2003 ☐ FCC/OET MP-4 (1987) ☐ Other

TEST REPORT PREPARED BY:

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TEST PERSONNEL:

Wolfgang Döring

HEAD OF LABORATORY:

Winfried Hoffmann

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1 GENERAL INFORMATION

1.1 Purpose

The purpose of this report is to show compliance to the FCC regulations for unlicensed devices operating under section 15.249 of the Code of Federal Regulations title 47.
Furthermore the receiver part was investigated to the requirements of section 15.109.

1.2 Limits and Reservations

The test results in this report apply only to the particular Equipment Under Test (EUT) as declared in this report. This test report shall not be reproduced except in full without the written permission of EMCC DR. RAŠEK.

1.3 Test Location

Company Name:	EMCCons DR. RAŠEK
Street:	Moggast, Boelwiese 8
City:	91320 Ebermannstadt
Country:	Germany
Laboratory:	Test Laboratory of EMCC DR. RAŠEK FCC Registration Number: 90566 This site has been fully described in a report submitted to the FCC, and accepted in the letter dated December 15, 2005 Registration Number 90566.
Phone:	+49-9194-9016
Fax:	+49-9194-8125
E-Mail:	emc.cons@emcc.de
Web:	www.emcc.de

1.4 Manufacturer

Company Name:	Sasse Elektronik GmbH
Street:	Mühlenstrasse 4
City:	91126 Schwabach
Country:	Germany
Name for contact purposes:	Mr. Reinhard Drechsel
Phone:	+49-9122-978-126
Fax:	+49-9122-978-133
E-mail:	drechsel@sasse-elektronik.de

1.5 Dates

Date of receipt of EUT:	CW 49/2006
Test date:	CW 49 - 50/2006

2 PRODUCT DESCRIPTION

2.1 Equipment Under Test (EUT)

Trade Name:	Transceiver Module
Model:	TM2.4-1 (integral antenna), TM2.4-2 (external antenna)
Article Number:	1350.9905162 (integral antenna), 1350.9905161 (external antenna)
Serial Number:	00017 (integral antenna), 00016 (external antenna)
FCC ID:	UXA-990516X
Application:	Remote Control Transceiver
Power:	3.3 V DC
Transmit Frequency:	2403 … 2481 MHz
Receive Frequency:	2403 … 2481 MHz
Internal clock frequencies:	7.37 MHz, 16 MHz
Antenna:	Model TM2.4-1: Integral antenna
	Model TM2.4-2: External dedicated antennas (2 Versions: rod antenna CENTURION model WCR2400SMRP, cable antenna EAD BT Blade model FBT25009-RS-XX). Max. external antenna gain according to data sheets: 2dBi.
Interface ports:	SPI bus, UART, DC power in
	Model TM2.4-2, only: RP-SMA antenna connector
Variants:	none
Remarks:	none

2.2 EUT Peripherals

None.

2.3 Mode of Operation During Testing

All tests performed with the EUT operated with application software "FM_2400 EA002". For all radiated the EUT was operated in stand-alone mode without external signals / load applied to signal interfaces.
For EUT mode control (prior to starting particular tests - switching in between IDLE/RX/TX, setting frequencies) the manufacturer supplied additional equipment:

- Notebook Fujitsu-Siemens E8110 with AC Adapter SPA-P30,
- Interface adapter for level conversion (Module UART 3.3V level into V24 level),
- Communication software application "Hyperterm" (settings: 9600 Baud, 8N1),
- AC Adapter CUI P/N DMS090110-P5P-IC (9 V DC output)

During all radiated emissions tests this equipment was disconnected.
All transmit tests performed with the transmitter operating at max. power setting.
For conducted emission measurement the EUT was operated with the above described additional equipment, i.e. inserted into the adapter board and supplied via AC Adapter.

Remark: For details on setting specific parameters please refer to the manufacturers operational description.

2.4 Modifications Required for Compliance

For compliance with the bandedge emission limit the lower transmit frequency was increased from 2402 MHz to 2403 MHz.
Furthermore the Model TM2.4-2 antenna socket had to be correctly soldered. Socket solder joint failure (cold-solder joint) caused increased TX spurious emissions exceeding limits.

3 TEST RESULTS SUMMARY

Summary of Test Results for the following EUT:

Manufacturer: **Sasse Elektronik GmbH**
Device: **Transceiver Module**
Model No.: **TM2.4-1, TM2.4-2**
Serial Number: **00017, 00016**

Requirement	CFR Section	Report Section	Test Result
Antenna Requirement	15.203	4	Pass
AC Line Conducted Emissions	15.107, 15.207	5	Pass
Field Strength Limits (Fundamental and Harmonics)	15.249	6	Pass
Transmitter Radiated Spurious Emissions	15.209, 15.249	6	Pass
Receiver Radiated Emissions	15.109	6	Pass

The client has made the determination that EUT Condition, Characterization, and Mode of Operation are representative of production units, and meet the requirements of the specifications referenced herein.

Consistent with Industry practice, measurement and test equipment not directly involved in obtaining measurement results but having an impact on measurements (such as cable loss, antenna factors, etc.) are factored into the "Correction Factor" documented in certain test results. Instrumentation employed for testing meets tolerances consistent with known Industry Standards and Regulations.

The measurements contained in this report were made in accordance with the procedure ANSI C63.4 - 2003 and all applicable Public Notices received prior to the date of testing. All emissions from the device were found to be within the limits outlined in this report.
The test results in this report apply only to the particular Equipment Under Test (EUT) as declared in this report.

Test Personnel: Wolfgang Döring
Issuance Date: 2007-01-26

4 ANTENNA REQUIREMENT

Test Requirement: FCC 47 CFR, Part 15C

4.1 Regulation

15.203 An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of Part 15C. The manufacturer may design the unit so that the user can replace a broken antenna, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of Sections 15.211, 15.213, 15.217, 15.219, or 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with Section 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this Part are not exceeded.

According to DA 00-2225 "OET Extends Effective Date of Antenna Connector Requirement Indefinitely", dated September 28, 2000, the OET extends the effective date of Public Notice, DA 00-1087, indefinitely.

4.2 Result

Manufacturer:	**Sasse Elektronik GmbH**
Device:	**Transceiver Module**
Model No.:	**TM2.4-1, TM2.4-2**
Serial Number:	**00017, 00016**

Model TM2.4-1: Antenna: permanently attached internal antenna (on-board SMD antenna).

Model TM2.4-2: Dedicated antennas with reverse polarity SMA connector (RP-SMA) and max. antenna gain of 2 dBi:

- rod antenna CENTURION model WCR2400SMRP,
- cable antenna EAD BT Blade model FBT25009-RS-XX.

The reverse polarity SMA connector is considered unique, i.e. satisfying the requirement in Section 15.203.

The EUT meets the requirements of this section.

5 CONDUCTED EMISSIONS TESTS

Test Requirement: FCC 47 CFR, Part 15C (TX part) Part 15B (RX part)

Test Procedure: ANSI C63.4-2003

5.1 Regulation

Section 15.207 (a) Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 µH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency of Emission (MHz)	Conducted Limit (dBuV)	
	Quasi-peak (QP)	Average (AV)
0.15-0.5	66 to 56 *	56 to 46 *
0.5-5	56	46
5-30	60	50

* Decreases with the logarithm of the frequency.

Section 15.207 (c) Measurements to demonstrate compliance with the conducted limits are not required for devices which only employ battery power for operation and which do not operate from the AC power lines or contain provisions for operation while connected to the AC power lines. Devices that include, or make provision for, the use of battery chargers which permit operating while charging, AC adaptors or battery eliminators or that connect to the AC power lines indirectly, obtaining their power through another device which is connected to the AC power lines, shall be tested to demonstrate compliance with the conducted limits.

5.1 Test Equipment

Type	Manufacturer/ Model No.	EMCC Ident No.	Last Calibration	Calibration Interval
EMI Receiver	Rohde & Schwarz ESS	304	2005-07	18 months
Protector Limiter 10 dB	Rohde & Schwarz ESH3-Z2	1519		n.a.
V-LISN 50 ohms//(50 uH + 5 ohms) [EUT]	Schwarzbeck NNLA8119(mod)	1469	2006-08	24 months
V-LISN 50 ohms//(50 uH + 5 ohms) [AE]	Schwarzbeck NSLK 8126	368	2006-08	24 months

5.2 Test Procedures

For tabletop equipment, the EUT is placed on a 1 meter by 1.5 meters wide and 0.8 meter high nonconductive table that is placed above the groundplane. Ceiling or wall-mounted devices also is positioned on a tabletop for testing purposes. Floor standing equipment is placed either directly on the groundplane or on insulating material if normally placed on a nonconducting floor. The EUT is connected to its associated peripherals, with any excess I/O cabling bundled to approximately 1 meter. The EUT is connected to a dedicated LISN and all peripherals are connected to a second separate LISN circuit. The LISNs are bonded to the groundplane.
Conducted measurements are made on each current carrying conductor with respect to ground.

The EUT was tested as a tabletop equipment operated and powered via the manufacturer supplied additional equipment (refer to section 2.3 of this report). Tests performed at the AC input of the AC Adapter CUI P/N DMS090110-P5P-IC powered by 115V 60 Hz AC operating the EUT in TX mode as well as in RX mode (covering section 15.107 requirements).
The Model TM2.4-2 transceiver was tested in the worst-case configuration, i.e. equipped with the blade antenna.
The power cord for the unit in the remainder of the configuration not under measurement (Ancillary Equipment AE - i.e. the AC Adapter of the Laptop computer) was connected to a LISN different from the LISN used for the power cord of the portion of the EUT being measured.
The initial step in collecting conducted data is a peak scan of the measurement range with an EMI test receiver. The significant peaks are then measured with quasi-peak detector.
Worst case conducted emissions are listed under chapter: test results.

5.3 Test Results

Manufacturer: Sasse Elektronik GmbH
Device: Transceiver Module
Model No.: **TM2.4-1, TM2.4-2**
Serial Number: **00017, 00016**

The EUT meets the requirements of this section.

Test Personnel: Wolfgang Döring
Test Date: 2006-12-12

Detailed test data please refer to the following pages.

5.3.1 Detailed Test Data, Model TM2.4-1

EMCC DR.RASEK

12. Dec 06 16:47

Conducted Emissions

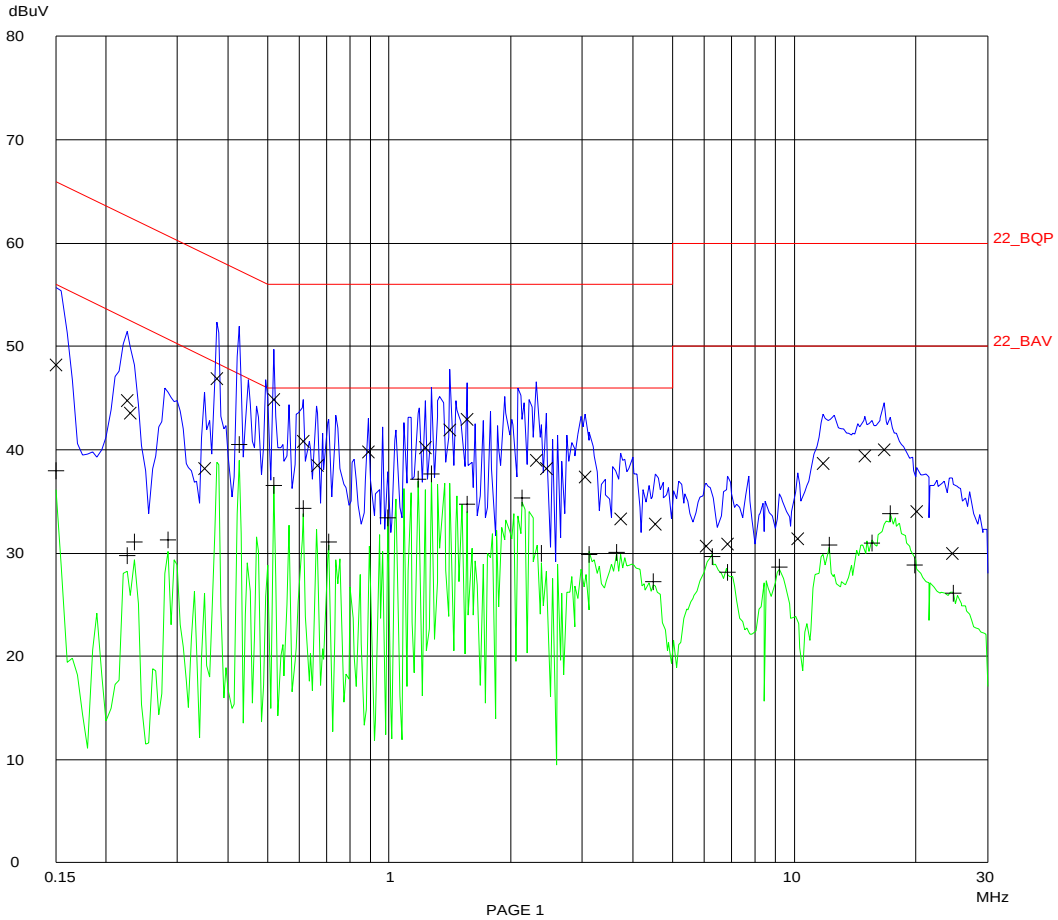
EUT: TM2.4-1
Manuf: SASSE
Op Cond: TX mode, modulated, integral antenna
Operator: Doering
Test Spec: 47CFR15
Comment: L
115V 60 Hz via Test board and AC Adapter (provided by SASSE)

Scan Settings (1 Range)

Frequencies			Receiver Settings				
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
150k	30M	5k	10k	PK+AV	10ms	AUTO	LN ON	60dB

Final Measurement: x QP / + AV
Meas Time: 1 s
Subranges: 25
Acc Margin: 25dB

Transducer No.	Start	Stop	Name
1	9k	30M	Limiter



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5.3.1 Detailed Test Data, Model TM2.4-1 (continued)

EMCC DR.RASEK 12. Dec 06 16:47

Conducted Emissions

EUT: TM2.4-1
Manuf: SASSE
Op Cond: TX mode, modulated, integral antenna
Operator: Doering
Test Spec: 47CFR15
Comment: L
115V 60 Hz via Test board and AC Adapter (provided by SASSE)

Scan Settings (1 Range)

Frequencies			Receiver Settings				
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
150k	30M	5k	10k	PK+AV	10ms	AUTO	LN ON	60dB

Final Measurement Results:

Frequency MHz	QP Level dBuV	QP Limit dBuV
0.15000	48.2	66.0
0.22500	44.7	62.7
0.23000	43.5	62.4
0.35000	38.1	59.0
0.37500	46.9	58.4
0.52000	44.8	56.0
0.61500	40.8	56.0
0.66500	38.5	56.0
0.89000	39.8	56.0
1.22500	40.1	56.0
1.41500	41.9	56.0
1.56000	42.8	56.0
2.30500	38.9	56.0
2.45000	38.1	56.0
3.04500	37.3	56.0
3.72000	33.2	56.0
4.53000	32.8	56.0
6.07500	30.7	60.0
6.83000	30.9	60.0
10.17500	31.3	60.0
11.80500	38.6	60.0
14.92500	39.3	60.0
16.63500	39.9	60.0
20.05000	34.0	60.0
24.58000	29.9	60.0

Frequency MHz	AV Level dBuV	AV Limit dBuV
0.15000	37.9	56.0
0.22500	29.7	52.7
0.23500	31.1	52.3
0.28500	31.2	50.7
0.42500	40.4	47.4
0.52000	36.5	46.0
0.61500	34.3	46.0
0.71000	31.0	46.0
0.99000	33.3	46.0
1.18000	37.1	46.0
1.27500	37.6	46.0
1.56000	34.6	46.0
2.12500	35.3	46.0
2.37500	30.0	46.0
3.11500	29.8	46.0

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5.3.1 Detailed Test Data, Model TM2.4-1 (continued)

3.63500	30.0	46.0
4.48500	27.1	46.0
6.28000	29.6	50.0
6.84500	28.1	50.0
9.20500	28.6	50.0
12.18000	30.8	50.0
15.52000	30.9	50.0
17.30500	33.7	50.0
19.83000	28.8	50.0
24.73500	26.0	50.0

12. Dec 06 16:47

* limit exceeded

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Test of Sasse Elektronik GmbH Transceiver Module Model TM2.4-1 and Model TM2.4-2 to 47 CFR Part 15.249

5.3.1 Detailed Test Data, Model TM2.4-1 (continued)

EMCC DR.RASEK 12. Dec 06 16:57

Conducted Emissions

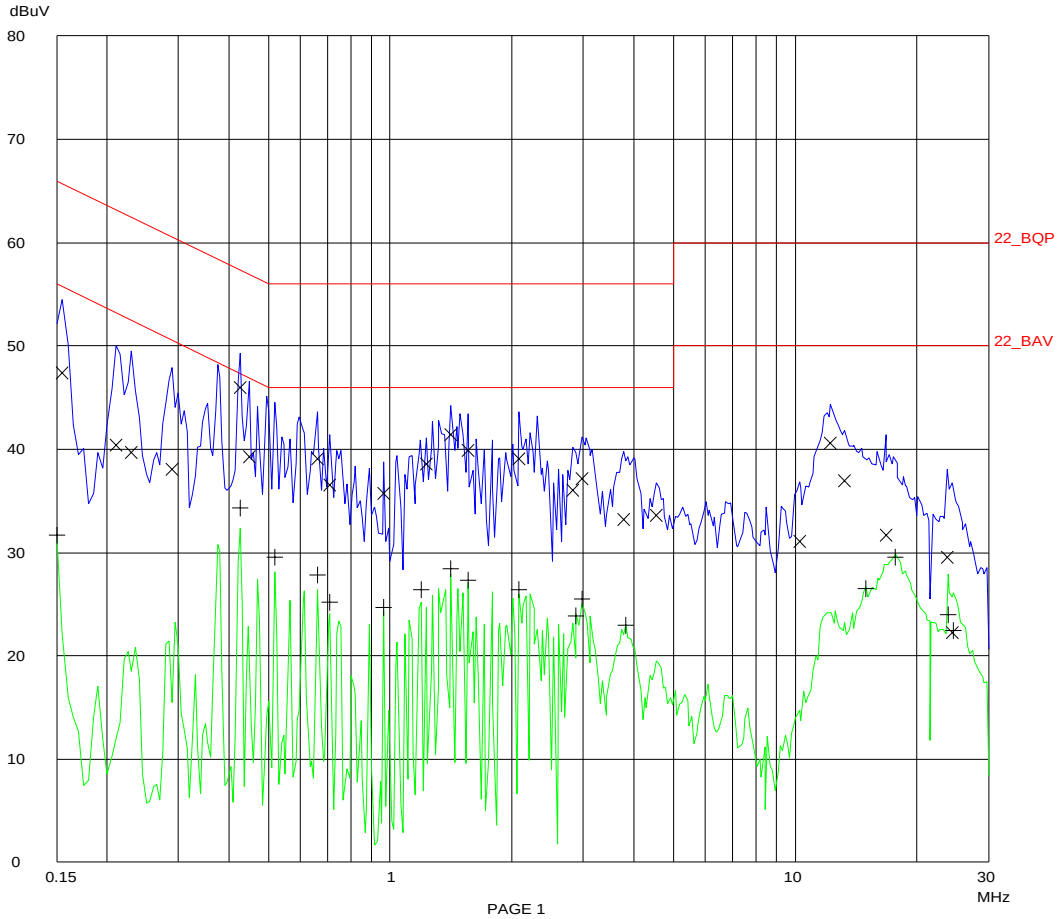
EUT: TM2.4-1
Manuf: SASSE
Op Cond: TX mode, modulated, integral antenna
Operator: Doering
Test Spec: 47CFR15
Comment: N
115V 60 Hz via Test board and AC Adapter (provided by SASSE)

Scan Settings (1 Range)
|--------- Frequencies ----------||---------- Receiver Settings ----------|

Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
150k	30M	5k	10k	PK+AV	10ms	AUTO	LN ON	60dB

Final Measurement: x QP / + AV
Meas Time: 1 s
Subranges: 25
Acc Margin: 25dB

Transducer No.	Start	Stop	Name
1	9k	30M	Limiter



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5.3.1 Detailed Test Data, Model TM2.4-1 (continued)

EMCC DR.RASEK 12. Dec 06 16:57

Conducted Emissions

EUT: TM2.4-1
Manuf: SASSE
Op Cond: TX mode, modulated, integral antenna
Operator: Doering
Test Spec: 47CFR15
Comment: N
115V 60 Hz via Test board and AC Adapter (provided by SASSE)

Scan Settings (1 Range)

Frequencies			Receiver Settings			
Start	Stop	Step	IF BW	Detector	M-Time	Atten Preamp OpRge
150k	30M	5k	10k	PK+AV	10ms AUTO LN	ON 60dB

Final Measurement Results:

Frequency MHz	QP Level dBuV	QP Limit dBuV
0.15500	47.3	65.7
0.21000	40.3	63.2
0.23000	39.6	62.4
0.29000	38.0	60.6
0.42500	46.0	57.4
0.45000	39.3	56.9
0.66000	39.0	56.0
0.71000	36.5	56.0
0.96500	35.7	56.0
1.22500	38.5	56.0
1.41000	41.3	56.0
1.56000	39.9	56.0
2.08000	39.1	56.0
2.82500	36.0	56.0
2.97500	37.1	56.0
3.77500	33.2	56.0
4.53500	33.6	56.0
10.26000	31.0	60.0
12.19000	40.5	60.0
13.23000	36.9	60.0
16.73000	31.6	60.0
23.79500	29.5	60.0
24.39500	22.2	60.0

Frequency MHz	AV Level dBuV	AV Limit dBuV
0.15000	31.6	56.0
0.42500	34.3	47.4
0.52000	29.5	46.0
0.66000	27.8	46.0
0.71000	25.2	46.0
0.96500	24.7	46.0
1.19000	26.4	46.0
1.41500	28.4	46.0
1.56000	27.2	46.0
2.08000	26.4	46.0
2.88000	23.8	46.0
2.97500	25.5	46.0
3.82500	22.9	46.0
14.94000	26.5	50.0
17.69000	29.5	50.0
23.86500	23.9	50.0
24.60500	22.4	50.0

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Test of Sasse Elektronik GmbH Transceiver Module Model TM2.4-1 and Model TM2.4-2 to 47 CFR Part 15.249

5.3.1 Detailed Test Data, Model TM2.4-1 (continued)

EMCC DR.RASEK 12. Dec 06 17:29

Conducted Emissions

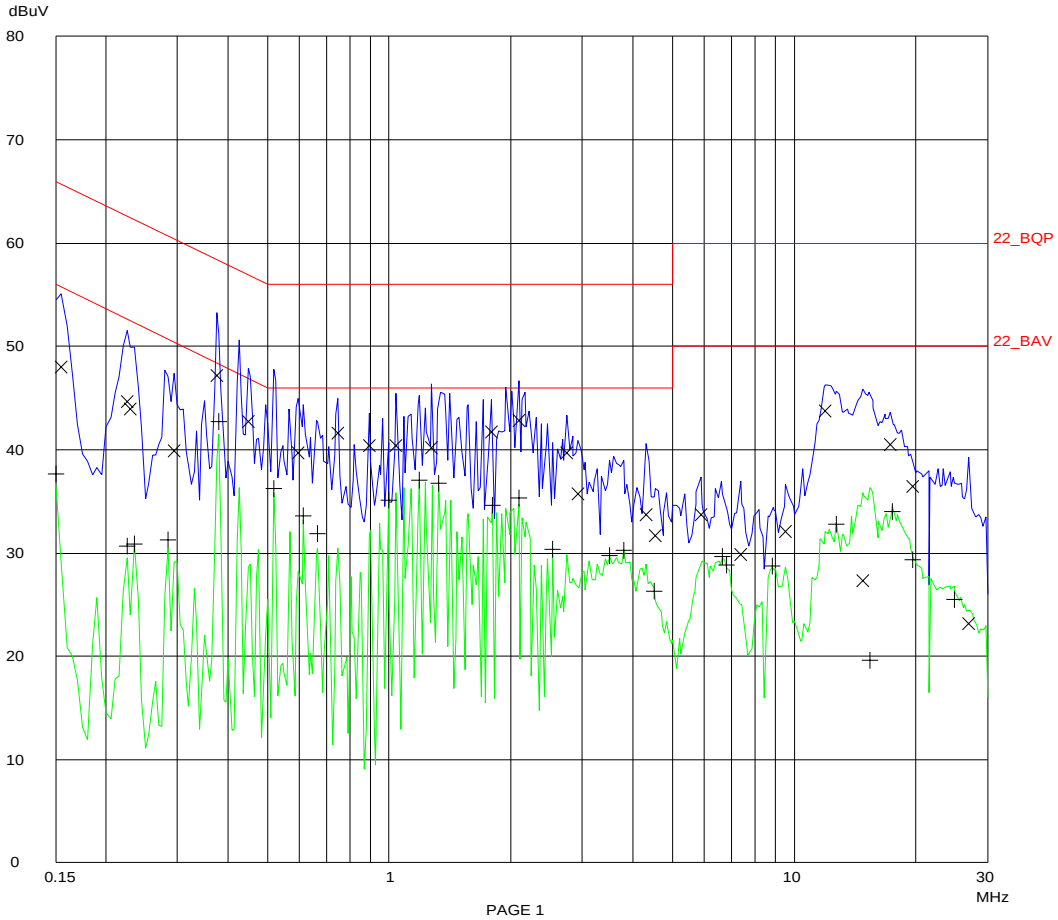
EUT: TM2.4-1
Manuf: SASSE
Op Cond: RX mode, integral antenna
Operator: Doering
Test Spec: 47CFR15
Comment: L
115V 60 Hz via Test board and AC Adapter (provided by SASSE)

Scan Settings (1 Range)
|--------- Frequencies ----------||---------- Receiver Settings ----------|

Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
150k	30M	5k	10k	PK+AV	10ms	AUTO	LN ON	60dB

Final Measurement: x QP / + AV
Meas Time: 1 s
Subranges: 25
Acc Margin: 25dB

Transducer No.	Start	Stop	Name
1	9k	30M	Limiter



5.3.1 Detailed Test Data, Model TM2.4-1 (continued)

EMCC DR.RASEK 12. Dec 06 17:29

Conducted Emissions

EUT: TM2.4-1
Manuf: SASSE
Op Cond: RX mode, integral antenna
Operator: Doering
Test Spec: 47CFR15
Comment: L
115V 60 Hz via Test board and AC Adapter (provided by SASSE)

Scan Settings (1 Range)

Frequencies			Receiver Settings			
Start	Stop	Step	IF BW	Detector	M-Time	Atten Preamp OpRge
150k	30M	5k	10k	PK+AV	10ms AUTO LN ON	60dB

Final Measurement Results:

Frequency MHz	QP Level dBuV	QP Limit dBuV
0.15500	48.0	65.7
0.22500	44.6	62.7
0.23000	43.9	62.4
0.29500	39.9	60.3
0.37500	47.1	58.4
0.45000	42.7	56.9
0.59500	39.6	56.0
0.74500	41.6	56.0
0.89500	40.3	56.0
1.04000	40.4	56.0
1.27500	40.2	56.0
1.78500	41.7	56.0
2.08500	42.8	56.0
2.75000	39.7	56.0
2.93000	35.7	56.0
4.31000	33.7	56.0
4.53500	31.6	56.0
5.87500	33.6	60.0
7.36500	29.8	60.0
9.52000	32.1	60.0
11.90000	43.7	60.0
14.79500	27.3	60.0
17.26000	40.5	60.0
19.64000	36.4	60.0
26.99000	23.1	60.0

Frequency MHz	AV Level dBuV	AV Limit dBuV
0.15000	37.6	56.0
0.22500	30.6	52.7
0.23500	30.8	52.3
0.28500	31.2	50.7
0.38000	42.7	48.3
0.52000	36.2	46.0
0.61500	33.5	46.0
0.66500	31.8	46.0
0.99500	35.1	46.0
1.18500	37.0	46.0
1.32500	36.7	46.0
1.80000	34.6	46.0
2.08500	35.3	46.0
2.53000	30.3	46.0
3.50500	29.7	46.0

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5.3.1 Detailed Test Data, Model TM2.4-1 (continued)

3.79000	30.2	46.0
4.50000	26.3	46.0
6.63000	29.6	50.0
6.82000	28.8	50.0
8.81000	28.7	50.0
12.71500	32.8	50.0
15.39000	19.6	50.0
17.48500	33.9	50.0
19.64000	29.3	50.0
24.85000	25.4	50.0

12. Dec 06 17:29

* limit exceeded

Test of Sasse Elektronik GmbH Transceiver Module Model TM2.4-1 and Model TM2.4-2 to 47 CFR Part 15.249

5.3.1 Detailed Test Data, Model TM2.4-1 (continued)

EMCC DR.RASEK 12. Dec 06 17:12

Conducted Emissions

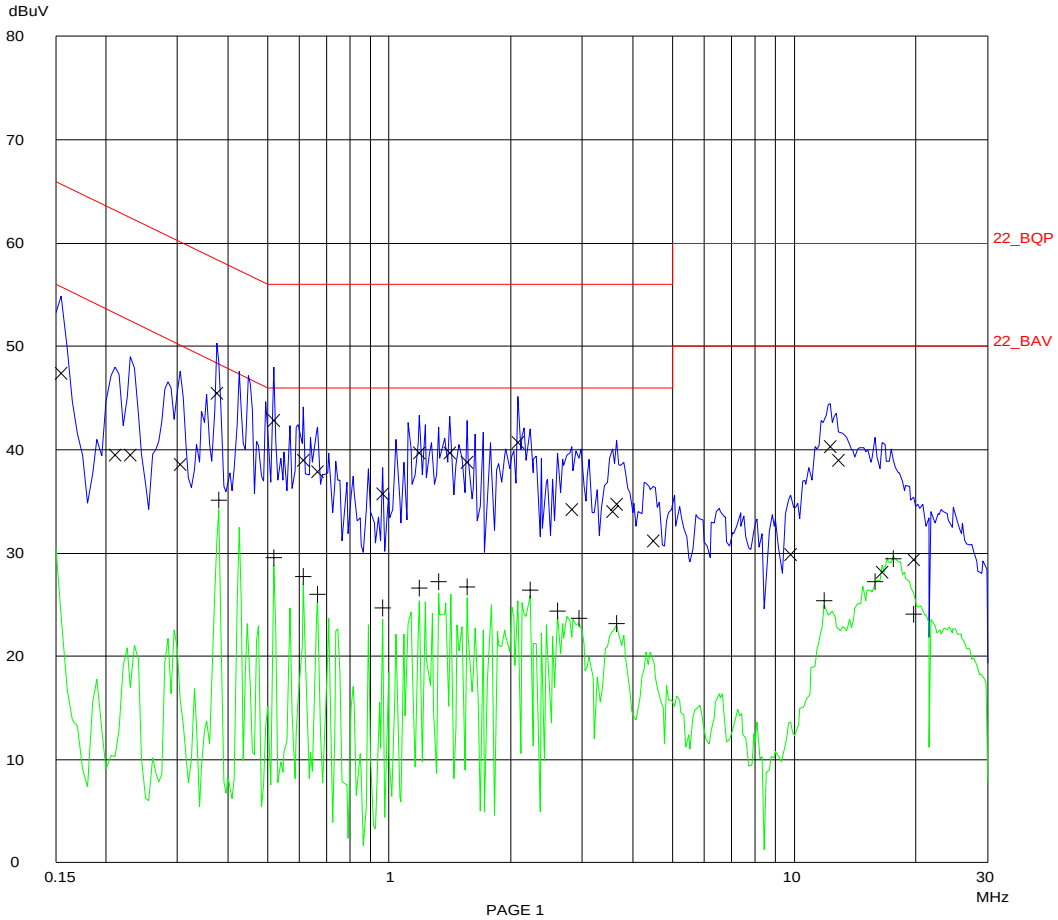
EUT: TM2.4-1
Manuf: SASSE
Op Cond: RX mode, integral antenna
Operator: Doering
Test Spec: 47CFR15
Comment: N
115V 60 Hz via Test board and AC Adapter (provided by SASSE)

Scan Settings (1 Range)
|--------- Frequencies ----------||---------- Receiver Settings ----------|

Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
150k	30M	5k	10k	PK+AV	10ms	AUTO	LN ON	60dB

Final Measurement: x QP / + AV
Meas Time: 1 s
Subranges: 25
Acc Margin: 25dB

Transducer No.	Start	Stop	Name
1	9k	30M	Limiter



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Test of Sasse Elektronik GmbH Transceiver Module Model TM2.4-1 and Model TM2.4-2 to 47 CFR Part 15.249

5.3.1 Detailed Test Data, Model TM2.4-1 (continued)

EMCC DR.RASEK 12. Dec 06 17:12

Conducted Emissions

EUT: TM2.4-1
Manuf: SASSE
Op Cond: RX mode, integral antenna
Operator: Doering
Test Spec: 47CFR15
Comment: N
115V 60 Hz via Test board and AC Adapter (provided by SASSE)

Scan Settings (1 Range)

Frequencies			Receiver Settings			
Start	Stop	Step	IF BW	Detector	M-Time	Atten Preamp OpRge
150k	30M	5k	10k	PK+AV	10ms AUTO LN ON	60dB

Final Measurement Results:

Frequency MHz	QP Level dBuV	QP Limit dBuV
0.15500	47.4	65.7
0.21000	39.5	63.2
0.23000	39.5	62.4
0.30500	38.5	60.1
0.37500	45.4	58.4
0.52000	42.7	56.0
0.61500	38.9	56.0
0.66500	37.8	56.0
0.96500	35.7	56.0
1.18500	39.6	56.0
1.41500	39.7	56.0
1.56000	38.8	56.0
2.08000	40.7	56.0
2.82500	34.2	56.0
3.55000	33.9	56.0
3.64000	34.7	56.0
4.49000	31.2	56.0
9.81000	29.8	60.0
12.26500	40.2	60.0
12.86000	39.0	60.0
16.51000	28.1	60.0
19.77000	29.3	60.0

Frequency MHz	AV Level dBuV	AV Limit dBuV
0.38000	35.0	48.3
0.52000	29.5	46.0
0.61500	27.7	46.0
0.66500	25.9	46.0
0.96500	24.7	46.0
1.18500	26.6	46.0
1.32500	27.2	46.0
1.56000	26.7	46.0
2.23000	26.4	46.0
2.60000	24.4	46.0
2.93500	23.6	46.0
3.64500	23.1	46.0
11.89000	25.3	50.0
15.83000	27.2	50.0
17.54000	29.4	50.0
19.77000	24.1	50.0

* limit exceeded

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Test of Sasse Elektronik GmbH Transceiver Module Model TM2.4-1 and Model TM2.4-2 to 47 CFR Part 15.249

5.3.2 Detailed Test Data, Model TM2.4-2

EMCC DR.RASEK

12. Dec 06 16:17

Conducted Emissions

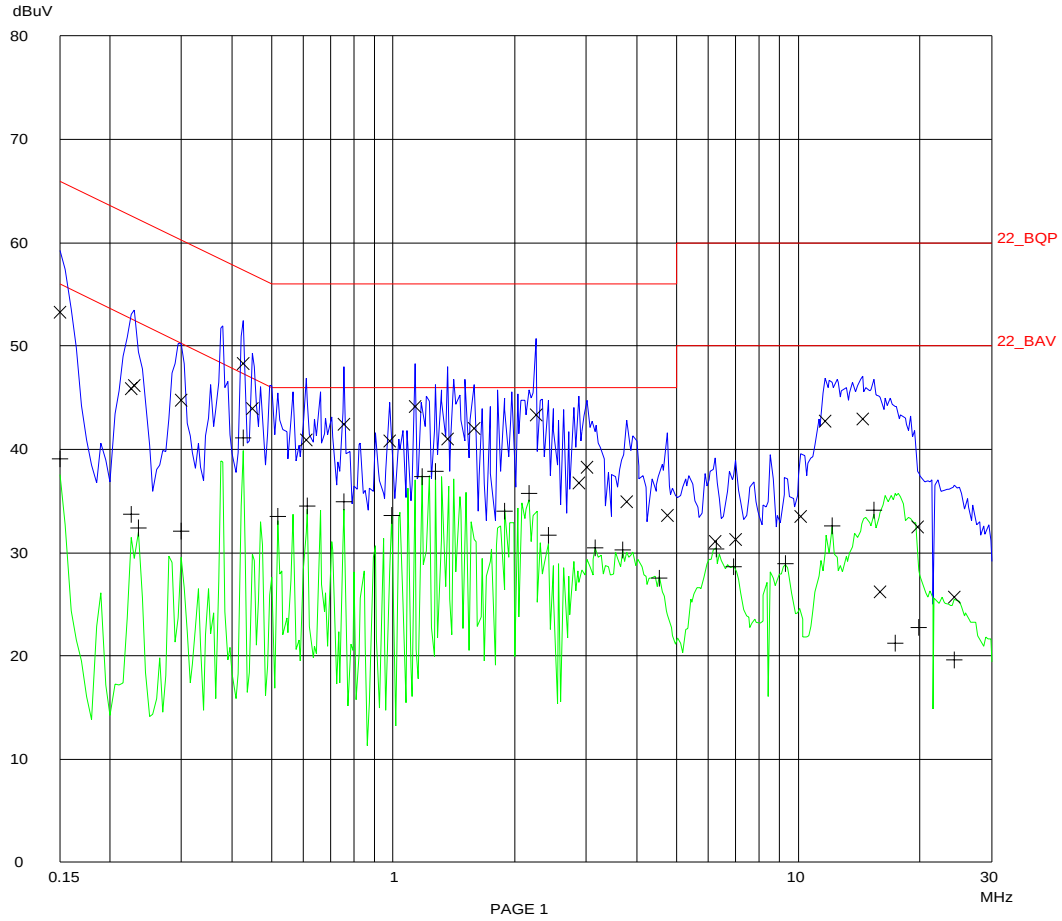
EUT: TM2.4-2
Manuf: SASSE
Op Cond: TX mode, modulated, blade antenna
Operator: Doering
Test Spec: 47CFR15
Comment: L
115V 60 Hz via Test board and AC Adapter (provided by SASSE)

Scan Settings (1 Range)

Frequencies			Receiver Settings					
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
150k	30M	5k	10k	PK+AV	10ms	AUTO	LN ON	60dB

Final Measurement: x QP / + AV
Meas Time: 1 s
Subranges: 25
Acc Margin: 25dB

Transducer No.	Start	Stop	Name
1	9k	30M	Limiter



5.3.2 Detailed Test Data, Model TM2.4-2 (continued)

EMCC DR.RASEK 12. Dec 06 16:17

Conducted Emissions

EUT: TM2.4-2
Manuf: SASSE
Op Cond: TX mode, modulated, blade antenna
Operator: Doering
Test Spec: 47CFR15
Comment: L
115V 60 Hz via Test board and AC Adapter (provided by SASSE)

Scan Settings (1 Range)

Frequencies			Receiver Settings				
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
150k	30M	5k	10k	PK+AV	10ms	AUTO	LN ON	60dB

Final Measurement Results:

Frequency MHz	QP Level dBuV	QP Limit dBuV
0.15000	53.2	66.0
0.22500	45.8	62.7
0.23000	46.2	62.4
0.30000	44.7	60.2
0.42500	48.3	57.4
0.45000	43.9	56.9
0.61000	40.9	56.0
0.75500	42.4	56.0
0.98000	40.8	56.0
1.13000	44.1	56.0
1.36000	41.0	56.0
1.58500	42.0	56.0
2.26000	43.3	56.0
2.87000	36.7	56.0
3.01000	38.2	56.0
3.76500	34.9	56.0
4.75000	33.6	56.0
6.25500	31.0	60.0
7.01000	31.2	60.0
10.17000	33.5	60.0
11.67500	42.7	60.0
14.46000	42.9	60.0
15.96500	26.2	60.0
19.71000	32.5	60.0
24.29500	25.6	60.0

Frequency MHz	AV Level dBuV	AV Limit dBuV
0.15000	39.0	56.0
0.22500	33.7	52.7
0.23500	32.3	52.3
0.30000	32.1	50.2
0.42500	41.1	47.4
0.52000	33.4	46.0
0.61500	34.5	46.0
0.75500	34.8	46.0
0.99000	33.6	46.0
1.18000	37.4	46.0
1.27500	37.8	46.0
1.88500	34.0	46.0
2.17000	35.7	46.0
2.41000	31.7	46.0
3.16000	30.4	46.0

5.3.2 Detailed Test Data, Model TM2.4-2 (continued)

3.68000	30.2	46.0
4.53000	27.5	46.0
6.27500	30.4	50.0
6.93500	28.6	50.0
9.29500	28.9	50.0
12.12500	32.5	50.0
15.36000	34.0	50.0
17.32000	21.2	50.0
19.86500	22.7	50.0
24.29500	19.6	50.0

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* limit exceeded

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Test of Sasse Elektronik GmbH Transceiver Module Model TM2.4-1 and Model TM2.4-2 to 47 CFR Part 15.249

5.3.2 Detailed Test Data, Model TM2.4-2 (continued)

EMCC DR.RASEK 12. Dec 06 16:04

Conducted Emissions

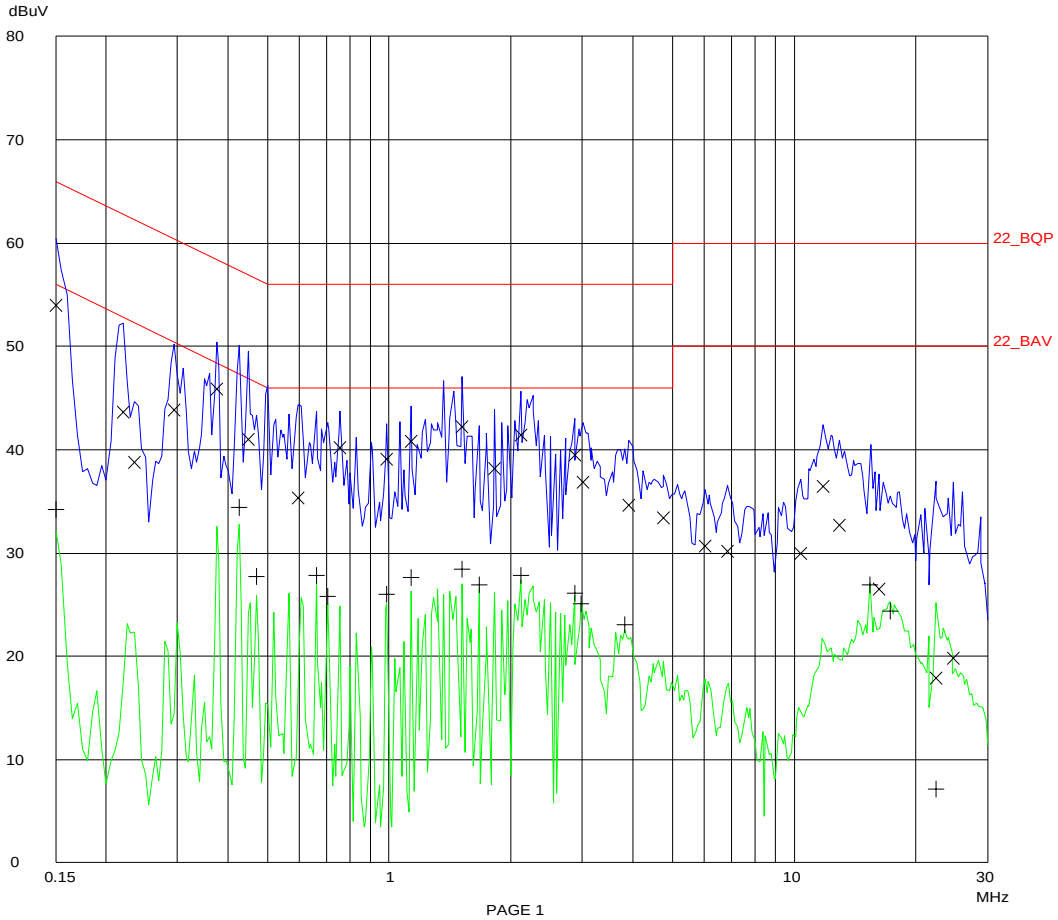
EUT: TM2.4-2
Manuf: SASSE
Op Cond: TX mode, modulated, blade antenna
Operator: Doering
Test Spec: 47CFR15
Comment: N
115V 60 Hz via Test board and AC Adapter (provided by SASSE)

Scan Settings (1 Range)

Frequencies			Receiver Settings				
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
150k	30M	5k	10k	PK+AV	10ms	AUTO	LN ON	60dB

Final Measurement: x QP / + AV
Meas Time: 1 s
Subranges: 25
Acc Margin: 25dB

Transducer No.	Start	Stop	Name
1	9k	30M	Limiter



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5.3.3 Detailed Test Data, Model TM2.4-2 (continued)

EMCC DR.RASEK 12. Dec 06 16:04

Conducted Emissions

EUT: TM2.4-2
Manuf: SASSE
Op Cond: TX mode, modulated, blade antenna
Operator: Doering
Test Spec: 47CFR15
Comment: N
115V 60 Hz via Test board and AC Adapter (provided by SASSE)

Scan Settings (1 Range)

Frequencies			Receiver Settings				
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
150k	30M	5k	10k	PK+AV	10ms	AUTO	LN ON	60dB

Final Measurement Results:

Frequency MHz	QP Level dBuV	QP Limit dBuV
0.15000	53.9	66.0
0.22000	43.6	62.9
0.23500	38.7	62.3
0.29500	43.8	60.3
0.37500	45.8	58.4
0.45000	40.9	56.9
0.59500	35.3	56.0
0.75500	40.2	56.0
0.98500	39.0	56.0
1.13500	40.8	56.0
1.51000	42.1	56.0
1.81500	38.1	56.0
2.12000	41.4	56.0
2.87500	39.4	56.0
3.01500	36.8	56.0
3.91000	34.6	56.0
4.76500	33.4	56.0
6.03000	30.6	60.0
6.83000	30.2	60.0
10.36000	29.9	60.0
11.79500	36.4	60.0
12.93000	32.7	60.0
16.18000	26.5	60.0
22.38500	17.9	60.0
24.66000	19.8	60.0

Frequency MHz	AV Level dBuV	AV Limit dBuV
0.15000	34.1	56.0
0.42500	34.3	47.4
0.47000	27.7	46.5
0.66000	27.7	46.0
0.70500	25.8	46.0
0.98500	26.0	46.0
1.13500	27.6	46.0
1.51000	28.4	46.0
1.66500	26.9	46.0
2.12000	27.8	46.0
2.87500	26.1	46.0
2.97000	25.1	46.0
3.82000	23.1	46.0
15.36000	26.9	50.0
17.23500	24.3	50.0

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5.3.4 Detailed Test Data, Model TM2.4-2 (continued)

22.38500 7.1 50.0

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* limit exceeded

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Test of Sasse Elektronik GmbH Transceiver Module Model TM2.4-1 and Model TM2.4-2 to 47 CFR Part 15.249

5.3.5 Detailed Test Data, Model TM2.4-2 (continued)

EMCC DR.RASEK 12. Dec 06 15:51

Conducted Emissions

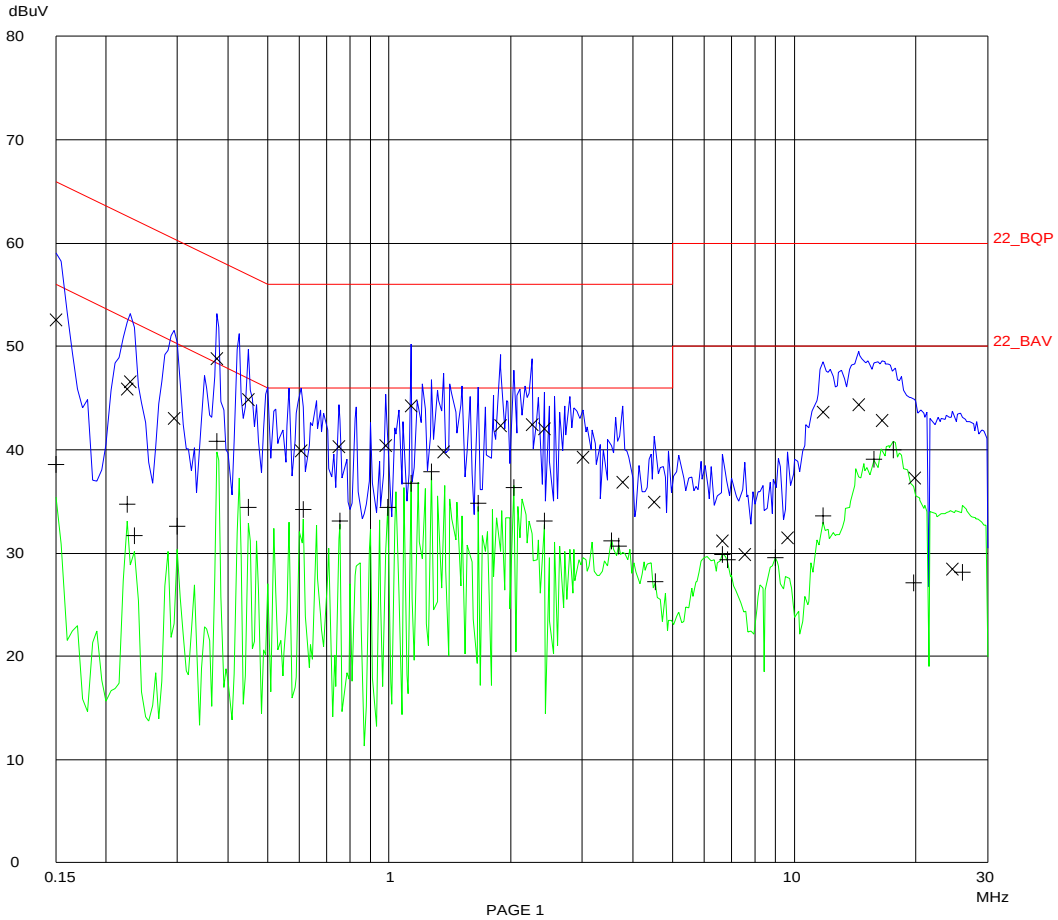
EUT: TM2.4-2
Manuf: SASSE
Op Cond: RX mode, blade antenna
Operator: Doering
Test Spec: 47CFR15
Comment: L
115V 60 Hz via Test board and AC Adapter (provided by SASSE)

Scan Settings (1 Range)

Frequencies			Receiver Settings				
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
150k	30M	5k	10k	PK+AV	10ms	AUTO	LN ON	60dB

Final Measurement: x QP / + AV
Meas Time: 1 s
Subranges: 25
Acc Margin: 25dB

Transducer No.	Start	Stop	Name
1	9k	30M	Limiter



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5.3.6 Detailed Test Data, Model TM2.4-2 (continued)

EMCC DR.RASEK 12. Dec 06 15:51

Conducted Emissions

EUT: TM2.4-2
Manuf: SASSE
Op Cond: RX mode, blade antenna
Operator: Doering
Test Spec: 47CFR15
Comment: L
115V 60 Hz via Test board and AC Adapter (provided by SASSE)

Scan Settings (1 Range)

Frequencies			Receiver Settings				
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
150k	30M	5k	10k	PK+AV	10ms	AUTO	LN ON	60dB

Final Measurement Results:

Frequency MHz	QP Level dBuV	QP Limit dBuV
0.15000	52.6	66.0
0.22500	45.9	62.7
0.23000	46.5	62.4
0.29500	43.0	60.3
0.37500	48.7	58.4
0.45000	44.8	56.9
0.60500	39.9	56.0
0.75000	40.3	56.0
0.98000	40.4	56.0
1.13000	44.2	56.0
1.36000	39.7	56.0
1.88000	42.3	56.0
2.26000	42.4	56.0
2.41000	42.0	56.0
3.01000	39.2	56.0
3.76500	36.8	56.0
4.52000	34.9	56.0
6.63500	31.1	60.0
7.53000	29.9	60.0
9.64500	31.5	60.0
11.76000	43.6	60.0
14.40000	44.3	60.0
16.51500	42.8	60.0
19.84000	37.3	60.0
24.60000	28.4	60.0

Frequency MHz	AV Level dBuV	AV Limit dBuV
0.15000	38.6	56.0
0.22500	34.7	52.7
0.23500	31.6	52.3
0.30000	32.5	50.2
0.37500	40.8	48.4
0.45000	34.3	46.9
0.61500	34.1	46.0
0.75500	33.0	46.0
0.99000	34.4	46.0
1.13500	36.7	46.0
1.27500	37.9	46.0
1.65500	34.8	46.0
2.03000	36.3	46.0
2.41000	33.0	46.0
3.54000	31.1	46.0

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5.3.7 Detailed Test Data, Model TM2.4-2 (continued)

3.68500	30.6	46.0
4.53500	27.2	46.0
6.66000	29.8	50.0
6.85000	29.3	50.0
8.97500	29.5	50.0
11.76000	33.5	50.0
15.76000	39.0	50.0
17.57500	39.9	50.0
19.76500	27.1	50.0
26.04000	28.0	50.0

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* limit exceeded

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Test of Sasse Elektronik GmbH Transceiver Module Model TM2.4-1 and Model TM2.4-2 to 47 CFR Part 15.249

5.3.8 Detailed Test Data, Model TM2.4-2 (continued)

EMCC DR.RASEK 12. Dec 06 15:16

Conducted Emissions

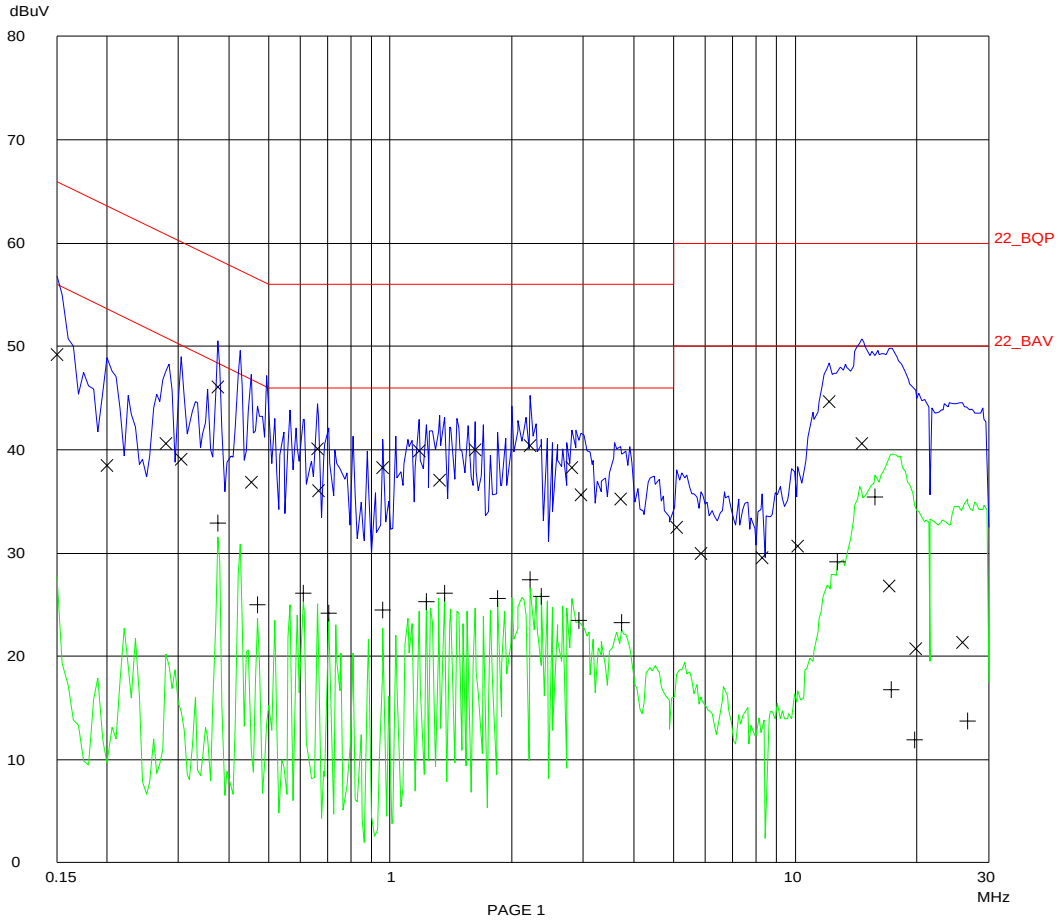
EUT: TM2.4-2
Manuf: SASSE
Op Cond: RX mode, blade antenna
Operator: Doering
Test Spec: 47CFR15
Comment: N
115V 60 Hz via Test board and AC Adapter (provided by SASSE)

Scan Settings (1 Range)

Frequencies			Receiver Settings				
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
150k	30M	5k	10k	PK+AV	10ms	AUTO	LN ON	60dB

Final Measurement: x QP / + AV
Meas Time: 1 s
Subranges: 25
Acc Margin: 25dB

Transducer No.	Start	Stop	Name
1	9k	30M	Limiter



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5.3.9 Detailed Test Data, Model TM2.4-2 (continued)

EMCC DR.RASEK 12. Dec 06 15:16

Conducted Emissions

EUT: TM2.4-2
Manuf: SASSE
Op Cond: RX mode, blade antenna
Operator: Doering
Test Spec: 47CFR15
Comment: N
115V 60 Hz via Test board and AC Adapter (provided by SASSE)

Scan Settings (1 Range)

Frequencies			Receiver Settings				
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
150k	30M	5k	10k	PK+AV	10ms	AUTO	LN ON	60dB

Final Measurement Results:

Frequency MHz	QP Level dBuV	QP Limit dBuV
0.15000	49.1	66.0
0.20000	38.4	63.6
0.28000	40.5	60.8
0.30500	39.0	60.1
0.37500	46.1	58.4
0.45500	36.8	56.8
0.66000	40.0	56.0
0.66500	36.0	56.0
0.96000	38.2	56.0
1.18000	39.8	56.0
1.32500	37.0	56.0
1.62500	39.9	56.0
2.21500	40.4	56.0
2.81000	38.2	56.0
2.95500	35.6	56.0
3.70000	35.2	56.0
5.11000	32.5	60.0
5.85000	29.9	60.0
8.30500	29.5	60.0
10.17000	30.7	60.0
12.11500	44.6	60.0
14.58000	40.6	60.0
17.05000	26.8	60.0
19.83000	20.7	60.0
25.84500	21.3	60.0

Frequency MHz	AV Level dBuV	AV Limit dBuV
0.37500	32.9	48.4
0.47000	25.0	46.5
0.61000	26.1	46.0
0.70500	24.1	46.0
0.96000	24.4	46.0
1.22500	25.2	46.0
1.36500	26.1	46.0
1.84500	25.6	46.0
2.21500	27.4	46.0
2.36500	25.8	46.0
2.92500	23.4	46.0
3.72500	23.2	46.0
12.71000	29.1	50.0
15.77500	35.4	50.0
17.27500	16.7	50.0

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5.3.10 Detailed Test Data, Model TM2.4-2 (continued)

19.68000	11.8	50.0
26.59500	13.7	50.0

12. Dec 06 15:16

* limit exceeded

6 RADIATED EMISSIONS

Test Requirement: FCC 47 CFR, Part 15C
Test Procedure: ANSI C63.4-2003

6.1 Regulation

Section 15.33 Frequency range of radiated measurements:
(a) Unless otherwise noted in the specific rule section under which the equipment operates for an intentional radiator the spectrum shall be investigated from the lowest radio frequency signal generated in the device, without going below 9 kHz, up to at least the frequency shown in this paragraph:
(1) If the intentional radiator operates below 10 GHz: to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.
(4) If the intentional radiator contains a digital device, regardless of whether this digital device controls the functions of the intentional radiator or the digital device is used for additional control or function purposes other than to enable the operation of the intentional radiator, the frequency range shall be investigated up to the range specified in paragraphs (a)(1)-(a)(3) of this section or the range applicable to the digital device, as shown in paragraph (b)(1) of this Section, whichever is the higher frequency range of investigation.
(b) For unintentional radiators *[Remark: Applies to the receiver part / receive mode]*:
(1) Except as otherwise indicated in paragraphs (b)(2) or (b)(3), for an unintentional radiator, including a digital device, the spectrum shall be investigated from the lowest radio frequency signal generated or used in the device, without going below the lowest frequency for which a radiated emission limit is specified, up to the frequency shown in the following table:

Highest frequency generated or used in the device or on which the device operates or tunes (MHz)	Upper frequency of measurement (MHz)
Below 1.705	30
1.705 - 108	1000
108 - 500	2000
500 - 1000	5000
Above 1000	5th harmonic of the highest frequency or 40 GHz, whichever is lower

(3) Except for a CB receiver, a receiver employing superheterodyne techniques shall be investigated from 30 MHz up to at least the second harmonic of the highest local oscillator frequency generated in the device. If such receiver is controlled by a digital device, the frequency range shall be investigated up to the higher of the second harmonic of the highest local oscillator frequency generated in the device or the upper frequency of the measurement range specified for the digital device in paragraph (b)(1) of this Section.

Section 15.35 Measurement detector functions and bandwidths.
The conducted and radiated emission limits shown in this Part are based on the following, unless otherwise specified elsewhere in this Part:
(a) On any frequency or frequencies below or equal to 1000 MHz, the limits shown are based on measuring equipment employing a CISPR quasi-peak detector function and related measurement bandwidths, unless otherwise specified. The specifications for the measuring instrument using the CISPR quasi-peak detector can be found in Publication 16 of the International Special Committee on Radio Interference (CISPR) of the International Electrotechnical Commission. As an alternative to CISPR quasi-peak measurements, the responsible party, at its option, may demonstrate compliance

with the emission limits using measuring equipment employing a peak detector function, properly adjusted for such factors as pulse desensitization, as long as the same bandwidths as indicated for CISPR quasi-peak measurements are employed.
Note: For pulse modulated devices with a pulse-repetition frequency of 20 Hz or less and for which CISPR quasi-peak measurements are specified, compliance with the regulations shall be demonstrated using measuring equipment employing a peak detector function, properly adjusted for such factors as pulse desensitization, using the same measurement bandwidths that are indicated for CISPR quasi-peak measurements.
(b) On any frequency of frequencies above 1000 MHz, the radiated limits shown are based upon the use of measurement instrumentation employing an average detector function. When average radiated emission measurements are specified in the regulations, including emission measurements below 1000 MHz, there is also a limit on the radio frequency emissions, as measured using instrumentation with a peak detector function, corresponding to 20 dB above the maximum permitted average limit for the frequency being investigated unless a different peak emission limit is otherwise specified in the rules in this part, e.g., see § 15.255. Unless otherwise specified, measurements above 1000 MHz shall be performed using a minimum resolution bandwidth of 1 MHz. Measurement of AC power line conducted emissions are performed using a CISPR quasipeak detector, even for devices for which average radiated emission measurements are specified.
(c) Unless otherwise specified, e.g. Section 15.255(b), when the radiated emission limits are expressed in terms of the average value of the emission, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum value. The exact method of calculating the average field strength shall be submitted with any application for certification or shall be retained in the measurement data file for equipment subject to notification or verification.

Section 15.209 (a) Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency	Field Strength	Measurement distance
(MHz)	(microvolts/meter)	(meters)
0.009–0.490	2400/F(kHz)	300
0.490–1.705	24000/F(kHz)	30
1.705–30.0	30	30
30–88	100	3
88–216	150	3
216–960	200	3
Above 960	500	3

(b) In the emission table above, the tighter limit applies at the band edges.
(c) The level of any unwanted emissions from an intentional radiator operating under these general provisions shall not exceed the level of the fundamental emission. For intentional radiators which operate under the provisions of other sections within this part and which are required to reduce their unwanted emissions to the limits specified in this table, the limits in this table are based on the frequency of the unwanted emission and not the fundamental frequency. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency.
(d) The emission limits shown in the above table are based on measurements employing a CISPR quasi peak detector except for the frequency bands 9–90 kHz, 110–490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.

(e) The provisions in §§ 15.31, 15.33, and 15.35 for measuring emissions at distances other than the distances specified in the above table, determining the frequency range over which radiated emissions are to be measured, and limiting peak emissions apply to all devices operated under this part.
(f) In accordance with Section 15.33(a), in some cases the emissions from an intentional radiator must be measured to beyond the tenth harmonic of the highest fundamental frequency designed to be emitted by the intentional radiator because of the incorporation of a digital device. If measurements above the tenth harmonic are so required, the radiated emissions above the tenth harmonic shall comply with the general radiated emission limits applicable to the incorporated digital device, as shown in Section 15.109 and as based on the frequency of the emission being measured, or, except for emissions contained in the restricted frequency bands shown in Section 15.205, the limit on spurious emissions specified for the intentional radiator, whichever is the higher limit. Emissions which must be measured above the tenth harmonic of the highest fundamental frequency designed to be emitted by the intentional radiator and which fall within the restricted bands shall comply with the general radiated emission limits in Section 15.109 that are applicable to the incorporated digital device.

Section 15.109 Radiated emission limits *[Remark: Applies to the receiver part / receive mode].*
(a) Except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values:

Frequency	Field Strength
(MHz)	(microvolts/meter)
30–88	100
88–216	150
216–960	200
Above 960	500

Section 15.249 Operation within the bands 902 - 928 MHz, 2400 - 2483.5 MHz, 5725 - 5875 MHz, and 24.0 - 24.25 GHz.
(a) Except as provided in paragraph (b) of this section, the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Fundamental Frequency	Field Strength of Fundamental	Field Strength of Harmonics
(MHz)	(millivolts/meter)	(microvolts/meter)
902 - 928	50	500
2400 - 2483.5	50	500
5725 - 5875	50	500
24,000 – 24,250	250	2500

(c) Field strength limits are specified at a distance of 3 meters.
(d) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in Section 15.209, whichever is the lesser attenuation.
(e) As shown in Section 15.35(b), for frequencies above 1000 MHz, the above field strength limits in paragraphs (a) and (b) of this section are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.

6.2 Test Equipment

Type	Manufacturer/ Model No.	EMCC Ident No.	Last Calibration	Calibration Interval
Antenna (30 MHz - 1 GHz)	EMCO Model 3143	897	2006-06	12 months
Receiver (30 MHz - 1 GHz)	Rohde & Schwarz ESS	264	2006-08	24 months
EMI Receiver / Analyzer (1 GHz – 25 GHz)	Rohde & Schwarz ESIB 40	516	2005-11	24 months
Antenna (1 GHz – 18 GHz)	Schwarzbeck BBHA 9120 D	549	2006-12	24 months
Standard Gain Horn Antenna (18 GHz – 25 GHz)	Mid Century MC 20/31B	1300	2006-08	24 months

6.3 Test Procedures

For tabletop equipment, the EUT is placed on a 1 meter by 1.5 meters wide and 0.8 meter high nonconductive table that is placed above the groundplane. Ceiling or wall-mounted devices also is positioned on a tabletop for testing purposes. Floor standing equipment is placed either directly on the groundplane or on insulating material if normally placed on a nonconducting floor. *[Remark: Not applicable].* The EUT is connected to its associated peripherals, with any excess I/O cabling bundled to approximately 1 meter.
Per ANSI C63.4-2003 clause 6.1.2.1
In certain applications, a remotely located device may be connected to the EUT. In these cases, it is permissible for cabling from the remotely located device to the EUT or accessories to be placed directly on the reference groundplane or, if normally installed beneath the reference groundplane, beneath it. The remotely located device shall be located at a distance sufficient to ensure that it does not contribute to the measured level. This procedure evaluates the interference potential of the EUT, its accessories, and interconnecting cables or wires standing apart from the remotely located device, which in turn shall be evaluated separately, if required. *[Remark: Not applicable].*

The EUT was tested on a 0.8 meter high tabletop. Measurement above 1 GHz performed placing the EUT at 1.5 meter high for better alignment with the antenna.

With the EUT operating in "worst case" mode, emissions from the unit are maximized by adjusting the polarization and height of the receive antenna and rotating the EUT on the turntable. Manipulating the system cables also maximizes EUT emissions *[Remark: Not applicable]*. All tests performed with the EUT placed in both vertical and horizontal polarizations on the nonconductive table. Worst case emissions are listed under chapter: test results.

Radiated Emissions Test Characteristics	
Frequency range	30 MHz - 25,000 MHz
Test distance	3 m*
Test instrumentation resolution bandwidth	120 kHz (30 MHz - 1,000 MHz)
	1 MHz (1,000 MHz - 25,000 MHz)
Receive antenna scan height	1 m - 4 m
Receive antenna polarization	Vertical/Horizontal

* According to Section 15.31 (f)(1): At frequencies at or above 30 MHz, measurements may be performed at a distance other than what is specified provided: measurements are not made in the near

field except where it can be shown that near field measurements are appropriate due to the characteristics of the device; and it can be demonstrated that the signal levels needed to be measured at the distance employed can be detected by the measurement equipment. (...) When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade (inverse linear-distance for field strength measurements; inverse-linear-distance-squared for power density measurements).

6.4 Calculation of Field Strength Limits

E.g. radiated spurious emissions field strength limits for the restricted band 108-121.94 MHz:

µV/m at 3 meters = 150

150 µV/m corresponds with 43.5 dBµV/m.

6.5 Calculation of Average Correction Factor

The average correction factor is computed by analyzing the "worst case" on time in any 100 mSec time period and using the formula:

Corrections Factor (dB) = 20*log (worst case on time/100 mSec)

The relationship between average and peak mode reading has been confirmed by direct measurement using the receiver's average and peak detectors.

All emission measurements performed using the test receiver's average detector and the max. hold facility; i.e. the average value measured directly without the necessity of additional correction factor.

6.6 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor. The basic equation with a sample calculation is as follows:

FS = RA + AF + CF
where
FS = Field Strength in dBµV/m
RA = Receiver Amplitude in dBµV
AF = Antenna Factor in dB(1/m)
CF = Cable Attenuation Factor in dB

Assume a receiver reading of 23.5 dBµV is obtained. The Antenna Factor of 7.4 dB(1/m) and a Cable Factor of 1.1 dB are added, giving a field strength of 32 dBµV/m. The 32 dBµV/m value can be mathematically converted to its corresponding level in µV/m.

FS = 23.5 + 7.4 + 1.1 = 32 [dBµV/m]

Level in µV/m = Common Antilogarithm (32/20) = 39.8

All emission measurements in the range 1 - 18 GHz performed using the test receiver's transducer factor setting capability, i.e. the field strength value measured directly without the necessity of additional correction factors.

For test distance other than what is specified, but fulfilling the requirements of Section 15.31 (f)(1) the field strength is calculated by adding additionally an extrapolation factor of 20 dB/decade (inverse linear-distance for field strength measurements). The basic equation with a sample calculation is as follows:

FS = FST + DF
where
FS = Field Strength in dBµV/m
FST = Field Strength at test distance in dBµV/m
DF = Distance Extrapolation Factor in dB,
where DF = 20 log (Dtest/Dspec) where Dtest = Test Distance and Dspec = Specified Distance

Assume the tests performed at a reduced Test Distance of 1.5 m instead of the Specified Distance of 3 m giving a Distance Extrapolation Factor of DF = 20 log(1.5m/3m) = -6 dB.
Assuming a measured field strength level of 32 dBµV/m is obtained. The Distance Factor of -6 dB is added, giving a field strength of 26 dBµV/m. The 26 dBµV/m value can be mathematically converted to its corresponding level in µV/m.

FS = 23.5 + 7.4 + 1.1 - 6 = 26 [dBµV/m]
Level in µV/m = Common Antilogarithm (26/20) = 20

6.7 Test Results

Manufacturer: Sasse Elektronik GmbH
Device: Transceiver Module
Model No.: **TM2.4-1, TM2.4-2**
Serial Number: **00017, 00016**

For transmitter bandwidth plots and band-edge compliance plots refer to **Annex 4**.

The EUT meets the requirements of this section.

Test Personnel: Wolfgang Döring

Test Date: 2006-12-06 ... 08, 2006-12-15

Detailed test data please refer to the following pages.

6.7.1 Detailed Test Results, Model TM2.4-1

PRODUCT EMISSIONS DATA, TRANSMIT MODE (fundamental and harmonics)										
No	Emission Frequency* [MHz]	Receiver Bandwidth and Mode [kHz]	Test Distance [m]	Receiver Reading FST [dB(µV/m)]	Distance Extrapol. Factor DF [dB]	Average Correction Factor [dB]	Result = Corrected Reading FS [dB(µV/m)]	Spec Limit [dB(µV/m)]	Polari-zation Ant.	Margin [dB]
1	2403	1000, AV 1000, PK	3	AV 90.0 PK 91.9	0	0	AV 90.0 PK 91.9	AV 94.0 PK 114.0	h	AV 4.0 PK 22.1
2	2433	1000, AV 1000, PK	3	AV 88.5 PK 90.5	0	0	AV 88.5 PK 90.5	AV 94.0 PK 114.0	h, v	AV 5.5 PK 23.5
3	2481	1000, AV 1000, PK	3	AV 88.5 PK 90.5	0	0	AV 88.5 PK 90.5	AV 94.0 PK 114.0	v	AV 5.5 PK 23.5
4	4806	1000, AV 1000, PK	3	AV 45.8 PK 52.6	0	0	AV 45.8 PK 52.6	AV 54 PK 74	v	AV 8.2 PK 21.4
5	4862	1000, AV 1000, PK	3	AV 46.2 PK 53.0	0	0	AV 46.2 PK 53.0	AV 54 PK 74	v	AV 7.8 PK 21
6	4962	1000, AV 1000, PK	3	AV 46.1 PK 51.7	0	0	AV 46.1 PK 51.7	AV 54 PK 74	h	AV 7.9 PK 22.3

Remark: * Tests performed for the lowest middle and highest frequency, successively. All emissions above noise floor reported.

PRODUCT EMISSIONS DATA, TRANSMIT MODE, (except fundamental and harmonics)										
No	Emission Frequency [MHz]	Receiver Bandwidth and Mode [kHz]	Test Dist-ance [m]	Receiver Reading FST [dB(µV/m)]	Distance Extrapol. Factor DF [dB]	Average Correction Factor [dB]	Result = Corrected Reading FS [dB(µV/m)]	Spec Limit [dB(µV/m)]	Polari-zation Ant.	Margin [dB]
1										
2										
3										
4										
5										
6										

ALL EMISSIONS MORE THAN 20 dB BELOW CORRESPONDING LIMIT

PRODUCT EMISSIONS DATA, IDLE MODE (STAND-BY)										
No	Emission Frequency [MHz]	Receiver Bandwidth and Mode [kHz]	Test Dist-ance [m]	Receiver Reading FST [dB(µV/m)]	Distance Extrapol. Factor DF [dB]	Average Correct-ion Factor [dB]	Result = Corrected Reading FS [dB(µV/m)]	Spec Limit [dB(µV/m)]	Polari-zation Ant.	Margin [dB]
1	4864	1000, PK	1	56.2	-9.5	0	46.7	AV 54 PK 74	h, v	7.3
2										
3										
4										
5										
6										

ALL OTHER EMISSIONS MORE THAN 20 dB BELOW CORRESPONDING LIMIT

PRODUCT EMISSIONS DATA, RECEIVE MODE										
No	Emission Frequency [MHz]	Receiver Bandwidth and Mode [kHz]	Test Dist-ance [m]	Receiver Reading FST [dB(µV/m)]	Distance Extrapol. Factor DF [dB]	Average Correct-ion Factor [dB]	Result = Corrected Reading FS [dB(µV/m)]	Spec Limit [dB(µV/m)]	Polari-zation Ant.	Margin [dB]
1	4802	1000, Pk	1	55.5	-9.5	0	46	AV 54 PK 74	h, v	8
2	4864	1000, Pk	1	57.5	-9.5	0	48	AV 54 PK 74	h, v	6
3	4960	1000, Pk	1	55.5	-9.5	0	46	AV 54 PK 74	h, v	8
4										
5										
6										

ALL OTHER EMISSIONS MORE THAN 20 dB BELOW CORRESPONDING LIMIT

6.7.2 Detailed Test Results, Model TM2.4-2

PRODUCT EMISSIONS DATA, TRANSMIT MODE; ROD ANTENNA (fundamental and harmonics)										
No	Emission Frequency* [MHz]	Receiver Bandwidth and Mode [kHz]	Test Distance [m]	Receiver Reading FST [dB(µV/m)]	Distance Extrapol. Factor DF [dB]	Average Correction Factor [dB]	Result = Corrected Reading FS [dB(µV/m)]	Spec Limit [dB(µV/m)]	Polari-zation Ant.	Margin [dB]
1	2403	1000, AV 1000, PK	3	AV 90 PK 91.9	0	0	AV 90 PK 91.9	AV 94.0 PK 114.0	h	AV 4 PK 22.1
2	2433	1000, AV 1000, PK	3	AV 90 PK 92	0	0	AV 90 PK 92	AV 94.0 PK 114.0	h, v	AV 4 PK 22
3	2481	1000, AV 1000, PK	3	AV 88.6 PK 90.7	0	0	AV 88.6 PK 90.7	AV 94.0 PK 114.0	v	AV 5.4 PK 23.3
4	4806	1000, AV 1000, PK	3	AV 48.1 PK 54	0	0	AV 48.1 PK 54	AV 54 PK 74	h	AV 5.9 PK 20
5	4862	1000, AV 1000, PK	3	AV 48.2 PK 54.4	0	0	AV 48.2 PK 54.4	AV 54 PK 74	h	AV 5.8 PK 19.6
6	4962	1000, AV 1000, PK	3	AV 50.7 PK 56.6	0	0	AV 50.7 PK 56.6	AV 54 PK 74	h	AV 3.3 PK 17.4

Remark: * Tests performed for the lowest middle and highest frequency, successively. All emissions above noise floor reported.

PRODUCT EMISSIONS DATA, TRANSMIT MODE; ROD ANTENNA (except fundamental and harmonics)										
No	Emission Frequency [MHz]	Receiver Bandwidth and Mode [kHz]	Test Dist-ance [m]	Receiver Reading FST [dB(µV/m)]	Distance Extrapol. Factor DF [dB]	Average Correction Factor [dB]	Result = Corrected Reading FS [dB(µV/m)]	Spec Limit [dB(µV/m)]	Polari-zation Ant.	Margin [dB]
1										
2										
3										
4										
5										
6										

ALL EMISSIONS MORE THAN 20 dB BELOW CORRESPONDING LIMIT

PRODUCT EMISSIONS DATA, IDLE MODE; ROD ANTENNA

No	Emission Frequency [MHz]	Receiver Bandwidth and Mode [kHz]	Test Dist-ance [m]	Receiver Reading FST [dB(µV/m)]	Distance Extrapol. Factor DF [dB]	Average Correct-ion Factor [dB]	Result = Corrected Reading FS [dB(µV/m)]	Spec Limit [dB(µV/m)]	Polari-zation Ant.	Margin [dB]
1	4802	1000, Pk	1	55	-9.5	0	45.5	AV 54 PK 74	h, v	8.5
2	4864	1000, Pk	1	54.5	-9.5	0	45	AV 54 PK 74	h, v	9
3	4960	1000, Pk	1	56.2	-9.5	0	46.7	AV 54 PK 74	h, v	7.3
4										
5										
6										

ALL OTHER EMISSIONS MORE THAN 20 dB BELOW CORRESPONDING LIMIT

PRODUCT EMISSIONS DATA, RECEIVE MODE; ROD ANTENNA

No	Emission Frequency [MHz]	Receiver Bandwidth and Mode [kHz]	Test Dist-ance [m]	Receiver Reading FST [dB(µV/m)]	Distance Extrapol. Factor DF [dB]	Average Correct-ion Factor [dB]	Result = Corrected Reading FS [dB(µV/m)]	Spec Limit [dB(µV/m)]	Polari-zation Ant.	Margin [dB]
1	4802	1000, Pk	1	54.5	-9.5	0	45	AV 54 PK 74	h, v	9
2	4864	1000, Pk	1	53.7	-9.5	0	44.2	AV 54 PK 74	h, v	9.8
3	4960	1000, Pk	1	56.4	-9.5	0	46.9	AV 54 PK 74	h, v	7.1
4										
5										
6										

ALL OTHER EMISSIONS MORE THAN 20 dB BELOW CORRESPONDING LIMIT

PRODUCT EMISSIONS DATA, TRANSMIT MODE; BLADE ANTENNA
(fundamental and harmonics)

No	Emission Frequency* [MHz]	Receiver Bandwidth and Mode [kHz]	Test Distance [m]	Receiver Reading FST [dB(µV/m)]	Distance Extrapol. Factor DF [dB]	Average Correction Factor [dB]	Result = Corrected Reading FS [dB(µV/m)]	Spec Limit [dB(µV/m)]	Polari-zation Ant.	Margin [dB]
1	2403	1000, AV 1000, PK	3	AV 89.1 PK 90.9	0	0	AV 89.1 PK 90.9	AV 94.0 PK 114.0	v	AV 4.9 PK 23.1
2	2433	1000, AV 1000, PK	3	AV 91 PK 92.9	0	0	AV 91 PK 92.9	AV 94.0 PK 114.0	h	AV 3 PK 21.1
3	2481	1000, AV 1000, PK	3	AV 88.7 PK 90.6	0	0	AV 88.7 PK 90.6	AV 94.0 PK 114.0	v	AV 5.3 PK 23.4
4	4806	1000, AV 1000, PK	3	AV 44.8 PK 52.6	0	0	AV 44.8 PK 52.6	AV 54 PK 74	h	AV 9.2 PK 21.4
5	4862	1000, AV 1000, PK	3	AV 44.9 PK 52.2	0	0	AV 44.9 PK 52.2	AV 54 PK 74	v	AV 9.1 PK 21.8
6	4962	1000, AV 1000, PK	3	AV 49 PK 55.2	0	0	AV 49 PK 55.2	AV 54 PK 74	h	AV 5 PK 18.8

Remark: * Tests performed for the lowest middle and highest frequency, successively. All emissions above noise floor reported.

PRODUCT EMISSIONS DATA, TRANSMIT MODE, BLADE ANTENNA
(except fundamental and harmonics)

No	Emission Frequency [MHz]	Receiver Bandwidth and Mode [kHz]	Test Dist-ance [m]	Receiver Reading RA [dB(µV)]	Antenna Factor AF [dB(1/m)]	Distance Extrapol. Factor DF [dB]	Average Correction Factor [dB]	Result = Corrected Reading FS [dB(µV/m)]	Spec Limit [dB(µV/m)]	Polari-zation Ant.	Margin [dB]
1	73.65	120, QP	3	18.3	8.9	0	0	27.2	40	h	12.8
2	132.6	120, QP	3	14.2	10	0	0	24.2	43.5	h	19.3
3											
4											
5											
6											

ALL OTHER EMISSIONS MORE THAN 20 dB BELOW CORRESPONDING LIMIT

PRODUCT EMISSIONS DATA, IDLE MODE; BLADE ANTENNA											
No	Emission Frequency [MHz]	Receiver Bandwidth and Mode [kHz]	Test Dist-ance [m]	Receiver Reading RA [dB(µV)]	Antenna Factor AF [dB(1/m)]	Distance Extrapol. Factor DF [dB]	Average Correction Factor [dB]	Result = Corrected Reading FS [dB(µV/m)]	Spec Limit [dB(µV/m)]	Polari-zation Ant.	Margin [dB]
1	73.65	120, QP	3	20.6	8.9	0	0	29.5	40	h	10.5
2	81	120, QP	3	9.6	9.5	0	0	19.1	40	h	20.9
3	132.6	120, QP	3	16	10	0	0	26	43.5	h	17.5

No	Emission Frequency [MHz]	Receiver Bandwidth and Mode [kHz]	Test Dist-ance [m]	Receiver Reading FST [dB(µV/m)]	Distance Extrapol. Factor DF [dB]	Average Correct-ion Factor [dB]	Result = Corrected Reading FS [dB(µV/m)]	Spec Limit [dB(µV/m)]	Polari-zation Ant.	Margin [dB]
4	4802	1000, Pk	1	54.2	-9.5	0	44.7	AV 54 PK 74	h, v	9.3
5	4864	1000, Pk	1	54.5	-9.5	0	45	AV 54 PK 74	h, v	9
6	4960	1000, Pk	1	55.5	-9.5	0	46	AV 54 PK 74	h, v	8

PRODUCT EMISSIONS DATA, RECEIVE MODE; BLADE ANTENNA											
No	Emission Frequency [MHz]	Receiver Bandwidth and Mode [kHz]	Test Dist-ance [m]	Receiver Reading RA [dB(µV)]	Antenna Factor AF [dB(1/m)]	Distance Extrapol. Factor DF [dB]	Average Correction Factor [dB]	Result = Corrected Reading FS [dB(µV/m)]	Spec Limit [dB(µV/m)]	Polari-zation Ant.	Margin [dB]
1	73.65	120, QP	3	19.2	8.9	0	0	28.1	40	h	11.9
2	81	120, QP	3	10.4	9.5	0	0	19.9	40	h	20.1
3	132.6	120, QP	3	14.6	10	0	0	24.6	43.5	h	18.9

No	Emission Frequency [MHz]	Receiver Bandwidth and Mode [kHz]	Test Dist-ance [m]	Receiver Reading FST [dB(µV/m)]	Distance Extrapol. Factor DF [dB]	Average Correct-ion Factor [dB]	Result = Corrected Reading FS [dB(µV/m)]	Spec Limit [dB(µV/m)]	Polari-zation Ant.	Margin [dB]
4	4802	1000, Pk	1	55.2	-9.5	0	45.7	AV 54 PK 74	h, v	8.3
5	4864	1000, Pk	1	54.6	-9.5	0	45.1	AV 54 PK 74	h, v	8.9
6	4960	1000, Pk	1	55.4	-9.5	0	45.9	AV 54 PK 74	h, v	8.1

7 VARIATION OF OUTPUT POWER DUE TO INPUT VOLTAGE VARIATION

Test Requirement: FCC 47 CFR, Part 15C

7.1 Regulation

Section 15.31 (e) For intentional radiators, measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage. For battery operated equipment, the equipment tests shall be performed using a new battery.
The appropriate supply voltage variation for the 3.3 V supply (as declared by the manufacturer) is between between 3.0 V and 3.6 V.

7.2 Test Equipment

Type	Manufacturer/ Model No.	EMCC Ident No.	Last Calibration	Calibration Interval
DC Supply	R&S/RK NGPE40	340	n.a.	n.a.
Voltmeter	Voltcraft ME-42	718	2004-06	12 month
Attenuator 10dB	Weinschel 54A-10	1745	n.a.	n.a.
EMI Receiver / Analyzer (1 GHz – 25 GHz)	Rohde & Schwarz ESIB 40	516	2005-11	24 months

7.3 Test Procedure

Measurement performed on Model TM2.4-2 with the EMI Receiver connected via RF cable and 10 dB Attenuator to the antenna port of the EUT.
Referring the obtained conducted power relations to the measured radiated emission under nominal conditions can be calculated the variation of the radiated fundamental emission. Additionally measured the carrier frequency (EUT in unmodulated test mode).
Test performed with the EUT connected to an external adjustable DC supply.

Test performed in transmit test mode.
Measurements performed successively at the nominal rated supply voltage, at the specified minimal and maximal input voltages. Additionally reported tests performed at extreme test conditions as required per European ETSI specifications.

7.4 Test Result

Manufacturer: Sasse Elektronik GmbH
Device: Transceiver Module
Model No.: **TM2.4-1, TM2.4-2**
Serial Number: **00017, 00016**

PRODUCT FUNDAMENTAL EMISSIONS TX MODE at 2403 MHz							
Temperature [°C]	Input Voltage [V]	Carrier Frequency [MHz]	Output Power [dBm]	Power Variation [dB]	Fundamental Emissions* [dBµV/m]	Spec. Limit QP [dB(µV/m)]	Margin [dB]
24	3.3	2403.030	-2.84	0	90	94	4
	3.0	2403.030	-2.84	0	90	94	4
	3.6	2403.030	-2.84	0	90	94	4
-20	3.0	2403.027	-0.44	+2.4	92.4	94	1.6
	3.6	2403.027	-0.44	+2.4	92.4	94	1.6
0	3.0	2403.037	-1.57	+1.27	91.3	94	2.7
	3.6	2403.037	-1.57	+1.27	91.3	94	2.7
55	3.0	2403.016	-5.08	-2.24	87.8	94	6.2
	3.6	2403.016	-5.08	-2.24	87.8	94	6.2

Remark: * related to worst-case (max. emissions) antenna: INTEGRAL (Model TM2.4-1) and ROD ANTENNA (Model TM2.4-2), respectively. Result values runded to tenth.

PRODUCT FUNDAMENTAL EMISSIONS TX MODE at 2433 MHz							
Temperature [°C]	Input Voltage [V]	Carrier Frequency [MHz]	Output Power [dBm]	Power Variation [dB]	Fundamental Emissions* [dBµV/m]	Spec. Limit QP [dB(µV/m)]	Margin [dB]
24	3.3	2433.031	-2.82	0	91	94	3
	3.0	2433.031	-2.82	0	91	94	3
	3.6	2433.031	-2.82	0	91	94	3
-20	3.0	2433.027	-0.17	+2.65	93.6	94	0.4
	3.6	2433.027	-0.17	+2.65	93.6	94	0.4
0	3.0	2433.038	-1.3	+1.52	92.5	94	1.5
	3.6	2433.038	-1.3	+1.52	92.5	94	1.5
55	3.0	2433.017	-4.89	-2.07	88.9	94	5.1
	3.6	2433.017	-4.89	-2.07	88.9	94	5.1

Remark: * related to worst-case (max. emissions) antenna: BLADE ANTENNA (Model TM2.4-2) Result values runded to tenth.

PRODUCT FUNDAMENTAL EMISSIONS TX MODE at 2481 MHz							
Temperature [°C]	Input Voltage [V]	Carrier Frequency [MHz]	Output Power [dBm]	Power Variation [dB]	Fundamental Emissions* [dBµV/m]	Spec. Limit QP [dB(µV/m)]	Margin [dB]
24	3.3	2481.031	-2.56	0	88.7	94	5.3
	3.0	2481.031	-2.56	0	88.7	94	5.3
	3.6	2481.031	-2.56	0	88.7	94	5.3
-20	3.0	2481.028	0.26	+2.3	91	94	3
	3.6	2481.028	0.26	+2.3	91	94	3
0	3.0	2481.038	-0.99	+1.57	90.3	94	3.7
	3.6	2481.038	-1.15	+1.57	90.3	94	3.7
55	3.0	2481.017	-4.89	-2.33	86.4	94	7.6
	3.6	2481.017	-4.89	-2.33	86.4	94	7.6

Remark: * related to worst-case (max. emissions) antenna: BLADE ANTENNA (Model TM2.4-2).
Result values runded to tenth.

The EUT meets this requirement.

Test Personnel: Wolfgang Döring
Test Date: 2006-12-18

8 PRODUCT LABELING

See **Annex 0** for label and label placement information.

9 MISCELLANEOUS COMMENTS AND NOTES

None.

10 LIST OF ANNEXES

The following annexes are separated parts to this test report. These annexes may be file attachments for electronic filing.

Annex	Description	File name	Pages
Annex 0	Label and Label Placement Diagrams	880104KC_Annex0.pdf	3
Annex 1	Photographs of test setups	880104KC_Annex1.pdf	3
Annex 2	Photographs of equipment under test (EUT) external views	880104KC_Annex2.pdf	7
Annex 3	Photographs of equipment under test (EUT) internal views	880104KC_Annex3.pdf	7
Annex 4	Transmitter conducted measurement plots: Bandwidth and Band-edge Compliance	880104KC_Annex4.pdf	16