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Si4010/Si4313 DEMO LINK RF EMISSION/IMMUNITY TEST REPORT ACCORDING TO EN 55025 AND GS 95002

1. Introduction

This document contains a complete test report that describes the RF Emission and RF Immunity tests that were performed on a Silicon Labs Si4010-Si4313 demo RF link.

An RF emission and RF immunity test was performed in a third party independent accredited test laboratory to demonstrate, that Silicon Laboratories' Si4010 crystal-less SoC RF transmitter and Si4313 low-cost ISM receiver is capable to constitute an RF link for automotive applications, that meets the requirements of EN 55025 and GS 95002 standards.

The tested equipments were as follows:

- Si4010 Universal Key Fob 434 MHz (S/N 4010-DAPB_434) and
- Si4343 LED receiver board low band pcb ant (S/N 4313-DAPB_LB)

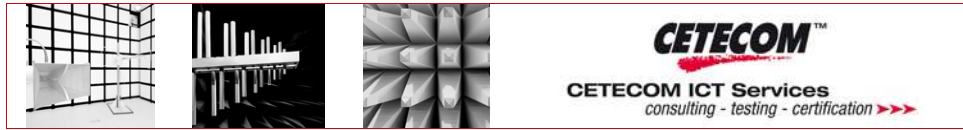


The boards are available from Silicon Laboratories as part of the Si4010 Simplified Key Fob Demo Kit 434 MHz (S/N 4010-DASKF_434).

The tested equipments passed all the tests described in detail in the appended test report.

For technical details on the tested ICs, boards, and demo kits visit <http://www.silabs.com>.

2. Test Report



TEST REPORT

Test Report No.: 4-3476-01-01/11



Testing Laboratory

CETECOM ICT Services GmbH
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66117 Saarbrücken/Germany
Phone: + 49 681 5 98 - 0
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Internet: <http://www.cetecom-ict.de>
e-mail: info@ict.cetecom.de

Accredited Test Laboratory:
The test laboratory is accredited according to:
DIN EN ISO/IEC 17025
DAR registration number: **DAT-P-176/94-D1**

And recognized by the KBA (Germany) and snch
(Luxembourg)
KBA-P 00070-97

Applicant

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Austin, TX 78701/USA
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e-mail: FERENC.MERNYEI@SILABS.COM
Phone: +36-1-4534251

Manufacturer

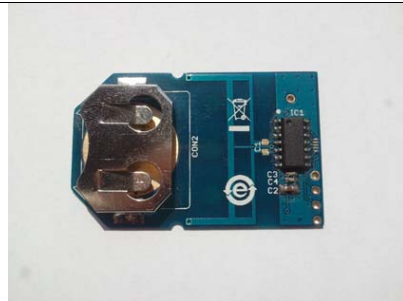
Same as Applicant

Test Standard/s

EN 55025	2003-01	Radio disturbance characteristics for the protection of receivers used on board vehicles, boats and on devices - Limits and methods of measurement (IEC/CISPR 25:2002)
GS 95002	01.10.04	Electromagnetic Compatibility (EMC) Electric, electronic, assemblies, motor vehicles, EMC, Electromagnetic Compatibility, requirements, test conditions

Test Item 1+2

Kind of test item 1 (TX): Remote Keyless Entry
Model name: 4010-DAPB_434 (Si4010 Universal Key Fob 434MHz)
HW hardware status: v1.3
Kind of test item 2 (RX): Remote Keyless Entry
Model name: 4313-DAPB_LB (Si4313 LED receiver board low band pcb ant)
HW hardware status: v1.0
Power Supply: 3 V DC



Test performed:

Test Report authorised:

2011-04-29

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2 General information

2.1 Notes

The test results of this test report relate exclusively to the test item specified in this test report. CETECOM ICT Services GmbH does not assume responsibility for any conclusions and generalisations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item. The test report may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval of CETECOM ICT Services GmbH.

2.2 Application details

Date of receipt of order: 2011-04-19
Date of receipt of test item: 2011-04-15
Start of test: 2011-04-15
End of test: 2011-04-15
Person(s) present during the test: Mr. Miklós Lukács

3 Test standard/s:

Test Standard	Version	Test Standard Description
EN 55025	2003-01	Radio disturbance characteristics for the protection of receivers used on board vehicles, boats and on devices - Limits and methods of measurement (IEC/CISPR 25:2002)
GS 95002	01.10.04	Electromagnetic Compatibility (EMC) Electric, electronic, assemblies, motor vehicles, EMC, Electromagnetic Compatibility, requirements, test conditions

4 Test Environment (Chamber)

Temperature: 20°C – 25°C
Relative humidity content: 30 % - 50 %
Air pressure: 1020 hPa
Power supply: 230 V / 50 Hz

5 Test Laboratories sub-contracted

-/-

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6 Information about test conditions

6.1 Test item

Kind of test item :	Remote Keyless Entry	
Type identification 1 (TX) :	4010-DAPB_434 (Si4010 Universal Key Fob 434MHz)	
Type identification 2 (RX) :	4313-DAPB_LB (Si4313 LED receiver board low band pcb ant)	
Equipment classification:	Equipment for vehicular use	
Supply voltage :	3 V DC	
Ports :	Description	Direction
	DC port (via Battery clip)	Input
Mounting position:	unknown	
In case of immunity testing (EMS): Observing or/and recording following functions:		
Observing status LED's at the receiver		
Additional information:		
During the test we have tested the transmitter and the receiver together in the chamber. In some cases TX and RX were tested in stand-alone.		

6.2 EUT: Type, S/N etc. and short descriptions used in this test report

short description*)	EUT	Type	S/N serial number	HW hardware status	SW software status
EUT A	TX	4010-DAPB_434	Demo	v1.3	---
EUT B	RX	4313-DAPB_LB	Demo	v1.0	---
EUT C					

*) EUT short description is used to simplify the identification of the EUT in this test report.

6.3 EUT operating modes

Tests are described in detailed test results

EUT operating mode no.*)	Description of operating modes	Additional information
op. 1	TX/RX active	Transmitting at 433 MHz and receiving
op. 2	TX/RX Stand-by	RX in receiving mode, no transmitter carrier
op. 3	TX alone	Transmitting at 433 MHz. (receiver outside the chamber)
op. 4		

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7 Summary of measurement results

- No deviations from the technical specifications were ascertained
- There were deviations from the technical specifications ascertained

7.1 Electrical Requirements

7.1.1 Emission measurements

Test Phenomenon	Test standard	chapter	Result
Radiated Emission with Antenna	ECE-R10 Rev.03	7 and 8	pass
Radiated Emission with Stripline	GS 95002	7.1.4.1	pass

7.1.2 Immunity measurements

Test Phenomenon	Test standard	chapter	Result
Radiated Immunity with Antenna 200-1000 MHz	GS 95002	7.2.4.2	pass
Radiated Immunity with Antenna 800-4000 MHz	GS 95002	7.2.4.2	pass
Conducted Immunity with BCI Open loop 1-400 MHz	GS 95002	7.2.3	pass
Conducted Immunity with BCI Closed loop 1-400 MHz	ISO 11452-4	8.3.2	pass
Radiated Immunity with Stripline 100 kHz-400 MHz	GS 95002	7.2.4.1	pass

Remarks: None

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7.2 Measurement and test set-up

Note: The test configuration is in accordance with the requirements given in the standards in point 3

7.3 Measurement uncertainty

The uncertainty of the measurement equipment fulfils CISPR 16 and the related European and national standards.

Measurement uncertainty calculations are on file and available from the test laboratory upon request.

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8 Detailed test results - Emission

8.1 Radiated Emission with Antenna 30-1000 MHz

8.1.1 Test results

EMI 30-1000 MHz only TX

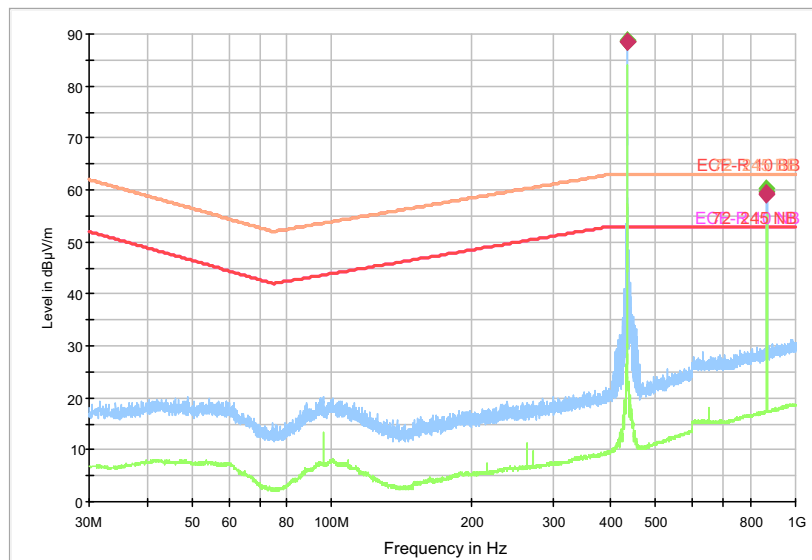
EUT Information

EUT Name:	Tx: 4010-DAPB_434; Rx: 4313-DAPB_LB
Manufacturer:	Silicon Labs
Serial Number:	Demo
Hardware Rev:	Tx: 1.3; Rx: 1.0

Common Information

Test Description:	Radiated Emission - Antenna 30-1000 MHz ver+hor (max)
Operating Conditions:	Transmitting 433 MHz
Operator Name:	SCN

ESU EMI 55025



The peaks are the transmitter frequency and the 1st harmonics.

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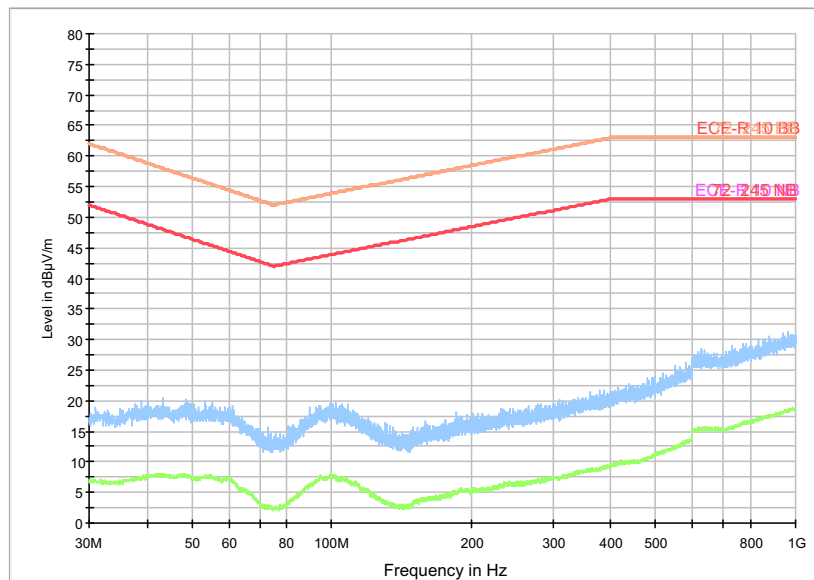
EMI 30-1000 MHz only RX

EUT Information

EUT Name:	Tx: 4010-DAPB_434; Rx: 4313-DAPB_LB
Manufacturer:	Silicon Labs
Serial Number:	Demo
Hardware Rev:	Tx: 1.3; Rx: 1.0

Common Information

Test Description:	Radiated Emission - Antenna 30-1000 MHz
Operating Conditions:	Receiver in stand-by (RX alone)
Operator Name:	SCN



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8.2 Radiated Emission with Stripline 500 kHz-1000 MHz

8.2.1 Test results

EMI Stripline 500k-1000M TX and RX

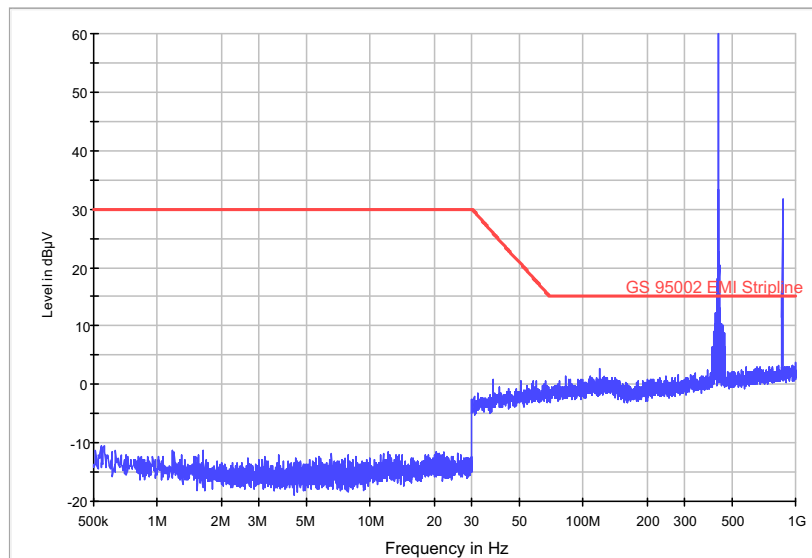
EUT Information

EUT Name:	Tx: 4010-DAPB_434; Rx: 4313-DAPB_LB
Manufacturer:	Silicon Labs
Serial Number:	Demo
Hardware Rev:	Tx: 1.3; Rx: 1.0

Common Information

Test Description:	Radiated Emission - Stripline 500kHz-1000 MHz
Operating Conditions:	Transmitting 433 MHz and receiving (Tx and Rx together)
Operator Name:	SCN

GS95002 Stripline 0,5-1000MHz ESU



The peaks are the transmitter frequency and the 1st harmonics.

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EMI Stripline 500k-1000M RX

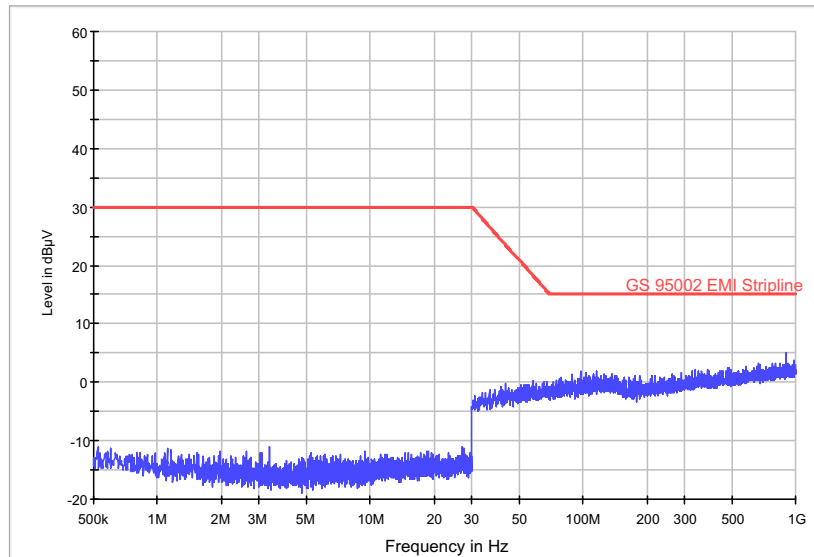
EUT Information

EUT Name:	Tx: 4010-DAPB_434; Rx: 4313-DAPB_LB
Manufacturer:	Silicon Labs
Serial Number:	Demo
Hardware Rev:	Tx: 1.3; Rx: 1.0

Common Information

Test Description:	Radiated Emission - Stripline 500kHz-1000 MHz
Operating Conditions:	Receiver in receive mode (RX alone)
Operator Name:	SCN

GS95002 Stripline 0,5-1000MHz ESU



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9 Detailed test results - Immunity

9.1 Radiated Immunity with Antenna 200-4000 MHz

9.1.1 Test Plan

EUT set-up	TX and RX					
Test method	Substitution method					
Power adjustment	Forward power					
Basic standard	Field strength	Start frequency	Stop frequency	Frequency step	Dwell time	Modulation
ISO 11452-2 (ALSE)	200 V/m	200 MHz 400 MHz	400 MHz 1000 MHz	LIN 10 MHz LIN 20 MHz	2 s	1 kHz, AM 80%
Operating mode	Antenna type / position		Functional status	Reaction during and after test		Result
TX and RX	LogPer / vertical		A	A/A		passed
	LogPer / horizontal		A	A/A		passed
Basic standard	Field strength	Start frequency	Stop frequency	Frequency step	Dwell time	Modulation
ISO 11452-2 (ALSE)	200 V/m	200 MHz 425 MHz 450 MHz	425 MHz 450 MHz 1000 MHz	LIN 10 MHz LIN 500 kHz LIN 10 MHz	2 s	OFF (CW)
Operating mode	Antenna type / position		Functional status	Reaction during and after test		Result
TX and RX	LogPer / vertical		A	B/A		passed
	LogPer / horizontal		A	B/A		passed
TX alone	LogPer / vertical		---	---		Not carried out
	LogPer / horizontal		A	B/A		passed
Basic standard	Field strength	Start frequency	Stop frequency	Frequency step	Dwell time	Modulation
ISO 11452-2 (ALSE)	200 V/m	800 MHz	4000 MHz	LIN 20 MHz	2 s	PULS Mod. 577µs/217Hz
Operating mode	Antenna type / position		Functional status	Reaction during and after test		Result
TX and RX	Horn / vertical		A	A/A		passed
	Horn / horizontal		A	A/A		passed

Remarks: During the measurements with RX and TX together the receiver stops working in the frequency range between 428,5 and 437,5 MHz.
During the measurement with TX alone (the transmitter signal was coupled via antennas to the receiver outside of the chamber) the receiver stops working between 431,5 and 433,5 MHz.

9.1.2 Reaction of EUT:

- A normal performance within the specification limits
- B temporary degradation or loss of function or performance which is self-recoverable
- C temporary degradation or loss of function or performance which requires operator intervention or system reset
- D degradation or loss of function which is not recoverable due to damage of equipment (components) or software, or loss of data

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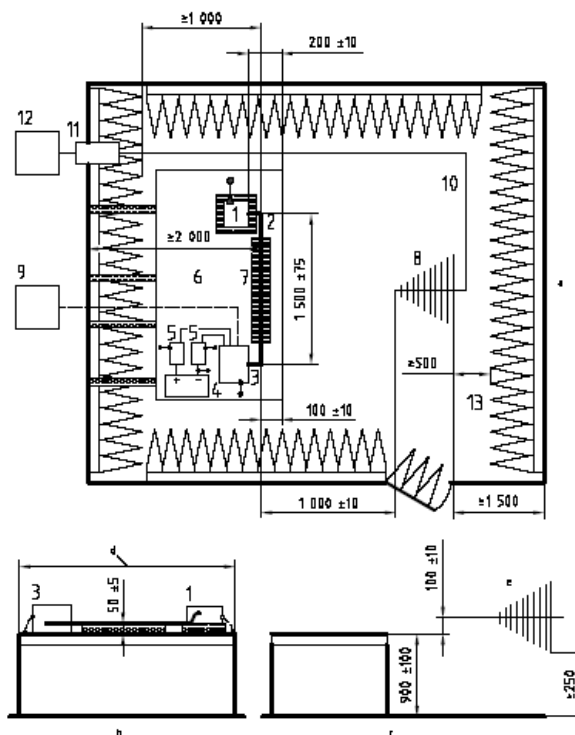


9.1.3 Test Set-up

According to EMC basic standard **ISO 11452-2**

Example test set-up — Log-periodic-antenna

Dimensions in millimetres

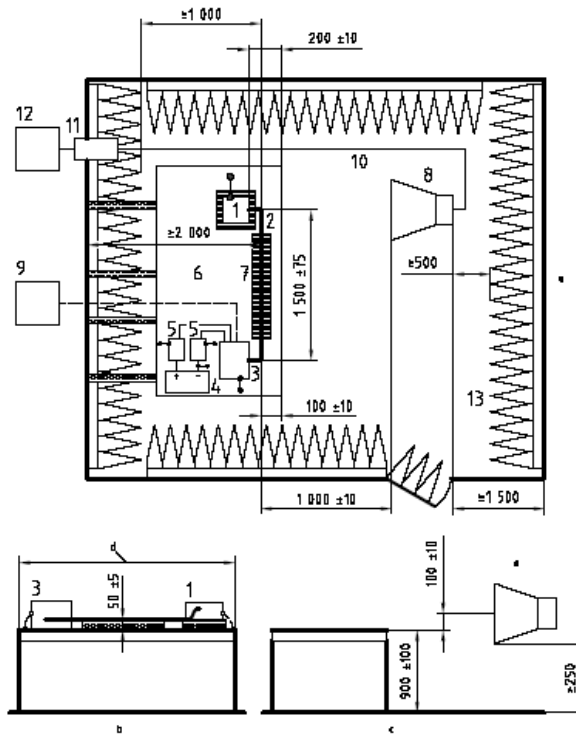


Key

- | | | |
|--|---|--|
| 1 DUT (grounded locally if required in test plan) | 6 ground plane (bonded to shielded enclosure) | 10 high quality double-shielded coaxial cable (50 Ω) |
| 2 test harness | 7 low relative permittivity support ($\epsilon_r \leq 1.4$) | 11 bulkhead connector |
| 3 load simulator (placement and ground: connection according to 7.5) | 8 log-periodic antenna | 12 RF signal generator and amplifier |
| 4 power supply (location optional) | 9 stimulation and monitoring system | 13 RF absorber material |
| 5 artificial network (AN) | | |
- a Upper view (horizontal polarisation).
 b Front view.
 c Side view.
 d See 7.1.
 e Vertical polarization.

Example test set-up for frequencies above 1 GHz — Horn antenna

Dimensions in millimetres



Key

- | | |
|--|---|
| 1 DUT (grounded locally if required in test plan) | 7 low relative permittivity support ($\epsilon_r \leq 1.4$) |
| 2 test harness | 8 horn antenna |
| 3 load simulator (placement and ground: connection according to 7.5) | 9 stimulation and monitoring system |
| 4 power supply (location optional) | 10 high quality double-shielded coaxial cable (50 Ω) |
| 5 artificial network (AN) | 11 bulkhead connector |
| 6 ground plane (bonded to shielded enclosure) | 12 RF signal generator and amplifier |
| | 13 RF absorber material |

- a Upper view (horizontal polarisation).
- b Front view.
- c Side view.
- d See 7.1.
- e Vertical polarization.

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9.2 Conducted Immunity with BCI 1-400 MHz

9.2.1 Test Plan

EUT set-up	TX and RX					
Test method	Substitution method					
Power adjustment	Forward power					
Basic standard	Field strength	Start frequency	Stop frequency	Frequency step	Dwell time	Modulation
ISO 11452-4 (BCI)	200 mA	1 MHz 10 MHz 200 MHz	10 MHz 200 MHz 400 MHz	LIN 1 MHz LIN 5 MHz LIN 10 MHz	2 s	1 kHz, AM 80%
Operating mode	Position		Functional status	Reaction during and after test		Result
Receiving	150 mm		A	A/A		passed
Test method	Closed-loop method with power limitation					
Power adjustment	Forward power					
Basic standard	Field strength	Start frequency	Stop frequency	Frequency step	Dwell time	Modulation
ISO 11452-4 (BCI)	200 mA	1 MHz 100 MHz	100 MHz 400 MHz	LOG 5% LOG 2%	2 s	1 kHz, AM 80%
Operating mode	Position		Functional status	Reaction during and after test		Result
Receiving	900mm / 50 mm		A	B/A		passed

Remarks: During closed loop method the LED4 stops flashing between 26,3 and 27 MHz

9.2.2 Reaction of EUT:

- A normal performance within the specification limits
- B temporary degradation or loss of function or performance which is self-recoverable
- C temporary degradation or loss of function or performance which requires operator intervention or system reset
- D degradation or loss of function which is not recoverable due to damage of equipment (components) or software, or loss of data

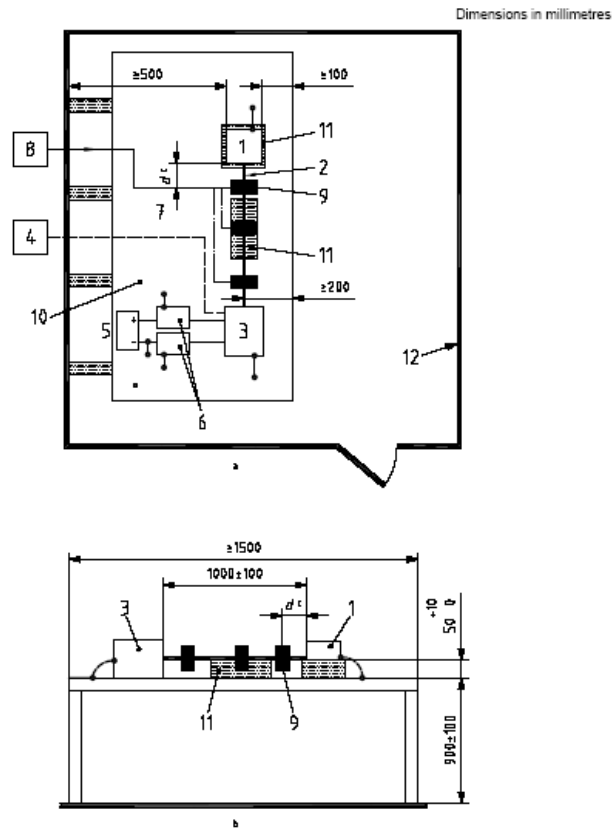
Test report no.: 4-3476-01-01/11



9.2.3 Test Set-up

According to EMC basic standard **ISO 11452-4**

BCI test set-up — Substitution method



- Key**
- | | |
|--|--|
| 1 DUT (grounded if required in test plan) | 7 optical fibres |
| 2 test harness | 8 high-frequency equipment |
| 3 load simulator (placement and ground: connection according to 7.5) | 9 injection probe |
| 4 stimulation and monitoring system | 10 ground plane (bonded to shielded enclosure) |
| 5 power supply | 11 low relative permittivity support ($\epsilon_r \leq 1.4$) |
| 6 artificial network (AN) | 12 Shielded enclosure |

NOTE The current measurement probe, optional for this test, is not represented. See 8.3.1.3.

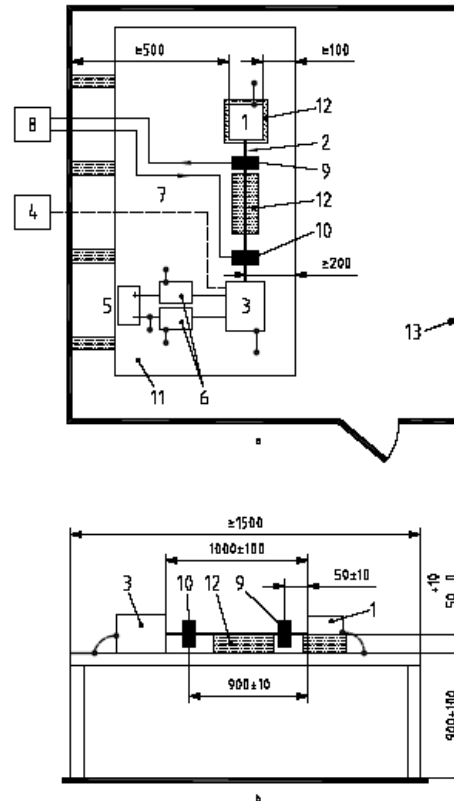
^a Upper view. ^b Side view. ^c See 7.6.1.

Test report no.: 4-3476-01-01/11



BCI configuration — Closed-loop method with power limitation

Dimensions in millimetres



- Key**
- | | | |
|--|--|--|
| 1 DUT (grounded if required in test plan) | 6 artificial network (AN) | 12 low relative permittivity support ($\epsilon_r \leq 1,4$) |
| 2 test harness | 7 optical fibres | 13 Shielded enclosure |
| 3 load simulator (placement and ground: connection according to 7.5) | 8 high-frequency equipment | |
| 4 stimulation and monitoring system | 9 current measurement probe | |
| 5 power supply | 10 injection probe | |
| a Upper view. | 11 ground plane (bonded to shielded enclosure) | |
| b Side view. | | |

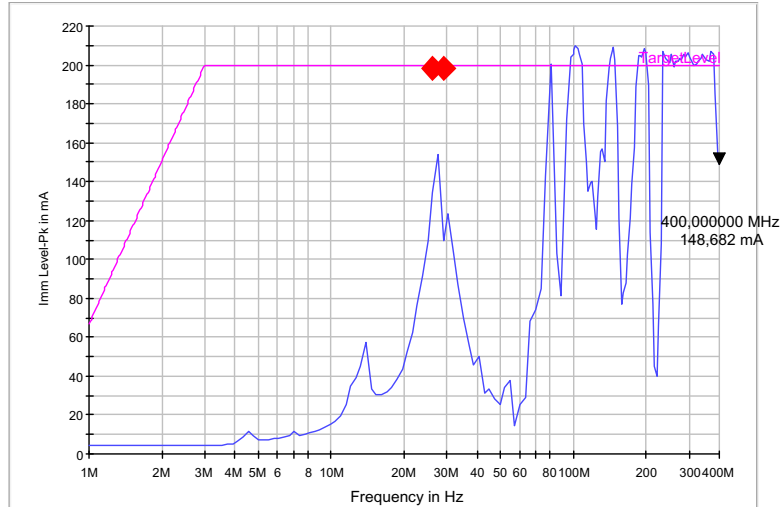
Test report no.: 4-3476-01-01/11



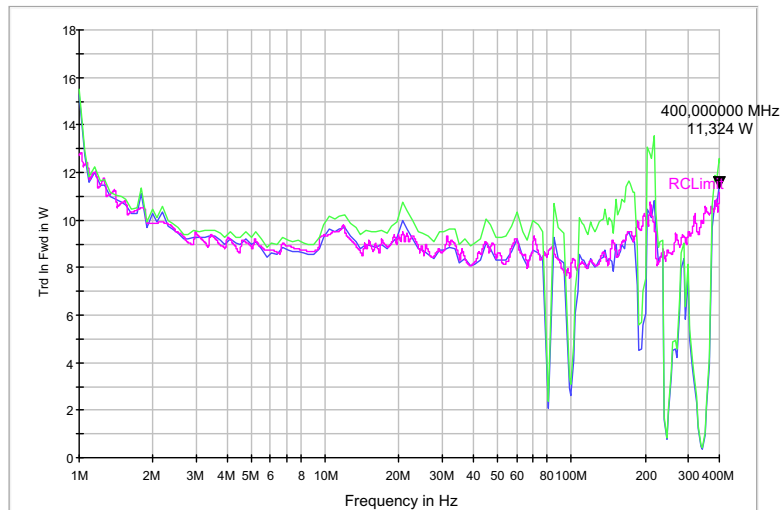
9.2.4 Measurement results

EMS BCI 1-400M 200mA CL AM TX and RX active

Imm Level-Pk



Trd In Fwd



Result Table NOGO

Frequency (MHz)	Imm Level-Pk (mA)	Trd In Fwd (W)	Amp In (dBm)	Gen Out (dBm)	Comment	Modulation
26.283490	134.137	8.572	-15.6	-14.5		
28.977547	109.733	8.717	-16.1	-15.0	LED 4 flashing cont.	AM;1kHz;80%

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9.3 Radiated Immunity with Stripline 100 kHz-400 MHz

9.3.1 Test Plan

EUT set-up	TX and RX					
Test method	Substitution method					
Power adjustment	Forward power					
Basic standard	Field strength	Start frequency	Stop frequency	Frequency step	Dwell time	Modulation
ISO 11452-5 (Stripline)	200 V/m	100 kHz 200 MHz	200 MHz 400 MHz	log 5%	2 s	1 kHz, AM 80%
Operating mode	EUT position		Functional status	Reaction during and after test		Result
TX and RX active	Under septum		A	A/A		passed
TX and RX Stand-by	Under septum		A	A/A		passed
Basic standard	Field strength	Start frequency	Stop frequency	Frequency step	Dwell time	Modulation
ISO 11452-5 (Stripline)	200 V/m	100 kHz 200 MHz	200 MHz 400 MHz	log 5%	2 s	OFF (CW)
Operating mode	EUT position		Functional status	Reaction during and after test		Result
TX and RX active	Under septum		A	A/A		passed
TX and RX Stand-by	Under septum		A	A/A		passed

Remarks:

9.3.2 Reaction of EUT:

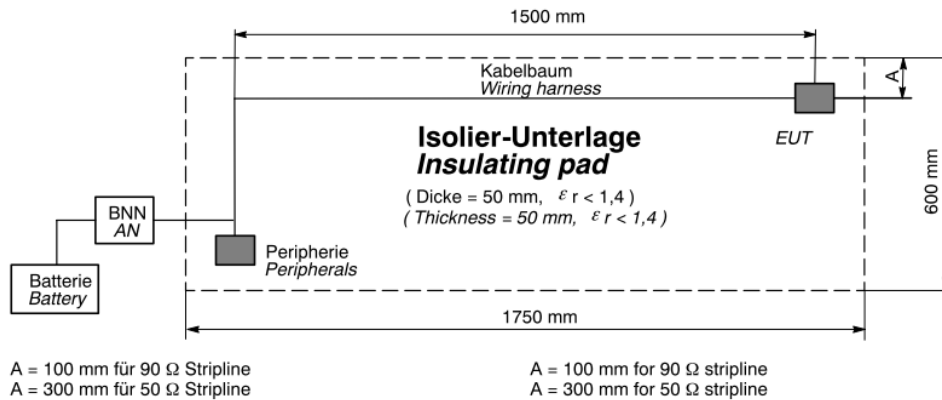
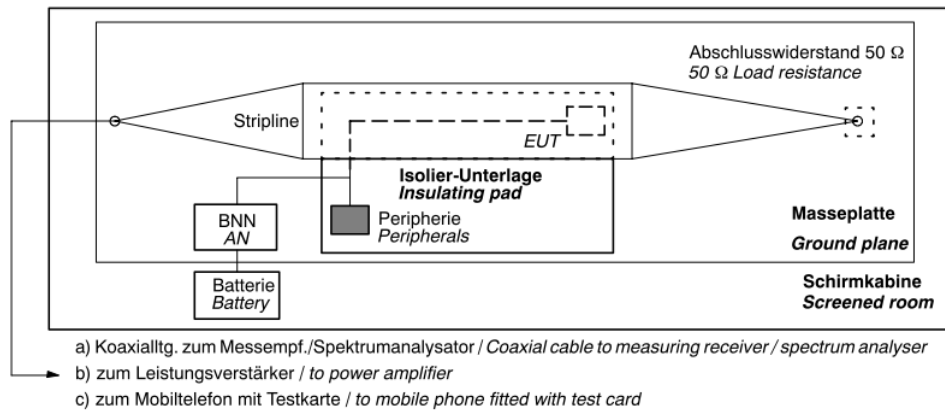
- A normal performance within the specification limits
- B temporary degradation or loss of function or performance which is self-recoverable
- C temporary degradation or loss of function or performance which requires operator intervention or system reset
- D degradation or loss of function which is not recoverable due to damage of equipment (components) or software, or loss of data

Test report no.: 4-3476-01-01/11



9.3.3 Test Set-up

According to EMC basic standard ISO 11452-5 (BMW Standard GS 95002)



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10 Test equipment and ancillaries used for tests

To simplify the identification of the test equipment and/or ancillaries which were used, the reporting of the relevant test cases only refer to the test item number as specified in the table below.

No.	Instrument/Ancillary	Manufacturer	Type	Serial-No.	Internal identification
Radiated immunity – annex I					
D-1	Signal Generator	Rohde & Schwarz	SMHU52	860 292/019	300002232
D-2	Function Generator	Rohde & Schwarz	AFGU	832063/002	300002037
D-3	Function Generator	Rohde & Schwarz	AFGU	862490/032	300001201
D-4	Log per antenna	Schwarzbeck	STLP 9128C	033	300003213
D-5	Double Ridged Broadband Horn Antenna	Schwarzbeck	BBHA 9120E	212	300003214
D-6	RF-Amplifier 0.01-220 MHz	Amplifier Research	250L	13163	300002180
D-7	Directional Coupler Unit	Rohde & Schwarz	DCU	316 790/005	300002242
D-8	RF-Amplifier 200-1000 MHz	Bonn	BLWA 2010-1000/700D	076820A	300003782
D-9	RF-Amplifier 0,8-4 GHz	Bonn	BLMA 0840-200/100D	076820B	300003783
D-10	Switch Unit 1	Rohde & Schwarz	RSU 15	316 790/001	300002241
D-11	Switch Unit 2	Rohde & Schwarz	RSU 11	316 790/001	300002220
D-12	Power Meter	Rohde & Schwarz	NRV	830 007/002	300002323
D-13	Power Sensor A	Rohde & Schwarz	NRV-Z4	829 714/011	300002323.01
D-14	Power Sensor B	Rohde & Schwarz	NRV-Z4	829 714/012	300002323.02
D-15	Relay Interface	ICS	4874B	112904	300002189
D-16	Cabling Unit	Rohde & Schwarz	CU	316 790/001	300002244
D-17	Pneumatic Manipulator	Heiden	2004-300	001402	300002199
D-18	Switch Control Unit	Hewlett Packard	3488A	---	---
D-19	GPIB-Extender	National Instruments	GPIB-110	10688	300002205
D-20	GPIB-Extender	National Instruments	GPIB-110	10700	300002206
D-21	Video Camera	TDK RF-Solutions	VC-04	---	300003260
D-22	Camera Control Unit	TDK RF-Solutions	SI-300	140021	300003260
D-23	Attenuator 30dB/500W	Tennline	8325	1530	40000
D-24	Stripline	Stimpfel	Stripline 150cm / 90 Ω	---	300003224
D-25	Bulk Current Injection Probe (BCI)	FCC	F-130A-1	14	300003220
D-26	RF Current Probe	FCC	F-55	77	300003225
D-27	Calibration fixture	FCC	FCC-BCICF-1	---	300000537
D-28	Power Meter	Rohde & Schwarz	URV5	833658/004	300002233
D-29	DC Power Supply	Agilent	N5767A	US26C4305J	300003840
D-30	Function Generator	Rohde & Schwarz	AFGU	862490/032	300001201
D-31	Audio Amplifier	Crown	Macro Tech 5002 VZ	8001641218	300004094
D-32	Shunt	Schwarzbeck	Shunt 9570	9570118	300004107
D-33	Coil	Schwarzbeck	FESP 5133-7/41	043	300004106
Radiated emission – annex E					
D-100	EMI Test Receiver	Rohde & Schwarz	ESU 8	100217	300003912
D-101	Log per antenna	Schwarzbeck	VULB 9163	216	300003288
D-102	Double Ridged Broadband Horn Antenna	Schwarzbeck	BBHA 9120E	212	300003214
D-103	Artificial Mains Network	Schwarzbeck	NNBM 8125	8125401	300000567
D-104	Artificial Mains Network	Schwarzbeck	NNBM 8125	8125399	300000945

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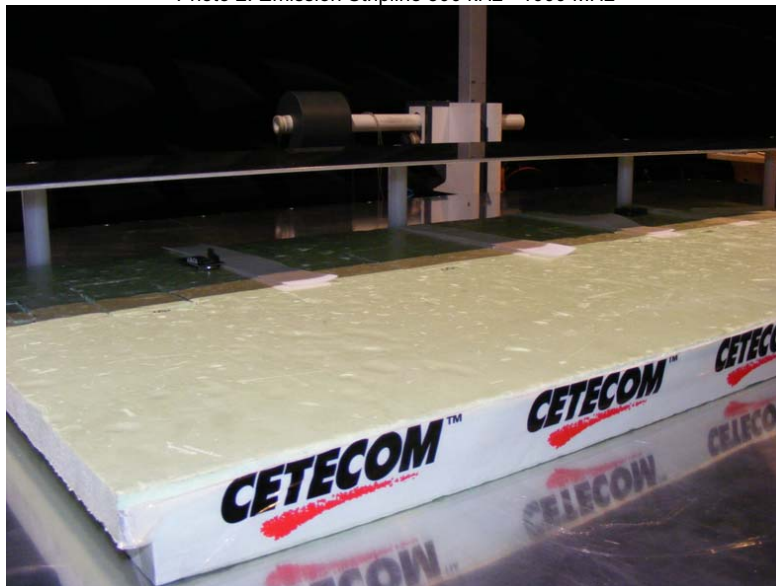


Annex A: Photographs of the test set-up

Photo 1: Emission Antenna 30 - 1000 MHz



Photo 2: Emission Stripline 500 kHz - 1000 MHz



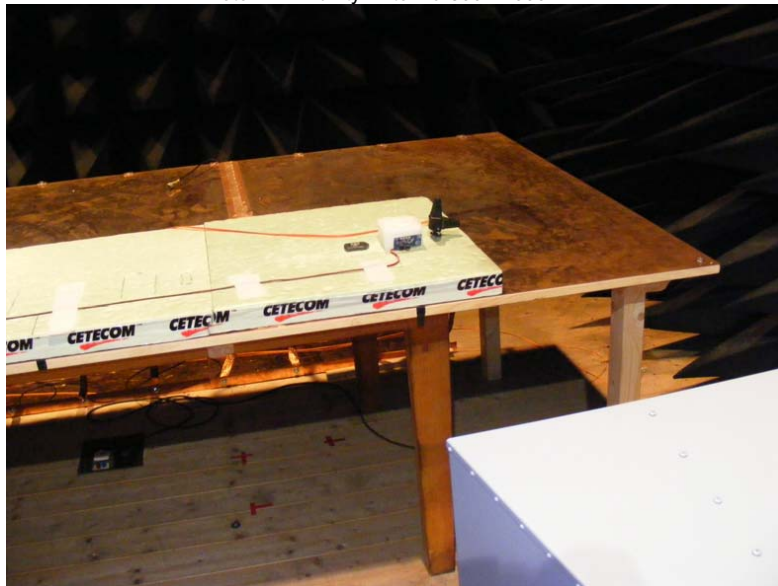
Test report no.: 4-3476-01-01/11



Photo 3: Immunity Antenna 200 - 1000 MHz



Photo 4: Immunity Antenna 800 - 4000 MHz



Test report no.: 4-3476-01-01/11



Photo 5: Immunity BCI 1 - 400 MHz open loop

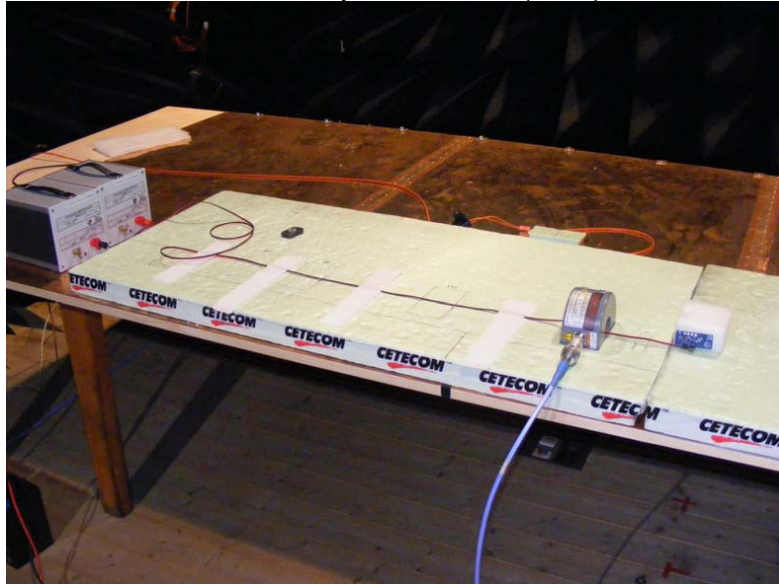
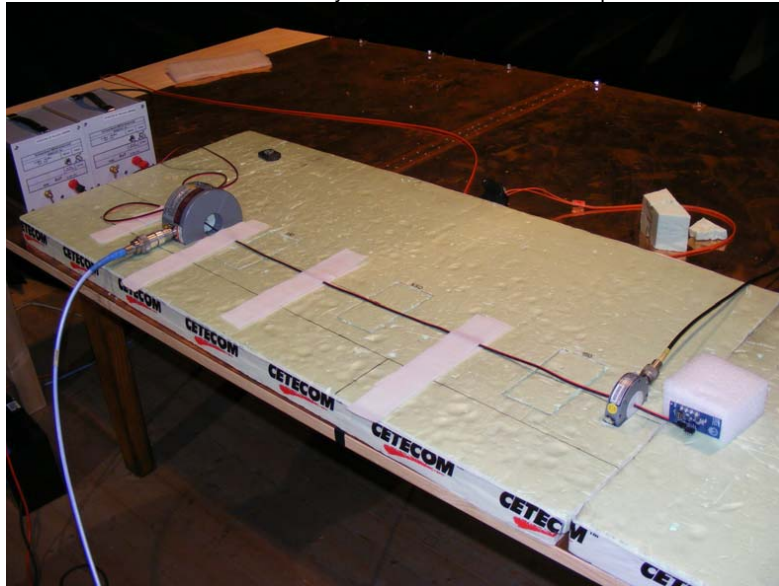


Photo 6: Immunity BCI 1 - 400 MHz closed loop



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Photo 7: Immunity Stripline 100 kHz - 400 MHz

