

CONTENTS

1	General Description of Equipment under Test	1-3
1.1	APPLICANT.....	1-3
1.2	MANUFACTURER.....	1-3
1.3	EQUIPMENT CLASSIFICATION.....	1-3
1.4	BASIC DESCRIPTION OF EQUIPMENT UNDER TEST	1-4
1.5	FEATURE OF EQUIPMENT UNDER TEST.....	1-5
2	Test Configuration of Equipment under Test	2-6
2.1	ENVIRONMENTAL CONDITIONS	2-6
2.2	DESCRIPTION OF SUPPORT EQUIPMENT.....	2-6
2.3	INTERFACE IDENTIFICATION AND CONNECTION DIAGRAM OF TEST SYSTEM.....	2-7
3	Operation of Equipment under Test	3-8
3.1	OPERATING TEST CONDITIONS.....	3-8
4	Tests Identification and Results	4-9
4.1	METHODS OF MEASUREMENT	4-10
4.2	FREQUENCY RANGE INVESTIGATED	4-10
5	Measurements and Tests Data	5-11
6	Additional Technical Information	6-22
6.1	ELECTROMAGNETICALLY RELEVANT COMPONENTS: ...	6-22
6.2	RFI SUPPRESSION DEVICES:	6-22
6.3	EMI PROTECTION DEVICES:	6-22
7	Technical Documentation	7-23
8	Photographic Documentation	8-24
8.1	EUT IDENTIFICATION	8-24
8.2	TEST SET-UP	8-28
9	Measurement and Test Equipment Instrumentation	9-29

1 GENERAL DESCRIPTION OF EQUIPMENT UNDER TEST

1.1 APPLICANT

NAME	AXESS TMC S.r.l.
ADDRESS	Via Della Filanda, 22 –I-40133 Bologna
COUNTRY	ITALY

1.2 MANUFACTURER

NAME	AXESS TMC S.r.l.
ADDRESS	Via Della Filanda, 22 –I-40133 Bologna
COUNTRY	ITALY

1.3 EQUIPMENT CLASSIFICATION

According to the definition 15.3 (o) EUT is a **Intentional Radiator operating within the bands 13.553 - 13.567 MHz** so it shall fulfil provisions of 47CFR Part 15 Subpart C – Intentional radiators – and Section 15.225.

1.4 BASIC DESCRIPTION OF EQUIPMENT UNDER TEST

Parameters	Value
Type of equipment :	▪ RFID module transmitter
Model :	▪ 90420515
FCC ID. :	▪ SYL90401-15
Trade Name	▪ AXESS TMC
Data cable :	▪ /
Telecom cable :	▪ /
Power supply type :	▪ DC 5-16 V
AC power input cable :	▪ Not provided
DC power input cable :	▪ /

Master type code: 904###15

The '###' characters are used as substitute symbols for the identification of production series; the following table describe all the product variants.

MODEL (basic)			
Code	Enclosure	Power Interface	Electronic Diagram
904 205 15	Plastic	DC 5 V	SC9040115RF02 + SC9040154MP02
VARIANTS			
Code	Enclosure	Power Interface	Electronic Diagram
904 121 15	None	DC 5 V	SC9040115RF02 + SC9040154MP02
904 122 15	None	DC 5 V	SC9040115RF02 + SC9040154MP02

1.5 FEATURE OF EQUIPMENT UNDER TEST

Parameters	Value
Nominal Supply Voltage:	▪ DC 5-12 V
Type of power source:	▪ From external DC power supply
Operating frequency:	▪ 13,56 MHz
Frequency Band :	▪ 13.553 - 13.567 MHz
Channel separation :	▪ None
Maximum RF output H/E field/ power :	▪ 15.848 dB μ V/m at 30m
Type of modulation	▪ OOK
Duty cycle:	▪ < 10 %

2 TEST CONFIGURATION OF EQUIPMENT UNDER TEST

2.1 ENVIRONMENTAL CONDITIONS

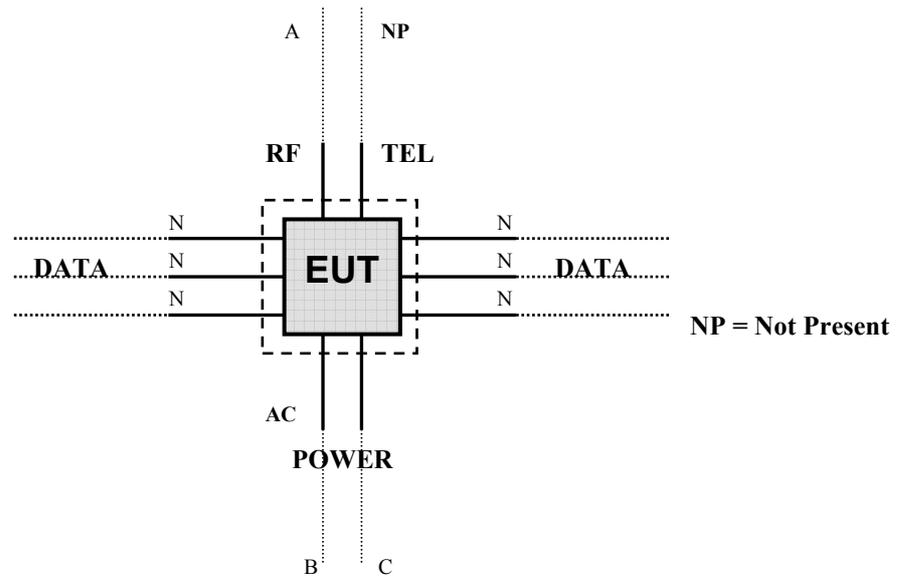
TEST CONDITIONS	MEASURED
Ambient Temperature	20 ÷ 25 °C
Relative Humidity	50 ÷ 60 %
Atmospheric Pressure	900 ÷ 1000 mbar

2.2 DESCRIPTION OF SUPPORT EQUIPMENT

Here following the details concerning equipment needed for correct operation or loading of the EUT:

EQUIPMENT	MANUFACTURER	MODEL
Serial port Adapter	AXESS TMC	TMC 914

2.3 INTERFACE IDENTIFICATION AND CONNECTION DIAGRAM OF TEST SYSTEM



#	Interface	Description	Maximum length	Ref. Document
1	Enclosure	Plastic surface	/	/
2	Mains power input/output port	DC input power port	> 3m	/
3	Antenna port (RF)	Integrated loop antenna	/	/

3 OPERATION OF EQUIPMENT UNDER TEST

3.1 OPERATING TEST CONDITIONS

Ref.	Description
#1	Continuous transmission

4 TESTS IDENTIFICATION AND RESULTS

TABLE 1 : SUMMARY OF TESTS

CFR47 Part 15 Section	Title	Operating condition	Result	Test No.
15.203 15.247 (b)(4)(i)	Antenna Requirements	/	PASS	1
15.207 (a)	Conducted Emission	#1	PASS	2
15.205 15.209	Radiated Emission	#1	PASS	3
15.225 (a) 15.225 (b) 15.225 (c)	Field strength (Operation within the band 13.110 – 14.010 MHz)	#1	PASS	4
15.225 (d)	Field strength (Operation outside the band 13.110 – 14.010 MHz)	#1	PASS	3
15.225 (e)	Frequency tolerance of the carrier	#1	PASS	5

4.1 METHODS OF MEASUREMENT

All compliance measurements have been carried out using the procedures described in the standard ANSI C63.4-2003 (excluding sub-par. 4.1.5.2, 5.7.9 and 14) and Section 15.31 of CFR47 Part 15 – Subpart A (General).

Additional test requirements have been adopted according to the reference Section indicated in the Test Table

4.2 FREQUENCY RANGE INVESTIGATED

- a. Conducted emission tests : from 150 kHz to 30 MHz.
- b. Radiated emission tests : from 9 kHz to 1 GHz.

5 MEASUREMENTS AND TESTS DATA

TEST No. 1	Title "Antenna Requirements"	47CFR Part 15 Ref. Section
		15.203 / 15.204
TEST REQUIREMENTS	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 this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, 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.	

Antenna specifications	
N° of authorized antenna types	▪ 1
Antenna type	▪ Integrated Loop coil antenna
Antenna size	▪ 0,0024 m ²
Maximum total gain	▪ /
External power amplifiers	▪ Not present

Test Result:

The transmitter meets the requirements of section 15.203 and 15.204

TEST No. 2	Title "Conducted emission"	47CFR Part 15 Ref. Section
		15.207
TEST REQUIREMENTS	Test setup	ANSI C63.4
	Limits of mains terminal disturbance voltage	15.207 (a)
	Frequency range	150 kHz – 30 MHz
	IF bandwidth	9 kHz
	EMC class	B

TEST DATA	PORT UNDER TEST	OPERATING CONDITION	RESULT
	AC mains power input port	#1	Complies

- 1) The EUT was placed on a wooden table of size, 80 cm by 80 cm, raised 80 cm in which is located 40 cm away from the vertical wall the shielded room.
- 2) Each EUT power cord input cord was individually connected through a 50Ω/50μH LISN to the input power source.
- 3) Exploratory measurements were made to identify the frequency of the emission that had the highest amplitude relative to the limit by operating the EUT in a range of typical modes of operation, cable position, and with a typical system equipment configuration and arrangement. Based on the exploratory tests of the EUT, the one EUT cable configuration and arrangement and mode of operation that had produced the emission with the highest amplitude relative to the limit was selected for the final measurement.
- 4) The final test on all current-carrying conductors of all of the power cords to the equipment that comprises the EUT (but not the cords associated with other non-EUT equipment is the system) was then performed over the frequency range of 0.15 MHz to 30 MHz.
- 5) The measurements were made with the detector set to PEAK and AVAREGE amplitude within a bandwidth of 10 kHz during the measurements.
- 6) The measurements with Quasi-Peak detector are performed only for frequencies for which the Peak values are \geq (Q.P. limit - 6 dB).

Test Result:

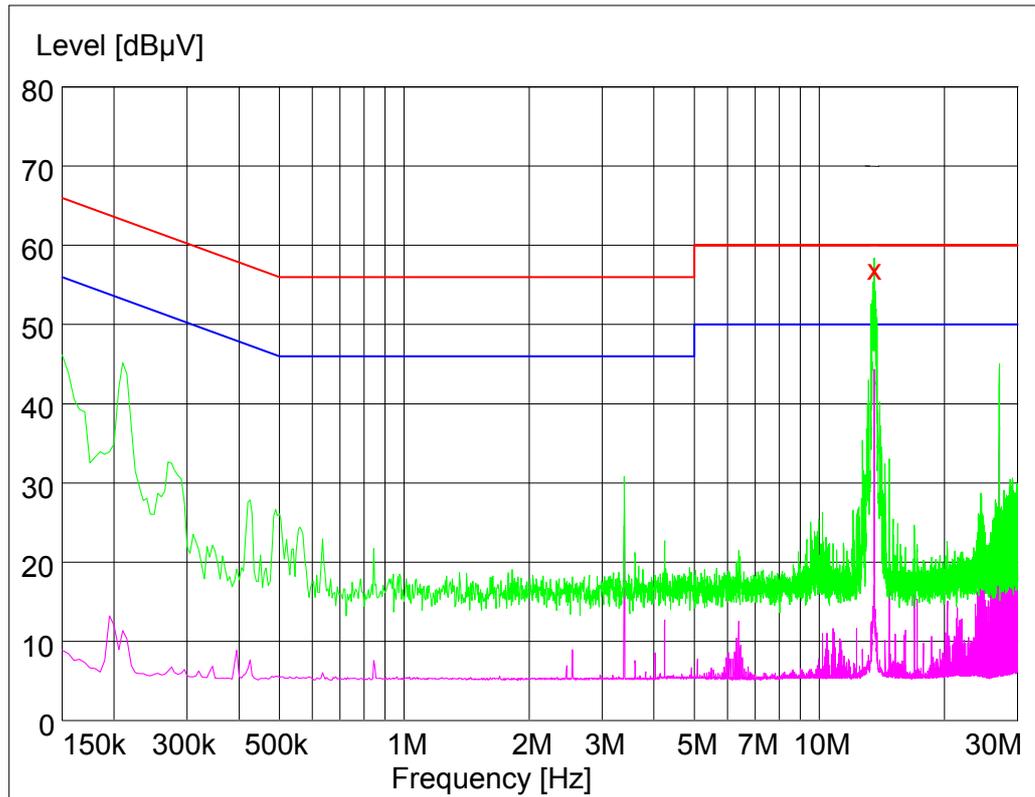
Within the specifications

Tested samples

SAMPLE	
1	904 205 15 powered by AC/DC Converter

MEASUREMENTS RESULTS

CONDUCTED DISTURBANCE ON THE EUT POWERED BY AC/DC CONVERTER



FINAL TEST (QUASI-PEAK DETECTOR)

Frequency	Level	Transd	Limit	Margin	Line	PE
MHz	dBµV	dB	dBµV	dB		
13.56	56.60	10.00	60.00	3.40	N	GND
	56.55	10.00	60.00	3.45	L	GND

TEST No. 3	Title "Restricted band of operation and Radiated disturbances"	47CFR Part 15 Ref. Section
		15.205 15.209 15.225 d)
TEST REQUIREMENTS	Test setup	ANSI C63.4
	Test facility	Anechoic chamber
	Test distance	3 m
	Limits for radiated disturbances	15.209(*)
	Frequency range	9 KHz ÷ 1 GHz
	if bandwidth (9 kHz÷ 150 kHz)	200 Hz
	if bandwidth (above 150 kHz)	100 kHz
	EMC class	B
	(*) In accordance with part 15.31 (f) (2), where the measurement distance was specified to be 30 or 300 meters, a correction factor was applied in order to permit measurement to be performed at a separation distance. The applied formula for limits at 3 meter is: Extrapolation (dB) = $40\log(300\text{meter} / 3\text{meter}) = +80\text{db}$ Extrapolation (dB) = $40\log(30\text{meter} / 3\text{meter}) = +40\text{db}$	

TEST DATA	PORT UNDER TEST	OPERATING CONDITION	RESULT
	Enclosure	#1	Complies

- 1) The EUT was placed on turntable which is 0.8 m above the ground plane
- 2) The turntable shall rotate from 0° to 360° degrees to determine the position of maximum emission level.
- 3) The EUT is positioned 3 m away from the receiving antenna which varied from 1 to 4 m to find the highest emission.
- 4) The measurements were made with the detector set to PEAK and AVERAGE amplitude within a bandwidth of 100 kHz below 1000 MHz and 1 MHz above 1000 MHz.
- 5) The receiving antenna was positioned in both horizontal and vertical polarization.
- 6) The measurements with Quasi-Peak detector, below 1000 MHz are performed only for frequencies for which the Peak values are \geq (Q.P. limit - 6 dB).

Tested samples

SAMPLE	
1	904 205 15 powered by AC/DC Converter

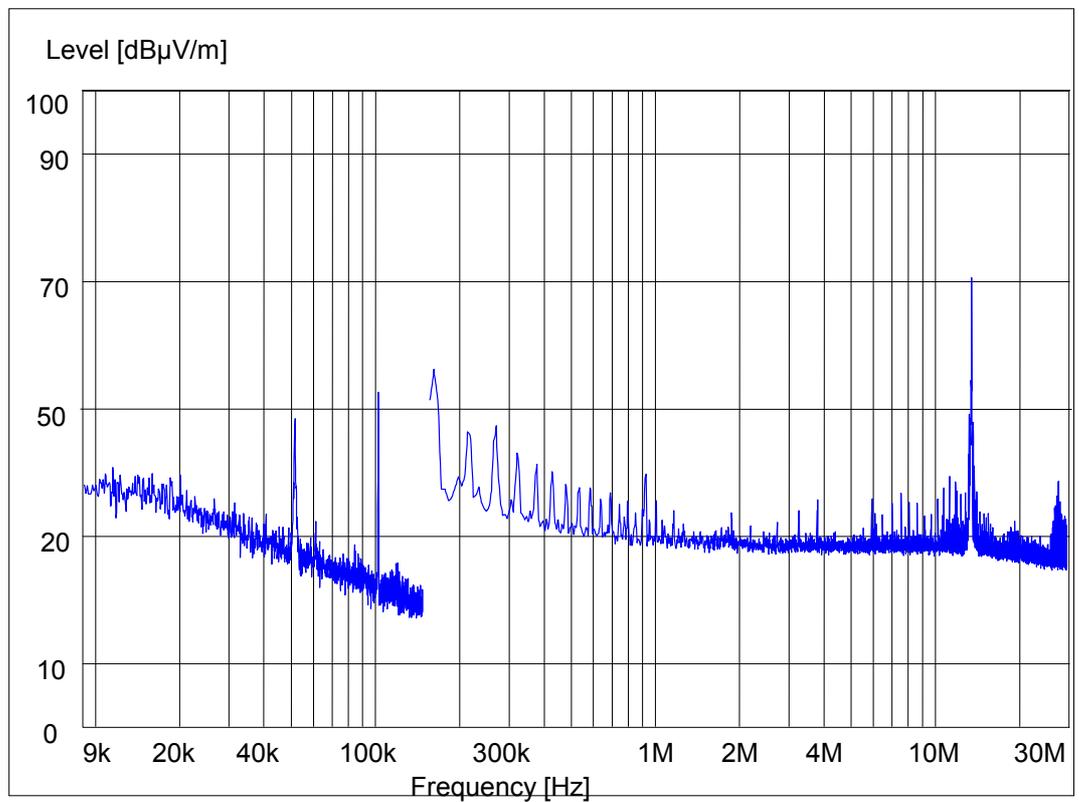
MEASUREMENTS RESULTS (below 30 MHz)

Frequency of Emission (MHz)	Field Strength limits @ 3 meters (dB μ V/m)	Result
0,009 ÷ 0,490	128,51 ÷ 93,79	Comply
0,490 ÷ 1,705	73,79 ÷ 62,96	Comply
1,705 ÷ 30,000	69,5	Comply

Quasi-Peak detector (X marked points)

Average detector

Peak detector

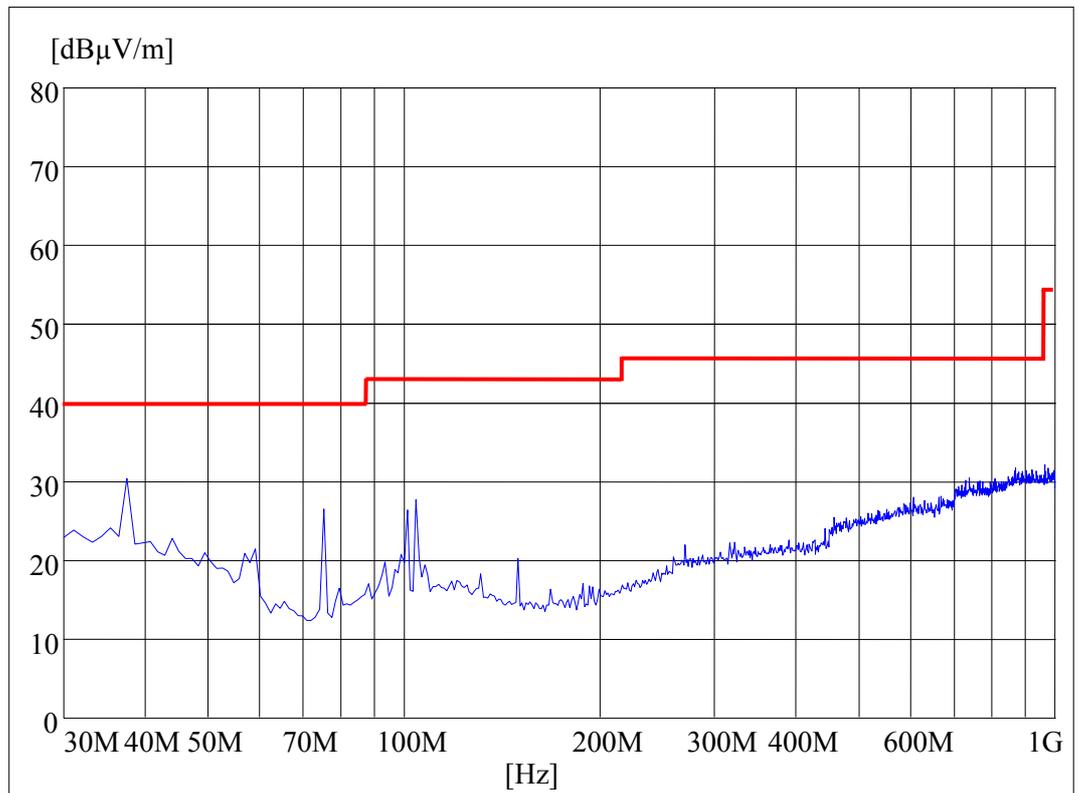


MEASUREMENTS RESULTS (30 MHz to 1 GHz)

Quasi-Peak detector (X marked points) []

Average detector []

Peak detector [X]



TEST No. 4	Title "Field strength within the assigned band"	47CFR Part 15 Ref. Section 15.225 (a)
TEST REQUIREMENTS	Test setup	ANSI C63.4
	Test facility	Semi-anechoic chamber
	Test distance	3 m
	Limits for radiated disturbances	84 dBµV/m @ 30 m (124 dBµV/m @ 3 m)
	frequency range	13.553 – 13.567 MHz
	if bandwidth	1 KHz
	(*) In accordance with part 15.31 (f) (2), where the measurement distance was specified to be 30 or 300 meters, a correction factor was applied in order to permit measurement to be performed at a separation distance. The applied formula for limit at 3 meter is: Extrapolation (dB) = 40log (30meter / 3meter) = +40db	

Modification during the test:

- None

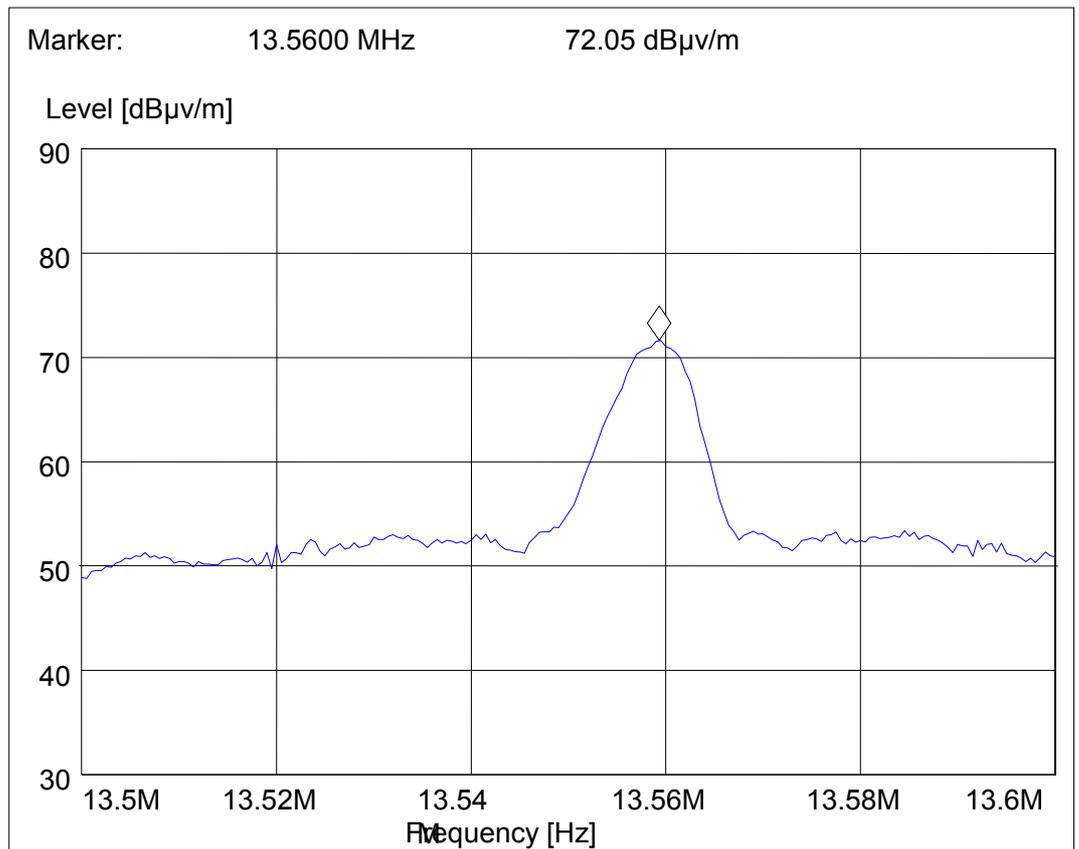
Tested samples

SAMPLE	
1	904 205 15 powered by AC/DC Converter

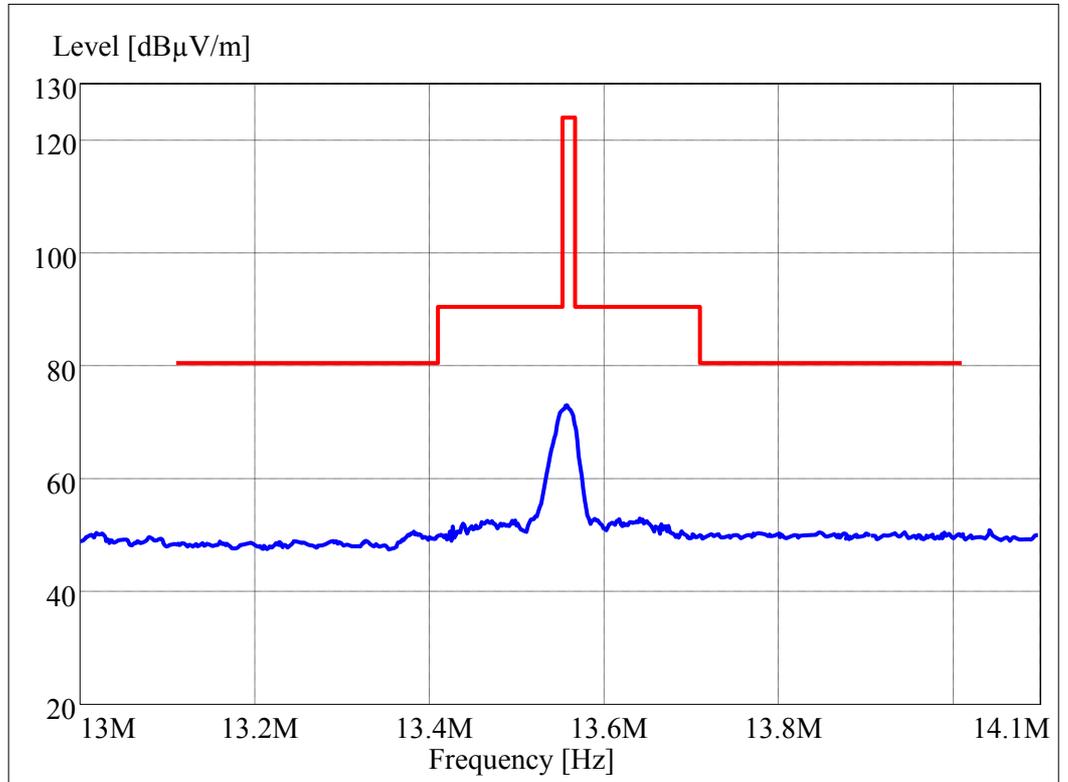
MEASUREMENTS RESULTS

Test distance : 3 m

Test conditions		Transmitter field strength
T _{nom} (20) °C	V _{nom} (+ 5) V	72,05 dBμV/m



MEASUREMENTS RESULTS (13.110÷14.010 MHz)



TEST No. 5	Title "frequency tolerance"	47CFR Part 15 Ref. Section
		15.225 (e)
TEST REQUIREMENTS	Test setup	ANSI C63.4
	Test facility	Climatic chamber
	Limits for radiated disturbances	± 0.01 % of operating frequency
	frequency range	13.553 – 13.567 MHz
	Power supply	external test power source
	Modulation state	ON

Modification during the test:

- None

Tested samples

SAMPLE	
1	904 205 15 powered by AC/DC Converter

MEASUREMENTS RESULTS

Measured operating frequency : 13.5600 MHz

Frequency drift limits : ± 135.56 kHz

Test conditions		Measured frequency (MHz)	Frequency drift (kHz)
Temperature	Power supply voltage		
5 V	-20 °C	13.559	- 0.1
	50 °C	13.557	- 0.3
12 V	-20 °C	13.559	- 0.1
	50 °C	13.558	- 0.2
4.25 V	20 °C	13.559	- 0.1
5.75 V		13.559	- 0.1
10.2 V		13.559	- 0.1
13.8 V		13.558	- 0.2

6 ADDITIONAL TECHNICAL INFORMATION

6.1 ELECTROMAGNETICALLY RELEVANT COMPONENTS:

Components	N°	Manufacturer	Type – Technical data
Radio Module			
See Technical document			

6.2 RFI SUPPRESSION DEVICES:

Components	N°	Manufacturer	Type – Technical data
None			

6.3 EMI PROTECTION DEVICES:

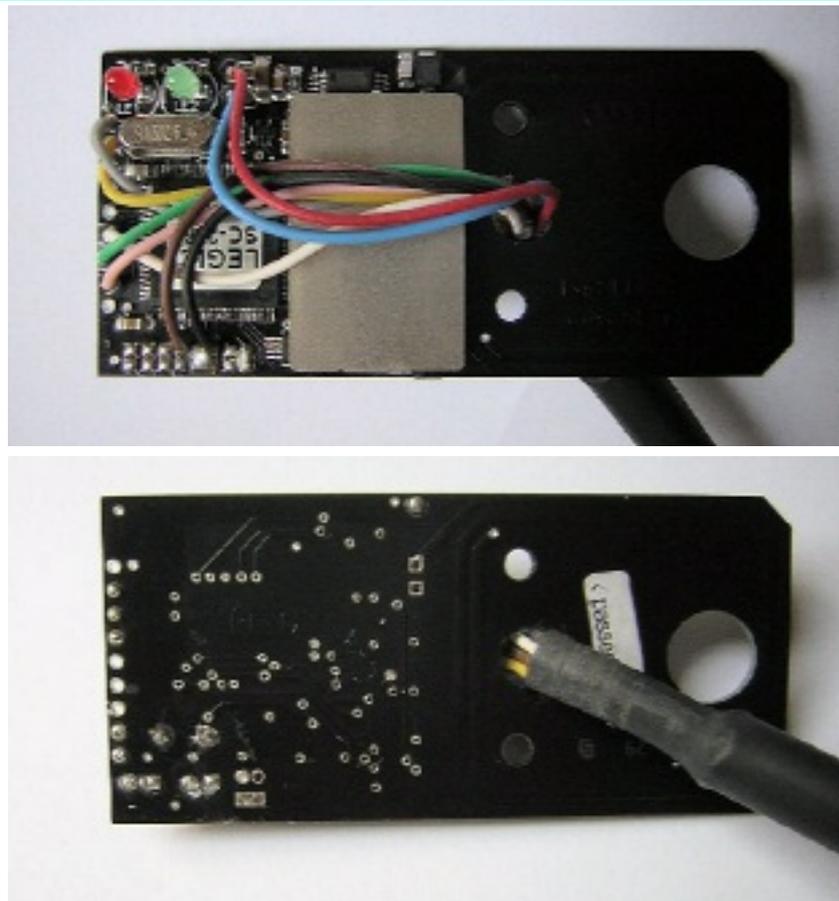
Components	N°	Manufacturer	Type – Technical data
None			

7 TECHNICAL DOCUMENTATION

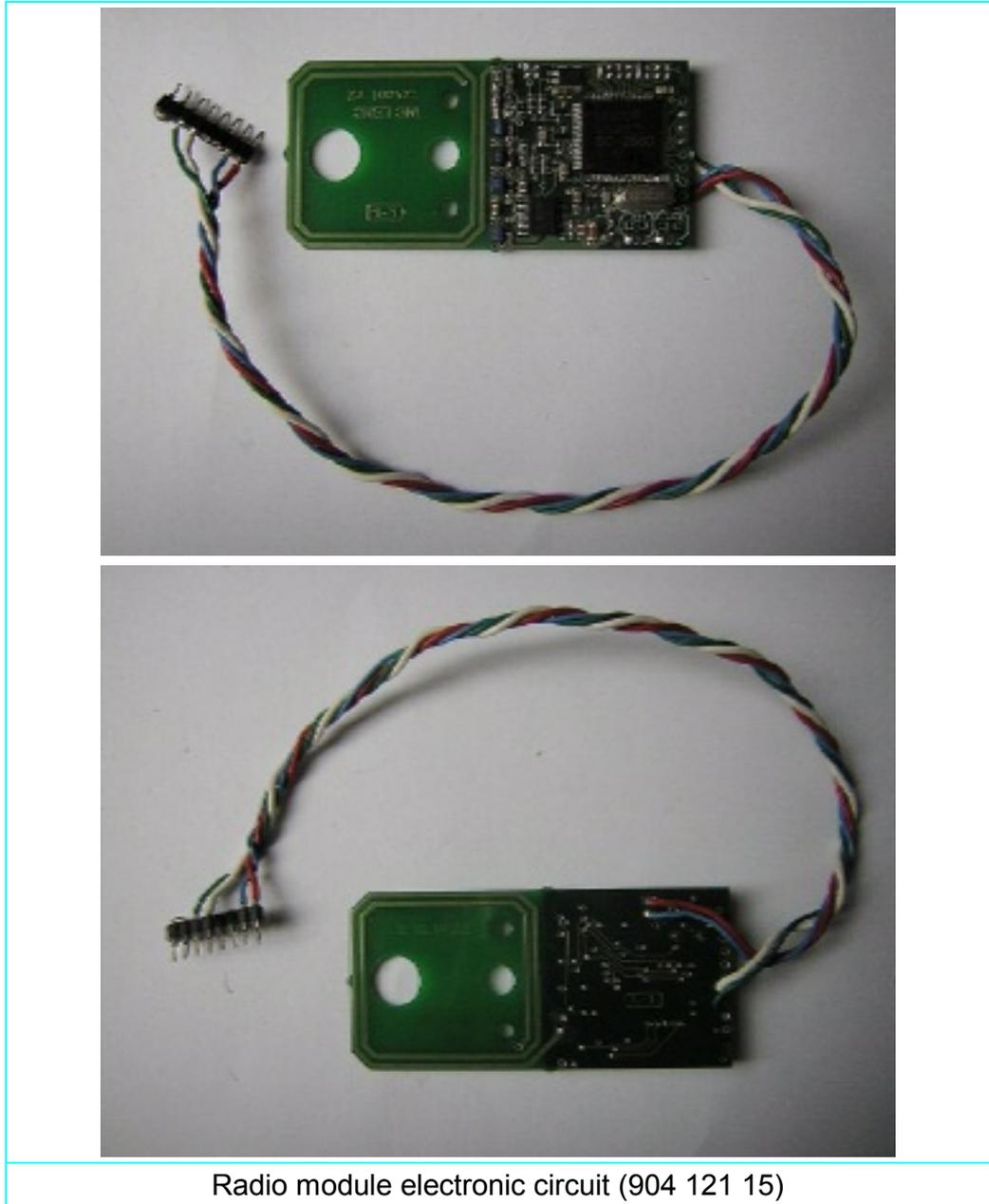
DOCUMENT	REFERENCE
Electronic diagram	SC9040115RF02 SC9040154MP02
Manual	/

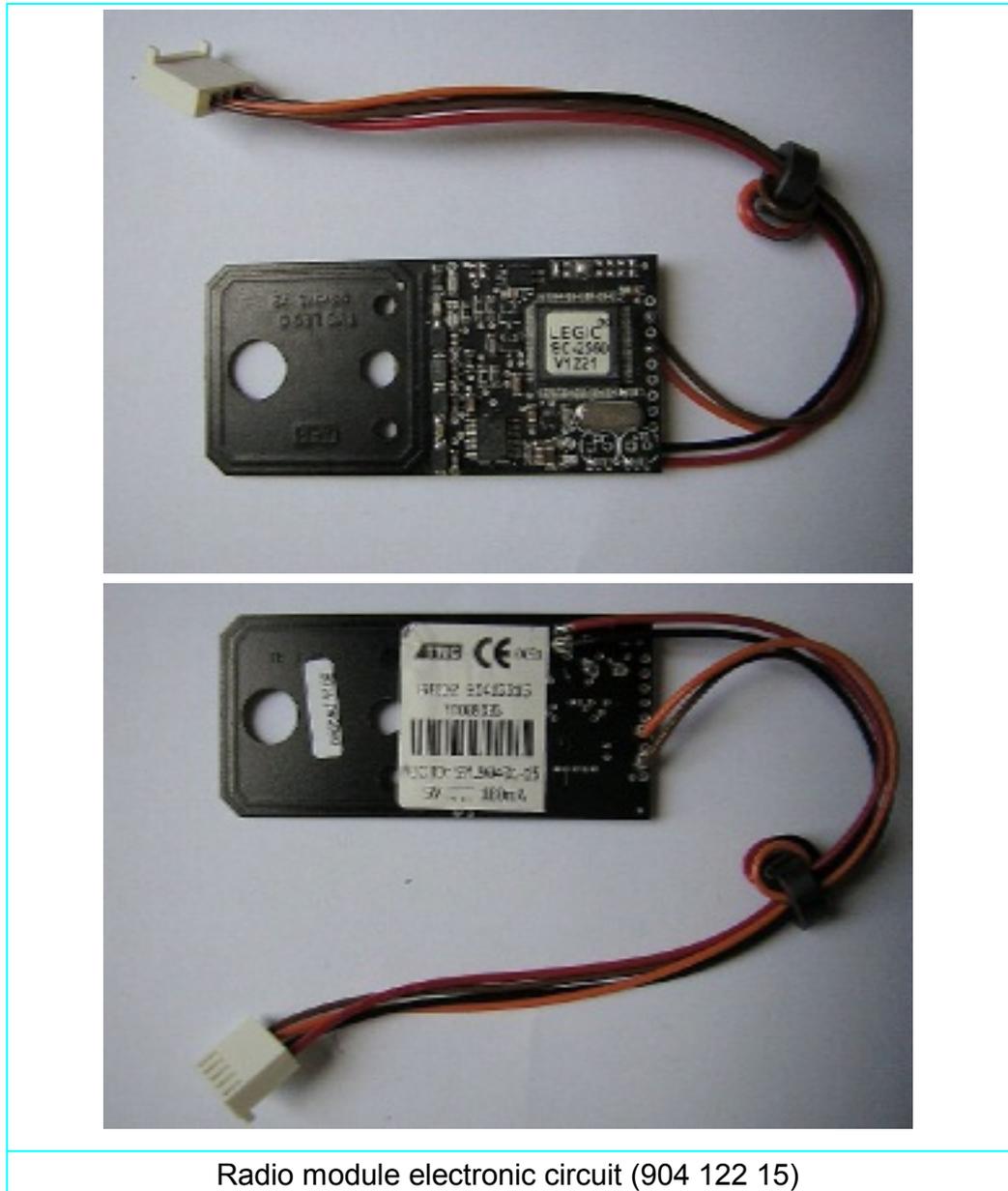
8 PHOTOGRAPHIC DOCUMENTATION

8.1 EUT IDENTIFICATION



Radio module electronic circuit (904 205 15)



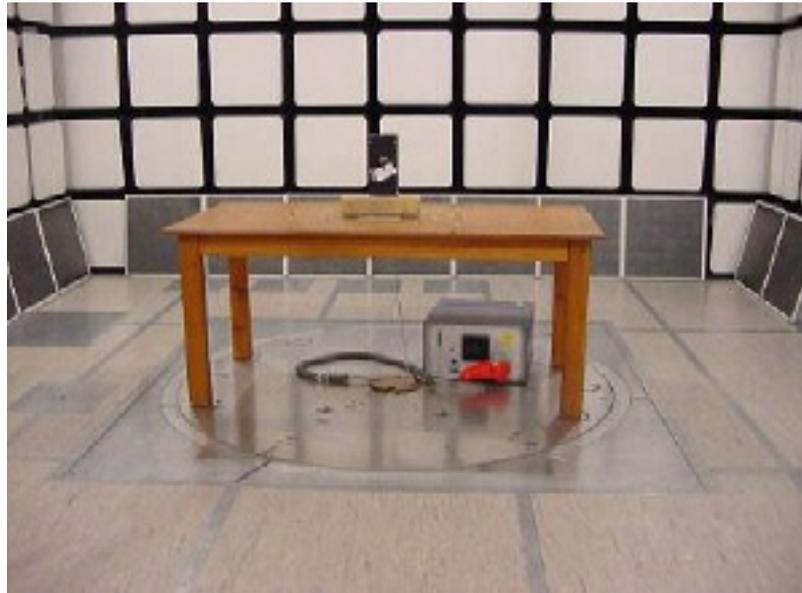


Radio module electronic circuit (904 122 15)



Radio module with Plastic enclosure (only for 904 205 15)

8.2 TEST SET-UP



Radio module with Plastic enclosure



Serial and AC-DC Adapter used for conducted emission test

9 MEASUREMENT AND TEST EQUIPMENT INSTRUMENTATION

Instruments	Manufacturer	Model	IMQ serial number	Calibration data	Calibration interval
					(Month)
Emi Receiver	Rohde & Schwarz	ESHS10	S-03494	08/2006	18
Artificial Mains V-network	COMTEST	/	S-02405	09/2005	24
Spectrum Analyzer	Rohde & Schwarz	FSP40	S-03629	07/2005	24
Antenna BilogP	ARA	LPD-2513	S-02385	05/2005	24
Antenna loop	Rohde & Schwarz	HFH2-Z2	S-02508	12/2006	24
Climatic chamber	Angelantoni	UV 300	P-00484	04/2005	24
Software for test automation	Rohde & Schwarz	ES-K1 V.1.60	-	-	-

The IMQ instruments are tested and calibrated according to UNI EN 45001, the IMQ procedure IP-037 "Calibration test equipment and measurement" and according to plans set on IMQ operating instruction IO-FT-034 "Criteria for the calibration of test equipment and measurement" which are an integral part of the Quality Manual of IMQ.