

Rapport d'essai / Test report

N° 200909-5712CR-R3-E

JDE : 95354

DELIVRE A / ISSUED TO

: TAGSYS S.A.
180, Chemin de Saint Lambert
13821 LA PENNE SUR HUVEAUNE
FRANCE

Objet / Subject

: Essais de compatibilité électromagnétique conformément aux normes
FCC CFR 47 Part 15, Subpart B et C.
*Electromagnetic compatibility tests according to the standards
FCC CFR 47 Part 15, Subpart B and C*

Matériel testé / Apparatus under test :

- Produit / Product : Portique Lecteur de tag RFID / Pedestal RFID tag reader
- Marque / Trade mark : TAGSYS
- Constructeur / Manufacturer : TAGSYS
- Type / Model : SCH400+L400-4
- N° de série / serial number : T0941005 + H0920010H0
- FCC ID : QHKMEDIOL400CHAN4

Date des essais / Test date

: Du 20 au 23 Octobre 2009 / From October 20th to 23th, 2009

Lieu d'essai / Test location

: BUREAU VERITAS LCIE SUD-EST
ZI Centr'Alp – 170 rue de Chatagnon
38430 MOIRANS - France

Test réalisé par / Test performed by : Anthony MERLIN

Ce document comporte / Composition of document : 24 pages.

MOIRANS, LE 23 OCTOBRE 2009 / OCTOBER 23TH, 2009

Ecrit par / Written by,
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Approuvé par / Approved by,
Yannick SAYOL



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SUMMARY

1. TEST PROGRAM	3
2. SYSTEM TEST CONFIGURATION	4
3. RADIATED EMISSION DATA	6
4. FUNDAMENTAL FREQUENCY TOLERANCE (15.225E)	10
5. BAND-EDGE COMPLIANCE §15.209	11
6. CONDUCTED EMISSION DATA	13
TEST EQUIPMENT LIST (MOIRANS SITE)	15
7. UNCERTAINTIES CHART	17
8. ANNEX 1 (GRAPHS)	18



1. TEST PROGRAM

Standard : FCC CFR 47, PART 15, Subpart C

ANSI C63-4 (2003).

Requirements for intentional radiator. Chapter 15.225 (Operation within the band 13.110-14.010MHz)

Standard : FCC CFR 47, PART 15, Subpart B

ANSI C63-4 (2003).

Requirements for unintentional radiator. Class B computer peripheral.

- Radiated emissions from 30MHz to 1GHz
- Conducted emissions from 150kHz to 30MHz

General conclusion:

Measures performed on the sample of the product SCH400+L400-4, SN: T0941005 + H0920010H0, in configuration and description presented in this test report, show compliance levels with FCC CFR 47, Part 15 B and Part 15 C.

2. SYSTEM TEST CONFIGURATION

2.1. JUSTIFICATION

The system was configured for testing in a typical fashion (as a customer would normally use it).
The Tunnel antenna is tested with the L400-4 reader, the power is set at 2.5W.
The L400-4 reader is considered as a computer peripheral device as it can be used in conjunction with a Personal Computer.

2.2. HARDWARE IDENTIFICATION

• Equipment under test (EUT):

SCH400+L400-4

Serial number: T0941005 + H0920010H0
FCC ID: QHKMEDIOL400CHAN4

The L400 reader is supplied with the AC/DC power adapter SWITCHBOX model FDF0453-A (Input: 100-240V / 50-60Hz ; Output : 18-24Vdc / 2.5A)

• Input/output on the Tunnel Antenna:

- * 2 Input RF channels (Cables 300cm)
- * 2 Antenna synchronization inputs (Cables 300cm)

• Input/output on the L400-4 reader :

- * USB port
- * Ethernet 10/100 (RJ45 connector)
- * Channel 1 antenna connector (SMA connector) + jack 3.5mm synchro connector
- * Channel 2 antenna connector (SMA connector) + jack 3.5mm synchro connector
- * Channel 3 antenna connector (SMA connector) + jack 3.5mm synchro connector, not used and not loaded.
- * Channel 4 antenna connector (SMA connector) + jack 3.5mm synchro connector, not used and not loaded.
- * I/O ports (DB9 connector)
- * Power supply (24Vdc)
- * TAGSYS Service connector (for TAGSYS internal use only), not used and not loaded.



• Auxiliaries used for testing:

Trade Mark – Model Number (Serial number)	Description	Cable description	FCC ID
DELL VOSTRO 1710 Sn: T932DA00	Laptop Personal Computer	Power cable unshielded Ethernet cable: shielded	DOC
TAGSYS - RFID tag (ISO 15693)			

• I/O cables used for testing:

- * 1 x Serial RS232 cable, shielded: 1.5m
- * 1 x USB cable, shielded: 1.8m
- * 1 x Ethernet cable, Cat5e, FTP, shielded: 5m
- * 1 x Mains AC power supply cable, unshielded: 1.8m (EUT,)

**2.3. EQUIPMENT MODIFICATIONS**

None

2.4. EUT EXERCISE SOFTWARE

The EUT exercise program used during radiated and conducted testing was exercised the L400 reader in a manner similar to a typical use.

The test program permits the continuous reading of a RFID tag.

(Tagsys Explorer v1.2.1)

Software parameters:

- ISO15693
- Multiplexage parameters:
 - Pattern 1: Emission/reception 2,5W time 0ms 1 round
 - Pattern 2: Emission/reception 2,5W time 0ms 1 round
- Tunnel feedback parameters: Delay 3ms
Min time 15ms
- Modulation parameters: 10% ASK
100% OOK
1 of 4 standard

2.5. EUT CONFIGURATION

Tests are performed with RFID tag compatible to ISO 15693 standards.

The L400 reader is fixed on a metallic plate, which is grounded to the tunnel by shielded of antenna cable.

The L400 reader is connected by Ethernet to a personal computer with the software TAGSYS Explorer.

2.6. SPECIAL ACCESSORIES

The RF antenna cable is coaxial 50Ω with six ferrites on the reader's side.

Ethernet, serial and I/Os cable are shielded.

USB is standard cable.

3. RADIATED EMISSION DATA

3.1. CLIMATIC CONDITIONS

Test performed by : A.MERLIN
Date of test : October 20th, 2009
Ambient temperature : 22°C

3.2. TEST SETUP

The installation of EUT is identical for pre-characterization measurement in a 3 meters full anechoic chamber and for measures on a 10 meters Open site.

Power supply: 230V/50Hz





3.3. TEST SEQUENCE AND RESULTS

3.3.1. Pre-characterization at 3 meters [9kHz-30MHz]

A pre-scan of all the setup has been performed in a 3 meters full anechoic chamber.

The distance between EUT and antenna is 3 meters. For Pre-characterization, the loop antenna was rotated during the test for maximized the emission measurement.

Frequency band investigated is 9kHz to 30MHz.

The pre-characterization graphs are obtained in PEAK detection.

See graph for 9kHz-30MHz band:

Emr#1

(See annex 1)

3.3.2. Pre-characterization at 3 meters [30MHz-1GHz]

A pre-scan of all the setup has been performed in a 3 meters full anechoic chamber.

The distance between EUT and antenna is 3 meters. Test is performed in horizontal (H) and vertical (V) polarization with a log-periodic antenna. The EUT is being rotated on 360° during the measurement. The pre-characterization graphs are obtained in PEAK detection.

See graphs for 30MHz-1GHz:

H polarization

Emr#2

(See annex 1)

V polarization

Emr#3

(See annex 1)

3.3.3. Characterization on 10 meters open site below 30 MHz

The product has been tested according to ANSI C63.4 (2003), FCC part 15 subpart C. Radiated Emissions were measured on an open area test site. A description of the facility is on file with the FCC.

The product has been tested at a distance of **10 meters** from the antenna and compared to the FCC part 15 subpart C §15.225 limits in the frequency range 13.553MHz 13.567MHz. Measurement bandwidth was 9kHz.

Antenna height was 1m for both horizontal and vertical polarization.

Antenna was rotated around its vertical axis.

Continuous linear turntable azimuth search was performed with 360 degrees range.

A summary of the worst case emissions found in all test configurations and modes is shown on clauses 3.2

Frequency (MHz)	QPeak Limit (dBµV/m) @ 30m	Qpeak (dBµV/m)	Qpeak-Limit (Margin dB)	Turntable Angle (deg)	Ant. Pol./ Angle (deg)	Tot Corr (dB)
13.56 * ¹	84.0	66.9	-17.1	40	90	35.3
27.12	29.5	/	/	/	/	/

*¹: Measure have been done at 10m distance and corrected according to requirements of 15.209.e) (M@30m = M@10m-19.1dB)



Limits Sub clause §15.225

Frequency (MHz)	Field strength (µV/m)	Measurement distance (m)
13.553-13.567	15 848 84 dBµV/m	30
13.410-13.553 13.567-13.710	334 50.5 dBµV/m	30
13.110-13.410 13.710-14.010	106 40.5 dBµV/m	30

See chapter 5 of this test report for band edge measurements.

3.3.4. Characterization on 10 meters open site from 30MHz to 1GHz

The product has been tested according to ANSI C63.4 (2003), FCC part 15 subpart C. Radiated Emissions were measured on an open area test site. A description of the facility is on file with the FCC.

The product has been tested at a distance of **10 meters** from the antenna and compared to the FCC part 15 subpart C §15.209 limits. Measurement bandwidth was 120kHz from 30 MHz to 1GHz.

Antenna height search was performed from 1m to 4m for both horizontal and vertical polarization. Continuous linear turntable azimuth search was performed with 360 degrees range.

A summary of the worst case emissions found in all test configurations and modes is shown on clause 3.2

Worst case final data result:

No	Frequency (MHz)	QPeak Limit (dBµV/m)	Qpeak * (dBµV/m)	Qpeak-Limit (Margin, dB)	Angle (deg)	Pol	Hgt (cm)	Tot Corr (dB)	Comments
1	38.719	40	39.2	-0.8	150	V	100	12.1	
2	40.68	40	36.3	-3.7	235	V	140	12	
3	54.209	40	28	-12	180	V	100	12.3	
4	67.786	40	28.8	-11.2	15	V	100	10.4	
5	155.459	43.5	29.6	-13.9	170	H	400	16	
6	894.941	46	42.7	-3.3	120	V	220	27.9	
7	904.052	46	39.6	-6.4	100	H	370	28	

*: Measure have been done at 10m distance and corrected according to requirements of 15.209.e)
(M@3m = M@10m+10.5dB)

RESULTS: PASS



3.4. FIELD STRENGTH CALCULATION

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follow:

$$FS = RA + AF + CF - AG$$

Where FS = Field Strength
 RA = Receiver Amplitude
 AF = Antenna Factor
 CF = Cable Factor
 AG = Amplifier Gain

Assume a receiver reading of 52.5dB μ V is obtained. The antenna factor of 7.4 and a cable factor of 1.1 are added. The amplifier gain of 29dB is subtracted, giving a field strength of 32 dB μ V/m.

$$FS = 52.5 + 7.4 + 1.1 - 29 = 32 \text{ dB}\mu\text{V/m}$$

The 32 dB μ V/m value can be mathematically converted to its corresponding level in μ V/m.

$$\text{Level in } \mu\text{V/m} = \text{Common Antilogarithm } [(32\text{dB}\mu\text{V/m})/20] = 39.8 \mu\text{V/m}.$$

**4. FUNDAMENTAL FREQUENCY TOLERANCE (15.225E)****4.1. TEST CONDITIONS**

Date of test : October 23th, 2009
Test performed by : A.MERLIN

The frequency tolerance of the carrier signal shall be maintained within $\pm 0.01\%$ of the operating frequency when the temperature is varied from -20°C to $+50^{\circ}\text{C}$ at the nominal power voltage and the primary power voltage is varied from 85% to 115% of the rated supply voltage at 20°C .

4.2. Temperature and voltage fluctuation

Temperature has been set at $+20^{\circ}\text{C}$, -20°C and $+50^{\circ}\text{C}$.

Voltage is varied from 93.5V/60Hz to 126.5V/60Hz

Frequency of carrier: 13.56 MHz

Upper limit: 13.561356 MHz

Lower limit: 13.558644 MHz

The equipment (RF box) is set in a climatic chamber. Measure is performed on one channel of RF module.

Temperature	-20°C	20°C	+50°C
Voltage			
Mains voltage: 110V/60Hz			
Frequency (MHz)	-0.000068	REF	-0.000022
Carrier level (dBc)	0.52	REF	-0.12
Mains voltage: 93,5V/60Hz			
Frequency (MHz)	-0.000068	0.000000	-0.000022
Carrier level (dBc)	0.47	-0.070000	-0.11
Mains voltage: 126V/60Hz			
Frequency (MHz)	-0.000068	0.000000	-0.000016
Carrier level (dBc)	0.50	-0.06	-0.12

Frequency drift measured is 68 Hz when the temperature is varied from -20°C to $+50^{\circ}\text{C}$ and voltage is varied from 110V/60Hz $\pm 15\%$.



5. BAND-EDGE COMPLIANCE §15.209

5.1. CLIMATIC CONDITIONS

Test performed by : A.MERLIN
Date of test : October 21th, 2009
Ambient temperature : 22°C

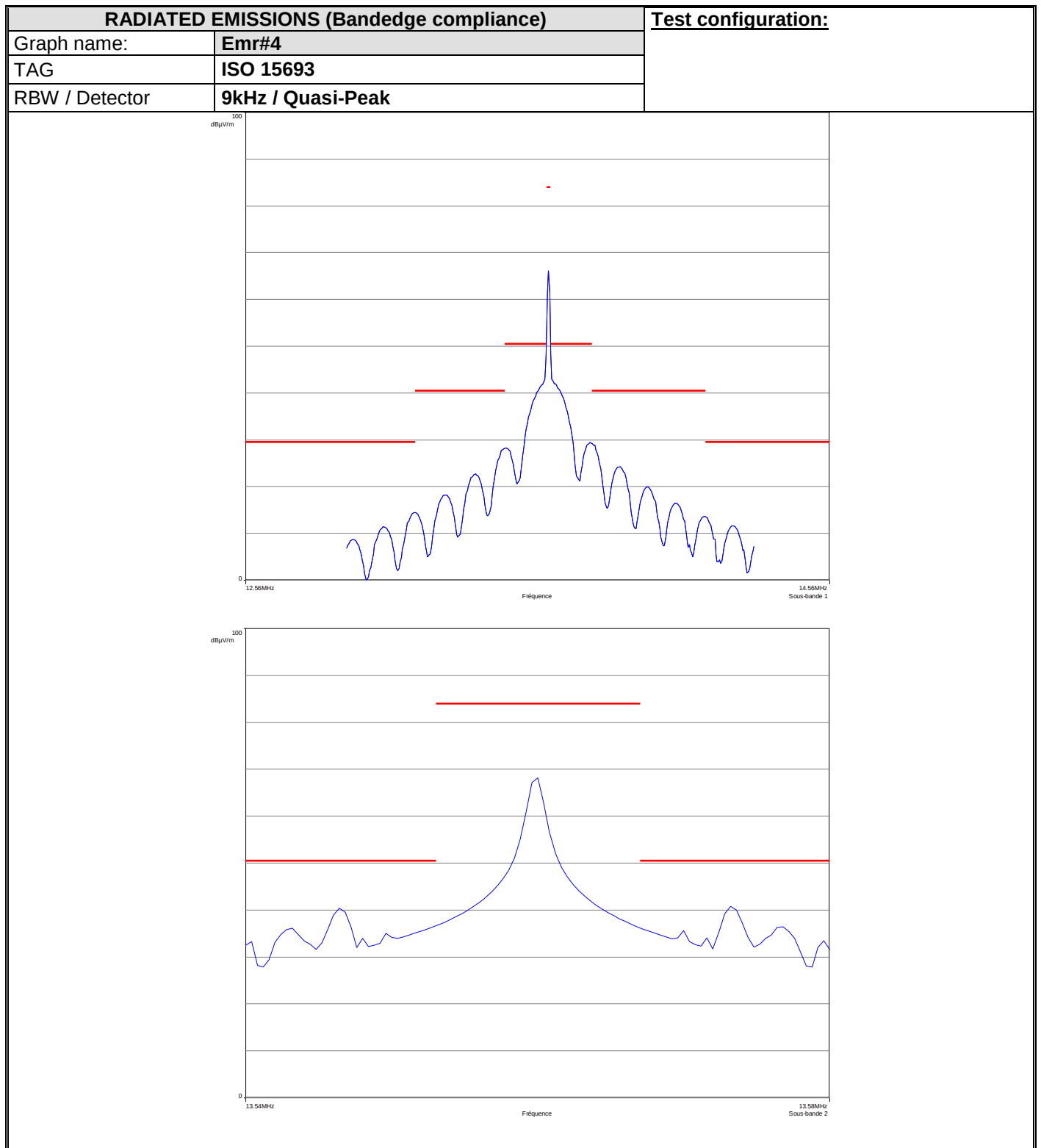
5.2. EQUIPMENT CONFIGURATION

The equipment is configured for tag reading, ISO 15693 standards.

5.3. Frequency band 13.110-14.010MHz

Following plots show radiated emission level in the frequency band 13.110-14.010MHz with a RBW of 9kHz and a quasi-peak detector.

The graphs are obtained with a measuring receiver ESU8.



6. CONDUCTED EMISSION DATA

6.1. CLIMATIC CONDITIONS

Date of test : October 22th, 2009
Test performed by : A.MERLIN

6.2. SETUP FOR CONDUCTED EMISSIONS MEASUREMENT

The product has been tested according to ANSI C63.4-(2003) and FCC Part 15 subpart C.

The product has been tested with 110V/60Hz power line voltage and compared to the FCC Part 15 subpart C §15.207 limits. Measurement bandwidth was 9kHz from 150 kHz to 30 MHz.

Measurement is made with a Rohde & Schwarz ESU8 receiver in peak mode. This was followed by a Quasi-Peak, i.e. CISPR measurement for any strong signal. If the average limit is met when using a Quasi-Peak detector, the EUT shall be deemed to meet both limits and measurement with the average detector is unnecessary. The LISN (measure) is 50 Ω / 50 μ H.

The Peak data are shown on plots in annex 1. Quasi-Peak and Average measurements are detailed in a table with frequencies and levels measured.

Interconnecting cables and equipment's were moved to position that maximized emission. A summary of the worst case emissions found in all test configurations and modes is shown on the following page.

6.3. TEST SETUP

The EUT is placed on the ground reference plane, at 80cm from the LISN. The distance between the EUT and the vertical ground plane is 40cm.

Auxiliaries are powered by another LISN.

The cable has been shorted to 1meter length. The EUT is powered trough the LISN (measure).





6.4. TEST SEQUENCE AND RESULTS

Measurements are performed on the phase (L1) and neutral (N) of one of the two pedestals.

A measurement is also performed with a 50Ω dummy load replacing the transmitter antenna in order to demonstrate that some 13.56MHz may be cross-coupled to AC line connection.

Graphs are obtained in PEAK detection.

Measures are also performed in Quasi-Peak and Average for any strong signal.

Measure on L1: graph **Emc#1** (see annex 1)

Measure on N: graph **Emc#2** (see annex 1)

Measure on L1 with Dummy Load: graph **Emc#3** (see annex 1)

Measure on N with Dummy Load: graph **Emc#4** (see annex 1)

Note: Measurement is performed with a dummy load (50Ω) replacing the antenna at the end of the cable:

RESULT: PASS


TEST EQUIPMENT LIST (MOIRANS SITE)

	N°LCIE	TYPE	COMPANY	REF	SN
RADIATED EMISSION MEASUREMENT (SEMI-ANECHOIC CHAMBER #1)					
	A5329032VO	Absorption clamp	LUTHI	MDS21	2826
	A5329044VO	Absorption clamp	RHODE ET SCHWARZ	85024A	194.0100.50
	A7102024VO	Amplifier 8 GHz	HEROTEK	A1080304A	222033
	A7085008VO	Amplifier 0.1MHz – 1300 MHz	HEWLETT PACKARD	8447D	2944A06838
	A7085009VO	Amplifier 0.1MHz – 1300 MHz	HEWLETT PACKARD	8447D	2944A08871
	A7085010VO	Amplifier 10MHz – 1300 MHz	A-INFO INC	JXWBLA-T	
X	C2040145VO	Antenna Bi-Log XWing	TESEQ	CBL6144	25903
	C2042027VO	Antenna horn	EMCO	3115	6382
	C2042028VO	Antenna horn 26GHz	SCHWARZBECK	BBHA 9170	BBHA9170232
X	C2040052VO	Antenna Loop	ELECTRO-METRICS	EM-6879	690234
X	F2000407	Antenna mast	MATURO Gmbh	AM 4.0	/037/1270308
X	A5329189VO	Cable EMI (s-Anechoic chamber)			
	A5329192VO	Cable Radiat EMI			
X	A5329198VO	Cable Radiat EMI			
X	A2642019VO	Measurement Receiver 20Hz – 8GHz	ROHDE & SCHWARZ	ESU8	100131
X	D3044016VO	Semi-Anechoic chamber #1	SIEPEL		
	A4060033VO	Spectrum Analyzer 9KHz – 12.8GHz	HEWLETT PACKARD	8596E	3409u00537
	A4060018VO	Spectrum Analyzer 9KHz – 26.5GHz	HEWLETT PACKARD	8593E	3409u00537
	A4060016VO	Spectrum analyzer 9kHz –1.8GHz	HEWLETT PACKARD	8591E	3536A00384
X	F2000406	Turntable chamber	MATURO Gmbh	TT 2.0 SI	/053/1270308
X	F2000408	Turntable controller chamber	MATURO Gmbh	Multiple Control Unit	MCU/060/1270308
X	A3169050VO	Radiated emission comb generator	BARDET		PR17B
RADIATED EMISSION MEASUREMENT (OPEN AREA TEST SITE)					
	A5329032VO	Absorption clamp	LUTHI	MDS21	2826
	A5329044VO	Absorption clamp	RHODE ET SCHWARZ	85024A	194.0100.50
	A4049059VO	Adapter quasi-peak	HEWLETT PACKARD	HP85650A	2811A01134
	A7102024VO	Amplifier 8 GHz	HEROTEK	A1080304A	222033
	A7102026VO	Amplifier 8-26GHz	ALDETEC	ALS01452	1
	A7085008VO	Amplifier 0.1MHz – 1300 MHz	HEWLETT PACKARD	8447D	2944A06838
	A7085009VO	Amplifier 0.1MHz – 1300 MHz	HEWLETT PACKARD	8447D	2944A08871
	A7085010VO	Amplifier 10MHz – 1300 MHz	A-INFO INC	JXWBLA-T	
X	C2040050VO	Antenna biconic	EMCO	3104C	9401-4636
	C2040051VO	Antenna Bi-log	CHASE	CBL6111A	1628
	C2042027VO	Antenna horn	EMCO	3115	6382
	C2042028VO	Antenna horn 26GHz	SCHWARZBECK	BBHA 9170	BBHA9170232
X	C2040056VO	Antenna log-periodic	EMCO	3146	2178
X	C2040052VO	Antenna Loop	ELECTRO-METRICS	EM-6879	690234
X	F2000288VO	Antenna mast	EMCO	1050	
X	A5329048VO	Cable EMR OATS	SUCOFLEX	106G	553
X	A5329199VO	Cable OATS (Mast at 10m)	UTIFLEX		
X	A5329188VO	Cable OATS (Mast at 10m)	UTIFLEX		
	A5329076VO	Cable OATS (Mast at 3m)	UTIFLEX		
	A5329196VO	Cable OATS (Turntable)	UTIFLEX		
	A5329187VO	Cable OATS (Turntable)	UTIFLEX		
	A2640011VO	Measurement receiver 9kHz–30MHz	ROHDE ET SCHWARZ	ESH3	972079/117
X	A2642019	Measurement Receiver 20Hz – 8GHz	ROHDE & SCHWARZ	ESU8	100131
	A4060027VO	Pre-selector RF	HEWLETT PACKARD	HP85685A	2837A00784
X	A3169050VO	Radiated emission comb generator	BARDET		PR17B
	A4060017VO	Spectrum analyzer	HEWLETT PACKARD	HP8568B	2732A04155
	A4060018VO	Spectrum Analyzer 9KHz – 26.5GHz	HEWLETT PACKARD	8593E	3409u00537
	A4060016VO	Spectrum analyzer 9kHz –1.8GHz	HEWLETT PACKARD	8591E	3536A00384
	A4060019VO	Spectrum analyzer display	HEWLETT PACKARD	HP85662A	2816A16603
X	F2000403VO	Turntable	ETS LINDGREN	Model 2187	
X	F2000286VO	Turntable / Antenna mast controller	ETS LINDGREN	Model 2066	
CONDUCTED MEASUREMENT EMISSION					
X	A5329061VO	Cable Conduct. EMI			
X	A5329060VO	Cable Conduct. EMI			
	A5329189VO	Shielded cable	UTIFLEX		
	A5329076VO	Shielded cable	UTIFLEX		

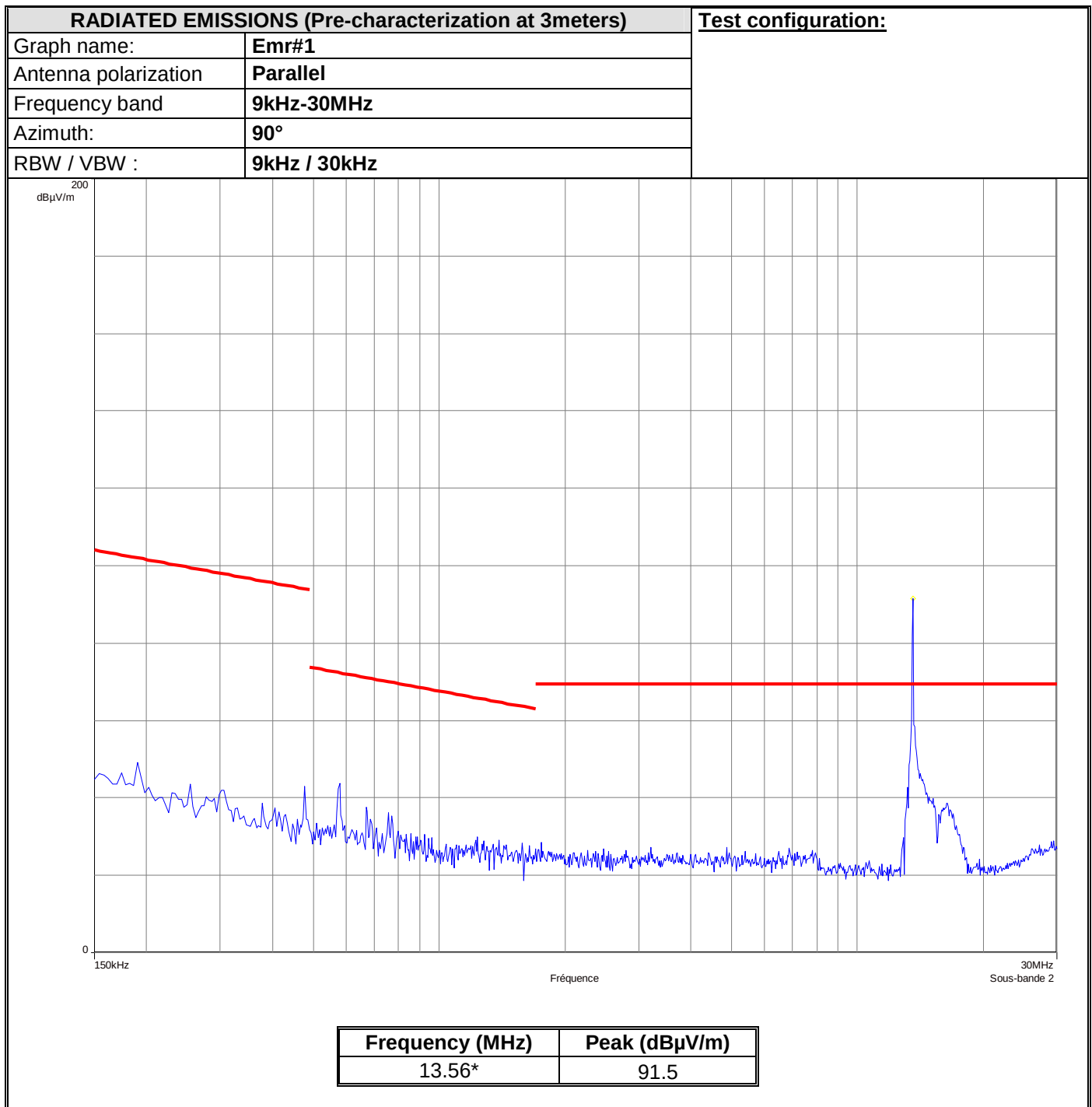


	N°LCIE	TYPE	COMPANY	REF	SN
	A5329206VO	Shielded cable	UTIFLEX		
	A5329207VO	Shielded cable	UTIFLEX		
	A5329060VO	Shielded cable	UTIFLEX		
	A5329071VO	Shielded cable	UTIFLEX		
X	A3169049VO	Conducted emission comb generator	BARDET		CGPR12
	A4040050VO	Clickmeter	SCHAFFNER	DIA1512D	22338
	A5329037VO	Current injection probe	SCHAFFNER	CIP8213	52
X	A1290017VO	Current probe	SCHAFFNER	CSP9160	1097
X	A5329036VO	Direct Injection Module 100+50 Ohms	LCIE	MID01-100 ohms	
	A7156004VO	Direct Injection Module 100+50 Ohms	LUTHI	CR100A	221
X	A5329042VO	Ferrite Tube	LUTHI	FTC 101	4485
	A1092042VO	Ferrite Tube	LUTHI	FTC101	4763
X	C2320059VO	LISN	EMCO	3810/2SH	9511/1182
	C2320068VO	LISN	EMCO	3825/2	9309/2122
	C2320061VO	LISN	TELEMETER ELECTRONIC	NNB-2/16Z	98010
	C2320062VO	LISN tri-phase ESH2-Z5	RHODE ET SCHWARZ	33852.19.53	841223/008
	C2320063VO	LISN tri-phase ESH2-Z5	RHODE ET SCHWARZ	33852.19.53	841223/007
X	C2320123VO	LISN	RHODE ET SCHWARZ	ENV216	100037
	A2640011VO	Measurement receiver 9kHz–30MHz	ROHDE ET SCHWARZ	ESH3	972079/117
X	A2642019VO	Measurement Receiver 20Hz – 8GHz	ROHDE & SCHWARZ	ESU8	100131
	C2320067VO	ISN 2 x 2 wires	RHODE ET SCHWARZ	ENY22	836727/015
	C2320066VO	ISN 4 wires	RHODE ET SCHWARZ	ENY41	838119/023
	C2320124VO	ISN 4 wires	TESEQ	T400A	24873
	D3044016VO	Semi-Anechoic chamber #1	SIEPEL		
	D3044017VO	Semi-Anechoic chamber #3	SIEPEL		
	D3044015VO	Semi-Anechoic chamber #2	SIEPEL		
X	D3044010VO	Faraday Cage	RAY PROOF		4854
X	A4049061VO	Transient limiter	HEWLETT PACKARD	11947A	3107A01596
	A4089117VO	Voltage probe	LCIE		

**7. UNCERTAINTIES CHART**

Type de mesure / Kind of measurement	Incertitude élargie laboratoire / Wide uncertainty laboratory (k=2) $\pm x$	Incertitude limite du CISPR / CISPR uncertainty limit $\pm y$
Mesure des perturbations conduites en tension sur le réseau d'énergie <i>Measurement of conducted disturbances in voltage on the power port</i>	3.57 dB	3.6 dB
Mesure des perturbations conduites en tension sur le réseau de télécommunication <i>Measurement of conducted disturbances in voltage on the telecommunication port.</i>	3.28 dB	A l'étude / Under consid.
Mesure des perturbations discontinues conduites en tension <i>Measurement of discontinuous conducted disturbances in voltage</i>	3.47 dB	3.6 dB
Mesure des perturbations conduites en courant <i>Measurement of conducted disturbances in current</i>	2.90 dB	A l'étude / Under consid.
Mesure du champ électrique rayonné sur le site en espace libre de Moirans <i>Measurement of radiated electric field on the Moirans open area test site</i>	5.07 dB	5.2 dB

8. ANNEX 1 (GRAPHS)



* Frequency carrier.

