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Schweizerischer Prüfstellendienst
Service suisse d'essai
Servizio di prova in svizzera
Swiss testing service

Report no:
Rapport no: **13'322**
Bericht Nr:

Title: **Radiocom-measurements on**
Titre: **LRS-100 / RFID 13.56**
Titel: **according to ETSI EN 300 330-1 and FCC 15 sub. C**

Date of test:
Date de l'essai: **March 6th, 2003**
Prüfdatum:

Customer:
Client: **LUCATRON AG**
Kunde:

Test place: **montena emc sa**
Lieu de l'essai: **CH-1728 Rossens**
Prüfört:

Test performed by
Essai effectué par :
Prüfer

Mr M. Portmann

.....

Test report prepared by
Rapport d'essai préparé par :
Berichterstatter

Mr M. Portmann

Test report controlled and approved by
Rapport d'essai contrôlé et approuvé par :
Prüfbescheinigung

Mr E. Staub

.....

Rossens,

(Issue Date / Date d'édition / Ausstelldatum)

V0116

Main language / Langue principale / Hauptsprache: english / français / deutsch

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Total Anzahl Seiten

1. Summary of test results / Résumé des résultats d'essais / Zusammenfassung der Prüfergebnisse

	ETSI EN 300 330-1	Results
Transmitter parameters		
Radiated H-field (carrier)	Chap. 7.2.1.2	Passed
RF carrier current	Not applicable	---
Radiated E-field (carrier)	Not applicable	---
Frequency range of the modulation bandwidth	Chap. 7.3 (normal test conditions)	Passed
Frequency range of the modulation bandwidth	Chap. 7.3 (extrem test conditions)	Not performed
Spurious emissions conducted (< 30 MHz)	Not applicable	---
Spurious emissions conducted ($\geq$ 30 MHz)	Not applicable	---
Spurious emissions radiated (< 30 MHz)	Chap. 7.4.3	Passed
Spurious emissions radiated ($\geq$ 30 MHz)	Chap. 7.4.4	Not performed
Duty cycle	Chap. 7.5	Passed
Receiver parameters		
Adjacent channel selectivity – in band	Not applicable	---
Blocking or desensitization	Not applicable	---
Spurious radiations	Not applicable	---

	CFR 47 Part 15 Subpart C	Results
Conducted emissions	Chap. 15.207	Not performed
Radiated emissions ($f \leq$ 30 MHz)	Chap. 15.209	Passed
Radiated emissions ($f \geq$ 30 MHz)	Chap. 15.209	Not performed
Carrier analysis	Chap. 15.225 (normal test conditions)	Passed
Carrier analysis	Chap. 15.225 (extrem test conditions)	Not performed

2. Applied standards / Normes appliquées / Verwendete Normen

ETSI EN 300 330-1 Electromagnetic compatibility and Radio spectrum Matters (ERM); Short Range Devices (SRD); Radio equipment in the frequency range 9 kHz to 25 MHz and inductive loop systems in the frequency range 9 kHz to 30 MHz; Part 1: Technical characteristics and test methods

CFR 47 Part 15
Subpart C Code of Federal Regulations - Telecommunication, Part 15, Subpart C: "Intentional Radiators"

3. Client / Client / Kunde

Client name and address Nom et adresse du client Name und Adresse des Kunden	<i>LUCATRON AG</i> <i>Stationstrasse 10</i> <i>CH-8606 Greifensee</i>
Contact Person / Responsable / Kontaktperson	<i>Mr Philipp Müller</i>
Telephone / Téléphone / Telefon	<i>+41 1 905 2070</i>
Fax / Télécopieur / Telefax	<i>+41 1 905 2075</i>
Mandate no / Mandat no / Auftrag Nr.	<i>2002-5427</i>

4. Equipment under test / Equipement à l'essai / Prüfling

Manufacturer name and address Nom et adresse du fabricant Name und Adresse des Herstellers	<i>LUCATRON AG</i> <i>Stationstrasse 10</i> <i>CH-8606 Greifensee</i>
Production country / Pays de fabrication / Ursprungsland	<i>Switzerland</i>
Brand name / nom de marque / Verkaufsmarke	<i>LRS-100</i>
Product name / Nom du produit / Produktname	<i>LRS-100 / RFID 13.56 MHz</i>
Product description / Description du produit / Produktbeschreibung	<i>Anti-theft system (13.56 MHz)</i>
Model number / Numéro de modèle / Modellnummer	<i>LRS-100</i>
Serial no / No. de série / Seriennummer	<i>Prototyp</i>
Software version / Version du logiciel / Softwareversion	<i>---</i>
Supply / Alimentation / Speisung	<i>U = 230 VAC</i>
Technical documentation Documentation technique Technische Dokumentation	<i>None. The identification of the equipment is in the responsibility of the manufacturer.</i>

5. Persons present / Personnes présentes / Anwesende Personen**Test Engineer(s) / Ingénieur(s) d'essai / Prüfsingenieur(e) :***Manfred Portmann***Other(s) / Autre(s) / Andere :**

Name / Nom / Name

Company / Société / Firma

*Mr Philipp Müller (partly)**Lucatron AG***6. Function of the EUT**

The EUT is a wireless anti-theft unit which is operating at a frequency of 13.56 MHz.

7. Definitions, classifications and test conditions

Definitions	Reference ETSI EN 300 330-1	Classification
Radiated H-field or power level	Table 1	Power class 2 and 8
Risk assessment of receiver performance	Table 2	---
Extreme temperature range	Chap 5.4.1.2	Category III (indoor)
Product classes (antenna type)	Chap. 7.1.4	Product class 1 (0.56 m ²)
Duty cycle classes	Chap. 7.5.3	Duty cycle class 4

Extreme test conditions	Level or range	Remark
Classification	Category III (indoor)	Not performed
Extreme temperatures	0 °C ÷ +55 °C	Not performed
Extreme test source voltages	207 - 253 VAC	Not performed

Normal test conditions	Value	Remark
Temperature:	20 – 22 °C	
Pression:	1005 hPa	
Relative humidity:	38 – 42 %	
Test period:	Feb. 14 th -15 th , 2003	

Full description of the modulated signal:

(only if EUT can not be tested in unmodulated condition)

Modulation:	<i>Not modulated during the test</i>
Transmission frequency	<i>13.56 MHz</i>
FM Deviation:	<i>---</i>
Full Modulation Bandwidth:	<i>Within 13.553 – 13.567 MHz ISM frequency band</i>
Bit rate:	<i>---</i>

Conducted tests performed with:

(only for equipment with integral antenna)

Test Fixture	<i>Not performed</i>
Temporary connector	<i>Not performed</i>
Permanent internal connector	<i>Not performed</i>

Power source for battery operated equipment:

Internal batteries (normal test conditions)	<i>Not applicable</i>
External test power source (extreme test conditions)	<i>Not applicable</i>

H-FIELD STRENGTH**SUB-CLAUSE 7.2.1**

(Class 2 / 8)

Rated field strength (maximum): 42 dB μ A/m at 10 metresAntenna size: around 0.56 m²

Test conditions		Transmitter field strength (dB μ A/m)		
		CH 1	CH 2	CH 3
$T_{nom}(22)^{\circ}C$	$V_{nom}(9.0)V$	≤ 42		
Maximum deviation from rated output under normal test conditions (dB)		0		
Measurement uncertainty		± 3.9 dB		

LIMIT SUB-CLAUSE 7.2.1.3

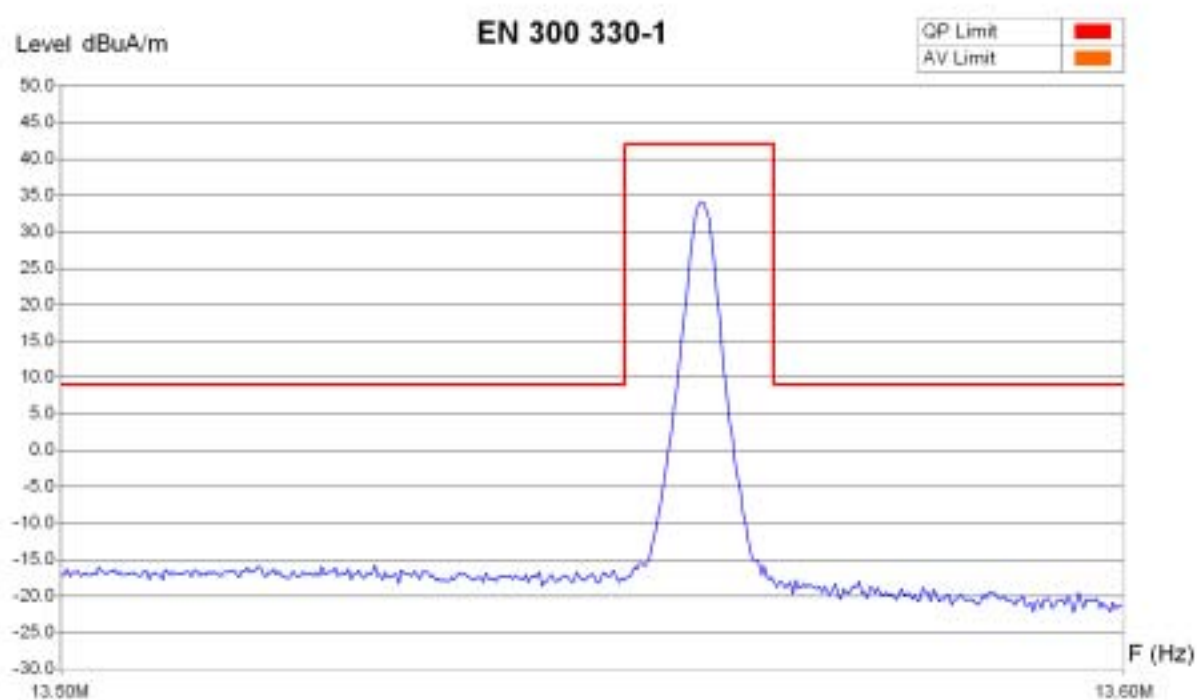
Frequency range (MHz)	H-field field strength limit (Hf) dB μ A/m at 10 m
$0,009 \leq f < 0,03$	72 *
$0,03 \leq f < 0,07$ $0,119 \leq f < 0,135$	72 at 0,03 MHz descending 3,0 dB/oct *
$0,05975 \leq f < 0.06025$ $0,07 \leq f < 0.119$	42
$0,135 \leq f < 1.00$	37.7 at 0,135 MHz descending 3,0 dB/oct
$1.0 \leq f < 4.642$	29 at 1.0 MHz descending 9,0 dB/oct
$4.642 \leq f < 30$	9
$6,765 \leq f \leq 6,795$ (ISM) $13,553 \leq f \leq 13,567$ (ISM) $26,957 \leq f \leq 27,283$ (ISM)	42
*For the frequency ranges 9 - 70 kHz and 119 – 135 kHz: – loop area ≥ 0.16 m ² : table values – 0.16 m ² $\geq$ loop area ≥ 0.05 m ² : table value + $10 \cdot \log(\text{area} / 0.16 \text{ m}^2)$ – loop area < 0.05 m ² : table values - 10 db	

Complies with the requirements.

Date/Date/Datum : **March 6th, 2003**

Measurement Type : Radiated Field
Polarisation : Horizontal
Table Angle : 0-360 deg.
Antenna Height : 1-4 m

Equipment Under Test : LRS-100 / RFID 13.56 MHz
Set-Up :
Operating Conditions : normal operating conditions / 2W
Remarks :



Zone	13.50 MHz - 13.60
Video Bandwidth	1 KHz
Resol Bandwidth	1 KHz
Sweep Time	0 s

Operator
Date/Time: 06.03.03 14:37
Filename
carr_EN_hor.png/.bit

Date/Date/Datum : **March 6th, 2003**

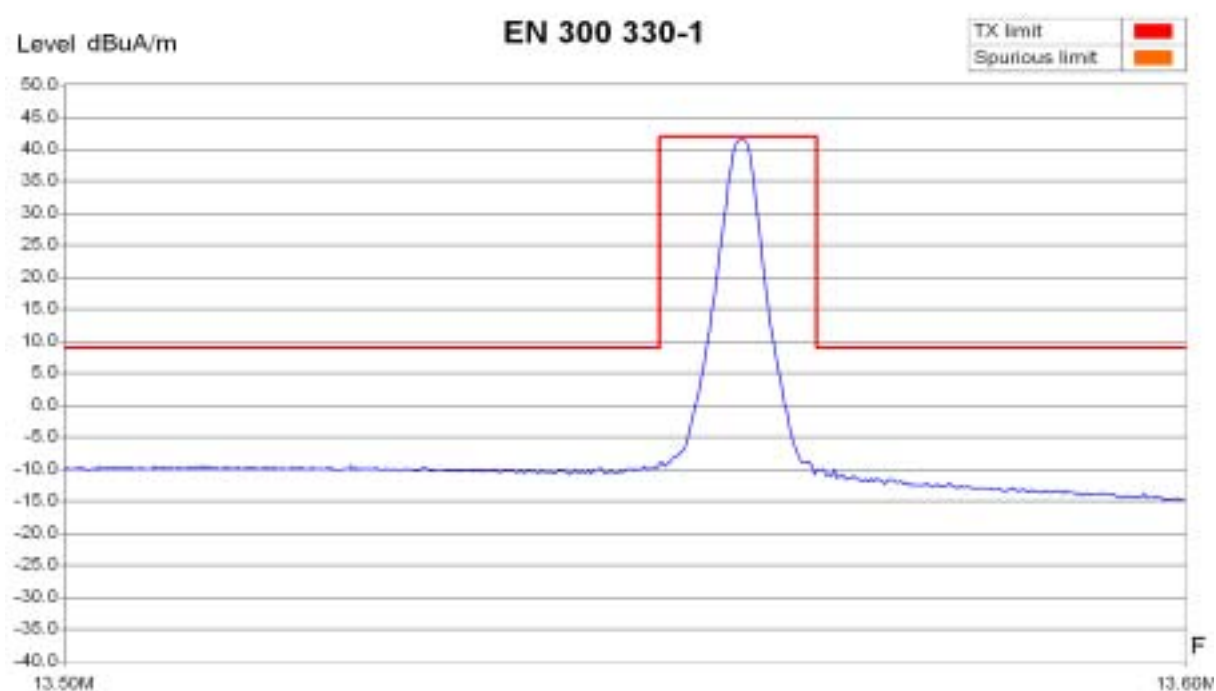
Measurement Type : Radiated Field
Polarisation : Vertical
Table Angle : 0-360 DEG.
Antenna Height : 1-4 M

Equipment Under Test : LRS-100 / RFID 13.56 MHz

Set-Up :

Operating Conditions : NORMAL OPERATING CONDITIONS / 2W

Remarks : NOMINAL VOLTAGE / NOMINAL TEMPERATURE



Zone	13.50 MHz - 13.60
Video Bandwidth	1 KHz
Resol Bandwidth	1 KHz
Sweep Time	0 s

Operator: PoM
Date/Time: 06.03.03 14:25
Filename:
calr_EN_vert.png/.txt

TRANSMITTER SPURIOUS EMISSIONS RADIATED (<30 MHz) AT 10 M**SUB-CLAUSE 7.4.3**Rated carrier output : 42 dB μ A/m

Transmitter operating

Modulated

SPURIOUS EMISSIONS LEVEL (dB μ A/m)								
CH 1			CH 2			CH 3		
f (MHz)	Band- Width** (kHz)	Level (dB μ A/m)	f (MHz)	Band- width** (kHz)	Level (dB μ A/m)	f (MHz)	Band- width** (kHz)	Level (dB μ A/m)
0.009– 0.15	0.3	OK <i>see following pages</i>						
0.15 – 30	9	OK <i>see following pages</i>						
Measurement uncertainty			± 3.9 dB					

** Bandwidth = the measuring receiver bandwidth

LIMIT SUB-CLAUSE 7.4.3.2

State	Frequency $9 \text{ kHz} \leq f < 10 \text{ MHz}$	Frequency $10 \text{ MHz} \leq f < 30 \text{ MHz}$
Transmit	27 dB μ A/m descending 3 dB/oct	-3.5 dB μ A/m
Standby	6 dB μ A/m descending 3 dB/oct	-24.5 dB μ A/m

REMARKS: The equipment can not be operated in TX off mode.

Complies with the requirements.

Date/Date/Datum : **March 6th, 2003**

Measurement Type : Radiated Field
 Polarisation : Horizontal
 Table Angle : 0-360 deg.
 Antenna Height : 1-4 m
 Equipment Under Test : LRS-100 / RFID 13.56 MHz
 Set-Up : on turntable
 Operating Conditions : normal operating / 2W
 Remarks : typical distance between antennas: 85 cm



Zone	9 KHz - 150 KHz	150 KHz - 3 MHz	3 MHz - 30 MHz
Video Bandwidth	300 Hz	30 KHz	30 KHz
Resol Bandwidth	300 Hz	9 KHz	9 KHz
Sweep Time	5 s	2 s	2 s

Operator: PoM
 Date/Time: 06.03.03 13:45
 Filename:
 spurious BF hor.png/.txt

Date/Date/Datum : **March 6th, 2003**

Measurement Type : Radiated Field
 Polarisation : Vertical
 Table Angle : 0-360 deg.
 Antenna Height : 1-4 m
 Equipment Under Test : LRS-100 / RFID 13.56 MHz
 Set-Up : on turntable
 Operating Conditions : normal operating / 2W
 Remarks : typical distance between antennas: 85 cm



Zone	9 KHz - 150 KHz	150 KHz - 3 MHz	3 MHz - 30 MHz
Video Bandwidth	300 Hz	30 KHz	30 KHz
Resol Bandwidth	300 Hz	9 KHz	9 KHz
Sweep Time	5 s	2 s	2 s

Operator: PoM
 Date/Time: 06.03.03 13.26
 Filename:
 spurious BF vert.png/.bt

DUTY CYCLE**SUB-CLAUSE 7.5**Total length of the message: [s] $\Rightarrow$ Value ADuration of "power ON": continuous [s] $\Rightarrow$ Value BNumber of message per hour $\Rightarrow$ Value N

If the equipment is not continuously transmitting $\Rightarrow$
$$Dutycycle = \frac{N \cdot B}{3600[s]}$$

If the equipment is continuously transmitting $\Rightarrow$
$$Dutycycle = \frac{B}{A + B}$$

Remarks: The equipment is continuously sending a carrier frequency.

LIMIT SUB-CLAUSE 7.5.3

Duty cycle Class	Duty cycle ratio
1	< 0.1 %
2	< 1.0 %
3	< 10 %
4	Up to 100%

The duty cycle class is 4.

Date/Date/Datum : **March 6th, 2003****FCC - Measurement of the magnetic field 9 kHz - 30 MHz**

Test site: ☒ anechoic chamber (ferrites) ☐ open test site
☐ anechoic chamber (foam) ☐

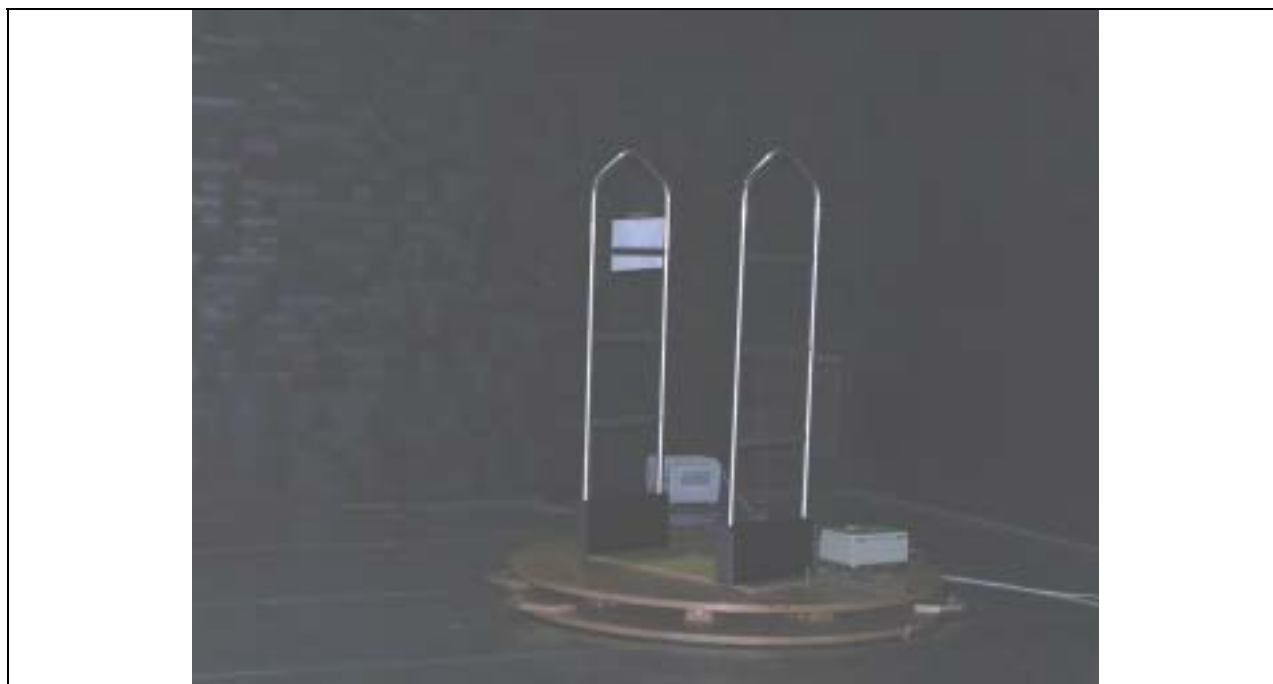
Meas. distance: ☐ 3 m ☒ 10 m ☐ 30 m ☐ m

Position of EUT: 0.8 m (height above floor of equipment under test)

Test precision: ± 2.8 dB (10 m)

Measuring method: The magnetic disturbance radiated by the equipment under test is measured from 150 kHz (9 kHz) to 30 MHz using a spectrum analyser and a wide band magnetic antenna. The antenna is placed in the direction of the apparatus under test and then at 90° to the apparatus. If possible the turning table is operated through 360° during the measurement. The recording is carried out taking into account the maximum value of the disturbance appearing during the functioning of the apparatus under test. The peak values are recorded continuously on a graph. The values exceeding the limits are remeasured manually in quasipeak values and the average using a measuring receiver, these measurements are indicated below the graph.

Test set-up:



Remarks:

Measurement equipment:

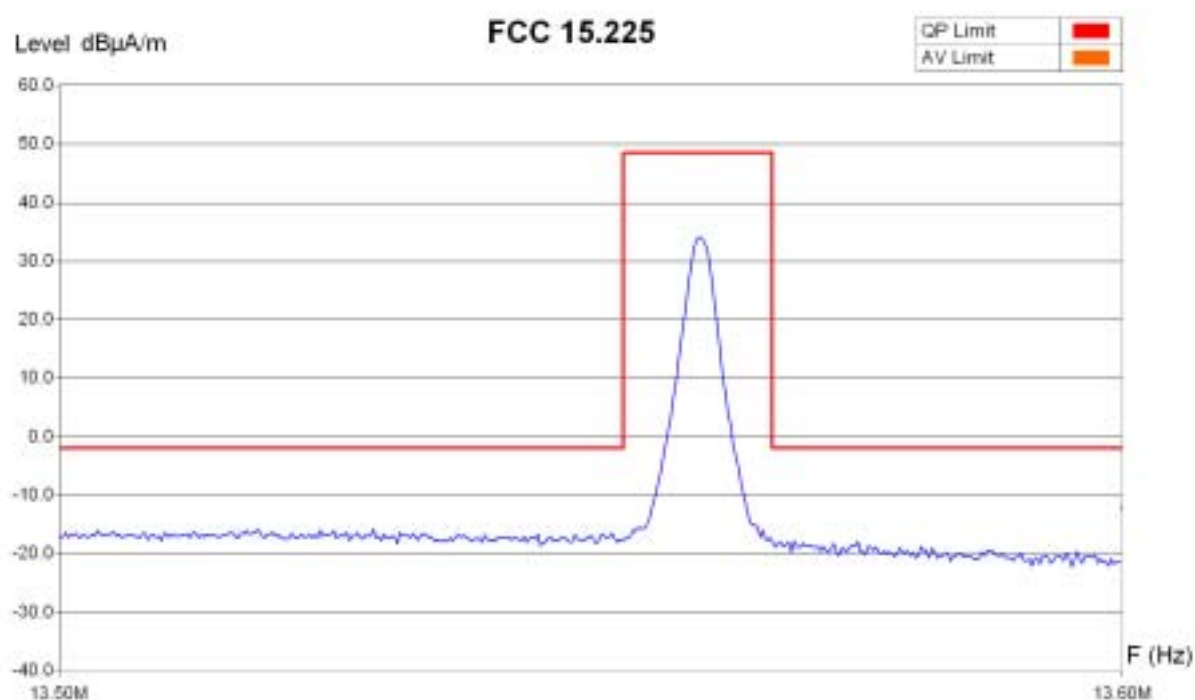
☒ Spectrum analyser	☐ 88-14	☐ 90-26	☒ 94-24	F =
☒ Receiver	☐ 85-12	☐ 90-11	☒ 94-34	☐
☒ Preamplifier	☐ 88-05	☐ 90-01	☒ 90-42	☐ 95-86
☒ Antenna (typ: magnetic)	☐ 90-25	☒ 90-28	☐ 99-32	☐

Result: ☒ pass ☐ fail ☐ not applicable ☐ not tested

Date/Date/Datum : **March 6th, 2003**

Measurement Type : Radiated Field
Polarisation : Horizontal
Table Angle : 0-360 deg.
Antenna Height : 1-4 m

Equipment Under Test : LRS-100 / RFID 13.56 MHz
Set-Up :
Operating Conditions : normal operating conditions / 2W
Remarks :



Zone	13.50 MHz - 13.60
Video Bandwidth	1 KHz
Resol Bandwidth	1 KHz
Sweep Time	1 s

Operator: pOm
Date/Time: 05.03.03 14:37
Filename: CARR_FCC_HCR.png/.txt

Date/Date/Datum : **March 6th, 2003**

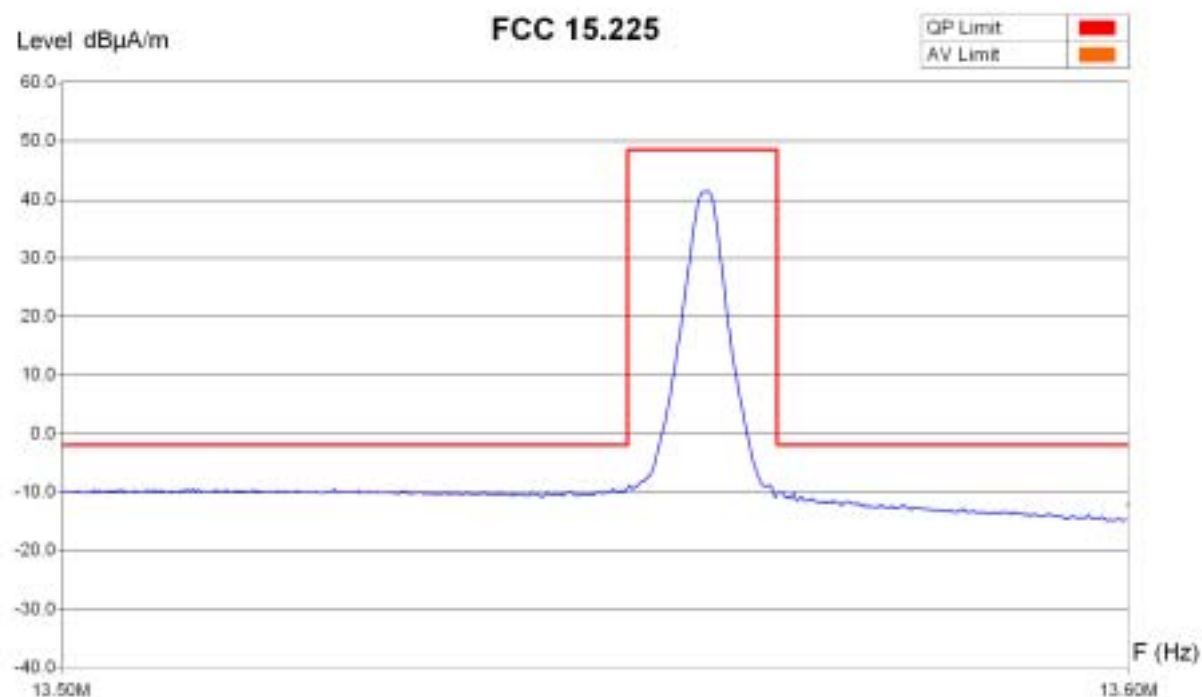
Measurement Type : Radiated Field
Polarisation : Vertical
Table Angle : 0-360 DEG.
Antenna Height : 1-4 M

Equipment Under Test : LRS-100 / RFID 13.56 MHz

Set-Up :

Operating Conditions : NORMAL OPERATING CONDITIONS / 2W

Remarks : NOMINAL VOLTAGE / NOMINAL TEMPERATURE



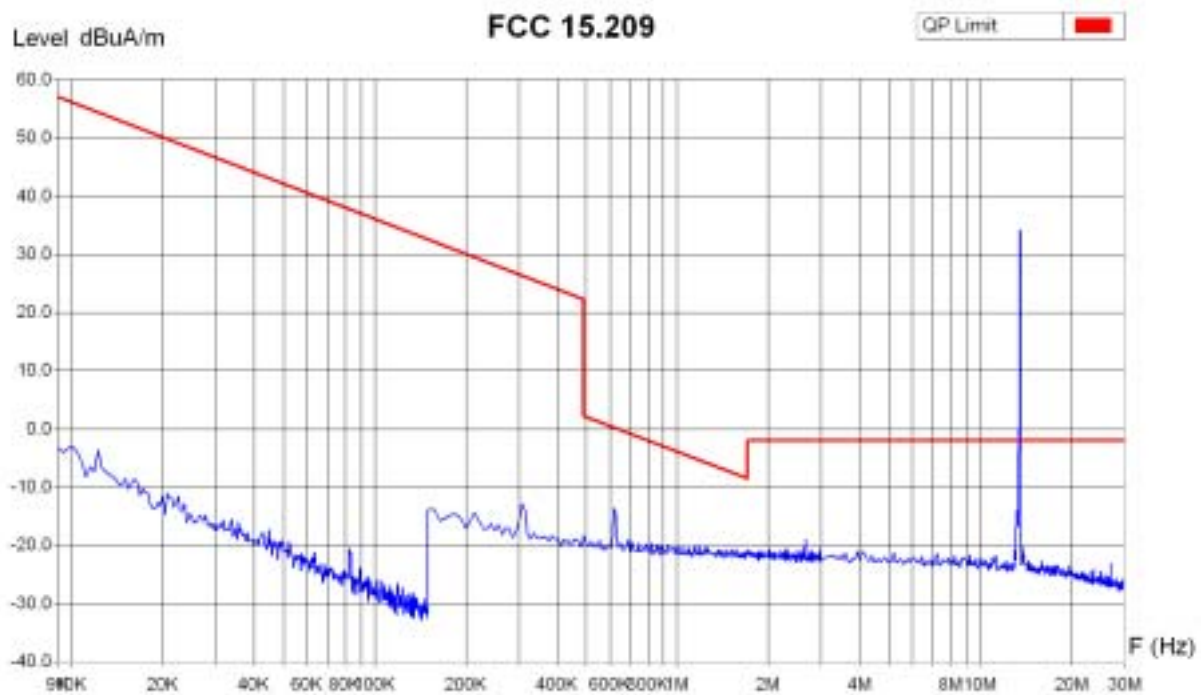
Zone	13.50 MHz - 13.60
Video Bandwidth	1 KHz
Resol Bandwidth	1 KHz
Sweep Time	1 s

Operator: pQm
Date/Time: 06.03.03 14:25
Filename: CARR_FCC_VERT.png/.txt

Date/Date/Datum : **March 6th, 2003**

Measurement Type : Radiated Field
Polarisation : Horizontal
Table Angle : 0-360 deg.
Antenna Height : 1-4 m

Equipment Under Test : LRS-100 / RFID 13.56 MHz
Set-Up : on turntable
Operating Conditions : normal operating / 2W
Remarks : typical distance between antennas: 85 cm



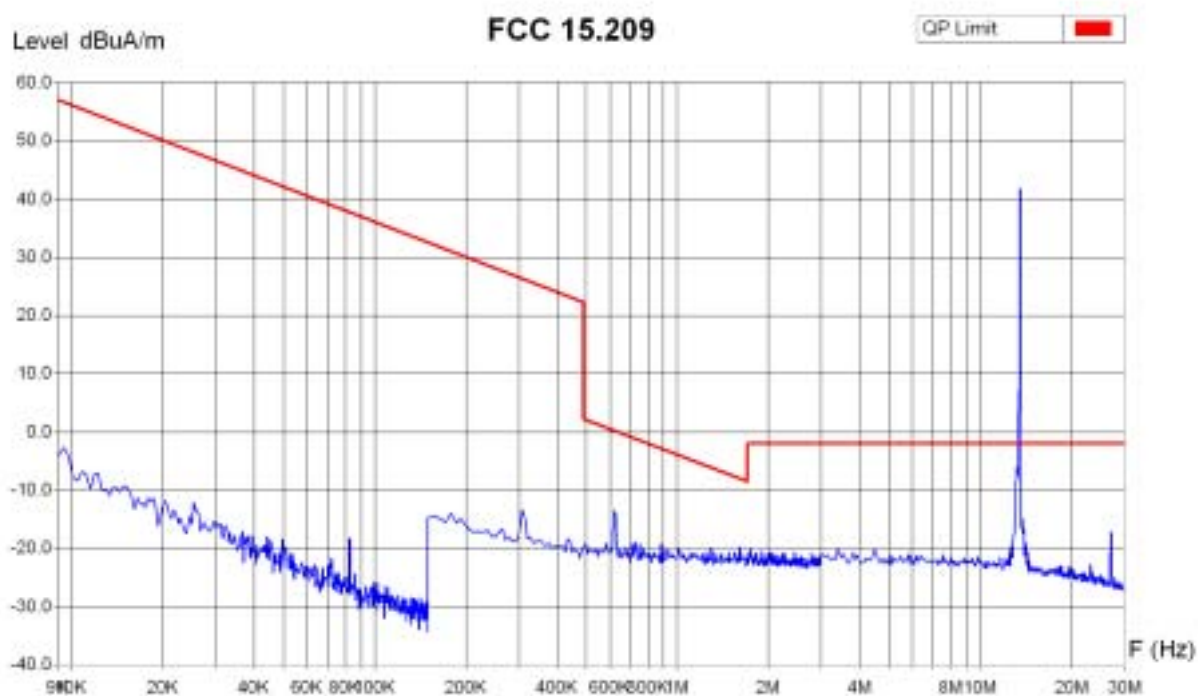
Zone	9 KHz - 150 KHz
Video Bandwidth	300 Hz
Resol Bandwidth	200 Hz
Sweep Time	0 s

Operator: pOm
Date/Time: 06.03.03 13:45
Filename:
SP_FCC_HOR.png/bit

Date/Date/Datum : **March 6th, 2003**

Measurement Type : Radiated Field
Polarisation : Vertical
Table Angle : 0-360 deg.
Antenna Height : 1-4 m

Equipment Under Test : LRS-100 / RFID 13.56 MHz
Set-Up : on turntable
Operating Conditions : normal operating / 2W
Remarks : typical distance between antennas: 85 cm



Zone	9 KHz - 150 KHz
Video Bandwidth	300 Hz
Resol Bandwidth	200 Hz
Sweep Time	0 s

Operator: pOm
Date/Time: 06.03.03 13:28
Filename:
SP_FCC_VERT.png! .txt

Photographs



view of the actual labelling



view of the PCB in the active antenna (without complementary filter)