Slovenski institut za kakovost in meroslovje
Slovenian Institute of Quality and Metrology

Poročilo o preskusu / Test Report

Št. / *No.:*

T251-0369/14

Datum / *Date:*

2014-04-10

Proizvod / *Product*	**Listov / *Pages***
RFID Reader Type: Display Combo DDIS SEE PAGE 3	35
	Vrsta preskusa / *Test procedure*
	FCC
Naročnik / *Applicant*	**Št. merjencev / *No. of items tested***
METRA INŽENIRING d.o.o. Špruha 19, 1236 Trzin, Slovenia	1
Proizvajalec / *Manufacturer*	**Mapa predmeta št. / *Subject file No.***
METRA INŽENIRING d.o.o. Špruha 19, 1236 Trzin, Slovenia	C20130735
Blagovna znamka / *Trade Mark*	**Kraj preskusa / *Place of test***
METRA ELS	SIQ Ljubljana, Laboratory for electromagnetics, Trpinčeva ul. 37 A, SI-1000 Ljubljana, Slovenia
Standardi – predpisi / *Standards - regulations*	**Opomba / *Remark***
FCC Part 15, Subpart C	/

Zaključek / *Conclusion*

Preskušani proizvod ustreza zahtevam navedenih standardov. / *Tested product complies with the requirements of stated standards.*

Rezultati preskusov se nanašajo samo na preskušan vzorec. / *The test results relate only to the item tested.*

Datum prispetja vzorca / *Date of receipt of test item: 2013-04-17*

Datum izvedbe preskusov / *Date of performance of tests: 2013-04-17 – 2014-04-10*

Testni laboratorij je akreditiran pri Slovenski Akreditaciji, Reg. Št.:LP-009 /
Testing laboratory is accredited by Slovenian Accreditation, Reg. No.LP-009

Odgovoren za preskušanje / *Responsible for the test*

Andrej Škof

Vodja področja / *Department Manager*

Marjan Mak

CONTENTS PAGE

1 GENERAL

1.1 Equipment under test description

RFID Reader

Type: Display Combo DDIS

Power supply: 12 VDC

Protective class: II.

Frequency range: 13,56 MHz – 13,56 MHz (1 channel)

Auxilliary Equipment used during testing:

- AC/DC adapter for powering Network Controller: PHIHONG, Type: PSAA30R-120
- Locker Controller ELS with code name LC32ELIS

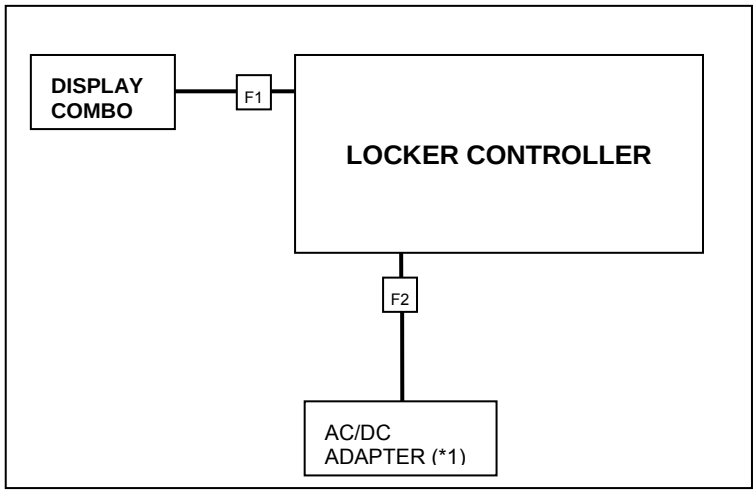
NOTE:

Product group Display consists of three different types:

Types:	**Display Combo**	**Display RFID**	**Display Keypad**
	• **DDIS** (ISO 15693, ISO14443A/B)	• **DSIS** (ISO 15693, ISO14443A/B)	• **DSKP**
	• **DDLF** (LF Multitag)	• **DSLF** (LF Multitag)	
	• **DDMF** (Mifare)	• **DSMF** (Mifare)	
	• **DDSD** (Skidata)	• **DSSD** (Skidata)	

NOTE: Tested was Display Combo DDIS which is most complex typle. All other types are also covered by this test report.

See Appendix A for Product description.



Schematic for testing

F1 – Ferrite WE 742 724 6, 2 turns

F2 – Ferrite WE 742 711 12, 2 turns

AC/DC ADAPTER (*1) – PHIHONG, Model: PSAA30R-120

1.2 List of measurements performed

PART 15 section	Test name
15.207	Conducted emission
15.209	Radiated emission
15.215	Bandwidth of the emission
15.225	Frequency tolerance

1.3 Occupied bandwidth measurement

Fundamental frequency	Minimum resolution bandwidth
9 kHz to 30 MHz	1 kHz
30 to 1000 MHz	10 kHz
1000 MHz to 40 GHz	100 kHz

1.4 Quasi-peak detector

Frequency range	Bandwidth (-6dB)
10 Hz to 20 kHz	Full range (wideband)
10 kHz to 150 kHz	200 Hz
150 kHz to 30 MHz	9 kHz
30 MHz to 1 GHz	120 kHz

1.5 Peak, rms, and average detectors

Frequency range	Bandwidth (-6dB)
10 Hz to 20 kHz	10, 100, 1000 Hz
10 kHz to 150 kHz	1 and 10 kHz
150 kHz to 30 MHz	1 and 10 kHz
30 MHz to 1 GHz	10 and 100 kHz
1 GHz to 40 GHz	0.1, 1.0 and 10 MHz

2 LIMITS

2.1 Subpart C: Intentional Radiators

2.1.1 Conducted emission limits:

Frequency Range (MHz)	Limits (dBµV)	
	Quasi-peak	Average
0.15 to 0.5	66 – 56*	59 – 46*
0.5 to 5.0	56	46
5.0 to 30.0	60	50

*Decreases with the logarithm of the frequency.

The shown limits in table shall not apply to carrier current systems operating as intentional radiators on frequencies below 30 MHz. In lieu thereof, these carrier current systems shall be subject to the following standards:

- For carrier current systems containing their fundamental emission within the frequency band 535-1705 kHz and intended to be received using a standard AM broadcast receiver: no limit on conducted emissions.
- For all other carrier current systems: 1000 µV within the frequency band 535-1705 kHz, as measured using a 50 µH/50 ohms LISN.
- Carrier current systems operating below 30 MHz are also subject to the radiated emission limits as appropriate.

2.1.2 Radiated emission limits:

Frequency Range (MHz)	Limits (dBµV/m)		Test distance (m)
	VERTICAL	HORIZONTAL	
0,009 to 0,490	20*log(2400/F(kHz))	20*log(2400/F(kHz))	300
0,490 to 1,705	20*log(2400/F(kHz))	20*log(2400/F(kHz))	30
1,705 to 30,0	30	30	30
30 to 88	40**	40**	3
88 to 216	43,5**	43,5**	3
216 to 960	46**	46**	3
Above 960	54	54	3

** Except as provided in paragraph below, fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz.

Perimeter protection systems may operate in the 54-72 MHz and 76-88 MHz bands under the provisions of this section. The use of such perimeter protection systems is limited to industrial, business and commercial applications.

NOTE: For special limits refer to standard

3 ALL TEST EQUIPMENT AND THEIR DESCRIPTION

3.1 General information

Description	Model No.	SIQ No.	Last calibration	Calibrated until	Calibration period	Used
Rohde-Schwarz, RFI receiver	ESU	105187	2013-10	2015-10	24 months	X
Rohde & Schwarz, Artificial main network	ESH 2-Z5	106899	2013-05	2015-05	24 months	X
ETS, Anechoic chamber	3m	103949	2012-12	2014-12	24 months	X
EMCO, Antenna	3142	06/068	2013-09	2015-09	24 months	X
EMCO, Antenna	3115	103002	2013-09	2015-09	24 months	X
Rohde & Schwarz, Active loop antenna	HFH2-Z2	/	2013-09	2015-09	24 months	X
Heinrich Deisel, Turn table	DS 420.00	103337	NA	NA	NA	X
ETS, Antenna tower	2175	/	NA	NA	NA	X
ETS, Controller for turn table and antenna tower	/	/	NA	NA	NA	X
Kambič, Temperature Chamber	I-190 CK	107298	NA	NA	NA	X
Fluke, Digital Multimeter	179	106728	2013-06	2014-06	12 month	X

4 GENERAL AND SPECIAL CONDITIONS DESCRIPTION

4.1 General condition description

Interconnect and power cabling (or wiring)

4.1.1 Test arrangement for conducted emissions

4.1.1.1 Interconnecting cables that hang closer than 40 cm to the ground-plane shall be folded back and forth in the center forming a bundle 30 to 40 cm long.

4.1.1.2 I/O cables that are not connected to a peripheral shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. The overall length shall not exceed 1 m.

4.1.1.3 EUT connected to one LISN. Unused LISN measuring port connectors shall be terminated in 50 Ω. LISN can be placed on top of, or immediately beneath, reference ground-plane.
4.1.1.3.1 All other equipment powered from additional LISN(s).
4.1.1.3.2 Multiple outlet strip can be used for multiple power cords of non-EUT equipment.
4.1.1.3.3 LISN at least 80 cm from nearest part of EUT chassis.

4.1.1.4 Cables of hand-operated devices, such as keyboards, mice, etc., shall be placed as for normal use.

4.1.1.5 Non-EUT components of EUT system being tested.

4.1.1.6 Rear of EUT, including peripherals, shall all be aligned and flush with rear of tabletop.

4.1.1.7 Rear of tabletop shall be 40 cm removed from a vertical conducting plane that is bonded to the ground-plane.

4.1.2 Test arrangement for conducted emissions- floor-standing equipment

4.1.2.1 Excess I/O cables shall be bundled in the center. If bundling is not possible, the cables shall be arranged in serpentine fashion. Bundling shall not exceed 40 cm in length.

4.1.2.2 Excess power cords shall be bundled in the center or shortened to appropriate length.

4.1.2.3 I/O cables that are not connected to a peripheral shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. If bundling is not possible, the cable shall be arranged in serpentine fashion.

4.1.2.4 EUT and all cables shall be insulated, if required, from the ground-plane by up to 12 mm of insulating material.

4.1.2.5 EUT connected to one LISN. LISN can be placed on top of, or immediately beneath, the ground-plane.
4.1.2.5.1 All other equipment powered from a second LISN or additional LISN(s).
4.1.2.5.2 Multiple outlet strip can be used for multiple power cords of non-EUT equipment.

4.1.3 Test arrangement for radiated emissions tabletop equipment

4.1.3.1 Interconnecting cables that hang closer than 40 cm to the ground-plane shall be folded back and forth in the center, forming a bundle 30 to 40 cm long.

4.1.3.2 I/O cables that are not connected to a peripheral shall be bundled in the center. The end of the cable may be terminated if required using the correct terminating impedance. The total length shall not exceed 1 m.

4.1.3.3 If LISNs are kept in the test setup for radiated emissions, it is preferred that they be installed under the ground-plane with the receptacle flush with the ground-plane.

4.1.3.4 Cables of hand-operated devices, such as keyboards, mice, etc., shall be placed as for normal use.

4.1.3.5 Non-EUT components of EUT system being tested.

4.1.3.6 Rear of EUT, including peripherals, shall all be aligned and flush with rear of tabletop.

4.1.3.7 No vertical conducting plane used.

4.1.3.8 Power cords drape to the floor and are routed over to receptacle.

4.1.4 Test arrangement for radiated emissions floor-standing equipment

4.1.4.1 Excess I/O cables shall be bundled in center. If bundling is not possible, the cables shall be arranged in serpentine fashion. Bundling not to exceed 40 cm in length.

4.1.4.2 Excess power cords shall be bundled in the center or shortened to appropriate length.

4.1.4.3 I/O cables that are not connected to a peripheral shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. If bundling is not possible, the cable shall be arranged in a serpentine fashion.

4.1.4.4 EUT and all cables shall be insulated, if required, from the ground-plane by up to 12 mm of insulating material.

4.1.4.5 If LISNs are kept in the test setup for radiated emissions, it is preferred that they be installed under the ground-plane with the receptacle flush with the ground plane.

Overhead cable trays and suspended ceilings

4.1.5 Test arrangement for floor-standing equipment

4.1.5.1 Only one vertical riser may be used where typical of system under test.

4.1.5.2 Excess power cord shall be bundled in the center or shortened to appropriate length.

4.1.5.3 EUT and cables shall be insulated from ground-plane by up to 12 mm. Where the manual has specified or there exists a code of practice for installation of the EUT, the test arrangement shall allow the use of this practice for the tests.

4.1.5.4 Power cords being measured connected to one LISN. All other system power cords powered through other LISN(s). A multiple receptacle strip may be used for other power cords.

4.1.5.5 For *conducted* tests, the LISNs may be placed on top of or immediately beneath and bonded directly to the ground-plane. For *radiated* tests, the LISN(s), if used, should be installed under, with the receptacle flush with the ground-plane.

4.1.6 Test arrangement for floor-standing equipment

4.1.6.1 Only one vertical riser may be used where typical of system under test.

4.1.6.2 Excess power cord shall be bundled in the center or shortened to appropriate length.

4.1.6.3 EUT and cables shall be insulated from ground-plane by up to 12 mm. Where the manual has specified or there exists a code of practice for installation of the EUT, the test arrangement shall allow the use of this practice for the tests.

4.1.6.4 Power cords being measured connected to one LISN. All other system power cords powered through other LISN(s). A multiple receptacle strip may be used for other power cords.

4.1.6.5 For c*onducted* tests, the LISNs may be placed on top of or immediately beneath and bonded directly to the ground-plane. For *radiated* tests, the LISN(s), if used, should be installed under, with the receptacle flush with the ground-plane.

4.1.7 Placement and manipulation of interconnect cabling (or wiring) of tabletop equipment

4.1.7.1 LISN(s) may have to be positioned to the side of the table to meet the criterion that the LISN receptacle shall be 80 cm away from the EUT. LISN(s) may be above ground-plane only for conducted emission measurements.

4.1.7.2 Accessories, such as ac power adapter, if typically table-mounted, shall occupy peripheral positions as is applicable.

4.1.7.3 Accessories, which are typically floor-mounted, shall occupy a floor position directly below the portion of the EUT to which they are typically connected. T

4.1.7.4 Table length may be extended beyond 1.5 m with peripherals aligned with the back edge. The table depth may be extended beyond 1 m. The 40 cm distance to the vertical conducting plane shall be maintained for conducted emission testing.

Placement of wall-mounted equipment

4.1.8 Test configuration/arrangement for combination floor-standing and tabletop equipment

4.1.8.1 Interconnecting cables that hang closer than 40 cm to the ground-plane shall be folded back and forth in the center, forming a bundle 30 to 40 cm long.

4.1.8.2 I/O cables that are not connected to a peripheral shall be bundled in the center. The end of the cable may be terminated if required using the correct terminating impedance.

4.1.8.3 If LISNs are kept in the test setup for radiated emissions, it is preferred that they be installed under the ground-plane with the receptacle flush with the ground-plane.

4.1.8.4 Cables of hand-operated devices, such as keyboards, mice, etc., have to be placed as for normal use.

4.1.8.5 Non-EUT components of EUT system being tested.

4.1.8.6 I/O cable to floor-standing unit drapes to the ground-plane and shortened or excess bundled. Cables not reaching the metal ground-plane are draped to the height of the connector or 40 cm, whichever is lower.

4.1.8.7 Power cords and signal cables shall drape to the floor. No extension cords shall be used to the power receptacles.

4.1.8.8 The floor-standing unit can be placed under the table if its height permits.

4.2 Special condition description

If for some reason the above measurement conditions can't be met, the description below should be used as an appropriate measurement condition and placement.

(Description is written additionally as the measurements differ – all is within test procedure)

5 TEST SUMMARY

	Test		Sample	
	Yes	Not	Pass	Fail
ANSI C63.4-2009; FCC Part 15, Subpart C	☑	☐	☑	☐

5.1 Purpose of the test

To determine whether the equipment under test fulfils the **ANSI C63.4-2009; FCC Part 15, Subpart C** requirements.

6 EMISSION TESTS

6.1 Conducted emission measurement (intentional radiator)

Section 15.207 Conducted limits

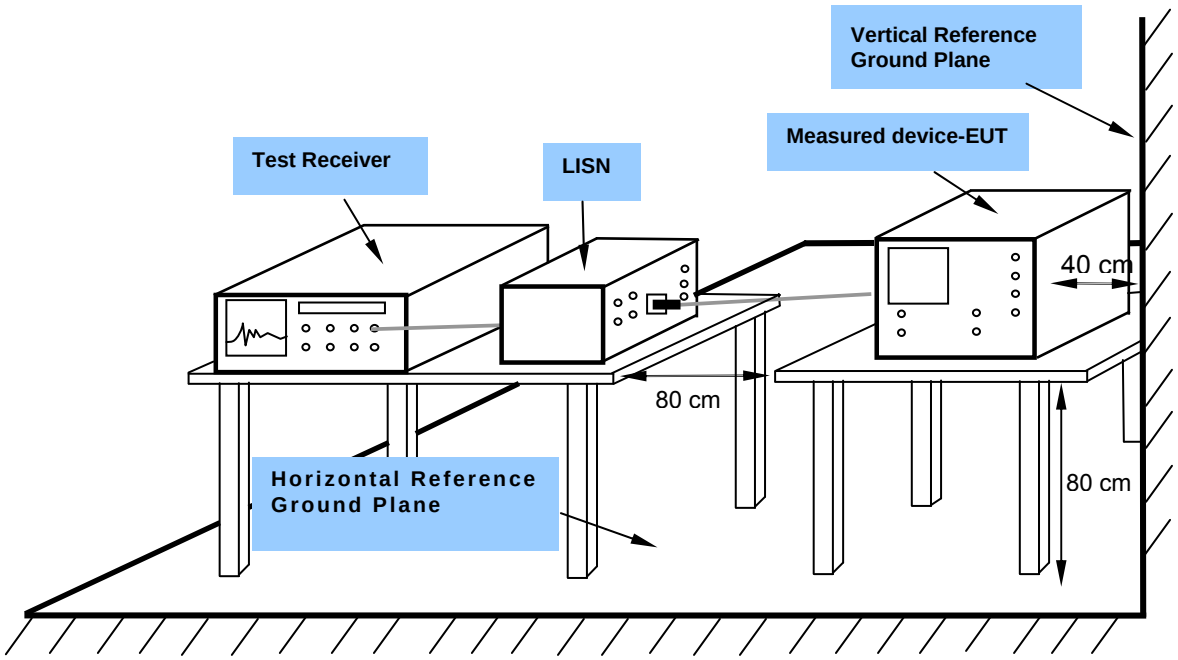
6.1.1 Test instruments

Description	Model No.	SIQ No.	Last calibration	Calibrated until	Calibration period	Used
Rohde-Schwarz, RFI receiver	ESU	105187	2013-05	2015-10	24 months	X
Rohde & Schwarz, Artificial main network	ESH 2-Z5	106899	2013-05	2015-05	24 months	X

6.1.2 Test procedure

- The EUT is placed on a non-conductive 0.1 meters high table, 0.4 meters from the vertical conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). LISN provide 50 Ohm/ 50 μH of coupling impedance for the measuring instrument.
- Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition.
- AC power lines of EUT are checked for maximum conducted interference.
- The frequency range from 150 kHz to 30 MHz is searched using PEAK, QUASI-PEAK and AVERAGE function of the receiver. Bandwidth is set to 9kHz.
- If applicable, functions are changed (data transfer speed, clock speed,…)

6.1.3 Test setup



For the actual test configuration, please refer to the related item – Photographs of the Test Configuration.

6.1.4 Test results

EUT	RFID Reader	**Type:**	Display Combo DDIS
Mode:	Transmitting		
Input voltage:	120 V, 60 Hz	**Date:**	09.04.2014
Environmental conditions:	25±10°C, 55±30% RH	**Tested by: Andrej Škof**	

Result: PASS

09.Apr 14 08:31

C20130735

Meas Type	CONDUCTED EMISSION
Equipment under Test	Display Combo DDIS
Manufacturer	METRA INZENIRING D.O.O.
OP Condition	TRANSMITTING
Operator	Andrej Skof

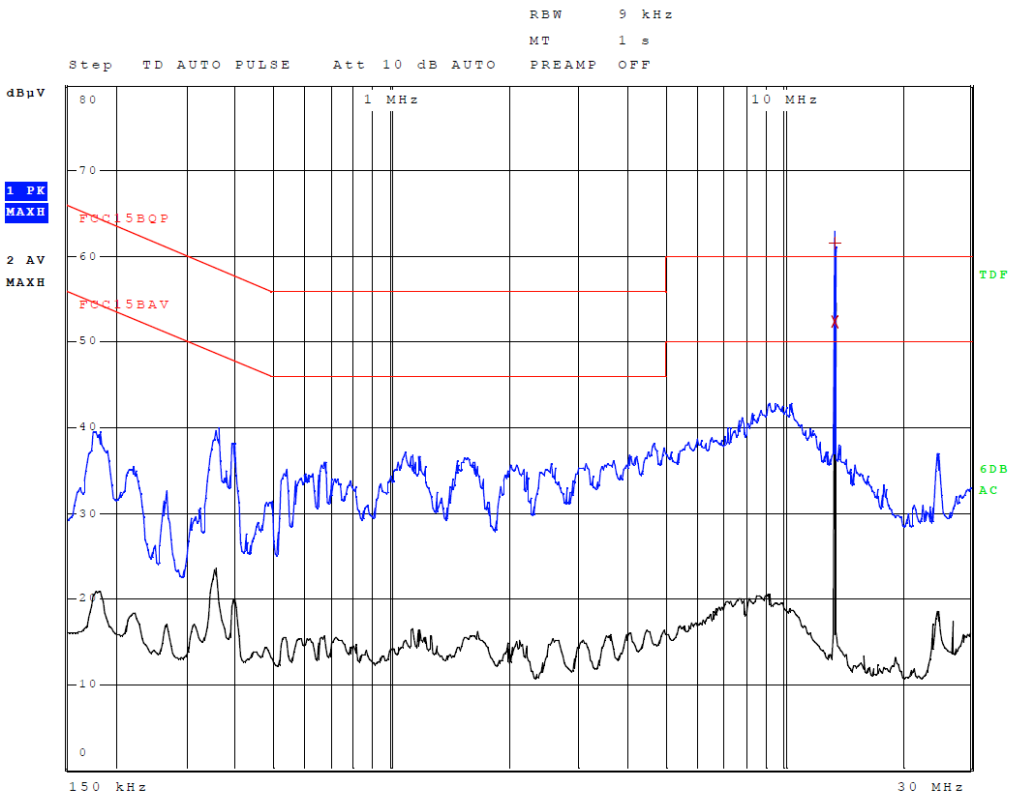
Test Spec

PHASE (120V/60Hz)

Time Domain Scan (1 Range)

Scan Start: 150 kHz
Scan Stop: 30 MHz
Detector: Trace 1: MAX PEAK Trace 2: Average
Transducer: ESH2-Z5

Start Frequency	Stop Frequency	Step Size	Res BW	Meas Time	RF Atten	Preamp	Input
150.000000 kHz	30.000000 MHz	2.25 kHz	9.00 kHz	50 ms	Auto	0 dB	INPUT2



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Meas Type	CONDUCTED EMISSION
Equipment under Test	Display Combo DDIS
Manufacturer	METRA INZENIRING D.O.O.
OP Condition	TRANSMITTING
Operator	Andrej Skof

Test Spec
PHASE (120V/60Hz)

Final Measurement

Meas Time:	1 s
Margin:	10 dB
Peaks:	2

Trace	Frequency	Level (dBµV)	Detector	Delta Limit/dB
1	13.560000000 MHz	61.64	Quasi Peak	1.64
2	13.560000000 MHz	52.39	Average	2.39

09.Apr 14 08:32

C20130735

Meas Type	CONDUCTED EMISSION
Equipment under Test	Display Combo DDIS
Manufacturer	METRA INZENIRING D.O.O.
OP Condition	TRANSMITTING
Operator	Andrej Skof

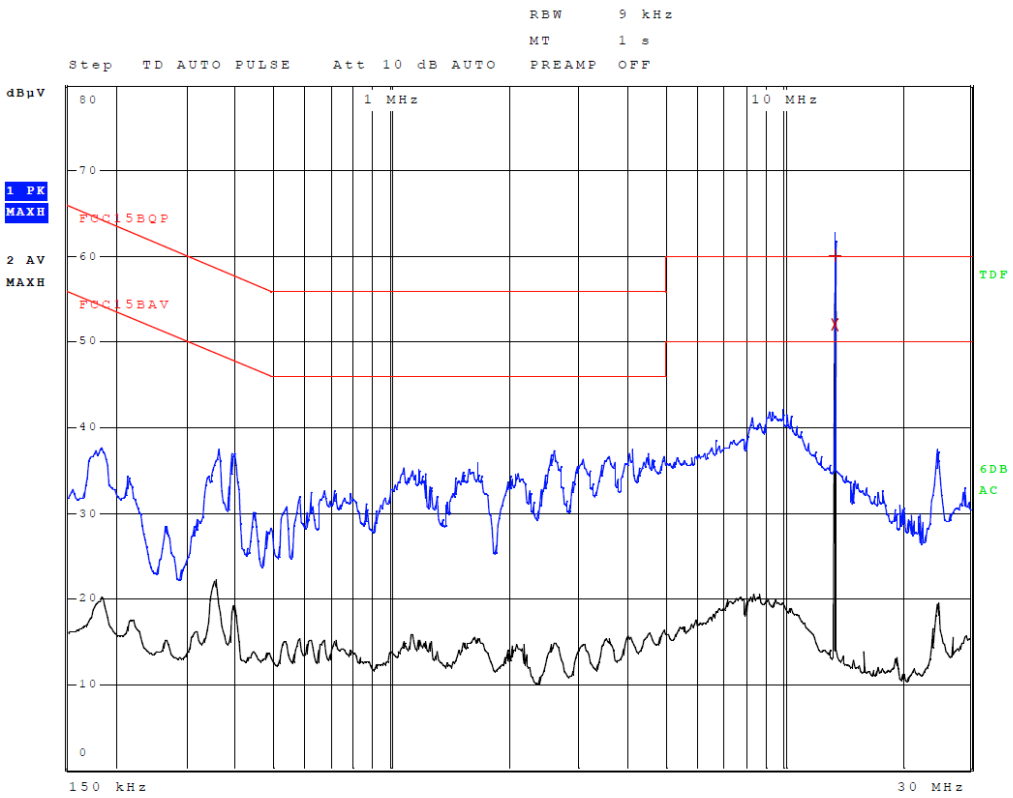
Test Spec

NEUTRAL (120V/60Hz)

Time Domain Scan (1 Range)

Scan Start: 150 kHz
Scan Stop: 30 MHz
Detector: Trace 1: MAX PEAK Trace 2: Average
Transducer: ESH2-Z5

Start Frequency	Stop Frequency	Step Size	Res BW	Meas Time	RF Atten	Preamp	Input
150.000000 kHz	30.000000 MHz	2.25 kHz	9.00 kHz	50 ms	Auto	0 dB	INPUT2



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Meas Type	CONDUCTED EMISSION
Equipment under Test	Display Combo DDIS
Manufacturer	METRA INZENIRING D.O.O.
OP Condition	TRANSMITTING
Operator	Andrej Skof

Test Spec
NEUTRAL (120V/60Hz)

Final Measurement

Meas Time:	1 s
Margin:	10 dB
Peaks:	2

Trace	Frequency	Level (dBµV)	Detector	Delta Limit/dB
1	13.560000000 MHz	60.07	Quasi Peak	0.07
2	13.560000000 MHz	52.01	Average	2.01

Figure 1: Conducted emission test

6.2 Bandwidth of the emission (intentional radiator)

Section 15.215 Additional provisions to the general radiated emission limitations

6.2.1 Test instruments

Description & Manufacturer	Model No.	SIQ No.	Last calibration	Calibrated until	Calibration period	Used
ETS, Anechoic chamber	3m	103949	2012-12	2014-12	24 months	X
Rohde-Schwarz, RFI receiver	ESU	105187	2013-10	2015-10	24 months	X
EMCO, Antenna	3142	06/068	2013-09	2015-09	24 months	X
Rohde & Schwarz, Active loop antenna	HFH2-Z2	/	2013-09	2015-09	24 months	X
Heinrich Deisel, Turn table	DS 420.00	103337	NA	NA	NA	X
ETS, Antenna tower	/	/	NA	NA	NA	X
ETS, Controller for turn table and antenna tower	/	/	NA	NA	NA	X

6.2.2 Test procedure

1. The EUT was placed on the top of a rotating table 0.8 meters above the ground in an Anechoic Chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
2. The EUT was set 3 m away from the interference-receiving antenna.
3. Resolution bandwidth is set to a value greater than 5% of the allowed bandwidth. If no bandwidth specifications are given, the guidelines in pt. 1.4 are used

6.2.3 Test results

EUT	RFID Reader	**Type:**	Display Combo DDIS
Mode:	Transmitting		
Input voltage:	120 V, 60 Hz	**Date:**	09.04.2014
Environmental conditions:	25±10°C, 55±30% RH	**Tested by: Andrej Škof**	

6.2.4 Summary of results

Device passed the requirements stated in ANSI C63.4, FCC Part 15, Subpart C.

6.2.4.1 Bandwidth of the emission at 3 m in an anechoic chamber

C20130735

09.Apr 14 07:08

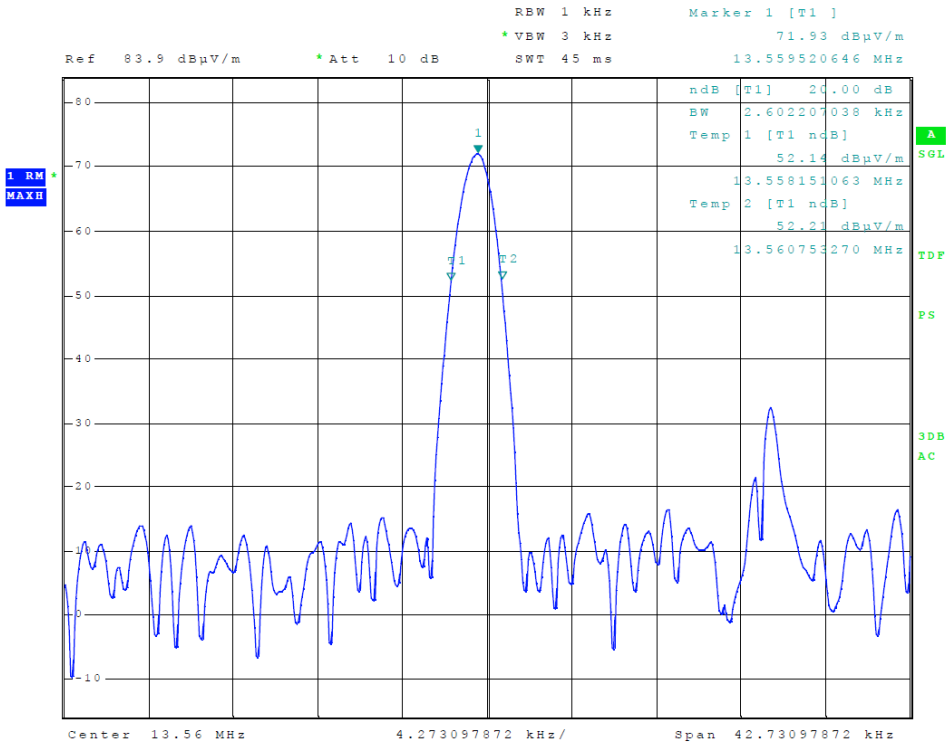
Meas Type	OCCUPIED BANDWIDTH
Equipment under Test	Display Combo DDIS
Manufacturer	METRA INZENIRING D.O.O.
OP Condition	TRANSMITTING
Operator	Andrej Skof

Test Spec

Sample: 335deg, Antenna: 10deg

Sweep Settings **Screen A**

Center Frequency	13.560000 MHz	Ref Level	83.870 dBµV/m
Frequency Offset	0.000000 Hz	Ref Level Offset	0.000 dB
Span	42.730979 kHz	Ref Position	100.000 %
Start Frequency	13.538635 MHz	Level Range	100.000 dB
Stop Frequency	13.581365 MHz	RF Att	10.000 dB
RBW	1.000000 kHz		
VBW	3.000000 kHz	X-Axis	LIN
Sweep Time	45.00 ms	Y-Axis	LOG



Bandwidth of the emission: 2.6022 kHz

6.3 Spectrum mask (intentional radiator)

Section 15.225 Operation within the band 13.110 – 14.010 MHz - pt.a – pt.d

6.3.1 Test instruments

Description & Manufacturer	Model No.	SIQ No.	Last calibration	Calibrated until	Calibration period	Used
ETS, Anechoic chamber	3m	103949	2012-12	2014-12	24 months	X
Rohde-Schwarz, RFI receiver	ESU	105187	2013-10	2015-10	24 months	X
EMCO, Antenna	3142	06/068	2013-09	2015-09	24 months	X
Rohde & Schwarz, Active loop antenna	HFH2-Z2	/	2013-09	2015-09	24 months	X
Heinrich Deisel, Turn table	DS 420.00	103337	NA	NA	NA	X
ETS, Antenna tower	/	/	NA	NA	NA	X
ETS, Controller for turn table and antenna tower	/	/	NA	NA	NA	X

6.3.2 Test procedure

1. The EUT was placed on the top of a rotating table 0.8 meters above the ground in an Anechoic Chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
2. The EUT was set 3 m away from the interference-receiving antenna.
3. Frequencies with maximum emission were retested on OATS.
4. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the turn table was turned from 0 degrees to 360 degrees to find the maximum reading.

6.3.3 Test results

EUT	RFID Reader	**Type:**	Display Combo DDIS
Mode:	Transmitting		
Input voltage:	120 V, 60 Hz	**Date:**	09.04.2014
Environmental conditions:	25±10°C, 55±30% RH	**Tested by: Andrej Škof**	

6.3.4 Summary of results

Device passed the requirements stated in ANSI C63.4, FCC Part 15, Subpart C.

6.3.4.1 Signal measurement at 3 m in an anechoic chamber

C20130735

09.Apr 14 07:21

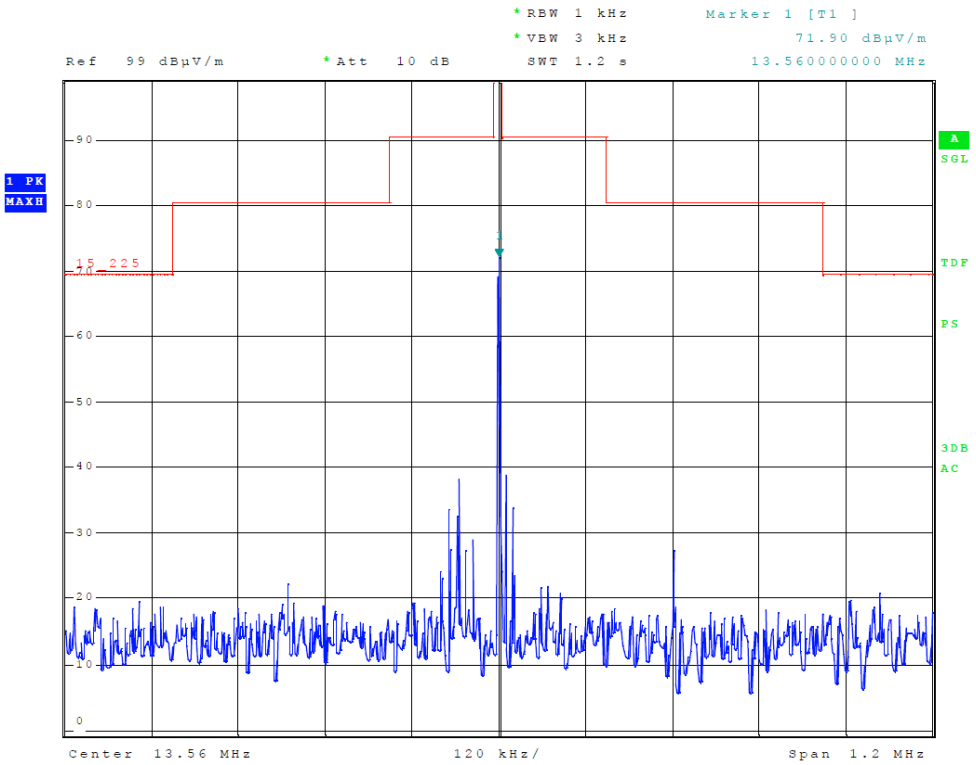
Meas Type	SPECTRUM MASK
Equipment under Test	Display Combo DDIS
Manufacturer	METRA INZENIRING D.O.O.
OP Condition	TRANSMITTING
Operator	Andrej Skof

Test Spec

Sample: 335deg, Antenna: 10deg

Sweep Settings **Screen A**

Center Frequency	13.560000 MHz	Ref Level	99.000 dBµV/m
Frequency Offset	0.000000 Hz	Ref Level Offset	0.000 dB
Span	1.200000 MHz	Ref Position	100.000 %
Start Frequency	12.960000 MHz	Level Range	100.000 dB
Stop Frequency	14.160000 MHz	RF Att	10.000 dB
RBW	1.000000 kHz		
VBW	3.000000 kHz	X-Axis	LIN
Sweep Time	1.20 s	Y-Axis	LOG



ROHDE&SCHWARZ

09.Apr 14 07:21

C20130735

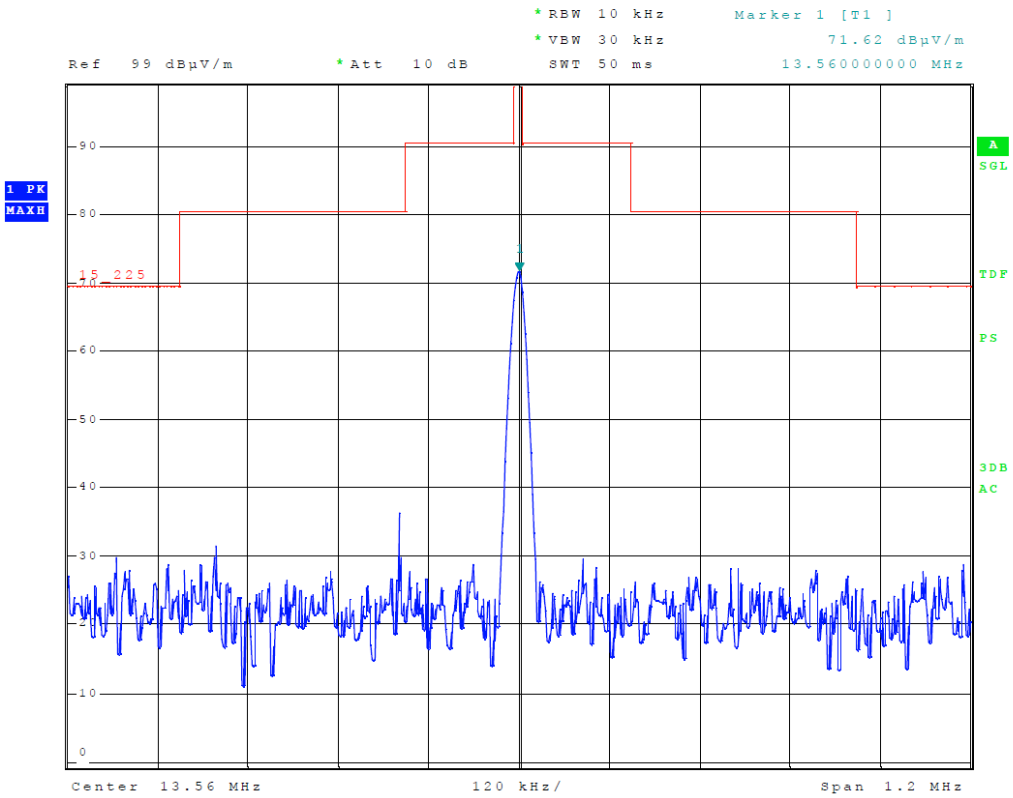
Meas Type	SPECTRUM MASK
Equipment under Test	Display Combo DDIS
Manufacturer	METRA INZENIRING D.O.O.
OP Condition	TRANSMITTING
Operator	Andrej Skof

Test Spec

Sample: 335deg, Antenna: 10deg

Sweep Settings Screen A

Center Frequency	13.560000 MHz	Ref Level	99.000 dBµV/m
Frequency Offset	0.000000 Hz	Ref Level Offset	0.000 dB
Span	1.200000 MHz	Ref Position	100.000 %
Start Frequency	12.960000 MHz	Level Range	100.000 dB
Stop Frequency	14.160000 MHz	RF Att	10.000 dB
RBW	10.000000 kHz		
VBW	30.000000 kHz	X-Axis	LIN
Sweep Time	50.00 ms	Y-Axis	LOG



6.4 Radiated emission measurement 9 kHz – 30 MHz (intentional radiator)

Section 15.209 Radiated emission limits, general requirements

6.4.1 Test instruments

Description & Manufacturer	Model No.	SIQ No.	Last calibration	Calibrated until	Calibration period	Used
ETS, Anechoic chamber	3m	103949	2012-12	2014-12	24 months	X
Rohde-Schwarz, RFI receiver	ESU	105187	2013-10	2015-10	24 months	X
EMCO, Antenna	3142	06/068	2013-09	2015-09	24 months	X
Rohde & Schwarz, Active loop antenna	HFH2-Z2	/	2013-09	2015-09	24 months	X
Heinrich Deisel, Turn table	DS 420.00	103337	NA	NA	NA	X
ETS, Antenna tower	/	/	NA	NA	NA	X
ETS, Controller for turn table and antenna tower	/	/	NA	NA	NA	X

6.4.2 Test procedure

1. The EUT was placed on the top of a rotating table 0.8 meters above the ground in an Anechoic Chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
2. The EUT was set 3 m away from the interference-receiving antenna, which was mounted on the top of variable-height antenna tower.
3. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the turn table was turned from 0 degrees to 360 degrees to find the maximum reading.
4. The test-receiver system was set to PEAK and QUASI-PEAK Detect Function and Specified Bandwidth with Maximum Hold Mode.
5. The highest points would be re-tested one by one using the quasi-peak method.

6.4.3 Test results

EUT	RFID Reader	**Type:**	Display Combo DDIS
Mode:	Transmitting		
Input voltage:	120 V, 60 Hz	**Date:**	09.04.2014, 10.04.2014
Environmental conditions:	25±10°C, 55±30% RH	**Tested by: Andrej Škof**	

6.4.4 Summary of results

Device passed the requirements stated in ANSI C63.4, FCC Part 15, Subpart C.

6.4.4.1 Preliminary measurement at 3 m in an anechoic chamber

ROHDE&SCHWARZ

C20130735

09.Apr 14 07:52

Meas Type	RADIATED EMISSION
Equipment under Test	Display Combo DDIS
Manufacturer	METRA INZENIRING D.O.O.
OP Condition	TRANSMITTING
Operator	Andrej Skof

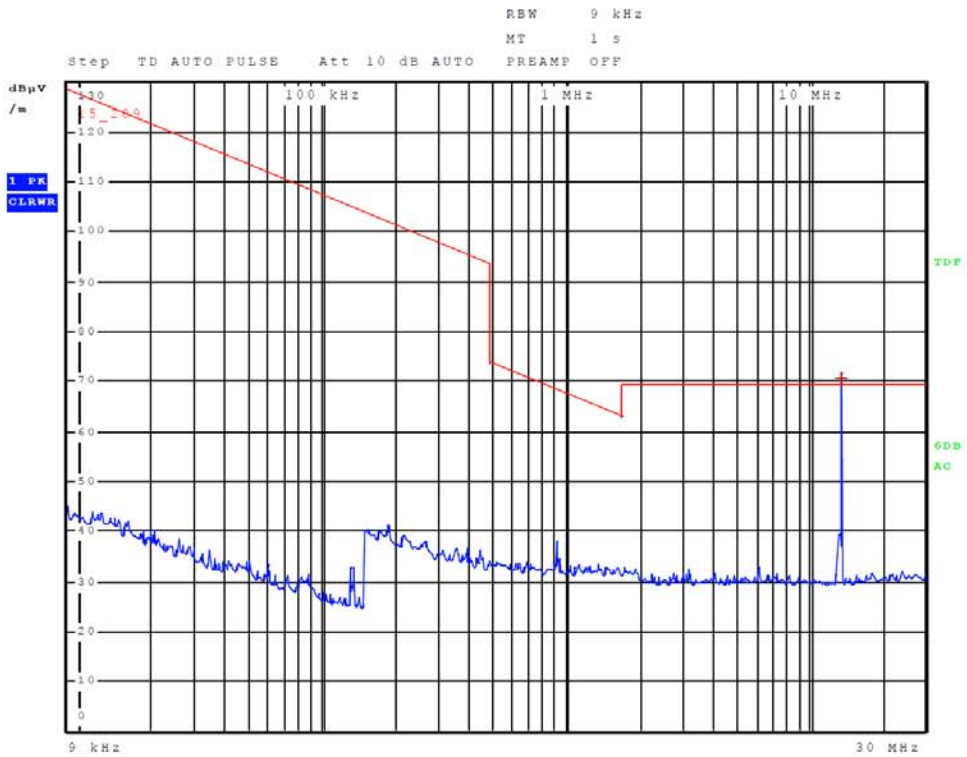
Test Spec

Sample: 335deg, Antenna: 10deg

Time Domain Scan (2 Ranges)

Scan Start:	9 kHz
Scan Stop:	30 MHz
Detector:	Trace 1: MAX PEAK
Transducer:	HFH2-Z2V

Start Frequency	Stop Frequency	Step Size	Res BW	Meas Time	RF Atten	Preamp	Input
9.000000 kHz	149.950000 kHz	50.00 Hz	200.00 Hz	300 ms	Auto	0 dB	INPUT2
150.000000 kHz	30.000000 MHz	2.25 kHz	9.00 kHz	50 ms	Auto	0 dB	INPUT2



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C20130735

09.Apr 14 07:52

Meas Type	RADIATED EMISSION
Equipment under Test	Display Combo DDIS
Manufacturer	METRA INZENIRING D.O.O.
OP Condition	TRANSMITTING
Operator	Andrej Skof

Test Spec

Sample: 335deg, Antenna: 10deg

Final Measurement

Meas Time:	1 s
Margin:	6 dB
Peaks:	1

Trace	Frequency	Level (dBµV/m)	Detector	Delta Limit/dB
1	13.560000000 MHz	70.50	Quasi Peak	1.00

6.4.4.2 Final measurement at 10 m in OATS

Results with measuring distance of 3 m			
Frequency (MHz)	Measured value (dBμV/m)	Limit (dBμV/m)	Margin (dB)
13,56	70,50	124,00	-53,50
Results with measuring distance of 10 m			
Frequency (MHz)	Measured value (dBμV/m)	Limit (dBμV/m)	Margin (dB)
13,56	52,41	104,00	-51,59

Calculated value from 10 m to 30 m					
Frequency (MHz)	Measured value at 10 m (dBμV/m)	Extrapolation factor (dB/decade)	Calculated value at 30 m (dBμV/m)	Limit at 30 m (dBμV/m)	Margin (dB)
13,56	52,41	40	32,41	84,00	-51,59

NOTE: Antenna factor and cable loss are already included in measurement correction.

6.5 Radiated emission measurement 30 MHz – 1 GHz (intentional radiator)

Section 15.209 Radiated emission limits, general requirements
Section 15.225 Operation within the band 13.110 – 14.010 MHz

6.5.1 Test instruments

Description & Manufacturer	Model No.	SIQ No.	Last calibration	Calibrated until	Calibration period	Used
ETS, Anechoic chamber	3m	103949	2012-12	2014-12	24 months	X
Rohde-Schwarz, RFI receiver	ESU	105187	2013-10	2015-10	24 months	X
EMCO, Antenna	3142	06/068	2013-09	2015-09	24 months	X
Rohde & Schwarz, Active loop antenna	HFH2-Z2	/	2013-09	2015-09	24 months	X
Heinrich Deisel, Turn table	DS 420.00	103337	NA	NA	NA	X
ETS, Antenna tower	/	/	NA	NA	NA	X
ETS, Controller for turn table and antenna tower	/	/	NA	NA	NA	X

6.5.2 Test procedure

4. The EUT was placed on the top of a rotating table 0.8 meters above the ground in an Anechoic Chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
5. The EUT was set 3 m away from the interference-receiving antenna, which was mounted on the top of variable-height antenna tower.
6. The antenna is a broadband antenna, and its height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
7. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the turn table was turned from 0 degrees to 360 degrees to find the maximum reading.
8. The test-receiver system was set to PEAK and QUASI-PEAK Detect Function and Specified Bandwidth with Maximum Hold Mode.
9. The highest points would be re-tested one by one using the quasi-peak method.

6.5.3 Test results

EUT	RFID Reader	**Type:**	Display Combo DDIS
Mode:	Transmitting		
Input voltage:	120 V, 60 Hz	**Date:**	09.04.2014
Environmental conditions:	25±10°C, 55±30% RH	**Tested by: Andrej Škof**	

6.5.4 Summary of results

Device passed the requirements stated in ANSI C63.4, FCC Part 15, Subpart C.

6.5.4.1 Signal measurement at 3 m in an anechoic chamber

C20130735 08.Apr 14 17:30

Meas Type	RADIATED EMISSION
Equipment under Test	Display Combo DDIS
Manufacturer	METRA INZENIRING D.O.O.
OP Condition	TRANSMITTING
Operator	Andrej Skof

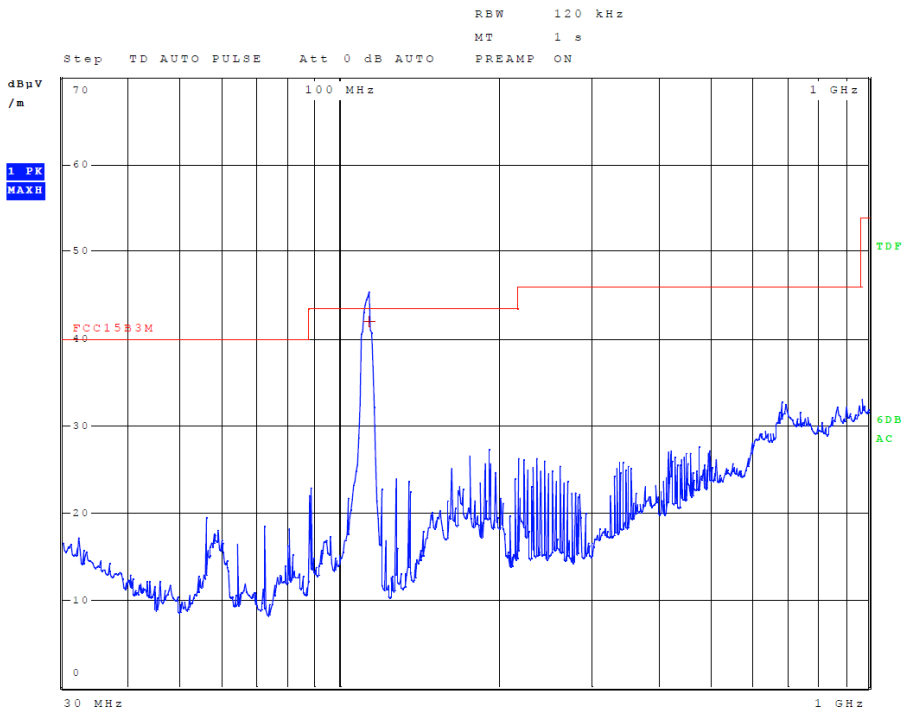
Test Spec

HORIZONTAL 206cm, 94deg

Time Domain Scan (1 Range)

Scan Start: 30 MHz
Scan Stop: 1 GHz
Detector: Trace 1: MAX PEAK
Transducer: 3142B3m

Start Frequency	Stop Frequency	Step Size	Res BW	Meas Time	RF Atten	Preamp	Input
30.000000 MHz	1.000000 GHz	30.00 kHz	120.00 kHz	5 ms	Auto	20 dB	INPUT2



C20130735

08.Apr 14 17:30

Meas Type	RADIATED EMISSION
Equipment under Test	Display Combo DDIS
Manufacturer	METRA INZENIRING D.O.O.
OP Condition	TRANSMITTING
Operator	Andrej Skof

Test Spec

HORIZONTAL 206cm, 94deg

Final Measurement

Meas Time:	1 s
Margin:	10 dB
Peaks:	1

Trace	Frequency	Level (dBµV/m)	Detector	Delta Limit/dB
1	113.700000000 MHz	41.97	Quasi Peak	-1.53

6.6 Frequency tolerance of the carrier signal

Section 15.225 Operation within the band 13.110 – 14.010 MHz - pt.e

6.6.1 Test instruments:

Description & Manufacturer	Model No.	SIQ No.	Last calibration	Calibrated until	Calibration period	Used
Rohde-Schwarz, RFI receiver	ESU	105187	2013-10	2015-10	24 months	X
Rohde & Schwarz, Active loop antenna	HFH2-Z2	/	2013-09	2015-09	24 months	X
Fluke, Digital Multimeter	179	106728	2013-06	2014-06	12 months	X
Kambič, Temperature chamber	I-190 CK	107298	Na	Na	/	X

6.6.2 Test requirements:

The frequency tolerance of the carrier signal shall be maintained within +/- 0.01% of the operating frequency over a temperature variation of –20 degrees to +50 degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

6.6.3 Test results

EUT	RFID Reader	**Type:**	Display Combo DDIS
Mode:	Transmitting		
Input voltage:	120 V, 60 Hz	**Date:**	22-23.11.2013
Environmental conditions:	25±10°C, 55±30% RH	**Tested by: Andrej Škof**	

Temperature (°C)	Supply voltage	Minutes after switch on	Frequency (MHz)	Allowed tolerance (kHz)	Measured tolerance (Hz)
50	120V/60Hz	0	13,559433	±1,356	-80
	120V/60Hz	2	13,559449	±1,356	-64
	120V/60Hz	5	13,559446	±1,356	-67
	120V/60Hz	10	13,559442	±1,356	-71
40	120V/60Hz	0	13,559458	±1,356	-54
	120V/60Hz	2	13,559455	±1,356	-58
	120V/60Hz	5	13,559446	±1,356	-67
	120V/60Hz	10	13,559446	±1,356	-67
30	120V/60Hz	0	13,559497	±1,356	-16
	120V/60Hz	2	13,559484	±1,356	-29
	120V/60Hz	5	13,559481	±1,356	-32
	120V/60Hz	10	13,559478	±1,356	-35
20	100V/60Hz	0	13,559535	±1,356	22
	100V/60Hz	2	13,559522	±1,356	10
	100V/60Hz	5	13,559516	±1,356	3
	100V/60Hz	10	13,559516	±1,356	3
20	120V/60Hz	0	13,559535	±1,356	22
	120V/60Hz	2	13,559519	±1,356	6
	120V/60Hz	5	13,559516	±1,356	3
	120V/60Hz	**10**	**13,559513**	**-**	**Reference**
20	240V/50Hz	0	13,559538	±1,356	26
	240V/50Hz	2	13,559522	±1,356	10
	240V/50Hz	5	13,559516	±1,356	3
	240V/50Hz	10	13,559513	±1,356	0
10	120V/60Hz	0	13,559561	±1,356	48
	120V/60Hz	2	13,559558	±1,356	45
	120V/60Hz	5	13,559551	±1,356	38
	120V/60Hz	10	13,559551	±1,356	38
0	120V/60Hz	0	13,559587	±1,356	74
	120V/60Hz	2	13,559583	±1,356	71
	120V/60Hz	5	13,559577	±1,356	64
	120V/60Hz	10	13,559574	±1,356	61
-10	120V/60Hz	0	13,559577	±1,356	64
	120V/60Hz	2	13,559583	±1,356	71
	120V/60Hz	5	13,559587	±1,356	74
	120V/60Hz	10	13,559583	±1,356	71
-20	120V/60Hz	0	13,559532	±1,356	19
	120V/60Hz	2	13,559554	±1,356	42
	120V/60Hz	5	13,559561	±1,356	48
	120V/60Hz	10	13,559564	±1,356	51

6.6.4 Photos of the actual measurement place and EUT placement

Figure 2: Radiated emission test – 9kHz to 30MHz

Figure 3: Radiated emission test – 30MHz to 1GHz

Figure 4: Radiated emission test – 9kHz to 30MHz (retested on a 10 m distance)

7 Appendix A: Manufacturer product description

• Product description

Display Combo

Display RFID

Display Keypad

Metra Display RFID is a user interface for Metra ELS systems, while Metra Display Combo and Keypad are a user interfaces for Metra ELS and Metra ELS SELECT systems.

Display Combo: Read RFID tickets as locker keys. Twelve key washable keypad is integrated to enable additional user interaction (PIN, locker number, etc.) and can be used for locking / unlocking instead of RFID media.

Display RFID: Reads RFID tickets as locker keys.

Display Keypad: Integrated 12 key washable keypad to enable user interaction (PIN, locker number, etc.).

Each model shows the locker number on a four digit LED display available in blue or white. They also perform audio signalization and show an alarm message if an attempt of break-in is detected on a Metra Electric Lock connected to a Metra Locker Controller.

Locker Controller's operating parameters are set up through integrated 4 key system keypad (Display RFID) or through 12 key keypad (Display Combo and Keypad) and stored in Locker Controller's internal battery powered memory. To simplify setup of Locker Controller and manage master keys and master/setup codes also Metra software can be used.