



EMC Test Report

2023-0221-EMC-TR-23-0162-V01

Designation:	Instrument Cluster with immobilizer circuit
Model	FPK10-5C
Manufacturer:	Visteon Corporation
Serial No(s):	PWB26595
FCC ID:	NT8-FPK105C
Regulation(s):	FCC 47 CFR Part 15 Subpart C
Measurement procedure(s):	ANSI C63.10:2013
Test Plan:	Not provided
Test Result:	Passed

Date of issue:	01.09.2023		Signature:
Version:	01	Technical Reviewer:	
Date of receipt EUT:	16.05.2023		
Performance date:	30.05.2023 – 30.08.2023	Report Reviewer:	



BNetzA-CAB-19/21-20



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EMC tests on "Visteon Instrument Cluster with immobilizer circuit"

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	DakkS D-PL-12024-06-04
Laboratory accreditation no:	BNETZA-CAB-19/21-20
FCC Designation Number:	DE0023
FCC Test Firm Registration:	366481

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V 01.00	Initial release
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1 General

1.1 Purpose

This report documents the qualification testing for the Instrument Cluster with immobilizer circuit to FCC 47CFR Part 15 Subpart C. The system is referred to as the EUT from here on for the purpose of this report. All emission testing was performed per ANSI C63.10 (Procedures for Compliance Testing of Unlicensed Wireless Devices).

1.2 Requirements according to FCC 47 CFR Part 15 Subpart C

Test Description	Regulation	Remarks	Test Result
AC powerline conducted emission	§15.207	Not applicable, device is battery powered	---
Electric field radiated emission 9kHz – 30 MHz	§15.209	Refer to corresponding test chapter for details.	Pass
Output power measurement	§15.209	Refer to corresponding test chapter for details.	Pass
Electric field radiated emission 30 – 1000 MHz	§15.209	Refer to corresponding test chapter for details.	Pass
Electric field radiated emission above 1 GHz	§15.209	Refer to corresponding test chapter for details.	Pass
Occupied Bandwidth	§2.1049	Refer to corresponding test chapter for details.	Pass

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2 EUT Description

The following information and instructions of this chapter was provided by client.

The performance and statements of applicability of the tests is based on this information and this may therefore have an impact on the validity of the test verdict.

2.1 General Information

Designation	Instrument Cluster with immobilizer circuit
Model	FPK10-5C
Manufacturer	Visteon Corporation
Serial No(s)	PWB26595
Hardware version	HW32X, X=0-9
Soft-/Firmware version	SW2YXX, XX=20-99, Y=5-9
Device type	Table top
Equipment classification	Domestic environment
Highest internal frequency	IMX6 processor: 700-800 MHz
Supply voltage(s)	12 V DC Battery powered
Supply voltage used for testing ¹	12 V DC

Ports:			
Designation	Type	Shielding	Remarks
DC Mains	L, N	Unshielded	Battery powered

Test Plan:
Not provided.

¹ If not otherwise specified in the corresponding test chapter

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2.2 EUT description

Instrument Cluster with immobilizer circuit, to be installed in various customized housings. The unit intended to be supplied by a vehicle battery power system. The product provides connections to additional sensors and control units via analog and digital inputs or a CAN bus interface. The immobilizer circuit provides connection to an external transponder coil for key authentication.

The base station is an integrated circuit which communicates and transfers the data to the microcontroller (defined area where the key data is stored)

The Antenna Coil (La) is the interface to the immobilizer. The data exchange between the immobilizer and the coil is based on 125 kHz carrier frequency, ASK proprietary modulation.

2.3 Setup

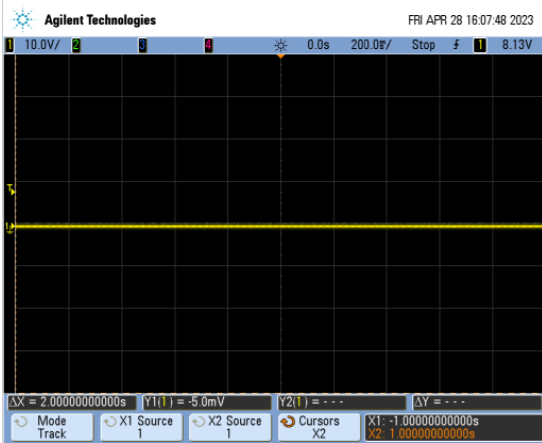
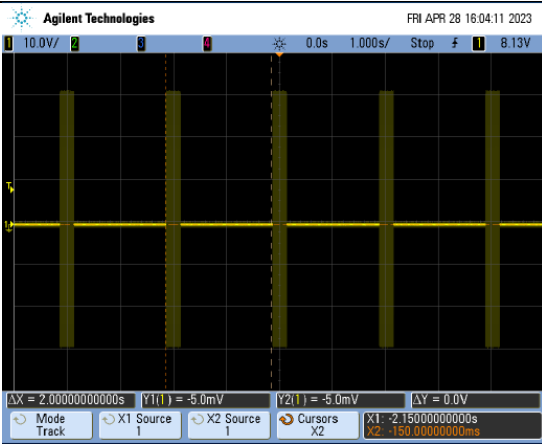
Details on radio technology:

Technology	125 kHz
RF type	Magnetic field antennas for immobilizer
Frequency range (band)	Min 116 kHz, Max= 134 kHz
Fundamental frequency	125 kHz $\pm 3\%$
Modulation scheme	ASK proprietary
Maximum radio output power:	65 dBuA/m @10m
Operating voltage	DC 9-16 V, 13.5 V (typical vehicle battery)
Operating current	2 A
Operating temperature range	-40° C to +80° C
Number of channels	1
Channel separation	Single channel operation
Antenna reference	Antenna
Antenna designation/Type	Costal Air Coil
Max. antenna gain	0 dBi
Dimensions / weight	341 x 160 x 80 mm / 0.800 kg TBC
Carlines:	VW Caddy, Ford City Van

2.4 Grounding

The DUT was isolated against ground during the test.

2.5 Operating modes

Mode	Description
Mode 1	 Test mode off
Mode 2	 Cyclic Mode
Mode 3	 Continuous Mode



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2.6 Modifications

None.

2.7 Ancillary equipment

Key Fob, see photo report.

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3 Description of EMC test laboratory

3.1 Climatic conditions during measurements

The climatic conditions were within the following ranges.

For ESD testing, the conditions during the test were denoted in the corresponding chapter.

Ambient temperature:	15 – 35 °C
Relative humidity:	30 – 60 %
Air pressure:	860 – 1060 hPa

3.2 Decision of conformity

If the standard or the customer defines no decision rule, the laboratory applies a decision rule following the "Binary Statement for Simple Acceptance Rule ($w=0$)" (chapter 4.2.1) of ILAC Guidelines on Decision Rules and Statements of Conformity (ILAC-G8:09/2019). If the measured value is at the limit value, it is evaluated as PASS. The client has agreed with application of the decision rule prior testing and demanded a statement of conformity by the test laboratory.

3.3 Measurement uncertainty

The table below shows the measurement uncertainties for each measurement method. The expanded uncertainty was calculated with worst case values over the complete frequency area.

Measurement method	Parameter	Description	Exp. Uncertainty (k=2)
Radiated emission	9 kHz – 1 GHz	Semi anechoic chamber	$\pm 5,3$ dB
	1 GHz – 6/18/26/40 GHz	Fully/Semi anechoic chamber	$\pm 4,7/ 4,4$ dB
Conducted emission	9 kHz - 150 kHz	Semi anechoic chamber	$\pm 3,8$ dB
	150 kHz - 30 MHz		$\pm 3,4$ dB

4 Measurements acc. to FCC 47 CFR Part 15 Subpart C

4.1 Electric field radiated emission in the frequency range 9 kHz – 30 MHz

4.1.1 Overview

DUT	Instrument Cluster with immobilizer circuit
Model	FPK10-5C
Serial No.	PWB26595
Modification	None
Mode(s)	Mode 3: Continuous Mode (refer to chapter 2.5 for detailed information)

	Test Parameter	Remarks
Requirement(s)	§15.209	
Test method	ANSI C63.10:2013	
Limit	§15.209	
Frequency Range	9 kHz – 30 MHz	
Resolution Bandwidth	200 Hz (9 kHz – 150 kHz) 9 kHz (150 kHz – 30 MHz)	
Detector (Final)	CISPR-Average (9-90 kHz & 110-490 kHz) Quasipeak (others)	
Distance	3 m	
Scan Heights	1 m	
Polarizations	2	
Test site	Semi anechoic chamber (SAC)	
DUT Orientation(s)	1	
Supply Voltage	12 V DC	Battery powered

4.1.2 Result

Test location	SAC
Test engineer	M. Conrad
Test Date	30.08.2023
Verdict	---

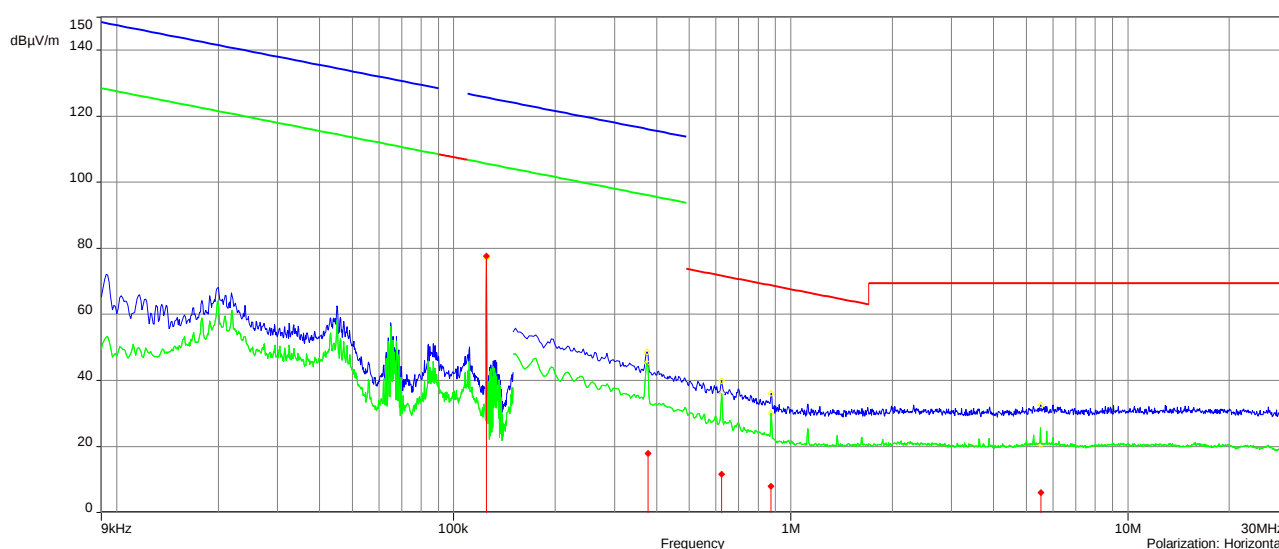
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4.1.3 Test equipment

Designation	Type	Manufacturer	Inventory No.	Cal. Date	Next Cal.
EMI test receiver	ESU40	Rohde & Schwarz	E-003138	13.10.2022	13.10.2023
Loop antenna	HFH2-Z2	R & S	E-003542	26.10.2021	26.10.2023
Measurement software	BAT-EMC	Nexio	V2022.0.9.0	---	---

4.1.4 Detailed measurement data



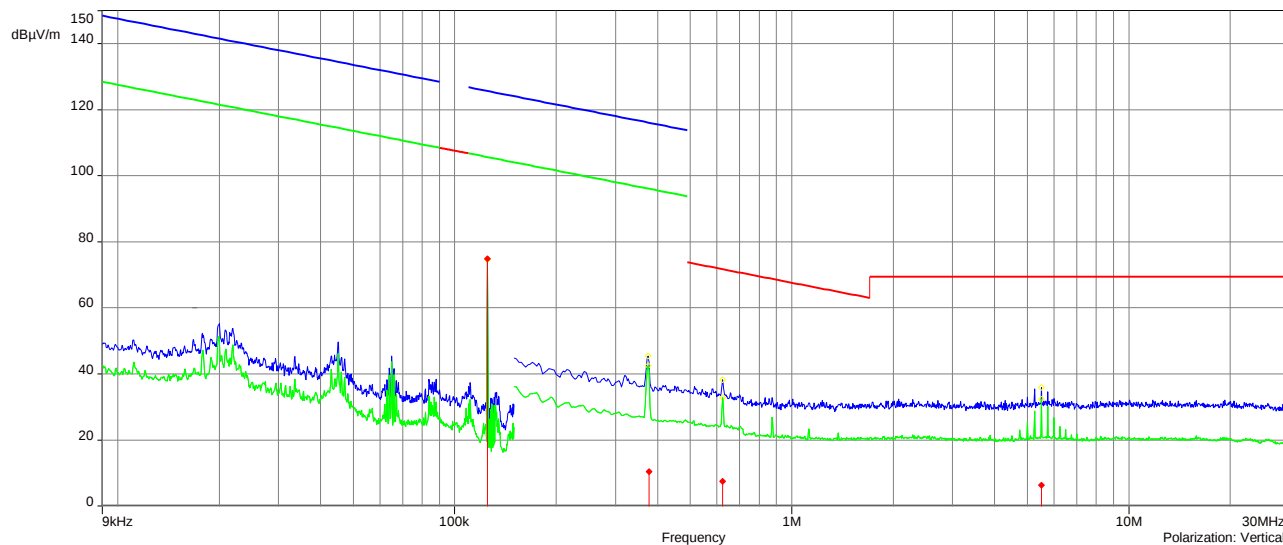
Frequency (MHz)	QP (dBμV/m)	Margin QP (dB)	AVG (dBμV/m)	Margin AV (dB)	Angle (°)	RBW (Hz)	Correction (dB)
0.125*	77.63	-	77.65	-28,04	192.60	200	20.51
0.37675	17.88	-	15.16	-80,97	184.60	9k	20.46
0.62215	11.57	-60.15	8.85	-	223.30	9k	20.48
0.87235	7.94	-60.86	4.76	-	-11.70	9k	20.50
5.5179	5.98	-63.52	3.23	-	165.00	9k	20.74

*TX Frequency, not subject to spurious emission testing.

Measurement 1: Antenna position X

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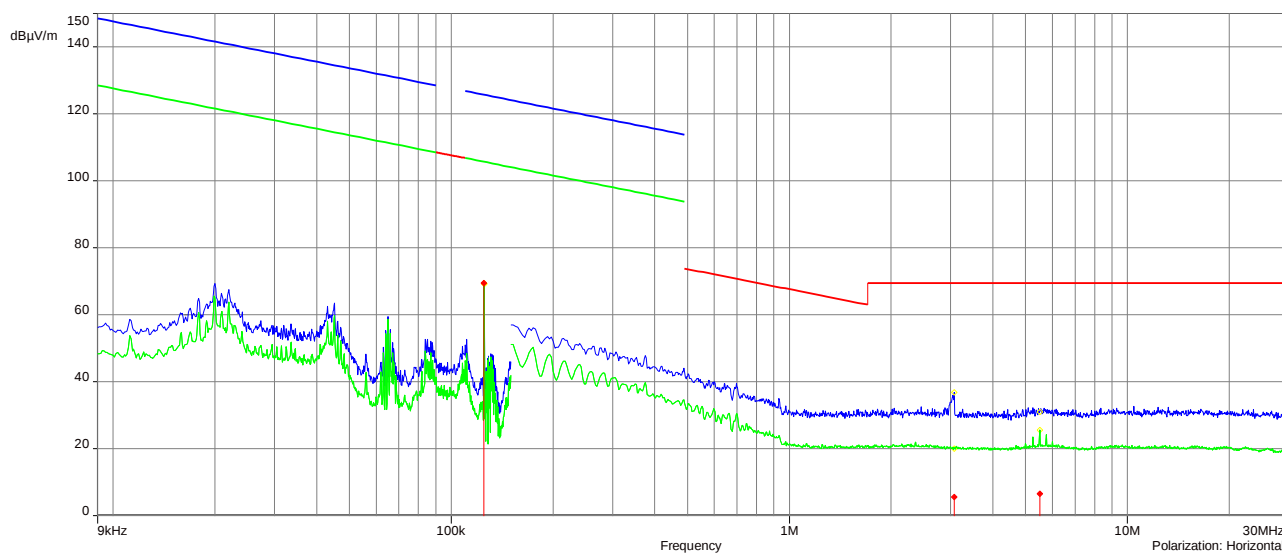
Frequency (MHz)	QP (dBμV/m)	Margin QP (dB)	AVG (dBμV/m)	Margin AV (dB)	Angle (°)	RBW (Hz)	Correction (dB)
0.125*	74.86	-	74.87	-30,82	274.70	200	20.51
0.37675	10.48	-	7.40	-88,73	274.60	9k	20.46
0.62255	7.45	-64.28	4.58	-	258.30	9k	20.48
5.4998	6.38	-63.12	3.59	-	343.20	9k	20.74

*TX Frequency, not subject to spurious emission testing.

Measurement 2: Antenna position Y

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Frequency (MHz)	QP (dBμV/m)	Margin QP (dB)	AVG (dBμV/m)	Margin AV (dB)	Angle (°)	RBW (Hz)	Correction (dB)
0.12505*	69.50	-	69.55	-69,63	188.40	200	20.51
3.0745	5.60	-63.90	2.74	-	88.80	9k	20.75
5.50175	6.50	-63.00	3.38	-	-9.60	9k	20.74

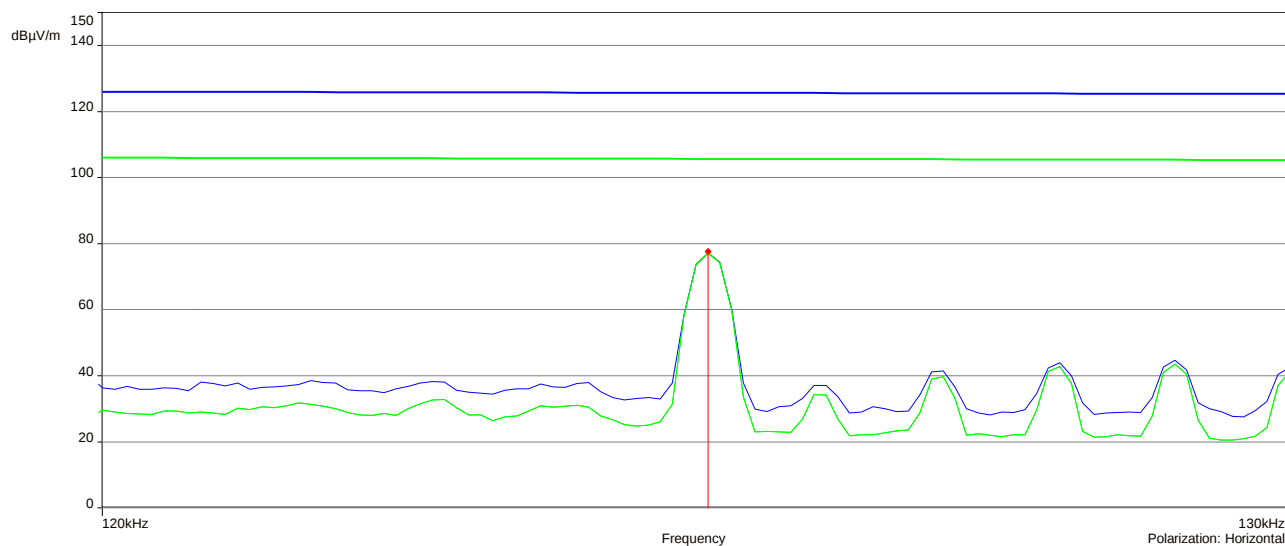
*TX Frequency, not subject to spurious emission testing.

Measurement 3: Antenna position Z

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4.1.5 Output power measurement



Frequency (MHz)	AVG (dBμV/m)	Margin AV (dB)	Angle (°)	RBW (Hz)	Correction (dB)
0.125	77.65	-28,04	192.60	200	20.51

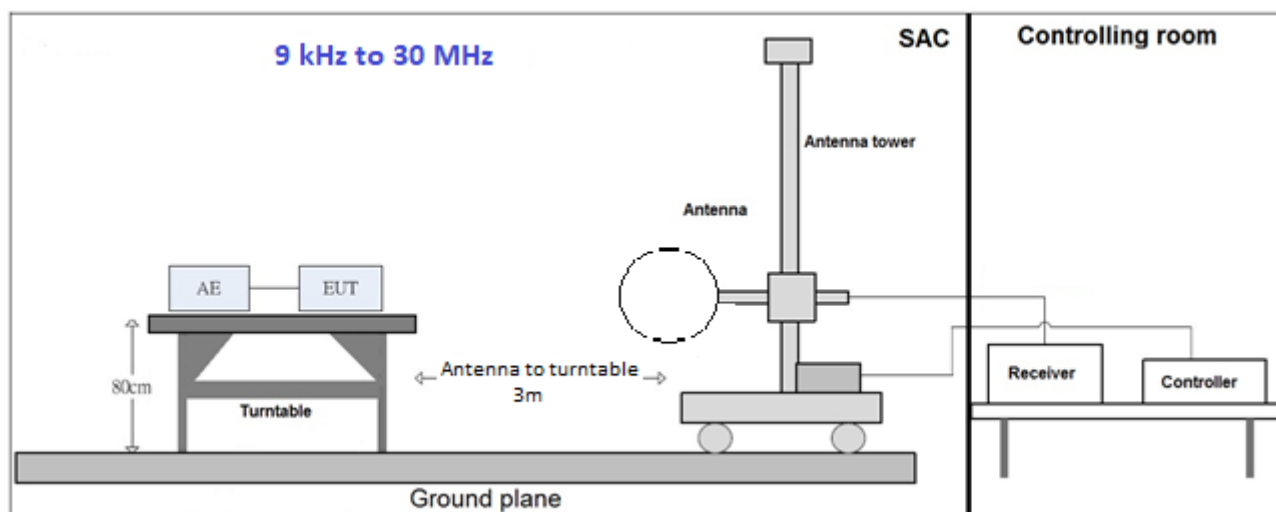
Measurement 4: Peak Output Power

4.1.6 Measurement Procedure

The measurements were made in the operating mode, with the EUT producing the maximum emission, consistent with normal applications. The EUT load was adjusted within the range specified by manufacturer in order to maximize the emission.

For this test, the EUT was placed on the turntable at a distance of 3 m from the receive antenna. The EUT was positioned on a 10 cm high wooden pallet or on a nonconductive table. The connecting lines to the EUT were fed in from above (as in the installation). The system ground was connected to the ground plane. The turntable was connected directly to the ground system of the test chamber.

While EUT power is on, an operator manually scans the selected frequency range using an EMI test receiver to identify signals being generated by the EUT. At this time the operator determines which signals generated by EUT are significant enough to assign to the final data list in the computer. The signals on the final list are automatically characterized while the antenna is in both horizontal and vertical polarity. The tower and turntable are controlled by the operator. The maximized signal indication on the receiver is then combined with the calibration factors, cable insertion loss and the proper antenna factors to provide the emission level in dB μ V/m which is compared directly with the requirement stored in the program libraries. The maximum RFI field strength was determined during the measurement by rotating the turntable (± 180 degrees).



Step 1: Preliminary scan

This is a preliminary test to identify the highest amplitudes relative to the limit.

Settings for step 1:

- Antenna distance: 3 m
- Detector: Peak-Maxhold / Quasipeak
- Frequency range: 9 kHz – 30 MHz
- Frequency steps: 100 Hz / 2.5 kHz
- IF-Bandwidth: 200 Hz / 9 kHz
- Measuring time / Frequency step: 10 ms
- Turntable angle range: -180° to 180°
- Turntable step size: 30°

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- Polarisation: parallel and axial

Intention of this step is, to determine the radiated EMI-profile of the EUT. Afterwards the relevant emissions for the final measurement are identified.

Step 2: Adjustment measurement

In this step the accuracy of the turntable azimuth and antenna height will be improved. This is necessary to find out the maximum value of every frequency.

For each frequency, which was determined the turntable azimuth and antenna height will be adjusted. The turntable azimuth will slowly vary by $\pm 30^\circ$ around this value. During this action, the value of emission is continuously measured. The turntable azimuth at the highest emission will be recorded and adjusted. In this position, the antenna height will also slowly vary by ± 100 cm around the antenna height determined. During this action, the value of emission is also continuously measured. The antenna height of the highest emission will also be recorded and adjusted.

- Detector: Peak – Maxhold
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 200 Hz / 9 kHz
- Measuring time: 10 ms
- Turntable angle range: $\pm 30^\circ$ around the determined value
- Antenna polarisation: max. value determined in step 1

Step 3: Final measurement with QP / AV detector

With the settings determined in step 3, the final measurement will be performed:

EMI receiver settings for step 4:

- Detector: Quasi-Peak / Average (depending on frequency acc. to §15.209 (d))
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 200 Hz / 9 kHz
- Measuring time: 1 s

After the measurement a plot will be generated which contains a diagram with the results of the preliminary scan and a chart with the frequencies and values of the results of the final measurement.

4.1.7 Field Strength Calculations

$$FS = SA + AF + CL$$

Where:

- FS** = Total Field Strength
- SA** = EMC test receiver Reading
- AF** = Antenna Factor
- CL** = Cable Loss

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4.2 Electric field radiated emission in the frequency range 30 – 1000 MHz

4.2.1 Overview

EUT	Instrument Cluster with immobilizer circuit
Model	FPK10-5C
Serial No.	PWB26595
Modification	None
Mode(s)	Mode 3: Continuous Mode (refer to chapter 2.5 for detailed information)

	Test Parameter	Remarks
Requirement(s)	§15.209	
Test method	ANSI C63.10:2013	
Limit	§15.209	
Frequency range	30 – 1000 MHz	
Resolution bandwidth	120 kHz	
Detector (Final)	Quasipeak	
Distance	3 m	
Scan heights	1 – 4 m	
Polarizations	horizontal & vertical	
Test site	Semi anechoic chamber (SAC)	
EUT orientation(s)	1	EUT has a defined orientation
Supply voltage	12 V DC	Battery powered

4.2.2 Result

Test location	SAC
Test engineer	M. Thomas
Test date	30.05.2023
Verdict	Pass



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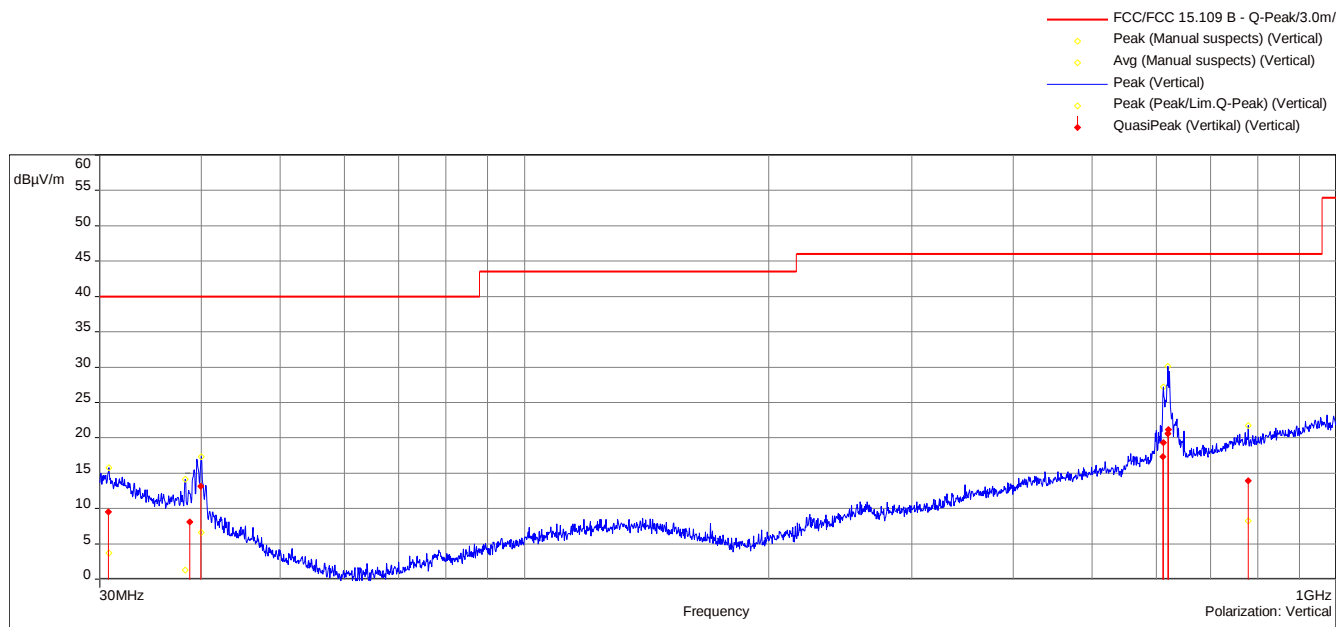
4.2.3 Test equipment

Designation	Type	Manufacturer	Inventory No.	Cal. Date	Next Cal.
EMI test receiver	ESU40	Rohde & Schwarz	E-003138	13.10.2022	13.10.2023
Antenna	CBL 6111	Chase	E-003226	19.02.2021	19.02.2024
Preamplifier	AM1431	Miteq	E-003365	21.10.2022	21.10.2023
Measurement software	BAT-EMC	Nexio	V2022.0.9.0	---	---

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4.2.4 Detailed measurement data

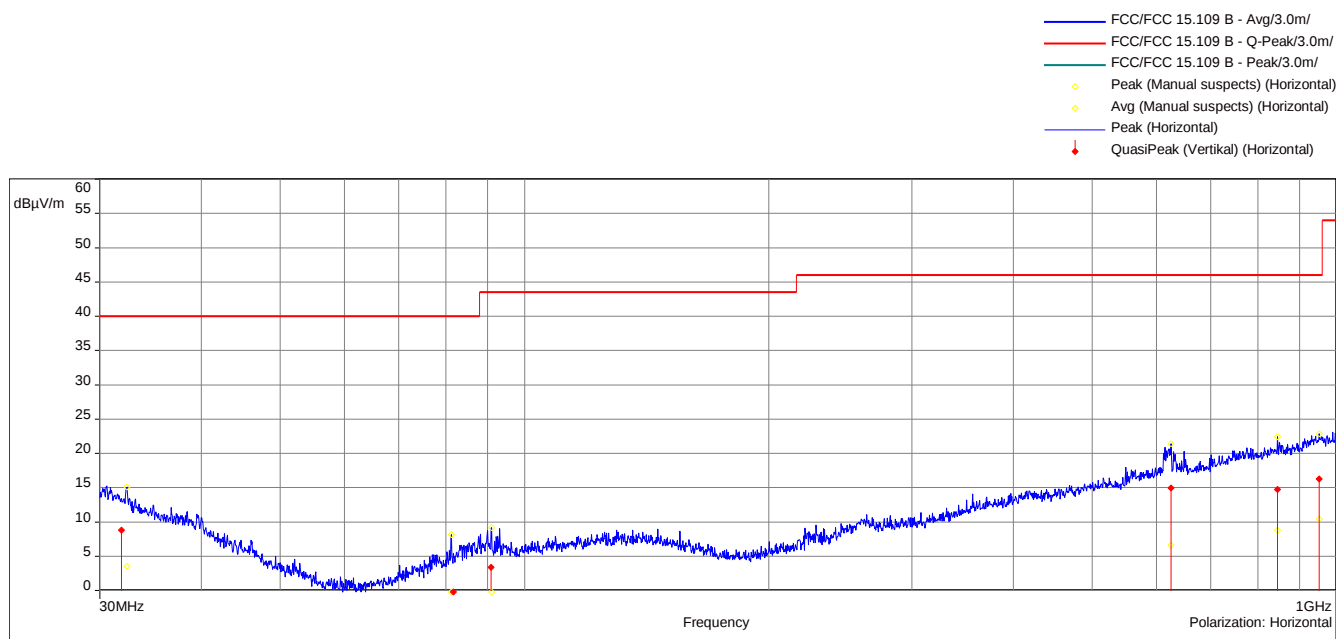


Frequency (MHz)	QuasiPeak (dBμV/m)	Margin (dB)	Limit (dBμV/m)	Angle (°)	Height (m)	Polarization	RBW (Hz)	Correction (dB)
30.76	9.51	30.49	40.00	-62.90	2.68	Vertical	120k	-18.05
38.74	8.09	31.91	40.00	-157.50	1.00	Vertical	120k	-22.35
39.97	13.16	26.84	40.00	42.60	1.00	Vertical	120k	-23.11
611.08	17.31	28.69	46.00	-173.20	2.04	Vertical	120k	-14.38
612.04	19.31	26.69	46.00	-175.10	1.00	Vertical	120k	-14.35
619.6	20.63	25.37	46.00	-158.30	1.81	Vertical	120k	-14.19
620.59	21.18	24.82	46.00	-160.80	2.06	Vertical	120k	-14.17
778.45	13.92	32.08	46.00	-112.30	2.68	Vertical	120k	-12.10

Measurement 5: Vertical polarization

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Frequency (MHz)	QuasiPeak (dBμV/m)	Margin (dB)	Limit (dBμV/m)	Angle (°)	Height (m)	Polarization	RBW (Hz)	Correction (dB)
31.9	8.79	31.21	40.00	-85.80	3.91	Horizontal	120k	-18.73
81.7	-0.46	40.46	40.00	110.10	1.70	Horizontal	120k	-29.24
90.97	3.41	40.09	43.50	-101.90	3.26	Horizontal	120k	-28.01
625.57	14.96	31.04	46.00	-16.30	1.47	Horizontal	120k	-14.07
844.9	14.75	31.25	46.00	-122.40	3.25	Horizontal	120k	-11.45
951.46	16.28	29.72	46.00	48.90	2.94	Horizontal	120k	-9.87

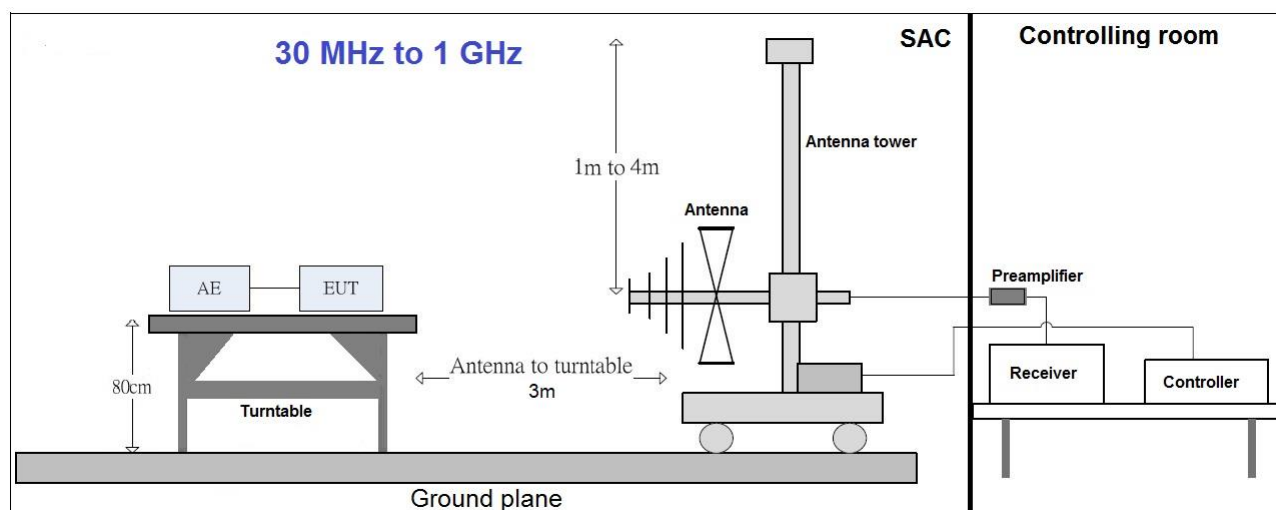
Measurement 6: Horizontal polarization

4.2.5 Measurement procedure

The measurements were made in the operating mode, with the EUT producing the maximum emission, consistent with normal applications. The EUT load was adjusted within the range specified by manufacturer in order to maximize the emission.

For this test, the EUT was placed on the turntable at a distance of 3m or 10 m (depending from the class B or A) from the receive antenna. The EUT was positioned on a 10 cm high wooden pallet or on a nonconductive table. The connecting lines to the EUT were fed in from above (as in the installation). The system ground was connected to the ground plane. The turntable was connected directly to the ground system of the test chamber.

While EUT power is on, an operator manually scans the selected frequency range using an EMI test receiver to identify signals being generated by the EUT. At this time the operator determines which signals generated by EUT are significant enough to assign to the final data list in the computer. The signals on the final list are automatically characterized while the antenna is in both horizontal and vertical polarity. The tower and turntable are controlled by the operator. The maximized signal indication on the receiver is then combined with the calibration factors, cable insertion loss and the proper antenna factors to provide the emission level in dB μ V/m which is compared directly with the requirement stored in the program libraries. The maximum RFI field strength was determined during the measurement by rotating the turntable (± 180 degrees) and varying the height of the receive antenna ($h = 1 \dots 4$ m).



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Step 1: Preliminary scan

This is a preliminary test to identify the highest amplitudes relative to the limit.

Settings for step 1:

- Antenna distance: 3m or 10 m (depending from the class B or class A)
- Detector: Peak-Maxhold / Quasipeak (FFT-based)
- Frequency range: 30 – 1000 MHz
- Frequency steps: 30 kHz
- IF-Bandwidth: 120 kHz
- Measuring time / Frequency step: 100 ms
- Turntable angle range: -180° to 180°
- Turntable step size: 15°
- Height variation range: 1 – 4 m
- Height variation step size: 1 m
- Polarization: Horizontal + Vertical

Intention of this step is, to determine the radiated EMI-profile of the EUT. Afterwards the relevant emissions for the final measurement are identified.

Step 2: Adjustment measurement

In this step the accuracy of the turntable azimuth and antenna height will be improved. This is necessary to find out the maximum value of every frequency.

For each frequency, which was determined the turntable azimuth and antenna height will be adjusted. The turntable azimuth will slowly vary by $\pm 15^{\circ}$ around this value. During this action, the value of emission is continuously measured. The turntable azimuth at the highest emission will be recorded and adjusted. In this position, the antenna height will also slowly vary from 1m to 4 m height. During this action, the value of emission is also continuously measured. The antenna height of the highest emission will also be recorded and adjusted.

- Detector: Peak – Maxhold
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 120 kHz
- Measuring time: 100 ms
- Turntable angle range: $\pm 15^{\circ}$ around the determined value
- Antenna Polarization: max. value determined in step 1

Step 3: Final measurement with QP detector

With the settings determined in step 3, the final measurement will be performed:

EMI receiver settings for step 4:

- Detector: Quasi-Peak
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 120 kHz
- Measuring time: 1 s

After the measurement a plot will be generated which contains a diagram with the results of the preliminary scan and a chart with the frequencies and values of the results of the final measurement.



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4.2.6 Field Strength Calculations

$$\mathbf{FS} = \mathbf{SA} + \mathbf{AF} + \mathbf{CL}$$

Where:

FS = Total field strength

SA = EMC test receiver reading

AF = Antenna factor

CL = Cable loss

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4.1 Electric field radiated emission in the frequency range 1 – 18 GHz

4.1.1 Overview

EUT	Instrument Cluster with immobilizer circuit
Model	FPK10-5C
Serial No.	PWB26595
Modification	None
Mode(s)	Mode 3: Continuous Mode (refer to chapter 2.5 for detailed information)

	Test Parameter	Remarks
Requirement(s)	§15.109	
Test method	ANSI C63.4:2014 + ANSI C63.4a:2017	
Limit	Class B	
Frequency range	1 – 18 GHz	5th harmonic of the highest frequency acc. to §15.33(b)
Resolution bandwidth	1 MHz	
Detector (Final)	Peak / Average	
Distance	3 m	
Scan heights	1 – 4 m	
Polarizations	horizontal & vertical	
Test site	Semi anechoic chamber (SAC) with rf absorbers on floor	
EUT orientation(s)	1	EUT has a defined orientation
Supply voltage	12 V DC	Battery powered

4.1.2 Result

Test location	SAC
Test engineer	G. Gass
Test date	29.06.2023
Verdict	Pass



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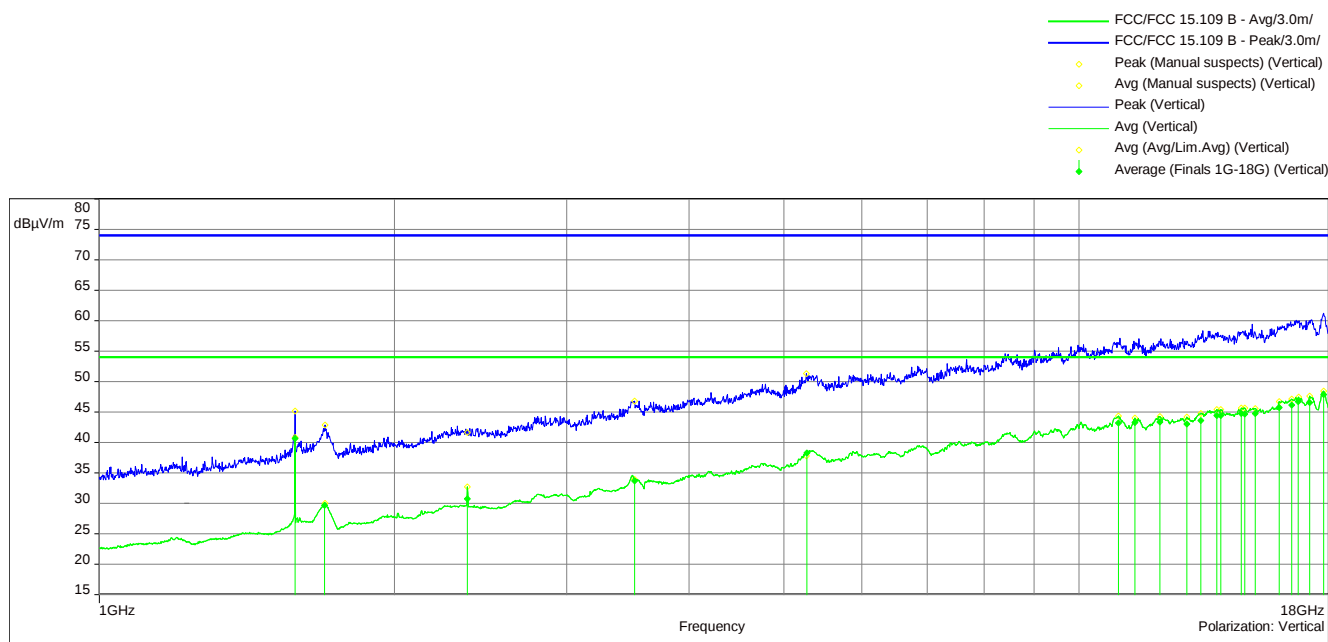
4.1.3 Test equipment

Designation	Type	Manufacturer	Inventory No.	Cal. Date	Next Cal.
EMI test receiver	ESU40	Rohde & Schwarz	E-003138	13.10.2022	13.10.2023
Antenna	HL025	Rohde & Schwarz	E-003259	12.01.2022	12.01.2023
Preamplifier	AFS4-00102000	Miteq	E-003633	20.10.2022	20.10.2023
Antenna	MWH-1826/B	ARA Inc.	E-003233	09.10.2020	09.10.2023
Antenna	MWH-2640/B	ARA Inc.	E-003234	09.10.2020	09.10.2023
Preamplifier	AMP-2000-43000-50-10-2.9-F	TTE Europe	E-003999	19.10.2022	19.10.2023
Preamplifier	BZ32-01001800-232360-282323	B&Z Technologies	E-004002	19.10.2022	19.10.2023
Preamplifier	AMP-18000-40000-60-18-2.9-F	TTE Europe	E-004003	19.10.2022	19.10.2023
Measurement software	BAT-EMC	Nexio	V2022.0.23.0	---	---

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4.1.4 Detailed measurement data from 1 GHz to 18 GHz

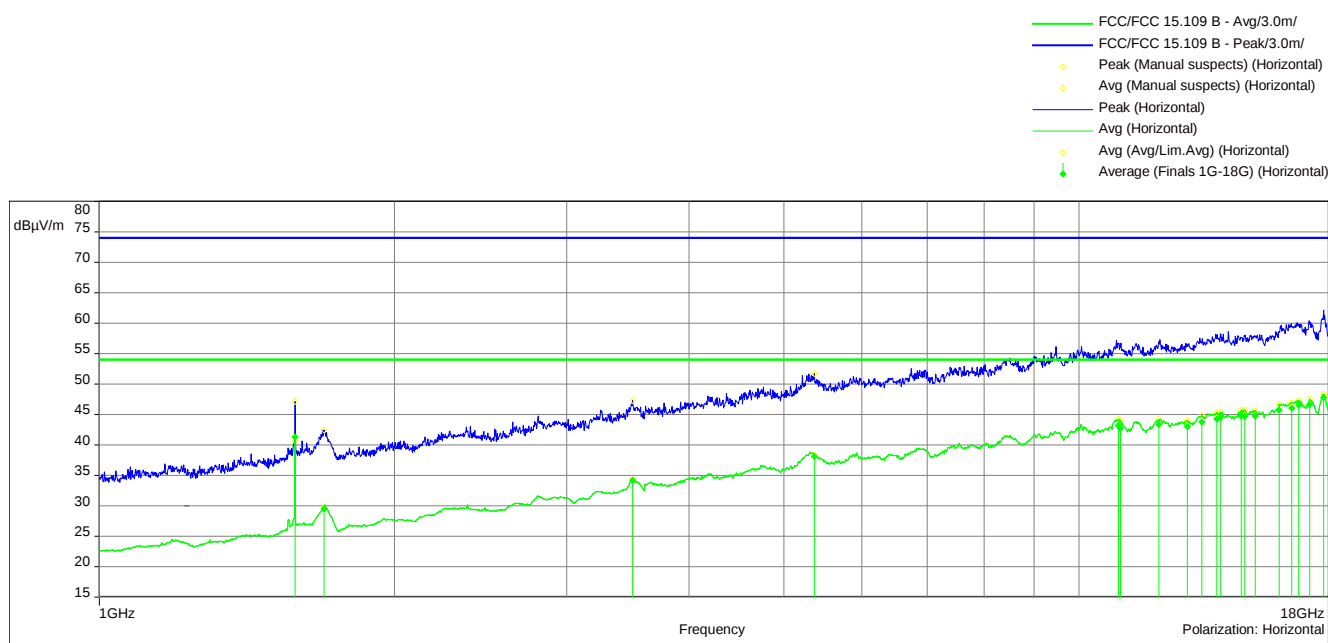


Frequency (MHz)	Average (dBμV/m)	Margin Avg (dB)	LIMIT AV (dBμV/m)	Height (m)	Angle (°)	Polarization	RBW (Hz)	Correction (dB)
1584	40.66	13.34	54.00	1.19	-170.10	Vertical	1M	8.55
1698.75	29.70	24.30	54.00	4.00	-56.80	Vertical	1M	12.02
2376	30.76	23.24	54.00	1.00	-4.50	Vertical	1M	12.72
3517	33.66	20.34	54.00	2.15	-93.00	Vertical	1M	18.00
5271.75	38.25	15.75	54.00	3.17	150.00	Vertical	1M	21.63
10968.25	43.22	10.78	54.00	1.02	-41.30	Vertical	1M	30.53
11406.25	43.27	10.73	54.00	2.76	-105.00	Vertical	1M	30.00
12089.75	43.40	10.60	54.00	1.15	135.00	Vertical	1M	30.33
12887.75	43.08	10.92	54.00	2.58	0.10	Vertical	1M	29.83
13319.75	43.63	10.37	54.00	2.94	-163.10	Vertical	1M	30.38
13817.75	44.44	9.56	54.00	1.29	82.90	Vertical	1M	31.02
13950	44.40	9.60	54.00	2.49	-15.50	Vertical	1M	31.03
14640.25	44.73	9.27	54.00	2.48	-16.90	Vertical	1M	31.89
14760.5	44.69	9.31	54.00	1.99	41.00	Vertical	1M	31.75
15138.25	44.76	9.24	54.00	1.56	63.30	Vertical	1M	31.72
16008.5	45.78	8.22	54.00	1.05	125.50	Vertical	1M	32.95
16475.25	46.12	7.88	54.00	2.46	179.90	Vertical	1M	33.33
16746.25	46.77	7.23	54.00	1.89	121.50	Vertical	1M	33.76
17194.75	46.57	7.43	54.00	1.19	180.00	Vertical	1M	33.54
17767.5	47.89	6.11	54.00	2.86	-31.50	Vertical	1M	34.52

Measurement 7: Vertical polarization

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Frequency (MHz)	Average (dBμV/m)	Margin Avg (dB)	LIMIT AV (dBμV/m)	Height (m)	Angle (°)	Polarization	RBW (Hz)	Correction (dB)
Frequency (MHz)	Average (dBμV/m)	Margin VA	LIMIT AV (dBμV/m)	Höhe	Winkel	Pol	RBW	Correction (dB)
1584	41.31	12.69	54.00	1.00	2.90	Horizontal	1M	8.55
1695	29.51	24.49	54.00	3.32	-164.20	Horizontal	1M	11.82
3503.25	34.22	19.78	54.00	2.02	-30.20	Horizontal	1M	17.97
5369.75	38.11	15.89	54.00	3.16	-131.70	Horizontal	1M	21.64
10968	43.19	10.81	54.00	3.20	-108.60	Horizontal	1M	30.53
11015.5	42.67	11.33	54.00	1.20	-6.30	Horizontal	1M	30.32
12059.75	43.40	10.60	54.00	2.04	33.30	Horizontal	1M	30.14
12894.75	43.02	10.98	54.00	3.95	26.80	Horizontal	1M	29.81
13351.75	43.78	10.22	54.00	1.00	-45.10	Horizontal	1M	30.47
13824.25	44.28	9.72	54.00	1.35	128.00	Horizontal	1M	30.97
13932.5	44.50	9.50	54.00	3.43	146.80	Horizontal	1M	30.95
14640.5	44.74	9.26	54.00	2.67	-89.90	Horizontal	1M	31.90
14760.75	44.67	9.33	54.00	2.73	122.40	Horizontal	1M	31.75
15138.75	44.80	9.20	54.00	1.53	-15.00	Horizontal	1M	31.72
16002.25	45.77	8.23	54.00	2.81	-144.60	Horizontal	1M	32.97
16493	46.08	7.92	54.00	3.83	85.90	Horizontal	1M	33.37
16747.5	46.52	7.48	54.00	1.26	166.10	Horizontal	1M	33.77
17191.5	46.61	7.39	54.00	3.24	62.80	Horizontal	1M	33.50
17773.75	47.82	6.18	54.00	2.88	90.00	Horizontal	1M	34.53

Measurement 8: Horizontal polarization

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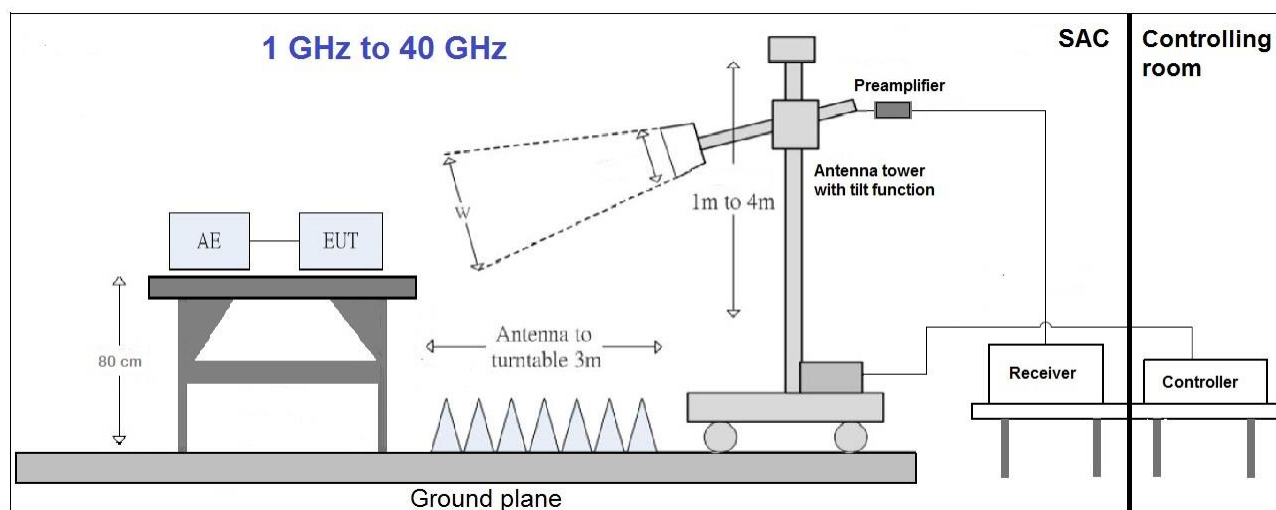
EMC tests on "Visteon Instrument Cluster with immobilizer circuit"

4.1.5 Measurement procedure

The measurements were made in the operating mode, with the EUT producing the maximum emission, consistent with normal applications. The EUT load was adjusted within the range specified by manufacturer in order to maximize the emission.

For this test, the EUT was placed on the turntable at a distance of 3 m from the receive antenna. The EUT was positioned on a 10 cm high wooden pallet or on a 80cm-non-conductive table. The connecting lines to the EUT were fed in from above (as in the installation). The system ground was connected to the ground plane. The turntable was connected directly to the ground system of the test chamber.

While EUT power is on, an operator manually scans the selected frequency range using an EMI test receiver to identify signals being generated by the EUT. At this time the operator determines which signals generated by EUT are significant enough to assign to the final data list in the computer. The signals on the final list are automatically characterized while the antenna is in both horizontal and vertical polarity. The tower and turntable are controlled by the operator. The maximized signal indication on the receiver is then combined with the calibration factors, cable insertion loss and the proper antenna factors to provide the emission level in dB μ V/m which is compared directly with the requirement stored in the program libraries. The maximum RFI field strength was determined during the measurement by rotating the turntable (± 180 degrees) and varying the height of the receive antenna ($h = 1 \dots 4$ m).



The following modifications apply to the measurement procedure for the frequency range above 1 GHz



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Step 1:

The Equipment Under Test (EUT) was set up on a non-conductive support at 0.8 m height in the semi-anechoic chamber. Absorbers are placed around and between the turn table and the antenna tower. The turn table step size (azimuth angle) for the preliminary measurement is 15 °.

Step 2:

The maximum RFI field strength was determined during the measurement by rotating the turntable (± 180 degrees) and varying the height of the receive antenna ($h = 1 \dots 4$ m) with an additional tilt function of the antenna. The turn table azimuth will slowly vary by $\pm 15^\circ$.

EMI receiver settings (for all steps):

- Detector: Peak, Average
- IF Bandwidth = 1 MHz

Step 3:

Spectrum analyzer settings for step 3:

- Detector: Peak / Average
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 1 MHz
- Measuring time: 1 s

4.1.6 Field Strength Calculations

$$\mathbf{FS} = \mathbf{SA} + \mathbf{AF} + \mathbf{CL}$$

Where:

- FS** = Total Field Strength
- SA** = EMC test receiver Reading
- AF** = Antenna Factor
- CL** = Cable Loss

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4.2 Occupied Bandwidth

4.2.1 Overview

DUT	Instrument Cluster with immobilizer circuit
Model	FPK10-5C
Serial No.	PWB26595
Modification	None
Mode(s)	Transmission mode (refer to chapter 2.5 for detailed information)

	Test Parameter	Remarks
Requirement(s)	§2.1049	
Test method	ANSI C63.10:2013	
Operating frequency	125 kHz	
Test site	Calibration Laboratory	
Supply Voltage	12 V DC	Battery powered

4.2.2 Result

Test location	SAC
Test engineer	T. Hufnagel
Test Date	30.08.2023
Verdict	---

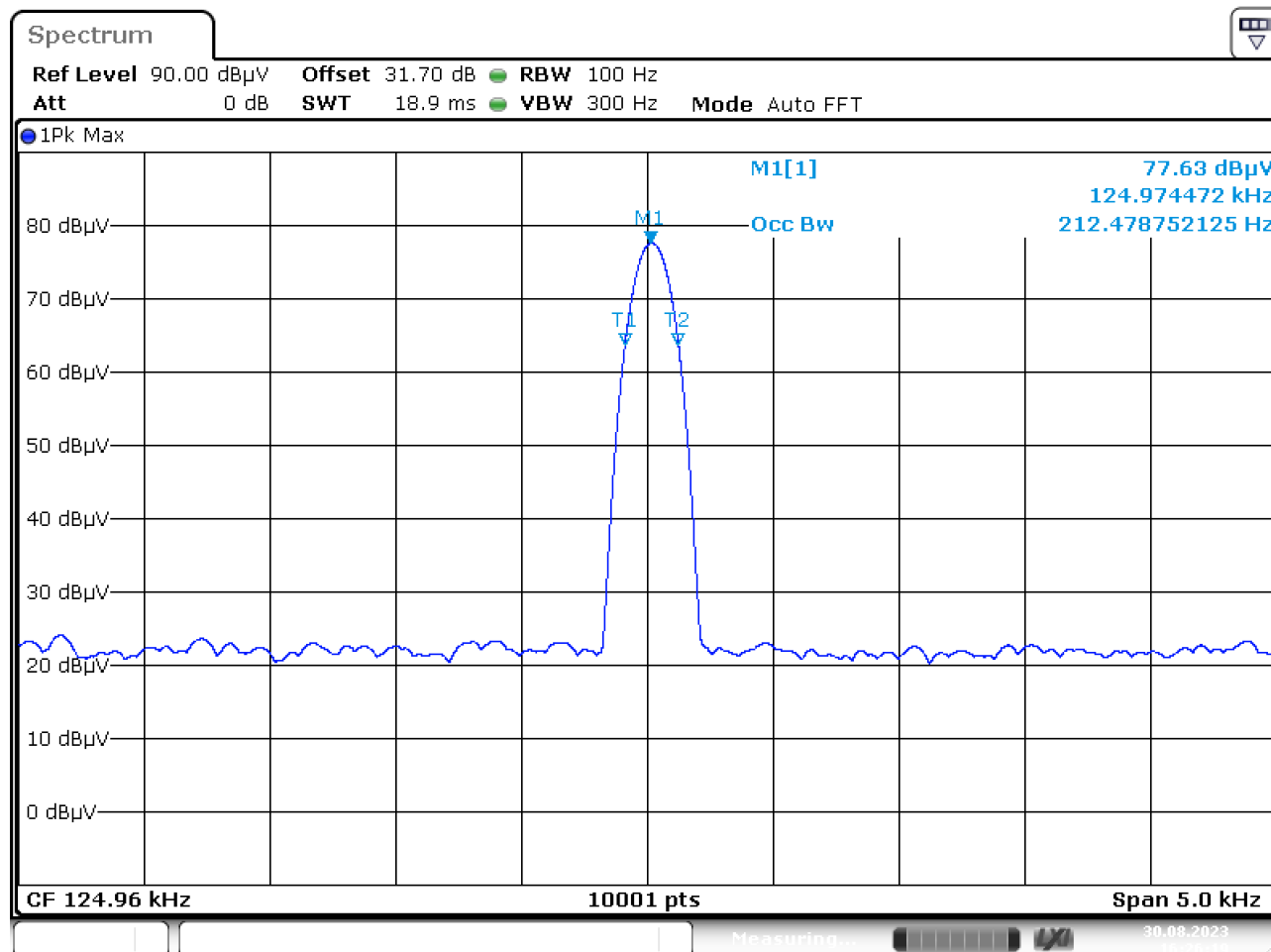
4.2.3 Test equipment

Designation	Type	Manufacturer	Inventory No.	Cal. Date	Next Cal.
Spectrum analyzer	FSV40	Rohde & Schwarz	E2050	14.10.2022	14.10.2023
Loop antenna	---	---	---	---	---

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4.2.4 Detailed measurement data

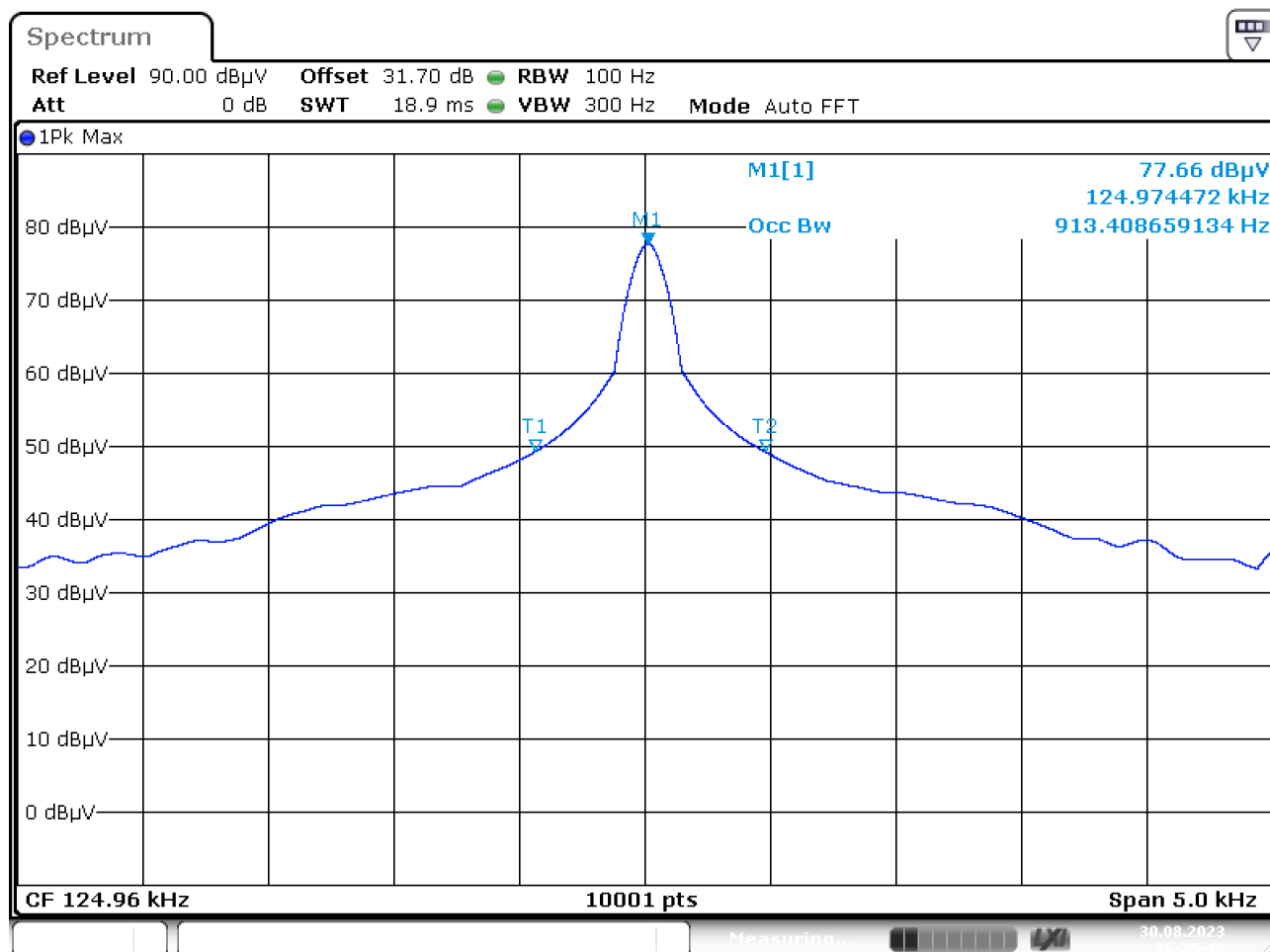


Messung 125 kHz Cont. Mode 99 %

Measurement 9: 99% Bandwidth (Continuous mode)

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EMC tests on "Visteon Instrument Cluster with immobilizer circuit"



Messung 125 kHz Cyclic Mode 99 %

Measurement 10: 99% Bandwidth (Cyclic mode)

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4.2.5 Measurement Procedure

The measurements were made in the operating mode, with the EUT producing the maximum emission, consistent with normal applications. The EUT load was adjusted within the range specified by manufacturer in order to maximize the emission.

The EUT was setup in a shielded room to perform the occupied bandwidth measurements.

The reference level is the level of the highest amplitude signal observed from the transmitter at either the fundamental frequency or first-order-modulation products in all typical modes of operation, including the unmodulated carrier, even if atypical.

The results recorded were measured with the modulation which produces the worst-case (widest) occupied bandwidth.



Test setup



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Annex A: Accreditation certificate (for information)

The accreditation relates to competences stated on the accreditation certificate. The current certificate is available on the homepage of the DAkkS and can be downloaded under accredited bodies with the processing number:

<https://www.dakks.de/en>



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Annex B: Additional information provided by client

None.

******* End of test report *******