

CTC advanced
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BNetzA-CAB-02/21-102

TEST REPORT

Test Report No.: 1-5550/17-01-06_A



DAkkS
Deutsche
Akkreditierungsstelle
D-PL-12076-01-01

Testing Laboratory

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Accredited Testing Laboratory:

The testing laboratory (area of testing) is accredited according to DIN EN ISO/IEC 17025 (2005) by the Deutsche Akkreditierungsstelle GmbH (DAkkS). The accreditation is valid for the scope of testing procedures as stated in the accreditation certificate with the registration number: D-PL-12076-01-01

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Manufacturer

same as applicant

Test Standard/s

FCC - Title 47 CFR Part 15	2018-07	FCC - Title 47 of the Code of Federal Regulations; Chapter I; Part 15 - Radio frequency devices
ANSI C63.4	2014-01	American National Standard for Methods of Measurement of Radio- Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz

Further applied test standards see section 3 of this test report

Test Item

Kind of test item: weighing electronics for mobile
use in construction machinery
Model name: WK 60
FCC ID: BT/WLAN: XPYELLOW163 /
mobile radio: RI7UE910GL
IC: BT/WLAN: 8595A-ELLAW163 /
mobile radio: 5131A-UE910NA
S/N serial number: 61177
HW hardware status: WK60.2
SW software status: Windows 7 embedded
Power Supply: DC: 12 V / 24 V



This test report is electronically signed and valid without handwritten signature. The public keys can be requested at the test laboratory to verify the electronic signatures.

Test Report authorised:

Hans-Joachim Wolsdorfer
Radio Communications & EMC

Test performed:

Jens Hennemann
Radio Communications & EMC

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2 General information

2.1 Notes and disclaimer

The test results of this test report relate exclusively to the test item specified in this test report. CTC advanced GmbH does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item.

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This test report replaces the test report with the number 1-5550/17-01-06 and dated 2018-08-29.

2.2 Application details

Date of receipt of order: 2018-06-25
Date of receipt of test item: 2018-07-26
Start of test: 2018-07-27
End of test: 2018-07-27
Person(s) present during the test: - / -

3 Test standard/s:

Test Standard	Version	Test Standard Description
FCC - Title 47 CFR Part 15	2018-07	FCC - Title 47 of the Code of Federal Regulations; Chapter I; Part 15 - Radio frequency devices
ANSI C63.4	2014-01	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
ICES-003, Issue 6	2017-04	Interference-Causing Equipment Standard Digital Apparatus

4 Test Environment

Temperature: 20°C – 25°C
Relative humidity content: 30 % - 50 %
Air pressure: 1020 hPa
Power supply: 230 V / 50 Hz

5 Test Laboratories sub-contracted

6 Information about Test Conditions

6.1 Test Item

Kind of test item :	weighing electronics for mobile use in construction machinery					
Type identification :	WK 60					
Equipment classification:	Equipment for vehicular use					
Environment classification:	Industrial environment					
Supply voltage :	DC: 12 V / 24 V					
Ports : (maximum cable lengths declared by manufacturer)	Description	Direction	Length			
	UB in:	input	> 3 m			
	UB out:	output	> 3 m			
	N1:	in- / output	> 3 m			
	N2:	in- / output	> 3 m			
	N3:	in- / output	> 3 m			
	ADW:	in- / output	> 3 m			
	MIO 1/2:	in- / output	> 3 m			
	CAN 1:	in- / output	> 3 m			
	CAN 2:	in- / output	> 3 m			
	2x USB A port (back and side):	in- / output	< 3 m			
	ETH port (unscreened):	in- / output	> 3 m			
	RS232:	in- / output	> 3 m			
	GPS antenna port:	input	> 3 m			
	mobile radio antenna port:	in- / output	> 3 m			
	wireless LAN antenna port:	in- / output	> 3 m			
	BT antenna port:	in- / output	> 3 m			
Is mounting position / usual operating position defined?	no					
Additional information:						
The following warning shall be included in the instruction of use:						
<i>This is a class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures</i>						
The EUT was powered with 24 V DC.						
At the ETH port a unscreened ETH cable was connected.						

6.2 EUT: Type, S/N etc. and Short Descriptions Used in this Test Report

short description*)	EUT	Type	S/N serial number	HW hardware status	SW software status
EUT A	weighing electronics for mobile use in construction machinery	WK 60	61177	WK60.2	windows 7 embedded

*) EUT short description is used to simplify the identification of the EUT in this test report.

6.3 Auxiliary Equipment (AE): Type, S/N etc. and Short Descriptions

AE description*)	Auxiliary equipment	Type	S/N serial number	HW hardware status	SW software status
AE A	3x LED module	EATON M22-LEDc	180308	unknown	- / -
AE B	proximity switch	PFREUNDT 30210100	14188	unknown	- / -
AE C	proximity switch	PFREUNDT 30210100	14188	unknown	- / -
AE D	proximity switch	PFREUNDT (30210100)	14188	unknown	- / -
AE E	level sensor	PFREUNDT LS1 WK60 (47001155)	180308	unknown	- / -
AE F	load cell	HBM Wägeotechnik HLCB1C3/550 kg	Z58018	2001	- / -
AE G	connection box for load cell	PFREUNDT pADC	unknown	unknown	unknown
AE H	LED	LED	180308	unknown	- / -
AE I	ethernet data gateway to 2x RS232	EXSYS EX-6032	608297142	unknown	unknown
AE J	RS232 bridge RX/TX	- / -	unknown	unknown	- / -
AE K	passive USB load	- / -	unknown	unknown	- / -
AE L	LTE WLAN dual Band antenna	DELOCK 12409	unknown	unknown	- / -
AE M	LTE WLAN dual Band antenna	DELOCK 12409	unknown	unknown	- / -
AE N	LTE WLAN dual Band antenna	DELOCK 12409	unknown	unknown	- / -

*) AE short description is used to simplify the identification of the auxiliary equipment in this test report.

6.4 EUT Set-up(s)

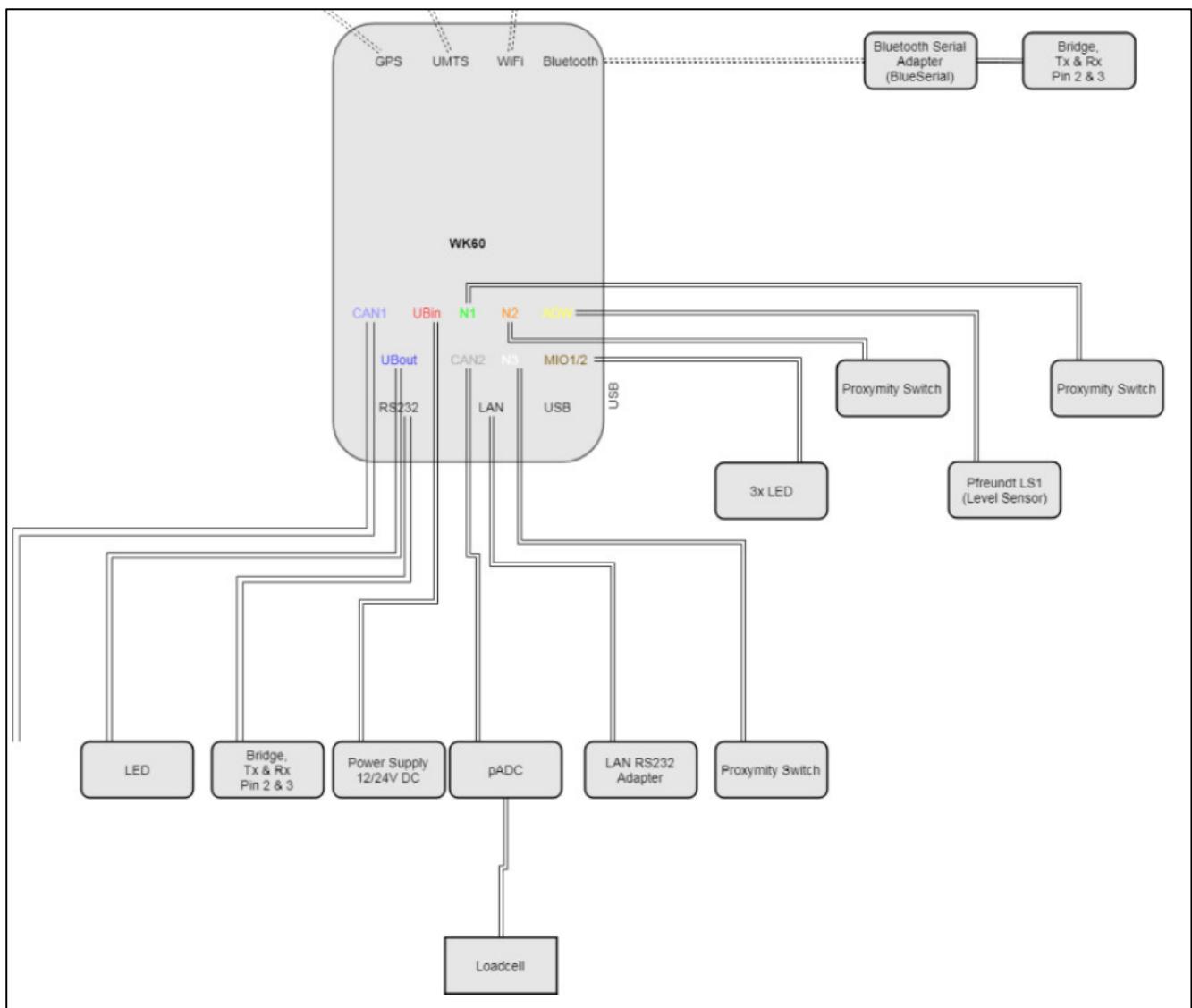
EUT set-up no.*)	Combination of EUT and AE	Remarks
set. 1	EUT A + AE A + AE B + AE C + AE D + AE E + AE F + AE G + AE H + AE I + AE J + AE k + AE L + AE M + AE N	details of setup see chapter 6.6 Setup description

6.5 EUT Operating Modes

EUT operating mode no.*)	Description of operating modes	Additional information
op. 1	EMV testmode	CAN terminated, RS232 bridge, UBout LED, CAN2 loadcell, LAN active, N1/N2/3 proximity switch, MIO1/2 LED, ADW level sensor LS1, USB load, radios idle
		the device was set into operation with a special test software (provided by customer) which performs a communication with the connected devices (AEs)

*) EUT operating mode no. is used to simplify the test report.

6.6 Setup description (declaration of the customer)



7 Summary of Test Results

No deviations from the technical specifications were ascertained
 There were deviations from the technical specifications ascertained

7.1 Emission

7.1.1 Enclosure

EMI Phenomenon	Frequency range	Basic standard	Result
Radiated Interference Field Strength	30 - 1000 MHz	FCC Part 15 Class A	passed
Radiated Interference Field Strength	> 1 GHz	FCC Part 15 Class A	passed

7.1.2 AC Mains Power Input/Output Ports

EMI Phenomenon	Frequency range	Basic standard	Result
Conducted interference voltage	0,15– 30 MHz	FCC Part 15 Class A	NA 7

Remarks:

NA1	Not tested because not required by used standard
NA2	Test not applicable because port does not exists
NA3	Test not applicable because port only for services
NA4	Test not applicable because port lengths not longer than 3m
NA5	Not tested because not required by customer
NA6	Not tested because used frequency < 108 MHz
NA7	Not tested because the device is for vehicular use

7.2 Measurement and Test Set-up

Note: The test configuration is in accordance with the requirements given in the standards in point 3

7.3 Measurement uncertainty

The uncertainty of the measurement equipment fulfils CISPR 16 and the related European and national standards.

The semi anechoic chamber fulfils the requirements of CISPR 16-1 (ANSI C63.4) for a test volume of 4m Ø.

The table below shows the measurement uncertainties for each measurement method. The expended uncertainty (k=2 or 95%) was calculated with worst case values.

Measurement Method	Frequency area Impulse duration time	Description	Expanded uncertainty (k=2 or 95%)
Radiated Emission FCC part 15 B, ANSI C63.4	30 MHz – 18 GHz	- / -	± 4.28 dB
Conducted Emission FCC part 15 B, ANSI C63.4	9 kHz – 30 MHz	- / -	± 3.49 dB

8 Detailed test results - Emission

8.1 Electromagnetic Radiated Emissions (Distance 10 m)

8.1.1 Instrumentation for Test (see equipment list)

F 1	F 2	F 4b	F 5	F 6	F 7	F 8						
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8.1.2 Test Plan

EUT set-up	set. 1		
Operating mode	Application	Limit	Result
op. 1	Enclosure	FCC part 15 B Class A	passed

Remarks: Powered by external power supply (DC 24 V)

8.1.3 Radiated Limits

Frequency- range	FCC part 15 B Class B	FCC part 15 B Class A
30 MHz – 88 MHz	30 dB μ V/m	39,1 dB μ V/m
88 MHz – 216 MHz	33,5 dB μ V/m	43,5 dB μ V/m
216 MHz – 960 MHz	36 dB μ V/m	46,4 dB μ V/m
above 960 MHz	44 dB μ V/m	49,5 dB μ V/m
	* This values are recalculated from the class B limits at 3 m antenna distance in §15.109 (g 2) of the FCC rules	.

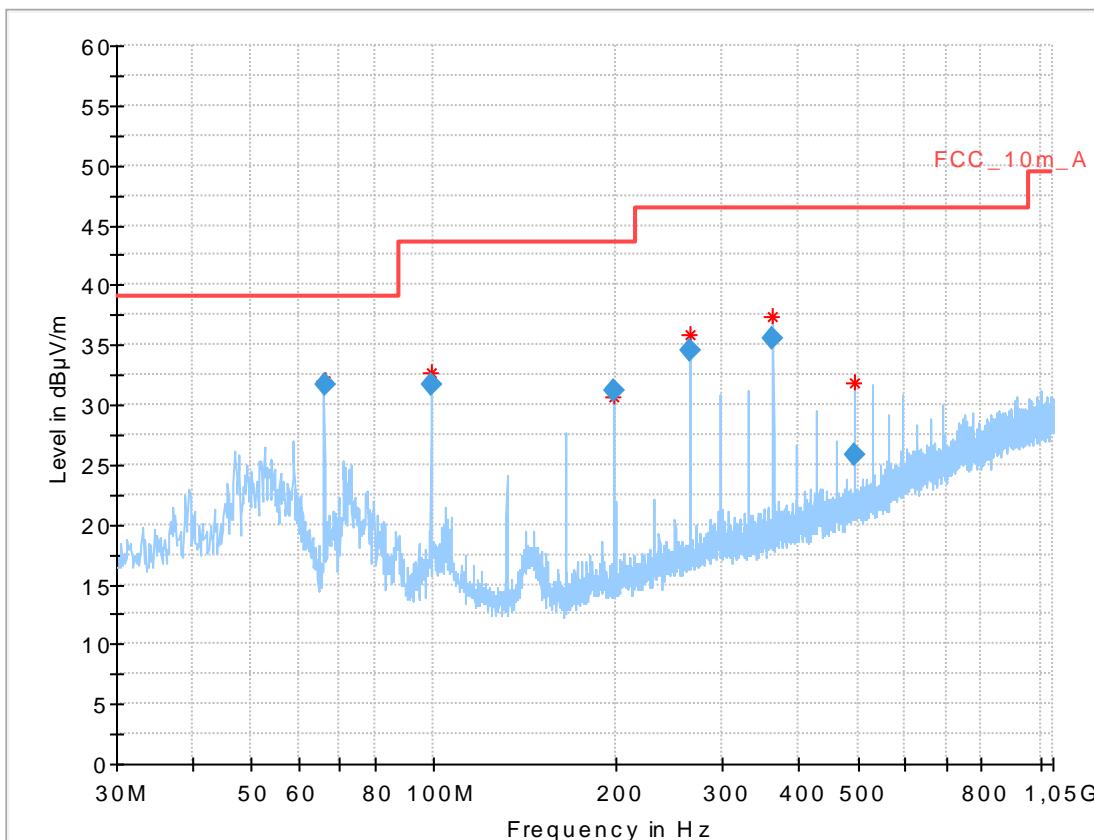
8.1.4 Calibration Information

Device	Serial number	ICT Number	Calibration valid until	Calibration interval
ESCI 3 Receiver	100083/003	300003312	12/2018	12 month
Trilog Antenna	9163-371	300003854	11/2019	24 month
Remarks: System check of all relevant devices and the chamber (weekly)				

8.1.5 Test Results

Common Information

EUT: WK60
 Serial number: 61177
 Test description: FCC part 15 B class A @ 10 m
 Operating condition: CAN terminated, RS232 bridge, UBoot LED, CAN2 loadcell, LAN active, N1/N2/3 proximity switch, MIO1/2 LED, ADW level sensor LS1, USB load, radios idle
 Operator name: Hennemann
 Comment: DC: 24 V / ETH-cable: UTP



Final Result

Frequency (MHz)	QuasiPeak (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
65.996	31.65	39.1	7.45	1000	120	272.0	V	-21.0	10.8
98.999	31.71	43.5	11.79	1000	120	103.0	V	204.0	12.1
198.003	31.21	43.5	12.29	1000	120	98.0	V	-4.0	11.9
264.005	34.55	46.4	11.85	1000	120	98.0	V	15.0	13.9
363.006	35.55	46.4	10.85	1000	120	98.0	V	-5.0	16.4
494.993	25.73	46.4	20.67	1000	120	101.0	H	-3.0	18.6

8.1.6 Hardware Set-up

Subrange 1

Frequency Range:

30 MHz - 2 GHz

Receiver:

Receiver [ESCI 3]
@ GPIB0 (ADR 20), SN 100083/003, FW 4.42

Signal Path:

without Notch

FW 1.0

Antenna:

VULB 9163
SN 9163-295, FW ---
Correction Table (vertical): VULP6113
Correction Table (horizontal): VULP6113
Correction Table (vertical): Cable_EN_1GHz (1005)
Correction Table (horizontal): Cable_EN_1GHz (1005)

Antenna Tower:

Tower [EMCO 2090 Antenna Tower]
@ GPIB0 (ADR 8), FW REV 3.12

Turntable:

Turntable [EMCO Turntable]
@ GPIB0 (ADR 9), FW REV 3.12

Software version

EMC32 V10.30.0

8.1.7 Sequence of testing

Setup

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- If the EUT is a tabletop system, a nonconducting table with 0.8 m height is used, which is placed on the ground plane.
- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- Measurement distance is 10 m or 3 m (see ANSI C 63.4) – see test details.
- EUT is set into operation.

Premereasurement

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna is polarized vertical and horizontal.
- The antenna height changes from 1 m to 3 m.
- At each turntable position, antenna polarization and height the analyzer sweeps three times in peak to find the maximum of all emissions.

Final measurement

- The final measurement is performed for at least six highest peaks according to the requirements of the ANSI C63.4.
- Based on antenna and turntable positions at which the peak values are measured the software maximize the peaks by changing turntable position $\pm 45^\circ$ and antenna height between 1 and 4 m.
- The final measurement is done with quasi-peak detector (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, antenna height, antenna polarization, turntable angle, correction factor, margin to the limit and limit are recorded. A plot with the graph of the premeasurement with marked maximum final results and the limit is stored.

8.1.8 Signal strength calculation

Calculation formula:

$$SS = U_R + CL + AF$$

List of abbreviations:

SS	►	signal strength
U_R	►	voltage at the receiver
CL	►	loss of the cable
AF	►	antenna factor

List with correction factors:

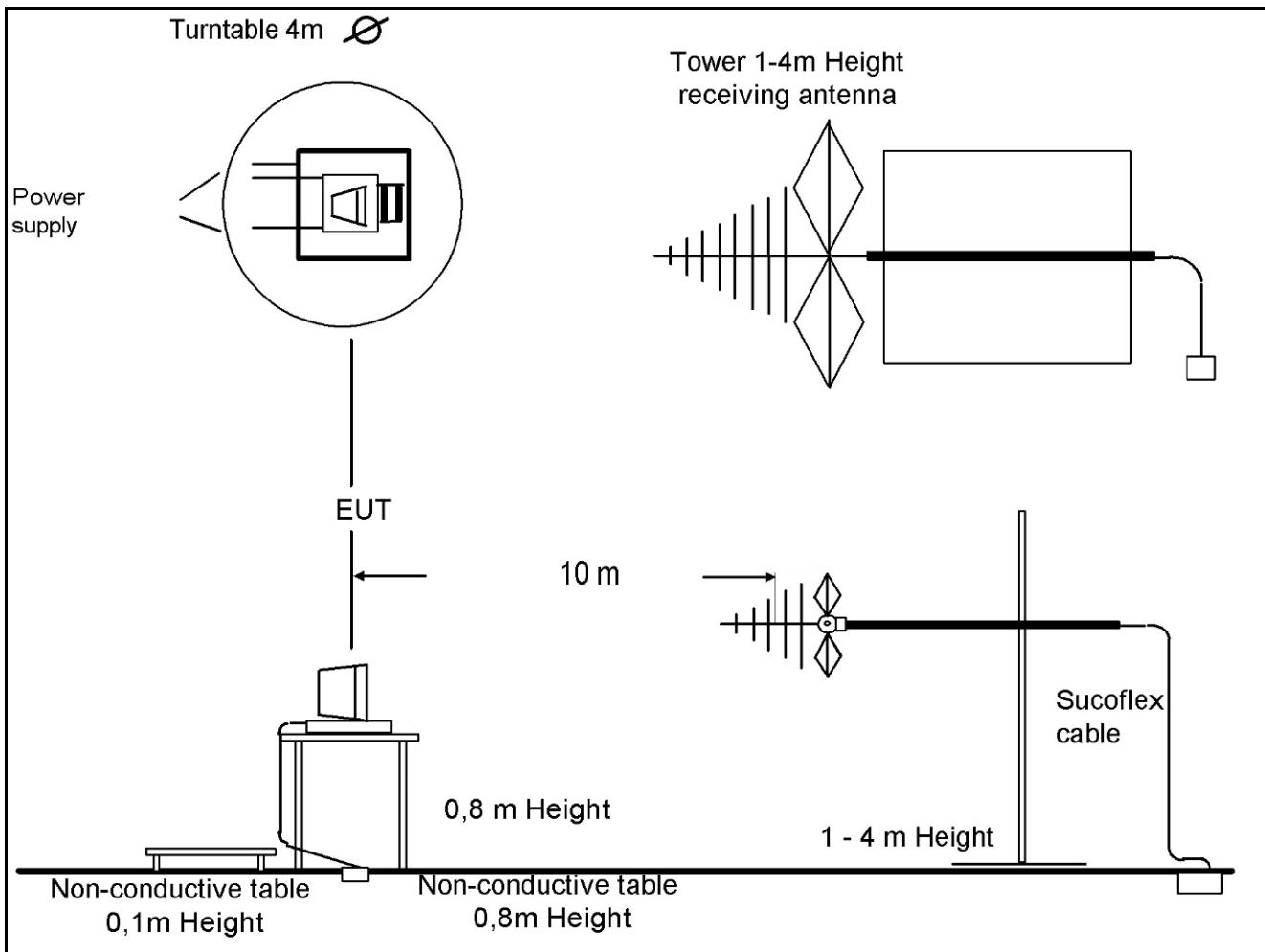
Frequency [MHz]	CL [dB]	AF [1/m]
30,000	0,20	12,30
100,000	0,60	11,30
200,000	1,10	10,60
300,000	1,30	13,20
400,000	1,60	15,30
500,000	1,90	16,80
600,000	2,00	18,80
700,000	2,20	20,30
800,000	2,30	21,50
900,000	2,40	22,80
1000,000	2,50	23,30

Example calculation:

For example at 500,000 000 MHz the measured Voltage (U_R) is 12,35 dB μ V, the loss of the cable (CL) is 1,90 dB and the antenna factor (AF) is 16,80 dB (m $^{-1}$) the final result will be calculated:

$$SS [dB\mu V/m] = 12,35 [dB\mu V] + 1,90 [dB] + 16,80 [dB (m^{-1})] = 31,05 [dB\mu V/m] (35,69 \mu V/m)$$

8.1.9 Test Set-up



8.2 Electromagnetic Radiated Emissions (Distance 5 m)

8.2.1 Instrumentation for Test (see equipment list)

F 1	F 6	F 29	F 30	F 33							
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8.2.2 Test Plan

EUT set-up	set. 1		
Operating mode	Application	Limit	Result
op. 1	Enclosure	47CFR15: (FCC part 15 B) Class A	passed

Remarks: The measured values are recalculated from 5m to 3m distance
Powered by external power supply (DC 24 V)

8.2.3 Radiated Limits

Frequency- range above 1GHz	47CFR15: (FCC part 15 B) Class B	47CFR15: (FCC part 15 B) Class A *
	54 dB μ V/m	59,5 dB μ V/m

* This values are recalculated from the class A limits at 10 m antenna distance in §15.109 (g 2) of the FCC rules.

8.2.4 Calibration Information

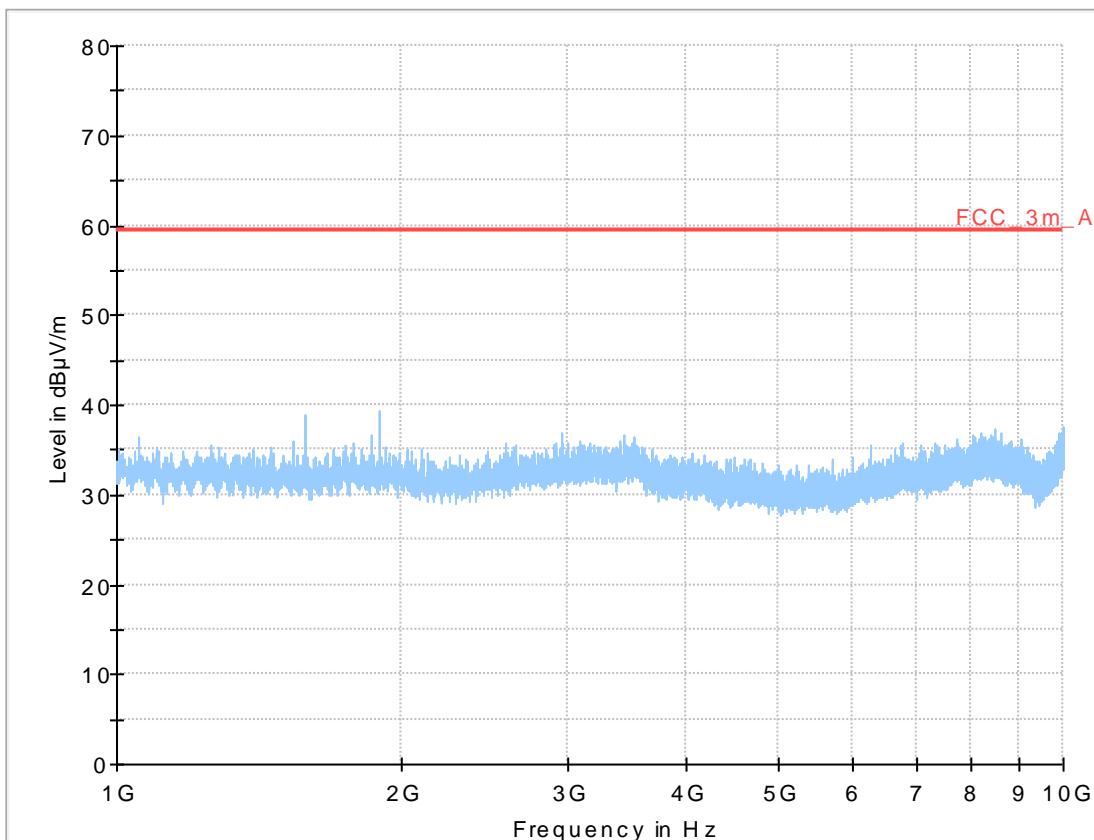
Device	Serial number	ICT Number	Calibration valid until	Calibration interval
FSU 26	200809	300003874	12/2018	12 month
Horn Antenna	9120B188	300003896	04/2020	24 month

Remarks:
System check of all relevant devices and the chamber (weekly)

8.2.5 Test Results

Common Information

EUT: WK60
Serial number: 61177
Test description: FCC part 15 B class A
Operating condition: CAN terminated, RS232 bridge, UBoot LED, CAN2 loadcell, LAN active, N1/N2/3 proximity switch, MIO1/2 LED, ADW level sensor LS1, USB load, radios idle
Operator name: Hennemann
Comment: DC: 24 V / ETH-cable: UTP



8.2.6 Hardware Set-up

Subrange 1

Frequency Range:

1 GHz - 10 GHz

Receiver:

FSU 26 [FSU 26]
@ GPIB0 (ADR 17), SN 200809/026, FW 4.71

Signal Path:

1_6_EN
FW 1.0
Correction Table: 3_5m
Correction Table: LNA_EN (matix)

Antenna:

BBHA 9120 B
Correction Table (vertical): BBHA9120
Correction Table (horizontal): BBHA9120
Correction Table (vertical): Cable_Horn_EN (1103)
Correction Table (horizontal): Cable_Horn_EN (1103)

Antenna Tower:

Manual [--]

Turntable:

Turntable [EMCO Turntable]
@ GPIB0 (ADR 9), FW REV 3.12

Software version:

EMC32 V10.30.0

8.2.7 Sequence of testing

Setup

- The Equipment was setup to simulate a typical usage like described in the user manual / or described by manufacturer.
- If the EUT is a tabletop system, a nonconducting table with 0,8 m height is used, which is placed on the ground plane.
- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.
- Auxiliary equipment and cables were positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- The measurement distance is: (see ANSI C 63.4)
< 18 GHz = 3 m
18-26 GHz = 1,5 m
26-40 GHz = 0,75 m
- The EUT was set into operation.

Premasurement

- The turntable rotates continuous from 0° to 360°
- The antenna is polarized vertical and horizontal.
- In accordance to the antenna beam and the size of the EUT the antenna height changes in 30 cm steps, start at 1 meter. If it is not possible to tilt the emissions will be checked with a manually tilted antenna from top side.
- The analyzer scans quickly to find the maximum emissions of the EUT

Final measurement

- The final measurement will be performed with minimum the six highest peaks (depends on emissions and number of measured points below 1 GHz)
- According to the maximum antenna and turntable positions of premeasurement the software maximize the peaks by changing turntable position ($\pm 45^\circ$) and antenna movement between 1 and 4 meter.
- The final measurement will be done with AV (Average / see ANSI C 63.4) detector
- The final levels, frequency, measuring time, bandwidth, antenna height, antenna polarization, turntable angle, correction factor, margin to the limit, and limit will be recorded. Also a plot with the graph of the premeasurement with marked maximum final measurements and the limit will be stored.

8.2.8 Signal strength calculation

Calculation formula:

$$SS = U_R + CL + AF + PA + DC$$

List of abbreviations:

SS	►	signal strength
U _R	►	voltage at the receiver
CL	►	loss of the cable and gain of the preamp
AF	►	antenna factor
DC	►	distance correction (results measured on 5 m calculated to 3 m)

List with correction factors: column CL in table contains cable factor and preamplifier correction

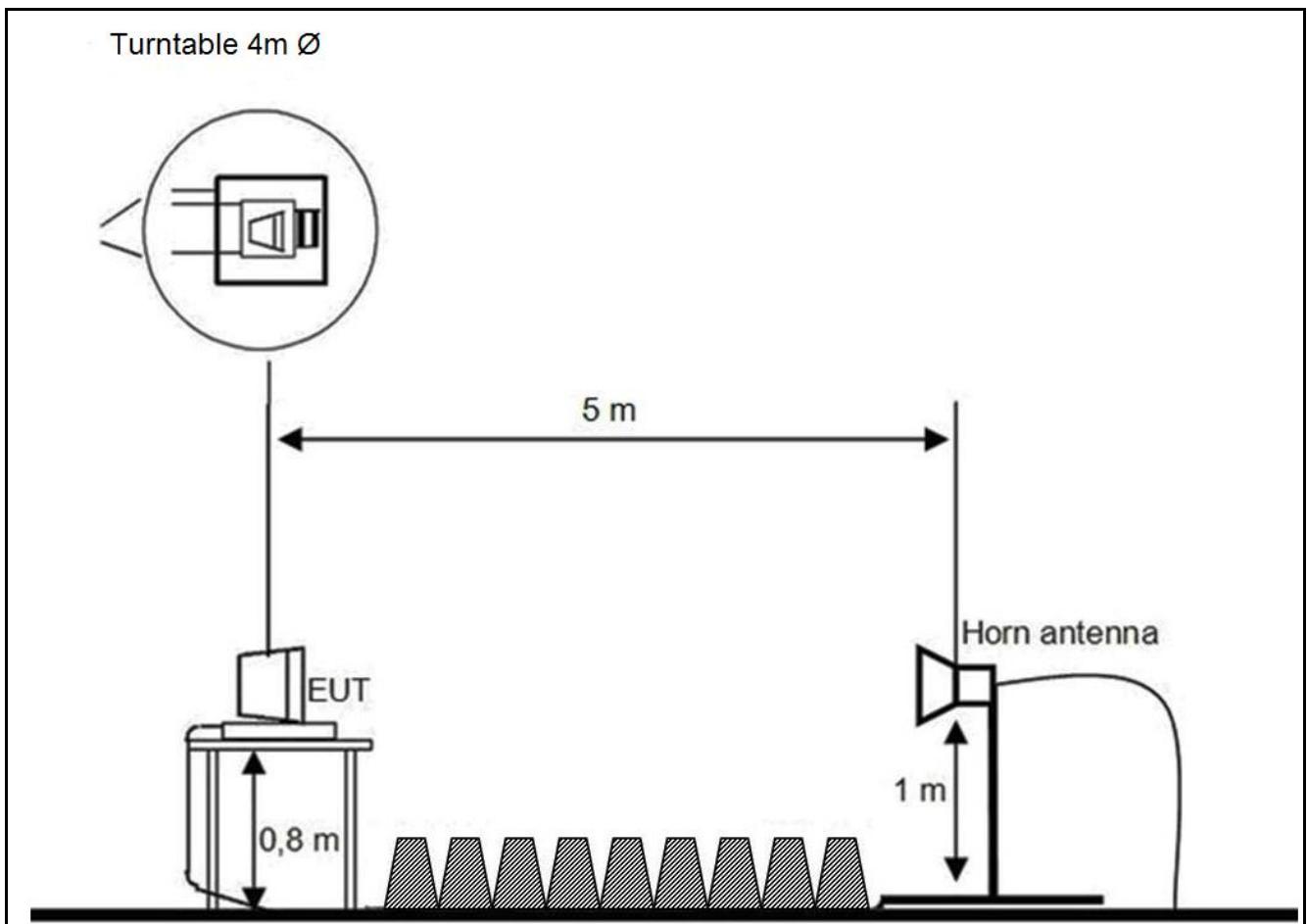
Frequency [GHz]	CL [dB]	AF [dB1/m]	DC [dB]
1,000	-35,50	26,20	4,40
1,500	-35,20	26,10	4,40
2,000	-35,10	26,70	4,40
2,500	-35,00	26,50	4,40
3,000	-34,70	27,60	4,40
3,500	-34,80	28,40	4,40
4,000	-35,00	28,60	4,40
4,500	-34,90	28,90	4,40
5,000	-34,80	29,30	4,40
5,500	-34,35	29,80	4,40
6,000	-34,00	30,30	4,40
6,500	-33,50	31,20	4,40
7,000	-33,10	31,20	4,40
7,500	-33,40	31,70	4,40
8,000	-33,80	32,10	4,40
8,500	-33,75	32,30	4,40
9,000	-33,70	31,70	4,40
9,500	-33,50	29,40	4,40
10,000	-33,40	33,00	4,40

Example calculation:

For example at 4,000 000 000 GHz the measured Voltage (U_R) is 46,13 dB μ V, the loss of the cable (CL) is -35,00 dB, the antenna factor (AF) is 28,60 dB(m $^{-1}$) and the distance correction (DC) is 4,40 dB the final result will be calculated:

$$SS [\text{dB}\mu\text{V}/\text{m}] = 46,13 [\text{dB}\mu\text{V}] + (-35,00) [\text{dB}] + 28,60 [\text{dB}(\text{m}^{-1})] + 4,4 [\text{dB}] = \underline{44,13 [\text{dB}\mu\text{V}/\text{m}]} (160,88 \mu\text{V}/\text{m})$$

8.2.9 Test Set-up



9 Test equipment and ancillaries used for tests

To simplify the identification of the test equipment and/or ancillaries which were used, the reporting of the relevant test cases only refer to the test item number as specified in the table below.

No.	Instrument/Ancillary	Manufacturer	Type	Serial-No.	Internal identification
Radiated emission in chamber F					
F-1	Control Computer	F+W		2934939v001	300005258
F-2	Trilog-Antenna	Schwarzbeck	VULB 9163	9163-371	300003854
F-3a	Amplifier	Veritech Microwave Inc.	0518C-138	- / -	- / -
F-4b	Switch	Netgear	GS108P	26V12A3H50336	300000368
F-5	EMI Test receiver	R&S	ESCI	100083	300003312
F-6	Turntable Interface- Box	EMCO / ETS- LINDGREN	Model 105637	44583	300003747
F-7	Tower/Turtable Controller	EMCO / ETS- LINDGREN	Model 2090	64672	300003746
F-8	Tower	EMCO / ETS- LINDGREN	Model 2175	64762	300003745
F-9	Ultra Notch-Filter Rejected band Ch. 62	WRCD		9	
F-35	RF- Amplifier	Bonn	BLMA 2060-5	097392A	300003908
F-36	Stacked Microwave Log.-Per. Antenna	Schwarzbeck	STLP9149	9149-044	300003919
Radiated immunity in chamber F					
F-10	Control Computer	F+W		FW0502032	300003303
F-11	Signal Generator	R&S	SMB 100A	1406.6000k02- 113856	300005266
F-13	RF-Amplifier	Bonn	BLMA 0825-50	035491	300003210
F-14	Stacked Logper Antenna	Schwarzbeck	STLP9128 E	9128 E 013	300003408
F-14a	Bicon-Antenna	EMCO	3109	8906-2309	300000575
F-14b	Bicon-Antenna	Schwarzbeck	Balun VHBD 9134 elements BBFA 9146	3011 0057	300005385
F-15	RF-Amplifier	Bonn	BLWA 0810-250	108105	300004536
F-15a	RF-Amplifier	ar	1000LM20	20562	-/-
F-16	Directional Coupler	ar	DC7144A	312786	300003411
F-16a	Directional coupler	env	DC 2000	9401-1677	300000592
F-17	Horn Antenna	ar	AT 4002	19739	300000633
F-18	Power Meter	R&S	NRP2	104973	300005114
F-19	Power sensor	R&S	NRP-Z91	103332	300005114-1
F-20	Power sensor	R&S	NRP-Z91	103333	300005114-2
Harmonics and flicker in front of chamber F					
F-21	Flicker and Harmonics Test System	Spitzenberger & Spies	PHE4500/B I PHE4500/B II	B5983 B5984	300003314
F-28	Power Supply	Hewlett Packard	6032 A	2920 A 04466	300000580
Radiated emission in chamber F > 1GHz					
F-29	Horn antenna	Schwarzbeck	BBHA 9120 B	188	300003896
F-30	Amplifier	ProNova	0518C-138	005	F 024
F-31	Amplifier	Miteq	42-00502650-28-5A	1103782	300003379
F-32	Horn antenna	Emco	3115	9709-5289	300000213
F-33	Spectrum Analyzer	R&S	FSU26	200809	300003874
F-34	Loop antenna	EMCO	6502	8905-2342	300000256

10 Observations

No observations, exceeding those reported with the single test cases, have been made.

Annex A Photographs of the test set-up

see document: 1-5550/17-01-06 ANNEX A B

Annex B Photographs of the EUT

see document: 1-5550/17-01-06 ANNEX A B

Annex C Document history

Version	Applied changes	Date of release
_A	Photos of setups and EUT removed from this report and added to separate annex 1-5550/17-01-06 ANNEX A B	2019-02-07
- / -	Initial release	2018-08-29

Annex D Further information

Glossary

DUT	-	Device under Test
EMC	-	Electromagnetic Compatibility
EUT	-	Equipment under Test
FCC	-	Federal Communication Commission
FCC ID	-	Company Identifier at FCC
HW	-	Hardware
IC	-	Industry Canada
Inv. No.	-	Inventory number
N/A	-	not applicable
S/N	-	Serial Number
SW	-	Software