

Test Report

Report Number:

F190480E2

Equipment under Test (EUT):

R60 VDES Base station

Applicant:

Saab AB (publ) TransponderTech

Manufacturer:

Saab AB (publ) TransponderTech



Deutsche
Akkreditierungsstelle
D-PL-17186-01-01
D-PL-17186-01-02
D-PL-17186-01-03

References

Family standards / generic standards:

- [1] **ETSI EN 301 489-1 V2.1.1 (2017-02)**, ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 1: Common technical requirements; Harmonised Standard covering the essential requirements of article 3.1(b) of Directive 2014/53/EU and the essential requirements of article 6 of Directive 2014/30/EU
- [2] Draft **ETSI EN 301 489-1 V2.2.0 (2017-03) ***, ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 1: Common technical requirements; Harmonised Standard covering the essential requirements of article 3.1(b) of Directive 2014/53/EU and the essential requirements of article 6 of Directive 2014/30/EU

*: Because of draft-status, this standard is not part of the laboratory accreditation.

Basic standards:

- [BS1] **EN 55032:2015 / CISPR 32:2015** Electromagnetic compatibility of multimedia equipment – Emission Requirements
- [BS2] **EN 61000-3-2:2014 / IEC 61000-3-2:2014** Limits for harmonic current emissions (equipment input current ≤ 16 A per phase)
- [BS3] **EN 61000-3-3:2013 / IEC 61000-3-3:2013** Limits – Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current ≤ 16 A per phase and not subject to conditional connection
- [BS4] **EN 61000-4-2:2009 / IEC 61000-4-2:2008** Electrostatic discharge immunity test
- [BS5] **EN 61000-4-3:2006 + A1:2008 + A2:2010 / IEC 61000-4-3:2006 + A1:2007 + A2:2010** Radiated, radio-frequency, electromagnetic field immunity test
- [BS6] **EN 61000-4-4:2012 / IEC 61000-4-4:2012** Electrical fast transient/burst immunity test
- [BS7] **EN 61000-4-5:2014 / IEC 61000-4-5:2014** Surge immunity test
- [BS8] **EN 61000-4-6:2014 / IEC 61000-4-6:2013** Immunity to conducted disturbances, induced by radio-frequency fields
- [BS9] **EN 61000-4-11:2004 / IEC 61000-4-11:2004** Voltage dips, short interruptions and voltage variations immunity tests

Test Result

The requirements of the tests performed as shown in the overview (clause 4) were fulfilled by the equipment under test. The complete test results are presented in the following.

Tested and written by:	Michael DINTER Name	 Signature	30.10.2019 Date
Reviewed and approved by:	Bernd STEINER Name	 Signature	30.10.2019 Date

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The test results herein refer only to the tested sample. PHOENIX TESTLAB GmbH is not responsible for any generalisations or conclusions drawn from these test results concerning further samples. Any modification of the tested samples is prohibited and leads to the invalidity of this test report. Each page necessarily contains the PHOENIX TESTLAB Logo and the TEST REPORT NUMBER.

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1 Identification

1.1 Applicant

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Applicant represented during the test by the following person:	Mr. Daniel FERM

1.2 Manufacturer

Name:	Saab AB (publ) TransponderTech
Address:	Låsblecksgatan 3 58941 Linköping
Country:	Sweden
Name for contact purposes:	Mr. Christian ANDERSSON
Phone:	+46 13 18 94 86
Fax:	+46 13 18 23 77
eMail Address:	christian.t.andersson@saabgroup.com
Manufacturer represented during the test by the following person:	Mr. Daniel FERM

1.3 Test Laboratory

The tests were carried out by: **PHOENIX TESTLAB GmbH**
Königswinkel 10
32825 Blomberg
Germany

Accredited by *Deutsche Akkreditierungsstelle GmbH* in compliance with DIN EN ISO/IEC 17025 under D-PL-17186-01-02.

1.4 EUT (Equipment under Test)

EUT						
Type: *	VDES Base station					
Type designation: *	R60					
Part Number: *	7000 120-200					
Serial No.: *	100002 and 100001					
Alignment range: *	156.025 to 162.025 MHz					
Switching range: *	156.025 to 162.025 MHz					
Channel separation: *	25 kHz					
Rated RF output power: *	Nominal low power: 1.0 W / 30 dBm Nominal high power: 12.5 W / 41 dBm					
Supply Voltage (DC): *	$U_{nom} =$	24.0 V _{DC}	$U_{min} =$	10.8 V _{DC}	$U_{max} =$	31.2 V _{DC}
Supply Voltage (AC): *	$U_{nom} =$	230 V _{AC}	$U_{min} =$	100 V _{AC}	$U_{max} =$	240 V _{AC}
Printed circuit designation: *	7000 120-110 Rev B4, 7000 120-130 Rev C3 and NHD-4.3C-FT813					
Hardware version: *	7000 120-100 Rev P6A1					
Software version: *	R60 0.4.11 and R60 0.4.13					
Temperature range: *	-20°C to +55°C (Operational), -55°C to +85°C (Storage)					

* Declared by the applicant

Note: Phoenix Testlab GmbH does not take samples. The samples used for tests are provided exclusively by the applicant.

1.5 Technical Data of Equipment

Ports/Connectors

Identification	Connector		Length
	EUT	Ancillary	
DC power supply	DC-Plug	4 mm connector	1 m *
AC mains	Rubber connector	AC plug	2 m *
GNSS	TNC	Fixed antenna	10 m *
VHF 1	N-female	N-female	3 m *
VHF 2	N-female	-	Not used
I/O	9 pole D-Sub	Left open	Not used
RS-422	9 pole D-Sub	9 pole D-Sub LOOP Plug	1.5 m *
RS-232	9 pole D-Sub	9 pole D-Sub LOOP Plug	1.5 m *
HOT-STB	9 pole D-Sub	9 pole D-Sub LOOP Plug	1.5 m *
ETH 1	RJ45 plug	RJ45 plug	3 m *
ETH 2	RJ45 plug	RJ45 plug	3 m *
ETH 1	RJ45 plug	RJ45 plug	3 m *

*: Length during the tests

Ancillary Equipment	
AIS transponder Saab* ²	R5 SOLID
Laptop PC* ²	DELL laptop PC type LATITUDE E6400 containing the R60 Radio test software
GPS Antenna* ²	Model:MA-700 (S/N:0025346)
Ethernet switch	Netgear ProSafe Gs108

*¹ Provided by the laboratory

*² Provided by the applicant

1.6 Dates

Date of receipt of test sample:	09.09.2019
Start of test:	12.09.2019
End of test:	25.09.2019

2 Operational States

Description of function of the EUT:

The EUT is a Base station for AIS application. Its main purpose is to receive data from and transmit data to AIS equipped vessels, travelling within the coverage area of the Base Station. This will give the possibility to monitor and follow ships' movements in an efficient way. The EUT is equipped with GNSS function.

The following states were defined as the operating conditions:

During all tests the EUT was always powered by 230 V AC mains power.
Additionally the conducted emission test was carried out with 12 V DC supply only.

An Ethernet communication via an Ethernet switch to a Laptop was established and ping commands were sending to each ETH port.
Additionally the states of the EUT were shown via web interface on the laptop's screen.
The serial interfaces were connected to a loop back connector and its function was shown on the laptop's screen.

The GPS function was shown on the laptop's screen by sending the NMEA data in a 1 second interval.
The GPS signal was provided by a GPS repeater.

The AIS functions was monitored by using a signal from an AIS Transponder R5 SOLID which receives every 2 second a signal from the base station and send every 10 second a request to the EUT.

All states of the EUT were shown also on the EUT's display or on the laptop's screen.

Definition of the functions to be monitored and corresponding tolerance limits:

For continuous immunity tests:

For Ethernet function no loss of ping is allowed.

For AIS RX / TX no loss of communication is allowed.

For serial interface function no change of state is allowed.

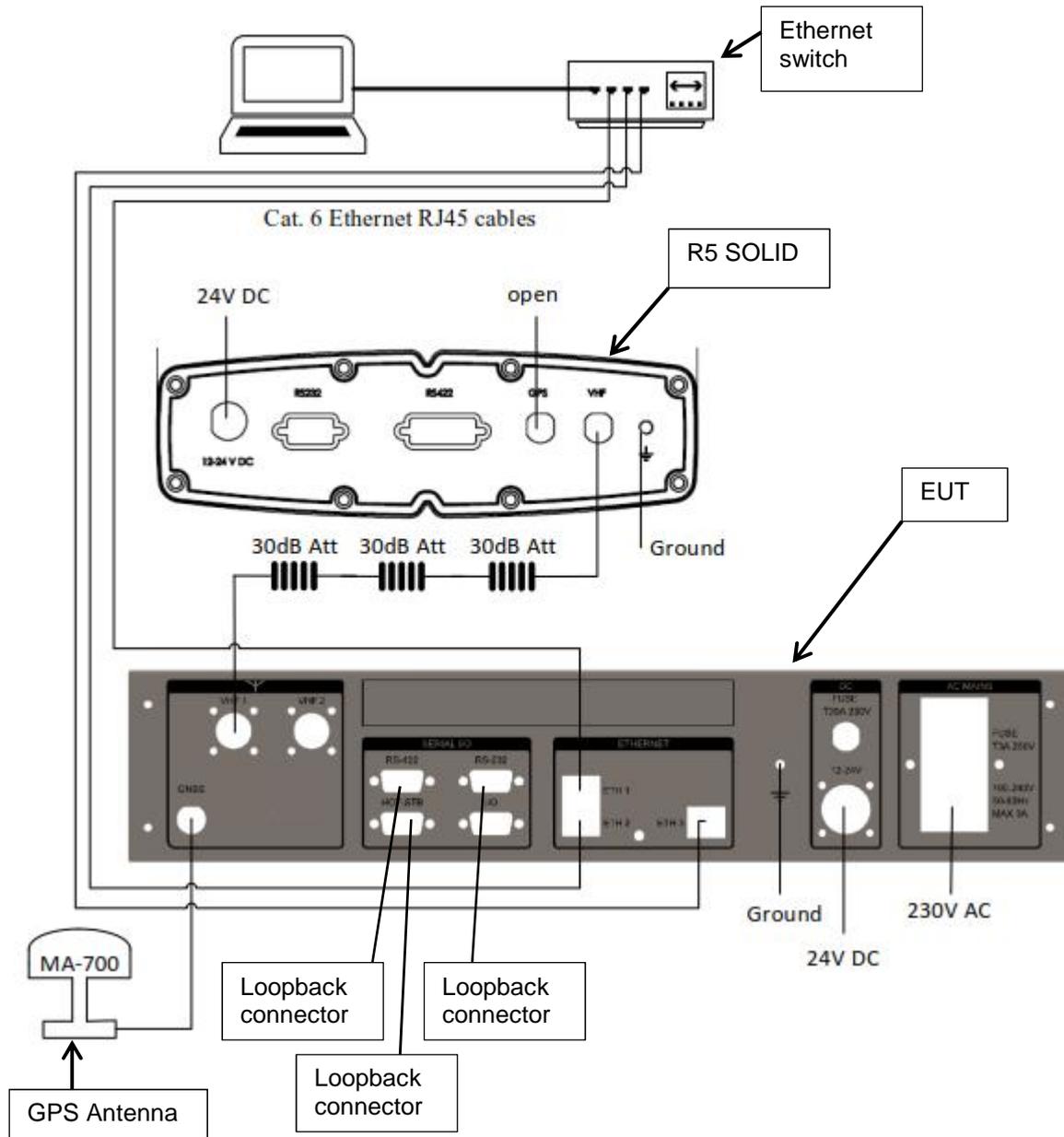
For GNSS function no loss of position is allowed.

For all other functions of the EUT the Alarm status may not change.

For transient immunity tests:

All function may have short interruptions but have to be self-recoverable after a short time.

The system was setup as follows:



3 Additional Information

General information:

- During the tests the EUT was exchanged therefore different serial numbers were reported for the tests.
- The test sample with S/N:100002 has had the software version R60 0.4.11 and test sample S/N:100001 has had the software version R60 0.4.13 during the tests.

Classification of cables:

- None.

Maximum length of cables, declared by the manufacturer:

- None.

Type of cables, declared by the manufacturer:

- None.

Deviation of the standard or test plan:

- None.

Special EMC measures, as a result of the tests:

- None.

4 Overview

Definition of performance criteria:

The performance criteria of the **family standards / generic standards** apply.

4.1 Emission

Emission – Radiated Emissions				
Frequency range	Limits (Class B)	Basic standard	Applicability	Test result
30 to 230 MHz	42 to 35 dB μ V QP	[BS1]	Applicable	Passed
230 to 1000 MHz	42 dB μ V/m QP			
1000 to 3000 MHz	70 dB μ V/m PK 50 dB μ V/m AV			
3000 to 6000 MHz	74 dB μ V/m PK 54 dB μ V/m AV			

Emission – Conducted Emissions DC Mains Port				
Frequency range	Limits	Basic standard	Applicability	Test result
0.15 to 0.5 MHz	66 to 56 dB μ V QP 56 to 46 dB μ V AV	[BS1]	Applicable	Passed
0.5 to 5 MHz	56 dB μ V QP 46 dB μ V AV			
5 to 30 MHz	60 dB μ V QP 50 dB μ V AV			

Emission – Conducted Emissions AC Mains Port				
Frequency range	Limits	Basic standard	Applicability	Test result
0.15 to 0.5 MHz	66 to 56 dB μ V QP 56 to 46 dB μ V AV	[BS1]	Applicable	Passed
0.5 to 5 MHz	56 dB μ V QP 46 dB μ V AV			
5 to 30 MHz	60 dB μ V QP 50 dB μ V AV			
0 to 2 kHz	See basic standard	[BS2]	Applicable	Passed
		[BS3]	Applicable	Passed

Emission – Conducted Emissions Wired Network Port(s)				
Frequency range	Limits	Basic standard	Applicability	Test result
0.15 to 0.5 MHz	84 to 74 dB μ V QP 74 to 64 dB μ V AV respectively 40 to 30 dB μ A QP 30 to 20 dB μ A AV	[BS1]	Applicable	Passed
0.5 to 30 MHz	74 dB μ V QP 64 dB μ V AV respectively 30 dB μ A QP 20 dB μ A AV			

4.2 Immunity

Immunity – Enclosure Ports					
Test phenomena	Test specification and units	Basic standard	Performance criterion	Applicability	Test result
Radio-Frequency Electromagnetic Field	80 - 1000 MHz; 3 V/m; 80% AM (1 kHz)	[BS5]	References and chapter 2	Applicable	Passed
	1000 - 6000 MHz; 3 V/m; 80% AM (1 kHz)				
Electrostatic Discharge (ESD)	Up to \pm 4 kV charge voltage (indirect discharge)	[BS4]	References and chapter 2	Applicable	Passed
	Up to \pm 4 kV charge voltage (contact discharge)			Applicable	Passed
	Up to \pm 8 kV charge voltage (air discharge)			Applicable	Passed

Immunity – DC Mains Port					
Test phenomena	Test specification and units	Basic standard	Performance criterion	Applicability	Test result
Electrical fast Transients / Bursts	\pm 0.5 kV (peak) 5/50 ns (t_r/t_h) 5 kHz rep. frequency	[BS6]	References and chapter 2	Applicable	Passed
Radio-Frequency common Mode	0.15 – 80 MHz, 3 V, 80% AM (1 kHz)	[BS8]	References and chapter 2	Applicable	Passed

Immunity – AC Mains Port					
Test phenomena	Test specification and units	Basic standard	Performance criterion	Applicability	Test result
Electrical fast Transients / Bursts	± 1 kV (peak) 5/50 ns (t _r /t _h) 5 kHz rep. frequency	[BS6]	References and chapter 2	Applicable	Passed
Radio-Frequency common Mode	0.15 – 80 MHz, 3 V, 80% AM (1 kHz)	[BS8]	References and chapter 2	Applicable	Passed
Voltage Dips	0% for 0.5 periods 0% for 1 period 70% for 25 periods	[BS9]	References and chapter 2	Applicable	Passed
Voltage Interruptions	0% for 250 periods	[BS9]	References and chapter 2	Applicable	Passed
Surges	1.2/50 (8/20) µs (t _r /t _h) Up to ± 1.0 kV line to line Up to ± 2.0 kV line to earth	[BS7]	References and chapter 2	Applicable	Passed

Immunity – Wired Network Port(s)					
Test phenomena	Test specification and units	Basic standard	Performance criterion	Applicability	Test result
Electrical fast Transients / Bursts	± 0.5 kV (peak) 5/50 ns (t _r /t _h) 5 kHz rep. frequency	[BS6]	References and chapter 2	Applicable	Passed
Radio-Frequency common Mode	0.15 – 80 MHz, 3 V, 80% AM (1 kHz)	[BS8]	References and chapter 2	Applicable	Passed
Surges	1.2/50 (8/20) µs (t _r /t _h) Up to ± 1.0 kV line / earth	[BS7]	References and chapter 2	Applicable	Passed

5 Results

5.1 Radiated Emissions

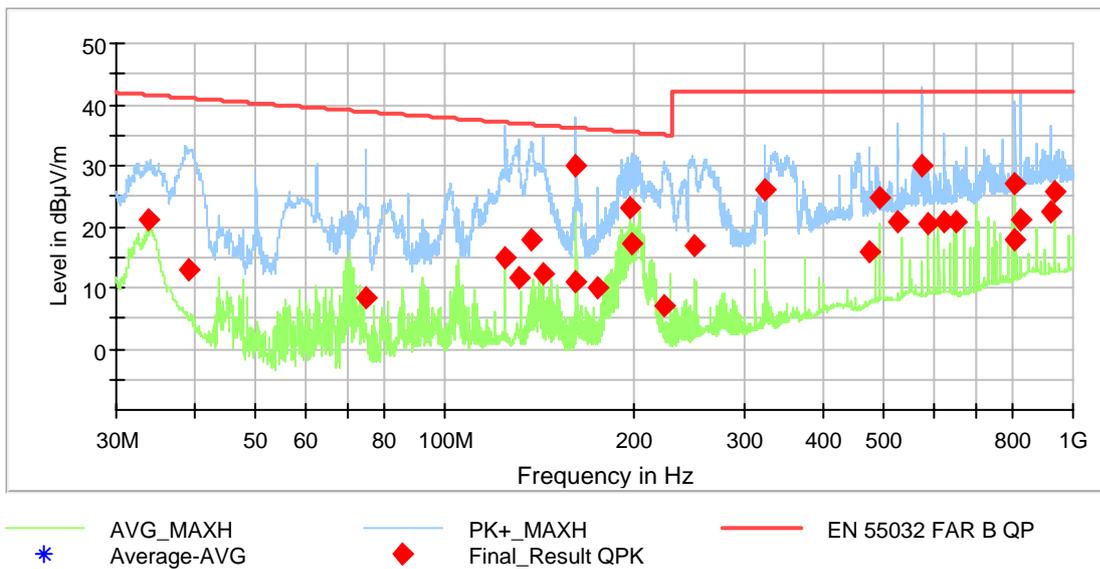
Test setup: Table setup according to [BS1].
Photos of the test setup are shown below.



Test procedure FAR: The interfering field strength measurements are made in a fully anechoic chamber (FAR). Here the equipment under test is measured from various sides in normal fitted position. This procedure makes it possible to ascertain without the effect of external interference sources and without adjusting the antenna in height whether the test object is emitting interference at certain frequencies. The frequencies determined in the preliminary measurements are measured in compliance with the standard in a fully anechoic chamber (FAR) with a quasi-peak detector below 1 GHz and peak / average detector above 1 GHz.

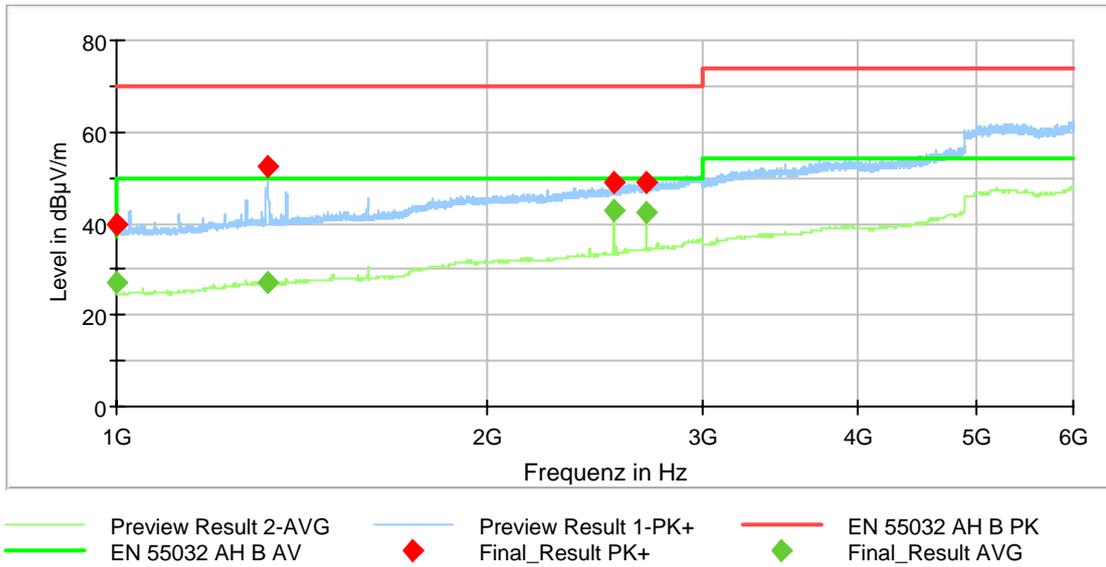
Measuring records: The measuring records are presented on the following pages.

Test description: Radiated emission measurement
 EUT: R60 VDES Base station (S/N:100002)
 Manufacturer: Saab AB (publ) TransponderTech
 Operating conditions: LAN GPS RX TX active RS 232 and RS 485 in loop
 Test site: Phoenix TESTLAB GmbH, anechoic chamber M20
 Operator: M. Dinter
 Comment: Main supply 230 V AC / 24 V DC as redundancy supply
 Comment: 12.09.2019 FAR measurement in the anechoic chamber M20



Frequency (MHz)	QuasiPeak (dB μ V)	Limit (dB μ V)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
33.690	21.14	41.60	20.46	1000.0	120.000	150.0	H	141.0	16.5
39.210	13.11	41.08	27.97	1000.0	120.000	150.0	V	34.0	13.5
74.880	8.23	38.86	30.63	1000.0	120.000	150.0	H	39.0	6.6
124.950	14.99	37.10	22.11	1000.0	120.000	150.0	V	297.0	12.2
131.340	11.72	36.93	25.21	1000.0	120.000	150.0	H	236.0	11.9
137.520	17.82	36.77	18.95	1000.0	120.000	150.0	H	114.0	11.5
143.880	12.19	36.61	24.42	1000.0	120.000	150.0	H	188.0	11.3
161.910	10.98	36.21	25.23	1000.0	120.000	150.0	H	314.0	10.1
161.970	29.85	36.21	6.36	1000.0	120.000	150.0	H	314.0	10.1
174.930	9.94	35.94	26.00	1000.0	120.000	150.0	H	6.0	9.8
196.950	23.06	35.53	12.47	1000.0	120.000	150.0	V	222.0	9.4
198.210	17.32	35.51	18.19	1000.0	120.000	150.0	H	317.0	9.3
224.040	7.10	35.09	27.99	1000.0	120.000	150.0	H	11.0	10.1
249.990	17.04	42.00	24.96	1000.0	120.000	150.0	H	28.0	12.9
323.940	26.05	42.00	15.95	1000.0	120.000	150.0	H	63.0	14.9
474.930	15.76	42.00	26.24	1000.0	120.000	150.0	V	180.0	18.6
491.520	24.67	42.00	17.33	1000.0	120.000	150.0	H	299.0	19.0
524.880	20.95	42.00	21.05	1000.0	120.000	150.0	H	338.0	19.0
575.100	29.84	42.00	12.16	1000.0	120.000	150.0	H	343.0	20.1
587.400	20.38	42.00	21.62	1000.0	120.000	150.0	H	335.0	19.9
625.050	20.95	42.00	21.05	1000.0	120.000	150.0	H	1.0	20.7
650.010	20.96	42.00	21.04	1000.0	120.000	150.0	V	15.0	20.6
810.120	26.92	42.00	15.08	1000.0	120.000	150.0	H	70.0	22.2
810.210	18.01	42.00	23.99	1000.0	120.000	150.0	H	70.0	22.2
825.060	21.29	42.00	20.71	1000.0	120.000	150.0	H	16.0	22.5
925.020	22.42	42.00	19.58	1000.0	120.000	150.0	V	250.0	22.9
937.680	25.72	42.00	16.28	1000.0	120.000	150.0	H	146.0	23.0

Measurement uncertainty ± 5.12 dB



Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1000.600	39.66	---	70.00	30.34	1000.0	1000.000	150.0	V	67.0	26.4
1000.600	---	27.18	50.00	22.82	1000.0	1000.000	150.0	V	67.0	26.4
1325.600	---	27.13	50.00	22.87	1000.0	1000.000	150.0	V	19.0	27.9
1325.600	52.61	---	70.00	17.39	1000.0	1000.000	150.0	V	19.0	27.9
2541.850	49.15	---	70.00	20.85	1000.0	1000.000	150.0	H	250.0	32.5
2541.850	---	42.84	50.00	7.16	1000.0	1000.000	150.0	H	250.0	32.5
2694.050	---	42.36	50.00	7.64	1000.0	1000.000	150.0	V	161.0	32.9
2694.050	49.10	---	70.00	20.90	1000.0	1000.000	150.0	V	161.0	32.9

Measurement uncertainty ± 5.14 dB

Test equipment (please refer to chapter 6 for details)

1 - 9

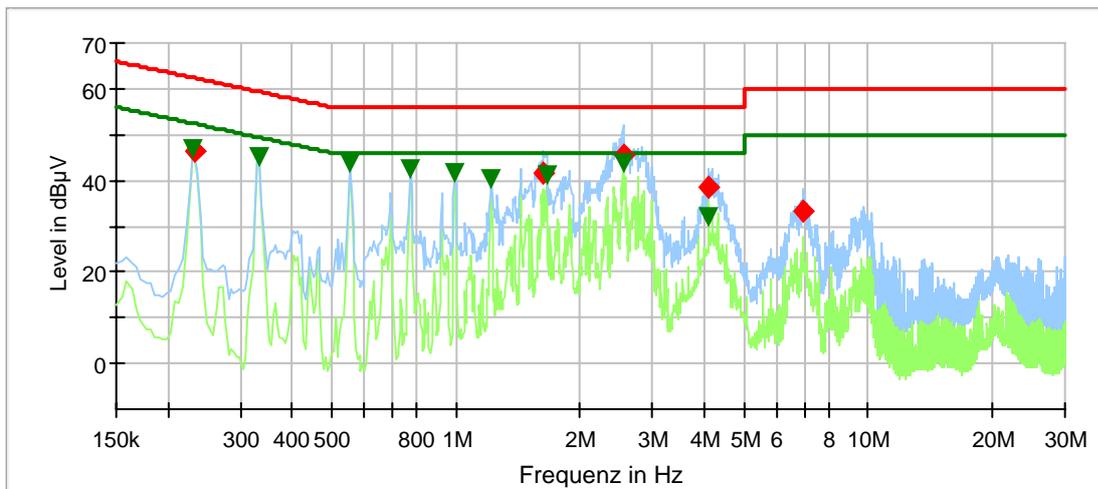
5.2 Conducted Emissions DC Mains Port

Test setup: Table setup according to [BS1].
A photo of the test setup is shown below.



Measuring records: The measuring records are presented on the following page.

Test description: Conducted emission measurement
 EUT: R60 VDES Base station (S/N:100001)
 Manufacturer: Saab AB (publ) TransponderTech
 Operating conditions: LAN GPS RX TX active RS 232 and RS 485 in loop
 Test site: Phoenix TESTLAB GmbH; Shielded room M4
 Operator: Michael Dinter
 Comment: 25.09.2019 Main supply 24 V DC only



— Preview Result 2-AVG — Preview Result 1-PK+ — EN 55032 V B QP
— EN 55032 V B AV ◆ Final_Result QPK ▼ Final_Result AVG

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	PE	Corr. (dB)
0.231000	---	46.68	52.41	5.73	5000.0	9.000	+	FLO	9.9
0.231900	46.53	---	62.38	15.85	5000.0	9.000	-	GND	9.9
0.331800	---	45.02	49.41	4.39	5000.0	9.000	-	GND	9.9
0.553200	---	43.71	46.00	2.29	5000.0	9.000	+	FLO	9.9
0.774600	---	42.37	46.00	3.63	5000.0	9.000	-	FLO	9.9
0.995100	---	41.56	46.00	4.44	5000.0	9.000	-	GND	9.9
1.216500	---	40.44	46.00	5.56	5000.0	9.000	-	GND	9.9
1.629600	41.80	---	56.00	14.20	5000.0	9.000	-	GND	10.0
1.659300	---	41.24	46.00	4.76	5000.0	9.000	-	FLO	10.0
2.543100	---	43.57	46.00	2.43	5000.0	9.000	-	GND	10.2
2.549400	45.36	---	56.00	10.64	5000.0	9.000	-	FLO	10.2
4.098300	38.49	---	56.00	17.51	5000.0	9.000	-	GND	10.3
4.100100	---	32.03	46.00	13.97	5000.0	9.000	-	GND	10.3
6.941400	33.45	---	60.00	26.55	5000.0	9.000	-	GND	10.4

Measurement uncertainty ± 2.76 dB

Test equipment (please refer to chapter 6 for details)

10 - 20

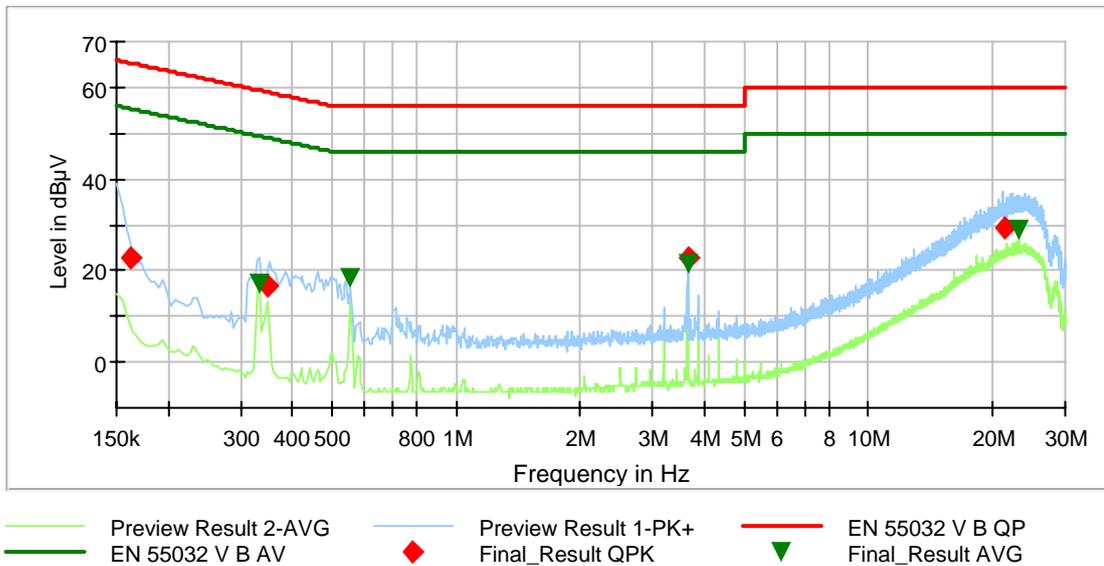
5.3 Conducted Emissions AC Mains Port

Test setup: Table setup according to [BS1].
A photo of the test setup is shown below.



Measuring records: The measuring records are presented on the following page.

Test description: Conducted emission measurement
 EUT: R60 VDES Base station (S/N:100002)
 Manufacturer: Saab AB (publ) TransponderTech
 Operating conditions: LAN GPS RX TX active RS 232 and RS 485 in loop
 Test site: Phoenix TESTLAB GmbH; Shielded room M4
 Operator: Michael Dinter
 Comment: 17.09.2019 Main supply 230 V AC / 24 V DC as redundancy supply



Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	PE	Corr. (dB)
0.162600	23.00	---	65.33	42.33	5000.0	9.000	L1	FLO	9.8
0.331800	---	17.32	49.41	32.09	5000.0	9.000	L1	FLO	9.9
0.350700	16.64	---	58.95	42.30	5000.0	9.000	L1	FLO	9.9
0.554100	---	18.52	46.00	27.48	5000.0	9.000	N	FLO	9.9
3.642900	22.70	---	56.00	33.30	5000.0	9.000	N	FLO	10.3
3.642900	---	21.53	46.00	24.47	5000.0	9.000	N	FLO	10.3
21.291900	29.22	---	60.00	30.78	5000.0	9.000	N	GND	11.0
23.128800	---	29.05	50.00	20.95	5000.0	9.000	L1	GND	10.9

Measurement uncertainty ± 2.76 dB

Test equipment (please refer to chapter 6 for details)
 10 – 18, 20

5.4 Conducted Emissions Wired Network Port(s)

Test setup:

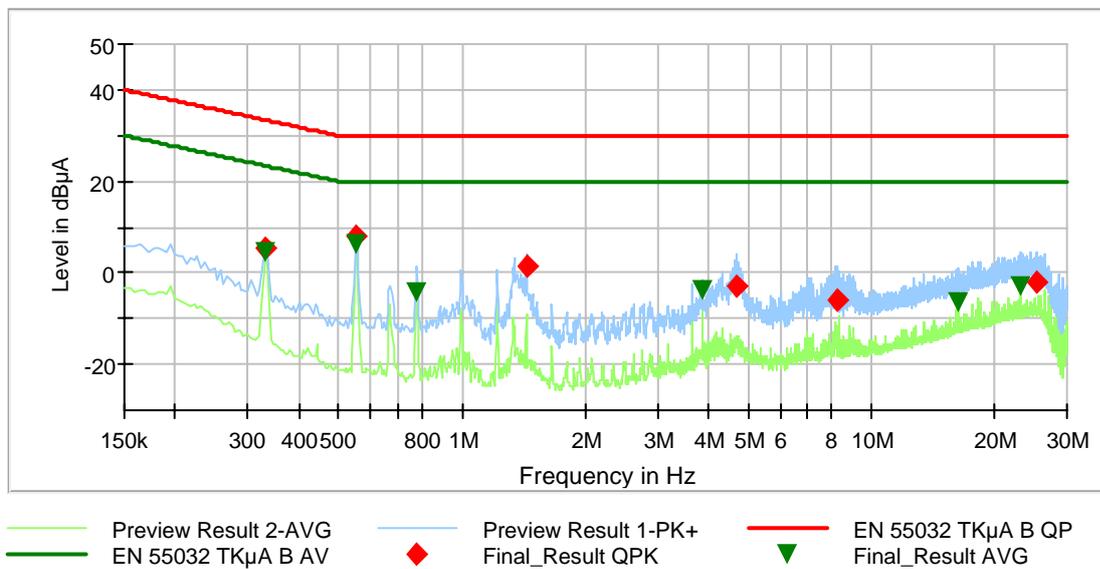
Table setup according to [BS1].
A photo of the test setup is shown below.



Measuring records:

The measuring records are presented on the following page.

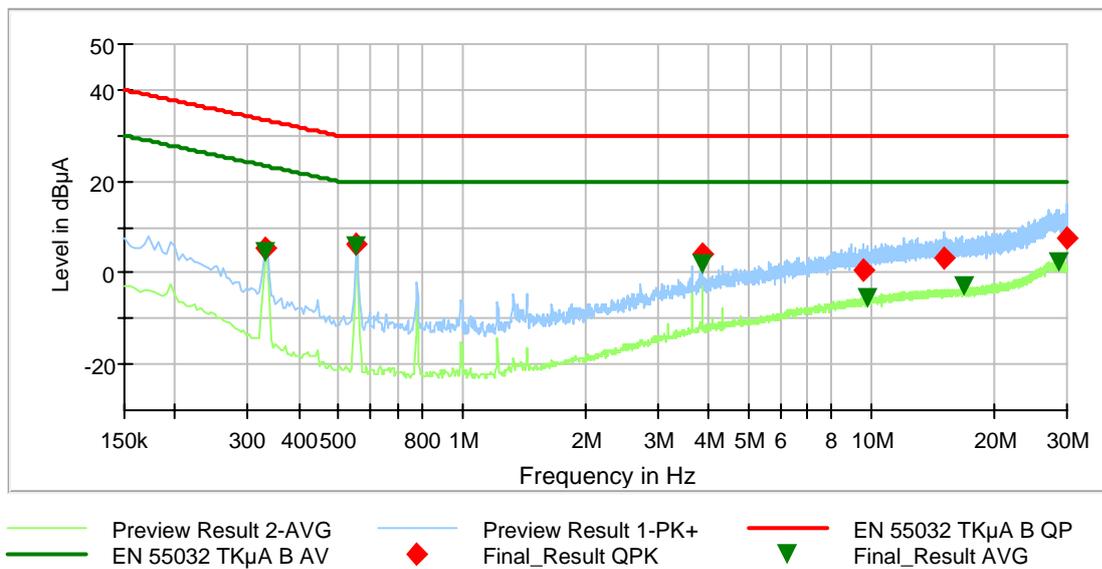
Test description: Conducted emission measurement at ETH1
 EUT: R60 VDES Base station (S/N:100002)
 Manufacturer: Saab AB (publ) TransponderTech
 Operating conditions: LAN GPS RX TX active RS 232 and RS 485 in loop
 Test site: Phoenix TESTLAB GmbH, shielded room M4
 Operator: M.DINTER
 Comment: 17.09.2019 Main supply 230 V AC / 24 V DC as redundancy supply



Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Corr. (dB)
0.331800	---	4.52	23.41	18.89	5000.0	9.000	-1.3
0.331800	5.49	---	33.41	27.92	5000.0	9.000	-1.3
0.553200	---	6.16	20.00	13.84	5000.0	9.000	-5.2
0.553200	7.92	---	30.00	22.08	5000.0	9.000	-5.2
0.774600	---	-4.08	20.00	24.08	5000.0	9.000	-6.6
1.438800	1.35	---	30.00	28.65	5000.0	9.000	-8.6
3.871500	---	-3.64	20.00	23.64	5000.0	9.000	-9.6
4.675200	-3.02	---	30.00	33.02	5000.0	9.000	-9.7
8.210400	-5.80	---	30.00	35.80	5000.0	9.000	-9.7
16.227600	---	-6.18	20.00	26.18	5000.0	9.000	-9.6
23.127900	---	-2.96	20.00	22.96	5000.0	9.000	-9.6
25.207800	-2.11	---	30.00	32.11	5000.0	9.000	-9.5

Measurement uncertainty ±2.86 dB

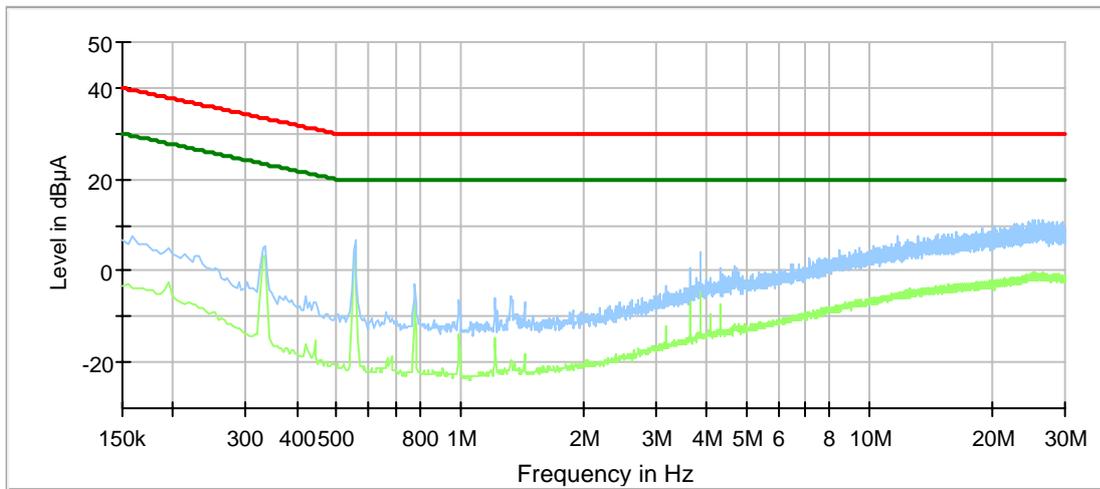
Test description: Conducted emission measurement at ETH2
 EUT: R60 VDES Base station (S/N:100002)
 Manufacturer: Saab AB (publ) TransponderTech
 Operating conditions: LAN GPS RX TX active RS 232 and RS 485 in loop
 Test site: Phoenix TESTLAB GmbH, shielded room M4
 Operator: M.DINTER
 Comment: 17.09.2019 Main supply 230 V AC / 24 V DC as redundancy supply



Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Corr. (dB)
0.331800	---	4.73	23.41	18.68	5000.0	9.000	-1.3
0.331800	5.49	---	33.41	27.92	5000.0	9.000	-1.3
0.553200	6.20	---	30.00	23.80	5000.0	9.000	-5.2
0.554100	---	5.78	20.00	14.22	5000.0	9.000	-5.2
3.870600	---	1.94	20.00	18.06	5000.0	9.000	-9.6
3.870600	4.13	---	30.00	25.87	5000.0	9.000	-9.6
9.583800	0.64	---	30.00	29.36	5000.0	9.000	-9.7
9.809700	---	-5.44	20.00	25.44	5000.0	9.000	-9.7
15.083700	3.01	---	30.00	26.99	5000.0	9.000	-9.6
16.874700	---	-2.72	20.00	22.72	5000.0	9.000	-9.6
28.530600	---	2.42	20.00	17.58	5000.0	9.000	-9.5
29.953500	7.65	---	30.00	22.35	5000.0	9.000	-9.5

Measurement uncertainty ±2.86 dB

Test description: Conducted emission measurement at ETH3
 EUT: R60 VDES Base station (S/N:100002)
 Manufacturer: Saab AB (publ) TransponderTech
 Operating conditions: LAN GPS RX TX active RS 232 and RS 485 in loop
 Test site: Phoenix TESTLAB GmbH, shielded room M4
 Operator: M.DINTER
 Comment: 17.09.2019 Main supply 230 V AC / 24 V DC as redundancy supply



— Preview Result 2-AVG — Preview Result 1-PK+ — EN 55032 TκµA B QP
— EN 55032 TκµA B AV ◆ Final_Result QPK ▼ Final_Result AVG

Remark: Plot is only for information because of the ETH3 is identical to ETH2. Therefore the spectrum but no final results were reported.

Test equipment (please refer to chapter 6 for details)
10 - 18, 20, 24

5.5 Harmonic Current Emissions

Test setup:

Test setup according to [BS2].
A photo of the test setup is shown below.



Note: The measurement was carried out according to class A requirements with sample (S/N:100002).

Measuring records: The measuring records are presented on the following page.

Maximum RMS current and corresponding values in timewindow 369:

Voltage: 230.91 Vrms THD=0.01 % THV=0.022 V POHV=0.011 V PWHD=0.03 %
 Current: 0.256 Arms THD=58.92 % THC=0.127 A POHC=0.011 A PWHD=65.41 %
 Power: 29.2 W P1=34.8 W 59.2 VA
 Power factor: 0.492 CosPhi: 0.700

Test conditions: EN 61000-3-2:2014, f=50 Hz, Phase=L1, Range=0.80 A
 Time window=10/12 (200ms), Grouping (>2nd harm.)=on
 No Ztest selected
 harmonic currents < 0.6% of I or < 5 mA are disregard for calc. of THD, THC, POHC, PWHD

HARMONIC ANALYSIS: Test PASS
 Tobs = entire measurement; POHC: avg=0.01 A, limits=0.25 A
 Iavg=0.252 Arms

Ha	Entire measurement (2.5 min = 750 time windows)							Worst 2.5 min		Average		P A S S	F A I L
	Maximum	Window	EN61000-3-2 Class A	Margin in MaxWin	100 to 150%	150 to 200%	Ex- ceeded	100 to 150%	Ex- ceeded	Value	Ex- ceeded		
DC	0.0162 A	599	-----	-----	0	0	0	n.e.	n.e.	0.0044 A	0	X	
1	0.2153 A	69	-----	-----	0	0	0	n.e.	n.e.	0.2126 A	0	X	
2	0.0117 A	719	1.0800 A	-98.9 %	0	0	0	n.e.	n.e.	0.0085 A	0	X	
3	0.1071 A	1	2.3000 A	-95.3 %	0	0	0	n.e.	n.e.	0.1053 A	0	X	
4	0.0091 A	319	0.4300 A	-97.9 %	0	0	0	n.e.	n.e.	0.0057 A	0	X	
5	0.0482 A	3	1.1400 A	-95.8 %	0	0	0	n.e.	n.e.	0.0474 A	0	X	
6	0.0121 A	669	0.3000 A	-96.0 %	0	0	0	n.e.	n.e.	0.0107 A	0	X	
7	0.0149 A	319	0.7700 A	-98.1 %	0	0	0	n.e.	n.e.	0.0141 A	0	X	
8	0.0099 A	158	0.2300 A	-95.7 %	0	0	0	n.e.	n.e.	0.0088 A	0	X	
9	0.0289 A	740	0.4000 A	-92.8 %	0	0	0	n.e.	n.e.	0.0284 A	0	X	
10	0.0035 A	158	0.1840 A	-98.1 %	0	0	0	n.e.	n.e.	0.0027 A	0	X	
11	0.0247 A	1	0.3300 A	-92.5 %	0	0	0	n.e.	n.e.	0.0242 A	0	X	
12	0.0094 A	707	0.1533 A	-93.9 %	0	0	0	n.e.	n.e.	0.0086 A	0	X	
13	0.0099 A	233	0.2100 A	-95.3 %	0	0	0	n.e.	n.e.	0.0097 A	0	X	
14	0.0102 A	706	0.1314 A	-92.2 %	0	0	0	n.e.	n.e.	0.0094 A	0	X	
15	0.0093 A	137	0.1500 A	-93.8 %	0	0	0	n.e.	n.e.	0.0088 A	0	X	
16	0.0042 A	619	0.1150 A	-96.3 %	0	0	0	n.e.	n.e.	0.0037 A	0	X	
17	0.0118 A	321	0.1324 A	-91.1 %	0	0	0	n.e.	n.e.	0.0113 A	0	X	
18	0.0071 A	706	0.1022 A	-93.0 %	0	0	0	n.e.	n.e.	0.0067 A	0	X	
19	0.0079 A	733	0.1184 A	-93.3 %	0	0	0	n.e.	n.e.	0.0077 A	0	X	
20	0.0102 A	706	0.0920 A	-88.9 %	0	0	0	n.e.	n.e.	0.0094 A	0	X	
21	0.0074 A	137	0.1071 A	-93.1 %	0	0	0	n.e.	n.e.	0.0070 A	0	X	
22	0.0058 A	706	0.0836 A	-93.1 %	0	0	0	n.e.	n.e.	0.0053 A	0	X	
23	0.0082 A	321	0.0978 A	-91.7 %	0	0	0	n.e.	n.e.	0.0075 A	0	X	
24	0.0048 A	666	0.0767 A	-93.7 %	0	0	0	n.e.	n.e.	0.0044 A	0	X	
25	0.0051 A	320	0.0900 A	-94.3 %	0	0	0	n.e.	n.e.	0.0047 A	0	X	
26	0.0090 A	706	0.0708 A	-87.2 %	0	0	0	n.e.	n.e.	0.0085 A	0	X	
27	0.0034 A	420	0.0833 A	-96.0 %	0	0	0	n.e.	n.e.	0.0030 A	0	X	
28	0.0069 A	706	0.0657 A	-89.4 %	0	0	0	n.e.	n.e.	0.0064 A	0	X	
29	0.0051 A	742	0.0776 A	-93.5 %	0	0	0	n.e.	n.e.	0.0043 A	0	X	
30	0.0032 A	101	0.0613 A	-94.8 %	0	0	0	n.e.	n.e.	0.0030 A	0	X	
31	0.0049 A	742	0.0726 A	-93.3 %	0	0	0	n.e.	n.e.	0.0043 A	0	X	
32	0.0073 A	6	0.0575 A	-87.2 %	0	0	0	n.e.	n.e.	0.0069 A	0	X	
33	0.0034 A	320	0.0682 A	-95.0 %	0	0	0	n.e.	n.e.	0.0032 A	0	X	
34	0.0072 A	6	0.0541 A	-86.6 %	0	0	0	n.e.	n.e.	0.0068 A	0	X	
35	0.0024 A	25	0.0643 A	-96.3 %	0	0	0	n.e.	n.e.	0.0019 A	0	X	
36	0.0036 A	16	0.0511 A	-92.9 %	0	0	0	n.e.	n.e.	0.0033 A	0	X	
37	0.0023 A	434	0.0608 A	-96.1 %	0	0	0	n.e.	n.e.	0.0018 A	0	X	
38	0.0056 A	5	0.0484 A	-88.4 %	0	0	0	n.e.	n.e.	0.0054 A	0	X	
39	0.0024 A	525	0.0577 A	-95.8 %	0	0	0	n.e.	n.e.	0.0022 A	0	X	
40	0.0068 A	4	0.0460 A	-85.1 %	0	0	0	n.e.	n.e.	0.0065 A	0	X	

average value < 0.6% of Iavg or < 5 mA n.e. = not evaluated

Tested with SPS EMC 41.10 / PAS10000 by Spitzenberger & Spies GmbH & Co. KG, Schmidstr. 32-34, 94234 Viechtach, Germany, 17.09.2019

Test equipment (please refer to chapter 6 for details)
 21 - 23

5.6 Voltage Fluctuations and Flicker

Test setup: Test setup according to [BS3].
A photo of the test setup is shown below.



Note: The measurement was carried with sample (S/N:100002).

Measuring records: The measuring records are presented on the following page.

Test conditions: EN 61000-3-3:2013 / 230 V / 50 Hz / Phase L1
 EN 61000-4-15:2011 / Obs 1 x 10 min / Ztest (0.400+j0.250) Ohm
 Ra+jXa (0.2400+j0.1500) Ohm/ Rn+jXn (0.1600+j0.1000) Ohm

FLICKER: Test PASS!

Time	Pmax	Pst	Sliding Plt	Tmax[s]	dmax[%]	dc [%]	PASS	FAIL
13:49:47	0.019	0.0990	- . - . - . - .	0.000	+0.000	- . - . - .	X	
Limits:		1.000	0.650	0.500	4.000	3.300		
Plt: 0.099000							X	
Evaluated: PST, PLT, Sliding PLT, dc, dmax, Tmax								

FLICKER: Source test PASS!

Time	Pmax	Pst	Sliding Plt	Tmax[s]	dmax[%]	dc [%]	PASS	FAIL
13:49:47	0.000	0.0040	- . - . - . - .	0.000	+0.000	- . - . - .	X	
Plt: 0.004000								
Evaluated: PST <= 0.4 dmax < 20 % dmax1								

Tested with SPS EMC 4.1.10 / PAS10000 by Spitzenberger & Spies GmbH & Co. KG, Schmidstr. 32-34, 94284 Viechtach, Germany, 17.09.2019

Test equipment (please refer to chapter 6 for details)

21 - 23

5.7 Radio-Frequency Electromagnetic Field

Test setup: Table setup according to [BS5].
The transmitting antenna is set at 1.5 m above the floor.
Photos of the test setup are shown below.



Measuring records: The measuring records are presented on the following page.

Date of test: 13.09.2019			
Ambient conditions: 22 °C, 67 % F _{rel} ; Air pressure conforms to the requirements of the standard			
Test level: 80 - 6000 MHz; 3 V/m; 80% AM (1 kHz)			
Increment: log 1%			
Dwell time: 2 s			
Distance antenna - EUT: 3 m			
Polarisation	Radiation direction	EUT reaction	Result
Vertical	0°	None detected.	Passed
	90°	None detected.	Passed
	180°	None detected.	Passed
	270°	None detected.	Passed
Horizontal	0°	None detected.	Passed
	90°	None detected.	Passed
	180°	None detected.	Passed
	270°	None detected.	Passed

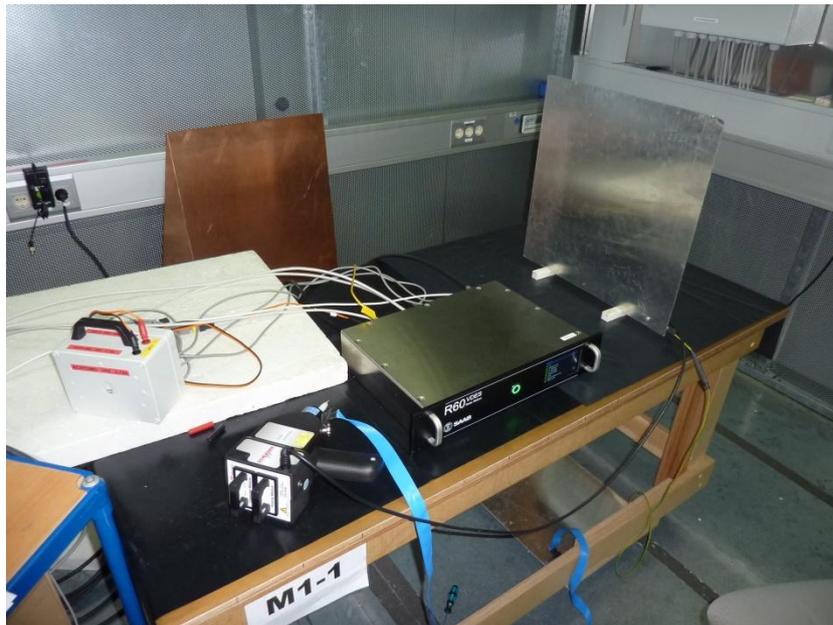
Note: The test was carried with sample (S/N:100002).

Test equipment (please refer to chapter 6 for details)
4 - 7, 12, 25 - 37

5.8 Electrostatic Discharge (ESD)

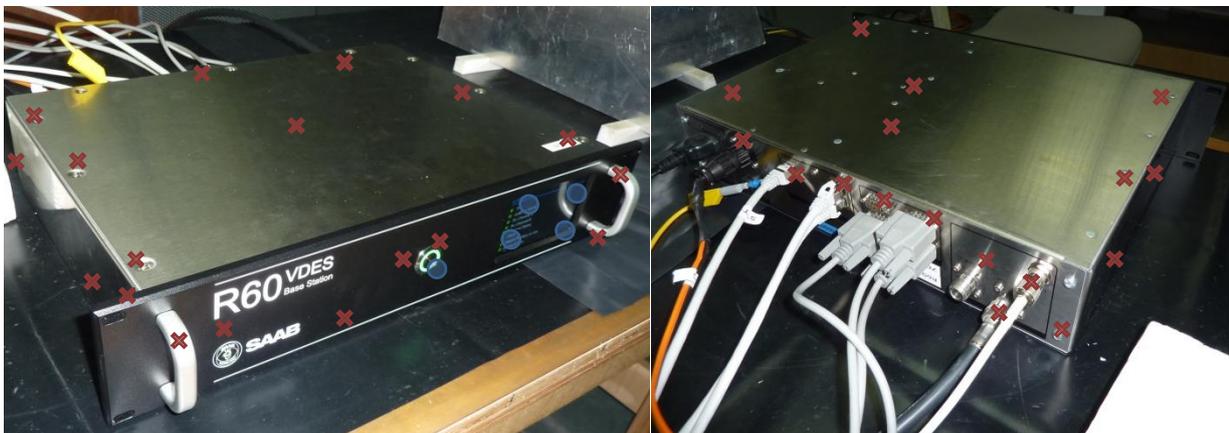
Test setup:

Table setup according to [BS4].
A photo of the test setup is shown below.



Test plan:

- Indirect discharge (ID) is carried out on the horizontal (HCP) and vertical (VCP) coupling plane, in case the housing of the EUT is made of insulating materials.
- Contact discharge (✕) is carried out on the conductive parts of the EUT.
- Air discharge (⊙) is carried out on isolating parts of the EUT.
- The discharge locations can be seen on the following figure(s).



Measuring records:

The measuring records are presented on the following page.

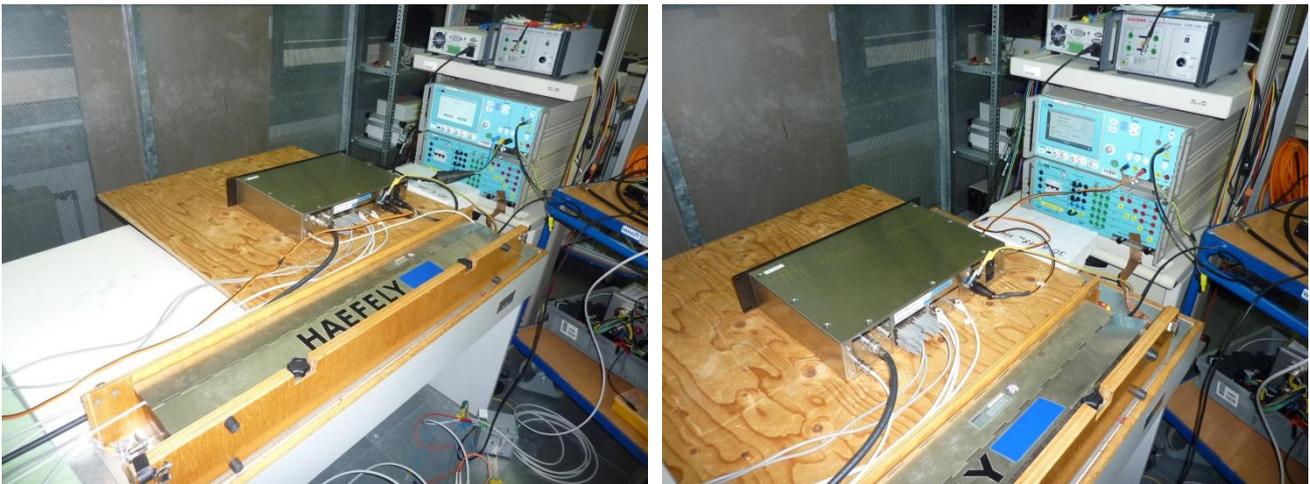
Date of test:		25.09.2019	
Ambient conditions:		22 °C, 49 % F _{rel} ; Air pressure conforms to the requirements of the standard	
Number of impulses:		10 per polarity, test voltage and discharge location	
Method of discharge	Discharge location	EUT reaction	Result
Indirect coupling ± 4 kV	HCP / VCP	None detected.	Passed
Contact discharge ± 4 kV	CD	None detected.	Passed
Air discharge ± 2 kV	AD	None detected.	Passed
Air discharge ± 4 kV	AD	None detected.	Passed
Air discharge ± 8 kV	AD	None detected.	Passed

Note: The measurement was carried with sample (S/N:100001).

Test equipment (please refer to chapter 6 for details)
38

5.9 Electrical fast Transients / Bursts

Test setup: Table setup according to [BS6].
The EUT is placed 10 cm above the ground plane.
A photo of the test setup is shown below.



Measuring records: The measuring records are presented on the following page.

Date of test:	24.09.2019			
Ambient conditions:	22 °C, 56 % F _{rel} ; air pressure conforms to the requirements of the standard			
Test duration:	60 s per polarity, test voltage and line			
Burst frequency:	5 kHz			
Method of coupling	Coupling to	Test voltage	EUT reaction	Result
CDN	230 V AC Mains	± 1 kV	None detected.	Passed
CDN	24 V DC	± 0.5 kV	None detected.	Passed
Clamp	RS232	± 0.5 kV	None detected.	Passed
Clamp	RS485	± 0.5 kV	None detected.	Passed
Clamp	HOT-STB	± 0.5 kV	None detected.	Passed
Clamp	ETH1	± 0.5 kV	None detected.	Passed
Clamp	ETH3	± 0.5 kV	None detected.	Passed
Clamp	GNSS Antenna	± 0.5 kV	None detected.	Passed
Clamp	VHF Antenna	± 0.5 kV	None detected.	Passed

Note: The test was carried with sample (S/N:100001).

Test equipment (please refer to chapter 6 for details)

39 - 40

5.10 Radio-Frequency common Mode

Test setup:

Table setup according to [BS8].
The EUT is placed 10 cm above the ground plane.
A photo of the test setup is shown below.



Measuring records:

The measuring records are presented on the following page.

Date of test: 24.09.2019				
Ambient conditions: 22 °C, 56 % F _{rel} ; Air pressure conforms to the requirements of the standard				
Test level: 150 kHz - 80 MHz, 3 V, 80% AM (1 kHz)				
Increment: log 1%				
Dwell time: 2 s				
CDN for coupling	CDN for 50 Ω termination	Coupling to connection	EUT reaction	Result
M2M3 A	M1	230 V AC Mains	None detected.	Passed
M2	M1	24 V DC *1	None detected.	Passed
S9	M1	RS232	None detected.	Passed
S9	M1	RS485	None detected.	Passed
S9	M1	HOT-STB	None detected.	Passed
ETH A	M1	ETH1	None detected.	Passed
ETH B	M1	ETH3	None detected.	Passed
S1 A	M1	GNSS Antenna	None detected.	Passed
S1 B	M1	VHF Antenna	None detected.	Passed

Remark *1: During this test the AC power supply was disconnected so that the EUT was DC powered only.

Note: The test was carried with sample (S/N:100001).

Test equipment (please refer to chapter 6 for details)
13, 15 - 20, 41 - 52

5.11 Voltage Dips and Interruptions

Test setup:

Table setup according to [BS9].
A photo of the test setup is shown below.



Measuring records:

The measuring records are presented on the following page.

Date of test: 17.09.2019			
Ambient conditions: 22 °C, 47 % F _{rel} ; the air pressure conforms to the requirements of the standard			
Tested frequencies: 50 Hz			
Variation	Test level	EUT reaction	Result
Voltage dips	0% for 0.5 periods	None detected.	Passed
Voltage dips	0% for 1 period	None detected.	Passed
Voltage dips	70% for 25 periods	None detected.	Passed
Voltage variations	0% for 250 periods	None detected with fall back DC connection. Without DC connection the EUT turns off and restarts automatically.	Passed

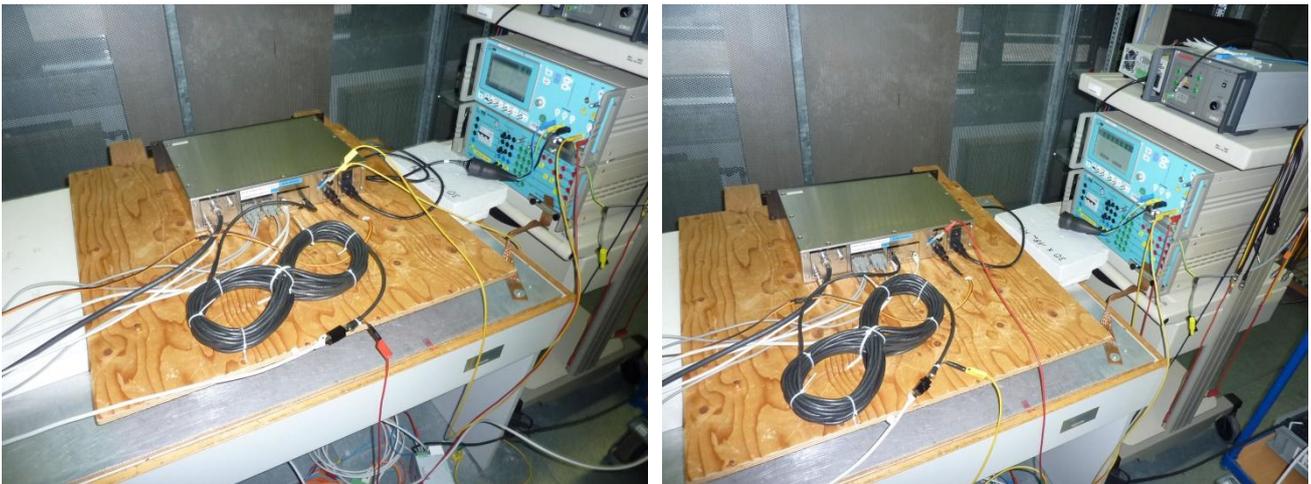
Note: The test was carried with sample (S/N:100002).

Test equipment (please refer to chapter 6 for details)
21 - 22, 53

5.12 Surges

Test setup:

Table setup according to [BS7].
The EUT is placed 10 cm above the ground plane.
A photo of the test setup is shown below.



Measuring records:

The measuring records are presented on the following page.

Date of test: 25.09.2019				
Ambient conditions: 22 °C, 59 % Frel; air pressure conforms to the requirements of the standard				
Test duration: 5 impulses per polarity, test voltage and line				
Pulse interruptions: 60 s				
Method of coupling	Coupling to	Test voltage	EUT reaction	Result
CDN (2 Ω, 18 μF line to line; 12 Ω, 9 μF, line to earth)	230 V AC Mains	± 0.5 kV line to line and line to earth	None detected.	Passed
		± 1.0 kV line to line and line to earth	None detected.	Passed
		± 2.0 kV line to earth	None detected.	Passed
CDN (2 Ω, 18 μF direct)	ETH 3	± 0.5 kV line to earth	None detected.	Passed
		± 1.0 kV line to earth	None detected.	Passed
CDN (2 Ω, 18 μF direct)	ETH 3	± 0.5 kV line to earth	None detected.	Passed
		± 1.0 kV line to earth	None detected.	Passed

Note: The test was carried with sample (S/N:100001).

Test equipment (please refer to chapter 6 for details)
39

6 Test Equipment used for Tests

No.	Test equipment	Type	Manufacturer	Serial No.	PM. No.	Cal. Date	Cal Due
1	Antenna (Bilog)	CBL6112B	Schaffner EMV GmbH (-Chase)	2688	480328	19.06.2017	06.2020
2	Antenna (Horn)	3115	EMCO Elektronik GmbH	9609-4918	480183	05.02.2018	02.2021
3	EMI Receiver / Spectrum Analyser	ESW44	Rohde & Schwarz	101635	482467	29.03.2018	03.2020
4	Fully anechoic chamber M20	B83117-E2439-T232	Albatross Projects	103	480303	Calibration not necessary	
5	Turntable	DS420 HE	Deisel	420/620/00	480315	Calibration not necessary	
6	Antenna support	AS620P	Deisel	620/375	480325	Calibration not necessary	
7	Multiple Control Unit	MCU	Maturo GmbH	MCU/043/971107	480832	Calibration not necessary	
8	Software	WMS32	Rohde & Schwarz		481800	Calibration not necessary	
9	RF-Cable No. 36	Sucoflex 106B	Suhner	500213/6B	482325	Calibration not necessary	
10	Transient Filter Limiter	CFL 9206A	Teseq GmbH	38268	481982	14.03.2018	03.2020
11	EMI Receiver / Spectrum Analyser	ESIB 26	Rohde & Schwarz	100292	481182	28.02.2018	02.2020
12	Software	EMC32	Rohde & Schwarz	100061	481022	Calibration not necessary	
13	Shielded chamber M4	B83117-S1-X158	Siemens	190075	480088	Calibration not necessary	
14	LISN	NSLK8128	Schwarzbeck	8128155	480058	14.03.2018	03.2020
15	Coupling / Decoupling Network	CDN 801-M2/M3	Lüthi	9450191	410038	Calibration not necessary	
16	Coupling / Decoupling network	CDN EMV-ETH S A	PHOENIX TESTLAB	-	480448	Calibration not necessary	
17	Coupling / Decoupling Network	CDN 801-S1 A	PHOENIX TESTLAB GmbH	-	410172	Calibration not necessary	
18	Coupling / Decoupling network	CDN EMV-ETH S B	PHOENIX TESTLAB	-	480449	Calibration not necessary	
19	Power probe	URV5-Z2 (10V 50Ohm)	Rohde & Schwarz	833196/036	480019	28.02.2018	02.2020
20	Coupling / Decoupling Network	CDN S10 A	PHOENIX TESTLAB GmbH	-	410199	Calibration not necessary	
21	Software	Software	Spitzenberger & Spies	-	480114	Calibration not necessary	
22	EMC test system	EMC D 30000 / PAS	Spitzenberger & Spies	A4507 00/1 1110	481301	Calibration not necessary	
23	Analyzer reference system	ARS 16/3	Spitzenberger/ BoConsult	A4507 07/0 1110	481303	12.06.2018	06.2020
24	Current Probe	EZ17	Rohde & Schwarz	846694/003	480238	Calibration not necessary	
25	Antenna (Horn)	BBHA 9120E	Schwarzbeck	131	480335	Calibration not necessary	
26	Antenna (Horn)	3115 C	EMCO Elektronik GmbH	6761	480368	12.12.2016	12.2019
27	Power amplifier 1 - 6 GHz	BLMA 1060-150	BONN Elektronik GmbH	1610775	482320	Calibration not necessary	

No.	Test equipment	Type	Manufacturer	Serial No.	PM. No.	Cal. Date	Cal Due
28	Directional coupler	AR DC6100	Amplifier Research	13027	480107	Calibration not necessary	
29	Field sensor	03006970	Dare Development	SN0-03	480460	Calibration not necessary	
30	Power amplifier	AR 150W1000	Amplifier Research	308331	480419	Calibration not necessary	
31	Antenna	HL046	Rohde & Schwarz	100013	480429	Calibration not necessary	
32	Relay switch unit	RSU	Rohde & Schwarz	338221/011	480175	Calibration not necessary	
33	Relays switching unit	KRE-3000	MTS Systemtechnik	280943-001-0010	480993	Calibration not necessary	
34	Signal Generator	SMB100A	Rohde & Schwarz	113140	482190	28.02.2018	02.2020
35	Power Meter	NRP2	Rohde & Schwarz	105219	482263	02.03.2018	03.2020
36	AVG Power Sensor	NRP-Z91	Rohde & Schwarz	103574	482279	27.02.2018	02.2020
37	AVG Power Sensor	NRP-Z91	Rohde & Schwarz	103573	482280	27.02.2018	02.2020
38	ESD Generator	SESD 30000	Schlöder GmbH	701186	480657	Calibration not necessary	
39	Combined generator burst / surge	IMU 4000 F/S	H+H High Voltage Technology	106754-2028	482891	Calibration not necessary	
40	Coupling clamp	IP4A	Haefely	082 672-02	480030	Calibration not necessary	
41	Decoupling clamp	FTC 101	Lüthi	4496	480172	Calibration not necessary	
42	Attenuator	BN745382	Spinner GmbH	20822	410061	Calibration not necessary	
43	Millivoltmeter	URV5	Rohde & Schwarz	833770/015	480015	28.02.2018	02.2020
44	ICS Relay Interface	4874		311084	480066	Calibration not necessary	
45	Directional coupler	DC 3400A	Amplifier Research	309723	480458	Calibration not necessary	
46	Power amplifier	AR 75A400	Amplifier Research	310618	480459	Calibration not necessary	
47	Signal generator	SMY 01	Rohde & Schwarz	835984/020	580010	28.02.2018	02.2020
48	Power probe	URV5-Z2 (10V 50Ohm)	Rohde & Schwarz	833196/037	480020	28.02.2018	02.2020
49	Coupling / Decoupling Network	CDN 801-M2 A	PHOENIX TESTLAB GmbH	-	410073	Calibration not necessary	
50	Coupling / Decoupling Network	M1-801/6A	Schaffner MEB	10189	410035	Calibration not necessary	
51	Coupling / Decoupling Network	CDN 801-S1 B	PHOENIX TESTLAB GmbH	-	410173	Calibration not necessary	
52	Coupling / Decoupling Network	CDN 801-S9B	Lüthi	9450188	410040	Calibration not necessary	
53	Contol unit	SyCore 1k4	Spitzenberger & Spies	A4507 12/0 1110	481302	Calibration not necessary	

7 Report History

Report Number	Date	Comment
F190480E2	30.10.2019	Initial Test Report

8 List of Annexes

Annex A

EUT Photos

6 pages