TEST REPORT # EMCC-170518A, 2017-04-18

EQUIPMENT UNDER TEST:

Device:	HPA-8000B-54
Serial Number:	17030143
Application:	Amplifier
Manufacturer:	Hilberling GmbH
Address:	Heinrich-Hertz-Str. 2 24790 Schacht-Audorf Deutschland
Phone:	+49 4331 20171-11
Email:	jhauschildt@hilberling.de

RELEVANT STANDARD(S): 47 CFR §§ 15.107, 15.109, 97.307, 97.317

MEASUREMENT PROCEDURE:

☒ ANSI C63.4-2014 ☐ RSS-Gen Issue 4 ☐ Other

TEST REPORT PREPARED BY:

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TEST PERSONNEL:

Daniel Mayle

HEAD OF COMMERCIAL EMC AND RADIO DEPT.:

Wolfgang Döring

CONTENTS

1 GENERAL INFORMATION

1.1 Purpose

The purpose of this report is to show compliance with the 47 CFR §97.307 and §97.317 requirements for the certification of external RF amplifiers operating in the amateur radio service. The further intention is to show compliance of licence-exempt 15B Unintentional Radiators with 47 CFR §15.107 and §15.109.

1.2 Limits and Reservations

The test results in this report apply only to the particular equipment under test (EUT) as declared in this report. This test report shall not be reproduced except in full without the written permission of EMCCons DR. RAŠEK GmbH & Co. KG.

1.3 Test Location

Test Laboratory:	EMCCons DR. RAŠEK GmbH & Co. KG
Accreditation No.:	D-PL-12067-01-02
Address of Labs I, II, III and Head Office:	EMCCons DR. RAŠEK GmbH & Co. KG Boelwiese 8 91320 Ebermannstadt GERMANY
Address of Labs IV and V:	EMCCons DR. RAŠEK GmbH & Co. KG Stoernhofer Berg 15 91364 Unterleinleiter GERMANY
Laboratory:	Test Laboratory IV The 3 m & 10 m semi-anechoic chamber site has been fully described in a report submitted to the FCC and accepted in the letter dated December 23, 2016, Registration Number 878769.
Phone:	+49 9194 7262-0
Fax:	+49 9194 7262-199
E-Mail:	emc.cons@emcc.de
Web:	www.emcc.de

1.4 Manufacturer

Company Name:	Hilberling GmbH
Street:	Heinrich-Hertz-Str. 2
City:	24790 Schacht-Audorf
Country:	Deutschland

1.5 Applicant

Company Name:	Hilberling GmbH
Street:	Heinrich-Hertz-Str. 2
City:	24790 Schacht-Audorf
Country:	Deutschland
Name for contact purposes:	Mr Jan Hauschildt
Phone:	+49 4331 20171-11
E-Mail:	jhauschildt@hilberling.de

1.6 Dates and Test Location

Date of Receipt of EUT:	2017-03-28
Test Date:	CW 13, 2017-03-28/29
Test Location:	Lab IV

1.7 Ordering Information

Purchase Order and Date:	B 002.016032017UI, 2017-03-16
Vendor Number:	none

1.8 Climatic Conditions

Date	Temperature [°C]	Relative Humidity [%]	Air Pressure [hPa]	Lab	Customer attended tests
2017-03-28	23	28	982	IV	Yes, Mr Hauschildt
2017-03-29	23	32	984	IV	Yes, Mr Hauschildt

2 PRODUCT DESCRIPTION

2.1 Equipment Under Test (EUT)

Trade Name:	HPA-8000B-54
Serial Number:	17030143
Software Version:	V 01.10 0027
Hardware Revision:	1.20
Application:	Amplifier
Power Supply:	200-260 VAC, 50-60 Hz
Highest internally generated or used frequency:	54 MHz
Ports:	1x AC power input 4x RF input transceiver, female N 4x RF output antenna 1-4, female N 2x PTT, RCA 2x ALC, RCA 2x ALC adjust, potentiometer 2x AUX transceiver1/2, DE-9 2x REMOTE transceiver1/2, DB-25 1x predistortion, SMA 1x REMOTE PC, USB-B 1x chassis ground, #6 screw
Accessories delivered with EUT:	Data cables D-Sub 9-pin Data cables D-Sub 25-pin operating manual Software CD-ROM
Variants:	None
Remarks:	None

For further information concerning port description see Annex 4.

2.2 Intended Use

The following information was delivered by the customer:

Product description (description of equipment function):
Amplifier for amateur radio service

General product information:

The following information was taken out of user´s manual delivered by the customer.

Tab. A1-1: Technical Data

Output Power (FM / AM / SSB / CW)	1 kW
Add. PA Output (Predistortion Feedback Channel)	–60 dBc ATT.
Amateur Radio Bands	160 m – 6 m (1.8 – 54 MHz) s. Tab A2–2
Input Power	typ. 50 W / 1 kW RF Out
Transceiver Connectors	2
Antenna Connectors	4
Antenna Tuner fully automatic	1.8 – 29.7 MHz (max. SWR 3:1)
Remote Control by Transceiver (CAT)	• Band Switch • Frequency Display
CAT Interfaces	• RS232 • Band Data 4bit • CI-V • Band Voltage
Manual Control	• Band Buttons • PTT Input (RCA) • ALC Input (RCA)
PC Interface (Programming / Update)	USB / RS232
Protective circuits	• Overcurrent • SWR • Temperature • Input Power • Output Power
Power Supply	Internal Power Supply Unit 200 – 260 V / 50 – 60 Hz / 13 A
Dimensions	approx. 425 x 459 x 173 mm (W x D x H) (approx. 16.75 x 18.1 x 6.8")
Weight	19.8 kg (43.7 lbs)

Technical specs subject to change without notice

Tab. A1–2: Frequency Bands HF

Button	Band	Sign	Frequency Range		
1.8 1	160 m	MF	1.810[1] /1.800[2,3]	...	2.000 MHz
3.5 2	80 m	HF	3.500	...	3.800[1] / 4.000[2] / 3.900[3] MHz
7.0 3	40 m		7.000	...	7.200[1] / 7.300[2,3]MHz
10 4	30 m		10.100	...	10.150 MHz
14 5	20 m		14.000	...	14.350 MHz
18 6	17 m		18.068	...	18.168 MHz
21 7	15 m		21.000	...	21.450 MHz
24 8	12 m		24.890	...	24.990 MHz
28 9	10 m		28.000	...	29.700 MHz

[1] = IARU Region 1 [2] = IARU Region 2 [3] = IARU Region 3

Tab. A1–3: Frequency Band VHF

Button	Band	Sign	Frequency Range		
50 0 52 MHz	6 m	VHF	50.000	...	52.000[1] / 54.000[2,3] MHz

[1] = IARU Region 1 [2] = IARU Region 2 [3] = IARU Region 3

2.3 EUT Peripherals/Simulators

A Hilberling PT-8000A HF/VHF Transceiver, Serial No. 13110148, was used as exciter.

The following information was taken out of user´s manual delivered by the customer.

RX Double Super Heterodyne 1st IF 40.7 MHz and 2nd IF 10.7 MHz					
RX-Range MAIN/SUB	9 kHz ... 30 MHz / 50 ... 54 MHz / 69.9 ... 70.5 MHz / 144 ... 148 MHz / 110 ... 143.99 MHz				
Xtal-Filter 1st and 2nd IF (BW)	40.7 MHz (BW 50 kHz) ; 10.7 MHz (BW 0.5 ... 6 kHz / 15 kHz ; Option CW-BW 250 Hz)				
Sensitivity @ 10 dB S+N/N	AM	FM	SSB	CW	
9 kHz ... 1.8 MHz *	6 kHz / 2 µV	15 kHz / 0.5 µV	2.4 kHz / 1 µV	0.5 kHz / 0.5 µV	
1.8 ... 30 MHz	6 kHz / 1.2 µV	15 kHz / 0.18 µV	2.4 kHz / 0.25 µV	0.5 kHz / 0.1 µV	
50 ... 54 MHz	6 kHz / 1.0 µV	15 kHz / 0.16 µV	2.4 kHz / 0.25 µV	0.5 kHz / 0.1 µV	
69.9 ... 70.5 MHz	6 kHz / 1.0 µV	15 kHz / 0.16 µV	2.4 kHz / 0.24 µV	0.5 kHz / 0.09 µV	
144 ... 148 MHz	6 kHz / 1.0 µV	15 kHz / 0.15 µV	2.4 kHz / 0.24 µV	0.5 kHz / 0.09 µV	
110 ... 143,99 MHz *	6 kHz / 1.5 µV	15 kHz / 0.18 µV	2.4 kHz / 0.36 µV	0.5 kHz / 0.14 µV	
IMD DR3 @ 2 kHz (typ.) **	105 dB / 1,8 ... 30 MHz				
Blocking @ 100 kHz (typ.)	142 dB / 1,8 ... 30 MHz				
Image Rejection and Spurious	1.8 ... 30 MHz	50 ... 54 MHz	69.9... 70.5 MHz	144 ... 148 MHz	110 ... 143.99 MHz
Signal Suppression	> 98 dB	> 86 dB	> 121 dB	> 142 dB	> 104 dB
Digital Signal Processing (DSP)	variable bandwidth for 2nd IF 10.7 MHz Xtal filters; multiple automatic audio notch filtering; almost undistorted audio when engaging automatic noise reduction through enhanced algorithms				
IF Outputs BW 50 kHz	center frequencies: 40.7 MHz ; 10.7 MHz ; 60 kHz				
AF Output	4.8 Watt (2 x 2.4 Watt MAIN / SUB) ; additional speaker in HN-8000 connectable				
* technical specs in subareas not guaranteed ** 3rd Order Intermodulation Distortion Dynamic Range					
TX All-Mode					
Frequency Range	1.8 ... 30 MHz (160 / 80 / 60 / 40 / 30 / 20 / 17 / 15 / 12 / 10 m-Band)		50 ... 54 MHz / 69.9 ... 70.5 MHz / 144 ... 148 MHz (6 / 4 / 2 m-Band)		
Mode	AM / AME	SSB / CW / FM	AM / AME	SSB / CW / FM	
Output Power	50 Watt	200 Watt	25 Watt	100 Watt	
PA IMD3 @ 10,1 MHz (typ.) / PEP	50 W / ≥49 dB ; 100 W / ≥ 44 dB ; 200 W / ≥38 dB				
Carrier Suppression	SSB ≥70 dB / PEP				
Opposite Sideband Suppression	SSB ≥70 dB / @1 kHz				
FM Frequency Deviation	± 3 kHz FMN ; repeater operation with variable shift ±0 ... 2 MHz				
General					
Memory Channels	organized in 3 banks ; 99 channels each bank ; automatic scanning mode				
Frequency Stability	0.005 ppm from 10°C to 50°C ; reference clock adjustable ±1.5 ppm ; 10 MHz oven ; int/ext ; in/out				
Environmental Conditions	temperature range 10°C to 50°C (50°F ... 120°F) ; avoid high humidity (operating below dew point) and dusty operating conditions				
Antenna Connectors	N-type: 2 x HF 50 Ohm and 1 x VHF 50 Ohm ; BNC-type: 1 x HF RX 50 Ohm				
Dimensions (W x H x D)	approx. 425 mm x 175 mm x 465 mm				
Weight	approx. 28 kg (62 lbs.)				
HN-8000 Switching Power Supply for PT-8000A					
Mains / Power Requirement	AC 90 ... 260 V Power Factor Correction (PFC) / 12.5 Amp. / 50 ... 60 Hz				
Output	DC 13.8 V / 11 Amp. ; 50 V / 14 Amp. ; 13.8 V / 5 Amp. (AUX)				
Dimensions (W x H x D)	approx. 225 mm x 175 mm x 440 mm				
Weight	approx. 10 kg (22 lbs.)				
Accessories					
All Versions	Cable Set (AC, DC, Ground, Speaker)				
Ham Version	Desk Microphone T9 ; 600 Ohm @ 1kHz ; dynamic ; RFI-proof ; kidney-shaped acoustic response				
Specification Professional Version					
	TX-range according to customers specification ; extended temperature range ; UL-listed and more ; for additional information and special requirements please contact Hilberling GmbH				

Technical specs subject to change without notice

Tab. A3- 1

2.4 Mode of Operation During Testing and Test Setup

Test mode a:
The EUT was supplied with 220 VAC / 60 Hz and switched on. The terminals “TRX 1” and “RF output antenna 1” were terminated with 50 Ohms.

Terminal	Tested with
Power supply	220 VAC / 60 Hz
RF input	“TRX 1”, terminated with 50 Ohms
RF output	“RF output antenna 1”, terminated with 50 Ohms

Test mode b:
The EUT was supplied with 220 VAC / 60 Hz and switched on. The two (frequency dependent) input terminals were connected alternating via coaxial cable to exciter “Hilberling PT-8000A Transceiver”. The exciter provided the desired parameters. “RF output antenna 1” was connected to a dummy load.

Terminal	Tested with
Power supply	220 VAC / 60 Hz
RF input	“TRX1” for f < 29,7 MHz “VHF TRX1” for f > 29,7 MHz
RF output	“ANT1”, for all frequencies

2.5 Modifications Required for Compliance

The following modifications were applied to the EUT before all measurements reported in this document:

- Two (additional) Ferrites on display (data) line, Würth Elektronik ferrite type: 7427224
- Ferrite on display (power) line, Würth Elektronik ferrite type: 74270043
- Ferrite on USB-cable -> “REMOTE PC”, Würth Elektronik ferrite type: 74271112
- Ferrite on cable -> “AUX TRX1” (DE-9), Würth Elektronik ferrite type: 74271112
- Ferrite on cable -> “REMOTE TRX1” (DB-25), Würth Elektronik ferrite type:74271131

Refer to Annex 3 for detailed pictures of the modifications.

3 TEST RESULTS SUMMARY

Summary of test results for the following EUT:

Manufacturer: Hilberling GmbH
Device: HPA-8000B-54
Serial No: 17030143

Requirement	47 CFR Section	Report Section	Result
Conducted AC Power Line Emissions 150 kHz – 30 MHz	15.107(a)	4	Passed
Radiated Emissions 30 MHz – 1000 MHz	15.109(a)	5	Passed
Spurious Emissions & Gain	97.307(d), 97.317(a)	6	Passed

N.A. – not applicable; N.T. – Not tested acc. to applicant's order.

The client has made the determination that EUT Condition, Characterization, and Mode of Operation are representative of production units and meet the requirements of the specifications referenced herein.
Consistent with Industry practice, measurement and test equipment not directly involved in obtaining measurement results but having an impact on measurements (such as cable loss, antenna factors, etc.) are factored into the "Correction Factor" documented in certain test results. Instrumentation employed for testing meets tolerances consistent with known Industry Standards and Regulations.
The measurements contained in this report were made in accordance with the procedures described in ANSI C63.4-2014. All requirements were found to be within the limits outlined in this report.
The test results in this report apply only to the particular equipment under test (EUT) as declared in this report.

Test Personnel: Daniel Mayle
Issuance Date: 2017-04-18

4 POWER LINE CONDUCTED EMISSIONS TEST

Test Requirement: FCC 47 CFR, § 15.107
Test Procedure: ANSI C63.4-2014

4.1 Regulation

§ 15.107 Conducted limits

(a) Except for Class A digital devices, for equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 μH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the band edges.

Frequency of emission [MHz]	Conducted limit [dBμV]	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5–5	56	46
0.5-30	60	50

*Decreases with the logarithm of the frequency.

§ 15.3 Definitions

(i) Class B digital device. A digital device that is marketed for use in a residential environment notwithstanding use in commercial, business and industrial environments. Examples of such devices include, but are not limited to, personal computers, calculators, and similar electronic devices that are marketed for use by the general public.

4.2 Test Equipment

Type	Manufacturer/ Model No.	EMCC Ident No.	Last Calibration	Next Calibration
60-Hz-Converter	AEG / DAMK4/DAGK4	1	n.a.	n.a.
Pulse Limiter	R&S / ESH3-Z2	1519	2015-09	2017-09
V-LISN 50 ohms//(50 μH + 5 ohms)	R&S / ESH2-Z5	1901	2015-09	2017-09
EMI Test Receiver	R&S / ESU8	3846	2017-01	2018-01
Digital Multimeter	Agilent / U1241A	2717	2016-01	2018-01

4.3 Test Procedures

ANSI C63.4-2014, 7.2 Measurement requirements

Measured levels of ac power-line conducted emission shall be the radio-noise voltage from the voltage probe, where permitted, or across the 50 Ω LISN port (to which the EUT is connected), as terminated into a 50 Ω EMI receiver or spectrum analyzer. All radio-noise voltage and current measurements shall be made on each current-carrying conductor at the plug end of the EUT power cord or calibrated extension cord by the use of mating plugs and receptacles on the EUT and LISN, if used. The manufacturer shall test equipment with power cords that are normally supplied or recommended by the manufacturer and that have electrical and shielding characteristics that are the same as those cords normally supplied or recommended. For measurements using a LISN, the 50 Ω measuring port is terminated into a 50 Ω EMI receiver or spectrum analyzer. All other ports are terminated into 50 Ω loads. Figure 7 through Figure 9 and Figure 14 show typical test setups for ac power-line conducted emissions testing.

ANSI C63.4-2014, 6.3.2.2 Placement of tabletop EUTs

For tabletop systems, the EUT shall be centered laterally (left to right facing the tabletop) on the tabletop, and its rear shall be flush with the rear of the table. If the EUT is a stand-alone unit, its center shall be located over the center of the turntable.

ANSI C63.4-2014, 6.3.2.3 Placement of tabletop accessories/peripherals

a) Accessories/peripherals that are part of a system tested on a tabletop shall be placed in a test arrangement on one or both sides of the host with a 10 cm separation between the nearest points of the cabinets (see Figure 7). The rear of the host and accessories should be flush with the back of the supporting tabletop unless that would not be typical of normal use. If more than two accessories are present, then an equipment test arrangement should be chosen that maintains a spacing of 10 cm between cabinets unless the equipment is normally located closer together.
b) Multiple peripherals/accessories (more than two) may be distributed around the table as shown in Figure 7. If the EUT peripherals are designed to be stacked in typical use, then they shall be stacked for emission testing, occupying positions of peripheral 1 or peripheral 2. See Figure 7.
c) When there is only one peripheral, place the peripheral as shown in Figure 7 for peripheral 1.
d) Accessories that are typically table mounted because of cable length, such as ac power adapters providing dc power to the EUT, shall be mounted on the tabletop in a typical manner.
e) Accessories that are typically floor mounted shall occupy a floor position directly below the portion of the EUT to which they are typically connected. NOTE—The keyboard and mouse cables from the back of a personal computer (PC) should be routed along the side of the central processing unit (CPU) to gain maximum coupling between the CPU and the cables. f) Power accessories, such as ac power adapters that power other devices, shall be tested in the following manner:
1) Power accessories that are not the EUT: If the power accessory connects to a tabletop EUT having a power cord to the power accessory less than 80 cm in length, the power accessory is placed on the tabletop. If the EUT power cord to the power accessory is 80 cm or greater in length, then the power accessory is placed on the floor immediately under the EUT. If the power accessory plugs directly into the wall outlet, it shall be attached to the source of power on top of the ground plane and directly under the EUT with the EUT connected If the EUT power cord is less than 80 cm, then a nonconductive support for raising the power accessory is needed along with a short extension cord from the source of power to the raised power accessory.
[..]

4.4 Test Result

Mode: test mode a

Line: L			
Freq. [MHz]	**Detector**	**Result [dBµV]**	**Margin [dB]**
0.200	PK	45.60	18.0
0.250	PK	43.14	18.6
12.0	QP	26.44	33.6
12.0	AV	25.34	24.7
18.0	QP	43.0	17.0
18.0	AV	42.81	7.2

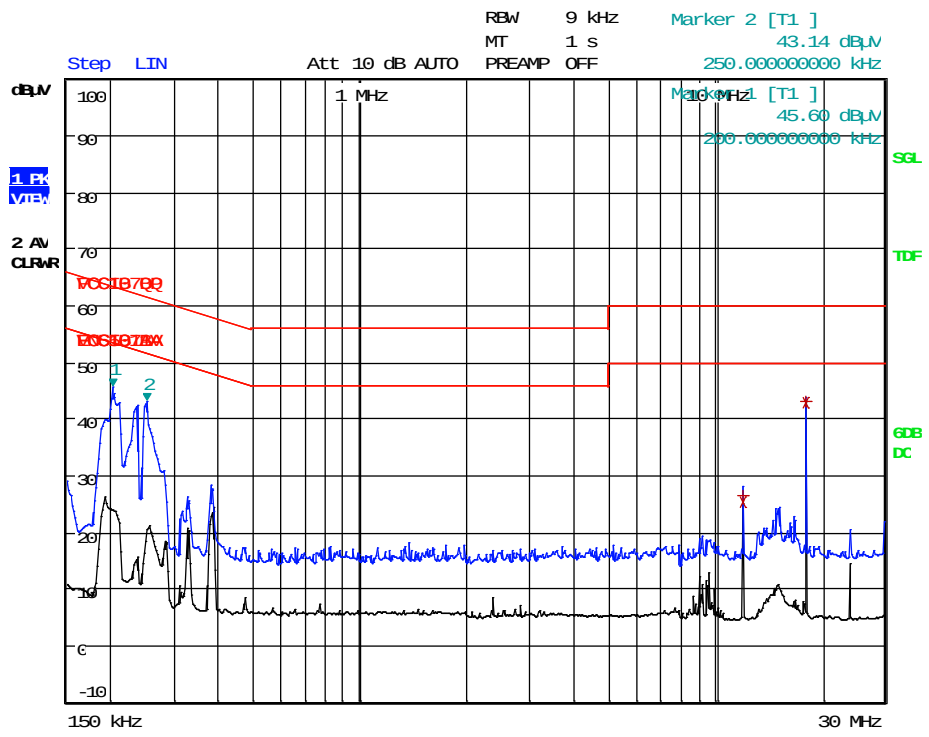
Line: N			
Freq. [MHz]	**Detector**	**Result [dBµV]**	**Margin [dB]**
0.200	PK	43.14	20.5
0.250	PK	43.18	18.0
12.0	QP	26.59	33.4
12.0	AV	25.55	24.5
18.0	QP	42.37	17.6
18.0	AV	42.15	7.9

The tables above contain worst-case emissions, only.

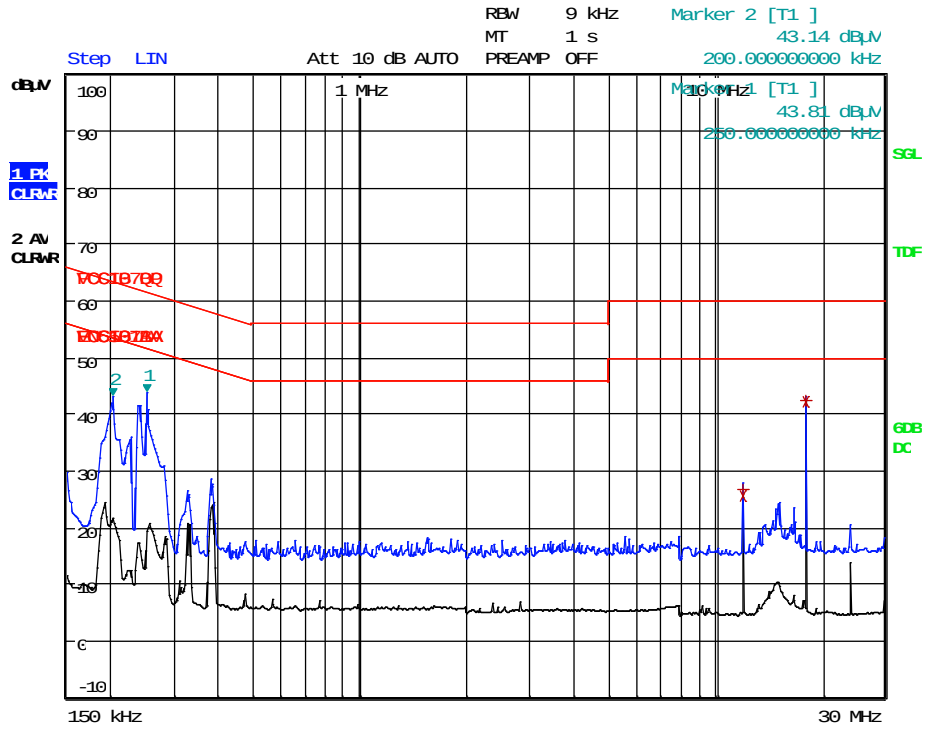
Manufacturer: Hilberling GmbH
Device: HPA-8000B-54
Serial No: 17030143
Test Date: 2017-03-28

The EUT meets the requirements of this section.

4.5 Measurement Plots



Mode: test mode a; 220V/60Hz; Line: L
Date: 2017-03-28



Mode: test mode a; 220V/60Hz; Line: N
Date: 2017-03-28

5 RADIATED EMISSIONS 30 MHz – 1000 MHz

Test Requirement: FCC 47 CFR, § 15.109
Test Procedure: ANSI C63.4-2014

5.1 Regulation

§ 15.109 Radiated emission limits

(a) Except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values:

Frequency of emission	Field strength
[MHz]	[microvolts/meter]
30-88	100
88-216	150
216-960	200
Above 960	500

(c) In the emission tables above, the tighter limit applies at the band edges. Sections 15.33 and 15.35 which specify the frequency range over which radiated emissions are to be measured and the detector functions and other measurement standards apply

§ 15.3 Definitions

(i) Class B digital device. A digital device that is marketed for use in a residential environment notwithstanding use in commercial, business and industrial environments. Examples of such devices include, but are not limited to, personal computers, calculators, and similar electronic devices that are marketed for use by the general public.

§ 15.33 Frequency range of radiated measurements

(b) For unintentional radiators:
(1) Except as otherwise indicated in paragraphs (b)(2) or (b)(3) of this section, for an unintentional radiator, including a digital device, the spectrum shall be investigated from the lowest radio frequency signal generated or used in the device, without going below the lowest frequency for which a radiated emission limit is specified, up to the frequency shown in the following table:
(3) Except for a CB receiver, a receiver employing superheterodyne techniques shall be investigated from 30 MHz up to at least the second harmonic of the highest local oscillator frequency generated in the device. If such receiver is controlled by a digital device, the frequency range shall be investigated up to the higher of the second harmonic of the highest local oscillator frequency generated in the device or the upper frequency of the measurement range specified for the digital device in paragraph (b)(1) of this section.

Highest frequency generated or used in the device or on which the device operates or tunes (MHz)	Upper frequency of measurement range (MHz)
Below 1.705	30.
1.705-108	1000.
108-500	2000.
500-1000	5000.
Above 1000	5th harmonic of the highest frequency or 40 GHz, whichever is lower.

§ 15.35 Measurement detector functions and bandwidths

The conducted and radiated emission limits shown in this part are based on the following, unless otherwise specified elsewhere in this part:
(a) On any frequency or frequencies below or equal to 1000 MHz, the limits shown are based on measuring equipment employing a CISPR quasi-peak detector function and related measurement bandwidths, unless otherwise specified. The specifications for the measuring instrument using the CISPR quasi-peak detector can be found in Publication 16 of the International Special Committee on Radio Interference (CISPR) of the International Electrotechnical Commission. As an alternative to CISPR quasi-peak measurements, the responsible party, at its option, may demonstrate compliance with the emission limits using measuring equipment employing a peak detector function, properly adjusted for such factors as pulse desensitization, as long as the same bandwidths as indicated for CISPR quasi-peak measurements are employed.
Note: For pulse modulated devices with a pulse-repetition frequency of 20 Hz or less and for which CISPR quasi-peak measurements are specified, compliance with the regulations shall be demonstrated using measuring equipment employing a peak detector function, properly adjusted for such factors as pulse desensitization, using the same measurement bandwidths that are indicated for CISPR quasi-peak measurements.

5.2 Test Equipment

Type	Manufacturer/ Model No.	EMCC Ident No.	Last Calibration	Next Calibration
VHF Test Dipole RX	Schwarzbeck / VHA 9103	899	2015-05	2017-05
Log Per. Antenna	Schwarzbeck / VUSLP 9111B	3203	2015-05	2017-05
Test Software	R&S / EMC32	5392	n.a.	n.a.
EMI Test Receiver	R&S / ESU8	3846	2017-01	2018-01
Digital Multimeter	Agilent / U1241A	2717	2016-01	2018-01

5.3 Test Procedures

ANSI C63.4-2014, 8.2.3 Electric field radiated emissions (30 MHz to 1 GHz)

Electric field measurements are made in the frequency range of 30 MHz to 1000 MHz using a calibrated linearly polarized antenna as specified in 4.5.4, which shall be positioned at the specified distance from the periphery of the EUT. The specified distance is the distance between the horizontal projection onto the ground plane of the closest periphery of the EUT and the projection onto the ground plane of the center of the axis of the elements of the receiving antenna. However, if the receiving antenna is an LPDA antenna, the specified distance shall be the distance between the closest periphery of the EUT and the front-to-back center (midpoint along boom/feeder transmission line) of the array of elements.
Measurements shall be made with the antenna positioned in both the horizontal and vertical planes of polarization. The measurement antenna shall be varied in height above the reference ground plane to obtain the maximum signal strength. Unless otherwise specified, the measurement distance shall be 3 m or 10 m. At either measurement distance, the antenna height shall be varied from 1 m to 4 m.
These height scans apply for both horizontal and vertical polarizations, except that for vertical polarization, the minimum height of the center of the antenna shall be increased so that the lowest point of the bottom of the lowest antenna element clears the site reference ground plane by at least 25 cm. For a tuned dipole, the minimum heights as measured from the center of the antenna are shown in Table D.3.

ANSI C63.4-2014, 8.3.1.1 Exploratory radiated emission measurements (9 kHz to 1 GHz)

a) Exploratory radiated measurements shall be performed at the measurement distance or at a closer distance than that specified for compliance to determine the emission characteristics of the EUT (see also 10.2.8 and Annex E) and recorded in tabular or graphical form. Significant emissions are identified using a remote-controlled turntable and antenna positioner and monitoring the spectrum while changing the EUT (turntable) azimuth, antenna polarity, and height. This spectrum exploratory monitoring can also be performed by manually moving the receiving antenna around the EUT to pick up significant emissions. A shielded room may be used for exploratory testing, but care must be taken to account for shielded room reflections that can lead to significant errors in amplitude measurements.
b) Broadband antennas and a spectrum analyzer or an EMI receiver with a panoramic display are most often used in this type of testing. It is recommended that either a headset or loudspeaker be connected as an aid in detecting ambient signals and finding frequencies of significant emission from the EUT when the exploratory and final testing is performed at an OATS with strong ambient signals. Caution should be taken if either antenna heights between 1 m and 4 m or EUT azimuth is not fully explored. Not fully exploring these parameters during exploratory testing may require complete testing at the OATS or semi-anechoic chamber when the final full spectrum testing is conducted.
c) The EUT should be set up in its typical configuration and arrangement and operated in its various modes. For tabletop systems, cables or wires not bundled in the initial setup shall be manipulated within the range of likely arrangements. For floor-standing equipment, the cables or wires should be located in the same manner as the user would install them and no further manipulation is made. For combination EUTs, the tabletop and floor-standing portions of the EUT shall follow the procedures for their respective setups and cable manipulation. If the manner of cable installation is not known, or if it changes with each installation, cables or wires for floor-standing equipment shall be manipulated to the extent possible to produce the maximum level of emissions.
d) Exploratory radiated emissions testing of handheld and/or body-worn devices shall include rotation of the EUT through three orthogonal axes to determine the orientation (attitude) that maximizes the emissions. Subclause 6.3.6 applies for exploratory radiated emissions testing of

ceiling-mounted devices. This equipment arrangement shall be used in the final measurements of radiated emission from the EUT.
e) For each mode of operation required to be tested, the frequency spectrum shall be monitored. Variations in antenna height between 1 m and 4 m, antenna polarization, EUT azimuth, and cable or wire placement (each variable within bounds specified elsewhere) shall be explored to produce the emission that has the highest amplitude relative to the limit. A suggested step-by-step technique for determining maximum radiated emission is given in Annex E.

ANSI C63.4-2014, 8.3.2.1 Final radiated emission measurements (9 kHz to 1 GHz)

Based on the exploratory radiated emissions measurement results (i.e., see 8.3.1.1), the single EUT, cable and wire arrangement, and mode of operation that produces the emission that has the highest amplitude relative to the limit are selected for the final measurement. The final measurements are then performed on a site meeting the requirements of 5.3 or 5.4, as appropriate. If the EUT is relocated from an exploratory test site to a final test site, the highest emission relative to the limit shall be remaximized at the final test location before final radiated emissions measurements are performed. However, antenna height and polarization and EUT azimuth are to be varied. In addition, the full frequency range to be checked for meeting compliance shall be investigated.
This investigation is performed with the EUT rotated 360°, the antenna height scanned between 1 m and 4 m, and the antenna rotated by 90° relative to the ground plane to repeat the measurements for both the horizontal and vertical antenna polarizations. During the full frequency range investigation, particular focus should be made on the frequencies found in exploratory testing that were used to find the final test configuration, mode of operation, and arrangement (associated with achieving the least margin with respect to the limit). This full range test constitutes the compliance measurement.

Radiated Emissions Test Characteristics	
Frequency range	30 MHz – 1000 MHz
Test distance	3 m
Test instrumentation resolution bandwidth	120 kHz
Receive antenna height	1 m - 4 m
Receive antenna polarization	Vertical/Horizontal

5.4 Calculation of Field Strength Limits

E.g. radiated emissions field strength limits for the frequency band 88 - 216 MHz:

150 µV/m at 3 meters

Using the equation:

$E_{dB\mu V/m} = 20 * \log (E_{\mu V/m})$

where

$E_{dB\mu V/m}$ = Field Strength in logarithmic units (dBµV/m)

$E_{\mu V/m}$ = Field Strength in linear units (µV/m)

A field strength limit of 150 µV/m corresponds with 43.5 dBµV/m.

5.5 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor. The basic equation with a sample calculation is as follows:

FS = RA + AF + CF
where
FS = Field Strength in dBµV/m
RA = Receiver Amplitude in dBµV
AF = Antenna Factor in dB(1/m)
CF = Cable Attenuation Factor in dB
Assume a receiver reading of 23.5 dBµV is obtained. The Antenna Factor of 7.4 dB(1/m) and a Cable Factor of 1.1 dB are added, giving a field strength of 32 dBµV/m. The 32 dBµV/m value can be mathematically converted to its corresponding level in µV/m.

FS = 23.5 + 7.4 + 1.1 = 32 [dBµV/m]

Level in µV/m = Common Antilogarithm (32/20) = 39.8

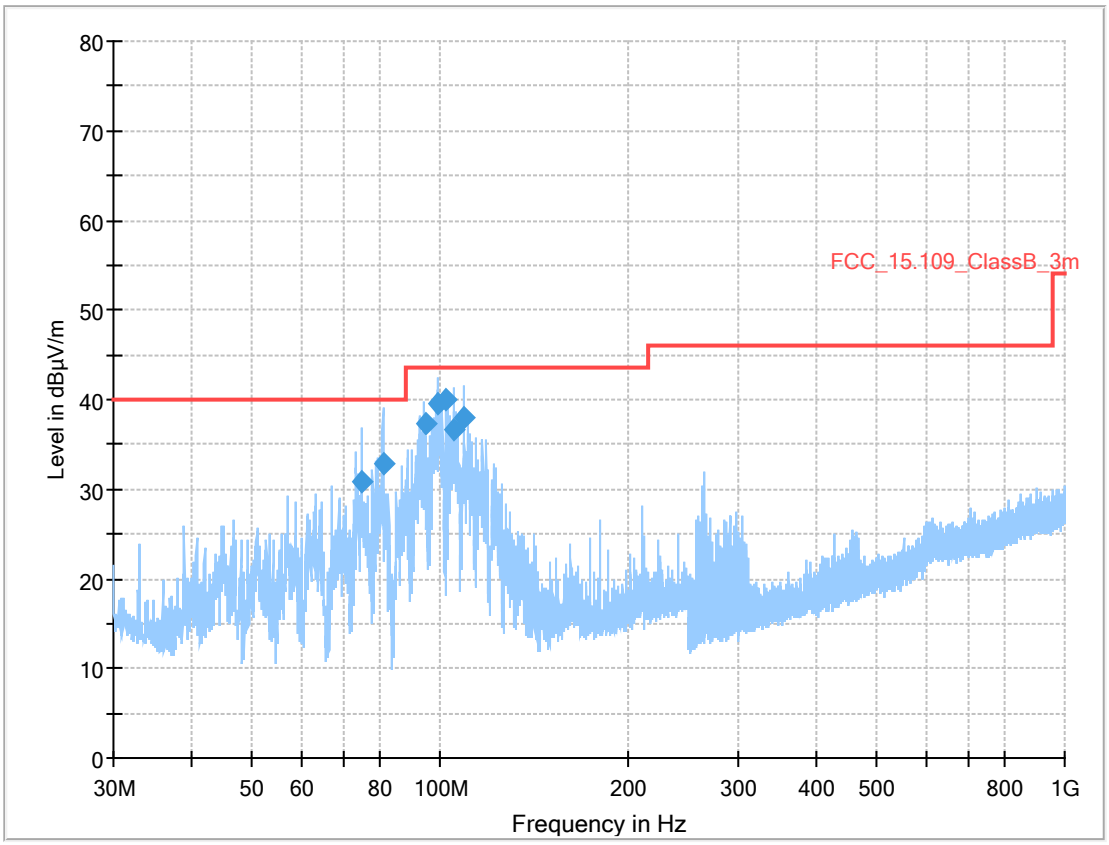
Using EMC32 software both corrections are combined in the Corr. Factor as listed in the results' table. "Result" represents the FS Result), "Corr." is the combined correction factor.
Receiver Amplitude (reading) is not listed separately.

5.6 Final Test Result

Mode: test mode a

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
75.020000	30.84	40.00	9.16	1000.0	120.000	100.1	V	28.0	9.5
81.020000	32.84	40.00	7.16	1000.0	120.000	100.2	V	21.0	9.7
94.780000	37.33	43.50	6.17	1000.0	120.000	129.7	V	-4.0	10.6
99.020000	39.51	43.50	3.99	1000.0	120.000	100.1	V	19.0	10.7
102.020000	40.10	43.50	3.40	1000.0	120.000	183.9	H	69.0	10.8
105.020000	36.64	43.50	6.86	1000.0	120.000	100.1	V	-162.0	10.9
109.220000	38.05	43.50	5.45	1000.0	120.000	180.0	H	54.0	11.0

All tests performed at 3 m distance. The table above contains worst-case emissions, only. For further details refer to the test plots.



Manufacturer:	Hilberling GmbH
Device:	HPA-8000B-54
Serial No:	17030143
Test Date:	2017-03-28

All measured emissions in the range 30 MHz to 1000 MHz are below the specified limits.

The EUT meets the requirements of this section.

6 SPURIOUS EMISSIONS & GAIN

Test Requirement: FCC 47 CFR, § 97.317(a) & § 97.317(b), § 97.307(d)

6.1 Regulation

§ 97.307 Emission standards.

(d) For transmitters installed after January 1, 2003, the mean power of any spurious emission from a station transmitter or external RF power amplifier transmitting on a frequency below 30 MHz must be at least 43 dB below the mean power of the fundamental emission. For transmitters installed on or before January 1, 2003, the mean power of any spurious emission from a station transmitter or external RF power amplifier transmitting on a frequency below 30 MHz must not exceed 50 mW and must be at least 40 dB below the mean power of the fundamental emission. For a transmitter of mean power less than 5 W installed on or before January 1, 2003, the attenuation must be at least 30 dB. A transmitter built before April 15, 1977, or first marketed before January 1, 1978, is exempt from this requirement.

§ 97.317 Standards for certification of external RF power amplifiers.

(a) To receive a grant of certification, the amplifier must:

(1) Satisfy the spurious emission standards of §97.307 (d) or (e) of this part, as applicable, when the amplifier is operated at the lesser of 1.5 kW PEP or its full output power and when the amplifier is placed in the “standby” or “off” positions while connected to the transmitter.

(2) Not be capable of amplifying the input RF power (driving signal) by more than 15 dB gain. Gain is defined as the ratio of the input RF power to the output RF power of the amplifier where both power measurements are expressed in peak envelope power or mean power.

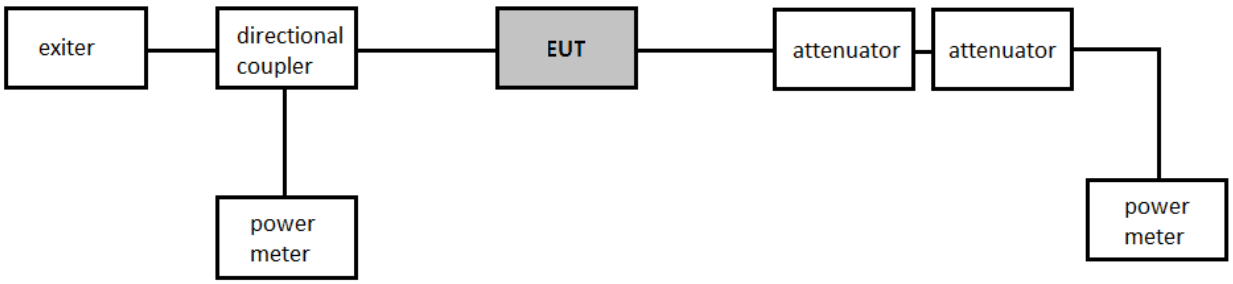
(3) Exhibit no amplification (0 dB gain) between 26 MHz and 28 MHz.

6.2 Test Equipment

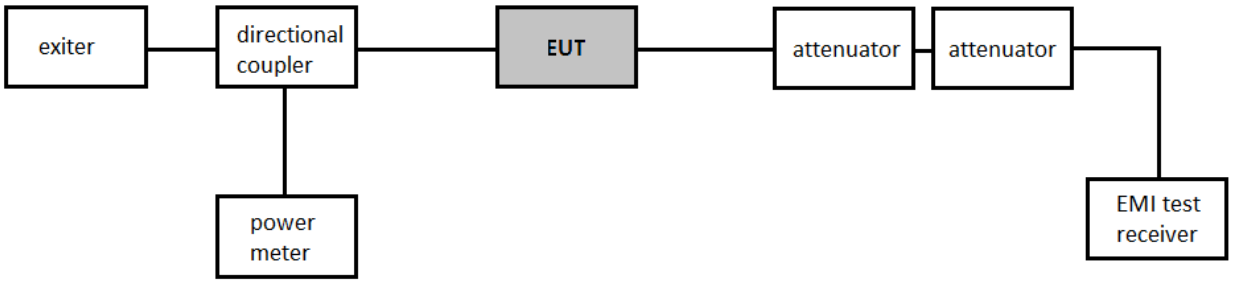
Type	Manufacturer/ Model No.	EMCC Ident No.	Last Calibration	Next Calibration
EMI Test Receiver	R&S / ESU8	3846	2017-01	2018-01
AC power source	California instruments / HGA	34	n.a.	n.a.
Digital Multimeter	Agilent / U1241A	2717	2016-01	2018-01
Dual Directional Coupler	Werlatone / C6021	302	2016-02	2018-02
RF Power Meter	R&S / NRVS	3540	2016-02	2018-02
RF Power Meter	R&S / NRVD	1265	2016-11	2018-11
Insertion Probe	R&S / URV 5-Z4	1499	2016-03	2018-03
Power sensor	R&S / NRV-Z32	530	2016-11	2018-11
Attenuator	Bird / 8329-300	828	2016-12	2018-12
Attenuator	Weinschel / 46-20-34	815	2016-06	2018-06

6.3 Test Setups

Schematic test setups for spurious emissions and gain:



test setup “gain”



test setup “spurious emissions”

6.4 Test Result

Mode: test mode b

power gain § 97.317				spurious emissions § 97.307(d)				
Frequency f1 [MHz]	Input power [W]	output power [kW]	amplifier gain [dB]	2 * f1 [dBc]	3 * f1 [dBc]	4 * f1 [dBc]	5-10 * f1 [dBc]	others [dBc]
1.9	36.2	1.05	14.6	-50.7	-56.2	x	> 70	> 70
3.75	44.4	1.01	13.6	> 70	-67.4	> 70	> 70	-60
7.15	53.9	0.97	12.6	> 70	-65.7	x	-48.7	> 60
10.125	47	1.01	13.3	-53.3	-49.4	> 60	-56.9	> 60
14.17	50.9	1.01	13	-50.1	-58.9	x	> 65	> 70
18.118	56.3	1.02	12.6	-53	-61.9	> 65	> 65	> 70
21.225	43.3	1.01	13.7	-61.3	> 60	-58.4	-58	> 65
24.94	44.4	1.02	13.6	-54.9	-58.7	> 70	-62.9	> 65
26	81.3	0.0813	0	/				
27	77.7	0.0774	0					
27.999	75.2	0.075	0					
28.5	58	1.02	12.5	-50.6	-62.1	x	> 65	> 60
29.2	50.2	0.97	12.9	51.6	x	> 60	-64.4	> 60
50.5	61.2	1.01	12.2	> 75	-63.4	x	x	> 70
53.5	73.2	1.01	11.4	> 70	-70.3	-74.6	-70.4	> 70

Manufacturer: Hilberling GmbH
Device: HPA-8000B-54
Serial No: 17030143
Test Date: 2017-03-29

The EUT meets the requirements of this section.

7 LIST OF ANNEXES

Following annexes are separated parts from this test report.

Description	Pages
Annex 1: Photographs of test set-up	4
Annex 2: Photographs of equipment under test (EUT)	4
Annex 3: Photographs of modifications of equipment under test (EUT)	2
Annex 4: Description of equipment under test (EUT), ports	3

Annex 1 to Test Report # EMCC-170518A, 2017-04-18

PHOTOGRAPHS OF TEST SET-UP

EQUIPMENT UNDER TEST:

Device:	HPA-8000B-54
Serial Number:	17030143
Equipment Class:	Amplifier
Manufacturer:	Hilberling GmbH
Address:	Heinrich-Hertz-Str. 2 24790 Schacht-Audorf Deutschland
Phone:	+49 4331 20171-11
Fax:	jhauschildt@hilberling.de

RELEVANT STANDARD(S): 47 CFR §§ 15.107, 15.109, 97.307, 97.317

MEASUREMENT PROCEDURE:

☒ ANSI C63.4-2014 ☐ RSS-Gen Issue 4 ☐ Other

Photo A1-1: Conducted emissions measurement

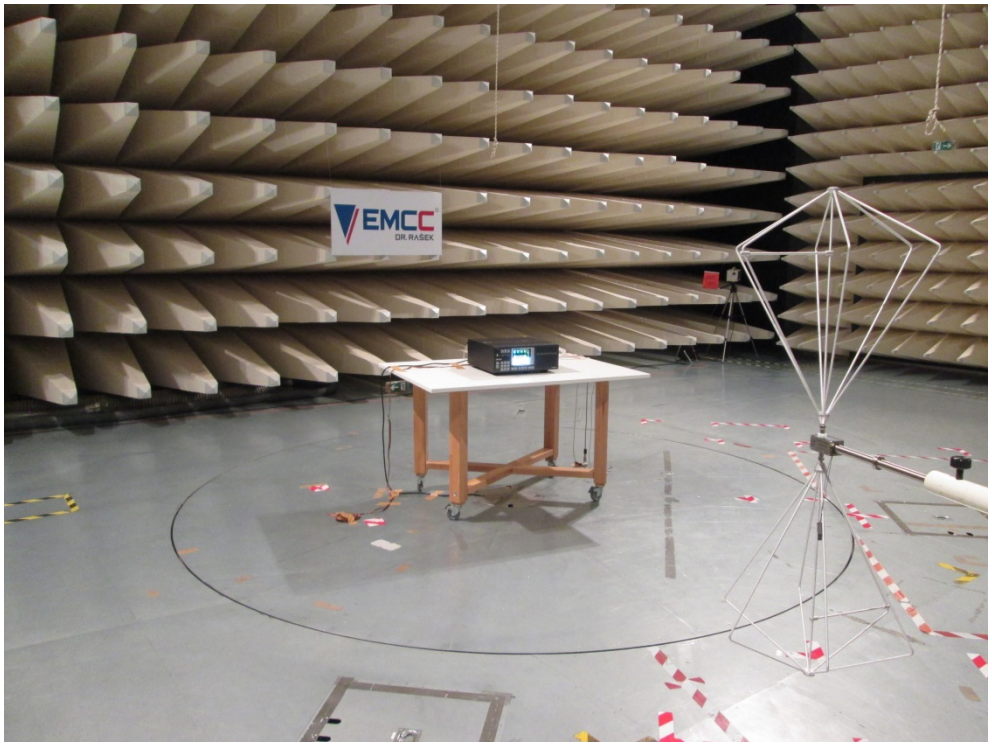


Photo A1-2: Radiated emissions measurement at 3 m distance, 30 MHz – 250 MHz

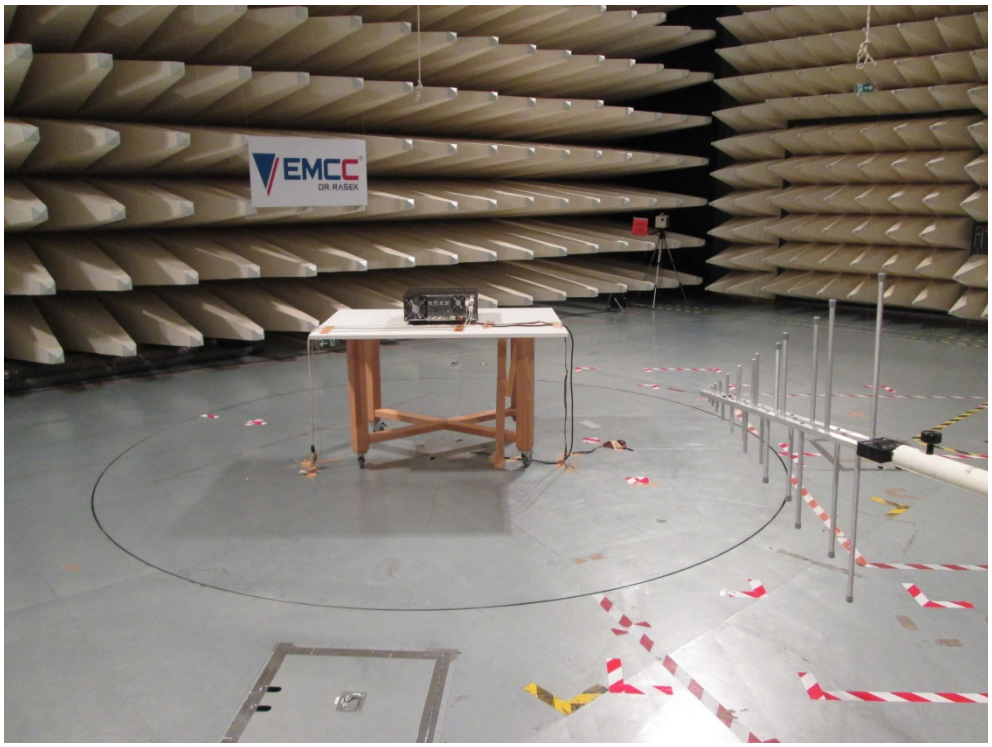


Photo A1-3: Radiated emissions measurement at 3 m distance, 250 MHz – 1000 MHz

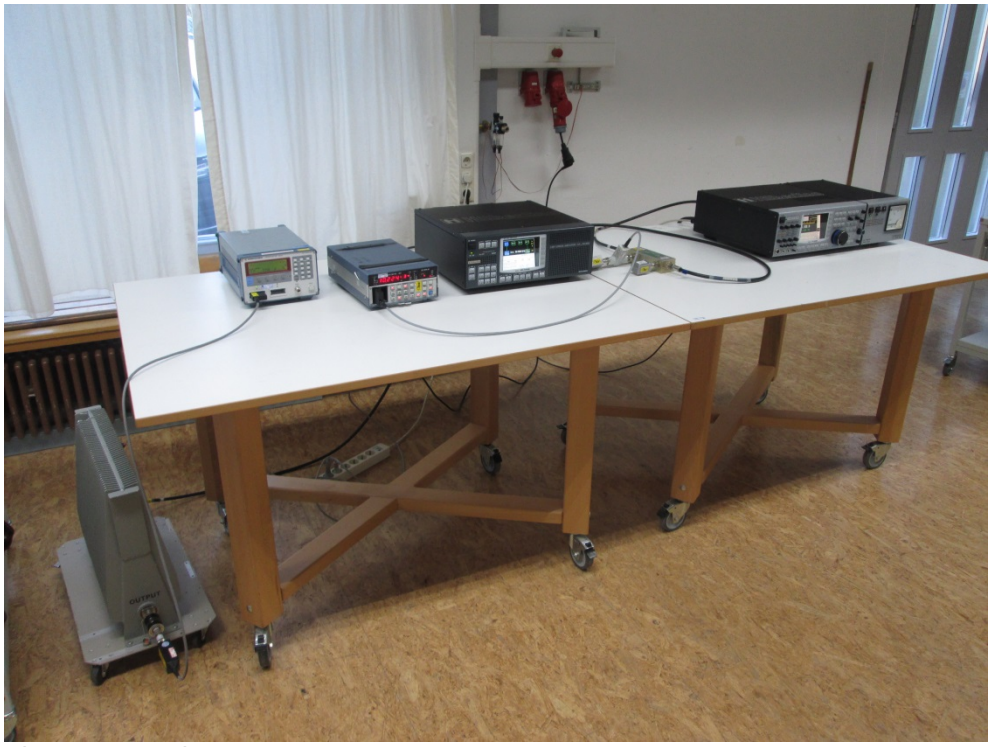


Photo A1-4: gain measurement

Photo A1-5: spurious emissions

Annex 2 to Test Report # EMCC-170518A, 2017-04-18

PHOTOGRAPHS OF EQUIPMENT UNDER TEST (EUT)

EQUIPMENT UNDER TEST:

Device:	HPA-8000B-54
Serial Number:	17030143
Equipment Class:	Amplifier
Manufacturer:	Hilberling GmbH
Address:	Heinrich-Hertz-Str. 2 24790 Schacht-Audorf Deutschland
Phone:	+49 4331 20171-11
Fax:	jhauschildt@hilberling.de

RELEVANT STANDARD(S): 47 CFR §§ 15.107, 15.109, 97.307, 97.317

MEASUREMENT PROCEDURE:

☒ ANSI C63.4-2014 ☐ RSS-Gen Issue 4 ☐ Other

Photo A2-1: EUT

Photo A2-2: EUT, front

Photo A2-3: EUT, back

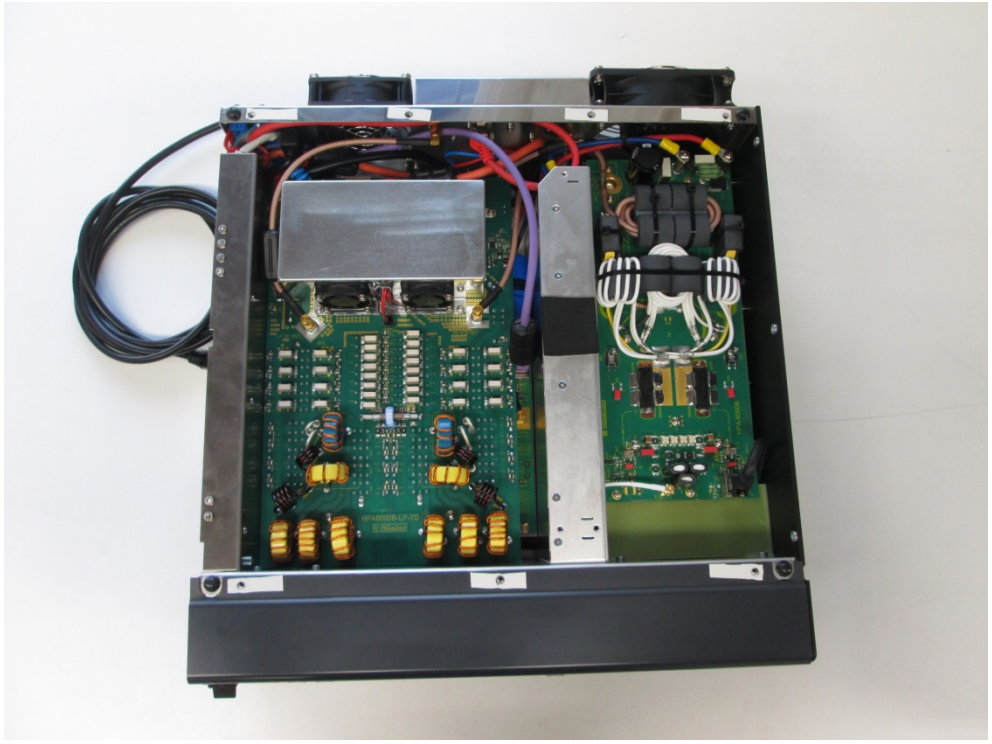


Photo A2-4: EUT, top with open casing

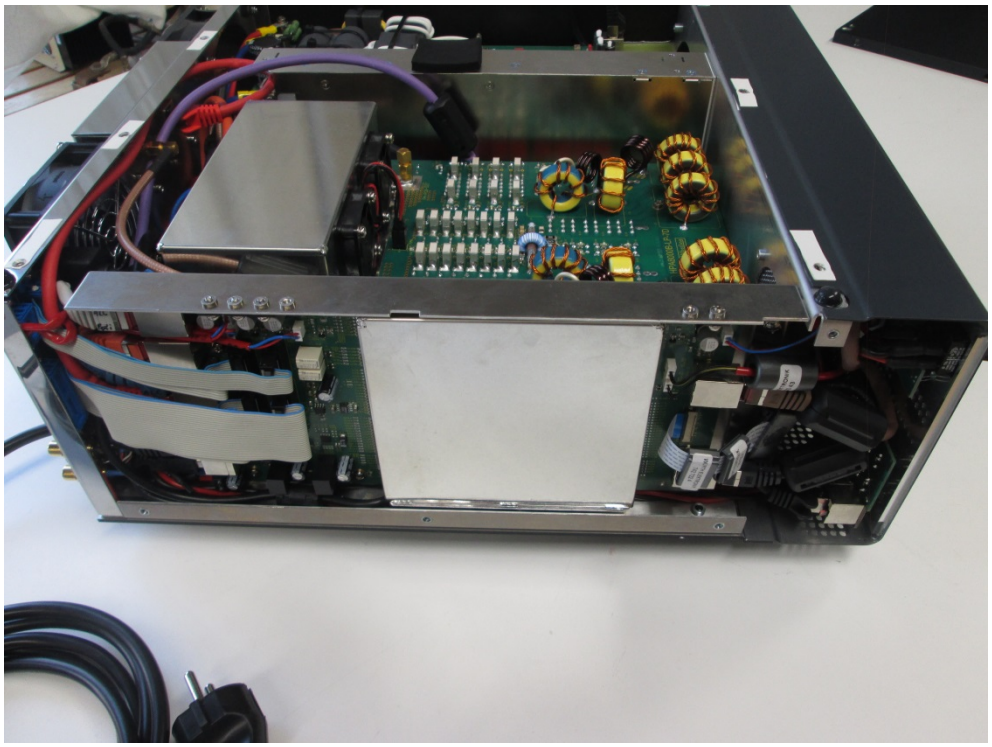


Photo A2-5: EUT, side

Annex 3 to Test Report # EMCC-170518A, 2017-04-18

PHOTOGRAPHS OF MODIFICATIONS OF EQUIPMENT UNDER TEST (EUT)

EQUIPMENT UNDER TEST:

Device:	HPA-8000B-54
Serial Number:	17030143
Equipment Class:	Amplifier
Manufacturer:	Hilberling GmbH
Address:	Heinrich-Hertz-Str. 2 24790 Schacht-Audorf Deutschland
Phone:	+49 4331 20171-11
Fax:	jhauschildt@hilberling.de

RELEVANT STANDARD(S): 47 CFR §§ 15.107, 15.109, 97.307, 97.317

MEASUREMENT PROCEDURE:

☒ ANSI C63.4-2014 ☐ RSS-Gen Issue 4 ☐ Other

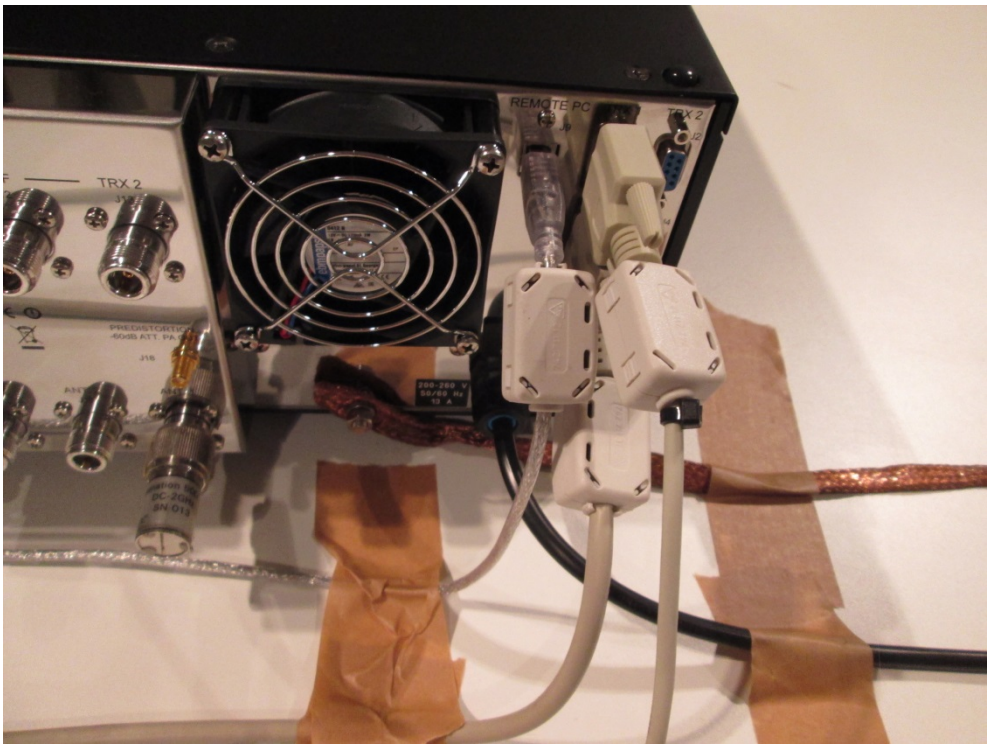


Photo A3-1: ferrites on cables “REMOTE PC”, “AUX TRX1” and “REMOTE TRX1”

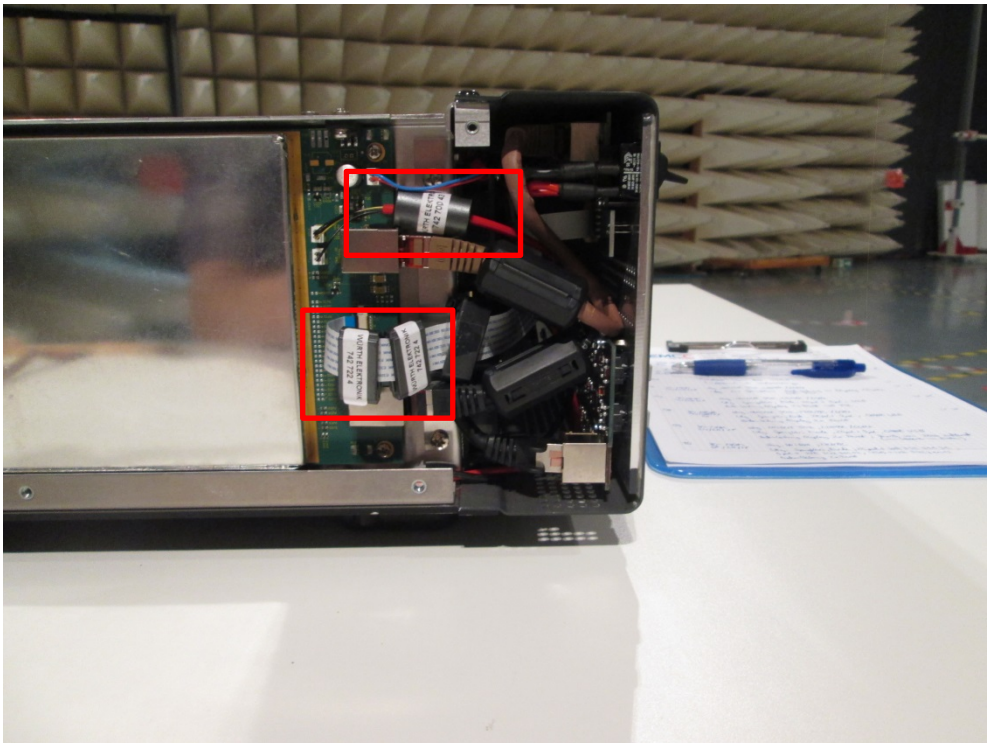


Photo A3-2: ferrites on display (data) line and display (power) line

Annex 4 to Test Report # EMCC-170518A, 2017-04-18

DESCRIPTION OF EQUIPMENT UNDER TEST (EUT), PORTS

EQUIPMENT UNDER TEST:

Device:	HPA-8000B-54
Serial Number:	17030143
Equipment Class:	Amplifier
Manufacturer:	Hilberling GmbH
Address:	Heinrich-Hertz-Str. 2 24790 Schacht-Audorf Deutschland
Phone:	+49 4331 20171-11
Fax:	jhauschildt@hilberling.de

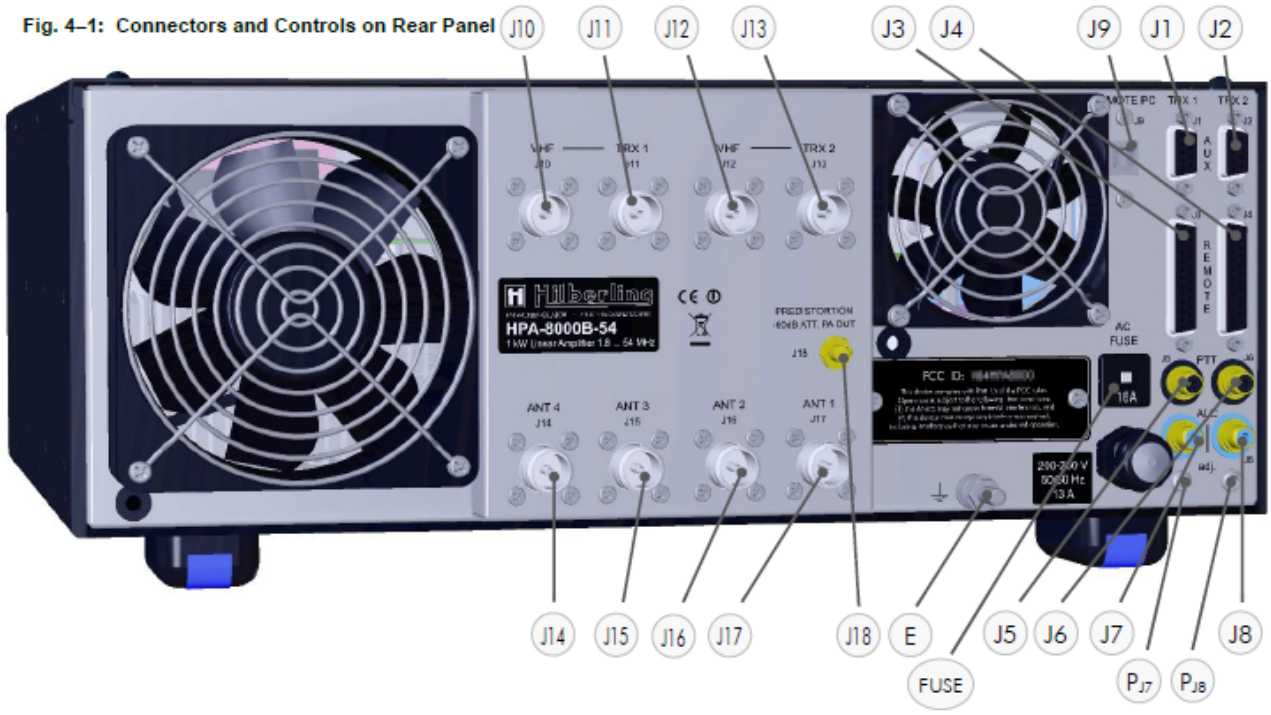
RELEVANT STANDARD(S): 47 CFR §§ 15.107, 15.109, 97.307, 97.317

MEASUREMENT PROCEDURE:

☒ ANSI C63.4-2014 ☐ RSS-Gen Issue 4 ☐ Other

The following table is an excerpt from user´s manual delivered by the customer:

Fig. 4–1: Connectors and Controls on Rear Panel



Tab. 4–1: Connectors on Rear Panel

No	Label	Type	Description		
E	⏚	Threaded Bolt M6	Grounding connector for station ground		
FUSE	AC FUSE	Thermal Fuse 16 A time-lag	Thermal circuit breaker, 230 V AC, resettable		
J1	AUX TRX 1	DE-9 (D-Sub 9-pin)	Output / input signals for transceiver 1 (Wiring Tab. 4–2)		
J2	AUX TRX 2	DE-9 (D-Sub 9-pin)	Output / input signals for transceiver 2 (Wiring Tab. 4–2)		
J3	REMOTE TRX 1	DB-25 (D-Sub 25-pin)	Output / input signals for transceiver 1 (Wiring Tab. 4–2)		
J4	REMOTE TRX 2	DB-25 (D-Sub 25-pin)	Output / input signals for transceiver 2 (Wiring Tab. 4–2)		
J5	PTT TRX 1	RCA	HF PTT transceiver 1 +5 V / GND (GND = TX)		
J6	PTT TRX 2	RCA	HF PTT transceiver 2 +5 V / GND (GND = TX)		
J7	ALC TRX 1	RCA	ALC output transceiver 1; adjustable by P_{J7}		
J8	ALC TRX 2	RCA	ALC output transceiver 2 ; adjustable by P_{J8}		
J9	REMOTE PC	USB-B	Input / output data (USB Cable Fig. 3–1) 1. Interface to PC for HPA-8000B-54 remote operation (CAT) 2. Interface to PC for update the software on HPA-8000B-54		
J10	VHF TRX 1	N	VHF input transceiver 1 only for TRX PT-8000A	50 MHz TRX PT-8000A only 'CAT Type' selection: 'Hilberling' (Sec. 5.4.2 and 7.2) *	
J11	TRX 1	N	Input transceiver 1	1.8 ... 29.7 MHz TRX PT-8000A	1.8 ... 29.7 / 50 MHz TRX by other manufacturer

Tab. 4–1: Connectors on Rear Panel (continued)

No.	Label	Type	Description		
J12	VHF TRX 2	N	VHF input transceiver 2 only for TRX PT-8000A	50 MHz TRX PT-8000A only 'CAT Type' selection: 'Hilberling' (Sec. 5.4.2 and 7.2). *	
J13	TRX 2	N	Input transceiver 2	1.8 ... 29.7 MHz TRX PT-8000A	1.8 ... 29.7 / 50 MHz TRX by other manufacturer
J14	ANT. 4	N	HF output antenna 4		
J15	ANT. 3	N	HF output antenna 3		
J16	ANT. 2	N	HF output antenna 2		
J17	ANT. 1	N	HF output antenna 1		
J18	PREDISTORSION -60dBc ATT. PA OUT	SMA	HF Output, attenuated by 60 dB , e.g. for predistorsion on TRX		
P_{J7}	ALC adj. TRX 1	Trim Pot	Adjustment of ALC output on transceiver 1 within range −10 ... +10 V at RCA J7 and D-Sub J1 Pin 6		
P_{J8}	ALC adj. TRX 2	Trim Pot	Adjustment of ALC output on transceiver 2 within range −10 ... +10 V at RCA J8 and D-Sub J2 Pin 6		

* Inputs J10 and J12 are only usable for a connection to the Hilberling PT-8000A Transceiver. If so select option 'Hilberling' as a 'CAT Type' at the TRX Setup (see Section 5.4.2 and 7.2).