

FCC RF Exposure Evaluation

Report Number:

F241002E11

Equipment under Test (EUT):

Control unit for welding inverters

BCU iWave 190/230 Smart 2

Applicant:

Fronius International GmbH

Manufacturer:

Fronius International GmbH



Deutsche
Akkreditierungsstelle
D-PL-17186-01-00

References

- [1] **CFR 47 Rule part 1** Practice and Procedure
- [2] **CFR 47 Rule part 2** Frequency Allocations and Radio Treaty Matters; General Rules and Regulations
- [3] **KDB 447498 D01 General RF Exposure Guidance v06**

Assessed and
written by:


Daniel BRUSCHINSKI
23.01.2026
Signature

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26.01.2026
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1 Identification

1.1 Applicant

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Applicant represented during the evaluation by the following person:	-

1.2 Manufacturer

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eMail address:	herndler.jan@fronius.com
Applicant represented during the evaluation by the following person:	-

1.3 Test Laboratory

The evaluation was carried out by: **PHOENIX TESTLAB GmbH**
Königswinkel 10
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accredited by *Deutsche Akkreditierungsstelle GmbH (DAkkS)* according to DIN EN ISO/IEC 17025:2018. The accreditation is only valid for the scope of accreditation listed in the annex of the certificate D-PL-17186-01-00. FCC Test Firm Designation Number DE0004, FCC Test Firm Registration Number 469623, CAB Identifier DE0003 and ISED# 3469A.

1.4 EUT (Equipment under Test)

Test object: *	Control unit for welding inverters
Model name: *	BCU iWave 190/230 Smart 2
Model number: *	43,0001,1788
Order number: *	N/A
FCC ID: *	QKWBCU2
IC certification number: *	12270A-BCU2
PMN: *	BCU iWAVE 190/230 Smart 2
HVIN: *	V0.2B_A
FVIN: *	N/A

* Declared by the applicant

	EUT number	
	1	2
Serial number: *	00002374	-
PCB identifier: *	4,071,879	-
Hardware version: *	V0.2B_A	-
Software version: *	2.3.0-38650.79495-G2	-

* Declared by the applicant

1.5 Technical Data of Equipment

General EUT data			
Power supply EUT: *	DC		
Supply voltage EUT: *	$U_{nom} = 24.0 \text{ V}_{DC}$	$U_{min} = 21.6 \text{ V}_{DC}$	$U_{max} = 26.4 \text{ V}_{DC}$
Temperature range: *	-20 °C to +65 °C		
Lowest / highest internal clock frequency: *	20 kHz / 2480 MHz		

* Declared by the applicant

Ports / Connectors				
Identification	Connector		Length during test	Shielding (Yes / No)
	EUT	Ancillary		
Ethernet *	HSD	RJ45	< 100 m	Yes (CAT6)
Speednet *	HSD	Left open	< 100 m	Yes (CAT6)
DC mains *	Customized	4 mm laboratory plug	≈ 2 m	No
Internal port *	Mini-B-USB	Left open	-	Yes
Antenna connector	SMA connector	SMA connector	-	Yes

* Declared by the applicant

RFID part	
Operating frequency: *	13.56 MHz
Number of channels: *	N/A
Type of modulation: *	ISO 14443A/B, ISO15693, ISO18092, NFCIP-2
Data rate: *	106 kbps - 848 kbps
Antenna type: *	PCB antenna
Antenna connector: *	PCB connector

* Declared by the applicant

Bluetooth® low energy / WLAN part			
Radio module: * ¹	muRata LBEE5PL2DL		
Antenna type: * ²	Dipole antenna		
Antenna name: * ²	Taoglas GW.40		
Antenna gain: * ²	3.15 dBi (peak)		
Antenna connector: * ²	SMA		
Supply voltage radio module: * ¹	$U_{nom} = 3.3 \text{ V}_{DC}$	$U_{min} = 3.14 \text{ V}_{DC}$	$U_{max} = 3.46 \text{ V}_{DC}$

*¹ based on the data sheet "Type 2DL Wi-Fi® + Bluetooth® Module"

*² based on the antenna data sheet "SPE-19-8-069-A"

Bluetooth® low energy frequencies			
Channel 00	2402 MHz	Channel 01	2404 MHz
Channel 02	2406 MHz	Channel 03	2408 MHz
...	...	...	...
...	...	...	...
Channel 18	2438 MHz	Channel 19	2440 MHz
...	...	...	...
...	...	...	...
Channel 36	2474 MHz	Channel 37	2476 MHz
Channel 38	2478 MHz	Channel 39	2480 MHz

Bluetooth® low energy radio mode		
Fulfil radio specification: *	Bluetooth® low energy (BLE) 5.3	
Type of modulation: *	BLE (1 Mbps PHY)	GFSK
	BLE (2 Mbps PHY)	GFSK
	BLE (500 kbps coded PHY)	GFSK
	BLE (125 kbps coded PHY)	GFSK
Operating frequency range: *	BLE (1 Mbps PHY)	2402 – 2480 MHz
	BLE (2 Mbps PHY)	2402 – 2480 MHz
	BLE (500 kbps coded PHY)	2402 – 2480 MHz
	BLE (125 kbps coded PHY)	2402 – 2480 MHz
Number of channels: *	BLE (1 Mbps PHY)	40 (2 MHz channel spacing)
	BLE (2 Mbps PHY)	40 (2 MHz channel spacing)
	BLE (500 kbps coded PHY)	40 (2 MHz channel spacing)
	BLE (125 kbps coded PHY)	40 (2 MHz channel spacing)

* based on the data sheet "Type 2DL Wi-Fi® + Bluetooth® Module"

IEEE 802.11 frequencies			
20 MHz		40 MHz	
Channel 1	2412 MHz	-	-
Channel 2	2417 MHz	-	-
Channel 3	2422 MHz	Channel 3	2422 MHz
Channel 4	2427 MHz	Channel 4	2427 MHz
Channel 5	2432 MHz	Channel 5	2432 MHz
Channel 6	2437 MHz	Channel 6	2437 MHz
Channel 7	2442 MHz	Channel 7	2442 MHz
Channel 8	2447 MHz	Channel 8	2447 MHz
Channel 9	2452 MHz	Channel 9	2452 MHz
Channel 10	2457 MHz	-	-
Channel 11	2462 MHz	-	-

IEEE 802.11 radio mode				
Fulfills radio specification: *1	IEEE 802.11 b IEEE 802.11 g IEEE 802.11 n (20 MHz) IEEE 802.11 n (40 MHz)			
Type of modulation: *1	IEEE 802.11b	DSSS (1 Mbps	BPSK)	
		DSSS (2 Mbps	DQPSK)	
		DSSS (5.5/11 Mbps	CCK)	
	IEEE 802.11g	OFDM (6/9 Mbps	BPSK)	
		OFDM (12 / 18 Mbps	QPSK)	
		OFDM (24/36 Mbps	16-QAM)	
		OFDM (48/54 Mbps	64-QAM)	
	IEEE 802.11n 20 MHz (Spatial Stream: 1)	MCS0	OFDM (7 Mbps	BPSK)
		MCS1/2	OFDM (14 – 22 Mbps	QPSK)
		MCS3/4	OFDM (28 – 43 Mbps	16-QAM)
		MCS5/6/7	OFDM (58 - 72 Mbps	64-QAM)
	IEEE 802.11n 40 MHz (Spatial Stream: 2)	MCS0	OFDM (15 Mbps	BPSK)
		MCS1/2	OFDM (30 / 45 Mbps	QPSK)
		MCS3/4	OFDM (60 – 90 Mbps	16-QAM)
		MCS5/6/7	OFDM (120 - 150Mbps	64-QAM)
Operating frequency range: *1	IEEE 802.11b		2412 – 2462 MHz	
	IEEE 802.11g		2412 – 2462 MHz	
	IEEE 802.11n 20 MHz		2412 – 2462 MHz	
	IEEE 802.11n 40 MHz		2422 – 2452 MHz	
Number of channels: *1	IEEE 802.11b		11 (5 MHz channel spacing)	
	IEEE 802.11g		11 (5 MHz channel spacing)	
	IEEE 802.11n 20 MHz		11 (5 MHz channel spacing)	
	IEEE 802.11n 40 MHz		9 (5 MHz channel spacing)	

*1 based on the data sheet "Type 2DL Wi-Fi® + Bluetooth® Module"

1.6 Additional Information

The EUT is fixed installed in a welding unit.

2 Evaluation Methods

2.1 RF exposure test exemptions for single sources

2.1.1 General Exemption CFR 47 §1.1307(b)(3)(i)(A)

The available maximum time-averaged power is no more than 1 mW, regardless of separation distance. This exemption may not be used in conjunction with other exemption criteria other than those in paragraph (b)(3)(ii)(A) of this section. Medical implant devices may only use this exemption and that in paragraph (b)(3)(ii)(A);

2.1.2 SAR Based Exemption CFR 47 §1.1307(b)(3)(i)(B)

The available maximum time-averaged power or effective radiated power (ERP), whichever is greater, is less than or equal to the threshold P_{th} (mW) described in the following formula. This method shall only be used at separation distances (cm) from 0.5 cm to 40 cm and at frequencies from 0.3 GHz to 6 GHz inclusive.

For the following separation distances [d] and frequency ranges P_{th} is given by the following formulas.

	0.5 cm ≤ d ≤ 20cm	20 cm < d ≤ 40 cm
0.3 GHz ≤ f < 1.5 GHz	$P_{th}(mW) = ERP_{20cm} \left(\frac{d}{20} \right)^x$ $ERP_{20cm} (mW) = 2040f$ $x = -\log_{10} \left(\frac{60}{ERP_{20cm} \sqrt{f}} \right)$	$P_{th}(mW) = ERP_{20cm}$ $ERP_{20cm} (mW) = 2040f$
1.5 GHz ≤ f ≤ 6 GHz	$P_{th}(mW) = ERP_{20cm} \left(\frac{d}{20} \right)^x$ $ERP_{20cm} (mW) = 3060$ $x = -\log_{10} \left(\frac{60}{ERP_{20cm} \sqrt{f}} \right)$	$P_{th}(mW) = ERP_{20cm}$ $ERP_{20cm} (mW) = 3060$

Relaxation for extremities according to appendix A [3]:

Finally, if 10-g extremity SAR applies, SAR test exemption may be considered by applying a factor of 2.5 to the SAR-based exemption thresholds.

2.1.3 MPE Based Exemption CFR 47 §1.1307(b)(3)(i)(C)

By using Table 1 and the minimum separation distance (d in meters) from the body of a nearby person for the frequency (f in MHz) at which the source operates, the ERP (watts) is no more than the calculated value prescribed for that frequency. For the exemption in Table 1 to apply, d must be at least $\lambda/2\pi$, where λ is the free-space operating wavelength in meters. If the ERP of a single RF source is not easily obtained, then the available maximum time-averaged power may be used in lieu of ERP if the physical dimensions of the radiating structure(s) do not exceed the electrical length of $\lambda/4$ or if the antenna gain is less than that of a half-wave dipole (1.64 linear value).

RF Source frequency [MHz]	Threshold ERP [W]
0.3 - 1.34	$1920 d^2$
1.34 - 30	$3450 d^2/f^2$
30 - 300	$3.83 d^2$
300 - 1500	$0.0128 d^2/f$
1500 - 100000	$19.2 d^2$

d : Minimal separation distance from antenna to the user

2.1.4 Standalone MPE evaluation limits

The human exposure to RF emissions from such devices could be evaluated based on the MPE limits adopted by the FCC for electric and magnetic field strength and / or power density. The limits for General Population / Uncontrolled Exposure are given in the following table from CFR 47 §1.1310(e)1:

Frequency range [MHz]	Electric field strength (E) [V/m]	Magnetic field strength (H) [A/m]	Power density (S) [mW/cm ²]	Averaging time [min]
(i)Limits for Occupational/Controlled Exposure				
0.3 – 3.0	614	1.63	*(100)	≤6
3.0 – 30	1842/f	4.89/f	*(900/f ²)	<6
30 – 300	61.4	0.163	1.0	<6
300 – 1,500			f/300	<6
1,500 – 100,000			5	<6
(ii)Limits for General Population / Uncontrolled Exposure				
0.3 – 1.34	614	1.63	*(100)	< 30
1.34 – 30	824/f	2.19/f	*(180/f ²)	< 30
30 – 300	27.5	0.073	0.2	< 30
300 – 1500			f/1500	< 30
1500 – 100,000			1.0	< 30

Note: f = frequency in MHz; * Plane – wave equivalent power density

The power density is calculated as follows:

$$S = \frac{P \cdot G \cdot D}{4 \cdot \pi \cdot d^2}$$

Where:

P: conducted power

G: Antenna gain (linear)

D: Duty Cycle

d: Minimal separation distance from antenna to the user

2.2 RF exposure test exemptions for simultaneous transmission sources

2.2.1 1 mW Test Exemption for simultaneous transmission sources

As discussed in CFR 47 §1.1307(b)(3)(ii)(A) [1] the 1 mW exemption intended for single transmitters may be also applied to simultaneous transmission conditions, within the same host device, according one of the following criteria:

- If the maximum available power of each individual transmitting antenna with the same time averaging period is ≤ 1 mW, and the nearest parts of the antenna structures of the simultaneously operating transmitters are separated by at least 2 cm
- If the aggregate maximum available power of all transmitting antennas is ≤ 1 mW in the same time-averaging period

This exemption may not be combined with any other exemption.

2.2.2 Simultaneous transmission SAR based and MPE based test exemptions

As described in detail in CFR 47 §1.1307(b)(3)(ii)(B) that covers the situations where both SAR-based and MPE-based exemption may be considered for test exemption in fixed, mobile, or portable device exposure conditions. For these cases, a device with multiple RF sources transmitting simultaneously will be considered an RF exempt device if the condition of the following formular is satisfied.

$$\sum_{i=1}^a \frac{P_i}{P_{th,i}} + \sum_{j=1}^b \frac{ERP_j}{ERP_{th,j}} + \sum_{k=1}^c \frac{Evaluated_k}{Exposure Limit_k} \leq 1$$

For these test exemptions to apply, the maximum output power, duty factor, and other applicable parameters used in the standalone ERP determination tests, must be the same, or corresponding to a more conservative choice, than those required for simultaneous transmission.

Simultaneous transmission MPE test exclusion applies if the sum of the MPE ratios for all simultaneously transmitting antennas incorporated in a host device is ≤ 1.0 , according to calculated/estimated, numerically modelled, or measured field strengths or power density. The MPE ratio of each antenna is determined at the minimum test separation distance required by the operating configurations and exposure conditions of the host device, according to the ratio of field strengths or power density to the MPE limit at the test frequency.

3 Results of evaluation

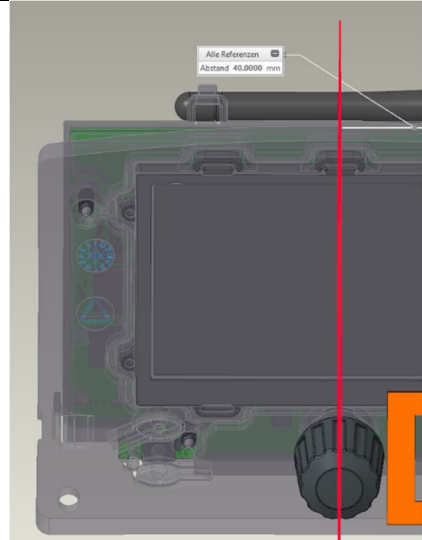
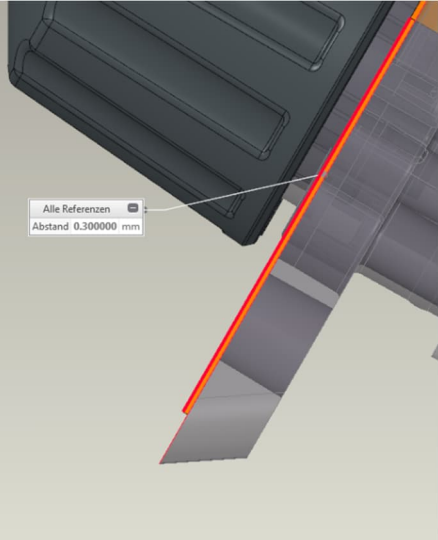
3.1 Used evaluation methods

RF Exposure test exemptions for single sources			
Used	Method	See sub-clause	Comment
☒	General Exemption acc. CFR 47 §1.1307(b)(3)(i)(A)	2.1.1	NFC
☒	SAR Based Exemption acc. CFR 47 §1.1307(b)(3)(i)(B)	2.1.2	WLAN / BLE
☐	MPE Based Exemption acc. CFR 47 §1.1307(b)(3)(i)(C)	2.1.3	-
☐	MPE Calculation	2.1.4	-

RF Exposure test exemptions for simultaneous transmission sources			
Used	Method	See sub-clause	Comment
☐	Not applicable	-	No simultaneous possible
☐	1 mW test exemption acc. CFR 47 §1.1307(b)(3)(ii)(A)	2.2.1	-
☒	Exemption acc. CFR 47 §1.1307(b)(3)(ii)(B)	2.2.2	-

3.2 Evaluation Distance

According to the CFR47 §2.1091 the device as declared by the applicant is a mobile device which is used at least with the following separation distances between the device and the user:

Antenna	Min separation distance as declared by the applicant	
Antenna 1 (WLAN / BLE)	40.0 mm	
Antenna 2 (NFC)	0.3 mm	
WLAN / BLE		NFC
		

3.3 WLAN emissions

Antenna 1 SAR Based Exemption CFR 47 §1.1307(b)(3)(i)(B)

Time averaged results were taken from test report "F241002E8" by PHOENIX TESTLAB GmbH.
A tune-up tolerance of 2 dB as declared by the applicant was considered.

P _{con} [dBm] incl. tune-up * ¹	P _{con} [mW] incl. tune-up	Antenna gain * ¹ [dBi]	Cable attenuation [dB]	P _{e.i.r.p} [dBm]	P _{e.i.r.p} [mW]	P _{e.r.p} * ² [dBm]	P _{e.r.p} [mW]
12.00	15.85	3.15	0	15.15	32.73	13.00	19.96
Frequency [GHz]	d [cm]	ERP _{20cm}	x	factor limb-worn	P _{th} [mW]	P _{e.r.p} [mW]	Result
2.412	4.0	3060	1.899	2.5	360.15	19.96	exempted
for 0.5 cm ≤ d ≤ 20 cm and 1.5 GHz ≤ f ≤ 6 GHz							

*¹ Declared by the applicant

*² P_{e.r.p.} = P_{con} [dBm] + antenna gain [dBi] - cable attenuation [dB] - 2.15 dB

3.4 BLE emissions

Antenna 1 SAR Based Exemption CFR 47 §1.1307(b)(3)(i)(B)

Time averaged results were taken from test report "F241002E7" by PHOENIX TESTLAB GmbH.
A tune-up tolerance of 2 dB as declared by the applicant was considered.

P _{con} [dBm] incl. tune-up * ¹	P _{con} [mW] incl. tune-up	Antenna gain * ¹ [dBi]	Cable attenuation [dB]	P _{e.i.r.p} [dBm]	P _{e.i.r.p} [mW]	P _{e.r.p} * ² [dBm]	P _{e.r.p} [mW]
2.30	1.70	3.15	0	5.45	3.51	3.30	2.14
Frequency [GHz]	d [cm]	ERP _{20cm}	x	factor limb-worn	P _{th} [mW]	P _{e.r.p} [mW]	Result
2.480	4.0	3060	1.905	2.5	356.67	2.14	exempted
for 0.5 cm ≤ d ≤ 20 cm and 1.5 GHz ≤ f ≤ 6 GHz							

*¹ Declared by the applicant

*² P_{e.r.p.} = P_{con} [dBm] + antenna gain [dBi] - cable attenuation [dB] - 2.15 dB

3.5 NFC emissions

General exemption CFR 47 §1.1307(b)(3)(i)(A)

The following information is based on test report “F241002E6” by PHOENIX TESTLAB GmbH.

The radiated field strength of the transmitter was measured at a distance of 3 m. The measured field strength at 3 m (= reading @ 3 m distance + antenna factor) was 59.8 dBμV/m. This value is converted into an EIRP power using ANSI C63-10, equation (39):

$$EIRP = E_{Meas} + 20 \log(d_{Meas}) - 104.7$$

Where

EIRP	is the equivalent isotropically radiated power
E_{Meas}	is the field strength of the emission at the measurement distance, in dBμV/m
d_{Meas}	is the measurement distance, in m

$$EIRP = 59.8 \text{ dB}\mu\text{V/m} + 20 \log(3\text{m}) - 104.7 = -35.4 \text{ dBm}$$

This value is converted into an ERP power with formula according to ANSI C63-10, equation (G.5):

$$ERP = EIRP - 2.15 = -37.55 \text{ dBm}$$

The ERP power of the transmitter is -37.55 dBm or 0.18 μW. This is below the 1 mW limit.

3.6 Simultaneous transmission

The same antenna is used for BLE and WLAN what means that no simultaneous transmission of BLE and WLAN is possible. Only NFC and BLE or NFC and WLAN can transmit simultaneously. As shown in clause 3.3 and 3.4 of this evaluation report, the output power of WLAN is higher than the output power of BLE. Therefore, the estimated SAR values are calculated for WLAN and NFC.

Calculation of the estimated SAR values according to KDB 447498 D01 General RF Exposure Guidance v06 4.3.2. b) 1)

	Frequency [GHz]	Max power incl tune-up [mW]	Min. separation distance [mm]	Estimated 10 g SAR [W/kg]
WLAN 2.4 GHz	2.412	19.96	40.0 (<50)	0.178973
NFC 13.56 MHz	0.014	0.00018	0.3 (<50)	0.000016

Calculation was done as follows:

$$\frac{[(\text{max. power of channel, including tune - up tolerance, mW})]}{\text{min. test separation distance, mm}} \sqrt{\frac{f(\text{GHz})}{x} \frac{\text{W}}{\text{kg}}} \text{ for test separation distances } \leq 50 \text{ mm}$$

where $x = 7.5$ for 1 - g SAR and 18.75 for 10 - g SAR

1.0 W/kg for 10-g SAR respectively 0.4 W/kg for 1-g SAR for separation distance > 50 mm.

Sum of estimated 10g SAR limb-worn according to 2.2.2

$$\sum_{\text{SAR}}^{\text{all TX}} \left(\frac{\text{estimated SAR1}}{4 \text{ W/kg}} + \frac{\text{estimated SAR2}}{4 \text{ W/kg}} + \frac{\text{estimated SAR3}}{4 \text{ W/kg}} + \dots \right) \leq 1$$

$$\sum_1^3 \left(\frac{0.178973 \text{ W/kg}}{4 \text{ W/kg}} + \frac{0.000016 \text{ W/kg}}{4 \text{ W/kg}} \right) = 0.04 \ll 1$$

4 Conclusion

The EUT complies in all operational modes to the limits given in CFR 47 §1.1310(c) in a separation distance of 40 mm for antenna 1 and 0.3 mm for antenna 2.

5 Report History

Report Number	Date	Comment
F241002E11	23.01.2026	Initial Evaluation Report
-	-	-
-	-	-

----- end of evaluation report -----