

FCC RF Exposure Evaluation

Report Number:

F230178E4

Equipment under Test (EUT):

NICS-EM30-IOL-HK1141

Applicant:

Turck Beierfeld GmbH

Manufacturer:

Turck Beierfeld 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 D04 Interim General RF Exposure Guidance v01**

Assessed and
written by:



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30.09.2025

Signature

Reviewed and
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30.09.2025

Signature

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1 Identification

1.1 Applicant

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Country:	Germany
Name for contact purposes:	Michael Siegel
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eMail address:	Michael.siegel@turck.com
Applicant represented during the test by the following person:	-

1.2 Manufacturer

Name:	Turck Beierfeld GmbH
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Country:	Germany
Name for contact purposes:	Michael Siegel
Phone:	+49 3774-135-153
eMail address:	Michael.siegel@turck.com
Applicant represented during the test by the following person:	-

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 Reg. No. D-PL-17186-01-06.

1.4 EUT (Equipment under Test)

Test object: *	Inductive Coupler
Model name: *	NICS-EM30-IOL-HK1141
Model number: *	-
Order number: *	100018259
FCC ID: *	YQ7-NICS-EM30
IC certification number: *	8821A-NICSEM30
PMN: *	NICS-EM30-IOL-HK1141
HVIN: *	7631/07
FVIN: *	V1

	EUT number		
	1 (All tests)	2	3
Serial number: *	V2_B6_FCC_UART	-	-
PCB identifier: *	07763107	-	-
Hardware version: *	2.0.0	-	-
Software version: *	-	-	-

* Declared by the applicant

1.5 Technical Data of Equipment

General			
Power supply EUT: *	DC		
Supply voltage EUT: *	$U_{nom} = 24.0$	$U_{min} = 8.0$	$U_{max} = 32.0$
Temperature range: *	-25 °C to +55 °C		
Lowest / highest internal frequency: *	16 MHz / 2472 MHz		

* Declared by the applicant

Ports / Connectors				
Identification	Connector		Length during test	Shielding (Yes / No)
	EUT	Ancillary		
NICS-EM30-IOL-HK1141 24V SDCI	M12 - Code A	M12 - Code A	~ 2 m	yes
-	-	-	-	-
-	-	-	-	-

EUT frequencies	
20 MHz	
Channel 1	2412 MHz
Channel 2	2417 MHz
Channel 3	2422 MHz
Channel 4	2427 MHz
Channel 5	2432 MHz
Channel 6	2437 MHz
Channel 7	2442 MHz
Channel 8	2447 MHz
Channel 9	2452 MHz
Channel 10	2457 MHz
Channel 11	2462 MHz
Channel 12	2467 MHz
Channel 13	2472 MHz

Radio mode	
Fulfil radio specification: *1	None (Proprietary)
Radio chip: *1	Semtech SX1281
Antenna type: *1	-
Antenna name: *1	Custom design
Antenna gain: *1	_*2
Antenna connector: *1	-
Supply voltage radio module: *1	$U_{nom} = 24.0 \text{ V}_{DC}$ $U_{min} = 8.0 \text{ V}_{DC}$ $U_{max} = 32.0 \text{ V}_{DC}$
Type of modulation: *1	FSK 2 Mbps
Operating frequency range: *1	2412 – 2472 MHz
Number of channels: *1	13 (5 MHz channel spacing)

*1 declared by the applicant

*2 All tests power end emissions tests were done radiated. Therefore, the antenna gain is not necessary.

1.6 Additional Information

None

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 of 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
0.2 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 2.1.1 [3]

Finally, when 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 Stand alone 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:

- a. When the maximum available power 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
- b. When 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

Although this is not a module integration in the sense of product approval, the procedure for simultaneous transmission specified in KDB 447498 D04 Interim General RF Exposure Guidance v01 [3] in chapter 2.2 was taken into account:

According to the RF exposure KDB 447498 D04 General RF Exposure Guidance v01 [3] in chapter 2.2.2: This case is described in detail in CFR 47 §1.1307(b)(3)(ii)(B) and 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 formula 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 when 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.

2.2.3 Test exemption based on the SAR to Peak Location Separation Ratio

When the ERP-based condition in the previous section does not apply, a test exemption may be still applicable based on the SAR to peak location separation ratio (SPLSR) procedure.

In this case, the simultaneously transmitting antennas in each operating mode and exposure condition combination must be considered one pair at a time to determine the SPLSR that qualifies for the additional test exemption.

This ratio is defined as:

$$SPLSR = (SAR_1 + SAR_2)^{\frac{1.5}{R_i}}$$

Where: SAR_1 and SAR_2 = highest reported SAR or estimated SAR values for the two sources in the pair i , and R_i is their distance in mm.

When $SPLSR \leq 0.0.4$ (rounded to two decimal digits), for all antenna pairs in the configuration, then the device qualifies for 1 g SAR test exemption.

When 10 g SAR applies (e.g. for extremities) the corresponding test exemption condition is $SPLSR \leq 0.10$.

If any antenna pair does not qualify for simultaneous transmission SAR test exemption, then the device must be tested for SAR compliance, according to the enlarged zoom scan and volume scan post-processing procedures in KDB Pub. 865664 D01.

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	-
☐	SAR Based Exemption acc. CFR 47 §1.1307(b)(3)(i)(B)	2.1.2	-
☐	MPE Based Exemption acc. CFR 47 §1.1307(b)(3)(i)(C)	0	-
☐	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. 2.2.1 [3]	2.2.1	-
☐	SAR Based Exemption acc. 2.2.2 [3]	2.2.2	
☐	MPE Based Exemption acc. 2.2.2 [3]	2.2.2	
☐	SAR to Peak location separation ratio acc. 2.2.3 [3]	2.2.3	

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 users.

Antenna	Min separation distance as declared by the applicant
2.4 GHz Antenna	NA*

* Not applicable, because exception is calculated on the basis of a general exemption, regardless of the distance to the user.

3.3 2.4 GHz Emissions

The following information are based on Test-Report F230178E2 of PHOENIX TESTLAB GmbH

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

The EIRP output power is calculated using formula 10.3.9 in [4] (measurement distance of 3m):

$$\text{EIRP [dBm]} = 55.8 \text{ dB}\mu\text{V/m} - 95.3 = -39.5 \text{ dBm} < 0\text{dBm}$$

The available maximum radiated time-averaged power is measured with -39.5 dBm or 0.112 μW . This is below the 1 mW limit, regardless of separation distance.

Due to this low RF output power this device is exempted from SAR evaluation.

4 Conclusion

The NICS-EM30-IOL-HK1141 complies in all operational modes to the limits given in CFR 47 §1.1310(e)1 regardless of the separation distance.

5 Report History

Report Number	Date	Comment
F230178E4	30.09.2025	Initial Test Report
-	-	-
-	-	-