

TEST REPORT

of the accredited test laboratory

TÜV Nr.:INE-AT/FG-21/203

Applicant: YUNEX GmbH
Otto-Hahn-Ring 6
D-81739 München

Product: ITS Radiocommunications equipment 'RSU2X'
RF Exposure Exemption only

FCC-ID: 2A2U3RSU2X

Manufacturer: see above

Output power Various **power supply:** See page 4

Frequency range: Various **Channel** Various
separation:

Accredited Standards: FCC: 47 CFR Part 90 (eCFR 22.12.2021);

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Inspection Body,
Certification Body,
Calibration Laboratory,
Verifizierungsstelle

Notified Body 0408

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Test laboratory for EMC

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TÜV AUSTRIA SERVICES
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22.12.2021

Ing. Michael Emminger

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The results of this test report only refer to the provided equipment.

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1. Applicant

Company: YUNEX GmbH

Department: ---

Address: Otto-Hahn-Ring 6; D- 81739 München

Contact person: Mr. Thomas Jatschka

2. Description of EUT

EUT:	ITS Radiocommunications equipment 'RSU2X'
Manufacturer:	YUNEX GmbH Otto-Hahn-Ring 6 D- 81739 München
Description:	RF Exposure Compliance is determined for 2A2U3RSU2X
Operating mode:	Worst case simultaneous transmission is considered as a conservative approach. Details are described below
Technical data EUT:	Rated voltage: 48 VDC Rated current: 1,5A Rated frequency: DC Mains voltage: Power over Ethernet (PoE)
Climatic conditions in the emc laboratory:	N/A

3. Standards / Final result

Name	Title	Deviation	Result
FCC: 47 CFR Part 90 (eCFR 22.12.2021)	PRIVATE LAND MOBILE RADIO SERVICES	*)	OK**)
Result: Opinions and interpretation of testing laboratory OK: EUT passed NOK: EUT failed			

*) Only RF exposure requirements for § 90.223

**) KDB 447498 D04 Interim General RF Exposure Guidance v01 was applied. The device was determined to be MPE exempt as per §1.1307(b)(3)(ii)(B) and §1.1307(b)(3)(i)(C), "Table 1 to §1.1307(b)(3)(i)(C) - Single RF Sources Subject to Routine Environmental Evaluation" for a minimum separation distance of $R = 0.25$ m.

4. Test results

4.1 TEST OBJECT DATA

This Radio Equipment incorporates multiple transceiver modules. This test report is only for the RF exposure compliance of the radio equipment.

The device contains a DSRC transceiver.

Bluetooth/BLE/WLAN capability is realised through an FCC certified module with FCC-ID: VPYLBEE5HY1MW.

UMTS/LTE capability is realised through an FCC certified module with FCC-ID: XPYTOBYL201

4.2 RF Exposure

§ 90.223
KDB 447498 D04 Interim General RF Exposure Guidance v01
§ 1.1307(b)(3)(ii)(B)
§ 1.1307(b)(3)(i)(C)

Summary:

This report considers the rule changes per Second Report and Order of FCC 19-126.
This report follows KDB 447498 D04 Interim General RF Exposure Guidance v01, version 11/29/2021.

The device was determined to be MPE exempt as per §1.1307(b)(3)(ii)(B) and §1.1307(b)(3)(i)(C), "Table 1 to §1.1307(b)(3)(i)(C) - Single RF Sources Subject to Routine Environmental Evaluation" for a minimum separation distance of $R = 0.25$ m.

2A2U3RSU2X is an RF exempt device.

General RF Exposure Considerations:

The device is a Road Side Unit (RSU) for installation in remote positions such as highway gantries. Installation will be performed only by professional installers. The device contains multiple RF sources: a DSRC transmitter, the UMTS/LTE module XPYTOBYL201 and the WLAN/BT/BLE module VPYLBEE5HY1MW. The UNII 5 GHz WLAN is deactivated.

DSRC:

Maximum EIRP values are taken from the test report TÜV AUSTRIA, FG21-126, Section 4.2. As a conservative approach, only the transmit powers of the strongest channels are considered. The transmitter can be configured with internal and external antennas as described in the system description and in the installation manual. As a conservative approach, only configurations with the higher gain antennas are considered. The DSRC part can be configured to use a combination of two transmit chains. As a conservative approach, the ERP/ERPth fractions are first calculated as per §1.1307(b)(3)(ii)(B) for all worst-case configurations and then the two largest fractions are summed up.

WLAN/BT/BLE:

The module is used with an on-board trace antenna, for which no gain measurements are available. Maximum EIRP values are taken from the test report TÜV AUSTRIA, FG21-195, Section 4.2. The 5 GHz WLAN U-NII part of the module is deactivated. The ERP/ERPth fractions are first calculated for each service, but BT, BLE and 2.4 GHz Wifi can not transmit simultaneously (only time-slotted) and the highest ERP/ERPth fraction is then chosen.

UMTS/LTE:

The conducted power output power values are taken from the test report exhibits in the XPYTOBYL201 FCC Grant. More conveniently, the maximum conducted output power values are summarized in the exhibit "MPE Calculation.pdf" of the module's FCC Grant. Maximum antenna gains are taken from the data sheet "Taoglas PA.710.A WARRIOR". As a conservative approach, the maximum gains given across the wider frequency bands in the antenna data sheet are taken, which might be higher than the maximum gains in the narrower UMTS/LTE bands. The ERP/ERPth fractions are first calculated for each band, then the highest value is chosen as the module can't transmit in different bands simultaneously.

Calculation of MPE Exemption, § 1.1307(b)(3)(i)(C)

Calculations were first done in a spreadsheet to determine the lowest required minimum separation distance R such that for multiple RF sources the summation according to § 1.1307(b)(3)(ii)(B) is below 1.

The ERPth values given below are calculated for a minimum separation distance R = 0.25 m.

	frequency [MHz]	ERPth [W]	conducted [W]	max gain [dBi]	EIRP [W]	ERP [W]	ERP/ERPth [1]
DSRC, Serton 1, Ch0	5920	1.2			0.573	0.349	0.291
DSRC, Serton 1, Ch1	5920	1.2			0.562	0.343	0.286
DSRC, Serton 2, Ch1	5920	1.2			0.451	0.275	0.229
Bluetooth	2402	1.2			0.00661	0.004	0.003
BLE	2402	1.2			0.00575	0.004	0.003
2.4 GHz Wifi	2412	1.2			0.07244	0.044	0.037
UNII 5 GHz Wifi deactivated							
UMTS 2			0.282				
LTE 2	1850-1910	1.2	0.181	3.2	0.589	0.359	0.299
LTE 4	1710-1755	1.2	0.211	3.2	0.441	0.269	0.224
UMTS 5			0.282				
LTE 5	824-849	0.6592	0.200	1	0.355	0.216	0.328
LTE 13	777-787	0.6216	0.168	1	0.211	0.129	0.207
LTE 17	704-716	0.5632	0.202	1	0.254	0.155	0.275

Calculation of MPE Exemption for multiple RF sources, § 1.1307(b)(3)(ii)(B)

Calculations were first done in a spreadsheet to determine the lowest required minimum separation distance R such that for multiple RF sources the summation according to § 1.1307(b)(3)(ii)(B) is below 1.

The ERP/ERPth fractions given below are calculated for a minimum separation distance R = 0.25 m.

DSRC	$0.291 + 0.286 = 0.577$
WLAN/BT/BLE	0.037
UMTS/LTE	0.328
Sum	0.942

The lowest required minimum separation distance was determined as R = 0.25 m.

The device 2A2U3RSU2X was determined to be "MPE" Exempt as per KDB 447498 D04 Interim General RF Exposure Guidance v01, version 11/29/2021. No further evaluation is required.

Calculation of MPE Exemption for minimum separation distance R = 0.4 m

For possible co-location with additional transmitters in future applications, the calculation for 40 cm minimum separation distance might be of interest.

The ERPth values given below are calculated for a minimum separation distance R = 0.4 m.

	frequency [MHz]	ERPth [W]	conducted [W]	max gain [dBi]	EIRP [W]	ERP [W]	ERP/ERPth [1]
DSRC, Sektion 1, Ch0	5920	3.072			0.573	0.349	0.114
DSRC, Sektion 1, Ch1	5920	3.072			0.562	0.343	0.112
DSRC, Sektion 2, Ch1	5920	3.072			0.451	0.275	0.089
Bluetooth	2402	3.072			0.00661	0.004	0.001
BLE	2402	3.072			0.00575	0.004	0.001
2.4 GHz Wifi	2412	3.072			0.07244	0.044	0.014
UNII 5 GHz Wifi deactivated							
UMTS 2		3.072	0.282				
LTE 2	1850-1910		0.181	3.2	0.589	0.359	0.117
LTE 4	1710-1755	3.072	0.211	3.2	0.441	0.269	0.088
UMTS 5			0.282				
LTE 5	824-849	1.688	0.200	1	0.355	0.216	0.128
LTE 13	777-787	1.591	0.168	1	0.211	0.129	0.081
LTE 17	704-716	1.442	0.202	1	0.254	0.155	0.108

Summation according to § 1.1307(b)(3)(ii)(B) for a minimum separation distance R = 0.4 m:

DSRC	$0.114 + 0.112 = 0.225$
WLAN/BT/BLE	0.014
UMTS/LTE	0.128
Sum	0.368

At a minimum separation distance R = 0.4 m, the summation according to § 1.1307(b)(3)(ii)(B) results in 0.368, leaving a margin of $1 - 0.368 = 0.632$.

--- END OF TEST REPORT ---