

## RF Exposure Evaluation Report

|                                                         |                                                                                                                                                                       |                                   |                                                                         |
|---------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------|-------------------------------------------------------------------------|
| <b>Date of Report</b>                                   | 30/04/2025                                                                                                                                                            | <b>Client's Contact person:</b>   | Seppo Laakkonen                                                         |
| <b>Number of pages:</b>                                 | 11                                                                                                                                                                    | <b>Responsible Test engineer:</b> | Ilari Kinnunen                                                          |
| <b>Testing laboratory:</b>                              | <b>Verkotan Oy</b><br><br>Elektroniikkatie 17<br>90590 Oulu<br>Finland                                                                                                | <b>Client:</b>                    | <b>Cargotec Oyj</b><br><br>Porkkalankatu 5<br>00180 Helsinki<br>Finland |
| <b>Tested devices</b>                                   | <b>Gateway CE-IMX8-01</b>                                                                                                                                             |                                   |                                                                         |
| <b>Related reports:</b>                                 | -                                                                                                                                                                     |                                   |                                                                         |
| <b>Testing has been carried out in accordance with:</b> | <b>47CFR §2.1091</b><br>Radiofrequency Radiation Exposure Evaluation: Mobile Devices<br><br><b>FCC published RF exposure KDB procedures</b>                           |                                   |                                                                         |
| <b>Documentation:</b>                                   | The test report must always be reproduced in full; reproduction of an excerpt only is subject to written approval of the testing laboratory                           |                                   |                                                                         |
| <b>Test Results:</b>                                    | <b>The DUT complies with the requirements in respect of all parameters subject to the test.</b><br>The test results relate only to devices specified in this document |                                   |                                                                         |

**Date and** 30.04.2025

**signatures:**

For the contents:

*Miia Nurkkala*

**Laboratory Manager**

## TABLE OF CONTENTS

|                                                            |          |
|------------------------------------------------------------|----------|
| <b>1. SUMMARY OF SAR TEST REPORT .....</b>                 | <b>3</b> |
| 1.1 TEST DETAILS.....                                      | 3        |
| 1.2 EVALUATION RESULTS .....                               | 3        |
| 1.2.1 Simultaneous Transmission Exposure.....              | 4        |
| <b>2. DESCRIPTION OF THE DEVICE UNDER TEST (DUT) .....</b> | <b>5</b> |
| 2.1 SUPPORTED FREQUENCY BANDS AND OPERATIONAL MODES .....  | 6        |
| <b>3. TEST EXCLUSIONS .....</b>                            | <b>7</b> |
| <b>4. RESULTS.....</b>                                     | <b>9</b> |
| 4.1 STANDALONE EXPOSURE.....                               | 9        |
| 4.2 SIMULTANEOUS TRANSMISSION ANALYSIS .....               | 10       |

## 1. SUMMARY OF SAR TEST REPORT

### 1.1 Test Details

#### Device under Test (DUT):

|                                          |                                                                                                                                                        |
|------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Product:</b>                          | Gateway                                                                                                                                                |
| <b>Manufacturer:</b>                     | Cargotec                                                                                                                                               |
| <b>Model:</b>                            | CE-IMX8-01                                                                                                                                             |
| <b>Hardware Version:</b>                 | REV A                                                                                                                                                  |
| <b>FCC ID:</b>                           | 2BGMHCE-IMX8-01<br>Contains FCC ID: XMR201906EG21G<br>Contains FCC ID: VPYLB1XK                                                                        |
| <b>Mobile/Portable device</b>            | Mobile                                                                                                                                                 |
| <b>Document ID:</b>                      | FCC RF exposure evaluation report_Cargotec Gateway_ID6207_30042025.docx                                                                                |
| <b>Document History/changes</b>          | This test report replaces report "FCC RF exposure evaluation report_Cargotec Gateway_ID6207_22042025.docx". Updated "47CFR §2.1091" in the front page. |
| <b>FCC Test Firm Designation Number:</b> | FI0005                                                                                                                                                 |

### 1.2 Evaluation Results

The device conforms to the requirements of the standards when the maximum ERP is less than or equal to the Test Exclusion Threshold Limit.

| System               | Maximum ERP [mW] | MPE-Based Exemption threshold at 50cm separation [mW] | Result |
|----------------------|------------------|-------------------------------------------------------|--------|
| WLAN 2.4GHz          | 79               | 4800                                                  | PASS   |
| Bluetooth 5.2        | 4                | 4800                                                  | PASS   |
| GSM 850              | 679              | 2637                                                  | PASS   |
| GPRS 850, 1-tx slot  | 679              | 2637                                                  | PASS   |
| GPRS 850, 2-tx slot  | 1079             | 2637                                                  | PASS   |
| GPRS 850, 3-tx slot  | 1285             | 2637                                                  | PASS   |
| GPRS 850, 4-tx slot  | 1081             | 2637                                                  | PASS   |
| GSM 1900             | 382              | 4800                                                  | PASS   |
| GPRS 1900, 1-tx slot | 382              | 4800                                                  | PASS   |
| GPRS 1900, 2-tx slot | 541              | 4800                                                  | PASS   |
| GPRS 1900, 3-tx slot | 574              | 4800                                                  | PASS   |
| GPRS 1900, 4-tx slot | 608              | 4800                                                  | PASS   |
| WCDMA 2              | 610              | 4800                                                  | PASS   |

|         |     |      |      |
|---------|-----|------|------|
| WCDMA 4 | 610 | 4800 | PASS |
| WCDMA 5 | 543 | 2637 | PASS |
| LTE 2   | 610 | 4800 | PASS |
| LTE 4   | 610 | 4800 | PASS |
| LTE 5   | 543 | 2637 | PASS |
| LTE 7   | 432 | 4800 | PASS |
| LTE 12  | 543 | 2237 | PASS |
| LTE 13  | 543 | 2486 | PASS |
| LTE 25  | 610 | 4800 | PASS |
| LTE 26  | 543 | 2605 | PASS |
| LTE 40  | 385 | 4800 | PASS |
| LTE 41  | 385 | 4800 | PASS |

### 1.2.1 Simultaneous Transmission Exposure

| System                                | $\sum ERP_j / ERP_{th,j}$ | Limit | Result |
|---------------------------------------|---------------------------|-------|--------|
| GPRS 850, 3-tx slot +<br>WLAN 2.4 GHz | 0.51                      | 1     | PASS   |

## 2. DESCRIPTION OF THE DEVICE UNDER TEST (DUT)

The DUT is a rugged low power gateway that is used for connecting cargo and load handling solutions to cloud services. It is designed for installation operating in worldwide environmental conditions.

The DUT supports cellular, WLAN 2.4 GHz and Bluetooth technologies. It has Murata LBEE5CJ1XK-687 WLAN/BT module and Quectel EG21-G cellular module.

According to the customer the minimum separation distance to the user from the antenna is 50 cm.



According to antenna datasheet "Cargotec gatewayCE-IMX08-1\_CB-v2.2.pdf" antenna gain is:

698-960MHz, 4.5dBi  
1710-1880MHz, 5dBi  
1920-2170MHz, 4.5dBi  
2300-2400MHz, 3.0dBi  
2500-2690MHz, 3.5dBi  
2400-2485MHz, 2.15dBi

|                             |                                  |
|-----------------------------|----------------------------------|
| <b>Exposure Environment</b> | General population, uncontrolled |
|-----------------------------|----------------------------------|

## 2.1 Supported Frequency Bands and Operational Modes

| TX<br>Frequency<br>bands | Modes of Operation | Transmitter Frequency<br>Range (MHz) |
|--------------------------|--------------------|--------------------------------------|
|                          | WLAN 2.4GHz        | 2412 – 2462                          |
|                          | Bluetooth 5.2      | 2402 – 2480                          |
|                          | GSM 850            | 824 – 849                            |
|                          | GSM 1900           | 1850 – 1910                          |
|                          | WCDMA 2            | 1850 – 1910                          |
|                          | WCDMA 4            | 1710 – 1755                          |
|                          | WCDMA 5            | 824 – 849                            |
|                          | LTE 2              | 1850 – 1910                          |
|                          | LTE 4              | 1710 – 1755                          |
|                          | LTE 5              | 824 – 849                            |
|                          | LTE 7              | 2500 – 2570                          |
|                          | LTE 12             | 698 – 716                            |
|                          | LTE 13             | 777 – 787                            |
|                          | LTE 25             | 1850 – 1915                          |
|                          | LTE 26             | 814 – 849                            |
|                          | LTE 40             | 2300 – 2400                          |
|                          | LTE 41             | 2496 – 2690                          |

### 3. TEST EXCLUSIONS

FCC MPE-based Exemption thresholds in 447498 D04 Interim General RF Exposure Guidance v01 are shown in a table below.

**TABLE B.1—THRESHOLDS FOR SINGLE RF SOURCES  
SUBJECT TO ROUTINE ENVIRONMENTAL EVALUATION**

| RF Source Frequency                                                                                                                      |   |           | Minimum Distance   |   |                    | Threshold ERP                        |
|------------------------------------------------------------------------------------------------------------------------------------------|---|-----------|--------------------|---|--------------------|--------------------------------------|
| $f_L$ MHz                                                                                                                                |   | $f_H$ MHz | $\lambda_L / 2\pi$ |   | $\lambda_H / 2\pi$ | W                                    |
| 0.3                                                                                                                                      | – | 1.34      | 159 m              | – | 35.6 m             | 1,920 R <sup>2</sup>                 |
| 1.34                                                                                                                                     | – | 30        | 35.6 m             | – | 1.6 m              | 3,450 R <sup>2</sup> /f <sup>2</sup> |
| 30                                                                                                                                       | – | 300       | 1.6 m              | – | 159 mm             | 3.83 R <sup>2</sup>                  |
| 300                                                                                                                                      | – | 1,500     | 159 mm             | – | 31.8 mm            | 0.0128 R <sup>2</sup> f              |
| 1,500                                                                                                                                    | – | 100,000   | 31.8 mm            | – | 0.5 mm             | 19.2R <sup>2</sup>                   |
| Subscripts L and H are low and high; $\lambda$ is wavelength.<br>From § 1.1307(b)(3)(i)(C), modified by adding Minimum Distance columns. |   |           |                    |   |                    |                                      |

According to Table B.1 in 447498 D04 Interim General RF Exposure Guidance v01, FCC MPE-based Exemption threshold can be calculated according to formulas:

$$\begin{aligned}
 300\text{-}1500 \text{ MHz:} & \quad 0.0128 * R^2 * f \\
 1500\text{-}100\,000 \text{ MHz:} & \quad 19.2R^2
 \end{aligned}$$

where:

R = Separation distance (m)

f = Frequency (MHz)

| Transmission mode | Frequency (f) | Separation distance (d) | P <sub>th</sub> [W] | P <sub>th</sub> [mW] |
|-------------------|---------------|-------------------------|---------------------|----------------------|
| WLAN 2.4GHz       | 2412          | 0.5                     | 4.800               | <b>4800</b>          |
| Bluetooth 5.2     | 2402          | 0.5                     | 4.800               | <b>4800</b>          |
| GSM 850           | 824           | 0.5                     | 2.637               | <b>2637</b>          |
| GPRS 850, 1-tx    | 824           | 0.5                     | 2.637               | <b>2637</b>          |
| GPRS 850, 2-tx    | 824           | 0.5                     | 2.637               | <b>2637</b>          |
| GPRS 850, 3-tx    | 824           | 0.5                     | 2.637               | <b>2637</b>          |
| GPRS 850, 4-tx    | 824           | 0.5                     | 2.637               | <b>2637</b>          |
| GSM 1900          | 1850          | 0.5                     | 4.800               | <b>4800</b>          |
| GPRS 1900, 1-tx   | 1850          | 0.5                     | 4.800               | <b>4800</b>          |
| GPRS 1900, 2-tx   | 1850          | 0.5                     | 4.800               | <b>4800</b>          |
| GPRS 1900, 3-tx   | 1850          | 0.5                     | 4.800               | <b>4800</b>          |
| GPRS 1900, 4-tx   | 1850          | 0.5                     | 4.800               | <b>4800</b>          |

|         |      |     |       |             |
|---------|------|-----|-------|-------------|
| WCDMA 2 | 1850 | 0.5 | 4.800 | <b>4800</b> |
| WCDMA 4 | 1710 | 0.5 | 4.800 | <b>4800</b> |
| WCDMA 5 | 824  | 0.5 | 2.637 | <b>2637</b> |
| LTE 2   | 1850 | 0.5 | 4.800 | <b>4800</b> |
| LTE 4   | 1710 | 0.5 | 4.800 | <b>4800</b> |
| LTE 5   | 824  | 0.5 | 2.637 | <b>2637</b> |
| LTE 7   | 2500 | 0.5 | 4.800 | <b>4800</b> |
| LTE 12  | 699  | 0.5 | 2.237 | <b>2237</b> |
| LTE 13  | 777  | 0.5 | 2.486 | <b>2486</b> |
| LTE 25  | 1850 | 0.5 | 4.800 | <b>4800</b> |
| LTE 26  | 814  | 0.5 | 2.605 | <b>2605</b> |
| LTE 40  | 2300 | 0.5 | 4.800 | <b>4800</b> |
| LTE 41  | 2496 | 0.5 | 4.800 | <b>4800</b> |



## 4. RESULTS

### 4.1 Standalone Exposure

| Transmission mode    | Maximum Conducted Power [dBm] | Time-Averaged Output power [dBm] | Time-Averaged Output power [mW] | Power Gain of Antenna, G [dBi] | Time-Averaged EIRP [dBm] | Time-Averaged ERP [dBm] | Time-Averaged ERP [mW] | P <sub>th</sub> [mW] |
|----------------------|-------------------------------|----------------------------------|---------------------------------|--------------------------------|--------------------------|-------------------------|------------------------|----------------------|
| WLAN 2.4GHz          | 19.0                          | 19.0                             | 79                              | 2.15                           | 21.15                    | 19.00                   | 79                     | 4800                 |
| Bluetooth 5.2        | 6.3                           | 6.3                              | 4                               | 2.15                           | 8.45                     | 6.30                    | 4                      | 4800                 |
| GSM 850              | 35.0                          | 26.0                             | 395                             | 4.50                           | 30.47                    | 28.32                   | 679                    | 2637                 |
| GPRS 850, 1-tx slot  | 35.0                          | 26.0                             | 395                             | 4.50                           | 30.47                    | 28.32                   | 679                    | 2637                 |
| GPRS 850, 2-tx slot  | 34.0                          | 28.0                             | 628                             | 4.50                           | 32.48                    | 30.33                   | 1079                   | 2637                 |
| GPRS 850, 3-tx slot  | 33.0                          | 28.7                             | 748                             | 4.50                           | 33.24                    | 31.09                   | 1285                   | 2637                 |
| GPRS 850, 4-tx slot  | 31.0                          | 28.0                             | 629                             | 4.50                           | 32.49                    | 30.34                   | 1081                   | 2637                 |
| GSM 1900             | 32                            | 23.0                             | 198                             | 5.00                           | 27.97                    | 25.82                   | 382                    | 4800                 |
| GPRS 1900, 1-tx slot | 32                            | 23.0                             | 198                             | 5.00                           | 27.97                    | 25.82                   | 382                    | 4800                 |
| GPRS 1900, 2-tx slot | 30.5                          | 24.5                             | 281                             | 5.00                           | 29.48                    | 27.33                   | 541                    | 4800                 |
| GPRS 1900, 3-tx slot | 29                            | 24.7                             | 298                             | 5.00                           | 29.74                    | 27.59                   | 574                    | 4800                 |
| GPRS 1900, 4-tx slot | 28                            | 25.0                             | 315                             | 5.00                           | 29.99                    | 27.84                   | 608                    | 4800                 |
| WCDMA 2              | 25                            | 25.0                             | 316                             | 5.00                           | 30.00                    | 27.85                   | 610                    | 4800                 |
| WCDMA 4              | 25                            | 25.0                             | 316                             | 5.00                           | 30.00                    | 27.85                   | 610                    | 4800                 |
| WCDMA 5              | 25                            | 25.0                             | 316                             | 4.50                           | 29.50                    | 27.35                   | 543                    | 2637                 |
| LTE 2                | 25                            | 25.0                             | 316                             | 5.00                           | 30.00                    | 27.85                   | 610                    | 4800                 |
| LTE 4                | 25                            | 25.0                             | 316                             | 5.00                           | 30.00                    | 27.85                   | 610                    | 4800                 |
| LTE 5                | 25                            | 25.0                             | 316                             | 4.50                           | 29.50                    | 27.35                   | 543                    | 2637                 |
| LTE 7                | 25                            | 25.0                             | 316                             | 3.50                           | 28.50                    | 26.35                   | 432                    | 4800                 |
| LTE 12               | 25                            | 25.0                             | 316                             | 4.50                           | 29.50                    | 27.35                   | 543                    | 2237                 |
| LTE 13               | 25                            | 25.0                             | 316                             | 4.50                           | 29.50                    | 27.35                   | 543                    | 2486                 |
| LTE 25               | 25                            | 25.0                             | 316                             | 5.00                           | 30.00                    | 27.85                   | 610                    | 4800                 |
| LTE 26               | 25                            | 25.0                             | 316                             | 4.50                           | 29.50                    | 27.35                   | 543                    | 2605                 |
| LTE 40               | 25                            | 25.0                             | 316                             | 3.00                           | 28.00                    | 25.85                   | 385                    | 4800                 |
| LTE 41               | 25                            | 25.0                             | 316                             | 3.00                           | 28.00                    | 25.85                   | 385                    | 4800                 |

The ERP of the DUT is below the test exclusion threshold.

## 4.2 Simultaneous Transmission Analysis

The simultaneous transmission compliance is determined by sum of the ratios that can be transmitting simultaneously using formula C.1 from 447498 D04 Interim General RF Exposure Guidance v01.

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

where

$ERP_j$  = the available maximum time-averaged power or the ERP, whichever is greater, of fixed, mobile, or portable RF source j.

$ERP_{th,j}$  = exemption threshold ERP for fixed, mobile, or portable RF source j, at a distance of at least  $\lambda/2\pi$ , according to the applicable § 1.1307(b)(3)(i)(C) Table 1 formula at the location in question.

Following simultaneous transmission combinations are supported:

Cellular + WLAN 2.4 GHz  
Cellular + Bluetooth 5.2

| Transmission mode                           | ERP <sub>j</sub> / ERP <sub>th,j</sub> |
|---------------------------------------------|----------------------------------------|
| WLAN 2.4GHz                                 | 0.02                                   |
| Bluetooth 5.2                               | 0.001                                  |
| GSM 850                                     | 0.26                                   |
| GPRS 850, 1-tx slot                         | 0.26                                   |
| GPRS 850, 2-tx slot                         | 0.41                                   |
| GPRS 850, 3-tx slot                         | 0.49                                   |
| GPRS 850, 4-tx slot                         | 0.41                                   |
| GSM 1900                                    | 0.08                                   |
| GPRS 1900, 1-tx slot                        | 0.08                                   |
| GPRS 1900, 2-tx slot                        | 0.11                                   |
| GPRS 1900, 3-tx slot                        | 0.12                                   |
| GPRS 1900, 4-tx slot                        | 0.13                                   |
| WCDMA 2                                     | 0.13                                   |
| WCDMA 4                                     | 0.13                                   |
| WCDMA 5                                     | 0.21                                   |
| LTE 2                                       | 0.13                                   |
| LTE 4                                       | 0.13                                   |
| LTE 5                                       | 0.21                                   |
| LTE 7                                       | 0.09                                   |
| LTE 12                                      | 0.24                                   |
| LTE 13                                      | 0.22                                   |
| LTE 25                                      | 0.13                                   |
| LTE 26                                      | 0.21                                   |
| LTE 40                                      | 0.08                                   |
| LTE 41                                      | 0.08                                   |
| <b>Maximum Cellular</b>                     | <b>0.49</b>                            |
| <b>Maximum WLAN 2.4 GHz / Bluetooth 5.2</b> | <b>0.02</b>                            |
| <b>Summation</b>                            | <b>0.51</b>                            |

The sum of simultaneously transmitting radios is below 1 thus the results are **PASS**.