

TEST REPORT

No.: 17-1-0078101T02a-C1

According to:
FCC Regulations
 Part 1.1310 , Part 2.1091

for
Gemalto M2M GmbH

EMS31-V

FCC-ID: QIPEMS31-V







| Laboratory Accreditation and Listings | | | |
|--|--|--|---|
|  DAKKS <small>Deutsche Akkreditierungsstelle D-PL-12047-01-01</small> |  FCC <small>FEDERAL COMMUNICATIONS COMMISSION USA</small> MRA US-EU 0003 |  Industry Canada Reg. No.: 3462D-2 Reg. No.: 3462D-3 |  Voluntary Controls for Electromagnetic Emissions Reg. No.: R-2666 C-2914, T-1967, G-301 |
|  WiFi <small>ALLIANCE</small> AUTHORIZED RF LABORATORY |  ctia Authorized Test Lab <small>Lab Code: 20011130-00</small> | | |
| accredited according to DIN EN ISO/IEC 17025 | | | |
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1. Summary of test results

The test results apply exclusively to the test samples as presented in this Report. The CETECOM GmbH does not assume responsibility for any conclusions and generalizations taken in conjunction with other specimens or samples of the type of the item presented to tests.

Following tests have been performed to show compliance with applicable FCC Part 2.1091 and FCC Part 1.1310 of the FCC CFR 47 Rules.

1.1 Summary of tests results

| RF-Exposure Evaluation (separation distance user to RF-radiating element greater 20cm) | | | | | | |
|--|---|---------------------|--|------------|--------------|--------|
| Test cases | Port | References & Limits | | EUT set-up | EUT op. mode | Result |
| | | FCC Standard | Test Limit | | | |
| Radio frequency radiation exposure Requirements | Cabinet + Inter-Connecting Cables (conducted) | §2.1091 §2.1093 | RF-Field Strength Limits: FCC: "general population/ uncontrolled" environment | 1 | 1 | Pass |

The current version of the Test Report CETECOM-17-1-0078101T02a-C1 replaces the Test Report CETECOM-17-1-0078101T02a dated 2017-11-30. The replaced test report is herewith invalid.

.....
 Dipl.-Ing. Rachid Acharkaoui
 Responsible for test section

.....
 B.Eng. Martin Nunier
 Responsible for test report

1.2 Summary of product description

| | | |
|---------------------|--|--|
| FCC ID: | QIPEMS31-V | |
| Product name | EMS31-V | |
| Exposure category | <input checked="" type="checkbox"/> General population/uncontrolled environment <input type="checkbox"/> Occupational exposure/controlled environment | |
| Output power | <input checked="" type="checkbox"/> Conducted <input type="checkbox"/> ERP <input type="checkbox"/> EIRP <input checked="" type="checkbox"/> Peak <input checked="" type="checkbox"/> Source-based time-averaging | |
| Antenna gain | none | |
| Technology | <input type="checkbox"/> MIMO | <input type="checkbox"/> 2T2R <input type="checkbox"/> 3T3R <input type="checkbox"/> 4T4R |
| | <input checked="" type="checkbox"/> non-MIMO | <input checked="" type="checkbox"/> 1T1R <input type="checkbox"/> 1T2R <input type="checkbox"/> 2T1R |
| Evaluation type | <input checked="" type="checkbox"/> Standalone <input type="checkbox"/> Simultaneous transmission | |
| Evaluation distance | <input checked="" type="checkbox"/> 20 cm | |
| | <input type="checkbox"/> XXX cm | declares by manufacturer |
| EUT type | <input checked="" type="checkbox"/> Production Unit <input type="checkbox"/> Engineering Unit | |
| Device type | <input checked="" type="checkbox"/> Mobile device <input type="checkbox"/> Fixed device | |
| Refer rules | <input checked="" type="checkbox"/> CFR 47 FCC Part 2.1091 <input checked="" type="checkbox"/> CFR 47 FCC Part 1.1310 <input checked="" type="checkbox"/> KDB 447497 D01v06 October 23, 2015 <input checked="" type="checkbox"/> KDB 865664 D01v01r04 August 7, 2015 <input checked="" type="checkbox"/> KDB 865664 D02v01r02 October 23, 2015 | |

1.3 Refer Rules

| | |
|---------------------------------------|---|
| ANSI C95.1-1999 | IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz. |
| KDB 447498 D01 v06 October 23, 2015 | Mobile and Portable Devices RF Exposure Procedures and Equipment Authorization Policies. |
| KDB 865664 D01v01r04 August 7, 2015 | SAR measurement requirements for 100 MHz to 6 GHz |
| KDB 865664 D02v01r02 October 23, 2015 | RF Exposure Compliance Reporting and Documentation Considerations. |
| CFR 47 FCC Part 2.1091 | Radiofrequency radiation exposure evaluation: mobile devices. |
| CFR 47 FCC Part 1.1310 | Radiofrequency radiation exposure limits. |

1.4 EUT Technologies

| Wireless Technologies | Frequency bands | Operation mode | | Duty cycle |
|---|---|--|---|---|
| <input type="checkbox"/> GSM | <input type="checkbox"/> 850 <input type="checkbox"/> 1900 | Voice (GMSK) | 1 slot | <input type="checkbox"/> 12.5% |
| | <input type="checkbox"/> Support DTM (Dual Transfer Mode) | | | |
| <input type="checkbox"/> GPRS | <input type="checkbox"/> 850 <input type="checkbox"/> 1900 | GPRS (GMSK) Multi – Slot Class | <input type="checkbox"/> 8 1 slot (1 Up, 4 Down) | <input type="checkbox"/> 12.5% |
| | | | <input type="checkbox"/> 10 2 slots (2 Up, 4 Down) | <input type="checkbox"/> 12.5% <input type="checkbox"/> 25% |
| | | | <input type="checkbox"/> 12 4 slots (4 Up, 4 Down) | <input type="checkbox"/> 12.5% <input type="checkbox"/> 25% <input type="checkbox"/> 37.5% <input type="checkbox"/> 50% |
| <input type="checkbox"/> EDGE | <input type="checkbox"/> 850 <input type="checkbox"/> 1900 | EDGE (8-PSK) Multi – Slot Class | <input type="checkbox"/> 8 1 slot (1 Up, 4 Down) | <input type="checkbox"/> 12.5% |
| | | | <input type="checkbox"/> 10 2 slots (2 Up, 4 Down) | <input type="checkbox"/> 12.5% <input type="checkbox"/> 25% |
| | | | <input type="checkbox"/> 12 4 slots (4 Up, 4 Down) | <input type="checkbox"/> 12.5% <input type="checkbox"/> 25% <input type="checkbox"/> 37.5% <input type="checkbox"/> 50% |
| <input type="checkbox"/> WCDMA (UMTS) | <input type="checkbox"/> Band II <input type="checkbox"/> Band IV <input type="checkbox"/> Band V | <input type="checkbox"/> UMTS Rel.99 (Voice & Data) <input type="checkbox"/> HSDPA(Rel.5) <input type="checkbox"/> HSUPA(Rel.6) <input type="checkbox"/> DC-HSDPA(Rel.8) <input type="checkbox"/> HSPA+(Rel.7) | | <input type="checkbox"/> 100% |
| <input type="checkbox"/> CDMA (CDMA2000) | <input type="checkbox"/> BC0 <input type="checkbox"/> BC1 <input type="checkbox"/> BC10 | <input type="checkbox"/> 1xRTT (Voice & Data) <input type="checkbox"/> 1xEVDO Rel.0 <input type="checkbox"/> 1xEVDO Rel.A <input type="checkbox"/> 1xAdvanced | | <input type="checkbox"/> 100% |
| <input type="checkbox"/> Support SV-DO (1xRTT-1xEVDO) | | | | |
| <input checked="" type="checkbox"/> LTE-FDD | <input type="checkbox"/> Band 2 <input type="checkbox"/> Band 4 <input type="checkbox"/> Band 5 <input type="checkbox"/> Band 7 <input type="checkbox"/> Band 12 <input checked="" type="checkbox"/> Band 13 <input type="checkbox"/> Band 17 <input type="checkbox"/> Band 25 <input type="checkbox"/> Band 26 <input type="checkbox"/> Band 27 <input type="checkbox"/> Band 30 | <input checked="" type="checkbox"/> QPSK <input checked="" type="checkbox"/> 16QAM | <input type="checkbox"/> Rel.11 Carrier Aggregation <input type="checkbox"/> 2 Uplinks 2 Downlinks <input type="checkbox"/> 2 Uplinks 3 Downlinks <input type="checkbox"/> 3 Uplinks 2 Downlinks <input type="checkbox"/> 3 Uplinks 3 Downlinks | 100% |
| | | <input type="checkbox"/> Supports SV-LTE (1xRTT-LTE) | | |
| <input type="checkbox"/> LTE-TDD | <input type="checkbox"/> Band 38 <input type="checkbox"/> Band 39 <input type="checkbox"/> Band 40 <input type="checkbox"/> Band 41 <input type="checkbox"/> Band 42 | <input type="checkbox"/> QPSK <input type="checkbox"/> 16QAM | <input type="checkbox"/> Rel.11 Carrier Aggregation <input type="checkbox"/> 2 Uplinks 2 Downlinks <input type="checkbox"/> 2 Uplinks 3 Downlinks <input type="checkbox"/> 3 Uplinks 2 Downlinks <input type="checkbox"/> 3 Uplinks 3 Downlinks | 63.3% This device supports uplink-downlink configuration 0-6. The configuration with highest duty cycle was used (configuration. 0 at 63.3%) |
| | | <input type="checkbox"/> Supports SV-LTE (1xRTT-LTE) | | |
| <input type="checkbox"/> Wi-Fi | <input type="checkbox"/> 2.4GHz | <input type="checkbox"/> IEEE 802.11b | <input type="checkbox"/> 2412 – 2462 MHz <input type="checkbox"/> 2412 – 2472 MHz | <input type="checkbox"/> 100% |
| | | <input type="checkbox"/> IEEE 802.11g | <input type="checkbox"/> 2412 – 2462 MHz <input type="checkbox"/> 2412 – 2472 MHz | <input type="checkbox"/> 100% |
| | | <input type="checkbox"/> IEEE 802.11n | <input type="checkbox"/> 2412 – 2462 MHz | <input type="checkbox"/> 100% |

| | | | | |
|------------------------------------|---------------------------------|---|--|--------------------------------|
| | | HT20 | <input type="checkbox"/> 2412 – 2472 MHz | |
| | | <input type="checkbox"/> IEEE 802.11n HT40 | <input type="checkbox"/> 2422 – 2452 MHz | <input type="checkbox"/> 100% |
| | <input type="checkbox"/> 5GHz | <input type="checkbox"/> IEEE 802.11a | <input type="checkbox"/> 5180 – 5240 MHz <input type="checkbox"/> 5260 – 5320 MHz <input type="checkbox"/> 5500 – 5700 MHz <input type="checkbox"/> 5745 – 5825 MHz | <input type="checkbox"/> 100% |
| | | <input type="checkbox"/> IEEE 802.11n HT20 | <input type="checkbox"/> 5180 – 5240 MHz <input type="checkbox"/> 5260 – 5320 MHz <input type="checkbox"/> 5500 – 5700 MHz <input type="checkbox"/> 5745 – 5825 MHz | <input type="checkbox"/> 100% |
| | | <input type="checkbox"/> IEEE 802.11n HT40 | <input type="checkbox"/> 5190 – 5230 MHz <input type="checkbox"/> 5270 – 5310 MHz <input type="checkbox"/> 5510 – 5670 MHz <input type="checkbox"/> 5755 – 5795 MHz | <input type="checkbox"/> 100% |
| | | <input type="checkbox"/> IEEE 802.11ac VHT20 | <input type="checkbox"/> 5180 – 5240 MHz <input type="checkbox"/> 5260 – 5320 MHz <input type="checkbox"/> 5500 – 5700 MHz <input type="checkbox"/> 5745 – 5825 MHz | <input type="checkbox"/> 100% |
| | | <input type="checkbox"/> IEEE 802.11ac VHT40 | <input type="checkbox"/> 5190 – 5230 MHz <input type="checkbox"/> 5270 – 5310 MHz <input type="checkbox"/> 5510 – 5670 MHz <input type="checkbox"/> 5755 – 5795 MHz | <input type="checkbox"/> 100% |
| | | <input type="checkbox"/> IEEE 802.11ac VHT80 | <input type="checkbox"/> 5210 – 5210 MHz <input type="checkbox"/> 5290 – 5290 MHz <input type="checkbox"/> 5530 – 5530 MHz <input type="checkbox"/> 5775 – 5775 MHz | <input type="checkbox"/> 100% |
| | | <input type="checkbox"/> Supports Band gap channels | | |
| <input type="checkbox"/> Others | <input type="checkbox"/> 2.4GHz | <input type="checkbox"/> 1 MHz Bandwidth | <input type="checkbox"/> 2402 – 2472 MHz | <input type="checkbox"/> 100% |
| <input type="checkbox"/> Bluetooth | <input type="checkbox"/> 2.4GHz | <input type="checkbox"/> Version 2.1+EDR | | <input type="checkbox"/> 77.5% |
| | | <input type="checkbox"/> Version 3.0+HS | | <input type="checkbox"/> 77.5% |
| | | <input type="checkbox"/> Version 4.0 | | <input type="checkbox"/> 100% |
| | | <input type="checkbox"/> Version 4.1+EDR | | <input type="checkbox"/> 77.5% |
| | | <input type="checkbox"/> Version 4.2+EDR | | <input type="checkbox"/> 77.5% |

1.5 Antenna Information

| Wireless Technologies | Frequency bands | Antenna type | Maximum antenna gain | |
|--|-----------------------------------|---|------------------------------------|--|
| <input type="checkbox"/> GSM | <input type="checkbox"/> 850 | <input type="checkbox"/> PIFA <input type="checkbox"/> PCB <input type="checkbox"/> | <input type="checkbox"/> Antenna 0 | |
| | | <input type="checkbox"/> PIFA <input type="checkbox"/> PCB <input type="checkbox"/> | <input type="checkbox"/> Antenna 1 | |
| <input type="checkbox"/> GSM | <input type="checkbox"/> 1900 | <input type="checkbox"/> PIFA <input type="checkbox"/> PCB <input type="checkbox"/> | <input type="checkbox"/> Antenna 0 | |
| | | <input type="checkbox"/> PIFA <input type="checkbox"/> PCB <input type="checkbox"/> | <input type="checkbox"/> Antenna 1 | |
| <input type="checkbox"/> WCDMA (UMTS) | <input type="checkbox"/> Band II | <input type="checkbox"/> PIFA <input type="checkbox"/> PCB <input type="checkbox"/> | <input type="checkbox"/> Antenna 0 | |
| | | <input type="checkbox"/> PIFA <input type="checkbox"/> PCB <input type="checkbox"/> | <input type="checkbox"/> Antenna 1 | |
| | <input type="checkbox"/> Band IV | <input type="checkbox"/> PIFA <input type="checkbox"/> PCB <input type="checkbox"/> | <input type="checkbox"/> Antenna 0 | |
| | | <input type="checkbox"/> PIFA <input type="checkbox"/> PCB <input type="checkbox"/> | <input type="checkbox"/> Antenna 1 | |
| | <input type="checkbox"/> Band V | <input type="checkbox"/> PIFA <input type="checkbox"/> PCB <input type="checkbox"/> | <input type="checkbox"/> Antenna 0 | |
| | | <input type="checkbox"/> PIFA <input type="checkbox"/> PCB <input type="checkbox"/> | <input type="checkbox"/> Antenna 1 | |
| <input type="checkbox"/> CDMA (CDMA2000) | <input type="checkbox"/> CDMA800 | <input type="checkbox"/> PIFA <input type="checkbox"/> PCB <input type="checkbox"/> | <input type="checkbox"/> Antenna 0 | |
| | | <input type="checkbox"/> PIFA <input type="checkbox"/> PCB <input type="checkbox"/> | <input type="checkbox"/> Antenna 1 | |
| | <input type="checkbox"/> CDMA1900 | <input type="checkbox"/> PIFA <input type="checkbox"/> PCB <input type="checkbox"/> | <input type="checkbox"/> Antenna 0 | |
| | | <input type="checkbox"/> PIFA <input type="checkbox"/> PCB <input type="checkbox"/> | <input type="checkbox"/> Antenna 1 | |
| <input type="checkbox"/> LTE-FDD | <input type="checkbox"/> Band 2 | <input type="checkbox"/> PIFA <input type="checkbox"/> PCB <input type="checkbox"/> | <input type="checkbox"/> Antenna 0 | |
| | | <input type="checkbox"/> PIFA <input type="checkbox"/> PCB <input type="checkbox"/> | <input type="checkbox"/> Antenna 1 | |
| | <input type="checkbox"/> Band 4 | <input type="checkbox"/> PIFA <input type="checkbox"/> PCB <input type="checkbox"/> | <input type="checkbox"/> Antenna 0 | |
| | | <input type="checkbox"/> PIFA <input type="checkbox"/> PCB <input type="checkbox"/> | <input type="checkbox"/> Antenna 1 | |
| | <input type="checkbox"/> Band 5 | <input type="checkbox"/> PIFA <input type="checkbox"/> PCB <input type="checkbox"/> | <input type="checkbox"/> Antenna 0 | |

| | | | | |
|---|---|---|------------------------------------|--|
| | | <input type="checkbox"/> PIFA <input type="checkbox"/> PCB <input type="checkbox"/> | <input type="checkbox"/> Antenna 1 | |
| | <input type="checkbox"/> Band 7 | <input type="checkbox"/> PIFA <input type="checkbox"/> PCB <input type="checkbox"/> | <input type="checkbox"/> Antenna 0 | |
| | | <input type="checkbox"/> PIFA <input type="checkbox"/> PCB <input type="checkbox"/> | <input type="checkbox"/> Antenna 1 | |
| | | <input type="checkbox"/> PIFA <input type="checkbox"/> PCB <input type="checkbox"/> | <input type="checkbox"/> Antenna 0 | |
| | <input type="checkbox"/> Band 12 | <input type="checkbox"/> PIFA <input type="checkbox"/> PCB <input type="checkbox"/> | <input type="checkbox"/> Antenna 1 | |
| | | <input type="checkbox"/> PIFA <input type="checkbox"/> PCB <input type="checkbox"/> | <input type="checkbox"/> Antenna 0 | |
| | | <input type="checkbox"/> PIFA <input type="checkbox"/> PCB <input type="checkbox"/> | <input type="checkbox"/> Antenna 0 | |
| | <input type="checkbox"/> Band 13 | <input type="checkbox"/> PIFA <input type="checkbox"/> PCB <input type="checkbox"/> | <input type="checkbox"/> Antenna 1 | |
| | | <input type="checkbox"/> PIFA <input type="checkbox"/> PCB <input type="checkbox"/> | <input type="checkbox"/> Antenna 0 | |
| | | <input type="checkbox"/> PIFA <input type="checkbox"/> PCB <input type="checkbox"/> | <input type="checkbox"/> Antenna 0 | |
| | <input type="checkbox"/> Band 17 | <input type="checkbox"/> PIFA <input type="checkbox"/> PCB <input type="checkbox"/> | <input type="checkbox"/> Antenna 1 | |
| | | <input type="checkbox"/> PIFA <input type="checkbox"/> PCB <input type="checkbox"/> | <input type="checkbox"/> Antenna 0 | |
| | | <input type="checkbox"/> PIFA <input type="checkbox"/> PCB <input type="checkbox"/> | <input type="checkbox"/> Antenna 0 | |
| | <input type="checkbox"/> Band 25 | <input type="checkbox"/> PIFA <input type="checkbox"/> PCB <input type="checkbox"/> | <input type="checkbox"/> Antenna 1 | |
| | | <input type="checkbox"/> PIFA <input type="checkbox"/> PCB <input type="checkbox"/> | <input type="checkbox"/> Antenna 0 | |
| | | <input type="checkbox"/> PIFA <input type="checkbox"/> PCB <input type="checkbox"/> | <input type="checkbox"/> Antenna 0 | |
| | <input type="checkbox"/> Band 26 | <input type="checkbox"/> PIFA <input type="checkbox"/> PCB <input type="checkbox"/> | <input type="checkbox"/> Antenna 1 | |
| | | <input type="checkbox"/> PIFA <input type="checkbox"/> PCB <input type="checkbox"/> | <input type="checkbox"/> Antenna 0 | |
| <input type="checkbox"/> PIFA <input type="checkbox"/> PCB <input type="checkbox"/> | | <input type="checkbox"/> Antenna 0 | | |
| <input type="checkbox"/> Band 27 | <input type="checkbox"/> PIFA <input type="checkbox"/> PCB <input type="checkbox"/> | <input type="checkbox"/> Antenna 1 | | |
| | <input type="checkbox"/> PIFA <input type="checkbox"/> PCB <input type="checkbox"/> | <input type="checkbox"/> Antenna 0 | | |
| | <input type="checkbox"/> PIFA <input type="checkbox"/> PCB <input type="checkbox"/> | <input type="checkbox"/> Antenna 0 | | |
| <input type="checkbox"/> LTE-TDD | <input type="checkbox"/> Band 38 | <input type="checkbox"/> PIFA <input type="checkbox"/> PCB <input type="checkbox"/> | <input type="checkbox"/> Antenna 1 | |
| | | <input type="checkbox"/> PIFA <input type="checkbox"/> PCB <input type="checkbox"/> | <input type="checkbox"/> Antenna 0 | |
| | <input type="checkbox"/> Band 39 | <input type="checkbox"/> PIFA <input type="checkbox"/> PCB <input type="checkbox"/> | <input type="checkbox"/> Antenna 1 | |
| | | <input type="checkbox"/> PIFA <input type="checkbox"/> PCB <input type="checkbox"/> | <input type="checkbox"/> Antenna 0 | |
| | <input type="checkbox"/> Band 40 | <input type="checkbox"/> PIFA <input type="checkbox"/> PCB <input type="checkbox"/> | <input type="checkbox"/> Antenna 0 | |
| | | <input type="checkbox"/> PIFA | <input type="checkbox"/> Antenna 1 | |

| | | | | |
|------------------------------------|----------------------------------|--|------------------------------------|--|
| | | <input type="checkbox"/> PCB <input type="checkbox"/> | | |
| | <input type="checkbox"/> Band 41 | <input type="checkbox"/> PIFA <input type="checkbox"/> PCB <input type="checkbox"/> | <input type="checkbox"/> Antenna 0 | |
| | | <input type="checkbox"/> PIFA <input type="checkbox"/> PCB <input type="checkbox"/> | <input type="checkbox"/> Antenna 1 | |
| | <input type="checkbox"/> Band 42 | <input type="checkbox"/> PIFA <input type="checkbox"/> PCB <input type="checkbox"/> | <input type="checkbox"/> Antenna 0 | |
| | | <input type="checkbox"/> PIFA <input type="checkbox"/> PCB <input type="checkbox"/> | <input type="checkbox"/> Antenna 1 | |
| <input type="checkbox"/> Wi-Fi | <input type="checkbox"/> 2.4GHz | <input type="checkbox"/> PIFA <input type="checkbox"/> PCB <input type="checkbox"/> | <input type="checkbox"/> Antenna 0 | |
| | | <input type="checkbox"/> PIFA <input type="checkbox"/> PCB <input type="checkbox"/> | <input type="checkbox"/> Antenna 1 | |
| | | <input type="checkbox"/> PIFA <input type="checkbox"/> PCB <input type="checkbox"/> | <input type="checkbox"/> Antenna 2 | |
| | <input type="checkbox"/> 5GHz | <input type="checkbox"/> PIFA <input type="checkbox"/> PCB <input type="checkbox"/> | <input type="checkbox"/> Antenna 0 | |
| | | <input type="checkbox"/> PIFA <input type="checkbox"/> PCB <input type="checkbox"/> | <input type="checkbox"/> Antenna 1 | |
| | | <input type="checkbox"/> PIFA <input type="checkbox"/> PCB <input type="checkbox"/> | <input type="checkbox"/> Antenna 2 | |
| <input type="checkbox"/> Others | <input type="checkbox"/> 2.4GHz | <input type="checkbox"/> PIFA <input type="checkbox"/> PCB <input type="checkbox"/> PRESTTA | <input type="checkbox"/> Antenna 0 | |
| | | <input type="checkbox"/> PIFA <input type="checkbox"/> PCB <input type="checkbox"/> Intel FA5 Port 1 | <input type="checkbox"/> Antenna 1 | |
| | | <input type="checkbox"/> PIFA <input type="checkbox"/> PCB <input type="checkbox"/> Intel FA5 Port 5 | <input type="checkbox"/> Antenna 2 | |
| <input type="checkbox"/> Bluetooth | <input type="checkbox"/> 2.4GHz | <input type="checkbox"/> PIFA <input type="checkbox"/> PCB <input type="checkbox"/> | <input type="checkbox"/> Antenna 0 | |

1.6 Description of EUT

| Short description*) | EUT | Type | S/N serial number | HW hardware status | SW software status |
|---------------------|---------|---------------|-------------------|--------------------|--------------------|
| EUT A | EMS31-V | LTE modulexxx | E4000044191-03 | B1.4 | 5.0.0.0a |

*) EUT short description is used to simplify the identification of the EUT in this test report.

Remark: Tests only performed with EUT A

1.7 Auxiliary Equipment (AE)

| AE short description *) | Auxiliary Equipment | Type | S/N serial number | HW hardware status | SW software status |
|-------------------------|---|--------|-------------------|--------------------|--------------------|
| AE 1 | Cellular/4G LTE MAGNETIC ANTENNA | 2J300M | -- | -- | -- |
| AE 2 | Development support board (Motherboard) | DSB75 | W30880-Q9812-X-2 | -- | -- |
| AE 3 | RS232 cable | -- | -- | -- | -- |

*) AE short description is used to simplify the identification of the auxiliary equipment in this test report.

1.8 EUT Set-ups

| EUT set-up no. *) | Combination of EUT and AE | Remarks |
|-------------------|---------------------------|---|
| set. 1 | EUT A | Only for theoretically calculation based on tune-up information |

*) EUT set-up no. is used to simplify the identification of the EUT set-up in this test report.

1.9 EUT operating modes

| EUT operating mode no. *) | Description of operating modes | Additional information |
|---------------------------|--------------------------------|--|
| 1 | LTE-Band 13 RMC Mode | A communication link is established between the mobile station (UE) and the test simulator. The transmitter is operated on its maximum rated output power class: 23dBm nominal. The input signal to the receiver is modulated with normal test modulation: QPSK or 16-QAM Modulation. The wanted RF input signal level to the receiver of the mobile station is set to a level to provide a stable communication link. |

*) EUT operating mode no. is used to simplify the test report.

1.10 Configuration of cables used for testing

| Cable number | Item | Type | S/N serial number | HW hardware status | Cable length |
|--------------|-------------|----------|-------------------|--------------------|--------------|
| Cable 1 | AC/DC cable | From AE1 | -- | -- | 1.90m |

2 Administrative Data

2.1 Identification of the testing laboratory

| | |
|-------------------------------------|--|
| Company name: | CETECOM GmbH |
| Address: | Im Teelbruch 116 45219 Essen - Kettwig Germany |
| Responsible for testing laboratory: | Dipl.-Ing. Rachid Acharkaoui |
| Deputy: | Dipl.-Ing. Niels Jeß |

2.2 Test location

2.2.1 Test laboratory "CTC"

| | |
|---------------|--|
| Company name: | see chapter 2.1 Identification of the testing laboratory |
|---------------|--|

2.3 Organizational items

| | |
|---|--------------------------|
| Responsible for test report and project leader: | B.Eng. Martin Nunier |
| Receipt of EUT: | 2017-05-16 |
| Date(s) of test: | 2017-05-16 to 2017-07-26 |
| Date of report: | 2017-12-08 |

Version of template: 13.02

Remark 1: based on applicants tune-up info

2.4 Applicant's details

| | |
|-------------------|---|
| Applicant's name: | Gemalto M2M GmbH |
| Address: | Werinherstrasse 81 81541 Munich Germany |
| Contact person: | Mr. Axel Heike |

2.5 Manufacturer's details

| | |
|----------------------|--------------------------------|
| Manufacturer's name: | please see Applicant's details |
| Address: | please see Applicant's details |

3 Measurements

3.1. Test location

| | | | |
|---|---|--------------------------|--------------------------|
| test location | <input checked="" type="checkbox"/> CETECOM Essen | <input type="checkbox"/> | <input type="checkbox"/> |
| For Evaluation instruments are not needed. Results are determined by calculation based on applicants delivered Tune-Up procedure. | | | |

3.2 Evaluation Rules for FCC Standard

Systems operating under the provisions of FCC 47 CFR section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission’s guidelines. In accordance with 47 CFR FCC Part 2 Subpart J, section 2.1091 this device has been defined as mobile device whereby a distance of 0.2m normally can be maintained between the user and the device, and below RF Permissible Exposure limit shall comply with.

In accordance with KDB447498D01 for Simultaneous transmission MPE test exclusion applies when the sum of the MPE ratios for all simultaneous transmitting antennas incorporated in a host device, based on the calculated/estimated, numerically modelled or measured field strengths or power density, is ≤ 1.0 . 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 MPE limit, at the test frequency. Either the maximum peak or spatially averaged results from measurements or numerical simulations may be used to determine the MPE ratios. Spatial averaging does not apply when MPE is estimated using simple calculations based on far-field plane-wave equivalent conditions. The antenna installation and operating requirements for the host device must meet the minimum test separation distances required by all antennas, in both standalone and simultaneous transmission operations, to satisfy compliance.

3.3 Limits for FCC Standard

Table 1: LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

| (A) Limits for Occupational/Controlled Exposure | | | | |
|---|-------------------------------|-------------------------------|-------------------------------------|--------------------------|
| Frequency range [MHz] | Electric field strength [V/m] | Magnetic field strength [A/m] | Power density [mW/cm ²] | Averaging time [minutes] |
| 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 |
| 300-1500 | -- | -- | -- | 6 |
| 1500-100,000 | -- | -- | -- | 6 |
| (B) Limits for General Population/Uncontrolled Exposure | | | | |
| Frequency range [MHz] | Electric field strength [V/m] | Magnetic field strength [A/m] | Power density [mW/cm ²] | Averaging time [minutes] |
| 0.3-3.0 | 614 | 1.63 | *(100) | 30 |
| 3.0-30 | 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 |

f=frequency in MHz

*Plane-wave equivalent power density

NOTE1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure. These limits apply to amateur station licensees and members of their immediate household as discussed in the text.

NOTE2: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or cannot exercise control over their exposure. As discussed in the text, these limits apply to neighbours living near amateur radio stations.

3.5 MPE Calculation method

Predication of MPE limit at a given distance
Equation from page 18 of OET Bulletin 65, Edition 97-01

$$S = \frac{EIRP}{4\pi R^2} = \frac{P * G}{4\pi R^2}$$

$$G_{NUMERIC} = \frac{S * 4\pi R^2}{P}$$

Where: S=power density
P=power input to antenna
G=power gain of the antenna in the direction of interest relative to an isotropic radiator
R=distance to the centre of radiation of the antenna

3.6 Conducted Output Power

| LTE FDD Band 13 | | | | | | |
|-----------------|-----------------------|-------|------------------|-------|------------------|-------|
| Test case | Max Power value [dBm] | | | | | |
| | UARFCN no. 23205 | | UARFCN no. 23230 | | UARFCN no. 23255 | |
| | PK | AV | PK | AV | PK | AV |
| QPSK | 27.09 | 23.03 | 27.31 | 22.91 | 26.94 | 22.70 |
| 16-QAM | 27.15 | 22.81 | 27.25 | 23.14 | 26.94 | 22.78 |

Regarding tune-up information maximum average output power is for QPSK 23dBm +2dB tolerance and for 16-QAM 22dBm +2dB tolerance. Applying customer’s declared tolerance the results of conducted power verification are below the target output power.

3.7 Evaluation Method

3.7.1 Standalone

Valid for LTE Mode:

A RMS detector was used. No duty-cycle correction factor is applicable

Please find in the following tables the calculations based on applicants tune-up information for the power values.

Results for FCC Standard

| Operating Mode | Frequency on channel (MHz) | Declared maximum conducted output power (dBm) | Duty cycle (%) | Declared Maximum ERP (W) | Equivalent ERP (maximum ERP x duty cycle) (mW) | MPE Limit accord. Table 1 (mW/cm ²) | MPE-Value (mW/cm ²) | Margin to limit: (mW/cm ²) | Fraction for Co-Location calculations | Max. Fraction-Value within Frequency-Band |
|--------------------|----------------------------|---|----------------|--------------------------|--|---|---------------------------------|--|---------------------------------------|---|
| LTE Band 13 QPSK | 779,5 | 25,0 | 100% | 0,316 | 316 | 0,5197 | 0,0629 | 0,4568 | 0,1211 | 0,1211 |
| | 782,0 | 25,0 | | 0,316 | 316 | 0,5213 | 0,0629 | 0,4584 | 0,1207 | |
| | 784,5 | 25,0 | | 0,316 | 316 | 0,5230 | 0,0629 | 0,4601 | 0,1203 | |
| LTE Band 13 16-QAM | 779,5 | 24,0 | 100% | 0,251 | 251 | 0,5197 | 0,0500 | 0,4697 | 0,0962 | 0,0962 |
| | 782,0 | 24,0 | | 0,251 | 251 | 0,5213 | 0,0500 | 0,4714 | 0,0959 | |
| | 784,5 | 24,0 | | 0,251 | 251 | 0,5230 | 0,0500 | 0,4730 | 0,0955 | |

| Maximum calculated MPE value: | | |
|---|--------|-----------------------|
| Lowest MPE-Limit in Frequency-Band: | 0,5197 | [mW/cm ²] |
| Highest MPE value in frequency-band: | 0,0629 | [mW/cm ²] |
| Lowest margin to limit in frequency band: | 0,4568 | [mW/cm ²] |

Maximum antenna gain considerations for fixed/mobile operations for complying with limits:

| | | |
|----------------|--|------|
| P | Maximum power input to the antenna incl. Duty cycle [mW]: (Avg. Burst Power or RMS) | 316 |
| R | Distance [cm]: | 20 |
| S | MPE limit acc. §1.1310 for uncontrolled exposure [mW/cm ²]: (FCC use mW/cm ²) | 0,52 |
| G ₁ | Maximum Antenna gain to comply with MPE limit [dBi]: | 9,17 |

(For G1 the lowest measured channel to reach minimum ant. Gain selected)

| | | |
|--|--|------|
| ERP power limit according to §2.1091 [W]: (Avg. Burst Power or RMS) | | 1,50 |
| G ₂ | Max. Antenna gain to comply with limit incl. Duty cycle [dBi]: | 8,91 |

(For G2 select the max. Avg. Burst Power or RMS value incl. Duty cycle)

| | | |
|---|---|-------|
| ERP power limit according to §27.50b(10) [W ERP]: | | 3,00 |
| G ₃ | Max. Antenna gain to comply with limit [dBd]: | 11,92 |

(For G3 select the max. Average burst power value excluding Duty cycle)

| | | |
|---------------------------|---|------|
| G _{850 MHz band} | Min (G ₁ , G ₂ , G ₃) [dBi] | 8,91 |
|---------------------------|---|------|

| | | | |
|---------------------|---|------|-----|
| Summarized results: | The max. ant. gain for mobile operation at 700MHz band to comply with MPE and EIRP limits incl. path loss shall not exceed [dBi]: | 8,91 | dBi |
|---------------------|---|------|-----|

Remark:

1. Output power (Average) including tune-up tolerance;
2. Output power was adjust to duty cycle at 100% if measured duty cycle less than 98%;
3. MPE evaluate distance is 20cm from user manual provide by manufacturer;
4. Depending on output power and antenna gain only the worst case is reported;

3.7.3 Simultaneous Transmission MPE

According to KDB447498 for Transmitters used in mobile exposure conditions for simultaneous transmission operations;
 \sum of MPE ratios ≤ 1.0

Wireless Module EMS31-V use only one transmitter antenna, no need consider simultaneous transmission.

3.8 Conclusion

The measurement results comply with the FCC Limit per 47 CFR 2.1091 for the uncontrolled RF Exposure of mobile device.

4 Measurement uncertainties

The reported uncertainties are calculated based on the standard uncertainty multiplied with the appropriate coverage factor **k**, such that a confidence level of approximately 95% is achieved.

For uncertainty determination, each component used in the concrete measurement set-up was taken in account and it's contribution to the overall uncertainty according it's statistical distribution calculated.

Following table shows expectable uncertainties for each measurement type performed.

| RF-Measurement | Reference | Frequency range | Calculated uncertainty based on a confidence level of 95% | | | | | | Remarks |
|---|--------------|--------------------|---|--------|-----|----|----|----------------------|---|
| Conducted emissions (U _{CISPR}) | CISPR 16-2-1 | 9 kHz - 150 kHz | 4.0 dB | | | | | | - |
| | | 150 kHz - 30 MHz | 3.6 dB | | | | | | |
| Radiated emissions Enclosure | CISPR 16-2-3 | 30 MHz - 1 GHz | 4.2 dB | | | | | | E-Field |
| | | 1 GHz - 18 GHz | 5.1 dB | | | | | | |
| Disturbance power | CISPR 16-2-2 | 30 MHz - 300 MHz | - | | | | | | - |
| Power Output radiated | - | 30 MHz - 4 GHz | 3.17 dB | | | | | | Substitution method |
| Power Output conducted | - | Set-up No. | Cel-C1 | Cel-C2 | BT1 | W1 | W2 | | |
| | | 9 kHz - 12.75 GHz | N/A | 0.60 | -- | -- | -- | | |
| | | 12.75 - 26.5GHz | N/A | 0.82 | -- | -- | -- | | |
| Conducted emissions on RF-port | - | 9 kHz - 2.8 GHz | 0.70 | N/A | -- | -- | -- | N/A - not applicable | |
| | | 2.8 GHz - 12.75GHz | 1.48 | N/A | -- | -- | -- | | |
| | | 12.75 GHz - 18GHz | 1.81 | N/A | -- | -- | -- | | |
| | | 18 GHz - 26.5GHz | 1.83 | N/A | -- | -- | -- | | |
| Occupied bandwidth | - | 9 kHz - 4 GHz | 0.1272 ppm (Delta Marker) | | | | | | Frequency error |
| | | | 1.0 dB | | | | | | Power |
| Emission bandwidth | - | 9 kHz - 4 GHz | 0.1272 ppm (Delta Marker) | | | | | | Frequency error |
| | | | See above: 0.70 dB | | | | | | Power |
| Frequency stability | - | 9 kHz - 20 GHz | 0.0636 ppm | | | | | | - |
| Radiated emissions Enclosure | - | 150 kHz - 30 MHz | 5.0 dB | | | | | | Magnetic field E-field Substitution |
| | | 30 MHz - 1 GHz | 4.2 dB | | | | | | |
| | | 1 GHz - 20 GHz | 3.17 dB | | | | | | |

Table: measurement uncertainties, valid for conducted/radiated measurements

5 Abbreviations used in this report

| The abbreviations | |
|-------------------|---|
| ANSI | American National Standards Institute |
| AV, AVG, CAV | Average detector |
| EIRP | Equivalent isotropically radiated power, determined within a separate measurement |
| EUT | Equipment Under Test |
| FCC | Federal Communications Commission, USA |
| n.a. | not applicable |
| Op-Mode | Operating mode of the equipment |
| PK | Peak |
| RBW | resolution bandwidth |
| RF | Radio frequency |
| RSS | Radio Standards Specification, Documents from Industry Canada |
| Rx | Receiver |
| TCH | Traffic channel |
| Tx | Transmitter |
| QP | Quasi peak detector |
| VBW | Video bandwidth |
| ERP | Effective radiated power |

6 Accreditation details of CETECOM's laboratories and test sites

| Ref.-No. | Accreditation Certificate | Valid for laboratory area or test site | Accreditation Body |
|---------------------------------|--|---|---|
| - | D-PL-12047-01-01 | All laboratories and test sites of CETECOM GmbH, Essen | DAkkS, Deutsche Akkreditierungsstelle GmbH |
| 337 487 558 348 348 | MRA US-EU 0003 | Radiated Measurements 30 MHz to 1 GHz, 3 m / 10 m (OATS) Radiated Measurements 30 MHz to 1 GHz, 3 m (SAR) Radiated Measurements above 1 GHz, 3 m (FAR) Mains Ports Conducted Interference Measurements Telecommunication Ports Conducted Interference Measur. | FCC, Federal Communications Commission Laboratory Division, USA |
| 337 487 550 558 | 3462D-1 3462D-2 3462D-2 3462D-3 | Radiated Measurements 30 MHz to 1 GHz, 3 m / 10 m (OATS) Radiated Measurements 30 MHz to 1 GHz, 3 m (SAR) Radiated Measurements 1 GHz to 6 GHz, 3 m (SAR) Radiated Measurements above 1 GHz, 3 m (FAR) | IC, Industry Canada Certification and Engineering Bureau |
| 487 550 348 348 | R-2666 G-301 C-2914 T-1967 | Radiated Measurements 30 MHz to 1 GHz, 3 m (SAR) Radiated Measurements 1 GHz to 6 GHz, 3 m (SAR) Mains Ports Conducted Interference Measurements Telecommunication Ports Conducted Interference Measur. | VCCI, Voluntary Control Council for Interference by Information Technology Equipment, Japan |

OATS = Open Area Test Site, SAR = Semi Anechoic Room, FAR = Fully Anechoic Room

7 Test report version

| Version | Applied changes | Date of release |
|---------|------------------------|-----------------|
| -- | Initial release | 2017-11-30 |
| C1 | Contact person changed | 2017-12-08 |