# exm10Rx8V4C

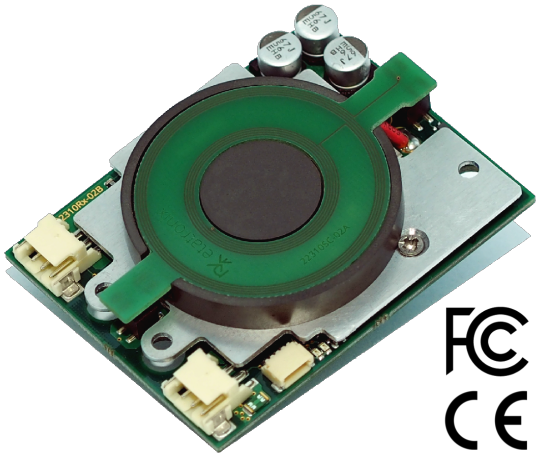
10W Wireless Power Receiver with Battery Charger

## Introduction

The exm module series provides easy to use plug and play solutions for high performance wireless power transmission between a power transmitter (Tx) and a power receiver (Rx). In combination with a proprietary data transmission channel, the series provides a fast regulation loop and the ability to transfer customer data in parallel. Compliance to global safety and EMC standards qualifies the series for worldwide markets.

The exm10Rx8V4C is an easy to use 8.4 V power receiver module that can be wirelessly powered with any etatronix exm10 power receiver. It provides up to 10 W at the DC output. A LiIon charge function as well as a battery management system including a state of charge algorithm is available.

In combination with an exm10 power transmitter, the system complies to CE and FCC regulations. It has a modular approval which minimizes the certification effort of the application containing the module.



## Features

- Up to 85% Efficiency
- 10 W Continuous Output Power
- Fast Dynamic Response
- Foreign Object Detection
- Up to 2kbps Data Transmission (optional)
- Low Standby Consumption
- Battery Management Functionality
- Low Emissions, Compliance to
  - EN 55011/CISPR 11 class B
  - FCC, part 15 & 18
  - IEC / EN 61000-4-3,4,5,6,8
  - Works with any exm10 Wireless Power Transmitter

# Table of Contents



# Revision History

| Revision | Date | Changes |
|---|---|---|
| Draft-01 | 11/2017 | First draft released |
| Draft-02 | 11/2017 | Reorganization of some chapters; Added mounting possibilities; Some smaller changes |
| Draft-03 | 04/2018 | System efficiency diagram added |
| Draft-04 | 08/2018 | Connector identifier added |
| Draft-05 | 08/2020 | Add optional features, Add FCC and Canada to compliance-table |
| -01A | 03/2021 | New Corporate Design |

# 1 Electrical Specification

## 1.1 Operating Conditions

| Parameter | Min | Typ | Max | Unit |
|---|---|---|---|---|
| Output voltage[1] | - | - | 8.4 | V |
| Output current[1,2] | - | - | 1.35 | A |
| Ambient temperature | -25 | - | 70 | °C |
| Standby current [3] | - | tbd. | - | mA |
| Data transmission frequency | - | 2 | - | MHz |

[1] In case of a connected battery, output current and voltage depend on actual charge state. The module works in CC/CV mode.
[2] Output current limitation can be tailored to specific load and battery requirements.
[3] Receiver module not connected with power transmitter, BMS active.

## 1.2 Interface

| Parameter | Min | Typ | Max | Unit |
|---|---|---|---|---|
| Low level digital interface [1] | -0.1 | - | 0.6 | V |
| High level digital interface [1] | 2.7 | - | 3.4 | V |
| Maximum voltage at PG [1,2] | - | - | 4.2 | V |
| Maximum current PG [1] | - | - | 10 | mA |
| Output Capacity | - | - | 440 | µF |
| Battery Fuse Rating | - | T7 | - | A |
| Battery Fuse Melting Integral | - | 8.7 | - | $A^2Sec$ |

[1] Internal limiting series resistor: 330 Ω.
[2] Voltage at PG-pin shall not exceed the output voltage.

## 1.3 Compliance

| Regulation | Description |
|---|---|
| EN 55011 class B | EMI regulation for home equipment |

# 2 Mechanical Specification

## 2.1 Dimensions

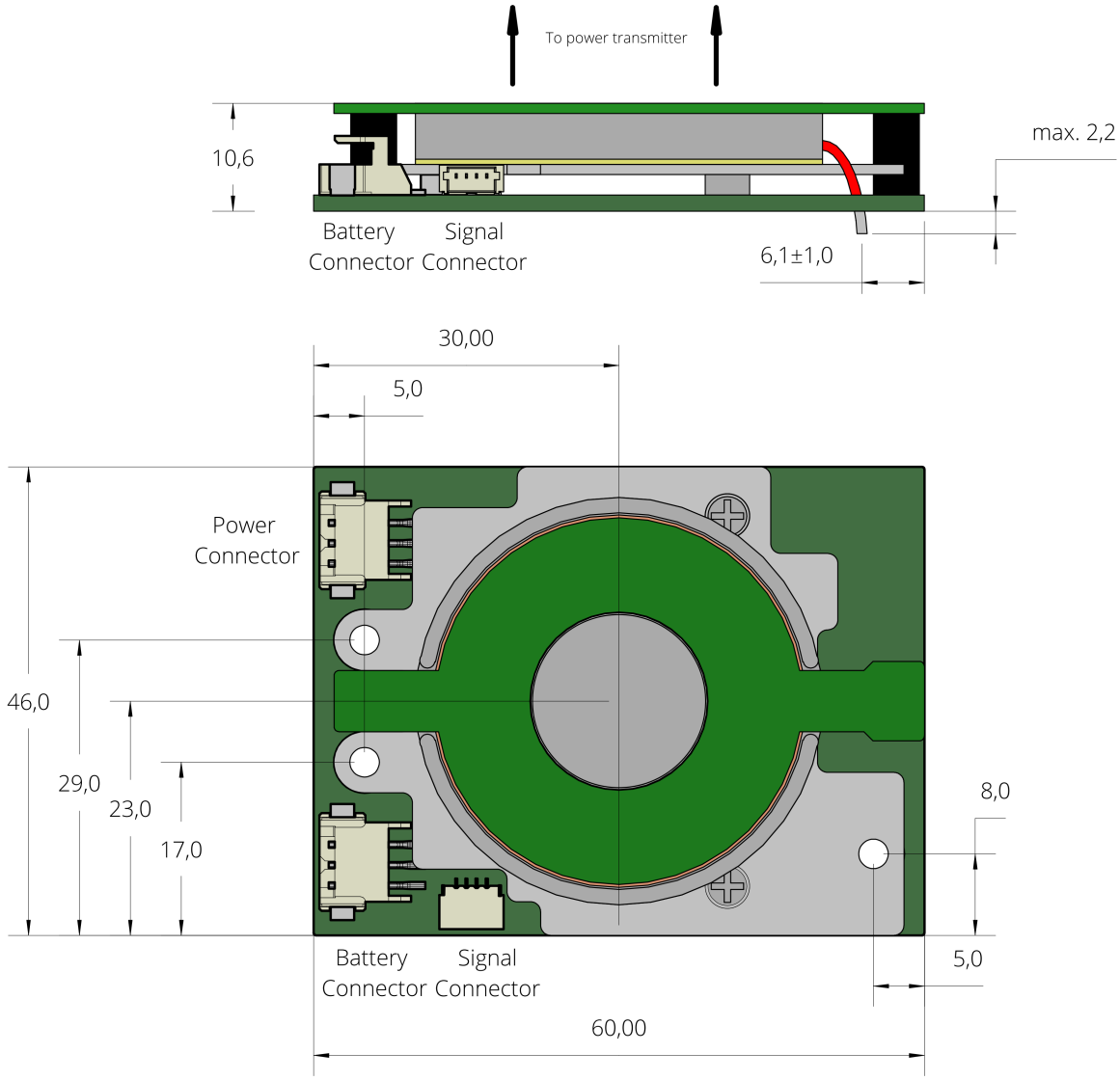


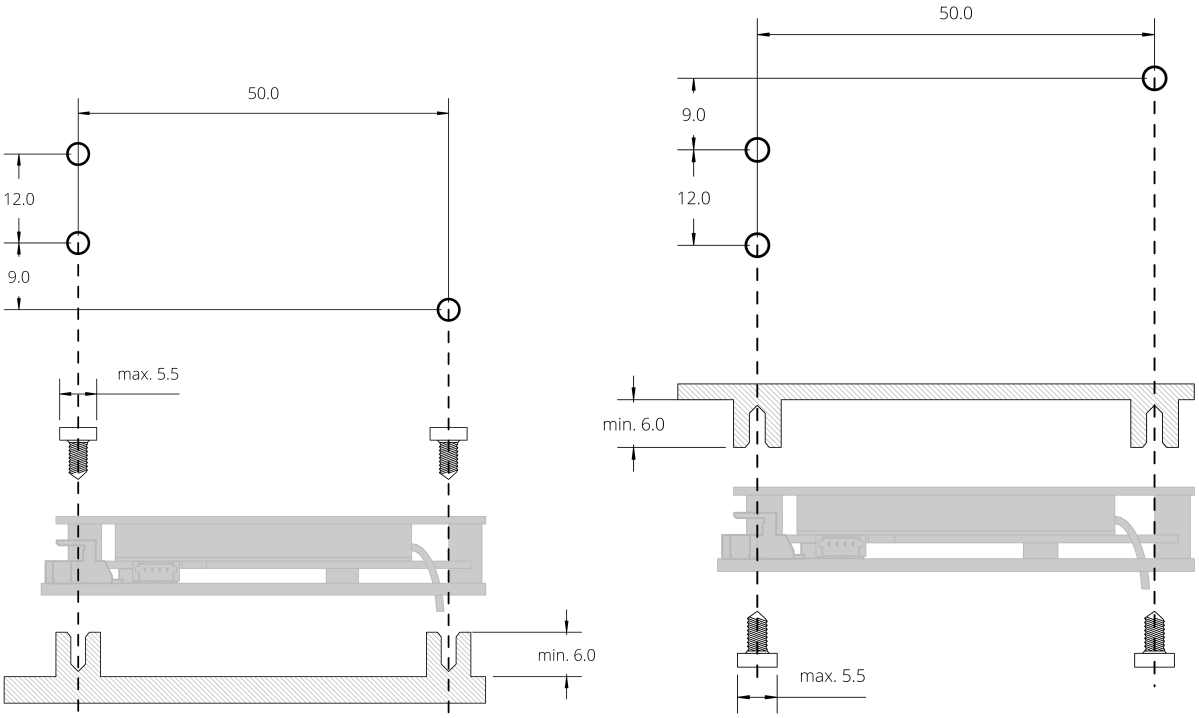

Figure 1: Dimensions

| Length | Width | Height | Weight |
|---|---|---|---|
| 60.0mm +/-0.2 | 46.0mm +/-0.2 | 10.6mm +/-0.2[1] | tbd |

[1] Notice that the height varies and will be higher at the solder points.

## 2.2 Mounting

Figure 2 shows two possible examples for the mounting of the exm module. Using the provided holes, the module can be mounted on a separate carrier (a) or on the surface which faces the power coil (b). In order to fit onto the module, the screw-head should have a maximum diameter of 5.5mm. The height of the standoffs should be at least 6mm.




(a) Carrier Mounting (b) Surface Mounting

Figure 2: Mounting Examples

# 3 Interfaces

The interface of the exm module consists of a power output to connect the load, a signal output for communication with the module or via the wireless link and a separate battery connector.

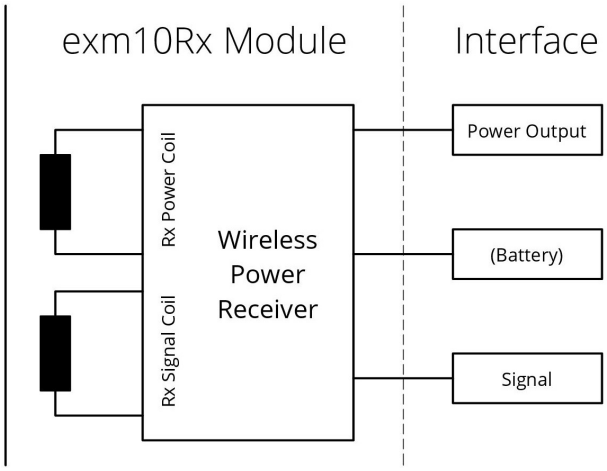



Figure 3: Interfaces

## 3.1 Power Connector

Type: TE Connectivity 1-292173-3

| Pin | Name | Function |
|---|---|---|
| 1 | Vout- | Output GND |
| 2 | PG | Power Good[1] |
| 3 | Vout+ | Output Voltage |

[1] Open collector to GND

## 3.2 Battery Connector

Type: TE Connectivity 1-292173-3

| Pin | Name | Function |
|---|---|---|
| 1 | GND | Battery - |
| 2 | NTC | Thermistor of the battery to GND[1] |
| 3 | Vbat+ | Battery +[2] |

[1] Open collector to GND
[2] Protected by an internal Fuse

## 3.3 Signal Connector

Connection to the signal connector is not necessary for power transmission but can be used for status updated and customer-specific data transmission. More details are specified in [1].

Type: JST SM04B-SRSS-TB

| Pin | Name | Function |
|---|---|---|
| 1 | VCCint | Internal Supply Voltage |
| 2 | COM1 | $I^2C$ SDA, UART Tx[1] |
| 3 | COM2 | $I^2C$ SCL, UART Rx[1] |
| 4 | GNDint | Internal GND |

[1] Depending on configuration

# 4 Functional Description

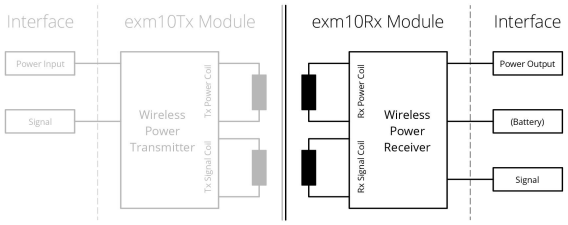



Figure 4: Block Diagram

To maximize the power transmission efficiency, the power transmission between transmitter and receiver modules of the exm10 series is realized using resonant circuits. These resonant circuits additionally provide the ability to vary the transmitted power by changing the switching frequency. By increasing the switching frequency, the available power in the receiver side decreases.

For the accurate output voltage regulation, a control loop is necessary. The output conditions like output current, voltage and power are measured on the receiver side and sent to the power transmitter. If corrections are necessary, the transmitter will change the switching frequency to the desired value.

An appropriate control loop needs a fast signal transmission with little delay. Often it's advantageous to transfer status or customer-specific information[1] between both units. To meet these two demands, the exm10 series provides a data channel that allows the parallel transmission of analog regulation information as well as digital status and customer-specific information[1]. This transmission is done using a second pair of coupled coils. Like the power transmission coils, the signal coils are forming a near field coupling system thus the intended use of radio waves isn't necessary.

The efficiency of the whole power transmission system (input connector to battery connector) depends on the setup such as distance, lateral displacement and output power. Figure 5 depicted the efficiency with a varying distance, measured with exm10Rx4V2C and exm10Tx24.

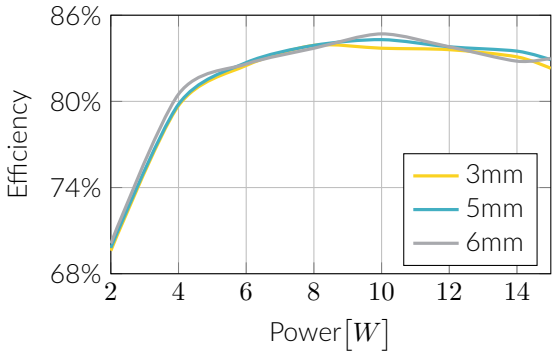



Figure 5: Efficiency over distance

[1] optional

# 5 Compliance

## 5.1 Compliance

| Regulation | Description |
|---|---|
| EN 55011/CISPR11 class B | Industrial, scientific and medical equipment - Radio-frequency disturbance characteristics - Limits and methods of measurement |
| IEC/EN 61000-4-3 | Electromagnetic compatibility (EMC) - Part 4-3: Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test |
| IEC/EN 61000-4-4 | Electromagnetic compatibility (EMC) - Part 4-4:Testing and measurement techniques - Electrical fast transient/burst immunity test |
| IEC/EN 61000-4-5 | Electromagnetic compatibility (EMC) - Part 4-5: Testing and measurement techniques - Surge immunity test |
| IEC/EN 61000-4-6 | Electromagnetic compatibility (EMC) - Part 4-6: Testing and measurement techniques - Immunity to conducted disturbances, induced by radio-frequency fields |
| IEC/EN 61000-4-8 | Electromagnetic compatibility (EMC) - Part 4-8: Testing and measurement techniques - Power frequency magnetic field immunity test |
| 47 CFR Part 15 | Title 47 of the Code of Federal Regulations; Chapter I; Part 15 - Radio frequency devices |
| RSS - 210 Issue 9 | Spectrum Management and Telecommunications Radio Standards Specification - Licence-Exempt Radio Apparatus: Category I Equipment |

This device complies with Part 15 of the FCC Rules [and with Industry Canada licence-exempt RSS standard(s)]. Operation is subject to the following two conditions:

1. this device may not cause harmful interference, and
2. this device must accept any interference received, including interference that may cause undesired operation.

## 5.2 EMI

The exm10 plug and play solutions complies to EMI regulations by a large margin to make the customer's design in process as easy as possible. Figure 6 shows the conducted and figure 7 the radiated emission, measured using exm10Tx24 and exm10Rx4V2C at full load.

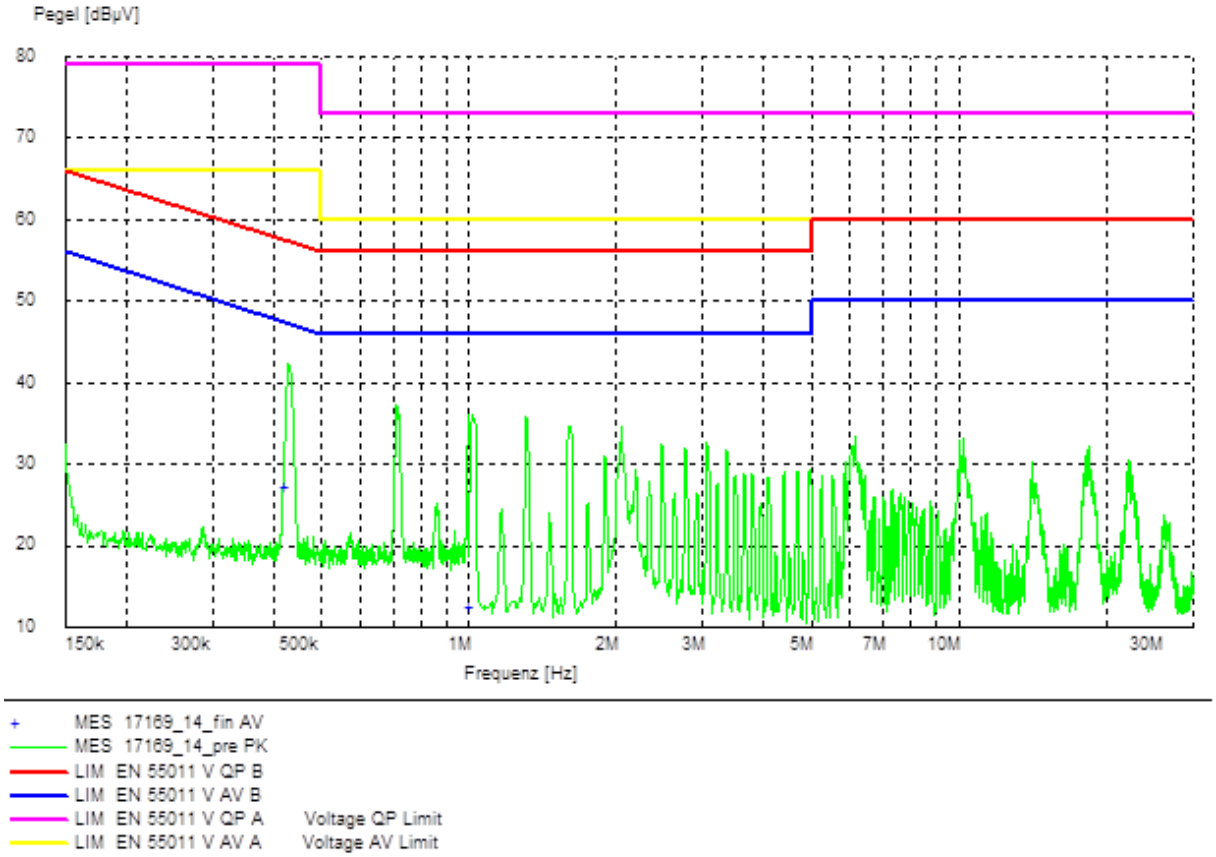



Figure 6: Conducted Emissions according to EN 55011/CISPR11. Limits for class A are shown in magenta and yellow, limits for class B in red and blue.

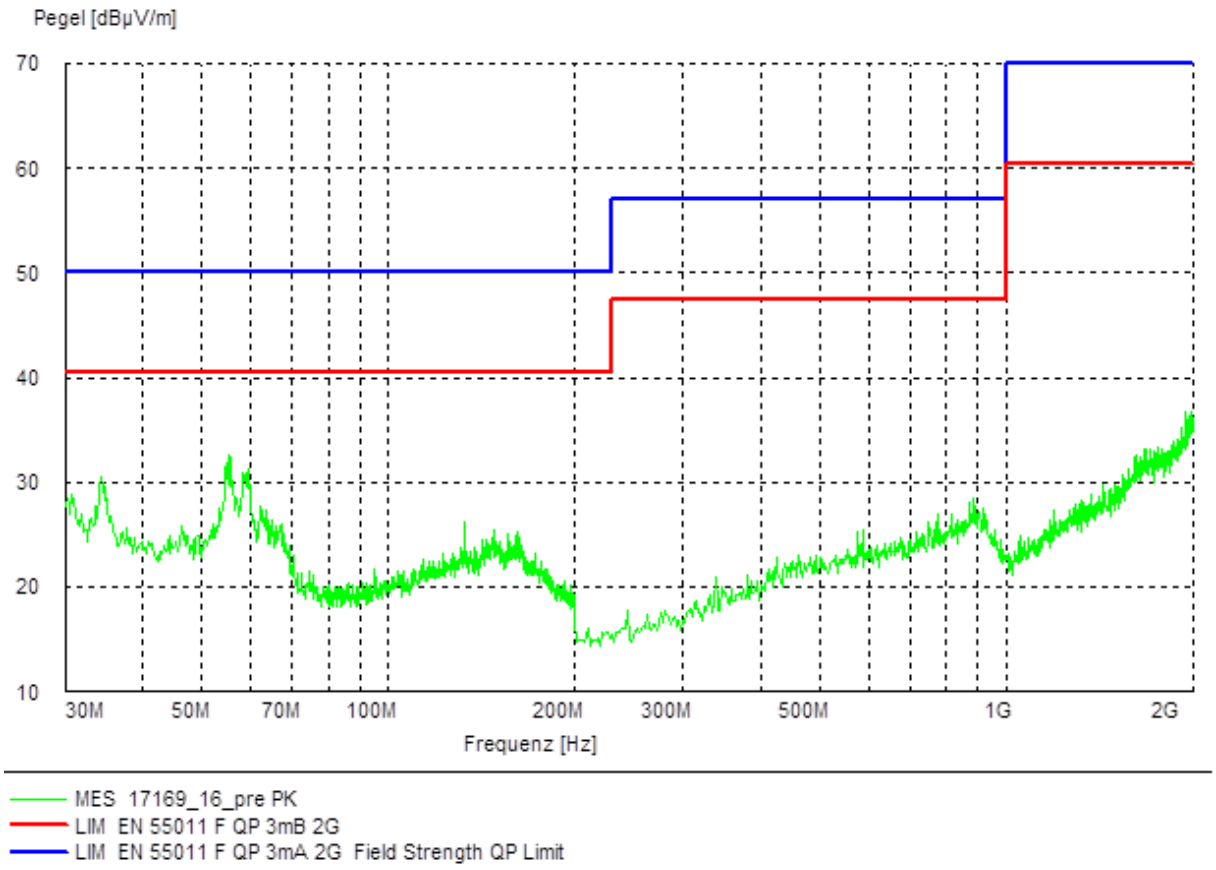



Figure 7: Radiated Emissions according to EN 55011/CISPR11. Limits for class A and B are shown in blue and red.

## References

[1] etatronix GmbH, *FDD - Kommunikation über UART mit WirelessPower Modul - Beschreibung der UART Kommunikation mit einem etatronix Lademodul*, Jun. 14, 2017.