exm10Tx24

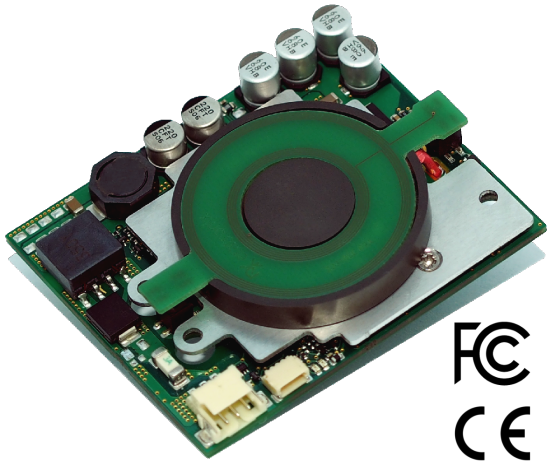
10W 24V Wireless Power Transmitter

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 exm10Tx24 is an easy to use 24 V power transmitter module that can power any etatronix exm10 power receiver with up to 10 W.

Each exm10 transmission 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 Power
- Fast Dynamic Response
- Foreign Object Detection
- Up to 2kbps Application Data Transmission (optional)
- Low Standby Consumption
- Low Emissions, Compliance to
  - EN 55011/CISPR 11 class B
  - FCC, part 15 & 18
  - IEC / EN 61000-4-3,4,5,6,8
- Open Loop Protection via SW & HW
- Supplies any exm10 Wireless Power Receiver

Table of Contents

1 Electrical Specification 3
1.1 Operating Conditions . . . 3
1.2 Interface . . . 3

2 Mechanical Specification 4
2.1 Dimensions . . . 4
2.2 Mounting . . . 5

3 Interfaces 6
3.1 CN101: Power Connector . . . 6
3.2 CN102: Signal Connector . . . 7

4 Functional Description 8

5 Compliance 9
5.1 Compliance . . . 9
5.2 EMI . . . 10

References 12

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	11/2019	Added optional functions; Some smaller changes
Draft-06	03/2020	Added Open Loop Protection
-01A	03/2021	New Corporate Design

1 Electrical Specification

1.1 Operating Conditions

Parameter	Min	Typ	Max	Unit
DC supply voltage[1]	22.8	24	27.6	V
Ambient temperature	-25	-	70	°C
Maximum power consumption with receiver [2]	-	12.9	-	W
Standby consumption [3]	-	240	-	mW
Switching frequency range	100	-	250	kHz
Ping cycle	-	1	-	Sec

[1] Please contact etatronix for an enlarged input voltage range.
[2] Power consumption at nominal supply voltage, coupled with receiver module exm10Rx4V2 at full load and a distance of 6 mm.
[3] Transmitter module powered with nominal supply voltage, no receiver coupled.

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]	-	-	27.6	V
Maximum current PG [1]	-	-	10	mA
Input Capacity	-	-	590	µF
Input Fuse Rating	-	T3	-	A
Input Fuse Melting Integral	-	14	-	A^2Sec

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

2 Mechanical Specification

2.1 Dimensions

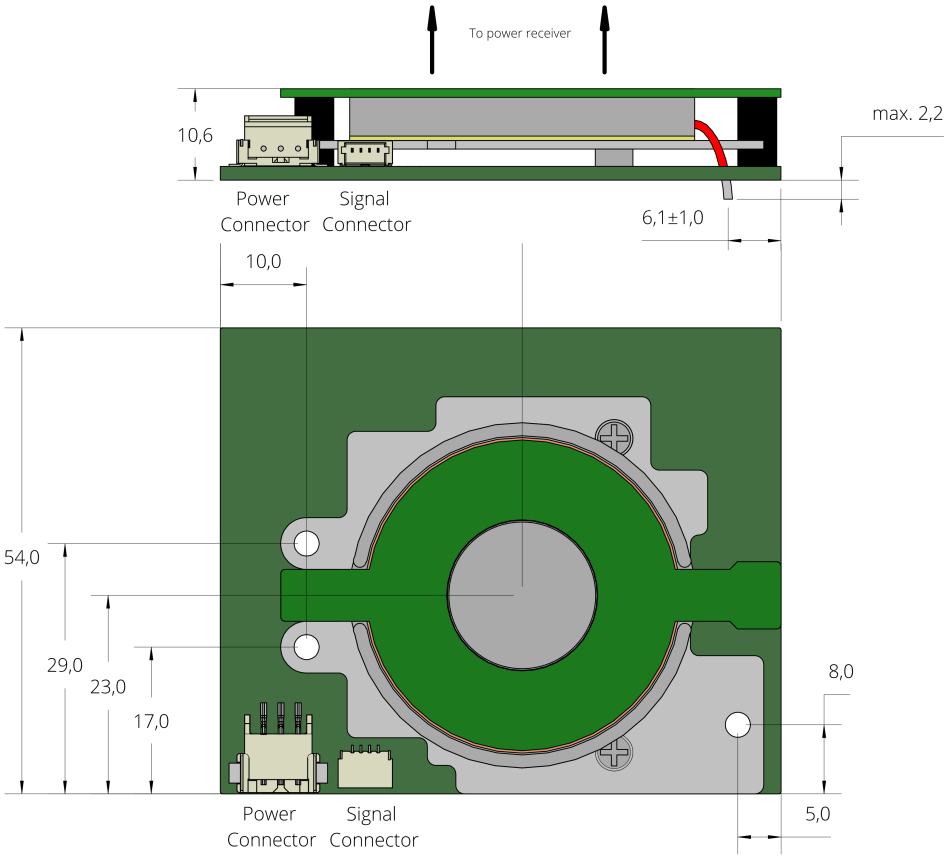


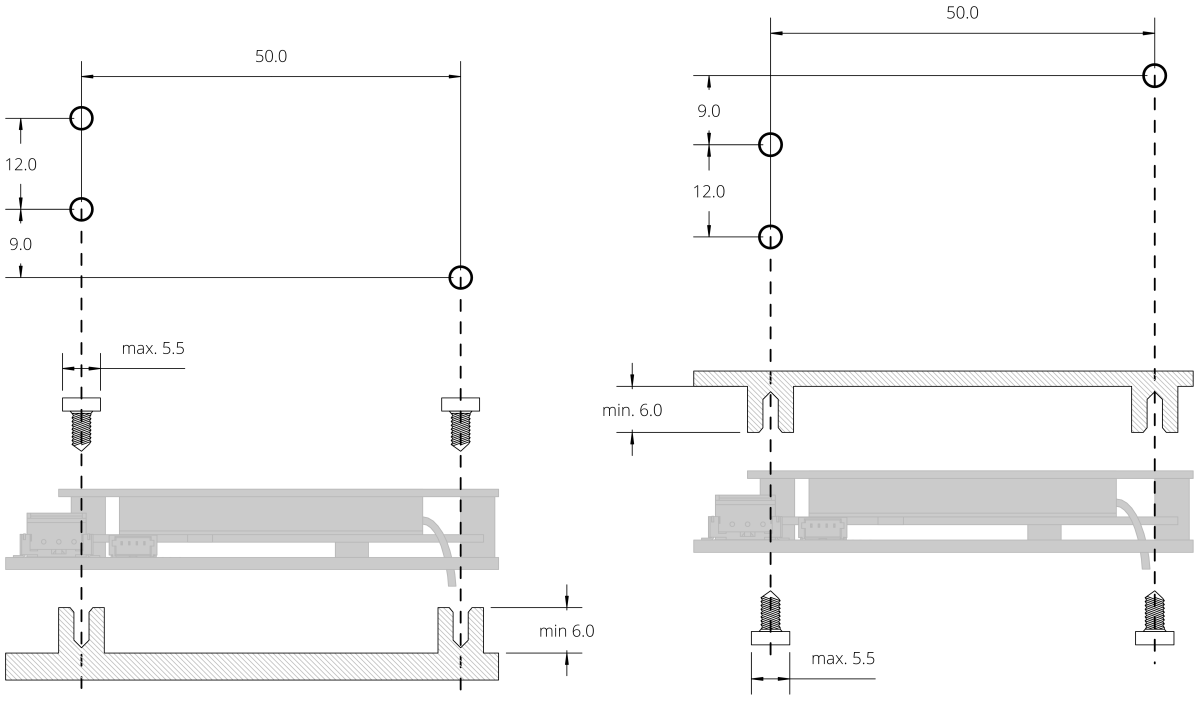
Figure 1: Dimensions

Length	Width	Height	Weight
65.0mm +/-0.2	54.0mm +/-0.2	10.6mm +/-0.2[1]	53g

[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 input to connect a power supply and signal connector for communication with the module or via the wireless link.

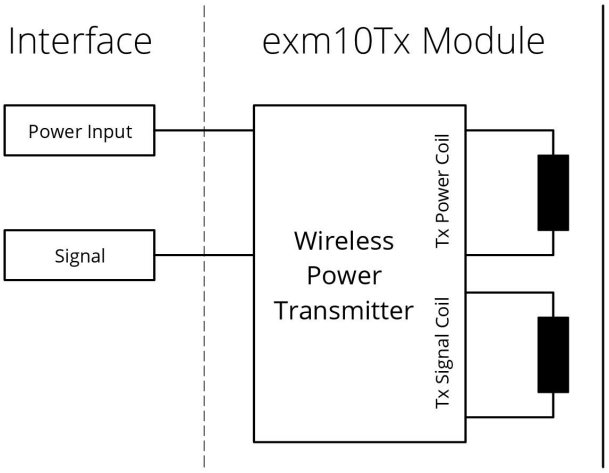


Figure 3: Interfaces

3.1 CN101: Power Connector

Type: TE Connectivity 1-292173-3

Pin	Name	Function
1	GND	Input GND
2	PG	Power Good[1]
3	Vin	Input Voltage[2]

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

3.2 CN102: Signal Connector

Connection to the signal connector is not necessary for power transmission but can be used for status updates 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

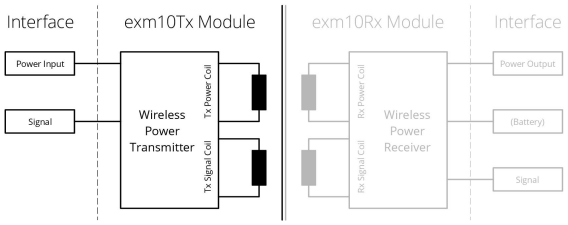


Figure 4: Block Diagram

To maximize the power transmission efficiency, the power transmission between the 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 on the receiver side decreases.

For an 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 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 optional customer-specific information. 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.

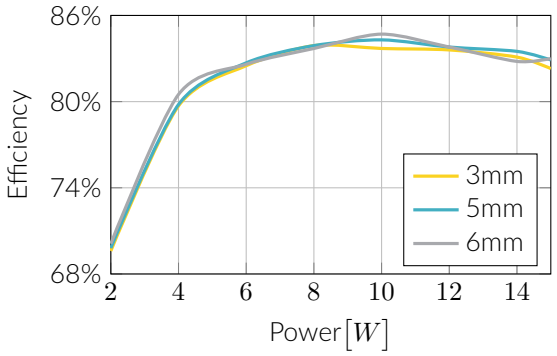


Figure 5: Efficiency over distance

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

The user must ensure that applicable EMF-standards surrounding the device are met.

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.

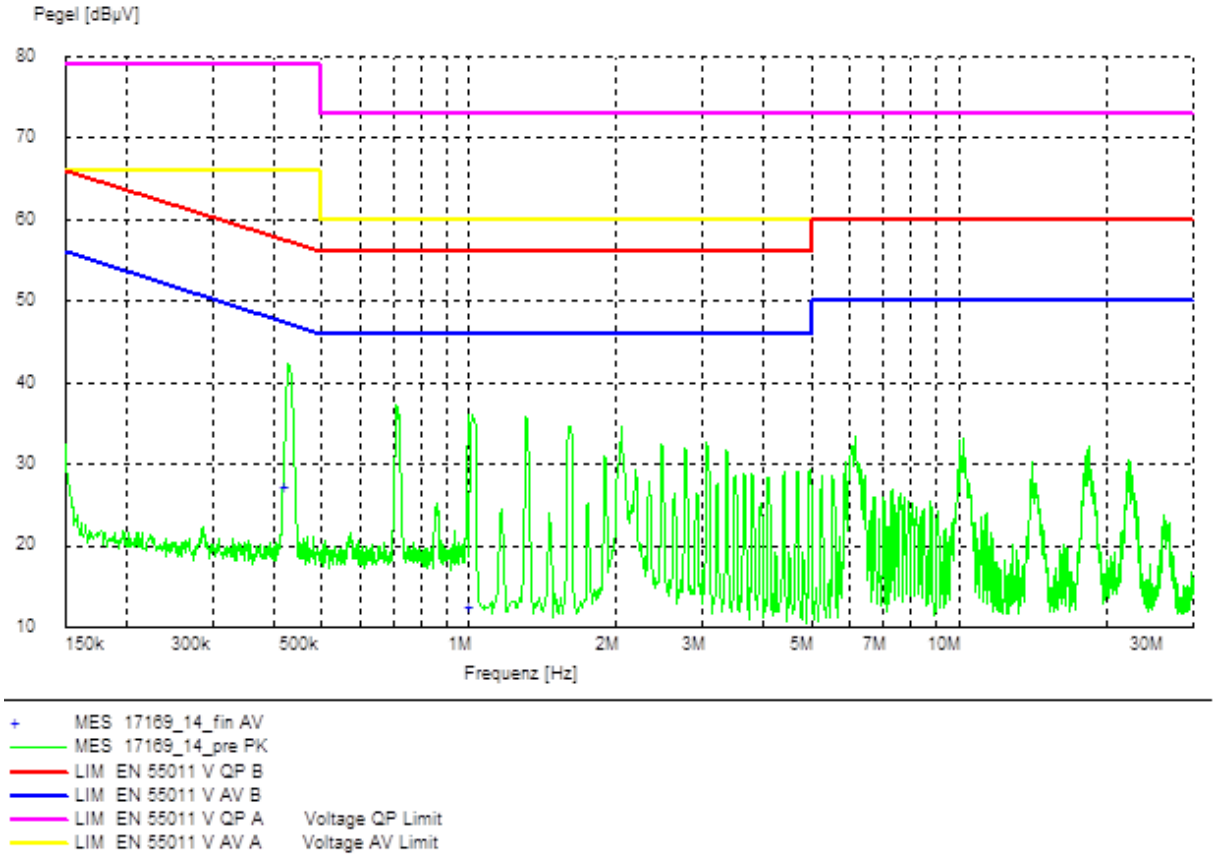


Figure 6: Conducted Emissions according to EN 55011/CISPR11. Limits for class A are shown in magenta and yellow, limits for class B in red and blue.

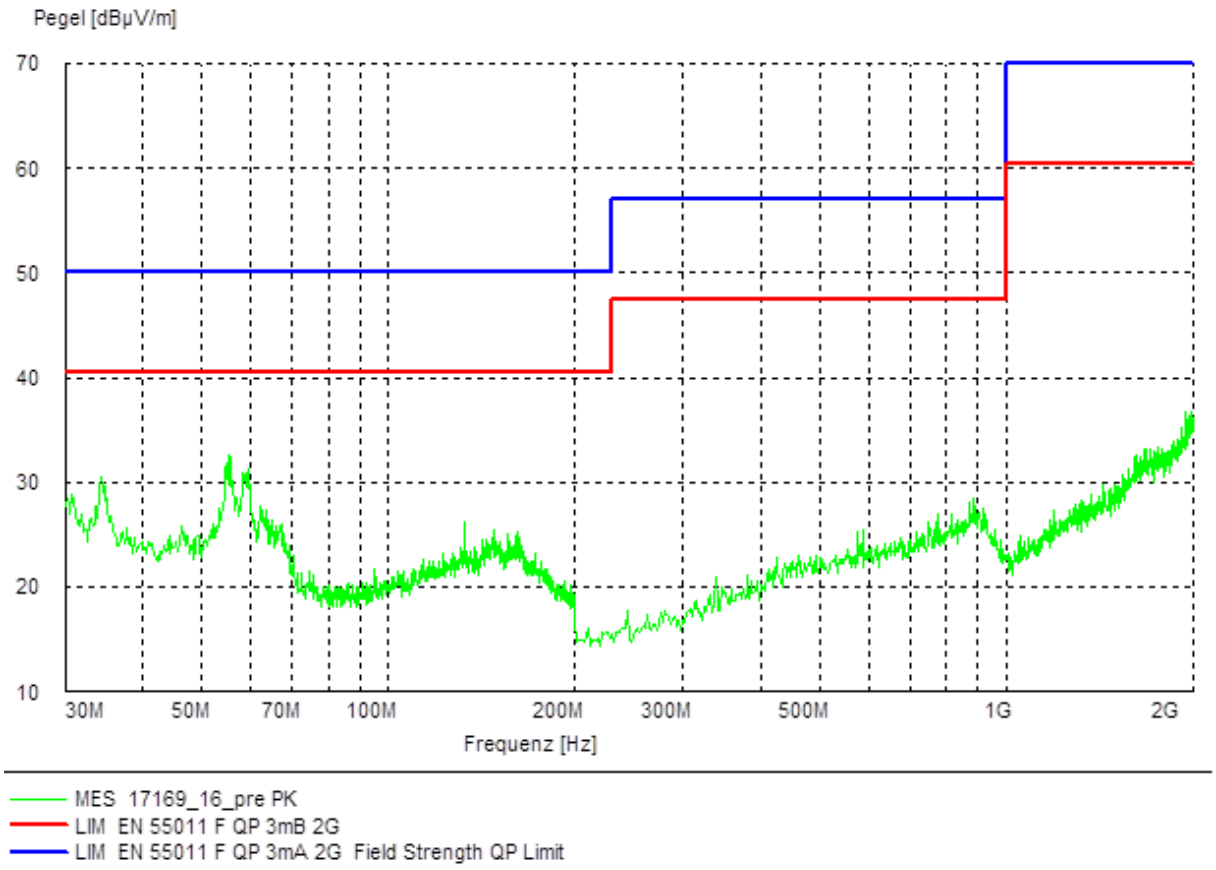


Figure 7: Radiated Emissions according to EN 55011/CISPR11. Limits for class A and B are shown in blue and red.

References

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