Datasheet PLRM UHF RFID Module

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1. General Information / Security Advice

1.1. Notes on the Use of this Documentation

This user manual and integration guide uses different symbols to point out potentially dangerous situations. The following signs and symbols are used throughout the document.

ATTENTION
Declares a potentially hazardous situation. If this is not avoided, the product or something in its surrounding could be damaged.

NOTES
Declares notes for the user as well as other useful information, where no harmful or dangerous situations can be expected.

1.2. Security Advice

The PLRM Long-Range UHF RFID Module was not designed for use in dangerous environments. Using this product in applications where a failure could directly result in severe injuries or death (“high risk activities”) is not permitted. This includes but is not limited to applications in nuclear facilities, flight control systems, life support systems or weapon systems. The manufacturer denies the suitability of this device for such scenarios.

1.3. Export Restriction

The PLRM Long-Range UHF RFID Module contains components that underlie US export restrictions. It is therefore forbidden to export the product to countries that are on the US trade embargo list. The same applies to any countries that are on the EU embargo list.

1.4. Further Documentation

While this documentation explains the electrical and mechanical characteristics of the PLRM module, it might be useful to also read the Metratec Protocol Guide, which explains the AT commands used to control the module in full detail.

Source: https://www.metratec.com

2. Product Description

The PLRM Long-Range UHF RFID Module is a high performance OEM RFID module which can be integrated into host devices that require reading UHF RFID transponders over a very long range or in high numbers. This allows you to equip your product with RFID functionality without designing your own RF electronics. Thanks to the tested and extremely flexible firmware you can easily read and write data to any RFID tag that follows the EPC Gen 2 v2 standard. The product features long read ranges and fast commmunication for managing large tag populations over large distances. The product implements advanced Impinj tag features such a Protected Mode and Authentication Service. Depending on the external antennas you connect to the module, a read range between 1 and 12m can be expected, depending on transponder size and type. Using large antennas and good transponders might allow even longer distances of up to 15m under good conditions.

The product is extremely rugged and features a currently unparalleled temperature range of -40° to +85°C at 33dBm output power.

Figure 1. PLRM OEM Module

2.1. Product Revision History / Migrating from prior Revisions

This document applies to all currently available PLRM modules. All future revisions 1.xx will be according to this documentation. The hardware revision is printed on the board or can be checked using the read device information command (AT+ATI).

2.2. Intended Use

The PLRM UHF long range RFID Module reads and writes RFID tags that comply to the EPC Class 1 Gen 2 standard in version 1 and 2. The rugged and very compact form factor makes it perfect for high power, high temperature and mobile applications.

These include: - long range UHF RFID identification in harsh environments - identification of goods and storage locationon on fork lift trucks - tracking of goods in logistics applications - integration of high performance RFID into machines and other equipment

Currently supported regions are Europe (CE), US (FCC) and China (CCC). Other regions can be implemented on request by firmware extensions.

2.3. Technical Specification

The following table shows the technical specification of the PLRM module with minimum, typical and maximum values for each parameter (where applicable).

Table 1. Technical Specification

	Min.	Typ.	Max.
Supply Voltage Vcc	4.7V	5.0V	5.5V
Supply Current Standby		30mA	
Supply Current RF on 2W	1800mA	2000mA	2500mA
RF output power	1mW	1000mW	2000mW
V_In_low UART	-0.3V	0V	0.9V
V_In_high UART	2.3V	3.3V	3.45V

	Min.	Typ.	Max.
V_out_low UART	0V	0.1V	0.4V
V_out_high UART	2.9V	3.3V	3.45V
Operating Temperature [1]	-20°C	20°C	+85°C
Antenna port impedance	40Ohm	50Ohm	60Ohm
Carrier frequency [2]	850MHz		950MHz
Supported RFID Protocol		EPC Class1 Gen2	
Dimensions	-0.2 mm	50 x 85 x 15 mm	+0.5 mm
Antenna Connector		4 x MMCX	
Communication Interface		3.3V UART	
Humidity		Non-condensing	

2.4. Pin assignments and description

All connections are available on a 2.5 mm pitch 4 position THT connector. The default connector is a JST S4B-EH-GU side entry wire-to-board connector. Other compatible connectors can be fitted on request. Power and UART connector is the 4 position pin header X1.

Figure 2. PLRM Pin Positions and Naming (top view)

Table 2. Power and UART Pin Connections

Pin Name	Pin Nr.	Pin Direction	Pin Function
+5V	X1.1	PWR	main supply, connect low noise regulated 5V supply
GND	X1.2	PWR	Power and UART GND
TXD	X1.3	out	3.3V UART transmit data output with EMI low pass filter
RXD	X1.4	in	3.3V UART receive data input with EMI low pass filter

On the output side, the PLRM module has an integrated 4x multiplexer and thus 4 MMCX antenna ports that are embedded in the edge of the board.

2.5. Mechanical Specification

The dimensions of the PLRM are shown in Fig. 3. A STEP model of the PLRM is available for download at the Metratec website.

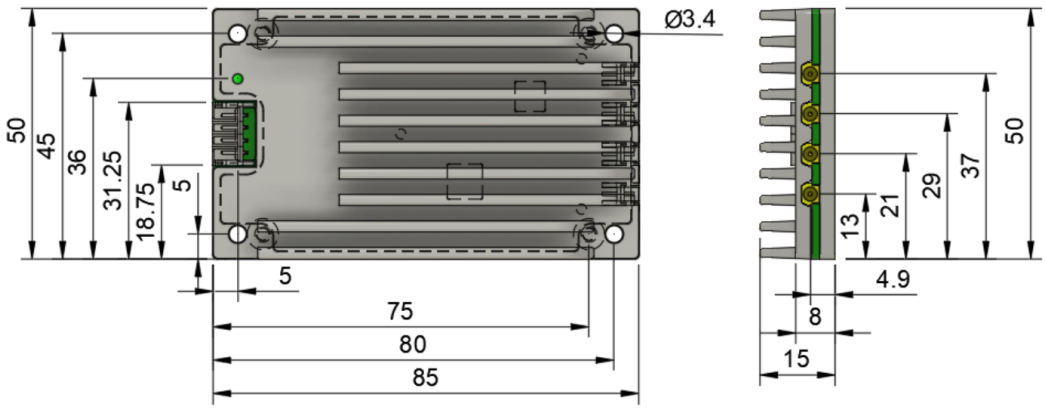

Figure 3. Mechanical Dimensions PLRM

2.6. Scope of Delivery

The PLRM UHF RFID Module comes with the following parts:

- PLRM UHF RFID Module incl. Heatsink and JST connector
- Documentation, Drivers and Demo Software are available via download from Metratec's website

2.7. Accessories

The following accessories and modules are available to extend and evaluate the functionality of the PLRM UHF RFID Module:

- UDB 4 Evaluation Board, Art. No. 22003454
- alternatively: RFID HaT for RaspberryPi, Art. No. 22003468
- PLRM adapter cable, 4-wire connection cable, 30cm, JST EHR-4 on both ends, Art. No. 25001250
- different RFID tags suitable for almost every application
- Echo-4 UHF RFID antenna European (ETSI) version, Art. No. 22003456
- Echo-4 UHF RFID antenna US (FCC) version, Art. No. 22003457 (also suitable for other regions using a subset of the FCC frequency range, eg. China.)

[1] RFID performance may vary with temperature, check in application, the module might enter smart overheating protection mode

[2] Used frequencies will follow region settings.

3. RFID Integration Hints

As RFID technology is about communicating with low cost passive transponders the technology is quite sensitive to in-band noise. This can be other devices using the same unlicensed frequency band or high speed digital electronics. However quite often the main disturbance is other RFID devices used at the same site. Make sure ther is time or frequency multiplexing synchronizing several RFID devices operating at the same site. Another option is to provide enough spacing between devices.

Use 50 Ohm antennas with the frequency range matching the region in which the reader is operating. Keep antenna cables as short as possible. Use low-loss 50 Ohm coaxial cables only. Do not place anything directly in front of the antenna. Do not place metallic parts close to the sides of the antenna. Only one antenna must be connected to each of the 4 MMCX output ports at a time.

The module features complete shielding of all RF circuitry which is necessary for the FCC modular approval. FCC modular approval is pending.

4. Power Supply and Power Consumption

The module does not feature a reverse polarity protection. It is the task of the host board to supply a well filtered 5V DC supply in order to achieve an optimum RFID performance. The module will change consumed power according to the selected RF output power level. The power supply must be able to provide an average current of 2A to the module. The peak current at RF ramp-up can be as high as 2.5A.

Make liberal use of bypass caps at the power input to the module. A minum value of 680u composed of large tantalum or electrolytic caps and 10u to 22u ceramic caps is recommended.

All internal voltages are derived from the 5V supply using onboard regulators. However, RFID systems require a very high level supply quality. Make sure the design is low noise over all load conditions and use an EMC optimized layout as well as shielded inductors.

4.1. Hints for additional EMC filtering

The PLRM module contains power supplies and a RF generator which will also generate harmonics. These will be radiated from the module below current certification limits. When integrating the module into another device with long cables or big ground planes, radiated emissions might increase. It is advisable to follow good layout practices and add additional EMC filtering to comply with all relevant norms.

5. Communication

The PLRM UHF RFID Module communicates with its host using a 3V3 UART connection. This enables direct connection to a host microcontroller. The communication details of the serial interface are given in the table below. The UART lines are filtered for low EMI and good signal quality on the module.

Table 3. Communication Interface Specification

	Min.	Typ.	Max.
Baudrate	114 000	115 200	116 500
Databits		8	
Parity		None	
Stopbits	1	1	1.5

There is a range of circuits available to convert the 3.3 V UART Signal to RS485, RS232, USB or Ethernet. Please contact Metratec if you need advice on converter circuits.

The UART commands used to control the PLRM Module are described in the Metratec AT-UHF Protocol Guide. This guide comprises a detailed description of all commands, response formats and examples. As this protocol is shared among several Metratec products the guide is available in a separate document from Metratec's website.

6. Thermal Integration

The PLRM module generates up to 2W RF output power in a small module. The thermal design of the host system must make sure that the 8W heat generated at maximum output power can be dissipated to the environment with as little as possible thermal resistance. Mounting the PLRM to a large and cool metallic backplane while not covering the heatsinking on the modules top side is best practice. At lower required RF output powers or reduced maximum ambient temperatures a sub-optimum thermal management is acceptable.

6.1. Smart thermal managment

When the module is operated at maximum output power for a long time and ambient temperature is close to the maximum of 85°C the module might enter smart thermal management. In this mode the module will suspend RFID reading for a short time interval and continously monitor the temperature of all critical components in the module. As soon as a save power up is guaranteed the module with resume operation. The user is periodically notified of this condition via the AT protocol by the message OVERTEMP as long as the overtemperature condition persists.

7. Digital Inputs / Outputs (GPIOs)

The PLRM Module does not feature GPIOs. Please consider using the the DwarfG2 line-up from the same product family if your application needs input or output pins. All DwarfG2 models feature 4 general purpose inputs and outputs.

8. Certification

ATTENTION

Changes or modifications to the module not expressly approved by Metratec could void the user's authority to operate the equipment.

8.1. CE / ETSI (EU)

The PLRM UHF RFID Module complies with ETSI EN 300 208 and all other relevant European standards. Nonetheless, the integrator of the module has to make sure that all requirements are met by the final product. It is his obligation to declare product conformity. We recommend to assign this task to a qualified third-party test lab specialized on EMC measurements.

8.2. FCC (USA)

This device complies with part 15 of the FCC rules. 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. Changes or modifications not expressly approved by the party responsible for compliance could void the user' s authority to operate the equipment. NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursua nt to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful inte rference in a residential installation. This equipment generates uses and can radiate radio frequency energy a nd, if not installed and used in accordance with the instructions, may cause harmful interference to radio com munications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turn ing the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.

- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

The module meets the requirements of FCC 47 part 15.247 and the requirements for an FCC modular approval as a single-modular transmitter. Please contact Metratec in case a modular approval is beneficial for your integration project.

8.2.1. Radiation Exposure Statement

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator and your body. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

8.3. IC (Canada)

Certification requirements for Industry Canada (IC) are similar to those of the FCC. Limits of ICES-003 for radiated emissions are similar to the formats specified in FCC Part 15 and CISPR 22. Industry Canada accepts FCC test reports or CISPR 22 test reports for compliance with ICES-003. The integrator is responsible for its product to comply with all relevant IC rules.

9. Further Notes

Electronic devices like the PLRM UHF RFID Module are covered by the (German) ElektroG (electronic waste law) as well as the European WEEE directive and as such may not be disposed of by way of the normal household trash. Instead they have to be recycled properly. For you as our customer this is no additional burden, however, as you can send the device back to us for proper recycling. We assure you that the devices received back will be recycled properly and in an environmentally friendly way. Our WEEE Registration ID is DE 56060482. When selecting electronic components we additionally made sure that all components are free of heavy metals and other harmful substances as required by the RoHS Directive for many industries. Hence, our products are produced in the most environmentally friendly way possible.

10. Version History

The following table shows the different version of this file.

Table 4. Version History

Version	Change	Changed by	Date
1.0	Initial Release	TM	4.12.2024
1.1	Fixed Typos	KD	8.4.2025
1.2	FCC Statement added	TM	15.7.2025

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