Technical Documentation

for metraTec Dwarf15 HF SMD RFID Module
Hardware Revision 2.X

Date: Mar 2017

Version: 1.7

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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 Dwarf15 HF SMD 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 Dwarf15 HF SMD 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 Dwarf15 module, it might be useful to also read the metraTec Protocol Guide, which explains the ASCII protocols used to control the module in full detail.

Source: http://www.metratec.com → Support → Downloads → Documentation

2 Product Description

The Dwarf15 HF SMD RFID Module is an easy to use RFID module which can be integrated into your electronics without big effort. This allows you to equip your product with RFID functionality without designing your own RF board. Thanks to the tested and extremely flexible firmware you can read and write data to any tag that follows the ISO 15693 standard in no time. Even special features, e.g. sensor tags, can be used without firmware modifications. Depending on the external antenna you connect to the module, a read range between 30 and 150 mm can be expected (also depending on transponder size and type)

Thanks to the quick firmware, the module is perfect for applications in printers and similar devices where high reading and writing speed is needed.

2.1 Product Revision History

This document applies to Dwarf15 revisions starting from 02.00. All future revisions 2.xx will be according to this documentation. The hardware revision is printed on the board or can be checked using the Read Hardware Revision (RHR) command. Compared to its predecessors revision 2.xx Dwarf15 modules feature the following improvements:

- ✔ native 3.3V UART interface
- ✔ switchable RF output power level
- ✔ up to 150 mm read range
- ✔ increased RX sensitivity
- ✔ two switchable Receivers
- ✔ improved EMI / EMC behaviour

2.2 Intended Use

The Dwarf15 HF RFID Module reads RFID tags that comply to the ISO 15693 standard on a short range of 30-150 mm. Custom tag commands can be used without firmware changes if the tags follow the ISO 15693 standard with regard to the air interface. For transponders that use a protocol with MIFARE® technology, please use our Dwarf14 RFID Module.

2.3 Technical Specification

	Min.	Typ.	Max.
Supply voltage	4.7 V	5.0 V	5.5 V
Supply Current Standby		20mA	
Supply Current RF on 200mW	135	150mA	160mA
Supply Current RF on 100mW	95	110mA	120mA
RF output power 200mW	150mW	200mW	225mW
Operating Temperature [1]	-25°C	20°C	+85°C
Antenna port impedance		50 Ohm single ended	
Carrier frequency [2]		13.56 MHz	
Supported RFID Protocol		ISO 15693	
Dimensions		18 x 36 mm	
Antenna Connector		U.FL / Edge Vias	
Communication Interface [3]		3V3 UART	
Humidity			Non-condensing

(1) RFID performance may vary with temperature, check in application

(2) assigned worldwide

(3) SPI available on request
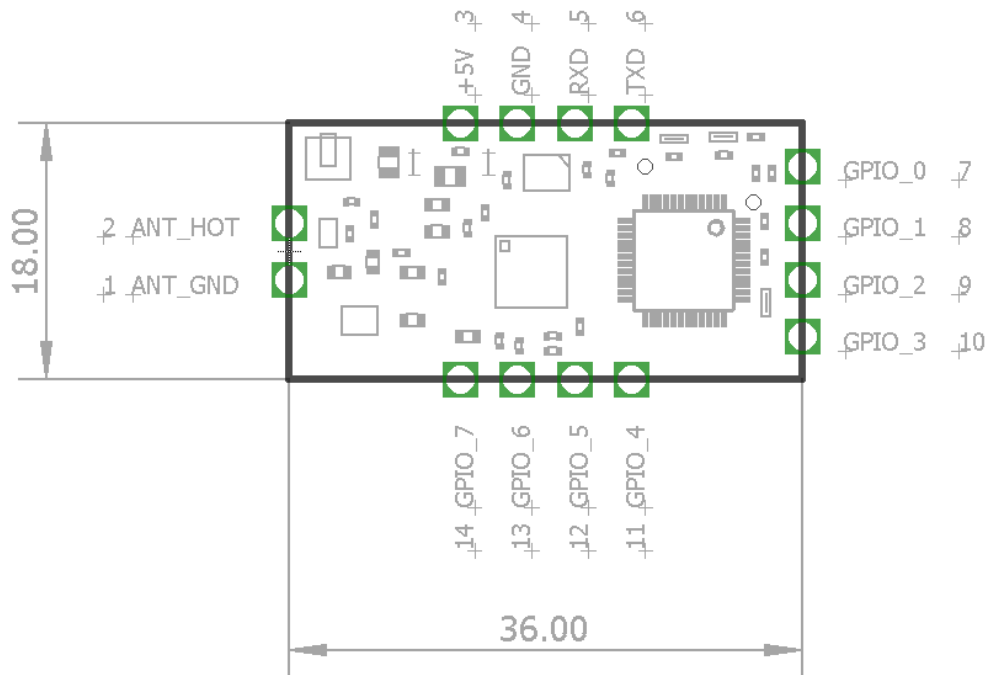
2.4 Pad assignments and description

Fig. 1: Pad numbers, pad names and mechanical dimensions of the Dwarf15 module

Pad name	Pad Nr.	Direction	Function
ANT_GND	1	Pass.	antenna ground, connect 50 Ohm antenna between ANT+ and ANT_GND via 50 Ohm transmission line
ANT_HOT	2	RF Out	Antenna driver, connect 50 Ohm antenna between ANT+ and ANT_GND via 50 Ohm transmission line
+5V	3	Pwr. In	main supply, connect low noise regulated 5V supply
GND	4	Pass.	Supply ground
RXD	5	In	3.3 V UART data input
TXD	6	Out	3.3 V UART data output
GPIO_0	7	I/O	3.3V GPIO, direction is configurable via FW command, alternate functions on request, high drive pin, 15mA drive strength
GPIO_1	8	I/O	3.3V GPIO, direction is configurable via FW command, alternate functions on request, high drive pin, 15mA drive strength
GPIO_2	9	I/O	3.3V GPIO, direction is configurable via FW command, alternate functions on request, 4mA drive strength
GPIO_3	10	I/O	3.3V GPIO, direction is configurable via FW command alternate functions on request, 4mA drive strength
GPIO_4	11	I/O	3.3V GPIO, direction is configurable via FW command, alternate function: SPI clock (SCK), 4mA drive strength,
GPIO_5	12	I/O	3.3V GPIO, direction is configurable via FW command, alternate function: SPI slave select (SSEL), alternate function: RS485 transmit driver enable (TXDEN), 4mA drive strength

GPIO_6	13	I/O	3.3V GPIO, direction is configurable via FW command, alternate function: SPI clock Master In Slave Out (MISO), 4mA drive strength
GPIO_7	14	I/O	3.3V GPIO, direction is configurable via FW command, alternate function: SPI Master Out Slave In (MOSI), 4mA drive strength

2.5 Module Building Blocks

The Dwarf15 module consists of three building blocks, each of them carrying out one of the following functions:

- *Power supply* – Uses the external 5 V power supply to generate various supply voltages for analog and digital functions

- *Microcontroller* – *the* heart of the Dwarf15 running the metraTec firmware and supplying the host interface

- *RF Frontend* – generates the RF signal transmitted to the tag and evaluates the tag response

2.6 Mechanical Specification

The modules dimensions are 36 x 18 x 3 mm.

For further specification of via locations, see our free Eagle Library which includes a footprint for the Dwarf15 SMD Module.

2.7 Scope of Delivery

The Dwarf15 HF RFID Module comes with the following parts:

- Dwarf15 HF RFID Module

- Documentation, Drivers and Demo Software are available via download from metraTec's website

2.8 Accessories

The following accessories and modules are available to extend and evaluate the functionality of the Dwarf15 HF RFID Module:

- UDB Mini Evaluation Board incl. SMD Adapter

- HF Field Detector

- different RFID tags suitable for almost every application

3 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 5 V DC supply in order to achieve an optimum RFID performance.

Via	Via Function
3	5 V DC
4	*GND*

Tab. 1: Power Supply Vias

Power supply voltage	5 V DC
Current consumption RF on	150 mA
Current consumption RF off / STB	20 mA
GPIO voltage level	3.3 V

Tab. 2: DC characteristics

RFID systems require a very high level supply quality. Use linear regulators with high precision and high control speed whenever possible. When using switching power supplies make sure the switching speed is above 500 kHz and us an EMC optimized layout as well as shielded inductors.

3.1 Hints for additional EMC filtering

The Dwarf15 Module contains an RF generator at 13.56 MHz which also generates harmonics. These will be radiated from the module below all current certification limits. When integrating the module into another device with long cables or big ground planes, radiated emissions might increase. It is be advisable to follow good layout practices and add additional EMC filtering to comply with all relevant norms. Common mode supply filters are required in most cases to comply with basic radiated emission rules. The following picture shows radiated emissions of a dwarf module mounted on a metratec evaluation board.
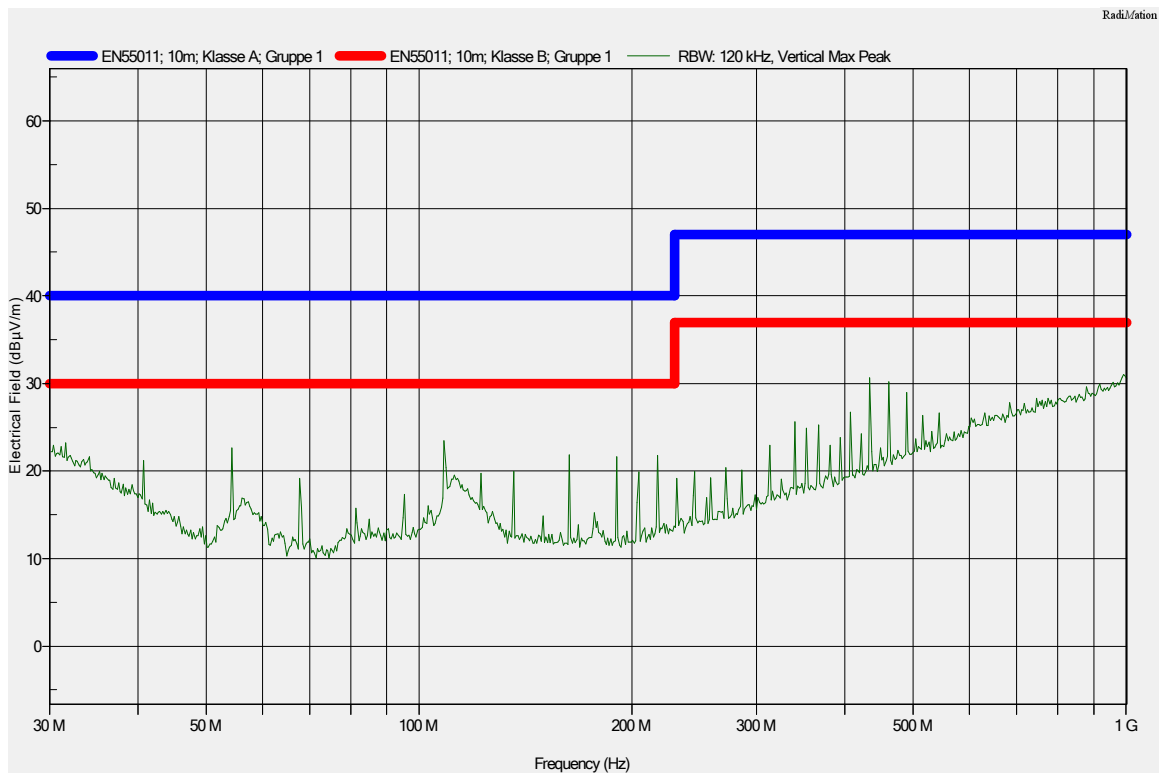
Abbildung 1: Radiated Emissions of Dwarf15 2.00 on metraTec evaluation board at full output power (200mW), 2500 mm² antenna area

4 Communication

The Dwarf15 HF 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.

	Min.	Typ.	Max.
Baudrate [1]	114 000	115 200	116 500
Databits		8	
Parity		None	
Stopbits	1	1	1.5
Vlow	-0.3 V	0	0.9 V
Vhigh	2.1 V	3.15 V	3.3 V

(1)　　Others on request

There is a range of circuits available to convert the 3.3 V UART Signal to RS232, RS422/485 or to USB or Ethernet. A RS485 driver enable signal is available as alternate pin function on GPIO_5 pad. Please contact metraTec if you need advice on converter circuits.

Via	Via Function
5	RxD, Receive data input, 330 Ohm series protection resistor
6	TxD, Transmit data output, 100 Ohm series protection resistor

Tab. 3: UART Via connections

The UART commands used to control the Dwarf15 Module are described in the metraTec 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.

5 External Antenna

The Dwarf15 SMD Module uses an external antenna to communicate with the RFID transponder. This antenna can be connected to the U.FL connector on the module or directly to the two antenna vias. In the later case you can directly bond the module to the antenna with no need of any cables. Only one antenna may be connected to the module at a time. If you require more read points antenna multiplexers are available from metraTec.

Via	Via Function
1	Antenna Ground
2	Antenna Signal / Hot Pin

Tab. 4: Antenna Via connections

Depending on the size of the external antenna, size of the transponder as well as mounting situation, you can expect a read range between 30 mm and 150 mm. A wide range of cost efficient OEM PCB antennas as well as custom antenna design services are available from metraTec.

6 Digital Inputs / Outputs (GPIOs)

The Dwarf15 Module has eight freely configurable input/output pins which can be set and read via the module. To use these GPIOs just connect your signals to the corresponding vias (X3). All signals are 3V3 signals.

ATTENTION

Please make sure that you only connect 3.3V level devices to the GPIOs or use the right level shifter if connecting other devices. Some industrial devices use 24 V DC inputs/outputs. If you connect these without proper protection, this will most likely destroy the Dwarf15.

Pin	Pin Function
7	Input/Output 0
8	Input/Output 1
9	Input/Output 2
10	Input/Output 3
11	Input/Output 4
12	Input/Output 5
13	Input/Output 6
14	Input/Output 7

Tab. 5: Overview of digital input/output pins

Alternate Pin functions are available. GPIO function and direction is disabled when an alternate function for a pin or pin group is selected. Not all functions can be combined.

7 Certification

ATTENTION

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

7.1 CE / ETSI (EU)

The Dwarf15 HF RFID Module complies with ETSI Rule EN 300 330. 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.

7.2 FCC (USA)

The Dwarf15 HF RFID Module complies with Part 15 of the FCC Rules. Since the module has no internal power supply regulation as well as no RF shielding the device has no modular approval according to FCC Rules (see FCC document DA 00-1407).

To fulfill all FCC requirements the integrator must test the final product to comply with FCC regulations regarding intentional and unintentional radiators before declaring FCC compliance of his own product.

7.3 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.

8 Further Notes

Electronic devices like the Dwarf15 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.

9 Version History

Version	Change	Changed by	Date
1.0	created	KD	05.11.09
1.1	Mechanical Dimensions added	KD	19.06.12
1.2	No of Pins corrected	KD	26.10.12
1.3	Corrected use of the Label MIFARE®	CS	20.01.14
1.4	Further Notes added, Security Advice added, current consumption corrected, minor changes	CS	05.05.2015
1.5	minor changes to certification note	CS	16.06.2015
1.6	Completely revised for hardware generation 2.xx	TM	05.09.2016
1.7	update address	KS	06.03.2017

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