



# Datasheet DwarfG2 v2

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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 DwarfG2 v2 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 DwarfG2 v2 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 DwarfG2 v2 module, it might be useful to also read the Metratec UHF AT Protocol Guide, which explains the AT protocol used to control the module in full detail. Source: <https://www.metratec.com>

## 2. Product Description

The DwarfG2 v2 UHF RFID Module is an easy to use RFID module which can be integrated into host 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 UHF EPC Gen 2 standard in no time. With its high efficiency medium power RF amplifier a read range of up to 1.5 m is possible (with modern Impinj M7xx/M8xx or NXP UCode9 transponder). A choice of suitable antennas is available from Metratec.

Thanks to the fast firmware, the module is perfect for applications on conveyors, laundries, retail logistics, point of sale and similar where medium range for finding up to 50 transponders is needed at an affordable price.



Figure 1. DwarfG2 v2 Module Shield Cage Side

### 2.1. Intended Use

The DwarfG2 v2 UHF RFID Module reads and writes RFID tags that comply to the EPC 1 Gen 2 standard. The DwarfG2 v2 is available in a single version for worldwide operation. Current firmware supports use in Europe, the US and China. The read range achievable is up to 5 m using latest generation tags. The host communication protocol is identical across the Metratec UHF EPC1 Gen2 product family. This family includes:

- DwarfG2 Mini v2, a short range UHF reader module
- DwarfG2 XR v2, a medium range UHF reader module

- DeskID UHF v2, a USB Desktop UHF reader (ETSI and FCC version)
- QRG2, a short range UHF reader modules with internal antenna (ETSI and FCC version)
- PulsarLR, a long range UHF reader for industrial use
- PLRM, a high power, high temperature UHF reader module with 4 antenna ports

The DwarfG2\_v2 is pin compatible with the short range module DwarfG2\_Mini\_v2 and the medium range DwarfG2\_v2 module. Only supply currents, RF output power and heat dissipation are different across the DwarfG2 lineup.

## 2.2. Technical Specification

The following table shows the technical specification of the DwarfG2 v2 module with minimum, typical and maximum values for each parameter (where applicable).

*Table 1. Technical Specification*

|   | Min.      | Typ.  | Max.      |
|---|-----------|-------|-----------|
| Supply Voltage Vcc  | 4.7 V     | 5.0 V | 5.3 V     |
| Supply Current Standby  |           | 35 mA | 50 mA     |
| Supply Current RF on<br>20dBm   |           | 380mA | 430mA     |
| RF output power   | 1 dBm     |       | 20dBm     |
| Carrier Frequency<br>Europe/ETSI  | 865.7 MHz |       | 867.5 MHz |
| Carrier Frequency US/FCC  | 902 MHz   |       | 928 MHz   |
| Operating Temperature<br>(RFID performance may<br>vary with temperature,<br>check in application) | -20°C     | 20°C  | +70°C     |

|                         | Min.  | Typ.                | Max.  |
|-------------------------|-------|---------------------|-------|
| Supported RFID Protocol |       | EPC 1 Gen 2         |       |
| Dimensions              |       | 40 x 36 x 6.5<br>mm |       |
| Antenna Connector       |       | U.FL and<br>SMT pad |       |
| Antenna Gain            |       | n.a.                |       |
| Humidity                |       | Non-<br>condensing  |       |
| Communication Interface |       | 3V3 UART            |       |
| V_In_low UART           | -0.3V | 0V                  | 0.9V  |
| V_In_high UART          | 2.3V  | 3.3V                | 3.45V |
| V_out_low UART *        | 0V    | 0.1V                | 0.4V  |
| V_out_high UART *       | 2.9V  | 3.3V                | 3.45V |
| GPIO voltage level      |       | 3V3                 |       |
| V_In_low                | -0.3V | 0V                  | 0.9V  |
| V_In_high               | 2.3V  | 3.3V                | 3.45V |
| V_out_low *             | 0V    | 0.1V                | 0.4V  |
| V_out_high *            | 2.9V  | 3.3V                | 3.45V |
| Output drive strength   | 1mA   | 2mA                 | 4mA   |

\*Output voltages at a typical load current of 100mA / 33 kOhm load impedance.

## 2.3. Pin Assignments and Description

All connections are available on SMT pads. Power and UART connections are optionally available on a wire to board connector which is not populated by default. The RF antenna connection is on both a SMT pad and a U.FL connector in parallel.



Do not connect the RF pad when using a U.FL cable for antenna connection. Route 50 Ohm microstrip or coplanar waveguide when using the SMT pad. Never connect two antennas to both optional connectors at the same time.

An Eagle library is available for download from our website for easy integration into the host PCB designs.

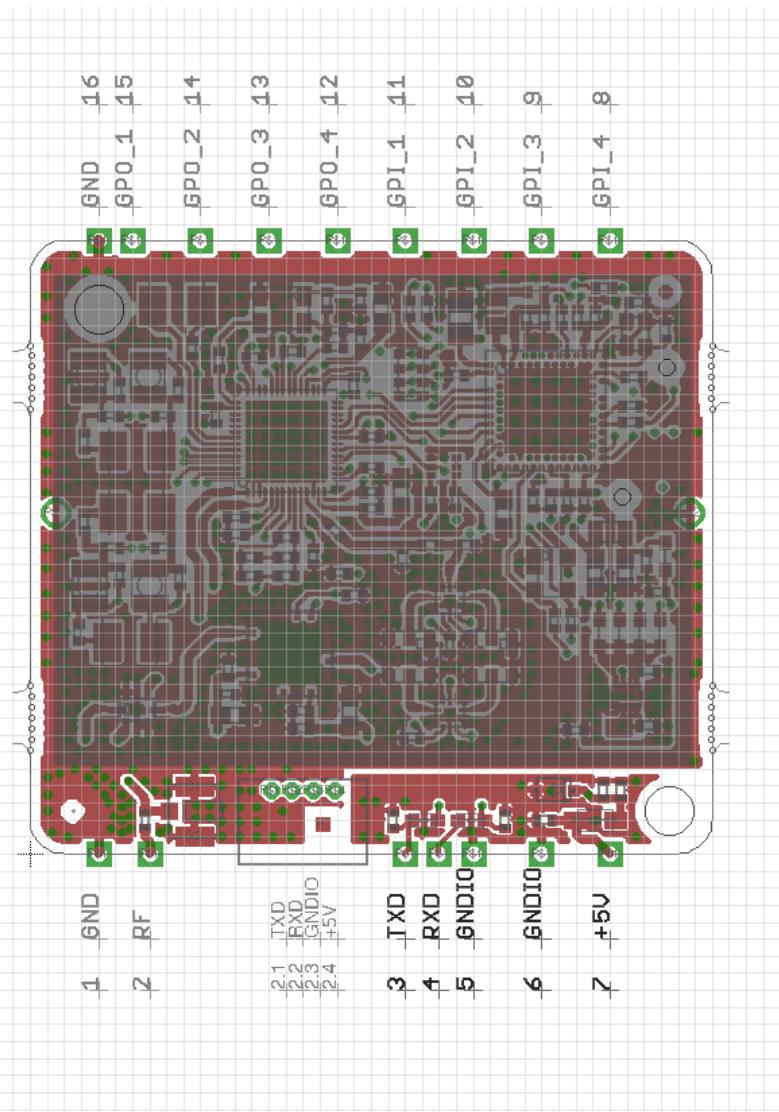


Figure 2. DwarfG2 v2 Pin Positions and Naming (top view, shieldcage side)

Table 2. Pin Connections

| Pin Name | Pin Nr. | Direction | Function   |
|----------|---------|-----------|--|
| GND      | 1       | pas       | RF GND, internally connected to PWR and UART GND |
| RF       | 2       | out       | RF antenna connection, parallel to UFL           |
| TXD      | 3       | out       | 3V3 UART transmit data output                    |
| RXD      | 4       | in        | 3V3 UART receive data input                      |
| GNDIO    | 5, 6    | pwr       | PWR and UART GND, internally connected to RF GND |
| +5V      | 7       | in        | 5V0 power input                                  |
| GPI_4    | 8       | in        | 3V3 general purpose input                        |
| GPI_3    | 9       | in        | 3V3 general purpose input                        |
| GPI_2    | 10      | in        | 3V3 general purpose input                        |
| GPI_1    | 11      | in        | 3V3 general purpose input                        |
| GP0_4    | 12      | out       | 3V3 general purpose output                       |
| GP0_3    | 13      | out       | 3V3 general purpose output                       |
| GP0_2    | 14      | out       | 3V3 general purpose output                       |
| GP0_1    | 15      | out       | 3V3 general purpose output                       |
| GND      | 16      | pas       | GPIO GND   |

## 2.4. Mechanical Specification

PCB dimensions as well as pin positions are shown in the figure. A STEP model is available for download on the Metratec website to facilitate your mechanical design. Recommended SMT Pad size is 1.4 x 1.4 mm.

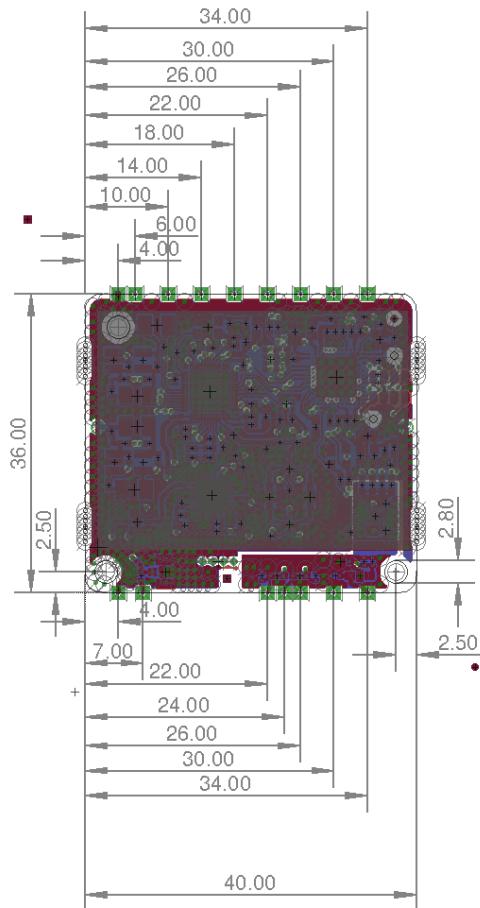


Figure 3. Mechanical Dimensions DwarfG2 v2

## 2.5. Scope of Delivery

The DwarfG2 v2 UHF RFID Module comes with the following parts:

- DwarfG2 v2 UHF RFID Module
- Documentation, Drivers and Demo Software are available via download from Metratec's website

## 2.6. Accessories and Services

The following accessories and modules are available to extend and evaluate the functionality of the DwarfG2 v2 UHF RFID module:

- Development Board (Metratec UDB4)
- Starter Kit incl. Development Board, antenna, tags, cables
- a selection of housed and PCB level antennas for various applications
- different UHF RFID tags suitable for almost every application
- custom antenna design services
- custom carrier board design
- RF integration and EMC support

### 3. RFID Module Integration

**ATTENTION**

This device must be professionally installed.

**ATTENTION**

This device must be used in a host device with an internal antenna or an unique external antenna connector only.

**ATTENTION**

This device must be operated with antennas of the following type only:

- linear or circular patch antennas with a maximum gain of 12dBi
- embedded monopole, dipole, inverted F or similar antennas with a maximum gain of 12dBi

**ATTENTION**

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

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 there 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 the RF ports at a time. Use a well filtered power supply.

### 3.1. List of applicable radio standards

When designing our module into your product, please keep in mind that UHF RFID applications must comply with:

- Europe: ETSI EN 303 208 - Radio Frequency Identification Equipment operating in the band 865 MHz to 868 MHz with power levels up to 2 W and in the band 915 MHz to 921 MHz with power levels up to 4 W; Harmonised Standard for access to radio spectrum
- US/FCC: 47 CFR § 15.247 - Operation within the bands 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz.
- CAN/ISED: RSS-210 (Issue 10) Licence-Exempt Radio Apparatus: Category I Equipment

### 3.2. Specific operational use conditions

Not applicable.

### 3.3. Limited module procedures

Not applicable.

### 3.4. Trace antenna designs

Not applicable.

### 3.5. RF exposure considerations

US/FCC: 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.

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

Cet équipement est conforme aux limites d'exposition aux rayonnements ISED établies pour un environnement non contrôlé. Cet équipement doit être installé et utilisé avec un minimum de 20 cm de distance entre la source de rayonnement et votre corps. Ce transmetteur ne doit pas être placé au même endroit ou utilisé simultanément avec un autre transmetteur ou antenne.

### 3.6. Antennas

The module may be operated using external antennas. The antennas should be 50 Ohms, operate in the correct frequency band and bandwidth for the region the system is operated in. This device must be operated with antennas of the following type only:

- ceramic patch antennas with a maximum gain of 2dBi

### 3.7. Label and compliance information

The final end product must be labeled in a visible area with the following "Contains FCC ID:YUH-DW22".

### 3.8. Information on test modes and additional testing requirements

The host manufacturer is strongly recommended to confirm compliance with FCC requirements for the transmitter when the module is installed in the host.

### 3.9. Additional testing, Part 15 Subpart B disclaimer

This modular transmitter is only FCC/ISED authorized for the specific rule part/radio standards specification listed on the grant/certificate. The host product manufacturer is responsible for compliance to any other FCC rules/ISED radio standards specifications that apply to the host not covered by the modular transmitter grant of certification.

If the host product manufacturer markets their product as being Part 15 Subpart B compliant (when it also contains unintentional-radiator digital circuitry), then the host product manufacturer shall provide one of the following notices whichever is applicable in the user manual:

Class A: For a Class A digital device or peripheral, the instructions furnished the user shall include the following or similar statement, placed in a prominent location in the text of the manual:

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Class B (use in a residential environment): For a Class B digital device or peripheral, the instructions furnished the user shall include the following or similar statement, placed in a prominent location in the text of the manual:

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. 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 turning 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.

### 3.10. EMI Considerations

The host manufacturer is advised to follow the guidance in "996369 D04 Module Integration Guide V02" when integrating this modular transmitter.

It is advisable to follow good layout practices and add additional EMC filtering to comply with all relevant norms. A short four wire connection to the DwarfG2 v2 using +5V, GND, RXD and TXD is usually best.

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

All internal voltages are derived from the 5V supply using onboard regulators. However, 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 use an EMC optimized layout as well as shielded inductors.

Please contact Metratec if you have any questions regarding your own power supply design when integrating our module into your board.

## 5. Communication

The DwarfG2 v2 UHF RFID Module communicates with its host using a 3V3 UART connection. This enables direct connection to a modern host microcontroller. The communication details of the serial interface are given in the table below.

*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 RS232, USB or Ethernet. Please contact Metratec if you need advice on converter circuits.

The UART commands used to control the DwarfG2 v2 Module are described in the Metratec UHF AT 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.

Other interfaces may be implemented on the UART or GPIO pins by Metratec in the future. Please inquire in case you require a custom host interface for your project.

## 6. LEDs

The DwarfG2 v2 Module has no internal LEDs. The drive strength of the general purpose outputs is sufficient to drive modern high efficiency LEDs directly. Use external switching on the host board for high power signalling.

## 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 DwarfG2 v2 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.

### 7.2. 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, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. 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 turning 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.

### 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 DwarfG2 v2 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.



## 9. Version History

The following table shows the different version of this file.

*Table 4. Version History*

| Version | Change                        | by | Date      |
|---------|-------------------------------|----|-----------|
| 1.0     | Initial release               | TM | 15.3.2025 |
| 1.1     | FCC statement added           | TM | 26.8.2025 |
| 1.2     | FCC KDB 996369 D03 info added | TM | 4.9.2025  |

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