Radiocrafts

Embedded Wireless Solutions

# Datasheet

RC1880-GPR

## Product Description

The RC1880-GPR is a sub-1 GHz co-processor module for RIIoT (Radiocrafts Industrial Internet of Things) gateways. It interfaces gateways with the RIIoT wireless network. The RC1880-GPR will function as the concentrator in the RIIoT network and the gateway can connect each node in the RIIoT network to the cloud.


The module contains a complete IEEE802.15.4g/e compliant stack which is accessed through an API via UART. Through the free middleware, *RIIOT Net Controller*, the interface to the RIIoT network is accessible through a local socket interface. This enables easy development of customer applications that can include fog computing or cloud connection though MQTT or RESTful HTTP.

The RC1880-GPR will always be the concentrator in an IEEE 802.15.4g/e network and be responsible for creating the network, setting the network and security policies.

## Applications

- Gateway for RIIoT
- Concentrator in a closed RIIoT network

## Features

- Closely bound with the RIIoT Net Controller middleware that enables socket interface for customer application
- Based on open standards IEEE 802.15.4 g/e
- Frequency hopping option
- AES128 network/MAC and application security
- Reliable communication, Automatic acknowledge and retransmission
- Broadcast support
- 8 km Line-of-sight range in 5 kb/s mode
- OTA (Over The Air) FW upgrade support
- Covers both 868 MHz for CE compliance (Europe++) and 915 MHz for FCC compliance (US++)

## Quick Reference Data (typical at 3.6V, 868 MHz, 50 kb/s)

| Parameter | RC1880-SPR | Unit |
|---|---|---|
| Frequency band | 862-930 | MHz |
| Max output power | 14 | dBm |
| Sensitivity (BER 1%) @50kb/s | -110 | dBm |
| Supply voltage | 1.8 - 3.8 | V |
| Current consumption, RX/TX | 6.2 / 26.5 | mA |
| Current consumption, Shutdown | 185 | nA |
| Flash memory | 128 | kB |
| RAM | 20 | kB |
| Internal EEPROM (optional) | 4 | kB |
| Internal SPI Flash(optional) | 256 | kB |
| Operating Temperature | -40 to +85 | °C |

## RIIoT network

The RIIoT network consists of some key elements

- The *RC1880-SPR* module
  - The module can be programmed to the customer specific application behaviour, through the SPR Software Development Kit(SDK)
- The *SPR SDK*
  - Software development kit with application framework and tools for building and uploading user application to the RC1880-SPR module
- The *RC1880-GPR* module for use in the gateway/concentrator
  - Support the concentrator or the gateway. Normally connected to a Linux gateway, but can also be controlled by MCU through a UART protocol
- The *RIIoT Net Controller* Linux middleware
  - A middleware SW that can be used on a Linux gateway. Interfaces the RC1880-GPR module and supply user application a socket interface for controlling and sending/receiving data through the wireless network.

Below is an illustration of the different element and the docuemention availeble

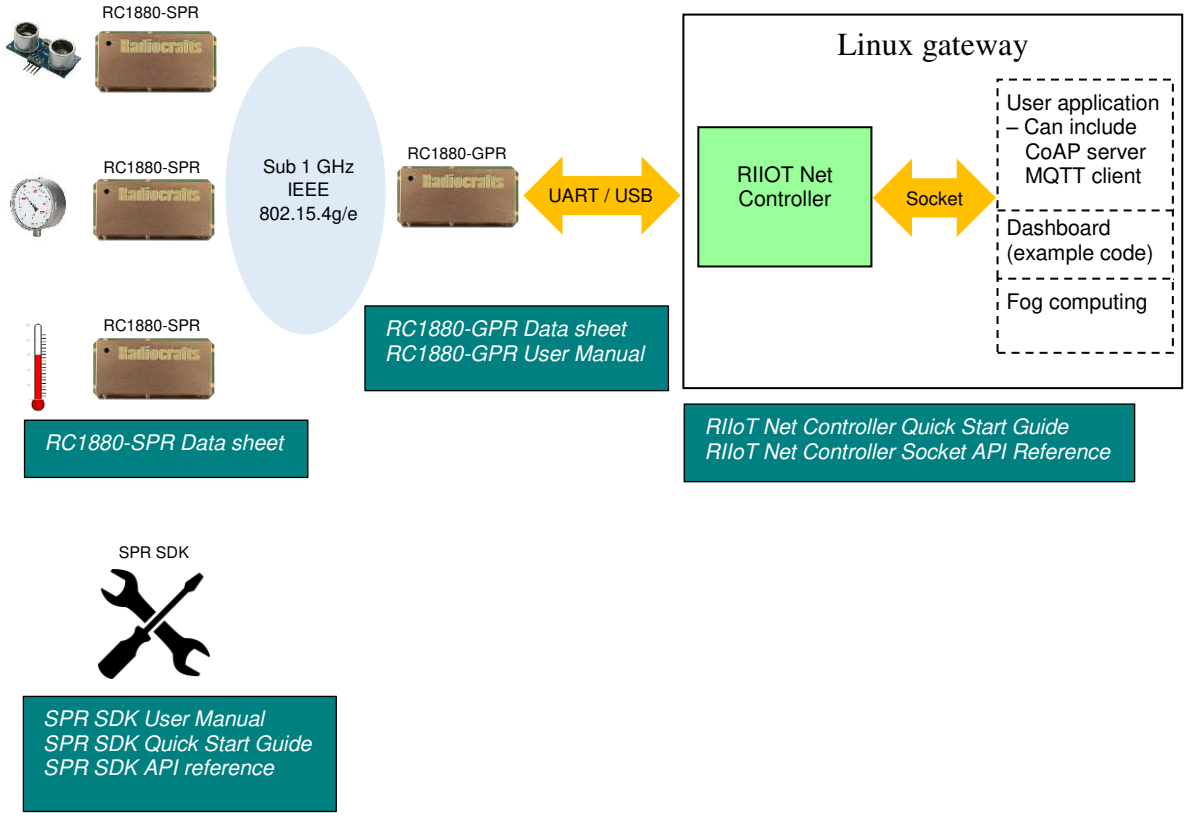



**Figure 1. RIIoT network – system and documentation overview**

## Use with Linux gateway (recommended)

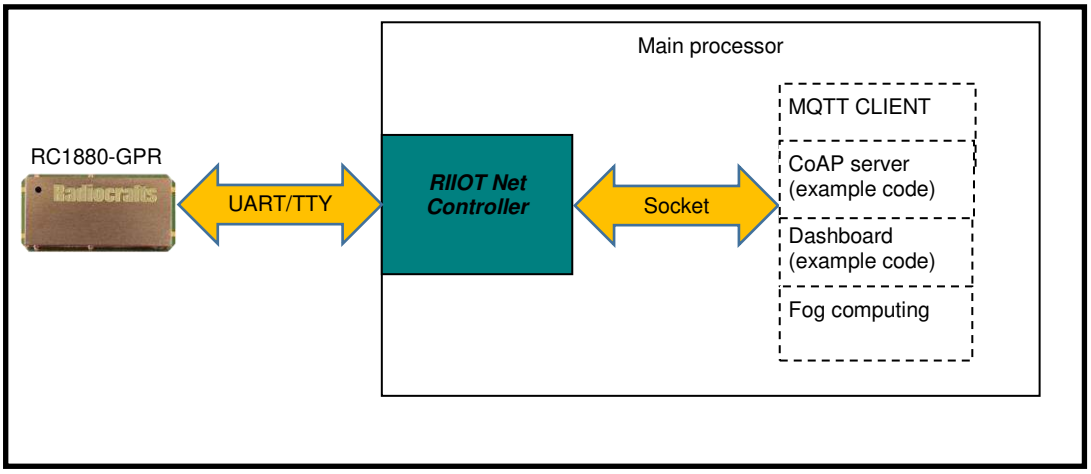



**Figure 2. Gateway architecture**

**Socket Interface:** The most common way to communicate with the GPR is indirect connection through the socket interface. Through the socket interface a high level API is available that allow the gateway application to do the following:

- Setup/configuring the network
- Access control (allow joining/whitelist)
- Set security policy for the network.
- Send and receive data to nodes though JSON objects

*The RIIoT Net Controller* is an intelligent middleware that contains the following functionality

- Start and optionally stop the RIIoT network
- Manage list of associated devices.
- Manage whitelist of pre-approved devices.
- Provide socket interface with high-level API for customer applications to access the network
- Handle serial port interface to RC1880-GPR

For more detailed info see the **RIIot Net Controller Quick Start** and **RIIoT Net Controller Socket API Reference**.

## Use in non-Linux gateway

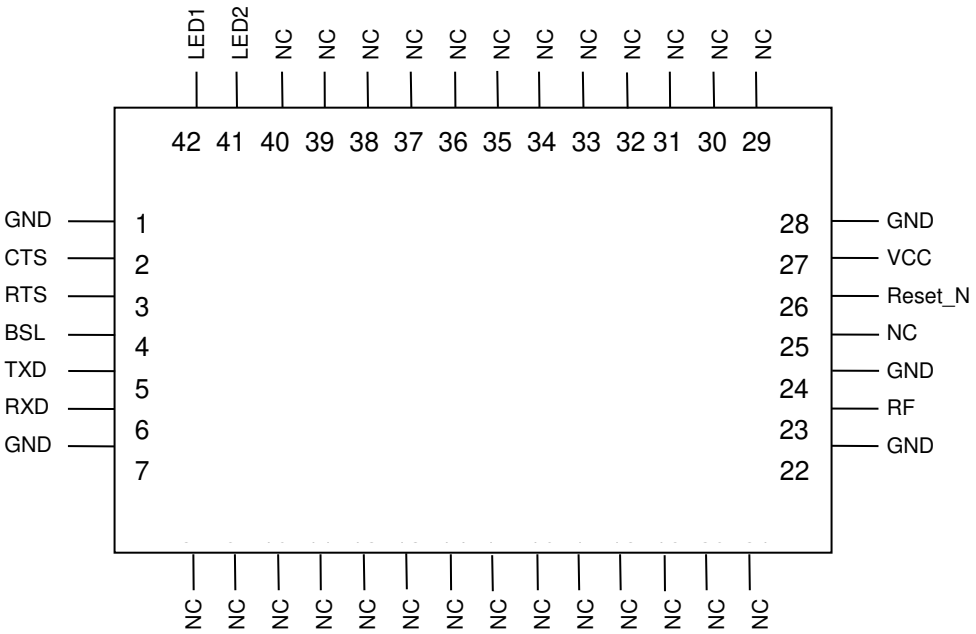
In a non-Linux gateway, the API though UART interface must be used to control the 802.15.4 stack directly. The details of this UART API is documented in the RC1880-GPR User Manual.

Below show some examples of commands that can be sent via the UART interface..

| **Command to RC1880-GPR** | |
|---|---|
| **MAC_SCAN_REQ** | Optional to use. Can be used to scan available channels and determine if any IEEE802.15.4 compliant network is operational or to simply scan channels to find channel with less noise. |
| **MAC_START_REQ** | Starts the network.<br>This command include important options like<br>- Band 868 MHz or 915 MHz<br>- Frequency hopping or not.<br>- Beacon or non beacon mode<br>- Channel<br>- PAN ID<br>- Security settings |
| **MAC_SET_REQ** | |
| **MAC_ASSOCIATE_RSP** | Based on the incoming *MAC_ASSOCIATE_IND* from RC1880-GPR the gateway can choose to send a confirmation that this device. The short address of the device is set by and stored on gateway |
| **MAC_DATA_REQ** | Command used to send data to a given device or to broadcast data. |

| **Command from RC1880-GPR** | |
|---|---|
| **MAC_SCAN_CNF** | Result of the scan request *(MAC_SCAN_REQ)* |
| **MAC_ASSOCIATE_IND** | Indication that a device wants to join the network. Based on this incoming command the gateway can send a *MAC_ASSOCIATE_RSP* command to the module. |
| **MAC_DATA_CNF** | Confirmation that data sent to a specific device has been acknowledged. |
| **MAC_DATA_IND** | Incoming data from a node |

## Pin Assignment




## Pin Description

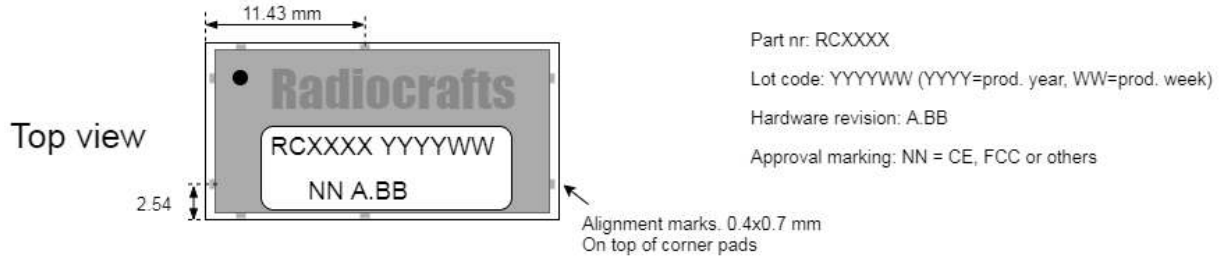
| Pin no | Pin name | Description |
|---|---|---|
| 1 | GND | System ground |
| 2 | CTS | UART flow control |
| 3 | RTS | UART flow control |
| 4 | BSL | Enable boot strap loader(Future Option) |
| 5 | TXD | Configurable I/O pin |
| 6 | RXD | Configurable I/O pin |
| 7 | GND | System ground |
| 8-21 | NC | Do not connect |
| 22 | GND | System ground |
| 23 | RF | RF I/O connection to antenna |
| 24 | GND | System ground |
| 25 | RX/TX | Not connected |
| 26 | RESET_N | Reset (Active low) |
| 27 | VCC | Supply voltage |
| 28 | GND | System ground |
| 29-40 | NC | Do not connect |
| 41 | LED2 | Reserved for future use with network status LED. 4 mA source/sink capability |
| 42 | LED1 | Reserved for future use with network status LED. 4 mA source/sink capability |

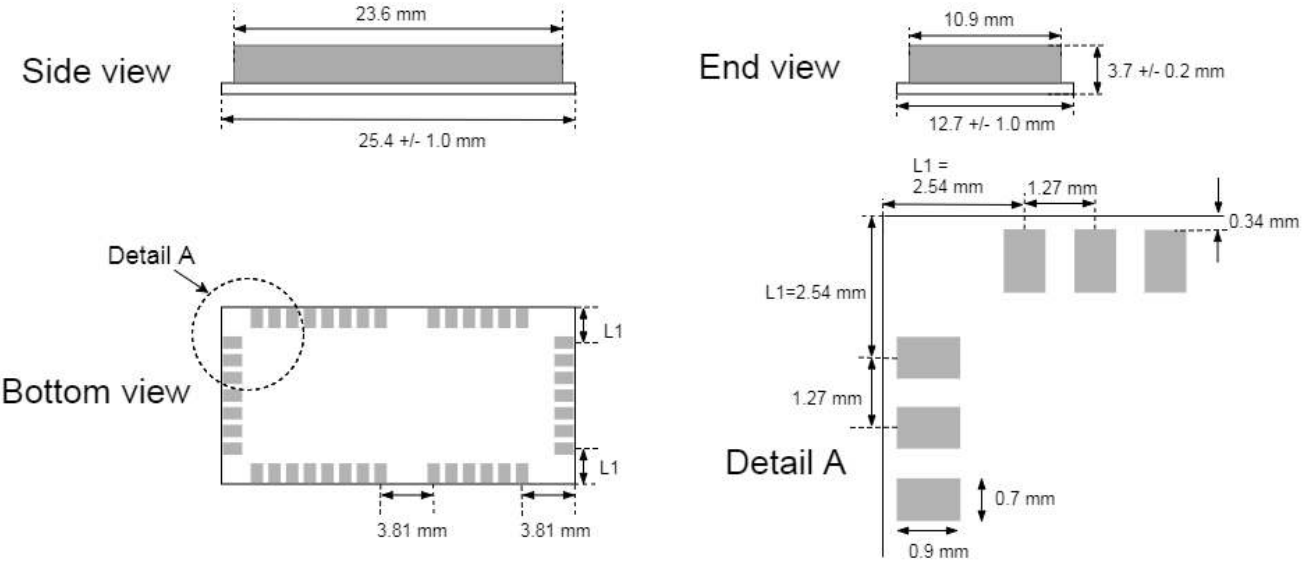
Note 1: Pins 8 and 9 are suggested as I2C interface. They can be configured otherwise, but are connected to an optional internal EEPROM with I2C address = 000. It is recommended to leave these pins as I2C. Sensors and actuators or any other I2C device can be connected to these pins and accessed from the module.

## Regulatory Compliance Information

The use of RF frequencies and maximum allowed transmitted RF power is limited by national regulations. The RC1880 have been designed to comply with world wide regulations (RED directive 2014/53/EU in Europe, ARIB for Japan, G.S.R. 542(E)/45(E) for India, and FCC for the US). Final approval needs to be done with the end product embedded firmware.

## Mechanical Drawing




## Mechanical Dimensions

The module size is 12.7 x 25.4 x 3.7 mm.

## Carrier Tape and Reel Specification

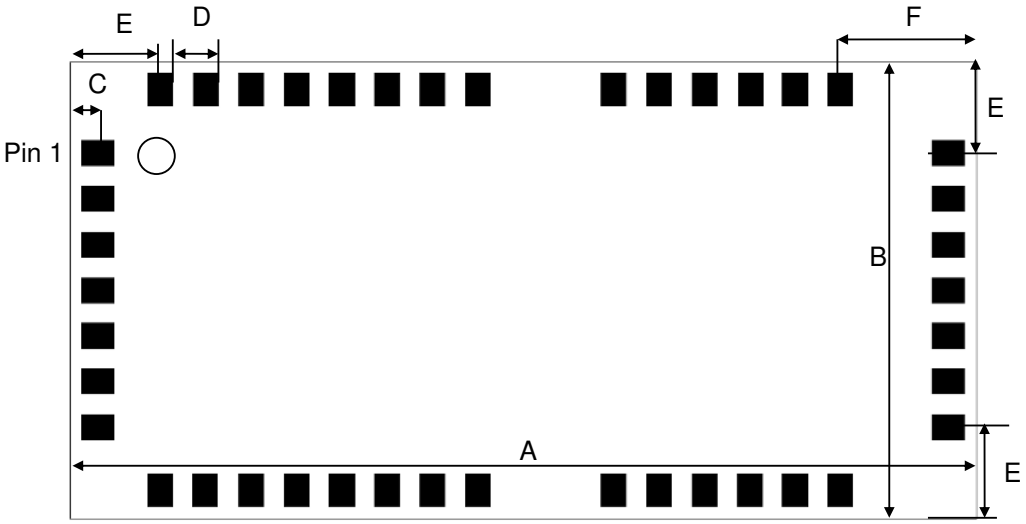
Carrier tape and reel is in accordance with EIA Specification 481.

| *Tape width* | *Component pitch* | *Hole pitch* | *Reel diameter* | *Units per reel* |
|---|---|---|---|---|
| 44 mm | 16 mm | 4 mm | 13” | Max 1000 |

## PCB Layout Recommendations

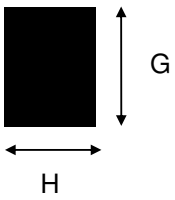
The recommended layout pads for the module are shown in the figure below.

The circle in upper left corner is an orientation mark only, and should not be a part of the copper pattern.




| *Dimention* | *Length [mm] (mil)* | *Comment* |
|---|---|---|
| A | 25.4 (1000) | Length of module |
| B | 12.7 (500) | Width of module |
| C | 0.79 (31) | Module edge vs centre of pad (Valid for all pads) |
| D | 1.27 (50) | Pad to pad distance |
| E | 2.54 (100) | Modul edge to pad (centre) |
| F | 3.81 (150) | Modul edge to pad (centre) |
| G | 0.9 (35.4) | Length of pad/recommend footprint pad |
| H | 0.7 (27.6) | Width of pad/recommend footprint pad |

Recommended pad design is shown below.




The recommended footprint for solder soldering is a one-to-one mapping between the LGA pad on module and the footprint.

For prototype build a solder hot plate is recommended. If the prototype is soldered manually by soldering iron, it is recommend to extend the pads of the footprint out from the module to make is accessible for a soldering iron.

A PCB with two or more layers and with a solid ground plane in one of the inner- or bottom layer(s) is recommended. All GND-pins of the module shall be connected to this ground plane with vias with shortest possible routing, one via per GND-pin.

Routing or vias under the module is not recommended as per IPC-recommendation. If any routing or vias is required under the module, the routing and vias must be covered with solder resist to prevent short circuiting of the test pads. It is recommended that vias are tented.

Reserved pins should be soldered to the pads, but the pads must be left floating electrically (no connection).

Note that Radiocrafts technical support team is available for free-of-charge schematic- and layout review of your design.

## Soldering Profile Recommendation

JEDEC standard IPC/JEDEC J-STD-020D.1 (page 7 and 8), Pb-Free Assembly is recommended.

The standard requires that the heat dissipated in the "surroundings" on the PCB is taken into account. The peak temperature should be adjusted so that it is within the window specified in the standard for the actual motherboard.

Aperture for paste stencil is normally areal-reduced by 20-35%, please consult your production facility for best experience aperture reduction. Nominal stencil thickness of 0.1-0.12 mm recommended.

## Absolute Maximum Ratings

| Parameter | Min | Max | Unit |
|---|---|---|---|
| Supply voltage, VCC | -0.3 | 4.1 | V |
| Voltage on any pin | -0.3 | VCC + 0.3 (max 4.1) | V |
| Input RF level | | 10 | dBm |
| Storage temperature | -40 | 150 | °C |
| Operating temperature | -40 | 85 | °C |

***Caution ! ESD sensitive device. Precaution should be used when handling the device in order to prevent permanent damage.***

Under no circumstances the absolute maximum ratings given above should be violated. Stress exceeding one or more of the limiting values may cause permanent damage to the device.

## Electrical Specifications

T=25°C, VCC = 3.3V, 868 MHz, 50 ohm if nothing else stated.

| Parameter | Min | Typ. | Max | Unit | Condition / Note |
|---|---|---|---|---|---|
| Operating frequency | 862 | | 930 | MHz | |
| Input/output impedance | | 50 | | Ohm | |
| Data rate | | 50 | | kbit/s | |
| Frequency stability | | | +/- 10<br>+/-15<br>+20/-26 | ppm<br>ppm<br>ppm | Initially<br>Temperature drift -30°-85°<br>Temperature drift -40°-85°<br>Other stability option available on request |
| Transmit power | -10 | | 14 | dBm | Programmable from firmware |
| Harmonics<br>2nd harmonic<br>3rd harmonic | | <br>-52<br>-58 | | | @ max output power |
| Spurious emission, TX,<br>868 MHz<br>30 – 1000 MHz<br>30 – 1000 MHz<br>1-12.75 GHz | | | <br>-59<br>-51<br>-37 | <br>dBm<br>dBm<br>dBm | <br>EN 300 220 restricted band<br>EN 300 220 un-restricted band |
| Spurious emission, TX,<br>915 MHz<br>30 – 88 MHz<br>88 – 960 MHz<br>960 – 2390 MHz<br>1-12.75 GHz | | < -66<br>< -65<br>< -55<br>< -43 | | | Within FCC restricted band<br>Within FCC restricted band<br>Within FCC restricted band<br>Outside FCC restricted band |

| | | | | | |
|---|---|---|---|---|---|
| Sensitivity | | -110 | | dBm | BER = 1%, 50 kbps 2 FSK, IEEE 802.15.4g mandatory settings |
| Saturation | | 10 | | dBm | |
| Spurious emission, RX 1-12.75 GHz | | -70 | | dBm | Complies with EN 300 320 CRF47 Part 15 and ARIB STD-T66 |
| Supply voltage Recommended operating voltage | 1.8 | | 3.8 | V | |
| Current consumption, RX | | 6.2 | | mA | VCC = 3.6V |
| Current consumption, TX | | 26.5<br><br>19 | | mA | Output power 14 dBm, VCC = 3.6V<br>Output power 12 dBm. |
| Current consumption, Shutdown<br>Sleep, RTC based on Crystal | | <br>185<br>700 | | <br>nA<br>nA | |
| MCU clock frequency | | 48 | | MHz | |
| MCU low frequency crystal | | 32.768 | | kHz | Optional |
| Antenna VSWR | | <2:1 | 3:1 | | |
| UART speed | | 115.2 | | kbaud | |

## Product Status and Definitions

| *Current Status* | *Data Sheet Identification* | *Product Status* | *Definition* |
|---|---|---|---|
| | Advance Information | Planned or under development | This data sheet contains the design specifications for product development. Specifications may change in any manner without notice. |
| | Preliminary | Engineering Samples and First Production | This data sheet contains preliminary data, and supplementary data will be published at a later date. Radiocrafts reserves the right to make changes at any time without notice in order to improve design and supply the best possible product. |
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| | Not recommended for new designs | Last time buy available | Product close to end of lifetime |

| | | | |
|---|---|---|---|
| | Obsolete | Not in Production Optionally accepting order with Minimum Order Quantity | This data sheet contains specifications on a product that has been discontinued by Radiocrafts. The data sheet is printed for reference information only. |

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