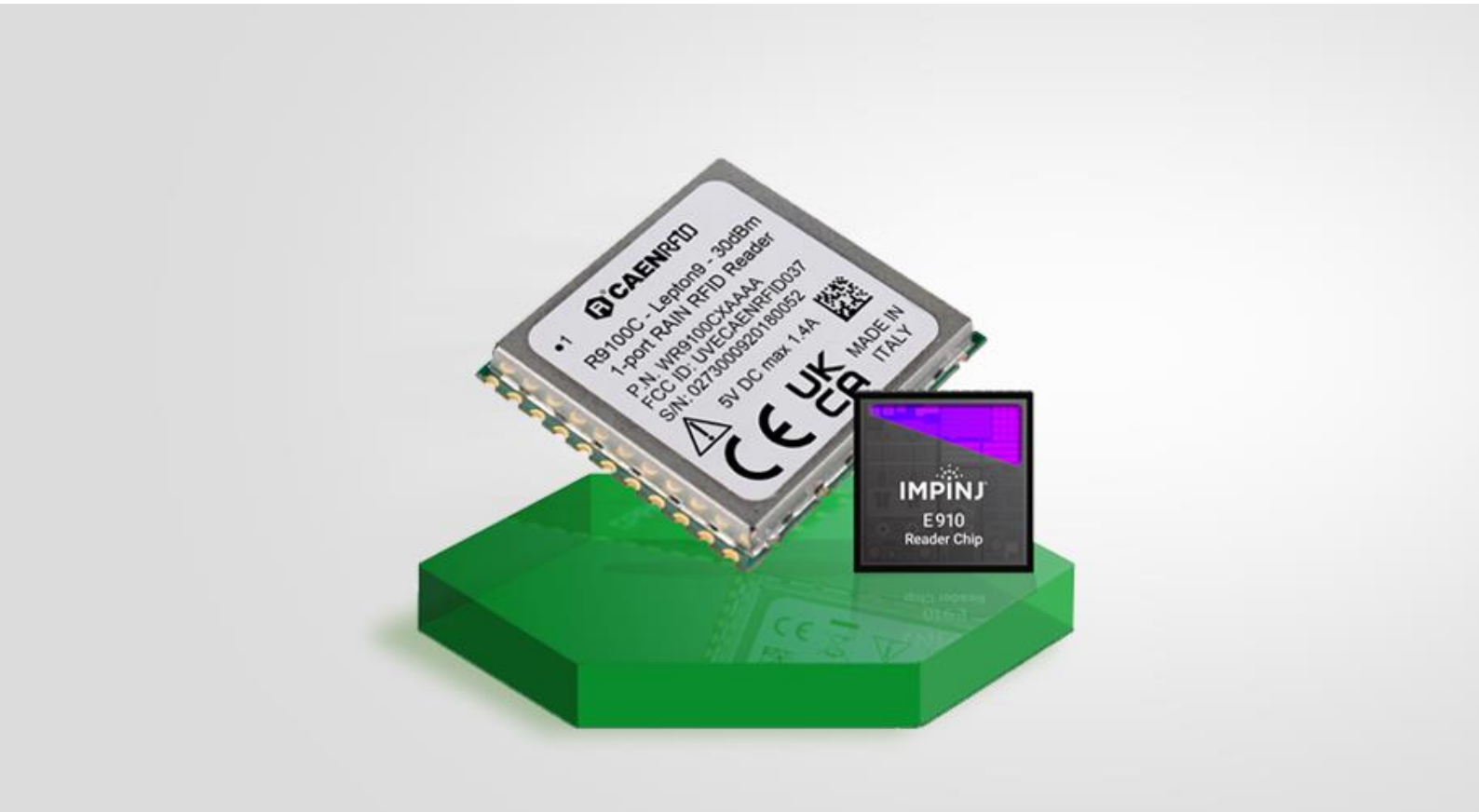
TECHNICAL INFORMATION MANUAL

Revision 1.1-21/06/2023

R9100C

Lepton^{9}

30dBm 1-Port RAIN RFID Reader Module



Visit the Lepton[9] R9100C web page, you will find the latest revision of data sheets, manuals, certifications, technical drawings, software and firmware. All you need to start using your reader in a few clicks!

Scope of Manual

The goal of this manual is to provide the basic information to work with the Lepton[9] R9100C Reader and the RHML37XEVB evaluation board.

This manual refers to:

- **Lepton[9] R9100C firmware revision 1.2.0**

Change Document Record

Date	Revision	Changes	Pages
22/12/2022	0	Preliminary revision	-
16/06/2023	1	Added CE Declaration of Conformity and UKCA Declaration of Conformity in the *Regulatory Compliance* chapter	22
		Removed *WKUP pin* information in Hardware Interface chapter	9÷14
		Modified Tab. 3.4: Supply Current Specifications	14
		Modified *Fig. 3.1: Lepton9 R9100C - Example of Block Diagram*	9
21/06/2023	1.1	Added FCC compliance information	22

Reference Document

[RD1] EPCglobal: EPC Radio-Frequency Identity Protocols Class-1 Generation-2 UHF RFID Protocol for Communications at 860 MHz - 960 MHz, Version 2.0.1 (April 2015).

CAEN RFID srl

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Federal Communications Commission (FCC) Notice

This device was tested and found to comply with the limits set forth in Part 15 of the FCC Rules. Operation is subject to the following 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. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment.

This device generates, uses, and can radiate radio frequency energy. If not installed and used in accordance with the instruction manual, the product may cause harmful interference to radio communications. Operation of this product in a residential area is likely to cause harmful interference, in which case, the user is required to correct the interference at their own expense. The authority to operate this product is conditioned by the requirements that no modifications be made to the equipment unless the changes or modifications are expressly approved by CAEN RFID.

Disposal of the product

Do not dispose the product in municipal or household waste. Please check your local regulations for disposal/recycle of electronic products.

CE UKCA RoHS COMPLIANT

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1 INTRODUCTION

Description

Reader

The Lepton[9] (Model R9100C), an embedded reader of the easy2read© product line, is an ultra compact reader for low power, high performance RAIN RFID applications.

With programmable output power from 10dBm to 30dBm, the reader can detect tags at more than 5 mt of distance (depending on antenna and tag dimensions).

Due to its low power consumption, the module is specifically designed to be easily integrated in battery powered devices.

The radio frequency core of the module is based on the Impinj E910 IC that permits to achieve fast reading speed and to be used in dense reader and dense tag environments for top-class rated performances.

The compactness of the device and the surface mount technology allow to embed the Lepton[9] inside the new small form factor industrial handhelds, smartphone accessories and other compact form factor devices.

The Lepton[9] complies with and can operate in both European and US regulatory environments and, thanks to its multiregional capabilities, it's ideal for integration in devices requiring compliance to different geographical regions.

The Lepton[9] is pin-to-pin compatible with the Impinj RS1000 and RS500 modules making it a perfect replacement for these devices.

Fig. 1.1: Lepton[9] Reader – top view

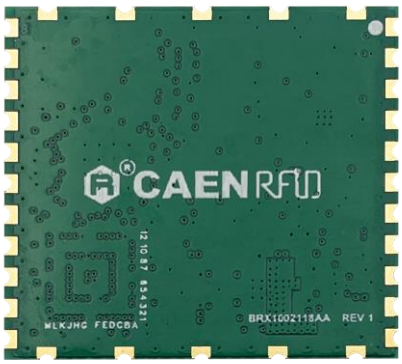


Fig. 1.2: Lepton[9] Reader – back view

2 TECHNICAL SPECIFICATIONS

Technical Specifications

Frequency Range	865.600÷867.600 MHz (ETSI EN 302 208 v3.3.1) 902÷928 MHz (FCC part 15.247)
RF Power	Configurable from 10 dBm to 30 dBm (from 10 mW to 1W) conducted power
RX Sensitivity	-90dBm – 10%PER, assuming 20 dB antenna RL @ 30 dBm output
Antenna VSWR Requirement	< 2:1 for optimum performances
Antenna Connectors	50 Ohm mono-static RF port on a single pin
Frequency Tolerance	±10ppm over the entire temperature range
Number of Channels	4 channels (compliant to ETSI EN 302 208 v3.3.1) 50 hopping channels (compliant to FCC part 15.247)
Standard Compliance	EPC C1G2 / ISO18000-63
I/O Interface	4 I/O lines 3.3V level I_{out} @ 8mA max
Connectivity	– UART Serial Port • Baudrate: from 9.6 to 921.6 kbps, default 921.6 kbps • Databits: 8 • Stopbits:1 • Parity: none • Flow control: none – 3.3 V I/O voltage level
Power Supply	4.75 ÷ 5.25 V DC
Power Consumption	- 1.4 A @ 5 V - RF out = 30 dBm - 5 mA in idle mode - Ready to receive commands
Dimensions	(L) 32 x (W) 29 x (H) 4.1 mm^3 1.26 x 1.14 x 0.16 $inches^3$
Package Type	32 pin surface mount module (SMT compatible)
Operating Temperature	-20°C to +70°C
Weight	5.4 g

Tab. 2.1: Lepton[9] R9100C Technical Specifications

Warning: The RF settings must match the operating country/region to comply with local laws and regulations.

The usage of the reader in different countries/regions from the one in which the device has been sold is not allowed.

Key Features

- RAIN RFID (UHF EPC Class1 Gen2, ISO 18000-63) compliant
- Both ETSI and FCC support in the same module
- Ultra compact size
- Up to 30 dBm (1W) output power
- -90 dBm Rx sensitivity, assuming 20 dB antenna return loss
- Impinj RS500 and RS1000 pin-to-pin compatibility
- Inventory (FastID, Tag Population Estimate, Select, Session, Target)
- Access (Read, Write, Lock, Kill, BlockPermalock, and QT)
- Shielded to prevent unwanted radiation and provide noise immunity in embedded environments
- 29 mm by 32 mm by 4.1 mm surface mount package with SMT compatibility
- Single mono-static RF port
- Field upgradability via firmware updates
- UART serial interface using CAEN RFID easy2read© protocol

3 HARDWARE INTERFACE

Introduction

An example Lepton[9] R9100C system-level block diagram for an embedded system is shown in *Fig. 3.1: Lepton9 R9100C - Example of Block* Diagram. This figure shows the electrical connections that may and must be made to control the Lepton[9] R9100C. In the figure, the required connections are illustrated with solid lines. Recommended and optional connections are illustrated with different dotted and dashed line patterns. More details for each connection are listed in the following paragraphs.

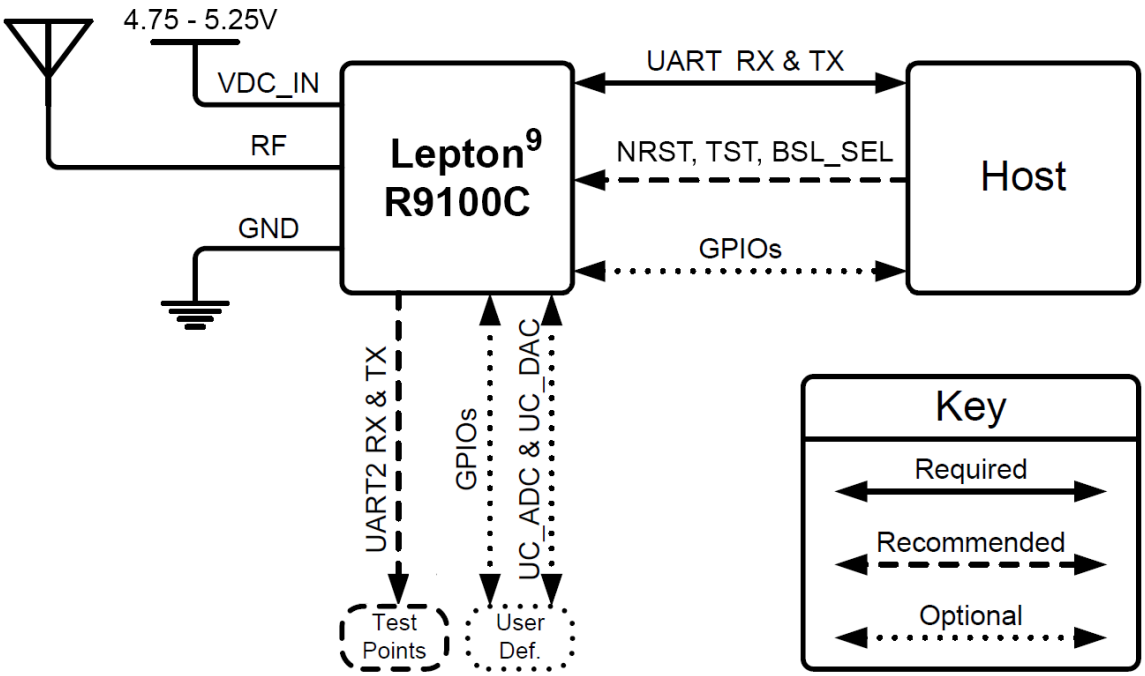


Fig. 3.1: Lepton[9] R9100C - Example of Block Diagram

Required connections:

- VDC_IN and GND are required to power the Lepton[9] R9100C.
- RF is required to connect to the UHF RFID antenna.
- UART1 Tx and Rx are required to communicate with the system host.

Recommended connections:

- nRST is used to reset the Lepton[9] R9100C if UART communication is not available. This connection is highly recommended. This pin is internally driven strong low during software resets, so it should only be driven externally by an open drain signal. It must not be driven strong high.
- TST and BSL_SEL shall be used for the FW recovery/upgrade procedure.

  To start the Boot Strap Loader of Lepton[9] internal microcontroller NRST, TST and BSL_SEL signals shall be driven as in the picture below:

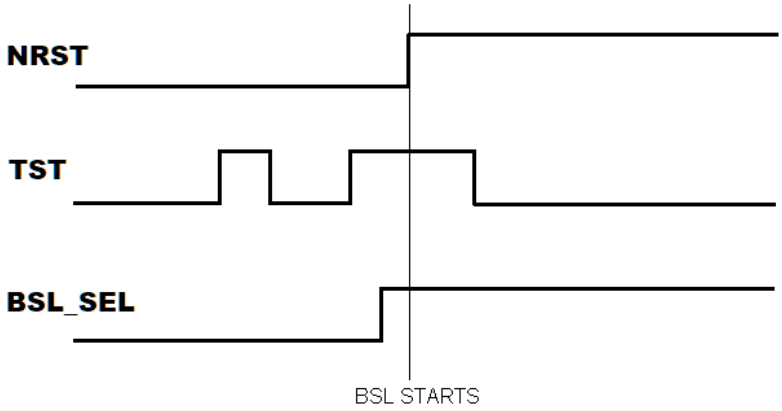


Fig. 3.2: BSL sequence

The BSL program execution starts when TST pin has received a minimum of two positive transitions and if TST is high while /RST rises from low to high. BSL_SEL shall be at high level before BSL starts. Pulses length and distance between edges of all signals shall be 10ms at least.

- UART2 Tx and Rx may be used to examine debug information.

Optional connections:

- GPIOs allow interaction with the Lepton[9] R9100C as both digital inputs and outputs. They may be used to trigger inventory, generate events based on inventory activity, or provide general-purpose user-controlled digital I/O.
- UC_ADC allows use of an ADC to convert an analog input voltage into a digital value.
- UC_DAC allows use of a DAC to generate an analog output voltage from a digital value.
- RFU is a GPIO reserved for future use.

Power Supply

The Lepton[9] R9100C is powered by a voltage applied to the VDC_IN pin (pin 11) relative to the GND pins. The supply voltage operating range is 4.75 V to 5.25 V. Current consumption varies from about 1400 mA to about 5mA depending on the operating mode. The power supply is internally bypassed and regulated, and no external bypass or bulk storage capacitance is required, as long as the input voltage is stable.

If Lepton[9] R9100C activity is not required at all times, and power reduction is desired, the VDC_IN supply voltage may be externally gated to remove power to the device.

RF Connection

The Lepton[9] R9100C has a single RF pin (pin 1) which should be connected to a 50 Ω antenna via 50 Ω controlled impedance connection. This connection could simply be a microstrip transmission line to a PCB antenna or SMT antenna, or it could include a connector and coaxial cable. The RF connection is single ended, referenced to ground.

For more information about impedance matching, see *PCB Layout for RF* page 17.

UART Communication

The Lepton[9] R9100C has two full-duplex UART standard interfaces, accessible using pins UART1-RX, UART1-TX, UART2-RX, and UART2-TX. UART1 implements the host communication interface via easy2read©, and UART2 implements the debug interface (RFU). The Tx pins are outputs from the Lepton[9] R9100C, and the Rx pins are inputs to the Lepton[9] R9100C. Both UART interfaces are 921,600 baud, with 8 data bits, 1 stop bit, and no parity bit (8-n-1 configuration).

Each of the UART interfaces signals at 3.3 V relative to GND. The specific VIH, VIL, VOH and VOL specifications may be found in the § *Device Input and Output Specifications* paragraph page 15. The TX pins are driven strong high and low with a sink/source current of about 8 mA. If the load on a pin draws more than

the 8 mA sink and source current, the pin is not guaranteed to meet the VOH and VOL specs listed in the § *Device Input and Output Specifications* paragraph page 15. Excessive current sunk or sourced on the GPIO pins can also cause electrical damage to the device.

Warning: Voltages outside of the maximum IO operating voltage range of -0.3 to 4.0 V should not be applied to the UART pins. This can cause permanent damage to the device.

Reset Pin

The Lepton[9] R9100C may be reset by a logic low voltage on the NRST pin (pin 9). Usage of this pin is recommended in all designs. It may be used to reset the part if an unexpected operating state is entered. The Lepton[9] R9100C does have an internal watchdog circuit that will reset it if abnormal operation occurs, but the NRST pin provides a further level of reliability.

The NRST pin is pulled high (3.3 V) by an internal 51,1 kΩ nominal resistor. To reset the part, drive the pin strong low for at least the minimum reset pulse width as specified in the § *Device Input and Output Specifications* paragraph page 15 (approximately 25 µs). This pin may be driven active low to reset the part, but should not be driven strong high. Driving the pin strong high prevents the Lepton[9] R9100C from resetting itself in case user requested software reset. This pin should be driven using an "open drain drives low" drive mode, which creates either a strong low voltage or a floating voltage output.

Warning: Voltages outside of the maximum IO operating voltage range of -0.3 to 4.0 V should not be applied to the NRST pin. This can cause permanent damage to the device.

GPIO Pins

The Lepton[9] R9100C's GPIOs can be controlled using the easy2read© interface. Their drive mode, direction, and state are all controllable via easy2read©. There are two directions: input and output. In both input and output directions, there are three possible pin states: high, low, and float. For more details on using easy2read© to control the GPIOs, see the easy2read© protocol documentation.

In the output direction, the GPIOs are driven strong high and low with a source and sink current of 8 mA, and in float mode the pin is not driven either high or low, leaving the pin floating, also known as "high impedance" or "high-Z". The pins are driven to 3.3 V nominally. If the load on a pin draws more than the 8 mA sink and source current, the pin is not guaranteed to meet the VOH and VOL specs listed in the § *Device Input and Output Specifications* paragraph page 15.

Warning: Excessive current sunk or sourced on the GPIO pins can also cause electrical damage to the device.

In the input direction, the high and low states apply a pull-up or pull-down resistor, and in float mode the pin is not pulled either high or low, leaving the pin floating, also known as "high impedance" or "high-Z". The pull-up and pull-down resistors are about 35 kΩ nominal. See the in the § *Device Input and Output Specifications* paragraph page 15 for more specific ratings. The inputs logic levels are proportional to 3.3 V. Specific VIH and VIL specs may be found in the § *Device Input and Output Specifications* paragraph page 15.

Warning: Voltages outside of the maximum IO operating voltage range of -0.3 to 4.0 V should not be applied to the pins, no matter their configuration. This can cause permanent damage to the device.

Pin Listing and Signal Definitions

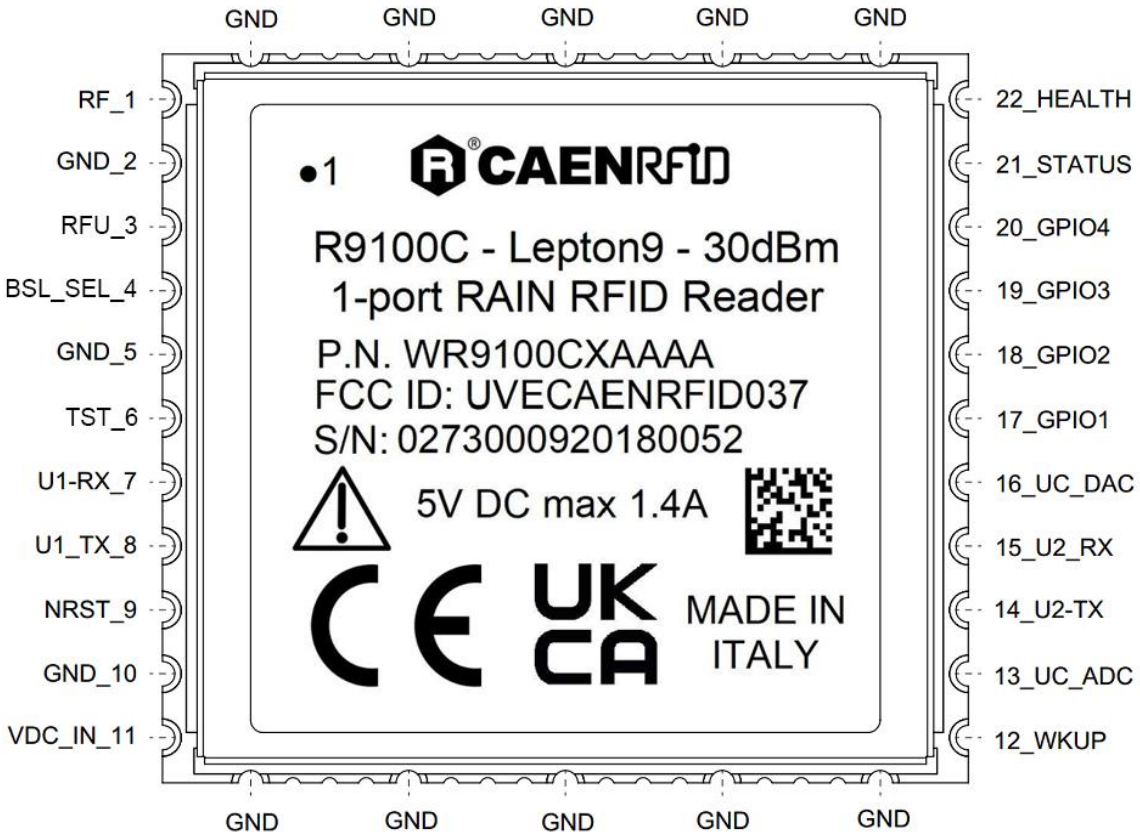


Fig. 3.3: Lepton[9] R9100C Pin Listing

Pin#	Pin Name	Pin Type	Description
1	RF	RF	RF antenna port
2	GND	Power	Ground
3	RFU	Digital I/O	Reserved for Future Use
4	BSL_SEL	Digital Input	Boot Strap Loader interface enable signal
5	GND	Power	Ground
6	TST	Digital Input	TST pin to be used for FW recovery/upgrade
7	UART1-RX	Digital Input	R9100C UART Rx (Receive) from host
8	UART1-TX	Digital Output	R9100C UART Tx (Transmit) to host
9	NRST	Digital Input	Active low reset. Connect to open drain driver. R9100C must be able to internally pull down this signal to reset.
10	GND	Power	Ground
11	VDC_IN	Power	DC voltage supply (4.75 – 5.25 V)
12	WKUP - RFU	Digital Input	Reserved for future use
13	UC_ADC	Analog Input	Analog to digital converter input
14	UART2-TX	Digital Output	R9100C Debug UART Tx to host
15	UART2-RX	Digital Input	R9100C Debug UART Rx from host
16	UC_DAC	Analog output	Digital to analog converter output
17	GPIO1	Digital I/O	General purpose I/O
18	GPIO2	Digital I/O	General purpose I/O
19	GPIO3	Digital I/O	General purpose I/O
20	GPIO4	Digital I/O	General purpose I/O
21	STATUS- RFU	Digital Output	Reserved for future use
22	HEALTH- RFU	Digital Output	Reserved for future use
23-32	GND	Power	Ground pins on the top and bottom edge of the package

Tab. 3.1: Pin Listing and Signal Definitions

Electrical Specifications

Absolute Maximum Ratings

The absolute maximum ratings (see *Tab. 3.2: Absolute Maximum Ratings*) define limitations for electrical and thermal stresses. These limits prevent permanent damage to the Lepton[9] R9100C.

Operation outside maximum ratings may result in permanent damage to the device.

Parameter	Min.	Max.	Unit	Conditions
Supply voltage	-0.3	5.5	V	VDC_IN pin relative to GND
IO voltage	-0.3	4.0	V	Non-VDC_IN pin voltages relative to GND
RF input power	-	+30	dBm	Incident to pin 1 (RF)
Storage temperature	-30	+100	ºC	
Humidity	-	95	% RH	Non-condensing
ESD immunity	-	2	kV	Human-body model, all I/O pads
Package moisture sensitivity level 3	-	-	-	Lepton[9] R9100C from open trays must be baked before going through a standard solder reflow process (48 hours at 125 ºC or 24hrs at 150 ºC)

Tab. 3.2: Absolute Maximum Ratings

Operating Conditions

This section describes operating voltage, frequency, and temperature specifications for the Lepton[9] R9100C during operation.

Parameter	Min.	Max.	Unit	Conditions
Supply	4.75	5.25	V	VDC_IN relative to GND
Temperature	-20	+70	ºC	Ambient Temperature
Frequency	902	928	MHz	FCC part 15.247
	865.6	867.6	MHz	ETSI EN 302 208 v3.3.1

Tab. 3.3: Operating Conditions

Device Functional Specifications

This section describes operating voltage, frequency, and temperature specifications for the Lepton[9] R9100C during operation.

Parameter	Typ.	Unit	Description
Supply Current			Current consumed by Lepton[9] R9100C via VDC_IN pin
Active mode - 5V supply	1400	mA	+30 dBm transmit power Inventorying tags
Idle mode – low latency	45	mA	Ready to receive easy2read© protocol packets. Lower latency to return to Active mode.
Idle mode – standard latency	5	mA	Ready to receive easy2read© packets

Tab. 3.4: Supply Current Specifications

UHF Gen 2 RFID Radio Specifications

Parameter	Min.	Typ.	Max.	Unit	Conditions
Frequency	902		928	MHz	See § *Tab. 2.1: Lepton9 R9100C Technical Specifications* page 7
	865.6		867.6	MHz	
Input impedance		50		Ω	
Input match		-10		dB	S11
Rx sensitivity		-90		dBm	10%PER, assuming 20 dB antenna RL @ 30 dBm output

Tab. 3.5: RF Receiver Specifications

Parameter	Min.	Max.	Unit	Notes
Tx Power	10	30	dBm	Meets FCC and equivalent regulatory constraints
Tx Power Error		1	dB	Difference between desired Tx power and actual Tx power
Return Loss	0		dB	No damage into open RF port at 30 dBm at any phase angle
Frequency	865.6	867.6	MHz	ETSI EN 302 208 v3.3.1
	902	928	MHz	FCC part 15.247

Tab. 3.6: RF Transmitter Specifications

Device Input and Output Specifications

Parameter	Min.	Typ.	Max.	Unit	Conditions
nRST					
VIL	-0.3		0.8	V	
VIH	2		3.6	V	
Hysteresis voltage		400		mV	
Internal pull-up resistor	14	21	25	kΩ	
Reset pulse width	25			µs	
WKUP					
VIL	-0.3		0.8	V	
VIH	2		3.6	V	
Hysteresis voltage		400		mV	
Internal pull-down resistor	20	35	50	kΩ	
Digital inputs					
VIL	-0.3		0.8	V	
VIH	2		3.6	V	
Hysteresis voltage		400		mV	
Internal pull-down resistor	20	35	50	kΩ	
Digital outputs					
VOL	0.0		0.6	V	
VOH	2.7		3.6	V	
Drive current (sink or source)	8			mA	
UART					
Default baud rate			921.6	kbaud	
Configurable baud rate	9.6		921.6	kbaud	
Data bits		8		bits	
Parity bit		None			
Stop bits		1		bits	

Tab. 3.7: Digital Interface Specification

Parameter	Min.	Typ.	Max.	Unit	Conditions
ADC (Pin 13)					
Resolution		12		Bits	
Conversion voltage range	0		3.3	V	
Sampling rate	0.47		2.7	MSPs	
Total conversion time			3.1	µsec	
Power-up time			3.1	µsec	
Sampling switch resistance			200	Ω	
Internal sample and hold capacitance			25	pF	
Total unadjusted error		±3.5	±7.1	LSB	
Offset error		±3.0	±5.6	LSB	
Gain error		±1	±2.5	LSB	
DNL error			±1	LSB	
INL error			±2	LSB	
DAC (Pin 16)					
Resolution		12		Bits	
Resistive load	3			kΩ	
Capacitive load			100	pF	Maximum capacitive load at the DAC_OUT pin
Output voltage range	0.1		3.15	V	
DNL			±1	LSB	
INL			±4	LSB	
Offset			±21	mV	
Gain error			±2.5	%FSR	
Settling time		15	30	µsec	CLOAD < 50 pF & RLOAD > 5 kΩ

Tab. 3.8: Analog Interface Specification

4 LAYOUT AND COMPONENTS

Introduction

This section describes hardware aspects of embedded RAIN RFID readers based on the Lepton[9] R9100C.

PCB Layout for RF

50 Ohm Characteristic Impedance

As discussed in paragraph *RF Connection* page 10, a properly matched RF connection is critical to achieving high performance with Lepton[9] R9100C. An improperly matched RF connection will reduce performance in multiple ways, by both reducing the transmitted RF power, and also increasing the reflected power that interferes with Lepton[9] R9100C's receive circuitry.

When impedance is improperly matched across a node, a signal's reflection coefficient will be proportional to the difference between the characteristic impedances on both sides of the node divided by their sum, as shown in the following equation.

Reflection Coefficient of a Load:

$$\Gamma = \frac{Z_L - Z_0}{Z_L + Z_0}$$

In this equation, ZL represents the characteristic impedance of the transmission line, and Z0 represents the characteristic impedance of the Lepton[9] R9100C, 50 Ohms. For example, if a 40 Ohm transmission line is used, the reflection coefficient will be = 10 / 90 = 11.1%, thus 11.1% of the power will be reflected back into the Lepton[9] R9100C, and only 88.9% of the power will be transmitted.

Lepton[9] R9100C is designed to connect to a 50-Ohm characteristic impedance load. The connection between the Lepton[9] R9100C module and its antennas should all be designed for a 50 Ohm characteristic impedance. Because the RF connection is made via PCB traces, this requires carefully designing the PCB layout.

PCB trace characteristic impedance depends on quite a few variables, only some of which can easily be controlled by the PCB designer. The two main categories of variables are the PCB geometry, and material properties. PCB geometry includes both the transmission line type, be it microstrip, stripline, or others, and also the specific dimensions of the forward and return paths and the adjacent dielectrics. Transmission line styles are shown in *Fig. 4.1: PCB Transmission Line Types* page 17. Material properties to note include the dielectric constant of the dielectrics in the PCB, and the conductivity of the conductor used.

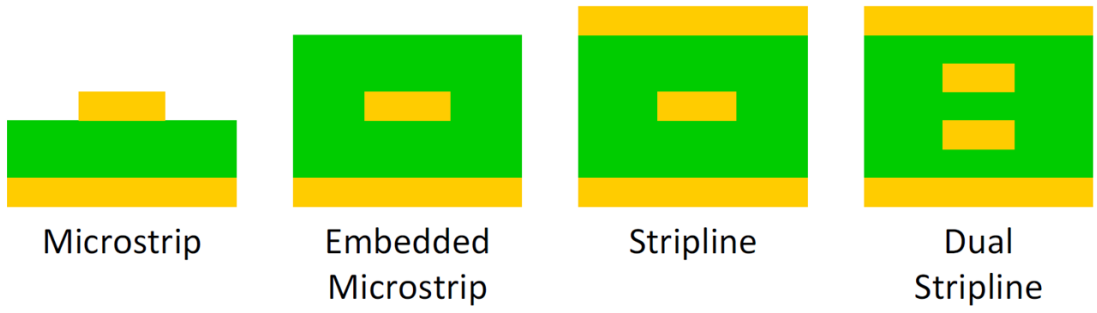


Fig. 4.1: PCB Transmission Line Types

In most PCB designs, many of the parameters of the PCB are already set, such as dielectric thickness and constant, trace conductivity and weight, etc. Usually, the only variables that can be easily modified are the style of transmission line, and its dimensions. The most common, and recommended PCB transmission line scheme is to use a microstrip on the top or bottom layer of the PCB, with a ground plane on the layer immediately adjacent as a return path. The width of this microstrip can then be varied to achieve the desired characteristic impedance. Care should be taken to ensure that the microstrip trace has enough current carrying capacity. This requires designing a trace that is heavy enough to withstand the heat generated by power losses due to the resistance of the trace.

There are many online resources and tools designed to assist in designing PCB transmission lines with the correct characteristic impedances. For example, the TXLine tool from National Instruments is very useful for performing these calculations automatically. There is also an online calculator on eeweb.com. These tools will require information about the PCB layout and also PCB characteristics, which should be obtained from the PCB manufacturer.

Package and Assembly Information

This section provides mechanical drawings and critical dimensions needed for PCB layout and housing design, as well as SMT assembly information.

Package Mass

The mass of the Lepton[9] R9100C module is roughly 5.4 grams.

Package Dimensions

Package dimensions are shown in the following figure:

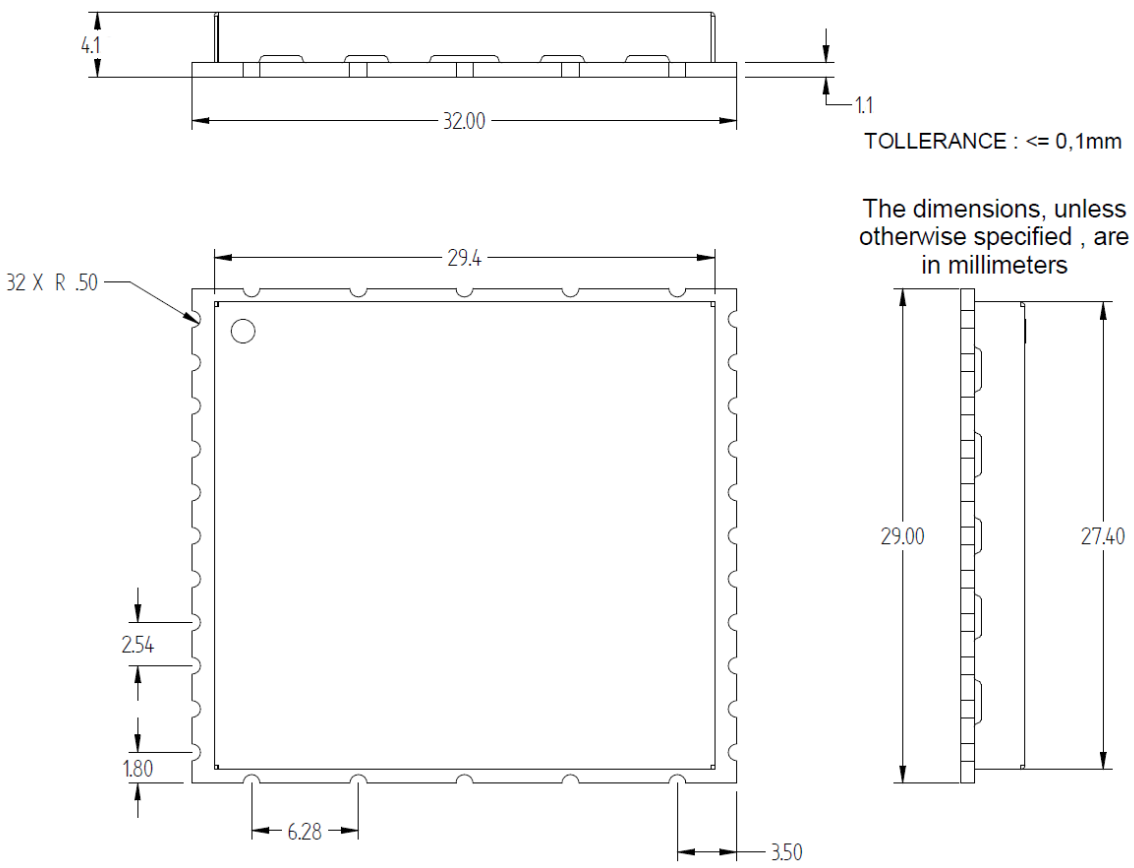


Fig. 4.2: Package Dimensions, Top, Front, and Side Views

Download the *Lepton[9] R9100C Technical drawing* at Lepton[9] R9100C web page (*Documents* section).

PCB Footprint

Recommended footprint copper and pastemask dimensions are shown in the following:

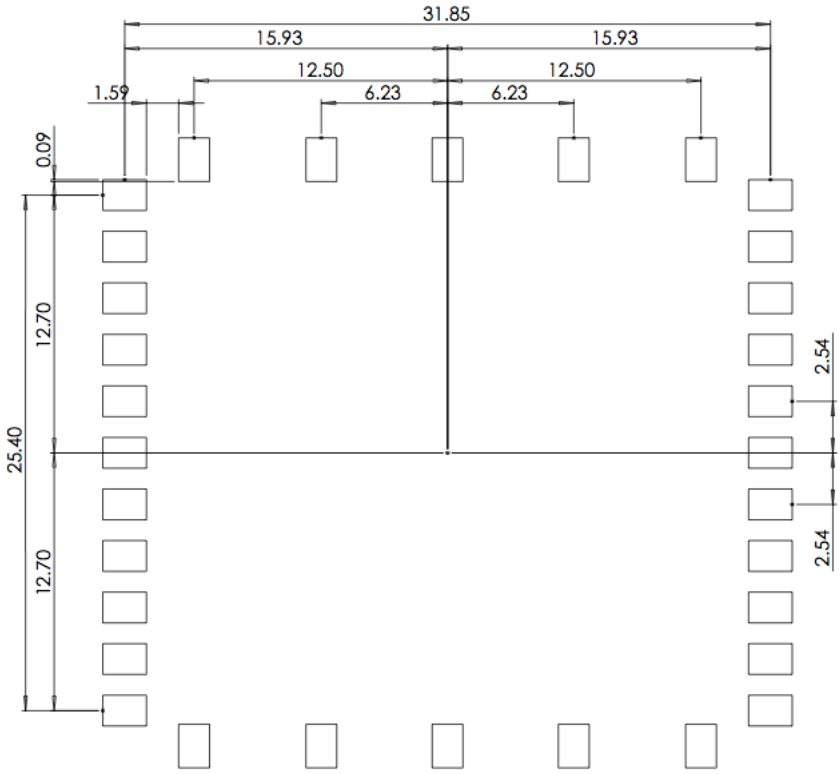
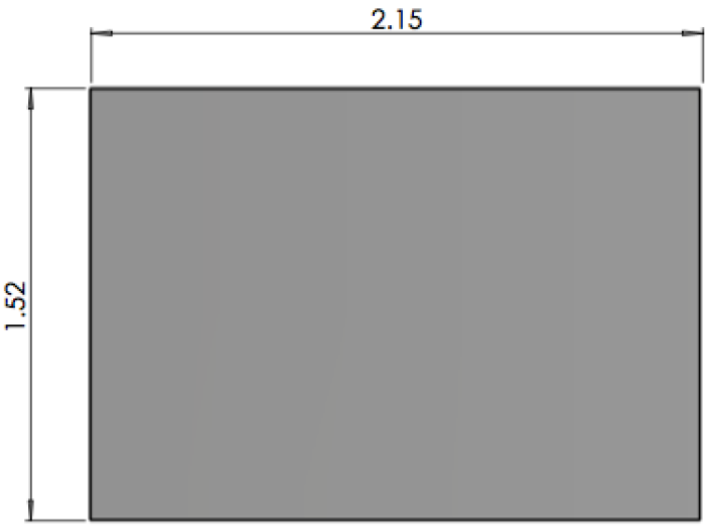


Fig. 4.3: Recommended Etched Copper Footprint – All Pads



units: mm

Fig. 4.4: Pad size

SMT Reflow Information

The solder manufacturer's recommended reflow profile is shown in the following figure:

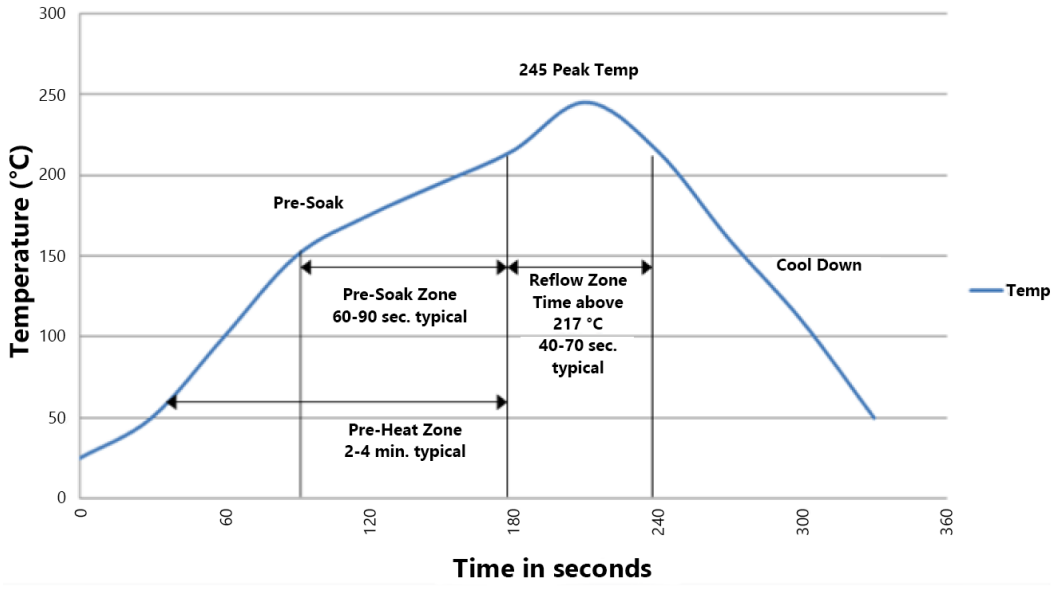


Fig. 4.5: Recommended Solder Reflow Profile for the Lepton[9] R9100C

Moisture Sensitive Level 3 (MSL 3)

CAEN RFID srl follows JEDEC standards for moisture classifications. The Lepton[9] R9100C RFID reader is classified as MSL 3.

Warning: The damaging effects of moisture absorbed in semiconductor packages during SMT assembly are known. Pay attention to the next paragraphs and follow the instructions to avoid problems.

MSL 3 Handling at PCB Assembly

The Lepton[9] R9100C package is moisture sensitive and needs to be handled within proper MSL 3 guidelines to avoid damage from moisture absorption and exposure to solder reflow temperatures that can result in yield and reliability degradation.

A. During PCB Assembly

1. Devices are baked and dry-packed before shipment from CAEN RFID. The packing uses a Moisture Barrier Bag (MBB). A Humidity Indicator Card (HIC) and drying desiccant are included inside the MBB. A MSL 3 label is attached to caution that the bag contains moisture sensitive devices.
2. Shelf life of devices in a sealed bag is 12 months at <40ºC and <90% room humidity (RH).
3. Upon opening of MBB, the HIC should be checked immediately; devices require baking before board mounting if the HIC is >10% when read at 23ºC ± 5ºC.
4. After MBB is opened, devices should go through reflow for board assembly within 168 hours at factory conditions of <30ºC/60% RH, or stored at <10% RH. If both conditions are not met, baking is required before board mounting.
5. If baking is required, devices should be baked for a minimum of 48 hours at 125ºC or 24 hours at 150°C.

B. Handling Unused Devices

1. Any unused devices after the MBB have been opened for more than 168 hours or not stored at <10% RH should be baked before any subsequent reflow and board assembly.
2. Re-baking should be done for a minimum of 48 hours at 125ºC or 24 hours at 150°C.
3. Unused devices can either be baked and dry-packed first before storage, or they can be baked just before the next board assembly. It is recommended that the former be practiced as it helps to prevent operator error from re-using devices without baking. In both cases, the re-packed materials should follow the guidelines in section A.

C. Reworking a Device on a PCB

1. Before a device is removed from the module, the module must first be baked.
2. Baking should be done for a minimum of 48 hours at 125ºC or 24 hours at 150°C.
3. It is recommended that during removal, localized heating be used, and the maximum body temperature of device should not exceed 200ºC.
4. The replacement device should not exceed the specified floor life of 168 hours.

5 REGULATORY COMPLIANCE

CE Compliance

Reference standard:

ETSI EN 301 489-1 V2.2.3:2019

ETSI EN 301 489-3 V2.1.1:2017

ETSI EN 302 208 V3.3.1:2020

EN 62368-1:2018

See § *Lepton[9] R9100C CE DECLARATION OF CONFORMITY* page 25 for the Lepton[9] R9100C CE Compliance Certificate.

Warning: The CE compliance is guaranteed only if the reader is used as described in this manual

UKCA Compliance

Reference standard:

ETSI EN 301 489-1 V2.2.3:2019

ETSI EN 301 489-3 V2.1.1:2017

ETSI EN 302 208 V3.3.1:2020

BS EN 62368-1:2014+A11:2017

See § *Lepton[9] R9100C UKCA DECLARATION OF CONFORMITY* page 26 for the Lepton[9] R9100C UKCA Compliance Certificate.

Warning: The UKCA compliance is guaranteed only if the reader is used as described in this manual

FCC Compliance

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 of the following measures:

a. Reorient or relocate the receiving antenna.

b. Increase the separation between the equipment and receiver.

c. Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

d. Consult the dealer or an experienced radio/TV technician for help.

This transmitter module has been tested and found to comply with Part 15 of the FCC Rules.

NOTE:

a. Any changes or modifications not approved by CAEN RFID could void the user's authority to operate the equipment.

b. Lepton[9] R9100C module is approved for operation with the following antenna:

   - CAEN RFID antenna Mod. WANTENNAX020 Circular polarized antenna FCC with 5.5dBi gain

   In order to operate the Lepton[9] R9100C under FCC ID: UVECAENRFID037, the OEM must strictly follow these antenna guidelines:

   • The OEM may operate only with the following antenna or antennas of the same type with maximum gain as shown:

   - CAEN RFID antenna Mod. WANTENNAX020 Circular polarized antenna FCC with 5.5dBi gain

   • RF I/O interface to the antenna connector on the PCB shall be accomplished via a microstrip or stripline transmission line with characteristic impedance of 50 ohms +/- 10%. A custom coaxial pigtail may also be utilized to connect to the antenna in lieu of a connector.

   • The connector on the OEM's PCB which interfaces to the antenna must be of a unique type to disable connection to a non-permissible antenna in compliance with FCC section 15.203.

   • The OEM must professionally install the Lepton[9] R9100C into its final environment to ensure that the conditions are met.

c. The device shall be used such that a minimum separation distance of 20cm is maintained between each antenna and user's/nearby people's body.

d. This transmitter module is authorized to be used in other devices only by OEM integrators under the following conditions:

   1. The RFID Module antenna shall have a separation distance of at least 20cm from all persons
   2. The host integrator shall provide the information related to the antenna separation distance in the user's manual of his product
   3. The transmitter module must not be co-located with any other antenna or transmitter

e. The host integrator installing this module into their product must ensure that the final composite product complies with the FCC requirements by a technical assessment or evaluation to the FCC rules, including the transmitter operation and should refer to guidance in KDB 996369.

f. The module is authorized for FCC part 15.247 only, the host product manufacturer is responsible for compliance to any other FCC rules that apply to the host not covered by the modular transmitter grant of certification.

g. The module has been tested and found to comply with the limits for a Class B digital device, however the final host product still requires Part 15 Subpart B compliance testing with the modular transmitter installed.

h. If the FCC ID is not visible when the module is installed inside another device, the OEM integrator shall apply a label in a visible area on his product with the following statement:

Contains Transmitter Module FCC ID: UVECAENRFID037

or

Contains FCC ID: UVECAENRFID037

RoHS Directive

The Lepton[9] R9100C RFID Reader is compliant with the EU Directive 2015/863/EU (RoHS3) and the UK Regulation 2012 SI 2012/3032 (RoHS) on the Restriction of the Use of certain Hazardous Substances in Electrical and Electronic Equipment.

LEPTON[9] R9100C
CE DECLARATION OF CONFORMITY

We

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Web site: www.caenrfid.com

herewith declare under our own responsibility that the product:

WR9100CXAAAA - R9100C - Lepton9 - 30dBm 1-Port RAIN RFID Reader Module

corresponds in the submitted version to the following standards:

ETSI EN 301 489-1 V2.2.3:2019

ETSI EN 301 489-3 V2.1.1:2017

ETSI EN 302 208 V3.3.1:2020

EN 62368-1:2018

and declare under our sole responsibility that the specified product meets the principle requirements and other applicable regulations of directives 2014/53/EU (RED) and 2015/863/EU (RoHS3)

Date: 16/06/2023

Adriano Bigongiari (Chief Executive Officer)

On the basis of this declaration, this product will bear the following mark: CE

The compliance is guaranteed only if the reader is used as described in the R9100C Lepton[9] Technical Information Manual.

LEPTON^9 R9100C
UKCA DECLARATION OF CONFORMITY

We

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WR9100CXAAAA - R9100C - Lepton9 - 30dBm 1-Port RAIN RFID Reader Module

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ETSI EN 301 489-1 V2.2.3:2019

ETSI EN 301 489-3 V2.1.1:2017

ETSI EN 302 208 V3.3.1:2020

BS EN 62368-1:2014+A11:2017

and declare under our sole responsibility that the specified product meets the principle requirements and other applicable regulations of directives UK Regulation 2016 No. 1206 and UK Regulation 2012 SI 2012/3032 (RoHS).

Date: 16/06/2023

CAEN RFID Srl
Via Vetraia, 11
55049 VIAREGGIO ITALY
VAT IT 02032050466

Adriano Bigongiari (Chief Executive Officer)

On the basis of this declaration, this product will bear the following mark: UKCA

The compliance is guaranteed only if the reader is used as described in the R9100C Lepton^9 Technical Information Manual.