

Pepper C1 RFID Reader (FCC approved)

User Manual

Manual version: V2.17¹
02/04/2024

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¹ The newest User manual can be found on our website: https://eccel.co.uk/wp-content/downloads/Pepper_C1/C1_FCC_user_manual.pdf

1. Introduction

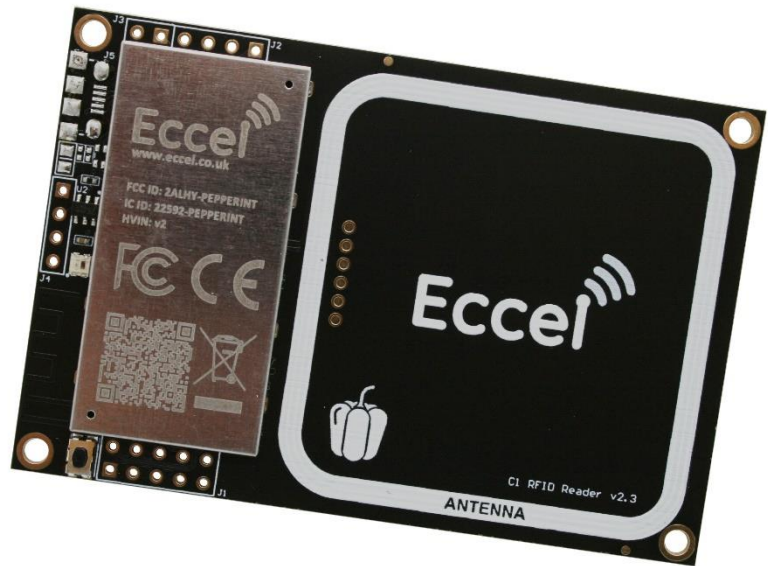
1.1 Device Overview

Features

- Low cost RFID Reader with MIFARE Classic® in 1K, 4K memory, ICODE®, MIFARE Ultralight®, MIFARE DESFire® EV1/EV2, MIFARE Plus® support
- Wireless connectivity:
 - Wi-Fi: 802.11 b/g/n
 - Bluetooth SPP profile, BLE HID, and custom BLE service
 - can be disabled by the user
- Built-in Web Interface
- Over-The-Air lifetime updates
- Command interface via UART and TCP sockets
- UART baud rate up to 921600 bps
- Configurable RGB LED indicator for RFID events
- 6 configurable GPIOs
- Stand-alone mode (polling)
- IoT interfaces: MQTT, WebSocket, REST API
- High transponder read and write speed
- -25°C to 85°C operating range
- Multiple internal reference voltages
- RoHS compliant
- FCC approved
- CE (RED) and UKCA compliant

Applications

- Access control
- Monitoring goods
- Approval and monitoring consumables
- Pre-payment systems
- Managing resources
- Contact-less data storage systems
- Evaluation and development of RFID systems



Description

The Pepper C1 module is the first Eccel Technology Ltd (IB Technology) product with wireless connectivity by Wi-Fi 802.11b/g/n and Bluetooth SPP profile. Thanks to this, the customer receives free lifetime Over-the-Air updates, and of course the communication protocol can be used over TCP instead of traditional UART/USB interface. Combining these features with standalone mode provides a ready to use device in many applications “straight out of the box”. In standalone mode, the module can be easily integrated with IOT systems thanks to many IOT protocols like MQTT, REST API, TCP sockets and more.

So, this is an ideal design choice if the user wishes to add RFID capability to their design quickly and without requiring extensive RFID and embedded software expertise and time. An advanced and powerful 32-bit microcontroller handles the RFID configuration setup and provides the user with a powerful yet simple command interface to facilitate fast and easy read/write access to the memory and features of the various transponders supported by this module.

2. Electrical specification

2.1 Absolute maximum ratings

Stresses beyond the absolute maximum ratings listed in the table below may cause permanent damage to the device. These are stress ratings only, and do not refer to the functional operation of the device that should follow the recommended operating conditions.

Symbol	Parameter	Min	Max	Unit
T_S	Storage temperature	-40	+125	°C
T_A	Ambient temperature	-40	+85	°C
V_{DDMAX}	Supply voltage (USB or J4 header)	3	5.5	V

Table 2-1. Absolute maximum ratings

2.2 Operating conditions

Symbol	Parameter	Min	Typ.	Max	Unit
T_S	Operating temperature	-25	25	+85	°C
H	Humidity	5	60	95	%
V_{DD}	Supply voltage (USB or J4 header)	3	5	5.5	V

Table 2-2. Operating conditions

2.3 DC characteristics ($V_{DD} = 5\text{ V}$, $T_S = 25\text{ °C}$)

Symbol	Parameter	Min	Typ.	Max	Unit
V_{OUT}	Output voltage (regulator output, 3V3 pin on the J1 header)	3.23	3.3	3.37	V
V_{IH}	High-level input voltage (J1 header)	$0.75 \times V_{OUT}$	-	$V_{OUT} + 0.3$	V
V_{IL}	Low-level input voltage (J1 header)	0	-	$0.3 \times V_{OUT}$	V
V_{OH}	High-level output voltage (J1 header)	$0.8 \times V_{OUT}$	-	-	V
V_{OL}	Low-level output voltage (J1 header)	-	-	$0.3 \times V_{OUT}$	V
V_{ORS232}	V output RS232 (J2 header, RS232_TX pin)	-	5	-	V
V_{IRS232}	V input RS232 (J2 header, RS232_RX pin)	-25	-	+25	V

Table 2-3. DC characteristics

2.4 Current consumption (5V input)

Symbol		Parameter	Typ.	Max	Unit	
Wi-Fi enabled	Access Point mode	$I_{PN_RFOFF_AP}$	RF field off (AP)	150	170	mA
		$I_{PN_RFON_AP}$	RF field on (AP)	190	210	mA
	Station mode	$I_{PN_RFOFF_STA}$	RF field off (STA)	75	95	mA
		$I_{PN_RFON_STA}$	RF field on (STA)	130	150	mA
Wi-Fi Off	I_{PN_RFOFF}		RF field off	65	70	mA
	I_{PN_RFON}		RF field on	120	140	mA

Table 2-4. Current consumption

3. Getting started

3.1 IO and peripherals

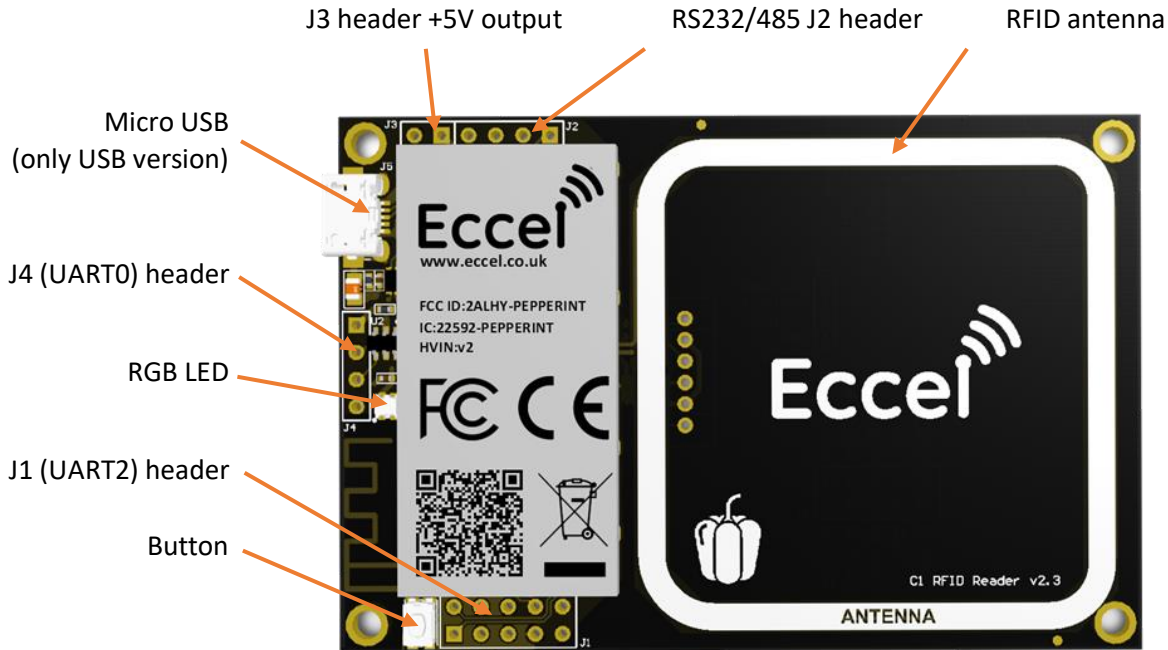
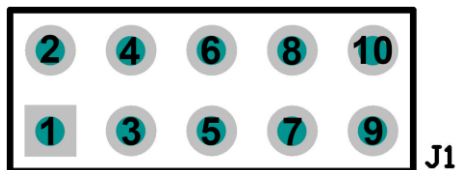


Figure 3-1. Pepper C1 RFID Reader v2.3

Micro USB socket – only in USB version. Connected to the built-in USB to TTL converter. This converter is routed to the UART0 header.

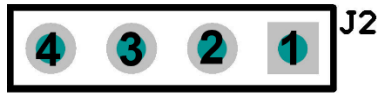
RS232/485 header – this connection is for optional built in RS232/485 converter. These options are available here:
<https://eccel.co.uk/product/pepper-c1-rs232-fcc-approved-rfid-reader/>
<https://eccel.co.uk/product/pepper-c1-rs485-fcc-approved-rfid-reader/>

3.1.1 J1 header description



1. **UART2 TX / GPIO 27**
2. **UART2 RX / GPIO 25**
3. **GPIO 34 / ADC 01**
4. **GPIO 35 / ADC 02**
5. **GPIO2**
6. **GPIO 21**
7. **GND**
8. **3.3V OUTPUT**
9. **GPIO 32**
10. **GPIO 33**

3.1.2 J2 header description (RS232 version only)



1. **Not connected**
2. **Not connected**
3. **RS232 RX** (from host to the C1, max input voltage level $\pm 25V$)
4. **RS232 TX** (from the C1 to host, max output voltage level $\pm 5V$)

3.1.3 J2 header description (RS485 version only)

By default, the Pepper C1 reader is working in full duplex mode using all four wires for RS485 communication. For half duplex communication pins A+Y and B+Z should be connected together.



1. **A** Noninverting Receiver Input
2. **B** Inverting Receiver Input
3. **Z** Inverting Driver Output
4. **Y** Noninverting Driver Output

3.1.4 J3 header description

The J3 header is an additional power supply output socket.



1. **+5V output** (100mA)
2. **GND**

3.1.5 J4 UART0 header

This is the UART0 header in the TTL standard with 3.3V levels. This is the same UART as it available on the USB port in the USB version.



1. **Vin** – Power supply, 3-5.5Voltage
2. **UART0 TX** – UART TX data from the module
3. **UART0 RX** – UART RX data to the module
4. **GND**

3.2 Typical connection

The Pepper C1 device can be connected to a host computer using a standard USB Micro cable. In the same way it can be powered to operate as a standalone device by using power sources such as a USB charger or power bank.

The computer operating system should recognize this device as a USB to TTL bridge or a USB to Serial port converter and it should appear in Windows device manager as a COM port. By default this COM port can be used for communication using the binary protocol described below.

The Reader also has the UART2 interface (J1 header) where the user can view console logs which contain additional information about temporary executing commands. The default configuration: baud: 115200, Data: 8 bit, Parity: none, Stop bits: 1 bit, Flow Control: none.

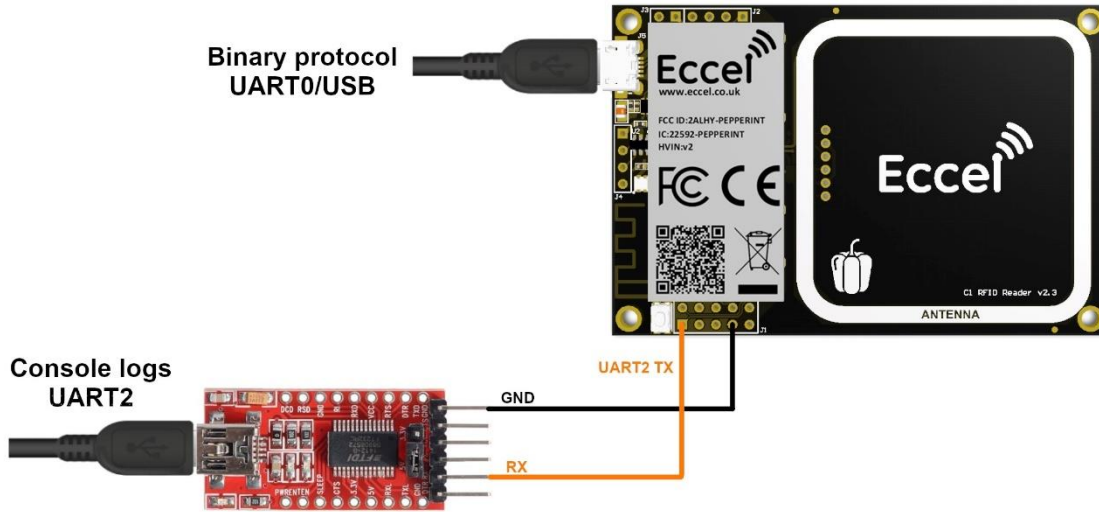


Figure 3-2. Typical connection to see the console logs on UART2

Hint – If you don't have a USB-UART converter to see the logs on the UART2 (J1 header), you can temporary change the default log interface from UART2 to UART0 in the Web Interface (Communication->UART tab). Then, the logs should be available on the USB port (in case of the Pepper C1 USB reader).

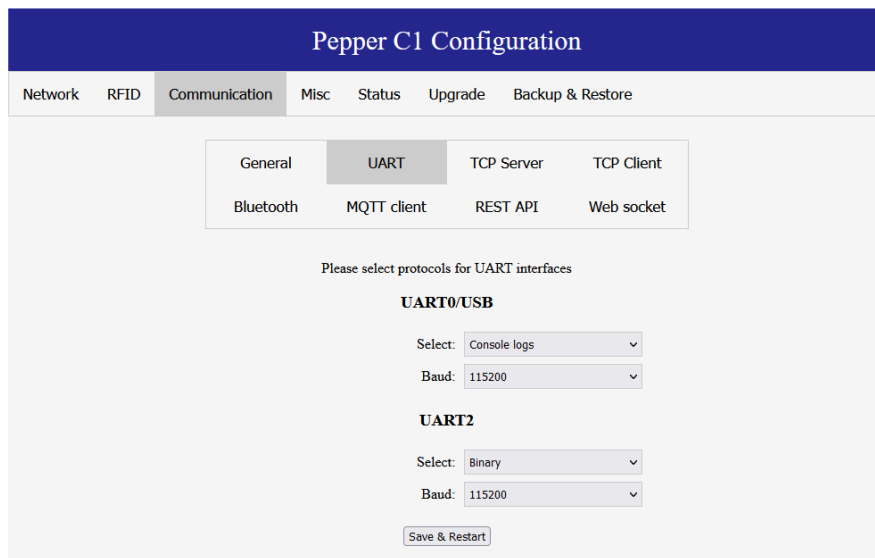


Figure 3-3. Console logs on the UART0/USB

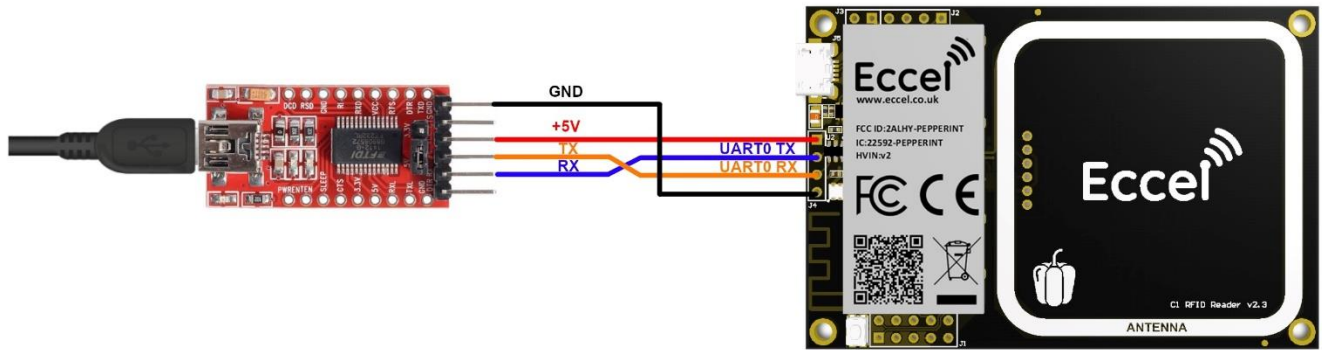


Figure 3-6. Pepper C1 FCC UART - typical connection with the USB-UART converter

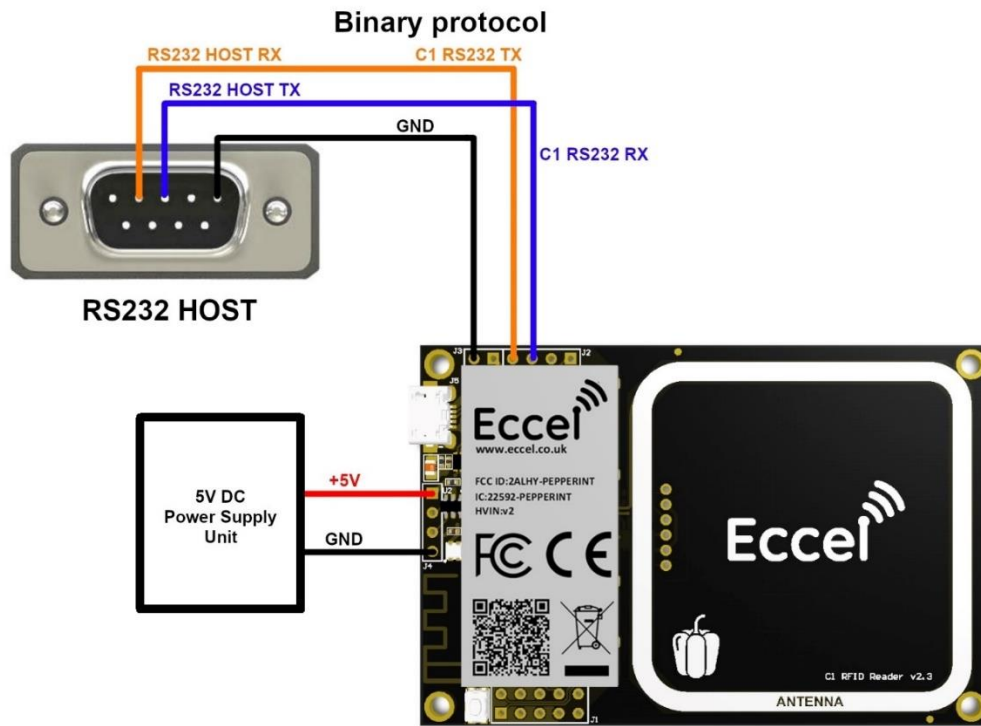


Figure 3-5. Pepper C1 FCC RS232 - typical connection with the RS232 host device

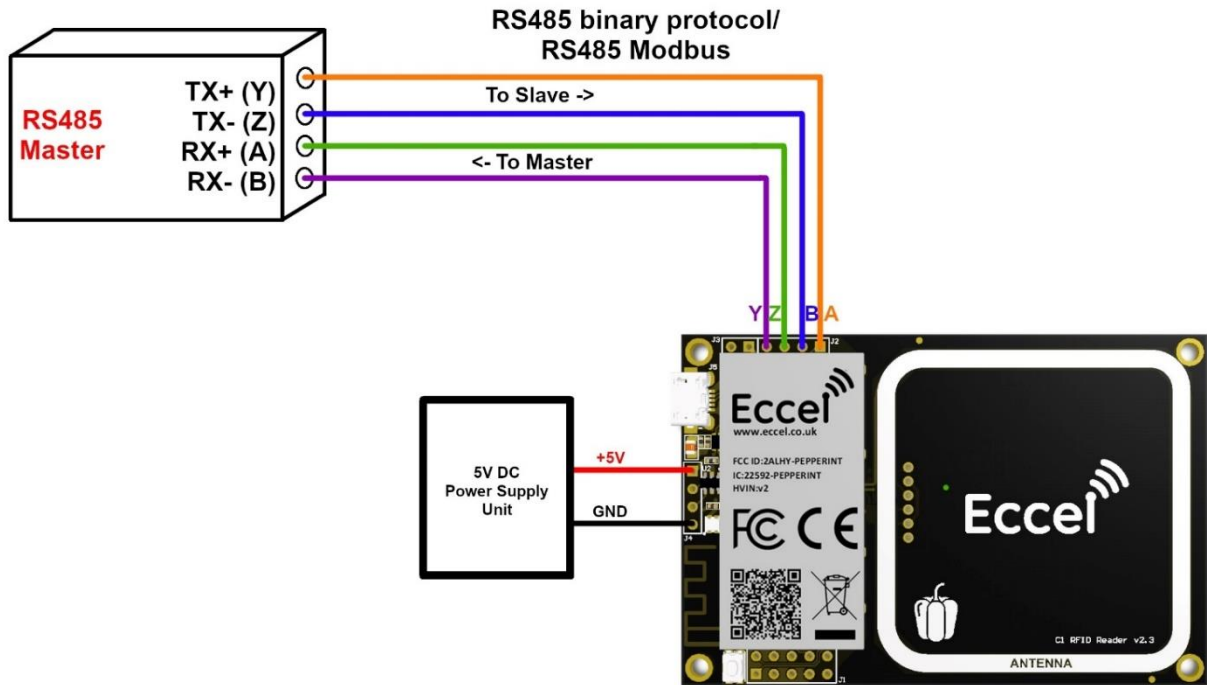


Figure 3-4. Pepper C1 FCC RS485 - Full duplex connection with the RS485 Master device

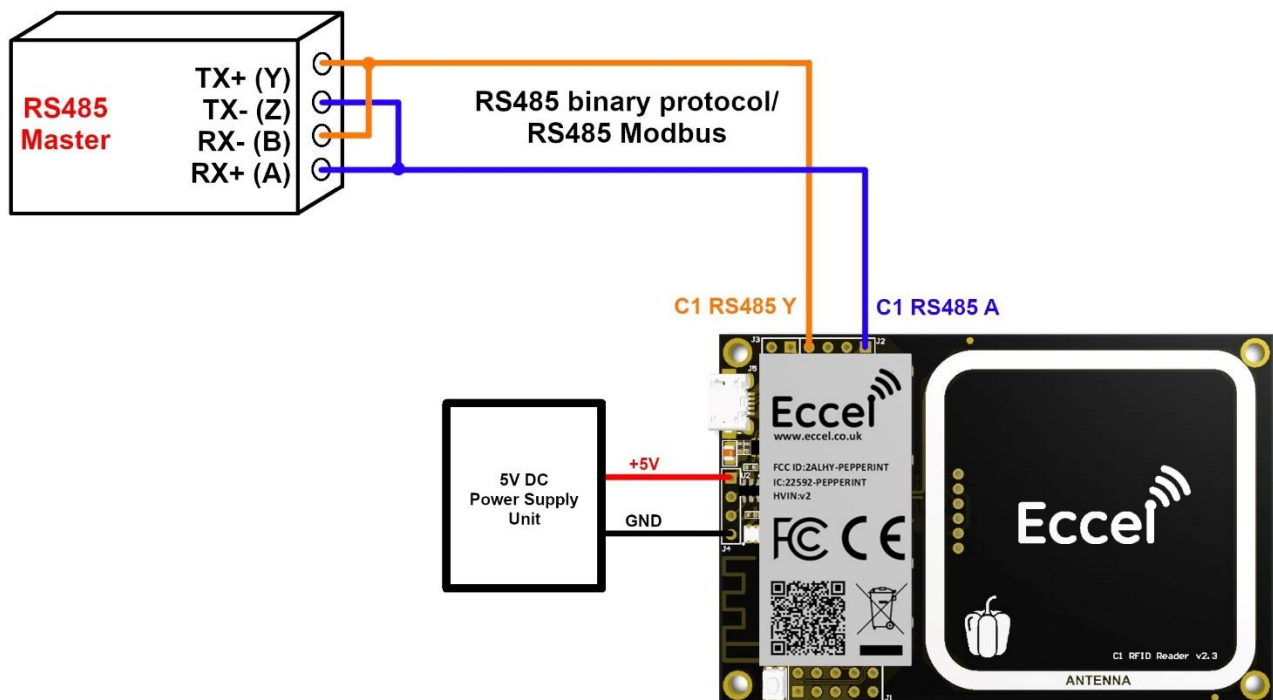


Figure 3-5. Pepper C1 FCC RS485 - half duplex connection with the RS485 Master device

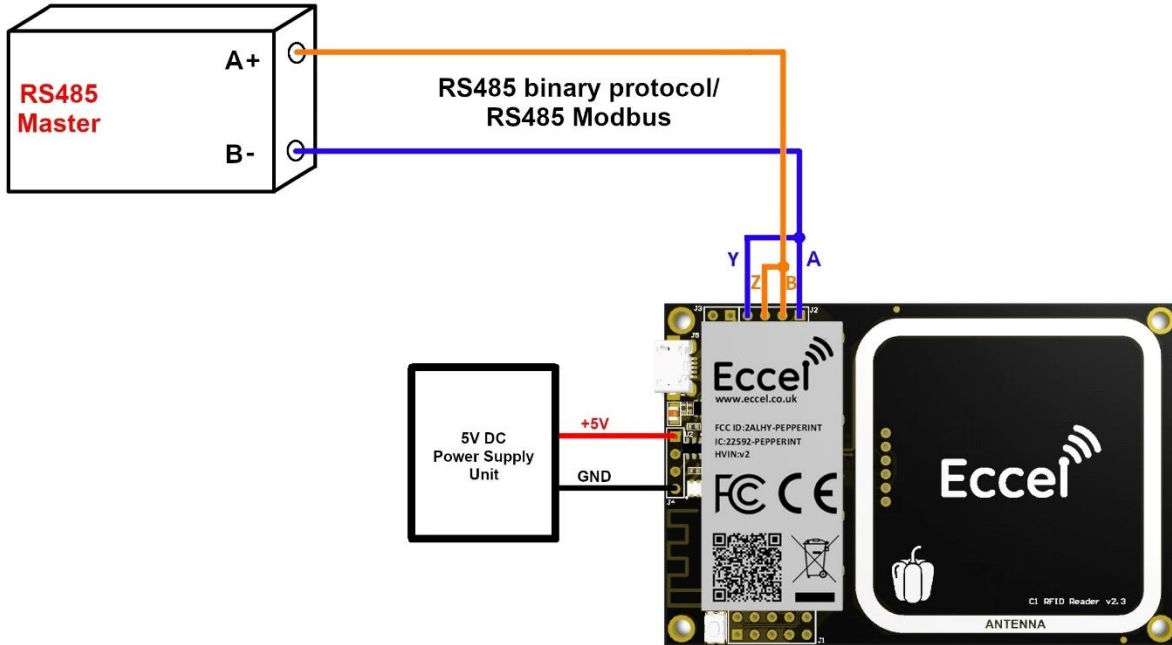


Figure 3-6. Pepper C1 FCC RS485 - half duplex example

4. Mechanical dimension

All dimensions are in mm.

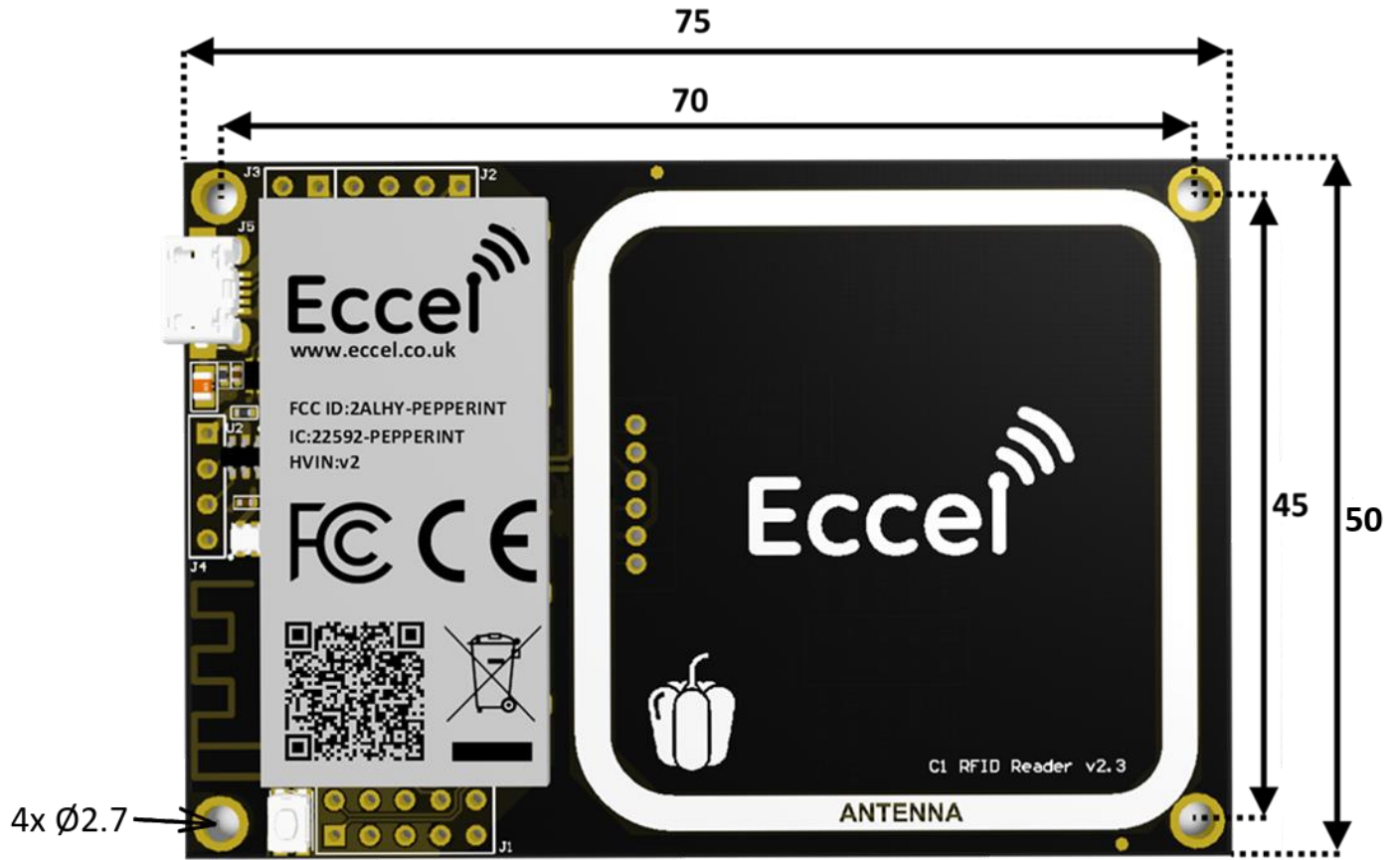


Figure 4-1. Pepper C1 FCC dimension

5. Configuration and functional description

Here is the document describing configuration, communication protocol, commands and all functions of the Pepper C1 FCC reader:

https://eccel.co.uk/wp-content/downloads/Pepper_C1/C1_software_manual.pdf

Eccel provides a variety of free tools & libraries ready to be downloaded from this link:

<https://eccel.co.uk/support-free-libraries/>

6. FCC Statement

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 important announcement Important Note:

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. Country Code selection feature to be disabled for products marketed to the US/Canada.

This device is intended only for OEM integrators under the following conditions:

1. The antenna must be installed such that 20cm is maintained between the antenna and users, and
2. The transmitter module may not be co-located with any other transmitter or antenna,

Important Note:

In the event that these conditions cannot be met (for example certain laptop configurations or co-location with another transmitter), then the FCC authorization is no longer considered valid and the FCC ID cannot be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC authorization.

End Product Labelling

The final end product must be labelled in a visible area with the following "Contains FCC ID: 2ALHY-PEPPERINT"

Integration instructions for host product manufacturers according to KDB 996369 D03 OEM Manual v01

2.2 List of applicable FCC rules

CFR 47 FCC PART 15 SUBPART C has been investigated. It is applicable to the modular transmitter

2.3 Specific operational use conditions

This module is stand-alone modular. If the end product will involve the Multiple simultaneously transmitting condition or different operational conditions for a stand-alone modular transmitter in a host, host manufacturer have to consult with module manufacturer for the installation method in end system.

2.4 Limited module procedures

Not applicable

2.5 Trace antenna designs

Not applicable

2.6 RF exposure considerations

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 & your body.

2.7 Antennas

This radio transmitter **FCC ID:2ALHY-PEPPERINT** has been approved by Federal Communications Commission to operate with the antenna types listed below, with the maximum permissible gain indicated. Antenna types not included in this list that have a gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device.

Internal Identification	Antenna type and antenna number	Operate frequency band	Maximum antenna gain	Note
Antenna	PCB Antenna	2400MHz-2500MHz	1.88dBi	BT Antenna
Antenna	Integrated PCB Antenna	13.56MHz	0dBi	NFC Antenna

2.8 Label and compliance information

The final end product must be labeled in a visible area with the following "Contains **FCC ID:2ALHY-PEPPERINT**".

2.9 Information on test modes and additional testing requirements

Host manufacturer which install this modular with single modular approval should perform the test of radiated emission and spurious emission according to FCC part 15C:15.247 and 15.209 requirement, only if the test result comply with FCC part 15.247 and 15.209 requirement, then the host can be sold legally.

2.10 Additional testing, Part 15 Subpart B disclaimer

Host manufacturer is responsible for compliance of the host system with module installed with all other applicable requirements for the system such as Part 15 B.

7. ISED Statement

- **English:** This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions: (1) This device may not cause interference, and (2) This device must accept any interference, including interference that may cause undesired operation of the device.
The digital apparatus complies with Canadian CAN ICES-3 (B)/NMB-3(B).
- **French:** Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.
l'appareil numérique du ciem conforme canadien peut - 3 (b) / nmb - 3 (b).

This device meets the exemption from the routine evaluation limits in section 2.5 of RSS 102 and compliance with RSS 102 RF exposure, users can obtain Canadian information on RF exposure and compliance.

cet appareil est conforme à l'exemption des limites d'évaluation courante dans la section 2.5 du cnr - 102 et conformité avec rss 102 de l'exposition aux rf, les utilisateurs peuvent obtenir des données canadiennes sur l'exposition aux champs rf et la conformité.

This equipment complies with Canada radiation exposure limits set forth for an uncontrolled environment.

Cet équipement est conforme Canada limites d'exposition aux radiations dans un environnement non contrôlé.

This equipment should be installed and operated with minimum distance 20cm between the radiator & your body. Cet équipement doit être installé et utilisé à une distance minimale de 0 cm entre le radiateur et votre corps.

ISED Modular Usage Statement

NOTE 1: When the ISED certification number is not visible when the module is installed inside another device, then the outside of the device into which the module is installed must also display a label referring to the enclosed module. This exterior label can use the wording "Contains transmitter module IC: 22592-PEPPERINT" or "Contains IC: 22592-PEPPERINT".

NOTE 1: Lorsque le numéro de certification ISED n'est pas visible lorsque le module est installé dans un autre appareil, l'extérieur de l'appareil dans lequel le module est installé doit également afficher une étiquette faisant référence au module inclus. Cette étiquette extérieure peut être libellée Contient le module émetteur IC: 22592-PEPPERINT ou Contient IC: 22592-PEPPERINT.

8. Revision history

Revision	Date	Changes
2.17	2-Apr-2024	First release after splitting software and hardware description

MIFARE, MIFARE Ultralight, MIFARE Plus, MIFARE Classic, and MIFARE DESFire are trademarks of NXP B.V.

No responsibility is taken for the method of integration or final use of the C1 readers

More information about the C1 reader and other products can be found at the Internet site:

<http://www.eccel.co.uk>

or alternatively contact ECCEL Technology (IB Technology) by e-mail at:

sales@eccel.co.uk