

# Pepper C1 MUX User Manual

Manual version: V2.17<sup>1</sup>

03/07/2024

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<sup>1</sup> The newest User manual can be found on our website: [https://eccel.co.uk/wp-content/downloads/Pepper\\_C1/C1\\_MUX\\_User\\_manual.pdf](https://eccel.co.uk/wp-content/downloads/Pepper_C1/C1_MUX_User_manual.pdf)

## 1. Introduction

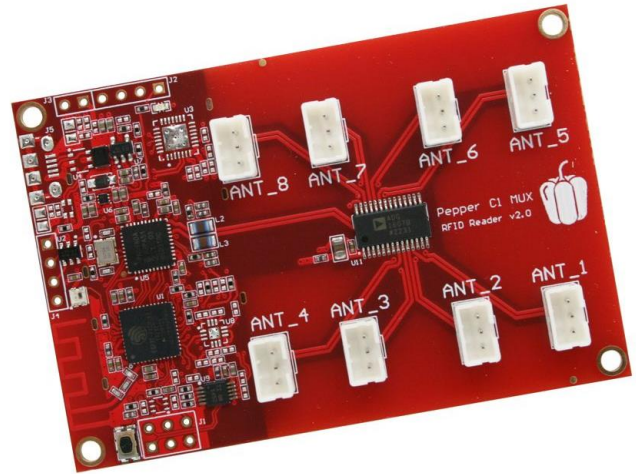
### 1.1 Device Overview

#### 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
  - 2.4GHz wireless communication (WPAN)
  - **can be disabled by the user**
- Built in Web Interface
- Over-the-Air lifetime updates
- UART baud rate up to 921600 bps
- Configurable RGB LED indicator for RFID or Wi-Fi events
- Stand-alone mode (polling) up to 8 external antennas
- Antenna selection by one simple command
- IoT interfaces: MQTT, WebSocket
- High transponder read and write speed
- -25°C to 85°C operating range
- Multiple internal reference voltages
- RoHS compliant
- CE (RED) and UKCA compliant.  
FCC/ISED/PSE and other approvals easily obtained (see section 15)

#### 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 MUX module is the multiplexed version of the Pepper C1 – the first Eccel Technology Ltd product with wireless connectivity by Wi-Fi 802.11b/g/n and WPAN (2.4GHz). The user can connect up to 8 external RFID antennas. Thanks to the wireless connectivity, the customer receives free lifetime Over-the-Air updates, and of course the communication protocol can be used over TCP instead of the traditional UART/USB interface. Combining these features with standalone mode provides a “straight out of the box” ready to use device for many application. 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. This facilitates 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
$V_{DDMAX}$	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
$T_{Op}$	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	5.4	V
$V_{IRS232}$	V input RS232 (J2 header, RS232_RX pin)	-25	-	+25	V

Table 2-3. DC characteristics

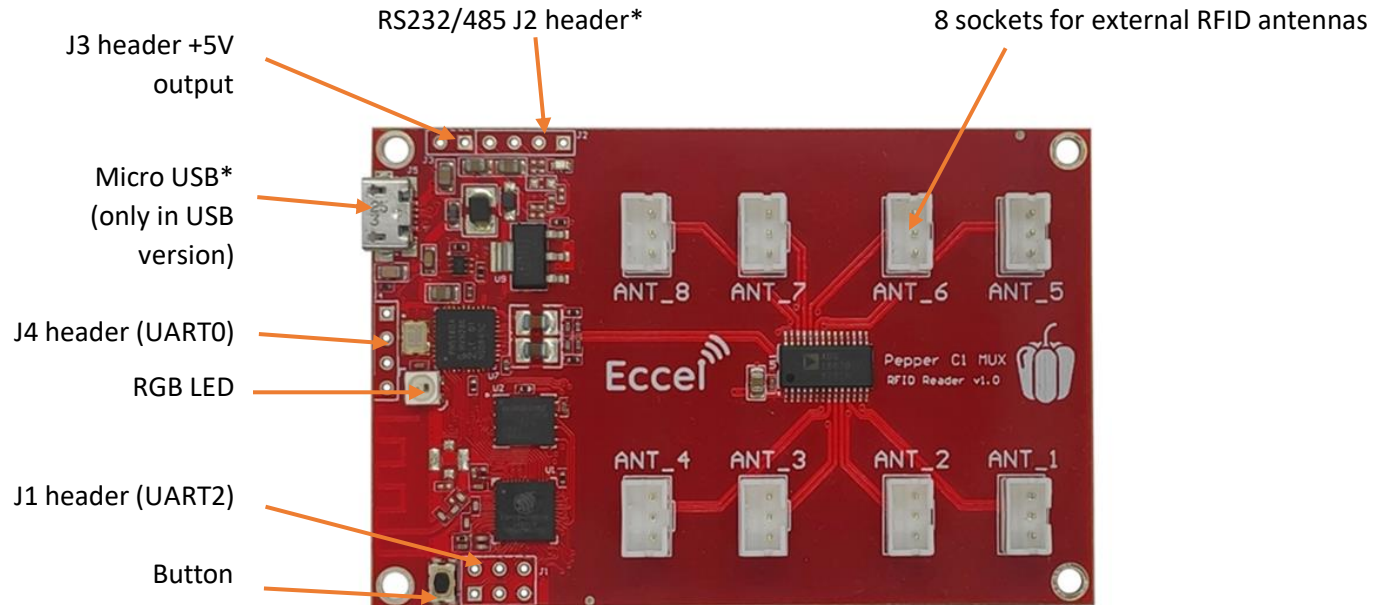
## 2.4 Current consumption ( $V_{DD} = 5V$ )

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 disabled	$I_{PN\_RFOFF}$		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



\*Micro USB – only in USB version. Connected internally to the built in USB to TTL converter. This converter is routed to the UART0 header.

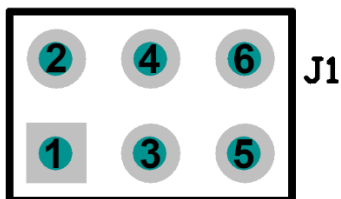
\*RS232/RS485 header – this connection is for optional built in RS232/RS485 converter.

These options are available here:

<https://eccel.co.uk/product/pepper-c1-mux-rs232/>

<https://eccel.co.uk/product/pepper-c1-mux-rs485/>

##### 3.1.1 J1 header description



1. **UART2 TX/GPIO27** (3.3V level)
2. **UART2 RX/GPIO25** (3.3V level)
3. **GPI 34** (input only)
4. **GPI 35** (input only)
5. **GND**
6. **3.3V output**

### 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. The maximum output current depends on the power supply connected to the J4 Vin pin, and is estimated as 100mA.



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

### 3.1.5 J4 UART0 header description

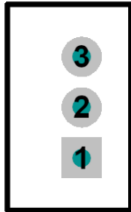
This is the UART0 header in the TTL standard with 3.3V levels. This is the same UART as it available on the USB port in the USB version.



1. **Vin** – Power supply, 3.3V – 5V
2. **UART0 TX** – UART TX data from the module
3. **UART0 RX** – UART RX data to the module
4. **GND**

### 3.1.6 J6 External antenna header

The user has the possibility to work with up to 8 external RFID antennas simultaneously. Eccel Technology Ltd provides a variety of RFID antennas which the user can use together with this device: <https://eccel.co.uk/product-category/antennas/> (only red ones).



1. **GND**
2. **TX1** – Antenna driver output
3. **TX2** – Antenna driver output

## 3.2 Typical connection

The Pepper C1 MUX 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 new COM port (for example COM3). By default this COM port can be used for communication using the binary protocol described below.

The Reader also has the UART2 connector (J1 header) where the user can view output 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.

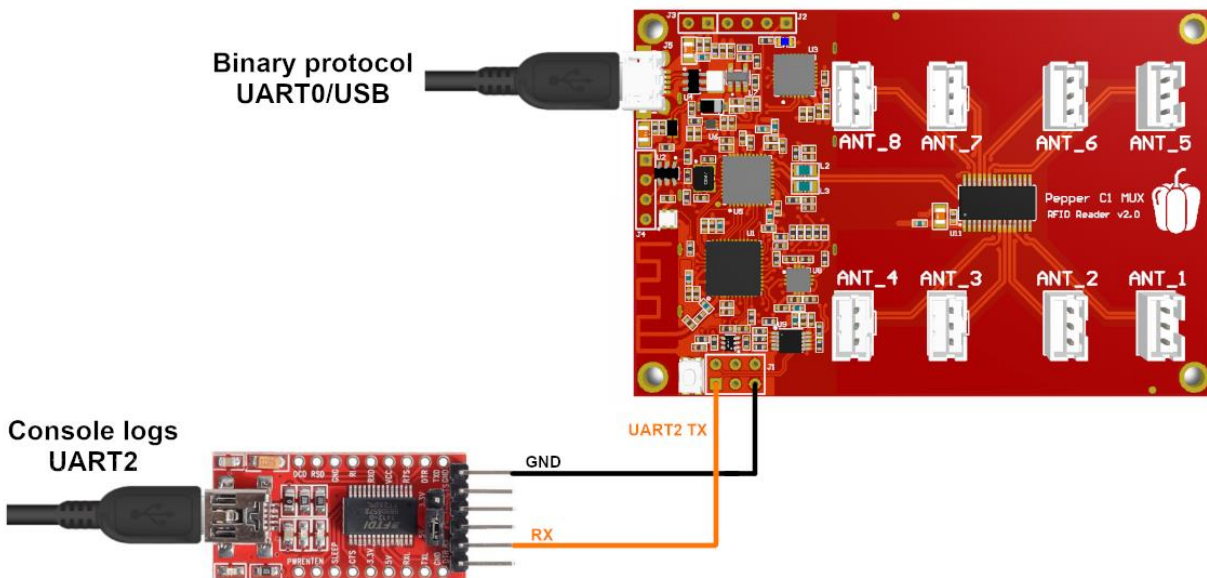
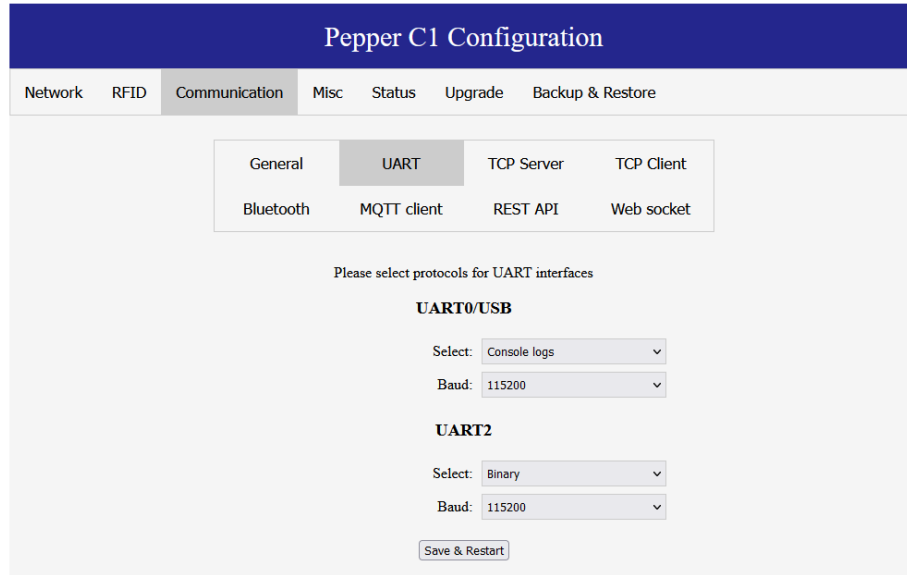


Figure 3-1. Typical connection to see console logs on UART2

**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 MUX USB reader).



The screenshot shows the 'Pepper C1 Configuration' web interface. The 'Communication' tab is selected. Under the 'UART' sub-tab, there are options for 'General', 'Bluetooth', 'MQTT client', 'TCP Server', 'TCP Client', 'REST API', and 'Web socket'. Below these, a message says 'Please select protocols for UART interfaces'. There are two sections: 'UART0/USB' and 'UART2'. In the 'UART0/USB' section, 'Select' is set to 'Console logs' and 'Baud' is set to '115200'. In the 'UART2' section, 'Select' is set to 'Binary' and 'Baud' is set to '115200'. A 'Save & Restart' button is at the bottom.

Figure 3-2. Console logs on the UART0/USB

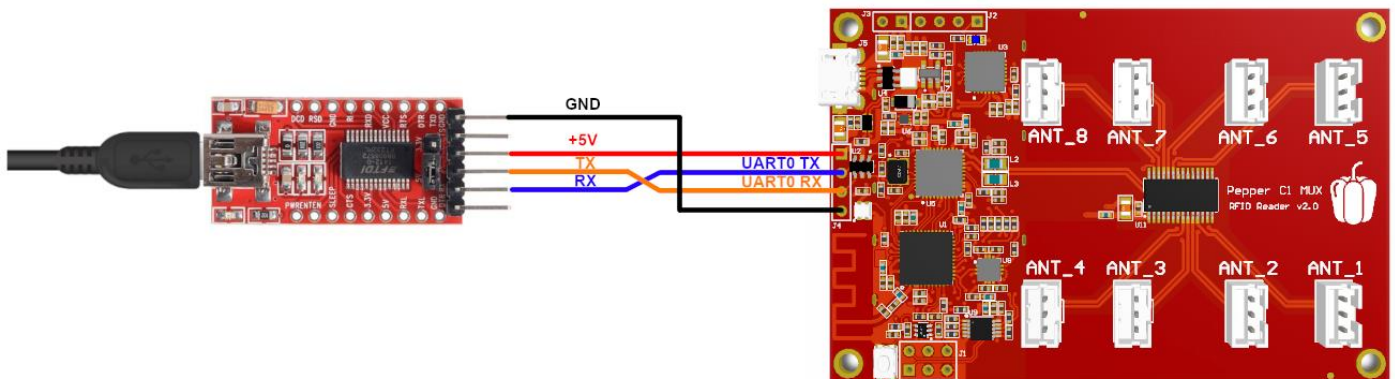


Figure 3-3. Pepper C1 MUX - schematic connection with the USB-UART converter



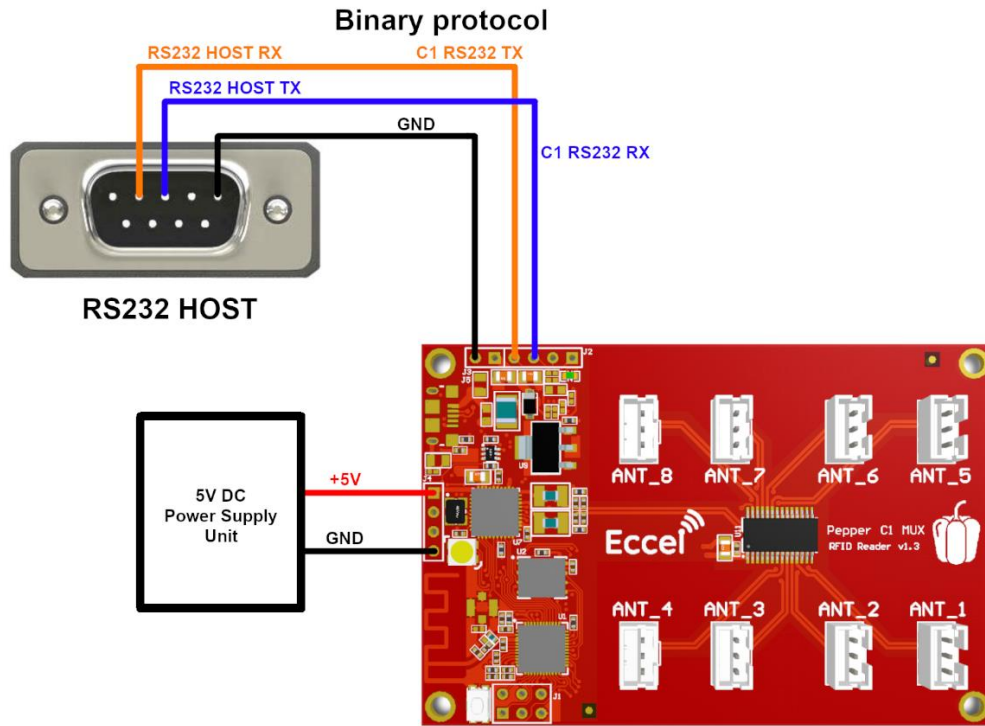


Figure 3-4. Pepper C1 MUX RS232 - typical connection with the RS232 host device

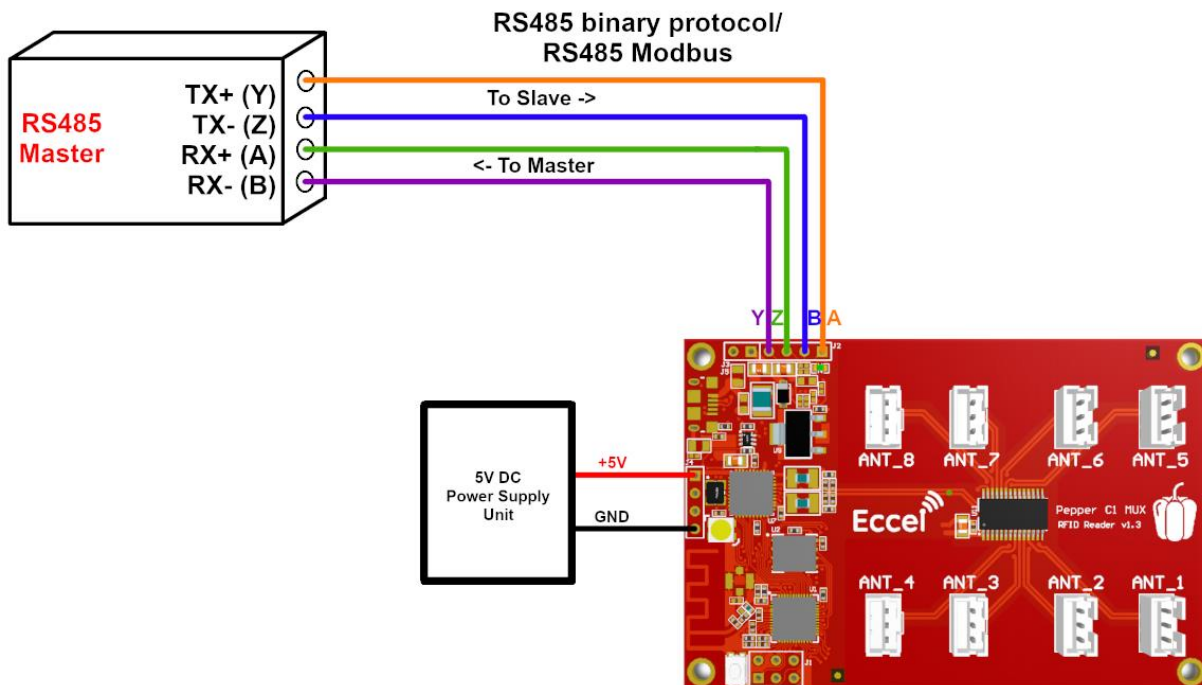


Figure 3-5. Pepper C1 RS485 - full duplex connection example

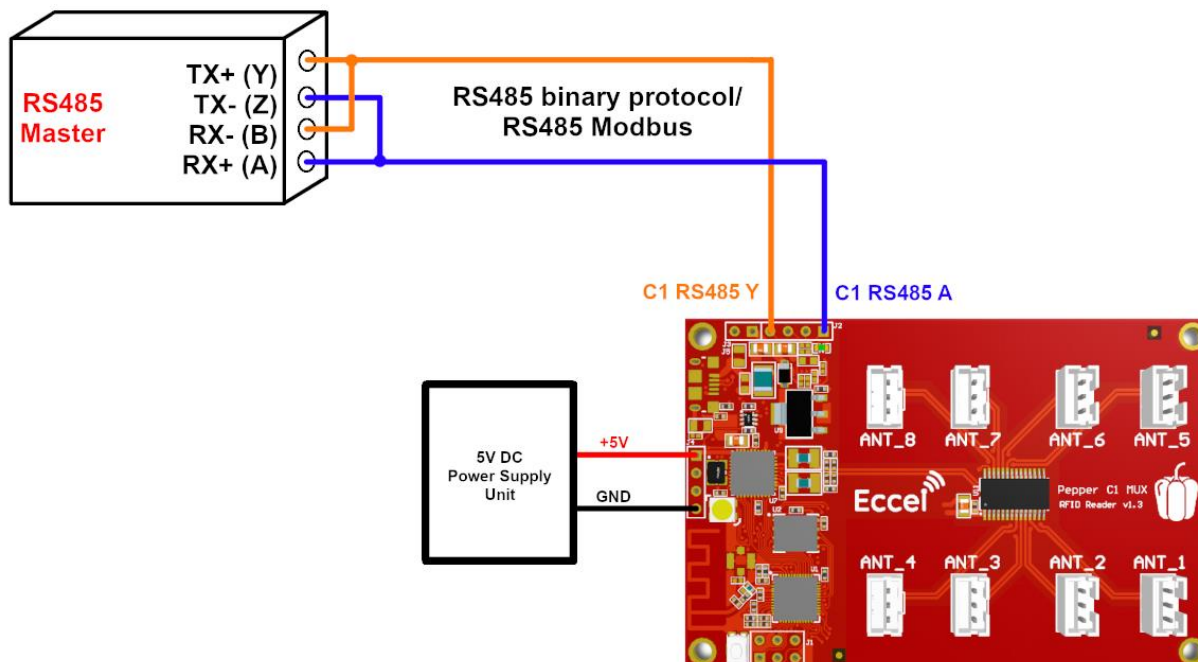


Figure 3-6. Pepper C1 MUX RS485 - half duplex connection schematic

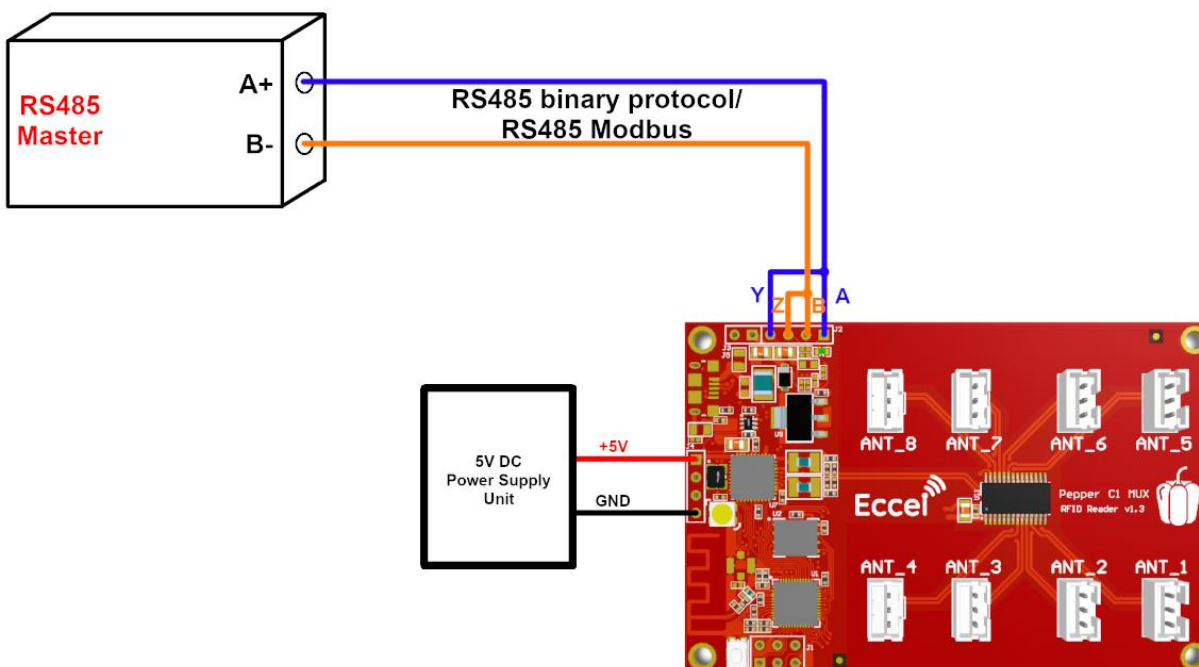


Figure 3-7. Pepper C1 MUX RS485 - half duplex connection schematic

## 4. Mechanical dimension

All dimensions are in mm.

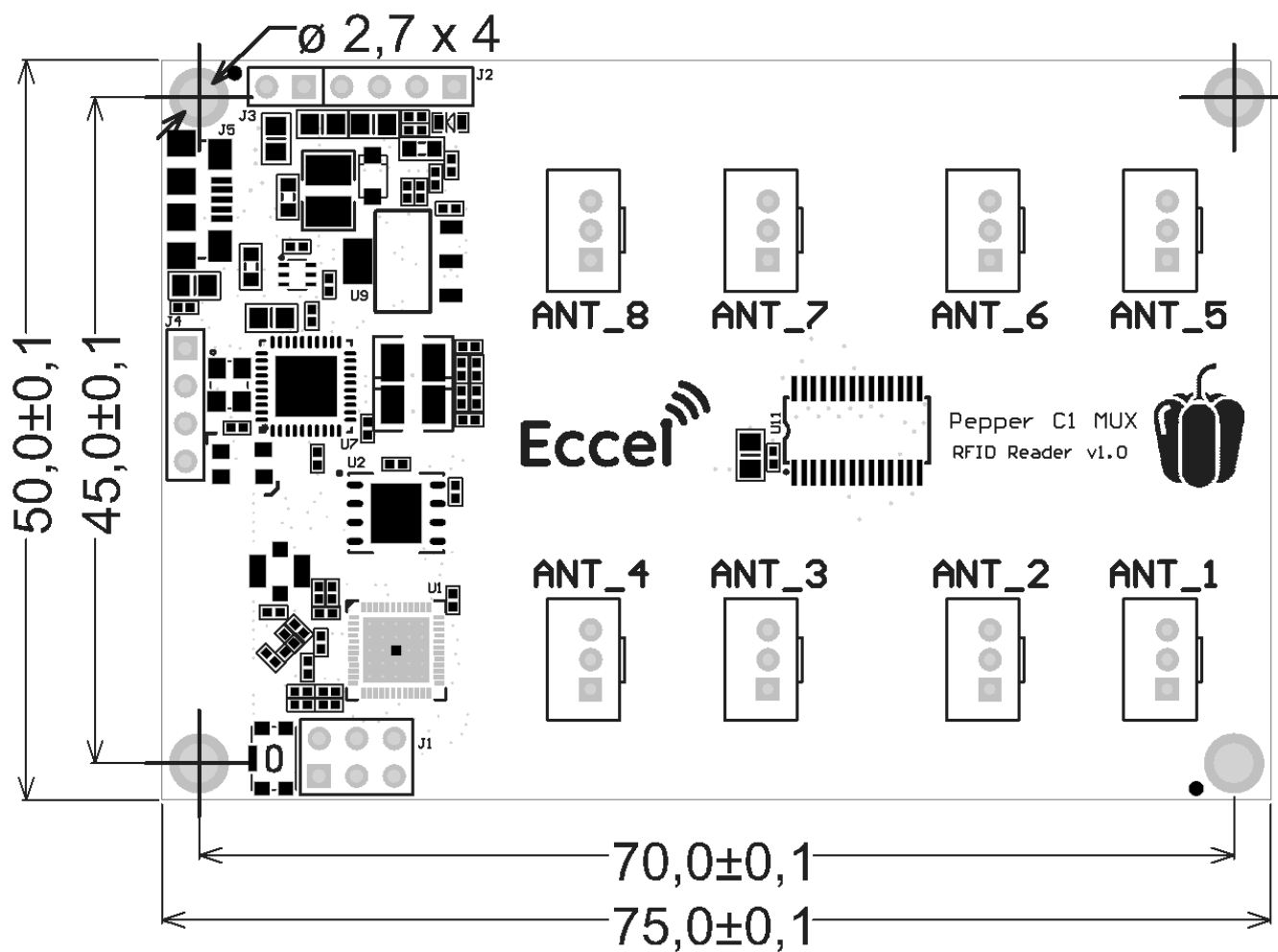


Figure 4-1

## 5. Configuration and functional description

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

[https://eccel.co.uk/wp-content/downloads/Pepper\\_C1/C1\\_software\\_manual.pdf](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. RF Emissions and Susceptibility Approvals

Eccel have tested and declare that this product meets all the requirements of the relevant RF directives (RED) to be declared CE (European Union) and UKCA (United Kingdom) compliant. Please see our declaration of conformity for this on the downloads tab of the product webpage.

This product is designed to be incorporated into products easily and quickly such that those products can pass any national or regional statutory RF requirements and certifications such as FCC (USA), ISED (Canada) and PSE (Japan) for example.

This product is designed to meet all statutory RF requirements applicable worldwide using the most cost effective but robust design methodology.

Eccel is pleased to offer customers very cost-effective certification for their end equipment that incorporate this product. Prices start from £3K per approval/ certification. Please contact us for more details at [sales@eccel.co.uk](mailto:sales@eccel.co.uk).

## 7. Revision history

Revision	Date	Changes
2.17	3-Jul-2024	Section 1.1 updated
2.16	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 MUX 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](mailto:sales@eccel.co.uk)**