

UART-B1 User Manual

V1.8
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1. Introduction

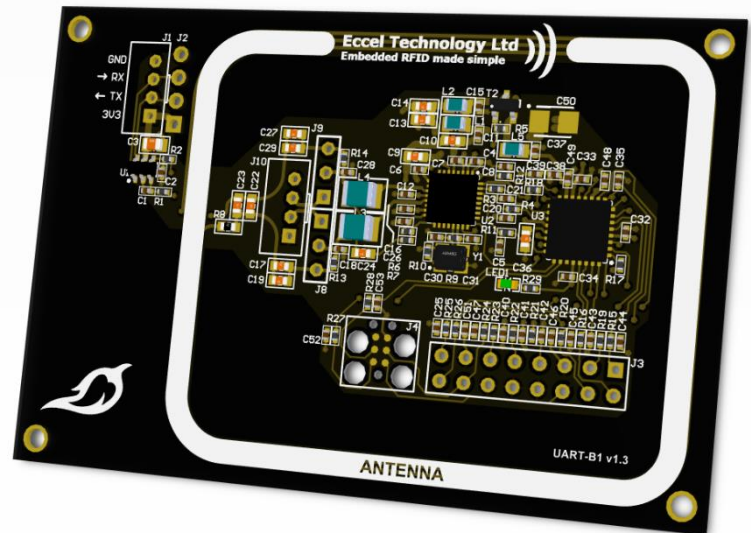
1.1 Device Overview

Features

- Low cost RFID Reader with MIFARE Classic®, MIFARE Ultralight® and NTAG2® support
- LED indicator of a tag presence in the antenna field
- Stand-alone mode (polling)
- Command interface via UART with optional AES-128 encryption
- UART baud rate up to 921600 bps
- High transponder read and write speed
- -25°C to 85°C operating range
- 4 configurable GPIOs with interrupts
- 3 configurable PWMs
- Comparator
- ADC
- Current Output DAC
- AES-128 encryption engine
- Multiple internal reference voltages
- RoHS 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 UART-B1 module is an expansion of the RFID B1 module - the second in an evolving family of 13.56 MHz sub assemblies from Eccel Technology Ltd (IB Technology). The product is designed with both embedded applications and computing / PLC platforms in mind. This product 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 on board low power ARM 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. The UART-B1 can be also used with the single boards computers e.g. Arduino.

1.2 System Overview

The UART-B1 device is an extension of our RFID B1 module. Below, In Figure 1-1 the System Diagram is presented.

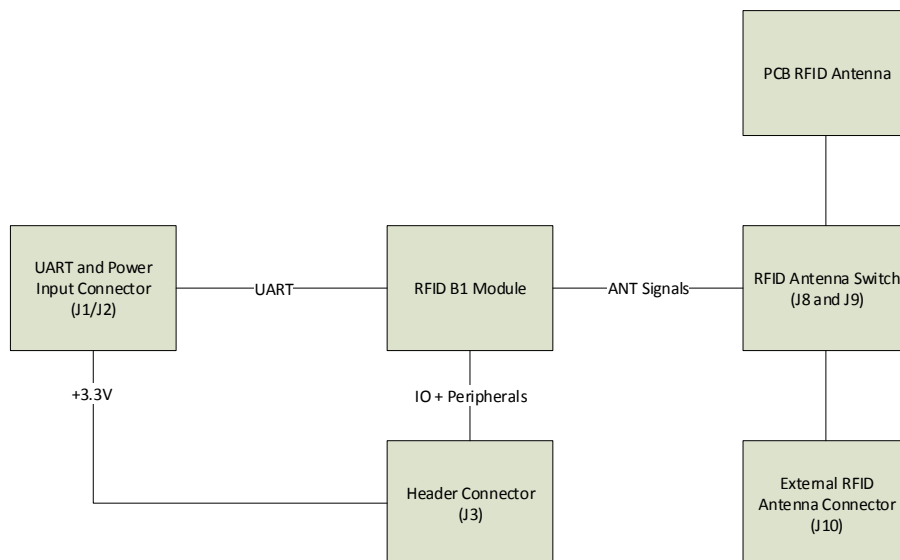


Figure 1-1 System Diagram

1.3 Features

Parameter	Typical Value
Range (dependent upon antenna dimensions and tuning, tag: MIFARE Classic® 1K ISO card)	
a) PCB antenna (on board)	up to 50 mm
b) External PCB antenna 50x50mm (RFID-ANT1356-50x50-300 v1)	up to 70 mm
c) External PCB antenna 25x25mm (RFID-ANT1356-25x25-300 v1)	up to 40 mm
Nominal RF frequency	13.56 MHz
Supported tags	MIFARE Classic®, MIFARE Ultralight®, NTAG2®
Time needed to read the whole tag memory (MIFARE Classic® 1K)	0.5 s
Time needed to write the whole tag memory (MIFARE Classic® 1K)	0.6 s
Width x Length	75 x 50 mm

Table 1-1

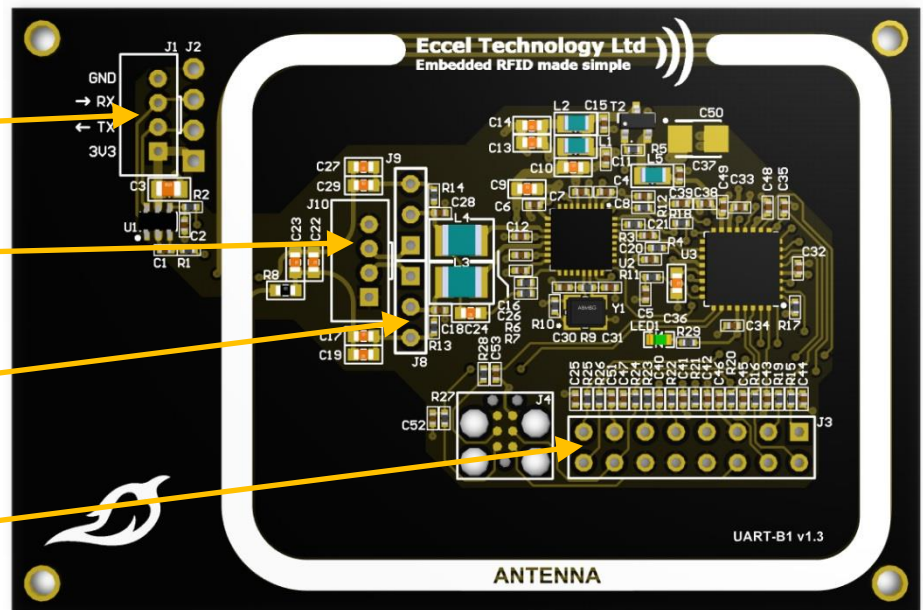
1.4 Connectors

UART Connectors (J1/J2)

External Antenna Connector (J10)

External/PCB Antenna Selection
Connectors (J8 and J9)

IO and Peripherals
Configuration Header (J3)

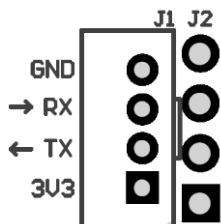


Picture 1-1

In the Picture 1-1 there are marked connectors available for the user when working with the UART-B1 device. The connectors used on the UART-B1 are described below.

1.4.1 UART Connectors J1 and J2

The device provides communication and power via UART J1/J2 connectors. The J1 and J2 connectors have a pin spacing of 2mm and 2.54mm respectively. The user can configure the COM Port with a baud rate up to the maximum allowed by the RFID B1 module.

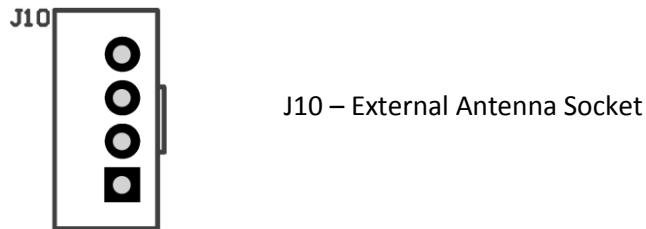


- J1.1, J2.1 – 3V3 – 3.3V Power Supply
- J1.2, J2.2 – TX (UART Tx data from the module)
- J1.2, J2.3 – RX (UART Rx data to the module)
- J1.4, J2.4 – GND – Ground

Note: The square pad is always pin number 1.

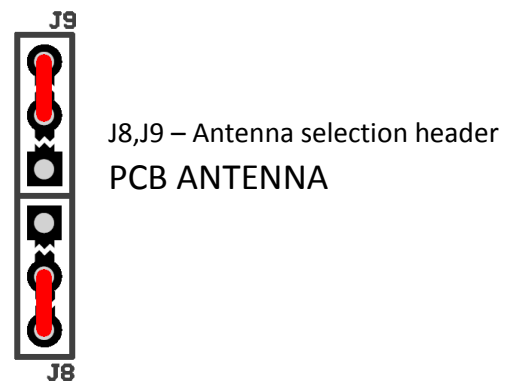
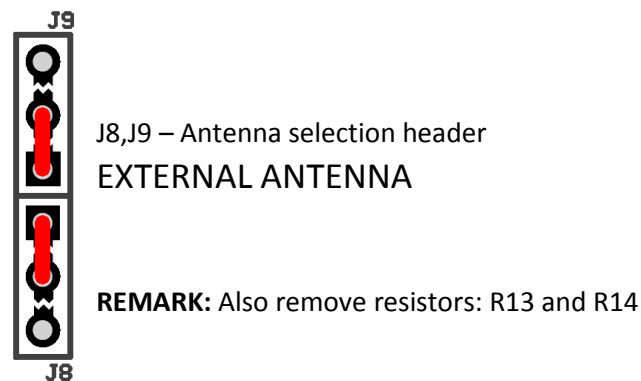
1.4.2 External Antenna Connector (J10)

The user has the option to work with an external RFID antenna connected to the USB-B1 device. Connector J10 is where this should be connected. Eccel Technology Ltd provides a variety of RFID antennas which the user can use together with this device.



1.4.3 External / PCB Antenna Selection Connectors J8 and J9

To switch between the PCB antenna and an external antenna, two jumpers have to be used with the J8 and J9 connectors. These jumpers (J8 and J9) are not mounted by default.



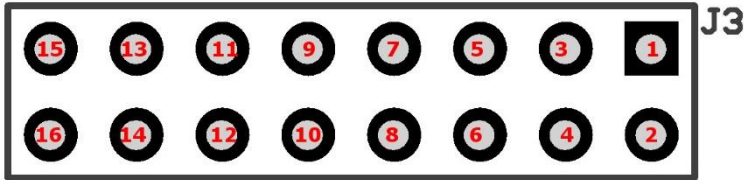
Before connecting an external antenna the user should remove the R13 and R14 resistors. These resistors are mounted by default and connect the RFID chip to the internal PCB antenna.

We recommend using our external antennas from series **RFID-ANT1356-50X50-xxx**, where **xxx** is the cable in mm. They have a read range of about 70mm, 50x50mm in size and 300 or 800mm cable length. We can also design antennas with higher read range and custom dimensions on request.

More information about antennas: <https://eccel.co.uk/product-category/antennas/>

1.4.4 IO and Peripheral Configuration Header

The device PCB connects the pins on this header to all IOs and peripherals provided by the onboard RFID B1 module and a few pins are available providing +3.3V and GND signals.



- J3.1 – GPIO 0
- J3.2 – GPIO 2
- J3.3 – GPIO 1
- J3.4 – GPIO 3
- J3.5 – GND
- J3.6 – 3.3 V
- J3.7 – IDAC (Digital to Analog Converter with current-type output)
- J3.8 – GND
- J3.9 – COMP (Comparator positive input)
- J3.10 – GND
- J3.11 – ADC (Analog to Digital Converter input)
- J3.12 – GND
- J3.13 – GND
- J3.14 – nRST (nRESET – reset input signal – active low)
- J3.15 – nSLEEP (Output signal indicating the device is in Sleep Mode or Power Down Mode – active low)
- J3.16 – nPWRDN (Power Down Request input signal – active low)

2. Electrical Characteristics

2.1 Test Conditions

Typical device parameters were measured at an ambient temperature $22^{\circ}\text{C} \pm 3^{\circ}\text{C}$ and using a power supply of $3.3\text{V} \pm 5\%$.

2.2 Absolute Maximum Ratings

Symbol	Parameter	Min	Max	Unit	Notes
T_s	Storage Temperature	-40	150	$^{\circ}\text{C}$	
V_{DDMAX}	Supply Voltage	0	3.8	V	
V_{IOMAX}	Input Pin Voltage	-0.3	$V_{DD} + 0.3$	V	
I_{IOMAX}	Output Pin Current	0	6	mA	
I_{ANT}	ANT1 and ANT2 Current	0	100	mA	Maximum continuous current. This depends upon the impedance of the circuit between ANT1 and ANT2 at 13.56MHz.

Table 2-1

2.3 Operating Conditions

Symbol	Parameter	Min	Max	Unit
T_O	Ambient Temperature	-25	85	$^{\circ}\text{C}$
V_{DD}	Supply Voltage	2.5	3.6	V

Table 2-2

2.4 GPIO

Symbol	Parameter	Min	Typ	Max	Unit	Notes
V_{IOL}	Input Low Voltage			$0.3V_{DD}$	V	
V_{IOIH}	Input High Voltage	$0.7V_{DD}$			V	
I_{IOMAX}	Output Pin Current			± 6	mA	
I_{IOLEAK}	Input Leakage Current		± 0.1	± 40	nA	High impedance IO connected to V_{3V3} or GND.
R_{IOESD}	Internal ESD Series Resistor		200		Ω	
V_{IOHYST}	IO Pin Hysteresis	$0.1V_{DD}$			V	

Table 2-3

2.5 Antenna Output

Symbol	Parameter	Min	Typ	Max	Unit	Notes
f_{ANT}	Antenna Signal Frequency		13.56		MHz	± 30 ppm ($-20^{\circ}\text{C} - 70^{\circ}\text{C}$).
f_{ANTAG}	Antenna Signal Frequency Aging	0		3	ppm	At 25°C .
V_{ANTH}	Antenna High Level Output Voltage	$V_{DD} - 0.64$			V	$I_{ANT} = 80\text{mA}$.
V_{ANTL}	Antenna Low Level Output Voltage			0.64	V	$I_{ANT} = 80\text{mA}$.
I_{ANT}	ANT1 and ANT2 Current	0	60	100	mA	Maximum continuous current. This depends upon the impedance of the circuit between ANT1 and ANT2 at 13.56MHz.

Table 2-4

2.6 Flash

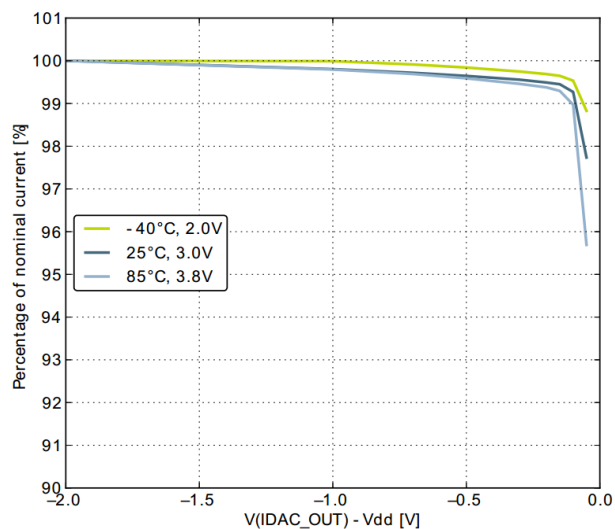
Symbol	Parameter	Min	Typ	Max	Unit	Notes
C_{FE}	Flash Erase Cycles Before Failure	20000			cycles	
T_{FDR}	Flash Data Retention Time	10			years	For ambient temperature $< 85^{\circ}\text{C}$
		20			years	For ambient temperature $< 70^{\circ}\text{C}$

Table 2-5

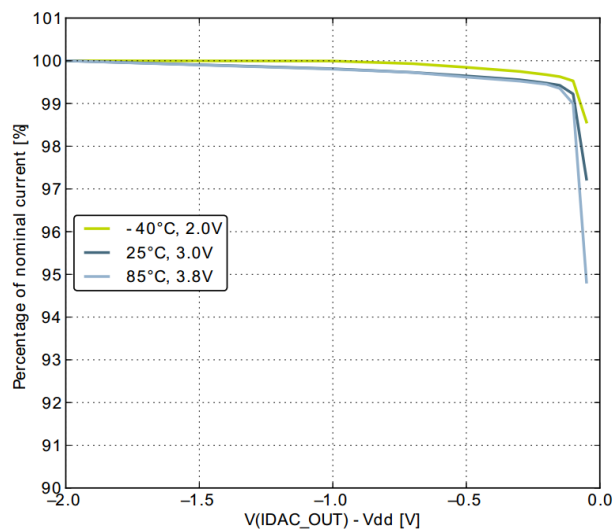
2.7 IDAC

IDAC Parameters									
Precision				Source			Sink		
Range No	Range [μA]	Step Size [nA]	Nominal Current [μA]	Current drop at $V_{dd} - 100\text{ mV}$ [%]	Temperature coefficient [$\text{nA}/^{\circ}\text{C}$]	Voltage coefficient [nA/V]	Current drop at 200 mV [%]	Temperature coefficient [$\text{nA}/^{\circ}\text{C}$]	Voltage coefficient [nA/V]
0	$< 0 ; 1.6 >$	50	0.85	0.79	0.3	11.7	0.3	0.2	12.5
1	$(1.6 ; 4.7 >$	100	3.2	0.75	0.7	38.4	0.32	0.7	40.9
2	$(4.7 ; 16 >$	500	8.5	1.22	2.8	96.6	0.62	2.8	94.4
3	$(16 ; 64 >$	2000	34	3.54	10.9	159.5	1.75	10.9	148.6

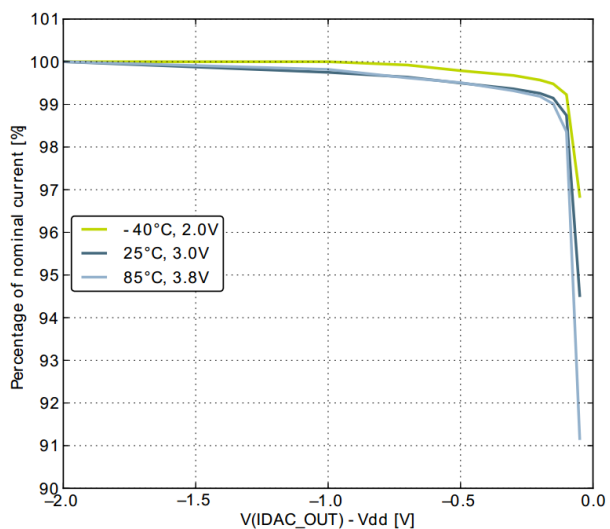
Table 2-6



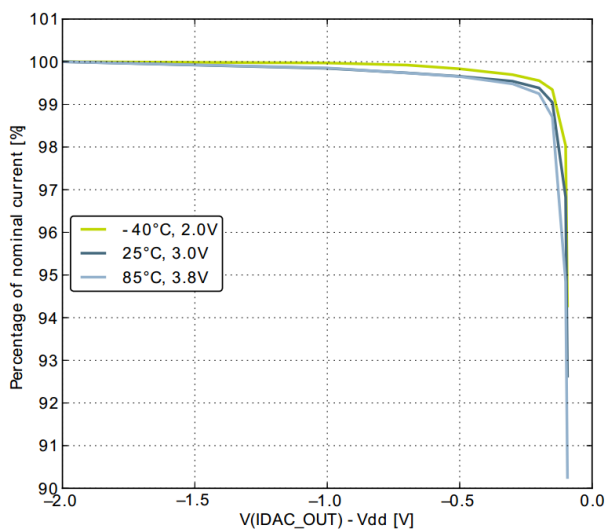
Range 0



Range 1

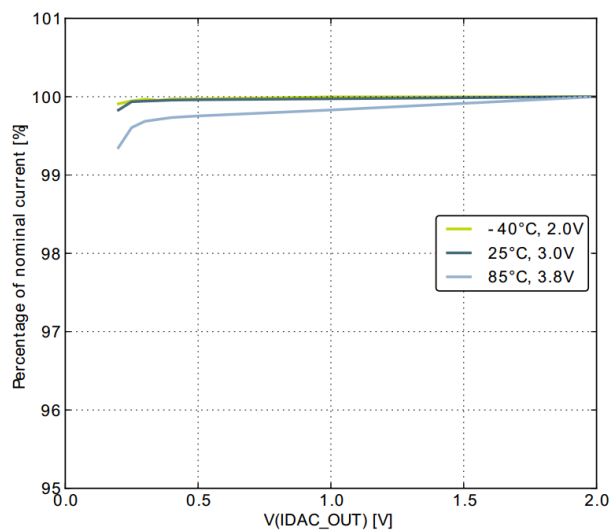


Range 2

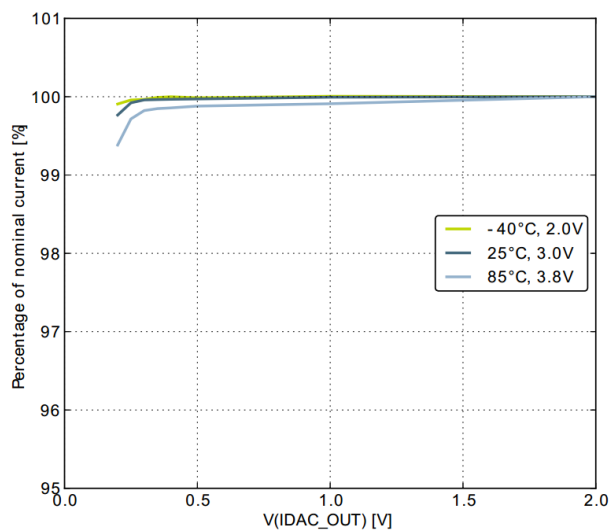


Range 3

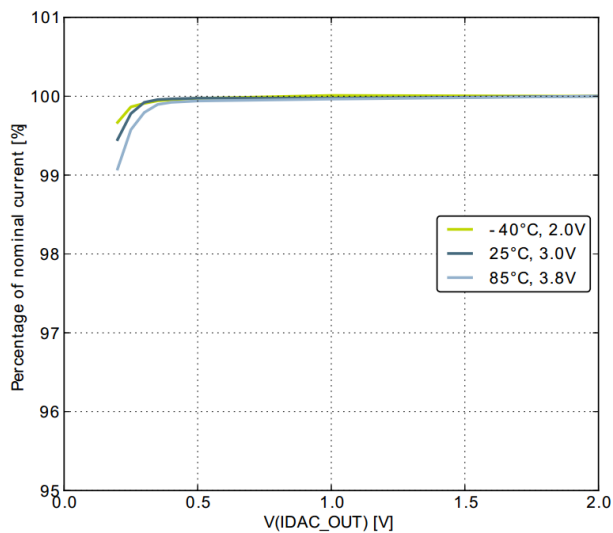
Figure 2-1 Source Current



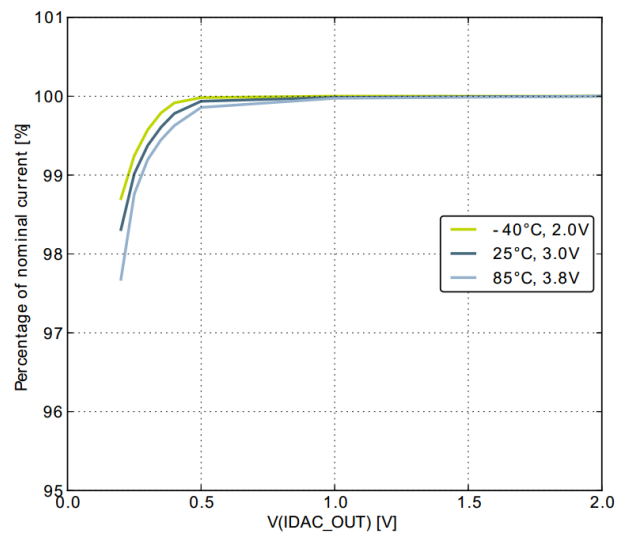
Range 0



Range 1



Range 2



Range 3

Figure 2-2 Sink Current

2.8 PWM

PWM Parameters				
Period		Frequency		
Minimum [μs]	Maximum [s]	Minimum [Hz]	Maximum [kHz]	Maximum Error [%]
4.81	3.19	0.313	207.9	3

Table 2-7

2.9 ADC

Symbol	Parameter	Min	Typ	Max	Unit	Notes
V _{ADCIN}	Input Voltage Range	0		2.5	V	Internal 2.5V reference voltage used.
I _{ADCIN}	Input Current			100	nA	
C _{ADCIN}	Input Capacitance			2	pF	
R _{ADCIN}	Input On Resistance	1			MΩ	

Table 2-8

2.10 Comparator

Symbol	Parameter	Min	Typ	Max	Unit	Notes
V _{CMPIN}	Input Voltage Range	0		V _{3V3}	V	
V _{CMPOFST}	Offset Voltage	-12	0	12	mV	
V _{CMPHYST}	Hysteresis		50		mV	

Table 2-9

3. Installation and operation

From the system and functionality point of view, the UART-B1 device provides the same features as the RFID B1 module, and the user should refer to the RFID B1 User Manual when working with the UART-B1. For a quick test the user can also use a UART-USB converter and simply connect the UART-B1 to a computer e.g. **TTL-232RG-VSW3V3-WE** (FTDI) or similar and then start the B1-client application which allows the user to test all features of the device. The B1-client along its user guide can be downloaded from [here](#). The best read range can be achieved when the tag is parallel to the surface of the reader (see Figure 3-1). There is also LED1 (green) which indicates a tag presence in the antenna field.

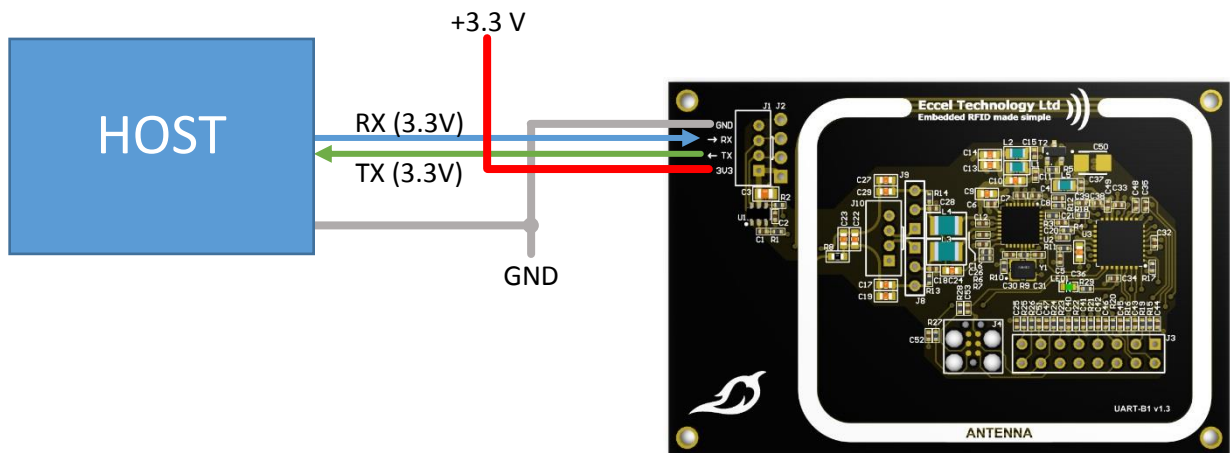


Figure 3-2 Minimal configuration to connect the host system.

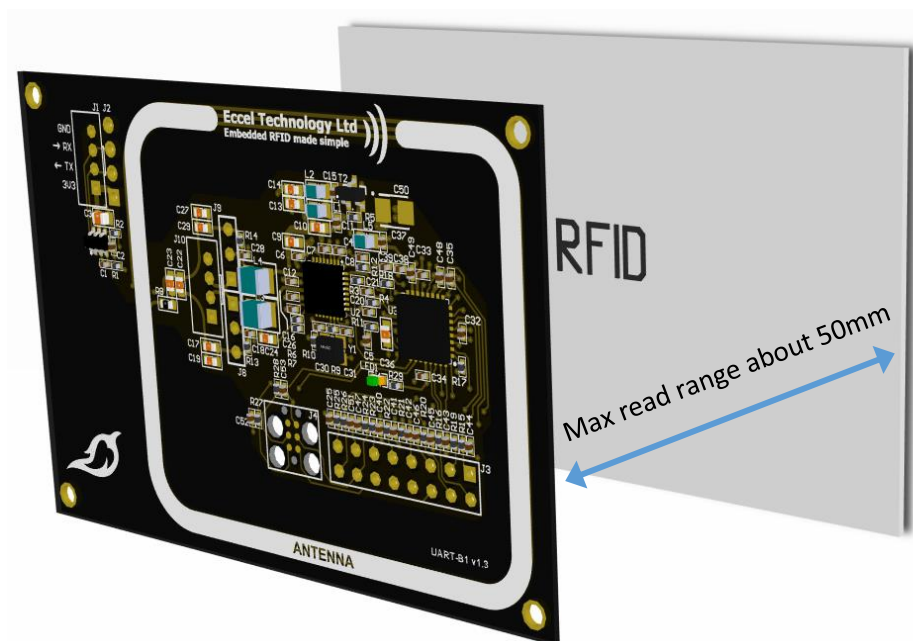
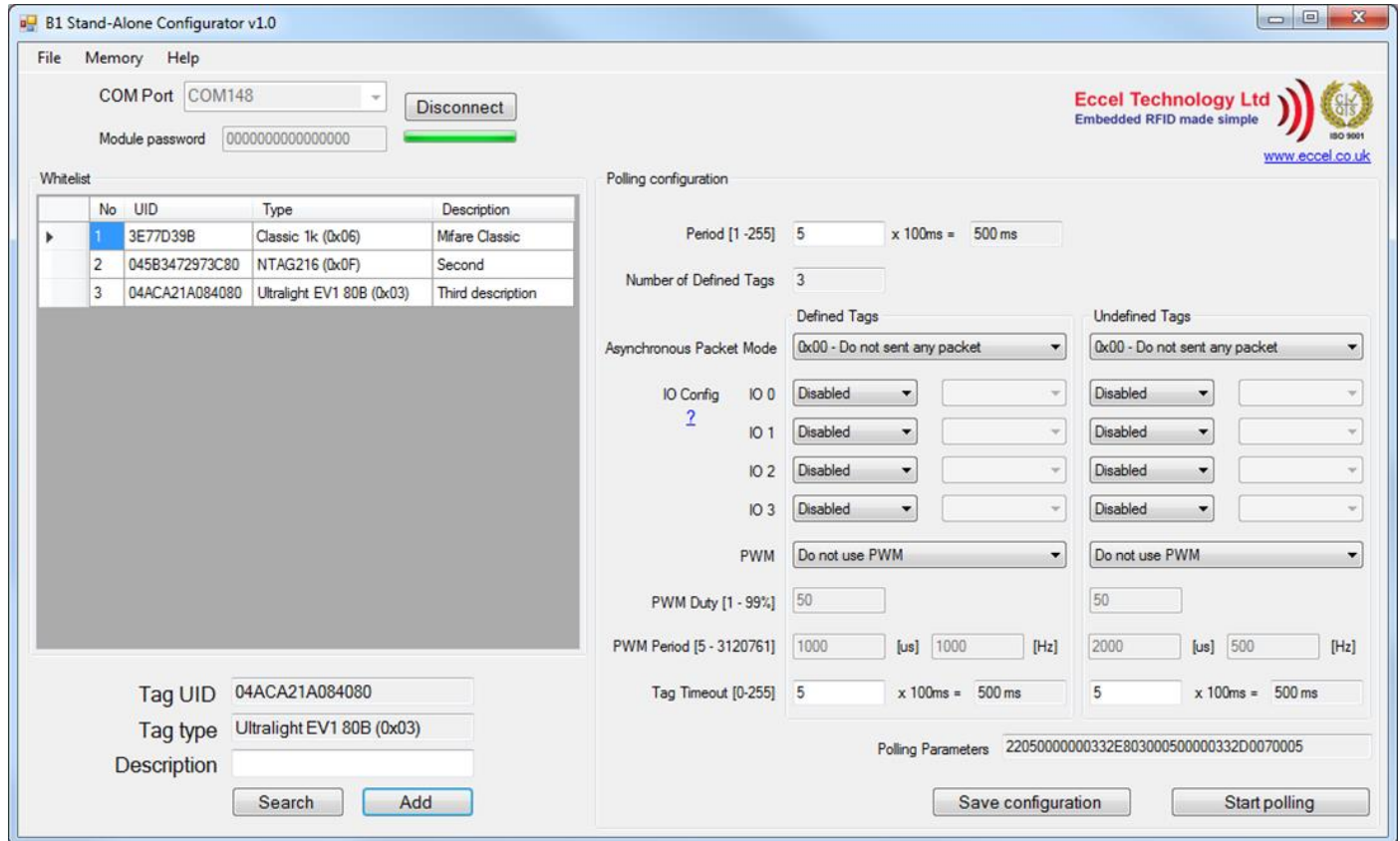


Figure 3-1 The correct way to read a RFID tag

The UART-B1 can also operate in a stand-alone mode. The user can control all GPIO's and add tags to the whitelist (a list of defined tags). For easy configuration of polling parameters we provide the B1 Stand-Alone Configurator application which can be downloaded from [here](#). This application allows the user to simply search for a new tag, add it to the whitelist, configure polling parameters, enable/disable all of GPIOs and control them. For more information please refer to the RFID-B1 [User Manual](#).



No	UID	Type	Description
1	3E77D39B	Classic 1k (0x06)	Mifare Classic
2	045B3472973C80	NTAG216 (0x0F)	Second
3	04ACA21A084080	Ultralight EV1 80B (0x03)	Third description

Figure 3-3 The main window of the B1 Stand-Alone Configurator

Dimensions in mm. LED1 is marked with a green circle. This LED indicates a tag presence in the antenna field.



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No responsibility is taken for the method of integration or final use of the B1 based modules

More information about the B1 module 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