

RaspberryPi-B1 User Manual

V1.6
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1 Introduction

1.1 Device Overview

Features

- Low cost RFID Reader with MIFARE Classic®, MIFARE Ultralight® and NTAG2® support
- Command interface via COM PORT 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
- On board buzzer, LEDs and button



Description

The RaspberryPi-B1 module is an expansion of the RFID B1 module - the second in an evolving family of 13.56MHz 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. This device is designed to be compatible with the Raspberry Pi Hat standard.

Applications

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

1.2 System Overview

The RaspberryPi-B1 device is an extension of our RFID B1 module dedicated for the Raspberry Pi platform as a ‘Hat’. Below, In Figure 1.1 the System Diagram is presented.

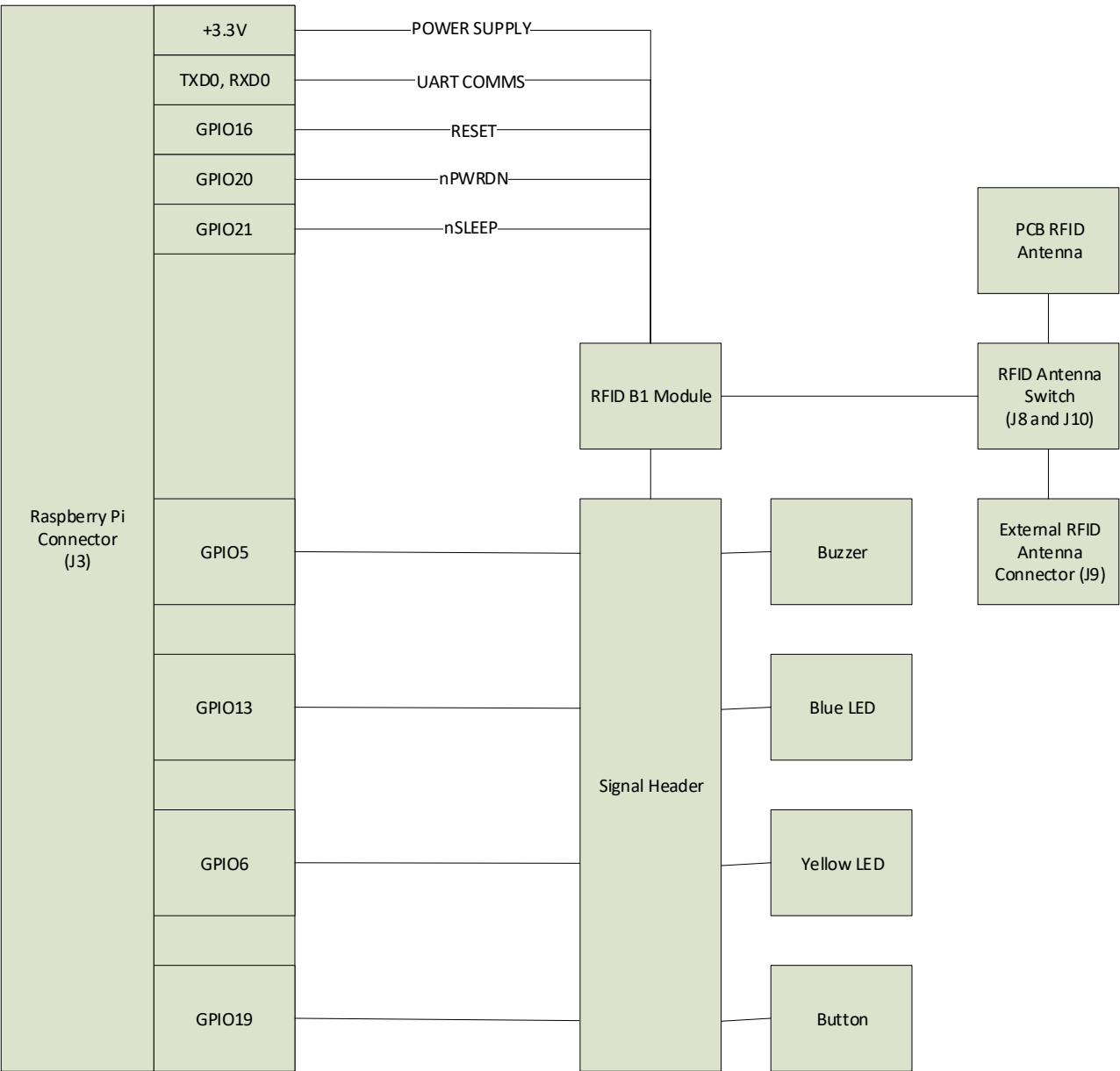
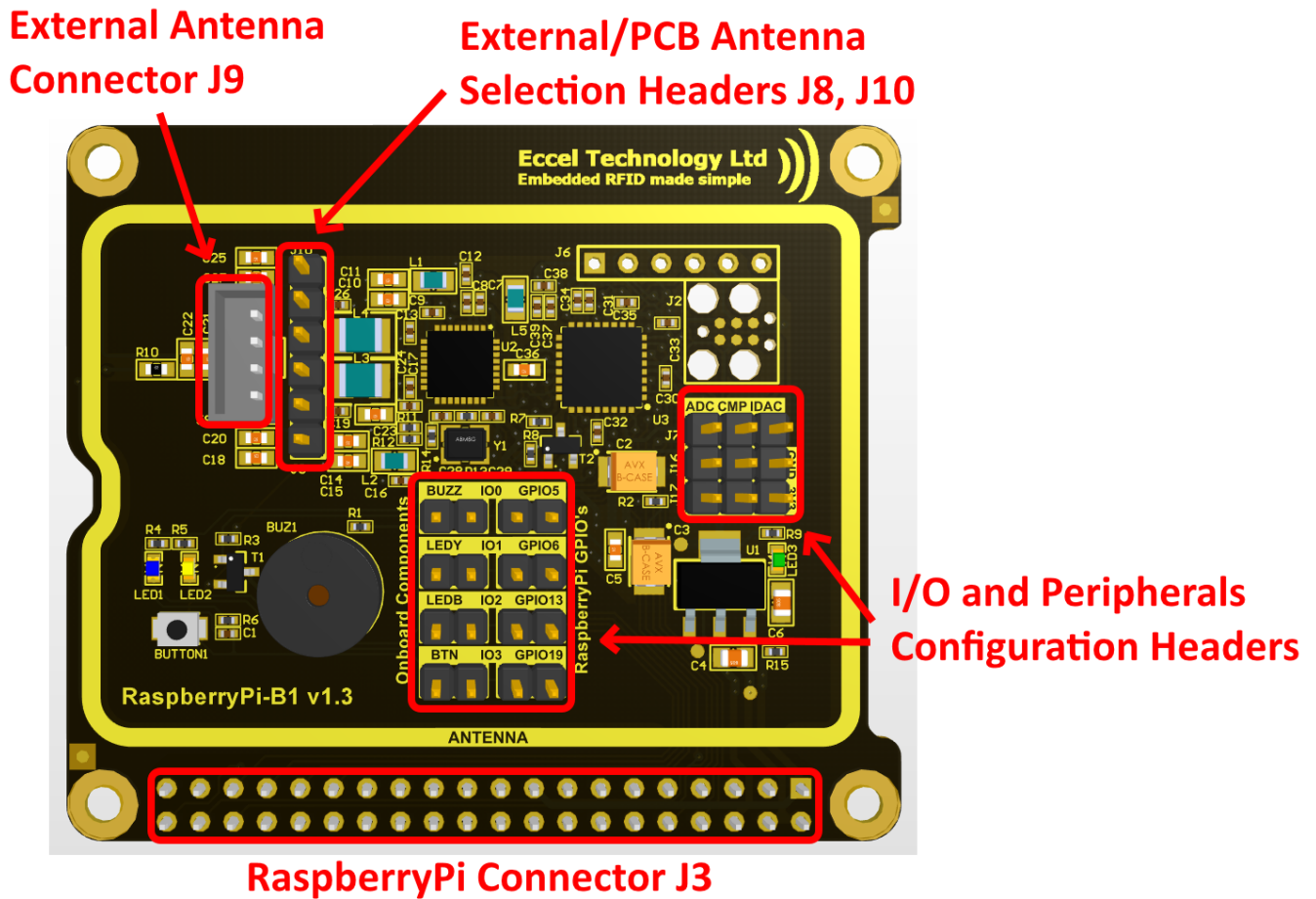


Figure 1.1 System Diagram

1.3 Connectors



Picture 1-1

In Picture 1-1 there are marked connectors available for the user when working with the RaspberryPi-B1 device.

1.3.1 Raspberry Pi Connector J3

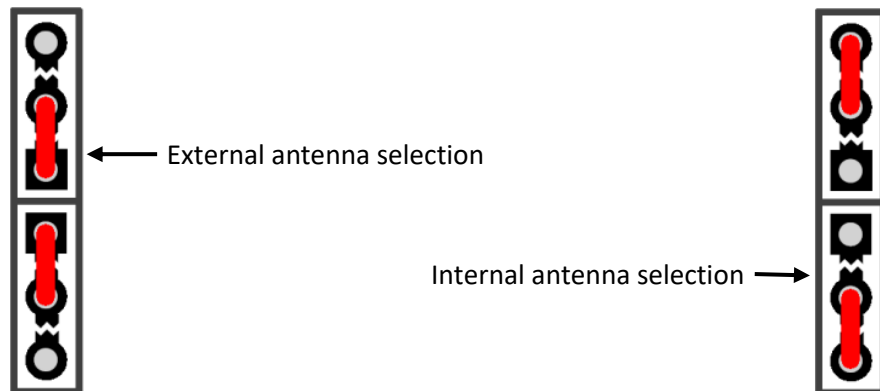
The device provides communication and power via the J3 connector. It is a standard Raspberry Pi connector for Hat boards. The UART port, connected to the B1 module, provides COM Port functionality. The user can configure the COM Port with a baud rate up to the maximum allowed by the B1 module.

1.3.2 External Antenna Connector (J9)

The user has the option to work with an external RFID antenna connected to the RaspberryPi-B1 device. Connector J9 is where to plug in an external antenna. Eccel Technology Ltd provides a variety of RFID antennas which the user can use together with this device.

1.3.3 External / PCB Antenna Selection Connectors J8 and J10

If the user wishes to switch between the PCB antenna and an external antenna, this is achieved the J8 and J10 connectors. Two jumpers are necessary to switch between these two antennas.



1.3.4 IO and Peripherals Configuration Header

The device PCB connects the pins on this header to all IOs and peripherals provided by the onboard RFID B1 module. Also, available are pins facilitating connection to an onboard buzzer, button and LEDs for use as necessary to fulfil the needs required when connecting external electronics, a few pins are available providing +5V, +3.3V and GND signals.

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_{5V}	5V Input (J3 - pins 2,4)	0	5,5	V	
V_{IOMAX}	Input Pin Voltage	-0,3	3,6	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_{IN}	Input Voltage	3.0	3.6	V

Table 2.2

2.4 GPIO

Symbol	Parameter	Min	Typ	Max	Unit	Notes
V_{IOL}	Input Low Voltage			$0.3V_{3V3}$	V	
V_{IOIH}	Input High Voltage	$0.7V_{3V3}$			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	$0.1V_{3V3}$			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°C - 70°C).
f_{ANTAG}	Antenna Signal Frequency Aging	0		3	ppm	At 25°C.
V_{ANTH}	Antenna High Level Output Voltage	$V_{3V3} - 0.64$			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°C
		20			years	For ambient temperature < 70°C

Table 2.5

2.7 IDAC

2.7.1 Parameters

IDAC Parameters									
Precision				Source			Sink		
Range No	Range [μA]	Step Size [nA]	Nominal Current [μA]	Current drop at Vdd - 100 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

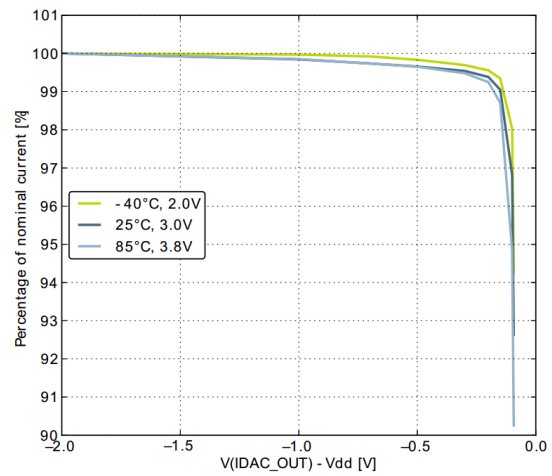
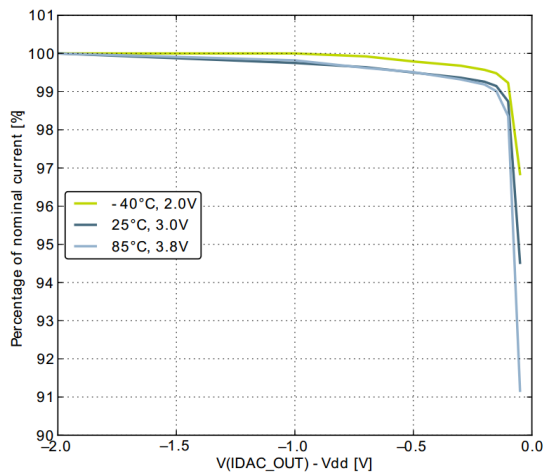
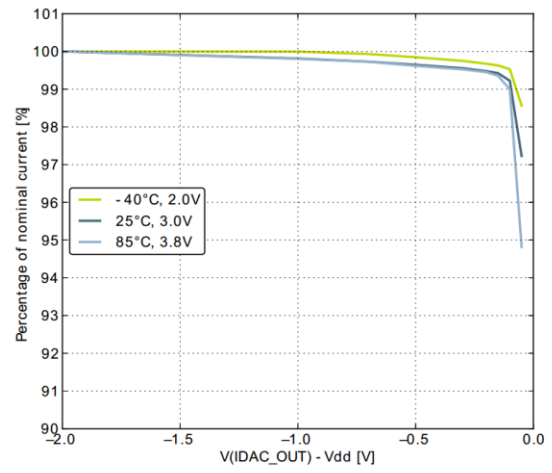
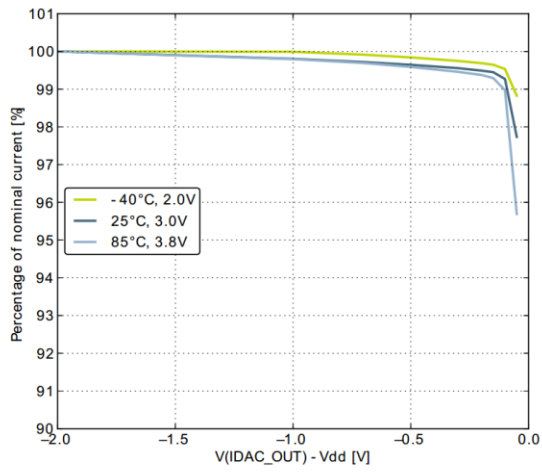
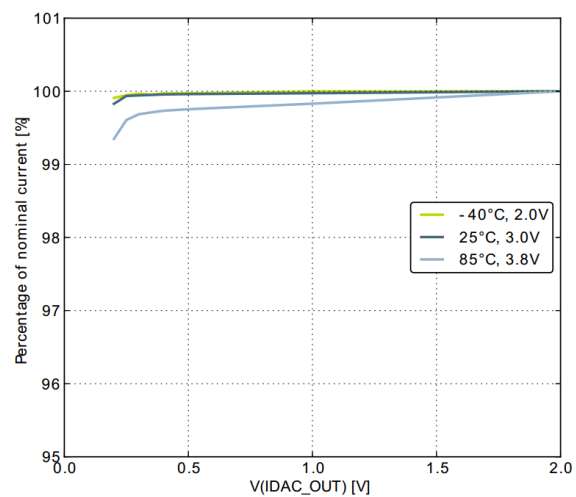
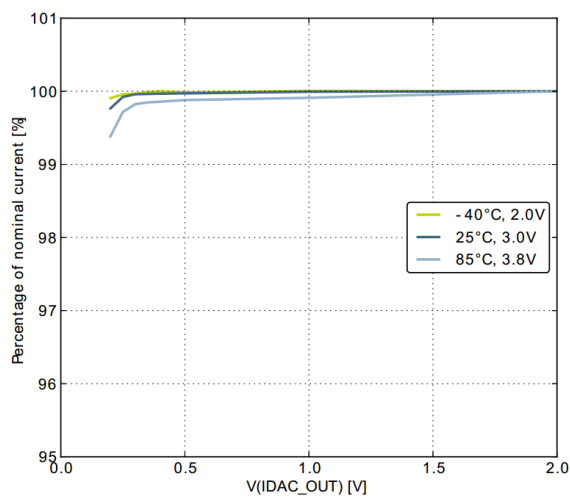


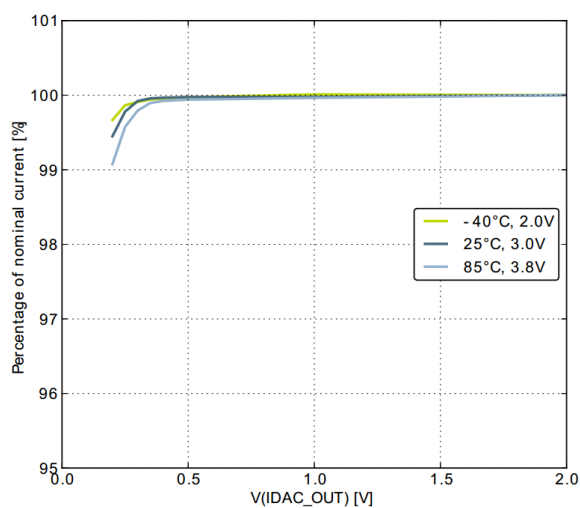
Figure 2.1 Source Current



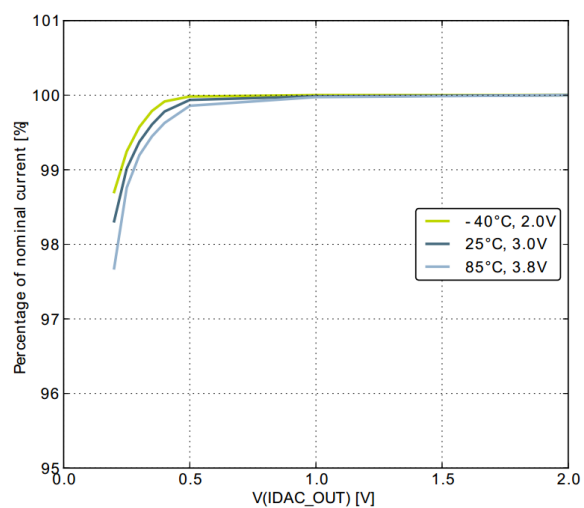
Range 0



Range 1



Range 2



Range 3

Figure 2.2 Sink Current

2.7.2 Example Measurement (Error and Offset)

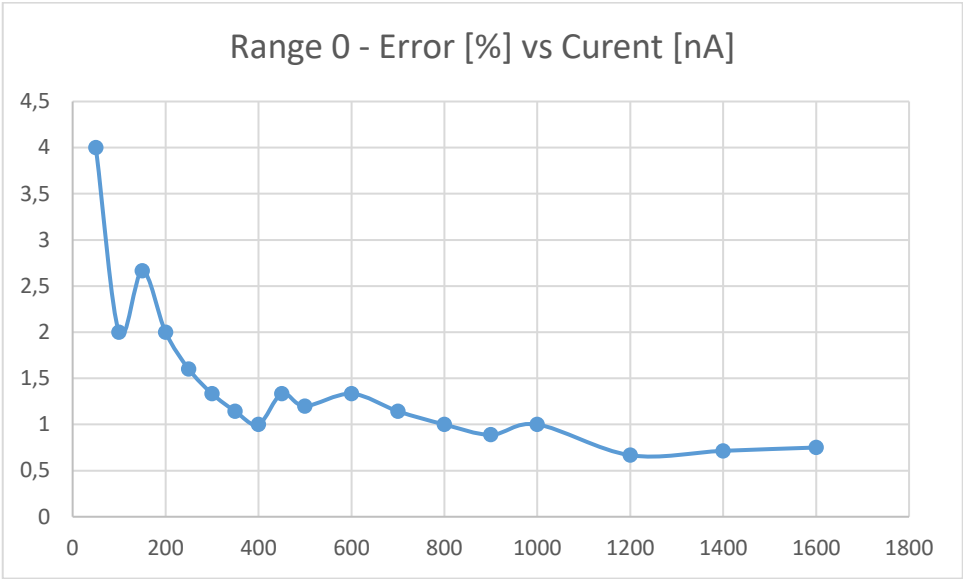


Figure 2.3 50kΩ Sourcing

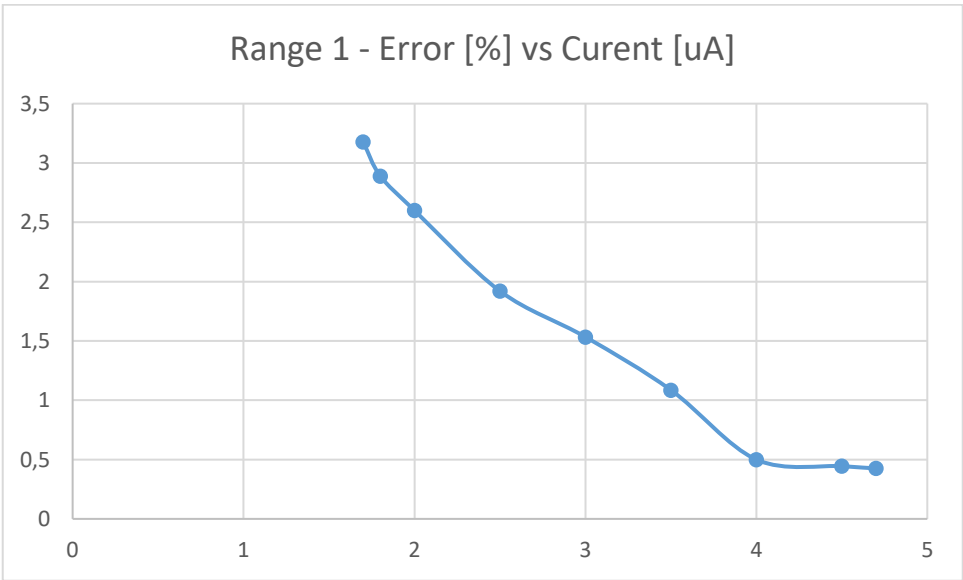


Figure 2.4 50kΩ Sourcing

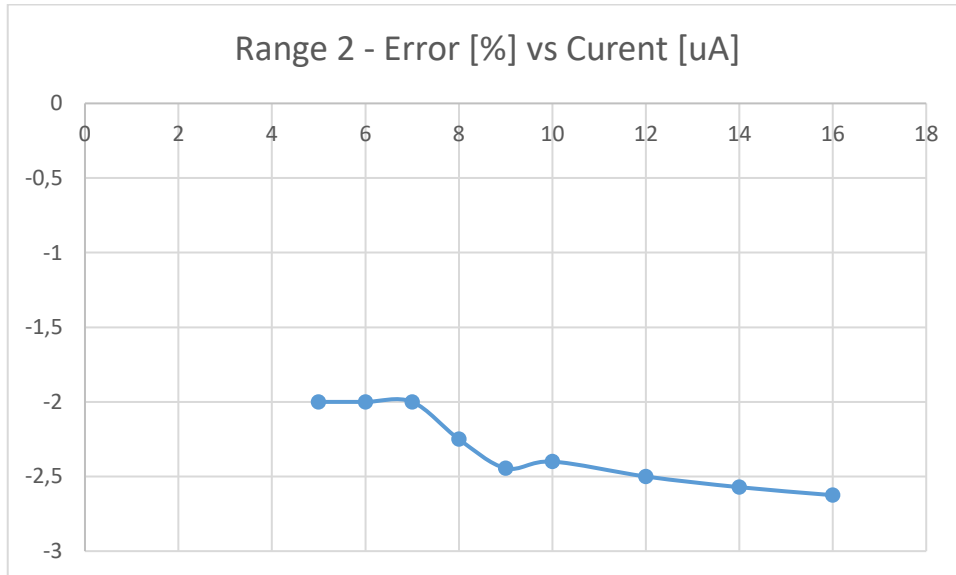


Figure 2.5 50k Ω Sourcing

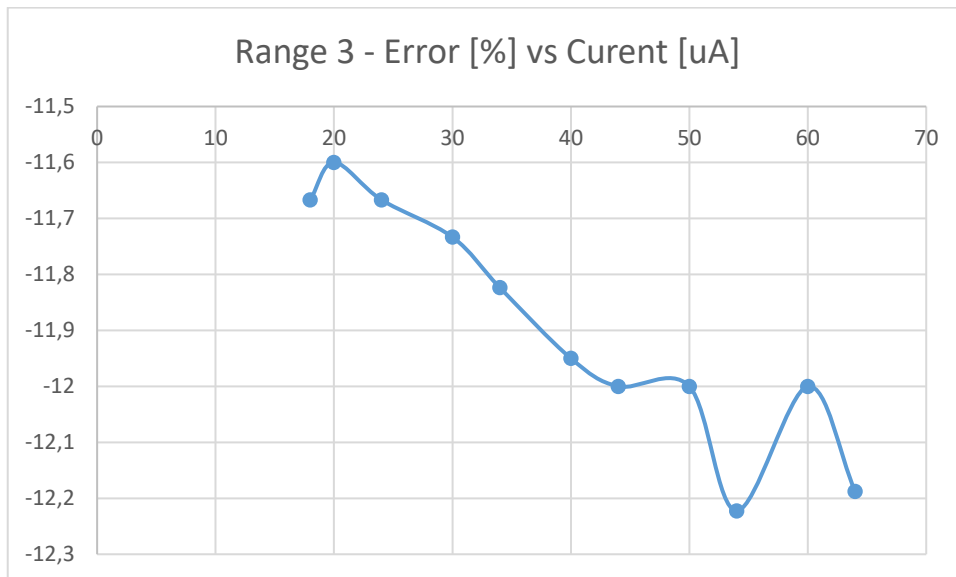


Figure 2.6 50k Ω Sourcing

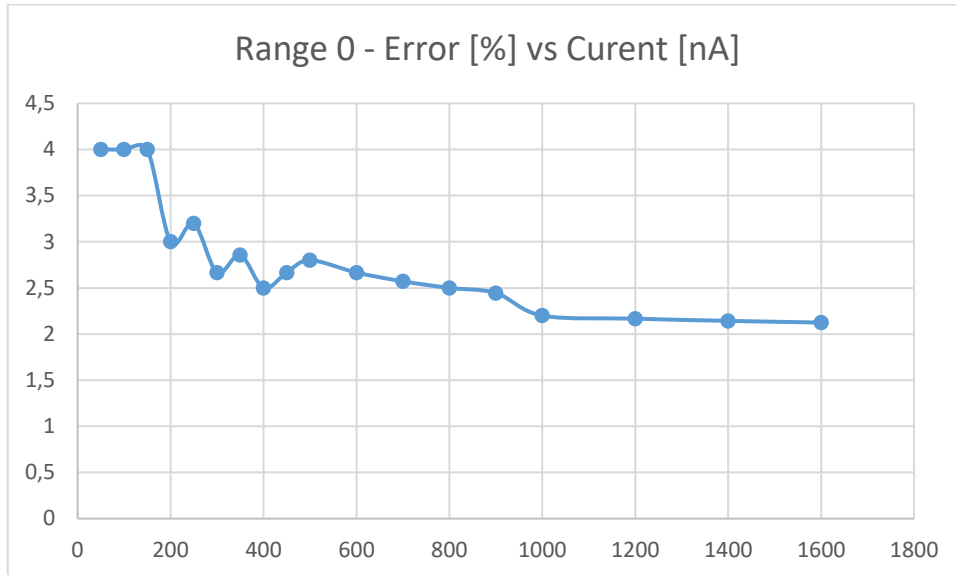


Figure 2.7 50k Ω Sinking

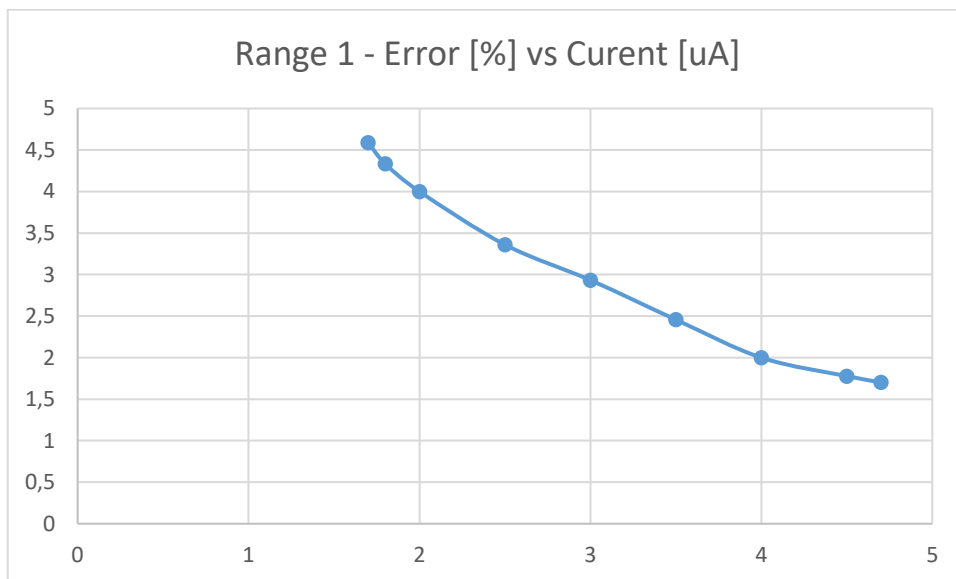


Figure 2.8 50k Ω Sinking

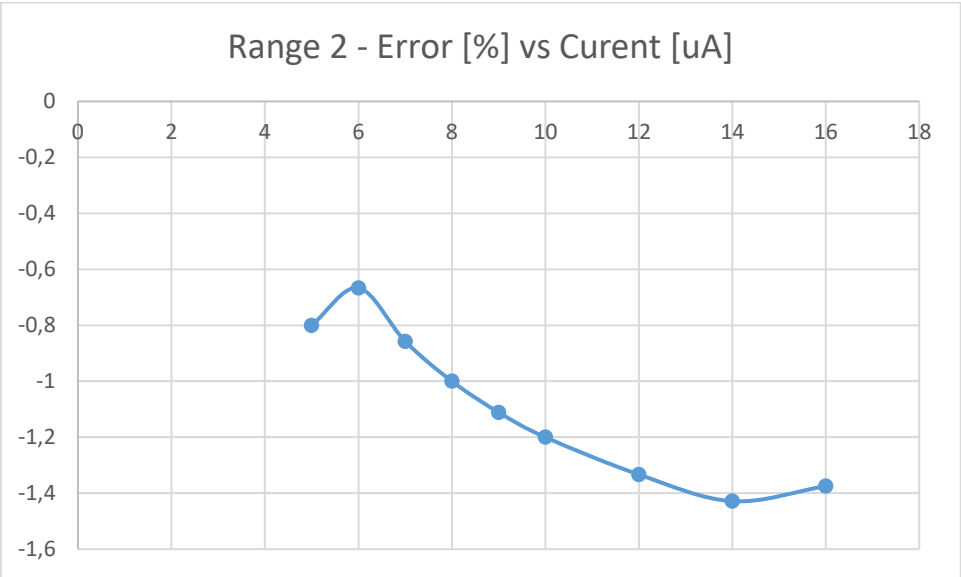


Figure 2.9 50kΩ Sinking

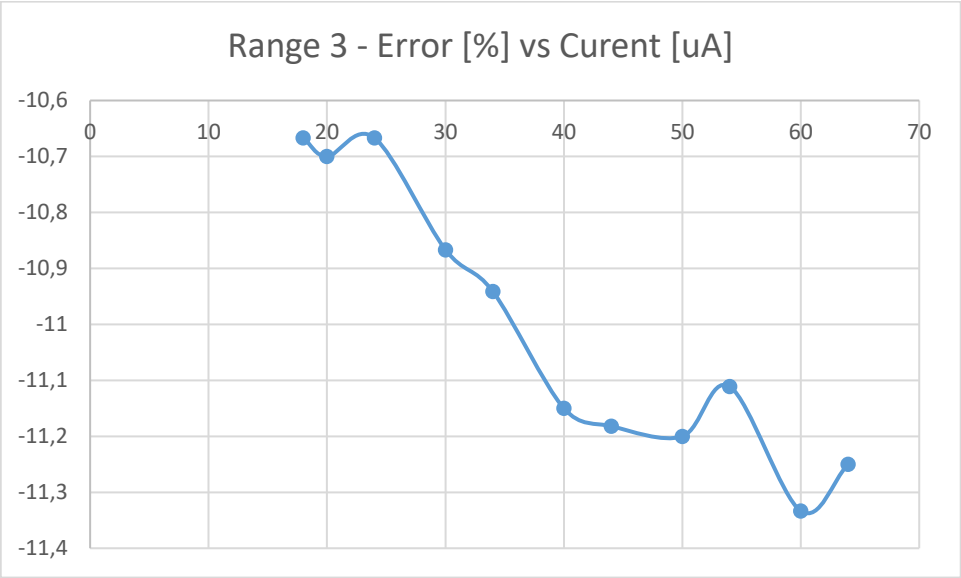


Figure 2.10 50kΩ Sinking

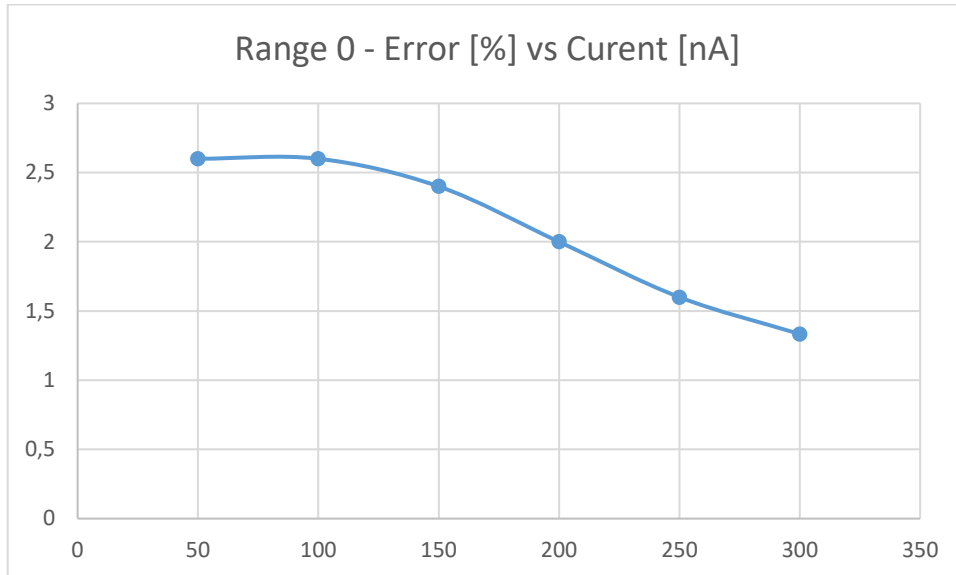


Figure 2.11 10MΩ Sourcing

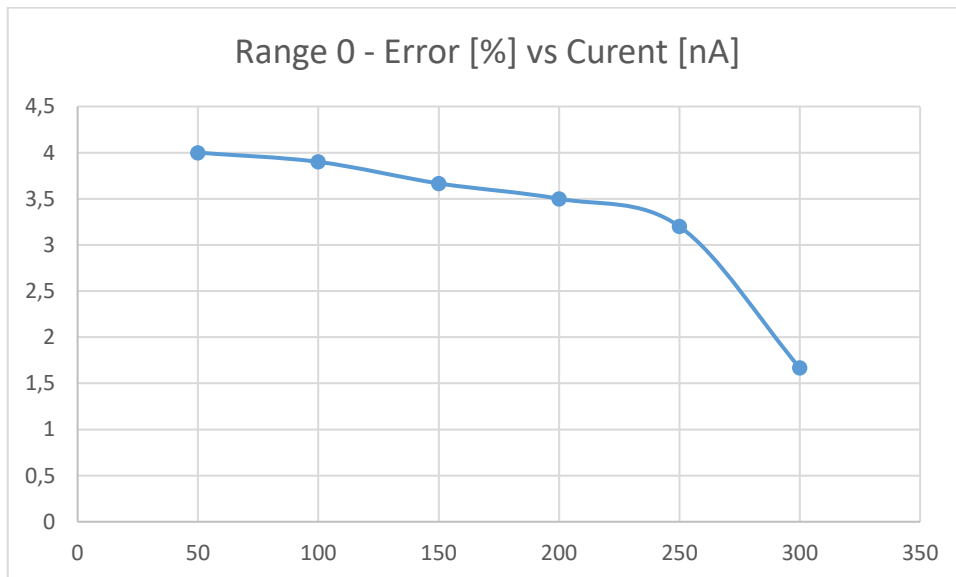


Figure 2.12 10MΩ Sinking

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 _{ADCI}	Input Voltage Range	0		2.5	V	Internal 2.5V reference voltage used.
I _{ADCI}	Input Current			100	nA	
C _{ADCI}	Input Capacitance			2	pF	
R _{ADCI}	Input On Resistance	1			MΩ	

Table 2.8

2.10 Comparator

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

Table 2.9

3 System

3.1 Functionality

From the system and functionality point of view, the RaspberryPi-B1 device gives the same features as the RFID B1 module, and the user should refer to the RFID B1 User Manual when working with the RaspberryPi-B1. The UART connection with the Raspberry Pi expands the communication interface to the on-board RFID B1 module and allows the board to communicate with the device via a Com Port. Most systems have built-in drivers for such a Com Port.

3.2 On board system

3.2.1 Buzzer

The RaspberryPi-B1 device has an onboard buzzer from BESTAR (PN BMT-0903H5.5). The user has the option to connect IO0 from the B1 module to the buzzer by placing a jumper on the 'BUZZ/IO0' connector. Its resonant frequency is around 2731Hz and it does not contain an internal generator. Thus the user has to enable the PWM peripheral on IO0 to generate sound.

3.2.2 LEDs

The RaspberryPi-B1 device has onboard yellow and blue LEDs. Their active state is low. The user has an option to connect a yellow LED to IO1 and blue LED to IO2 via jumpers.

3.2.3 Button

The RaspberryPi-B1 device has an onboard button. The button has the default state of high. After pressing the button a falling edge is generated on the signal line. The user has the option to connect the button to IO3 via jumpers.

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

No responsibility is taken for the method of integration or final use of the RaspberryPi-B1 module

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