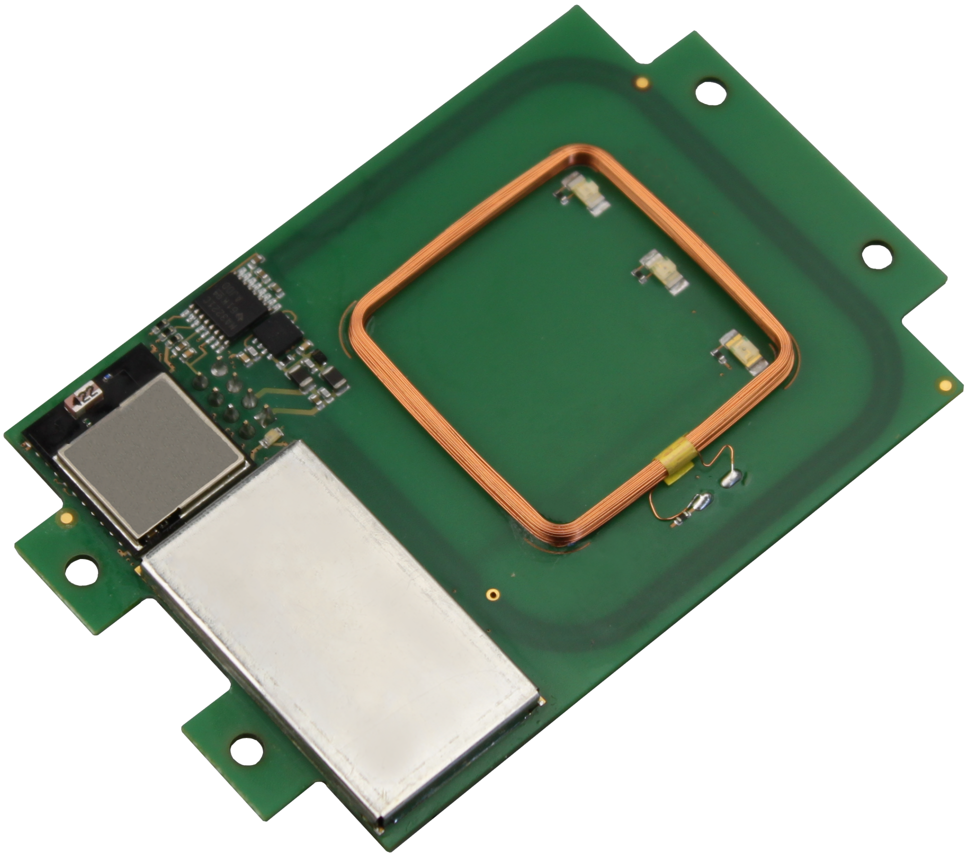
TWN4 MultiTech 2 BLE

Technical Handbook

DocRev2, July 7, 2017



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1. Introduction

The TWN4 MultiTech 2 BLE Module is a configurable Reader/Writer of RFID transponders. This addition to the TWN4 family offers the Bluetooth Low Energy (BLE) interface. The Module has both the low (125kHz, 134.2kHz) and high (13.56MHz) frequency antennas, allowing the User access to a wide range of RFID standards.

This Technical Handbook provides the details needed to get started using the TWN4 MultiTech 2 BLE. We begin with a functional overview of the board, listing the features and interface options available. We then proceed with short introduction to the BLE Standard itself and the details of its implementation on the board.

The custom User App can be loaded onto the module using the AppBlaster software. For more information regarding the programming of the TWN4 module please see a dedicated User Guide for AppBlaster.

2. TWN4 MultiTech 2 BLE PCB

2.1. Functional Overview

The TWN4 MultiTech 2 BLE is a complete RFID Reader system that requires a 5V power source and connection to host to work. The majority of the circuitry responsible for processing the RFID card information and executing the module firmware is shielded as shown on Figure 2.1. The device can be connected to the host via USB or UART interface; both use the same connector (DF11). The cable can be simply connected with no extra configuration required. The pinout for the DF11 connector is described in Table A.1. A more generic breakout interface to the main controller is available; its pinout is shown on Table A.2. The TWN4 MultiTech 2 BLE also offers 2 SAM slots and a speaker on board.

The TWN4 MultiTech 2 BLE can also interact with the User via Bluetooth Low-Energy interface. This development pack contains documentation on BLE protocol and API implemented on the module.

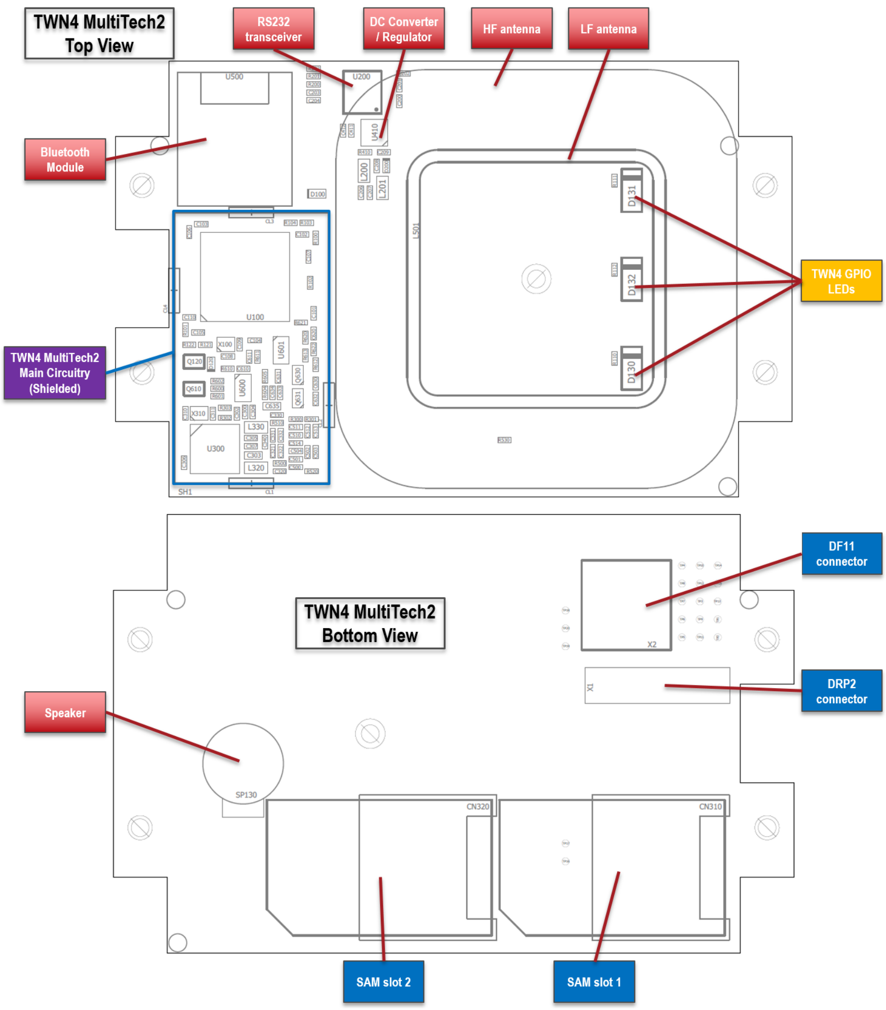

Figure 2.1.: TWN4 MultiTech 2 BLE View Functional

2.2. Dimensions and Pinout

Figure 2.2 provides the physical dimensions of the TWN4 MultiTech 2 BLE.

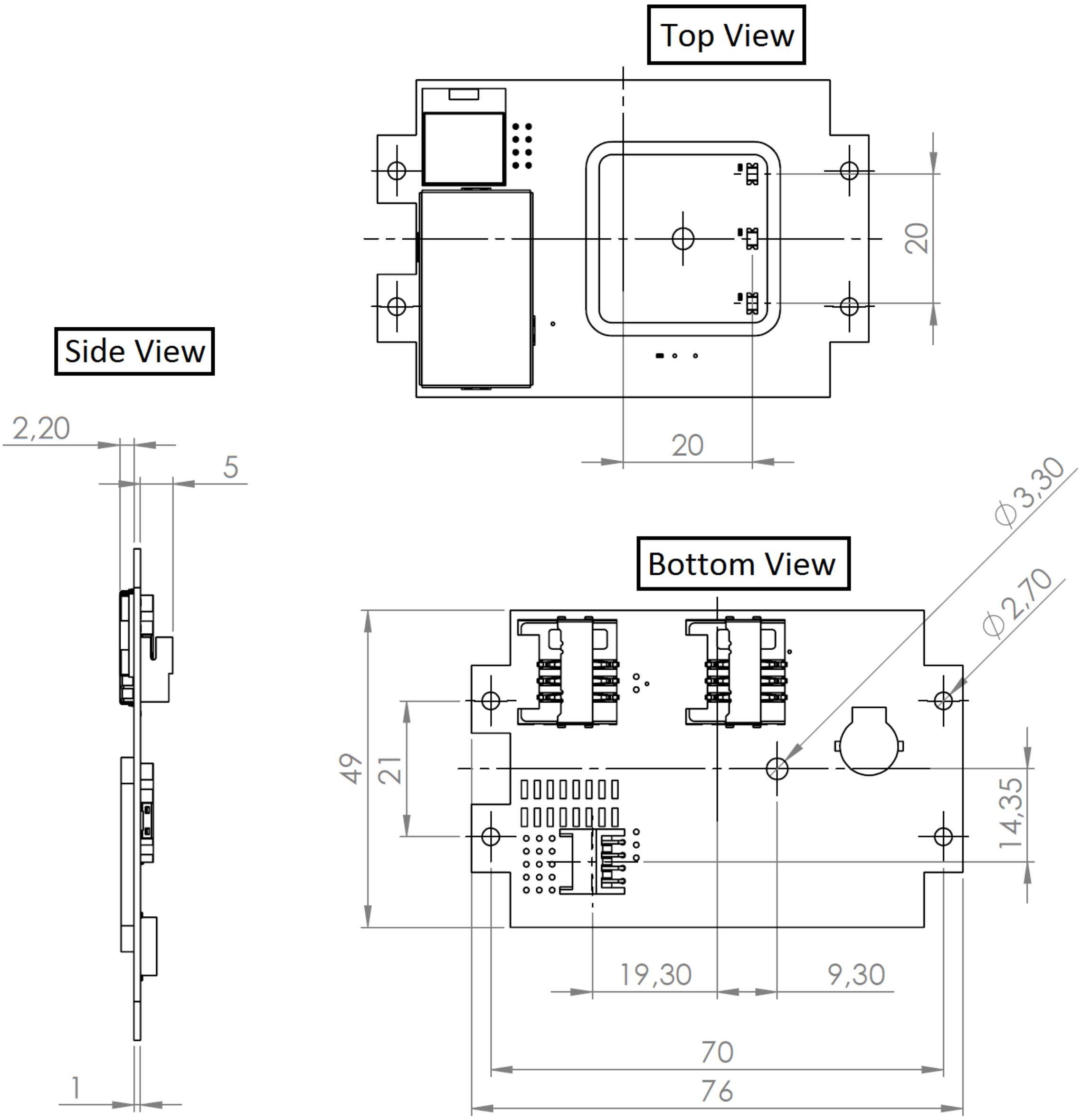

Figure 2.2.: PCB Dimensions

The module provides a generic access port that allows the User to bypass the main DF11 connector and interact with the TWN4 MultiTech 2 BLE microcontroller directly. The port name is DRP2 and the polarity of its pins is shown on Figure 2.3. The pinout is provided in Table A.2.

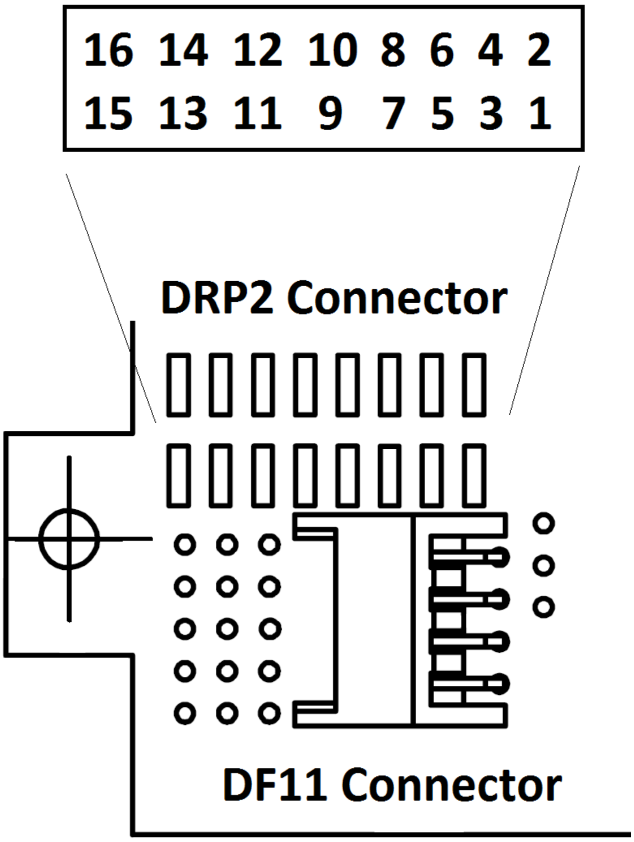

Figure 2.3.: PCB Dimensions

3. Bluetooth Low Energy (BLE) Feature

The traditional Bluetooth standard is convenient for constant-flow media transfer applications such as video streaming. The Bluetooth Low Energy standard was introduced for applications requiring a lower power consumption profile. Data is sent in bursts, followed by periods of electrical idle.

The TWN4 MultiTech 2 BLE uses the BGM111 module from Silicon Labs. The chip implements the Physical, Link and L2CAP Layers of the BLE Protocol. The API is implemented within the firmware of the main TWN4 microcontroller. The 2 chips interact via the COM2 port of the microcontroller, thereby rendering this port unavailable for custom user functions.

Devices supporting the BLE standard communicate using a protocol named *Generic Attribute Profile (GATT)*. GATT defines two roles: Server and Client. A GATT Server stores attributes of the device and sends them to a Client upon request. The TWN4 MultiTech 2 BLE acts as a GATT server, receiving requests for information from the link partner (ex. cellphone) and transmitting relevant attributes back.

Some attributes are pre-defined by the Bluetooth standard; they include the *General Access Profile* and *Device Information*. This information is read-only and is used for identification of the device. In the case of the TWN4 MultiTech 2 BLE module, these read-only attributes are listed in Table B.1. The UUID identifies the attribute in a global sense; this is the ID that the GATT Client (cellphone) sees. The Attribute Handle is what is used within the Application running on the TWN4 microcontroller. When a request for a certain UUID comes from outside TWN4, the App running on TWN4 microcontroller requests this information from the BGM111 module using the Attribute Handle (See API command *BLEGetGattServerAttributeValue*).

Developers are free to introduce custom product-specific attributes with variable (read-only, read/write) permissions. In the case of the TWN4 MultiTech 2 BLE module, the *Generic Attribute* service is introduced (Table B.2). This is the method by which a GATT Client can obtain RFID card information from the TWN4. The GATT Client (cellphone) makes a request for a custom-defined UUID (see Table B.3). This triggers a request for the Generic Attribute service from the BLE module. The RFID data is then sent from the BLE module to the TWN4 microcontroller and subsequently to the GATT Client.

The list of available attribute handlers is not sent to the GATT Client at any point, and no command is available to request it. The UUIDs must be pre-programmed into the GATT Client in advance. This is not an issue for Bluetooth-defined UUIDs such as *Device Information*, but is something to be aware of regarding the custom-defined attributes.

For more information regarding the Bluetooth Low Energy Standard please see document *"Designing for Bluetooth Low Energy"*[1] from Silicon Labs.

For the description of all the BLE-related commands available, please see the TWN4 API document.

4. Power states and current consumption breakdown

The TWN4 MultiTech 2 BLE supports 3 power states that can be used to reduce the current consumption of the reader when the application calls for it.

In Normal state the reader can accommodate a request to search for a high-/low-frequency tag, perform a BLE action or interact with peripherals on short notice; the current consumption in this state is the highest.

In Sleep state the reader is not capable of any of the above, but consumes considerably less current. The reader can be woken by communication on USB/COM ports, predefined timeout, or a Low-Power-Card-Detection (LPCD) event and taken to Normal state.

In Stop state the reader consumes the least current and can be woken up via external/internal interrupt, or a Low-Power-Card-Detection (LPCD) event and taken to Normal state.

Changing the LPCD poll time will change the current consumption, which can be estimated with the following formula:

$$I_{LPCD} = 0.5mA + \frac{0.1mAs}{t_{Poll}[s]}$$

The first section of Table 4.1 shows the expected *typical* current draw in the 3 states described above, depending on the reader interface used. The second section of the table lists the *maximum* additional current drawn by the device's peripherals; these values are to be added to those in the "Normal Idle" base state. It is assumed that a +5V DC Power Source is used.

Host Connection	USB	UART-TTL
Typical Consumption in Base System States		
Normal Idle	65	59
Sleep	15	6,8
Sleep LPCD Option	15,3	7,0
Stop	N/A	0,45
Stop LPCD Option	N/A	0,8
Maximum Consumption by Function wrt. Normal Idle System State		
SearchTag-HF	+140	
SearchTag-LF	+25	
RS232	+4	
BLE Active Packet Reception	+9	
BLE Active Transmission (0 dBm output power)	+9	
BLE Active Transmission (8 dBm output power)	+24	
Speaker Constant Tone	+80	
LED (Red)	+2	
LED (Green)	+6	
LED (Yellow)	+8	

Table 4.1.: Current Consumption Breakdown given +5V DC Supply (mA)

5. Disclaimer

Elatec reserves the right to change any information or data in this document without prior notice. The distribution and the update of this document is not controlled. Elatec declines all responsibility for the use of product with any other specifications but the ones mentioned above. Any additional requirement for a specific custom application has to be validated by the customer himself at his own responsibility. Where application information is given, it is only advisory and does not form part of the specification.

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6. Bibliography

1. Silicon Labs Website. Application Note *"Designing for Bluetooth Low Energy Applications"*, taken from http://www.silabs.com on 24. January, 2017

A. Appendix: Connector Pinout Reference

Pin	Pin Name	Function
1	UGND	USB Ground. Fed to main Ground through noise-reduction circuit.
2	USB_D+	USB Data +
3	UVCC	USB VCC (5V). When using RS232, connect this to external 5V supply.
4	USB_D-	USB Data -
5	V24_RXD	RS232 RXD (Input)
6	GND	Ground
7	V24_TXD	RS232 TXD (Output)
8	Hostsense	Active-low, enables RS232 transceiver. Short to Pin 6 (GND) when using RS232.

Table A.1.: Main Interface DF11 Port (X2) Pin Configuration

Pin	Pin Name	Function
1	GND	Ground
2	USB_D+	USB Data +
3	Supply 5V	Powers the 5V circuitry on board. Input to 3.3V Regulator.
4	USB_D-	USB Data -
5	VCC 3.3V	Direct access to 3.3V supply net after Regulator. Microcontroller and majority of circuitry is powered by this.
6	COM1_RX	COM1 RX Single-ended port
7	I2C_SCL	I2C Clock
8	COM1_TX	COM1 TX Single-ended port
9	I2C_SDA	I2C Data
10	GPIO3	direct access to microcontroller
11	RESET-	Active-low reset to the microcontroller
12	GPIO4	direct access to microcontroller
13	PWRDWN-	Active-low powerdown to 3.3V Converter/Regulator
14	GPIO5	direct access to microcontroller
15	GPIO6	direct access to microcontroller
16	GPIO7	Active-low reset to BLE module

Table A.2.: Generic Interface DRP2 Port (X1) Pin Configuration

B. Appendix: BLE Technical Information

UUID (hex)	Attr. Handle	Name	R/W	Type	Description
1800		General Access Profile		Service	Service 1
2a00	7	Device name	R	Descriptor	xgatt_1800_2A00, fix "TWN4 BLE"
2a01	9	Appearance	R	Descriptor	xgatt_1800_2A01, fix 0000
180a		Device Information		Service	Service 2
2a29	12	Manufacturer Name	R	Descriptor	xgatt_180A_2A29, fix "OEM BLE"
2a24	14	Model Number	R	Descriptor	xgatt_180A_2A24, "TWN4 MultiTech"
2a25	16	Serial Number	R	Descriptor	xgatt_180A_2A25
2a26	18	Firmware Revision	R	Descriptor	xgatt_180A_2A26, f.e. "V1.04,16.05.2017"

Table B.1.: Read-only Bluetooth Standard-defined GATT Services

UUID Name	Attr. Handle	Name	R/W	Type	Description
UID1		Generic Attribute		Service	Service 3
UID2	21	SPP Data	Read, Notify, Write no response	Descriptor	xgatt_spp_data var. length=255, HEX data.
UID3	24	SP1 Data	Notify, Write no response	Descriptor	xgatt_sp1_data var. length=20, HEX data.
UID4	27	SP2 Data	Indicate, Read	Descriptor	xgatt_sp2_data var. length=20, HEX data.

Table B.2.: Custom GATT Services defined within Firmware

UUID Name	User UUID (hex)	Description
UID1	"5a44c004-4112-4274-880e-cd9b3daedf8e"	SPP Service
UID2	"43c29edf-2f0a-4c43-aa22-489d169ec752"	xgatt_spp_data
UID3	"a897339f-adf0-4a2b-a2ef-4a57512e6eb6"	xgatt_sp1_data
UID4	"71f1ae4d-e1d1-438c-b05d-2c2c16abeaa7"	xgatt_sp2_data

Table B.3.: Definition of Custom UUIDs