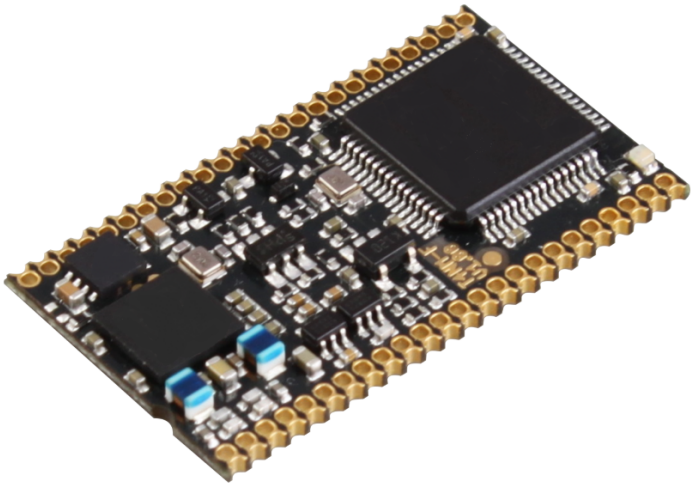
TWN4

MultiTech Nano

DocRev9, June 17, 2020



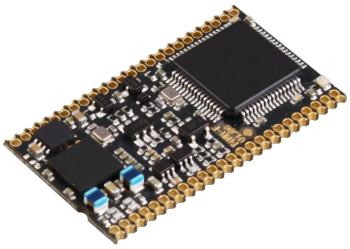
Elatec GmbH

Contents

1 Introduction . . . 3
2 Versions . . . 4
2.1 Color Marking . . . 4
3 Connector and Pin-Out . . . 5
3.1 Assembly Information . . . 9
3.1.1 Dimensions . . . 9
3.1.2 Through-Hole Technology (THT) . . . 10
3.1.3 Surface Mount Technology (SMT) . . . 10
3.1.3.1 Footprint . . . 10
3.1.3.2 Placement . . . 11
3.1.3.3 Temperature Profile . . . 12
3.1.3.4 Baking . . . 12
4 Antenna . . . 13
4.1 LF-Antenna . . . 13
4.2 HF-Antenna . . . 13
5 Power Supply . . . 14
6 Power states and current consumption breakdown . . . 15
7 Label on TWN4 Nano Module . . . 17
8 Additional Hardware Requirements . . . 18
8.1 Programming Firmware . . . 18
8.2 Using PI Option . . . 18
8.2.1 SIO Chip soldered on PCB . . . 18
8.2.2 SAM Card Connection . . . 18
8.3 Bluetooth BLE . . . 19
8.3.1 Connecting BLE Module . . . 19
8.3.2 Initial Programming of BLE Module . . . 20
8.3.3 Connection to the BGM Module . . . 21
8.3.3.1 Debug Connector of Development Kit . . . 21
8.3.3.2 Software . . . 22
9 Packaging . . . 25
9.1 Carrier Tape . . . 25
9.1.1 Dimensions of Tape Leader & Trailer . . . 26
9.2 Tray . . . 26
9.3 Package . . . 26
9.4 Label . . . 28
9.5 Position of Label . . . 29
10 Disclaimer . . . 30

1 Introduction

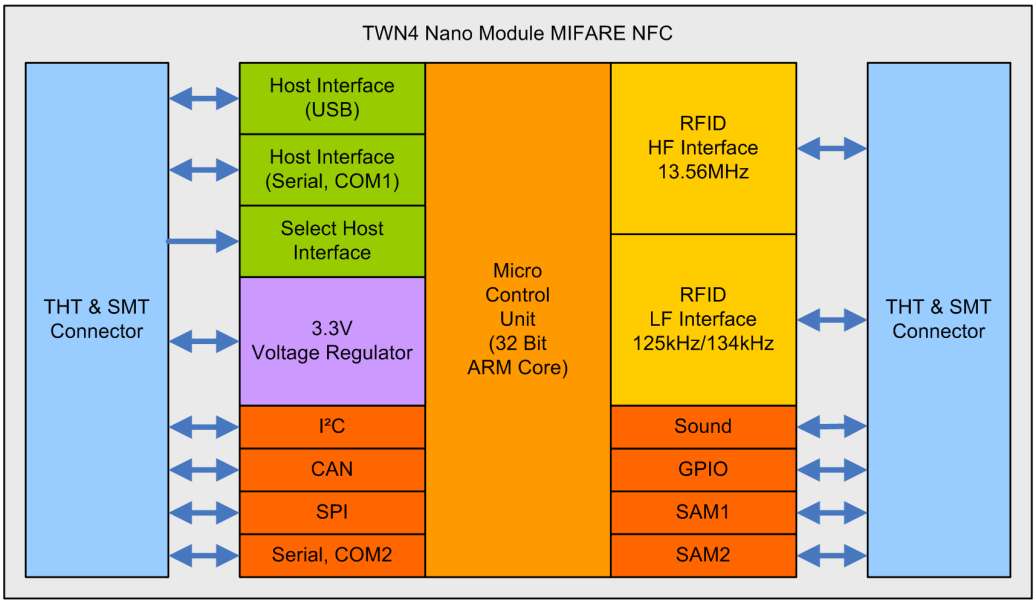
Here is a picture of the TWN4 MultiTech Nano:



Currently, there are two models of TWN4 Nano Module available:

- TWN4 MultiTech Nano
- TWN4 MultiTech Nano LEGIC 42

The TWN4 Nano Module contains voltage regulator, control unit, RFID front ends and communication interfaces.



2 Versions

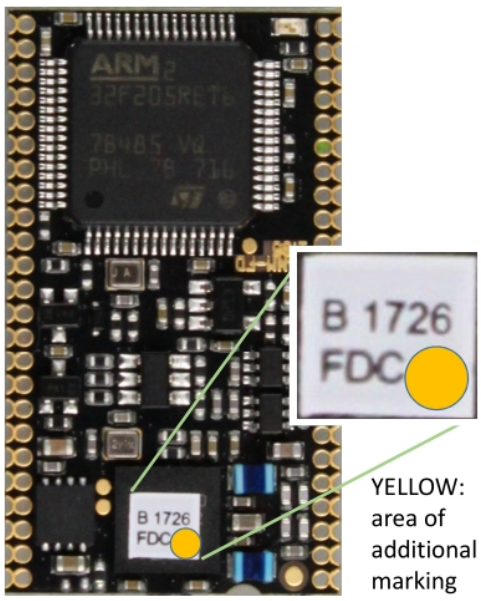
As mentioned above, there are two models with different HF frontends (MIFARE and LEGIC) of the TWN4 Nano Module. In case of MIFARE it is available in three different versions, which support either both LF (125kHz / 134.2kHz) and HF (13.56MHz), LF only or HF only. In case of LEGIC there is only the full version with both LF (125kHz / 134.2kHz) and HF (13.56MHz). The following table lists all possible options.

Feature	TWN4 MultiTech Nano Module	TWN4 MultiTech Nano Module HF	TWN4 MultiTech Nano Module LF	TWN4 MultiTech Nano Legic 42
LF	√	-	√	√
HF	√	√	-	√

Table 2.1: Different features of TWN4 MultiTech Nano Module Versions

2.1 Color Marking

The different versions of the TWN4 Nano Module are marked with a color dot on the label.



Nano Mifare

Nano Module Type	Standard	P Option	I Option	PI Option
Full version HF + LF + BLE	T4NM-FDC0 T4NM-FDC1 **Color code** -NONE-	T4NM-FDC0-P T4NM-FDC1-P **Color code** RED	*T4NM-FDC0-I** *T4NM-FDC1-I** **Color code** LIGHT BLUE	T4NM-FDC0-PI T4NM-FDC1-PI **Color code** PURPLE
LF-only	T4NM-FDB0 **Color code** DARK BLUE	T4NM-FDB0-P **Color code** GREEN	n.a.	n.a.
HF-only	T4NM-FDA0 **Color code** YELLOW	n.a.	*T4NM-FDA0-I** **Color code** BLACK	n.a.

- Paint color dot code
- Tray versions only
- Pure **I** Option not yet available *
- Legic T4NM-BDCx only Standard or P Option

3 Connector and Pin-Out

The TWN4 Nano Module has two rows of pins (24 pins each), which can be used either for THT or SMT mounting on the carrier board. The contact pitch is 1.27mm (50mil).

Pin	Pin Name	Function
1	HF_ANT1	TWN4 MultiTech Nano: Together with pin HF_ANT2, this pin is doing load modulation on antenna 13.56MHz TWN4 MultiTech Nano LEGIC 42: Not connected
2	HF_RXP	TWN4 MultiTech Nano: Together with pin HF_RXN, this pin builds the input from the direct matched antenna 13.56MHz TWN4 MultiTech Nano LEGIC 42: Not connected
3	HF_TX1	TWN4 MultiTech Nano: Together with pin HF_TX2, this pin builds the output to the direct matched antenna 13.56MHz TWN4 MultiTech Nano LEGIC 42: Output for antenna (50 Ohm)
4	HF_GND	Antenna Ground (connected to GND)
5	HF_TX2	TWN4 MultiTech Nano: Together with pin HF_TX1, this pin builds the output to the direct matched antenna 13.56MHz TWN4 MultiTech Nano LEGIC 42: Not connected
6	HF_RXN	TWN4 MultiTech Nano: Together with pin HF_RXP, this pin builds the input from the direct matched antenna 13.56MHz TWN4 MultiTech Nano LEGIC 42: Not connected
7	HF_ANT2	TWN4 MultiTech Nano: Together with pin HF_ANT1, this pin is doing load modulation on antenna 13.56MHz TWN4 MultiTech Nano LEGIC 42: Not connected
8	LF_ANT1	Output 1 for connecting external 125 kHz / 134.2 kHz antennas
9	LF_ANT2	Output 2 for connecting external 125 kHz / 134.2 kHz antennas
continued on next page. . .		

10	GPIO0	GPIO0, I/O pin for general purposes.
11	GPIO1	GPIO1, I/O pin for general purposes.
12	GPIO2	GPIO2, I/O pin for general purposes.
13	GPIO3	GPIO3, I/O pin for general purposes.
14	GPIO4	GPIO4, I/O pin for general purposes.
15	GPIO5	GPIO5, I/O pin for general purposes.
16	GPIO6	GPIO6, I/O pin for general purposes.
17	GPIO7	GPIO7, I/O pin for general purposes.
18	SAM1_CLK	Clock output for SAM1
19	SAM1_IO	I/O line for SAM1
20	SAM1_RST	Reset output for SAM1
21	GND	Ground
22	SAM2_CLK	Clock output for SAM2
23	SAM2_IO	I/O line for SAM2
24	SAM2_RST	Reset output for SAM2
25	BOOT	Shortcut against ground during reset will guide firmware directly into boot loader
26	SPK+	Digitally modulated output for a speaker. Second connection for the speaker is ground. The impedance of the speaker should be greater than 24 ohm.
27	COM2_TX-	Low active output (logic level, push/pull) of asynchronous TXD from COM2.
28	COM2_RX-	Low active input (logic level) with internal pull-up resistor of asynchronous RXD to COM2.
29	SPI_SS-	Pin SS- of SPI interface
30	SPI_MISO	Pin MISO of SPI interface
31	SPI_MOSI	Pin MOSI of SPI interface
32	SPI_SCK	Pin SCK of SPI interface
33	GND	Ground
34	CAN_TX	TTL TX pin of CAN interface. A external interface circuit is required.
35	CAN_RX	TTL RX pin of CAN interface. A external interface circuit is required.

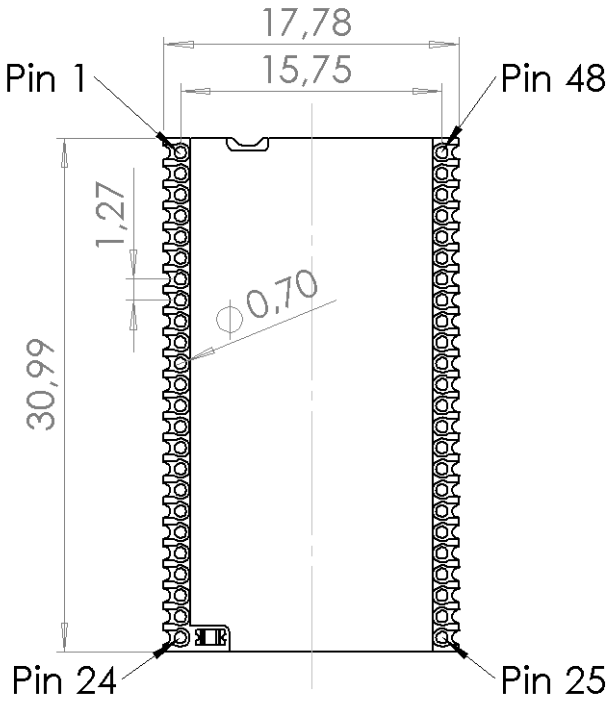
continued on next page. . .

36	I2C_SCL	Clock pin of I2C interface. No internal pull up.
37	I2C_SDA	Data pin of I2C interface. No internal pull up.
38	PWRDWN-	Low active TTL input with internal pull-up resistor for turning off the voltage regulator.
39	RESET-	Low active TTL input with internal pull-up resistor for hard reset.
40	VCC	3.3V power supply input.
41	VREG	3.3V output from on-board voltage regulator
42	HOSTSEL	Host channel selector: Low = COM1, high = USB. This pin is internally pulled high.
43	USB_DM	USB Data -
44	USB_DP	USB Data +
45	COM1_TX-	Low active output (logic level, push/pull) of asynchronous TXD from COM1.
46	COM1_RX-	Low active input (logic level) with internal pull-up resistor of asynchronous RXD to COM1.
47	VIN	Unregulated input to on-board voltage regulator.
48	GND	Ground

3.1 Assembly Information

3.1.1 Dimensions

The dimensions of TWN4 Nano Module are as follows (All dimensions in mm unless otherwise stated.)



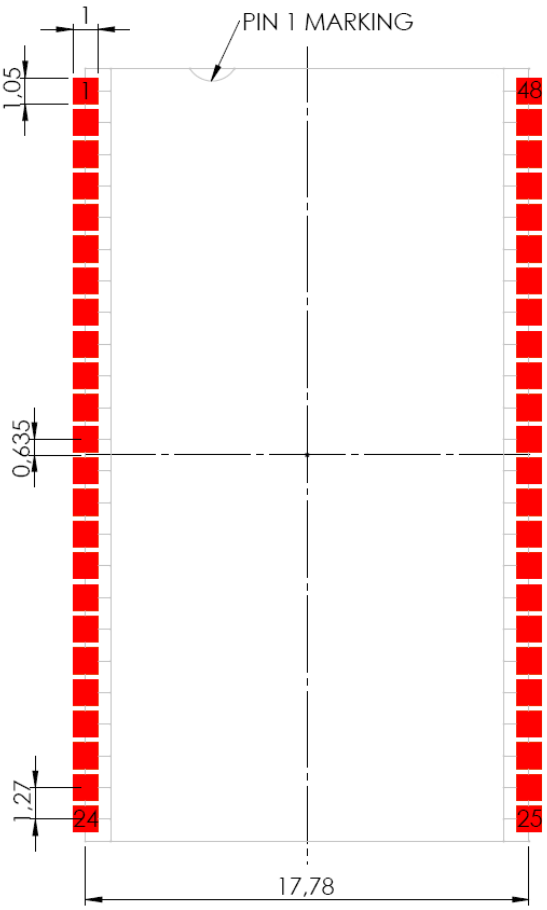
3.1.2 Through-Hole Technology (THT)

Suggested connector for THT assembly is Samtec TMS-124-02-G-S.

In case a detachable connection is required, mating part (to be mounted on carrier board) is Samtec SLM-124-01-G-S.

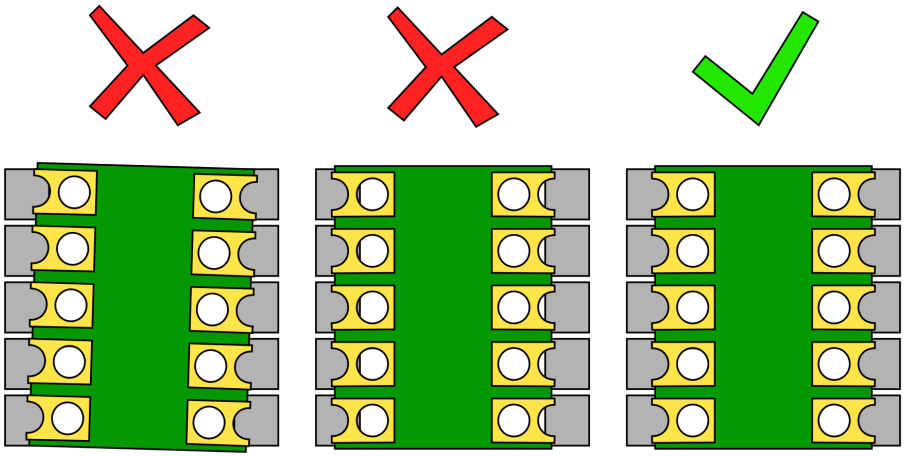
3.1.3 Surface Mount Technology (SMT)

3.1.3.1 Footprint



3.1.3.2 Placement

Please take special care about correct placement of TWN4 MultiTech Nano on the soldering pads. Wrong placement might cause holes for THT assembly to absorb tin from the SMT pads. Please follow these rules:



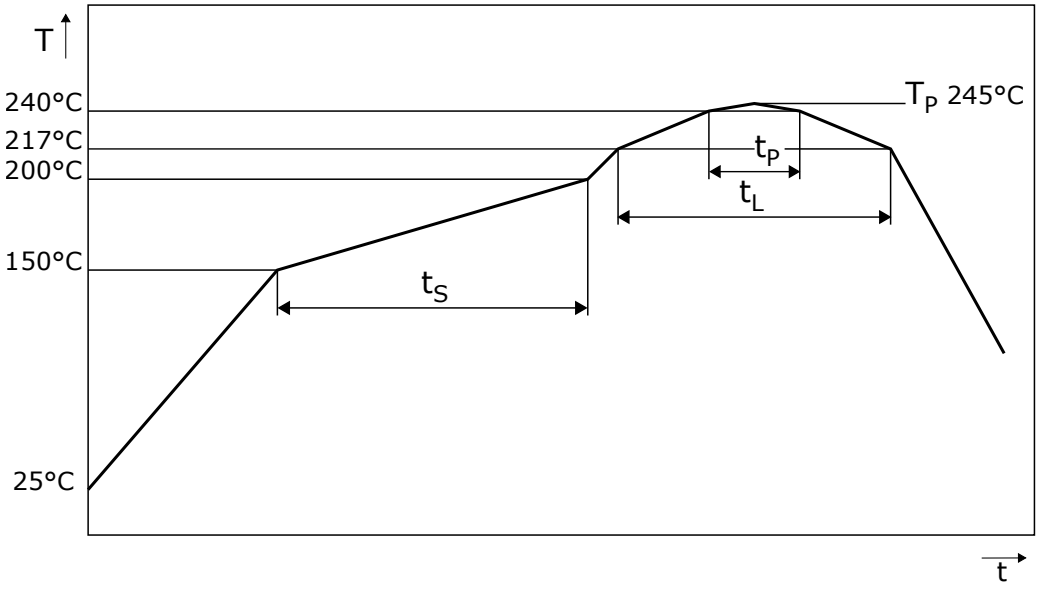
Module is not placed straight on the pads.

Module is not placed centered on the pads.

Module is placed well aligned on the pads.

3.1.3.3 Temperature Profile

For reflow soldering, following temperature profile is recommended:



Ramp-up rate	1-3 K/s
Preheat time (t_s)	60-180 seconds
Time within liquidus temperature (t_L)	60-150 seconds
Peak temperature (T_P)	245 +0/-5 °C
Time within peak (t_P)	10-30 seconds

3.1.3.4 Baking

The TWN4 MultiTech Nano has a moisture sensitivity level (MSL) of 3. This means, that the modules must be baked prior to reflow soldering, if the modules are removed from their sealed dry-bags and not soldered within their out-of-bag time, which is 168 hours.

In this case it is recommended to bake the TWN4 MultiTech Nano for 10 days at 85°C

4 Antenna

4.1 LF-Antenna

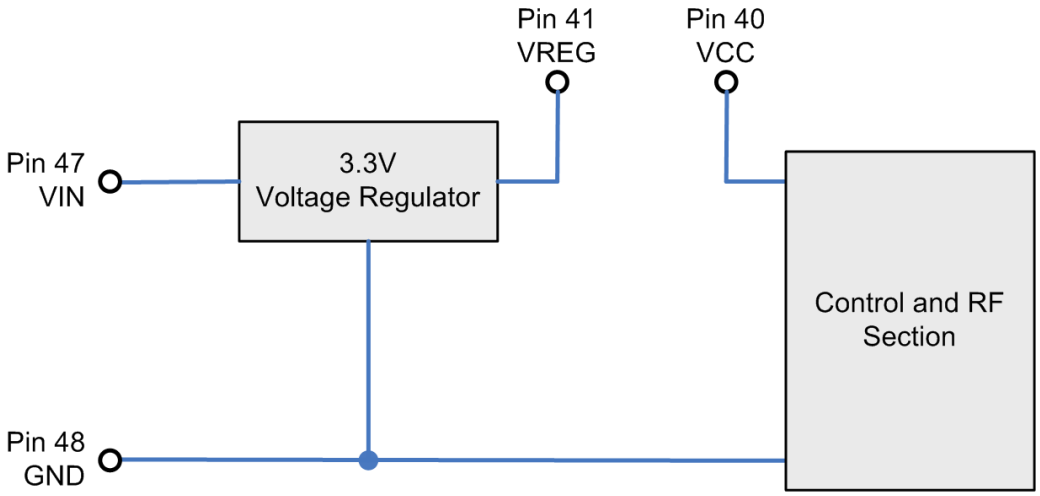
The nominal inductance for an external 125 kHz/134.2 kHz antenna is 490 µH. The series resistance of the antenna should be lower than 10 ohms.

4.2 HF-Antenna

Please see separate document TWN4 Nano Antenna Match Calc Guide DocRev1.pdf and AntennaTuner.exe. AntennaTuner allows to do an antenna design interactively.

5 Power Supply

The picture below is showing how power is routed through TWN4 Nano Module:



6 Power states and current consumption breakdown

The TWN4 Nano Module 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:

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

.

Table 6.1 shows the expected *typical* current draw in the 3 states described above, depending on the reader interface connected. It is assumed that a +5V DC Power Source is used. Results vary marginally when +3.3V source is used in the UART-TTL option. The UART-RS232 option was exercised using *MAX3221A* chip.

Host Connection	**USB**	**UART-TTL**
Normal Idle	65	59,4
Sleep	15,0	7,1
Sleep LPCD Option	15,4	7,5
Stop	N/A	0,45
Stop LPCD Option	N/A	0,8

Table 6.1: Typical Current Consumption in Base System States (mA)

Table 6.2 shows the extra current observed when the TWN4 Nano Module is integrated into a reader (these results are to be taken as example only and are expected to change); these values are to be added to those in the "Normal Idle" base state.

Function	Current Consumption
SearchTag-HF	+130
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

Table 6.2: Extra Current Consumption per Function added to "Normal Idle" base state (mA)

7 Label on TWN4 Nano Module

The content of the label is as follows:

Code	Meaning	Example
YY	Year	17
WW	Calendar week	05
ZZZ	Part number code 6th to 8th digit of part number, e.g. part number: T4NM-FDC0 part number code: FDC	FDC

Table 7.1: Label content description

8 Additional Hardware Requirements

8.1 Programming Firmware

To program firmware to the TWN4 Nano Module, it is mandatory to have at least one of the following connections:

- USB
- COM1
- COM2

This should be kept in mind while designing a mainboard for the TWN4 Nano Module.
For a description how to program firmware to the TWN4 Nano Module please refer to documents *TWN4 AppBlaster Config Cards User Guide DocRev6.pdf* for Windows and *TWN4 Programming with Command Line under Linux DocRev1.pdf* for Linux.

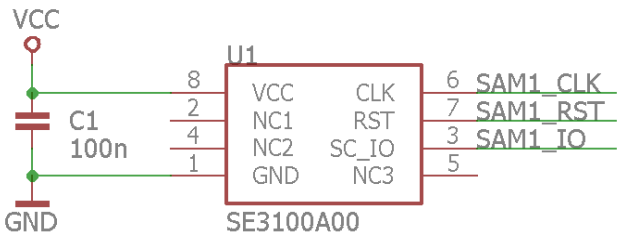
8.2 Using PI Option

To use the PI Option, e.g. to read the PAC bits from an iCLASS transponder, a SIO processor is needed. This can be either a SIO chip which is soldered directly on a PCB or a SAM card incorporating the SIO processor.

8.2.1 SIO Chip soldered on PCB

The SIO processor has to be added to the design of the mainboard. The chip can be connected either to SAM1 or SAM2 of the TWN4 Nano Module.

Recommended schematic:



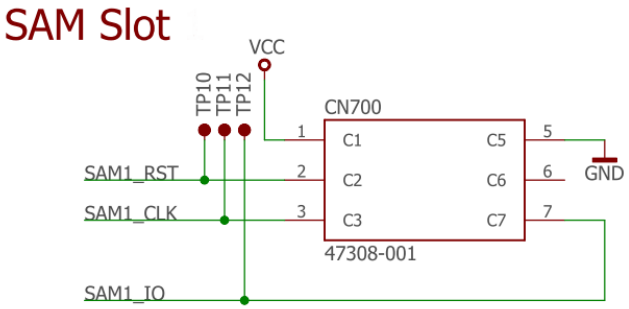
8.2.2 SAM Card Connection

A SAM socket has to be added to the design of the mainboard. The SAM socket can be connected either to SAM1 or SAM2 of the TWN4 Nano Module.

Following SAM sockets are recommended:

- Molex 47388-2001
- Molex 47308-0001

Recommended schematic:



8.3 Bluetooth BLE

8.3.1 Connecting BLE Module

The firmware of the TWN4 Nano Module has direct support for the Silicon Labs BGM111, BGM121 and BGM11S BLE module.

To use this feature, it is needed to connect following signals to the TWN4 Nano Module:

- COM2_TX-
- COM2_RX-
- GPIO7

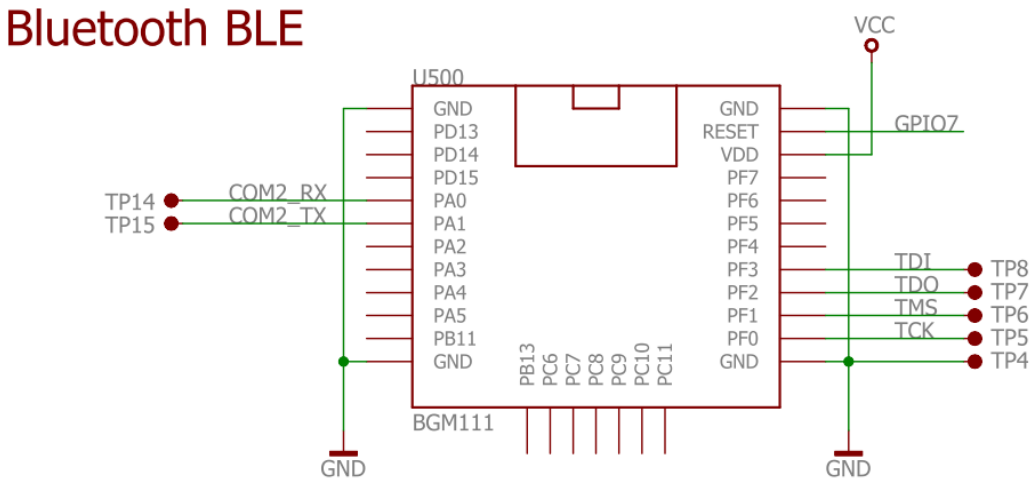
The signals TDI, TDO, TMS and TCK are needed to do an initial programming of the BLE Module.

Please note:

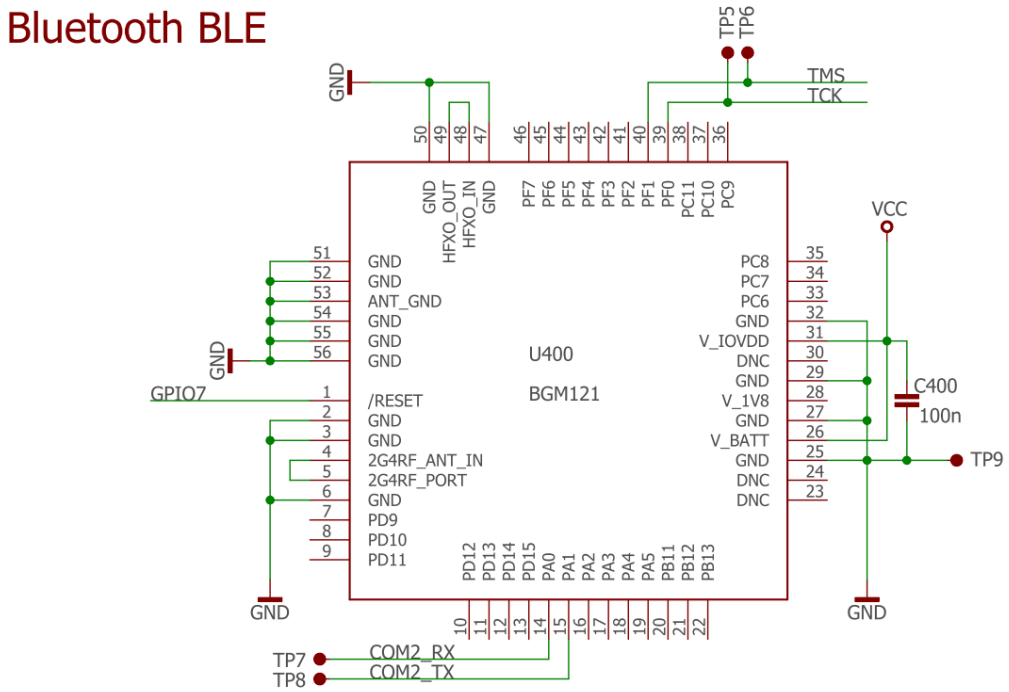
In order to have BLE module with support by TWN4 Nano Module firmware, TWN4 must be purchased with activated B Option. Otherwise, BLE functionality must be programmed from within the App. Please contact your distributor for TWN4 Nano Module with B option.

Following schematics are recommended:

BGM111



BGM121 / BGM11S



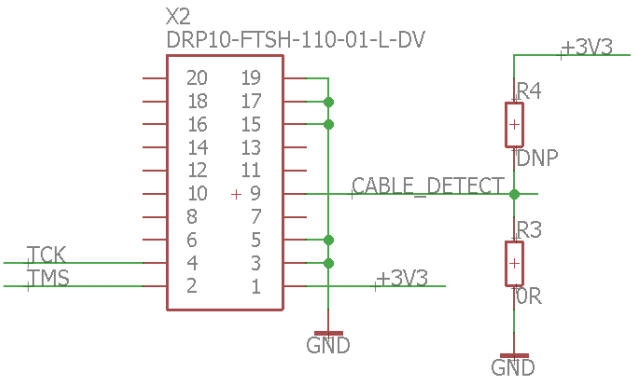
8.3.2 Initial Programming of BLE Module

All the BGM Bluetooth Modules from Silicon Labs must first be programmed.

With Silicon Labs Development Kit SLWSTK6101C all BGM modules can be programmed via the SWD pins TMS and TCK. The Silicon Labs software Simplicity Studio is a universal development package which can be used for the initial programming of the BGM modules. This software contains the tool "Flash Programmer" for programming the BGM Modules. The following part describes a possible way to programm the BGM Modules.

8.3.3 Connection to the BGM Module

8.3.3.1 Debug Connector of Development Kit



The BGM Module must be connected to the Starter Kit SLWSTK6101C: Connect GND, TMS and TCK to the BGM Module. Note: Pin 9 of the connector is used for cable detection. In case of a high level (3.3V), the plugged in module is signaled to the programming adapter. In case of low level no module is detected.

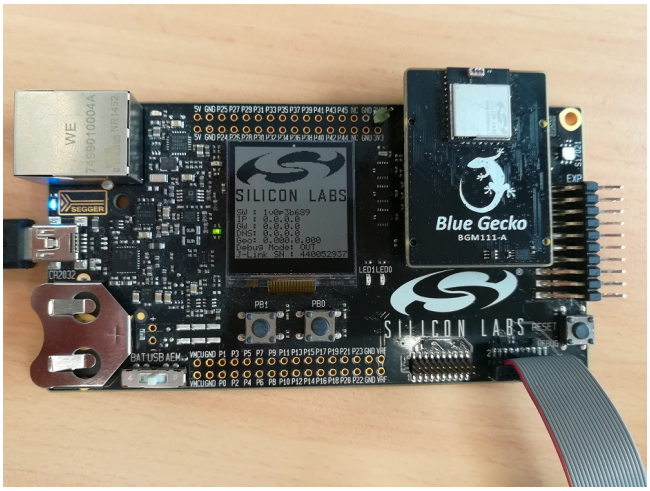


Figure 8.1: Silicon Labs Development Kit

8.3.3.2 Software

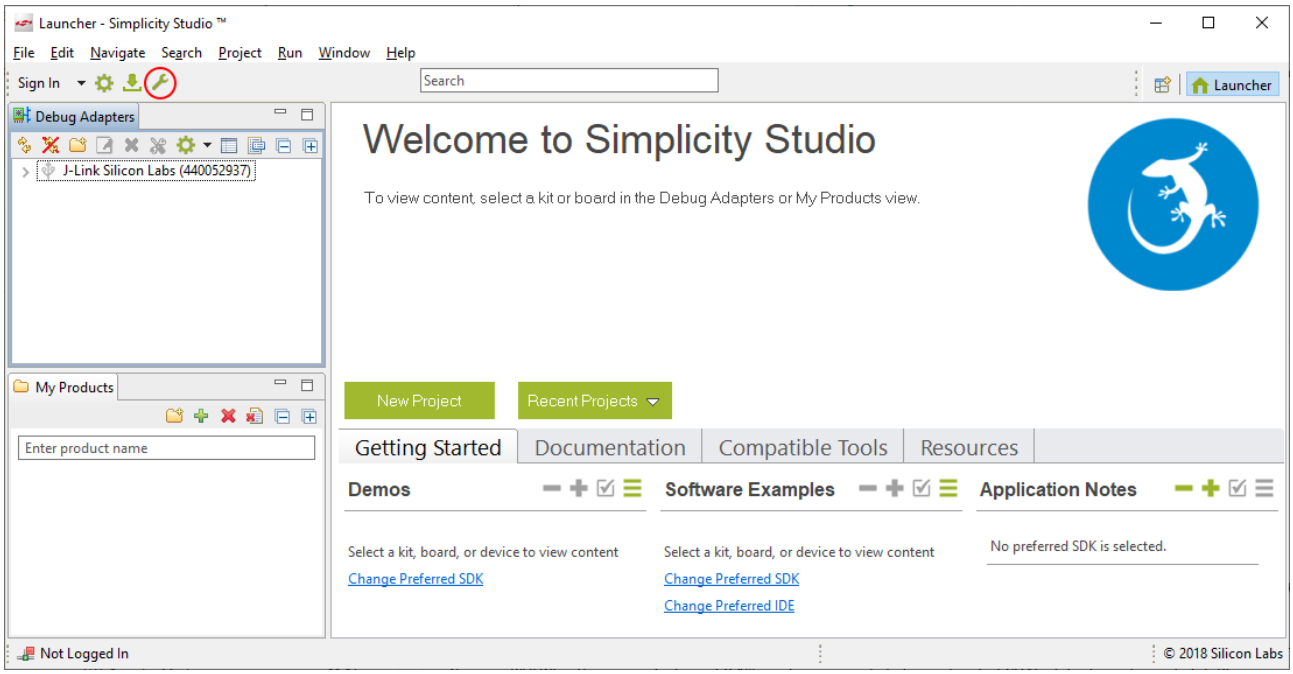


Figure 8.2: Silicon Labs Simplicity Studio

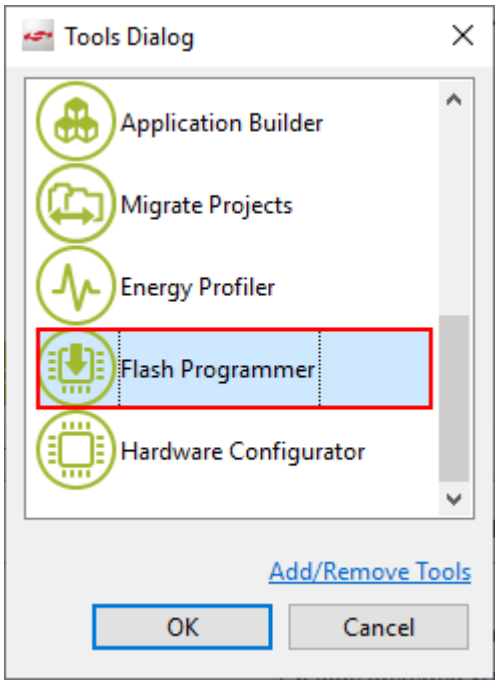


Figure 8.3: Silicon Labs Simplicity Studio Tools Dialog

Procedure for initial programming of BGM module

- Insert BGM module (e.g. BGM111) to Development Kit
- Connect the Development Kit SLWSTK6101C via USB to PC
- Connect target BGM module to the debug connector of the Development Kit
- Power on the target BGM module with 3.3V
- Start the software "Simplicity Studio" and the tool "Flash Programmer" (see screenshots above)
- Select file type bin and load binary file. The current version of this file can be requested from Elatec Support support-rfid@elatec.com
- Press button "Program" to program the BGM Module.

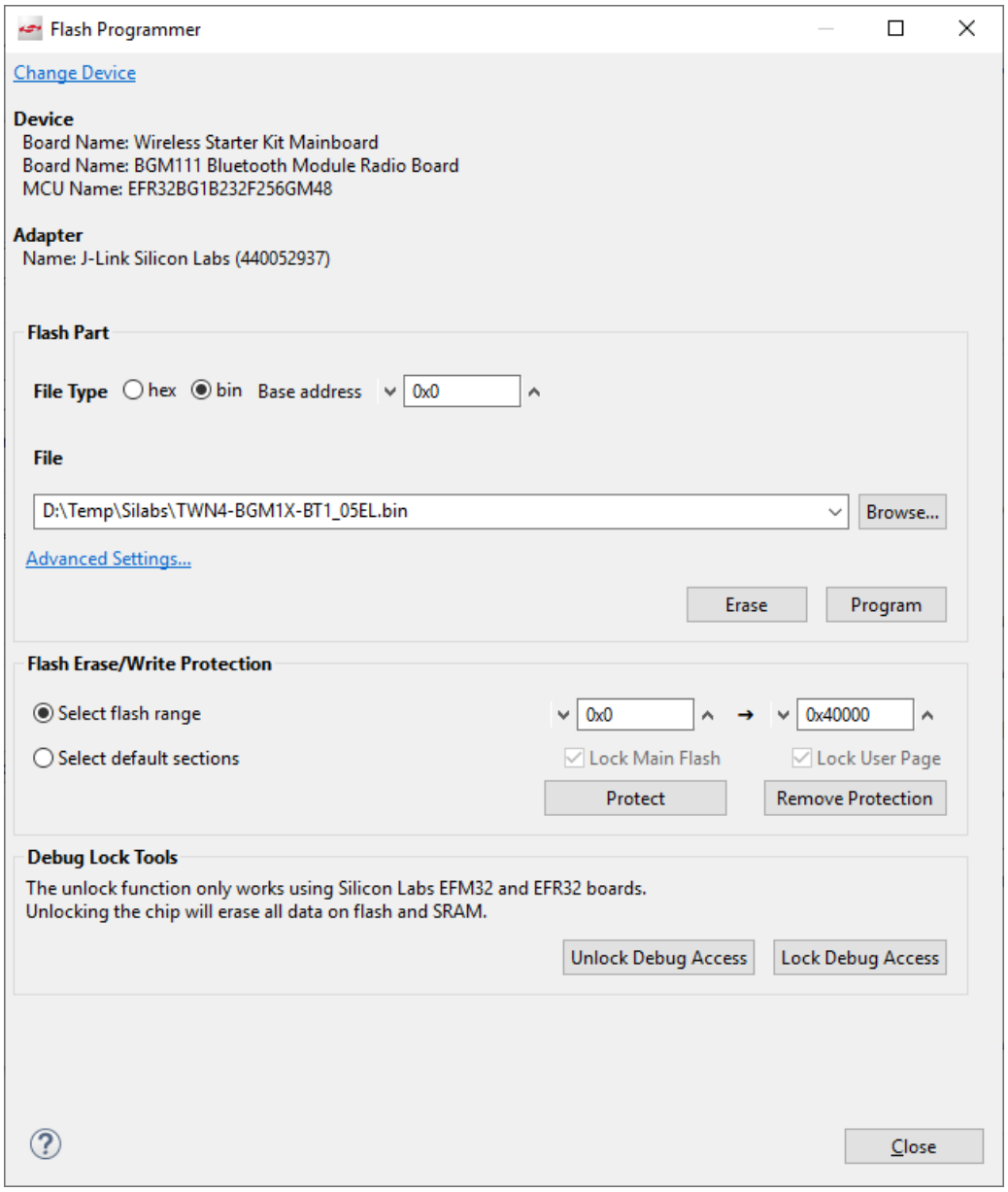
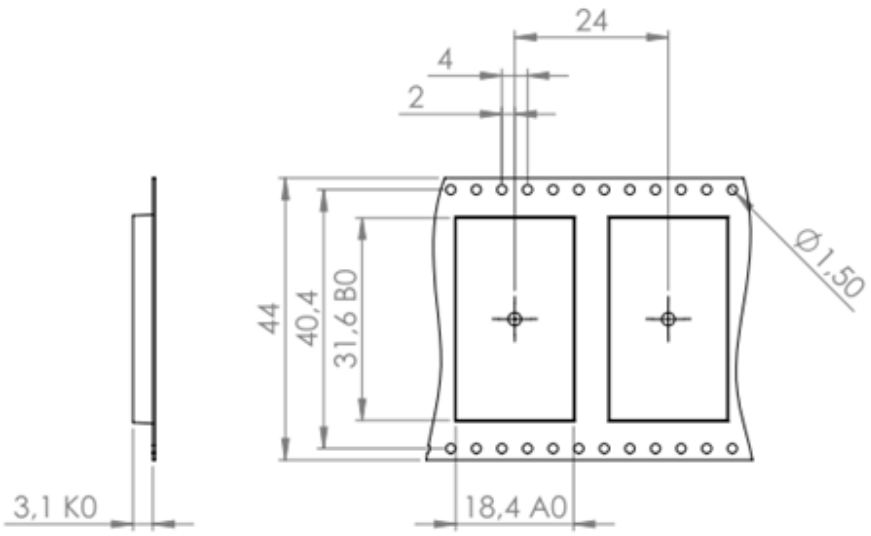


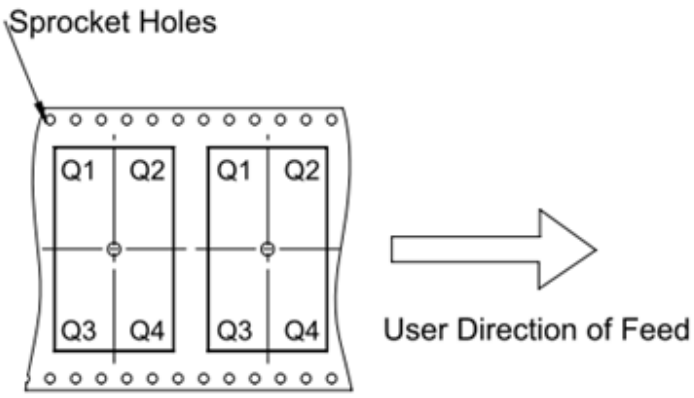
Figure 8.4: Silicon Labs Flash Programmer

9 Packaging

TWN4 Nano Modules on reel always have Elatec standard firmware "CDC Simple Protocol".

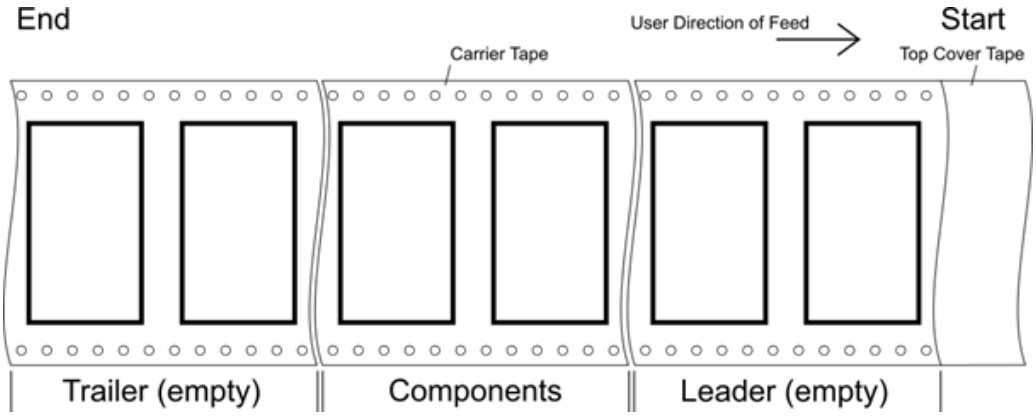
9.1 Carrier Tape





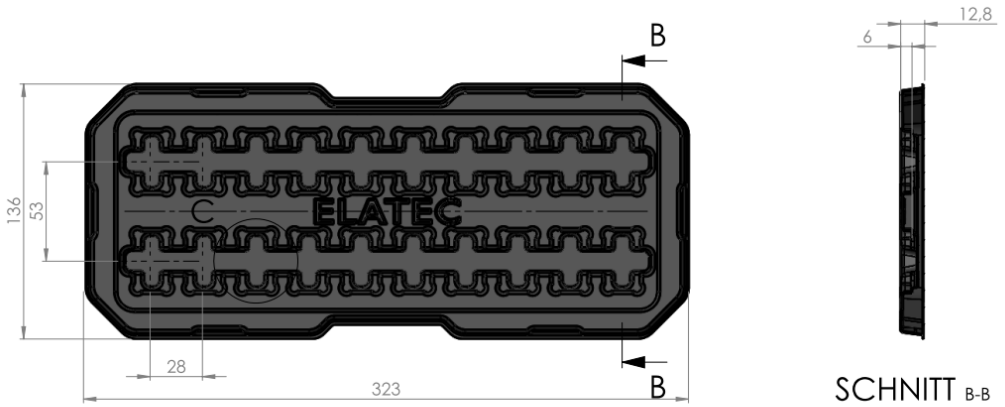
TWN4NanoModule Pin1 Marking: Quadrant Q1

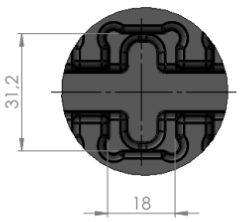
9.1.1 Dimensions of Tape Leader & Trailer



- Start: Top Cover Tape 1x circumference plus 100mm (minimum 300mm)
- Leader: 10 pitch (minimum 100mm)
- Components: area with packed modules
- Trailer: 1 x circumference (minimum 160mm)

9.2 Tray





DETAIL C

9.3 Package

A moisture barrier bag (MBB) is used to pack the reel or tray (size of MBB according to reel / tray dimension)

The MBB contains:

- The reel with TWN4 MultiTech Nano
- Desiccant packs
- Humidity indicator card

The packed MBB is de-aerated and sealed.

9.4 Label

Manufacturer Logo	 ESD MSL 3
Part number T4NM-FDC0	Version B/B1.08/NCF3.04/PRS1.04
Date code 17050101	Quantity 100

- Part number: Part number (P/N) of contained product as text and barcode (Code 128)
- Version: Hardware version/firmware version
- Date code: Date code and charge number as [YYWWNNPP], where:
  YY = Year, e.g. 17
  WW = Calendar week, e.g. 05
  NN = Production lot in decimal (incremented for each lot), e.g. 01
  PP = Production site, e.g. 01 (internal use only)
- Quantity: Number of modules on reel

9.5 Position of Label

There are two identical labels, one on MBB, one on contained reel. In case of tray, there is only a label on the MBB and no label on the tray.
Following positions:

Label on MBB:

Label on reel:

10 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.

All referenced brands, product names, service names and trademarks mentioned in this document are the property of their respective owners.