ANR016 Radio Module Migration Guide

Always be up to date: Replacing a radio module by its successor

Version 1.1

February 28, 2020

Revision history

Manual version	Notes	Date
1.0	• Initial version	October 2019
1.1	• Added Proteus-III	February 2020

Abbreviations and abstract

Abbreviation	Name	Description
ACK	Acknowledgement	Radio packet send back to the transmitter to acknowledge the reception of data.
	Blocking	The ability to receive the wanted radio signal with close radio noise.
LRM	Long range mode	Special radio profile for large transmission ranges.
	Payload	The intended message in a frame / package.
RF	Radio frequency	Describes wireless transmission.
SRD	Short Range Device	Unlicensed frequency bands.

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1 Introduction

The radio frequency spectrum is regulated by designated regulatory authorities that define how specific spectrum bands can be used. As each frequency band has its strength, Würth Elektronik eiSos provides for each frequency band proprietary radio modules, which allow energy efficient and fast data transmission.

With the evolution of radio chips, new proprietary radio modules have been developed, that are more energy efficient during data transmission and reception. Furthermore new coding and modulation techniques have been added, that allow higher transmission ranges (long range mode) and/or higher data rates.

Due to this natural evolution, when redesigning a device that is already using a proprietary radio module, it is recommended to use the latest member of the corresponding radio module family.

This application note describes the key factors to be considered, when replacing a proprietary Würth Elektronik eiSos radio module with its successor from the same family.

Due to changes in hardware platform and firmware when replacing a radio module with its successor, the end device's radio certification becomes void. A new radio certification or declaration needs to be acquired by performing actions according to the local statutory requirements at the location of deployment.

If a switch from 868 MHz to 915 MHz is desired to serve also the North American market, the application note ANR015 "FROM 868 MHZ TO 915 MHZ" describes the necessary steps to be performed.

2 Tarvos-I to Tarvos-III

The Tarvos series is a family of 868 MHz proprietary radio modules. The Tarvos-I has been succeeded by the Tarvos-II (chapter 3), that scores with lower sleep, transmission and receptions currents, as well with a cleaner frequency spectrum. The Tarvos-II itself has been succeeded by the Tarvos-III, that further reduces the power consumption and provides new modulation techniques to boost the transmission range. Each generation also includes improvements in the blocking capabilities.

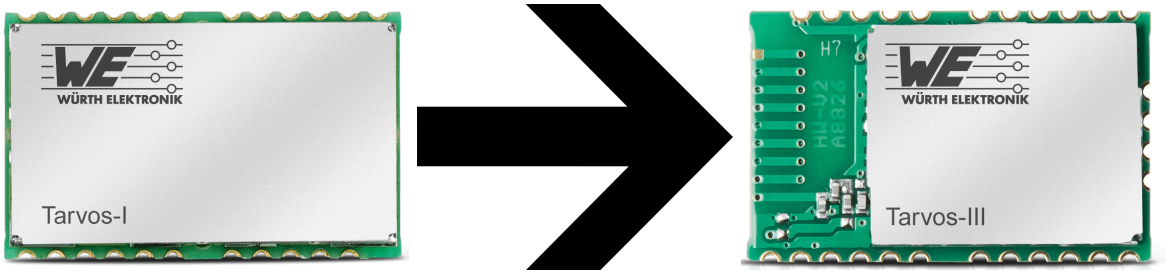


Figure 1: Tarvos-I to Tarvos-III

2.1 Summary

In comparison to the Tarvos-I, the Tarvos-III has 4 additional pins. Since the size and the remaining footprint of the two modules are the same, the Tarvos-I can be replaced by the Tarvos-III, if no underlying non-insulated copper area touches the 4 new pins of the Tarvos-III.
Besides of this, a few pin functions changed, such that the sleep mode for example has to be triggered in a different way on the Tarvos-III. Due to this, and due to new firmware functions the host firmware must be adapted to communicate with the Tarvos-III.
Radio compatibility of both modules is given in most operation modes.

2.2 Hardware adaption

2.2.1 Foot print

Both Tarvos-I and Tarvos-III have the same dimensions of 17×27×4 mm with the pins located at the same positions. The only change in the footprint is the presence of 4 additional pins (i1-i4) of the JTAG interface on the Tarvos-III.
If a design has been made for Tarvos-I, the footprint matches the Tarvos-III, if no underlying non-insulated copper area touches the JTAG pins i1-i4 of the Tarvos-III.

In addition to the radio signal to an external antenna on pin 1, the Tarvos-III offers an option to use the on-board PCB antenna. In order to ensure a comparable radio performance to Tarvos-I, it is recommended to use the antenna pin to connect to an external antenna.

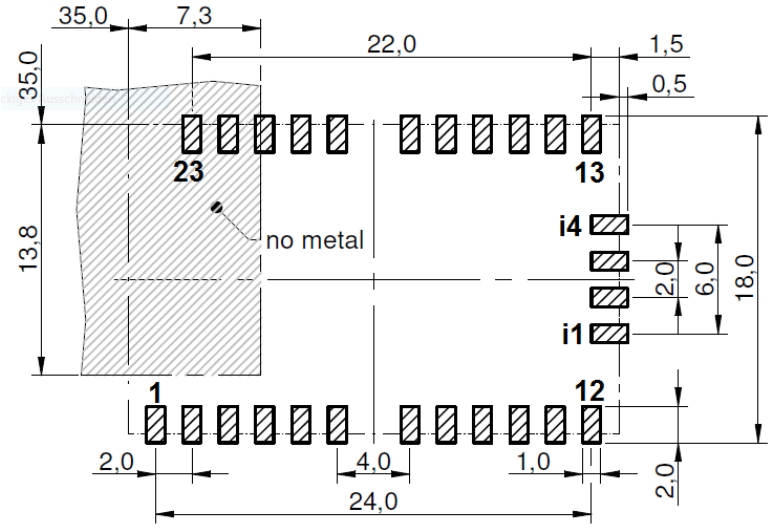


Figure 2: Universal footprint

2.2.2 Pinout

Although the Tarvos-I and Tarvos-III share the same footprint, some of the pin functions differ on the new hardware platform. The main pin functions such as power supply and UART use the same footprint pin on both modules:

Pin No.	Tarvos-I	Tarvos-III	Comment
1	*ANT*	*ANT*	Antenna pin connection
2	*GND*	*GND*	Ground
3	*VCC*	*VCC*	Supply voltage
4	*UTXD*	*UTXD*	UART TX
5	*URXD*	*URXD*	UART RX
6	*/RTS*	*/RTS*	UART */RTS*
9	*RESERVED*	*RESERVED*	
10	*RESERVED*	*RESERVED*	
16	*RESERVED*	*RESERVED*	
17	*RESERVED*	*RESERVED*	
18	*RESERVED*	*RESERVED*	
19	*/RESET*	*/RESET*	Reset pin
20	*/TX_IND*	*/TX_IND*	Pin indicating when a radio packet is transmitted
21	*/RX_IND*	*/RX_IND*	Pin indicating when a radio packet is received
22	*RESERVED*	*RESERVED*	
23	*GND*	*GND*	Ground

Table 1: Pins with same functions on both, Tarvos-I and Tarvos-III

But pins with special functions changed:

Pin No.	Tarvos-I	Tarvos-III	Comment
7	*/CTS*	*RESERVED*	*/CTS* function no longer supported.
8	*DATA_IND*	*RESERVED*	*DATA_IND* function no longer supported.
11	*DATA_REQ*	*RESERVED*	*DATA_REQ* function no longer supported, as the Tarvos-III does not support transparent mode[1].
12	*RESERVED*	*BOOT*	The *BOOT* pin is used on the Tarvos-III to set the module into boot mode, where the module's firmware can be updated using the ACC tool.
13	*SLEEP*	*RESERVED*	Sleep function by pin no longer supported, as the Tarvos-III enters the sleep modes via command.
14	*TRX_DISABLE*	*WAKE-UP*	Pin function changed. The *WAKE-UP* pin is used to wake-up the module from sleep mode.
15	*/CONFIG*	*RESERVED*	Mode switching function no longer supported, as the Tarvos-III does not support transparent mode[1].

Table 2: Pins of the Tarvos-I and Tarvos-III that have different functions

2.2.3 Antenna

The Tarvos-III is available in two hardware variants. The first variant provides the radio signal at the *ANT* pin, the same as Tarvos-I. Using this variant an external antenna matched to 50 Ω can be connected at this pin.
The second variant of the Tarvos-III offers an internal PCB antenna. Using this variant the *ANT* pin has no function and can be left open. No external antenna has to be connected.

2.3 Host firmware adaption

2.3.1 UART interface

The Tarvos-I uses 9600 Baud 8n1 and Tarvos-III uses 115200 Baud 8n1 by default. The Tarvos-I provides the command and transparent mode on the UART (transparent mode by default), where as the Tarvos-III currently provides only the command mode (command mode by default).
The command interface[2] on the UART uses of the same command structure. The UART command numbers itself and range of parameter values for a specific command may differ. Thus the command interface of the Tarvos-III must be updated in the host controller.

[1] Transparent mode for the Tarvos-III scheduled for Q2 2020.
[2] Reference implementations of the command interfaces of all Würth Elektronik eiSos radio modules are available in the *Wireless Connectivity SDK*.

2.3.2 Radio interface

The radio interface of the Tarvos-III is compatible to that of Tarvos-I provided that the Tarvos-III is configured to use the 38.4 kbps or the 100 kbps profile with the radio settings as described in section 2.3.2.1. Using these radio settings, a higher radio range can be achieved compared to Tarvos-I owing to the higher default transmission power of Tarvos-III. The new radio profiles of the Tarvos-III are incompatible to the previous Tarvos generations, but offer various advantages. The radio profiles 3 and 4 allow a higher transmission range, where radio profile 5 provides a fast data transmission due to the increased data-rate.
Furthermore, all the radio channels, that are used by the Tarvos-I, are supported by the Tarvos-III.

Radio profile	Data rate (gross) [kbps]	Max packet size [Byte]	Radio channels
-	4.8	125-128[3]	101 - 111
-	10	125-128[3]	101 - 111
-	38.4	125-128[3]	101 - 111
-	76.8	125-128[3]	101 - 111
-	100	125-128[3]	101 - 111

Table 3: Radio profiles of the Tarvos-I

Radio profile	Data rate (gross) [kbps]	Max packet size [Byte]	Radio channels
0	38.4	128	101 - 139
2	100	128	101 - 139
3 (LRM)	10 (=0.625 kbps net)	48	101 - 139
4 (LRM)	20 (=2.5 kbps net)	64	101 - 139
5	400	224	101 - 139

Table 4: Radio profiles of the Tarvos-III

2.3.2.1 Radio compatibility settings

General: Tarvos-I firmware must be of version 2.1.0 or later.

Address mode: Tarvos-I supports only address mode 0 and 1.

Addresses: The Tarvos-III uses broadcast addresses by default, where as the Tarvos-I uses 0 as default destination address and network ID.

Timings: The ACK timeouts must be adjusted to ensure interoperability between Tarvos-III and Tarvos-I, when using acknowledgments.

[3]The maximum payload size depends on the selected address mode.

2.3.3 Power saving modes

As the pins *SLEEP* and *TRX_DISABLE* of the Tarvos-I are no more available on the Tarvos-III, the low power modes are handled in a different way. The Tarvos-III does not enable the possibility to switch off the radio exclusively by a pin, but allows to enter into two different sleep modes via UART command. The Tarvos-III can be woken up again from any sleep mode using the *WAKE-UP* pin, which is at the location of the Tarvos-I *TRX_DISABLE* pin.

2.3.4 Boot mode

The Tarvos-III needs to be set to boot mode, if a firmware update is performed. To switch the boot mode on, the *BOOT* pin has to be handled by host controller. The firmware update uses the UART interface at the dedicated module UART pins. Both, Tarvos-I and Tarvos-III can be connected to the ACC PC tool to perform changes in user settings and a firmware update. Please refer to the product specific details for the firmware update.

3 Tarvos-II to Tarvos-III

The Tarvos series is a family of 868 MHz proprietary radio modules. The Tarvos-II has been succeeded by the Tarvos-III, that reduces the power consumption, improves the blocking capabilities and provides new modulation techniques to boost the transmission range.

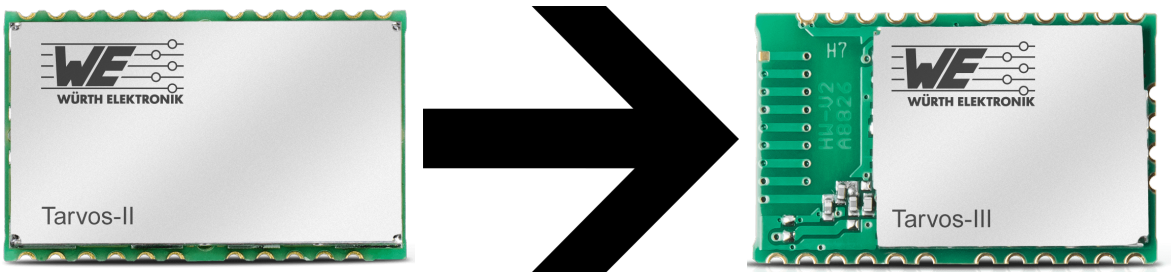


Figure 3: Tarvos-II to Tarvos-III

3.1 Summary

In comparison to the Tarvos-II, the Tarvos-III has 4 additional pins. Since the size and the remaining footprint of the two modules are the same, the Tarvos-II can be replaced by the Tarvos-III, if no underlying non-insulated copper area touches the 4 new pins of the Tarvos-III.
Besides of this, a few pin functions changed, such that the sleep mode for example has to be triggered in a different way on the Tarvos-III. Due to this, and due to new firmware functions the host firmware must be adapted to communicate with the Tarvos-III.
Radio compatibility of both modules is given in most operation modes.

3.2 Hardware adaption

3.2.1 Foot print

Both Tarvos-II and Tarvos-III have the same dimensions of 17×27×4 mm with the pins located at the same positions. The only change in the footprint is the presence of 4 additional pins (i1-i4) of the JTAG interface on the Tarvos-III.
If a design has been made for Tarvos-II, the footprint matches the Tarvos-III, if no underlying non-insulated copper area touches the JTAG pins i1-i4 of the Tarvos-III.

In addition to the radio signal to an external antenna on pin 1, the Tarvos-III offers an option to use the on-board PCB antenna. In order to ensure a comparable radio performance to Tarvos-II, it is recommended to use the antenna pin to connect to an external antenna.

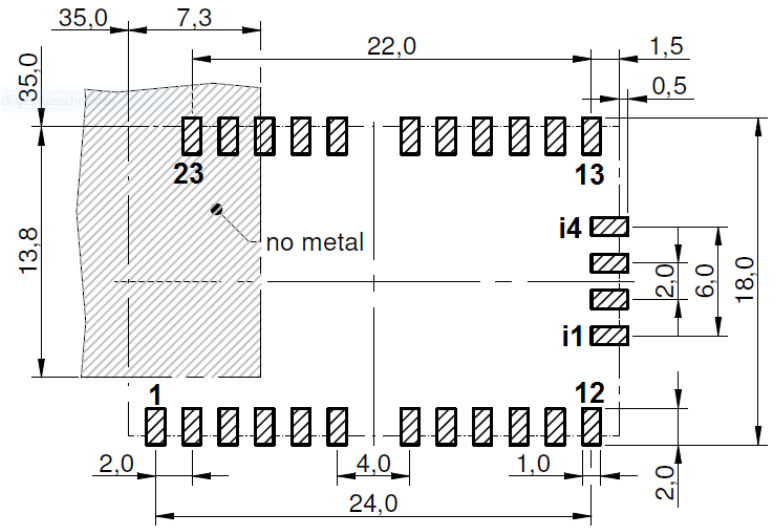


Figure 4: Universal footprint

3.2.2 Pinout

Although the Tarvos-II and Tarvos-III share the same footprint, some of the pin functions differ on the new hardware platform. The main pin functions such as power supply and UART use the same footprint pin on both modules:

Pin No.	Tarvos-II	Tarvos-III	Comment
1	*ANT*	*ANT*	Antenna pin connection
2	*GND*	*GND*	Ground
3	*VCC*	*VCC*	Supply voltage
4	*UTXD*	*UTXD*	UART TX
5	*URXD*	*URXD*	UART RX
6	*/RTS*	*/RTS*	UART */RTS*
9	*RESERVED*	*RESERVED*	
10	*RESERVED*	*RESERVED*	
13	*RESERVED*	*RESERVED*	
16	*RESERVED*	*RESERVED*	
17	*RESERVED*	*RESERVED*	
18	*RESERVED*	*RESERVED*	
19	*/RESET*	*/RESET*	Reset pin
20	*/TX_IND*	*/TX_IND*	Pin indicating when a radio packet is transmitted
21	*/RX_IND*	*/RX_IND*	Pin indicating when a radio packet is received
22	*RESERVED*	*RESERVED*	
23	*GND*	*GND*	Ground

Table 5: Pins with same functions on both, Tarvos-II and Tarvos-III

But pins with special functions changed:

Pin No.	Tarvos-II	Tarvos-III	Comment
7	*/CTS*	*RESERVED*	*/CTS* function no longer supported.
8	*DATA_IND*	*RESERVED*	*DATA_IND* function no longer supported.
11	*DATA_REQ*	*RESERVED*	*DATA_REQ* function no longer supported, as the Tarvos-III does not support transparent mode[1].
12	*RESERVED*	*BOOT*	The *BOOT* pin is used on the Tarvos-III to set the module into boot mode, where the module's firmware can be updated using the ACC tool.
14	*TRX_DISABLE*	*WAKE-UP*	Pin function changed. The *WAKE-UP* pin is used to wake-up the module from sleep mode.
15	*/CONFIG*	*RESERVED*	Mode switching function no longer supported, as the Tarvos-III does not support transparent mode[1].

Table 6: Pins of the Tarvos-II and Tarvos-III that have different functions

[1] Transparent mode for the Tarvos-III scheduled for Q2 2020.

3.2.3 Antenna

The Tarvos-III is available in two hardware variants. The first variant provides the radio signal at the *ANT* pin, the same as Tarvos-II. Using this variant an external antenna matched to 50 Ω can be connected at this pin.
The second variant of the Tarvos-III offers an internal PCB antenna. Using this variant the *ANT* pin has no function and can be left open. No external antenna has to be connected.

3.3 Host firmware adaption

3.3.1 UART interface

The Tarvos-II uses 9600 Baud 8n1 and Tarvos-III uses 115200 Baud 8n1 by default. The Tarvos-II provides the command and transparent mode on the UART (transparent mode by default), where as the Tarvos-III currently provides only the command mode (command mode by default).
The command interface[2] on the UART uses of the same command structure. The UART command numbers itself and range of parameter values for a specific command may differ. Thus the command interface of the Tarvos-III must be updated in the host controller.

3.3.2 Radio interface

The radio interface of the Tarvos-III is compatible to that of Tarvos-II provided that the Tarvos-III is configured to use the 38.4 kbps or the 100 kbps profile with the radio settings as described in section 3.3.2.1. Using these radio settings, a higher radio range can be achieved compared to Tarvos-I owing to the higher default transmission power of Tarvos-III. The new radio profiles of the Tarvos-III are incompatible to the previous Tarvos generations, but offer various advantages. The radio profiles 3 and 4 allow a higher transmission range, where radio profile 5 provides a fast data transmission due to the increased data-rate.
Also the radio channels, that are used by the Tarvos-II, are supported by the Tarvos-III.

Radio profile	Data rate (gross) [kbps]	Max packet size [Byte]	Radio channels
0	38.4	128	101 - 139
1	2.4	128	101 - 139
2	100	128	101 - 139

Table 7: Radio profiles of the Tarvos-II

[2] Reference implementations of the command interfaces of all Würth Elektronik eiSos radio modules are available in the *Wireless Connectivity SDK*.

Radio profile	Data rate (gross) [kbps]	Max packet size [Byte]	Radio channels
0	38.4	128	101 - 139
2	100	128	101 - 139
3 (LRM)	10 (=0.625 kbps net)	48	101 - 139
4 (LRM)	20 (=2.5 kbps net)	64	101 - 139
5	400	224	101 - 139

Table 8: Radio profiles of the Tarvos-III

3.3.2.1 Radio compatibility settings

General: Tarvos-II firmware must be of version 3.5.0 or later.

Address mode: Tarvos-II supports only address mode 0, 1 and 2.

Addresses: The Tarvos-III uses broadcast addresses by default, where as the Tarvos-II uses 0 as default destination address and network ID.

Timings: The ACK timeouts must be adjusted to ensure interoperability between Tarvos-III and Tarvos-II, when using acknowledgments.

3.3.3 Power saving modes

As the pin *TRX_DISABLE* of the Tarvos-II is no more available on the Tarvos-III, the low power modes are handled in a different way. The Tarvos-III does not enable the possibility to switch off the radio exclusively by a pin, but allows to enter into two different sleep modes via UART command. The Tarvos-III can be woken up again from any sleep mode using the *WAKE-UP* pin, which is at the location of the Tarvos-II *TRX_DISABLE* pin.

3.3.4 Boot mode

The Tarvos-III needs to be set to boot mode, if a firmware update is performed. To switch the boot mode on, the *BOOT* pin has to be handled by host controller. The firmware update uses the UART interface at the dedicated module UART pins. Both, Tarvos-II and Tarvos-III can be connected to the ACC PC tool to perform changes in user settings and a firmware update. Please refer to the product specific details for the firmware update.

4 Thebe-I to Thebe-II

The Thebe series is a family of 868 MHz proprietary radio modules with 500 mW output power to achieve high transmission ranges. The Thebe-I has been succeeded by the Thebe-II, that is significantly smaller in size and provides new modulation techniques to boost the transmission range.

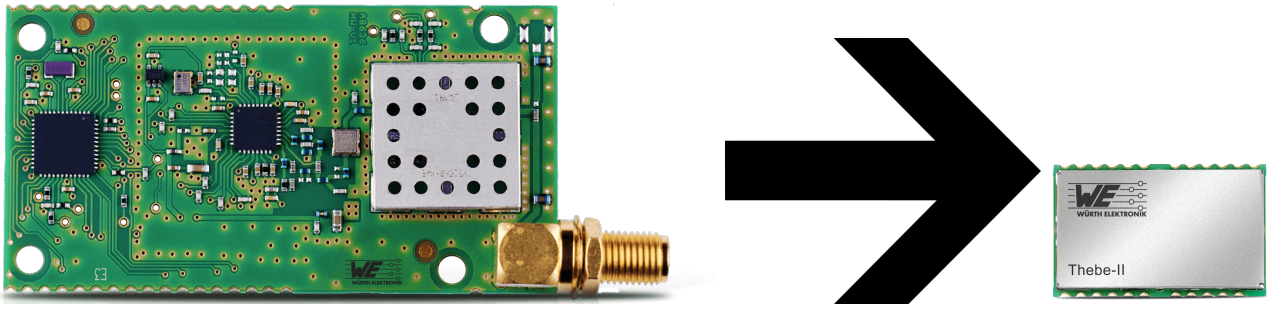


Figure 5: Thebe-I to Thebe-II

4.1 Summary

The Thebe-I and Thebe-II have different sizes and footprints. Thus, when replacing the Thebe-I by a Thebe-II, a redesign of the hardware is needed. Due to new firmware functions the host firmware must be adapted to communicate with the Thebe-II.
Radio compatibility of both modules is not given.

4.2 Hardware adaption

4.2.1 Foot print

The Thebe-I and Thebe-II have different footprints. Besides the number of pins, the size has been reduced significantly. The Thebe-I has dimensions of 33.5×76×14.5mm where as the Thebe-II has a significantly smaller form factor of 17×27×3.8 mm.

4.2.2 Pinout

Although the Thebe-I and Thebe-II have different footprints, the main pin functions such as power supply, reset and UART are retained. Only the following pin functions have changed. On Thebe-II

- the pins */CTS*, *DATA_IND*, *DATA_REQ*, *TRX_DISABLE* and */CONFIG* are no longer supported.
- the pin *BOOT* has been added, that can be used to set the Thebe-II into boot mode.
- the pin *WAKE-UP* has been added to wake-up the module from sleep mode.
- the pin *ANT* has been added to attach an external 50 Ω antenna.

4.2.3 Antenna

The Thebe-I has a SMA antenna connector to attach an external antenna. Instead, the Thebe-II provides a module pin to connect a 50 Ω matched external antenna.

4.3 Host firmware adaption

4.3.1 UART interface

The Thebe-I uses 9600 Baud 8n1 and Thebe-II uses 115200 Baud 8n1 by default. The Thebe-I provides the command and transparent mode on the UART (transparent mode by default), where the Thebe-II currently provides only the command mode (command mode by default).
The command interface[1] on the UART uses of the same command structure. The UART command numbers itself and range of parameter values for a specific command may differ. Thus the command interface of the Thebe-II must be updated in the host controller.

4.3.2 Radio interface

The radio of the Thebe-I and Thebe-II are not compatible.

The radio profiles and channel frequencies differ. The new radio profiles of the Thebe-II offer various advantages. The radio profiles 3 and 4 allow a higher transmission range, where radio profile 2 provides a fast data transmission due to the increased data-rate.

Radio profile	Data rate (gross) [kbps]	Max packet size [Byte]	Radio channels
0	4.8	128	0 - 18
1	4.8	128	9
2	9.6	128	9
7	50	128	9

Table 9: Radio profiles of the Thebe-I

[1] Reference implementations of the command interfaces of all Würth Elektronik eiSos radio modules are available in the *Wireless Connectivity SDK*.

Radio profile	Data rate (gross) [kbps]	Max packet size [Byte]	Radio channels
0	38.4	128	129 - 132
2	100	128	131
3 (LRM)	10 (=0.625 kbps net)	48	129 - 132
4 (LRM)	20 (=2.5 kbps net)	64	129 - 132
7	50	128	131

Table 10: Radio profiles of the Thebe-II

4.3.3 Power saving modes

As the pin *TRX_DISABLE* of the Thebe-I is no more available on the Thebe-II, the low power modes are handled in a different way. The Thebe-II does not enable the possibility to switch off the radio exclusively by a pin, but offers the possibility to enter into two different sleep modes via UART command. The Thebe-II can be woken up again from any sleep mode using the *WAKE-UP* pin.

4.3.4 Boot mode

The Thebe-II needs to be set to boot mode, if a firmware update is performed. To switch the boot mode on, the *BOOT* pin has to be handled by host controller. The firmware update uses the UART interface at the dedicated module UART pins. Both, Thebe-I and Thebe-II can be connected to the ACC PC tool to perform changes in user settings and a firmware update. Please refer to the product specific details for the firmware update.

5 Metis-I to Metis-II

The Metis series is a family of 868 MHz wireless M-BUS radio modules. The Metis-I has been succeeded by the Metis-II, that scores with lower sleep, transmission and receptions currents, as well with a cleaner frequency spectrum and better blocking capabilities.

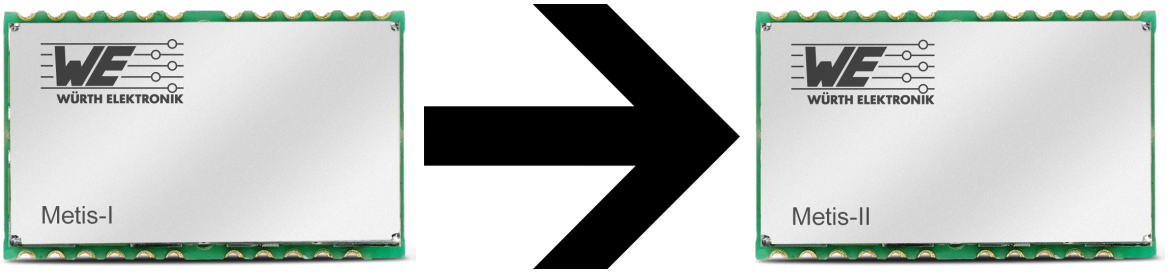


Figure 6: Metis-I to Metis-II

5.1 Summary

As the footprint, pinout and firmware functions coincide, the Metis-I can be replaced by Metis-II without any modification to the hardware design or the host controller firmware.

6 Proteus-I to Proteus-II

The Proteus series is a family of Bluetooth® LE radio modules. The Proteus-I has been succeeded by the Proteus-II, that scores with additional Bluetooth® 5.0 related features.

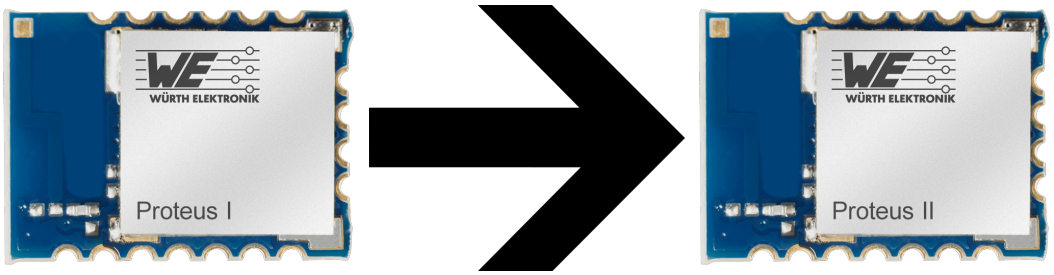


Figure 7: Proteus-I to Proteus-II

6.1 Summary

As the footprints and pinouts coincide and the Proteus-II includes all features of Proteus-I, the Proteus-I can be replaced by Proteus-II without any change in the hardware design. If needed, the host controller firmware can be extended by including the following new Bluetooth® 5.0 functions of the Proteus-II:

- Option to enable the high throughput mode with 4 times the original throughput and data packets of 964 bytes.
- New commands to set up the radio to 2 Mbit data rate mode.

Both, the Proteus-I and Proteus-II are available with integrated PCB-antenna or antenna pin to connect an external antenna. Depending on the Proteus-I variant, the right Proteus-II variant shall be chosen to achieve same ranges.

7 Proteus-II to Proteus-III

The Proteus series is a family of Bluetooth® LE radio modules. The Proteus-I has been succeeded by the Proteus-II, that scores with additional Bluetooth® 5.0 related features. Both are succeeded by the Bluetooth® 5.1 radio module Proteus-III.

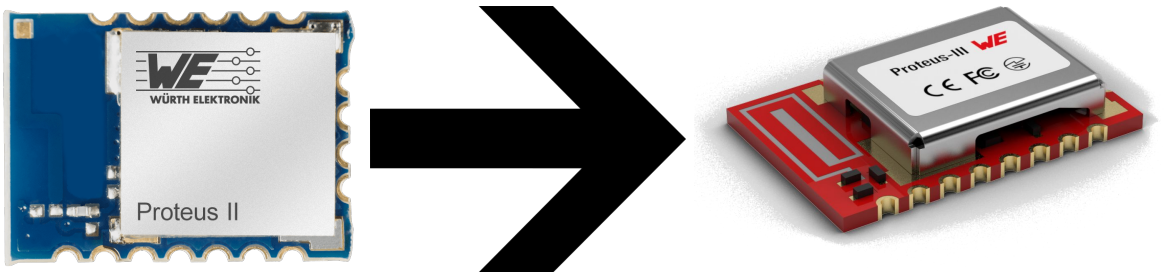
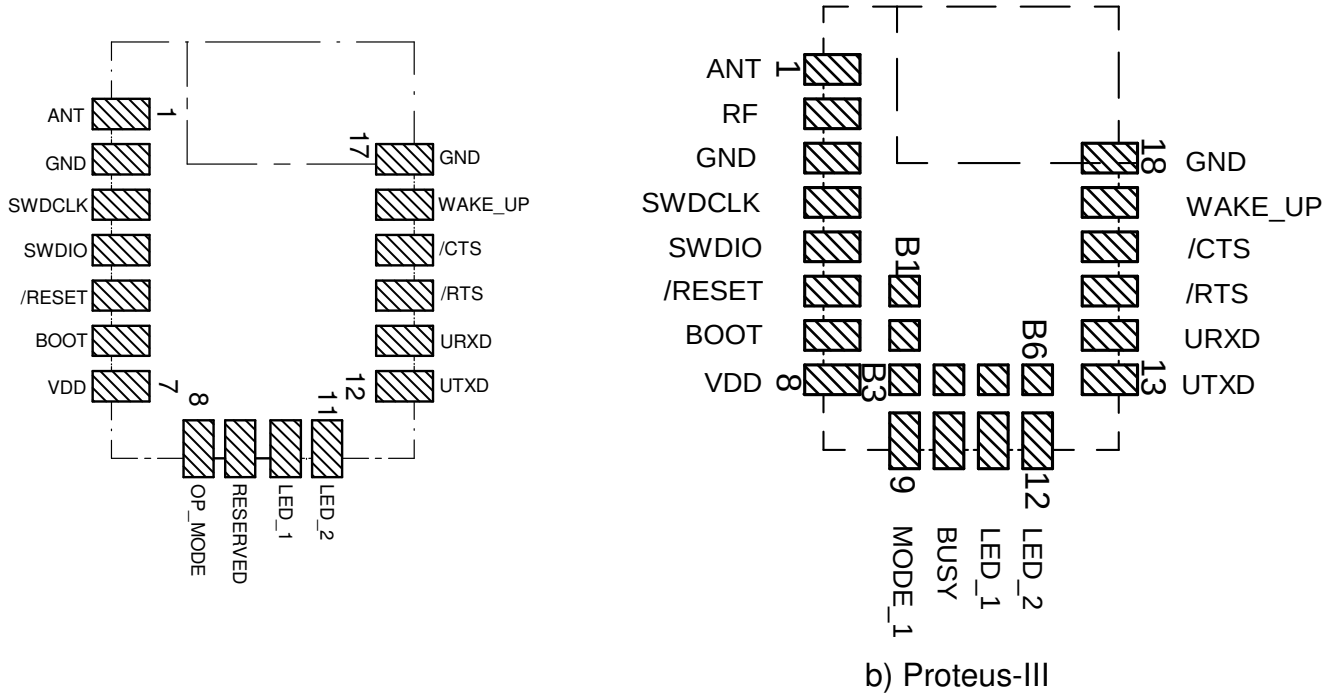


Figure 8: Proteus-II to Proteus-III

7.1 Summary

The Proteus-III has been designed in a way that the footprint and pinout matches the one of the Proteus-II. Under certain conditions the Proteus-II can be replaced by the Proteus-III without hardware modification of the base PCB.
The firmware of the Proteus-III includes additional features and improvement of existing features. Therefore, the host firmware shall be updated if new or improved functions of the Proteus-III shall be used.



a) Proteus-II

b) Proteus-III

Figure 9: Pinout

7.2 Hardware adaption

7.2.1 Foot print

In comparison to the Proteus-II, the Proteus-III has one additional pin on the left edge, which increases the length to 12×8×2 mm. Six more additional pins have been added on the bottom side of the Proteus-III.
If a design has been made for Proteus-II, the footprint matches the Proteus-III, if no underlying non-insulated copper area touches the new *B1-B6* and *ANT* pins of the Proteus-III. Due to the increase size of the Proteus-III by 1 mm, the base PCB must be large enough to solder the new module.

7.2.2 Pinout

Although the Proteus-II and Proteus-III share the same footprint, some of the pin functions differ on the new hardware platform.

Pin No	Proteus-II	Pin No	Proteus-III	Comment
2	*GND*	3	*GND*	Ground
3	*SWDCLK*	4	*SWDCLK*	Serial wire clock (SWD Interface).
4	*SWDIO*	5	*SWDIO*	Serial wire input/output (SWD Interface).
5	*/RESET*	6	*/RESET*	Reset pin.
6	*BOOT*	7	*BOOT*	Boot pin.
7	*VDD*	8	*VDD*	Supply voltage
8	*OP_MODE*	9	*MODE_1*	Operation mode pin to switch between Command Mode and Peripheral only Mode.
10	*LED_1*	11	*LED_1*	Indicates the module state.
11	*LED_2*	12	*LED_2*	Indicates the module state.
12	*UTXD*	13	*UTXD*	UART Transmission.
13	*URXD*	14	*URXD*	UART Reception.
14	*/RTS*	15	*/RTS*	UART /RTS signal.
15	*/CTS*	16	*/CTS*	UART /CTS signal.
16	*WAKE_UP*	17	*WAKE_UP*	Wake-up will allow leaving the system-off mode or re-enabling the UART.
17	*GND*	18	*GND*	Ground

Table 11: Pins with same functions on both, Proteus-II and Proteus-III

Pin No	Proteus-II	Pin No	Proteus-III	Comment
-	-	1	*ANT*	Connection to the internal PCB antenna.
1	*ANT*	2	*RF*	Pin providing the radio signal.
9	RESERVED	10	*BUSY*	Indicates on the Proteus-III if module is busy with data transmission when using Peripheral only Mode.
-	-	B1	RESERVED	Pin for remote GPIO access.
-	-	B2	RESERVED	Pin for remote GPIO access.
-	-	B3	RESERVED	Pin for remote GPIO access.
-	-	B4	RESERVED	Pin for remote GPIO access.
-	-	B5	RESERVED	Pin for remote GPIO access.
-	-	B6	RESERVED	Pin for remote GPIO access.

Table 12: Pins of the Proteus-II and Proteus-III, that have different functions

Besides the differences in the antenna configuration that is addressed in the following chapter, the only function change is the presence of the *BUSY* pin on the Proteus-III. This pin indicates, when the module is ready for radio transmission. If the pin level is high, the radio

module is busy.
In Proteus-II the pin number of the *BUSY* pin has been marked as "reserved, do not connect". Thus, it's possible to replace a Proteus-II by Proteus-III without forcing an increased current consumption at this pin.

7.2.3 Antenna

The Proteus-II has been available in two variants. Variant one is providing the radio signal on the *ANT* pin to connect an external antenna. Variant two uses the internal PCB antenna, where the *ANT* pin has no function. In contrast, the Proteus-III combines both variants. The *RF* pin provides the radio signal, where the *ANT* pin can be used to access the internal PCB antenna. This means, that either an external antenna can be connected to the *RF* pin, or a shortcut between the *RF* and *ANT* pin must be created on the base PCB to use the internal PCB antenna.

7.3 Host firmware adaption

In comparison to the firmware of the Proteus-II, the Proteus-III contains new Bluetooth® features as well as improved features, that already existed on Proteus-II.
New features are:

- Commands to switch Proteus-III GPIOs via remote access.
- Option to enable connection setup and data transmission in long range mode (LE Coded).
- Option to receive beacons (iBeacon, Eddystone beacon) from other devices than Proteus radio modules.
- Option to choose between different contents of the advertising packet.
- Additional security modes for pairing: LescPasskey mode (enter a secure generated pass key) and LescNumComp mode (compare two secure generated pass keys).

The following features changed:

- Extended user setting `RF_ConnectionTiming` to allow finer selection of the timing behavior.
- Extended user setting `RF_ScanTiming` to allow finer selection of the timing behavior.
- Replaced the user settings `UART_Flags` and `UART_BaudrateIndex` by `UART_ConfigIndex`.

In case one of the above features is used in host controller firmware, it must be updated.

8 AMB2520 to Thalassa

The AMB2520 is a 2.4 GHz proprietary radio module. It has been replaced by the Thalassa, that is still conform with the current radio regulations.

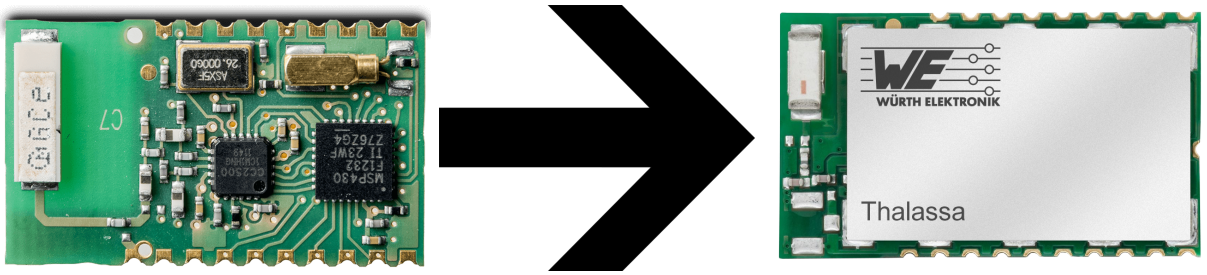


Figure 10: AMB2520 to Thalassa

8.1 Summary

In comparison to the AMB2520, the Thalassa contains one additional pin i1. If this pin does not touch any underlying non-insulated copper area, the AMB2520 can be exchanged by the Thalassa without any modification.

8.2 Hardware adaption

8.2.1 Foot print

Both, the AMB2520 and Thalassa have the same dimensions of 16×27.5×3.2 mm with the pins located at the same positions. The only change in the footprint is the presence of one additional pin (i1) of the JTAG interface on the Thalassa.
If a design has been made for AMB2520, the footprint matches the Thalassa, if no underlying non-insulated copper area touches the JTAG pin i1 of the Thalassa.

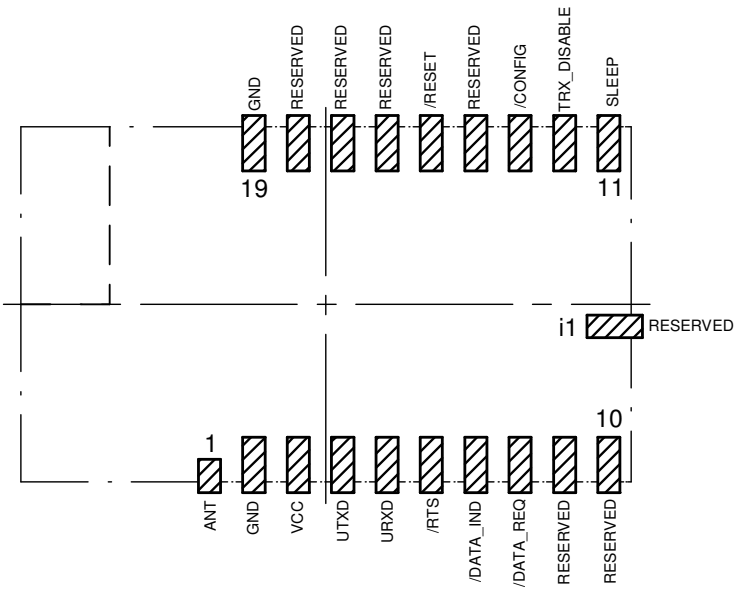


Figure 11: Universal footprint

8.2.2 Pinout

The pinout of both, the AMB2520 and Thalassa is the same.

8.2.3 Antenna

The Thalassa is available in two hardware variants. The first variant provides the radio signal at the *ANT* pin, the same as the AMB2520. Using this variant an external antenna matched to 50 Ω can be connected at this pin.
The second variant of the Thalassa offers an internal PCB antenna. Using this variant the *ANT* pin has no function and can be left open. No external antenna has to be connected.

8.3 Host firmware adaption

The firmware of both, the AMB2520 and Thalassa is the same. Thus there is no need to update the host controller's firmware.

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