Preliminary

Panasonic
INDUSTRY

PAN1781

Migration from PAN1762 to PAN1781

Migration Guide

Rev. 0.1

Wireless Connectivity

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1 About This Document

1.1 Purpose and Audience

This Migration Guide contains useful information for customers that want to know the differences between PAN1762 and PAN1781 or want to migrate an existing product from PAN1762 to PAN1781.

It is intended for hardware and software engineers working on the development of PAN1781-based products.

1.2 Revision History

Revision	Date	Modifications/Remarks
0.1	2020-11-16	First preliminary version

1.3 Use of Symbols

Symbol	Description
	**Note** Indicates important information for the proper use of the product. Non-observance can lead to errors.
	**Attention** Indicates important notes that, if not observed, can put the product's functionality at risk.
	**Tip** Indicates useful information designed to facilitate working with the module and software.
⇨ [chapter number] [chapter title]	**Cross Reference** Indicates cross references within the document. **Example:** Description of the symbols used in this document ⇨ 1.3 Use of Symbols.

1.4 Related Documents

For related documents please refer to the Panasonic website ⇨ 6.2 Product Information.

2 Overview

The PAN1762 module is not recommended for new designs since end of August 2020.

The PAN1781 module is the designated successor, which can be integrated in an existing design with minimal changes.

Because of the switch from the chip supplier Toshiba to Nordic Semiconductor, existing applications must be ported from the Toshiba Bluetooth® SDK to the Nordic SDK.

For related documents please refer to ⇨ 6.2 Product Information.

3 Details Comparison

3.1 Features

Function	PAN1762	PAN1781	Comment
Dimensions (in mm)	15.6 × 8.7 × 1.9	15.6 × 8.7 × 2	+0.1 mm height ⇨ 3.2.1 Pin Assignment
Processor	Cortex®-M0 at 16 MHz	Cortex-M4 at 64 MHz	⇨ 3.3 General Architecture
Memory	128 kB flash	256 kB flash	Not comparable ⇨ 3.6 ROM, RAM, and Flash Memory
	Approximately 70 kB RAM	32 kB RAM	
Bluetooth Stack	ROM (built-in), Bluetooth 5	Stored in flash multiple versions	Stack and features can now be updated. For new features see ⇨ 4 New Features
Bootloader	ROM (built-in)	Stored in flash	Can be customized ⇨ 3.7 Bootloader
Over-the-air (OTA) Update	Minimal concept	Sophisticated solution	⇨ 3.8 Over-the-Air Update
Internal Temperature Sensor	No	Yes	⇨ 3.9.2 Temperature Sensor
GPIO‘s	18	16	More flexible function routing ⇨ 3.9.1 Function Routing
UART	2	1	
ADC	5	-	Internal temperature sensor ⇨ 3.9.2 Temperature Sensor
COMP	-	1	Use COMP instead of ADC ⇨ 3.9.3 Comparator (COMP) vs. Analog-to-Digital-Conversion (ADC)
SPI	2	2	
I^2C	2	2	
PWM	4	-	Emulation via timer possible
QDEC	-	1	

3.2 Module Pins

3.2.1 Pin Assignment

The following table compares both pin assignments and notes the changes to be made.

Pin No.	PAN1762	PAN1781
A1	GND	GND
A2	GPIO3	P0.03/AIN1
A3	RESET	nRESET

Pin No.	PAN1762	PAN1781
A4	n.c.[1]	n.c.
A5	V_{CC}	V_{CC}
A6	V_{CC}	V_{DDH}
A7	GND	GND
A8	GPIO16	P0.16
A9	GND	GND
A11	GND	GND
A12	GND	GND
B1	GPIO9/I^2C-SCL2	P0.29
B2	GPIO4	P0.04/AIN2
B3	n.c.	n.c.
B4	n.c.	n.c.
B5	GPIO7/UART RTS	UART_RTS
B6	GPIO8/UART CTS	UART_CTS
B7	GPIO17	n.c.
B8	n.c.	n.c.
B9	n.c.	n.c.
C1	n.c.	n.c.
C2	n.c.	n.c.
C3	GPIO10/I^2C-SDA2	P0.05/AIN3
C4	SWDIO	SWDIO
C5	SWDCLK	SWDCLK
C6	GPIO1	P0.15
C7	n.c.	n.c.
C8	GND	GND
C9	GND	GND
D1	n.c.	n.c.
D2	n.c.	n.c.
D3	n.c.	n.c.
D4	GPIO0	n.c.
D5	n.c.	n.c.
D6	GPIO15	n.c.
D7	GND	GND
D8	GND	GND
D9	n.c.	GND

[1] Not connected

Pin No.	PAN1762	PAN1781
E1	GPIO12/I²C-SDA2	P0.14
E2	GPIO11/I²C-SCL2	P0.20
E3	n.c.	V_{BUS}
E4	n.c.	n.c.
E5	SLPXOIN	n.c.
E6	GPIO6/UART1-RX	UART_RXD
E7	n.c.	n.c.
E8	GND	GND
E9	GND	GND
F1	GND	GND
F2	n.c.	n.c.
F3	n.c.	DP
F4	n.c.	DN
F5	GPIO14	P0.02/AIN0
F6	GPIO2	P0.17
F7	GPIO5/UART1-TX	UART_TXD
F8	GPIO13	P0.28
F9	GND	GND
F10	n.c.[2]	n.c.
F11	GND	GND
F12	GND	GND

3.2.2 Pin Differences

Pin A5 and A6

On PAN1762 pin A6 is: V_{CC}; on PAN1781 pin A6 is: V_{DDH}.

Rules for A5 on PAN1781 (V_{CC})

- Connect to V_{CC} (1.7 V to 3.6 V) in Normal Voltage Mode (e.g. 3.3 V).
- Leave open in High Voltage Mode, e.g. do not connect if 5 V USB voltage is connected to pin A6.

Rules for A6 on PAN1781 (V_{DDH})

- Connect to V_{CC} (1.7 V to 3.6 V) in Normal Voltage Mode (e.g. 3.3 V).
- Connect 2.5 V to 5.5 V in High Voltage Mode (e.g. 5 V USB voltage).

[2] On PAN1762 the pin F10 does not exist. For PAN1781 pin F10 must be unconnected.

Pin D9

On PAN1762 pin D9 is: ANT; on PAN1781 pin D9 is: GND.

For PAN1781 connect Pin D9 to GND.

Pin E3

On PAN1762 pin E3 is open; on PAN1781 pin E3 is: V_{BUS}.

If USB should be used on PAN1781 on pin F3 and pin F4: Connect pin E3 to USB bus supply voltage.

3.3 General Architecture

PAN1762 has a rather low-end Cortex-M0 processor. The Bluetooth stack is located in ROM and can only be patched, but not updated during the lifetime of a product.

Originally the underlying chipset series only supported the so-called “host mode configuration”, where the PAN1762 would serve as a "Bluetooth companion" to a separate host processor. Therefore, PAN1762 has a feature-rich bootloader and the communication protocol is already built-in the controller. In such a configuration, the Toshiba Bluetooth SDK needed to be run on the host processor.

The chipset series gained support for the so-called “standalone mode configuration” only later, where customer-specific application code could directly be run on the Cortex-M0 processor as well.

A variant that was possible to use was called “hybrid mode”, where a customer-specific Bluetooth application would run on PAN1762 and a customer-specific protocol would allow control from a host controller via UART. The AT Command Set from Toshiba was implemented in this mode and is discussed in ⇨ 3.5 AT Command Set Support.

PAN1781 features a largely unmodified high-end Cortex-M4 microcontroller. Besides the Bluetooth radio controller all Bluetooth features are implemented in software and all microcontroller features can be fully exploited when running in standalone mode.

PAN1781 can be used in a strict host mode configuration in theory, where the Nordic Semiconductor Bluetooth SDK must be run on the host processor. There is an example code that shows this usage. That code assumes that two devices are used that use Nordic chipsets and where the Bluetooth communication is routed to from one device to the other.

In practice many porting problems can be anticipated, when this approach needs to be ported to a different processor architecture.

In practice a “hybrid mode” approach is applicable most when a separate host processor should be used. In that case the necessary Bluetooth functionality needs to be encapsulated in customer-specific code and the communication functions and protocol need to be implemented individually, depending on the use-case.

3.4 Standalone Mode Software Development Environments

For PAN1762 only IAR Embedded Workbench could be used for development which required a commercial license.

For PAN1781 a variety of options are available. IAR Embedded Workbench and Keil MDK can be used together with a commercial license. Also, Segger Embedded Studio can be used, which is the preferred development environment by Nordic Semiconductor. It can be used completely for free with a free commercial license provided by Nordic.

3.5 AT Command Set Support

For PAN1762 Toshiba provide an AT Command firmware as part of the Bluetooth SDK, to develop Bluetooth peripheral applications.

For PAN1781 no AT Command firmware is available. If a simpler access to the Bluetooth features is desired, the hybrid approach must be used as explained in ⇨ 3.3 General Architecture.

3.6 ROM, RAM, and Flash Memory

PAN1762 has the Bluetooth stack in ROM. The application is copied from flash to RAM upon boot and is executed from RAM, so RAM is used for both code and data. Some RAM is used by the Bluetooth stack, so in practice, maximum 70 kB can be used by the customer application for both code and RAM.

PAN1781 has the Bluetooth stack in flash. Different Bluetooth stacks are available depending on the use-case. A minimal peripheral-only stack with four connections (S113) is approximately 110 kB in size. Code is executed from flash; RAM is used for data only. In practice, application code can be up to approximately 146 kB and application RAM usage can be up to 32 kB, which is more than twice than PAN1762 offered.

3.7 Bootloader

PAN1762 has a built-in bootloader that can be accessed via UART. It includes flash access routines and supports Bluetooth test commands as specified by the Bluetooth Core Specification.

For PAN1781 a bootloader must be implemented as part of the overall product software. In the Bluetooth SDK, Nordic Semiconductor provides a bootloader that follows the update concept over-the-air closely and which may be modified to fit the customer's needs.

Furthermore, two separate software projects are part of the Bluetooth SDK: radio test firmware and Direct Test Mode (DTM) firmware, which handle all aspects of certification and regulatory testing.

For more information please refer to the section “Bootloader” in the Nordic Semiconductor Infocenter https://infocenter.nordicsemi.com/index.jsp.

3.8 Over-the-Air Update

For PAN1762 the Toshiba Bluetooth SDK provides a minimalist example for over-the-air update. But because security and firmware authentication are not included, this example requires significant modifications and adaptations by the customer. Only an Android update application is available, but no application for iOS®.

The Nordic Semiconductor Bluetooth SDK contains a feature-complete implementation for over-the-air update which includes security and firmware authentication if desired. Apps for Android and iOS are available from their respective app stores.

Please be aware that some of the use-cases that are possible with other Nordic Semiconductor chipsets, are not possible with PAN1781 because of the restricted flash and RAM size.

For more information please refer to the section “Device Firmware Update process” in the Nordic Semiconductor Infocenter https://infocenter.nordicsemi.com/index.jsp.

3.9 Function Differences

3.9.1 Function Routing

PAN1762 has an inflexible function routing because only a limited number of pre-selected functions can be assigned to individual pins.

PAN1781 has fully flexible function routing, where besides of the analog COMP inputs, any functionality can be routed to any pin, giving more flexibility.

3.9.2 Temperature Sensor

PAN1781 has a built-in temperature sensor which saves costs, because an external temperature sensor may not be necessary anymore, depending of the use-case of the device.

The resolution is 0.25 °C and the accuracy is given as ±5 °C.

The sensor is included in the die of the Nordic Semiconductor chipset. The sensor measures the on-die temperature, not the ambient temperature of any device.

When a product is running from a coin-cell and is in low-power mode most of the operating time, the on-die temperature draws near the ambient temperature and should be a good approximation in most of the cases.

3.9.3 Comparator (COMP) vs. Analog-to-Digital-Conversion (ADC)

While PAN1762 has full ADC capabilities, the PAN1781 only has Comparator (COMP) capabilities. In most application designs the ADC's are mainly used for ambient temperature measurements and supply voltage measurements.

The PAN1781 has a built-in temperature sensor which saves costs because an external temperature sensor is not necessary anymore. The COMP circuit supports fully flexible hysteresis in single-ended mode, so the detection of under voltage of the supply voltage is easily possible, eliminating the need for a full ADC circuit.

For more information please refer to the section "COMP Description" in the Nordic Semiconductor Infocenter https://infocenter.nordicsemi.com/index.jsp.

3.10 Low-Power Mode Handling

When used in a host mode configuration, the PAN1762 uses a fixed, built-in power mode handling which is bound to certain pins. The power mode handling controls the wake-up of the module and signal the low-power mode status of the module. When used in a standalone mode configuration, low-power modes are handled entirely automatically.

As explained in ⇨ 3.3 General Architecture, the preferred operation mode for PAN1781 is either standalone mode or hybrid mode. In these cases, the low-power mode handling is part of the customer-specific application, but largely handled by the system support code. When using hybrid mode with a separate host controller, wake-up and sleep handling must be manually implemented by the application code using some of the available GPIO pins.

3.11 Power Consumption

As of today, no measurements are available to compare the power consumption of PAN1762 and PAN1781.

As an indication, measurements from different product specifications and application notes may be compared. In the "PAN1762 Application Note" the power consumption is given for "sleep mode", "backup mode", and "deep sleep mode".

In the "PAN1780 Product Specification" the current consumption are given in "No RAM retention", "Wake on Reset", "SYS OFF", "Full RAM retention", Wake on any event", and SYS ON", which correspond to "deep sleep mode" and "sleep mode".

Because PAN1780 and PAN1781 use the same chipset family, the results are likely to be very similar. Therefore, the power consumption in the regular sleep mode is comparable, while the power consumption in the "essentially off" state is higher. If that mode is used in an existing product, it may be useful to consider a different circuitry to boot PAN1781.

PAN1762		PAN1780		Description
Sleep mode	2.5 µA	Full RAM retention	2.35 µA	Device is sleeping.
		Wake on any event		
		SYS ON		
Deep sleep mode	0.05 µA	No RAM retention	0.4 µA	Device is essentially off and must reboot.
		Wake on reset		
		SYS OFF		

3.12 Programming

3.12.1 Production

For PAN1762 the preferred method of programming in production is via UART, using the built-in bootloader. It is possible to use SWD as well, but this was introduced later, and extra care had to be taken to preserve the built-in Bluetooth device address.

For PAN1781 the only method of programming in production is SWD, which may require a change in production setup, when switching from PAN1762 to PAN1781.

3.12.2 In-Product Programming

If programming has to be done from within a product using PAN1762 and a host controller: the reset and/or power supply and a boot selector pin must be connected in the final design. Afterwards the same programming method as for production could be used.

If programming has to be done from within a product using PAN1781 and a host controller in either host mode or hybrid configuration, then a customer-specific method must be implemented. There is no bootloader or any dedicated boot or reprogram mechanism besides SWD.

4 New Features

Bluetooth Direction Finding

For an introduction of the Bluetooth Direction Finding feature please refer to https://www.nordicsemi.com/Products/Low-power-short-range-wireless/Direction-finding.

Advertising Extensions

For an introduction of the Advertising Extensions feature please refer to https://www.nordicsemi.com/News/2018/02/Bluetooth-5s-advertising-extensions.

5 Certification

For PAN1781 the following certifications are planned:

- RED (Europe)
- FCC (USA)
- ISED (Canada)
- SRRC (China)
- MIC (Japan)
- KCC (Korea)
- AS (Australia)
- NZS (New Zealand)

6 Contact Details

6.1 Contact Us

Please contact your local Panasonic Sales office for details on additional product options and services:

For Panasonic Sales assistance in the **EU**, visit

https://eu.industrial.panasonic.com/about-us/contact-us

Email: wireless@eu.panasonic.com

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https://na.industrial.panasonic.com/distributors

Please visit the **Panasonic Wireless Technical Forum** to submit a question at

https://forum.na.industrial.panasonic.com

6.2 Product Information

Please refer to the Panasonic Wireless Connectivity website for further information on our products and related documents:

For complete Panasonic product details in the **EU**, visit

http://pideu.panasonic.de/products/wireless-modules.html

For complete Panasonic product details in **North America**, visit

http://www.panasonic.com/rfmodules