AN12792

End of life TDA80xx migration path to active portfolio

Rev. 1.0 — 18 March 2020 Application note

Document information

Information	Content
Keywords	TDA, TDA8007, TDA8020, TDA8023, TDA8026, TDA8029, TDA8034, TDA8035, TDA8037, PN7412
Abstract	This document describes the path to migrate from an end of life TDA80xx to a TDA80xx or PN7412 from the active portfolio.

Revision History

Revision history

Rev	Date	Description
1.0	20200318	Initial version

1 Introduction

The 2nd generations of TDAs are end-of-life by April 2021 (last time supply). This document helps to migrate to a new, active, TDA product by listing possible configurations to replace a 2nd generation device.

Not all TDAs can be replaced with a drop-in replacement and might need software and/or hardware changes. The most crucial differences and advice are described within this document.

1.1 Linecard

Following table is a list of all TDA products with some of their key functionalities. For their full functionality have a look on the datasheets available at NXP.com.

Table 1. TDA linecard and short overview

Product Features	TDA8020	TDA8023	TDA8024	TDA8026	TDA8034	TDA8035	TDA8037	TDA8007	TDA8029	PN7412
End Of Life	**EOL**	**EOL**	**EOL**	**Active**	**Active**	**Active**	**Active**	**EOL**	**EOL**	**Active**
Analog interfaces	2	1	1	5	1	1	1	2	1	1
ISO 7816 UART	-	-	-	-	-	-	-	yes	yes	yes
µC-core	-	-	-	-	-	-	-	-	80C51RB+	Cortex-M0
ROM(byte) / RAM(byte)	-	-	-	-	-	-	-	-	16k / 768	160k / 12k
EMVCo compliance	yes	yes	-	yes	yes	yes	yes	yes	yes	yes
NDS compliance	-	-	yes	-	yes	yes	-	-	yes	-

2 Replacements

Following table lists various NXP proposed replacement configurations. Other configurations are possible but are not handled within this document.

If no drop-in replacement is available the software and hardware effort to switch can vary depending on the chosen products. Following chapters describe the necessary software and hardware changes.

Table 2. Replacement overview

	PN7412	TDA8034	TDA8035	TDA8037	TDA8026	PN7412 & TDA8034	2xTDA8035 parallel
TDA8007						• Software and hardware adaptation necessary See Section 7.3	• Software and hardware adaptation necessary See Section 5.5
TDA8020					• Software compatible • Hardware adaptation necessary See Section 3		• Software and hardware adaptation necessary See Section 5.5
TDA8023		• Software and hardware adaptation necessary See Section 4	• Software and hardware adaptation necessary See Section 5		• Software compatible • Hardware adaptation necessary See Section 3		
TDA8024		• Software compatible • Hardware adaptation necessary See Section 4	• Software compatible • Hardware adaptation necessary See Section 5	• Software compatible • Hardware adaptation necessary See Section 6			
TDA8029	• Software example for ALPAR protocol available • Hardware adaptation necessary See Section 7						

3 TDA8026

The TDA8026 is a cost-effective, analog interface for addressing multiple smart card slots in a Point of Sales (POS) terminal. It can address up to two main cards (synchronous or asynchronous smart cards supported) and up to four Security Access Modules (SAMs). The electrical characteristics of the TDA8026 are in accordance with EMV 4.3 requirements and also comply with ISO7816-3 for class A, B, and C cards.

Its packaging supports the latest payment terminal security requirements.

See product data sheet for more information: [DS-TDA8026]

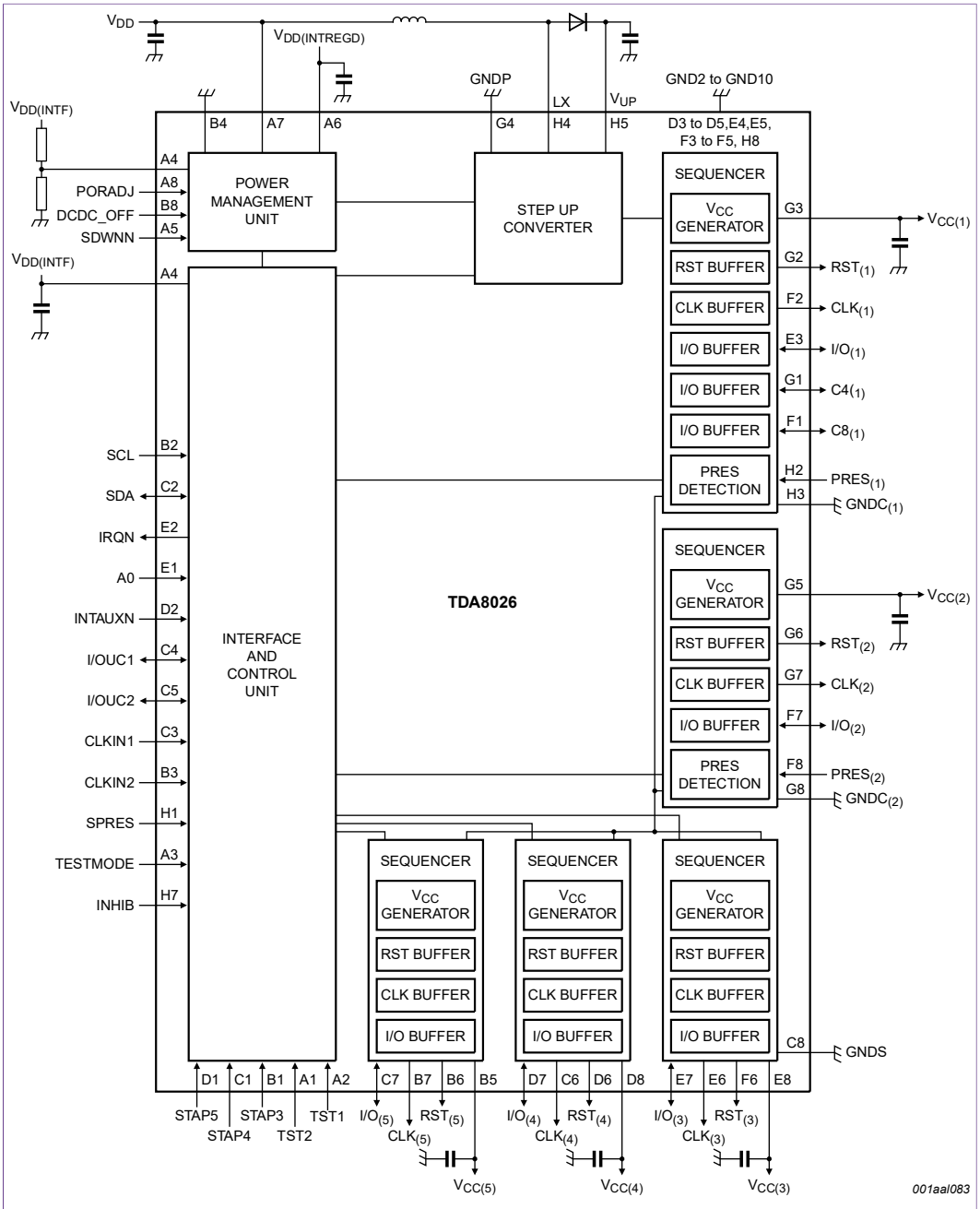

Figure 1. TDA8026 Block diagram

3.1 Feature Comparison

Table 3. Product feature comparison TDA8026, TDA8020, TDA8023, TDA8024

Product Features	TDA8026	TDA8020	TDA8023
Analog interfaces	5	2	1
ISO 7816 UART	-	-	-
ISO 7816 dedicated timers	-	-	-
µC-core	-	-	-
ROM[kbyte] / RAM[byte]	-	-	-
Host interface	I^2C	I^2C	I^2C
ESD protection on ISO pads [kV]	7	6	6
Auxiliary protected lines for C4 and C8	2	0	2
VCC card power supply [V]	1.8 & 3 & 5	3 & 5	1.8 & 3 & 5
Card supply current @ 5 V VCC [mA]	55	60	55
Card supply current @ 3 V VCC [mA]	55	55	55
Card supply current @ 1.8 V VCC [mA]	35	-	35
Card supply current @ 1.2 V VCC [mA]	-	-	-
Card clock frequency max. [MHz]	20	10	10
Card activation time max. [µs]	135	135	135
Card deactivation time max. [µs]	100	110	100
Protocol Support			
Synchronous card management	yes	-	yes
Asynchronous protocl T=0 and T=1	yes	yes	yes
Security Features			
Voltage supervisor and over current detection	yes	yes	yes
Additional product information			
Power supply interface VDDI [V]	-	1.5 - V_{DD}	1.5 - 6.5
Power supply [V]	2.7 - 5.5	2.5 - 6.5	2.7 - 6.5
Power down current max [µA]	40	150	200
Temperature range [°C]	-25 / 85	-25 / 85	-25 / 85
Package	TFBGA64	LQFP32	TSSOP28
EVMCo compliance	yes	yes	yes
NDS compliance	-	-	-

3.2 Differences TDA8020 - TDA8026

3.2.1 Summary

Table 4. TDA8020 - TDA8026 differences summary

Item	TDA8020	TDA8026	Comments
Package	LQFP32	TFBGA64	-
Low-power modes	power down inactive mode	shutdown mode standby mode clock-stop mode	TDA8026 has an exclusive pin to enter shut-down mode (SDWNN).
DC-to-DC converter	Switched-capacitor	Inductor-based switching	-
Card class support	Classes A and B (5 V and 3 V)	Classes A, B, and C (5 V, 3 V, and 1.8 V)	-
Supply voltage range	2.7 V to 6.5 V	2.7 V to 5.5 V	-
Card clock generation	10 MHz	20 MHz	-
Card clock divider	1, 2, 4 and 8	1, 2, 4 and 5	-
I2C Address selection pins	2	1	The TDA8020 has to I2C Address pins which enables to address 4 different TDA8020. Such is not offered for the TDA8026.
Presence pin	active High	active High or active Low	Configurable via pin SPRES.
Synchronous card management	No	Yes	-

3.2.2 Low-power modes

The TDA8020 only offers one power-down mode, which is similar to the Clock-stop mode of the TDA8026. The TDA8026 in addition as two more low-power modes to increase power saving.

3.2.2.1 Standby

The TDA8020 does not offer such an option. At the TDA8026 supply voltages are applied and the DC-to-DC converter is not running and card slots are not activated.

3.2.2.2 Clock-stop

This mode of the TDA8026 is similar to the 'Power down mode' of the TDA8020 when CLK = STOP LOW or CLK = STOP HIGH. This mode is triggered when a card is activated without any communication.

3.2.2.3 Shutdown

The shutdown mode is exclusive for the TDA8026 and is the very low power consumption mode, typically 25 µA. The TDA8026 enters this mode when the SDWNN pin (exclusive for the TDA8026) is driven LOW.

Only presence monitoring on card slot 1 remains enabled.

3.2.3 DC-to-DC converter

The DC-DC converter is changed from switched-capacitor DC-to-DC on the TDA8020 to inductor-based switching DC-to-DC on the TDA8026. Due to that change, a dedicated inductance of 10 µH must be placed between VDD and LX. The capacitor between SAM and SAP as well as the pins are removed due to the changed DC-to-DC concept.

See [AN10724 3.2 Using the DC-DC converter] for detailed information.

3.3 Differences TDA8023 - TDA8026

3.3.1 Summary

Table 5. TDA8023 - TDA8026 differences summary

Item	TDA8023	TDA8026	Comments
Package	TSSOP28	TFBGA64	-
DC-to-DC converter	Capacitive or inductive	inductive	
Card Slots	1	5 (2 independent)	-
Card clock up to	10 MHz	20 MHz	Both dividable by 1, 2, 4 or 5 with synchronous frequency changes
Low-power modes	Shutdown mode Inactive mode Power-down mode	Shutdown mode Standby mode Clock-stop mode	-

3.3.2 Low-power modes

3.3.2.1 Shutdown Mode

The shutdown modes of both devices, the TDA8023 and TDA8026, are comparable the same. The TDA8026 has a slightly higher power consumption while being in shutdown mode.

Table 6. Max current on I_{DD} in shutdown mode

Item	TDA8023	TDA8026
I_{DD}	10 µA	40 µA

3.3.2.2 Inactive Mode

The inactive mode of the TDA8023 is comparable to the standby mode of the TDA8026. The power consumption of the TDA8026 is slightly higher.

Table 7. Maximum current on I_{DD} in inactive mode.

Item	TDA8023	TDA8026
Power consumption max.	200 µA	450 µA

3.3.2.3 Power-down mode

At both devices in power-down, or clock-stop, mode clocks on card slots are stopped. At the TDA8026, supporting several card slots, at maximum two slots can be active at the same time, the rest is in clock-stop mode.

3.3.3 DC-to-DC converter

The TDA8023 supporting inductive and capacitive DC-to-DC converter while the TDA8026 only supports an inductive DC-to-DC converter.

Coming from an **inductive** DC-to-DC converter setup the inductor has to be changed from 6.8 µH to 10 µH.

Table 8. Inductive TDA8026 DC-to-DC compared to inductive TDA8026 DC-to-DC

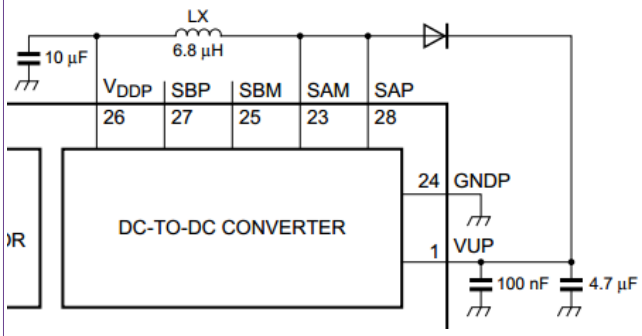

Figure 2. TDA8023 inductive DC-to-DC converter

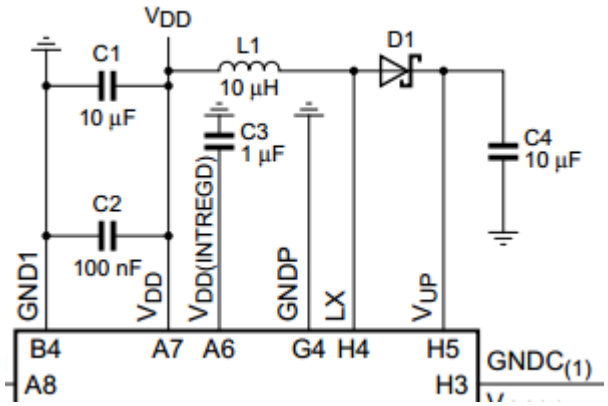

Figure 3. TDA8026 inductive DC-to-DC converter

Coming from a **capacitive** DC-to-DC converter setup a 10 µH inductor has to be placed between pin V_{DD} and pin LX. The capacitors on SBP to SBM and SAM to SAP are removed as well as the pins.

Table 9. Capacitive TDA8023 DC-to-DC compared to inductive TDA8026 DC-to-DC

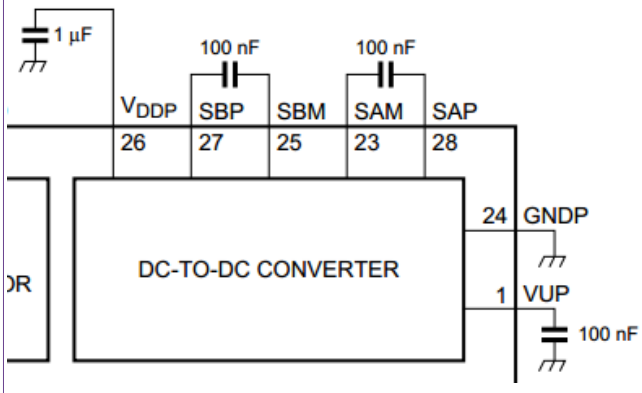

Figure 4. TDA8023 capacitive DC-to-DC converter

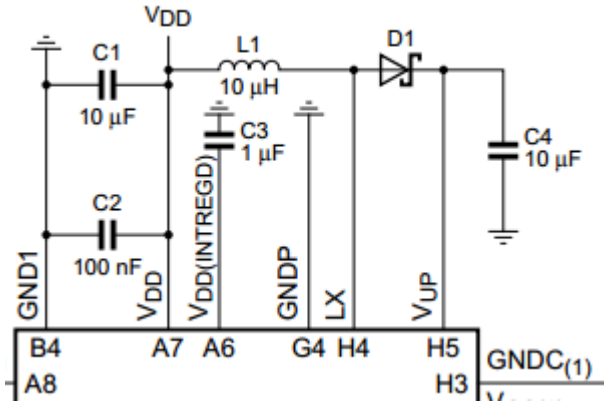

Figure 5. TDA8026 inductive DC-to-DC converter

See [AN10724 3.2 Using the DC-DC converter] for detailed information.

3.4 Application Information

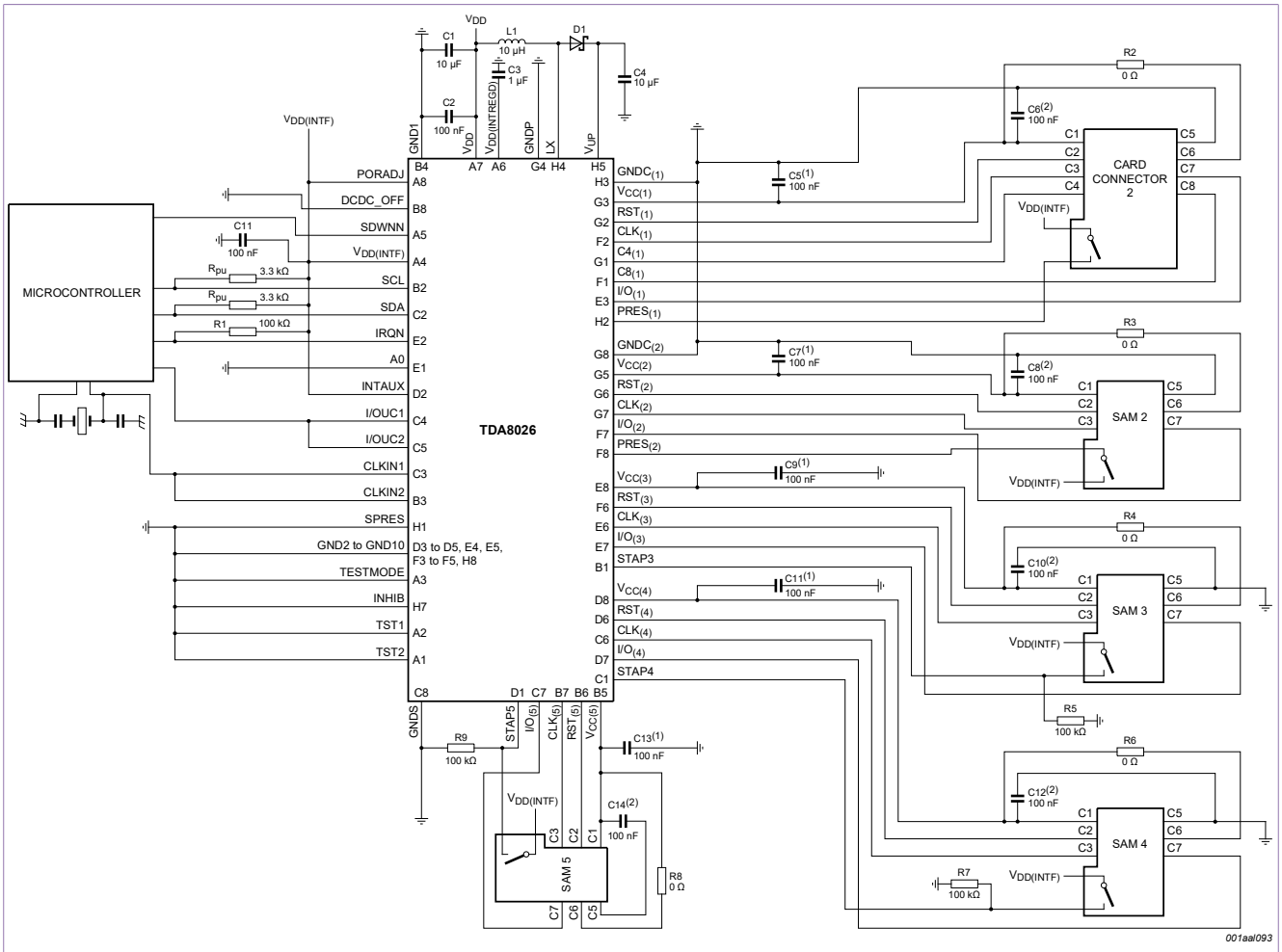

Figure 6. TDA8026 Application diagram

3.5 Product Support Package

Website: https://www.nxp.com/products/security-and-authentication/contact-readers/multiple-smart-card-slot-interface:TDA8026ET

Product data sheet: [PS_TDA8026]

User Manual: [UM10319]

- This user manual describes how to use the Cake8026_02_D, a demo board used to evaluate the TDA8026 device, a 5 slots smart cardreader.

User Manual: [UM10349]

- This document describes the way to use the Cake80xx_MBA motherboard: power supply, protocols, plug of the daughter boards, firmware.

Application Note: [AN10724]

- This application note describes the smart card interface integrated circuit TDA8026ET. This document helps to design the TDA8026 in an application. The general characteristics are presented and different application examples are described.

Application Note: [AN11079]

- This product gives a summary of all available product support packages for the contact reader ICs, the TDA family.

4 TDA8034

The TDA8034HN is a cost-effective analog interface for asynchronous and synchronous smart cards operating at 5 V, 3 V, and 1.8 V. Using few external components, the TDA8034HN provides all supply, protection, and control functions between a smart card and the microcontroller.

See product data sheet for more information: [DS-TDA8034]

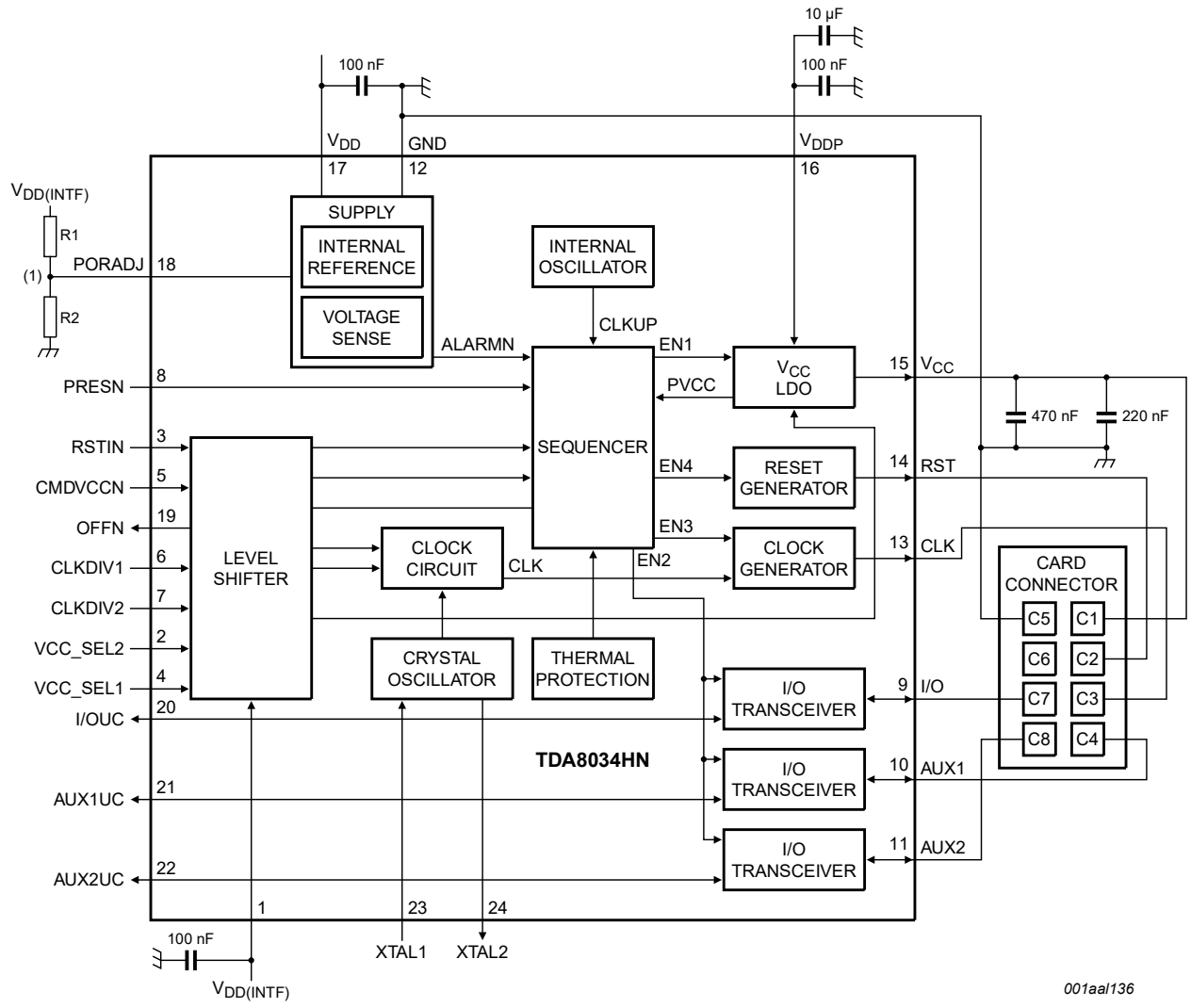

Figure 7. TDA8034 Block diagram

4.1 Feature Comparison

Table 10. Product feature comparison TDA8034, TDA8023, TDA8024

Product Features	TDA8034	TDA8023	TDA8024
Analog interfaces	1	1	1
ISO 7816 UART	-	-	-

Product Features	TDA8034	TDA8023	TDA8024
ISO 7816 dedicated timers	-	-	-
µC-core	-	-	-
ROM[kbyte] / RAM[byte]	-	-	-
Host interface	I/O lines	I^2C	I/O lines
ESD protection on ISO pads [kV]	8	6	6
Auxiliary protected lines for C4 and C8	2	2	2
VCC card power supply [V]	1.8 & 3 & 5	1.8 & 3 & 5	3 & 5
Card supply current @ 5 V VCC [mA]	65	55	80
Card supply current @ 3 V VCC [mA]	65	55	65
Card supply current @ 1.8 V VCC [mA]	65	35	-
Card clock frequency max. [MHz]	20	10	26
Card activation time max. [µs]	4160	135	220
Card deactivation time max. [µs]	250	100	100
Protocol Support			
Synchronous card management	yes	yes	-
Asynchronous protocl T=0 and T=1	yes	yes	yes
Security Features			
Voltage supervisor and over current detection	yes	yes	yes
Current protection on VCC, I/O, RST, CLK	yes	yes	yes
Additional product information			
Power supply interface VDDI [V]	1.6 - 3.6	1.5 - 6.5	-
Power supply [V]	3 - 5.5	2.7 - 6.5	2.7 - 6.5
Power down current max [µA]	12	2	-
Temperature range [°C]	-25 / 85	-25 / 85	-25 / 85
Package	HVQFN24 & SO16 & TSSOP16	TSSOP28	SO28 & TSSOP28
EVMCo compliance	yes	yes	-
NDS compliance	yes	-	yes

4.2 Differences TDA8023 - TDA8034

4.2.1 Summary

Table 11. TDA8023 - TDA8034 differences summary

Item	TDA8023	TDA8034	Comments
Package	TSSOP28	HVQFN32	-
Supply voltage min.	2.7 V	3 V	For class A cards (5 V), the supply voltage at the TDA8034 must be at least 4.85 V.
DC-to-DC converter	Capacitive or inductive follower, doubler, tripler	Low Drop-Off voltage regulator	-
Clock input max.	20 MHz	26 MHz	-
ESD protection	6 kV	8 kV	-
Card clock generation	up to 10 MHz Divider: 1, 2, 4 or 5	up to 20 MHz Divider: 1, 2, 4 or 8	-
I2C configuration interface	Yes	No	The TDA8034 is not configurable by any interface.
Low-power modes	Shutdown mode Inactive mode Power-down mode	Shutdown mode Deep shutdown mode	

4.2.2 Low-power modes

The shutdown mode of the TDA8023 is comparable the same as the shutdown mode of the TDA8034. Also the inactive mode of the TDA8023, with a slightly higher power consumption, is comparable to the deep shutdown mode of the TDA8034.

4.2.3 PRES

The presence pin connection of TDA8034 designs must be switched. Depending on the smart card connector type: normally open or normally closed. The difference coming from a TDA8023 and going to a TDA8034 is displayed below.

Table 12. Presence pin change - Card connector normally open

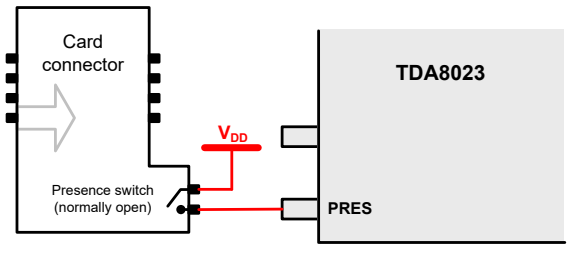

Figure 8. TDA8023 PRES normally open

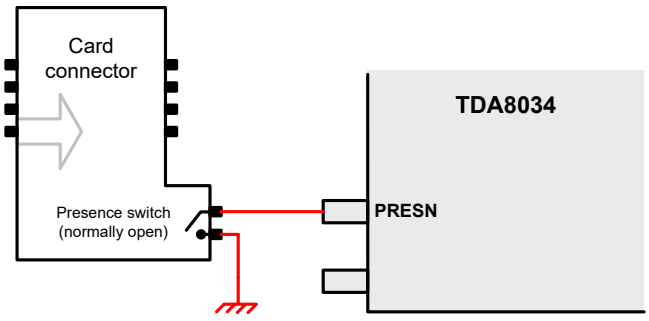

Figure 9. TDA8034 PRESN normally open

Table 13. Presence pin change - Card connector normally closed

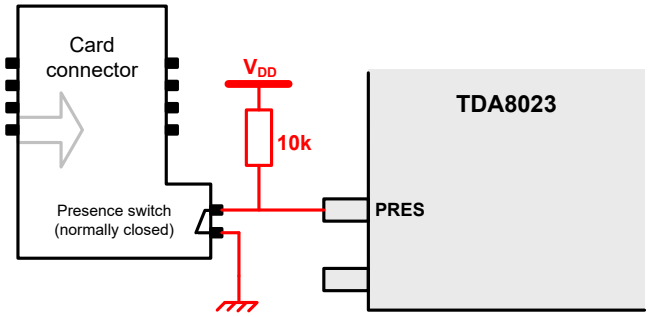

Figure 10. TDA8023 PRES normally closed

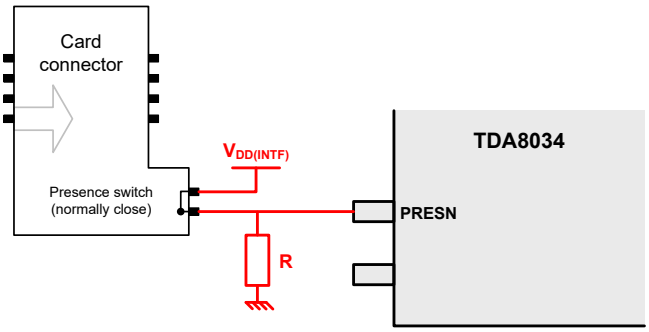

Figure 11. TDA8034 PRESN normally closed

4.2.4 DC-to-DC to LDO

The TDA8023 card power supply is either a capacitive or inductive DC-to-DC converter. The TDA8034 has an LDO for the card supply. Two capacitors, 10 µF and 100 nF, must be placed close to the LDO of the TDA8034. All other components for the supply of V_{DDP} have to be removed.

Table 14. TDA8023 DC-to-DC to TDA8034 LDO

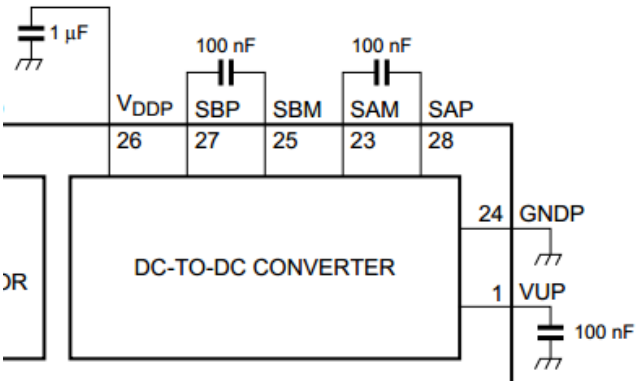

Figure 12. TDA8023 capacitive DC-to-DC

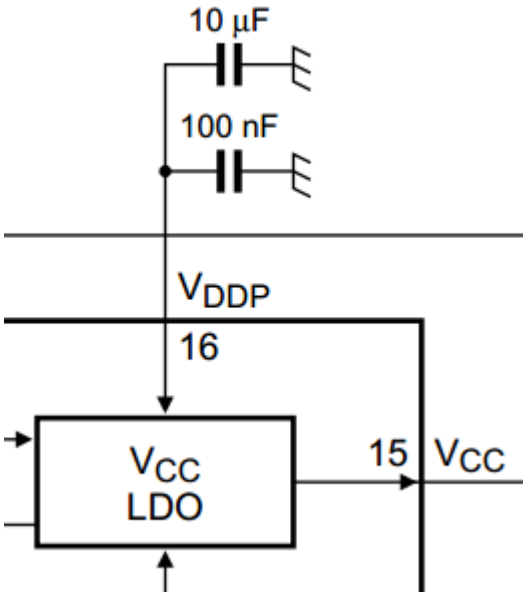

Figure 13. TDA8034 LDO

4.3 Application Information

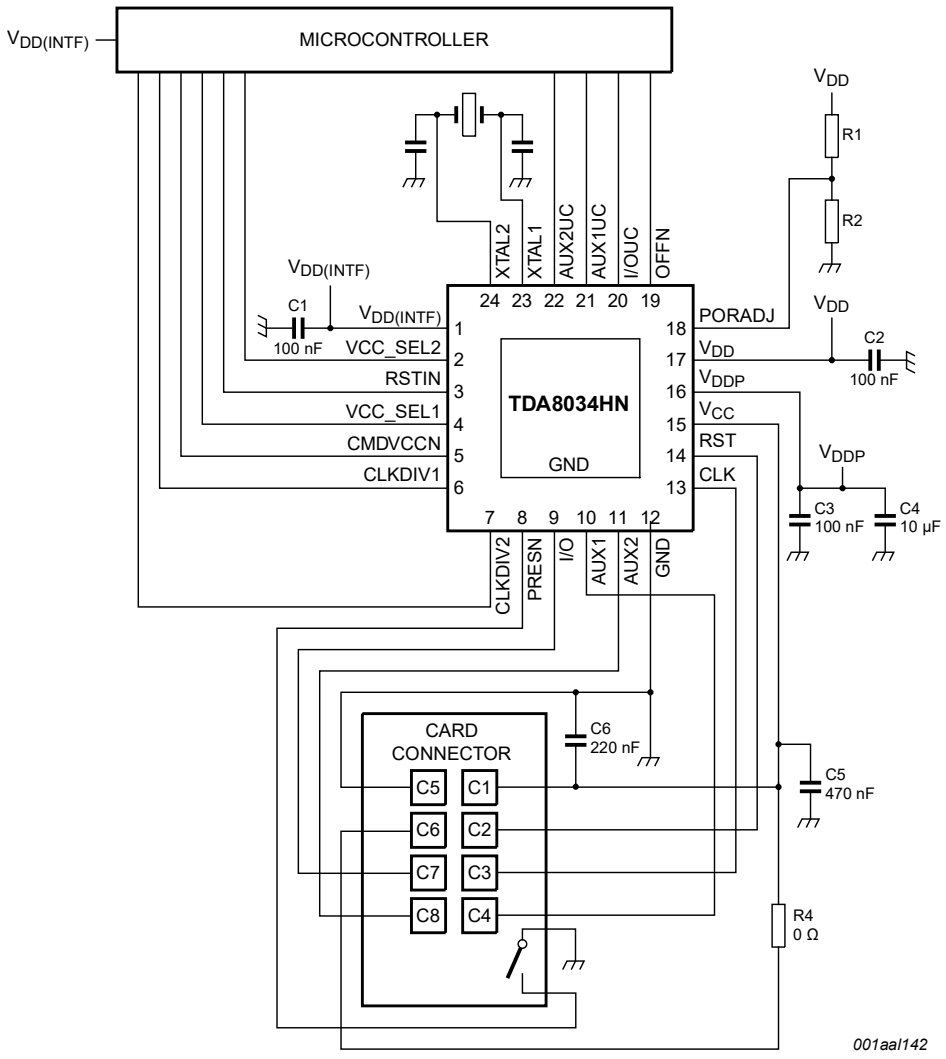

Figure 14. TDA8034 Application diagram

4.4 Product Support Package

Website: https://www.nxp.com/products/security-and-authentication/contact-readers/low-power-smart-card-interface:TDA8034

Product Data Sheet: [TDA8034HN]

Application Note: [AN10792]

- This application note describes the smart card interface integrated circuit TDA8034HN. This document helps to design the TDA8034HN in an application. The general characteristics are presented and different application examples are described.

Application Note: [AN11079]

- This product gives a summary of all available product support packages for the contact reader ICs, the TDA family.

Application Note: [AN10807]

- This application note describes the smart card interface integrated circuit TDA8034T/AT/BT. This document helps to design the TDA8034T, TDA8034AT, or TDA8034BT in an application. The general characteristics are presented and different application examples are described.

Application Note: [AN10794]

- The application note describes the Cake8034_01_D Cake8034_02_D demo boards for TDA8034: schematics, layout, and use of this board.

User Manual: [UM10349]

- This document describes the way to use the Cake80xx_MBA mother board: power supply, protocols, plug of the daughter boards, firmware.

5 TDA8035

The TDA8035 is the cost efficient successor of the established integrated contact smart card reader IC TDA8024. It offers a high level of security for the card by performing current limitation, short-circuit detection, ESD protection as well as supply supervision.

The current consumption during the standby mode of the contact reader is very low as it operates in the 3 V supply domain. The TDA8035 is therefore the ideal component for a power efficient contact reader.

See product data sheet for more information: [DS-TDA8035]

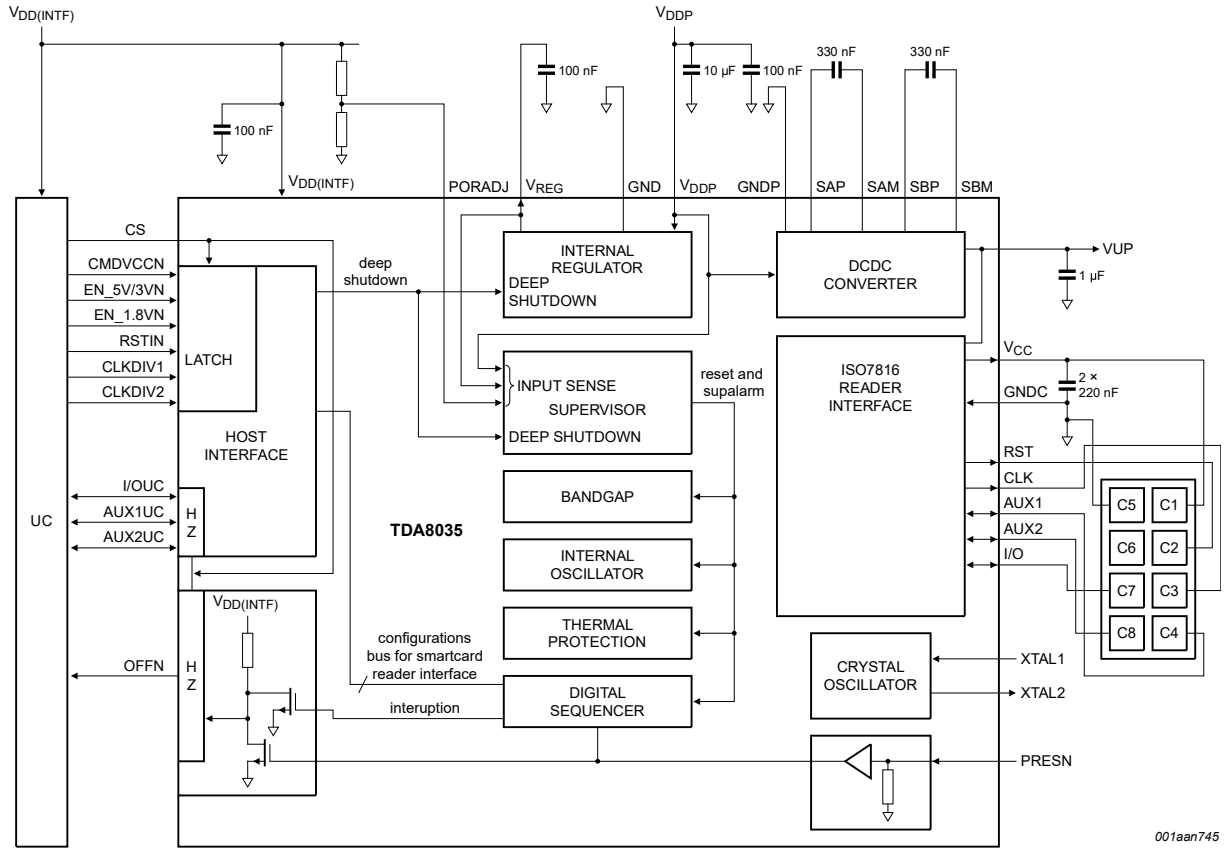

Figure 15. TDA8035 Block diagram

5.1 Feature Comparison

Table 15. Product feature comparison TDA8035, TDA8023, TDA8024

Product Features	TDA8035	TDA8023	TDA8024
Analog interfaces	1	1	1
ISO 7816 UART	-	-	-
ISO 7816 dedicated timers	-	-	-
µC-core	-	-	-
ROM[kbyte] / RAM[byte]	-	-	-

Product Features	TDA8035	TDA8023	TDA8024
Host interface	I/O lines	I^2C	I/O lines
ESD protection on ISO pads [kV]	8	6	6
Auxiliary protected lines for C4 and C8	2	2	2
VCC card power supply [V]	1.8 & 3 & 5	1.8 & 3 & 5	3 & 5
Card supply current @ 5 V VCC [mA]	65	55	80
Card supply current @ 3 V VCC [mA]	65	55	65
Card supply current @ 1.8 V VCC [mA]	35	35	-
Card supply current @ 1.2 V VCC [mA]	-	-	-
Card clock frequency max. [MHz]	20	10	26
Card activation time max. [µs]	3400	135	220
Card deactivation time max. [µs]	250	110	100
Protocol Support			
Synchronous card management	yes	yes	-
Asynchronous protocl T=0 and T=1	yes	yes	yes
Security Features			
Voltage supervisor and over current detection	yes	yes	yes
Current protection on VCC, I/O, RST, CLK	yes	yes	yes
Additional product information			
Power supply interface VDDI [V]	1.6 - 3.6	1.5 - 6.5	-
Power supply [V]	2.7 - 5.5	2.7 - 6.5	2.7 - 6.5
Power down current max [µA]	3	2	-
Temperature range [°C]	-25 / 85	-25 / 85	-25 / 85
Package	HVQFN32	TSSOP28	SO28 & TSSOP28
EVMCo compliance	yes	yes	-
NDS compliance	yes	-	yes

5.2 Differences TDA8023 - TDA8035

5.2.1 Summary

Table 16. TDA8023 - TDA8035 difference summary

Item	TDA8023	TDA8035	Comment
Package	TSSOP28	HVQFN24	-
DC-to-DC Converter	capacitive doubler, tripler, follower, or inductive	capacitive doubler, tripler, or follower	-
I²C-bus controlled IC card interface	Yes	No	The TDA8035 does not offer any configuration interface.
Low-power modes	Shutdown mode Inactive mode Power-down mode	Deep shutdown mode Shutdown mode	-

5.2.2 Low-power modes

5.2.2.1 Deep Shutdown Mode

The TDA8035 deep shutdown mode can be compared to the shutdown mode of the TDA8023. The smart card reader is inactive and the supervisors are turned off, but the presence detection is still available: The OFFN pin follows the status of presence.

To enter, or leave, the deep shutdown mode the host microcontroller has to change the state of the control pins.

Table 17. Deep shutdown mode current consumption comparison

Item	TDA8023	TDA8035
Power supply current	10 µA	3 µA

5.2.2.2 Shutdown mode

The TDA8035 shutdown mode can be compared to the inactive mode of the TDA8023. This mode is the default mode when no card is active. Supervisors are active, card presence detection is available.

Table 18. Shutdown mode current consumption comparison

Item	TDA8023	TDA8035
Power supply current	200 µA	500 µA

5.2.3 PRES

The PRESN pin on the TDA8035 is active low and the circuitry around it must be changed coming from TDA8023.

Table 19. Presence pin change - Card connector normally open

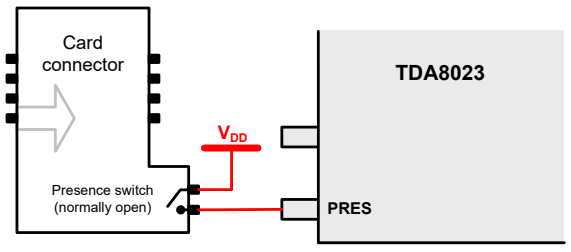

Figure 16. TDA8023 PRES normally open

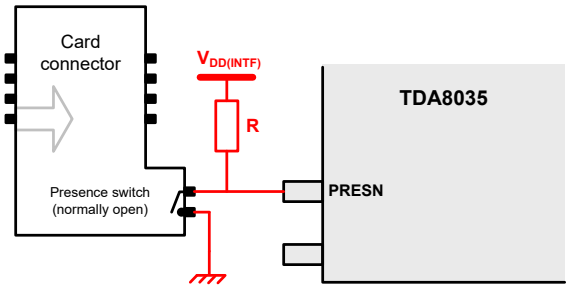

Figure 17. TDA8035 PRESN normally open

Table 20. Presence pin change - Card connector normally closed

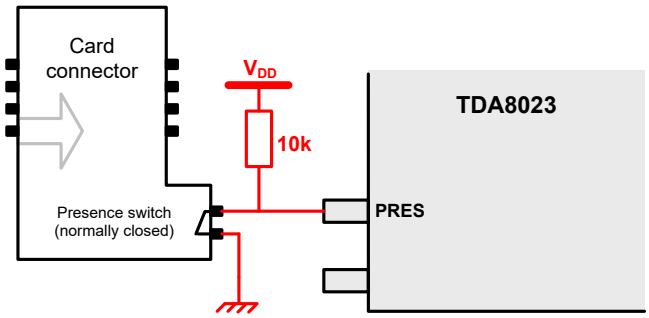

Figure 18. TDA8023 PRES normally closed

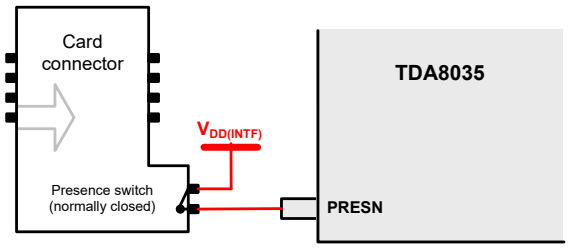

Figure 19. TDA8035 PRESN normally closed

5.2.4 DC-to-DC converter

While the TDA8023 offices the choice between a capacitive or inductive driven DC-to-DC converter the TDA8035 only can be driven capacitive. Coming from the TDA8023 with a capacitive DC-to-DC converter only the capacitor values have to be changed. Changing from an inductive DC-to-DC converter to a capacitive DC-to-DC converter involves slightly more effort in redesign.

Table 21.

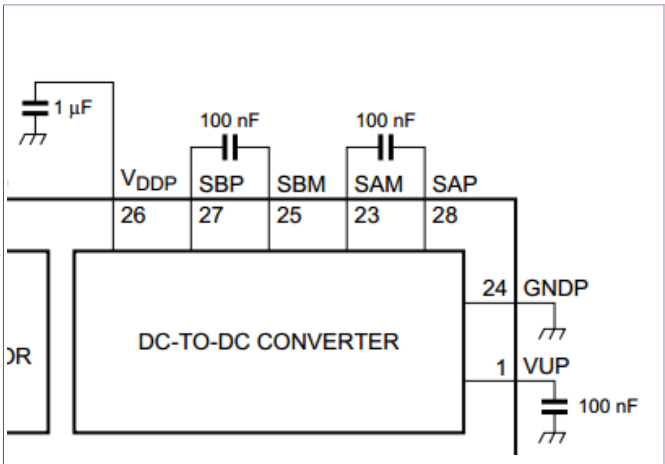

Figure 20. TDA8023 capacitive DC-to-DC

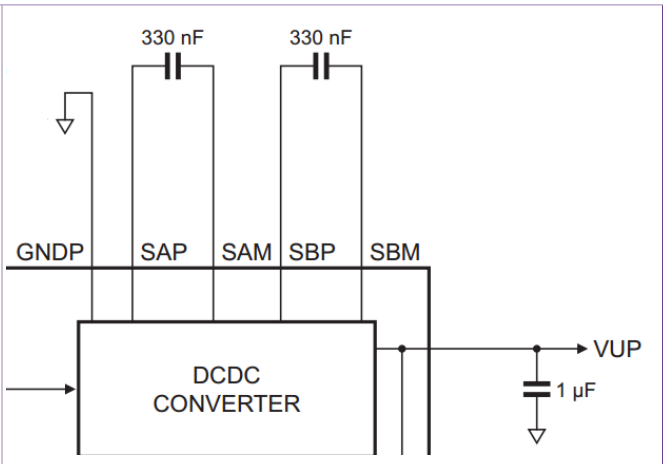

Figure 21. TDA8035 capacitive DC-to-DC

5.3 Differences TDA8024 - TDA8035

For this transition, consult following Application Note [AN11058 - Design migration from TDA8024 to TDA8035].

5.4 Application Information

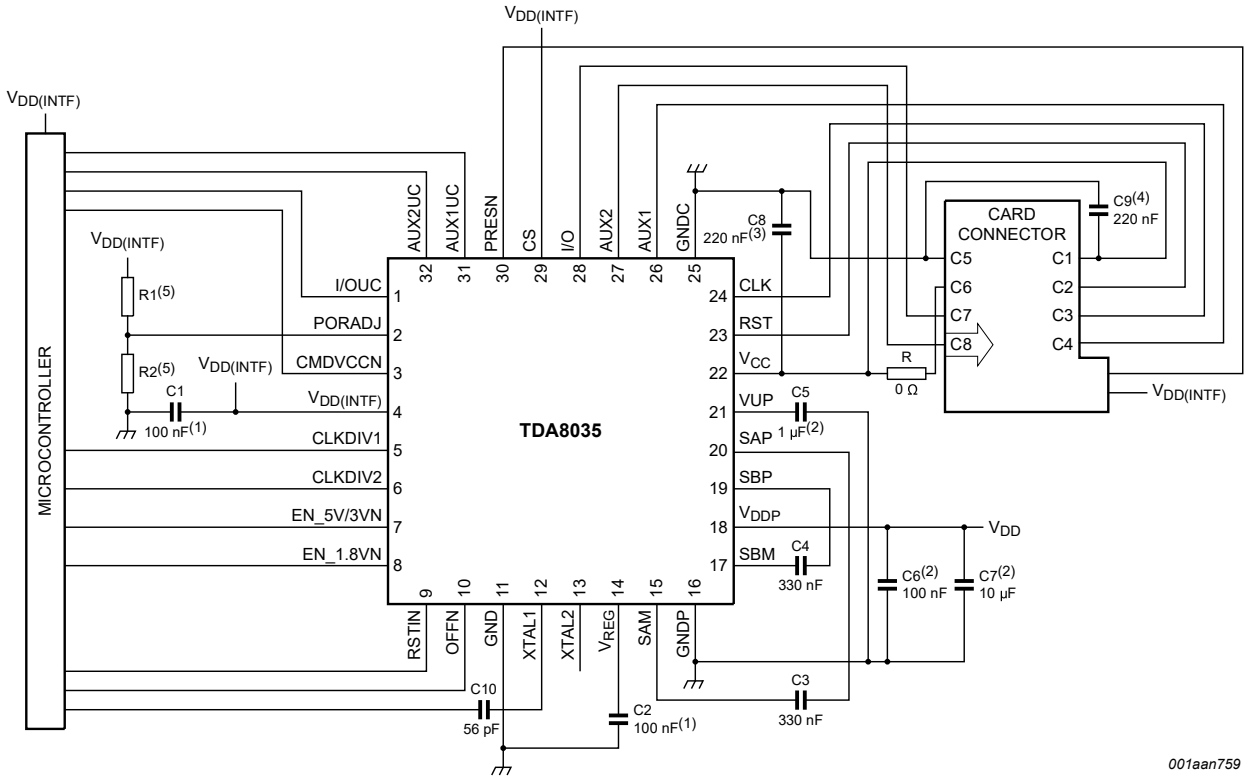

Figure 22. TDA8035 Application diagram

5.5 Two TDA8035 parallel

It is possible to cascade several devices using the same connection pins by driving its chip select (CS) pin. For further information check following application note [AN10997] chapter [4. Chip select].

Following schematic is an example on how to connect 2 TDA8035 to a single host.

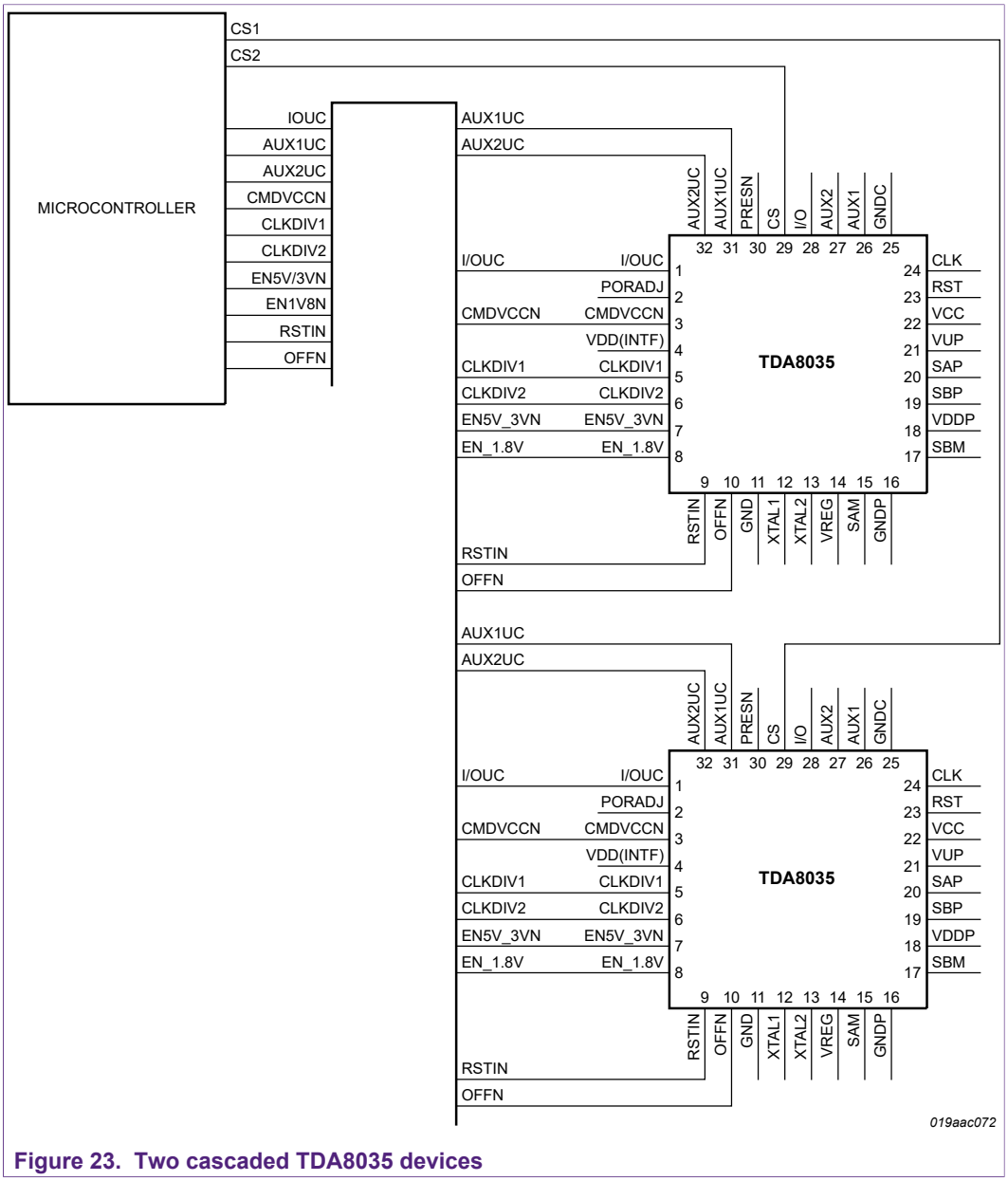

Figure 23. Two cascaded TDA8035 devices

5.6 Product Support Package

Website: https://www.nxp.com/products/security-and-authentication/contact-readers/high-integrated-and-low-power-smart-card-interface:TDA8035HN

Product data sheet: [TDA8035]

Application Note: [AN10997]

- This application note describes the smart card interface integrated circuit TDA8035HN. This document helps to design the TDA8035HN in an application. The general characteristics are presented and different application examples are described.

Application Note: [AN11079]

- This product gives a summary of all available product support packages for the contact reader ICs, the TDA family.

Application Note: [AN10999]

- The application note describes the Cake8035 demo board for TDA8035: schematics, layout, and use of this board.

Application Note: [AN11058]

- This application note describes how to migrate a design from TDA8024 to TDA8035: SW updates, HW differences, and an example based on a double layout implementation.

User Manual: [UM10349]

- This document describes the way to use the Cake80xx_MBA mother board: power supply, protocols, plug of the daughter boards, firmware.

6 TDA8037

The TDA8037 is the cost efficient successor of the established integrated contact smart card reader IC TDA8035. Operating only in the 3 V supply domain and **supporting only Class B cards** it reduces complexity and costs. If the target system operates only with Class B cards. Due to the very low power consumption in shutdown mode, it is the ideal component for a power efficient contact reader.

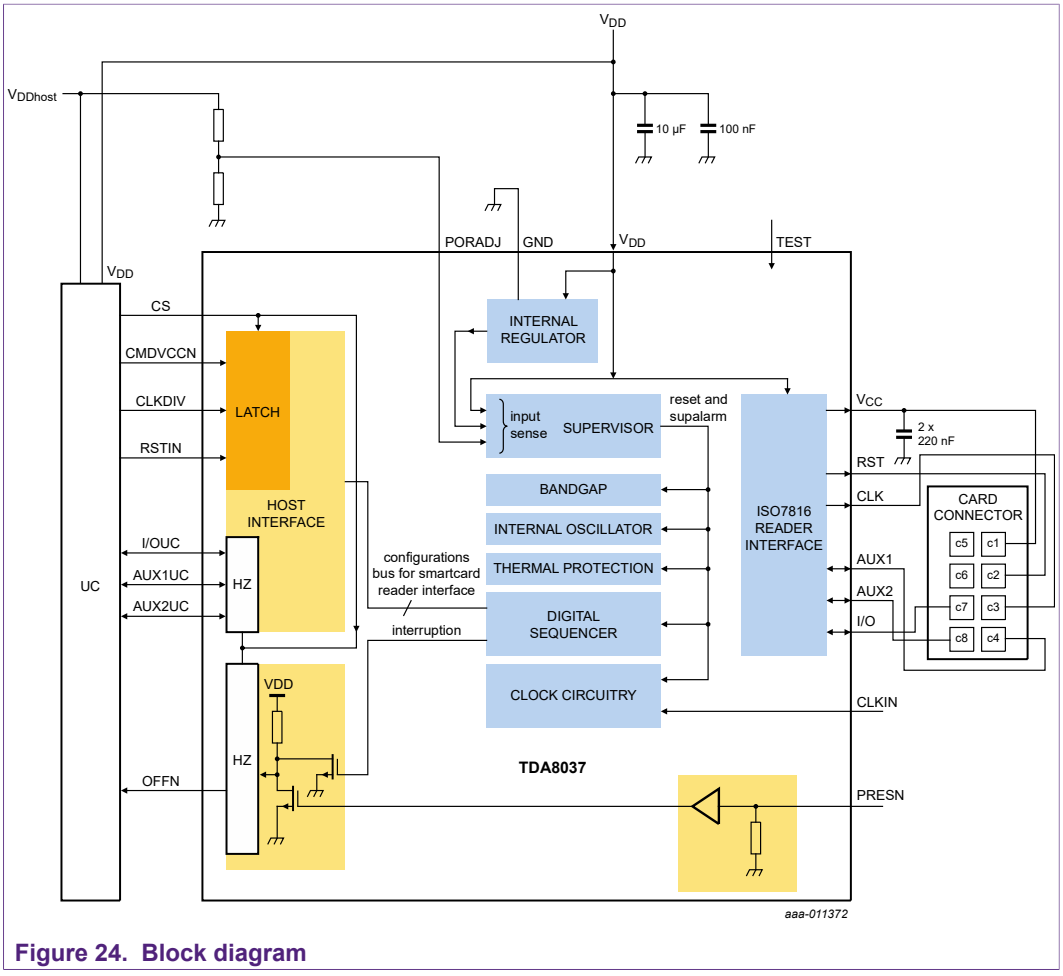

Figure 24. Block diagram

6.1 Feature Comparison

Table 22. Product feature comparison TDA8035, TDA8023, TDA8024

Product Features	TDA8023	TDA8024	TDA8035	TDA8037
Analog interfaces	1	1	1	1
ISO 7816 UART	-	-	-	-
ISO 7816 dedicated timers	-	-	-	-
µC-core	-	-	-	-
ROM[kbyte] / RAM[byte]	-	-	-	-

Product Features	TDA8023	TDA8024	TDA8035	TDA8037
Host interface	I^2C	I/O lines	I/O lines	I/O Lines
ESD protection on ISO pads [kV]	6	6	10	8
Auxiliary protected lines for C4 and C8	2	2	2	3 (C8)
VCC card power supply [V]	1.8 & 3 & 5	3 & 5	1.8 & 3 & 5	3
Card supply current @ 5 V VCC [mA]	55	80	65	-
Card supply current @ 3 V VCC [mA]	55	65	65	65
Card supply current @ 1.8 V VCC [mA]	35	-	35	-
Card supply current @ 1.2 V VCC [mA]	-	-	-	-
Card clock frequency max. [MHz]	10	26	20	10
Card activation time max. [µs]	135	220	3400	554
Card deactivation time max. [µs]	100	100	250	250
Protocol Support				
Synchronous card management	yes	-	yes	yes
Asynchronous protocl T=0 and T=1	yes	yes	yes	yes
Security Features				
Voltage supervisor and over current detection	yes	yes	yes	yes
Current protection on VCC, I/O, RST, CLK	yes	yes	yes	yes
Additional product information				
Power supply interface VDDI [V]	1.5 - 6.5	-	1.6 - 3.6	-
Power supply [V]	2.7 - 6.5	2.7 - 6.5	2.7 - 5.5	3 - 3.6
Power down current max [µA]	2	-	1	400
Temperature range [°C]	-25 / 85	-25 / 85	-25 / 85	-25 / 85
Package	TSSOP28	SO28 & TSSOP28	HVQFN32	SO28 & TSSOP16
EVMCo compliance	yes	-	yes	yes
NDS compliance	-	yes	yes	-

6.2 Differences TDA8024 - TDA8037

For the transition from TDA8024 to TDA8037, consult following application note AN11460.

6.3 Product Support Package

Website: https://www.nxp.com/products/security-and-authentication/contact-readers/low-power-3v-smart-card-interface:TDA8037

Product data sheet: [TDA8037]

Application Note: [AN11458] Design guideline for TDA8037

- This document helps to design the TDA8037 in an application. The general characteristics are presented and different application examples are described.

Application Note: [AN11460] Design migration from TDA8024 to TDA8037T

- This application note describes how to migrate a design from TDA8024 to TDA8037: SW updates, HW differences, and an example based on a double layout implementation.

Application Note: [AN11459] Application with TDA8037 - Demonstration board description

- The application note describes the Cake8037 demo boards for TDA8037T and TDA8037TT: schematics, layout, and use of this board.

User Manual: [UM10349]

- This document describes the way to use the Cake80xx_MBA mother board: power supply, protocols, plug of the daughter boards, firmware.

7 PN7412

The PN7412 is part of the PN7462 family having a 32-bit Cortex-M0-based microcontroller, offering high performance, and low power consumption. The contact interfaces offer a high level of security for the card by performing current limiting, short-circuit detection, ESD protection as well as supply supervision. An additional UART output is also implemented to address applications where more than one contact card slot is needed. It enables an easy connection to multiple smart card slot interfaces like TDA8026, TDA8034, and others.

It provides thermal and short-circuit protection on all card contacts. It also provides automatic activation and deactivation sequences initiated by software or hardware.

See product data sheet for more information: [DS-PN7412]

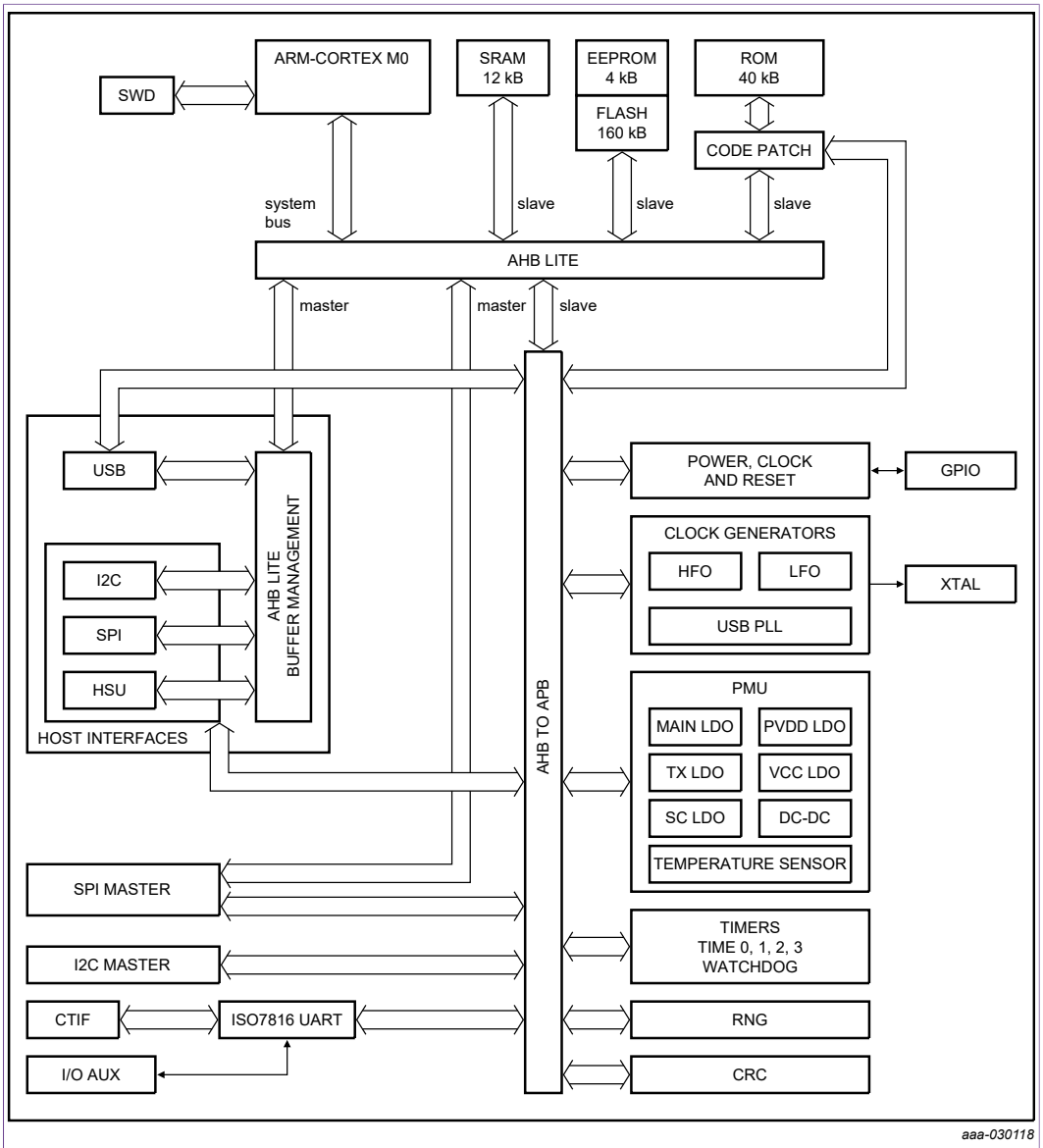

Figure 25. PN7412 Block diagram

7.1 Feature Comparison

Table 23. Product feature comparison PN7412, TDA8007, TDA8020, TDA8029

Product Features	PN7412	TDA8029
Analog interfaces	1	1
ISO 7816 UART	yes	yes
ISO 7816 dedicated timers	yes	yes
µC-core	Cortex-M0	80C51RB+
ROM[kbyte] / RAM[byte]	160 / 12000	16 / 768
Host interface	SPI, UART, I^2C, USB	serial or I^2C
ESD protection on ISO pads [kV]	8	6
Auxiliary protected lines for C4 and C8	2	0
VCC card power supply [V]	1.8 & 3 & 5	1.8 & 3 & 5
Card supply current @ 5 V VCC [mA]	60	65
Card supply current @ 3 V VCC [mA]	55	50
Card supply current @ 1.8 V VCC [mA]	35	30
Card supply current @ 1.2 V VCC [mA]	-	-
Card clock frequency max. [MHz]	13.56	20
Card activation time max. [µs]	2200	225
Card deactivation time max. [µs]	250	100
Synchronous card management	yes	yes
Asynchronous protocl T=0 and T=1	yes	yes
Voltage supervisor and over current detection	yes	yes
Current protection on VCC, I/O, RST, CLK	yes	yes
Power supply [V]	2.3 - 5.5	2.7 - 6.0
Power down current max [µA]		20
Temperature range [°C]	-40 / +85	-25 / +85
Package	HVQFN64	LQFP32
EVMCo compliance	yes	yes
NDS compliance	-	yes

7.2 Differences TDA8029 - PN7412

7.2.1 Summary

Table 24. TDA8029 - PN7412 differences summary

Item	TDA8029	PN7412	Comments
Package	LQFP32	HVQFN64	-
DC-to-DC converter	doubler, tripler, or follower	doubler or follower	-
Inactive Modes	4 modes available: Stop clock, Shut-down, Power-down, and Sleep mode	2 modes available: Standby and Hard Power Down	-
ALPAR Protocol	Fully implemented	Demo example	-
Activation time	130 µs	up to 22 ms	-
Maximum card clock	20 MHz	13.56 MHz	-
WakeUpSlave	INT1_N	Configurable	The PN7412 wake-up source can be configured to nearly every pin.
SlaveI2CMute	P27	Configurable	Any GPIO of the PN7412 can be utilized for this matter.
Power-On Reset delay	CDEL pin configurable per capacitor value.	Not offered	-

7.2.2 Low-power modes

7.2.2.1 Hard Power Down

This hard power-down mode is the deepest power-down mode and consumes the least amount possible. The PN7412 hard power-down mode is similar to the Shut-down mode of the TDA8029. The card is deactivated, all clocks are stopped, all LDOs are turned off, except the MLDO which is set to low-power mode.

The behavior of RST_N and SDW_N in this case is the same. If the supply voltage is sufficient and RST_N gets high the PN7412 exits the Hard Power-down mode.

7.2.2.2 Standby

The PN7412 deactivates a contact card before entering standby. This mode is in contrast of the TDA8029 sleep mode which holds the card active via clock-stop. While being in standby, several wake-up sources can be set. Such as the insertion of a contacted card or activity on the host interface.

7.2.3 ALPAR protocol

As host communication protocol the TDA8029 implements 'ALPAR'. For the PN7412, a software example with a few mandatory commands implemented is available on request. The PN7412 with Cortex-M0 and 160 kByte flash opens up the possibility to implement additional commands and logic.

The ALPAR protocol is explained in AN [AN10207].

Table 25. PN7412 implemented commands

Command	Code	Expected command [hex]
power_up_5V	6Eh	60 00 01 6E 01 0E
power_off	4Dh	60 00 00 4D 2D
check_pres_card	09h	60 00 00 09 69
card_command (APDU)	00h	60 xx xx 00 xx xx .

Table 26. PN7412 implemented error codes

Status code	Meaning	Complete Frame [hex]
55h	Unknown command	E0 00 00 55 B5
80h	Card mutes	E0 00 01 6E 80 0F
00h	Activation failed	E0 00 01 6E 00 8F

7.3 PN7412 and TDA80XX

The PN7412 family can handle more than one smart card by controlling an extra contact interface front-end (TDA). Consolidate User Manual [UM10858] chapter [13.5 Connect an external TDA] for further information.

For one additional slot, the TDA8034 or TDA8035 can be used.

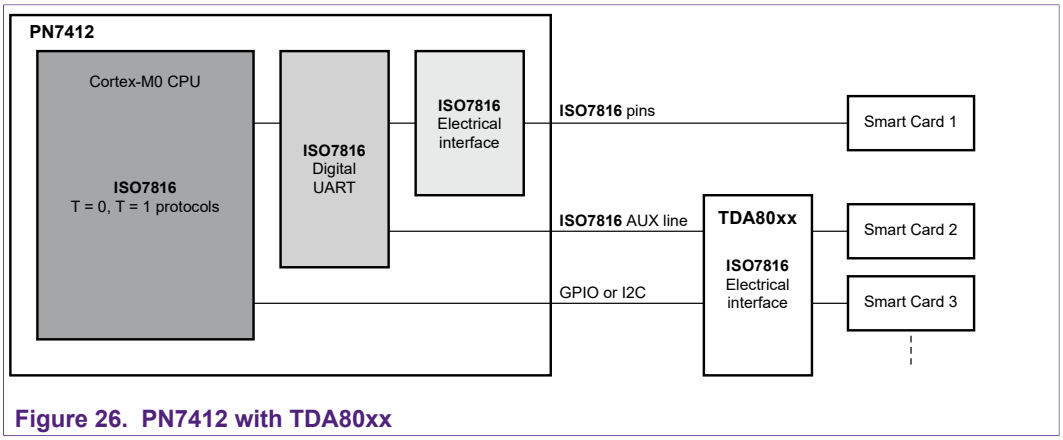

Figure 26. PN7412 with TDA80xx

Are several interfaces required the TDA8026 would be the correct choice.

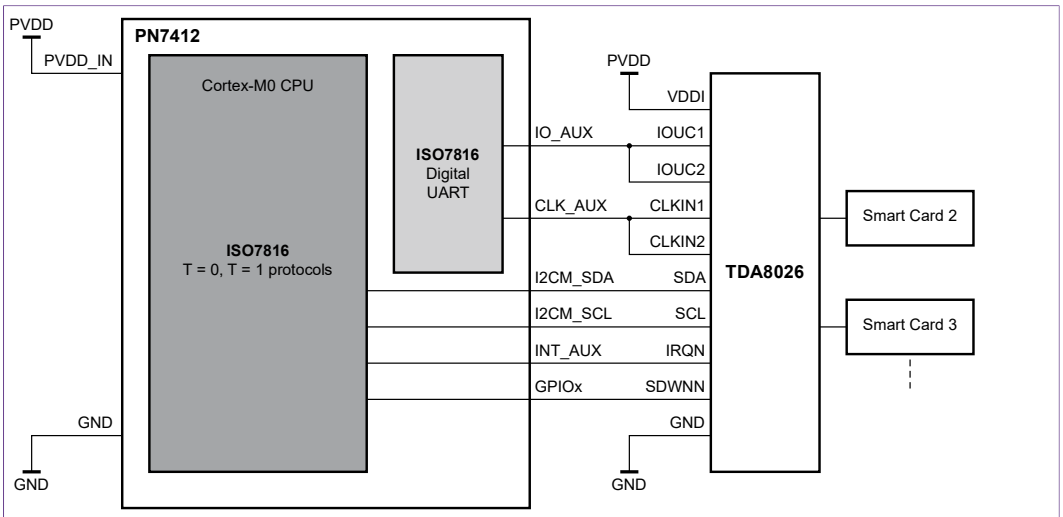

Figure 27. PN7412 with TDA8026

7.4 Application Information

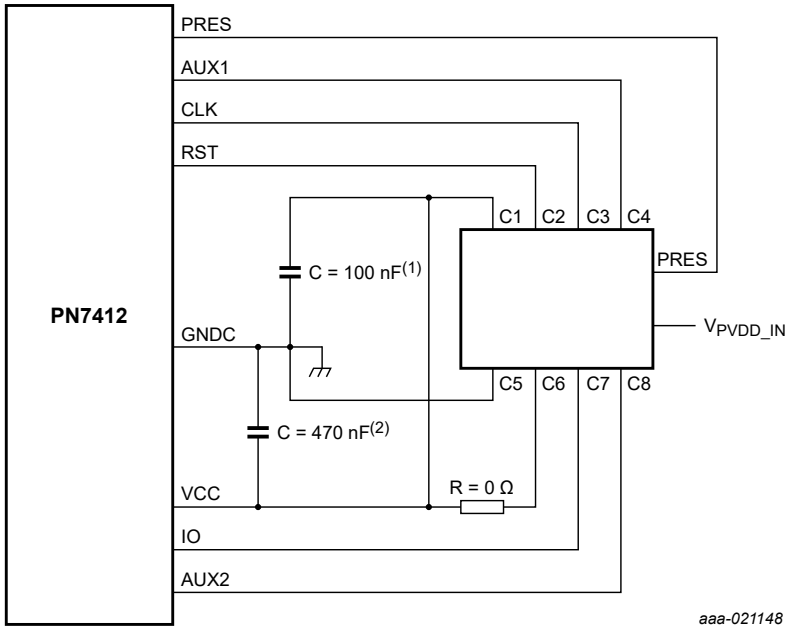

Figure 28. PN7412 Application diagram

7.5 Product Support Package

Website: https://www.nxp.com/products/rfid-nfc/nfc-hf/nfc-readers/nfc-cortex-m0-all-in-one-microcontroller-with-optional-contact-interface-for-access-control:PN7462

Product data sheet: [PN7412]

Application Note: [AN11738]

- How to use contact smart card interface on PN7462AU.

Application Note: [AN11784]

- The following document describes steps required for integration of RTOS with PN7462AU Firmware.

User Manual: [UM10883]

- This document describes PN7462 Controller Development Kits. It also describes PN7462 software stack, gives directions to run example application using the MCUXpresso IDE. Document provides PN7462 customer board configuration instructions, board hardware overview, and provides basic steps how to use NFC Cockpit application.

User Manual: [UM10915]

- This document briefs the setup environment required for PC CCID Reader use case demo on PN7462 Board.

User Manual: [UM10858]

- This document describes how to use the PN7462 family.

User Manual: [UM10948]

- This document describes how to manage EEPROM of PN7462 family.

8 References

[1] Product data sheet - TDA8026 - Multiple smart card slot interface IC
http://www.nxp.com

[2] Product data sheet - TDA8034HN - Low-power smart card interface
https://www.nxp.com/docs/en/data-sheet/TDA8034HN.pdf

[3] Product data sheet - TDA8035 - High integrated and low-power smart card interface
https://www.nxp.com/docs/en/data-sheet/TDA8035.pdf

[4] Product data sheet - PN7462 family - NFC Cortex-M0 microcontroller
http://www.nxp.com

[5] AN10724 - TDA8026ET - 5 slots smart card interface
https://www.nxp.com/docs/en/application-note/AN10724.pdf

[6] AN11079 - Contact reader ICs - TDA product support packages
https://www.nxp.com/docs/en/application-note/AN11079.pdf

[7] UM10319 - Cake8026_02_D
https://www.nxp.com/docs/en/user-guide/UM10319.pdf

[8] UM10349 - Contact smart card reader chips evaluation with CAKE80xx_MBA
https://www.nxp.com/docs/en/user-guide/UM10349.pdf

[9] AN10792 - TDA8034HN - Smart Card reader interface
https://www.nxp.com/docs/en/application-note/AN10792.pdf

[10] AN10807 - TDA8034T/AT/BT - Smart Card reader interface
https://www.nxp.com/docs/en/application-note/AN10807.pdf

[11] AN10794 - Application with TDA8034 - Demonstration boards description
https://www.nxp.com/docs/en/application-note/AN10794.pdf

[12] AN10997 - TDA8035 Smart Card Reader
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[13] AN10999 - Application with TDA8035 - Demonstration board description
https://www.nxp.com/docs/en/application-note/AN10999.pdf

[14] AN11058 - Design migration from TDA8024 to TDA8035
https://www.nxp.com/docs/en/application-note/AN11058.pdf

[15] AN11738 - PN7462AU - Contact Smart Card application
https://www.nxp.com/docs/en/application-note/AN11738.pdf

[16] AN11784 - PN7462AU How to integrate RTOS
https://www.nxp.com/docs/en/application-note/AN11784.pdf

[17] UM10883 - PN7462 family Quick Start Guide - Development Kit
https://www.nxp.com/docs/en/user-guide/UM10883.pdf

[18] UM10915 - PN7462AU PC CCID Reader User Manual
https://www.nxp.com/docs/en/user-guide/UM10915.pdf

[19] UM10858 - PN7462 family HW user manual
https://www.nxp.com/docs/en/user-guide/UM10858.pdf

[20] UM10948 - EEPROM Management of PN746X and PN736X
https://www.nxp.com/docs/en/user-guide/UM10948.pdf

[21] AN10207 - Smart Card reader application with TDA8029 Mask 06 and Mask 07
https://www.nxp.com/docs/en/application-note/AN10207.pdf

[22] AN11460 - Design migration from TDA8024 to TDA8037T
https://www.nxp.com/docs/en/application-note/AN11460.pdf

[23] Product data sheet - TDA8037 - Low-power 3 V smart card interface
https://www.nxp.com/docs/en/data-sheet/TDA8037.pdf

[24] AN11458 - Design guideline for TDA8037

https://www.nxp.com/docs/en/application-note/AN11458.pdf

[25] AN11459 - Application with TDA8037 - Demonstration board description
https://www.nxp.com/docs/en/application-note/AN11459.pdf

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