



# NEX52080

## USB Type-C and Power Delivery controller

Rev. 1 — 27 May 2025

Product data sheet

## 1. General description

The NEX52080 is a USB Type-C and Power Delivery (PD) controller with support to multiple DP/DM based fast charging protocols. It is designed for the power source application supporting Type-C CC detection, PD communication with cables and PD devices, as well as DP/DM power contract negotiation with flash charging supported mobile devices.

It is designed with Constant-Voltage (CV), Constant-Current (CC) control loop to support applications with optocoupler and to work with different DC/DC or AC/DC converters.

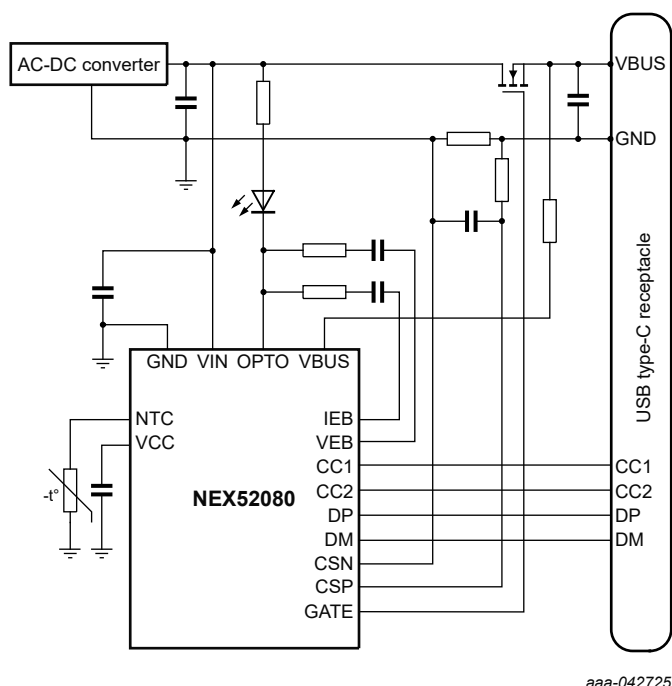


Table 1. Device information

Part number	Package	Body size (nominal)
NEX5208000BV	HWQFN16	4.0 mm x 4.0 mm
NEX5208000BY	HWQFN24	4.0 mm x 4.0 mm

## 2. Features and benefits

- USB Type-C Power Delivery (PD) controller
  - Programmable Type-C default, 1.5 A, 3 A source capability advertisement
  - USB PD3.1 SPR with PPS
  - Integrated  $V_{CONN}$  power supply and switch
  - SOP' communication support for E-Marker
- Mobile charging protocols support
  - BC1.2 DCP and legacy charging protocols
  - Proprietary charging protocols
- Wide operation ranges from 3.3 V to 29.4 V
- CC1 and CC2 pins with 30 V tolerance to stand against short-to-VBUS
- Programmable GPIOs
- I<sup>2</sup>C interface
- Integrated N-MOSFET gate driver
- Programmable cable compensation for VBUS
- Built-in VIN and VBUS discharge (GPIO configurable to drive external discharge low-side MOSFET)
- Low power mode support
- Programmable fault protection and threshold
  - OVP and UVP
  - OVP for CC pins and DP/DM pins
  - Programmable VBUS output OCP
  - OTP
- Multi-IC communication for smart power distribution in multi-port applications
- Embedded MCU with 32 kB MTP

## 3. Applications

- Power adapters
- Wall adapters
- Power storage

4. Ordering information

Table 2. Ordering information

Type number	Package			
	Temperature range (T <sub>j</sub> )	Name	Description	Version
<a href="#">NEX5208000BV</a>	-40 °C to 125 °C	HWQFN16	plastic thermal enhanced very very thin quad flat package; no leads; 16 terminals; 0.65 mm pitch; 4.0 mm x 4.0 mm x 0.75 mm body	<a href="#">SOT8109-1</a>
<a href="#">NEX5208000BY</a>	-40 °C to 125 °C	HWQFN24	plastic thermal enhanced very very thin quad flat package, no leads; 24 terminals; 0.5 mm pitch; 4.0 mm x 4.0 mm x 0.75 mm body	<a href="#">SOT8041-2</a>

5. Marking

Table 3. Marking code

Type number	Marking code
NEX5208000BV	NEX52080
NEX5208000BY	NEX52080

6. Pin configuration and description

6.1. Pin configuration

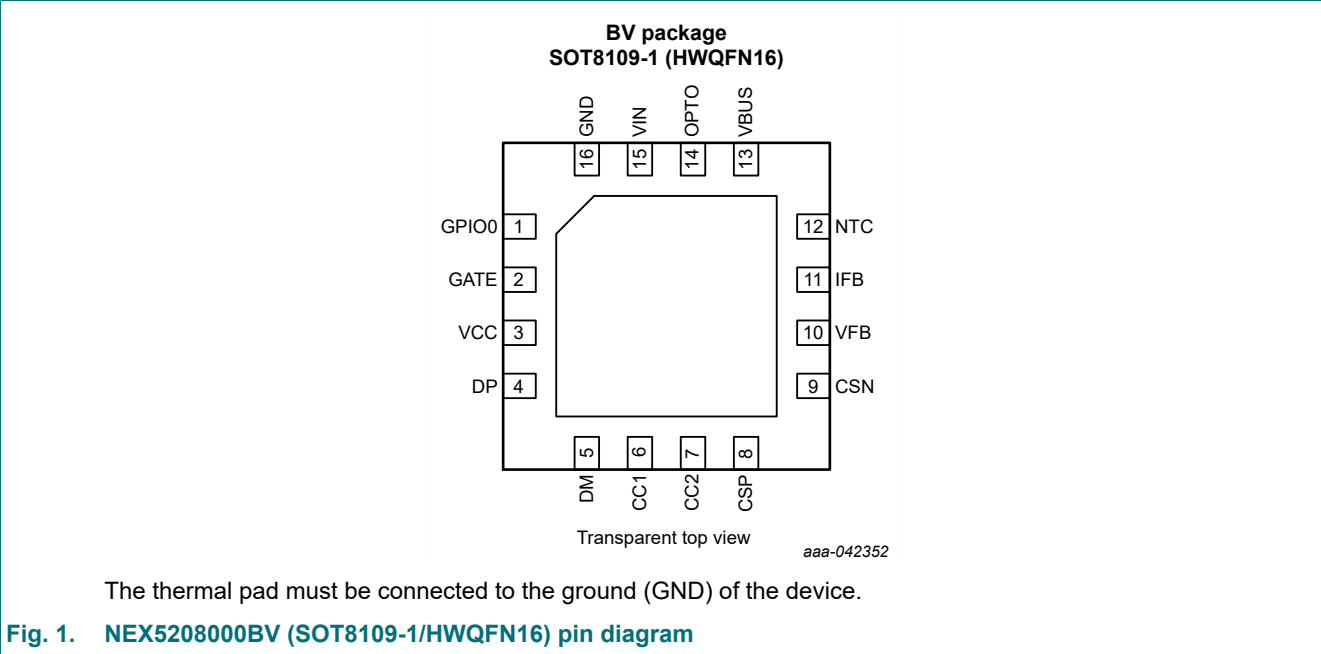


Table 4. NEX5208000BV (SOT8109-1/HWQFN16) pin description

Symbol	Pin	I/O	Description
GPIO0	1	digital input/output analog input	GPIO0 pin, could work as configurable GPIO, open-drain output only, can also be configured as ADC
GATE	2	analog output	N-channel MOSFET gate drive
VCC	3	PWR	internal 3.5 V LDO regulator output pin, connect to 1 $\mu$ F capacitor to GND
DP	4	-	USB DP channel
DM	5	-	USB DM channel
CC1	6	-	type-C configuration channel 1 (CC1)
CC2	7	-	type-C configuration channel 2 (CC2)
CSP	8	analog input	current sense amplifier positive input
CSN	9	analog input	current sense amplifier negative input
VFB	10	analog input	voltage feedback pin for the compensation
IFB	11	analog input	current feedback pin for the compensation
NTC	12	analog input	connect NTC thermistor to this pin. The pin has internal pull-up current source
VBUS	13	-	VBUS sensing and discharging pin
OPTO	14	-	current sink of voltage/current regulation for optocoupler
VIN	15	PWR	power source of the IC
GND	16	PWR	ground, connect this pin close to the GND terminal of the input and output capacitors
PowerPad	-	PWR	thermal pad and ground of the device

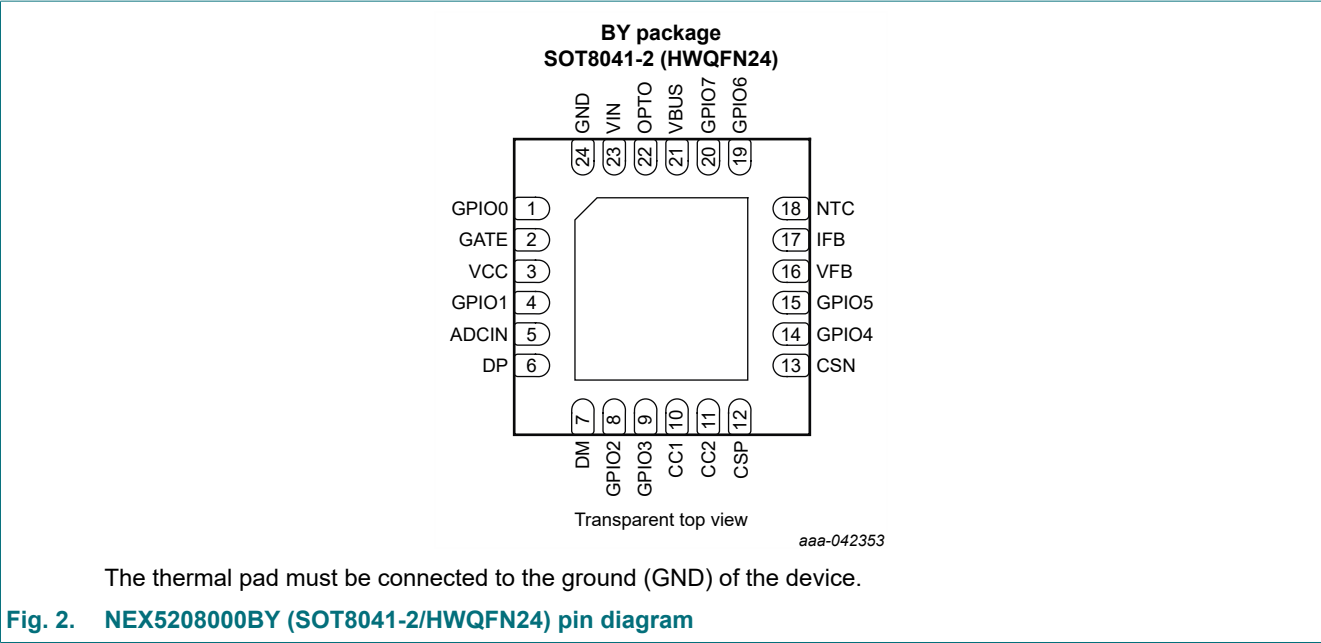


Table 5. NEX5208000BY (SOT8041-2/HWQFN24) pin description

Symbol	Pin	I/O	Description
GPIO0	1	digital input/output analog input	GPIO0 pin, open-drain output only, can also be configured as ADC
GATE	2	analog output	N-channel MOSFET gate drive
VCC	3	PWR	internal LDO regulator output pin, connect to 1 $\mu$ F capacitor to GND
GPIO1	4	digital input/output	GPIO1, open-drain output only
ADCIN	5	analog input	ADC input pin reserved for external voltage sensing
DP	6	-	USB DP channel
DM	7	-	USB DM channel
GPIO2	8	digital input/output	GPIO2 pin, open-drain output only
GPIO3	9	digital input/output	GPIO3 pin, open-drain output only
CC1	10	-	type-C configuration channel 1 (CC1)
CC2	11	-	type-C configuration channel 2 (CC2)
CSP	12	analog input	current sense amplifier positive input
CSN	13	analog input	current sense amplifier negative input
GPIO4	14	digital input/output	GPIO4, open-drain output only
GPIO5	15	digital input/output	GPIO5, open-drain output only
VFB	16	analog input	voltage feedback pin for the compensation
IFB	17	analog input	current feedback pin for the compensation
NTC	18	analog input	connect NTC thermistor to this pin. The pin has internal pull-up current source
GPIO6	19	digital input/output analog input	GPIO6 pin, open-drain output only, can also be configured as ADC
GPIO7	20	digital input/output	GPIO7, open-drain output only
VBUS	21	-	VBUS sensing and discharging pin
OPTO	22	-	current sink of voltage/current regulation for optocoupler
VIN	23	PWR	power source of the IC
GND	24	PWR	ground, connect this pin close to the GND terminal of the input and output capacitors
PowerPad	-	PWR	thermal pad and ground of the device

7. Limiting values

Table 6. Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134). Voltages are referenced to GND (ground = 0 V).[1]

Symbol	Parameter	Conditions	Min	Max	Unit
V <sub>PIN</sub>	pin voltage	pins VIN, VBUS, GATE, OPTO	-0.3	35	V
		pins CC1, CC2, DP, DM, CSP, CSN	-0.3	30	V
		GATE to VIN	-	10	V
		pins GPIO 0-7, VFB, IFB, ADCIN, NTC	-0.3	7	V
		pin VCC	-0.3	2	V
T <sub>j</sub>	junction temperature		-40	125	°C

[1] Stresses beyond those conditions under absolute maximum ratings may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions beyond those indicated under recommended operating conditions is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

8. ESD ratings

Table 7. ESD ratings

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V <sub>ESD</sub>	electrostatic discharge voltage	Human-Body Model (HBM), per ANSI/ESDA/JEDEC JS-001	-2000	-	2000	V
		Charged-Device Model (CDM), per JEDEC specification JESD22-C101	-500	-	500	V

9. Recommended operating conditions

Table 8. Recommended operating conditions

Typical values correspond to T<sub>j</sub> = 25 °C. Minimum and maximum limits apply over -40 °C to 125 °C junction temperature range unless otherwise stated.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V <sub>VIN</sub>	supply voltage V <sub>IN</sub>		3.3	-	29.4	V
T <sub>amb</sub>	ambient temperature		-40	-	85	°C
T <sub>j</sub>	junction temperature		-40	-	125	°C

10. Thermal information

Table 9. Thermal information

Thermal resistance according to JEDEC51-5 and -7.

Symbol	Parameter	HWQFN16 SOT8109-1	HWQFN24 SOT8041-2	Unit
R <sub>θJA</sub>	junction to ambient thermal resistance	47	46	°C/W
R <sub>θJC(top)</sub>	junction to case(top) thermal resistance	22	23	°C/W

## 11. Electrical characteristics

### Power supply and regulation characteristics

Table 10. Power supply and regulation characteristics

Symbol	Parameter	Conditions	T <sub>j</sub> = -40 °C to 125 °C			Unit
			Min	Typ[1]	Max	
VIN supply parameters						
VIN	VIN power supply range		3.3	-	29.4	V
VIN <sub>UVLO_R</sub>	IC power on reset threshold	VIN rising	-	3.1	-	V
VIN <sub>UVLO_F</sub>	IC under voltage lock-out threshold	VIN falling	-	2.85	-	V
VCC <sub>LDO_OUT</sub>	internal LDO output on VCC pin	For VIN = 3.6 V to 23 V	-	1.5	-	V
I <sub>active</sub>	device connected, block active	CCx is attached with an R <sub>d</sub>	-	3.2	-	mA
I <sub>sleep</sub>	device connected, enter sleep mode	CCx is attached with an R <sub>d</sub> , VIN = 5 V	-	1.5	-	mA
		CCx is unattached, VIN = 5 V	-	1.0	-	mA
VIN <sub>OVP</sub>	programmable rising threshold to trigger VIN OVP		-	10	-	%
			-	15	-	%
			-	20	-	%
			-	25	-	%
I <sub>load_DCHG</sub>	programmable load discharge current		-	70	-	mA
			-	100	-	mA
			-	140	-	mA
			-	170	-	mA
I <sub>VBUS_DCHG</sub>	VBUS discharge current	VBUS = 5 V	-	15	-	mA
		VBUS = 20 V	-	60	-	mA
CC and CV regulation parameters						
V <sub>acc_5V</sub>	5 V output by default		4.75	5.00	5.50	V
N <sub>acc_V</sub>	output voltage control accuracy	T <sub>amb</sub> = 25 °C	-1	-	1	%
N <sub>acc_V</sub>	output voltage control accuracy	T <sub>J</sub> = -40 °C to 125 °C	-3	-	3	%
R <sub>CS</sub>	current sensing resistor		-	5	-	mΩ
N <sub>acc_C</sub>	output current control accuracy	I <sub>output</sub> < 3 A	-0.15	-	0.15	A
N <sub>acc_C</sub>	output current control accuracy	I <sub>output</sub> ≥ 3 A	-3	-	3	%
I <sub>OCP</sub>	over current protection tripping point	configured to 3 A	-	3.2	-	A
I <sub>SCP</sub>	short-circuit protection tripping point	configured to 12 A	-	12	-	A

[1] All typical values are measured at T<sub>j</sub> = 25 °C.

## Gate driver characteristics

Table 11. Gate driver characteristics

Symbol	Parameter	Conditions	T <sub>j</sub> = -40 °C to 125 °C			Unit
			Min	Typ[1]	Max	
N-MOSFET gate driver parameters						
V <sub>GATE</sub>	output high voltage	V <sub>IN</sub> ≤ 21 V	VBUS + 4	-	VBUS + 7	V
I <sub>GATE_DCHG</sub>	gate discharge current		-	20	-	mA

[1] All typical values are measured at T<sub>J</sub> = 25 °C.

## CC detection and PD PHY characteristics

Table 12. CC detection and PD PHY characteristics

Symbol	Parameter	Conditions	T <sub>j</sub> = -40 °C to 125 °C			Unit
			Min	Typ[1]	Max	
CC1/2 detection parameters (Type C-function)						
I <sub>Rp_default</sub>	type-C source current at default current		64	80	96	μA
I <sub>Rp_1.5A</sub>	type-C source current at 1.5 A		166	180	194	μA
I <sub>Rp_3A</sub>	type-C source current at 3 A		304	330	356	μA
V <sub>th_Rd</sub>	threshold for internal circuit to start CC recognition for R <sub>d</sub> when configured to default or 1.5 A type-C source current		1.45	1.60	1.75	V
	threshold for internal circuit to start CC recognition for R <sub>d</sub> when configured to 3 A type-C source current		2.45	2.60	2.75	V
V <sub>th_Ra</sub>	threshold for internal circuit to start CC recognition for R <sub>d</sub> when configured to default type-C source current		0.15	0.20	0.25	V
	threshold for internal circuit to start CC recognition for R <sub>d</sub> when configured to 1.5 A Type-C source current		0.35	0.40	0.45	V
	threshold for internal circuit to start CC recognition for R <sub>d</sub> when configured to 3 A type-C source current		0.75	0.80	0.85	V
CC-V <sub>CONN</sub> parameters						
V <sub>CONN_Valid</sub>	V <sub>CONN</sub> output voltage range		3.0	5.0	5.5	V
I <sub>VCONN</sub>	source current capability on V <sub>CONN</sub>		20	-	-	mA
BMC Common Parameters						
f <sub>BitRate</sub>	bit rate		270	300	330	Kbps
t <sub>UnitInterval</sub>	bit unit interval	1/f <sub>BitRate</sub>	3.03	3.30	3.70	μs
BMC Transmitter Parameters						
P <sub>BitRate</sub>	maximum difference between the bitrate during the part of the packet following the preamble and the reference bitrate.	the reference bit rate is the average bit rate of the last 32 bits of the Preamble.	-	-	0.25	%

Symbol	Parameter	Conditions	T <sub>j</sub> = -40 °C to 125 °C			Unit
			Min	Typ[1]	Max	
V <sub>TX_CC_H</sub>	BMC transmitter high voltage	applies to both no load condition and under the load condition specified in CC1/2 Transmitter load mode	1.050	1.125	1.200	V
V <sub>TX_CC_L</sub>	BMC transmitter low voltage	applies to both no load condition and under the load condition specified in CC1/2 Transmitter load mode	-75	-	75	mV
t <sub>BMC_RISE</sub>	BMC (Biphase Mark Coding) rising time	R <sub>load</sub> = 5.1 kΩ, C <sub>load</sub> = 1 nF, C <sub>cc</sub> = 520 pF, 10 % and 90 % amplitude points, minimum is under an unloaded condition. (10 % and 90 % amplitude points, minimum is under an unloaded condition of CC1/2)	300	-	-	ns
t <sub>BMC_FALL</sub>	BMC (Biphase Mark Coding) fallingtime		300	-	-	ns
Z <sub>BMCDriver</sub>	transmitter output impedance	during transmission	33	50	75	Ω
BMC Receiver Parameters						
t <sub>RxFilter</sub>	Rx bandwidth limiting filter (digital or analog)		100	-	-	ns
Z <sub>BMC Rx</sub>	receiver input impedance	does not include pull-up or pull-down resistance from cable detect. Transmitter is Hi-Z.	2	-	-	MΩ

[1] All typical values are measured at T<sub>j</sub> = 25 °C.

DP/DM detection PHY characteristics

Table 13. DP/DM detection PHY characteristics

Symbol	Parameter	Conditions	T <sub>j</sub> = -40 °C to 125 °C			Unit
			Min	Typ[1]	Max	
BC1.2 DP/DM interface parameters						
V <sub>SEL_REF</sub>	output voltage selection reference		1.8	2	2.2	V
V <sub>DAT_REF</sub>	data detection reference		0.250	0.325	0.400	V
t <sub>DBC_H</sub>	DP, DM high debounce time		1.0	-	1.5	s
R <sub>DCP_DAT</sub>	DP to DM short resistance during DCP mode		-	-	200	Ω
R <sub>DM_DWN</sub>	DM pull-down resistance		-	15	-	kΩ
R <sub>DP_LKG</sub>	DP leakage resistance		-	800	-	kΩ
R <sub>DM_LKG</sub>	DM leakage resistance		-	800	-	kΩ

[1] All typical values are measured at T<sub>j</sub> = 25 °C.



ADC characteristics

Table 14. ADC characteristics

Symbol	Parameter	Conditions	T <sub>j</sub> = -40 °C to 125 °C			Unit
			Min	Typ[1]	Max	
ADC Parameters						
V <sub>ADC_REF</sub>	ADC reference voltage range		-	2500	-	mV
N <sub>ADC</sub>	ADC resolution	Min effective bits	-	11	-	bit
R <sub>sample</sub>	ADC sample rate	Min required sample rate	-	125	-	ksps

[1] All typical values are measured at T<sub>j</sub> = 25 °C.

Thermal sensing characteristics

Table 15. Thermal sensing characteristics

Symbol	Parameter	Conditions	T <sub>j</sub> = -40 °C to 125 °C			Unit
			Min	Typ[1]	Max	
Thermal protection						
T <sub>SD</sub>	thermal shutdown temperature	rising junction temperature	-	150	-	°C
	thermal shutdown hysteresis		-	20	-	°C
I <sub>NTC_EXT</sub>	external NTC pull-high current		-	80	-	μA

[1] All typical values are measured at T<sub>j</sub> = 25 °C.

## 12. Detailed description

The NEX52080 is a USB Type-C and Power Delivery (PD) controller with support to multiple DP/DM based fast charge protocols. It is designed for the power source application supporting Type-C CC detection, PD communication with cables and PD devices, as well as D+/D- power contract negotiation with flash charging supported mobile devices.

It is designed with Constant-Voltage (CV), Constant-Current (CC) control loop programmable and integrated to minimize external components with support of optocoupler.

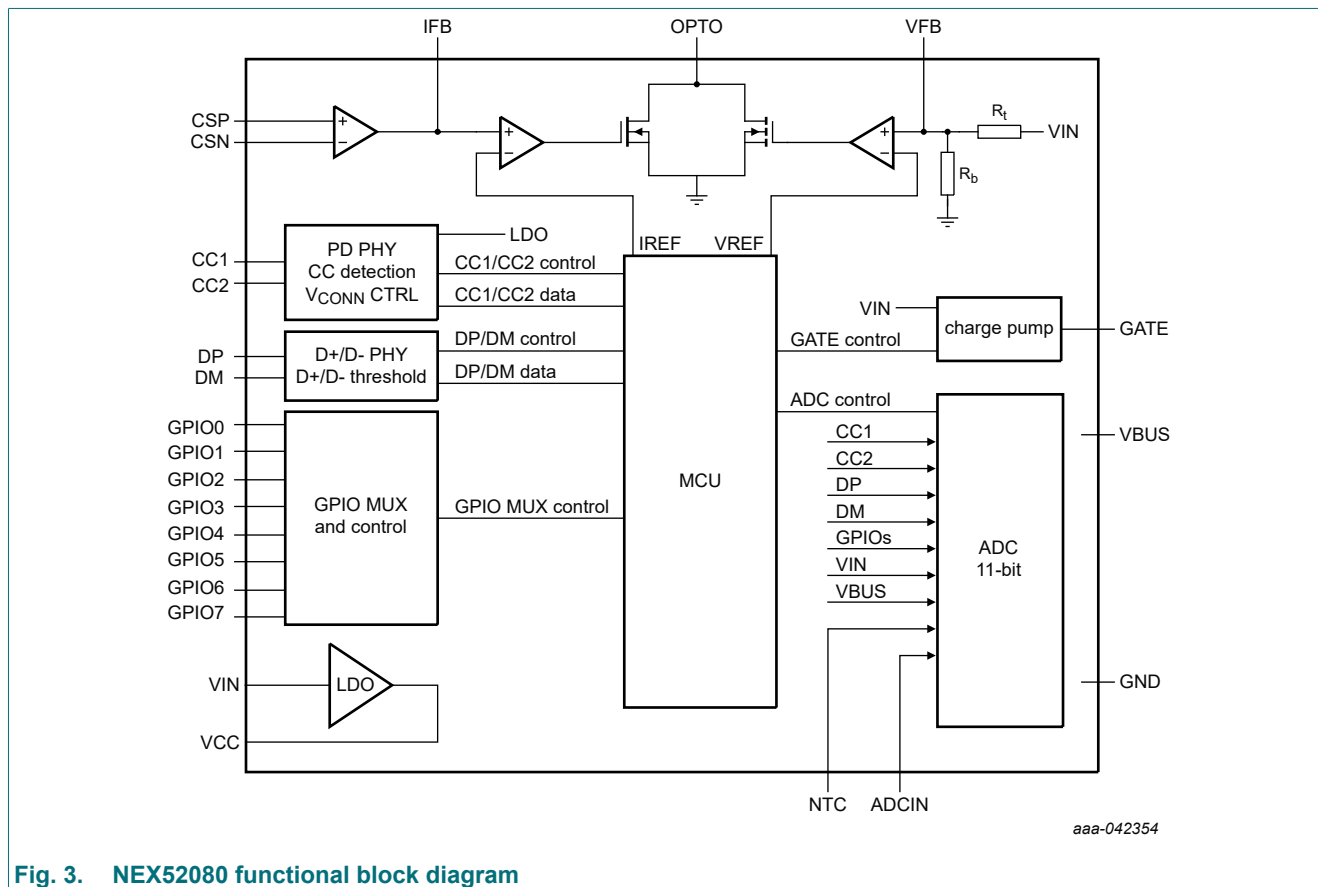


Fig. 3. NEX52080 functional block diagram

### 12.1. USB Type-C and PD

#### Features

- Programmable Type-C default, 1.5 A, 3 A source capability advertisement
- USB PD3.1 compliant, SPR with PPS, support up to 7 PDOs
  - Fixed PDO – Source: 5 V/9 V/15 V/20 V at 3 A max, and 20 V at 5 A max
  - APDO: PPS range of 5 V to 11 V, 5 V to 16 V, 5 V to 21 V at 3 A max, and 5 V to 21 V at 5 A max
- V<sub>CONN</sub> power supply and switch integrated
- SOP' communication support for e-marker

## USB-PD physical layer

The pull-high current  $I_{Rp}$  on CC pins are configurable to advertise USB Type-C source current with default, 1.5 A, 3 A ratings, as well as to set the DC bias voltage on CC pin during USB-PD communication. It supports to detect  $R_d$  pull-low resistor and also  $R_a$  for cables that supports the SOP' communications. One of the CC lines with  $R_d$  is used to transmit and receive the USB-PD message.

CC1 and CC2 designed to tolerant 30 V voltage that is helpful to stand against a short-to-VBUS fault during connection or disconnection.

## 12.2. DP/DM interface

DP/DM interface is designed to support BC1.2 DCP mode and other legacy charging protocols.

The NEX52080 also support customized proprietary charging protocols and operations.

## 12.3. MCU

The NEX52080 is designed with MCU and MTP. It can support customized operation and interruptions.

For multi-port application, the NEX52080 can support "multi-IC" feature, in which two or more NEX52080 can communicate with others through GPIO or I<sup>2</sup>C to support multi-port power supply system.

## 12.4. Control loop compensation

The Constant Voltage (CV) loop compensation and Constant Current (CC) loop compensation are implemented. VIN voltage is scaled by a resistor divider to be as the feedback voltage. It is compared with the internal voltage reference to generate an error signal. The CV loop can compensate this error signal. And then the compensated signal is employed to drive the primary side of the optocoupler and control the AC-DC power loop.

## 12.5. GATE drive and VBUS discharge

NEX52080 implements charge pump to drive external N-MOSFET. Also, the GATE pin has internal discharge circuit in order to fast turn-off the power path when fault states are detected.

The VBUS pin also has internal discharge circuits, it helps to discharge VSAFE5V to VSAFE0 when reset happens. Also, in the case of a 20 V to 5 V or 0 V transition, the discharge circuit helps to decrease the time dissipating the energy on VBUS to settle the voltage efficiently.

## 12.6. GPIO

NEX52080 contains 8 GPIOs in total and can be configured into different functions. Typically, the GPIO can be configured to support the function of interrupt input, ADC input, or output pin controlled by the FW. The GPIO allowed configurations are summarized in [Table 16](#).

**Table 16. GPIO configuration**

	INT	ADC	Pull-up	Pull-down	Open-drain output	Direct output	UART
GPIO0					√		
GPIO1					√		
GPIO2	√	√	√	√	√	√	√
GPIO3	√	√	√	√	√	√	√
GPIO4					√		
GPIO5					√		
GPIO6	√	√	√	√	√	√	
GPIO7	√	√	√	√	√	√	

## 12.7. Protections

NEX52080 implements adjustable OVP function with 4 options.

OCP is also implemented and can be configured through FW. When the OCP occurs, the FW handles the fault state.

The SCP is implemented to deal with short to GND condition.

The NTC pin allows external thermal sensing to trigger over temperature protection.

## 12.8. Thermal shutdown

The junction temperature ( $T_j$ ) of the device is monitored by an internal temperature sensor. When  $T_j$  exceeds the thermal shutdown temperature  $T_{SD}$  of 150 °C, the device enters thermal shutdown. When  $T_j$  decreases below the hysteresis amount of typically 20 °C, the device resumes operation.

## 13. Application implementation

### Application diagram

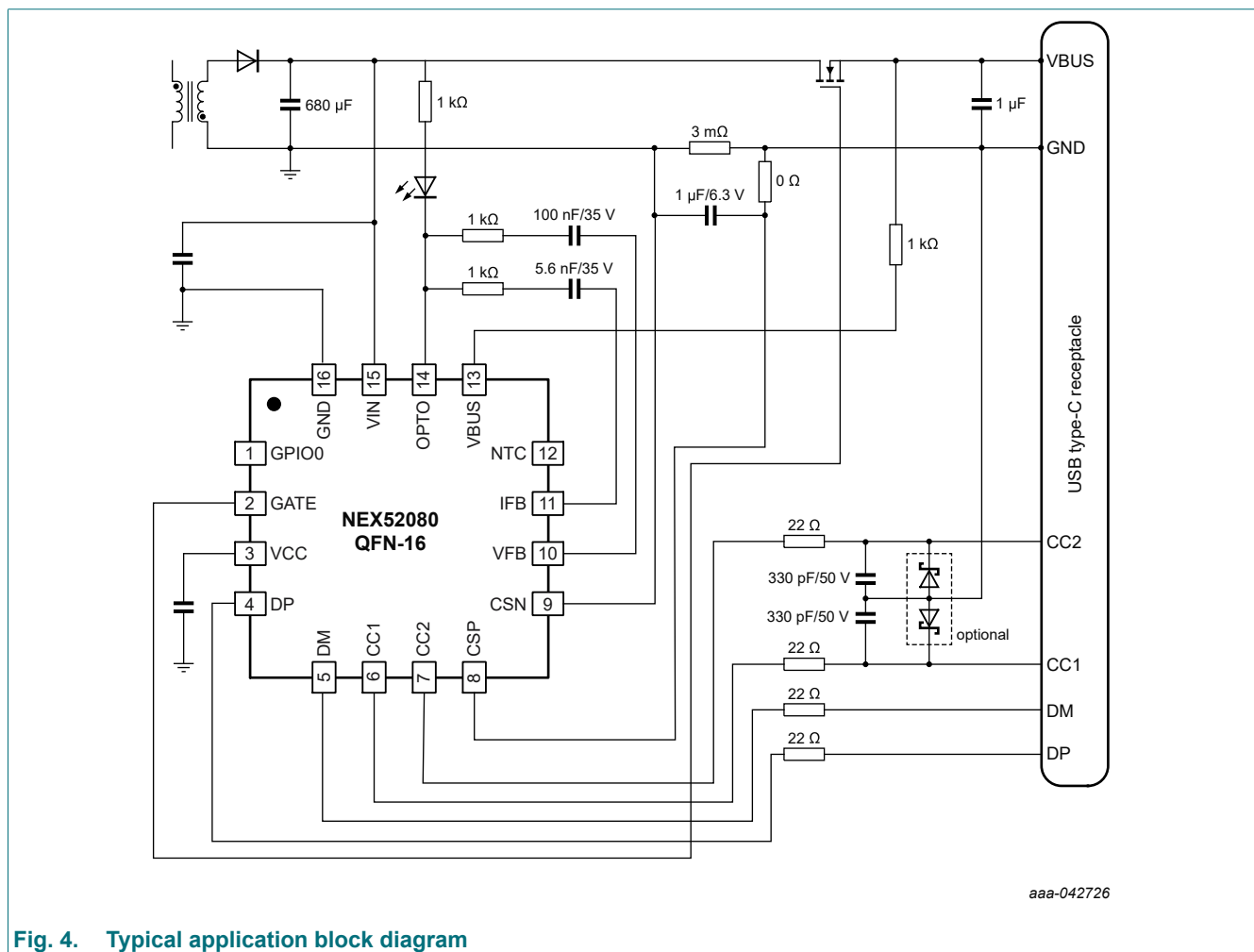


Fig. 4. Typical application block diagram

14. Package outline

Plastic thermal enhanced very very thin Quad Flat package;  
no leads; 16 terminals; 0.65 mm pitch; 4.0 mm x 4.0 mm x 0.75 mm body

SOT8109-1

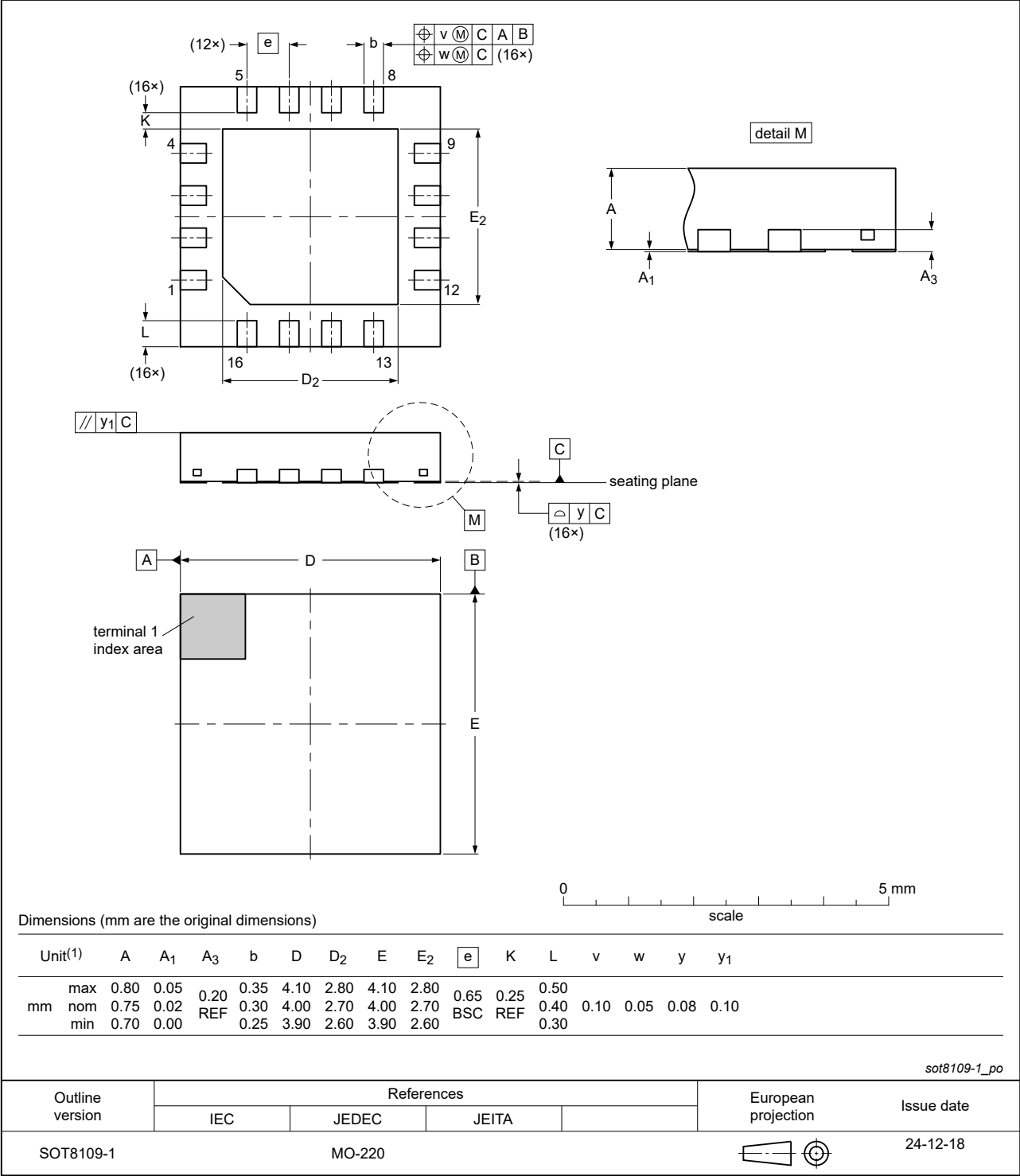


Fig. 5. Pin configuration SOT8109-1 (HWQFN16)

Plastic thermal enhanced very very thin Quad Flat package,  
no leads; 24 terminals; 0.5 mm pitch; 4.0 mm x 4.0 mm x 0.75 mm body

SOT8041-2

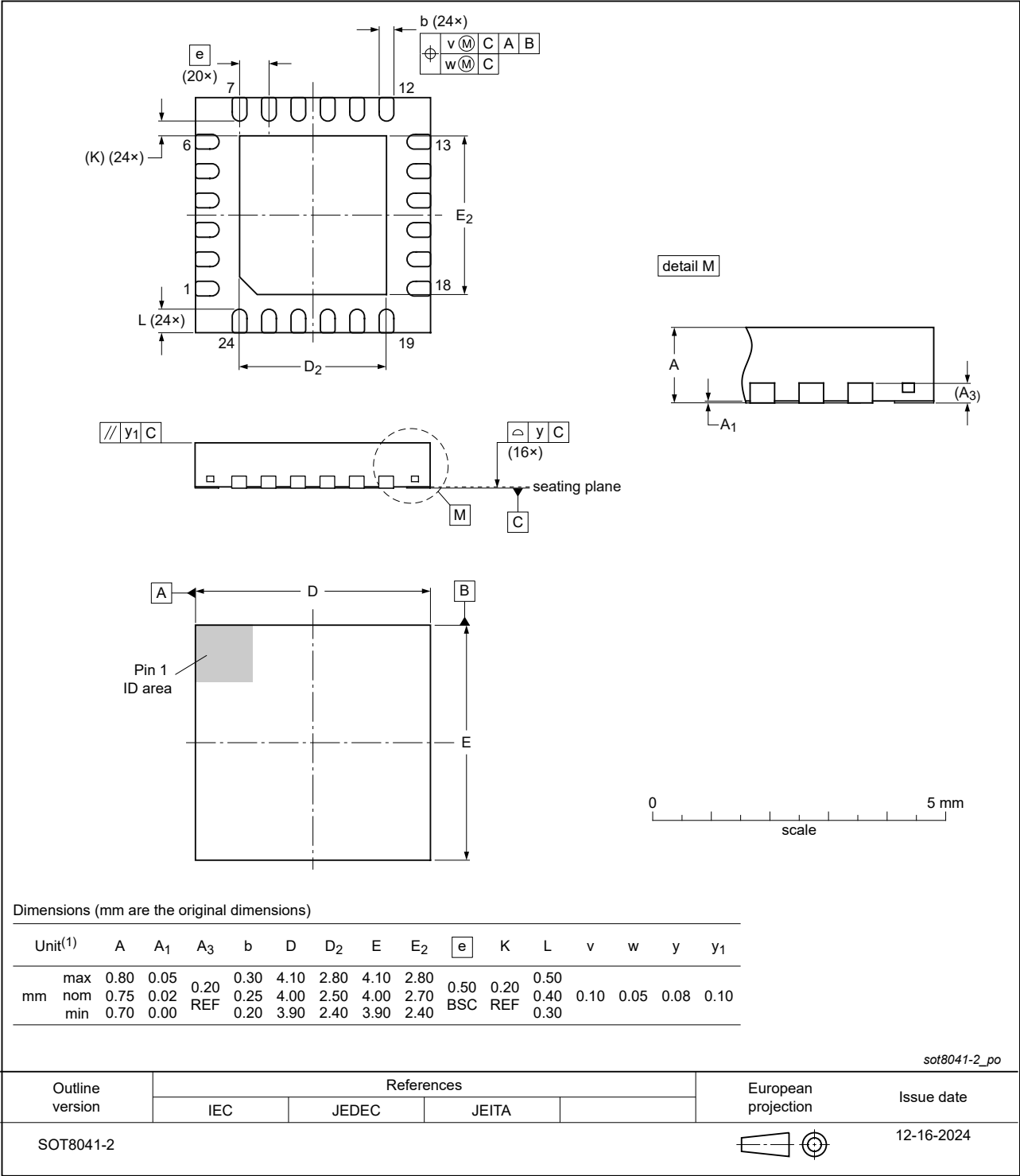


Fig. 6. Pin configuration SOT8041-2 (HWQFN24)

15. Abbreviations

Table 17. Abbreviations

Acronym	Description
AC	Alternate Current
APDO	Augmented Power Data Object
CC	Configuration Channel
CDM	Charged Device Model
DC	Direct Current
HBM	Human Body Model
LDO	Low-DropOut
MCU	Microcontroller Unit
MTP-ROM	Multi-time Programmable Read-Only Memory
NTC	Negative Temperature Coefficient
OCP	Over-Current Protection
OTP	Over Temperature Protection
OVP	Over-Voltage Protection
PDO	Power Data Object
PPS	Programmable Power Supply
SPR	Standard Power Range
USB	Universal Serial Bus
UVLO	UnderVoltage LockOut
UVP	Under-Voltage Protection

16. Revision history

Table 18. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
NEX52080 v. 1	20250527	Product data sheet	-	-

## 17. Legal information

### Data sheet status

Document status [1][2]	Product status [3]	Definition
Objective [short] data sheet	Development	This document contains data from the objective specification for product development.
Preliminary [short] data sheet	Qualification	This document contains data from the preliminary specification.
Product [short] data sheet	Production	This document contains the product specification.

- [1] Please consult the most recently issued document before initiating or completing a design.
- [2] The term 'short data sheet' is explained in section "Definitions".
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