

NX20P0477

USB Type-C CC smart protection

Rev. 1.0 — 3 February 2020

Product data sheet

1 General description

NX20P0477 is a single-chip USB Type-C (USB-C) port overvoltage protection solution integrating a corrosion prevention algorithm from moisture. CC1/CC2 pins in the system side are protected from 28 V short to VBUS.

USB-C allows VBUS voltage to increase up to 20 V through Power delivery protocol. CC1/2 pins can be shorted to VBUS due to mechanical twisting and sliding of the connector since USB-C connector contact pins are 25 % closer to each other than a micro USB connector. Moisture or fine dust may also cause the 20 V VBUS pin to be shorted to adjacent pins.

NX20P0477 enables CC pins to be more robust in even abnormal conditions. NX20P0477 is 28 V DC tolerant on CON_CC pins in connector side and quickly disconnects switches if the voltage is above overvoltage threshold, protecting CC pins in system side from high voltage.

USB PD standard requires 80 μ A, 180 μ A or 330 μ A as R_p to detect sink device, but this R_p current accelerates USB-C connector pin corrosion when CC pins are contaminated with water, especially salt water. Furthermore, CC/PD controller may recognize this water impedance as detected sink, providing 5 V through VBUS pin, which accelerates corrosion.

NX20P0477 converts these USB standard R_p currents from CC/PD controller to ultra-low current source to prevent corrosion.

NX20P0477 integrates IEC 61000-4-2 ESD protection of +6 kV contact discharge and +8 kV air discharge on CON_CC1 and CON_CC2, which helps to reduce external BOM cost.

NX20P0477 CON_CC1 and CON_CC2 pins are designed to be protected from surge voltage up to +/-40 V.

NX20P0477 is offered with 0.5 mm pitch, 9 bumps, 1.49 mm x 1.49 mm x 0.555 mm WLCSP package.

2 Features and benefits

- USB Type-C CC1 and CC2 short protection to VBUS
- CON_CC1 / CON_CC2: 28V_{DC} AMR
- Rd clamp circuit in CON_CC1/CON_CC2 in dead battery condition
- Smart corrosion prevention scheme with low current source
- 250 m Ω Low R_{DSon} switch
- Robust ESD immunity for CON_CC1/CON_CC2
 - IEC 61000-4-2 contact discharge: 6 kV
 - IEC 61000-4-2 air discharge: 8 kV
- +/-40 V surge protection on CON_CC1/CON_CC2



- Low leakage current: 14 μ A
- CC1 / CC2 leakage current: < 1 μ A
- Fast OVP turn-off time: 60 ns

3 Applications

- Smartphone
- Tablet
- Laptop

4 Ordering information

Table 1. Ordering information

Type number	Topside marking	Package		
		Name	Description	Version
NX20P0477UK	N77	WLCSP9	wafer level chip scale package, 9 terminals, 0.5 mm pitch, 1.49 mm x 1.49 mm x 0.555 mm body (backside coating included)	SOT1385-2

4.1 Ordering options

Table 2. Ordering options

Type number	Orderable part number	Package	Packing method	Minimum order quantity	Temperature
NX20P0477UK	NX20P0477UKZ	WLCSP9	REEL 7" Q1 DP CHIPS	3000	T _{amb} = -40 °C to +85 °C

5 Functional diagram

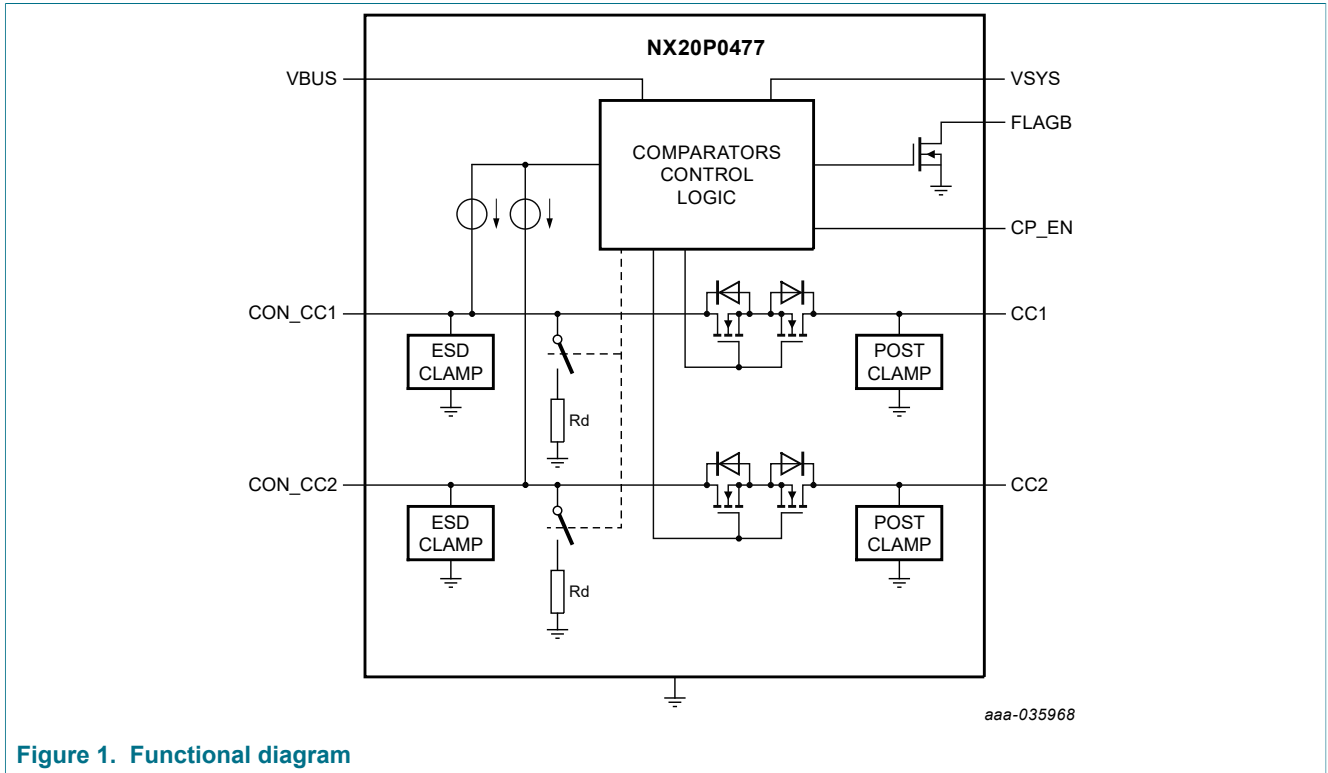


Figure 1. Functional diagram

6 Pinning information

6.1 Pinning

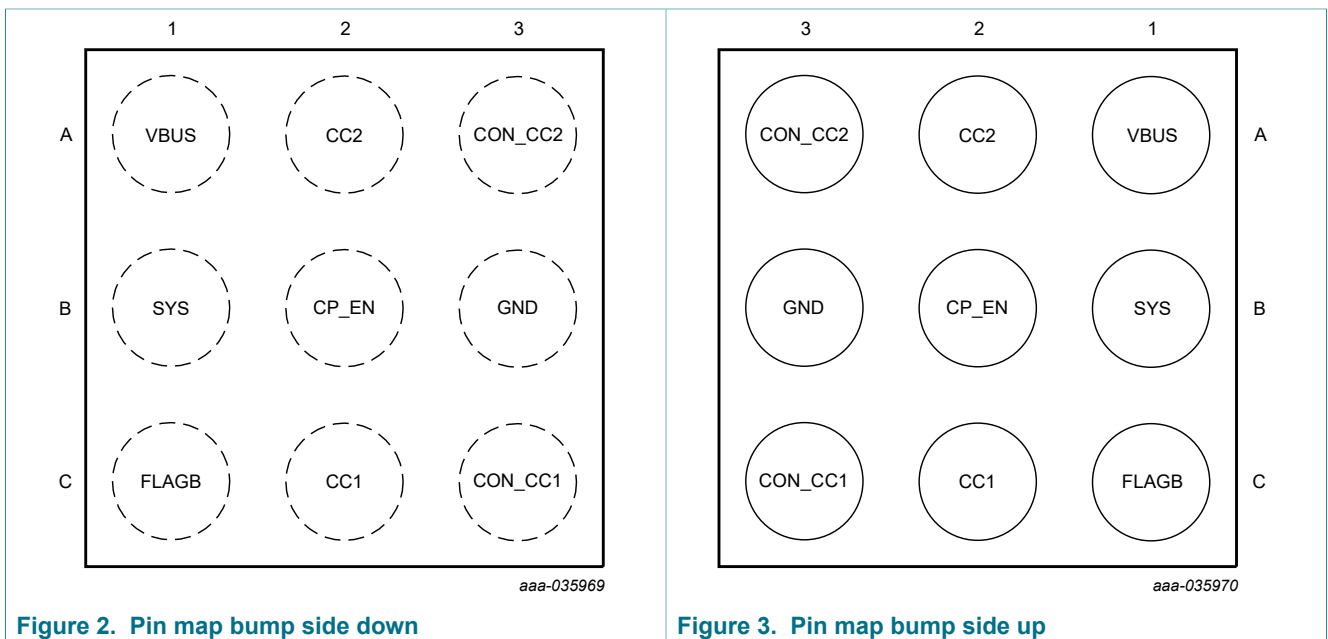


Figure 2. Pin map bump side down

Figure 3. Pin map bump side up

6.2 Pin description

Table 3. Pin description

Symbol	Pin	Type	Description
CON_CC1	C3	P	USB-C connector side CC1. Connect CC1 of USB-C connector.
CON_CC2	A3	P	USB-C connector side CC2. Connect CC2 of USB-C connector.
CC1	C2	P	System side CC1. Connect CC1 of USB CC/PD controller.
CC2	A2	P	System side CC2. Connect CC2 of USB CC/PD controller.
VBUS	A1	AI	VBUS detection pin
VSYS	B1	P	Power supply input, connect System voltage and add 1 μ F capacitor to GND.
FLAGB	C1	DO	Open-drain output indicating water detection. Low when water is detected. External 100 k Ω pull up resistor is required.
CP_EN	B2	DI	Corrosion protection Enable pin. It should be driven high to enable corrosion protection scheme. If it is low, CC switches are ON and acts as OVP switch.
GND	B3	GND	Ground

7 Functional description

NX20P0477 is placed between USB-C connector and CC/PD controller to protect CC pins in System side CC/PD controller from 20 V VBUS short, ESD and Surge voltage.

NX20P0477 has corrosion prevention feature, which can be enabled by driving CP_EN pin high. In this mode, the CC switch is off and Rp source from CC/PD controller is converted to low current source integrated in NX20P0477. CC switch is turned on only when true accessories are detected.

NX20P0477 has Rd clamp circuit on both CON_CC1 and CON_CC2 when VSYS is below UVLO threshold, known as dead battery condition. It allows USB-C adapter to detect SINK through the Rd clamp and start providing 5 V through VBUS. Main charger regulates system voltage from 5 V VBUS. Once VSYS comes up, NX20P0477 enables switchers and disconnects internal Rd clamp circuit from CON_CCx pins.

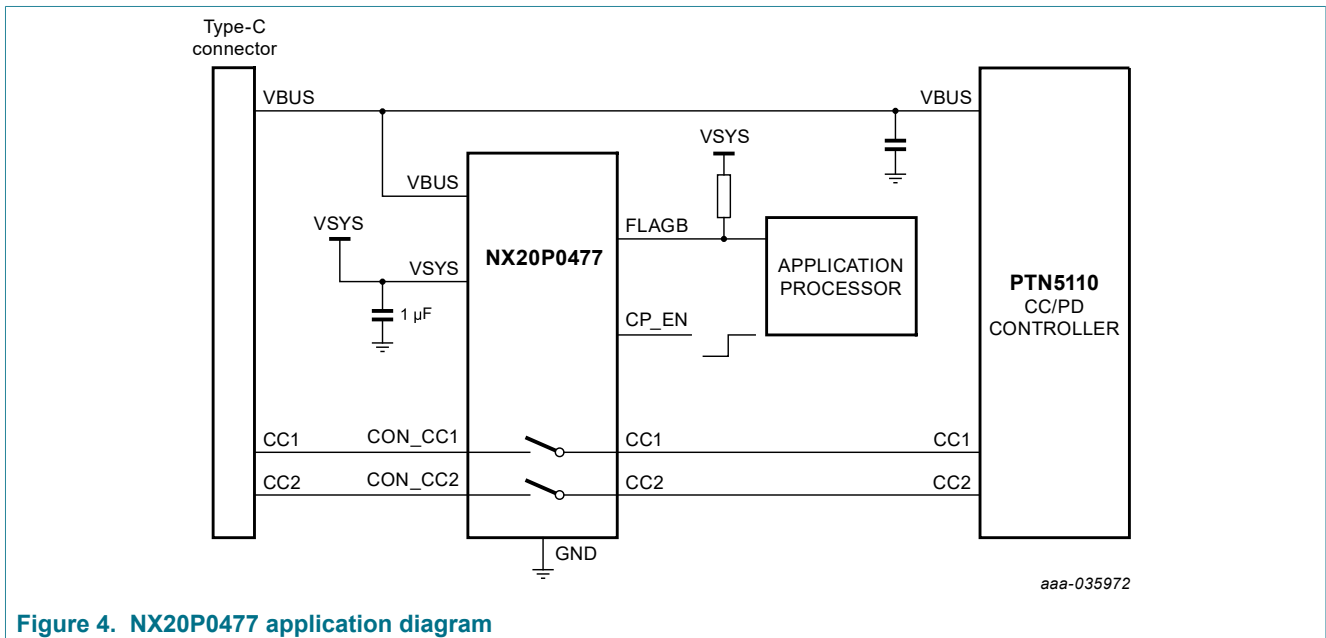


Figure 4. NX20P0477 application diagram

7.1 Internal block diagram

Figure 5 shows internal block diagram, where only one channel is shown. The other channel has the same circuit. CC switch is comprised with back-to-back MOSFET to truly isolate CC pin from CON_CC pin. There are four comparators in each CC channel. COMP1 on CC pin detects Rp or Rd by external CC/PD controller. COMP1 comparator output is used to enable internal Rd or Rp on CON_CC pin. COMP2 and COMP3 is used to detect accessory plugged in connector or moisture inside connector. COMP4 detects overvoltage on CON_CC pin.

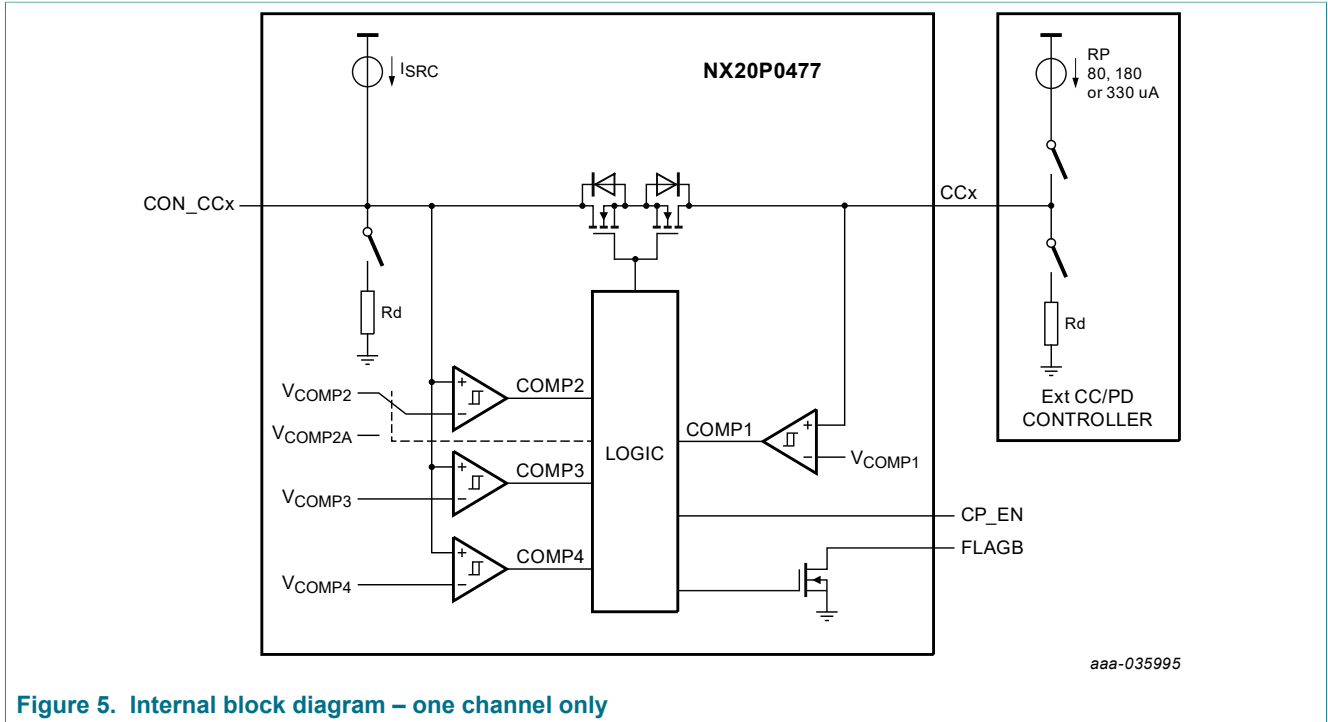


Figure 5. Internal block diagram – one channel only

7.2 Power status

When VSYS is below $V_{SYSUVLO}$, NX20P0477 stays in shutdown mode, where bias, switches and all comparators are disabled, but Rd clamp circuits on CON_CC1 and CON_CC2 are enabled. It allows USB-C adapter to detect the Rd and to supply 5 V through VBUS in dead battery condition. Table 4 lists NX20P0477 power states.

Table 4. Power state

Power state	VSYS	CP_EN	CCx	CON_CCx	FLAGB	CC Switch
Shutdown	$VSYS < UVLO$	X	X	Rd	Hi-Z	OFF
Wait.SRC	$VSYS \geq UVLO$	H	L	Rd COMP2 = L	Previous status	OFF
Wait.SNK	$VSYS \geq UVLO$	H	H	Isrc COMP3 = H	Hi-Z	OFF
Moisture.det	$VSYS \geq UVLO$	H	H	Isrc COMP2 = H, COMP3 = L	L	OFF
Active	$VSYS \geq UVLO$	H	-	Accessory detected	Previous status	ON
	$VSYS \geq UVLO$	L	-	-	Previous status	ON

7.2.1 Shutdown state

When VSYS is below UVLO threshold, NX20P0477 enters Shutdown state, where both CC switches are turned off and Rd clamp circuit on CON_CC1 and CON_CC2 is enabled. Once VSYS is above OVLO, then NX20P0477 transitions to Active state by turning CC switch ON. If VBUS is not present for $t_{CC_OFF_VBUS}$ and CP_EN is high, it

transitions to Wait.SNK or Wait.SRC depending on CCx voltage. When CP_EN is low, NX20P0477 stays at Active state.

7.2.2 Wait.SNK state

When VSYS is above UVLO threshold and comparator1 (CP1) on CC1 and CC2 pins is high, NX20P0477 enters Wait.SNK state. Internal low current source is enabled on CON_CC1 and CON_CC2 by turning CC switches off. When CP1 is driven low by external CC/PD controller, the device transitions to Wait.SRC. If CP2 comparator on CON_CCx is low, it moves to Active state. If CP2 is high and CP3 is low, then it enters Moisture.det state. If FLAGB is driven low after detecting water on connector before, then FLAGB is cleared when CP3 is detected high in this state.

7.2.3 Wait.SRC state

When VSYS is above UVLO threshold and comparator1 (CP1) on CC1 and CC2 pins is low, NX20P0477 enters Wait.SRC state. Internal Rd is enabled on CON_CC1 and CON_CC2 by turning CC switches off. When CP1 is driven high by external CC/PD controller, the device transitions to Wait.SNK. If CP2 comparator on CON_CCx is high, it moves to Active state.

7.2.4 Moisture.Det state

NX20P0477 transitions to Moisture.DET state from Wait.SNK state when CP2 is high and CP3 is low, where FLAGB is driven low. The device transitions to Wait.SRC or Wait.SNK depending to CP1 status on CCx pins.

7.2.5 Active state

When either sink or source accessory is detected successfully, the device enters Active status where both CCx switches are turned on and internal current source or Rd is turned off. The rest of CC detection process is accomplished by external CC/PD controller. The device exits Active state in $t_{CC_OFF_VBUS}$ after removing VBUS. If CP_EN is driven low, the device remains in Active state.

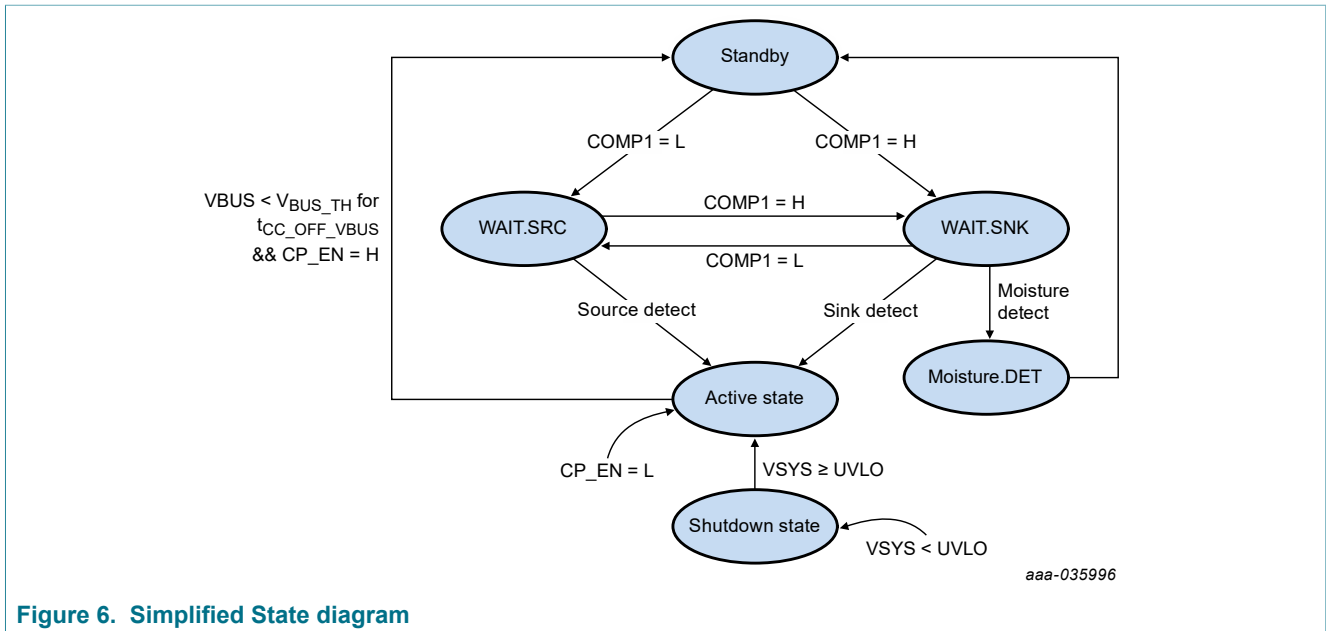


Figure 6. Simplified State diagram

7.3 Corrosion prevention feature

USB PD standard requires 80 μA, 180 μA or 330 μA as R_p to detect sink device. But it may accelerate corrosion when CC pins are contaminated with water, especially sea water. Furthermore, CC/PD controller may recognize this water impedance as sink detection, providing 5 V to V_{BUS} pin and accelerating corrosion.

NX20P0477 isolates CC pin from CON_CC pin by turning CC switches off and imitating CC/PD controller behavior monitoring CC pin status. If CC/PD controller terminates CC pins with R_d, then NX20P0477 enables internal R_d on CON_CC pins. If the controller sources R_p current, it enables internal low current source. NX20P0477 can detect any accessory through connector with internal comparators synchronizing CC/PD Controller R_d/R_p timing.

7.4 Timing diagram

When CP_EN is driven high, CC switch is turned OFF and CON_CC pin follows CC pin status with logic delay, T_{CC_delay}.

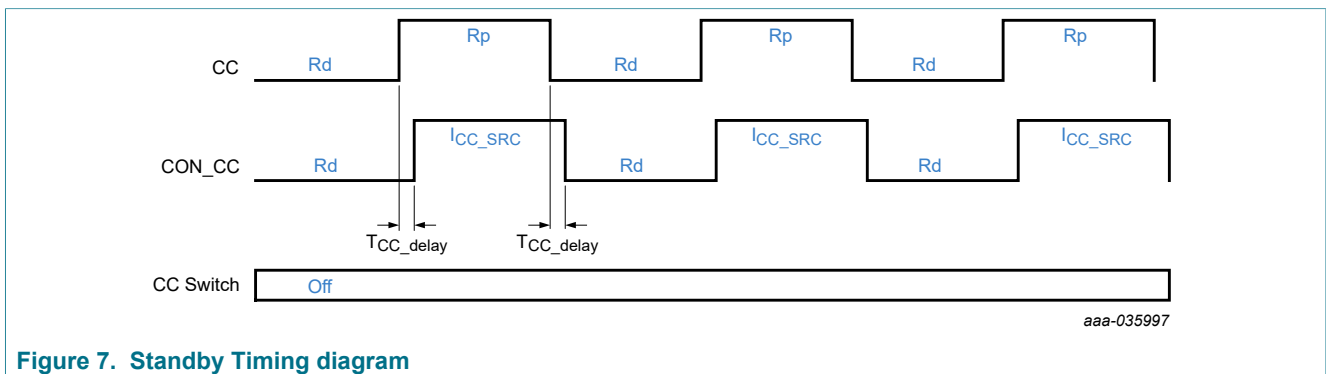
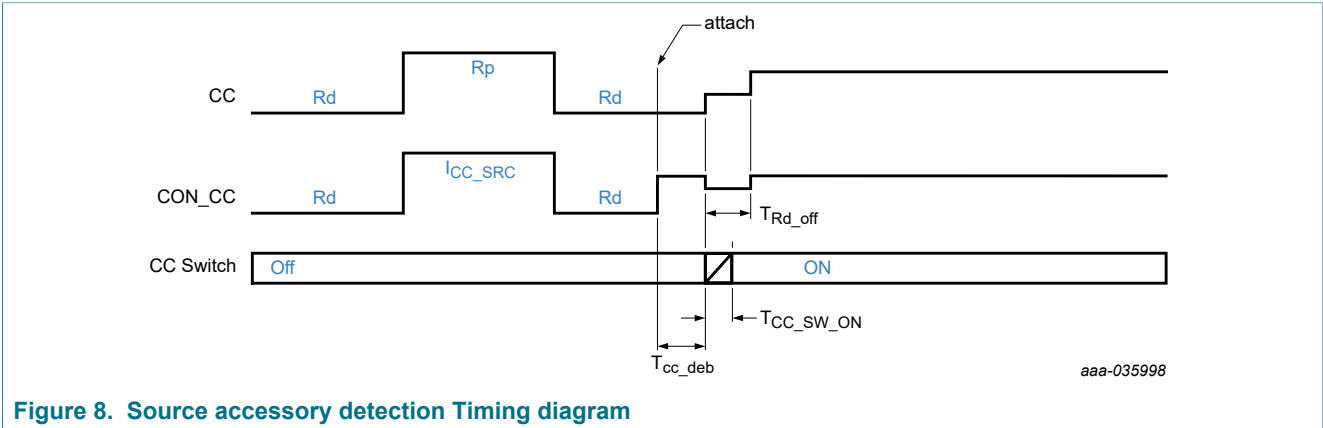


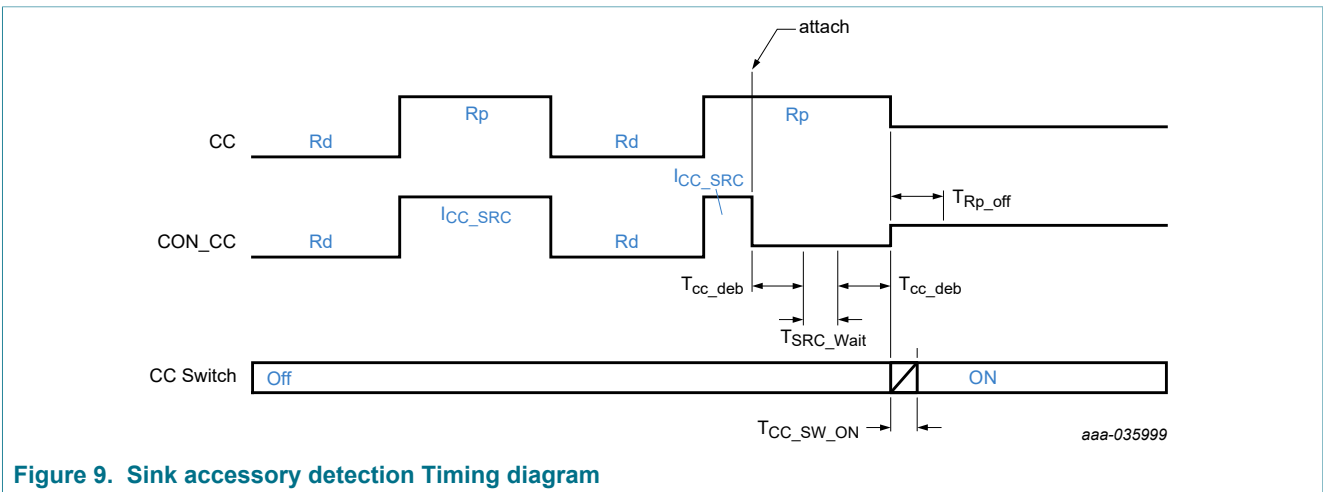
Figure 7. Standby Timing diagram

When source accessory (R_p) is plugged in, CON_CC voltage comes up above V_{COMP2} from current source in source accessory. After debounce timer, T_{CC_deb}, NX20P0477

turns CC switch ON. Internal Rd is off after T_{Rd_off} , which is for Source accessory not to lose Rd during switch transition.



When Sink accessory (R_d) is plugged in, CON_CC voltage falls to $R_d * I_{CC_SRC}$ which is below V_{COMP3} . NX20P0477 detects when something is plugged in and enables internal current source for T_{SRC_WAIT} , to discriminate R_d from water or dead battery. After T_{SRC_WAIT} , CON_CC voltage comes back to $R_d * I_{CC_SRC}$, which is below V_{COMP2} . After T_{CC_deb} , NX20P077 detects as Sink accessory and turns on CC switch.



When Dead battery accessory (R_d Clamp) is plugged in, CON_CC voltage is clamped from R_d clamp circuit in accessory which is below V_{COMP3} . NX20P0477 detects when something is plugged in and enables internal current source for T_{SRC_WAIT} . Unlike R_d accessory, CON_CC voltage doesn't fall below V_{COMP2} due to clamp circuit after T_{SRC_WAIT} . NX20P0477 enables internal current source for T_{CC_deb} , to discriminate Dead battery accessory from water. NX20P0477 then turns I_{CC_SRC} off and turns R_d on. Since there is no source, CON_CC voltage falls below V_{COMP2} . After T_{CC_deb} , NX20P077 detects as Dead battery accessory and turns on CC switch.

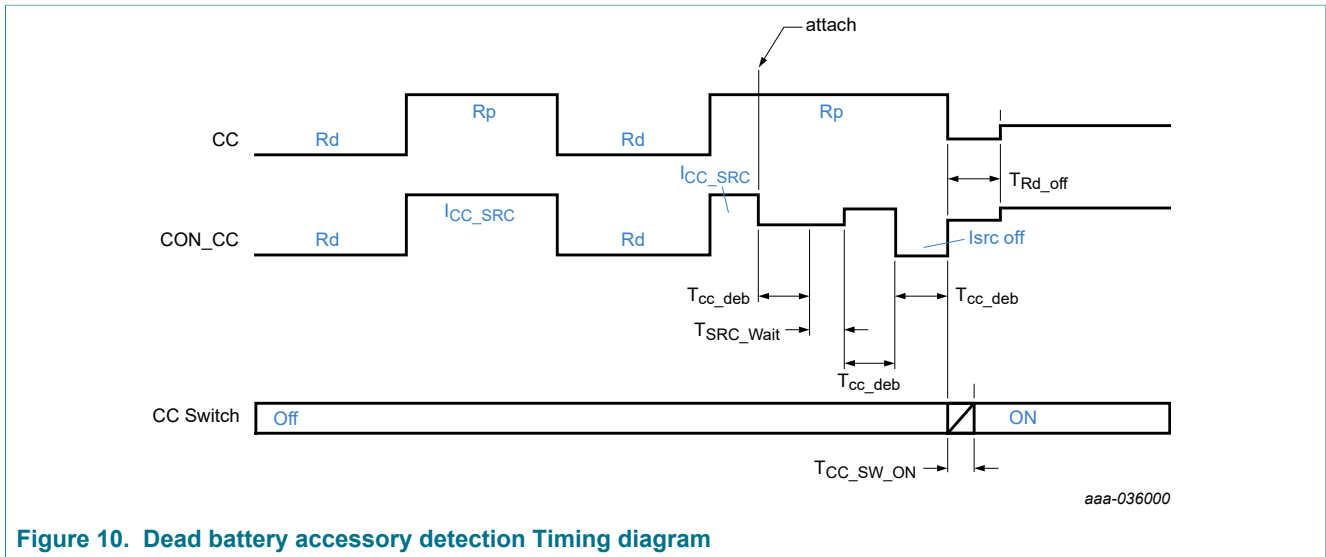


Figure 10. Dead battery accessory detection Timing diagram

Water impedance can be simply modeled with resistance and capacitance. Tap water and purified water show a few hundred kΩ and a few hundred nF capacitance. Sea water has a few tens kΩ and around 1 μF capacitance. NX20P0477 utilizes this characteristic to detect water from normal accessory.

When water comes into contact with a USB-C connector pin, CON_CC voltage drops due to water impedance which is below VCOMP3. NX20P0477 detects a change and enables internal current source for T_{SRC_WAIT}, and then enables the current source for T_{CC_deb}. During this time, CON_CC voltage increases above VCOMP3 in case of tap water, it detects as water, where CC switch stays off and FLAGB is pulled low. In case of sea water, the voltage doesn't go over VCOMP3 even if enabling internal current source for T_{CC_deb}, after then NX20P0477 turns off internal all current source and enables Rd. CON_CC voltage doesn't fall below VCOMP2 due to water capacitance.

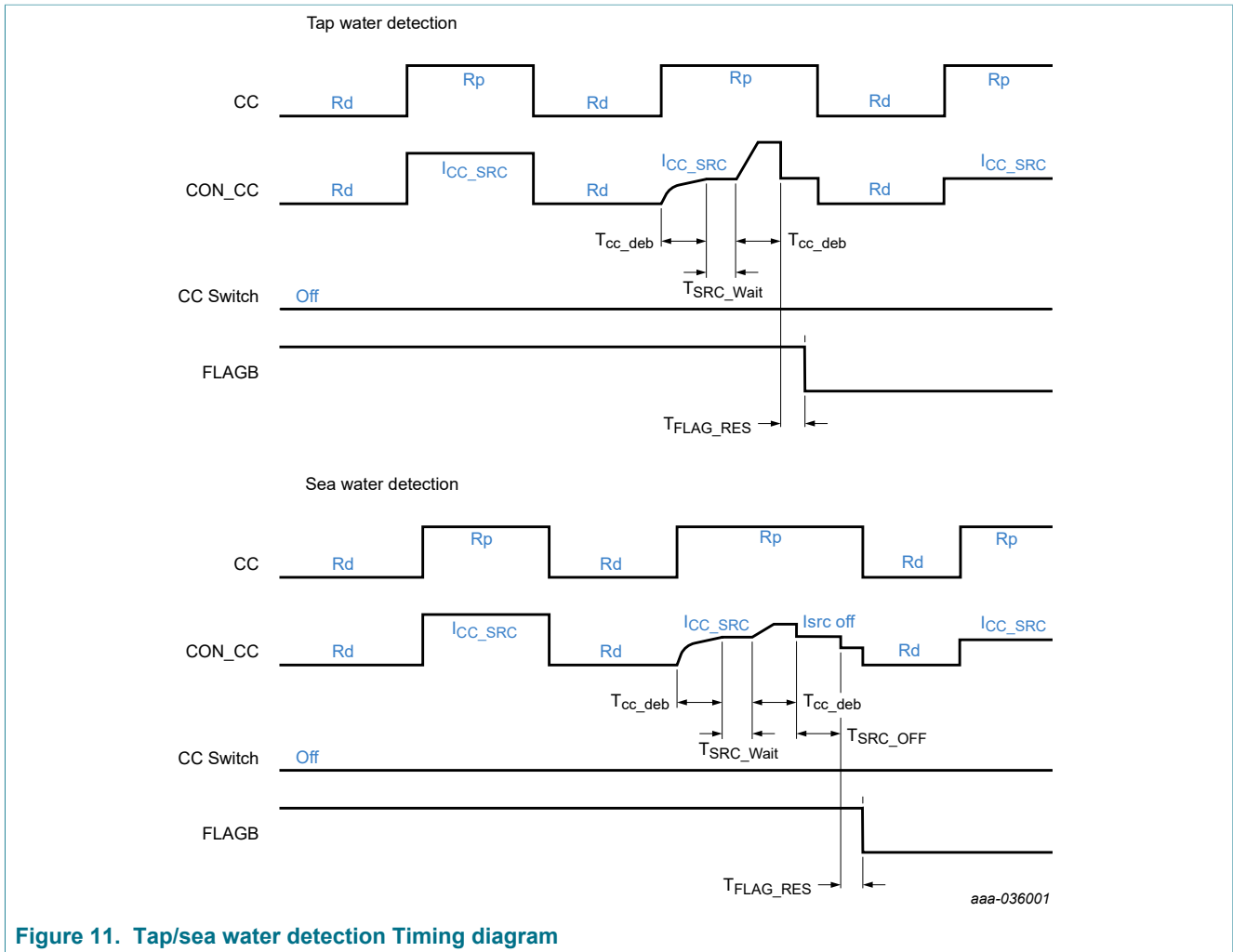


Figure 11. Tap/sea water detection Timing diagram

7.5 Overvoltage protection

NX20P0477 has overvoltage protection of CON_CC1 and CON_CC2 up to 28 V. CC switch overvoltage threshold is V_{OVPCC} to guarantee 5 V VCONN power supply, which is maximum 5.5 V by USB USB-C spec.

Once overvoltage on either channel is detected, the switch is quickly turned off within t_{OVP_res}, to prevent passing overvoltage to system side. If the voltage of the channel triggered OVP comes down below overvoltage threshold for t_{OVP_Deb}, NX20P0477 CC switch turns back on.

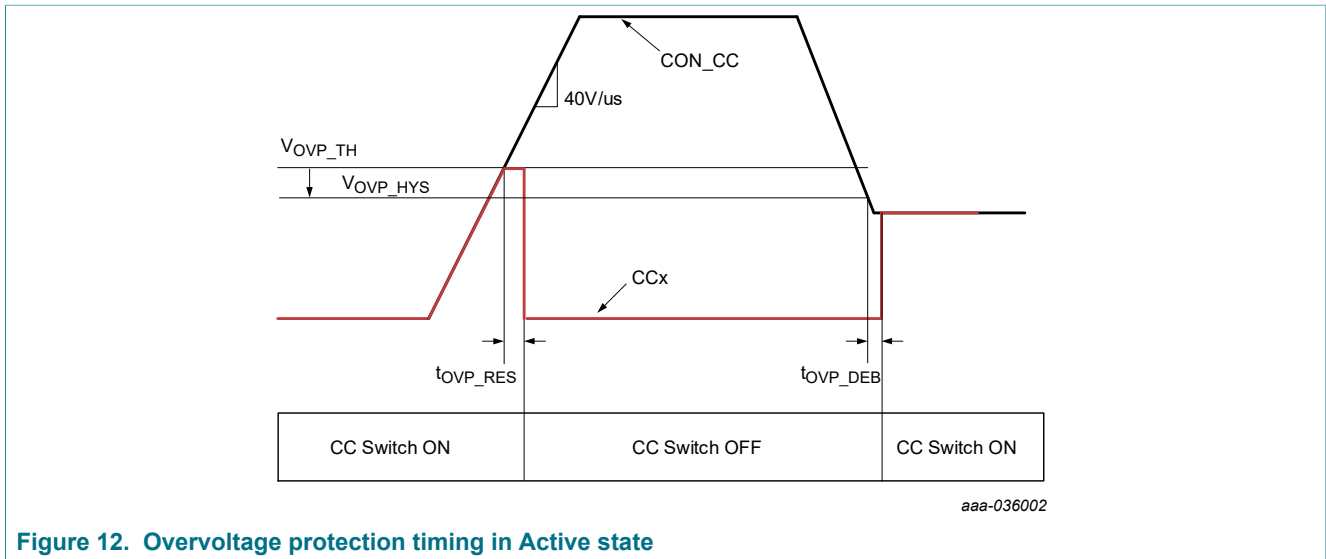


Figure 12. Overvoltage protection timing in Active state

7.6 CP_EN

CP_EN pin is a control pin that enables the corrosion prevention feature.

When CP_EN pin is driven high, corrosion prevention circuit is enabled. If CP_EN pin is driven low, corrosion prevention circuit is disabled and enters active state by turning CC switches on, where NX20P0477 acts as an overvoltage protection switch.

7.7 VBUS

VBUS pin detects VBUS presence and uses this signal to turn off CC switch. Whenever an accessory is detected, VBUS comes up according to USB USB-C specification. When accessory is removed, VBUS disappears. NX20P0477 turns off CC switch 2.5 sec after VBUS is removed.

7.8 FLAGB

FLAGB pin is an open drain output to indicate moisture condition on USB-C connector pins to application processor. When NX20P0477 detects water, such as tap or sea water, it drives FLAGB low. If both CON_CC1 and CON_CC2 voltages exceed V_{COMP3} in Wait.SNK state, it is regarded as dry condition on connector and FLAGB gets High-Z. When VSYS voltage falls below UVLO threshold, FLAGB gets High-Z.

8 Limiting values

Table 5. Limiting values

Absolute Maximum Ratings

Explanation	Pin	Conditions	Min	Max	Unit
Voltage range (with respect to GND)	CON_CC1, CON_CC2		-0.5	+28	V
	CC1, CC2		-0.5	+6	V
	VSYS		-0.5	+6	V
	FLAG, CP_EN		-0.5	+6	V
	VBUS		-0.5	+28	V
Output Current	CON_CC1, CON_CC2, CC1, CC2	$T_j < 105\text{ °C}$	-350	+350	mA
Junction temperature			-40	+135	°C
V_{ESD} Electrostatic discharge voltage	All pins for HBM and CDM specs	HBM (JESD22-001)	-2	+2	kV
		CDM (JESD22-C101E)	-500	+500	kV
	CON_CC1, CON_CC2 for IEC specs	IEC 61000-4-2 contact discharge	-6	+6	kV
		IEC 61000-4-2 air discharge	-8	+8	kV
P_{tot}	Total power dissipation ^[1]			1.35	W

[1] The (absolute) maximum power dissipation depends on the junction temperature T_j . Higher power dissipation is allowed in conjunction with lower ambient temperatures. The conditions to determine the specified values are $T_{amb} = 25\text{ °C}$ and the use of a two-layer PCB

9 Recommended operating conditions

Table 6. Recommended Operating Conditions

Explanation	Pin	Conditions	Min	Max	Unit
Voltage range (with respect to GND)	VSYS		2.5	+5.5	V
	VBUS		0	+22	V
	FLAG, CP_EN		0	+5.5	V
	CC1, CC2, CON_CC1, CON_CC2		0	+5.5	V
CC current	CON_CC1, CON_CC2, CC1, CC2		-200	+200	mA
Ambient temperature			-40	85	°C

10 Thermal characteristics

Table 7. Thermal characteristics

Symbol	Parameter	Conditions	Typ	Unit
Rth(j-a)	thermal resistance from junction to ambient		[1] [2] 72.3	°C/W

[1] The overall Rth(j-a) can vary depending on the board layout. To minimize the effective Rth(j-a), all pins must have a solid connection to larger Cu layer areas e.g. to the power and ground layer. In multi-layer PCB applications, the second layer should be used to create a large heat spreader area right below the device. If this layer is either ground or power, it should be connected with several vias to the top layer connecting to the device ground or supply. Try not to use any solder-stop varnish under the chip

[2] This Rth(j-a) is calculated based on JEDEX2S2P board. The actual Rth(j-a) value may vary in applications using different layer stacks and layouts.

11 Electrical characteristics

11.1 Static characteristics

Table 8. Static characteristics

Unless otherwise specified, $V_{SYS} = 3.6\text{ V}$, $V_{BUS} = 5\text{ V}$, $C_{V_{SYS}} = 1\ \mu\text{F}$, $T_{amb} = -40\text{ }^{\circ}\text{C to }+85\text{ }^{\circ}\text{C}$

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Supply current / Leakage current						
$V_{SYSUVLO}$	VSYS Under Voltage Lockout	Falling, 100 mV hysteresis	2.14	2.27	2.40	V
I_{SYS_STDBY}	Standby current	$V_{SYS} = 3.6\text{ V}$, $CCx = 5.1\text{ k}\Omega$, CON_CCx floating, $CP_EN = H$		13	20	μA
I_{SYS_STDBY}	Standby current	$V_{SYS} = 3.6\text{ V}$, $CCx = 3.6\text{ V}$, CON_CCx floating, $CP_EN = H$		13	20	μA
I_{SYS_ACTIVE}	Active Current	$V_{SYS} = 3.6\text{ V}$, $CCx = 5.1\text{ k}\Omega$, CON_CCx floating, $CP_EN = L$		44	60	μA
I_{VBUS}	VBUS leakage current	$V_{SYS} = 3.6\text{ V}$, $V_{BUS} = 5.0\text{ V}$		4	10	μA
I_{CC_Leak}	Leakage current for CC1, CC2	$V_{SYS} = 3.6\text{ V}$, $CCx = 3.0\text{ V}$, CON_CCx floating, $V_{SYS} > V_{CCx} + 0.6\text{ V}$. Switch OFF		0.5	2	μA
	Leakage current for CC1, CC2	$V_{SYS} = 3.6\text{ V}$, $CCx = 3.6\text{ V}$, CON_CCx floating, Switch OFF		0.5	5	μA
CC switcher						
R_{on_CC}	On resistance	$V_{SYS} = 3.6\text{ V}$, $CCx = 5.5\text{ V}$, $I_{CON_CCx} = 200\text{ mA}$, Switch ON	-	230	400	m Ω
R_{on_Flat}	On resistance flatness	Sweep CC voltage between 0 V and 3.6 V, $I_{CON_CCx} = 200\text{ mA}$		2	10	m Ω
V_{CLAMPH}	CON_CCx clamping voltage	External 330 μA , $V_{SYS} = 0\text{ V}$	0.9	1.4	2.13	V
V_{CLAMPM}	CON_CCx clamping voltage	External 180 μA , $V_{SYS} = 0\text{ V}$	0.5	0.8	1.2	V
V_{CLAMPD}	CON_CCx clamping voltage	External 80 μA , $V_{SYS} = 0\text{ V}$	0.3	0.7	1.2	V
R_d	R_d resistance on CON_CCx	$V_{SYS} = 3.6\text{ V}$, $V_{CCx} = 0\text{ V}$, $CP_EN = H$		5.1		k Ω
R_{d_STR}	Strong R_d resistance on CON_CCx	$V_{SYS} = 3.6\text{ V}$, $V_{CCx} = 0\text{ V}$		150		Ω
V_{OVP}	OVP threshold on CON_CCx	$V_{SYS} = 3.6\text{ V}$, Rising	5.6	5.8	6.0	V
V_{OVP_hys}	OVP threshold hysteresis			100		mV

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
C_{on_cc}	Equivalent on capacitance	Capacitance between CCx/ CON_CCx and GND when Powered up. $V_{CCx} = 0\text{ V}$ to 1.2 V , $f = 240\text{ MHz}$		25		pF
BW_{CC}	3dB Bandwidth	Single ended, $50\ \Omega$ termination, $V_{CCx} = 0.1\text{ V}$ to 1.2 V		100		MHz
Detection						
V_{COMP1}	Comparator 1 threshold	$VSYS = 3.6\text{ V}$	1.28	1.6	1.92	V
V_{COMP2}	Comparator 2 threshold	$VSYS = 3.6\text{ V}$, $V_{CCx} > 2.0\text{ V}$	40	50	60	mV
V_{COMP2}	Comparator 2 threshold	$VSYS = 3.6\text{ V}$, $V_{CCx} < 1.0\text{ V}$	160	200	240	mV
V_{COMP3}	Comparator 3 threshold	$VSYS = 3.6\text{ V}$, $V_{CCx} > 2.0\text{ V}$	1.44	1.8	2.16	V
I_{CC_SRC}	Current source	$VSYS = 3.6\text{ V}$, $V_{CCx} > 2.0\text{ V}$ $V_{CON_CCx} = 2\text{ V}$	2	2.5	3.125	μA
V_{VBUS_th}	Valid VBUS detection threshold	Falling	2.6	2.8	3.0	V
$V_{VBUS_th_Hys}$	VBUS detection hysteresis			500		mV
FLAGB						
V_{OL}	Output low voltage	$I_{OL} = 5\text{ mA}$			0.3	V
I_{OH}	High level leakage current	$V_{FLAG} = 5.5\text{ V}$, $VSYS = 5.5\text{ V}$			1	μA
CP_EN						
V_{IH}	Valid input high		1.5			V
V_{IL}	Valid input low				0.4	V
I_{IH}	Input leakage current	$VSYS = 3.6\text{ V}$, $V_{CP_EN} = 3.6\text{ V}$			1	μA
Over Temperature						
T_{OTP}	Over temperature			125		$^{\circ}\text{C}$
T_{OTP_hys}	Over temperature hysteresis		-	10	-	$^{\circ}\text{C}$

11.2 Dynamic characteristics

Table 9. Dynamic characteristics

Unless otherwise specified, $VSYS = 3.6\text{ V}$, $VBUS = 5\text{ V}$, $C_{VSYS} = 1\ \mu\text{F}$, $T_{amb} = -40\text{ }^{\circ}\text{C}$ to $+85\text{ }^{\circ}\text{C}$

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Switch Dynamic Characteristics						
t_{pwrap}	Power up time from Valid power source of VSYS			2	4	ms

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
t _{OVP_res}	OVP response time	Time from OVP trip to 80 % of the trip voltage after OVP FET turn-off; Load 50 Ω to GND on CCx; CON_CCx voltage slope is 40 V		60		ns
t _{OVP_deb}	Minimum time to exit OVP shutdown	CON_CCx voltage should be lower than OVP threshold for this time		50		μs
t _{CC_SW_ON}	CC switch enable time after accessory detected	90 % of V _{CON_CCx} , V _{CON_CCx} =2 V, I _{CC} =330 μA		500	800	μs
t _{CC_OFF_VBUS}	CC switch OFF time after VBUS is removed		1.6	2.5		sec
t _{OTP_deb}	Minimum time to exit Over Temperature	[1]		30		μs
t _{FLAG_RES}	Time to FLAG assertion from water impedance detected	[1]		20		μs
t _{CC_delay}	Logic delay to transfer CCx voltage to CONN_CCx				100	μs
t _{CC_deb}	Debounce time for comparators			2		ms
t _{Rd_OFF}	Rd off time after CC switch is turned on			2		ms
t _{SRC_WAIT}	Wait time to check comparator at source mode			1		ms
t _{Rp_OFF}	I _{CC_SRC} off time after CC switch is turned on			2		ms
t _{Rd_STR_ON}	Rd_STR ON time after transition to Wait.SRC			3		ms
t _{SRC_OFF}	I _{SRC} off time			1		ms

[1] No production test, guaranteed by design

12 Package outline

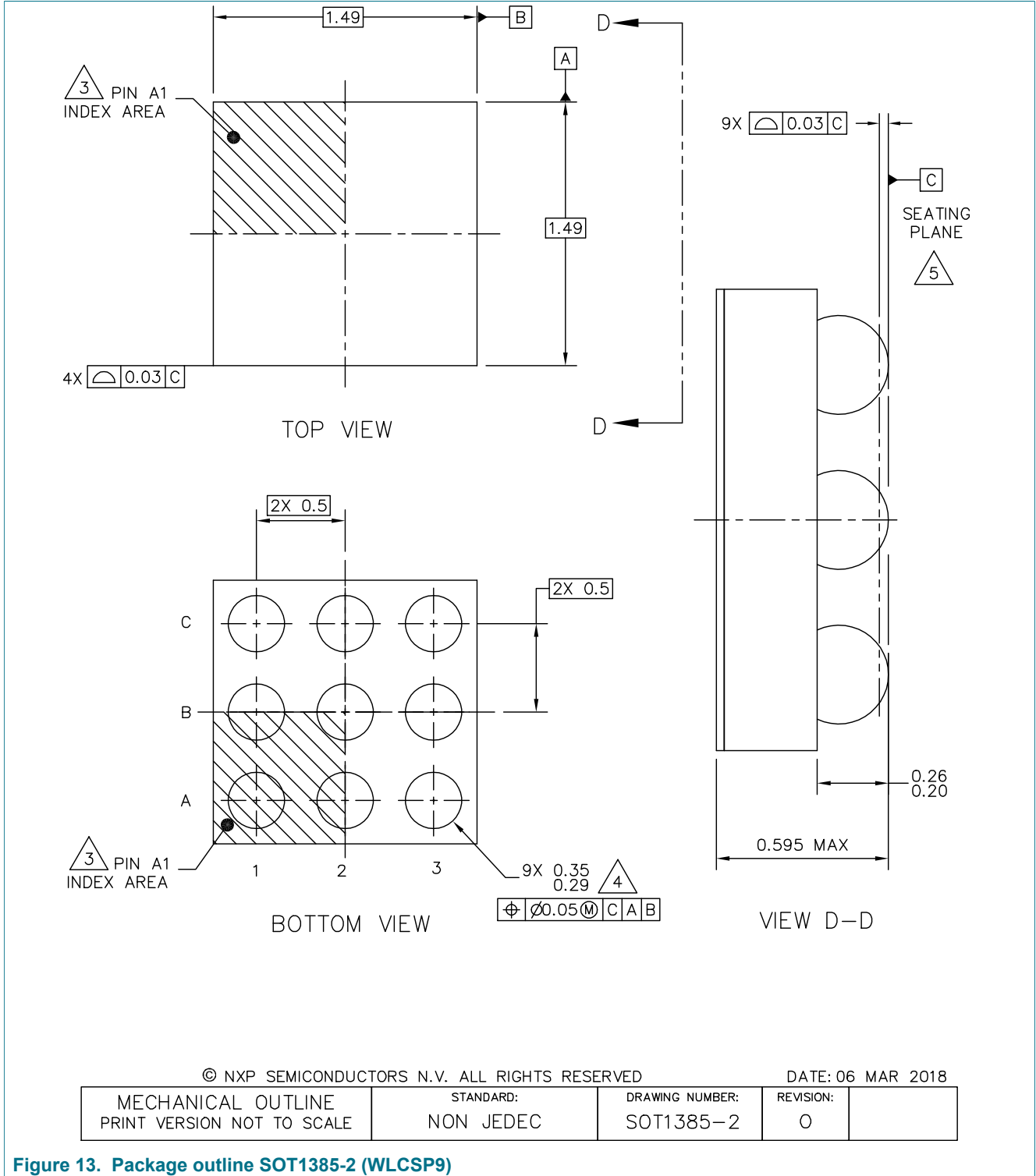


Figure 13. Package outline SOT1385-2 (WLCSP9)

13 Revision history

Table 10. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
NX20P0477 v.1.0	20200203	Product data sheet	-	-

14 Legal information

14.1 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".

[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL <http://www.nxp.com>.

14.2 Definitions

Draft — The document is a draft version only. The content is still under internal review and subject to formal approval, which may result in modifications or additions. NXP Semiconductors does not give any representations or warranties as to the accuracy or completeness of information included herein and shall have no liability for the consequences of use of such information.

Short data sheet — A short data sheet is an extract from a full data sheet with the same product type number(s) and title. A short data sheet is intended for quick reference only and should not be relied upon to contain detailed and full information. For detailed and full information see the relevant full data sheet, which is available on request via the local NXP Semiconductors sales office. In case of any inconsistency or conflict with the short data sheet, the full data sheet shall prevail.

Product specification — The information and data provided in a Product data sheet shall define the specification of the product as agreed between NXP Semiconductors and its customer, unless NXP Semiconductors and customer have explicitly agreed otherwise in writing. In no event however, shall an agreement be valid in which the NXP Semiconductors product is deemed to offer functions and qualities beyond those described in the Product data sheet.

14.3 Disclaimers

Limited warranty and liability — Information in this document is believed to be accurate and reliable. However, NXP Semiconductors does not give any representations or warranties, expressed or implied, as to the accuracy or completeness of such information and shall have no liability for the consequences of use of such information. NXP Semiconductors takes no responsibility for the content in this document if provided by an information source outside of NXP Semiconductors. In no event shall NXP Semiconductors be liable for any indirect, incidental, punitive, special or consequential damages (including - without limitation - lost profits, lost savings, business interruption, costs related to the removal or replacement of any products or rework charges) whether or not such damages are based on tort (including negligence), warranty, breach of contract or any other legal theory. Notwithstanding any damages that customer might incur for any reason whatsoever, NXP Semiconductors' aggregate and cumulative liability towards customer for the products described herein shall be limited in accordance with the Terms and conditions of commercial sale of NXP Semiconductors.

Right to make changes — NXP Semiconductors reserves the right to make changes to information published in this document, including without limitation specifications and product descriptions, at any time and without

notice. This document supersedes and replaces all information supplied prior to the publication hereof.

Suitability for use — NXP Semiconductors products are not designed, authorized or warranted to be suitable for use in life support, life-critical or safety-critical systems or equipment, nor in applications where failure or malfunction of an NXP Semiconductors product can reasonably be expected to result in personal injury, death or severe property or environmental damage. NXP Semiconductors and its suppliers accept no liability for inclusion and/or use of NXP Semiconductors products in such equipment or applications and therefore such inclusion and/or use is at the customer's own risk.

Applications — Applications that are described herein for any of these products are for illustrative purposes only. NXP Semiconductors makes no representation or warranty that such applications will be suitable for the specified use without further testing or modification. Customers are responsible for the design and operation of their applications and products using NXP Semiconductors products, and NXP Semiconductors accepts no liability for any assistance with applications or customer product design. It is customer's sole responsibility to determine whether the NXP Semiconductors product is suitable and fit for the customer's applications and products planned, as well as for the planned application and use of customer's third party customer(s). Customers should provide appropriate design and operating safeguards to minimize the risks associated with their applications and products. NXP Semiconductors does not accept any liability related to any default, damage, costs or problem which is based on any weakness or default in the customer's applications or products, or the application or use by customer's third party customer(s). Customer is responsible for doing all necessary testing for the customer's applications and products using NXP Semiconductors products in order to avoid a default of the applications and the products or of the application or use by customer's third party customer(s). NXP does not accept any liability in this respect.

Limiting values — Stress above one or more limiting values (as defined in the Absolute Maximum Ratings System of IEC 60134) will cause permanent damage to the device. Limiting values are stress ratings only and (proper) operation of the device at these or any other conditions above those given in the Recommended operating conditions section (if present) or the Characteristics sections of this document is not warranted. Constant or repeated exposure to limiting values will permanently and irreversibly affect the quality and reliability of the device.

Terms and conditions of commercial sale — NXP Semiconductors products are sold subject to the general terms and conditions of commercial sale, as published at <http://www.nxp.com/profile/terms>, unless otherwise agreed in a valid written individual agreement. In case an individual agreement is concluded only the terms and conditions of the respective agreement shall apply. NXP Semiconductors hereby expressly objects to applying the customer's general terms and conditions with regard to the purchase of NXP Semiconductors products by customer.

No offer to sell or license — Nothing in this document may be interpreted or construed as an offer to sell products that is open for acceptance or the grant, conveyance or implication of any license under any copyrights, patents or other industrial or intellectual property rights.

Export control — This document as well as the item(s) described herein may be subject to export control regulations. Export might require a prior authorization from competent authorities.

Translations — A non-English (translated) version of a document is for reference only. The English version shall prevail in case of any discrepancy between the translated and English versions.

14.4 Trademarks

Notice: All referenced brands, product names, service names and trademarks are the property of their respective owners.

Tables

Tab. 1.	Ordering information	2	Tab. 6.	Recommended Operating Conditions	14
Tab. 2.	Ordering options	2	Tab. 7.	Thermal characteristics	15
Tab. 3.	Pin description	4	Tab. 8.	Static characteristics	16
Tab. 4.	Power state	6	Tab. 9.	Dynamic characteristics	17
Tab. 5.	Limiting values	13	Tab. 10.	Revision history	20

Figures

Fig. 1.	Functional diagram	3	Fig. 8.	Source accessory detection Timing diagram	9
Fig. 2.	Pin map bump side down	3	Fig. 9.	Sink accessory detection Timing diagram	9
Fig. 3.	Pin map bump side up	3	Fig. 10.	Dead battery accessory detection Timing diagram	10
Fig. 4.	NX20P0477 application diagram	5	Fig. 11.	Tap/sea water detection Timing diagram	11
Fig. 5.	Internal block diagram – one channel only	6	Fig. 12.	Overvoltage protection timing in Active state ...	12
Fig. 6.	Simplified State diagram	8	Fig. 13.	Package outline SOT1385-2 (WLCSP9)	19
Fig. 7.	Standby Timing diagram	8			

Contents

1	General description	1
2	Features and benefits	1
3	Applications	2
4	Ordering information	2
4.1	Ordering options	2
5	Functional diagram	3
6	Pinning information	3
6.1	Pinning	3
6.2	Pin description	4
7	Functional description	5
7.1	Internal block diagram	5
7.2	Power status	6
7.2.1	Shutdown state	6
7.2.2	Wait.SNK state	7
7.2.3	Wait.SRC state	7
7.2.4	Moisture.Det state	7
7.2.5	Active state	7
7.3	Corrosion prevention feature	8
7.4	Timing diagram	8
7.5	Overvoltage protection	11
7.6	CP_EN	12
7.7	VBUS	12
7.8	FLAGB	12
8	Limiting values	13
9	Recommended operating conditions	14
10	Thermal characteristics	15
11	Electrical characteristics	16
11.1	Static characteristics	16
11.2	Dynamic characteristics	17
12	Package outline	19
13	Revision history	20
14	Legal information	21

Please be aware that important notices concerning this document and the product(s) described herein, have been included in section 'Legal information'.

© NXP B.V. 2020.

All rights reserved.

For more information, please visit: <http://www.nxp.com>

For sales office addresses, please send an email to: salesaddresses@nxp.com

Date of release: 3 February 2020
Document identifier: NX20P0477

Mouser Electronics

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

NXP:

[NX20P0477UKZ](#)