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## MAX77958

# Standalone USB Type-C and USB Power Delivery Controller

### General Description

The MAX77958 is a robust solution for USB Type-C CC detection and power delivery (PD) protocol implementation. It detects connected accessories or devices by using Type-C CC detection and USB PD messaging. The IC protects against overvoltage and overcurrent, and detects moisture and prevents corrosion on the USB Type-C connector. The IC also has a D+/D- USB switch and BC1.2 detection to support legacy USB standards. It contains  $V_{CONN}$  switches for USB PD and an enable pin for an external  $V_{CONN}$  boost or buck converter. When the USB PD negotiation is complete, the IC configures an alternate mode setting for external multiplexers.

The IC is compliant with USB Type-C Specification Release 1.3 and PD 3.0. It can be customized easily without affecting the compliance.

The IC has an I<sup>2</sup>C master that can read and write to other devices in the system so that its firmware can configure related devices without the main processor's assistance. For example, it can configure an external charger based on BC1.2 detection, CC detection, and PD communication.

The IC has an interrupt output pin to report event detection and status changes. It also has an I<sup>2</sup>C interface that the system can use to read/write and configure internal registers.

The IC has nine configurable GPIOs that can be used for detection, as interrupts, and as the enable/disable pin for external devices, or as ADC inputs.

The IC is available in a 3.10mm x 2.65mm, 0.5mm pitch, wafer-level package (WLP).

### Applications

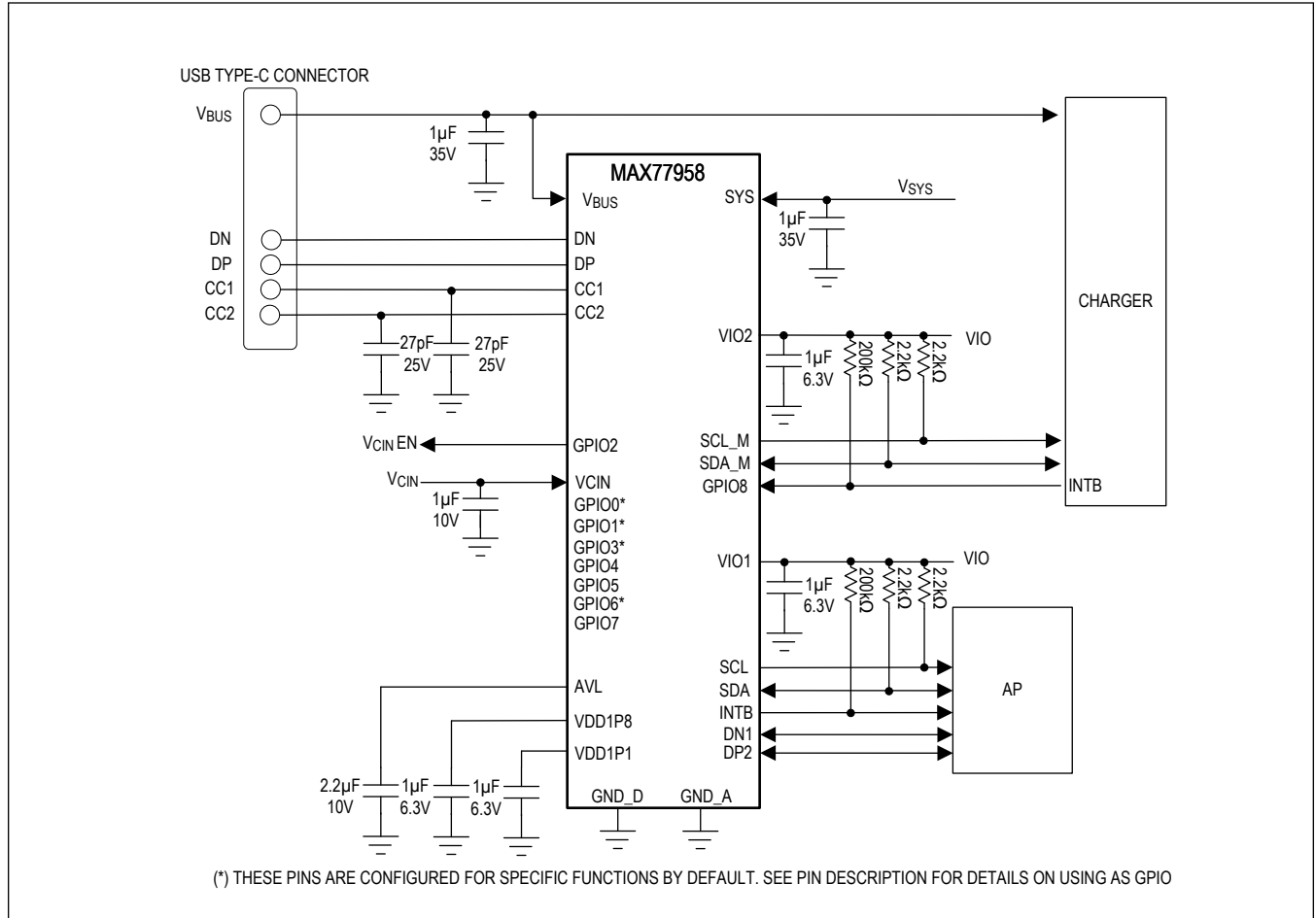
- Smartphones
- Tablets
- Cameras
- Game Players
- Power Banks
- Industrial Equipment PoE to USB Type-C Adapters
- Handheld Devices
- Portable Devices
- Monitors
- Healthcare and Medical Devices
- Other USB Type-C Devices

### Benefits and Features

- Supports Autonomous or MCU Based Configuration
  - No Firmware Development Needed in Autonomous Configuration
  - Customizable Based on Application Requirements
- Customizable Firmware
  - USB Compliant Default Embedded Firmware
  - Supports Customizable Actions on Events
  - Firmware Updates for Future Specification Revisions
- USB Type-C Support and USB-PD Support
  - USB Type-C Version 1.3 and PD3.0 Compliant
  - Mode Configuration: Sink/Source/Dual Role Port
  - Programmable Power Supply (PPS) Sink Support
  - Fast Role Swap (FRS) Initial Sink Support
  - Alternate Mode Support
  - Cable Orientation and Power Role Detection
  - Integrated  $V_{CONN}$  Switch with OCP
  - Support Try.Snk State
  - Audio and Debug Accessory Sink/Source Mode
- Supports BC1.2 Legacy/Proprietary Charger Detection
  - Integrated D+/D- Switches
- Moisture Detection/Corrosion Prevention
- High Voltage  $V_{BUS}$  (28V)
- Short to  $V_{BUS}$  Protection on CC Pins (22V)
- Dead Battery Support
- Dual Supply Inputs from SYS and  $V_{BUS}$
- I<sup>2</sup>C Programmable Configuration
- I<sup>2</sup>C Master to Control External Charger or Direct Charge IC
- Nine Configurable GPIOs
  - SuperSpeed Mux/Detection/IRQ
  - Configuration for Alternate Mode
  - ENABLE/DISABLE External Switches or Devices
- 30-Bump, 6x5, 0.5mm Pitch WLP

**Ordering Information appears at end of data sheet.**

Simplified Block Diagram



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**Absolute Maximum Ratings**

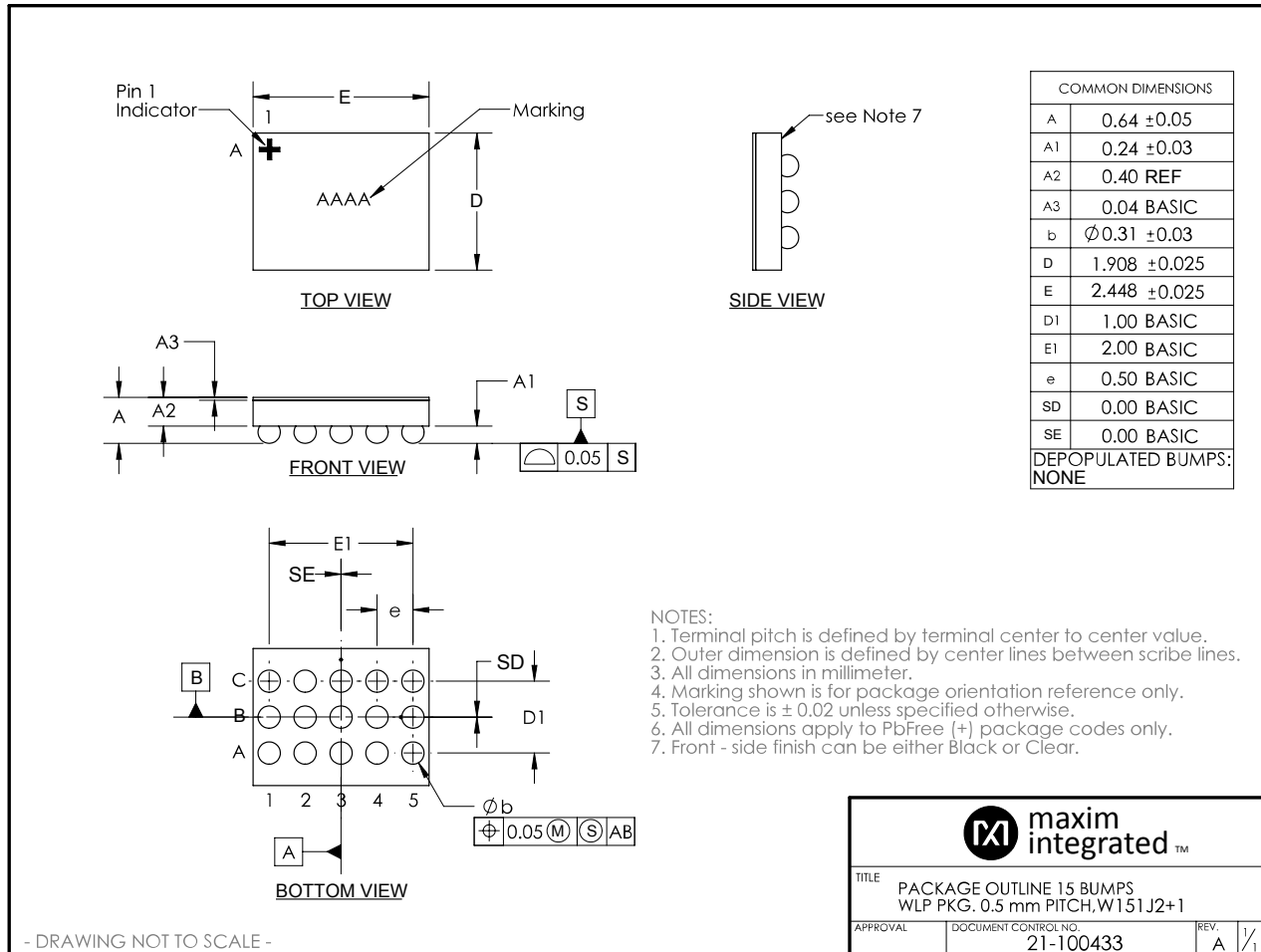
TOP and Interface Logic		CC1, CC2 to GND .....	-0.3V to +22.0V
SYS to GND .....	-0.3V to +22.0V	VDD1P1 to GND .....	-0.3V to VDD1P8 + 0.3V
V <sub>BUS</sub> to GND .....	-0.3V to +30.0V	SCL_M, SDA_M to GND .....	-0.3V to VIO2 + 0.3V
AVL to GND .....	-0.3V to +6.0V	GPIO0, GPIO1, GPIO2, GPIO3, GPIO8 to GND .....	-0.3V to VIO2 + 0.3V
VDD1P8 to GND .....	-0.3V to +2.2V	GPIO4, GPIO5, GPIO6, GPIO7 to GND .....	-0.3V to VIO1 + 0.3V
VIO1 to GND .....	-0.3V to +6.0V	Thermal Absolute Maximum Rating	
VIO2 to GND .....	-0.3V to +6.0V	Continuous Power Dissipation (Multilayer Board) (T <sub>A</sub> = +70°C, derate 24.4mW/°C above +70°C.).....	21.0mW to 24.4mW
SCL, SDA, INTB to GND .....	-0.3V to VIO1 + 0.3V	Operating Temperature Range .....	-40°C to +85°C
GND_A, GND_D to GND .....	-0.3V to +0.3V	Storage Temperature Range.....	-65°C to +150°C
USB Type-C			
VCIN to GND .....	-0.3V to +6.0V		
DN, DP, DN1, DP2 to GND.....	-0.3V to +6.0V		

Stresses beyond those listed 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 in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

**Package Information**

**WLP**

Package Code	W302B3+1
Outline Number	<a href="#">21-100339</a>
Land Pattern Number	Refer to <a href="#">Application Note 1891</a>
<b>Thermal Resistance, Four-Layer Board:</b>	
Junction to Ambient (θ <sub>JA</sub> )	41°C/W
Junction to Case (θ <sub>JC</sub> )	N/A



For the latest package outline information and land patterns (footprints), go to [www.maximintegrated.com/packages](http://www.maximintegrated.com/packages). Note that a "+", "#", or "-" in the package code indicates RoHS status only. Package drawings may show a different suffix character, but the drawing pertains to the package regardless of RoHS status.

Package thermal resistances were obtained using the method described in JEDEC specification JESD51-7, using a four-layer board. For detailed information on package thermal considerations, refer to [www.maximintegrated.com/thermal-tutorial](http://www.maximintegrated.com/thermal-tutorial).



## Electrical Characteristics

(Limits are 100% tested at  $T_A = +25^\circ\text{C}$ . Limits over the operating temperature range and relevant supply voltage range are guaranteed by design and characterization.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
<b>GENERAL ELECTRICAL CHARACTERISTICS</b>						
SYS Operating Voltage	$V_{\text{SYS}}$		$AVL_{\text{UVL}}$ OR		+20	V
AVL UVLO Rising	$AVL_{\text{UVLOR}}$	AVL	2.6	2.7	2.8	V
AVL UVLO Falling	$AVL_{\text{UVLOF}}$	AVL	2.4	2.5	2.6	V
AVL UVLO Hysteresis	$AVL_{\text{UVLOHYS}}$	AVL		200		mV
AVL Operating Voltage	$V_{\text{AVL}}$		$AVL_{\text{UVL}}$ OF		+5.5	V
SYS OV HR Rising	$SYS_{\text{OV\_HR\_R}}$	SYS	4.60	4.87	5.15	V
SYS OV HR Falling	$SYS_{\text{OV\_HR\_F}}$	SYS	4.40	4.71	5.05	V
SYS OV HR Hysteresis	$SYS_{\text{OV\_HR\_H}}$	SYS		160		mV
SYS OV LR Rising	$SYS_{\text{OV\_LR\_R}}$	SYS	3.60	3.87	4.15	V
SYS OV LR Falling	$SYS_{\text{OV\_LR\_F}}$	SYS	3.50	3.75	4.00	V
SYS OV LR Hysteresis	$SYS_{\text{OV\_LR\_H}}$	SYS		115		mV
SYS Factory Ship Supply Current	$I_{\text{FSHIP}}$	$V_{\text{IO1}} = V_{\text{IO2}} = 0\text{V}$ , $CC_{\text{detEn}} = 0$ , $chg_{\text{DetEn}} = 0$ , $V_{\text{BUS}} = 0\text{V}$	SYS = 4.2V	7		$\mu\text{A}$
			SYS = 8.4V	14		
			SYS = 12.6V	19		
		$V_{\text{IO1}} = V_{\text{IO2}} = 0\text{V}$ , $CC_{\text{detEn}} = 0$ , $chg_{\text{DetEn}} = 0$ , $V_{\text{BUS}} = 0\text{V}$	SYS = 16.8V	25		
SYS Dead Battery Supply Current	$I_{\text{DEADBAT}}$	$V_{\text{IO1}} = V_{\text{IO2}} = 0\text{V}$ , $CC_{\text{detEn}} = 0$ , $chg_{\text{DetEn}} = 0$ , $V_{\text{BUS}} = 0\text{V}$	SYS = 4.2V, $SYS_{\text{OV\_HR}}$	87		$\mu\text{A}$
			SYS = 8.4V	51		
			SYS = 12.6V	59		
			SYS = 16.8V	67		
SYS Shutdown Supply Current	$I_{\text{SHDN}}$	$V_{\text{IO1}} = V_{\text{IO2}} = 0\text{V}$ , $CC_{\text{detEn}} = 0$ , $chg_{\text{DetEn}} = 0$ , $V_{\text{BUS}} = 0\text{V}$	SYS = 4.2V, $SYS_{\text{OV\_HR}}$	146		$\mu\text{A}$
			SYS = 8.4V	109		
			SYS = 12.6V	117		
			SYS = 16.8V	124		

**Electrical Characteristics (continued)**

(Limits are 100% tested at  $T_A = +25^\circ\text{C}$ . Limits over the operating temperature range and relevant supply voltage range are guaranteed by design and characterization.)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
SYS Standby Supply Current	I <sub>STANDBY</sub>	Sink mode, CCdetEn = 1, chgDetEn = 1, VIO1 = VIO2 = 1.8V, V <sub>BUS</sub> = 0V	SYS = 4.2V, SYS_OV_LR		110		μA
			SYS = 4.2V, SYS_OV_HR		158		
			SYS = 8.4V		120		
			SYS = 12.6V		128		
			SYS = 16.8V		135		
V <sub>BUS</sub> Operating Voltage	V <sub>BUS</sub>			V <sub>BDET_R</sub>		+28	V
V <sub>BUS</sub> Detect Rising	V <sub>BDET_R</sub>	550mV hysteresis	V <sub>BUS</sub>	3.6	3.8	4.0	V
V <sub>BUS</sub> Detect Falling	V <sub>BDET_F</sub>	550mV hysteresis	V <sub>BUS</sub>	2.95	3.25	3.55	V
V <sub>BUS</sub> Detect Hysteresis	V <sub>BDET_H</sub>	550mV hysteresis	V <sub>BUS</sub>		525		mV
V <sub>BUS</sub> Supply Current	I <sub>STANDBY</sub>	V <sub>BUS</sub> = 5V, VIO1 = 1.8V, VIO2 = 1.8V, CCdetEn = 1, sink only, STOP mode	V <sub>SYS</sub> = 4.2V		150		μA
			V <sub>SYS</sub> = 16.8V		192		
V <sub>BUS</sub> Debounce	t <sub>vBDeb</sub>			9	10	11	ms
VIO Low Voltage	VIO_LV	VIO1, VIO2		1.7	1.8	1.9	V
VIO High Voltage	VIO_HV	VIO1, VIO2		2.4	3.8	5.5	V
VIO_OK	VIO_OK_LV_R	VIO1, VIO2, rising		1.0	1.30	1.65	V
	VIO_OK_LV_F	VIO1, VIO2, falling		0.8	1.0	1.4	
	VIO_OK_LV_H	VIO1, VIO2, hysteresis			225		mV
	VIO_OK_HV_R	VIO1, VIO2, rising		1.3	1.55	1.80	V
	VIO_OK_HV_F	VIO1, VIO2, falling		1.25	1.52	1.8	
	VIO_OK_HV_H	VIO1, VIO2, hysteresis			25		mV
	t <sub>VIO_OK_DEB</sub>	Debounce			50		
Output Low Voltage INTB		I <sub>SINK</sub> = 1mA				0.4	V
Output High Leakage INTB		V <sub>INTB</sub> = 5.5V, T <sub>A</sub> = +25°C		-1000	0	+1000	nA
		V <sub>INTB</sub> = 5.5V, T <sub>A</sub> = +85°C			100		
VDD_OK	VDD_OK_R	VDD1P8, rising		1.30	1.65	1.70	V
	VDD_OK_F	VDD1P8, falling		1.15	1.55	1.65	
	VDD_OK_H	VDD1P8, hysteresis			100		mV
<b>INTERFACE / I<sup>2</sup>C INTERFACE AND INTERRUPT</b>							
SCL, SDA Input Low Level		T <sub>A</sub> = +25°C				0.3 x VIO1	V

**Electrical Characteristics (continued)**

(Limits are 100% tested at  $T_A = +25^\circ\text{C}$ . Limits over the operating temperature range and relevant supply voltage range are guaranteed by design and characterization.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
SCL, SDA Input High Level		$T_A = +25^\circ\text{C}$	0.7 x VIO1			V
SCL, SDA Input Hysteresis		$T_A = +25^\circ\text{C}$		0.05 x VIO1		V
SCL, SDA Logic Input Current		SDA = SCL = 5.5V	-10		+10	$\mu\text{A}$
SDA Output Low Voltage		Sinking 20mA			0.4	V
Output Low Voltage INTB		$I_{\text{SINK}} = 1\text{mA}$			0.4	V
Output High Leakage INTB		$V_{\text{INTB}} = 5.5\text{V}$ , $T_A = +25^\circ\text{C}$	-1000		+1000	nA
<b>INTERFACE / I<sup>2</sup>C-COMPATIBLE INTERFACE TIMING FOR STANDARD, FAST, AND FAST-MODE PLUS</b>						
Clock Frequency	$f_{\text{SCL}}$				1000	kHz
Hold Time (Repeated) START Condition	$t_{\text{HD};\text{STA}}$		260			ns
CLK Low Period	$t_{\text{LOW}}$		500			ns
CLK High Period	$t_{\text{HIGH}}$		260			ns
Setup Time Repeated START Condition	$t_{\text{SU};\text{STA}}$		260			ns
DATA Hold Time	$t_{\text{HD};\text{DAT}}$		0			ns
DATA Valid Time	$t_{\text{VD};\text{DAT}}$				450	ns
DATA Valid Acknowledge Time	$t_{\text{VD};\text{ACK}}$				450	ns
Rise/Fall Time of SCL	$t_{\text{SCL}}$				120	ns
Rise/Fall Time of SDA	$t_{\text{SDA}}$				120	ns
DATA Setup time	$t_{\text{SU};\text{DAT}}$		50			ns
Setup Time for STOP Condition	$t_{\text{SU};\text{STO}}$		260			ns
Bus-Free Time Between STOP and START	$t_{\text{BUF}}$		500			ns
Pulse Width of Spikes that Must be Suppressed by the Input Filter				50		ns
<b>INTERFACE / I<sup>2</sup>C-COMPATIBLE INTERFACE TIMING FOR HS-MODE (CB = 100pF)</b>						
Clock Frequency	$f_{\text{SCL}}$				3.4	MHz
Setup Time Repeated START Condition	$t_{\text{SU};\text{STA}}$		160			ns
Hold Time (Repeated) START Condition	$t_{\text{HD};\text{STA}}$		160			ns
CLK Low Period	$t_{\text{LOW}}$		160			ns
CLK High Period	$t_{\text{HIGH}}$		60			ns

**Electrical Characteristics (continued)**

(Limits are 100% tested at  $T_A = +25^\circ\text{C}$ . Limits over the operating temperature range and relevant supply voltage range are guaranteed by design and characterization.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
DATA Set-Up time	$t_{\text{SU;DAT}}$		10			ns
DATA Hold Time	$t_{\text{HD;DAT}}$		0			ns
Rise/Fall time of SCL	$t_{\text{SCL}}$		10		40	ns
Rise/Fall time of SDA	$t_{\text{SDA}}$		10		80	ns
Set-Up Time for STOP Condition	$t_{\text{SU;STO}}$		160			ns
Pulse Width of Spikes that Must be Suppressed by the Input Filter				10		ns
<b>INTERFACE / I<sup>2</sup>C-COMPATIBLE INTERFACE TIMING FOR HS-MODE (CB = 400pF)</b>						
Clock Frequency	$f_{\text{SCL}}$				1.7	MHz
Setup Time Repeated START Condition	$t_{\text{SU;STA}}$		160			ns
Hold Time (Repeated) START Condition	$t_{\text{HD;STA}}$		160			ns
CLK Low Period	$t_{\text{LOW}}$		320			ns
CLK High Period	$t_{\text{HIGH}}$		120			ns
DATA Set-Up time	$t_{\text{SU;DAT}}$		10			ns
DATA Hold Time	$t_{\text{HD;DAT}}$		0			ns
Rise/Fall Time of SCL	$t_{\text{SCL}}$		20		80	ns
Rise/Fall Time of SDA	$t_{\text{SDA}}$		10		160	ns
Setup Time for STOP Condition	$t_{\text{SU;STO}}$		160			ns
Pulse Width of Spikes that Must be Suppressed by the Input Filter				10		ns
<b>USB TYPE-C / CHARGER DETECTION</b>						
BC1.2 State Timeout	$t_{\text{TMO}}$		180	200	220	ms
Data Contact Detect Timeout	$t_{\text{DCDtm0}}$	DCDCpl = 0b1 (default), DCDCpl = 0b0	700	800	900	ms
Primary to Secondary Timer	$t_{\text{PDSWait}}$		27	35	39	ms
Charger Detection Debounce	$t_{\text{CDDeb}}$		45	50	55	ms
I <sub>WEAK</sub> Current	I <sub>WEAK</sub>		10	100	500	nA
R <sub>DM_DWN</sub> Resistor	R <sub>DM_DWN</sub>		14.25	20	24.8	kΩ
I <sub>DP_SRC</sub> Current	I <sub>DP_SRC</sub> /I <sub>DCD</sub>	Accurate over 0V to 2.5V	-13	-10	-7	μA
I <sub>DM_SINK</sub> Current	I <sub>DM_SINK</sub> /I <sub>DAT_SINK</sub>	Accurate over 0.15V to 3.6V	50	80	110	μA
V <sub>LGC</sub> Threshold	V <sub>LGC</sub>		1.62	1.7	1.9	V
V <sub>LGC</sub> Hysteresis	V <sub>LGC_H</sub>			0.015		V

**Electrical Characteristics (continued)**

(Limits are 100% tested at  $T_A = +25^\circ\text{C}$ . Limits over the operating temperature range and relevant supply voltage range are guaranteed by design and characterization.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
V <sub>DAT_REF</sub> Threshold	V <sub>DAT_REF</sub>		0.25	0.32	0.4	V
V <sub>DAT_REF</sub> Hysteresis	V <sub>DAT_REF_H</sub>			0.015		V
OVDX Comparator Falling Threshold	V <sub>OVDX_THF</sub>	Falling DP/DN threshold with respect to AVL	-40		+80	mV
OVDX Comparator Rising Threshold	V <sub>OVDX_THR</sub>	Rising DP/DN threshold with respect to AVL	0		150	mV
DP/DN Overvoltage Debounce	t <sub>OVDxDeb</sub>		90	100	110	μs
DN/DP Load Resistor	R <sub>USB</sub>	Load resistor on DP/DN	3	6.1	12	MΩ
VD33 Voltage	$\frac{V_{DP}}{DM_{3p3VSR}} / \frac{V_{SR}}{V_{SR33}}$	Tested at zero load and at 200μA load	2.6	3.0	3.3	V
VSRC33ILIM Current Limit	I <sub>LIMVSRC33</sub>	Force 1.6V on DP/DN, measure current		1.5	3	mA
VDN_SRC Voltage	$\frac{V_{DN\_SRC}}{V_{SR}} / \frac{V_{SR}}{V_{SR33}}$	Accurate over I <sub>LOAD</sub> = 0 to 200μA	0.5	0.6	0.7	V
VDP_SRC Voltage	$\frac{V_{DP\_SRC}}{V_{SR}} / \frac{V_{SR}}{V_{SR33}}$	Accurate over I <sub>LOAD</sub> = 0 to 200μA	0.5	0.6	0.7	V
<b>USB TYPE-C / CC DETECTION</b>						
CC Pin Voltage, in DFP 1.5A Mode	V <sub>CC_PIN</sub>	Measured at CC pins with 126kΩ load, IDFP1.5_CC enable and V <sub>AVL</sub> ≥ 2.6V	1.85			V
CC Pin Voltage, in DFP 3.0A Mode	V <sub>CC_PIN</sub>	Measured at CC pins with 126kΩ load, IDFP3.0_CC enable and AVL ≥ 3.65V	3.1			V
CC Pin Clamp Voltage	V <sub>CC_CIAMP</sub>	60μA ≤ I <sub>CC</sub> ≤ 600μA	0.88	1.1	1.32	V
CC UFP Pulldown Resistance	R <sub>PD_UFP</sub>		-10%	5.1	+10%	kΩ
CC DFP Low-Power Mode	V <sub>DFPLP_CC</sub>	AVL ≥ 2.6V, I <sub>DFPULP_CC</sub> current source enabled, 1.1V	1.2			V
CC DFP Ultra-Low-Power Current Source	I <sub>DFPULP_CC</sub>	Measured at CC = 0.5V	-10%	1	+10%	μA
		Measured at CC = 1.0V, T <sub>A</sub> = +25°C	-10%	1	+10%	
		Measured at CC = 1.0V	-12%	1	+12%	
CC DFP 0.5A Current Source	I <sub>DFP0.5_CC</sub>		-20%	80	+20%	μA
CC DFP 1.5A Current Source	I <sub>DFP1.5_CC</sub>		-8%	180	+8%	μA
CC DFP 3A Current Source	I <sub>DFP3A_CC</sub>		-8%	330	+8%	μA
CC RA RD Threshold	V <sub>RA_RD0.5</sub>		0.15	0.2	0.25	V
CC UFP 0.5A RD Threshold	V <sub>UFP_RD0.5</sub>		0.61	0.66	0.7	V
CC UFP 0.5A RD Hysteresis	V <sub>UFP_RD0.5_H</sub>			0.015		V
CC UFP 1.5A RD Threshold	V <sub>UFP_RD1.5</sub>		1.16	1.23	1.31	V

**Electrical Characteristics (continued)**

(Limits are 100% tested at  $T_A = +25^\circ\text{C}$ . Limits over the operating temperature range and relevant supply voltage range are guaranteed by design and characterization.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
CC UFP 1.5A RD Hysteresis	$V_{UFP\_RD1.5\_H}$			0.015		V
CC DFP $V_{OPEN}$ Detect Threshold	$V_{DFP\_VOPEN}$		1.5	1.575	1.65	V
CC DFP $V_{OPEN}$ Detect Hysteresis	$V_{DFP\_VOPEN\_H}$			0.030		V
CC DFP $V_{OPEN}$ With 3.0A Detect Threshold	$V_{DFP\_VOPEN3\_A}$	$V_{AVL} \geq 3.5\text{V}$	2.45	2.6	2.75	V
CC DFP $V_{OPEN}$ With 3.0A Detect Hysteresis	$V_{DFP\_VOPEN3\_A\_H}$	$V_{AVL} \geq 3.5\text{V}$		0.030		V
$V_{BUS}$ Discharge Value Threshold	$V_{SAFE0V}$	Falling voltage level where a connected UFP finds the $V_{BUS}$ removed	0.6	0.67	0.75	V
$V_{BUS}$ Discharge Value Hysteresis	$V_{SAFE0V\_h}$	Rising hysteresis		40		mV
CC Pin Power-Up Time	$t_{ClampSwap}$	Max time allowed from removal of voltage clamp until a 5.1k $\Omega$ resistor attached			15	ms
CC Detection Debounce	$t_{CCDeb}$		100	119	200	ms
Type-C Debounce	$t_{PDDeb}$		10	15	20	ms
Type-C Quick Debounce	$t_{QDeb}$		0.9	1	1.1	ms
$V_{SAFE0V}$ Debounce	$t_{VSAFE0VDeb}$		9	10	11	ms
Type-C Error Recovery Delay	$t_{ErrorRecovery}$		25			ms
Type-C DRP Toggle Time	$t_{DRP}$		50	75	100	ms
DFP Duty Cycle at DRP		Programmable from 35% to 50% in 5% step, $CCDRPPhase = 0b00$		35		%
Type-C DRP Try	$t_{DRPtry}$		90	100	110	ms
DRP Transition Time	$t_{DRPTrans}$	Time for a role swap from DFP to UFP or the reverse is completed			1	ms
$V_{CONN}$ Enable Time	$t_{VCONNON}$				2	ms
$V_{CONN}$ Disable Time	$t_{VCONNOFF}$	Time from UFP detached or as directed by I <sup>2</sup> C command until $V_{CONN}$ is removed			35	ms
CC Pin Current Change Time	$I_{SINKADJ}$	Time from CC pin changes state in UFP mode until current drawn from DFP reaches a new value			60	ms
$V_{BUS}$ On Time	$t_{VBUSON}$	Time from UFP is attached until $V_{BUS}$ ON			275	ms
$V_{BUS}$ Off Time	$t_{VBUSOFF}$	Time from UFP is detached until $V_{BUS}$ reaches $V_{SAFE0V}$			650	ms
$V_{BUS}$ Input Self-Discharge Resistance	$R_{VBUS\_SD\_US\_B}$			10		k $\Omega$

**Electrical Characteristics (continued)**

(Limits are 100% tested at  $T_A = +25^\circ\text{C}$ . Limits over the operating temperature range and relevant supply voltage range are guaranteed by design and characterization.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
CC1/2 Water Comp Threshold	$V_{CC\_Comp}$	1.0V Comp	-8%	1.00	+8%	V
		0.8V Comp	-8%	0.8	+8%	
		0.6V Comp	-8%	0.6	+8%	
		0.4V Comp	-8%	0.4	+8%	
CC1/2 Water Comp Hysteresis	$V_{CC\_Comp\_H}$		0.015		V	
CC_OVP Threshold	CC_OVP	Rising	5.375	5.735	6.325	V
		Falling	5.175	5.670	6.275	
CC_OVP Hysteresis	CC_OVP_H		85		mV	
<b>USB TYPE-C / <math>V_{CONN}</math> SWITCH</b>						
$V_{CIN\_PRES}$	$V_{CIN\_PRES\_R}$	Rising	0.75	1.38	2.45	V
	$V_{CIN\_PRES\_F}$	Falling	0.45	0.75	1.75	
	$V_{CIN\_PRES\_H}$	Hysteresis		600		mV
	$t_{V_{CIN\_PRES\_D\_EB}}$	Debounce		50		$\mu\text{s}$
$V_{CIN\_OK}$	$CC\_V_{CIN\_OK\_R}$	Rising	2.40	2.75	3.00	V
	$CC\_V_{CIN\_OK\_F}$	Falling	2.35	2.72	3.00	
	$CC\_V_{CIN\_OK\_H}$	Hysteresis		30		mV
	$t_{V_{CIN\_OK\_DEB}}$	Debounce		50		$\mu\text{s}$
$V_{CONN}$ Source Requirements			3.0		5.5	V
$V_{CONN}$ SW Ron	$R_{ONVCONNSW}$	$V_{CIN} = 5.0\text{V}$ , $I_{CC} = 0.5\text{A}$		500	900	$\text{m}\Omega$
OCP Accuracy		$V_{CIN} = 5.0\text{V}$ , $T_A = +25^\circ\text{C}$	-40	-20		%
OCP_ShortCircuit Protection	$I_{SCP}$			700		mA
OCP Programmable Step	$I_{STEP}$	Programmable range is 200mA to 500mA		100		mA
OCP Interrupt Debounce Time T1	$t_{Deb1}$	From detecting OCP to generating INT		2		ms
Wait Time Before Turn Off T2	$t_{Deb2}$	From generating INT to turning OFF $V_{CONN}$ switch		12		ms
Startup Time At 90%		Time from $V_{CONN}$ switch enable to CC settled at 90% of final value with $V_{CIN} = 3.0\text{V}$		0.05	0.2	ms
Turn Off Time At 10%		Time from $V_{CONN}$ switch disable to CC settled at 10% of final value with $V_{CIN} = 3.0\text{V}$		0.05	0.06	ms
$V_{CIN}$ Leakage Current		$V_{CIN}$ detection disabled, $V_{CIN} = 4.4\text{V}$	-2000		+2000	nA

**Electrical Characteristics (continued)**

(Limits are 100% tested at  $T_A = +25^\circ\text{C}$ . Limits over the operating temperature range and relevant supply voltage range are guaranteed by design and characterization.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS	
<b>USB TYPE-C / PD CONTROLLER</b>							
Time Until BMC Bus Drive End	$t_{\text{EndDriveBMC}}$	Time to cease driving the line after the end of the last bit of the frame, Min value is limited by $t_{\text{HoldLowBMC}}$			23	$\mu\text{s}$	
Transmit Hold Time	$t_{\text{HoldLowBMC}}$	Time to cease driving the line after the final high-to-low transition	1			$\mu\text{s}$	
BMC TX Rise Time	$t_{\text{Rise}}$	10% to 90% with no load on CC wires	300	410	540	ns	
BMC TX Fall Time	$t_{\text{Fall}}$	90% to 10% with no load on CC wires	300	410	540	ns	
BMC TX Swing	$V_{\text{SWING}}$	Applies to no load and with max load defined by cable/receiver model for both Sink and Source	1.05	1.125	1.2	V	
BMC Driver Output Impedance	$Z_{\text{Driver}}$	Source output impedance at the Nyquist frequency of [USB 2.0] low speed (750kHz)		42	75	$\Omega$	
BMC Receiver Noise Filter	$t_{\text{RXFilter}}$	Time constant of noise filter in RX path	100			ns	
Time To Detect Non-Idle Bus	$t_{\text{TransitionWindow}}$		12		20	$\mu\text{s}$	
Receiver Detect Rising Threshold in SRC Mode			0.63	0.66	0.68	V	
Receiver Detect Falling Threshold in SRC Mode			0.56	0.58	0.61	V	
Receiver Detect Rising Threshold SNK Mode			0.51	0.54	0.56	V	
Receiver Detect Falling Threshold in SNK Mode			0.44	0.46	0.49	V	
Hysteresis of BMC RX	$RX\_Hys$			60		mV	
<b>USB TYPE-C / <math>V_{\text{BUS}}</math> ADC</b>							
$V_{\text{BUS}}$ ADC Threshold 1	$THV_{\text{BUS\_01}}$	$ADCIN\_SEL = 0$	$VBADC = 0b00000$	3.0	3.5	4.0	V
$V_{\text{BUS}}$ ADC Threshold 2	$THV_{\text{BUS\_02}}$	$ADCIN\_SEL = 0$	$VBADC = 0b00001$	4.0	4.5	5.0	V
$V_{\text{BUS}}$ ADC Threshold 3	$THV_{\text{BUS\_03}}$	$ADCIN\_SEL = 0$	$VBADC = 0b00010$	5.0	5.5	6.0	V
$V_{\text{BUS}}$ ADC Threshold 4	$THV_{\text{BUS\_04}}$	$ADCIN\_SEL = 0$	$VBADC = 0b00011$	6.0	6.5	7.0	V
$V_{\text{BUS}}$ ADC Threshold 5	$THV_{\text{BUS\_05}}$	$ADCIN\_SEL = 0$	$VBADC = 0b00100$	7.0	7.5	8.0	V
$V_{\text{BUS}}$ ADC Threshold 6	$THV_{\text{BUS\_06}}$	$ADCIN\_SEL = 0$	$VBADC = 0b00101$	8.0	8.5	9.0	V
$V_{\text{BUS}}$ ADC Threshold 7	$THV_{\text{BUS\_07}}$	$ADCIN\_SEL = 0$	$VBADC = 0b00110$	9.0	9.5	10.0	V
$V_{\text{BUS}}$ ADC Threshold 8	$THV_{\text{BUS\_08}}$	$ADCIN\_SEL = 0$	$VBADC = 0b00111$	10.0	10.5	11.0	V
$V_{\text{BUS}}$ ADC Threshold 9	$THV_{\text{BUS\_09}}$	$ADCIN\_SEL = 0$	$VBADC = 0b01000$	11.0	11.5	12.0	V
$V_{\text{BUS}}$ ADC Threshold 10	$THV_{\text{BUS\_10}}$	$ADCIN\_SEL = 0$	$VBADC = 0b01001$	12.0	12.5	13.0	V
$V_{\text{BUS}}$ ADC Threshold 11	$THV_{\text{BUS\_11}}$	$ADCIN\_SEL = 0$	$VBADC = 0b01010$	13.0	13.5	14.0	V
$V_{\text{BUS}}$ ADC Threshold 12	$THV_{\text{BUS\_12}}$	$ADCIN\_SEL = 0$	$VBADC = 0b01011$	14.0	14.5	15.0	V



**Electrical Characteristics (continued)**

(Limits are 100% tested at  $T_A = +25^\circ\text{C}$ . Limits over the operating temperature range and relevant supply voltage range are guaranteed by design and characterization.)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
V <sub>BUS</sub> ADC Threshold 13	THV <sub>BUS_13</sub>	ADCIN_SEL = 0	VBADC = 0b01100	15.0	15.5	16.0	V
V <sub>BUS</sub> ADC Threshold 14	THV <sub>BUS_14</sub>	ADCIN_SEL = 0	VBADC = 0b01101	16.0	16.5	17.0	V
V <sub>BUS</sub> ADC Threshold 15	THV <sub>BUS_15</sub>	ADCIN_SEL = 0	VBADC = 0b01110	17.0	17.5	18.0	V
V <sub>BUS</sub> ADC Threshold 16	THV <sub>BUS_16</sub>	ADCIN_SEL = 0	VBADC = 0b01111	18.0	18.5	19.0	V
V <sub>BUS</sub> ADC Threshold 17	THV <sub>BUS_17</sub>	ADCIN_SEL = 0	VBADC = 0b10000	19.0	19.5	20.0	V
V <sub>BUS</sub> ADC Threshold 18	THV <sub>BUS_18</sub>	ADCIN_SEL = 0	VBADC = 0b10001	20.0	20.5	21.0	V
V <sub>BUS</sub> ADC Threshold 19	THV <sub>BUS_19</sub>	ADCIN_SEL = 0	VBADC = 0b10010	21.0	21.5	22.0	V
V <sub>BUS</sub> ADC Threshold 20	THV <sub>BUS_20</sub>	ADCIN_SEL = 0	VBADC = 0b10011	22.0	22.5	23.0	V
V <sub>BUS</sub> ADC Threshold 21	THV <sub>BUS_21</sub>	ADCIN_SEL = 0	VBADC = 0b10100	23.0	23.5	24.0	V
V <sub>BUS</sub> ADC Threshold 22	THV <sub>BUS_22</sub>	ADCIN_SEL = 0	VBADC = 0b10101	24.0	24.5	25.0	V
V <sub>BUS</sub> ADC Threshold 23	THV <sub>BUS_21</sub>	ADCIN_SEL = 0	VBADC = 0b10110	25.0	25.5	26.0	V
V <sub>BUS</sub> ADC Threshold 24	THV <sub>BUS_24</sub>	ADCIN_SEL = 0	VBADC = 0b10111	26.0	26.5	27.0	V
V <sub>BUS</sub> ADC Threshold 25	THV <sub>BUS_25</sub>	ADCIN_SEL = 0	VBADC = 0b11000	27.0	27.5	28.0	V
V <sub>BUS</sub> ADC Hysteresis	HV <sub>BUS</sub>	ADCIN_SEL = 0			150		mV
<b>USB TYPE-C / ADCIN ADC</b>							
GPIO ADC Threshold 1	THGPIO_01	ADCIN_SEL = 1	VBADC = 0b00000	0.6	0.7	0.8	V
GPIO ADC Threshold 2	THGPIO_02	ADCIN_SEL = 1	VBADC = 0b00001	0.8	0.9	1.0	V
GPIO ADC Threshold 3	THGPIO_03	ADCIN_SEL = 1	VBADC = 0b00010	1.0	1.1	1.2	V
GPIO ADC Threshold 4	THGPIO_04	ADCIN_SEL = 1	VBADC = 0b00011	1.2	1.3	1.4	V
GPIO ADC Threshold 5	THGPIO_05	ADCIN_SEL = 1	VBADC = 0b00100	1.4	1.5	1.6	V
GPIO ADC Threshold 6	THGPIO_06	ADCIN_SEL = 1	VBADC = 0b00101	1.6	1.7	1.8	V
GPIO ADC Threshold 7	THGPIO_07	ADCIN_SEL = 1	VBADC = 0b00110	1.8	1.9	2.0	V
GPIO ADC Threshold 8	THGPIO_08	ADCIN_SEL = 1	VBADC = 0b00111	2.0	2.1	2.2	V
GPIO ADC Threshold 9	THGPIO_09	ADCIN_SEL = 1	VBADC = 0b01000	2.2	2.3	2.4	V
GPIO ADC Threshold 10	THGPIO_10	ADCIN_SEL = 1	VBADC = 0b01001	2.4	2.5	2.6	V
GPIO ADC Threshold 11	THGPIO_11	ADCIN_SEL = 1	VBADC = 0b01010	2.6	2.7	2.8	V
GPIO ADC Threshold 12	THGPIO_12	ADCIN_SEL = 1	VBADC = 0b01011	2.8	2.9	3.0	V

**Electrical Characteristics (continued)**

(Limits are 100% tested at  $T_A = +25^\circ\text{C}$ . Limits over the operating temperature range and relevant supply voltage range are guaranteed by design and characterization.)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
GPIO ADC Threshold 13	THGPIO_13	ADCIN_SEL = 1	VBADC = 0b01100	3.0	3.1	3.2	V
GPIO ADC Threshold 14	THGPIO_14	ADCIN_SEL = 1	VBADC = 0b01101	3.2	3.3	3.4	V
GPIO ADC Threshold 15	THGPIO_15	ADCIN_SEL = 1	VBADC = 0b01110	3.4	3.5	3.6	V
GPIO ADC Threshold 16	THGPIO_16	ADCIN_SEL = 1	VBADC = 0b01111	3.6	3.7	3.8	V
GPIO ADC Threshold 17	THGPIO_17	ADCIN_SEL = 1	VBADC = 0b10000	3.8	3.9	4.0	V
GPIO ADC Threshold 18	THGPIO_18	ADCIN_SEL = 1	VBADC = 0b10001	4.0	4.1	4.2	V
GPIO ADC Threshold 19	THGPIO_19	ADCIN_SEL = 1	VBADC = 0b10010	4.2	4.3	4.4	V
GPIO ADC Threshold 20	THGPIO_20	ADCIN_SEL = 1	VBADC = 0b10011	4.4	4.5	4.6	V
GPIO ADC Threshold 21	THGPIO_21	ADCIN_SEL = 1	VBADC = 0b10100	4.6	4.7	4.8	V
GPIO ADC Threshold 22	THGPIO_22	ADCIN_SEL = 1	VBADC = 0b10101	4.8	4.9	5.0	V
GPIO ADC Threshold 23	THGPIO_23	ADCIN_SEL = 1	VBADC = 0b10110	5.0	5.1	5.2	V
GPIO ADC Threshold 24	THGPIO_24	ADCIN_SEL = 1	VBADC = 0b10111	5.2	5.3	5.4	V
GPIO ADC Threshold 25	THGPIO_25	ADCIN_SEL = 1	VBADC = 0b11000	5.4	5.5	5.6	V
GPIO ADC Hysteresis	HGPIO	ADCIN_SEL = 1			25		mV
<b>USB TYPE-C / CC ADC RANGE 1</b>							
CC ADC Threshold 1	THCC_01	ADCIN_SEL = 001 or 011	VBADC = 0b00000	0.312	0.362	0.416	V
CC ADC Threshold 2	THCC_02	ADCIN_SEL = 001 or 011	VBADC = 0b00001	0.416	0.468	0.520	V
CC ADC Threshold 3	THCC_03	ADCIN_SEL = 001 or 011	VBADC = 0b00010	0.520	0.573	0.624	V
CC ADC Threshold 4	THCC_04	ADCIN_SEL = 001 or 011	VBADC = 0b00011	0.624	0.682	0.728	V
CC ADC Threshold 5	THCC_05	ADCIN_SEL = 001 or 011	VBADC = 0b00100	0.728	0.783	0.832	V
CC ADC Threshold 6	THCC_06	ADCIN_SEL = 001 or 011	VBADC = 0b00101	0.832	0.885	0.936	V
CC ADC Threshold 7	THCC_07	ADCIN_SEL = 001 or 011	VBADC = 0b00110	0.936	0.988	1.040	V
CC ADC Threshold 8	THCC_08	ADCIN_SEL = 001 or 011	VBADC = 0b00111	1.040	1.093	1.144	V

**Electrical Characteristics (continued)**

(Limits are 100% tested at T<sub>A</sub> = +25°C. Limits over the operating temperature range and relevant supply voltage range are guaranteed by design and characterization.)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
CC ADC Threshold 9	THCC_09	ADCIN_SEL = 001 or 011	VBADC = 0b01000	1.144	1.196	1.248	V
CC ADC Threshold 10	THCC_10	ADCIN_SEL = 001 or 011	VBADC = 0b01001	1.248	1.308	1.352	V
CC ADC Threshold 11	THCC_11	ADCIN_SEL = 001 or 011	VBADC = 0b01010	1.352	1.408	1.456	V
CC ADC Threshold 12	THCC_12	ADCIN_SEL = 001 or 011	VBADC = 0b01011	1.456	1.513	1.560	V
CC ADC Threshold 13	THCC_13	ADCIN_SEL = 001 or 011	VBADC = 0b01100	1.560	1.618	1.664	V
CC ADC Threshold 14	THCC_14	ADCIN_SEL = 001 or 011	VBADC = 0b01101	1.664	1.725	1.768	V
CC ADC Threshold 15	THCC_15	ADCIN_SEL = 001 or 011	VBADC = 0b01110	1.768	1.823	1.872	V
CC ADC Threshold 16	THCC_16	ADCIN_SEL = 001 or 011	VBADC = 0b01111	1.872	1.930	1.976	V
CC ADC Threshold 17	THCC_17	ADCIN_SEL = 001 or 011	VBADC = 0b10000	1.976	2.026	2.080	V
CC ADC Threshold 18	THCC_18	ADCIN_SEL = 001 or 011	VBADC = 0b10001	2.080	2.143	2.184	V
CC ADC Threshold 19	THCC_19	ADCIN_SEL = 001 or 011	VBADC = 0b10010	2.184	2.240	2.288	V
CC ADC Threshold 20	THCC_20	ADCIN_SEL = 001 or 011	VBADC = 0b10011	2.288	2.345	2.392	V
CC ADC Threshold 21	THCC_21	ADCIN_SEL = 001 or 011	VBADC = 0b10100	2.392	2.450	2.496	V
CC ADC Threshold 22	THCC_22	ADCIN_SEL = 001 or 011	VBADC = 0b10101	2.496	2.550	2.600	V
CC ADC Threshold 23	THCC_23	ADCIN_SEL = 001 or 011	VBADC = 0b10110	2.600	2.660	2.704	V
CC ADC Threshold 24	THCC_24	ADCIN_SEL = 001 or 011	VBADC = 0b10111	2.704	2.757	2.808	V
CC ADC Threshold 25	THCC_25	ADCIN_SEL = 001 or 011	VBADC = 0b11000	2.808	2.858	2.912	V
CC ADC Hysteresis	HCC	ADCIN_SEL = 001 or 011		15			mV
<b>USB TYPE-C / CC ADC RANGE 2</b>							
CC ADC Threshold 1	THCC_01	ADCIN_SEL = 001 or 011	VBADC = 0b00000	0.189	0.220	0.252	V
CC ADC Threshold 2	THCC_02	ADCIN_SEL = 001 or 011	VBADC = 0b00001	0.252	0.284	0.315	V
CC ADC Threshold 3	THCC_03	ADCIN_SEL = 001 or 011	VBADC = 0b00010	0.315	0.347	0.378	V
CC ADC Threshold 4	THCC_04	ADCIN_SEL = 001 or 011	VBADC = 0b00011	0.378	0.413	0.441	V

**Electrical Characteristics (continued)**

(Limits are 100% tested at  $T_A = +25^\circ\text{C}$ . Limits over the operating temperature range and relevant supply voltage range are guaranteed by design and characterization.)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
CC ADC Threshold 5	THCC_05	ADCIN_SEL = 001 or 011	VBADC = 0b00100	0.441	0.475	0.504	V
CC ADC Threshold 6	THCC_06	ADCIN_SEL = 001 or 011	VBADC = 0b00101	0.504	0.536	0.567	V
CC ADC Threshold 7	THCC_07	ADCIN_SEL = 001 or 011	VBADC = 0b00110	0.567	0.599	0.630	V
CC ADC Threshold 8	THCC_08	ADCIN_SEL = 001 or 011	VBADC = 0b00111	0.630	0.662	0.693	V
CC ADC Threshold 9	THCC_09	ADCIN_SEL = 001 or 011	VBADC = 0b01000	0.693	0.724	0.756	V
CC ADC Threshold 10	THCC_10	ADCIN_SEL = 001 or 011	VBADC = 0b01001	0.756	0.792	0.819	V
CC ADC Threshold 11	THCC_11	ADCIN_SEL = 001 or 011	VBADC = 0b01010	0.819	0.853	0.882	V
CC ADC Threshold 12	THCC_12	ADCIN_SEL = 001 or 011	VBADC = 0b01011	0.882	0.917	0.945	V
CC ADC Threshold 13	THCC_13	ADCIN_SEL = 001 or 011	VBADC = 0b01100	0.945	0.980	1.008	V
CC ADC Threshold 14	THCC_14	ADCIN_SEL = 001 or 011	VBADC = 0b01101	1.008	1.045	1.071	V
CC ADC Threshold 15	THCC_15	ADCIN_SEL = 001 or 011	VBADC = 0b01110	1.071	1.104	1.134	V
CC ADC Threshold 16	THCC_16	ADCIN_SEL = 001 or 011	VBADC = 0b01111	1.134	1.166	1.197	V
CC ADC Threshold 17	THCC_17	ADCIN_SEL = 001 or 011	VBADC = 0b10000	1.197	1.227	1.260	V
CC ADC Threshold 18	THCC_18	ADCIN_SEL = 001 or 011	VBADC = 0b10001	1.260	1.293	1.323	V
CC ADC Threshold 19	THCC_19	ADCIN_SEL = 001 or 011	VBADC = 0b10010	1.323	1.357	1.386	V
CC ADC Threshold 20	THCC_20	ADCIN_SEL = 001 or 011	VBADC = 0b10011	1.386	1.421	1.449	V
CC ADC Threshold 21	THCC_21	ADCIN_SEL = 001 or 011	VBADC = 0b10100	1.449	1.484	1.512	V
CC ADC Threshold 22	THCC_22	ADCIN_SEL = 001 or 011	VBADC = 0b10101	1.512	1.545	1.575	V
CC ADC Threshold 23	THCC_23	ADCIN_SEL = 001 or 011	VBADC = 0b10110	1.575	1.612	1.638	V
CC ADC Threshold 24	THCC_24	ADCIN_SEL = 001 or 011	VBADC = 0b10111	1.638	1.671	1.701	V
CC ADC Threshold 25	THCC_25	ADCIN_SEL = 001 or 011	VBADC = 0b11000	1.701	1.731	1.764	V
CC ADC Hysteresis	HCC	ADCIN_SEL = 001 or 011			15		mV

**Electrical Characteristics (continued)**

(Limits are 100% tested at  $T_A = +25^\circ\text{C}$ . Limits over the operating temperature range and relevant supply voltage range are guaranteed by design and characterization.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS	
<b>USB TYPE-C / CC ADC RANGE 3</b>							
CC ADC Threshold 1	THCC_01	ADCIN_SEL = 001 or 011	VBADC = 0b00000	0.150	0.175	0.200	V
CC ADC Threshold 2	THCC_02	ADCIN_SEL = 001 or 011	VBADC = 0b00001	0.200	0.225	0.250	V
CC ADC Threshold 3	THCC_03	ADCIN_SEL = 001 or 011	VBADC = 0b00010	0.250	0.275	0.300	V
CC ADC Threshold 4	THCC_04	ADCIN_SEL = 001 or 011	VBADC = 0b00011	0.300	0.325	0.350	V
CC ADC Threshold 5	THCC_05	ADCIN_SEL = 001 or 011	VBADC = 0b00100	0.350	0.375	0.400	V
CC ADC Threshold 6	THCC_06	ADCIN_SEL = 001 or 011	VBADC = 0b00101	0.400	0.425	0.450	V
CC ADC Threshold 7	THCC_07	ADCIN_SEL = 001 or 011	VBADC = 0b00110	0.450	0.475	0.500	V
CC ADC Threshold 8	THCC_08	ADCIN_SEL = 001 or 011	VBADC = 0b00111	0.500	0.525	0.550	V
CC ADC Threshold 9	THCC_09	ADCIN_SEL = 001 or 011	VBADC = 0b01000	0.550	0.575	0.600	V
CC ADC Threshold 10	THCC_10	ADCIN_SEL = 001 or 011	VBADC = 0b01001	0.600	0.625	0.650	V
CC ADC Threshold 11	THCC_11	ADCIN_SEL = 001 or 011	VBADC = 0b01010	0.650	0.675	0.700	V
CC ADC Threshold 12	THCC_12	ADCIN_SEL = 001 or 011	VBADC = 0b01011	0.700	0.725	0.750	V
CC ADC Threshold 13	THCC_13	ADCIN_SEL = 001 or 011	VBADC = 0b01100	0.750	0.775	0.800	V
CC ADC Threshold 14	THCC_14	ADCIN_SEL = 001 or 011	VBADC = 0b01101	0.800	0.825	0.850	V
CC ADC Threshold 15	THCC_15	ADCIN_SEL = 001 or 011	VBADC = 0b01110	0.850	0.875	0.900	V
CC ADC Threshold 16	THCC_16	ADCIN_SEL = 001 or 011	VBADC = 0b01111	0.900	0.925	0.950	V
CC ADC Threshold 17	THCC_17	ADCIN_SEL = 001 or 011	VBADC = 0b10000	0.950	0.975	1.000	V
CC ADC Threshold 18	THCC_18	ADCIN_SEL = 001 or 011	VBADC = 0b10001	1.000	1.025	1.050	V
CC ADC Threshold 19	THCC_19	ADCIN_SEL = 001 or 011	VBADC = 0b10010	1.050	1.075	1.100	V
CC ADC Threshold 20	THCC_20	ADCIN_SEL = 001 or 011	VBADC = 0b10011	1.100	1.125	1.150	V
CC ADC Threshold 21	THCC_21	ADCIN_SEL = 001 or 011	VBADC = 0b10100	1.150	1.175	1.200	V
CC ADC Threshold 22	THCC_22	ADCIN_SEL = 001 or 011	VBADC = 0b10101	1.200	1.225	1.250	V

**Electrical Characteristics (continued)**

(Limits are 100% tested at  $T_A = +25^\circ\text{C}$ . Limits over the operating temperature range and relevant supply voltage range are guaranteed by design and characterization.)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
CC ADC Threshold 23	THCC_23	ADCIN_SEL = 001 or 011	VBADC = 0b10110	1.250	1.275	1.300	V
CC ADC Threshold 24	THCC_24	ADCIN_SEL = 001 or 011	VBADC = 0b10111	1.300	1.325	1.350	V
CC ADC Threshold 25	THCC_25	ADCIN_SEL = 001 or 011	VBADC = 0b11000	1.350	1.375	1.400	V
CC ADC Hysteresis	HCC	ADCIN_SEL = 001 or 011		7			mV
<b>USB TYPE-C / USB ANALOG SWITCH (DN1/DP2)</b>							
Analog Signal Range	$V_{DN1}, V_{DP2}$			0		$V_{AVL}$	V
On-Resistance	$R_{ONUSB}$	AVL = 3.0V, $I_{DN}/I_{DP} = 10\text{mA}$ , $V_{DN}/V_{DP} = 0\text{V}$ to 3.0V			3	6	$\Omega$
On-Resistance Match Between Channels	$\Delta R_{ONUSB}$	AVL = 3.0V, $I_{DN}/I_{DP} = 10\text{mA}$ , $V_{DN}/V_{DP} = 400\text{mV}$				0.5	$\Omega$
On-Resistance Flatness	$R_{FLATUSB}$	AVL = 3.0V, $I_{DN}/I_{DP} = 10\text{mA}$ , $V_{DN}/V_{DP} = 0\text{V}$ to 3.0V			0.1	0.4	$\Omega$
Off Leakage Current	$I_{LUSBOFF}$	AVL = 4.2V; Switch opened; $V_{DN1}$ or $V_{DP2} = 0.3\text{V}, 2.5\text{V}$ ; $V_{DN}$ or $V_{DP} = 2.5\text{V}, 0.3\text{V}$		-360		+360	nA
<b>USB TYPE-C / DYNAMIC PERFORMANCE</b>							
Analog Switch Turn On Time	$t_{ON}$	$I^2\text{C}$ stop to switch on; $R_L = 50\Omega$			0.1	0.3	ms
Analog Switch Turn Off Time	$t_{OFF}$	$I^2\text{C}$ stop to switch off; $R_L = 50\Omega$			0.1	0.3	ms
<b>USB TYPE-C / GPIO0, 1, 2, 3, 8</b>							
Input Low Voltage	$V_{IL}$					$0.3 \times V_{IO2}$	V
Input High Voltage	$V_{IH}$			$0.7 \times V_{IO2}$			V
Input Hysteresis (Schmitt)	$V_{IHYS}$				250		mV
Output Low Voltage	$V_{OL}$	$I_{SINK} = 2\text{mA}$				0.4	V
Output High Voltage	$V_{OH}$	$I_{SINK} = 2\text{mA}$		$0.7 \times V_{IO2}$			V
Input Leakage Current	IL	$T_A = +25^\circ\text{C}$			100		nA
Input Pullup Resistor	$R_{PU}$				100		$k\Omega$
Input Pulldown Resistor	$R_{PD}$				100		$k\Omega$
<b>USB TYPE-C / GPIO4, 5, 6, 7</b>							
Input Low Voltage	$V_{IL}$					$0.3 \times V_{IO1}$	V
Input High Voltage	$V_{IH}$			$0.7 \times V_{IO1}$			V
Input Hysteresis (Schmitt)	$V_{IHYS}$				250		mV

**Electrical Characteristics (continued)**

(Limits are 100% tested at  $T_A = +25^\circ\text{C}$ . Limits over the operating temperature range and relevant supply voltage range are guaranteed by design and characterization.)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Output Low Voltage	$V_{OL}$	$I_{SINK} = 2\text{mA}$				0.4	V
Output High Voltage	$V_{OH}$	$I_{SINK} = 2\text{mA}$		$0.7 \times V_{IO1}$			V
Input Leakage Current	IL	$T_A = +25^\circ\text{C}$			100		$\mu\text{A}$
Input Pullup Resistor	$R_{PU}$				100		$\text{k}\Omega$
Input Pulldown Resistor	$R_{PD}$				100		$\text{k}\Omega$
<b>USB TYPE-C / I<sup>2</sup>C MASTER / I<sup>2</sup>C LOGIC LEVEL</b>							
SCL_M, SDA_M Input Low Level		$T_A = +25^\circ\text{C}$				$0.3 \times V_{IO2}$	V
SCL_M, SDA_M Input High Level		$T_A = +25^\circ\text{C}$		$0.7 \times V_{IO2}$		$V_{IO2}$	V
SCL_M, SDA_M Input Hysteresis		$T_A = +25^\circ\text{C}$			$0.05 \times V_{IO2}$		V
SCL_M, SDA_M Logic Input Current		$SCL\_M = SD\_AM = V_{IO2} = 5.5\text{V}$		-1000		+1000	nA
SCL_M, SDA_M Input Capacitance					10		pF
SCL_M, SDA_M Output Low Voltage		Sinking 3mA	VIO = HV			0.4	V
			VIO = LV			$0.2 \times V_{IO}$	
SCL_M, SDA_M Input Leakage Current	$I_{LK}$	$T_A = +25^\circ\text{C}$		-1000		+1000	nA
		$T_A = +85^\circ\text{C}$			100		
<b>USB TYPE-C / I<sup>2</sup>C MASTER / I<sup>2</sup>C TIMING FOR STANDARD, FAST, AND FAST-MODE PLUS</b>							
Clock Frequency	$f_{SCL}$					1000	kHz
Hold Time (Repeated) START Condition	$t_{HD;STA}$			0.26			$\mu\text{s}$
CLK Low Period	$t_{LOW}$			0.5			$\mu\text{s}$
CLK High Period	$t_{HIGH}$			0.26			$\mu\text{s}$
Setup Time Repeated START Condition	$t_{SU;STA}$			0.26			$\mu\text{s}$
DATA Hold Time	$t_{HD;DAT}$			0			$\mu\text{s}$
DATA Valid Time	$t_{VD;DAT}$					0.45	$\mu\text{s}$
DATA Valid Acknowledge Time	$t_{VD;ACK}$					0.45	$\mu\text{s}$
DATA Setup time	$t_{SU;DAT}$			50			ns
Setup Time for STOP Condition	$t_{SU;STO}$			0.26			$\mu\text{s}$
Bus-Free Time Between STOP and START	$t_{BUF}$			0.5			$\mu\text{s}$
Pulse Width of Spikes that Must be Suppressed by the Input Filter					50		ns

**Electrical Characteristics (continued)**

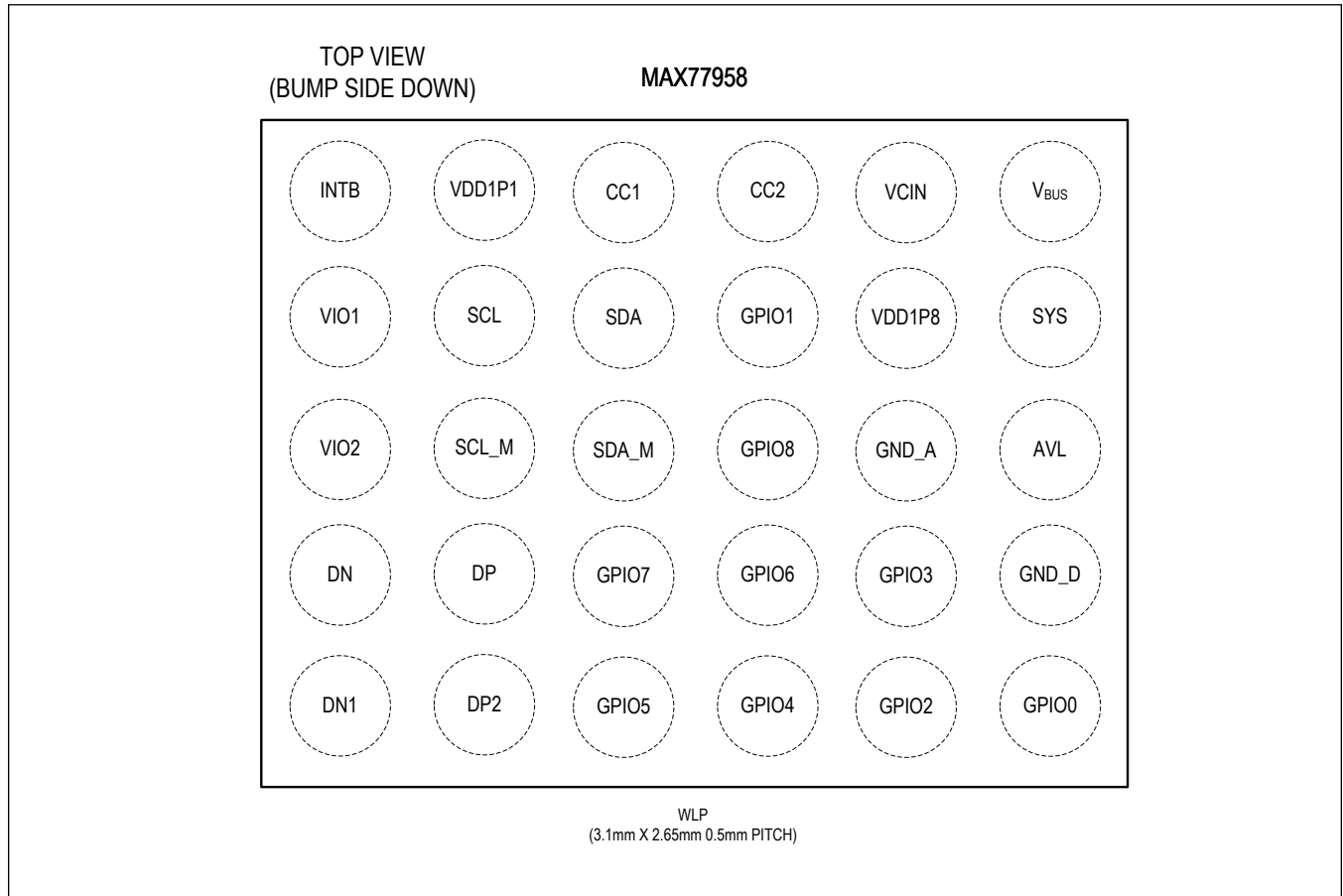
(Limits are 100% tested at  $T_A = +25^\circ\text{C}$ . Limits over the operating temperature range and relevant supply voltage range are guaranteed by design and characterization.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
<b>USB TYPE-C / MTP</b>						
VCIN Input Supply	VCIN_MTP	Reading, erasing, programming	4.7	5.15	5.5	V
VCIN Current Consumption	IVCIN_MTP_ERASE	Erasing		8		mA
	IVCIN_MTP_PROG	Programming		16		
MTP Erasing/ Programming Time	$t_{\text{MTP\_ERASE}}$	Erasing (1 page = 128 x 32-bits word)		100		ms
	$t_{\text{MTP\_PROG}}$	Programming		500		$\mu\text{s}/32\text{-bit word}$
MTP Write Capacity	NWrite	VDD1P8 = 2V, VCIN = 5.5V		100		Write
MTP Data Retention	$t_{\text{MTP}}$	VDD1P8 = 2V, VCIN = 5.5V		10		Year
<b>USB TYPE-C / POWER SUPPLY</b>						
LDO—Output Voltage		$I_L = 1\text{mA}$	1.05	1.125	1.2	V
LDO—Current Limit			-19	-11	-5	mA
LDO—Power Up Consumption				5	12	$\mu\text{A}$
LDO—Turn On Time		From BMC_PWDN_LDO = 0 to V1P1 = 95% of final value			300	$\mu\text{s}$
LDO—Output Pulldown Current		VDD1P1 = 1.125V and BMC_LDO_LOAD = 1	330			$\mu\text{A}$
<b>ESD RATINGS</b>						
Human Body Model (HBM)		All pins			$\pm 4000$	V
Charged Device Model (CDM)		All pins			$\pm 1000$	V
IEC Contact Discharge		CC1 and CC2			$\pm 4000$	V
		DP and DN			$\pm 2000$	
IEC Air Discharge		CC1 and CC2			$\pm 14000$	V
		DP and DN			$\pm 2000$	



Pin Configuration

MAX77958



Pin Description

PIN	NAME	FUNCTION
B1	VIO1	System IO Voltage Input. Connect a 1µF/6.3V ceramic capacitor to GND.
C1	VIO2	System IO Voltage Input. Connect a 1µF/6.3V ceramic capacitor to GND.
A6	V <sub>BUS</sub>	V <sub>BUS</sub> Input. V <sub>BUS</sub> provides power for internal circuitry when SYS is less than V <sub>BUS</sub> . Bypass V <sub>BUS</sub> to GND with a 1µF (min) ceramic capacitor.
B6	SYS	Power Input. SYS provides power for internal circuitry when V <sub>BUS</sub> is less than SYS. Bypass SYS to GND with a 1µF (min) ceramic capacitor.
C6	AVL	Analog Voltage Level. Output of the on-chip LDO is used to power the on-chip and low-noise circuits. Bypass with a 2.2µF/10V ceramic capacitor to GND. Powering external loads from AVL is not recommended, other than pullup resistors.
B5	VDD1P8	1.8V Internal LDO Output. Bypass the pin to ground with a 1µF/6.3V ceramic capacitor.
A2	VDD1P1	Digital Supply Voltage of 1.1V. Bypass with a 1µF/6.3V ceramic capacitor.
B3	SDA	I <sup>2</sup> C Serial Data. Add an external 2.2kΩ pullup resistor to VIO1.
B2	SCL	I <sup>2</sup> C Serial Clock. Add an external 2.2kΩ pullup resistor to VIO1.

## Pin Description (continued)

PIN	NAME	FUNCTION
A1	INTB	Interrupt Output. Active-low open-drain output. Add a 200kΩ pullup resistor to VIO1.
E1	DN1	USB Input 1 for D-
E2	DP2	USB Input 2 for D+
D1	DN	Common Negative Output 1. Connect to D- on USB Type-C connector.
D2	DP	Common Positive Output 2. Connect to D+ on USB Type-C connector.
A3	CC1	USB Type-C CC Pin 1
A4	CC2	USB Type-C CC Pin 2
A5	VCIN	MTP and V <sub>CONN</sub> power supply input. Apply 5V power to V <sub>CIN</sub> . Required for MTP program and to generate V <sub>CONN</sub> power supply to unused CC pin if required.
E6	GPIO0	GPIO0—ADC Input 0. Used for Moisture detection functionality as default. If Moisture detection is disabled, this pin is freed up for use as GPIO.
B4	GPIO1	GPIO1—ADC Input 1. Used for Moisture detection functionality as default. If Moisture detection is disabled, this pin is freed up for use as GPIO.
E5	GPIO2	GPIO2
D5	GPIO3	GPIO3. Used for Moisture detection functionality as default. If Moisture detection is disabled, this pin is freed up for use as GPIO.
E4	GPIO4	GPIO4
E3	GPIO5	GPIO5
D4	GPIO6	Used for I <sup>2</sup> C Slave ID (SID) Selection at Power Up. Tie this pin to GND, pullup, pulldown with an external 470kΩ ±10% resistor. See <a href="#">Table 3</a> . After power up is complete, this pin can be used for GPIO.
D3	GPIO7	GPIO7
C4	GPIO8	GPIO8
C5	GND_A	Analog GND
D6	GND_D	Digital GND
C3	SDA_M	Master I <sup>2</sup> C Serial Data. Add an external 2.2kΩ pullup resistor to VIO2.
C2	SCL_M	Master I <sup>2</sup> C Serial Clock. Add an external 2.2kΩ pullup resistor to VIO2.

## Detailed Description

The MAX77958 is a robust solution for USB Type-C CC detection and power delivery (PD) protocol implementation. It detects overvoltage and overcurrent, and detects moisture and prevents corrosion on the USB Type-C connector. The IC also has a D+/D- USB switch and BC1.2 detection to support legacy USB standards. It contains  $V_{CONN}$  switches for USB PD and an enable pin for an external  $V_{CONN}$  boost or buck converter.

The IC can be used in sink mode to determine the source capabilities of the connected device to optimize power into the sink device. The IC can also be used in source mode to advertise the power capabilities of the source to connected devices and accessories.

The IC is compliant with USB Type-C Version 1.3 and PD 3.0. It can be further customized without affecting the compliance. The embedded default firmware in the MAX77958 is able to support operations that are expected in the Type-C and PD applications.

The default firmware operations are as follows:

- BC1.2, Type-C, and PD adapter detection
- Automatic PD negotiation
- Default sink PDOs: 5V/3A, 9V/3A, and 15V/3A. If there are multiple source PDOs matching to the MAX77958 sink PDO list, the MAX77958 requests the highest power of PDO.
- Automatic role setting according to port partner's role

In addition to the default operation, operation of the IC can be customized for specific applications. This is accomplished using the customization script in the evaluation kit (EV kit) GUI to support different Maxim chargers.

The MAX77958 supports both standalone and MCU based systems. In the standalone system (see [Figure 1](#)), the MAX77958 plays a role as system MCU along with the customization script that can be generated through the GUI SW. The customization script is stored in the MTP. In response to events that are happening in the Type-C connector, the customization script automatically executes commands specified by the designer. All sequential control operations are possible without the need for MCU.

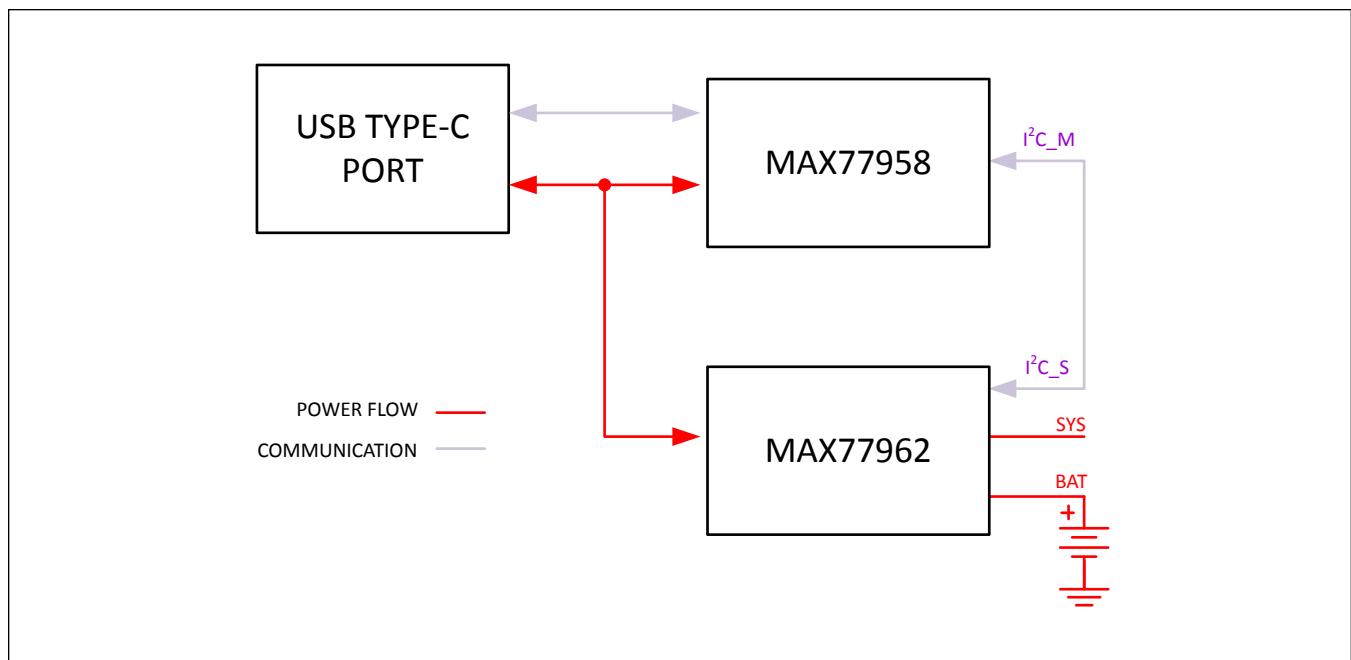


Figure 1. Standalone System

In the MCU based system (see [Figure 2](#)), the MCU controls the peripheral ICs. In response to port events, the MAX77958 interrupts the MCU and controls the MAX77958 and MAX77962 according to system needs.

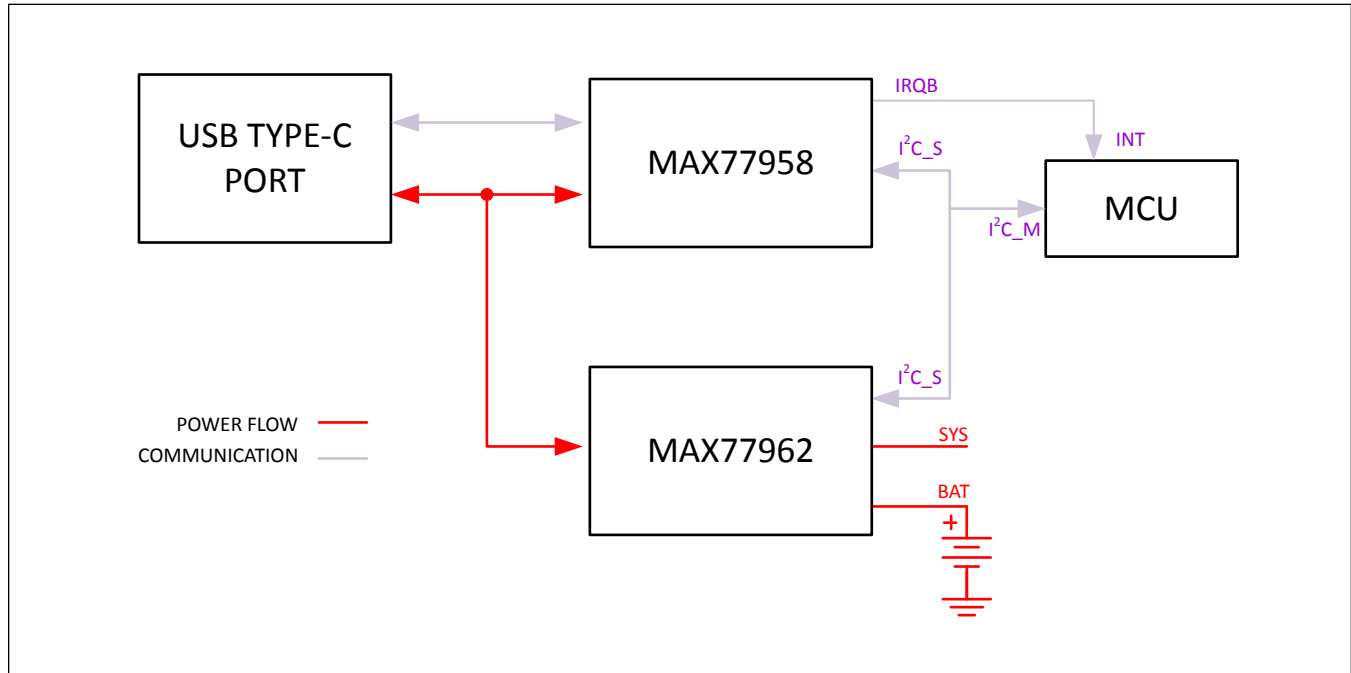


Figure 2. MCU Based System

### USB Type-C Interface and Control

The MAX77958 is a complete solution for USB port charger detection and High-Power USB charging on a single USB Type-C connector. It can also be used in any power sink or source application.

The USB Type-C is an internal block that detects connected accessories by using USB Type-C, USB PD messaging and USB BC1.2 charger detection. The USB Type-C block auto-configures switches for common connected accessories including USB cables (SDP/CDP/DCP).

### CC/USB PD Interface

The MAX77958 works as a Dual Role Port (DRP) compliant to USB Type-C Version 1.3. The USB Type-C functions are controlled by a logic state machine which follows the USB Type-C requirements. There is support for the optional Try.Sink function which places priority on the sink role. This creates the appearance of legacy operation when the device is connected to another DRP. The IC automatically becomes a sink and draws power from the source. The IC firmware can optionally set an external charger's input current limit based on the current advertised on the CC lines through the master I<sup>2</sup>C interface.

### USB Type-C Definitions

- UFP—Upstream Facing Port. Typical USB device role for data transfer.
- DFP—Down Stream Facing Port. Typical USB host role for data transfer.
- DRP—Dual Role Port. USB Type-C port that can operate in either DFP or UFP roles.
- Source—Initial power state for a DFP. Power role can be swapped by USB Power Delivery command.
- Sink—Initial power state for a UFP. Power role can be swapped by USB Power Delivery command.

### DRP

The USB Type-C connector management block supports DRP operation. The port cycles between advertising DFP/source and UFP/sink operations while waiting for a port to be connected. The internal state machine handles all the

tasks of detecting and configuring the CC pins for the correct mode. A manual mode allows forcing either DFP or UFP operation in cases where the DRP operation is not appropriate

### Detecting Connected DFP

When a DFP is detected (either from DRP mode or force UFP mode), the USB Type-C Connection State Machine detects the active CC line and reports this with an interrupt to the host application processor (AP). The AP then uses this information to de-mux the SuperSpeed USB lines as required. The USB Type-C Connection State Machine also auto detects the DFP advertised current (default, 1.5A and 3.0A). Upon detection of a change in the advertised current, an interrupt is sent to the AP.

### Detecting Connected UFP

When a UFP is detected (either from DRP mode or force DFP mode), the USB Type-C State Machine detects the active CC line. If the Interrupt is enabled, and an AP is present, the IC toggles the INT line to report this to the host AP. Additionally, if an active cable is connected, the IC detects the presence of  $R_A$  on the unconnected CC line to determine if it is necessary to turn on  $V_{CONN}$ . The advertised initial supply current is the default USB current (500mA/900mA depending on if SuperSpeed is active). The advertised current can be changed through an I<sup>2</sup>C command or automatically to 1.5A. 3.0A is optionally available but is disabled by default.

## Controls

### Reported Status and Interrupts

- Connected Device Detection
- Active CC Line
- $V_{CONN}$  Enabled ( $R_A$  Present)
- Advertised Current in UFP (Source) Mode
- Error State

### Operation Controls

- Force Source (DFP) or Sink (UFP) State
- Control Swap of Power Role or  $V_{CONN}$  Role
- Enable/Disable of Audio or Debug Accessories
- Set Advertisement of CC Pin Current in Source Role

### Try.SNK Support

The MAX77958 operates as a DRP by default. This type of port can act as either a Power Sink/USB Data Peripheral or a Power Source/USB Data Host. The USB Type-C logic state machine cycles between Source and Sink at a rate typically around 75ms. This means that when the IC is connected to another device, which is also a DRP (for example, PC with a C port), the source and sink roles are randomly assigned. The customer prefers that the mobile phone assumes the sink role if connected to a PC. The IC includes support for Try.SNK, which allows it to be set to strongly prefer the sink role if connected to a standard DRP. If two devices with Try.SNK enable are connected, the role setting is again random.

### Audio Accessory Mode Support

The IC detects an audio accessory device when both the CC1 and CC2 pins are pulled down to ground by an  $R_A$  resistor from the connected device.

### DebugAccessory.SRC Support

The IC detects a connection to a debug and test system (DTS) when it operates in source power role. A debug accessory device is detected when the CC1 and CC2 pins are pulled down to ground by an  $R_D$  resistor from the connected device.

### DebugAccessory.SNK Support

The IC detects a connection to a DTS when it operates in sink power role. A debug accessory device is detected when the CC1 and CC2 pins are pulled up by an  $R_p$  resistor from the connected device.

The voltage levels on the CC1 and CC2 pins give the orientation and current capability.

**Table 1. Rp/Rp Charging Current Values for a DTS Source**

MODE OF OPERATION	CC1	CC2
Default USB Power	Rp for 3A	Rp for 1.5A
USB Type-C Current at 1.5A	Rp for 1.5A	Rp for Default
USB Type-C Current at 3A	Rp for 3A	Rp for Default

**Moisture Detection**

The MAX77958 features Moisture and Dry detection on the USB Type-C receptacle. When the Moisture detection feature is enabled (enabled as default), the MAX77958 is monitoring CC1/CC2 and SBU1/SBU2 for 1 DRP source cycle periodically. In case the impedance on these pins are less than Moisture threshold, the MAX77958 runs its unique algorithm until Dry is detected on the receptacle.

When Moisture and Dry are detected, the MAX77958 reports to the AP by setting CC\_STATUS1[1].

To take advantage of the MAX77958 Moisture detection feature, external resistor configuration on the SBU1 and SBU2 are required.

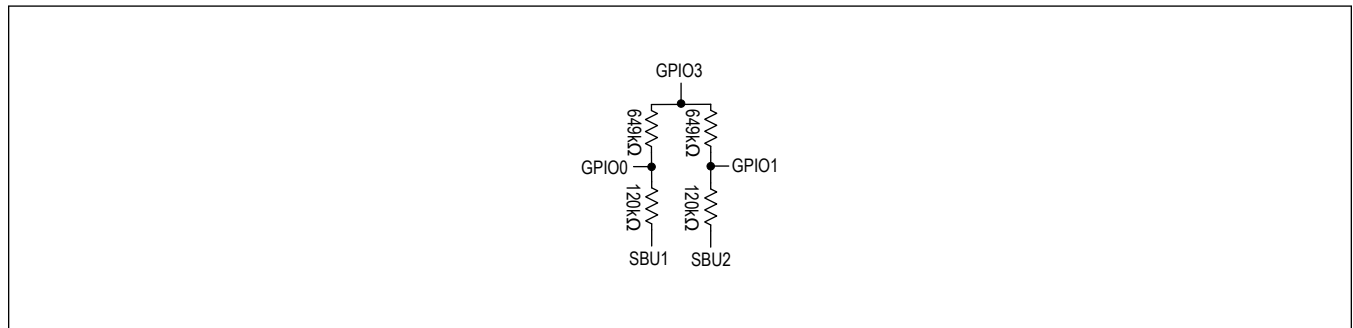


Figure 3. SBU Configuration

**USB BC1.2 D+/D- Adapter Detection**

**Description**

The USB adapter detection is USB BC1.2 compliant with the ability to automatically detect common charger types.

USB adapter detection has the following controls in the I<sup>2</sup>C register file:

- Charger detection enable (ChgDetEn)
- Charger detection manual—request a new run of charger detection (ChgDetMan)

The Adapter Detection State Machine follows USB BC1.2 requirements and detects SDP, CDP, and DCP types. If the D+/D- lines are detected as open, the adapter detection state machine indicates SDP as required by BC1.2 requirements.

With a USB BC1.2 compliant state machine, the IC reports that a DCP is detected based on the bias voltage. The IC default firmware can automatically set an external charger's input current limit based on the BC1.2 adapter type that was detected.

The IC also reports the operation status of the Adapter Detection State Machine in the ChgTypRun interrupt bit in the I<sup>2</sup>C register map.

**Charger Type Detection Table**

**Table 2. BC1.2 Adapter Detection**

USB BC1.2 DETECTED ADAPTER TYPE	
ChgTyp VALUE	CHARGER DETECTED
00	No V <sub>BUS</sub>

**Table 2. BC1.2 Adapter Detection (continued)**

USB BC1.2 DETECTED ADAPTER TYPE	
01	SDP
10	CDP
11	DCP

**Note:** Adapter Detect running state is indicated until the Adapter Detection State Machine is complete.

**V<sub>CONN</sub> Switch**

**Description**

The MAX77958 integrates the V<sub>CONN</sub> switch which connects V<sub>CIN</sub> to one of CC1 and CC2. Once CC detection identifies Ra/Ra on CC1 and CC2, the V<sub>CONN</sub> switch routes V<sub>CIN</sub> to the pin that is not connected to the CC line in the cable.

The MAX77958 also provides programmable V<sub>CONN</sub> switch current limit from 200mA to 500mA in 100mA step. If V<sub>CONN</sub> load current exceeds the current limit for 3ms, then an interrupt is generated to the Application Processor (AP). If AP wants to keep supplying V<sub>CONN</sub> power, then the AP must configure a higher current limit or no current limit within 12ms. If not, the V<sub>CONN</sub> switch is turned OFF in 12ms after an Interrupt is generated.

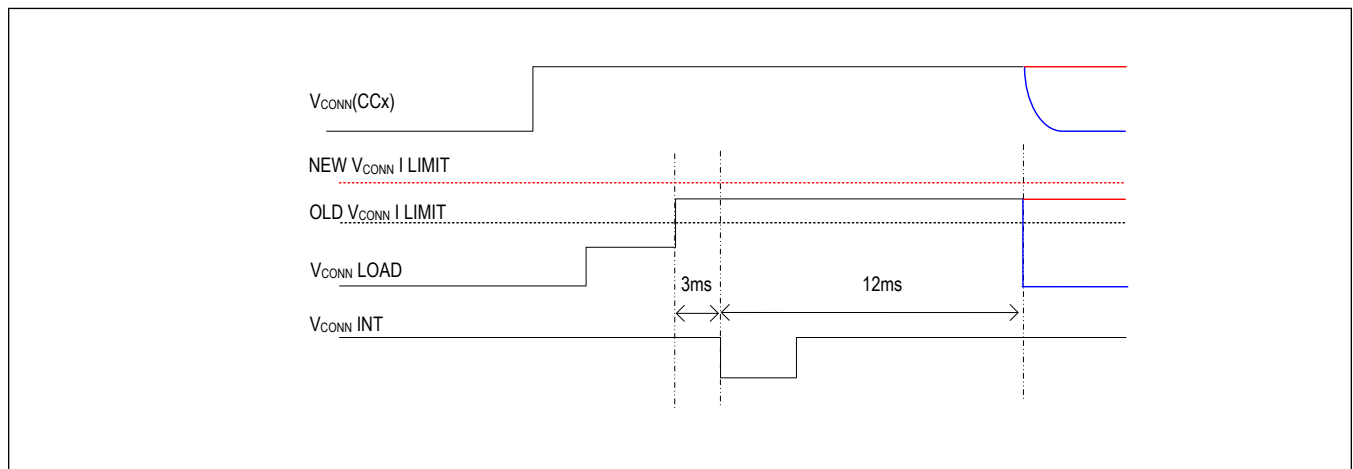


Figure 4. V<sub>CONN</sub> Overcurrent Protection Operation

**USB Type-C Interface and Control**

**Automatic Accessory Detection**

**Autoconfiguration Details**

CCDetEn = 0 or ChgDetEn = 0

1. Nothing happens when V<sub>BUS</sub> is attached. Nothing occurs when ChgDetMan is set to 1.

CCDetEn = 1 and ChgDetEn = 1

1. Charger detection runs automatically when V<sub>BUS</sub> is attached
2. If V<sub>BUS</sub> voltage enters the valid range, all switches connected to DP/DN are opened
3. Charger detection algorithm begins.
4. When charger detection finishes, DP/DN switch settings are restored.

USBAuto = 0

1. No automatic switch configuration happens

USBAuto = 1

1. Operates only after charger detection completes, SDP or CDP is found, and if no special charger is found (SpChgTyp = 000 unknown).
2. Set DP/DN connected to DP2/DN1, over-riding any previous switch setting.
3. At any time, the AP is allowed to change these switch settings.
4. If AP has not changed the switch settings when  $V_{BUS}$  drops below the valid level, DP/DN sets to Hi-Z.



## USB Power Delivery

### Description

The IC supports USB Power Delivery Revision 3.0. The power delivery subsystem is separated into 2 parts: Automatic Power Control and Application Processor Message Passthrough.

### Automatic Power Control

When a USB Type-C connection is made, the IC automatically handles the initial PD power contract. If a source is connected, the IC reads selects an appropriate voltage and current from the offered capabilities. The IC automatically configures the companion chip input current limit based on the contract if the  $I_{LIM\_FW}$  bit is set to 1. The AP may later negotiate a new operating power and manually set the input limiter and charger. If a sink is connected, the IC sends a capabilities message to the attached sink.

### Application Processor Message Passthrough

There are many USB PD messages that are unrelated to power control. These messages pass on to the AP to decode and reply. USB PD messages have time critical components and the IC automatically handles these time critical events.

### IC Wakeup events

The IC automatically operates in the lowest possible power state. The IC power consumption depends on the following conditions:

- Request has been made across the I<sup>2</sup>C bus
- USB Type-C end-to-end detection is valid
- $V_{BUS}$  is present

The lowest possible power consumption state is no  $V_{BUS}$ ,  $CCDetEn = 0$ , and no I<sup>2</sup>C traffic requests.

**Interrupt Output (INTB)**

INTB is an open-drain and active-low output. It reports an interrupt event to the main microprocessor. Individual interrupt sources can be masked. Once the main microprocessor reads the interrupt registers, the INTB pin is cleared.

**Interconnected Block Diagram**

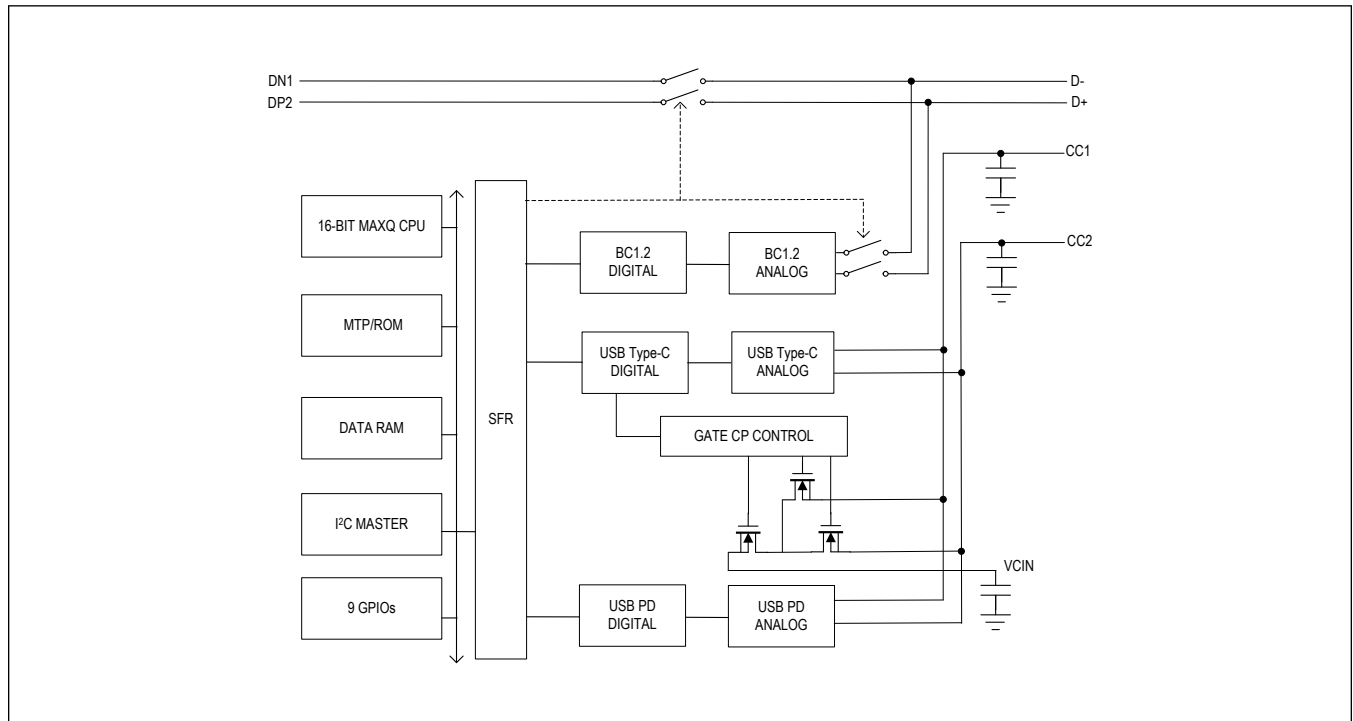


Figure 5. Interconnected Block Diagram

**System Faults**

The IC monitors the system for the following faults:

- Undervoltage lockout
- VIO fault

**Undervoltage Lockout**

When the  $V_{AVL}$  falls below  $AVL_{UVLOF}$  (2.6V max) for more than 8ms, the MAX77958 enters into a shutdown state. Once the  $V_{AVL}$  voltage is higher than  $AVL_{UVLOR}$  (2.8V max), the MAX77958 exits shutdown state to be functional.

**VIO Fault**

When VIO1 and VIO2 fall below 1.0V, the IC goes into shutdown state. Once VIO1 and VIO2 voltages rise higher than 1.3V, the IC comes out of shutdown state.

## Reset Conditions

The IC has different levels of reset as follows:

- **Type S:** Registers are reset each time when  $VDD1P8 < VDD\_OK_F$
- **Type O:** Registers are reset each time when  $VDD1P8 < VDD\_OK_F$  or when the software reset command is transmitted ( $SW\_RESET = 0x0F$ )

## WDT Reset

1. Firmware restarts a watchdog timer in 1.86s.
2. If the watchdog timer is not kicked in 1.86s, it executes the following actions:
  - a.) MAX77958 reboots
  - b.) MAX77958 notifies MA\_SYSERROR\_BOOT\_WDT

## I<sup>2</sup>C Serial Interface

The I<sup>2</sup>C serial bus consists of a bidirectional serial-data line (SDA) and a serial clock (SCL). I<sup>2</sup>C is an open-drain bus. SDA and SCL require pullup resistors (500Ω or greater). Optional 24Ω resistors in series with SDA and SCL help to protect the device inputs from high voltage spikes on the bus lines. Series resistors also minimize crosstalk and undershoot on bus lines.

## System Configuration

The I<sup>2</sup>C bus is a multi-master bus. The maximum number of devices that can attach to the bus is only limited by bus capacitance.

[Figure 6](#) shows an example of a typical I<sup>2</sup>C system. A device on the I<sup>2</sup>C bus that sends data to the bus is called a transmitter. A device that receives data from the bus is called a receiver. The device that initiates a data transfer and generates SCL clock signals to control the data transfer is a master. Any device that is being addressed by the master is considered a slave. When the MAX77958 I<sup>2</sup>C-compatible interface is operating, it is a slave on the I<sup>2</sup>C bus and it can be both a transmitter and a receiver.

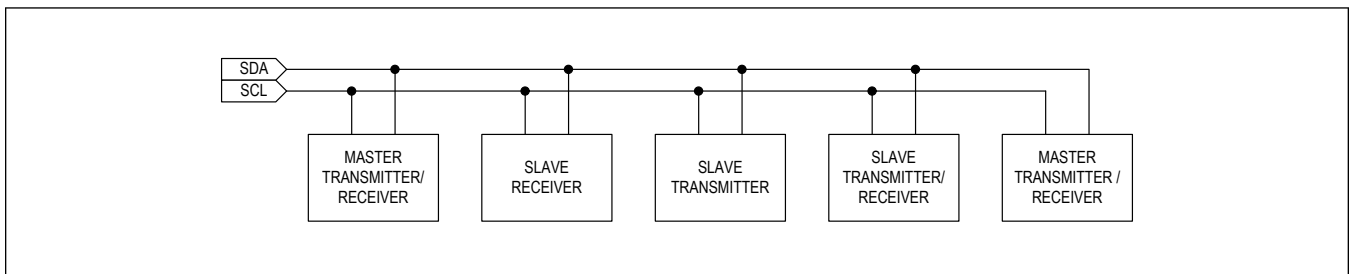


Figure 6. Functional Logic Diagram for Communications Controller

**Bit Transfer**

One data bit is transferred for each SCL clock cycle. The data on SDA must remain stable during the high portion of the SCL clock pulse. Changes in SDA while SCL is high are control signals (START and STOP conditions).

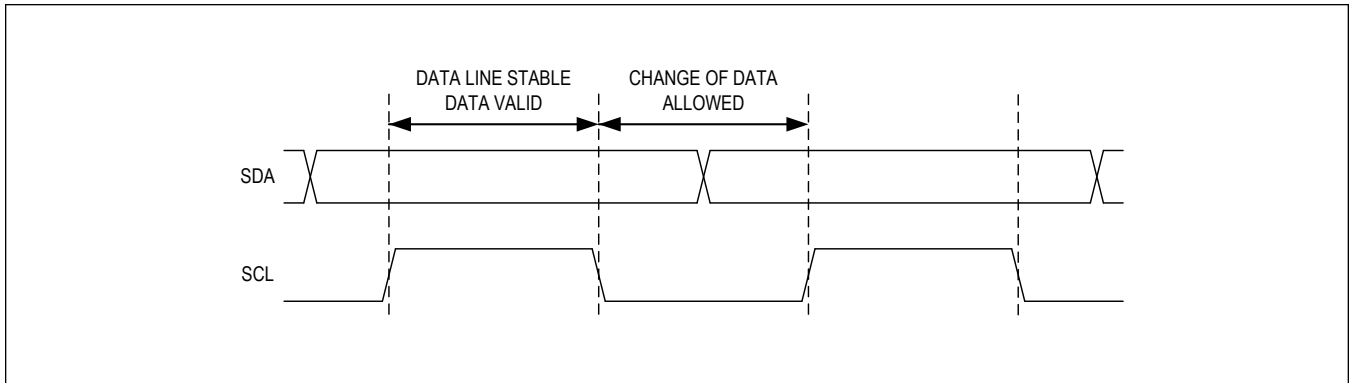


Figure 7. I<sup>2</sup>C Bit Transfer

**START and STOP Conditions**

When the I<sup>2</sup>C serial interface is inactive, SDA and SCL idle high. A master device initiates communication by issuing a START condition. A START condition is a high-to-low transition on SDA with SCL high. A STOP condition is a low-to-high transition on SDA, while SCL is high.

A START condition from the master signals the beginning of a transmission to the IC. The master terminates transmission by issuing a NOT ACKNOWLEDGE followed by a STOP condition.

A STOP condition frees the bus. To issue a series of commands to the slave, the master can issue REPEATED START (Sr) commands instead of a STOP command in order to maintain control of the bus. In general, a REPEATED START command is functionally equivalent to a regular START command.

When a STOP condition or incorrect address is detected, the IC internally disconnects SCL from the I<sup>2</sup>C serial interface until the next START condition, minimizing digital noise and feed-through.

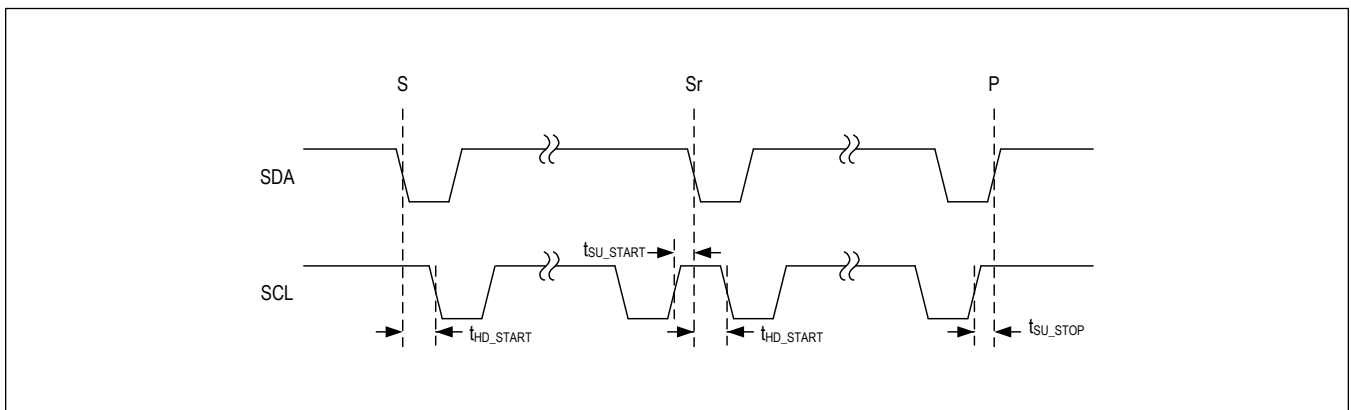


Figure 8. I<sup>2</sup>C Start and Stop

**Acknowledge**

Both the I<sup>2</sup>C bus master and the IC (slave) generate acknowledge bits when receiving data. The acknowledge bit is the last bit of each nine bit data packet. To generate an ACKNOWLEDGE (A), the receiving device must pull SDA low before the rising edge of the acknowledge-related clock pulse (ninth pulse) and keep it low during the high period of the clock pulse. To generate a NOT-ACKNOWLEDGE (nA), the receiving device allows SDA to be pulled high before the rising edge of the acknowledge-related clock pulse and leaves it high during the high period of the clock pulse.

Monitoring the acknowledge bits allows for detection of unsuccessful data transfers. An unsuccessful data transfer occurs if a receiving device is busy or if a system fault has occurred. In the event of an unsuccessful data transfer, the bus master should reattempt communication at a later time.

**Slave Address**

The IC acts as a slave transmitter/receiver. The slave address of the IC is 0x4Ah/0x4Bh, 0x4Ch/0x4Dh and 0x4Eh/0x4Fh depending on configuration of GPIO6. The least significant bit is the read/write indicator (1 for read, 0 for write).

**Table 3. I<sup>2</sup>C Slave Address**

GPIO6	SLAVE ADDRESS (7-BIT)	SLAVE ADDRESS (WRITE)	SLAVE ADDRESS (READ)
GND	010 0101	0x4A (0100 1010)	0x4B (0100 1011)
Pullup (470kΩ ±10%) to VIO1	010 0110	0x4C (0100 1100)	0x4D (0100 1101)
Pulldown (470kΩ ±10%) to GND	010 0111	0x4E (0100 1110)	0x4F (0100 1111)

**Clock Stretching**

In general, the clock signal generation for I<sup>2</sup>C bus is the responsibility of the master device. I<sup>2</sup>C specification allows slow slave devices to alter the clock signal by holding down the clock line. The process in which a slave device holds down the clock line is typically called clock stretching. The IC does not use any form of clock stretching to hold down the clock line.

**General Call Address**

The IC does not implement an I<sup>2</sup>C specification general call address. If the IC sees general call address (0000000b), it does not issue an ACKNOWLEDGE (A).

**Communication Speed**

The IC provides I<sup>2</sup>C 3.0-compatible (1MHz) serial interface.

- I<sup>2</sup>C Revision 3 Compatible Serial Communications Channel
  - 0Hz to 100kHz (Standard Mode)
  - 0Hz to 400kHz (Fast Mode)
  - 0Hz to 1MHz (Fast-Mode Plus)
- Does not Support I<sup>2</sup>C Clock Stretching

Operating in standard mode, fast mode, and fast-mode plus does not require any special protocols. The main consideration when changing the bus speed through this range is the combination of the bus capacitance and pullup resistors. Higher time constants created by the bus capacitance and pullup resistance (C x R) slow the bus operation. Therefore, when increasing bus speeds the pullup resistance must be decreased to maintain a reasonable time constant. Refer to the “*Pullup Resistor Sizing*” section of the I<sup>2</sup>C revision 3.0 specification for detailed guidance on the pullup resistor selection. In general, for bus capacitance of 200pF, a 100kHz bus needs 5.6kΩ pullup resistors, a 400kHz bus needs about 1.5kΩ pullup resistors, and a 1MHz bus needs 680Ω pullup resistors. Note that the pullup resistor dissipates power when the open-drain bus is low. The lower the value of the pullup resistor, the higher the power dissipation ( $V^2/R$ ).

Operating in high-speed mode requires some special considerations. For the full list of considerations, see the I<sup>2</sup>C 3.0 specification. The major considerations with respect to the IC are:

- I<sup>2</sup>C bus master uses current source pullups to shorten the signal rise times.
- I<sup>2</sup>C slave must use a different set of input filters on its SDA and SCL lines to accommodate for the higher bus speed.
- The communication protocols need to utilize the high-speed master code.

At power-up and after each STOP condition, the IC input filters are set for standard mode, fast mode, or fast-mode plus (i.e., 0Hz to 1MHz). To switch the input filters for high-speed mode, use the high-speed master code protocols that are described in the [Communication Protocols](#) section.

### Communication Protocols

The IC supports both writing and reading from its registers.

#### Writing to a Single Register

[Figure 9](#) shows the protocol for the I<sup>2</sup>C master device to write one byte of data to the IC. This protocol is the same as SMBus specification's "Write Byte" protocol.

The "Write Byte" protocol is as follows:

1. The master sends a START command (S).
2. The master sends the 7-bit slave address followed by a write bit ( $R/\overline{W} = 0$ ).
3. The addressed slave asserts an ACKNOWLEDGE (A) by pulling SDA low.
4. The master sends an 8-bit register pointer.
5. The slave acknowledges the register pointer.
6. The master sends a data byte.
7. The slave acknowledges the data byte. At the rising edge of SCL, the data byte is loaded into its target register and the data becomes active.
8. The master sends a STOP condition (P) or a REPEATED START condition (Sr). Issuing a P ensures that the bus input filters are set for 1MHz or slower operation. Issuing a REPEATED START (Sr) leaves the bus input filters in their current state.

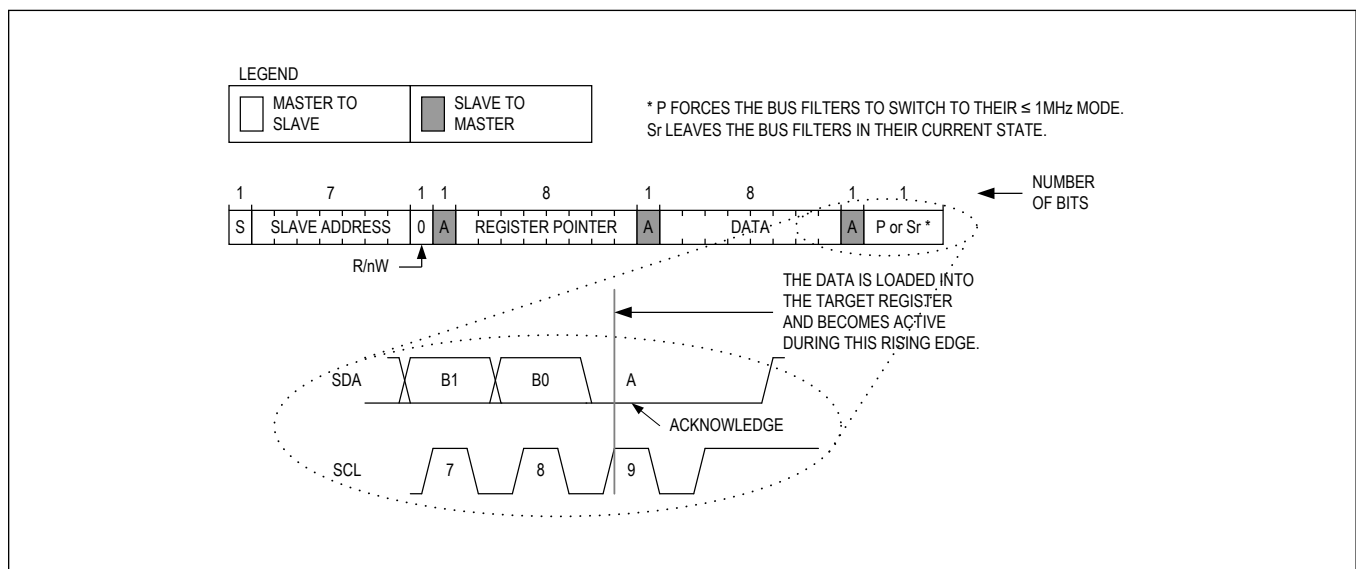


Figure 9. Writing to a Single Register

**Writing to Sequential Registers**

Figure 10 shows the protocol for writing to sequential registers. This protocol is similar to the “Write Byte” protocol, except the master continues to write after it receives the first byte of data. When the master is done writing, it issues a STOP or REPEATED START.

The “Writing to Sequential Registers” protocol is as follows:

1. The master sends a START command (S).
2. The master sends the 7-bit slave address followed by a write bit ( $R/\overline{W} = 0$ ).
3. The addressed slave asserts an ACKNOWLEDGE (A) by pulling SDA low.
4. The master sends an 8-bit register pointer.
5. The slave acknowledges the register pointer.
6. The master sends a data byte.
7. The slave acknowledges the data byte. At the rising edge of SCL, the data byte is loaded into its target register and the data becomes active.
8. Steps 6 to 7 are repeated as many times as the master requires.
9. During the last acknowledge related clock pulse, the slave issues an ACKNOWLEDGE (A).
10. The master sends a STOP condition (P) or a REPEATED START condition (Sr). Issuing a P ensures that the bus input filters are set for 1MHz or slower operation. Issuing a REPEATED START (Sr) leaves the bus input filters in their current state.

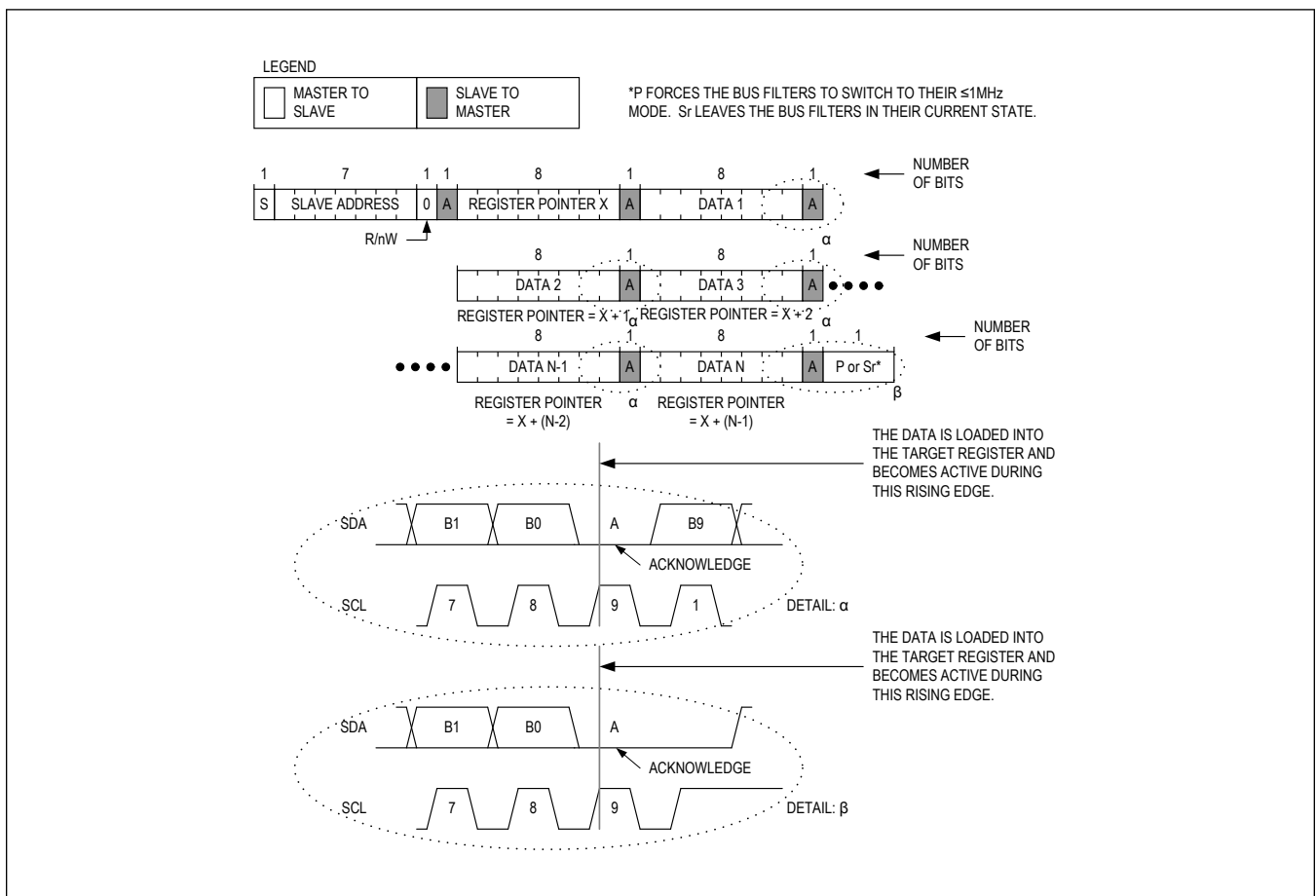


Figure 10. Writing to Sequential Registers

### Reading from a Single Register

The I<sup>2</sup>C master device reads one byte of data to the IC. This protocol is the same as SMBus specification's "Read Byte" protocol.

The "Read Byte" protocol is as follows:

1. The master sends a START command (S).
2. The master sends the 7-bit slave address followed by a write bit ( $R/\overline{W} = 0$ ).
3. The addressed slave asserts an ACKNOWLEDGE (A) by pulling SDA low.
4. The master sends an 8-bit register pointer.
5. The slave acknowledges the register pointer.
6. The master sends a REPEATED START command (Sr).
7. The master sends the 7-bit slave address followed by a read bit ( $R/\overline{W} = 1$ ).
8. The addressed slave asserts an ACKNOWLEDGE (A) by pulling SDA low.
9. The addressed slave places 8-bits of data on the bus from the location specified by the register pointer.
10. The master issues a NOT-ACKNOWLEDGE (nA).
11. The master sends a STOP condition (P) or a REPEATED START condition (Sr). Issuing a P ensures that the bus input filters are set for 1MHz or slower operation. Issuing a REPEATED START (Sr) leaves the bus input filters in their current state.

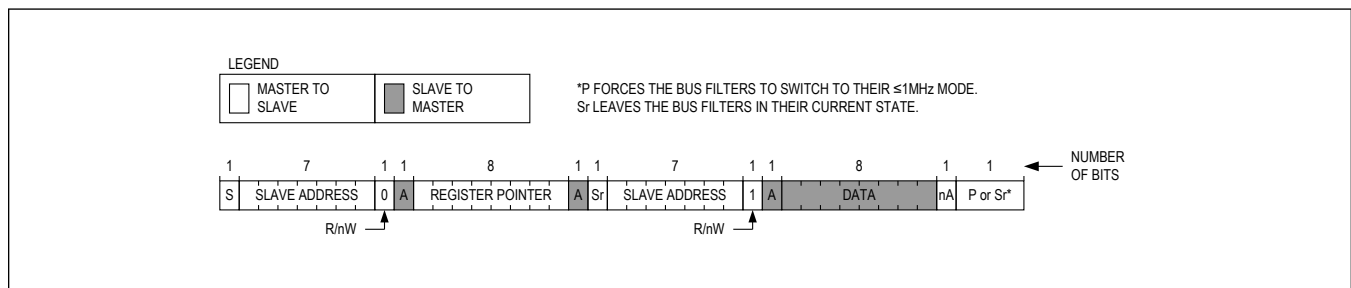


Figure 11. Reading from a Single Register

### Reading from Sequential Registers

Figure 12 shows the protocol for reading from sequential registers. This protocol is similar to the "Read Byte" protocol except the master issues an ACKNOWLEDGE (A) to signal the slave that it wants more data—when the master has all the data it requires, it issues a NOT-ACKNOWLEDGE (nA) and a STOP (P) to end the transmission.

The "Continuous Read from Sequential Registers" protocol is as follows:

1. The master sends a START command (S).
2. The master sends the 7-bit slave address followed by a write bit ( $R/\overline{W} = 0$ ).
3. The addressed slave asserts an ACKNOWLEDGE (A) by pulling SDA low.
4. The master sends an 8-bit register pointer.
5. The slave acknowledges the register pointer.
6. The master sends a REPEATED START command (Sr).
7. The master sends the 7-bit slave address followed by a read bit ( $R/\overline{W} = 1$ ).
8. The addressed slave asserts an ACKNOWLEDGE (A) by pulling SDA low.
9. The addressed slave places 8-bits of data on the bus from the location specified by the register pointer.
10. The master issues an ACKNOWLEDGE (A) signaling the slave that it wishes to receive more data.
11. Steps 9 to 10 are repeated as many times as the master requires. Following the last byte of data, the master must issue a NOT-ACKNOWLEDGE (nA) to signal that it wishes to stop receiving data.
12. The master sends a STOP condition (P) or a REPEATED START condition (Sr). Issuing a STOP (P) ensures that the bus input filters are set for 1MHz or slower operation. Issuing a REPEATED START (Sr) leaves the bus input filters in their current state.



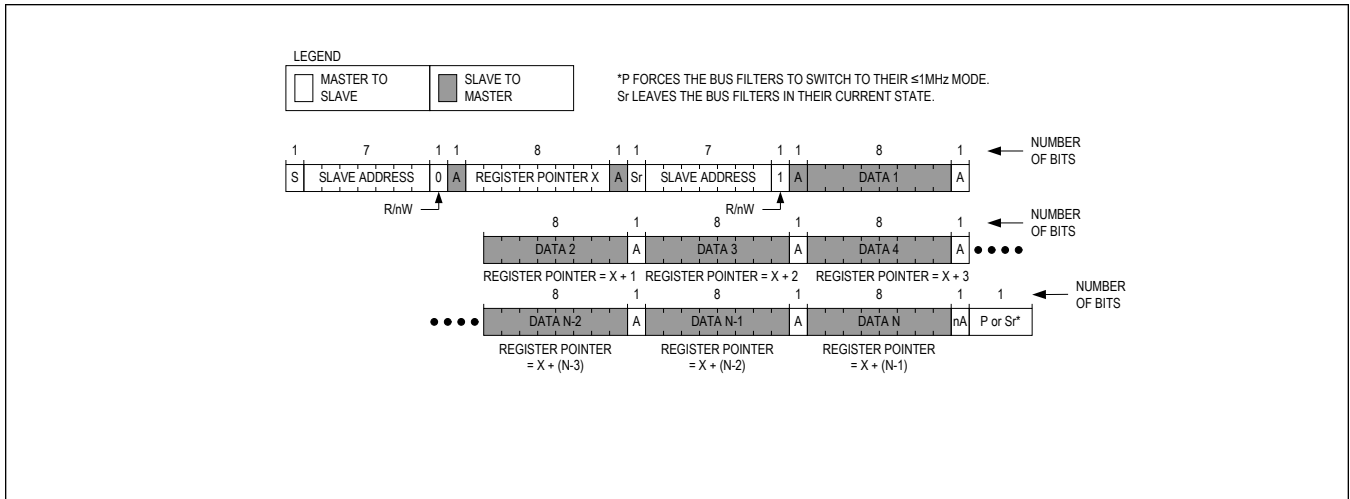


Figure 12. Reading from Sequential Registers

**Engaging HS-Mode for Operation up to 3.4MHz**

Figure 13 shows the protocol for engaging HS-Mode operation. HS-Mode operation allows for a bus operating speed up to 3.4MHz.

The “Engaging HS-Mode” protocol is as follows:

1. Begin the protocol while operating at a bus speed of 1MHz or lower.
2. The master sends a START command (S).
3. The master sends the 8-bit master code of 0000 1xx0b, where ‘xx’ are don’t care bits.
4. The addressed slave issues a NOT-ACKNOWLEDGE (nA).
5. The master may now increase its bus speed up to 3.4MHz and issue any read/write operation.

The master may continue to issue high-speed read/write operations until a STOP (P) is issued. Issuing a STOP (P) ensures that the bus input filters are set for 1MHz or slower operation.

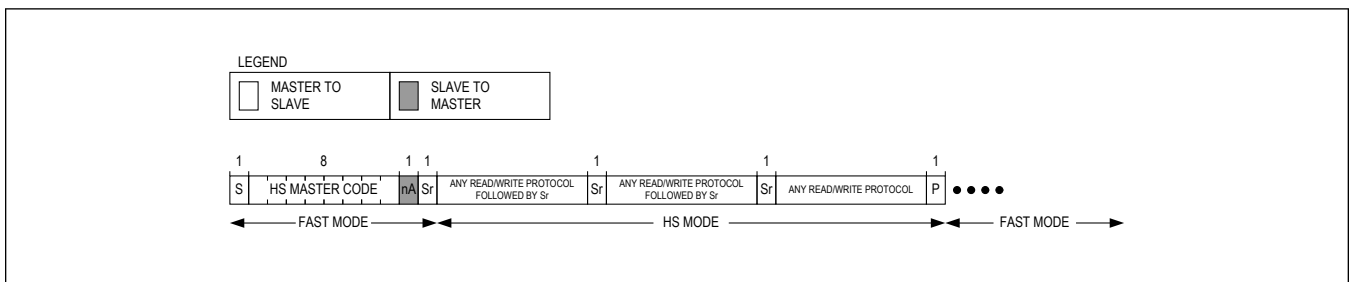


Figure 13. Engaging HS-Mode

The MAX77958 I<sup>2</sup>C supports the HS mode extension feature. The HS extension feature keeps the high-speed operation even after a 'STOP' condition. This eliminates the need for HS master code issued by the I<sup>2</sup>C master controller when the I<sup>2</sup>C master controller wants to stay in HS mode for multiple read/write cycles.

As shown in [Figure 14](#), the HS extension mode can be enabled by setting HS\_EXT bit in I2C\_CFG register (ADDR 0x15) from LS mode only (entering HS extension mode from HS mode is not supported).

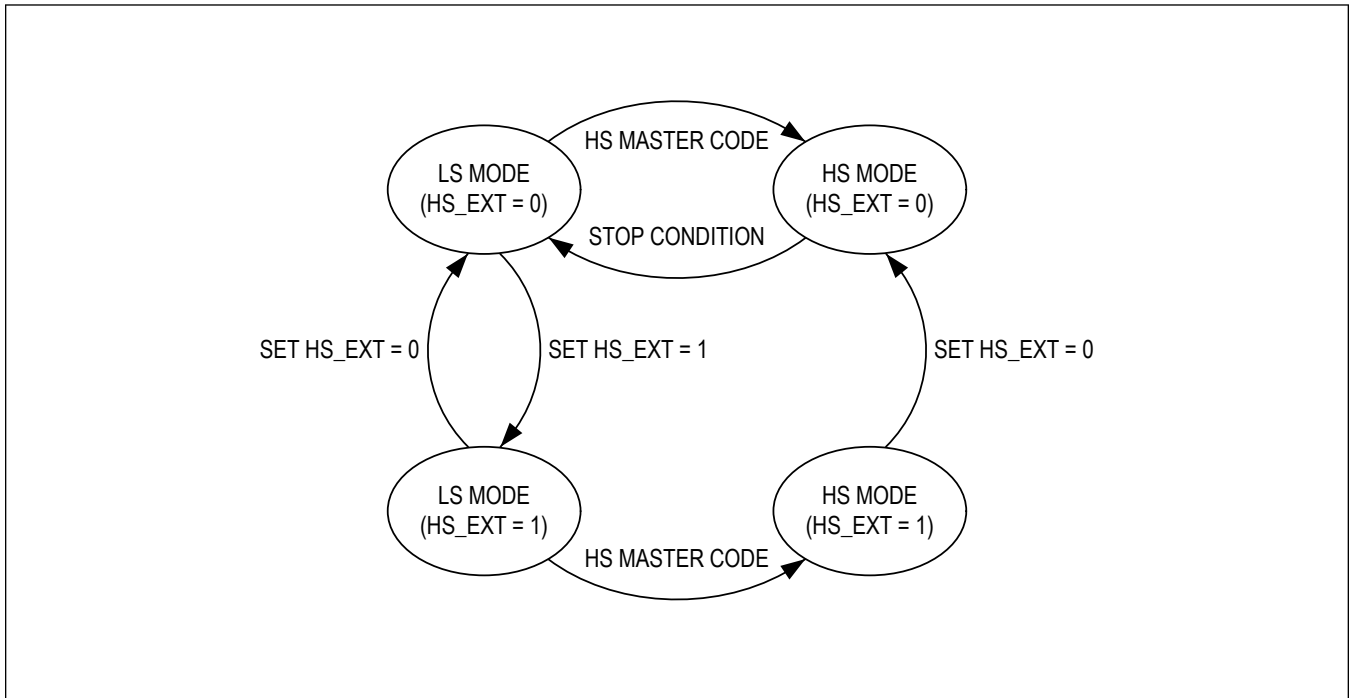


Figure 14. I<sup>2</sup>C Operating Mode State Diagram

## Register Map

### Register Map

I<sup>2</sup>C Slave Address

The MAX77958 has a total of 3 slave addresses. See [Table 3](#) for more information.

#### Functional Reset Conditions

The IC has different levels of reset as follows:

- Type S: Registers are reset each time when  $VDD1P8 < VDD\_OK_F$
- Type O: Registers are reset each time when  $VDD1P8 < VDD\_OK_F$  or when the software reset command is transmitted ( $SW\_RESET = 0x0F$ )

#### Functional Register Reset Type Summary

	REGISTER ADDRESS (HEX)	REGISTER FUNCTION	REGISTER NAME	RESET TYPE
USBC SID (functional registers)				
USBC	0x00	USBC	DEVICE_ID	S
USBC	0x01	USBC	DEVICE_REV	S
USBC	0x02	USBC	FW_REV	S
USBC	0x03	USBC	FW_SUB_VER	S
USBC	0x04	USBC	UIC_INT	O
USBC	0x05	USBC	CC_INT	O
USBC	0x06	USBC	PD_INT	O
USBC	0x07	USBC	ACTION_INT	O
USBC	0x08	USBC	USBC_STATUS1	S
USBC	0x09	USBC	USBC_STATUS2	S
USBC	0x0A	USBC	BC_STATUS	S
USBC	0x0B	USBC	DP_STATUS	S
USBC	0x0C	USBC	CC_STATUS0	S
USBC	0x0D	USBC	CC_STATUS1	S
USBC	0x0E	USBC	PD_STATUS0	S
USBC	0x0F	USBC	PD_STATUS1	S
USBC	0x10	USBC	UIC_INT_M	O
USBC	0x11	USBC	CC_INT_M	O
USBC	0x12	USBC	PD_INT_M	O
USBC	0x13	USBC	ACTION_INT_M	O
USBC	0x21	USBC	AP_DATAOUT0	O
USBC	0x22	USBC	AP_DATAOUT1	O
USBC	0x23	USBC	AP_DATAOUT2	O
USBC	0x24	USBC	AP_DATAOUT3	O
USBC	0x25	USBC	AP_DATAOUT4	O
USBC	0x26	USBC	AP_DATAOUT5	O
USBC	0x27	USBC	AP_DATAOUT6	O
USBC	0x28	USBC	AP_DATAOUT7	O

USBC	0x29	USBC	AP_DATAOUT8	O
USBC	0x2A	USBC	AP_DATAOUT9	O
USBC	0x2B	USBC	AP_DATAOUT10	O
USBC	0x2C	USBC	AP_DATAOUT11	O
USBC	0x2D	USBC	AP_DATAOUT12	O
USBC	0x2E	USBC	AP_DATAOUT13	O
USBC	0x2F	USBC	AP_DATAOUT14	O
USBC	0x30	USBC	AP_DATAOUT15	O
USBC	0x31	USBC	AP_DATAOUT16	O
USBC	0x32	USBC	AP_DATAOUT17	O
USBC	0x33	USBC	AP_DATAOUT18	O
USBC	0x34	USBC	AP_DATAOUT19	O
USBC	0x35	USBC	AP_DATAOUT20	O
USBC	0x36	USBC	AP_DATAOUT21	O
USBC	0x37	USBC	AP_DATAOUT22	O
USBC	0x38	USBC	AP_DATAOUT23	O
USBC	0x39	USBC	AP_DATAOUT24	O
USBC	0x3A	USBC	AP_DATAOUT25	O
USBC	0x3B	USBC	AP_DATAOUT26	O
USBC	0x3C	USBC	AP_DATAOUT27	O
USBC	0x3D	USBC	AP_DATAOUT28	O
USBC	0x3E	USBC	AP_DATAOUT29	O
USBC	0x3F	USBC	AP_DATAOUT30	O
USBC	0x40	USBC	AP_DATAOUT31	O
USBC	0x41	USBC	AP_DATAOUT32	O
USBC	0x51	USBC	AP_DATAIN0	S
USBC	0x52	USBC	AP_DATAIN1	S
USBC	0x53	USBC	AP_DATAIN2	S
USBC	0x54	USBC	AP_DATAIN3	S
USBC	0x55	USBC	AP_DATAIN4	S
USBC	0x56	USBC	AP_DATAIN5	S
USBC	0x57	USBC	AP_DATAIN6	S
USBC	0x58	USBC	AP_DATAIN7	S
USBC	0x59	USBC	AP_DATAIN8	S
USBC	0x5A	USBC	AP_DATAIN9	S
USBC	0x5B	USBC	AP_DATAIN10	S
USBC	0x5C	USBC	AP_DATAIN11	S
USBC	0x5D	USBC	AP_DATAIN12	S
USBC	0x5E	USBC	AP_DATAIN13	S
USBC	0x5F	USBC	AP_DATAIN14	S
USBC	0x60	USBC	AP_DATAIN15	S
USBC	0x61	USBC	AP_DATAIN16	S
USBC	0x62	USBC	AP_DATAIN17	S

USBC	0x63	USBC	AP_DATAIN18	S
USBC	0x64	USBC	AP_DATAIN19	S
USBC	0x65	USBC	AP_DATAIN20	S
USBC	0x66	USBC	AP_DATAIN21	S
USBC	0x67	USBC	AP_DATAIN22	S
USBC	0x68	USBC	AP_DATAIN23	S
USBC	0x69	USBC	AP_DATAIN24	S
USBC	0x6A	USBC	AP_DATAIN25	S
USBC	0x6B	USBC	AP_DATAIN26	S
USBC	0x6C	USBC	AP_DATAIN27	S
USBC	0x6D	USBC	AP_DATAIN28	S
USBC	0x6E	USBC	AP_DATAIN29	S
USBC	0x6F	USBC	AP_DATAIN30	S
USBC	0x70	USBC	AP_DATAIN31	S
USBC	0x71	USBC	AP_DATAIN32	S
USBC	0x80	USBC	SW_RESET	S

ADDRESS	NAME	MSB								LSB
<b>USBC_FUNC</b>										
0x00	<a href="#">DEVICE_ID[7:0]</a>	DeviceId[7:0]								
0x01	<a href="#">DEVICE_REV[7:0]</a>	DeviceRev[7:0]								
0x02	<a href="#">FW_REV[7:0]</a>	FwRev[7:0]								
0x03	<a href="#">FW_SUB_VER[7:0]</a>	FwSubRev[7:0]								
0x04	<a href="#">UIC_INT[7:0]</a>	APCmdResl	SYSMsgl	VBUSDe tl	VbADCI	DCDTmo l	StopMod el	ChgTypI	Attached HoldI	
0x05	<a href="#">CC_INT[7:0]</a>	VCONN OCPI	VSAFE0 VI	DetAbrtl	Wtrl	CCPinStatl	CCISatI	CCVcnStatl	CCStatI	
0x06	<a href="#">PD_INT[7:0]</a>	PDMsgl	PSRDYI	DataRole I	RSVD	RSVD	DisplayPortI	-	-	
0x07	<a href="#">ACTION_INT[7:0]</a>	-	-	-	-	ExtendedActionI	Action2I	Action1I	Action0I	
0x08	<a href="#">USBC_STATUS1[7:0]</a>	VbADC[4:0]					RSVD[2:0]			
0x09	<a href="#">USBC_STATUS2[7:0]</a>	SYSMsg[7:0]								
0x0A	<a href="#">BC_STATUS[7:0]</a>	VBUSDet	RSVD	PrChgTyp[2:0]			DCDTmo	ChgTyp[1:0]		
0x0B	<a href="#">DP_STATUS[7:0]</a>	DP_Exit Mode	DP_Atten tion	DP_Conf igure	DP_Stat us	DP_Ente rMode	DP_Disc overMod e	DP_Disc overSVI D	DP_Disc overIdent ity	
0x0C	<a href="#">CC_STATUS0[7:0]</a>	CCPinStat[1:0]		CCISat[1:0]		CCVcnStat	CCStat[2:0]			
0x0D	<a href="#">CC_STATUS1[7:0]</a>	RSVD[1:0]		VCONN OCP	VCONN S C	VSafeOV	DetAbrt	Wtr	RSVD	
0x0E	<a href="#">PD_STATUS0[7:0]</a>	PDMsg[7:0]								
0x0F	<a href="#">PD_STATUS1[7:0]</a>	DataRole	PowerRole	VCONN S	PSRDY	-	-	-	-	
0x10	<a href="#">UIC_INT_M[7:0]</a>	APCmdResM	SYSMsg M	VBUSDe tM	VbADCM	DCDTmo M	StopMod eM	ChgTyp M	Attached HoldM	

ADDRESS	NAME	MSB							LSB
0x11	<a href="#">CC_INT_M[7:0]</a>	VCONN OCPM	VSAFE0 VM	DetAbrt M	WtrM	CCPinSt atM	CCIStat M	CCVcnSt atM	CCStatM
0x12	<a href="#">PD_INT_M[7:0]</a>	PDMsgM	PSRDY M	DataRole M	RSVD	RSVD	DisplayP ortM	-	-
0x13	<a href="#">ACTION_INT_M[7:0]</a>	RSVD[3:0]				Extende dActionM	Action2M	Action1M	Action0M
0x21	<a href="#">AP_DATAOUT0[7:0]</a>	AP_REQUEST_OPCODE[7:0]							
0x22	<a href="#">AP_DATAOUT1[7:0]</a>	OPCODE_DATAOUT_01[7:0]							
0x23	<a href="#">AP_DATAOUT2[7:0]</a>	OPCODE_DATAOUT_02[7:0]							
0x24	<a href="#">AP_DATAOUT3[7:0]</a>	OPCODE_DATAOUT_03[7:0]							
0x25	<a href="#">AP_DATAOUT4[7:0]</a>	OPCODE_DATAOUT_04[7:0]							
0x26	<a href="#">AP_DATAOUT5[7:0]</a>	OPCODE_DATAOUT_05[7:0]							
0x27	<a href="#">AP_DATAOUT6[7:0]</a>	OPCODE_DATAOUT_06[7:0]							
0x28	<a href="#">AP_DATAOUT7[7:0]</a>	OPCODE_DATAOUT_07[7:0]							
0x29	<a href="#">AP_DATAOUT8[7:0]</a>	OPCODE_DATAOUT_08[7:0]							
0x2A	<a href="#">AP_DATAOUT9[7:0]</a>	OPCODE_DATAOUT_09[7:0]							
0x2B	<a href="#">AP_DATAOUT10[7:0]</a>	OPCODE_DATAOUT_10[7:0]							
0x2C	<a href="#">AP_DATAOUT11[7:0]</a>	OPCODE_DATAOUT_11[7:0]							
0x2D	<a href="#">AP_DATAOUT12[7:0]</a>	OPCODE_DATAOUT_12[7:0]							
0x2E	<a href="#">AP_DATAOUT13[7:0]</a>	OPCODE_DATAOUT_13[7:0]							
0x2F	<a href="#">AP_DATAOUT14[7:0]</a>	OPCODE_DATAOUT_14[7:0]							
0x30	<a href="#">AP_DATAOUT15[7:0]</a>	OPCODE_DATAOUT_15[7:0]							
0x31	<a href="#">AP_DATAOUT16[7:0]</a>	OPCODE_DATAOUT_16[7:0]							
0x32	<a href="#">AP_DATAOUT17[7:0]</a>	OPCODE_DATAOUT_17[7:0]							
0x33	<a href="#">AP_DATAOUT18[7:0]</a>	OPCODE_DATAOUT_18[7:0]							
0x34	<a href="#">AP_DATAOUT19[7:0]</a>	OPCODE_DATAOUT_19[7:0]							
0x35	<a href="#">AP_DATAOUT20[7:0]</a>	OPCODE_DATAOUT_20[7:0]							
0x36	<a href="#">AP_DATAOUT21[7:0]</a>	OPCODE_DATAOUT_21[7:0]							
0x37	<a href="#">AP_DATAOUT22[7:0]</a>	OPCODE_DATAOUT_22[7:0]							
0x38	<a href="#">AP_DATAOUT23[7:0]</a>	OPCODE_DATAOUT_23[7:0]							
0x39	<a href="#">AP_DATAOUT24[7:0]</a>	OPCODE_DATAOUT_24[7:0]							
0x3A	<a href="#">AP_DATAOUT25[7:0]</a>	OPCODE_DATAOUT_25[7:0]							
0x3B	<a href="#">AP_DATAOUT26[7:0]</a>	OPCODE_DATAOUT_26[7:0]							
0x3C	<a href="#">AP_DATAOUT27[7:0]</a>	OPCODE_DATAOUT_27[7:0]							
0x3D	<a href="#">AP_DATAOUT28[7:0]</a>	OPCODE_DATAOUT_28[7:0]							
0x3E	<a href="#">AP_DATAOUT29[7:0]</a>	OPCODE_DATAOUT_29[7:0]							
0x3F	<a href="#">AP_DATAOUT30[7:0]</a>	OPCODE_DATAOUT_30[7:0]							
0x40	<a href="#">AP_DATAOUT31[7:0]</a>	OPCODE_DATAOUT_31[7:0]							
0x41	<a href="#">AP_DATAOUT32[7:0]</a>	OPCODE_DATAOUT_32[7:0]							
0x51	<a href="#">AP_DATAIN0[7:0]</a>	USBC_RESPONSE_OPCODE[7:0]							
0x52	<a href="#">AP_DATAIN1[7:0]</a>	OPCODE_DATAIN_01[7:0]							
0x53	<a href="#">AP_DATAIN2[7:0]</a>	OPCODE_DATAIN_02[7:0]							
0x54	<a href="#">AP_DATAIN3[7:0]</a>	OPCODE_DATAIN_03[7:0]							

ADDRESS	NAME	MSB						LSB
0x55	<a href="#">AP_DATAIN4[7:0]</a>							OPCODE_DATAIN_04[7:0]
0x56	<a href="#">AP_DATAIN5[7:0]</a>							OPCODE_DATAIN_05[7:0]
0x57	<a href="#">AP_DATAIN6[7:0]</a>							OPCODE_DATAIN_06[7:0]
0x58	<a href="#">AP_DATAIN7[7:0]</a>							OPCODE_DATAIN_07[7:0]
0x59	<a href="#">AP_DATAIN8[7:0]</a>							OPCODE_DATAIN_08[7:0]
0x5A	<a href="#">AP_DATAIN9[7:0]</a>							OPCODE_DATAIN_09[7:0]
0x5B	<a href="#">AP_DATAIN10[7:0]</a>							OPCODE_DATAIN_10[7:0]
0x5C	<a href="#">AP_DATAIN11[7:0]</a>							OPCODE_DATAIN_11[7:0]
0x5D	<a href="#">AP_DATAIN12[7:0]</a>							OPCODE_DATAIN_12[7:0]
0x5E	<a href="#">AP_DATAIN13[7:0]</a>							OPCODE_DATAIN_13[7:0]
0x5F	<a href="#">AP_DATAIN14[7:0]</a>							OPCODE_DATAIN_14[7:0]
0x60	<a href="#">AP_DATAIN15[7:0]</a>							OPCODE_DATAIN_15[7:0]
0x61	<a href="#">AP_DATAIN16[7:0]</a>							OPCODE_DATAIN_16[7:0]
0x62	<a href="#">AP_DATAIN17[7:0]</a>							OPCODE_DATAIN_17[7:0]
0x63	<a href="#">AP_DATAIN18[7:0]</a>							OPCODE_DATAIN_18[7:0]
0x64	<a href="#">AP_DATAIN19[7:0]</a>							OPCODE_DATAIN_19[7:0]
0x65	<a href="#">AP_DATAIN20[7:0]</a>							OPCODE_DATAIN_20[7:0]
0x66	<a href="#">AP_DATAIN21[7:0]</a>							OPCODE_DATAIN_21[7:0]
0x67	<a href="#">AP_DATAIN22[7:0]</a>							OPCODE_DATAIN_22[7:0]
0x68	<a href="#">AP_DATAIN23[7:0]</a>							OPCODE_DATAIN_23[7:0]
0x69	<a href="#">AP_DATAIN24[7:0]</a>							OPCODE_DATAIN_24[7:0]
0x6A	<a href="#">AP_DATAIN25[7:0]</a>							OPCODE_DATAIN_25[7:0]
0x6B	<a href="#">AP_DATAIN26[7:0]</a>							OPCODE_DATAIN_26[7:0]
0x6C	<a href="#">AP_DATAIN27[7:0]</a>							OPCODE_DATAIN_27[7:0]
0x6D	<a href="#">AP_DATAIN28[7:0]</a>							OPCODE_DATAIN_28[7:0]
0x6E	<a href="#">AP_DATAIN29[7:0]</a>							OPCODE_DATAIN_29[7:0]
0x6F	<a href="#">AP_DATAIN30[7:0]</a>							OPCODE_DATAIN_30[7:0]
0x70	<a href="#">AP_DATAIN31[7:0]</a>							OPCODE_DATAIN_31[7:0]
0x71	<a href="#">AP_DATAIN32[7:0]</a>							OPCODE_DATAIN_32[7:0]
0x80	<a href="#">SW_RESET[7:0]</a>							UIC_SWRST[7:0]
<b>I2C_FUNC</b>								
0xE0	<a href="#">I2C_CNFG[7:0]</a>	RSVD		PAIR[2:0]		RSVD[2:0]		HS_EXT_EN

## Register Details

### [DEVICE\\_ID \(0x0\)](#)

BIT	7	6	5	4	3	2	1	0
Field	DeviceId[7:0]							
Reset	0x58							
Access Type	Read Only							

BITFIELD	BITS	DESCRIPTION	DECODE
DeviceId	7:0	Device ID	0x00: Reserved 0x01: Reserved 0x58: MAX77958

**DEVICE\_REV (0x1)**

BIT	7	6	5	4	3	2	1	0
Field	DeviceRev[7:0]							
Reset	0x02							
Access Type	Read Only							

BITFIELD	BITS	DESCRIPTION	DECODE
DeviceRev	7:0	FW Revision	0x01: Initial release 0x02: Second release

**FW\_REV (0x2)**

BIT	7	6	5	4	3	2	1	0
Field	FwRev[7:0]							
Reset	0x00							
Access Type	Read Only							

BITFIELD	BITS	DESCRIPTION	DECODE
FwRev	7:0	FW Revision	0x00: Initial release 0x01: Second release

**FW\_SUB\_VER (0x3)**

BIT	7	6	5	4	3	2	1	0
Field	FwSubRev[7:0]							
Reset	0x00							
Access Type	Read Only							

BITFIELD	BITS	DESCRIPTION	DECODE
FwSubRev	7:0	FW Revision	0x00: Initial release 0x01: Second release

**UIC\_INT (0x4)**

BIT	7	6	5	4	3	2	1	0
Field	APCmdResl	SYSMsgI	VBUSDetI	VbADCI	DCDtmol	StopModel	ChgTypI	AttachedHoldI
Reset	0b0	0b0	0b0	0b0	0b0	0b0	0b0	0b0
Access Type	Read Clears All	Read Clears All	Read Clears All	Read Clears All	Read Clears All	Read Clears All	Read Clears All	Read Clears All



BITFIELD	BITS	DESCRIPTION	DECODE
APCmdResl	7	AP Command Response Interrupt	0b0: No interrupt. 0b1: AP command response pending.
SYSMsgl	6	USBC System Message Interrupt	0b0: No interrupt. 0b1: USBC system message pending.
VBUSDetl	5	V <sub>BUS</sub> Detection Interrupt	0b0: No interrupt. 0b1: New V <sub>BUS</sub> Det status interrupt.
VbADCI	4	V <sub>BUS</sub> Voltage ADC Interrupt	0b0: No interrupt. 0b1: New VbADC status interrupt.
DCDTmol	3	DCD Timer Interrupt	0b0: No interrupt. 0b1: New DCDTmo status interrupt.
StopModel	2	Stop Mode Interrupt	0b0: No interrupt. 0b1: New stop mode status interrupt.
ChgTypI	1	Charger Type Interrupt	0b0: No interrupt. 0b1: New ChgTyp status interrupt.
AttachedHoldI	0	Attached Hold Interrupt	0b0: No interrupt. 0b1: New attached hold status interrupt.

**CC\_INT (0x5)**

BIT	7	6	5	4	3	2	1	0
Field	VCONNOCPI	VSAFE0VI	DetAbrtl	Wtrl	CCPinStatl	CCISatl	CCVcnStatl	CCStatl
Reset	0b0	0b0	0b0	0b0	0b0	0b0	0b0	0b0
Access Type	Read Clears All	Read Clears All	Read Clears All	Read Clears All	Read Clears All	Read Clears All	Read Clears All	Read Clears All

BITFIELD	BITS	DESCRIPTION	DECODE
VCONNOCPI	7	V <sub>CONN</sub> OCP Interrupt	0b0: No interrupt. 0b1: New V <sub>CONN</sub> OCP status interrupt.
VSAFE0VI	6	VSAFE0V Interrupt	0b0: No interrupt. 0b1: New VSAFE0V status interrupt.
DetAbrtl	5	CC Detection Abort Interrupt	0b0: No interrupt. 0b1: New CC detection abort interrupt.
Wtrl	4	Moisture/Dry Interrupt	0b0: No interrupt. 0b1: New moisture/dry status interrupt.
CCPinStatl	3	CC Pin State Interrupt	0b0: No interrupt. 0b1: New CCPinStat status interrupt.
CCISatl	2	CCISat Interrupt	0b0: No interrupt. 0b1: New CCISat status interrupt.
CCVcnStatl	1	CCVcnStat Interrupt	0b0: No interrupt. 0b1: New CCVcnStat status interrupt.
CCStatl	0	CCStat Interrupt	0b0: No interrupt. 0b1: New CCStat status interrupt.

PD\_INT (0x6)

BIT	7	6	5	4	3	2	1	0
Field	PDMsgI	PSRDYI	DataRoleI	RSVD	RSVD	DisplayPortI	–	–
Reset	0b0	0b0	0b0	0b0	0b0	0x0	–	–
Access Type	Read Clears All	Read Clears All	Read Clears All	Read Only	Read Only	Read Clears All	–	–

BITFIELD	BITS	DESCRIPTION	DECODE
PDMsgI	7	PD Message Interrupt	0b0: No interrupt. 0b1: New PD message issued.
PSRDYI	6	PSRDY Interrupt	0b0: No interrupt. 0b1: New PSRDY message issued.
DataRoleI	5	Data Role Change Interrupt	0b0: No interrupt. 0b1: DataRole status is changed.
RSVD	4	Spare	
RSVD	3	Spare	
DisplayPortI	2	Display Port Interrupt	0x0: No interrupt. 0x1: New DisplayPort status update interrupt.

ACTION\_INT (0x7)

BIT	7	6	5	4	3	2	1	0
Field	–	–	–	–	ExtendedActionI	Action2I	Action1I	Action0I
Reset	–	–	–	–	0b0	0b0	0b0	0b0
Access Type	–	–	–	–	Read Clears All	Read Clears All	Read Clears All	Read Clears All

BITFIELD	BITS	DESCRIPTION	DECODE
ExtendedActionI	3	Extended Action Table Interrupt	0b0: No interrupt. 0b1: Extended action table interrupt.
Action2I	2	Action Table Interrupt 2	0b0: No interrupt. 0b1: Action table set interrupt 2.
Action1I	1	Action Table Interrupt 1	0b0: No interrupt 0b1: Action table set interrupt 1.
Action0I	0	Action Table Interrupt 0	0b0: No interrupt. 0b1: Action table set interrupt 0.

USBC\_STATUS1 (0x8)

BIT	7	6	5	4	3	2	1	0
Field	VbADC[4:0]					RSVD[2:0]		
Reset	0x0					0b111		
Access Type	Read Only					Read Only		

BITFIELD	BITS	DESCRIPTION	DECODE
VbADC	7:3	Indicates Value on V <sub>BUS</sub> Input	0x00: V <sub>BUS</sub> < 3.5V 0x01: 3.5V ≤ V <sub>BUS</sub> < 4.5V 0x02: 4.5V ≤ V <sub>BUS</sub> < 5.5V 0x03: 5.5V ≤ V <sub>BUS</sub> < 6.5V 0x04: 6.5V ≤ V <sub>BUS</sub> < 7.5V 0x05: 7.5V ≤ V <sub>BUS</sub> < 8.5V 0x06: 8.5V ≤ V <sub>BUS</sub> < 9.5V 0x07: 9.5V ≤ V <sub>BUS</sub> < 10.5V 0x08: 10.5V ≤ V <sub>BUS</sub> < 11.5V 0x09: 11.5V ≤ V <sub>BUS</sub> < 12.5V 0x0A: 12.5V ≤ V <sub>BUS</sub> < 13.5V 0x0B: 13.5V ≤ V <sub>BUS</sub> < 14.5V 0x0C: 14.5V ≤ V <sub>BUS</sub> < 15.5V 0x0D: 15.5V ≤ V <sub>BUS</sub> < 16.5V 0x0E: 16.5V ≤ V <sub>BUS</sub> < 17.5V 0x0F: 17.5V ≤ V <sub>BUS</sub> < 18.5V 0x10: 18.5V ≤ V <sub>BUS</sub> < 19.5V 0x11: 19.5V ≤ V <sub>BUS</sub> < 20.5V 0x12: 20.5V ≤ V <sub>BUS</sub> < 21.5V 0x13: 21.5V ≤ V <sub>BUS</sub> < 22.5V 0x14: 22.5V ≤ V <sub>BUS</sub> < 23.5V 0x15: 23.5V ≤ V <sub>BUS</sub> < 24.5V 0x16: 24.5V ≤ V <sub>BUS</sub> < 25.5V 0x17: 25.5V ≤ V <sub>BUS</sub> < 26.5V 0x18: 26.5V ≤ V <sub>BUS</sub> < 27.5V 0x19: 27.5V ≤ V <sub>BUS</sub> 0x1A: RSVD
RSVD	2:0		

**USBC\_STATUS2 (0x9)**

BIT	7	6	5	4	3	2	1	0
Field	SYSMsg[7:0]							
Reset	0x00							
Access Type	Read Only							

BITFIELD	BITS	DESCRIPTION	DECODE
SYSMsg	7:0	SYSMsg	0x00: SYSERROR_NONE 0x01: Reserved 0x02: Reserved 0x03: SYSERROR_BOOT_WDT 0x04: SYSERROR_BOOT_SWRSTREQ 0x05: SYSMSG_BOOT_POR 0x10: SYSERROR_HV_NOVBUS 0x11: SYSERROR_HV_FMETHOD_RXPERR 0x12: SYSERROR_HV_FMETHOD_RXBUFOW 0x13: SYSERROR_HV_FMETHOD_RXTFR 0x14: SYSERROR_HV_FMETHOD_MPNAK 0x15: SYSERROR_HV_FMETHOD_RESET_FAIL 0x20: SYSMSG_AFC_Done 0x30: SYSERROR_SYSPOS 0x31: SYSERROR_APCMD_UNKNOWN 0x32: SYSERROR_APCMD_INPROGRESS 0x33: SYSERROR_APCMD_FAIL

**BC\_STATUS (0xA)**

BIT	7	6	5	4	3	2	1	0
Field	V <sub>BUS</sub> Det	RSVD	PrChgTyp[2:0]			DCDTmo	ChgTyp[1:0]	
Reset	0b0	0b0	0b000			0b0	0b00	
Access Type	Read Only	Read Only	Read Only			Read Only	Read Only	

BITFIELD	BITS	DESCRIPTION	DECODE
V <sub>BUS</sub> Det	7	Status of V <sub>BUS</sub> Detection	0b0: V <sub>BUS</sub> < V <sub>BDET</sub> 0b1: V <sub>BUS</sub> > V <sub>BDET</sub>
RSVD	6	Spare	
PrChgTyp	5:3	Output of Proprietary Charger Detection	0b000: Unknown 0b001: RSVD 0b010: RSVD 0b011: RSVD 0b100: RSVD 0b101: RSVD 0b110: 3A DCP (If enabled AND chgTyp=DCP) 0b111: Nikon TA (If enabled AND chgTyp=SDP)
DCDTmo	2	During Charger Detection, DCD Detection Timed Out. Indicates D+/D- are open. BC1.2 detection continues as required by BC1.2 specification but SDP most likely is found.	0b0: No timeout or detection has not run. 0b1: DCD timeout occurred.
ChgTyp	1:0	Output of Charger Detection	0b00: Nothing attached. 0b01: SDP, USB cable attached. 0b10: CDP, Charging Downstream Port: current depends on USB operating speed. 0b11: DCP, Dedicated Charger: current up to 1.5A.

**DP\_STATUS (0xB)**

BIT	7	6	5	4	3	2	1	0
Field	DP_ExitMode	DP_Attention	DP_Configure	DP_Status	DP_EnterMode	DP_DiscoverMode	DP_DiscoverSVID	DP_DiscoverIdentity
Reset	0b0	0b0	0b0	0b000	0b0	0b0	0b0	0x00
Access Type	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only

BITFIELD	BITS	DESCRIPTION	DECODE
DP_ExitMode	7	Display Port Exit Mode	0b0: No interrupt. 0b1: DisplayPort Exit mode message.
DP_Attention	6	Display port Attention Message	0b0: No interrupt. 0b1: DisplayPort Attention message.
DP_Configure	5	Display port Configure message	0b0: No interrupt. 0b1: DisplayPort Configure message.
DP_Status	4	Display Port Status message	0b0: No interrupt. 0b1: DisplayPort Status message.
DP_EnterMode	3	Display Port Enter Mode	0b0: No interrupt 0b1: DisplayPort Enter mode message.
DP_DiscoverMode	2	Display Port Discover Mode	0b0: No interrupt 0b1: DisplayPort Discover mode message.

BITFIELD	BITS	DESCRIPTION	DECODE
DP_Discover SVID	1	Display Port Discover SVID	0b0: No interrupt 0b1: DisplayPort Discover SVID message.
DP_Discover Identity	0	Display Port Discover Identity	0b0: No interrupt. 0b1: DisplayPort Discovers Identity message.

**CC\_STATUS0 (0xC)**

BIT	7	6	5	4	3	2	1	0
Field	CCPinStat[1:0]		CCStat[1:0]		CCVcnStat	CCStat[2:0]		
Reset	0b00		0b00		0b0	0b000		
Access Type	Read Only		Read Only		Read Only	Read Only		

BITFIELD	BITS	DESCRIPTION	DECODE
CCPinStat	7:6	Output of Active CC Pin	0b00: No determination 0b01: CC1 Active 0b10: CC2 Active 0b11: RFU
CCStat	5:4	CC Pin Detected and Allows V <sub>BUS</sub> Current in UFP Mode	0b00: Not in UFP mode 0b01: 500mA 0b10: 1.5A 0b11: 3.0A
CCVcnStat	3	Status of V <sub>CONN</sub> Output	0b0: V <sub>CONN</sub> disabled 0b1: V <sub>CONN</sub> enabled
CCStat	2:0	CC Pin State Machine Detection	0b000: No connection 0b001: SINK 0b010: SOURCE 0b011: Audio accessory 0b100: DebugSrc accessory 0b101: Error 0b110: Disabled 0b111: DebugSnk accessory

**CC\_STATUS1 (0xD)**

BIT	7	6	5	4	3	2	1	0
Field	RSVD[1:0]		V <sub>CONN</sub> OCP	V <sub>CONN</sub> SC	VSafeOV	DetAbrt	Wtr	RSVD
Reset	0b00		0b0	0b0	0b0	0b0	0b0	0b0
Access Type	Read Only		Read Only	Read Only	Read Only	Read Only	Read Only	Read Only

BITFIELD	BITS	DESCRIPTION	DECODE
RSVD	7:6	Spare	
V <sub>CONN</sub> OCP	5	V <sub>CONN</sub> Overcurrent Detection	0b0: V <sub>CONN</sub> current < V <sub>CONN_ILIM</sub> 0b1: V <sub>CONN</sub> current > V <sub>CONN_ILIM</sub>
V <sub>CONN</sub> SC	4	V <sub>CONN</sub> Short-Circuit Detection	0b0: V <sub>CONN</sub> current < V <sub>CONN_SC</sub> 0b1: V <sub>CONN</sub> current > V <sub>CONN_SC</sub>
VSafeOV	3	Status of V <sub>BUS</sub> Detection. Valid only in Attached.SRC_CCx, Attached.SNK_CCx state.	0b0: V <sub>BUS</sub> < V <sub>SAFE0V</sub> 0b1: V <sub>BUS</sub> > V <sub>SAFE0V</sub>

BITFIELD	BITS	DESCRIPTION	DECODE
DetAbt	2	Charger Detection Abort Status	0b0: Charger detection runs if CHGDetEn = 1 and V <sub>BUS</sub> is valid for the debounce time. 0b1: Charger detection is aborted by USB Type-C State Machine. Charger does not run if CHGDetEn = 1 and V <sub>BUS</sub> is valid for the debounce time. CHGDetMan allows manual run of charger detection. If charger detection is in progress, DetAbt = 1 immediately stops the in progress detection.
Wtr	1	Moisture/Dry Status	0x0: Dry 0x1: Moisture
RSVD	0	Spare	

**PD\_STATUS0 (0xE)**

BIT	7	6	5	4	3	2	1	0
Field	PDMsg[7:0]							
Reset	0x00							
Access Type	Read Only							

BITFIELD	BITS	DESCRIPTION	DECODE
PDMsg	7:0	PD Message	0x00: Nothing happened 0x01: Sink_PD_PSRdy_Received 0x02: Sink_PD_Error_Recovery 0x03: Sink_PD_SenderResponseTimer_Timeout 0x04: Source_PSRdy_Sent 0x05: Source_PD_Error_Recovery 0x06: Source_PD_SenderResponseTimer_Timeout 0x07: PD_DR_Swap_Request_Received 0x08: PD_PR_Swap_Request_Received 0x09: PD_VCONN_Swap_Request_Received 0x11: VDM_Attention_Message_Received 0x0A: Received PD Message in illegal state 0x0B: Sink_PD_Evaluate_State_SrcCap_Received 0x11: VDM_Attention_Message_Received 0x12: Reject_Received 0x13: Not_Supported_Received 0x14: PD_PR_Swap_SNKTOSRC_Cleanup 0x15: PD_PR_Swap_SRCTOSNK_Cleanup 0x16: HardReset_Received 0x17: PD_PowerSupply_VbusEnable 0x18: PD_PowerSupply_VbusDisable 0x19: HardReset_Sent 0x1A: PD_PR_Swap_SRCTOSWAP 0x1B: PD_PR_Swap_SWAPTOSNK 0x1C: PD_PR_Swap_SNKTOSWAP 0x1D: PD_PR_Swap_SWAPTOSRC 0x20: Sink_PD_Disabled 0x21: Source_PD_Disabled 0x30: Get_Source_Capabilities_Extended_Received 0x31: Get_Status_Received 0x32: Get_Battery_Cap_Received 0x33: Get_Battery_Status_Received 0x34: Get_Manufacturer_Info_Received 0x35: Source_Capabilities_Extended_Received 0x36: Status_Received 0x37: Battery_Capabilities_Received 0x38: Battery_Status_Received 0x39: Manufacturer_Info_Received 0x3A: Security_Request_Received 0x3B: Security_Response_Received 0x3C: Firmware_Update_Request_Received 0x3D: Firmware_Update_Response_Received 0x3E: Alert_Received 0x40: VDM_NAK_Received 0x41: VDM_BUSY_Received 0x42: VDM_ACK_Received 0x43: VDM_REQ_Received 0x63: DiscoverMode_Received 0x65: PD_Status_Received

PD\_STATUS1 (0xF)

BIT	7	6	5	4	3	2	1	0
Field	DataRole	PowerRole	VCONNS	PSRDY	–	–	–	–
Reset	0b0	0b0	0b0	0b0	–	–	–	–
Access Type	Read Only	Read Only	Read Only	Read Only	–	–	–	–

BITFIELD	BITS	DESCRIPTION	DECODE
DataRole	7	Current Data Role	0b0: UFP 0b1: DFP
PowerRole	6	Power Role	0b0: Sink 0b1: Source
VCONNS	5	VCONNS	0b0: V <sub>CONN</sub> Sink 0b1: V <sub>CONN</sub> Source
PSRDY	4	PSRDY Received as Sink	0b0: Nothing happened 0b1: PSRDY received

UIC\_INT\_M (0x10)

BIT	7	6	5	4	3	2	1	0
Field	APCmdResM	SYSMsgM	VBUSDetM	VbADCM	DCDTmoM	StopModeM	ChgTypM	AttachedHoldM
Reset	0b1	0b0	0b1	0b1	0b1	0b1	0b1	0b1
Access Type	Write, Read	Write, Read	Write, Read	Write, Read	Write, Read	Write, Read	Write, Read	Write, Read

BITFIELD	BITS	DESCRIPTION	DECODE
APCmdResM	7	APCmdRes Interrupt Mask	0b0: Unmask 0b1: Mask
SYSMsgM	6	SYSMsg Interrupt Mask	0b0: Unmask 0b1: Mask
VBUSDetM	5	VBUSDet Interrupt Mask	0 = Unmask 1 = Mask
VbADCM	4	VbADC Interrupt Mask	0 = Unmask 1 = Mask
DCDTmoM	3	DCDTmo Interrupt Mask	0 = Unmask 1 = Mask
StopModeM	2	Fake V <sub>BUS</sub> Interrupt Mask	
ChgTypM	1	ChgTyp Interrupt Mask	0 = Unmask 1 = Mask
AttachedHoldM	0	UIDADC Interrupt Mask	0 = Unmask 1 = Mask



CC\_INT\_M (0x11)

BIT	7	6	5	4	3	2	1	0
Field	VCONNOCP PM	VSAFE0VM	DetAbrtM	WtrM	CCPinStatM	CCISatM	CCVcnStat M	CCStatM
Reset	0b1	0b1	0b1	0b1	0b1	0b1	0b1	0b1
Access Type	Write, Read	Write, Read	Write, Read	Write, Read	Write, Read	Write, Read	Write, Read	Write, Read

BITFIELD	BITS	DESCRIPTION	DECODE
VCONNOCP M	7	VCONNOCP Interrupt Mask	0b0: Unmask 0b1: Mask
VSAFE0VM	6	VSAFE0V Interrupt Mask	0b0: Unmask 0b1: Mask
DetAbrtM	5	DetAbrt Interrupt Mask	0b0: Unmask 0b1: Mask
WtrM	4	Wtr Interrupt Mask	0b0: Unmask 0b1: Mask
CCPinStatM	3	CCPinStat Interrupt Mask	0b0: Unmask 0b1: Mask
CCISatM	2	CCISat Interrupt Mask	0b0: Unmask 0b1: Mask
CCVcnStatM	1	CCVcnStat Interrupt Mask	0b0: Unmask 0b1: Mask
CCStatM	0	CCStat Interrupt Mask	0b0: Unmask 0b1: Mask

PD\_INT\_M (0x12)

BIT	7	6	5	4	3	2	1	0
Field	PDMsgM	PSRDYM	DataRoleM	RSVD	RSVD	DisplayPort M	–	–
Reset	0b1	0b1	0b1	0b1	0b1	0b1	–	–
Access Type	Write, Read	Write, Read	Write, Read	Write, Read	Write, Read	Write, Read	–	–

BITFIELD	BITS	DESCRIPTION	DECODE
PDMsgM	7	PDMsg Interrupt Mask	0b0: Unmask 0b1: Mask
PSRDYM	6	PDRDY Interrupt Mask	0b0: Unmask 0b1: Mask
DataRoleM	5	DataRole Interrupt Mask	0b0: Unmask 0b1: Mask
RSVD	4	Spare	0b0: Unmask 0b1: Mask
RSVD	3	Spare	0b0: Unmask 0b1: Mask
DisplayPortM	2	Display Port Interrupt Mask	0b0: Unmask 0b1: Mask

ACTION\_INT\_M (0x13)

BIT	7	6	5	4	3	2	1	0
Field	RSVD[3:0]				ExtendedActionM	Action2M	Action1M	Action0M
Reset	0xF				0b1	0b1	0b1	0b1
Access Type	Write, Read				Write, Read	Write, Read	Write, Read	Write, Read

BITFIELD	BITS	DESCRIPTION	DECODE
RSVD	7:4		
ExtendedActionM	3	Extended Action Table Interrupt Mask	0b0: Unmask 0b1: Mask
Action2M	2	Action Table Interrupt 2 Mask	0b0: Unmask 0b1: Mask
Action1M	1	Action Table Interrupt 1 Mask	0b0: Unmask 0b1: Mask
Action0M	0	Action Table Interrupt 0 Mask	0b0: Unmask 0b1: Mask

AP\_DATAOUT0 (0x21)

BIT	7	6	5	4	3	2	1	0
Field	AP_REQUEST_OPCODE[7:0]							
Reset	0x00							
Access Type	Write, Read							

BITFIELD	BITS	DESCRIPTION
AP_REQUEST_OPCODE	7:0	<p>All configuration and control commands to the USBC are sent and received as a packet using an opcode to identify the packet.</p> <p><b>A. Messages sent to the USBC</b></p> <ul style="list-style-type: none"> <li>• 0x21—Opcode sent to USBC.</li> <li>• 0x22 to 0x41—Message sent to USBC.</li> <li>• Message size can be as short as 1 byte (Opcode only) and up to 33 bytes (Opcode plus 32 bytes). But all messages must write to all bytes even if the rest of the message is stuffed with 0s.</li> <li>• Registers 0x21 to 0x41 act as a scratch pad for writing the message to the USBC. The message is latched in when a value is written to register 0x41.</li> <li>• All messages are acknowledged by the USBC by sending and generating an interrupt.</li> <li>• Data written to 0x21 to 0x41 is not auto cleared—the data remains in the registers until the application processor overwrites it with a new message.</li> </ul> <p><b>B. Messages received from USBC</b></p> <ul style="list-style-type: none"> <li>• 0x51—Opcode identifying the message type.</li> <li>• 0x52 to 0x71—Message sent to application processor.</li> <li>• Message size can be as short as 1 byte (Opcode only) and up to 33 bytes (Opcode plus 32 bytes).</li> <li>• Data written to 0x51 to 0x71 is not auto cleared—the data remains in the registers until the USBC overwrites them with a new message.</li> </ul>

AP\_DATAOUT1 (0x22)

BIT	7	6	5	4	3	2	1	0
Field	OPCODE_DATAOUT_01[7:0]							
Reset	0x00							
Access Type	Write, Read							

BITFIELD	BITS	DESCRIPTION
OPCODE_DATAOUT_0 1	7:0	

AP\_DATAOUT2 (0x23)

BIT	7	6	5	4	3	2	1	0
Field	OPCODE_DATAOUT_02[7:0]							
Reset	0x00							
Access Type	Write, Read							

BITFIELD	BITS	DESCRIPTION
OPCODE_DATAOUT_0 2	7:0	

AP\_DATAOUT3 (0x24)

BIT	7	6	5	4	3	2	1	0
Field	OPCODE_DATAOUT_03[7:0]							
Reset	0x00							
Access Type	Write, Read							

BITFIELD	BITS	DESCRIPTION
OPCODE_DATAOUT_0 3	7:0	

AP\_DATAOUT4 (0x25)

BIT	7	6	5	4	3	2	1	0
Field	OPCODE_DATAOUT_04[7:0]							
Reset	0x00							
Access Type	Write, Read							

BITFIELD	BITS	DESCRIPTION
OPCODE_DATAOUT_0 4	7:0	

**AP\_DATAOUT5 (0x26)**

BIT	7	6	5	4	3	2	1	0
Field	OPCODE_DATAOUT_05[7:0]							
Reset	0x00							
Access Type	Write, Read							

BITFIELD	BITS	DESCRIPTION
OPCODE_DATAOUT_05	7:0	

**AP\_DATAOUT6 (0x27)**

BIT	7	6	5	4	3	2	1	0
Field	OPCODE_DATAOUT_06[7:0]							
Reset	0x00							
Access Type	Write, Read							

BITFIELD	BITS	DESCRIPTION
OPCODE_DATAOUT_06	7:0	

**AP\_DATAOUT7 (0x28)**

BIT	7	6	5	4	3	2	1	0
Field	OPCODE_DATAOUT_07[7:0]							
Reset	0x00							
Access Type	Write, Read							

BITFIELD	BITS	DESCRIPTION
OPCODE_DATAOUT_07	7:0	

**AP\_DATAOUT8 (0x29)**

BIT	7	6	5	4	3	2	1	0
Field	OPCODE_DATAOUT_08[7:0]							
Reset	0x00							
Access Type	Write, Read							

BITFIELD	BITS	DESCRIPTION
OPCODE_DATAOUT_08	7:0	

AP\_DATAOUT9 (0x2A)

BIT	7	6	5	4	3	2	1	0
Field	OPCODE_DATAOUT_09[7:0]							
Reset	0x00							
Access Type	Write, Read							

BITFIELD	BITS	DESCRIPTION
OPCODE_DATAOUT_09	7:0	

AP\_DATAOUT10 (0x2B)

BIT	7	6	5	4	3	2	1	0
Field	OPCODE_DATAOUT_10[7:0]							
Reset	0x00							
Access Type	Write, Read							

BITFIELD	BITS	DESCRIPTION
OPCODE_DATAOUT_10	7:0	

AP\_DATAOUT11 (0x2C)

BIT	7	6	5	4	3	2	1	0
Field	OPCODE_DATAOUT_11[7:0]							
Reset	0x00							
Access Type	Write, Read							

BITFIELD	BITS	DESCRIPTION
OPCODE_DATAOUT_11	7:0	

AP\_DATAOUT12 (0x2D)

BIT	7	6	5	4	3	2	1	0
Field	OPCODE_DATAOUT_12[7:0]							
Reset	0x00							
Access Type	Write, Read							

BITFIELD	BITS	DESCRIPTION
OPCODE_DATAOUT_12	7:0	

**AP\_DATAOUT13 (0x2E)**

BIT	7	6	5	4	3	2	1	0
Field	OPCODE_DATAOUT_13[7:0]							
Reset	0x00							
Access Type	Write, Read							

BITFIELD	BITS	DESCRIPTION
OPCODE_DATAOUT_1 3	7:0	

**AP\_DATAOUT14 (0x2F)**

BIT	7	6	5	4	3	2	1	0
Field	OPCODE_DATAOUT_14[7:0]							
Reset	0x00							
Access Type	Write, Read							

BITFIELD	BITS	DESCRIPTION
OPCODE_DATAOUT_1 4	7:0	

**AP\_DATAOUT15 (0x30)**

BIT	7	6	5	4	3	2	1	0
Field	OPCODE_DATAOUT_15[7:0]							
Reset	0x00							
Access Type	Write, Read							

BITFIELD	BITS	DESCRIPTION
OPCODE_DATAOUT_1 5	7:0	

**AP\_DATAOUT16 (0x31)**

BIT	7	6	5	4	3	2	1	0
Field	OPCODE_DATAOUT_16[7:0]							
Reset	0x00							
Access Type	Write, Read							

BITFIELD	BITS	DESCRIPTION
OPCODE_DATAOUT_1 6	7:0	

AP\_DATAOUT17 (0x32)

BIT	7	6	5	4	3	2	1	0
Field	OPCODE_DATAOUT_17[7:0]							
Reset	0x00							
Access Type	Write, Read							

BITFIELD	BITS	DESCRIPTION
OPCODE_DATAOUT_1 7	7:0	

AP\_DATAOUT18 (0x33)

BIT	7	6	5	4	3	2	1	0
Field	OPCODE_DATAOUT_18[7:0]							
Reset	0x00							
Access Type	Write, Read							

BITFIELD	BITS	DESCRIPTION
OPCODE_DATAOUT_1 8	7:0	

AP\_DATAOUT19 (0x34)

BIT	7	6	5	4	3	2	1	0
Field	OPCODE_DATAOUT_19[7:0]							
Reset	0x00							
Access Type	Write, Read							

BITFIELD	BITS	DESCRIPTION
OPCODE_DATAOUT_1 9	7:0	

AP\_DATAOUT20 (0x35)

BIT	7	6	5	4	3	2	1	0
Field	OPCODE_DATAOUT_20[7:0]							
Reset	0x00							
Access Type	Write, Read							

BITFIELD	BITS	DESCRIPTION
OPCODE_DATAOUT_2 0	7:0	

**AP\_DATAOUT21 (0x36)**

<b>BIT</b>	<b>7</b>	<b>6</b>	<b>5</b>	<b>4</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>0</b>
<b>Field</b>	OPCODE_DATAOUT_21[7:0]							
<b>Reset</b>	0x00							
<b>Access Type</b>	Write, Read							
<b>BITFIELD</b>	<b>BITS</b>		<b>DESCRIPTION</b>					
OPCODE_DATAOUT_21	7:0							

**AP\_DATAOUT22 (0x37)**

<b>BIT</b>	<b>7</b>	<b>6</b>	<b>5</b>	<b>4</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>0</b>
<b>Field</b>	OPCODE_DATAOUT_22[7:0]							
<b>Reset</b>	0x00							
<b>Access Type</b>	Write, Read							
<b>BITFIELD</b>	<b>BITS</b>		<b>DESCRIPTION</b>					
OPCODE_DATAOUT_22	7:0							

**AP\_DATAOUT23 (0x38)**

<b>BIT</b>	<b>7</b>	<b>6</b>	<b>5</b>	<b>4</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>0</b>
<b>Field</b>	OPCODE_DATAOUT_23[7:0]							
<b>Reset</b>	0x00							
<b>Access Type</b>	Write, Read							
<b>BITFIELD</b>	<b>BITS</b>		<b>DESCRIPTION</b>					
OPCODE_DATAOUT_23	7:0							

**AP\_DATAOUT24 (0x39)**

<b>BIT</b>	<b>7</b>	<b>6</b>	<b>5</b>	<b>4</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>0</b>
<b>Field</b>	OPCODE_DATAOUT_24[7:0]							
<b>Reset</b>	0x00							
<b>Access Type</b>	Write, Read							
<b>BITFIELD</b>	<b>BITS</b>		<b>DESCRIPTION</b>					
OPCODE_DATAOUT_24	7:0							



**AP\_DATAOUT25 (0x3A)**

BIT	7	6	5	4	3	2	1	0
Field	OPCODE_DATAOUT_25[7:0]							
Reset	0x00							
Access Type	Write, Read							
BITFIELD	BITS		DESCRIPTION					
OPCODE_DATAOUT_25	7:0							

**AP\_DATAOUT26 (0x3B)**

BIT	7	6	5	4	3	2	1	0
Field	OPCODE_DATAOUT_26[7:0]							
Reset	0x00							
Access Type	Write, Read							
BITFIELD	BITS		DESCRIPTION					
OPCODE_DATAOUT_26	7:0							

**AP\_DATAOUT27 (0x3C)**

BIT	7	6	5	4	3	2	1	0
Field	OPCODE_DATAOUT_27[7:0]							
Reset	0x00							
Access Type	Write, Read							
BITFIELD	BITS		DESCRIPTION					
OPCODE_DATAOUT_27	7:0							

**AP\_DATAOUT28 (0x3D)**

BIT	7	6	5	4	3	2	1	0
Field	OPCODE_DATAOUT_28[7:0]							
Reset	0x00							
Access Type	Write, Read							
BITFIELD	BITS		DESCRIPTION					
OPCODE_DATAOUT_28	7:0							

AP\_DATAOUT29 (0x3E)

BIT	7	6	5	4	3	2	1	0
Field	OPCODE_DATAOUT_29[7:0]							
Reset	0x00							
Access Type	Write, Read							

BITFIELD	BITS	DESCRIPTION
OPCODE_DATAOUT_29	7:0	

AP\_DATAOUT30 (0x3F)

BIT	7	6	5	4	3	2	1	0
Field	OPCODE_DATAOUT_30[7:0]							
Reset	0x00							
Access Type	Write, Read							

BITFIELD	BITS	DESCRIPTION
OPCODE_DATAOUT_30	7:0	

AP\_DATAOUT31 (0x40)

BIT	7	6	5	4	3	2	1	0
Field	OPCODE_DATAOUT_31[7:0]							
Reset	0x00							
Access Type	Write, Read							

BITFIELD	BITS	DESCRIPTION
OPCODE_DATAOUT_31	7:0	

AP\_DATAOUT32 (0x41)

BIT	7	6	5	4	3	2	1	0
Field	OPCODE_DATAOUT_32[7:0]							
Reset	0x00							
Access Type	Write, Read							

BITFIELD	BITS	DESCRIPTION
OPCODE_DATAOUT_32	7:0	

**AP\_DATAIN0 (0x51)**

BIT	7	6	5	4	3	2	1	0
Field	USBC_RESPONSE_OPCODE[7:0]							
Reset	0x00							
Access Type	Read Only							

BITFIELD	BITS	DESCRIPTION
USBC_RESPONSE_OPCODE	7:0	

**AP\_DATAIN1 (0x52)**

BIT	7	6	5	4	3	2	1	0
Field	OPCODE_DATAIN_01[7:0]							
Reset	0x00							
Access Type	Read Only							

BITFIELD	BITS	DESCRIPTION
OPCODE_DATAIN_01	7:0	

**AP\_DATAIN2 (0x53)**

BIT	7	6	5	4	3	2	1	0
Field	OPCODE_DATAIN_02[7:0]							
Reset	0x00							
Access Type	Read Only							

BITFIELD	BITS	DESCRIPTION
OPCODE_DATAIN_02	7:0	

**AP\_DATAIN3 (0x54)**

BIT	7	6	5	4	3	2	1	0
Field	OPCODE_DATAIN_03[7:0]							
Reset	0x00							
Access Type	Read Only							

BITFIELD	BITS	DESCRIPTION
OPCODE_DATAIN_03	7:0	

AP\_DATAIN4 (0x55)

BIT	7	6	5	4	3	2	1	0
Field	OPCODE_DATAIN_04[7:0]							
Reset	0x00							
Access Type	Read Only							

BITFIELD	BITS	DESCRIPTION
OPCODE_DATAIN_04	7:0	

AP\_DATAIN5 (0x56)

BIT	7	6	5	4	3	2	1	0
Field	OPCODE_DATAIN_05[7:0]							
Reset	0x00							
Access Type	Read Only							

BITFIELD	BITS	DESCRIPTION
OPCODE_DATAIN_05	7:0	

AP\_DATAIN6 (0x57)

BIT	7	6	5	4	3	2	1	0
Field	OPCODE_DATAIN_06[7:0]							
Reset	0x00							
Access Type	Read Only							

BITFIELD	BITS	DESCRIPTION
OPCODE_DATAIN_06	7:0	

AP\_DATAIN7 (0x58)

BIT	7	6	5	4	3	2	1	0
Field	OPCODE_DATAIN_07[7:0]							
Reset	0x00							
Access Type	Read Only							

BITFIELD	BITS	DESCRIPTION
OPCODE_DATAIN_07	7:0	

**AP\_DATAIN8 (0x59)**

<b>BIT</b>	<b>7</b>	<b>6</b>	<b>5</b>	<b>4</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>0</b>
<b>Field</b>	OPCODE_DATAIN_08[7:0]							
<b>Reset</b>	0x00							
<b>Access Type</b>	Read Only							

<b>BITFIELD</b>	<b>BITS</b>	<b>DESCRIPTION</b>
OPCODE_DATAIN_08	7:0	

**AP\_DATAIN9 (0x5A)**

<b>BIT</b>	<b>7</b>	<b>6</b>	<b>5</b>	<b>4</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>0</b>
<b>Field</b>	OPCODE_DATAIN_09[7:0]							
<b>Reset</b>	0x00							
<b>Access Type</b>	Read Only							

<b>BITFIELD</b>	<b>BITS</b>	<b>DESCRIPTION</b>
OPCODE_DATAIN_09	7:0	

**AP\_DATAIN10 (0x5B)**

<b>BIT</b>	<b>7</b>	<b>6</b>	<b>5</b>	<b>4</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>0</b>
<b>Field</b>	OPCODE_DATAIN_10[7:0]							
<b>Reset</b>	0x00							
<b>Access Type</b>	Read Only							

<b>BITFIELD</b>	<b>BITS</b>	<b>DESCRIPTION</b>
OPCODE_DATAIN_10	7:0	

**AP\_DATAIN11 (0x5C)**

<b>BIT</b>	<b>7</b>	<b>6</b>	<b>5</b>	<b>4</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>0</b>
<b>Field</b>	OPCODE_DATAIN_11[7:0]							
<b>Reset</b>	0x00							
<b>Access Type</b>	Read Only							

<b>BITFIELD</b>	<b>BITS</b>	<b>DESCRIPTION</b>
OPCODE_DATAIN_11	7:0	

**AP\_DATAIN12 (0x5D)**

BIT	7	6	5	4	3	2	1	0
Field	OPCODE_DATAIN_12[7:0]							
Reset	0x00							
Access Type	Read Only							

BITFIELD	BITS	DESCRIPTION
OPCODE_DATAIN_12	7:0	

**AP\_DATAIN13 (0x5E)**

BIT	7	6	5	4	3	2	1	0
Field	OPCODE_DATAIN_13[7:0]							
Reset	0x00							
Access Type	Read Only							

BITFIELD	BITS	DESCRIPTION
OPCODE_DATAIN_13	7:0	

**AP\_DATAIN14 (0x5F)**

BIT	7	6	5	4	3	2	1	0
Field	OPCODE_DATAIN_14[7:0]							
Reset	0x00							
Access Type	Read Only							

BITFIELD	BITS	DESCRIPTION
OPCODE_DATAIN_14	7:0	

**AP\_DATAIN15 (0x60)**

BIT	7	6	5	4	3	2	1	0
Field	OPCODE_DATAIN_15[7:0]							
Reset	0x00							
Access Type	Read Only							

BITFIELD	BITS	DESCRIPTION
OPCODE_DATAIN_15	7:0	

**AP\_DATAIN16 (0x61)**

BIT	7	6	5	4	3	2	1	0
Field	OPCODE_DATAIN_16[7:0]							
Reset	0x00							
Access Type	Read Only							

BITFIELD	BITS	DESCRIPTION
OPCODE_DATAIN_16	7:0	

**AP\_DATAIN17 (0x62)**

BIT	7	6	5	4	3	2	1	0
Field	OPCODE_DATAIN_17[7:0]							
Reset	0x00							
Access Type	Read Only							

BITFIELD	BITS	DESCRIPTION
OPCODE_DATAIN_17	7:0	

**AP\_DATAIN18 (0x63)**

BIT	7	6	5	4	3	2	1	0
Field	OPCODE_DATAIN_18[7:0]							
Reset	0x00							
Access Type	Read Only							

BITFIELD	BITS	DESCRIPTION
OPCODE_DATAIN_18	7:0	

**AP\_DATAIN19 (0x64)**

BIT	7	6	5	4	3	2	1	0
Field	OPCODE_DATAIN_19[7:0]							
Reset	0x00							
Access Type	Read Only							

BITFIELD	BITS	DESCRIPTION
OPCODE_DATAIN_19	7:0	

AP\_DATAIN20 (0x65)

BIT	7	6	5	4	3	2	1	0
Field	OPCODE_DATAIN_20[7:0]							
Reset	0x00							
Access Type	Read Only							

BITFIELD	BITS	DESCRIPTION
OPCODE_DATAIN_20	7:0	

AP\_DATAIN21 (0x66)

BIT	7	6	5	4	3	2	1	0
Field	OPCODE_DATAIN_21[7:0]							
Reset	0x00							
Access Type	Read Only							

BITFIELD	BITS	DESCRIPTION
OPCODE_DATAIN_21	7:0	

AP\_DATAIN22 (0x67)

BIT	7	6	5	4	3	2	1	0
Field	OPCODE_DATAIN_22[7:0]							
Reset	0x00							
Access Type	Read Only							

BITFIELD	BITS	DESCRIPTION
OPCODE_DATAIN_22	7:0	

AP\_DATAIN23 (0x68)

BIT	7	6	5	4	3	2	1	0
Field	OPCODE_DATAIN_23[7:0]							
Reset	0x00							
Access Type	Read Only							

BITFIELD	BITS	DESCRIPTION
OPCODE_DATAIN_23	7:0	



AP\_DATAIN24 (0x69)

BIT	7	6	5	4	3	2	1	0
Field	OPCODE_DATAIN_24[7:0]							
Reset	0x00							
Access Type	Read Only							

BITFIELD	BITS	DESCRIPTION
OPCODE_DATAIN_24	7:0	

AP\_DATAIN25 (0x6A)

BIT	7	6	5	4	3	2	1	0
Field	OPCODE_DATAIN_25[7:0]							
Reset	0x00							
Access Type	Read Only							

BITFIELD	BITS	DESCRIPTION
OPCODE_DATAIN_25	7:0	

AP\_DATAIN26 (0x6B)

BIT	7	6	5	4	3	2	1	0
Field	OPCODE_DATAIN_26[7:0]							
Reset	0x00							
Access Type	Read Only							

BITFIELD	BITS	DESCRIPTION
OPCODE_DATAIN_26	7:0	

AP\_DATAIN27 (0x6C)

BIT	7	6	5	4	3	2	1	0
Field	OPCODE_DATAIN_27[7:0]							
Reset	0x00							
Access Type	Read Only							

BITFIELD	BITS	DESCRIPTION
OPCODE_DATAIN_27	7:0	

**AP\_DATAIN28 (0x6D)**

BIT	7	6	5	4	3	2	1	0
Field	OPCODE_DATAIN_28[7:0]							
Reset	0x00							
Access Type	Read Only							

BITFIELD	BITS	DESCRIPTION
OPCODE_DATAIN_28	7:0	

**AP\_DATAIN29 (0x6E)**

BIT	7	6	5	4	3	2	1	0
Field	OPCODE_DATAIN_29[7:0]							
Reset	0x00							
Access Type	Read Only							

BITFIELD	BITS	DESCRIPTION
OPCODE_DATAIN_29	7:0	

**AP\_DATAIN30 (0x6F)**

BIT	7	6	5	4	3	2	1	0
Field	OPCODE_DATAIN_30[7:0]							
Reset	0x00							
Access Type	Read Only							

BITFIELD	BITS	DESCRIPTION
OPCODE_DATAIN_30	7:0	

**AP\_DATAIN31 (0x70)**

BIT	7	6	5	4	3	2	1	0
Field	OPCODE_DATAIN_31[7:0]							
Reset	0x00							
Access Type	Read Only							

BITFIELD	BITS	DESCRIPTION
OPCODE_DATAIN_31	7:0	

AP\_DATAIN32 (0x71)

BIT	7	6	5	4	3	2	1	0
Field	OPCODE_DATAIN_32[7:0]							
Reset	0x00							
Access Type	Read Only							

BITFIELD	BITS	DESCRIPTION
OPCODE_DATAIN_32	7:0	

SW\_RESET (0x80)

BIT	7	6	5	4	3	2	1	0
Field	UIC_SWRST[7:0]							
Reset	0x00							
Access Type	Write, Read							

BITFIELD	BITS	DESCRIPTION	DECODE
UIC_SWRST	7:0	UIC (and MAXQ) Software Reset	When AP writes 0x0F, UIC is reset (registers and MAXQ).

I2C\_CNFG (0xE0)

Spare mask register.

BIT	7	6	5	4	3	2	1	0
Field	RSVD	PAIR[2:0]			RSVD[2:0]			HS_EXT_EN
Reset	0b0	0b000			0b000			0b0
Access Type	Write, Read	Write, Read			Write, Read			Write, Read

BITFIELD	BITS	DESCRIPTION	DECODE
RSVD	7	Spare	

BITFIELD	BITS	DESCRIPTION	DECODE
PAIR	6:4	I <sup>2</sup> C Pair Address Mode Control	<p>PAIR[2]: Pair address mode of Shared Bus 3 channel: Slave ID 3 Functional Pair address mode option at burst write operation on customer registers. 1 = Pair address mode is enabled for the channel. 0 = Pair address mode is disabled and sequential mode is used.</p> <p>PAIR[1]: Pair address mode of Shared Bus 2 channel: Slave ID 2 Functional Pair address mode option at burst write operation on customer registers. 1 = Pair address mode is enabled for the channel. 0 = Pair address mode is disabled and sequential mode is used.</p> <p>PAIR[0]: Pair address mode of Shared Bus 1 channel: Slave ID 1 Functional Pair address mode option at burst write operation on customer registers. 1 = Pair address mode is enabled for the channel. 0 = Pair address mode is disabled and sequential mode is used.</p>
RSVD	3:1	Spare	
HS_EXT_EN	0	HS-mode Extension Control	<p>0x0: HS-mode Extension is disabled. (I<sup>2</sup>C Rev. 4 Compliant) 0x1: HS-mode Extension is enabled. HS-mode is enabled without HS-mode entrance code and keeps HS-mode during STOP condition.</p>

## Applications Information

### D+/D- USB 2.0 Switch Control

The integrated D+/D- switches in the MAX77958 are automatically configured by BC1.2 detection results.

**Table 4. D+/D- Configuration**

PART NUMBER	BC1.2 DETECTION RESULTS	D+/D- SWITCH CONFIGURATION
MAX77958	SDP and CDP	OPEN
	DCP	
MAX77958C	SDP and CDP	CLOSED
	DCP	OPEN

The configured D+/D- switch based on the BC1.2 detection result can be overridden by the AP through OP-Command 0x05. Refer to the [User Guide](#) for more information.

### Push-Button Function

The MAX77958C supports the Push-Button function with GPIO7. When the Push-Button function is enabled by AP or MCU, the GPIO7 pin starts the monitoring status. When a Falling Edge or Rising Edge transition is detected, the MAX77958C interrupts AP through ACTION\_INT[1]=1. See the [Ordering Information](#) table and the OP-Command 0x64 in the [User Guide](#) for more information.

### External Interrupt

The MAX77958C supports an external interrupt function with GPIO8. This is useful when an external device such as a companion charger needs to interrupt the MAX77958 to perform an operation specified by the application. When the external interrupt function is enabled by AP or MCU, the GPIO8 pin starts the monitoring interrupt request. When the interrupt request is detected, the MAX77958C sets the register ACTION\_INT[0]=1. See the [Ordering Information](#) table and the OP-Command 0x64 in the [User Guide](#) for more information.

### MAX77958 IC Firmware Update with Dongle Board

The MAX77958C provides a firmware update capability through the dongle board. To update firmware through the dongle board, the dongle board and evaluation kit GUI are required. Refer to the [User Guide](#) for more information.

Typical Application Circuits

2/3-Cell Configurable Charger Application

Figure 15 illustrates a configurable charger application diagram using the MAX77958 and buck-boost charger devices. In this application, the USB Type-C connector is used for SINK as well as SOURCE. The SINK role is automatically active when the battery is charged using USB Type-C SOURCE that is connected to the USB Type-C connector in Figure 15. Based on the CC detection result, the SOURCE advertises its capability. The IC negotiates power contract with the SOURCE connected to the USB Type-C connector. AP can choose appropriate SOURCE PDO and configure charging current in the buck-boost charger accordingly.

The SOURCE role is active when SINK device is attached to the UBS Type-C connector as shown in Figure 15. The IC becomes a power provider with the SOURCE role and advertises its capability to a device connected to USB Type-C connector.

In this scenario, AP configures the buck-boost charger as reverse-buck mode to provide OTG voltage to the device connected to the USB Type-C connector. The communication between the IC.

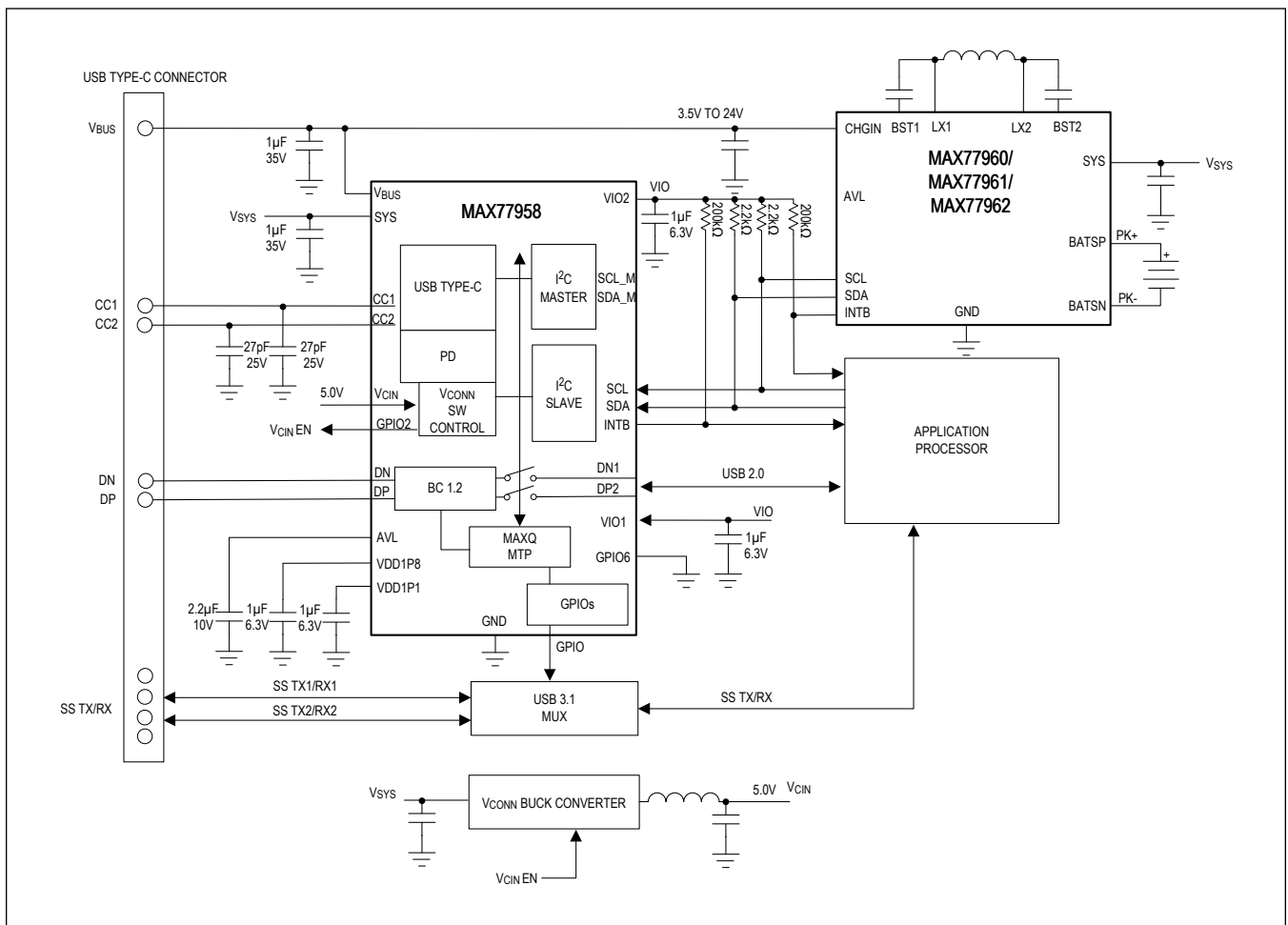


Figure 15. Configurable Charger Application

Typical Application Circuits (continued)

2/3-Cell Autonomous Charger Application

Figure 16 illustrates an autonomous charger application diagram using the MAX77958 and a buck-boost charger device. In this application, the USB Type-C connector is used for SINK as well as SOURCE. The SINK role is automatically active when the battery is charged using the USB Type-C SOURCE that is connected to the USB Type-C connector. Based on the CC detection result, the SOURCE advertises its capability. The IC negotiates a power contract with the SOURCE connected to the USB Type-C connector. The IC chooses an appropriate SOURCE PDO, and configures charging current in the buck-boost charger accordingly through the master I<sup>2</sup>C interface in the IC.

The SOURCE role is active when a SINK device is attached to the USB Type-C connector as shown in Figure 16. The IC becomes a power provider with the SOURCE role and advertises its capability to a device connected to USB Type-C connector. In this scenario, the IC configures the buck-boost charger to reverse-buck mode to provide OTG voltage to the device connected to the USB Type-C connector.

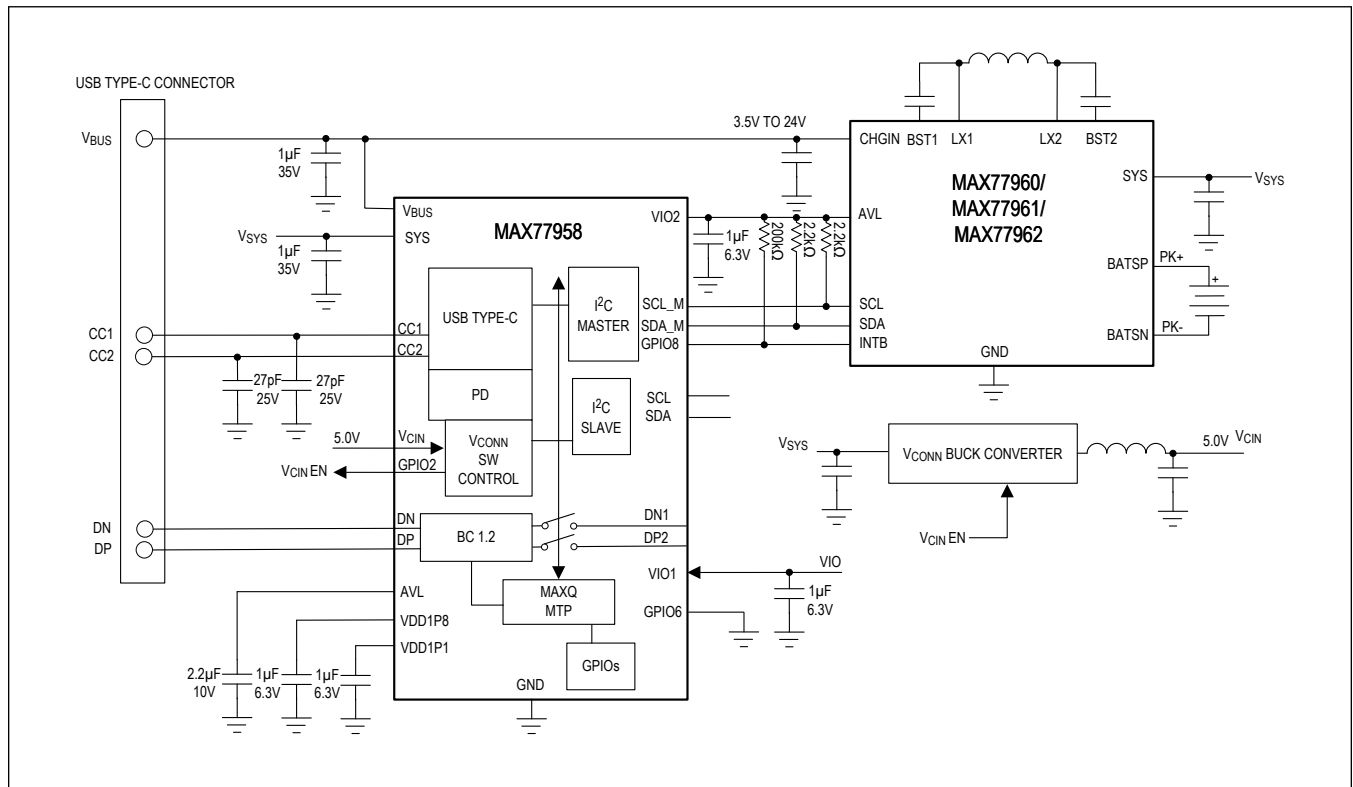


Figure 16. Autonomous Charger Application

Typical Application Circuits (continued)

Autonomous DC-DC Application

Figure 17 illustrates an autonomous DC-DC application diagram using the MAX77958. In this application, the USB Type-C connector is used for SINK. Based on the CC detection result, the SOURCE advertises its capability. The IC negotiates a power contract with the SOURCE connected to the USB Type-C connector. The IC chooses an appropriate SINK PDO among PDOs as shown in Figure 17. The IC then sets the Enable on the DC-DC converter to supply power to the application device.

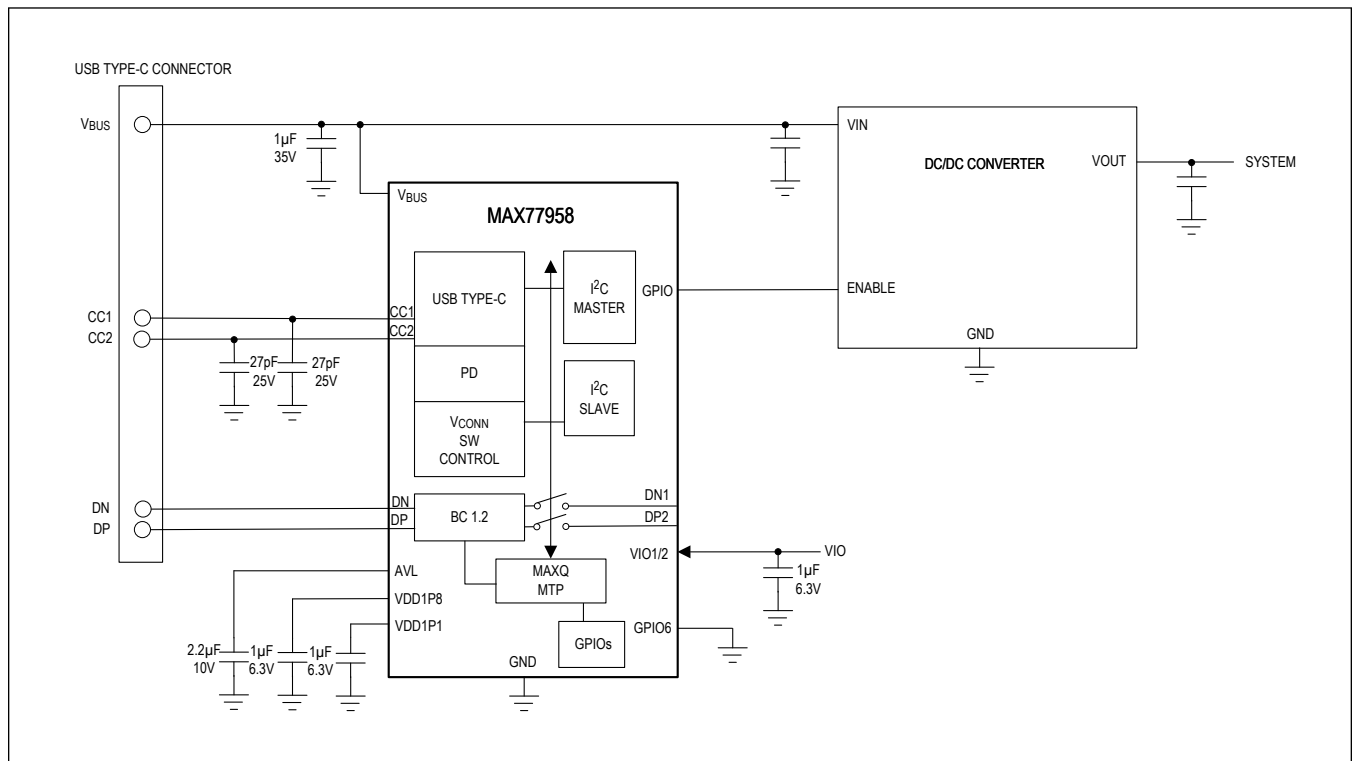


Figure 17. Autonomous DC-DC Application



Typical Application Circuits (continued)

PD Power Adapter Application

Figure 18 illustrates an adapter application diagram using the MAX77958 device. In this application, the USB Type-C connector is only used for SOURCE. The IC negotiates a power contract with the SINK connected to the USB Type-C connector. When SINK is attached, the IC advertises its SOURCE PDO to the SINK. Based on contracts, the IC controls GPIOs to adjust  $V_{BUS}$  that the SINK is requesting. When disconnection happens, the IC also controls GPIOs to disconnect the power path on the  $V_{BUS}$  path and discharges capacitors on the  $V_{BUS}$  path to meet the USB Type-C specification.

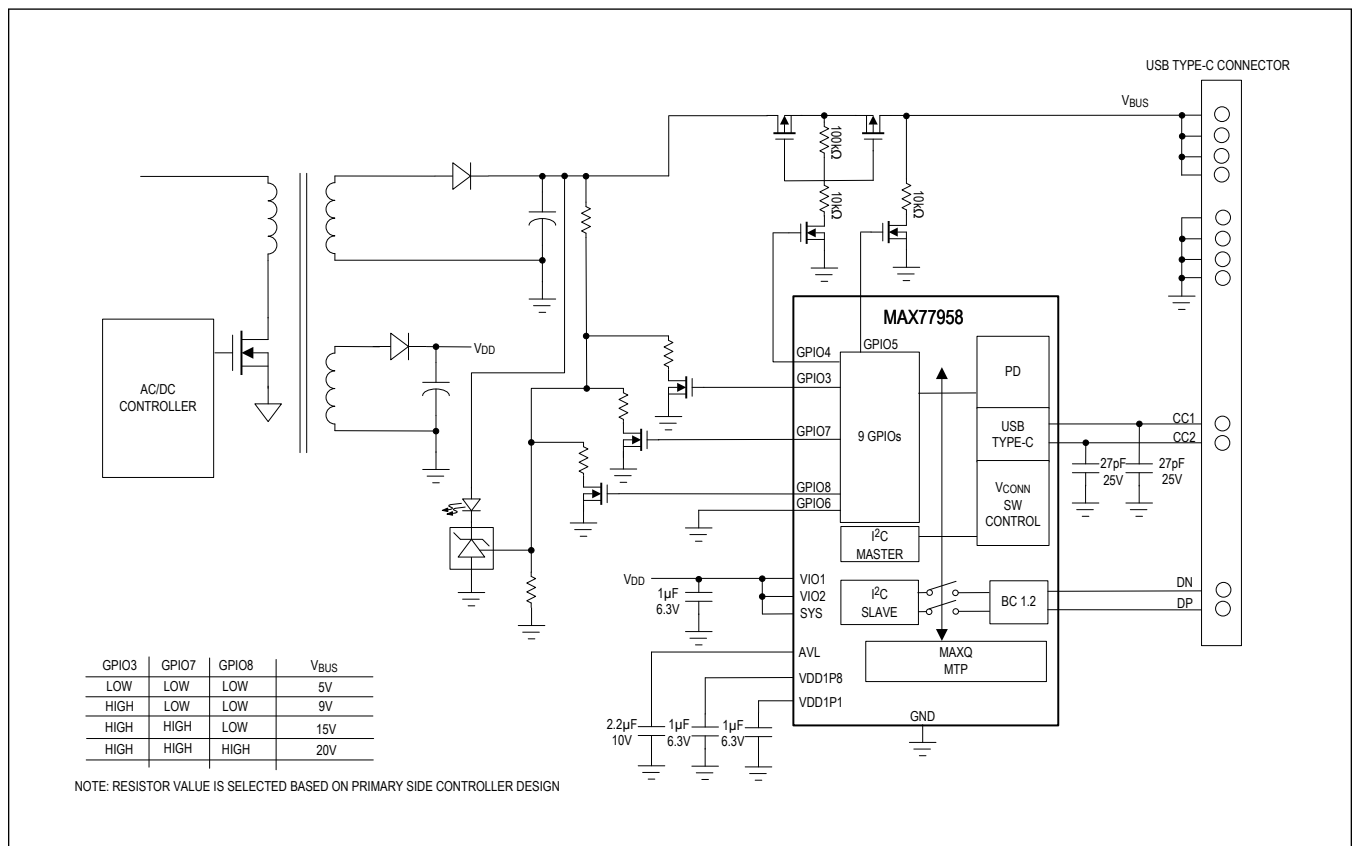


Figure 18. Adapter Application

## Ordering Information

PART NUMBER	TEMP RANGE	PIN-PACKAGE	FW VERSION	DP/DN SWITCH SETTING	GPIO7/GPIO8 FUNCTIONALITY	DONGLE BOARD FIRMWARE UPDATE FUNCTIONALITY
MAX77958EWV+T	-40°C to +85°C	6x5 WLP, 0.5mm pitch, 3.1mm x 2.65mm	06.2C	SDP/CDP: OPEN	GPO	Disabled
				DCP: OPEN		
MAX77958EWV+	-40°C to +85°C	6x5 WLP, 0.5mm pitch, 3.1mm x 2.65mm	06.2C	SDP/CDP: OPEN	GPO	Disabled
				DCP: OPEN		
MAX77958CEWV+T	-40°C to +85°C	6x5 WLP, 0.5mm pitch, 3.1mm x 2.65mm	06.54	SDP/CDP : CLOSE	GPIO7: External Interrupt GPIO8: Push-button (Falling/Rising Edge)	Enabled
				DCP: OPEN		
MAX77958CEWV+	-40°C to +85°C	6x5 WLP, 0.5mm pitch, 3.1mm x 2.65mm	06.54	SDP/CDP: CLOSE	GPIO7: External Interrupt GPIO8: Push-button (Falling/Rising Edge)	Enabled
				DCP: OPEN		

+Denotes a lead(Pb)-free/RoHS-compliant package.

T = Tape and reel.

## Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	12/19	Initial release	—
1	4/20	Updated data sheet title, updated <i>VCIN_OK</i> and added <i>USB Type-C/MTP</i> section to the <i>Electrical Characteristics</i> table, updated <i>AVL</i> in the <i>Pin Description</i> section, updated the <i>Detailed Description</i> and <i>Register Map</i> sections, updated <i>Typical Application Circuits</i> Figures 11, 12, and 13	1–73
2	1/21	Updated <i>General Description and Benefits and Features</i> sections, Simplified Block Diagram, <i>Electrical Characteristics</i> tables, <i>Pin Description</i> table, <i>Detailed Description</i> section, <i>Register Map</i> tables, <i>Detecting Connected DFP</i> section, and Figures 11, 12, 13, added <i>Moisture Detection</i> section	1, 2, 15, 24, 25, 27, 29, 30, 33, 35, 41, 45, 51, 72–75
3	5/21	Updated <i>General Description and Benefits and Features</i> sections, added <i>USB BC1.2 D+/D- Adapter Detection</i> , <i>V<sub>CONN</sub> Switch</i> , and <i>Applications Information</i> section, updated decode in <i>PD_STATUS0 (0xE)</i> table, updated <i>Ordering Information</i> table	1, 30, 31, 42, 54, 75, 76, 80, 81

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