

# FUSB380

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## Autonomous USB Type-C Cable Marker

### Description

The FUSB380 provides a small footprint solution for passive and active cable applications. 28 V Tolerant VCONN and CC provides VBUS shorting protection. One FUSB380 can be used in a VCONN through Type-C cable application or two FUSB380s can be used in each plug avoiding the high cost of routing VCONN through the Type-C cable. The FUSB380 offers industry leading VCONN operating range down to 2.4 V.

### Features

- Integrated USB-PD 3.0 Protocol Layer and Device Policy Engines
- 5x Programmable for Different Cable Configurations
- USB PD 2.0 and 3.0 Certified
- Robust Design Features:
  - ◆ 28 V Tolerant CC and VCONN
  - ◆ Integrated Isolation Between VCONN1 and VCONN2
  - ◆ 2.4 V – 5.5 V VCONN Operation
- Field Programmable for Different Cable Configurations
- SOP<sup>7</sup> Signaling Support
- Automatic Ra Weakening to Reduce Power Consumption
- 12 Pin WLCSP (1.21 mm x 1.67 mm)
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

### Applications

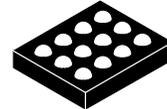
- Passive Cables
- Active Cables



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**WLCSP12  
CASE 567VZ**

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### MARKING DIAGRAM



NA = Two Digit Device Code  
KK = Two Digit Lot Run Code (&K)  
XY = Two Digit Date Code (&2)  
Z = Assembly Plant Code (&Z)

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### ORDERING INFORMATION

See detailed ordering and shipping information on page 2 of this data sheet.

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# FUSB380

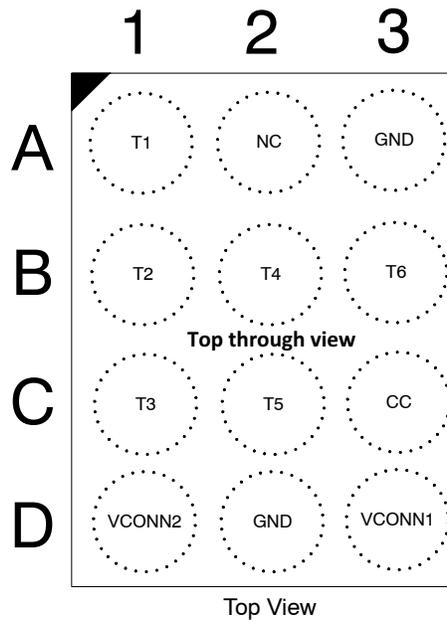
**Table 1. DEVICE ORDERING INFORMATION**

Device	Top Marking	Temperature Range	Package	Shipping <sup>†</sup>
FUSB380UCX	NA	-40°C to +85°C	WLCSP12 (Pb-Free)	3000 / Tape & Reel

<sup>†</sup>For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

**Table 2. 12-BALL WLCSP PIN DESCRIPTION**

Pin#	Name	Description
A1	T1	Test Pin – Float
A2	NC	No Connect
A3	GND	Ground
B1	T2	Test Pin – Float
B2	T4	Test Pin – Float
B3	T6	Test Pin – Float
C1	T3	Test Pin – Float
C2	T5	Test Pin – Float
C3	CC	Configuration Channel (28V Tolerant)
D1	VCONN2	VCONN Power (28V Tolerant)
D2	GND	Ground
D3	VCONN1	VCONN Power (28V Tolerant)



**Figure 1. 12-Ball WLCSP Top-Through View**

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**Table 3. MAXIMUM RATINGS**

Symbol	Parameter	Conditions	Min	Typ	Max	Units
V <sub>CCX</sub>	CC and VCONNx pins (Note 1)		-0.5		28	V
T <sub>J</sub>	Maximum Junction Temperature				+150	°C
T <sub>STORAGE</sub>	Storage Temperature Range		-65		+150	°C
T <sub>L</sub>	Lead Temperature (Soldering 10 Seconds) (Note 2)				+260	°C
ESD	Human Body Model, JEDEDC JESD22-A114	Connector Pins (CC, VCONNx)	4.5			kV
		Others	2			
	Charged Device Model, JEDEC LESD22-C101	All Pins	2			

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. Refer to ELECTRICAL CHARACTERISTICS, RECOMMENDED OPERATING RANGES and/or APPLICATION INFORMATION for Safe Operating parameters.
2. For information, please refer to our Soldering and Mounting Techniques Reference Manual, SOLDERRM/D

**Table 4. RECOMMENDED OPERATING RANGES**

Symbol	Parameter	Conditions	Min	Typ	Max	Units
V <sub>CONNx</sub>	VCONN Voltage (Note 3)		2.4		5.5	V
T <sub>A</sub>	Operating Ambient Temperature		-40		+85	°C

Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.

3. Programming Voltage range = 4.7 V to 5.5 V

**DC AND TRANSIENT ELECTRICAL CHARACTERISTICS** (Minimum and maximum values are at VCONNx = 2.4 V to 5.5 V, T<sub>A</sub> = -40°C to +85°C unless otherwise noted. Typical values are at T<sub>A</sub> = 25°C, VCONNx = 3.3 V)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
<b>Current Consumption</b>						
I <sub>pd_stby</sub>	BMC PD standby current	VCONN = 2.4 to 5.5 Device attached, BMC PD active but not sending or receiving, Ra weakened. Other VCONN pin floating. CC pulled-up/down/float.			400	µA

**BASEBAND PD SYSTEM**

Symbol	Parameter	Conditions	Min	Typ	Max	Units
UI	Unit Interval		3.03	3.33	3.7	µs

**TRANSMITTER**

PBitRate	Maximum difference between the bit-rate during the payload and last 32 bits of preamble				0.25	%
t <sub>EndDriveBMC</sub>	Time to cease driving the line after the end of the last bit of the Frame				23	µs
t <sub>HoldLowBMC</sub>	Time to cease driving the line after the final high-to-low transition		1			µs
t <sub>StartDrive</sub>	Time before the start of the first bit of the preamble when the transmitter shall start driving the line		-1		1	µs
t <sub>InterFrameGap</sub>	Any PD transmission cannot be sent out before a dead time of at least t <sub>InterFrameGap</sub> from receiving or sending a packet		25			µs
t <sub>Transmit</sub>	GoodCRC response time from last transition following EOP to start of preamble of GoodCRC		25		195	µs
t <sub>Rise</sub>	Rise Time		300			ns
t <sub>Fall</sub>	Fall Time		300			ns

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**DC AND TRANSIENT ELECTRICAL CHARACTERISTICS** (Minimum and maximum values are at  $V_{CONNx} = 2.4\text{ V}$  to  $5.5\text{ V}$ ,  $T_A = -40^\circ\text{C}$  to  $+85^\circ\text{C}$  unless otherwise noted. Typical values are at  $T_A = 25^\circ\text{C}$ ,  $V_{CONNx} = 3.3\text{ V}$ )

Symbol	Parameter	Conditions	Min	Typ	Max	Units
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## TRANSMITTER

$V_{\text{Swing}}$	BMC voltage swing		1.05	1.125	1.2	V
$Z_{\text{Driver}}$	TX output impedance at 750 kHz with an external 220 pF or equivalent load		33		75	$\Omega$

## RECEIVER

$C_{\text{Receiver}}$	Receiver capacitance when driver isn't turned on (Note 4)	$V_{\text{rms}}=0.371$ ; $V_{\text{dc}}=0.5\text{V}$ ; $\text{Freq.}=1\text{MHz}$		25		pF
$Z_{\text{BmcRx}}$	Receiver Input Impedance (cannot be tested but can be simulated and guaranteed by design)		1			$M\Omega$
$\eta_{\text{TransitionCount}}$	Transitions count in a time window of 20 $\mu\text{s}$ max.		3			edges
$t_{\text{RxFilter}}$	Rx bandwidth limiting filter (Note 4)		100			ns
$t_{\text{TransitionWindow}}$	Time window for detecting non-idle		12		20	$\mu\text{s}$

## TYPE-C PHY

$R_A$	Powered Cable Termination before $V_{\text{CONN}}$ Power		800		1200	$\Omega$
$R_{A\_WEAK}$	Weakened $R_A$ when $V_{\text{CONN}}$ is applied	$V_{\text{CONN}} > V_{V_{\text{CONN}}_{RA\_WEAK}}$ after $t_{V_{\text{CONN}}_{\text{Stable}}}$ (min)	18		22	$k\Omega$
$Z_{\text{OPEN}}$	CC resistance when $V_{\text{CONN}x}$ is valid and when $V_{\text{CONN}x} = 0\text{ V}$		126			$k\Omega$

## USB PD SPECIFIC TIMING PARAMETERS

$t_{\text{BISTContMode}}$	BIST Carrier Mode 2 pattern sent only for this length of time		30		60	ms
$t_{\text{Transmit}}$	From receiving a packet, we have to send a GoodCRC in response within $t_{\text{Transmit}}$ time. It is measured from the last bit of the EOP of the received packet to the first bit sent of the preamble of the GoodCRC packet				195	$\mu\text{s}$

## CABLE MARKER SPECIFIC

$t_{V_{\text{CONN}}_{\text{Stable}}}$	The time between the application of $V_{\text{CONN}}$ until 'SOP' and 'SOP'' shall be ready for communication.	$V_{\text{CONN}} \geq 2.4\text{ V}$	10		50	ms
$V_{V_{\text{CONN}}_{RA\_WEAK}}$	Voltage threshold when $R_{A\_WEAK}$ is presented after $t_{V_{\text{CONN}}_{\text{Stable}}}$				2.4	V
$t_{V_{\text{CONN}}_{\text{Discharge}}}$	The time from the point that the cable is detached until $v_{V_{\text{CONN}}_{\text{Discharge}}}$ shall be met.	Cable loading = 10 $\mu\text{F}$ , $R_{A\_WEAK}$			230	ms
$V_{V_{\text{CONN}}_{\text{Discharge}}}$	The $V_{\text{CONN}}$ voltage following cable detach and self-discharge.				800	mV
$V_{V_{\text{CONN}}_{\text{Disconnect}}}$	Threshold used to detect $V_{\text{CONN}}$ disconnect.		0.8		2.4	V

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

4. Guaranteed by Design. Characterized on the ATE or Bench.



# FUSB380

## Functional Behaviour

### VCONN Terminations

The FUSB380 device presents a  $R_A$  termination whenever the VCONNx pins are unpowered. Only the VCONNx pin that has a voltage in the valid range for  $t_{VCONNStable}$  will be weakened to  $R_{A\_WEAK}$ .

The function of  $R_{A\_WEAK}$  is to discharge the voltage on VCONN to  $V_{VCONNDischarge}$  within a maximum time of  $t_{VCONNDischarge}$  and a maximum load of 10  $\mu$ F. The  $R_{A\_WEAK}$  termination will be applied until VCONN voltage drops below the  $V_{RARereconnect}$  threshold. Once this threshold is crossed  $R_A$  is reapplied.

### Field Programmable Function

The FUSB380 can be programmed by the customer via Vendor Defined Messages. The user can re-program the device a maximum of 5 times.

The device's Discover Identity response can be fully customized for both Active and Passive cables, with or without Modal support.

The FUSB380 also offers the ability to program a Serial Number that can be read via a VDM Specific command.

**Table 5. SUMMARY OF FIELD PROGRAMMABLE BITS**

Parameter	Description	# of Bits
<b>ID HEADER</b>		
MEM_USB_HOST		1
MEM_USB_DEV		1
MEM_PROD_TYPE	Product Type	3
MEM_MODAL	Modal Operation	1
MEM_ID_RSVD_B25_23	Reserved	3
MEM_ID_RSVD_B22_16	Reserved	7
MEM_VID	USB Vendor ID	16
<b>CERTIFICATION STATUS VDO</b>		
MEM_XID	XID	32
<b>PRODUCT VDO</b>		
MEM_USB ID	<b>USB PID</b>	<b>16</b>
MEM_bcdDevice	<b>bcdDevice</b>	<b>16</b>
<b>CABLE VDO</b>		
MEM_HW_VER	Hardware Version	4
MEM_FW_VER	Firmware Version	4
MEM_VDO_VER		3
MEM_CABLE_RSVD_B20	Reserved	1
MEM_TYPEC_TO_X	USB Type-C to X	2
MEM_CABLE_RSVD_B17	Reserved	1
MEM_LATENCY	Cable Latency	4
MEM_TERM_TYPE	Cable Termination Type	2
MEM_CABLE_VDO_BIT10_9	Max VBUS V	2
MEM_CABLE_VDO_BIT8_7	SS Direction	2
MEM_VBUS_AMPS	VBUS Current Handling	2
MEM_VBUS_THROUGH	VBUS Through Cable	1
MEM_SOP2	SOP2 Present	1
MEM_SS_SIG	USB SS Signaling	3
<b>CABLE VDO 2</b>		
MEM_CABLE2_MAX_TEMP	Maximum Operating Temperature	8
MEM_CABLE2_SHUTDOWN_TEMP	Shutdown Temperature	8
MEM_CABLE2_RSVD_B15	Reserved	10
MEM_CABLE2_RSVD_B14_12	Reserved	10
MEM_CABLE2_RSVD_B11	Reserved	10

# FUSB380

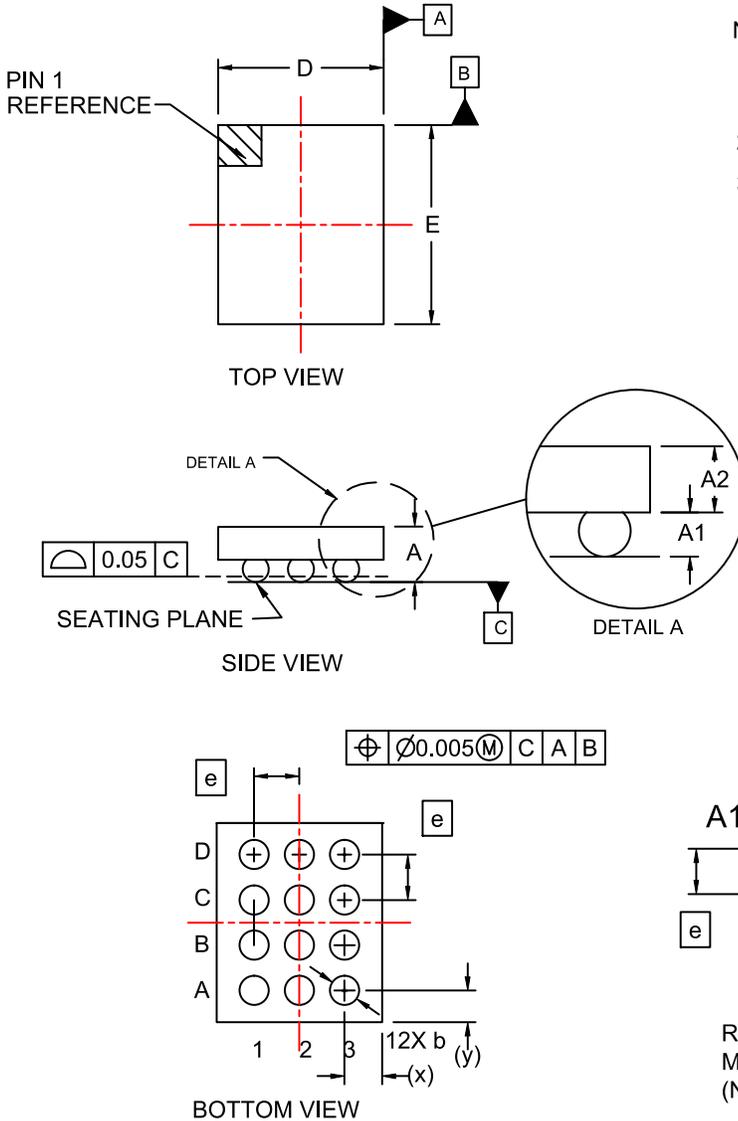
**Table 5. SUMMARY OF FIELD PROGRAMMABLE BITS**

Parameter	Description	# of Bits
<b>CABLE VDO 2</b>		
MEM_CABLE2_RSVD_B10_8	Reserved	10
MEM_CABLE2_RSVD_B7_6	Reserved	10
MEM_CABLE2_USB2_SUP	USB 2.0 Supported	1
MEM_CABLE2_SS_SUP	SuperSpeed Supported	1
MEM_CABLE2_SS_LANES	SuperSpeed Lanes Supported	1
MEM_CABLE2_RSVD_B2	Reserved	1
MEM_CABLE2_SS_SIG	SuperSpeed Signaling	2
<b>DISCOVER SVID RESPONSE</b>		
SVID0	SVID0 = VID	0
MEM_SVID1	SVID1	16
<b>DISCOVER MODES VDO</b>		
MEM_VDO_SVID0		32
MEM_VDO_SVID1	Mode VDO for SVID1 (Alternate Mode)	32
<b>SERIAL NUMBERS</b>		
MEM_CABLE_SN	Cable Serial Number	136
MEM_SN_SVID	Serial numbers replied in SVIDx 0 = SVID0 1 - SVID1	1
MEM_SN_COMMAND	Customer Serial Number SVID specific command	5
MEM_DIESN_COMMAND	Die Serial Number SVID specific command	5



**WLCSP12, 1.21x1.67x0.586**  
CASE 567VZ  
ISSUE O

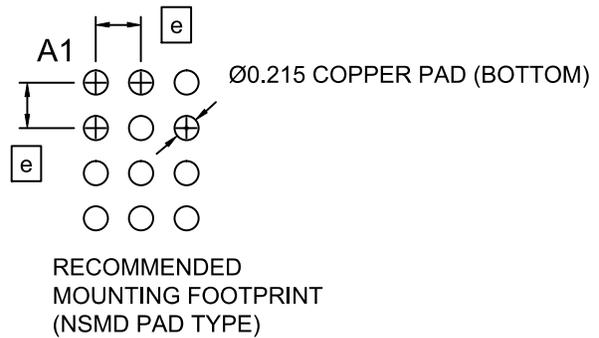
DATE 09 FEB 2018



NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2009.
2. CONTROLLING DIMENSION: MILLIMETERS
3. DATUM C APPLIES TO THE SPHERICAL CROWN OF THE SOLDER BALLS

DIM	MILLIMETERS		
	MIN.	NOM.	MAX.
A	.536	.574	.612
A1	.176	.196	.216
A2	.360	.378	.396
b	.240	.260	.280
D	1.18	1.21	1.24
E	1.64	1.67	1.70
e	0.40 BSC		
x	0.190	0.205	0.220
y	0.220	0.235	0.250



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