# FUSB380C

*Product Preview*

# Autonomous USB Type-C Passive Cable Marker

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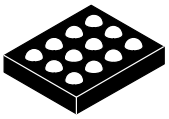


**WLCSP12**
**CASE 567VZ**

### Description

The FUSB380C provides a small footprint solution for passive cable applications. 28 V Tolerant VCONN and CC provides VBUS shorting protection. One FUSB380C can be used in a VCONN through Type−C cable application or two FUSB380Cs can be used in each plug avoiding the high cost of routing VCONN through the Type−C cable. The FUSB380C offers industry leading VCONN operating range down to 2.4 V.

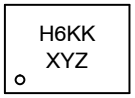
### Features

- 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' 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

### MARKING DIAGRAM




H6 = Two Digit Device Code
KK = Two Digit Lot Run Code (&K)
XY = Two Digit Date Code (&2)
Z = Assembly Plant Code (&Z)

### ORDERING INFORMATION

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

This document contains information on a product under development. ON Semiconductor reserves the right to change or discontinue this product without notice.

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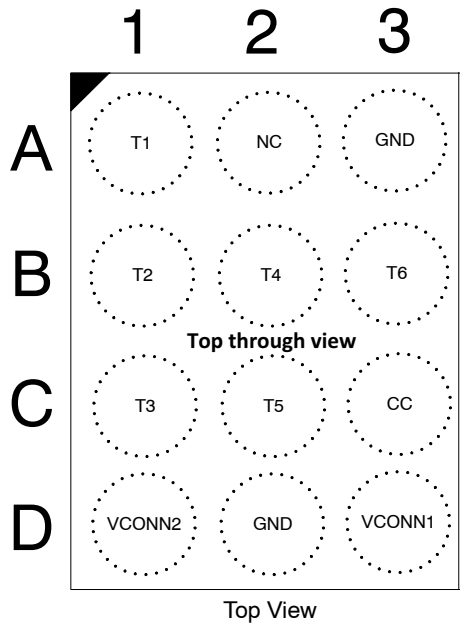
**Table 1. DEVICE ORDERING INFORMATION**

| Device | Top Marking | Temperature Range | Package | Shipping† |
|---|---|---|---|---|
| FUSB380CUCX | H6 | −40°C to +85°C | WLCSP12 (Pb−Free) | 3000 / Tape & Reel |

†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) |




Top View

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

**Table 3. MAXIMUM RATINGS**

| Symbol | Parameter | Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| $V_{CCX}$ | CC and VCONNx pins (Note 1) | | −0.5 | | 28 | V |
| $T_J$ | Maximum Junction Temperature | | | | +150 | °C |
| $T_{STORAGE}$ | Storage Temperature Range | | −65 | | +150 | °C |
| $T_L$ | 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 | | | |
| Surge | IEC61000−4−5, Surge Protection | Connector Pins (CC, VCONNx) | 32 | | | V |

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 |
|---|---|---|---|---|---|---|
| $V_{CONNx}$ | VCONN Voltage (Note 3) | | 2.4 | | 5.5 | V |
| $T_A$ | 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, $T_A$ = −40°C to +85°C unless otherwise noted. Typical values are at $T_A$ = 25°C, VCONNx = 3.3 V)

| Symbol | Parameter | Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| **Current Consumption** | | | | | | |
| $I_{pd_stby}$ | 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** | | | | | | |
| UI | Unit Interval | | 3.03 | 3.33 | 3.7 | μs |
| **TRANSMITTER** | | | | | | |
| $p_{BitRate}$ | Maximum difference between the bit−rate during the payload and last 32 bits of preamble | | | | 0.25 | % |
| $t_{EndDriveBMC}$ | Time to cease driving the line after the end of the last bit of the Frame | | | | 23 | μs |
| $t_{HoldLowBMC}$ | Time to cease driving the line after the final high−to−low transition | | 1 | | | μs |
| $t_{StartDrive}$ | Time before the start of the first bit of the preamble when the transmitter shall start driving the line | | −1 | | 1 | μs |
| $t_{InterFrameGap}$ | Any PD transmission cannot be sent out before a dead time of at least $t_{InterFrameGap}$ from receiving or sending a packet | | 25 | | | μs |
| $t_{Transmit}$ | GoodCRC response time from last transition following EOP to start of preamble of GoodCRC | | 25 | | 195 | μs |
| $t_{Rise}$ | Rise Time | | 300 | | | ns |

**DC AND TRANSIENT ELECTRICAL CHARACTERISTICS** (Minimum and maximum values are at VCONNx = 2.4 V to 5.5 V, $T_A$ = −40°C to +85°C unless otherwise noted. Typical values are at $T_A$ = 25°C, VCONNx = 3.3 V)

| Symbol | Parameter | Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| **TRANSMITTER** | | | | | | |
| $t_{Fall}$ | Fall Time | | 300 | | | ns |
| $v_{Swing}$ | BMC voltage swing | | 1.05 | 1.125 | 1.2 | V |
| $z_{Driver}$ | TX output impedance at 750 kHz with an external 220 pF or equivalent load | | 33 | | 75 | Ω |
| **RECEIVER** | | | | | | |
| $c_{Receiver}$ | Receiver capacitance when driver isn't turned on (Note 4) | Vrms=0.371; Vdc=0.5V; Freq.=1MHz | | 25 | | pF |
| $z_{BmcRx}$ | Receiver Input Impedance (cannot be tested but can be simulated and guaranteed by design) | | 1 | | | MΩ |
| $n_{TransitionCount}$ | Transitions count in a time window of 20 μs max. | | 3 | | | edges |
| $t_{RxFilter}$ | Rx bandwidth limiting filter (Note 4) | | 100 | | | ns |
| $t_{TransitionWindow}$ | Time window for detecting non−idle | | 12 | | 20 | μs |
| **TYPE−C PHY** | | | | | | |
| $R_A$ | Powered Cable Termination before VCONN Power | | 800 | | 1200 | Ω |
| $R_{A_WEAK}$ | Weakened $R_A$ when VCONN is applied | VCONN > $V_{VCONN_RA_WEAK}$ after $t_{VCONNStable}$ (min) | 18 | | 22 | kΩ |
| $z_{OPEN}$ | CC resistance when VCONNx is valid and when VCONNx = 0 V | | 126 | | | kΩ |
| **USB PD SPECIFIC TIMING PARAMETERS** | | | | | | |
| $t_{BISTContMode}$ | BIST Carrier Mode 2 pattern sent only for this length of time | | 30 | | 60 | ms |
| $t_{Transmit}$ | From receiving a packet, we have to send a GoodCRC in response within $t_{Transmit}$ 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 | μs |
| **CABLE MARKER SPECIFIC** | | | | | | |
| $t_{VCONNStable}$ | The time between the application of VCONN until SOP' and SOP" shall be ready for communication. | VCONN ≥ 2.4 V | 10 | | 50 | ms |
| $V_{VCONN_RA_WEAK}$ | Voltage threshold when RA_WEAK is presented after $t_{VCONNStable}$ | | | | 2.4 | V |
| $t_{VCONNDischarge}$ | The time from the point that the cable is detached until $v_{VCONNDischarge}$ shall be met. | Cable loading = 10 μF, $R_{A_WEAK}$ | | | 230 | ms |
| $v_{VCONNDischarge}$ | The VCONN voltage following cable detach and self−discharge. | | | | 800 | mV |
| $v_{VCONNDisconnect}$ | Threshold used to detect VCONN 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.

## Product Block Diagram

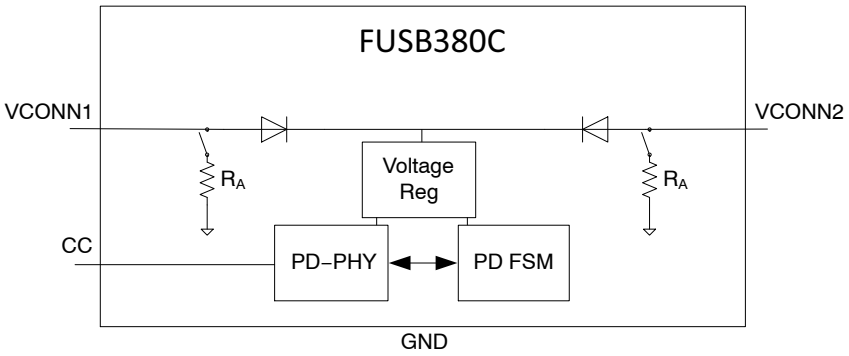



**Figure 2. Block Diagram**

## Application Diagrams

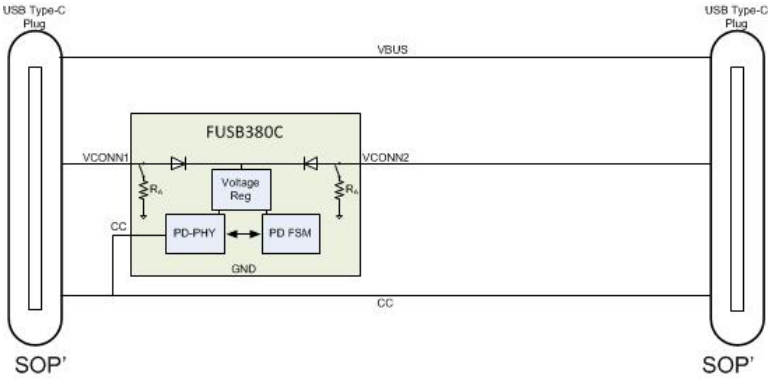



**Figure 3. One eMarker and VCONN Through Cable**

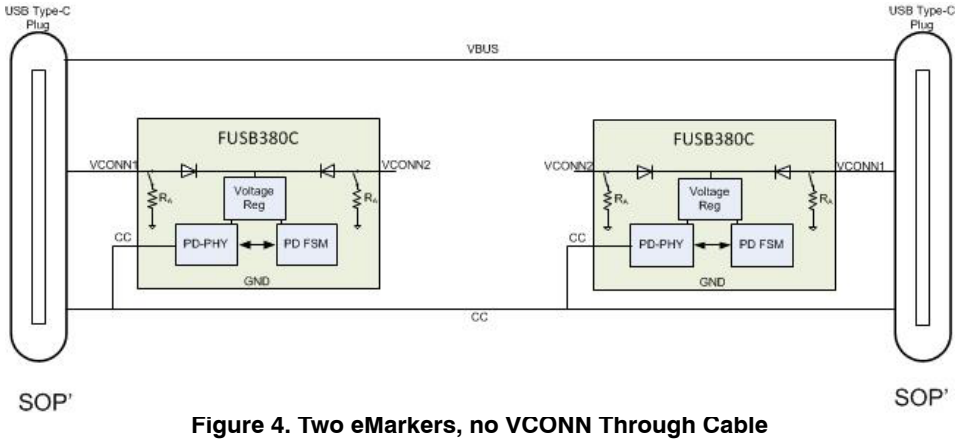



**Figure 4. Two eMarkers, no VCONN Through Cable**

## Functional Behaviour

### VCONN Terminations

The FUSB380C 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 μF. The $R_{A_WEAK}$ termination will be applied until VCONN voltage drops below the $V_{RAReconnect}$ threshold. Once this threshold is crossed $R_A$ is reapplied.

### Field Programmable Function

The FUSB380C 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 Passive cables, with or without Modal support.

The FUSB380C 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 |
|---|---|---|
| **ID HEADER** | | |
| 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 |
| **CERTIFICATION STATUS VDO** | | |
| MEM_XID | XID | 32 |
| **PRODUCT VDO** | | |
| MEM_USB ID | **USB PID** | **16** |
| MEM_bcdDevice | **bcdDevice** | **16** |
| **CABLE VDO** | | |
| 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 |
| **DISCOVER SVID RESPONSE** | | |
| SVID0 | SVID0 = VID | 0 |
| MEM_SVID1 | SVID1 | 16 |
| **DISCOVER MODES VDO** | | |
| MEM_VDO_SVID0 | | 32 |
| MEM_VDO_SVID1 | Mode VDO for SVID1 (Alternate Mode) | 32 |

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

| Parameter | Description | # of Bits |
|---|---|---|
| **SERIAL NUMBERS** | | |
| MEM_CABLE_SN | Cable Serial Number | 136 |
| MEM_SN_SVID | Serial numbers replied in SVIDx<br>0 = SVID0<br>1 – SVID1 | 1 |
| MEM_SN_COMMAND | Customer Serial Number SVID specific command | 5 |
| MEM_DIESN_COMMAND | Die Serial Number SVID specific command | 5 |

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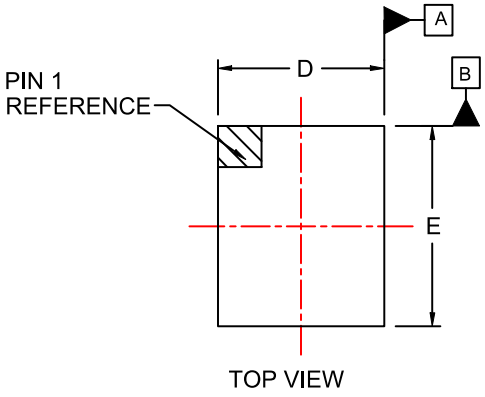
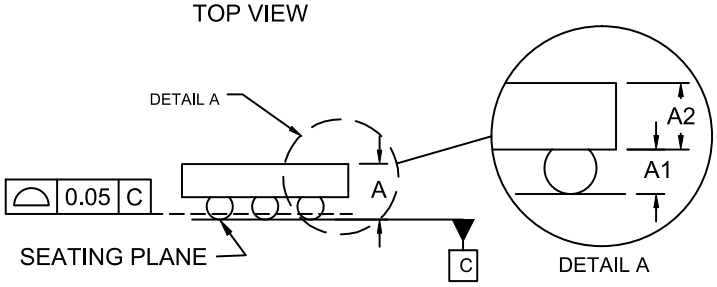
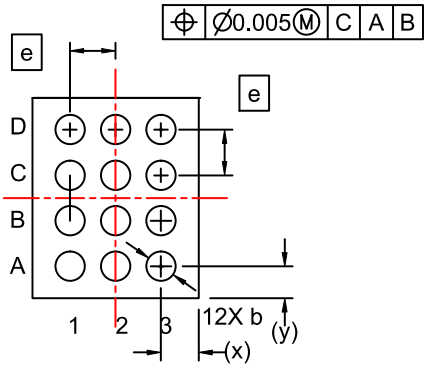



TOP VIEW




SIDE VIEW

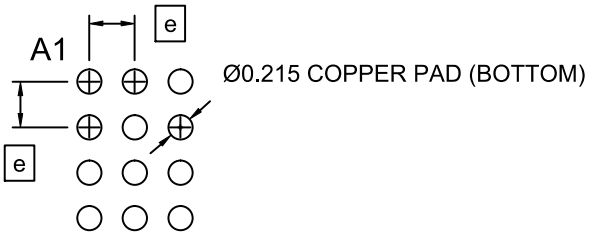



BOTTOM VIEW

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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