KTU1128

USB Type-C 28V EPR Port Protector for CC and SBU Pins

Features

- Thunderbolt™ compatible
- Overvoltage Protection
  - ▸ 32VDC Tolerance on CC1/2, SBU1/2
  - ▸ CC1/2 OVP = 5.8V
  - ▸ SBU1/2 OVP = 4.8V
  - ▸ Fast 30ns Response Time
- IEC61000-4-5 Surge Protection
  - ▸ ±60V Surge Tolerance on CC1/2
  - ▸ ±40V Surge Tolerance on SBU1/2
- IEC61000-4-2 ESD Protection
  - ▸ ±30kV/±30kV contact/air-gap on CC1/2
  - ▸ ±10kV/±25kV contact/air-gap on SBU1/2
  - ▸ ±2kV HBM on all pins (JEDEC JS-001-2017)
- CC Switches:
  - ▸ 1.25A, 270mΩ, 33pF, 180MHz
  - ▸ Automatic 5.1kΩ dead battery pull-down
- SBU Switches:
  - ▸ 3Ω, 11pF, 850MHz
- 2.5V to 5.5V Operating Supply Voltage Range
- -40°C to 85°C Operating Temperature Range
- 16-bump WLCSP 1.694mm x 1.694mm (0.4mm pitch)
- 20 pin WQFN 3mmx3mm (0.4mm pitch)
- P2P upgrade of KTU1121A for 28V EPR
- RoHS and Green Compliant

Brief Description

The KTU1128 provides four conducting paths with overvoltage protection (OVP) for Type-C's CC, SBU signals. Once an overvoltage event is detected, it will shut down all paths to protect circuits in system side, like PD controller from damage.

All the SBU and CC switches have very low on-capacitance for broad bandwidth to allow high-speed signal passing through without loss. The CC1/2 switches have low on-resistance for passing V_{CONN} power up to 1.25A.

During dead battery conditions, internal 5.1kΩ resistors automatically pull-down on CC1/2 to ensure that the up-stream source provides 5V on VBUS.

The KTU1128 is packaged in RoHS and Green compliant 16-bump WLCSP 1.694mm x 1.694mm package or 20 pin 3mm x 3mm WQFN package.
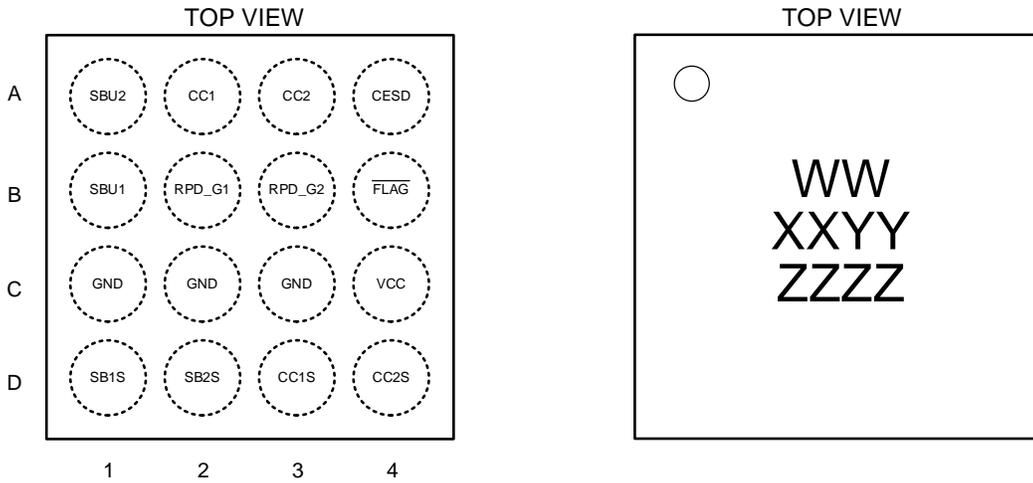
Applications

- Notebook PCs, Netbooks, Tablets, Monitors, TVs
- Gaming Devices, Set-Top Boxes, Networking

Typical Application
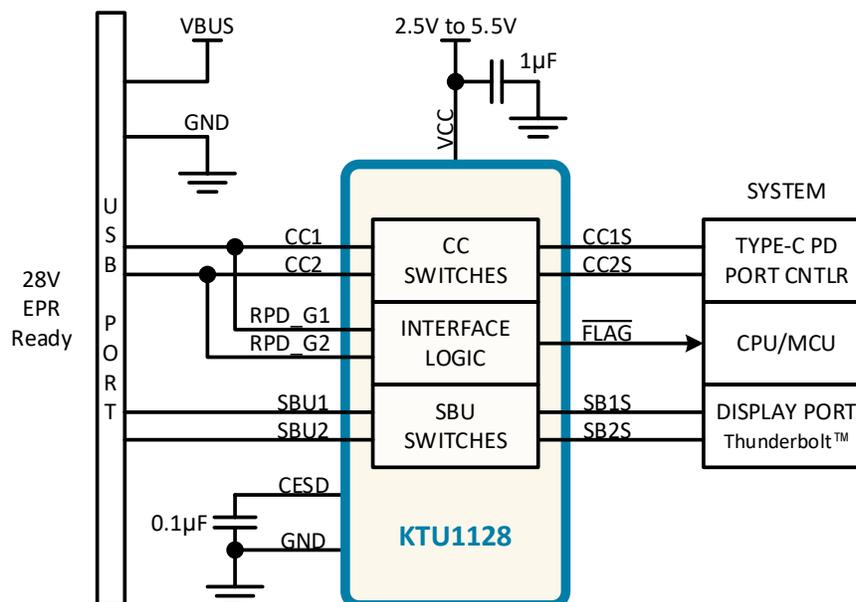
Pinout Diagram

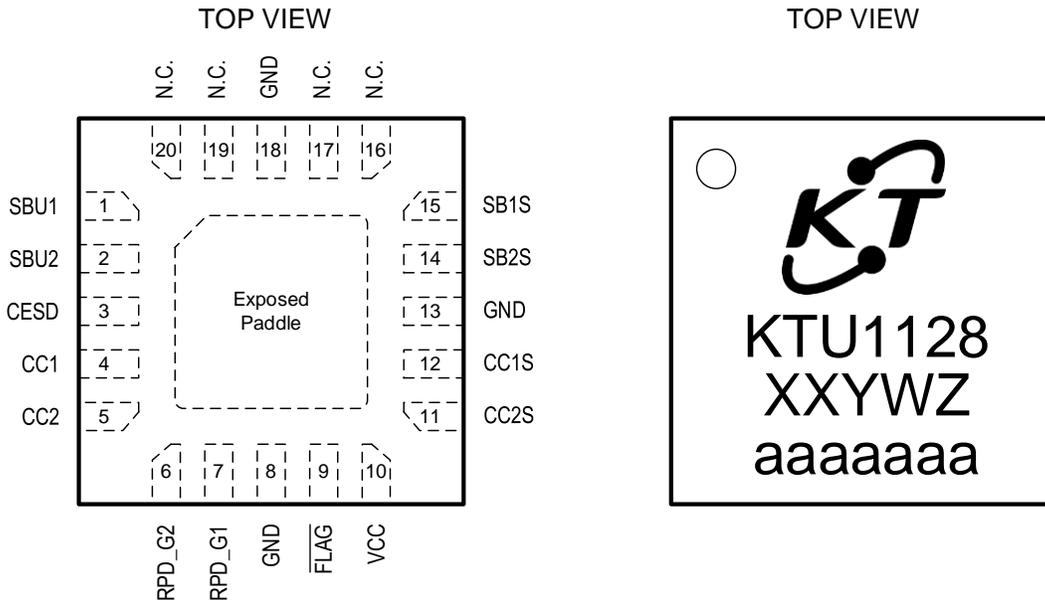### WLCSP44-16

TOP VIEW

TOP VIEW

WW
XXYY
ZZZZ

16-Pin 1.694mm x 1.694mm
WLCSP Package, 0.4mm pitch

Top Mark
WW = Device ID Code
XX = Date Code, YY = Assembly Code
ZZZZ = Serial Number

WQFN33-20

TOP VIEW

TOP VIEW

KTU1128
XXYWZ
aaaaaaa

20-Pin 3mm x 3mm x 0.75mm
WQFN Package, 0.4mm pitch
Top Mark
XX = Device ID Code, YW = Date Code, Z = Serial Number
aaaaaaa = Assembly Lot Tracking Number

Pin Descriptions

Pin # (CSP)	Pin # (WQFN)	Name	Function
B1	1	SBU1	Connector side of SBU1 switch
A1	2	SBU2	Connector side of SBU2 switch
A4	3	CESD	Capacitor connection for ESD protection for CC1, CC2, SBU1 and SBU2 inputs
A2	4	CC1	Connector side of CC1 switch
A3	5	CC2	Connector side of CC2 switch
C1 ~ C3	8, 13, 18, ExPad	GND	Ground
B4	9	$\overline{FLAG}$	Active low fault flag output to alert system to an OVP fault condition
C4	10	VCC	Device supply input – connect to a 2.5V to 5.5V source.
D4	11	CC2S	System side of CC2 switch
D3	12	CC1S	System side of CC1 switch
D2	14	SB2S	System side of SBU2 switch
D1	15	SB1S	System side of SBU1 switch
B2	7	RPD_G1	Dead battery resistor setup: Short to CC1 if dead battery resistors are needed. Short to GND if not required.
B3	6	RPD_G2	Dead battery resistor setup: Short to CC2 if dead battery resistors are needed. Short to GND if not required.
--	16, 17, 19, 20	NC	No connect -- optionally connect to ground.

Ordering Information

Part Number	Marking	Operating Temperature	Package
KTU1128EGAD-TA	SGXXYYZZZZ[1]	-40°C to +85°C	WLCSP44-16
KTU1128EUAJ-TD	SGYWZ[2] aaaaaaa	-40°C to +85°C	WQFN33-20

1. XX = Date Code, YY = Assembly Code, ZZZZ = Serial Number

2. XX = Device ID Code, YW = Date Code, Z = Serial Number, aaaaaaa = Assembly Lot Tracking Number

Absolute Maximum Ratings[3]

(T_A = 25°C unless otherwise noted)

Symbol	Description	Value	Units
V_{CC}	VCC to GND	-0.3 to 6	V
V_{IO}	CC1, CC2, RPD_G1, RPD_G2, SBU1, SBU2 to GND	-0.3 to 32	V
	CC1S, CC2S, SB1S, SB2S to GND	-0.3 to 8	
	$\overline{FLAG}$ to GND	-0.3 to 6	
I_{IO}	CCn to CCnS Continuous Current	±1250	mA
	CCn to CCnS Peak Current (2.5ms)	±2000	
	SBUn to SBnS, Continuous Current	±100	
V_{CESD}	CESD to GND	-0.3 to 32	V
T_J	Junction Operating Temperature Range	-40 to 150	°C
T_S	Storage Temperature Range	-55 to 150	°C
T_{LEAD}	Maximum Soldering Temperature (at leads, 10 sec)	260	°C

ESD and Surge Ratings[4]

Symbol	Description	Value	Units
V_{ESD_HBM}	JEDEC JS-001-2017 ESD Human Body Model (all pins)	±2	kV
V_{ESD_CDM}	JEDEC JESD22-C101 Charged Device Model (all pins)	±500	V
V_{ESD_CD}	IEC61000-4-2 ESD Contact Discharge (CC1, CC2)	±30	kV
	IEC61000-4-2 ESD Contact Discharge (SBU1, SBU2)	±10	kV
V_{ESD_AGD}	IEC61000-4-2 ESD Air-Gap Discharge (CC1, CC2)	±30	kV
	IEC61000-4-2 ESD Air-Gap Discharge (SBU1, SBU2)	±25	kV
V_{SURGE}	IEC61000-4-5 Surge (CC1, CC2 to GND)	±60	V
	IEC61000-4-5 Surge (SBU1, SBU2 to GND)	±40	V

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3 Stresses above those listed in Absolute Maximum Ratings may cause permanent damage to the device. Functional operation at conditions other than the operating conditions specified is not implied. Only one Absolute Maximum rating should be applied at any one time.

4 ESD and Surge Ratings conform to JEDEC and IEC industry standards. Some pins may actually have higher performance. Surge ratings apply with chip enabled, disabled, or unpowered based on Kinetic EVB, unless otherwise noted.

Thermal Capabilities[5]

Symbol	Description	Value	Units
WLCSP-16			
θ_{JA}	Thermal Resistance – Junction to Ambient	100.8	°C/W
P_D	Maximum Power Dissipation at $T_A \leq 25°C$	1240	mW
$\Delta P_D/\Delta T$	Derating Factor Above $T_A = 25°C$	-9.92	mW/°C
WQFN33-20			
θ_{JA}	Thermal Resistance – Junction to Ambient	60.24	°C/W
P_D	Maximum Power Dissipation at $T_A \leq 25°C$	2075	mW
$\Delta P_D/\Delta T$	Derating Factor Above $T_A = 25°C$	-16.6	mW/°C

Electrical Characteristics[6]

Unless otherwise noted, the *Min* and *Max* specs are applied over the full operation temperature range of -40°C to +85°C and V_{CC} = 2.5V to 5.5V. Typical values are specified at T_A = +25°C with V_{CC} = 3.0V.

Supply Specifications

Symbol	Description	Conditions	Min	Typ	Max	Units
V_{CC}	Supply Operating Range		2.5		5.5	V
V_{UVLO}	Under-Voltage Lockout Threshold	Rising threshold	2.12	2.3	2.48	V
		Hysteresis		200		mV
I_{CC}	Supply Current	V_{CC} = 3.0V		40		µA

Logic Specifications

Symbol	Description	Conditions	Min	Typ	Max	Units
V_{OL}	Output Logic Low ($\overline{FLAG}$)	I_{OSINK} = 3mA		0.1	0.4	V
I_{O_LK}	Output Logic Leakage ($\overline{FLAG}$)	T_A = +25°C, V_O = high-Z or V_{CC}		0.01	1	µA
t_{FLAGB}	$\overline{FLAG}$ Response Time (with 100k pull-up)[7]	Activation		45		ns
$t_{FLAG\_RECOVER}$	From OVP removed to $\overline{FLAG}$ recovered			5		ms

Thermal Shutdown Specifications

Symbol	Description	Conditions	Min	Typ	Max	Units
T_{J_SHDN}	IC Junction Thermal Shutdown[7]	T_J rising		150		°C
		Hysteresis		20		°C

(continued next page)

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5 Junction to Ambient thermal resistance is highly dependent on PCB layout. Values are based on thermal properties of the device when soldered to an EV board.

6. Device is guaranteed to meet performance specifications over the –40°C to +85°C operating temperature range by design, characterization and correlation with statistical process controls.

7. Guarantee by characterization and/or simulation.

Electrical Characteristics (continued)[6]

Unless otherwise noted, the *Min* and *Max* specs are applied over the full operation temperature range of -40°C to +85°C and V_{CC} = 2.5V to 5.5V. Typical values are specified at T_A = +25°C with V_{CC} = 3.0V.

CC Switch Specifications

Symbol	Description	Conditions	Min	Typ	Max	Units
$V_{CC1/2}$	Switch Voltage Operating Range		-0.3		5.5	V
V_{OVP_CC}	OVP Threshold	Rising threshold	5.6	5.8	6.0	V
		Hysteresis		50		mV
R_{ON_CC}	On-Resistance ($-40°C \leq T_J \leq +85°C$)	Value, $V_{CC1/2}$ = 0V to V_{CC}		270	390	mΩ
C_{ON_CC}	On-Capacitance[7]	Capacitance from CCx or CCxS to GND when device is powered. Measure at V_{CCx}/V_{CCxS} = 0V to 1.2V, f = 400kHz.		33		pF
BW_{ON_CC}	On-Bandwidth[7]	Measure the -3dB bandwidth from CCx to CCxS. Single ended measurement, 50Ω system. Vcm = 0.1V to 1.2V.		180		MHz
$R_{CC1/2\_GND}$	Resistance to GND	$V_{CC1/2} \leq V_{CC}$, T_A = +25°C	10	12.8		MΩ
I_{CCLK}	Switch Off Leakage Current	V_{CC} = 0V, $V_{CC1/2}$ = 5.5V, $V_{CC1/2S}$ = 0V, T_A = +25°C, measure current out of CC1/2S		0.1	1	µA
$V_{CC1/2\_DB}$	Dead Battery Threshold Voltage	$V_{CC} < V_{UVLO}$, $I_{CC1/2}$ = 80µA	0.5	0.82	1.1	V
t_{ON_CC}	Switch Turn-On Time	V_{CC} rising > V_{UVLO}		1.3	3.5	ms
t_{OFF_CC}	Switch Turn-Off Time[7]	V_{CC} falling < V_{UVLO}		1		µs
$t_{OVP\_CC\_R}$	OVP Rising Response Time[7]	V_{CC} = 3.0V, short CC1/2 to VBUS (28V) T_A = +25°C		30		ns
$V_{CC1/2S\_MAX}$	OVP Rising Maximum System Voltage[7]	Hot-Plug CCx with a 1 meter USB Type C Cable. Hot-Plug voltage CCx = 32V. Vcc = 3.3V. Place a 30Ω load on CCxS		7		V
$t_{OVP\_CC\_F}$	OVP Falling Debounce Time			0.9		ms

Electrical Characteristics (continued) [6]

Unless otherwise noted, the *Min* and *Max* specs are applied over the full operation temperature range of -40°C to +85°C and V_{CC} = 2.5V to 5.5V. Typical values are specified at T_A = +25°C with V_{CC} = 3.0V.

SBU Switch Specifications

Symbol	Description	Conditions	Min	Typ	Max	Units
$V_{SBU1/2}$	Switch Voltage Operating Range		-0.3		4.5	V
V_{OVP_SBU}	OVP Threshold	Rising threshold	4.7	4.8	4.9	V
		Hysteresis		50		mV
R_{ON_SBU}	On-Resistance (–40°C ≤ T_J ≤ +85°C)	Value, $V_{SBU1/2}$ = 0V to V_{CC}		3	6.3	Ω
C_{ON_SBU}	On-Capacitance[7]	Capacitance from SBUx or SBxS to GND when device is powered. Measure at V_{SBUx}/V_{SBxS} = 0.3V to 4.2V.		11		pF
BW_{ON_SBU}	On-Bandwidth Single Ended(-3dB) [7]	Measure the -3dB bandwidth from SBUx to SBxS. Single ended measurement, 50Ω system. Vcm = 0.1V to 3.6V.		850		MHz
X_{TALK}	Crosstalk[7]	Measure crosstalk at f = 1 MHz from SB1S to SBU2 or SB2S to SBU1. Vcm1 = 3.6V, Vcm2 = 0.3V. Terminate open sides to 50Ω.		-70		dB
$R_{SBU1/2\_GND}$	Resistance to GND	$V_{SBU1/2}$ ≤ V_{CC}, T_A = +25°C	10	12.8		MΩ
I_{SBULK}	Switch Off Leakage Current	V_{CC} = 0V, $V_{SBU1/2}$ = 4.5V, $V_{SB1/2S}$ = 0V, T_A = +25°C, measure current out of SBU1/2S		0.1	1	µA
t_{ON_SBU}	Switch Turn-On Time	V_{CC} rising > V_{UVLO}		1.3	3.5	ms
t_{OFF_SBU}	Switch Turn-Off Time[7]	V_{CC} falling < V_{UVLO}		1		µs
$t_{OVP\_SBU\_R}$	OVP Response Time[7]	V_{CC} = 3.0V, initial $V_{SBU1/2}$ = 3.3V, short SBU1/2 to VBUS (28V), T_A = +25°C		20		ns
$V_{SB1/2S\_MAX}$	OVP Rising Maximum System Voltage[7]	Hot-Plug SBUx with a 1 meter USB Type C Cable. Hot-Plug voltage SBUx = 32V. Vcc = 3.3V. Put a 150nF capacitor in series with a 40Ω resistor to GND on SBUxS		6		V
$t_{OVP\_SBU\_F}$	OVP Falling Debounce Time			0.6		ms

Electrical Characteristics (continued) [6]

Unless otherwise noted, the *Min* and *Max* specs are applied over the full operation temperature range of -40°C to +85°C and V_{CC} = 2.5V to 5.5V. Typical values are specified at T_A = +25°C with V_{CC} = 3.0V.

Dead Battery Resistors Specifications

Symbol	Description	Conditions	Min	Typ	Max	Units
$t_{ON\_DB\_DELAY}$	From VCC exceeding UVLO to dead battery resistors are off. (CCx and SBUx channels should be on prior to DB off)			5.7	9.5	ms
$t_{ON\_DB\_OVP}$	From OVP recover to DB resistors back to turn off. Same period as $t_{FLAG\_RECOVER}$. See Figure 2 for more details			5		ms
R_{DB}	Dead Battery Pull-Down Resistance	$V_{CC} < V_{UVLO}$, $V_{CC1/2}$ = 2.6V	4.1	5.1	6.1	kΩ

Timing Diagrams
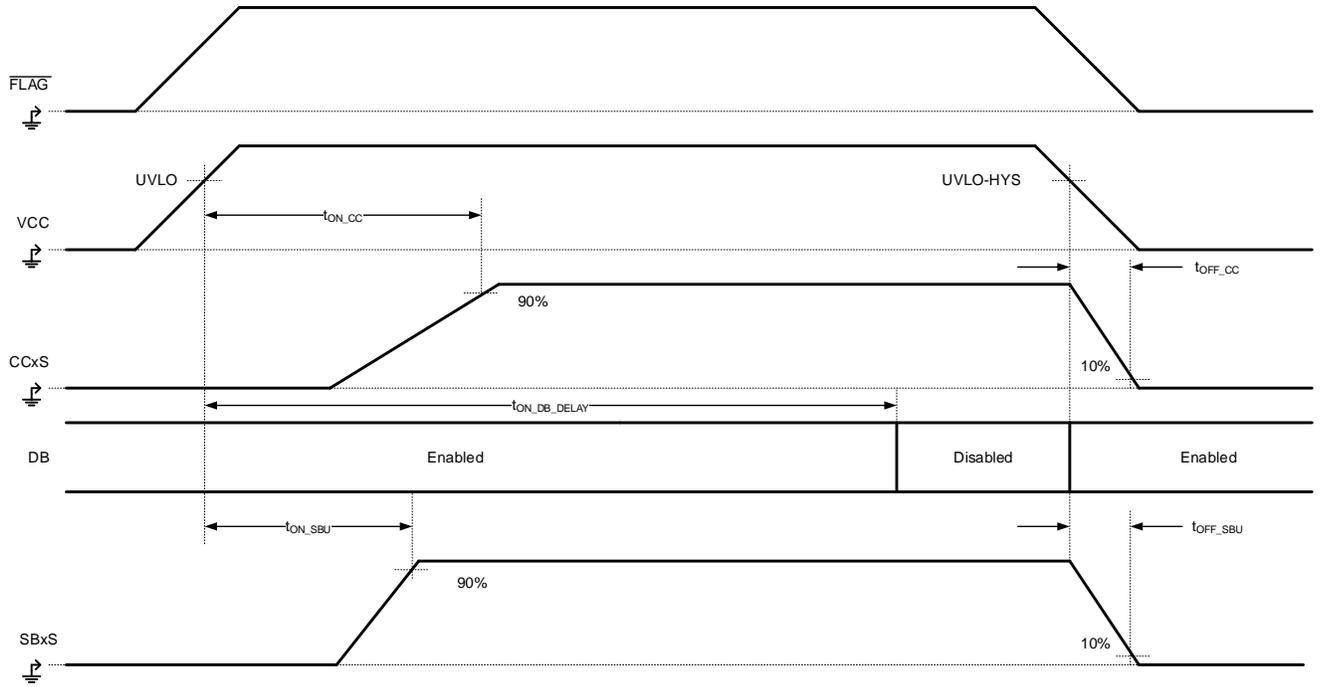
Figure 1. Power Up and Down
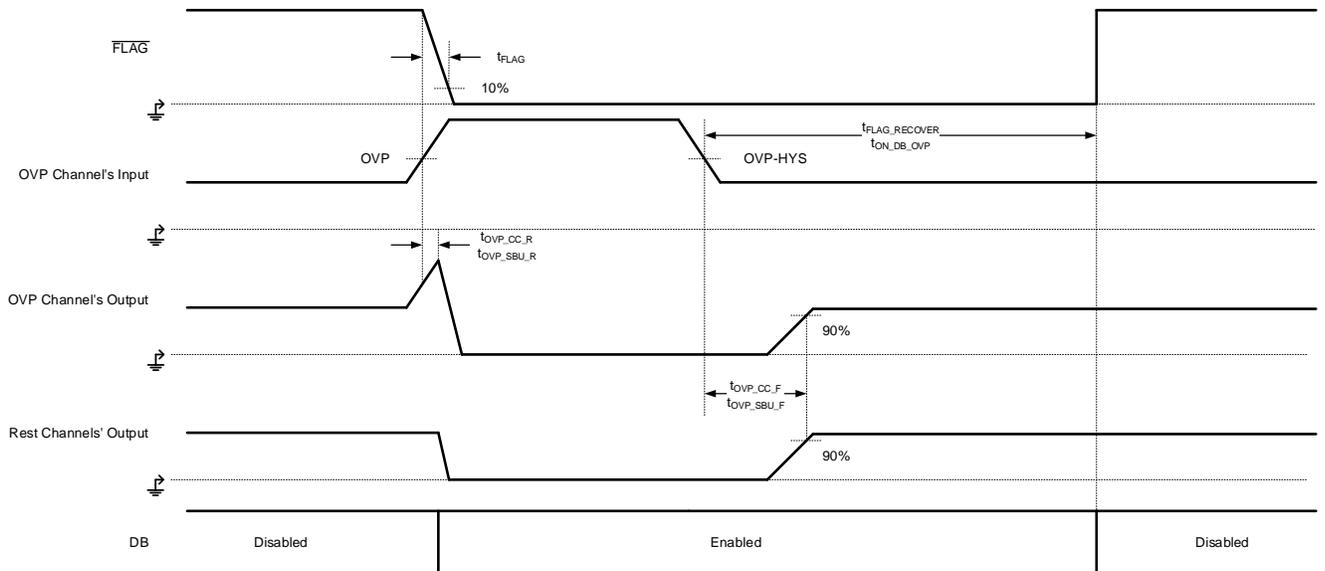
Figure 2. OVP
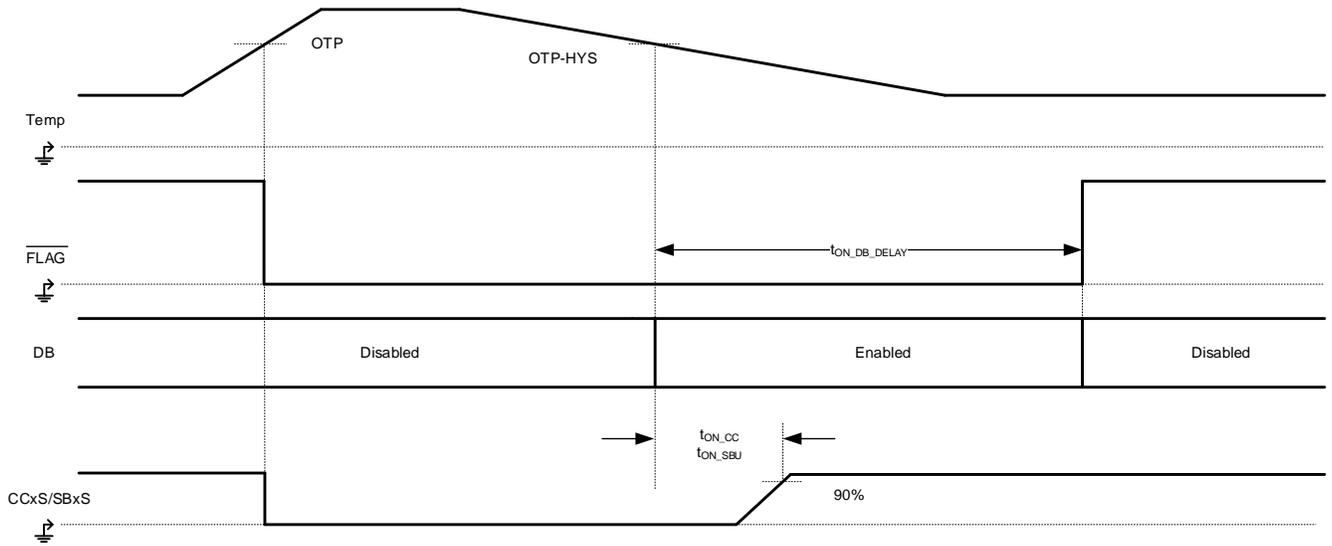
Figure 3. OTP

Typical Characteristics

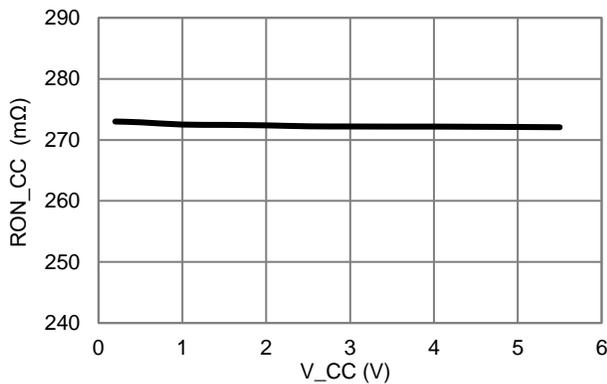V_{CC} = 3.3V, C_{VCC} = 1μF, C_{ESD} = 0.1μF, T_{AMB} = 25°C unless otherwise specified.
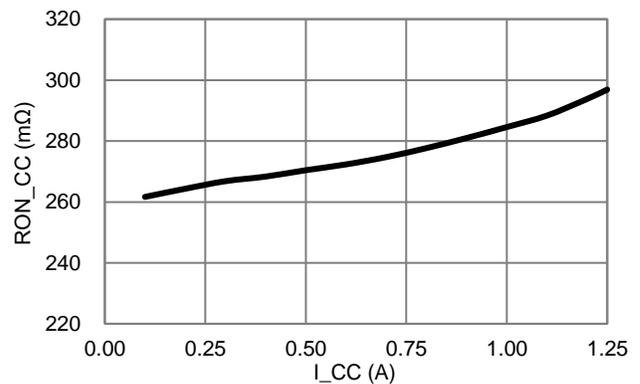
V_{CC} Supply Current vs V_{CC} Voltage
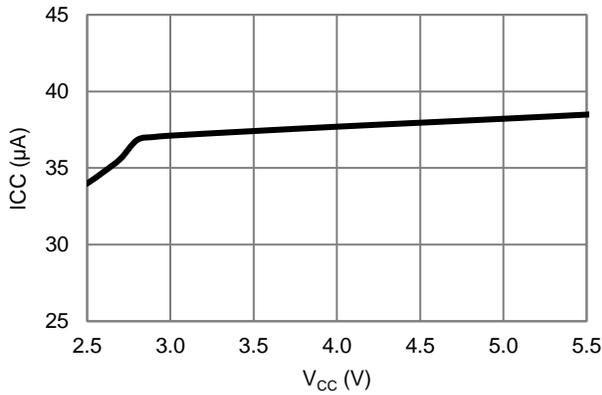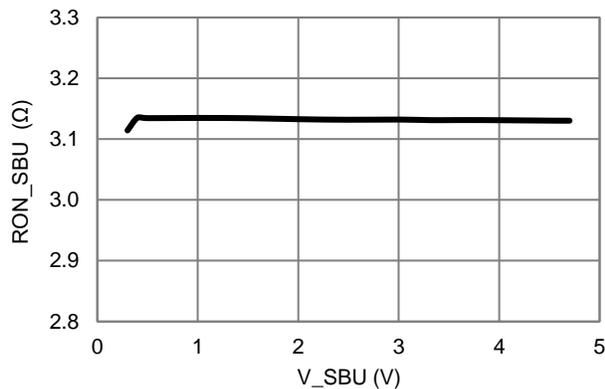
V_{CC} Supply Current vs. Temperature
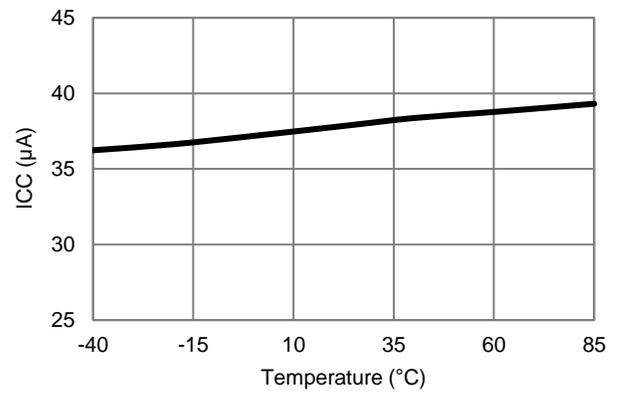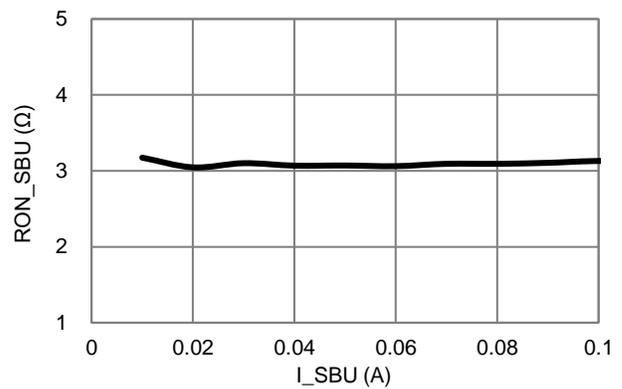
CC Switch R_{ON} vs. Switch Voltage
(I_CC = 200mA)

CC Switch R_{ON} vs. Switch Current

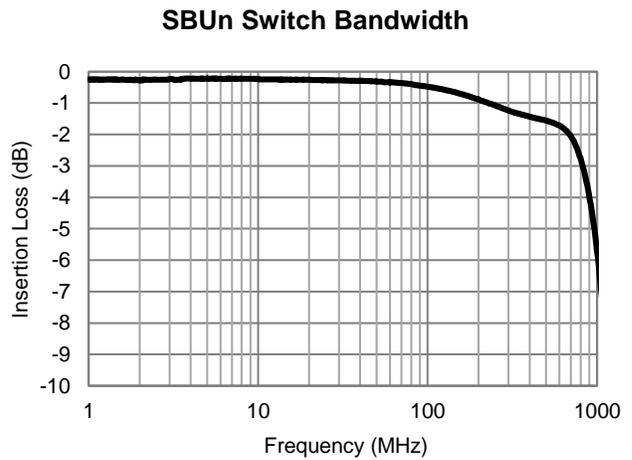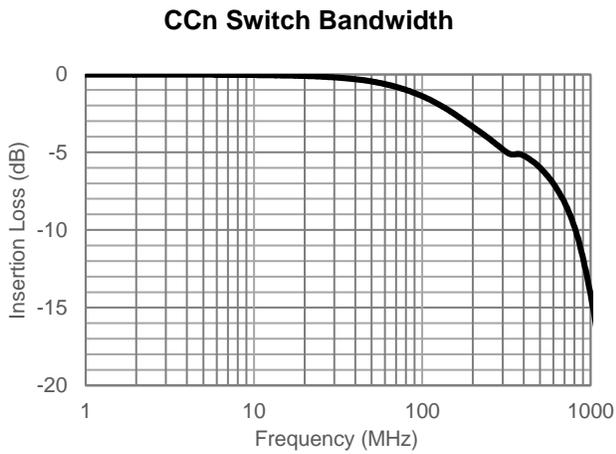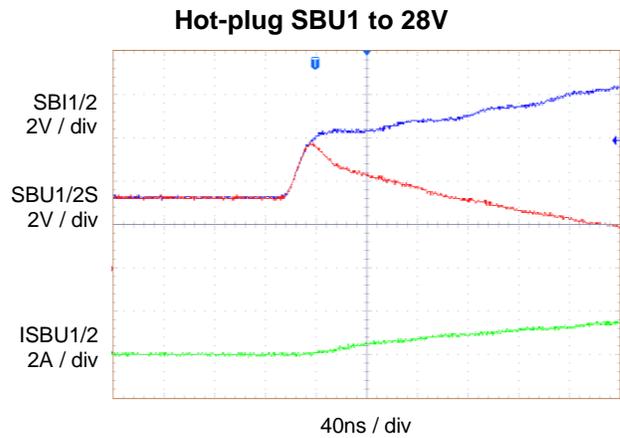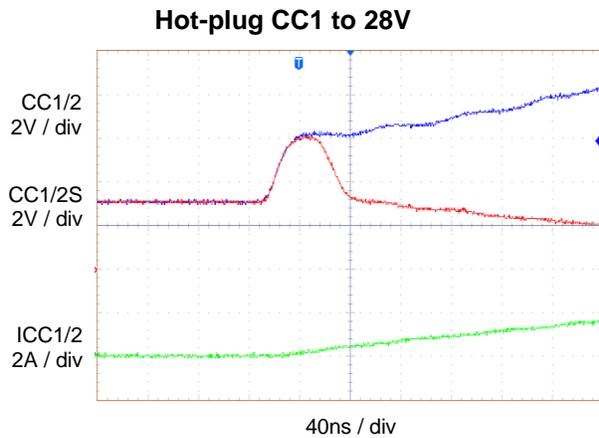**SBU Switch R_{ON} vs. Switch Voltage**
(I_SBU = 100mA)
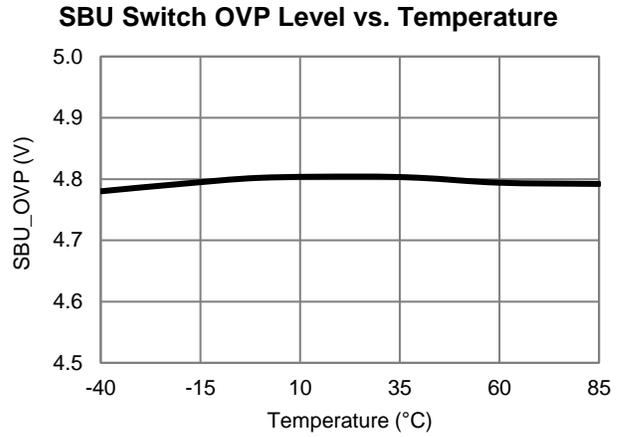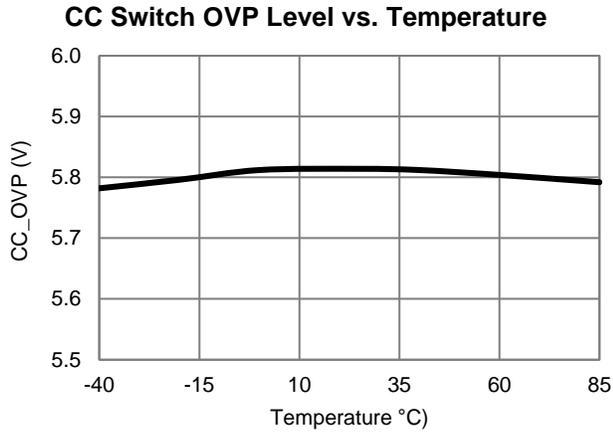
SBU Switch R_{ON} vs. Switch Current

Typical Characteristics (continue)
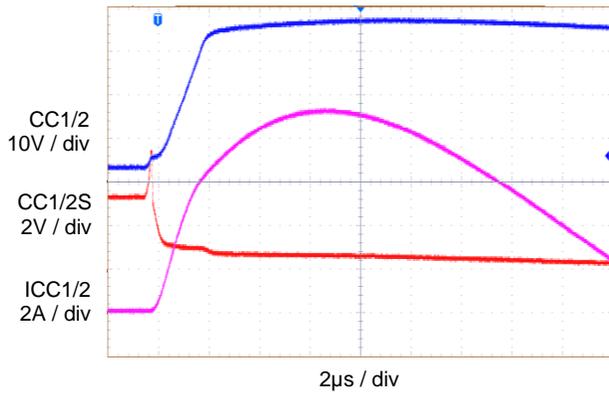
V_{CC} = 3.3V, C_{VCC} = 1µF, C_{ESD} = 0.1µF, T_{AMB} = 25°C unless otherwise specified.

CC Switch OVP Level vs. Temperature

SBU Switch OVP Level vs. Temperature

Hot-plug CC1 to 28V

Hot-plug SBU1 to 28V

CCn Switch Bandwidth

SBUn Switch Bandwidth

Typical Characteristics (continue)

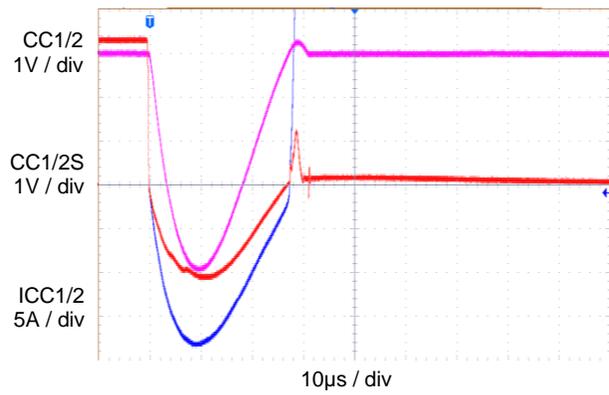V_{CC} = 3.3V, C_{VCC} = 1μF, C_{ESD} = 0.1μF, T_{AMB} = 25°C unless otherwise specified.

CC OVP during +60V Surge Event

CC1/2
10V / div

CC1/2S
2V / div

ICC1/2
2A / div

2μs / div

CC -60V Surge Event

CC1/2
1V / div

CC1/2S
1V / div

ICC1/2
5A / div

10μs / div

SBU OVP during +40V Surge Event

SBU1/2
10V / div

SBU1/2S
2V / div

ISBU1/2
2A / div

2μs / div

SBU -40V Surge Event

SBU1/2
2V / div

SBU1/2S
2V / div

ISBU1/2
5A / div

10μs / div
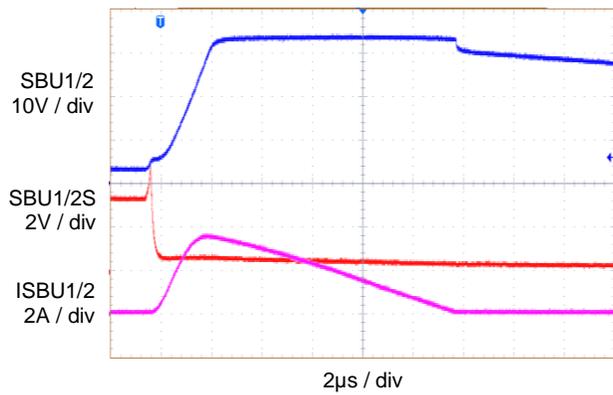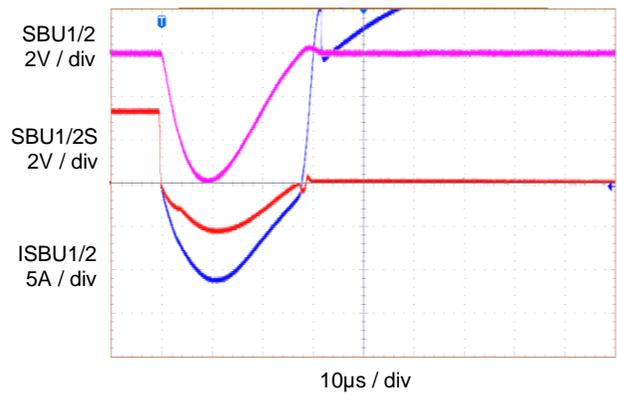
Functional Block Diagram
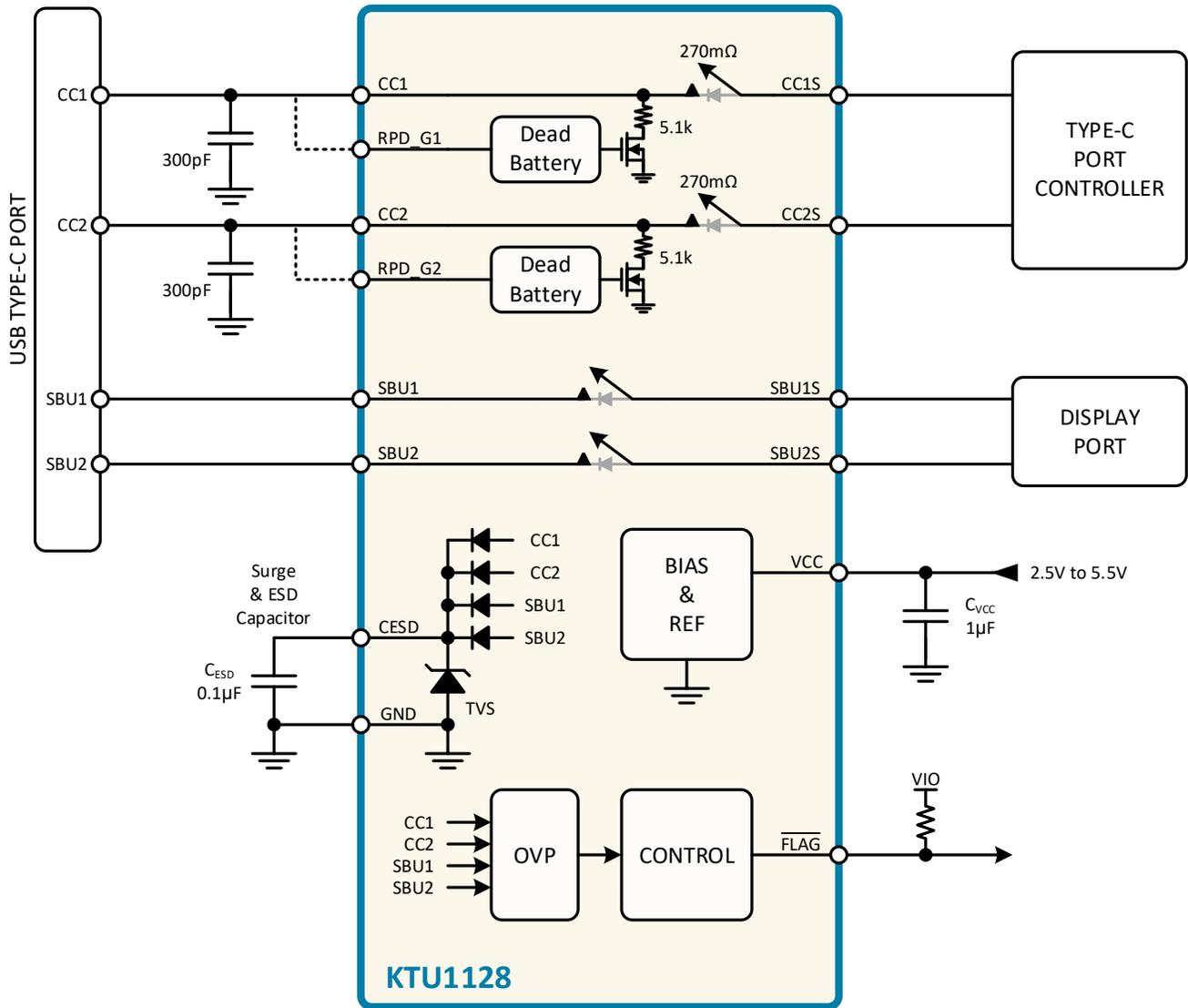
Functional Description

The KTU1128 integrates 4 switches to provide overvoltage protections for CC and SBU channels. Once there is a high voltage applied on any of them, for example, any of CC1/2 and SBU1/2 are shorted to VBUS (CC and SBU are adjacent to VBUS for a type-C connector.), all switches will be turned off to prevent damage to the downstream system.

Power Up and Down

After V_{CC} ramps up and beyond UVLO, part will turn on CC and SBU switches with respective delays of t_{ON_CC} and t_{ON_SBU}. However, longer time of $t_{ON\_DB\_DELAY}$ needs to wait for exiting DB (disconnecting 5.1k from CCx to GND) if RPD_G1 and RPD_G2 are all connected to CC1 and CC2 respectively, until stable connections have been established for CC channels.

When V_{CC} ramps down and below UVLO, all switches are turned off, and DB resistors are re-connected immediately.

More details can be found from "Power Up and Down" in "Timing Diagram" section.

Table 1. Control Logic Table (RPD_G1 and RPD_G2 are Connected to CC1 and CC2 Respectively)

IC Power	Conditions	Switch On/Off Status			$\overline{\text{FLAG}}$
		CC1/2	**SBU1/2**	**Dead Battery**	
$V_{CC} > V_{UVLO}$	No Faults	ON	ON	OFF	High-Z
	$V_{CC1/2} > V_{OVP\_CC}$	OFF	OFF	ON	Active Low
	$V_{SBU1/2} > V_{OVP\_SBU}$	OFF	OFF	ON	Active Low
	$T_J > T_{J\_SHDN}$	OFF	OFF	OFF	Active Low
$V_{CC} < V_{UVLO}$	$V_{CC1/2} = 2.6V$	OFF	OFF	ON	High-Z

Dead Battery Automatic 5.1kΩ Pull-Down

KTU1128 integrated pull-down resistor from CCx to GND, can be enabled by connecting RPD_G1 to CC1 and RPD_G2 to CC2. When under dead battery condition, DFP or adpaper can recognize the device through these pull-down resistors and start to feed power. After CC channels are turned on, KTU1128 cut those pull-down resistors automatically with a short period of delay. Those resistors are reconnected when CCx channels are off, for example when caused by UVLO or OVP, except OTP event.

See Figure 2 and Figure 3 for more details.

If there is no need for dead battery resistors, please short both RPD_G1 and RPD_G2 to ground.

Overvoltage Protection

Once any of those channels meet with OVP event, KTU1128 will shut all channels at once. $\overline{\text{FLAG}}$ will be pulled low to indicate there is a fault. After part is recovered, $\overline{\text{FLAG}}$ would be automatically return to High-Z.

Over-Temperature Protection

KTU1128 will also turn off all channels when OTP happens. $\overline{\text{FLAG}}$ will be pulled low to indicate there is a fault. However, dead-battery resistors will not be presented during OTP. They will be presented when OTP is over and before CCx channels are closed. See Figure 2.

Applications Information

For typical USB Type-C CC and SBU input port protection applications, only two external components are required for the KTU1128 to provide protection functions.

Input Supply and Bypass Capacitor Selection
Place a 1.0µF/10V ceramic capacitor between the VCC pin and ground. X5R or X7R dielectric ceramic capacitors are preferred for input supply bypass applications as they maintain better capacitance value and tolerance over operating voltage and temperature ranges when compared to lower cost Y5V dielectric type ceramic capacitors.

ESD Capacitor
KTU1128 utilizes an ESD support capacitor to meet ESD protection requirements. The ESD support capacitor should be placed between the CESD pin and ground. The CC1/2 and SBU1/2 inputs can have as much as 32V applied during a short-to-VBUS event. A 0.1µF/50V X5R or X7R dielectric ceramic capacitor is recommended for this application.

Dead Battery Detection / Operation
USB Type-C specification allows the host and peripheral device to charge internal batteries through the Type-C port receptacle. Dead battery detection is an important feature that allows a device to be charged when its internal battery supply is depleted. Another scenario for dead battery support is when the CC1/2 or SBU1/2 switches are shut down due to an OVP condition. Automatic 5.1kΩ dead battery pull-down resistors on the CC1/2 inputs signal to a connected upstream USB current source PD host or wall adapter to allow charging through the USB Type-C port VBUS. When an applied adapter senses a 5.1kΩ pull-down on CC1/2, 5V should be applied to the VBUS line to enable charging. For this reason, the KTU1128 contains an automatic dead battery sub-circuit. The CC1/2 pin impedance to ground is 5.1kΩ when the IC is shut down by the UVLO function due to a dead battery. When the IC is enabled under regular operation conditions, the CC1/2 impedance to ground is switched to over 10MΩ to support normal CC line functions. Refer to Table 1 for the control logic of CC1/2 line-states versus operation conditions.

Moisture Testing
In systems that perform moisture detection on the USB port, it is typical to apply a test current through the KTU1128 and out of the connector-side pins. Moisture presents itself as a resistance path from the connector-side pins to ground. The threshold for moisture detection is usually less than 1MΩ of external leakage resistance to ground. To simplify moisture detection, the KTU1128 features over 10MΩ internal impedance from the connector-side pins to ground. However, it is important to keep in mind that KTU1128's internal impedance reduces when the voltage on the connector-side pins (CC1/2, SBU1/2) is greater than the device supply voltage (V_{CC}). Therefore, it is important to use a weak test current for a suitably low moisture detection threshold. An alternate solution is to use a pull-up resistor to a voltage source, for example, 30kΩ pull-up to 2.7V.

Fault Flag Operation
The KTU1128 fault flag will alert the system controller to an OVP, surge or IC over temperature fault. The fault flag circuit is an open-drain MOSFET output that connects the $\overline{\text{FLAG}}$ pin to ground when there is an active fault condition. Refer to the IC functional block diagram for internal fault flag circuit connections. Common system controllers can typically be configured to place a logic pull-up on the fault flag input signal, in these cases the $\overline{\text{FLAG}}$ output can be connected directly to the controller I/O. If a logic pull-up termination is not available, the $\overline{\text{FLAG}}$ output may be manually pulled-up high to a logic level voltage supply through a 10kΩ or greater value resistor.

Recommended PCB Layout
See Figure 4 for an example PCB layout. When laying out a PCB, follow the below guidelines:

1. Place the bypass capacitors as close as possible to the VCC pin, and ESD protection capacitor as close as possible to the CESD pin. Capacitors must be attached to a solid ground. This minimizes voltage disturbances during transient events such as short-to-VBUS and ESD strikes.

2. The SBU lines must be routed as straight as possible, and any sharp bends must be minimized. Standard ESD recommendations apply to the CC1, CC2, SBU1, SBU2.

3. The optimum placement for the device is as close to the connector as possible:

a) EMI during an ESD event can couple from the trace being struck to other nearby unprotected traces, resulting in early system failures.

b) The PCB designer must minimize the possibility of EMI coupling by keeping any unprotected traces away from the protected traces which are between the KTU1128 and the connector.

4. Route the protected traces as straight as possible.

5. Eliminate any sharp corners on the protected traces between the TVS and the connector by using rounded corners with the largest radii possible.
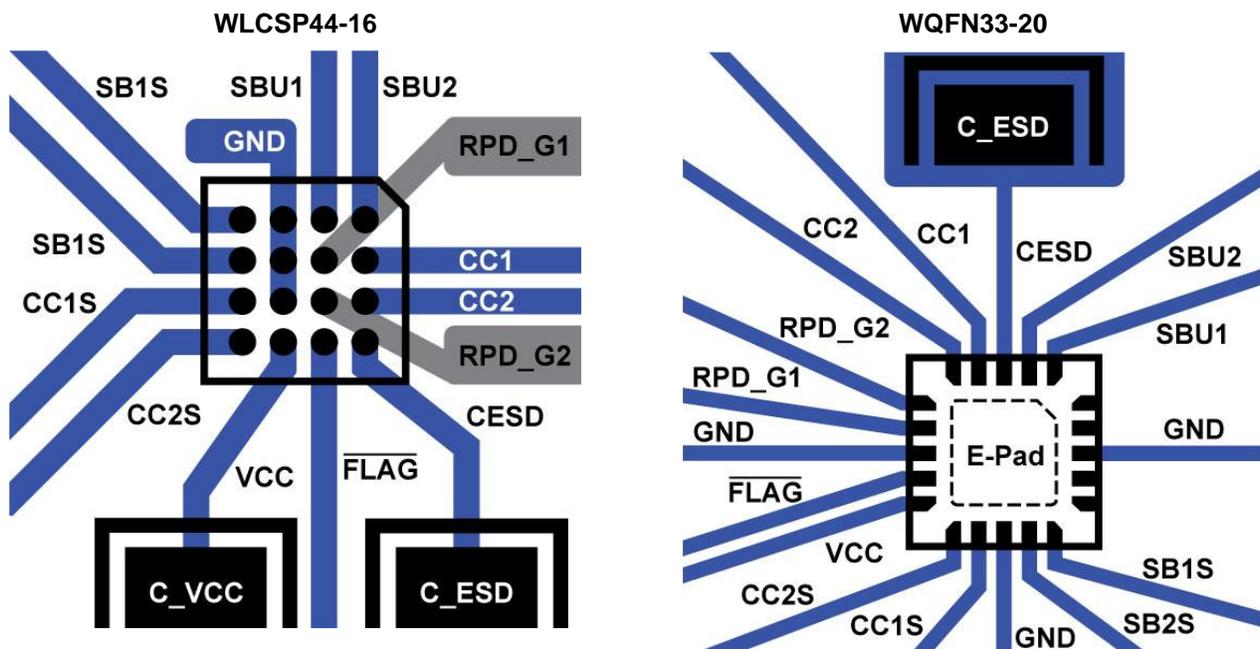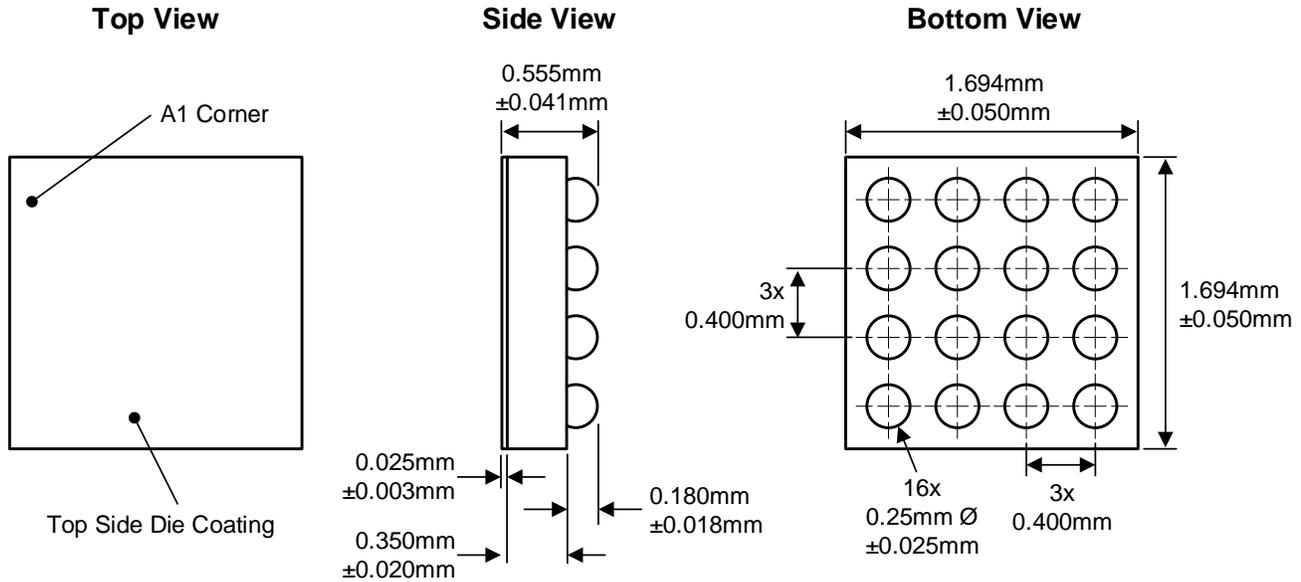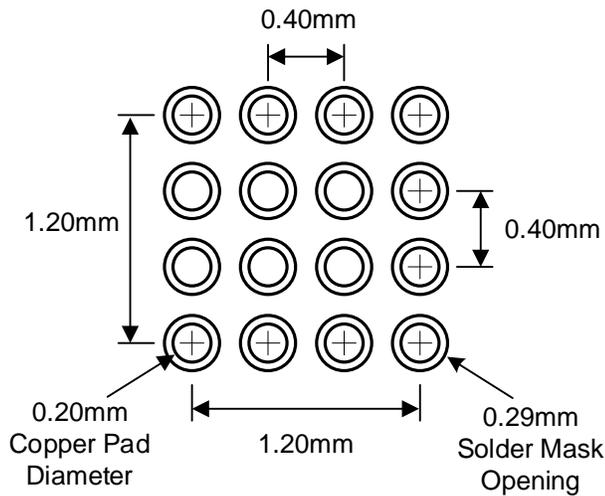

Figure 4. Recommended PCB Layout

Packaging Information

WLCSP44-16 (1.694mm x 1.694mm x 0.555mm)

Top View

A1 Corner

Top Side Die Coating

Side View

0.555mm
±0.041mm

0.025mm
±0.003mm

0.350mm
±0.020mm

0.180mm
±0.018mm

Bottom View

1.694mm
±0.050mm

1.694mm
±0.050mm

3x
0.400mm

16x
0.25mm Ø
±0.025mm

3x
0.400mm

Recommended Footprint

(NSMD Pad Type)

0.40mm

1.20mm

0.40mm

1.20mm

0.20mm
Copper Pad
Diameter

0.29mm
Solder Mask
Opening

Packaging Information

WQFN33-20 (3.00mm x 3.00mm x 0.75mm)

Top View

Bottom View

A1 Corner

b x20

Side View
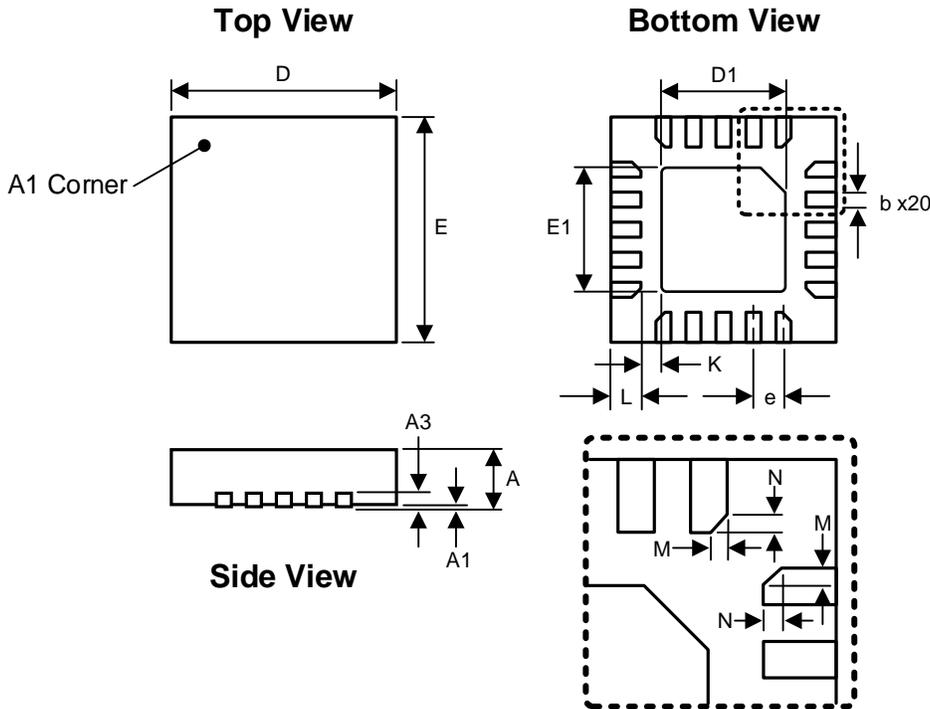
Dimension	mm		
	Min.	Typ.	Max.
A	0.70	0.75	0.80
A1	0.00	0.02	0.05
A3	0.203 REF		
b	0.15	0.20	0.25
D	2.90	3.00	3.10
D1	1.60	1.65	1.70
E	2.90	3.00	3.10
E1	1.60	1.65	1.70
e	0.40 BSC		
K	0.20	–	–
L	0.30	0.40	0.50
M	–	0.10	–
N	–	0.10	–

Recommended Footprint

2.05

1.65

1.65

0.40

0.22

0.83

2.05