# USB Type-C Protector for CC and SBU Pins

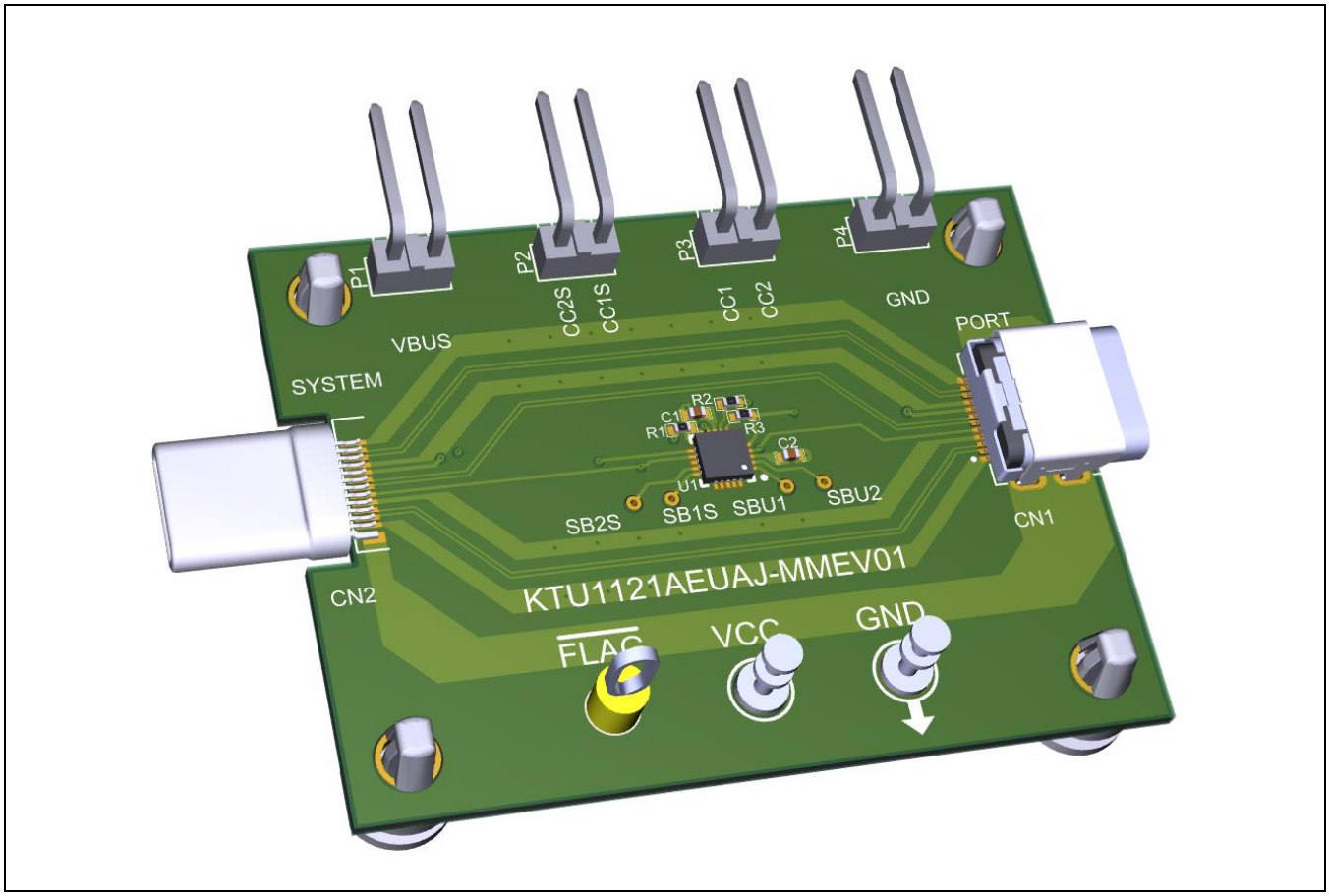
## Brief Description

The KTU1121A Evaluation (EVAL) Kit is used to demonstrate and evaluate the KTU1121A USB Type-C CC and SBU pin protection switch functionality, performance, and PCB layout. The kit includes a fully assembled and tested PCB with the KTU1121A IC installed and a printed copy of the Quick Start Guide (also contained within this document).

## Ordering Information

| Part Number | Description | IC Package |
|---|---|---|
| KTU1121AEUAJ-MMEV01 | KTU1121A EVAL Kit | TQFN33-20 |

## 3D CAD Image



## EVAL Kit Physical Contents

| Item # | Description | Quantity |
|---|---|---|
| 1 | KTU1121A EVAL fully assembled PCB | 1 |
| 3 | Anti-static bag | 1 |
| 4 | Quick Start Guide, printed 1 page (A4 or US Letter) | 1 |
| 5 | EVAL Kit box | 1 |

## QR Links for Documents

| EVAL Kit Manual | IC Datasheet |
|---|---|
| https://www.kinet-ic.com/ktu1121a/ | https://www.kinet-ic.com/ktu1121aeuaj-mmev01/ |

## User-Supplied Equipment

### Required Equipment

1. Bench Power Supplies for VCC and $V_{CC1}$/$V_{CC2}$ or $V_{SUB1}$/$V_{SBU2}$, 0 to 5.0V variable with a 1A or more capability, as needed for the intended application.
2. Digital Multimeters – one or more, used to measure input/output voltages and currents.

### Optional Equipment

1. Waveform signal generator to create simulated pulse for OVP shutdown timing experiments or CC data line signal source.
2. Oscilloscope – To observe CC1/CC2 to CC1S/CC2S or SBU1/SBU2 to SBU1S/SBU2S signals.

## Recommended Operating Conditions

| Symbol | Description | Value | Units |
|---|---|---|---|
| $V_{CC}$ | Input Operating Voltage | 2.5 to 5.5 | V |
| $V_{SBU1/2}$ | SBU1/2 Switch Operating Voltage | -0.3 to 4.5 | |
| $V_{CC1/2}$ | CC1/2 Switch Operating Voltage | -0.3 to 5.5 | V |
| $V_{IO}$ | Output Withstand Voltage | -0.3 to 24 | V |
| $V_{CC1/2S\_MAX}$ | OVP Rising Maximum System Voltage | 5.9 | V |

## Quick Start Procedures

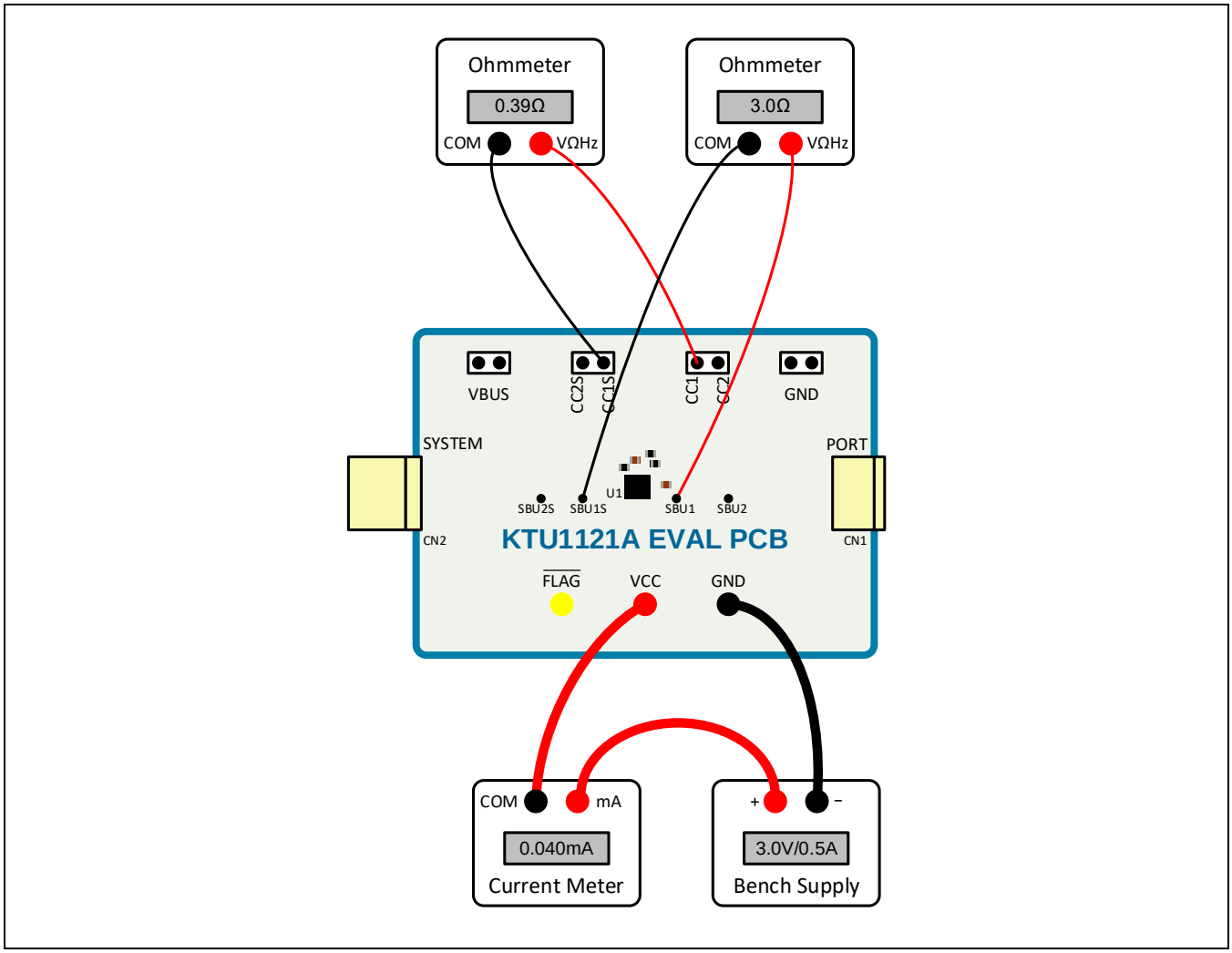
1. Before connecting the EVAL Kit board to the VCC bench supply, turn on the supply and adjust the voltage as close to 0V as possible. Then turn off or disable the supply output. While off, connect power supply test leads to the power supply output.
2. Connect the power supply positive test lead to the evaluation board VCC terminal and the negative or ground lead to the GND terminal.
3. Turn on the VCC bench supply and very slowly ramp the output voltage to an appropriate level for the intended system, typically between 3.0V and 5.0V. While ramping VCC slowly, use the bench supply's

output current indication (or a digital multimeter) to monitor the VCC current. If the current becomes high, reduce the VCC voltage quickly to prevent damage, then inspect the setup for any wiring errors.

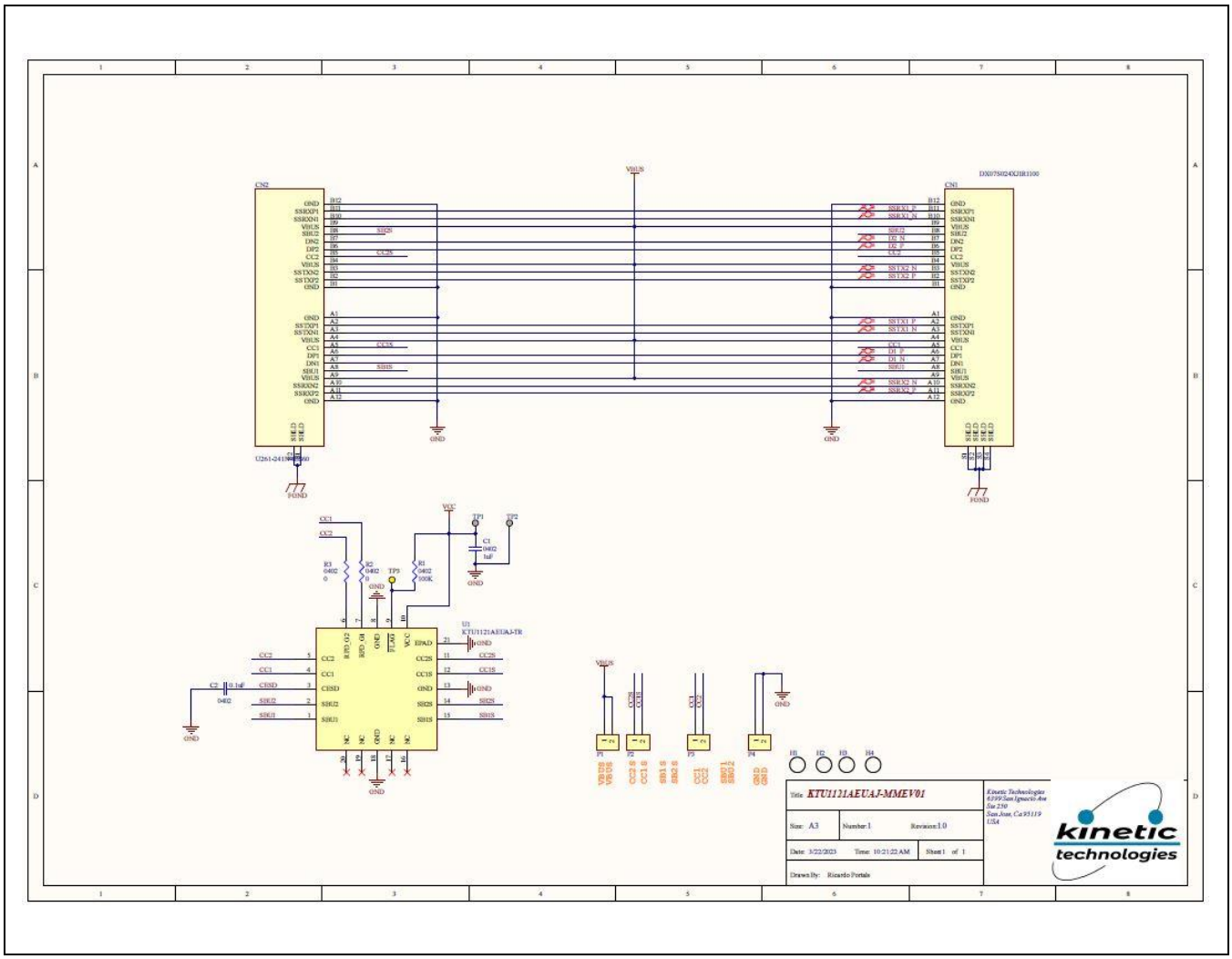
4. With a valid VCC voltage to enable the KTU1121A IC, use a digital multimeter to check the resistance between the SBU1 to SBU1S test pads or the SBU2 to SBU2S test pads. When powered, the resistance from SBU1 to SBU1S or SBU2 to SBU2S should be typically be 3Ω and less than 6.3Ω.
5. With the VCC power supply disabled or turned off, the SBU switches should be open or high impedance. Measured resistance between SBU1 to SBU1S or SBU2 to SBU2S should be greater than 1MΩ.
6. With a valid VCC voltage to enable the KTU1121A IC, use a digital multimeter to check the resistance between the CC1 to CC1S pins or the CC2 to CC2S pins. When powered, the resistance from CC1 to CC1S or CC2 to CC2S should be less than 1Ω.
7. With the VCC power supply disabled or turned off, the CC switches should be open or high impedance. Measured resistance between CC1 to CC1S or CC2 to CC2S should be greater than 1MΩ.

## Typical Test Setup Diagram

As an example, use the following test setup to measure items 4 through 7 in the Quick Start Procedures.



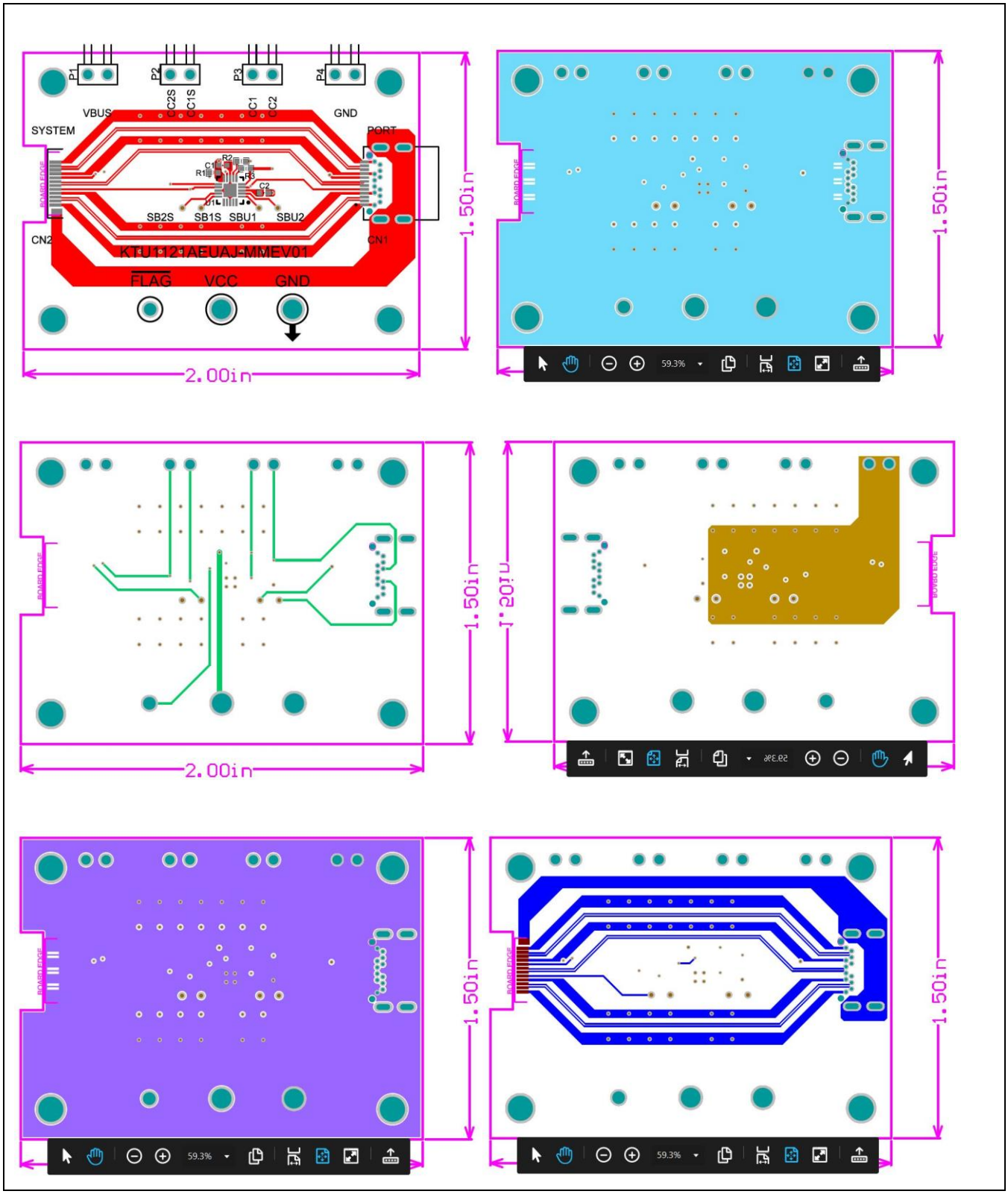
## Electrical Schematic



## Bill of Materials (BOM)

| Item # | Quantity | Designator | Description | Value | Package | Manufacturer | Manufacturer Part Number | Digikey Part Number | Mouser Part Number |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | C1 | CAP CER 1.0uF 35V X5R 0402 | 1uF | 0402 | Samsung | CL05A105KL5NRNC | 1276-6796-1-ND | 187-CL05A105KL5NRNC |
| 2 | 1 | C2 | CAP CER 0.1uF 50V X7R 0402 | 0.1uF | 0402 | Samsung | CL05B104KB54PNC | 1276-CL05B104KB54PNCCT-ND | 187-CL05B104KB54PNC |
| 3 | 1 | CN1 | CONN RCP USB3.1 TYPEC 24P SMD RA | | | JAE Electronics | DX07S024XJ1R1100 | 670-2848-1-ND | 656-DX07S024SJ1R1100 |
| 4 | 1 | CN2 | 5A USB 3.1 1 260℃ Board Edge, Straddle Mount 24 Male - 40℃~+85℃ Gold Copper Alloy Type-C SMD USB Connectors ROHS | | | XKB Connectivity | U261-241N-4BS60 | | |
| 5 | 4 | H1, H2, H3, H4 | BRD SPT SNAP LOCK REST MNT 4MM | | | Essentra Components | PSD-4M-19 | PSD-4M-19-ND | 144-PSD-4M-19 |
| 6 | 4 | P1, P2, P3, P4 | CONN HEADER R/A 2POS 2.54MM | | | Molex | 0022122021 | 23-0022122021-ND | NA |
| 7 | 1 | R1 | RES 100K OHM 1% 1/16W 0402 | 100K | 0402 | Yageo | RC0402FR-07100KL | 311-100KLRCT-ND | 603-RC0402FR-07100KL |
| 8 | 2 | R2, R3 | RES O OHM 1% 1/16W 0402 | 0 | 0402 | Yageo | RC0402FR-070RL | 311-0.0LRCT-ND | 603-RC0402FR-070RL |
| 9 | 2 | TP1, TP2 | TERM TURRET SINGLE L=5.56MM TIN | | TH | Keystone | 1502-2 | 36-1502-2-ND | 534-1502-2 |
| 10 | 1 | TP3 | PC TEST POINT MULTIPURPOSE YELLOW | | TH | Keystone | 5014 | 36-5014-ND | 534-5014 |
| 11 | 1 | U1 | USB Type-C Port Protector for CC and SBU Pins | | TQFN33-20 | Kinetic Technologies | KTU1121AEUAJ-TR | | 389-KTU1121EUAJ-TD |

## Printed Circuit Board (PCB)



## Additional Test Procedures

1. SBU Switch Turn on time
    a. The KTU1121A SBU switch turn-on time requires two power supplies and the use of a 2-Channel oscilloscope.
    b. Set one bench power supply to the desired VCC level between 3.0V and 5.0V (typical), then disable the supply output. Connected the bench power supply positive test lead to VCC and the negative test lead to GND.
    c. Set a second bench power supply to output any desired voltage level greater than 0V, but less than or equal to 5.0V to simulate the SBU line logic high voltage level. Disable the supply and connect the positive test lead to either the SBU1 or SBU2 terminal on the EVB and the negative test lead to GND.
    d. Connect Channel 1 of the oscilloscope to the VCC terminal to trigger on the applied input power event. Connect Channel 2 to the respective SBU1S to SBU2S data line test pad for the switch under test.
    e. Enable the supply to CC1/CC2, then enable the supply to VCC.
    f. Observe the turn-on switch waveform on the oscilloscope to measure the SBU switch turn-on time vs the VCC input supply turn-on event.
2. SBU Switch OVP Response
    a. The KTU1121A SBU switch OVP response time and threshold may be observed using an oscilloscope and power supply or pulse generator applied to the SBU1 or SBU2 input.
    b. Set one bench power supply to the desired VCC level between 3.0V and 5.0V (typical), then disable the supply output. Connected the bench power supply positive test lead to VCC and the negative test lead to GND.
    c. Use a pulse generator or bench power supply to provide simulated SBU line voltage to the SBU1 or SBU2 input. If using a bench power supply, set an initial output level to apply to the SBU pin in the range of 0.5V. If using a pulse generator, set a pulse for 0.5V amplitude with an on-time greater than 10µs.
    d. Connect an oscilloscope channel 1 to the respective SBU1 or SBU2 input under test. Connect Channel 2 to the respective SBU1S or SBU2S switch output.
    e. Enable the KTU1121A SBU switches by turning on the VCC input supply.
    f. Slowly increase the applied SBU input signal amplitude and observe the SBU1S/SBU2S voltage level tracking SBU1/2 input level. The KTU1121A typical OVP threshold is 4.8V, when the applied input signal amplitude meets or exceeds the switch OVP threshold, the SBU protection switches will open and the signal observed at SBU1S or SBU2S should drop to 0V. The SBU switch input can withstand signal levels up to 24V without damage to the device. Refer to the KTU1121A device datasheet Absolute Maximum Ratings and Electrical Characteristics tables for the complete set of limits and specifications for the SBU protections switches.
    g. If an additional oscilloscope channel is available, a probe may be attached to the FLAG-BAR terminal to observe the logic active low fault flag response during an OVP event.
3. CC Switch Turn on time
    a. The KTU1121A CC switch turn on time requires two power supplies and the use of a 2-Channel oscilloscope.
    b. Set one bench power supply to the desired VCC level between 3.0V and 5.0V (typical), then disable the supply output. Connected the bench power supply positive test lead to VCC and the negative test lead to GND.

c. Set a second bench power supply to output any desired voltage level greater than 0V, but less than or equal to 5.0V to simulate the CC line logic high voltage level. Disable the supply and connect the positive test lead to either the CC1 or CC2 terminal on the EVB and the negative test lead to GND.
d. Connect Channel 1 of the oscilloscope to the VCC terminal to trigger on the applied input power event. Connect Channel 2 to the respective CC1S to CC2S terminal for the switch under test.
e. Enable the supply to CC1/CC2, then enable the supply to VCC
f. Observe the turn-on switch waveform on the oscilloscope to measure the CC switch turn-on time vs the VCC supply turn-on event.

4. CC Switch OVP Response
   a. The KTU1121A CC switch OVP response time and threshold may be observed using an oscilloscope and power supply or pulse generator applied to the CC1 or CC2 input.
   b. Set one bench power supply to the desired VIN level between 3.0V and 5.0V (typical), then disable the supply output. Connected the bench power supply positive test lead to VCC and the negative test lead to GND.
   c. Use a pulse generator or bench power supply to provide simulated CC line voltage to the CC1 or CC2 input. If using a bench power supply, set an initial output level to apply to the CC pin in the range of 0.5V. If using a pulse generator, set a pulse for 0.5V amplitude with an on-time greater than 10µs.
   d. Connect an oscilloscope channel 1 to the respective CC1 or CC2 input under test. Connect Channel 2 to the respective CC1S or CC2S switch output.
   e. Enable the KTU1121A CC switches by turning on the VCC supply.
   f. Slowly increase the applied CC input signal amplitude and observe the CC1S/CC2S voltage level tracking CC1/2 input level. The KTU1121A typical OVP threshold is 5.8V, when the applied input signal amplitude meets or exceeds the switch OVP threshold, the CC protection switches will open, and the signal observed at CC1S or CC2S should drop to 0V. The CC switch input pins can withstand signal levels up to 24V without damage to the device. Refer to the KTU1121A device datasheet Absolute Maximum Ratings and Electrical Characteristics tables for the complete set of limits and specifications for the CC protections switches.
   g. If an additional oscilloscope channel is available, a probe may be attached to the FLAG-BAR terminal to observe the logic active low fault flag response during an OVP event.

## Evaluating Other ICs

This EVAL Kit may optionally be used to evaluate the similar KTU1121 (non-A version) USB Type-C Port Protector. Before ordering samples of these devices, please confirm capability to reflow and exchange with this TQFN package device.

# Important Notices

## Legal notice



Kinetic Technologies assumes no responsibility or liability for information contained in this document. Kinetic Technologies reserves the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or services without notice. The information contained herein is believed to be accurate and reliable at the time of printing.

## Reference design policy

This document is provided as a design reference and Kinetic Technologies assumes no responsibility or liability for the information contained in this document. Kinetic Technologies reserves the right to make corrections, modifications, enhancements, improvements, and other changes to this reference design documentation without notice.

Reference designs are created using Kinetic Technologies' published specifications as well as the published specifications of other device manufacturers. This information may not be current at the time the reference design is built. Kinetic Technologies and/or its licensors do not warrant the accuracy or completeness of the specifications or any information contained therein.

Kinetic Technologies does not warrant that the designs are production worthy. Customer should completely validate and test the design implementation to confirm the system functionality for the end use application.

Kinetic Technologies provides its customers with limited product warranties, according to the standard Kinetic Technologies terms and conditions.

For the most current product information visit us at www.kinet-ic.com

## Life support policy

LIFE SUPPORT: KINETIC TECHNOLOGIES' PRODUCTS ARE NOT DESIGNED, INTENDED, OR AUTHORIZED FOR USE AS COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS. NO WARRANTY, EXPRESS OR IMPLIED, IS MADE FOR THIS USE. AUTHORIZATION FOR SUCH USE SHALL NOT BE GIVEN BY KINETIC TECHNOLOGIES, AND THE PRODUCTS SHALL NOT BE USED IN SUCH DEVICES OR SYSTEMS, EXCEPT UPON THE WRITTEN APPROVAL OF THE PRESIDENT OF KINETIC TECHNOLOGIES FOLLOWING A DETERMINATION BY KINETIC TECHNOLOGIES THAT SUCH USE IS FEASIBLE. SUCH APPROVAL MAY BE WITHHELD FOR ANY OR NO REASON.

“Life support devices or systems” are devices or systems which (1) are intended for surgical implant into the human body, (2) support or sustain human life, or (3) monitor critical bodily functions including, but not limited to, cardiac, respirator, and neurological functions, and whose failure to perform can be reasonably expected to result in a significant bodily injury to the user. A “critical component” is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

## SUBSTANCE COMPLIANCE

Kinetic Technologies IC products are compliant with RoHS, formally known as Directive 2002/95/EC of the European Parliament and of the Council of 27 January 2003 on the restriction of the use of certain hazardous substances in electrical and electronic equipment. However, this evaluation kit does not fall within the scope of the EU directives regarding electromagnetic compatibility, restricted substances (RoHS), recycling (WEEE), FCC, CE or UL, and may not meet the requirements of these or related directives. To the best of our knowledge the information is true and correct as of the date of the original publication of the information. Kinetic Technologies bears no responsibility to update such statement.