Surge Protected Load Switch with OVP and OCP

Brief Description

The KTS1693 Evaluation (EVAL) Kit is used to demonstrate and evaluate the KTS1693 functionality, performance, and PCB layout. The kit includes a fully assembled and tested PCB with the KTS1693 IC installed, two pairs of high-current XT30-to-Banana power cables, and a printed copy of the Quick Start Guide (also contained within this document).

Ordering Information

Part Number	Description	IC Package
KTS1693EVB-MMEV01	KTS1693 EVAL Kit	WLCSP-20

3D CAD Image

EVAL Kit Physical Contents

Item #	Description	Quantity
1	KTS1693 EVAL fully assembled PCB	1
2	XT30-to-Banana power cables, red/black pair	2 pairs
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

IC Datasheet	EVAL Kit Landing Page
https://www.kinet-ic.com/kts1693/	https://www.kinet-ic.com/kts1693evb-mmev01/

User-Supplied Equipment

Required Equipment

1. Bench Power Supply for VIN – 10V/30V and 0.5A/6A, as needed for the intended application. For testing over-voltage protection and withstand voltage, a 28V adjustable bench power supply is preferred.
2. Digital Multimeter – one or more, used to measure input/output voltages and currents.

Optional Equipment

1. Bench Power Supply for VIO – 1.5V to 5V, low current. Needed for shutdown mode ($\overline{EN}$ = VIO = High) and power good monitoring ($\overline{ACOK}$ pull-up voltage).
2. Oscilloscope – for dynamic testing of voltages (and currents with a current probe, if available).
3. Load – either an eLoad, power resistors, or an actual system load.
4. Additional Digital Multimeters

Recommended Operating Conditions

Symbol	Description	Value	Units
VIN	Input Withstand Voltage	-0.3 to 28	V
	Input Operating Voltage	2.8 to 5.7 (OVP)	V
VIO	VIO Operating Voltage	1.5 to 5.5	V
I_{OUT}	Output Load Current	0 to 6	A
I_{VDET}	VDET Output Current	0 to 3	mA

Jumper Descriptions

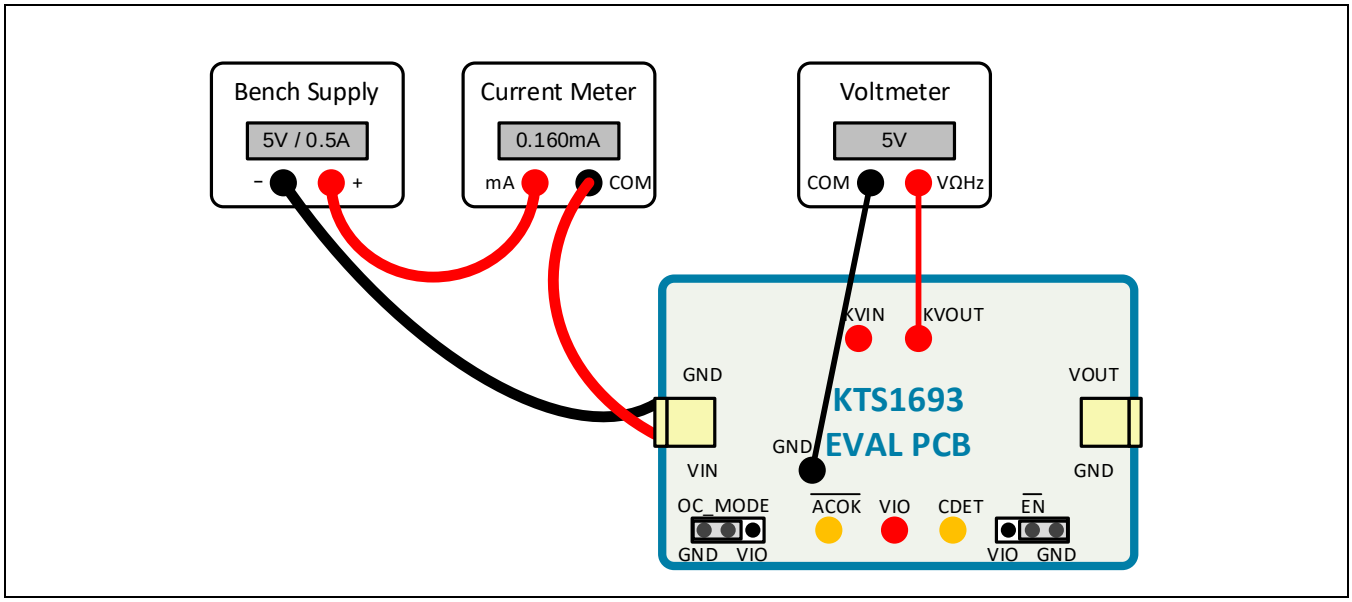
Designator	Name	Description	Default
P1	$\overline{EN}$	Active-Low Enable Input VIO (High): Shutdown Mode – switch disabled GND (Low): Enable Mode – normal switch operation	GND
P2	OC_MODE	OCP behavior select pin with internal pull-up 5MΩ. VIO (High): Auto restart mode during over-current condition. GND (Low): Over-current protection mode during over-current condition	GND

Quick Start Procedures

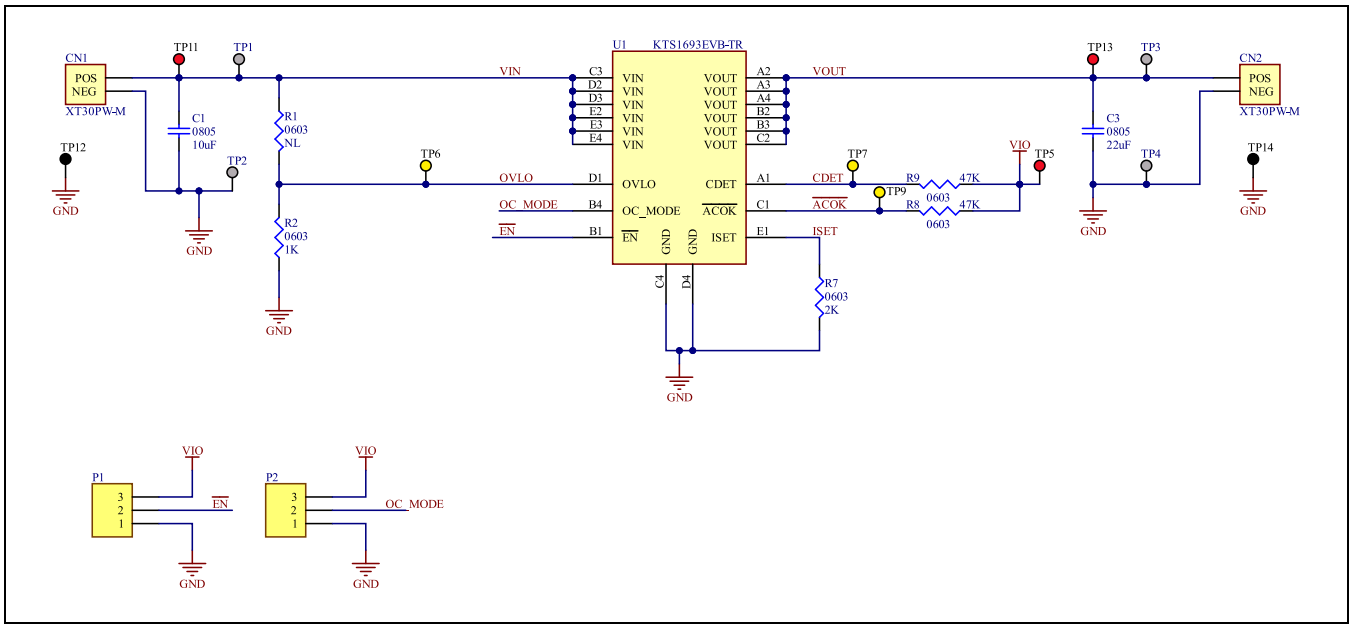
1. Set Jumpers to default: $\overline{EN}$ = GND
2. Connect one pair of XT30-to-Banana power cables to the XT30 connector at VIN and GND (left edge of EVAL Kit).
3. Before connecting the EVAL Kit to the VIN bench supply, turn on the supply and adjust the voltage as close to 0V as possible. Then turn off the supply. While off, connect the banana ends of the XT30-to-Banana power cables to the VIN bench supply.
4. Turn on the VIN bench supply and very slowly ramp its voltage to an appropriate voltage, such as 5V. While ramping VIN slowly, use the bench supply's output current indication (or a digital multimeter) to monitor the VIN current. If the current becomes high, reduce the VIN voltage quickly to prevent damage. Then inspect the setup for any wiring errors.
5. With valid VIN voltage such as 5V, use a digital multimeter to check the output voltage between the KVOUT and GND terminals on the EVAL Kit. It should be the same as the input voltage.
6. Use a digital multimeter to check the no-load supply current at VIN. Consult the KTS1693 datasheet for the expected current range at the VIN voltage condition in use. For conditions of VIN = 5V, $\overline{EN}$ = GND, and no-load, it should be close to 160μA.

Typical Test Setup Diagram

As an example, use the following test setup to measure items 5 and 6 in the Quick Start Procedures.



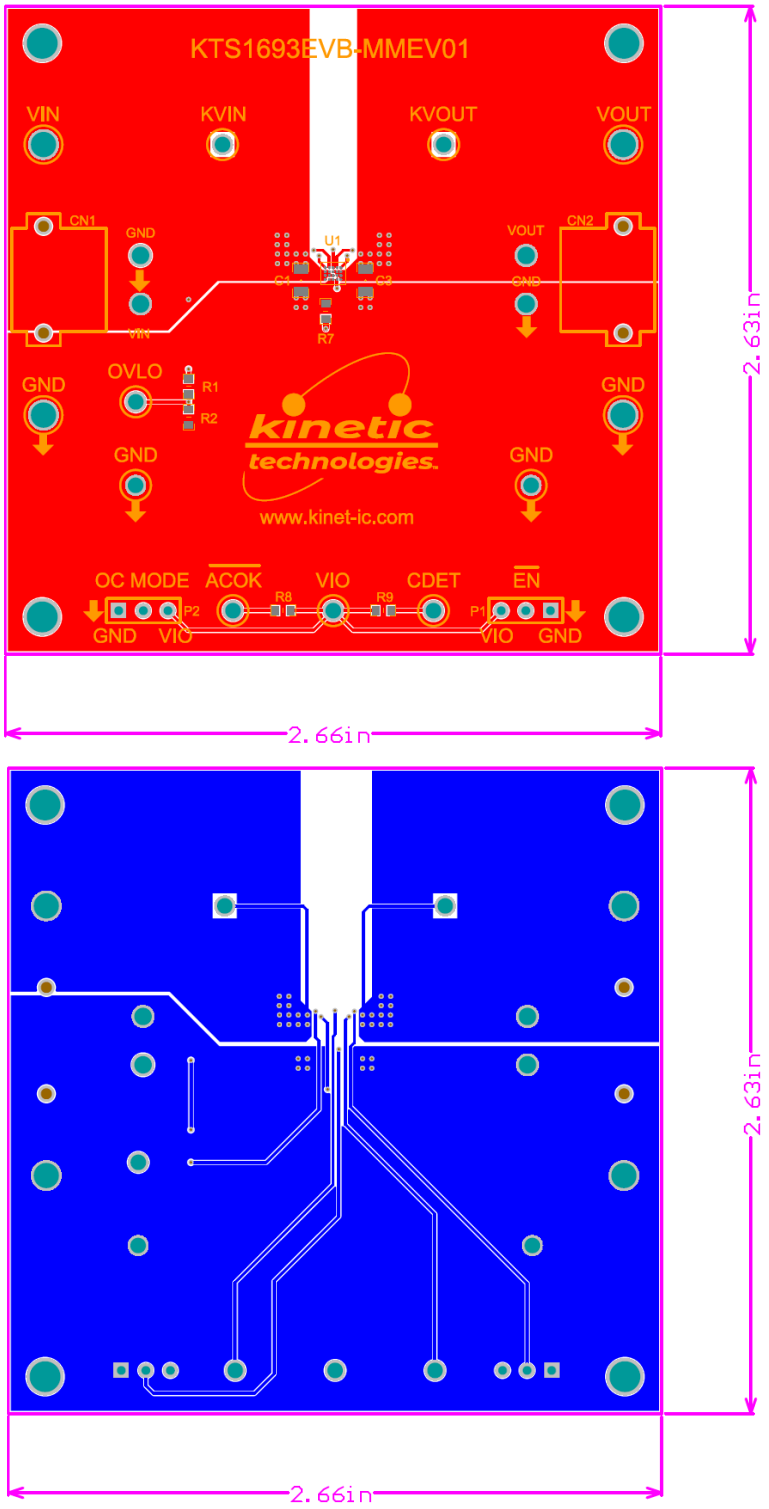
Electrical Schematic



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 10uF 50V X5R 0805	10uF	0805	Murata	GRM21BR61H106KE43L	490-18663-1-ND	81-GRM21BR61H106KE3L
2	1	C3	CAP CER 22uF 25V X5R 0805	22uF	0805	Murata	GRM21BR61E226ME44L	490-10749-1-ND	81-GRM21BR61E226ME4L
3	2	CN1, CN2	30A Right Angle Through Hole Power Connectors			AMASS	XT30PW-M		
4	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
5	2	P1, P2	CONN HEADER VERT 3POS 2.54MM		TH	Sullins Connector Solutions	PREC003SAAN-RC	S1012EC-03-ND	
6	1	R1	RES SMD 0603	NL	0603				
7	1	R2	RES 1K 1% 1/10W 0603	1K	0603	Yageo	RC0603FR-071KL	311-1.00KHRCT-ND	603-RC0603FR-071KL
8	1	R7	RES 2.0K 1% 1/10W 0603	2K	0603	Yageo	RC0603FR-072KL	311-2.00KHRCT-ND	603-RC0603FR-072KL
9	2	R8, R9	RES 47K 1% 1/10W 0603	47K	0603	Yageo	RC0603FR-0747KL	311-47.0KHRCT-ND	603-RC0603FR-0747KL
10	4	TP1, TP2, TP3, TP4	TERM TURRET SINGLE L=5.56MM TIN		TH	Keystone	1502-2	36-1502-2-ND	534-1502-2
11	3	TP5, TP11, TP13	PC TEST POINT MULTIPURPOSE RED		TH	Keystone	5010	36-5010-ND	534-5010
12	3	TP6, TP7, TP9	PC TEST POINT MULTIPURPOSE YELLOW		TH	Keystone	5014	36-5014-ND	534-5014
13	2	TP12, TP14	PC TEST POINT MULTIPURPOSE BLACK		TH	Keystone	5011	36-5011-ND	534-5011
14	1	U1	Surge Protected Load Switch with OVP and OCP		WLCSP45-20	Kinetic Technologies	KTS1693EVB-TR		389-KTS1693EVB-TR

Printed Circuit Board (PCB)



Additional Test Procedures

1. Logic Pins Testing:
    a. Before connecting the EVAL Kit to the VIO bench supply, turn on the supply and adjust the voltage as close to 0V as possible. Then turn off the supply. While off, connect the VIO bench supply to VIO and GND terminals on the EVAL Kit (with user-supplied banana-to-clip leads).
    b. Turn on the VIO bench supply and very slowly ramp its voltage to an appropriate voltage, such as 1.8, 3.3, or 5V. While ramping VIO slowly, use the bench supply's output current indication (or a digital multimeter) to monitor the VIO current. If the current becomes high, reduce the VIO voltage quickly to prevent damage. Then inspect the setup for any wiring errors.
    c. With valid VIO at 3V and VIN voltage at 5V, check the $\overline{EN}$ and $\overline{ACOK}$ functionality.
    d. Check the shutdown supply current at VIN with $\overline{EN}$ = VIO. The shutdown supply current should be around 1μA only. $\overline{ACOK}$ Power Good flag pin voltage should be close to VIO = 3V.
    e. With $\overline{EN}$ = GND, check the $\overline{ACOK}$ Power Good output pulls low to GND when VIN > 2.8V (UVLO) and VIN < 5.77V (OVLO).
2. Testing with Load:
    a. Use the second XT30-to-Banana power cable pair to apply loads between VOUT and GND.
    b. Under heavy-load conditions, use caution. The KTS1693 IC may become hot; avoid skin contact.
    c. Use multimeters and an oscilloscope to make DC and transient measurements as desired.

3. To check the KTS1693 OVP (over voltage protection) functionality:
    a. Slowly increase the power-supply voltage VIN from 5V to 6V.
    b. Check that the output voltage VOUT drops to zero once the input voltage VIN exceeds the Internal Overvoltage Trip level or 5.95V typical.

4. To check the KTS1693 OCP (over current protection) functionality:
    a. Slowly increase the E-load output current IOUT from 4.5A to 5.5A.
    b. Check that the output voltage VOUT drops to zero once the output current IOUT exceeds about 5.0A typical.

5. To measure the KTS1693 OVP/OCP switch on-resistance $R_{DS(ON)}$:
    a. Measure the output current between the VOUT terminal and the load.
    b. Measure the voltage between the test points KVin and KVout (Kelvin connections).
    c. The switch resistance can be calculated with the formula: $R_{DS(ON)}$ = (VKVin – VKVout) / IOUT.

Troubleshooting

Symptom	Root Cause	Solution
$\overline{ACOK}$ does not go high during faults.	VIO supply is off or not connected.	Connect and enable a VIO pull-up supply. $\overline{ACOK}$ has an Absolute Maximum Rating of 6V.
$\overline{EN}$ = VIO does not disable the switch.	VIO supply is off or not connected.	Connect and enable a VIO pull-up supply. $\overline{EN}$ has an Absolute Maximum Rating of 6V.

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