IEEE® 802.3af/at/bt PoE PD with Active Clamp Flyback/Forward DC-DC Controller

Brief Description

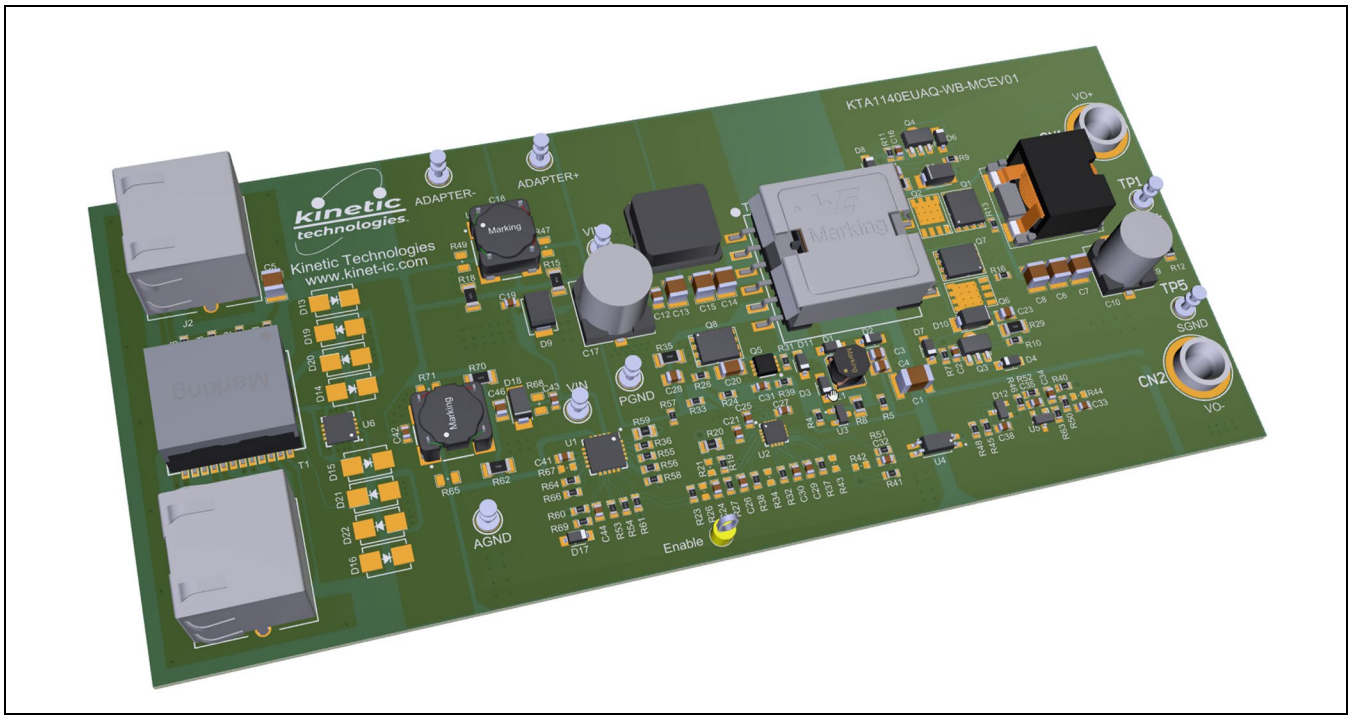
The KTA1140 Evaluation (EVAL) Kit is used to demonstrate and evaluate the functionality, performance and PCB layout of KTA1140. The kit includes a fully assembled and tested PCB with the KTA1140 IC installed. The KTA1140 device is an IEEE® 802.3af/at/bt compliant powered device interface controller optimized for isolated and non-isolated converter topologies. Along with the KTA1140, this evaluation board is also designed with Kinetic's KTB2140 and KTA1170. The KTB2140 is an active clamp current-mode DC-DC PWM controller that is optimized for Flyback and Forward topologies. The KTA1170 is a single chip dual MOSFET bridge rectifier for Power over Ethernet applications. Together, this design kit demonstrates a highly integrated and power efficient solution for designing an IEEE® 802.3bt standard compliant PD system with best-in-class efficiency and size. This evaluation board delivers 72W at 12V output with an active clamp forward topology and includes power and signal I/O connections with an array of test points for signal observation.

Please note that there is an alternative KTA1140 kit created for the evaluation of the KTA1140 together with the KTB1095, which is a flyback voltage regulator that integrates a gate driver for a fully synchronous output rectification and a built-in digital isolator providing up to 3000V RMS isolation. Click on this link or contact a Kinetic Technologies Sales representative for further details.

Ordering Information

Part Number	Description	IC Package
KTA1140EUAQ-WB-MCEV01	KTA1140 EVAL Kit – including KTB2140 and the KTA1170	WQFN55-20

3D CAD Image



EVAL Kit Physical Contents

Item #	Description	Quantity
1	KTA1140 (+KTB2140) Evaluation board fully assembled PCB	1
2	Anti-static bag	1
3	KTA1140 (+KTB2140) Quick Start Guide, printed 1 page (A4 or US Letter)	1
4	EVAL Kit box	1

QR Links for Documents

KTA1140 IC Datasheet	KTA1140 (+KTB2140) EVAL Kit Landing Page
https://www.kinet-ic.com/kta1140/	https://www.kinet-ic.com/kta1140euaq-wb-mcev01/
KTB2140 IC Datasheet	**KTA1170 IC Datasheet**
https://www.kinet-ic.com/ktb2140/	https://www.kinet-ic.com/kta1170/

User-Supplied Equipment

Required Equipment

1. Power Sourcing Equipment (PSE), PoE power injector or PoE powered network switch that can source 48V at 90W or greater.
    a. Alternatively, a bench Power Supply may be substituted for a PoE power injector, but this will bypass the KTA1140 functionality. Such a supply should provide 37V-57V up to 3A as needed for intended application.
    b. When sourcing power from non-compliant PSE environments, which have no PD detection or handshaking, ensure that the fastest rise time is 15µs from 10%-90% of 57V (maximum from POWER_ON to POWER_UP as per the IEEE802.3 standards).
2. CAT-5, CAT-5e or CAT-6 RJ45 M/M ethernet cable, 1m length or shorter.
3. Digital Multimeters, two required – used to measure input/output voltages and currents.
4. Load – any of the following may be used:
    a. Electronic load capable of sinking 12V at 6A (72W)
    b. Power Resistor - 2Ω / 72W or greater value is required
    c. Actual system load that does not exceed 72W at 12V
5. Test leads:
    a. One pair of banana-to-clip test leads to connect a voltmeter to the eval board VIN and AGND
    b. Two pairs of banana-jack test leads to connect VO+/VO- to an electronic load and volt meter

Optional Equipment

1. Oscilloscope with 10x probes to monitor switching regulator waveforms

Recommended Operating Conditions

Parameter	Description	Value	Units
Input Voltage	PoE PSE/Injector to the J1 RJ45 connector	48	V
	Bench Supply applied to the Adapter + and Adapter- Pins	37-57	V
Output Voltage	VO+ to VO-	12	V
Output Current	Max Load = 72W (12V @ 6A)	6	A

Quick Start Procedures

The output voltage of this board is set to 12V by the Kinetic Technologies KTA1140 controller. There are two methods to power KTA1140 (+KTB2140) evaluation board:

Method 1: Connect to PSE

1. Connect a voltage meter between the VIN and AGND test points to monitor the input supply voltage.
2. Connect a voltage meter to the VO+ and VO- output jacks to monitor the regulated output voltage.
3. Connect the load to the output VO+ and VO- output jacks.
4. Connect the RJ45 ethernet cable from the PSE into the evaluation board ethernet Jack J1. The board will automatically start up.

Method 2: Connect to Local Power Supply

1. Connect one pair of power cables to the Test pins (Adapter+ and Adapter-) of EVAL Kit.
2. Before connecting the EVAL Kit to the bench power supply, turn on the supply and adjust the voltage as close to 0V as possible. Then disable the power supply output or turn the supply off. While disabled or off, connect the Adapter + / Adapter - power cables' ends to the bench supply.
3. Connect a voltage meter to the VO+ and VO- output jacks.
4. Connect the load to the output VO+ and VO- output jacks.
5. Turn on the bench supply and very slowly ramp its voltage to an appropriate voltage, such as 48V (37V ~ 57V). While ramping bench supply slowly, use the bench supply's output current indication (or a digital multimeter) to monitor the bench supply current. If the current becomes high, reduce the bench supply voltage quickly to prevent damage. Then inspect the setup for any wiring errors.
6. Verify 12 Volts on the VO+ / VO- output jacks.
7. If power is sourced from a non-compliant PSE and supplied through an RJ45 ethernet cable, see Required Equipment section above, item 1b.

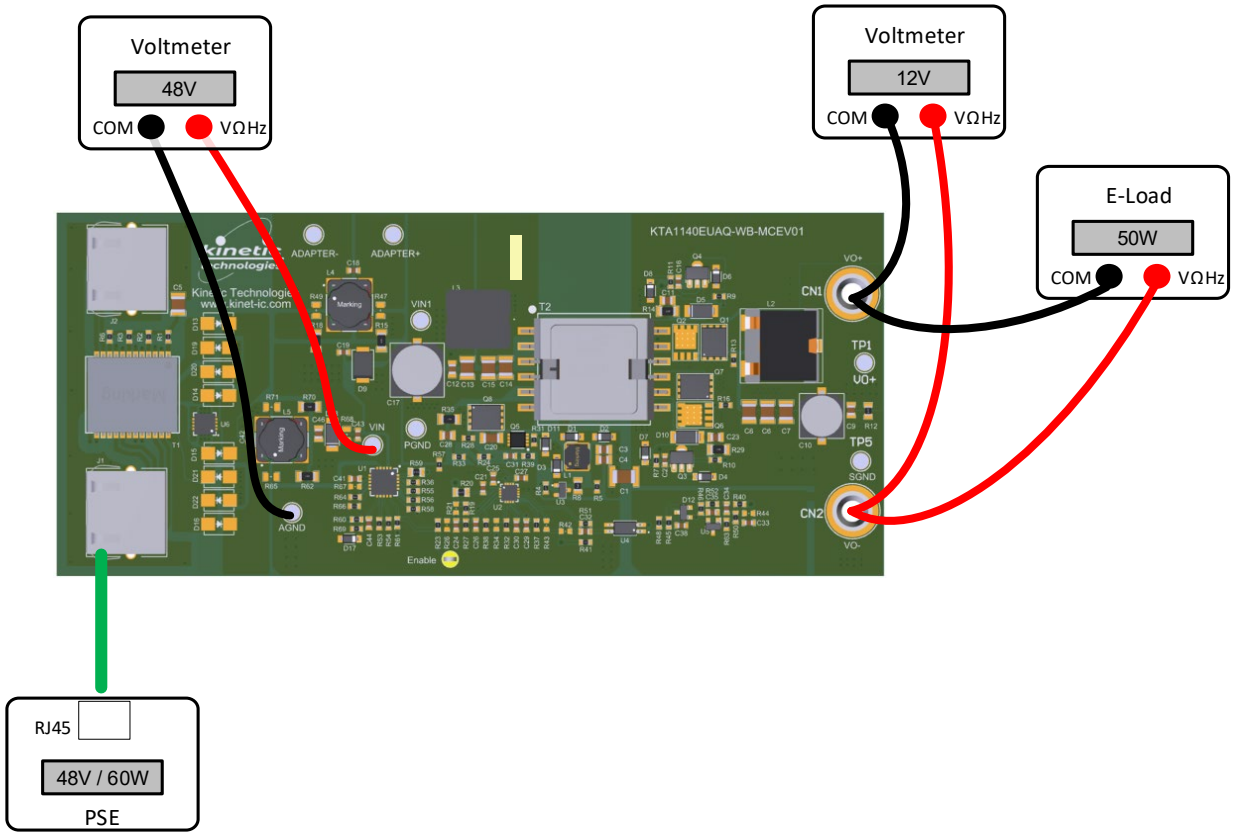
General Configuration

Connector Functionality

Connector	Description
J1	Ethernet power input connector (RJ45 connector)
J2	Ethernet data port connector (RJ45 connector)
VO-, VO+	VOUT (output) to system DC power
Adapter-	Negative of local power supply input
Adapter+	Positive of local power supply input (37V ~ 57V)

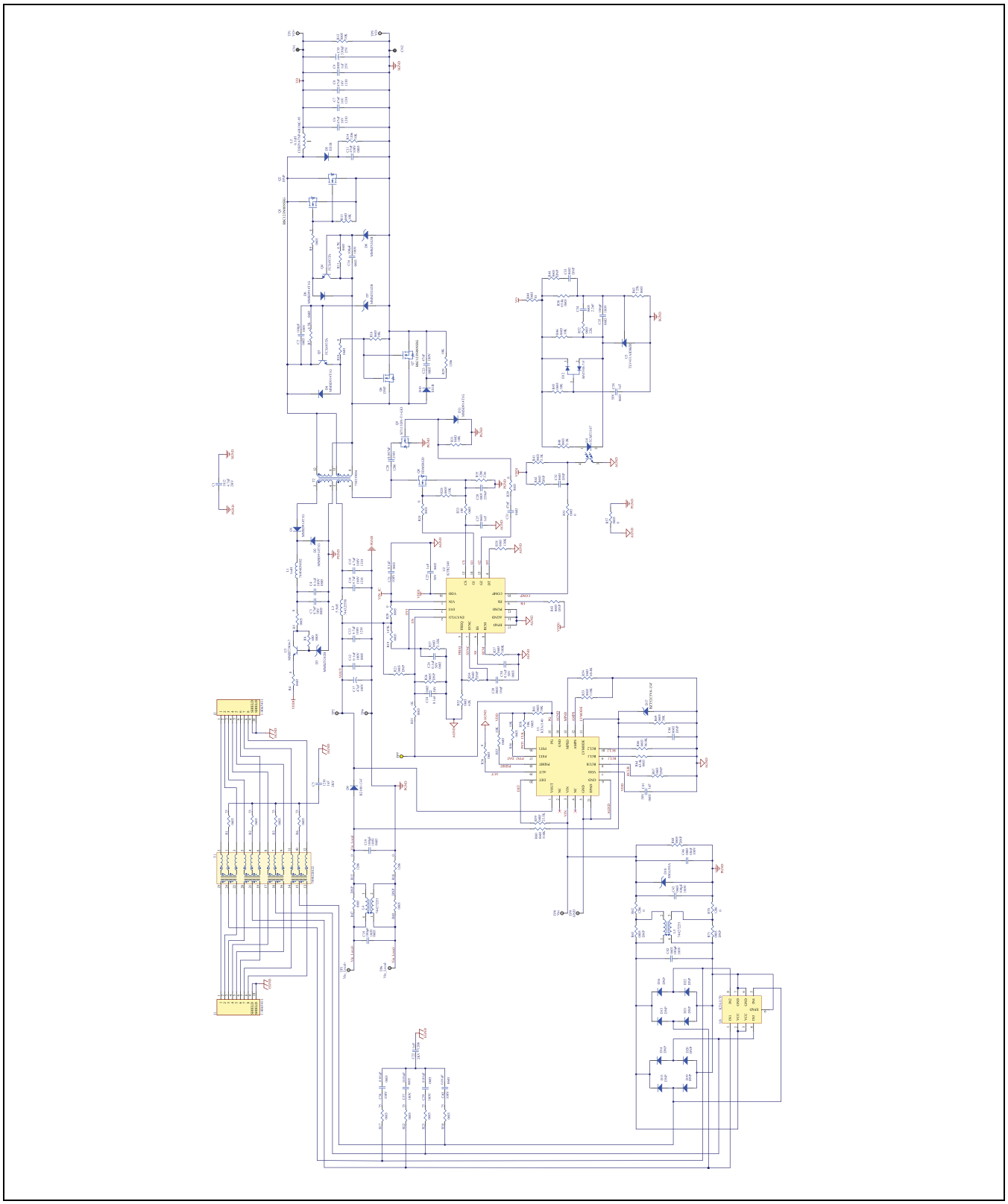
Typical Test Setup

The figure below shows a typical setup for KTA1140 (+KTB2140) EVB. Input voltage can be applied as described in the Connector Functionality table above.



Typical KTA1140 (including KTB2140) Test Setup

Electrical Schematic



Bill of Materials

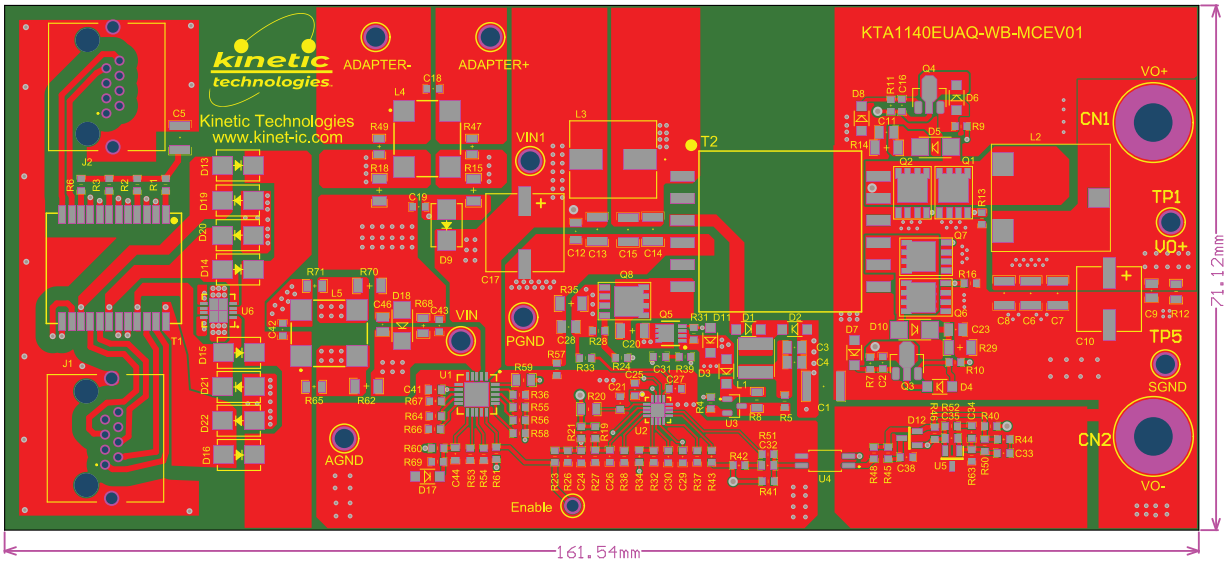
Designator	Description	Quantity	Value	Manufacturer	Manufacturer Part Number
C1	CAP CER 4.7nF 2KV 1812	1	4.7nF	Yageo	CC1812KKX7RDBB472
C2, C16, C18, C19, C35, C42, C43	CAP CER 100pF 100V X7R 0603	7	100pF	Yageo	CC0603KRX7R0BB101
C3	CAP CER 4.7µF 50V X5R 0805	1	4.7µF	Samsung	CL21A475KBQNNNE
C4, C12	CAP CER 0.1µF 100V X7R 0805	2	0.1µF	Yageo	CC0805KKX7R0BB104
C5	CAP CER 1nF 2KV 1210	1	1nF	Johanson Dielectrics Inc.	202S41W102KV4E
C6, C7, C8	CAP CER 47µF 16V X6S 1210	3	47µF	Murata	GRM32EC81C476KE15L
C9	CAP CER 1µF 25V X7R 0805	1	1µF	Samsung	CL21B105KAFNNNE
C10	CAP ALUM 330µF 20% 25V SMD	1	330µF	Kemet	EEV337M025A9MAA
C11, C23	CAP CER 47nF 100V X7R 0805	2	47nF	Yageo	CC0805KKX7R0BB473
C13, C14, C15	CAP CER 4.7µF 100V X7S 1210	3	4.7µF	Samsung	CL32Y475KCIVPNE
C17	CAP ALUM 47µF 20% 100V SMD	1	47µF	Nichicon	UUR2A470MNL1GS
C20	CAP CER 0.047µF 250V X7R 1206	1	0.047uF	Murata	GRM31CR72E473KW03L
C21	CAP CER 0.1µF 100V X7R 0603	1	0.1µF	Samsung	CL10B104KC8NNNC
C22	CAP CER 1000pF 2KV X7R 1206	1	1nF	Yageo	CC1206KKX7RDBB102
C24, C26, C30	CAP CER 0.1µF 50V X7R 0603	3	0.1µF	Samsung	CL10B104KB8NNNC
C25, C38, C41	CAP CER 1µF 50V X7R 0603	3	1µF	Taiyo Yuden	UMK107AB7105KA-T
C27	CAP CER 1nF 50V X7R 0603	1	1nF	Samsung	CL10B102KB8NNNC
C28	CAP CER 220nF 50V X7R 0805	1	220nF	Samsung	CL21B224KBFNFNE
C29	CAP CER 10nF 50V X7R 0603	1	10nF	Samsung	CL10B103KB8NNNC
C31	CAP 47nF 50V X7R 0603	1	47nF	Samsung	CL10B473KB8NNNC
C32, C33, C44	0603 DNP	3	DNP		
C34	CAP CER 2.2nF 50V C0G/NP0 0603	1	2.2nF	Samsung	CL10C222JB8NNNC
C36, C37, C39, C40	CAP CER 0.01µF 100V X7R 0603	4	0.01µF	Samsung	CL10B103KC8NNNC
C46	CAP CER 0.068uF 100V X7R 0805	1	68nF	Yageo	CC0805KKX7R0BB683
CN1, CN2	CONN BANANA JACK SOLDER	2		Keystone Electronics	575-4
D1, D2, D4, D6, D11	DIODE GEN PURP 100V 200MA SOD123	5		onsemi	MMSD914T1G
D3, D7, D8	ZENERDIODE, SOD-123, 11.40V~12V,	3		Diotec Semiconductor	MMSZ5242B
D5, D10	DIODE GEN PURP 100V 1A SMA	2		onsemi	ES1B
D9	DIODE SCHOTTKY 100V 2A SMB	1			B2100-13-F
D12	DIODE ARRAY SCHOTTKY 30V SOT23-3	1		Diodes Inc.	BAT54S-7-F
D13, D14, D15, D16, D19, D20, D21, D22	SMB DNP	8	DNP		
D17	DIODE ZENER 5.6V 500MW SOD123	1		Diodes Inc	BZT52C5V6-13-F
D18	TVS DIODE 58VWM 93.6VC DO214AC	1		Littelfuse Inc.	SMAJ58A

Designator	Description	Quantity	Value	Manufacturer	Manufacturer Part Number
J1, J2	Mod Jack; Right Angle; 8 Position; Cat 5; Shielded; Inverted; Panel & PCB Ground	2		TE Connectivity	1-406541-1
L1	FIXED IND 1MH 200MA 6Ω SMD	1	1mH	Würth Elektronik	74404054102
L2	FIXED IND 6.1µH 11A 7.8 MΩ SMD	1	6.1µH	Sumida America Components Inc.	CDEP147NP-6R1MC-95
L3	FIXED IND 5.5µH 10A 10.3MΩ SMD	1	5.5µH	Wurth Electronics	744325550
L4, L5	WE-SL5 SMT Common Mode Line Filter, 250µH, 2A, 0.035Ω	2		Wurth Elektronik	744272251
Q1, Q7	MOSFET N-CH 80V 11A/55A TDSON	2		Infineon	BSC123N08NS3G
Q2, Q6	TDSON DNP	2	DNP		
Q3, Q4	TRANS NPN 100V 1A SOT89-3	2		Diodes Incorporated	FCX493TA
Q5	MOSFET P-CH 150V 8.9A PPAK1212-8	1		Vishay Siliconix	SI7115DN-T1-GE3
Q8	MOSFET N-CH 150V 9.6A/35A 8PQFN	1		ON Semiconductor	FDMS86200
R1, R2, R3, R6, R17, R22, R25, R30	RES 75Ω 1% 1/10W 0603	8	75	Yageo	RC0603FR-0775RL
R4, R5, R9, R10, R24, R36, R39, R51, R57	RES 0Ω JUMPER 1/10W 0603	9	0	Yageo	RC0603FR-070RL
R7, R11	RES 4.7KΩ 1% 1/10W 0603	2	4.7K	Yageo	RC0603FR-074K7L
R8	RES 680Ω 1% 1/10W 0805	1	680	Yageo	RC0805FR-07680RL
R12	RES 10KΩ 1% 1/10W 0805	1	10K	Yageo	RC0805FR-0710KL
R13, R16, R28, R31, R45, R46, R55, R56, R58, R61	RES 10KΩ 1% 1/10W 0603	10	10K	Yageo	RC0603FR-0710KL
R14, R29	RES 10KΩ 1% 1/10W 1206	2	10K	Yageo	RC1206FR-1010KL
R15, R18, R62, R70	RES 0Ω JUMPER 1/4W 1206	4	0	Yageo	RC1206FR-070RL
R19	RES 147KΩ 1% 1/10W 0603	1	147K	Yageo	RC0603FR-07147KL
R20	RES 0Ω JUMPER 1/8W 0805	1	0	Yageo	RC0805FR-070RL
R21, R26, R34, R42, R43, R44, R67	0603 DNP	7	DNP		
R23	RES 1KΩ 1% 1/10W 0603	1	1K	Yageo	RC0603FR-071KL
R27	RES 2.32KΩ 1% 1/10W 0603	1	2.32K	Yageo	RC0603FR-072K32L
R32	RES 62KΩ 1% 1/10W 0603	1	62K	Yageo	RC0603FR-07100RL
R33	RES 100Ω 1% 1/10W 0603	1	100	Yageo	RC0603FR-07100RL
R35	RES 33mΩ 1% 1/10W 1206	1	33m	Yageo	RL1206FR-070R033L
R37	RES 100KΩ 1% 1/10W 0603	1	100K	Yageo	RC0603FR-07100KL
R38	RES 130KΩ 1% 1/10W 0603	1	130K	Yageo	RC0603FR-07130KL
R40	RES 10Ω 1% 1/10W 0603	1	10	Yageo	RC0603FR-0710RL
R41	RES 3.3KΩ 1% 1/10W 0603	1	3.3K	Yageo	RC0603FR-073K3L
R47, R49, R65, R68, R71	0805 DNP	5	DNP		
R48	RES 2.2KΩ 1% 1/10W 0603	1	2.2K	Yageo	AC0603FR-072K2L

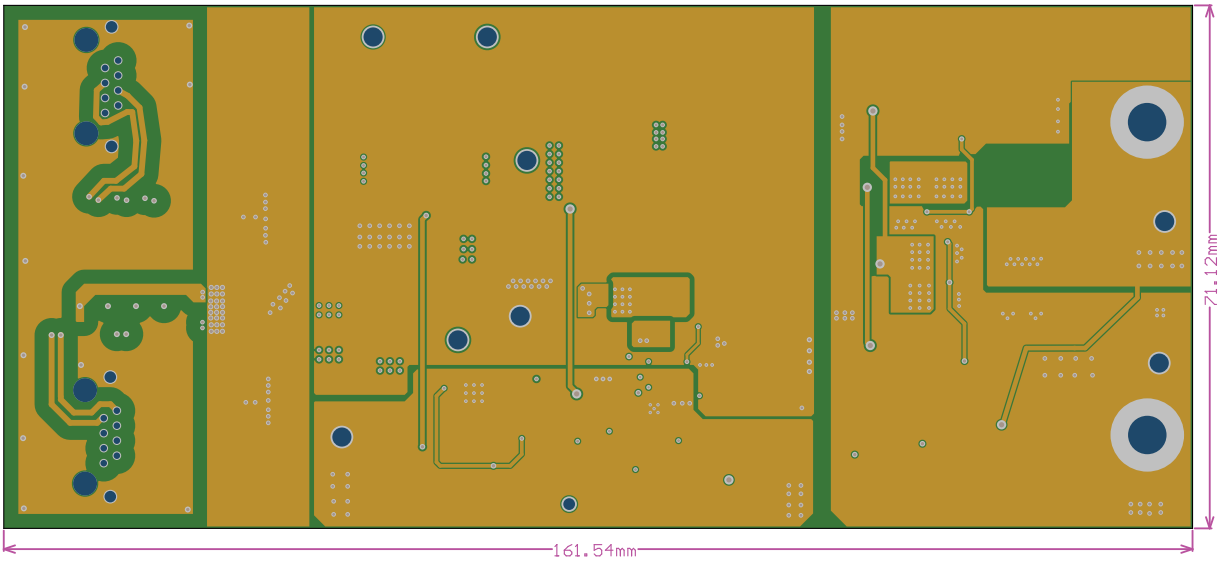
Designator	Description	Quantity	Value	Manufacturer	Manufacturer Part Number
R50, R64	RES 63.4KΩ 1% 1/10W 0603	2	63.4k	Yageo	RC0603FR-0763K4L
R52	RES 22KΩ 1% 1/10W 0603	1	22K	Yageo	RC0603FR-0722KL
R53	RES 118KΩ 1% 1/10W 0603	1	118K	Yageo	RC0603FR-07118KL
R54	RES 60.4KΩ 1% 1/10W 0603	1	60.4K	Yageo	RC0603FR-0760K4L
R59	RES 25.5KΩ 1% 1/8W 0805	1	25.5K	Yageo	RC0805FR-0725K5L
R60	RES SMD 510KΩ 1% 1/10W 0603	1	510K	Yageo	RT0603FRE07510KL
R63	RES 7.23KΩ 1% 1/10W 0603	1	7.23k	Yageo	RT0603FRE077K23L
R66	RES 90.9KΩ 1% 1/10W 0603	1	90.9K	Yageo	RC0603FR-0790K9L
R69	RES 30KΩ 1% 1/10W 0603	1	30K	Yageo	RC0603FR-0730KL
T1	WE-LAN LAN Transformer, SMT, 1000 Base-T, 1 port	1		Wurth Elektronik	7490220122
T2	XFMR POE DC/DC CONV 70UH SMD	1		Wurth Electronics	750319034
TP1, TP2, TP3, TP4, TP5, TP6, TP8, TP9	TERM TURRET SINGLE L=5.56MM TIN	8		Keystone	1502-2
TP7	PC TEST POINT MULTIPURPOSE YELLOW	1		Keystone	5014
U1	Power Over Ethernet Controller 1 Channel 802.3at (PoE+), 802.3af (PoE), 802.3bt 20-WQFN55 (5x5)	1		Kinetic Technologies	KTA1140EUAQ-TB
U2	Flyback, Forward Converter Regulator Positive, Isolation Capable Output Step-Up/Step-Down DC-DC Controller IC 16-WQFN33 (3x3)	1		Kinetic Technologies	KTB2140GUAP-TB
U3	TRANS NPN 40V 0.2A SOT23-3	1		Diotec Semiconductor	MMBT3904-7
U4	Optoisolator Transistor Output 3750Vrms 1 Channel 4-SOP	1		Vishay Semiconductor	TCMT1107
U5	IC VREF SHUNT ADJ 1% SOT23-3	1		Texas Instruments	TLV431AIDBZR
U6	Integrated Dual MOSFET Bridge Rectifier for Power over Ethernet - WDFN44 (4x4)	1		Kinetic Technologies	KTA1170GVAE-TB

Printed Circuit Board (PCB)

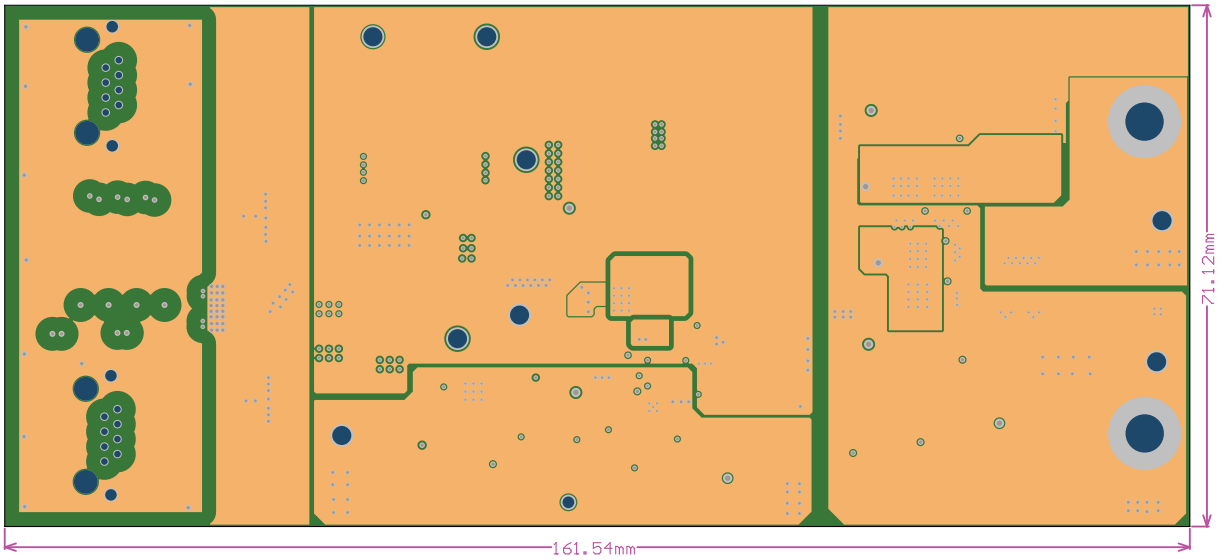
Top Side Layout/Routing



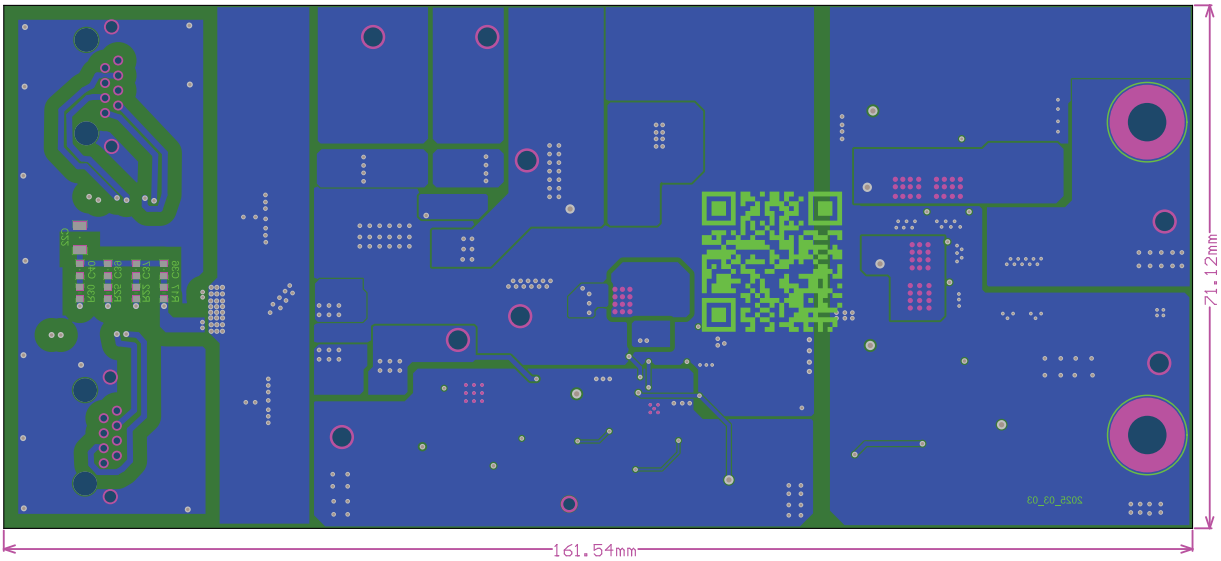
Layer Two Routing



Layer Three Routing



Bottom Layer Routing



Test Setup

1. The “Typical Test Setup Diagram” shows a typical setup for the KTA1140 (including KTB2140) EVAL board. Input voltage can be applied as described in the “Recommended Operating Conditions” Table
2. When a PSE PoE injector or PoE capable switch is used to source power, the KTA1140 (including KTB2140) EVAL board will automatically start up and 12V may be observed on the output VO+/VO- pins.
3. If an external bench power supply is used to source power to the Adapter+ and Adapter- input pins, the KTA1140 functionality will be bypassed. However, when power is applied to this input, the KTB2140 active clamp forward controller will regulate the EVAL board output to 12V.
4. Digital multimeters may be used to monitor the input voltage level (VIN and AGND test points) and output voltage levels at VO+/VO-
5. A load may be applied to the output at VO+/VO-. The load should not exceed 72W (6A at 12V)

Important Notices

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