PI3740-00-EVAL1

Cool-Power® ZVS Switching Regulators
Buck-Boost Eval Board User Guide

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Introduction

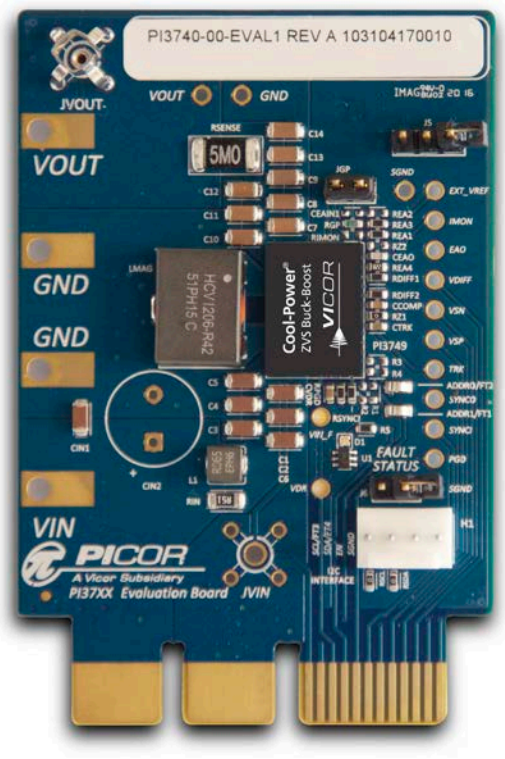
The PI3740-00-EVAL1 evaluation board demonstrates the features and benefits of Vicor's ZVS Buck-Boost regulator; pre-configured for either a 12V or 24V output voltage and rated for up to 140W under certain input and output ranges with proper thermal management. The output is set to 12V by default and 24V when JGP is removed. Please refer to the corresponding PI3740-00-LGIZ data sheet for all power specifications. The PI3740-00-EVAL1 evaluation board is used with the following ZVS buck-boost products: PI3740-00-LGIZ.

The evaluation board provides several options for applying input power (V_{IN} and GND) and output load (V_{OUT} and GND). The user can solder tab style banana jacks or wire, use threaded connectors with retaining nuts, or solder turret pins for clip-on connections.

The evaluation board comes with most of the PI3740-00-LGIZ's features accessible to the user. LGH function is not accessible in this board and it can be evaluated with a dedicated evaluation board. See website or contact sales for further information. The current monitor function (I_{MON}) is set-up to monitor the PI3740-00-LGIZ's output current, sensed across a 5mΩ resistor. The general purpose amplifier (V_{DIFF}) comes pre-set with a gain of 2, but can be easily re-configured for differential measurements by adding extra 0603 resistors.

The I/O pins are brought out to the right edge of the evaluation board to allow for easy monitoring or for adding additional circuitry. The status of the PGD pin is indicated by a dual colored LED; red indicating a fault and green indicating no faults. The SYNCO (sync out) and SYNCI (sync in) pins are accessible to allow for paralleling or for synchronizing to an external clock. See PI3740-00-LGIZ data sheet for paralleling options. Shorting J5 between IMON and VSP on the board will connect the output of IMON to the positive input of the general purpose amplifier, allowing for user designed signal scaling and conditioning.

Figure 1
PI3740-00-EVAL1 Evaluation Board



The board is designed with an edge connector to facilitate testing at the factory, but this connection can also be used for board evaluation. The PCB is 4 layer FR-4 170Tg material with 2oz copper per layer, ENIG pad finish and a board thickness of 0.062".

Output Voltage Setpoint Adjustment

The error amplifier's output (EAO) is brought to a pin and in conjunction with the TRK pin can be used for paralleling converters. The error amplifier's input (EAIN) is not directly connected to a pin, but connects to the pin EXT_V_{REF} via a 1.4k series resistor REA3. Applying a dc voltage from 0V to 2V maximum (over voltage could damage the module) to this pin will allow the user to change the regulated output voltage without changing the feedback network. Setting the trim voltage between 0 – 2V will set V_{OUT} from 24V to 10V when JGP is installed, and set V_{OUT} from 50V to 19.4V when JGP is not installed. The trim voltage must not be applied until after the unit has started up, otherwise the soft start time will be reduced and could lead to unsuccessful startup. The trim voltage adjustment slew rate should not exceed 1V/0.5S over the entire trim range to avoid triggering the output over voltage protection circuitry.

Bill of Materials

Table 1

Bill of Materials Populated Components

Qty	Designator	Value	Description	Vendor Name	Vendor Part Number
8	C7, C8, C9, C10, C11, C12, C13, C14	10µF	Ceramic Cap, X5R, 50V, 1206	TDK	C3216X5R1H106K160AB [1]
7	C1, C2, C3, C4, C5, C6, CIN1	2.2µF	Ceramic Cap, X7S, 100V, 1206	TDK	C3216X7S2A225K160AB
1	CCOMP	4.7nF	Ceramic Cap, X7R, 50 V, 0603	Murata	GRM188R71H472KA01D
1	D1	Fault Status	1 x 1 mm Dual Color SM LED	Rohm	SML-P24MUWT86
2	FT1, FT2	TEST 1, TEST 2	SM Testpoint	Keystone	5015
2	JGP, J6		Connector Header 2 Position 0.1" Pitch	Samtec	TSW-148-07-F-S
1	L1	65nH	FP0404 Series Inductor	Cooper	FP0404R1-R065-R
1	LMAG	0.42µH	HCV1206 Inductor	Cooper	HCV1206-R42-R
1	PCB		PI37xx-xx Edge Connector Eval Board	VICOR	PCB0175rD
1	PI3740	ZVS Buck-Boost	Low Voltage ZVS B-B SIP 10 x 14 mm	VICOR	PI3740-00-LGIZ
1	R5	1.00kΩ	Resistor, 1%, 0.1 W, 0603	Rohm	MCR03EZPFX1001
5	RDIFF1, RDIFF2, RPGD, RSYNCI, REA1	10.0kΩ	Resistor, 1%, 0.1 W, 0603	Rohm	MCR03EZPFX1002
1	REA3	1.4kΩ	Resistor, 1%, 0.1W, 0603	Yageo	RC0603FR-071K4L
1	REA4	1.65kΩ	Resistor, 1%, 0.1W, 0603	Yageo	RC0603FR-071K65L
1	RGP	11.7kΩ	Resistor, 1%, 0.1 W, 0603	Vishay Dale	TNPW060311K7BEEA
1	RIN	0.51Ω	Resistor, 1%, 0.25 W, 1206	Rohm	MCR18EZHFLR510
1	RSENSE	0.005Ω	Resistor, 1%, 1 W, 2512	Panasonic	ERJ-M1WSF5M0U
3	RSDA, RSCL, RZ1	0Ω	Resistor, 1%, 0.1 W, 0603	Rohm	MCR03EZPJ000
1	U1	NC7WZ14EP6X	Dual Schmidt trigger Inverter	Fairchild	NC7WZ14EP6X
1	CVDR	0.1µF	Capacitor, X7R Ceramic, 0.1µF, 50V, 0603	Murata	GRM188R71H104KA93D
1	JVOUT		Johnson Jack	Tektronix	131503100
1	CIN2	100µF	Capacitor Alum. 100V, 20%, Radial	Nichicon	UHE2A101MPD
1	J5		Connector Header 3 Position 0.1" Pitch	Molex	22-28-4035
1	CEAO	47pF	Ceramic Cap, ±5%, 0603, 50V	Murata	GRM1885C1H470JA01D
1	CTRK	47nF	Ceramic Cap, 0603, 25V, X7R	Murata	GRM188R71E473KA01D

Note 1: For higher voltage outputs over 40V, the output capacitors C7–C14 should be changed to 2.2µF or 4.7µF 100V.

Non-Populated Components

Table 2

Bill of Material
Non-Populated Components

Qty	Designator	Description
3	REA2, RIMON, RZ2	Resistor, 1%, 0.1 W, 0603
4	R1, R2, R3, R4	Factory Use Only
16	EAO, EXT_VREF, PGD, IMON, SGND1, SGND2, TRK, SYNCI, SYNCO, VDIFF, VDR, VSN, VSP, VIN_F, VOUT, GND	Thru-hole Testpoints, Vector K24C
3	CEAIN1, CEAO, CTRK	Ceramic Cap, 50 V, 0603
1	JVIN	Johnson Jack, Tektronix 131503100
3	ENABLE, FT3, FT4	SM Testpoint, Keystone 5015
1	H1	Factory Test Header

Figure 2
Evaluation Board Schematic

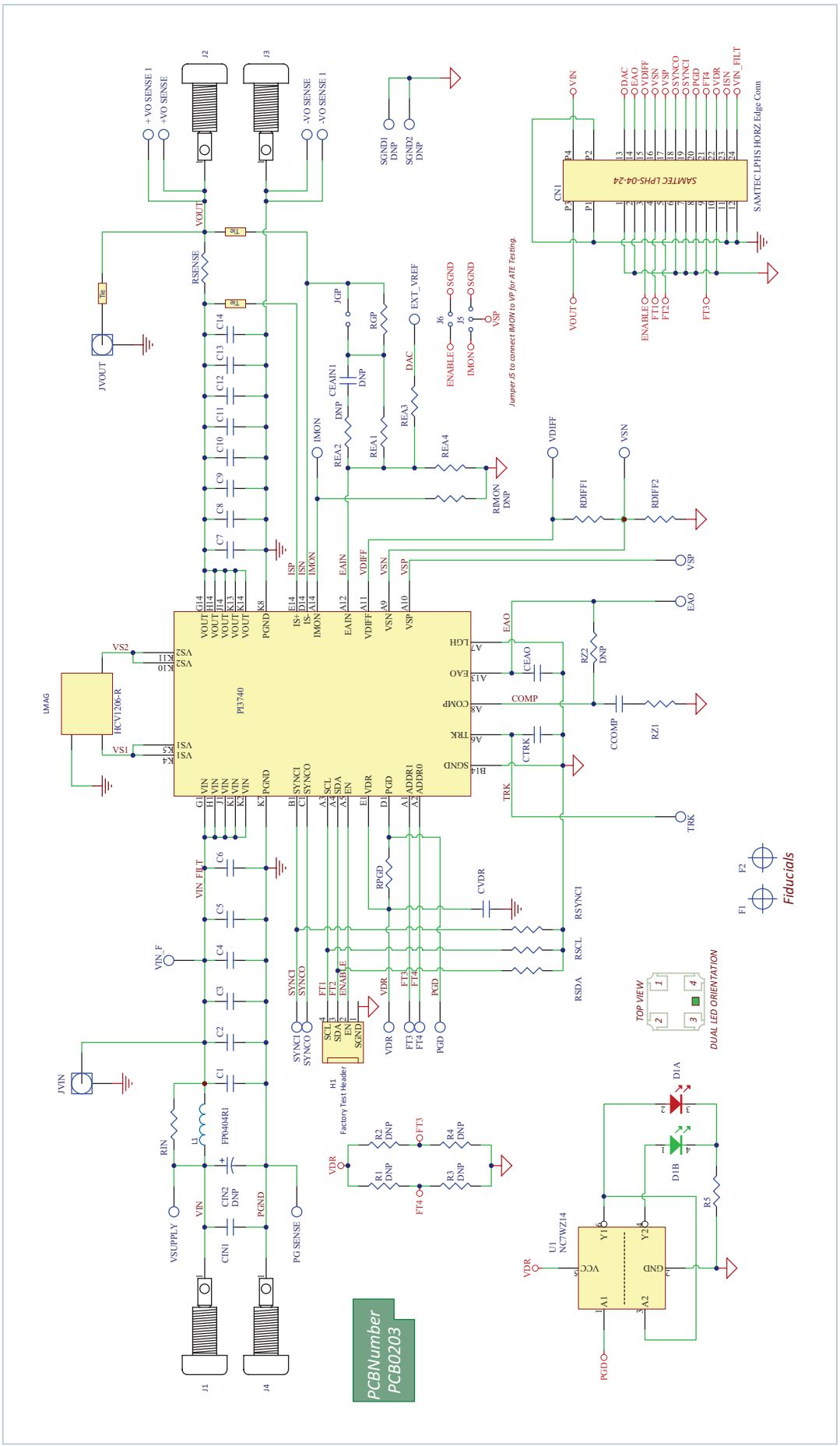
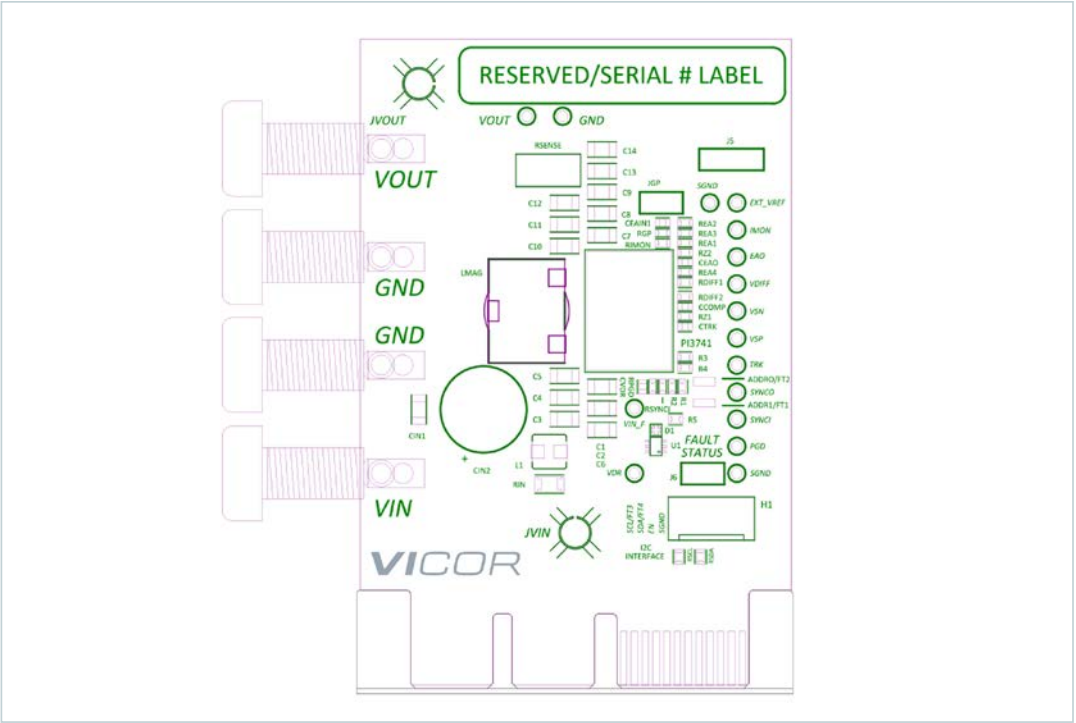


Figure 3
Evaluation Board Details

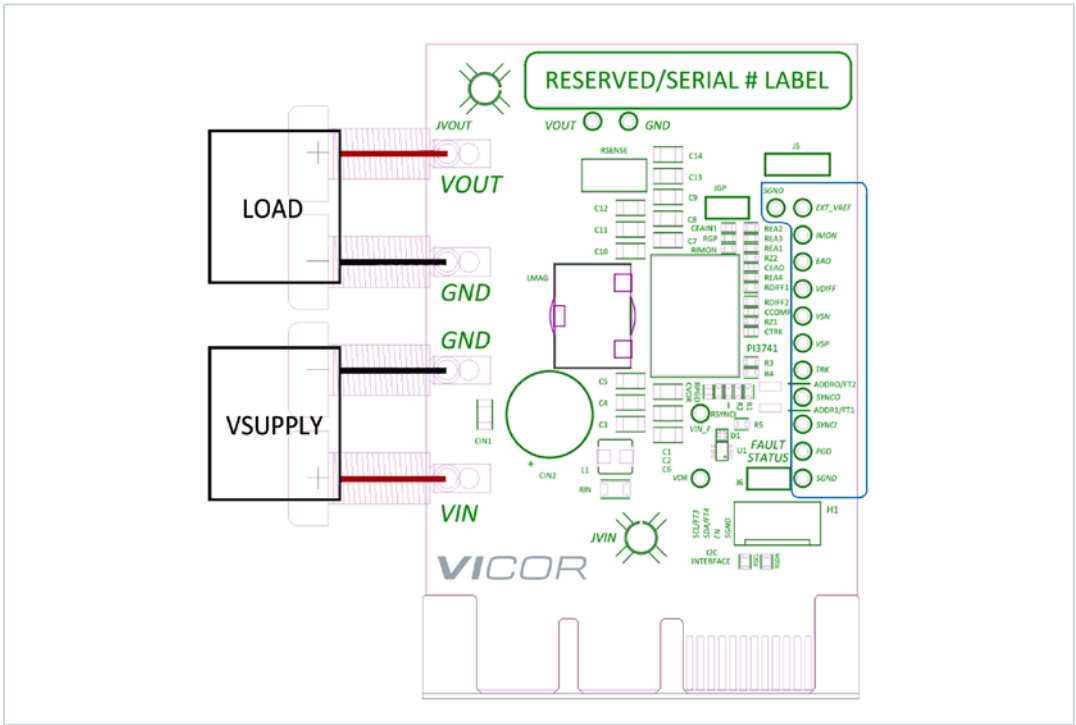


Typical Connections

Figure 4 illustrates the typical input supply and output load connections required to power the PI3740-00 evaluation board. The test points on the right side of the board provide access to key nodes used to assess the board's performance. The jumper "JGP" provides an change in the output voltage set. The output is set to 12V by default with JGP in place, and becomes 24V when JGP is removed. The jumper J5 will connect the IMON output signal to the positive input of the general purpose amplifier, allowing this signal to be scaled. The J6 jumper will disable the converter when connected.

J_{VIN} is an unpopulated "Johnson Jack" location that may be used to measure input ripple voltage.

Figure 4
Typical Input and Output Connections



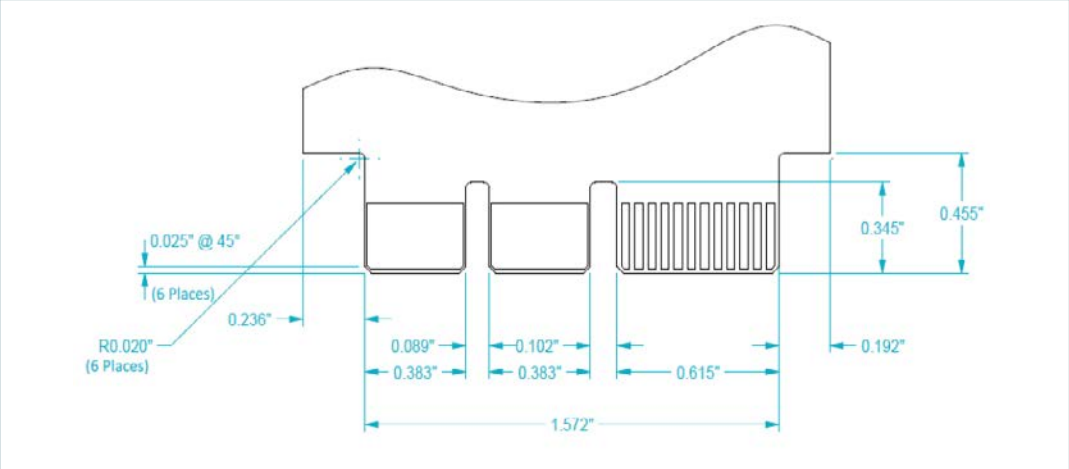
VICOR PCB Edge Connector Description

SAMTEC Reference Mechanical Drawings: based on EXTreme LPHPower™ Socket Assembly series, available from Samtec's website PCB Dimensions: "Recommended PCB layout for LPHS-XX-XX-X-VXX-XX PCB Layout.pdf"

Right Angle Socket: "LPHS-XX-XX-X-RTX-XX-MKT.pdf"

Vertical Socket: "LPHS-XX-XX-X-VXX-XX-MKT.pdf"

Figure 5
Edge Connector Details



PAD Numbering

Figure 6
Top (Component) View

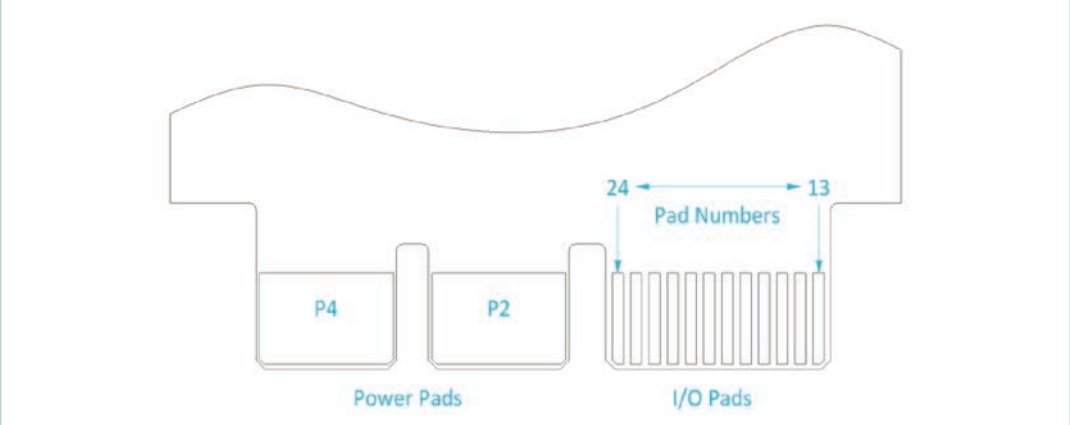
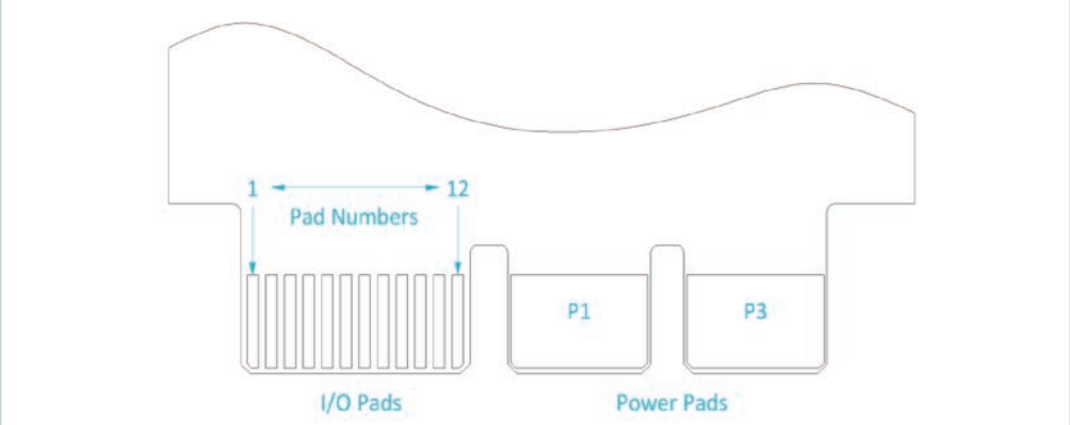
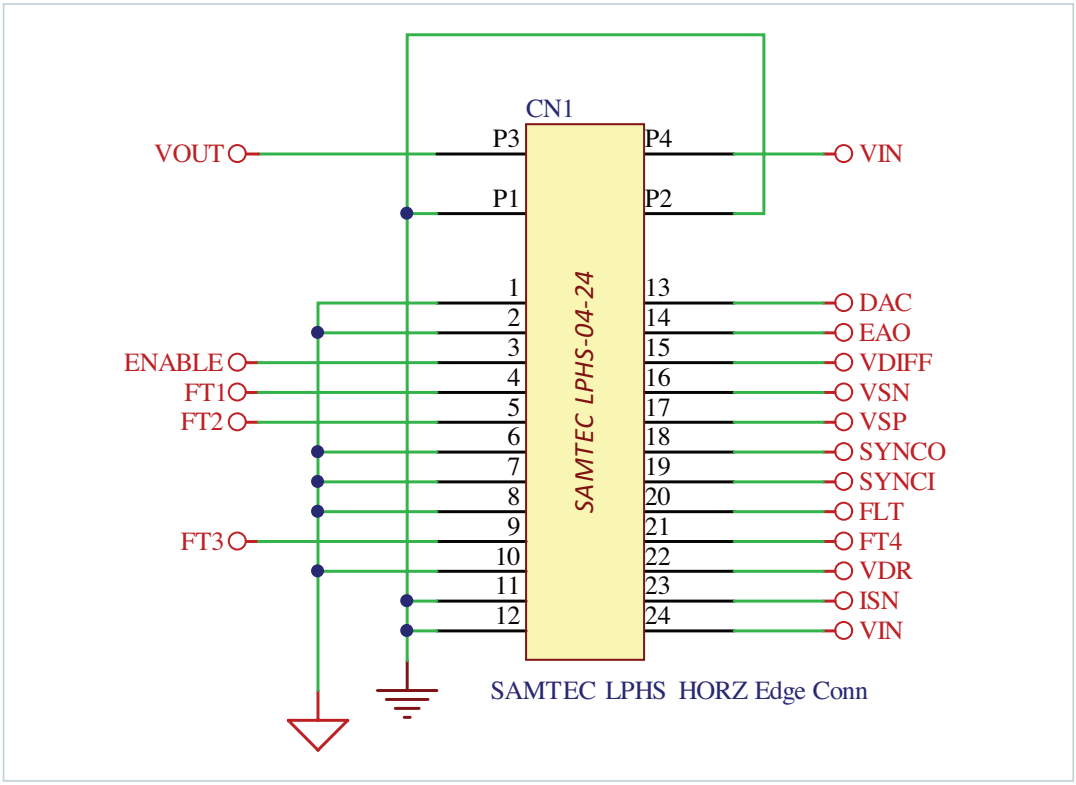


Figure 7
Bottom View



Schematic Symbol

Figure 8
Schematic of edge connector



PAD Definitions

PAD	Name	Description
P1,P2	PGND	Power ground connection for the input supply and output load
P3	VOUT	Output voltage connection
P4	VIN	Input voltage connection
1, 2, 6, 7, 8, 10	SGND	Signal ground used as reference for I/O measurements
11, 12	PGND	Power ground used as reference for input and output voltage measurements
3	ENABLE	Enable
4	FT1	Factory use only
5	FT2	Factory use only
9	FT3	Factory use only
13	DAC	External voltage node to adjust regulated output voltage (EXT_V_{REF})
14	EAO	Error amplifier output
15	VDIFF	Differential amplifier output
16	VSN	Differential amplifier inverting input
17	VPN	Differential amplifier non-inverting input
18	SYNCO	Sync output pin
19	SYNCI	Sync input pin
20	PGD	Power good status pin
21	FT4	Factory use only
22	VDR	Internal generated 5.1V supply for gate drivers and internal logic
23	ISN	Remote sensed output voltage, after the IMON resistor
24	VIN	Input supply voltage measured at SIP's input

PCB Design Files

ODB++ evaluation board design files are available for download on Vicor's website.

www.vicorpower.com

Product	Design File Format	Link to Download
PI3740-00-EVAL1	ODB++	http://www.vicorpower.com/files/live/sites/vicor/files/documents/pcb_files/PI3740-00 Eval ODB++.zip