REFERENCE DESIGN IRDCiP1206-A

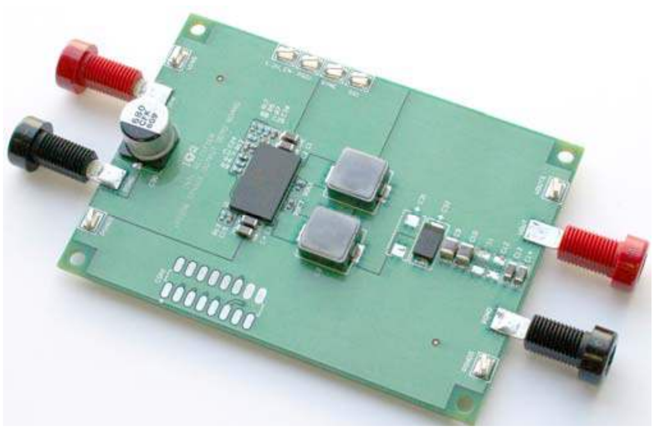
International Rectifier • 233 Kansas Street, El Segundo, CA 90245 USA

IRDCiP1206-A: 300 kHz, 30A, Synchronous Buck Converter using iP1206

Overview

This reference design is capable of delivering a continuous current of 30A (at an ambient temperature of 25ºC and no airflow. Figures 1–16 provide performance graphs, thermal images, and waveforms. Figures 17–27, and Table 1 are provided to engineers as design references for implementing an iP1206 solution. The components installed on this demoboard were selected based on operation at an input voltage of 12V and at a switching frequency of 300 kHz. Changes from these set points may require optimizing the control loop and/or adjusting the values of input/output filters in order to meet the user's specific application requirements. Refer to the iP1206 datasheet User Design Guidelines section for more information.

Note: The 16-pin connector (CON1) is used only for production test purposes and should not be used for evaluation of this demoboard.



Demoboard Quick Start Guide

Initial Settings:

VOUT is set to 1.2V, but can be adjusted from 0.8V to 5.5V by changing the values of R5 and R6 according to the following formula:

$$R5 = R6 = (10.0k * 0.8) / (VOUT - 0.8)$$

The switching frequency is set to 300kHz, but can be adjusted by changing the value of R_T. The graph in Figure 18 shows the relationship between R_T and the switching frequency.

Power Up Procedure:

1. Apply input voltage across VIN and PGND.
2. Apply load across VOUT pads and PGND pads.
3. Adjust load to desired level. See recommendations below.

IRDCiP1206-A Recommended Operating Conditions

(Refer to the iP1206 datasheet for maximum operating conditions)

Input voltage:	7.5V – 14.5V
Output voltage:	0.8 – 5.5V
Switching Freq:	300kHz
Output current:	This reference design is capable of delivering a continuous current of 30A (without heatsink) at an ambient temperature of 45ºC with 200LFM of airflow.

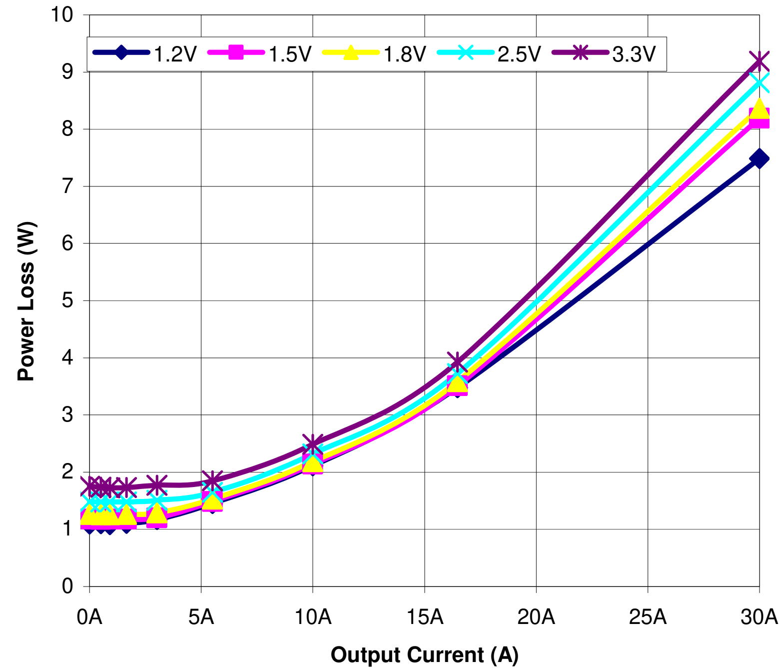


Fig. 1: Power Loss vs. Output Current

Conditions:
Vin = 12V
Vout = 1.2V to 3.3V
Fsw= 300KHz
Ta = 25^{O} C
No heat sink
No Airflow

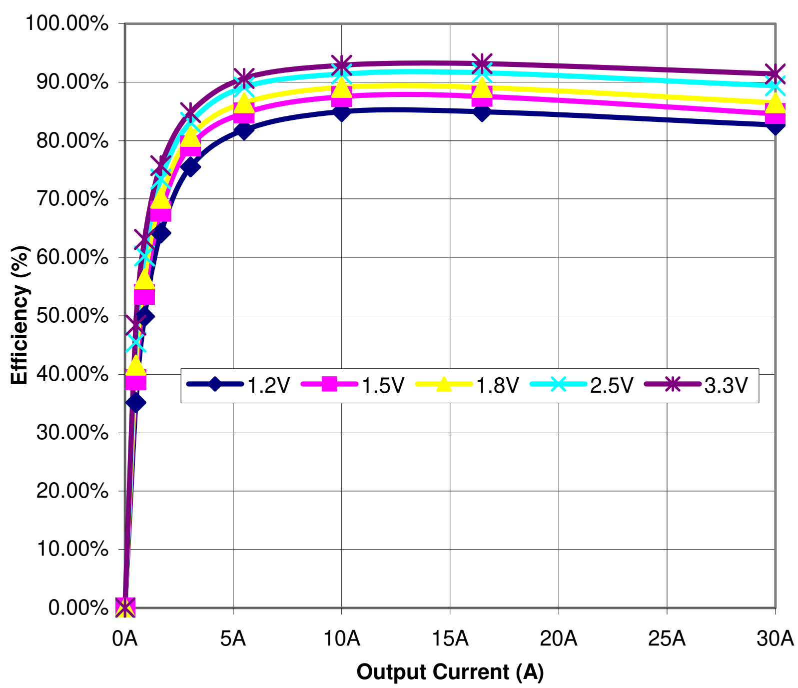


Fig. 2: Efficiency vs. Output Current

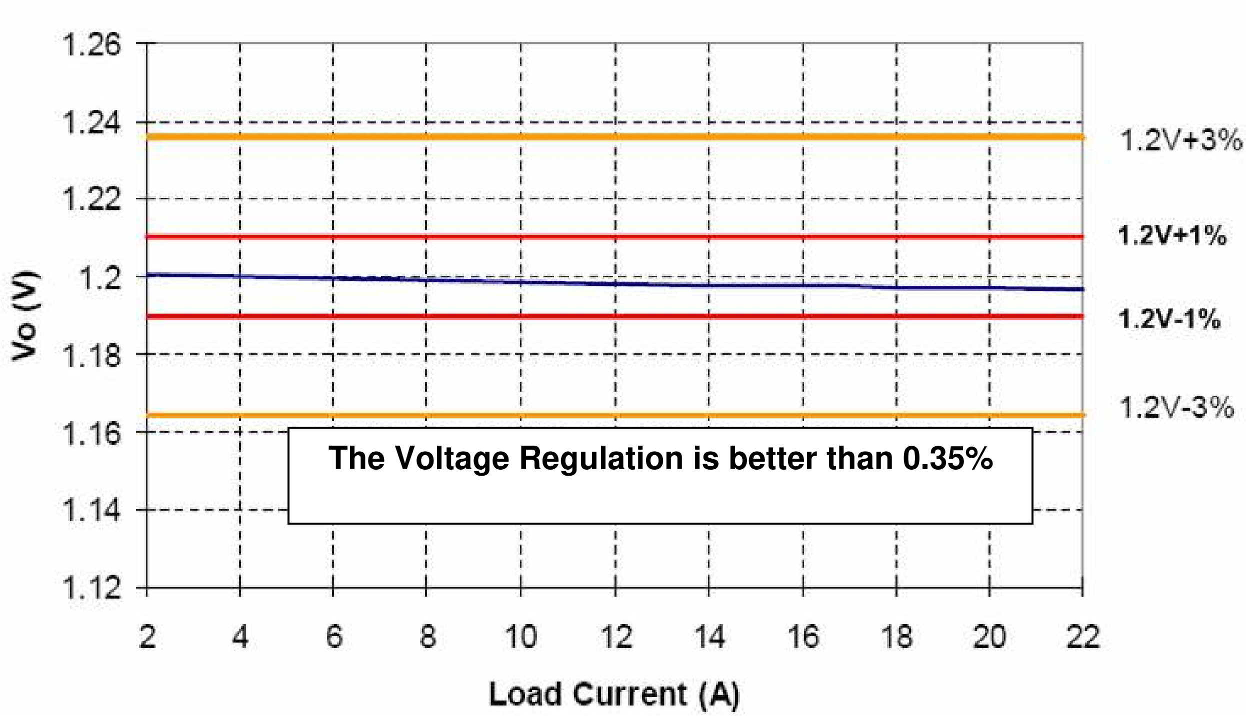


Fig. 3: Output Voltage Regulation vs. Current

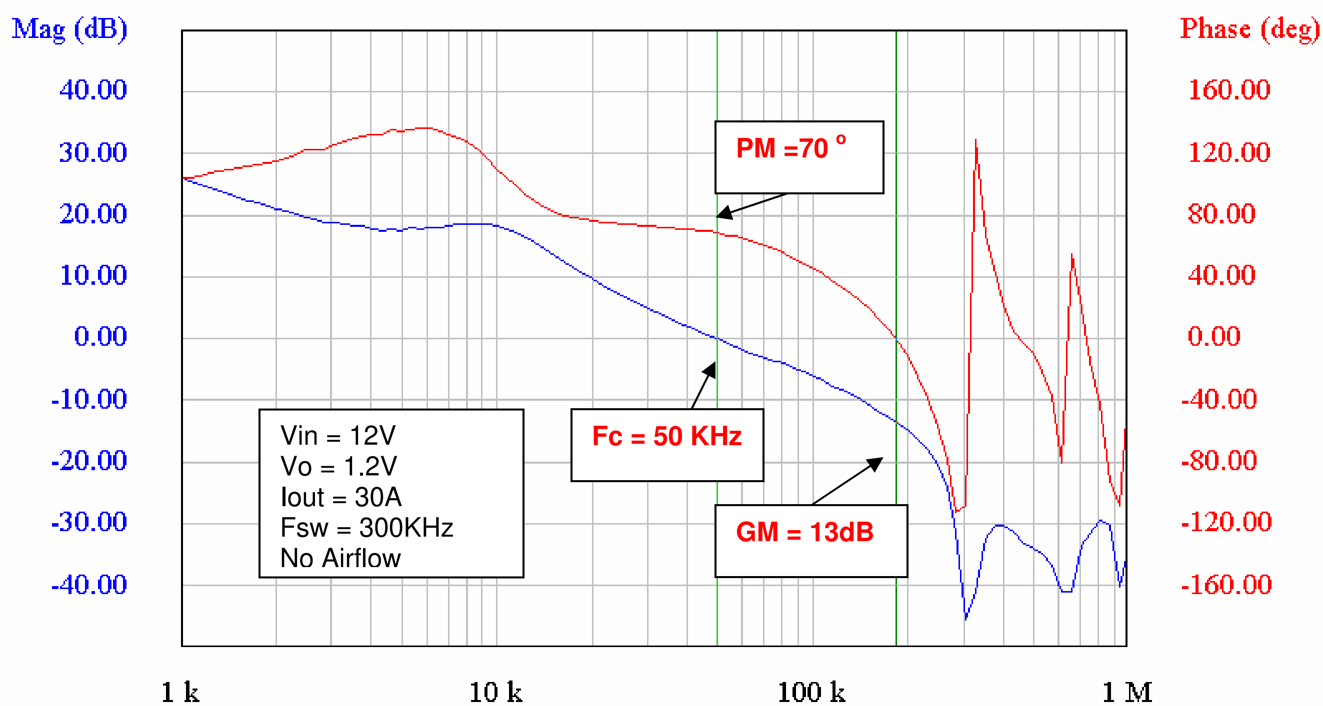
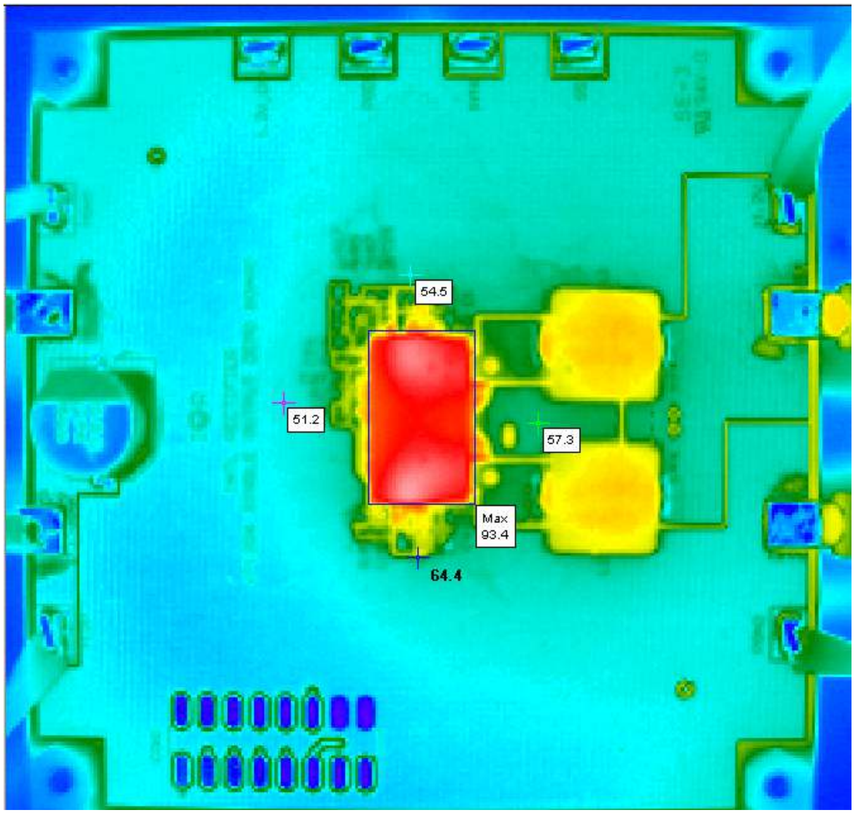


Fig. 4: Bode Plot



Conditions:
Vin = 12V
Vout = 1.2V
Iout = 30A
Fsw = 300kHz
Ambient Temp. = 45ºC
Airflow = 200LFM
Stabilizing Time = 15 min

Fig. 5: Thermograph (No Heatsink)

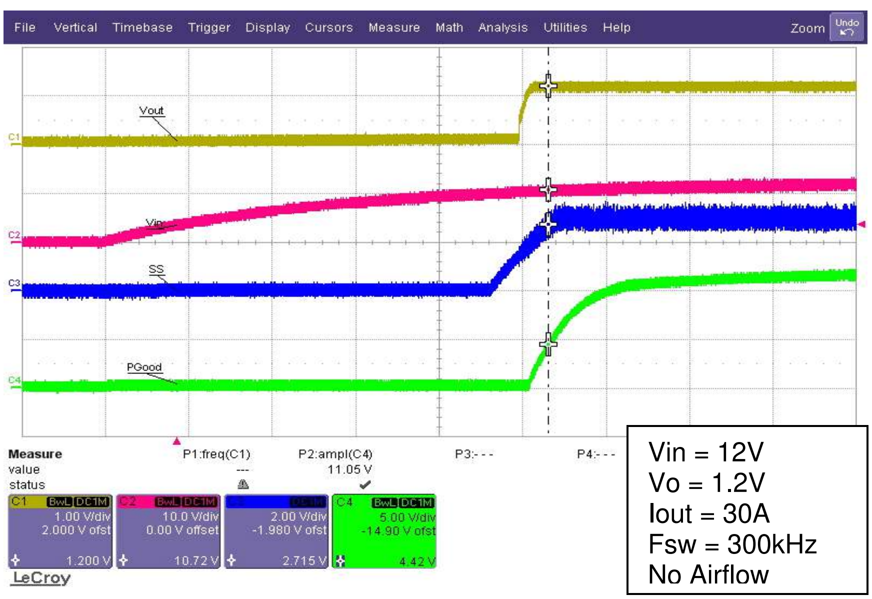


Fig. 6: Power Up Sequence

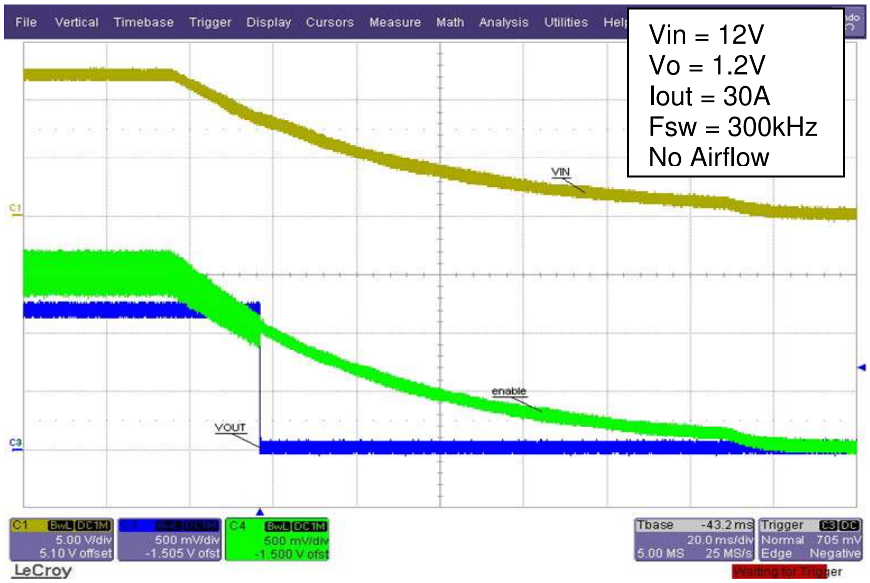


Fig. 7: Power Down Sequence (Turning off a 30A Load)

Fig. 8: Close-up of Power Down when Enable is pulled low

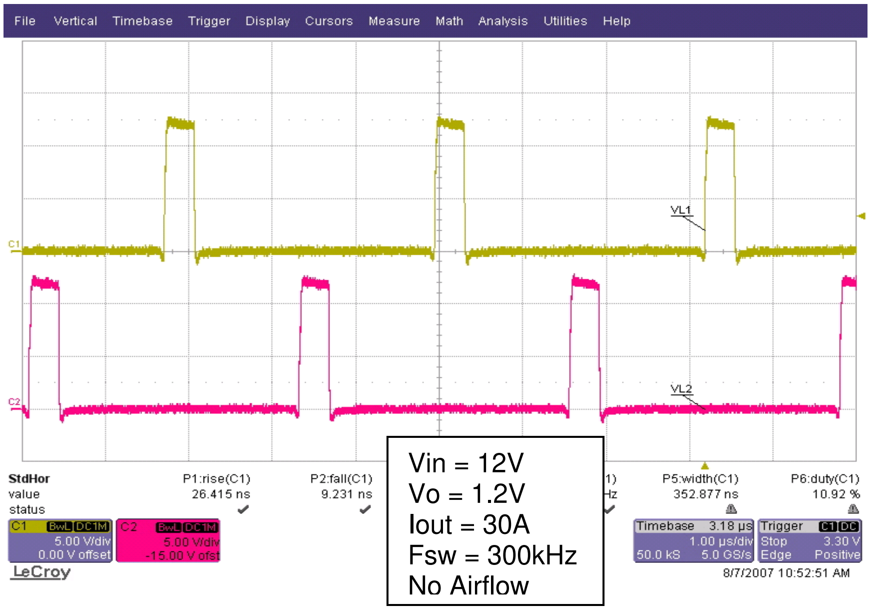


Fig. 9: Current Share Mode (Switch Node Waveforms)

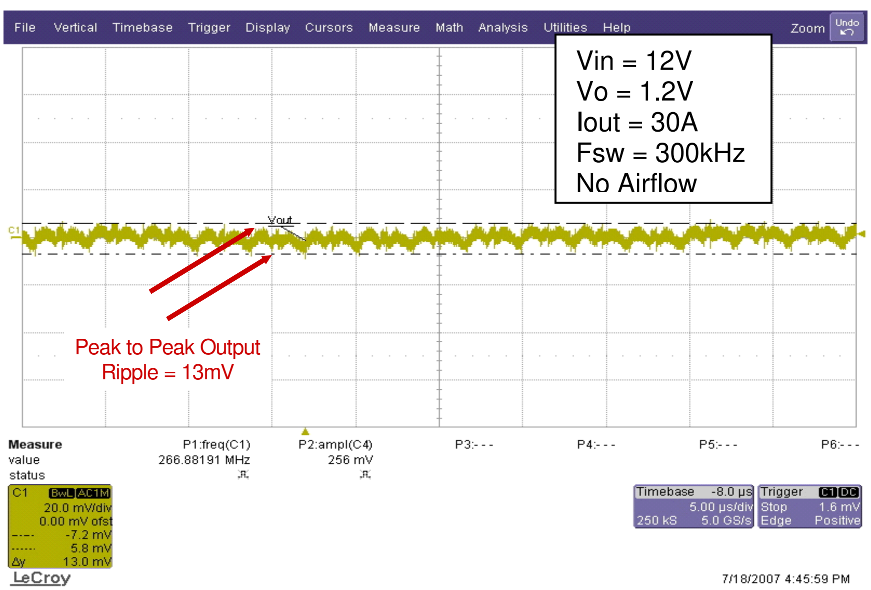


Fig. 10: Output Voltage Ripple

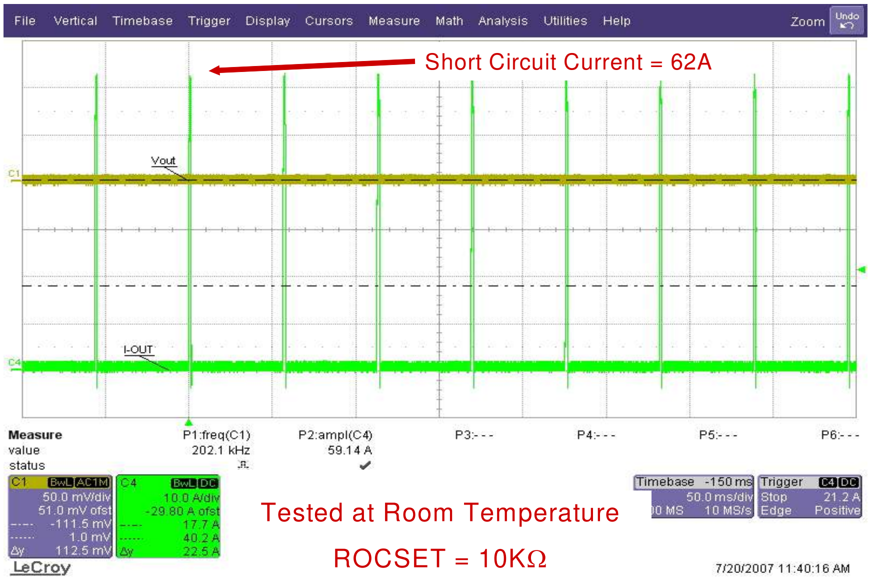


Fig. 11: Short Circuit Protection

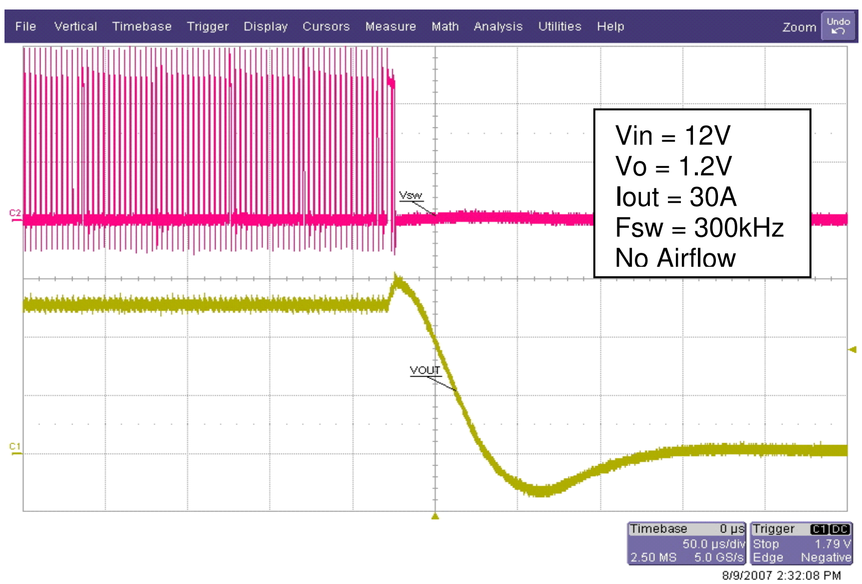


Fig. 12: Over-voltage Protection

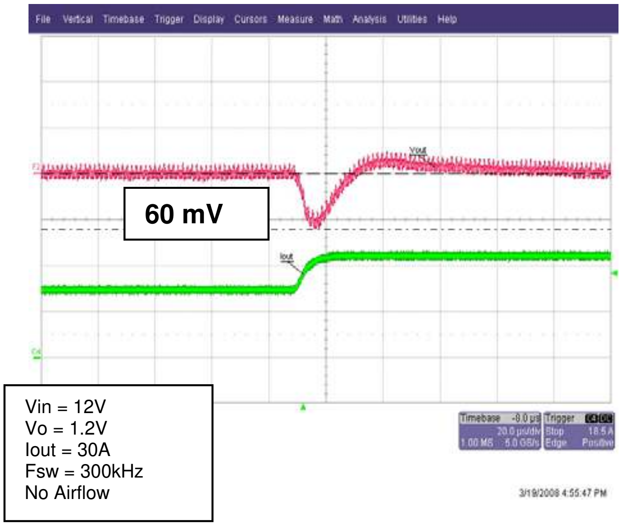


Fig. 13: Iout Transient Step-Up 50% - 75%

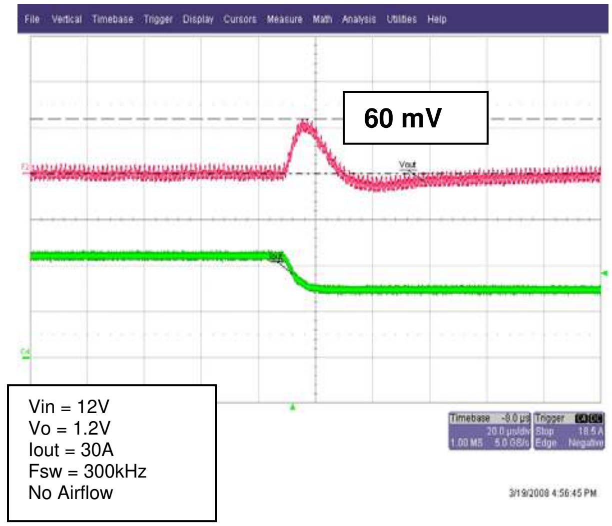


Fig. 14: Iout Transient Step-Down 75% - 50%

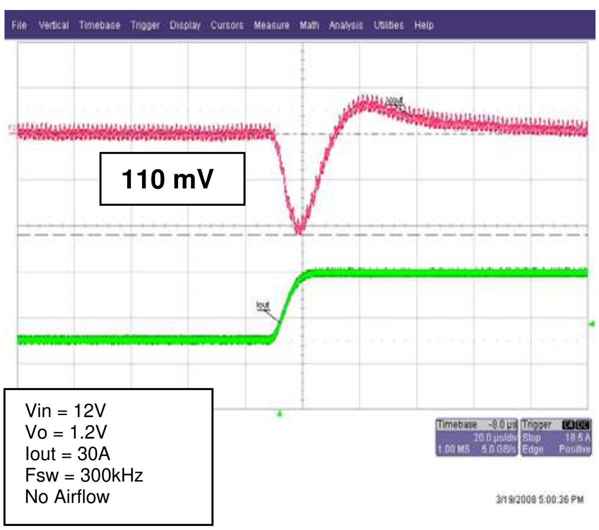


Fig. 15: Iout Transient Step-Up 50% - 100%

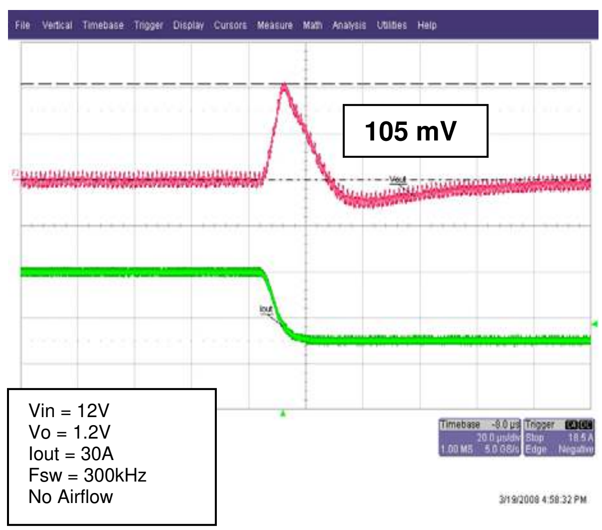


Fig. 16: Iout Transient Step-Down 100% - 50%

Adjusting the Over-Current Limit

ROCx is the resistor used to adjust the over-current trip point. The trip point corresponds to the peak inductor current indicated on the x-axis of Fig. 21. (Note: The trip point will be higher than expected if the reference board is cool and is being used for short circuit testing.)

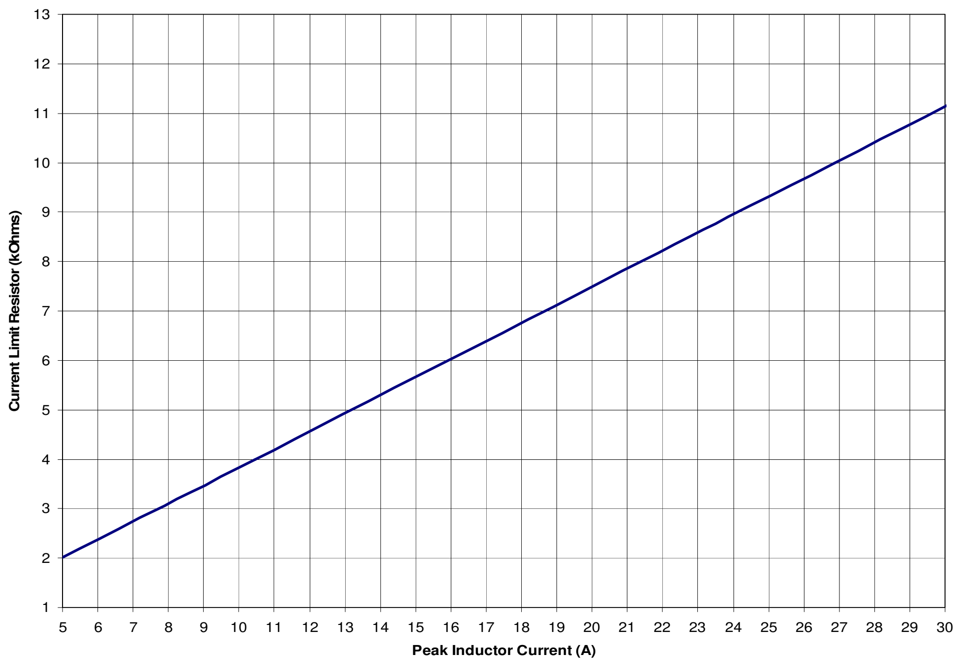


Fig. 17: R_{OCSET} vs. Over-Current Trip Point

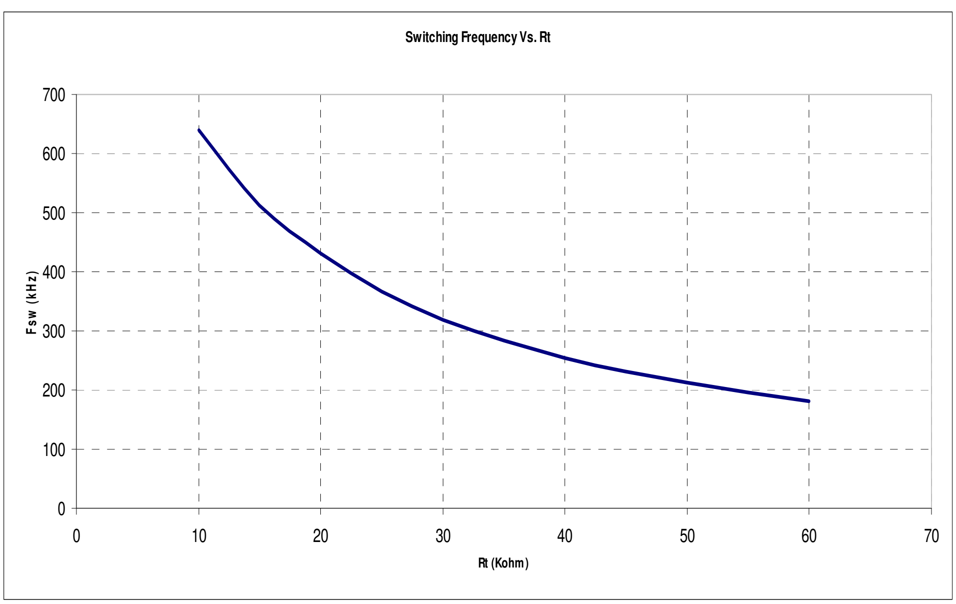


Fig. 18: R_T vs. Frequency

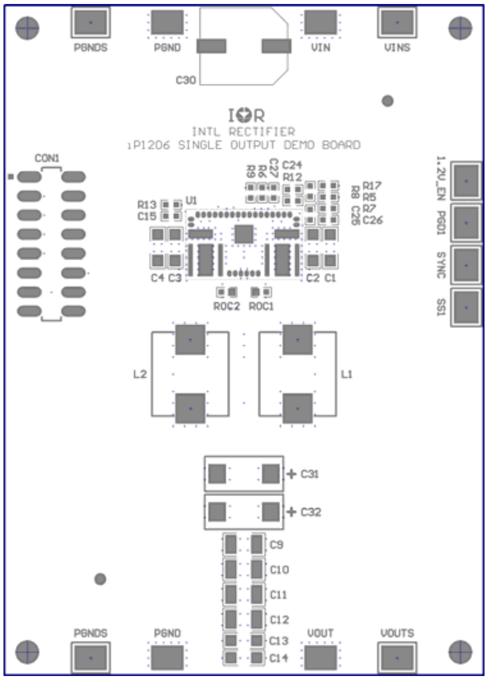


Fig. 19: Component Placement Top Layer

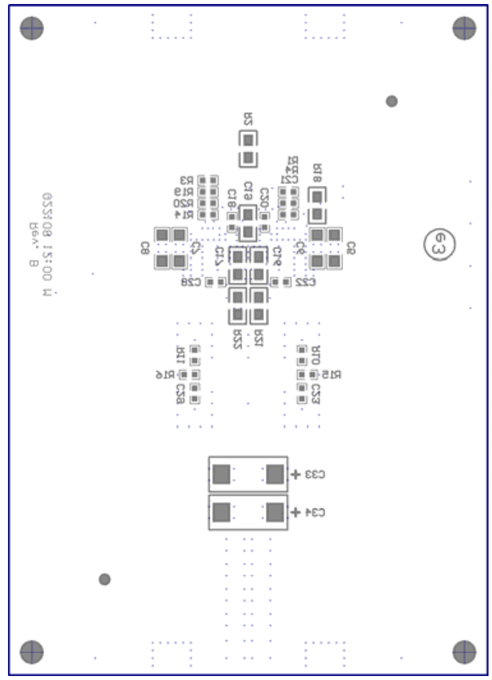


Fig. 20: Component Placement Bottom Layer

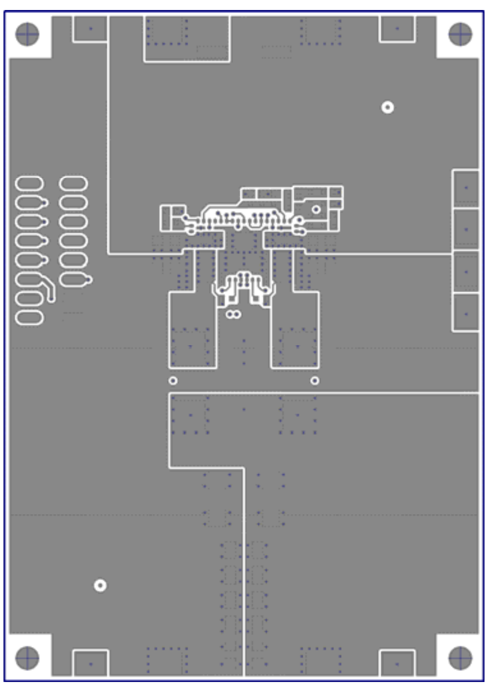


Fig. 21: Top Copper Layer

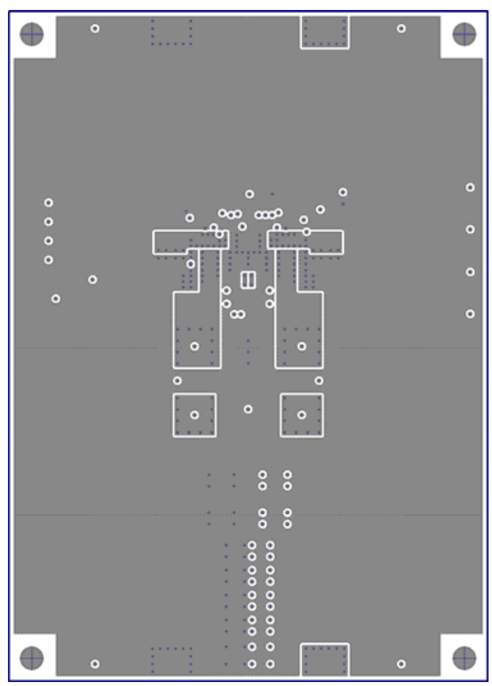


Fig. 22: 1st Mid Copper Layer

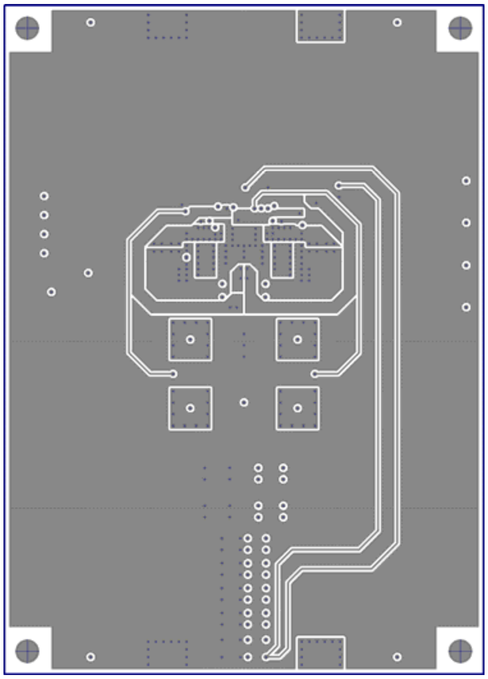


Fig. 23: 2nd Mid Copper Layer

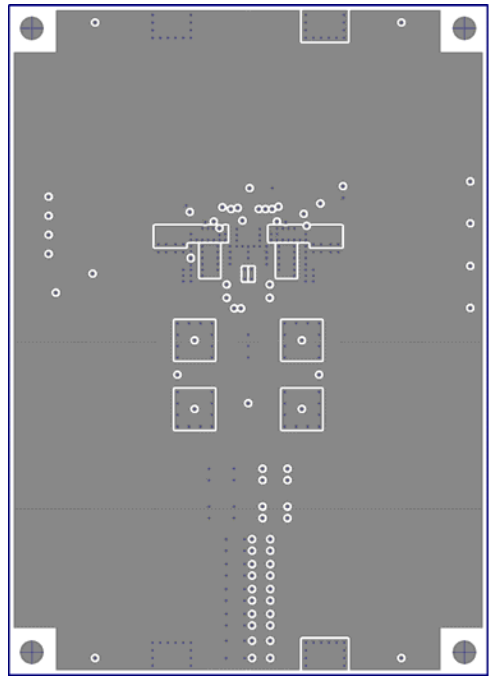


Fig. 24: 3rd Mid Copper Layer

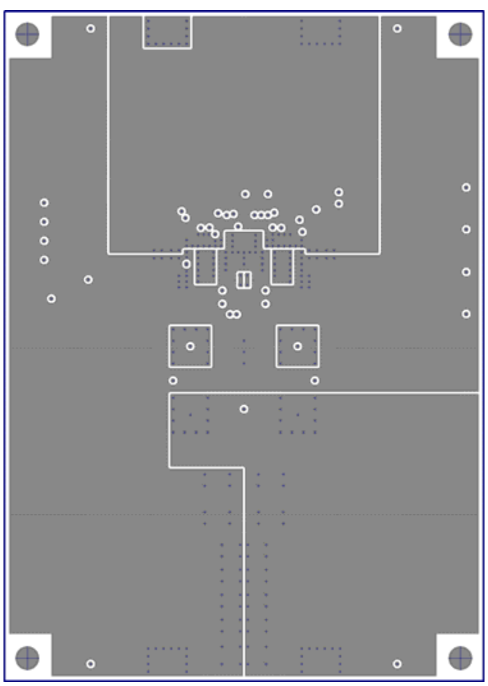


Fig. 25: 4th Mid Copper Layer

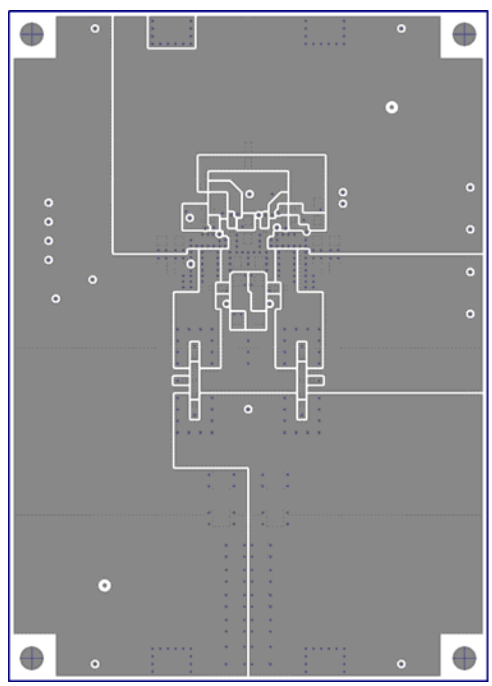


Fig. 26: Bottom Copper Layer

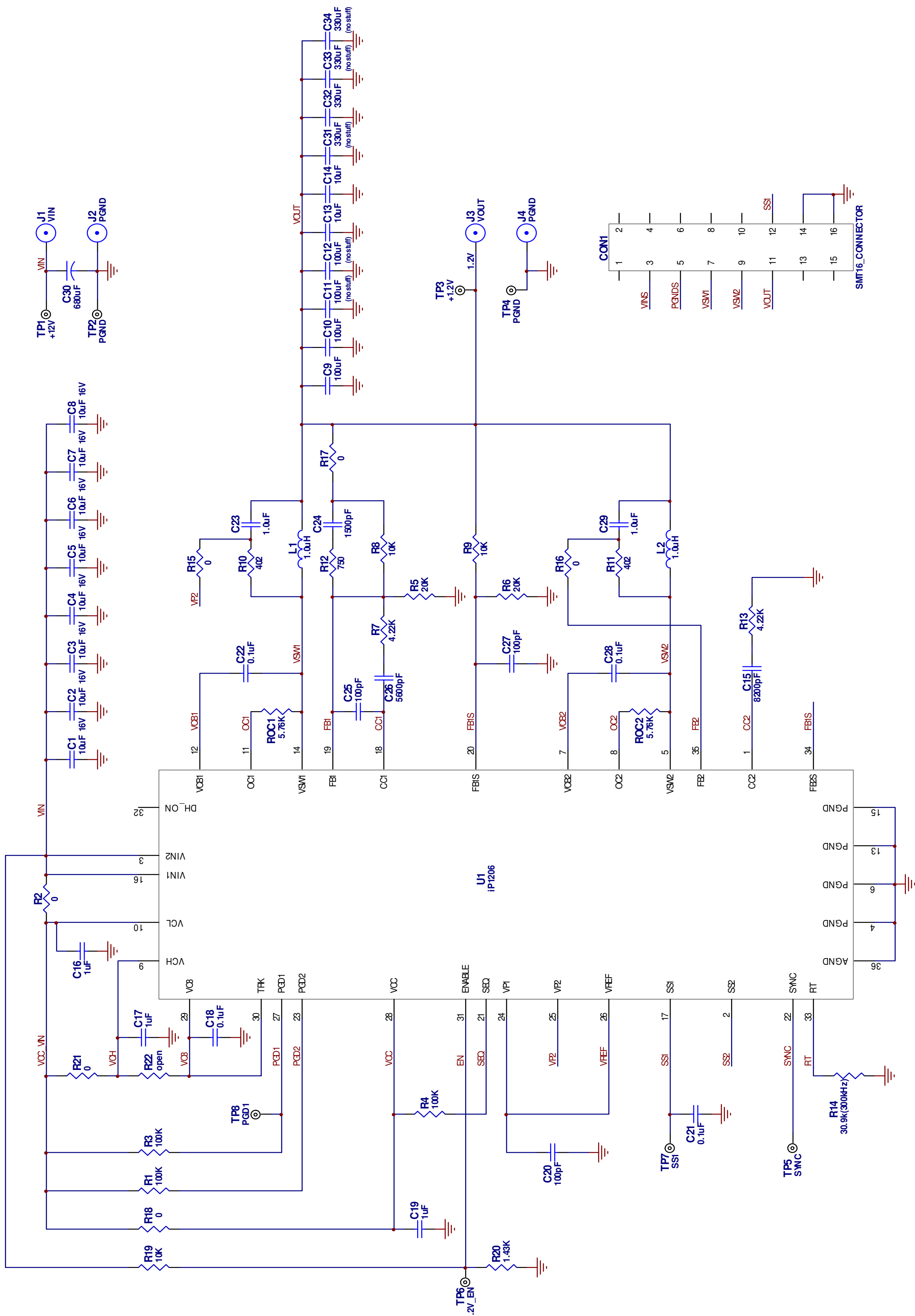


Fig. 27. Reference Design Circuit Schematic

Quantity	Designator	Type 1	Type 2	Value 1	Value 2	Tolerance	Package	Manufac 1	Manufac 1No
10	C1, C2, C3, C4, C5, C6, C7, C8, C13, C14	capacitor	X7R	10.0uF	16V	10%	1206	TDK	C3216X7R1C106KT
2	C9, C10	capacitor	X5R	100uF	6.3V	20%	1210	TDK	C3225X5R0J107M
1	C15	capacitor	X7R	8200pF	50V	10%	0603	KOA	X7R0603HTTD822K
3	C16, C17, C19	capacitor	X7R	1.00uF	16V	10%	0805	MuRata	GRM40X7R105K016
4	C18, C21, C22, C28	capacitor	X7R	0.100uF	16V	10%	0603	MuRata	GRM188R71C104KA01D
3	C20, C25, C27	capacitor	NPO	100pF	50V	5%	0603	Phycomp	0603CG101J9B20
2	C23, C29	capacitor	X7R	1.00uF	16V	10%	0603	TDK	C1608X7R1C105KT
1	C24	capacitor	X7R	1500pF	50V	10%	0603	KOA	X7R0603HTTD152K
1	C26	capacitor	X7R	5600pF	50V	10%	0603	KOA	X7R0603HTTD562K
1	C30	capacitor	electrolytic	680uF	16V	20%	SMD	Panasonic	EEV-FK1C681GP
1	C32	capacitor	tantalum polymer	330uF	2.5V	20%	7343	Sanyo	2R5TPE330M9
2	L1, L2	inductor	ferrite	1.00uH	25A	20%	SMT	Delta Electronics	MPL105-1R0IR
3	R1, R3, R4	resistor	thick film	100K	1/10W	1%	0603	KOA	RK73H1J1003F
2	R10, R11	resistor	thick film	402	1/10W	1%	0603	KOA	RK73H1JLTD4020F
1	R12	resistor	thick film	750	1/10W	1%	0603	KOA	RK73H1JLTD7500F
2	R7, R13	resistor	thick film	4.22K	1/10W	1%	0603	KOA	RK73H1JLTD4221F
1	R14	resistor	thick film	30.9K	1/10W	1%	0603	KOA	RK73H1J3092F
3	R15, R16, R17	resistor	thick film	0	1/10W	1%	0603	KOA	RK73Z1JLTD
3	R2, R18, R21	resistor	thick film	0	1/8W	<50m	0805	ROHM	MCR10EZHJ000
3	R8, R9, R19	resistor	thick film	10.0K	1/10W	1%	0603	KOA	RK73H1J1002F
1	R20	resistor	thick film	1.43K	1/10W	1%	0603	KOA	RK73H1JLTD1431F
2	R5, R6	resistor	thick film	20.0K	1/10W	1%	0603	KOA	RK73H1J2002F
2	ROC1, ROC2	resistor	thick film	5.76K	1/10W	1%	0603	KOA	RK73H1JLTD5761F
8	1.2V_EN, PGD1, PGNDS, PGNDS, SS1, SYNC, VINS, VOUTS	hardware	test point	90 mils	112 x 150 mils	-	SMT	Keystone	5016
1	U1	iP1206	LGA unit	rev- b	-	-	9.25 x 15.5mm	IRF	rev- b
	*Red - Top Side Components *Blue - Bottom Side Components								

Table 1: Bill of Materials for the Reference design

Refer to the following application notes for detailed guidelines and suggestions when implementing iPOWIR Technology products:

AN-1028: Recommended Design, Integration and Rework Guidelines for International Rectifier's iPowIR Technology BGA and LGA and Packages
This paper discusses optimization of the layout design for mounting iPowIR BGA and LGA packages on printed circuit boards, accounting for thermal and electrical performance and assembly considerations. Topics discussed includes PCB layout placement, and via interconnect suggestions, as well as soldering, pick and place, reflow, inspection, cleaning and reworking recommendations.

AN-1030: Applying iPOWIR Products in Your Thermal Environment
This paper explains how to use the Power Loss and SOA curves in the data sheet to validate if the operating conditions and thermal environment are within the Safe Operating Area of the iPOWIR product.

AN-1047: Graphical solution for two branch heatsinking Safe Operating Area
Detailed explanation of the dual axis SOA graph and how it is derived.

Use of this design for any application should be fully verified by the customer. International Rectifier cannot guarantee suitability for your applications, and is not liable for any result of usage for such applications including, without limitation, personal or property damage or violation of third party intellectual property rights.

IR WORLD HEADQUARTERS: 233 Kansas St., El Segundo, California 90245, USA Tel: (310) 252-7105
TAC Fax: (310) 252-7903