Sup*IR*Buck™

USER GUIDE FOR IR3847 EVALUATION BOARD

DESCRIPTION

The IR3847 is a synchronous buck converter, providing a compact, high performance and flexible solution in a small 5mmx6mm QFN package.

Key features offered by the IR3847 include internal Digital Soft Start, precision 0.6V reference voltage, Power Good, thermal protection, programmable switching frequency, Enable input, input under-voltage lockout for proper start-up, enhanced line/ load regulation with feed forward, external frequency synchronization with smooth clocking, internal LDO, true differential remote sensing and pre-bias start-up.

A thermally compensated output over-current protection function is implemented by sensing the voltage developed across the on-resistance of the synchronous rectifier MOSFET for optimum cost and performance.

This user guide contains the schematic and bill of materials for the IR3847 evaluation board. The guide describes operation and use of the evaluation board itself. Detailed application information for IR3847 is available in the IR3847 data sheet.

BOARD FEATURES

- V_{in} = +12V (+ 13.2V Max), ***No Vcc required.***
- V_{out} = +0.95V / +1.0V @ 0-25A
- F_s=600kHz
- L= 0.215uH
- C_{in}= 4x22uF (ceramic 1206) + 1x330uF (electrolytic)
- C_{out}=6x22uF (ceramic 0805) + 11x47uF (ceramic 0805)

CONNECTIONS and OPERATING INSTRUCTIONS

A well regulated +12V input supply should be connected to VIN+ and VIN-. A maximum of 25A load should be connected to VOUT+ and VOUT-. The inputs and output connections of the board are listed in Table I.

IR3847 needs only one input supply and internal LDO generates Vcc from Vin. If operation with external Vcc is required, then R33 should be removed and external Vcc can be applied between Vcc+ and Vcc- pins. Vin pin and Vcc pins should be shorted together for external Vcc operation by installing R35.

This version of the demoboard was built with a previous revision of the IR3847 for which Vp was pin 14 and Vref was pin 15. However, in the new revision, these pins have been interchanged in order to allow easier bypass of the Vref pin. The consequence of this is that the Vp input on the board should be considered Vref and the Vref input on the board should be considered Vp.

The board is configured for remote sensing. If local sense is desired, R8 should be uninstalled and R16 should be installed instead.
External Enable signal can be applied to the board via exposed Enable pad and *R18 should be removed for this purpose.*

Table I. Connections

Connection	Signal Name
VIN+	Vin (+12V)
VIN-	Ground of Vin
Vout+	Vout(+0.95/+1.0V)
Vout-	Ground for Vout
Vcc+	Vcc Pin
Vcc-	Ground for Vcc input
Enable	Enable
PGood	Power Good Signal
AGnd	Analog ground

LAYOUT

The PCB is a 6-layer board. All of layers are 2 Oz. copper. The IR3847 and most of the passive components are mounted on the top side of the board.

Power supply decoupling capacitors and feedback components are located close to IR3847. The feedback resistors are connected to the output of the remote sense amplifier of the IR3847 and are located close to the IR3847. To improve efficiency, the circuit board is designed to minimize the length of the on-board power ground current path. Separate power ground and analog ground are used and may be connected together using a 0 ohm resistor at one of three possible locations. It is preferred to use one of R43 or R44.

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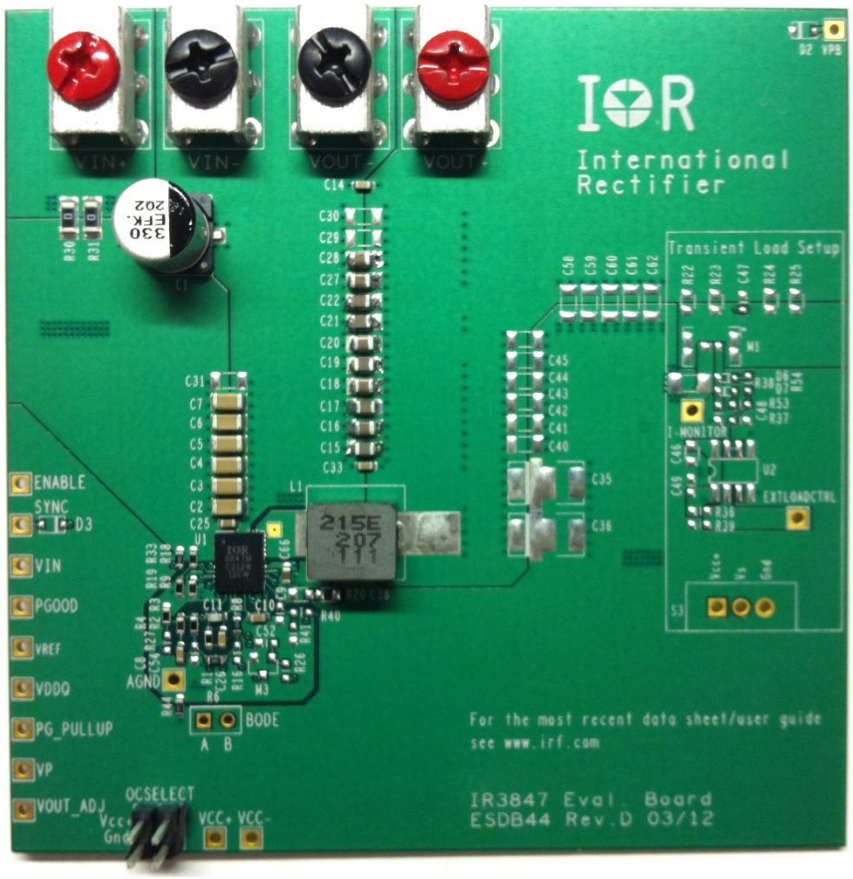
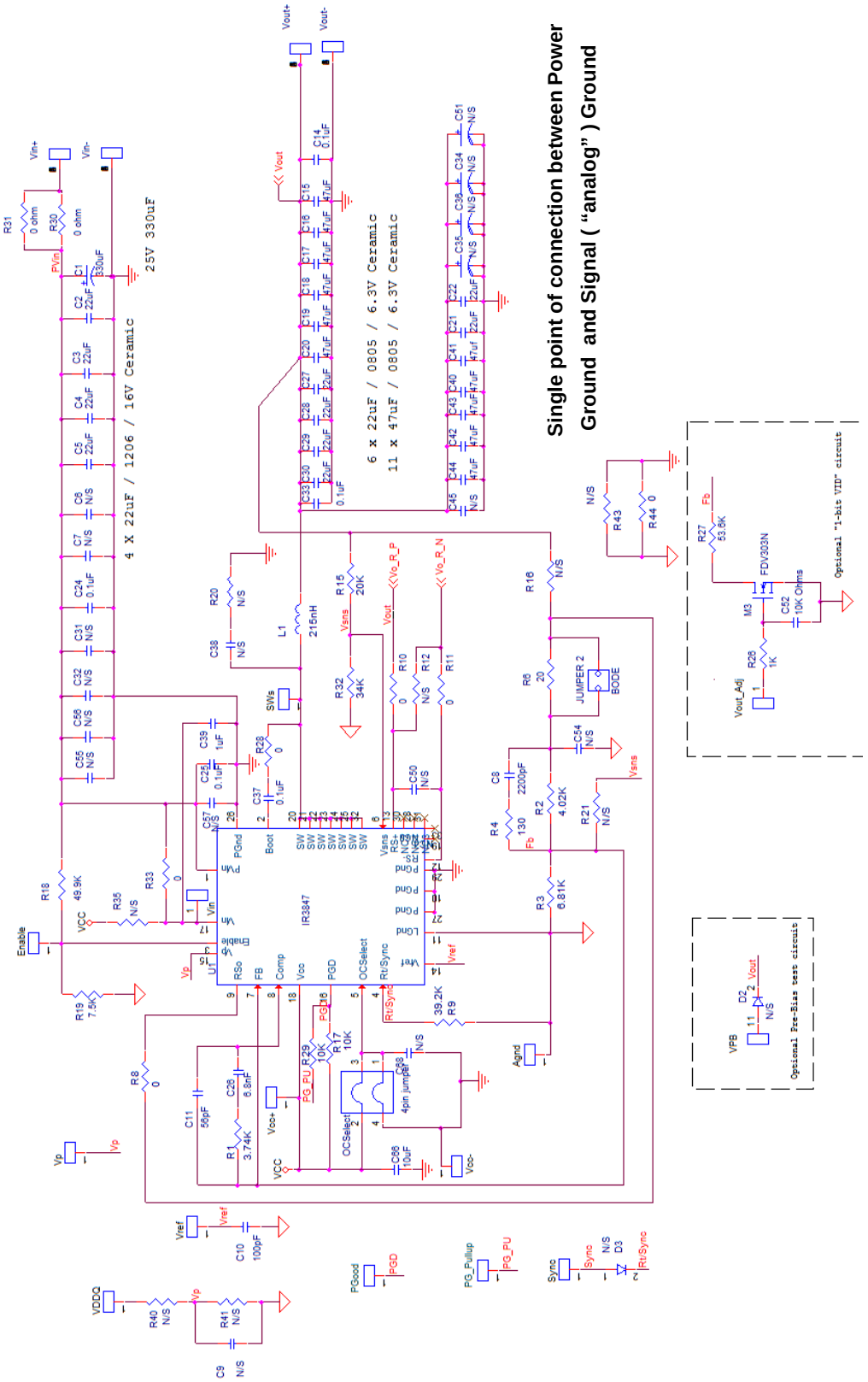
Vin **Gnd** **Gnd** **Vo**



Top View

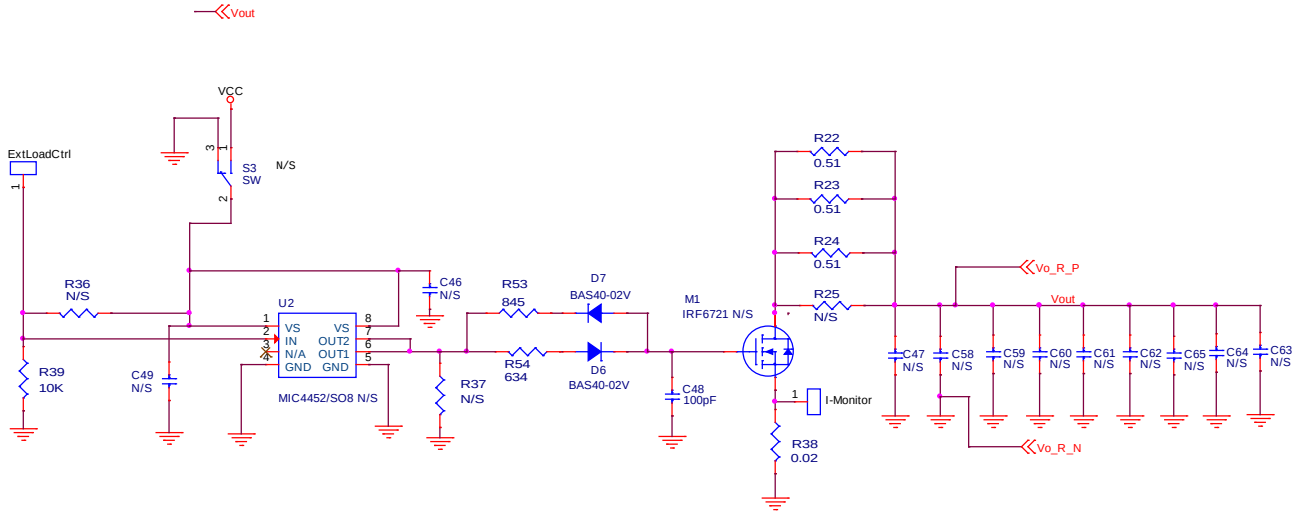


NOTE:
“1-bit VID” Circuit
PVCCIO_VID0=1, VCCIO=1V, OVP=114%, PGood=90%
PVCCIO_VID0=0, VCCIO=0.954V, OVP=120%, PGood=95%

Fig. 1: Schematic of the IR3847 evaluation board

This evaluation board is a preliminary version meant for the engineering evaluation of the IR3847. Based on the results of the continuing evaluation, this board can evolve and change without notice

Schematic for Transient Load set up



Optional transient load circuit

Bill of Materials

Item	Quantity	Part Reference	Value	Description	Manufacturer	Part Number
1	4	C2 C3 C4 C5	22uF	1206, 25V, X5R, 20%	Murata	GRM31CR61E226KE15L
2	1	C1	330uF	SMD Elecrolytic, Fsize, 25V, 20%	Panasonic	EEV-FK1E331P
3	5	C14 C24 C25 C37 C33	0.1uF	0603, 25V, X7R, 10%	Murata	GRM188R71E104KA01D
4	1	C8	2200pF	0603, 50V, X7R, 10%	Murata	GRM188R71H222KA01D
5	1	C11	56pF	0603, 50V, NP0, 5%	Murata	GRM1885C1H560JA01D
6	11	C15 C16 C17 C18 C19 C20 C40 C41 C42 C43 C44	47uF	0805, 6.3V, X5R, 20%	Murata	GRM21BR60J476ME15L
7	6	C21 C22 C27 C28 C29 C30	22uF	0805, 6.3V, X5R, 20%	Murata	GRM21BR60J226ME39
8	1	C26	6.8nF	0603, 50V, X7R, 10%	Murata	GRM188R71H682KA01D
9	2	C10 C48	100pF	0603, 50V, NP0, 5%	Panasonic	C1608C0G1H101J
10	1	L1	0.215uH	0.215uH, DCR=0.29mohm	Cyntec	PCDC1008-R215EMO
11	1	R1	3.74K	0603,1/10W,1%	Panasonic	ERJ-3EKF3741V
12	1	R2	4.02K	0603,1/10W,1%	Panasonic	ERJ-3EKF4021V
13	1	R3	6.81K	0603,1/10W,1%	Panasonic	ERJ-3EKF6811V
14	1	R4	130	0603,1/10W,1%	Panasonic	ERJ-3EKF1300V
15	1	R6	20	0603,1/10 W,1%	Vishay/Dale	CRCW060320R0FKEA
16	1	R9	39.2K	0603,1/10 W,1%	Panasonic	ERJ-3EKF3922V
17	6	R8 R28 R10 R11 R44 R33	0	0603,1/10 W,5%	Vishay/Dale	CRCW06030000Z0EA
18	1	C39	1uF	0603, X5R, 25V, 20%	TDK	C1608X5R1E105M
19	1	C66	10uF	0603, X5R, 10V, 20%	TDK	C1608X5R1A106M
20	1	R15	20K	0603,1/10 W,1%	Panasonic	ERJ-3EKF2002V
21	4	R17 R29 R39 C52	10K	0603,1/10 W,1%	Panasonic	ERJ-3EKF1002V
22	1	R18	49.9K	0603,1/10 W,1%	Panasonic	ERJ-3EKF4992V
22	1	R19	7.5K	0603,1/10 W,1%	Panasonic	ERJ-3EKF7501V
23	3	R22 R23 R24	0.51	0805, 1/4W, 5%	Panasonic	ERJ-6BQFR51V
24	1	R26	1K	0603,1/10 W,1%	Panasonic	ERJ-3EKF1001V
25	1	R27	53.6K	0603,1/10 W,1%	Panasonic	ERJ-3EKF5362V
26	2	R30 R31	0	1206,1/4 W, 5%	Yageo	RC1206JR-070RL
27	1	R32	34K	0603,1/10 W,1%	Panasonic	ERJ-3EKF3402V
28	1	R38	0.02	1206, 1/2 W, 1%	KOA Speer	UR73D2BTBK20L0F
30	1	R53	845	0603,1/10 W,1%	Panasonic	ERJ-3EKF8450V
31	1	R54	634	0603,1/10 W,1%	Panasonic	ERJ-3EKF6340V
32	2	D6 D7		Schottky Diode	Vishay	BAS40-02V-G-08
33	1	M1		DirectFET	International Rectifier	IRF6721
34	1	M3		N-CH 25V 680mA SOT-23	Fairchild Semi	FDV303N
35	1	Jumper		PLUG 40 POS DBL ROW STR	Omron Electronics Inc.	XG8W-4041-ND
36	2	Vin+ Vout+	RED	SCREW TERMINAL	Keystone Electronics	8199-2
37	2	Vin- Vout-	BLACK	SCREW TERMINAL	Keystone Electronics	8199-3
38	1	U1	IR3847	IR3847 5mm X6mm	International Rectifier	IR3847
39	1	U2		IC DRIVER MOSF 12A LO SIDE 8SOIC	Micrel	MIC4452YM TR

TYPICAL OPERATING WAVEFORMS
Vin=12.0V, Vo=0.954V, Io=0-25A, 600kHz, Room Temperature, no airflow

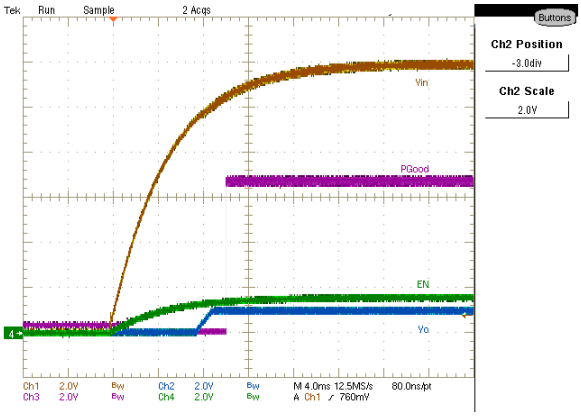


Fig. 2: Start up at 25A Load
Ch_1:V_{in}, Ch_2:V_o, Ch_3:PGood, Ch_4:Enable

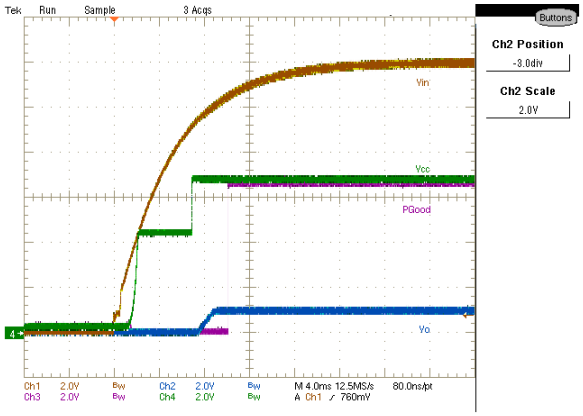


Fig. 3: Start up at 25A Load,
Ch_1:V_{in}, Ch_2:V_o, Ch_3:PGood,Ch_4:V_{cc}

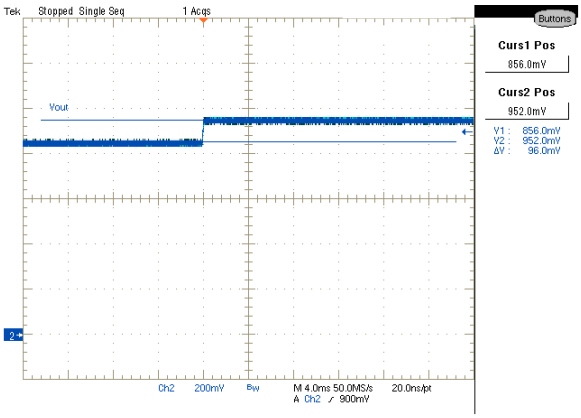


Fig. 4: Start up with 0.859 V Pre Bias , 0A Load, Ch_2:V_{out},

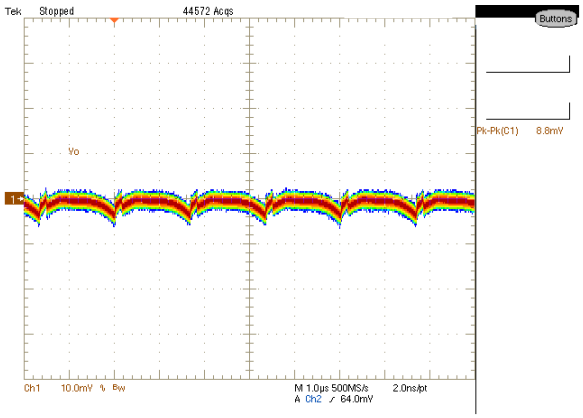


Fig. 5: Output Voltage Ripple, 25A load Ch_1: V_{out}

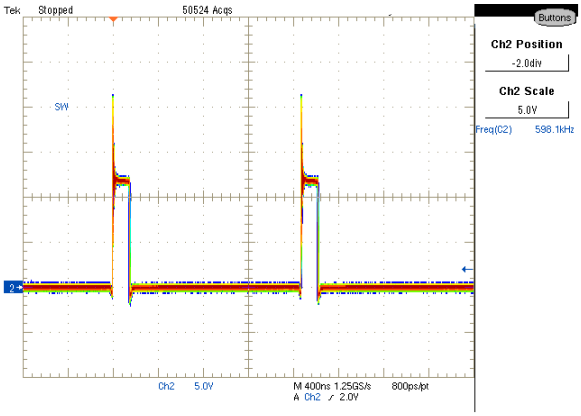


Fig. 6: Inductor node at 25A load
Ch_2:LX

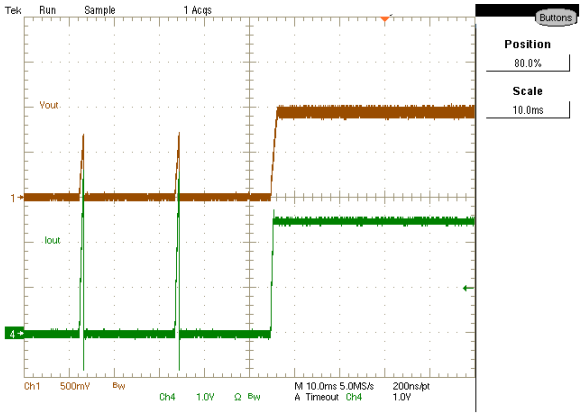


Fig. 7: Short (Hiccup) Recovery
Ch_2:$V_{out;}$ Ch_4=Io

TYPICAL OPERATING WAVEFORMS
Vin=12.0V, Vo=1.0V, Io=0-25A, 600kHz, Room Temperature, no airflow

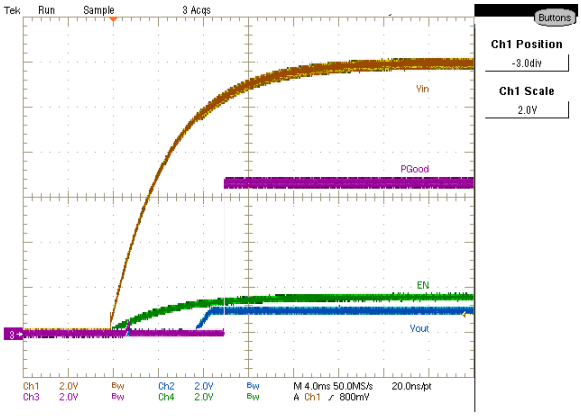


Fig. 8: Start up at 25A Load
Ch_1:V_{in}, Ch_2:V_o, Ch_3:PGood, Ch_4:Enable

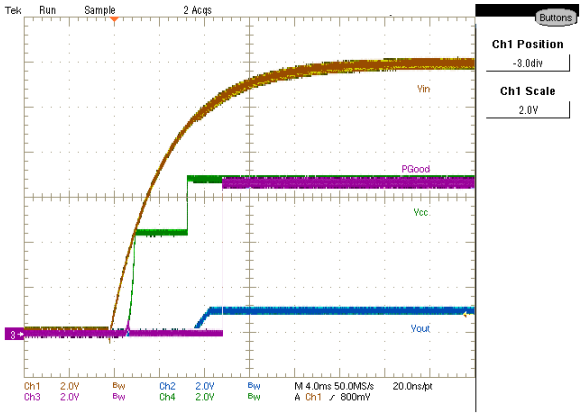


Fig. 9: Start up at 25A Load,
Ch_1:V_{in}, Ch_2:V_o, Ch_3:PGood,Ch_4:V_{cc}

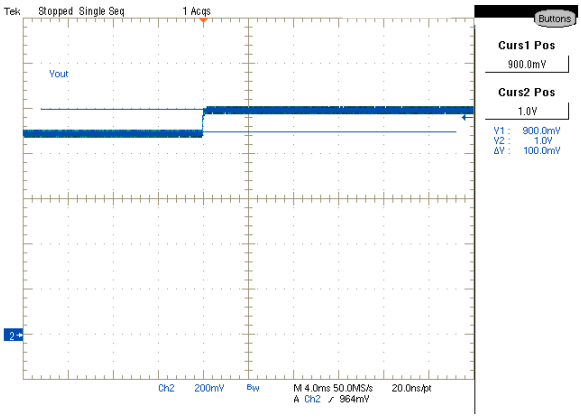


Fig. 10: Start up with 0.90 V Pre Bias , 0A Load, Ch_2:V_{out},

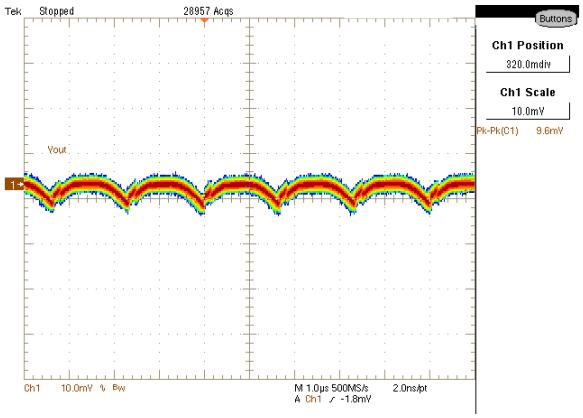


Fig. 11: Output Voltage Ripple, 25A load Ch_1: V_{out}

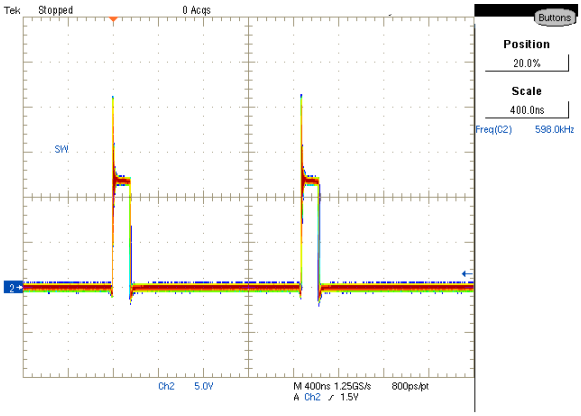


Fig. 12: Inductor node at 25A load
Ch_2:LX

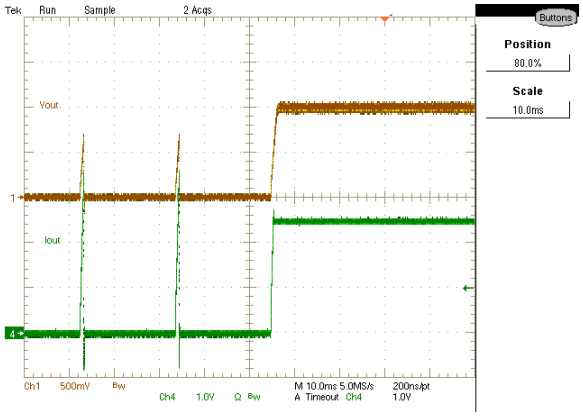
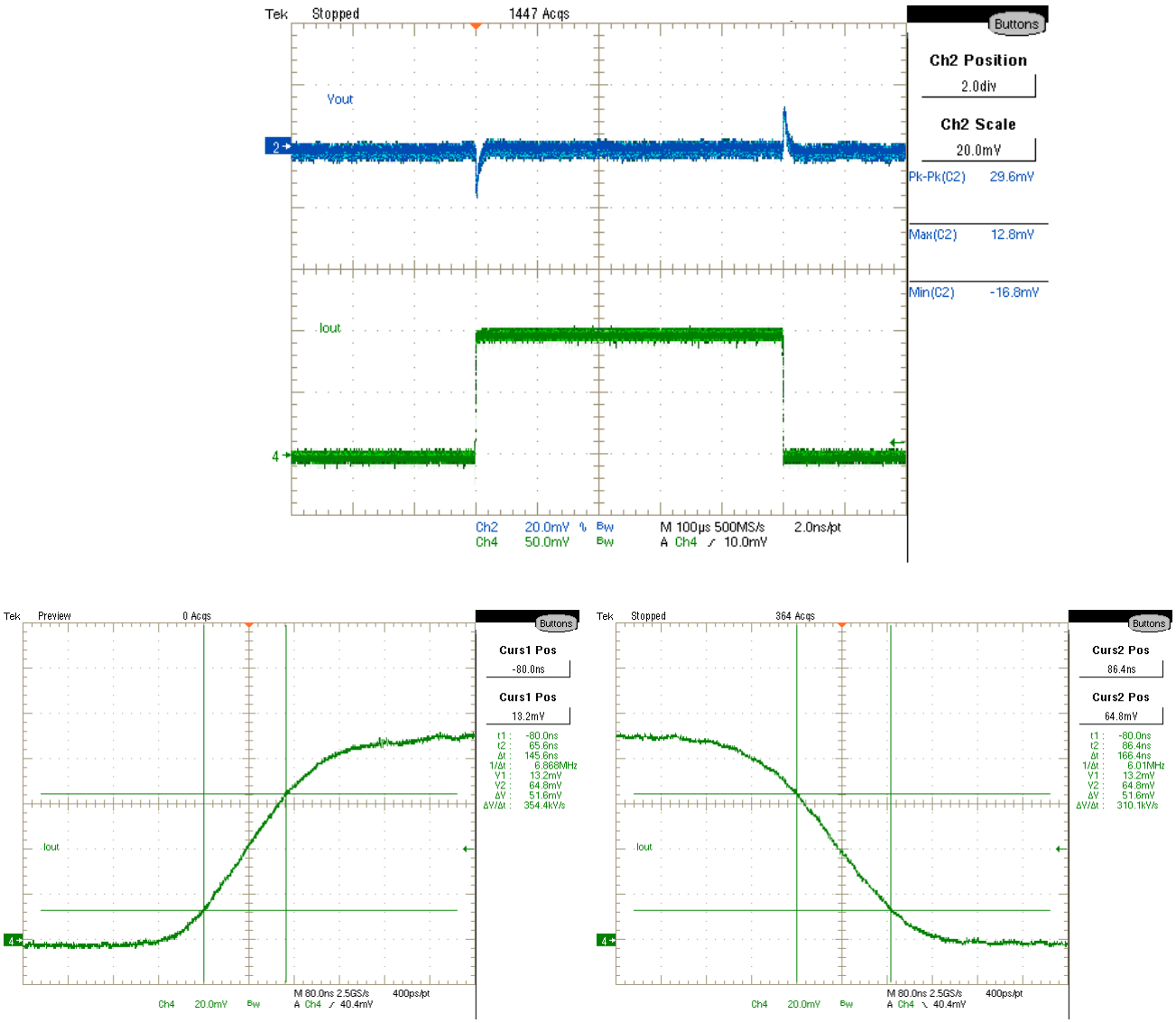


Fig. 13: Short (Hiccup) Recovery
Ch_2:$V_{out;}$ Ch_4=Io

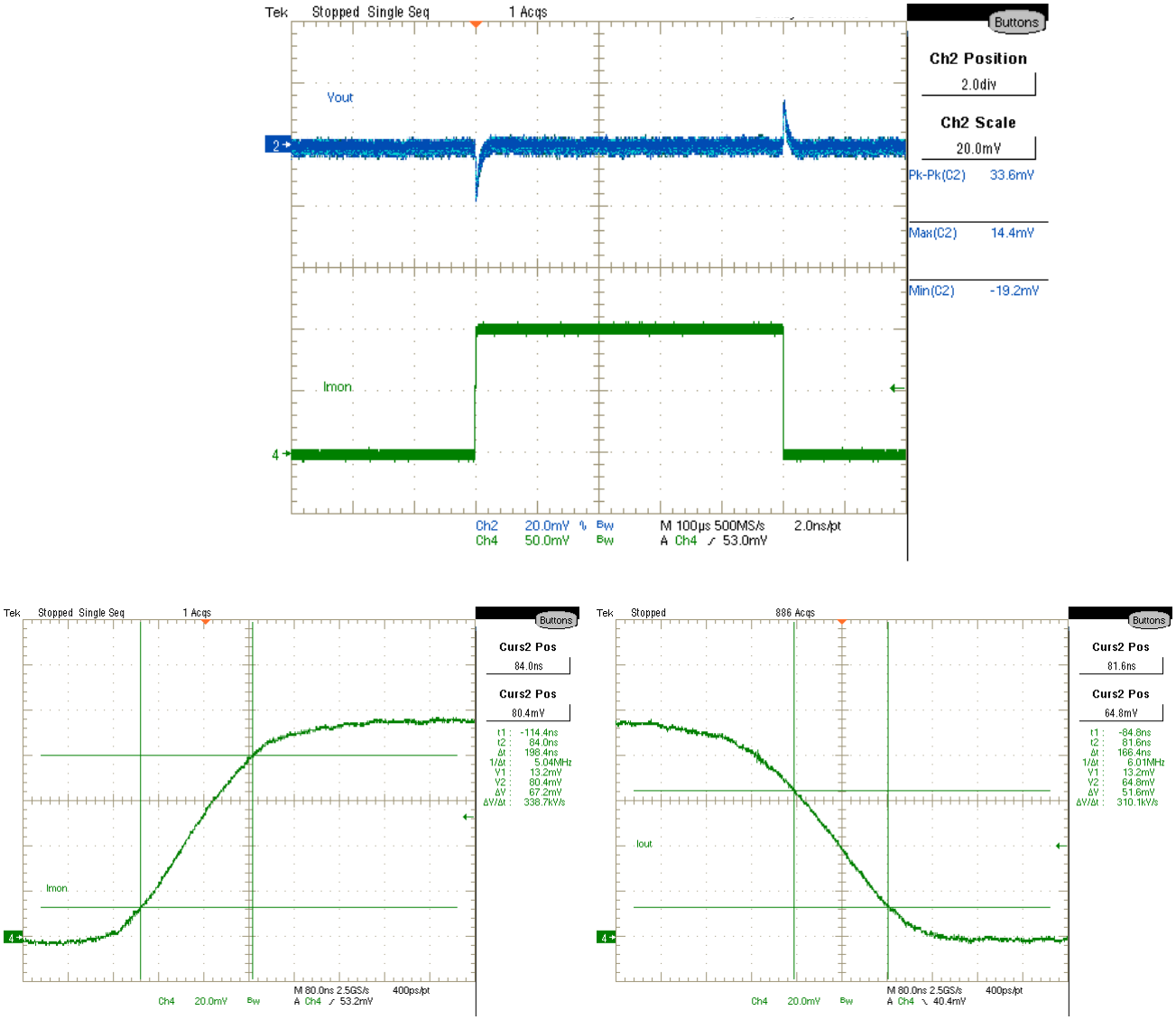
TYPICAL OPERATING WAVEFORMS
Vin=12.0V, Vo=0.954V, Io=2.5A-12.5A, 600kHz, Room Temperature, no air flow



Imon is measured across a 20 mOhm resistor.

Fig. 14: Transient Response, 6A to 11A step (16A/us)
Ch_2:V_{out}

TYPICAL OPERATING WAVEFORMS
Vin=12.0V, Vo=1.0V, Io=6A-11A, 600kHz, Room Temperature, no air flow



Imon is measured across a 20 mOhm resistor.

Fig. 15: Transient Response, 6A to 11A step (16A/us)
Ch_2:V_{out}

TYPICAL OPERATING WAVEFORMS

Vin=12.0V, Vo=0.95V / 1.0V , Io=0A-25A, 600kHz, Room Temperature, No air flow

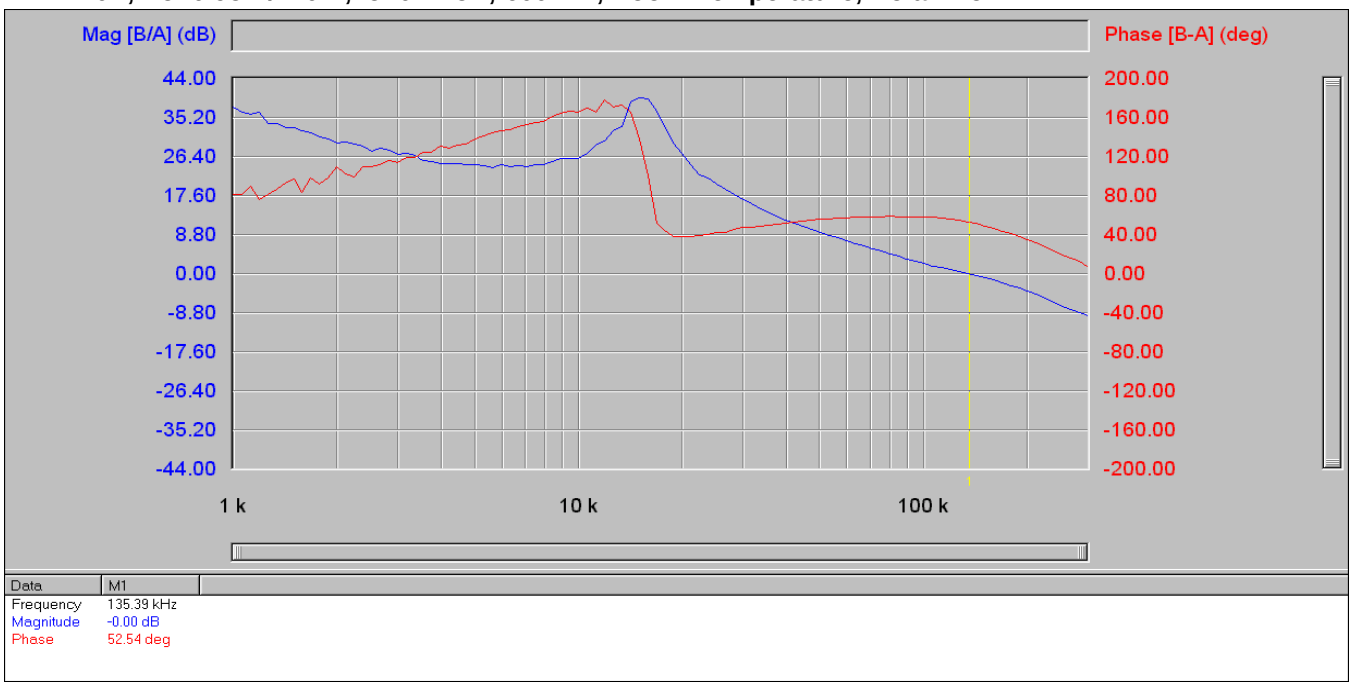


Fig. 16a: Bode Plot at Vout = 0.95V and 25A load: bandwidth of 135.4 kHz; phase margin = 52.5 degrees

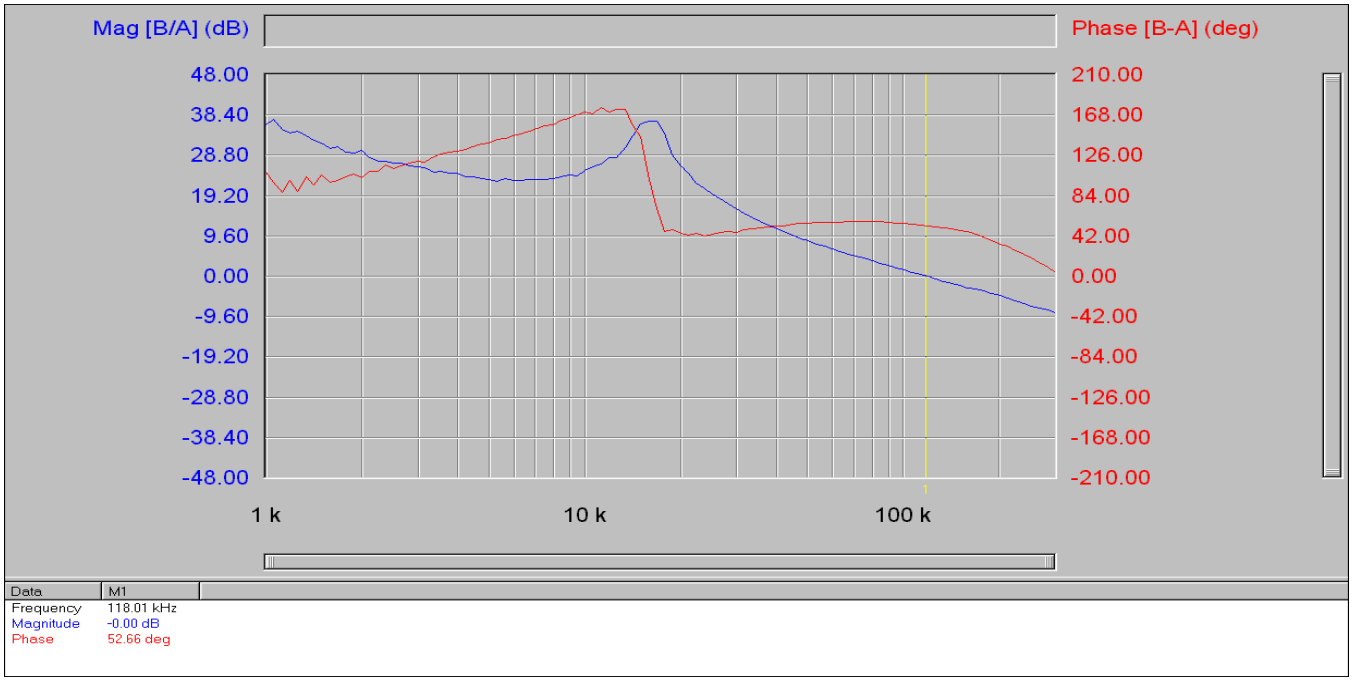


Fig. 16b: Bode Plot at Vout = 1.0V and 25A load: bandwidth of 118.0 kHz; phase margin = 52.7 degrees

TYPICAL OPERATING WAVEFORMS
Vin=12.0V, Vo=0.95V, Io=0A-25A, Room Temperature, no air flow

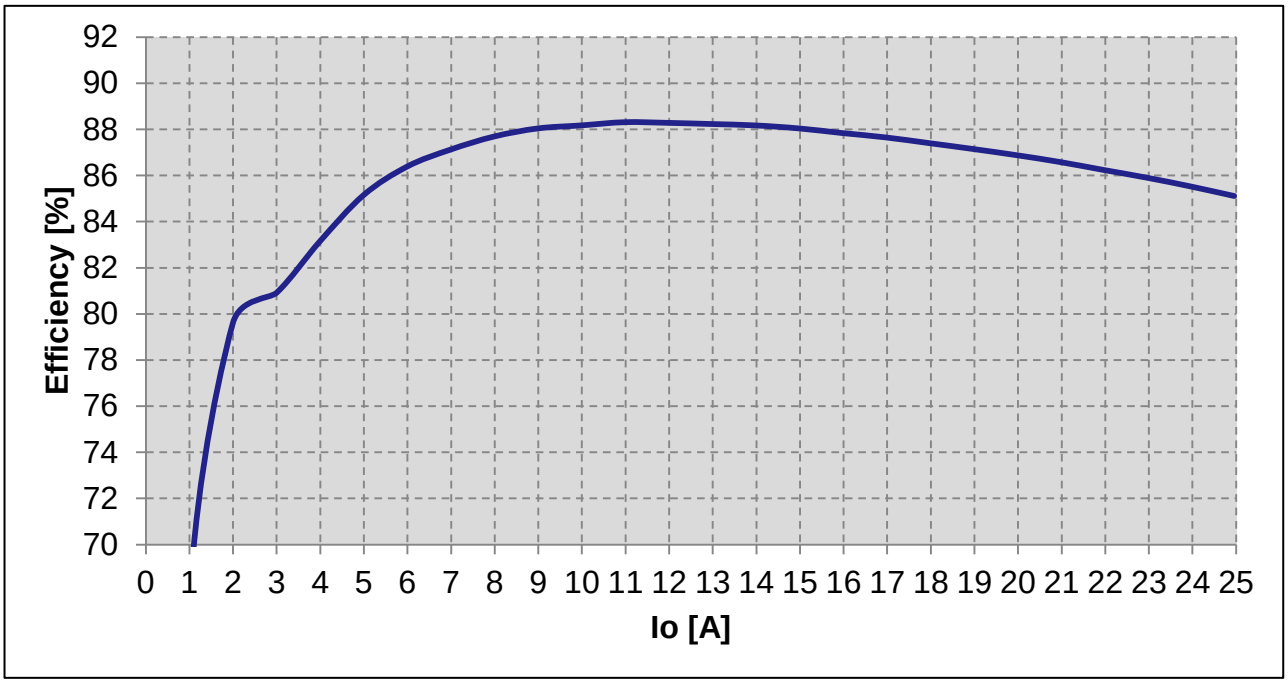


Fig.17: Efficiency versus load current

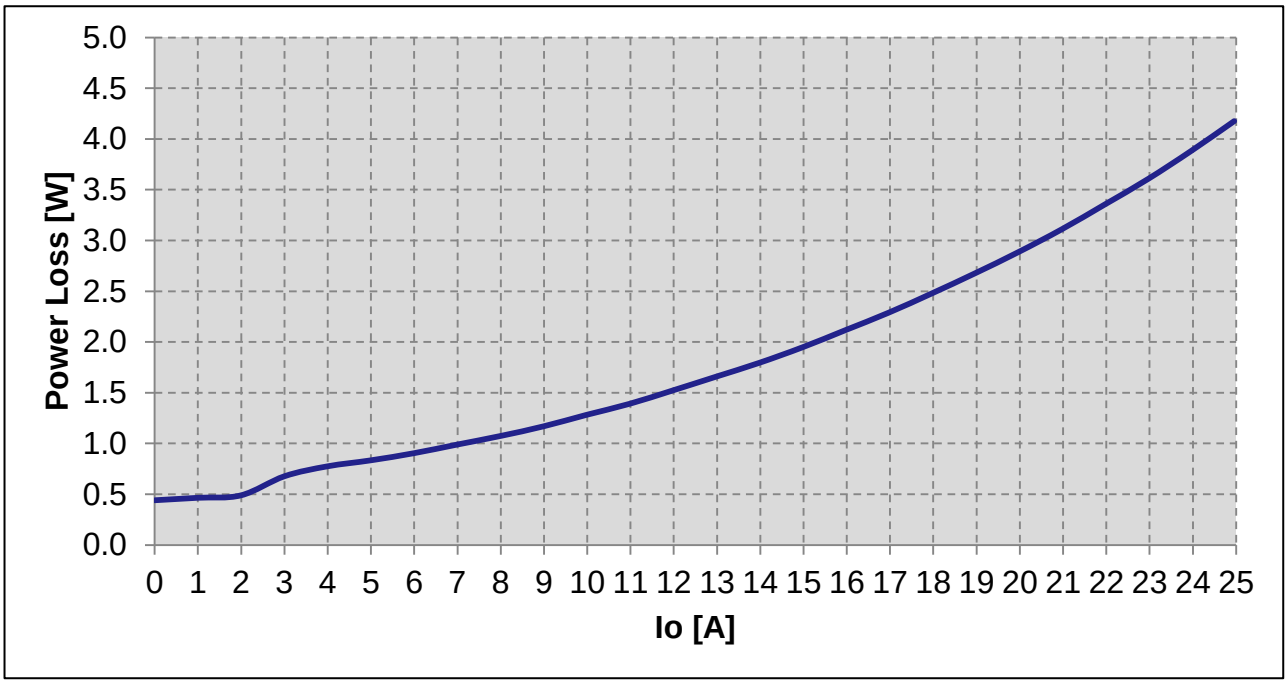


Fig.18: Power loss versus load current

TYPICAL OPERATING WAVEFORMS
Vin=12.0V, Vo=1.0V, Io=0A-25A, Room Temperature, no air flow

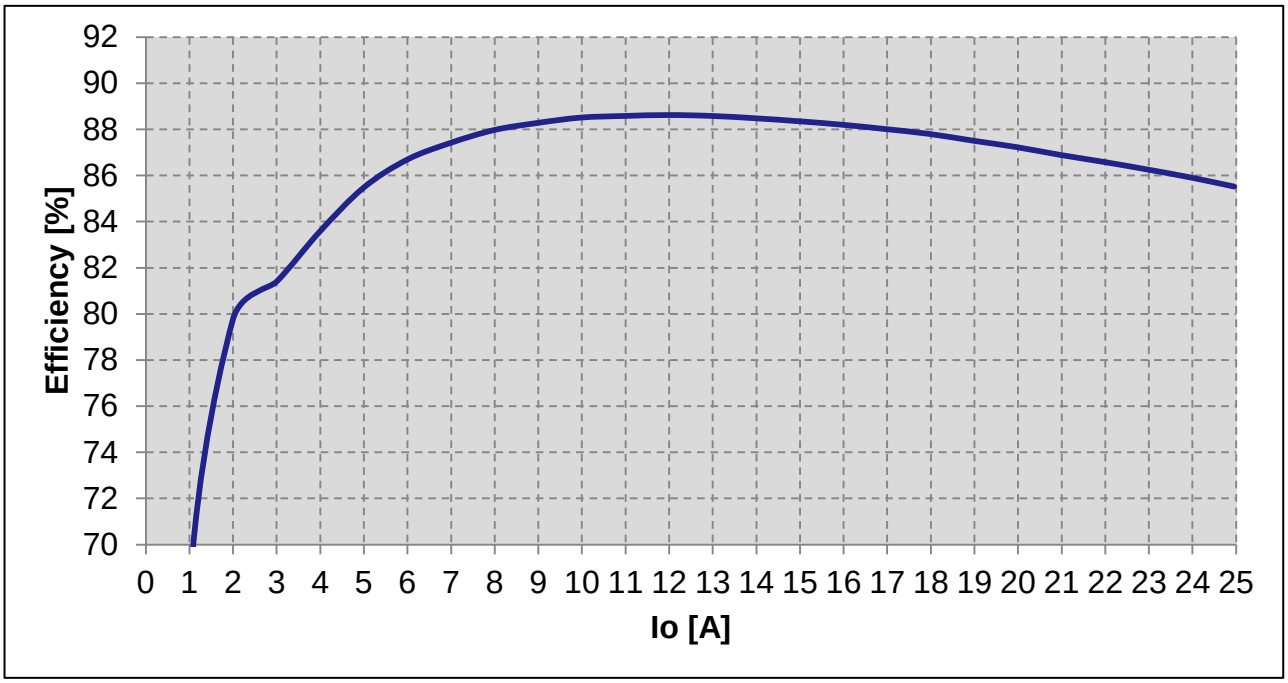


Fig.19: Efficiency versus load current

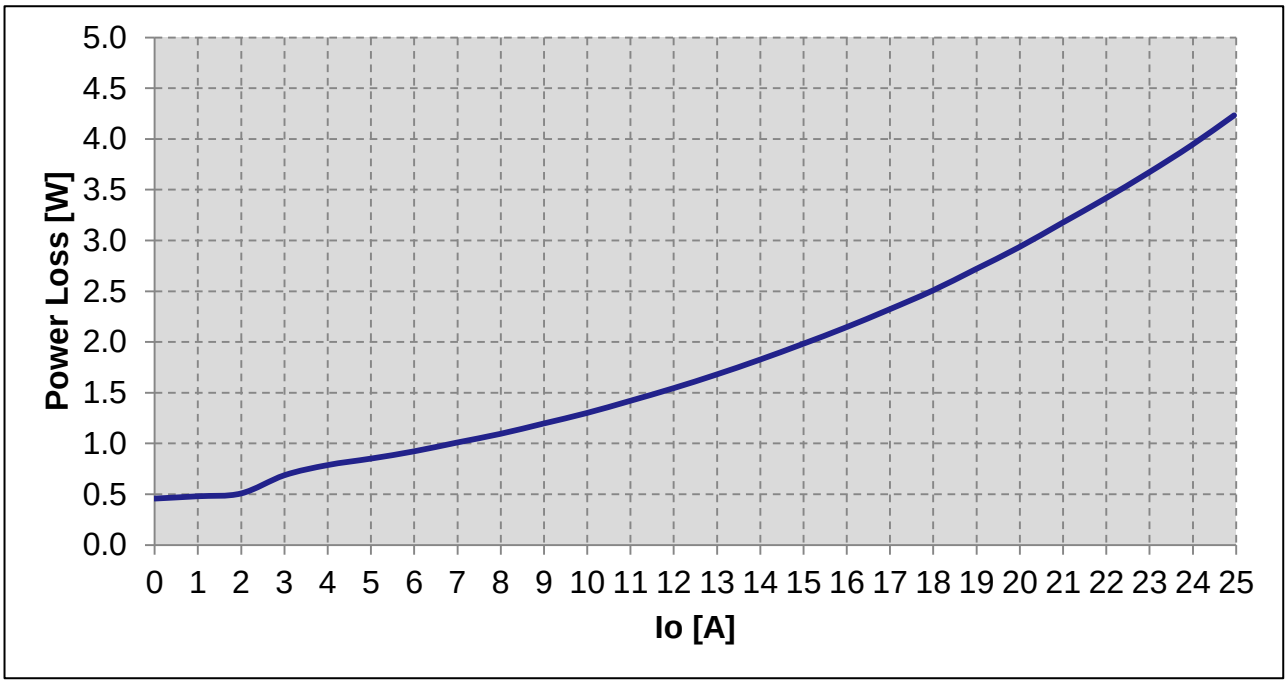


Fig.20: Power loss versus load current

THERMAL IMAGES
Vin=12.0V, Vo=0.95V/1.0V, Io=0A-25A, 600kHz, Room Temperature, No airflow

Fig. 21a: Thermal Image of the board at Vout = 0.95V and 25A load
Test point 1 is IR3847: 69.5^{0}C
Test point 2 is inductor: 56^{0}C

Fig. 21b: Thermal Image of the board at Vout = 1.0V and 25A load
Test point 1 is IR3847: 71.7^{0}C
Test point 2 is inductor: 58.5^{0}C