ISL6721EVAL

Current Mode Active Clamp Forward with SR for Middle Power Level Applications

Introduction:

The ISL6721EVAL board is a 48V input to 3.3V output DC/DC converter which can output current up to 30A.This user guide includes the test setup, test report, schematics, layout and BOM.

This board uses the ISL6721, an advanced current mode PWM controller to implement control of an active clamp forward topology. The circuit operates at fixed frequency with peak current control mode. The converter adopts synchronous rectifier to replace the diode rectifier to get high efficiency.

Features of ISL6721

- 1A MOSFET Gate Driver
- 100µA Startup Current
- Fast Transient Response with Peak Current Mode Control
- Adjustable Switching Frequency up to 1MHz
- Bi-directional Synchronization
- Low Power Disable Mode
- Delayed Restart from OV and OC Shutdown Faults
- Adjustable Slope Compensation
- Adjustable Soft-start
- Adjustable Overcurrent Shutdown Delay
- Adjustable UV and OV Monitors
- Leading Edge Blanking
- Integrated Thermal Shutdown
- 1% Tolerance Voltage Reference
- Pb-free Plus Anneal Available (RoHS Compliant)

Applications

- Telecom and Datacom Power

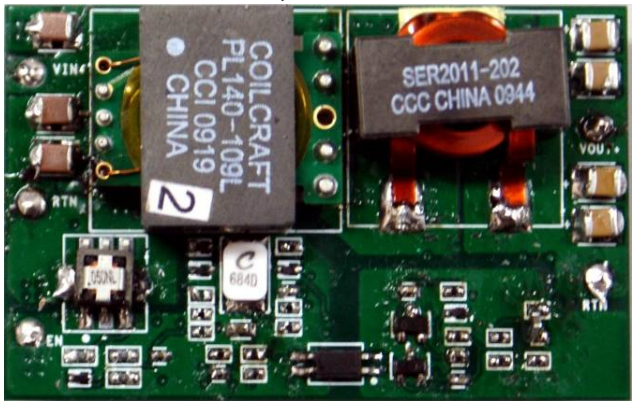
- Wireless Base Station Power
- File Server Power
- Industrial Power Systems
- Isolated Buck and Flyback Regulators
- Boost Regulators

Design Specifications

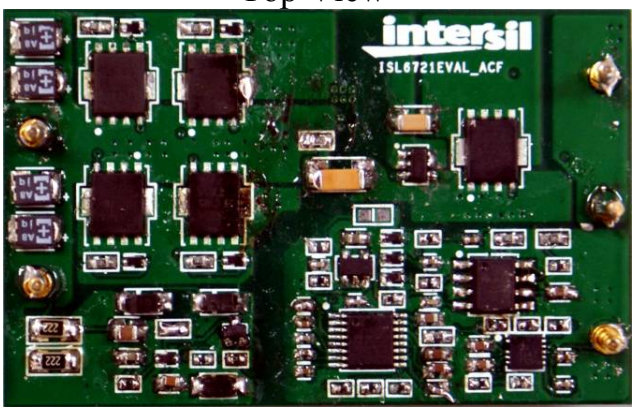
The evaluation board ISL6741EVAL aims at the following design Specifications (Recommended operating conditions unless otherwise noted : Vin=48V)

Characteristics		Conditions	Min	Typ	Max	Unit
Frequency				220		KHZ
Input Voltage			36		75	V
Output Voltage				3.3		V
Output Current			0		30	A
Efficiency		Io=30A		92		%
Load Regulation				7		mV
Line Regulation		Io=30A		1		mV
Ripple & Noise		Io=30A		50		mV
Start Up Time		Io=30A		50		ms
Dynamic		7.5A-15A-7.5A 15A-22.5A-15A (f=100Hz 1A/us)		350 (Without external capacitor)		mV
OCP	Value			36		A
	Hiccup delay time			300		ms
OTP	Value			105		ºC
	Hysteresis			20		ºC
Input UVP	Value	Io=30A		34		V
	Hysteresis			2		V
Output OVP	Value	Io=30A		3.7		V
	Hiccup delay time			300		ms
EN	Negative logical signal		1.6		2.5	V
Output Capacitor		Io=30A	0		6600	uF

Photo (Size: 37×59×15 mm)



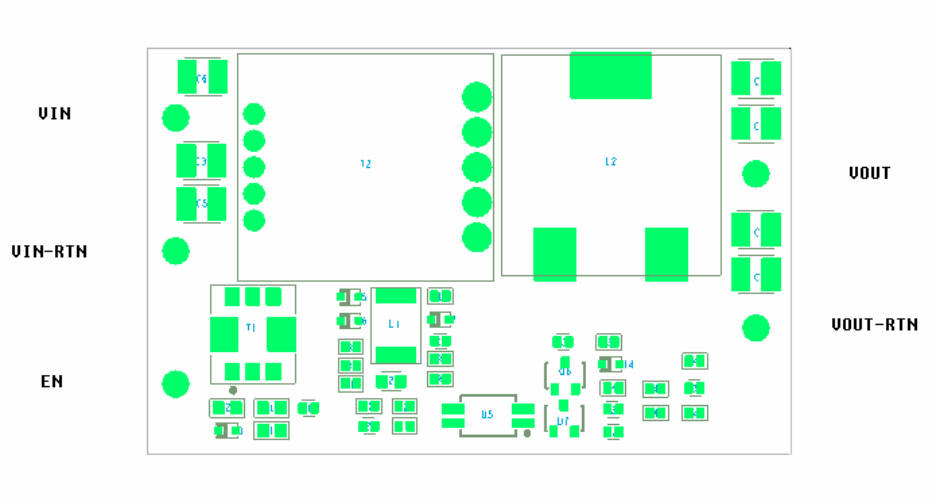
Top View



Bottom View

Test setup:

Pin Assignment



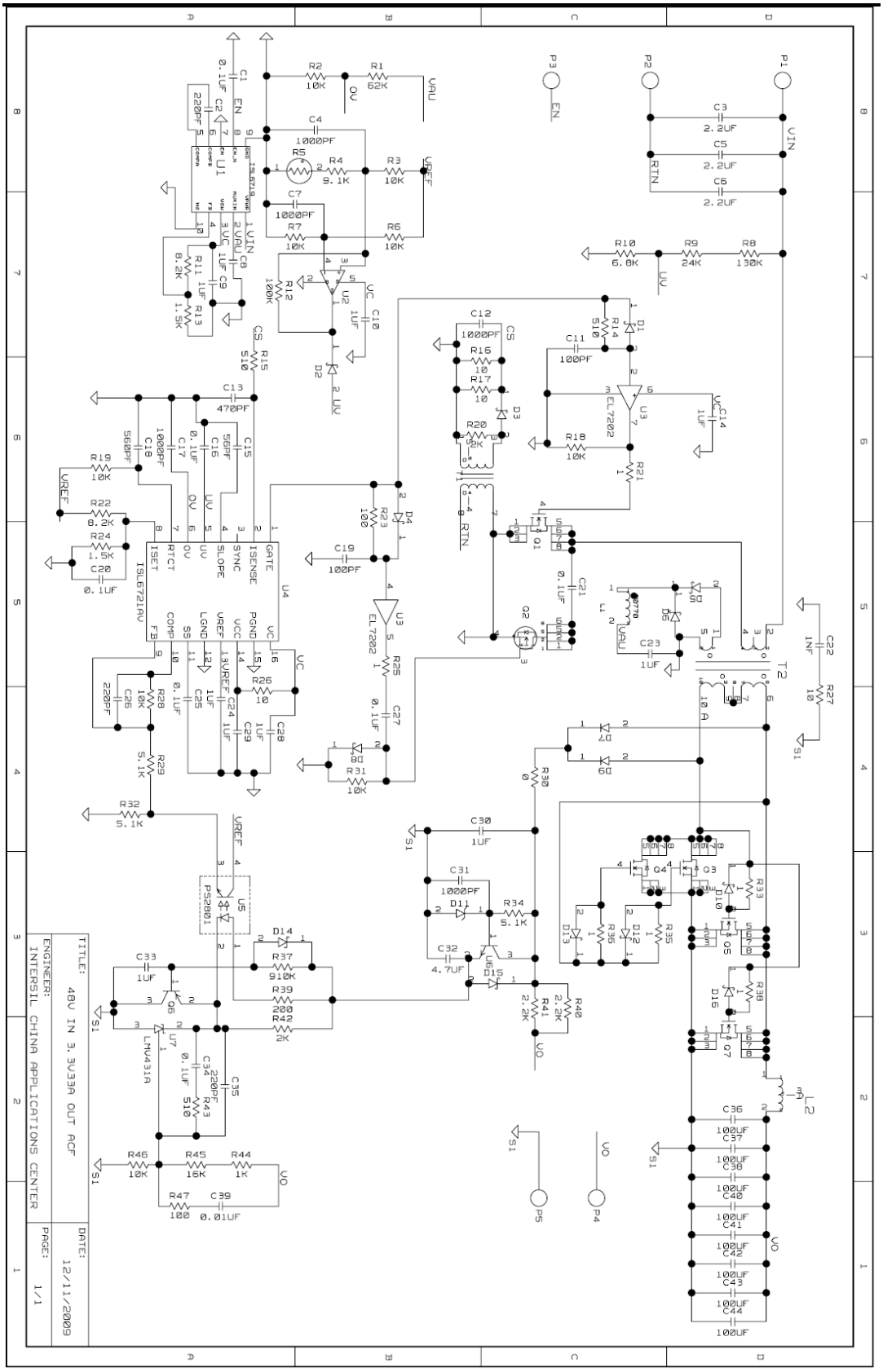
Top View

- **VIN:** Input Voltage Positive
- **VIN-RTN:** Input Voltage Negative
- **EN:** Enable (Negative logical)
- **VOUT:** Output Voltage Positive
- **VOUT-RTN:** Output Voltage Negative

Description

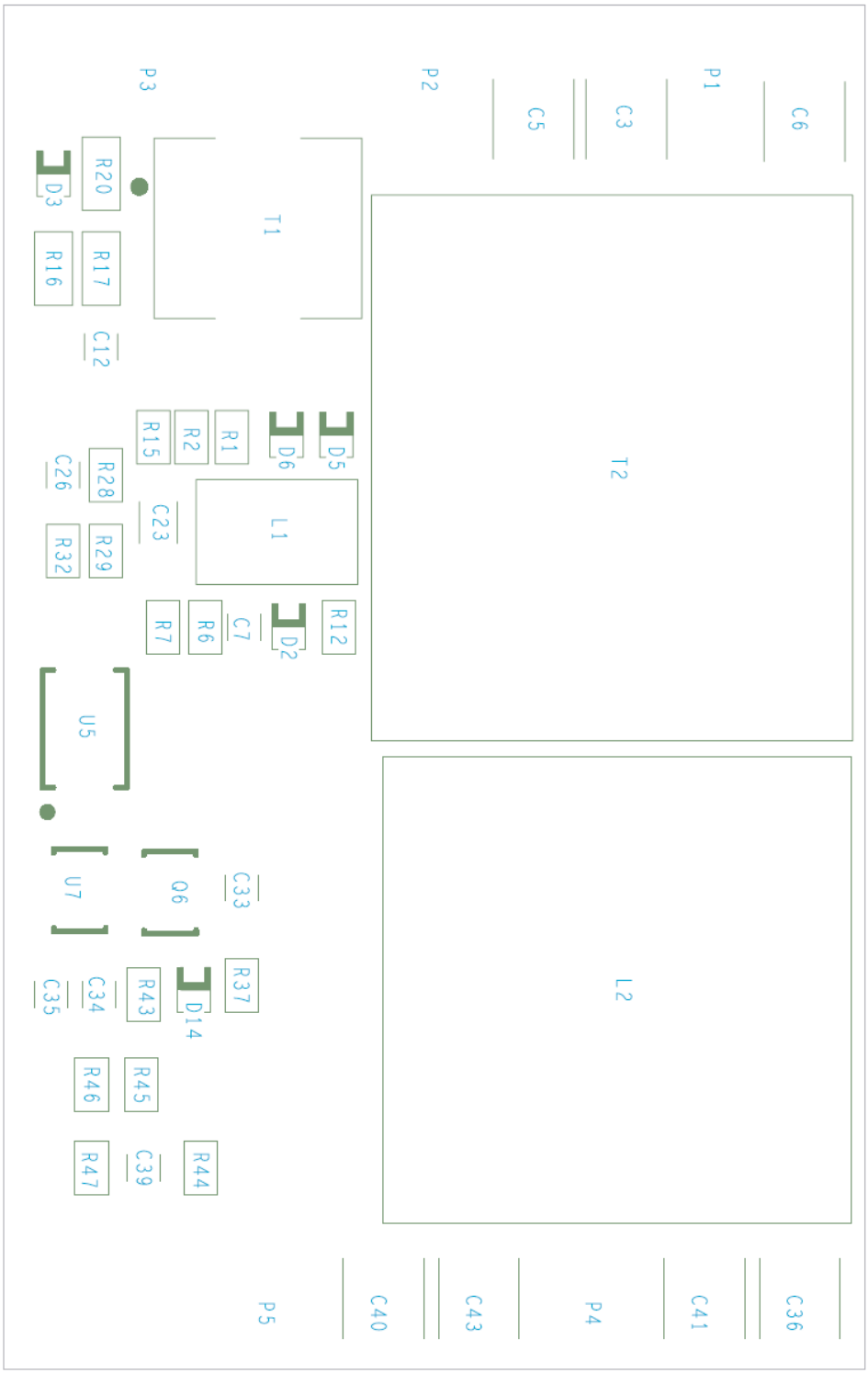
1. **Enable Logic**
   The enable logic is active low.
2. **Input Voltage**
   The range of input voltage is from 36V to 75V, and the maximum voltage applied to the converter can not be higher than 75V.
3. **The output load**
   The load must be connected to the VOUT and VOUT-RTN pins. The maximum output current is 30A
4. **Cooling:**
   This converter needs forced air cooling, and the recommended air speed is 3m/S at full load.
5. **Output OCP & OVP:**
   The output OVP and OVP are implemented in hiccup mode. The hiccup delay time is 300ms.

Schematics:

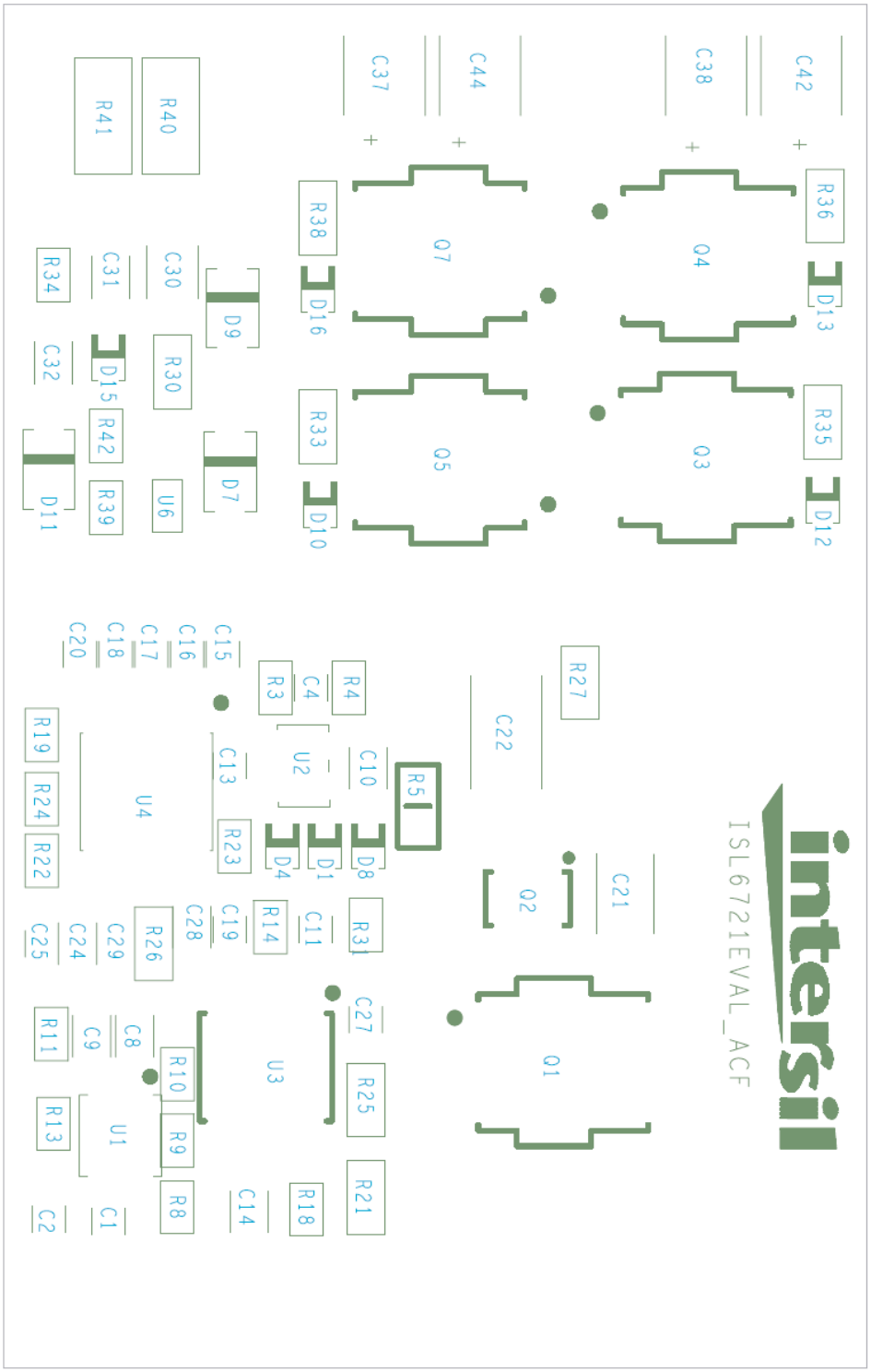

TITLE:
48V IN 3.3V33A OUT ACF
ENGINEER:
INTERSIL CHINA APPLICATIONS CENTER
PAGE:
1/1
DATE:
12/11/2009

SILKSCREEN

TOP:



BOTTOM:


intersil
ISL6721EVAL_ACF
C42
C38
C44
C37
R36
R38
R33
R35
D13
D16
D10
D12
Q4
Q7
Q5
Q3
R41
R40
C30
C31
R34
C32
D9
D15
R42
D11
R30
R39
D7
U6
R27
C22
C21
Q2
Q1
R51
C15
C16
C17
C18
C20
R4
C4
R3
C10
U2
C13
R23
D8
D1
D4
R31
R14
C11
C19
C28
R26
C29
C24
C25
U4
R19
R24
R22
C27
R25
R21
R18
C14
U3
R10
R9
R8
C8
C9
R11
R13
U1
C1
C2

BOM

Part Number	Ref Des	Qty	Value	Manufacturer
DO1608C-105MLC	L1	1	1mH	COILCRAFT
SER2011-202MLD	L2	1	2uH	COILCRAFT
SI7738DP	Q1	1	150V/30A	VISHAY
SI3437DV	Q2	1	150V/1.4A	VISHAY
PL140-109L (AUX=9)	T2	1	12:02:09	COILCRAFT
ISL6719	U1	1	100V	INTERSIL
MMBT3904WT1G	U6	1	40V NPN	ONSEMI
CAPACITOR	C3,C5,C6	3	2.2UF	TDK
CAPACITOR	C22	1	1NF/2000V	TDK
CDBM1100-G	D7,D9	2	100V/1A	DIODE
CAPACITOR	C32	1	4.7UF	TDK
PIN	P1-P5	5		TDK
BAS516	D1-D6,D8,D10, D12-D16	13	75V/0.25A	NXP
MMSZ5V1T1G	D11	1	5.1V ZENER	ONSEMI
CAPACITOR	C2,C26,C35	3	220PF/50V	TDK
CAPACITOR	C8-C10,C14, C23,C24,C28, C29	8	1UF/16V	TDK
CAPACITOR	C21	1	0.1UF/250V	TDK
EL7202CS	U3	1		INTERSIL
EL5111	U2	1		INTERSI
NTC	R5	1	10K	TDK
CAPACITOR	C11,C19	2	100PF	TDK
CAPACITOR	C4,C7,C12,C17	4	1000PF	TDK
CAPACITOR	C39	1	0.01UF	TDK
CAPACITOR	C1,C16,C20, C25,C27,C34	6	0.1UF	TDK
CAPACITOR	C33	1	1UF/6.3V	TDK
CAPACITOR	C13	1	470PF/50V	TDK
CAPACITOR5	C15	1	56PF/50V	TDK
CAPACITOR	C18	1	560PF/50V	TDK
CAPACITOR	C31	1	1000PF/50V	TDK
CAPACITOR	C30	1	1UF/50V	TDK
CAPACITOR	C36,C40,C41,C43	4	100UF/6.3V	MURATA
CAPACITOR	C37,C38,C42,C44	4	100UF/6.3V	SANYO
RESISTOR	R23,R47	2	100	WALSIN
RESISTOR	R44	1	1K	WALSIN
RESISTOR	R2,R3,R6,R7, R18,R19,R28, R31,R46	9	10K	WALSIN
RESISTOR	R12	1	100K	WALSIN
RESISTOR	R8	1	130K	WALSIN
RESISTOR	R13,R24	2	1.5K	WALSIN

RESISTOR	R45	1	16K	WALSIN
RESISTOR	R39	1	200	WALSIN
RESISTOR	R42	1	2K	WALSIN
RESISTOR	R9	1	24K	WALSIN
RESISTOR	R14,R15,R43	3	510	WALSIN
RESISTOR	R29,R32,R34	3	5.1K	WALSIN
RESISTOR	R1	1	62K	WALSIN
RESISTOR	R10	1	6.8K	WALSIN
RESISTOR	R11,R22	2	8.2K	WALSIN
RESISTOR	R4	1	9.1K	WALSIN
RESISTOR	R37	1	910K	WALSIN
RESISTOR	R21,R25,R33, R35,R36,R38	6	1	WALSIN
RESISTOR	R16,R17,R26, R27	4	10	WALSIN
RESISTOR	R30	1	0	WALSIN
RESISTOR	R20	1	2K	WALSIN
RESISTOR	R40,R41	2	2.2K	WALSIN
ISL6721AV	U4	1		INTERSIL
LMV431AIMF	U7	1		NATIONAL
MMBT3906	Q6	1		DIODES
PA1005.050	T1	1		PULSE
PS2801-1-A	U5	1		NEC
SI7336DP	Q3-Q5,Q7	4		VISHAY

Test Report

1. Load Regulation

Vin=48V

Io(A)	0	3	6	9	12	15
Vo(V)	3.2720	3.2710	3.2708	3.2705	3.2700	3.2694
Io(A)	18	21	24	27	30	
Vo(V)	3.2688	3.2683	3.2672	3.2660	3.2652	

Table 1

The Load Regulation is: 0.21%

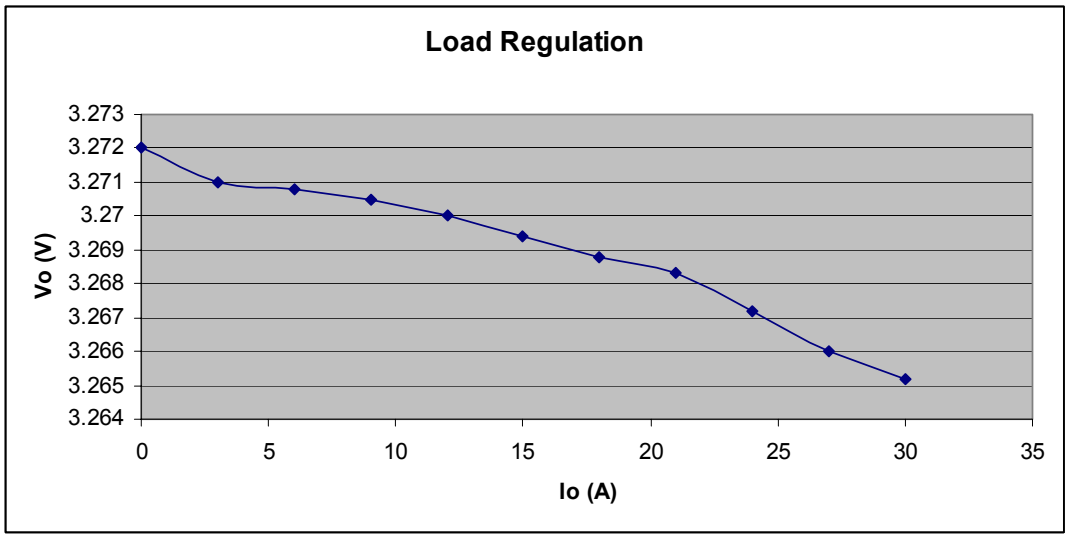


Figure 1

2. Line Regulation

Io=0A

Vin(V)	36	40	44	48	52	56
Vo(V)	3.2715	3.2717	3.2719	3.2720	3.2718	3.2716
Vin(V)	60	64	68	72	75	
Vo(V)	3.2716	3.2714	3.2710	3.2707	3.2707	

Table 2

The Line Regulation is: 0.04%

Io=30A

Vin(V)	36	40	44	48	52	56
Vo(V)	3.2649	3.2649	3.2650	3.2652	3.2652	3.2651
Vin(V)	60	64	68	72	75	
Vo(V)	3.2651	3.2651	3.2651	3.2651	3.2651	

Table 3

The Line Regulation is: 0.03%

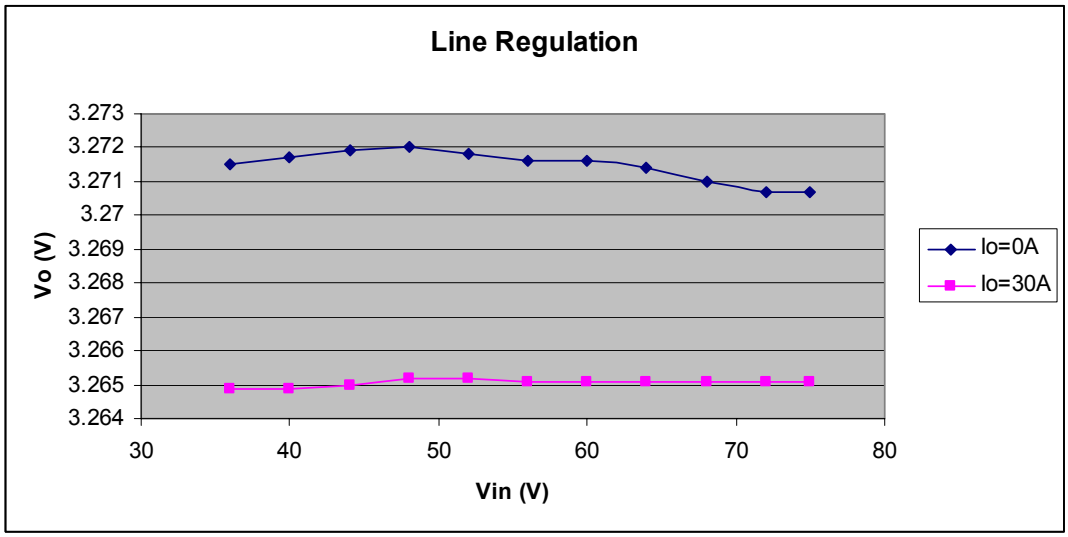


Figure 2

3. Efficiency

Vin=36V

Vin(V)	Iin(A)	Pin(W)	Vo(V)	Io(A)	Po(W)	η
36	0.334	12.024	3.271	3	9.813	0.816
36	0.6091	21.9276	3.2709	6	19.6254	0.895
36	0.889	32.004	3.2709	9	29.4381	0.919
36	1.1731	42.2316	3.2703	12	39.2436	0.929
36	1.4623	52.6428	3.2698	15	49.047	0.931
36	1.7552	63.1872	3.2692	18	58.8456	0.931
36	2.0523	73.8828	3.2682	21	68.6322	0.928
36	2.355	84.78	3.2673	24	78.4152	0.925
36	2.6611	95.7996	3.266	27	88.182	0.920
36	2.9707	106.9452	3.2649	30	97.947	0.916

Table 4

Vin=48V

Vin(V)	Iin(A)	Pin(W)	Vo(V)	Io(A)	Po(W)	η
48	0.2577	12.3696	3.271	3	9.813	0.793
48	0.4638	22.2624	3.2708	6	19.6248	0.881
48	0.673	32.304	3.2705	9	29.4345	0.911
48	0.8853	42.4944	3.27	12	39.24	0.923
48	1.1005	52.824	3.2694	15	49.041	0.928
48	1.3189	63.3072	3.2688	18	58.8384	0.929
48	1.5405	73.944	3.2683	21	68.6343	0.928
48	1.7648	84.7104	3.2672	24	78.4128	0.925
48	1.9929	95.6592	3.266	27	88.182	0.921
48	2.2239	106.7472	3.2652	30	97.956	0.918

Table 5

Vin=75

Vin(V)	Iin(A)	Pin(W)	Vo(V)	Io(A)	Po(W)	η
75	0.1827	13.7025	3.2703	3	9.8109	0.715
75	0.3122	23.415	3.2702	6	19.6212	0.837
75	0.4459	33.4425	3.2701	9	29.4309	0.880
75	0.5812	43.59	3.2696	12	39.2352	0.900
75	0.7185	53.8875	3.269	15	49.035	0.909
75	0.858	64.35	3.2684	18	58.8312	0.914
75	1.0001	75.0075	3.2677	21	68.6217	0.914
75	1.1433	85.7475	3.2669	24	78.4056	0.914
75	1.2885	96.6375	3.266	27	88.182	0.912
75	1.4363	107.7225	3.2651	30	97.953	0.909

Table 6

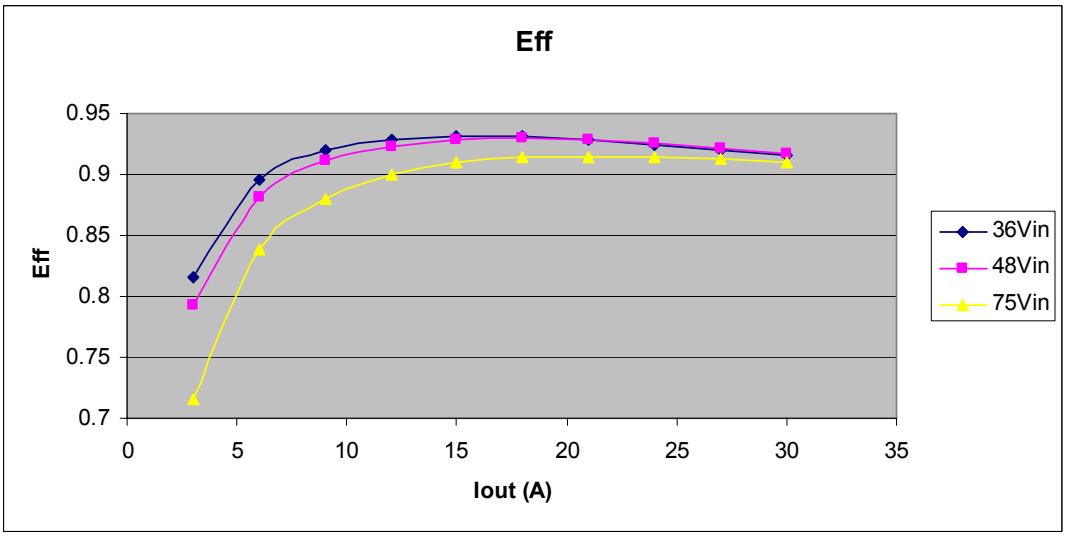


Figure 3

4. Turn On Waveform



36V Input , 0A Output



48V Input , 0A Output



75V Input , 0A Output



36V Input , 30A Output



48V Input , 30A Output



75V Input , 30A Output

Figure 4

5. Turn Off Waveform



36V Input , 0A Output



48V Input , 0A Output



75V Input , 0A Output



36V Input , 30A Output

The negative voltage is caused by the inductance of load



48V Input , 30A Output

The negative voltage is caused by the inductance of load



75V Input , 30A Output

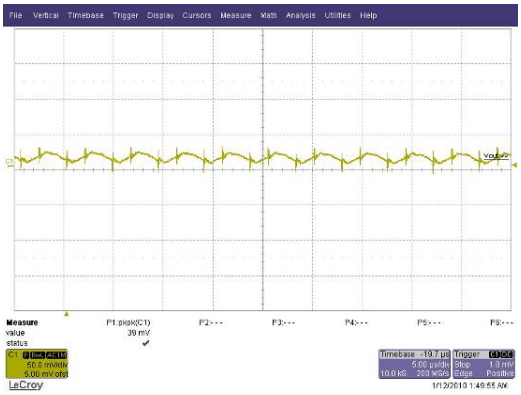
The negative voltage is caused by the inductance of load

Figure 5

6. Output Ripple and noise Voltage



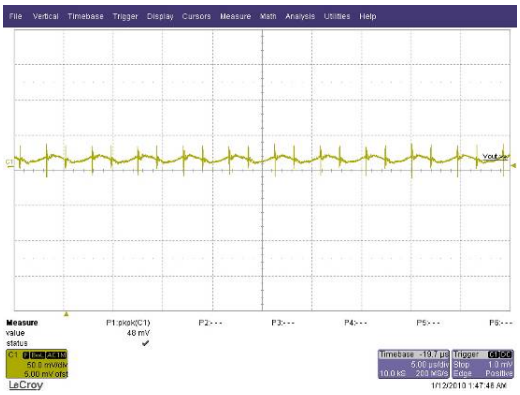
36V Input , 0A Output
37mV



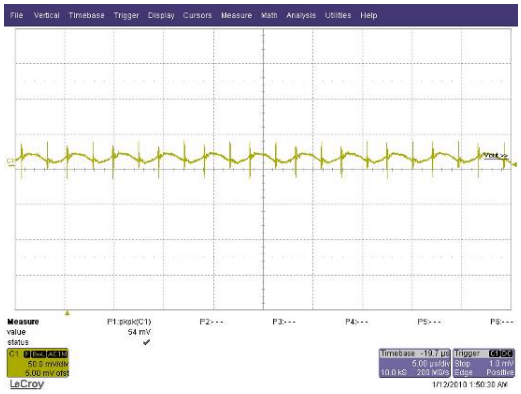
48V Input , 0A Output
39mV



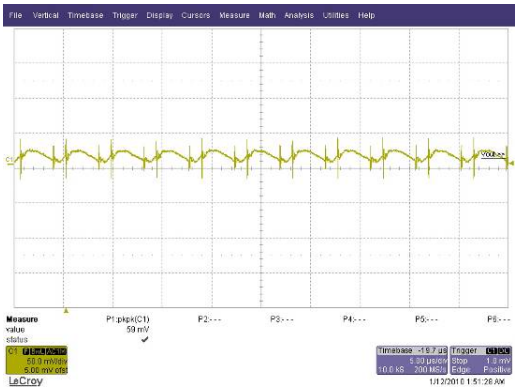
75V Input , 0A Output
52mV



36V Input , 30A Output
48mV



48V Input , 30A Output
54mV

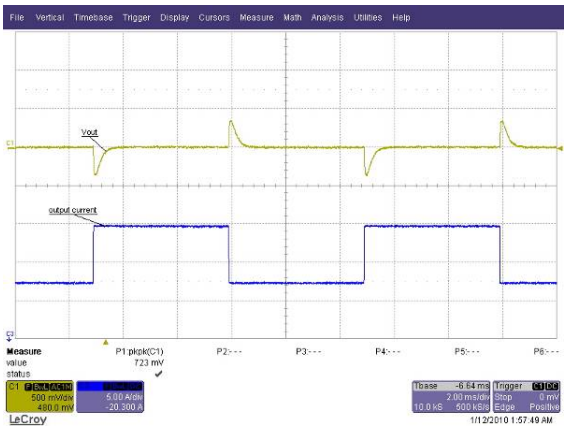


75V Input , 30A Output
59mV

Figure 6

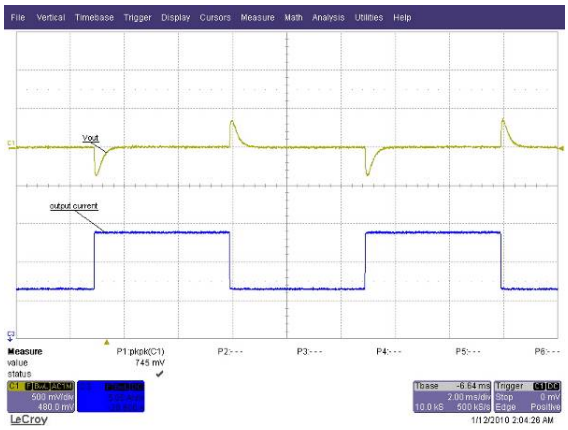
7. Dynamic Load Test

(Vin=48V)



15A—7.5A—15A 1A/us

Vpp=730mV



15A —22.5A—15A 1A/us

Vpp=745mV

Figure 7

8. Input UV Protection



UVP:33.4V (0A output)



Recover : 35.3V (0A output)



UVP:33.6V (30A output)



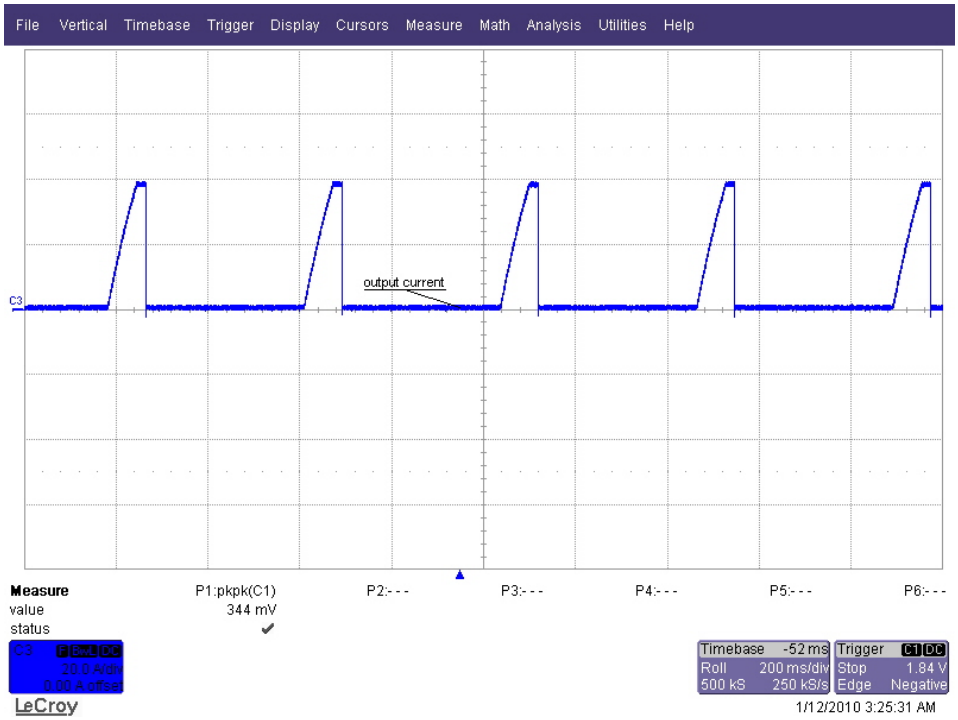
Recover : 35.3V (30A output)

The negative voltage is caused by the inductance of load

Figure 8

9. Over Current and short Protection

(All the waveform below are output current)



Input Voltage: 48V

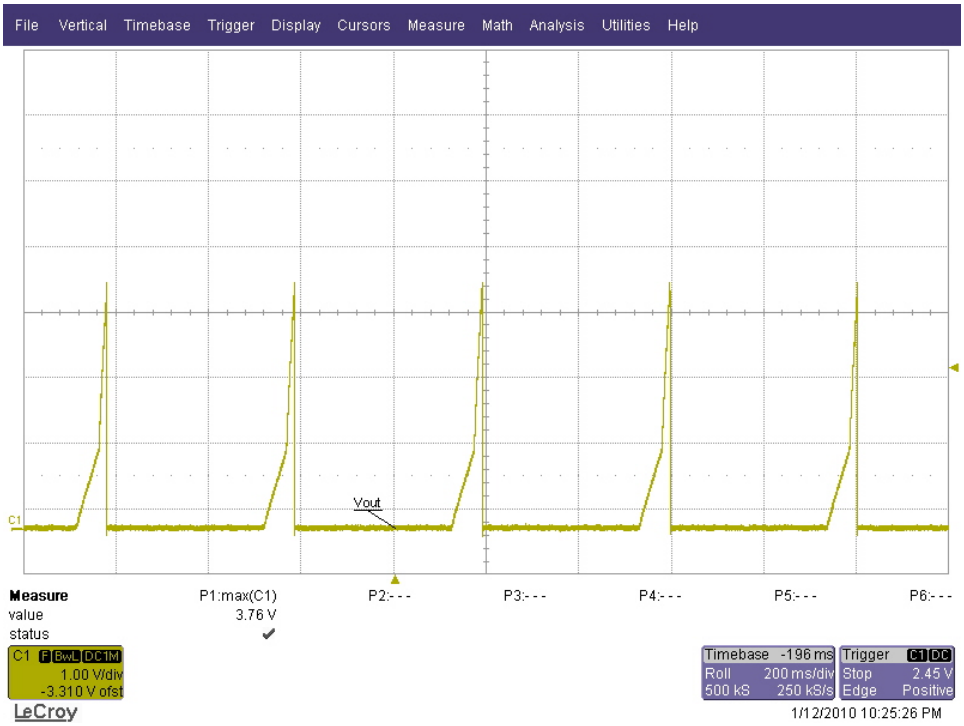
Over current: 38A

Recover current: 37.0A

Figure 9

10. Output OVP

(Input Voltage is 48V)



OVP point: 3.76V

Figure 10

11. OTP

Vin=48V



OTP shut down

Recover

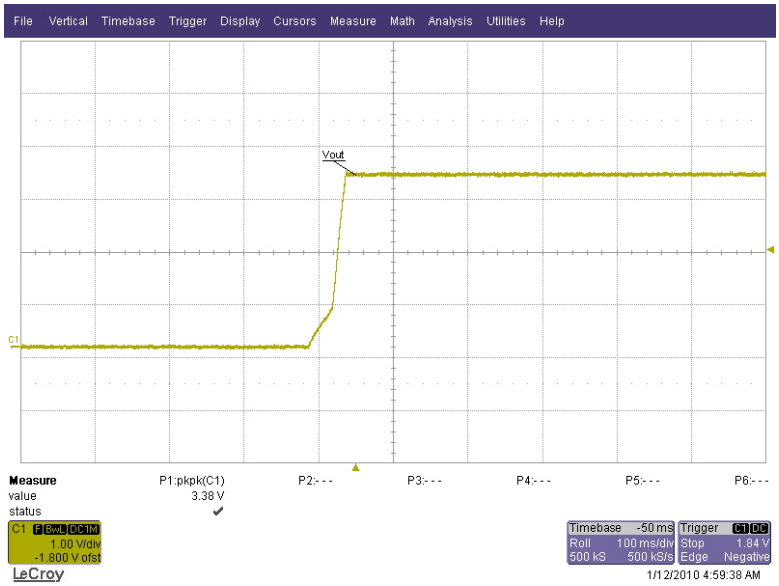


Figure 11

12. Capacitor Load start up:

Add 6600uF external capacitor to output



Vin=48V Io=30A

Figure 12

***Test equipment**

Oscilloscope: Wave surfer 44MXS , Lecory
Source: 62012P-100-50 , Chroma
Load: 63103 , Chroma
Multimeter: 3146A , ESCORT