SC4820
Push-Pull Controller For Isolated Power Supplies

POWER MANAGEMENT **PRELIMINARY**

Description

The SC4820 is a controller with maximum features for its small SO-8 outline. It is optimized for cost critical applications requiring minimum space.

The controller is intended for converters used in push-pull and bridge topologies, typically in point of use power supplies with 18V to 75V supply rails, but can be readily adapted for other input voltage ranges.

The controller is a current mode device, with slope compensation, and cycle by cycle current limit, which provides rapid transient response and prevents core saturation. Use of low voltage, fully differential logic in the control circuit, allows high frequency capability together with optimum low noise performance.

The device is capable of driving power MOSFETs with up to 1 Amp peak drive current, and is available in two switching frequency options.

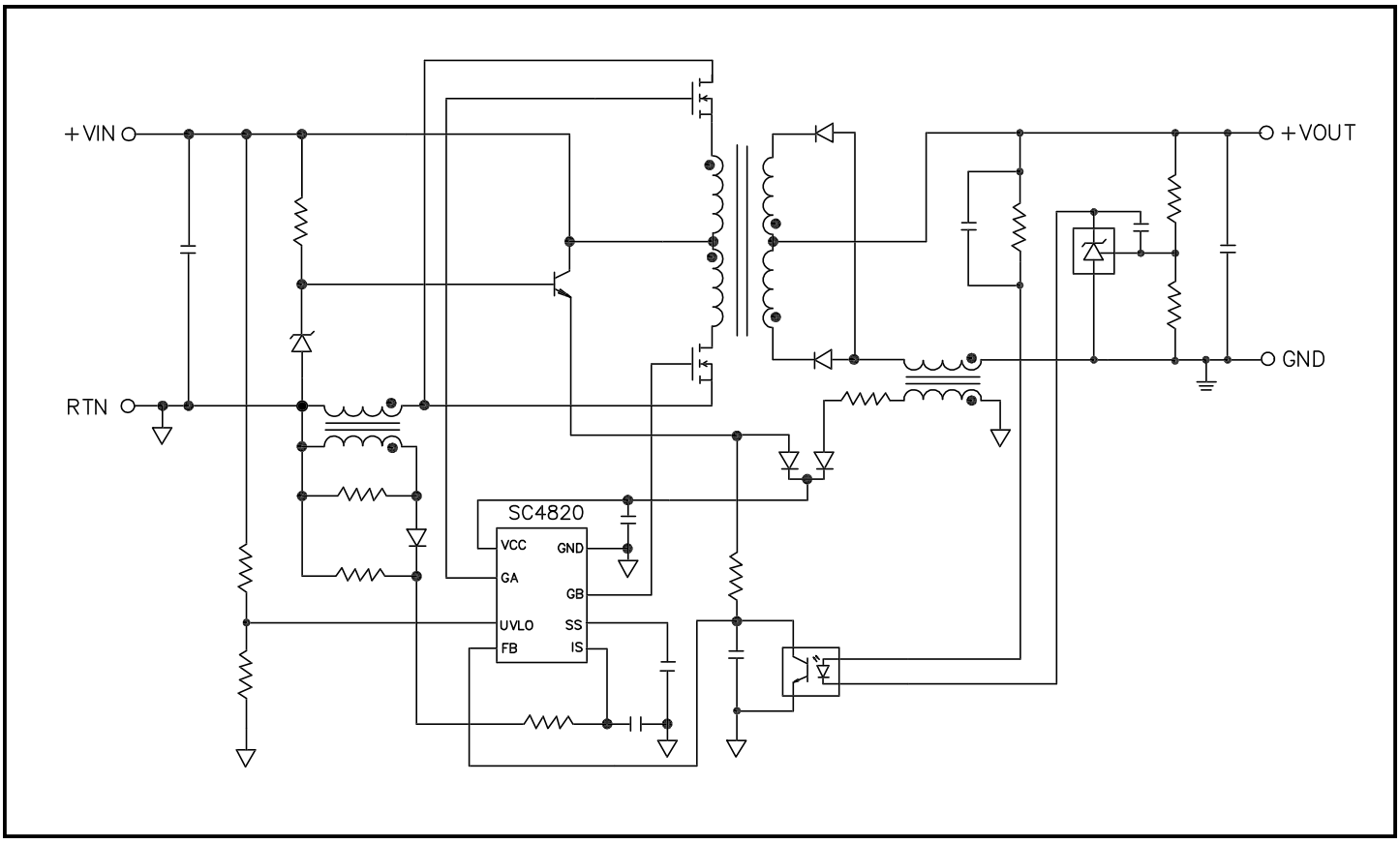
Features

- Current mode
- Cycle by Cycle current limit
- Direct drive for N-channel MOSFETs with non-overlap protection
- Internal leading edge blanking
- Undervoltage lockout with user programmable hysteresis
- Soft start
- Dead time control built in
- 1 Amp peak drive capability
- Precise thermal shutdown
- Trimmed switching frequency

Applications

- Telecom and datacom power supplies
- Point of use power supplies

Typical Application Circuit



Absolute Maximum Ratings

Parameter	Symbol	Maximum	Units
V_{CC}		18	V
Cload		5	nF
Thermal Resistance Junction to Case	θ_{JC}	40	°C/W
Thermal Resistance Junction to Ambient	θ_{JA}	165	°C/W
Operating Temperature Range	T_A	-40 to 85	°C
Storage Temperature Range	T_{STG}	-60 to 150	°C
Lead Temperature (Soldering) 10 seconds	T_{LEAD}	300	°C

Electrical Characteristics

Unless specified: V_{CC} = 12V; T_A = 25ºC

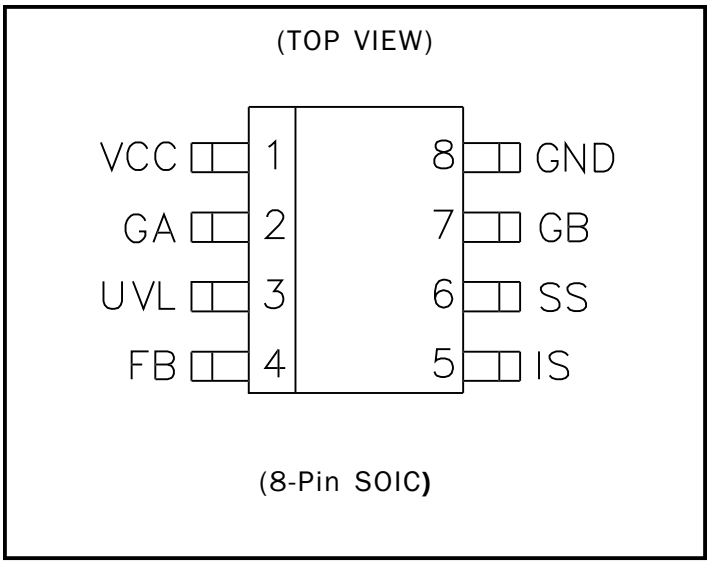
Parameter	Conditions	MIN	TYP	MAX	UNITS
Supply Voltage Range		9		17	V
VCC Lockout Threshold		6.5	7	8	V
Supply Current	No gate pulses	5	7	10	mA
Supply Current	F_{OSC} = 250 kHz, CL = 3nF	18	22	30	mA
Supply Current	F_{OSC} = 500 kHz, CL = 3nF	30	33	38	mA
Undervoltage Lockout					
Lower Threshold		3.182 (-5%)	3.350	3.518 (+5%)	V
Hysteresis Current (1)		39	43	47	µA
Soft Start					
Charge Voltage		3	3.1	3.25	V
Input Resistance		50	60	70	kohm
Discharge Voltage (2)(3)	I_{SS} (inj) = 100µA		100	200	mV
Peak Discharge Voltage (2)(3)	I_{SS} (inj) = 3mA		0.5	0.6	V
SS / Drive Enable Threshold		2.25	2.55	2.75	V
Oscillator					
Operating Frequency (when trimmed to 250kHz)	SC4820A, Tj = 25°C	237.5 (-5%)	250	262.5 (+5%)	kHz
(when trimmed to 500 kHz)	SC4820B, Tj = 25°C	475 (-5%)	500	525 (+5%)	kHz
Slope Compensation (Preset) (5)	Internally Preset		25		%
			50		mVp-p
Slope Compensation (External) (4)	Modulation sensitivity		±0.5		%/µA
Current Sense					
Propagation Delay to Gate	C_L = 3nF		150		ns
Current Limit					
Threshold		0.8	1.05	1.4	V
Crowbar Threshold		1.6	1.9	2.2	V

Electrical Characteristics (Cont.)

Parameter	Conditions	MIN	TYP	MAX	UNITS
Feedback					
Input Quiescent Voltage (5)		4.5	5.0	5.5	V
Input Resistance (5)	In linear range	100			Kohm
Gain (to comp. Input) (5)			1		
Drive					
Gate "Low" Voltage	V_{CC} = open, 2µA into G1, G2			0.1	V
Gate "Low" Voltage	V_{CC} = 12V, no switching, 1mA into G1, G2			1	V
Gate "High" Voltage		V_{CC} - 1.2	V_{CC} - 1.0		V
Peak Sink Current		0.7	1		A
Peak Source Current		0.7	1		A
Rise Time	C_L = 3nF		60		ns
Fall Time	C_L = 3nF		60		ns
Leading Edge Blanking					
Blank Time (5)			50		ns
Dead Time Control					
Dead Time	F = 250kHz		350		ns
	F = 500kHz		250		ns
Thermal Protection					
High Threshold			150		°C
Hysteresis			10		°C

Notes:
(1) When input voltage is ramped up, 43µA flows into UVLO pin until pin voltage reaches “HIGH” threshold.
(2) Clmax = 20nF @ 250kHz; Clmax = 15nF @ 500kHz.
(3) Specified current, Iss (inj) flows into soft start pin, soft start voltage is “Low”.
(4) ±10µA injected or removed from soft start pin will change slope compensation to 30% and 20%, respectively.
(5) Guaranteed by design.

Pin Configurations



Ordering Information

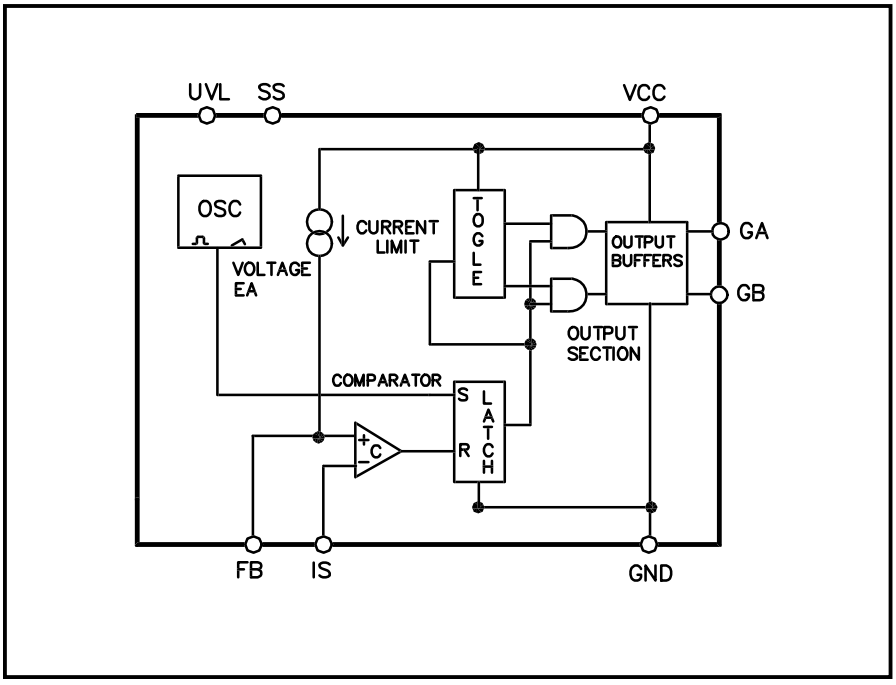
Device[1]	Freq. kHz	Device	Temp. Range (T_J)
SC4820AISTR	250	SO-8	-40 to 150°C
SC4820BISTR	500		
SC4820EVB-A	SC4820A Evaluation Board		
SC4820EVB-B	SC4820B Evaluation Board		

Note: (1) Only available in tape and reel packaging. A reel contains 2500 devices.

Pin Descriptions

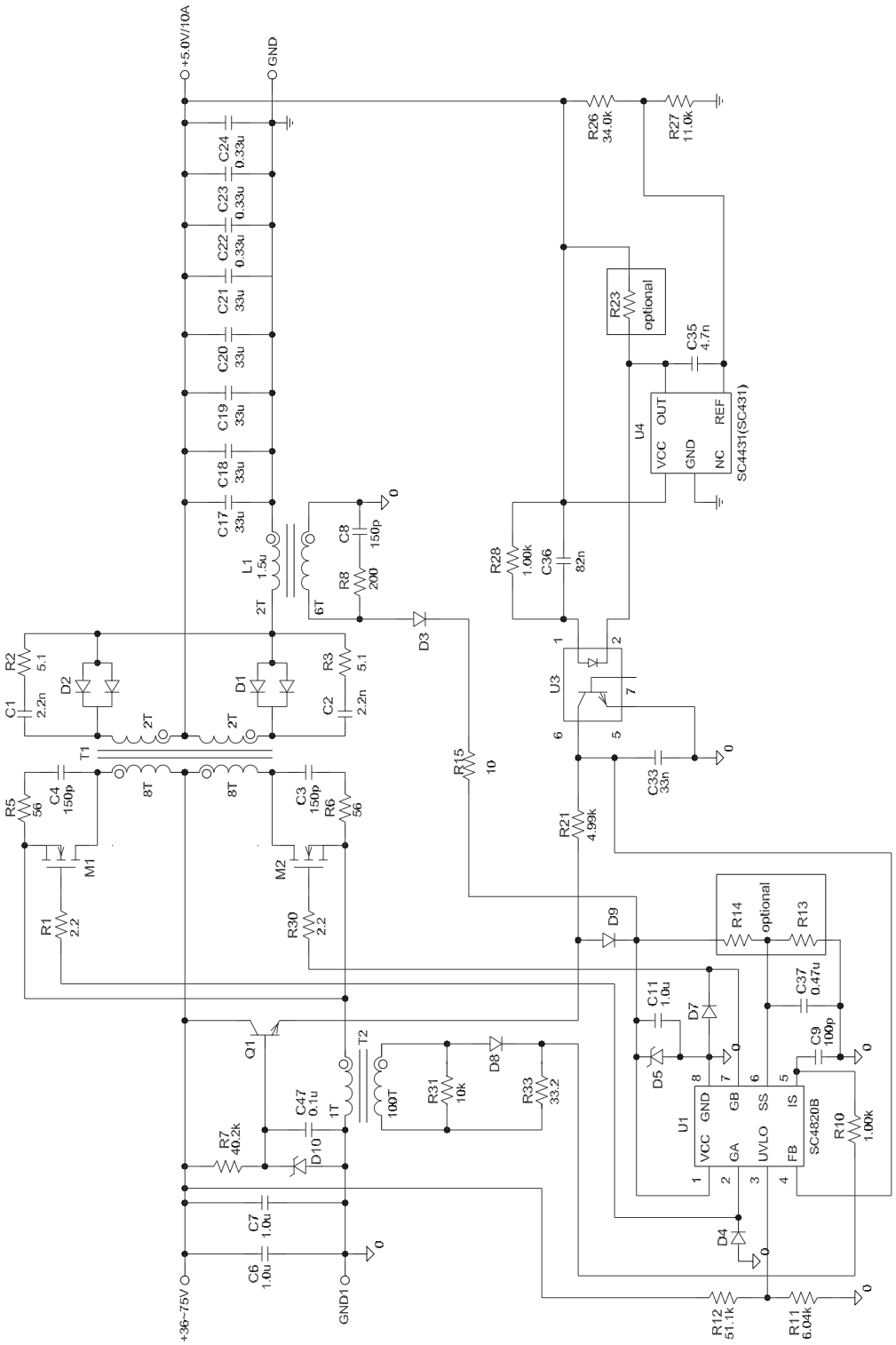
Pin#	Pin Name	Description
1	VCC	Chip power supply voltage.
2	GA	Gate drive of FET A.
3	UVL	Under voltage lockout. This pin acts as a 43µA current sink below UVLO upper threshold when the UVLO sense voltage is swept upwards from zero volts. The hysteresis is determined by this sink current and the source resistance of the UVLO sense voltage divider resistors, as observed at the UVLO.
4	FB	Feedback. This pin has a high source resistance in the linear region and below. Source resistance reduces to 3 kohm above the linear region.
5	IS	Current sense. The pin receives the current sense signal from the current transformer. The current limit threshold is typically 1.05V. The Crowbar Threshold is at 1.9V typical. When the Crowbar Threshold is reached the Gate Drives are turned off and latched "Low". The soft start pin is also latched to approx. 1.0V. This condition stays unchanged until the soft start pin is momentarily forced to GND, or the supply voltage is switched off.
6	SS	Soft start/Enable. The input resistance to this pin is 60 kohm typical. The input resistance and the external soft start capacitor determine the soft start delay. Soft start begins as the Drive Enable threshold is passed. After the soft start cycle is completed, the soft start pin voltage is 3.1V. When up to ±10µA is injected into this pin, the internal ramp compensation changes from its preset value which is 25% to approx. 30% or 20%, respectively. The soft start pin can also be utilized as Enable/Disable pin. When the soft start pin voltage is held below the Drive Enable threshold, the device will not generate switching waveforms. When the device is latched in "Crowbar" condition, the soft start pin is set to 1V. The "Crowbar" condition can be removed by momentarily shorting the soft start pin to GND.
7	GB	Gate drive of FET B.
8	GND	Ground.

Block Diagram



Typical Applications

ISOLATED APPLICATION - 48V Input, 5V/10A Output. Using SC4820B



Typical Applications (Cont.)

Bill of Material for Isolated Application

Item	Qty	Reference	Part Number/Value	Manufacturing
1	2	C1,C2	2.2n, 50V, 1206, Cer.	Any
2	2	C3,C4	150p, 200V, ±5%, NPO, Cer.	Any
3	2	C6,C7	1.0u, 100V, 1812, Cer.	Any
4	1	C8	150p, 1206, Cer.	Any
5	1	C9	100p, 1206, Cer.	Any
6	1	C11	1.0u, 1206, Cer.	Any.
7	5	C17 - C21	33u, 8V, SMD, Poly. Alum. Cap.	Panasonic P/N: EEF-CDOK330R
8	3	C22,C23,C24	0.33u, 1206, Cer.	Any
9	1	C33	33n, 1206, Cer.	Any
10	1	C35	4.7n, 1206, Cer.	Any
11	1	C36	82n, 1206, Cer.	Any
12	1	C37	0.47u, 1206, Cer.	Any
13	1	C47	0.1u, 1206, Cer.	Any
14	2	D1,D2	35V, 25A, TO-220AC, Schottky	Motorola P/N: MBR2535CTL
15	1	D3	250V, 100mA, SOT-23	Motorola P/N: BAS21LT1
16	3	D4,D7, D9	30V, 200mA, Schottly	Any. MA729-(TX)
17	1	D5	12V, 500mW, SOD-123	Any. MMSZ4699T1
18	1	D8	75V, 50mA, SOT-23	Motorola P/N: BAS16LT1
19	1	D10	10V, 500mW, SOD-123	Any. MMSZ4697T1
20	1	L1	E-I Core - Inductor	Magnetics. R-41805-E&I
			4-Layer FR-4 PCB, Inductor, 1.5µH	Any
21	2	M1,M2	200V, 18A, 0.18 ohm, TO-220AB, MOSFET	IR P/N: IRF640
22	1	Q1	100V, 1000mA, SOT-23, NPN Bipolar	Any. FMMT493TA
23	2	R1,R30	2.2, 5%, 1206, 1/8W	Any
24	2	R2,R3	5.1, 5%, 1206, 1/8W	Any
25	2	R5,R6	56, 5%, 1206, 1/8W	Any

Typical Applications (Cont.)

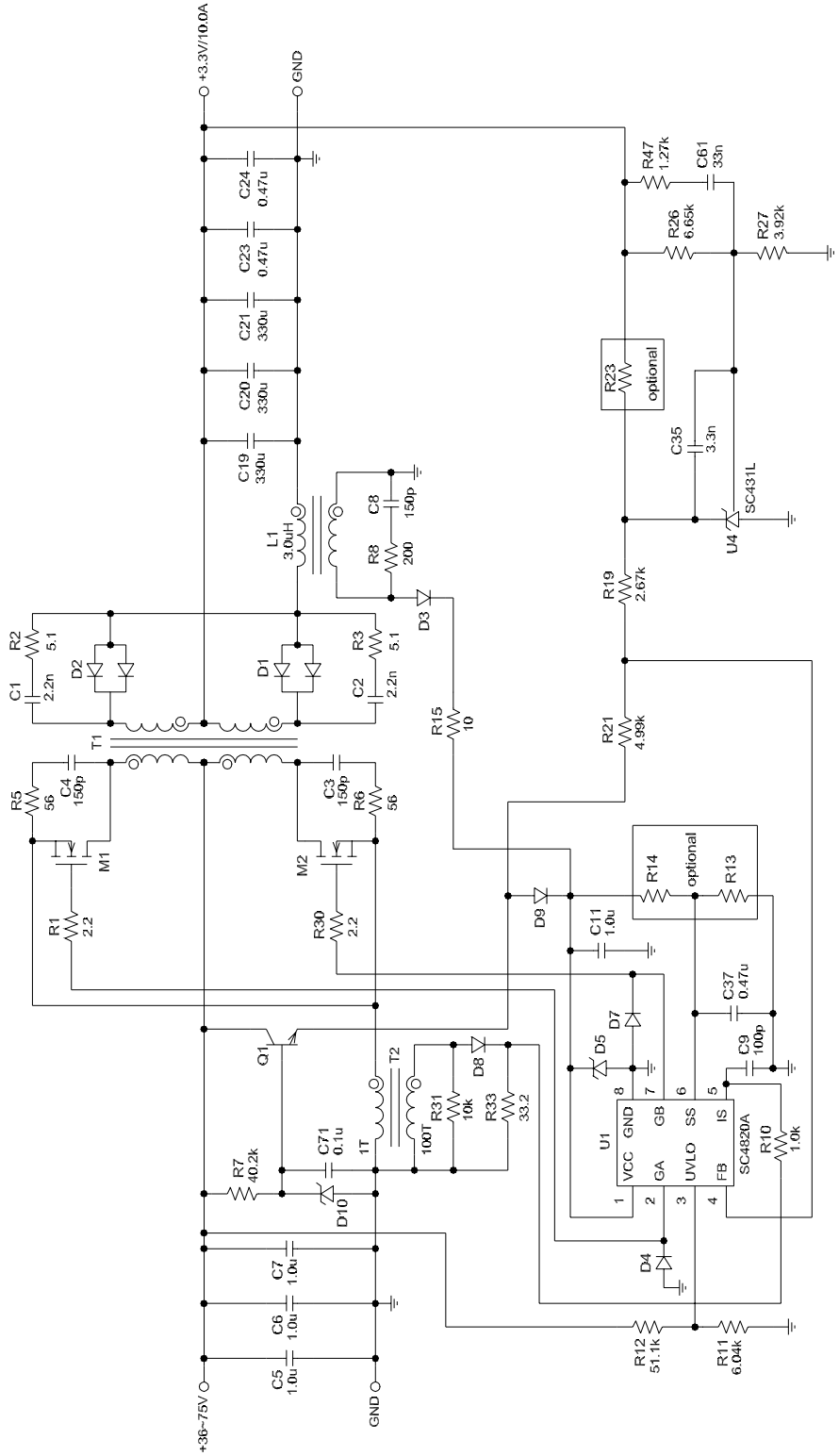
Bill of Material for Isolated Application (Cont.)

Item	Qty	Reference	Part Number/Value	Manufacturing
26	1	R7	40.2k, 1%, 1206, 1/8W	Any
27	1	R8	200, 5%, 1206, 1/8W	Any
28	2	R10,R28	1.00k, 1%, 1206, 1/8W	Any
29	1	R11	6.04k, 1%, 1206, 1/8W	Any
30	1	R12	51.1k, 1%, 1206, 1/8W	Any
31	1	R15	10.0, 5%, 1206, 1/8W	Any
32	1	R21	4.99k, 1%, 1206, 1/8W	Any
33	1	R26	34.0k, 1%, 1206, 1/8W	Any
34	1	R27	11.0k, 1%, 1206, 1/8W	Any
35	1	R31	10k, 5%, 1206, 1/8W	Any
36	1	R33	33.2, 1%, 1206, 1/8W	Any
37	1	T1	E-I Core - Main Transformer	Magnetics. P/N: R-41805-E&I
			6-Layer FR-4 PCB, Main Transformer	Any
38	1	T2	Current Sensor Transformer, 1:100	Panasonic: P/N: TJ0042T
39	1	U1	Push-Pull Controller for Isolated Power Supplies	Semtech P/N: SC4820B
40	1	U3	Surface Mount Optocouplers	Any. MOC206-M
41	1	U4	Shunt Regulator	Semtech P/N: SC4431CSK.5
		*	Low Voltage Adjustable Shunt Reg.	Semtech P/N: SC431LCSK-.5

Notes:
1. * indicates optional parts.
2. Some parts are selected due to availability or lead time, and are not optimized.

Typical Applications (Cont.)

NON-ISOLATED APPLICATION - 48V Input, 3.3V/10A Output. Using SC4820A

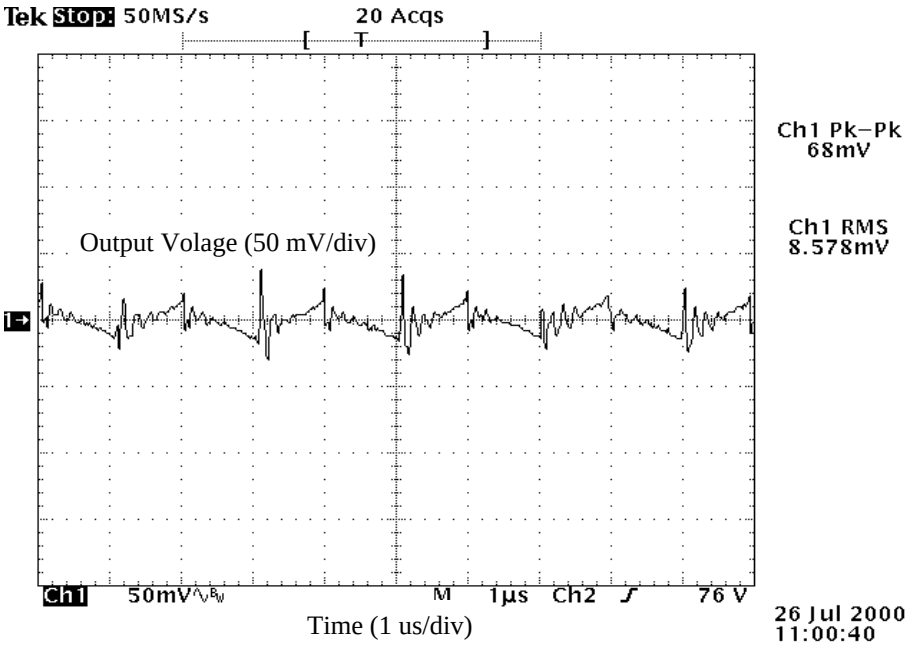


Electrical Characteristic Curves

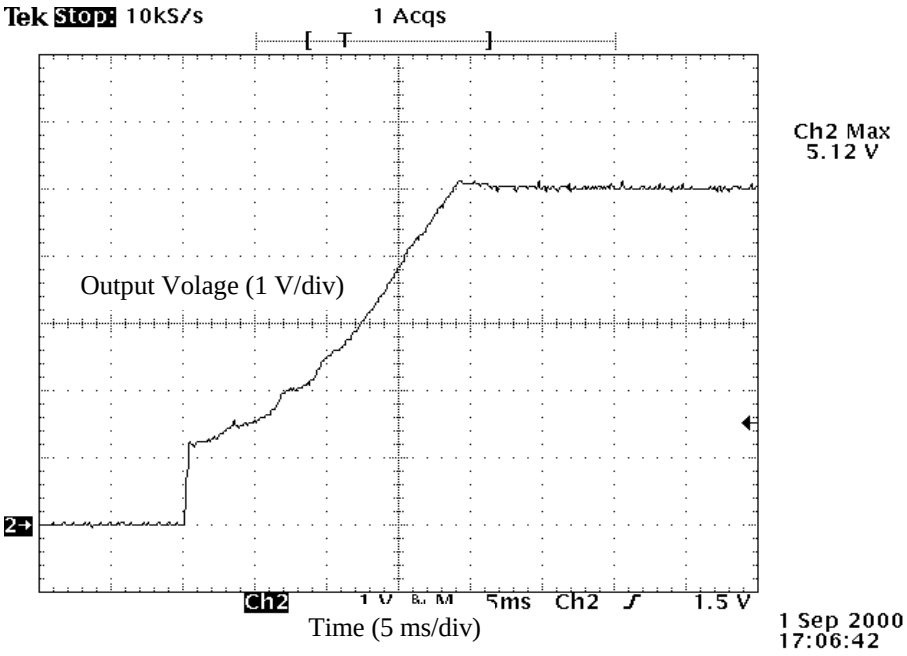
All of the characteristic curves are:

1. For isolated application with 36 ~ 75V input, 5V/10A output, and 500kHz switching frequency
2. Tested at 25°C ambient temperature.

Typical output ripple voltage at 48V input and full load

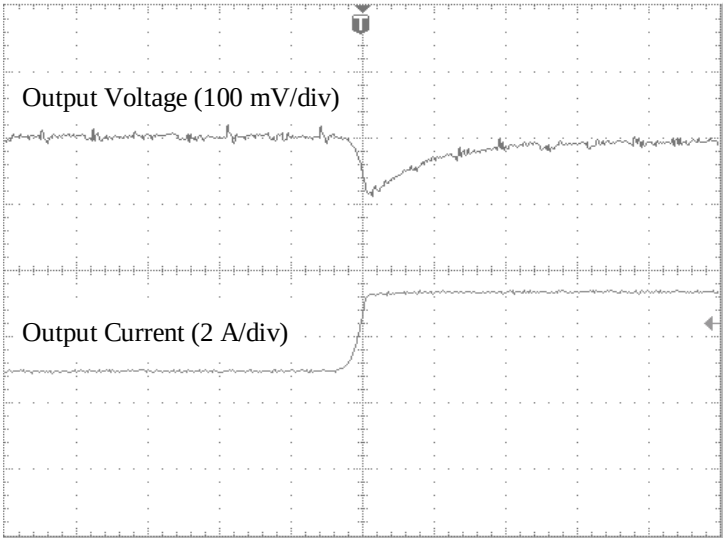


Typical start-up at 48V input and full load



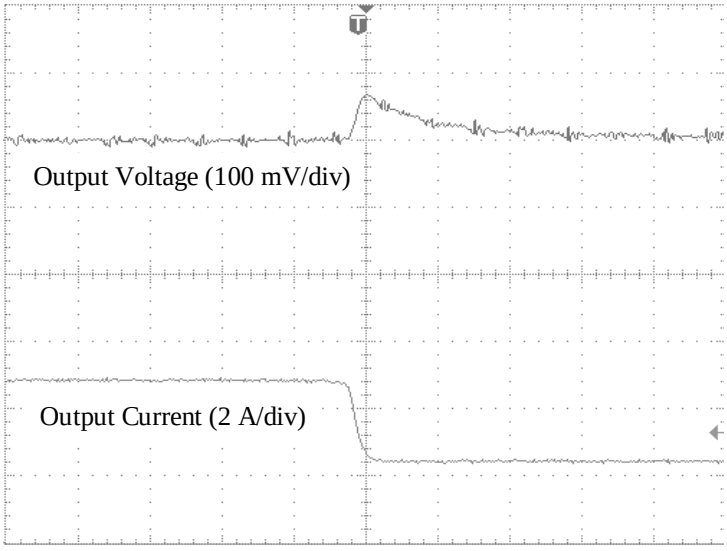
Electrical Characteristic Curves (Cont.)

Typical transient response to step increase in load from 50% to 75% of full load at 0.1A/µs slew rate and 48V input.



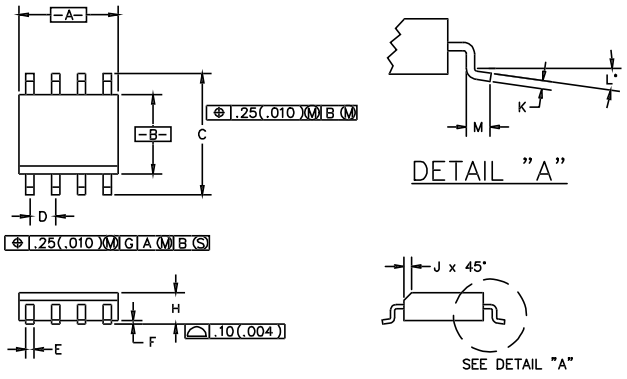
Time (100 us/div)

Typical transient response to step decrease in load from 50% to 25% of full load at 0.1A/µs slew rate and 48V input.



Time (100 us/div)

Outline Drawing - S0-8



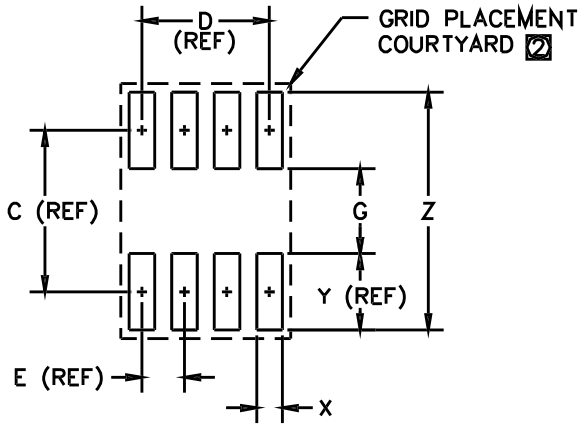
DIMENSIONS					
DIM	INCHES		MM		NOTE
	MIN	MAX	MIN	MAX	
A	.188	.197	4.80	5.00	2
B	.149	.158	3.80	4.00	3
C	.228	.244	5.80	6.20	
D	.050	BSC	1.27	BSC	
E	.013	.020	0.33	0.51	
F	.004	.010	0.10	0.25	
H	.053	.069	1.35	1.75	
J	.011	.019	0.28	0.48	
K	.007	.010	.19	.25	
L	0°	8°	0°	8°	
M	.016	.050	0.40	1.27	

[3] DIMENSION "B" DOES NOT INCLUDE INTER-LEAD FLASH OR PROTUSIONS. INTER-LEAD FLASH AND PROTUSIONS SHALL NOT EXCEED .25 mm (.010") PER SIDE.

[2] DIMENSION "A" DOES NOT INCLUDE MOLD FLASH, PROTUSIONS OR GATE BURRS. MOLD FLASH, PROTUSIONS AND GATE BURRS SHALL NOT EXCEED .15 mm (.010") PER SIDE.

[1] CONTROLLING DIMENSION : MILLIMETER

Land Pattern - S0-8



DIMENSIONS [1]					
DIM	INCHES		MM		NOTE
	MIN	MAX	MIN	MAX	
C	–	.19	–	5.00	–
D	–	.15	–	3.81	–
E	–	.05	–	1.27	–
G	.10	.11	2.60	2.80	–
X	.02	.03	.60	.80	–
Y	–	.09	–	2.40	–
Z	–	.29	7.20	7.40	–

[2] GRID PLACEMENT COURTYARD IS 12x16 ELEMENTS (6 mm X 8mm) IN ACCORDANCE WITH THE INTERNATIONAL GRID DETAILED IN IEC PUBLICATION 97.

[1] CONTROLLING DIMENSION: MILLIMETERS

Contact Information

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