

Description

The YB1685 is a 380 KHz fixed frequency monolithic step down switch mode regulator with a built in internal Power MOSFET. It achieves 2A continuous output current over a wide input supply range with excellent load and line regulation. The device includes a voltage reference, oscillation circuit, error amplifier, internal PMOS and etc.

The PWM control circuit is able to adjust the duty ratio linearly from 0 to 100%. An enable function, an over current protection function and a short circuit protection function are built inside. An internal compensation block is built in to minimize external component count.

The YB1685 serves as ideal power supply units for portable devices.

Features

- 2A Constant Output Current
- 140mΩ $R_{DS(ON)}$ Internal Power PMOSFET Switch
- Up to 92% Efficiency Fixed 380KHz Frequency
- Wide 3.6V to 32V Input Voltage Range
- Output Adjustable from 1.235V to 30V
- Output Current Protection
- Built in Frequency Compensation
- Built in Thermal Shutdown Function
- Built in Current Limit Function
- SOP8 Package is Available
- The Minimum Dropout up to 0.3V
- Pb-free Package

Applications

- Portable DVD
- LCD Monitor / TV
- Battery Charger
- ADSL Modem
- Telecom / Networking Equipment

Typical Application Circuit

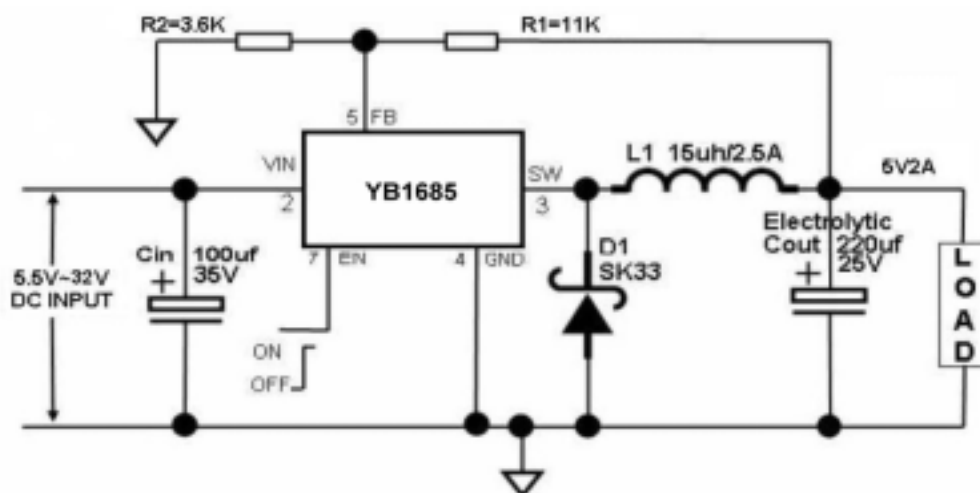


Figure 1: Typical Application Circuit

Pin Configuration

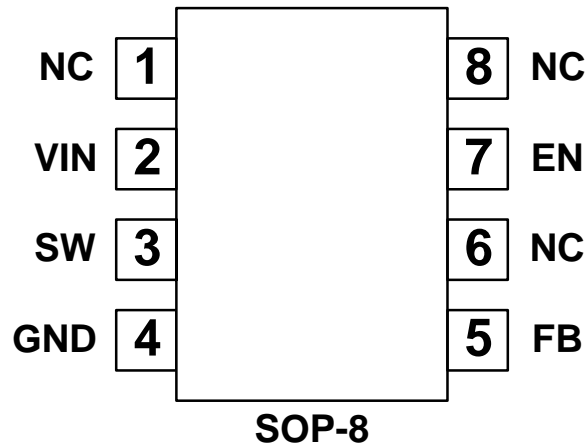


Figure 2: Pin Configuration

Pin Description

Table 1

Pin	Name	Description
1,6,8	NC	Not Connect.
2	VIN	Supply Voltage Input Pin. YB1685 operates from a 3.6V to 32VDC voltage. Bypass V_{IN} to GND with a suitably large capacitor to eliminate noise on the input.
3	SW	Power Switch Output Pin. SW is the switch node that supplies power to the output.
4	GND	Ground Pin. Care must be taken in layout. This pin should be placed outside of the Schottky Diode to output capacitor ground path to prevent switching current spikes from inducing voltage noise into YB1685.
5	FB	Feedback Pin. Through an external resistor divider network, FB senses the output voltage and regulates it. The feedback threshold voltage is 1.235V.
7	EN	Enable Pin. EN is a digital input that turns the regulator on or off. Drive EN pin high to turn on the regulator, drive it low to turn it off.

Ordering Information

Order Number	Package Type	Supplied As	Package Marking
YB1685SPX8P	SOP-8	2500 units Tape & Reel	Please contact sales representative

Absolute Maximum Ratings

Input Voltage	-0.3V to 32V
Feedback Pin Voltage	-0.3V to V_{IN}
Enable Pin Voltage.....	-0.3V to 12V
Switch Pin Voltage	-0.3V to V_{IN}
Power Dissipation	Internally Limited
Operating Junction Temperature.....	150°C
Storage Temperature	-65°C to 150°C

Recommended Operating Conditions

Input Voltage.....	3.6V to 32V
Operating Junction Temperature ...	-40°C to 125°C
Operating Ambient Temperature.....	-40°C to 85°C
Lead Temperature (Soldering, 10 sec)...	260°C
ESD (HBM).....	2000V

Note:

Stresses greater than those listed under Maximum Ratings may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operation is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

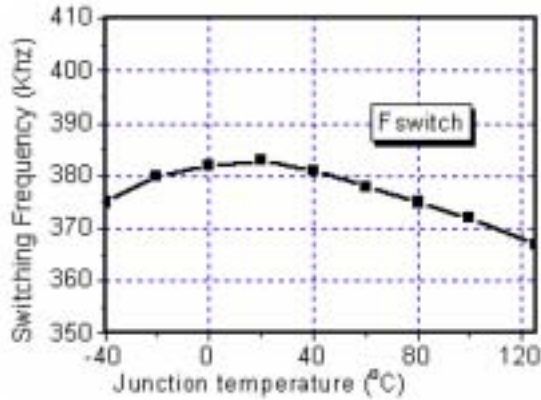
Electrical Characteristics

Table 2 ($V_{CC} = 12V$, $T_A = 25^\circ C$, unless otherwise specified.)

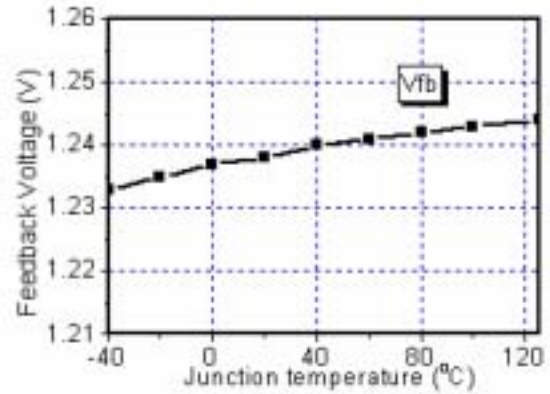
Description	Symbol	Test Conditions	MIN	TYP	MAX	Units
Input Voltage	V_{IN}		3.6		32	V
Shutdown Supply Current	I_{STBY}	$V_{EN} = 0V$		30	90	μA
Supply Current	I_{CC}	$V_{EN} = 2V$, $V_{FB} = 1.3V$		3.6	4	mA
Feedback Voltage	V_{FB}	$V_{IN} = 3.6V$ to 23V	1.21	1.235	1.26	V
Feedback Bias Current	I_{FB}	$V_{FB} = 1.3V$		0.1	0.5	μA
Switch Current Limit	I_{LIM}			3	4	A
Oscillator Frequency	F_{OSC}		320	380	440	KHz
EN Pin Threshold	V_{EN}		0.7	1.2	1.7	V
EN Pin Input Leakage Current	I_H	$V_{EN} = 2.5V$		-0.1	-1	μA
	I_L	$V_{EN} = 0.5V$		-3	-10	μA
Internal PMOS $R_{DS(ON)}$	$R_{DS(ON)}$	$V_{IN} = 12V$, $V_{FB} = 0V$ $V_{EN} = 12V$, $I_{OUT} = 2A$		140		m Ω
Max. Duty Cycle	D_{MAX}	$V_{FB} = 0V$, $I_{SW} = 0.1A$		100		%
Efficiency	η	$V_{IN} = 12V$, $V_{OUT} = 5V$, $I_{OUT} = 2A$		92		%
Thermal Shutdown	T_{OTSD}			165		$^\circ C$

Typical Performance Characteristics

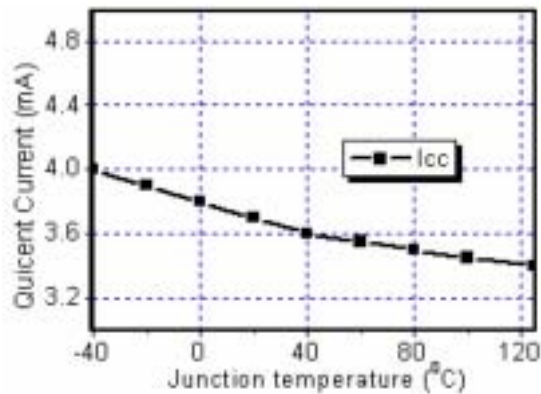
Switching Frequency vs. Temperature



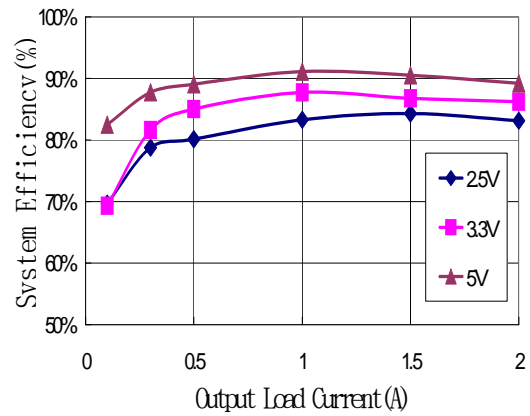
V_{FB} vs. Temperature



I_{cc} vs. Temperature



Efficiency V.S Load (V_{in}=12V)



Function Block

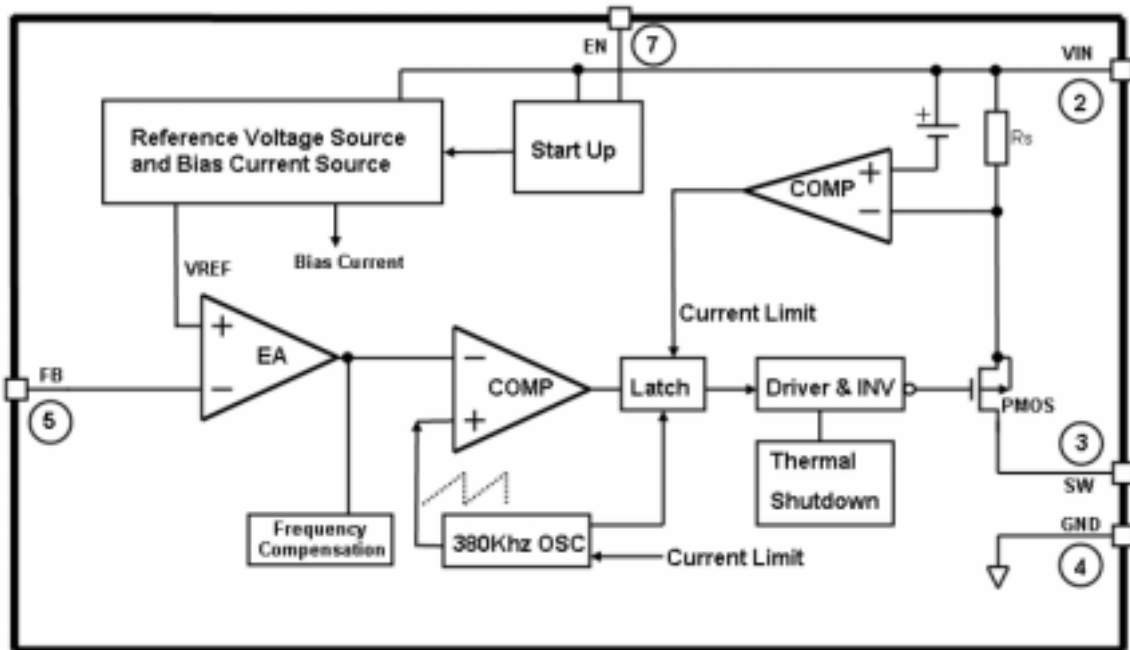


Figure 3: Function Block

Functional Description

VIN

This is the positive input supply for the IC switching regulator. A suitable input bypass capacitor must be present at this pin to minimize voltage transients and to supply the switching currents needed by the regulator.

Gnd

Circuit ground.

SW

Internal switch. The voltage at this pin switches between $(V_{IN} - V_{GS})$ and approximately $-0.5V$, with a duty cycle of approximately V_{OUT} / V_{IN} . To minimize coupling to sensitive circuitry, the PC board copper area connected to this pin should be kept a minimum.

FB

Senses the regulated output voltage to complete the feedback loop.

EN

Allows the switching regulator circuit to be shutdown using logic level signals thus dropping the total input supply current to approximately $30\mu A$.

Pulling this pin below a threshold voltage of approximately $0.7V$ turns the regulator down, and pulling this pin above $1.3V$ (up to a maximum of $12V$) shuts the regulator on. For automatic star up condition, can be implemented by the addition of a resistive voltage divider from VIN to GND.

Thermal Considerations

The SOP8 package needs a heat sink under most conditions. The size of the heat sink depends on the input voltage, the output voltage, the load current and the ambient temperature. The YB1685 junction temperature rises above ambient temperature for a 2A load and different input and output voltages. The data for these curves was taken with the YB1685 (SOP8 package) operating as a buck-switching regulator in an ambient temperature of 25 °C (still air). These temperature rise numbers are all approximate and there are many factors that can affect these temperatures. Higher ambient temperatures require more heat sinking.

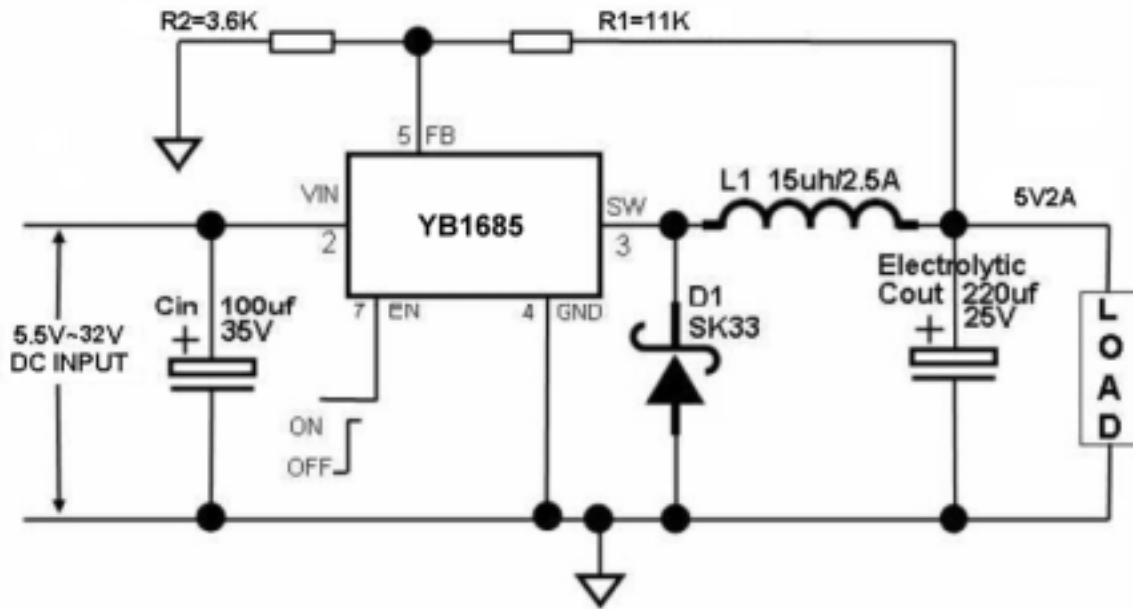
For the best thermal performance, wide copper traces and generous amounts of printed circuit board copper should be used in the board layout. (Once exception to this is the output (switch) pin, which should not have large areas of copper.) Large areas of copper provide the best transfer of heat (lower thermal resistance) to the surrounding air, and moving air lowers the thermal resistance even further.

Package thermal resistance and junction temperature rise numbers are all approximate, and there are many factors that will affect these numbers. Some of these factors include board size, shape, thickness, position, location, and even board temperature. Other factors are, trace width, total printed circuit copper area,

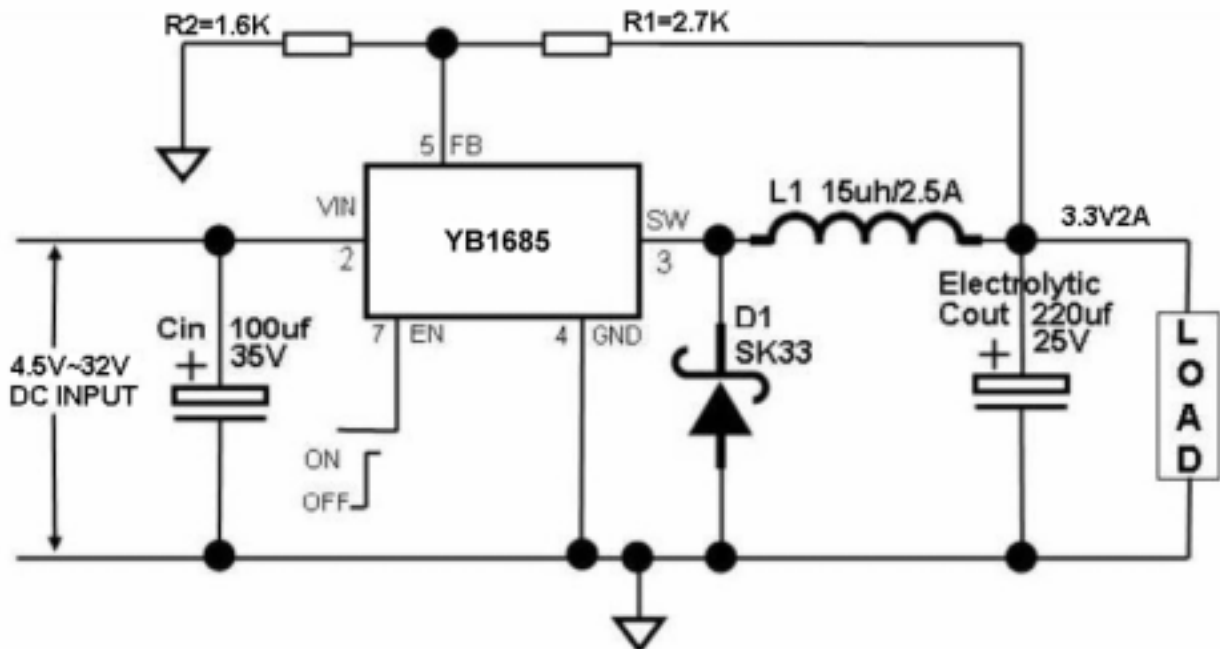
copper Thick ness, single or double-sided, multi-layer board and the amount of solder on the board.

The effectiveness of the PC board to dissipate heat also depends on the size, quantity and spacing of other components on the board, as well as whether the surrounding air is still or moving. Furthermore, some of these components such as the catch diode will add heat to the PC board and the heat can vary as the input voltage changes. For the inductor, depending on the physical size, type of core material and the DC resistance, it could either act as a heat sink taking heat away from the board, or it could add heat to the board.

Typical Application Circuit



Typical Application Circuit @ 3.3V/2A



Schottky Rectifier Selection Guide

YB1685 Lists some rectifier manufacturers.

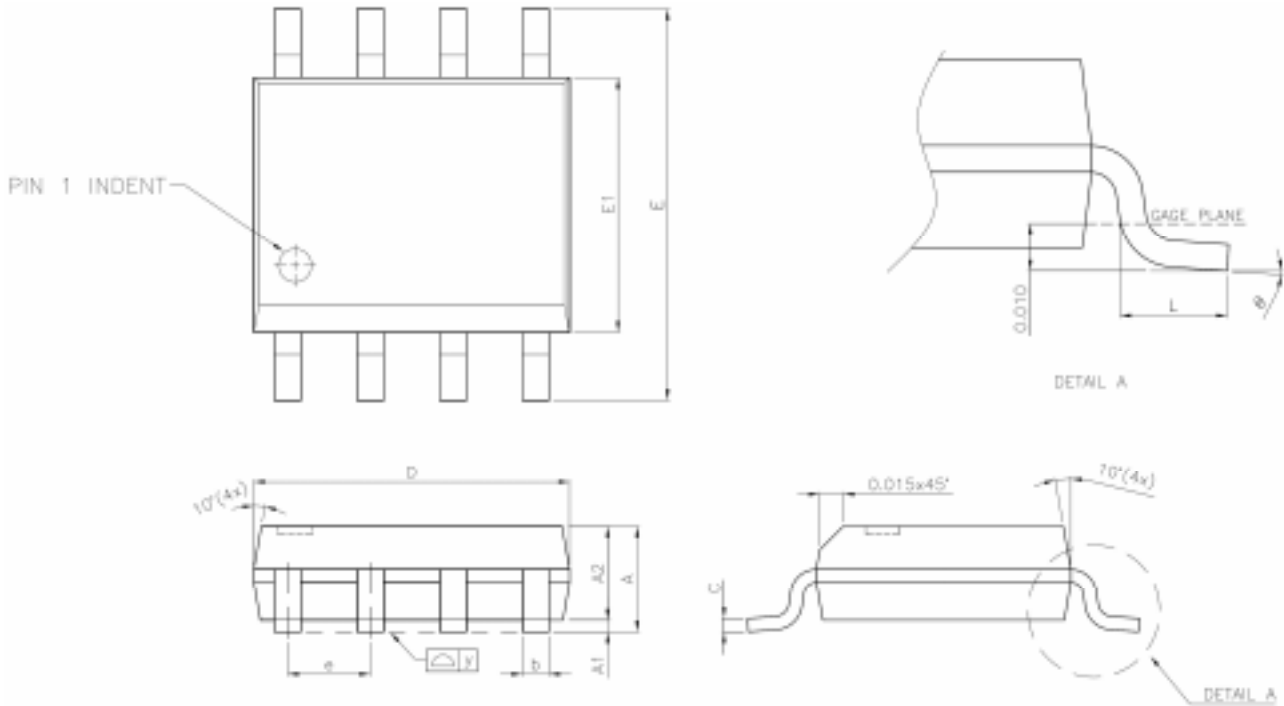
V _{IN} (Max)	2A Load Current	
	Part Number	Vendor
20V	B220	Diodes, Inc.
	SK23	Pan Jit International
	SR22	Pan Jit International
30V	20QB030	International Rectifier
	B230	Diodes, Inc.
	SK23	Pan Jit International
	SR23	General Semiconductor, Pan Jit International
	SS23	General Semiconductor

Output Voltage vs. R1, R2 Resistor Selection Guide ($V_{OUT} = (1 + R1 / R2) * 1.235V$)

YB1685 V_{OUT} vs. R1, R2 Select Table

V _{OUT}	R1	R2
1.8V	5.1K	11K
2.5V	5.1K	5K
3.3V	2.7K	1.6K
5V	11K	3.6K
9V	43K	6.8K
12V	13K	1.5K

Package Information (SOP-8)



SYMBOLS	DIMENSIONS IN MILLIMETERS			DIMENSIONS IN INCHES		
	MIN	NOM	MAX	MIN	NOM	MAX
A	1.47	1.60	1.73	0.058	0.063	0.068
A1	0.10	—	0.25	0.004	—	0.010
A2	—	1.45	—	—	0.057	—
b	0.33	0.41	0.51	0.013	0.016	0.020
C	0.19	0.20	0.25	0.0075	0.008	0.0098
D	4.80	4.85	4.95	0.189	0.191	0.195
E	5.80	6.00	6.20	0.228	0.236	0.244
E1	3.80	3.90	4.00	0.150	0.154	0.157
e	—	1.27	—	—	0.050	—
L	0.40	0.71	1.27	0.016	0.028	0.050
y	—	—	0.076	—	—	0.003
Ø	0"	—	8"	0"	—	8"

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