

### Description

YB1693 Series are step-down switching regulators with all required active functions. It is capable of driving 2A load with excellent line and load regulations. These devices are available in fixed output voltages of 3.3V, 5V and an adjustable output version.

YB1693 series operates at a switching frequency of 150KHz thus allowing smaller sized filter components than what would be needed with lower frequency switching regulators. It substantially not only reduces the area of board size but also the size of heat sink, and in some cases no heat sink is required. The  $\pm 4\%$  tolerance on output voltage within specified input voltages and output load conditions is guaranteed. Also, the oscillator frequency accuracy is within  $\pm 10\%$ . External shutdown is included. Featuring 70 $\mu$ A (typical) standby current. The output switch includes cycle-by-cycle current limiting, as well as thermal shutdown for full protection under fault conditions.

### Features

- Output Voltage: 3.3V, 5V & Adjustable version
- Adjustable Output Voltage Range 1.23V~19.5V  $\pm 4\%$
- 150KHz  $\pm 15\%$  fixed switching frequency
- Voltage Mode Non-synchronous PWM control
- Thermal Shutdown and Current Limit Protection
- ON/OFF Shutdown Control Input
- Soft-start (SS) Function
- Short Circuit Protect (SCP)
- Operating Voltage Can be up to 24V
- Output Load Current 2A
- Low Power Standby Mode

### Applications

- Simple High-efficiency Step down Regulator
- On-Card Switching Regulators

### Typical Application Circuit

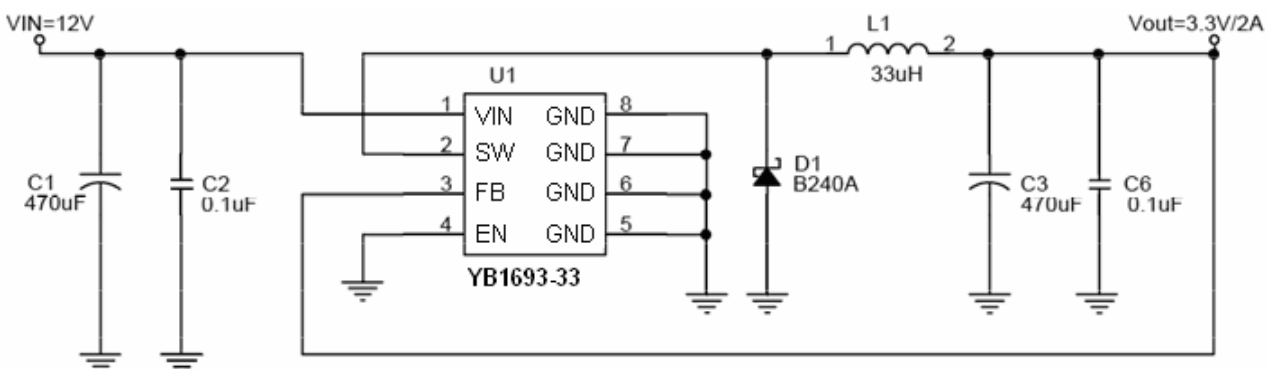


Figure 1: Typical Application Circuit

## Pin Configuration

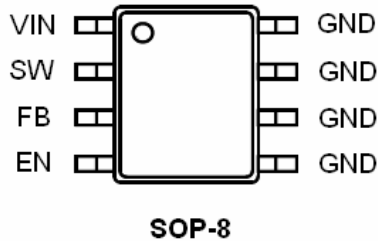


Figure 2: YB1693 Pin Configuration

## Pin Description

Table 1

NAME	Description
VIN	This is the positive input supply for the IC switching regulator. A suitable input bypass capacitor must be presented at this pin to minimize voltage transients and to supply the switching currents needed by the regulator.
SW	Internal switch. The voltage at this pin switches between (+Vcc – Vsat) and approximately – 0.5V, with a duty cycle of approximately Vout / Vcc. To minimize coupling to sensitive circuitry, the PC board copper area connected to this pin should be minimized.
FB	Sense 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 100uA. Pulling this pin below a threshold voltage of approximately 1.3V turns the regulator on, and pulling this pin above 1.3V (up to a maximum of Vcc) shuts the regulator down. If this shutdown feature is not needed, the EN pin can be wired to the ground pin.
GND	Circuit ground

## Ordering Information

Table 2

Order Number	Package Type	Supplied as	Package Marking
YB1693-33	SOP-8	2500 units Tape & Reel	YB1693-33
YB1693-50	SOP-8	2500 units Tape & Reel	YB1693-50
YB1693-ADJ	SOP-8	2500 units Tape & Reel	YB1693-ADJ

### Absolute Maximum Ratings

Supply Voltage ..... +28V  
 Operating Voltage Range ..... +4.5V to +24V  
 SW, EN Pin Input Voltage ..... -0.3V to Vcc  
 Feedback Pin Voltage ..... -0.3V to Vcc  
 Power Dissipation ..... Internally Limited  
 Output Voltage to Ground ..... -1V  
 Storage Temperature Range ..... -65°C to +150°C  
 Operating Temperature Range ... -40°C to +125°C

### Thermal Resistance

Junction to Case  $\theta_{JA}$  ..... 70°C / W  
 Junction to Ambient  $\theta_{JC}$  ..... 15°C / W

**Note:**  $\theta_{JA}$  is measured with the PCB copper area (need connect to GROUND pins) of approximately 1.5 in<sup>2</sup> (Multi-layer)

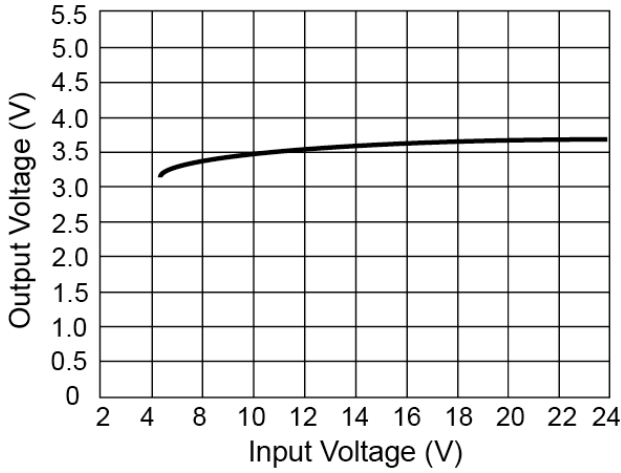
### Electricity Characteristics

**Table 3** (  $T_A=25^\circ\text{C}$ , unless otherwise noted,  $V_{IN}=12\text{V}$  for 3.3V, 5V, Adj version.  $I_{LOAD}=0.2\text{A}$  )

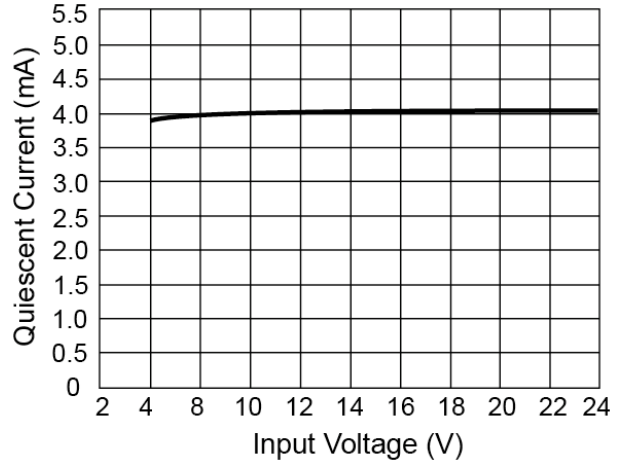
Function Parameter		Symbol	Test Conditions	Min	Typ	Max	Units
Output Feedback	ADJ	$V_{FB}$	$4.5\text{V} \leq V_{IN} \leq 24\text{V}$	1.193	1.23	1.267	V
			$0.2\text{A} \leq I_{LOAD} \leq 2\text{A}$	1.180		1.280	
Efficiency		$\eta$	$V_{IN}=12\text{V}, I_{LOAD}=2\text{A}$	76			%
Output Feedback	3.3V	$V_{FB}$	$4.75\text{V} \leq V_{IN} \leq 24\text{V}$	3.168	3.3	3.432	V
			$0.2\text{A} \leq I_{LOAD} \leq 2\text{A}$	3.135		3.465	
Efficiency		$\eta$	$V_{IN}=12\text{V}, I_{LOAD}=2\text{A}$	80			%
Output Feedback	5V	$V_{FB}$	$7\text{V} \leq V_{IN} \leq 24\text{V}$	4.80	5	5.20	V
			$0.2\text{A} \leq I_{LOAD} \leq 2\text{A}$	4.75		5.25	
Efficiency		$\eta$	$V_{IN}=12\text{V}, I_{LOAD}=2\text{A}$	84			%
Feedback Bias Current		$I_{FB}$	$V_{FB}=1.3\text{V}$ (Adj version only)		-10	-100	nA
Oscillator Frequency		$F_{OSC}$		127	150	173	KHz
Soft-Start Time		$T_{SS}$	Rising edge of EN on to $I_{CL}$		3		mS
Current Limit		$I_{CL}$	Pear Current, no outside circuit $V_{FB}=0\text{V}$ force driver on	2.4			A
Oscillator Frequency of Short Circuit Protect		$F_{SCP}$	When current limit occurred and $V_{FB} < 0.5\text{V}$ , $T_a = 25^\circ\text{C}$		60		KHz
Saturation Voltage		$V_{SAT}$	$I_{OUT}=2\text{A}$ , No outside circuit $V_{FB}=0\text{V}$ force driver on		1.15	1.50	V
ON/OFF Pin Logic Input Threshold Voltage		$V_{IL}$	Low (regulator ON)		1.3	0.6	V
			High (regulator OFF)	2.0			
ON/OFF Pin Logic Input Current		$I_L$	$V_{LOGIC}=2.5\text{V}$ (OFF)		-0.1	-0.5	$\mu\text{A}$
			$V_{LOGIC}=0.5\text{V}$ (ON)			-0.01	
Maximum Duty Cycle (ON)	DC		$V_{FB}=0\text{V}$ force driver on		100		%
Maximum Duty Cycle (OFF)			$V_{FB}=12\text{V}$ force driver off		0		
Quiescent Current		$I_Q$	$V_{FB}=12\text{V}$ force driver off		4	8	mA
Standby Quiescent Current		$I_{STBY}$	ON/OFF pin=5V		45	100	$\mu\text{A}$
			$V_{IN}=24\text{V}$			100	
SW Pin Leakage Current	SW pin = 0	$I_{SWL}$	No outside circuit, $V_{FB}=12\text{V}$ force driver off			-200	$\mu\text{A}$
	SW pin = -1		$V_{IN}=24\text{V}$		-5	mA	

**Electrical Characteristics Curve**

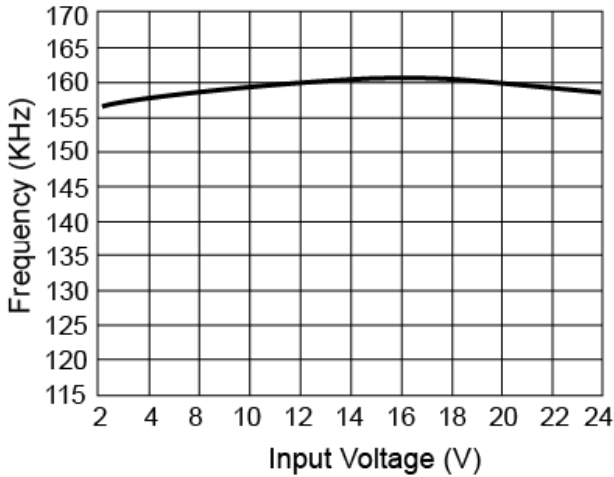
**Vout vs. Vin**



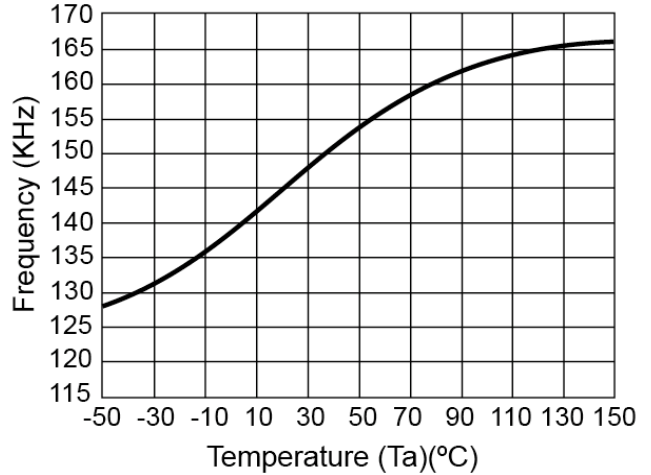
**Quiescent Current vs. Vin**



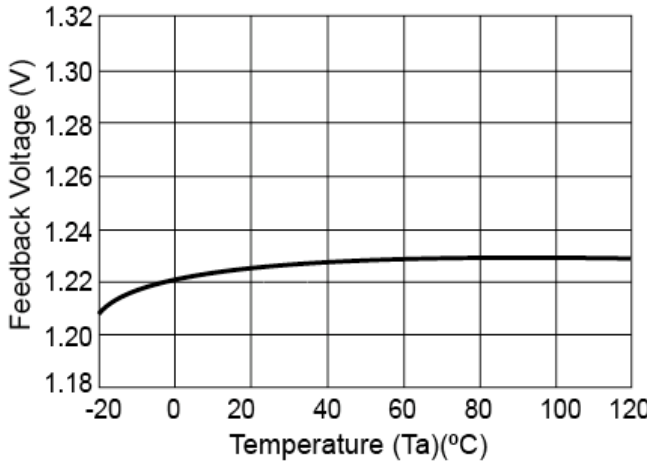
**Frequency vs. Vin**



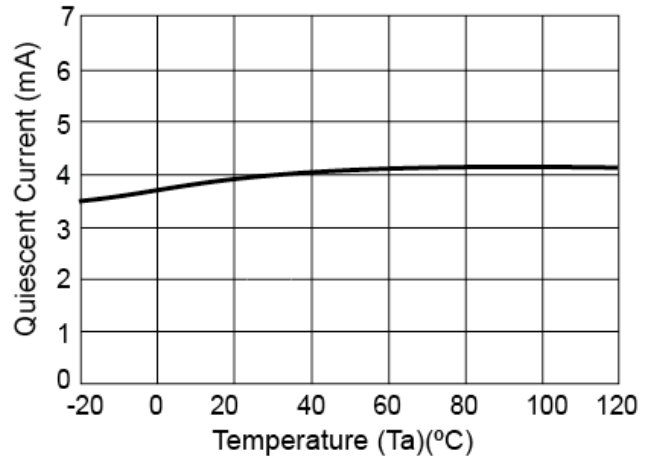
**Frequency vs. Temperature**



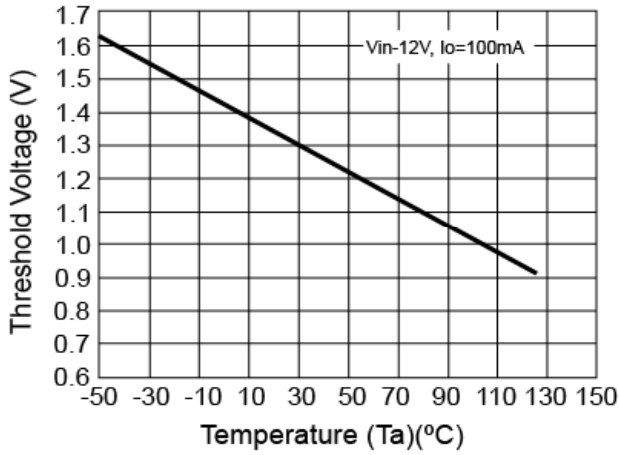
**Feedback Voltage vs. Temperature**



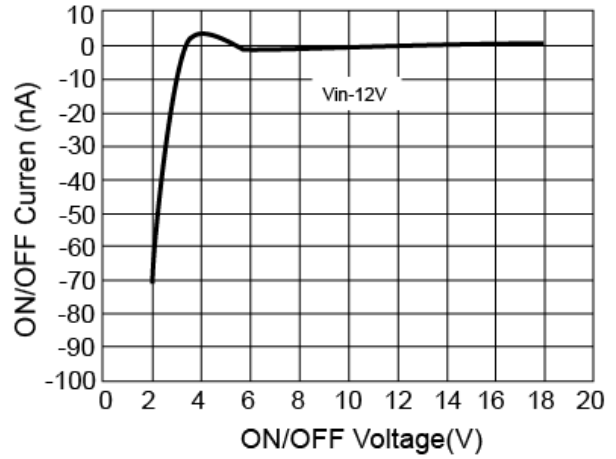
**Quiescent Current vs. Temperature**



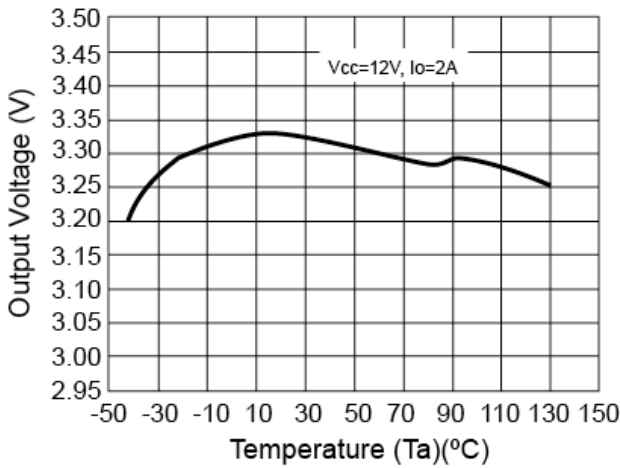
**Threshold Voltage vs. Temperature**



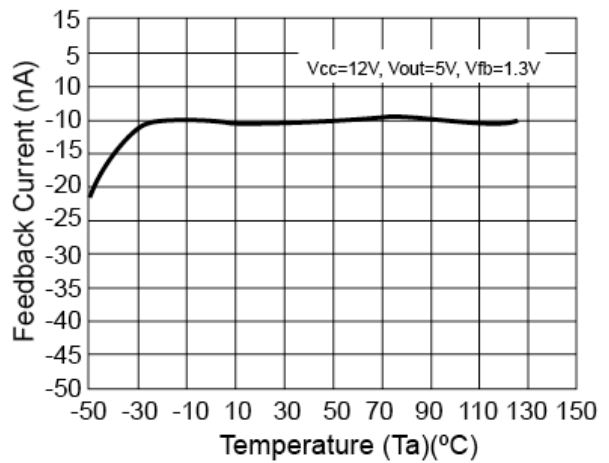
**ON/OFF Current vs. voltage**



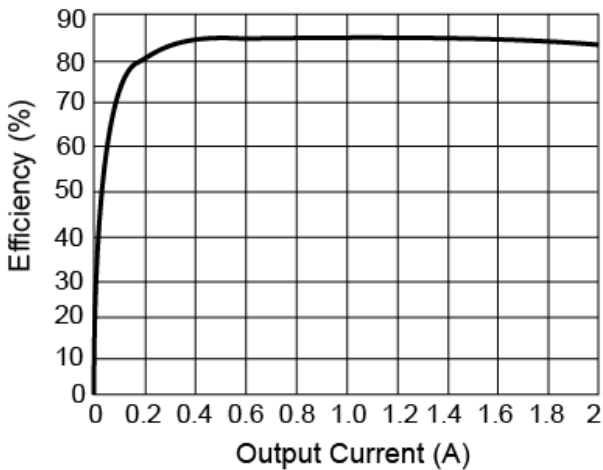
**Output Voltage vs. Temperature**



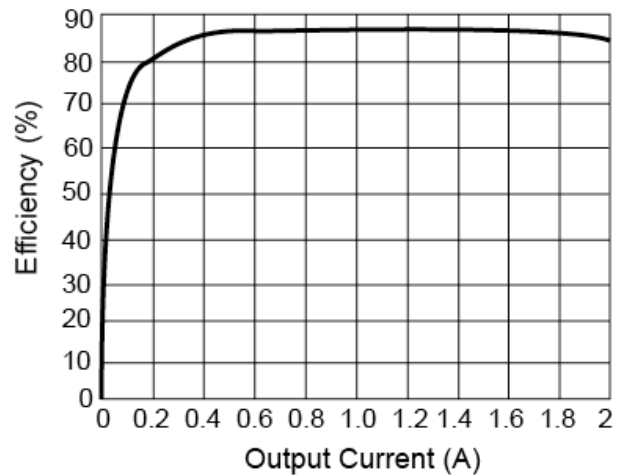
**Feedback Current vs. Temperature**



**Efficiency (Vin=12V, Vo=3.3V)**



**Efficiency (Vin=12V, Vo=5V)**



**Functional Block**

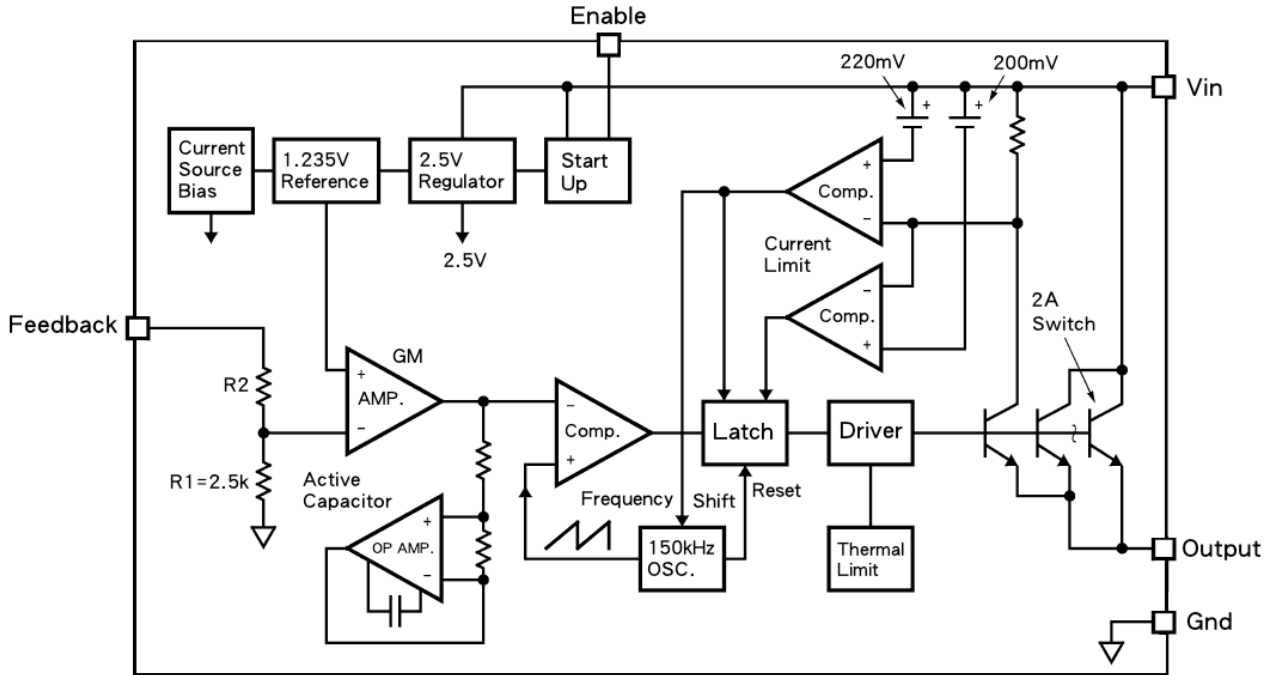
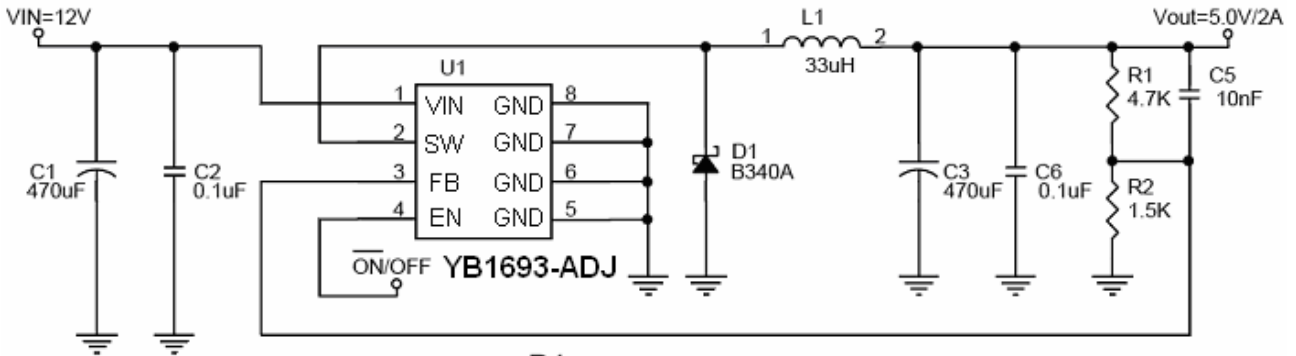


Figure 3: YB1693 Block Diagram

**Typical Applications**



$$V_{out} = V_{FB} \times \left(1 + \frac{R1}{R2}\right)$$

$$V_{FB} = 1.23V$$

$$R2 = 0.47K \sim 2.6K$$

Resistor select for output voltage setting

Vout	R1	R2
5V	4.7K	1.5K
	5.6K	1.8K
3.3V	2.5K	1.5K
	3.0K	1.8K
2.5V	1.8K	1.8K
1.8V	0.82K	1.8K

Figure 4: Adjustable Output Voltage Version

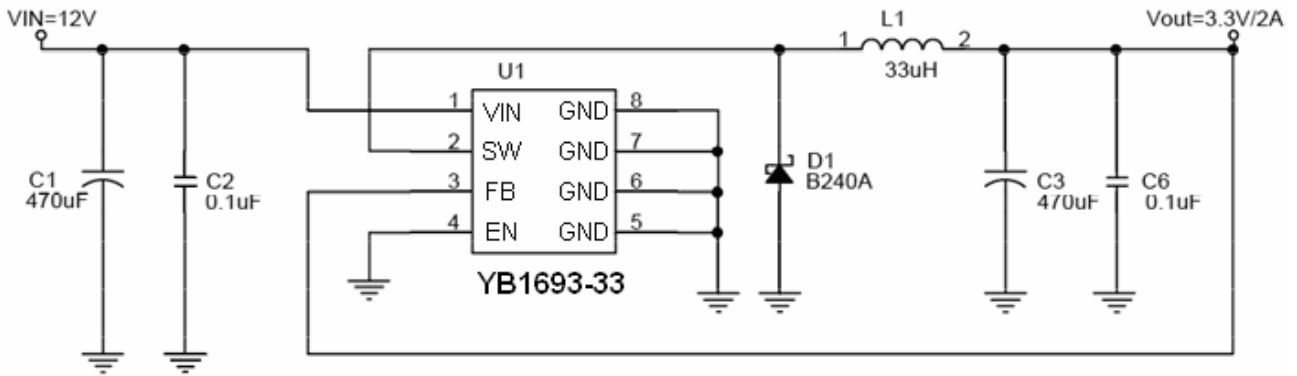
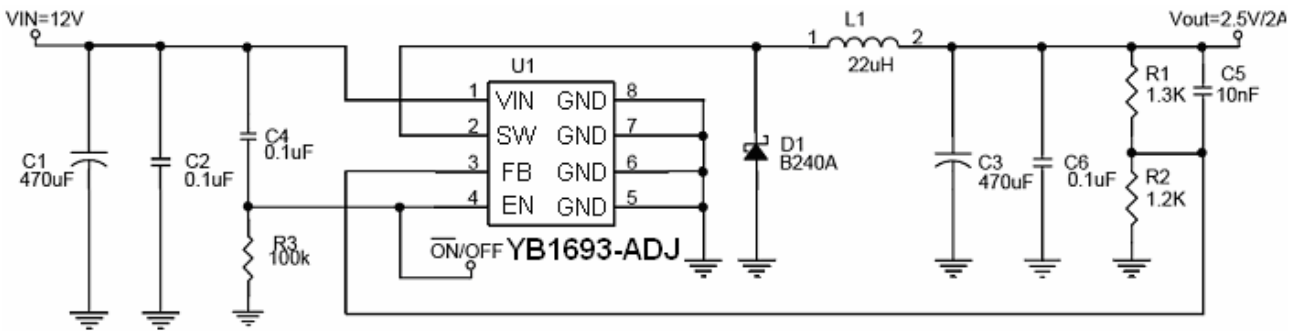


Figure 5: Fixed Output Voltage Version



$$V_{out} = V_{FB} \times \left(1 + \frac{R1}{R2}\right)$$

$$V_{FB} = 1.23V$$

$$R2 = 0.47K \sim 2.6K$$

Figure 6: Adjustable Output Voltage Version with Delayed Startup

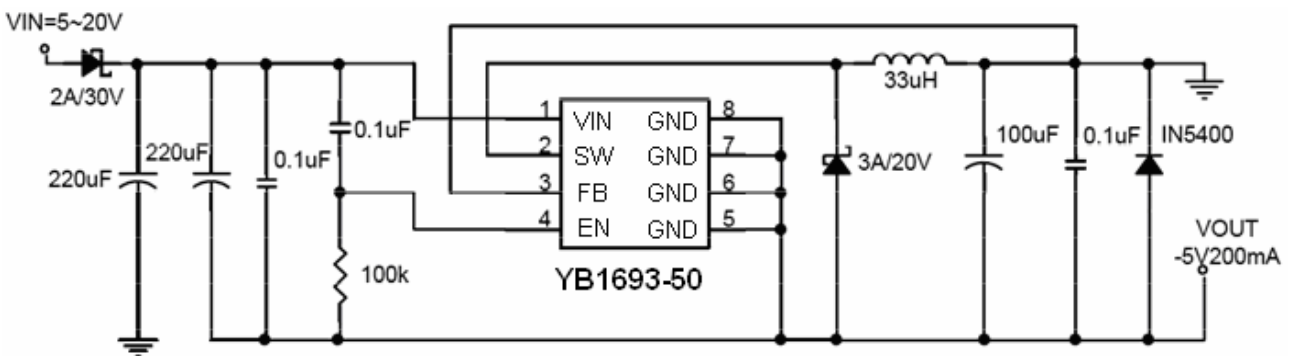
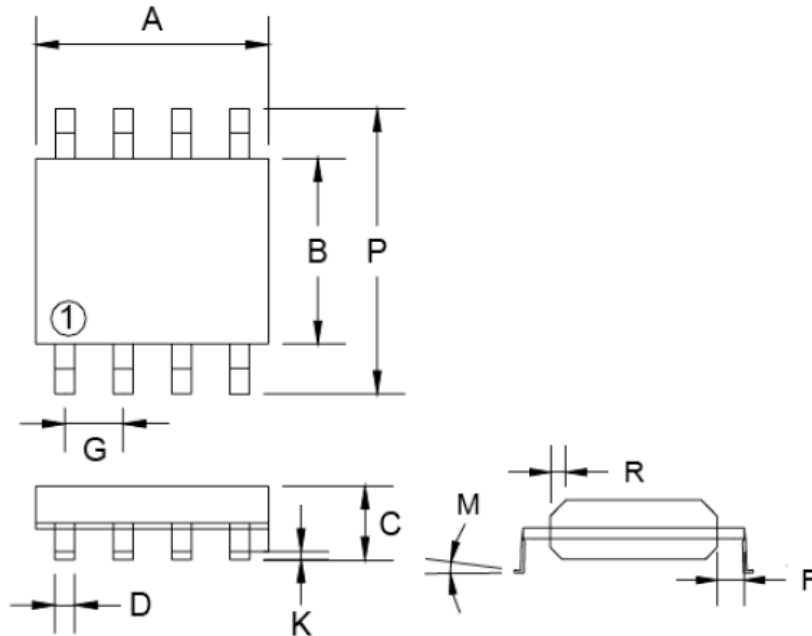


Figure 7: Inverting -5V Regulator with Delayed Startup

**Package Description**

**SOP-8**



SOP-8 DIMENSION				
DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX.
A	4.80	5.00	0.189	0.196
B	3.80	4.00	0.150	0.157
C	1.35	1.75	0.054	0.068
D	0.35	0.49	0.014	0.019
F	0.40	1.25	0.016	0.049
G	1.27BSC		0.05BSC	
K	0.10	0.25	0.004	0.009
M	0°	7°	0°	7°
P	5.80	6.20	0.229	0.244
R	0.25	0.50	0.010	0.019