

# ELM600xB 1A 1.5MHz

## high efficiency synchronous PWM step down DC/DC converter

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### ■ General description

ELM600xB is a high efficiency step down DC/DC converter operated with current mode and constant frequency. The internal switch and synchronous rectifier are integrated for high efficiency. External Schottky diodes are not required. The supply current is only 100 $\mu$ A during operation and drops to less than 1 $\mu$ A in shutdown. ELM600xB can supply 1A of load current from 2.5V to 5.5V supply voltage.

The switching frequency is set at 1.5MHz, allowing the use of small surface mount inductors and capacitors. It can run 100% duty cycle for low dropout application. The output voltage of ELM600xB is adjustable from the FB pin.

### ■ Features

- Current mode operation
- Thermal shutdown protection and short circuit protection
- Constant frequency : Typ.1.5MHz
- Output current : 1A
- High efficiency : Max.95%
- Shutdown current : Max.1 $\mu$ A(Ven=0V, Vin=5.5V)
- Supply voltage : 2.5V to 5.5V
- Low quiescent current : Typ.110 $\mu$ A(Outgoing stopped)
- Full duty ratio : 0 to 100% (in dropout)
- Package : DFN6-2x2, TSOT-25

### ■ Application

- Cellular phone
- PDA and smart phone
- MP3 player
- Digital camera
- Wireless and DSL card
- Microcomputer and DSP power supply
- Portable machine

### ■ Maximum absolute ratings

Parameter	Symbol	Limit	Unit
VIN power supply voltage	Vin	-0.3 to +6.0	V
Apply voltage to SW	Vsw	GND-0.3 to Vin+0.3	V
Apply voltage to EN	Ven	GND-0.3 to Vin+0.3	V
Apply voltage to FB	Vfb	GND-0.3 to Vin+0.3	V
SW peak current	Isw	3.0 <sup>(*2)</sup>	A
Power dissipation	Pd	1000 (DFN6-2x2) <sup>(*3)</sup>	mW
		600 (TSOT-25) <sup>(*3)</sup>	
Operating temperature range	Top	-40 to +85	°C
Storage temperature range	Tstg	-65 to +150	°C

Caution:

- \* 1. Permanent damage to the device may occur when ratings above maximum absolute ones are used.
- \* 2. Output current must not exceed power dissipation specified in maximum absolute ratings.
- \* 3. Mounted on glass epoxy board (FR-4). (76.2mm $\times$ 114.3mm $\times$ 1.6mm : based on EIJ/JEDEC standard size), 2layers, Cu thickness 35 $\mu$ m, Cu area : top side 20%, back side 100%.

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## ■ Selection guide

### ELM600xB-x

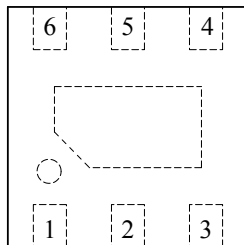
Symbol		
a	Package	G: DFN6-2x2 L: TSOT-25
b	Product version	B
c	Taping direction	N: DFN6-2x2(Refer to PKG file) S: TSOT-25(Refer to PKG file)

ELM600 x B - x  
 ↑ ↑ ↑  
 a b c

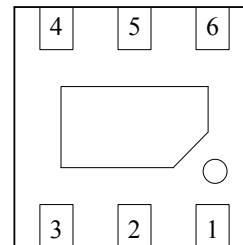
\* Taping direction is one way.

## ■ Pin configuration

DFN6-2x2(TOP VIEW)

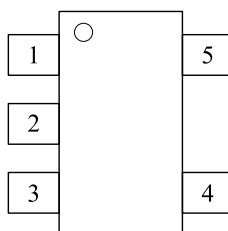


DFN6-2x2(BOTTOM VIEW)



Pin No.	Pin name	Pin description
1	NC	No connected.
2	EN	Enable control input
3	VIN	Main supply
4	SW	Power switch output
5	GND	Ground
6	FB	Voltage feedback
Exposed Pad	NC	No connected.

TSOT-25(TOP VIEW)

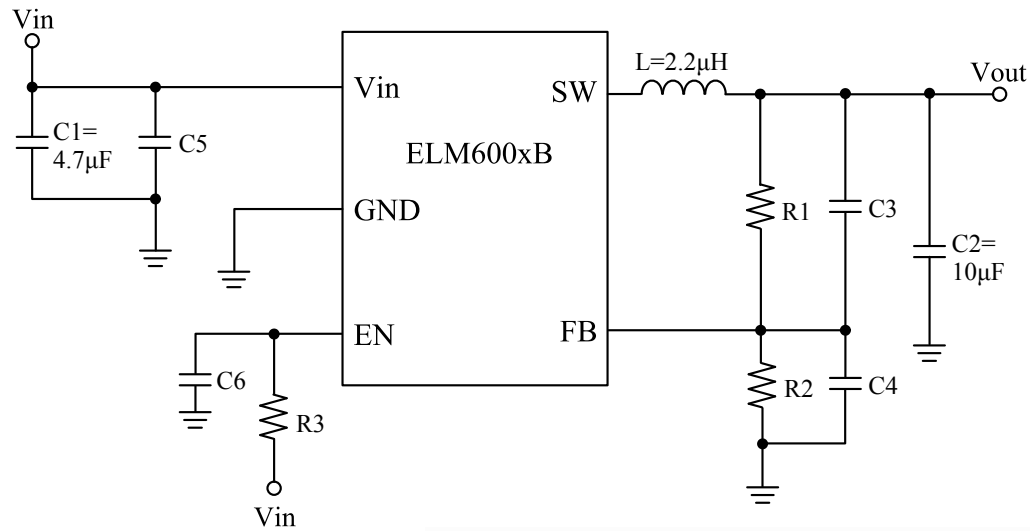


Pin No.	Pin name	Pin description
1	EN	Enable control input
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5	FB	Voltage feedback

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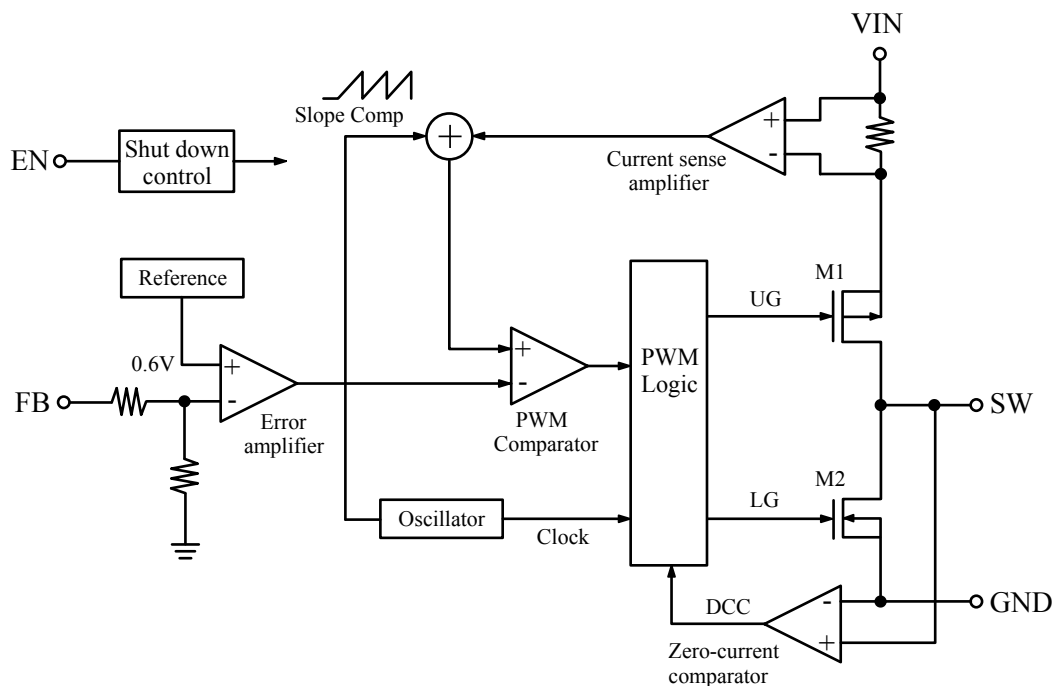
## ■Standard circuit ( Adjustable Output Voltage )



$$V_{out} = V_{fb} \times (1 + R1/R2)$$

with R1 = 300k for typical application, and C3 should be in the range between 10pF and 47pF for component selection.

## ■Block diagram



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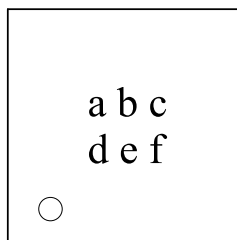
## ■Electrical characteristics

$V_{in}=5V$ ,  $V_{out}=1.8V$ ,  $L=2.2\mu H$ ,  $C_{out}=10\mu F$ ,  $T_{op}=25^{\circ}C$ , unless otherwise specified

Parameter	Symbol	Test condition	Min.	Typ.	Max.	Unit
Supply voltage	$V_{in}$		2.5		5.5	V
Output voltage line regulation	$\Delta V_{out}/\Delta V_{in}$	$V_{in}=2.5V$ to $5.5V$	-3		3	%/V
Output voltage load regulation	$V_{lr}$		-3		3	%
Reference voltage	$V_{ref}$	For adjustable $V_{out}$	0.588	0.600	0.612	V
Output range (adjustable voltage)	$V_{out}$	$V_{in}=2.5V$ to $5.5V$	-3		+3	%
Shutdown current	$I_s$	$V_{en}=0V$		0.1	1.0	$\mu A$
Quiescent current	$I_q$	$V_{en}=V_{in}$ , $V_{fb}=V_{ref}\times 1.1$ No switching		110		$\mu A$
SW leakage current	$I_{leak}$	$V_{en}=0V$ , $V_{sw}=0V$ or $V_{in}$	-1		1	$\mu A$
PMOSFET on resistance	$R_{dsonP}$	$I_{sw}=100mA$		250		$m\Omega$
NMOSFET on resistance	$R_{dsonN}$	$I_{sw}=-100mA$		200		$m\Omega$
PMOSFET current limit	$I_{Pcl}$	Duty cycle=100% Current pulse width<1ms		2		A
Oscillator frequency	$F_{osc}$		1.2	1.5	1.8	MHz
Thermal shutdown threshold	$T_s$			160		$^{\circ}C$
EN high level input voltage	$V_{enh}$	$-40^{\circ}C \leq T_{op} \leq +85^{\circ}C$	1.5			V
EN low level input voltage	$V_{enl}$	$-40^{\circ}C \leq T_{op} \leq +85^{\circ}C$			0.4	V
EN input current	$I_{en}$	$V_{en}=0V$ to $V_{in}$	-1		1	$\mu A$

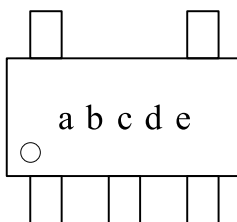
## ■Marking

DFN6-2x2



Mark	Content
a ~ f	Assembly lot No. : 0 ~ 9 and A ~ Z

TSOT-25



Mark	Content
a ~ e	Assembly lot No. : 0 ~ 9 and A ~ Z

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## ■Application notes

ELM600xB is constant frequency current mode PWM step down converter. ELM600xB is optimized for low voltage, Li-ion battery, powered applications where high efficiency and small size are critical. The device integrates both a main switch and a synchronous rectifier, which provides high efficiency and eliminates an external Schottky diode. ELM600xB can achieve 100% duty cycle. The duty cycle D of a step down converter is defined as:

$$D = T_{on} \times F_{osc} \times 100\% \approx (V_{out}/V_{in}) \times 100\%$$

Where  $T_{on}$  is the main switch on time,  $F_{osc}$  is the oscillator frequency (1.5MHz),  $V_{out}$  is the output voltage and  $V_{in}$  is the input voltage.

### 1) Current mode PWM control

Slope compensated current mode PWM control provides stable switching and cycle-by-cycle current limit for superior load and line response and protection of the internal main switch and synchronous rectifier. ELM600xB switches at a constant frequency (1.5MHz) and regulates the output voltage. During each cycle the PWM comparator modulates the power transferred to the load by changing the inductor peak current based on the feedback error voltage. During normal operation, the main switch is turned on for a certain time to ramp the inductor current at each rising edge of the internal oscillator, and switched off when the peak inductor current is above the error voltage. When the main switch is off, the synchronous rectifier will be turned on immediately and stay on until either the next cycle starts or the inductor current drops to zero. The device skips pulses to improve efficiency at light load.

### 2) Dropout operation

ELM600xB allows the main switch to remain on for more than one switching cycle and increases the duty cycle while the input voltage is dropping close to the output voltage. When the duty cycle reaches 100%, the main switch is held on continuously to deliver current to the output up to the P MOSFET current limit. The output voltage then is the input voltage minus the voltage drop across the main switch and the inductor.

### 3) Short circuit protection

ELM600xB has short circuit protection. When the output is shorted to ground, the oscillator frequency is reduced to prevent the inductor current from increasing beyond the P MOSFET current limit. The frequency will return to the normal values once the short circuit condition is removed and the  $V_{out}$  reaches regulated voltage.

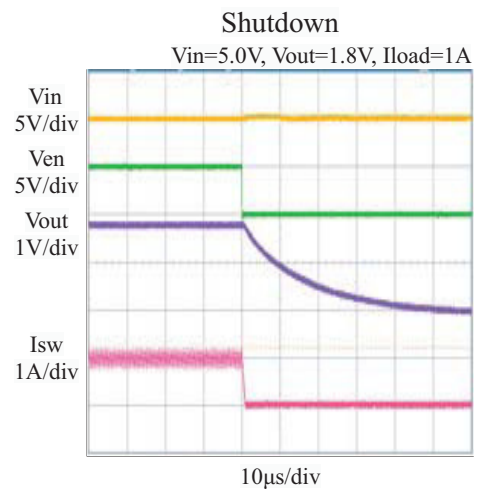
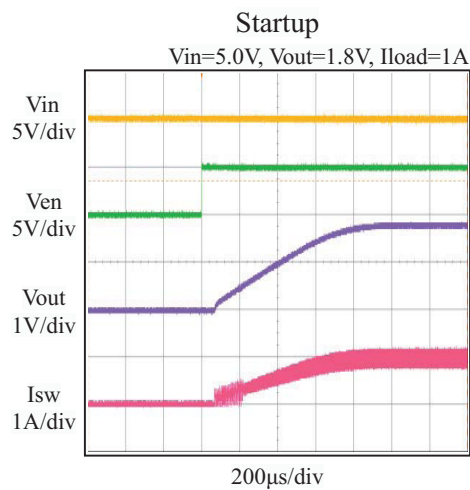
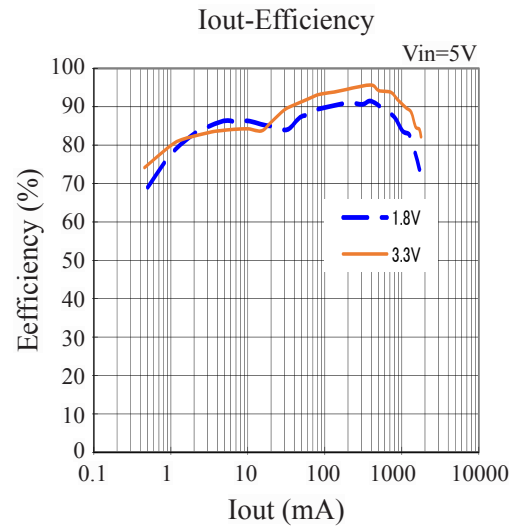
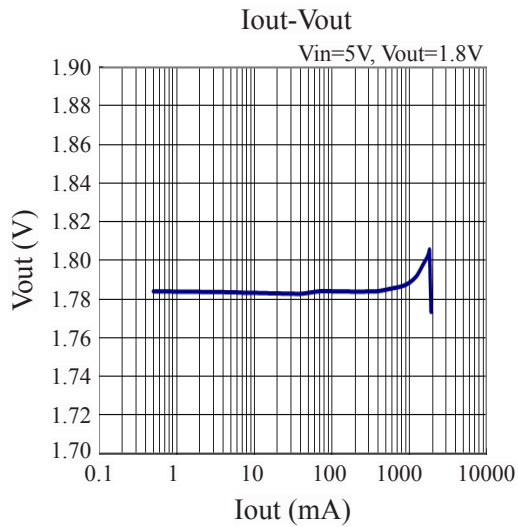
### 4) Maximum load current

ELM600xB can operate down to 2.5V input voltage; however the maximum load current decreases at lower input due to large IR drop on the main switch and synchronous rectifier. The slope compensation signal reduces the peak inductor current as a function of the duty cycle to prevent sub-harmonic oscillations at duty cycles greater than 50%. Conversely the current limit increases as the duty cycle decreases.

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## ■ Typical characteristics



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