

ELM630BA 1.5A 5.5V 2.5MHz Synchronous step down DC/DC converter

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■General description

ELM630BA 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 300 μ A during operation and drops to 1 μ A in shutdown. ELM630BA can supply 1.5A of load current from 2.9V to 5.5V supply voltage. The output voltage of ELM630BA is from 1V to 5V, and is adjustable from the FB pin.

The switching frequency is set at 2.5MHz, allowing the use of small surface mount inductors and capacitors. It can run 100% duty cycle for low dropout application.

■Features

- Low output noise across load range
- Excellent transient response
- Start up into pre-bias output
- Internal soft start
- Input under-voltage lockout
- Output over voltage protection
- Output current limit protection
- Over temperature protection
- Supply Voltage : 2.9V to 5.5V
- Output voltage (adj.) : 1V to 5V
- Output current : 1.5A
- Shutdown current : < Typ.1 μ A
- High efficiency : Max.93%
- Switching frequency : Typ.2.5MHz
- duty-cycle low dropout operation : 100%
- Package : SOT-25

■Application

- Bluetooth radios
- DSC and PMPs
- GPS devices
- xDSL systems
- POL regulators
- Portable HDD
- Wireless LAN

■Maximum absolute ratings

Parameter	Symbol	Limit	Unit
Vin power supply voltage	Vin	-0.3 to +6.0	V
Vout Voltage	Vout	-0.3 to Vin+0.3	V
Apply voltage to SW	Vsw	-1 to Vin+1 (Max.6V) -3 (Max.20ns)	V
Apply voltage to EN	Ven	-0.3 to Vin+0.3	V
Power dissipation	Pd	300	mW
Operating temperature range	Top	-40 to +85	°C
Storage temperature range	Tstg	-65 to +150	°C

Caution: Permanent damage to the device may occur when ratings above maximum absolute ones are used.

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■Selection guide

ELM630BA-S

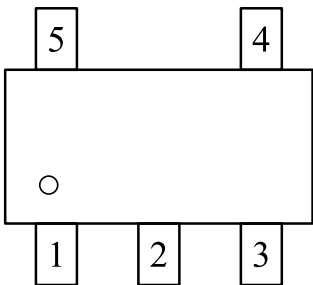
Symbol		
a	Package	B: SOT-25
b	Product version	A
c	Taping direction	S: Refer to PKG file

ELM630BA - S
↑↑↑
a b c

* Taping direction is one way.

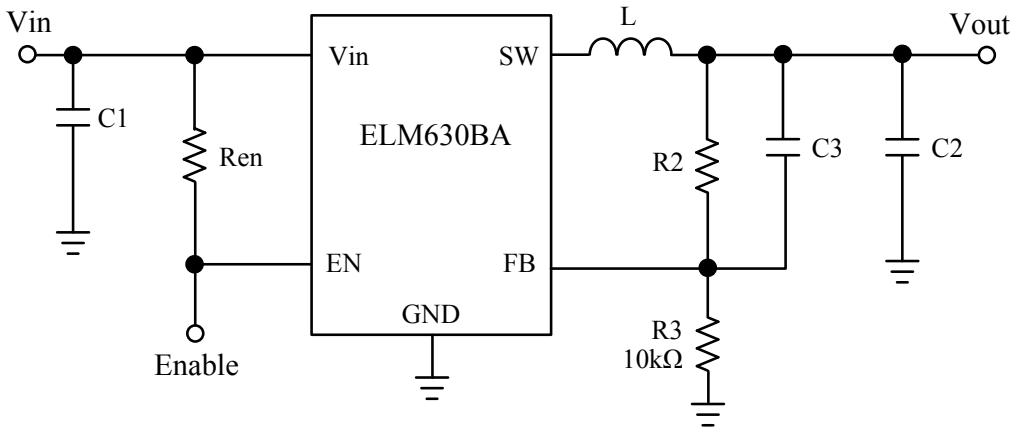
■Pin configuration

SOT-25(TOP VIEW)



Pin No.	Pin name	Pin description
1	VIN	Main supply.
2	GND	Ground.
3	EN	Enable control input.
4	FB	Feedback input.
5	SW	Power switch output.

■Standard circuit

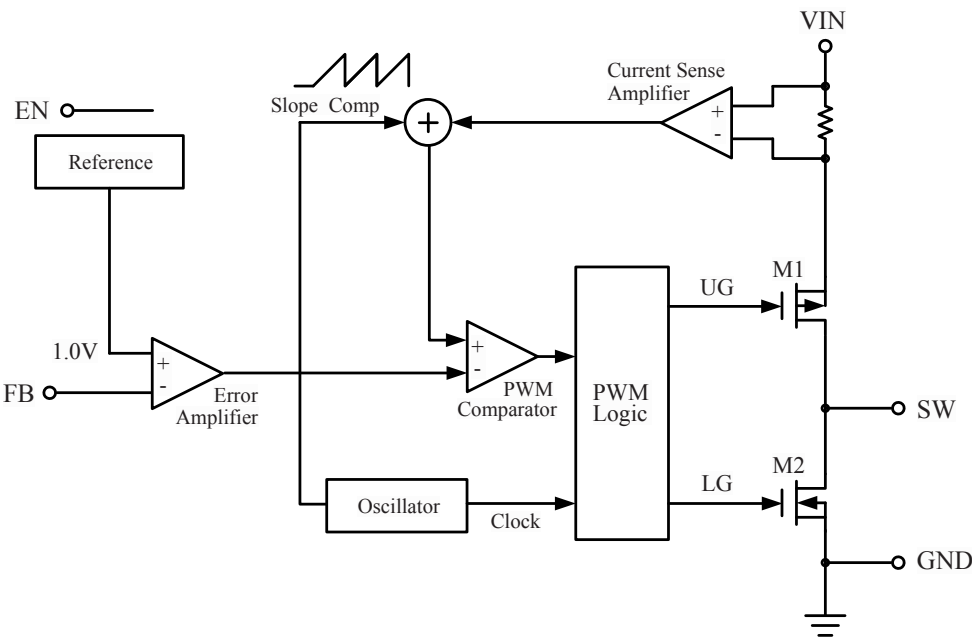


* $V_{out}=1.0 \times (1+R2/R3)$

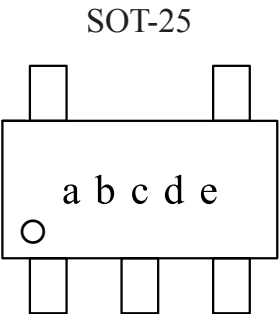
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■Block diagram



■Marking



Mark	Content
a to e	Assembly lot No.: 0 to 9 & A to Z

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■Electrical characteristics(Adjustable output voltage)

Vin=5.0V, Cin=10μF, Cout=10μF, L=1.2μH, typical Top=25°C, Tj(max.)=125°C, unless otherwise noted.

Parameter	Symbol	Test condition	Min.	Typ.	Max.	Unit
Supply voltage	Vin		2.9		5.5	V
Output voltage	Vout	Adjustable	1		5	V
Output current	Iout				1.5	A
Output voltage tolerance (Note1)	ΔVout	Vin=3.6V to 5.0V, no load	-2.5		+2.5	%
Feedback voltage	Vfb	Ta=+25°C	0.98	1.00	1.02	V
Current limit	Ilimit	Peak inductor current	2.0			A
Under-voltage lockout	UVLO	Rising Vin	2.20	2.35	2.50	V
		Hysteresis		250		mV
Quiescent current	Iq	Ven=Vin, no switching		300		μA
Shutdown current	Is	Ven=GND		1	10	μA
PMOSFET on resistance	Rdson P	Isw=100mA		150		mΩ
NMOSFET on resistance	Rdson N	Isw=-100mA		125		mΩ
SW leakage current	Ileak	Vin=5.5V, Vsw=0V, Ven=GND		1	10	μA
		Vin=5.5V, Vsw=5.0V, Ven=GND	-10	-1		
Line regulation	ΔVline-reg	Vin=3.6V to 5.0V, Iout=0A		±1.0		%
Load regulation (Note2)	ΔVload-reg	Vin=5.0V, Iout=10mA to 1.5A		±1.0		%
Oscillator frequency	Fosc		2.0	2.5	3.0	MHz
Soft-Start time (Note2)	Tss			100		μs
EN input high current	Ien_Hi	Ven=Vin	-2.0		2.0	μA
EN input low current	Ien_Lo	Ven=GND	-2.0		2.0	μA
EN input high threshold	Ven_Hi		1.2			V
EN input low threshold	Ven_Lo				0.4	V
FB over voltage protection(note2)	Vovp			115		%
Thermal shutdown temperature (Note2)	Tsd	Junction temperature		+160		°C
Thermal shutdown hysteresis (Note2)	Tsd_hys	Junction temperature		10		°C

Note 1: The “ Output voltage tolerance ” includes output voltage accuracy, voltage drift over temperature and the line regulation.

Note 2: Guaranteed by design, not tested.

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■Application notes

ELM630BA is a constant frequency current mode PWM step down converter. ELM630BA 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. ELM630BA 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 (2.5MHz), 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. ELM630BA switches at a constant frequency (2.5MHz) 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

ELM630BA 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

ELM630BA 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.

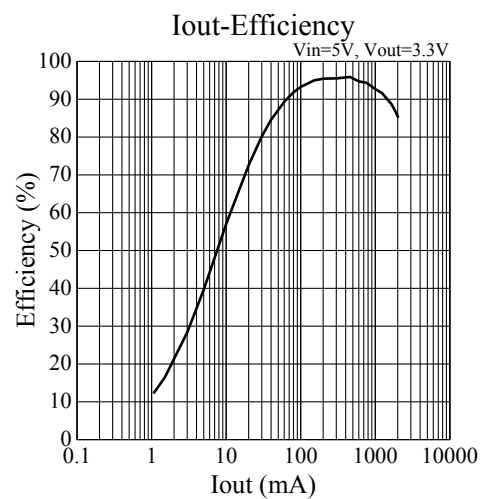
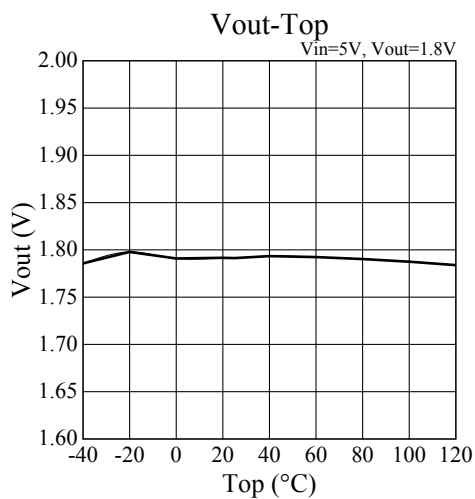
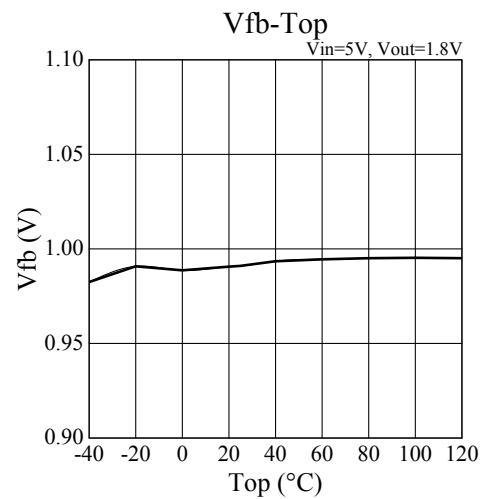
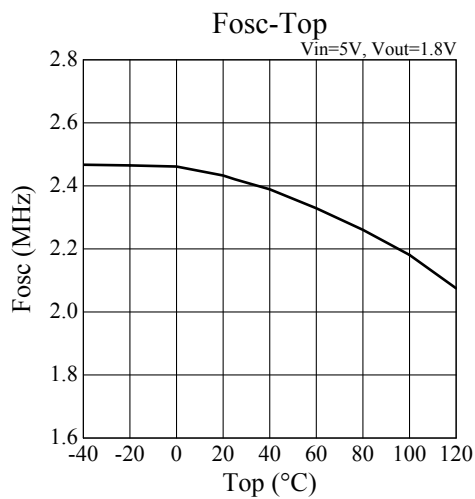
4) Maximum load current

ELM630BA can operate down to 2.9V 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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