ELM600LA 800mA 1.4MHz
high efficiency synchronous PWM step down DC/DC converter

■General description

ELM600LA is high efficiency synchronous step down DC/DC converter operated with current mode and 1.4MHz constant frequency; internal switch and synchronous rectifier are integrated for high efficiency. In application, ELM600LA does not require any external Schottky diode. Internal current consumption under operation of ELM600LA is as low as 200μA and drops to less than 1μA in shutdown mode. With supply voltage from 2.5V to 6V, ELM600LA can supply load current of 800mA; the output voltage can be regulated as low as 0.6V.

With 1.4MHz switching frequency, ELM600LA makes it possible to adopt small surface amount inductors and capacitors. Switch duty cycle would be on continuously and 100% at maximum when input voltage is set be to lower than output voltage.

■Features

- Current mode operation
- Thermal shutdown protection and short circuit protection
- Constant frequency : Typ.1.4MHz
- Output current : 800mA
- High efficiency : Max.95%
- Shutdown current : Max.1μA(Ven=0V, Vin=6V)
- Supply voltage : 2.5V to 6V
- Low quiescent current : Typ.200μA
- Full duty ratio : 0 to 100% (in dropout)
- Package : 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 +6.5	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	1.7	A
Power dissipation	Pd	200	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.

■Selection guide

ELM600LA-S, ELM600LA-xx-S

Symbol		
a	Package	L: TSOT-25
b	Product version	A
c, d	Output voltage	e.g. : 12: Vout=1.2V, 18: Vout=1.8V
e	Taping direction	S: Refer to PKG file

∗ Taping direction is one way.

- Adj. version

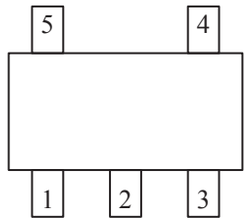
ELM600LA - S
↑↑ ↑
a b e

- Fixed version

ELM600 LA - x x - S
↑↑ ↑ ↑ ↑
a b c d e

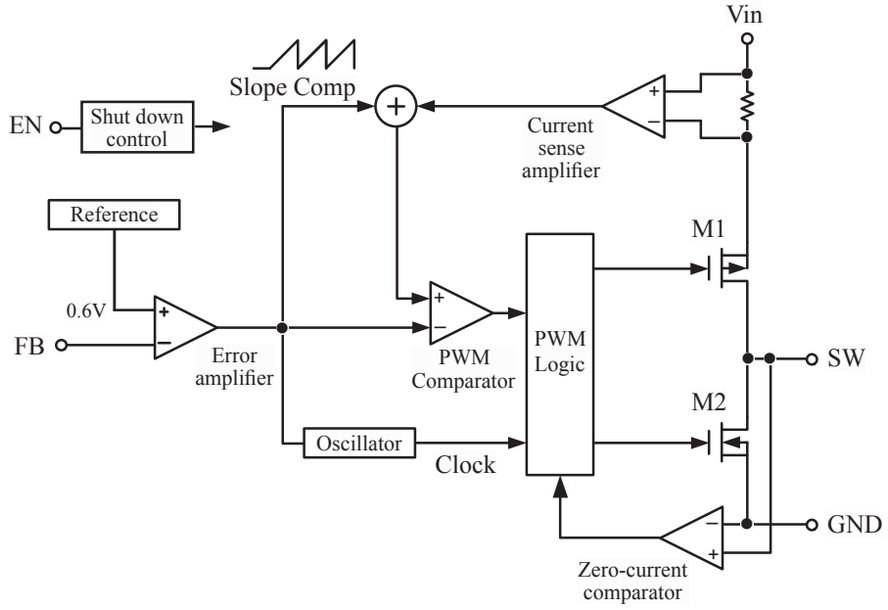
■Pin configuration

TSOT-25(TOP VIEW)



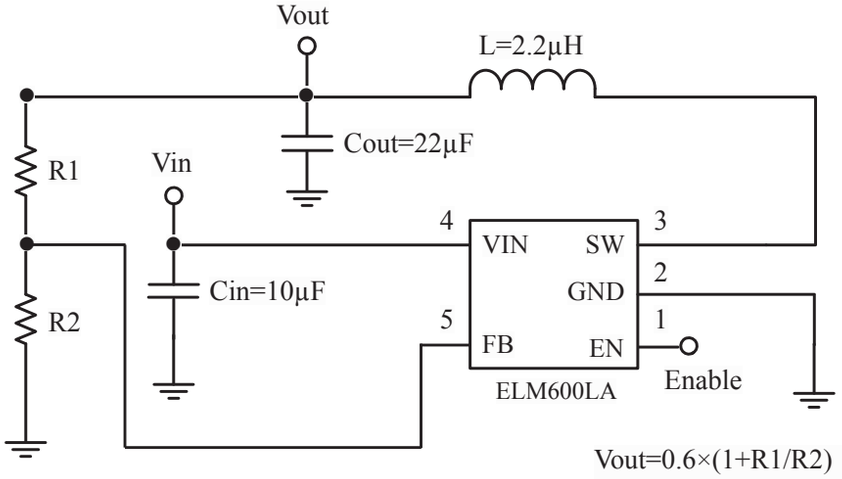
Pin No.	Pin name	Pin description
1	EN	Enable control input
2	GND	Ground
3	SW	Power switch output
4	VIN	Main supply
5	FB	Voltage feedback

■Block diagram



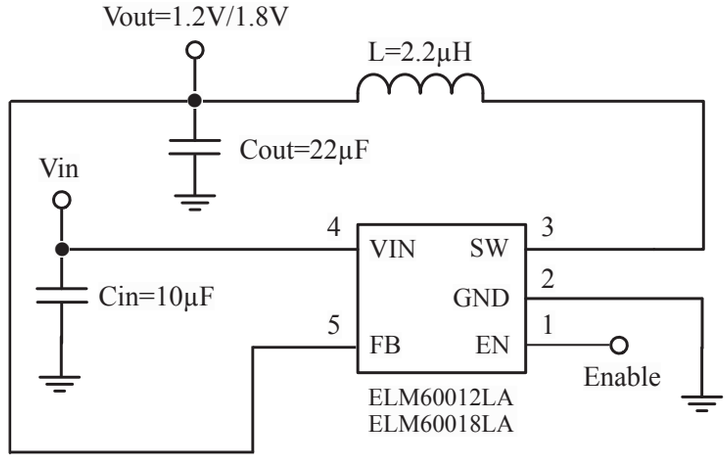
■Standard circuit

• Adjustable output voltage



Vout=0.6×(1+R1/R2)
Vout=3.3V, R1=300KΩ, R2=68KΩ
Vout=1.8V, R1=1MΩ, R2=499KΩ

• Fixed output voltage



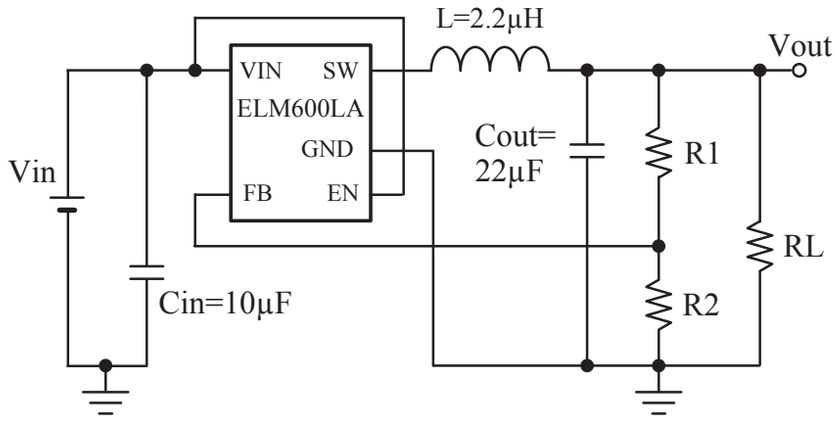
∗ Passive components without specified values in the above figure are optional.

■Electrical characteristics(Adjustable output voltage)

Vin=3.6V, Typical values are at Top=25°C, unless otherwise noted.

Parameter	Symbol	Test condition	Min.	Typ.	Max.	Unit
Supply voltage	Vin		2.5		6.0	V
Output voltage	Vout	Adjustable	0.6		6.0	V
Feedback current	Ifb		-30.0		30.0	nA
Regulated feedback voltage	Vfb	-40°C ≤ Top ≤ +85°C	0.582	0.600	0.618	V
Reference voltage line regulation	ΔVfb/ΔVin	Vin=2.5V to 6V		0.04	0.40	%/V
Output voltage line regulation	ΔVout/ΔVin	Vin=2.5V to 6V		0.04	0.40	%/V
Output voltage load regulation	Vlr			0.5		%
Shutdown current	Is	Ven=0V, Vin=6V		0.01	1.00	µA
Quiescent current	Iq	Ven=Vin, Vfb=0.65V No switching		200		µA
SW leakage current	Ileak	Ven=0V, Vfb=0.65V Vsw=0V or 6V	-1		1	µA
PMOSFET on resistance	RdsonP	Isw=100mA		0.35		Ω
NMOSFET on resistance	RdsonN	Isw=-100mA		0.24		Ω
PMOSFET current limit	IPcl	Duty cycle=100% Current pulse width<1ms	0.8	1.1	1.5	A
Oscillator frequency	Fosc		1.12	1.40	1.68	MHz
Thermal shutdown threshold	Tsd			145		°C
EN high level input voltage	Venh	-40°C ≤ Top ≤ +85°C	1.1			V
EN low level input voltage	Venl	-40°C ≤ Top ≤ +85°C			0.3	V
EN input current	Ien	Ven=0V to Vin	-1		1	µA

■Test circuits(Adjustable output voltage)



■Electrical characteristics(Fixed output voltage)

Vout=1.2V Vin=3.6V, Typical values are at Top=25°C, unless otherwise noted.

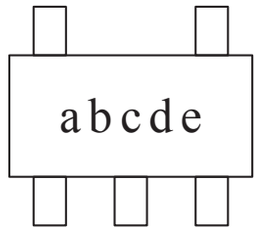
Parameter	Symbol	Test condition	Min.	Typ.	Max.	Unit
Supply voltage	Vin		2.5		6.0	V
Feedback current	Ifb		-30.0		30.0	nA
Regulated feedback voltage	Vfb	-40°C ≤ Top ≤ +85°C	0.582	0.600	0.618	V
Reference voltage line regulation	ΔVfb/ΔVin	Vin=2.5V to 6V		0.04	0.40	%/V
Output voltage line regulation	ΔVout/ΔVin	Vin=2.5V to 6V		0.04	0.40	%/V
Output voltage load regulation	Vlr			0.5		%
Output range (Fixed voltage)	Vout	Vin=2.5V to 6V	1.164	1.200	1.236	V
Shutdown current	Is	Ven=0V, Vin=6V		0.01	1.00	µA
Quiescent current	Iq	Ven=Vin,Vfb=0.65V, No switching		200		µA
SW leakage current	Ileak	Ven=0V, Vfb=0.65V Vsw=0V or 6V	-1		1	µA
PMOSFET on resistance	RdsonP	Isw=100mA		0.35		Ω
NMOSFET on resistance	RdsonN	Isw=-100mA		0.24		Ω
PMOSFET current limit	IPcl	Duty cycle=100% Current pulse width < 1ms	0.8	1.1	1.5	A
Oscillator frequency	Fosc		1.12	1.40	1.68	MHz
Thermal shutdown threshold	Tsd			145		°C
EN high level input voltage	Venh	-40°C ≤ Top ≤ +85°C	1.1			V
EN low level input voltage	Venl	-40°C ≤ Top ≤ +85°C			0.3	V
EN input current	Ien	Ven=0V to Vin	-1		1	µA

Vout=1.8V Vin=3.6V, Typical values are at Top=25°C, unless otherwise noted.

Parameter	Symbol	Test condition	Min.	Typ.	Max.	Unit
Supply voltage	Vin		2.5		6.0	V
Feedback current	Ifb		-30.0		30.0	nA
Regulated feedback voltage	Vfb	-40°C ≤ Top ≤ +85°C	0.582	0.600	0.618	V
Reference voltage line regulation	ΔVfb/ΔVin	Vin=2.5V to 6V		0.04	0.40	%/V
Output voltage line regulation	ΔVout/ΔVin	Vin=2.5V to 6V		0.04	0.40	%/V
Output voltage load regulation	Vlr			0.5		%
Output range (Fixed voltage)	Vout	Vin=2.5V to 6V	1.764	1.800	1.836	V
Shutdown current	Is	Ven=0V, Vin=6V		0.01	1.00	μA
Quiescent current	Iq	Ven=Vin,Vfb=0.65V, No switching		200		μA
SW leakage current	Ileak	Ven=0V, Vfb=0.65V Vsw=0V or 6V	-1		1	μA
PMOSFET on resistance	RdsonP	Isw=100mA		0.35		Ω
NMOSFET on resistance	RdsonN	Isw=-100mA		0.24		Ω
PMOSFET current limit	IPcl	Duty cycle=100% Current pulse width<1ms	0.8	1.1	1.5	A
Oscillator frequency	Fosc		1.12	1.40	1.68	MHz
Thermal shutdown threshold	Tsd			145		°C
EN high level input voltage	Venh	-40°C ≤ Top ≤ +85°C	1.1			V
EN low level input voltage	Venl	-40°C ≤ Top ≤ +85°C			0.3	V
EN input current	Ien	Ven=0V to Vin	-1		1	μA

■Marking

TSOT-25



a to e : Assembly lot No. ——
A to Z (I, O, X excepted) and 0 to 9

■Application notes

ELM600LA is constant frequency current mode PWM step down converter which is suitable for applications that require high efficiency and small assembly area and use low voltage, such as Li-ion battery. By external resistor divider, output voltage of ELM600LA can be set within the range from 0.6V to 6V. To provide operation with high efficiency, ELM600LA consists of main switch and synchronous rectifier while external Schottky diode is not necessary. Duty cycle of ELM600LA can reach upto 100%. Duty cycle D of step down converter is defined as follows:

$$D = Ton \times Fosc \times 100\% \approx (Vout/Vin) \times 100\%$$

Ton=main switch on time; Fosc=oscillator frequency (1.4MHz); Vout=output voltage;Vin=input voltage

1) Current mode PWM control

Slope compensated current mode control PWM provides superior load and line response, and protection of internal main switch and synchronous rectifier to current limit by stable switching and switch cycle. ELM600LA switches at a constant frequency (1.4MHz) and regulates output voltage. During each cycle, the PWM comparator modulates the power transferred to load by changing inductor peak current which is based on the feedback error voltage. Under 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 off when inductor peak current is above error voltage. When the main switch is turned off, the synchronous rectifier will be turned on immediately and stay on until either the next cycle begins or the inductor current drops to zero. With light load, ELM600LA would skip pulses to improve efficiency.

2) Dropout operation

ELM600LA allows the main switch to remain on for more than one switching cycle and increases the duty cycle while the input voltage is dropping under the output voltage. When duty cycle reaches 100%, the main switch transistor would be on continuously to supply current to output until current limit generates. Output voltage then is input voltage minus voltage drop across main switch and inductor.

3) Short circuit protection

ELM600LA consists of short circuit protection; when output is short 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 normal values once the short circuit condition is recovered and the feedback voltage goes back to 0.6V.

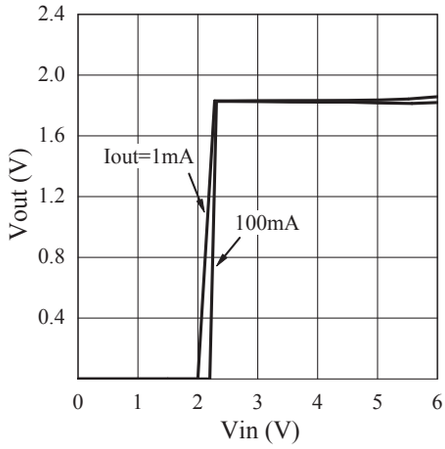
4) Maximum load current

ELM600LA can operate when input voltage is down to 2.5V; however, the maximum load current would descend because of the increase IR drop which results from the ON resistor of main switch and synchronous rectifier along with the drop of input voltage. The slope compensation signal would reduce the peak inductor current to avoid sub-harmonic oscillations when duty cycles is larger than 50%; on the contrary, it would increase the peak inductor current when duty cycle is decreased, as which is shown in the graph.

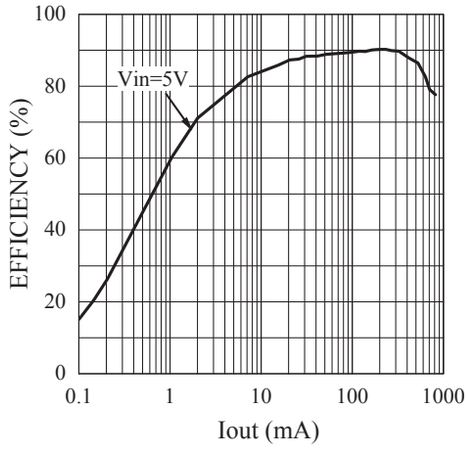
■Typical characteristics

- ELM600LA(Adj.version) : Unless otherwise noted
  Vout=1.8V, Cin=10µF, Cout=22µF, L=2.2µH, R1=22kΩ, R2=11kΩ, Top=25°C

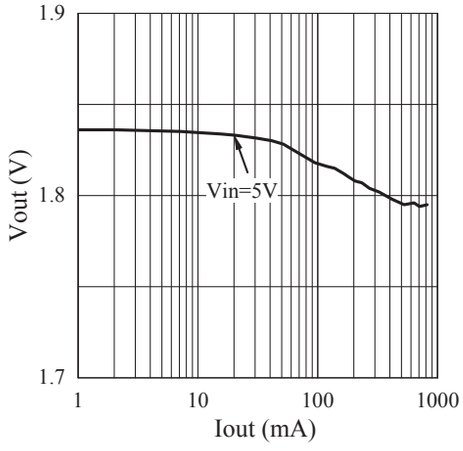
Vout-Vin



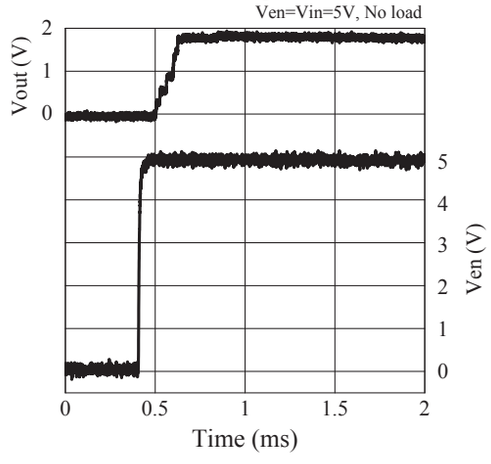
EFFICIENCY-Iout



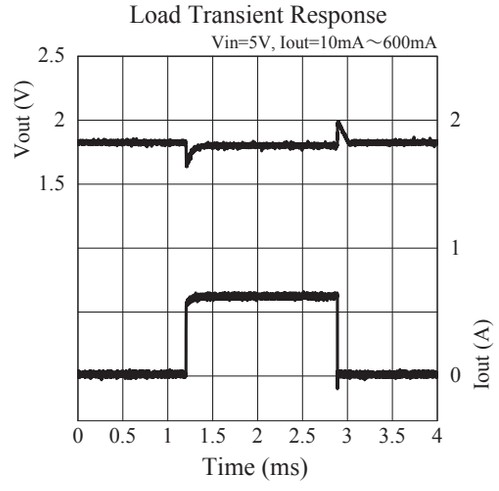
Vout-Iout



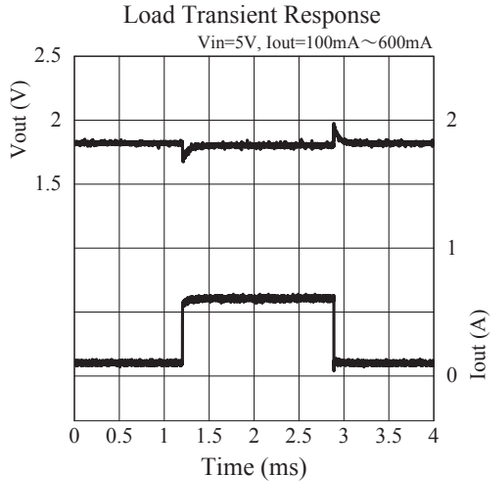
Start Response



Load Transient Response

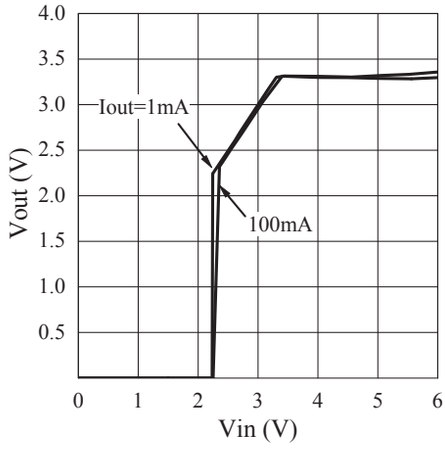


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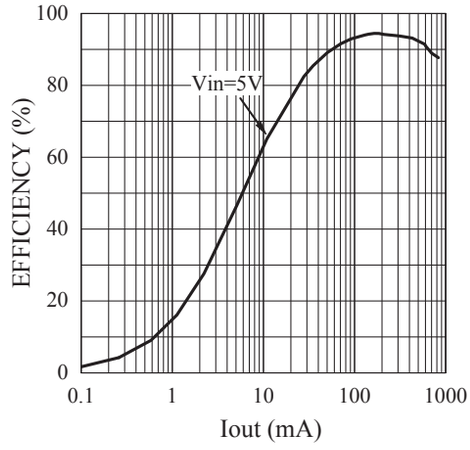


• ELM600LA(Adj.version) : Unless otherwise noted
Vout=3.3V, Cin=10µF, Cout=22µF, L=2.2µH, R1=47kΩ, R2=10.4kΩ, Top=25°C

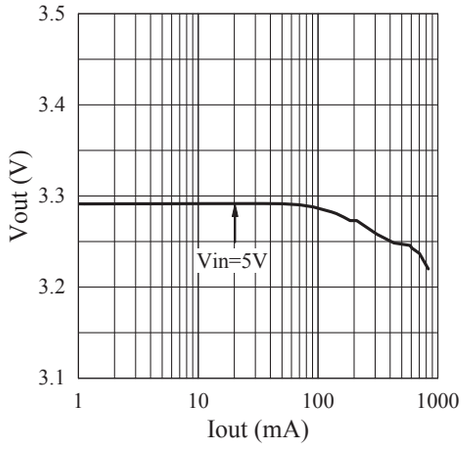
Vout-Vin



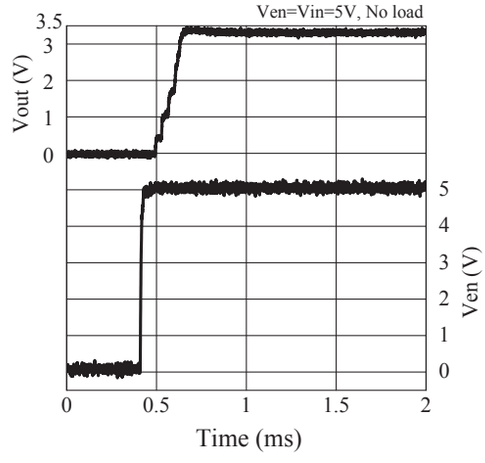
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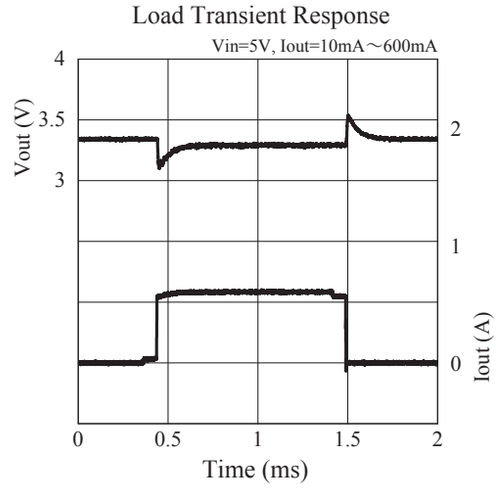
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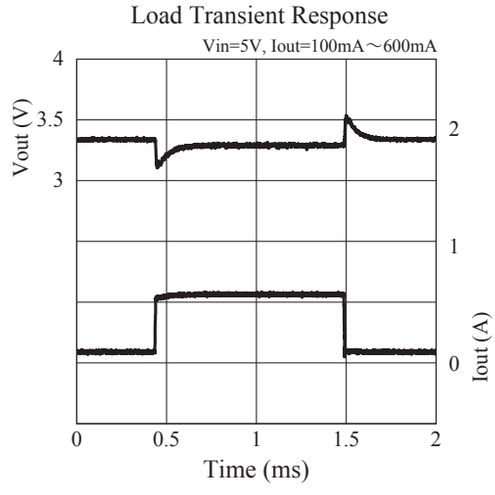
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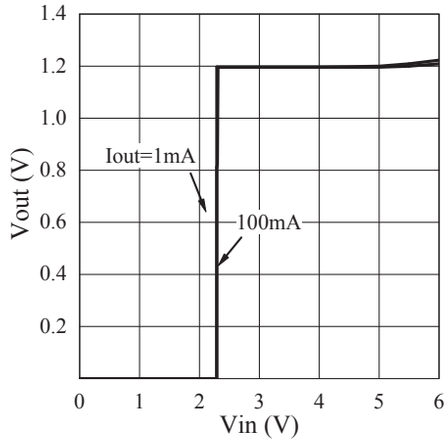


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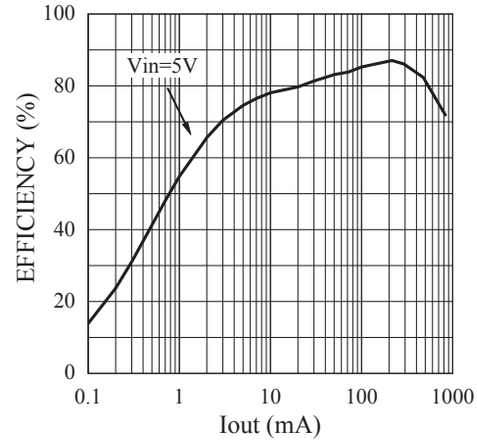


- ELM600LA-12(Fixed version) : Unless otherwise noted
  Vout=1.2V, Cin=10µF, Cout=22µF, L=2.2µH, Top=25°C

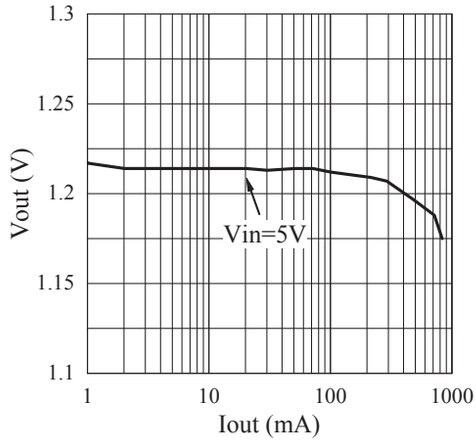
Vout-Vin



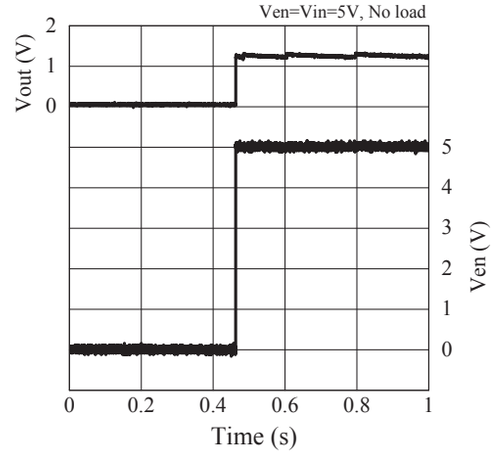
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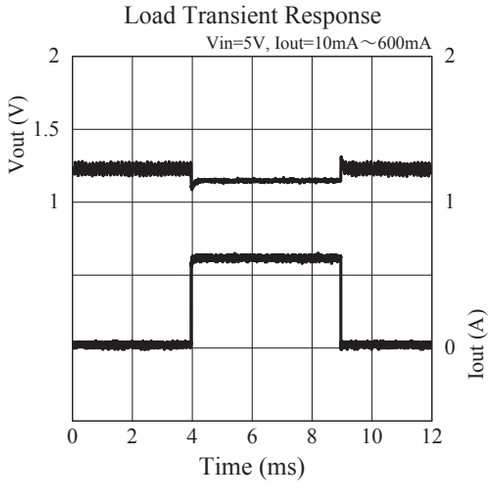
Vout-Iout



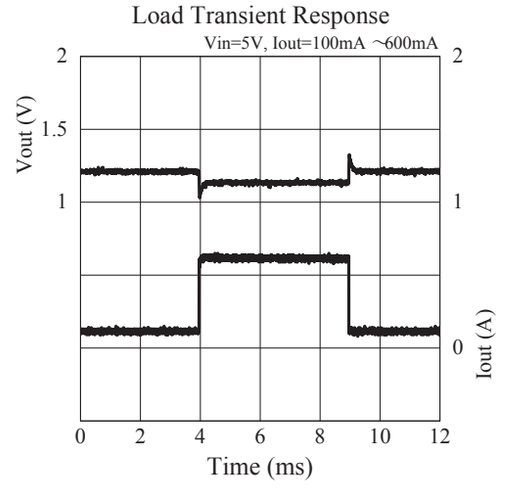
Start Response



Load Transient Response

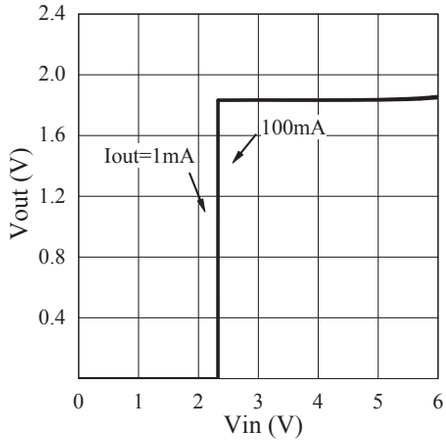


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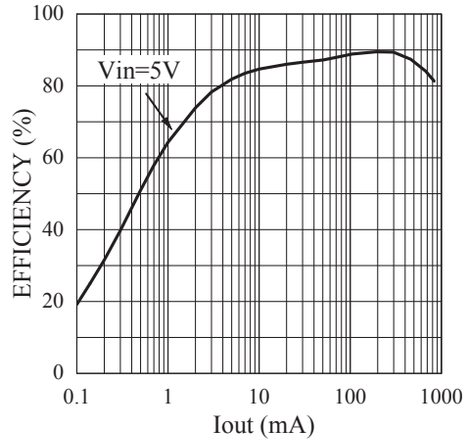


- ELM600LA-18(Fixed version) : Unless otherwise noted
  Vout=1.8V, Cin=10µF, Cout=22µF, L=2.2µH, Top=25°C

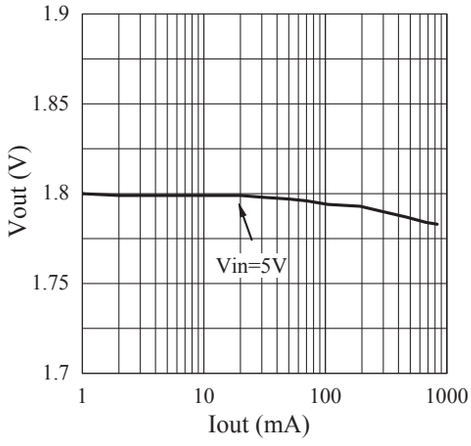
Vout-Vin



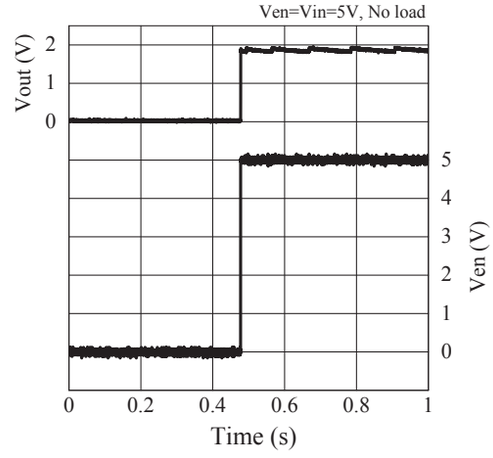
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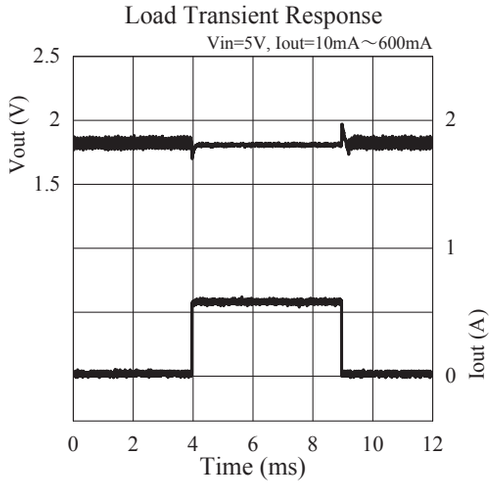
Vout-Iout



Start Response



Load Transient Response



Load Transient Response

