Shenzhen LIZE Electronic Technology Co., Ltd

SPECIFICATION

L4003

Current Mode PWM Controller

VERSION 1.0

GENERAL DESCRIPTION

L4003 consists of step-down switching regulator with PWM control. These devise include a reference voltage source, oscillation circuit, error amplifier, internal PMOS and etc.

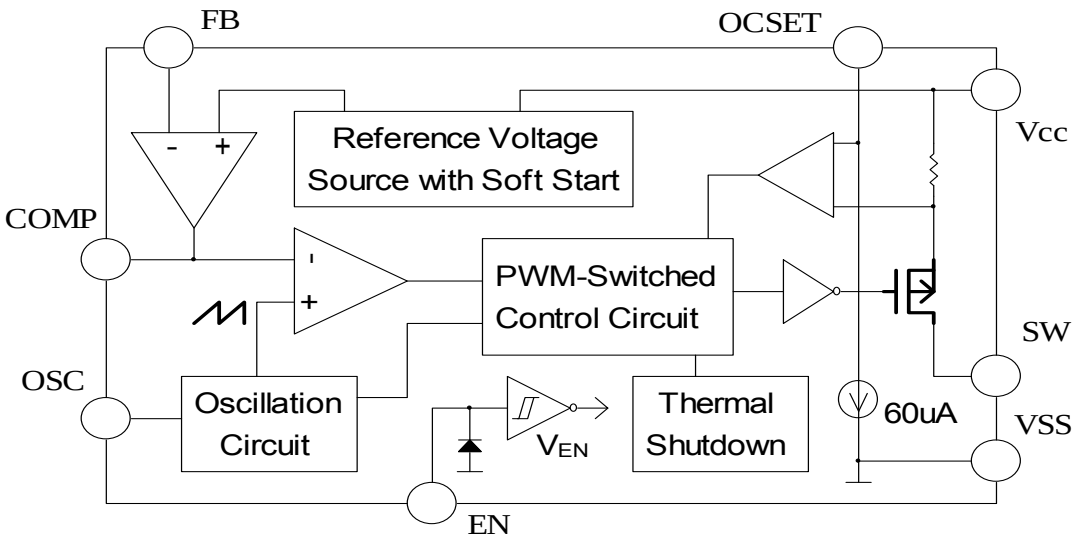
L4003 provides low-ripple power, high efficiency, and excellent transient characteristics. The PWM control circuit is able to the duty ratio linearly form 0 up to 100%. This converter is build out soft start function that prevents overshoot and inrush current at startup. An over current protect function and short circuit protect function are built inside, and when OCP or SCP happens, the operation frequency will be reduced. The operating frequency is decided by outside resistance. An external compensation is easily to system stable.

With the addition of an internal P-channel Power MOS, a coil, capacitors, and a diode connected externally, these ICs can function as step-down switching regulators. They serve as ideal power supply units for portable devices when coupled with the SOP8-EP with exposed pad package, providing such outstanding features as low current consumption. Since this converter can accommodate an input voltage up to 40V, it is also suitable for the operation via an AC adapter.

FEATURES

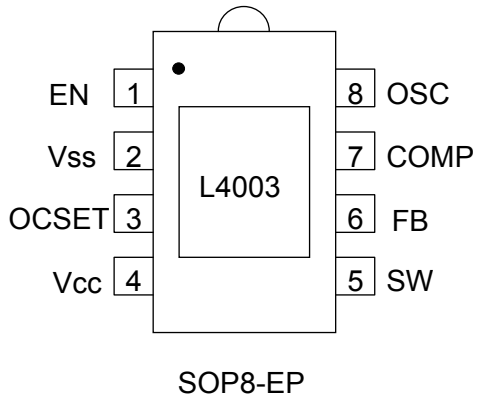
- Input voltage：4.2V to 40V
- Output voltage：0.8V to 38V
- Duty ratio：0% to 100% PWM control
- Oscillation frequency range is 50K — 500KHz by outside resistance setting
- Current Limit, Short Circuit Protect (SCP) and Thermal Shutdown protection
- Built-in internal SW P-channel MOS.
- SOP8-EP Pb-Free package.

Block Diagram



PIN ASSIGNMENT

The package of L4003 is SOP8-EP; the pin assignment is given by:



SOP8-EP

Name	Description
EN	ON/OFF Shutdown OPEN ON / L OFF
VSS	GND pin
OCSET	Add an external resistor to set max output current.
VCC	IC power supply pin
SW	Switch pin. Connect external inductor & diode here.
FB	Feedback pin
COMP	Compensation pin
OSC	Frequency Set Pin. The pin connect a resistance to GND.

ORDER/MARKING INFORMATION

Order Information	Top Marking
L4003 X Packing Blank: Tube	L4003 → Part number XX XX → ID code: internal WW: 01 -- 52 Year: 13= 2013

Absolute Maximum Ratings (at Ta=25℃)

Characteristics	Symbol	Rating	Unit
VCC Pin Voltage	V_{CC}	V_{SS} - 0.3 to V_{SS} + 42	V

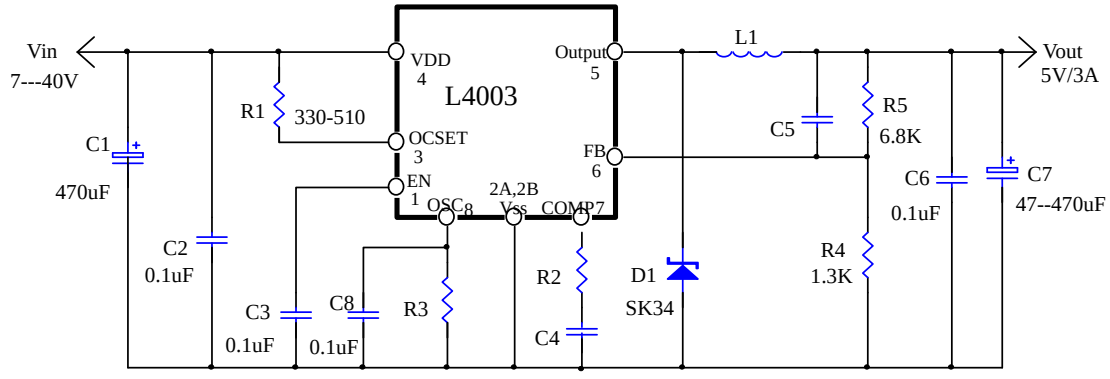
Feedback Pin Voltage	V_{FB}	V_{SS} - 0.3 to 6	V
EN Pin Voltage	$V_{EN/SS}$	V_{SS} - 0.3 to 6	V
OSC Pin Voltage	V_{OSC}	V_{SS} - 0.3 to 3	V
COMP Pin Voltage	V_{COMP}	V_{SS} - 0.3 to 6	V
OCSET Pin Voltage	V_{OCSET}	V_{SS} - 0.3 to V_{CC}	V
Switch Pin Voltage	V_{SW}	V_{SS} - 0.3 to V_{CC} + 0.3	V
Power Dissipation	PD	Internally limited	mW
Storage Temperature Range	T_{ST}	-65 to +150	℃
Operating Junction Temperature Range	T_{OJP}	-40 to +125	℃
Operating Supply Voltage	V_{OP}	4.2 to 40	V
Thermal Resistance from Junction to case	θ_{JC}	15	℃/W
Thermal Resistance from Junction to ambient	θ_{JA}	40	℃/W

Note: θ_{JA} is measured with the PCB copper area(need connect to Exposed Pad) of approximately 1.5 in^2(Multi-layer).

Electrical Characteristics (V_{CC} = 12V, Ta=25℃, unless otherwise specified)

Characteristics	Symbol	Conditions	Min	Typ	Max	Units
Feedback Voltage	V_{FB}	V_{CC} = 10V~30V I_{OUT} = 0 to 2A Tj=-20℃~125℃	0.784	0.800	0.816	V
Quiescent Current	I_{CCQ}	V_{FB}=1.2V force driver off	-	3	6	mA
Feedback Bias Curren	I_{FB}	I_{OUT}=0.1A	-	0.1	0.5	uA
Shutdown Supply Current	I_{SD}	$V_{EN/SS}$ =0V	-	150	300	uA
Switch Current	I_{SW}		3.5	-	-	A
Adjustable frequency range	F_{OSC}		50	-	500	KHz
Short frequency	F_{OSC} /F_{OSCS}	V_{CC} = 10V~30V		6		
EN Pin Shutdown Logic input threshold voltage	V_{ENL}		-	-	0.8	V
Internal MOSFET R_{DSON}	R_{DSON}	V_{CC}=12V, V_{FB}=0V	-	100	150	mΩ
Efficiency	EFFI	V_{CC} = 12V, V_{OUT} = 5V, I_{OUT} =2A	-	91	-	%
		V_{CC} = 30V, V_{OUT} = 5V, I_{OUT} =2A		86		

Application Circuit 1



Compensation Table

Frequency	L1	R2	C4	C5
50K—120K	68--160uH	330	8.2n	6.8n
120K—180K	47—68uH	330	4.7n	1.8n
180K—250K	33—47uH	330	1.8n	1n
250K—330K	22—33uH	330	1n	510p
330K—410K	15—22uH	100	510p	510p
410K—500K	10—15uH	100	330p	330p

Function Descriptions

EN

This pin can be supplied shutdown function. It is inside pull high function. For normal application, the pin must be connected a capacitor to ground. Allow the switching regulator circuit to be shutdown pulling this pin below a 0.8V threshold voltage; the shutdown supply current is approximately 150uA.

OSC

External frequency set pin. The pin connects a resistance (R3) to reduce system frequency. This converter's frequency can be set from 50K to 500KHz, Please refer the below table to set frequency.

R3	510K	220K	91K	47K	27K	20K
Frequenc	50KHz	100KHz	200KHz	300KHz	400KHz	500KHz

COMP

Compensation pin. For EL output capacitor application, the COMP pin connects R2 and C4 to ground for all condition;

OCSET

The current limit threshold is setting by the external resistor connecting from V_{CC} supply to

OCSET. The internal 60uA sink current crossing the resistor sets the voltage at pin of OCSET. When the Vs voltage is less than the voltage at OCSET, an over-current condition is triggered.

Application Information

Setting the Output Voltage

Application circuit item shows the basic application circuit with adjustable output version.The external resistor sets the output voltage according to the following equation:

Table 1 Resistor select for output voltage setting

V_{OUT}	R4	R5
5V	1.3K	6.8K
3.3V	1.5K	4.7K
2.5V	2.2K	4.7K
1.8V	2K	2.5K
1.5V	2.2K	2.0K
1.2V	2K	1K

Inductor Selection

For most designs, the different frequency can be reducing the inductor value; The L4003 is suggested 15μH to 160μH for 50K to 500KHz frequencies. Please refer the below table to design.

L1 recommend value (V_{IN}=8~40V ,V_{OUT}=5V, I_{OUT}=3A)				
Frequency (Hz)	300KHz~500KHz	200K~300KHz	100K~200K	50K~100K
L1 Value (uH)	10uH ~ 22uH	22uH ~47uH	33uH ~68uH	68uH ~160uH

Where is inductor Ripple Current. Large value inductors lower ripple current and small value inductors result in high ripple currents. Choose inductor ripple current approximately 20% of the maximum load current 3A, ΔI_L=0.6A. The DC current rating of the inductor should be at least equal to the maximum load current plus half the ripple current to prevent core saturation (3A+0.3A).

Input Capacitor Selection

This capacitor should be located close to the IC using short leads and the voltage rating should be approximately 1.5 times the maximum input voltage. The RMS current rating requirement for the input capacitor of a buck regulator is approximately 1⁄2 the DC load current. A low ESR input capacitor sized

for maximum RMS current must be used. A 470μF low ESR capacitor for most applications is sufficient.

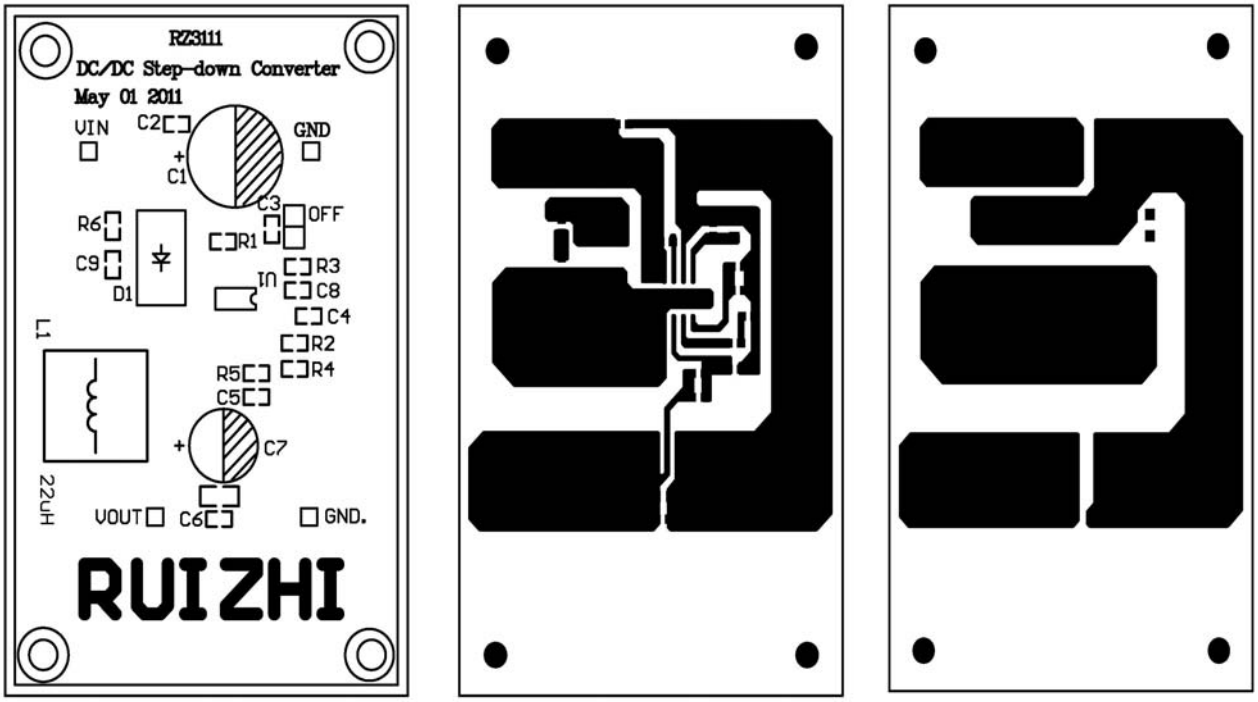
Output Capacitor Selection

The output capacitor is required to filter the output and provide regulator loop stability. The important capacitor parameters are; the 100 KHz Equivalent Series Resistance (ESR), the RMS ripples current rating, voltage rating, and capacitance value. For the output capacitor, the ESR value is the most important parameter. The ESR can be calculated from the following formula.

$$V_{RIPPLE} = \Delta I_L \times ESR = 0.6A \times 80m\Omega = 48mV$$

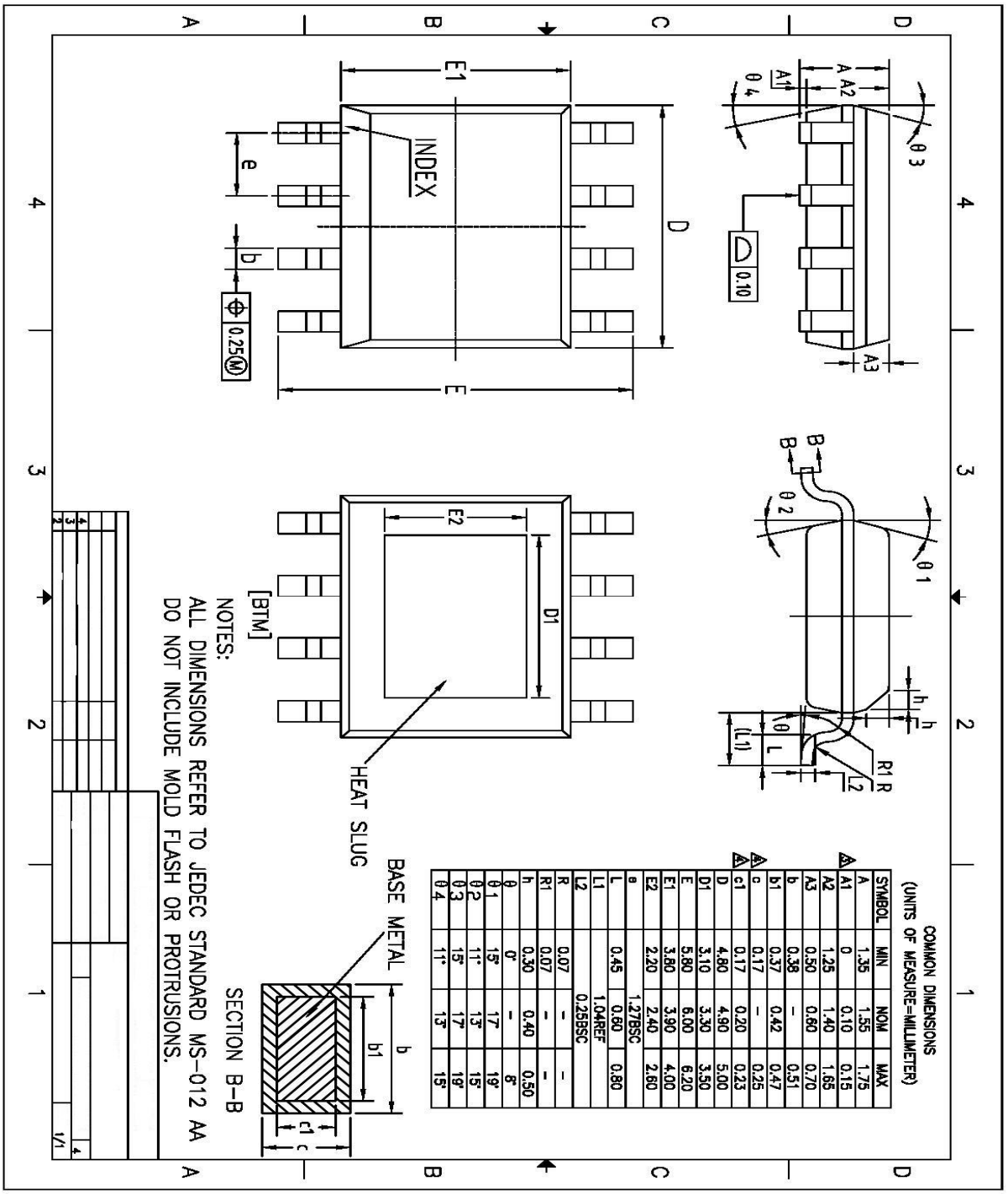
An aluminum electrolytic capacitor's ESR value is related to the capacitance and its voltage rating. In most case, higher voltage electrolytic capacitors have lower ESR values. Most of the time, capacitors with much higher voltage ratings may be needed to provide the low ESR values required for low output ripple voltage. It is recommended to replace this low ESR capacitor by using a 470μF low ESR values < 80mΩ.

Demoboard PCB layout



Package Outlines

SOP8-EP



SYMBOL	MIN	NOM	MAX
A	1.35	1.55	1.75
A1	0	0.10	0.15
A2	1.25	1.40	1.65
A3	0.50	0.60	0.70
b	0.38	–	0.51
b1	0.37	0.42	0.47
c	0.17	–	0.25
c1	0.17	0.20	0.23
D	4.80	4.90	5.00
D1	3.10	3.30	3.50
E	5.80	6.00	6.20
E1	3.80	3.90	4.00
E2	2.20	2.40	2.60
e	1.27BSC		
L	0.45	0.60	0.80
L1	1.04REF		
L2	0.25BSC		
R	0.07	–	–
R1	0.07	–	–
h	0.30	0.40	0.50
θ	0°	–	8°
θ1	15°	17°	19°
θ2	11°	13°	15°
θ3	15°	17°	19°
θ4	11°	13°	15°