1.2MHz, High Voltage, Boost Converter

❖ GENERAL DESCRIPTION

The MA2003 is a current mode step up converter intended for small, low power applications. The converter input voltage ranging from 2.6V to 5.5V. The Output voltage can be set up to 28V. The frequency is 1.2MHz allows the use of small external inductors and capacitors and provides fast transient response. Internal soft start results in small inrush current and extends battery life. Internal power MOSFET with very low RDS (ON) provides high efficiency. The MA2003 automatically transits from PWM to PFM during light load condition further increasing efficiency. The converter also provides protection functions such as under-voltage lockout, current limit and thermal shutdown. The MA2003 is available in 5-pin SOT23 packages.

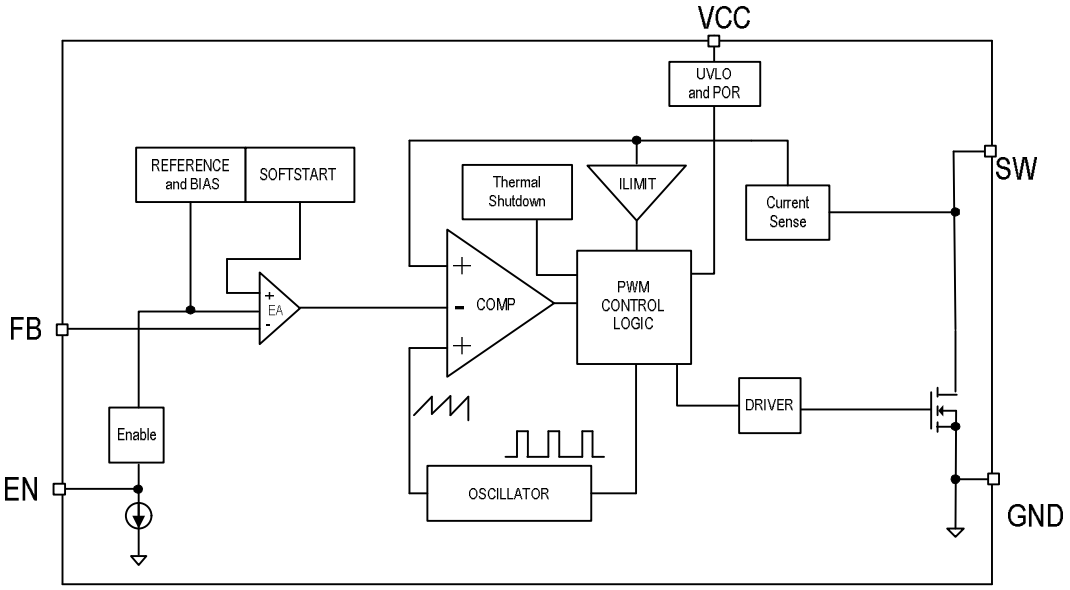
❖ FEATURES

- 2.5V to 5.5V operating input voltage range
- 1.2MHz Fixed Switching Frequency
- Adjustable output voltage range up to 28V
- Internal 1.2A switching current limit
- Internal Soft-start Function
- Current limit and Thermal shutdown protection
- Under voltage Lockout
- Available in the 5-pin SOT23 Packages

❖ APPLICATIONS

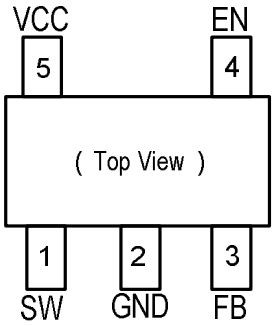
- Cellular Phones
- Digital Cameras
- Tablet PC and Handheld Computers
- PDA, DVD and GPS Receivers
- Portable Instruments

❖ BLOCK DIAGRAM



❖ PIN ASSIGNMENT

The package of MA2003 is SOT23-5L ; the pin assignment is given by:



Name	Description
VCC	VCC Input Pin
GND	Ground Pin.
FB	Feedback Pin.
EN	Chip Enable & Dimming pin. Active high. Internal pull low.
SW	Switching Pin

❖ ORDER/MARKING INFORMATION

Order Information	Top Marking
MA2003 X X Package Type B: SOT23-5L Packing Blank : Bag A : Taping	A 5 Y W X → ID Code: Internal Week: 01~26(A~Z) 27~52(a~z) Year : 4 = 2014

❖ ABSOLUTE MAXIMUM RATINGS (at T_A=25°C)

Characteristics	Symbol	Rating	Unit
VCC pin voltage	V_{IN}	-0.3 to 6.5	V
SW pin voltage	V_{SW}	-0.3 to 30	V
EN, FB pins voltage		-0.3 to V_{IN}+0.3	V
Continuous Power Dissipation	PD	(T_J-T_A) / θ_{JA}	mW
Operating Junction Temperature	Top	-40 to 125	°C
Storage Temperature Range		-65 to 150	°C
Thermal Resistance from Junction to case	θ_{JC}	110	°C/W
Thermal Resistance from Junction to ambient	θ_{JA}	250	°C/W

Note: θ_{JA} is measured with the PCB copper are (need connect to GND of the MA2003) of approximately 1 in^2 (Multi-layer).

❖ ELECTRICAL CHARACTERISTICS

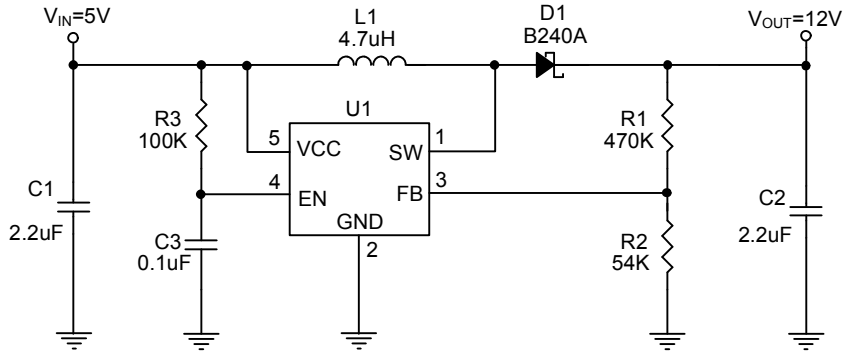
(V_{IN} = 5V, V_{EN} = 5V, I_{OUT} = 20mA, T_A = 25°C)

Characteristics	Symbol	Conditions	Min	Typ	Max	Units
Input Voltage Range	V_{IN}		2.5	-	5.5	V
Input UVLO	UVLO	Rising	-	2.25	2.45	V
UVLO Hysteresis			-	0.2	-	V
Step-Up Voltage Adjust Range	V_{OUT}		3	-	28	V
Quiescent Current	I_{CCQ}	I_{OUT}= 0mA, V_{FB} =1.5V	-	150	250	μA
Shutdown Current	I_{SD}	V_{EN} = 0V	-	1	4	μA
FB Pin Voltage	V_{FB}		1.213	1.238	1.263	V
FB Pin Current	I_{FB}	V_{FB} = 1.3V	-	-	±100	nA
Line Regulation		V_{IN} = 2.5 to 5.5V I_{OUT} = 20mA	-	0.2	-	%
Load Regulation		V_{IN} = 5V I_{OUT} = 1mA to 400mA	-	0.2	-	%
Switching frequency	F_{OSC}		900	1200	1500	KHz
Maximum Duty	D_{MAX}		87	90	-	%
N-channel MOSFET current limit	I_{LIM}	Duty=50%	-	1.6	-	A
MOSFET on-resistance **(Note 1)**	$R_{DS(on)}$	V_{CC}=3V, I_{SW}=1A	-	600	-	mΩ
		V_{CC}=5V, I_{SW}=1A	-	500	-	

SW Leakage Current	I_{SWL}	V_{SW} = 28V, V_{FB} =1.5V	-	-	1	μA
EN high-level input voltage	V_{IH}		1.4	-	-	V
EN low-level input voltage	V_{IL}		-	-	0.4	V
EN Hysteresis	hys		-	200	-	mV
Thermal Shutdown	T_{DS}		-	150	-	°C
Thermal Shutdown Hysteresis	T_{SH}		-	35	-	°C

❖ APPLICATION CIRCUIT

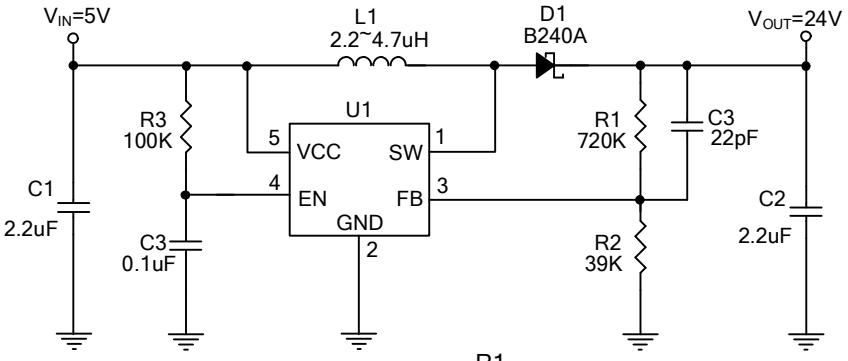
1. VOUT < 18V



$$V_{OUT} = 1.238V \times (1 + \frac{R1}{R2})$$

R1 Suggest 300K~850K

2. VOUT >= 18V



$$V_{OUT} = 1.238V \times (1 + \frac{R1}{R2})$$

R1 Suggest 300K~850K

❖ FUNCTION DESCRIPTION

Setting the Output Voltage

Application circuit item shows the basic application circuit with MA2003 adjustable output version. The external resistor sets the output voltage according to the following equation:

$$V_{OUT} = 1.238V \times (1+\frac{R2}{R1})$$

Table 1—Resistor Selection for Common Output Voltages

V_{OUT} (V)	R1 (kΩ)	R2 (kΩ)
12	54	470
16	39	470
24	39	720
27	36	750

For most applications, R2 is a suggested a value by 300K~850KΩ. Place the resistor-divider as close to the IC as possible to reduce the noise sensitivity.

Under Voltage Lockout (UVLO)

To avoid mis-operation of the device at low input voltages an under voltage lockout is included that disables the device, if the input voltage falls below (2.25V-200mV).

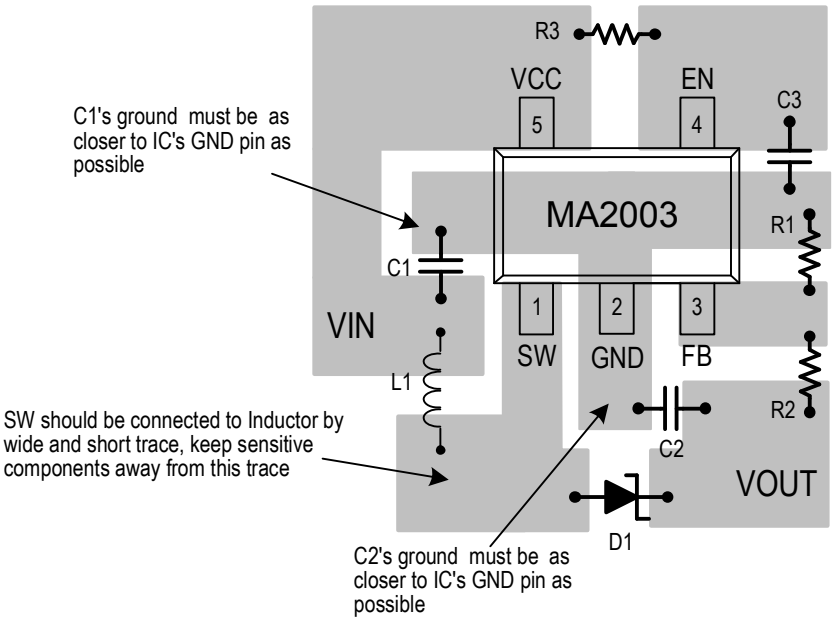
Input Capacitor Selection

The input capacitor reduces the surge current drawn from the input and switching noise from the device. The input capacitor impedance at the switching frequency shall be less than input source impedance to prevent high frequency switching current passing to the input. A low ESR input capacitor sized for maximum RMS current must be used. Ceramic capacitors with X5R or X7R dielectrics are highly recommended because of their low ESR and small temperature coefficients. A 4.7μF ceramic capacitor for most applications is sufficient. For a lower output power requirement application, this value can be decreased.

Output Capacitor Selection

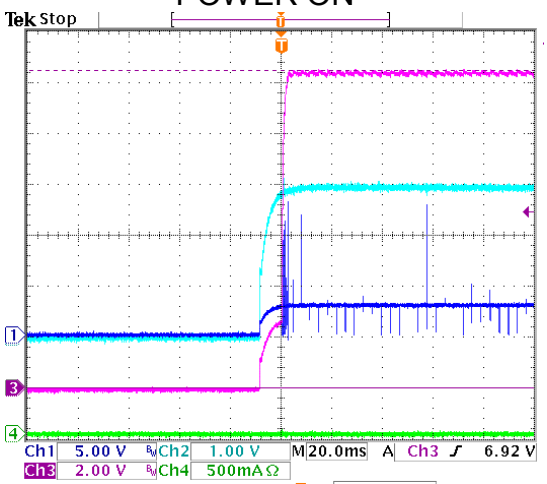
The output capacitor is required to keep the output voltage ripple small and to ensure regulation loop stability. The output capacitor must have low impedance at the switching frequency. Ceramic capacitors with X5R or X7R dielectrics are recommended due to their low ESR and high ripple current. A 2.2uF ceramic capacitors works for most of the applications. Higher capacitor values can be used to improve the load transient response.

Layout Guide



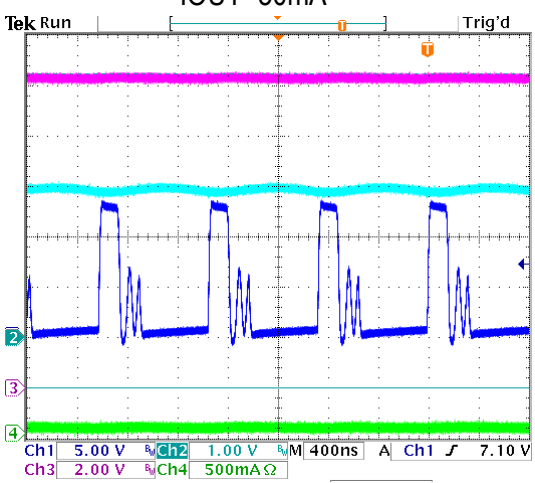
❖ TYPICAL CHARACTERISTICS

POWER ON



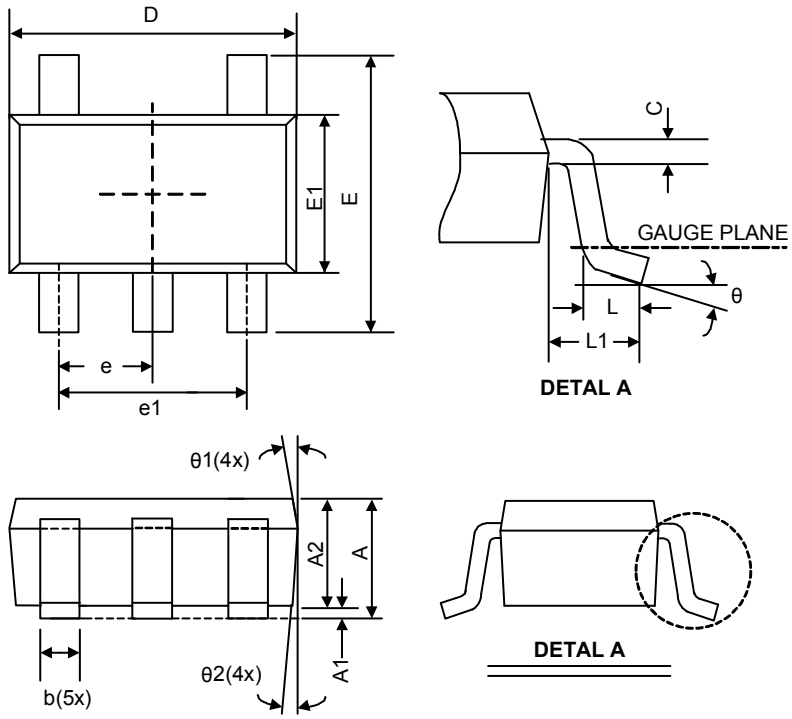
Ch1=SW , Ch2=V_{IN} ,Ch3=V_{OUT} , Ch4=I_{OUT}

IOUT=50mA



Ch1=SW , Ch2=V_{IN} ,Ch3=V_{OUT} , Ch4=I_{OUT}

❖ Package Outlines



Symbol	Dimensions in Millimeters			Dimensions in Inches		
	Min.	Nom.	Max.	Min.	Nom.	Max.
A	1.05	-	1.35	0.041	-	0.053
A1	0.05	-	0.15	0.002	-	0.006
A2	1.00	1.10	1.20	0.039	0.043	0.047
b	0.30	-	0.50	0.012	-	0.020
C	0.08	-	0.22	0.003	-	0.009
D	2.80	2.90	3.00	0.110	0.114	0.118
E1	1.50	1.60	1.70	0.059	0.063	0.067
E	2.60	2.80	3.00	0.102	0.110	0.118
L	0.30	-	0.60	0.012	-	0.024
L1	0.50	0.60	0.70	0.020	0.024	0.028
e1	1.80	1.90	2.00	0.071	0.075	0.079
e	0.85	0.95	1.05	0.033	0.037	0.041
θ	0°	4°	8°	0°	4°	8°
θ1	5°	10°	15°	5°	10°	15°
θ2	5°	10°	15°	5°	10°	15°