2A, 24V, Synchronous Step-Down Converter

General Description

The RP6003 is a high-efficiency, monolithic synchronous step-down DC/DC converter that can deliver up to 2A output current from a 4.5V to 24V input supply. The RP6003's current mode architecture and external compensation allow the transient response to be optimized over a wide range of loads and output capacitors.

The IC Provides cycle-by-cycle current limit protection against shorted outputs and soft-start eliminates input current surge during start-up. Fault conditions also include output under voltage protection and thermal shutdown. The low current (<3μA) shutdown mode provides output disconnect, enabling easy power management in battery-powered systems. The RP6003 is available in HDIP-12 and SOP-8(Exposed Pad) packages.

Features

- **Wide Operating Input Range : 4.5V to 24V**
- **Output Current up to 2A**
- **Integrated N-MOSFET Switches**
- **Current Mode Control**
- **Fixed Frequency Operation : 340kHz/1.2MHz**
- **Adjustable Output Voltage Range : 0.8V to 20V**
- **High Efficiency up to 95%**
- **Stable with Low ESR Output Ceramic Capacitors**
- **Programmable Soft-Start**
- **Cycle-By-Cycle Over Current Protection**
- **Input Under Voltage Lockout**
- **Output Under Voltage Protection**
- **Thermal Shutdown Protection**
- **RoHS Compliant and Halogen Free**

Ordering Information

RP6003□□□□

- □ Package Type
  - N : HDIP-12
  - SP : SOP-8 (Exposed Pad-Option 1)
- □ Operating Temperature Range
  - G : Green (Halogen Free with Commercial Standard)
- □
  - H : UVP Hiccup
  - L : UVP Latch-Off
- □ Frequency Operation
  - A : 340kHz
  - B : 1.2MHz

Note :

Richpower Green products are :

- RoHS compliant and compatible with the current requirements of IPC/JEDEC J-STD-020.
- Suitable for use in SnPb or Pb-free soldering processes.

Applications

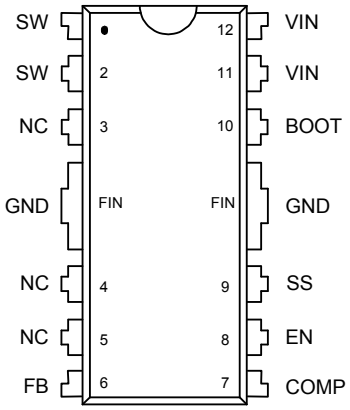
- Industrial and Commercial Low Power Systems
- Computer Peripherals
- LCD Monitors and TVs
- Green Electronics/ Appliances
- Point of Load Regulation of High-Performance DSPs
- FPGAs and ASICs

Marking Information

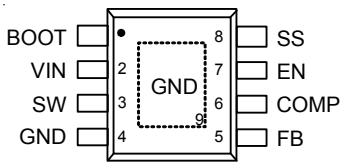
For marking information, contact our sales representative directly or through a Richpower distributor located in your area, otherwise visit our website for detail.

Pin Configurations

(TOP VIEW)

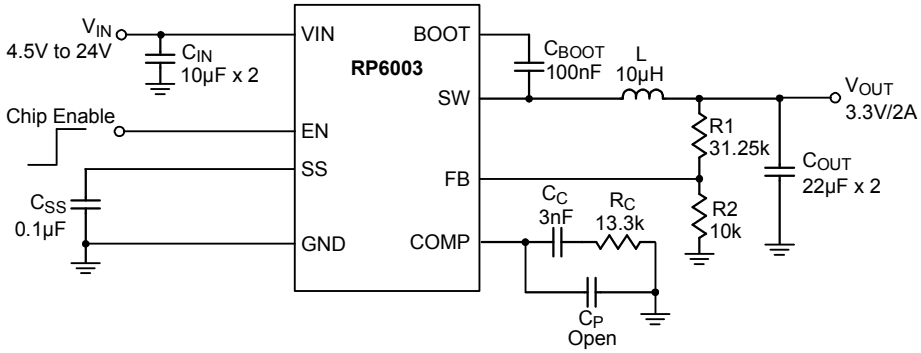


HDIP-12

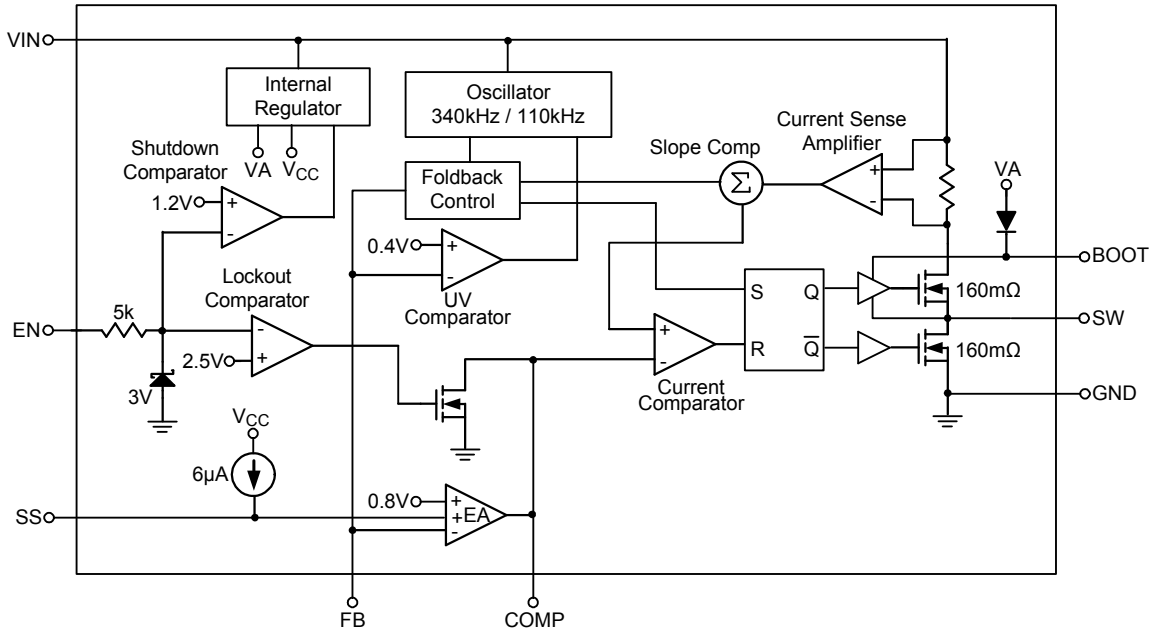


SOP-8 (Exposed Pad)

Typical Application Circuit



Function Block Diagram



Functional Pin Description

Pin No.		Pin Name	Pin Function
HDIP-12	SOP-8 (Exposed Pad)		
1, 2	3	SW	Phase Node. Connect to external L-C filter.
3, 4, 5	--	NC	No Internal Connection.
6	5	FB	Feedback Input Pin. This pin is connected to the converter output. It is used to set the output of the converter to regulate to the desired value via an internal resistive divider. For an adjustable output, an external resistive divider is connected to this pin.
7	6	COMP	Compensation Node. COMP is used to compensate the regulation control loop. Connect a series RC network from COMP to GND to compensate the regulation control loop. In some cases, an additional capacitor from COMP to GND is required.
8	7	EN	Enable Input. Is a logic high enables the converter; a logic low forces the IC into shutdown mode reducing the supply current to less than 3μA. Attach this pin to IN with a 100kΩ pull up resistor for automatic startup.
9	8	SS	Soft-Start Control Input. SS controls the soft start period. Connect a capacitor from SS to GND to set the soft-start period. A 0.1μF capacitor sets the soft-start period to 13.5ms. To disable the soft-start feature, leave SS unconnected.
10	1	BOOT	High-Side Gate Drive Boost Input. Connect a 0.1μF or greater capacitor from SW to BOOT to power the high side switch.
11, 12	2	VIN	Power Input. Bypass VIN to GND with a suitable large capacitor to eliminate noise on the input to the IC.
FIN	4, 9(Exposed Pad)	GND	Ground. The exposed pad must be soldered to a large PCB and connected to GND for maximum power dissipation.

Absolute Maximum Ratings (Note 1)

- Supply Voltage, V_{IN} ---------- –0.3V to 26V
- Switching Voltage, SW ---------- –0.3V to V_{IN} + 0.3V
- BOOT Voltage ---------- (V_{SW} – 0.3V) to (V_{SW} + 6V)
- All Other Voltage ---------- –0.3V to 6V
- Power Dissipation, P_D @ T_A = 25°C T_J = 125°C
  - HDIP-12 ---------- 2.701W
  - SOP-8 (Exposed Pad) ---------- 1.333W
- Package Thermal Resistance (Note 4)
  - HDIP-12, θ_{JA} ---------- 37°C/W
  - HDIP-12, θ_{JC} ---------- 13°C/W
  - SOP-8 (Exposed Pad), θ_{JA} ---------- 75°C/W
  - SOP-8 (Exposed Pad), θ_{JC} ---------- 15°C/W
- Junction Temperature ---------- 150°C
- Lead Temperature (Soldering, 10 sec.) ---------- 260°C
- Storage Temperature Range ---------- –40°C to 150°C
- ESD Susceptibility (Note 2)
  - HBM (Human Body Mode) ---------- 2kV
  - MM (Machine Mode) ---------- 200V

Recommended Operating Conditions (Note 3)

- Supply Voltage, V_{IN} ---------- 4.5V to 24V
- Junction Temperature Range ---------- –40°C to 125°C
- Ambient Temperature Range ---------- –40°C to 85°C

Electrical Characteristics

(V_{IN} = 12V, T_A = 25°C unless otherwise specified)

Parameter		Symbol	Test Conditions	Min	Typ	Max	Units
Shutdown Supply Current			V_{EN} = 0V	--	0.3	3	μA
Supply Current			V_{EN} = 3V, V_{FB} = 1V	--	0.7	1.2	mA
Feedback Reference Voltage		V_{FB}	4.5V ≤ V_{IN} ≤ 24V	0.784	0.800	0.816	V
Error Amplifier Tansconductance		G_m	ΔI_C = ±10μA	--	840	--	μA/V
High-Side Switch-On Resistance		$R_{DS(ON)1}$		--	160	--	mΩ
Low-Side Switch-On Resistance		$R_{DS(ON)2}$		--	160	--	mΩ
High-Side Switch Leakage Current			V_{EN} = 0V, V_{SW} = 0V	--	0	10	μA
Upper Switch Current Limit			Minimum Duty Cycle	--	3	--	A
Lower Switch Current Limit			From Drain to Source	--	1	--	A
Current Sense Transconductance		G_{CS}	Output Current to V_{COMP}	--	4.1	--	A/V
Oscillator Frequency	RP6003A	f_{OSC1}		300	340	380	kHz
	RP6003B			1000	1200	1400	kHz

To be continued

Parameter		Symbol	Test Conditions	Min	Typ	Max	Units
Short Circuit Oscillation Frequency	RP6003A	f_{OSC2}	V_{FB} = 0V	--	110	--	kHz
	RP6003B			--	280	--	kHz
Maximum Duty Cycle		D_{MAX}	V_{FB} = 0.8V	--	93	--	%
Minimum On-Time		t_{ON}		--	100	--	ns
EN Input Voltage	Logic Low	V_{EN_L}		--	--	0.4	V
	Logic High	V_{EN_H}		1.4	--	--	V
EN Lockout Threshold Voltage			V_{FB} = 1V	2.2	2.5	2.7	V
EN Lockout Hysteresis				--	200	--	mV
Soft-Start Current			V_{SS} = 0V	--	6	--	μA
Soft-Start Period			C_{SS} = 0.1μF	--	13.5	--	ms
Thermal Shutdown		T_{SD}		--	150	--	°C

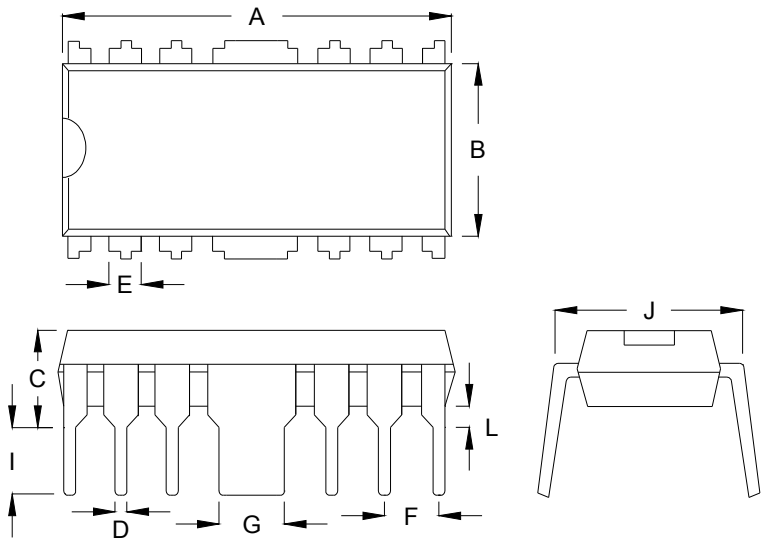
Note 1. Stresses listed as the above "Absolute Maximum Ratings" may cause permanent damage to the device. These are for stress ratings. Functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may remain possibility to affect device reliability.

Note 2. Devices are ESD sensitive. Handling precaution is recommended.

Note 3. The device is not guaranteed to function outside its operating conditions.

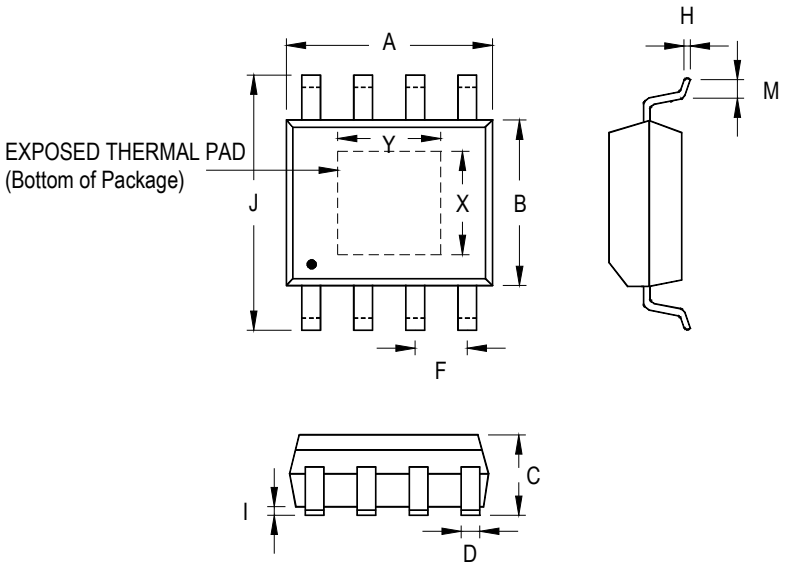
Note 4. θ_{JA} is measured in the natural convection at T_A = 25°C on a high effective four layers thermal conductivity test board of JEDEC 51-7 thermal measurement standard. The case point of θ_{JC} is on the exposed pad for SOP-8 (Exposed Pad) package, on the central lead of the HDIP-12 package. The PCB copper area of the HDIP-12 is about 300m^2 connected with the HDIP-12 exposed lead.

Outline Dimension



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	18.800	19.300	0.740	0.760
B	6.200	6.600	0.244	0.260
C	3.700	4.320	0.146	0.170
D	0.360	0.560	0.014	0.022
E	1.143	1.778	0.045	0.070
F	2.54		0.100	
G	2.920	3.100	0.115	0.122
I	3.000	3.600	0.118	0.142
J	7.320	7.920	0.288	0.312
L	0.381	0.710	0.015	0.028

12-Lead HDIP Plastic Package



Symbol		Dimensions In		Dimensions In Inches	
		Min	Max	Min	Max
A		4.801	5.004	0.189	0.197
B		3.810	4.000	0.150	0.157
C		1.346	1.753	0.053	0.069
D		0.330	0.510	0.013	0.020
F		1.194	1.346	0.047	0.053
H		0.170	0.254	0.007	0.010
I		0.000	0.152	0.000	0.006
J		5.791	6.200	0.228	0.244
M		0.406	1.270	0.016	0.050
Option 1	X	2.000	2.300	0.079	0.091
	Y	2.000	2.300	0.079	0.091
Option 2	X	2.100	2.500	0.083	0.098
	Y	3.000	3.500	0.118	0.138

8-Lead SOP (Exposed Pad) Plastic Package

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