

2A, 2MHz, High-Efficiency Synchronous Buck PWM Converter

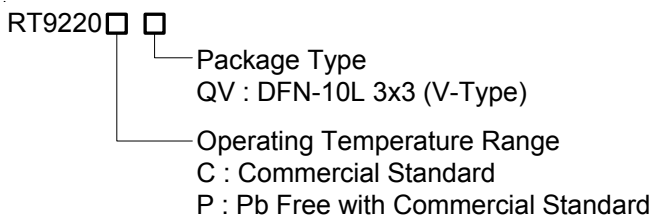
General Description

The RT9220 is a high-efficiency synchronous buck PWM converter with integrated P-Channel and N-Channel power MOSFET switches. Capable of delivering 2A output current over a wide input voltage range of 2.4V to 5.5V, the RT9220 is ideally suited for portable applications powered by a single Li-Ion battery or by 3-cell NiMH/NiCd batteries.

The device operates at 500kHz PWM switching frequency by floating the RT pin, and can be set up to 2MHz by placing a resistor (R_{RT}) from this pin to GND that allows the use of the smallest external components. The RT9220 integrate two low $R_{DS(ON)} \cong 150m\Omega$ of high- and low-side switching MOSFETs reduces board space, as only resistors and capacitors along with one inductor are required externally for operation.

The RT9220 has adjustable output range down to 0.8V. The other features include external soft-start, chip enable, over-temperature and over-current protections. It is available in a space-saving 10-lead 3mmx3mm DFN package with a height of only 1.0mm.

Ordering Information



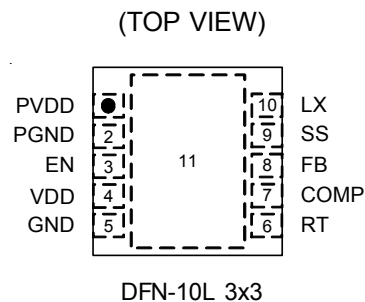
Features

- 2.4V to 5.5V Input Voltage Range
- Adjustable Output from 0.8V to VIN
- Guaranteed 2A Output Current
- Accurate Reference: 0.8V ($\pm 1.5\%$)
- Up to 90% Conversion Efficiency
- Typical Quiescent Current: 250 μ A
- Integrated Low $R_{DS(ON)}$ High- and Low-Side Power MOSFET Switches: 150m Ω
- Current Mode PWM Operation
- Programmable Frequency: 500kHz to 2MHz
- 100% Maximum Duty Cycle for Lowest Dropout
- External Soft-Start
- No Schottky Diode Required
- Over-Temperature and Over-Current Protection
- Small 10-lead 3mmx3mm DFN Package

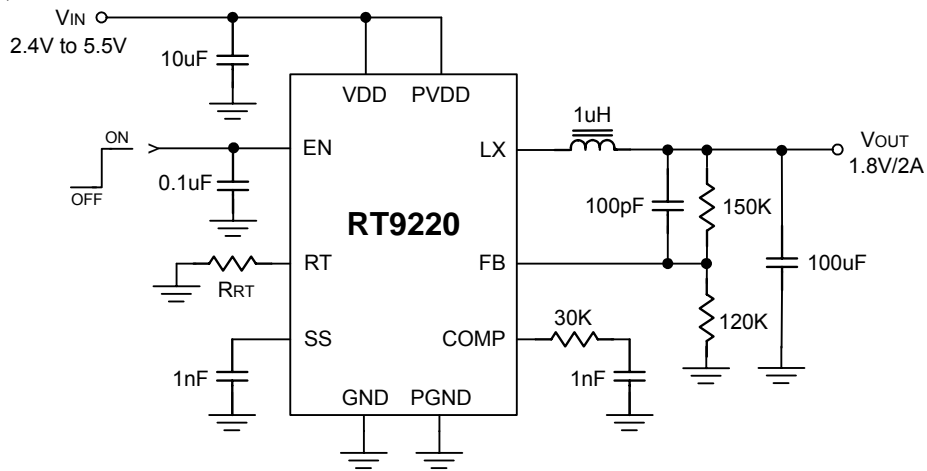
Applications

- Battery-Powered Equipment
- Low Power CPU and DSP Supply
- Digital Cameras and Hard Disks
- Portable Instruments and Notebook Computers
- Cellular Phones, PDAs, and Handheld PCs
- USB-Based DSL Modems and Other Network Interface Cards

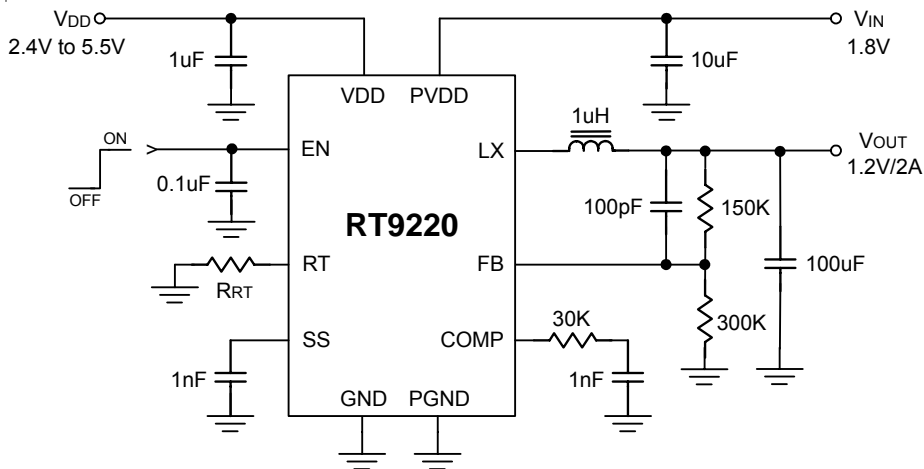
Pin Configurations



Typical Application Circuit



Typical Application Circuit as Single Supply Voltage (VDD = VIN = 2.4V to 5.5V)



Typical Application Circuit as Dual Supply Voltage (VDD = 2.4V to 5.5V, VIN = 1.8V)

Functional Pin Description

PVDD (Pin 1)

Power Input Supply. Input voltage which supplies current to the output pin. Connect this pin with a low-ESR capacitor to PGND.

PGND (Pin 2)

Power Ground. Ties the pin directly to the cathode terminal of C_{IN} and C_{OUT} and ground plane with the lowest impedance.

EN (Pin 3)

Logic high enables operation. Logic low shuts down the converter. Do not allow pin to float.

VDD (Pin 4)

Signal Input Supply. VDD supplies the internal control circuitry and provides the drive voltage. The driving capability of output current is proportioned to the VDD. Requires a bypass capacitor to GND.

GND (Pin 5 & 11)

Signal and Common Ground (Exposed thermal pad is connected to GND). The GND pad area should be as large as possible and using many vias to conduct the heat into the buried GND plate of PCB layer. All small-signal, compensation and feedback components should connect to this pin, and in turn connect to PGND at one point. All voltage levels are measured with respect to this pin.

FB (Pin 6)

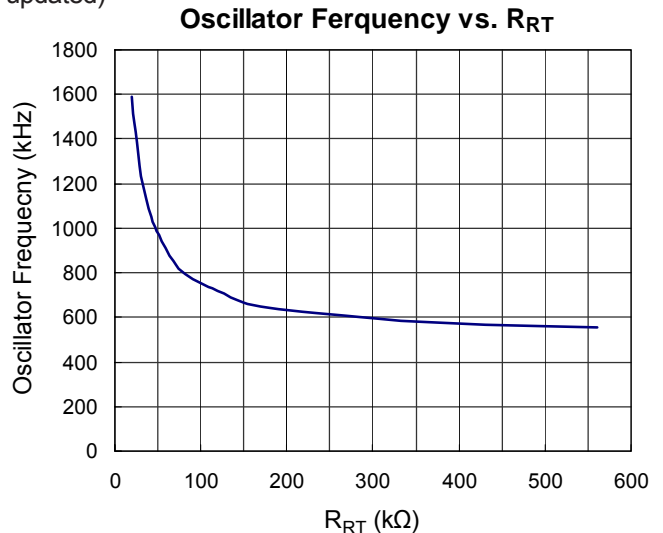
Switcher Feedback Voltage. This pin is the inverting input of the error amplifier. FB senses the switcher output through an external resistor divider network. FB regulation voltage is 0.8V.

COMP (Pin 7)

Compensation Input. This pin is the output of the internal error amplifier. Connect to a RC network to compensate the regulator control loop.

RT (Pin 8)

This pin provides oscillator switching frequency adjustment. The switching frequency is set to 500kHz internally when the RT pin be left floating. By placing a resistor (R_{RT}) from this pin to GND, the nominal 500kHz switching frequency is increased according to the following curve: (to be updated)



SS (Pin 9)

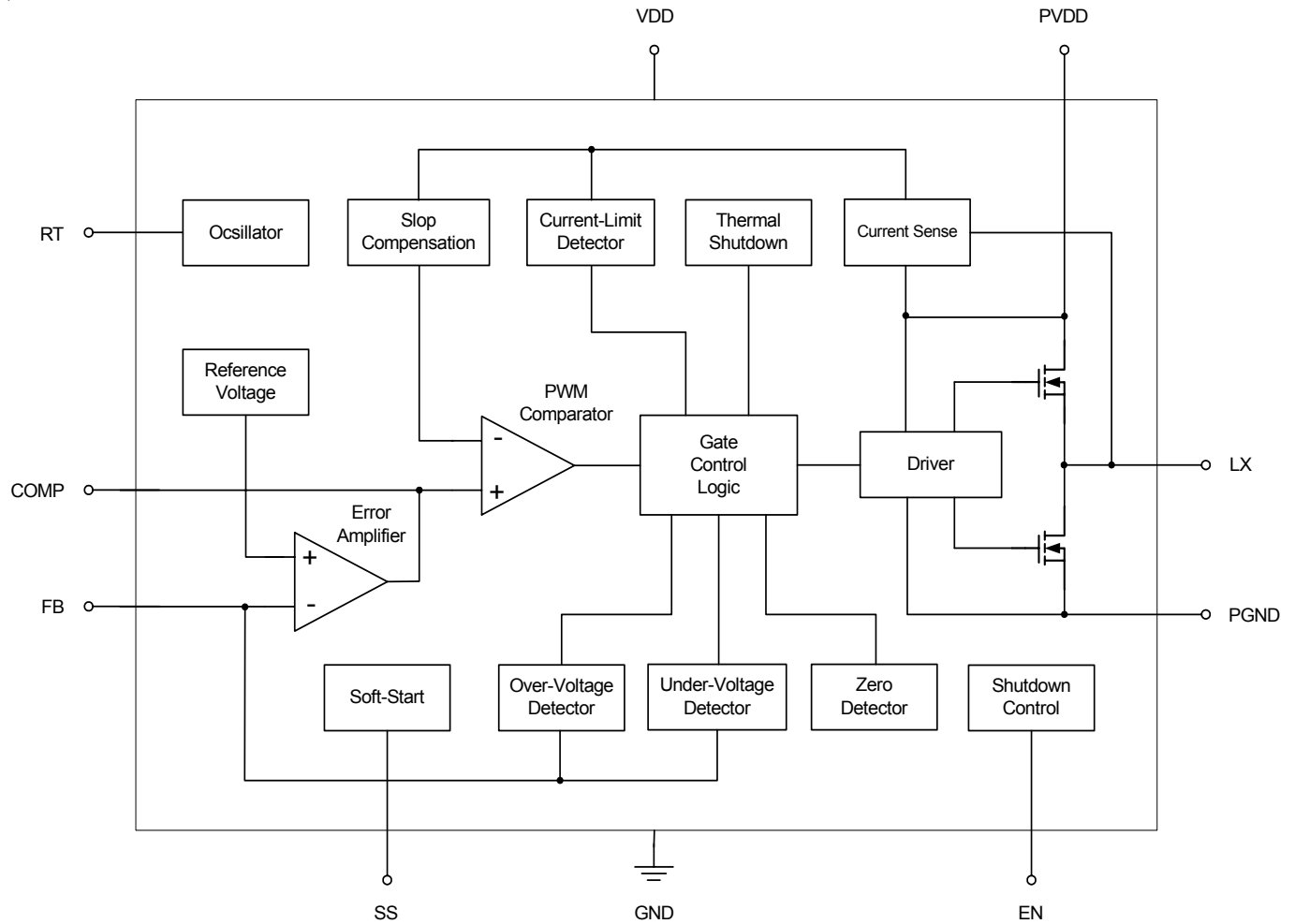
Connect a capacitor from this pin to ground. Triangle wave will be appeared on SS pin, which provides a clock base for soft-start. The soft-start timing would be setted by following formular:

$$T_{SS} = 200\mu s \times \frac{C_{SS}}{1nF} \times 50$$

LX (Pin 10)

Internal Power MOSFET Switches Output. Connect this pin to the inductor.

Function Block Diagram



Absolute Maximum Ratings (Note 1)

- Supply Voltage (PV_{DD} & V_{DD}) ----- -0.3V to 6V
- LX Voltage ----- -0.3V to (V_{DD} + 0.3V)
- PGND to GND ----- -0.3V to 0.3V
- Voltage on EN, SS, COMP, FB, RT ----- -0.3V to 6V
- Package Thermal Resistance
- DFN-10L 3x3, θ_{JA} ----- TBD
- Junction Temperature ----- 150°C
- Lead Temperature (Soldering, 10 sec.) ----- 260°C
- Storage Temperature Range ----- -65°C to 150°C
- ESD Susceptibility (Note 2)
- HBM ----- 2kV
- MM ----- 200V

Recommended Operating Conditions (Note 3)

- Supply Voltage, PV_{DD} & V_{DD} ----- 2.4V to 5.5V
- Shutdown Input Voltage, V_{EN} ----- 0V to 5.5V
- Ambient Temperature Range ----- -40°C to 85°C
- Junction Temperature Range ----- 0°C to 125°C

Electrical Characteristics

(V_{DD} = 3.3V, T_A = 25°C, unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
V_{DD} Supply Current						
Quiescent Current	I _Q	V _{EN} = 3.3V, V _{FB} = V _{REF} + 0.15V, I _{OUT} = 0mA	--	250	400	μA
Shutdown Current	I _{SHDN}	V _{EN} = 0V	--	0.01	1	μA
Reference						
Reference Voltage	V _{REF}		0.788	0.800	0.812	V
Oscillator						
Switching Frequency	f _{OSC}	RT = Open	--	0.5	--	MHz
Switching Frequency Range		By setting RT	--	--	2	MHz
Maximum Duty Cycle	DC	PV _{DD} = V _{OUT}	100	--	--	%
Error Amplifier (GM)						
E/A Transconductance	g _m		--	0.2	--	ms
Compensation Source Current	I _{C_SOURCE}	V _{FB} = V _{REF} - 0.15V	--	22	--	μA
Compensation Sink Current	I _{C_SINK}	V _{FB} = V _{REF} + 0.15V	--	-22	--	μA

To be continued

Parameter		Symbol	Test Conditions	Min	Typ	Max	Units
Power Switches							
R _{DS(ON)} of P-Channel MOSFET		R _{P_FET}	PV _{DD} = 3.3V, I _{LX} = 1A	--	150	250	mΩ
R _{DS(ON)} of N-Channel MOSFET		R _{N_FET}	PV _{DD} = 3.3V, I _{LX} = -1A	--	150	250	mΩ
P-Channel Current Limit		I _{LIMIT}	PV _{DD} = 3.3V, V _{FB} = V _{REF} - 0.15V	2.3	3	3.7	A
Logic Input							
EN Threshold	Logic-Low Voltage	V _{IL}	V _{DD} = 2.4V to 5.5V, Shutdown	--	--	0.4	V
	Logic-High Voltage	V _{IH}	V _{DD} = 2.4V to 5.5V, Enable	1.5	--	--	
EN Current		I _{EN}	V _{DD} = 5.5V, Enable	--	1	--	μA
Protection							
FB Under-Voltage Trip		Δ _{FBUVT}	FB Falling	--	50	--	%V _{REF}
FB Over-Voltage Trip		Δ _{FBOVT}	FB Rising	--	125	--	%V _{REF}
Thermal Shutdown Temperature		T _{SD}		--	180	--	°C
Thermal Shutdown Hysteresis		ΔT _{SD}		--	20	--	°C

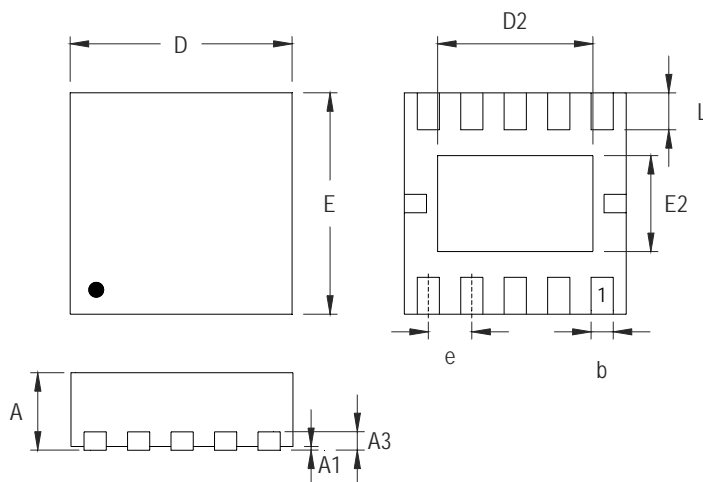
Note 1. Stresses beyond those listed under "Absolute Maximum Rating" may cause permanent damage to the device.

These are stress ratings only, and 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 affect device reliability.

Note 2. Devices are ESD sensitive. Handling precaution recommended. The human body model is a 100pF capacitor discharged through a 1.5kΩ resistor into each pin.

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

Outline Dimension



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	0.80	1.00	0.031	0.039
A1	0.00	0.05	0.000	0.002
A3	0.20 Ref.		0.008 Ref.	
b	0.18	0.30	0.007	0.012
D	3.00		0.118	
D2	0.00	2.70	0.000	0.106
E	3.00		0.118	
E2	0.00	1.75	0.000	0.069
e	0.50		0.020	
L	0.20	0.50	0.008	0.020

V-Type 10L DFN 3x3 Package

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