

VRM 8.5 Synchronous PWM Buck Converter Controller and Output Voltage Monitor

General Description

The RT9224E is a high speed switching controller designed for use in Synchronous DC/DC buck converter for modern CPUs. The regulated output voltage is digitally programmable from 1.05V to 1.825V by a 5-bit DAC which provides initial accuracy of $\pm 1\%$. The RT9224E drives two external N-Channel MOSFETs, providing high efficiency and eliminating the need for high cost P-Channel devices. It senses the output current across the on-resistance of the N-channel MOSFET and provides an adjustable current limit without external sense resistor.

RT9224E monitors the output voltage and provides the output signal for power-good and over-voltage protections. The switching frequency is 200kHz. The high switching frequency cooperating with a high speed error amplifier maintains a fast response to the dynamic load of modern CPUs.

Ordering Information

RT9224E □ □

Package Type
S : SOP-20

Operating Temperature Range
C : Commercial Standard
P : Pb Free with Commercial Standard

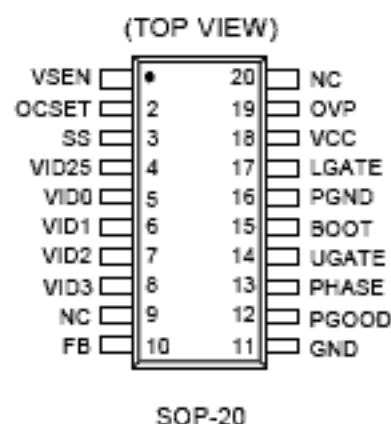
Features

- Simple Voltage-Mode PWM Control with Buck Rectification
- $\pm 1\%$ DAC Output Voltage Accuracy
- 5-Bit Digital-to-Analog Output Voltage Range from 1.05V to 1.825V
- Fast Transient Response and Excellent Output Voltage Regulation
- Fault Protection for Over-Voltage and Over-Current
- Power-Good Output Voltage Monitor

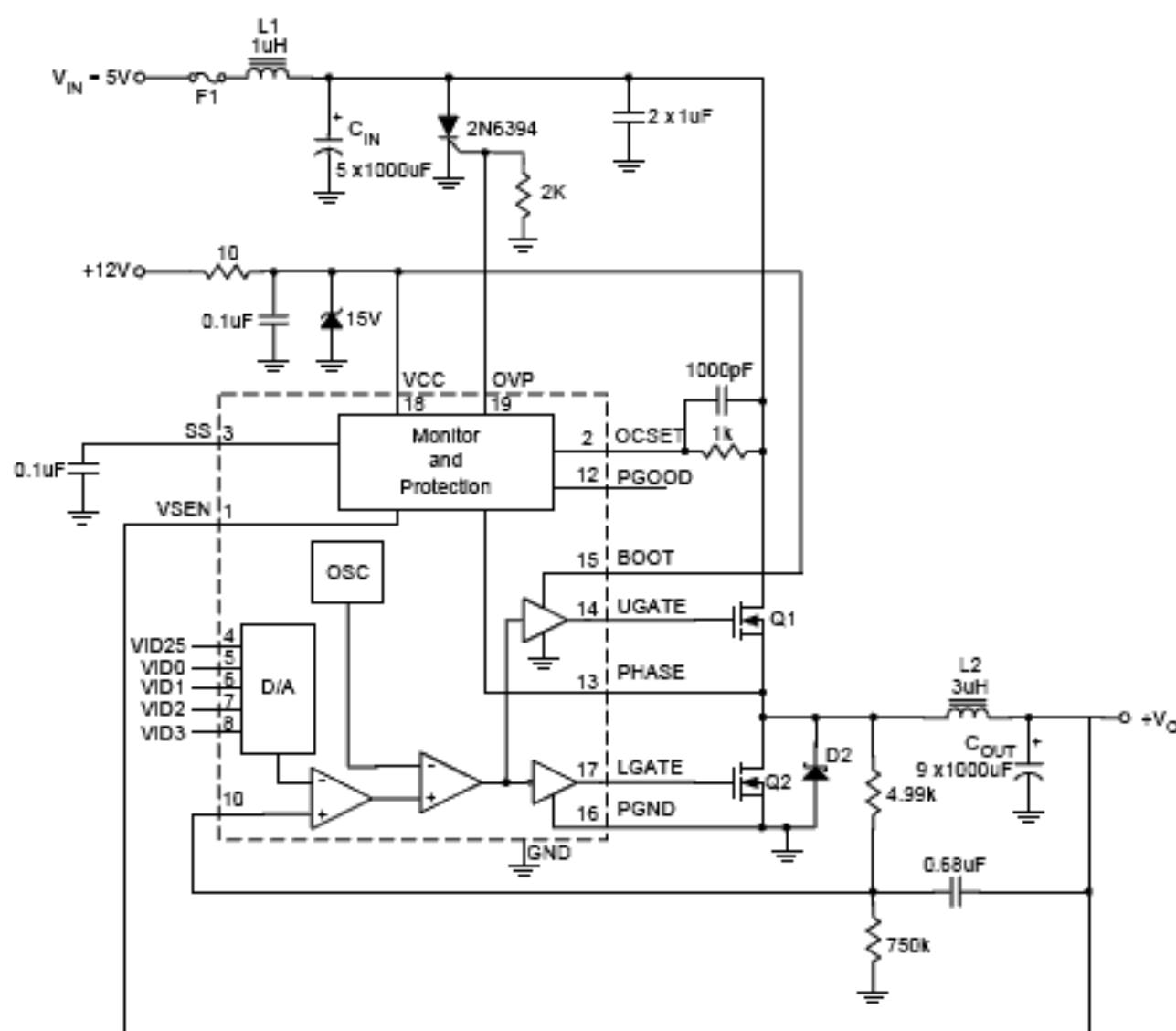
Applications

- Power Supply for VRM 8.5 Microprocessors
- Low-voltage Distributed Power Supplies
- High Power 5V to 1.05V to 1.85V Switching Regulator

Pin Configurations



Typical Application Circuit



Component Selection Notes:

C_{OUT} , C_{IN} – Each 1000 μ F 6.3WV DC, Sanyo MV-GX or Equivalent.

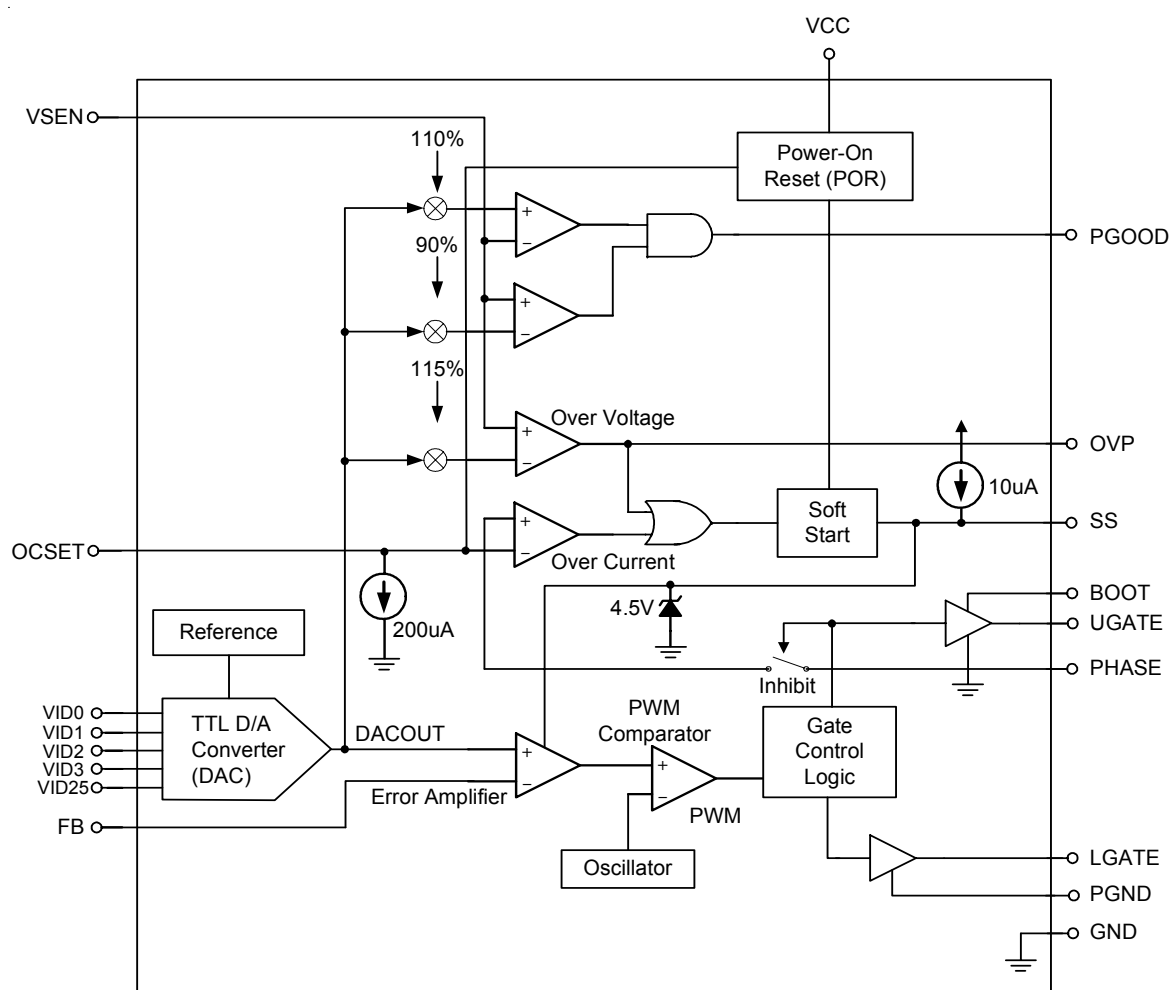
L2 – Core: Micrometals T50-52B; Winding: 10 Turns of 18AWG.

L1 – Core: Micrometals T50-52; Winding: 5 Turns of 18AWG.

D2 – 3A, 40V Schottky, Motorola MBR340 or Equivalent.

Q1, Q2 – PHB83N03LT; PHB05N03LT

Function Block Diagram



Functional Pin Description

Pin No.	Pin Name	Pin Function
1	VSEN	Output Voltage Monitoring Input for OVP and PGOOD
2	OCSET	<p>Over current set pin, sinks 200μA through a resistor (R_{OCs}) from this upper N-MOSFET to set the trip point:</p> $I_{PEAK} = \frac{200\mu A \times R_{OCs}}{\text{MOSFET - on resistance}}$ <p>An over-current trip cycles the soft-start function</p>
3	SS	Soft start speed is set by internal 10μA current source and capacitor from this pin to GND
4	VID25	Switching regulator output voltage setting
5	VID0	Switching regulator output voltage setting
6	VID1	Switching regulator output voltage setting
7	VID2	Switching regulator output voltage setting
8	VID3	Switching regulator output voltage setting
9,20	NC	No connection
10	FB	Feedback input pin
11	GND	IC signal ground
12	PGOOD	<p>Open drain logic output</p> <p>This pin is pulled low when the converter output is not within ±10% of the DACOUT reference voltage</p>
13	PHASE	Current limit sense input
14	UGATE	High side driver output
15	BOOT	Driver power
16	PGND	Low-side driver GND
17	LGATE	Low side driver output
18	VCC	Power supply input
19	OVP	<p>Over voltage protection</p> <p>This pin is pulled high when the VSEN voltage is over 15% of the DACOUT reference voltage</p>

Table 1 Output Voltage Program

Pin Name					Nominal Output Voltage DACOUT
VID25	VID3	VID2	VID1	VID0	
0	0	1	0	0	1.050V
1	0	1	0	0	1.075V
0	0	0	1	1	1.100V
1	0	0	1	1	1.125V
0	0	0	1	0	1.150V
1	0	0	1	0	1.175V
0	0	0	0	1	1.200V
1	0	0	0	1	1.225V
0	0	0	0	0	1.250V
1	0	0	0	0	1.275V
0	1	1	1	1	1.300V
1	1	1	1	1	1.325V
0	1	1	1	0	1.350V
1	1	1	1	0	1.375V
0	1	1	0	1	1.400V
1	1	1	0	1	1.425V
0	1	1	0	0	1.450V
1	1	1	0	0	1.475V
0	1	0	1	1	1.500V
1	1	0	1	1	1.525V
0	1	0	1	0	1.550V
1	1	0	1	0	1.575V
0	1	0	0	1	1.600V
1	1	0	0	1	1.625V
0	1	0	0	0	1.650V
1	1	0	0	0	1.675V
0	0	1	1	1	1.700V
1	0	1	1	1	1.725V
0	0	1	1	0	1.750V
1	0	1	1	0	1.775V
0	0	1	0	1	1.800V
1	0	1	0	1	1.825V

Note: (1) 0:Connected to GND (2) 1:Open

Absolute Maximum Ratings

- Supply Voltage ----- +15V
- Boot Voltage ----- +15V
- Input, Output or I/O Voltage ----- GND -0.3V to $V_{CC} + 0.3V$
- Storage Temperature Range ----- -65°C to 150°C
- Package Thermal Resistance
SOP-20, θ_{JA} ----- 87°C/W

Recommended Operating Conditions

- Supply Voltage ----- +12V $\pm 10\%$
- Ambient Temperature Range ----- 0°C to 70°C
- Junction Temperature Range ----- 0°C to 125°C

Electrical Characteristics

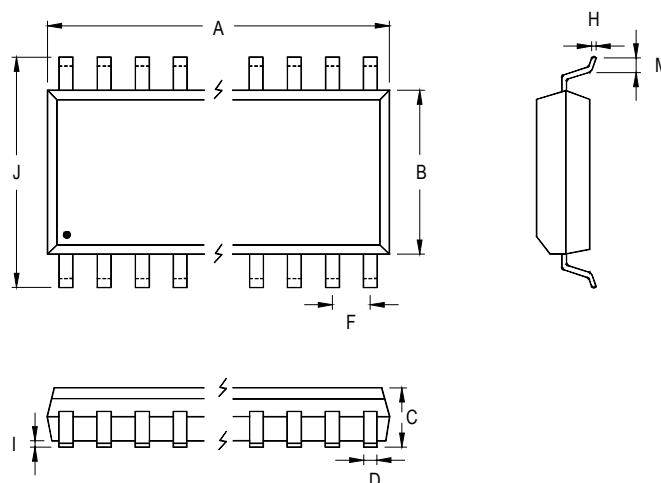
($T_A = 25^\circ\text{C}$, recommended operating conditions, unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
VCC Supply Current						
Nominal Supply	I_{CC}	UGATE and LGATE	--	3	--	mA
Power-on Reset						
VCC Rising Threshold		$V_{OCSET} = 4.5V$	--	9.5	--	V
VCC Falling Threshold		$V_{OCSET} = 4.5V$	--	7.5	--	V
Rising V_{OCSET} Threshold			--	1.6	--	V
Oscillator						
Free Running Frequency			170	200	230	kHz
Ramp Amplitude	ΔV_{OSC}		--	1.9	--	V_{P-P}
Reference and DAC						
DAC (VID0-VID25) Input Low Voltage			--	--	0.8	V
DAC (VID0-VID25) Input High Voltage			2.0	--	--	V
DACOUT Voltage Accuracy			-1.0	--	+1.0	%
Error Amplifier						
DC Gain			--	65	--	dB
Gate Drivers						
UGATE Source	R_{UGATE}	$V_{BOOT} - V_{PHASE} = 12V$	--	8	--	Ω
UGATE Sink	R_{UGATE}	$V_{UGATE} - V_{PHASE} = 1V$	--	5	--	Ω
LGATE Source	I_{LGATE}	$V_{CC} = 12V, V_{LGATE} = 6V$	--	500	--	mA
LGATE Sink	R_{LGATE}	$V_{LGATE} = 1V$	--	5	--	Ω

To be continued

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Protection						
Over-voltage Trip (VSEN/DACOUT)			--	115	120	%
OCSET Current Source	I _{OCSET}	V _{OCSET} = 4.5V	167	200	233	μA
OVP Sourcing Current	I _{OVP}	V _{SEN} = 5.5V, V _{OVP} = 0V	60	--	--	mA
Soft-Start Current	I _{SS}	V _{SS} = 1.5V	--	10	--	μA
Power Good						
Upper Threshold (VSEN/DACOUT)		VSEN Rising	106	--	114	%
Lower Threshold (VSEN/DACOUT)		VSEN Falling	89	--	96	%
Hysteresis (VSEN/DACOUT)		Upper and Lower Threshold	--	2	--	%
PGOOD Voltage Low	V _{PGOOD}	I _{CPGOOD} = -5mA	--	0.5	--	V

Outline Dimension



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	12.598	13.005	0.496	0.512
B	7.391	7.595	0.291	0.299
C	2.362	2.642	0.093	0.104
D	0.330	0.508	0.013	0.020
F	1.194	1.346	0.047	0.053
H	0.229	0.330	0.009	0.013
I	0.102	0.305	0.004	0.012
J	10.008	10.643	0.394	0.419
M	0.381	1.270	0.015	0.050

20-Lead SOP Plastic Package

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