

5-Bit Programmable Synchronous PWM Buck Converter Controller

General Description

The RT9223 is a high efficiency synchronous switching regulator for modern CPU application. The output is controlled by a 5-bit DAC programmed from 1.3V to 2.05V in 0.05V steps and from 2.1V to 3.5V in 0.1V increments.

The switching controller drives two N-MOSFETs at 200KHz frequency and provides an optimal solution for size, efficiency and cost in any application circuits. The controller also offers integrated functions including PGOOD, output enable, over-voltage, internal digital-count soft start, and current-limiting protection in one chip.

Ordering Information

RT9223□ □
 □ Package type
 S : SOP-20
 □ Operating temperature range
 C: Commercial standard

Features

- High Efficiency Synchronous N-MOSFET Driver Operating at 200KHz
- 1.3V ~ 2.05V (0.05V steps) and 2.1V ~ 3.5V (0.1V steps) Output Voltage
- Enable Input, PGOOD Output, OVP, and Current-limiting Protection
- Internal Digital-count Soft Start

Applications

- Power Supply for Pentium Pro™, PowerPC™, K6™, 6x86™, and Alpha™ Microprocessors
- High-power 5V to 3.xV DC-DC Regulators
- Low-voltage Distributed Power Supplies
- Programmable Step-down Power Supplies

Pin Configurations

Part Number	Pin Configurations	
RT9223CS (Plastic SOP-20)	TOP VIEW	
	GND [1]	[20] VID0
	VCC [2]	[19] VID1
	OVP [3]	[18] VID2
	PGOOD [4]	[17] VID3
	CSN [5]	[16] VID4
	CSP [6]	[15] VSEN
	PGNDH [7]	[14] SHDN
	DH [8]	[13] BSTH
	NC [9]	[12] BSTL
	PGNDL [10]	[11] DL

Absolute Maximum Ratings

- VCC to GND -0.3 to +5.5V
- PGND to GND $\pm 0.3V$
- BST to GND -0.3 to +14V
- Ambient Temperature Range 0 to +70°C
- Junction Temperature Range 0 to +125°C
- Storage Temperature Range -65 to +150°C
- Lead Temperature (Soldering, 10 sec.) 300°C
- Package Thermal Resistance
SOP-20, θ_{JA} 87°C/W

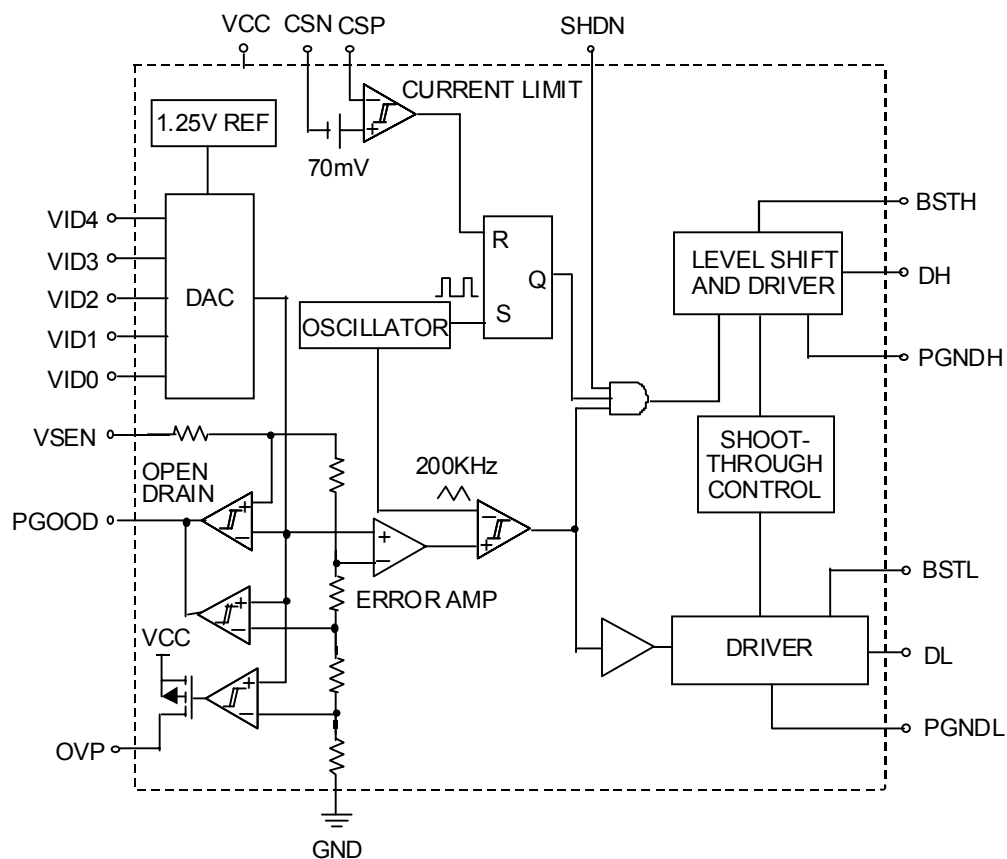
Electrical Characteristics

(VCC = 5V; GND = 0V; PGNDH = PGNDL = 0V; VSEN = VOUT; 0mV < (V_{CSP}-V_{CSN}) < 60mV; T_A = 25°C)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Switching Section						
Output Voltage	V _{OUT}	I _O = 2A	--	(1)	--	--
Supply Voltage	V _{CC}	V _{CC}	4.3	--	5.5	V
Supply Current	I _{CC}		--	2	5	mA
Load Regulation	ΔV_{LOAD}	I _O = 0.8A to 15A	--	1	--	%
Line Regulation	ΔV_{LINE}	V _{CC} = 4.75V to 5.25V	--	0.5	--	%
Power On Reset Trip Point		V _{CC} Rising	--	4.2	--	V
Current Limit Voltage	V _{LIMIT}	V _{CSP} - V _{CSN}	65	75	85	mV
Oscillator Frequency			170	200	230	KHz
Oscillator Max Duty Cycle	D _{MAX}		90	95	--	%
DH Source		V _{BSTH} - V _{DH} = 1V	--	4.5	--	Ω
DH Sink		V _{DH} - V _{PGNDH} = 1V	--	3.5	--	Ω
DL Source		V _{BL} - V _{DL} = 5V	--	1	--	A
DL Sink		V _{DL} - V _{PGNDL} = 1V	--	2	--	Ω
OVP Threshold Voltage			114	120	122	%
OVP Source Current	I _{OVP}	V _{OVP} = 3.0V	10	--	--	mA
Power Good Threshold Voltage		V _{SEN} Rising	87	--	115	%

Note: (1) See output voltage table.

Function Block Diagram



Pin Description

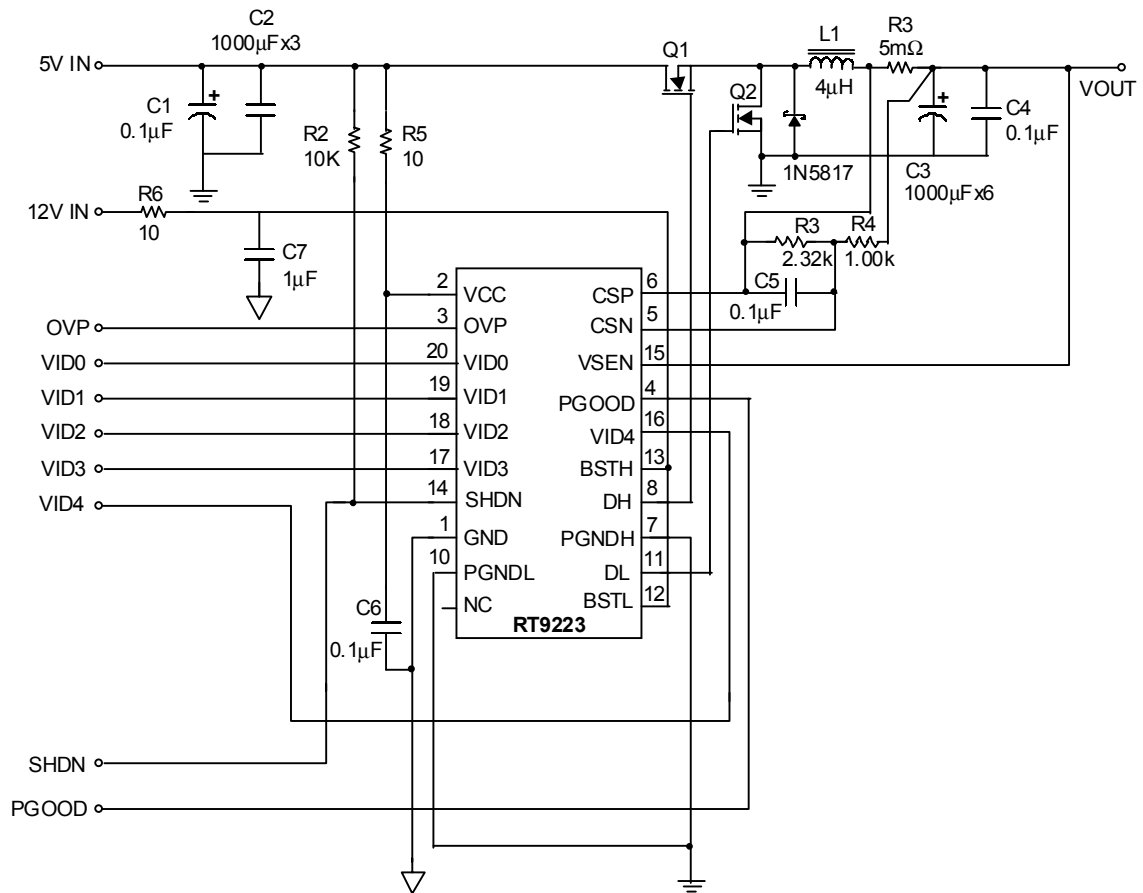
Pin No.	Pin Name	Pin Function
1	GND	Small signal analog and digital ground
2	VCC	Power supply input
3	OVP	High signal out if $V_O > \text{setting point} + 20\%$
4	PGOOD ⁽¹⁾	Open collector logic output; High if V_O within 10% of the setting point
5	CSN	Current sense input (Negative)
6	CSP	Current sense input (Positive)
7	PGNDH	High side drive GND
8	DH	High side driver output
9	NC	No connection
10	PGNDL	Low side drive GND
11	DL	Low side driver output
12	BSTL	Supply for low side driver
13	BSTH	Supply for high side driver
14	SHDN ⁽¹⁾	Logic low shutdown the converter
15	VSEN	Top end of internal feedback chain
16	VID4 ⁽¹⁾	Programming input (MSB)
17	VID3 ⁽¹⁾	Programming input
18	VID2 ⁽¹⁾	Programming input
19	VID1 ⁽¹⁾	Programming input
20	VID0 ⁽¹⁾	Programming input (LSB)

Note: (1) All logic level inputs and outputs are TTL compatible.

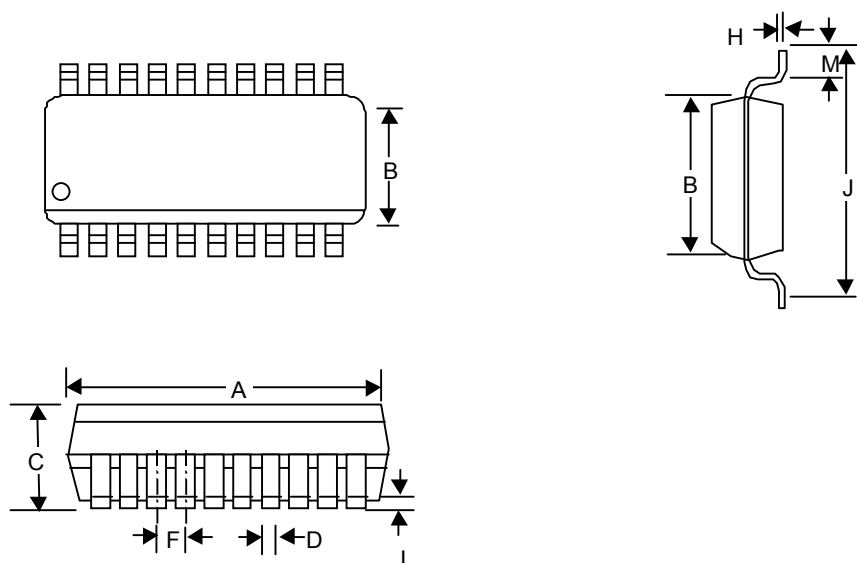
Table 1 Output Voltage Program

Test	Conditions	VID 43210	Min	Typ	Max	Units
Output Voltage	$I_o = 2A$ in application circuit	01111	1.287	1.300	1.313	V
		01110	1.336	1.350	1.364	
		01101	1.386	1.400	1.414	
		01100	1.435	1.450	1.465	
		01011	1.485	1.500	1.515	
		01010	1.534	1.550	1.566	
		01001	1.584	1.600	1.616	
		01000	1.633	1.650	1.667	
		00111	1.683	1.700	1.717	
		00110	1.732	1.750	1.768	
		00101	1.782	1.800	1.818	
		00100	1.831	1.850	1.869	
		00011	1.881	1.900	1.919	
		00010	1.930	1.950	1.970	
		00001	1.980	2.000	2.020	
		00000	2.029	2.050	2.071	
		11111	1.980	2.000	2.020	
		11110	2.079	2.100	2.121	
		11101	2.178	2.200	2.222	
		11100	2.277	2.300	2.323	
		11011	2.376	2.400	2.424	
		11010	2.475	2.500	2.525	
		11001	2.574	2.600	2.626	
		11000	2.673	2.700	2.727	
		10111	2.772	2.800	2.828	
		10110	2.871	2.900	2.929	
		10101	2.970	3.000	3.030	
		10100	3.069	3.100	3.131	
		10011	3.168	3.200	3.232	
		10010	3.267	3.300	3.333	
		10001	3.366	3.400	3.434	
		10000	3.465	3.500	3.535	

Typical Application Circuit



Package Information



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

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