Programmable Synchronous PWM Buck Converter with 1.5V/2.5V Dual Low Dropout Linear Regulator Controller

General Description

The RT9221 integrates a PWM controller and two low-dropout linear regulators into a single chip. The PWM controller provides the CPU core voltage controlled by a 5-bit DAC and the linear section regulates power for GTL bus, clock driver or other circuits on motherboards. The PWM controller provides an adjustable Intel-compatible 1.3V~3.5V output voltage. The synchronous N-MOSFET driver with 200 KHz switching frequency optimizes the efficiency, device size, and cost built-in over–voltage and current-limiting protection prevent the CPU from damage. Power-good signal is sent when the core voltage is within ±10% of the setting point.

The linear section is a low dropout regulator which drives low cost NPN transistors to supply the 1.5V and 2.5V regulated output power.

Ordering Information

RT9221□ □

- Package type
  S : SOP-24
- Operating temperature range
  C: Commercial standard

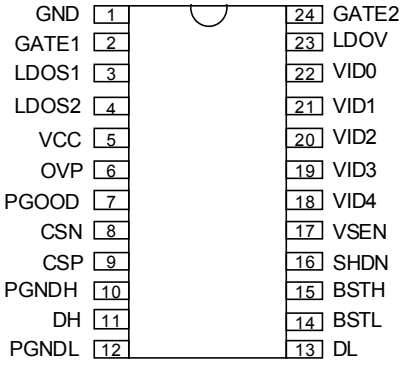
Features

- **Provides 3 Regulated Voltages**
- **N-MOSFET Driver for High Efficiency Switching Section**
- **Power-good, Over-voltage, and Current-limiting Protection for Switching Section**
- **1.5V and 2.5V Fixed Output Voltage for Linear Section**
- **Linear Section Uses Low Cost NPN Transistor as Power Device**
- **TTL-compatible 5-bit DAC Core Output Voltage**

Applications

- Power Supply for Pentium, Pentium Pro™, Pentium II™, Power PC™, K6™, 6×86™, and Alpha™ Microprocessors
- High-power 5V to 3.xV DC-DC Regulators
- Low-voltage Distributed Power Supplies
- Programmable Power Supplies

Pin Configurations

Part Number	Pin Configurations
RT9221CS (Plastic SOP-24)	TOP VIEW 

Absolute Maximum Ratings

- VCC to GND ---------- -0.3 to +5.5V
- PGND to GND ---------- ± 0.3V
- BSTH and BSTL 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-24, θ_{JA} ---------- 75°C/W

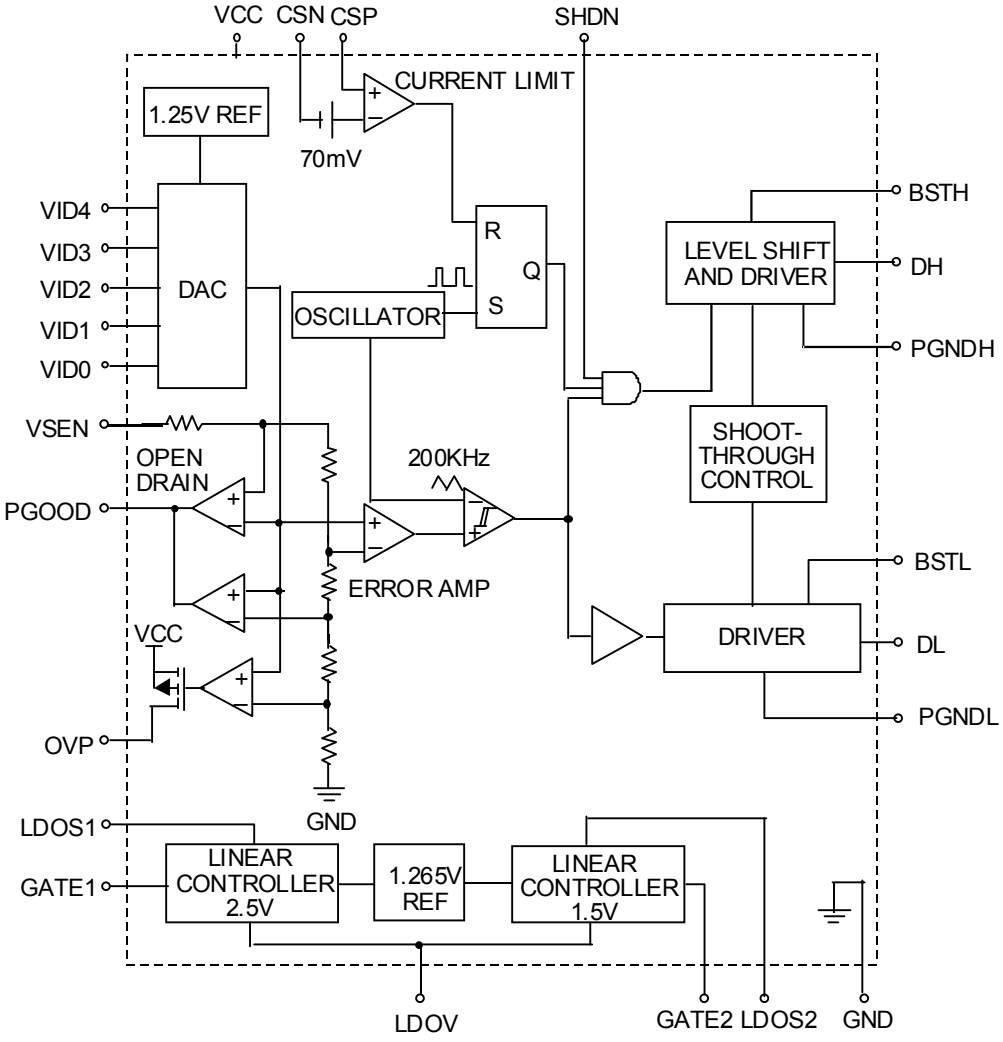
Electrical Characteristics

(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}	VCC	4.5	--	5.5	V
Supply Current	I_{CC}		--	3	6	mA
Load Regulation	ΔV_{LOAD}	I_O = 0.8A to 15A	--	1	--	%
Line Regulation	ΔV_{LINE}	VCC = 4.75V to 5.25V	--	0.5	--	%
Power On Reset Trip Point		VCC 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	--	3.5	--	Ω
DH Sink		V_{DH} - V_{PGNDH} = 1V	--	3.5	--	Ω
DL Source		V_{BSTH} - V_{DL} = 3V	--	2	--	Ω
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		VSEN Rising	87	--	113	%
Linear Sections						
Quiescent Current	I_Q	LDOV = 12V	--	--	5	mA
Output Voltage (LDO1 RT9221)			2.450	2.500	2.550	V
Output Voltage (LDO2 RT9221)			1.470	1.500	1.530	V
Gain (A_{OL})		LDOS (1,2) to GATE (1,2)	--	65	--	dB
Load Regulation	ΔV_{LOAD}	I_O = 0 to 5A	--	1	--	%
Line Regulation	ΔV_{LINE}	LDOV = 11.4V to 12.6V	--	1	--	%

Note: (1) See output voltage table.

Function Block Diagram



Pin Description

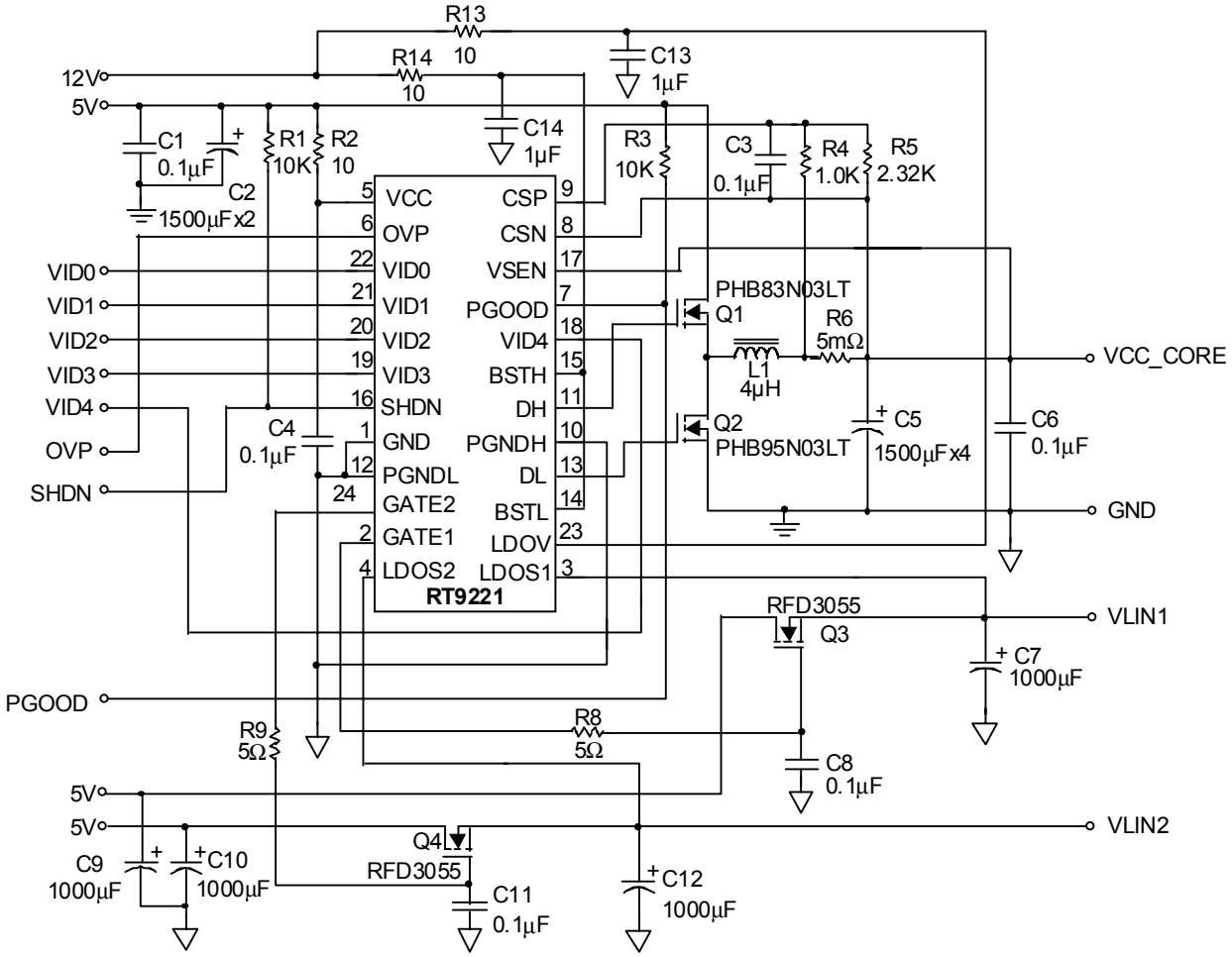
Pin No.	Pin Name	Pin Function
1	GND	Small signal analog and digital ground
2	GATE1	LDO1 gate drive output
3	LDOS1	LDO1 sense input
4	LDOS2	LDO2 sense input
5	VCC	Input voltage
6	OVP	High signal out if V_O > setting point + 20%
7	PGOOD (1)	Open collector logic output; High if V_O within 10% of the setting point
8	CSN	Current sense input (Negative)
9	CSP	Current sense input (Positive)
10	PGNDH	High side drive GND
11	DH	High side drive output
12	PGNDL	Low side drive GND
13	DL	Low side drive output
14	BSTL	Supply for low side driver
15	BSTH	Supply for high side driver
16	SHDN (1)	Logic low shutdown the converter
17	VSEN	Top end of internal feedback chain
18	VID4 (1)	Programming input (MSB)
19	VID3 (1)	Programming input
20	VID2 (1)	Programming input
21	VID1 (1)	Programming input
22	VID0 (1)	Programming input (LSB)
23	LDOV	+12V for LDO section
24	GATE2	LDO2 gate drive output

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

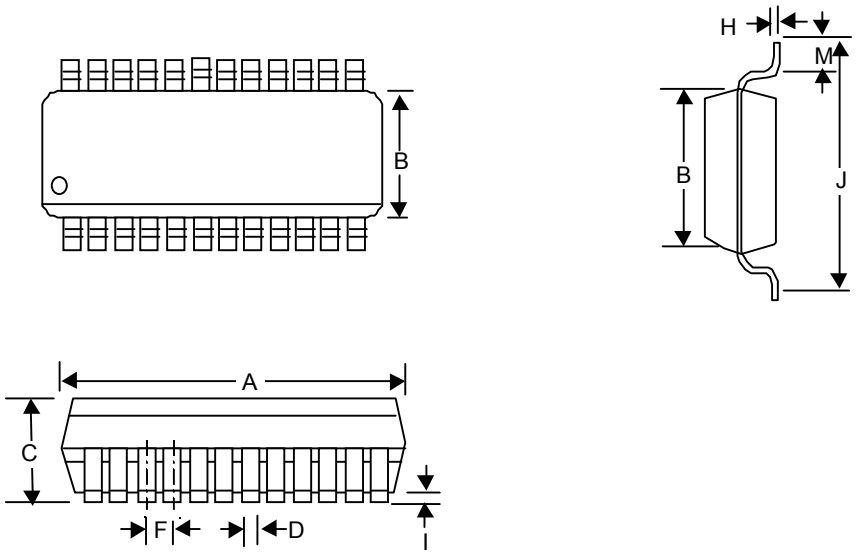
Table 1 Output Voltage Program

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	15.189	15.596	0.598	0.614
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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