RC5043

Programmable DC-DC Converter

Features

- Programmable output from 2.1V to 3.5V using integrated 4-bit DAC
- Operates from 12V input power supply
- Mimumum 80% efficiency at I_{LOAD} = 10A
- Oscillator frequency adjustable from 200KHz to 1MHz
- On-chip Power Good function
- Over-Voltage Protection
- Precision trimmed zero TC voltage reference
- Drives P-Channel MOSFETs
- 16 pin SOIC package
- Meets Intel Pentium® Pro VRM specifications using minimum number of external components

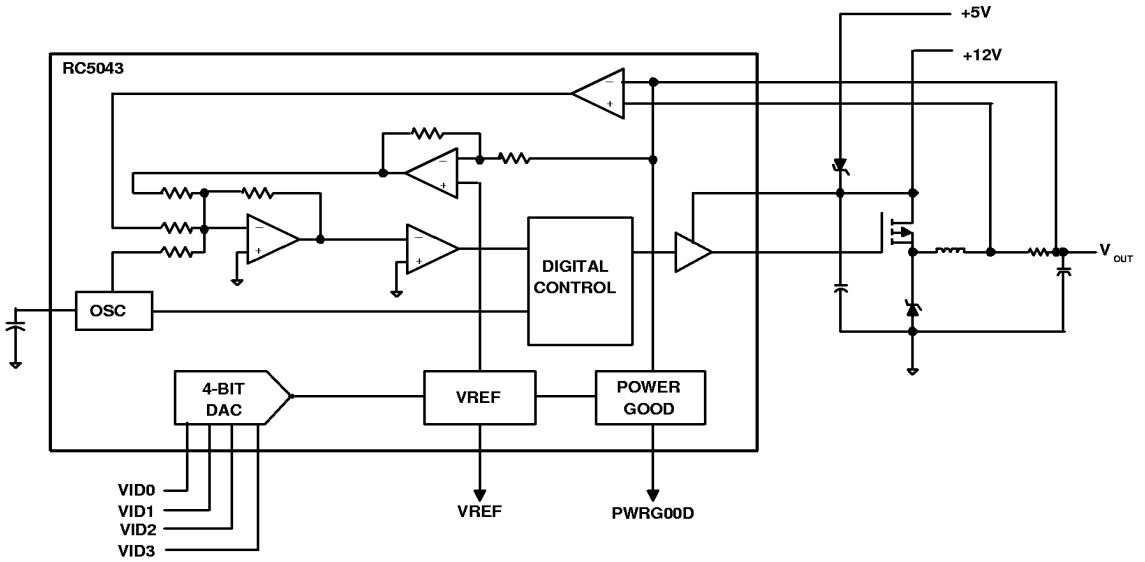
Applications

- Programmable power supply for Pentium® Pro based CPU motherboards
- VRM module for Pentium® Pro CPU
- Programmable power supply

Description

The RC5043 is a non-synchronous DC-DC controller IC which provides an accurate, programmable output for Pentium® Pro CPU applications. Its ability to operate primarily from a 12V input supply allows the RC5043 to be used in applications where the 5V source may be power limited. Using an integrated 4-bit DAC to accept a voltage identification (VID) code directly from the CPU, the RC5043 can generate precise output voltages between 2.1V and 3.5V in 100mV increments. Output load currents up to 12A can be delivered using minimal external circuitry. The RC5043 is designed to operate in a standard PWM control mode under heavy load conditions and in PFM control mode while supplying light loads for optimal efficiency. An on-board precision zero TC voltage reference eliminates the requirement for external components in order to achieve tight voltage regulation. The Pentium Pro™ CPU is continuously protected by an integrated Power Good function, which sends an active-low interrupt signal to the CPU in the event that the output voltage is out of tolerance. The internal oscillator can be programmed to operate over a range of 200KHz to 1MHz to allow flexibility in choosing external components.

Block Diagram

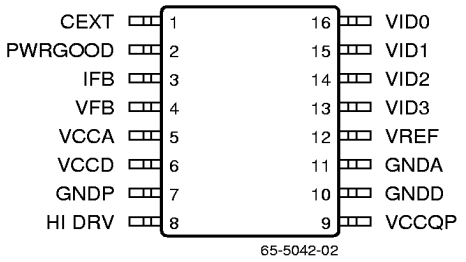


Preliminary Information

Rev. 0.5.0

PRELIMINARY INFORMATION describes products that are not in full production at the time of printing. Specifications are based on design goals and limited characterization. They may change without notice. Contact Raytheon for current information.

Pin Assignments



Pin Definitions

Pin Number	Pin Name	Pin Function Description
1	CEXT	External Capacitor for setting oscillator frequency
2	PWRGOOD	Open collector output; Logic HIGH indicated power is within limits
3	IFB	Current Feedback Input
4	VFB	Voltage Feedback Input
5	VCCA	Analog supply input; nominally 5V
6	VCCD	Digital supply input; nominally 5V
7	GNDP	Power ground for high current drivers
8	HIDRV	FET driver output
9	VCCQP	FET supply input; nominally 12V
10	GNDD	Digital ground
11	GNDA	Analog ground
12	VREF	Reference voltage output
13-16	VID3-VID0	Voltage identification (VID) code input

Absolute Maximum Ratings

Control Supply Voltages, VCCA and VCCD	13.2V
Voltage Identification Code Inputs, VID3-VID0	13.2V
FET Supply Voltage, VCCQP	13.2V
All Other Input Pins	13.2V
Junction Temperature	175˚C
Storage Temperature	-65 to 150˚C
Lead Soldering Temperature, 10 seconds	300˚C
Short Circuit Duration	Continuous

Note:
Functional operation under any of these conditions is NOT implied. Permanent damage may occur if the device is subjected to conditions outside these ratings.

Operating Conditions

Parameter	Conditions	Min	Typ	Max	Units
Control Supply Voltages, VCCA and VCCD		4.5	5	7	V
Driver Supply Voltage, VCCQP		10.8	12	13.2	V
VID Code Input Voltage, Logic HIGH	I = 1mA	2			V
VID Code Input Voltage, Logic LOW				0.8	V
PWRGOOD Enable HIGH Threshold				+7	%VREF
PWRGOOD Enable LOW Threshold		-7			%VREF
Ambient Temperature, T_A		0		70	˚C

DC Electrical Specifications

(V_{CC}, V_{DD} = 5V, V_{CCQP} = 12V, f_{osc} = 650 KHz, and T_A = +25˚C using circuit in figure 1, unless otherwise noted.

Parameter	Conditions	Min	Typ	Max	Units
Output Voltage	T_A = 0–70°C, See Table 1.	2.0		3.5	V
Output Current			10	12	A
Setpoint Accuracy[1]	I_{LOAD} = 1A		1.0	1.5	%
Output Temperature Drift	T_A = 0–70°C		40		ppm/°C
Load Regulation	ILOAD = 0.5 to 10A		1		%Vo
Line Regulation	VIN = 4.75- 5.25V, ILOAD = 10A		0.14		%Vo
Output Ripple/Noise	V_{OUT} = 2.1-3.5V, 20MHz BW		30		mV
Cumulative Accuracy[2]	T_A = 0–70°C		3	5	%
Efficiency	ILOAD = 10A		80		%
Short Circuit Threshold	Internal Comparator Threshold	100	120	140	mV
Output Current Driver		0.5	1.0		A
Power Dissipation	No external components		0.1	0.2	W
Thermal Impedance, θ_{JA}			80		°C/W

Notes:

1. Setpoint Accuracy includes Output Ripple/Noise.
2. Cumulative Accuracy is determined by Setpoint Accuracy, Line and Load Regulation, Output Ripple/Noise, Transient Performance and Temperature Drift.

AC Electrical Specifications[1]

(V_{CCA}, V_{CCD} = 5V, V_{CCQP} = 12V, T_A = +25˚C using circuit in figure 1, unless otherwise noted)

Parameter	Min	Typ	Max	Units
Response Time Sleep-to-Full Load		10		µs
Oscillator Frequency Range	.2		1	MHz
Oscillator Frequency Precision (excluding tolerance of C_{EXT})		10		%
Maximum Duty Cycle in PWM Mode	90	95		%
Minimum Duty Cycle in PFM Mode			100	ns
Short Circuit Current, r_{sense} = 8mΩ		14		A
Response Time to Short Circuit		15	30	ns
Soft Start duration at Power-Up and Power-Down		10		µs

Notes: 1.Guaranteed by characterization, not tested 100%.

Advanced Preliminary

Table 1: Voltage Identification Codes[1]

Pentium® Pro Processor Pins				V_{OUT} (VDC)	Set Point[2] (mV)	Cumulative Accuracy[3] (mV)
VID3	VID2	VID1	VID0			
1	1	1	1	2.0	—	—
1	1	1	0	2.1	±24	±105
1	1	0	1	2.2	±24	±110
1	1	0	0	2.3	±24	±115
1	0	1	1	2.4	±24	±120
1	0	1	0	2.5	±25	±125
1	0	0	1	2.6	±26	±130
1	0	0	0	2.7	±27	±135
0	1	1	1	2.8	±28	±140
0	1	1	0	2.9	±29	±145
0	1	0	1	3.0	±30	±150
0	1	0	0	3.1	±31	±155
0	0	1	1	3.2	±32	±160
0	0	1	0	3.3	±33	±165
0	0	0	1	3.4	±34	±170
0	0	0	0	3.5	±40	±175

Notes:
1. 0 = processor pin connected to V_{SS}. 1 = Open.
2. Setpoint includes Output Ripple/Noise.
3. Cumulative Accuracy includes Setpoint Accuracy, Line & Load regulation, Transient effects and Temperature Drift.

Preliminary Information

Test Circuits

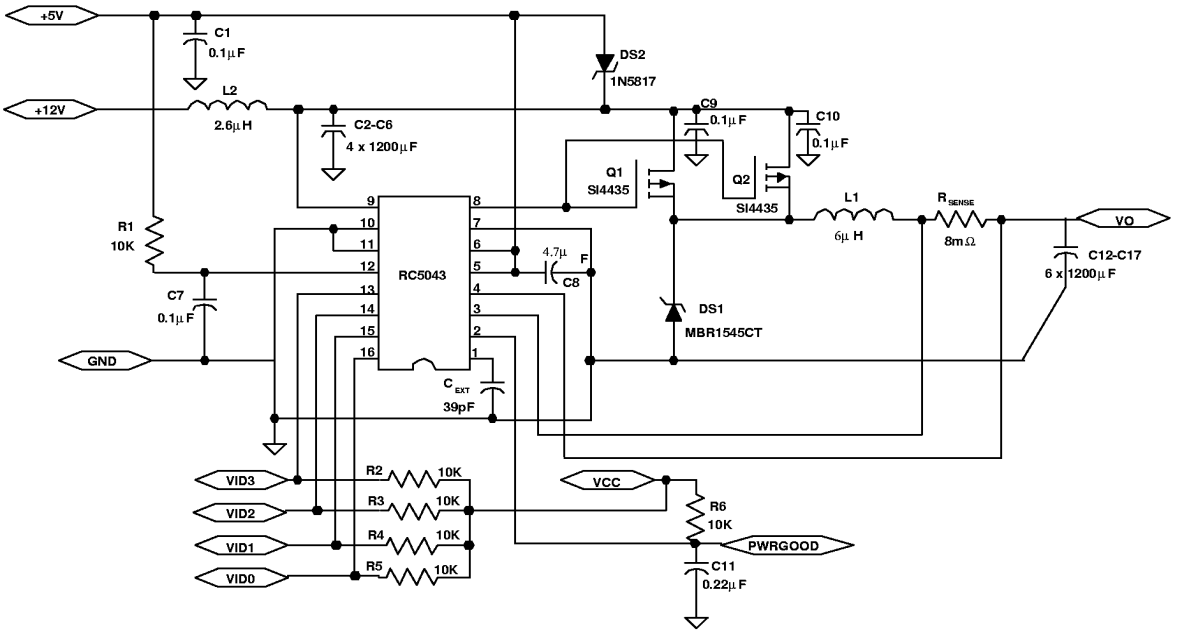


Figure 1. Standard Test or Application Schematic

Table 2. Components for RC5043

RC5043 Standard Application Circuit Bill of Materials			
Ref Designator	**Quantity**	**Part No.**	**Manufacturer**
L1	1	4.7mH	Pulse Engineering
L2	1	2.6mH	Pulse Engineering
DS1	1	MBR1545CT	Motorola
DS2	1	1N5817	General Instruments
Q1, Q2	2	SI4435	Siliconix
C1, C7, C9, C10, C18	5	0.1µF, 16V	SMD Ceramic
C2-C5	4	1200µF, 16V	Radial Electrolytic
C8	1	4.7µF, 6V	SMD Tantalum
C11	1	0.22µF, 6V	SMD Cap
C12-C17	6	1200µF, 6V	Radial Electrolytic
C_{EXT}	1	75pF	SMD Cap
R_{SENSE}	1	WSL-2512 .008Ω	Dale
R1-R6	6	10KΩ, 1/8W	SMD Resistor

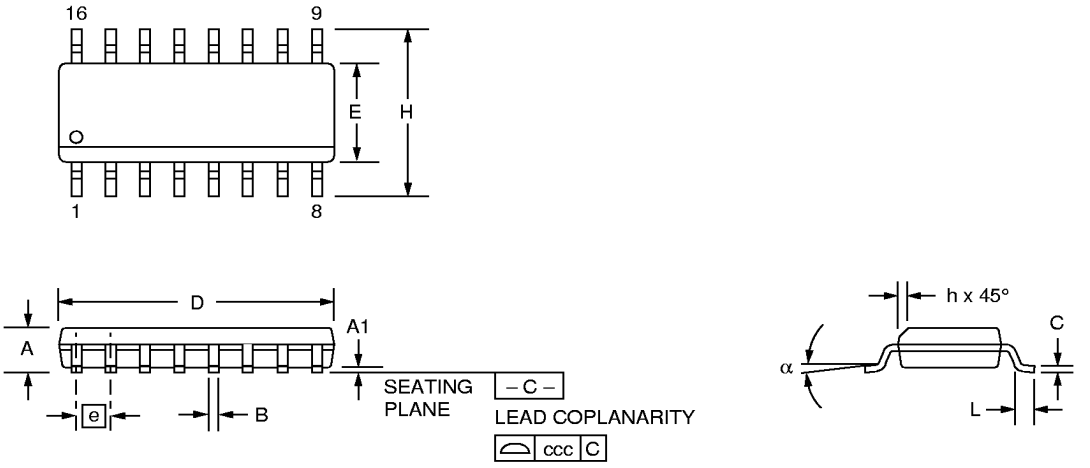
Notes:

Mechanical Dimensions – 16 Lead SOIC

Symbol	Inches		Millimeters		Notes
	Min.	Max.	Min.	Max.	
A	.053	.069	1.35	1.75	
A1	.004	.010	0.10	0.25	
B	.013	.020	0.33	0.51	
C	.008	.010	0.19	0.25	5
D	.386	.394	9.80	10.00	2
E	.150	.158	3.81	4.00	2
e	.050 BSC		1.27 BSC		
H	.228	.244	5.80	6.20	
h	.010	.020	0.25	0.50	
L	.016	.050	0.40	1.27	3
N	16		16		6
α	0°	8°	0°	8°	
ccc	—	.004	—	0.10	

Notes:

1. Dimensioning and tolerancing per ANSI Y14.5M-1982.
2. "D" and "E" do not include mold flash. Mold flash or protrusions shall not exceed .010 inch (0.25mm).
3. "L" is the length of terminal for soldering to a substrate.
4. Terminal numbers are shown for reference only.
5. "C" dimension does not include solder finish thickness.
6. Symbol "N" is the maximum number of terminals.



Advanced Preliminary

Ordering Information

Product Number	Package
RC5043M	16 pin SOIC

Preliminary Information

Raytheon Electronics
Semiconductor Division
350 Ellis Street
Mountain View CA 94043
415 968 9211
FAX 415 966 7742

4/96 0.0m
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