RCB005

5 Bit Voltage Regulator Module (VRM) for Pentium® II Processors

For 5V Power Supply

Features

• Programmable 1.3V to 3.5V output
• Output current to 15A
• 5-bit digital input selects output voltage
• Typical efficiency > 82%
• DC output accuracy within ±60mV
• Current limiting short-circuit protection
• Power Good output
• Output Enable function
• Excellent transient response
• Meets Intel VRM specifications

Applications

• Pentium II Klamath VRM
• Next generation Pentium II VRM

Description

The RCB005 is a programmable DC-DC VRM designed to deliver the selectable processor core voltage required by Pentium II microprocessors. This VRM converts the +5V power supply voltage to the voltage required by the CPU. The RCB005 takes full advantage of Raytheon's RC5051 programmable DC-DC controller IC, utilizing synchronous architecture for maximum efficiency. This VRM integrates a 5-bit DAC function, Power Good, and Output Enable features. The result is a VRM with a minimum number of components that achieves high reliability at a competitive cost.

The RCB005 provides an extremely well regulated selectable output voltage from 1.3V to 3.5V. Voltage selection is accomplished through a 5-bit digital input. The Power Good output provides a logic LOW when an out-of-tolerance voltage is detected at the VRM output. Other features include high efficiency, short-circuit and over-voltage protection, output enable, and low package weight. The RCB005 VRM module is designed as a point-of-load converter for Pentium II processors, minimizing the distribution losses normally occuring when drawing high currents from a centralized power supply.
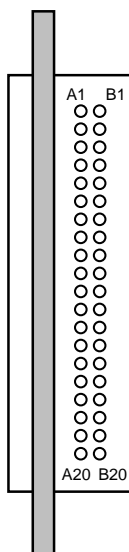
Block Diagram

65-RCB005-1

Rev 1.1.0
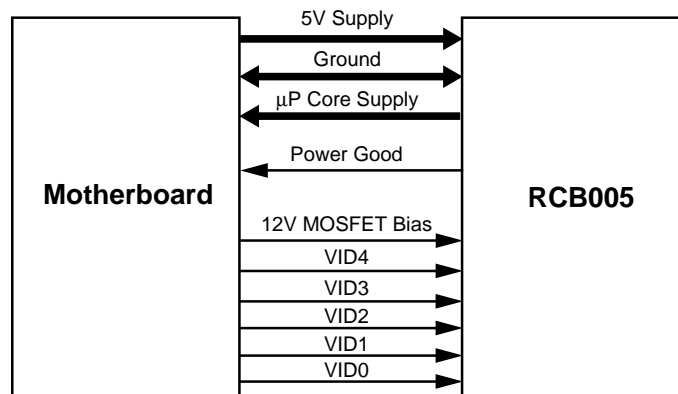
Pin Orientation — Top View

(Socket: AMPMOD2 532956-7 or equivalent)

A1   B1

A20 B20

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Table 1. RCB005 Pin Definitions

Pin #	Row A	Row B
1	5Vin	5Vin
2	5Vin	5Vin
3	5Vin	5Vin
4	12Vin	12Vin
5	12Vin	NC[1]
6	NC[1]	OUTEN
7	VID0	VID1
8	VID2	VID3
9	VID4	PWRGD
10	V_{CCCORE}	Vss
11	Vss	V_{CCCORE}
12	V_{CCCORE}	Vss
13	Vss	V_{CCCORE}
14	V_{CCCORE}	Vss
15	Vss	V_{CCCORE}
16	V_{CCCORE}	Vss
17	Vss	V_{CCCORE}
18	V_{CCCORE}	Vss
19	Vss	V_{CCCORE}
20	V_{CCCORE}	Vss

Note:

1. Not used on module; no current is drawn.

VRM Connector Pin Reference

Pin Description	Input/Output	Function
5Vin	I	Primary module supply voltage.
12Vin	I	MOSFET bias supply voltage.
OUTEN (Output Enable) Open collector TTL input.	I	If OUTEN = HIGH (floating), output enabled. If OUTEN = LOW, output disabled and PWRGD output LOW.
VID0 to VID4 (Voltage Identification Code) Open collector TTL inputs.	I	These five signals are used to indicate the voltage required by the processor. See Table 2.
PWRGD (Power Good) Open collector TTL output.	O	If PWRGD = HIGH, output voltage within specifications. If PWRGD = LOW, output voltage not within ±10% of nominal. The PWRGD output will change to the proper state within 5ms of the output coming into or going out of its specified range.
V_{CCCORE}	O	Processor core voltage.
Vss	I, O	Ground.

Table 2. Output Voltage vs. Voltage Identification Code

VID4	VID3	VID2	VID1	VID0	Nominal Voltage to CPU (V$_{CCCORE}$)	VID4	VID3	VID2	VID1	VID0	Nominal Voltage to CPU (V$_{CCCORE}$)
0	1	1	1	1	1.30V	1	1	1	1	1	2.0V
0	1	1	1	0	1.35V	1	1	1	1	0	2.1V
0	1	1	0	1	1.40V	1	1	1	0	1	2.2V
0	1	1	0	0	1.45V	1	1	1	0	0	2.3V
0	1	0	1	1	1.50V	1	1	0	1	1	2.4V
0	1	0	1	0	1.55V	1	1	0	1	0	2.5V
0	1	0	0	1	1.60V	1	1	0	0	1	2.6V
0	1	0	0	0	1.65V	1	1	0	0	0	2.7V
0	0	1	1	1	1.70V	1	0	1	1	1	2.8V
0	0	1	1	0	1.75V	1	0	1	1	0	2.9V
0	0	1	0	1	1.80V	1	0	1	0	1	3.0V
0	0	1	0	0	1.85V	1	0	1	0	0	3.1V
0	0	0	1	1	1.90V	1	0	0	1	1	3.2V
0	0	0	1	0	1.95V	1	0	0	1	0	3.3V
0	0	0	0	1	2.00V	1	0	0	0	1	3.4V
0	0	0	0	0	2.05V	1	0	0	0	0	3.5V

Note:

1. "0" indicates processor pin is tied to 0V (V$_{SS}$)
   "1" indicates it is tied to 5V or is open.

Electrical Specifications

5Vin = +5V, 12Vin = +12V, T_A = 0°C to 60°C, Vcc_{CORE} = 2.8V, and airflow of 100LFM, unless otherwise specified.

| Parameter		Test Conditions	Min.	Typ.	Max.	Units
Input Specifications						
Primary Module Supply, 5Vin			4.75	5	5.25	V
MOSFET Bias Supply, 12Vin			11.4	12	12.6	V
Output Specifications						
Output Voltage Range, Vcc_{CORE}		See Table 2	1.3		3.5	V
Output Voltage Regulation	Steady State[2]	Vcc_{CORE} = 2.8V, $Icc_{CORE, Max}$ = 14.2A	2.74	2.80	2.90	V
	Transient[3]	Vcc_{CORE} = 2.8V, Icc_{CORE} = 1.0 to 14.2A	2.67	2.80	2.93	
Output Voltage Regulation	Steady State[2]	Vcc_{CORE} = 2.0V, $Icc_{CORE, Max}$ = 11.1A	1.94	2.0	2.06	V
	Transient[3]	Vcc_{CORE} = 2.0V, Icc_{CORE} = 0.5 to 11.1A	1.90	2.0	2.10	
Output Current, Icc_{CORE}			0.3		15	A
Initial Voltage Setpoint		Icc_{CORE} = 6A, T_A = 25°C		±20		mV
Load Regulation		Icc_{CORE} = 0.8A to 14.2A		-40		mV
Line Regulation		5Vin = 4.75V to 5.25V		±2		mV
Output Ripple		20MHz BW, Icc_{CORE} = 14.2A		20		mVp-p
Output Temperature Drift				+10		mV
Efficiency		Icc_{CORE} = 0.5A Icc_{CORE} = 14A	40 80	67 82		%
Turn-on Response Time					10	ms
General Specifications						
Switching Frequency				300		kHz
Short Circuit Protection				18		A

Notes:

1. The voltage tolerance is measured at the DC-DC converter Header Output on the motherboard.

2. The Steady State Voltage Regulation includes Initial Voltage Setpoint, DC load regulation, Output Ripple and temperature drift, measured with a digital voltmeter with 1mV resolution. $Icc_{CORE, MIN}$ = 0.1A unless otherwise specified.

3. The output voltage is measured using the Intel provided EMT Tester (Rev. 1.0). It is assumed that a minimum of 20 x 0.1μF ceramic capacitors are placed directly next to the CPU to provide adequate high-speed decoupling. Additional bulk capacitors may be required as closely as possible to the CPU socket on the motherboard when using the VRM. See Application Bulletin AB 5 for details.
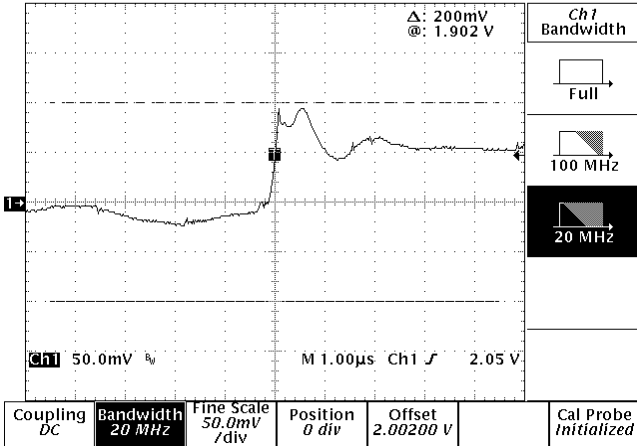
Transient Plots

Transient Plot, Vout =2.8V, Iload=14.2A to 0.8A
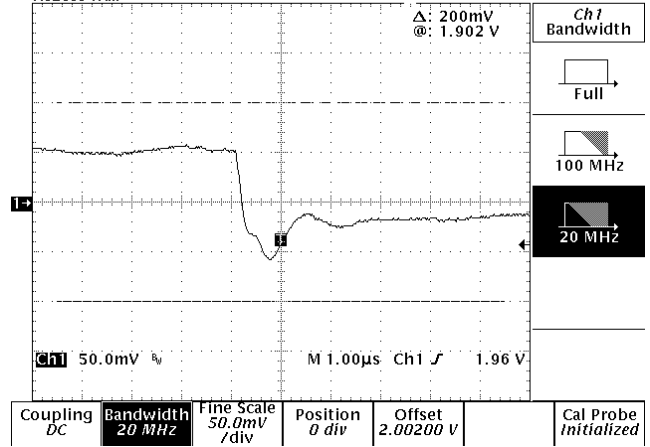RCB005 VRM
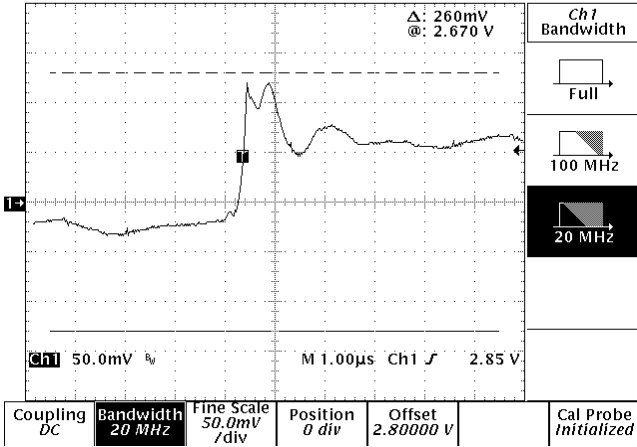
Transient Plot, Vout=2.8V, Iload=0.5A to 14.2A
RCB005 VRM
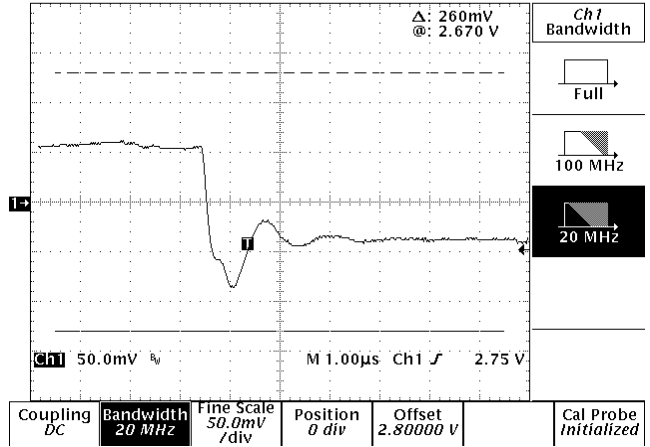
Transient Plot Vout=2.0V, Iload=11.1A to 0.5A
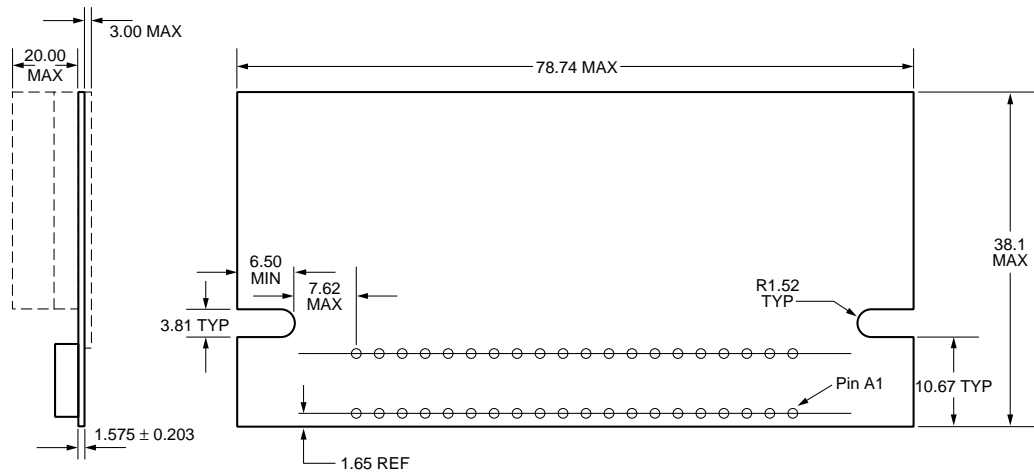RCB005 VRM

Transient Plot Vout=2.0V, Iload=0.5A to 11.1A
RCB005 VRM

Notes:

Mechanical Dimensions (mm)

Ordering Information

Part Number	Input	Output Current
RCB005	5V DC	15A