RCB004

Voltage Regulator Module (VRM)
for Pentium® Pro and Pentium II Processors

Features

- Programmable 1.3V to 3.5V output from 5V supply using 5-bit digital input
- Maximum output current 13A
- Typical efficiency > 83%
- Output initial setpoint tolerance typically ±1%
- Short circuit protection with current foldback
- Power Good output
- Output Enable function
- Excellent transient response
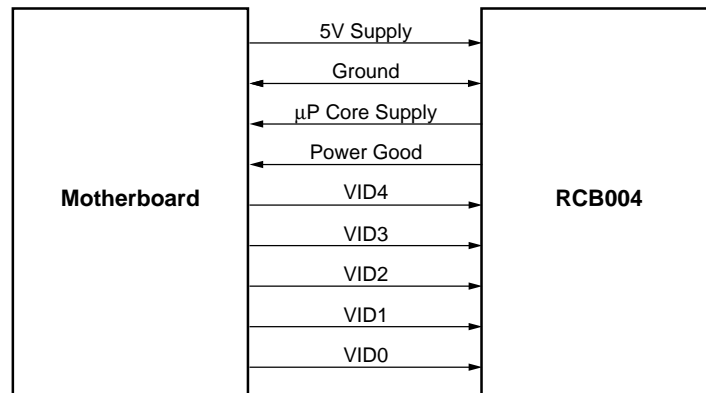- Meets Intel Pentium II VRM 8.1 specification

Applications

- Motherboard VRM module
- Programmable power supply module
- Template for motherboard implementation

Description

The RCB004 is a non-synchronous programmable DC-DC VRM designed to deliver the selectable processor core voltage required by Pentium Pro and Pentium II microprocessors. This VRM offers the flexibility to support both the Pentium Pro and Pentium II processors with a single motherboard design. The RCB004 takes full advantage of a proprietary Raytheon Electronics programmable DC-DC controller IC that integrates the 5-bit DAC function, and 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 synchronous counterpart to the RCB004, the RCB005, offers higher efficiency, which can be significant in the lower output range.

The RCB004 provides an extremely well regulated selectable output voltage from 1.3V to 3.5V. Voltage selection is accomplished throught a 5-bit digital input (VID0 to VID4). The Power Good open collector outputs a logic LOW when an out-of-tolerance voltage is detected at the VRM output. Other features include high efficiency, short circuit protection, output enable, and low package weight. The RCB004 VRM module is designed as a point-of-load converter for Pentium Pro and Pentium II processors, minimizing the distribution losses normally occuring when drawing high currents from a centralized power supply.
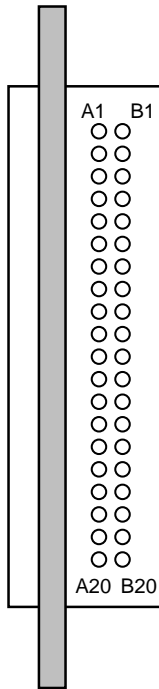
Block Diagram

Motherboard		RCB004
	5V Supply	
	Ground	
	µP Core Supply	
	Power Good	
	VID4	
	VID3	
	VID2	
	VID1	
	VID0	

65-RCB004-01

Rev 0.9.6

Preliminary Information

Pin Orientation - Top View
(Socket: AMPMOD2 532956-7 or equivalent)

A1 B1
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A20 B20

Table 1. RCB004 Pin Definitions

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

Note:

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

VRM Connector Pin Reference

Pin Description	Input/ Output	Function
PWRGD (Power Good) Open collector TTL output.	O	If PWRGD = HIGH, output voltage withing 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.
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 ID) Open collector TTL inputs.	I	These five signals are used to indicate the voltage required by the processor. See Table 2.
$5V_{IN}$	I	Primary module supply voltage.
$12V_{IN}$	I	MOSFET bias supply voltage
$V_{CC}P$	O	Processor core VCC.
V_{SS}	I,O	Ground.

## Electrical Specifications (V_{IN} = +5V, T_A = 0°C to 60°C, VID4–VID0 = 10111 (V_{CCP} = 2.8V), 100LFM airflow, 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[1] Transient[2]	Vcc_{CORE} = 2.8V Icc_{CORE} = 0.8 to 13.2A, 20A/µs	2.74 2.66	2.80 2.80	2.90 2.94	V V
Output Voltage Regulation Steady State[1] Transient[2]	Vcc_{CORE} = 1.8V Icc_{CORE} = 0.8 to 11.7A, 20A/µs	1.74 1.70	1.80 1.80	1.90 1.90	V V
Output Current, Icc_{CORE}				13.2	A
Initial Voltage Setpoint	Icc_{CORE} = 6A, T_A = 25°C		±20		mV
Load Regulation	Icc_{CORE} = 0.8A to 13.2A		±30		mV
Line Regulation	5Vin = 4.75V to 5.25V		±2		mV
Output Ripple	20MHz BW, Icc_{CORE} = 13.2A		20		mVp-p
Output Temperature Drift			+10		mV
Efficiency	Icc_{CORE} = 0.8A Icc_{CORE} = 13.2A	40 80	67 84		%
Turn-on Response Time				10	ms
General Specifications					
Switching Frequency			300		KHz
Short Circuit Protection			18		A

Notes:

1. Steady State Voltage Regulation includes Initial Voltage Setpoint, DC load regulation, output ripple/noise and temperature drift.

2. The output voltage measured at the converter output will be within the voltage range specified as a result of a load transient occuring at a slew rate of 20A/µs. These specifications assume a minimum of 20 x 0.1µF ceramic capacitors are placed directly next to the CPU in order to provide adequate high-speed decoupling. Additional bulk capacitors may be required directly next to the CPU when using any VRM; see Application Bulletin AB 5 for details.

Mechanical Dimensions (mm)
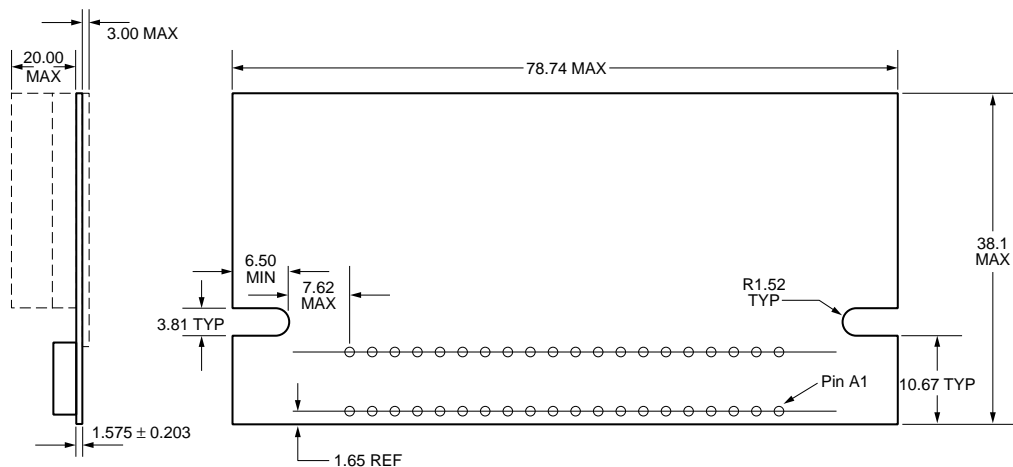
Preliminary Information

Table 2. Output Voltage vs. Voltage Identification Code

VID4	VID3	VID2	VID1	VID0	Nominal Voltage to CPU (Vcc_{CORE})	VID4	VID3	VID2	VID1	VID0	Nominal Voltage to CPU (Vcc_{CORE})
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.

Ordering Information

Part Number	Input	Output Current
RCB004-12	5V DC	13A
RCB004	5V DC	13A