

# 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  $\pm 1\%$
- Short circuit protection with current foldback
- Power Good output
- Output Enable function
- Excellent transient response
- Meets Intel Pentium II VRM 8.1 specification

### Applications

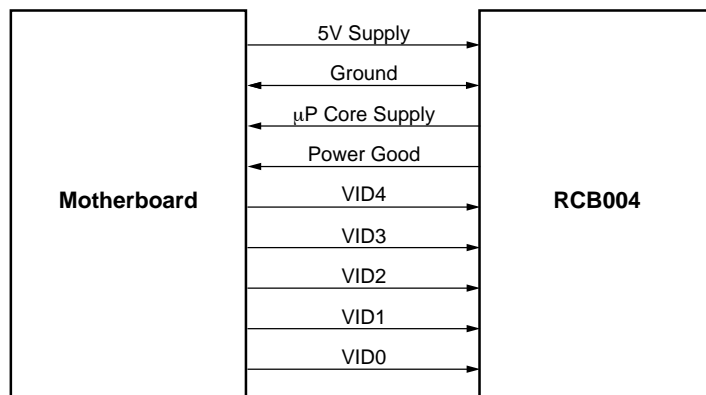
- Motherboard VRM module
- Programmable power supply module
- Template for motherboard implementation

### 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 Fairchild 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 through 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 occurring when drawing high currents from a centralized power supply.

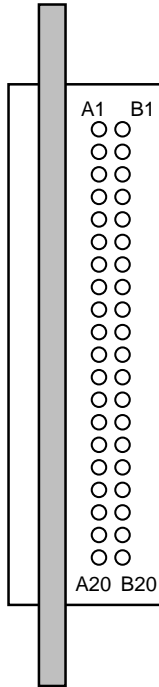
### Block Diagram



65-RCB004-01

Preliminary Information

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



### Table 1. RCB004 Pin Definitions

Pin #	Row A	Row B
1	5Vin	5Vin
2	5Vin	5Vin
3	5Vin	5Vin
4	12Vin	12Vin
5	NC <sup>1</sup>	NC <sup>1</sup>
6	NC <sup>1</sup>	OUTEN
7	VID0	VID1
8	VID2	VID3
9	VID4	PWRGD
10	V <sub>CCP</sub>	V <sub>SS</sub>
11	V <sub>SS</sub>	V <sub>CCP</sub>
12	V <sub>CCP</sub>	V <sub>SS</sub>
13	V <sub>SS</sub>	V <sub>CCP</sub>
14	V <sub>CCP</sub>	V <sub>SS</sub>
15	V <sub>SS</sub>	V <sub>CCP</sub>
16	V <sub>CCP</sub>	V <sub>SS</sub>
17	V <sub>SS</sub>	V <sub>CCP</sub>
18	V <sub>CCP</sub>	V <sub>SS</sub>
19	V <sub>SS</sub>	V <sub>CCP</sub>
20	V <sub>CCP</sub>	V <sub>SS</sub>

#### 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 within specifications. If PWRGD = LOW, output voltage not within $\pm 10\%$ 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.
5VIN	I	Primary module supply voltage.
12VIN	I	MOSFET bias supply voltage
V <sub>CCP</sub>	O	Processor core VCC.
V <sub>SS</sub>	I,O	Ground.

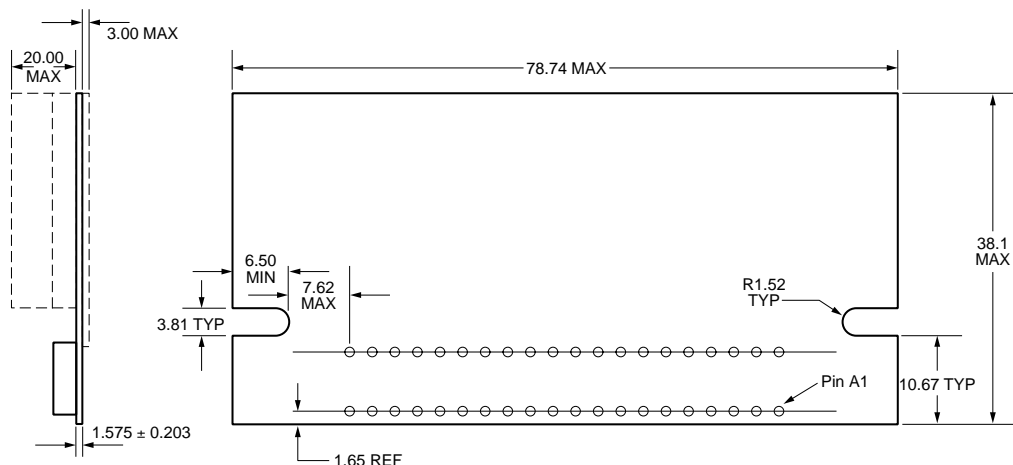
**Electrical Specifications** ( $V_{IN} = +5V$ ,  $T_A = 0^{\circ}C$  to  $60^{\circ}C$ , VID4–VID0 = 10111 ( $V_{CCP} = 2.8V$ ), 100LFM airflow, unless otherwise specified.)

Parameter	Test Conditions	Min.	Typ.	Max.	Units
<b>Input Specifications</b>					
Primary Module Supply, 5Vin		4.75	5	5.25	V
MOSFET Bias Supply, 12Vin		11.4	12	12.6	V
<b>Output Specifications</b>					
Output Voltage Range, $V_{CCORE}$	See Table 2	1.3		3.5	V
Output Voltage Regulation Steady State <sup>1</sup> Transient <sup>2</sup>	$V_{CCORE} = 2.8V$ $I_{CCORE} = 0.8$ to $13.2A$ , $20A/\mu s$	2.74	2.80	2.90	V
		2.66	2.80	2.94	V
Output Voltage Regulation Steady State <sup>1</sup> Transient <sup>2</sup>	$V_{CCORE} = 1.8V$ $I_{CCORE} = 0.8$ to $11.7A$ , $20A/\mu s$	1.74	1.80	1.90	V
		1.70	1.80	1.90	V
Output Current, $I_{CCORE}$				13.2	A
Initial Voltage Setpoint	$I_{CCORE} = 6A$ , $T_A = 25^{\circ}C$		$\pm 20$		mV
Load Regulation	$I_{CCORE} = 0.8A$ to $13.2A$		$\pm 30$		mV
Line Regulation	$5V_{in} = 4.75V$ to $5.25V$		$\pm 2$		mV
Output Ripple	20MHz BW, $I_{CCORE} = 13.2A$		20		mVp-p
Output Temperature Drift			+10		mV
Efficiency	$I_{CCORE} = 0.8A$ $I_{CCORE} = 13.2A$	40	67		%
		80	84		%
Turn-on Response Time				10	ms
<b>General Specifications</b>					
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 occurring at a slew rate of  $20A/\mu s$ . These specifications assume a minimum of  $20 \times 0.1\mu F$  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 (V <sub>CC</sub> CORE)
0	1	1	1	1	1.30V
0	1	1	1	0	1.35V
0	1	1	0	1	1.40V
0	1	1	0	0	1.45V
0	1	0	1	1	1.50V
0	1	0	1	0	1.55V
0	1	0	0	1	1.60V
0	1	0	0	0	1.65V
0	0	1	1	1	1.70V
0	0	1	1	0	1.75V
0	0	1	0	1	1.80V
0	0	1	0	0	1.85V
0	0	0	1	1	1.90V
0	0	0	1	0	1.95V
0	0	0	0	1	2.00V
0	0	0	0	0	2.05V

VID4	VID3	VID2	VID1	VID0	Nominal Voltage to CPU (V <sub>CC</sub> CORE)
1	1	1	1	1	2.0V
1	1	1	1	0	2.1V
1	1	1	0	1	2.2V
1	1	1	0	0	2.3V
1	1	0	1	1	2.4V
1	1	0	1	0	2.5V
1	1	0	0	1	2.6V
1	1	0	0	0	2.7V
1	0	1	1	1	2.8V
1	0	1	1	0	2.9V
1	0	1	0	1	3.0V
1	0	1	0	0	3.1V
1	0	0	1	1	3.2V
1	0	0	1	0	3.3V
1	0	0	0	1	3.4V
1	0	0	0	0	3.5V

**Note:**

- "0" indicates processor pin is tied to 0V (VSS), "1" indicates it is tied to 5V or is open.

**Ordering Information**

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

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Preliminary Information