

RCB005-K

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

For 5V Input Voltage

Features

- Programmable 1.3V to 3.5V output
- Output current to 15A
- 5-bit digital input selects output voltage
- Current limiting short-circuit protection
- Power Good output
- Output Enable function
- Excellent transient response
- Meets Intel VRM specifications

Applications

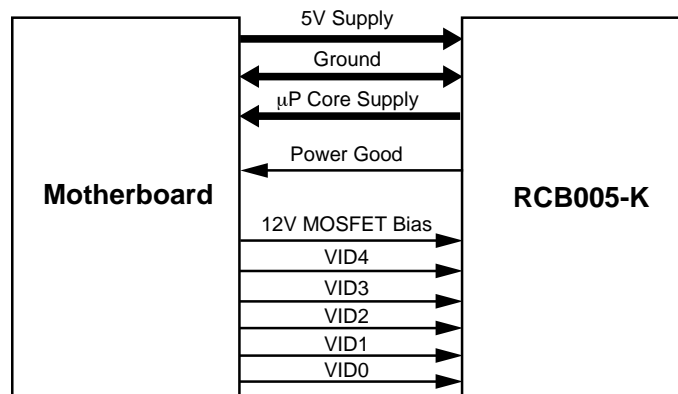
- Pentium II (Klamath type) 233—300MHz VRM

Description

The RCB005-K 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-K takes full advantage of Fairchild'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-K 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-K VRM module is designed as a point-of-load converter for Pentium II (Klamath type) processors, minimizing the distribution losses normally occurring when drawing high currents from a centralized power supply.

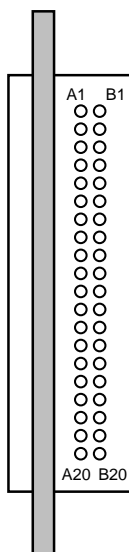
Block Diagram



65-RCB005-1

Pin Orientation — Top View

(Socket: AMPMOD2 532956-7 or equivalent)



65-RCB005-2

Table 1. RCB005-K 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 | VCCCORE | Vss |
| 11 | Vss | VCCCORE |
| 12 | VCCCORE | Vss |
| 13 | Vss | VCCCORE |
| 14 | VCCCORE | Vss |
| 15 | Vss | VCCCORE |
| 16 | VCCCORE | Vss |
| 17 | Vss | VCCCORE |
| 18 | VCCCORE | Vss |
| 19 | Vss | VCCCORE |
| 20 | VCCCORE | 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 $\pm 10\%$ 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. |
| VCCCORE | 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 _{CC} 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 _{CC} 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 (V_{SS})
 "1" indicates it is tied to 5V or is open.

Electrical Specifications

5Vin = +5V, 12Vin = +12V, TA = 0°C to 60°C, VCCORE = 2.8V, and airflow of 100LFM, unless otherwise specified.

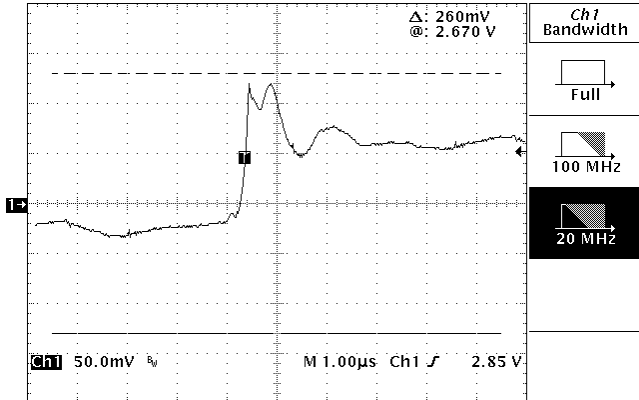
| Parameter | | Test Conditions | Min. | Typ. | Max. | Units |
|-------------------------------|-----------------------------|--------------------------------------|------|------|------|-------|
| Input Specifications | | | | | | |
| Primary Module Supply, 5Vin | | | 4.75 | 5 | 5.25 | V |
| MOSFET Bias Supply, 12Vin | | | 11.4 | 12 | 12.6 | V |
| Output Specifications | | | | | | |
| Output Voltage Range, VCCORE | | See Table 2 | 1.3 | | 3.5 | V |
| Output Voltage Regulation | Steady State ^{1,2} | VCCORE = 2.8V, ICCORE, Max = 14.2A | 2.74 | 2.80 | 2.90 | V |
| | Transient ^{1,3} | VCCORE = 2.8V, ICCORE = 1.0 to 14.2A | 2.67 | 2.80 | 2.93 | |
| Output Current, ICCORE | | | 0.3 | | 15 | A |
| Initial Voltage Setpoint | | ICCORE = 6A, TA = 25°C | | ±20 | | mV |
| Load Regulation | | ICCORE = 0.8A to 14.2A | | -40 | | mV |
| Line Regulation | | 5Vin = 4.75V to 5.25V | | ±2 | | mV |
| Output Ripple | | 20MHz BW, ICCORE = 14.2A | | 20 | | mVp-p |
| Output Temperature Drift | | | | +10 | | mV |
| Efficiency | | ICCORE = 0.5A | 40 | 67 | | % |
| | | ICCORE = 14.2A | 80 | 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. ICCORE, 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 close as possible to the CPU socket on the motherboard when using the VRM. See Application Bulletin AB 5 for details.

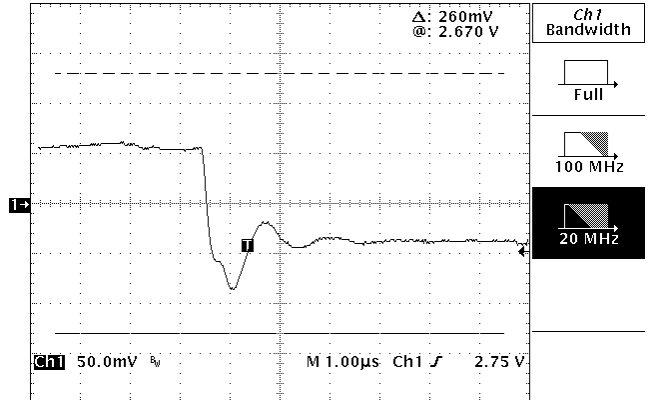
Transient Plots

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



| | | | | | |
|----------------|---------------------|--------------------------|-------------------|---------------------|--------------------------|
| Coupling DC | Bandwidth 20 MHz | Fine Scale 50.0mV/div | Position 0 div | Offset 2.80000 V | Cal Probe Initialized |
|----------------|---------------------|--------------------------|-------------------|---------------------|--------------------------|

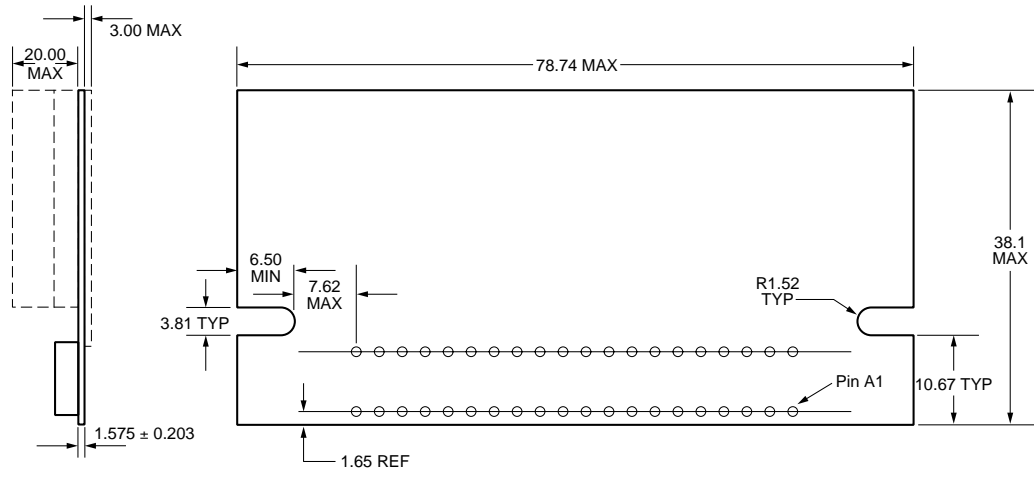
Transient Plot, Vout=2.8V, Iload=0.5A to 14.2A
RCB005 VRM



| | | | | | |
|----------------|---------------------|--------------------------|-------------------|---------------------|--------------------------|
| Coupling DC | Bandwidth 20 MHz | Fine Scale 50.0mV/div | Position 0 div | Offset 2.80000 V | Cal Probe Initialized |
|----------------|---------------------|--------------------------|-------------------|---------------------|--------------------------|

Notes:

Mechanical Dimensions (mm)



Ordering Information

| Part Number | Input | Output Current |
|-------------|-------|----------------|
| RCB005-K | 5V DC | 15A |

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