RCB001

Voltage Regulator Module (VRM) for Pentium® Pro Processors

Features

- Programmable 2.0V to 3.5V output from 5V supply
- Maximum output current 12.4A
- Typical Efficiency > 84%
- Total output accuracy typically ±3%
- Short circuit protection
- Power Good output
- Output Enable function
- Excellent transient response
- Meets Intel Pentium Pro VRM specifications

Applications

- Pentium Pro motherboard VRM module
- Programmable power supply module
- Template for motherboard implementation

Description

The RCB001 VRM module is a programmable DC-DC voltage regulator module designed to deliver the selectable processor core voltage required by the Pentium Pro micro-processor family. This VRM module provides the flexibility to board designers to support the entire Pentium Pro processor family with a single motherboard design. The RCB001 design takes full advantage of a proprietary Raytheon pro-grammable DC-DC voltage controller IC which integrates the DAC function as well as the Power Good and Output Enable features. The result is a voltage regulator module that uses a minimum number of external components to achieve high reliability at a competitive cost. The RCB001 provides an extremely well regulated voltage selectable from 2.0V to 3.5V. Voltage selection is accomplished through a 4 bit digi-tal input (VID0 - VID3) and can be incremented in 100mV steps. The Power Good open collector output provides a logic LOW state when an out-of-tolerance voltage is detected at the VRM output. Other features include high effi-ciency, short circuit protection, output enable and low pack-age weight. The RCB001 VRM module is designed as a point-of-load converter for the Pentium Pro processor, thus minimizing the distribution losses normally occuring when drawing high currents from a centralized power supply.

Block Diagram
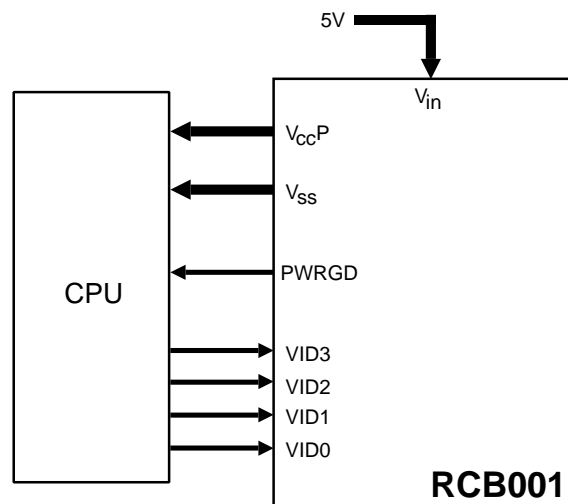
Mechanical Dimensions (mm):
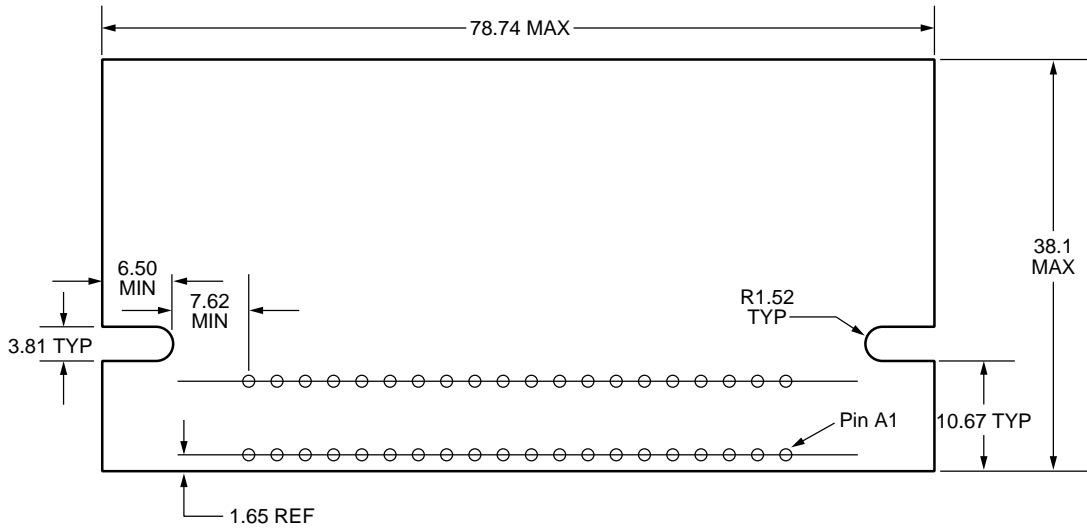
Pin Orientation
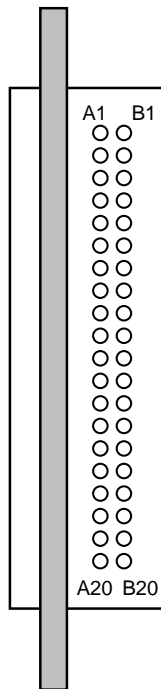**(Top View)**

(socket: AMPMOD2 532956-7 or equivalent)

Table 1. VRM Pin Definitions

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

Notes:

1. Not used on module; no current is drawn.
2. This pin is not used on the RCB001-12A.

VRM Connector Pin Reference

Pin Name	Input/Output	Function
Power-Good (PWRGD) (Open collector TTL output)	O	PWRGD = High, output voltage within specifications PWRGD = Low, output voltage not within specifications (nominal or selected voltage ±10%) The PWRGD signal will change to the proper state within 5ms of the output coming into or going out of its specified range.
Output Enable (OUTEN)[1] (Open collector TTL input)	I	OUTEN = Floating or high, output enabled OUTEN = Low, output disabled and PWRGD = Low
Voltage Identification (VID0 to VID3) (Open collector TTL input)	I	These four signals are used to indicate the voltage required by the processor. See Table 2.
5 V_{IN}	I	Module supply voltage.
V_{CCP}	O	Processor core V_{CC}
V_{SS}	I, O	Ground reference voltage.

Note:

1. This pin is not used on the RCB001-12A.

Electrical Specifications

(V_{IN} = +5V, T_A = 0 to 70°C unless otherwise specified)

Parameter	Test Conditions	Min.	Typ.	Max.	Units
Input Specifications					
Input Voltage, V_{IN}		4.75	5	5.25	V
Output Specifications					
Output Voltage (V_{CCP}) Range	Intel VID code, Table 2	2.0		3.5	V
DC Output Current, I_{OUT}	RCB001-12 and RCB001-12A	0.5		12.4	A
Set Point Accuracy[1]	I_{LOAD} = 5.25A, T_A = 25°C		±0.8	±1.5	%
DC Load Regulation	I_{LOAD} = 0.5A to 12.4A		0.8	±1.5	%
Line Regulation	4.75 ≤ V_{IN} ≤ 5.25		0.1	±0.2	%
Output Ripple and Noise	I_{LOAD} = 10A, BW = 20MHz		30		mVpp
Output Temperature Drift			+20		ppm/°C
Load Transient	I_{LOAD} = 0.5A to 10A, 30A/μSec VID code 0010 (V_{CCP} =3.3V)		100	120	mV
Cumulative Accuracy	All Conditions, see Note 2		±3	±5	%
Efficiency	I_{LOAD} = 0.5A	40	67		%
	I_{LOAD} = 10A	80	84		%
General Specifications					
Switching Frequency			650		kHz
Short Circuit Protection			16		A

Notes:

1. Set Point Accuracy is defined as the static accuracy of the output voltage at 5.25A @ T_A = 25°C.

2. Cumulative Accuracy includes Setpoint Accuracy, Output Temperature Drift, Line and Load Regulation, Output Ripple/Noise and Load Transient Response.

Table 2. Voltage Identification (VID) and Overall Regulation[1]

Pentium Pro Processor Pins				Output (V$_{CC}$P)		
VID3	VID2	VID1	VID0	Min.	Nominal	Max.
1	1	1	1	1.900 V	2.0V	2.100V
1	1	1	0	1.995V	2.1V	2.205V
1	1	0	1	2.090V	2.2V	2.310V
1	1	0	0	2.185V	2.3V	2.415V
1	0	1	1	2.280V	2.4V	2.520V
1	0	1	0	2.375V	2.5V	2.625V
1	0	0	1	2.470V	2.6V	2.730V
1	0	0	0	2.565V	2.7V	2.835V
0	1	1	1	2.660V	2.8V	2.940V
0	1	1	0	2.755V	2.9V	3.045V
0	1	0	1	2.850V	3.0V	3.150V
0	1	0	0	2.945V	3.1V	3.255V
0	0	1	1	3.040V	3.2V	3.360V
0	0	1	0	3.135V	3.3V	3.465V
0	0	0	1	3.230V	3.4V	3.570V
0	0	0	0	3.325V	3.5V	3.675V

0 = Processor pin connected to V$_{SS}$

1 = Processor pin open

Note:

1. Includes set point accuracy, load transient, ripple and noise, thermal drift, load regulation and line regulation.

Ordering Information

Part Number[1]	Input	Maximum DC Output Current	Comments
RCB001-12	5V	12.4A	
RCB001-12A	5V	12.4A	No Output Enable

Note:

1. Please refer to our Application Note 42 (AP-42) for more information on the board level voltage regulator design using Raytheon's DC-DC voltage controllers (RC5040 and RC5042).