

**RUBY-MM-
1616A** 4/8/16
channel 16-bit
Analog Output
PC/104 Module
with Digital I/O



DIAMOND
S Y S T E M S

 **PC104**



16-Channel Model with 48 DIO

FEATURES

- 4, 8, or 16 analog outputs
- 16-bit D/A resolution
- Unipolar and bipolar operation
- Simultaneous updating of all outputs
- $\pm 10V$, $\pm 5V$, 0-10V, 0-5V voltage output ranges
- 0-20mA, 4-20mA, 0-24mA current output ranges
- Independent output range for each channel
- D/A digital calibration
- Waveform generator up to 16 channels
- 48 digital I/O lines, bit and byte-wide
- External trigger capability
- 2 32-bit programmable counter/timers
- 4 24-bit pulse width modulators
- Requires only +5V power supply
- Fully calibrated for highest accuracy
- PC/104 form factor (3.55" x 3.775") with ISA interface
- Operating temperature -40°C to +85°C

 **Description**

The Ruby-MM-1616 PC/104 module provides up to 16 channels of 16-bit resolution analog voltage or current output. The output range can be individually selected for 0-5V, 0-10V, $\pm 5V$, $\pm 10V$, 0-20mA, 4-20mA, or 0-24mA. All outputs are updated simultaneously, either with a software command or in response to an external signal. A waveform generator is available on up to 16 channels with simultaneous updating of all channels.

The board also includes 48 lines of digital I/O, 40 lines of byte-wide and 8 lines of bit-wide, two 32-bit counter/timers, and four 24-bit pulse width modulators. Other features include +5V only operation, individual DC/DC converters with filtered outputs for each DAC to supply $\pm 15V$ for operation, and a six layer circuit board to bury and shield the analog signals.

Rugged Design for the Real World

Extended temperature capability of $-40^{\circ}C$ to $+85^{\circ}C$ enables the board to operate in environments with extreme temperature swings, such as vehicles or outdoor installations. In addition, the board may be custom-configured with 0-ohm resistors in place of jumpers for increased ruggedness in high-vibration environments. As with all of Diamond's analog I/O boards, Ruby-MM-1616 utilizes a 6-layer PCB with split analog and digital power and ground planes to keep the analog outputs quiet. All analog and digital lines reset to a known state on power up or system reset to guarantee predictable behavior. Factory calibration ensures the highest possible accuracy over the lifetime of the product. The board requires only +5V from the system power supply. These features make Ruby-MM-1616's quality and performance a leader in the market.

◆ Analog Output Ranges

A wide selection of output ranges is selectable on Ruby-MM-1616A. Each output can have its own output range. The table below lists the available output ranges and the associated resolution.

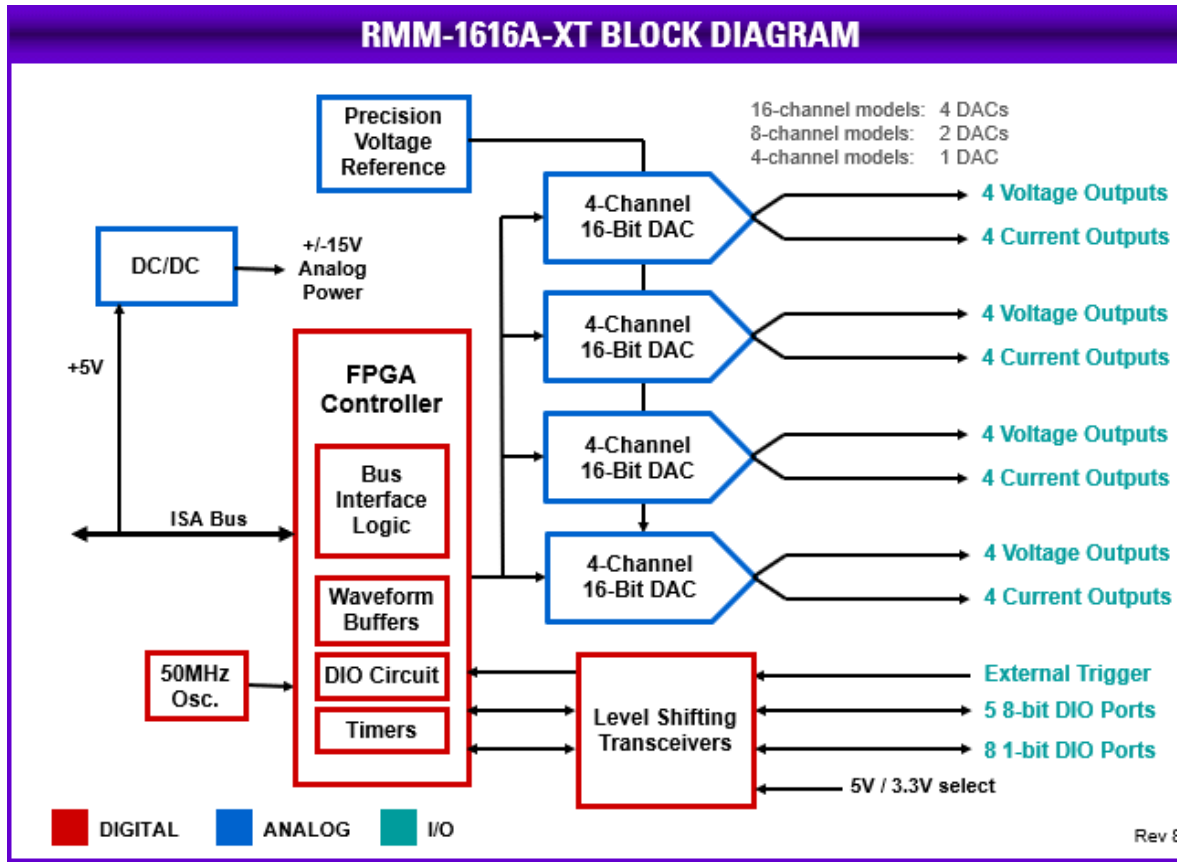
Output Range	Resolution (1 LSB)
$\pm 5V$	153 μV
$\pm 10V$	310 μV
0 - 10V	153 μV
0 - 5V	76 μV
0 - 20mA	1 LSB
4 - 20mA	1 LSB
0 - 24mA	1 LSB

◆ Simultaneous Update

All analog outputs are updated simultaneously with a single read command. This feature minimizes time skew effects when multiple channels are being used to control a single device (for example, when two channels are controlling the X-Y position on a laser). When an update command occurs, only channels with new data written to them will

change; the remaining channels will maintain their current output voltage level without interruptions or glitches.

◆ Block Diagram



◆ Software Support

The Ruby-MM-1616 ships with Diamond's free [Universal Driver software](#) for C language programming under Windows 7, Windows Embedded 7, Windows XP, Linux and DOS. All major functions of the board are supported by the driver and example programs are also included. Some examples of the supported board operations are:

- Analog output on single channel
- Analog output on multiple channels with simultaneous update
- Interrupt-driven analog outputs with internal or external trigger
- Digital input, bit, byte, and word
- Digital output, bit, byte, and word

◆ Analog I/O Header Pinout

Vout 0	1	2	Iout 0
Agnd	3	4	Vout 1
Iout 1	5	6	Agnd

Vout 2	7	8	Iout 2
Agnd	9	10	Vout 3
Iout 3	11	12	Agnd
Vout 4	13	14	Iout 4
Agnd	15	16	Vout 5
Iout 5	17	18	Agnd
Vout 6	19	20	Iout 6
Agnd	21	22	Vout 7
Iout 7	23	24	Agnd
Vout 8	25	26	Iout 8
Agnd	27	28	Vout 9
Iout 9	29	30	Agnd
Vout 10	31	32	Iout 10
Agnd	33	34	Vout 11
Iout 11	35	36	Agnd
Vout 12	37	38	Iout 12
Agnd	39	40	Vout 13
Iout 13	41	42	Agnd
Vout 14	43	44	Iout 14
Agnd	45	46	Vout 15
Iout 15	47	48	Agnd
Ext Trig	49	50	Dgnd

Analog Outputs	
Number of outputs	4, 8, or 16
Resolution	16-bits
Output ranges	0-5V, 0-10V unipolar, ±5V, ±10V bipolar 0-20mA, 4-20mA, 0-24mA

Settling time	10 μ s maximum to \pm .003%
Linearity error	\pm 2 LSB maximum
Differential nonlinearity	\pm 2 LSB maximum
Monotonicity	15 bits minimum
Maximum output current	\pm 5mA/2K Ω minimum load
Reset	All DACs reset to 0V
Calibration	Digital with internal scale and offset registers for each channel
Waveform generator	Up to 16 channels
Digital I/O	
Number of lines	40 byte-wide, 8 bit-wide, programmable direction CMOS/TTL compatible (82C55)
Input voltage	Logic 0: -0.5V min, 0.8V max Logic 1: 2.0V min, 5.5V max
Output voltage	Logic 0: 0.0V min, 0.4V max Logic 1: 3.0V min, 4.6V max
Output current	\pm 2.5mA maximum per line
Pull-up resistor	10K Ω on each I/O lines
External trigger	TTL/CMOS compatible, 10K Ω pull-up resistor, active high edge
Reset	All digital I/O lines are set to input and all data registers are set to 0
Counter/timers	2 32-bit programmable; 40MHz clock
Pulse width modulators	4 24-bit
General	
Input Power	+5VDC \pm 10%
Operating temperature	-40 $^{\circ}$ C to +85 $^{\circ}$ C Extended
Dimensions	90mm x 96mm (3.55" x 3.775")
Form Factor	PC/104 compliant
Weight	3.0oz (85g)
MTBF	100,000 hours
RoHS	Compliant

◆ Models and Accessories

Ruby-MM-1616A		
available models:		
RMM-1616A-XT	16 Channel 16-bit Analog Output PC/104 Module with 48 Digital I/O, extended temperature	Available
RMM-816A-XT	8 Channel 16-bit Analog Output PC/104 Module with 48 Digital I/O, extended temperature	Min Order Quantity
RMM-416A-XT	4 Channel 16-bit Analog Output PC/104 Module with 48 Digital I/O, extended temperature (minimum order quantities apply)	Min Order Quantity

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