



**Intronics  
Power®**

# IBM PC/XT/AT Compatible Multifunction Analog and Digital Boards

## RTI-800/815

### FEATURES

#### RTI-800 Analog Input and Digital I/O Board

- 16 Analog Input Channels (Expandable to 32)
- Software Programmable Gain 1, 10, 100 and 500
- 12-Bit 25 $\mu$ s A/D (Optional 8 and 12 $\mu$ s Versions)
- Throughputs up to 71,000 Sample/Second
- Three A/D Trigger Modes Including External Trigger
- 8 Digital Input and 8 Digital Output Channels
- 3 Counter/Timer Channels

#### RTI-815 Multifunction Analog Input/Output and Digital I/O Board

- (Same Features as RTI-800 and Includes)
- 2 Analog Output Channels
- 12-Bit Resolution

### GENERAL

- Supports DMA, Polled Status and Interrupt Operation
- Compatible to IBM PC/XT/AT\* or 100% Compatibles
- Optional Screw Termination Panels - AC1585

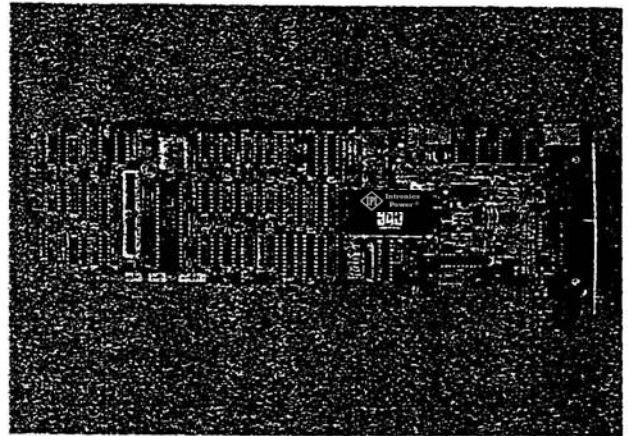
### TYPICAL APPLICATIONS

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|-----------------------------|-----------------|
| Electronic Test             | Process Control |
| Quality Assurance           | Data Logging    |
| Machine Control             | Instrumentation |
| Analytical Data Acquisition |                 |

### GENERAL DESCRIPTION

The RTI-800 and RTI-815, IBM-compatible members of the RTI® Interface family, are multifunction analog and digital I/O boards that plug into one of the expansion slots in the IBM PC/XT/AT. Their functions include analog input, analog output (RTI-815 only) digital I/O and time related functions.

The boards provide data acquisition for 16 single-ended or 8 differential channels with optional expansion to 32 single ended or 16 differential channels. The instrumentation amplifier is software selectable for gains of 1, 10, 100 and 500 which increases the dynamic input range for a variety of input signals. Combining this with a sample-hold circuit and a 12-bit A/D converter, the data acquisition section features  $\pm 0.02\%$  accuracy and 12-bit resolution with conversion times of either 8, 12 or 25 $\mu$ s (depending on option). The RTI-815 provides two analog output channels consisting of two 12-bit D/A converters.



The digital I/O is brought out on a separate connector and contains 8 digital inputs and 8 digital outputs. A counter/timer device is used to generate a pacer clock for A/D triggers and can be set up for event counting, frequency measurements, time proportional outputs, or single pulse outputs. This provides two channels of frequency measurements to 100kHz or three channels for event counting or pulse train outputs.

There are six interrupt lines (jumper selectable) to select from which are used by the PC to indicate an end of conversion. Several modes of A/D operation are possible, since the RTI-800/815 contains the hardware necessary to support Direct Memory Access (DMA), Polled Status, or Interrupt Operation.

The RTI-800/815 maps into the I/O channel address structure as 16 consecutive bytes, addressable in any unoccupied 16-byte boundary via a DIP switch. The board contains a dc/dc converter and is powered from the PC's +5V supply. It installs in one of the long slots in the PC expansion bus.

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\*IBM PC/XT/AT is a trademark of International Business Machines Corporation

# SPECIFICATIONS

(typical @ 25°C with nominal power supply voltage unless otherwise noted)

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## ANALOG INPUT

Number of Input Channels	16 Single-Ended, 8 Differential or 32 Single-Ended, 16 Differential Using MUX Expansion
Analog Resolution	12 Bits (4096 Counts)
A/D Ranges	0 to 10V; $\pm 5V$ ; $\pm 10V$
Instrumentation Amplifier Gain Ranges	1, 10, 100, 500V/V (Software Selectable)
A/D Conversion Time (Converter Only)	
RTI-800 and RTI-815	25 $\mu$ s
RTI-800-A and RTI-815-A	12 $\mu$ s
RTI-800-F and RTI-815-F	8 $\mu$ s
Measurement Accuracy	$\pm 0.02\%$ of Full-Scale Range (10V) $\pm 0.03\%$ of Full-Scale Range (1V) $\pm 0.12\%$ of Full-Scale Range (100mV) $\pm 0.25\%$ of Full-Scale Range (20mV)
Common Mode Rejection (CMR)	80dB
Linearity	$\pm 1/2$ LSB
Differential Nonlinearity	$\pm 1$ LSB max

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## ANALOG OUTPUT (RTI-815 ONLY)

Number of Output Channels	2
Output Voltage Ranges	0 to +10V, $\pm 10V$ @2mA
D/A Resolution	12 Bits (4096 Counts)
Analog Output Accuracy	$\pm 0.02\%$
Differential Nonlinearity	$\pm 1$ LSB max

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## DIGITAL I/O

Digital I/O	8-Bit Digital Input Port and 8-Bit Digital Output Port, Polarity Inverted for Solid-State Relay Subsystem Compatibility (Active Low)
Input/Output Configuration	TTL Compatible

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## TIME-RELATED DIGITAL I/O

Number of Counter/Timer Channels	3
Modes of Operation	Event Counting, Frequency Measurement, Pulse Output, Time Proportional Outputs
Event Counting	
Maximum Count Rate	100kHz
Range	65,531 (16 Bits)
Frequency Measurement	
Frequency Range	0 to 100kHz
Gate Time	1 $\mu$ s to 655.35 s (Programmable)
Resolution	16 Bits
Pulse Output (Single Pulse)	
Pulse Range	2 $\mu$ s to 655.35 s (Programmable)
Resolution	16 Bits
Time Proportional Outputs	
Duty Cycle Range	0 to 100%
Period Range	1 $\mu$ s to 655.35 s (Programmable)
Time Base Accuracy	$\pm 0.01\%$
Input/Output Configuration	TTL-Compatible

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## A/D PACER CLOCK

Number of Channels	1
Use	Time-Based Triggering for A/D Conversions
Resolution	5 Decades of 16-Bit Resolution
Period Range	3 $\mu$ s to 655.35 s

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## POWER

Power Consumption	+5V @ 1.1A
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Specifications subject to change without notice.

## ANALOG INPUT FEATURES

The standard version of the RTI-800/815 has two CMOS input multiplexers. Together, these multiplexers have analog input capabilities for 16 channels of single-ended inputs, 16 channels of pseudo-differential inputs, or 8 channels of differential inputs (jumper-selectable). With the addition of two user-installed multiplexers (Multiplexer Expansion Kit, Analog Devices P/N OA10), the user has the option of doubling the input channel capacity of the RTI-800/815 to 32 channels of single-ended or pseudo-differential inputs, or 16 channels of differential inputs.

The RTI-800/815 contains a software programmable instrumentation amplifier that is used to provide low-level analog input signals with gain settings of 1, 10, 100, or 500. In the  $\pm 10V$  A/D range these four gain settings allow accurate measurement of input signals in the range of  $\pm 10V$ ,  $\pm 1V$ ,  $\pm 100mV$ ,  $\pm 20mV$ , respectively. In the 0 to  $+10V$  A/D range these four gain settings allow accurate measurement of input signals in the range of 0 to  $+10V$ , 0 to  $+1V$ , 0 to  $+100mV$ , 0 to  $+20mV$ , respectively. In the  $\pm 5V$  A/D range these four gain settings allow accurate measurement of input signals in the range of  $\pm 5V$ ,  $\pm 500mV$ ,  $\pm 50mV$ ,  $\pm 10mV$ , respectively.

The board contains a 12-bit A/D converter. This converter can be configured to receive analog input voltages within the range of 0 to  $+10V$ ,  $-5V$  to  $+5V$ , or  $-10V$  to  $+10V$  (unipolar or bipolar, jumper-selectable). The digital code selection of the A/D converter is jumper-selectable as straight binary or two's complement. The resolution is twelve bits (4096 counts), providing an LSB value of 4.88mV when in the  $\pm 10V$  range, 2.44mV when in either the 0 to  $+10V$  and  $\pm 5V$  range (assuming a gain selection of 1).

Table I presents a listing of the different signal ranges (bipolar mode), LSB values, and potential sample throughput for the four gain selections.

Gain	Signal Range	LSB Value	Sample Throughput		
			800/815	800-A/815-A	800-F/815-F
1	$\pm 10V$	4.88mV	32.2kHz	55.5kHz	71.4kHz
10	$\pm 1V$	488 $\mu V$	32.2kHz	50kHz	50kHz
100	$\pm 100mV$	48.8 $\mu V$	25kHz	25kHz	25kHz
500	$\pm 20mV$	9.76 $\mu V$	12.5kHz	12.5kHz	12.5kHz

Table I. Table of Signal Ranges/LSB Values per Gain Setting

## ANALOG OUTPUT FEATURES (RTI-815 ONLY)

In addition to the data acquisition channels of the RTI-815, the board contains two independent channels of analog output voltage. Each output channel has its own 12-bit D/A converter. These two channels can be individually set to output a voltage within the range of 0 to  $+10V$  (unipolar setting, selected by jumpering) or  $-10V$  to  $+10V$  (bipolar setting, selected by jumpering).

The D/A code selection is jumper-selectable as straight binary or two's complement. The resolution is twelve bits (4096 counts) with an output settling time of 20 $\mu s$  for full-scale step changes. The 12-bit resolution provides least significant bit values of 4.88mV on the  $\pm 10V$  range, 2.44mV in the 0 to  $+10V$  range.

## DIGITAL INPUT/OUTPUT FEATURES

The RTI-800/815 also provides an 8-bit (eight-channel) non-latching parallel digital input port and an 8-bit latching parallel digital output port. Both ports are TTL-compatible. The digital output port has the logic of its individual output channels inverted for compatibility with a solid-state relay I/O subsystem such as the Opto 22. Each output channel is capable of sinking up to 8mA (useful for applications such as driving a relay).

## TIME-RELATED DIGITAL I/O FEATURES

For time-related digital I/O applications, a Counter/Timer chip provides the RTI-800/815 with three independent 16-bit channels that can be used for such counter/timer functions as event counting, frequency measurement, single pulse output, and time proportional output. Each channel has its own individual source input, output, and gate input. In addition, the Counter/Timer chip provides a dedicated 4-bit programmable frequency output channel.

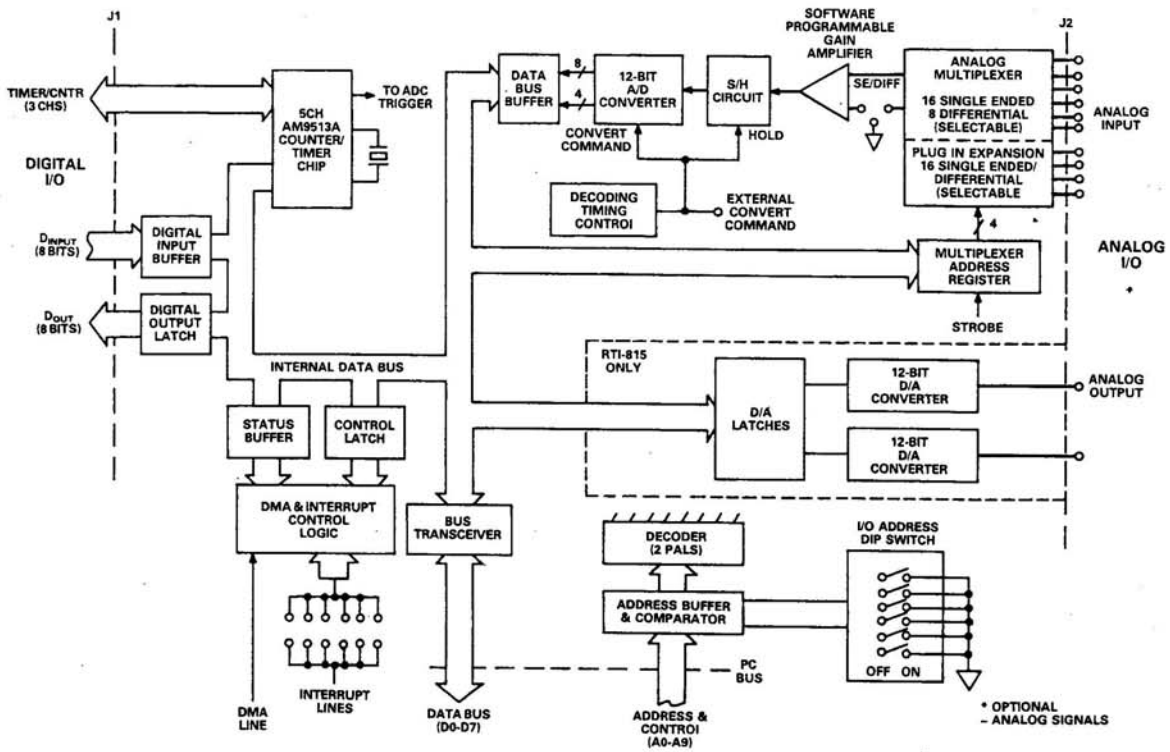


Figure 1. RTI-800/RTI-815 Block Diagram

# Appendix A

## Connector Pin Assignments

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This appendix provides the connector pin assignments and the signal descriptions of the J1 and J2 connectors on the RTI-800/815 board.

### DIGITAL I/O CONNECTOR (J1)

Connector J1 is used for digital I/O and time-related digital I/O connections. Table A-1 lists the digital I/O pin assignments and signal descriptions of the J1 connector on the RTI-800/815 board.

**Table A-1. Connector J1 Pin Assignments**

Pin	Function	AC1585-3 Screw Term. #	AC1585-10 Panel #	DB-16 Module Ch. #	DB-24 Module Ch. #	DB-24 Screw Term. #
1	+5 V	1	N/A <sup>1</sup>	N/A	N/A	N/A
3	Digital Output 0	3	N/A	0	0	1
5	Digital Output 1	5	N/A	1	1	2
7	Digital Output 2	7	N/A	2	2	3
9	Digital Output 3	9	N/A	3	3	4
11	Digital Output 4	11	N/A	4	4	5
13	Digital Output 5	13	N/A	5	5	6
15	Digital Output 6	15	N/A	6	6	7
17	Digital Output 7	17	N/A	7	7	8
19	Digital Common	19	DIG GND TB2	N/A	N/A	N/A
21	C/T Input 0	21	IN0 TB2	N/A	N/A	N/A
23	C/T Gate 0	23	GATE0 TB2	N/A	N/A	N/A
25	C/T Output 0	25	OUT0 TB2	N/A	N/A	N/A

# Connector Pin Assignments

Table A-1. Connector J1 Pin Assignments (cont.)

Pin	Function	AC1585-3 Screw Term. #	AC1585-10 Panel #	DB-16 Module Ch. #	DB-24 Module Ch. #	DB-24 Screw Term. #
27	C/T Input 1	27	IN1 TB2	N/A	N/A	N/A
29	C/T Gate 1	29	GATE1 TB3	N/A	N/A	N/A
31	C/T Output 1	31	OUT1 TB3	N/A	N/A	N/A
33	Digital Common	33	N/A	N/A	N/A	N/A
2	N/C <sup>2</sup>	2	N/A	N/A	N/A	N/A
4	Digital Input 0	4	N/A	8	8	9
6	Digital Input 1	6	N/A	9	9	10
8	Digital Input 2	8	N/A	10	10	11
10	Digital Input 3	10	N/A	11	11	12
12	Digital Input 4	12	N/A	12	12	13
14	Digital Input 5	14	N/A	13	13	14
16	Digital Input 6	16	N/A	14	14	15
18	Digital Input 7	18	N/A	15	15	16
20	Digital Common	20	DIG GND TB1	N/A	N/A	N/A
22	C/T Input 2	22	IN2 TB3	N/A	N/A	N/A
24	C/T Gate 2	24	GATE 2 TB3	N/A	N/A	N/A
26	C/T Output 2	26	OUT2 TB3	N/A	N/A	N/A
28	C/T Frequency Output	28	FOUT TB1	N/A	N/A	N/A
30	Digital Common	30	N/A	N/A	N/A	N/A
32	Digital Common	32	N/A	N/A	N/A	N/A
34	Digital Common	34	N/A	N/A	N/A	N/A

**NOTE**

<sup>1</sup>N/A = Not Applicable.

<sup>2</sup>N/C = Not Connected.

# Connector Pin Assignments

## ANALOG I/O CONNECTOR (J2)

Connector J2 is used for analog input connections on the RTI-800/815 and analog output connections on the RTI-815. The pin assignments and signal descriptions of the J2 connector are listed in Table A-2.

**Table A-2. Connector J2 Pin Assignments**

Pin	Function	Pin	Function
1	Analog Common	26	Analog Input 27 (Input 11 Low)
2	Analog Common	27	Analog Input 12 (Input 4 Low)
3	Analog Input 0 (Input 0 High <sup>1</sup> )	28	Analog Input 28 (Input 12 Low)
4	Analog Input 16 (Input 8 High)	29	Analog Input 13 (Input 5 Low)
5	Analog Input 1 (Input 1 High)	30	Analog Input 29 (Input 13 Low)
6	Analog Input 17 (Input 9 High)	31	Analog Input 14 (Input 6 Low)
7	Analog Input 2 (Input 2 High)	32	Analog Input 30 (Input 14 Low)
8	Analog Input 18 (Input 10 High)	33	Analog Input 15 (Input 7 Low)
9	Analog Input 3 (Input 3 High)	34	Analog Input 31 (Input 15 Low)
10	Analog Input 19 (Input 11 High)	35	Analog Input Sense <sup>2</sup>
11	Analog Input 4 (Input 4 High)	36	Analog Common
12	Analog Input 20 (Input 12 High)	37	Analog Common
13	Analog Input 5 (Input 5 High)	38	Analog Common
14	Analog Input 21 (Input 13 High)	39	Analog Output 0
15	Analog Input 6 (Input 6 High)	40	Analog Output 1
16	Analog Input 22 (Input 14 High)	41	Analog Output Sense 0
17	Analog Input 7 (Input 7 High)	42	Analog Output Sense 1
18	Analog Input 23 (Input 15 High)	43	Analog Output Common
19	Analog Input 8 (Input 0 Low)	44	Analog Output Common
20	Analog Input 24 (Input 8 Low)	45	Digital Common
21	Analog Input 9 (Input 1 Low)	46	Digital Common
22	Analog Input 25 (Input 9 Low)	47	External Convert Command
23	Analog Input 10 (Input 2 Low)	48	External Trigger
24	Analog Input 26 (Input 10 Low)	49	External Clock
25	Analog Input 11 (Input 3 Low)	50	Digital Common

**NOTE**

<sup>1</sup>All text within parentheses in this table refers to differential input channels.

<sup>2</sup>Reference all analog input applications to pin 35.