Low Cost Multifunction I/O – 100 kS/s, 12-Bit, 8 Analog Inputs

1200 Families

1200 Family
PCI-1200
DAQCard-1200
Lab-PC-1200
DAQPad-1200

1200AI Family
Lab-PC-1200AI

Analog Inputs
8 single-ended, 4 differential channels
100 kS/s sampling rate
12-bit resolution

Analog Output (not for Lab-PC-1200AI)
2 channels, 12-bit resolution

Digital I/O
24 (5V/TTL) lines in 8-bit ports

Counter/Timers
3, 16-bit resolution

Triggering
Digital

NI-DAQ Software
Windows NT/98/95
Mac OS*
*Not for all hardware
(refer to page 200 for other operating systems)

Application Software
LabVIEW
LabWindows/CVI
ComponentWorks
VirtualBench
Measure
BridgeVIEW
Lookout

Calibration Certificate Included!

Family	Analog Inputs	Resolution	Sampling Rate	Input Range	Analog Outputs	Resolution	Output Rate	Output Range	Digital I/O	Counter/ Timers	Triggers
1200	8 SE/4 DI	12 bits	100 kS/s	up to ±5 V	2	12 bits	1 kS/s	± 5 V	24	3, 16-bit	Digital
1200AI	8 SE/4 DI	12 bits	100 kS/s	up to ±5 V	-	-	-	-	24	3, 16-bit	Digital

Table 1. 1200 Families Channel, Speed, and Resolution Specifications (refer to page 322 for more detailed specifications)

Overview

The 1200 Family boards are low-cost, multifunction I/O devices. You get up to 100 kS/s, 12-bit performance on 8 single-ended analog inputs.

These 1200 Family boards feature digital triggering capability, as well as three 16-bit, 8 MHz counter/timers; two 12-bit analog outputs; and 24 digital I/O lines. The 1200AI is available without the two analog outputs.

Hardware

Analog Input

The 1200 Series boards have two CMOS analog input multiplexers connected to eight analog input channels. The input circuitry gives input overvoltage protection of ±35 V (±42 V for the DAQPad) powered on or ± 25 V (±15 V for the DAQPad) powered off. You can use the analog input channels as eight single-ended inputs, eight nonreferenced single-ended inputs with a shared common, or four fully differential inputs.

Voltage input range is software programmable for 0-10 V (unipolar) or ±5 V (bipolar). A software-programmable gain amplifier has gain selections of 1, 2, 5, 10, 20, 50, or 100.

The 1200 Series boards have a 12-bit ADC with analog signal resolution of 2.44 mV at a gain of 1. You can achieve finer resolutions down to 24.4 µV by using a higher gain. The 12-bit output of the ADC is automatically sign-extended to 16 bits. By enabling dithering, you can achieve higher resolution.

The 1200 Series boards perform both single A/D conversions and multiple A/D conversions of a set number of samples. A FIFO memory buffers the data during multiple A/D conversions, which can be handled by DMA (PCI, Lab-PC), programmed I/O, or interrupts.

The single-channel sampling rate of the ADC is 100 kS/s. The PCI, DAQCard, and Lab-PC versions can sustain this rate but the DAQPad cannot. The sustainable data transfer rate to a standard PC parallel port is 25 kS/s. You can acquire waveforms of up to 2 kSamples into the FIFO buffer of the DAQPad-1200 at the maximum sampling rate of 100 kS/s, and then transfer the data to the PC at the slower rate. Alternatively, you can connect the DAQPad-1200 to a compatible EPP adapter, available as either a plug-in board or PCMCIA card, and continuously

ACH0	1	2	ACH1
ACH2	3	4	ACH3
ACH4	5	6	ACH5
ACH6	7	8	ACH7
AISENSE/AIGND	9	10	DAC0OUT[1]
AGND	11	12	DAC1OUT[1]
DGND	13	14	PA0
PA1	15	16	PA2
PA3	17	18	PA4
PA5	19	20	PA6
PA7	21	22	PB0
PB1	23	24	PB2
PB3	25	26	PB4
PB5	27	28	PB6
PB7	29	30	PC0
PC1	31	32	PC2
PC3	33	34	PC4
PC5	35	36	PC6
PC7	37	38	EXTTRIG
EXTUPDATE[1]	39	40	EXTCONV*
OUTB0	41	42	GATB0
OUTB1	43	44	GATB1
CLKB1	45	46	OUTB2
GATB2	47	48	CLKB2
+5 V	49	50	DGND

[1] Not available on Lab-PC-1200AI

Figure 1. 1200 Families I/O Connector

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acquire data at 100 kS/s. When scanning multiple channels, the maximum sampling rate for all 1200 family products is 83.3 kS/s at a gain of 1.

An onboard counter/timer controls the timing of multiple A/D conversions. The counter/timer generates the sample interval clock with a resolution of 1 µs. As an alternative, an external signal can generate the timing for the sample interval. Data acquisition with the 1200 devices is available in three modes: 1) continuous acquisition of a single channel, 2) multichannel acquisition with continuous scanning, or 3) multichannel acquisition with interval scanning. In the third mode, all channels are scanned at one sample interval, with a second interval determining the time before repeating the scan. Both single A/D conversions and multiple A/D conversion sample sequences are initiated from either software or external timing control signals.

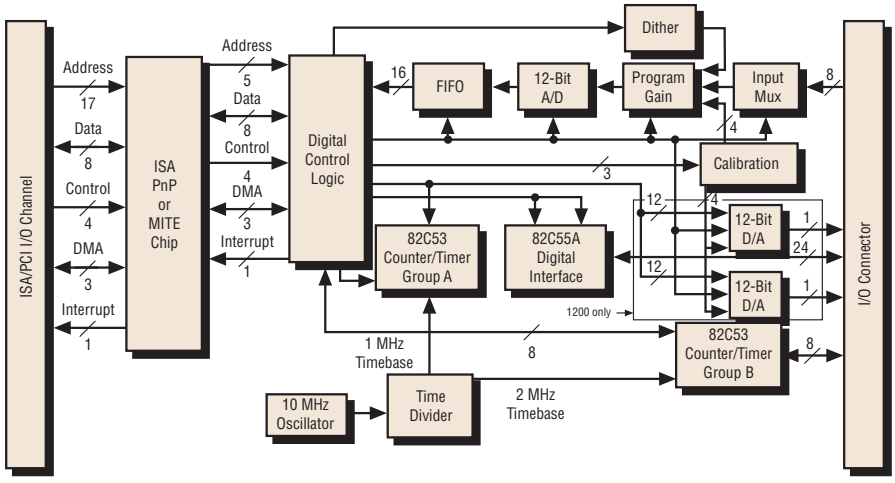

Figure 2. 1200 Families Hardware Block Diagram

There are two hardware triggering modes – pretrigger mode and posttrigger mode. In pretrigger mode, the board collects samples until a trigger is received at the external trigger input, and then continues to collect a specified number of samples. In posttrigger mode, the board collects a specified number of samples after the board receives a trigger. By combining the pretrigger and posttrigger modes, the 1200 Series boards can acquire data before and after a trigger condition.

In a multichannel acquisition mode, you can scan any number of channels between 2 and 8 in single-ended or between 2 and 4 in differential mode. These channels are scanned in a round-robin sequence, taking one reading per interval with scanning always occurring in the same order – beginning with the last channel through 0.

Analog Output

The 1200 Series boards have two double-buffered 12-bit DACs that are connected to two analog output channels. You can independently configure each channel through software for unipolar (0-10 V) or bipolar (±5 V) operation. The resolution of the 12-bit DAC is 2.44 mV in both polarities.

You can generate waveforms by programmed I/O or interrupts. One of the 82C53 counter/timers is used with the DACs for waveform generation. The counter/timer generates periodic interrupts and update signals for the double-buffered DACs.

Self-Calibration

The analog inputs and outputs of the 1200 Series have self-calibration circuitry to correct for gain and offset errors. You can calibrate additional analog I/O errors caused by time and temperature drift at run time through software to accommodate changing environmental conditions. Factory calibration constants are permanently stored in an onboard 256-by-8 EEPROM and cannot be modified. You can return the board to its initial factory calibration using these constants from the unmodifiable area. You can also store additional calibration constants in a modifiable section of the EEPROM for different operating conditions.

Digital I/O

The 1200 Series boards have 24 digital I/O lines, configurable as three 8-bit ports for input, output, bidirectional, or handshaking modes. With the PCI-1200 and the Lab-PC boards, two of the ports can drive Darlington transistors directly for higher current applications. The digital I/O lines are 5V/TTL compatible. The digital output ports of the 1200 series can sink 2.5 mA on each line.

PCI-1200 Interface

The PCI-1200 uses the MITE ASIC to interface the board to the PCI bus and to provide bus master capability. All bus-related configuration, such as base memory address and interrupt assignments, are automatically configured through software.

DAQPad-1200 Parallel Port Interface

The parallel port interface circuitry provides a communication interface between the decode circuitry and the parallel port and places the DAQPad-1200 in either active mode or transparent mode. In active mode, the parallel port interface circuitry interprets the data and control lines and drives the status lines.

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In transparent mode, the status, control, and data lines to and from the transparent parallel port (port B) are passed through with minimal propagation delay.

Counter/Timer

The 1200 Series boards use two 82C53 system timing controllers (STCs) for counting and timing. Each STC contains three independent 16-bit counter/timers. One of the STCs, counter A, is dedicated for A/D and D/A timing. The three counters on the other STC, counter B, are available to you for general time-related functions such as clock output, pulse output, and event and frequency measurement. One of these counters can increase the sampling interval when required. The gate and output of the three counter/timers are available at the I/O connector. The clock source of counters 1 and 2 is also available at the connector. The clock source of the third counter/timer is tied internally to a 2 MHz clock so that an external clock signal is not required. Counter 1 can be used to obtain the scan interval in the interval scanning mode.

I/O Connector

The I/O connector is a 50-pin male ribbon cable connector diagrammed in Figure 2. ACH <0..7> are eight analog input channels. DAC0OUT and DAC1OUT are the two analog output channels. A TTL low-level signal on the EXTUPDATE* pin updates the analog output channels. A rising edge on EXTUPDATE* generates an interrupt on the PCI I/O channel, making externally controlled voltage output possible. EXTCONV* can control individual A/D conversions externally. The EXTTRIG is the external trigger input for pretrigger or posttrigger applications. CLKB<1..2>, GATB<0..2>, and OUTB<0..2> are the clock, gate, and output of the user-available counter. PA<0..7>, PB<0..7>, and PC<0..7> are the three 8-bit digital I/O ports.

Refer to page 322 for more detailed specifications.

DAQPad-1200 Parallel Port Connectors

The DAQPad-1200 includes a 1 m cable with two 25-pin D-Sub connectors. The DAQPad-1200 rear panel includes two parallel port connectors, Port A and Port B, for connection to the PC parallel port and optionally to a pass-through standard parallel port device.

DAQPad-1200 Power

The DAQPad-1200 is powered by any 9 to 42 VDC source. With the AC adapter unit included, you can power the DAQPad-1200 from any standard 120 VAC or 230 VAC source.

The optional BP-1 rechargeable battery pack powers the DAQPad-1200 for 11 hours. The BP-1 includes a 12 V 3.2 Ah battery packaged in an enclosure with the same dimensions as the DAQPad-1200. A charger unit is included with the BP-1. The charger is not CE certified.

Make sure you consider our new low-cost E Series products – refer to page 247.

Ordering Information

1200 Families

PCI-1200 and NI-DAQ for
- Windows NT/98/95 777386-01
- Mac OS 777097-01

DAQCard-1200 and NI-DAQ for
- Windows NT/98/95 777087-01
- Mac OS 777087-02

Lab-PC-1200 777227-01

Lab-PC-1200AI 777292-01

DAQPad-1200 for USB with AC adapter
- U.S. 120 VAC 776895-01
- Universal Euro 240 VAC 776895-31
- United Kingdom 240 VAC 776895-06

Includes NI-DAQ for Windows NT/98/95 on CD unless otherwise noted. See page 228 for more details.

DAQPad products include 0.9 m parallel port cable.

BP-1 rechargeable battery pack with charger
- 120 VAC 776896-01
- 240 VAC 776896-31

Example Configurations

Family	DAQ Board	Cable (page 305-309)	Accessory (page 295-304)
1200	PCI-1200	NB1 (180524-10)	CB-50LP (777101-01)
	DAQCard-1200	PR50-50F (182799-01)	CB-50LP (777101-01)
	Lab-PC-1200	NB1 (180524-01)	CB-50LP (777101-01)
	Lab-PC-1200AI	NB1 (180524-01)	CB-50LP (777101-01)
1200AI	DAQPad-1200	NB1 (180524-01)	CB-50LP (777101-01)

For more detailed cable and accessory options, refer to page 205.

Specifications

1200 Families

These specifications are typical at 25 °C unless otherwise stated.

Analog Input

Input Characteristics

Number of channels ..... 8 single-ended, or 4 differential, software selectable
Type of ADC ..... Successive approximation
Resolution ..... 12 bits, 1 in 4,096
Maximum sampling rate
PCI, DAQCard, Lab-PC ..... 100 kS/s
DAQPad ..... 100 kS/s to FIFO; 25 kS/s to PC with standard Centronics port

Input signal ranges

Gain (Software Selectable)	Range (Software Selectable)	
	bipolar	unipolar
1	±5 V	0 to 10 V
2	±2.5 V	0 to 5 V
5	±1 V	0 to 2 V
10	±500 mV	0 to 1 V
20	±250 mV	0 to 500 mV
50	±100 mV	0 to 200 mV
100	±50 mV	0 to 100 mV

Input coupling ..... DC
Maximum working voltage
(signal + common mode) ..... In differential or NRSE mode, the negative input/AISENSE should remain within ±5 V (bipolar) or -5 to 2 V (unipolar) of AGND except for the DAQCard-1200, where the values are ±6 V (bipolar) and -6 to 2 V (unipolar). The positive input should remain within -5 V to +10 V of AGND. For the DAQCard-1200 in RSE mode, the input signal referenced to AGND should remain within ±5 V(bipolar) or 0 to 10 V (unipolar).
Overvoltage protection
PCI, DAQCard, Lab-PC ..... ±35 V powered on, ±25 V powered off
DAQPad ..... ±42 V powered on, ±15 V powered off
Inputs protected ..... ACH<0..7>
FIFO buffer size
PCI ..... 4,096 samples
DAQCard ..... 1,024 samples
Lab-PC ..... 512 samples
DAQPad ..... 2,048 samples
Data transfers
PCI, Lab-PC ..... DMA, interrupts, programmed I/O
DAQCard, DAQPad ..... Interrupts, programmed I/O
DMA modes
PCI ..... Scatter-gather
Lab-PC ..... Single transfer
Dither ..... Available

Transfer Characteristics

Relative accuracy ..... ±0.5 LSB typical dithered, ±1.5 LSB max undithered
DNL ..... ±1 LSB max
No missing codes ..... 12 bits, guaranteed
Offset error

		PCI, DAQCard, Lab-PC	DAQPad
Pregain error	After calibration	±10 µV max	±5 µV max
	Before calibration	±20 mV max	±15 mV max
Postgain error	After calibration	±1 mV max	±360 µV max
	Before calibration	±200 mV max	±150 mV max

Gain error (relative to calibration reference)
After calibration ..... 0.02% of reading max
Before calibration ..... ±2% of reading max

Amplifier Characteristics

Input bias current
PCI, DAQCard, Lab-PC ..... ±100 pA
DAQPad ..... ±200 pA
Input offset current ..... ±100 pA
Input impedance
Normal powered on ..... 100 GΩ in parallel with 50 pF
Powered off ..... 4.7 kΩ min
Overload ..... 4.7 kΩ min
CMRR ..... 70 dB typical, DC to 60 Hz

Dynamic Characteristics

Bandwidth (small signal -3 dB)

Gain	PCI, DAQCard, Lab-PC	DAQPad
1 to 10	250 kHz	400 kHz
20	150 kHz	200 kHz
50	60 kHz	80 kHz
100	30 kHz	40 kHz

Settling time for full-scale step

	Accuracy ±0.024% (±1 LCB)		
	PCI, Lab-PC	DAQCard	DAQPad
Gain	µs typical/µs max	µs typical/µs max	µs max
1	10/14	–/10	25
2 to 10	13/16	–/10	25
20	15/19	12/15	25
50	27/34	25/30	25
100	60/80	60/80	60

System noise (including quantization error) in LSB_{rms}

	PCI, DAQCard, Lab-PC		DAQPad	
Gain	Dither Off	Dither On	Dither Off	Dither On
1 to 50	0.3	0.5	0.3	0.6
100	0.5	0.7	0.6	0.8

Stability

Recommended warm-up time ..... 15 minutes
Offset temperature coefficient
Pregain ..... ±15 µV/°C
Postgain ..... ±100 µV/°C
Gain temperature coefficient
PCI, DAQCard, Lab-PC ..... ±40 ppm/°C
DAQPad ..... ±50 ppm/°C

Analog Output (not for Lab-PC-1200AI)

Output Characteristics

Number of channels ..... Two voltage
Resolution ..... 12 bits, 1 in 4,096
Typical update rate ..... 1 kS/s (system dependent)
Type of DAC ..... Double buffered, multiplying
Data transfers ..... Interrupts, programmed I/O

Transfer Characteristics

Relative accuracy ..... ±0.25 LSB typical, ±0.50 LSB max
±0.50 LSB typical, ±1.0 LSB max (DAQCard)
DNL ..... ±0.25 LSB typical, ±0.75 LSB max
±0.50 LSB typical, ±0.90 LSB max (DAQCard)
Monotonicity ..... 12 bits, guaranteed
Offset error
After calibration ..... ±0.2 mV max; ±0.5 mV max for DAQCard
Before calibration ..... ±50 mV max; ±75 mV max for DAQCard
Gain error (relative to internal reference)
After calibration ..... 0.01% of reading max
0.02% of reading max (DAQCard)
Before calibration ..... ±1% of reading max
±2% of reading max (DAQCard)

Voltage Output

Ranges ..... 0 to 10 V, ±5 V, software selectable
Output coupling ..... DC
Output impedance ..... 0.2 Ω typical
0.5 Ω typical (DAQCard)
Current drive ..... ±2 mA
1 mA max per channel (DAQCard)
Protection ..... Short circuit to ground
80 mA momentary short circuit protection to ground (DAQCard)
Power-on state
PCI, DAQCard, Lab-PC ..... 0 V
DAQPad ..... 0 V bipolar mode, 5 V unipolar mode

1200 Families (continued)

Dynamic Characteristics

Settling time to full-scale range (FSR)
- PCI, Lab-PC ..... 5 µs to ±1 LSB
- DAQCard ..... 20 µs to ±1 LSB
- DAQPad ..... 6 µs to ±1 LSB

Stability

Offset temperature coefficient
- PCI, DAQCard, Lab-PC ..... ±50µV/°C
- DAQPad ..... ±60µV/°C

Gain temperature coefficient
- PCI, DAQCard, Lab-PC ..... ±30 ppm/°C
- DAQPad ..... ±10 ppm/°C

Digital I/O

Number of channels ..... 24 I/O (three 8-bit ports; uses the 82C55A PPI)
Compatibility 5V/TTL
Digital logic levels

Level	Minimum	Maximum
Input low voltage	-0.3 V	0.8 V
Input high voltage	2.2 V	5.3 V
Output low voltage (I_{out} = 2.5 mA)	–	0.4 V
Output high voltage (I_{out} = 2.5 mA)	3.7 V	–

Handshaking ..... 2-wire, 2 ports
Power-on state ..... Input
Protection ..... -0.5 to 5.5 V powered on, ±0.5 V powered off
Data transfers ..... Interrupts, programmed I/O

Timing I/O

Number of channels ..... 3 counter/timers (uses two 82C53 STCs)
Protection ..... -0.5 V to 5.5 V powered on, ±0.5 V powered off
Resolution ..... 16 bits
Compatibility ..... 5V/TTL, counter gate and clock inputs are pulled up with 100 kΩ onboard resistors
Base clock available ..... 2 MHz
Base clock accuracy ..... ±50 ppm max, ±0.01%
Maximum source frequency ..... 8 MHz
Minimum source pulse duration ..... 60 ns
Minimum gate pulse duration ..... 50 ns
Digital logic levels

Level	Minimum	Maximum
Input low voltage	-0.3 V	0.8 V
Input high voltage	2.2 V	5.3 V
Output low voltage (I_{out} = 2.1 mA for PCI, Lab-PC) (I_{out} = 4 mA for DAQCard, DAQPad)	–	0.45 V
Output high voltage (I_{out} = 0.92 mA for PCI, Lab-PC) (I_{out} = 1 mA for DAQCard, DAQPad)	3.7 V	–

Data transfer ..... Interrupts, programmed I/O

Digital Trigger

Compatibility 5V/TTL
Response ..... Rising edge
Pulse width ..... 50 ns min

Bus Interface

PCI ..... Master, slave
DAQCard, Lab-PC, DAQPad ..... Slave

Power Requirements

+5 VDC (±5%)
- PCI ..... 425 mA
- DAQCard ..... 150 mA, 50 mA power-down mode
- Lab-PC ..... 185 mA
- Lab-PC-1200AI ..... 150 mA

+12 VDC
- DAQPad ..... 250 mA

Power available at I/O connector ..... +4.65 to +5.25 V, 400 mA fused
+5 VDC, 500 mA (DAQCard)

Physical

Dimensions
- PCI, Lab-PC ..... 17.5 x 10.6 cm (6.9 by 4.2 in.)
- DAQCard ..... Type II PC Card
- DAQPad ..... 14.6 by 21.3 by 3.8 cm (5.8 by 8.4 by 1.5 in.)

Weight
- DAQPad ..... 0.77 kg (1.7 lb)

I/O connectors ..... 50-pin male
Paralle port connector
- Type ..... 2 female 25-pin D-Sub, EPP and SPP (Centronics)
- Throughput ..... 180 kbytes/s (EPP), 41 kbytes/s (Centronics)

Environment

Operating temperature ..... 0 to 50 °C, DAQCard should not exceed 50 °C while in PCMCIA slot
Storage temperature ..... -20 to 70 °C
Relative humidity ..... 5% to 90% noncondensing

BP-1 Rechargeable Battery Pack

Output ..... 12 VDC, 3.2 Ah
Run time with DAQPad ..... 5 h loaded at 350 mA from +5 V I/O; 11 h unloaded
Dimensions ..... 14.6 by 21.3 by 3.8 cm (5.8 by 8.4 by 1.5 in.)
Weight ..... 1.92 kg (4.2 lb)

Phone: (512) 794-0100 ▪ Fax: (512) 683-8411 ▪ info@natinst.com ▪ www.natinst.com