AD 512

DATA ACQUISITION CARD

USER'S MANUAL

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1. Introduction

1.1. General Description

The AD 512 data acquisition card is desined for the need of connecting IBM PC compatible computers to real world signals. The AD 512 contains a 100 kHz throughput 12 bit A/D converter with sample/hold circuit, four software selectable input ranges and 8 channel input multiplexer, 2 independent double buffered 12 bit D/A converters, 8 bit digital input port and 8 bit digital output port. The card is designed for standard data acquisition and control applications and optimized for use with Real Time Toolbox for MATLAB®. Because of the small size and low power consumption AD 512 can be used not only in desktop computers but also in portable computers and notebooks.

1.2. Features List

The AD 512 offers following features:

- 100 kHz 12 bit A/D converter with sample & hold circuit
- 8 channel single ended fault protected input multiplexer
- Software selectable input ranges ±10V, ±5V, 0-10V, 0-5V
- Internal clock & voltage reference
- 2 double buffered D/A converters with 12 bit resolution and simultaneous update
- Output ranges ±10V, ±5V, 0-10V, 0-5V jumper selectable for each analog output

- 8 bit TTL compatible digital input port
- 8 bit TTL compatible digital output port
- DIP switch selectable I/O port base address
- Requires one ISA slot
- Power consumption 100 mA@+5V, 50 mA@+12V, 50 mA@-12V
- Operating temperature 0°C to +70°C

2. Hardware Installation

2.1. DIP Switch and Jumper Settings

The bank of eight switches (SW1) on the AD 512 specifies the base address of I/O ports on this card. AD 512 occupies eight consequent addresses in PC's I/O address space. Weights of these switches are listed in table 1. According to this table selecting I/O address 300H means that switches 1, 2 and 8 should be switched OFF and all other switches ON. Factory setting of base address is 300H. Switch 8 should be always set OFF otherwise the card is disabled.

Switch	OFF	ON
1	**200H**	0H
2	**100H**	0H
3	80H	**0H**
4	40H	**0H**
5	20H	**0H**
6	10H	**0H**
7	8H	**0H**
8	**enable**	disable

Table 1. I/O Address Setting

Jumper JP1 is used to select the D/A converters analog outputs range. Output voltage ranges can be set for each analog output independently to ±10V, ±5V (factory default), 0-10V or 0-5V according to table 2.

Output range	±10V	±5V	0-10V	0-5V
D/A0	1-2	**1-2, 4-5**	2-3	2-3, 4-5
D/A1	6-7	**6-7, 9-10**	7-8	7-8, 9-10

Table 2. JP1 Analog Outputs Range Setting

2.2. Installation

Once you have properly set all jumpers and switches you can install the AD 512 card in any free ISA expansion slot of your computer. Follow the steps outlined below:

- Turn off the power to the computer system and unplug the power cord.
- Disconnect all cables connected to the computer system.
- Using a screwdriver (or nut driver), remove the cover-mounting screws. that screws are at the rear side of the PC.
- Remove the computer system's cover.
- Find an empty expansion slot for in your computer for AD 512 card. If the slot still has the metal expansion-slot cover attached, remove the cover with a screwdriver (or nut driver). Save the screw to install the AD 512.
- Hold the AD 512 firmly at the top of the board, and press the gold edge connector into an empty expansion slot.
- Using a screwdriver (or nut driver), screw the retaining bracket tightly against the rear plate of the computer system.
- Replace the cover of the computer, and plug in the power cord.
- Reconnect all cables that were previously attached to the rear of the computer.

3. Programming Guide

3.1. I/O Port Map

I/O space of AD 512 card consists of eight registers immediately following the base address selected by SW1:

Address	Read	Write
Base+0	**ADLO** - A/D data low byte	**DA0LO** - D/A 0 data low byte
Base+1	**ADHI** - A/D data high byte	**DA0HI** - D/A 0 data high byte
Base+2		**DA1LO** - D/A 1 data low byte
Base+3		**DA1HI** - D/A 1 data high byte
Base+4		**DACTRL** - D/A control reg.
Base+5	**ADSTAT** - A/D status reg.	**ADCTRL** - A/D control reg.
Base+6		
Base+7	**DIN** - Digital input register	**DOUT** - Digital output register

Table 3. I/O Port Map

3.2. A/D Converter

All functions of A/D converter are accessible through four registers.
A/D control register **ADCTRL** is used to select input channel, input range and to

start conversion. For ADCTRL bit assignment see table 4.

D7 (MSB)	**D6**	**D5**	**D4**	**D3**	**D2**	**D1**	**D0** (LSB)
0	1	0	RNG	BIP	A2	A1	A0

BIT	**NAME**	**DESCRIPTION**
7		Must be always 0
6		Must be always 1
5		Must be always 0
4	RNG	Selects 10V input range (see table 5)
3	BIP	Selects bipolar input range (see table 5)
2, 1, 0	A2, A1, A0	Selects input channel (see table 6)

Table 4. A/D Control Byte Format

RNG	**BIP**	**INPUT RANGE (V)**
0	0	0 to 5
1	0	0 to 10
0	1	± 5
1	1	± 10

Table 5. Input Range Selection

A2	A1	A0	CH0	CH1	CH2	CH3	CH4	CH5	CH6	CH7
0	0	0	*							
0	0	1		*						
0	1	0			*					
0	1	1				*				
1	0	0					*			
1	0	1						*		
1	1	0							*	
1	1	1								*

Table 6. Input Channel Selection

Conversion is initiated with a write operation to **ADCTRL** register which also selects the input multiplexer channel and input range. When the conversion is complete bit 7 in A/D status register **ADSTAT** is set to zero. Then the data is ready and can be read from **ADLO** and **ADHI** registers. The read operation of **ADLO** and **ADHI** registers sets the conversion complete bit in **ADSTAT** register back to one. Writing a new control byte during conversion cycle will abort conversion and start a new conversion cycle.

D7 (MSB)	**D6**	**D5**	**D4**	**D3**	**D2**	**D1**	**D0** (LSB)
CC	0	0	0	0	0	0	0

Table 7. A/D Status Byte Format

	D7	**D6**	**D5**	**D4**	**D3**	**D2**	**D1**	**D0**
ADLO	D7	D6	D5	D4	D3	D2	D1	D0
ADHI	0 or D11	0 or D11	0 or D11	0 or D11	D11	D10	D9	D8

Table 8. A/D Data Registers Format

The output data format is binary in unipolar mode and twos-complement binary in bipolar mode. When reading **ADLO** the lower eight bits are read. When reading **ADHI** the upper four MSBs are available and the output data bits D4-D7 are either set 0 (in unipolar mode) or set to the value of MSB (in bipolar mode) as described in Table 8.

AD converter voltage reference can be adjusted by R11.

3.3. D/A Converters

D/A converters are accessed through four data input latch registers (**DA0LO, DA0HI, DA1LO, DA1HI**) and one control register **DACTRL**. D/A converters are double-buffered with simultaneous update of DAC registers from input latch registers which allows synchronous update of both analog outputs. Therefore analog outputs are updated in following two steps:

1. New output values are written to **DA0LO, DA0HI, DA1LO, DA1HI** registers.
2. Any value is written into **DACTRL** register which results in loading current values from **DA0LO, DA0HI, DA1LO, DA1HI** registers into DAC registers and simultaneous update of both analog outputs.

	D7	**D6**	**D5**	**D4**	**D3**	**D2**	**D1**	**D0**
DA0LO	D7	D6	D5	D4	D3	D2	D1	D0
DA0HI	0	0	0	0	D11	D10	D9	D8
DA1LO	D7	D6	D5	D4	D3	D2	D1	D0
DA1HI	0	0	0	0	D11	D10	D9	D8

Table 9. D/A Data Registers Format

Output voltage ranges of D/A converters can be set to either ±10V, ±5V, 0-10V or 0-5V by jumper JP1 as described in table 2.

3.4. Digital Inputs

AD 512 contains one 8-bit digital input port which can be accessed directly by read from **DIN** register. Inputs are TTL compatible.

3.5. Digital Outputs

AD 512 contains one 8-bit digital output port which can be accessed directly by write to **DOUT** register. Outputs are TTL compatible.

4. I/O Signals

4.1. Output Connector Signal Description

The AD 512 data acquisition card is equipped with a 37 pin D-type female connector X1 with pin assignment as described in table 10.

AD0-AD7	Analog inputs
DA0-DA1	Analog outputs
+5V REFOUT	D/A converter reference voltage output (+5V)
+4.096V REFOUT	A/D converter reference voltage output (+4.096V)
DIN0-DIN7	TTL compatible digital inputs
DOUT0-DOUT7	TTL compatible digital outputs
+12V	+12V power supply
-12V	-12V power supply
+5V	+5V power supply
AGND	Analog ground
GND	Digital ground

AD0	**1**	**20**	DA0
AD1	**2**	**21**	DA1
AD2	**3**	**22**	AGND
AD3	**4**	**23**	+5V REFOUT
AD4	**5**	**24**	+4.096V REFOUT
AD5	**6**	**25**	AGND
AD6	**7**	**26**	-12V
AD7	**8**	**27**	+12V
AGND	**9**	**28**	+5V
AGND	**10**	**29**	GND
GND	**11**	**30**	DOUT0
DIN0	**12**	**31**	DOUT1
DIN1	**13**	**32**	DOUT2
DIN2	**14**	**33**	DOUT3
DIN3	**15**	**34**	DOUT4
DIN4	**16**	**35**	DOUT5
DIN5	**17**	**36**	DOUT6
DIN6	**18**	**37**	DOUT7
DIN7	**19**		

Table 10. X1 Connector Pin Assignement

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