EAS MiniDaq
12bit 8Channel A/D System

Ver. 1/20/03

EAS MiniDaq is an 8 channel, 12bit analog to digital converter for the IBM PC, with 4 digital input channels and 7 digital output channels. It connects to the parallel port of your PC and requires no external power. Typical uses are, high speed strip chart recording, data logging, process control, home automation, an electronic workbench, etc. When used with Labview, It becomes a very versatile instrument for process control and data logging. With the supplied software libraries, you can create custom control and data logging applications, in C, BASIC, and Excel.

MiniDaq Assembly

Construction notes
This kit requires good soldering techniques due to its small size.
Tools necessary: A fine tip soldering gun and a good wire cutter.
Recommended tools: Mechanical clamp-known as a third hand, fine solder wick to remove excess solder.

Caution: Integrated circuits U1 and U2 are static and heat sensitive. Do not apply too much heat with your soldering iron when installing these two parts. Please take precautions while handing U1 and U2 to protect against static electricity, ground your body before handling these parts. It is also very difficult to take apart the shell coverings once they are snapped together. Leave this as the last assembly step.

An online construction manual with images is available on our web site to help in the construction of the MiniDaq.

Start by installing the top half components first.

Step 1
Start by installing the IC's and the resistor pack. Observe proper orientation for pin 1.

U1 - MAX186
U2 - MAX1044
RP1 - 10K ohm isolated resistor pack

Step 2
Install capacitors C1, C4 and C8.

C1 - .1uf monolithic capacitor. The printed value on the capacitor will normally be 104, denoting a .1uf value.

C4 - .01uf monolithic capacitor. The printed value on the capacitor will normally be 103, denoting a .01uf value.

C8 - .1uf monolithic capacitor. The printed value on the capacitor will normally be 104, denoting a .1uf value.

Step 3
Install the resistors R2, R3, R4 and R5.

R2, R3 - 22 ohm
R4 - 47 ohm
R5 - 1K ohm

Step 4
Install diode D2. Observe silkscreen markings when installing the diode. The black line on the diode is the cathode and should be installed in the same orientation as the silkscreen marking.

D2 - 1N4733A

Step 5
Install the two 3 pin headers.

JP3, JP4 - 3pin 2mm headers

Step 6
Since components will be installed on the bottom side of the PCB, trim off any excess lead length. This will allow the bottom components to lay flat and the plastic shell cover to close properly.

Start by installing resistor R1. Bend and pre-form the resistor. Cut the leads to a short length so the resistor lays flat on the PCB.

R1 - 47 ohms

Step 7
Install diode D1. Bend and pre-form the diode. Cut the leads to a short length so the diode lays flat on the PCB. Observe silkscreen markings when installing the diode. The black line on the diode is the cathode and should be installed in the same orientation as the silkscreen marking.

D1 - 1N4148

Step 8
Install the capacitors C2, C3, C6, C7 and C9. Bend and pre-form the capacitor. Cut the leads to a short length so the capacitor lays flat on the PCB. Observe the polarity of the capacitors before soldering.

C2, C3, C6, C7, C9 - 10uF tantalum, 6volts

Step 9
Install capacitor C5. Bend and pre-form the capacitor. Cut the leads to a short length so the capacitor lays flat on the PCB. Observe the polarity of the capacitors before soldering.

C5 - 22uF tantalum, 6volt

Step 10
Install the two DB25 connectors. They are installed with the leads lined up with the pads on the PCB. Make sure the connectors are pressed flush with the board and that you have the correct connector gender before soldering. Pin1 on the connector should line up with the silkscreened pin1 on the PCB.

P1 - Male DB25 solder tail
P2 - Female DB25 solder tail

Step 11
You should wash and clean the completed board before installing the two jumper shunts. We use water soluble flux solder here at EAS. This permits easy board cleaning. Radio Shack sells flux removing solvent made for pc board cleaning. Take a close look at all solder joints and touch-up any joints that look bad. A 2x or 3x magnifying glass helps to find any solder bridges.

The MiniDaq has two jumper shunts that can be configured.

JP4

INT of JP4 is for internal power from PC
EXT of JP4 is for external power - needed for low power laptops

When set to INT, the MiniDaq utilizes the parallel port to supply power. Some PC's may not be able to supply enough current to run the MiniDaq. If this is the case, set JP4 to EXT and connect an external 6-12Volt supply to connector P2 pin#13 and ground.

JP3

UNI of JP3 is for Unipolar mode 0v to 4v input
BI of JP3 is for Bipolar mode -2v to 2v input

When set to bipolar mode, the maximum input voltage range to the A/D is -2 to +2 volts.
When set to unipolar mode, the maximum input voltage range to the A/D is 0 to 4 volts

The standard configuration is usually set to internal power and bipolar mode.

Step 12
Testing the MiniDaq.

Plug the MiniDaq P1 connector side to the PC parallel port. You can use a short 2 or 3 foot cable to connect the MiniDaq to your computer. Make sure the cable you use has all 25pins extended.

Download `calibrt.exe` and `brun45.exe`. These programs can be found on our ftp web site, `http://www.hooked.net/~jfong` under the /Electronics/minidaq/qbasic directory.

Calibrt.exe is a DOS application and brun45.exe is the runtime library needed to run. Start the program and choose P to set the parallel port to the one you have the MiniDaq plugged into. If the board is working correctly, you should see changing data on the screen. Connect a 1.5volt battery to analog input 0 (pin 1) and analog ground (pin14). You should immediately see the 1.5 volts displayed on the screen.

Test all the other channels by moving the battery lead to the other analog input channels and changing the displayed channel by choosing and setting "C".

Connecting to the MiniDaq

Connect P1 (male DB25) to your PC parallel port. Be careful to not plug P2 side (female DB25) to your parallel port or damage to the MiniDaq may happen. Some computers also have a DB25 male connector on back and this is usually a serial port. You can also use a short 2 or 3 foot cable to extend the MiniDaq. Make sure the cable you use has all 25pins extended.

P2 (female DB25) connector is where the analog A/D and digital I/O input signals hookup to.

You can purchase several male DB25 from your local Radio Shack and dedicate those connectors to various projects, allowing you to plug MiniDaq among them.

Note: Digital output 6 is an Open Collector output. All other input and output pins are standard TTL logic. We have found that some parallel ports do not implement the original specification of the PC parallel port. Digital output 6 may not work on your computer parallel port due to this.
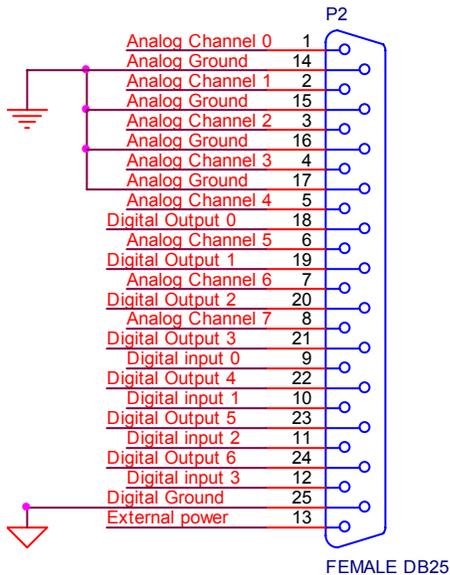
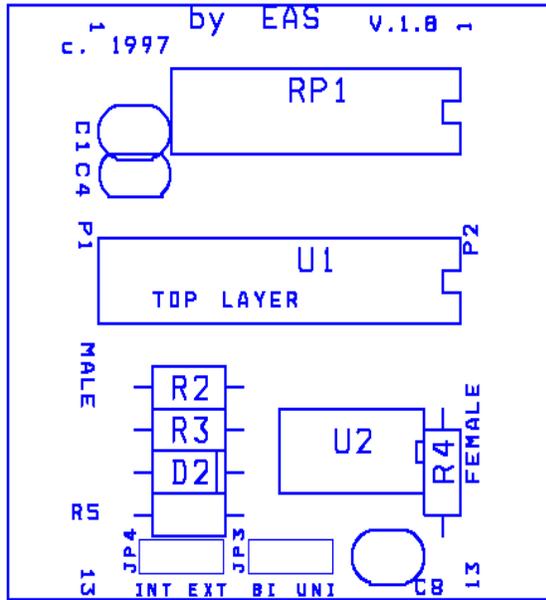| Pin #	Connector P2 pinout (female DB25 side)
1	Analog input channel 0
2	Analog input channel 1
3	Analog input channel 2
4	Analog input channel 3
5	Analog input channel 4
6	Analog input channel 5
7	Analog input channel 6
8	Analog input channel 7
9	Digital input 0
10	Digital input 1
11	Digital input 2
12	Digital input 3
13	External DC power input (6-12 volts)
14	Analog ground
15	Analog ground
16	Analog ground
17	Analog ground
18	Digital output 0
19	Digital output 1
20	Digital output 2
21	Digital output 3
22	Digital output 4
23	Digital output 5
24	Digital output 6 (open collector output)
25	Digital ground

Installing the RS232 Shell casing

If you intend to change the settings of the jumpers often, then it is recommended that you trim the latching tabs so that they don't lock so hard. To take apart the cases, we found that a dull X-acto blade works well along the tab line. The case does not fully cover the board, to keep cost down we have decided this is the next best alternative. We have found the Radio Shack shielded RS-232 serial jumper box (CAT 276-1403A) is a perfect fit for the MiniDaq. This jumper box is coated with a metallic paint that may help reduce noise if you plan to use the MiniDaq in a less than ideal environment.

PARTS LIST FOR EAS MINIDAQ

Item	Quantity	Reference	Part
1	2	C1,C8	.1uF, 104
2	5	C2,C3,C6,C7,C9	10uF, 106
3	1	C4	.01uF, 103
4	1	C5	22uF (longer lead is positive)
5	1	D1	1N4148 (brown with black stripe)
6	1	D2	1N4733A (silver with black stripe)
7	2	JP4,JP3	3 Pin 2mm Headers
8	1	P1	Male DB25 solder tail
9	1	P2	Female DB25 solder tail
10	1	RP1	10K Isolated Resistor Pack, 103 (orange color)
11	2	R1,R4	47 Ohms, Yellow Violet Black Gold
12	2	R3,R2	22 Ohms, Red Red Black Gold
13	1	R5	1K Ohms, Brown Black Red Gold
14	1	U1	MAX186
15	1	U2	MAX1044
16	2		2mm Shunts
17	1		RS232 Shell casing
18	1		PCB Board

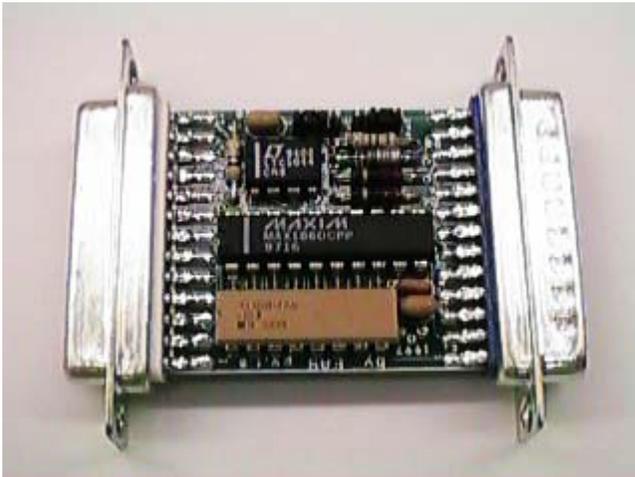Silkscreen Top View   Silkscreen Bottom View
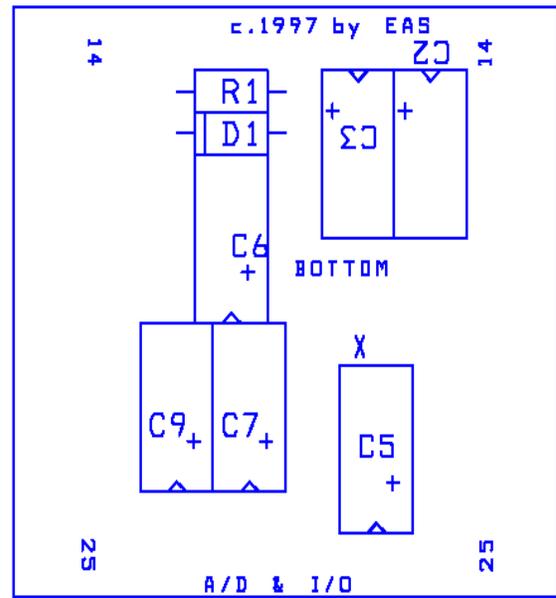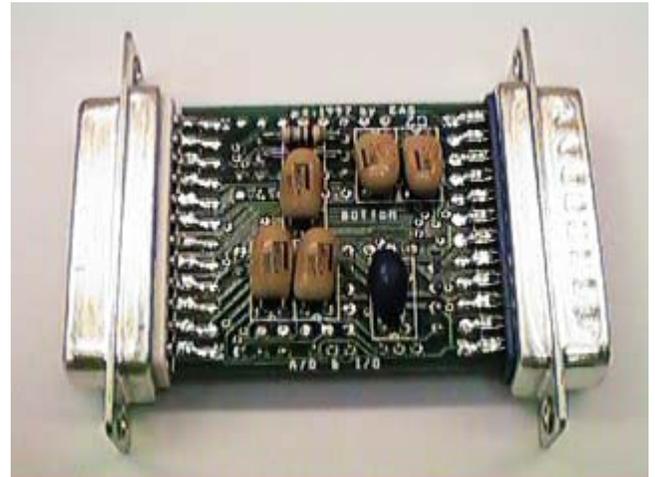

Top Image   Bottom Image

Frequently Asked Questions (FAQ)

Please check out web site for the latest version of the FAQ.

The board shows voltages on other A/D channels, even though nothing is connected.
This should not effect the readings of your current channel. Because of the internal multiplexing done by the A/D, other channels will float. We recommend grounding all unused analog input channels.

The board works but it doesn't zero when grounded.
This is normal, you will get minor offset between all channels. These are very small and consistent offsets that can be nulled out in software. Typically, all A/D routines incorporate a calibrate procedure. By grounding all A/D channels and recording the offsets, they then add these small offsets to the final value read.

Is it possible to build the board from scratch?
Yes, but we don't recommend it, our several prototypes ended up being quite noisy, we were only able to meet the specification of the Maxim chip after we professionally laid out the PCB board. You might as well build an 8 bit A/D for you efforts.

How do I make differential readings?
You have 4 channels of differential inputs. You must place a .1uf capacitor between the negative input and analog ground of each channel used for proper readings to be taken. The negative input should not vary.

	Negative	Positive
Channel 0	pin 1	pin 2
Channel 1	pin 3	pin 4
Channel 2	pin 5	pin 6
Channel 4	pin 7	pin 8

The MiniDaq was working until I put a higher voltage than specified.
Try unplugging the MiniDaq from the PC parallel port and plugging it back in. This will reset the board and release any latch up conditions. Damage to the MiniDaq may occur if you exceed recommended input voltage.

Can the input to the parallel port be damaged?
You can damage the parallel port by not using proper TTL logic levels for the digital I/O. A good practice is to provide a buffer such as a 74LS244 in your circuit. Check out our web page for various interface circuits and projects.

How can I get more I/O?
You can run up to 4 MiniDaqs by providing 4 parallel ports for your PC. This will give you a total of 32 A/D channels, 16 TTL input channels and 28 TTL output channels

How can I further protect my Computer from my experiments?
You can use a separate parallel port ISA card for the interface to the MiniDaq. If the maximum input voltages have been exceeded, the separate parallel board provides an extra layer of protection between your circuit and the motherboard of your PC. You can purchase 3rd party add on ISA parallel port boards for $19 or less at your local computer supply store.

How are input and output ports connected to the PC?
The digital input and output ports are passed directly to your parallel port with no buffers or protection circuitry. You must observe TTL levels or provide buffers to protect your parallel port from excessive input voltage. To learn more about the PC parallel port, there is a Parallel Port FAQ located on our Web site.

Note: Digital output 6 is an Open Collector output. All other input and output pins are standard TTL logic. We have found that some parallel ports do not implement the original specification of the PC parallel port. Digital output 6 may not work on your computer parallel port due to this.

Can I damage the A/D if I accidentally exceed the maximum input voltage?
The input to the A/D are protected by internal clamping diodes as well as a current limiting resistor. It provides a fair amount of protection. We have tested the Mini Daq with a 9volt analog input source without any problems for a short period of time.

How do I interface relays and other devices to the MiniDaq.
We have provided circuits on our web page in PDF format to do this. If you have further questions feel free to email us.

How can I increase the A/D sample rate?
Sample speed varies with the speed of your PC. The faster your PC, the higher the sample rate. Although the A/D chip is rated at 133 Khz sampling rate, sampling frequency is quite effected by software overhead and by Windows itself. You can run in a Dos environment to get better results. We have provided interface libraries to C and Quick Basic. In Labview, optimized loops will significantly increase your sample rate.

I'm getting A/D fluctuations every time I control an output port.
Connect unused A/D inputs to ground. You might be drawing too much current from the parallel port, effecting the power input to the Mini Daq. Try switching to external power such as a 9V battery.

Why does my MiniDaq not work with jumper JP4 set to INT power?
We have designed the Mini Daq with the option to get its supply voltage from the PC parallel port. Some parallel port adapters may not be able to supply enough current to fully power the MiniDaq. This is common with laptop computers that use low power 3.3 volt logic circuits. If you are experiencing this problem, set jumper JP4 to the EXT setting and connect an external 6 to 12volt supply to Pin 13 of DB25 connector P2. A 9volt battery works quite well for this.

Trouble shooting

If you have purchased the assembled MiniDaq, it is fully tested and operational before shipping. If it fails to function properly, inspect the board for obvious physical damage. If there is damage, please contact us for replacement.

The most common problems are improperly configured parallel port or attempting to use the wrong parallel port on the PC. Verify that your port is working by connecting a printer and performing a print test. Some PC's may not be able to supply enough current to run the MiniDaq. If this is the case, set JP4 to EXT and connect an external 6-12Volt supply to connector P2 pin#13 and ground.

For kits,
Check and make sure all components are installed and properly orientated.
Check diode polarity.
Check IC positions.
Check Tantalum capacitor polarities.
Check for shorts
Check for cold solder joints, especially around RP1 and U1.
Cable from PC to MiniDaq should be 6 foot or less. Shorter is better.
Try external power, PC port may not provide adequate power

Specifications:

12 bit, eight channel analog to digital converter or four channel differential (4096 discrete points)
bipolar mode -2 to +2 volt input
unipolar mode 0 to 4 volt input
Relative accuracy +- 1 LSB
Do not exceed maximum analog input voltage or damage to Mini Daq may occur.

A/D sample speed
6000 samples/sec using a Pentium 166 with data acquisition program written in Microsoft Quick Basic version 4.5 for DOS. Depending on the speed of your computer, the actual sample rate may vary. The maximum sample rate of Mini Daq is dependent on how fast your computer is and by using acquisition programs written in optimized C and assembly language.

4 digital TTL inputs (0 to 5 volts). Do not exceed TTL input voltage range or damage to your PC parallel port may occur.

7 digital TTL outputs (0 to 5 volts).

Power requirements:
5volts DC taken internally from PC parallel port or external 6 to 12volt DC supply. Unit can be run from a 9V battery for best results. This is set using jumper JP4.

Current consumption: 7ma DC.

Dimensions:
2.45" long
2.1"   wide
.65" deep

Software:
Labview, C, Quick Basic, Visual Basic and Excel libraries, demos and example software is available on floppy disk. Software and updates may also be downloaded from our WEB site.

STANDARD LEGAL STUFF

Although all of the circuits and projects provided have been thoroughly tested by Embedded Acquisition Systems (EAS). We cannot take responsibility for the circuits, nor will we take any responsibility for anything happening as a result of using any of our designs.

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