

Dios 28/40 Interface to MCP3008 8-Channel 10-bit A/D Converter

While the Dios can have up to 8 AtoD ports, there are times you may need more. With the Microchip MCP3008 you can add as many as you like. You get 8 10-bit AtoD ports with each chip you add.

MCP 3008 Features

- 10-bit resolution
- ± 1 LSB max DNL
- ± 1 LSB max INL
- 4 (MCP3004) or 8 (MCP3008) input channels
- Analog inputs programmable as single-ended or pseudo-differential pairs
- On-chip sample and hold
- SPI serial interface (modes 0,0 and 1,1)
- Single supply operation: 2.7V - 5.5V
- 200 ksp/s max. sampling rate at VDD = 5V
- 75 ksp/s max. sampling rate at VDD = 2.7V
- Low power CMOS technology
- 5 nA typical standby current, 2 μ A max.
- 500 μ A max. active current at 5V
- Industrial temp range: -40°C to +85°C

Hookup

In this application note we will use the Dios 28 pin chip. You may use the Dios 40 pin chip or any of the Dios Carrier boards. The results will be the same.

Schematic 1 shows the connection to the dios for 1 chip while schematic 2 shows 2 chips. The hookup is the same except for the additional CS lead needed for each chip. The remaining 3 leads clk, din, and dout are tied together for each chip you add.

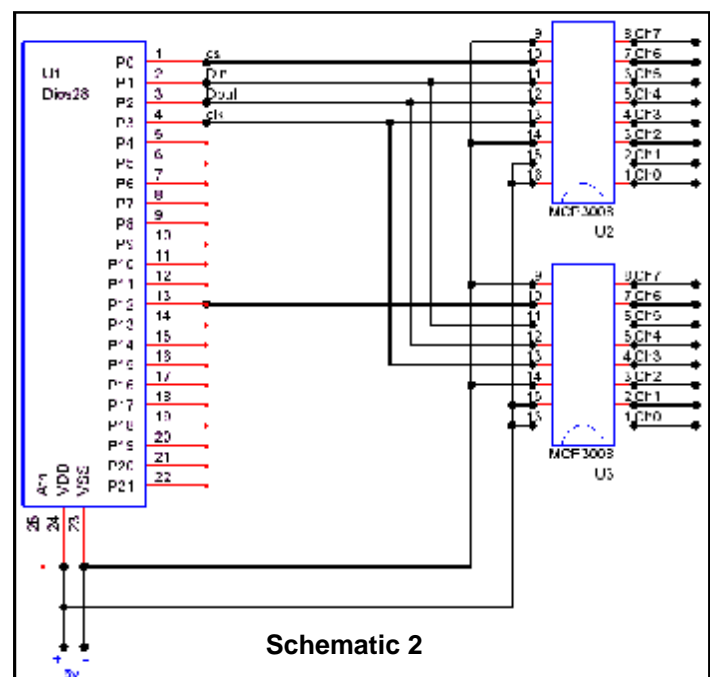
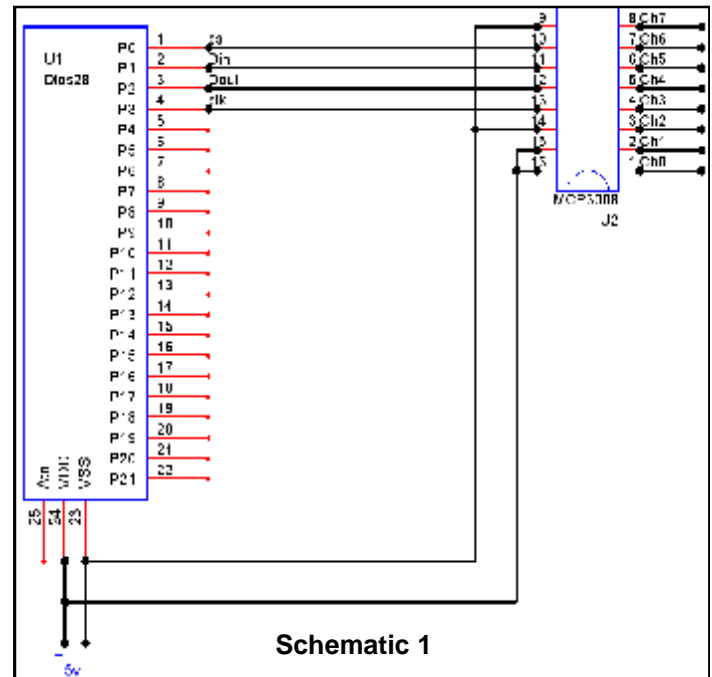
The MCP3008 typically pulls less then 1ua of power when in standby mode.

Note that we are not showing any of the external components or connections to the Dios. It is assumed that the Dios is in a carrier board or has the appropriate support componets connected.

Place at least a 100uf capacitor across Gnd and Vdd to help stabilize the readings. I don't really see a limit to the number of MCP3008 chips you can add.

Refer to the Dios manuals for hookup instructions.

You have the ability to split the Digital and Analog grounds to gain a more stable reading. The MCP3008 has a few more reference voltage options please refer to the MCP3004 documentation for more information.



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Software

First lets take a look at the `getMCP3008` function shown in the **Code 1** segment. This is the heart of the interface and is where all the work gets done.

To initiate communications we need to bring the cs pin for the chip we wish to talk to low.

To set things in motion we need to transmit the start bit. This is done by placing the din line high and sending a pulse out the clk line. The actual data is clocked in on the low to high clock pulse.

We have provided a KRAalyzer snapshot and will refer to the pulses by numver as indicated at the top of the snapshot. The start bit is pulse 1.

The next pulse sent (pulse 2) is the SGL/DIFF bit. If its high the conversion will be in SGLmode. Low will place the chip in Diff mode. Refer to the MCP3008 for information on the different modes.

The next three bits sent are the channel number. They are pulses 3-5. Note that they are sent MSBfirst.

Once the last channel bit has been sent we must send one more pulse to start the conversion process. Pulse 6.

The MCP3008 will respond by goinf low for one clock cycle.

At this point we start clocking in the 10 data bits as the conversion takes place. They are in MSB form and the data is presont at the falling edge of the pulse. The MSB is sent first. Pulses 7-16

Once we have all 10 conversion bits we bring cs back high and the function returns the 10 bit total.

Signle Chip Interface

Before we can call the `getMCP3008` function we must set up a few of the ports to there idle state. The **Code 2** segment is used to set up the ports for a single chip connection.

We declare some constants set up the ports then enter a loop where we pass the pins to the `getMCP3008` function.

Multi Chip Interface

Multiple chips can be controlled in software with the same `getMCP3008` function. We however must configure an extra cs port for each MCP3008 we wish to control.

Notice in the **Code 3** segment we declare an extra cs line and make 2 calls to the `getMCP3008` function.

```
func getMCP3008(tcs,tclk,tdin,tdout,tmode,tchan) as integer

    low tcs
    dim xin
    dim x

    'Set start bit
    high tdin
    pulseout tclk,1

    'SGL/DIFF bit
    portbitset tmode,0,tdin
    pulseout tclk,1

    'Set Channel
    for x = 2 to 0 step -1
        portbitset tchan,x,tdin
        pulseout tclk,1
    next

    'Tell Chip to start conversion
    pulseout tclk,1

    'At this point conversion has started
    xin = 0

    for x = 9 to 0 step -1
        pulseout tclk,1
        portbitget xin,x,dout
    next

    high tcs

    exit xin
endfunc
```

Code 1

```
'MCP3008 Interface for 1 chip
'Vref tied high
'Agnd and Dgnd tied to Vss

func main()

    dim tvall

    const clk 4
    const datin 2
    const cs1 1
    const datout 3

    'Set the start state of the pins
    output clk
    output datin
    output cs1

    high cs1
    low clk

    'Main demo loop
again:
    tvall = getMCP3008(cs1,clk,datin,datout,1,0)
    print tvall
    goto again
endfunc
```

Code 2

KRAnalyzer Snapshot

We have provided a snapshot from our KRAnalyzer to better help you visualize the software to MCP3008 interface.

We have numbered the pulses in red so that you can follow along in the getMCP3008 function description.

Note that the KRAnalyzer is a Dios project that you can build. The KRAnalyzer software is free and can be downloaded from the Kronos Robotics web site. Please visit the and Kronos Robotics web site for a complete description of this project at:

www.kronosrobotics.com

```
'MCP3008 Interface for 2 chips
'Vref tied high
'Agnd and Dgnd tied to Vss

func main()

    dim tval1
    dim tval2

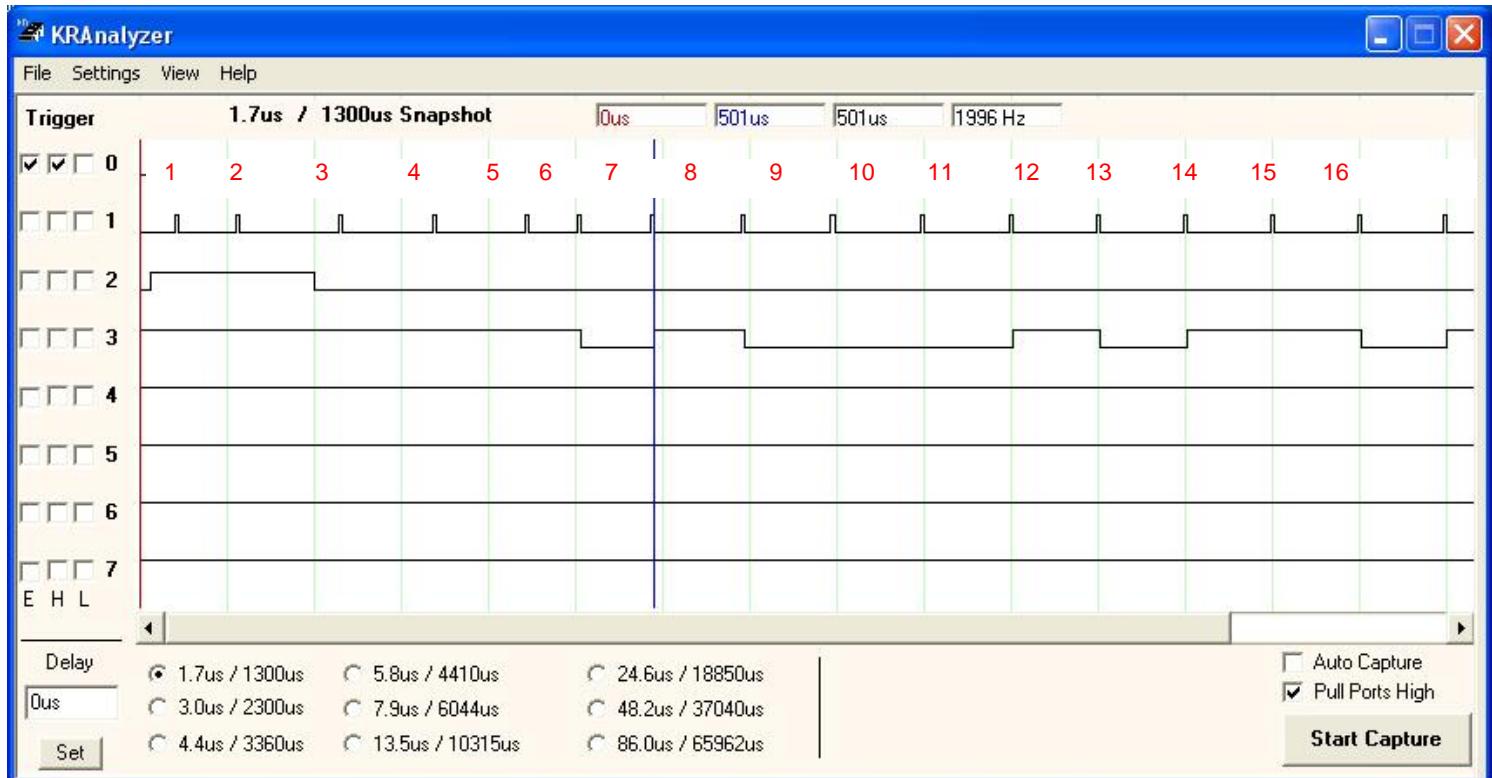
    const clk 4
    const datin 2
    const cs1 1
    const cs2 12
    const datout 3

'Set the start state of the pins
output clk
output datin
output cs1,cs2

high cs1,cs2
low clk

'Main demo loop
again:
    tval1 = getMCP3008(cs1,clk,datin,datout,1,0)
    tval2 = getMCP3008(cs2,clk,datin,datout,1,0)
    print tval1," ",tval2
    goto again
endfunc
```

Code 3



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Related Products

DiosPro 28	http://kronosrobotics.com/xcart/customer/product.php?productid=16429
DiosPro 40	http://kronosrobotics.com/xcart/customer/product.php?productid=16428
EZRS232 Driver	http://kronosrobotics.com/xcart/customer/product.php?productid=16167
Dios Componets Package	http://kronosrobotics.com/xcart/customer/product.php?productid=16172
Dios Carrier 1 Kit	http://kronosrobotics.com/xcart/customer/product.php?productid=16170
Dios Carrier 2 Kit	http://kronosrobotics.com/xcart/customer/product.php?productid=16171
Dios Workboard Deluxe Kit	http://kronosrobotics.com/xcart/customer/product.php?productid=16452
9 Pin Cable	http://kronosrobotics.com/xcart/customer/product.php?productid=16259
MCP3008	Digikey part # MCP3008-IP-ND