DID Howto

Rev 5

< 3-2017 >

The Digital Input Device (“DID”) is a remote input device that is used to send data to the Overdrive Control Computer (“CC”). The DID can also communicate with the Overdrive Embedded computer on its CAN bus. DIDs can read in both analog and digital signals and connect to the CC by either RS232 serial or via CAN bus, utilizing a subset of CANopen protocol. Only one DID at a time may connect on a RS232 serial port, but many DIDs may connect at once on a CAN bus, provided there is adequate bandwidth.

DIDs have the capability of providing sixteen 5V TTL/CMOS digital inputs, eight single-ended 12-bit analog inputs, two single-ended quadrature encoder inputs, and eight 16-bit bipolar analog inputs (via a mezzanine). In special cases DIDs may be configured to read serial input from a third party device and pass that stream on to Overdrive.

The DID version 1A (shown in Fig 1) uses a Freescale 56F8345 Digital Signal Controller. The more recent version 1B uses a Freescale 56F8355 DSC.

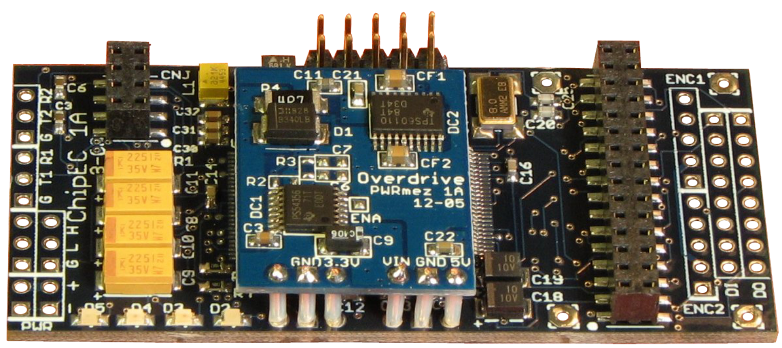


Figure 1. DID revision 1A

~ The DID is static sensitive and may be damaged if its pins are touched without taking static dissipation safety precautions. ~

Dimensions: (per image above)

length (horizontal) : 3.06in (77.72mm)
width (vertical): 1.31in (33.27mm)
maximum height (with ADC mezzanine): 0.50in (12.7mm)

Logic Power

Supply power for the DID can be in the range 4.3V to 16V. The device logic uses a maximum of 820 mW :

at 12V : 68 mA
9 V : 83 mA
7.2V : 97 mA
4.8V : 135 mA

This is the power into the DID's onboard DC-DC converter. The converter becomes less efficient (wastes Watts) as the input voltage gets higher.

At least 4.3V is needed by the DC-DC converter. This facilitates battery-powered applications, where batteries are less likely to cause a DID to turn off as the battery discharges.

Wiring

The DID logic wiring uses Molex SL contacts and crimps. Molex Part numbers are on the pin diagram at the end of this document.

ID and Flashing

Serial ID flashing:

Unique IDs (between 1 and 127) must be set for multiple DIDs to connect to Overdrive on a common CAN bus.

Configuration via a serial port: Turn off all other DIDs and connect just one at a time to the CC serial port when flashing an ID.

Plug the DID into a Control Computer ("CC") serial port and turn it on. Once a connection is established

- Select Type: "Serial DID" in the drop-down menu of the EC page
- Highlight the green connected DID
- Click the "Configure Device" button
- Click the "Assign EC ID" button

Depending on how long it takes for the DID to flash itself, it may generate communications warnings, or it may lose connection with the CC altogether. This is harmless.

To confirm that the ID assignment succeeded, turn the DID off, turn it back on, the red LED will blink the ID every 2 seconds. If it is not possible to view the LEDs, let the device connect to the CC again, click the "Assign EC ID" button to see what the new ID is, then Cancel.

DID's with IDs greater than 1 will take longer to connect to the CC on a serial port when first turned on; they also attempt to connect less frequently (this may be seen by looking at a transmitting optical fiber). This staggered connect timing helps multiple units to connect to a single CC.

CAN bus ID flashing

Shut down all other DIDs and connect just one at a time to the Control Station CAN port when performing flashing operations.

Use the “EC” section of the Overdrive Control Panel to set the ID, where a “ChipEC” settings or “ChipEC Advanced” settings menus allow setting of communications bitrate, and other settings of a DID via the CAN bus.

Note: A number marked on capacitors on the top of the DID board is a manufacturing serial number (not the ID of the device).

LEDs

The Green LED flashes at ½ the communications rate. It signifies that the DID is communicating with something on either the serial or the CAN bus.

The Red LED blinks to indicate the device ID. It blinks like a grandfather clock: one blink means an ID of one, two blinks means an ID of two, etc. A pause of 2 seconds takes place after the unit blinks its ID. This is the ID that was flashed into the DID.

A Yellow LED is either an error indication, or, the completion of a flashing operation. It should not be illuminated under normal operating conditions.

The Blue LED flashes at ½ the communications frequency of the peripheral serial bus, if the DID is configured to use the peripheral serial bus.

Digital Input

The DID rev1A and 1B have two sets of eight Digital Input pads labeled “DIN 1-8” and “DO 1-8”, for a total of 16 digital inputs, which are 3.3V CMOS logic but are designed to be tolerant of 5V TTL/CMOS signals.

Digital inputs are pulled high by internal pull-up resistors, so if left unconnected each bit will read a value of logical “1”. Connecting a DIN pad to PWR-COMMON asserts a logical “0”. The DID continuously sends the state of the digital inputs to the CC each Mocon frame, via telemetry packets.

Quadrature

The DID 1A and 1B have two single-ended five-volt quadrature ports for incremental encoder input. Contact tech support for further details on enabling these ports.

Inputs and Telemetry

A DID performs “Telemetry”, transmitting remote measurement to the CC. DID channels can be sourced on the Overdrive Telemetry Channel page, one channel per “Telemetry Device'.

CAN DID Telemetry Device mapping

Telem Device	“Bit Width”	TD “Channel”	Function	Type
first	8	1	Digital Port A	Position
second	8	2	Digital Port B	Position
third	16	5	1st Analog	Position
fourth	16	6	2nd Analog	Position
fifth	16	7	3rd Analog	Position
sixth	16	8	4th Analog	Position
seventh	16	9	5th Analog	Position
eighth	16	10	6th Analog	Position
nineth	16	11	7th Analog	Position
tenth	16	12	8th Analog	Position
Quad 1 (option)	32	7	Encoder	Position
Quad 2 (option)	32	8	Encoder	Position

The chart above shows how to configure telemetry patch-bays to receive two 8-bit digital input words and eight 16-bit analog inputs, which is a common DID configuration. In this example, the sixteen digital bits arrive as two 8-bit words on the first two TD channels. If desired, one-bit values could be chosen in the patchbay to extract bits out of the first two words. Quadrature inputs are disabled by default but can be available via an alternative configuration – contact tech support.

High-resolution Analog Inputs
With a “MADC-16” mezzanine, the DID is capable of reading eight 16bit analog inputs. These are configurable in firmware for input ranges:
0-5V, +/-5V, 0-10V, +/-10V.

There is a 5VDC, 120mA Analog Reference output power source available on the MADC-16 mezzanine. This can be used for potentiometer excitation voltage. It is indicated as “REF OUT” on pads “G”, “+5” seen in Figure 2.

There are pads on the mezzanine for an external 12V supply. This power source is normally bridged to the Chip-EC logic power, but may alternatively be supplied externally by removing the wiring on the underside of the MADC-16 mezzanine, supplied during manufacturing. Use a linearly regulated supply (not switching) for best analog signal integrity.

The MADC-16 mezzanine has on-board RC low-pass filters available for signal conditioning. Typically the (2.2uf) capacitors are removed such that filters are not operative. Note that there are 100 ohm resistors are in series with input signals by default, remove those if it is desirable to replace them with zero-ohm links.

Digital Inputs
There are two sets of 8 Digital Input channels, “DIN1” through “DIN8” and “DO1” through “DO8”. Access to these digital ports is typically 8-bit wide such that an integer between 0-255 representing one port will appear in the Telemetry Channel. Bit-wise operators are available in the Math plugin language to facilitate bit checking or extraction (See “Math Mixer User Help” document).

Low-resolution Analog Inputs
There are eight 12-bit Analog Input channels on the DID, as seen in the circuit board pictures below. Power for sensors to be read by the Analog Input may come from the the analog supply provided on this connector: “3.3V”, “AGND”. Do not put voltages higher than 3.75V into an analog input or it may be damaged. These channels are not enabled by default when there is a “MADC-16” analog input mezzanine on the board; contact Tech Support to enable them.

Serial DID Telemetry Device Mapping

Channel	Bit width	Type	PCB pad Name
1	32	Position	Digital “DO” port
2	32	Position	Digital “DIN” port
9	32	Position	Analog A1
10	32	Position	Analog A2
11	32	Position	Analog A3
12	32	Position	Analog A4
13	32	Position	Analog A5
14	32	Position	Analog A6
15	32	Position	Analog A7
16	32	Position	Analog A8

When a DID is connected on a serial port, the Telemetry Device channels are as in the chart above.

Two-ADC DID Telemetry Device Mapping

The DID can also be configured to utilize both its low resolution 12-bit ADC and the MADC mezzanine (16-bit) at once. Contact tech support for channel mapping information.

Channel	Bit width	Type	PCB pad Name
1	16	Position	Mezzanine AIN 1
2	16	Position	Mezzanine AIN 2
3	16	Position	Mezzanine AIN 3
4	16	Position	Mezzanine AIN 4
5	16	Position	Mezzanine AIN 5
6	16	Position	Mezzanine AIN 6
7	16	Position	Mezzanine AIN 7
8	16	Position	Mezzanine AIN 8
9	16	Position	Analog A1
10	16	Position	Analog A2
11	16	Position	Analog A3
12	16	Position	Analog A4
13	16	Position	Analog A5
14	16	Position	Analog A6
15	16	Position	Analog A7
16	16	Position	Analog A8

Alternative CAN DID Telemetry Device Mapping

When connected as a CAN DID, the data can be accessed in different ways. It can be accessed as twenty-four 8-bit channels, as six 32-bit channels, as twelve 16-bit channels, or even as 192 1-bit channels. Optionally, two additional 32-bit quadrature encoder channels are available. Contact technical support at Concept Overdrive to enable the quadrature encoder feature.

The telemetry of the CAN DID is detailed in the following table:

DID Pin	Bits	32-bit channel	16-bit channel	8-bit channel	1-bit channel
DO1	1	1	1	1	1
DO2	1				2
DO3	1				3
DO4	1				4
DO5	1				5
DO6	1				6
DO7	1				7
DO8	1				8
DIN1	1			2	9
DIN2	1				10
DIN3	1				11
DIN4	1				12
DIN5	1				13
DIN6	1				14
DIN7	1				15
DIN8	1				16
unused	16		2	3-4	17-32
unused	32	2	3-4	5-8	33-64
A1	16	3	5	9-10	65-80
A2	16		6	11-12	81-96
A3	16	4	7	13-14	97-112
A4	16		8	15-16	113-128
A5	16	5	9	17-18	129-144
A6	16		10	19-20	145-160
A7	16	6	11	21-22	161-176
A8	16		12	23-24	177-192
Quad 1	32	7	13-14	25-28	193-224
Quad 2	32	8	15-16	29-32	225-256

Note: “DO” pins are actually inputs when the device is configured this way.
Note: The Analog Channels A1 to A8 contain 16-bit values.
Note: “Channel” above refers to the “Channel” field on the Telem Device Tab (not a Telemetry Channel).

The entries in red font above are the recommended way to access the different inputs. The telemetry patch bay allows any word or bit to be extracted from the DID data individually, though the data above can also be accessed byte-wise, then parsed in the Math Mixer with bitwise operators.

Examples:

1. To access DIN2, set Bits to “1 bit” and Channel to “10”
2. To access A3, set Bits to “16 bit” and Channel to “7”
3. To access DIN as an 8-bit data, set Bits to “8 bit” and Channel to “2”
4. To access quadrature encoder 1 as a 32-bit channel, set Bits to "32 bit", and Channel to "7"

Advanced: Low-level CAN Mapping

	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
PDO1	Digital DO port	Digital DIN port	unused					
PDO2	Analog A1		Analog A2		Analog A3		Analog A4	
PDO3	Analog A5		Analog A6		Analog A7		Analog A8	
PDO4	Unused							

The chart above shows CANopen PDO mapping of the data coming from the DID to the CAN master. See Telemetry Channel How-to for more details on alternate ways to configure the Telemetry Channel page.

Serial Bandwidth Utilization

A CAN DID will use different amounts of communications bandwidth depending on the configuration of the device and how many channels of data it is transmitting. The Mocon framerate determines how much time there is for CAN traffic. Below are typical Mocon framerates and their frame-periods:

Mocon Frame Rate	Frame Period (available transmission time)
60 Hz	16.66 msec
120 Hz	8.33 msec
125 Hz	8.0 msec
200 Hz	5.0 msec

DID configurations and Transmission Time

Eight 16bit analogs, 16 Dig Ins :	1.00 msec
Eight 16bit analogs, 8 Dig Ins, eight 12 bit analogs:	1.50 msec
Eight 16bit analogs, 8 Dig Ins, four 2 bit analogs:	1.25 msec
Eight 16bit analogs, 16 Dig Ins, eight 12bit analogs:	1.50 msec

Whereas the Control Station's CAN bus is normally not busy, an EC's CAN bus may be full of servo drive traffic and thus a DID on that bus may compete for bandwidth. Since EC configuration will vary according to user preference, it may be necesssary to put an oscilloscope on the CAN bus to determine actual bandwidth utilization.

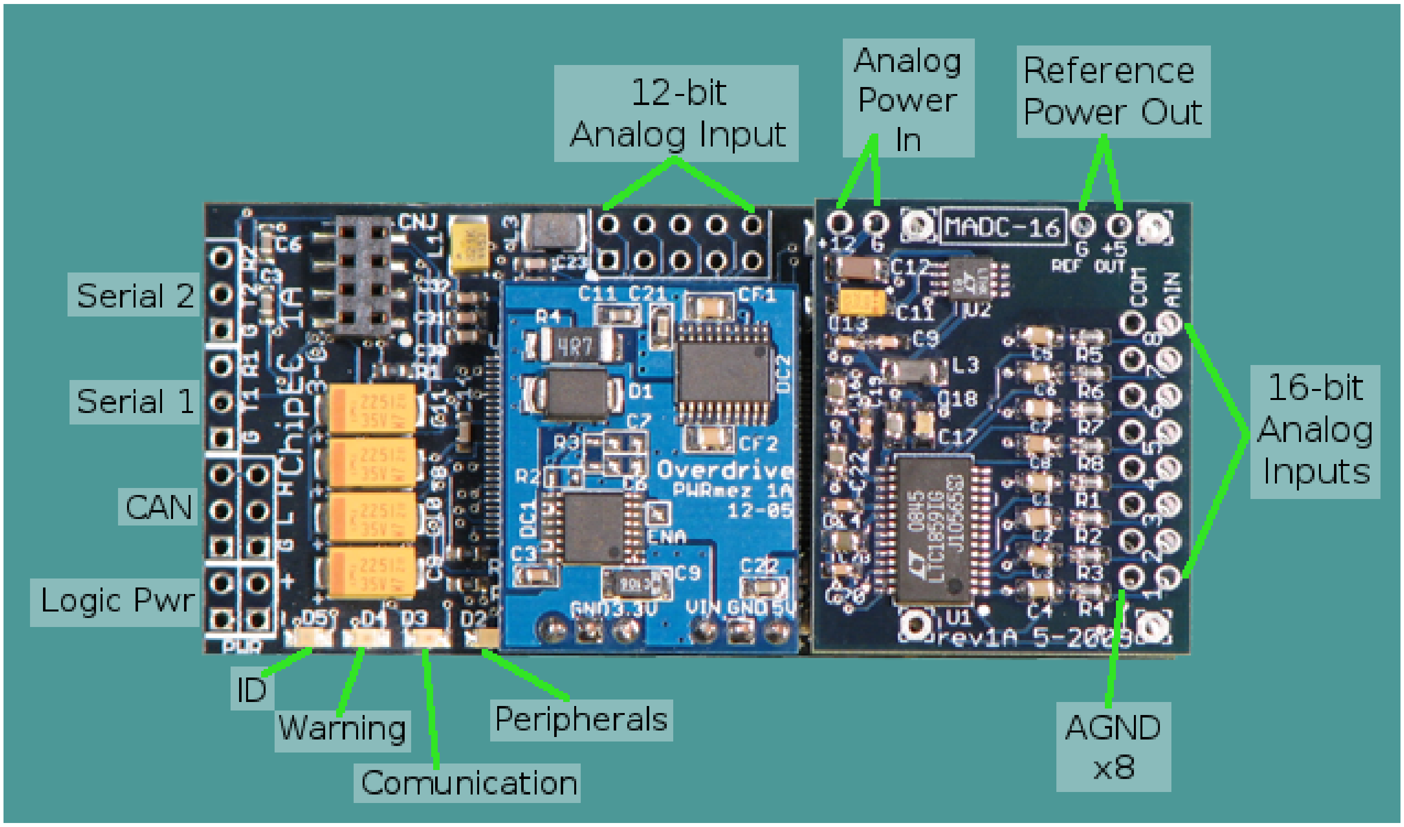


Figure 2. DID 1A/1B Pad & Connector Identification
with MADC-16 Mezzanine

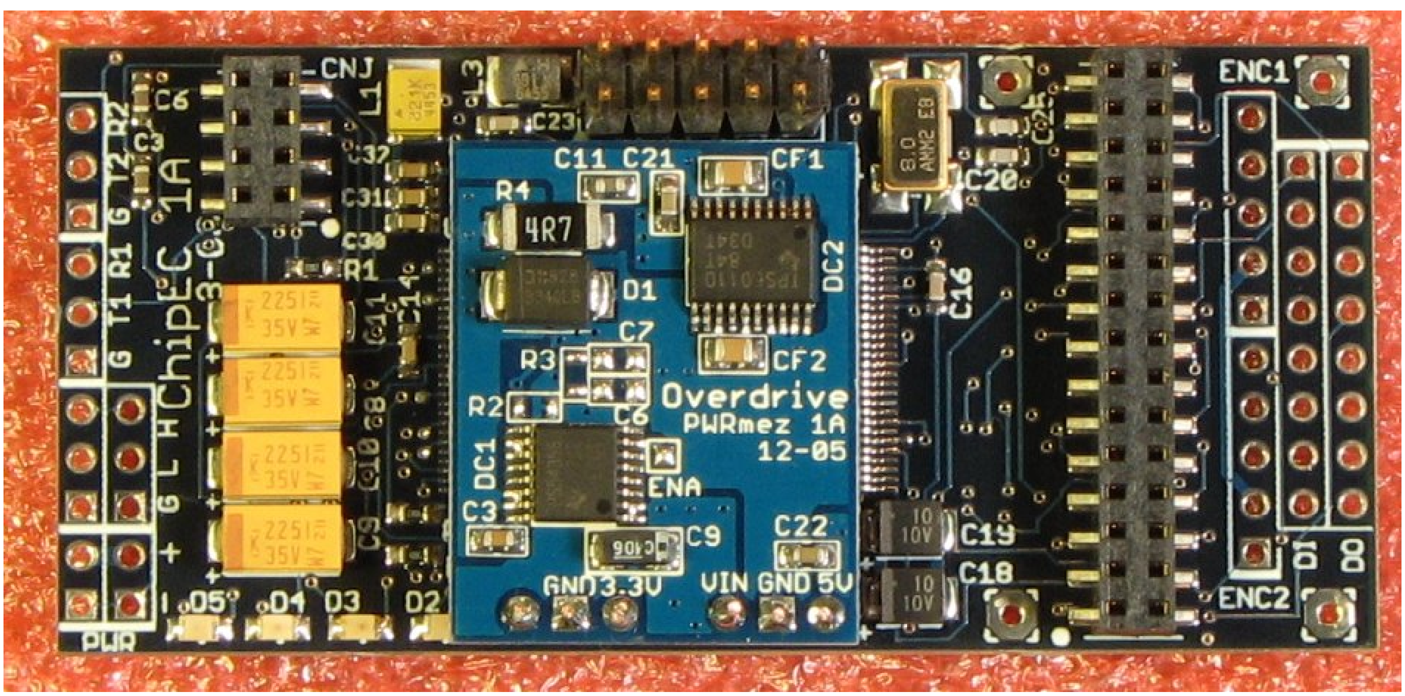


Figure 3. DID without Mezzanine
Showing digital input pads and encoder pads

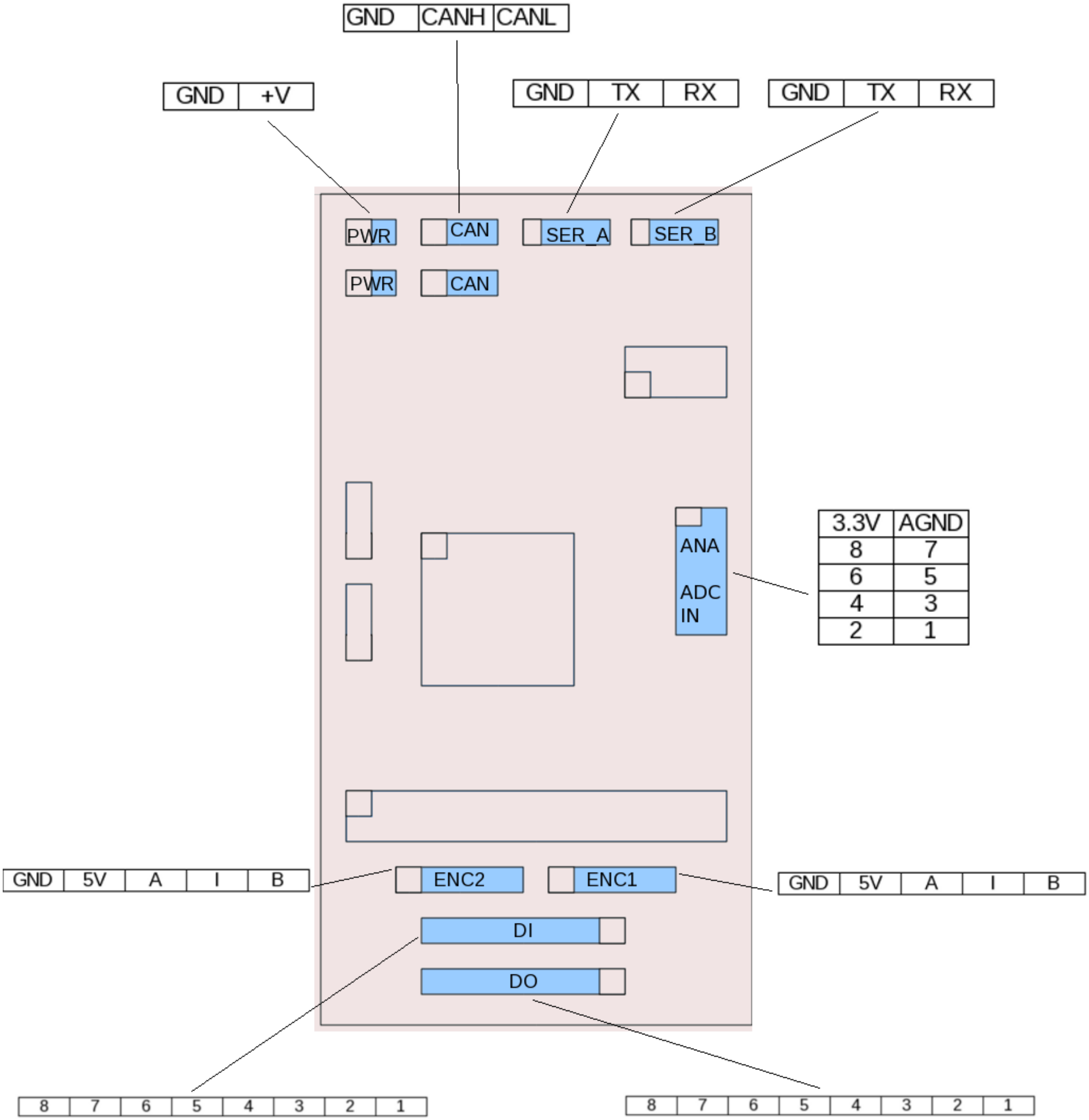
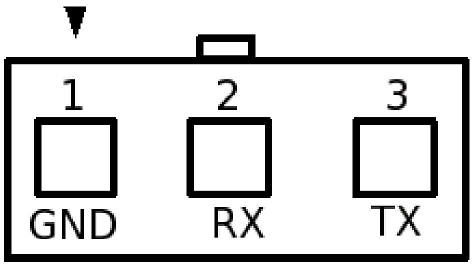


Figure 4. DID Port Pinouts
(analog input ports are on MADC-16 mezzanine, seen in Figure 2)

Chip-EC Pinout - rev 3 8/2005

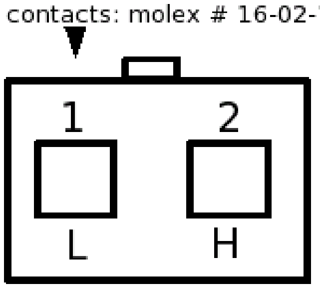


Serial
Female - Front View
Female molex connector #50-57-9403
(mates with male molex #70-107-0002)
contacts: molex # 16-02-1125

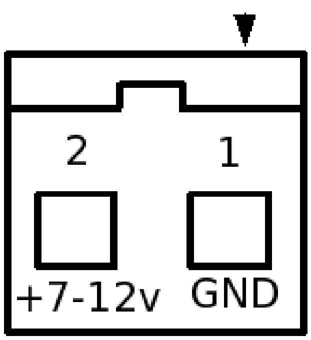
<u>Color Code</u>

Gnd	Black
+7 to 12V	Yellow
Signal	White

Note: Pin one indicated by arrow on top of connector



Inter-EC Bus
Female - Front View
Female molex connector #50-57-9402
(mates with male molex #70-107-0001)
contacts: molex # 16-02-1125



PWR
Male pins - Front View
Male molex connector #70-107-0001
(mates with female molex #50-57-9402)
contacts: molex 16-02-0115

~ These wired connector pinouts are common to DID and Chip-EC devices ~