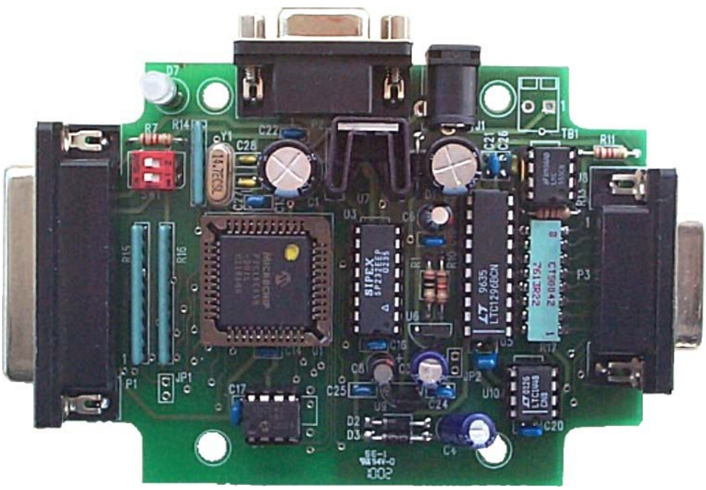
SuperLogics

SuperLogics Inc.
300 Third Avenue
Waltham, MA 02451

Phone 781-893-1600
Fax 781-893-0600
Tech E-Mail support@superlogics.com

http://www.superlogics.com



ADC-1R2
I/O Module

Digital I/O
Analog I/O

Table of Contents

Introduction

Welcome to the SuperLogics **ADC-1R2 Series** of I/O modules. These modules using RS-232 communications are available in different configurations dependent on your needs and applications. In addition they are offered in an enclosure, or open allowing you the end user complete flexibility when determining the parameters for your project.

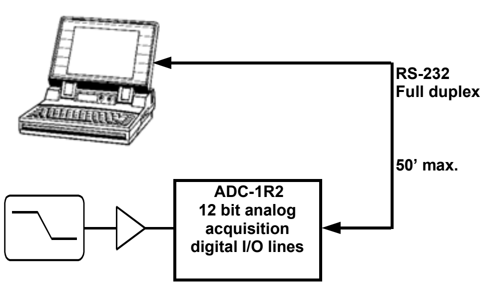
In addition SuperLogics offers a full line of peripheral attachment boards for analog signal conditioning and digital I/O interface. These boards conveniently plug into the main unit for ease of installation. See page 24.

Configurations for 232M200 models with enclosure are:

ADC-1R2-DIO	16 digital I/O
ADC-1R2	16 digital I/O and 8 channels A/D conversion
ADC-1R2-AOT	16 digital I/O and 8 channels A/D conversion and 2 channels D/A conversion

I/O Module features:

MPU:	Microchip PIC16C65B
EEPROM:	Microchip 25C040
MPU Clock:	14.7456 Mhz
Interface:	RS-232 (single ended)
Baud:	9600, 19200, 57600, 115200 (DIP switch selectable)
LED:	Bicolor diagnostic LED
Watchdog:	MPU has built-in watchdog timer
POR:	MPU contains timed Power On Reset circuitry
Brownout:	MPU brownout detection ciruictry built-in
Temperature:	0° to 70°C (32° to 158°F) *Commercial Temperature Range*
	-40° to 85°C (40° to 185°F) *Industrial Temperature Range*
PCB:	FR4
Power:	7.5Vdc to 15.0 Vdc (approx. 50 ma nominal power)
Peripherals	See the plug in peripheral section on page 24.



ADC-1R2 Series Features

- 16 Digital I/O lines
- 8 12 bit Analog Inputs
- 2 12 bit Analog Outputs
- PWM Output
- 32 bit Pulse Counter 1 Mhz

Quick Start Instructions

You need the following:

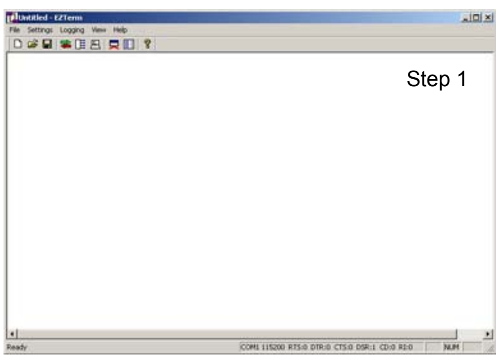
- EZTerminal program available **free** on our website http://**www.SuperLogics.com**
- An open COMPORT on your PC
- Power supply PS9J (9VDC 400 ma unregulated)
- A cable to connect your PC (C9F9M-6 6 foot serial cable)

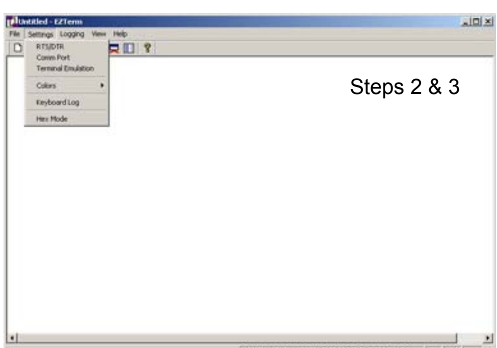
Make these DIP switch settings for 115,200 baud

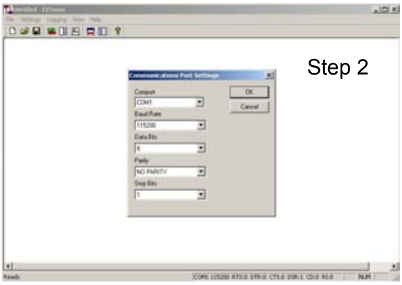
SW1: ON
SW2: ON (These are **factory default** settings, see page 21)

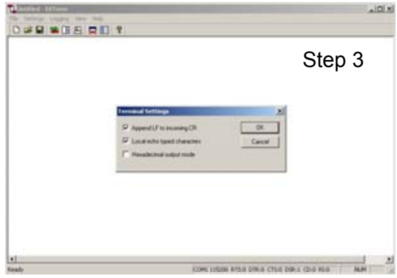
Launch the EZTerminal program

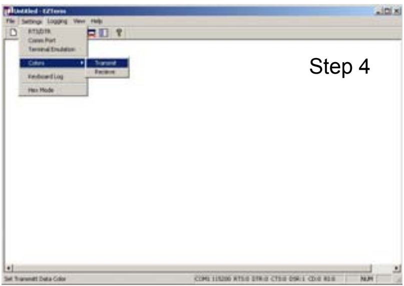
1. Double click the icon in whatever area you have put the program.
2. Under "**Settings**" then choose Comport and select your RS-232 port, 115,200 Baud Rate, 8 Data Bits, NO PARITY, and 1 Stop Bits.
3. Under "**Settings**" now choose "**Terminal Settings**", and check the "**Append LF to incoming CR**" box, and "**Local echo typed characters**" check box.
4. You may change the color of the transmitted and received characters by going under "**Settings**" and selecting "**Colors**" then "**Transmit**" or "**Receive**" and pick the color of your choice.

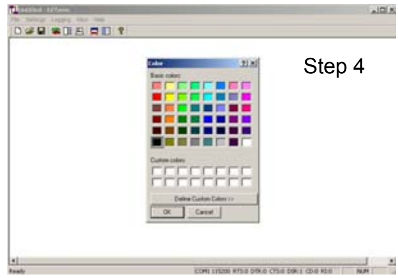












Your First Command

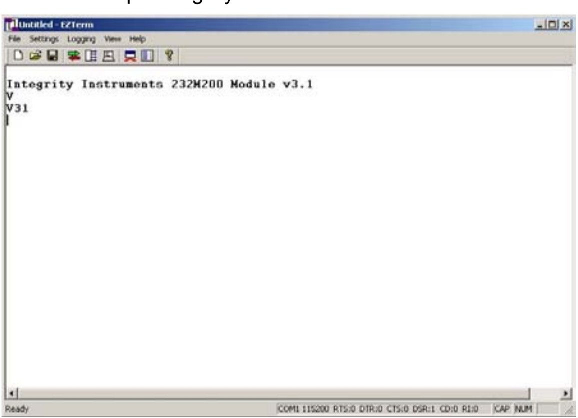
Now that you have a EZTerminal session running, your ready to power up the **ADC-1R2 Series** I/O Module. After powering up your **ADC-1R2 Series** Module, EZTerminal will receive a welcome message from the unit indicating you are ready to provide your first command.

RS-232 Firmware Version 3.1 Command:

- Typethe letter **V** and the **Enter Key**
- You should see V30 on the screen
- **NOTE:** Make sure to type **CAPITAL V**, not lowercase v!

After your first command, see **Commands and Responses** section for more commands.

Screenshots and setup instructions performed running EZTerminal on a PC installed with Microsoft® Windows® XP Operating System.



Commands and Responses v3.0 Firmware

Command Sent by Host	**Response** Sent by I/O Module	**Description**
V	Vxy	Firmware version x.y
I	Ixxyy	Input digital port status xx = PORT1 yy = PORT2 ***Also returns current output port status***
Oxxyy	O	Output digital port: xx = PORT1 yy = PORT2)
Txxyy	T	Set digital direction: xx = PORT1 yy = PORT2 bit set(1) = Input, bit clear(0) = Output
G	Gxxyy	Get current digital direction: xx = PORT1 yy = PORT2 bit set(1) = Input, bit clear(0) = Output
N	Nxxxxxxxx	Get Pulse Counter (xxxxxxxx 32 bit counter value)
M	M	Clear Pulse Counter
Qy	Qyxxx	Bipolar sample analog (y control nibble, xxx analog value)
Uy	Uyxxx	Unipolar sample analog (y control niblle, xxx analog value)
Lyxxx	L	D/A output (y channel setting 0 or 1, xxx 12 bit D/A output)
K	Kxx	Get receive error count (xx current count)
J	J	Clear receive error count
Pxxyyy	P	PWM (xx = PWM frequency, yyy = PWM duty)
Wyyxx	W	Write EEPROM (yy address, xx value)
Ryy	Rxx	Read EEPROM (yy address in command, xx value in reponse)
S	S	Start continuous stream mode
H	H	Halt continuous stream mode
Z	Z	Reset CPU
	X	**Command error response**

Commands and Responses
The following table illustrates actual command and response data for an RS-232 interface.
NOTE:
- All numeric data is represent as ASCII Hexadecimal integers.
- The symbol ↵ equates to a carriage return (decimal 13, hex 0x0D).

Command Sent by Host	**Response** Sent by I/O	**Description**
V↵	V30↵	Module Firmware version 3.0
I↵	IFF00↵	Input digital port [PORT1 bits0-7 ON] [PORT2 bits0-7 OFF] **Note:** this command also returns the current digital output
O007F↵	O↵	Output digital port [PORT1 bits 0-7 OFF] [PORT2 bit 7 OFF, bits 0-6 ON]
TFF80↵	T↵	Set digital direction [PORT1 bits 0-7 INPUT] [PORT2 bit 7 INPUT, bits 0-6 OUTPUT]
G↵	GFF80↵	Get current digital direction [PORT1 bits 0-7 INPUT][PORT2 bit 7 INPUT, bits 0-6 OUTPUT]
N↵	N0000000F↵	Get pulse counter: Current count = 15
M↵	M↵	Clear pusle counter: Current count = 0
Q1↵	**Q1**00F↵	Bipolar analog control nibble = 0x1 Analog reading = 0x00F
U8↵	**U8**40F↵	Unipolar analog control nibble = 0x8 Analog reading = 0x40F
L1800↵	L↵	D to A Output Channel 1 = 2.5 Volts
K↵	K00↵	Current receive errors = 0
J↵	J↵	Clear receive error count: Current receive errors
P4801F↵	P↵	PWM freq = 50499 Hz, PWM duty = 10.6%
W0410↵	W↵	Write EEPROM Address 0x04 with value 0x10
R04↵	R10↵	Read EEPROM Adress 0x04 (value is 0x10)
S↵	S↵ IFF00↵ Q100F↵ IFF00↵ Q100F↵	**START** continuous stream mode **See Modes of Operation section** This example illustrates continuous stream mode configured to continuously update with **Input Digital Port** command and **Query Analog** command with control 0x1. **The module continues until a command H↵is received.**
H↵	H↵	**HALT** continuous stream mode
Z↵	Z↵	Reset CPU (forces a watchdog timeout)

Analog Control Nibble and Example

The **ADC-1R2 Series** I/O modules equipped with analog inputs utilizes the Linear Technologies LTC1296 analog to digital conversion chip. In the process of performing a data sample, the user sends a control nibble to the **ADC-1R2 Series** module. The **ADC-1R2 Series** module in turn performs a data conversion using the control nibble and transmitts a response data sample back. The following table lists each of the 16 possible analog configurations.

NOTE

- All numeric data is represent as ASCII Hexadecimal integers
- The symbol ↲ equates to a carriage return (decimal 13, hex 0x0D)
- See **Analog I/O Technical Information** section for sample to volts conversion

Control Nibble	Analog Sample
0	Differential: CH0+ CH1-
1	Differential: CH2+ CH3-
2	Differential: CH4+ CH5-
3	Differential: CH6+ CH7-
4	Differential: CH0- CH1+
5	Differential: CH2- CH3+
6	Differential: CH4- CH5+
7	Differential: CH6- CH7+
8	Single Point: CH0
9	Single Point: CH2
A	Single Point: CH4
B	Single Point: CH6
C	Single Point: CH1
D	Single Point: CH3
E	Single Point: CH5
F	Single Point: CH7

Command Sent by Host	**Response** Sent by I/O Module	**Description**
Q0↲	**Q0**00F↲	Bipolar sample differential CH0+ CH1- (Control = 0) Analog sample = 0x00F (decimal 15)
UA↲	**UA**123↲	Unipolar sample CH4 (Control = A) Analog sample = 0x123 (decimal 291)

EEPROM Map:

Address	Description
0x00	N/A - Reserved
0x01	N/A - Reserved
0x02	Data Direction Port 1 Bit set (1) = Input Bit clear (0) = Output **[factory default = 0xFF]**
0x03	Data Direction Port 2 Bit set (1) = Input Bit clear (0) = Output **[factory default = 0xFF]**
0x04/0x05	Asynchronous Update Mode Configuration 0x0000= No asynchronous updates 0x0001= Change Update on Digital Input or Counter change 0x0002...0xFFFF = Timed Update (Time = Value * 1 milliseconds) 16 bits - upper byte in 0x04 lower byte in 0x05 **[factory default = 0x0000]**
0x06	Port 1 Power on Default output **[factory default = 0x00]**
0x07	Port 2 Power on Default output **[factory default = 0x00]**
0x08 *See Note 1*	Expander board flag (Opto-22® modules attached) 0x00 = No expander board attached 0xFF = Expander board attached (invert digital signals) **[factory default = 0x00]**
0x09/0x0A	D/A Channel 0 Power on Default output 12 bits - upper nibble in 0x09, lower byte in 0x0A **[factory default = 0x000]**
0x0B/0x0C	D/A/ Channel 1 Power on Default output 12 bits - upper nibble in 0x0B, lower byte in 0x0C **[factory default = 0x000]**
0x0D *See Note 2*	A/D Channels sample clock rate 0x00 = Normal A/D Channels sample clock rate 0xFF = Slowed A/D Channels sample clock rate **[factory default = 0x00]**
0x0E	N/A - Reserved

WARNING!
The I/O Module CPU must be reset before new EEPROM settings take effect.

NOTE

1. This flag is used when an expander board is attached. It allows for polarity interface to the industry standard I/O modules used with the expander board based on open collector logic that these modules use.
2. This is used to slow the A/D Channel sample clock rate. This may help when the A/D channels have a high impedance input attached.

EEPROM Map:

Address	Description
0x0F	N/A - Reserved
0x10	Continuous Stream Analog configuration count 0x00 = No analog stream readings 0x01... 0x08 = Number of analog queries **[factory default = 0x00]**
	See Modes of Operation Continuous Stream for locations 0x11...0x1A
0x11	Analog Query 1 - control byte - **analog control nibble**
0x12	Analog Query 2 - control byte **- analog control nibble**
0x13	Analog Query 3 - control byte **- analog control nibble**
0x14	Analog Query 4 - control byte **- analog control nibble**
0x15	Analog Query 5 - control byte **- analog control nibble**
0x16	Analog Query 6 - control byte **- analog control nibble**
0x17	Analog Query 7 - control byte **- analog control nibble**
0x18	Analog Query 8 - control byte **- analog control nibble**
0x19	Continuous Stream Digital Input configuration 0x00 = Digital Input status OFF 0xFF= Digital Input status ON **[factory default = 0x00]**
0x1A	Continuous Stream Pulse Counter configuration 0x00 = Pulse Counter status OFF 0xFF = Pulse Counter status ON **[factory default = 0x00]**
0x1B ... 0xFF	Available to User

Analog& Digital I/O Sampling Rates

Analog I/O		
Baud Rate	**Polled Mode**	**Continuous Mode**
115,200	777	1515
57,600	412	847
19,200	143	310
9600	72	157
Digital I/O		
Baud Rate	**Polled Mode**	**Continuous Mode**
115,200	878	1884
57,600	456	960
19,200	156	319
9600	78	159

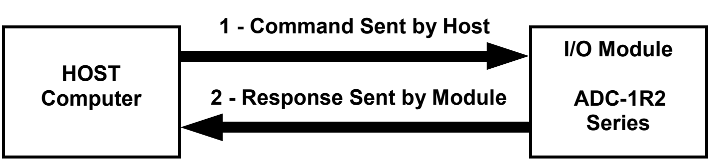
Sampling rates are in samples per second for a single analog channel or 8 bit digital I/O port tested on Windows 2000 850 Mhz P3 with A/D clock running at full speed. Samples per channel = Sample rate ÷ number of channels being sampled.

Modes of Operation:
The SuperLogics I/O modules can operate in three operation modes:

1) Polled
2) Asynchronous Update
3) Continuous Stream.

These modes of operation can be used singularly or together in combination.

#1) Polled Mode
By far, the Polled Mode is the most common usage of the **ADC-1R2 Series** I/O modules. In this mode the Host computer sends a command to the I/O Modules which in turn sends an associated response back to the Host computer.



#2) Asynchronous Update Mode
The I/O Module sends data **without** the Host sending a command to poll the I/O Module in Asynchronous Update Mode.

NOTE: Asynchronous Update Mode is configured using EEPROM locations 0x04/0x05.

Value at EEPROM Location 0x04/0x05	Description
0x0000	Asynchronous Update Mode disabled
0x0001	**State Change Update** Digital Input or Pulse Counter change
0x0002 to 0xFFFF Decimal Range 2 to 65535)	**Timed Update** Time = Value * 1 millisecond Range = .002 second - 65.5 seconds

#2a) Asynchronous Update Mode — State Change Update

When EEPROM locations 0x04/0x05 = 0x01, the **ADC-1R2 Series** I/O module enters an asynchronous update mode whereby any detected change on the Digital Input port or the Counter Capture port causes the I/O module to transmit data to the host.

Status Change	Data Sent by I/O Module
Digital Input port change	Ixxxx
Counter Capture change	Nxxxx

#2b) Asynchronous Update Mode — Timed Update

When EEPROM locations 0x04/0x05 = 0x0002...0xFFFF, the **ADC-1R2 Series** I/O module enters a timed update mode whereby the I/O module will send data to the host after the specified time period has elapsed.

Time Period = Value (EEPROM locations 0x04/0x05) * .001 second

When using Asynchronous Update Mode, the I/O module uses the **Continuous Stream Mode** configuration to determine the data sent to the host.

#3) Continuous Stream Mode

The final mode of operation is Continuous Stream mode. This mode constantly sends or ***streams*** data to the host until the host halts the mode. In brief, the I/O Module can send 0 thru 8 analog samples, digital input status, and the counter capture status.

The I/O module uses parameters found in EEPROM locations 0x10 thru 0x1A to configure the Continuous Stream mode. Therefore, the EEPROM must be configured before engaging the Continuous Stream mode.

Continuous Stream Mode setup steps

1. Configure EEPROM locations 0x10 thru 0x1A
2. Begin Continuous Stream mode by sending command '**S**' to the I/O Module
3. Halt Continuous Stream mode by sending command '**H**' to the I/O Module

Continuous Stream Mode Configuration — EEPROM Locations

All parameters configuring the Continuous Stream mode are strored in EEPROM. See the following table for a description of the locations and the parameters. Use command **'W'** to update EEPROM values.

EEPROM	Value	Description
0x10	0x00...0x08	**Analog Configuration** 0x00 = No analog samples 0x01...0x08 = Number of analog samples
0x11 *Sample 1*	0x0y ... 0x0y 0x8y ... 0x8y	Bipolar Analog: y = analog control nibble Unipolar Analog: y = analog control nibble
0x12 *Sample 2*	0x0y ... 0x0y 0x8y ... 0x8y	Bipolar Analog: y = analog control nibble Unipolar Analog: y = analog control nibble
0x13 *Sample 3*	0x0y ... 0x0y 0x8y ... 0x8y	Bipolar Analog: y = analog control nibble Unipolar Analog: y = analog control nibble
0x14 *Sample 4*	0x0y ... 0x0y 0x8y ... 0x8y	Bipolar Analog: y = analog control nibble Unipolar Analog: y = analog control nibble
0x15 *Sample 5*	0x0y ... 0x0y 0x8y ... 0x8y	Bipolar Analog: y = analog control nibble Unipolar Analog: y = analog control nibble
0x16 *Sample 6*	0x0y ... 0x0y 0x8y ... 0x8y	Bipolar Analog: y = analog control nibble Unipolar Analog: y = analog control nibble
0x17 *Sample 7*	0x0y ... 0x0y 0x8y ... 0x8y	Bipolar Analog: y = analog control nibble Unipolar Analog: y = analog control nibble
0x18 *Sample 8*	0x0y ... 0x0y 0x8y ... 0x8y	Bipolar Analog: y = analog control nibble Unipolar Analog: y = analog control nibble
0x19	0x00 0xFF	Digital Input status **disabled** Digital Input status **enabled**
0x1A	0x00 0xFF	Pulse Counter status **disabled** Pulse Counter status **enabled**

Continuous Stream Mode Example

In this example, the I/O module EEPROM is configured to take 2 Analog samples and update the Counter status.

EEPROM Location 0x10	0x02	*Take 2 Analog samples*
EEPROM Location 0x11	0x08	*Sample 1 - Bipolar sample CH0*
EEPROM Location 0x12	0x89	*Sample 2 - Unipolar sample CH2*
EEPROM Location 0x1A	0x01	*Pulse Counter Status enabled*

Continuous Stream Mode Example continued

The following table illustrates the Host Command and I/O Module responses for the continuous stream example configuration and usage.

EEPROM Location 0x10	0x02	*Take 2 Analog samples*
EEPROM Location 0x11	0x08	*Sample 1 - Bipolar sample CH0*
EEPROM Location 0x12	0x89	*Sample 2 - Unipolar sample CH2*
EEPROM Location 0x1A	0x01	*Counter Status enabled*

NOTE

- All numeric data is represent as ASCII Hexadecimal integers
- The symbol ↲ equates to a carriage return (decimal 13, hex 0x0D)

Host Sends	I/O Module Sends
W1002↲	W↲
W1108↲	W↲
W1289↲	W↲
W1A01↲	W↲
S↲	S↲ ***Continuous Stream mode started***
	Q8023↲
	U9823↲
	N0000 0044↲
	Q8023↲
	U9823↲
	N0000 0044↲
	.... repeats continually
H↲	H↲ ***Continuous Stream mode halted***

The HOST may send any command during the Continuous Stream mode and it will be accepted and processed by the I/O Module as in normal operation.

NOTE

Engaging the Continuous Stream mode at a high baud rate (115.2K baud) may overwhelm certain host computer systems due to the high volume of data transmitted on the RS-232 link. The is especially true of slower 386 or 486 based systems running Windows 95 with limited memory resources.

Digital I/O Characteristics
The following chart lists the Digital I/O characteristics and values.

Characteristic	Value
Digital I/O Current	I/O line source & sink 25 ma Total current PORT1 200 ma Total current PORT2 200 ma
Digital I/O Voltage Levels	Input Off (0) = 0V - 0.8V Input On (1) = 2.0V - 5.0V Output Off (0) = 0.6V max. Output On (1) = 4.3V min.
Pulse Counter Input	1 Mhz max. input rate 32 bit counter capture **Counter increments on high-low transition**

Digital Port Configuration Example
Any Digital I/O configuration changes made to the I/O Module using the '**T**' command are stored in EEPROM locations 0x02 and 0x03.

EEPROM Location 0x02 Port 1 I/O Configuration
EEPROM Location 0x03 Port 2 I/O Configuration

When using either the '**T**' command or directly writing to EEPROM using the '**W**' command, a binary 1 at a bit location puts the I/O line into Input mode, while a binary 0 at a bit location puts the I/O line into Output mode.

NOTE

- All numeric data is represent as ASCII Hexadecimal integers
- The symbol ↵ equates to a carriage return (decimal 13, hex 0x0D)

Host Command	Module Response	Action
T0000↵	T↵	All I/O lines are configured as Outputs
TFFFF↵	T↵	All I/O lines are configured as Inputs
TFF00↵	T↵	Port 1 bits 0-7 Inputs Port 2 bits 0-7 Outputs
T00FF↵	T↵	Port 1 bits 0-7 Outputs Port 2 bits 0-7 inputs
T1234↵	T↵	Port 1 bits 4,1 Inputs Port 1 bits 7,6,5,3,2,0 Outputs Port 2 bits 4,5,2 Inputs Port 2 bits 7,6,3,1,0 Outputs

Pulse Width Modulation (PWM) Characteristics

The **ADC-1R2 Series** modules have a configurable PWM output. There are two settings to configure for proper PWM operation: **PWM frequency** and **PWM duty cycle**.

PWM — Command

Pxxyyy xx = Pwm_Divisor yyy = Pwm_Duty (10 bits max.)

Pwm_Divisor = 0x00 ... 0xFF
Pwm_Duty = 0x000 ... 0x3FF **Pwm_Duty = 0, PWM output is disabled (output 0)**

PWM — Control Values (14.7456 Mhz clock)

PWM Period = (Pwm_Divisor + 1) / 3686400
PWM Duty Period = (Pwm_Duty) / 14745600
Duty_Resolution = log (14745600/ Fpwm) / log (2)
PWM Duty Cycle % = PWM Duty Period / PWM Period

if (PWM Duty Period > PWM Period) then PWM Duty Cycle = 100%

Pwm_Divisor	PWM Freq	Duty_Resolution
0xFF (255)	14400 Hz	10 bits* (**see note**)
0xFE (254)	14456 Hz	10 bits
0x5B (91)	40069 Hz	8 bits
0x00 (0)	3686400 Hz	2 bits

* **Note:** Pwm_Divisor 0xFF cannot achieve complete 100% duty cycle. Use Pwm_Divisor 0xFE if 100% duty cycle is required.

Example PWM Commands

- All numeric data is represent as ASCII Hexadecimal integers
- The symbol ↲ equates to a carriage return (decimal 13, hex 0x0D)

Host Command	Module Response	Action
P0000↲	P↲	**PWM off** Any duty cycle of 0 disables PWM output
P4801F↲	P↲	PWM frequency = 50499 Hz PWM duty = 10.6%
PFE3FF↲	P↲	PWM frequency = 14456 Hz PWM duty = 100%
PFE1FE↲	P↲	PWM frequency = 14456 Hz PWM duty = 50%

Analog I/O Characteristics:

Characteristic	Value
A/D Converter	Linear Tech LTC1296BCN ± .5 LSB
Linearity Error	LTC1296BCN ± 0.012% (± .5 LSB)
Gain Error	± 0.012% (± .5 LSB)
Offset Error	± 0.17%
Temperature Drift	100 ppm/ºC (max.)
Max Input Voltage	5V
D/A Converter	Linear Tech LTC1448
Offset Error	± 10 mv

LTC1296 Operation

The analog inputs of the LTC1296 look like a 100pf capacitor (**C**in) in series with a 500 Ω resistor (**R**on). **C**in gets switched between (+) and (-) inputs once during each conversion cycle. Large external source resistors and capacitances will slow the settling of the inputs. It is important that the overall RC time constant is short enough to allow the analog inputs to settle completely within the allowed time.

The voltage on the inputs must settle completely within the sample period. Minimizing **R**source will improve the settling time. If large source resistance must be used, the sample time can be increased by using a slower CLK frequency.

Sampling Analog Voltage Inputs

By far the most common configuration of the **ADC-1R2 Series** I/O modules is to sample voltage values. Analog voltage levels are converted to integer digital values using the Linear Technologies LTC1296 A/D (Analog/Digital) chip. The input voltage range is determined by the reference voltage.

There are two analog sample types:

1) **Unipolar**
2) **Bipolar**

Both A/D sampling types result in a 12 bit binary integer value.

Vref = 5.000 standard

Unipolar Analog Sampling Resolution

Unipolar analog sampling span is from ground (GND) to voltage reference (Vref). **Only positive voltages are sampled in unipolar mode.** The unipolar sample is represented as an unsigned integer as follows:

Unipolar voltages: 0V ... +Vref

The benefit of using Unipolar samples over Bipolar samples is that a 12 bit binary value is spread out over less total voltage span (Vref total.)

1 LSB unipolar = Vref/4096
1 LSB unipolar = 5.000/4096
1 LSB unipolar = 0.0012207 volt

Bipolar Analog Sampling Resolution
Bipolar analog sampling span is from -Vref to +Vref. Both negative and positive voltages are sampled and represented as a signed binary integer (2’s complement) as follows:

Bipolar voltages: -Vref ... 0 ... +Vref

The benefit of using Bipolar sampling over Unipolar is obvious, negative voltages! The downfall of using Bipolar sampling is that a 12 bit binary value is spread out over a larger total voltage span (2*Vref total.)

1 LSB bipolar = Vref/2048
1 LSB bipolar = 5.000/2048
1 LSB bipolar = 0.0024414 volt

Voltage Conversion
The Analog conversion value obtained from the **ADC-1R2 Series** module is represented as an integer value (either signed for Bipolar samples or unsigned for Unipolar sample) and is normally converted to a Real or Floating Point number for ultimate usage.

Vref = 5.000 standard

Unipolar Voltage Conversion Formula

Volts [unipolar] = ADC_Sample * (5.000/4096)
Volts [unipolar] = ADC_Sample * 0.0012207

Bipolar Voltage Conversion Formula
The following assumes that ADC_Sample is an unsigned integer value.

```
if (ADC_Sample >= 2048)
        Volts [bipolar] = (ADC_Sample-4096) * (5.000/2048)

if (ADC_Sample <= 2047)
        Volts [bipolar] = ADC_Sample * (5.000/2048)



if (ADC_Sample >= 2048)
        Volts [bipolar] = (ADC_Sample-4096) * 0.0024414

if (ADC_Sample <= 2047)
        Volts [bipolar] = ADC_Sample * 0.0024414
```

Sampling Current (4-20 ma) Inputs

Many devices output a current value instead of a voltage value. The secret to obtaining current readings is a 250 ohm resistor. Placing a 250 ohm resistor to ground on a 4-20 ma. current input will create a voltage potential of 1V to 5V.

If we remember Ohm's law: E = I * R

R = 250 ohms
I = .004 to .020 amps (4-20 ma.)
E = 1.0V to 5.0V

Obtaining current readings is a three step process:

1. Perform analog Unipolar sample
2. Convert unipolar sample to volts
3. Convert voltage to amps

The following formula will convert the raw analog sample reading to a current value.

Current = (ADC_Sample * (5.000/4096)) / 250

Obtaining accurate Analog samples

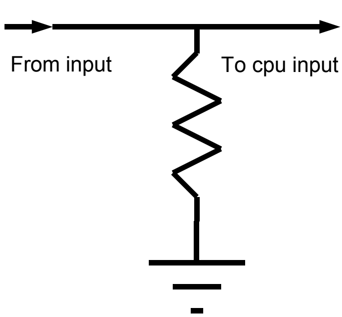
Please keep the following points in mind when attempting to obtain accurate samples.

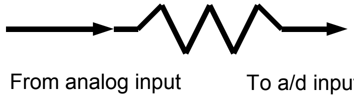
- Avoid high impedance analog signal sources!
- Watch out for UPS systems! They create loads of EMI/EMF noise.
- Keep the analog signal source as close to the ADC-x module as possible.
- Keep transformers far away from the **ADC-1R2 Series** module.
- Use good wiring practices, especially in regards to ground connections.
- RS-232 interface can generate approx. 2 mv noise.

Resistors for Analog and Digital I/O

The digital I/O points have a 100K Ω resistor to ground to prevent floating inputs.

The analog inputs have a 560 Ω resistor in series to afford some protection to the A to D converter.





Digital & Analog I/O Port Pin outs And Hex Conversion Chart

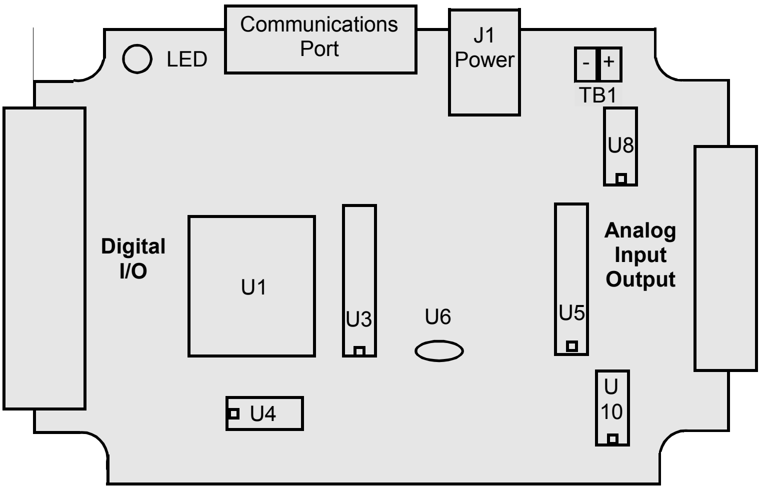
Analog I/O	
DB15 Pins	**Description**
1	ANALOG IN CHANNEL 7
2	ANALOG IN CHANNEL 6
3	ANALOG IN CHANNEL 5
4	ANALOG IN CHANNEL 4
5	ANALOG IN CHANNEL 3
6	ANALOG IN CHANNEL 2
7	ANALOG IN CHANNEL 1
8	ANALOG IN CHANNEL 0
9	GND
10	+ V UNREG
11	+ 5VDC REG
12	- V UNREG
13	V REFERENCE
14	ANALOG OUT B
15	ANALOG OUT A

	EXAMPLE HEX CONVERSION															
	X				X				Y				Y			
BITS	1	1	0	0	1	0	0	0	1	0	1	1	0	1	1	1
HEX	C				8				B				7			

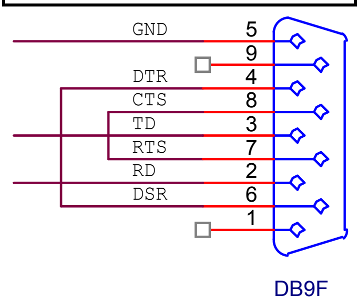
Digital I/O	
DB25 Pins	**Description**
1	Port 2 Bit 0
2	Port 2 Bit 1
3	Port 2 Bit 2
4	Port 2 Bit 3
5	Port 2 Bit 4
6	Port 2 Bit 5
7	Port 2 Bit 6
8	Port 2 Bit 7
9	PWM output
10	N/A
11	+V Unreg
12	+5Vdc
13	GND
14	Port 1 Bit 0
15	Port 1 Bit 1
16	Port 1 Bit 2
17	Port 1 Bit 3
18	Port 1 Bit 4
19	Port 1 Bit 5
20	Port 1 Bit 6
21	Port 1 Bit 7
22	Pulse Counter Input
23	-V Unreg
24	+5Vdc
25	GND

PORT 1										PORT 2									
X					X					Y					Y				
HEX VALUE	BIT VALUE				HEX VALUE	BIT VALUE				HEX VALUE	BIT VALUE				HEX VALUE	BIT VALUE			
	7	6	5	4		3	2	1	0		7	6	5	4		3	2	1	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	1	1	0	0	0	1	1	0	0	0	1	1	0	0	0	1
2	0	0	1	0	2	0	0	1	0	2	0	0	1	0	2	0	0	1	0
3	0	0	1	1	3	0	0	1	1	3	0	0	1	1	3	0	0	1	1
4	0	1	0	0	4	0	1	0	0	4	0	1	0	0	4	0	1	0	0
5	0	1	0	1	5	0	1	0	1	5	0	1	0	1	5	0	1	0	1
6	0	1	1	0	6	0	1	1	0	6	0	1	1	0	6	0	1	1	0
7	0	1	1	1	7	0	1	1	1	7	0	1	1	1	7	0	1	1	1
8	1	0	0	0	8	1	0	0	0	8	1	0	0	0	8	1	0	0	0
9	1	0	0	1	9	1	0	0	1	9	1	0	0	1	9	1	0	0	1
A	1	0	1	0	A	1	0	1	0	A	1	0	1	0	A	1	0	1	0
B	1	0	1	1	B	1	0	1	1	B	1	0	1	1	B	1	0	1	1
C	1	1	0	0	C	1	1	0	0	C	1	1	0	0	C	1	1	0	0
D	1	1	0	1	D	1	1	0	1	D	1	1	0	1	D	1	1	0	1
E	1	1	1	0	E	1	1	1	0	E	1	1	1	0	E	1	1	1	0
F	1	1	1	1	F	1	1	1	1	F	1	1	1	1	F	1	1	1	1

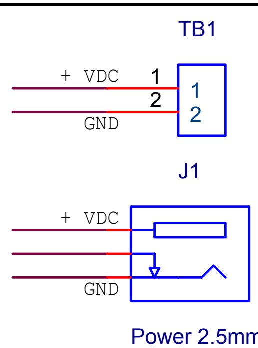
Model ADC-1R2 Series



COMMUNICATION PORT ON BOARD WIRING



POWER CONNECTIONS ON BOARD WIRING



Baud Rate Switch Settings		
SW1	**SW2**	**Baud Rate**
OFF	OFF	9600 baud
ON	OFF	19200 baud
OFF	ON	57600 baud
ON	ON	115200 baud **(factory default)**

IC Description (Position and type is the same for all sub-models)

IC	**ADC-1R2 I/O Module**
U1	PIC16C65B MPU [44 pin PLCC]
U3	RS-232 driver [16 pin DIP]
U4	25C040 EEPROM [8 pin DIP]
U5	LTC1296 A to D [20 pin DIP]
U6	LM4040AIZ-5.0 [TO-92] 5 Vdc 0.1% Voltage Reference
U8	LMC555 Timer charge pump [8 pin DIP]
U10	LTC1448 D to A [8 pin DIP]

LED Operation

Blinking Green	[1 per Second]	Unit functioning correctly - idle
Blinking Green	[Rapid or Steady]	Unit receiving serial data
Blinking Red	[Rapid or Steady]	Unit transmitting serial data
No LED		Unit is not functioning

Power Supply
7.5-15.0 Vdc approx. 50 ma. nominal power (we suggest our PS9J a 9VDC 400 ma un-regulated power supply)

GND and Shield
The GND and Shield terminals are connected on the **ADC-1R2 Series** boards and are therefore electrically equivalent.

RS-232 Cabling
The RS-232 interface uses a "***3 wire***" RS-232 connection. That is to say only three wires are connected between the I/O Module and the Host PC: **TxD**, **RxD** and **GND**.

RS-232 Flow Control
The SuperLogics modules **do not support hardware or Xon/Xoff flow control.**

Peripheral Add-On Modules

AE-8CH	8 channel analog connection board
ASC-2CH	2 channel signal conditioner
ADC-1R2-TB	DB15 terminal strip (for analog connector)
DB25TSM	DB25 terminal strip (for digital connector)
EXP-x	Digital Interface board

Model: AE-8CH Analog Connection Board

Jumper configurable analog inputs:

1) 4-20 ma inputs
2) +/- 10 Vdc inputs
3) Solid state temperature probes

Handy terminal strip for all analog connections and voltages. MTA .100 jacks are also available for solid state temperature probes available from SuperLogics.

Model: ASC-2CH Signal Conditioning Board

2 channels of precision instrumentation amplifiers.
Gains of 1, 10, 100, 1000

Handy terminal strip for all analog connections and voltages.

Models: ADC-1R2-TB and DB25TSM DB Terminal Strip

Terminal strip boards to conveniently connect to DB15 and DB25 connectors.

Models: EXP-x Digital Interface Board

The **EXP-X** unit provides for digital interface and signal conditioning via industry standard opto-isolated I/O modules such as Opto-22. Each unit has 4 I/O points with large easy to use terminal screws. If more I/O points are required, simply plug in another unit up to 16 total I/O points. **Opto isolated modules:** 90V-140V AC input, 12V-140V AC output, 3.3V-32V DC input, 3V-60V DC output.

WARRANTY
SuperLogics Inc. warranties **all** products against defective workmanship and components for the life of the unit. SuperLogics Inc. agrees to repair or replace, at it's sole discretion, a defective product if returned to SuperLogics with proof of purchase. Products that have been mis-used, improperly applied, or subject to adverse operating conditions fall beyond the realm of defective workmanship and are not convered by this warranty.

Revision: December 30, 2004 - v3.0