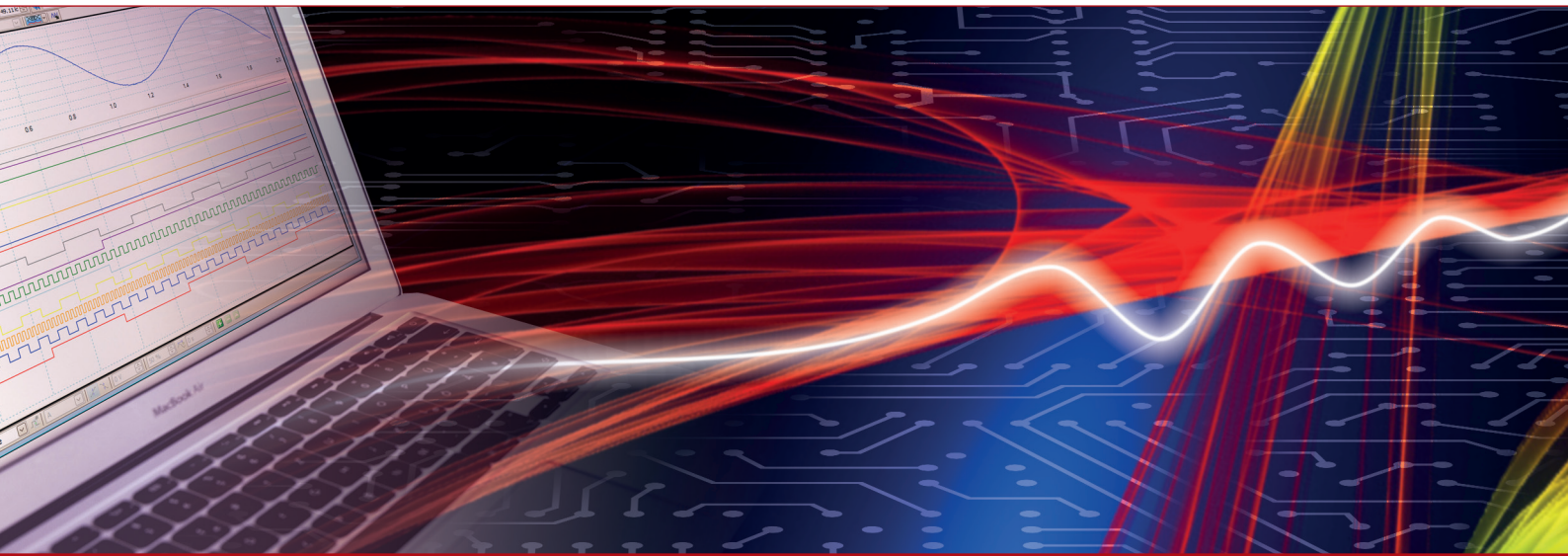


## Product Datasheet - Technical Specifications



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# Specifications

Typical for 25 °C unless otherwise specified.

Specifications in *italic text* are guaranteed by design.

## Analog Input

| Parameter                                                   | Conditions                   | Specification                                        |
|-------------------------------------------------------------|------------------------------|------------------------------------------------------|
| A/D converter type                                          |                              | Successive approximation type                        |
| Input voltage range for linear operation, single-ended mode | CHx to GND                   | ±10 V max                                            |
| Input voltage range for linear operation, differential mode | CHx to GND                   | -10 V min, +20V max                                  |
| <i>Absolute maximum input voltage</i>                       | <i>CHx to GND</i>            | <i>±40 V max</i>                                     |
| Input current (Note 1)                                      | Vin = +10 V                  | 70 µA typ                                            |
|                                                             | Vin = 0 V                    | -12 µA typ                                           |
|                                                             | Vin = -10 V                  | -94 µA typ                                           |
| Number of channels                                          |                              | 8 single-ended / 4 differential, software selectable |
| Input ranges, single-ended mode                             |                              | ±10 V, G=2                                           |
| Input ranges, differential mode                             |                              | ±20 V, G=1                                           |
|                                                             |                              | ±10 V, G=2                                           |
|                                                             |                              | ±5 V, G=4                                            |
|                                                             |                              | ±4 V, G=5                                            |
|                                                             |                              | ±2.5 V, G=8                                          |
|                                                             |                              | ±2.0 V, G=10                                         |
|                                                             |                              | ±1.25 V, G=16                                        |
|                                                             |                              | ±1.0 V, G=20                                         |
| Throughput                                                  |                              | Software selectable                                  |
|                                                             | Software paced               | 50 S/s                                               |
|                                                             | Continuous scan              | 1.2 kS/s                                             |
| Channel gain queue                                          | Burst scan to 4K sample FIFO | 8 kS/s                                               |
|                                                             | Up to 8 elements             | Software configurable channel, range, and gain.      |
| Resolution (Note 2)                                         | Differential                 | 12 bits, no missing codes                            |
|                                                             | Single-ended                 | 11 bits                                              |
| CAL accuracy                                                | CAL = 2.5 V                  | ±0.05% typ, ±0.25% max                               |
| Integral linearity error                                    |                              | ±1 LSB typ                                           |
| Differential linearity error                                |                              | ±0.5 LSB typ                                         |
| Repeatability                                               |                              | ±1 LSB typ                                           |
| CAL current                                                 | Source                       | 5 mA max                                             |
|                                                             | Sink                         | 20 µA min, 200 nA typ                                |
| Trigger source                                              | Software selectable          | External digital: DIO0-DIO3                          |

**Note 1:** Input current is a function of applied voltage on the analog input channels. For a given input voltage, Vin, the input leakage is approximately equal to  $(8.181 \cdot V_{in} - 12) \mu A$ .

**Note 2:** The AD7870 converter only returns 11-bits (0-2047 codes) in single-ended mode.

Table 6. Accuracy, differential mode

| Range   | Accuracy (LSB) |
|---------|----------------|
| ±20 V   | 5.1            |
| ±10 V   | 6.1            |
| ±5 V    | 8.1            |
| ±4 V    | 9.1            |
| ±2.5 V  | 12.1           |
| ±2 V    | 14.1           |
| ±1.25 V | 20.1           |
| ±1 V    | 24.1           |

Table 7. Accuracy, single-ended mode

| Range | Accuracy (LSB) |
|-------|----------------|
| ±10 V | 4.0            |

Table 8. Accuracy components, differential mode - all values are (±)

| Range   | % of Reading | Gain Error at FS (mV) | Offset (mV) | Accuracy at FS (mV) |
|---------|--------------|-----------------------|-------------|---------------------|
| ±20 V   | 0.2          | 40                    | 9.766       | 49.766              |
| ±10 V   | 0.2          | 20                    | 9.766       | 29.766              |
| ±5 V    | 0.2          | 10                    | 9.766       | 19.766              |
| ±4 V    | 0.2          | 8                     | 9.766       | 17.766              |
| ±2.5 V  | 0.2          | 5                     | 9.766       | 14.766              |
| ±2 V    | 0.2          | 4                     | 9.766       | 13.766              |
| ±1.25 V | 0.2          | 2.5                   | 9.766       | 12.266              |
| ±1 V    | 0.2          | 2                     | 9.766       | 11.766              |

Table 9. Accuracy components, single-ended mode

| Range | % of Reading | Gain Error at FS (mV) | Offset (mV) | Accuracy at FS (mV) |
|-------|--------------|-----------------------|-------------|---------------------|
| ±10 V | 0.2          | 20                    | 19.531      | 39.531              |

## Analog output

| Parameter                  | Conditions     | Specification                                           |
|----------------------------|----------------|---------------------------------------------------------|
| D/A converter type         |                | PWM                                                     |
| Resolution                 |                | 10-bits, 1 in 1024                                      |
| Maximum output range       |                | 0 -5 Volts                                              |
| Number of channels         |                | 2 voltage output                                        |
| Throughput                 | Software paced | 100 S/s single channel mode<br>50 S/s dual channel mode |
| Power on and reset voltage |                | Initializes to 000h code                                |
| Maximum voltage (Note 3)   | No load        | Vs                                                      |
|                            | 1 mA load      | 0.99 * Vs                                               |
|                            | 5 mA load      | 0.98 * Vs                                               |
| Output drive               | Each D/A OUT   | 30 mA                                                   |
| Slew rate                  |                | 0.14 V/mS typ                                           |

**Note 3:** Vs is the USB bus +5V power. The maximum analog output voltage is equal to Vs at no-load. V is system dependent and may be less than 5 volts.

## Digital input / output (screw terminal DIO3:0)

| Parameter                             | Conditions  | Specification                                           |
|---------------------------------------|-------------|---------------------------------------------------------|
| Digital type                          |             | Discrete, 5V/TTL compatible                             |
| Number of I/O                         |             | 4                                                       |
| Configuration                         |             | 4 bits, independently programmable for input or output. |
| Input high voltage                    |             | 3.0 V min, 15.0 V absolute max                          |
| Input low voltage                     |             | 0.8 V max                                               |
| Output voltage (Note 4)               | No load     | Vs - 0.4 V min, Vs typ                                  |
|                                       | 1 mA load   | Vs - 1.5 V                                              |
| Input leakage current                 |             | $\pm 1.0 \mu A$                                         |
| Output short-circuit current (Note 4) | Output high | 3.3 mA                                                  |
| Power-up / reset state                |             | Input mode (high impedance)                             |

**Note 4:** The DIO[3:0] lines available at the screw terminals are protected with 1.5 KOhm series resistors.

## Digital input / output (DB37)

|                                     |                                                                                                                                               |
|-------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| Digital type                        | 82C55                                                                                                                                         |
| Number of I/O                       | 24 (Port A0 through Port C7)                                                                                                                  |
| Configuration                       | 2 banks of 8 and 2 banks of 4, or 3 banks of 8                                                                                                |
| Pull up/pull-down configuration     | All pins pulled up to Vs via 47K resistors (default). Positions available for pull down to ground. Hardware selectable via zero ohm resistor. |
| Input high voltage                  | 2.0 V min, 5.5 V absolute max                                                                                                                 |
| Input low voltage                   | 0.8 V max, -0.5 V absolute min                                                                                                                |
| Output high voltage (IOH = -2.5 mA) | 3.0 V min                                                                                                                                     |
| Output low voltage (IOL = 2.5 mA)   | 0.4 V max                                                                                                                                     |

## External trigger

| Parameter             | Conditions          | Specification                                                       |
|-----------------------|---------------------|---------------------------------------------------------------------|
| Trigger source        | External digital    | DIO[3:0], only DIO may be selected as a trigger input               |
| Trigger mode          | Software selectable | Level sensitive: user configurable for TTL level high or low input. |
| Trigger latency       | Burst               | 25 $\mu s$ min, 50 $\mu s$ max                                      |
| Trigger pulse width   | Burst               | 40 $\mu s$ min                                                      |
| Input high voltage    |                     | 3.0 V min, 15.0 V absolute max                                      |
| Input low voltage     |                     | 0.8 V max                                                           |
| Input leakage current |                     | $\pm 1.0 \mu A$                                                     |

## Counters

|                            |                            |
|----------------------------|----------------------------|
| Counter type               | Event counter              |
| Number of channels         | 1                          |
| Input source               | CTR screw terminal         |
| Input type                 | TTL, rising edge triggered |
| Resolution                 | 32 bits                    |
| Schmitt trigger hysteresis | 20 mV to 100 mV            |
| Input leakage current      | $\pm 1 \mu A$              |
| Maximum input frequency    | 1 MHz                      |
| High pulse width           | 500 ns min                 |
| Low pulse width            | 500 ns min                 |
| Input low voltage          | 0V min, 1.0 V max          |
| Input high voltage         | 4.0 V min, 15.0 V max      |

## Non-volatile memory

|                      |                 |            |                       |
|----------------------|-----------------|------------|-----------------------|
| Memory size          | 8192 bytes      |            |                       |
| Memory configuration | Address Range   | Access     | Description           |
|                      | 0x0000 – 0x17FF | Read/Write | A/D Data (4k samples) |
|                      | 0x1800 – 0x1EFF | Read/Write | User data area        |
|                      | 0x1F00 – 0x1FEF | Read/Write | Calibration Data      |
|                      | 0x1FF0 – 0x1FFF | Read/Write | System Data           |

## Power

| Parameter                        | Conditions                    | Specification          |
|----------------------------------|-------------------------------|------------------------|
| Supply Current (Note 5)          |                               | 20 mA                  |
| +5V USB power available (Note 6) | Connected to Self-Powered Hub | 4.5 V min, 5.25 V max  |
|                                  | Connected to Bus-Powered Hub  | 4.1 V min, 5.25 V max  |
| Output Current (Note 7)          | Connected to Self-Powered Hub | 450 mA min, 500 mA max |
|                                  | Connected to Bus-Powered Hub  | 50 mA min, 100 mA max  |

**Note 5:** This is the total current requirement for the RedLab-1008 which includes up to 5mA for the status LED.

**Note 6:** Self-powered refers to USB hubs and hosts with a power supply. Bus-powered refers to USB hubs and hosts without their own power supply.

**Note 7:** This refers to the total amount of current that can be sourced from the USB +5V, analog outputs and digital outputs.

## General

| Parameter                         | Conditions   | Specification     |
|-----------------------------------|--------------|-------------------|
| <i>USB controller clock error</i> | 25 °C        | ±30 ppm max       |
|                                   | 0 to 70 °C   | ±50 ppm max       |
|                                   | -40 to 85 °C | ±100 ppm max      |
| Device type                       |              | USB 1.1 low-speed |
| Device compatibility              |              | USB 1.1, USB 2.0  |

## Environmental

|                             |                         |
|-----------------------------|-------------------------|
| Operating temperature range | -40 to 85 °C            |
| Storage temperature range   | -40 to 85 °C            |
| Humidity                    | 0 to 90% non-condensing |

## Mechanical

|                               |                                                            |
|-------------------------------|------------------------------------------------------------|
| Case dimensions               | 157 mm (L) x 102 mm (W) x 40 mm (H) , including connectors |
| <i>USB cable length</i>       | 3 meters max                                               |
| <i>User connection length</i> | 3 meters max                                               |

## Main connector and pin out

|                  |                  |
|------------------|------------------|
| Connector type   | Screw terminal   |
| Wire gauge range | 12 AWG to 22 AWG |

### 4-channel differential mode

| Pin | Signal Name | Pin | Signal Name |
|-----|-------------|-----|-------------|
| 1   | CH0 IN HI   | 16  | DIO0        |
| 2   | CH0 IN LO   | 17  | DIO1        |
| 3   | GND         | 18  | GND         |
| 4   | CH1 IN HI   | 19  | DIO2        |
| 5   | CH1 IN LO   | 20  | DIO3        |
| 6   | GND         | 21  | GND         |
| 7   | CH2 IN HI   | 22  | D/A OUT 0   |
| 8   | CH2 IN LO   | 23  | D/A OUT 1   |
| 9   | GND         | 24  | GND         |
| 10  | CH3 IN HI   | 25  | CTR         |
| 11  | CH3 IN LO   | 26  | GND         |
| 12  | GND         | 27  | GND         |
| 13  | PC +5V      | 28  | PC +5V      |
| 14  | PC +5V      | 29  | PC +5V      |
| 15  | CAL         | 30  | TST         |

### 8-channel single-ended mode

| Pin | Signal Name | Pin | Signal Name |
|-----|-------------|-----|-------------|
| 1   | CH0 IN      | 16  | DIO0        |
| 2   | CH1 IN      | 17  | DIO1        |
| 3   | GND         | 18  | GND         |
| 4   | CH2 IN      | 19  | DIO2        |
| 5   | CH3 IN      | 20  | DIO3        |

| Pin | Signal Name | Pin | Signal Name |
|-----|-------------|-----|-------------|
| 6   | GND         | 21  | GND         |
| 7   | CH4 IN      | 22  | D/A OUT 0   |
| 8   | CH5 IN      | 23  | D/A OUT 1   |
| 9   | GND         | 24  | GND         |
| 10  | CH6 IN      | 25  | CTR         |
| 11  | CH7 IN      | 26  | GND         |
| 12  | GND         | 27  | GND         |
| 13  | PC +5V      | 28  | PC +5V      |
| 14  | PC +5V      | 29  | PC +5V      |
| 15  | CAL         | 30  | TST         |

## DB37 connector and pin out

|                               |                                                                  |
|-------------------------------|------------------------------------------------------------------|
| Connector type                | 37 D-Type, shielded                                              |
| Compatible Cables             | C37FF-x                                                          |
|                               | C37FFS-x                                                         |
|                               | C37FM-x                                                          |
| Compatible accessory products | CIO-MINI37<br>SSR-RACK24<br>SSR-RACK08<br>CIO-ERB24<br>CIO-ERB08 |

| Pin | Signal Name | Pin | Signal Name |
|-----|-------------|-----|-------------|
| 1   | n/c         | 20  | USB +5V Out |
| 2   | n/c         | 21  | GND         |
| 3   | Port B7     | 22  | Port C7     |
| 4   | Port B6     | 23  | Port C6     |
| 5   | Port B5     | 24  | Port C5     |
| 6   | Port B4     | 25  | Port C4     |
| 7   | Port B3     | 26  | Port C3     |
| 8   | Port B2     | 27  | Port C2     |
| 9   | Port B1     | 28  | Port C1     |
| 10  | Port B0     | 29  | Port C0     |
| 11  | GND         | 30  | Port A7     |
| 12  | n/c         | 31  | Port A6     |
| 13  | GND         | 32  | Port A5     |
| 14  | n/c         | 33  | Port A4     |
| 15  | GND         | 34  | Port A3     |
| 16  | n/c         | 35  | Port A2     |
| 17  | GND         | 36  | Port A1     |
| 18  | USB +5V Out | 37  | Port A0     |
| 19  | GND         |     |             |