IA-400D Bridge Amplifier and Signal Conditioner

Hardware Manual

IA-400D

Overview

The iWorx IA-400D is a dedicated bridge amplifier for iWorx transducers that provides four channels of excitation power, gain, and noise filtration. It exhibits low system noise and offset, making it suitable for use with high resolution data acquisition systems. Each channel of the IA-400D has a switch to allow selection of either a 40 Hz or 10 kHz low-pass filter. This makes the IA-400D an ideal solution for conditioning signals from low bandwidth transducers, such as those used to measure blood pressure and force as well as those applications requiring wider bandwidth.

Gain control on the IA-400D is very straightforward. A programming resistor in the DIN8 connector is used to set the gain. iWorx transducers set the IA-400D gain to the optimal value for that transducer. However, this does not limit the IA-400D to use with iWorx transducers. Many non-iWorx transducers can be modified to work with the IA-400D.

The IA-400D is an inherently low offset device. This, together with the low offsets produced by bridge-style transducers and the high resolution of iWorx data acquisition systems dramatically minimize the need for offset control.

The IA-400D is packaged in a low profile aluminum enclosure that provides both durability and noise immunity. The device has a small foot print and multiple units are easily stacked to save bench space.

Included Items

IA-400D four-channel bridge amplifier and signal conditioner
12 VDC power supply (A-UP12-DC-25-1.5A)
Package of 50 disposable electrodes (A-GC-7165)

iWorx Systems, Inc.

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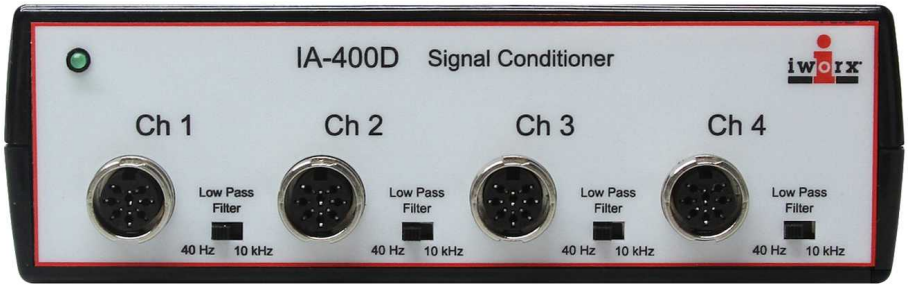
IA-400D Bridge Amplifier and Signal Conditioner

Front Panel



IA-400D Front Panel

Inputs

Input connectors are DIN8 transducer connectors.
Each channel can provide ±5.0V of excitation at 50 mA, adequate for most commonly used transducers.

Low-Pass Filter [LPF(Hz)] Switch

The low-pass filter control sets the upper limit of frequencies measurable by the IA-400D. The setting labeled 10k offers a maximum frequency response of about 10k Hz. The 40 Hz filter removes signals above 40 Hz. AC noise at 60 Hz, the most common source of electrical interference, would be filtered from the recording along with any other frequencies above 40 Hz.

Rear Panel

IA-400D Rear Panel

The BNC output connectors for the IA-400D are located on the rear panel. They can be cabled to your data acquisition system using a BNC-BNC cable. The power transformer input and the power switch are also found on the rear panel of the IA-400D.

IA-400D Bridge Amplifier and Signal Conditioner

Technical Data and Specifications

SPECIFICATIONS - IA-400D	
Number of channels	Four (DIN8 connectors)
Operational Modes	Bridge
Low-pass Filter	Switchable 40 Hz and 10K Hz (± 10%) 8 pole Bessel filter
Input Impedance	10 gigOhm
Input Range	±10 VDC
Transducer Excitation Voltage	± 5 VDC
Gain	1–10K (set by transducer)
CMRR	
Gain = 1	> 80 dB (Minimum) / >92 dB (Typical)
Gain = 10	> 95 dB (Minimum) / >110 dB (Typical)
Gain = 100	> 110 dB (Minimum) / >120 dB (Typical)
Gain = 1000	> 112 dB (Minimum) / >135 dB (Typical)
System Noise	<10 µV (RTI) / < 2 µV (RTO)
Number of Outputs	4 single-ended BNC connectors
Output Impedance (Maximum)	<10 Ohm (Maximum) / <1 Ohm (Typical)
Current	100mA / channel
Power	12 VDC, 1.5 A
Enclosure	Plastic
Dimensions	17.5 cm W, 13.5 cm D, and 6 cm H
Part Number	IA-400D

How to Use the IA-400D

Setting Up

Connect the power cable and switch the hardware on.
Connect the BNC output cable to the data acquisition input.
Connect the transducer input to the IA-400D DIN8 input connector.

Excitation Power

Each channel on the IA-400D can deliver up to 100mA of ±5 V excitation to power a transducer. Each channel provides separate excitation power so that problems on one channel will not affect the operation of other channels. If the transducer on a given channel draws in excess of 100 mA the fault is detected thermally, and power is shut down to protect both the transducer, and the IA-400D. Typically, this will cause a slow pulsing of the IA-400D output as the channels excitation power regulator heats, is turned off, cools to its reset point, then begins heating again.

Gain Selection

Gain control of the IA-400D is programmed by a gain set resistor in the input transducer. To minimize noise, the gain set resistor is housed in the transducer cable connector so that it is as close to the IA-400D input as possible. For iWorx transducers, gain values are preset, and are selected so that the IA-400D output will be large without exceeding ± 5 Volts to maintain compatibility with data acquisition systems with that input range. For non-iWorx transducers, a gain set resistor can be inserted in the input connector. As a rule of thumb, to determine an appropriate gain value, multiply the input voltage range of the device following the IA-400D by 0.7, then divide the result by the transducers maximum peak to peak output signal including its offset. If the input voltage range of the device following the IA-400D is greater than ± 10 Volts, then substitute in ± 10 Volts to ensure that the IA-400D amplifier is never saturated.

Choose the appropriate resistor by the equation:

$$R_{GainSet} = 49.9K/Gain-1$$

Frequency Response

Each IA-400D channel contains an 8-pole, Besssel style, low-pass filter with a switchable cut-off frequency set at 40 or 10K Hertz.
In general, a filter is used to reduce noise content, where noise content refers to any energy in frequency bands outside of the signal of interest. A low-pass filter is used to remove energy content with frequency greater than the signal of interest. An ideal low- pass filter would pass all frequencies up to the cut-off frequency while removing all energy above that frequency. Real filters roll off around the cut-off frequency such that signals at the cut-off frequency are reduced to 70% of their input value, and signals with greater frequency content are reduced in direct proportion with frequency.

The filter in the IA-400D limits noise with frequency content greater than the switched value, while passing signals with frequency content less than this value. The Bessel style filter is chosen to minimize ringing that results in other filter configurations when the filter input has a step, or sudden change, such as might occur when a displacement transducer is moved quickly, or when a force-transducer measures a striated muscle twitch.

From a practical standpoint, 60 Hertz noise due to mains power supplies is the most common and largest noise observed on bridge-style transducers, and most of it will be eliminated by the common-mode rejection of the ETH- 401input amplifier. What remains will be more than cut in half by the filter.

System Noise

System noise is the noise attributed to the IA-400D amplifier itself, and is measured by shorting its inputs to ground through 10 kOhm Resistors and

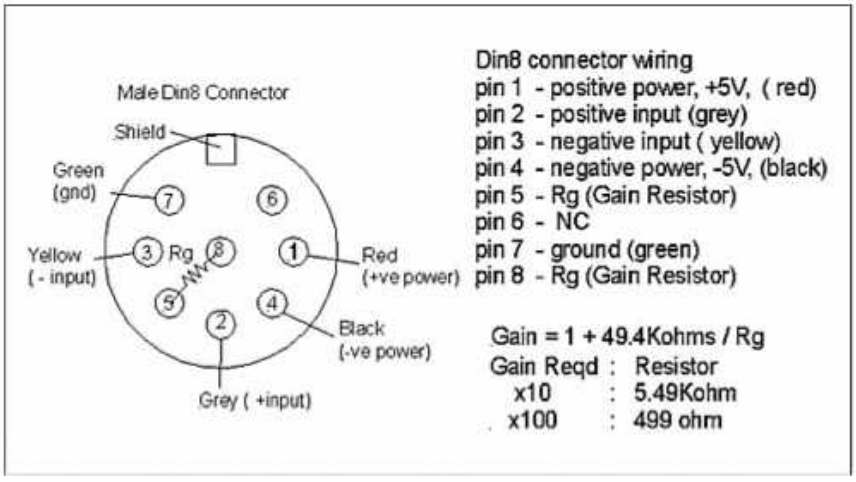
measuring the output. The system noise is specified with reference to input (RTI), because this is a good indicator of the appropriateness of the amplifier to an application. The IA-400D is specified to have system noise that does not exceed 10 µV, though it typically is less than 2 µV RTI. The IA-400D with appropriate gain, is a good choice for transducers that provide a full-scale output signal of at least 100 µV, though typically it will remain a good choice even for transducers with a full-scale output as low as 20 µV.

Input Signal

The IA-400D has differential inputs, meaning that each channel measures the difference between two signals. The inputs are the four DIN8 connectors located on the front panel. The input range is ± 10 Volts, extending its useful range to signals other than those derived from its excitation power. The input impedance of each channel is 10 gigohms so that high output impedance transducers such as pH or ion-selective electrodes can be used without loading.

Input Connector

iWorx transducers are configured to work with the IA-400D, but other transducers can be built or modified to work with it as well. In most cases the modification will consist replacing the existing cable connector with a DIN8 male connector and inserting an appropriate gain set resistor in the connector shell. The figure below details the pin designations for the IA-400D input connector. Note that the view is from the solder-side of the connector pins.



IA400D input connector

Output Signal

The output impedance of the IA-400D is typically less than 1 Ohm, and is specified to be less than 10 Ohms at all frequencies up to 50 Hertz.