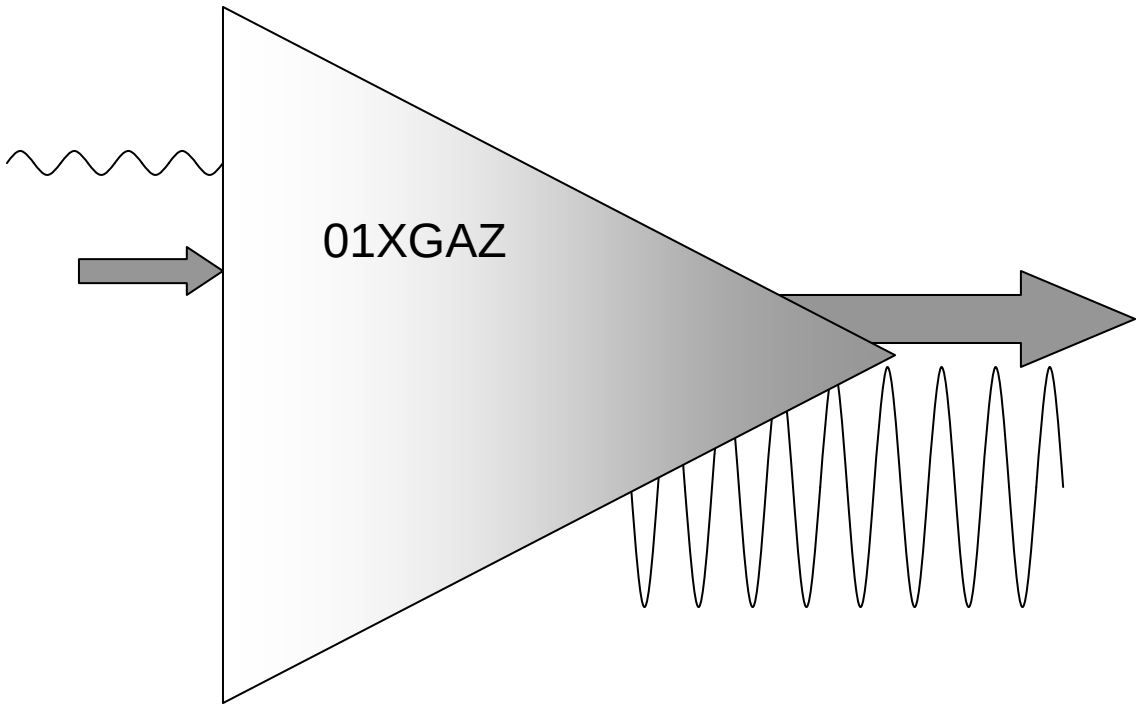
TURTLE
TURTLE INDUSTRY Co., Ltd.

T-01HGAZ/LGAZ/MGAZ

Voltage Amplifier

Operating Instruction Manual



April 9, 2012

Introduction

This compact amplifier was developed with the aim of providing a high level of performance at a reasonable price. AD convertors are used for importing data into computer measurement systems. The input voltage level of an AD convertor is generally high unless of a specific dedicated type such as a sensor, which often makes it impossible to use an AD convertor to import ultra-low voltage. There are a number of high performance amplifiers for use with measurement systems available but they are typically very expensive and therefore can be difficult to justify with respect to the price of the overall system.

This is exactly where this amplifier comes in. At a very reasonable price it can take advantage of a maximum gain of 10000 and amplify ultra-low signals to the level where the AD convertor can fully exercise its capabilities. A total of three models are available with different gains in ensuring the best fit to the purpose.

This compact, light product can also be powered by a battery due to its low current requirements.

Specifications

Number of Input Channels: 1

Input Method: Differential balanced input, BNC connector x 2

Input Resistance: 2 MΩ (differential) ±1%, Parallel capacitance 10 pF or less

Allowable Maximum Input Voltage: approx. ±10V (versus ground, power supply voltage ±15V)

Allowable Common Mode Maximum Input Voltage: approx. ±10V (versus ground, power supply voltage ±15V)

Common Mode Rejection Ratio: approx. 50 dB (100Hz, power supply voltage ±15V)

Gain: T-01HGAZ: x 100, x 1000, x 10000 (within 5% off the full scale)

T-01MGAZ: x 10, x 100, x 1000 (Same as above)

T-01LGAZ: x 1, x 10, x 100 (Same as above)

Frequency Properties (±3dB, power supply voltage ±15V and output voltage ±0.5V)

	T-01HGAZ	T-01MGAZ	T-01LGAZ
x 1			200kHz
x 10		290kHz	200kHz
x 100	80kHz	450kHz	80kHz
x 1000	60kHz	40kHz	
x 10000	40kHz		

Flank Time: approx. 2.8 V/µsec

Low-Pass Filter: 1 kHz, 10 kHz, 30 kHz (Individual attenuation rate - 6dB/oct within 10% accuracy)

Remnant Noise (power supply voltage ±15V, input short, filter through, output)

	T-01HGAZ	T-01MGAZ	T-01LGAZ
x 1			approx. 330 µV
x 10		approx. 950 µV	approx. 330 µV
x 100	approx. 3.3 mV	approx. 1050 µV	approx. 330 µV
x 1000	approx. 6 mV	approx. 1300 µV	
x 10000	approx. 13 mV		

Output Resistance: 50 Ω

Maximum Output Voltage: approx. ±12 V

Example Maximum Output Current: ±10 mA

Offset Adjustable Range (power supply voltage ±15V, output)

	T-01HGAZ	T-01MGAZ	T-01LGAZ
x 1			approx. ±1V
x 10		approx. ±0.5V	approx. ±1V
x 100	approx. ±5V	approx. ±0.5V	approx. ±1V
x 1000	approx. ±5V	approx. ±0.5V	
x 10000	approx. ±5V		

Power Supply Voltage Range: DC ±4.5 V ~ ±15 V

Consumed Current: approx. ±12 mA at ±9 V / approx. ±18 mA at ±15 V

Dimensions: 80 (W) x 35 (H) x 75 (D) mm (protrusion not included)

Weight: approx. 200g

Accessories

Power supply cable with plug (1m): 1 cable

Snap holder for 2 x 006p (laminated dry battery): 1 set

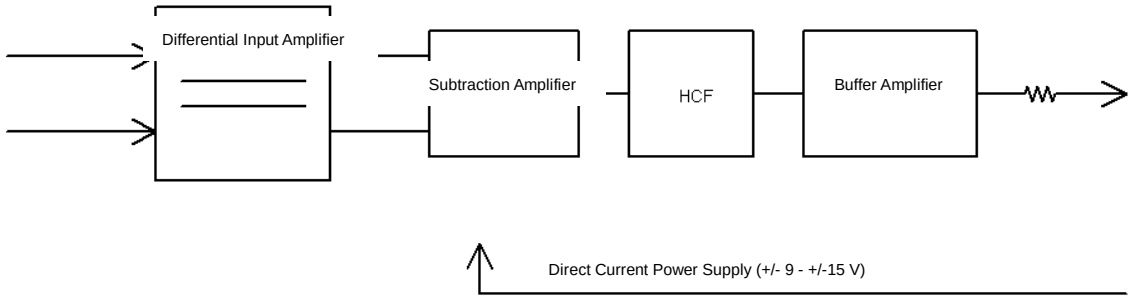
Internal Structure

As the block diagram in Figure 1 reveals the amplifier consists of a differential input, a subtraction part, a low-pass filter, and a buffer amplifier.

The differential input part supports two high impedance input signals, which then literally get subtracted at the next stage of the subtraction part in thereby determining the difference between the two inputs. In this way it can dramatically reduce any noise from the two inputs of the same amplitude and phase (common mode noise).

The low-pass filter utilizes a simple CR1 stage method (-6dB/OCT), and therefore no attenuated signals will get increased again as with the active type. This then ensures reliability.

The signals then pass through the buffer amplifier and 50Ω before being output in thereby ensuring that the property of the load connected behind it does not negatively affect the filter.



(Figure 1) Block Diagram

Use of the Product

Connecting the Input Signal Cable

The product utilizes the differential balanced input method via 2 BNC connectors.

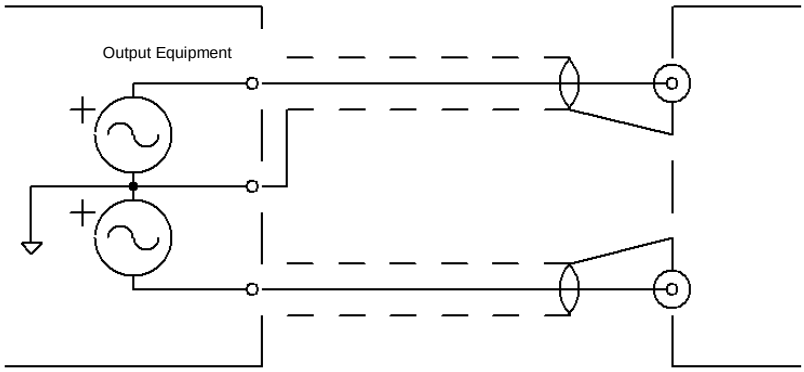
If the equipment to be connected is of the differential balanced output type then make the connections as shown in Figure 2. This then allows the best results to be obtained because any common mode noise gets significantly attenuated.

If the equipment to be connected is of the unbalanced single-end output type then make the connections as shown in Figure 3.

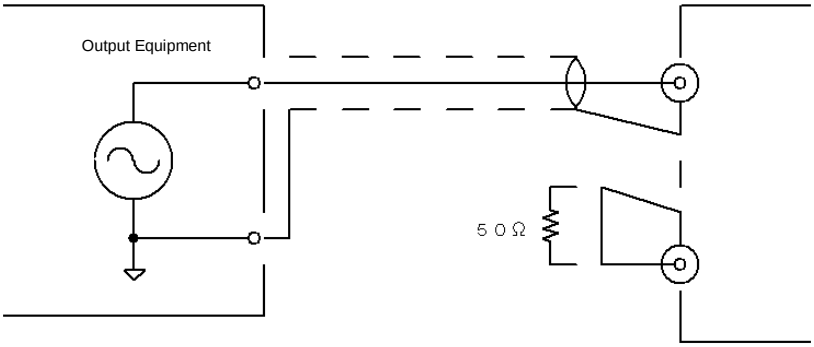
In this case, however, ensure the input connector left unconnected can short circuit or terminate at 50Ω.

Failure to fulfill this could result in the product not being capable of its full performance as

noise could get mixed into the output or offset voltage generated. Input signals from the connector on the left side of the front panel will result in signals of the same phase as the input being output, whereas signals from the connector on the right side will result in signals with the reversed phase of the input being output.



(Figure 2) Connection with differential balanced output equipment



(Figure 3) Connection with unbalanced single-end output equipment

Use of the Low-Pass Filter

The product can either be used with no filter or with the low-pass filter that can be switched between three cutoff frequency levels. When used with no filter the property of the product will be apparent and as is. When the filter is used any high frequency noise will be cut and only the necessary signals used.

The frequency distribution of any noise will differ depending on the environment, thus making selection of the optimum cutoff frequency according to the purpose very important.

To switch the cutoff frequency levels remove the 2 retaining screws on the upper cover of the product, thereby revealing the short JP1 plug that is surrounded by white print on the

printed board. Shorting 1 will result in a cutoff frequency of 1 KHz, and in a similar manner 2 and 3 will result in 10 KHz and 30 KHz, respectively.
The default when shipped is the short pin being set to “no filter” (open).
Before carrying the above procedure ensure to turn off the power supply switch and unplug the power supply cable. The above procedure can be dangerous with the power on, and also lead to a breakdown.

Connection and Supply of Power

Power is supplied to the product through the 4P nylon connector located on the rear panel. There are four pins, the leftmost one being the positive voltage input, the middle two 0V, and the rightmost negative voltage.

1	2	3	4
Positive Voltage	0V		Negative Voltage

Pin-out of Power Connector

Full utilization of the performance of the product necessitates a supply of stable direct current power from ±9V to ±15V with minimal ripple noise being used as the operating power supply.
In addition, the snap holder that comes with the product allows 2 006P type laminated dry batteries to be used as the power supply. Batteries provide close to the ideal power supply, with therefore very good results being obtainable with almost no noise.
When supplying the power using the accompanying power supply cable the orange or red will be for positive voltage, blue or green for negative voltage, and black for 0V. Please ensure no mistaken power supply connections are made or it could result in damage to the product or a significant deterioration in performance.
In addition, before connecting the power supply ensure to turn off the power supply switch. Correctly connect all the cables to the positive, negative and 0V connections, double-check that no mistaken connections were made, and then turn on the power supply switch. Supplying power to only the one side of the positive or negative could result in damage to the product or a significant deterioration in performance.
Waiting at least 10 minutes after the power has been supplied and making any needed offset adjustments before using the product will provide the best results and a high level of stability.

If you change the power supply voltage the position of the offset adjustment may shift slightly, but can be adjusted using the volume of the offset adjustment that is located on the front panel.

Adjustment of Offset Voltage

The front panel has potentiometers for making any necessary offset adjustments. Any direct current components overlapping in input other than signals will get amplified when output, and in extreme cases the output may max out on either the positive or negative side. The offset adjustment can be used to cancel or adjust that to the optimum value. Offset voltage can also be generated due to output impedance in the signal sources to be connected, power supply voltage, or setting gain. This function can also be used to make adjustments for these events as well.

To adjust the offset voltage gently turn it clockwise or counterclockwise using a fine-tipped slotted screwdriver to avoid any damage to the thread of the screw or to the panel.

Service Life of Battery

The service life of the batteries used in the equipment will vary according to the type of battery used, the manufacturer, temperature, and frequency of usage.

The values below are typical examples of alkaline primary batteries made by Company A in constant use. Please use the data as reference material with bearing in mind that they are merely rough guidelines.

006P Type Laminated Dry Battery (x 2): When used until having dropped to 5V --- approx. 20 hours

Size D (6 series x 2 sets): When used until having dropped to 5V --- approx. 1100 hours

Note: The LED on the front panel will not light up when below approx. 7.5 V.

Limited Warranty

The Turtle Industry (Turtle-Ind) warrants each product of its manufacture to be free from defects in material and workmanship subject to the following terms and conditions. The warranty is effective for half a year after the shipment by Turtle-Ind to the original purchaser.

The obligation of Turtle-Ind under the warranty is limited to servicing or adjusting any product returned to the head office of Turtle-Ind for this purpose and to replacing any defective part thereof. Such product must be returned by the original purchaser, transportation charges prepaid, with sufficient and detailed proof in writing of the defect. If the fault has been caused by misuse or abnormal conditions of operation, repairs must be paid for. Prior to repair, in this instance, a quotation will be submitted. Service or shipping information will be notified depending on the difficulty encountered. Model and serial numbers must be supplied by user. Batteries are specifically excluded under warranty.

Turtle-Ind shall not be liable for any injury to persons or property or for expenses incurred by the use of any Turtle-Ind product.

Contact for any Questions or Product Failures

Please contact us at the following and let us know such information as the product name, serial number, how you purchased it, the date of purchase, and any questions you have or the details of a breakdown. We will ensure to promptly handle any problems that arise.

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