

# GIA100

## Gated Integrating Amplifier



Read this instruction manual before performing any task!

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# Original Operating Instructions

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# 1 Product Overview

## HIGHLIGHTS

- Fast switching 300 ns
- Fast settling < 1  $\mu$ s
- Output integrating analogue
- Dimensions (2 channel unit) 130 x 66 x 120(W x H x L)

## APPLICATIONS

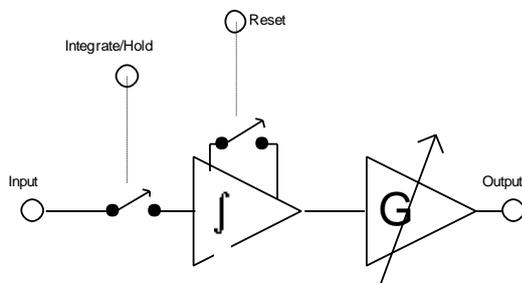
- Sensitive photodiode preamplification
- Optical pulse energy measurement
- Signal recovery
- OEM

## MEASUREMENT PRINCIPLE

The GIA100 series of gated integrating amplifiers employ a switched integrating topology with very low leakage error, charge injection error and pickup. The precision input stage may be configured for current or voltage inputs.

## FIELDS OF APPLICATION

The GIA100 series of gated integrators is useful for signal processing in a wide range of applications such as photodiode monitoring and time domain signal analysis. The output is a voltage linearly proportional to the integral of the input during a period of time set by a TTL-compatible gate. Between gates, the output is held constant for readout or digital conversion via an external A/D-converter or I/O-card (not included). The fast response time at high signal-noise-ratio makes the GIA100 series particularly useful in online production control. The GIA100 series is insensitive to electromagnetic interference by design, an important factor when working in „dirty“ industrial environments. The case wings provide for mounting on standard 25mm and 1” optical table tops and for OEM applications.



About this manual

## 1.1 Information about this manual

This manual enables you to handle the device in a safe and efficient manner. This manual is part of the device and must be kept in its vicinity in order to ensure that it is available to the personnel at all times.

The personnel must have carefully read and understood this manual before commencing any work. The compliance with all safety information and instructions provided in this manual is essential for safe operation.

Furthermore, all local work protection and general safety regulations applicable at the device's place of installation must be observed.

The illustrations used throughout this manual are intended to provide a general understanding and may deviate from the actual model of the machine.

## 1.2 Explanation of symbols

### Safety instructions

Safety instructions are marked with symbols in these instructions. The safety instructions are always introduced by signal words which express the extent of the danger.



#### **DANGER!**

This combination of symbol and signal word indicates an immediately-dangerous situation which could cause death or severe injuries if not avoided.



#### **WARNING!**

This combination of symbol and signal word indicates a possibly-dangerous situation which could cause death or severe injuries if it is not avoided.



### **CAUTION!**

This combination of symbol and signal word indicates a possibly-dangerous situation which could cause slight injuries if it is not avoided.



### **NOTICE!**

This combination of symbol and signal word indicates a possibly-dangerous situation which could cause property and environmental damage if it is not avoided.



Tips and recommendations

*This symbol highlights useful tips and recommendations as well as information designed to ensure efficient and smooth operation.*

## **Special safety instructions**

The following symbols are used in the safety instructions to draw attention to specific dangers:



### **DANGER!**

This combination of symbol and signal word indicates an immediately-dangerous situation due to electric shock. If an instruction so marked is not heeded, severe or even fatal injuries can be the consequence.



### **DANGER!**

This combination of symbol and signal word indicates an immediately-dangerous situation due to laser emission. If an instruction so marked is not heeded, severe or even fatal injuries can be the consequence.

### **1.3 Copyright**

The contents of these instructions are copyrighted. Their use is permitted in the context of using the device. Any use extending beyond this is not allowed without written permission from the manufacturer.

### **1.4 Customer service**

Our customer service is available for technical information and service:

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We are also always interested in information and experiences gathered from use which could be valuable for the improvement of our products.

## 2 Safety

This section provides an overview of all safety aspects that are essential to the best possible protection of the personnel and the safe and trouble-free operation of the machine. Additional safety instructions for specific work tasks are contained in the sections regarding the individual life stages of the machine.

### 2.1 Intended use

The gated integrating amplifier GIA100 is designed exclusively as a test system for the characterization of pulsed currents or voltages depending on the model chosen.

The intended use also includes adherence to all specifications in this manual.

Any use exceeding or differing from the intended use applies as misuse.

### 2.2 Basic dangers

The following section describes remaining risks which can arise from the device even with proper use.

In order to reduce risks of personal injury and property damage and avoid dangerous situations, the safety instructions listed here and the safety instructions in the other sections of these instructions must be followed.

#### Electrical current



#### **DANGER!**

#### **Life-threatening danger from electrical current!**

When touching live parts there is an immediate, life-threatening danger from electric shock. Damage to the housing of the power supply can be life-threatening!

- Work on the electrical system in the interior of the power supply may only be performed by the manufacturer.
- In the event of damage to the housing of the power supply, immediately disconnect the voltage supply by pulling out the mains plug.

### 2.3 Responsibility of the owner

Owner:

The owner is any such person who operates the GIA100 for commercial or economic purpose either by itself or transfers it to a third party for use and bears the legal responsibility for the safety of the user, the personnel or third parties during the operation.

#### Owner's duties:

The GIA100 is used in commercial applications. Therefore, the owner of the respective GIA100 is subject to the statutory duties of work safety.

In addition to the safety instructions in this manual, the safety, work safety and environmental safety regulations applicable for the area in which the electronic ballast is used must be adhered to. In the process, the following applies in particular:

- The owner must remain updated on the applicable work safety regulations and determine, in the scope of a risk assessment, additional dangers which can arise due to the special working conditions at the place in which the electronic ballast is used. This must be implemented in the form of working instructions for the operation of the GIA100.
- During the entire period of use of the GIA100, the owner must check whether the working instructions meet the current status of the rules and regulations and to adapt them as necessary.
- The owner must clearly regulate and define responsibilities for the operation, fault rectification and cleaning.
- The owner must make sure that all persons who work with the GIA100 have read and understood this manual. Moreover, the owner must train the personnel in regular intervals and inform them of the dangers.
- The owner must adhere to all statutory provisions in regard to the regular testing of electrical equipment and document this testing.
- 

In addition, the owner is responsible for ensuring that the unit is always in a technically faultless condition.

## 2.4 Personnel requirements

Qualifications:

The various tasks described in this manual place different requirements on the qualification of the persons to whom these tasks are entrusted.



### **NOTICE!**

#### **Insufficiently qualified personnel can cause property damage!**

Insufficiently qualified personnel cannot assess the risks when working with the unit.

- All work may only be performed by personnel who are qualified for this purpose.
- Keep insufficiently qualified personnel away from the work area.

Only persons who can be expected to reliably perform this work are permitted to carry out any work with this equipment. Persons whose ability to react is impaired by drugs, alcohol, medications, etc. are not permitted to work with this equipment.

In this manual the following qualifications listed for the personnel for the various tasks are specified:

User:

The user uses and operates the device for its intended purpose without other prior knowledge.

## 2.5 Symbols on the unit

The following symbols and instruction signs are affixed in the work area. These symbols and instruction signs refer to the immediate vicinity in which they are affixed.

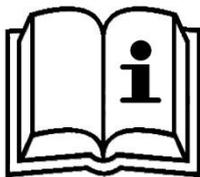
### WARNING!

#### Danger due to illegible signage!



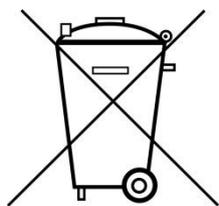
- Over time, stickers and signs can get dirty or in some other manner become illegible, so that dangers cannot be recognized and necessary operating instructions cannot be followed. Thus an injury hazard occurs.
- Keep all safety, warning, and operating instructions that are affixed to the device in legible condition.
- Replace damaged signs or stickers immediately.

#### Observe the operating manual



Do not use the indicated appliance until the operating manual has been read.

#### Do not dispose of with the household waste



Notice that the GIA100 may not be disposed of with the household waste. The worn out unit can be taken to an electronics and metal recycling service for disposal. The manufacturer also accepts old units for disposal.

## 2.6 Scope of delivery

Depending of the chosen model, the scope of delivery will vary:

- GIA100 gated integrating amplifier
- Power supply
- USB-Stick with user's manual

## 2.7 Transport inspection

On receipt, immediately inspect the delivery for completeness and transport damage.

Proceed as follows in the event of externally apparent transport damage:

- Do not accept the delivery, or only accept it subject to reservation.
- Note the extent of the damage on the transport documentation or the shipper's delivery note.
- Initiate complaint procedures.



*Issue a complaint in respect of each defect immediately following detection. Damage compensation claims can only be asserted within the applicable complaint deadlines.*

## 2.8 Packaging

### About the packaging

The individual GIA100 is packaged according to the expected transport conditions. Only environmentally friendly materials were used for the packaging.

The packaging should protect the individual GIA100 from transport damage, corrosion and other types of damage. Therefore, do not destroy the packaging and save it for later transport and for storage.

### Handling packaging materials

If the GIA100 no longer has to be transported, dispose of the packaging materials in accordance with the respective statutory provisions and local regulations.



### NOTICE!

#### **Danger for the environment from improper disposal!**

Packaging materials are valuable raw materials and can be reused in many cases or prepared and recycled. Dangers for the environment can arise through improper disposal of packaging material.

- Only dispose of packaging materials once it has been determined that the electronic ballast will no longer be transported.
- Dispose of packaging materials in an environmentally friendly manner.
- Observe the locally applicable disposal regulations. If necessary, commission a specialist company with the disposal.

## 2.9 Transporting



### **NOTICE!**

**Property damage from improper transport!**

Improper transport can damage the GIA100.

- Always transport the GIA100 in the packaging provided for this purpose.
- Always proceed with caution with the transport of the GIA100 in the packaging.
- Do not throw the GIA100.
- Protect the GIA100 from vibrations and moisture.
- Do not let the GIA100 fall.

## 2.10 Storage

Store the electronic ballasts in the packaging under the following conditions:

- Do not store outdoors.
- Store in a dry and dust-free area.
- Do not expose to any aggressive media.
- Protect from sun radiation.
- Avoid mechanical vibrations.
- Storage temperature: 15 to 35 °C.
- Relative air humidity: max. 60 %.



*Under certain circumstances there are instructions for the storage on the packaging, which exceed the requirements specified here. Follow these accordingly.*

### 3 Absolute Maximum Ratings

	Current Input	Voltage Input
Average input	$\pm 5$ mA	$\pm 5$ V
Temperature Range	0 – 60 °C	0 – 60 °C

### 4 Ordering Information

Order code: GIA100 c i n r

	Options	Description
Case style	G	OEM style with gullwing mounts
Input	I V	Current Voltage
Number of channels	2 4	
Input receptacle	BNC BR2	

The possible versions and order codes are as follows:

30.030.00001: GIA100GV2-BNC

30.030.00002: GIA100GI2-BNC

30.030.00006: GIA100GV4-BNC

30.030.00007: GIA100GI4-BNC

30.030.00008: GIA100GI2-BR2

30.030.00009: GIA100GI4-BR2

For mixed systems (mixed amplifiers or receptacles), please contact us.

## 5 Specifications

Parameter	Conditions	Current Input			Voltage Input			Units
		Min	Typ	Max	Min	Typ	Max	
<b>Input</b>								
Range		1 nA		100 $\mu$ A	10 $\mu$ V		1 V	
Connectors		BNC or BR2 <sup>1</sup>			*			
<b>Output</b>								
Range (full scale)				10V			*	
Function		Linear analogue $V_{out} = \frac{scale}{100pF} \int I_{in} dt$			Linear analogue $V_{out} = \frac{scale}{1\mu s} \int V_{in} dt$			
Output scale			0.1, 1, 10			*		
Connectors		BNC <sup>1</sup> and DB37			*			
Settling time (1%)				1			*	$\mu$ s
Accuracy <sup>2</sup>		$\pm 3$			*			%
Linearity				$\pm 1$			*	% FSR
Output impedance				1			*	$\Omega$
<b>Logic</b>								
Switching time (integrate / hold, reset, gain)				300			*	ns
<b>Power Supply</b>								
Type		Wall plug (supplied)			*			
Dimensions		30 x 60 x 50			*			mm
<b>Dimensions</b>								
	2 channels	130 x 66 x 120 mm (WxHxL)			*			mm
	4 channels	130 x 106 x 120 mm (WxHxL)			*			mm

\* Identical values as for current input version

<sup>1</sup> Adapters for other connector systems are available.

<sup>2</sup> Within the upper two decades of input range.

# 6 Case Styles

2 Channel:

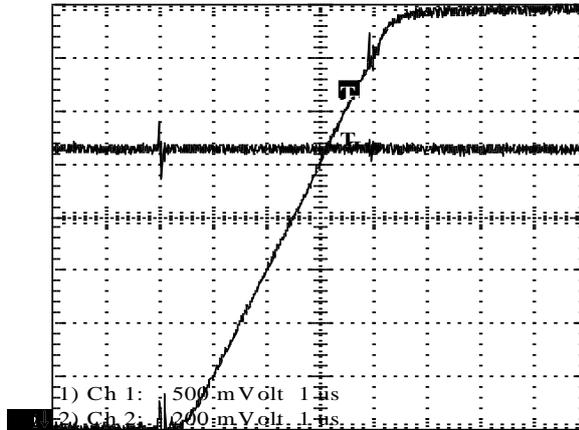


4 Channel:

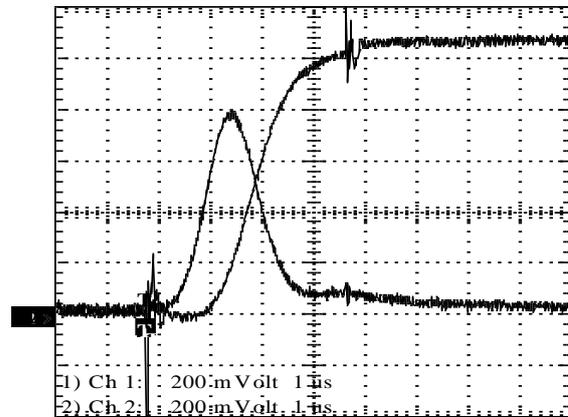


## 7 Performance

### Output (4 $\mu$ s integration time)

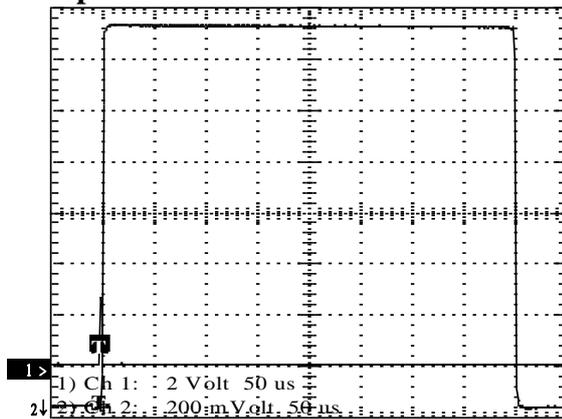


Input: 1.0 VDC  
Output: 1.0 V/ $\mu$ s

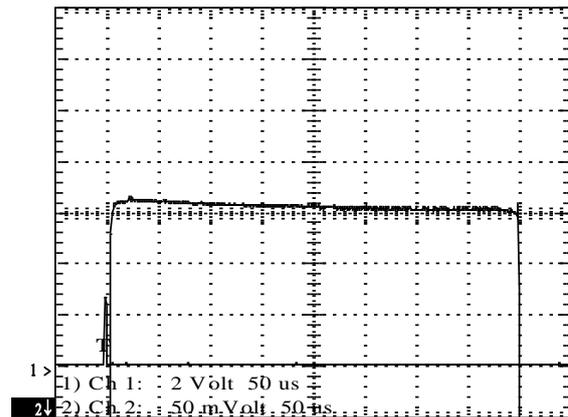


Input: 800 mV      1.2 $\mu$ s FWHM  
Output:            < 1% overshoot

### Droop



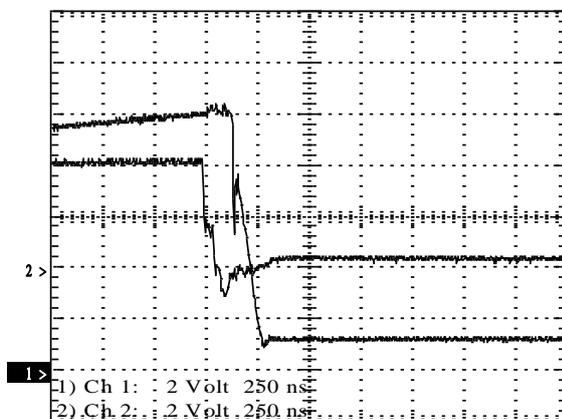
lower trace: 2 VDC input  
upper trace: GIA output (1.5V) held  
for 400  $\mu$ s following 4  $\mu$ s integration



upper trace: as previous graph;  
4x expanded vertical scale

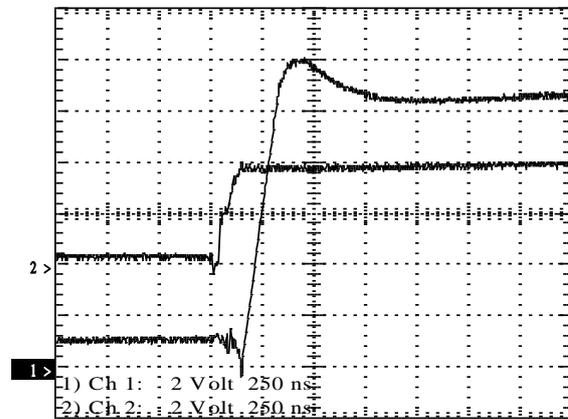
### Gain Switching Dead Time

high sensitivity  $\rightarrow$  low sensitivity



4V step:            control voltage  
8V step:            GIA100 output

low sensitivity  $\rightarrow$  high sensitivity



## 8 Instructions for measurement

The GIA100 gated integrating amplifier comprises independent measurement channels, from 2 to 4 channels per unit depending on the model chosen. Each channel consists of an input (current or voltage), a function output and a logic monitor output. These three user interfaces are arranged in logical groups on the front and back panels.

To make a measurement, proceed as follows:

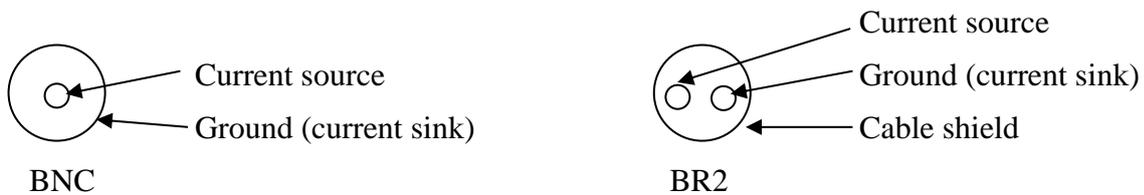
1. Turn the unit on. For the most accurate measurement, please allow for a 15 minute warm up before using.  
Connect an electrical source to the desired channel via the corresponding receptacle.  
Caution: see „  
Absolute Maximum Ratings “ for maximum allowed input values.
2. Connect a BNC-cable from the BNC output socket corresponding to the chosen input receptacle to an oscilloscope. Note that the output receptacle of channel 1 is not next to the input receptacle.
3. Select the appropriate range setting for the expected signal (see „Interface “).
4. Provide digital control signals for integration, result hold and reset via the interface (see „Interface“).
5. Monitor the input signal and the logic monitor simultaneously on an oscilloscope.
6. Input zero current or voltage depending on the model chosen. Note that this does not mean opening the input connection. The connection must be complete with zero input.
7. Adjust the offset potentiometer below the input receptacle to achieve zero integration of the output during the integration period. Now the instrument is ready for measurement.
8. Connect a BNC-cable from the BNC output socket corresponding to the chosen input receptacle to a suitable measurement instrument (voltmeter, oscilloscope, I/O card, etc.). Note that the output receptacle of channel 1 is not next to the input receptacle. Alternatively, the output may be taken from the interface receptacle using the interface cable supplied with the unit (see „Interface“).
9. Read the voltage output.

## 8.1 Inputs

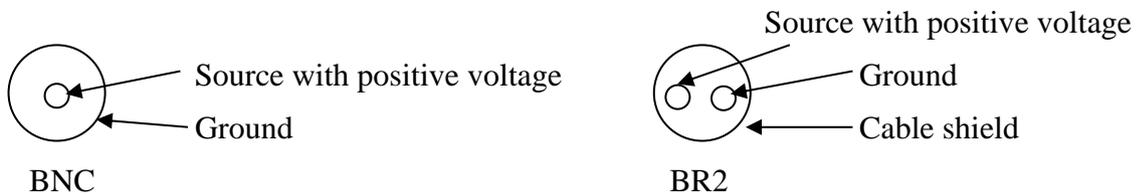
There are two types of input receptacles: BNC and BR2. The BR2 receptacle should be used when shielding of the signal source is required.

The connections of these two connectors are as follows.

### Current Input



### Voltage Input



Note that when connecting photodiodes as the signal source, the photodiode anode is the current source and the cathode is the current sink.

## 8.2 Outputs

The analogue output is provided via standard BNC sockets as well as through the interface. The output is a voltage linearly proportional to the integral of the input during a period of time set by a TTL-compatible gate. Between gates, the output is held constant for readout or digital conversion via an external A/D-converter or I/O-card (not included).

## 8.3 Indicators

LEDs

Power (green):            The unit is powered.

The interface provides an additional power indicator, useful for automated operation:

Pin 19: +5 V = power on      0 V (analogue ground) = power off

## 8.4 Logic

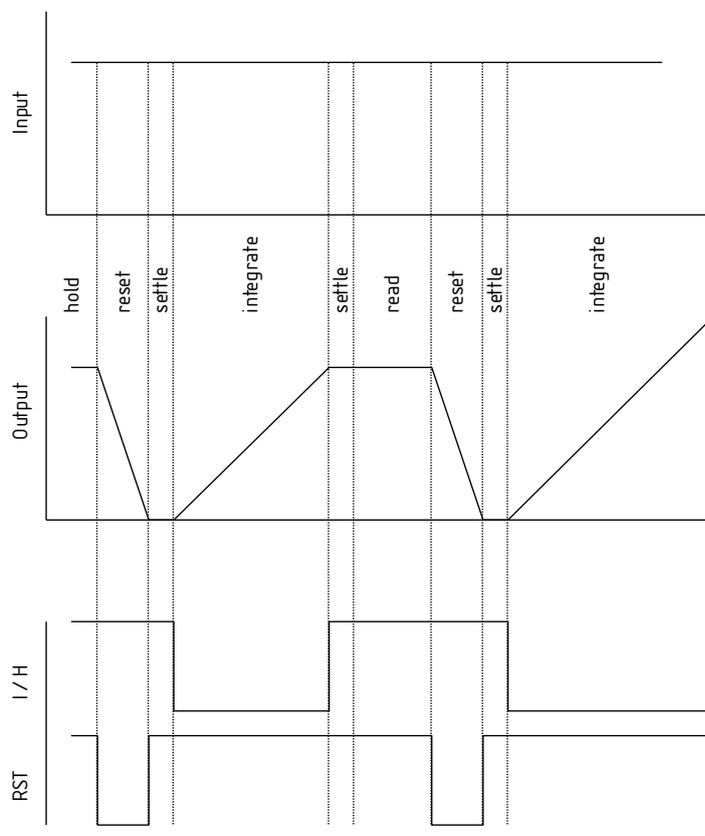
Logic control is via the DB37 interface. This instrument uses +5 V / 0 V (= digital ground) logic, which may be TTL<sup>3</sup>. The pin assignment is described under „Interface“.

Function	LO	HI
Integrate / Hold	integrate	hold
Reset	reset	enable

The status of the logic for each channel may be monitored by connecting the corresponding BNC logic monitor socket to an oscilloscope. This output is HI during „reset“ and „integrate“ and is LO at all other times. This is useful for setting the gate positions and durations.

A typical measurement begins by resetting the channel in question by setting the „reset“ pin LO for a minimum of 1.5 $\mu$ s, in order to allow the amplifiers to settle (see „Output“). During this time it is convenient to hold the „integrate / hold“ pin HI. When the „reset“ pin is held HI, the channel is enabled for integration and holding. Set the „integrate / hold“ pin LO for the period of time required for the integration. At the end of the integration period, the „integrate / hold“ pin is switched to HI to hold the value. After the settling time of 1 $\mu$ s, the measured value may be read out. This sequence may now be repeated for further measurements.

This sequence is depicted in the following diagramme:



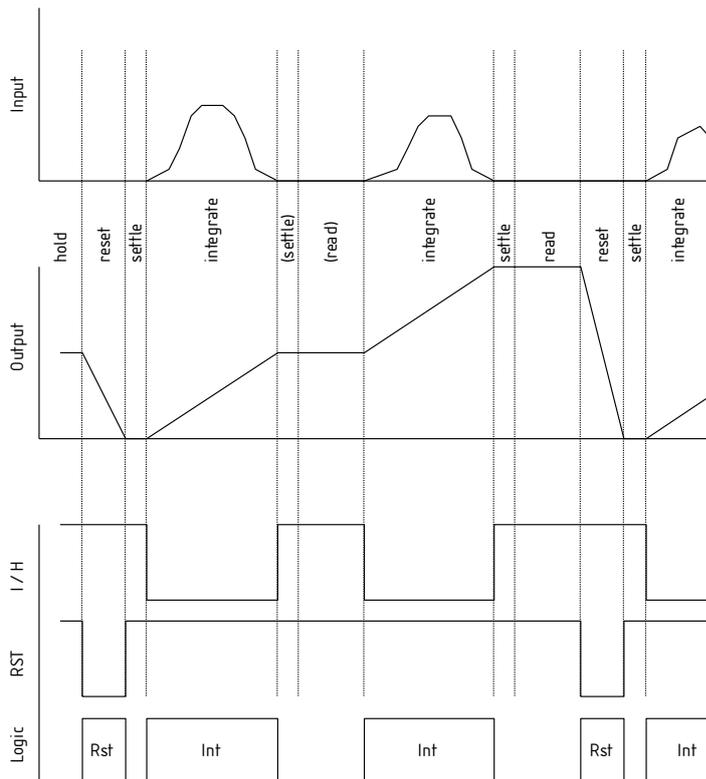
<sup>3</sup> LO = TTL low (-0,3 .. +0,8 V); HI = TTL high (+2,4 .. +5,1V)

Note that when using current input versions of the GIA100 for photodiode monitoring, the photodiode itself will store charge during the time between the end of the reset period and the beginning of the integration period. Thus, for photodiode monitoring purposes, the effective integration time is from the end of the reset period to the end of the integration period. This assumes that the photodiode will not saturate during this period.

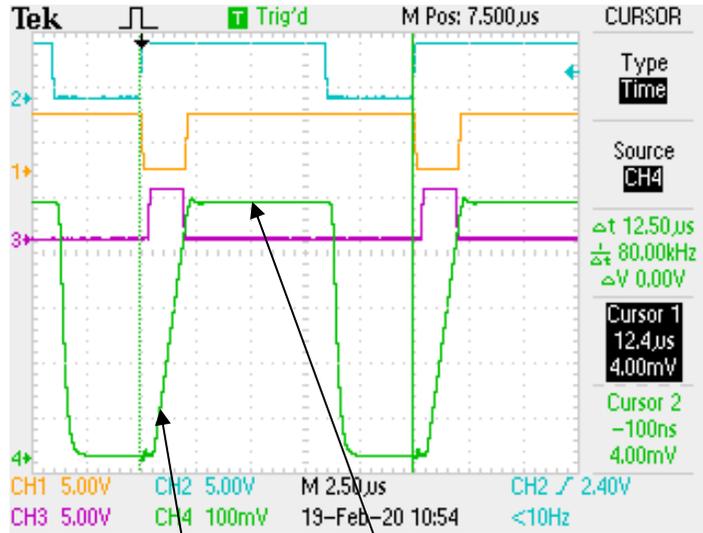
A further restriction here is that the voltage on the photodiode due to the charge stored during the time between the end of the reset period and the beginning of the integration period should be kept below 500mV. For example, a photodiode with a capacitance of 100pF must not be allowed to collect more than  $100\text{pF} \cdot 500\text{mV} = 50\text{pC}$  of charge. Depending on the illumination of the photodiode, the settling time after the reset pulse may have to be adjusted accordingly.

Note further that the charge storage capability of photodiodes can be effectively used for the measurement of the total energy of short light pulses, even if the speed of the GIA100 itself is not high enough to follow in real time. A short pulse of light, from a pulsed laser for example, will produce a charge on a photodiode which can then be read out by the GIA100 with no loss of signal. We will be happy to assist you with questions regarding photodiode monitoring.

In order to improve the signal-to-noise ratio of repetitive signals, the GIA100 may be used to integrate isolated events as a „boxcar integrator“. In this case, the output is not reset between measurements, until the desired number of events has been integrated. This sequence is depicted in the following diagramme:



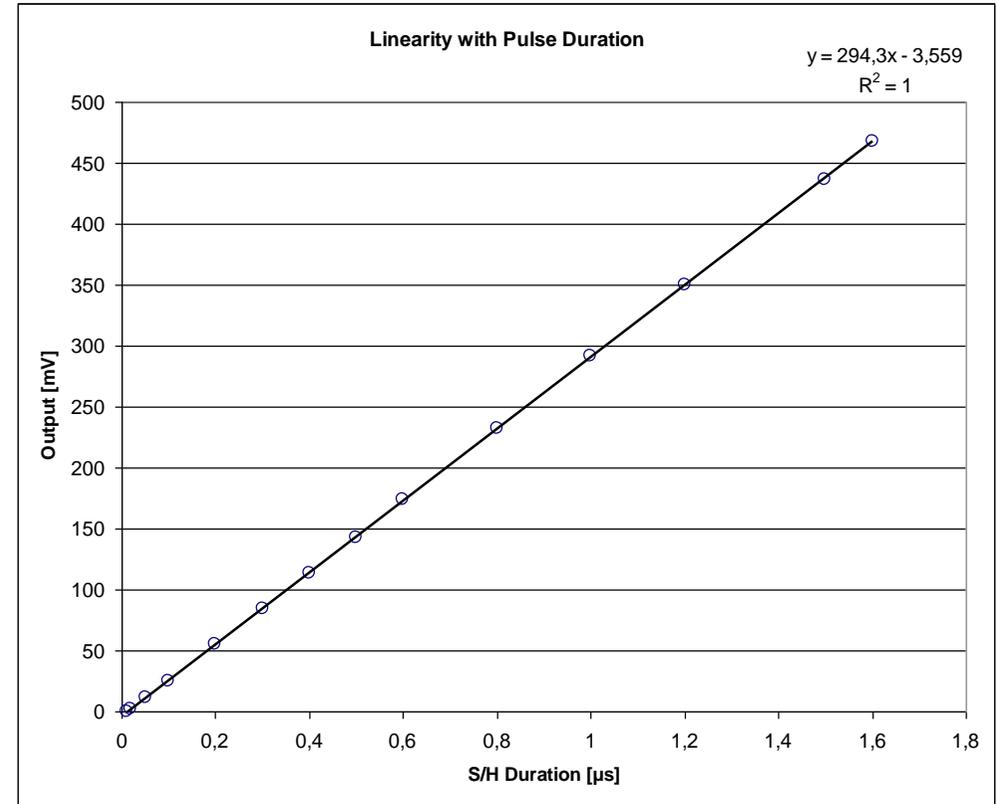
# Recommended Pulse Timing for 300ns Pulse at 80kHz Repetition Rate



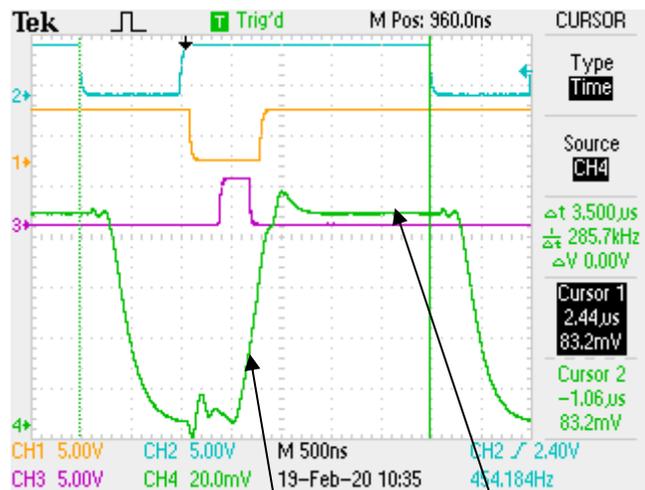
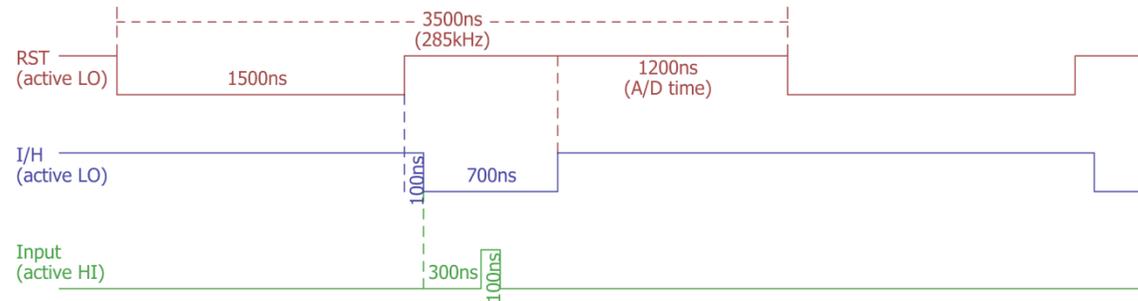
- Blue = RST
- Yellow = I/H
- Purple = Input Pulse
- Green = GIA100 Output

Pulse integration

Period for A/D conversion



**Recommended Absolute Minimum Pulse Timing (285kHz repetition rate)**



Blue = RST

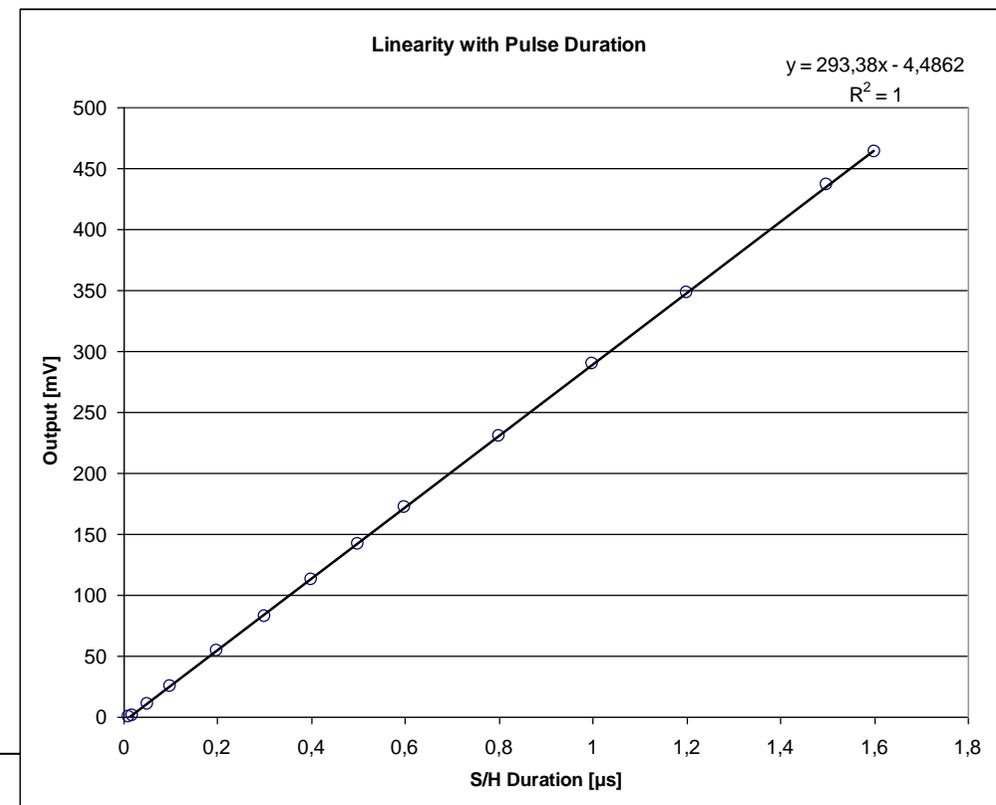
Yellow = I/H

Purple = Input Pulse

Green = GIA100 Output

Pulse integration

Period for A/D conversion



## **8.5 Logic Monitor**

The status of the logic for each channel may be monitored by connecting the corresponding BNC-socket to an oscilloscope. This output is:

HI during „reset“ and „integrate“

LO at all other times.

This is useful for setting the gate positions and durations.

## **8.6 Damage**

The unit may be damaged by exceeding the maximum average inputs. Please read „Absolute Maximum Ratings“ for these maximum values before working with the instrument.

Use only the power supply and power supply cable provided with the unit.

## 8.7 Interface

The interface on the back panel allows readout of the measurement values, as well as control of the unit. The pin correlation of the interface connector and the cable supplied with the unit is given in the following table.

The digital inputs (I/H = integrate/hold and RST = reset as well as MSB = most significant bit and LSB = least significant bit) are internally pulled up to +5V. Therefore the external digital input needs only to pull down to 0V for logic LO or leave the input floating (high impedance) for logic HI.

In the 2-channel version, only the pins 1-19 are functional. All other pins are not connected internally.

Pin	Function	Pin	Function
1	Gain Channel 1, MSB <sup>4</sup>	20	Gain Channel 3, MSB
2	Gain Channel 1, LSB <sup>5</sup>	21	Gain Channel 3, LSB
3	I/H Channel 1	22	I/H Channel 3
4	RST Channel 1	23	RST Channel 3
5	AGND <sup>6</sup>	24	AGND
6	AGND	25	AGND
7	AGND	26	AGND
8	DGND <sup>7</sup>	27	DGND
9	RST Channel 2	28	RST Channel 4
10	I/H Channel 2	29	I/H Channel 4
11	Gain Channel 2, MSB	30	Gain Channel 4, MSB
12	Gain Channel 2, LSB	31	Gain Channel 4, LSB
13	AGND	32	AGND
14	Output Channel 2	33	Output Channel 4
15	AGND	34	AGND
16	AGND	35	AGND
17	Output Channel 1	36	Output Channel 3
18	AGND	37	AGND
19	Power On Indicator (+5V)		

Gain	MSB	LSB
0.1	LO	LO
1	LO	HI
10	HI	LO
invalid	HI	HI

<sup>4</sup> MSB = most significant bit

<sup>5</sup> LSB = least significant bit

<sup>6</sup> AGND = analogue ground

<sup>7</sup> DGND = digital ground

## 8.8 Troubleshooting

In the event that a measurement is not successful, the following possibilities should be analysed:

Symptom	Possible Errors	Correction
No output and power LED is not on	System is not powered	Ensure the power cord is connected at both ends.
No output and power LED is on	Input too low	Switch to more sensitive range or increase input
Output at full scale, independent of input	Range too sensitive	Switch to a less sensitive range or lower the input

In the unlikely event that you are not able to obtain a measurement in spite of these troubleshooting measures, please contact us. We will be pleased to help you solve your problem.

## 9 Disposal

Do not dispose of the GIA100 with the household waste. The worn out unit can be taken to an electronics and metal recycling centre for disposal. The manufacturer also accepts old units for disposal.

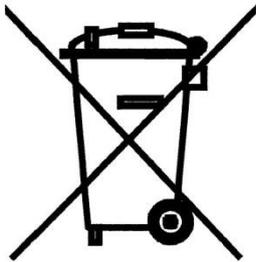


### NOTICE!

#### **Danger for the environment from improper disposal!**

Dangers for the environment can arise through improper disposal.

- Never dispose of the electronic ballast with the household waste.
- Take the electrical scrap or electronic components to an approved specialist company for disposal.
- In case of doubt, contact the local authorities or a special disposal company for information about the environmentally compatible disposal.



## 10 Type plate

The type plate is located on the back door of the enclosure and includes the following information:

- Manufacturer
- Part number
- Serial number
- Manufacturing date



GIA100

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Model No.: GIA100

Ser. No.: 0011

[www.artifex-engineering.com](http://www.artifex-engineering.com)



## 11 Notice

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**DANGER!** The GIA series of gated integrating amplifiers may be used with lasers. In such cases, personnel who use this instrument must, therefore, be instructed in the safe use of lasers and laser beams.

**Always wear the proper laser safety glasses designed for the laser in use!**

**Never allow the direct or reflected laser beam to impinge on the eyeball or to come into contact with the skin!**

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