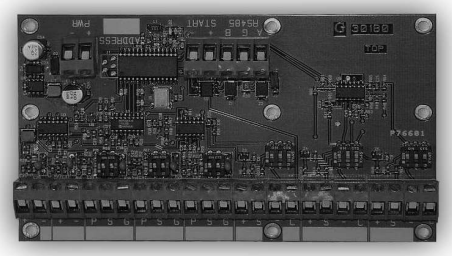
GDA8M1 Data Acquisition Module for Mixed Signals

FEATURES

- **POWERS AND MEASURES THE SIGNAL OF TWO LOOP POWER 4-20 mA SENSORS**
- **POWERS AND MEASURES THE SIGNAL OF THREE ANALOG SENSORS, UNIVERSAL INPUT 0-20mA, 4-20mA, 0-5V OR 0-10V, PROGRAMMABLE**
- **POWERS AND MEASURES THREE PULSE / FREQUENCY SENSORS UP TO 10 kHz, UNIVERSAL INPUT OPEN DRAIN / COLLECTOR, NPN. PNP, REED SWITCH, DRY CONTACT, WAVES, LOGICAL SIGNALS, COILS**
- **NO PREAMPLIFIERS FOR THE COILS NEEDED**
- **PROVIDES TOTAL PULSES FOR EACH PULSE INPUT AND THE DIFFERENCE OF THE TOTALS, FREQUENCY, FREQUENCY RATIO AND FREQUENCY DIFFERENCE**
- **ALL ANALOG INPUTS MEASURED 100 TIMES PER SECOND**
- **ERROR 0.01% FS TYP. ON ALL ANALOG INPUTS**
- **ALL INPUTS PROTECTED**
- **WORKS WITH 7- 40 VDC POWER, REVERSE POLARITY AND SURGE PROTECTED**
- **STOP WATCH INPUT**
- **STOP WATCH TIME ERROR LOWER THAN 1 ms**
- **SYNCHRONOUS WORK OF ALL PULSE INPUTS AND THE STOP WATCH, INDEPENDENTLY PROGRAMMABLE FOR EACH INPUT**
- **RS485, 1/8 LOAD, TWO WIRE COMMUNICATION**
- **PROGRAMMABLE BAUD RATE UP TO 115 200**
- **PROGRAMMABLE PARITY AND STOP BITS**
- **HIGH PROTECTION ON THE RS485**
- **BUILT-IN TERMINATION RESISTOR, JUMPER SELECTABLE**
- **MODBUS RTU COMPLIANT**
- **LOW POWER CONSUMPTION**
- **SMALL SIZE**

APPLICATIONS

- **TO POWER AND ACCURATELLY MEASURE ANALOG SIGNALS FROM VARIOUS SENSORS AND DEVICES**
- **TO POWER AND ACCURATELLY MEASURE FREQUENCY, TOTAL PULSES, PULSES DIFFERENCE, FREQUENCY DIFFERENCE AND RATIO**
- **REMOTE MONITORING**
- **FLOW MEASUREMENT**
- **TEMPERATURE MEASUREMENT**
- **PRESSURE MEASUREMENT**
- **SCADA**



1. DESCRIPTION

GDA8M1 powers up to eight sensors or devices that provide loop power 4-20 mA signal, 0-20mA, 4-20mA, 0-5V or 0-10V analog signals or pulse / frequency signals from various sensors. Two of the analog inputs are fixed 4-20 mA loop power, three are universal analog and three are universal pulse inputs. It measures all analog inputs 100 times a second with an error of 0.01% FS typ., filters and conditions their signal.

GDA8M1 measures and filters the universal pulse inputs and provides accurate data for frequency, frequency difference, frequency ratio, total pulses and total pulses difference.

Each pulse input can be programmed to work independently from the stop watch, to be enabled by the stop watch or to be cleared and enabled by the stop watch.

A special way is provided to synchronously read the total of all pulse inputs at exactly the same time. Also all totals can be cleared at exactly the same time.

GDA8M1 has a stop watch input and measures accurately the duration for which that input has been shorted.

Using its RS485 two wire communication capabilities all data can be read by a MODBUS RTU master. The RS485 driver represents only 1/8 load which allows up to 247 devices on the same network. Baud rate, parity and stop bits are programmable. Using multiple GDA8M1 on different remote locations a high quality data acquisition system can be built. The stop watch time provided by each GDA8M1 can be used for detailed and accurate data logging and reports, or just as a digital input. The high protection of all inputs, the power supply and RS485 connection ensures high reliability and accuracy.

A blue LED provides indication for the inputs being measured, while a green and yellow LED provide indication about sending and receiving data over the RS485 communication port.

2. ABSOLUTE MAXIMUM RATINGS *

Operating temperature	-20 to +70 ℃
Power supply voltage	40 V DC
Pulse sensors consumption	20 mA DC

*** NOTICE: Stresses above those ratings may cause permanent damage to the device.**

3. CHARACTERISTICS

Parameter	Conditions	Min	Typ	Max	Units
Power Supply					
Voltage	25 ° C, NOTE 1		24	36	V DC
Power Consumption	25 ° C, 24 VDC, NOTE 5			4.8	VA
Analog Input					
Voltage for the sensor	25 ° C, NOTE 1		24	36	V DC
Error	Input 4 – 20 mA, 24 V, 25 ℃, NOTE 2		0.01		% FS
Temperature coefficient	Input 4-20 mA, -40 ℃ to +85 ℃, 24 V DC		30		ppm/℃
Pulse Input					
Voltage for the sensor	25 ° C		5.0		V DC
Frequency	NOTE 6			10	kHz
Reed switch current	-40 ℃ to +85 ℃			1.6	mA DC
Threshold, low	Wave or logical signal (CMOS, TTL etc.)		1		V DC
Threshold, high	Wave or logical signal (CMOS, TTL etc.)		1.4		V DC
Coil voltage	Symmetrical signal from the coil (sine, triangle, saw etc)	20			mVpp
Stop Watch					
Error	Open drain electronic switch, 24 V, 25 ℃, NOT E 3, NOTE 4			1	ms
Delay to a total clear	Delay from shorting the start input to clearing/enabling a total		< 5	20	us
Time base error	Time base for the stop watch and frequency measurement, -20 to +70 ℃			25	ppm
Minimum time	-20 to +70 ℃	100			ms
Minimum pause	-20 to +70 ℃	100			ms

Note 1: The voltage to power all analog input sensors equals the power supply voltage. The minimum power supply voltage must be at least 5 VDC higher than the minimum sensor voltage for any analog input.

Note 2: The parameter includes all errors, non-linearity and noise at constant voltage and temperature. Only one analog input is connected and measured.

Note 3: If an electro-mechanical switch, button or dry contact is used there will be a bouncing time of the mechanical contact. The error will be higher and an external filtering capacitor across that contact will be needed.

Note 4: Both high and low registers of the stop watch must be read every time, in that order

Note 5: 10 mA max for each pulse input, all analog inputs 4-20 mA loop power, at 20 mA

Note 6: The value is for reference only. The maximum frequency strongly depends on the duty cycle of the signal and the type of the sensor.

4. PROGRAMMING

There are a few parameters that may need to be programmed before starting using GDA8M1:

- MODBUS address [1 – 247], factory default is 1. This is needed only if the device will work on a 2 wire MODBUS network. If stand alone, leave the address to its factory default 1.
  Use the white rectangle on the board to write the MODBUS address.

- The baud rate is programmable to 9800, 19200, 38400, 57600 and 115200. The factory default is **19200**.

- Parity is programmable to even, odd and none. The factory default is **even parity**.

- Stop bits are fixed to **one** if the parity is **even** or **odd**. If the parity is programmed to **none**, then the stop bits are **programmable to one or two**.

  NOTE: MODBUS standard requires two stop bits with no parity.

- The type of the universal analog inputs: 0-20 mA, 4-20 mA, 0-5V or 0-10V.
  Factory default is 4-20 mA.

  NOTE: The DIP switches for each input must be set accordingly

- Pulse input total configuration – independent from the stop watch, stop watch enables the particular pulse input totalizing, stop watch clears the total and enables the totalizing. Factory default is independent from the stop watch.

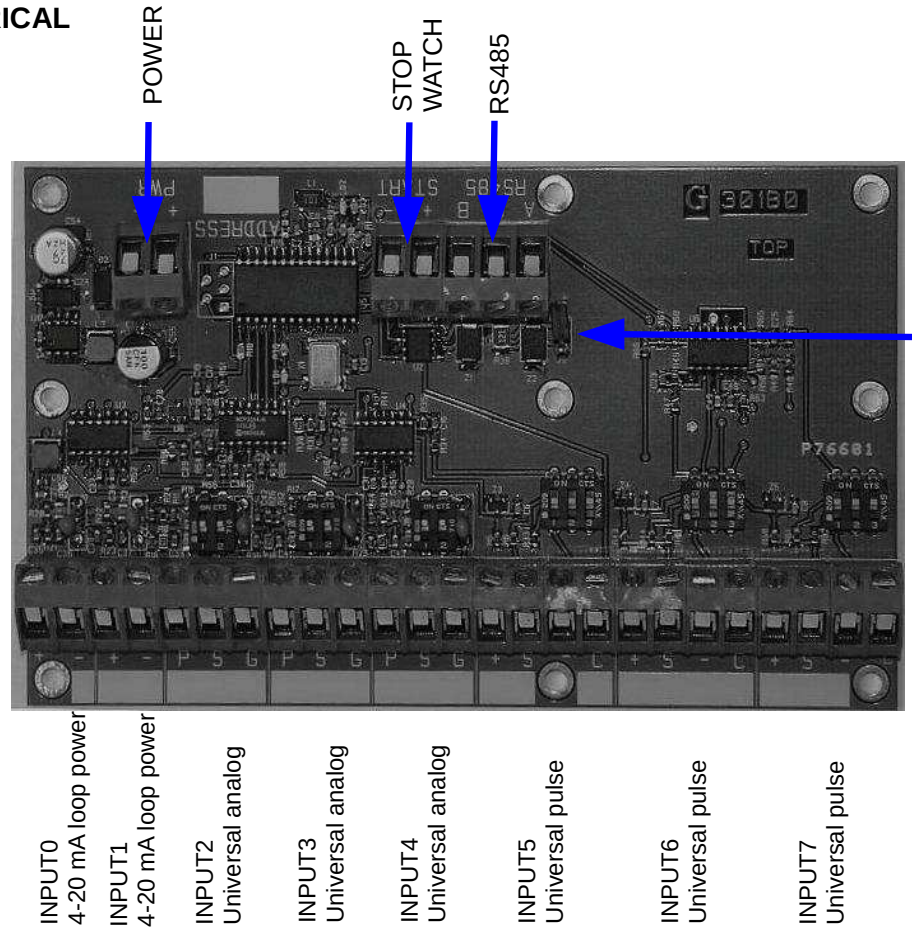
  - Independent: the total is always incrementing regardless of the stop watch
  - Stop watch enables totalizing: the total will increment only while the stop watch input is shorted
  - Stop watch clears and enables totalizing: when the stop watch gets shorted it will immediately clear the total and then the total will increment while the stop watch input is shorted

  NOTE: There are MODBUS registers provided for clearing each total independently or all three totals at once. This clearing the total/s is independent from the stop watch.

  NOTE: The frequency data for each pulse input is always available regardless of the total.

5. APPLICATION

5.1. ELECTRICAL

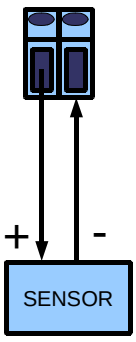


NOTE 1: The inputs are not isolated from the power and from the RS485 terminals

If the board is at the end of a two wire RS485 network a termination may be needed. Shorting the jumper on the GDA8M1 board will connect a 120 ohm / 0.5W resistor between A and B wires.

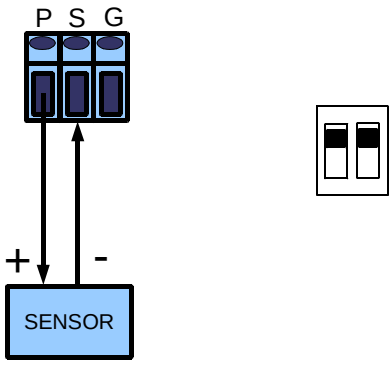
5.1.1. Wiring the sensors

5.1.1.1. Input_0 and Input_1, 4-20 mA loop power

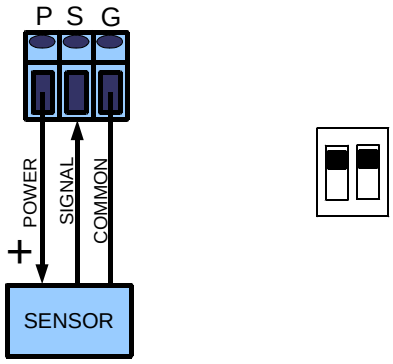


5.1.1.2. Wiring Input_2 to Input_4, universal analog inputs

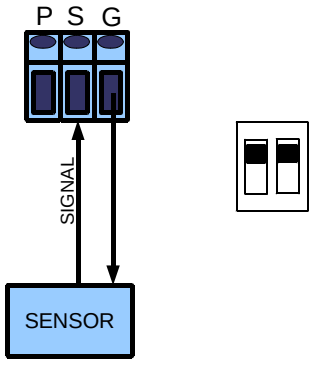
- **Loop power sensor 4-20 mA**



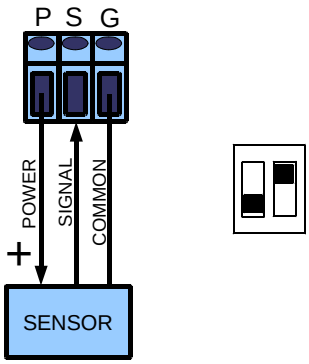
- **Passive 0-20 mA or 4-20 mA**



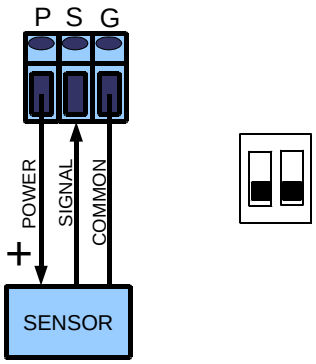
- **Active 0-20 mA or 4-20 mA**



- **0 – 5V**



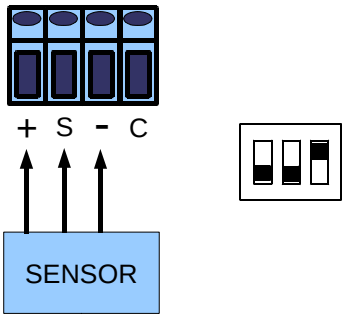
- **0 – 10V**



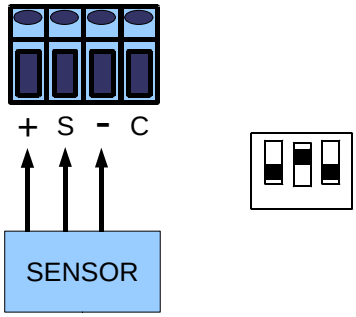
NOTE: Every time the input type is changed, the MODBUS register for that analog input type must be programmed accordingly.

5.1.1.3. Wiring Input_5 to Input_7, universal pulse inputs

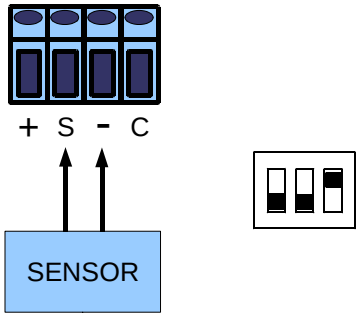
- **NPN Open Drain, Open Collector**



- **PNP Open Drain, Open Collector**

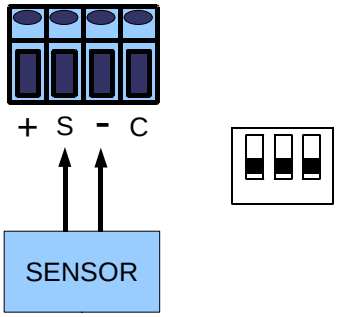


- **Reed Switch, Dry Contact**

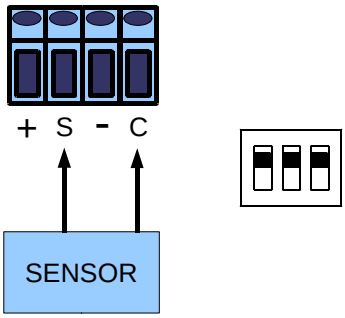


NOTE: A small capacitor in parallel may be needed. Different reed switches and dry contacts have different bouncing time. Test and evaluate carefully to determine the right capacitor.

- **Wave (square, sine, triangle, saw etc.), Logical Signal (CMOS, TTL etc.)**



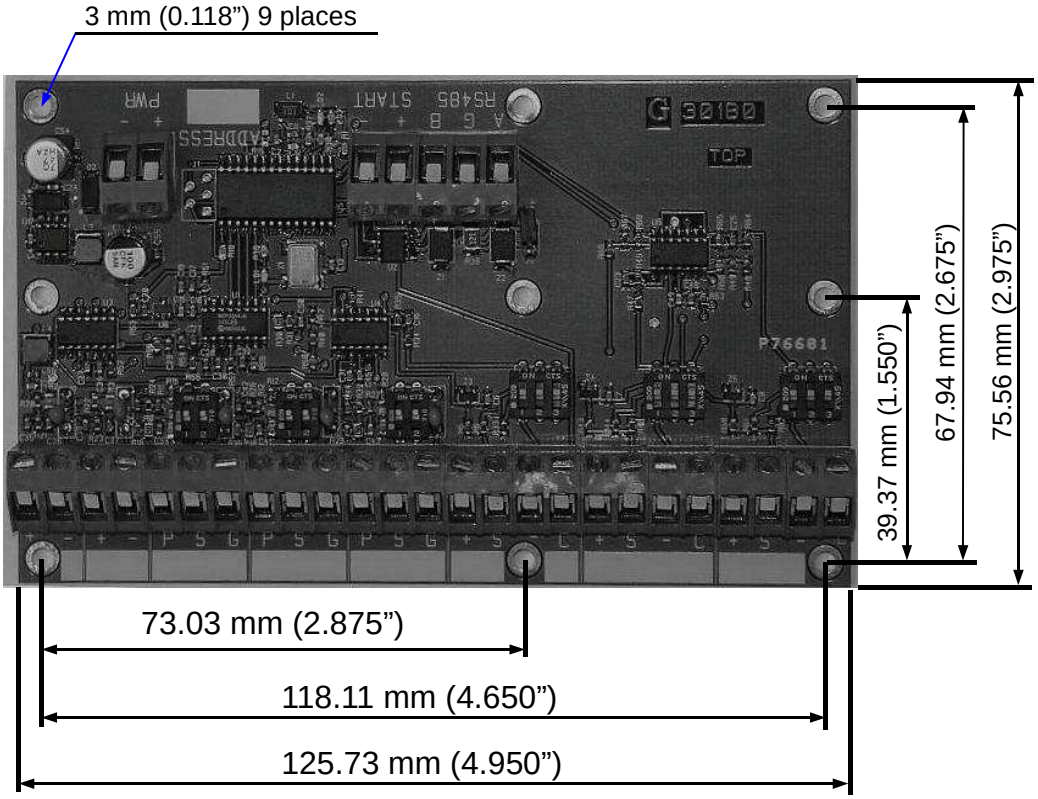
- **Coils**



NOTE: If the cable to the coil is shielded, connect the shield to "-" ONLY. Do not connect the shield to anything at the other (coil) end of the cable. In order to keep the isolation the shield has to be isolated from earth ground and all other equipment or electrical connections.

5.2. MECHANICAL

5.2.1. Dimensions



6. COMMUNICATION

GDA8M1 communication port is a 2 wire RS485 – A and B plus ground - G. If the distance to the master is significant a twisted pair must be used.

The **default** port settings are: baud rate 19 200, 8 bit character, 1 stop bit, even parity, no handshaking.
Baud rate and parity are programmable.
Stop bits are fixed to **one** if the parity is **even** or **odd**. If the parity is programmed to **none**, then the stop bits are **programmable to one or two**.

NOTE: MODBUS standard requires two stop bits with no parity.

The communication protocol is MODBUS RTU. Functions 0x03 (read holding registers), 0x04 (read input registers) and 0x06 (write a single holding register) are implemented. The GDA8M1 device handles exceptions 1, 2, 3 and 6.

Here are the registers implemented:

Register address	***Register Type***	***Read/Write***	***Description***	***Format***
31	Input	R	Stop Watch time, high	In ms * 65536, Note 2
32	Input	R	Stop Watch time, low	In ms, Note 2
38	Input	R	Input 5 total, High	Total number of pulses, Note 2, Note 3
39	Input	R	Input 5 total, Low	
40	Input	R	Input 6 total, High	Total number of pulses, Note 2, Note 3
41	Input	R	Input 6 total, Low	
42	Input	R	Input 7 total, High	Total number of pulses, Note 2, Note 3
43	Input	R	Input 7 total, Low	
44	Input	R	Normalized value of input 0	0-10000 = 0.00 – 100.00 %, Note 1
45	Input	R	Normalized value of input 1	0-10000 = 0.00 – 100.00 %, Note 1
46	Input	R	Normalized value of input 2	0-10000 = 0.00 – 100.00 %, Note 1
47	Input	R	Normalized value of input 3	0-10000 = 0.00 – 100.00 %, Note 1
48	Input	R	Normalized value of input 4	0-10000 = 0.00 – 100.00 %, Note 1
49	Input	R	All totals reading strobe	Always returns 0, Note 4
50	Input	R	Input 5 total buffer, High	Total number of pulses buffered, Note 2, Note 5
51	Input	R	Input 5 total buffer, Low	
52	Input	R	Input 6 total buffer, High	Total number of pulses buffered, Note 2, Note 5
53	Input	R	Input 6 total buffer, Low	
54	Input	R	Input 7 total buffer, High	Total number of pulses buffered, Note 2, Note 5
55	Input	R	Input 7 total buffer, Low	
56	Input	R	Total_5 - Total_6, High	Note 2, Note 6
57	Input	R	Total_5 - Total_6, Low	
58	Input	R	Total_6 - Total_7, High	Note 2, Note 6
59	Input	R	Total_6 - Total_7, Low	
60	Input	R	Total_5 - Total_7, High	Note 2, Note 6
61	Input	R	Total_5 - Total_7, Low	

62	Input	R	Frequency_5, High	In Hz, Note 7
63	Input	R	Frequency_5, Low	
64	Input	R	Frequency_6, High	In Hz, Note 7
65	Input	R	Frequency_6, Low	
66	Input	R	Frequency_7, High	In Hz, Note 7
67	Input	R	Frequency_7, Low	
68	Input	R	Frequency_5 - Frequency_6, High	In Hz, Note 7
69	Input	R	Frequency_5 - Frequency_6, Low	
70	Input	R	Frequency_6 - Frequency_7, High	In Hz, Note 7
71	Input	R	Frequency_6 - Frequency_7, Low	
72	Input	R	Frequency_5 - Frequency_7, High	In Hz, Note 7
73	Input	R	Frequency_5 - Frequency_7, Low	
74	Input	R	Frequency_5 / Frequency_6, High	0 – 1 000 000.0, Note 7, Note 12
75	Input	R	Frequency_5 / Frequency_6, Low	
76	Input	R	Frequency_6 / Frequency_7, High	0 – 1 000 000.0, Note 7, Note 12
77	Input	R	Frequency_6 / Frequency_7, Low	
78	Input	R	Frequency_5 / Frequency_7, High	0 – 1 000 000.0, Note 7, Note 12
79	Input	R	Frequency_5 / Frequency_7, Low	
1000	Holding	R/W	MODBUS slave address	1 - 247, default is 1
1039	Holding	R/W	Input_2 type	0 – 2, default is 1 (4-20 mA), Note 8
1040	Holding	R/W	Input_3 type	0 – 2, default is 1 (4-20 mA), Note 8
1041	Holding	R/W	Input_4 type	0 – 2, default is 1 (4-20 mA), Note 8
1042	Holding	R/W	Input_5 configuration	0 – 2, default is 0 (independent), Note 9
1043	Holding	R/W	Input_6 configuration	0 – 2, default is 0 (independent), Note 9
1044	Holding	R/W	Input_7 configuration	0 – 2, default is 0 (independent), Note 9
1045	Holding	W	Total_5 clear	Writing 0xAAAA will clear the total, Note 10
1046	Holding	W	Total_6 clear	Writing 0xAAAA will clear the total, Note 10
1047	Holding	W	Total_7 clear	Writing 0xAAAA will clear the total, Note 10
1048	Holding	W	All totals clear	Writing 0xAAAA will clear all totals, Note 11
1053	Holding	R/W	Baud rate	0 – 4 = 19200, 38400, 57600, 115200, 9800 default is 0 = 19200
1054	Holding	R/W	Parity, NOTE 13	0 – 2 = even, odd, none default is 0 = even
1057	Holding	R/W	Stop bits, NOTE 14	0 = 2 stop bits, 1 = 1 stop bit

NOTE 1: This is a 2 byte unsigned integer. Convert it to a floating point, then divide by 10000.0 to get the normalized value. If the input is 4-20 mA and the current is below about 3.5 mA GDA8M1 will return 0xFFFF (65535) for that input.

NOTE 2: This is a 4 byte unsigned long integer. Merge the high and low parts to construct the long integer:

Value = (((unsigned long)high) << 16) + low;
Both high and low registers must be read every time, in that order.

NOTE3: Reading one total is independent from reading another. Use these registers only if the three totals are not related, not synchronized and do not need to be read at exactly the same time.

NOTE4: Reading this register will make GDA8M1 to immediately read all three totals at exactly the same time and store them for a later

reading using the registers that follow

NOTE5: Reads the totals stored at the last strobe

NOTE6: Treat this long variable like a signed long

NOTE7: This is a IEEE-754 floating point number. High word contains the exponent and the most significant byte of the mantissa. The low word contains the middle and the least significant byte of the mantissa. For an accurate reading both high and low must be read, merged and used like a IEEE754 floating point number.

NOTE8: 0 = 0-20 mA, 1 = 4-20 mA, 2 = 0-5V, 3 = 0-10V

NOTE9: 0 = the total of this input increments independently from the stop watch input
1 = the total will increment only while the stop watch input is shorted
2 = shorting the stop watch input will immediately clear the total of this input and after that it will increment only while the stop watch input is shorted

NOTE10: Writing exactly and only 0xAAAA to this register will clear the total

NOTE11: Writing exactly and only 0xAAAA to this register will clear all totals at exactly the same time

NOTE12: If the frequency divisor is 0.0 Hz, reading these High/Low registers will return 1 000 000.0 (one million)

NOTE13: If parity is even or odd the device will automatically use 1 stop bit. If the parity is none, then the stop bits will be programmable to 1 or 2

NOTE14: The stop bits are fixed to 1 with even or odd parity. They are programmable to 1 or 2 only if the parity is none.

NOTE: MODBUS standard requires two stop bits with no parity.

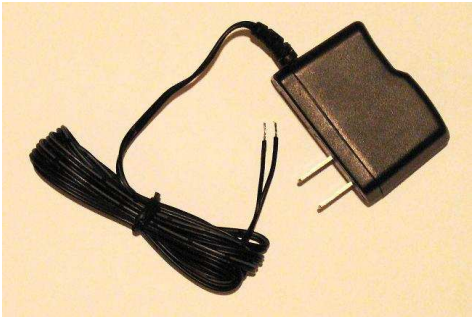
7. POWER SUPPLY

GDA8M1 can be powered by any DC power supply providing high enough voltage and current.

It is strongly recommended using an isolated power supply.

The voltage must be at least 5VDC higher than the minimum voltage for the sensor at any analog input.

An excellent choice for a power supply is the adapter GPS124 on the picture below that we offer. It provides 24VDC / 250 mA regulated and filtered. It also has high isolation, protection and small size.



8. ORDERING

For ordering please use the following G Instruments part numbers:

Description	*G Instruments PN*
GDA8M1, 8 mixed signal inputs data acquisition board	30246
GPS124 power supply, 115VAC to 24VDC/0.25A, regulated	30138

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