A8911-23 Modbus Pulse Input Module
Obvius, LLC

Installation and Operation Manual

Date Nov 3, 2011

Copyright Information

Copyright © 2006 - 2011 by Obvius

Obvius and **AcquiSuite** are trademarks of Obvius Holdings LLc

Other brand and product names are trademarks or registered trademarks of their respective holders.

U.S. Government Restricted Rights: Use, duplication or disclosure by the Government is subject to restrictions set fourth in subparagraph (a) through (d) of the Commercial Computer Restricted Rights clause at FAR 52.227-19 when applicable, or subparagraph (c) (1) (ii) of the Rights in Technical Data and Computer Software clause at DFARS 252.227-7013, and in similar clauses in the NASA FAR Supplement.

Limited Warranty

OBVIUS IS PROVIDING THIS WARRANTY IN LIEU OF ALL OTHER EXPRESS OR IMPLIED WARRANTIES, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. THIS WARRANTY IS BUYER'S EXCLUSIVE REMEDY FOR ALL CLAIMS AGAINST OBVIUS. OBVIUS SHALL NOT BE LIABLE FOR ANY CONSEQUENTIAL OR INCIDENTAL DAMAGES. OBVIUS'S TOTAL LIABILITY FOR ALL CLAIMS SHALL BE LIMITED TO THE PRICE PAID FOR ITS PRODUCT.

Obvius promises buyer that any standard product manufactured by Obvius shall be free from all material defects in design, material, or manufacturing for a period of 2 years from the manufacture date; provided, however, that the warranty shall not extend to ordinary wear and tear or to normally replaceable components (e.g., batteries). During the warranty period, Obvius may repair or replace (in its sole discretion) any product suffering from a warranty defect and returned freight prepaid by buyer, with no charge to buyer for any warranty repair or replacement. The warranty shall remain in full force and effect for such 2 year period, provided that the product: (1) was installed, operated, and maintained properly; (2) has not been abused or misused; (3) has not been repaired, altered, or modified outside of Obvius's authorized facilities; (4) has not been sold subject to other warranty terms specified at the time of sale; and (5) is still owned by the original purchaser. This warranty provides specific legal rights that may be varied by state law. Obvius's products are not designed for life or safety applications.

Product Application Limitation

Obvius products are not intended for use in critical applications such as nuclear facilities, human implantable devices or life support. Obvius is not liable, in whole or in part, for any claims or damages arising from such uses.

Obvius strongly believes in continuous improvement, therefore we must reserve the right to change specifications and product offerings without notice. Where possible, we will substitute products with equivalent functionality when necessary.

NOTICE
● This product is not intended for life safety applications. ● Do not install this product in hazardous or classified locations. ● The installer is responsible for conformance to all applicable codes.

FCC Part 15 Information

Note: This equipment has been tested by the manufacturer and found to comply with the limits of a class A digital device, pursuant to part 15 of the FCC rules. These limits are designed to provide reasonable protection against interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense. Modifications of this product without the express authorization of Obvius nullify this statement.

Obvius
3300 NW 211th Terrace
Hillsboro, OR 97007
ph: 503-601-2099
www.obvius.com

Table of Contents

Markings and Symbols:

WARNING: A potential risk exists if the operating instructions are not followed

General Warning Symbol: This symbol indicates the need to consult the operating instructions provided with the product.

This symbol indicates the presence of electric shock hazards.

This symbol indicates: Do not apply to or remove from hazardous live conductors.

Direct Current symbol.

Overview

The A8911-23 is designed for pulse counting applications where large number of pulse output devices need to be connected to a Modbus network. The A8911-23 will count contact closures on 23 separate inputs and store the totalized pulse count internally using non-volatile memory. The pulse count totals are then read using the RS485/Modbus protocol. Applications include reading gas/water/electric meters in common building areas for energy information and reporting purposes.

Features and Specifications

Processor	Arm7, field upgradeable firmware.
LED	23 input status LEDs (red), 2 Modbus TX/RX (yellow), 1 power/alive status. (green)
Protocols	Modbus/RTU
Power Supply	9VDC to 30VDC, 200mA, Required (not included)
	The unit is to be sourced by a NEC Class 2 power supply, or Listed ITE power supply marked LPS and rated from 9 to 30Vdc, 200 mA minimum but not to exceed 8A
Serial Port[1]	RS-485 two wire, 19200 or 9600 baud. N81
Pulse Inputs[1]	23 independent pulse count inputs.
	Intended for use with isolated dry contact outputs.
	Pulse rate/width user selectable to 10hz, 50hz or 100hz.
	Pulse rate option: 10hz, minimum pulse width 50ms
	Pulse rate option: 50hz, minimum pulse width 10ms
	Pulse rate option: 100hz, minimum pulse width 5ms
	Contact closure threshold 100Ω to 2.5kΩ user selectable
	Pulse count values are stored in non-volatile memory.
Isolation[2]:	Pulse inputs, power input and RS485 are non-isolated.
Environmental	Pollution Degree 2, Altitude up to 2000M.
	For indoor and outdoor use when used in an appropriate enclosure.
	The A8911-23 must be mounted inside a NEMA rated electrical enclosure for safety and isolation requirements.
	North America: Indoor, temperature -30º - +70ºc, 0 - 95% humidity, non-condensing. [4]
Safety	UL61010 Recognized[4]
	File: E320540 (Model A8911-23)
EMC	FCC CFR 47 Part 15, Class A
	EN 61000, EN 61326
Size	4.13" x 3.39" x 1.18" (105mm x 86mm x 30mm)
Mass	3.7 oz (105 g)

[1] inputs are intended for low voltage NEC Class 2 or equivalent outputs.

[2] if the product is used in a manner not specified by the manufacture, the protection provided by the equipment may be impaired.

[4] Devices manufactured before Nov 1, 2011 are rated to
0 ~ 50c, and are not UL recognized.

Installation Checklist

The following components are required for a complete A8911-23 I/O module installation:

- A8911-23 I/O module
- Modbus/RTU master device such as an AcquiSuite™ A8812 server
- Pulse output meter
- Power supply: 24VDC typical. (9VDC to 30VDC ok)
- Wire. Typically 18 to 24 gauge [3] for pulse meter connection.
- 2 wire, twisted pair with shield for Modbus/RS485 connection. (Belden 1120A or equivalent)[3]
- Optional: Termination resistor (120 ohm) for long RS485 runs over 200ft.

[3] Wire connected to pulse meters inside high voltage panels should have an insulation rating in excess of the service voltage. Consult a licensed electrician and local building codes for further requirements that may apply.

Electrical Connections
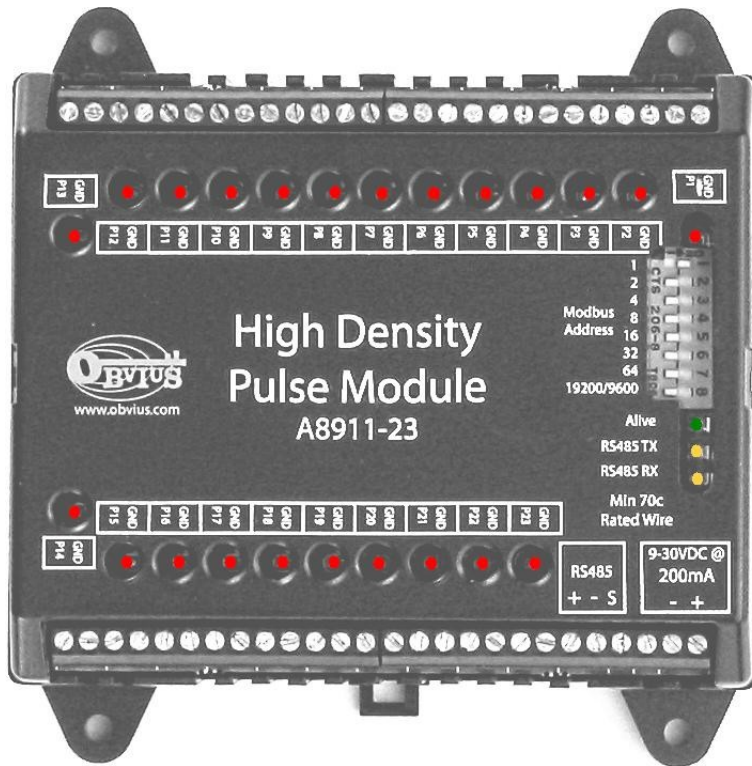
Hardware Installation

1) Mount the A8911-23 on a DIN-Rail or appropriate mounting enclosure.

2) Attach the power supply to the input terminals on the A8911-23 module.

3) Turn on the power supply. Confirm the green Alive LED starts blinking. Turn off the power to the module.

4) Attach the RS485 +, - and shield wires to the A8911-23 module. Attach the other end of the RS485 line to the Modbus master device, such as an AcquiSuite. Be careful to observer polarity on both ends of the RS485 connection. RS485 wiring runs should be limited to 4000 ft.
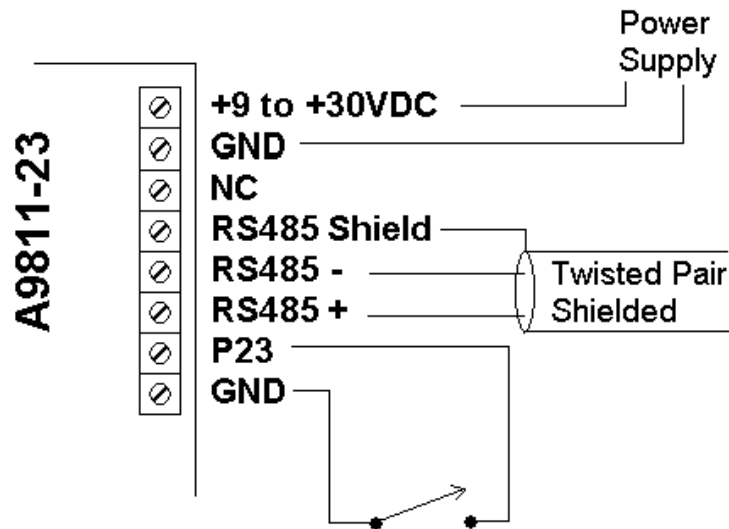
5) Set the Modbus address dipswitches and baud rate dipswitch. For more information on the switch options, see the section below for configuration.

6) Turn on the power supply. Confirm the green Alive LED starts blinking. Also check the RS485 yellow LEDs.
- If the A8911-23 receives any Modbus traffic on the RS485 port, the yellow RX led should blink.
- If the A8911-23 receives a Modbus query that is addressed to it specifically, the yellow TX LED should blink and it will respond to the query.

If you are using an AcquiSuite Data Acquisition Server, the A9811-23 should appear in the Modbus device list after about 2 minutes. Click on the device, and select "Configure" to give the A8911-23 a logical name. This will allow the AcquiSuite to begin logging data for the device.

7) With the power disconnected, attach the pulse input lines to the pulse terminals. Each pulse input should have a GND and a P# terminal. If the pulse output device is polarity sensitive, attach the pulse – terminal to the A8911-23 GND terminal, and the pulse + terminal to the A8911-23 P# terminal.   The A8911-23 provides 3-5 volts on the P# terminal for sensing. The remote pulse output device must not supply voltage to the terminals.

Wiring runs to pulse input terminals should be kept as short as possible. Wiring runs longer than 200 ft should be avoided.   Wiring should avoid proximity to sources of electrical noise such as running in parallel to electrical cable, and VFD systems.

8) Power up the A8911-23. The Input LEDs for each connected input should now blink. The input LED will be on when the contacts are closed.

⚠ **WARNING: After wiring the A8911-23, remove all scraps of wire or foil shield from the electrical panel. This could be dangerous if wire scraps come into contact with high voltage wires.**

Configuration

Modbus Address: Before the A8911-23 can be used, you must set the Modbus address of the A8911-23. This address must be unique among all Modbus devices in the system. The A8911-23 supports address 1 through 127.

Select an address, and set the dipswitches to match.

The sum of the value of the switches is the address. In the example to the right, address 52 is set by placing switch 4, 16 and 32 to the on position.

Note: 4 + 16 + 32 = **52**

Baud Rate: This option sets the serial port speed for the RS485 port.   Set this option to "off" for 19200. Set the switch to "on" for 9600 baud.
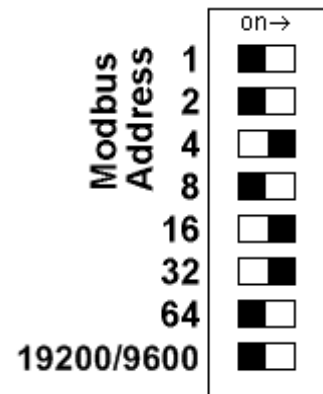
Operation

The device should power up and be ready in a few seconds. The LEDs should blink in the following manner.

● The green "Alive" LED should start to blink approximately once per second.
● The yellow RS485 TX and RX LEDs will blink for local Modbus activity.
● The red input status LEDs will blink when input contact closures are detected. Input status LEDs are adjacent to the corresponding input screw terminals.

If the A8911-23 is attached to an AcquiSuite Data Acquisition Server, you will need to configure each pulse input with a Name, Engineering Unit, and Multiplier.

Troubleshooting

Pulse count not incrementing:

Check the input LED for the specific input that is not working. The LED should blink when the pulse meter closes the contact output. If th not blinking, try bridging the input terminals with a short piece of wire to confirm the LED comes on .

Try bridging the terminals at the other end of the pulse wiring run. This will confirm there are no breaks in the wire.

Verify the pulse output device is operating.

Disconnect the A8911-23 input and use a hand held digital meter and measure resistance of the pulse output device. Verify that the pulse output device is operational and the contact closure reads less than 1000 ohms when closed. For high resistance pulse devices such as intrinsic barriers, the "contact closure threshold" register may need to be configured to a larger value. The default is 1k however up to 2.5k is allowed.   If using the AcquiSuite data acquisition server, use the advanced configuration page of the A8911-23 in the Modbus/device list to set this option.Modbus registers

Register Listing

The A8911-23 responds to the following Modbus/RTU functions:

> 0x11   Report slave id.
> 0x03   read holding registers (multiple)
> 0x06   preset single register

All Modbus registers are read-only unless otherwise noted. Registers listed as "NV" are options that are stored in non-volatile memory and will be preserved when power is removed from the device.
Modbus 40xxx registers (read registers)

```
Data points:
------- ------- ------- ------------------
offset  point   type    desc

0       40001   UINT32  pulse count 1 MSW (NV Mem, all pulse counts)
1       40002   UINT32  pulse count 1 LSW
2       40003   UINT32  pulse count 2 MSW
3       40004   UINT32  pulse count 2 LSW
4       40005   UINT32  pulse count 3 MSW
5       40006   UINT32  pulse count 3 LSW
6       40007   UINT32  pulse count 4 MSW
7       40008   UINT32  pulse count 4 LSW
8       40009   UINT32  pulse count 5 MSW
9       40010   UINT32  pulse count 5 LSW
10      40011   UINT32  pulse count 6 MSW
11      40012   UINT32  pulse count 6 LSW
12      40013   UINT32  pulse count 7 MSW
13      40014   UINT32  pulse count 7 LSW
14      40015   UINT32  pulse count 8 MSW
15      40016   UINT32  pulse count 8 LSW
16      40017   UINT32  pulse count 9 MSW
17      40018   UINT32  pulse count 9 LSW
18      40019   UINT32  pulse count 10 MSW
19      40020   UINT32  pulse count 10 LSW
20      40021   UINT32  pulse count 11 MSW
21      40022   UINT32  pulse count 11 LSW
22      40023   UINT32  pulse count 12 MSW
23      40024   UINT32  pulse count 12 LSW
24      40025   UINT32  pulse count 13 MSW
25      40026   UINT32  pulse count 13 LSW
26      40027   UINT32  pulse count 14 MSW
27      40028   UINT32  pulse count 14 LSW
28      40029   UINT32  pulse count 15 MSW
29      40030   UINT32  pulse count 15 LSW
30      40031   UINT32  pulse count 16 MSW
31      40032   UINT32  pulse count 16 LSW
```

```
32     40033   UINT32  pulse count 17 MSW
33     40034   UINT32  pulse count 17 LSW
34     40035   UINT32  pulse count 18 MSW
35     40036   UINT32  pulse count 18 LSW
36     40037   UINT32  pulse count 19 MSW
37     40038   UINT32  pulse count 19 LSW
38     40039   UINT32  pulse count 20 MSW
39     40040   UINT32  pulse count 20 LSW
40     40041   UINT32  pulse count 21 MSW
41     40042   UINT32  pulse count 21 LSW
42     40043   UINT32  pulse count 22 MSW
43     40044   UINT32  pulse count 22 LSW
44     40045   UINT32  pulse count 23 MSW
45     40046   UINT32  pulse count 23 LSW

System information points:
-------  -------  -------  ------------------
offset  point   type    description

1000   41001   UINT16  Serial Number (bytes 1,2) (our serial number)
1001   41002   UINT16  Serial Number (bytes 3,4)
1002   41003   UINT16  Serial Number (bytes 5,6)
1003   41004   UINT16  firmware version major
1004   41005   UINT16  firmware version minor
1005   41006   UINT32  mfg date MSW
1006   41007   UINT32  mfg date LSW
1007   41008   UINT32  up time (seconds) MSW.
1008   41009   UINT32  up time (seconds) LSW.
1009   41010   UINT16  Our modbus address
1010   41011   UINT16  Hardware Version major (8911)
1011   41012   UINT16  Hardware Version minor.  HighByte=pcb-rev(0=rev A, etc),
                        lowbyte = part-rev (0=rev A, etc)
1012   41013   UINT16  (NV/r/w) contact closure threshold in ohms, default 1000 =
                        1kohm. 100-2550 ohms allowed.
1013   41014   UINT16  (NV/r/w) contact closure speed, pulse speed:
                        0=10hz/default, 1=50hz, 2=100hz
1014   41015   UINT16  (NV/r/w) Pulse KYZ flag bitmap.  channels 1-16   0x01 =
                        pulse1 kyz mode, 0x02 = p2, etc.
1015   41016   UINT16  (NV/r/w) Pulse KYZ flag bitmap.  channels 17-23
1016   41017   UINT16  power supply voltage monitor. scale: x100
1017   41018   INT16   pcb temperature monitor. scale: x100
1018   41019   UINT16  5V internal power supply voltage monitor. scale: x100
1019   41020   UINT16  RS485 baud rate.  2=9600, 3=19200.
1020   41021   UINT16  reason for reboot.  0x01=POR, 0x02=EXTR 0x04=WDTR
                        0x08=BODR, 0x8000=WDTOF
```

Modbus function 0x11 Slave ID response will report the following:

```
"Obvius, A8911-23, pulse counter, 23 channel",  id=47
```

Register Functions

Pulse Count: The pulse count is stored as an unsigned 32bit integer. This allows for 2^32 pulses (4.2billion) to be counted before rollover. On Modbus systems that do not allow you to read 32bit values, you can calculate the pulse count as follows:

count = (MSW * 65536) + LSW

or

count = (MSW << 16) | LSW   [bit shift high order word by 16 bits and xor against low order word]

Pulse count registers accumulate a total number of pulses received on each pulse input. The pulse count totals always increment and can not be cleared or set to an arbitrary value to prevent tampering.   All pulse count totals are stored in non-volatile memory to preserve counts during power failure.   The unsigned 32 bit counter values can accumulate up to 4.29 billion (2^32) pulses before rollover.

All 32 bit data point values are encoded in 2 Modbus registers (16bits each). Modbus master systems should always query the A8332-8F2D using a single query to read an entire block of registers. Never use two queries to read one register and then combine the two results into a single 32 bit value. Doing so will allow the pulse count to increment in the middle of the two Modbus queries, and will cause intermittent data readings that are incorrect.

For example, a pulse input has a count of 65534. This is represented as a 32 bit hex number 0x0000FFFE. The first 4 digits are the MSW register, the second 4 digits are the LSW register. The Modbus Master reads the first (MSW) register and gets 0x0000. In between the two readings, the pulse input counts 2 more pulses, making the total 65536 or 0x00010000 in hex. Next the Master reads the second (LSW) register and gets 0x0000. When the two registers are combined, the result is 0x00000000. The proper way to handle this situation is to simply read both registers in a single Modbus query.

A8911-23 Firmware Update

From time to time, Obvius may release firmware updates with additional features and system changes. To find out what firmware your A8911-23 has installed, read the firmware version register with a Modbus utility, or use the "Advanced configuration" page in the AcquiSuite setup menu.   Firmware update files may be obtained from Obvius technical support.

The firmware update process requires an RS232 serial port and a windows computer to run the firmware update utility. Before starting this process, verify your computer has a serial port available. You may need to deactivate other software such as the palm pilot utility or ups monitor software. USB connected serial ports may be used, however these are not as fast or reliable as standard computer serial ports and may fail to upgrade the firmware correctly.

To update the firmware, use the following procedure.

Step 1: Install the Philips LPC2000 software as provided by Obvius.

Step 2: Remove power and DC load current from the A8911-23. Power can be disconnected by removing the +24V wire from the screw terminal from the A8911-23 power connection.

**WARNING: Disconnect power and lock-out all power sources during installation.
DO NOT CONNECT RS232 PORT WITH CURRENT INPUTS LIVE**

Step 3: Remove the plastic lid from the A8911-23 module. The plastic lid is held in place with two plastic clips, one on each side.

Step 4: Attach the A8911-23 to your computer with an RS232 serial cable. The A8911-23 programming connector is the 9 pin RS232 connector on the top of the device.

Step 5: Power up the power supply to the A8911-23. The Green Alive LED should light up and blink.

Step 6: Run the LPC2000 Flash Utility. The following screen will be displayed.
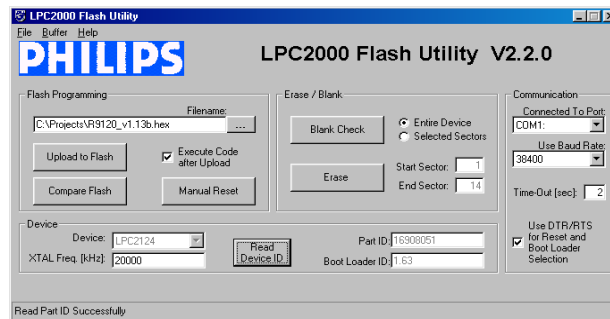
Step 7: Set the following communications options:
> COM1 or COM2 depending on your computer serial port.
> Use baud rate: 38400 or slower.
> Check "Use DTR/RTS for Reset"
> XTAL Freq[kHz] = 14745

Step 8: Click the "Read Device ID" button. The PartID and BootLoaderID fields will be shown if successful. Also, the "Device" dropdown menu should switch to LPC2131.   The bottom of the window will display "Read Part ID Successfully."

Step 9: Click the "Filename" "..." button. A dialog box will appear. Locate and select the A8911-23 firmware image file. In the example above, this is named "A8911-23_v1.07.hex".

Step 10: Click the "Erase" button. This will remove the existing firmware from the A8911-23 device.

Step 11: Click the "Upload to Flash" button.   The firmware update will start, and a blue progress bar will be shown across the bottom of the screen. While the upload is in progress, the green Alive LED on the A8911-23 will stop blinking and stay on solid.

Step 12: when the update is complete, disconnect power from the A8911-23. Remove the RS232 serial cable.

Step 13: place the lid back on the body of the A8911-23. The lid should snap into place.

Step 14: Re-attach any signal and data connections. Power up the A8911-23. The new firmware should now operate.   To confirm the new firmware is installed, use the AcquiSuite device details page, click the "configure" button, and then the "Advanced" button. The firmware version number will be displayed on the lower right side of the advanced details page.

Mechanical Drawings

DIN-Rail (EN50022) mount package: Width 105mm (6 modules)