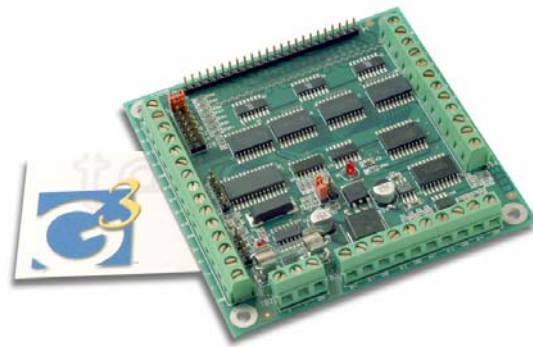


Model G301

MODBUS REMOTE I/O (RIO)



USER DOCUMENTATION

INTRODUCTION

G3 Technologies, Inc. offers the Model G301 RIO (Remote I/O) board as a low cost single board solution for expanded I/O and remote I/O requirements in SCADA and Process Control applications. The G301 uses industry standard RS485 data communications and Modbus Slave RTU protocol. It is especially suited for applications requiring low power and/or environmental tolerance, including SOLAR powered applications. It can also be paired with a model G306C RioLink Wireless Modem for Wireless I/O apps.

The G301 board is also designed to install directly into a VAREC Series 1650 or 1750 Tank Gauge encoding head (or compatible unit) with direct connection to the Gray Code signal. In addition, it supports the additional analog and digital I/O requirements for a typical Tank Monitoring application.

FEATURES

- Serial Port: RS485, Modbus slave RTU protocol, 8 bit device address (hdwr jumpers).
- I/O: 24 Digital Inputs, 8 Digital Outputs, 4 Analog Inputs plus internal Battery Voltage monitor (AI-5)
- Power Input: 10-30Vdc, approx. 20Ma
- Operating temperature: -40 to 80 degrees C.

APPLICATIONS

- I/O Data Concentrator for PLC based systems
- Discrete I/O termination for stand-alone PC based controller
- General purpose SCADA (remote monitoring and control)
- Solar powered systems

G301 RTU BOARD - TECHNICAL SPECIFICATIONS:

PHYSICAL:	
PC BOARD	3.8" x 3.8" x 0.6" overall, multi-layer, SMT components
MOUNTING	Panel mount: #6 screw holes 4 corners, 3.4" x 3.4" pattern
FIELD WIRE CONNECTIONS	Power, Serial Data port, Analog Inputs, Digital Outputs, and 8 ea. Digital Inputs are terminated using fixed screw terminals, 0.2" spacing. Pluggable screw terminals optional. Remaining Digital Inputs (16 ea.) are on a single row 24 position pin header.
POWER:	
POWER SOURCE	Solar/Battery or DC power supply. 5x20mm Fast Blow 2 amp Fuse on-board.
INPUT VOLTAGE	10 to 30 volts DC normal operation
INPUT CURRENT	Approx. 20 mA w/o Digital Outputs active
DISCRETE I/O:	
DIGITAL INPUTS (DI)	24 total. 16 on pin header (for Varec gray code, or general use) and 8 ea. on screw terminals. Contact closure to P.S. Common (Gnd). Inputs are active low and are non-latching. 0.5mA active.
DIGITAL OUTPUTS (DO)	8 ea. FET sink (open Drain) drivers. Rated for 1 amp continuous per channel. Total current drain limited by 2 amp on-board fuse.
ANALOG INPUTS (AI)	5 ea. single-ended 0-5 volt inputs. 12 bit resolution. Overall accuracy of 0.25% FS. Over-voltage tolerance of +/-30VDC. AI 1-4 on screw terms along with power supply voltage for transducer excitation. AI 5 is used internally to monitor supply voltage, 0-30Vdc range.
SERIAL COMMUNICATIONS:	
HOST PORT	RS485 (multi-drop) 2 wire or 4 wire. Async 8N1. Baud rate selection 1200, 2400, 4800, 9600 with two hardware jumpers. (9600 baud standard).
CORE SYSTEM:	
MICROPROCESSOR	MicroChip PIC18F876 processor, 18MHz, memory internal
FLASH MEMORY	8KB internal, in-circuit programmable (1x5 pin header)
DIAGNOSTICS	Power Input LED, and Transmit Data (Tx) LED. Watchdog timer in software.
SOFTWARE	Standard firmware supports Modbus Slave RTU read and write commands for supporting the raw I/O data described above. See software definition below.
MISCELLANEOUS:	
RTU ADDRESSING	8 bit, hardware strapped
OPERATING TEMPERATURE	-40 to 80 degrees C. with 5% to 95% non-condensing humidity
TRANSIENT PROTECTION	All power, serial port and I/O connections meet or exceed minimum standards for ESD, EFT, and Surge withstand per the international IEC 1000-4 standards
CERTIFICATIONS	FCC Part 15, Class A

HARDWARE - G301 PCB:

FIELD WIRING TERMINATIONS

TB1 Digital Inputs (DI) 1-8: Screw terminals for dry contact closure to GND

TB1-1	DI 1	TB1-6	DI 5
TB1-2	DI 2	TB1-7	DI 6
TB1-3	DI 3	TB1-8	DI 7
TB1-4	DI 4	TB1-9	DI 8
TB1-5	GND	TB1-10	GND

TB1 RS485 Serial Comm Port: Screw terminals for 2 or 4 wire network. See Program Jumper Definitions below for 2 or 4 wire configuration and for baud rate selection.

TB1-11	Rx +	TB1-13	Tx +
TB1-12	Rx -	TB1-14	Tx -
		TB1-15	GND

TB2 RTU Power Input: Screw terminals for 10-30 VDC (Fused at 2A)

TB2-1	Positive (+) Power Input
TB2-2	Negative (-) Power Input (GND)
TB2-3	Earth Ground (GND)

TB3 Analog Inputs (AI) 1-4: Screw terminals for signal input and transducer excitation voltage (BAT) output. (BAT is the Power Input voltage supplied through the on-board fuse.)

TB3-1	BAT	TB3-6	BAT
TB3-2	AI 1 Signal	TB3-7	AI 3 Signal
TB3-3	AnGND	TB3-8	AnGND
TB3-4	AI 2 Signal	TB3-9	AI 4 Signal
TB3-5	AnGND	TB3-10	AnGND

TB4 Digital Outputs (DO) 1-8: Screw terminals for FET Sink Drivers (to GND), and excitation voltage (BAT). FET Drivers rated at 1 amp each, with total current limited by on-board 2 amp FUSE.

TB4-1	DO 1	TB4-4	DO 3	TB4-7	DO 5	TB4-10	DO 7
TB4-2	BAT	TB4-5	BAT	TB4-8	BAT	TB4-11	BAT
TB4-3	DO 2	TB4-6	DO 4	TB4-9	DO 6	TB4-12	DO 8

P1 Digital Inputs (DI) 16 ea: 24 pin single row Pin Header for direct connection of 16 bit Gray Code in VAREC Tank Gauge system. Can also be used as discrete Digital Inputs (dry contact to gnd).

P1-6	Bit 0	P1-5	Bit 8	P1-1	GND
P1-8	Bit 1	P1-7	Bit 9	P1-2	GND
P1-10	Bit 2	P1-9	Bit 10	P1-4	N/C
P1-12	Bit 3	P1-11	Bit 11	P1-20	N/C
P1-14	Bit 4	P1-13	Bit 12	P1-21	same as TB1-1
P1-16	Bit 5	P1-15	Bit 13	P1-22	same as TB1-2
P1-18	Bit 6	P1-17	Bit 14	P1-23	same as TB1-3
P1-3	Bit 7	P1-19	Bit 15	P1-24	same as TB1-4

PROGRAM JUMPER DEFINITION

- J1 8 bit device Address. Inserted strap enables the corresponding bit. Bit values are marked on the PCB (1, 2, 4, 8, 16, 32, 64, 128). The sum of the values of the inserted straps is the Address.
- J3-4 Baud Rate selection. These jumpers are read by the microprocessor on power-up, and are used to select one of four baud rates (neither =1200, J4=2400, J3=4800 & both=9600 baud). Std is 9600.
- J5-6 RS485 2-wire configuration. These two jumpers are inserted to connect the Rx and TX pairs together on the RS485 port. This configures the RS485 port for 2-wire operation, rather than 4-wire. When configured for 2-wire, the RS485 wire pair can be terminated either to the +/- Rx terminations or to the +/- Tx terminations.

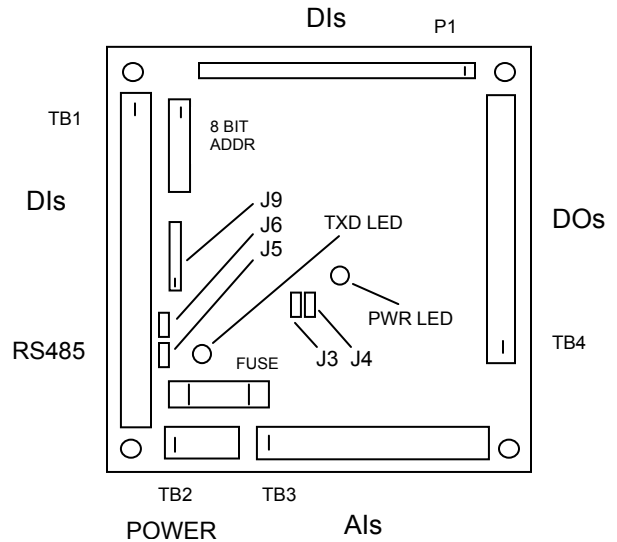


FIG. 1: G301 PCB Terminations

J9 This pin header is used only for connection of an In-Circuit PIC Processor FLASH Programmer. Since the software is factory installed, this connector will not normally be used in the field. However, it does allow qualified personnel to perform in-circuit software modification when required. Pin 2 is cut off.

SOFTWARE DEFINITION:

FIRMWARE VERSION 2.0

Modbus Implementation

The Modbus Slave RTU mode protocol is used. Communications parameters are eight data bits, no parity bit, and one stop bit (8N1).

Baud rate for the serial comm port is selectable with straps J3 and J4 on the PCB. The following baud rates are supported: Neither jumper = 1200, J4 = 2400, J3 = 4800, both = 9600.

The Modbus slave address is read from the 8-bit address straps located on the board.

Function code 04 (Read Input Registers) and function code 06 (Single Register Write) are supported. If the Modbus master attempts to perform a function not listed, the slave returns an Illegal Function exception response.

Consecutive register reads return values for Digital Inputs from the pin header, Digital Inputs from the screw terminals, Analog Inputs 1 through 5 respectively, followed by the software version number.

The fifth analog channel monitors the power supply input voltage through an on-board resistor divider network. Zero value equals 0.0 volts DC, and 4095 value equals 30.0 volts DC.

The software returns raw analog and digital input values. No data conversion is done in the unit. Data values are right justified in the register.

Each register is a 16-bit value. The data is formatted with the high byte followed by the low byte. Unimplemented bits are zero-filled.

Register numbers are zero based.

The controller returns an Illegal Data Address exception response if the Modbus master attempts to read a register that is not in the register map listed below.

Data integrity checking uses 16 bit CRC that follows the CRC-CCITT specification.

The version number high byte contains the major version number and the low byte contains the minor version number. For example, if register 1008 contains 020b hex, it can be viewed as version 2.11.

Modbus Register Map

<u>Register #</u>	<u>Description</u>	<u>Read/Write</u>
1001	Digital Input bits (pin header)	Read Only
1002	Digital Input bits (screw term)	Read Only
1003	Analog Input #1	Read Only
1004	Analog Input #2	Read Only
1005	Analog Input #3	Read Only
1006	Analog Input #4	Read Only
1007	Analog Input #5	Read Only
1008	Code Version #	Read Only
4001	Digital Output bits	Write Only

Self Test Mode

The Self Test Mode of operation is used primarily for bench testing the unit. However, this mode can also be used to test and calibrate end-device signals since the I/O data can be repeatedly displayed on a Laptop using HyperTerm.

In this mode, the board repeatedly transmits the contents of the 8 defined data registers (1001-1008) out the RS485 port in ASCII format. Also, expecting a loop-back on the data, it checks to see that the received data matches what was transmitted. If no match is detected, the routine halts.

With a Laptop running HyperTerm, the ASCII data from the G301 board can be displayed by connecting the Laptop's "RX" line on its RS232 serial port to the "TX-" terminal on the G301's RS485 port (along with connecting Gnd between the laptop and the G301). HyperTerm must be set up with the same baud rate selected as on the G301 board, and set to a word structure of 8N1 (eight data bits, no parity, one stop bit).

Setup: Pryor to powering the board, place jumpers on J5, J6, and all 8 RTU address jumpers. Powering up the RTU board with address 255 selected puts it into Test Mode operation (Note that the Modbus standard defines 255 as an invalid system address). J5 & J6 connects TX to RX for the loop-back check.

Windows based DEMO routine

For demonstration purposes only, a simple Windows based routine is available from G3 Technologies that will communicate with the G301 using Modbus. It will interrogate the G301 using a selected RTU address, and display the sent and returned data. It will also send commands to activate the Digital Outputs.

Connection of the Laptop's RS232 Serial Port to the G301's RS485 Serial Port (without requiring an RS232-to-RS485 adaptor):

1. Remove J5 & J6 on the G301 so that TX is not looped back to RX.
2. On the G301's serial port, use wire to connect RX+ (TB1-11), TX+ (TB1-13) and Gnd (TB1-15) together.
3. Connect the Laptop's Gnd (DB9 pin 5) to the G301's Gnd (TB1-15).
4. Connect the Laptop's TX (DB9 pin 3) to the G301's RX- (TB1-12)
5. Connect the Laptop's RX (DB9 pin 2) to the G301's TX- (TB1-14)

PART NUMBER FOR ORDERING:

G301-01 Standard assembly: Modbus read/write, all I/O supported, 2A Fuse.

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