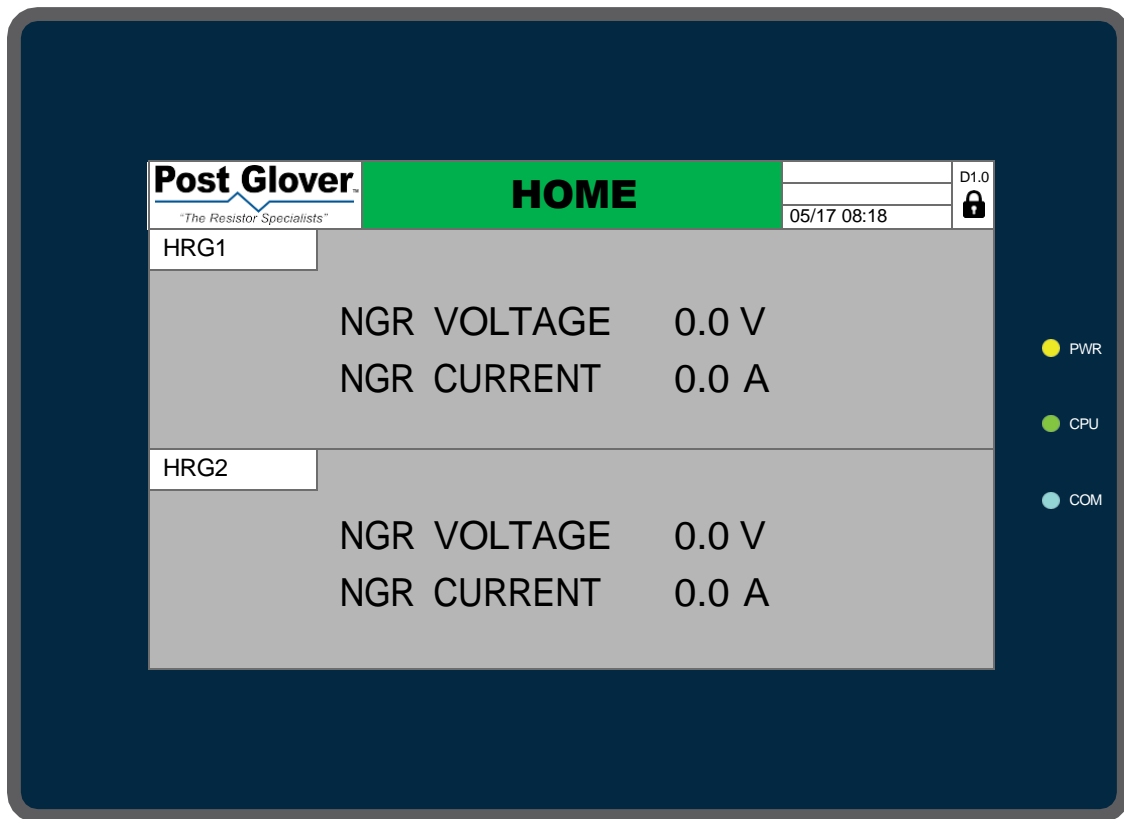


# SmartPulse Low Voltage High Resistance Grounding System

Communication Manual with  
Modbus Memory Map



# SMARTPULSE™ COMMUNICATION MANUAL

Revision	Date	Changes
HR503-23	03/01/2023	Original Release
HR503-24	03/1/2024	Updated Modbus Memory Map Tables
HR503-24.A	07/11/2024	Added NGR Failed to Modbus Memory Map Table
HR503-24.B	9/23/2024	Added Summary Alarm to Modbus Memory Map Table

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## 1.0 Introduction

This manual describes the communication ports of the SmartPulse High Resistance Grounding System and the information that is accessible from them. The manual and the terminology used assume that the user has a basic understanding of the communication technologies and protocols implemented.

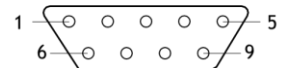
## 2.0 Communications Ports

This section presents information on the communication ports available on the SmartPulse HRG. Changes to the HRG’s communications ports should only be made by qualified technicians. The HRG is provided with serial RS- 485 port by default and has an option for an Ethernet port. Single units can be configured as RS-485 only or RS- 485 and Ethernet. Dual units can only be configured as RS-485 and Ethernet.

The serial ports are as follows:

1. COM 0/2: Not Configured
2. COM 1/CAN: This port is located on the back of the HMI and is configured as RS-485. When power cycles, the HMI will load the latest port 1 “RS-485 Network ID”. COM 1 is configured as follows:
  - a. 1 channel RS-485, no galvanic isolation, 1200 to 187,500 bps baud rate (default 115,200), -7 to +12VDC differential maximum control voltage, shielded twisted pair cable (EIA 485) and a maximum cable length of 4000 feet (1200 meters).
  - b. Port range is 1 to 127.
  - c. HMI DB-9 male connector pin-out. Flow control signals are not used
    - i. Pin #1: B signal (-).
    - ii. Pin #2: N/A
    - iii. Pin #3: N/A
    - iv. Pin #4: N/A
    - v. Pin #5: 0V reference.
    - vi. Pin #6: A signal (+).
    - vii. Pin #7: N/A
    - viii. Pin #8: N/A
    - ix. Pin #9: N/A
  - d. Signals are related to the controllers 0V; the same 0V is used by the power supply.
  - e. This port is not isolated. If the controller is used with a non-isolated external device, avoid potential voltage that exceeds ±10V.

HMI COM1 PIN-OUTS



HMI COM1 PIN-OUT ASSIGNMENTS	
PIN	ASSIGNMENT
1	RS - 485 “B”
2	N/A
3	N/A
4	N/A
5	SIGNAL GROUND
6	RS - 485 “A”
7	N/A
8	N/A
9	N/A

**FIGURE 1**  
RS - 485 PIN-OUT VIEW FACING COM1 PINS

3. Ethernet Switch ESW: Ethernet TCP/IP, RJ45 type connection, 10/100Mbps transmission speed, star network topology based on external hub/switch, Category 5 shielded twisted pair with a drop line length of up to 333 feet (100 meters) controller to hub/switch.
  - a. ESW RJ45 terminal
    - i. Pin #1: RX+
    - ii. Pin #2: RX-
    - iii. Pin #3: TX+
    - iv. Pin #6: TX-
  - b. Ethernet LEDs
    - i. Green LED (LNK): ON when link exists.
    - ii. Yellow LED (ACT): Blinks during RX/TX.

**Note:** Connection through the HMI Ethernet Ports Ethernet0 and Ethernet1 are not available. Connections are made through the Ethernet Switch.

## 2.1 Communication Port Settings

HRG communications to an external customer network is either by MODBUS RTU via RS-485 on HMI serial port COM 1 or via Ethernet TCP/IP on Ethernet Switch ESW RJ45 connection. MODBUS TCP/IP is via Ethernet, port 502 on the HMI.

### COM 1:

The default status of HMI COM1 is MODBUS RTU via RS-485. The default network ID number is 1. The default baud rate is 115,200.

To change the port 1 communication parameters for the controller, use the following procedure:

1. If the user is not already logged in, proceed to the Login screen and login as “Administrator”.
2. On the “RS-485” screen, select any of the “Baud Rate”, “Timeout” or “RS-485 Network ID” values for editing. Upon leaving the screen, all values are saved to the COM1 port configuration. The controller will need to reboot for the new configuration to take effect. These values will be reloaded into the controller any time power cycles.

### ETHERNET:

The IP address for the HMI uses the IP4 protocol. Each part is made up of four octets with decimal points between each octet. The customer must provide an IP address, subnet mask and gateway mask for communicating on the customer Ethernet network.

A default set of values is preloaded in the Smart Relay. When power cycles, the Smart Relay will load the latest Ethernet port configuration.

To change the Ethernet communication parameters for the Smart Relay, use the following procedure:

1. Press the “OK” button on the Smart Relay.
2. Press the “OK” button again when the menu pops up. (“STOP RUN” should be flashing)
3. Use the up arrow to select “YES” and press the “OK” button again.
4. Use the down arrow to select “SYSTEM INFORMATION” and press the “OK” button.
5. Use the down arrow to select “ETHERNET” and press the “OK” button.
6. Use the down arrow to select “IP ADDRESS” and press the “OK” button.
7. Use the arrow buttons to set the IP Address and press the “OK” button when complete.
8. Repeat for “SUBNET MASK” and “GATEWAY ADDRESS”.
9. When complete press the “ESC” button twice to get back to the main menu.
10. Use the arrow buttons to select “STOP RUN” and press the “OK” button.
11. Select “YES” and press the “OK” button.

12. Press the “ESC” button to return to the main screen.

A default set of values is preloaded in the HMI. When power cycles, the HMI will load the latest Ethernet port configuration. The default/updated values can be viewed from the “Comm Setting” screen.

To change the Ethernet communication parameters for the HMI, use the following procedure:

13. If the password is not already disabled or entered, proceed to the Login screen and login as “Administrator”.
14. On the “HMI COMMUNICATIONS SETTINGS” screen, select any of the “IP address”, “Subnet mask” or “Gateway mask” values for editing. Upon leaving the screen, all values are saved to the Ethernet port configuration. The controller will need to reboot for the new configuration to take effect. These values will be reloaded into the controller any time power cycles.

To change the Ethernet communication parameters for the HMI to connect to the Smart Relay(s), use the following procedure:

1. If the password is not already disabled or entered, proceed to the Login screen and login as “Administrator”.
2. On the “SMART RELAY COMMUNICATIONS SETTINGS” screen, select any of the “IP address” values for editing.
3. After 30 seconds the HMI & Smart Relay should reconnect and the System Reset button on the home screen will need to be pushed.

## 3.0 Modbus Memory Map

### 3.1 Introduction

To facilitate communications with external monitoring and control devices, the SmartPulse HMI uses the Modbus protocol. This protocol is provided in two implementations. For RS-485 networks, the controller uses the Modbus RTU protocol. For Ethernet-based networks, the controller uses Modbus TCP/IP. A thorough discussion of these protocols is beyond the purpose of this document. Since each customer installation will be different, the customer is referred to the specific installation documents for further details.

### 3.2 Modbus Memory Map

In this section, the Modbus memory map is provided. This map lists the HMI variable, the variable type (Bool, word, or double word), variable name, read command, and Modbus address. Based upon this information, it is the customer's responsibility to properly configure the message request to the controller. Since the SmartPulse HRG can be configured as a dual unit, HMI and Modbus addresses are provided for both units.

Variable Type	Variable Name	Read/ Write	Modbus Address	
			Device 1	Device 2
BOOL	OVERVOLTAGE	#03/NA	1000.00	2000.00
BOOL	OVERCURRENT	#03/NA	1000.01	2000.01
BOOL	NGR SHORT (RESISTOR SENSING)	#03/NA	1000.02	2000.02
BOOL	NGR OPEN (RESISTOR SENSING)	#03/NA	1000.03	2000.03
BOOL	SYSTEM NORMAL	#03/NA	1000.04	2000.04
BOOL	NGR OK	#03/NA	1000.06	2000.06
BOOL	NGR FAILED	#03/NA	1000.11	2000.11
BOOL	SUMMARY ALARM	#03/NA	1000.12	2000.12
BOOL	GROUND FAULT OUTPUT	#03/NA	1002.03	2002.03
BOOL	OPEN NEUTRAL (NEUTRAL SENSING)	#03/NA	1002.04	2002.04



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Variable Type	Variable Name	Read/ Write	Modbus Address	
			Device 1	Device 2
WORD (16 bit)	ALARM TYPE	#03/NA	1257	2257
DWORD (32 bit)	NGR Current x 10,000 at System Charging Current time-out	#03/NA	1602	2602
DWORD (32 bit)	NGR Voltage x 1,000 at System Charging Current time-out	#03/NA	1604	2604
DWORD (32 bit)	Test Resistor Current x 10,000	#03/NA	1606	2606
DWORD (32 bit)	NGR Current x 10,000	#03/NA	1608	2608
DWORD (32 bit)	NGR Voltage x 1,000	#03/NA	1610	2610

## Notes

To access the variables listed above, the controller responds to the following Modbus command numbers:

#03 - Read Holding Registers

NA - Write operation not available. Attempting to write to these variables may cause mis-operation of the SmartPulse HRG HMI or Smart Relay.

*Note: May need to add a register offset of 1 to read registers correctly depending on software being used by the customer.*

*Note: DWORD Variables (32-bit) are listed with least significant register first.*