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Peerless® PureFire®

PFC-625/750 MODBUS Application Supplement

NOTICE

These instructions are intended as a supplement to the Peerless® PureFire® Installation, Operation and Maintenance Manual and are intended for use by a **qualified** technician.

A. Scope

PFC-625, and PFC-750 boilers are factory equipped with a 975PB display adapter which allows external communication and control via the Modbus serial communication protocol. This document provides information about the data registers and values associated with the Modbus protocol.

- With the addition of a gateway device (stock code 54486), the control allows communication to BACnet™ MS/TP or BACnet™/IP protocols.

B. Specification

Table 1: 975PB Analog Interface Specifications

Communications Protocol	Modbus RTU
Default Dependent Address	0x01
Baud Rate	9600 bps
Data Length	8
Parity	None
Stop Bits	2
Physical Layer	RS485 (2-wire)
Modbus 1A Connection	19
Modbus 1B Connection	18

C. Wiring 975PB

Figure 1 shows the wiring of the 975PB display board on the PFC-625 and PFC-750 boiler. A twisted-pair cable that is 22AWG is used to connect from the labeled Modbus terminals 18 and 19, to Modbus or an approved Modbus Gateway device.

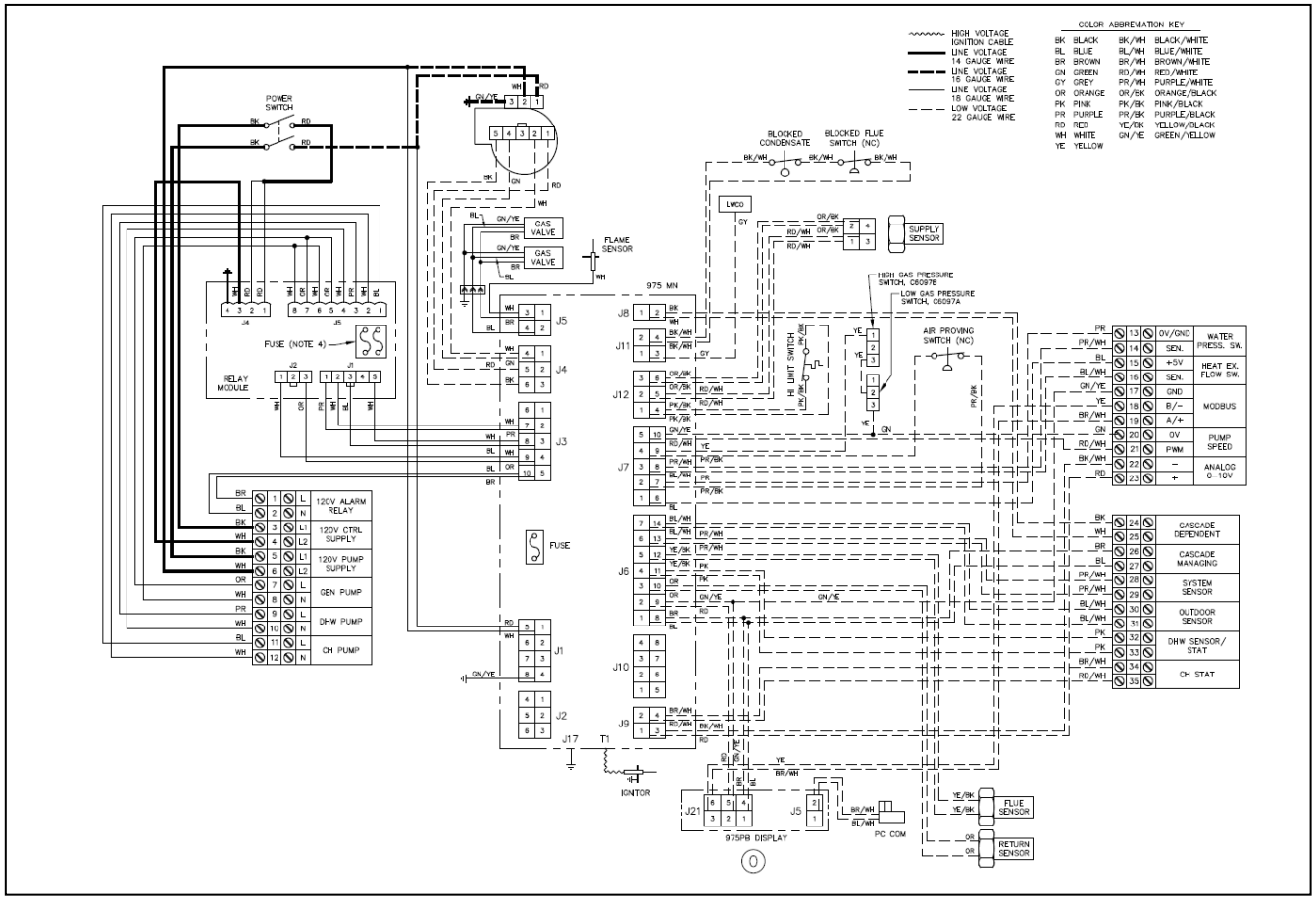


Figure 1: Wiring Schematic

D. Modbus Address

In order to communicate with several boilers, each boiler must be given a discrete Modbus Address.

- By default, this Modbus address is 1.
- To change the Modbus address, use the menu selection in the Menu under " Other Settings" for the "Modbus Address".
- The Modbus Address may be set to any value between 0 and 254.
- **Do not** change the Modbus stopbits, this must remain as 2 to communicate properly.

E. Modbus Operation

1. ***Holding Registers:*** Table 2 below shows the Modbus holding registers for the 975PB. Further tables detail potential values for some of these registers.

2. ***Writing Registers:*** To write to a register via Modbus, the Modbus device sends a Write Single Register command to the 900PB. The command consists of the device address, function code, register address, new value to be written, and checksum. The 900PB processes the request and returns an acknowledgment containing the same command, confirming that the write request was received. For registers requiring an enabled write action to a holding register, Register 99 must first be written with a value of 1. The desired register can then be updated by sending the appropriate write command within 3 seconds of enabling the write action.

Table 2 – 900MN Holding Registers

Holding Register		Access*		Parameter Name	Conversion	Range
Dec.	Hex.	Read	Write			
95	005F	X		Group Number		900
96	0060			Not Applicable		Not Applicable
97	0061	X		Device Type		20 = 900PB
98	0062	X		Unit Selection		0 = °C/°F; 1 = bar/psi
99	0063	X		Control Register		0 = Write Enable; 14 = Controller Reset
100	0064	X		State		See Table 3
101	0065			Not Applicable		Not Applicable
102	0066	X		Error Code (Managing)		See Table 4 & 5
103	0067	X		CH Setpoint		Temp is in C or F depending on Modbus Units
104	0068			Reserved		
105	0069			Reserved		
106	006A			Reserved		
107	006B			Reserved		
108	006C			Reserved		
109	006D			Reserved		
110	006E	X		CH Pump		0-100%
111	006F	X		DHW Pump		0-100%
112	0070	X		General Pump		0-100%
113	0071			Reserved		
114	0072			Reserved		
115	0073			Reserved		
116	0074			Reserved		
117	0075			Reserved		
118	0076			Reserved		
119	0077			Reserved		
120	0078	X		Supply Temperature	Value/100= Temp	Temp is in C or F depending on Modbus Units
121	0079	X		Return Temperature	Value/100= Temp	Temp is in C or F depending on Modbus Units
122	007A	X		DHW Temperature	Value/100= Temp	Temp is in C or F depending on Modbus Units
123	007B	X		Flue Gas Temperature	Value/100= Temp	Temp is in C or F depending on Modbus Units
124	007C	X		System Temperature	Value/100= Temp	Temp is in C or F depending on Modbus Units
125	007D	X		Outside Temperature	Value/100= Temp	Temp is in C or F depending on Modbus Units
126	007E	X		Cascade Temperature	Value/100= Temp	Temp is in C or F depending on Modbus Units
127	007F			Reserved		
…				Reserved		
138	008A			Reserved		
139	008B			Reserved		
140	008C	X		Fire rate (power output)		0-100%
142	008E	X		Flame current		µA
143	008F	X		Water pressure		Bar/psi
…				Reserved		
159	0099			Reserved		

3. ***Temperature Input/Output:*** Be sure to change the Modbus units to the appropriate value (Fahrenheit or Celsius) before reading or writing these values. When reading the values of register number 106, 107, 112, 113, 114, 115 & 116 the value is automatically converted. When writing the value for register numbers 106 & 107, the desired value must be multiplied by 10 before entering. This scaling is the same

for both Fahrenheit and Celsius units.

- In order to write CH set point, boiler must be set to CH Mode 0 or 3.

4. ***Successful Ignitions:*** The value read from register 126 (Successful Ignitions) must be multiplied by 16 to get the actual value.

5. ***State:*** The registers shown in Table 3 give information about the current condition of the control. Note that there are “State” & “Status” values that can be read for both the Managing control and the Dependent control.

Table 3: Control State Descriptions

STATE		*State Name*	*Description*
Dec	*Hex*		
0	0x00	INIT	Initialization
1	0x01	RESET	Initialization
2	0x02	STANDBY	Standby waiting for heat demand
3	0x03	PRE_PURGE_0	Ignition Sequence
4	0x04	PRE_PURGE_1	Ignition Sequence
5	0x05	PRE_IGNIT	Ignition Sequence
6	0x06	IGNIT	Ignition Sequence
7	0x07	FLAME_PROVING	Burner flame stays lit
8	0x08	BURN	Following Boiler Demand
9	0x09	POST_BURN	Burn off Combustion Chamber
10	0x0A	POST_PURGE_0	Purging Combustion Chamber
11	0x0B	POST_PURGE_1	Purging Combustion Chamber
12	0x0C	ERROR_CHECK	Error Handling
13	0x0D	ALARM_1	Error Handling
14	0x0E	BURNER_BOOT	Controller (re)start

6. ***Error Codes:*** There are two types of error codes: Blocking and Lockout. Blocking errors will prevent the control from firing the burner until the condition causing the error is corrected. Lockout errors require a manual reset at the control to resume normal boiler operation. Table 4 (below) lists Lockout error codes and their descriptions. Table 5 lists Blocking error codes and their descriptions. Refer to the boiler installation and operations manual provided with the unit for more details about individual error codes.

Table 4: ERROR_NUMBER (Lockout Errors)

Error Number		*Error Description*	*Display Code*
Dec	*Hex*		
0	0x00	Internal Control Error – Communication Error E2PROM	E2PROM_READ_ERROR
1	0x01	Ignition Error – one failed ignition attempt	IGNIT_ERROR
2	0x02	Internal Control Error - Gas Valve Relay Error	GV_RELAY_ERROR
3	0x03	Internal Control Error – Safety Relay Error	SAFETY_RELAY_ERROR
4	0x04	Blocking Error Present for 20 hours	BLOCKING_TOO_LONG
5	0x05	Fan is not running for more than 60 seconds	FAN_ERROR_NOT_RUNNING
6	0x06	Fan runs too slow for more than 60 seconds	FAN_ERROR_TOO_SLOW
7	0x07	Fan runs too fast for more than 60 seconds	FAN_ERROR_TOO_FAST
8	0x08	Internal Control Error – RAM Error	RAM_ERROR
9	0x09	Internal Control Error – E2PROM Out of Date	WRONG_EEPROM_SIGNATURE
10	0x0A	Internal Control Error – E2PROM Safety Parameter	E2PROM_ERROR
11	0x0B	Internal Control Error – State Error	STATE_ERROR
12	0x0C	Internal Control Error – ROM Error	ROM_ERROR
13	0x0D	Internal Control Error – Air Switch Not Open	APS_NOT_OPEN
14	0x0E	Internal Control Error – Air Switch Not Closed	APS_NOT_CLOSED_IN_PRE_PURGE
15	0x0F	Boiler Supply Temperature exceeded 195°F	MAX_TEMP_ERROR
16	0x10	Flue Temperature exceeded max flue temp limit	FLUE_GAS_ERROR
17	0x11	Internal Control Error – Stack Error	STACK_ERROR
18	0x12	Internal Control Error – Instruction Error	INSTRUCTION_ERROR
19	0x13	Internal Control Error – ION Check Failed	ION_CHECK_FAILED
20	0x14	Flame Detected After Shutdown	FLAME_OUT_TOO_LATE
21	0x15	Flame Detected Before Ignition	FLAME_BEFORE_IGNIT
22	0X16	Flame Failure – 3 failures during one heat call	TOO_MANY_FLAME_LOSS
23	0X17	Internal Control Error – RAM corrupted	CORRUPTED_ERROR_NR
25	0X19	The 2 supply sensors deviated too much	TSUPPLY_DIFF_ERROR
29	0x1D	Internal Control Error – PSM Error	PSM_ERROR
30	0x1E	Internal Control Error – Register Error	REGISTER_ERROR
32	0x20	The 2 exchange sensors deviated too much	T_EXCHANGE_DIFF_ERROR
33	0x21	Low water cut-off error	LWCO_1_ERROR
34	0x22	Low water cut-off 2 error	LWCO_2_ERROR
35	0x23	Air Pressure Switch did not close during post-purge	APS_NOT_CLOSED_IN_POST_PURGE
36	0x24	Gas Pressure Switch is open for more than timeout	GAS_PRESSURE_ERROR
37	0x25	Air Damper Failure – 3 failures during one heat call	AIR_DAMPER_LOCKING
38	0x26	Flue/Condensate Switch Failure – 3 failures during 24-hour period	FLUE_PRESSURE_LOCKING

Table 5: ERROR_NUMBER (Blocking Errors)

Error Number		*Error Description*	*Error Display*
Dec	*Hex*		
100	0x64	Internal Control Error – RAM Error	WD_ERROR_RAM
101	0x65	Internal Control Error – ROM Error	WD_ERROR_ROM
102	0x66	Internal Control Error – Stack Error	WD_ERROR_STACK
103	0x67	Internal Control Error – Register Error	WD_ERROR_REGISTER
104	0x68	Internal Control Error – XRL Error	WD_ERROR_XRL
105	0x69	Boiler Supply Temperature exceeded 190°F	HIGH_TEMP_ERROR
106	0x6A	Internal Control Error – REFHI Too High Error	REFHI_TOO_HIGH
107	0x6B	Internal Control Error – REFHI Too Low Error	REFHI_TOO_LOW
108	0x6C	Internal Control Error – REFLO Too High Error	REFLO_TOO_HIGH
109	0x6D	Internal Control Error – REFLO Too Low Error	REFLO_TOO_LOW
110	0x6E	Internal Control Error – REFHI2 Too High Error	REFHI2_TOO_HIGH
111	0x6F	Internal Control Error – REFHI2 Too Low Error	REFHI2_TOO_LOW
112	0x70	Internal Control Error – REFLO2 Too High Error	REFLO2_TOO_HIGH
113	0x71	Internal Control Error – REFLO2 Too Low Error	REFLO2_TOO_LOW
114	0x72	Flame Detected with no flame present	FALSE_FLAME
117	0x75	Blocked Condensate Drain	BLOCKED_DRAIN
118	0x76	Internal Control Error – WD Comm Error	WD_COMM_ERROR
119	0x77	Return Sensor Not Connected	RETURN_OPEN

120	0x78	Supply Sensor Not Connected	SUPPLY_OPEN
121	0x79	Supply 2 Sensor Not Connected	SUPPLY2_OPEN
122	0x7A	DHW Sensor Not Connected	DWH_OPEN
123	0x7B	Flue Sensor Not Connected	FLUE_OPEN
124	0x7C	Flue 2 Sensor Not Connected	FLUE2_OPEN
125	0x7D	Outdoor Sensor Not Connected	OUTDOOR_OPEN
126	0x7E	Return Sensor Shorted	RETURN_SHORTED
127	0x7F	Supply Sensor Shorted	SUPPLY_SHORTED
128	0x80	Supply 2 Sensor Shorted	SUPPLY2_SHORTED
129	0x81	DHW Sensor Shorted	DHW_SHORTED
130	0x82	Flue Sensor Shorted	FLUE_SHORTED
132	0x83	Outdoor Sensor Shorted	OUTDOOR_SHORTED
133	0x84		NET_FREQ_ERROR
134	0x85	Reset Button Error (Activated 7 times in 1 minute)	RESET_BUTTON_ERROR
135	0x86	Line and neutral of main power supply input are reversed	PHASE_NEUTRAL_ RESERVED_ERROR
155	0x9B	Internal Control Error- WD Comm Error	WD_CONFIG_ERROR
156	0x9C	Blocked Flue/Condensate Switch closed	FLUE_PRESSURE_ERROR
162	0xA2	Pressure is too low	FILL_WARNING
163	0xA3	Flue is blocked	FLUE_BLOCKED
164	0xA4	Low Flow	LOWEXFLOW_PROTECTION
165	0xA5	Main supply voltage too low for more than 60 seconds	VSUPPLY_TOO_LOW
166	0xA6	Main supply voltage too high for more than 60 seconds	VSUPPLY_TOO_HIGH
167	0xA7	Gas Pressure Low	LOW_GAS_PRESSURE

7. ***Warning Errors:*** Table 6 shows values for warning codes. Warnings are associated with temperature sensors that are either shorted or open. At the boiler, these errors are indicated by a flashing burner control displays (in the electrical enclosure on the boiler).

Table 6: WARNING_NUMBER			
Warning Number		*Error Description*	*Error Display*
Dec	*Hex*		
200	0xC8	Cascade lost communication with dependent	CC_LOSS_COMMUNICATION
202	0xCA	Unknown appliance model selected	APP_SELECTION_ERROR
204	0xCC	Outdoor Sensor Shorted	OUTDOOR_WRONG
205	0xCD	System Sensor Shorted	T_SYSTEM_WRONG

8. ***CH & DHW Mode:*** Table 7 shows register values for central heating (CH) modes. These values are typically set upon commissioning based on the piping configuration. Table 8 shows the values for domestic hot water (DHW) modes. Again, these values are dependent on the piping and wiring configuration.

Table 7: CH Mode			
CH Mode Number		*CH Mode Description*	*Description*
Dec	*Hex*		
0	0x00	Fixed Setpoint	Boiler maintains a fixed, user-defined, temperature setpoint
			Boiler responds to thermostat demand targeting temperature setpoint
1	0x01	Outdoor reset with Thermostat	Boiler temperature is calculated based on outdoor temperature
			Boiler responds to thermostat demand targeting the calculated temperature
2	0x02	Outdoor reset with Permanent Demand	Boiler temperature is calculated based on outdoor temperature
			Boiler maintains targeted temperature calculated by the control with no thermostat input
			When CH demand is not present, calculated setpoint decreases gradually
3	0x03	Fixed Setpoint with Permanent Demand	Boiler maintains a fixed, user-defined, temperature setpoint
			Boiler maintains targeted temperature calculated by the control with no thermostat input
4	0x04	Analog Input Control of Setpoint	Boiler starts if analog voltage is above 1.5 VDC
			Boiler temperature corresponds to an external analog input between 2 VDC (60° F) and 10 VDC (185° F)
5	0x05	Analog Input Control of Power Output	Boiler starts if analog voltage is above 1.5 VDC
			Boiler fan speed corresponds to an analog input signal provided by a Building Management System (BMS) or controller.

Table 8: DHW Mode			
DHW Mode Number		*DHW Mode Description*	*Description*
Dec	*Hex*		
0	0x00	No DHW	No indirect hot water tank is connected
			Boiler will not respond to any input on terminals #32 & #33
1	0x01	DHW store with sensor	Indirect hot water tank is piped in the system, and a tank sensor is used
			Boiler monitors indirect tank temperature using sensor input on terminals #32 & #33
2	0x02	DHW store with thermostat	Indirect hot water tank is piped in the system, and a thermostat is used to monitor the tank temperature
			Boiler responds to DHW call for heat when the circuit is made between terminals #32 & #33

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