

VB1285 Burner Control Board Serial Communications Interface

REQUIRED SIGNATURES			
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Document Revision History

Revision	Date	Description
Rev 0.01	May 15, 2017	Initial draft.
Rev 0.02	Aug 10, 2017	Updated Firing Rate Demand registers so the value and complement will both occupy only 1 register.
Rev 0.03	Oct 23, 2017	Updated Transmission Mode and added some electrical info including some initial 1287 DIP switch notes. Clarified the Firing Rate Demand register description and added other write accessible register descriptions. Added 1287 specific register details. Some details are still TBD in this draft!
Rev 0.04	Nov 15, 2017	Removed 1287 references, added diagnostic status and fault code details, and updated holding registers and input registers mapping details.
Rev 0.05	Dec 18, 2017	Added an “ A I I ” alert code for failed ignition on the split manifold burner.
Rev 0.06	Mar 1, 2018	Added Diagnostic Status Code Log Entry holding register definitions. Added Alert Status Bits, Reset Pending Counter and Split Manifold Stage status registers to the read input register map.
Rev 0.07	Mar 12, 2018	Added an additional Flame Rod Current register along with an Air Pressure Switch setting register to the read input register map. Moved the Ambient Temperature, Barometric Pressure, and Line Cycle Frequency registers to accommodate the new Flame Rod Current register(s). Added Alert Status Bits Table. Updated the Diagnostic Status Codes Table with some corrections.
Rev 0.08	May 8, 2018	Added ID Plug Version Number and Label info to the read input register map.
Rev 0.09	May 10, 2018	Added additional burner details from the ID Plug to the read input register map.
Rev 0.10	May 23, 2018	Added ‘Open fuse’ to the Diagnostic Codes Table and to the Error Codes Table.

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1 GENERAL DESCRIPTION

1.1 Application

The VB1285 burner control board is intended to modulate the firing rate of burners, primarily for commercial rooftop furnaces. Applications are typically limited to burners approved to operate below 400k BTU/hour per manifold segment unless specifically certified otherwise in an OEM's product. Both air and gas are modulated to maintain a desired efficiency throughout the full firing rate range. The air is modulated by controlling the voltage to a 120/208/240 VAC single phase shaded pole, PSC, or ECM inducer. The gas is modulated via a modulating gas valve or a valve actuator.

1.2 Scope

This document details the associated Serial Communications Interface between the burner control board and a packaged unit controller or external system level controller. This interface will provide that controller with the capability to initiate diagnostic and test operations as well as request a call for heat and specify the heating capacity level to be output by the VB1285 controlled modulating burner in order to satisfy the needed demand for heat. The interface will also provide furnace status including various sensor feedback values along with faults detected by the burner control as detailed within this document.

1.3 Overview

The default and optionally supported interface configurations are summarized in the table below:

	Initial default configuration	Future supported options
Addressing	Slave with address of decimal 20	Slave with address range <i>TBD</i>
Unicast/Broadcast	Unicast Mode only	Unicast Mode only
Baud Rate	19200 or 115200	9600, 19200, 115200
Parity + stop bits	<u>Even parity + 1 stop bit</u>	Even + 1, Odd + 1, No parity + 2
RTU/ASCII Mode	RTU only	RTU only
Electrical	Half-duplex, RS485 "Two-Wire" with <u>no</u> line termination resistor	
Connector	See Board connector: TE Connectivity/AMP VAL-U-LOK 1586037-4	

2 DATA LINK LAYER

2.1 Messaging Mode

2.1.1 Unicast

Each MODBUS transaction shall consist of a master node initiated request uniquely addressed to a specific slave node with a corresponding reply from that specific slave node.

2.1.2 Slave Node – VB1285

The VB1285 control board will function as a slave node with a default address of 20 (decimal).

2.1.3 Slave Node – 1287 (*deleted*)

2.2 Transmission Mode

2.2.1 Baud Rate

The clock signal used for generating the baud rate of the RS485 serial bus on the control boards will be trimmed to within 0.2% at production. This clock is designed to have up to a 1% deviation across temperature range of 0°C to 70 °C and a 2% deviation across the temperature range of -40 °C to 105 °C.

2.2.2 Bits per byte

2.2.2.1 1 start bit

2.2.2.2 8 data bits, least significant bit sent first

2.2.2.3 Even parity bit

2.2.2.4 One stop bit

2.2.3 RTU Mode

4 PROTOCOL DATA UNITS

4.1 Supported Public Function Codes

4.1.1 Holding Registers – VB1285

The Holding Registers to be read accessed via Function Code 03 shall be mapped as shown in the table below. Several of these registers shall also be writable via Function Code 16 in the Checkout Test Mode as detailed in Section [Function Code 16 \(0x10\) Write Multiple Holding Registers](#).

Holding Registers accessed via Read Holding Registers (03) and Multiple Register Write (16)			
Register Address	Write able?	Data Field Name	Data Format
0 - msb		Holding Register Array Version #	Unsigned Numeric, (0 to 255)
0 - lsb		Total # of registers in this array	Unsigned Numeric, (1 to 125)
1		Control Board Number	Numeric (12852 = 2" WC or 12855 = 5" WC pressure sensor)
2		Software Version Number	Numeric (SCD number in production)
3 - msb		Control Operating Mode	ASCII character, 'C' = Checkout Test Mode, 'N' = Normal Control Mode, 'S' = Standalone Mode (timed out from Normal Control Mode)
3 - lsb		Burner State	See Section Burner States Table
4		Time In State	Unsigned Numeric, Seconds (0 to 65535)
5 - msb		Diagnostic Status Code	See Section Diagnostic Codes Table
5 - lsb		Lockout Error Code	See Section Error Codes Table
6 - msb	W	! Firing Rate Demand	One's complement of the lo byte
6 - lsb	W	Firing Rate Demand	0 : off/standby; 1-200 : Percent x 2 (e.g., 1 = 0.5 %, 200 = 100 %)
7 - msb	W*	! Inducer Air Pressure Target	One's complement of the lo byte
7 - lsb	W*	Inducer Air Pressure Target	Inches WC x 50 (e.g., 1 = 0.02"WC, 110 = 2.20"WC)
8 - msb	W*	! Modulating Gas Valve Output	One's complement of the lo byte
8 - lsb	W*	Modulating Gas Valve Output	Volts x 20 (e.g., 1 = 0.05 VDC, 200 = 10.00 VDC)
9 - msb	W*	! Auxiliary Analog Output Target	One's complement of the lo byte
9 - lsb	W*	Auxiliary Analog Output Target	Volts x 20 (e.g., 1 = 0.05 VDC, 200 = 10.00 VDC)
10 - msb	W*	! LED override	One's complement of the lo byte
10 - lsb	W*	LED override	0 : override off 1-3 : Set decimal point for digit 1 to 3 10-19 : 1 st digit, set from 0 to 9 20-29 : 2 nd digit, set from 0 to 9 30-39 : 3 rd digit, set from 0 to 9 90-99 : All three digits, set from 0 to 9
11 - msb	W	Diagnostic Status Code Log Entry 0	Most recent entry. Write to this register to reset log to "0" entries.
11 - lsb	W	Diagnostic Status Code Log Entry 1	See Section Diagnostic Codes Table . "0" means no log entry.
12 - msb		Diagnostic Status Code Log Entry 2	See Section Diagnostic Codes Table . "0" means no log entry.
12 - lsb		Diagnostic Status Code Log Entry 3	See Section Diagnostic Codes Table . "0" means no log entry.
13 - msb		Diagnostic Status Code Log Entry 4	See Section Diagnostic Codes Table . "0" means no log entry.
13 - lsb		Diagnostic Status Code Log Entry 5	See Section Diagnostic Codes Table . "0" means no log entry.
14 - msb		Diagnostic Status Code Log Entry 6	See Section Diagnostic Codes Table . "0" means no log entry.
14 - lsb		Diagnostic Status Code Log Entry 7	See Section Diagnostic Codes Table . "0" means no log entry.
15...29		(deleted)	

* Write accessible only in the Checkout Test Mode.

4.1.2 Function Code 16 (0x10) Write Multiple Holding Registers

Several of the registers in the Holding Registers table above are also write accessible via Function Code 16 as detailed further below. While the Firing Rate Demand register can be write accessed at any time, all other write accessible holding registers can only be written when the control is in Checkout Test Mode. This test mode is entered by writing a value of **251** into the Firing Rate Demand register. Doing so will actually reset the Firing Rate Demand to zero and put the control into Checkout Test Mode. The Checkout Test Mode can then be exited by writing any other valid firing rate value, including 0, to the Firing Rate Demand register.

4.1.2.1 Firing Rate Demand

The Firing Rate Demand is the serially commanded Call for Heat (CFH) output control parameter for those burners on the manifold being controlled by the addressed control board. However, this serially provided digital Firing Rate Demand value will be ignored if the VB1285 is ID plug configured for an alternative analog (0-10V) Firing Rate Input signal or if the R-W enable circuit connection is not closed. This serially commanded Firing Rate Demand is expected to be provided every 1 to 6 seconds to confirm that a CFH is still current. If the Firing Rate Demand value is neither updated nor confirmed over a **15 second** period, then the burner control board will consider that to be an end to a CFH and the control board operating mode status will be changed to a standby Standalone Mode until a subsequent Firing Rate Demand is received.

Along with monitoring responses from the VB1285 control board, an OEM controller may also read a “Time between Messages” Read Input register to confirm that the reported time between the last two valid CFH maintenance messages (aka, “keep alive” messages) matches expectations.

If the R-W circuit is opened and a non-zero Firing Rate Demand value is sent to the control board, then an **E09** fault code will be displayed and the Firing Rate Demand by itself will not be considered sufficient to either initiate or maintain a CFH.

A Firing Rate Demand value of **0** corresponds to no CFH. A value of **1 to 200** corresponds to a modulating output target with a range of from 0.5% to 100% in increments of 0.5%. If the burner is currently “Off” or in “Standby” without any CFH, or if it is in Lockout, then a value of **251** will put the control into Checkout Test Mode so that additional output related Holding Registers can be written in order to manipulate them for subsystem level diagnostic purposes.

4.1.2.2 Modulating Gas Valve Output Target Register

This value is writeable only in Checkout Test Mode. It is the target output voltage for the modulating gas valve drive circuitry with a range of from 0.00 VDC to 10.00 VDC in increments of 0.05 VDC. That is, a value of 40 corresponds to 2.00 VDC and a value of 200 corresponds to 10.00 VDC. Note that for some applications, the modulating gas valve may be configured for a control signal operating range from 2 to 10 V and that for such valves, control signals of less than 2 volts will result in the valve staying in the minimum output position.

4.1.2.3 Inducer Air Pressure Target Register

This value is writeable only in Checkout Test Mode. This value is the target feedback air pressure for the closed loop inducer motor control with a range of from 0.00 inches WC to 5.00 inches WC in increments of 0.02 inches WC. That is, a value of 40 corresponds to 0.80 inches WC and a value of 100 corresponds to 2.00 inches WC. Note that the range of the default configuration pressure sensor (2 inches WC) will limit the air pressure target value to maximum of ~2.14 inches WC.

4.1.2.4 Auxiliary Analog Output Register

This value is writeable only in Checkout Test Mode. It is the target voltage for the analog output signal with a range of from 0.00 VDC to 10.00 VDC in increments of 0.05 VDC. That is, a value of 40 corresponds to 2.00 VDC and a value of 200 corresponds to 10.00 VDC.

4.1.2.5 LED Override

This value is writeable only in Checkout Test Mode. It provides a way for the system controller to override the normal status information displayed on the 3-digit, 7-segment LED. The display will remain in the override state until the override is cancelled by writing ‘0’ to this register or by exiting the Checkout Test Mode.

4.1.3 Function Code 04 (0x04) Read Input Registers

The Input Registers to be accessed via Function Code 04 shall be mapped as shown below.

Registers accessed via Read Input Registers Function Code (04)			
Register Address	Example Value	Data Field Name	Data Format
0 - msb	0	Input Register Array Version #	Unsigned Numeric, (0 to 255)
0 - lsb		Total number of registers in array	Unsigned Numeric, (1 to 125)
1	12852	Control Board Number	Numeric (12852 = 2" WC or 12855 = 5" WC pressure sensor)
2		Software Version Number	Numeric, <1000 for development ; ≥1000 for released SCD #
3 - msb		Control Operating Mode	ASCII, 'C' = Checkout Test Mode, 'N' = Normal Control Mode, or 'S' = Standalone Mode (timed out from Normal Ctrl Mode)
3 - lsb		Burner State	See Section Burner Status Table
4		Time In State	Unsigned Numeric, Seconds (0 to 65535)
5 - msb		Diagnostic Status Code	See Section Diagnostic Codes Table
5 - lsb		Lockout Error Code	See Section Error Codes Table
6		Flame Rod Current (Main)	Unsigned Numeric, Microamps x 1000 (0 to 5000)
7		Flame Rod Current (Split Stage A)	Unsigned Numeric, Microamps x 1000 (0 to 5000)
8		Flame Rod Current (Split Stage B)	Unsigned Numeric, Microamps x 1000 (0 to 5000)
9...10		(reserved)	
11		Firing Rate Input (0-10 VDC)	Unsigned Numeric, Millivolts (0 to 10000) - For applications with an analog voltage firing rate control
12		Inducer Motor RPM	Unsigned Numeric, RPM (0 to 10000) for an ECM inducer 65535 (that is, 0xFFFF) for applications w/o any RPM feedback
13		Gas Valve Position Fdbk (PWM)	Unsigned Numeric, Millivolts (0 to 10000) for valves w/PWM fdbk 65535 (that is, 0xFFFF) for applications w/o any PWM feedback
14		Gas Valve Position Fdbk (VDC)	Unsigned Numeric, Millivolts (0 to 10000) for valves w/0-10V fdbk 65535 (that is, 0xFFFF) for applications w/o any VDC feedback
15		Inducer P _{AIR} (digital output)	Unsigned Numeric, Inches WC x 1000 (0 to 5500) - For applications with an I ² C pressure sensor
16		Inducer P _{AIR} (analog output)	Unsigned Numeric, Inches WC x 1000 (0 to 5500) - For applications with an analog output pressure sensor
17		Expected Manifold Gas Pressure	Unsigned Numeric, Inches WC x 1000 (0 to 10000)
18		Auxiliary Analog Output	Unsigned Numeric, Millivolts (0 to 10000)
19		Alert Status Bits	Status bits for various alert. See Section Alert Status Bits Table
20		Time between Messages	Numeric, Seconds (0 to 65535, i.e., Maximum 18:12:15)
21		Reset pending counter	Numeric, Seconds (0 to 600, 0xFFFF if more than 10 minutes)
22 - msb		Stage A Stage – Diagnostic Code	Typically, the split manifold stage of a 10:1 burner. - A value of 0xFF indicates that no such stage is supported.
22 - lsb		Stage A Slave - Burner State	See Section Burner States Table
23		Stage A Slave - Time In State	Unsigned Numeric, Seconds (0 to 65535)
24 - msb		Stage B Slave – Diagnostic Code	Typically, the second split manifold stage of a “triple-split” burner. - A value of 0xFF indicates that no such stage is supported.
24 - lsb		Stage B Slave - Burner State	See Section Burner States Table
25		Stage B Slave - Time In State	Unsigned Numeric, Seconds (0 to 65535)
26...29		(reserved)	
30		Air Pressure Switch setting	Unsigned Numeric, Inches WC x 1000 (0 to 10000)
31	68	Ambient Temperature ¹	Signed Numeric, Degrees Fahrenheit (-40 to 257)
32	~950	Barometric Pressure ²	Unsigned Numeric, Millibar or hPa (260 to 1260)
33	6000	Line Frequency (of 24 VAC power)	Unsigned Numeric, Hertz x 100 (5455 to 6667)
34	500	Furnace Size	Numeric, KBTU / hour
35 - msb	10	Customer Code / Model	Coded value, 10 : Trane Quantum

Registers accessed via Read Input Registers Function Code (04)

Register Address	Example Value	Data Field Name	Data Format
35 - lsb		Burner Code	Coded value, 1 : Modulated Natural Gas, 2 : Modulated LP, 3 : Split Manifold Modulated NG, 4 : Split Manifold Modulated LP, 5 : Triple Split Manifold Mod. NG, 6 : Triple Split Manifold Mod. LP
36 - msb	50	Stage A, Firing Rate Demand Off	Numeric, Percent x 2, (200 indicates no Stage A for Burner Code = 1 or 2)
36 - lsb	76	Stage A, Firing Rate Demand On	Numeric, Percent x 2, (202 indicates no Stage A for Burner Code = 1 or 2)
37 - msb	126	Stage B, Firing Rate Demand Off	Numeric, Percent x 2, (200 indicates no Stage B for Burner Code = 1, 2, 3 or 4)
37 - lsb	154	Stage B, Firing Rate Demand On	Numeric, Percent x 2, (202 indicates no Stage B for Burner Code = 1, 2, 3 or 4)
38...39		(reserved)	
40		ID Plug Version Number	Numeric, 0 for none; <1000 for dev.; ≥1000 for released IDPCD #
41...52		ID Plug Label (up to 24 characters)	ASCII String (optional termination character)
53	1750	Furnace Turndown Ratio	Numeric, Ratio x 100
54		Customer Specific (reserved)	

¹ A default value of **68 F** is reported for applications without an ambient temperature sensor.

² A default value of **1000 Millibar** is reported for applications without an absolute pressure sensor.

4.1.4 Burner Status Table

Bit #	Value	Burner State
7	T/F	Flame Presence Detected for this burner
6	T/F	deleted
5	T/F	Pressure Switch Closed
4	T/F	deleted
0-3	9-15	reserved
	8	Run_2
	7	Run
	6	Warm-Up
	5	Gas On
	4	Igniter On
	3	Pre-Purge
	2	Off
	1	Retry (Interpurge)
	0	Lockout

4.1.5 Diagnostic Codes Table

LED Display	Diagnostic Code	Type	Description
888	1	Lockout	Board Failure <i>(Also during power up)</i>
0FF	2	Status	UP Mode: Burner state = Off
PUR	3	Status	UP Mode: Burner state = Purge
IGN		Status	UP Mode: Burner state = Ignition
HEA		Status	UP Mode: Burner state = Warmup
RUN		Status	UP Mode: Burner state = Run
REt	4/5	Status	UP Mode: Burner state = Retry
A01	4	Alert	Failed ignition attempt
A02	5	Alert	Lost Flame
A03	6	Alert	Insufficient Combustion Air – auto-derating
A04	7	Alert	Limited Low Fire <i>(due to Lost Flame Auto-Adaptation)</i>
A05	8	Alert	Weak Flame Signal, Main burner
A06	9	Alert	reserved
A07	33	Alert	Air Modulation Failure (Inducer isn't modulating down)
A08	34	Alert	Air Sensor Null Pressure Check (out of tolerance)
A11	24	Alert	Failed Ignition, Split manifold burner, retries exhausted
A15	10	Alert	Weak Flame Signal, one or more split-manifold staged burners
E01	11	Lockout	Failed Ignition, retries have been exhausted.
E02	12	Lockout	Primary Limit Failure (or open fuse)
E03	13	Lockout	Modulation Valve Failure
E04	14	Lockout	Air Pressure Sensor Reading Low (Pressure switch failed to open or insufficient air/blocked vent)
E05	15	Lockout	Air Pressure Sensor Reading High (Pressure switch failed to close)
E08	18	Lockout	Unexpected flame, Main burner
E09	19	Lockout	No R-W enable signal during a CFH
E13	23	Lockout	Open fuse
E18	22	Lockout	Unexpected flame, Split manifold burner
E1d	20	Lockout	Invalid I.D. Plug Installed

4.1.6 Error Codes Table

LED Display	Lockout Error Code	Type	Description
888	various	Lockout	Board Failure (<i>Also during power up</i>)
E01	22	Lockout	Failed Ignition, retries have been exhausted.
E02	7	Lockout	Primary Limit Failure (or open fuse)
E03	8	Lockout	Modulation Valve Failure
E04	28	Lockout	Air Pressure Sensor Reading Low (Pressure switch failed to open or insufficient air/blocked vent)
E05	29	Lockout	Air Pressure Sensor Reading High (Pressure switch failed to close)
E08	3 or 4	Lockout	Unexpected flame, Main burner
E09	26	Lockout	No R-W enable signal during a CFH
E13	6	Lockout	Open fuse
E18	18	Lockout	Unexpected flame, Split manifold burner
E1d	10	Lockout	Invalid I.D. Plug Installed

4.1.7 Alert Status Bits Table

Bit #	Value	Alert Condition or Status being Indicated
15	T/F	Weak Flame Signal, one or more split-manifold staged burners
14	T/F	Reserved
13	T/F	Reserved
12	T/F	Ignition failure or lockout, Stage B
11	T/F	Ignition failure or lockout, Split-manifold (or Stage A)
10	T/F	
9	T/F	No serial communication with expected Stage B burner
8	T/F	Air Sensor Null Pressure Check (out of tolerance)
7	T/F	Air Modulation Failure (Inducer isn't modulating down)
6	T/F	
5	T/F	Weak Flame Signal, Main burner
4	T/F	Limited Low Fire (<i>due to Lost Flame Auto-Adaptation</i>)
3	T/F	Insufficient Combustion Air – auto-derating
2	T/F	Lost flame, Main burner
1	T/F	Failed ignition attempt, Main burner
0	T/F	

4.2 User Defined BPP-specific Function Codes

4.2.1 Tbd (0xtbd) BPP specific

4.3 Exception Codes

4.3.1 01 Invalid/Unsupported Function Code

4.3.2 02 Invalid Data Address

4.3.3 03 Invalid Data Value

5 VISUAL STATUS INDICATORS (*deleted*)