MOD-6001
APRIL 4, 2013

NEXUS NX6100/PPC6000 SERIES MODBUS RTU and TCPIP COMMUNICATIONS

DESCRIPTION

The MODBUS interface is designed to connect Fireye's NX6100 or PPC6000 Nexus Controllers to other devices using the 'MODBUS RTU' or 'MODBUS TCP' protocols, using 3 wire RS485. This bulletin shows connections and the available MODBUS memory map for these controls only.

NX6100/PPC6000 series controllers may be connected to a MODBUS communications system to enable data collection and limited control functions. The controllers are connected to the MODBUS via the Isolated RS485 Communications terminals on the NX6100 or PPC6000. The MODBUS function requires a daughter board to be fitted to each controller.

The protocol supported is MODBUS RTU and the data configuration supported is 8-bits, no parity, 1-stop bit. This is the simplest and most common data configuration because the MODBUS protocol includes 'crc' to ensure data packet integrity.

A network of up to 14 Fireye Nexus NX6100 or PPC6000 controls can be linked to MODBUS.

Consideration needs to be given to the total number of registers to be communicated, refer to page 4 for further details.

MODBUS RTU can be accessed via two daughter boards for the NX6100 or PPC6000. The NXDBMB (MODBUS only) or NXDBVSD (MODBUS and variable speed drive) allow access to the NX6100/PPC6000 through the isolated RS485 terminals. See Figure 1, Section 1.2. Also, refer to the appropriate bulletin, NEX-6101 or PPC-6001.

Safety information

WARNING

The equipment described in this manual is capable of causing property damage, severe injury, or death. It is the responsibility of the owner or user to ensure that the equipment described herein is installed, operated and commissioned in compliance with the requirements of all national and local legislation, which may prevail.

When this equipment is fitted to an appliance due regard must also be given to the requirements of that appliance.

Before attempting to install, commission or operate this equipment all relevant sections of this document must be read and fully understood. If in doubt about any requirements consult Fireye.

Installation, commissioning or adjustment of this product MUST be carried out by suitably trained engineers or personnel qualified by training and experience.

After installation or modifications to the installation all functions of the equipment MUST be checked to ensure safe and reliable operation of the control.

The manufacturer of this equipment accepts no liability for any consequences resulting from inappropriate, negligent or incorrect installation, commissioning or adjustment of operating parameters of the equipment.
Control panels **must not** be left uncovered while power is on. If it is essential to do so while rectifying faults only personnel qualified by training and experience should be involved.

The time any covers are off must be kept to a minimum and warning notices **must** be posted.

Before attempting any work on this equipment or any equipment controlled by or connected to this equipment, all related electrical supplies **must** be isolated.

Safety interlocks **must not** be removed or over-ridden. Any faults once detected **must** be corrected before the control is operated.

The manufacturer of this equipment has a policy of continual product improvement and reserves the right to change the specification of the equipment and the contents of this manual without notice.

Table of contents

Please read the safety information at the front of this manual before proceeding.

1. Introduction.

1.1 Compatibility and Conventions

MODBUS RTU communication with NX6100/PPC6000 series controllers is compatible with NX6100 or PPC6000 at firmware revision 1.2 or greater. Engineer's Key EK55 indicates the firmware version. See Section 4 and 6.6 of the relevant NX6100 or PPC6000 bulletin for more information. The NX6100/PPC6000 require the use of either the NXDBMB (MODBUS only) or the NXDBVSD (MODBUS and Variable Speed Drive) daughter boards. These boards are inserted into the NX6100/PPC6000 through the back side. The firmware revision of these boards must be 1.103 or above. Consult the factory to verify the revision level.

This guide covers several different products; hence the parameters to be entered and connector terminal references may be different depending on the product used. Where such information is given, it will be given for both types of controllers in the following format of the following example:

…. option parameter 12.0^{6000} / 13.0^{6100} must be set to ….

where the required parameter may be 12.0 on a PPC6000, and 13.0 on an NX6100 controller.

1.2 Overview

NX6100/PPC6000 series controllers may be connected to a MODBUS communications system to enable data collection and limited control functions. The controllers are connected to the MODBUS via the Isolated RS485 Communications terminals on the controller, not the daughterboard. The MODBUS function requires a daughter board to be fitted to the controller.

The protocol supported is MODBUS RTU and the data configuration supported is 8-bits, no parity, 1-stop bit. This is the simplest and most common data configuration because the MODBUS protocol includes 'crc' to ensure data packet integrity.

NX6100/PPC6000 series controllers support 2-wire MODBUS, which in fact is often a 3-wire system where the 3rd wire is a 0V logic connection. This is the preferred wiring method. The MODBUS cable loops from one device to the other, a 'daisy chain' configuration as shown below.

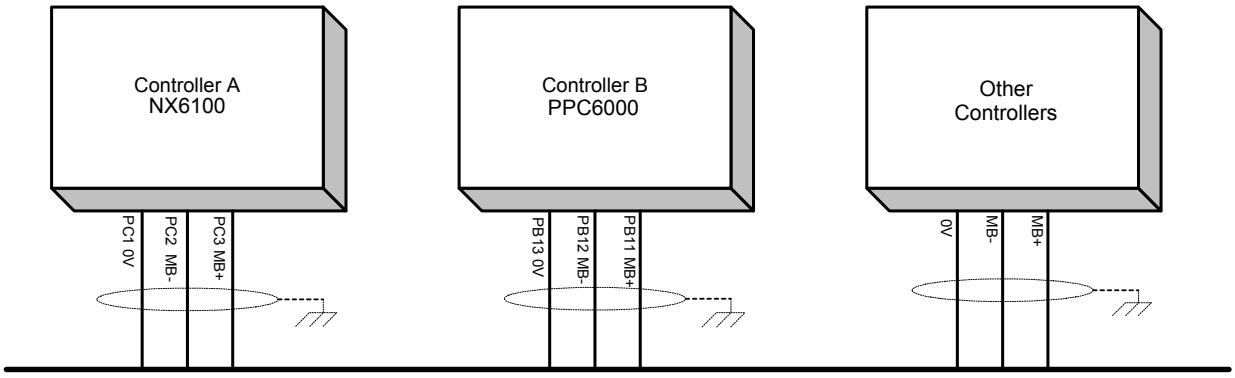


Figure 1: MODBUS Connections

Commands via MODBUS are only valid when the NX6100/PPC6000 series controller is in Normal/Remote operating mode as selected from the display. See the relevant NX6100 or PPC6000 bulletin for more information.

2. Wiring and Hardware Configuration

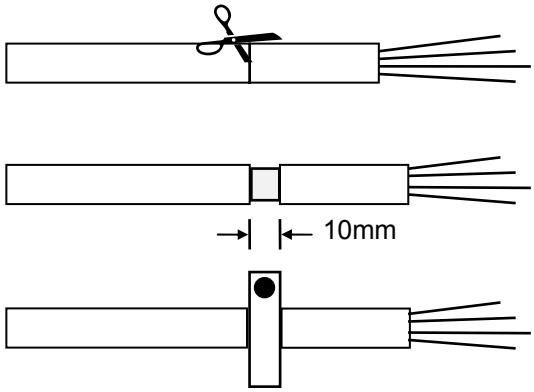
2.1 MODBUS cables

FIREYE recommends that RS485 MODBUS cables should be overall 'braid' screened, PVC insulated, 3-core of 24 AWG (7/0.2mm) wire minimum. This cable may be run adjacent to, and/or in the same conduit as high voltage wiring. Therefore, the cable voltage rating must exceed the maximum voltage carried by any other cable connected to the controller or run in the same conduit.

Terminate the screen **at each controller** using the cable clamps provided. **Incorrect connection or application of excess voltage may damage or destroy the controllers being connected.**

2.2 Screen termination

Screen termination clamps are provided on the main controller for termination of cable screens (tinned copper braid type). It is important to ensure that the screen and associated insulation cover the cable cores as close as possible to the terminals to which they are connected, and **not** cut-back to where the cable passes through the screen termination clamp.

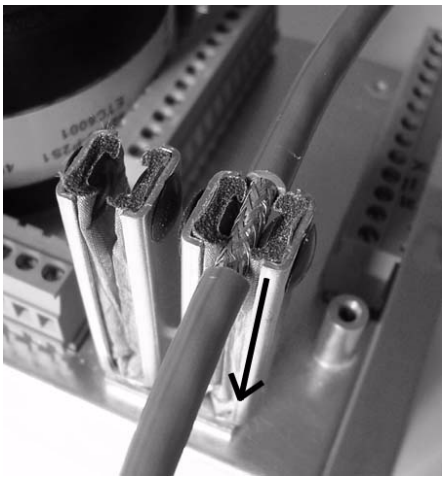


The cable should be prepared by cutting around the outer insulation, taking care not to damage the screen (1).

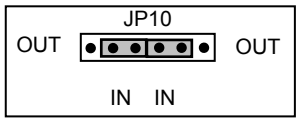
Pull the insulation apart to expose 10mm of the screen braid (2).

Place the exposed length of screen braid between the conductive strips attached to the cable 'clamps', ensure a 'good' connection between the screen and the 'clamp' is achieved (3).

NOTE: The 'clamps' are not intended to provide strain relief for the cables.



2.3 RS485 serial communications termination resistor



RS485 communication buses require balancing. This is achieved by applying termination resistors at the extremes of the cable. There are two resistors, one for each of the RS485 + and – wires. NX6100/PPC6000 series daughter boards have termination resistors on-board, which are selected by JP1 jumpers on the daughter board.
If a FIREYE device is at the end of the bus then set both of the JP1 links to the IN position. All other controllers should have the links set to the OUT position. If only two controllers are on the communications bus, set the termination resistors on both controllers to the IN position.

NOTE: The 'clamps' are not intended to provide strain relief for the cables.

3. Controller configuration.

3.1 Overview

Before configuring the NX6100/PPC6000 series controllers for MODBUS communications, the user must have a clear operating strategy defined. This strategy should define the operating speed of the bus, the bus addresses for each device on the bus and the data sets required of each bus device. Only when this information is clear should the system option parameters be set and the MODBUS system tested against the operating strategy.

3.2 Entering the Parameters

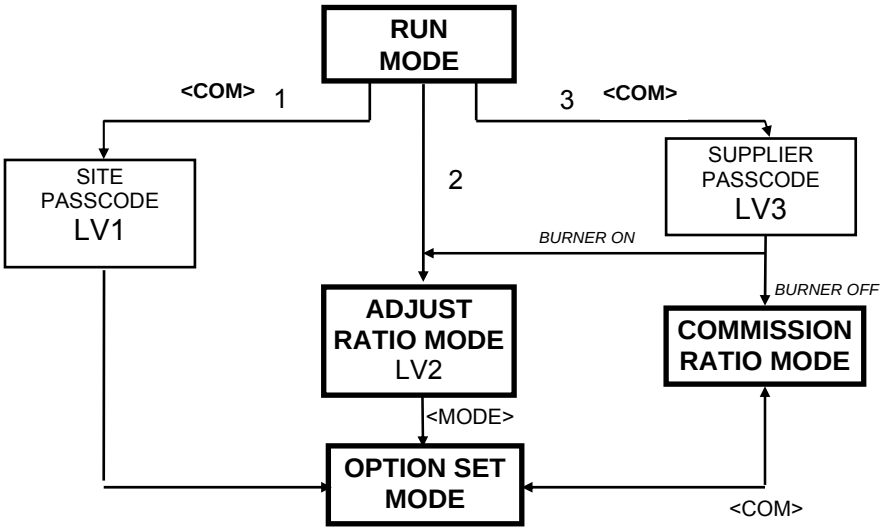
The NX6100/PPC6000 series controllers require configuration to match the MODBUS. Device address and communications speed are configured by setting option parameters in the controller. These parameters must be set for each and every NX6100/PPC6000 series controller on the MODBUS and are programmed when the controller is in Commissioning mode.

The controllers may be configured in any order but it is important to keep a record of the values programmed into each controller.

3.3 General

If any settings in the control are to be changed, it is necessary to enter a commission mode. Three passcodes are available for this purpose, shown as LV1 (Level 1), LV2 (Level 2), and LV3 (Level 3) in this manual

- *Supplier passcode* – LV3 – allows entry to all commissioning modes.
- *Adjust ratio passcode* – LV2 -- allows adjustment of some option parameters and entry to adjust ratio mode.
- *Site passcode* – LV1 -- allows adjustment of some option parameters.



3.3.1.1 Entering commission ratio mode

To enter commission mode, press the key labeled **COM** and select the site passcode value using the **UP/DOWN** keys. The site passcode has a factory default setting of 154. Enter this value as shown below.

*** - NOTE: If the site passcode has been changed, you will have to enter that number.**

3.3.1.2 Exiting from commission mode

To exit from any commission mode to run condition, press the key labeled **RUN** and then **ENTER**.

- Use the UP/DOWN keys to change the value of the option parameter. When the correct value is selected then press the ENTER key to store the new value.
- Set or adjust all of the parameters as required by moving between the parameters and adjusting as detailed above.

e.g.

5.4.1 Option parameter list

> ***CAUTION***
>
> - Use extreme care when entering option parameters. Incorrect data entry could cause a hazardous situation to occur.
> - It is possible that additional parameters may be present in the unit depending on the application and/or supplier.

Note: Option parameters are marked with LV1, LV2, and LV3, which indicate what level passcode is required. If, when using the supplier passcode (LV3), it is not possible to adjust the value of an option parameter, then the burner must be turned off to make the adjustment.

Option 00.1 - Site passcode (0 - 999) LV3

This is a three digit passcode that will allow the site engineer or end-user to enter option set mode and adjust a limited range of option parameters (those not marked with 'LV2' or ' LV3' in this section). This passcode can be zero, in which case the user only needs to press the COM / ENTER key twice to enter option set mode with limited access. Factory default is 154.

Option 00.2 - Serial communications control address (0 - 15) LV1

If the control is to be connected to other equipment via the serial communications interface, it must be given a unique address using this option parameter. Additionally if more than one control unit is connected on the CAN bus (for example to share a display), the units must all have unique addresses BEFORE THEY ARE CONNECTED TO THE SAME CANbus. **This passcode is used with Comfire or sequencing and is not part of the MODBUS RTU setup.**

Option 00.7 – MODBUS device address (1 – 99) LV3
Default value is 0= OFF
This option sets the MODBUS device address for the controller and must be unique for each device on the bus.

Option 00.8 – MODBUS communications speed (0 – 3) LV3
Default value 0
This option sets the MODBUS communications speed in each controller as follows:

Option 00.8 value	Speed, bits/s
0	9600
1	4800
2	9600
3	19200

4. MODBUS RTU Data Sets

4.1 Overview.

The NX6100/PPC6000 series controllers support the following MODBUS register types :

- Coils (1 to 19) - These registers can be written to by a MODBUS master to provide control of NX6100/PPC6000 series controllers. In addition these registers can be read to interrogate the last value written.
- Input registers (1 to 1200, 16 bit) - These can be read by a MODBUS master to monitor combustion and other variables, from the NX6100/PPC6000 series controllers.
- Holding registers (1 to 1600, 16 bit) - These can be written to by a MODBUS master to change modulation control of NX6100/PPC6000 series controllers. As with Coils, these registers can be read to interrogate the last value written.

For daughterboard firmware levels 1.103 and greater, the MODBUS system can keep a maximum of 100 items (including read and written items) updated. Values will normally all refresh within one second, but if more than 50 items are being updated, this will extend to two seconds.

Only the last 100 registers requested from the MODBUS master will be remembered by the NX6100/PPC6000 controller. If more than 100 items are requested, the oldest items will cease to be active. This means that if more than 100 different items have been accessed since a particular item was read, this item may return zero the next time it is read, since the MODBUS system is no longer tracking that item. It will then become active and will hold valid data on the next read. In practice this is not an issue since there are nowhere near 100 items available from the NX6100/PPC6000 series controllers that will be of interest to plant operators etc. Most values that are available are ‘engineers key’ values that are provided for fault-finding and diagnostic purposes.

However, Coils and Holding registers are never ‘dropped’ from the item list in this way. So if the burner is turned off via MODBUS (for example), then 100 or more different read items are requested but the ‘burner off’ register is not updated, the burner will stay off.

The MODBUS ‘read’ functions listed in section 4.4 below allow multiple items to be read in one MODBUS request. However the maximum size of MODBUS messages is limited to 128 bytes. The maximum number of items that can be read in one message is 61, but it is recommended that significantly fewer registers are read. Again, this many contiguous registers will not all contain useful data anyway.

Note: Check daughterboard firmware level if Option 0.7 and 0.8 are correctly set and the MODBUS message structure has been verified as correct.

All address references in the MODBUS messages use numbers relative to zero. For example, the first holding register SETPOINT 1 CONTROL VALUE, would be 40001 and be referenced as register 0000. Similarly, coil 0008, BURNER ON/OFF, would be register 0007.

4.2 MODBUS system reset and timeout

It is possible to change operational parameters of the burner / boiler by writing to coils and holding registers (see following sections). Once one of these registers is written to, it will become 'active' and start to control the burner using the data written to it.

This register will remain 'active' controlling the burner forever unless there is no MODBUS communication to this slave for three minutes. So, if there are no MODBUS read requests or write requests for three minutes, all control functions will be disabled and the FIREYE controller will operate in it's default or local state.

As soon as communication resumes (even if just one register is read), the system will remember the active control register setting from before and those values previously written will be asserted once more.

Note : For daughterboard firmware levels less than 1.103, the timeout mechanism is slightly different – each MODBUS item had it's own 3 minute timeout and there isn't a 'global' MODBUS timeout. This means that all control registers have to be refreshed at least once every 3 minutes. Whilst this is good practice, it is no longer required for daughterboard firmware 1.103 onwards.

From version 1.103, it is possible to 'reset' the MODBUS system completely by writing a value of 1 to coil address 999. This will reset all coils and holding registers to the default (inactive) or local state. This will allow the burner to run from its local values in the event that some registers are holding it in an undesirable state. Note that there is a one minute timeout before the control 'forgets' the effects of the coils / holding registers and runs using it's default values.

4.3 Coils (0XXX(X)) – WRITE TO registers (MODBUS Function Code 5)

There are 20 coil registers available in the NX6100/PPC6000 series controllers. Coils are similar to switches in that they are set on or off. The MODBUS function code 15 (write multiple coils) is not supported.

The MODbus function code 15 (write multiple coils) is not supported.

Once a coil is written to, this value will be current until either
- the coil register is written to again with a different value, or
- there is no MODBUS activity to or from this slave for three minutes (MODBUS time-out), or
- the power is removed from the controller, or
- the MODBUS system is reset (see 'MODBUS reset').

For daughterboard firmware levels 1.103 and greater, the coil values may also be read using MODBUS function code 1. The value read back will be the last value that was written to that coil register. This function needs to be used with care because reading from a coil register that is currently inactive (i.e. never has been written to) will activate that coil with a default value of zero. So, if after a power-up the burner is running and then coil address 7 is read (never having been written to before) a value of zero will be returned and the burner will turn off. To turn the burner back on again, a value of 1 must be written to this coil (or the MODBUS system reset / power cycled).

Note: Not all items are valid for all models within the NX6100/PPC6000 series.

Reg Address	Function	Details
0	Setpoint Select	0 = Run to setpoint 1 1 = Run to setpoint 2 (use for night setback etc.)
1	Release to Ignite	If used, must be 1 to allow the burner to ignite.
2	Low Fire Hold	0= Normal modulation. 1= Low Fire Hold.
3	Lead boiler Select	Choose this to be the lead boiler if boiler sequencing is in operation.
4	Mute / Reset	Due to differing approvals requirements, this function may be disabled.
5	Oxygen Trim Enable	1 = Allow trim to be ON
6	Boiler Sequencing Enable	1 = Enable boiler sequencing (lead-lag). Must be done for every unit.
7	Burner ON/OFF	If the burner is firing / able to fire, it can be held OFF by writing a zero to this register.
8 – 10	Reserved for future use.	
11	Select Profile 1	1 = Force profile 1, 0 = Run with current profile.
12	Select Profile 2	1 = Force profile 2, 0 = Run with current profile.
13	Select Profile 3	1 = Force profile 3, 0 = Run with current profile.
14	Select Profile 4	1 = Force profile 4, 0 = Run with current profile.
15 – 998	Reserved for future use.	
999	Reset MODBUS	1 = Reset all coils and holding registers to the default (inactive) state. This will allow the burner to run from its local values.

4.4 Input Registers (3XXX(X)) – READ FROM (MODBUS function code 4)

There are many input registers available. The majority of these read current display or engineering (test) values from the system, but a subset of the fault log is also available if the control firmware is 1.201 or higher and the daughterboard firmware is 1.103 or higher.

For display and engineering values, these are all 16 bit registers holding signed integer numbers. When a number has decimal information, it is multiplied up to give an integer number.
For example:
173 ºC Flue Temperature will read as 173
3.2% oxygen will read as 32.
17.4º servo position will read as 174.
-12% trim will read as -12.
5.00 bar setpoint will read as 500.

Whilst the decimal precision is different for different items, it will not change for any particular item during normal use.

Each fault log item is an 8 byte structure stored in 4 consecutive 16 bit registers.

- Register 0 = (256 * fault number) + condition.
- Register 1 = (256 * year) + month
- Register 2 = (256 * day) + hour
- Register 3 = (256 * minute) + subset

Where :

- Condition = 0 for restart / reset, 1 = Cleared fault or limit (Cx), 2 = Fault (Fx) fault, 3 = Limit (Lx).
- Year is 00 to 99
- Month is 1 to 12
- Day is 1 to 31
- Hour = 0 to 23
- Minute is 0 to 59
- Subset is the fault subset information (0 to 255), if applicable.

Reg address	Function	Details
0	Drive 0 Position	As on product display.
1	Drive 1 Position	As on product display.
2	Drive 2 Position	As on product display.
3	Drive 3 Position	As on product display.
4	Drive 4 Position	As on product display.
5	Drive 5 Position	As on product display.
6	Drive 6 Position	As on product display.
7	Drive 7 Position	As on product display.
8	Drive 8 Position	As on product display.
9	Drive 9 Position	As on product display.
10	Spare	Do not use
11	Spare	Do not use
12	Measured Value	As on product display.
13	Efficiency	As on product display.
14	Inlet Temp	As on product display.
15	O2 Level	As on product display.
16	CO2 Level	As on product display.
17	Spare	
18	Hours Run	As on product display.
19	Burner Status	As on product display.
20	Trim	As on product display.
21	Setpoint	As on product display.
22	Flue Temp	As on product display.
23	Fault Number	As on product display.
24	Spare	
25	Spare	
26	Spare	
27	Profile Number	As on product display.
28	Do not use.	
29	Do not use.	
30	Modulation Rate	As on product display.
31	Spare	
32	Spare	
33	Spare	
34	Spare	

Reg address	Function	Details
35	Gas Pressure	As on product display.
36	Valve Prove Status	As on product display.
37	Flame Signal	As on product display.
38	2nd Flame Signal	UV level if IR is used
39 to 49	Reserved for future use	
1000	Engineers Key 0	Device specific data
1001	Engineers Key 1	Device specific data
1002	Engineers Key 2	Device specific data
1003 to 1199	Engineers Key 3 to 199	Device specific data
2000 to 2003	Fault log item 0	Most recently logged fault event
2004 to 2007	Fault log item 1	Next recently logged fault event
2008 to 2011	Fault log item 2	Next recently logged fault event
2012 to 2015	Fault log item 3	Next recently logged fault event
2016 to 2019	Fault log item 4	Next recently logged fault event
2020 to 2023	Fault log item 5	Next recently logged fault event
2024 to 2027	Fault log item 6	Next recently logged fault event
2028 to 2031	Fault log item 7	Next recently logged fault event
2032 to 2035	Fault log item 8	Next recently logged fault event
2036 to 2039	Fault log item 9	Next recently logged fault event
2040 to 2043	Fault log item 10	Next recently logged fault event
2044 to 2047	Fault log item 11	Next recently logged fault event
2048 to 2051	Fault log item 12	Next recently logged fault event
2052 to 2055	Fault log item 13	Next recently logged fault event
2056 to 2059	Fault log item 14	Next recently logged fault event
2060 to 2063	Fault log item 15	Next recently logged fault event
2064 to 2067	Fault log item 16	Next recently logged fault event
2068 to 2071	Fault log item 17	Next recently logged fault event
2072 to 2075	Fault log item 18	Next recently logged fault event
2076 to 2079	Fault log item 19	Next recently logged fault event
2080 to 2083	Fault log item 20	Next recently logged fault event
2084 to 2087	Fault log item 21	Next recently logged fault event
2088 to 2091	Fault log item 22	Next recently logged fault event
2092 to 2095	Fault log item 23	Oldest logged fault event

4.5 Holding Registers (4XXX(X)) – WRITE TO (MODBUS function code 6)

There are 20 holding (write to) registers available. These are 16 bit registers holding integer values. Writing an out of range value (for example 1000) will disable the control item and the system will go back to using its default value (immediately).

The MODBUS function code 16 (write multiple registers) is <u>not</u> supported.

Once a holding register is written to, this value will be current until either
- the holding register is written to again with a different value, or
- the holding register is written to again with an out of range value (>999), or
- there is no MODBUS activity to or from this slave for three minutes (MODBUS times out), or
- the power is removed from the controller, or
- the MODBUS system is reset (see 'MODBUS reset').

For daughterboard firmware levels 1.103 and greater, the holding register values may also be read using MODBUS function code 3. The value read back will be the last value that was written to that holding register. This function needs to be used with care because reading from a holding register that is currently inactive (i.e. has never been written to) will activate that holding with a default value of zero. So, for example, if after a power-up the burner is running with a default setpoint of 10.0 and then holding register address 0 is read (never having been written to before) a value of zero will be returned and the burners setpoint will become ZERO. To get the setpoint back to 10.0, a value of 100 (or >999) must be written to this register (or the MODBUS system reset / power cycled).

Reg. Address	Function	Details
0	Setpoint 1 Control Value	Strip decimal information – i.e. 999 = 99.9 = 9.99
1	Setpoint 2 Control Value	Strip decimal information – i.e. 999 = 99.9 = 9.99
2	Setpoint 1 Low Control Limit	Strip decimal information – i.e. 999 = 99.9 = 9.99
3	Setpoint 2 Low Control Limit	Strip decimal information – i.e. 999 = 99.9 = 9.99
4	Setpoint 1 High Control Limit	Strip decimal information – i.e. 999 = 99.9 = 9.99
5	Setpoint 2 High Control Limit	Strip decimal information – i.e. 999 = 99.9 = 9.99
6	Modulation Rate	0 = low fire, 999 = high fire
7 – 15	Reserved for future use.	

5. Modbus TCPIP Data Sets

5.1 Overview.

Only the register spaces for coils, input registers and holding registers are used by this system. Modbus defines each of these spaces as having 65536 possible 16 bit registers. These registers are numbered 1 to 65536 but are accessed in modbus messages by their addresses, which are always one less - so the addresses range from 0 to 65535. To attempt to avoid confusion, this document refers to both the number and address of each register.

Sometimes modbus register numbers are preceded by a number such as 0xxxx for coils, 4xxxx for holding registers and 3xxxx for input registers. This notation is not part of the modbus standard and is not used in this document.

The modbus register map for modbus TCP is DIFFERENT to the register map used by 6000 series products with modbus RTU via RS485.

The following Modbus register types are supported :

- Coils (0 or 1) - These registers can be written to by a Modbus TCP master to provide control of certain ON/OFF functions such as turning the burner off, or selecting the night-setback setpoint. In addition these registers can be read to interrogate the last value written to them.

- Input registers (32 bit floating point, sent as two consecutive registers, low word first) - These can be read by a Modbus master to monitor combustion and other variables. Pairs of 16 bit modbus registers are used to give 32 bit floating-point registers. The value 1.205 (IEE754 = 3F9A3D71) would be sent as two holding registers, the first one containing 3D71 and the second one containing 3F9A.

  Alternatively, the same data is available as 16 bit integers in the holding registers map, if required.

- Holding registers (16 bit integer) – Some of these registers provide access to the same read-only values as the input registers described above. Others can be written to by a Modbus master to change modulation control of the boiler. As with Coils, these registers can be read to interrogate the last value written. Decimal values are transferred ‘multiplied up’ as required to maintain precision so, 1.234, 12.34, 123.4 and 1234 are all sent as 1234.

The system will attempt to provide up-to-date data for all values read. However, values from the ‘engineers key’ lists can become out of date and if required should be requested frequently (or at least twice in succession with two or three seconds between) to ensure up-to-date data is returned. The expected scenario would be that the master would poll values once every 10 seconds or more frequently.

Values from the ‘display values’ list will always be up-to-date no matter how infrequently they are read.

Control functions initiated by writing to coils and holding registers are subject to a one minute timeout per function. When used carelessly, these functions can prevent the boiler from running as it should so these functions must be written to at least as often as once a minute to keep them active.

5.2 Coils (READ / WRITE) registers (Modbus Function Codes 1 & 5)

Sometimes these registers are referred to as registers 0xxxx registers although this notation is not part of the modbus standard and is not used here.

There are 16 coil registers available for a single burner system. Coils are similar to switches in that they are set on or off. The modbus function code 15 (write multiple coils) is NOT supported however the coil values may also be read using modbus function code 1. The value read back will be the last value that was written to that coil register. These registers must be used with care since they can prevent the boiler from operating or meeting the site load.

If used, these registers must be written to at least as often as once a minute. After one minute, the function will timeout and the control will revert to it's default mode of operation.

Note : Not all items are valid for all models within the Fireye 6000 series.

Register number	Register address	Function	Details
1	0	Setpoint Select	0 = Run to setpoint 1. 1 = Run to setpoint 2 (use for night setback etc.). This register MUST NOT be written to if the built-in boiler sequencing system is being used,
2	1	Release to Ignite	If used, must be 1 to allow the burner to ignite.
3	2	Low Fire Hold	0= Normal modulation. 1= Low Fire Hold.
4	3	Lead boiler Select	Choose this to be the lead boiler if boiler sequencing is in operation.
5	4	Mute / Reset	Due to differing approvals requirements, this function may be disabled. This register will mute the alarms and reset the fault, allowing the burner to restart. To do this, the register must be set to 1 for typically 5 seconds. Once the fault has been reset, or after 5 seconds, the register should be cleared. DO NOT ACTIVATE THIS REGISTER WHEN THERE ARE NO ALARMS TO MUTE. If this is repeatedly done, an F36 fault will lockout the burner. This fault cannot be reset remotely.
6	5	Oxygen Trim Enable	1 = Allow trim to be ON
7	6	Boiler Sequencing Enable	1 = Enable boiler sequencing (lead-lag). Must be done for every unit.
8	7	Burner ON/OFF	If the burner is firing / able to fire, it can be held OFF by writing a zero to this register.
9	8	Fault Mute Only	When set to 1, this register will mute fault alarms. Unlike register number 5 (address 4), this register will not cause the burner to restart if the fault has cleared, no matter how long it is left on for. As with the other register, it should be set to 0 after use. **Compatibility note :** This function requires controls with firmware versions 1.221 or greater. Also, these controls must have modulation program 41 or later installed (check EK 56 and EK 200).
10 - 11	9 – 10	Reserved for future use.	
12	11	Select Profile 1	1 = Force profile 1, 0 = Run with current profile. Integrated controls only.
13	12	Select Profile 2	1 = Force profile 2, 0 = Run with current profile. Integrated controls only.
14	13	Select Profile 3	1 = Force profile 3, 0 = Run with current profile. Integrated controls only.
15	14	Select Profile 4	1 = Force profile 4, 0 = Run with current profile. Integrated controls only.
16 onwards	15 onwards	Reserved for future use.	

5.3 Input (READ ONLY) registers (Modbus function code 4)

Sometimes these registers are referred to as registers 3xxxx registers although this notation is not part of the modbus standard and is not used here.

There are many input registers available, these read current display or engineering (test) values from the system.

These values are sent as 32 bit IEE754 floating point values, sent as two consecutive registers - low word first.

This example illustrates reading the burner control firmware version via EK56 (EK stands for engineers key). From the table opposite, EK56 starts at register 314 (address 313). A modbus poll for two registers 314 & 315 (addresses 313 & 314) yields :
Address 313 = 0x3D71
Address 314 = 0x3F9A.

The value 1.205 (IEE754 = 3F9A3D71) has been sent as two holding registers, the first one containing 3D71 and the second one containing 3F9A.

Alternatively, the same data is available as 16 bit integers in the holding registers map, if the modbus master is easier configured to use standard modbus integer registers.

Register Number	*Register address*	*Function*	*Details*
1	0	Drive 0 Position	As on product display.
3	2	Drive 1 Position	As on product display.
5	4	Drive 2 Position	As on product display.
7	6	Drive 3 Position	As on product display.
9	8	Drive 4 Position	As on product display.
11	10	Drive 5 Position	As on product display.
13	12	Drive 6 Position	As on product display.
15	14	Drive 7 Position	As on product display.
17	16	Drive 8 Position	As on product display.
19	18	Drive 9 Position	As on product display.
21	20	Spare	Do not use
23	22	Spare	Do not use
25	24	Measured Value	As on product display.
27	26	Efficiency	As on product display.
29	28	Inlet Temp	As on product display.
31	30	O2 Level	As on product display.
33	32	CO2 Level	As on product display.
35	34	Spare	
37	36	Hours Run	As on product display.
39	38	Burner Status	As on product display.
41	40	Trim	As on product display.
43	42	Setpoint	As on product display.
45	44	Flue Temp	As on product display.
47	46	Fault Number	As on product display.
49	48	Spare	
51	50	Spare	
53	52	Spare	
55	54	Profile Number	As on product display.

Register Number	Register address	Function	Details
57	56	Do not use.	
59	58	Do not use.	
61	60	Modulation Rate	As on product display.
63	62	Spare	
65	64	Spare	
67	66	Spare	
69	68	Spare	
71	70	Gas Pressure	As on product display.
73	72	Valve Prove Status	As on product display.
75	74	Flame Signal	As on product display.
77	76	2nd Flame Signal	UV level if IR is used
79 – 198	78 - 197	Reserved for future use	
199	198	Touchscreen firmware version	The firmware version of the touchscreen providing modbus TCP.
		Reserved for future use	
201	200	Engineers Key 0	See product manual 'EK' list
203	202	Engineers Key 1	See product manual 'EK' list
205	204	Engineers Key 2	See product manual 'EK' list
207	206	Engineers Key 3	See product manual 'EK' list
209	208	Engineers Key 4	See product manual 'EK' list
211	210	Engineers Key 5	See product manual 'EK' list
213	212	Engineers Key 6	See product manual 'EK' list
215	214	Engineers Key 7	See product manual 'EK' list
217	216	Engineers Key 8	See product manual 'EK' list
219	218	Engineers Key 9	See product manual 'EK' list
221	220	Engineers Key 10	See product manual 'EK' list
223	222	Engineers Key 11	See product manual 'EK' list
225	224	Engineers Key 12	See product manual 'EK' list
227	226	Engineers Key 13	See product manual 'EK' list
229	228	Engineers Key 14	See product manual 'EK' list
231	230	Engineers Key 15	See product manual 'EK' list
233	232	Engineers Key 16	See product manual 'EK' list
235	234	Engineers Key 17	See product manual 'EK' list
237	236	Engineers Key 18	See product manual 'EK' list
239	238	Engineers Key 19	See product manual 'EK' list
241	240	Engineers Key 20	See product manual 'EK' list
243	242	Engineers Key 21	See product manual 'EK' list
245	244	Engineers Key 22	See product manual 'EK' list
247	246	Engineers Key 23	See product manual 'EK' list
249	248	Engineers Key 24	See product manual 'EK' list
251	250	Engineers Key 25	See product manual 'EK' list
253	252	Engineers Key 26	See product manual 'EK' list
255	254	Engineers Key 27	See product manual 'EK' list
257	256	Engineers Key 28	See product manual 'EK' list
259	258	Engineers Key 29	See product manual 'EK' list
261	260	Engineers Key 30	See product manual 'EK' list
263	262	Engineers Key 31	See product manual 'EK' list
265	264	Engineers Key 32	See product manual 'EK' list
267	266	Engineers Key 33	See product manual 'EK' list
269	268	Engineers Key 34	See product manual 'EK' list
271	270	Engineers Key 35	See product manual 'EK' list
273	272	Engineers Key 36	See product manual 'EK' list
275	274	Engineers Key 37	See product manual 'EK' list
277	276	Engineers Key 38	See product manual 'EK' list

Register Number	Register address	Function	Details
279	278	Engineers Key 39	See product manual 'EK' list
281	280	Engineers Key 40	See product manual 'EK' list
283	282	Engineers Key 41	See product manual 'EK' list
285	284	Engineers Key 42	See product manual 'EK' list
287	286	Engineers Key 43	See product manual 'EK' list
289	288	Engineers Key 44	See product manual 'EK' list
291	290	Engineers Key 45	See product manual 'EK' list
293	292	Engineers Key 46	See product manual 'EK' list
295	294	Engineers Key 47	See product manual 'EK' list
297	296	Engineers Key 48	See product manual 'EK' list
299	298	Engineers Key 49	See product manual 'EK' list
301	300	Engineers Key 50	See product manual 'EK' list
303	302	Engineers Key 51	See product manual 'EK' list
305	304	Engineers Key 52	See product manual 'EK' list
307	306	Engineers Key 53	See product manual 'EK' list
309	308	Engineers Key 54	See product manual 'EK' list
311	310	Engineers Key 55	See product manual 'EK' list
313	312	Engineers Key 56	See product manual 'EK' list
315	314	Engineers Key 57	See product manual 'EK' list
317	316	Engineers Key 58	See product manual 'EK' list
319	318	Engineers Key 59	See product manual 'EK' list
321	320	Engineers Key 60	See product manual 'EK' list
323	322	Engineers Key 61	See product manual 'EK' list
325	324	Engineers Key 62	See product manual 'EK' list
327	326	Engineers Key 63	See product manual 'EK' list
329	328	Engineers Key 64	See product manual 'EK' list
331	330	Engineers Key 65	See product manual 'EK' list
333	332	Engineers Key 66	See product manual 'EK' list
335	334	Engineers Key 67	See product manual 'EK' list
337	336	Engineers Key 68	See product manual 'EK' list
339	338	Engineers Key 69	See product manual 'EK' list
341	340	Engineers Key 70	See product manual 'EK' list
343	342	Engineers Key 71	See product manual 'EK' list
345	344	Engineers Key 72	See product manual 'EK' list
347	346	Engineers Key 73	See product manual 'EK' list
349	348	Engineers Key 74	See product manual 'EK' list
351	350	Engineers Key 75	See product manual 'EK' list
353	352	Engineers Key 76	See product manual 'EK' list
355	354	Engineers Key 77	See product manual 'EK' list
357	356	Engineers Key 78	See product manual 'EK' list
359	358	Engineers Key 79	See product manual 'EK' list
361	360	Engineers Key 80	See product manual 'EK' list
363	362	Engineers Key 81	See product manual 'EK' list
365	364	Engineers Key 82	See product manual 'EK' list
367	366	Engineers Key 83	See product manual 'EK' list
369	368	Engineers Key 84	See product manual 'EK' list
371	370	Engineers Key 85	See product manual 'EK' list
373	372	Engineers Key 86	See product manual 'EK' list
375	374	Engineers Key 87	See product manual 'EK' list
377	326	Engineers Key 88	See product manual 'EK' list
379	328	Engineers Key 89	See product manual 'EK' list
381	380	Engineers Key 90	See product manual 'EK' list
383	382	Engineers Key 91	See product manual 'EK' list
385	384	Engineers Key 92	See product manual 'EK' list

Register Number	Register address	Function	Details
387	386	Engineers Key 93	See product manual 'EK' list
389	388	Engineers Key 94	See product manual 'EK' list
391	390	Engineers Key 95	See product manual 'EK' list
393	392	Engineers Key 96	See product manual 'EK' list
395	394	Engineers Key 97	See product manual 'EK' list
397	396	Engineers Key 98	See product manual 'EK' list
399	398	Engineers Key 99	See product manual 'EK' list
401	400	Engineers Key 100	See product manual 'EK' list
403	402	Engineers Key 101	See product manual 'EK' list
405	404	Engineers Key 102	See product manual 'EK' list
407	406	Engineers Key 103	See product manual 'EK' list
409	408	Engineers Key 104	See product manual 'EK' list
411	410	Engineers Key 105	See product manual 'EK' list
413	412	Engineers Key 106	See product manual 'EK' list
415	414	Engineers Key 107	See product manual 'EK' list
417	416	Engineers Key 108	See product manual 'EK' list
419	418	Engineers Key 109	See product manual 'EK' list
421	420	Engineers Key 110	See product manual 'EK' list
423	422	Engineers Key 111	See product manual 'EK' list
425	424	Engineers Key 112	See product manual 'EK' list
427	426	Engineers Key 113	See product manual 'EK' list
429	428	Engineers Key 114	See product manual 'EK' list
431	430	Engineers Key 115	See product manual 'EK' list
433	432	Engineers Key 116	See product manual 'EK' list
435	434	Engineers Key 117	See product manual 'EK' list
437	436	Engineers Key 118	See product manual 'EK' list
439	438	Engineers Key 119	See product manual 'EK' list
441	440	Engineers Key 120	See product manual 'EK' list
443	442	Engineers Key 121	See product manual 'EK' list
445	444	Engineers Key 122	See product manual 'EK' list
447	446	Engineers Key 123	See product manual 'EK' list
449	448	Engineers Key 124	See product manual 'EK' list
451	450	Engineers Key 125	See product manual 'EK' list
453	452	Engineers Key 126	See product manual 'EK' list
455	454	Engineers Key 127	See product manual 'EK' list
457	456	Engineers Key 128	See product manual 'EK' list
459	458	Engineers Key 129	See product manual 'EK' list
461	460	Engineers Key 130	See product manual 'EK' list
463	462	Engineers Key 131	See product manual 'EK' list
465	464	Engineers Key 132	See product manual 'EK' list
467	466	Engineers Key 133	See product manual 'EK' list
469	468	Engineers Key 134	See product manual 'EK' list
471	470	Engineers Key 135	See product manual 'EK' list
473	472	Engineers Key 136	See product manual 'EK' list
475	474	Engineers Key 137	See product manual 'EK' list
477	476	Engineers Key 138	See product manual 'EK' list
479	478	Engineers Key 139	See product manual 'EK' list
481	480	Engineers Key 140	See product manual 'EK' list
483	482	Engineers Key 141	See product manual 'EK' list
485	484	Engineers Key 142	See product manual 'EK' list
487	486	Engineers Key 143	See product manual 'EK' list
489	488	Engineers Key 144	See product manual 'EK' list
491	490	Engineers Key 145	See product manual 'EK' list
493	492	Engineers Key 146	See product manual 'EK' list

Register Number	Register address	Function	Details
495	494	Engineers Key 147	See product manual 'EK' list
497	496	Engineers Key 148	See product manual 'EK' list
499	498	Engineers Key 149	See product manual 'EK' list
501	500	Engineers Key 150	See product manual 'EK' list
503	502	Engineers Key 151	See product manual 'EK' list
505	504	Engineers Key 152	See product manual 'EK' list
507	506	Engineers Key 153	See product manual 'EK' list
509	508	Engineers Key 154	See product manual 'EK' list
511	510	Engineers Key 155	See product manual 'EK' list
513	512	Engineers Key 156	See product manual 'EK' list
515	514	Engineers Key 157	See product manual 'EK' list
517	516	Engineers Key 158	See product manual 'EK' list
519	518	Engineers Key 159	See product manual 'EK' list
521	520	Engineers Key 160	See product manual 'EK' list
523	522	Engineers Key 161	See product manual 'EK' list
525	524	Engineers Key 162	See product manual 'EK' list
527	526	Engineers Key 163	See product manual 'EK' list
529	528	Engineers Key 164	See product manual 'EK' list
531	530	Engineers Key 165	See product manual 'EK' list
533	532	Engineers Key 166	See product manual 'EK' list
535	534	Engineers Key 167	See product manual 'EK' list
537	536	Engineers Key 168	See product manual 'EK' list
539	538	Engineers Key 169	See product manual 'EK' list
541	540	Engineers Key 170	See product manual 'EK' list
343	542	Engineers Key 171	See product manual 'EK' list
545	544	Engineers Key 172	See product manual 'EK' list
547	546	Engineers Key 173	See product manual 'EK' list
549	548	Engineers Key 174	See product manual 'EK' list
551	550	Engineers Key 175	See product manual 'EK' list
553	552	Engineers Key 176	See product manual 'EK' list
555	554	Engineers Key 177	See product manual 'EK' list
557	556	Engineers Key 178	See product manual 'EK' list
559	558	Engineers Key 179	See product manual 'EK' list
561	560	Engineers Key 180	See product manual 'EK' list
563	562	Engineers Key 181	See product manual 'EK' list
565	564	Engineers Key 182	See product manual 'EK' list
567	566	Engineers Key 183	See product manual 'EK' list
569	568	Engineers Key 184	See product manual 'EK' list
571	570	Engineers Key 185	See product manual 'EK' list
573	572	Engineers Key 186	See product manual 'EK' list
575	574	Engineers Key 187	See product manual 'EK' list
577	526	Engineers Key 188	See product manual 'EK' list
579	528	Engineers Key 189	See product manual 'EK' list
581	580	Engineers Key 190	See product manual 'EK' list
583	582	Engineers Key 191	See product manual 'EK' list
585	584	Engineers Key 192	See product manual 'EK' list
587	586	Engineers Key 193	See product manual 'EK' list
589	588	Engineers Key 194	See product manual 'EK' list
591	590	Engineers Key 195	See product manual 'EK' list
593	592	Engineers Key 196	See product manual 'EK' list
595	594	Engineers Key 197	See product manual 'EK' list
597	596	Engineers Key 198	See product manual 'EK' list
599	598	Engineers Key 199	See product manual 'EK' list
601	600	Engineers Key 200	See product manual 'EK' list

5.4 Holding (READ FROM / WRITE TO) registers (Modbus function codes 3 & 6)

Sometimes these registers are referred to as registers 4xxxx registers although this notation is not part of the modbus standard and is not used here.

There are many holding registers available :

- The display values 0 to 40 as in the input registers above but as 16 bit integers (READ ONLY)
- The engineers values (EK's) 0 to 200 as in the input registers above but as 16 bit integers (READ ONLY)
- The remote control holding registers that can be written to (READ / WRITE).
- A copy of the holding registers from a fireye burner control if used.

The 16 writable holding registers are register numbers 801 to 816 (address 800 to 815). These are 16 bit registers holding integer values which normally range from 0 to 999. Writing an out of range value (for example 1000) will disable the control item and the system will go back to using its default value (immediately).

The modbus function code 16 (write multiple registers) is **not** supported. The writable registers must be used with care because the parameters available can stop the boiler from operating as required to meet the site load.

If used, these registers must be written to at least as often as once a minute. After one minute, the function will timeout and the control will revert to it's default mode of operation.

For display, engineers (EK) values and remote control values, these are all 16 bit registers holding signed integer numbers. When a number has decimal information, it is multiplied up to give an integer number.
For example:
173 ºC Flue Temperature will read as 173
3.2% oxygen will read as 32.
17.4º servo position will read as 174.
-12% trim will read as -12.
5.00 bar setpoint will read as 500.

Whilst the decimal precision is different for different items, it will not change for any particular item during normal use.

		READ ONLY HOLDING REGISTERS	
Regieter Number	***Register Address***	***Function***	***Details***
1	0	Drive 0 Position	As on product display.
2	1	Drive 1 Position	As on product display.
3	2	Drive 2 Position	As on product display.
4	3	Drive 3 Position	As on product display.
5	4	Drive 4 Position	As on product display.
6	5	Drive 5 Position	As on product display.
7	6	Drive 6 Position	As on product display.
8	7	Drive 7 Position	As on product display.
9	8	Drive 8 Position	As on product display.
10	9	Drive 9 Position	As on product display.
11	10	Spare	Do not use
12	11	Spare	Do not use
13	12	Measured Value	As on product display.
14	13	Efficiency	As on product display.
15	14	Inlet Temp	As on product display.
16	15	O2 Level	As on product display.
17	16	CO2 Level	As on product display.

		READ ONLY HOLDING REGISTERS	
Regieter Number	**Register Address**	**Function**	**Details**
18	17	Spare	
19	18	Hours Run	As on product display.
20	19	Burner Status	As on product display.
21	20	Trim	As on product display.
22	21	Setpoint	As on product display.
23	22	Flue Temp	As on product display.
24	23	Fault Number	As on product display.
25	24	Spare	
26	25	Spare	
27	26	Spare	
28	27	Profile Number	As on product display.
29	28	Do not use.	
30	29	Do not use.	
31	30	Modulation Rate	As on product display.
32	31	Spare	
33	32	Spare	
34	33	Spare	
35	34	Spare	
36	35	Gas Pressure	As on product display.
37	36	Valve Prove Status	As on product display.
38	37	Flame Signal	As on product display.
39	38	2nd Flame Signal	UV level if IR is used
40…99	39…98	Reserved for future use	
100	99	Touchscreen firmware version	The firmware version of the touchscreen providing modbus TCP.
101	100	Engineers Key 0	See product manual ‘EK’ list
102	101	Engineers Key 1	See product manual ‘EK’ list
103	102	Engineers Key 2	See product manual ‘EK’ list
104	103	Engineers Key 3	See product manual ‘EK’ list
105	104	Engineers Key 4	See product manual ‘EK’ list
106	105	Engineers Key 5	See product manual ‘EK’ list
107	106	Engineers Key 6	See product manual ‘EK’ list
108	107	Engineers Key 7	See product manual ‘EK’ list
109	108	Engineers Key 8	See product manual ‘EK’ list
110	109	Engineers Key 9	See product manual ‘EK’ list
111	110	Engineers Key 10	See product manual ‘EK’ list
112	111	Engineers Key 11	See product manual ‘EK’ list
113	112	Engineers Key 12	See product manual ‘EK’ list
114	113	Engineers Key 13	See product manual ‘EK’ list
115	114	Engineers Key 14	See product manual ‘EK’ list
116	115	Engineers Key 15	See product manual ‘EK’ list
117	116	Engineers Key 16	See product manual ‘EK’ list
118	117	Engineers Key 17	See product manual ‘EK’ list
119	118	Engineers Key 18	See product manual ‘EK’ list
120	119	Engineers Key 19	See product manual ‘EK’ list
121	120	Engineers Key 20	See product manual ‘EK’ list
122	121	Engineers Key 21	See product manual ‘EK’ list
123	122	Engineers Key 22	See product manual ‘EK’ list
124	123	Engineers Key 23	See product manual ‘EK’ list
125	124	Engineers Key 24	See product manual ‘EK’ list
126	125	Engineers Key 25	See product manual ‘EK’ list
127	126	Engineers Key 26	See product manual ‘EK’ list

		READ ONLY HOLDING REGISTERS	
Regieter Number	Register Address	Function	Details
128	127	Engineers Key 27	See product manual 'EK' list
129	128	Engineers Key 28	See product manual 'EK' list
130	129	Engineers Key 29	See product manual 'EK' list
131	130	Engineers Key 30	See product manual 'EK' list
132	131	Engineers Key 31	See product manual 'EK' list
133	132	Engineers Key 32	See product manual 'EK' list
134	133	Engineers Key 33	See product manual 'EK' list
135	134	Engineers Key 34	See product manual 'EK' list
136	135	Engineers Key 35	See product manual 'EK' list
137	136	Engineers Key 36	See product manual 'EK' list
138	137	Engineers Key 37	See product manual 'EK' list
139	138	Engineers Key 38	See product manual 'EK' list
140	139	Engineers Key 39	See product manual 'EK' list
141	140	Engineers Key 40	See product manual 'EK' list
142	141	Engineers Key 41	See product manual 'EK' list
143	142	Engineers Key 42	See product manual 'EK' list
144	143	Engineers Key 43	See product manual 'EK' list
145	144	Engineers Key 44	See product manual 'EK' list
146	145	Engineers Key 45	See product manual 'EK' list
147	146	Engineers Key 46	See product manual 'EK' list
148	147	Engineers Key 47	See product manual 'EK' list
149	148	Engineers Key 48	See product manual 'EK' list
150	149	Engineers Key 49	See product manual 'EK' list
151	150	Engineers Key 50	See product manual 'EK' list
152	151	Engineers Key 51	See product manual 'EK' list
153	152	Engineers Key 52	See product manual 'EK' list
154	153	Engineers Key 53	See product manual 'EK' list
155	154	Engineers Key 54	See product manual 'EK' list
156	155	Engineers Key 55	See product manual 'EK' list
157	156	Engineers Key 56	See product manual 'EK' list
158	157	Engineers Key 57	See product manual 'EK' list
159	158	Engineers Key 58	See product manual 'EK' list
160	159	Engineers Key 59	See product manual 'EK' list
161	160	Engineers Key 60	See product manual 'EK' list
162	161	Engineers Key 61	See product manual 'EK' list
163	162	Engineers Key 62	See product manual 'EK' list
164	163	Engineers Key 63	See product manual 'EK' list
165	164	Engineers Key 64	See product manual 'EK' list
166	165	Engineers Key 65	See product manual 'EK' list
167	166	Engineers Key 66	See product manual 'EK' list
168	167	Engineers Key 67	See product manual 'EK' list
169	168	Engineers Key 68	See product manual 'EK' list
170	169	Engineers Key 69	See product manual 'EK' list
171	170	Engineers Key 70	See product manual 'EK' list
172	171	Engineers Key 71	See product manual 'EK' list
173	172	Engineers Key 72	See product manual 'EK' list
174	173	Engineers Key 73	See product manual 'EK' list
175	174	Engineers Key 74	See product manual 'EK' list
176	175	Engineers Key 75	See product manual 'EK' list
177	176	Engineers Key 76	See product manual 'EK' list
178	177	Engineers Key 77	See product manual 'EK' list
179	178	Engineers Key 78	See product manual 'EK' list

		READ ONLY HOLDING REGISTERS	
Regieter Number	Register Address	Function	Details
180	179	Engineers Key 79	See product manual 'EK' list
181	180	Engineers Key 80	See product manual 'EK' list
182	181	Engineers Key 81	See product manual 'EK' list
183	182	Engineers Key 82	See product manual 'EK' list
184	183	Engineers Key 83	See product manual 'EK' list
185	184	Engineers Key 84	See product manual 'EK' list
186	185	Engineers Key 85	See product manual 'EK' list
187	186	Engineers Key 86	See product manual 'EK' list
188	187	Engineers Key 87	See product manual 'EK' list
189	188	Engineers Key 88	See product manual 'EK' list
190	189	Engineers Key 89	See product manual 'EK' list
191	190	Engineers Key 90	See product manual 'EK' list
192	191	Engineers Key 91	See product manual 'EK' list
193	192	Engineers Key 92	See product manual 'EK' list
194	193	Engineers Key 93	See product manual 'EK' list
195	194	Engineers Key 94	See product manual 'EK' list
196	195	Engineers Key 95	See product manual 'EK' list
197	196	Engineers Key 96	See product manual 'EK' list
198	197	Engineers Key 97	See product manual 'EK' list
199	198	Engineers Key 98	See product manual 'EK' list
200	199	Engineers Key 99	See product manual 'EK' list
201	200	Engineers Key 100	See product manual 'EK' list
202	201	Engineers Key 101	See product manual 'EK' list
203	202	Engineers Key 102	See product manual 'EK' list
204	203	Engineers Key 103	See product manual 'EK' list
205	204	Engineers Key 104	See product manual 'EK' list
206	205	Engineers Key 105	See product manual 'EK' list
207	206	Engineers Key 106	See product manual 'EK' list
208	207	Engineers Key 107	See product manual 'EK' list
209	208	Engineers Key 108	See product manual 'EK' list
210	209	Engineers Key 109	See product manual 'EK' list
211	210	Engineers Key 110	See product manual 'EK' list
212	211	Engineers Key 111	See product manual 'EK' list
213	212	Engineers Key 112	See product manual 'EK' list
214	213	Engineers Key 113	See product manual 'EK' list
215	214	Engineers Key 114	See product manual 'EK' list
216	215	Engineers Key 115	See product manual 'EK' list
217	216	Engineers Key 116	See product manual 'EK' list
218	217	Engineers Key 117	See product manual 'EK' list
219	218	Engineers Key 118	See product manual 'EK' list
220	219	Engineers Key 119	See product manual 'EK' list
221	220	Engineers Key 120	See product manual 'EK' list
222	221	Engineers Key 121	See product manual 'EK' list
223	222	Engineers Key 122	See product manual 'EK' list
224	223	Engineers Key 123	See product manual 'EK' list
225	224	Engineers Key 124	See product manual 'EK' list
226	225	Engineers Key 125	See product manual 'EK' list
227	226	Engineers Key 126	See product manual 'EK' list
228	227	Engineers Key 127	See product manual 'EK' list
229	228	Engineers Key 128	See product manual 'EK' list
230	229	Engineers Key 129	See product manual 'EK' list
231	230	Engineers Key 130	See product manual 'EK' list

		READ ONLY HOLDING REGISTERS	
Regieter Number	Register Address	Function	Details
232	231	Engineers Key 131	See product manual 'EK' list
233	232	Engineers Key 132	See product manual 'EK' list
234	233	Engineers Key 133	See product manual 'EK' list
235	234	Engineers Key 134	See product manual 'EK' list
236	235	Engineers Key 135	See product manual 'EK' list
237	236	Engineers Key 136	See product manual 'EK' list
238	237	Engineers Key 137	See product manual 'EK' list
239	238	Engineers Key 138	See product manual 'EK' list
240	239	Engineers Key 139	See product manual 'EK' list
241	240	Engineers Key 140	See product manual 'EK' list
242	241	Engineers Key 141	See product manual 'EK' list
243	242	Engineers Key 142	See product manual 'EK' list
244	243	Engineers Key 143	See product manual 'EK' list
245	244	Engineers Key 144	See product manual 'EK' list
246	245	Engineers Key 145	See product manual 'EK' list
247	246	Engineers Key 146	See product manual 'EK' list
248	247	Engineers Key 147	See product manual 'EK' list
249	248	Engineers Key 148	See product manual 'EK' list
250	249	Engineers Key 149	See product manual 'EK' list
251	250	Engineers Key 150	See product manual 'EK' list
252	251	Engineers Key 151	See product manual 'EK' list
253	252	Engineers Key 152	See product manual 'EK' list
254	253	Engineers Key 153	See product manual 'EK' list
255	254	Engineers Key 154	See product manual 'EK' list
256	255	Engineers Key 155	See product manual 'EK' list
257	256	Engineers Key 156	See product manual 'EK' list
258	257	Engineers Key 157	See product manual 'EK' list
259	258	Engineers Key 158	See product manual 'EK' list
260	259	Engineers Key 159	See product manual 'EK' list
261	260	Engineers Key 160	See product manual 'EK' list
262	261	Engineers Key 161	See product manual 'EK' list
263	262	Engineers Key 162	See product manual 'EK' list
264	263	Engineers Key 163	See product manual 'EK' list
265	264	Engineers Key 164	See product manual 'EK' list
266	265	Engineers Key 165	See product manual 'EK' list
267	266	Engineers Key 166	See product manual 'EK' list
268	267	Engineers Key 167	See product manual 'EK' list
269	268	Engineers Key 168	See product manual 'EK' list
270	269	Engineers Key 169	See product manual 'EK' list
271	270	Engineers Key 170	See product manual 'EK' list
272	271	Engineers Key 171	See product manual 'EK' list
273	272	Engineers Key 172	See product manual 'EK' list
274	273	Engineers Key 173	See product manual 'EK' list
275	274	Engineers Key 174	See product manual 'EK' list
276	275	Engineers Key 175	See product manual 'EK' list
277	276	Engineers Key 176	See product manual 'EK' list
278	277	Engineers Key 177	See product manual 'EK' list
279	278	Engineers Key 178	See product manual 'EK' list
280	279	Engineers Key 179	See product manual 'EK' list
281	280	Engineers Key 180	See product manual 'EK' list
282	281	Engineers Key 181	See product manual 'EK' list
283	282	Engineers Key 182	See product manual 'EK' list

		READ ONLY HOLDING REGISTERS	
Regieter Number	**Register Address**	**Function**	**Details**
284	283	Engineers Key 183	See product manual 'EK' list
285	284	Engineers Key 184	See product manual 'EK' list
286	285	Engineers Key 185	See product manual 'EK' list
287	286	Engineers Key 186	See product manual 'EK' list
288	287	Engineers Key 187	See product manual 'EK' list
289	288	Engineers Key 188	See product manual 'EK' list
290	289	Engineers Key 189	See product manual 'EK' list
291	290	Engineers Key 190	See product manual 'EK' list
292	291	Engineers Key 191	See product manual 'EK' list
293	292	Engineers Key 192	See product manual 'EK' list
294	293	Engineers Key 193	See product manual 'EK' list
295	294	Engineers Key 194	See product manual 'EK' list
296	295	Engineers Key 195	See product manual 'EK' list
297	296	Engineers Key 196	See product manual 'EK' list
298	297	Engineers Key 197	See product manual 'EK' list
299	298	Engineers Key 198	See product manual 'EK' list
300	299	Engineers Key 199	See product manual 'EK' list
301	300	Engineers Key 200	See product manual 'EK' list

		READ / WRITE HOLDING REGISTERS	Note that reading these only returns values previously written.
Regieter Number	**Register Address**	**Function**	**Details**
801	800	Setpoint 1 Control Value	Strip decimal information – i.e. 999 = 99.9 = 9.99
802	801	Setpoint 2 Control Value	Strip decimal information – i.e. 999 = 99.9 = 9.99
803	802	Setpoint 1 Low Control Limit	Strip decimal information – i.e. 999 = 99.9 = 9.99
804	803	Setpoint 2 Low Control Limit	Strip decimal information – i.e. 999 = 99.9 = 9.99
805	804	Setpoint 1 High Control Limit	Strip decimal information – i.e. 999 = 99.9 = 9.99
806	805	Setpoint 2 High Control Limit	Strip decimal information – i.e. 999 = 99.9 = 9.99
807	806	Modulation Rate	0 = low fire, 999 = high fire. This register MUST NOT be written to if the controls built-in boiler sequencing is being used unless this is the lead boiler.
808 – 816	807 – 815	Reserved for future use.	

		READ ONLY HOLDING REGISTERS (FIREYE)	Only available when used in conjunction with FIREYE PPC6000 / Burnerlogix.
Regieter Number	**Register Address**	**Function**	**Details**
901	900	STATUS	See BL-1001
902	901	MSGN	See BL-1001
903	902	GSTAT	See BL-1001
904	903	TIMER	See BL-1001
905	904	FLAME	See BL-1001
906	905	LOGSTAT	See BL-1001
907	906	INPUTS	See BL-1001
908	907	OUTPUTS	See BL-1001
909 – 910	908 – 909	SYSMINS	See BL-1001
911 – 912	910 – 911	BNRMINS	See BL-1001
913 – 914	912 – 913	CYCLES	See BL-1001
915	914	LOCKOUT COUNT	See BL-1001
916 - 921	915 - 920	MOST RECENT LOCKOUT	See BL-1001

6. Specification.

6.1 MODbus RTU

Protocol	MODBUS RTU, 4800/9600/19200 baud, 8-bit, No parity, 1 stop bit. MODBUS Functions supported: 1 – Read Coils 3 – Read Holding Registers 4 – Read Input Registers 5 – Write to Coils 6 – Write to Holding Registers
RS485 Interface	2-wire plus 0Vdc. Screen terminated to controller chassis. Termination resistors - 120Ω, set by jumper link.
Isolation	50Vdc

6.2 MODbus TCPIP

Protocol	Modbus TCP. Modbus Functions supported: 1 – Read Coils 3 – Read Holding Registers 4 – Read Input Registers 5 – Write to Coils 6 – Write to Holding Registers
Ethernet Interface	10 / 100Mbit, Isolated.

7. Appendix - Communications

7.1 E110 Flame Monitor.

SETUP
Each E110 connected to the MODBUS communication bus must have a unique address. This is set using the ED510 display module. Scroll to PROGRAM SETUP, enter this sub-menu, scroll to UNIT ADDRESS, press and release the RESET key to obtain the desired address.

COMMUNICATIONS
The protocol to be used is MODBUS RTU. This is implemented by the master (PC, PLC, etc.) issuing a poll to the slave (Flame-Monitor) and the slave responding with the appropriate message.

A typical format of a poll request is as follows:

DST	FNC	ADR HI	ADR LO	DAT HI	DAT LO	CRC LO	CRC HI

DST refers to the logical address of the slave.
FNC is the function being requested. FNC 03 is a read request.
ADR is the message number or register number of the data being requested. In MODBUS, register addresses begin at 40001 but is interpreted as address 00.
DAT is the number of words being requested. A word is an integer consisting of 2 bytes.
The normal response from a slave is as follows:

DST	FNC	DBC	DATA….	CRC	CRC
			Hi/Lo	LO	HI

DBC is the data byte count being returned. It must be two times the DAT number from the poll request.
DATA is the data returned and is always a series of 2 byte integers. If 4 words were requested then DBC would be 8 and there would be 8 data bytes or 4 data words containing the requested data.

The format of the data is 4800,N,8,1 meaning 4800 baud, no parity, and 1 stop bit.

Below is a table of currently available messages provided by the Flame-Monitor programmers, followed by a description where necessary, EP engineering code 38 or greater and EPD engineering code 4 or greater.

MODBUS MESSAGE TABLE – Holding registers (4XXX(X))

MESSAGE ADDRESS	WORD REQUESTED	RESPONSE	VALUE
00	1-6	STATUS	83 (053H) = RUN; 202 (0CAH) = LOCKOUT
01	1	MSGN	Current message being displayed (see Table 1)
02	1	GSTAT	Defines Timer Type
03	1	TIMER	Time, Flame, Address
04	1	FLAME	Flame Signal
05	1-3	LOGSTAT	Current logic module, PURGE, PTFI, AUTO (See Table 2)
06	1	INPUTS	Input limits state
07	1	OUTPUTS	Output relays state
08	2	SYSMINS	System on minutes
10	2	BNRMINS	Burner on minutes
12	2	CYCLES	Completed Burner Cycles

MESSAGE ADDRESS	WORD REQUESTED	RESPONSE	VALUE
14	1	LOCKOUT COUNT	Stored Lockout Count
15	1-6	LOCKOUT HISTORY	Last 6 Lockouts, first word is most current lockout
21	1-2	DEVTYP	Programmer device type, 5=EP, 6=EPD, 7=MicroM
22	1	AMPTYP	Amplifier Type; EUVS4=0C0H; EIR1=0A0H; ERT1, EUV1=090H;
23			
24	2	FLAME SIGNAL AVERAGES	PTFI and Auto Flame Signal Averages
35	6	Most Recent Lockout Data	Returns complete lockout description of stored lockout history. Includes lockout message, lockout module, @ burner hours, and @ burner cycles
41	6	2nd Most Recent Lockout Data	
47	6	3rd Most Recent Lockout Data	
53	6	4th Most Recent Lockout Data	
59	6	5th Most Recent Lockout Data	
65	6	6th Most Recent Lockout Data	
71	1-3	Input limits and Expansion Module registers	Returns input limits state and lower and upper expansion module (E300) registers. See Table 3
72	1-2	Expansion Module (E300) registers	Returns lower and upper Expansion Module registers
73	1		Return only upper Expansion Module register

It is suggested that polling intervals not be less than 200 mSec per request. Requesting data such as burner minutes, system minutes and burner cycles should be kept at a minimum due to the amount of processing time required to gather that data.

Messages 00, 05, 08, 10, 15, 21 and 26 are unique in that a limited number of successive registers can be combined with these requests. For example, a request to message 00 can contain up to 6 data words. The response to this would contain STATUS, MSGN, GSTAT, TIMER, FLAME and LOGSTAT. If the requested data word count (DAT) were to be 2 then the response would contain STATUS and MSGN only. Message 15, last 6 lockouts, can return data ranging from 1 to 6, with 1 referring to the most recent lockout.

The MSGN being transmitted is a numerical value and must be interpreted by the communicating device, which actually is an advantage since this can be made to be whatever message text the end user wants. In other words, it allows for programming custom messages without actually changing the message in the programmer. Refer to Table 1 for message information.

The Flame-Monitor stores its burner on time and system on time (L1 powered) in minutes. For display purposes, the programmer converts this to hours. The information being supplied by MODBUS will be the actual time in minutes and it is up to the communicating device to do the conversion. Since the maximum value stored in the Flame-Monitor is 9,999,999 minutes, the maximum value in hex therefore is 98967FH and comprises two data words. The maximum cycle count is 999,999 decimal or F423FH, still two data words. As an example, the System on Minutes data is transmitted from the Flame-Monitor to the interface as high word / low word as shown below:

ADDRESS 8		ADDRESS 9	
HIGH		LOW	
HIGH BYTE	LOW BYTE	HIGH BYTE	LOW BYTE
0	98H	97H	FH

Note: *Data from address 9 cannot be accessed directly.*
All values are represented in a HEX or base 16 format.

GSTAT determines the type of value TIMER represents. TIMER can be a running timer such as is used in purge, a flame signal or meaningless. Only the lower nibble of GSTAT has any value. If this value is 0 then the TIMER value has no meaning. The value in TIMER is a background minute timer in the Flame-Monitor and should be ignored. If GSTAT is between 4 and 7, the TIMER represents the current value flame signal. If GSTAT is a 1, 2, or 3 then TIMER represents a running timer value.

The baud rate of the Flame-Monitor is fixed at 4800 bits per second. The format of the data is 8 data bits, no parity and 1 stop bit. Due to the RS485 format, the communication format is considered half- duplex. That is, only one user is permitted on the communication lines at a time.

The information contained in INPUTS and OUTPUTS represents the status of the interlocks and relays respectively. For the INPUTS, a 1 in the interlock position defines the interlock as being on or active where a 1 in any bit position in the OUTPUT register signifies the relay as being energized.

Table 3 - Refer to Fireye bulletin E-3001 for terminal designations

INPUTS

Bit 7 Term P	Term 5/6	Term D		Term 8	Term 7	Term 3	bit 0 Term 13
Air Flow	Ignition	Low Fire	Ref	High Fire	Main Fuel	FVES or POC	Op Ctrl

A ‘1’ in the opto-coupler position indicates the opto-coupler is on or interlock closed.

EXPANSION MODULE (E300) LOWER - REFER TO BULLETIN E-3001

Term 35	Term 34	Term 33	Term 32	Term 23	Term 22	Term 21	Term 20
Aux #6	Aux #5	Aux #4	High Temp	High Water	AUX #2	AUX #1	Op Ctrl

EXPANSION MODULE (E300) UPPER - REFER TO BULLETIN E-3001

Term 31	Term 30	Term 29	Term 28	Term 27	Term 26	Term 25	Term 24
High Pressure	Low Gas Pressure or Low Atomizing Media	Low Oil Temp.	Low Oil Pressure	High Gas Pressure	Oil Selected	Gas Selected	Low Water

OUTPUTS

Term 11	Term M	Term 6		Term 5	Term 7	Term A	Term X
Auto (RA1)	Blower (RB)	Ignition (RA2)	FVES (RV)	Pilot (RP)	Main Fuel (RF)	Alarm (RL)	High Fire (RH)

LOGSTAT is an indication of what logic module the control is currently in during its operating sequence and is used for diagnostic purposes only. The message displayed corresponds to the current logic module. The range of values are 4EH for Standby, 45H for PostIdle through 4DH for Shut down 2. Note that the above values are represented in hexadecimal format.

EXPLANATION OF LOGSTAT IN E110 STSTEMS

Table 2:

LOGIC DISPATCHER			
VALUE		MODULE	FUNCTION
DEC	HEX		
69	45H	MPOSTIDLE	
70	46H	MPREPURGE1	Wait for air flow and/or high fire switch to close
71	47H	MPURGE	Open Damper Purge
72	48H	MPOST PURGE	Low Fire Purge
73	49H	MTFI	Pilot Trial
74	4AH	MTFMF	Main Trial
75	4BH	MAUTO	AUTO
76	4CH	MSHTDWN1	Post Purge
77	4DH	MSHTDWN2	Post Purge
78	4EH	MIDLE	Standby

Logstat represents the current software module the Flame-Monitor is currently executing. They are named as close to the logic module the actual burner sequence is in. For instance, in the Flame-Monitor, MPURGE represents High Fire Purge where MPOSTPURGE represents the low fire start period where the mod motor is sent to the low fire position in preparation for pilot light-off. MSHUTDWN1 represents the post purge period after a complete cycle or the cool down period after a lockout.

MIDLE or STANDBY is the period of time where the operating control is open or the control is in lockout waiting for reset. On instances of false flame during the purge period, the control algorithm forces the control back to STANDBY until false flame ceases or lockout occurs.

MPREPURGE1 is the period of time prior to PURGE where the control checks the status of the air flow interlocks or the high fire proving switch (D-8). If either switch is found open, the control will remain in this state until the respective switch closes or lockout occurs.

MTFI represents the pilot trial for ignition stage of a burner sequence. MTFMF represents the main trial for main flame period where main fuel is introduced along with pilot and igniter.

MAUTO is the run period of the burner sequence.

MPOSTIDLE and MSHTDWN2 are small periods of time where certain internal tests are conducted and general cleanup before and after a cycle is performed.

The Flame-Monitor outputs the current displayed message as well as the historical lockout messages as numbers. The table that follows correlates the message number with the actual displayed test message.

Table 1- Message Table

DEC	HEX		TYPE AND MESSAGES
			E110 FLAME-MONITOR MESSAGES
1	1	R	L1-13 OPEN
2	2	H	HOLD FALSE FLAME- STANDBY
3	3	R	LOW FIRE PURGE
4	4	H	HOLD D-8 LIMIT OPEN- PURGE
5	5	H	HOLD 3-P AIR FLOW OPEN
6	6	L	LOCKOUT LINE FREQUENCY NOISE DETECTED
7	7	L	LOCKOUT FLAME FAIL - PTFI
8	8	C	CHECK UNIT ADDRESS
9	9	H	HOLD M-D LIMIT OPEN
10	A	R	IGNITION TIMING - PTFI
11	B		
12	C	R	FLAME SIGNAL - AUTO
13	D	R	CYCLE COMPLETE - POST PURGE
14	E	R	L1-13 OPEN (AFTER 2 MINUTES)
15	F	L	LOCKOUT AC POWER FAIL (EP165, EP166)
16	10	L	LOCKOUT SHORT CIRCUIT TERMINAL 5, 6 or 7
17	11	L	LOCKOUT D-8 LIMIT OPEN
18	12	L	LOCKOUT M-D LIMIT OPEN
19	13	L	LOCKOUT FLAME FAIL - MTFI
20	14	L	LOCKOUT FALSE FLAME
21	15	L	LOCKOUT 3-P INTLK OPEN (PURGE)
22	16	L	LOCKOUT 3-P INTLK CLOSED
23	17	H	HOLD 3-P INTLK CLOSED
24	18	H	HIGH FIRE PURGE
25	19	R	PLEASE WAIT (INITIALIZING)
26	1A	L	LOCKOUT 3-P INTLK OPEN -AUTO
27	1B	L	LOCKOUT 3-P INTLK OPEN (MTFI)
28	1C	L	LOCKOUT 3-P INTLK OPEN (PTFI)
29	1D	L	LOCKOUT 13-3 FVES OPEN
30	1E		
31	1F	C	CHECK FLAME SIGNAL - PTFI
32	20	C	CHECK D-8 HI LIMIT
33	21	C	CHECK M-D LOW LIMIT (CHECK)
34	22	R	FLAME SIGNAL- PTFI
35	23	C	CHECK LOW FIRE SIGNAL
36	24	R	FLAME SIGNAL - MTFI
37	25	L	LOCKOUT FLAME FAIL (AUTO)
38	26	H	HOLD 3-P INTLK OPEN - PURGE
39	27	L	LOCKOUT FUEL VALVE STATE CHANGE
			E300 EXPANSION MODULE LOCKOUT MESSAGES
40	28	L	3-P AIR FLOW OPEN
41	29	L	3-P HIGH WATER
42	2A	L	3-P LOW WATER
43	2B	L	3-P HIGH GAS PRESSURE
44	2C	L	3-P LOW GAS PRESSURE
45	2D	L	3-P LOW OIL PRESSURE
46	2E	L	3-P LOW OIL TEMPERATURE
47	2F	L	3-P LOW ATOMIZING MEDIA
48	30	L	3-P HIGH STEAM PRESSURE

DEC	HEX		TYPE AND MESSAGES
49	31	L	3-P HIGH TEMPERATURE
50	32	L	3-P AUX #4 OPEN
51	33	L	3-P AUX #5 OPEN
52	34	L	3-P AUX #6 OPEN
53	35	L	3-P FUEL SELECT
SYSTEM DIAGNOSTIC MESSAGES			
54	36	L	LOCKOUT CHECK CHASSIS
55	37	L	LOCKOUT CHECK PROGRAMMER
56	38	L	LOCKOUT CHECK AMPLIFIER
57	39	L	LOCKOUT CHECK EXPANSION MODULE
58	3A	L	LOCKOUT AMPLIFIER AUTO CHECK FAIL
59	3B	L	LOCKOUT SCANNER NOISE
76	4C	L	LOCKOUT CHECK SCANNER
E300 EXPANSION MODULE HOLD MESSAGES			
60	3C	H	L1-13 AUX #1 OPEN (TERMINAL 20)
61	3D	H	L1-13 AUX #2 OPEN (TERMINAL 21)
62	3E	H	L1-13 AUX #3 OPEN (TERMINAL 22)
63	3F	H	3-P HIGH WATER (TERMINAL 23)
64	40	H	3-P LOW WATER (TERMINAL 24)
65	41	H	3-P HIGH GAS PRESSURE
66	42	H	3-P LOW GAS PRESSURE
67	43	H	3-P LOW OIL PRESSURE
68	44	H	3-P LOW OIL TEMPERATURE
69	45	H	3-P LOW ATOMIZING MEDIA
70	46	H	3-P HIGH PRESSURE (TERMINAL 31)
71	47	H	3-P HIGH TEMPERATURE (TERMINAL 32)
72	48	H	3-P AUX #4 OPEN (TERMINAL 33)
73	49	H	3-P AUX #5 OPEN (TERMINAL 34)
74	4A	H	3-P AUX #6 OPEN (TERMINAL 35)
75	4B	H	3-P FUEL SELECT
PURGE INTERLOCK RELATED MESSAGES			
76	4C	L	LOCKOUT CHECK SCANNER
77	4D	H	HOLD D-8 LIMIT CLOSED
78	4E	L	LOCKOUT D-8 LIMIT CLOSED
79	4F	H	HOLD M-D LIMIT CLOSED
80	50	L	LOCKOUT M-D LIMIT CLOSED
81	51	L	LOCKOUT 13-3 POC CLOSED (CB ONLY)
82	52	R	DYNAMIC CHECK (CB ONLY)

R = Run

H = Hold

C = Check

L = Lockout

7.2 YB110 BurnerLogix.

SETUP
Each YB110 connected to the MODBUS communication bus must have a unique address. This is set using the BLV512 or BLL510 display module. Scroll to PROGRAM SETUP, enter this sub-menu, scroll to UNIT ADDRESS, press the RESET/MODIFY key, press the NEXT or BACK key to obtain the desired address, and RESET/MODIFY key to save the selection.

COMMUNICATIONS

The protocol to be used is MODBUS RTU. This is implemented by the master (PC, PLC, etc.) issuing a poll to the slave (BurnerLogix) and the slave responding with the appropriate message.

A typical format of a poll request is as follows:

MESSAGE FORMAT

DST	FNC	ADR HI	ADR LO	DAT HI	DAT LO	CRC LO	CRC HI

DST refers to the logical address of the slave.

FNC is the function being requested. FNC 03 is a read request.

ADR is the message number or register number of the data being requested.

For the BurnerLogix all registers are mapped as HOLDING REGISTERS, FNC 03. Register addresses begin at 40001 but is interpreted as address 00.

DAT is the number of words being requested. A word is an integer consisting of

2 bytes. The normal response from a slave is as follows:

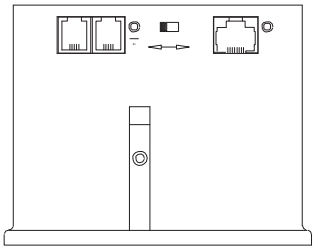
DST	FNC	DBC	DATA…. Hi/Lo	CRC LO	CRC HI

DBC is the data byte count being returned. It must be two times the DAT number from the poll request.

DATA is the data returned and is always a series of 2 byte integers. If 4 words were requested then
DBC would be 8 and there would be 8 data bytes or 4 data words containing the requested data.

The format of the data is N,8,1 meaning no parity, and 1 stop bit. Baud rate is selectable through the keypad / display. As shipped the baud rate is 9600.

Communication to the BurnerLogix control is made through either of the RJ-12 jacks located on the underside of the control (note figure on right). The jacks are internally wired in parallel to ease multi-dropping of BurnerLogix controls. For each of the RJ-12 connections, the outside contacts are connected together and are designated as “A” or “+” while the inside contacts are connected together and are designated as “B” or “-”. Fireye supplies the ED512 cables in various lengths with RJ-12 plugs on each end. Refer to bulletin E-8002 for additional information.



MODBUS MESSAGE TABLE – HOLDING REGISTERS (4XXX(X))

HOLDING REGISTER	MESSAGE ADDRESS	WORD REQUESTED	WORD RESPONSE	VALUE
40001	00	1	STATUS	83 (053H) = RUN; 202 (0CAH) = LOCKOUT
40002	01	1	MSGN	Current message being displayed (see Table 7)
40003	02	1	GSTAT	Defines Timer Type
40004	03	1	TIMER	Time in seconds
40005	04	1	FLAME	Flame Signal
40006	05	1	LOGSTAT	Current logic module, PURGE, PTFI, AUTO (see Table 6)
40007	06	1	INPUTS	Input limits state
40008	07	1	OUTPUTS	Output relays state
40009	08	2	SYSMINS	System on minutes
40011	10	2	BNRMINS	Burner on minutes
40013	12	2	CYCLES	Completed Burner Cycles
40015	14	1	LOCKOUT COUNT	Stored Lockout Count
40016	15	6	LOCKOUT ISTORY Most Recent Lockout data	Beginning of Last 10 Lockouts
40022	21	6	2nd Most Recent Lockout Data	Returns complete lockout description of stored lockout history. Includes lockout message (1), lockout module (1), @ burner hours (2), and @ burner cycles (2)s
40028	27	6	3rd Most Recent Lockout Data	
40034	33	6	4th Most Recent Lockout Data	
40040	39	6	5th Most Recent Lockout Data	
40046	45	6	6th Most Recent Lockout Data	
40052	51	6	7th Most Recent Lockout Data	
40058	57	6	8th Most Recent Lockout Data	
40064	63	6	9th Most Recent Lockout Data	
40070	69	6	10th Most Recent Lockout Data	
40076 - - - 40079	75 - - - 78	4		
40080 - - - 40090	79 - - - 89	11	N/A	Reserved for Fireye use
INTERLOCK ANNUNCIATOR				
40901	900	1 - 3	YZ300 Expansion Module registers (see Table 5)	Returns lower, middle and upper interlock annunciator (YZ300) registers.
40902	901	1 - 2		Returns middle and upper interlock annunciator (YZ300) registers.
40903	902	1		Returns upper interlock annunciator (YZ300) register.

It is suggested that polling intervals not be less than 200 mSec per request. Requesting data such as burner minutes, system minutes and burner cycles should be kept at a minimum due to the amount of processing time required to gather that data.

The MSGN being transmitted is a numerical value and must be interpreted by the communicating device, which actually is an advantage since this can be made to be whatever message text the end user wants. In other words, it allows for programming custom messages without actually changing the message in the programmer. Refer to Table 7, for message information.

The BurnerLogix stores its burner on time (7 powered) and system on time (L1 powered) in minutes. For display purposes, the programmer converts this to hours. The information being supplied by MODBUS will be the actual time in minutes and it is up to the communicating device to do the conversion. Since the maximum value stored in the BurnerLogix is 9,999,999 minutes, the maximum value in hex therefore is 98967FH and comprises two data words. The maximum cycle count is 999,999 decimal or F423FH, still two data words.

*To convert, multiply high word by 10000H (65536), add to this high byte of low word multiplied by 100H (256) and add to this the low byte of low word. Example: (98H*100H) + (96H*10000H) + 7FH = 98967FH = 9,999,999 minutes.*

As an example, the System on Minutes data is transmitted from the BurnerLogix to the interface as high word / low word as shown below: The same applies to Burner On Minutes and Burner Cycles.

ADDRESS 8		ADDRESS 9	
HIGH WORD		LOW WORD	
HIGH BYTE	LOW BYTE	HIGH BYTE	LOW BYTE
0	98H	96H	7FH

All values are represented in a HEX or base 16 format.

GSTAT determines the type of value TIMER represents. TIMER can be a running timer such as is used in purge, a flame signal or meaningless. Only the lower nibble of GSTAT has any value. If this value is 0 then the TIMER value has no meaning. The value in TIMER is a background minute timer in the BurnerLogix and should be ignored. If GSTAT is between 4 and 7, the TIMER represents the current value flame signal. If GSTAT is a 1, 2, or 3 then TIMER represents a running timer value.

The format of the data is 8 data bits, no parity and 1 stop bit. Due to the RS485 format, the communication format is considered half-duplex. That is, only one user is permitted on the communication lines at a time.

The information contained in INPUTS and OUTPUTS represents the status of the interlocks and out- put relays respectively. For the INPUTS, a 1 in the interlock position defines the interlock as being on or active where a 1 in any bit position in the OUTPUT register signifies the relay as being energized.

INPUTS (40007)

Bit 15							Bit 8
AC Line	Term D	Term 16	Term 13	Term 21	Term 22	Term 23	Term 8
Ref	Low Fire Start	Pilot Hold	FVES POC	Start Input	Remote Reset	Spare	Purge Damper

Bit 7							Bit 0
Term P	Term 3	Term M	Term 5	Term 6	Term W	Term 7	KS
Run Interlock	Op Cntrl	Blower	Ignition	Pilot Valve	Delayed Valve	Main Valve	Safety Relay

A ‘1’ in the opto-coupler position indicates the opto-coupler is on or interlock closed.

OUTPUTS (4008)

Bit 15				Bit 11			Bit 8
				Term A	Term11	Term X	Term 12
				Alarm	Auto	High Fire	Low Fire

Bit 7				Bit 3			Bit 0
	IS	Term W	Term 7	Term M	Term 6	Term 5	
	Internal Safety	Delayed Valve	Main Valve	Blower	Pilot Valve	Ignition	

Note: *A "1" in any bit position indicates the output or terminal is on or active.*

Table 5:

YZ300 LOWER (40901) – REFER TO BULLETIN YZEM-3001

Bit 7							Bit 0
Term 47	Term 46	Term 44*	Term 43	Term 3	Term 42	Term 41	Term 40
Low Oil Temp	High Oil Temp	Low Water	High Water	Aux #3	Aux #2	Aux #1	Op Control

* Terminals 44 and 45 are internally connected

YZ300 MIDDLE (40902) – REFER TO BULLETIN YZEM-3001

Bit 7							Bit 0
Term 57	Term 56	Term 55	Term 54*	Term 52	Term 51	Term 49*	Term 48
Aux #4	High Temp	High Pres-sure	Aux Gas	High Gas Pressure	Low Gas Pressure	Low Atomizing Media	Low Oil Pressure

* Terminals 49 and 50 are internally connected

* Terminals 53 and 54 are internally connected

YZ300 UPPER (40903) – REFER TO BULLETIN YZEM-3001

Bit 7							Bit 0
				Term P	Term 60	Term 59	Term 58
Unused	Unused	Unused	Unused	Air Flow	Aux #7	Aux #6	Aux #5

* Unused Bits 4-7 will always return 0

EXPLANATION OF LOGSTAT IN YB110 SYSTEMS

Table 6:

LOGSTAT is an indication of what logic module the control is currently operating in during its cycle and is used for diagnostic purposes only. If a lockout occurs the current value of LOGSTAT is stored as part of the lockout information. The message displayed corresponds to the current logic module.

LOGIC DISPATCHER			
VALUE		MODULE	FUNCTION
DEC	HEX		
1	01H	STANDBY	Idle state
2	02H	BLOWER ON	1/2 second period after operating control closes when blower motor is energized
3	03H	PURGE	Open Damper Purge or waiting for air flow and/or high fire switch to close
4	04H	PURGE	Low Fire Purge
5	05H	PTFI	Pilot Trial for Ignition
6	06H	PTFI	Pilot Trial for Ignition for YP3XX programmers
7	07H	PTFI	If PTFI is greater than 5 seconds and early spark termination is not needed
8	08H	PTFI	If PTFI is greater than 5 seconds and early spark termination is needed
9	09H	PILOT	Pilot Hold, YP138 only
10	0AH	MTFI	Main Trial for Ignition
11	0BH	MTFI	Main Trial for Ignition with terminal 5 de-energized
12	0CH	AUTO	Delayed valve on
13	0DH	AUTO	AUTO
14	0EH	AUTO	On YP138 programmer, hold for 20 seconds with terminals 6 and 7 energized
15	0FH	AUTO	On YP138 programmer, when terminal 21 first energized, wait for M-D to close
16	10H	POSTPURGE	Post Purge
17	11H	POSTPURGE	Post Purge period if flame fail lockout
18	12H	POSTPURGE	Idle state if unit is in lockout

Logstat represents the current software module the BurnerLogix is currently executing.

The BurnerLogix outputs the current displayed message as well as the historical lockout messages as numbers. The table below correlates the message number with the actual displayed text message.

Table 7:

DEC	HEX		BURNERLOGIX MESSAGES
1	1	H	T16 M-D LIMIT OPEN - AUTO
2	2	H	HOLD FALSE FLAME- STANDBY
3	3	R	LOW FIRE PURGE
4	4	H	HOLD M-8 LIMIT OPEN- PURGE
5	5	H	See Interlock Annunciation Message Table
6	6	H	T16 M-D LOW LIMIT - AUTO
7	7	L	LOCKOUT FLAME FAIL - PTFI
8	8	H	T16 INPUT CLOSED
9	9	H	HOLD M-D LIMIT OPEN
10	A	R	IGNITION TIMING - PTFI
11	B	C	CHECK FLAME SIGNAL - MTFI
12	C	R	FLAME SIGNAL - AUTO
13	D	R	CYCLE COMPLETE - POST PURGE
14	E	R	L1-3 OPEN
15	F	H	T21 INPUT CLOSED
16	10	L	LOCKOUT M-D LIMIT OPEN - PTFI
17	11	L	LOCKOUT M-8 LIMIT OPEN
18	12	L	LOCKOUT M-D LIMIT OPEN
19	13	L	LOCKOUT FLAME FAIL - MTFI
20	14	L	LOCKOUT FALSE FLAME
21	15	L	LOCKOUT 3-P INTLK OPEN (PURGE)
22	16	L	LOCKOUT 3-P INTLK CLOSED
23	17	H	HOLD 3-P INTLK CLOSED - STANDBY
24	18	H	HIGH FIRE PURGE
25	19	L	LOCKOUT M-D LIMIT OPEN - MTFI
26	1A	L	LOCKOUT 3-P INTLK OPEN -AUTO
27	1B	L	LOCKOUT 3-P INTLK OPEN - MTFI
28	1C	L	LOCKOUT 3-P INTLK OPEN - PTFI
29	1D	L	LOCKOUT T13 FVES OPEN
30	1E	L	LOCKOUT 3-P INTLK OPEN - PREPURGE
31	1F	C	CHECK FLAME SIGNAL - PTFI
32	20	C	CHECK M-8 HI LIMIT (HI FIRE PURGE)
33	21	C	CHECK M-D LOW LIMIT (LO FIRE START)
34	22	R	FLAME SIGNAL- PTFI
35	23	C-H	HOLD T21 or CHECK LOW FIRE SIGNAL - AUTO
36	24	R	FLAME SIGNAL - MTFI
37	25	L	LOCKOUT FLAME FAIL (AUTO)
38	26	H	HOLD 3-P INTLK OPEN - PREPURGE
39	27	L	LOCKOUT FUEL VALVE STATE CHANGE
104	68	R	LEARNING FLAME (PTFI and AUTO)
SYSTEM DIAGNOSTIC MESSAGES			
54	36	L	LOCKOUT CHECK CHASSIS
55	37	L	LOCKOUT CHECK PROGRAMMER

DEC	HEX		BURNERLOGIX MESSAGES
56	38	L	See Interlock Annunciation Message Table
57	39	L	LOCKOUT CHECK EXPANSION MODULE
58	3A	L	LOCKOUT CHECK WIRING
59	3B	L	LOCKOUT CHECK FUSE
76	4C	L	LOCKOUT CHECK SCANNER
PURGE INTERLOCK RELATED MESSAGES			
77	4D	H	HOLD M-8 LIMIT CLOSED
78	4E	L	LOCKOUT M-8 LIMIT CLOSED
79	4F	H	HOLD M-D LIMIT CLOSED
80	50	L	LOCKOUT M-D LIMIT CLOSED
81	51		Reserved for future use
82	52		Reserved for future use
83	53	L	LOCKOUT FLAME FAIL - PILOT
84	54	L	LOCKOUT 3-P INTLK OPEN - PILOT
85	55	L	LOCKOUT M-D LIMIT OPEN - PILOT
86	56	L	LOCKOUT T13 FVES OPEN - PILOT
87	57	L	LOCKOUT T13 FVES OPEN - POST PURGE

Table 8:

INTERLOCK ANNUNCIATOR				
DEC	HEX	STATE	TERMINAL	YZ300 INTERLOCK ANNUNCIATOR LOCKOUT MESSAGES
41	29	L	3-43	HIGH WATER
42	2A	L	43-44	LOW WATER
43	2B	L	51-52	HIGH GAS PRESSURE
44	2C	L	50-51	LOW GAS PRESSURE
92	5C	L	52-54	AUX GAS
45	2D	L	47-48	LOW OIL PRESSURE
56	38	L	44-46	HIGH OIL TEMPERATURE
46	2E	L	46-47	LOW OIL TEMPERATURE
47	2F	L	48-50	LOW ATOMIZING MEDIA
48	30	L	54-55	HIGH PRESSURE
49	31	L	55-56	HIGH TEMPERATURE
50	32	L	56-57	AUX #4 OPEN
51	33	L	57-58	AUX #5 OPEN
52	34	L	58-59	AUX #6 OPEN
53	35	L	59-60	AUX #7 OPEN
40	28	L	60-P	AIR FLOW OPEN

INTERLOCK ANNUNCIATOR				
DEC	HEX	STATE	TERMINAL	YZ300 INTERLOCK ANNUNCIATOR HOLD MESSAGES
94	5E	H	L1-40	OP CONTROL OPEN
60	3C	H	40-41	L1-3 AUX #1 OPEN
61	3D	H	41-42	L1-3 AUX #2 OPEN
62	3E	H	42-3	L1-3 AUX #3 OPEN
63	3F	H-C	3-43	HIGH WATER
64	40	H-C	43-44	LOW WATER
65	41	H-C	51-52	HIGH GAS PRESSURE
66	42	H-C	50-51	LOW GAS PRESSURE
95	5F	H-C	52-54	AUX GAS
67	43	H-C	47-48	LOW OIL PRESSURE
96	60	H-C	44-46	HIGH OIL TEMPERATURE
68	44	H-C	46-47	LOW OIL TEMPERATURE
69	45	H-C	48-50	LOW ATOMIZING MEDIA
70	46	H-C	54-55	HIGH PRESSURE
71	47	H-C	55-56	HIGH TEMPERATURE
72	48	H-C	56-57	AUX #4 OPEN
73	49	H-C	57-58	AUX #5 OPEN
74	4A	H-C	58-58	AUX #6 OPEN
75	4B	H-C	59-60	AUX #7 OPEN
5	5	H-C	60-P	AIR FLOW OPEN

R = RUN H = HOLD L = LOCKOUT C = CHECK

NOTICE

When Fireye products are combined with equipment manufactured by other and/or integrated into systems designed or manufactured by others, the Fireye warranty, as stated in its General Terms and Conditions of Sale, pertains only to the Fireye products and not to any other equipment or to the combined system or its overall performance.

WARRANTIES

FIREYE guarantees for *one year from the date of installation or 18 months from date of manufacture* of its products to replace, or, at its option, to repair any product or part thereof (except lamps and photocells) which is found defective in material or workmanship or which otherwise fails to conform to the description of the product on the face of its sales order. **THE FOREGOING IS IN LIEU OF ALL OTHER WARRANTIES AND FIREYE MAKES NO WARRANTY OF MERCHANTABILITY OR ANY OTHER WARRANTY, EXPRESS OR IMPLIED.** Except as specifically stated in these general terms and conditions of sale, remedies with respect to any product or part number manufactured or sold by Fireye shall be limited exclusively to the right to replacement or repair as above provided. In no event shall Fireye be liable for consequential or special damages of any nature that may arise in connection with such product or part.

FIREYE
3 Manchester Road
Derry, New Hampshire 03038 USA
www.fireye.com

MOD-6001
APRIL 4, 2013
Supersedes May 10, 2012