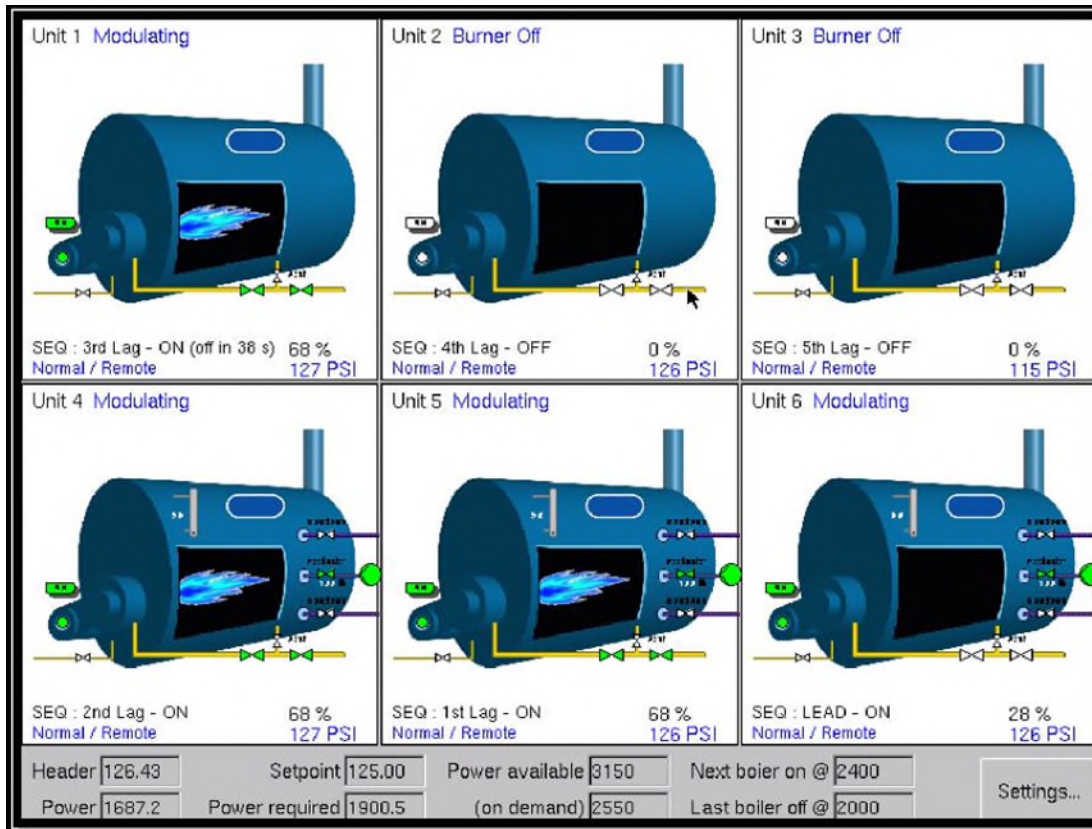


Plant Master Touch-Screen Guide



DESCRIPTION

The Plant Master is a special stand-alone version touch-screen NXTSD104 which connects each Nexus (PPC6000 or NX6100) to the screen via Ethernet hosting as many as 10 boilers. Each Nexus requires either, an NX6330 (12 key) Ethernet capable display or an NXTSD104 Touch Screen.

The normal 'Overview' button on the screen provides an overview of all connected systems, not just a single boiler. It is possible to 'drill down' into any of these and access it as if the plant-mater screen was a locally connected touch-screen. In fact, even though the Nexus may only have an NX6330 (12 key) keypad, the operator will have the look and feel of the NXTSD104. Certain TSD104 functions will not be available unless the Nexus has an NXTSD104.

The plant-master system incorporates boiler sequencing of up to 10 boilers. When used as a sequencing master, the operator can select the lead boiler, limit the modulation of any boiler as well as remove a boiler from the sequence. There are also provisions for re-configuring the boiler sequence without having to enter the changes at each individual Nexus.

Another feature of the Plant Master sequencing is "Optimum Modulation". This feature attempts to match the minimum number of boilers to the present load. The operator inputs a value that represents each boilers contribution to the total plant capacity along with the approximate burner turn down. The operator also enters a value that represents the "optimum" firing rate for the boilers on average. This optimum value effectively limits the mod rate until the operating boilers can't meet the load demand, then overrides itself allowing the boilers to modulate to their maximum input. This feature reduces unnecessary stress on the boiler rear door, wall and tube sheet thus reducing maintenance cost.



Safety information

WARNING



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.

CAUTION – SOME VERSIONS OF THIS EQUIPMENT CONTAIN A LITHIUM BATTERY IN THE DISPLAY UNIT

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.



WARNING

Failure to observe a **WARNING** about the equipment described in this manual can cause property damage, severe injury, or death.



CAUTION

Failure to observe a **CAUTION** may cause minor injury or damage to equipment.



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IMPORTANT: Please read the Health and Safety Issues before working on this equipment.

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1. Introduction

1.1 Outline.

The Fireye 6000 Series Plant Master is a NXTSD104 standard touch screen, which has been set to run as a Plant Master. The Fireye 6000 Series Plant Master will control and sequence up to 10 burner controllers for Steam Plant applications. The communications are delivered via Ethernet, therefore all controllers will need a display which supports Ethernet.

1.2 Controller compatibility.

The device described in this manual is powered, and compatible with all Fireye 6000 series controllers, NXTSD104 touch screens, and NX6330 key pad displays.



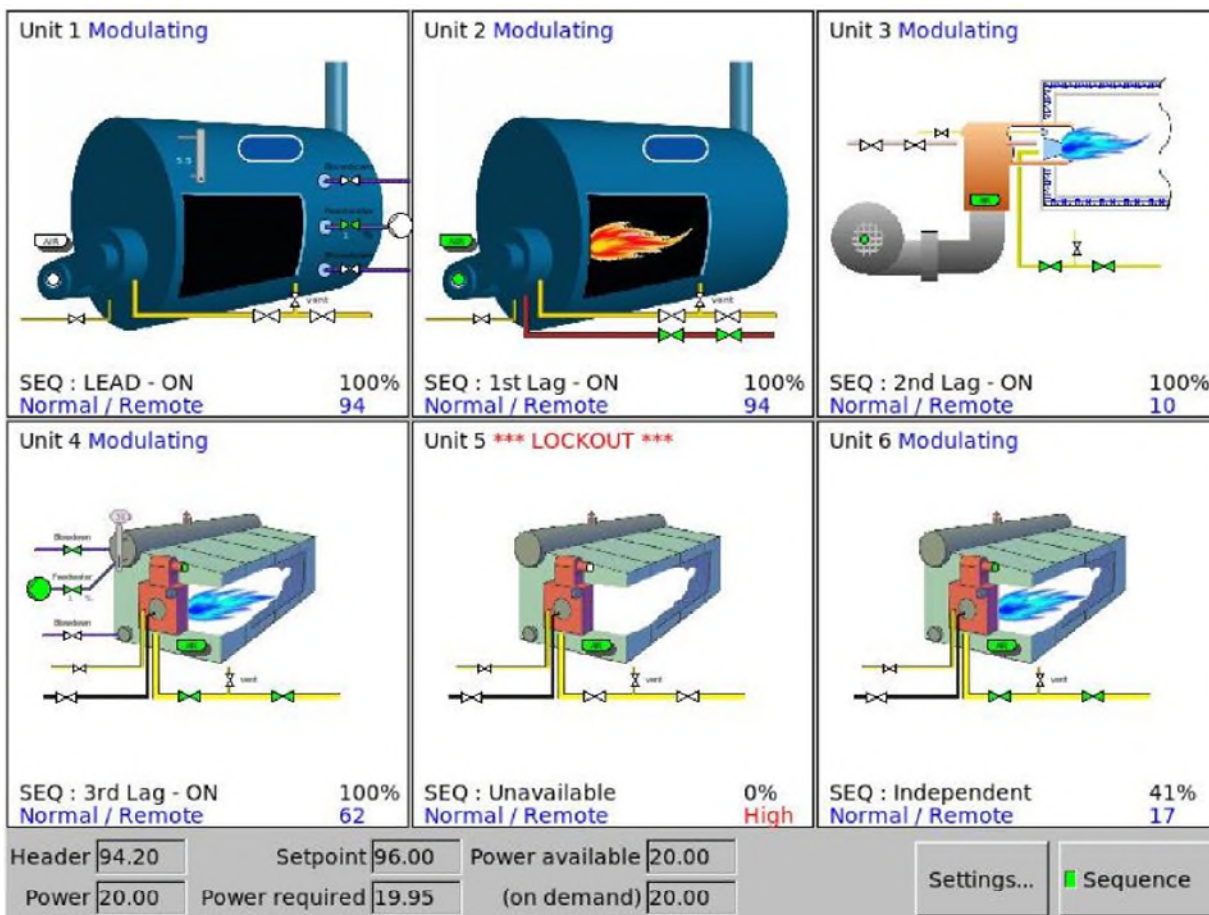
2. Description of Plant Master Sequencing

2.1 Plant Master Description.

The Plant Master is a special touch-screen mode where there is no CAN bus connection to local 6000 series burner controllers, but Ethernet is used to connect to up to 10 remote burners / boilers instead. All boilers must therefore have Ethernet capable display modules (NX6330), or touch-screens (NXTSD-104).

The normal 'Overview' button on the screen is then used to view an overview of all connected systems, not just a single boiler. It is possible to 'drill down' into any of these and access it as if the plant-master screen was a locally connected touch-screen.

The plant-master system also incorporates steam boiler sequencing of up to 10 boilers





2.2 Plant Master Sequencing Description.

The intention is to model all the boilers as one system providing heat input to the steam generation process.

The steam pressure is measured (ideally) from a common header using a CAN bus sensor, or a separate dedicated 6000 series controller that is used only to provide 24VAC power and accommodate a 4-20mA input from a third party pressure transmitter for the plant master HMI. Alternatively, the pressure sensor of the lead boiler can be used to drive the sequencing system as each boiler will still have its own local pressure transmitter (used for checking cut-in / cut-out limits, or if the sequencing system goes off line).

The sequencing is configured by entering high and low fire power output values for each boiler, these are entered as Horse Power (HP). It is important that the units used are consistent as they are used to compare the output of each boiler and it's turn-down. With this information along with the priorities of the boilers, the system attempts to match output in a single PID loop running in the plant master. The 'Power Requirement is apportioned to the boilers by setting their firing rates.

The system requires the usual P, I, and D settings. The I and D times are entered in seconds. The proportional band is entered as two settings, a steam pressure band and a power band. Together these set the gain for the PID control loop. If the pressure drops by the amount entered in the pressure band, the PID output will rise by the amount entered in the power band (excluding effects from I and D).

Example:

For a 10 PSI set-point, proportional band of 1.0 PSI and 5.0 (power units), the power (from the P-band) would be 5.0 when steam pressure dropped to 9.0 PSI.



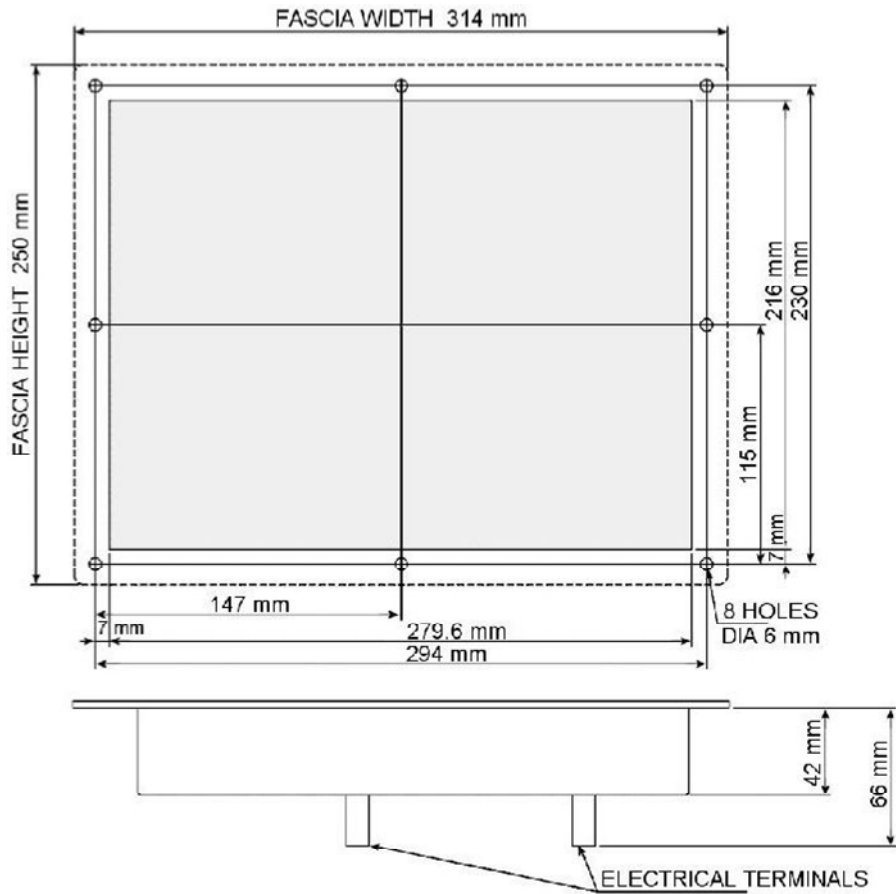
3. Plant Master specification.

Interface Type	Ethernet
Power Supply	24 Vac
Ambient Temperature Range	32 – 140°F (0 - 60 °C)
Touch screen Protection Category	IP65 screen/bezel to panel IP20 electronics behind panel
Mounting Attitude	Any
Number of Relays	4
Relay Type	Volt-free single pole change-over.
Maximum Relay Current	6 A 250 V rms
Minimum Relay Current	100 mA
Unit Dimensions	9.2"h x 12.4"w x 2.6"d (250h x 314w x 66d mm)
Weight	5.85 lb (2.65 kg)





3.1 Plant Master dimensions (NXTSD104).





4. How to install and wire the Plant Master

This section contains basic installation information, wiring specification and connection details.

The process of installing the Plant Master (NXTSD104) has 2 aspects:

- Mechanical mounting
- Electrical connection



WARNING

The Touch screen chassis earth point MUST be earthed to maintain electrical safety and ensure reliable operation.

The screen of the CANbus cable is NOT designed to provide the earth connection for the Touch screen display. Therefore, you must make a separate earth

4.1 Mechanical Mounting.

Mount the Touch screen on the front of the burner cabinet, or similar location. If possible, avoid reflections from windows or boiler house lighting when planning the location of the screen.

The maximum allowable cabinet wall thickness is 0.28 " (7 mm.)

Install the Touch screen so that the part within the panel is in a PD1 or PD2 environment according to EN6730-1, and the ambient operating temperature range of the equipment is 32 to 140 °F (0 to 60 °C).

With the sealing gasket installed between the panel and the Touch screen, the protection from 'outside' the panel will be IP65.

4.2 Wiring Requirements.

Please pay particular attention to the wiring requirements for the Plant Master. These will protect the equipment from electrical interference, earth loop problems, and damage to the controller and modules.



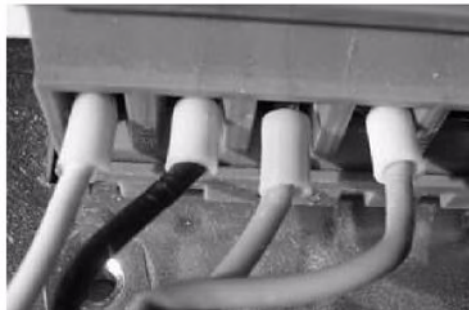
4.2.1 General.

WIRING INSTALLATION MUST BE CARRIED OUT BY A COMPETENT ELECTRICIAN, AND IS SUBJECT TO ALL LOCAL REGULATIONS AND STANDARDS THAT MAY PREVAIL.

The main controller **MUST** be mounted within a 'burner cabinet' or similar panel in a designated 'safe' area, and **MUST** be earthed to the overall enclosure to ensure safe and reliable operation; use the largest cross-sectional area green/yellow earth wire available. **Do not use a green/yellow conductor for any purpose other than earth.** The metal body of all other component parts **MUST** be connected to earth using a green/yellow conductor.

To comply with EMC requirements, the controller and any optional units must be wired using the specified cable sizes, and screen connections, observing any maximum cable length limitations. Cabinet designers **MUST** segregate Line voltage and Extra Low Voltage (ELV) cables within the burner cabinet, distribution panels and conduits.

The manufacturer of this equipment recommends the use of bootlace ferrules on all wire ends, as a "best practice".



Bootlace ferrules

All cabling that operates at more than 50 V must be multi-strand, single core, PVC insulated, 16/0.2 mm (0.5mm²), and must meet the requirements of IEC 227 or IEC 225.

For cables carried in conduit, secure all cables at both ends, using a suitable anchorage method in the cabinet. Ensure that cables, conduit and conduit connections meet the requirements for hazardous area operation. **No additional cable or conduit entry holes are permitted in the casing or cover of the actuator.**

Connect all signal cable 'braid' screens to earth using the screen termination clamps provided on the controller. Connect all cable screens to earth at the **controller only**, unless stated otherwise. Where CANbus wiring connects through one device to connect to another, terminals 5 and 6 are common to maintain screen continuity.

The equipment described in this manual has been tested for compliance to safety directives listed in the section headed 'Plant Master specification'. However, after it has been connected to a burner and other associated controls, it is the responsibility of the installer to make sure the complete installation meets the requirements of the directives relevant to the particular installation.



4.2.2 Earth Connection.

All sections of the control system with metal enclosures **MUST** be connected to earth.

Connect at the tag showing the **Earth** symbol, inside the cover on the body of the device. These connections are required to maintain the overall electrical safety of the installation and ensure the EMC performance of the equipment. Failure to comply with the wiring requirements will affect the performance of the system and may cause a hazardous condition to occur.

DO NOT use the screen of the signal cable to provide the electrical safety earth. You **MUST** make a separate earth connection using color coded earth wire of cross-sectional area 0.75mm² or greater, as permitted by conduit sizing.

4.2.3 ELV signal cable Screen Connection (CANbus).

ELV (low-voltage) signal cables **MUST** have a screen of the 'tinned copper braid shield' type.

The manufacturers of this equipment recommend

Harting 09 45 600 0102

Belden type 9927 or 3084A,

Alpha type 3233 or 6352.

These types of cable may also employ a 'foil with drain wire'. This is **not** suitable as a screen because the cross section of the drain wire is insufficient to provide correct screening of the signals. Also, there is no provision to connect the foil or drain at the main controller.

You must connect the ELV signal cable screens at the screen termination clamps only, unless stated otherwise in this manual. The screen termination clamps on the controller are only to allow connection of the cable screens to the main controller - they do not provide strain relief.



4.2.4 Plant Master terminal connections.

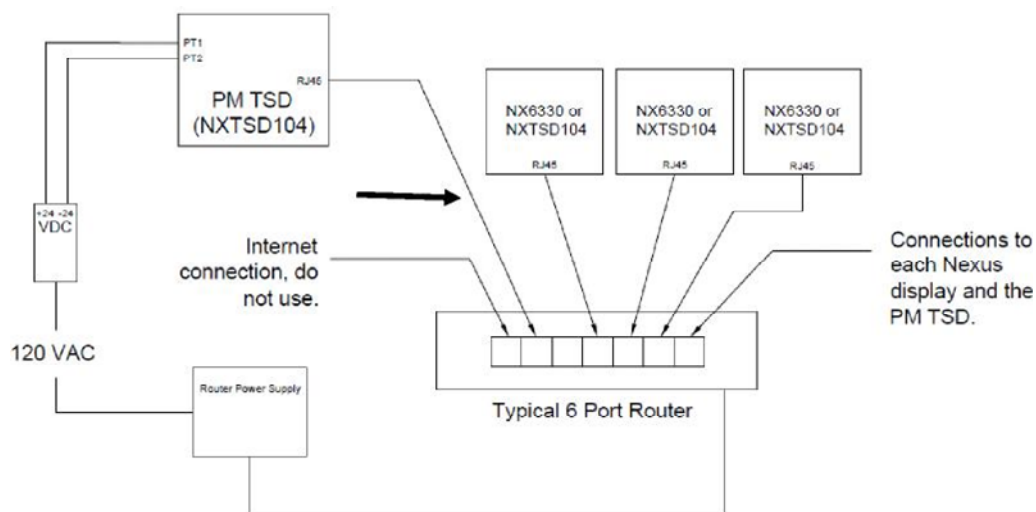
PR1	Touch screen Unit	*Relay output 1 common	0 – 250 V
PR2	Touch screen Unit	*Relay output 1 normally closed	0 – 250 V
PR3	Touch screen Unit	*Relay output 1 normally open	0 – 250 V
PR4	Touch screen Unit	*Relay output 2 common	0 – 250 V
PR5	Touch screen Unit	*Relay output 2 normally closed	0 – 250 V
PR6	Touch screen Unit	*Relay output 2 normally open	0 – 250 V
PR7	Touch screen Unit	*Relay output 3 common	0 – 250 V
PR8	Touch screen Unit	*Relay output 3 normally closed	0 – 250 V
PR9	Touch screen Unit	*Relay output 3 normally open	0 – 250 V
PR10	Touch screen Unit	*Relay output 9 common	0 – 250 V
PR11	Touch screen Unit	*Relay output 9 normally closed	0 – 250 V
PR12	Touch screen Unit	*Relay output 9 normally open	0 – 250 V
PT1	Touch screen Unit	24 Vac Supply +	24 – 40 Vac
PT2	Touch screen Unit	24 Vac Supply -	24 – 40 Vac
PT3	Touch screen Unit	Unused	Unused
PT4	Touch screen Unit	Unused	Unused
Earth tag	Touch screen Unit	CANbus screen connection	

Note that all the relay outputs on the Touch screen are isolated.

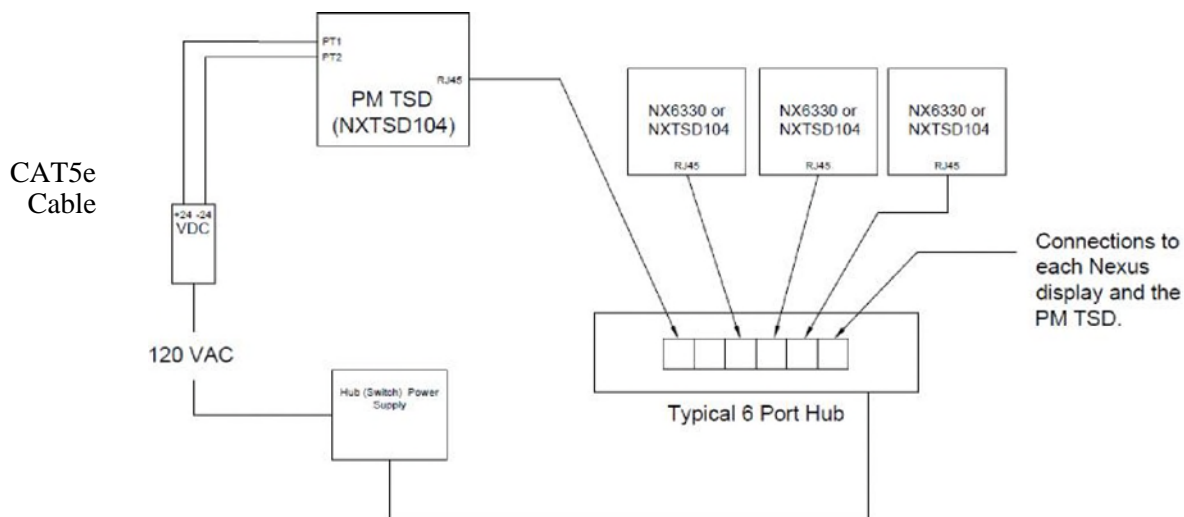


4.2.5 Wiring

NOTE: The NXTSD104, when used as a plant master, can be powered from a separate 24 VAC 1 amp, power supply. The 24 VAC will be applied to the PT1 & 2 terminals on the TSD104. PT1 will be +24, PT2 -24 VAC. If this method is used, the TSD104 will need to be temporarily connected to a powered Nexus PPC6000 or NX6100 for configuration as the Plant Master TSD. No other connections to the PM TSD are permitted at this time.



Wiring showing external 24vac power supply and router. All devices have automatic IP address enabled.



Wiring showing external 24VAC power supply and switch (Hub). All devices have manual IP address's set in the burner display.



5. Setting up the Plant Master

5.1 Entering Plant Master Mode

Any touch screen with the required firmware (version 3.102 or greater) can be switched to Plant Master mode. The process requires a seven-digit passcode to be entered. In this mode the CANbus connection is disabled, as all digital communication will be made via Ethernet connection.

To select Plant Master mode navigate to the Ethernet Configuration screen.

Bottom row > Menu button > right > Screen Configuration > top tabs > Ethernet

From the Ethernet Configuration screen select "Connect Via Ethernet". In Plant Master mode; the local CAN bus is disabled and the touch screen connects to burner and water level controls indirectly via Ethernet.

The Plant Master will detect all controls on the same network subnet as itself. In the usual application this will be all the controllers which are connected to the same network router, however this is dependent on network configuration.

Where there is a router that is set to assign the IP addresses (DHCP), leave the Ethernet settings for all devices to automatic (DHCP)'.

If the devices are connected by a simple Ethernet switch (or a hub) then IP addresses for each device will have to be set manually. First uncheck 'Automatic (DHCP)' and enter the IP Address, Mask and Gateway. It is vital that all three lines are entered if automatic is turned off, the IP Address and Mask must be valid but the Gateway value does not have to exist.

Example: 192.168.1.150
 255.255.255.0
 192.168.1.1

Other than setting the IP addresses, the only other configuration required at this stage is to ensure that all burner controllers have unique unit addresses (option parameter 0.2). The system will not work correctly if there are duplicate unit addresses visible on the Ethernet subnet.

Note: that it is not a requirement that water-level controllers have unique addresses. These default to unit 10 and it is okay for all water-level controllers the share this address.

To Configure the stand alone NXTSD104 as a Plant Master, use the commissioning mode procedure and use the **seven** figure pass-code - 3933163 This enables the Plant Master routine.

Note: There will be no feedback that indicates you are in Plant Master mode.



Entering the Settings screen

Unit 1 Modulating

Unit 2 Modulating

Press the Settings button

SEQ : LEAD - ON
Normal / Remote

99%
89

SEQ : 1st Lag - ON
Normal / Remote

99%
84

Header 89.93 Setpoint 100.00 Power available 40.00

Power 39.70 Power required 40.00 (on demand) 40.00

Settings... Sequence

Header Control

Power units BHP

Setpoint 125 P Band 5

(power output from proportional gain only, when pressure is P band below setpoint)

I sec 90 D sec 2

ON deadband 150 delay (s) 60

OFF deadband 250 delay (s) 60

Unit 1 Unit 2 Unit 3 Unit 4 Unit 5 Unit 6

Sequence this boiler

Next boiler unit address : 2

Boiler high fire power 300

Boiler low fire power 60

Optimum modulation rate 80

Lead Boiler

Boiler unit address : 5

Use LEAD for header pressure

Enter Passcode :

1 2 abc 3 def

4 ghi 5 jkl 6 mno

7 pqrs 8 tuv 9 wxyz

DEL 0 space .

Cancel OK

Then enter passcode 903 here:

Sequencing Set Up Screen



5.2 Configuring Boiler Sequencing.

5.2.1 Overview

The Plant Master boiler sequencing system is separate from the existing boiler sequencing system built in to NEXUS series controls, however it does have some similarities in its operation.

The system uses a Setpoint 1 (SP1) and Setpoint 2 (SP2) selection mechanism to select “LAG ON” and “LAG BANKING” modes. These must be set as follows:

- SP1 (option parameter 21.x) define the normal operating range of the boiler, including cut-in and cut-out limits. While the Plant Master controls the modulation rate, the cut-in and cutout limits are applied locally. Should the sequencing system fail, the boilers will fall back to independent running using SP1.
- SP2 (option parameters 22.x) define the banking cut-in and cut-out limits of the lag boilers. When the Plant Master has a lag boiler off, SP2 is selected and keeps the boiler warm and at a pressure/temperature that it can be brought back on to contribute steam/heat in a reasonable time.

Boiler sequencing can be enabled or disabled from the ‘overview’ screen using the ‘Sequence’ light button.

The boiler sequencing configuration is accessed from the ‘Settings...’ button on the same screen.

The system will automatically show all boilers it can find on the local ethernet subnet. For each boiler, it is possible to select it to be stand-alone or to specify the next boiler to fire after it.

5.2.2 Settings

Header Control :

Power units: BHP

Setpoint: 100

(power output from proportional gain only, when pressure is P band below setpoint)

P Band: 10

I sec: 180

D sec: 0

ON deadband: 150

OFF deadband: 200

delay (s): 60

delay (s): 60

ON deadband must be smaller than OFF deadband so a boiler doesn't come ON as soon as it turns OFF.

ON delay will be cancelled if the header pressure drops out of the proportional band and the next boiler will start immediately.

Lead Boiler :

Boiler unit address : 1

Use LEAD for header pressure

Modulate in unison

Unit 0 | Unit 1 | Unit 2 | Unit 3 | Unit 9

Sequence this boiler

Next boiler unit address : 9

Boiler high fire power: 5

Boiler low fire power: 1

Optimum modulation rate: 80

Ethernet settings ...

Sequence

Unlock Close



5.2.3 Overview

Here, the (header) setpoint, proportional band, I and D times can be entered. The setpoint is, of course, the desired header pressure. The header pressure measurement can come from an independent CAN bus sensor, or from the measured pressure of the lead boiler.

The proportional band is entered as two settings a P Band and a power band. Typically, the P Band might be around 10% of the setpoint, the power band would be the high fire output in BHP of the largest boiler.

The I and D times are entered in seconds and relate to the proportional band in the usual way. It would be normal for I to be more than 100 seconds and for D to be much less than this (or zero).

The 'lead boiler' tab allows the lead boiler to be specified (by unit address) and also allows the choice of reading the header pressure from there.

For each boiler (ordered by unit address), there are some settings to be entered. First, the unit address of the next boiler to come on after this one. If there is a problem with that boiler, the next one will be called in, and so on. This setting alone (with the lead boiler selection) determines the priority of the lag boilers.

Then, for each boiler the high and low fire power output needs to be entered. The actual units are not important, just the relative values for all boilers. The sequencing system uses this information to aid in determining when it is time to bring a boiler on or off.

Finally, there is an optimum modulation setting. The system will try to keep all boilers (apart from the last lag boiler) as close to this fire rate as possible. Typically boiler efficiency peaks at around 75% modulation but all boilers are different. The tradeoff is that it is inefficient to unnecessarily bring on other boilers. So once the last lag has reached 100% modulation the other boilers will modulate up to 100%.

Tuning the sequencing system will largely be about setting the PID parameters so that the system responds quickly enough to load changes, without unnecessarily turning boilers on and off. The banking cut-in and cut-out limits will also affect the time it takes for a lag boiler to start contributing steam so will have a bearing on the overall system performance.

5.2.4 Boiler Priorities

The boiler priorities start with the currently selected lead boiler. Whichever boiler is set as the lead boiler's 'next boiler' will be the first lag boiler to come on. Subsequent lag boilers are determined from the 'next boiler' setting of each lag boiler in turn, while other boilers are available. Once the 'next boiler' for the currently firing last lag boiler equals the lead boilers unit address, the sequencing system will determine that there are no boilers left.

It is possible to misconfigure such a system so that a boiler could be 'orphaned' - meaning that it is nobodies 'next boiler'. The HMI display will display 'Orphaned' if this is the case.

Example:

Boiler 1 next boiler is boiler 2

Boiler 2 next boiler is boiler 3

Boiler 3 next boiler is boiler 1

Boiler 4 next boiler is boiler 1.

In this example, boiler 4 is orphaned because it will never come on (unless it is the lead boiler).



The priority of the boilers is simply determined by the lead boiler selected. If boiler 1 is lead boiler, the priorities are 1, 2, 3, 4. If boiler 3 is selected as lead, the priorities will be 3, 4, 1, 2.

If a boiler is unavailable for sequencing because it has locked out or is otherwise held off, the sequencing system just skips it and goes to its 'next boiler'.

5.2.5 Modulation of Boilers

The system can modulate the currently firing set of boilers using one of two selectable methods:

- 1 - Fire in unison. All firing boilers modulate to the same firing position.
- 2 - Staged. All boilers apart from the last lag boiler will fire at their optimum modulation rate.

Boiler efficiency usually drops close to high fire so ideally they are not run at high fire for significant amounts of time. On this system an optimal firing rate (say 80%) can be entered for each boiler. Normally, all firing boilers apart from the last one will be commanded to fire at this rate. The last boiler will modulate to make up the power as required by the PID. If the last boiler is up to its optimum fire rate, all the boilers will be fired (in unison) above their optimal rates until the next boiler comes on line and is able to contribute towards the load. See 'On/Off strategy' below for more details.

The 'power' output range of the PID is limited to just over the maximum available power from all currently firing boilers at high fire. This is to prevent integral wind up of the PID when waiting for boilers to come on.

5.2.6 On/Off Strategy

There are two settings relating to when the system brings boilers ON:

- ON headroom / deadband (power), and
- ON delay (seconds).

If the PID power requirement exceeds the calculated power that all boilers currently firing (and in start-up) can supply at high fire, MINUS the 'headroom', the ON delay will be initiated. The ON delay will count-down all the while the above condition is true. At the end of this delay time, the next lag boiler will be brought on. The ON delay timer is reset if the PID power requirement drops below this level at any point.

An additional feature is that if the header pressure drops below the bottom of the range set by the proportional band, the ON delay timer will be reduced to zero and the next boiler will come on immediately.

The next lag boiler is defined by the 'next boiler' settings as described in 'Boiler priorities'. However, if a 'lag off' boiler is currently firing because it is 'warming', it will be temporarily told to go to SP1 - full operating pressure. The idea is that it will be able to provide steam quicker than bringing on a boiler that is currently off.

Once the correct lag boiler has come on and is firing, the sequencing system will command the out of sequence lag boiler to bank on SP2 once more, which will cause it to go off as it will be over the SP2 cut-out pressure.



The sequencing system will determine the maximum power output available if the lowest priority firing boiler was turned off. If that is more than what is currently needed PLUS the OFF headroom, the OFF delay will be initiated. The OFF delay will count-down all the while the above condition is true. At the end of this delay time, that last boiler will be modulated to low fire then switched off. The other boilers modulated up to compensate.

Restore Procedure

To restore NXTSD104 back to 6000 controller mode:

Press on unit button top right hand corner of NXTSD104.

Select Ethernet.

Select Ethernet Button to Disable Plant Master.

Restoration complete.

WARNING: Before enabling the “Sequencing” button, be certain that all parameters in the various boiler and header sections are correct and make sense. Enabling sequencing will immediately take control of all connected boilers and, should the parameters be incorrect, may shut boilers



NOTICE

When Fireeye products are combined with equipment manufactured by other and/or integrated into systems designed or manufactured by others, the Fireeye warranty, as stated in its General Terms and Conditions of Sale, pertains only to the Fireeye 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 Fireeye shall be limited exclusively to the right to replacement or repair as above provided. In no event shall Fireeye be liable for consequential or special damages of any nature that may arise in connection with such product or part.

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