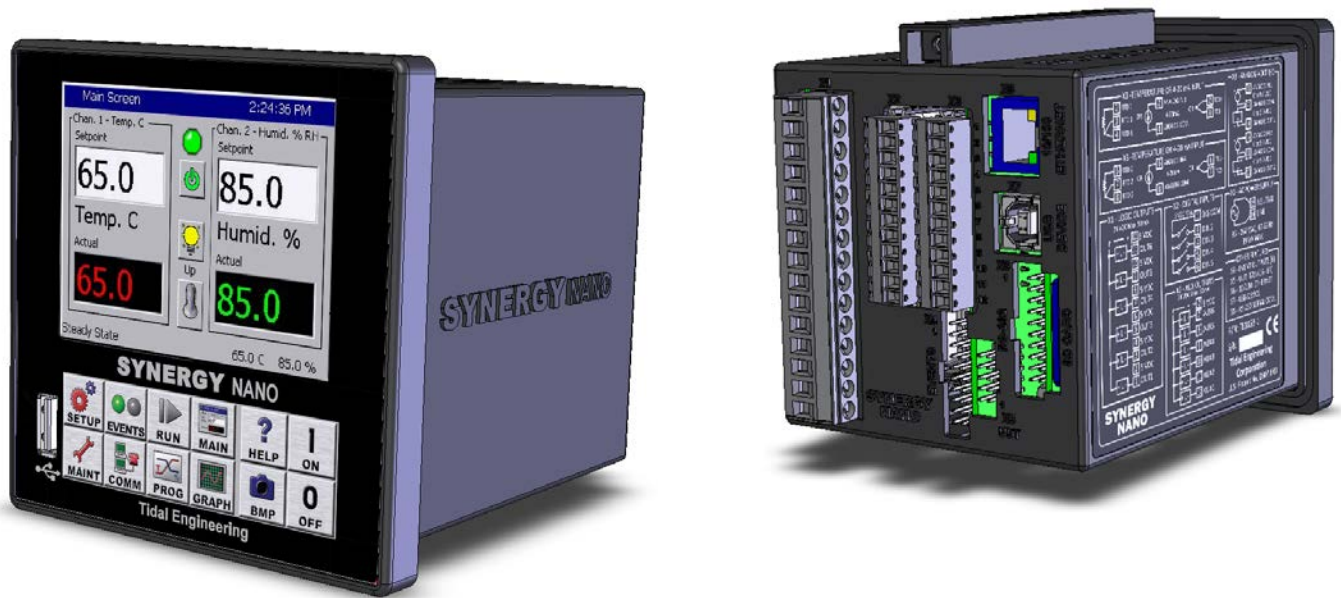


SYNERGY NANO 2

Designed Specifically For Environmental Test Chambers

Installation Manual



Synergy Nano 2

For One to Four Channel Systems

TIDAL
ENGINEERING

SYNERGY SERIES
FOR ENVIRONMENTAL TEST CHAMBERS



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Revision History

Rev.	Date	Revision
A	February 14, 2013	Created this document, P/N TE2258, "Synergy Nano Installation Manual" from "Synergy_Nano_Installation_Guide_REV_P30".
B	July 14, 2019	Updated from "Synergy Nano Installation Manual" to "Synergy Nano 2 Installation Manual".

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1. Introduction

This Synergy Nano 2 Installation Manual, written for OEMs, installers, and service personnel, is designed to provide a guide for controller installations. The information and instructions are provided to help the reader select, configure, wire, and test a Synergy Quattro Controller.

The [Synergy Controller Unified Technical Manual](#), Part Number TE1813, provides information for operators and programmers.

Tidal Engineering's family of Synergy Controllers provide state-of-the-art usability and connectivity for environmental test control and data acquisition and are designed to improve test efficiency by supporting both factory automation and test and measurement protocols and standards.

The 1/4 DIN Synergy Nano controller provides most of the high-end environmental test chamber control features of our full-sized Synergy Micro but in a compact 1/4 DIN package.

The **new** features and improvements in the Synergy Nano 2 Controller highlights include:

- Faster Processor:
 - Dual Core, 1GHz NVIDIA Tegra 2 Processor (Original Quattro was Single Core 312MHz)
 - 512 MB Memory (Original Quattro was 64 MB)
- New WEC7 Operating System (Original Quattro was Windows CE 5)
- New Low Cost WiFi Option
- X4 Plug Expansion features
 - Use TE2251-x Synergy Quattro expansion option cards
 - Use TE2551-12S Super Switching Model (up to 30 Outs)
- 100% Compatible with all existing Synergy Controller Programs and configurations

Original Synergy Nano Controller highlights include:

- Color touch screen in a compact ¼ DIN package.
- Up to four control channels.
- Ethernet and RS-232 communications standard. GPIB /IEEE 488 (Optional).
- Built in Data logger with USB Flash drive support
- Data Acquisition; Four process inputs. Up to (64) T-type thermocouples (Optional).
- Built-in Web Server for remote control; WebTouch Remote™ (Optional).
- Compatible with Synergy Manager Software for PC control, monitoring, and programming.
- LabVIEW Driver
- Built-in FTP Server for factory automation and test and measurement applications.
- Two Analog Outputs
- 18 Digital Outputs, Time Proportioning and On-Off.
- Bar code reader with Macro feature for fast and error-proof setup

For more information regarding the controller including links for Synergy Manager and the Synergy Nano Technical Manual downloads see our website at: www.tidaleng.com/synergy.htm

This Installation manual includes the following sections:

1. Controller Overview
2. Model Selection
3. Wiring
4. Setup
5. Tuning
6. Configuration Backup
7. Safety
8. Communications.

In addition, the following information is supplied in the Appendices as follows.

Appendix A: Accessories and Options

Appendix B: Output Primitive Descriptions

Appendix C: Frequently Asked Questions, FAQ

Appendix D: Standard Chamber Definitions

Appendix E: Example Wiring Diagram, NANO_TO5A

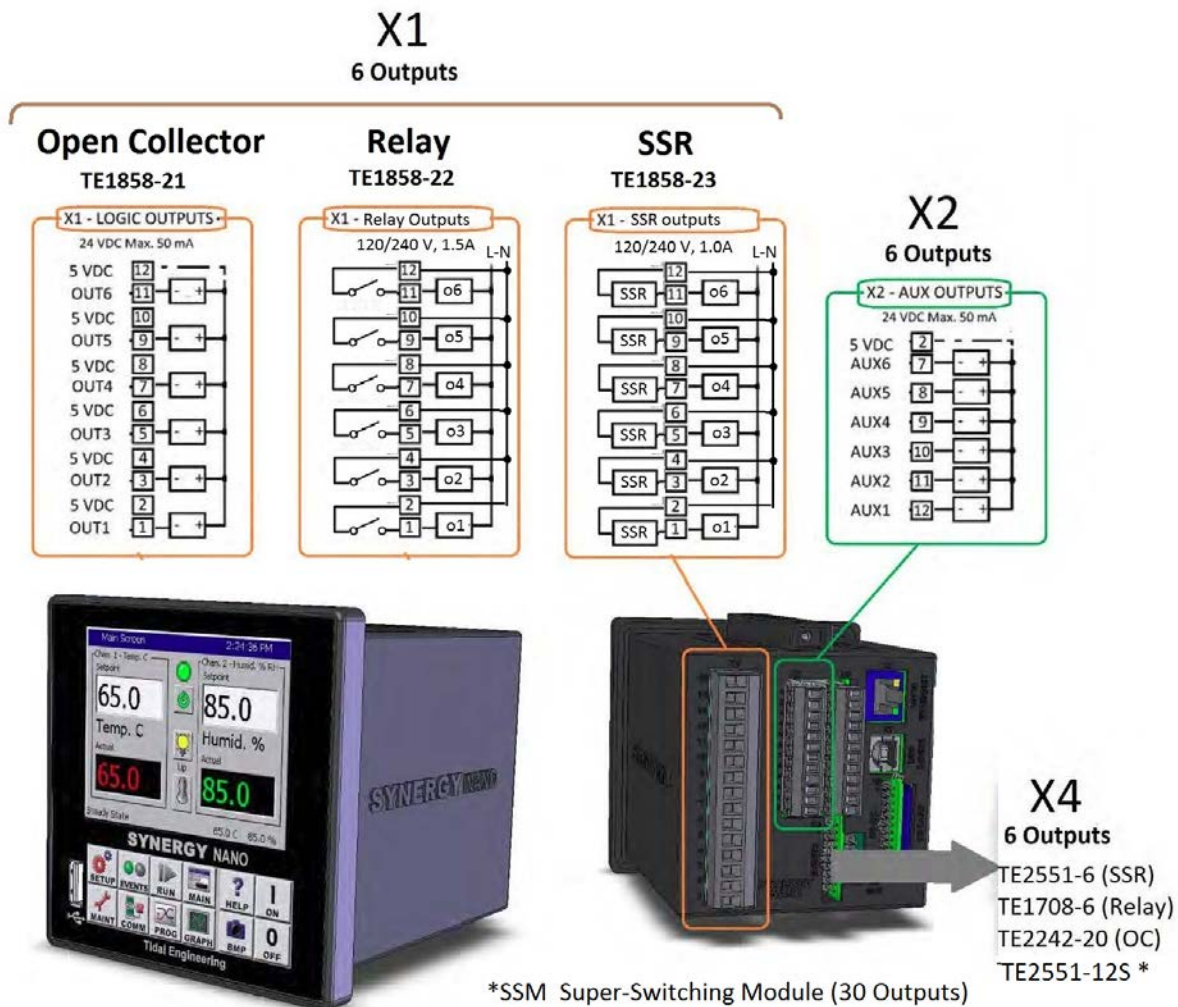
Appendix F: Example Wiring Diagram, NANO_TH_F4_02

2. Controller Overview

The Synergy Nano Controller can operate a wide range of temperature chambers and industrial ovens. It supports simple time proportioning logic for heating and cooling, as well as complex output functions such as Boost Heat, Boost Cool, Vacuum and Vent, High and Low Stage Compressors, Artificial Load, Ambient Cooling, Vibration, etc.

All Synergy Nano 2 models support three groups of six outputs for a total of 18. Each output can be time proportioning or On/Off. The six Main outputs for each model are as follows:

P/N	Main Outputs
TE1858-1	Logic Outputs to drive external SSR's
TE1858-2	Relay Outputs
TE1858-3	SSR Outputs
TE1858-4	Synergy Nano Controller Expanded outputs



Note: The only difference between the above three models is the type of outputs for the six main outputs.

X4 Event Options

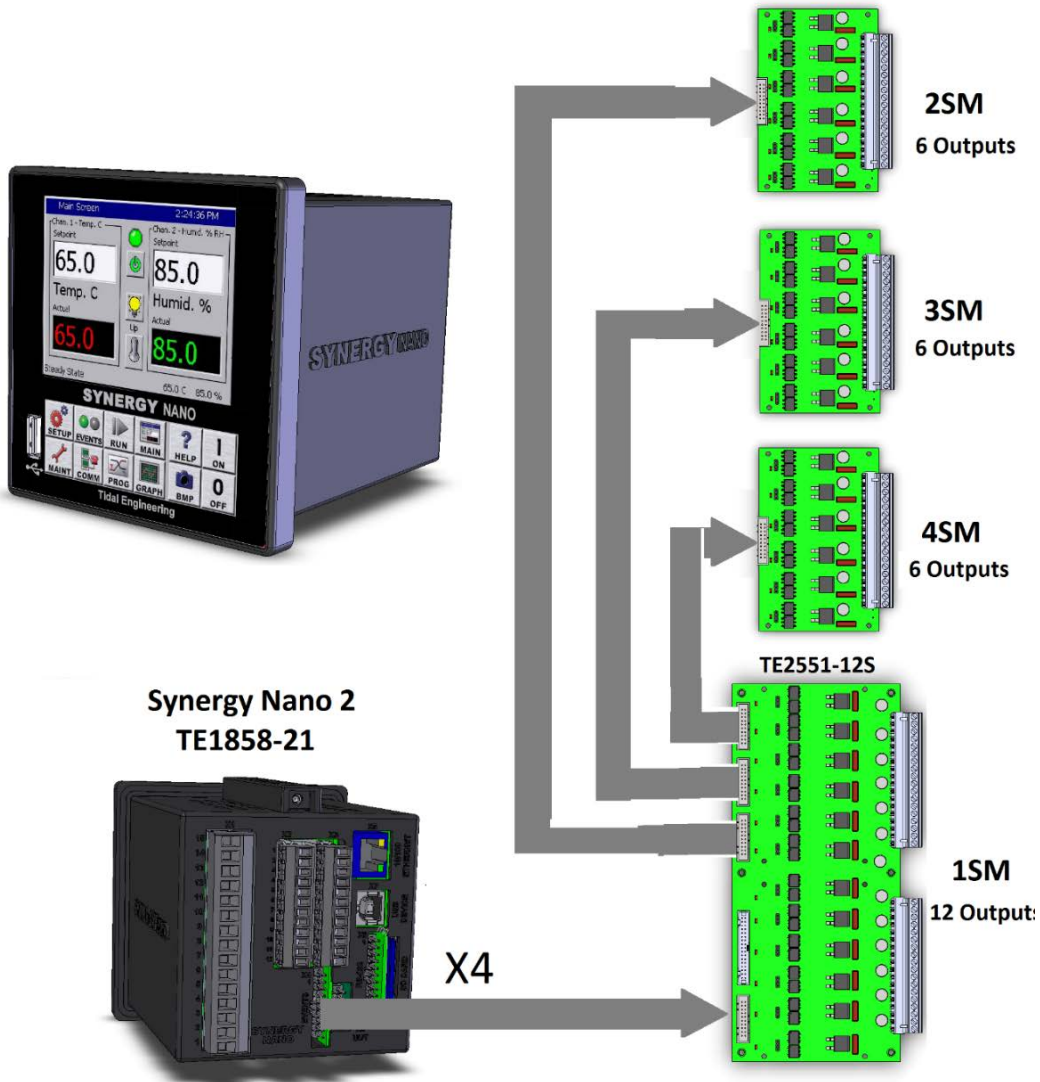
SYNERGY NANO 2

Synergy Nano and Synergy Nano 2 Expansion options for X4 connection are shown below.

P/N	Outputs		Type	Rating
TE2551-6	6	Synergy Nano	SSR	90-240VAC, 2 Amps
TE1708-6	6	Synergy Nano	Relays	90-240VAC, 6 Amps
TE2242-20	6	Synergy Nano	Open Collector	24VDC Max, 25 mA

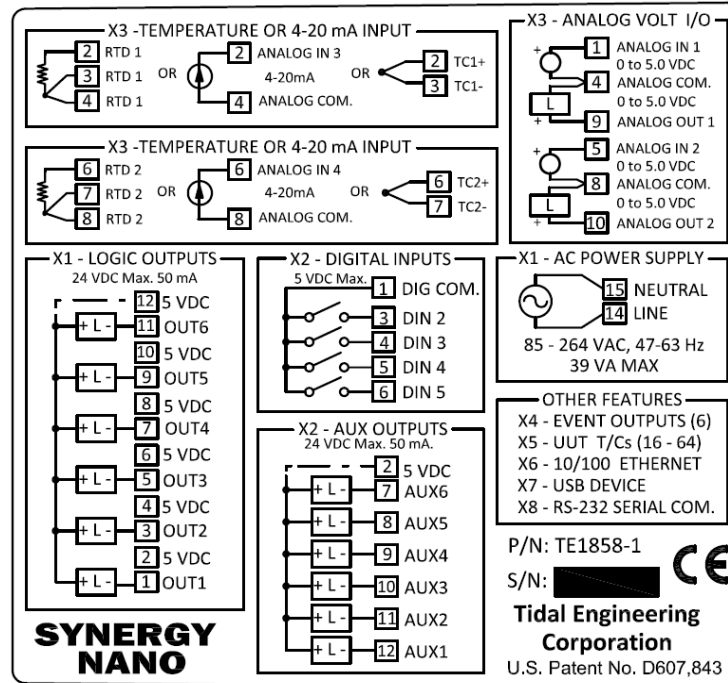
P/N	Outputs		Type	Rating
TE2551-12S	30	Synergy Nano 2	SSR	90-240VAC, 2 Amps

With the P/N TE2551-12S Synergy Super Switching Module, the Synergy Nano 2 is expanded to handle up to 30 Outputs using Tenney legacy style outputs boards as shown below.



The fourth model, TE1858-4 is the expanded configuration model and provides the full features of the Synergy Micro. This module is supplied with an external Olympic I/O processor board.

TE1858-1 Product Label



The six Auxiliary outputs are transistor (Open Collector) on all three models.

The six Event outputs control six external outputs, ether relay or Triac using a ribbon-cable connected Event board. There are two 6-Output Event Cards available: Triac (TE1151-6) and electro-mechanical relays (TE1708-6).

Note that any output primitive (aka function) can be placed on any of the 18 outputs. The output group names Main, Auxiliary, and Events are based on typical usage. These three groups of outputs don't restrict the type of output primitives that they can be assigned. The flexibility offered by the three different Nano models and the two different Event output cards allow the controller to handle virtually any complex retrofit application.

Typically, transistor outputs are used to drive external DC operated medium to high amperage and voltage SSRs. The electromechanical and solid-state relays available on the TE1858-2 and TE1858-3 models respectively provide the ability to drive low current AC loads directly. The six optically isolated Event Board outputs provide cost effective control of small AC loads (Up to 6 amps).

The Synergy Nano controller, like the Synergy Micro work with a wide range of environmental test chamber configurations including; Temperature, Humidity, Altitude, Thermal Vacuum, Thermal Shock and HALT/HASS test chambers.

3. Model Selection

When selecting which Synergy Nano model to use for a new or retrofit chamber application, engineers and installers should start by selecting the Chamber Definition from a list of standard definitions list.

The Chamber Definition defines the configuration of Channels, Outputs, Inputs, and Alarms. The Standard Chamber Definitions cover a wide range of applications. Custom Chamber Definitions can be provided by the factory and loaded onto the controller.

Channels Assignment

The Synergy Nano supports up to four channels. Each channel has a process input and at least one control output and can be temperature, humidity, altitude (pressure) Torr or kft, Vibration (GRMS), Air Velocity, or light. Typically, temperature is assigned to channel 1. The Chamber Definition file defines the channels. The Synergy Nano supports a variety of process inputs. See the block diagram below for an overview.

Output Assignments

Each configuration file defines the set of outputs for each channel. For simple chambers, like Temperature only configurations, a compressor and a heater output are all that is required. For more sophisticated temperature applications and for cascade refrigeration systems, there may be 11 outputs or more. Fan, PID Heat, PID Cool, Hi and Low Stage compressors, Boost Heat, Boost Cool, Full Cool, Cascade Condenser, Hi Artificial Load (bypass), Low Artificial Load, etc.

Each primitive executes an algorithm that defines its function. The algorithms used to control these primitives are defined in the sections that follow. Primitive can be very simple. The Fan primitive for example comes on whenever Channel 1 is on. More complicated primitives such as the dehumidify coil are controller by L-values L11 and L12, Digital Input 2 and LEV 1, and the dehumidifier PID.

Chamber Definition Selection

If none of the pre-configured chamber definitions fits the application, contact the factory or a Synergy Certified installer for a modified configuration.

The Chamber Definition File (CDF) can also be used to re-define standard alarms and define custom alarms.

The Chamber Definition also defines default sensors (sensor IDs) and default PID tuning. These settings can be modified after the configuration is loaded. The channel assignments and Output Primitive assignments cannot be changed from the controller.

Synergy Nano Sensors

Process Input 1 (one of the following inputs)

Signal	Signal Location	Sensor ID	Comments
RTD1	Hi Resolution RTD 1	110	
T/C1	Hi Resolution T/C 1	170	
4-20mA	Hi Resolution Analog 3	150	

And Voltage 1

Signal	Signal Location	Sensor ID	Comments
Voltage	Hi Resolution Analog 1	130	

Process Input 2 (one of the following inputs)

Signal	Signal Location	Sensor ID	Comments
RTD2	Hi Resolution RTD 2	120	
T/C2	Hi Resolution T/C 2	180	
4-20mA	Hi Resolution Analog 4	160	

And Voltage 2

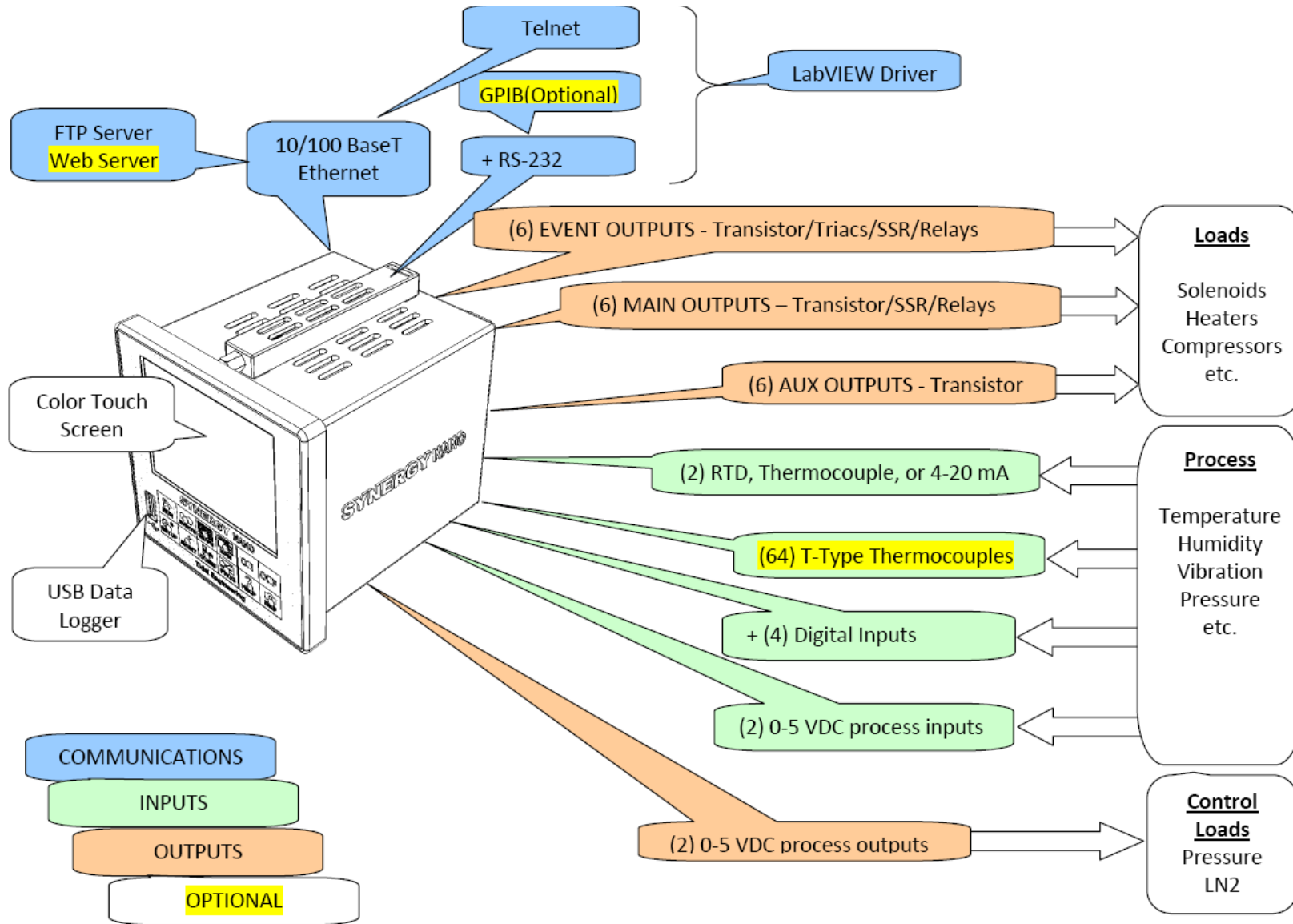
Signal	Signal Location	Sensor ID	Comments
Voltage	Hi Resolution Analog 2	140	

UUT Inputs

Up to 64 T-Type Thermocouples

Signal	Signal Location	Sensor ID	Comments
Temperature	UUT 1	211-218	UUT Module 1, Sensor 1 to 8
Temperature	UUT 2	221-228	UUT Module 1, Sensor 9 to 16
Temperature	UUT 3	231-238	UUT Module 2, Sensor 1 to 8
Temperature	UUT 4	241-248	UUT Module 2, Sensor 9 to 16
Temperature	UUT 5	251-258	UUT Module 3, Sensor 1 to 8
Temperature	UUT 6	261-268	UUT Module 3, Sensor 9 to 16
Temperature	UUT 7	271-278	UUT Module 4, Sensor 1 to 8
Temperature	UUT 8	281-288	UUT Module 1, Sensor 9 to 16

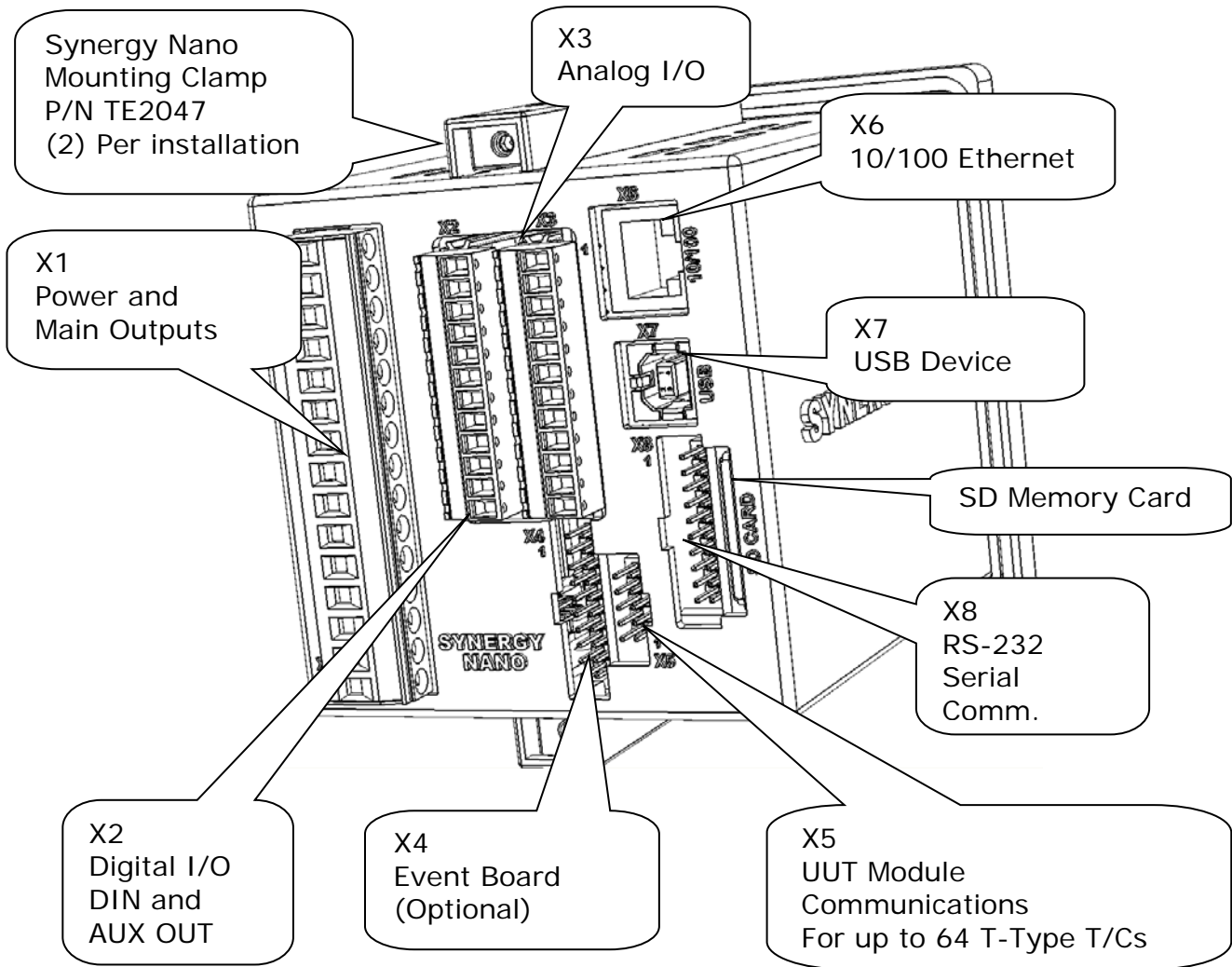
SYNERGY NANO 2



4. Wiring

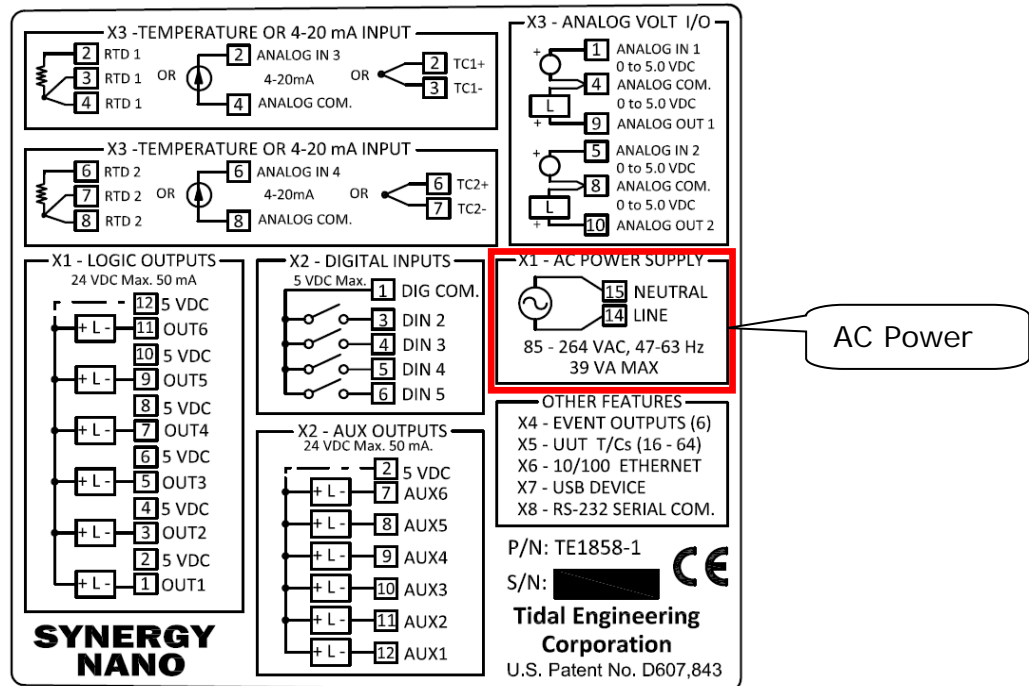
An example Synergy Nano Controller mounting and wiring arrangement for a simple Temperature/Humidity chamber using an RTD temperature sensor and a loop-back humidity sensor is described in this section.

The figure below identifies the plug arrangement on the back of the controller.

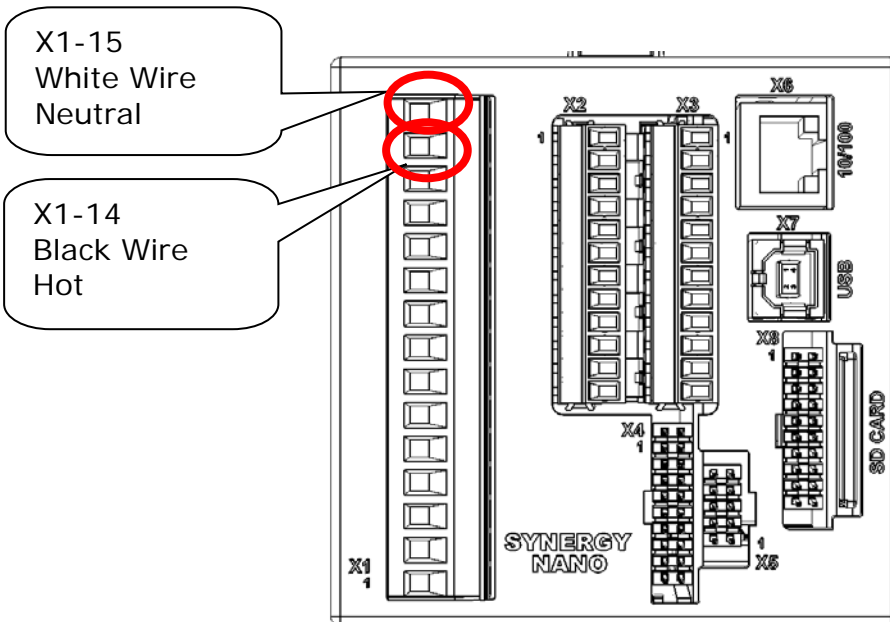


- 3.1. Connect an AC power source, to the X1 plug as follows:
 White wire (AC Neutral) to X1 Pin 15
 Black wire (AC Line) to X1 Pin 14.

TE1858-1 Product Label

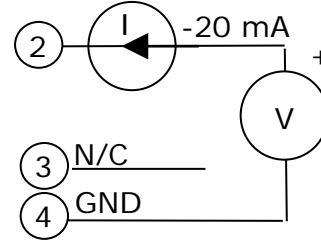
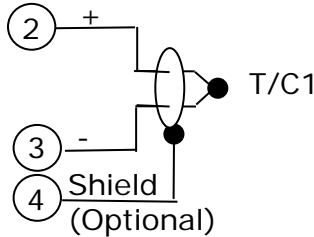
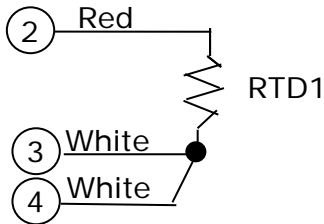


WARNING: BE SURE THAT THE UNIT IS NOT CONNECTED TO THE AC SOURCE WHILE WIRING.



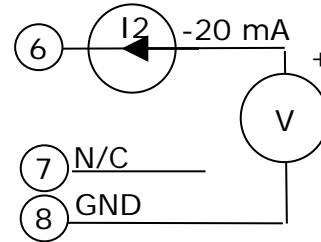
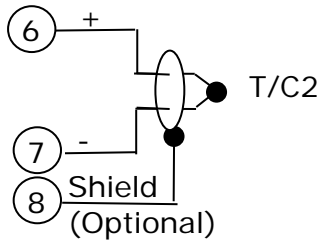
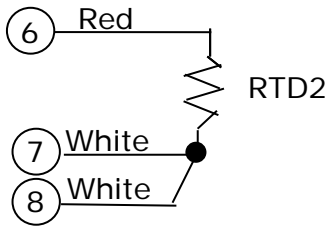
Input Sensor Wiring

The Synergy Controller supports four types of RTDs (100 Ohm pt. DIN or JIS, 500 Ohm pt. DIN or JIS), eight Thermocouple types, T, S, J, B, K, R and various 4-20 mA transducers. These sensors connect to the Synergy Nano X3 plug according to the tables shown below. These sensors are typically used for air temperature or product temperature.



RTD1, T/C1, I1 (4-20mA)

Pin	RTD	T/C	I1 (4-20mA)	Signal
2	RTD1-Red	T/C+	I+	+
3	RTD1-White	T/C-	N/C	-
4	RTD1-White	Shield (optional)	I-	Analog Common

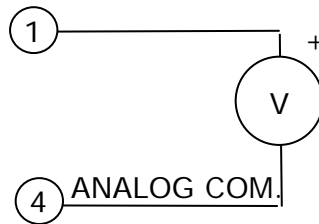


Process Input Wiring

The Synergy Controller supports two 0-5VDC Analog Inputs. These sensors connect to the Synergy Nano X3 connector according to the tables shown below.

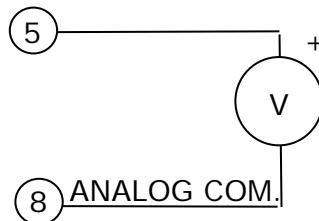
Analog In 1

Pin	Signal
1	V+ Analog In 1
4	V- Analog Com.

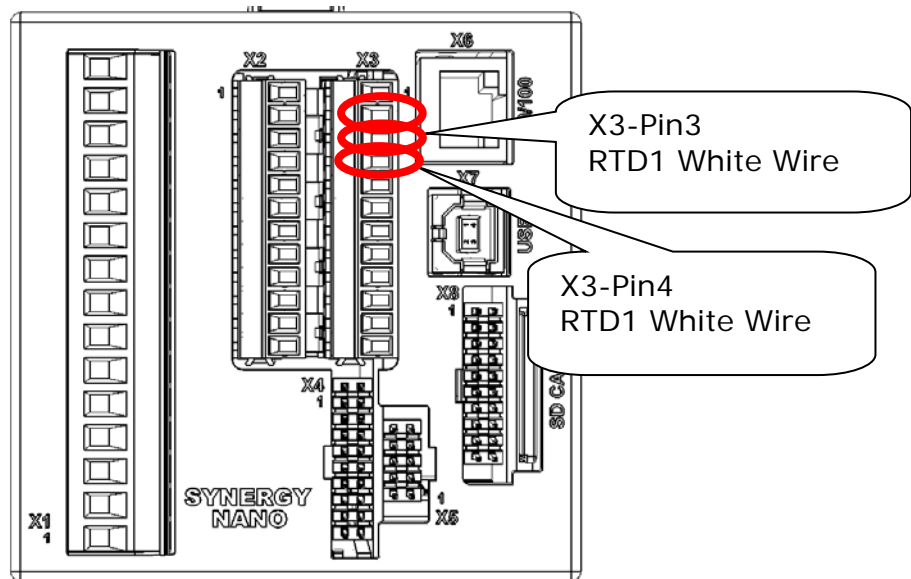
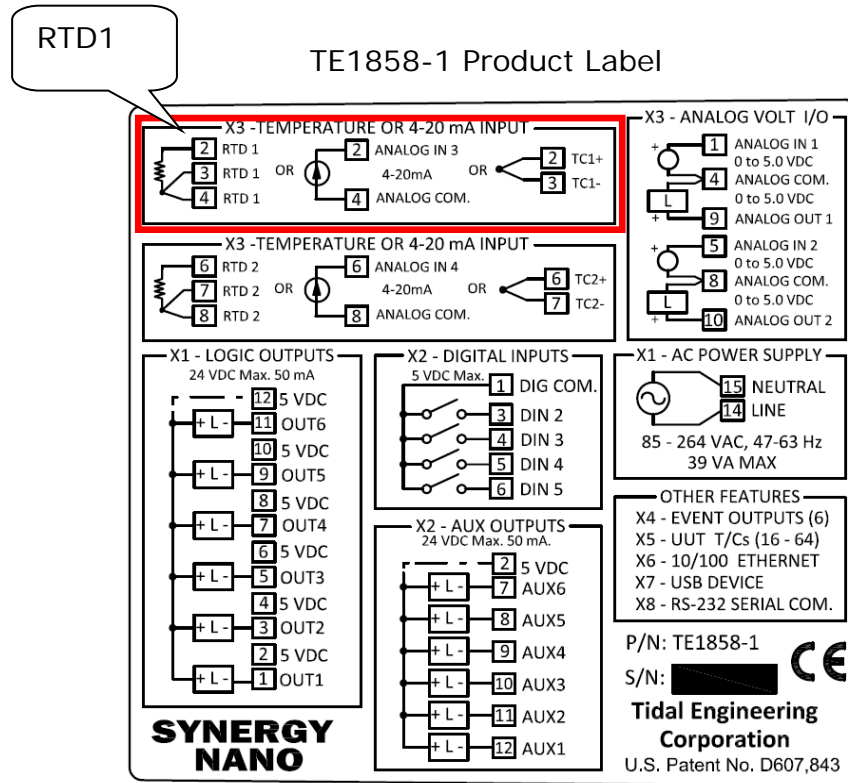


Analog In 2

Pin	Signal
5	V+ Analog In 2
8	V- Analog Com.

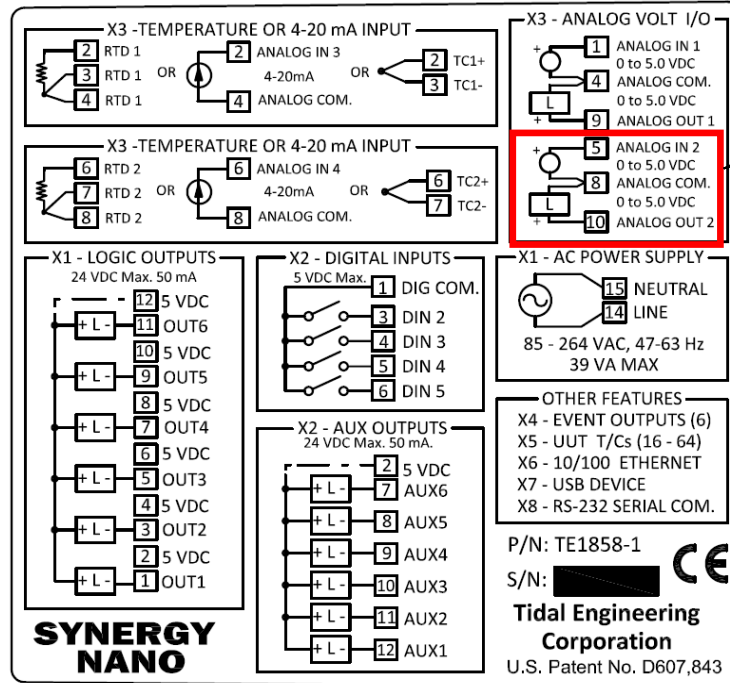


3.2. Wire the RTD Sensor to X3 plug, Pins 2, 3, and 4 as shown below. Alternatively use the T/C or 4..20mA Inputs.

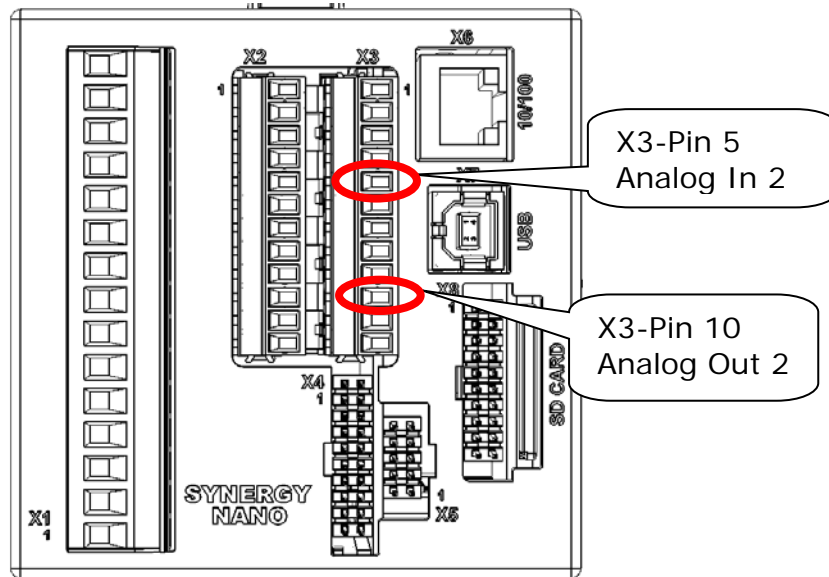


3.3 Wire the Channel 2 Sensor

For Humidity chambers, a 0..5VDC humidity sensor can be wired to Analog In 1 or 2 or a 4..20 mA sensor can be wired to Analog In 4 .
 For demonstration purposes you can loop-back Analog Out 2 to Analog Input 2 to simulate the humidity sensor and control channel.



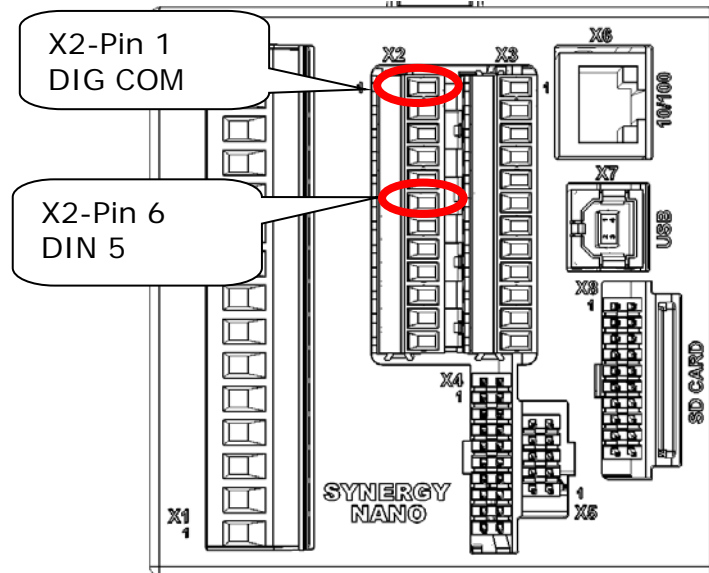
With a 18-22 AWG wire, approximately 3 inches long, connect Analog Out 2 (X3 Pin 10) to Voltage input 2 (X3 Pin 5).



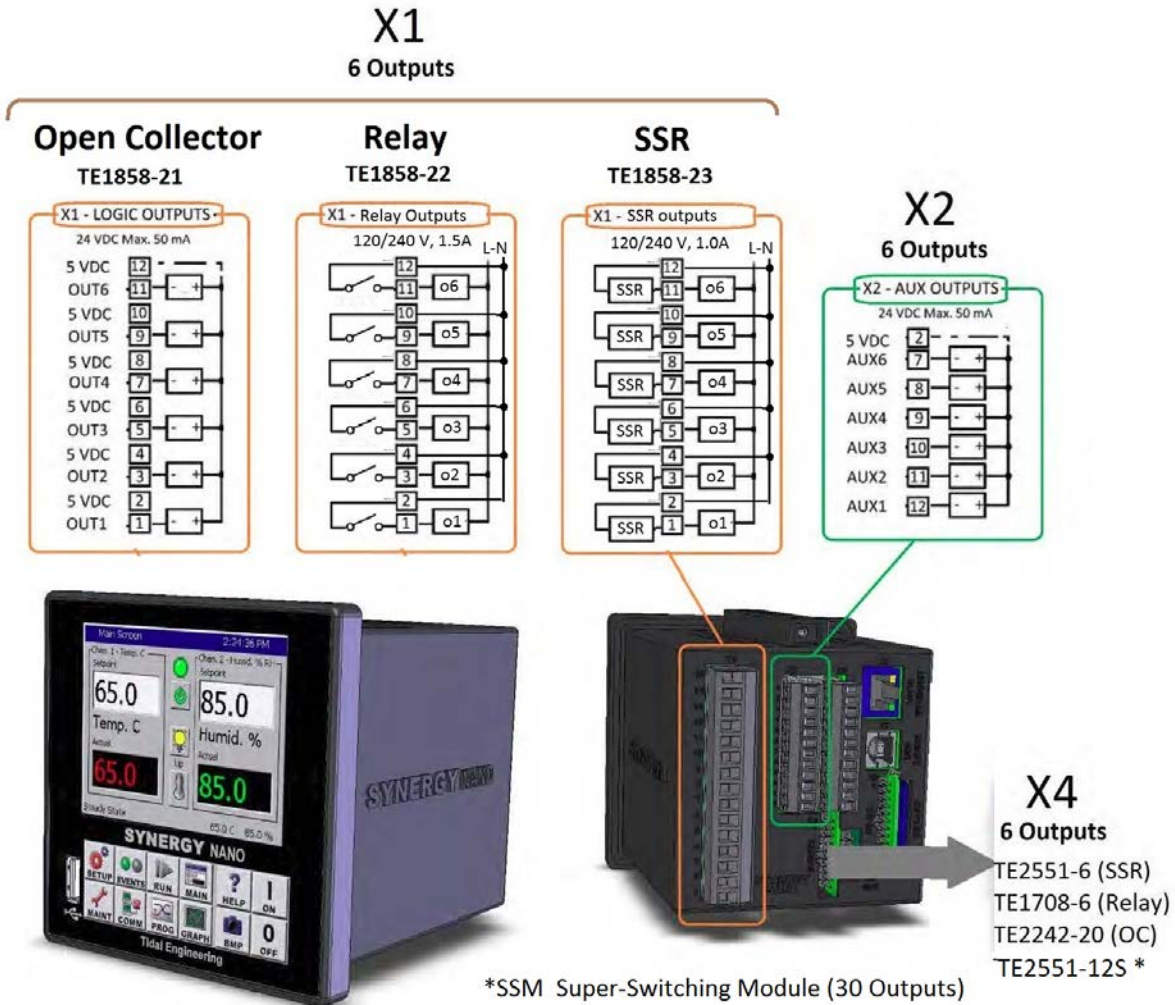
3.4 TempGard:

All standard standalone Synergy Nano Chamber Definition Files expect a TempGard input on Digital Input 5. See Safety Section 8 regarding TempGard and other safety features of the controller.

With a 18-22 AWG wire, approximately 3 inches long, connect DIN5 (X2 Pin 6) to Ground (X2 Pin 1) to establish the TempGard safety. A Secondary Limit Controller (SLC) should be wired in place of this jumper in a complete implementation.

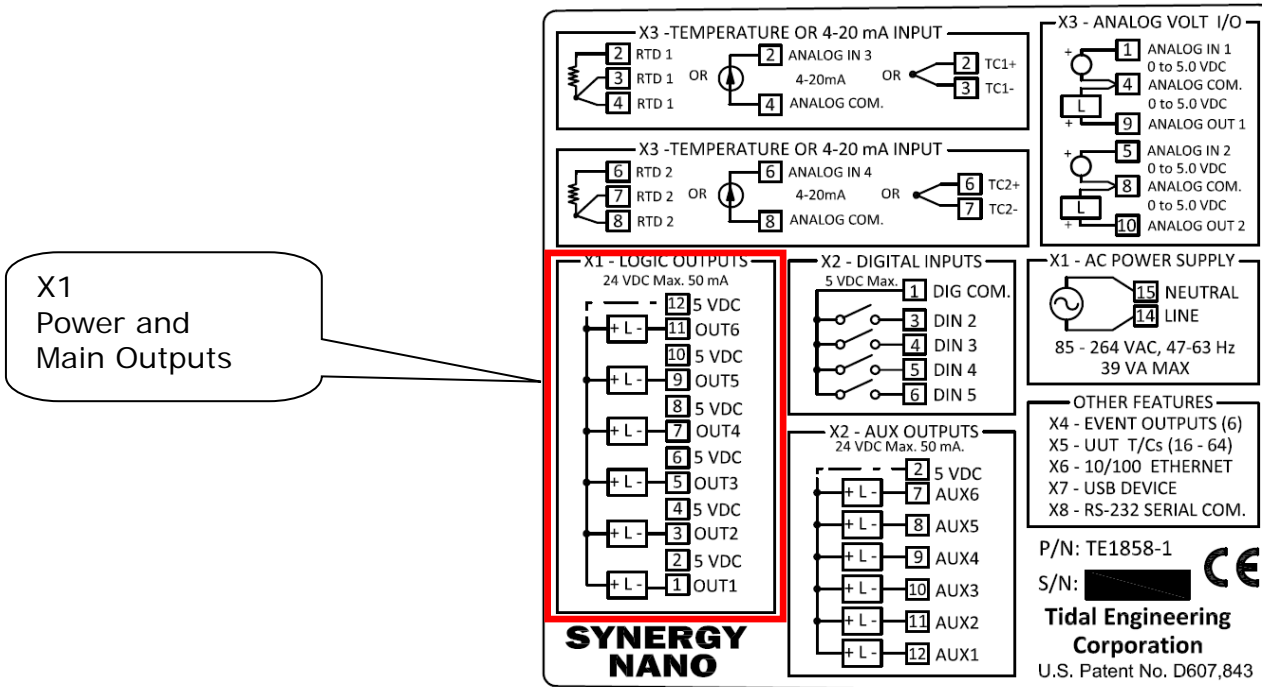
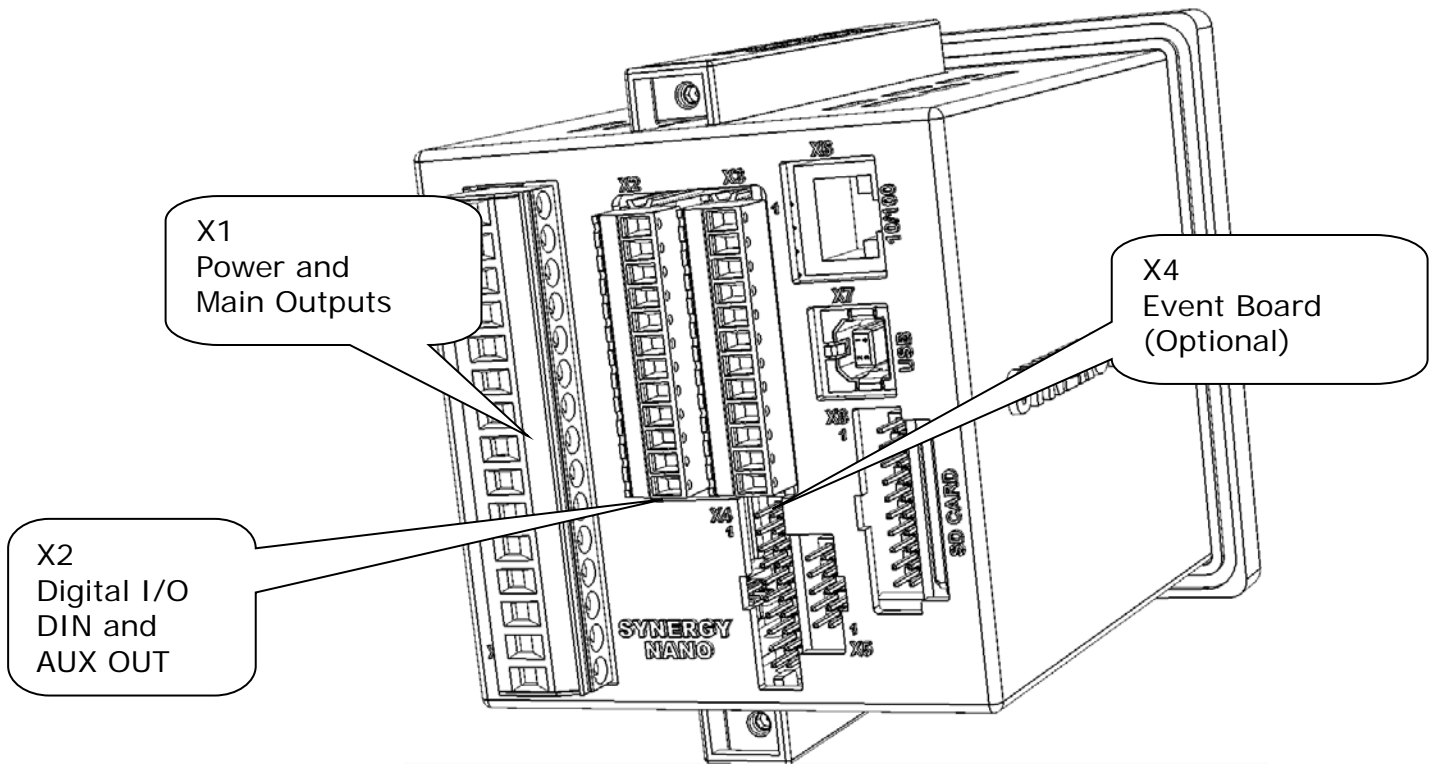


Digital Output Wiring

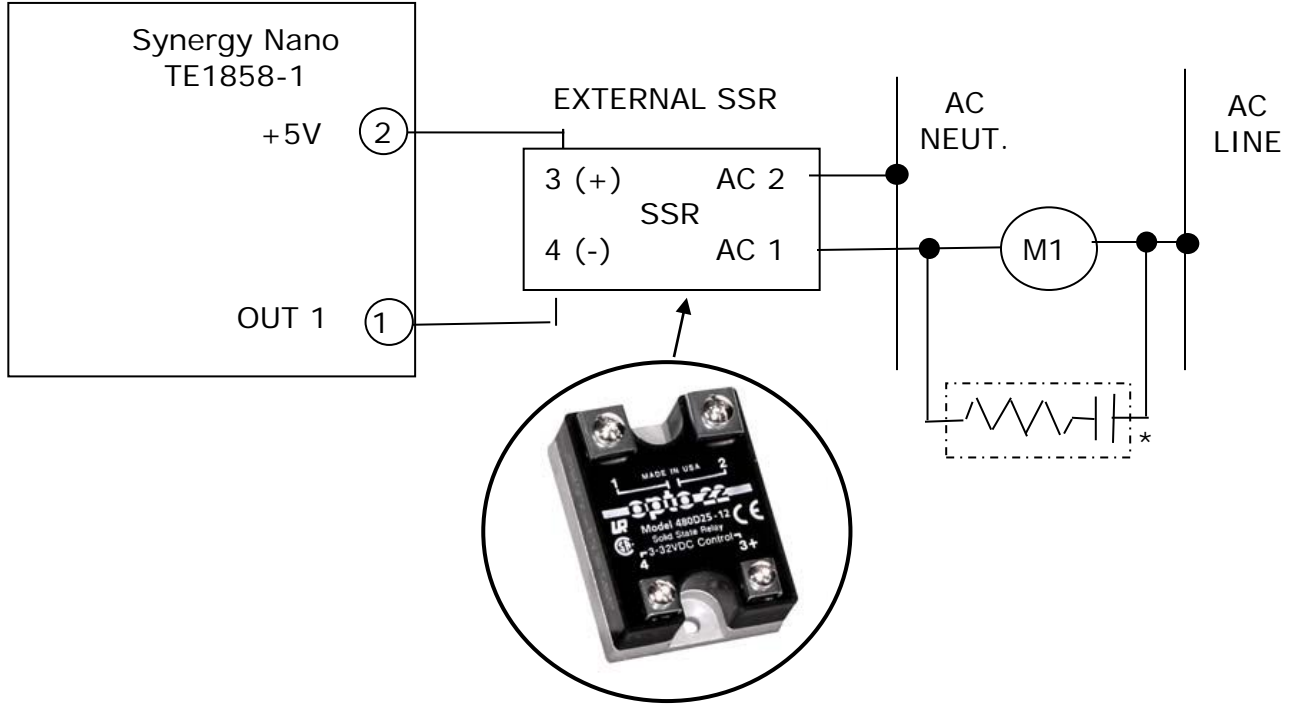


SYNERGY NANO 2

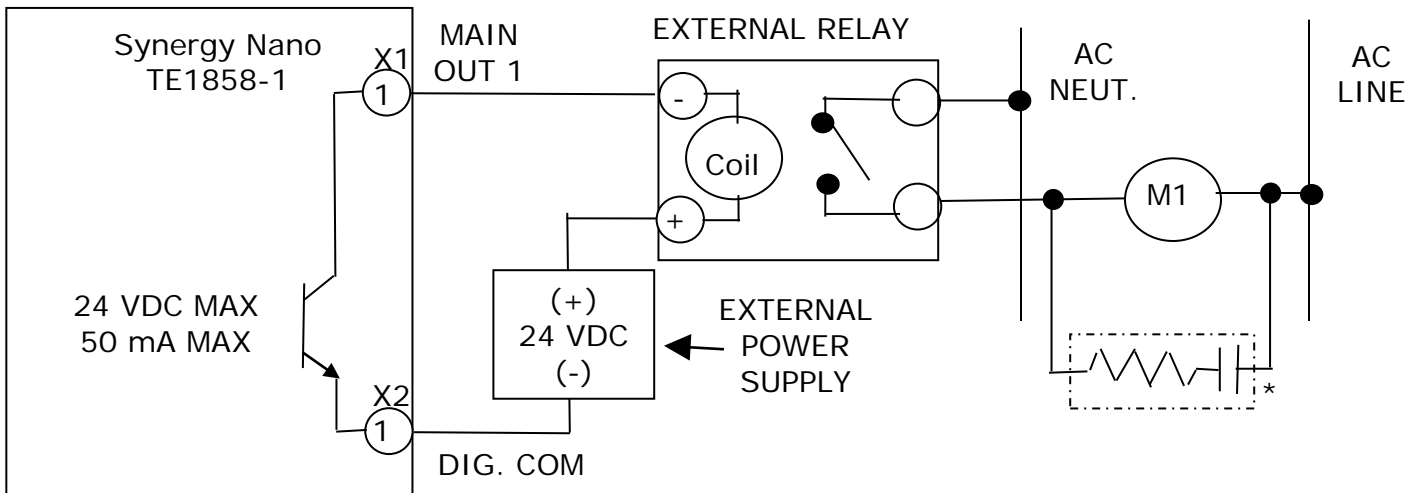
The Synergy Nano TE1858-1 model features transistor (Open Collector) 5 VDC, 50 mA outputs. These outputs can drive SSR Relays from Opto22, Grayhill etc. A wiring example of the SSR connection is shown below.



The Synergy Nano TE1858-1 configuration features Open Collector (OC) transistor outputs; rated at 24 VDC and 50 mA. These outputs can drive external SSRs from Opto22, Grayhill, etc. There are six +5 VDC outputs on the X1 connector that source control power for these loads as shown in the figure below. An external source can also be used as shown in the figure at the bottom of the page.

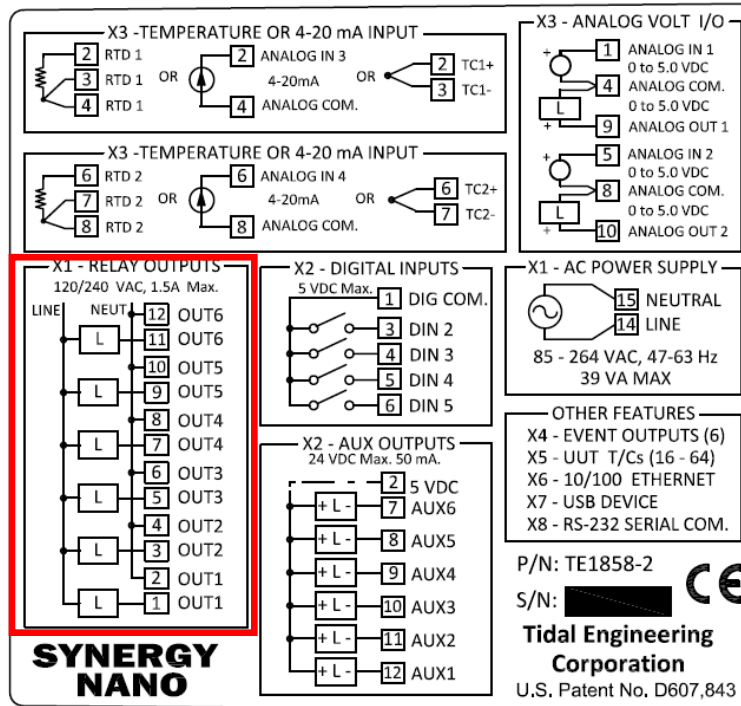


The figure below shows an example of a transistor output (OC) driving a load with an external power supply source. This configuration is applicable to the six Main outputs on TE1858-1 as well as the six AUX outputs on the TE1858-1, -2, and -3 models.

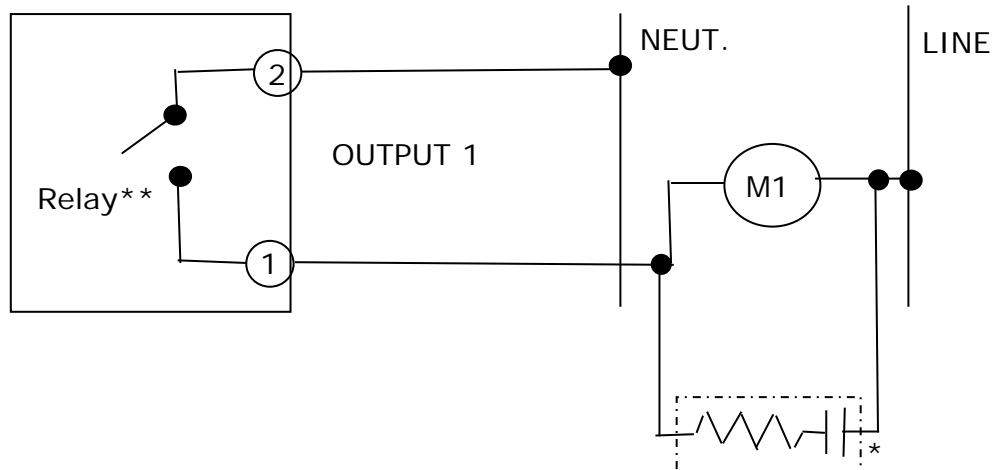


Note: * A transient suppressor (aka Quench Arc or equivalent) is recommended across all switched Inductive loads.

TE1858-2 Relay Outputs



Synergy Nano
TE1858-2

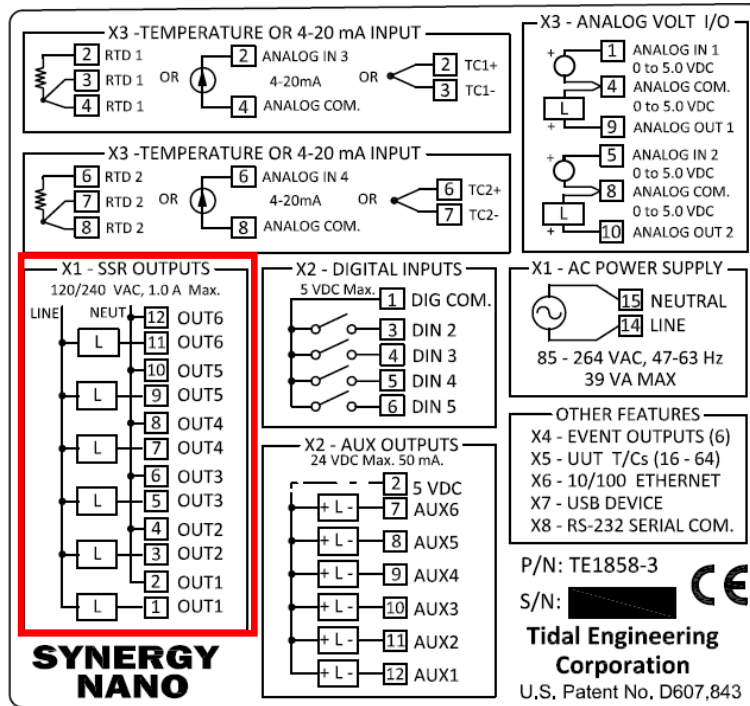


Notes:

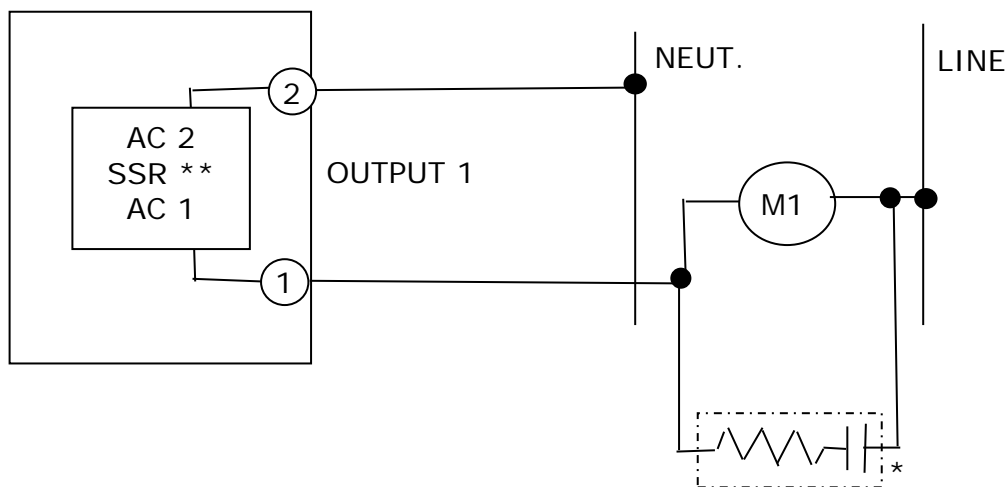
* A transient suppressor (aka Quench Arc or equivalent) is required across any switched Inductive loads.

**Relay Rating: 1.5 AAC Continuous, 8 APK, 120/240 VAC

TE1858-3 SSR Outputs



Synergy Nano
TE1858-3



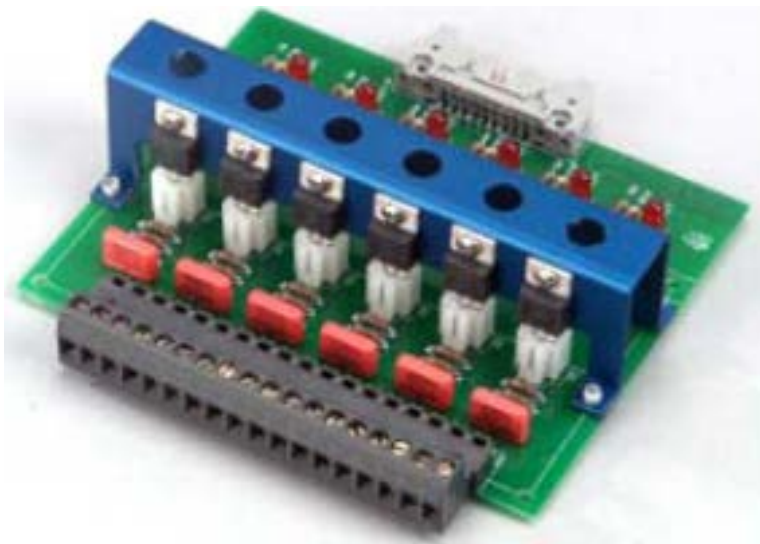
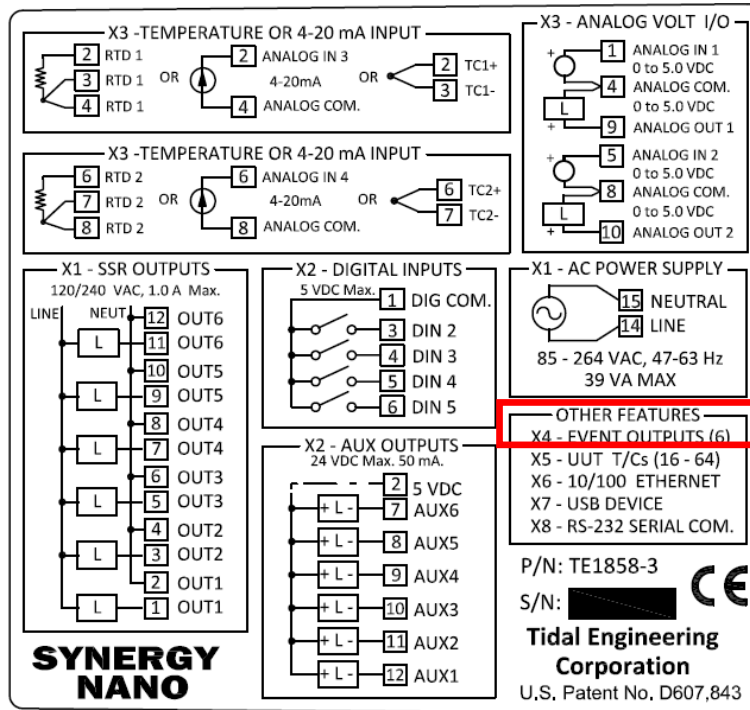
Notes:

* A transient suppressor (aka Quench Arc or equivalent) is required across any switched Inductive loads.

**SSR Rating: 1.0 AAC Continuous, 8 APK, 120/240 VAC

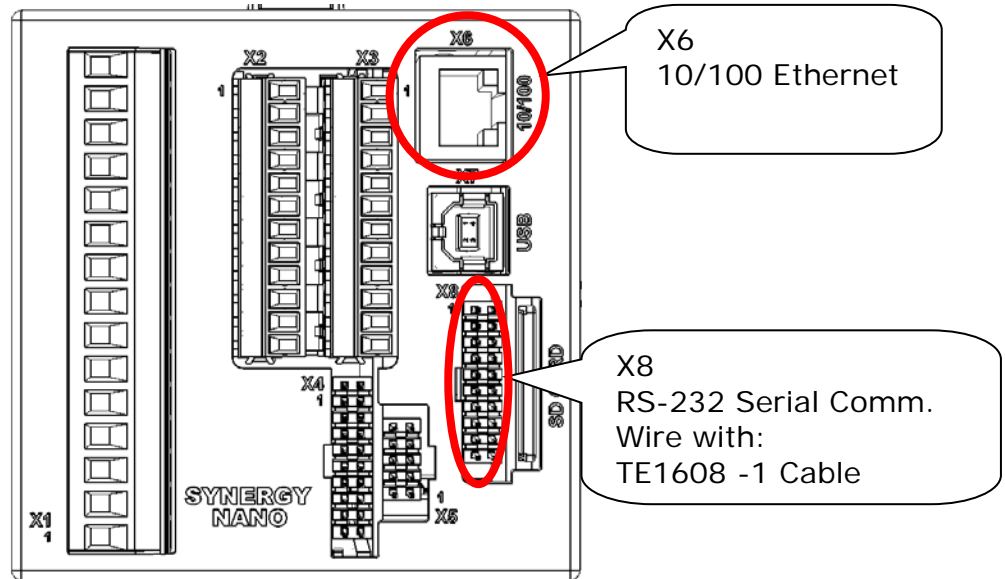
TE1151-6 Triac output board

The Triac output board can drive 6 small AC loads. It can also drive an AC controller Solid State Relay (SSR) module. When driving an SSR, an additional load resistor is required across the SSR input to prevent nuisance firing because of leakage current. The Triac output can also drive an external high current Triac as shown below.

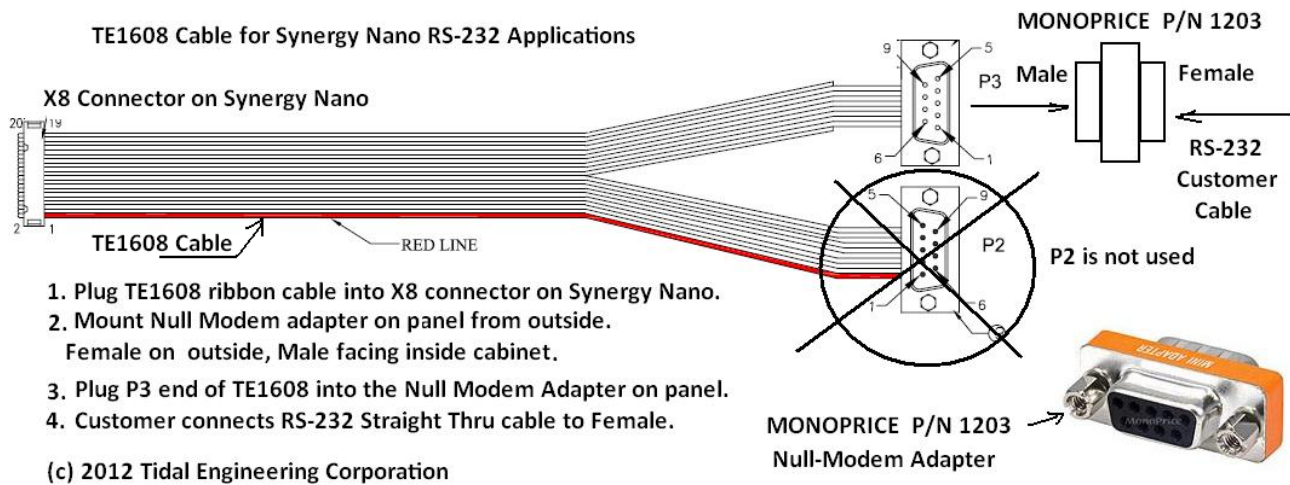


Wire Communications.

Wire the Ethernet and or Serial Communications as required. Note that the TE1608-1 cable is supplied with the Synergy Nano to connect the controller to your PC's serial port.



Now the controller is wired and can be configured for the demonstration.



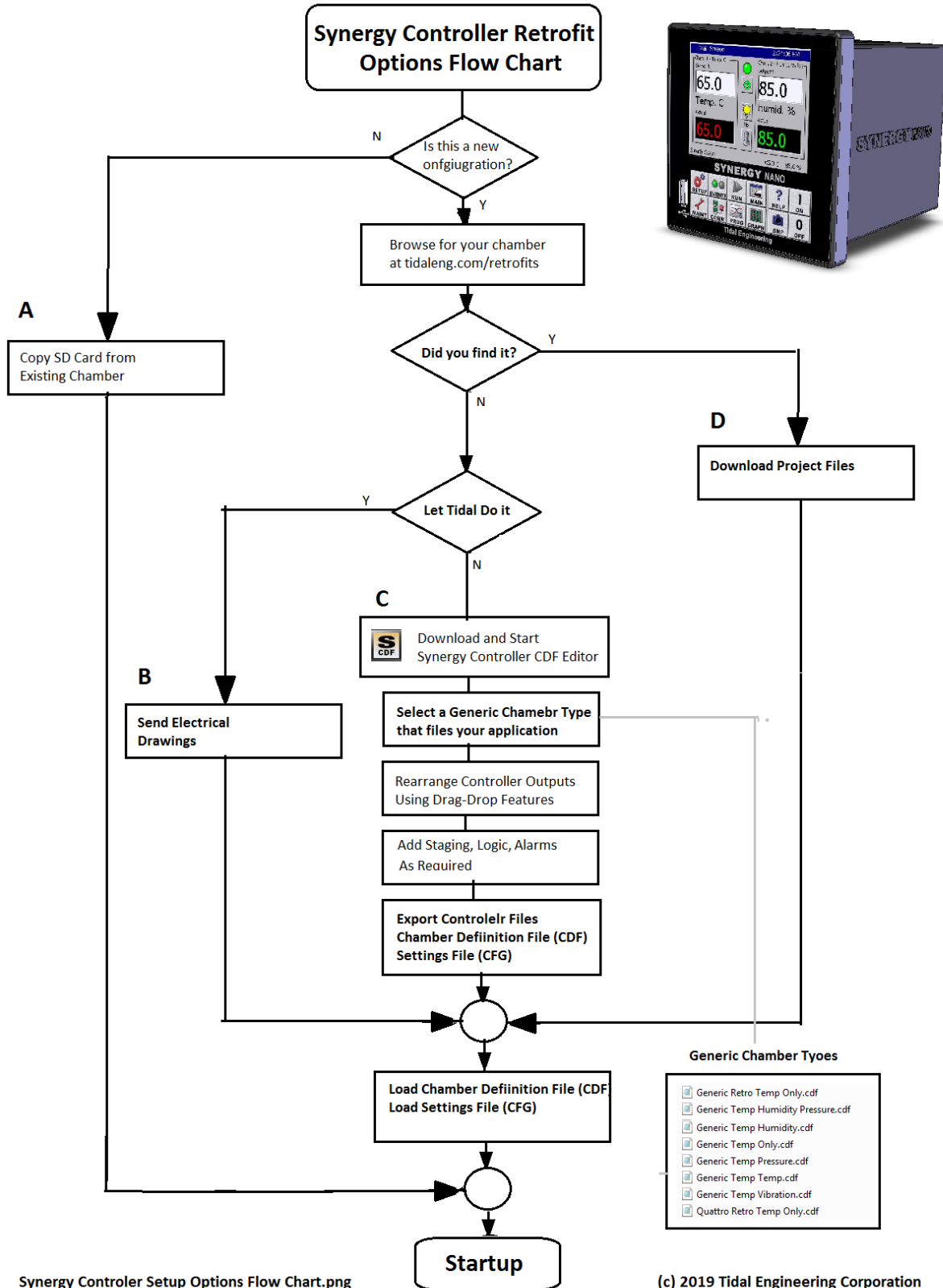
5. Setup

The Synergy Controller adapts to any chamber brand and configuration using a Chamber Definition File (CDF) and a Settings aka Configuration file (CFG).

These files can be obtained a variety of ways: (See the flow chart below)

- A. You can copy the files from an identical or similar chamber. This works great if you have multiple chambers of the same type.
- B. Let the experts at Tidal Engineering build a custom configuration for. Just send us the chamber documentation: Electrical Schematics.
- C. Customize your own configuration using one of the seven Generic Chamber Configurations (see the list below) with the Free Synergy CDF Editor Software.
- D. Download one of the 400 Configuration available on our website at Tidaleng.com/retrofits.

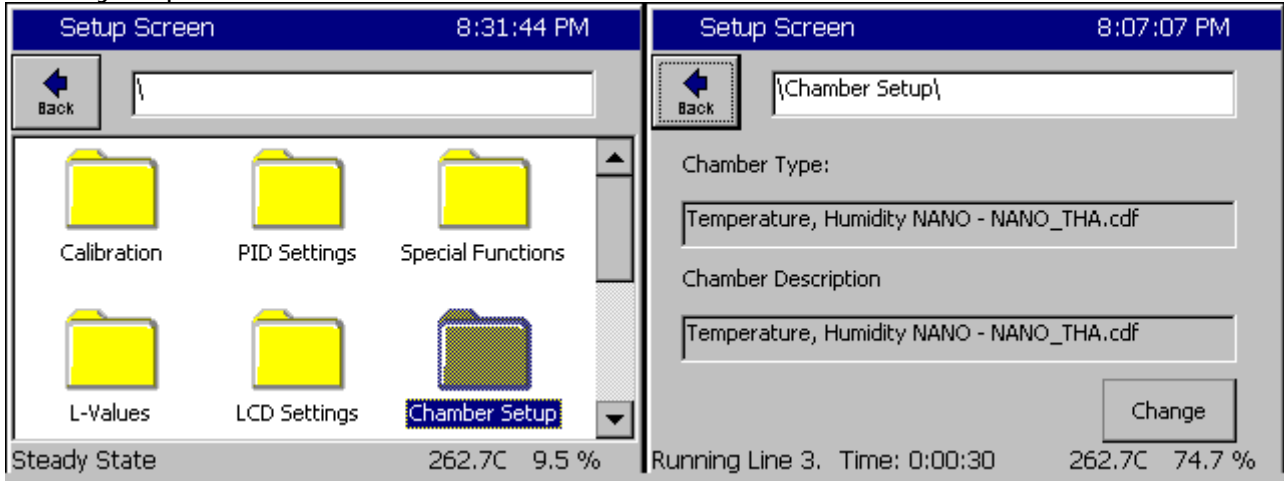
Number	Generic Test Chamber and Process Oven Configurations
1	Generic Temperature Only
2	Generic Temperature/Temperature
3	Generic Temperature/Humidity
4	Generic Temperature/Pressure
5	Generic Temperature/Humidity/Pressure
6	Generic Temperature/Vibration
7	Retro Temperature Only



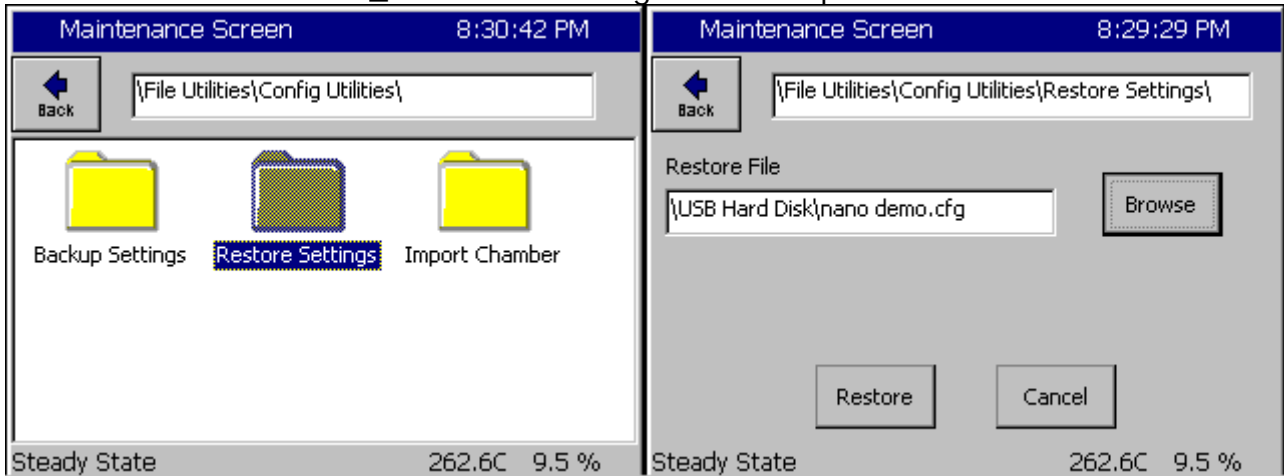
Synergy Controller Setup Options Flow Chart.png

(c) 2019 Tidal Engineering Corporation

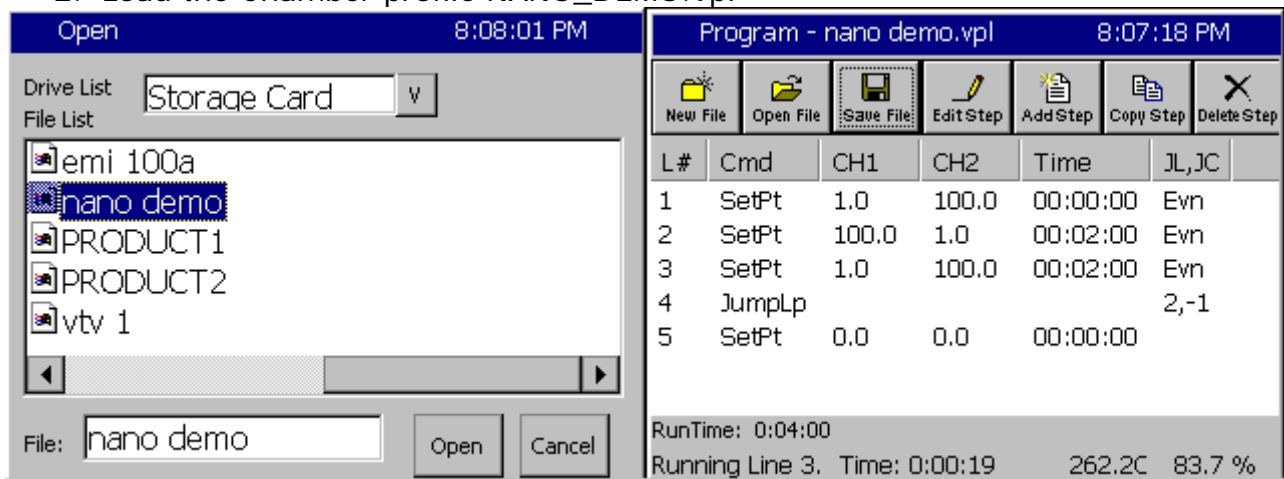
Load the NANO_THA configuration from the SETUP Screen's Chamber Setup folder then cycle power on the controller.



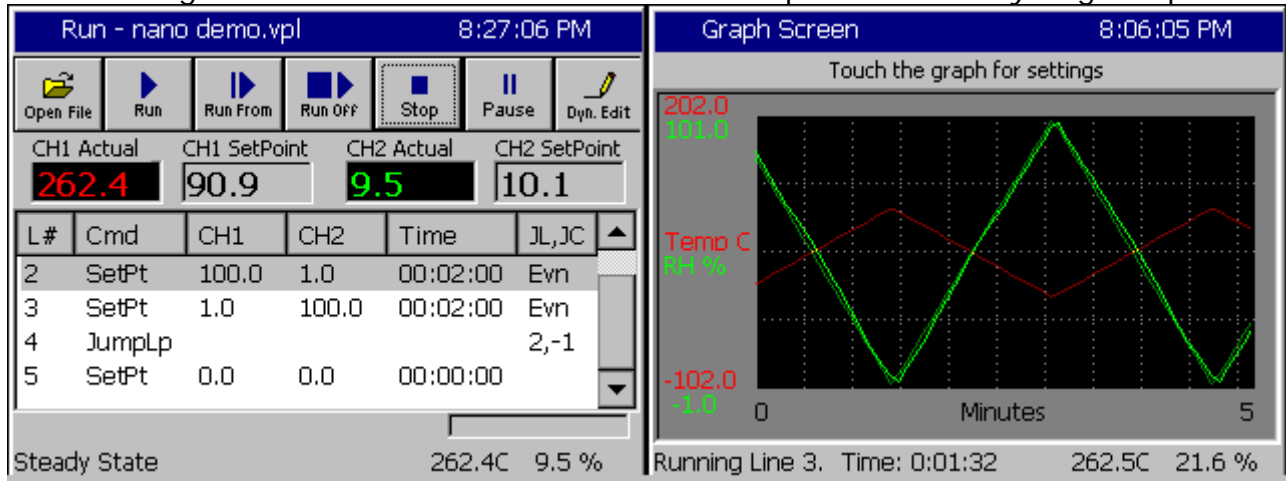
1. Restore the NANO_DEMO.CFG Configuration file provided.



2. Load the Chamber profile NANO_DEMO.vpl

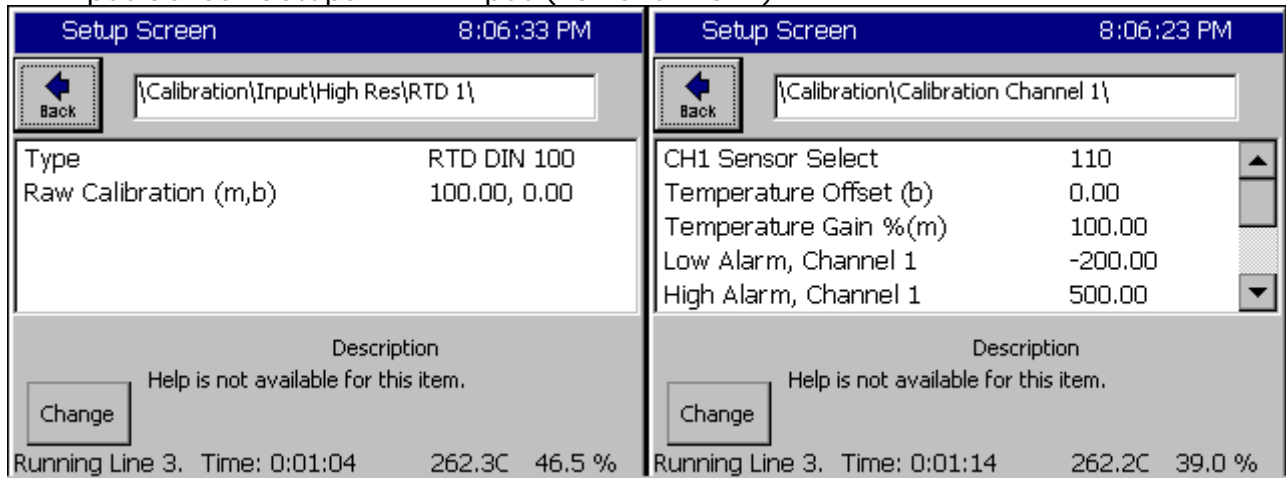


- Run the profile from the Run Screen by pressing the Run button. *
- *Warning: Make sure the circuit breaker is off to prevent short cycling compressor

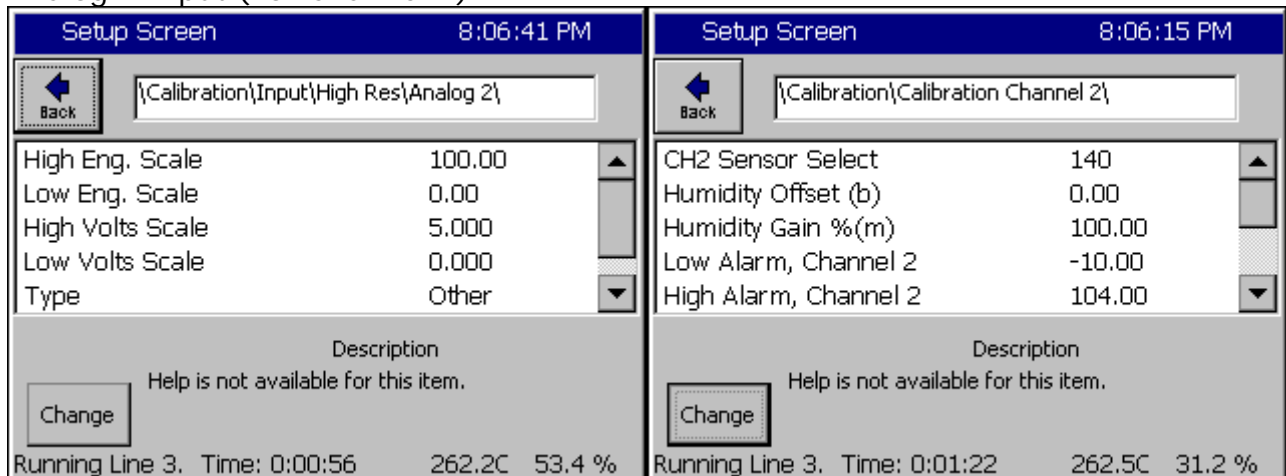


The following controller screens can be used to adjust the controller setup the to the NANO_DEMO.cfg. This is for reference only.

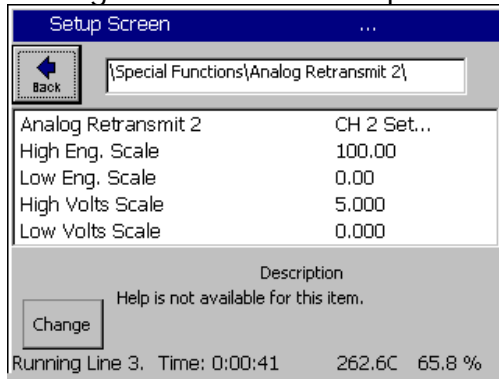
1. Input Sensor Setups: RTD Input (For Channel 1)



Analog 2 Input (For Channel 2)

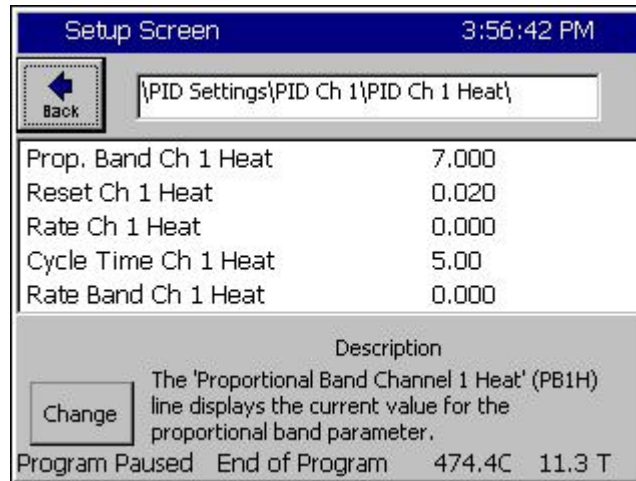


Analog Retransmit 2 Setup for Demonstration



6. Tuning

Synergy Nano PID algorithms provide high performance and flexible for up to 4 channels. The PID tuning parameter screen is shown in the following screenshot. Tuning parameters are available for each half of the split, Heat/Cool system for each channel.

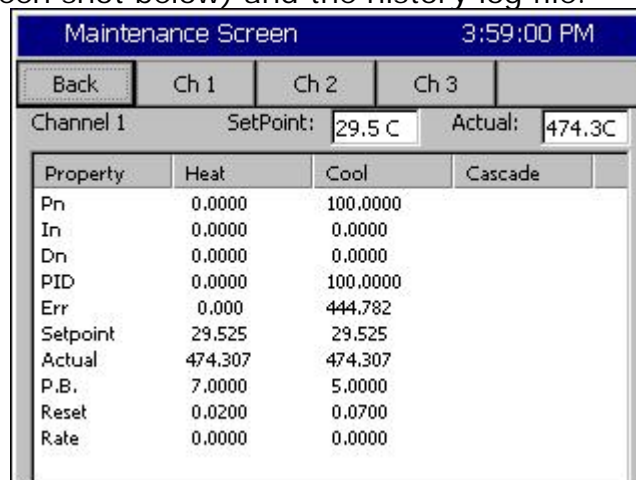


Optimum test chamber performance criteria depend on the application however typical criteria is summarized as follows:

1. Minimum over-shoot.
2. Minimum transition time.
3. Minimum energy.

The later provides reduced LN2 and/or electricity consumption.

Synergy Controller provides built-in tools for PID tuning which include the on-screen PID monitor (See screen shot below) and the history log file.

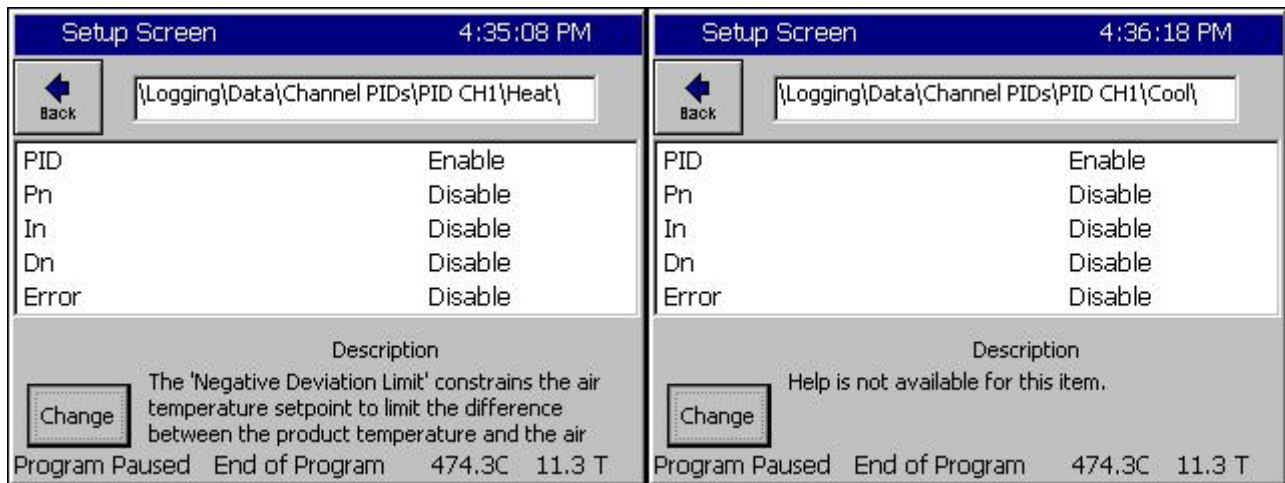


Logging Setup

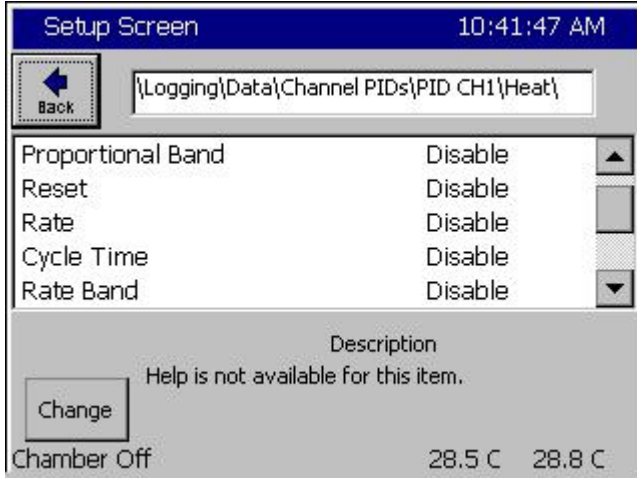
To gather data to help in the tuning process, a 10 second logging interval is recommended as shown below.



In addition, the Heat and Cool PID value logging can be enabled for all the channels of interest. These values are very helpful when evaluating the controller tuning.



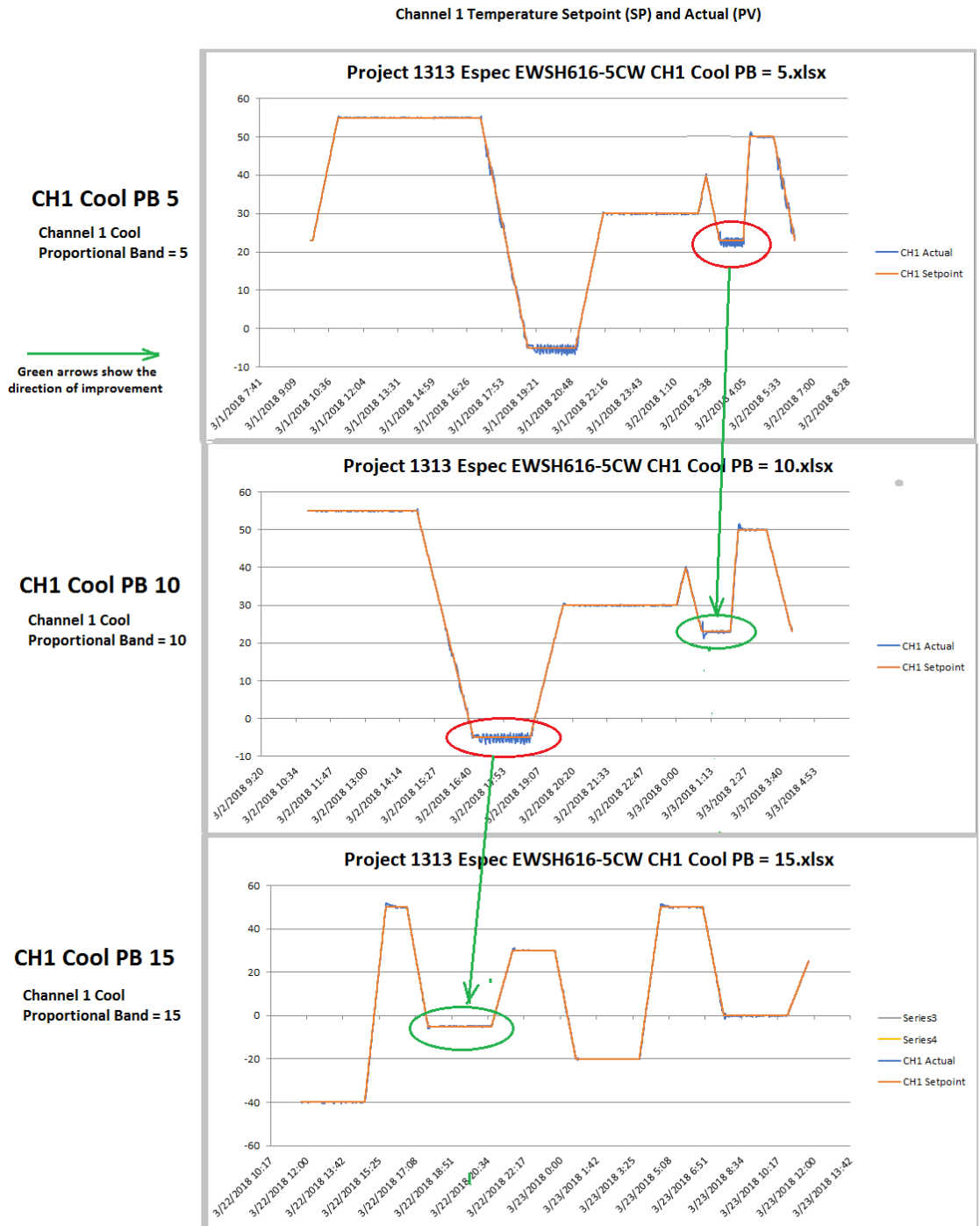
Logging the PID constants can also be helpful during tuning experiments since the tuning constants such as Proportional Band, Reset, and Cycle time are then recorded with the PID Outputs and process data. This makes it easy to see which tuning changes improved the performance and which tuning changes did not.



Differentiating between PID Tuning versus Control System Issues

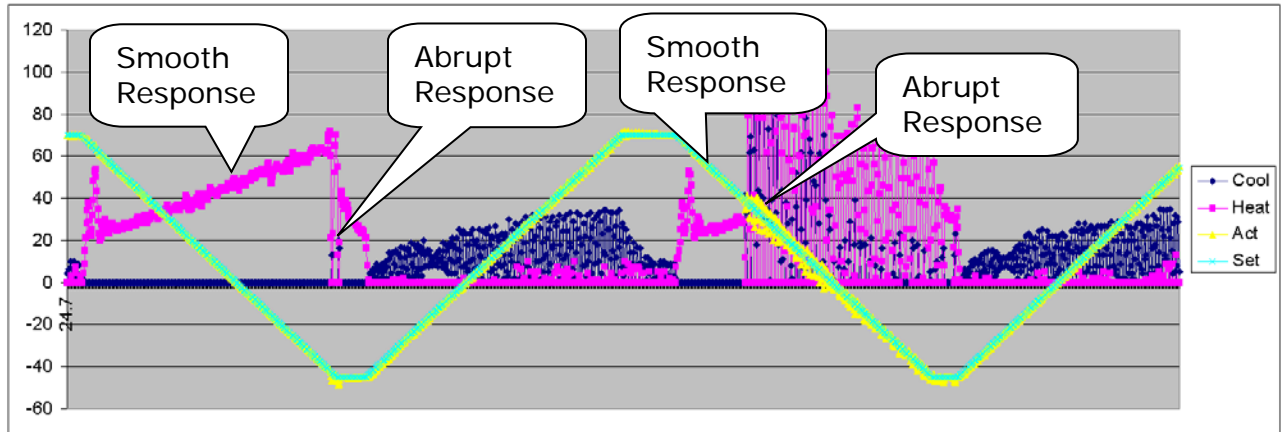
Control system non-linearities, refrigeration, and other issues can disrupt chamber performance and can appear to be symptoms of PID tuning problems.

On the other hand, in the following chart the cooling control loop is clearly unstable. This was corrected by increasing the Cool Proportional band for 5, to 10, to 15.

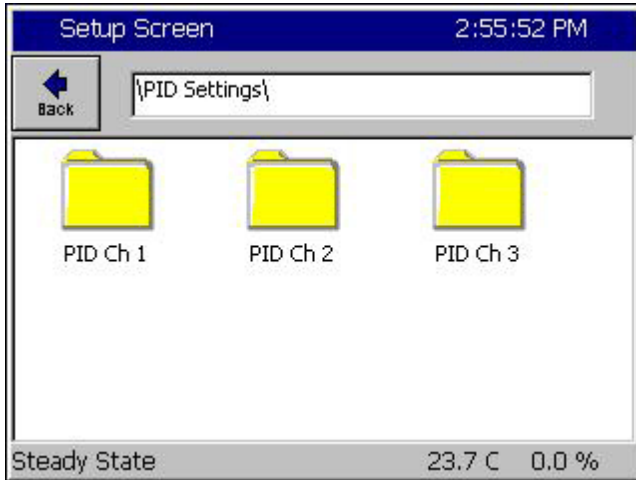


The following chart shows the log file of a control system issue that wasn't caused by PID tuning. In this case, the boost cooling system was turning on during the linear portion of a cooling ramp and causing substantial perturbations in the control system because of the system gain.

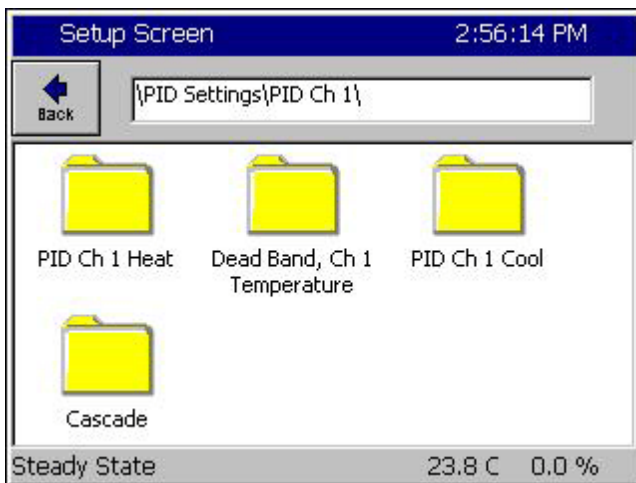
The following chart shows the log file of this issue. In this plot, the actual (Act) temperature in yellow shows significant fluctuations



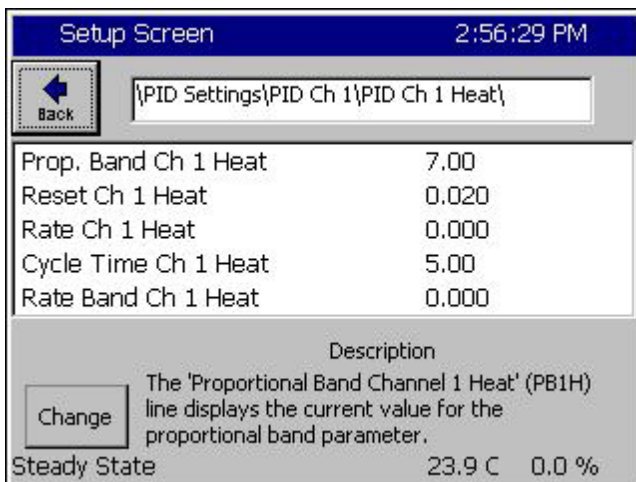
The PID Settings screen is used to edit the PID constants. that control the PID algorithms. In general, PID adjustment should only be performed by a qualified technician. For more information on PID control refer to a resource book dedicated to the subject.



To modify your PID settings, navigate to *Setup \ PID Settings*. Then select the desired channels PID folder.



Select the Heat PID or Cool PID folder. For information concerning cascade control see the fully Synergy Nano Technical Manual.



Within the Heat or Cool PID folders are settings for:

- ◆ Prop. Band Ch n Heating
- ◆ Reset Channel n Heating
- ◆ Rate Channel n Heating
- ◆ Cycle Time for Ch n Heating
- ◆ Rate Band for Ch n Heating

These settings are discussed in greater detail on the following pages.

Where n is the Channel of interest.

You can monitor the performance of your PID settings using the Channel PIDs screen in the Maintenance directory.

Maintenance Screen 2:48:14 PM			
Back	Ch 1	Ch 2	Ch 3
Channel 1	SetPoint: 125.6F	Actual: 158.0F	
Property	Heat	Cool	Cascade
Pn	0.0000	100.0000	
In	0.0000	0.0000	
Dn	0.0000	0.0000	
PID	0.0000	100.0000	
Err	0.0000	17.9870	
Setpoint	52.0000	52.0000	
Actual	69.9870	69.9870	
P.B.	7.0000	5.0000	
Reset	0.0200	0.0700	
Rate	0.0000	0.0000	

Channel PIDs

Select channel with the Ch1, Ch 2, and Ch 3 buttons along the top. The following values are displayed.

- ◆ Pn - Proportional Term
- ◆ In - Integral Term
- ◆ Dn - Derivative Term
- ◆ PID - PID Output Sum of Pn, In, Dn Terms
- ◆ Err - Error or difference between SP and PV
- ◆ Setpoint - SP
- ◆ Actual- PV
- ◆ P.B- Constant
- ◆ Reset- Constant
- ◆ Rate - Constant

PID

PID is the abbreviation for Proportional, Integral, and Derivative and is a popular control algorithm used to regulate a process variable (temperature, humidity, etc) at a fixed or moving setpoint. The setpoint is the desired level of the process variable. The PID control variable is the output of the controller. The output of a PID controller changes in response to a change in process value or setpoint.

$$PID\ Output = Proportional + Integral + Derivative$$

The Proportional Band, Reset and Rate constants are used in the calculation of the PIDs.

$$\begin{array}{ll}
 P & Proportional\ Band = 100/gain \\
 I & Integral = 1/reset \quad (units\ of\ time) \\
 D & Derivative = rate \quad (units\ of\ time)
 \end{array}$$

Error – Err

Error is the difference between setpoint and process variable.

$$Error = SP - PV\ (measurement)$$

Proportional Band

The proportional band is the range of error that forces the output from 1 to 100%. In the proportional band, the proportional controller output is proportional to the error. Decreasing the proportional band increases the controller gain; increasing the controller gain can help the PV respond faster but can also make it less stable.

If error < the proportional band

$$Proportional\ Output = (error) * 100 / (proportional\ band)$$

Else

$$Proportional\ Output = 100\%.$$

Integral – In

With integral action, the integral portion of the controller output is proportional to the integral of the Error. Integral action is used to eliminate the steady state error of a strictly proportional control. Increasing the reset (the integral gain) can speed the chamber response, decreasing the reset can stabilize and slow the system response.

$$Integral\ Output = \int (100/proportional\ band * Reset * Error)$$

Derivative – Dn

The derivative portion of the controller output is proportional to the rate of change of the error.

$$\text{Derivative Output} = 100 / (\text{proportional band}) * \text{Rate} * d(\text{error}) / dt$$

Proportional Output – Pn

Proportional output is the difference between setpoint and actual value divided by the proportional band. As an example: if the proportional band is 10 and the actual temperature is 90C and the setpoint is 100 then the Pn term is 100%. When the actual value reaches 95 degrees the Pn term is at 50%, at 99C the Pn term is 10%, at 100C the Pn term is 0%.

Reset Constant

Reset controls the integral portion of the PID algorithm. The larger this value the faster the integration term will change. Increasing reset adds gain to the system. A lower Reset slows the controller response and increases stability.

Rate Constant

The Rate is used to scale the rate of change with time and controls the calculation of the derivative. The derivative aids in canceling out the oscillation that can occur with PID calculations.

Cycle Time Constant

Cycle Time controls the time period of the proportional cycle. The output goes through one on and off cycle each period. Faster Cycle times reduce the size of steps on the output but may put more strain on the output devices such as valves. Slow cycle times may increase the size of steps but can also increase the life span of certain chamber hardware.

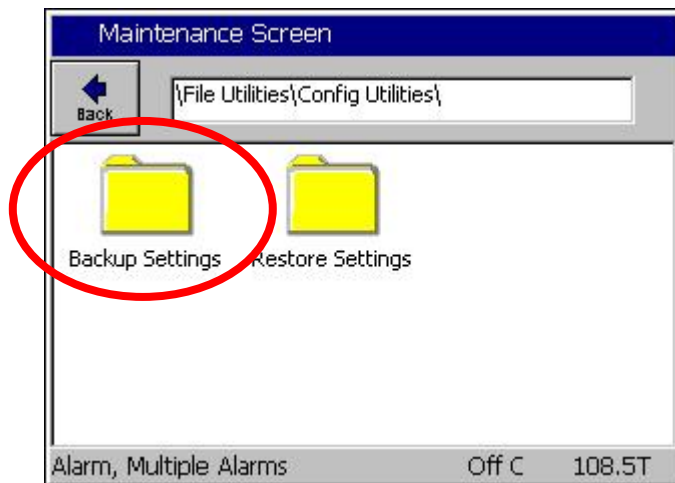
7. Configuration Backup

After the controller is setup, tuned and calibrated for the test chamber it is a good idea to backup the settings in case the configuration is accidentally changed, a hardware failure requires a controller replacement, or you need to configure additional controllers for similar test chambers. The Synergy Controller's "Backup Settings" and "Restore settings" feature in the Maintenance/File Utilities folder makes this easy.

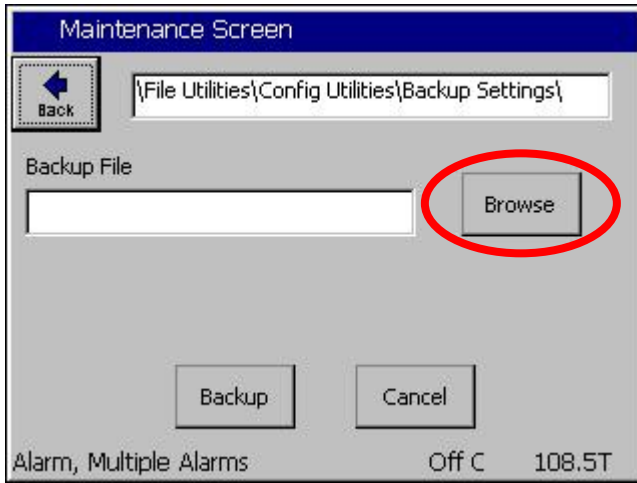
The controller settings can be backed up to the controllers Storage Card and/or to a removal USB Flash drive. We recommend both.

Note that the Backup and Restore Setting function doesn't handle Test Programs or the Chamber Definition. Test Programs (AKA Profiles) can be backed up separately using the Profile Utilities Screen.

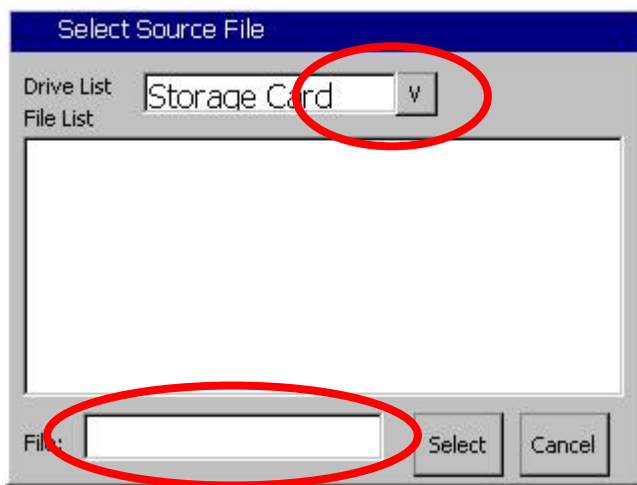
To backup the controller settings follow these steps



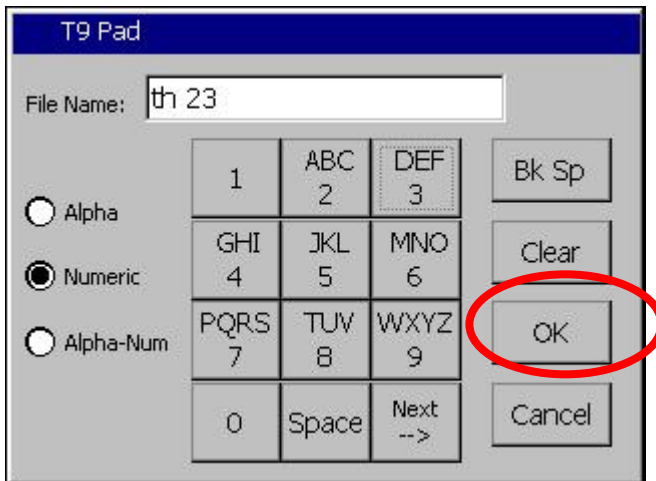
Browse to the Maintenance Screen's **\File Utilities\Config Utilities** folder and open the **Backup Settings** folder.



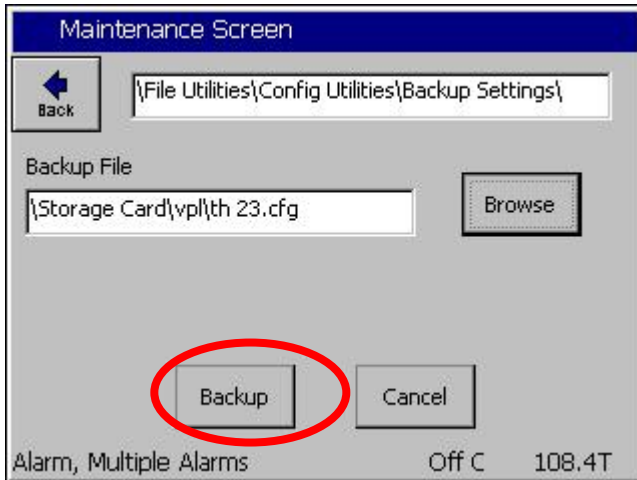
From the Maintenance Screen's \File Utilities\Config Utilities\Backup Settings\ folder Press the **Browse** button.



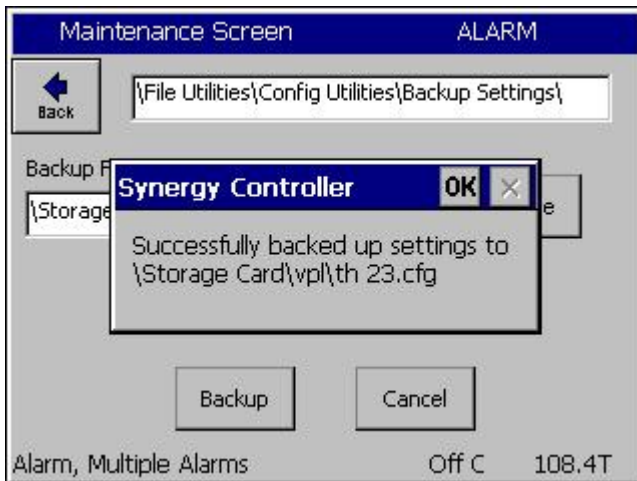
Then select either the Storage Card or the USB Hard Disk from the Drive List and press the **File:** text box at the bottom of the screen.



Enter the File Name using the T9 Pad. Then press OK.



The file name appears in the Backup File text box. Press Backup.

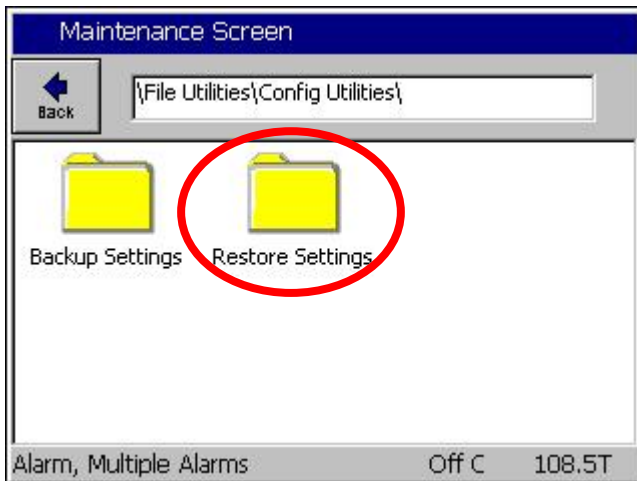


The controller will confirm that the settings were backed up successfully as shown at the left.

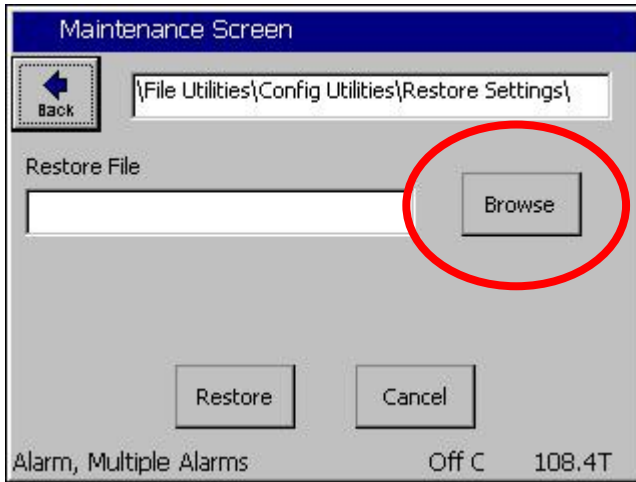
Acknowledge the window by pressing **OK**.

Restore Settings

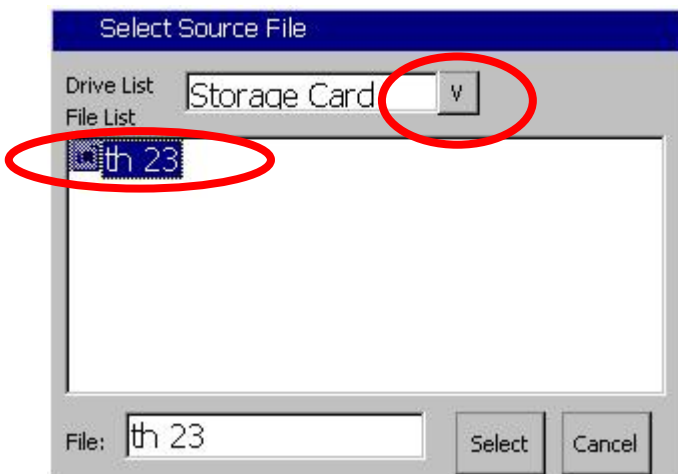
In this section we will restore the settings from the backup.



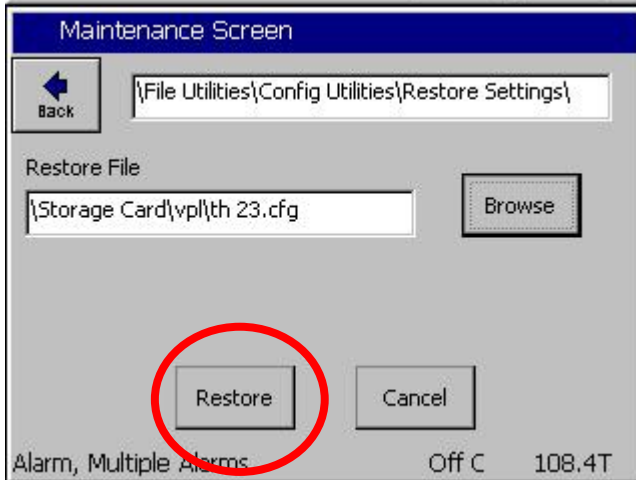
Browse to the Maintenance Screen \File Utilities\Config Utilities folder and open the Backup Settings Folder. Then press the Restore Settings Folder.



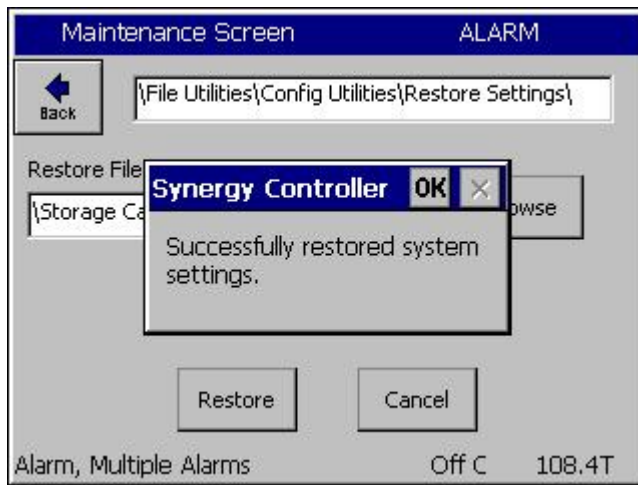
Press the Browse button.



Then select either the **Storage Card** or the USB Hard Disk from the Drive List. Then select the appropriate file from the list and press **Select**.



Confirm the File Name that appears in the Restore File text box and then press **Restore**.



The Controller will confirm that the settings were restored.

The controller's Backup and Restore features can be used to store multiple PID sets for different product/environment conditions.

8. Safety

The Synergy Controller offers multiple built-in alarms to protect the chamber and the unit-under-test from conditions outside their ratings and capabilities. The alarms should be carefully set to appropriate limits based on the capabilities of the chamber and the safe limits of product exposure. In addition to these built-in alarms, a Secondary Limit Controller (SLC), referred to here as a TempGard controller should always be employed to provide protection in the case of a controller failure.

1. Channel Alarm Limits

The Synergy Controller features high and low absolute limits and high and low deviations limits for each channel. Look for the alarms in the setup folder for each channel under SETUP/Calibration/Channel 1, 2, etc.

2. User Alarm Limits

In addition to the channel alarm limits, the Programmable User Alarm System can provide additional protection against open or failed sensors and process variables outside expected limits. User alarms can be created using redundant sensors for any channel and provide shut down protection to reduce the probability of damage or machinery failure.

3. Secondary Controller Alarms

Redundant protective mechanisms such as a TempGard SLC should be used to provide protection against controller and/or sensor failure. When used with a separate sensor, secondary alarm controllers reduce the probability that a single point failure will cause damage to the chamber or to the product under test. The secondary controller should be wired to remove power from all the chamber's machinery to provide maximum protection.

3. Live Loads

When testing a product that dissipates heat (a "live" load) wire the TempGard SLC to some means to remove the power source from the product in the event of an alarm.

4. Alarm System Testing

It is important that users periodically verify all alarm systems by test. As a minimum, it is important to verify that a chamber shut-down occurs and power is removed from heaters, compressor, etc. when standard alarm limits, user programmable alarm limits, and secondary controller limits are reached.



No complex software or hardware system is perfect. Defects are always present in a software system of any size. To prevent danger to life or property, it is the responsibility of the system designer/owner to incorporate redundant protective mechanisms appropriate to the risk involved.



All Tidal Engineering products are 100 percent functionally tested. Additional testing may include visual inspections. Specifications are based on characterization of tested sample units; each production unit isn't tested over temperature and voltage. Additional testing or burn-in of a system is available by special order. Tidal Engineering reserves the right to make changes and improvements to its products without providing notice.



Make sure you completely understand the operation and function of the Synergy Controller before you begin using your test chamber.



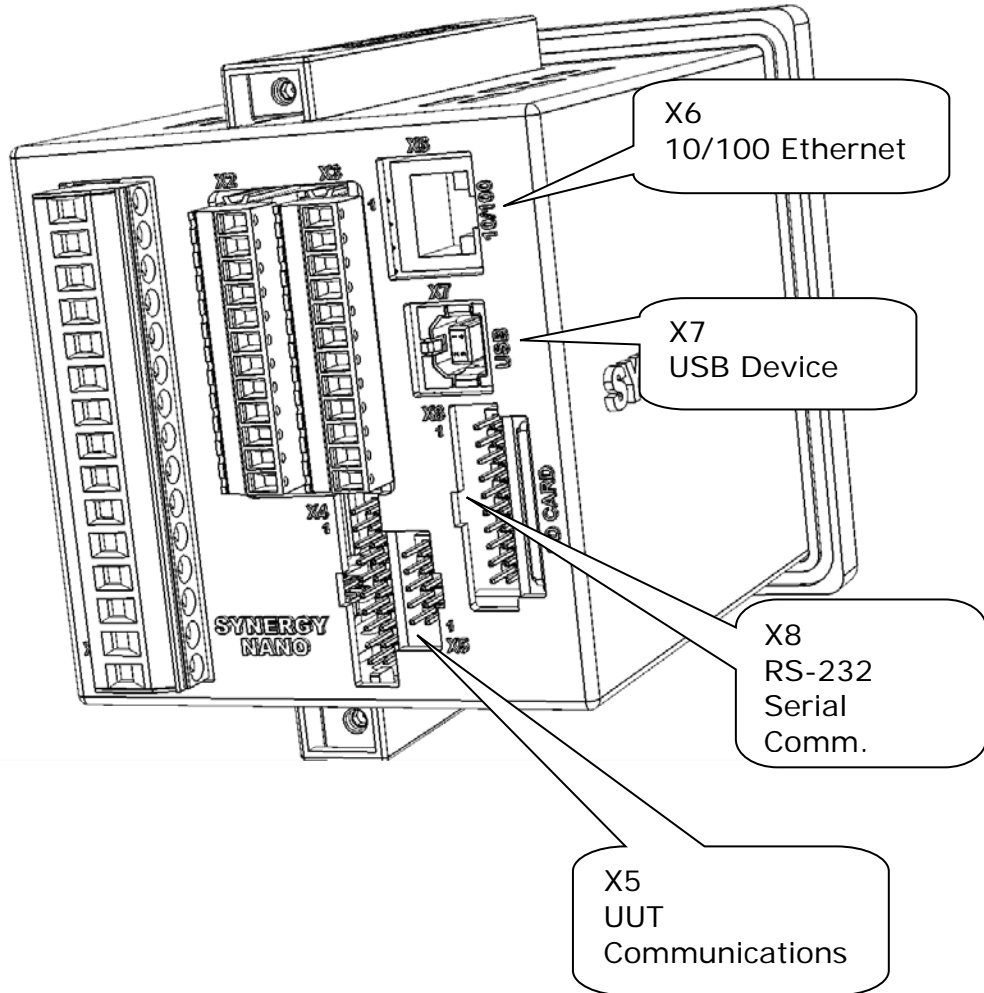
Dangerous voltages are present both in the controller and in the test chamber. Disconnect electrical service from source and tag circuit out before servicing or replacing components.



Do not use the Synergy Controller in any manner not specified in this manual. Improper use may impair the safety features employed and may void your test chamber and controller warranty. Failure to follow the proper operating procedures listed throughout could cause damage to your equipment, personal injury, or death.

9. Communications

The Synergy Nano offers both Ethernet communications and RS-232 standard. An optional IEEE 488/GPIB board, P/N TE1588-1, provides GPIB communications for the Synergy Nano.



Ethernet

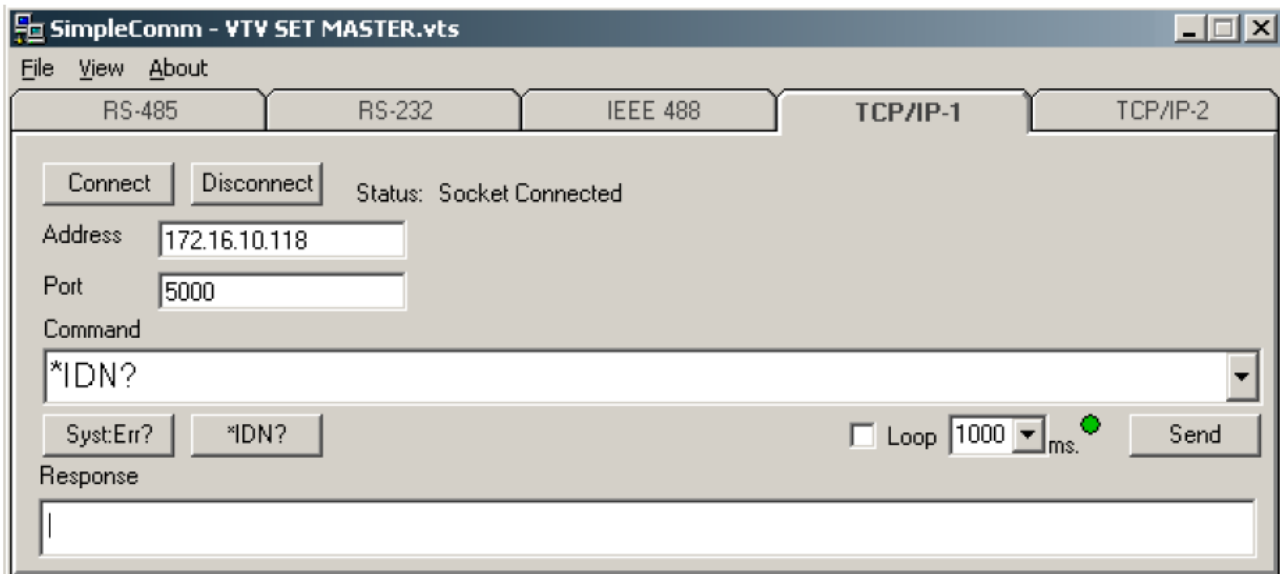
The Synergy Nano features a 10/100 BaseT Ethernet port. See X6 in the figure above.

RS-232

The Synergy Nano features an RS-232 port, see X8 in the figure above. (Requires a Null Modem cable or adapter)

GPIB (Optional)

The optional GPIB feature requires the Synergy488, TE1588-1 option. See the unit in the figure below.



Synergy Remote Control and Application Programming

This Synergy Controller application note describes the various methods available to users for remote control and application programming on both the full-sized Micro and the ¼ DIN Synergy Nano controllers.

Tidal Engineering’s Synergy Controllers provide state-of-the-art usability and connectivity for environmental test control and data acquisition and are designed to improve test efficiency by supporting both factory automation and test and measurement protocols and standards.

The following table includes the seven remote control and application programming methods available for use the Synergy Controllers and identifies the communication ports and capabilities of each.

Synergy Controller Remote Control and Programming Option Table

Application	Communication Port			Remote Control		Remote Monitor	File Transfer
	Ethernet	RS-232	GPIB*	Web Browser	Other		
WebTouch Remote™	✓			✓		✓	
Synergy Manager	✓	✓	✓			✓	
Synergy Manager (Full)	✓	✓	✓		✓	✓	✓
SimpleComm	✓	✓	✓		✓	✓	✓
LabVIEW	✓	✓	✓		✓	✓	✓
User Application	✓	✓	✓		✓	✓	✓
FTP Client	✓						✓

Note: GPIB communications are standard on Synergy Micro Controller and Synergy Plus (TE1858-4) and optional on other Synergy Nano Controllers.


As shown in the table above, the Synergy Controller supports many protocols and standards. These methods range from the simple and straightforward; WebTouch Remote - requires only a network connection and a web browser for remote control and monitoring through the Synergy Manager; a multi-chamber environmental lab control, monitoring and programming application. In addition to these turnkey pre-programmed applications, user application programs can be readily developed with the LabVIEW driver available from Tidal Engineering and downloadable from the website. In addition, custom Windows™ applications can be developed using the SimpleComm source code as a starting point. And finally, the controller’s built-in ftp server can be used to drag and drop chamber profiles, history and other files thru the local area network.

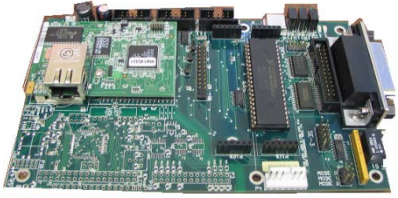
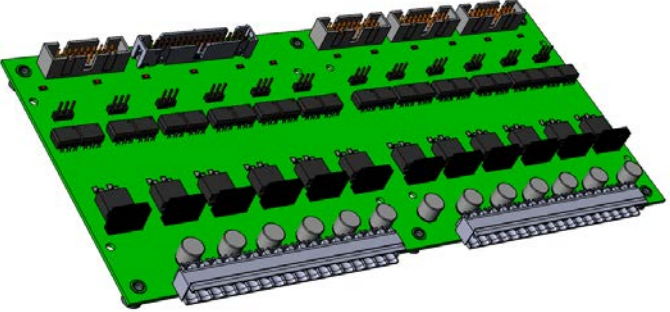
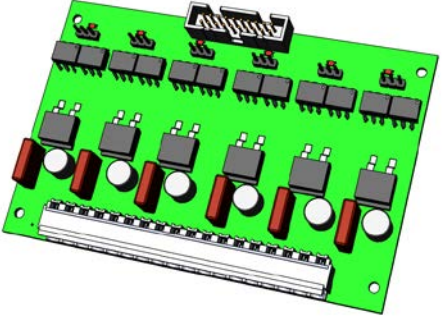
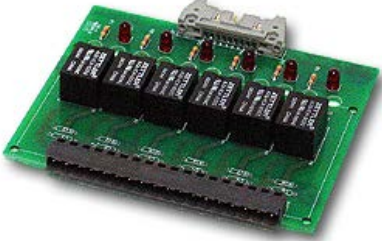

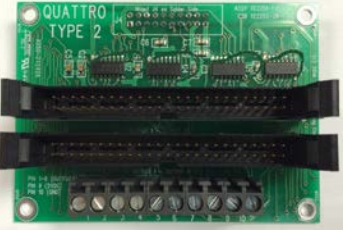
Appendix A: Accessories and Options

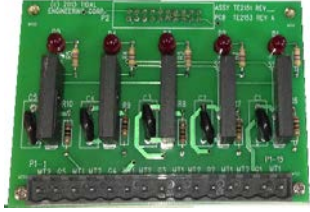


Synergy Nano 2 Accessories Kit

Item	Quantity	Part	Description
1	2	110-A-111/12	Olympic Plugs, CONN PLUG 3.5MM 12 POS
2	1	121-A-111/15	AC Power Connector (120 is 5mm)
3	1	311013-01	Cord 18AWG 3Cond 79" Black SJT
4	1	TE1608	RS-232/RS-485 Cable, 6 Feet
5	1	TE1722-34-6	Ribbon Cable Assembly, 34 position, 6 feet
6	2	TE1722-20-6	Ribbon Cable Assembly, 20 position, 6 feet
7	1	TE2013	Synergy USB Flash Drive, 8GB
8	1	TE2318	Synergy Controller Technical Manual
9	1	TE2281	Synergy Nano 2 Controller Installation Manual (this document)
10	1	1770-06C	CAT6 Panel-Mount Extension 6FT.
11	1	TE2077-4	Synergy Bulkhead Connector Panel, SS
12	1	TE1566-0	Synergy Manager (Monitor Only Version)
13	1	15206	Hex Key driver, 3/32"
14	3	TE2183	Triac Leakage Suppression Resistor, 4K, 6.5W

Synergy Nano 2 Options

Part Number	Model	Description
TE1566-1	Synergy Manager Software	Windows Based, Multi-Chamber Monitor Program
TE1567	Synergy Web Touch Remote™	Operate your Synergy Controller over a network or the Internet using a standard web browser. For all Synergy Controller models
TE2013	Synergy Pressure Feature Registration	Pressure channel for altitude and thermal vacuum (Space) chamber applications. For all Synergy controller models.
TE2042	Synergy Cascade Feature Registration	Synergy Controller Cascade Feature Registration. For all Synergy Controller models.
TE1299-16	UUT Thermocouple Monitor - 16 Channel T-Thermocouple Monitor - Daisy chain up to four of these 16-Channel monitors together and acquire 64 temperatures. - Displays and log readings to the Synergy internal log file for analysis, graphing and reporting	

TE1588	IEEE 488/ GPIB Communications Adapter	
TE2551-12S	12-Channel Triac Event Board Super Switching Module	
TE2551-6	6-Channel Triac Event Board	
TE1708-6	6-Channel Relay Event Board	
TYPE 1	P/N TE2251-1 8-Channel Expansion 4 x Ribbon Cable connections	
TYPE 2	P/N TE2251-2 OPTO-22 I/O Board	

<p>TYPE 3</p>	<p>P/N TE2251-3 LED Outputs</p>	
<p>TYPE 4</p>	<p>P/N TE2251-4 I/O Expander</p> <p>8-Digital Inputs 8-Analog Inputs 8-Digital Outputs</p>	
<p>TYPE 5</p>	<p>P/N TE2251-5 5-SSR Board 2 Amp SSRs</p>	

Appendix B: Output Primitive Descriptions

Cascade Temperature Control Outputs

- PID Heat
- Boost Heat
- Hi Stage Compressor
- Lo Stage Compressor
- PID Cool
- Boost Cool
- Full Cool
- Cascade Condenser
- High Artificial Load
- Low Artificial Load

Humidity Outputs

- Wick Pan (AKA Humidity Enable)
- Drier
- PID Dehumidify (AKA Dehumidify Coil)
- PID Humidify
- Ambient Coil

Single Stage Temperature Control Outputs

- Compressor
- Artificial Load
- PID Cool, Temperature Only or Thermal Shock

Altitude Outputs

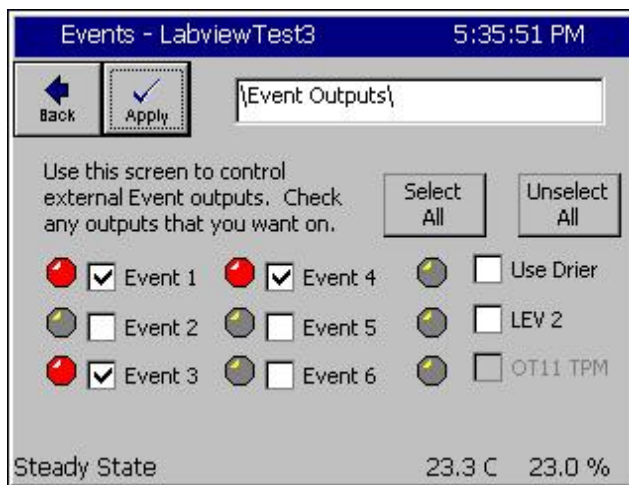
- Vacuum
- Vent (Vent/BC)

Other Outputs

- Fan Output
- Event Outputs (1 thru 6)
- Alarm Relays
- Copy Output
- Inverse Output
- Timed Output
- Input Controlled Output
- PWM Output

Event Outputs

Up to 6 Event Outputs are available for user functions. These Events are controlled from the Events\Event Outputs screen. All the events are disabled when the Chamber is turned Off.



Alarm Relays

There are two Alarm Relay Primitives designed to operate when there is a standard channel alarm. In addition, the Alarm Relay Primitives can be programmed to operate with any number of User Defined Alarms. The Alarm Relay primitives are the only primitives that are enabled when the chamber is turned Off (The chamber Off button is pressed).

Copy Outputs

Copy Outputs follow another output on an instantaneous basis. For example, some application might require two Humidity enable outputs.

Inverse Outputs

Inverse Outputs follow the inverse of another output on an instantaneous basis. For example, a Hot Gas Bypass output is the instantaneous inverse of the PID Cooling output.

Timed Outputs

Timed Outputs are used to control defrost or other periodic features.

Digitally Controlled Output

Digitally Controlled Outputs follow the state of one of the Digital Inputs.

PWM Outputs

PWM Outputs are Time Proportioning (AKA Pulse Width Modulated) outputs. These outputs are controlled by setpoints, process variables, or PID values.

PWM outputs setup screen is identical to the Analog Retransmit Output screen.

Appendix C: Frequently Asked Questions, FAQ

Q1: The TempGard Alarm is always on. What is it and how do I get rid of it?

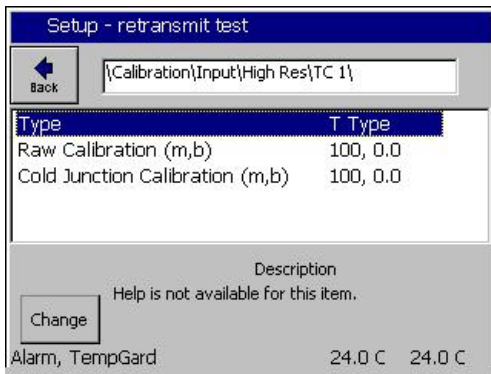
A1: The Synergy Micro and Synergy Nano controllers can optionally display the state of a secondary limit controller (SLC). An SLC provides extra protection for the chamber and the unit(s) under test in case of a controller or chamber failure and is recommended for all systems. The Chamber Definition File (CDF File) determines if the controller is configured to display this alarm and if so, the digital input used. "TempGard Alarm" is the message displayed in the Alarm folder [MAINT\Alarms\] and in the Log file when the secondary limit controller is in the Alarm state. An auxiliary contact from the SLC is wired to the Synergy Controller digital input to trigger this alarm. The default digital input for the Synergy Micro Controller is Input 9 (P1-1 to P1-11) and the default for the Synergy Nano is Input 5 (X2-1 to X2-6).

Browse to the [EVENTS\Digital Inputs\] folder to monitor the state of the Digital Inputs on your Synergy touch screen. Wire a jumper in place of the auxiliary contact if your system doesn't include an SLC. Alternatively, contact the factory for a modified Chamber Definition File that doesn't include the TempGard alarm feature.

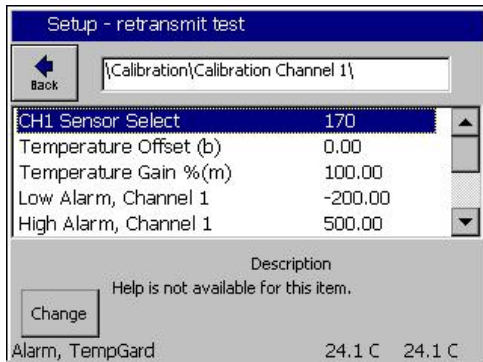
Q2: We would like to use a type T Thermocouple for our air temperature sensor, but the Nano reads “Open Sensor” when wired according to the manual. Do we need to order the Nano specifically for T/C inputs?

A2: The Synergy Nano TE1858-1, -2, and -3 models support RTD’s, T/C’s, Process voltage and Process current inputs. A default Sensor ID for each channel is loaded when you select a chamber definition file (CDF). The default Sensor ID defines the input assigned to each channel control loop. The default Sensor ID for the chamber definition file you loaded is RTD but that can be easily changed. Follows these two steps:

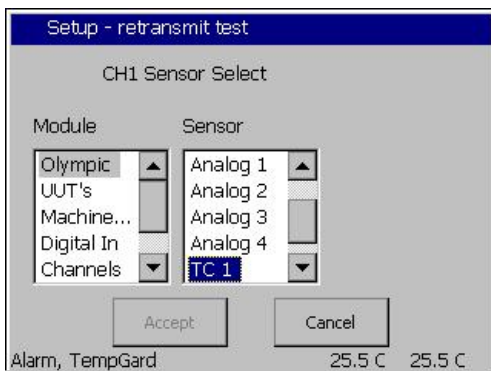
1. Setup either T/C Input for the appropriate T/C Type.
2. Assign the Sensor ID for the sensor in step 1 to the channel on the SETUP/Calibration/Channel 1 Calibration screen,



1. To setup TC1, browse to the SETUP [\Calibration\Input\Hi Res\TC 1\] folder as shown at left and select the **Type** parameter. Then press **Change** and make your selection. (Note that this screen is also used to calibrate the sensors if required with the raw and cold junction calibration parameters).



2. Browse to the SETUP [\ Calibration \Calibration Channel 1\] folder as shown at left and select the CH1 Sensor Select parameter, then press **Change**. Select TC 1 as shown below, and press **Accept**.



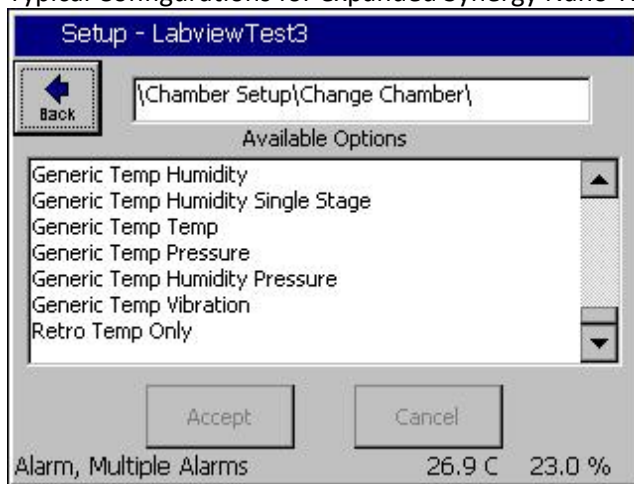
Q3: When I select the Generic Temp/Humidity Chamber Setup on my Synergy Nano I don't get any outputs. What's wrong?

A3: The Synergy Nano TE1858-1, TE1858-2, and TE1858-3 self contained models support 18 outputs; the expanded TE1858-4 and the full-sized Synergy Micro support 32 outputs. Configurations that begin with "NANO" are designed to work on the Synergy Nano TE1858-1, -2, and -3 self contained models. Configurations in the [SETUP\Chamber Setup] folder that begin with GENERIC are designed for the expanded TE1858-4 and the full-sized Synergy Micro.

Typical Configurations for Synergy Nano TE1858-1, -2, and -3 self contained models.



Typical Configurations for expanded Synergy Nano TE1858-4 and the full-sized Synergy Micro TE1704-1



Q4: We have an issue with our vacuum oven when we pull vacuum of 3 Torr or less and then go back to atmosphere. The controller vacuum/pressure reading climbs to 10 Torr but does not go any higher even when the chamber reached pressure ambient unless we manually reset the controller.

A4: Your vacuum oven is equipped with two vacuum sensors, 10 Torr and 1000 Torr to enhance the accuracy of pressure measurements at low pressures. The Synergy Controller Virtual Pressure Sensor algorithm handles the automatic switchover from one sensor to the other.

The Virtual Pressure sensor is controlled by two L-Values named Transfer Pressure Threshold and Transfer Pressure Hysteresis.

Since the Low Pressure (High Altitude sensor) is only reading 10 Torr when the system returns to ambient pressure, the pressure does not reach the switch over point (Transfer Pressure Threshold plus Transfer Pressure Hysteresis) and therefore the transfer to the 1000 Torr sensor isn't occurring. The controller assumes that the 10 Torr sensor is still in range since it's reading hasn't exceeded 10 Torr. This may be occurring because of a calibration issue with the sensor or because the output clamp designed to protect the input from damage during over range is clamping at or below 5.0 Volts.

To correct this, you can make the transfer to the 1000 Torr sensor occur at 9.5 or 9.0 Torr by adjusting the Transfer Pressure Threshold (default 9 Torr) or the Transfer Pressure Hysteresis (Default 1 Torr).

If you lower the Transfer Pressure Threshold by 0.5 Torr to 8.5 Torr, it will lower the switch over point (Transfer Pressure Threshold plus Transfer Pressure Hysteresis) to 9.5 Torr.

Note that with the default virtual pressure sensor settings, the reading will transfer to the 10 Torr sensor when the 10 Torr sensor reads below 8 Torr and transfer back to the 1000 Torr Sensor when the 10 Torr sensor reads above 10 Torr.

Q5: Does the WebTouch Remote (tm) feature have any hardware requirements for the PC?

A5: There are no specific hardware requirements except that you'll need a computer with a web browser such as Internet Explorer, Firefox or Safari.

Even an Apple iPad will work.



WebTouch Remote™ is a web server that runs on the Synergy test chamber controller and any computer with a web browser can remotely monitor and control the test chamber by connecting to it.

You can watch a video that explains the controller's WebTouch Remote feature by following the link below.

http://www.tidaleng.com/swf/Synergy_Controller_WebTouch_Remote_Demonstration.htm

The Synergy Controller Technical Manual also covers the WebTouch Remote feature.

Q6: How do I change the temperature range limits allowed on the Setpoint number pad?

A6: The Setpoint Limits for Channel 1 are controlled from the folders:

SETUP [\Special Functions\Low Limit, Channel 1]

SETUP [\Special Functions\High Limit, Channel 1]

Similarly named folders are used for the other channels enabled on your controller.

Q7: The first step of my program is a setpoint of 100 C but the controller does not go to 100 C when it starts.

A7: The Synergy Controller's Ramp step begins at that the controller temperature setpoint when the profile starts (for the first step of the profile) or the ending setpoint of the previous step otherwise.

If you want the chamber setpoint to go immediately to a temperature, set the ramp time for the first step to 00:00:00 (Hr:Min:Sec).

Q8: Can you explain the purpose of the deviation alarm limits and the deviation alarm delay?

A8: The Synergy Controllers Deviation alarms monitor the deviation between the controller's setpoints (SP) and the Process Variables (PV). The Deviation Alarm limits are based on a deviation from setpoint; i.e. relative to the setpoints. This is in contrast with the standard alarms which are absolute limits.

To allow short excursions outside the deviation alarm limits, the Deviation Alarm Delay feature can help avoid nuisance alarms when the setpoint is ramping and the chamber machinery can't keep up with the setpoint.

To adjust the Deviation Low Alarm limit, select Deviation Low Alarm in the SETUP [\Calibration\Calibration Channel X\]" folder and press Change. Then enter the new value in the number pad.

To adjust the Deviation High Alarm limit, select Deviation High Alarm, press Change and enter the new value on the number pad.

The Deviation Alarm limits can be disabled or delayed using the Deviation Alarms Enabled and Deviation Alarm Delay parameters.

Q9: What are the responses from the “DIGITAL OUTPUT QUERY” command?

A9: The “? DO n” query reports the current state of the nth digital output from the controller (n out of 32 digital controller outputs). The controller’s digital outputs control fans, compressors, heaters, etc. The response is:

n:m=x, o = y where: n is the channel, x is the mode and y is the output value.

For example, the query “? DO 1” reports the status of the Fan output for standard chambers.

“1:M=0, O=1”

"1:" for Output 1, "M=0" for Mode On/Off (not time proportioning), "O=1" for Output is On.

How do I tie those outputs to events?

If you are interested in determining if one of the six User Events is on, you can use the “? EVENTS n” query. The response is 1 for On, 0 for Off. You can also use the “? DO n” command. Output 11 is Event 1 on standard generic chambers. You can use the “= EVENTS n,x” commands to set the state of Event Outputs. N is the event number and x is the value.

Q10: The OT11 TPM event is grayed out and not selectable?

A10: When you are running a profile, the OT11 control type is configured for each step from the Events screen in the profile wizard. When running a steady state condition, the OT11 output type is controlled from the Setup\Special Functions Screen. See the Output 11 Control Type folder.

Q11: Channel 2 humidity calibration is wrong. I'm feeding the Synergy input with a 0-5 Volt source and the humidity reading is not linearly following the voltage.

A11: When the SETUP [\Calibration\Input\High Res\Analog 1\] input is set to Vaisala-RTD1 (or other Vaisala setting), the Synergy Controller displays a temperature compensated humidity reading using the Vaisala compensation algorithm and therefore the reading in %RH will not be linearly proportional to the input voltage. Set the Type parameter to “Other” and the reading will be proportional.

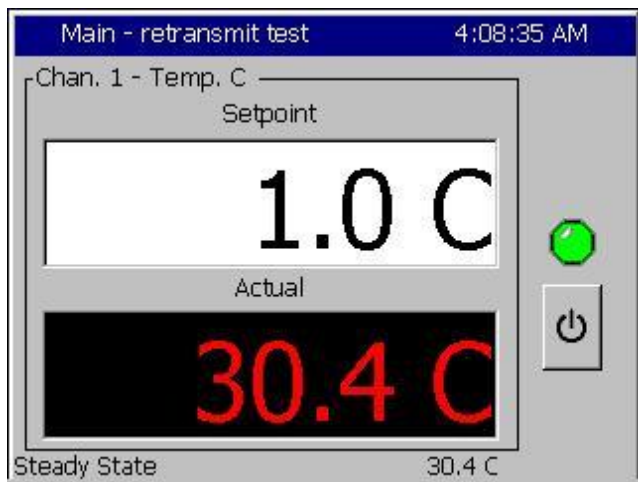
Q12: My controller is setup for WB/DB and the Humidity readings are going below 0% and driving the controller into an alarm when the chamber temperature goes below 0C and.

A12: Synergy Controller Virtual Wet bulb/Dry bulb Humidity Sensor will give erroneous humidity values below 0C (32F). To prevent an alarm from occurring in this situation and shutting down the chamber, turn off the Humidity channel and set the disable the humidity alarm when the channel is off.

Set "SETUP\Calibration\Calibration Channel 2\Ignore Alarm When Off" to ENABLED.

Q13: Why doesn't the state of the small button with the "on led and off led" change from green to red depending on the chamber status?

A13: The graphic on the On-Off button is static and was designed to provide a legend for the on and off state of the LED above the button; i.e. when the LED is Green, the chamber is On, and when the LED is Grey (off) the chamber is off. We have changed the button graphic on the latest software to the universal On-Off symbol as shown below. The LED indicates the On Off state of the chamber, the button toggles the chamber between these states.



Q14: In Graph screen, I can change the temp range but can not change the time range. Is this correct?

A14: Currently, the y axis is adjustable but the time (x) axis is not. We are working on the adjustable time axis feature in an upcoming version.

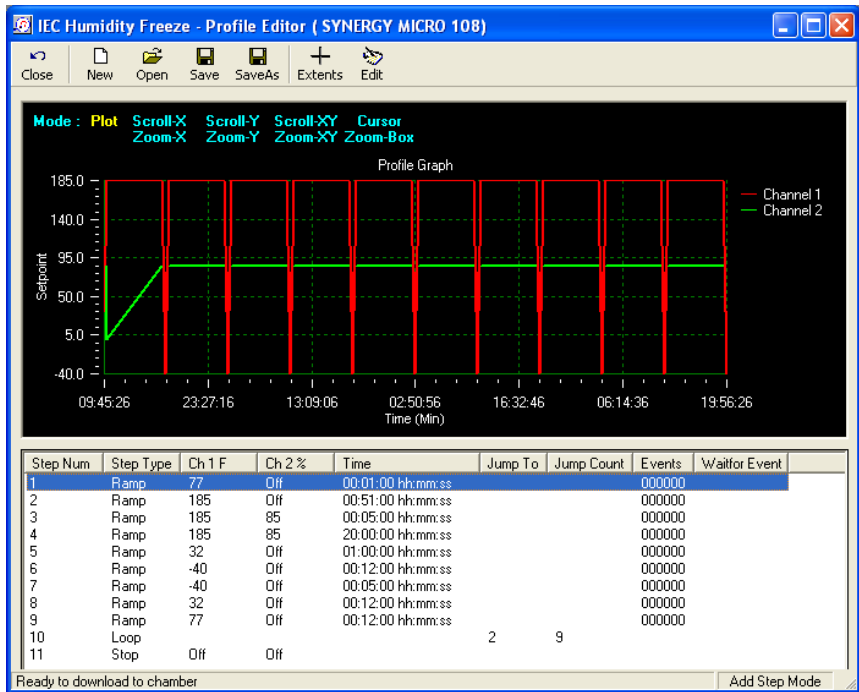
Q15: What parts come with a 16-Channel thermocouple UUT module, P/N TE1299-16?

A15: In addition to the UUT Module itself, the following items are included with the TE1299-16.

QTY	REF DES	P/N	Description
1	XTR1	TE1435 (100853)	WALL TRASFORMER WITH 120-D-111/10 CONNECTOR
3	XP2-XP4	120-D-121/12	HEADER PLUG, 12 POS, 5 MM
1	Daisy Chain Cable	TE1467	UUT and TCweb Slave cable

Q16: Can the operator view the profile on the controller screen after he writes a profile?

A16: The operator can view the list of steps in the profile on the controller from the RUN and PROGRAM screens. In addition, the Synergy Manager’s profile editor can be used to create profiles for the controller. The Profile Editor can display the profile graphically as well. Profiles created on the PC can be copied to a flash drive in "VPL" format and installed on the controller. Users that purchase the full version of Synergy Manager can use the software to send profiles to the controller thru the network or Serial/GPIB ports.



Q17: When the pressure gets close to ambient pressure on our Temperature/Pressure chamber, the electric solenoid valve that vents off chamber pressure is clacking on and off about every second. It is very loud, and I am afraid it is going to shorten the life of the solenoid. Any idea how we can slow this cycling on and off down a little?

A17: The Cycle Time parameter (in seconds) for the Vent valve can be set from the following folder: SETUP [\PID Settings\PID Ch 2\PID Ch 2 Vent]. Increasing the cycle time will slow down the clacking.

Appendix D: Standard Chamber Definitions

	Temperature Only	Temperature Only	Temperature Only	Temperature Only
CDF Name	NANO_TO_T2	NANO_TO_SCIREF	NANO_TO2B	NANO_TO_SIGMA_A
Channel 1	Temperature	Temperature	Temperature	Temperature
X1-MAIN				
1	PID Heat	Fan	PID Heat	PID Heat
2	Compressor	PID Heat	PID Cool	PID Cool
3	Event 1	Compressor	Event 1	Event 1
4	Event 2	PID Cool	Event 2	Event 2
5	Fan	~PID Cool	Fan	Fan
6	Not Used	Event 1	Hi Compressor	Not Used
X2-AUX				
1	Alarm Relay 2	Not Used	Not Used	Not Used
2	Not Used	Not Used	Not Used	Not Used
3	Not Used	Not Used	Not Used	Not Used
4	Not Used	Not Used	Not Used	Not Used
5	Not Used	Not Used	Not Used	Not Used
6	Not Used	Not Used	Not Used	Not Used
X4-EVENTS				
1	Event 1	Event 1	Event 1	Event 1
2	Event 2	Event 2	Event 2	Event 2
3	Event 3	Event 3	Event 3	Event 3
4	Event 4	Event 4	Event 4	Event 4
5	Alarm Relay 1	Event 5	Event 5	Event 5
6	Alarm Relay 1	Event 6	Event 6	Event 6
Ch1-Sensor	RTD1. 100 ohm	RTD1. 100 ohm	RTD1. 100 ohm	RTD1. 100 ohm
Ch2-Sensor	N/A	N/A	N/A	N/A
DIGITAL INPUTS				
Dig-In-1	Not Used	Not Used	Not Used	Not Used
Dig-In-2	Not Used	Not Used	Not Used	Not Used
Dig-In-3	Not Used	Not Used	Not Used	Not Used
Dig-In-4	Not Used	Not Used	Not Used	Not Used
Dig-In-5	TempGuard	TempGuard	TempGuard	TempGuard

	Thermal Shock	Temperature Pressure	Thermal Shock	Temperature Only
CDF Name	NANO_TT_B	NANO_TP	NANO_TT_01_A	NANO_TO3B
Channel 1	Temperature	Temperature	Temperature	Temperature
X1-MAIN				
1	PID Heat	PID Heat	PID Heat	PID Heat
2	PID Cool	PID Cool	PID Cool	PID Cool
3	Compressor	Event 1	Compressor	Event 1
4	Artificial Load (Bypass)	Event 2	Artificial Load (Bypass)	Event 2
5	Fan	Not Used	Fan	Fan
6	Event 1	Not Used	Event 1	Hi Compressor
X2-AUX				
1	PID Heat	Event 1	PID Heat	PID Heat
2	PID Cool	Event 2	Fan	PID Cool
3	Compressor	Event 3	Compressor	Event 1
4	Artificial Load (Bypass)	Event 4	Artificial Load (Bypass)	Event 2
5	Fan	Event 5	PID Cool	Fan
6	Event 2	Event 6	Event 2	Hi Compressor
X4-EVENTS				
1	Event 1	Alarm Relay 1	Event 1	Event 1
2	Event 2	Vacuum	Event 2	Event 2
3	Event 3	Not Used	Event 3	Event 3
4	Event 4	Not Used	Event 4	Event 4
5	Event 5	Not Used	Event 5	Event 5
6	Event 6	Not Used	Event 6	Event 6
Ch1-Sensor	RTD1. 100 ohm	RTD1. 100 ohm	RTD1. 100 ohm	RTD1. 100 ohm
Ch2-Sensor	RTD2. 100 ohm	Analog 2	RTD2. 100 ohm	N/A
DIGITAL INPUTS				
Dig-In-1	Not Used	Not Used	Not Used	Not Used
Dig-In-2	Not Used	Not Used	Not Used	Not Used
Dig-In-3	Not Used	Not Used	Not Used	Not Used
Dig-In-4	Not Used	Not Used	Not Used	Not Used
Dig-In-5	TempGuard	TempGuard	TempGuard	TempGuard

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	Temperature Only	Temperature Only	Temperature Only	Temperature Only
CDF Name	NANO_TO_T2_HARRIS_3	NANO_TO_T2_HARRIS_3	NANO_TO_T2_HARRIS_3	NANO_TO4A
Channel 1	Temperature	Temperature	Temperature	Temperature
X1-MAIN				
1	PID Heat	PID Heat	PID Heat	PID Heat
2	Compressor	Compressor	Compressor	PID Cool
3	Event 1	Event 1	Event 1	Hi Compressor
4	Event 2	Event 2	Event 2	Full Cool
5	Fan	Fan	Fan	Fan
6	Not Used	Not Used	Alarm Rly 2 (Deviation)	Not Used
X2-AUX				
1	Alarm Rly 2 (Deviation)	Alarm Rly 2 (Deviation)	Alarm Rly 2 (Deviation)	PID Heat
2	Not Used	PID Heat	PID Heat	PID Cool
3	Not Used	Fan	Fan	Hi Compressor
4	Not Used	Alarm Rly 2 (Deviation)	Not Used	Full Cool
5	Not Used	Not Used	Not Used	Fan
6	Not Used	Not Used	Not Used	Not Used
X4-EVENTS				
1	Event 1	Event 1	Event 1	Event 1
2	Event 2	Event 2	Event 2	Event 2
3	Event 3	Event 3	Event 3	Event 3
4	Event 4	Event 4	Event 4	Event 4
5	Alarm Rly 1 (Hi Temp.)	Alarm Rly 1 (Hi Temp.)	Alarm Rly 1 (Hi Temp.)	Event 5
6	Alarm Rly 1 (Hi Temp.)	Alarm Rly 1 (Hi Temp.)	Alarm Rly 1 (Hi Temp.)	Event 6
Ch1-Sensor	T Type T/C	T Type T/C	T Type T/C	RTD1. 100 ohm
Ch2-Sensor	T Type T/C	T Type T/C	T Type T/C	N/A
DIGITAL INPUTS				
Dig-In-1	Not Used	Not Used	Not Used	Not Used
Dig-In-2	Not Used	Not Used	Not Used	Not Used
Dig-In-3	Not Used	Not Used	Not Used	Not Used
Dig-In-4	Not Used	Not Used	Not Used	Not Used
Dig-In-5	TempGuard	TempGuard	TempGuard	TempGuard

	Temperature Only	Temperature Only	Temperature Only
CDF Name	NANO_TO_CHILLER	NANO_TO_BSCI	NANO_TO5A
Channel 1	Temperature	Temperature	Temperature
X1-MAIN			
1	PID Heat	PID Heat	PID Heat
2	PID Cool	Compressor	Event 1
3	Hi Temp Alarm	Event 1	PID Cool
4	Lo Temp Alarm	Event 2	Full Cool
5	Fan	Fan	Hi Compressor
6	Hi Compressor	Alarm Relay 2	Event 2
X2-AUX			
1	PID Heat	Not Used	PID Heat
2	PID Cool	Not Used	Event 1
3	Hi Temp Alarm	Not Used	PID Cool
4	Lo Temp Alarm	Not Used	Full Cool
5	Fan	Not Used	Hi Compressor
6	Hi Compressor	Not Used	Event 2
X4-EVENTS			
1	Event 1	Event 1	Event 1
2	Event 2	Event 2	Event 2
3	Event 3	Event 3	Event 3
4	Event 4	Event 4	Event 4
5	Event 5	Event 5	Event 5
6	Event 6	Event 6	Event 6
Ch1-Sensor	T/C 1	RTD1 100 ohm	RTD1. 100 ohm
Ch2-Sensor	N/A	N/A	N/A
DIGITAL INPUTS			
Dig-In-1	Not Used	Not Used	Not Used
Dig-In-2	Not Used	Not Used	Not Used
Dig-In-3	Not Used	Not Used	Not Used
Dig-In-4	Not Used	Not Used	Not Used
Dig-In-5	TempGuard	TempGuard	TempGuard

	Temperature Humidity	Temperature Humidity	Temperature Humidity	Temperature Humidity
CDF Name	NANO_TH_SCIREF_01	NANO_TH_TRW_H	NANO_TH_CC_01B	NANO_TH_CEOF
Channel 1	Temperature	Temperature	Temperature	Temperature
Channel 2	Humidity	Humidity	Humidity	Humidity
X1-MAIN				
1	PID Humidify	PID Heat	PID Cool	PID Heat
2	Wick Pan	PID Humidify	PID De-Humidify	Temp. Alarm
3	Event 1	Event 1	PID Heat	PID Humidify
4	Event 2	Event 2	PID Humidify	Event 1
5	Event 3	Event 3	Fan	Event 2
6	Low Compressor	Event 4	Wickpan	Event 3
X2-AUX				
1	Not Used	Not Used	Event 3	PID Heat
2	Not Used	Not Used	Event 4	Temp. Alarm
3	Not Used	Not Used	Event 5	PID Humidify
4	Not Used	Not Used	Temp. Alarm	Event 1
5	Not Used	PID Cool	Not Used	Event 2
6	Not Used	Full Cool	Not Used	Event 3
X4-EVENTS				
1	Fan	Fan	Not Used	Event 1
2	PID Heat	Hi Compressor	Not Used	Event 2
3	Compressor	Wick Pan	Not Used	Event 3
4	PID Cool	Lo Compressor	Not Used	Event 4
5	Dump Solenoid	PID De-Humidify	Not Used	Event 5
6	PID De-Humidify	Artificial Load (Bypass)	Not Used	Event 6
Ch1-Sensor	RTD1. 100 ohm	RTD1. 100 ohm	RTD1. 100 ohm	RTD1. 100 ohm
Ch2-Sensor	Analog 2	Analog 2	Analog 2	Analog 2
DIGITAL INPUTS				
Dig-In-1	Not Used	Not Used	Not Used	Not Used
Dig-In-2	Not Used	Not Used	Not Used	Not Used
Dig-In-3	Not Used	Not Used	Not Used	Not Used
Dig-In-4	Not Used	Not Used	Not Used	Not Used
Dig-In-5	TempGuard	TempGuard	TempGuard	TempGuard

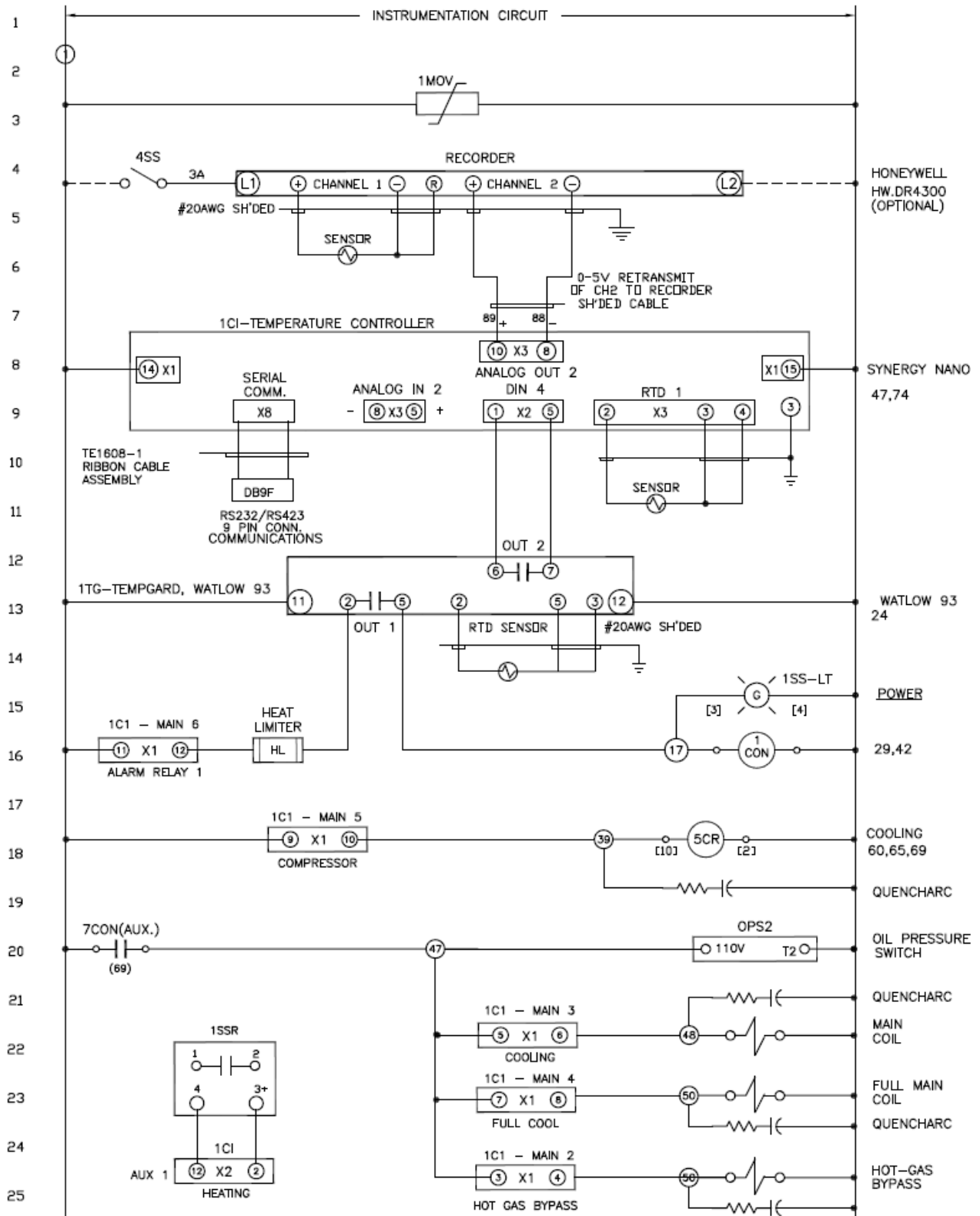
SYNERGY NANO 2

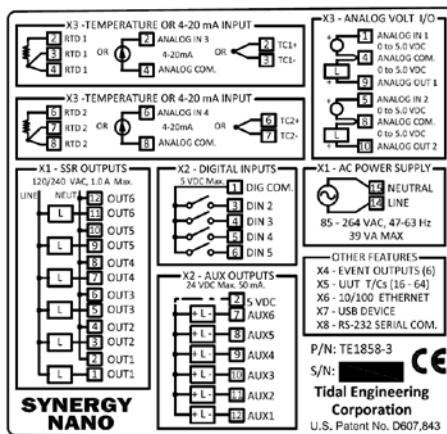
	Temperature Humidity	Temperature Humidity	Temperature Humidity	Temperature Humidity
CDF Name	NANO_TH_ESPEC_01	NANO_TH_INTEL_01B	NANO_TH_INTEL_02B	NANO_TH_INTEL_03C
Channel 1	Temperature	Temperature	Temperature	Temperature
Channel 2	Humidity	Humidity	Humidity	Humidity
X1-MAIN				
1	PID Heat	Wick Pan	Wick Pan	Fan Output
2	PID Humidify	Temp. Alarm	Temp. Alarm	Temp. Alarm
3	PID Cool	PID Cool	PID Cool	PID Cool
4	Full Cool	PID De-Humidify	PID De-Humidify	PID De-Humidify
5	Ambient Coil	PID Heat	PID Heat	PID Heat
6	Drier	PID Humidify	PID Humidify	PID Humidify
X2-AUX				
1	Fan	Event 1	Wick Pan	Fan Output
2	Hi Compressor	Event 2	Temp. Alarm	Temp. Alarm
3	Wick Pan	Event 3	PID Cool	PID Cool
4	PID De-Humidify	Event 4	PID De-Humidify	PID De-Humidify
5	Vent	Event 5	PID Heat	PID Heat
6	Temp. Alarm	Event 6	PID Humidify	PID Humidify
X4-EVENTS				
1	Event 1	Not Used	Event 1	Event 1-Range 1/Range 2
2	Event 2	Not Used	Event 2	Event 2- User Alarm
3	Event 3	Not Used	Event 3	Event 3-Timer Run/Reset
4	Event 4	Not Used	Event 4	Event 4-End of Test
5	Event 5	Not Used	Wick Pan	Alarm Rly 2-Door Lock
6	Event 6	Not Used	Temp. Alarm	Alarm Rly 1-Temp. Alarm
Ch1-Sensor	RTD1. 100 ohm	RTD1. 100 ohm	RTD1. 100 ohm	RTD1. 100 ohm
Ch2-Sensor	Analog 2	Analog 2	Analog 2	Virtual WB-DB/RTD2 100 ohm
DIGITAL INPUTS				
Dig-In-1	Not Used	Not Used	Not Used	
Dig-In-2	Not Used	Not Used	Not Used	Digital Timer Signal
Dig-In-3	Not Used	Not Used	Not Used	Not Used
Dig-In-4	Not Used	Not Used	Not Used	Not Used
Dig-In-5	TempGuard	TempGuard	TempGuard	TempGuard

	Temperature Humidity	Temperature Humidity	Temperature Humidity	Temperature Humidity
CDF Name	NANO_TH_ESPEC_02	NANO_TH_03_A	NANO_TH_F4_01	NANO_TH_HOTPACK_01
Channel 1	Temperature	Temperature	Temperature	Temperature
Channel 2	Humidity	Humidity	Humidity	Humidity
X1-MAIN				
1	Fan Output	PID Heat	PID Heat	PID Heat
2	Wick Pan	PID Humidify	PID Cool	PID Cool
3	Hi Compressor	ALARM 1	PID Humidity	PID Humidity
4	Heater Control	Event 2	PID De-humidify	Drier
5	Humidifier Control	Event 3	Fan Output	Fan Output
6		Event 4	Low Compressors	Low Compressors
X2-AUX				
1	PID Heat	Not Used	Boost Heat	PID Heat
2	PID Cool	Not Used	Boost Cool	PID Cool
3	PID Humidify	Not Used	High compressors	PID Humidity
4	PID De-Humidify	Not Used	Wick Pan	Drier
5		PID Cool	Drier	Fan Output
6		Full Cool	Temperature alarm	Low Compressors
X4-EVENTS				
1	Event 1-Specimen Power	Fan	Event 1	Event 1-User Defined
2	Event 2-External Alarm	Hi Compressor	Event 2	Event 2-User Defined
3	Event 3-Time Signal 1	Wick Pan	Event 3	Event 3-User Defined
4	Event 4-Time Signal 2	Lo Compressor	Event 4	Alarm Rly 1-Temp. Alarm
5	Event 5	PID De-Humidify	Event 5	Alarm Rly 1-Temp. Alarm
6	Event 6	Artificial Load (Bypass)	Event 6	Alarm Rly 2-Deviation
Ch1-Sensor	RTD1. 100 ohm	RTD1. 100 ohm	RTD1. 100 ohm	RTD1. 100 ohm
Ch2-Sensor	Analog 2	Analog 2	Analog 2	Analog 1
DIGITAL INPUTS				
Dig-In-1		Not Used	N/A	N/A
Dig-In-2	OVERHEAT FAULT	Not Used	Refrigeration Alarm	Not Used
Dig-In-3	HUMIDIFIER FAULT	Not Used	Circulator Fault	Not Used
Dig-In-4	CIRCULATOR FAULT	Not Used	User defined	Door Switch
Dig-In-5	REFRIGERATION FAULT	TempGuard	TempGard	TempGard

	Temperature Humidity	
CDF Name	NANO_TH_INTEL_03D	
Channel 1	Temperature	
Channel 2	Humidity	
X1-MAIN		
1	Fan Output	
2	Wick Pan	
3	PID Cool	
4	PID De-Humidify	
5	PID Heat	
6	PID Humidify	
X2-AUX		
1	Fan Output	
2	Wick Pan	
3	PID Cool	
4	PID De-Humidify	
5	PID Heat	
6	PID Humidify	
X4-EVENTS		
1	Event 1-Range 1/Range 2	
2	Event 2- User Alarm	
3	Event 3-Timer Run/Reset	
4	Event 4-End of Test	
5	Alarm Rly 2-Door Lock	
6	Alarm Rly 1-Temp. Alarm	
Ch1-Sensor	RTD1. 100 ohm	
Ch2-Sensor	Virtual WB-DB/RTD2 100 ohm	
DIGITAL INPUTS		
Dig-In-1		
Dig-In-2	Digital Timer Signal	
Dig-In-3	Not Used	
Dig-In-4	Not Used	
Dig-In-5	TempGuard	

Appendix E: Example Wiring Diagram, NANO_T05A

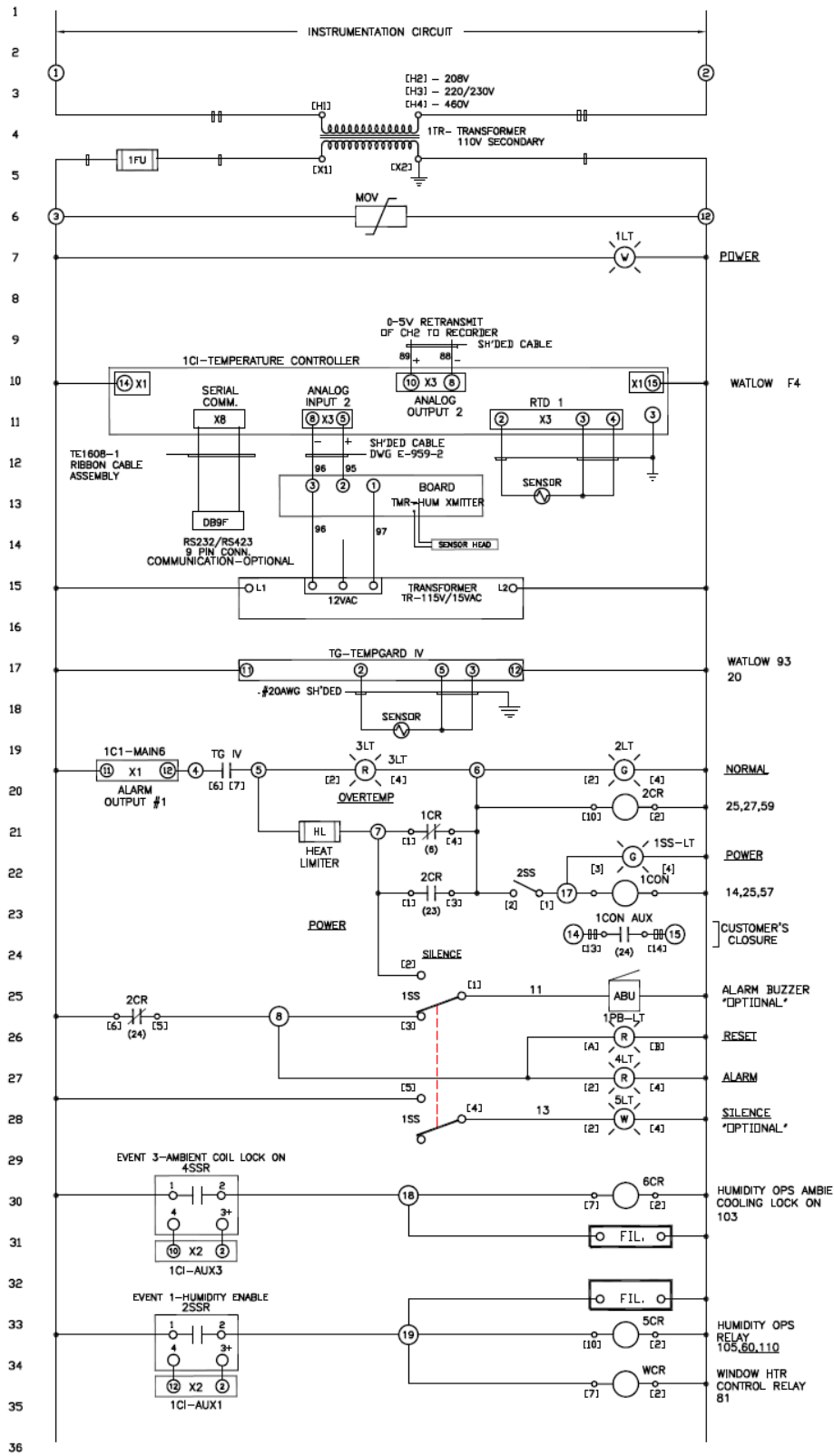


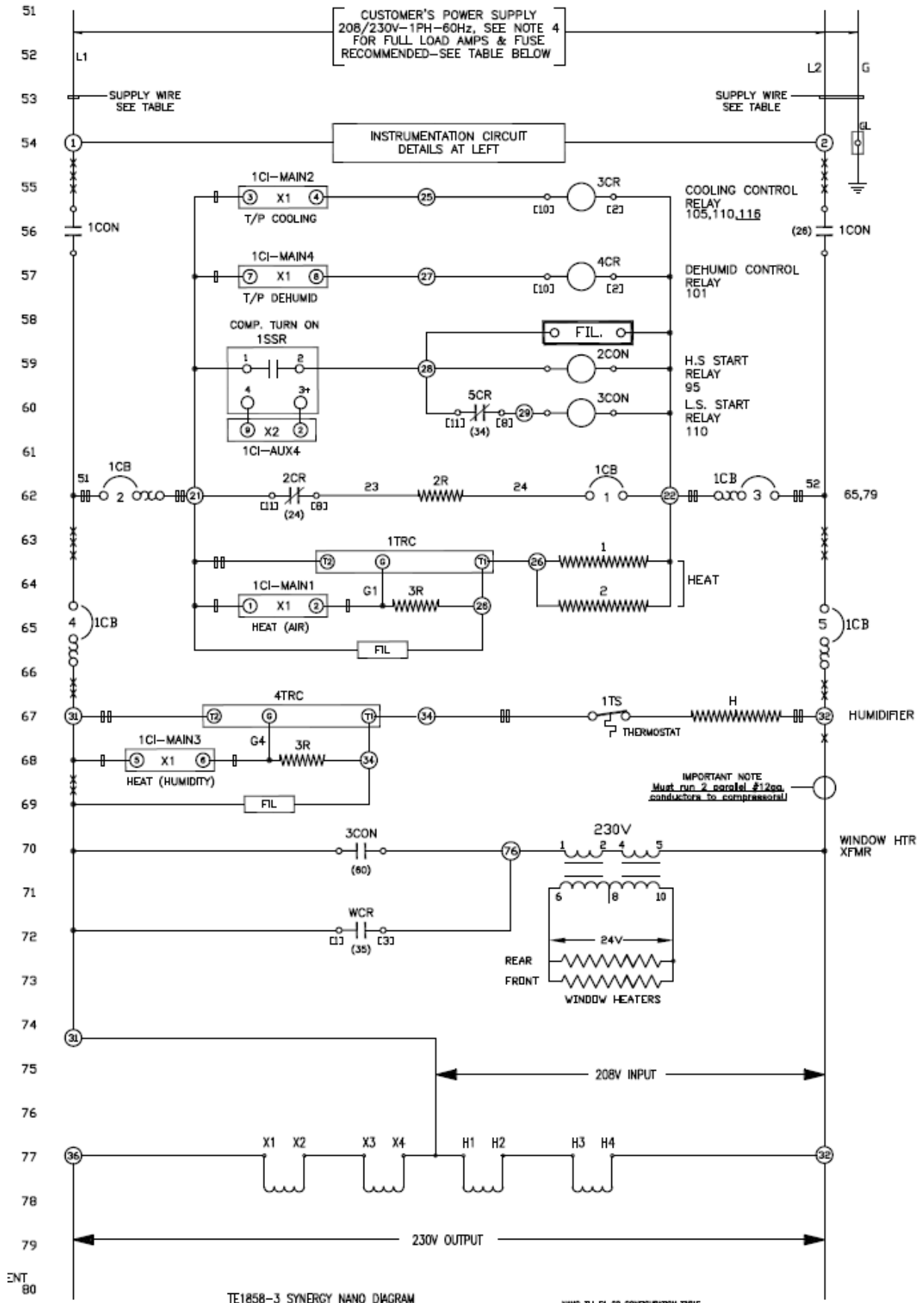


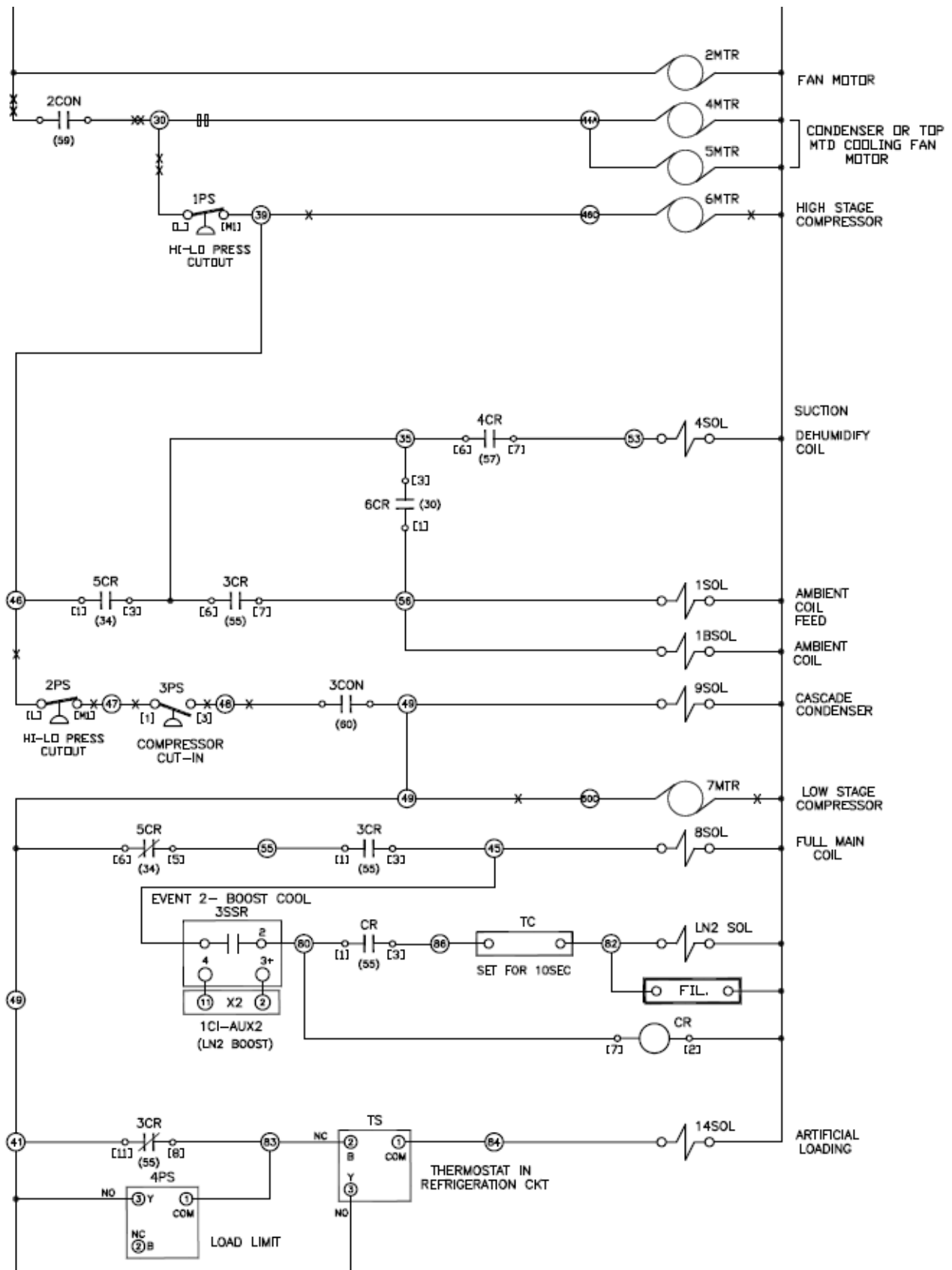
NANO_TO5A CONFIGURATION TABLE

X1-MAIN OUTPUTS -SSR		
OUT1	PID HEAT	F4-01A
OUT2	HOT GAS BYPASS	
OUT3	PID COOL	F4-01B
OUT4	FULL COOL	
OUT5	HIGH STAGE COMPRESSOR	
OUT6	ALARM RELAY 1	
X2-AUX OUTPUTS -TRANSISTOR		
AUX1	PID HEAT	F4-01A
AUX2	HOT GAS BYPASS	
AUX3	PID COOL	F4-01B
AUX4	FULL COOL	
AUX5	HIGH STAGE COMPRESSOR	
AUX6	ALARM RELAY 1	
X4-EVENTS OPTIONAL		
1	EVENT 1	
2	EVENT 2	
3	EVENT 3	
4	EVENT 4	
5	EVENT 5	
6	EVENT 6	
SENSORS		
Ch1	Sensor RTD1. 100 ohm	
Ch2	NOT USED	
DIGITAL INPUTS		
DIN1	NOT USED	()
DIN2	NOT USED	
DIN3	NOT USED	
DIN4	NOT USED	
DIN5	TempGard	

Appendix F: Example Wiring Diagram, NANO_TH_F4_02







Appendix D: Synergy Controller Application Notes

[AppNote 1 - Replacing a VersaTenn III Controller](#)
[AppNote 2 - Synergy Controller Data Logging Capacity Calculations](#)
[AppNote 3 - Retrofitting a Qualmark HALT/HASS Chamber](#)
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About the Synergy Controller Family

Tidal Engineering's Synergy Controllers, the Synergy Micro 2, Synergy Quattro, and the ¼ DIN Synergy Nano provide state-of-the-art usability and connectivity for environmental test control and data acquisition. They combine the functions of a chamber controller and a data logger and are designed to improve test efficiency by supporting both factory automation and test and measurement protocols and standards.

Synergy Controller feature highlights includes:

- ➔ Color touch screen
- ➔ Ethernet, RS-232 and GPIB communications
- ➔ Built in 100 MB Data logger with USB drive support
- ➔ Data Acquisition, up to 64 T-type thermocouples (Optional)
- ➔ Built-in Web Server for remote control; WebTouch Remote™
- ➔ Compatible with Synergy Manager for PC based control, monitoring and programming.
- ➔ Built-in FTP Server for factory automation and test and measurement applications

For more information regarding these controllers please see the full Synergy Controller Technical Manual on our website at <http://www.tidaleng.com/synergy.htm>

About Tidal Engineering

Headquartered in Randolph, NJ, Tidal Engineering Corporation has been designing and building award-winning embedded hardware and software for test and measurement and data acquisition applications since 1992. The company is recognized for technical expertise in such areas as Embedded IEEE 488, and turnkey SCADA (Supervisory Control and Data Acquisition) systems.

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