



Getting Started manual for the Synergy Nano Temperature Controller and Thermal Vacuum System 7/1/21

It is strongly recommended to read and fully understand the features and potential risks before using the thermal platform. Below are a set of instructions to use the platform and product safely and efficiently. Please get familiar with the functionality and many features of the Synergy Nano controller and the Leybold 350 Turbo Pump before operating.

CAUTION: The TotalTemp Technologies **thermal platform** is capable of **extreme temperatures**. A “Hands off” approach should be the general rule, so always be aware of the many potential dangers of extreme temperatures and compressed coolants. Please read the more detailed safety warnings in platform manual before using.

Powering Up:

The front switch turns on the Synergy Nano controller, while the rear circuit breaker(s) enable the heating and cooling circuits. Always check if the rear breakers are flipped to the “**ON**” position before using the system. If the back breakers are set to the “**OFF**” position, the controller will power up, but there would be **no heating or cooling**.

The two connectors from the Synergy Nano controller called the umbilical must be connected to the thermal vacuum platform before operation is initiated. The **larger connector** carries the **POWER** for **heat, cool** and **bimetal failsafe trip**, the **smaller connector** controls the **temperature sensor(s)**. These sensors also control the **optional redundant failsafe**. If the **smaller connector** becomes **disconnected**, the “open sensor” ALARM must be cleared from the Synergy Nano before continued operation, as per display below.

*Additionally, if the Synergy Nano controller comes with an **optional high-low failsafe system**, the failsafe controller will indicate a **FAIL** and then you must also manually press the “**reset**” button to continue operation. The system temperature must of course be back within range before operation will be allowed.

On the optional **failsafe system**, repeatedly pressing the green “circular arrows” button will cycle through the selected menu screens. The **LL.S** menu indicates the **low limit setpoint**, the **Lh.S** menu sets the **high limit setpoint** (make sure each temperature limit is set to your specified settings).

Ca is **calibration offset** (if **optional failsafe** temp. reading differs greatly from the **Synergy Nano Controller** temp. reading, check to make sure setting is at 0). The **up** and **down arrows** can be used to adjust the **Hi / Lo limits** or **Ca** to **offset to values appropriate** before use. Once the temperature limits have been set, press the “**Reset**” button on the failsafe limit controller to enter settings and to restore normal operation. Within a couple seconds the display should indicate ‘**SAFE**’.

Basic operation:

Press the **MAIN** button on the front panel, then touch the white part of ‘**setpoint**’ window to change the set point temperature. Enter the new temperature set point, then press **Accept** button. Press the **Start** button and the green virtual ‘LED’ indicator should come on showing that system is controlling temperature.

Touch Screen Note:

The Synergy Nano touch screen can be operated with a standard USB mouse in the front panel. If touchscreen seems unresponsive to touch, moistening user fingertip will improve responsiveness.

When **selecting parameters** through the **touchscreen menus**, make sure the selected parameter is **highlighted dark blue** when pressed. When it is **highlighted in grey**, it is **not selected** and therefore not likely to accept desired input.

Manual Control:

Controlling to a setpoint is very straight forward, if the Main screen is not showing (See title at the top of screen) press the MAIN button below the touch screen.

To change the setpoint, touch the screen in the number area where it says *Setpoint*. The Channel 1 Setpoint screen will come up allowing entry of the setpoint in Celsius. Enter the setpoint temperature value and press *Accept*.

Start controlling by pressing the ON/OFF button on the screen or the ON button below the screen. Either operation will result in the same function, you will see the Green "Controlling" indicator on the screen light up. Controllers are initially set up to not resume operation at last setpoint at power up.

Exceptions:

If the word ALARM shows on the upper right header of the screen, typically this indicates that the probe is disconnected, temperature out of acceptable range or other alarm condition exists. Additionally, if the display on the screen will indicate OFF for "Actual" value, this is an indication of loss of the connection to the controlling probe. The "OFF" indication can also be an indication that the control output has been disabled from the setpoint screen.

If the system is operated with the probe connection unhooked, the ALARM indication will flash on the screen per above. As a safety precaution, the alarm condition will persist after connecting the sensor connector. The alarm condition can be cleared by pressing the MAINT button and then pressing the "Alarms" icon on the screen. Touch the "Bad Sensor 1 Connect" or other message on the screen and then press AckAlarm to acknowledge the alarm. At this point you can continue with use of the system. If the "Bad Sensor" or other alarm condition persists the display will indicate that the alarm has been acknowledged but the error condition has not been cleared. The error condition must be remedied before continuing.

See note above regarding resetting the optional failsafe limit controller(s)

Logging:

Logging functions are located under the SETUP button menu. Enabling logging, selecting maximum file size, logging interval and data to be logged is easily accomplished by following the menus. Logging has a menu setting that is set so that logs are recorded only when the temperature controller is controlling.

The menu screen is also has flexible configurations. It is shipped so that auxiliary thermocouples are shown to the right of the main control setpoint and actual values. Press the Main button again to toggle between this display PJ1-0706M and showing the rest of the 16 auxiliary thermocouples.

Backup and Restore:

Backup and restore of system settings can be performed from the Maintenance\Config Utilities screen. This is a useful and recommended procedure to become familiar with.

Additional Options and Features:

Many other features are available under the respective SETUP, MAINT, and COMM menus which are accessed from the buttons below the touch screen. Some items can be retrofit, some less so. See detailed documentation and on line

Web Server, Network Printing/Plotting, Synergy Server and E-mail functions are optional features that require an access code to enable functionality. Web Server can be activated on a No-Charge basis, other features are available for nominal fee. Contact TotalTemp Support or Tidal Engineering for access codes.

EVENTS button shows status of various inputs and outputs. The PROG button will lead you through the execution and building of programs. The AddStep Wizard will lead you through the process of creating or editing a program. Programs can be easily stored locally or on a USB memory device plugged into the front panel.

The RUN button on the keypad allows for running of stored programs.

Basic Ethernet or serial control is included, Web server, Cascade control, and several other options typically is enabled via software key available from TotalTemp. GPIB option requires additional hardware. If this feature is ordered, there is no additional setup required to communicate with the GPIB. There is an address switch set on the back of the unit. By default, it is set to address 1.

Exhaust Fitting:

Do not apply torque to the exhaust fitting. It is well supported but not designed for rough handling. Gently slide exhaust hose on outlet nipple and tighten without twisting. It is recommended to avoid making or loosening any coolant inlet or outlet fittings when plumbing is very cold with Liquid Nitrogen. Hose is designed to be secured to leg of system directing spent coolant to safely exhaust near the floor. The escaping Nitrogen gas is not considered toxic or dangerous.

Important aspects of using Synergy Nano temperature controller with Thermal Platform.

The Vacuum pump system is expensive, fragile and heavy. Extra caution should always be employed with this equipment. Risks of extreme temperatures, high differential pressures and use cryogenic coolants must be paid attention to for personal safety and the safety of the equipment.

Important Precautions and Notes with Thermal Vacuum Systems:

Always avoid any type of contamination from entering the thermal vacuum chamber; that includes water, oils and particles. The turbo pump is very expensive and sensitive to contamination. It can be ruined from exposure to such. Units under test and even as much as grease from fingerprints can significantly slow the pump-down speed.

Two main classes of leaks can exist that impair or prevent the turbo pump from reaching high vacuum levels effectively. 1) real leaks where even minute amounts of air allowed to encroach the vacuum chamber. This can include unexpected sources such as air that becomes trapped below the tip of a screw inside the system and releases slowly enough to make it difficult to reach high vacuum. 2) Virtual leaks which are mainly a result of outgassing of items inside the chamber. See lists of materials which are considered compatible and not compatible with high vacuum environments.

The turbo pump in the system is very sensitive to vibration when it is in operation. DO NOT move or jar the system when the turbo pump is running.

Notes on Leaks, tips for use and achieving vacuum levels quickly

- 1) Every time the bell jar is removed, set it down only on a secure, clean lint-free surface. When replacing the bell jar onto the top flange of the chamber, remove grease from the chamber flange and also wipe any potentially contaminated grease from the bottom of the Viton seal between jar and the top flange of the chamber. Typically the grease between the jar and the gasket does not need to be cleaned and replaced every time. Apply the smallest amount of grease (recommended Apiezon AP 101 – See highvacuumdepot.com or other source) to the bottom of the (Black Viton) seal. Use only enough to produce an even sheen on the material. Carefully avoid tabs of grease extending beyond the surface of the gasket, especially on the inside of the chamber.
- 2) Gloves are recommended when handling anything that is inside chamber or anything to be placed inside chamber. Always avoid grease, dirt, or fingerprints inside the chamber as they will slow or prevent the ability to draw vacuum. As mentioned before, it bears repeating that the pump can be damaged as well by contamination.

- 3) Verify that vacuum can be achieved with a clean, empty chamber without devices inside before putting test devices inside.
- 4) When using Liquid Nitrogen cooling for the first time, after the system has been stored or moved, monitor the vacuum level while momentarily turning the cooling function on and off to make sure that Nitrogen is not leaking into the chamber. Make sure vacuum level is not impaired when coolant is introduced. Cooling effect should help achieve vacuum not make it less. Gross leaks could damage turbo pump.
- 5) Wipe with a lint free rag and alcohol, all of the accessible interior volume of bell jar, platform surface and any accessible parts of the inside of the chamber when the chamber is open. Do not allow alcohol to drip into chamber or risk entering Turbo pump. High vacuum operation liberates particles from the system and the device which can be deposited inside the bell jar and chamber. This contamination can impede future vacuum pull down.
- 6) Use maximum caution to never drop parts, particles or liquids into the chamber. This could potentially damage or destroy the pump.
- 7) The thermal platform can be removed from chamber however this is to be avoided as wiring is carefully routed to avoid electrical hazard and contact with extreme temperature components. Compression fittings for the liquid Nitrogen have a limited life in number of resealing and undoing operations.
- 8) Never run the cooling function of the thermal platform when the platform is at atmospheric pressure or with the bell jar removed. Due to the extreme cold temperatures of the liquid Nitrogen coolant, condensation will occur when there are water molecules in the air near the platform or plumbing. Additionally, if the coolant is run to facilitate bringing the temperature down, before opening the vacuum, allow temperatures to stabilize at or above ambient for long enough to be sure that associated internal plumbing does not accumulate condensation or frost which could subsequently be drawn into the turbo pump. Running the platform hot at atmospheric pressure has no substantial risk beyond keeping hands and materials away from platform which can cause burning. Outgassing from burning will impede vacuum performance. In many cases allowing items to outgas at temperature before closing the vacuum system will improve vacuum performance and help keep the inside of the vacuum chamber clean – which is important.
- 9) Venting to end test. Press the STOP function button below the touch screen to stop system. Wait to allow turbo pump (time as indicated in pump operation manual) to fully spin down before moving system or attempting to remove bell jar. Observe the reading on the vacuum pump panel and when the numbers get into the $x \cdot 10^{-2}$ Bell jar will be loose enough to remove with a gentle twisting and lifting motion. More sophisticated venting systems can be installed to the system later however in the as-shipped configuration, when the turbo pump has spun down as indicated by 0Hz on the vacuum controller display screen, the process can be speeded up by gradually releasing the wing nut clamp connector in the rear that connects the internal roughing pump to the turbo High vacuum pump. See photo below. Use caution to not introduce dirt into the plumbing and avoid sudden release of vacuum. Take time to avoid damaging the pump.
- 10) A high vacuum helium leak detector may be needed if it becomes difficult to achieve the vacuum levels needed and possibility of virtual leaks have been ruled out. This test is performed by connecting the leak detector to the junction (shown below) between the High Vacuum turbo pump and the internal roughing pump. Pressure regulated Helium is sprayed at suspected leak locations one at a time while monitoring the leak detector. There will always be some very minor leakage indicated near the Viton seal for the bell jar but one by one, scan locations which may be potential leaks while monitoring the leak detector to identify and then eliminate the leak source.

- 11) Understand that heating is the process of exciting and liberating molecules, so when heating in vacuum, the vacuum will always diminish somewhat. When system is properly functioning, the vacuum level of $4e^{-6}$ would be expected but may take several hours. Less time when cold. Cleanliness of the interior of the chamber is important.
- 12) To achieve highest vacuum levels when at high temperatures, it is recommended to first go to a cold temperature, wait for vacuum to be achieved then go to required hot temperatures. Of course some vacuum will still be lost going hot but the loss will be minimized and take less time for the vacuum to recover.
- 13) When the thermal platform is cold, you will find it easier to quickly achieve high vacuum levels.
- 14) If any of the 2.75" CF (ConFlat) fittings around the vacuum chamber are opened, the copper gasket should be replaced. Additional gasket sealants are not recommended on CF fittings.
- 15) Become familiar with the controls on the Turbo pump panel of the Leybold Turbolab 350. Once operation is established, the four main parameters can be scrolled from the minimized display on the right side of the display 1) Rotation Speed in Hz. (1000 is expected when turbo is up to speed) 2) Motor current ~ 1.6 Amps 3) Bearing Temperature $\sim 40^{\circ}\text{C}$ 4) Current Vacuum level P1 $5.0 e^{-6}$
- 16) The F4 button to illuminates the screen on the vacuum pump. Left, Right up and down buttons navigate menus as expected.



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