FYRA

for

Freeze Dryer Controlling

[OPERATION MANUAL]

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OVERVIEW

The purpose of this document is to describe the purpose, implementation and use of the **FYRA Freeze Dryer Controller**.

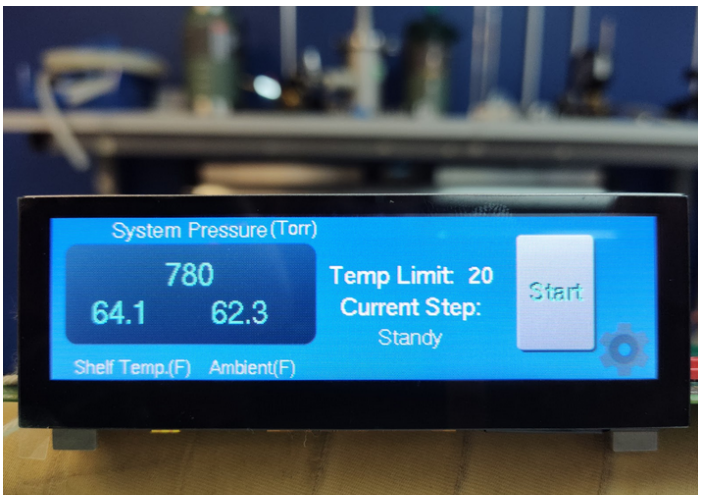
The **FYRA for Freeze Drying Bundle** includes all of the components necessary to enable easy retrofits of older or broken freeze dryers. It also includes a vacuum control facility that can enhance drying time and improve product quality in many instances. This vacuum control ability is found typically in the most expensive freeze drying products.

INCLUDES

- FYRA platform
- Temperature card to read type "K" thermocouples for displaying 2 temperatures: *Shelf* and *Ambient*
- Vacuum gauge driver card and Agilent 536 vacuum gauge
- VLC card and VacStable valve for controlling the vacuum pressure
- Solid state relay driver card
- UI that enables manual freeze-dry or automated freeze-drying modes
- **Variables** that can be customized to your drying process
- Platform designed from the ground up to be safe and reliable.
- Solid-state quad-relay

INSTALLATION CONSIDERATIONS

- Ideally the bleed valve should be installed on a vessel fitting **opposite** where the vacuum pump is attached. This isn't required, but helpful to promote flow.
- If the freezedryer does not have Type K Thermocouples, Type K Thermocouples should be installed on the shelf.
  - For the shelf temperature, it is important that the thermocouple is *on the actual shelf* otherwise inconsistent heating and poor temperature control will result.
  - Type K Thermocouples should be placed where ambient temperature can be taken.



VARIABLES

For Manual and Auto Mode

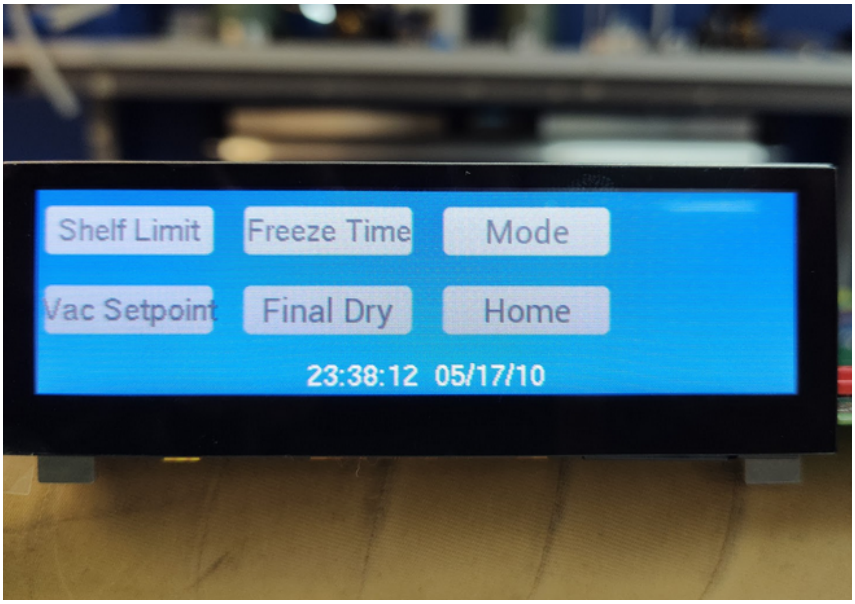
- **Shelf Limit**: When in step 3, or *Drying mode*, this is the temperature that the shelf will be controlled at 70 -170 F
  - User settable
  - Common range for this is 20-40F, but can be just about anything
- **Vac Setpoint**: This is the vacuum level, expressed in Torr that the system will not go below.
  - Typical values for this range from 0.3 Torr to 1 Torr.
  - Vacuum level is maintained by bleeding in a small amount of air.
  - It is best that this valve be placed on the chamber opposite where the vacuum pump is installed.

For Auto Mode Only

- **Freeze Time**: The time the user would like the freeze-dryer to spend freezing the product.
  - Note: The vacuum pump will be turned on the *last 60 minutes* of the user specified freeze time.
- **Dry Time**: The time the user would like the freeze-dryer to *Dry* the product. During *Drying*, the refrigeration system, the vacuum pump and the shelf heater are on.

SAFETY

If temperature of shelf exceeds preset *Shelf Limit*, which might happen if a thermocouple fails or is disconnected, the heater will be turned off. The pump and refrigeration would remain on.



4 MODES

- **Freezing**
  - Refrigeration is active
- **Freezing + Pumping**
  - Both refrigeration system and vacuum pump are energized
- **Drying**
  - Refrigeration, vacuum pump and heater are on, so long as the heat doesn't exceed the shelf temp set point.
- **Defrost**
  - Heater is on, Temperature is factory set to 220 F

AUTO

1. Turns refrigeration system on for "*Freeze Time*"
2. In last 60 minutes of Freeze Time, the vacuum pump turns on.
   a. If Freeze Time < 60 minutes, then the vacuum pump and the refrigeration system will come on immediately.
3. After Freeze Time is complete, **Final Dry** will last for the time set in "*Final Dry*."
4. When Final Dry is on, the refrigeration system, the pump and the heater are on
5. The heater will stay at "shelf temp"
   a. Heat *does not* turn on unless the shelf temperature is *below* the shelf temperature limit variable
6. Refrigeration pump and heat is off after the auto cycle is complete

MANUAL

1. Touch screen has 4 buttons describing above modes [1.**Freezing**, 2. **Freezing + Pumping**, 3. **Drying**, and **Defrost**]
2. Modes can be manually switched between/changed by tapping on these buttons