

PINNACLE CONTROLS MANUAL

PINNACLE | AccuDry
powered by Dryer Master® technology

PINNACLE | TruDry Technology



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Introduction

Overview

This volume of the manual is intended to provide you with a thorough overview and explanation of the touch screen software that interfaces with the Programmable Logic Controller (PLC). All possible features of the current Pinnacle software (HMI version 15.12.0152.XX and PLC version 15.11.0200.XX, where XX refers to a minor revision, 01, 02, etc.) will be explained. It is important to note that all dryers made from 2010-2015 will use HMI version 15.12.0151.XX.

Pinnacle and Pinnacle Lite are members of the Pinnacle family of control systems. The Pinnacle Lite system controls the dryer through a combination of a PLC interfaced with a Human Machine Interface (HMI) or "touch screen" and conventional relays and timers that are interfaced through buttons and switches. Conversely, Pinnacle, a completely PLC-controlled system, does not include any buttons or switches as all operator control is done through a larger touch screen.



Pinnacle Lite Remote Cabinet



Pinnacle Remote Cabinet

The Pinnacle control system's components are intermixed between the High Voltage Cabinet and the Remote Control Cabinet. The PLC is located in the High Voltage Cabinet, whereas the HMI is located on the Remote Control Cabinet.

User Interface

The touch screen interface of Pinnacle has been initially designed and continues to be refined, based on user feedback over past years, to provide the most intuitive and straightforward approach to interfacing with the machine. Navigation through the screens is accomplished by selecting one of the eight main chapters (Dryer Overview, Dryer Operation, Operational Setpoints, Alarm Setpoints, Alarms, PLC I/O, Trending, and System Configuration) that are shown across the bottom banner of the touch screen. Depending on what chapter you are on, the corresponding icon will illuminate in color which helps understand where you are within the program.

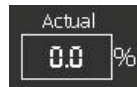


The side bar gives an operational overview, showing the Operation and Discharge modes and the green colored lights indicate what components are operating. Additionally, the Alarm Reset button will allow you to reset a current alarm.



The touch screen allows you to not only monitor parameters, but to also change operational and alarm set points. For the most part, values that can be changed will be displayed as black text with a white background. Values that display in white with the dark gray background are read-only values and cannot be changed.

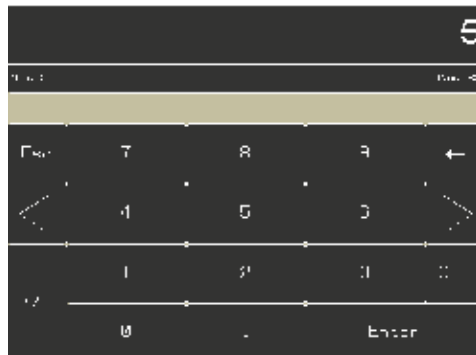
Example of a displayed value that cannot be changed:



Example of a displayed value that can be changed:



Selecting a white field to change the numerical value will bring up a number keypad. Depending on the input that is being changed, there may be a minimum and maximum range to the value which will be displayed on the keypad. When attempting to enter a value outside of the min/max range, the value will be displayed red on the keypad and will not allow the value to be entered. Once a suitable value has been entered, press "Enter" to input the value and be returned to the screen that the value was being entered on. If you do not wish to change the value, press "Esc" to return without making a change. The "←" button will delete one digit and "Clr" will delete the entire entry.

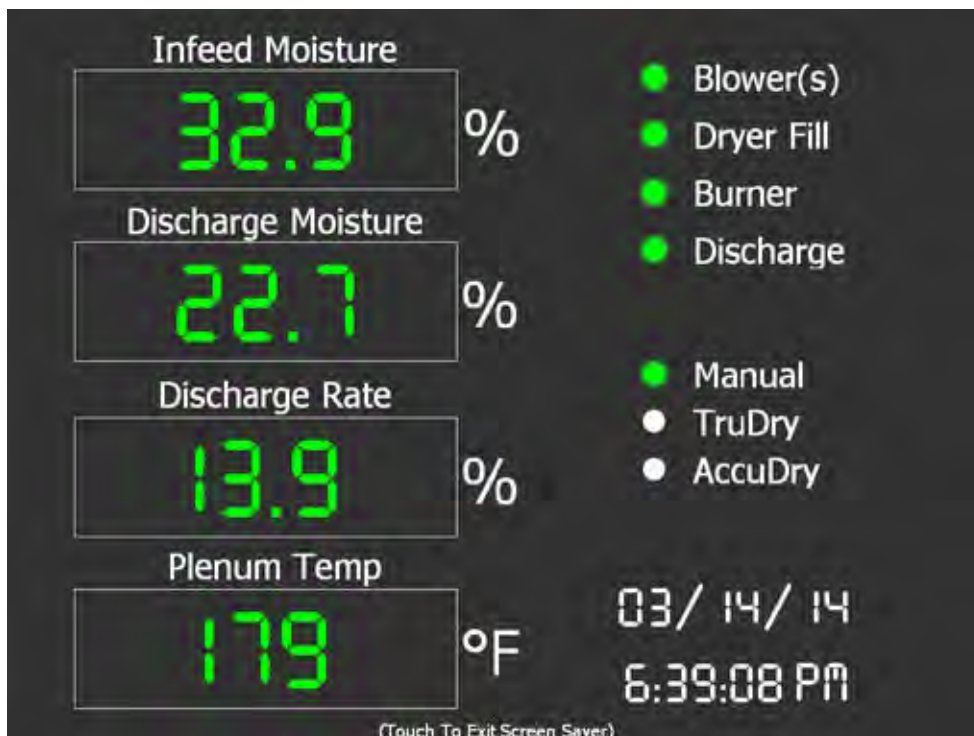


Certain data field inputs or buttons have a help button associated with it so that it's function or purpose is readily available. This will be indicated with a "?" button and simply pressing it will display a help message pop-up which can easily be closed by pressing the "x" button in the upper right hand corner.

Example of a "?" help button:



After a lapse of time, the screen saver will appear. Simply touch anywhere on the screen to make the screen saver disappear and revert to the screen most recently displayed. You can also hold the Dryer Overview button to manually start the screen saver.



Operation

Overview

While operating the dryer, the majority of the time you will be monitoring the Dryer Overview screen to see the dryer's discharge rate, average mid-grain temperature, grain moisture and temperature, as well as the status of the fill and takeaway equipment, burner and fan(s):

The screenshot shows the 'PINNACLE' Dryer Overview screen. At the top, it displays 'Infeed' with 'Infeed Moist / Temp Actual' at 24.0% and 27°F. The central part features a 3D animation of the dryer with a green 'Infeed' arrow at the top and a green 'Takeaway' arrow at the bottom. To the right of the animation, there are several data fields: 'Average Mid-Grain Temperature Actual/Default' at 110/112°F, 'Plenum Temperature Actual/Setpoint' at 207/210°F, and 'Discharge Moist / Temp Actual' at 14.8% and 77°F. Below the animation, there are controls for 'Air Pressure Switch' (a green indicator light), 'Gas Control Valve Opening Actual' at 15%, and 'Discharge Rate Actual/Setpoint' at 26.5/26.5%. On the right side, there is an 'Operational Overview' section with 'Operation Mode' (Manual) and 'Discharge Mode' (Automatic) both shown as green indicators. Below that is an 'Equipment Overview' section with indicators for 'Blower(s)', 'Dryer Fill', 'Burner', and 'Discharge', all shown as green. At the bottom right, there is an 'Alarm Reset' button. The bottom of the screen has a navigation bar with icons for 'Dryer Overview', 'Dryer Operation', 'Operational Setpoints', 'Alarm Setpoints', 'Alarms', 'PLC I/O', 'Trending', 'System Configuration', and 'Exit Runtime'. Red arrows point from various text annotations to specific elements on the screen.

Turns green when the customer fill equipment is energized.

Turns green when enabled and the grain fill is occurring.

Average of the readings from the four mid-grain temperature probes (RTDs).

Change the plenum temperature set point by touching the white setpoint field.

Discharge temperature and moisture percentages are displayed.

Animation shows the center dump or discharge auger action and flashes green when activated.

Change the discharge rate in manual mode by touching the white set point field.

Valves turn green as gas train is energized. Animation shows position of gas control valve.

Dryer overview screen (shown) is an animated visualization of the drying process.

Set operation and discharge modes and monitor the operational timers as the dryer runs. Also used for starting/stopping the dryer in manual or automatic mode.

Change any of the operational set points for various parts of the system.

Change any of the alarm set points for various parts of the system.

View and address faults and fault history.

See values of analog inputs/ outputs or status of digital inputs/outputs.

View current and past data in a chartable graph format.

Configure system options and view factory settings.



Overview Animations

New in 2013, Pinnacle Software has included 3-dimensional renderings of the grain dryers. Along with the new renderings, additional notifications have been added to the Overview screen. Such animations include; the air pressure indicator LED, the blower and burner ON arrows, and the infeed and discharge active illuminations.

Overview (Stopped)



Overview (Blowers On, Filling)



Overview (Blowers On, Burners On, Infeed On)



Overview (Infeed On, Blowers On, Burners On, Discharging)



Note that there will be multiple other states of operation, but for the purposes of this manual only a select few were shown during critical states of operation.



Dryer Operation

From the Dryer Operation screen, you can select *Manual* or *Automatic* Start Up Mode for the dryer as well as set the discharge mode of control, either *Manual*, *TruDry*, or *AccuDry*. Attempting to change the start up mode while the dryer is running is not possible as the button is grayed out.

Start Up Mode

The start up mode section of the Dryer Operation screen allows you to set the mode of operation in either manual or automatic; manual allows you to manually start and stop components, whereas automatic allows you to perform an automatic sequence of events to start, stop or cool down the machine.

There is also a safety feature to prevent repeated starts of the blower(s) and this will be seen with a check box next to the field labeled "OK To Restart Blower(s)"; a blower cannot be started unless the box is checked. After a blower is started and subsequently shutdown, a timer will start and a repeated start of the blower will not be permitted until the timer has elapsed. If the machine is not equipped with a soft starter, this can be overridden by checking the box and accepting the warning message about repeated starts of the fan motor(s); this will require a service level login. If the system is equipped with a soft starter, overriding the timer is not permitted.

Manual Start Up Mode

Manual operation mode allows you to manually start and stop the dryer blowers, burner, fill equipment and discharge/takeaway equipment).



To start a component, press the button in the left hand column with the white lettering. To stop that particular component, press the opposite red-lettered button in the right hand column. If a button has white text, that button may be pressed, if a button has grey text that button is currently unavailable, and if a button has green text that operation is currently running.

Automatic Start Up Mode

Automatic operation allows you to initiate an automatic start-up, shut-down or cool-down sequence of operation with a single push button.



To start-up the machine automatically, a checklist needs to be fulfilled to confirm that the start-up conditions are met. The "OK To Restart Blower(s)" check box needs to be checked per the conditions previously explained. Similarly, the "No Faults", "Fill Off", "Blower(s) Off" and the "Discharge Off" conditions need to be met and the system will show the status of these conditions with the check boxes checked. Lastly, the "Gas Turned On", "Fill Equipment Enabled", "Burner Cover Removed" and the "Takeaway Equipment Enabled" check boxes are manually checked once those un-monitored conditions are met. Once all of the Start-Up conditions are met, the Start-Up button will illuminate indicating that it is active and start-up operations are permitted.

When the Start-Up button has been pressed, the dryer will sequentially start the blowers and enable the fill equipment. As the blower(s) are starting, a blower confirmation delay timer will elapse to allow air pressure to build up. If the dryer is empty, the fill equipment will operate and grain will be introduced to the dryer until the fill level is sufficient to actuate the fill switch, which indicates to the system that the dryer has completed a first-time fill. Provided that sufficient air pressure has been developed, the ignition process will be initiated and pop-up windows will appear, advising you the status of the burner ignition process.

Once the burner has successfully been lit, the dryer will now be fully operational and the only options that exist are to shut-down or cool-down the machine by selecting the corresponding button on the bottom of the screen. If cool-down mode is selected, the fan(s) will continue to run for the duration of the cool-down timer. If you desire to re-start the dryer while the machine is in cool-down, simply press the re-start button and after confirmation of the re-start, you will be guided through the burner ignition process again. Selecting the shut-down button will completely shut all equipment off once you have confirmed that you intend to shutoff the dryer.

Discharge Mode

The discharge mode refers to the manner in which the speed of the discharge system changes. The options are: (1) Manual discharge mode in which the user sets the intended discharge rate and (2) TruDry mode in which the system will change the speed with the goal of maintaining the average mid-grain temperature equal to the target mid-grain temperature and (3) AccuDry mode in which the system will change the speed with the goal of maintaining the discharge moisture equal to the target discharge grain moisture.

Manual

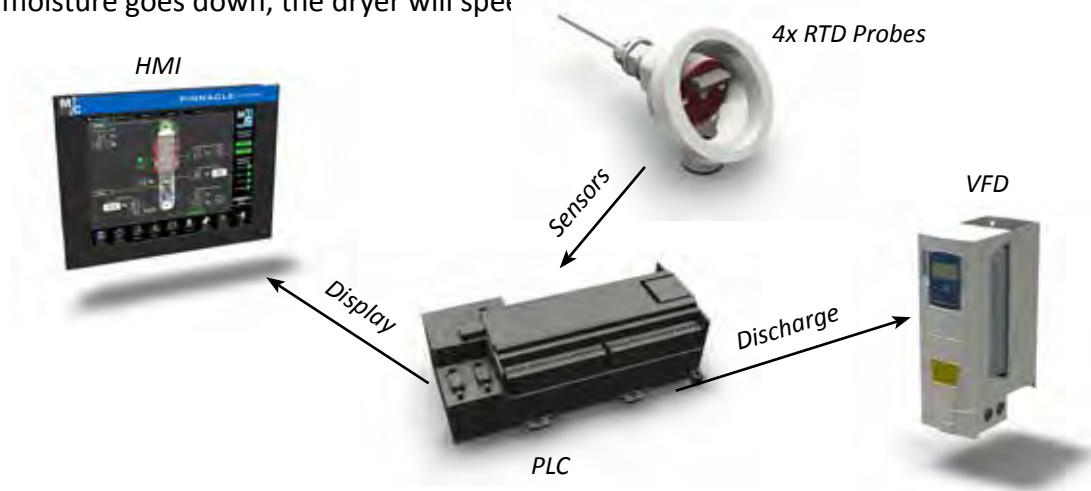
Manual mode of operation means you can directly tell the discharge metering system what speed the dryer will discharge grain at. Depending on what model dryer you are operating, the % discharge speed will correspond to an approximate bu/hr value. These values are calculated based on discharge capacity values which will be discussed further in the settings section. Additionally, a table is included below so that you may correlate the discharge speed % to bu/hr.

	Heat + Cool					
	20%-15% Moisture			25%-15% Moisture		
	bu/hr	tonnes/hr	speed	bu/hr	tonnes/hr	speed
10520	560	13.0	37%	320	7.5	18%
10630	690	16.1	48%	395	9.2	24%
10730	790	18.4	56%	455	10.6	29%
10840	945	22.0	57%	545	12.7	30%
101050	1,155	26.9	71%	670	15.6	38%
101275	1,385	32.3	87%	805	18.8	47%
10530	700	16.3	28%	400	9.3	12%
10740	930	21.7	26%	540	12.6	11%
10950	1,240	28.9	27%	720	16.8	12%
101160	1,500	34.9	27%	870	20.3	12%
101375	1,700	39.6	25%	1,000	23.3	11%
2000	2,000	46.6	44%	1,200	28.0	23%
2400	2,400	55.9	44%	1,440	33.5	23%
2700	2,700	62.9	42%	1,620	37.7	21%
12-20-100	2,000	46.6	44%	1,160	27.0	22%
12-24-125	2,400	55.9	44%	1,390	32.4	21%
12-28-150	2,800	65.2	44%	1,620	37.7	21%
3000	3,000	69.9	46%	1,800	41.9	24%
3500	3,500	81.5	48%	2,100	48.9	25%
4000	4,000	93.2	50%	2,400	55.9	26%
4800	4,800	111.8	55%	2,800	65.2	28%



TruDry Technology

TruDry is the name of a discharge mode of operation that automatically increases or decreases the discharge speed of the dryer. TruDry is not an automatic moisture control mode of operation and does not utilize the discharge moisture value, but instead controls the discharge rate by attempting to maintain an average mid-grain temperature setpoint. The principal of operation is that as the grain entering the dryer increases in moisture, the mid-grain temperature will go down and when the grain entering the dryer decreases in moisture, the mid-grain temperature will go up. Therefore, what the controller will do is utilize a negative responding Proportional-Integral-Derivative (PID) control loop which will increase the discharge rate when the mid-grain temperature goes up and decrease the discharge rate when the mid-grain temperature goes down. This essentially means that as the grain's moisture goes up, the dryer will slow down and as the grain's moisture goes down, the dryer will speed up.



In order to effectively use the TruDry mode of operation, it is important to allow the dryer to get to a steady state operating condition for 2-3 hours (depending on the size of the machine and the incoming grain moisture) with a desirable and consistent discharge moisture output. Once this steady state condition has been met, you will want to set the mid-grain temperature setpoint to a value equal to the current actual mid-grain temperature. Note that although you are running the dryer in manual, you will still be able to change the mid-grain temperature setpoint. At this point, the dryer has been running for 2-3 hours and steady state has been reached, so the current reading for the actual mid-grain temperature should correspond to the desired grain moisture that is currently being discharged from the dryer. It is important to understand that TruDry is not controlling the dryer on discharge moisture, but rather indirectly based on the average mid-grain temperature.

Another step to ensure a smooth and successful transition from manual mode to TruDry is to verify the minimum and maximum discharge speeds on the Operational Setpoints page of the Setpoints Chapter are set to a reasonable values. The minimum and maximum speed setpoint refers to the minimum and maximum speed that the dryer can run at. When running in TruDry mode this is especially important because the TruDry control algorithm will attempt to speed up and slow down to maintain the mid-grain temperature setpoint, and the amount of room that the controller has to work with is determined by the minimum and maximum speed setpoints. For example if the min/max speed setpoints are 0% - 100%, the range of speed output from the controller will be higher, which means the rate at which the speed changes will be higher. On the other hand, if the min/max setpoints are 30% - 75%, the controller can only operate within that band and only has a range of 45% to work with. More information on how to change the minimum and maximum speed setpoints on the Operational Setpoints screen is found in the Settings



section of this manual. A table of suggested minimum and maximum values is shown on page 2.8.

	Heat + Cool	
	Recommended	
	Min	Max
10520	0%	50%
10630	10%	60%
10730	10%	70%
10840	10%	70%
101050	20%	90%
101275	30%	100%
10530	0%	40%
10740	0%	40%
10950	0%	40%
101160	0%	40%
101375	0%	40%
2000	10%	60%
2400	10%	60%
2700	10%	60%
12-20-100	10%	60%
12-24-125	10%	60%
12-28-150	10%	60%
3000	10%	65%
3500	10%	65%
4000	10%	65%
4800	10%	65%

Once the average mid-grain temperature setpoint has been set and the minimum and maximum speed range has been established, TruDry mode of operation can be selected by touching the TruDry check box. Once TruDry mode of operation has been selected, the ability to manually change the speed will be inhibited and the only parameter that can be adjusted will be the mid-grain temperature setpoint.

While running in TruDry, you will see the speed continuously increase or decrease to maintain the target mid-grain temperature. Do not continuously tweak the mid-grain temperature, let it try to control to the setpoint value that you previously established. TruDry should be able to handle 3-5% swings in incoming moisture with reasonable discharge moisture variation if the dryer was properly brought up to steady state as previously explained. If after running for an extended period of time you have determined that the target mid-grain temperature is too high or too low, minor adjustments can be made, but should only be done periodically, not continuously. If you want to meticulously control the dryer, then you should be running in the manual mode of operation in which you can directly control the dryer's discharge rate.

AccuDry Technology

The AccuDry mode of operation utilizes input signals from both the discharge moisture sensor and the infeed moisture sensor to control the dryer's discharge rate. When the AccuDry mode of operation is available, it will display it's corresponding toggle button under the TruDry button. Also, when AccuDry is available, an additional input will be made available which allows you to enter the target discharge moisture setpoint.



When running in AccuDry, similar to the guidelines that were provided for TruDry, the minimum and maximum speed setpoints are important to the controller's operation. The AccuDry control algorithm will attempt to speed up and slow down to maintain the discharge moisture setpoint, and the amount of room that the controller has to work with is determined by the minimum and maximum speed setpoints. For example if the min/max speed setpoints are 1% - 100%, the range of speed output from the controller will be higher, which means the rate at which the speed changes will be higher. On the other hand, if the min/max setpoints are 30% - 75%, the controller can only operate within that band and only has a range of 45% to work with. More information on how to change the minimum and maximum speed setpoints on the Operational Setpoints screen is found in the Settings section of this manual.

Similar to how the mid-grain temperature setpoint (used in TruDry) can be changed while in manual mode, so too can the discharge moisture setpoint (used in AccuDry) be changed while in manual mode. The only limitation is that you cannot change the discharge speed setpoint when you are in TruDry or AccuDry.

In order to effectively use the AccuDry mode of operation, it is important to allow the dryer to get to a steady state operating condition for 2-3 hours upon initial installation (depending on the size of the machine and the incoming grain moisture) with a desirable and consistent discharge moisture output. Once this steady state condition has been met, you will confirm the discharge moisture setpoint that you want and make any required changes. Also, be sure to set the minimum and maximum discharge speed on the Operational Setpoints page of the Settings Chapter to an accurate band.

The AccuDry system will remember grain moistures upon startup from the previous shutdown. For example, if you were discharging 15.5% moisture the night prior, and start up with 15.4% the following morning, the system will allow you to quickly enter AccuDry mode.

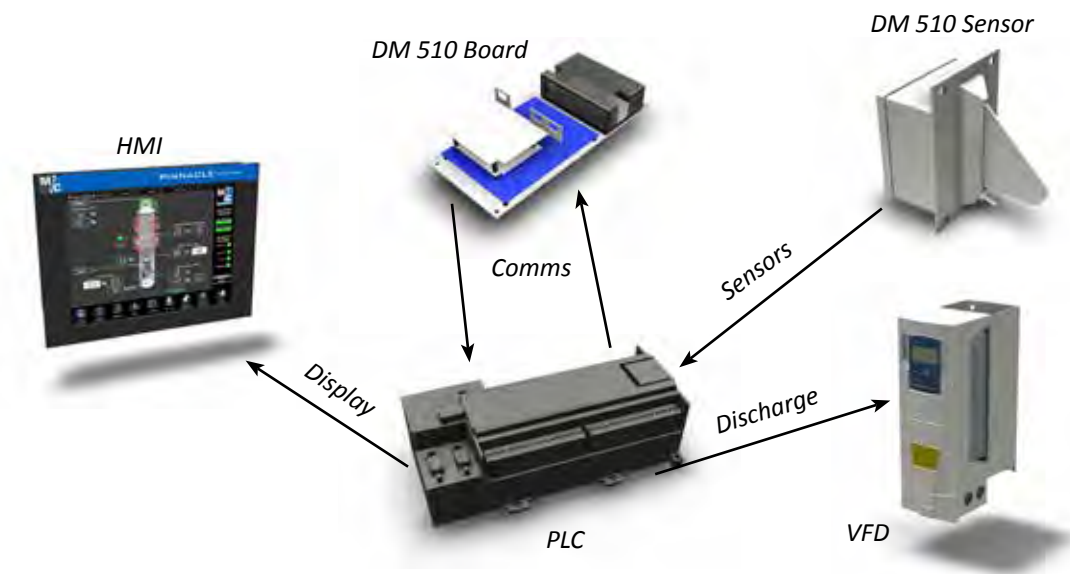
If the discharge moisture is significantly different from the previous operations moisture, the system will not enable AccuDry until it has gathered sufficient information to run correctly and efficiently.



How AccuDry Works

AccuDry technology utilizes the Dryer Moisture Systems Dryer Master DM510 system. The DM510 system uses specially designed on-line moisture and temperature sensors located at both the infeed and discharge of the dryer. These sensors provide continuous moisture and temperature readings to the PLC, which is shared with the DM510 logic board.

The DM510 board uses this information to build an operating model of your dryer, as infeed moistures and drying conditions change throughout the day; AccuDry continuously calculates and automatically adjusts to the optimum discharge rate for current conditions.



AccuDry has two important advantages. First, in automatic mode, it can continually watch the dryer. It does not have to help unload trucks, load trains, or do any other jobs around the elevator that a normal dryer operator does throughout the day. The dryer receives the user's full attention.

Second, it has the benefit of continuous moisture information from both the infeed and discharge of the dryer, giving it a complete picture of all the grain in the dryer, and the grain exiting the dryer.

With this information, AccuDry does not have to wait to react to changes in the outlet moisture. It is able to adjust the discharge rate as the incoming moisture changes. For example, as wetter grain comes into the dryer, AccuDry begins to slow down the discharge rate just as the wetter grain reaches the hot zone.

AccuDry Status

While running in manual mode, you will not be able to enter AccuDry mode until the system is "Ready." The ready state is shown by the color of the AccuDry button, which is explained below. There are three (3) different states of AccuDry which are as follows:

AccuDry Not Ready (Grayed Out AccuDry Button)

By default, the dryer will not have enough information for you to jump right into AccuDry mode. In order for AccuDry to be "Ready," the system must achieve the following before it will let you enter AccuDry mode:

1. There must not be any alarms present;
2. The dryer must be in the "Running" state of operation, further explanation may be found below;
3. The Actual Discharge Rate must be within 5% of the Suggested Rate;
4. The Discharge Moisture must be within 2% of the Setpoint Moisture and;
5. The AccuDry system must have enough knowledge and runtime, to have a Predicted Discharge Moisture within 2% of the Actual Discharge Moisture.

If you attempt to enter AccuDry Mode before the system is ready, you will encounter the AccuDry Status screen as shown below.

This screen will display the dryer running state, the not ready reason, the AccuDry predicted discharge moisture, the actual measured discharge moisture, the AccuDry suggested rate, the actual discharge rate, and whether or not the DM510 board is recording data (AccuDry Learning).

This screen will provide information to better achieve AccuDry readiness, and will get you into AccuDry much faster than guess work in Manual mode (see next page for full breakdown).



AccuDry Mode Of Operation

At the top of the AccuDry Status screen your current operating mode will be illuminated by a green indicator. These modes include; Manual Mode, Learn Mode, and AccuDry Mode. Manual mode is the default startup mode, where you will be constantly controlling the discharge rate. Learn mode will be illuminated when the dryer is operating (discharge is ON), and the moisture sensors have product being detected. This indicator states that the AccuDry system is "learning" from it's current operating inputs, and will stop "learning" and saving data when the discharge is turned OFF. Lastly is AccuDry mode, for when you are running in AccuDry mode.

AccuDry Dryer State

The dryer state field indicates the seven (7) stages of operating your dryer. The seven states are as follows;

Stand-By

The dryer fans, discharge, and burner(s) are off. The dryer may not be full (no moisture displayed by the infeed moisture sensor).

Primed

The dryer fans, discharge, and burner(s) are off. The dryer is full (moisture displayed by the infeed moisture sensor).

Idle Running

The dryer fans, discharge, and burner(s) are off. The dryer is full (moisture displayed by the infeed moisture sensor). This feature is only available on systems that make use of the fan switch input.

Shutdown

The dryer is OFF. The fans, the discharge, and burner(s) are off. The dryer is full (moisture displayed by the infeed moisture sensor). This feature is only available on systems that make use of the fan switch input.

Preheat

The dryer fans are on, the burner(s) are on, the discharge is off. The dryer is full (moisture displayed by the infeed moisture sensor).

Running

The dryer fans are on, the burner(s) are on, the discharge is on. The dryer is full (moisture displayed by the infeed moisture sensor). Moisture is displayed at the discharge sensor.

Holding

The dryer fans are on, the burner(s) are on, the discharge is off. The dryer is full (moisture displayed by the infeed moisture sensor). This is a temporary state and it will revert to Manual mode after 25 minutes as a safety precaution.

AccuDry Not Ready Reason

The not ready field indicates the reason the dryer will not allow you to enter AccuDry mode.

Discharge Off

The discharge is off and must be turned on.

Drying Temp Critical

Plenum temperature is in alarm and must be corrected.

Inlet Moisture Critical

Inlet grain moisture is in alarm and must be corrected.

Outlet Moisture Critical

Discharge grain moisture is in alarm and must be corrected.

Inlet Temperature Critical

Inlet grain temperature is in alarm and must be corrected.

Outlet Temperature Critical

Discharge grain temperature is in alarm and must be corrected.

Burner Off

Burner is OFF and must be lit.

Rate Off

Discharge rate is in alarm and must be corrected.

Fan Off

Fan is OFF and must be turned on.

Model Prediction

AccuDry is gathering data, and the predicted moisture (based on current data) is not acceptably close to the actual discharge moisture. Continue running in manual until enough data is taken to accurately predict correct discharge moistures.

Beta 2 Filling

A technical subset of model prediction. The system is gathering feedback on how your dryer is efficiently drying your particular grain. Continue running in manual until enough data is taken to accurately predict correct discharge moistures.

Beta 2 Stabilizing

A technical subset of model prediction as well. The system is fine-tuning feedback based on how your dryer is operating. Continue running in manual until enough data is taken to accurately predict correct discharge moistures.



Target Difference

Moisture setpoint is not acceptably close to the actual discharge moisture. Continue running in manual until discharge moisture is within 2% of setpoint moisture. This is done to alleviate moisture overshoot when switching to AccuDry.

Suggested Rate

The suggested rate field indicates what the AccuDry system would run at that given moment if it were to take over controls of the VFD. It is important to note that this field updates regularly, and will become more and more accurate as the dryer learns for each individual grain type.

Actual Rate

The actual rate field indicates the real-time commanded speed from the PLC to the VFD.

AccuDry Ready

While running in manual and AccuDry reaches the "Ready" state, the AccuDry button text will change from gray to white. You may now press the white AccuDry button to re-enter the AccuDry Status popup. When you now select AccuDry, the button will flash "Enabling..." for a few seconds, and will illuminate the AccuDry text in green lettering; you are now in AccuDry mode.



Once AccuDry mode of operation has been selected, the ability to manually change the speed will be inhibited and the only parameter that can be adjusted will be the discharge moisture setpoint. While running in AccuDry, you will see the speed continuously increase or decrease to maintain the target discharge moisture setpoint. Do not continuously tweak the discharge moisture setpoint, let it try to control to the setpoint value that you previously established.

A Typical Daily Routine

The following steps should be included in your daily routine when using the AccuDry system:

1. Before dryer start-up, check the outlet moisture sensor to ensure it is clean and free of debris. The sensor chute has no obstructions ahead of the sensor, and the flow-metering device is operating.
2. Start your dryer as you have in the past from the dryer control panel. The Pinnacle software will indicate that you are in "Manual" mode.
3. On the Dryer Overview screen, verify your discharge rate and discharge moisture setpoints. Modify them accordingly.
4. After the normal fan and burner startup procedure, as outlined in the Operations Manual, begin discharging.
5. AccuDry can be selected when the AccuDry button is illuminated white. Begin running in AccuDry and double-check the discharge moisture setpoint (now the only setpoint you can change) is correct.
6. AccuDry will now automatically adjust the dryer discharge rate to achieve the displayed product target moisture.
7. Periodically check the moisture sensors to ensure they are clean and there is good product flow. You may turn off your metering for roughly 60 seconds to clear out any fines or bees wings that may have accumulated in the sampling chute.
8. While operating the dryer, calibrate the moisture sensors as required.
9. When you turn off the dryer discharge, AccuDry will automatically revert to "Manual" mode after 25 minutes.

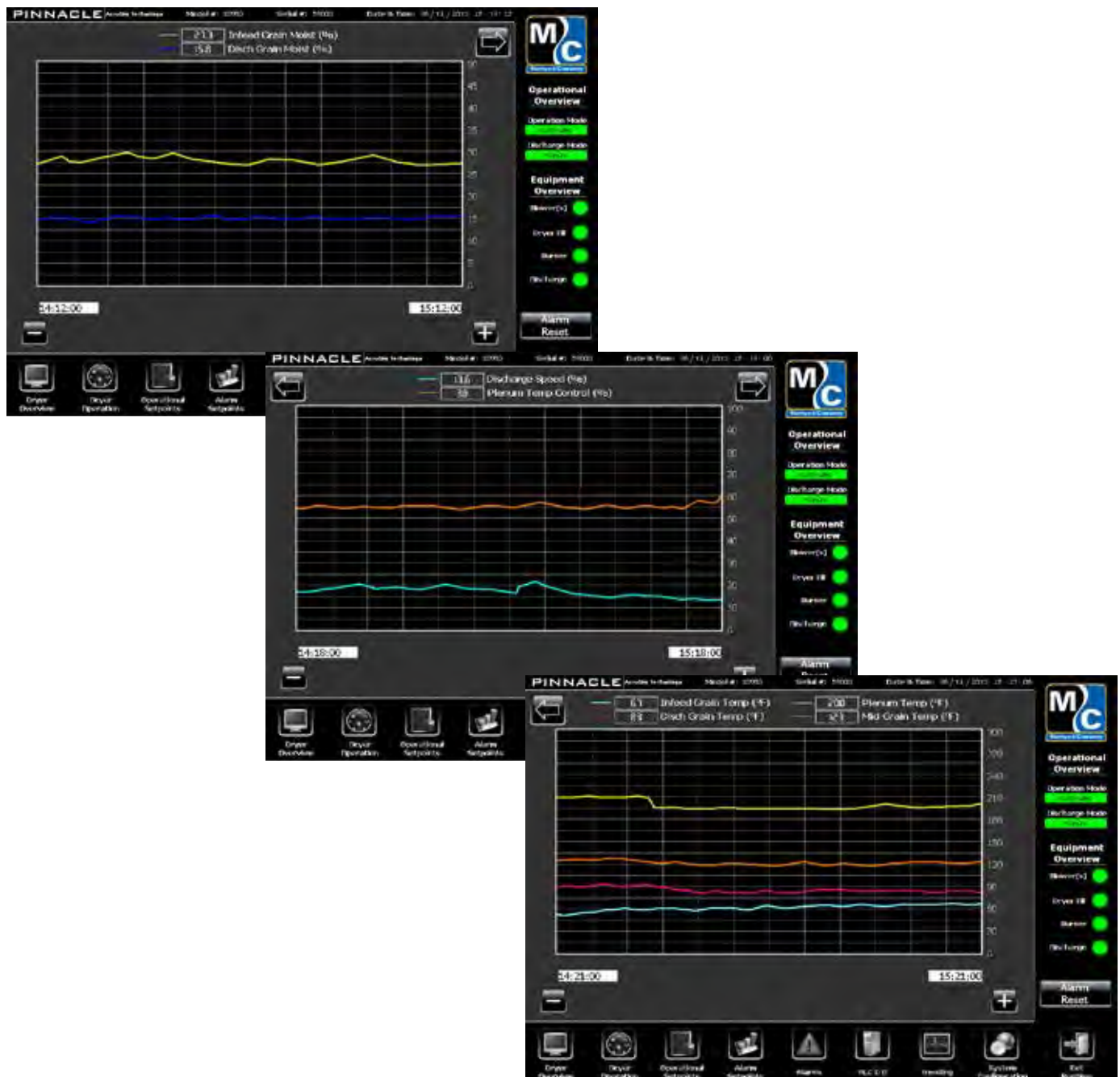


Operational Timers

The Operational Timers section of the Dryer Operation screen display the values and the status of any timer as it is running. Some of the timer values can be changed in the Setpoints area of the software and those will be explained further in this manual.

Trending

The trending chapter is where you will go to view one of three historical data plots for: (1) Moistures - both infeed and discharge grain moistures (2) Percentages (%) - discharge speed and plenum temperature control valve opening, and (3) Temperatures - infeed, discharge, plenum and mid-grain temperatures. Although you will be able to access the Trending screens, you will not actually see data trends unless the dryer is currently discharging grain.



The (-) button will increase the time from the current time period to the prior time up to 36 hours to view on the trending screen. This will give you a day and a half of data to view on one screen.

The (+) button will shorten the time period from the prior to the current time. This will give you a shorter view of the data from prior time to the current time period.

PLC I/O

The PLC I/O chapter displays values corresponding to the digital and analog inputs and outputs that are interfaced with the PLC. Analog inputs and outputs refer to values that change in numerical value such as a temperature or a moisture reading, whereas digital inputs or outputs refer to parameters that are discrete and are either on or off, such as a high limit switch. The purpose of the PLC I/O chapter is for several reasons, some of which include the ability to diagnose issues that may arise or to get additional information pertaining to a particular input or output value.

Digital Inputs

Upon selecting the PLC I/O chapter button, you will be taken to the Digital Inputs screen. Because both digital inputs and digital outputs refer to discrete parameters, their values can be indicated with the equivalent of a colored bulb. If the indicator is white, the input is off, whereas if the indicator is green, the input is on.



The digital inputs that are monitored by the PLC are presented below with a brief description of their purpose:

I0.0 - Master Control Relay (MCR)

A green light indicates that the control power is ON and the safety circuit is functioning properly. White indicates it is OFF.

I0.1 - Blower(s) Overload

Green indicates that the blower circuit is OK, white indicates overload.

I0.2 - In-feed Bin Switch

Green indicates the grain level has fallen low enough for the paddle in the rotary bin switch to rotate. If white, the fill level is sufficient.

I0.3 - Discharge Level Switch

Green indicates that the level switch is made. White indicates that the grain has overloaded the level switch and it is open.

I0.4 - Discharge VFD OK

If green, the VFD is functioning properly. White indicates that the VFD is sending a fault signal to the PLC.

I0.6 - Discharge Prox Switch

Flashes from white to green at intervals in conjunction with the state of the RPM proximity sensor. When the discharge is running, the RPM proximity sensor will change state based on the rate of discharge. If the proximity sensor does not change state within a predetermined amount of time, an alarm indicating a discharge fault will be generated.

I0.7 - Linear Limit Circuit (LLC)

Green indicates that the linear limit circuit is complete and functioning properly. If white, the circuit is either incomplete or there is an error.

I1.0 - Blower #1 Auxiliary

Green indicates that the auxiliary contact for the #1 motor starter is ON. If white, it is OFF.

I1.1 - Blower #1 Press Switch

Green indicates that the #1 blower pressure switch has been activated and the blower is generating sufficient pressure. White indicates low or no pressure.

I1.2 - Discharge Prox Switch

Follows the same signal as I0.6 and is used for jam detection.

I1.3 - Low Gas Press Switch (CGA Only)

When white, the switch is off. When green, the switch is on. If CGA is enabled, the low gas pressure switch is monitored when the burner is ignited. If the gas pressure falls too low, the switch will be deactivated.

I1.4 - Burner High Limit

Green indicates that the high limit circuit is complete and is functioning properly. White indicates that the burner high limit setpoint has been reached, tripping the high limit switch.

I1.5 - Burner Ignition On

A green signal verifies that a flame is present. White signifies the absence of flame.

I1.6 - Blower #2 Auxiliary

Green indicates that the auxiliary contact for the #2 motor starter is ON. If white, it is OFF.

I1.7 - Blower #2 Press Switch

Green indicates that the blower pressure switch has been activated and the blower is generating sufficient pressure. White indicates low or no pressure.

I2.0 - High Gas Press Switch (CGA Only)

When white, the switch is OFF. When green, the switch is ON. If CGA is enabled, the high gas pressure switch is monitored when the burner is ignited. If the gas rises too high, the switch will be deactivated.

I2.1 - Tri-Start Auxiliary Contact

In an 18' tower/3-blower system only, green indicates that the auxiliary contacts of start contactor A and start contactor B are closed. White indicates one or both of the auxiliary contacts are open.

I2.3 - Blower #3 Auxiliary

Green indicates that the auxiliary contact for the #3 motor starter is ON. If white, it is OFF.

I2.4 - Blower #3 Press Switch

Green indicates that the blower pressure switch has been activated and the blower is generating sufficient pressure. White indicates low pressure.

I2.5 - LLC#1 OK

Green indicates that linear limit circuit #1 is complete and functioning properly.

I2.6 - LLC#2 OK (12' and 18' Tower Only)

Green indicates that linear limit circuit #2 is complete and functioning properly.

I2.7 - LLC#3 OK (12' and 18' Tower Only)

Green indicates that linear limit circuit #3 is complete and functioning properly.

NOT USED/SPARE

Inputs & outputs marked Not Used/Spares are never used.

NOT USED

Inputs & outputs marked Not Used are not used in a particular configuration but when that feature is active, the input/output is used.



Digital Outputs

Advancing to the next screen from the Digital Inputs by pressing the Next button will take you to the Digital Outputs screen. Similar to the digital inputs, digital outputs refer to discrete parameters and their values can be indicated with the equivalent of a colored bulb. If the indicator is white, the output is off, whereas if the indicator is green, the output is on.



The digital outputs that are monitored by the PLC are presented below with a brief description of their purpose:

Q0.0 - Customer Remote Fill Run

Green indicates that the customer's remote fill equipment is running and grain is filling the dryer. White indicates that the fill equipment is not running.

Q0.1 - Customer Remote Fill Clean Out

Green indicates that the customer's remote fill equipment will continue to run to permit clean out of the customer fill equipment. White indicates that it is not running.

Q0.2 - Blower #1 Motor Starter

Green indicates that the blower motor has been commanded to run. White indicates that it has not been commanded to run.

Q0.3 - Blower #2 Motor Starter

Green indicates that the blower motor has been commanded to run. White indicates that it has not been commanded to run.

Q0.4 - Blower #3 Motor Starter

Green indicates that the blower motor has been commanded to run. White indicates that it has not been commanded to run.

Q0.6 - Discharge VFD Run

Green indicates that the discharge VFD has been commanded to run. White indicates that it has not been commanded to run.

Q0.7 - Customer Takeaway Run

Green indicates that the customer's takeaway system has been commanded to run. White indicates that it has not been commanded to run.

Q1.0 - Burner Ignition

Green indicates that the burner has been commanded to ignite and will stay ON while operating. White indicates that it is OFF.

Q1.1 - Tri-Start Contactors

Green indicates that the start contactors A and B are turned ON. White means they are OFF.

Q1.2 - Green Lamp (if equipped)

The Green Lamp digital output commands the green light on the stack lamp to turn on when illuminated green. The green lamp on the stack light is on continuously when the control power is on and will continuously blink when the discharge is running. This digital output is only available if the machine is equipped with the auxiliary alarms feature.

Q1.4 - Discharge VFD Fault Reset

Flashes green momentarily when the PLC sends a reset request to the VFD. When white, no request is being sent.

Q1.5 - Maxon Solenoid (if configured)

Green indicates that the Maxon valve is energized. White indicates that it is not.

Q1.6 - Red Lamp (if equipped)

The Red Lamp digital output commands the red light on the stack lamp to turn on when illuminated. The red lamp on the stack light will blink when the dryer has shutdown with a Type "C" alarm or will alternate red/green blinking with a Type "A" alarm while discharging. More information is available on alarms in the Troubleshooting section of this manual. This digital output is only available if the machine is equipped with the auxiliary alarms feature.

Q1.7 - Fire Alarm Signal

Green indicates that the fire alarm has been activated. White indicates that it has not.

NOT USED/SPARE

Inputs & outputs marked Not Used/Spares are never used.

NOT USED

Inputs & outputs marked Not Used are not used in a particular configuration but when that feature is active, the input/output is used.



Analog Inputs & Outputs

Advancing to the next screen from the Digital Outputs by pressing the Next button will take you to the Analog Inputs and Outputs screen. The Analog Inputs and Outputs screen displays the raw and scaled values.



The analog inputs and outputs that are monitored by the PLC are presented below with a brief description of their purpose:

AIW0 & AIW4 - Infeed and Discharge Grain Moisture

Indicate the moisture of the grain flowing across the infeed and discharge moisture sensors respectively.

AIW2 & AIW6 - Infeed and Discharge Grain Temperature

Indicate the temperature of the grain flowing across the infeed and discharge moisture sensors respectively.

AIW8 - Plenum Temperature

Indicates the plenum temperature from the plenum RTD.

AIW12 - Mid-Grain Temperature #1

Indicates mid-grain temperature #1 from the RTD transmitter.

AIW14 - Mid-Grain Temperature #2

Indicates mid-grain temperature #2 from the RTD transmitter.

AIW16 - Mid-Grain Temperature #3

Indicates mid-grain temperature #3 from the RTD transmitter.

AIW18 - Mid-Grain Temperature #4

Indicates mid-grain temperature #4 from the RTD transmitter.



AQW0 - Discharge Speed Control

Indicates the commanded discharge speed sent to the VFD.

The discharge speed analog output provides all pertinent discharge speed information. The scaled discharge speed output % that is defined either manually in Manual mode or automatically in Trudry or AccuDry mode is shown as well as the corresponding output voltage from the PLC. This is the analog output voltage that is sent to the VFD for discharge speed control. This value can be verified for troubleshooting purposes by measuring the voltage across the output of the PLC output or by measuring the analog input voltage on the VFD. A tabulation of data for all dryer models is shown on the next page with VFD frequency, metering speed, and discharge rate (bu/hr) for 0% - 100% in 10% increments.

The VFD frequency is shown to provide an indication of what frequency the discharge metering motor is running at; this value is not read directly from the VFD, but rather it is a calculated value based on the discharge speed %.

The discharge motor speed and the corresponding metering system speed are both shown with units of revolutions per minute (RPM). The metering speed is the speed at which either the metering rolls or sweep system are running at downstream of the discharge gearbox speed reduction.

The bu/hr portion of the screen is the real-time output of bushels per hour of dryer operation, if the dryer were to run for one hour at the exact same state. This value will change in response to incoming moisture fluctuations.

A tabulation of data for all tower dryer models is shown on the next page with VFD frequency, metering speed, and discharge rate (bu/hr and metric tonnes/hr) for 0% - 100% in 10% increments.

Model	Discharge Speed (%)																						
	0%		10%		20%		30%		40%		50%												
VFD Freq (Hz)	Measring Speed (RPM)	Disch Rate (bu/hr)	Disch Rate (tonnes/hr)	VFD Freq (Hz)	Measring Speed (RPM)	Disch Rate (bu/hr)	Disch Rate (tonnes/hr)	VFD Freq (Hz)	Measring Speed (RPM)	Disch Rate (bu/hr)	Disch Rate (tonnes/hr)	VFD Freq (Hz)	Measring Speed (RPM)	Disch Rate (bu/hr)	Disch Rate (tonnes/hr)								
L1250	0.6	85	2.0	10.5	1.2	178	4.1	16.0	1.9	271	6.3	21.5	2.5	364	8.5	27.0	3.1	457	10.7	32.5	3.8	551	12.8
L1350	0.6	85	2.0	10.5	1.2	178	4.1	16.0	1.9	271	6.3	21.5	2.5	364	8.5	27.0	3.1	457	10.7	32.5	3.8	551	12.8
L2550	0.8	179	4.2	10.5	1.7	375	8.7	16.0	2.6	572	13.3	21.5	3.5	769	17.9	27.0	4.4	965	22.5	32.5	5.3	1162	27.1
L2650	0.8	179	4.2	10.5	1.7	375	8.7	16.0	2.6	572	13.3	21.5	3.5	769	17.9	27.0	4.4	965	22.5	32.5	5.3	1162	27.1
L2700	0.8	179	4.2	10.5	1.7	375	8.7	16.0	2.6	572	13.3	21.5	3.5	769	17.9	27.0	4.4	965	22.5	32.5	5.3	1162	27.1
L3100	1.6	358	8.3	10.5	3.4	751	17.5	16.0	5.2	1144	26.6	21.5	7.0	1537	36.8	27.0	8.8	1931	45.0	32.5	10.6	2324	54.1
L4145	1.6	358	8.3	10.5	3.4	751	17.5	16.0	5.2	1144	26.6	21.5	7.0	1537	36.8	27.0	8.8	1931	45.0	32.5	10.6	2324	54.1
L5175	1.6	358	8.3	10.5	3.4	751	17.5	16.0	5.2	1144	26.6	21.5	7.0	1537	36.8	27.0	8.8	1931	45.0	32.5	10.6	2324	54.1
L6205	1.6	358	8.3	10.5	3.4	751	17.5	16.0	5.2	1144	26.6	21.5	7.0	1537	36.8	27.0	8.8	1931	45.0	32.5	10.6	2324	54.1
CF 320 / 320C	0.6	42	1.0	10.5	0.8	89	2.1	16.0	1.9	136	3.2	21.5	2.5	192	4.2	27.0	3.1	229	5.3	32.5	3.8	275	6.4
CF 420 / 240C	0.6	64	1.5	10.5	1.2	133	3.1	16.0	1.9	203	4.7	21.5	2.5	273	6.4	27.0	3.1	343	8.0	32.5	4.4	413	9.6
CF 520 / 520C	0.6	85	2.0	10.5	1.2	178	4.1	16.0	1.9	271	6.3	21.5	2.5	364	8.5	27.0	3.1	457	10.7	32.5	3.8	551	12.8
CF 620 / 620C	0.6	85	2.0	10.5	1.2	178	4.1	16.0	1.9	271	6.3	21.5	2.5	364	8.5	27.0	3.1	457	10.7	32.5	3.8	551	12.8
CF 720	0.6	106	2.5	10.5	1.2	222	5.2	16.0	1.9	339	7.9	21.5	2.5	455	10.6	27.0	3.1	572	13.3	32.5	3.8	689	16.0
CF 730	0.6	106	2.5	10.5	1.2	222	5.2	16.0	1.9	339	7.9	21.5	2.5	455	10.6	27.0	3.1	572	13.3	32.5	3.8	689	16.0
CF 820 / 820C	0.6	128	3.0	10.5	1.2	268	6.2	16.0	1.9	409	9.5	21.5	2.5	549	12.8	27.0	3.1	690	16.1	32.5	3.8	830	19.3
T2030 / 2030V	0.6	106	2.5	10.5	1.2	222	5.2	16.0	1.9	339	7.9	21.5	2.5	455	10.6	27.0	3.1	572	13.3	32.5	3.8	689	16.0
T2440 / 2440V	0.6	128	3.0	10.5	1.2	268	6.2	16.0	1.9	409	9.5	21.5	2.5	549	12.8	27.0	3.1	690	16.1	32.5	3.8	830	19.3
T2850 / 2850V	0.6	149	3.5	10.5	1.2	313	7.3	16.0	1.9	477	11.1	21.5	2.5	641	14.9	27.0	3.1	804	18.7	32.5	3.8	968	22.6
10520	0.6	93	2.2	11.7	1.3	219	5.1	18.4	2.1	344	8.0	25.1	2.9	469	10.9	31.8	3.7	594	13.8	38.5	4.4	719	16.8
10630	0.6	93	2.2	11.7	1.3	219	5.1	18.4	2.1	344	8.0	25.1	2.9	469	10.9	31.8	3.7	594	13.8	38.5	4.4	719	16.8
10730	0.6	93	2.2	11.7	1.3	219	5.1	18.4	2.1	344	8.0	25.1	2.9	469	10.9	31.8	3.7	594	13.8	38.5	4.4	719	16.8
10840	0.6	110	2.6	11.7	1.3	257	6.0	18.4	2.1	405	9.4	25.1	2.9	552	12.9	31.8	3.7	699	16.3	38.5	4.4	847	19.7
101050	0.6	110	2.6	11.7	1.3	257	6.0	18.4	2.1	405	9.4	25.1	2.9	552	12.9	31.8	3.7	699	16.3	38.5	4.4	847	19.7
101275	0.6	110	2.6	11.7	1.3	257	6.0	18.4	2.1	405	9.4	25.1	2.9	552	12.9	31.8	3.7	699	16.3	38.5	4.4	847	19.7
10530	0.6	173	4.0	10.5	0.8	362	8.4	16.0	1.8	552	12.9	21.5	2.5	742	17.3	27.0	3.1	932	21.7	32.5	3.7	1121	26.1
10740	0.6	242	5.6	10.5	1.2	507	11.8	16.0	1.8	773	18.0	21.5	2.5	1038	24.2	27.0	3.1	1304	30.4	32.5	3.7	1570	36.6
10950	0.6	311	7.2	10.5	1.2	652	15.2	16.0	1.8	994	23.1	21.5	2.5	1335	31.1	27.0	3.1	1677	38.1	32.5	3.7	2018	47.0
101160	0.6	380	8.8	10.5	1.2	797	18.6	16.0	1.8	1214	28.3	21.5	2.5	1632	38.0	27.0	3.1	2049	47.7	32.5	3.7	2467	57.5
101375	0.6	449	10.4	10.5	1.2	942	21.9	16.0	1.8	1435	33.4	21.5	2.5	1929	44.9	27.0	3.1	2422	56.4	32.5	3.7	2915	67.9
2000	0.6	345	8.0	10.5	1.2	725	16.9	16.0	1.8	1104	25.7	21.5	2.5	1484	34.6	27.0	3.1	1863	43.4	32.5	3.7	2243	52.2
2400	0.6	414	9.6	10.5	1.2	869	20.3	16.0	1.8	1325	30.9	21.5	2.5	1780	41.5	27.0	3.1	2236	52.1	32.5	3.7	2691	62.7
2700	0.6	483	11.3	10.5	1.2	1014	23.6	16.0	1.8	1546	36.0	21.5	2.5	2077	48.4	27.0	3.1	2608	60.8	32.5	3.7	3140	73.1
12-20-100	0.6	345	8.0	10.5	1.2	725	16.9	16.0	1.8	1104	25.7	21.5	2.5	1484	34.6	27.0	3.1	1863	43.4	32.5	3.7	2243	52.2
12-24-125	0.6	414	9.6	10.5	1.2	869	20.3	16.0	1.8	1325	30.9	21.5	2.5	1780	41.5	27.0	3.1	2236	52.1	32.5	3.7	2691	62.7
12-28-150	0.6	483	11.3	10.5	1.2	1014	23.6	16.0	1.8	1546	36.0	21.5	2.5	2077	48.4	27.0	3.1	2608	60.8	32.5	3.7	3140	73.1
3000	0.2	496	11.6	10.5	0.4	1042	24.3	16.0	0.7	1588	37.0	21.5	0.9	2135	49.7	27.0	1.1	2881	62.4	32.5	1.3	3227	75.2
3500	0.2	558	13.0	10.5	0.4	1173	27.3	16.0	0.7	1787	41.6	21.5	0.9	2401	55.9	27.0	1.1	3016	70.2	32.5	1.3	3630	84.6
4000	0.2	621	14.5	10.5	0.4	1303	30.4	16.0	0.7	1986	46.3	21.5	0.9	2688	62.1	27.0	1.1	3361	78.0	32.5	1.3	4033	93.9
4800	0.2	683	15.9	10.5	0.4	1433	33.4	16.0	0.7	2184	50.9	21.5	0.9	2935	68.4	27.0	1.1	3686	85.9	32.5	1.3	4437	103.3



	Discharge Speed (%)																													
	60%						70%						80%						90%						100%					
	VFD Freq (Hz)	Metering Speed (RPM)	Disch Rate (bu/hr)	Disch Rate (tonnes/hr)	VFD Freq (Hz)	Metering Speed (RPM)	Disch Rate (bu/hr)	Disch Rate (tonnes/hr)	VFD Freq (Hz)	Metering Speed (RPM)	Disch Rate (bu/hr)	Disch Rate (tonnes/hr)	VFD Freq (Hz)	Metering Speed (RPM)	Disch Rate (bu/hr)	Disch Rate (tonnes/hr)	VFD Freq (Hz)	Metering Speed (RPM)	Disch Rate (bu/hr)	Disch Rate (tonnes/hr)										
L1250																														
L1350																														
L2550																														
L2650																														
L2700																														
L3100																														
L3105																														
L4145																														
L5175																														
L6205																														
CF 320 / 320C																														
CF 420 / 240C																														
CF 520 / 520C																														
CF 620 / 620C																														
CF 720																														
CF 730																														
CF 820 / 820C																														
T2030 / 2030V																														
T2440 / 2440V																														
T2850 / 2850V																														
10520																														
10630																														
10730																														
10840																														
101050																														
101275																														
10530																														
10740																														
10950																														
101160																														
101375																														
2000																														
2400																														
2700																														
12-20-100																														
12-24-125																														
12-28-150																														
3000																														
3500																														
4000																														
4800																														

The calculated discharge rate is displayed in bu/hr and is calculated based on the quantity of grain that is discharged with each revolution of the metering system and is referred to as the discharge capacity with units of bu/rev. The default value for this parameter is model specific and has been approximated based on past experience, as shown in the following table. It is important to understand that this value can be adjusted for a more accurate discharge rate indication. A further explanation on how to adjust this parameter will be found in the Settings section of this manual.

	Discharge Capacity	
	bu/rev	(m3/rev)
10520	2.708	0.09540
10630		
10730		
10840	3.187	0.11227
101050		
101275		
10530	5.000	0.17857
10740	7.000	0.25000
10950	9.000	0.32143
101160	11.000	0.39286
101375	13.000	0.46429
2000	10.000	0.35714
2400	12.000	0.42857
2700	14.000	0.49340
12-20-100	10.000	0.35714
12-24-125	12.000	0.42857
12-28-150	14.000	0.49340
3000	40.000	1.42857
3500	45.000	1.60714
4000	50.000	1.78571
4800	55.000	1.96429

AQW4 - Plenum Temperature Control

Indicates the commanded opening for the fuel control valve to regulate plenum temperature.





Settings

The Pinnacle control system has features that are customizable with several settings that can be changed as necessary. These settings are thoroughly discussed throughout this section of the manual. It is important to note that this portion of the manual is dependant on the two main technologies that may be installed (1) TruDry Technology and (2) AccuDry Technology.

Setpoints (TruDry)

Selecting the setpoints chapter button will take you to the first of three screens, alarms setpoints, followed by operational setpoints and lastly, sensor calibration.

Alarm Setpoints (TruDry)

The alarm setpoints screen provides you with the ability to change limits and other values that correspond to alarm values. The alarms that these setpoints correspond to will be explained further in the Troubleshooting section of this manual.



Mid-Grain Band

The Alarm Set Point is the allowed deviation from the mid-grain temperature set point while the discharge system is running.

Mid-Grain Band Delay

The Mid-Grain Band delay is a user-defined time duration that will delay the cool down of the dryer after the Mid-Grain Band warning alarm has occurred.



Grain Flow Timeout

The Grain Flow Timeout set point is the time delay allowed once the grain level has dropped below the bin level switch. Once the grain flow timeout set point has been reached, an alarm will be triggered that will place the dryer into COOL-DOWN mode.

Discharge Moisture Low Limit

The Discharge Moisture Low Limit alarm set point is a discharge moisture value that will trigger an alarm when the value drops below the discharge moisture low limit set point for duration of 5-minutes while the discharge is running.

Discharge Moisture High Limit

This Discharge Moisture High Limit alarm set point is a discharge moisture value that will trigger an alarm when the value exceeds the discharge moisture high limit set point for duration of 5-minutes while the discharge is running.

Plenum Temperature Band

The Plenum Temperature band is the maximum allowed deviation between the actual plenum temperature and the plenum temperature set point.

Bushel Count Warning Enable

This button enables an alarm (to be displayed) when the bushel count limit is achieved (see below).

Bushel Count Limit

The total bushels that the dryer is permitted to discharge (up to the dry storage capacity). Once the set point is reached, a warning alarm will be displayed.

Operational Setpoints (TruDry)

Selecting the Operational Setpoints screen from the bottom ribbon will provide you with the ability to change operational values that affect the performance of the machine.



Plenum Temperature

The Plenum Temperature set point is used to control the plenum temperature when the burner is lit. The PLC will control plenum temperature by adjusting the burner control valve to increase or decrease the amount of fuel flowing to the burner.

Control Valve Initial Opening

The Control Valve Initial Opening is the position of the fuel control valve commanded as the burner is undergoing the initial ignition sequence.

Control Valve Min Opening

The Fuel Control Valve Minimum Opening % set point is the lowest possible control valve output allowed by the dryer.

Control Valve Max Opening

The Fuel Control Valve Maximum Opening % set point is the highest possible control valve output allowed by the dryer.

Auto Temp Adjust Jump

The Auto Temp Adjust Jump set point refers to the automatic temperature decrease of the plenum temperature set point when the VFD back off speed set point has been reached.

Auto Temp Adjust Max

The Auto Temp Adjust Max set point refers to the total allowed adjustment to the plenum temperature as a result of multiple auto temp adjustments.

Auto Adjust Timer

The Auto Adjust Timer refers to the time before an automatic temperature adjustment is made to the plenum temperature set point.

VFD Back off Speed

The VFD Back-off Speed refers to the VFD speed at which the automatic plenum temperature set point adjustment feature will become enabled.

Cool-Down Timer

The Cool-Down Timer refers to the length of time that the dryer will be placed in COOL-DOWN mode following a type-B fault or when the dryer is placed in COOL-DOWN mode.

Mid-Grain Temp

The Mid-Grain Temperature set point refers to the target mid-grain temperature that the dryer will attempt to maintain during automatic discharge control.

Fill Start Delay

The Fill Start Delay set point refers to the time between when the grain level has dropped below the Bin Level switch and when the Dryer Fill System is activated.

Fill Stop Delay

The Fill Stop Delay set point refers to the time between when the grain level has risen above the Bin Level switch and when the Dryer Fill System is deactivated.



Takeaway Cleanout Delay

The Takeaway Cleanout Delay setpoint refers to the amount of time that the dryer takeaway system will be commanded to operate after the Dryer Discharge system has stopped.

Sensor Calibration (TruDry)

Selecting the Next button from the Operational Setpoints screen will take you to the Sensor Calibration screen:

The moisture sensors that are used on the dryer are special devices that measure the capacitance of the grain passing over the sensor's surface which correlates to a voltage that is then calibrated to a moisture value. Furthermore, the moisture sensor also measures the grain temperature because grain temperature is an important parameter to monitor while drying, but also because the temperature is used to compensate the measured grain moisture; this temperature compensation step is done within the PLC so that the moisture value that is displayed on the touch screen is a temperature compensated moisture which reflects what is measured with third party moisture testers.

Accurate calibration equations are critical for reliable and consistent operation. The Pinnacle software is equipped with four different calibration methods: (1) Single Point, (2) Advanced Linear (3) Advanced Polynomial and (4) Slope & Offset. Regardless of what calibration method is utilized, the end result is that there will be an equation that correlates the moisture sensor's voltage to an uncompensated moisture value. It is referred to as an uncompensated moisture because the moisture measured by the sensor needs to be compensated from a reference temperature to the actual grain temperature. It is important to note that depending on the moisture sensor(s) installed, some methods of calibration may not apply to your model.

Moisture Sensor(s)

The presence of a moisture sensor on the discharge and the infeed of the dryer can be selected. The option to select an infeed moisture sensor requires the presence of a discharge moisture sensor. Once a discharge moisture sensor is selected, you will have the option to specify what type of sensor is installed and whether or not the sensor is mounted in a sampler assembly. Correctly selecting the model of the moisture sensor will ensure that the proper temperature scaling is used and the presence of the moisture sampler assembly will enable the Advanced Linear and Advanced Polynomial calibration methods. The same applies to the infeed sensor as well. In order to determine the correct moisture sensor installed on your machine, see the images below to correctly identify the physical sensor with the model:



FP21C Moisture Sensor

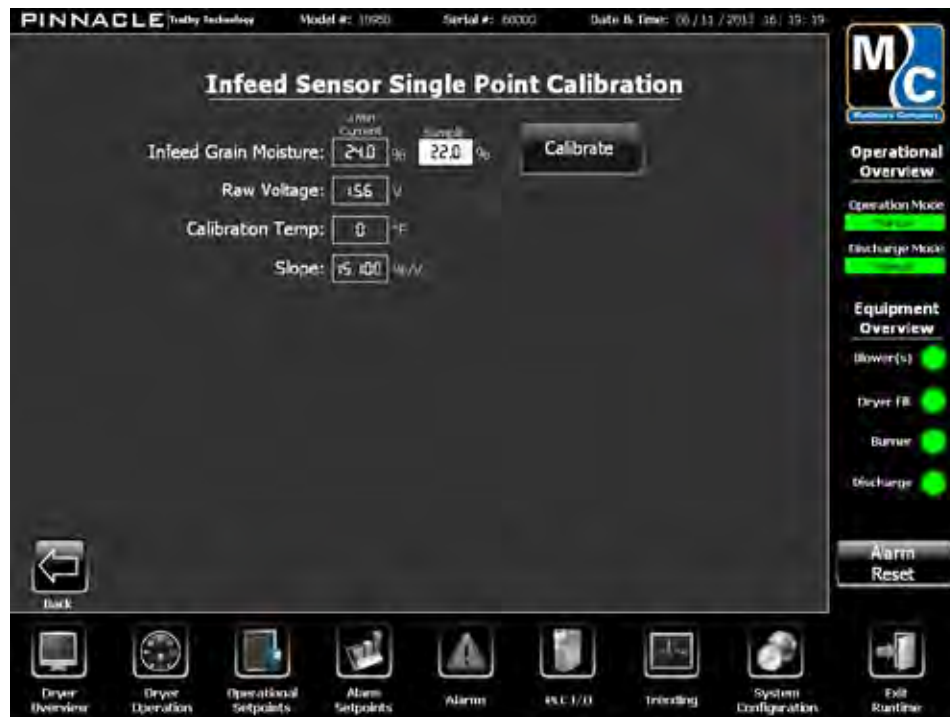


FP32C Moisture Sensor



DM510 Moisture Sensor

Once you are on the sensor calibration screen, you will select what calibration method will be applied to the moisture sensor(s). The Features Enable section where the moisture sensors are enabled also has a toggle to indicate what model moisture sensor is being used (FP21C, FP32C, or DM510) and whether or not the moisture sensor is installed. The Pinnacle software needs to know what sensor is being used because the temperature-voltage relationship is different and each model of moisture sensor has its own calibration methods.



Single Point Calibration (FP21C or FP32C Model)

The Single Point calibration method establishes a simple relationship between sensor voltage and grain moisture. Additionally, when using the single point calibration method, it is assumed that 0.00V corresponds to 0% moisture (uncompensated). For example, if it is known that the grain's moisture is 16.2% and the sensor's voltage is reading 1.15V, the calculated calibration will be 14.09 %/V which is referred to as the "slope". This is a simple linear relationship that calculates the moisture as 14.09 %/V, so if the sensor's voltage changes to 1.05V, the calculated moisture will then change to 14.8% which is calculated as the product of the "slope" and the current voltage or $14.09\%/V \times 1.05V = 14.8\%$.

The benefit of using the Single Point Calibration is that it is easy to quickly setup the moisture sensor, however the limitation is that it will not be accurate over a wide moisture range.

In order to apply a single point calibration to your moisture sensor, make sure the Single Point method is selected and navigate to the Single Point Settings screen. On this screen you will see the current voltage being measured by the moisture sensor as well as the current moisture being calculated from the current single point calibration slope being used. The calibration slope will be shown on the screen as well as the calibration temperature that is in effect. Lastly, the sample moisture value is shown.



To establish and apply a new calibration slope, pull a sample of grain as close as possible to the moisture sensor. This will ensure that the voltage that is read off the touch screen corresponds with the grain that is passing over the sensor. Once that sample is taken, measure the sampled grain's moisture in your third party moisture tester, enter the value in the sample input box and select the Calibrate button. Once the Calibrate button is pressed, the new slope will be calculated as well as the new calibration temperature which is taken as the current grain temperature measured from the sensor.

After the calibrate button is pressed, you will then start to see the current moisture value change because the new calibration slope is now in effect.

Advanced Linear Calibration (FP32C Model Only)

Because of the limitations of the Single Point calibration method, the Pinnacle Lite software also includes an Advanced Linear calibration method which is based on more than one data point. Up to 8 data points can be used to establish an advanced linear calibration equation and the way in which you input the data points into the touch screen allow you to view the calibration data before applying it.

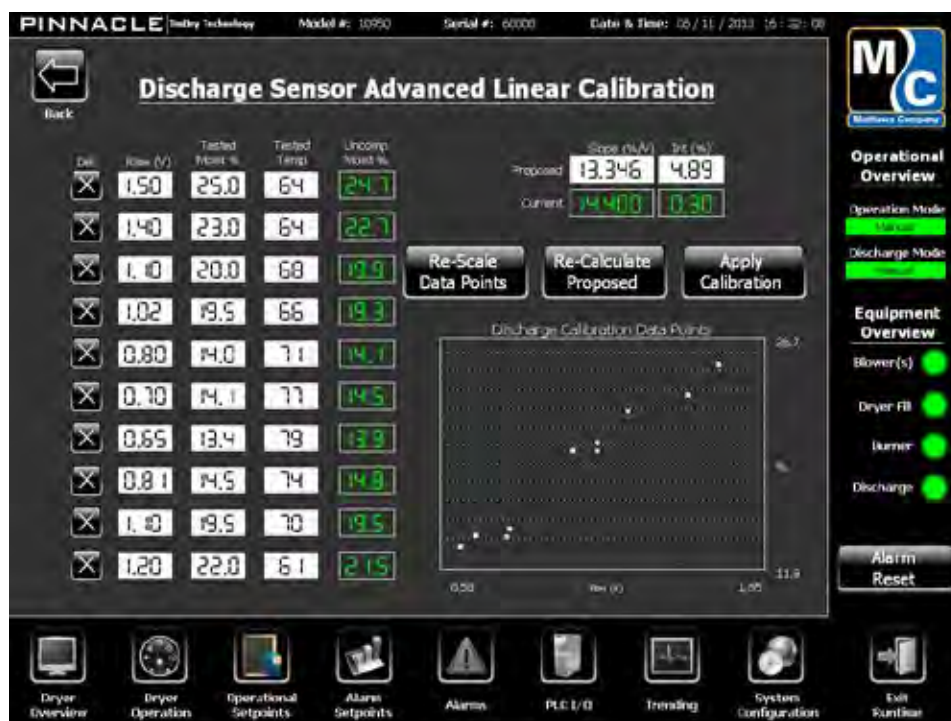
The principal behind the Advanced Linear Calibration method is that a collection of sensor voltages, tested moistures, and tested temperatures are plotted over the desired range of the sensor. The ideal time to collect this data is when the dryer is first being put into operation at the start of a drying session. The more tested samples the better, as long as they are spread out over the desired range - be aware that two data points at 13% and 17% will produce much better results than five data points between 14.5% and 15.5%.



When you are ready to collect a sample, it is important to pull a sample of grain as close as possible to the moisture sensor which will ensure that the voltage that is read off the touch screen corresponds with the grain that is currently passing over the sensor. When you do pull a sample of grain, be sure to record the moisture sensor's voltage from the touch screen (15-sec average on the Analog Input screen). After you have recorded the voltage, measure the grain's moisture and temperature at least 3-5 times taking an average of the values. You will likely see that each time you test the grain moisture, you will get a different value from your third party moisture tester which is normal and expected.

Date/Time	Sensor Voltage	Grain Temp	Grain Moist

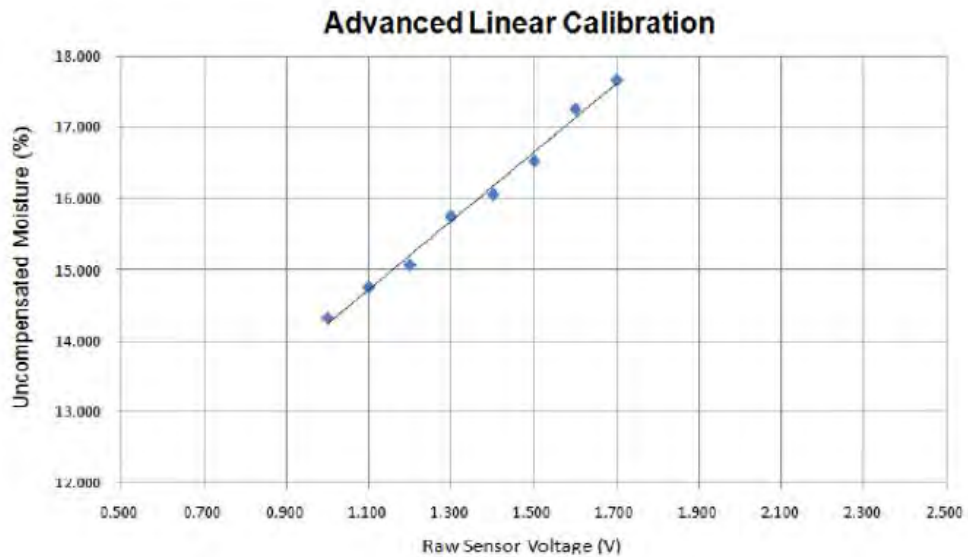
You can also skip logging on a sheet of paper and enter it directly on the touchscreen by enabling the Advanced Linear Calibration method and selecting the Settings button.



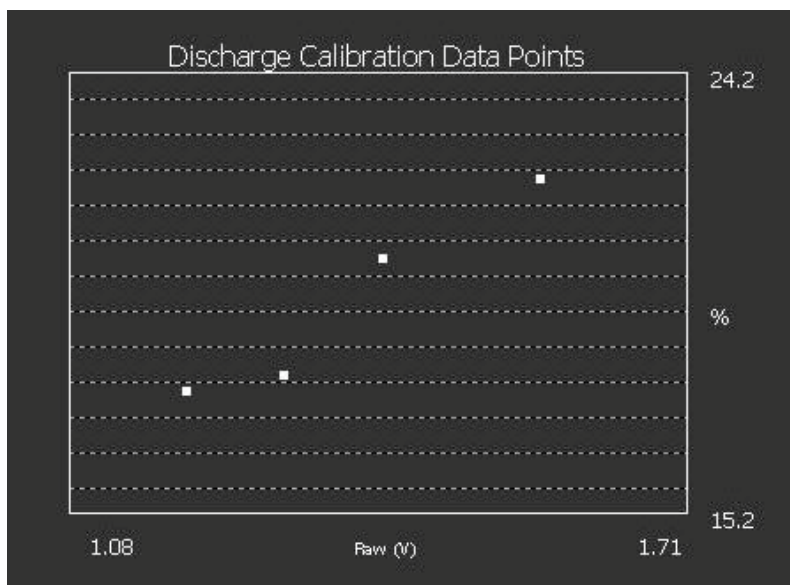
Here you will see a table that allows for entry of the previously mentioned voltage, moisture, and temperature values collected for multiple samples.

Based on the tested temperature, the uncompensated moisture will be calculated as shown in the read-only column. To clear the values of a sample row, simply press the x button to the left of the values. When clearing a row of sample data, it will then be excluded from the calculated calibration equation.

Because you now have the ability to enter multiple data points, the slope of the calibration will be calculated, as previously mentioned in the Single Point Calibration method, as well as an "intercept" value. At any point you can see what slope and intercept values currently being used by looking in the lower right hand corner where they are presented in green on a dark background. After all of your samples are entered in the table, press the re-scale data points button and followed by the re-calculate proposed button and a linear regression will be performed on the samples entered. A linear regression will calculate the slope and intercept of a trend line that passes through the data points previously input. Graphically, this can be represented as follows:



The sample data points are plotted as uncompensated moisture values on the vertical axis with the corresponding raw sensor voltage on the horizontal axis. The trend line shown above is drawn as close as possible through the data points and the corresponding slope and intercept of the line is then taken to be the calibration equation once the calibration is applied. After the slope and intercept are calculated, the values will be shown in the upper right hand corner as proposed values. In order to determine if entered samples produce a reasonable calibration curve, you can select the View Data Points button which will show a scatter plot of the entered samples:



Note that when viewing the plotted data points, the values should always produce a line that slopes from the lower left corner to the upper right hand corner as shown above. Once the values are determined to be acceptable, the proposed calibration can be applied by pressing the Apply Calibration button. Once this is done, the Current Calibration will be copied from the Proposed Calibration values and the moisture will now be calculated from the new calibration.

You are also able to perform the same process in a spreadsheet program of your choice if more than 8 samples are collected. Instead of entering the samples individually and calculating the slope and intercept on the touch screen, you can enter the slope and intercept directly in the white input boxes in the lower left hand corner.

The advantage of the Advanced Linear Calibration method is that it covers a wider range of moisture and, as a result, is more accurate and reliable when compared to the Single Point calibration method. The limitation is that it requires some dedicated time to get the calibration accurate for a particular grain to be dried.

Advanced Polynomial Calibration (FP32C Model Only)

Because of the limitations of the Single Point and Advanced Calibration methods, the Pinnacle Lite system offers a third method that allows for the input of the sensor manufacturer's certified calibration constants. This is the easiest method to apply and is the most accurate. Enabling the Advanced Polynomial Calibration option and selecting the Settings screen will display the advanced polynomial constants which are provided by the sensor manufacturer for a particular type of grain and sensor type.



Similar to third party moisture testers, updated calibration data is occasionally made available for different grain types used with different sensor types. The default values that are loaded are for standard Corn being used with a moisture sampler that is equipped with the FP32C moisture sensor. Updated and/or new calibration constant for use with the Advanced Polynomial Calibration method will periodically be made available for other grains or hybrid varieties of Corn.



In the event that these constants need to be changed or updated, simply touch the value and enter the updated value. This should only be done as directed by your dealer or Mathews Company personnel.

Although this calibration data is provided by the sensor manufacturer, it is possible that there may be a discrepancy between the correlation of sensor voltage and the moisture reading on the sensor. This discrepancy would be due to the type, variety or hybrid of grain that was used to perform the certified calibration by the sensor manufacturer. In the event that there is a consistent discrepancy, for example, consistently 1.3% low or high from what your 3rd party moisture sensor is reading, there is a feature that you can employ to close the gap of this discrepancy. On the calibration screen when the advanced polynomial calibration mode is selected, you will see the up and down arrows which allows you to make minor adjustments to the offset of the sensor. If your display is consistently showing the measured grain moisture to be 1.3% lower than your 3rd party moisture tester, you will want to add a positive offset adjustment, by increasing to +1.3%. After a few minutes, you will see the results of the adjustment and your moisture display should be more consistent with your 3rd part testing equipment.

Slope & Offset Calibration (DM510 Model Only)

The DM510 sensor will require only two main values (1) the moisture point offset and (2) the moisture sensor calibration slope.

The value entered as the offset is the incremental change the sensor will compensate. The default value is 0%. So if the sensor is reading 14.5% but the lab measurement says 16.0%, entering an offset value of 1.5% will have the sensor now read 16%.

If logged in, the user will be able to see the DM sensor slope value as shown below. The sensors moisture value is the product of the slope and voltage reading plus the offset. While this slope value can be changed, it is recommended to first consult with a qualified technician before doing so.



Setpoints (AccuDry)

Selecting the setpoints chapter button will take you to the first of three screens, alarms setpoints, followed by operational setpoints and lastly, sensor calibration.

Alarm Setpoints (AccuDry)

The alarm setpoints screen provides you with the ability to change limits and other values that correspond to alarm values. The alarms that these setpoints correspond to will be explained further in the Troubleshooting section of this manual.



Mid-Grain Band

The Alarm Set Point is the allowed deviation from the mid-grain temperature set point while the discharge system is running.

Mid-Grain Band Delay

The Mid-Grain Band delay is a user-defined time duration that will delay the cool down of the dryer after the Mid-Grain Band warning alarm has occurred.

Grain Flow Timeout

The Grain Flow Timeout set point is the time delay allowed once the grain level has dropped below the bin level switch. Once the grain flow timeout set point has been reached, an alarm will be triggered that will place the dryer into COOL-DOWN mode.

Plenum Temperature Band

The Plenum Temperature band is the maximum allowed deviation between the actual plenum temperature and the plenum temperature set point.



Bushel Count Warning Enable

This button enables an alarm (to be displayed) when the bushel count limit is achieved (see below).

Bushel Count Limit

The total bushels that the dryer is permitted to discharge (up to the dry storage capacity). Once the set point is reached, a warning alarm will be displayed.

DM Cooldown Delay

You have the ability to enable the dryer to cooldown on eight (8) alarms pertaining to grain moistures and temperatures. This delay is the amount of time the dryer will wait until the cooldown sequence is initiated.

Enable DM Cooldown

This is a toggle switch allowing the Dryer Master board to cooldown the dryer when selected alarms have reached this critical alarm setpoints. These alarms can only be displayed and toggled to cooldown the dryer when the Enable DM Cooldown box is checked. Those alarms can be viewed by clicking the next button. These specific alarms will be mentioned in the next chapter, and can be found when hitting the "AccuDry Alarms" button on the Alarm Setpoints screen.

AccuDry Specific Setpoints

These specific alarms can be found when hitting the "Next" button on the Alarm Setpoints screen. These alarms pertain directly to the Dryer Master board alarms. All setpoints are easily modified by the user to increase alarm precision and/or fine tune the grain moisture and temperature to each individual installation and runtime environment.

For each alarm limit there are two states of alarm. The first stage is a warning alarm and the second stage is a critical alarm. The warning alarm alerts the user of a situation they may want to keep an eye on. In many instances the dryer will have made changes attempting to correct the situation. If the dryer cannot correct the situation, a critical alarm will be reached. This will either cooldown the dryer, after the specified delay time, if the "Enabled DM Cooldown" is selected and the individual shutdown "Enable" is checked, or prompt a critical alarm without cooling down if the "Enabled DM Cooldown" is not selected.



Discharge Rate / Plenum Temp Alarm Setpoints

The discharge rate and plenum temperature alarm setpoints are similar to the grain moisture and temperature alarms, however these four (4) alarms will NOT cooldown the dryer. These alarms will simply prompt the user with alert pop-ups.

Operational Setpoints (AccuDry)

Selecting the Next button from the Alarm Setpoints screen will take you to the Operational Setpoints screen which provides you with the ability to change operational values that affect the performance of the machine.



Plenum Temperature

The Plenum Temperature set point is used to control the plenum temperature when the burner is lit. The PLC will control plenum temperature by adjusting the burner control valve to increase or decrease the amount of fuel flowing to the burner.

Control Valve Initial Opening

The Control Valve Initial Opening is the position of the fuel control valve commanded as the burner is undergoing the initial ignition sequence.

Control Valve Min Opening

The Fuel Control Valve Minimum Opening % set point is the lowest possible control valve output allowed by the dryer.

Control Valve Max Opening

The Fuel Control Valve Maximum Opening % set point is the highest possible control valve output allowed by the dryer.

Auto Temp Adjust Jump

The Auto Temp Adjust Jump set point refers to the automatic temperature decrease of the plenum temperature set point when the VFD back off speed set point has been reached.



Auto Temp Adjust Max

The Auto Temp Adjust Max set point refers to the total allowed adjustment to the plenum temperature as a result of multiple auto temp adjustments.

Auto Adjust Timer

The Auto Adjust Timer refers to the time before an automatic temperature adjustment is made to the plenum temperature set point.

VFD Back off Speed

The VFD Back-off Speed refers to the VFD speed at which the automatic plenum temperature set point adjustment feature will become enabled.

Cool-Down Timer

The Cool-Down Timer refers to the length of time that the dryer will be placed in COOL-DOWN mode following a type-B fault or when the dryer is placed in COOL-DOWN mode.

Mid-Grain Temp

The Mid-Grain Temperature set point refers to the target mid-grain temperature that the dryer will attempt to maintain during automatic discharge control.

Fill Start Delay

The Fill Start Delay set point refers to the time between when the grain level has dropped below the Bin Level switch and when the Dryer Fill System is activated.

Fill Stop Delay

The Fill Stop Delay set point refers to the time between when the grain level has risen above the Bin Level switch and when the Dryer Fill System is deactivated.

Takeaway Cleanout Delay

The Takeaway Cleanout Delay setpoint refers to the amount of time that the dryer takeaway system will be commanded to operate after the Dryer Discharge system has stopped.

Sensor Calibration (AccuDry)

Selecting the Next button from the Operational Setpoints screen will take you to the Sensor Calibration screen:

The moisture sensors that are used on the dryer are special devices that measure the capacitance of the grain passing over the sensor which correlates to a voltage that is then calibrated to a moisture value. Furthermore, the moisture sensor also measures the grain temperature because grain temperature is an important parameter to monitor while drying, but also because the temperature is used to compensate the measured grain moisture; this temperature compensation step is done either within the PLC or the sensor so that the moisture value that is displayed on the touch screen is a temperature compensated moisture which reflects what is measured with third party moisture testers.

If AccuDry is enabled, the calibration process for the sensor is automated:

Notice that there will be an option to skip the walk through and simply begin calibration. By clicking the walkthrough you will be prompted with a list of things you will be doing during the calibration process.



DM510 Moisture Sensor



After hitting the "Continue" button you will be taken to the Moisture Calibration main screen. This screen will have calibration routines for both your infeed and discharge sensors. Calibration will begin by selecting "Start" on your desired sensor. The button will now display "Sampling," at which point you will gather a sample of grain for calibration. It is important that you do this right after beginning the calibration process because for the next 30 seconds, the system will be taking an average of grain moistures at that sensor. For best results, comparing like grain to measured grain is desired.



You will now notice a white box will appear for you to enter the "Lab Measured Moisture". This is the reading that you have measured on your moisture tester. Enter the moisture that your tester has given you. Now press confirm calibration, and your sensor will be calibrated accordingly.



It is important to note that the calibration will only make a 0.5% adjustment for each individual calibration performed. This is done to protect the system from a user entering an extremely large or small number and drastically changing the sensor.

System Configuration (TruDry)

Selecting the System Configuration chapter button will take you to the System Configuration screen which provides the ability to change various system parameters. Most of the system configuration will be performed at the factory and will not need to be changed by the operator.

General Configuration (TruDry)



The system configuration parameters are presented below with a brief description of their purpose:

Customer

The Customer name input is used for system identification and personalization throughout the program interface.

Model Number

The Model Number refers to the Mathews Company dryer model. This is a factory configured setting that will enable or disable features that are unique to a given dryer model.

Dryer Serial Number

The Dryer Serial Number is logged at the factory for system identification purposes.

Number of Blowers

The Number of Blowers is based on the dryer type and does not require an input. Based on the dryer model number that is selected, the corresponding number of blowers will be selected.



Discharge Capacity

The Discharge Capacity parameter is what the system uses to determine how many bu/hr the system is discharging. This also determines the total amount of grain dried. The only time this parameter should be changed is when adjustments need to be made based on measured operational data. If it is determined that the displayed bu/hr meter shown on the Dryer Overview screen, the Analog Inputs & Outputs screen or the Screen Saver screen is inaccurate, the following procedure should be followed to calibrate the discharge capacity:

1. Run the discharge constant for a set duration of time (minimum 30 min) and record the Metering Speed (RPM) from the Discharge Speed Analog Output.
2. Multiply the recorded Metering Speed (RPM) by the number of minutes the test was conducted. This will be the number of revolutions that the metering system turned over the course of the test.
3. Determine how much grain was discharged from the dryer by either unloading the grain to a truck which can be weighed or (b) determining how much of a particular bin was filled during the time duration of the test. If bin volume is used, the total number of bushels or cubic meters will then be obtained. If grain weight is used, convert to volume based on the test weight of the grain.
4. Once the total volume of grain has been determined, divide that value by the number of revolutions calculated in step number 2 above. This value will now have units of bu/rev or m³/rev depending on what units are being used.
5. Update the Discharge Capacity parameter on the Factory Settings screen and select the Save Settings button.

Grain Type

The Grain Type that is being dried can be selected from a drop down list of options so that you may keep track of what grain is currently being processed. The DM Board uses this value to determine the appropriate preset parameters to be used when drying different grains.

Screen Saver

The screen saver setting determines how long the touchscreen will wait before going into screen saver mode.

Date

The displayed Date is a system parameter that can be changed by the user.

Time

The displayed Time is a system parameter that can be changed by the user.

HMI Version

The HMI Version refers to the software version of the HMI (Human Machine Interface) currently installed on the system.

PLC Version

The PLC Version refers to the software version of the PLC (Programmable Logic Controller) currently installed on the system.



Brightness

Use the Brightness adjustment to increase or decrease the HMI screen brightness.

Fill Switch Bypass

The Fill Switch Bypass toggle is used to bypass the In-feed Bin switch. Bypassing the bin switch will remove safeties associated with lighting the burner and should only be used for testing or diagnostic purposes. Use this toggle with caution.

History

The history button opens another screens that will display the following;

Total Grain Dried

The total grain dried value is a bushel counter that refers to the total number of bushels that the dryer has processed.

Grain Dried

The grain dried value is a bushel counter that refers to the number of bushels that the dryer has processed since the Reset Grain Dried button has been pushed.

Grain Dried Reset

The Grain Dried Reset will reset the Grain Dried bushel counter back to zero.

Lifetime Hours

The Lifetime Hours is an hour counter that refers to the total number of hours that the dryer has been in operation.

Resettable Hours

The Resettable Hours is an hour counter that refers to the number of hours that the dryer has been in operation over a defined length of time.

Reset Hours

The Reset Hours button will reset the resettable hours counter back to zero.



Bypass Air Pressure

The Bypass Air Pressure toggle enables or disables the Air Pressure switch. Bypassing the Air Pressure switch will remove safeties associated with lighting the burner and should only be used for testing or diagnostic purposes. Use this toggle with caution.

Soft Start

If the dryer is equipped with a Soft Start, this toggle will be enabled by the factory.

CGA Gas Train

If the dryer is equipped with a CGA-Approved Gas Train, this toggle will be enabled by the factory. A CGA approved gas train will include high and low gas pressure switches.

Enable Gas Valve Limits

The Fuel Control Valve Opening % set point is limited by the minimum and maximum valve opening % allowed by the dryer.

Advanced Configuration (TruDry)

In the upper left hand corner there is a login button to provide dealer and factory level access to advanced system configuration parameters. Upon logging in, the background color will change to an orange color indicating that you have logged into the system:



Additionally, a Next arrow will now appear in the lower right hand corner and upon selecting the Next button, you will be taken to the advanced system configuration screen:



The advanced system configuration parameters are presented below with a brief description of their purpose. The first section of the advanced system configuration screen is the features enable section which is used to select what options the dryer is equipped with. These settings will be done during system software configuration and testing at the Mathews Company facility, however your dealer or Mathews Company service personnel may make adjustments based on addition of upgrades or retrofits.

Sensor Selection

The upper portion of this screen is dedicated to enabling/selecting the sensors installed on the machine. The user may select the location of the sensor, as well as the technology version of that sensor. It is important to note that when "AccuDry" is selected, the system will automatically select the DM510 sensors. This is because only these sensors alone can be used with this technology.

Bypass Prox Switch

The Bypass Prox Switch enable will allow the discharge to run un-monitored without checking for the presence of a rotating discharge metering shaft. This feature is only used as directed by M-C service personnel or for demonstration purposes on tabletop Pinnacle Lite demonstration units.

Enable Alarm Beacon

The alarm beacon is used to annunciate alarms with either a flashing red or green lamp on the outside of the high voltage cabinet. This feature is only selected if the machine is equipped with this hardware. Once this procedure has been followed, the discharge capacity has now been calibrated.



TruDry PID Setpoints

The purpose of the Mid-Grain Temp PID Values is to set the Proportional, Integral, and Derivative parameters of the TruDry PID control loop. Please note that changes to these parameters will drastically impact the operation of the dryer when running in TruDry mode and any settings change should only be done when instructed by Mathews Company service personnel.

On the left side, values for the Proportional, Integral, and Derivative parameters can be adjusted. On the right side you will see the mid-grain temperature setpoint and the actual mid-grain temperature. The default values for the Proportional, Integral, and Derivative parameters are recommended to be used. If fine-tune adjustments need to be made, the following explains the impact of each parameter:

Proportional - The Proportional parameter determines the gain of the control loop based on the difference between the setpoint and the actual value. Adjustment of this parameter will increase or decrease the gain when a difference between the setpoint and actual value is established.

Integral - The Integral parameter determines the responsiveness of the control loop from a time standpoint. Adjustment of this parameter will cause the control loop to become more or less responsive.

Derivative - The Integral parameter determines the amount of dampening that the control loop will exhibit. Adjustment of this parameter will increase or decrease the amount of overshoot that is observed by the control loop.

Plenum Temp PID Setpoints

The purpose of the Plenum Temp PID Values is to set the Proportional, Integral, and Derivative parameters of the Plenum Temperature PID control loop. Please note that changes to these parameters will drastically impact the operation of the dryer when controlling the plenum temperature and any settings change should only be done when instructed by Mathews Company service personnel.

On the left side, values for the Proportional, Integral, and Derivative parameters can be adjusted. On the right side you will see the mid-grain temperature setpoint and the actual mid-grain temperature. The default values for the Proportional, Integral, and Derivative parameters are recommended to be used. If fine-tune adjustments need to be made, the following explains the impact of each parameter:

Proportional - The Proportional parameter determines the gain of the control loop based on the difference between the setpoint and the actual value. Adjustment of this parameter will increase or decrease the gain when a difference between the setpoint and actual value is established.

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Derivative - The Integral parameter determines the amount of dampening that the control loop will exhibit. Adjustment of this parameter will increase or decrease the amount of overshoot that is observed by the control loop.



Discharge Speed Settings

On the Advanced System Configuration screen you may click the "Discharge VFD Settings" button. This button will bring you to a screen where the user may manually modify the maximum and minimum discharge rate limits. These values include;

Minimum VFD Speed

The Minimum VFD Speed setting will correlate with what has been programmed on the discharge metering VFD. This value allows for the calculation of the VFD Frequency displayed on the Discharge Speed Analog Output screen.

Maximum VFD Speed

The Maximum VFD Speed setting will correlate with what has been programmed on the discharge metering VFD. This value allows for the calculation of the VFD Frequency displayed on the Discharge Speed Analog Output screen.

Maximum Discharge Motor Speed

The Maximum Discharge Motor Speed setting will correlate with what has been programmed on the discharge metering VFD. This value allows for the calculation of the Motor Speed displayed on the Discharge Speed Analog Output screen.



System Configuration (AccuDry)

Selecting the System Configuration chapter button will take you to the System Configuration screen which provides the ability to change various system parameters. Most of the system configuration will be performed at the factory and will not need to be changed by the operator.

General Configuration (AccuDry)



The system configuration parameters are presented below with a brief description of their purpose:

Customer

The Customer name input is used for system identification and personalization throughout the program interface.

Model Number

The Model Number refers to the Mathews Company dryer model. This is a factory configured setting that will enable or disable features that are unique to a given dryer model.

Dryer Serial Number

The Dryer Serial Number is logged at the factory for system identification purposes.

Number of Blowers

The Number of Blowers is based on the dryer type and does not require an input. Based on the dryer model number that is selected, the corresponding number of blowers will be selected.



Discharge Capacity

The Discharge Capacity parameter is what the system uses to determine how many bu/hr the system is discharging. This also determines the total amount of grain dried. The only time this parameter should be changed is when adjustments need to be made based on measured operational data. If it is determined that the displayed bu/hr meter shown on the Dryer Overview screen, the Analog Inputs & Outputs screen or the Screen Saver screen is inaccurate, the following procedure should be followed to calibrate the discharge capacity:

1. Run the discharge constant for a set duration of time (minimum 30 min) and record the Metering Speed (RPM) from the Discharge Speed Analog Output.
2. Multiply the recorded Metering Speed (RPM) by the number of minutes the test was conducted. This will be the number of revolutions that the metering system turned over the course of the test.
3. Determine how much grain was discharged from the dryer by either unloading the grain to a truck which can be weighed or (b) determining how much of a particular bin was filled during the time duration of the test. If bin volume is used, the total number of bushels or cubic meters will then be obtained. If grain weight is used, convert to volume based on the test weight of the grain.
4. Once the total volume of grain has been determined, divide that value by the number of revolutions calculated in step number 2 above. This value will now have units of bu/rev or m³/rev depending on what units are being used.
5. Update the Discharge Capacity parameter on the Factory Settings screen and select the Save Settings button.

Grain Type

The Grain Type that is being dried can be selected from a drop down list of options so that you may keep track of what grain is currently being processed. The DM Board uses this value to determine the appropriate preset parameters to be used when drying different grains.

History Button

The history button allows the user to access all recorded dryer operations history. These values include;

Total Grain Dried

The total grain dried value is a bushel counter that refers to the total number of bushels that the dryer has processed.



Grain Dried

The grain dried value is a bushel counter that refers to the number of bushels that the dryer has processed since the Reset Grain Dried button has been pushed.

Grain Dried Reset

The Grain Dried Reset will reset the Grain Dried bushel counter back to zero.

Lifetime Hours

The Lifetime Hours is an hour counter that refers to the total number of hours that the dryer has been in operation.

Resettable Hours

The Resettable Hours is an hour counter that refers to the number of hours that the dryer has been in operation over a defined length of time.

Reset Hours

The Reset Hours button will reset the resettable hours counter back to zero.

Screen Saver

The screen saver setting determines how long the touchscreen will wait before going into screen saver mode.

Date

The displayed Date is a system parameter that can be changed by the user.

Time

The displayed Time is a system parameter that can be changed by the user.

HMI Version

The HMI Version refers to the software version of the HMI (Human Machine Interface) currently installed on the system.

PLC Version

The PLC Version refers to the software version of the PLC (Programmable Logic Controller) currently installed on the system.

Brightness

Use the Brightness adjustment to increase or decrease the HMI screen brightness.

Fill Switch Bypass

The Fill Switch Bypass toggle is used to bypass the In-feed Bin switch. Bypassing the bin switch will remove safeties associated with lighting the burner and should only be used for testing or diagnostic purposes. Use this toggle with caution.

Bypass Air Pressure

The Bypass Air Pressure toggle enables or disables the Air Pressure switch. Bypassing the Air Pressure switch will remove safeties associated with lighting the burner and should only be used for testing or diagnostic purposes. Use this toggle with caution.

Soft Start

If the dryer is equipped with a Soft Start, this toggle will be enabled by the factory.

CGA Gas Train

If the dryer is equipped with a CGA-Approved Gas Train, this toggle will be enabled by the factory. A CGA approved gas train will include high and low gas pressure switches.

Enable Gas Valve Limits

The Fuel Control Valve Opening % set point is limited by the minimum and maximum valve opening % allowed by the dryer.

Advanced Configuration (AccuDry)

In the upper left hand corner there is a login button to provide dealer and factory level access to advanced system configuration parameters. Upon logging in, the background color will change to an orange color indicating that you have logged into the system:



Additionally, a Next arrow will now appear in the lower right hand corner and upon selecting the Next button, you will be taken to the advanced system configuration screen:





The advanced system configuration parameters are presented below with a brief description of their purpose. The first section of the advanced system configuration screen is the features enable section which is used to select what options the dryer is equipped with. These settings will be done during system software configuration and testing at the Mathews Company facility, however your dealer or Mathews Company service personnel may make adjustments based on addition of upgrades or retrofits.

Sensor Selection

The upper portion of this screen is dedicated to enabling/selecting the sensors installed on the machine. The user may select the location of the sensor, as well as the technology version of that sensor. It is important to note that when "AccuDry" is selected, the system will automatically select the DM510 sensors. This is because only these sensors alone can be used with this technology.

Bypass Prox Switch

The Bypass Prox Switch enable will allow the discharge to run un-monitored without checking for the presence of a rotating discharge metering shaft. This feature is only used as directed by M-C service personnel or for demonstration purposes on tabletop Pinnacle Lite demonstration units.

Enable Alarm Beacon

The alarm beacon is used to annunciate alarms with either a flashing red or green lamp on the outside of the high voltage cabinet. This feature is only selected if the machine is equipped with this hardware. Once this procedure has been followed, the discharge capacity has now been calibrated.

TruDry PID Setpoints (Will Only Affect TruDry If Re-Enabled)

The purpose of the Mid-Grain Temp PID Values is to set the Proportional, Integral, and Derivative parameters of the TruDry PID control loop. Please note that changes to these parameters will drastically impact the operation of the dryer when running in TruDry mode and any settings change should only be done when instructed by Mathews Company service personnel.

On the left side, values for the Proportional, Integral, and Derivative parameters can be adjusted. On the right side you will see the mid-grain temperature setpoint and the actual mid-grain temperature. The default values for the Proportional, Integral, and Derivative parameters are recommended to be used. If fine-tune adjustments need to be made, the following explains the impact of each parameter:

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Integral - The Integral parameter determines the responsiveness of the control loop from a time standpoint. Adjustment of this parameter will cause the control loop to become more or less responsive.

Derivative - The Integral parameter determines the amount of dampening that the control loop will exhibit. Adjustment of this parameter will increase or decrease the amount of overshoot that is observed by the control loop.

Plenum Temp PID Setpoints (Will Only Affect TruDry If Re-Enabled)

The purpose of the Plenum Temp PID Values is to set the Proportional, Integral, and Derivative parameters of the Plenum Temperature PID control loop. Please note that changes to these parameters will drastically impact the operation of the dryer when controlling the plenum temperature and any settings change should only be done when instructed by Mathews Company service personnel.

On the left side, values for the Proportional, Integral, and Derivative parameters can be adjusted. On the right side you will see the mid-grain temperature setpoint and the actual mid-grain temperature. The default values for the Proportional, Integral, and Derivative parameters are recommended to be used. If fine-tune adjustments need to be made, the following explains the impact of each parameter:

Proportional - The Proportional parameter determines the gain of the control loop based on the difference between the setpoint and the actual value. Adjustment of this parameter will increase or decrease the gain when a difference between the setpoint and actual value is established.

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Discharge Speed Settings

On the Advanced System Configuration screen you may click the "Discharge VFD Settings" button. This button will bring you to a screen where the user may manually modify the maximum and minimum discharge rate limits. These values include;

Minimum VFD Speed

The Minimum VFD Speed setting will correlate with what has been programmed on the discharge metering VFD. This value allows for the calculation of the VFD Frequency displayed on the Discharge Speed Analog Output screen.

Maximum VFD Speed

The Maximum VFD Speed setting will correlate with what has been programmed on the discharge metering VFD. This value allows for the calculation of the VFD Frequency displayed on the Discharge Speed Analog Output screen.

Maximum Discharge Motor Speed

The Maximum Discharge Motor Speed setting will correlate with what has been programmed on the discharge metering VFD. This value allows for the calculation of the Motor Speed displayed on the Discharge Speed Analog Output screen.



AccuDry Settings

Upon clicking the AccuDry Settings button, you will initially be taken to the AccuDry Factory Settings page. This page displays the critical values for the AccuDry system to operate effectively. These values are; Garner Volume, Hot Zone Volume, Cold Zone Volume, Throughput rate, Dryer Off Rate, and Plenum Temp Off. Although these can be input manually, these values will be automatically generated by selecting a dryer model on the general "System Configuration" screen.

These values are dryer specific, and the AccuDry system uses these values to best determine the rate at which the dryer should be operating. These values also play a crucial role in how the AccuDry predicted moisture value is calculated. Although these valves can be input manually they can be automatically generated by selecting a dryer model on the general "System Configuration" screen.

This screen also provides all data being sent from the Dryer Master board to the PLC, in regards to the readiness of the AccuDry system. All values here can also be seen on the Not Ready Pop-Up screen when attempting to enter AccuDry mode if the system is Not Ready. Additionally, the DM Heart Beat indicator shows a green flashing dot, which indicates whether or not the DM board is both powered ON and communicating with the PLC.

The screenshot displays the AccuDry Settings interface. At the top, it shows the Pinnacle logo, Model # (102375), Serial # (60777), and Date & Time (03/14/2024 19:24:54). The main title is "AccuDry Settings" with a "Logout" button. The interface is divided into several sections:

- System Information:** DM Version (M02.1), DM Serial (12.6), Heart Beat (OFF), Heart Beat Error (0).
- Operational Status:** AccuDry State (Running), AccuDry Ready (Model Prediction).
- Moisture and Rate Data:** Predicted Moist (28.28%), Suggested Rate (8.1%), Actual Rate (8.0%).
- Volume and Throughput:** Garner Vol (11 bushels), Hot Zone Vol (853 bushels), Cold Zone Vol (296 bushels), Thrupt Rate 100%(1hr) (14.5%), Dryer Off Rate (1.0%), Plenum Temp Off (125 °F).
- Control Parameters:** Infeed (4.80), Discharge (1.00), Offset (4.80), Slope (4.50 %/N), Beta 2 Value (1.533), Beta 2 Exp (4), Moist Target Diff (2.00%), Rate Target Diff (2.00%).
- Buttons:** "Update" buttons are present for Infeed, Discharge, Slope, Beta 2 Value, and Rate Target Diff.
- Operational Overview (Right Panel):** Shows Operation Mode (Running), Discharge Mode (Running), and Equipment Overview (Blower(s), Dryer Fill, Burner, Discharge) all with green status indicators. Includes an "Alarm Reset" button.
- Navigation (Bottom Panel):** Includes a "Lock" button and icons for Dryer Overview, Dryer Operation, Operational Setpoints, Alarm Setpoints, Alarms, PLC I/O, Trending, System Configuration, and Exit Runtime.

The target difference values are also listed here, and can be modified only by Mathews Company Engineers. These values determine the ranges in which the DM510 Board will allow the AccuDry Ready state to be met.



This screen is where Mathews Company employees, and trained service technicians may manually adjust the DM sensors. This is done to alleviate the need to calibrate multiple times upon initial setup, due to the 0.5% restriction placed on normal calibration routines. The installer may simply enter the desired offset with a single touch of the button, and see the saved values in the white display fields.



This screen also displays the Analog Scale, which refers to the scaling of sensor inputs on the PLC. This can be used for installing older sensors to a Dryer Master system in certain extreme cases. Also, the installer may define the Dryer Off Rate on this screen.

This is the minimum rate at which the dryer will operate, and it is recommended to remain at 1.0%. This parameter is used to signal the DM510 that the dryer is not discharging and should not be taking any more data. If this is different than the Operational Setpoint Minimum Discharge Rate, then there is a risk that the system will be calculating dryer operations while shutdown; hurting the overall re-startup time for the next drying run.

If you wish to modify this parameter of the system it is strongly urged that you contact a Mathews Company Engineer or Mathews Company Service Technician before doing so.

Lastly, there is a field for entering the Plenum Temp Off temperature. This value is used by the DM 510 board in determining whether or not the burners are lit.

This screen also displays Beta2 values used on the algorithm inside the DM Board.

The Beta2 Value is a feedback from the sensors comparing the predicted moistures versus the actual measured values. This feedback determines how the dryer will control the discharge speed, and should not be modified.

If desired, an installer may use this field to gain access to AccuDry Mode within a series of minutes, regardless of the Dryer State. By consulting with a Mathews Company Engineer it is possible to modify the feedback such that the dryer will "Learn" at a much faster rate, and enter AccuDry much quicker than the initial start-up time of 2-3 hours.

The suggested and actual discharge rates are displayed here for real-time feedback on how the Beta2 change is affecting the system.





Troubleshooting

Alarms are presented to the user in three ways: (1) As pop ups when the alarm condition occurs, (2) A recorded event in the Alarms chapter, or (3) By means of the red and green stack light mounted to the High Voltage cabinet (if equipped).

Alarm Pop-Ups and History

When an alarm condition occurs, a popup will appear on the screen detailing the reason for the alarm and what type of alarm it is. Press the "Accept" button to acknowledge the alarm and return to the previous screen.



To navigate to the alarm history, press the Faults icon on the bottom navigation bar. The alarm history shows a brief description of the alarm as well as the date it was recorded:



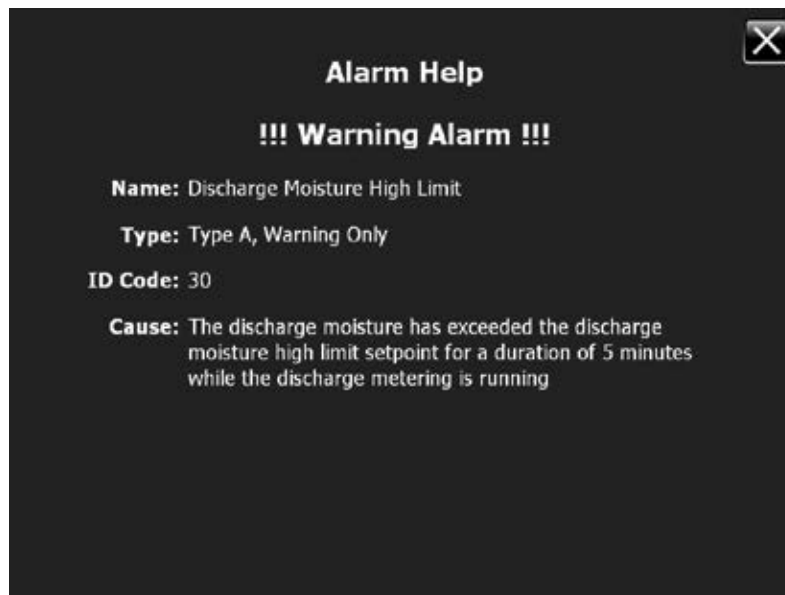
Stack Light Status (If Equipped)



Alarm Color Indication	Description
Solid Green Light	Control Power On Not Discharging
Pulsing Green Light	Dryer Is Discharging
Pulsing Green & Red Light	Dryer Is Discharging With Active Warning Alarms
Flashing Red Light	Dryer Has Shutdown



The alarms are in reverse chronological order so that the most recent alarms will always appear at the top. Alarms that have been acknowledged are shown in yellow. Alarms that have been resolved appear in green. Scroll to the right using the scroll bar or arrows to show the date/time of the alarm and the date/time that it was accepted from the initial pop up. Selecting a row from the alarm history list will pull up screen that explains the type of alarm, the ID code of the alarm and the cause of the alarm:



Alarm List

The following table summaries all of the possible alarms that can be generated by the Pinnacle Lite Control System:

Alarm Number	Alarm Name	Alarm Cause
1	Master Control Relay (MCR) De-Energized	The Master Control Relay has become de-energized due to lost power or a tripped safety circuit.
2	Linear Limit Fire Alarm	Linear Limits Circuit is Open - One of the LLC switches has opened due to high temperature.
3	High Gas Pressure	High gas pressure detected in the gas train.
6	Blower(s) Overload	Overload detected for blowers - Check motor circuit protector or soft starter if equipped.
7	Blower #1 Motor Starter	Blower #1 motor starter has experienced a fault condition.
8	Blower #1 Air Pressure	Blower #1 is not providing adequate air pressure for burner operation.
9	Blower #1 Air Pressure Switch	Blower #1 air pressure switch is indicating air pressure when the blower is not operating.
11	Blower(s) Tr-Start	One of the two contactors A or B has experienced a fault condition.
12	Blower #2 Motor Starter	Blower #2 motor starter has experienced a fault condition.
13	Blower #3 Motor Starter	Blower #3 motor starter has experienced a fault condition.



Alarm Number	Alarm Name	Alarm Cause
14	Blower #2 Air Pressure	Blower #2 is not providing adequate air pressure for burner operation.
16	Grain Fill Timeout	Infed grain fill is insufficient to maintain grain level.
18	Burner Ignition Failure	Burner failed to ignite after 3 trials.
19	Burner High Limit	Plenum temperature has reached high limit setpoint.
20	High Plenum Temperature	The plenum temperature has risen outside of the plenum temperature band.
21	False Flame	The flame sensing system has detected the presence of a flame with the burner off.
22	Low Plenum Temperature	Plenum temperature has dropped below the low limit setpoint.
23	Plenum Temperature RTD Failure	The plenum RTD input module on the PLC has detected a fault.
24	Low Gas Pressure	Low gas pressure detected in the gas train.
25	Discharge VFD	The discharge VFD has detected a fault due to a possible overload of the metering system.
26	Discharge Level	The discharge level switch is open due to a possible overload of grain or a blocked discharge takeaway system.



Alarm Number	Alarm Name	Alarm Cause
28	Discharge Jam or Proximity Switch Failure	The discharge metering system has stopped running. The proximity sensor is not detecting rotation of the metering system.
29	Discharge Moisture Low Limit	The discharge moisture has dropped below the discharge moisture low limit setpoint for a duration of 5-minutes while the discharge metering is running.
30	Discharge Moisture High Limit	The discharge moisture has exceeded the discharge moisture high limit setpoint for a duration of 5-minutes while the discharge metering is running.
31	Blower #3 Air Pressure	Blower #3 is not providing adequate pressure for burner operation.
33	Blower #2 Air Pressure Switch	Blower #2 air pressure switch is indicating air pressure when the blower is not operating.
34	Blower #3 Air Pressure Switch	Blower #3 air pressure switch is indicating air pressure when the blower is not operating.
35	Mid-Grain Band	The mid-grain temperature has exceeded or dropped below the mid-grain band alarm setpoint for a 30-second duration.
36	Mid-Grain Band Delay	The mid-grain temperature has exceeded or dropped below the mid-grain band alarm setpoint for the duration of the mid-grain band delay.
37	Mid-Grain Temperature Probe #1	The #1 mid-grain temperature probe has failed or become disconnected from the transmitter.
38	Mid-Grain Temperature Probe #2	The #2 mid-grain temperature probe has failed or become disconnected from the transmitter.
39	Mid-Grain Temperature Probe #3	The #3 mid-grain temperature probe has failed or become disconnected from the transmitter.

Alarm Number	Alarm Name	Alarm Cause
40	Mid-Grain Temperature Probe #4	The #4 mid-grain temperature probe has failed or become disconnected from the transmitter.
41	Mid-Grain Temperature Probe Transmitter #1	The #1 mid-grain temperature probe transmitter in the junction box has failed of become disconnected.
42	Mid-Grain Temperature Probe Transmitter #2	The #2 mid-grain temperature probe transmitter in the junction box has failed of become disconnected.
43	Mid-Grain Temperature Probe Transmitter #3	The #3 mid-grain temperature probe transmitter in the junction box has failed of become disconnected.
44	Mid-Grain Temperature Probe Transmitter #4	The #4 mid-grain temperature probe transmitter in the junction box has failed of become disconnected.
71	Discharge Grain Temperature Low Limit Alarm	The discharge grain temperature has dropped below the sensor temperature low limit setpoint.
72	Discharge Grain Temperature High Limit Alarm	The discharge grain temperature has exceeded the sensor temperature high limit setpoint.
73	Infeed Grain Temperature Low Limit Alarm	The infeed grain temperature has dropped below the sensor temperature low limit setpoint.
74	Infeed Grain Temperature High Limit Alarm	The infeed grain temperature has exceeded the sensor temperature high limit setpoint.
75	Infeed Moisture Sensor Signal Missing	The infeed sensor signal has dropped below the acceptable range of 0.5VDC. Check sensor wiring to PLC and 24VDC power to sensor.
76	Infeed Moisture Sensor Too High	The infeed sensor signal has exceeded the acceptable range of 9.5VDC. Check the sensor wiring to PLC and verify the integrity of the sensor wiring box and fin cleanliness.



Alarm Number	Alarm Name	Alarm Cause
77	Discharge Moisture Sensor Signal Missing	The discharge sensor signal has dropped below the acceptable range of 0.5VDC. Check sensor wiring to PLC and 24VDC power to sensor.
78	Discharge Moisture Sensor Too High	The discharge sensor signal has exceeded the acceptable range of 9.5VDC. Check the sensor wiring to PLC and verify the integrity of the sensor wiring box and fin cleanliness.
111	High Discharge Moisture	The AccuDry moisture control system has experienced high discharge moisture.
112	Critical High Discharge Moisture	The AccuDry moisture control system has experienced critical high discharge moisture.
113	High Discharge Temperature	The AccuDry moisture control system has experienced high discharge temperature.
114	Critical High Discharge Temperature	The AccuDry moisture control system has experienced critical high discharge temperature.
115	Low Discharge Moisture	The AccuDry moisture control system has experienced low discharge moisture.
116	Critical Low Discharge Moisture	The AccuDry moisture control system has experienced critical low discharge moisture.
117	Low Discharge Temperature	The AccuDry moisture control system has experienced low discharge temperature.
118	Critical Low Discharge Temperature	The AccuDry moisture control system has experienced critical low discharge temperature.
121	High Infeed Moisture	The AccuDry moisture control system has experienced high infeed moisture.

Alarm Number	Alarm Name	Alarm Cause
122	Critical High Infeed Moisture	The AccuDry moisture control system has experienced critical high infeed moisture.
123	High Infeed Temperature	The AccuDry moisture control system has experienced high infeed temperature.
124	Critical High Infeed Temperature	The AccuDry moisture control system has experienced critical high infeed temperature.
125	Low Infeed Moisture	The AccuDry moisture control system has experienced low infeed moisture.
126	Critical Low Infeed Moisture	The AccuDry moisture control system has experienced critical low infeed moisture.
127	Low Infeed Temperature	The AccuDry moisture control system has experienced low infeed temperature.
128	Critical Low Infeed Temperature	The AccuDry moisture control system has experienced critical low infeed temperature.
131	High Plenum Temperature	The AccuDry moisture control system has experienced high plenum temperature.
132	Critical High Plenum Temperature	The AccuDry moisture control system has experienced critical high plenum temperature.
133	Low Plenum Temperature	The AccuDry moisture control system has experienced low plenum temperature.
134	Critical Low Plenum Temperature	The AccuDry moisture control system has experienced critical low plenum temperature.



Alarm Number	Alarm Name	Alarm Cause
135	AccuDry Suspended	The AccuDry moisture control system has determined that the dryer is off.
141	High Discharge Speed	The AccuDry moisture control system has experienced high discharge speed.
142	Critical High Discharge Speed	The AccuDry moisture control system has experienced critical high discharge speed.
143	Low Discharge Speed	The AccuDry moisture control system has experienced low discharge speed.
144	Critical Low Discharge Speed	The AccuDry moisture control system has experienced critical low discharge speed.



GRAIN DRYER
SPECIALISTS



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