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RECOGNIZED COMPONENT
ETL LISTED C US
Intertek
3080852

INTRODUCTION

The Artisan Controls Model 5400 controller provides a modern graphical user interface via it's 3.5" diagonal color display and includes two inputs for temperature probes, two switch inputs, two relay contact outputs, and two DC outputs for driving solid state relays, thereby providing an excellent platform for heating, cooking, or equipment control for virtually any application.

The 5400 controller also provides a USB port which allows the exporting and importing of the controller configuration and recipes using USB flash drives. This allows the manufacturer to quickly replicate standard configurations for various products and end customers.

Refer to the end of this manual for more detailed dimensional information including installation and wiring

1.50 Max

Component Area

4.13

3.5

Color LCD Display w/ touchscreen

4.50

Plastic Front Panel

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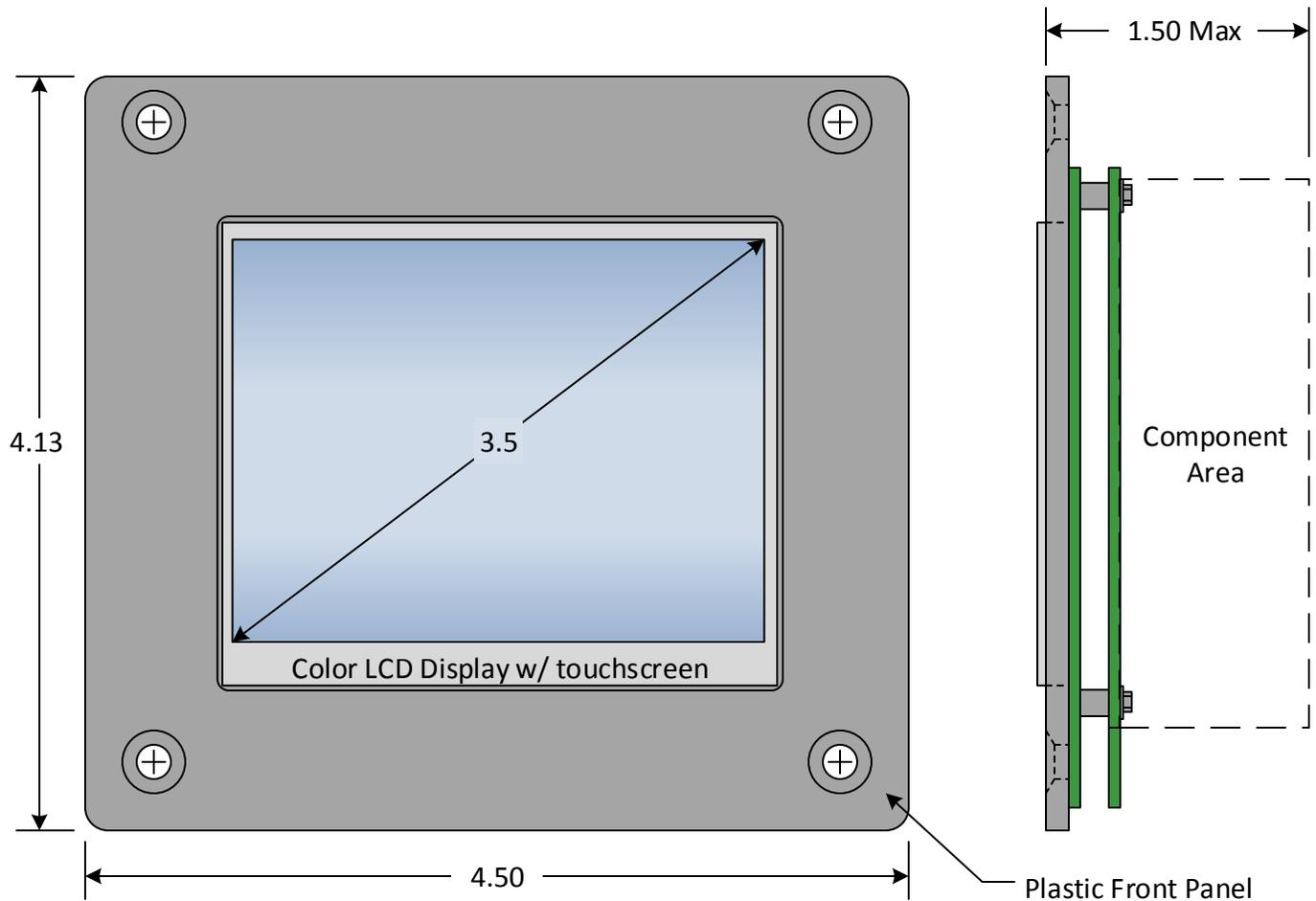
CONFIGURATION ACCESS

Access to the controller configuration has three security levels: Supervisor, Technician, and Factory. The Supervisor level has access to the recipe editing, changing the access code, recipe importing and exporting, and the controller history.

To gain access to the configuration, press and hold the area shown below in the main menu list until the controller emits a double chirp. The initial press will not cause an initial chirp to prevent accidental access to these features.
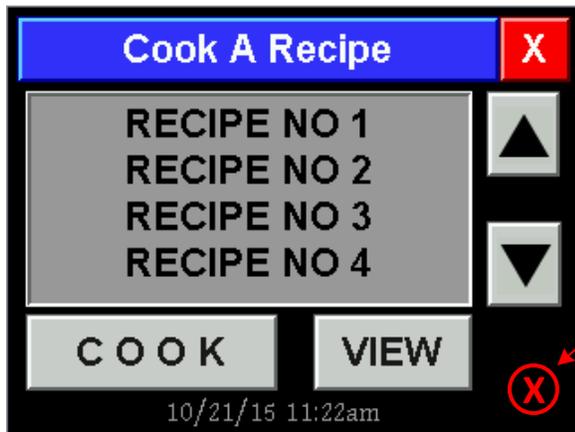
Press and hold here until the double chirp

Once the controller chirps twice, release your finger and the access code entry window appears as shown below. The default supervisor access code is 1234, the factory access code is 9999. Enter the appropriate code using the numeric keys (a * is displayed for each digit) and press the [Enter] button. The [Delete] button deletes the last character, [Clear] deletes everything.

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CONFIGURATION WINDOWS

There are three levels of access into the controller configuration, Supervisor, Technician, and Factory. Each level has their own window. The Supervisor level can edit recipes, change their access code, change the clock, view the controller history, and import and export recipes and history.
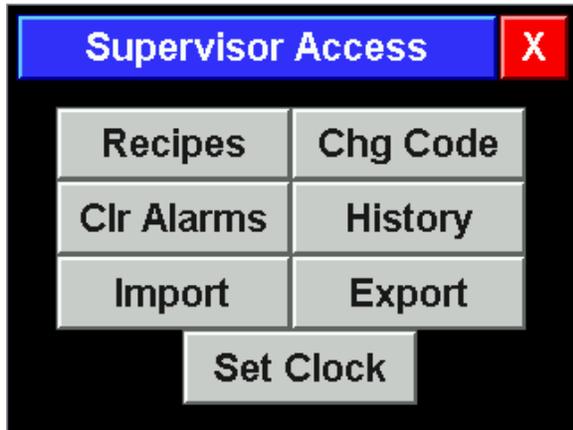
SUPERVISOR LEVEL
CONFIGURATION WINDOW

CODE = "1234", CHANGEABLE
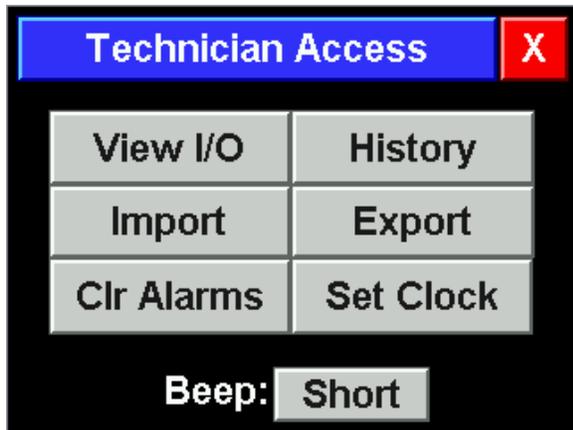
TECHNICIAN LEVEL
CONFIGURATION WINDOW
CODE = "5142", NOT CHANGEABLE
ACCESSES I/O WINDOW, CONTROLLER
HISTORY, USB FUNCTIONS, ALARM
CLEARING AND REAL TIME CLOCK

FACTORY LEVEL
CONFIGURATION WINDOW
CODE = "9999", NOT CHANGEABLE
ACCESSES ALL TECHNICIAN FUNCTIONS
PLUS ALARMS, CONTROLLER AND
COOKING CONFIGURATION.

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FACTORY CONFIGURATION

Entering the factory level password of "9999" opens the Factory Access window shown below.
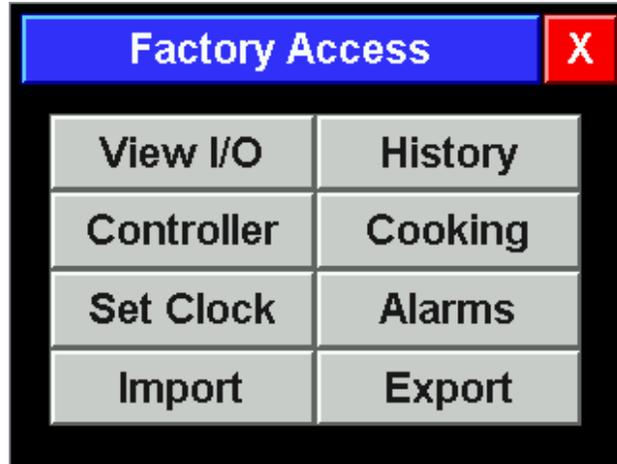
The [View I/O] button opens a window which shows the states of all inputs, allows the manual activation of all outputs, and from which the temperature offset from the probe to the visible temperature can be set.

The [History] button opens the controller history window which shows the total number of operating hours, the total number of cooking hours, and a log of errors and events.

The [Controller] button opens a window from which the controller operation is configured, allowing the OEM to set the probe type and the temperature control method.

The [Cooking] button opens a window to allow configuration of the allowable time value which can be added to a cooking cycle, the units (°F/°C) displayed to the operator, and other parameters.

The [Set Clock] buttons loads the current time and allows for editing and saving

The [Alarms] button accesses the alarming configuration and editing windows.

The [Import] button opens the USB Import window from which the recipes and controller configuration can be imported from a USB flash drive. The [Export] button opens a window from which the recipes and configuration can be exported.

INPUTS & OUTPUTS WINDOW

Pressing the [I/O] button opens the System I/O window which shows the state of all the inputs and allows the user to change the state of all system outputs.
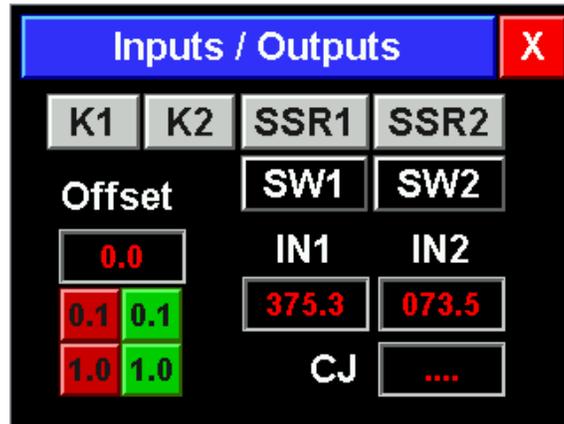
K1 & K2: These buttons change the state of the two relay contact outputs. Pressing one of these buttons will toggle its state (shown by a highlight change) and the state of the output relay.

SSR1 & SSR2: These are the SSR1 and SSR2 outputs, similar to the relay buttons pressing these will toggle its state and the state of the actual output.

SW1 & SW2: These buttons show the state of the SW1 and SW2 inputs, when the inputs are activated the button turns green.

IN1 & IN2: Temperature of the input probes in 0.1°F increments.

CJC: Temperature of the on board cold junction compensation for thermocouples.

OFFSET: The temperature displayed and used in the PID control can be offset to accommodate sensor position and calibration. Use the [0.1] and [1.0] buttons to add or subtract to the current offset value (default = 0.0°F)

NOTE: Exiting this window will set all outputs to their off state

CONTROLLER HISTORY WINDOW

Pressing the [View History] button opens the Controller History window which shows the following:

Total: The total number of hours the controller has been turned on.
Cook: The total number of hours the controller has been cooking which includes preheating.

The scrollable list below the time values shows all of the trackable events and errors the controller has experienced, the controller remembers up the last 128 events. The date and time of the event and a descriptive string are displayed, use the up and down arrows to view the list.

ERRORS: These events cause the controller to halt operation and display the fault in the System Error screen as they are not recoverable. This window does allow the controller to be rebooted in an attempt to rectify the fault but that may not work.

This error window has two lines above the CALL FOR SERVICE line which provide more detailed information about the type of error.

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ERRORS

Here is a list of the errors with their descriptive text in the history and error windows:

History Text	Error Window Text

Probe Error	TEMPERATURE PROBE ERROR

The temperature probe is monitored for out of range readings indicating a failure. When a probe value is out of range the reported temperature is driven to 999.9 degrees to shut down the temperature control. If the probe returns to normal the temperatures are again used to control temperature in the effort to continue and complete a current cooking cycle. If the probe remains at 999.9 degrees for 10 seconds the controller is halted, the red error window is displayed, and the error code and time are written into the history log.

Tch Scr Error	TOUCHSCREEN ERROR

The resistive touchscreen is monitored in the splash screen for the length of the touch which exits to the main recipe window. A touch lasting more than 5 seconds will cause a double chirp after which releasing the touchscreen will access the touchscreen calibration function. A touch lasting more than 15 seconds indicates that the touch screen is cracked or contaminated and will cause an error screen and a history log entry.

NVM-W Error	ERROR SAVING TO MEMORY STORAGE

The controller has detected a problem with writing to its internal non-volatile memory (NVM). All calibration, configuration, and recipe data is saved in NVM, and an write error causes the error window to appear and a log entry to be made.

NVM-R Error	ERROR READING FROM MEMORY STORAGE

All critical data written to the NVM is saved with a checksum, and when this information is read from that memory the checksum is verified. If this first verification fails the data will be read two more times. If the data does not verify three times the error window is displayed and a log entry is made.

GP Fault	GP FAULT:nnnnnnnn AT ADDR:aaaaaaaa

A general protection fault is when the program attempts to read or write data to an invalid memory address. The "nnnnnnnn" is the code for the type of internal address, and "aaaaaaaa" is the code address which caused the fault.

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SYSTEM EVENTS

Here is a list of the system events which cause a history log entry:

Factory Rst	Factory Reset is performed as the controller is being tested at the factory. This resets the recipes and controller configuration to defaults and performs a touchscreen calibration.
Tch Scr Cal	Touch screen calibration, either during the factory reset or performed by the user
Config Chg	This indicates that the controller configuration has been changed which includes Supervisory or Factory level changes but not PID configuration changes.
PID Cfg Chg	The PID configuration was changed
Access Err	An invalid password was entered
Access Chg	The Supervisor password was changed
Recipe Imp	The recipes were imported from a USB flash drive
Recipe Exp	The recipes were exported to a USB flash drive.
Cfg Import	The controller configuration was imported from a USB flash drive
Cfg Export	The controller configuration was exported to a USB flash drive.
USB Error	The controller was unable to create or find the proper file on the flash drive
CJ Warning	The lower level CJ time and temperature alarm was exceeded *(V2.4)*
CJ Alarm	The higher level CJ time and temperature alarm was exceeded *(V2.4)*
IN2 Warning	The lower level IN2 time and temperature alarm was exceeded *(V2.4)*
IN2 Alarm	The higher level IN2 time and temperature alarm was exceeded *(V2.4)*
Heat Alarm	The oven temperature did not rise fast enough when the preheat was started *(V2.4)*
Alarm Chg	The warning / alarming configuration was changed *(V2.4)*

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SETTING THE CLOCK

The 5400 has a real time clock which will maintain the current date and time for up to 7 days with no power. This information is used for the errors and events in the history log.

To set the clock, touch the [Set Clock] button from any of the configuration windows to load the window.
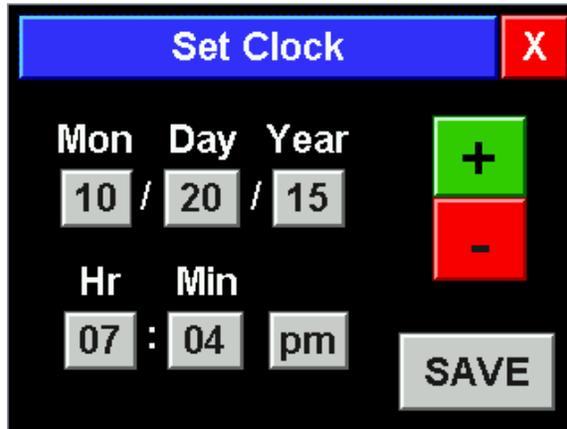
Touch the item to be changed and the button showing the value is highlighted. Use the plus and minus buttons to change the item to the desired value.
To change the am/pm simply touch the button and it changes back and forth.

Once the clock is set properly touch the [SAVE] button and the controller returns to the configuration window appropriate to the current access level (Supervisor, Technician, or Factory).

The current date and time is visible in the main recipe selection window below the [COOK] and [View] buttons

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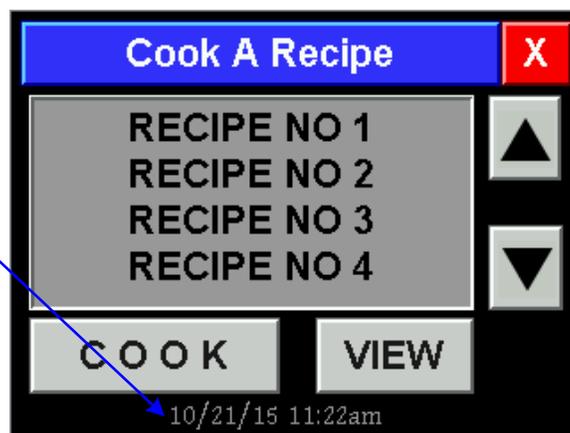
WARNINGS & ALARMS

The 5400 controller has multiple alarms which can be configured to warn the users in case of a problem within the oven. The CJ alarms use the cold junction temperature which is the temperature of the sensor connector and is representative of the controller circuit board temperature. The IN2 alarms use the secondary sensor input which can be used in conjunction with an additional temperature probe (RTD or thermocouple) which can sense the temperature of critical components within the oven. The heater alarm detects the oven temperature when the preheat cycle is started and monitors it to detect faulty heating.

NOTE: *None of these alarms will stop the controller from functioning, they are informational only and will flash a message on the screen every 30 seconds.* The end users can still operate the oven unless the higher temperature alarm has occurred 5 times, at which time the cooking and preheating buttons are locked out. Turning the controller off and back on does reset the lockout. Each of the three access levels can clear the current alarms using their [Clr Alarm] buttons, but if the alarm conditions are still present the alarm will reappear.

The CJ and IN2 alarms have two levels for which the user can configure the temperature limit, the number of minutes above the limit required to create the alarm, and the text displayed on the screen. The lower temperature alarm is displayed as a warning, the higher temperature as an alarm.

The Heater alarm has a configurable temperature and time, it will display "OVEN NOT HEATING" and "CALL FOR SERVICE".

The first window below shows the CJ warning being displayed over the cooking window.

To access the alarm configuration use the [Alarms] button in the factory configuration window and the Alarm Configuration window on the right will appear. The grey values displayed indicate that the lower alarm for the CJ alarm and both the IN2 and heater alarms are disabled.

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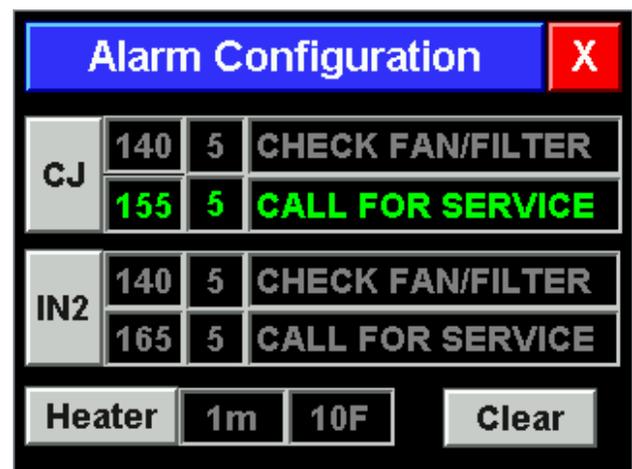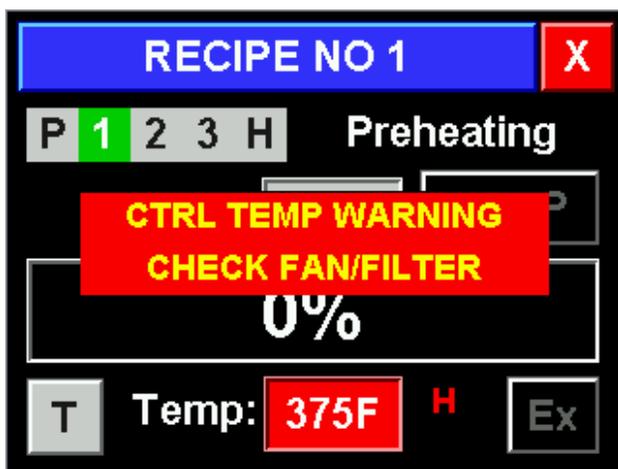
WARNINGS & ALARMS

Touching either the CJ or IN2 button from the alarm configuration window will open the alarm editing window below, the blue title bar will indicate the alarm being edited. You can increase or decrease the temperature using the first plus and minus buttons, the only limitations are that the lower temperature (upper window) can not be increased above the higher temperature. The times are in minutes and they are changed with the second pair of plus and minus buttons. Touching the [Edit] button to the right of the alarm text will open a text editing window (same as the recipe name window) so the message displayed can be changed. Once all the changes are complete touch the [SAVE] button to return to the alarm configuration window
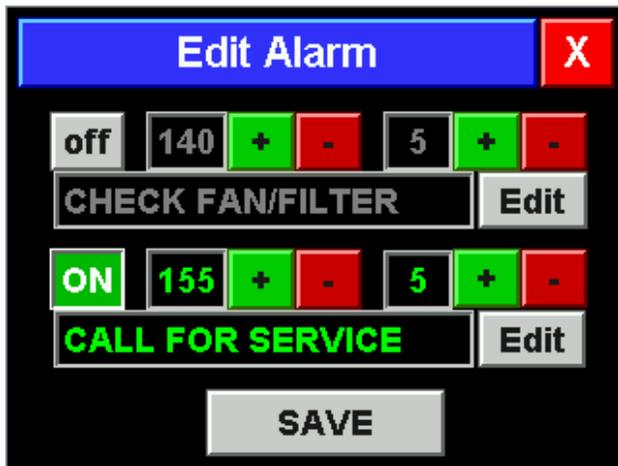
NOTE: The upper CJ alarm temperature can be decreased as you choose <u>but can not be increased above 155°F</u> for the protection of the controller. In addition, this alarm can not be disabled like all of the other system alarms again for the protection of the controller.

Touching the [Heater] button in the alarm configuration window loads the window below. The time (in minutes) and temperature can be changed using the plus and minus buttons, and the alarm can be disabled or enabled by touching the button to the right. Touch [SAVE] to save your changes and return to the alarm configuration window.

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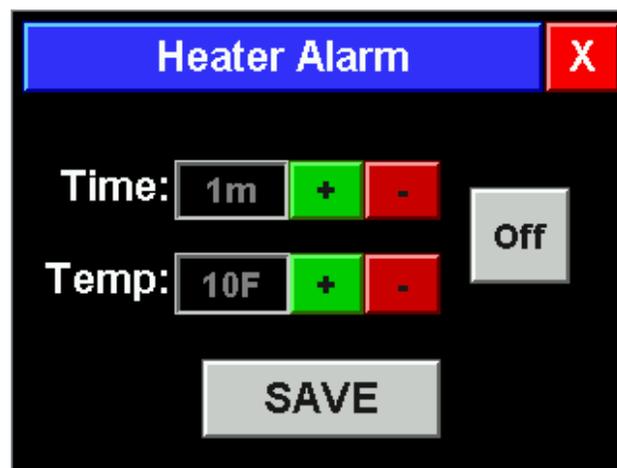
USB IMPORT / EXPORT

Pressing the [USB Export] button opens the Save To USB window below. When a USB flash drive is inserted to the USB port the message changes to "Drive Inserted" and the two buttons below it are activated. To save the current recipe configuration simply press the [Save Recipes] button and they are saved in a file named RECIPES.CFG on the flash drive. The same follows for the [Save Config] button, the controller configuration is saved in a file named CONFIG.CFG and PID configuration in PID.CFG. Once complete you can remove the flash drive and the controller automatically returns to the OEM configuration window. The Save History button saves the history items to a CSV file named HISTORY.CSV.

Pressing the [USB Import] button opens the Read From USB window below. When a USB flash drive is inserted to the USB port the message changes to "Drive Inserted" and the two buttons below it are activated. To read the recipe configuration on the drive simply press the [Read Recipes] button and they are read from the file RECIPES.CFG on the flash drive and stored in the internal non-volatile memory. The same follows for the [Read Config] button, the enter controller configuration is read from the CONFIG.CFG and PID.CFG files. Once complete you can remove the flash drive and the controller automatically returns to the previous window.

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CONTROLLER CONFIGURATION

Pressing the [Controller] button opens this window which shows the current controller configuration.
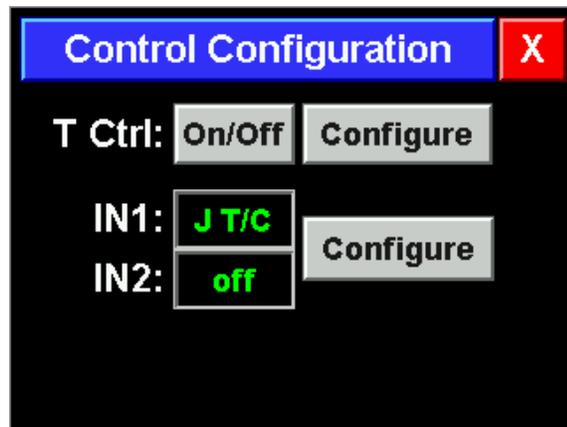
T Ctrl: Determines the method of temperature control and the configuration of that method. The control system always uses the first temperature input as the process variable. The button can be pressed to change from PID to ON/OFF control. The PID control output is always the SSR1 output, in ON/OFF control the output can be changed between K1 and SSR1 with an adjustable hysteresis value. The [Configure] button opens either the PID configuration window or the On/Off configuration window

IN1 & IN2: Shows the configuration of the two analog inputs, press [Configure] to change or calibrate the system analog inputs.

ON/OFF CONFIGURATION

Select the heat output to be used and the control hysteresis here, setting the hysteresis below 3 degrees automatically changes the Heat Output to SSR1.

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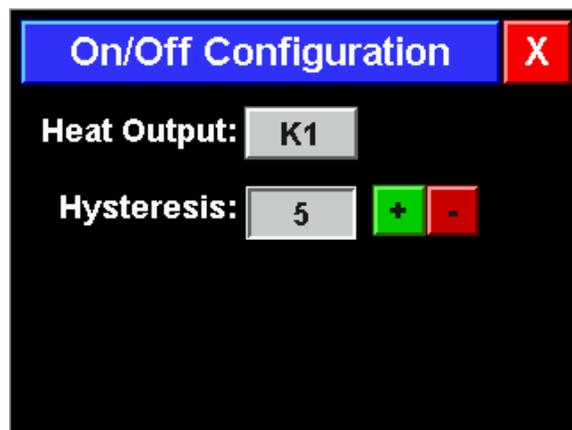
INPUT CONFIGURATION

Pressing the [Configure] button for the inputs opens this window which shows the current input configuration. Press the buttons for IN1 or IN2 to change between J T/C or RTD to select the input type for your application. The 5400 is pre-calibrated at the factory for both of these input types so calibration by the user is not required.
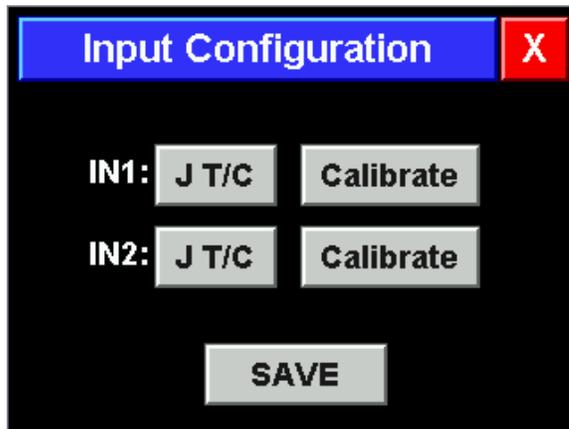
If you choose to re-calibrate either of the inputs you must have a thermocouple calibrator or precision 100 ohm and 200 ohm resistors, please contact Artisan for further information. The controller will lead the technician through a Zero and Gain calibration using the appropriate input value and recalibrate the sensor input. The thermocouple calibrator must supply a copper connection (not T/C metals) and have CJC compensation turned off for accurate calibration.

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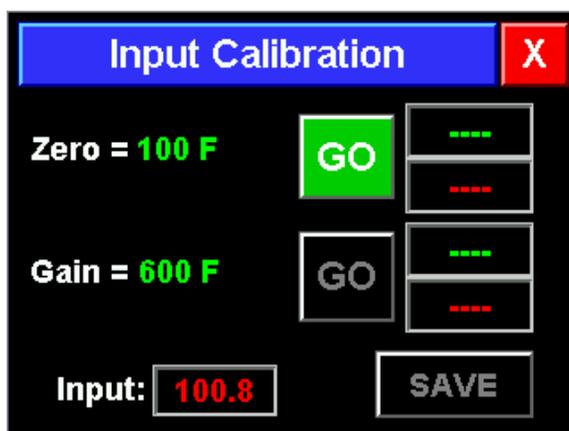
PID CONFIGURATION

Pressing the [Configure] button with PID selected opens the PID Configuration window which displays the control constants and provides access to auto tuning of the controller and testing of the PID constants.
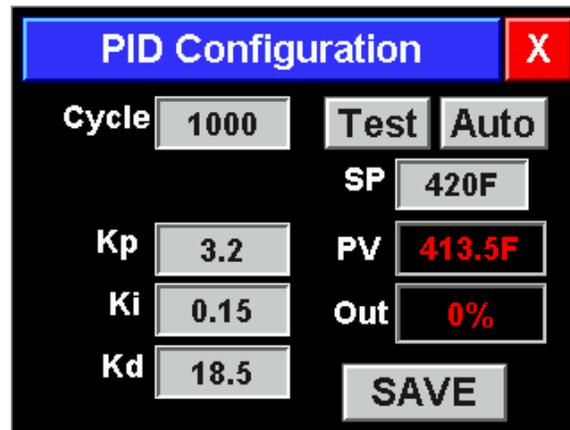
Cycle: This is the output cycling time and PID calculation cycle time in milliseconds, non-adjustable.

Kp, Ki, & Kd: Unit-less PID control constants. These can be edited by touching the item, a numeric entry window appears and a new value can be entered.

SP: Editable setpoint value used for testing and auto tune.

PV & Out: Real-time values of the current temperature and the output percentage.

Pressing the [Test] button will start the PID control system so the constants can be tested.
The button toggles to the on state and is highlighted when the PID control is running. The PV and Out values are updated once per second so that the system response can be observed. Pressing the [Test] button again terminates the PID control. The control system must be turned off before PID constants can be edited.

Pressing the [SAVE] button saves the PID constants into the non-volatile memory.

NOTE: Exiting this window will halt the PID control system if it is left running.

Pressing the [Auto] button opens the PID Auto Tune window, this process is discussed in detail on the next page.

PID AUTO TUNING

The PID auto tune in the 5400 controller is a customized Ziegler - Nichols tuning based on the system performance using relay step / closed loop analysis. The controller uses a setpoint calculated from the setpoint value entered in the PID Configuration window and then calculates positive and negative offsets based on that setpoint. The heating output is driven between the high and low percentages, switching back and forth based on the setpoint and offsets on a thermostatic basis. The auto tune systems runs a total of 6 cycles, 3 to allow the system to stabilize and then 3 to measure the performance of the system and determine the performance of the system. From these values the Kp, Ki, and Kd constants are calculated. The closer these percentages are to each other the more accurately the auto tune system can determine the performance of the environment. On systems with higher heat losses the High percentage needs to be high in order to get a reasonable change of the temperature from low to high, and conversely highly insulated systems with low heat loss will need the Low percentage to be lower for the same reason.
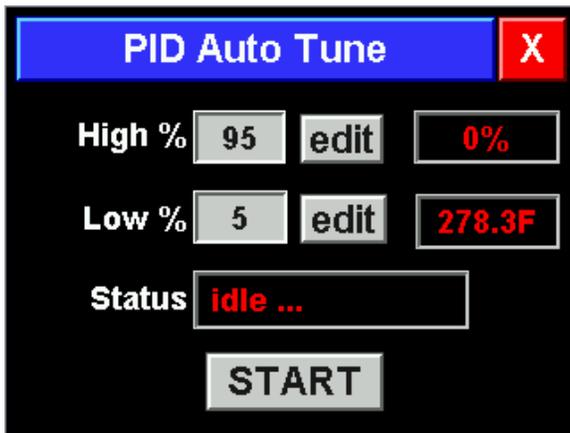
The High % value can be changed by pressing the [edit] button which displays a numeric entry window. The same method is used to edit the Low % value. The upper window on the right side displays the real-time output percentage and the window below is the temperature. The two percentage values are saved in the non-volatile memory with the other PID configuration information to simplify additional auto tuning cycles for maximum control tuning.
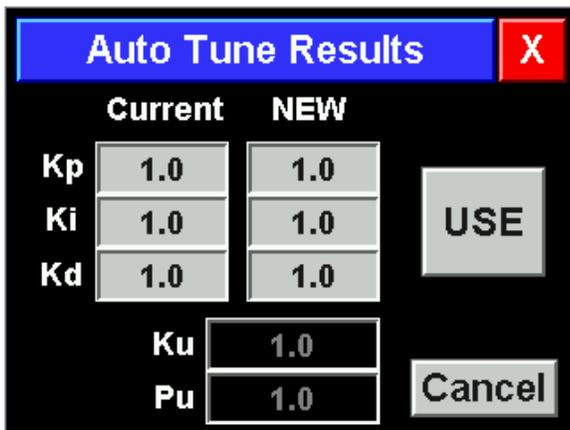
Pressing the [START] button begins the auto tune process, the Status window displays "Cycling" during the 3 stabilization cycles and "Measuring" during the 3 analysis cycles. Once the process is complete the Auto Tune Results window is displayed showing the current and new PID constants along with the calculated system performance values (Ku & Pu). Press the [USE] button to save these new values and the controller returns to the PID Configuration window to allow these new constants to be tested and/or saved.

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RECIPE EDITING

Access to the editing of the system recipes follows the same instructions as accessing the supervisor configuration: Press and hold in the main cooking window, enter the supervisor access code, and then the Supervisor Access window appears ...

Cook A Recipe	X
RECIPE NO 1	▲
RECIPE NO 2	
RECIPE NO 3	
RECIPE NO 4	▼
COOK	VIEW
10/21/15 11:22am	

Enter Access Code	X
1 2 3	Delete
4 5 6	Clear
7 8 9	ENTER

Supervisor Access	X
Recipes	Chg Code
Clr Alarms	History
Import	Export
Set Clock	

Select Recipe X

RECIPE NO 1
RECIPE NO 2
RECIPE NO 3
RECIPE NO 4

▲ ▼
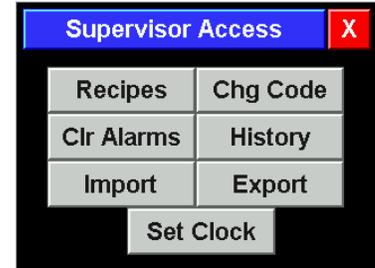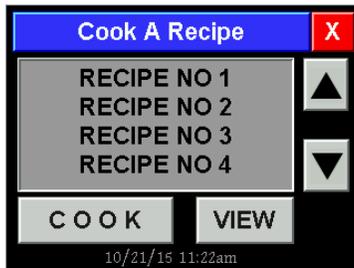
E D I T

Press the [Recipes] button in the configuration window and the Select Recipe window appears. Use the up and down arrows to scroll the recipe list until the desired recipe is shown. Touch the recipe to be edited and it is highlighted, then press the [E D I T] button and the recipe configuration is shown in the window and is ready for editing

The Select Item window shows all the items that make up that recipe. The first item is the name of the recipe, then the preheat temperature is shown, then any number of cook cycles and an optional hold cycle are displayed.

Select Item X

RECIPE NO 1
Preheat: 420F
Cook1: 0:20 at 420F
Cook2: Off
Cook3: Off
Hold: 200F

EDIT   SAVE
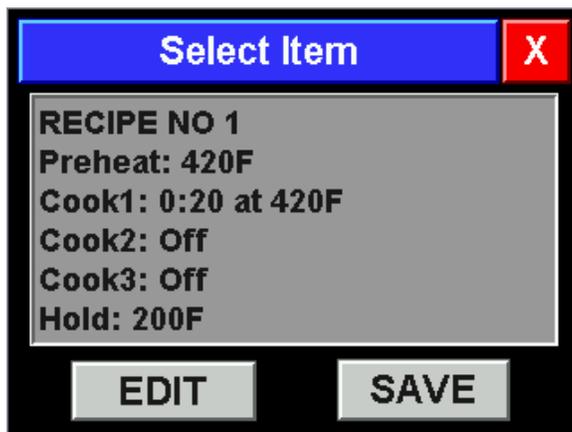
The number of cook and hold cycles displayed are dependent on the customization of the controller done by Artisan. The standard 5400 model has three different cook cycles and a hold cycle.

Press the item desired to be edited, it will be highlighted, and then press the [EDIT] button to show the editing window.

Once all changes have been made you must press the [SAVE] button to store this new recipe into the non-volatile memory.

NAME & COOK SEGMENT EDITING

Touch and highlight the recipe name in the selection window, then press [EDIT] to load the recipe name editing window below. It will display the current name in the editing box above the keyboard

Name Editing:

[Clr] button: Clears the editing box of all characters
[Rst] button: Restores the original recipe name
[Del] button: Deletes the last character
[Space] buttons: Adds a space character at the end.

Edit the name using the buttons above and the alpha-numeric keyboard and press the [SAVE] buttons to change the recipe name. Recipe names are limited to 14 characters maximum.

Cook Item Editing:

All recipe segments (preheat, cook, hold) are edited in the window shown to the left. The [<<] and [>>] buttons allow the editor to change between all the cooking segments, and they will wrap around from the last item to the first item and vice versa.

The color of the value fields and the buttons show which item is being edited, red = active item. Cook segments have a time and a temperature, pressing the grey [<] button switches to that item. Use the dial to the right or the [+] and [-] buttons to change the value. Press [SAVE] to save the current values then use the [<<] or [>>] buttons to select the next item to edit. Press the red [X] button to return to the item selection window.

NOTE: Preheat and hold segments only have a temperature value, the time field and [<] button are greyed out and non selectable.

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COOKING A RECIPE

Touch and highlight the recipe name in the selection window, then press [VIEW] to view the recipe details as shown in the window to the right. Press the [C O O K] button to open the window showing the [PREHEAT] and [C O O K] buttons in order to start cooking
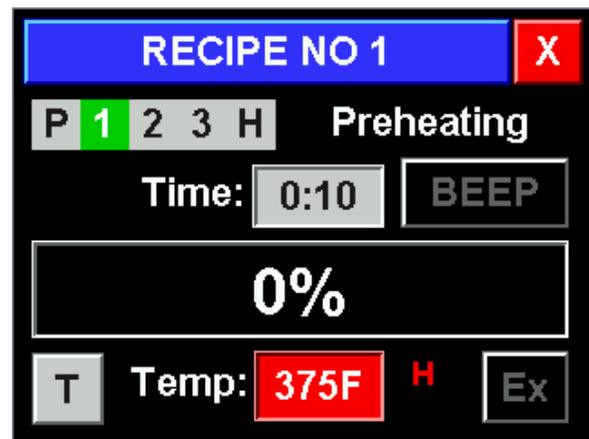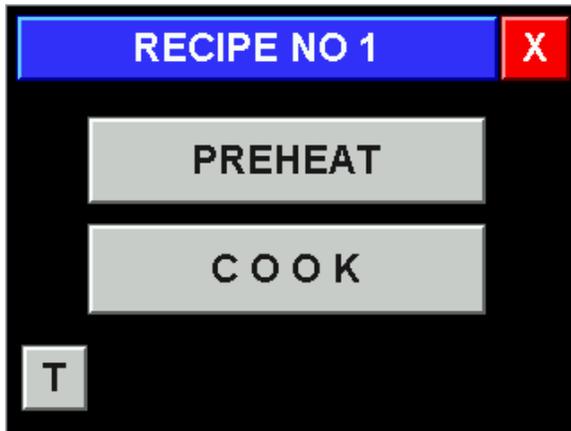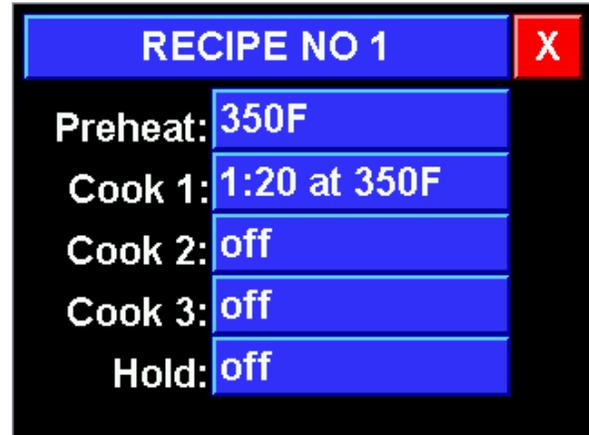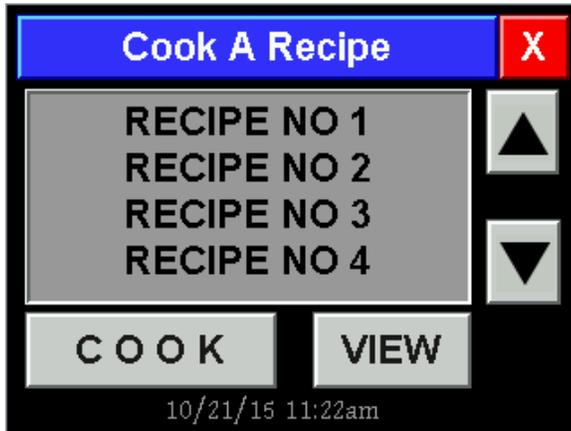
Touching the [T] button will display the current oven temperature. Press the [PREHEAT] or [C O O K] buttons to start cooking.

The cooking progress is displayed in the above window. See the next page for more details

COOKING
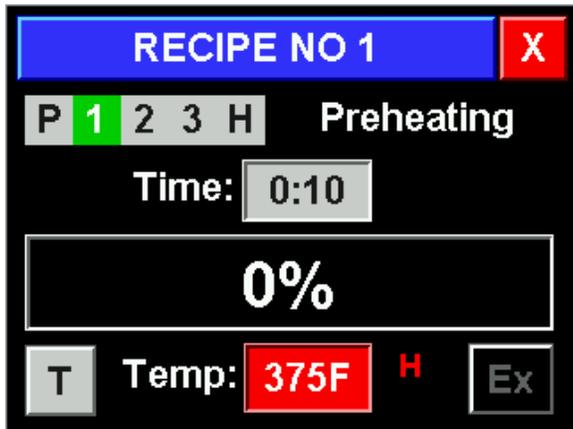
This is the cooking window displayed when [PREHEAT] is selected.

The window displays "Preheating" during the preheating cycle, once the oven is up to temperature the controller beeps and displays the LOAD OVEN window. The large button changes from green to blue once per second

While this window is displayed the controller is monitoring the SW1 input. If the controller sees that the input changes state twice (indicating the door is opened and then closed) the controller advances to the START COOK window below. Alternately, the user may touch the large button.

NOTE: The controller looks for state changes only, it does not matter if the door switch is wired in the normally closed or normally open position.

Once the operator has loaded the oven and advanced to this window they must touch the large button to start cooking.

The large button alternates between green and blue once per second similar to the LOAD OVEN button above.

Table of Contents

Artisan Controls Corporation, 111 Canfield Ave., Bldg B15-18, Randolph, NJ 07869
www.artisancontrols.com
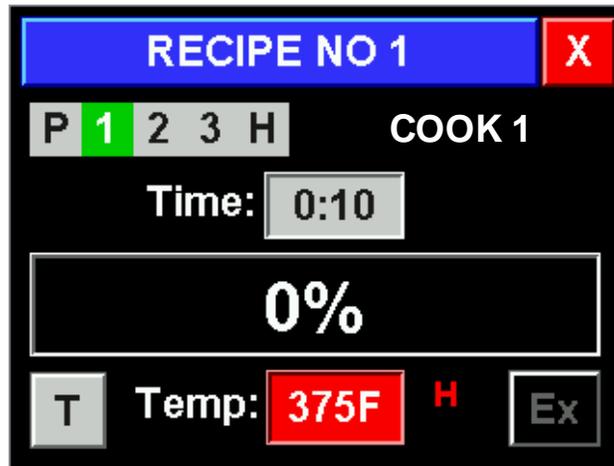
This is the main cooking window displayed during the cook and hold cycles

Pressing the [START COOK] button starts the first configured cooking segment and automatically proceeds through all cooking cycles, the progress bar at the bottom shows the progress thru the sum of all the cooking cycle times.

Pressing the [T] button changes the "Temp:" to "Oven:" and displays the real-time oven temperature for 10 seconds then reverts to the setpoint temperature for the current segment.

The [Ex] button automatically adds the preset extra time to the current cook cycle, and in the holding cycle the controller will revert back to the last cooking cycle for the added time to cook for a longer period of time.

If the controller customizing has only one cook cycle the cooking segment icons in the upper left corner are not displayed.

To stop a cooking cycle, press and hold the red [X] button until the controller chirps twice and the system returns to the preheat / cook selection window.

Once the controller enters the hold cycle it starts beeping repeatedly and a red [BEEP] button appears to the right of the time display box. Pressing the [BEEP] button will turn the beeper off but the controller will stay in the hold cycle.

1.50 Max
0.12
Component Area
Plastic Front Panel
0.05
2.52
2.07
0.43
0.32
0.196 Dia
0.13
3.03
2.76
LCD Active Area
Color LCD Display w/ touchscreen
3.75
4.50
0.38
0.36
0.25
3.50
4.13

Controller

#8 Male Stud, ½"
Far side, 4 places

Front Sheet
Metal

2.63

0.37

3.10

3.10 x 2.63 Cutout
In front sheet metal
0.062 max corner R

3.75

4.50 REF

0.38

0.33

0.25

4.13 REF

3.50

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R1 R2

SSR1 SSR2 SW1 SW2

USB Port

+ IN1 −

+5V DC

+ IN2 −

Analog Ground

Earth Ground

P4

C3

PS1

R1
R2

TAZ3
TAZ2

K1

K2

CR1 CR2

AL1

C4

C5

M1

P2

ARTISAN

P3

Hot

Note: Hot connections tied together on PCB

AC POWER

SPECIFICATIONS:

LCD DISPLAY: Color 3.5" diagonal TFT display, 320 x 240 pixels, 16 bit color, resistive touchscreen, 300 nits minimum.

INPUTS:
SW1 & SW2: Low voltage dry contact inputs, <5mA @ 5VDC
IN1 & IN2: Universal analog inputs. Software configurable for 100 Ohm RTD (385 or 392 curve), J or K thermocouple, other analog inputs (ie: 4-20mA, 0-10V) available. +5V DC for sensor power limited to 50mA maximum[2].

OUTPUTS:
R1 & R2: SPNO relay contacts rated 10A @ 125V, 7A @ 250V.
SSR1 & SSR2: 5VDC @ 50mA maximum[2].

FUNCTIONALITY:
Up to 15 menu selections, multiple cook cycles, thermostatic or PID control, custom windows, logos, and control schemes available.

ARCHITECTURE:
Microcontroller: 32 bit processor, 80MHz, w/floating point.
Graphics: Epson graphics controller, 60 fps refresh rate
Measurement: 16 bit A/D converter.

USB PORT:
Flash drive interface for importing & exporting cooking recipes and controller configuration.

CONNECTIONS:
Supply: Wago 231-134/001-000
Input/Output: Wago 231-140/001-000
Analog Inputs: Rising cage w/screw, 16-30 GA

ENVIRONMENTAL:
PCB's: Edge sealed to each other with RTV to prevent penetration of moisture or other contaminants.
Operating Temperature: 0°C to +70°C

AC POWER: 90-265VAC, 50/60Hz, 5W maximum

RECOGNITIONS:
Conforms to UL STDS 60730-1 & 60730-2-9
Certified to CSA STDS E60730-1 & E60730-2-9

RECOGNIZED COMPONENT

ᶜ **ETL** ᵤₛ
LISTED

Intertek
3080852

[2]- *Total external 5VDC current draw = 80mA maximum.*

REVISION HISTORY:

V2.4 – October 2015:
Added real time clock setting and storage into history log.
Added large buttons for Ready To Cook and Start Cook events.
Added temperature warnings & alarms for internal cold junction temp and IN2 input.
Added low heating alarms for during preheat cycle to detect heater fault.

V2.41 – November 2015:
Fixed error in upscale break protection in J T/C measurement.
Set cooking timing to be fixed in hours & minutes.

V2.42 – December 2015:
Added F/C temperature units selection button in cooking configuration window.
Added revision history page to user's manual.