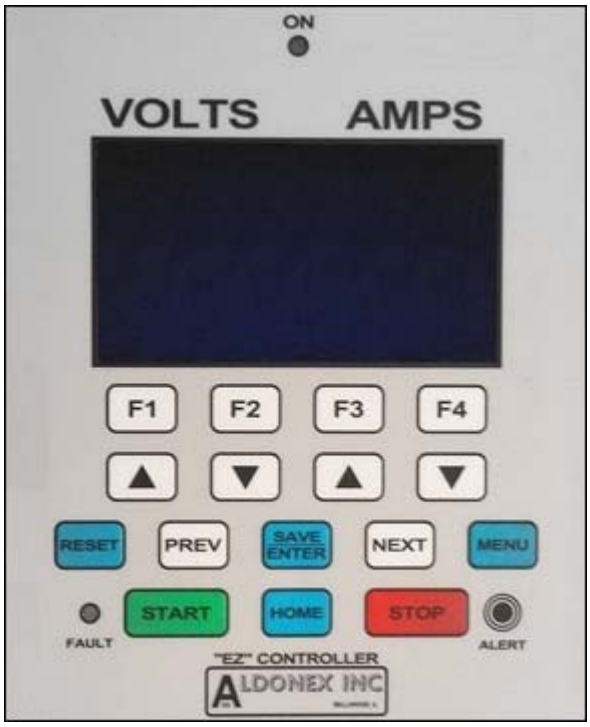
Aldonex “EZ” Controller Operation Manual



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Contents

Contents

Overview

The Aldonex "EZ" Controller is an intelligent user control panel and display that gives the operator control of a Regulator Board and a Digital IO board. Together this system controls the operation of an Aldonex industrial power supply.

The control panel has a graphic 240x128 LCD display, 15 keypad buttons, two status LED's and an audible beeper annunciator. The HMI communicates with the Regulator Board and IO Board through a serial RS-485 data network. The HMI is the RS-485 bus master.

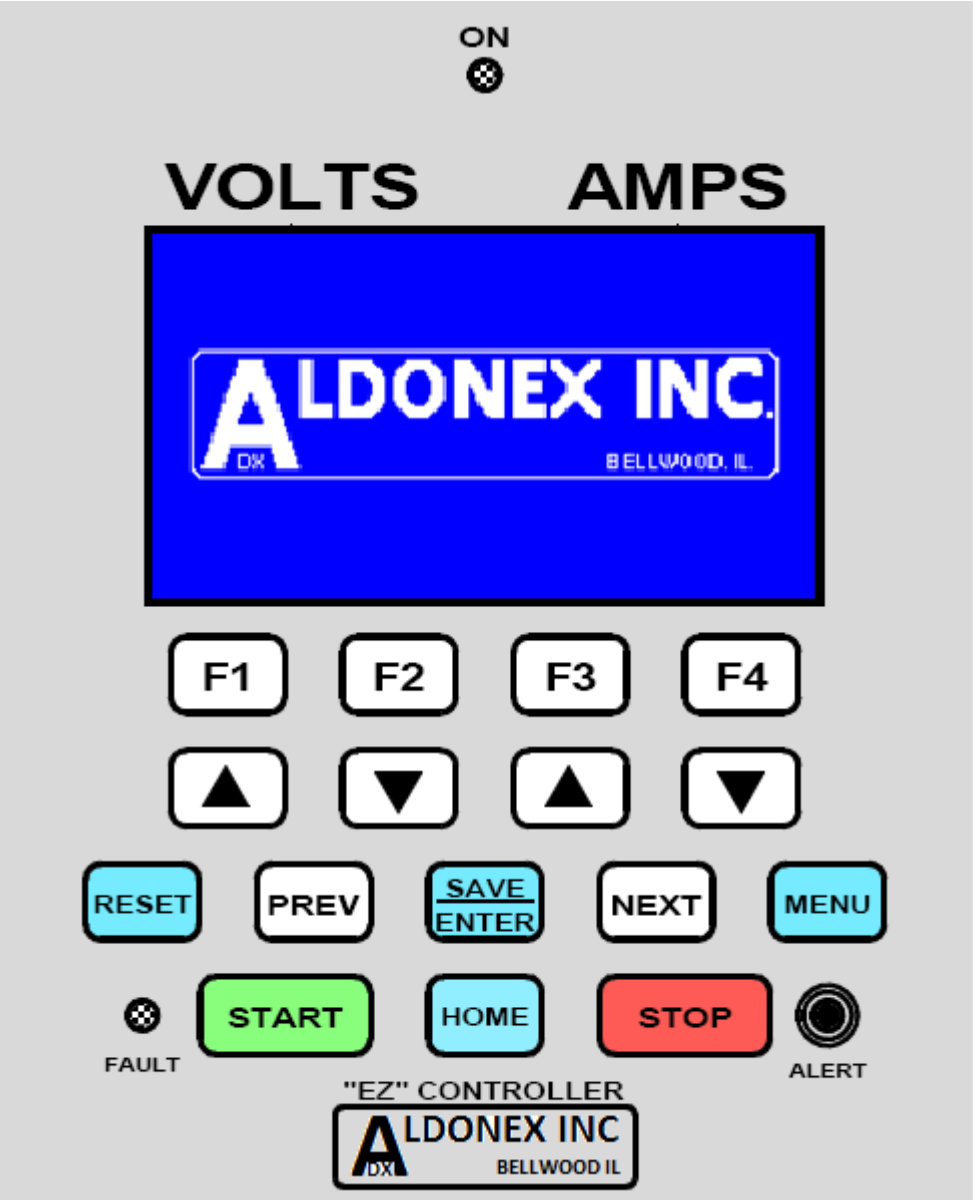
The operation of the control panel is organized into a series of display pages. These pages display information organized in various ways. Some pages provide information only, such as the fault status page. Other pages allow settings to be made with various fields that can be selected and adjusted. The HOME page is displayed while the power supply is operating and shows the present status of the power supply's output and set point.

Optional automatic features allow timed cut-off of the power supply output, Amp-Hour tracking, ramp and soak sequences, timed polarity reversal, remote control settings and voltage tap selection. The features can be combined or used independently. Once the HMI is set up with a specific combination of features, the settings can be stored as a "recipe" in non-volatile memory.

Definitions

Rectifier Off	This is a full power supply shutdown which includes opening the main contactor.
Output Off	This is a power supply turn off where the main contactor remains closed, but the output of the regulator board is dropped to zero.
Alert	An alert condition can be configured to occur at the end of an automatic function. It will flash certain LED's and sound the beeper.
Fault	A fault condition indicates that a problem has been detected and needs attention. The power supply is shut down. The fault condition is also indicated with flashing LED's and beeper.
Function Keys	The four buttons on the bottom edge of the display are function keys. They can be configured from the factory or user programmed.
Power-Up Reset	This is a setting for various timer and counting functions. If the power-up reset is enabled, the count or time value will be restarted each time the power supply is started. If it is disabled, the counter or timer will continue where it left off each time the power supply is started.
Recipe	All of the settings on the HMI that control its operation are together referred to as a recipe. The HMI can store and recall recipe information to allow rapid reconfiguration of the system for different types of operation.

Overall Keypad & Display



Overview of the Button Functions

START Button

The start button only operates from the HOME display screen. When the START button is pressed, the main contactor is closed and the power supply will begin operating. In addition to the main contactor, the I/O Board will turn on any other relays required at start up. If a fault condition exists, and the START button is pressed, the power supply will not start, and the HMI will display the fault/status page identifying the fault. The START button may or may not be enabled when remote control is active. This will depend upon the configuration of the remote control features.

STOP Button

The stop button only operates from the HOME display screen. When the STOP button is pressed, the power supply will turn off. The main contactor will open. In addition to the main contactor, the I/O Board will turn off any other relays required at shut down.

The STOP button will have a second function while the power supply is not running. The STOP button will perform the same function as the RESET button. This will allow alarms and alerts to be cancelled by using the STOP button. The STOP button will also cancel the fan contactor's turn-off-delay timer. This only applies when the HOME display screen is active.

The STOP button may or may not be enabled when remote control is active. This will depend upon the configuration of the remote control features. The STOP button will always cancel the ALERT condition and/or cancel the fan contactor's turn-off-delay timer, even while remote control is active.

MENU Button

The MENU button only operates while the power supply is off. Pressing the MENU button from any display page will transfer the display to the menu page. The menu page will list all of the possible pages which can be selected and viewed. The menu page shows the available pages in two columns on the display. The UP and DOWN (either set) or PREV and NEXT will be used to identify which page the operator wants to go to.

Once the desired page has been selected, the operator can press ENTER to jump to that page.

When leaving a setting screen with the MENU button, if changes have been made to the values on that screen, a prompt will ask whether the changes should be saved. The operator will be asked to press ENTER to save the changes or MENU again to discard the changes.

V-UP and V-DOWN, I-UP and I-DOWN

These UP and DOWN buttons will adjust the voltage and current levels, respectively, when a display screen contains both voltage and current that need to be adjusted. For example, on the HOME page, the voltage and current set points can be adjusted (if not locked). For any other entry or selection field on a page, the buttons will act in parallel with each other. Either UP button can be used to adjust a value upwards. Either down button can be used to adjust a value downward.

PREV and NEXT

These buttons select and highlight a field on the display. These buttons are not active on the HOME page. They are only used on pages which contain data entry fields or selections.

These buttons allow the operator to select which data entry field is selected (by inverse text) for adjustment with the UP and DOWN buttons. The data entry fields will generally begin toward the upper left of a page and be selectable in order left to right and top to bottom.

If the operator adjusts a value in one of the setting fields and then presses PREV or NEXT, the value that was set is left in that field and the next (or previous) field is highlighted for entry. The operator can move from field to field in that manner, making changes to all of the settings.

ENTER/SAVE Button

If the operator is on a setting page and is making changes, those changes are not accepted and remembered by the HMI until the SAVE button is pressed. If the operator attempts to leave the page without saving using the MENU button, a prompt will come up asking if the changes should be saved or discarded. Pressing SAVE will save the changes. Pressing MENU again, will discard them.

While on a setting page, the SAVE button can be pressed at any time. That will cause the changes that have already been made to be saved to the HMI's memory. This will not cause the page to exit. You can press the SAVE button on a setting page as many times as you want. If the SAVE button is pressed and no further changes are made, the MENU button will exit right back to the menu page without any prompt because the changes were already saved.

It was discussed that perhaps on the very last entry on a page the screen would automatically exit if the ENTER/SAVE button was pressed. We decided to leave this out for now. It can be added later if it is important.

The SAVE function is not required for changes to the set point on the HOME page. The voltage or current (if not locked) can be changed using the two sets of UP and DOWN buttons. The new values are accepted immediately and no SAVE button press is required. Likewise, the manual polarity selected on the HOME page is saved without the SAVE button needing to be pressed.

The "ENTER" portion of this button's name applies to when the MENU screen is active. The UP and DOWN buttons are used to select a menu entry. The ENTER/SAVE button is then pressed to jump to that new page.

RESET

The RESET button has a number of different functions, depending on the screen that is displayed and the status of alarms, alerts, timers and counts.

1. Resetting the HMI after a fault - If the HMI is actively reporting a fault with visual and audible alarms, the RESET button will cancel the latched fault condition.
2. Clearing an Alert Condition – The next highest priority is to clear an alert. Depending on the configuration of the HMI, an alert may occur with the power supply running or the power supply off, the alert might include audible alarms or not. Pressing the RESET button during an alert will cancel the alert.
3. Power Off if the power supply is running, just like the STOP button. Note that the RESET button will continue to be able to shut off the power supply, even if the HMI's STOP button has been disabled while operating under remote control.
4. Resetting Timers and Counters – On the HOME page, when the power supply is off, pressing the RESET button will reset the displayed counters and timers back to their initial starting conditions. A prompt screen will come up to confirm that is the operator's intention.
5. HMI Setting Clear – On the HOME page, if the RESET button is pressed and held (for 2 seconds) the operator will be prompted to see if the present settings should be cleared. (This does not clear stored recipes, just the present values loaded into the setting screens. It will be as if a blank recipe had been loaded. A prompt screen will come up to confirm that is the operator's intention.
6. Clear an Entry – On a setting page, if the RESET button is pressed while a specific entry is selected, that entry will be returned to its default setting.
7. Clear a Setting Page – If the RESET button is pressed and held (for 2 seconds) while on a setting screen, the operator will be prompted to see if the settings on the page should be reset to their default levels.

Function Buttons F1 to F4

The Function Buttons can be assigned different operations that are performed when they are pressed. The buttons are associated with text fields at the bottom of the graphic display. The labels for the buttons will appear there. The labels can be changed on the display, indicating their function at that time. The labels can be one or two lines of text.

On the HOME page, the operation of the function buttons can be either factory configured or customer configured. If the buttons are factory configured, they will always be associated with the factory configured function. Only buttons that are not assigned by the factory can be assigned by the customer. The operations performed can be anything from triggering a polarity reversal (factory option) or loading a specific recipe (customer option).

On other menu and setting pages, the function buttons may be given other functions specifically related to the information displayed. This might include things like page-up or page-down functions for larger lists of information.

Factory Options:

- Manual Polarity Reversal
    a. When pressed, if the output polarity is not presently under automatic control, the polarity will reverse.
    b. If the power supply is operating, the output voltage and current levels will first be lowered before the polarity is changed. After a short pause the PR output relay will be changed, and then the voltage and current will soft-start back to their original levels.
    c. The present polarity of the output will be displayed on the HOME page.
- Local or Remote Control
    a. While the power supply is off, pressing this button will toggle the operation of the HMI between local control and remote control. The operation of the power supply while under remote control will depend upon the specific remote control settings.
- Voltage Tap Selection
    a. While the power supply is off, pressing this button will allow the operator to step through the available voltage tap selections. The label for the function key will show the voltage of the selected voltage tap.

Customer Options:

1. Quick Access to Menu Pages
    a. The customer could select one of the menu pages which could be jumped to quickly by pressing the button.
    b. The user would select from one of the available menu pages.
    c. A configuration page would allow the button to be assigned.
2. Quick Access to a Stored Recipe
    a. The customer could select a specific recipe that would be loaded when the quick button was pressed.

Dynamic Function Key Assignment

The new factory-selectable function keys being implemented will include two additional function keys on the HOME page. The HMI will have a total of three pre-defined function keys that can be enabled:

- Local/Remote Control
- Manual PR
- Voltage Tap Control

Each of these three function keys is optional and they are separately enabled. There can be any combination of 0, 1, 2 or 3 of them enabled, depending on the customer's requirements. Rather than permanently assigning them a specific function key that they would use, the function keys will instead "fill in" from the left. If three function keys are used, they will always be F1, F2 and F3. If only two are enabled, any two, they will be F1 and F2. If any single function key is enabled, it will always be F1.

Details:

1. The remaining unassigned keys will be available for customer assignment on the function key configuration page. The function key configuration page will only show the keys available. The 4th function key will always be available for customer assignment.

2. The function keys will have a pre-defined display order. When the function keys are enabled, they will always appear, left to right, in the following order: Local/Remote -> Manual PR -> Voltage Tap. If fewer function keys are enabled, they will still follow this order, skipping any function keys that aren't assigned.

3. The Local/Remote function key is enabled through a factory configuration setting.
    a. For function key control, all we need is the enable/disable of LOCAL/REMOTE. Additional settings are required to fully configure the LOCAL/REMOTE feature. They are described later in this document.

4. The Manual PR is enabled either with a factory configuration setting, or a Premium Feature access key. (This is existing functionality.)

5. The Voltage Tap function key is enabled and controlled through the following factory configuration setting with the
    a. Number of voltage taps enabled (0 = voltage tap feature disabled).
    b. Voltage range for each of the taps
    c. These configuration settings much match the equivalent settings in the regulator board.
    d. The order of the voltage ranges must match the connections of contactors on the IO board.

6. The Local/Remote function key label will identify whether local is active or remote is active. In LOCAL mode the function key will read: "LOCAL" "CONTROL". When in remote mode, the function key will read "REMOTE" "CONTROL". Pressing the function key (while the power supply is off) will toggle between these two.

7. The Voltage Tap function key label will identify the active voltage tap selection. The top line will read "VOLT TAP". The bottom line will read "#V", "##V" or "###V". The voltage will always be displayed in whole-volt units such as "6V", "12V" or "100V". When the function key is pressed

(with the power supply off), the voltage tap ranges will be displayed in the sequence they are configured into the HMI's memory.

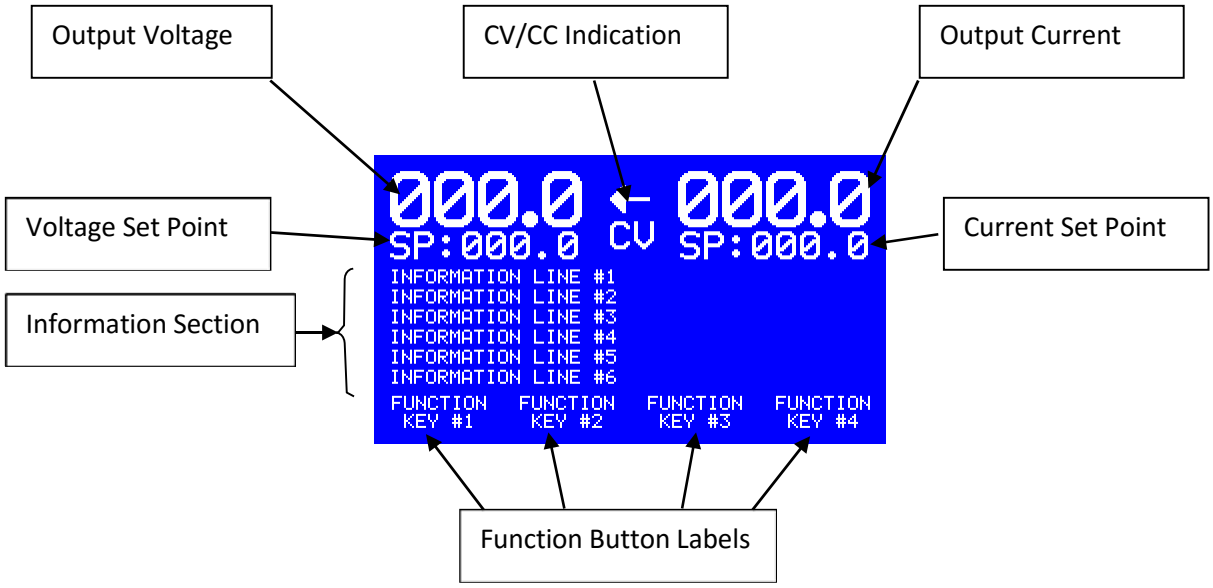
8. At some times the function keys will be locked and will show lock symbols. These relate to how they operate under remote control situations. At this point in the firmware project, we will set up the function key to show the lock symbol when a control flag is set. It will be more fully implemented during the implementation of the actual feature.
    a. Local/Remote will never show a lock symbol. (It is understood, however, that this function key will not function while the power supply is operating.)
    b. The Manual PR function key will show a lock symbol while in REMOTE mode and the remote PR control feature is enabled.
    c. The voltage tap will show a lock symbol while in REMOTE mode and remote control of voltage taps is enabled. (It is understood that this function key will not operate while the power supply is operating, even when it isn't showing a lock symbol.) The lock symbol will be shown on the lower line next to the voltage number.

Example Function Key Display

HOME Button

The HOME button will transfer operation back to the HOME page. If the operator is presently on a setting page, and changes to the settings have been made, the operator will first be prompted to save the changes.

Organization of the HOME page



The HOME page is organized into three areas. The top section is the power supply status section. It shows the present output voltage and current, as well as the "CV" or "CC" regulation mode. These values are reported to the HMI from the regulator board. The status information also includes the present set points for both the voltage and the current. Note that labels for "Volts" and "Amps" are included on the keypad label above the LCD display to clearly define the functions of the left and right sides of the screen.

The center portion of the display is the information section. It has up to six lines of text that will show the status of the automatic control functions, if they are active, as well as status of specific user control functions, such as output polarity, if they are enabled in the HMI's configuration. These display lines will be blank unless they are required to display information.

The bottom section of the display contains four labels for the keypad buttons that are located immediately below them. These four labels may be factory configured, or may be available for user configuration. Some of the setting pages have specific uses for these.

Voltage Display

The voltage display for the present power supply output and the present set point will depend upon the output voltage range of the power supply:

Voltage Range	Display Format
<10V	0.0
10-99V	00.0
100V+	000

The HMI will identify the voltage range by reading the value set configured into the HMI's EEPROM memory. This is set using serial commands at the factory.

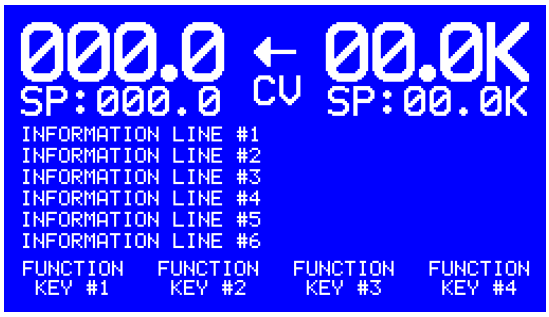
The active voltage range will be used on the HOME page when displaying voltage and set point. It will also affect all of the setting and status pages to control how they show voltage and what range of settings is allowed.

Current Display

The current display for the present power supply output and the present set point will depend upon the current range of the power supply:

Current Range	Display Format
<1000A	000
1000-9999	0000
10KA+	00.0K

Below is an example of the "00.0K" representation for the KA representation:



Special Handling of the 00.0K Format

To allow more natural presentation of currents while in this format, the display will use either “00.0K” or “0000” depending on the magnitude of the value being shown. Generally small magnitude values will be shown in “0000” format and larger values will be shown in the “00.0K” format.

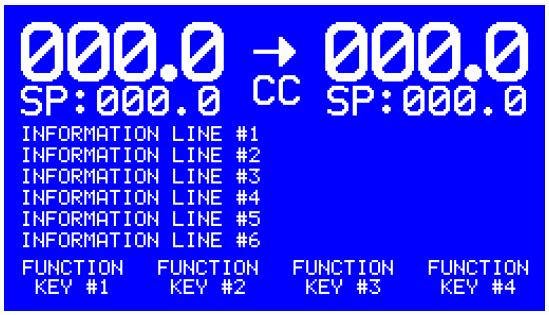
1. When in the “0000” format, the lowest two digits will always show “00”. When the value is incremented or decremented, it will be in units of 100.

2. When displaying the power supply output amps, we will implement a hysteresis between 10.0K and 9500. This will prevent the display from flickering back and forth between the two display formats as transitions are made back and forth across this range. As currents are rising, the display format will remain in “0000” format until it reaches 10.0K, where the format will be switched to “00.0K”. When the current is dropping, the format will stay in “00.0K’ until the current reaches 9500 at which point the format will switch to “0000”.

3. When displaying the set point on the HOME page or the RAMP setting page, the hysteresis won’t be implemented, the display format will change when the value transitions between 9900 and 10.0K.

CC and CV Indication

The examples above show the “CV” indication with the letters CV and the left-pointing arrow. This is for constant voltage regulation at the regulator board. The alternative is “CC” with a right-pointing arrow. An example of that is shown below:



Manual Adjustment of the Voltage or Current

There are UP and DOWN adjustment buttons for the voltage, and a separate set of UP and DOWN adjustment buttons for the current. If the set points are not under automatic control the operator may adjust the set points.

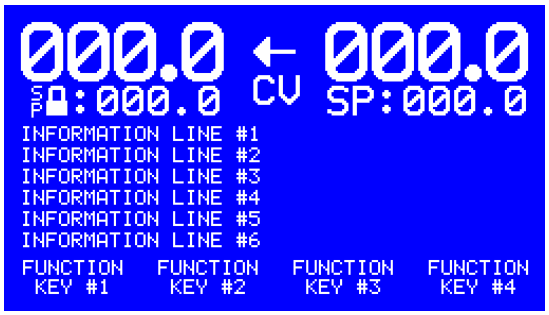
Each single quick press of the UP or DOWN buttons will adjust the displayed set point one digit up or down. If the operator holds down the UP or DOWN button for 1 second, the count will automatically increment (or decrement) at a rate of 200mS. If the button is held down for 5 more seconds, the count will begin incrementing by 10's. For settings of four digits, if the button is held down an additional 5 seconds, the count will start incrementing by 100's.

The value can be increased up to the power supply output range, as read from the regulator board. When the maximum value has been reached, the value will no longer increase. When decreasing, the value will be allowed to reach zero and then stop.

The power supply set points can be adjusted with the power supply off or with the power supply running. If the set points are adjusted with the power supply off, the changes will take effect the next time the power supply is turned on. If the set points are adjusted with the power supply running, the HMI will react to the set point changes immediately as they are made. The new values will be relayed to the regulator board and they will take effect even while further adjustments are being made.

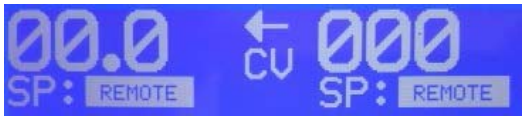
Locked Set Points

When a set point is under automatic control, the active set point will be displayed, but the operator will not be able to adjust the value. The display will show a "locked" symbol for the set point that is not adjustable. The display below shows a locked symbol for the voltage set point. The symbol represents a padlock.



Set Points under Remote Control

Another display that might be observed for the set points will come up if remote control is active. The set point display will be replaced by the word "Remote". Under remote control, the set point control is received by analog levels (0-5V, 0-10V or 4-20mA) directly into the regulator board.



Voltage Set Point versus Voltage Tap

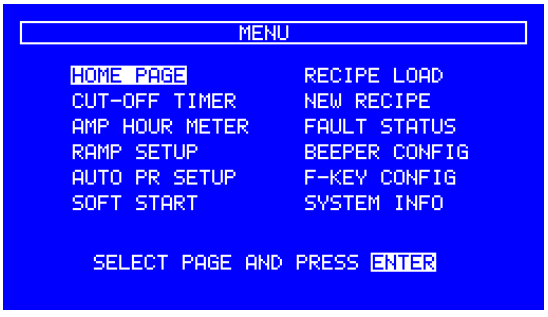
When the voltage tap feature is enabled, there may be a situation where the selected voltage tap value is lower than the active voltage set point. In that case, the active voltage set point is reduced so that it doesn't exceed the selected voltage tap. Note that the set point is not increased again if the operator selects a higher voltage tap.

Typical Manual Operating Scenario

While operating the power supply under manual control, a typical operating sequence might be as follows:

1. With the power supply off, the voltage and current set points are adjusted to the desired operating levels.
2. The START button is pressed, turning the power supply on. The power supply will soft-start up to the set point levels.
3. The power supply output levels and CV/CC status are continuously monitored and reported on the screen.
4. While the power supply is running, the operator may further adjust the set points up and down.
5. Pressing the STOP button switches the power supply off again.

Menu



The MENU page will contain a list of the displayable setting and status pages. The operator will use the PREV and NEXT buttons to highlight a specific page from the list. Pressing SAVE/ENTER will transfer the operator to the selected page. If no selection is made for 5 minutes, the page will automatically exit back to the HOME page.

The technician access page is also reached through the MENU page, although there is no listing for it shown. The operator presses the PREV and NEXT keys together to get there. The PREV and NEXT keys need to be held for 2 seconds before they are recognized. This prevents accidental access.

Faults

The HMI will continuously track the power supply, the IO Board, the Regulator Board and itself for faults. Generally speaking, faults are unexpected problems that make it necessary to turn off the power supply. These are problems that require operator correction before proceeding.

Faults Detected While the Power Supply is Running

If the power supply is operating, we will shut it off as quickly as possible. The HOME contactor will be opened. The fan contactor will be opened. The regulator board will be commanded to turn off its outputs. The IO board will be commanded to turn on, off, or flash its outputs as described below.

The HMI will notify the operator to the fault using lights and sound:

- The HMI will turn off its “ON” LED and flash its “FAULT” LED at a fast rate (4Hz).
- The HMI will sound its piezo beeper at the same rate as the FAULT LED.
- The HMI will command the IO Board to turn on its ALARM relay output (not flashing).
- The HMI will command the IO Board to flash its PILOT relay output at 4Hz.
- The HMI display will transfer to a screen showing the fault condition.

The HMI will latch and remember that a fault has occurred. If the fault condition clears itself, for example a thermal input switch closes again, the HMI will continue to remember that the fault has occurred until it is reset. The fault condition will continue to be identified and displayed on the fault status page. The fault condition can be cleared by pressing RESET or STOP. When the fault condition is cleared, the HMI piezo beeper will turn off and the two IO Board relay outputs, PILOT and ALARM, will turn off. The HMI’s FAULT LED will continue to report the status of whatever triggered the alarm. If the problem has gone away, for example the thermal input switch has closed, the FAULT LED will turn off, otherwise it will stay on.

Faults Detected While Power Supply is Not Running

Faults detected while the power supply is not running will not trigger the same reaction as when the power supply is running. However, the operator will be prevented from starting the power supply while the fault exists. Attempting to start the power supply while a fault is active will trigger the same reaction as described above.

The Fault LED on the HMI will continuously track the fault status while the power supply is off. While a fault condition is active, the LED will be on. If the fault condition is cleared, the LED will turn off. Note that certain fault conditions may take several seconds to be cleared after the fault condition is removed.

Before turning on, the HMI will test the IO board inputs that should always be closed, i.e. the "STATIC" fault inputs. If any of them are open, the fault condition is latched before the power supply is started. Once the power supply is started the HMI will add the non-static IO board inputs to be tested. Those are inputs that track the contactor outputs. If those inputs do not turn on within ½ second after the corresponding output is energized, a fault is latched.

Faults Detected While In Output Off /"Hot Standby" Mode

The automatic functions can turn off the output of the power supply and leave the HOME contactor closed. This occurs when the end function "Output Off" is selected instead of "Contactor Off". While operating in this mode, the fault testing occurs just as if the power supply were running.

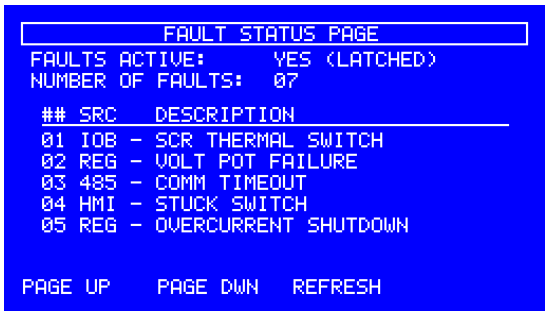
Faults Detected While Fan is in Turn Off Delay

While the power supply is off, but the fan is running in its turn-off delay interval, the HMI will continue to monitor for faults. If a fault is detected, the fan will be shut down immediately, and the fault information screen will be shown.

Since the operator is allowed to navigate the menus and view setting pages while the fan turn-off delay is active, a fault will cause the displayed page to be exited immediately, possibly causing adjustments to settings to be lost.

Fault Status Page

The fault status page can be accessed at any time through the MENU system. If a fault is discovered when the power supply is running, the HMI will automatically jump to the fault status page. A sample page is shown below.



At the top of the page are two summary lines. The first entry is a YES or NO whether faults have been detected. The extra "(LATCHED)" is included to indicate that the faults being described have been latched and stored. This goes away when the stored faults are cleared and the display shows the present status. The second line indicates how many faults have been found. Since it is possible to have more than one fault active, we must allow for many of them to be active at once.

The lower section of the screen is a list of the active faults. We can show five at a time. We number each fault on the left of the line. Next is a three letter code indicating the source of the fault. The codes can be "IOB" for IO Board, "REG" for Regulator Board, "485" for communications problems or "HMI" for problems detected with the HMI itself. To the right of each line is descriptive text identifying the fault. A complete list of all of the faults will be included in a separate document.

Typically you would expect only a single fault condition to be active at a time. However, the fault status screen is designed to show many faults being active at once. The sample screen above is indicating that there are 7 simultaneous faults that triggered a shutdown and were latched. Certain wiring errors, or perhaps a regulator board that hasn't been calibrated, might show up as multiple simultaneous faults.

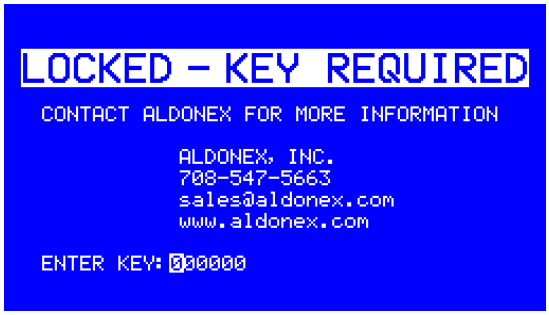
If there are more than five faults, the limit of how many can be shown at one time, the first two Function keys have been assigned "PAGE UP" and "PAGE DWN" (down) functionality. The list of faults will jump up or down five at a time. Pressing down once from the screen shown would present faults 06 to 10.

The third function key has been assigned to "REFRESH" the displayed fault list. A new copy of the active fault information is fetched and the information is updated on the screen. Use the REFRESH button to observe if a fault condition has cleared, or been added.

Premium Features & Key Code Entry Screen

Certain features on the HMI are considered premium features. Aldonex may charge customers additional fees to enable these features. During factory configuration and setup, Aldonex may choose to have this feature initially enabled, or they can set up a 6-digit numeric "key". The four automatic control functions are considered premium features.

If one of the premium features is not enabled, if the customer selects the setting screen from the MENU page for that feature, they will be prompted to enter the key value.

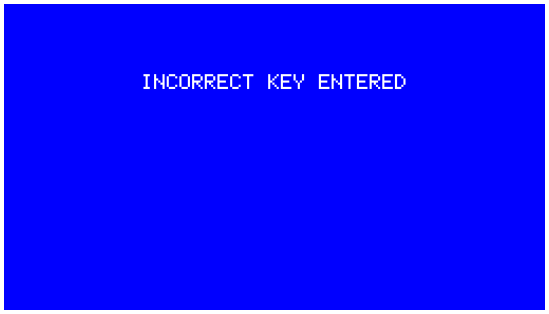


Note how the first digit of the "000000" key prompt is in inverse text. That data field is selected for data entry. That value can be adjusted with the UP and DOWN buttons. The active field can be changed with the PREV and NEXT buttons. When all fields are set with the proper values, the SAVE/ENTER button is pressed to store it. The operator may then use the MENU button to transfer back to the menu and attempt to re-enter the premium feature. If the proper number has been entered, the display will button to the setting screen for that fe

The following features will be configured as premium features for the HMI:

1) Cut-off Timer
2) Amp-Hour Meter
3) Ramp Control
4) Automatic PR Cycle Control
5) Recipe Storage and Recall

If the correct key value is entered, the page will change to the requested destination page. The premium feature key will be cleared, and the feature will be enabled from that point on. If the incorrect key value is entered, the screen will display a failure message, and the screen will return to the MENU page after a short pause.



Setting Clear Prompt

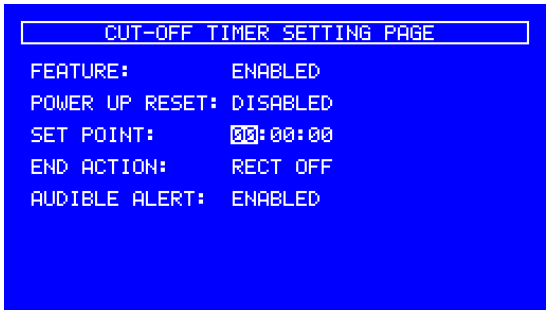
On the HOME page, or on any of the individual setting pages, if the RESET button is pressed and held for 2 seconds, the operator can choose to erase the active settings. From the HOME page, all of the automatic features would be disabled, returning the unit to default manual control. From a specific setting page, all of the settings on that page would be returned to the default values. The HMI will display the following screen to confirm that the operator wants to clear the settings.

From this prompt, a press of the RESET button will reset the settings. Any other key press will cancel the reset. The setting screen will return once a button is pressed. If no buttons are pressed in 5 minutes, the clear is aborted and the original page comes back unaltered.

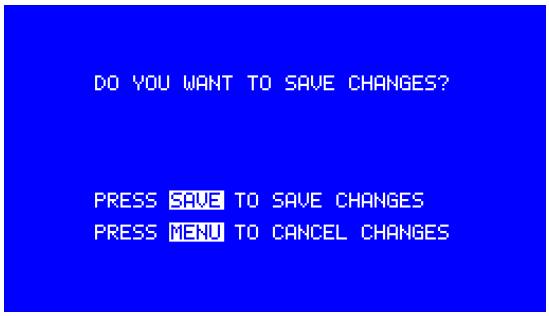
Saving Changes

As fields are modified on the various setting screens, the values are held in temporary memory. That memory will only hold the settings while the setting page is shown. If the operator wants to keep the changes that have been made, the SAVE/ENTER button must be pressed.

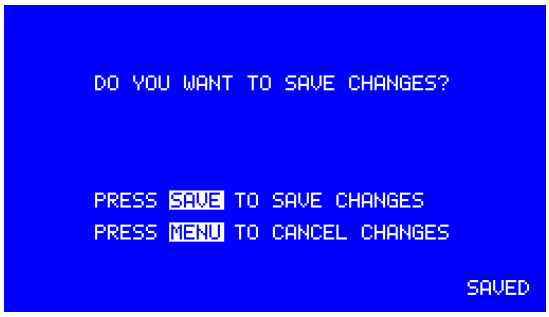
If the SAVE/ENTER button is pressed at any time during the data entry on the setting screen, the word “SAVED” will show up in the lower right-hand corner for 2 seconds. For example, on the setting screen below, the “SAVED” text is in the lower right corner.



If the operator attempts to leave a screen with the MENU button, and there are unsaved changes on the screen, a special prompt will come up asking whether the changes should be saved.



If MENU or HOME is pressed, the screen will exit. If SAVE/ENTER is pressed, the screen will show the "SAVED" text in the corner, delay for 2 seconds, and then the screen will exit.



If no buttons are pressed for 5 minutes, the prompt page exits and the setting screen comes back.

Power-Up Reset & Run-Time Count Values

The automatic control functions have counts and timers associated with them. These run-time values are used to track the time remaining, the active ramp step, amp-hour countdown, etc. These values are used while the power supply is running to track the progress of these functions. Special logic is used to decide when these values are reset to their initial starting conditions.

Each of the automatic control functions can have the Power-Up Reset feature enabled or disabled. When the feature is enabled, the count or timer that is associated with that feature will automatically restart at the beginning each time the power supply is run. When the START button is pressed, that particular feature will always start over. For the Cut-Off Timer, the full cycle is timed. For the Ramp feature, the programmed steps start over with the first ramp on the first step.

When the power-up reset feature is enabled, the counts and timers will be reloaded or cleared when the power supply is stopped.

The features that do not have power-up reset enabled will be left at whatever time/count remaining when the power supply was turned off. If a 10 minute cut-off timer were stopped after 5 minutes, the count would continue to show 5 minutes remaining. When the power supply is restarted, the cut-off timer would continue to count for the remaining 5 minutes.

The operator will be allowed to exit the HOME page and review settings on the various menu pages without resetting these run-time counts. However, if adjustments are made to any of the configuration settings, the run-time counts will be reset. This prevents any conflict between the adjusted settings and the run-time setting values.

Clearing and Restarting Automatic Features

When the Power-Up Reset feature is not enabled, the Cut Off timer or any of the other automatic features will not reload/restart themselves automatically. If the operator attempts to restart the power supply with no time remaining on the count, the power supply will not turn on but will jump immediately to the ALERT notification. If the power supply was halted before the timer had completed its timing of the previous cycle, the next time the power supply is started, it would not execute a full cycle, it would only run for however much time was remaining. To reset the time back to its starting value the operator would press RESET. The following prompt would come up.

From this prompt, the operator can press RESET to clear the count back to its starting value, or press any other button to cancel and leave the values as they were.

Pausing Counts with Current Interrupt

For firmware version C05 the current interrupt feature has been implemented. When the associated input is active, the power supply outputs are dropped to zero. The counts for the automatic features, specifically the Cut-Off Timer, Ramp and Automatic PR, are paused while the input is active. The counts will resume when the input is deactivated again.

Audible Alert Feature

The four automatic functions can individually be configured to sound an audible alarm when they reach their set point count. If the feature is enabled, the beeper on the HMI and the alarm output relay on the IO board will activate.

When activated, the beeper on the HMI and the IO board output relay will both alternate at a (relatively) slow 1Hz rate. This is done to distinguish it from an ALARM condition which uses a faster 4Hz rate for the HMI beeper. Note that the IO board relay output stays on continuously for an ALARM.

If one of the automatic functions is being used, and if that feature has the audible ALERT feature enabled, the beeper and IO relay output will activate at the end of the cycle. The ALERT condition will continue until cancelled by the operator. The operator can cancel the ALERT condition by using either the RESET or the STOP or the START keys.

RESET will always cancel the ALERT.
When not under remote control, STOP will always cancel the ALERT, and will also shut down the power supply while it is running. START, if the power supply is not running, will cancel the ALERT and start the power supply.

Under remote control, if the HMI START and STOP buttons are enabled, they will still operate as described above. If the Run/Stop inputs are being used to start and stop the power supply, de-activating the run/stop signal will cancel the ALERT and turn off the power supply. If the power supply is not running, asserting the run/stop will cancel the ALERT and start the power supply.

When more than one of the automatic functions is being used, each of them may be independently configured for the audible alert enabled or disabled. All combinations are legal. If more than one of the

automatic functions is being used, they may not all have the audible ALERT feature enabled. If the first one that ends does not have it enabled, when the ALERT condition is reached, the beeper and IO board relay output will not activate. Only when an automatic function with the audible ALERT feature enables ends will it be activated.

Voltage Tap Control

Function Key Operation

1. The function key location on the HOME page is dynamic. Its position is determined by filling in spots starting from the left, along with the Manual PR key and the Local/Remote Key. The voltage tap function key is the lowest priority and will be placed to the right of the other two, when they are enabled. The voltage tap control function key can be in position 1, 2 or 3 depending on which keys are enabled.
2. The function key label top line will read “VOLT TAP”. The function key bottom line will show the active voltage tap voltage in whole numbers. The bottom key label will be in the format “#V”, “##V” or “###V” depending on the magnitude of the voltage tap voltage.
3. When pressed, the active voltage tap will increment from Tap #1 -> Tap #2 -> Tap #3 -> Tap #4 and back to Tap #1. The number of displayed taps will depend upon how many have been configured. Only voltage taps that have been enabled through configuration can be selected. Once the final configured voltage tap is shown, the next press of the function key returns the active voltage tap back to Tap #1.
4. The function key is only active when the power supply is off (“rectifier off”). Pressing the function key at any other time will have no effect. It will not operate when the power supply is on or still has a contactor closed (“output off”).
5. The function key label shows a lock symbol when remote control is enabled and voltage tap are configured to be controlled remotely. Pressing the function key while the lock symbol is showing has no effect.

Set Point Adjustment

6. When the voltage tap is changed, if the active voltage set point on the home page is above the active voltage tap voltage, the set point voltage is reduced to the voltage tap voltage. Note that the voltage will never be increased if the voltage tap voltage is higher.
7. On the RAMP setting screen, when setting voltage set points, the maximum setting that will be allowed will be the active voltage tap voltage.

Ramp Interactions:

8. If the RAMP function is enabled, and a voltage set point is set in the ramp/soak sequence which is higher than the presently active voltage tap, the power supply will not be allowed to start. A warning message will be displayed. “Ramp contains voltage settings higher than selected voltage tap. Adjust before running.”
9. When the operator enters the HMI SETUP menu page, the contents of the RAMP settings are analyzed. If there are voltage set points higher than the presently active voltage tap, the set points are reduced. A warning message will be displayed. “Ramp contained voltage settings higher than selected voltage tap. They have been reduced to fit active range.” When exiting the RAMP SETUP page, the operator will have the opportunity to save or discard these changes.

Local and Remote Control

Details of Operation

1. This feature is a factory configurable option. It is not be a Premium feature. It does not have a customer setting screen. The BASIC program used to configure the HMI has been modified to support these additional settings:
    a. LOCAL/REMOTE feature enable/disable.
    b. Remote PR control enable/disable.
    c. Remote voltage tap control enable/disable.
    d. HMI START/STOP buttons operational during REMOTE control enable/disable.

2. If the START and STOP buttons are disabled under REMOTE control, an input on the Digital IO board is used as a RUN/STOP signal from the PLC. It is digital input #13. It will remain active while the power supply is running. The power supply turns off when the input goes inactive. If the START and STOP buttons are enabled, the RUN/STOP input on the Digital IO Board is ignored.

3. When multiple voltage taps have been configured into the HMI, these can be controlled from the PLC if remote voltage tap control is enabled. The PLC controls voltage taps through separate RUN/STOP inputs on the Digital IO board, one for each of the configured voltage taps. If voltage taps have been configured into the HMI, but the remote tap control feature is not enabled, the taps can be manually selected through the function key. In that case, a single RUN/STOP control signal, or the HMI's START and STOP buttons would be used to turn on and off the power supply, depending on configuration settings.

4. A function key on the HOME page is used to select between LOCAL and REMOTE control, as described earlier. When toggled to remote control, there may be other effects on the HOME page, for example, RAMP and AUTO PR may be disabled and removed from the screen. A lock symbol may appear on the manual PR function key. A lock symbol may appear on the voltage tap function key. The manual set points will be replaced by the word "Remote".

5. Certain features on the HMI will be disabled when REMOTE control is active.
    a. Manual voltage and current set points.
    b. Automatic RAMP operation.
    c. Manual and Automatic PR operation will be disabled if remote PR has been enabled.
    d. Voltage Tap selection at the HMI if remote tap control has been enabled.
    e. HMI START and STOP control buttons will be disabled if they haven't been enabled for REMOTE control.

6. Certain features on the HMI will remain available when REMOTE control is active. They will operate like to presently do on the HMI.
    a. Cut-off timer.
    b. AH Meter automatic operation and totalizers.
    c. Manual and Automatic PR operation will be available if remote PR has been disabled.
    d. HMI Soft Start Override
    e. Voltage back-off during polarity changes.
    f. Fan contactor turn-off delay.
    g. All fault input tracking, including E-Stop with powers-supply shutdown if a fault occurs.

7. Control of the set points will be done through the remote analog inputs on the regulator board. These inputs will allow 0-5V, 0-10V or 4-20mA input control. If only one of these will be controlled by the PLC, the other input can be strapped to 100% using jumpers on the regulator board. The J2/J3 jumpers must be in place on the regulator board. The control potentiometer inputs on the regulator board cannot be used for REMOTE control.

8. Other optional inputs on the digital IO board will implement On/Off control, Remote PR control and voltage tap control. The HMI will remain in control of the contactors, pilot light, alarm and PR through relay outputs on the digital IO board.
    a. If the remote PR feature is enabled, an active signal on that input will be interpreted as reverse polarity. If the input is inactive, it will be interpreted as forward polarity.
    b. A maximum of five additional inputs are required on the Digital IO Board: Remote PR, Tap #1 (Main) RUN/STOP, Tap #2 RUN/STOP, Tap #3 RUN/STOP and Tap #4 RUN/STOP. There are presently (6) unassigned digital inputs on the IO board. Note that the digital inputs are electrically arranged in groups of (4) with each group sharing a return. I have assigned the final empty group of (4) to be the RUN/STOP signals.
    c. To keep the Remote PR signal from being electrically connected to a different group of (4) inputs, it will share the input for the Tap #4 RUN/STOP. Aldonex advises that it is rare that four taps are used and the sharing of this input won't typically be a problem. When the remote PR is enabled, only three voltage taps can be controlled remotely.

9. While under REMOTE control, the HMI logic will continue to perform the voltage back-off and soft-start for all PR changes, whether controlled locally or remotely, manually or automatically.

10. The implementation of these features involves changes to the regulator board firmware. It has been changed to allow selective use of the remote analog inputs while still under "automatic" control by the HMI. The combined approach is necessary since the HMI will still retain partial control of the regulator board during REMOTE operation, handling voltage back-off during PR, among other things.

11. Since some of the automatic features are still functional under REMOTE control, we will add the LOCAL/REMOTE setting to the active recipe. The LOCAL/REMOTE setting will be remembered if the HMI is powered down, and then turned back on. If a recipe is stored with the unit in REMOTE control, that setting will be restored when that recipe is loaded.

Additional Details Regarding Run/Stop Control

Under remote control, when the run/stop inputs are used, it is intuitive to expect that the power supply will always be turned on when the run/stop is active. There are some important exceptions to this, however. There are some situations where the run/stop input can be active and the power supply will not be running.

1. If the HMI is powered up with REMOTE control active, and the run/stop signal is active, the power supply will not immediately start. The run/stop must be disabled, then reactivated in order to turn on the power supply.
2. If the HMI is under LOCAL control and the function key is pressed to transfer to REMOTE control while the run/stop is active, the power supply will not start. For safety sake, we don't want to allow the function key to trigger the power supply to start. The run/stop must be disabled, then reactivated in order to turn on the power supply.
3. If a fault occurs and is cleared while the run/stop is high the power supply will not immediately restart when the operator clears the fault and returns to the HOME page. The run/stop must be disabled, then reactivated in order to turn on the power supply.
4. If the run/stop input goes active while the operator is viewing the setting menus the power supply will not start. The operator must return to the HOME page and the run/stop must be disabled, then reactivated in order to turn on the power supply.
5. If one of the automatic functions (ex. Cut-off timer) turns off the power supply while the run/stop input remains active, the power supply will turn off. The run/stop must be disabled, then reactivated in order to turn on the power supply.
6. If one of the automatic functions ends in "OUTPUT OFF" while the run/stop input is high, the power supply outputs will be set to zero, but the main contactor will remain closed. The run/stop must be disabled, then reactivated in order to turn on the power supply. Note that deactivating the run/stop from the output-off condition (main contactor closed) will result in the power supply shutting all the way off (main contactor open). There is no reasonable way that I could come up with that would allow the run/stop input signal restart the power supply from the output-off (main contactor closed) condition.
7. The new Current Interrupt feature, if active, will result in the power supply outputs being held to zero (main contactor closed). This may make it appear that the power supply has not started. There will, however, be an indicator on the HOME page reporting that current interrupt is active. The main contactor and pilot light will also light, indicating a power-on condition.

Cancelling Alerts with Run/Stop Inputs

Under normal (local) operation, the STOP button would normally be used to cancel an ALERT. Under remote control, when the Run/Stop inputs are configured for starting and stopping the power supply, the Run/Stop inputs replace the HMI START and STOP buttons for controlling the power supply. The automatic control functions, such as the cut-off timer, are still available. For example, at the end of a timing sequence, the cut-off timer will activate the alert (light and optional beeper).

The following can be used to cancel the ALERT.

- The STOP button, even though it will not turn off the power supply, will still function to cancel an ALERT.
- When the Run/Stop is de-activated, it will clear the ALERT.
- The RESET button will always be available to cancel an ALERT.

Additional Details Regarding Remote Tap Control with HMI Start/Stop

In this mode of operation, the voltage taps are selected using the run/stop inputs, but they don't start the power supply since the HMI START/STOP option has been selected.

- This mode is enabled by configuring the remote controls settings as follows: Remote Control = enabled, Remote Tap Control = Enabled, HMI START/STOP = Enabled, Remote PR = Don't Care.
- The run/stop inputs are used to select the desired voltage tap, but won't start or stop the power supply by themselves.
- When a run/stop input is activated, the voltage tap identified on the function key label changes based on the voltage of the tap selected. If no run/stop inputs are active, the function key label will remain at whatever voltage tap was selected last.
- In order to get the power supply to start, one, and only one of the run/stop inputs must be active when the START button is pressed. If there are no run/stop inputs active, the power supply will not start.
- The power supply can be turned off with the STOP button.
- The power supply can also be turned off by disabling the run/stop input since one of the run/stop inputs must be active while in this operating mode.

Current Interrupt Function

Details of Operation

1. This function will be assigned to digital input #11.
2. Automatic control functions: cut-off timer, amp-hour meter, ramp or automatic PR control will be paused by the current interrupt, when it is active. They will restart at their current counts when the current interrupt input is deactivated.
3. The text "C-INTR" will be shown on the screen when this input is active. See image below.
4. The current interrupt function will work for both Local and Remote control modes.
5. This feature will not be factory enabled. It will always be enabled and available. If it will not be used for a particular installation, the input will simply not be connected.
6. The current interrupt input will be ignored when the power supply is not running.

Cut-Off Timer

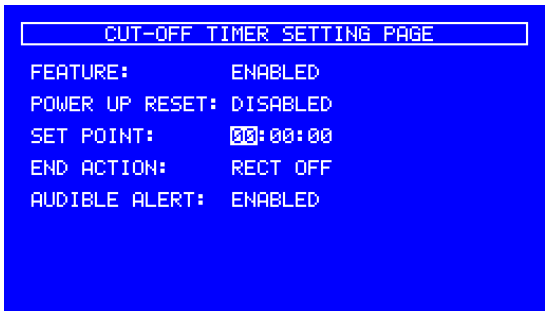
The cut-off timer is a timer that counts down while the power supply is on. When the time reaches zero, the power supply is either shut off, its output is turned off or if the power supply will continue to run (i.e "alert only").

The Cut-Off Timer has the following settings available:

1. Enable/Disable
    a. The feature can be enabled or disabled without changing any of the other settings on the page.
    b. When enabled, the Cut-Off Timer status is displayed on the HOME page. When disabled, the Cut-Off Timer status is not displayed on the HOME page.
    c. The default (reset) condition of this setting is DISABLED.
2. Power-Up Reset Enable/Disable
    a. This setting describes whether the cut-off timer should automatically restart whenever the power supply is turned on (Power-Up Reset enabled), or whether the timer must be manually restarted with the RESET button (Power-Up Reset disabled).
    b. The default (reset) condition of this setting is ENABLED.
3. Timer Set Point
    a. The timer set point is the time that is loaded whenever the timer is reset.
    b. The time is in HH:MM:SS format.
    c. The maximum allowed setting is 99:59:59.
    d. The default (reset) condition of this setting is 00:00:00.
4. End Function
    a. This setting identifies what action should be taken when the time reaches zero after its count down.
    b. Rectifier Off – Full shut down with main contactor open.
    c. Output Off – Regulator board drops output to 0V, 0A. Main contactor stays closed.
    d. Continue– Power supply output is unaffected and continues to run. The normal alert that occurs at the end of the function occurs.
    e. The default (reset) condition of this setting is RECTIFIER OFF.
5. Audible Alert
    a. This setting indicates whether the beeper and the IO Board's alarm output should sound when the cut-off function reaches the end of its timing.
    b. The default (reset) condition of this setting is ENABLED.

The Cut-Off Timer Setting Screen

The Cut-Off Timer feature can be set up using the setting page selected through the menu.



In the example screen, the "hours" data field is highlighted for entry. When the menu page is first entered, the feature "enabled" field will always be highlighted for entry first. Using the PREV and NEXT

buttons, the selected, highlighted entry field can be moved. The fields will highlight in order on the screen, generally from left to right and from top to bottom in a natural progression as the NEXT button is pressed. Pressing the PREV button will move the selection in the other direction.

Operation of Keypad Buttons on Setting Screen

START and STOP	Disabled
MENU	Return to MENU page.
HOME	Return to HOME page.
Function Keys	Disabled
Volts UP and DOWN	Increment and Decrement of the selected entry field.
Current UP and Down	Same as Volts UP and DOWN.
PREV and NEXT	Moves between different entry fields on the screen.
RESET	Short press clears the presently selected entry to its default value.
	Long press (2 Seconds) clears all fields on the page to their default values.
SAVE/ENTER	Saves all values on page to memory.

Cut-Off Timer on the HOME Page

When enabled, the cut-off timer will have its information showing on the HOME page in the information section. The logic controlling the information section of the HOME page will take advantage of the available space. When features are enabled and additional lines of data are added to the information section, it will fill in from the middle line upward and downward. The example below shows what the display would look like with only the Cut-Off Timer enabled.

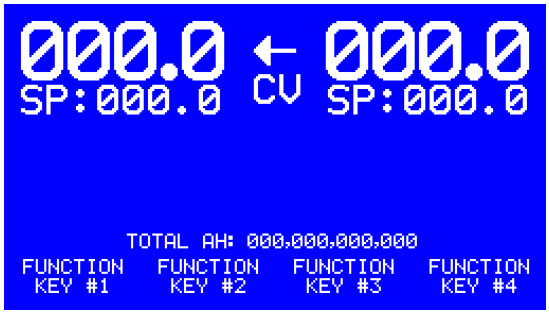
The first time value will be the active count down, counting down while the power supply is on. The second time value is the time set point. At the end of the line, in parenthesis, is the selected end action. In the example, the end action is Rectifier Off.

Amp-Hour Meter

The Amp-Hour function gives the operator access to the Amp-Hour totalizer, and the Amp-Hour metering function.

Amp-Hour Totalizer

The Amp-Hour totalizer is a 12-digit running count of the total Amp-Hours output from the power supply. There are two totalizers. One is the factory AH totalizer and it is not resettable by the customer. The other one is the customer AH totalizer. It can be reset by the customer. When the Amp-Hour premium feature is enabled in the HMI, the customer Amp-Hour totalizer is automatically displayed on the HOME page. It is located near the bottom, just above the function key labels. The totalizer will display in either Amp-Hours (as shown below) or in Amp-Minutes, depending on the units selection on the Amp-Hour setting page.



Amp-Hour Metering Control

The automatic Amp-Hour Meter function allows a specific amp hour (AH) level to be set. When the AH count reaches the set point, the specified action is taken, shutting down the power supply or letting the power supply continue to run. This feature is very much like the Cut-Off Timer function, except that it tracks the power supply AH output and the count increments up to the set point.

The feature allows a six digit count value to be loaded (000,000). The count may be in Amp Hours (AH) or in Amp Minutes (AM).

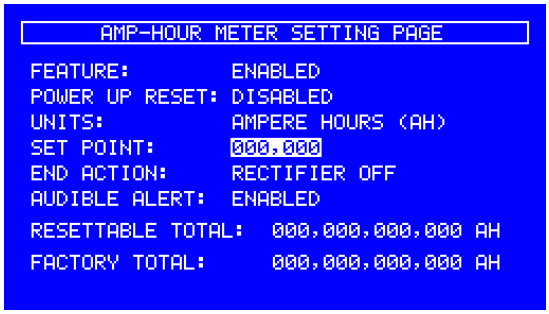
The Amp-Hour Meter Cut-Off function has the following settings available:

1. Enable/Disable
    a. The feature can be enabled or disabled without changing any of the other settings on the page.
    b. When enabled, the Amp-Hour Meter status is displayed on the HOME page. When disabled, the Amp-Hour Meter status is not displayed on the HOME page.
    c. The default (reset) value for this setting is DISABLED.
2. Power-Up Reset Enable/Disable
    a. This setting describes whether the cut-off timer should automatically restart whenever the power supply is turned on (Power-Up Reset enabled), or whether the timer must be manually restarted with the RESET button (Power-Up Reset disabled).
    b. The default (reset) value for this setting is ENABLED.
3. Amp-Hour or Amp-Minutes Units Selection

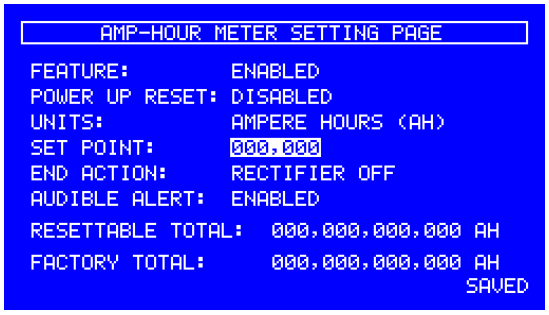
   a. The setting page will allow units of amp hours or amp minutes to be selected. This will affect the rate at which the count decrements. The Amp-Minute count will decrement 60 times faster than the Amp-Hour count under the same conditions.
   b. The default (reset) value for this setting is AMP HOURS.
   c. The Amp-Hour totalizer display on the HOME page will track with this setting. If Amp-Hours are selected, that totalizer will display in units of Amp-Hours. If Amp-Minutes are selected, that totalizer will display in units of Amp-Minutes. The totalizer display will be affected by this setting even if the Amp-Meter feature itself is not enabled.
4. Set Point
   a. The set point is the amp hour count (or amp minute count) that is the end value that the incrementing count is trying to reach.
   b. The count value may have six digits in 000,000 format.
   c. The maximum allowed setting is 999,999.
   d. The default (reset) value for this setting is 000,000.
5. End Function
   a. This setting identifies what action should be taken when the time reaches zero after its count down.
   b. Rectifier Off – Full shut down with main contactor open.
   c. Output Off – Regulator board drops output to 0V, 0A. Main contactor stays closed.
   d. Continue – Power supply output is unaffected, but alert condition is triggered at the end of the count.
   e. The default (reset) value for this setting is RECTIFIER OFF.
6. Audible Alert
   a. This setting indicates whether the beeper and the IO Board's alarm output should sound when the count reaches the set point.
   b. The default (reset) condition of this setting is ENABLED.
7. Customer AH Totalizer
   a. Totalizer can be cleared.
8. Factory AH Totalizer
   a. Count displayed only.

The Amp-Hour Meter Setting Screen

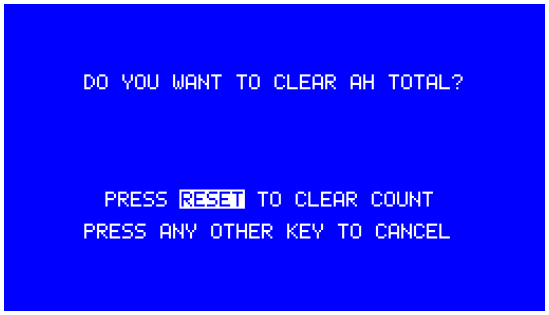
The Amp-Hour Meter feature can be set up using the setting page selected through the menu.



Below we show the “SAVED” display field in the lower right corner. This will be shown only when the SAVE/ENTER button is pressed.

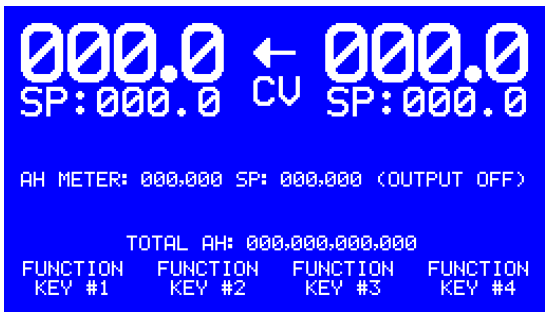


The operator will be able to reset the “RESETTABLE TOTAL” amp-hour totalizer using this screen. The count field can be selected using the PREV and NEXT buttons and the RESET is pressed. The operator will get a prompt screen to verify that the count should be cleared.



Amp-Hour Meter on the HOME Page

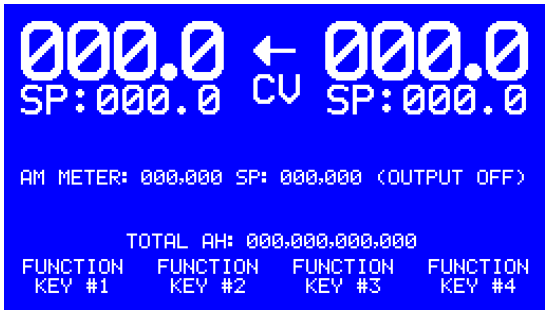
When enabled, the Amp-Hour Meter will have its information showing on the HOME page in the information section.



The first count value will be the active count, counting up to the Amp Hour set point while the power supply is on. The second time value is the set point. At the end of the line, in parenthesis, is the selected end action. In the example, the end action is Output Off.

If the operator has selected Amp-Minutes as the units on the setting page, the screen will have that

indicated in the label field on the left side with “AM” instead of “AH”.



Ramp Function

The HMI will allow a sequence of ramp and soak steps to be programmed. When this feature is running, the output (voltage or current) will ramp up to the set point for a duration programmed. The output will then hold at that level for the soak duration programmed. This may have a single ramp step or be repeated for up to 24 ramp soak steps. At the end of last step, the output can set up to shut off the power supply, bring the output of the power supply to zero, or leave the power supply running.

The Ramp Function has the following settings available:

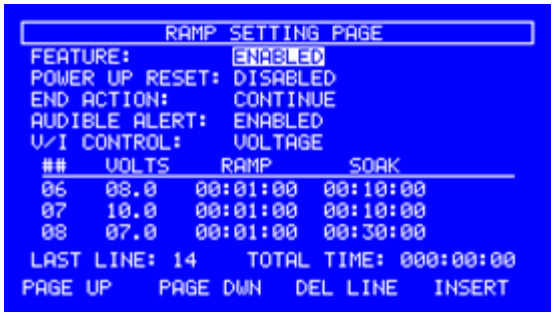
1. Enable/Disable
    a. The feature can be enabled or disabled without changing any of the other settings on the page.
    b. When enabled, the Ramp status is displayed on the HOME page. When disabled, the Ramp status is not displayed on the HOME page.
    c. The default (reset) condition of this setting is DISABLED.
2. Power-Up Reset Enable/Disable
    a. This setting describes whether the ramp sequence should automatically restart whenever the power supply is turned on (Power-Up Reset enabled), or whether the Ramp sequence must be manually restarted with the RESET button (Power-Up Reset disabled).
    b. The default (reset) condition of this setting is ENABLED.
3. Voltage or Current
    a. This setting identifies whether the RAMP sequence will control voltage or current set points. All of the set points must be voltage or current. We do not support switching back and forth at this time.
4. For each step in the programmed sequence:
    a. Target Set Point
    b. Ramp Duration
    c. Soak Duration
    d. The default (reset) condition is Voltage control, set point = 0, both durations = 00:00:00.
5. End Function
    a. This setting identifies what action should be taken when the time reaches zero after its count down.
    b. Rectifier Off – Full shut down with main contactor open.
    c. Output Off – Regulator board drops output to 0V, 0A. Main contactor stays closed.

d. Continue – Power supply output is unaffected, but alert condition is triggered at the end of the count.
    i. Note that the Continue option for RAMP will NOT trigger an Alert when it reaches the end of its count.
e. Repeat – This option is being added for firmware version "C06". When this option is selected, the ramp sequence will start over when it reaches the final step.
    i. Note that the Repeat option for RAMP will NOT trigger an Alert when it reaches the end of its count.
f. The default (reset) value for this setting is RECTIFIER OFF.

6. Audible Alert
    a. This setting indicates whether the beeper and the IO Board's alarm output should sound when the function reaches the end of its timing.
    b. The default (reset) condition of this setting is ENABLED.

The Ramp Setting Screen

The Ramp feature can be set up using the setting page selected through the menu.

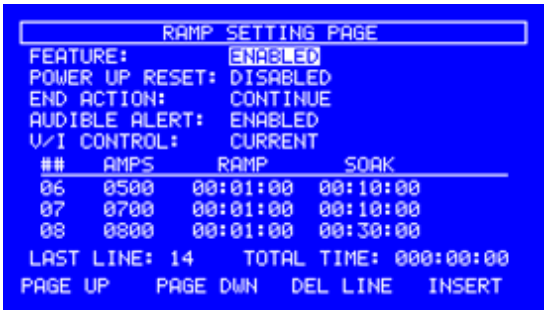


This page is organized as follows:

- The top section of the page shows five entries that relate to the overall function of the ramp. The feature is enabled or disabled, the Power-Up Reset feature is enabled or disabled, the end action is one of three available options: rectifier off, output off or continue, the audible alert is enabled or disabled, and the set points will be voltage or current.
- In the middle section, the screen contains three data lines along with column titles. The operator will be able to use the PREV and NEXT buttons to select the voltage or current, the set point and the ramp and soak times. The UP and DOWN buttons adjust the selected value.
- Just above the bottom is an information line. It identifies the last line of the sequence and the total time for all of the lines entered. (The last line of the sequence is identified by the program by scanning backwards starting at the end of the list. The last line of the sequence is identified as the last line which contains times that aren't zero.)
- At the bottom of the screen are labels for the four function keys. They will all be used by this menu page:
    - PAGE UP shows the previous three setting lines.
    - PAGE DWN shows the next three setting lines.
    - DEL LINE is an editing feature that allows the current line that has a highlighted field to be deleted. All of the lines below will be moved up. (The highlighted field must be on one of the three displayed program lines.)

- INSERT is also an editing feature. It will add a blank line at the current line that has a highlighted field. All of the lines below it will be moved down. (The highlighted field must be on one of the three displayed program lines.)

Note that the column heading for the set point will change depending on the value set for the V/I control. If current is selected, the column heading will be “AMPS” instead of “VOLTS”.



Control of the Three Line Program List

Since the Ramp program can have as many as 24 entries, it is not possible to display the information for all of them on the display at the same time. The display will allow three of the lines to be displayed. The operator will be able to jump up and down the list of program steps using the PAGE UP and PAGE DWN (down) function keys. Pressing either of these will cause the display to jump up or down to the next group of four.

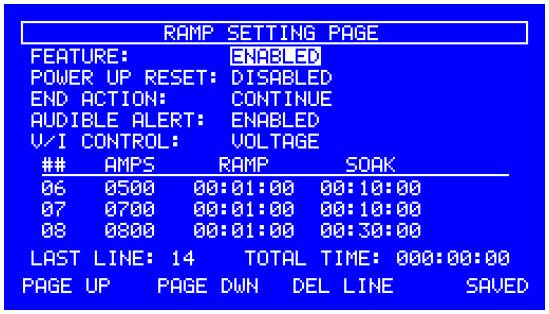
If the presently selected (highlighted with inverse text) data field is on one of the displayed program lines when the PAGE UP or PAGE DWN occurs, the highlighted field will remain in the same position relative to the page, it will not jump to the first or last entry. If the set point for program line 3 is highlighted, and the PAGE DWN button is pressed, the display would have the set point for program line 6 highlighted.

While loading settings into the fields for the program lines, it will be possible to use the NEXT button to jump down to the next group of three. For instance, if the display is presently showing program lines 5 through 8 and the final soak time field for program line 8 is highlighted, and NEXT button is pressed, the display will shift to show program lines 9 through 11 with the V/I setting field highlighted.

The PREV button will do the same thing in the upward direction. Only when the program lines 1 to 3 are showing will the PREV button allow the operator to get back to the three settings at the top of the page: feature enable, power up reset and end action. If the display is presently showing the last four lines (21-24), it might take many presses to get there. The PREV and NEXT arrows will have typematic (auto repeat) enabled to allow more convenient access to all of the information.

Saved Notification

The other setting screens show the word “Saved” at the bottom briefly to indicate when the saving has occurred. Since the Ramp page uses the bottom of the screen for Function keys, this page will handle it slightly differently. When the SAVE/ENTER key is pressed, the function key label on the right will briefly disappear and the word saved will be shown. Two seconds later, the normal function key label display will return.



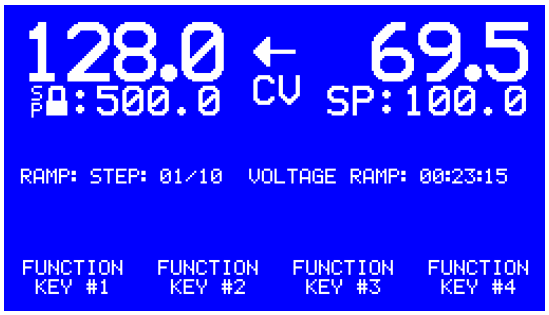
Operation of Keypad Buttons on Setting Screen

START and STOP	Disabled
MENU	Return to MENU page.
HOME	Returns to HOME page.
Function Keys	Page Up, Page Down, Delete Line and Insert
Volts UP and DOWN	Increment and Decrement of the selected entry field.
Current UP and Down	Same as Volts UP and DOWN.
PREV and NEXT	Moves between different entry fields on the screen.
RESET	Short press clears the presently selected entry to its default value. Long press (2 Seconds) clears all fields on the page to their default values.
SAVE/ENTER	Saves all values on page to memory.

Note: If the ramp time and soak time for a line are both zero, the line will NOT be executed by the HMI. It will be skipped. The voltage or current set point on that line will be ignored completely.

Ramp Function on the HOME Page

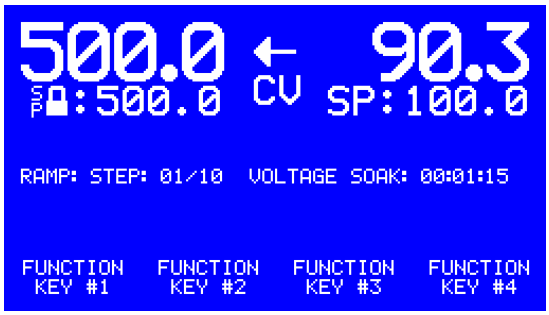
When enabled, the Ramp function will have its information showing on the HOME page in the information section.



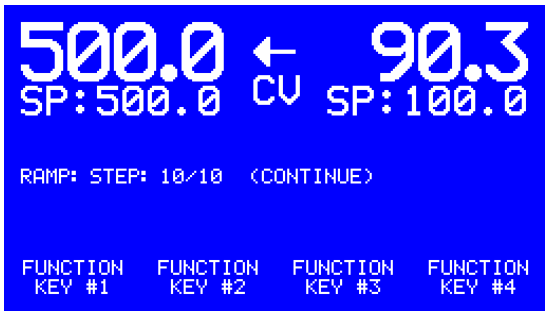
The example shows the following:

- We are on step 1 of 10.
- The step is set up for voltage control.
- We are in the ramping portion of the step with 23 minutes and 15 seconds remaining.
- The voltage set point (that we are ramping up to) is shown as the set point of 500V.
- Since this is a voltage control operation, the voltage set point is shown to be locked.
- The present output of the power supply (voltage) is 128V.
- The current set point is not locked.

Once the ramp portion of the step was completed, the text would show the soak time.



At the end of the sequence, the display would change to show the final action selected. Note that for the Repeat end-action option, the cycle restarts when it reaches the end. In that case it will not display the end-of-sequence display as shown below.



Restarting the Ramp Sequence

When the operator presses the START button to turn on the power supply and execute a ramp program, the program may be starting at the beginning, or it may be re-starting where it left off. When a program is restarting in the middle, the operator will be given some additional options to control how it executes. A prompt screen will be used to give the operator choices on how it should start.
This new prompt screen will come up when the START button is pressed, but only if the Ramp sequence has not been manually or automatically reset to start at the beginning. The following conditions will prevent the prompt screen from being shown:

1) There will be no prompt when the ramp function is not presently enabled.
2) When power-up-reset is enabled, the ramp program will always start at the beginning of step 1. There is no prompt.
3) The operator can reset the ramp count when the power supply is off using the RESET button. If this is done, the ramp program will start at the beginning of step 1 at the next start.

The prompt screen will allow the operator to select the following:

1) Which program step will be executed first. The prompt screen has a data field with the program step number which can be changed by the operator. The data field will be initialized to the step number the power supply was on when it was stopped. If the program had ended, the program step will be 1.
2) The operator may select “Ramp” or “Soak” of the active step.
3) The operator will be shown the time remaining of the selected ramp or soak step. When the prompt screen first comes up, it will show the time remaining for the ramp or soak step that was running when it was stopped. If the program step or the ramp/soak selection is changed, the time will be reloaded to show the full time of that selection. The time displayed can’t be adjusted directly.
4) Pressing the RESET button while this screen is active will clear all settings back to the beginning of the program.
5) The operator will be prompted to press the START button again to begin operation.
6) The operator may press STOP to cancel and leave the page without starting the power supply. The prompt screen will also self-cancel after 5 minutes if there is no keypad activity. When the prompt screen is cancelled, the display returns to the HOME page and no changes are made to any settings.

When a ramp is restarted, the HMI will select initial levels for the voltage and current set points. If the active ramp step is controlling voltage, the voltage initial level will be 0V, the power off level. If the active ramp step is controlling current, the current initial level will be 0A, the power off level. This will affect the ramp operation. The "uncontrolled" output will be left at its present level.

Ramp Interaction with Voltage Taps

When voltage taps can be selected through a function key on the HOME page, there can be conflicts between the settings of the Ramp function and the selected voltage tap. If the Ramp function is enabled, and if voltage is being controlled, and if there are settings within the sequence that are higher than the selected voltage tap, a conflict exists. The ramp sequence cannot run properly with the conflict. The HMI will scan for this conflict situation and react accordingly.

If there is an attempt to start the power supply and a ramp/voltage tap conflict is detected, the following warning screen will be displayed. The power supply will not be allowed to start.

When entering the Ramp setting page, if the setting conflict is found, the following message will be displayed. The voltage settings on the page will be reduced so they don't exceed the selected voltage tap. The operator may choose to save or discard these changed when exiting the page.

Automatic Polarity Reversing

The fourth automatic function is the PR automatic polarity reversing function. This function requires specific configuration of the power supply hardware to allow the feature to work. The HMI controls the polarity reversing function through a relay output on the IO board. In the normal, un-energized state, the polarity direction is forward. When the relay is energized, the polarity direction is reversed.

This function must be enabled by the factory before it is available to the customer. When it is factory enabled, the customer will have access to manual polarity reversal through a function key on the HOME page. The customer may then purchase the premium feature to allow automatic timed control of the polarity.

Polarity Reversing Sequence

When the polarity is reversed, the following sequence is executed by the HMI, Regulator Board and IO Board:

Step 1 - Voltage Drop Interval

Prior to the reversal of the polarity, the output voltage of the power supply is dropped. This prevents cumulative damage to the reversing contactor by reducing the voltage and current carried.

Step 2 – Transfer Interval

During this interval, the HMI is sending a serial command to the IO board to request that the polarity output relay be changed. As originally implemented, this time interval was 0.2 seconds.

Step 3 – Settling Time Interval

During this time interval, the HMI commands the regulator to drop the power supply output briefly is dropped to 0V/0A which will enable a soft-start back to the original set point output level.

Step 4 – Soft Start Back to Operating Levels

Here the HMI commands the regulator to return to the normal operating levels for voltage and current. Because the power supply was briefly shut off, the regulator board uses soft start ramping when returning to the set points.

Other Details

- Regulator output current settings are not changed throughout this sequence.
- The main contactor remains closed during this process.

Manual Polarity Reversing

When the polarity reversing feature is configured for the HMI, the operator will be able to manually control the power supply output polarity through one of the function keys. Also, the present output polarity will be displayed on the HOME page.

The present polarity is always displayed on the upper right area of the Information section. It shows the present status of the polarity output relay.

The "MANUAL PR" control will be assigned to Function Key #1 when the polarity feature is enabled at the factory.

If the MANUAL PR button is pressed while the power supply is running, the power supply will execute the power supply reversing sequence as described above. The active polarity will change to show "POLARITY: REVERSE".

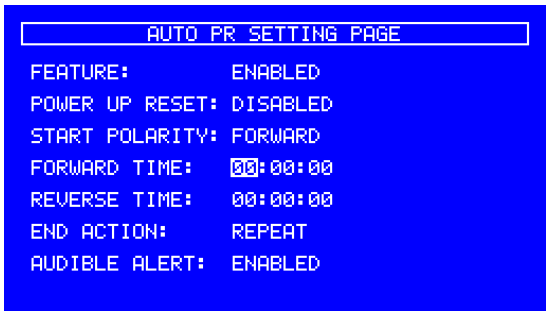
Automatic Polarity Reversing Settings

The HMI will allow the output polarity to be automatically reversed under timer control. The function will have the following settings available:

1. Enable/Disable
    a. The feature can be enabled or disabled without changing any of the other settings on the page.
    b. When enabled, the PR status is displayed on the HOME page. When disabled, the PR status is not displayed on the HOME page.
    c. The default (reset) condition of this setting is DISABLED.
2. Power-Up Reset Enable/Disable
    a. This setting describes whether the function should automatically restart whenever the power supply is turned on (Power-Up Reset enabled), or whether the function must be manually restarted with the RESET button (Power-Up Reset disabled).
    b. The default (reset) condition of this setting is ENABLED.
3. Starting Polarity Setting
    a. The automatic sequence can start with either FORWARD or REVERSE polarity.

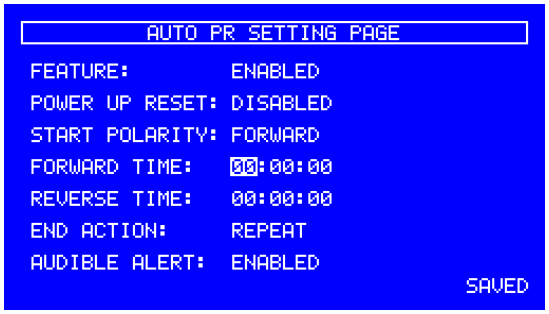
   b. The default (reset) condition of this setting will be FORWARD.
4. First Half Time
   a. This will be the time that the starting polarity is held before reversing. On the setting screen, it will be labeled either “FWR” or “REV” depending on the starting polarity setting.
   b. The time is in HH:MM:SS format.
   c. The maximum allowed setting is 99:99:99.
   d. The default (reset) condition of this setting is 00:00:00.
5. Second Half Time
   a. This is the same as the first half time, but will be the duration that the other polarity is held before we get to the end of the cycle.
6. End Function
   a. This setting identifies what action should be taken when the time reaches zero after its count down.
   b. Repeat – This selection will cause the cycle to automatically restart at the beginning. This is the same as “Flip Flop Operation”. The normal ALERT does not occur.
   c. Rectifier Off – Full shut down with main contactor open.
   d. Output Off – Regulator board drops output to 0V, 0A. Main contactor stays closed.
   e. Continue– Power supply output is unaffected and continues to run at the levels and polarity that were active at the end of the second half time. The normal ALERT that occurs at the end of the function occurs when the second half timer ends.
   f. The default (reset) condition of this setting is RECTIFIER OFF.
7. Audible Alert
   a. This setting indicates whether the beeper and the IO Board’s alarm output should sound when the function reaches the end of its timing.
   b. The default (reset) condition of this setting is ENABLED.

The Auto PR Setting Page



This screen operates like the other setting screens. The example shown has the “SAVED” text displayed. This would only be visible for a couple of seconds after the screen information was saved.

Note that the “Forward Time” and “Reverse Time” labels will swap places depending on the “Start Polarity” setting. Below is an example of the screen with the settings reversed.



The Auto PR Function on the HOME Page

When the PR function is enabled, its information will be displayed on the HOME page.

Depending on which starting polarity was selected, the display will either be like the one above with the forward polarity first, or as shown below with the reverse polarity first.

During operation, the first half timer would count down to zero first. When the first half timer reaches zero, the polarity output reverses and the second half timer begins counting down. When the second half timer reaches zero, the end action is performed. If the action is REPEAT, as shown above, the polarity is returned to the starting polarity, the timers are reloaded, and the cycle starts again.

Manual polarity control will only be available when the automatic polarity control is disabled.

Soft Start

The HMI will include a setting screen to set the soft start rate. The soft start rate will be used to control the ramping of voltage and current when the unit transitions from a Rectifier Off or an Output Off up to the set point levels. The soft start will also be applied when the polarity is reversed and the output is turned back up after the polarity change. Soft start is only applied to rising voltage and current levels. When the output of the power supply is turned down or turned off, the soft start is not used.

There will be two soft start functions running together in the system. The regulator board will have its own soft start that is programmed into it. The regulator board soft start will always be in effect, even when the power supply is operated without the HMI. The HMI soft start will be in addition to the regulator board's soft start. The HMI soft start can be slower than rate programmed into the regulator board, but not faster. The regulator board will always limit the soft start rate to its internal setting.

The soft start rate is set in seconds. The range of adjustment is from 0 (**) to 60 seconds.
Note (**) Although we will allow a setting of 0 seconds, the low limit for the soft start will be determined by the regulator board, as described above.

Soft Start Setting Screen

This screen follows the same operating rules as the other setting screens. The sample above shows the "SAVED" text in the lower corner that will show for two seconds each time the page's settings are saved.

Storing Recipes

The operation of the power supply under HMI control is controlled by a number of settings on several different pages. This includes the following:

1. Set points for voltage and current on the HOME page.
2. Manual setting of polarity on the HOME page (if configured for polarity control).
3. Soft Start setting.
4. Cut-Off Timer control.
5. Amp-Hour Meter control.
6. Ramp control.
7. Automatic PR control.

For convenience, we will allow the operator of the HMI to store all of the present settings and to give it a name. All of the settings together are referred to as a "recipe".

New Recipe Page

The first line of information on this page indicates the location in memory where this recipe will be stored. When this page is opened, the HMI will look through its recipe memory and select the first empty location. The total number of recipes already in memory is shown in the "TOTAL STORED" field.

The recipe storage page allows a 8-character name to be assigned to the recipe. On the sample above, the first character in the name is highlighted and shows an "A". The UP and DOWN arrow keys will allow "A" to "Z" and "0" to "9" along with space characters. The letters are selected one by one. It is not necessary to fill in all 8 characters, the remaining characters will be filled in with spaces.

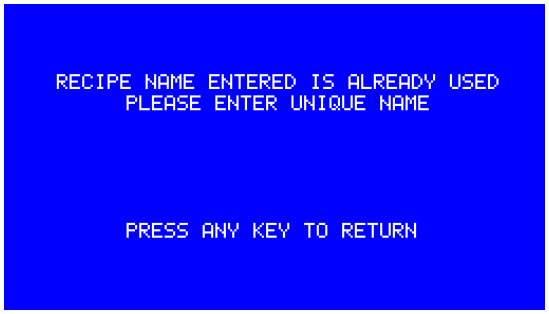
The middle section of the display is a summary of the various settings that are stored with the recipe. In the example above all of the various features that can be individually enabled are shown with all of their data fields. If a particular feature was disabled, it would show up with the word "DISABLED" instead of the setting information.

If the HMI is not factory configured to use a particular feature, or if the premium feature is not enabled, the data line for that feature will be listed as disabled.

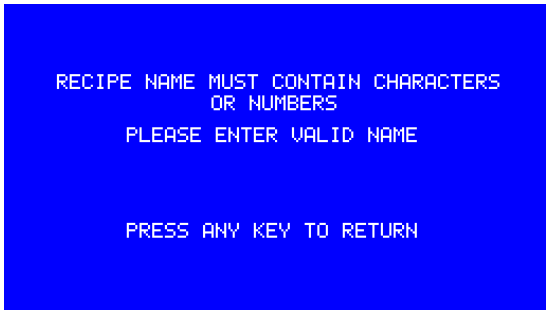
The recipe is stored using the SAVE/ENTER button, just like the settings on the other pages. If the operator attempts to leave the page without saving, they will get the normal prompt to SAVE the data. The example screens above show the "SAVED" text which would come up when the SAVE/ENTER button is pressed.

Name Already Used

All recipes must have unique names with at least one character that is not a space. If the operator attempts to store a recipe using a name that is already used, they will get the following message:



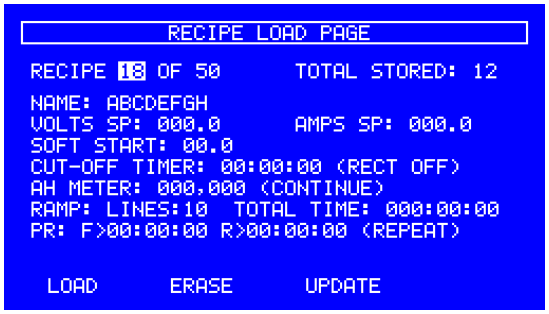
If the operator attempts to store a name that is all spaces, they will get the following screen:



If the operator attempts to enter the recipe storage screen and the recipe memory is full, the following screen will come up:

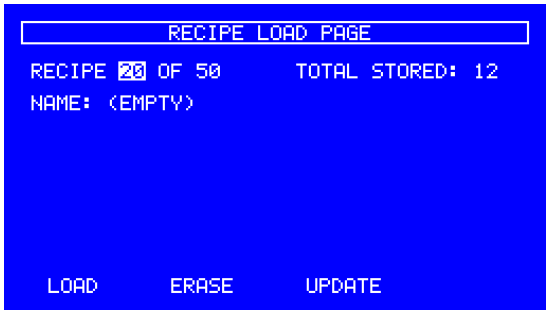
Recipe Recall Page

The following screen will be used to recall recipes.



The recall page looks very similar to the store page. The recipe number is highlighted. By pressing the UP or DOWN buttons, the different stored recipes are accessed. The name and summary information for the stored recipe is displayed.

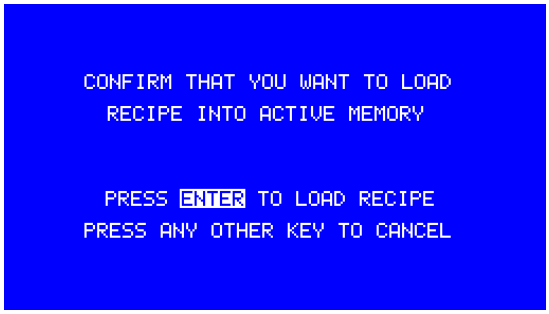
Certain locations in the recipe memory don't have recipes stored in them. They will be identified as "empty".



Loading Recipes

The “LOAD” function key will fetch the data from the stored recipe and hold the values in active memory. After loading the recipe, the operator can go to the HOME page and run the power supply with the settings from that recipe.

Because recalling the recipe will overwrite the settings in active memory, the HMI will prompt the operator to make sure they want to continue.

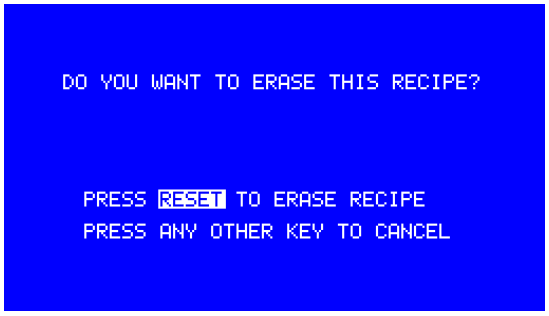


If the ENTER key is pressed, the recipe is loaded and the display jumps back to the HOME page.
If any other key is pressed, the operator is returned to the loading recipe page.

Erasing Recipes

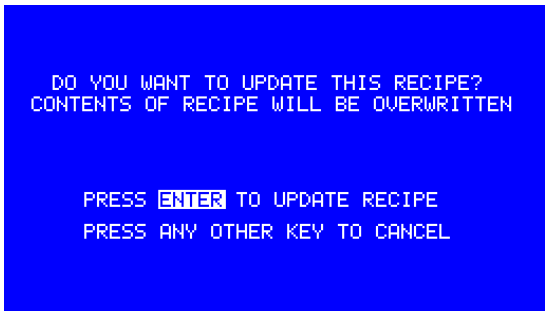
The “ERASE” function allows the operator to manage the recipe memory and erase one of the recipes. The memory space that used to contain the recipe can then be used to store a new recipe. When a recipe is erased, that memory location will shown as “Empty”.

Because erasing a recipe will destroy those settings in memory, the HMI will prompt the operator to make sure they want to continue.



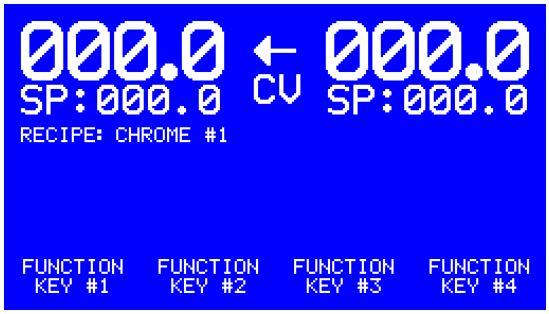
Updating Recipes

The “UPDATE” function allows a recipe to be changed. Pressing the UPDATE function key will cause the settings in active memory to be loaded into the recipe memory under this same name. Sometimes this is helpful when a recipe needs a small adjustment. The recipe can be loaded, adjusted, then updated in memory to capture and store this adjustment without creating a brand new recipe.
Because information is changed in the recipe storage memory, the operator gets the following prompt:



Recipe Name Display on HOME Page

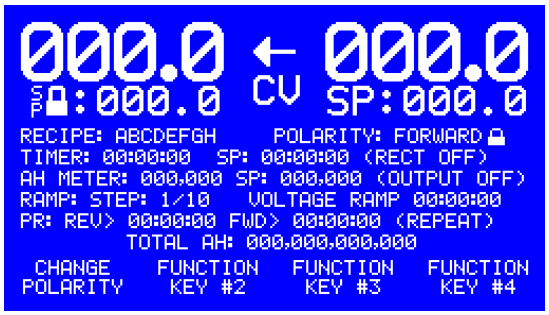
When one of the stored recipes is loaded into the HMI, the name of the stored recipe will be displayed on the HOME page. The recipe name will be displayed in a fixed location on the upper left of the information display area.



The recipe name is displayed when the active settings match the settings in a specific recipe after it is loaded. If any changes or adjustments have been made to the recipe (Cut-off times changed, Amp-Hour meter set point, etc.) the recipe is considered to be modified, and the recipe name is not shown on the HOME page. The recipe name is shown only when the settings have not been modified in any way.

HOME Page with All Functions Active

The various automatic features can be enabled in any combination. The HOME page has been designed to hold all of the associated information at one time. Below is an example of the HOME page with information displayed for all functions enabled at once.



Function Key Assignment – User Configuration

The operation of the function keys from the HOME display page is factory configurable or user configurable. The factory configuration takes precedence. Only function keys that have not been assigned functions by the factory are available for user configuration.

Factory assignments of the function keys include the following:

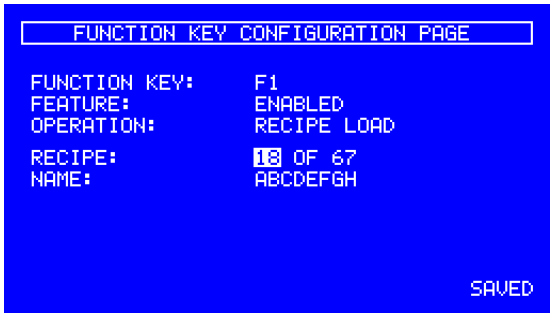
1. Manual Polarity Control.

The user assignment of the function keys may be one of the following:

1. Shortcut to Menu Page
2. Specific Recipe Load

Loading a Recipe

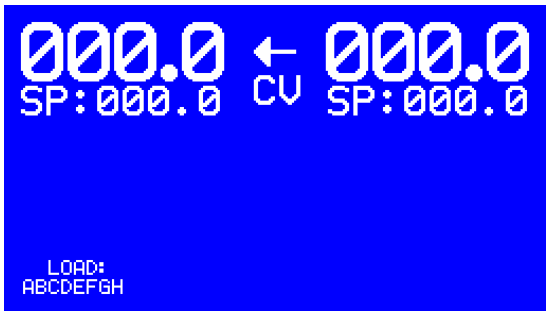
When configuring the function key to load a recipe, the setting page will look like this:



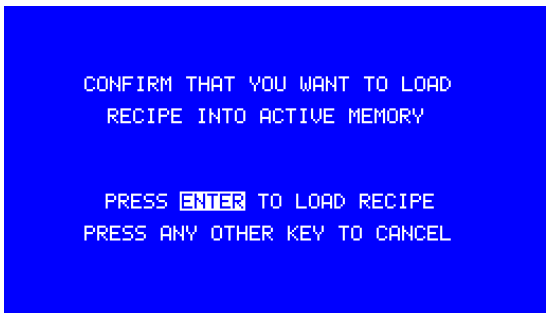
The operator will first select which function key they want to assign. In the screen example above, the function key “F1” has been selected. The screen will only allow the operator to assign function keys that have not been pre-defined by the factory configuration. The function key can be enabled or disabled.

The operation of the button may be for recipe load or to jump to a menu page. In the example above the “RECIPE LOAD” feature has been selected. The user may then step through the stored recipes and identify which one they want to use. The setting is saved using the SAVE/ENTER function, just like the other setting pages.

On the HOME page, the function key assignment will show up as “LOAD:” with the name of the recipe underneath.



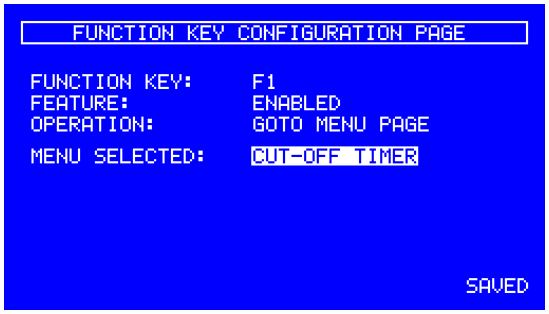
When the function key is pressed, the recipe loading prompt screen would come up, making sure the operator wants to load the new recipe. (This prompt screen was described earlier.)



If the operator presses ENTER, the HOME page will return, now showing the loaded recipe.

Jumping to a Menu Page

The function keys can also be used to quickly jump to regularly used menu pages. This can save several key presses.



Here is an example of the Cut-Off Timer setup menu has been selected. The operator will be able to scroll through the available list of MENU pages. The menu page names will be listed as clearly as possible, limited by our two-line by eight-character function key naming limits. For the cut-off timer example, the HOME page would look like the following:

List of Faults

HMI Internal Faults "HMI"

1 STUCK KEYPAD KEY
2 OTHER

Regulator Board Faults "REG"

1 COMMUNICATION FAILURE
   a. If communications fail after four retries, a 10-second timer is started. While this timer si running, the fault is reported.
2 CURRENT TRIP SHUTDOWN
3 ADC INPUT FAULT
4 DAC OUTPUT FAULT
5 CALIBRATION FAULT
6 AUTO MODE DISABLED
7 REMOTE SWITCHES OPEN
8 OTHER

IO Board Faults "IOB"

1 COMMUNICATION FAILURE
   a. If communications fail after four retries, a 10-second timer is started. While this timer is running, the fault is reported. The timer "extends" the fault, allowing an operator to observe the problem, even though it might be intermittent and short in duration.
2 MAIN STARTER OVERLOAD
   a. Normally closed switch.
3 FAN STARTER OVERLOAD
   a. Normally closed switch
4 MAIN STARTER AUX FTC (Failed to close)
5 MAIN STARTER AUX FTO (Failed to open)
6 FAN STARTER AUX FTC (Failed to close)
7 FAN STARTER AUX FTO (Failed to open)
   a. All four of the AUX contact faults relate to the activity of the two starters, Main and Fan.
   b. A time allowance of one second is allowed after the starter changes position. After the timer expires, the AUX contact inputs are tested for proper position.
8 E-STOP
   a. Normally closed switch.
9 DIODE THERMAL
   a. Normally closed switch.
10 SCR THERMAL
   a. Normally closed switch.
11 TRANSFORMER THERMAL
   a. Normally closed switch.
12 PHASE INDICATOR ERR
   a. Normally closed switch.

13 DOOR INTERLOCK

a. Normally closed switch.

14 Multiple Run/Stop Error

a. Trips if multiple run/stop inputs active simultaneously.