KSI CONVEYORS, INC.
KSi Automation

KSi Liquid Flow Controller
System User's Manual
Seed Count Controller User's Manual

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Do not attempt to operate or maintain this panel(s) until you have read and thoroughly understand all of the safety information contained in this manual. All such information must be taken seriously. This panel contains high voltage which can cause serious injury or death. If you do not understand any part of this manual, seek assistance from your supervisor or call KSi Conveyors, Inc. before operating this equipment.
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1 - Introduction

Document Scope and purpose, and general responsibilities.

Thank you for choosing KSi Conveyors, Inc. for your automation needs. We appreciate your business and will work diligently to ensure that you are satisfied with your choice.

Document Scope & Purpose

This document describes the logic and control functions provided by the control software. It includes sequence of operations for the PLC. It does not cover any equipment controlled by the panel. Safety and other necessary information should be included in the documentation for those specific components.

This manual is not intended to provide instruction on specific applications of the equipment nor on the safety practices common to your industry.

Owner Responsibilities

As the purchaser/owner/integrator of this equipment and control system, you have an obligation to design, install, operate and maintain the equipment in a manner that minimizes the exposure of people in your care to any potential hazards inherent in using this control system and associated equipment. This control panel(s) is a component of a process stream. It works together with other components to form a complete system. It cannot operate as a standalone component. Therefore it is critical that the owner of this equipment and control system:

- Has a clear and documented understanding of the process this panel is being used in, and of any resulting hazards or special requirements arising from this specific application.
- Allow only properly trained and instructed personnel to install, operate or service this equipment.
- Maintain a comprehensive safety program involving all who work with this panel(s) and other associated process equipment.
Establish clear areas of staff responsibility (e.g. operation, setup, sanitation, maintenance and repairs).

Perform an electrical hazard analysis to determine the Incident Energy Exposure to select the level of personal protection equipment and to determine the Flash Boundary. Refer to NFPA 70E for further information.

Provide all personnel with the necessary safety equipment.

Periodically inspect the equipment to insure that the doors, covers, guards and safety devices are in place and functioning, that all safety instructions and warning labels are intact and legible and that the equipment is in good working order.

In addition to the operating instructions, observe and enforce all applicable legal and other binding regulations, national and local codes.

Install the panel(s) in the process stream in accordance with the guidelines outlined in the chapter titled “Installation”.
Operator Responsibilities

As the person with the most to gain or lose from working safely, it is important that you work responsibly and stay alert. By following a few simple rules, you can prevent an accident that could injure or kill you or a co-worker.

- Disconnect, lockout and tagout electrical and all other energy sources before inspecting, cleaning, servicing, repairing or performing any other activity that exposes you to an electrical hazard.

- Do not operate, clean or service this panel until you have read and understood the contents of this manual. If you do not understand the information in this manual, bring it to the attention of your supervisor or call KSi Conveyors, Inc. for assistance.

- Understand and follow the safety practices required by your employer and this manual.

- Do no attempt to perform electrical work if you are not an electrically qualified worker. Know you limitations and do not attempt to perform electrical work beyond what you are capable of doing safely.

- Wear the appropriate personal protection equipment and use the appropriate tools for the electrical work to be performed.

- PAY ATTENTION to what you and other personnel are doing and to how these activities may affect your safety.

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**WARNING**

Failure to follow these instructions may result in serious personal injury or death.
Receiving Your Equipment

As soon as the panel is received, it should be carefully inspected to make certain the unit sustained no damage during shipment and that all items listed on the packing list are accounted for. All damage or shortages should be noted on the Bill of Lading. The purchaser must take immediate steps to file reports and damage claims with the carrier. All damages incurred during transit are the responsibility of the common carrier if the equipment was shipped FOB. Ownership passes to purchaser when the unit is loaded and accepted by carrier. By law, any claims for in-transit damage or shortage must be brought against the carrier by the purchaser.

Handling and Storage of Your Equipment

If the panel is not going to be installed soon after arrival, it should be stored in a dry location to protect against rust and corrosion. The panel is shipped from the factory mounted in a heavy shipping crate to prevent foreign materials and moisture from contaminating the panel during shipping. It is recommended that the panel remain in the crate until just prior to installation. Transport the panel from the unloading site to the installation or storage site by using a forklift or hand-truck. The panel should be picked up by the crate, not by the panel itself.
2 - Safety Information

Alerts, symbols, warnings and cautions for safe operation of the equipment.

Every year, accidents in the work place injure, maim and kill people. Some of these accidents involve electrical shock or arc flash. Although it may be impossible to prevent all accidents, those involving electrocution are completely preventable with the right combination of training, operating practices, safety devices and operator vigilance. The purpose of this section is to help educate panel users about potential hazards, unsafe practices and recommend hazard avoidance techniques.

Do not attempt to operate or maintain this panel(s) until you have read and thoroughly understand all of the safety information contained in this manual. All such information must be taken seriously. This panel contains high voltage which can cause serious injury or death. If you do not understand any part of this manual, seek assistance from your supervisor or call KSi Conveyors, Inc. before operating this equipment.

Signal Words and Symbols

It is very important that operators and maintenance personnel understand the words and symbols that are used to communicate safety information. Signal words, their meaning and format have been standardized for U.S. manufacturers and published by ANSI. The European Community (E.C.) has adopted a different format based on the International Standards Organization (I.S.O.) and applicable machinery directives. Both formats are presented below.
Graphic symbols are not standardized, but most manufacturers will use some variation of the ones seen in this manual.

**DANGER** Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

**WARNING** Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

**CAUTION** Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury and/or property damage.

**SAFETY INSTRUCTIONS** Provides additional information that the operator needs to be aware of to avoid a potentially hazardous situation.

**Mandatory Lockout Power Symbol.** Disconnect, lockout and tagout electrical and all other energy sources before inspecting, cleaning or performing maintenance on this panel.

**International Safety Alert Symbol.** The exclamation point (!) surrounded by a yellow triangle indicates that an injury hazard exists. However, it does not indicate the seriousness of the potential injury. An exclamation point (!) is used with the DANGER, WARNING and CAUTION warnings. When used in conjunction with these symbols the potential injury is indicated.

**Electrocution Hazard Symbol.** This symbol indicates that an electrocution hazard exists. Serious injury or death could result from contacting high voltage.

**Electrocution Hazard Symbol.** (ISO format) This symbol indicates that an electrocution hazard exists. Serious injury or death could result from contacting high voltage points.
Mandatory Lockout Tagout Action Symbol (I.S.O. format). This symbol instructs the operator to disconnect, lockout and tagout all electrical power and other energy sources before inspecting, servicing or cleaning a panel.

Mandatory Read Manual Action Symbol (I.S.O. format). This symbol instructs personnel to read the Operator Manual before servicing or operating this panel.

Mandatory Read Manual Action Symbol. This symbol instructs personnel to read the Operators Manual before servicing or operating this panel.

This symbol indicates that an important maintenance or installation detail is being described. Special notice should be taken to heed the instructions to prevent damage to the equipment.

This symbol indicates that there is an arc flash explosion danger. Arc flash explosions can release tremendous amounts of energy instantaneously. This can propel debris, vaporized metal and extremely hot gases at very high velocities. Serious injuries, burns or death could result from being in close proximity to or in the direct path of an arc flash explosion and the flying debris.
This symbol indicates that appropriate personal protection equipment and clothing are required before inspecting, servicing or cleaning the control panel. Employees must wear and be trained in the use of appropriate protective equipment for possible electrical hazards they may face. Examples of protective equipment could include a hard hat, face shield, flame resistant neck protection, ear protectors, Nomex™ suit, insulated rubber gloves with leather protectors, and insulated leather footwear. All protective equipment must meet the requirements as shown in the latest edition of NFPA 70E. Protective equipment, sufficient for protection against the potential electrical flash, is required for every part of the body. The selection of the required thermal rated PPE depends on the incident energy level at the point of work.

This symbol indicates that only qualified personnel should inspect or service this panel and the connected electrical components. A qualified worker is someone who has the skill, knowledge, and ability to safely perform the work to which they are assigned.
Warning Signs

Warning signs are placed on the panel(s) to serve as reminders to anyone who is working on or near the panel that they must be careful and exercise proper care to avoid serious personal injuries, death or equipment damage. The warning signs that are commonly found on the control panels are described below. These signs should be inspected periodically by the Owner to make sure that all of the warning signs are in place and legible. If any of the warning signs are damaged or become illegible, please contact KSi Conveyors, Inc. for replacement signs.

Arc Flash Sign

This sign is designed to remind personnel working on or near this control panel of the electrical shock and arc flash explosion hazards. It also indicates key hazard avoidance techniques as well as ways to reduce the severity of potential injuries through the use of proper personal protection equipment.
Multiple Power Sources

This sign indicates that the panel may be powered from more than one source. All sources of power must be properly locked out and tagged out before the panel is fully de-energized.

UPS Voltage Sign

This sign indicates that there is an uninterruptible power supply in the panel (UPS) that will continue to provide a power source even if the primary power source to the panel is off. The UPS must be properly locked out and tagged out before the panel is fully de-energized.
Incoming Power Hazard

This sign informs the electrical worker that the incoming power to the panel remains energized even when the main disconnect is in the “ON or “OFF” position. It will remain energized until the panel power source is de-energized and properly locked out.

Panel Clearance Sign

This sign informs the owner that there is an OSHA and NEC requirement that space in front of the panel be kept clear for a minimum of 36 inches. The owner should consult these standards for additional information and guidance regarding this requirement.
Terms

Unless expressly stated elsewhere, the following terms shall have the meanings indicated below.

Alternate Method—A deviation from established procedures or policy that includes compensatory measures that assure equivalent objectives can be achieved by establishing and maintaining effective safety.

Approved—The result of a process implemented by qualified electrical workers or qualified supervisor that control measures effectively mitigate the electrical hazards associated with a task.

Approved Equipment—(1) listed equipment, or (2) unlisted equipment that is acceptable to the qualified workers who designed or will use the equipment and that is approved by Owner.

Authorized Work—Electrical work that a supervisor has permitted the qualified electrical worker(s) to perform based on an approved safe work procedure and appropriate work practices.

Barrier—A physical obstruction that is intended to prevent contact with exposed energized electrical conductors or circuit parts. Barriers can be temporary or permanent.

Clarify—To make codes, standards, and regulations understandable and free from confusion through an oral or written process.

Compelling Reason—The reason for authorizing workers to perform work on or near hazardous energized electrical circuit parts. The reasons include two types:

- increased or additional hazards of de-energizing critical systems; and
- unfeasible due to equipment design or operational limitations (e.g., testing of electric circuits that can only be performed with the circuit energized).

Conductive—Any material suitable for carrying electric current.

Contract Personnel/Worker—Individuals whose services are obtained from subcontractors and who are supervised by the Owner’s employees. Contract personnel are not employees of the Owner.

Critical Systems—Any system which would result in increased or additional hazards if de-energized, e.g., life support equipment, emergency alarm systems, hazardous location ventilation equipment, area lighting.

De-Energized—Free from any electrical connection to a source of potential difference and from electrical charge; not having a potential different from that of the earth. A state in which the conductor or circuit part to be worked on or near has been disconnected from energized parts, locked out and tagged out in accordance with established standards, tested/verified to ensure the absence of voltage, and grounded if determined necessary.

Electrical Hazard—A dangerous condition such that inadvertent or unintentional contact or equipment failure can result in shock, arc flash-burn, thermal burn, or blast.

Electrical Safety—Recognizing hazards associated with the use of electrical energy and
taking precautions so that hazards do not cause injury or death.

**Electrical One-Line Diagram**—A record of all power sources to electrical equipment.

**Electrical Work**—(1) working on or near energized electrical parts; (2) servicing or maintenance of potentially hazardous electrical equipment.

**Electrically Qualified Worker**—A worker who has successfully passed a formal electrical training program and has been determined by his/her supervisor to have the skill, knowledge, and abilities to safely perform the work to which he/she is assigned.

**Energized**—Electrically connected to a source of potential difference, or electrically charged to have a potential significantly different from that of earth in the vicinity. NOTE: “De-energized” parts that have not been verified and locked out and tagged out in accordance with established standards are considered energized.

**Flash Hazard**—A dangerous condition associated with the release of energy caused by an arc that suddenly and violently changes material(s) into a vapor.

**Hazardous Electrical Work**—All electrical operations in which workers may be exposed to an electrical hazard.

**Insulated**—Separated from other conducting surfaces by a dielectric (including airspace) offering a high resistance to the passage of current.

**Listed Equipment**—Equipment that meets nationally recognized standards. All listed equipment is approved for use consistent with the manufacturer’s instructions.

**Live Parts**—Electric conductors, busses, terminals, or components that are uninsulated or exposed and a shock hazard exists.

**Safety Watch**—A safety watch is a more stringent hazard control measure than the two-person rule and shall be implemented when there are grave consequences from a failure to follow safe-work procedures. The safety watch shall be a qualified electrical worker who must be responsible for monitoring qualified worker(s) performing high-hazard electrical work.

**Shock Hazard**—A dangerous condition associated with the release of energy caused by contact or approach to exposed electrical conductors or circuit parts nearer than the minimum air insulation distance.

**Standard Operating Procedure (SOP)**—A document which records the review of an operation to (1) identify the equipment, hazards, and operating limits that are present in the operation; (2) develop control measures that eliminate unacceptable risks; and (3) describe how an operation is to be safely performed.

**Subcontractors**—A party entering into a subcontract with the Owner.

**Two-Person Rule**—The requirement for two qualified electrical workers to be present in the workplace and to be aware of the other worker’s task while performing electrically hazardous work.

**Working Near**—Any activity inside the limited approach boundary or the flash protection boundary (see NFPA 70E) of exposed energized electrical conductors or circuit parts that are not put into an electrically safe work condition.
SAFETY

**Working On**—Coming in contact with exposed energized electrical conductors or circuit parts with the hands, feet, or other body parts, with tools, probes, or with test equipment, regardless of the personal protective equipment a person is wearing.

**100% Rule**—Work on or near energized parts must be performed only after all participating qualified electrical workers are in 100% agreement on the work to be completed, on the sequence in which it should be performed, and that the hazards are fully controlled or mitigated.
Important Codes and Standards for Owners

There are many codes and standards that apply to the owner of this panel. These include both national and local standards and codes. It is the Owner’s responsibility to identify and follow all applicable codes and standards. Listed below are several of the key national standards. This list is not a complete list of all applicable standards.

OSHA 1910.147

Control of this equipment must be in accordance with OSHA Standard 1910.147 "The control of hazardous energy (lockout-tagout)". This standard "requires employers to establish a program and utilize procedures for affixing appropriate lockout devices or tagout devices to energy isolating devices and to otherwise disable machines or equipment to prevent unexpected energizing, start-up or release of stored energy in order to prevent injury to employees". For further information on Lockout-Tagout requirements, see your company’s Safety Director or refer to OSHA Standard 1910.147.

110.16 Flash Protection Field Marking

110.16 Flash Protection. Switchboards, panel boards, industrial control panels, and motor control centers in other than dwelling occupancies that are likely to require examination, adjustment, servicing or maintenance while energized, shall be field marked to warn qualified persons of potential electric arc flash hazards. The marking shall be located so as to be clearly visible to qualified persons before examination, adjustment, servicing, or maintenance of the equipment.

FPN No. 1: NFPA 70E-2000, Electrical Safety Requirements for Employee Workplace, provides assistance in determining severity of potential exposure, planning safe work practices, and selecting personal protective equipment.

FPN No. 2: ANSI Z535.4-2002, Product Safety Signs and Labels, provides guidelines for the design of safety signs and labels for application to products.
NFPA 79

NFPA 79 provides guidance for industrial control panels. The following Emergency Stop definitions come from this standard.

**Emergency-Stop**

Actuators of emergency stop devices shall be colored RED. The background immediately around the device actuator shall be colored YELLOW. The actuator of a push-button-operated device shall be of the palm or mushroom-head type.

**Category-0 Stop**

Where a Category 0 stop is used for the emergency stop function, it shall have only hardwired electromechanical components. In addition, its operation shall not depend on electronic logic (hardware or software) or the transmission of commands over a communications network or link.

**Controlled Stop**

The stopping of machine motion by reducing the electrical command signal to 0 once the stop signal has been recognized by the control but retaining power to the machine actuators during the stopping process. (IEC 204-1 and NFPA 79).
Hazard Review and Safety Instructions

**ARC FLASH HAZARD**

- **DANGER**
  
  Serious injuries, burns or death could result from being in close proximity to or in the direct path of an arc flash explosion and the flying debris.

  Arc flash accidents are most likely to occur during maintenance of the electrical system or when working on or near energized high voltage sources. This hazard does not exist when all electrical power sources have been disconnected, properly locked and tagged out. Serious injuries, burns or death could result from being in close proximity to or in the direct path of an arc flash explosion and the flying debris.

**ELECTROCUTION HAZARD**

- **DANGER**
  
  Severe burns or death may result from contact with exposed high voltage sources.

  Electrocution accidents are most likely to occur during maintenance of the electrical system or when working on or near energized high voltage sources. This hazard does not exist when the electrical power has been disconnected, properly locked and tagged out.

**AUTOMATIC START HAZARD**

- **WARNING**
  
  Equipment controlled by this panel may start without warning, causing serious injury. STAY CLEAR.
Process equipment is usually controlled by an automated system and may start without warning. However, automatic startup by itself is not a hazard. Failure to properly disconnect, lockout and tagout all energy sources while inspecting, servicing or maintaining remotely controlled equipment creates a very hazardous situation. Serious personal injury may result. Always lockout and tagout all process equipment before while inspecting, servicing or maintaining remotely controlled equipment.
3 – Hardware/Software Overview

General Description of the system Hardware and Software

This control system is designed to accurately pump treatment into a treating chamber to applied to seed that is flowing through the treater at a set rate. The operator will enter a desired treatment rate, either in oz/100, oz/unit or mg AI/Seed, for each pump and a seed flow rate and put the system in auto. Once the system has this information, the pump(s) will turn on automatically every time the system gets a signal that seed is flowing applying treatment and the desired rate. This system is designed as a self contained, plug and play solution for any existing or new treating device.
**Hardware**

The hardware included in your Seed Count Controller Package is as follows.

**Main Panel**

This control panel, as shown to the right, houses the Schneider Electric main controller and touch screen. The touch screen is the way that the operator interfaces and controls the system. This panel includes a 10’ 120VAC power cable. Power can be turned on to this panel by plugging it in to 120V and turning on both mini breakers inside panel (see provided electrical schematics for more details).

**IP Pump**

This pump could be either high-rate or low-rate depending on the rate that this pump will be required to achieve. This is plumbed into either the liquid tank or keg and then the system will control of the speed of the pump depending on the feedback from either the flow meter or scale.

**Flow Meter Assembly**

The flow meter is used to determine the flow that the liquid is being applied. The control system reads this flow meter and makes decisions on what speed the pump should run at to accurately delivery the desired flow rate. This flow meter needs to be calibrated every day or every time a new slurry or keg is being used.
**PLATFORM SCALE**

In the case that the system is controlling liquid flow based on loss-in-weight instead of volumetric, a scale is needed. This platform scale is mounted to the liquid controller platform and is tied into a Cardinal readout. The slurry tank or keg is set on this scale and the control system monitors the loss-in-weight on the scale to determine the rate at which the liquid is being applied. Just like with the flow meter, the system then makes adjustments to the speed of the pump so that the correct liquid application rate is achieved.

**SCALE READOUT**

When a scale is being used to control liquid flow, this Cardinal scale readout is used to communicate with the platform scale to determine the weight. The control system then communicates with this readout via an ethernet cable.

**CALIBRATION TUBE**

This calibration tube is used to calibrate the flow meter as well as it is used to determine the density of the liquid when using a scale. From the control system, the operator runs a calibration procedure to calibrate the system.

**PUMP VFD ENCLOSURE**

Each pump (can control up to 4) has an enclosure mounted on the back side of the Liquid Flow Controller assembly that contains the pump VFD. This VFD communicates with the main controller and controls the speed of the pump. This panel includes a 10’ 120VAC power cable that needs to be plugged in before the pump can run.
Software

Following are the main pages within the KSi Liquid Flow Controller system.

**HOME SCREEN**

When the main panel is powered on, the first screen that appears is the home screen, which is shown to the right. Once the system is setup and configured this is the main page that the operator will be working from. From this screen, the operator can turn pumps off or auto and set the system up to run when the seed signal is triggered.

**SYSTEM SETUP**

The system setup screen is where the operator will go to setup tolerances and delays that best match the site and treater that the Liquid Flow Controller will be applying treatment to. This controller can control up to 4 pumps and this page is where the number of pumps connected to the system are setup.

**PUMP SETUP**

This page is accessed by selected on the “Pump X” text on the top of the home page. From this page the operator sets up pump specific settings, such as the application rate and flow meter settings. This is also the page where the flow meter is calibrated from.
4 - Operator Controls

General Description of the operation of the system.

The following pages describe recommended methods for operating the KSi Liquid Flow Controller. This chapter will step you through each of the different pages in this system and give instructions and descriptions of the different fields and values on these pages.
Home Screen

This HOME screen view shows one pump enabled and system status idle.

A. Functions as a header for the following PUMP 1 information and as a button to access the setup screen for PUMP 1. The button is only accessible with this gray view of the header. When the system is enabled and the header is yellow the setup screen is not accessible.

B. Displays the currently calculated target liquid flow in oz/min based on the seed flow, seed size, and the rate defined on the setup screen for this pump.

C. Displays current flow meter reading for this pump in oz/min.

D. Displays current totalized value for this pump in oz.

E. Displays the selected status for a pump. If AUTO is selected as shown then the pump will run at the target rate when the system is enabled and the seed flow sensor is positive.

F. This button must be pressed for 1 second to operate and will reset all pump totalized values to zero. You must go to each individual pump setup screen via button “A” if you wish to only reset one specific pump.
G. Entry for the system seed flow. This is manually determined by the operator prior to system operation and is a constant value, although it can be adjusted while the pump control is on and running.

H. Entry for the current seed size value in seeds per lb. This value is required to correctly calculate flow rate targets when various rate definitions are selected. Refer to the PUMP setup section for further information on different available rate definitions.

I. Master AUTO button enables or disables the system control. As displayed here the system control is disabled and a positive seed flow signal will not turn on the pumps. When this button is green as shown in other screen shots the system control would be enabled and a positive seed flow signal would turn the pumps on.

J. The SETUP button must be pressed for 1 second to activate and will navigate to the SETUP screen where you can select up to four pumps total and adjust other system wide settings.

K. K is pointing to the border around the PUMP 1 information. This border is red when the pump is set to OFF or when it is in AUTO but faulted. This border is yellow when the pump is set to AUTO but is not running. This border is green when the pump is set to AUTO and is running.
System Setup Screen

This SETUP screen view shows one pump enabled and successful communication.

A. Each pump has a header display that indicates if the communication functions for this pump are successful, faulted, or idle. If the pump is disabled then the communication is idle. If the pump is enabled but the communication function does not receive a response from the appropriate pump controller then a communication fault will be displayed. If the pump is enabled and communicating successfully the display will be as shown here.

B. This is a button that enables the communication to a connected pump. As shown pump 1 is enabled.

C. You will notice that the next available pump to enable is pump 2, if pump 2 is enabled then pump 3 button will be displayed and available.

D. If a pump is enabled and you wish to disable it then you must press and hold the RESET SELECTION button for 2 seconds. This will disable all pump communications and allow you to begin your selection back over with pump 1.
E. E,F, and G are all related to defining the conditions that will trigger a fault while the system is actively delivering liquid. The START DELAY is the amount of time the system is given when started to get the actual flow on target. During this time the fault monitor is essentially disengaged.

F. This is the “window” of acceptable fault. As long as the actual flow is within +/- (defined %) of the target then the operation is acceptable.

G. If the application falls outside of the acceptable window for this amount of time then a fault is triggered.

H. This is the amount of time that will elapse after receiving a seed flow signal and before turning the liquid pumps on.

I. This is the amount of time that will elapse after the seed flow signal goes away and before turning the liquid pumps off. Both H and I are intended to compensate for necessary delays that various seed handling equipment may impose on the system.

J. This button must be pressed for 2 seconds and is intended to be used as a tool for KSi support. In case of any condition that causes the processor to stop, it can be started again using this button.

K. The BACK button navigates back to the HOME screen.

L. The SYSTEM button gets the operator into the touch screen system menu. Various operations can be handled here related to the operation of the touch screen but the most common operation will be setting the date and time. Following are two pictures of the System screen. The image below and on the left shows some different setting options that can be adjusted by the operator. The image below and to the right show the date and time setup page where the date and time can be set.
Pump Communications Fault

When a pump is enabled the controller begins communication on the network expecting the additional pump station to be connected, powered, and correctly addressed. If the main controller does not get a response from the appropriate pump station then a fault is triggered. On the setup screen the fault is indicated as shown in (A) in the image to the right.

This communication fault will also be indicated on the HOME screen by flashing the header (A) and auto selector (B) for the faulted pump. The main controller alarm light will also flash. The operator at this point must resolve the communication issue before proceeding.
Pump Setup Screen

This PUMP SETUP Screen view shows tools that are available for each pump.

A. Each pump totalizer can be reset individually by coming to the desired setup screen and pressing this button.

B. This RATE header is also a button that toggles through three possible rate definition selections. As shown OZ/CWT is selected for operation.

C. This is the actual application rate that will be used when OZ/CWT is selected.

D. This is a display for the current flow rate as well as a button to open the flow meter parameters popup window. Press and hold for 2 seconds to open the flow meter parameters window.

E. MANUAL control of the pump. Press once to turn the pump on, press again to turn the pump off again.

F. JOG control of the pump. Press and hold to turn the pump on, release to turn the pump off again.

G. SPEED control of the pump. Press and hold this SLOW button to decrease the pump speed.
H. SPEED control of the pump. Optionally touch on the speed displayed and enter a new speed directly.
I. SPEED control of the pump. Press and hold the FAST button to increase the pump speed.
J. This starts the flow meter calibration column. This is the speed the pump will run during the calibration cycle. (See page 31 for more details on the calibration process)
K. This is the amount of time the pump will run during the calibration cycle.
L. After the speed and time have been set, press START to start the calibration cycle.
M. This is the totalized amount that is calculated during the calibration cycle using a flow meter calibration factor of 1.
N. This is where you will enter the total amount of liquid that was captured in the calibration tube.
O. Several buttons will become available here when required to complete the calibration cycle and calculate operational values.
P. This displays the current CALIBRATION FACTOR. You can manually adjust this value at any time, just note that your manual adjustment will be written over the next time a calibration cycle is performed.
Q. Press and hold the PID button for 2 seconds to open the PID parameter popup window.
Calibration Cycle

This PUMP SETUP Screen shows a calibration process running

A. Once the calibration cycle has been started… the button area and the border of this group of objects turn green. The amount of cycle run time that is left is displayed to the right of the time setting.

B. A CANCEL button is visible during the calibration cycle process. IF needed press and hold for 2 seconds and the calibration cycle will be aborted… stopping the pump and resetting the totalizer. No changes will be made to operational parameters.

Once the calibration cycle is complete a green border will become visible around the second group of objects (A) indicating that you must now enter the actual amount of liquid captured in the calibration tube. The totalized value must be more than 25oz. if less than 25oz an abort button will become visible and is the only option available because a calibration using less than 25oz is not advisable.
**Complete calibration process**

A. As you can see here we entered 75oz as read from the calibration tube. After entering a value greater than 15oz two additional buttons become visible.

B. This is the button to press and hold for 1 second if you want to accept the calibration values. Pressing this button will use known calibration values to calculate three new operational parameters. Calibration Factor, Proportional Gain, and Initial PID Boost.

C. Press and hold this button for 1 second if you decide at this point that you want to abort the calibration cycle and not make adjustments to the operational parameters.

D. The current calibration factor will be displayed here.
Pump Flow Meter Setup

A. This is a header to indicate the purpose of the popup window but is also a button to close the popup window. Press this header to close the window. Press and hold the Manual/Jog header for 2 seconds to access this popup window.

B. This is a display object only and is displaying the raw analog value from the flow meter. C and D can be checked by cycling power on the flow meter and noting the min and max of the analog input as the flow meter boots up.

C. This is the analog count value the controller should expect when there is no flow through the flow meter.

D. This is the analog count value the controller should expect when there is maximum flow through the flow meter.

E. This is the minimum flow in oz that the previous count values represent and is determined by the flow meter settings.

F. This is the maximum flow in oz that the previous count values represent and is determined by the flow meter settings.

G. This is a value set for filtering the analog input and this filtering that happens internally to the controller before the value is displayed. Additional filtering of dAP= .5 should be set in the flow meter for optimal accuracy and performance.
Pump PID Setup

A. This is a header to indicate the purpose of the popup window but is also a button to close the popup window. Press this header to close the window. Press and hold the PID footer for 2 seconds to access this popup window.

B. This is the proportional value and is automatically set and/or adjusted every time a calibration cycle is performed to compensate for system variations that may influence flow characteristics.

C. This is the integral value used for the PID control. It is less critical and is set at a constant value.

D. This is the derivative value and usually not used for most applications encountered by this liquid controller.

E. P SLOPE is a value that is used in the automatic calculation of the PROPORTIONAL value. It is a constant should not be changed unless instructed by KSi.

F. P INTERCEPT is also a value that is used in the automatic calculation of the PROPORTIONAL value. It is a constant and should not be changed unless instructed by KSi.

G. P MIN is this minimum value that can be used for the PROPORTIONAL value. If the system does and automatic calculation that is less than this minimum than the minimum value is used.

H. Initial Boost is automatically calculated when the calibration cycle is performed and gives the controller a starting point for the liquid pump at the beginning of a treatment cycle. This allows the pump to start at a speed to deliver very close to the liquid target immediately when seed flow is sensed. After this initial boost period of two seconds then the PID controller engages and takes over adjusting the pump speed as needed to maintain the target rate.
**Pump Auto Vs. Pump Off**

From the Home Screen, each pump can be set to “AUTO” so that it will run when seed is flowing or set to “OFF” so that it does not run when seed is flowing. In the image above, Pump 1 is set to AUTO and Pump 2 is set to OFF (A). In this case, only pump 1 will run when the system is enabled and seed flow is positive.

The image to the right shows 4 pumps enabled but only pump 1 is in AUTO and ready to run. Pumps 2-4 are enabled but set to OFF so they will not run when seed is flowing.
System Enabled (System Running)

Home Screen View with system enabled (set to run)

A. PUMP headers have changed from gray/white to yellow/green. This indicates that the system is enabled and pump setups can no longer be accessed.

B. Press this button to set the system into AUTO ENABLED. As displayed this system is ready to run pump one as soon as seed flow is sensed.

C. You will notice that the main system SETUP button is no longer available when the system AUTO is enabled.
**Home Screen View with system enabled and SEED IS FLOWING**

A. When the seed sensor detects seed, this “SEED IS FLOWING!” text is displayed and all pumps set to AUTO will run and automatically adjust speed to maintain the target flow rate. All liquid that runs through the flow meter will be added to the totalizer.

B. Displays the target as calculated based on the rate definition, seed flow, and seeds size.

C. Displays the current liquid flow.

D. Displays the current totalized amount since the last RESET function.
System Running (Pump FAULT)

*Home Screen View with system running and an Application Fault has Occurred*

A. You will notice that the border around the pump information is red. If this is red when the pump is in AUTO you can know that an application fault has occurred with this pump. When the system is unable to maintain liquid flow within constrains as defined on the SETUP screen then a fault is triggered. This fault will sound the alarm horn and flash the alarm light. The operator’s first response should be to stop seed flow as soon as it makes the most sense, when seed flow stops both the pump and the alarm horn will also stop. An application fault does not stop the pump! The system will continue to attempt to treat accurately as long as seed flow is indicated.

B. Once the application process has completed you must reset the fault by toggling the faulted pump OFF. You should then determine and resolve the source of the problem before continuing.

C. You will also note that an application fault will make the system AUTO button border red.
Setting Pump Rate

**Pump Rate Definition 1 (OZ/CWT)**

![Image of Pump Rate Definition](image)

A. Pressing the RATE header will toggle to the next RATE definition. The RATE definition that is displayed is the one that is used to calculate the OZ/MIN flow target. In this case the rate definition is in OZ/CWT.

B. Enter here the label application rate of oz/cwt.
**Pump Rate Definition 2 (AI MG/SEED)**

A. Pressing the RATE header will toggle to the next RATE definition. The RATE definition that is displayed is the one that is used to calculate the OZ/MIN flow target. In this case the rate definition is in milligrams of active ingredient per seed.

B. Enter here the label application rate of milligrams of active ingredient per seed.

C. Enter here the label concentration rate of grams of active ingredient per oz.

D. Toggle this button to display and enter a label concentration rate of lbs of active ingredient per gallon.
A. Pressing the RATE header will toggle to the next RATE definition. The RATE definition that is displayed is the one that is used to calculate the OZ/MIN flow target. In this case the rate definition is in ounces per unit.

B. Enter the label application rate of ounces per unit here.

C. This rate definition requires knowing how many seeds per unit, usually 140,000 for soybeans but the value can be changed here to accommodate other unit sizes.