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**BULLETIN
BUL-042**

Safety Direct Controller Operations

As of 2015-03-19 not all features have been implemented. Documentation is actively being developed alongside the firmware and may differ from the loaded firmware.

Introduction

The Safety Direct controller is an independent, hand-held interface for Pronto4 Series 4 (P4S4) and Uomo equipped vehicles. The interface supports a sub-set of the command interactions available on a standard ground control station, to include tele-operation of a vehicle, recording of new paths, and playback of recorded paths. The unit can also serve as an independent, radio-controlled E-Stop.

This document is organized into the following sections:
• Basic Usage – a minimal introduction on using the actual controller
• Controller Functions – details on sensors, functions, and settings related to the controller
• Vehicle Operations – details on operating P4S4 vehicles with the Safety Direct Controller
• Function Tree Reference – a list of all options available via the LCD screen

Non-splash-resistant model

Splash-resistant model

Note that splash-resistant models can easily be identified by their accordion gasket joysticks, the military connector on the bottom, or the rubberized port cover on the bottom.

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Basic Usage

The controller is turned on or off with the toggle switch to the right of the E-Stop (i.e. the big red button).

LCD display and buttons
The main interface for the controller is the LCD display and the buttons to the right of the LCD. The buttons allow the user to navigate the LCD system.

Boot-up
The unit will transition from the splash screen, to a boot-up sequence screen, and to the splash screen automatically. The final splash screen displays the controller's firmware version. From this screen the green checkmark button or the down button can be pressed to access the main menu (as of 2015-03-19, multiple presses may be required). All further directions are referenced from the main menu.

When the LCD displays a menu, there is a cursor (i.e. "❙"), a black triangle (i.e. "►"), or a down arrow (i.e. "↓") on the left side of the screen. In this mode, the buttons can be used to navigate the system as follows:
• up/down buttons – Move up and down, respectively, through the menu options.
• green check button – Select the indicated menu option.
• red x button – Return to the previous menu.

When the LCD displays an interaction option, there is a cursor (i.e. "❙") to the *right* of the selected interaction. In this mode, the buttons function as follows:
• up/down buttons – Move through the available options for the selected interaction; if the option is an incrementing input, then holding the up or down button will rapidly increase or decrease the value.
• green check button – Set the selected value *or*, if there is a preset default value, press and hold the button to reload the default value.
• red x button – Cancel the selected interaction and return to the previous menu.

LEDs
The LEDs to the left of the LCD screen have a common scheme where solid green indicates "good", flashing green indicates "operational, but not good", and red indicates "non-operational". Specifically, the LEDs indicate:
• Robot
   ▪ Solid Green = Ready
   ▪ Red = Not Ready

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- Comms
    - Solid Green = Good
    - Flashing Green = Operational, but poor radio communication
    - Red = Non-operational
- Battery
    - Solid Green = Operational
    - Flashing Green = Low battery, will need do be charged soon
    - Red = Low battery, needs to be charged; *will be non-operational momentarily*
- E-Stop
    - Solid Green = Run
    - Flashing Green = Pause
    - Red = E-Stopped

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Controller Functions

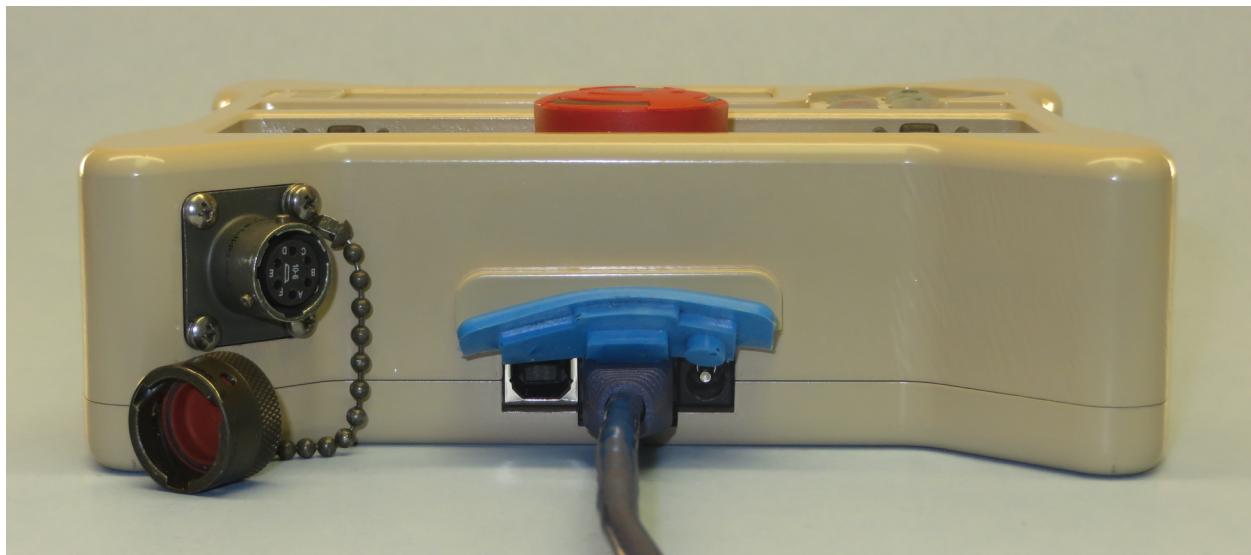The Safety Direct itself has the following input and output hardware integrated into the controller:
• Backlit LCD display
• Ambient light sensor (not available on all models)
• GPS
• 9 Degrees of Freedom (DOF) INU (not available on all models)
• Audible indicator
• Vibration buzzer
• Steering and velocity joysticks

The Safety Direct also has the following connectors integrated into the controller:
• USB
• Ethernet (depending on model, may have 1 or 2)
• 12V 1A input (depending on model, may have 1 or 2)
• Programming switch (in battery compartment; not available on all models)
• Mil connector (not available on all models) with CBL-147 provides alternative power and an additional Ethernet connection
All models have USB, Ethernet, and power connectors on the bottom of the unit. The rubberized cover is not available on all models.

More information, including pin-outs, can be found in the Controller Connections and Pin-outs section, at the end of this document.

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CONTROLLER SETTINGS (not fully implemented as of 2015-03-19)

Controller Configuration Parameters
Main → Tools/Config/Diag → System Functions → Save Parameters *or* Load Parameters
All current controller configuration parameters can be saved and subsequently loaded with the Save Parameters and Load Parameters options.

LCD Display's Backlight
Main → Tools/Config/Diag → System Functions
The LCD can be set to On, Off, or — based on the ambient light sensor — it can be set to Auto.

View the Controller's IP
Main → Communications
The Controller's IP is displayed as the first entry in the "Communications" menu.

Set the Controller's IP Address
Main → Communications → Configure IP Addr
The "Configure IP Addr" menu allows each octet of the Controller's IP address and the subnet mask to be set. The default is 192.168.200.2: 255.255.0.0.

Set the Controller's IP Ports
Main → Communications → Configure IP Ports
The "Configure IP Ports" menu allows both the Controller's Local Port and Remote Port to be modified. The default value for both is 4000.

Set Communication Interface
Main → Communications → Select Interface
The Safety Direct has four integrated communication mechanisms, but is limited to actively using only one at a time. The "Select Interface" menu is used to select the active communication mechanism. The options are: Ethernet, WiFi, ZigBee, and External Serial. If using Ethernet or ZigBee ensure the IP and IP Ports are correctly configured. If using WiFi ensure the IP, IP Ports, and Wifi SSID are correctly configured.

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Select WiFi SSID
Main → Communications → Select WiFi SSID
The "WiFi SSID" menu lists available Wifi networks' SSIDs.

Set the Serial Port communication values
Main → Communications → Serial Port Config
The "Serial Port Config" menu is used to change settings related to Serial Port communication.

CONTROLLER DATA (not fully implemented as of 2015-03-19)

The Safety Direct controller has a range of on-board data collection and communication functions. The following describe how to access the controller data functions. Most data functions can be accessed from the "Tools/Config/Diag" sub-menu.

Controller's GPS Data Stream
Main → Tools/Config/Diag → System Functions
The "View GPS" option displays the controller's GPS data stream

Controller's GPS Positional Data
Main → Tools/Config/Diag → GPS
The GPS screen provides a count of GPS queries to the controller (i.e. scan count), timestamp, latitude, longitude, velocity, and heading data for the controller.

NOTE
If the time value is not incrementing then there is no GPS fix and default values will be displayed.

Controller Orientation
Main → Tools/Config/Diag → Orientation
The Orientation screen provides the following information for the controller:
• Gyroscopic roll, pitch, and yaw (in rotational degrees)
• Acceleration in x, y, and z directions (in linear G-force)
• Magnetism in x, y, and z directions

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Controller Sensors
Main → Tools/Config/Diag → Sensors
The Sensors screen provides the Fahrenheit temperature, light, battery current (in milliamps), and battery voltage for the controller.

View RAM and SEEPROM Contents
Main → Tools/Config/Diag → RAM Contents *or* Pri SEEPROM Dump *or* Sec SEEPROM Dump
The "RAM Contents" and "SEEPROM Contents" menus show the contents of the RAM and SEEPROM, respectively.

DEVELOPMENT VALIDATIONS

The Safety Direct controller has a set of meta-validations to test and demonstrate controller hardware interactions. The following section describes how to access these validations. Most validation functions can be accessed from the "Tools/Config/Diag" *or* "System Tests" sub-menu.

System Activity
Main → Tools/Config/Diag → System Activity
The "System Activity" menu shows the transmit and receive counts for several different data transfer mechanisms.

• "SL" shows the counts for SharedLink messages. These messages include such things as commanded vehicle throttle value (outbound from the controller to the vehicle) or the vehicle's actual GPS position values (inbound to the controller from the vehicle).
• "ID" shows the beacon id messages count. These are messages that are broadcast from individual beacon units, such as Operator Control Units and P4S4 units.

• "ES" shows the E-Stop message count.
• "GPS Scan" shows the count of GPS queries.

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Inputs/Outputs (not fully implemented as of 2015-03-19)
Main → Tools/Config/Diag → Inputs/Outputs
The "Inputs/Outputs" menu shows the current setting of each input device on the controller.

- The joysticks' data are initially shown in hex values (i.e., the "JyLV JyLH JyRV JyRH" line) further down they are shown individually in decimal (e.g., the "LftJoy Vert" line).
- Each joystick can also be used as a pushbutton; this is shown in the "Left Joy Switch" and "Right Joy Switch".
- The left and right motion enable push buttons (i.e., "Left Motion Enb" and "Right Motion Enb") are on the underside of each joystick.

Controller Alert Outputs Validation
Main → Tools/Config/Diag → Output Test
The audio buzzer, vibration motor, and E-Stop button LED functions can be independently validated.

- The vibration motor and E-Stop have two states, represented by even and odd values.
- The audio makes a variety of clicking patterns.
- Unlike navigation elsewhere, the output will change as the user scrolls through values (i.e. the select button does not need to be pressed).

Controller LED, LCD, and Keypad Validation (not implemented as of 2015-03-19)
Main → Tools/Config/Diag → LCD/Keypad Test
The LCD/Keypad Test allows the user to manually test the controller's LEDs and LCD screen.

Backlight Validation
Main → System Tests → Function Tests
The LCD backlight can be turned on or off for validation testing.

User Entry Validation
Main → System Tests → Entry Tests
Each of the possible user data entry tests can be accessed for validation testing. For example, in the "Decimal" test, the user can use the arrow up and down buttons to increment or decrement the decimal value. Holding down the arrow up or down button will increase the rate of incrementing or decrementing.

Pipe Data Transfer Validation
Main → System Tests → Pipe Tests
This is a developmental tool for testing communications.

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Vehicle Operations (not fully implemented as of 2015-03-19)

SAFETY POINT E-STOP ONLY FUNCTION

The Safety Point controller can be used solely as a remote E-Stop. The procedure for doing so follows. For more control of a Pronto4 vehicle refer to the following sub-sections.

1. Perform the standard start-up procedures for the Pronto4 (refer to the system's Operations Manual).
2. Connect the Ethernet cable to the controller and either the radio network or Pronto4 Series 4.
3. Turn the Safety Point controller On/Off switch to the On position.
4. When the controller has successfully booted the LCD displays the standard Kairos Autonomi boot-up screen that includes the firmware version.
5. When the standard boot-up screen is displayed, press the green check or down button to switch to the main menu.
6. Navigate to and select "Safety Point E-Stop" (e.g., main menu → Safety Point E-Stop).
7. The controller is now functioning as a remote E-Stop for all Pronto4 systems within range.

BASIC VEHICLE CHECKS

The basic vehicle checks should be run at least once per day prior to all other checks and operations, and prior to moving the vehicle.

1. Verify all vehicle maintenance is current and documented.
2. On the steering wheel, verify all zip ties or hose clamps are properly located and secure, and are safely secured with F4 self-fusing silicone rubber tape.
3. Determine the appropriate tire pressure for the range and weather conditions. Verify tire pressure is within these parameters.
4. Verify motor oil is the appropriate grade for the weather conditions, and the quantity is within manufacturer's recommended parameters.
5. Verify transmission fluid is within manufacturer's recommended parameters.
6. Verify there are no vehicle fluids leaking from the vehicle.
7. Verify the battery charge is at least 12V or greater. If the battery's charge is less than 12V or the battery fails to retain a charge, replace the battery.

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CAUTION
If the P4S4 system is powered and the vehicle key is set to the "ON" position there is a significant and rapid power draw from the battery. To avoid the battery being drained, the vehicle should be running or connected to an external battery charger whenever possible. Failure to do so will result in the battery being drained below the necessary voltage in less than an hour.

NOTE
An additional battery can be added to each system. Contact Kairos Autonomi for details.

INITIAL SYSTEM SET-UP AND CONNECTIONS CHECKS

The initial system set-up and connections checks should be run after the basic vehicle checks have been completed, prior to the manual operations checks, and prior to moving the vehicle.
1. Safety operator removes vehicle electrical power from the P4S4. This is accomplished either by opening the system blade fuse holder (in the engine compartment) or opening the system power circuit breaker. Vehicle hood may be left open.
2. Safety operator verifies the transmission cable (ACBL-002) is NOT connected to the vehicle's shifter lever.
3. Safety operator verifies all cables are properly connected to the P4S4 as listed in deployment documentation.
4. Safety operator verifies the P4S4 is properly secured into the P4S4 bracket.

WARNING
Failure to secure the P4S4 into its bracket may result in erratic movement of the vehicle which could result in bodily injury or death.

CAUTION
Driving the vehicle without the P4S4 secured in its bracket WILL result in damage to cables and potentially to the P4S4 itself.

5. Safety operator ensures the vehicle's shift lever is in the "Park" position.
6. Safety operator ensures the vehicle's parking brake is engaged.

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MANUAL OPERATIONS CHECKS

The manual operation checks should be run after the initial system set-up and connections checks have been completed, prior to any tele-op operations, and prior to moving the vehicle.

1. Using the vehicle key, safety operator manually starts the vehicle engine, leaving the transmission in "Park".
2. Safety operator manually turns the Vehicle Steering Wheel full left, then full right, then back to center.
3. Safety operator verifies that the steering wheel and steering ring does not bind throughout the whole range of motion.
4. OCU operator or another outside observer verifies that the front wheels steer freely lock-to-lock.

NOTE
If range of motion is not smooth, check bearings for free movement, and steering wheel tilt for appropriate angle.

5. Using the vehicle key, safety operator manually turns off the vehicle engine, leaving power on (i.e. vehicle auxiliary powered).

P4S4 START-UP

The system start-up should be run after all manual checks have been verified, and prior to moving the vehicle. All steps in the system start-up are performed by the safety operator.

1. Ensure safety operator is in the driver's seat, with seat belt secured, clear of all controls, including the steering wheel, and in a position to activate controls, including the brake pedal.
2. Ensure switches are in the following states:
   a. VIM E-Stop is NOT activated (i.e., not depressed). Rotate the red button 1/4 turn clockwise and up to release, and to verify the E-Stop is not depressed.
   b. VIM ON/OFF switch is in the "OFF" position.
   c. VIM AUTO/MAN switch is in the "MAN" position. The "MAN" position is in the center of the AUTO/MAN switch.
   d. VIM PAUSE/RUN switch is in the "RUN" position.
3. Apply power to the P4S4 and verify that the system boots up normally as follows:

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   a. Safety operator applies vehicle electrical power to the P4S4. This is accomplished either by connecting the system blade fuse holder or closing the system power circuit breaker.

   b. Close vehicle hood. Verify hood is securely closed.

   c. Ensure safety operator is in the driver's seat, with seat belt secured, clear of all controls, including the steering wheel, and in a position to activate controls.

NOTE
From this point on, for all operations — except live missions or training missions at speeds above 15 MPH — the safety operator should be in the driver's seat, clear of all controls, and in a position to activate controls.

WARNING
During tele-operations, the safety operator shall keep hands away from the steering wheel. Failure to do so can cause injury to the operator's hands and arms.

WARNING
During tele-operations, the safety operator shall be prepared to engage the foot brake, VIM E-Stop, and VIM pause switch. Failure to do so can result in bodily injury or death.

   d. Turn the vehicle ignition key to the auxiliary power option (e.g., On).

   e. Verify the transmission cable is NOT connected to the vehicle shifter.

   f. Switch the VIM ON/OFF switch to the "ON" position.

   g. Verify that there are NO LED indicators on the VIM.

   h. Verify that the following LEDs are lit on the P4S4:
      i. Batt OK
      ii. 6vdc OK
      iii. 12vdc OK
      iv. UPS OK
      v. PWR switch

NOTE
The LEDs listed MUST be lit; other LEDs may be illuminated.

Safety Direct Controller Pre-Op Checks and Calibrations

8. Turn the controller On/Off switch to the On position.

9. When the controller has successfully booted the LCD displays the standard Kairos Autonomi boot-up screen that includes the firmware version.

10. When the standard boot-up screen is displayed, press the green check or down button to switch to the main menu.

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11. Connect the Ethernet cable to the controller and either the radio network or Pronto4 Series 4.
12. Switch the VIM to AUTO.
13. On the controller, login to the vehicle, as follows:
    a. Navigate to and select the desired vehicle (e.g. Available Assets → *Vehicle number*).
    b. Navigate to the Login into Asset [sic] option and select it.
    c. Navigate back to the main menu (i.e. press the red X button twice).

NOTE
All subsequent procedures presume a specific vehicle has been logged into.

14. On the controller, enable the engine, as follows:
    a. Press *and continue holding* one of the deadman buttons (i.e. Motion Enable buttons).
    b. Navigate to and select the "Engine Enable" option (e.g. Main → Select Operations → Tele-Op Vehicle → Tele-Op Start → Engine Enable).
    c. Verify there is an audible soft click from the Pronto4 unit.

NOTE
If the Pronto4 has not previously been commissioned for the vehicle or there has been maintenance that may impact previous commissioning, then perform the procedures covered in the "P4S4 Commissioning" document before continuing.

15. On the controller, verify operation of the throttle, brake, and transmission servos, as follows:
    a. Ensure the transmission cable is NOT connected.
    b. Ensure the vehicle engine is NOT running.
    c. Press *and continue holding* one of the deadman buttons (i.e. Motion Enable buttons).
    d. Navigate to and select "Shift to Drive".
    e. Verify the following happen in order:
        i. The vehicle brake is fully engaged by Pronto4.
        ii. The transmission servo arm rotates to the drive position.
        iii. The vehicle brake is fully disengaged by the Pronto4.
    f. Navigate to and select "Shift to Park".
    g. Verify the following happen in order:
        i. The vehicle brake is fully engaged by Pronto4.
        ii. The transmission servo arm rotates to the park position.
        iii. The vehicle brake is fully disengaged by the Pronto4.
    h. Press and hold the right joystick 100% down (i.e. fully engage brake).

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   i.   Verify the brake servo is fully engaged by the Pronto4.
   j.   Release the right joystick.
   k.   Verify the brake servo is fully disengaged by the Pronto4.
   l.   Press and hold the right joystick 100% forward (i.e. fully engage throttle).
   m. Verify the throttle servo is fully engaged by the Pronto4.
   n.   Release the right joystick.
   o.   Verify the throttle servo is fully disengaged by the Pronto4.
16. Start the engine, as follows:
   a.   Navigate to and select "Engine Start" (e.g., red x → Teleop Vehicle → Engine Start).
   b.   Verify the engine starts.

WARNING
The "Cal Steering" option may cause steering wheel movement. Failure to keep clear of the steering wheel could result in injury.

17. Calibrate the steering, as follows:
   a.   Ensure the vehicle's wheels are aligned straight ahead.
   b.   Press *and continue holding* one of the deadman buttons (i.e. Motion Enable buttons).
   c.   Navigate to and select "Cal Steering" (e.g., Tele-Op Vehicle → Cal Steering.
18. Verify the steering, as follows:
   a.   Press *and continue holding* one of the deadman buttons (i.e. Motion Enable buttons).
   b.   Press and hold left joystick fully to the left.
   c.   Verify vehicle tires reach left limit.
   d.   Release the left joystick.
   e.   Verify vehicle tires return to straight.
   f.   Press and hold left joystick fully to the right.
   g.   Verify vehicle tires reach right limit.
   h.   Release the left joystick.
   i.   Verify vehicle tires return to straight.
19. Hold a deadman, verify that the Pronto4 brake releases, and engage the E-Stop. Verify:
   a.   Brake on the Pronto4 immediately goes to 100%.
   b.   Engine on the Pronto4 disables.
   c.   LED on Safety Direct turns from Green to Red.
   d.   Speaker on Safety Direct begins clicking.

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20. Verify that the Safety Direct can no longer control the actuation on the vehicle using the joysticks
21. Release the E-Stop. Verify:
    a. Brake on the Pronto4 goes to 0%.
    b. LED on Safety Direct turns from Red to Green.
    c. Speaker on Safety Direct stops clicking.
22. Verify that actuation control has returned to the Safety Direct via joystick control.
23. Hold a deadman, verify the Pronto4 brake releases, and engage the Pause switch. Verify:
    a. Brake on the Pronto4 ramps to 100%
    b. Engine on the Pronto4 stays enabled
    c. LED on Safety Direct turns from solid Green to flashing Green
24. Verify that the Safety Direct can no longer control the actuation on the vehicle using the joysticks
25. Toggle the Run switch to Run. Verify:
    a. Brake on the Pronto4 goes to 0% after approx 3 secs
    b. LED on Safety Direct turns to solid Green
26. Verify that actuation control has returned to the Safety Direct via joystick control.
27. Hold a deadman, verify brake releases, shift to Drive, and then release deadman. Verify:
    a. Brake on the Pronto4 ramps to 100%
    b. The transmission servo arm rotates to the park position.
    c. Engine on the Pronto4 stays enabled.
28. Verify that the Safety Direct can no longer control the actuation on the vehicle using the joysticks without deadman.
    a. Without holding a deadman, press and hold right joystick fully forward then fully back.
    b. Verify no vehicle throttle or brake applied.
    c. Without holding a deadman, press and hold the left joystick fully left then fully right.
    d. Verify no tires turn.

MISSION PRE-OP CHECKS

The following checks should be performed prior to starting each mission.

1. Vehicle's parking brake is engaged.
2. Vehicle has no operational discrepancies, damage, servicing needs, or maintenance requirements.
3. Vehicle has, at a minimum, sufficient fuel of the proper density for the mission.

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4. Vehicle heat or air conditioning is set according to mission and range requirements.
5. Vehicle's VIM E-stop is NOT activated.
6. Any other vehicle E-stops (e.g., wired E-stop on tailgate) are NOT activated.
7. Transmission cable is NOT connected.
8. VIM switches are:
   a. ON
   b. RUN
   c. MAN

PATH RECORDING (not fully implemented as of 2015-03-19)

To use path playback features, the paths must be recorded.

1. Ensure the vehicle is in a state to be manually driven, as follows:
   a. Ensure the VIM switches are:
      i. ON
      ii. RUN
      iii. MAN
   b. Ensure the Transmission Cable is NOT connected.
2. On the controller, navigate to and select the "Record Path" option (e.g., Main → Select Operations → Path Following → Record Path).

NOTE
Path #0 is a scratchpad path and is NOT saved. Paths #1-9 are saved. For example, path #0 can be recorded and immediately replayed, but if the controller is turned off then the recorded path may not be playable.

3. With the "Record Path" number blinking, use the up and down arrow buttons to select the desired path number, then use the green check button to set the value.
4. Navigate to and select "Record Start".
5. Drive the desired path either manually or via tele-op.
6. When the path is completed, navigate to and select "Record Complete". The path has now been recorded and can be played back.

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BULLETIN
BUL-042

PLAYBACK - SINGLE (not fully implemented as of 2015-03-19)

The following procedure will allow a single previously recorded path to be played back, either at the speeds recorded or a single set speed.

1. Ensure the vehicle is in a safe state, as follows:
   a. Ensure the VIM switches are:
      i. ON
      ii. RUN
      iii. MAN
2. Ensure the Transmission Cable is NOT connected.
3. On the controller, navigate to the "Playback Single" option (e.g., Main → Select Operations → Path Following → Playback Single.
4. With the "Playback Single" number blinking, use the up and down arrow buttons to select the desired path number, then use the green check button to set the value.
5. Select the Playback Speed, as follows:
   a. Navigate to either "Set Speed to Actual" or "Set Speed". Actual will replay the path at the speeds recorded, while "Set Speed" will take a single input speed to replay.
   b. If using "Set Speed", with the last number blinking, use the up and down arrow buttons to select a desired playback speed.
   c. Use the green check button to set the desired playback speed value.
6. Set the vehicle into a playback state, as follows:
   a. Connect the Transmission Cable.
   b. Ensure the VIM switches are:
      i. ON
      ii. RUN
      iii. AUTO
7. Navigate to and select "Single Path Start".
8. When the vehicle has completed playback, set the vehicle back to a safe state, as follows:
   a. Ensure the VIM switches are:
      i. ON
      ii. RUN
      iii. MAN
   b. Disconnect the Transmission Cable.

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PLAYBACK – MULTI (<mark>not fully implemented as of 2015-03-19</mark>)

The following procedure will allow three previously recorded paths to be played back sequentially with the middle path looping until instructed to egress.

1. Ensure the vehicle is in a safe state, as follows:
   a. Ensure the VIM switches are:
      i. ON
      ii. RUN
      iii. MAN
   b. Ensure the Transmission Cable is NOT connected.
2. On the controller, choose the three paths, as follows:
   a. Navigate to and select "Ingress Path".
   b. With the "Ingress" number blinking, use the up and down arrow buttons to select the desired path number, then use the green check button to set the value.
   c. Navigate to and select "Loop Path".
   d. With the "Loop" number blinking, use the up and down arrow buttons to select the desired path number, then use the green check button to set the value.
   e. Navigate to and select "Egress Path".
   f. With the "Egress" number blinking, use the up and down arrow buttons to select the desired path number, then use the green check button to set the value.
3. Set the three paths' speeds, as follows:
   a. Navigate to and select "Set Ingress Speed".
   b. With the "Set Ingress Speed" number blinking, use the up and down arrow buttons to select the desired path number, then use the green check button to set the value.
   c. Navigate to and select "Set Loop Speed".
   d. With the "Set Loop Speed" number blinking, use the up and down arrow buttons to select the desired path number, then use the green check button to set the value.
   e. Navigate to and select "Set Egress Speed".
   f. With the "Set Egress Speed" number blinking, use the up and down arrow buttons to select the desired path number, then use the green check button to set the value.
4. Set the vehicle into a playback state, as follows:
   a. Connect the Transmission Cable.

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    b. Ensure the VIM switches are:
        i. ON
        ii. RUN
        iii. AUTO

5. Navigate to and select "Multi Path Start". The vehicle will drive the previously recorded ingress path then pause.

6. When the vehicle should run the loop path, set the controller to pause then back to run. The vehicle will drive the loop until instructed otherwise.

7. When the vehicle is in the last 10% of the last looped path, set the controller to pause for more than two (2) minutes, then set it back to run. The vehicle will drive the egress path.

8. When the vehicle has completed playback, set the vehicle back to a safe state, as follows:
    a. Ensure the VIM switches are:
        i. ON
        ii. RUN
        iii. MAN
    b. Disconnect the Transmission Cable.

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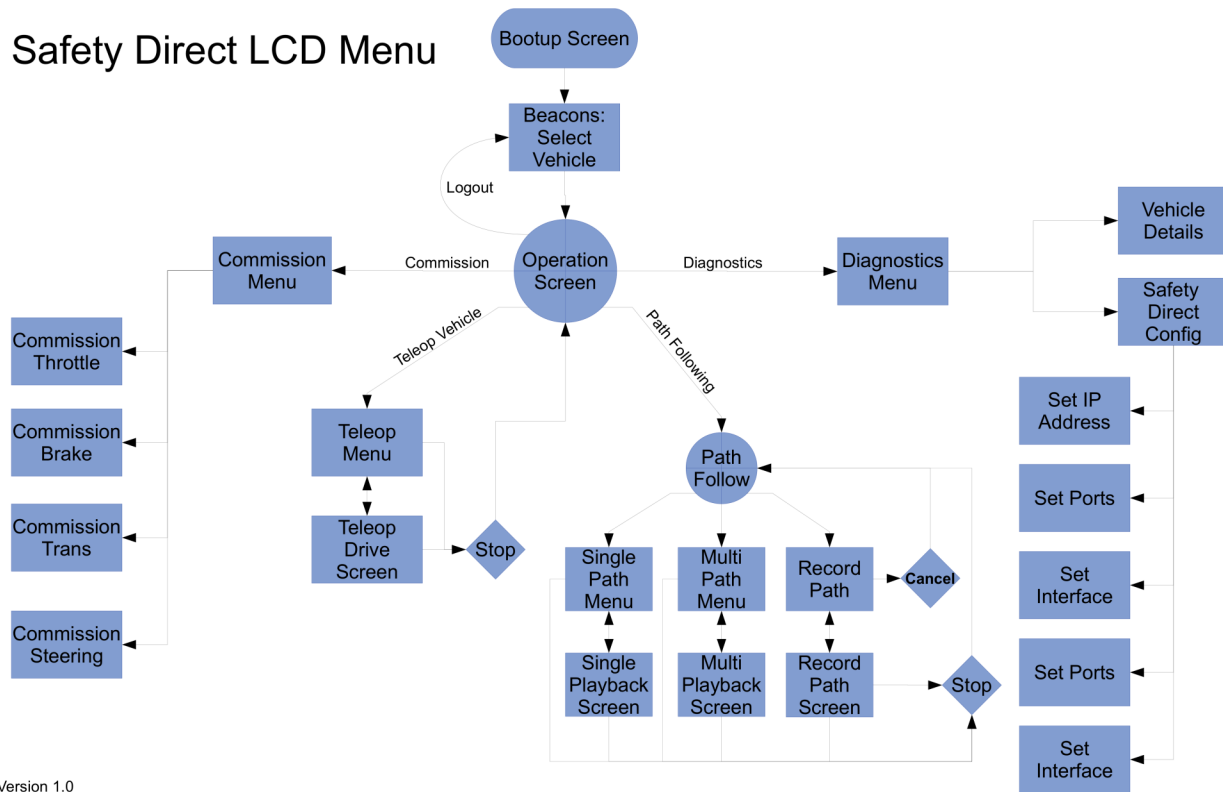2015-03-19 / 14:57
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Safety Direct LCD Menu

Version 1.0

Proposed Function Tree Reference (as of 2015-03-19 not all features have been implemented)

Safety Point E-Stop

Available Assets
        #:Asset
                Asset Name
                Asset IP
                Asset Count (vehicle's auxiliary asset count)
                Login
                        ID
                        IP
                        ##
                Login into Asset
                Logout of Asset

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Select Operations (must be logged into an asset)

Teleop Vehicle
- Teleop Start
- Teleop Stop
- Engine Enable
- Engine Start
- Engine Disable
- Cal Steering
- Force Zero Steering
- Shift to Drive
- Shift to Neutral
- Shift to Reverse
- Shift to Park
- Go to Teleop Screen

Path Following
- Playback Single
  - Single Path
  - Set Speed
  - Single Path Start
  - Path Stop
  - Path Abort
  - Path Pause
  - Set Speed Actual
  - Start at Beginning
  - Start at Current
  - Seamless Tele Off
  - Seamless Tele On
  - Assisted Tele Off
  - Assisted Tele On
  - Course Forward
  - Course Reverse
  - Travel Forward
  - Travel Reverse
  - Goto Sing Path Scrn

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Playback Multi
Ingress Path
Loop Path
Egress Path
Multi Path Select
Multi Path Start
Path Stop
Path Abort
Path Pause
Set Ingress Speed
Set Loop Speed
Set Egress Speed
Goto Multi Path Scrn

Record Path
Record Path (path number)
Record Path Start
Record Path Stop
Go to Record Screen

Commission Vehicle
Throttle
Throttle Pos (0-1000; default 0)
Set MIN Throttle
Set MAX Throttle

Brake
Brake Pos (0-100; default 0)
Set MIN Brake
Set MAX Brake

Transmission
Trans Pos (0-100; default 0)
Set Park Pos
Set Reverse Pos
Set Neutral Pos
Set Drive Pos

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Steering
> Set Steps/Deg
>> (ticks per degree; 0-100; default 16)
> Cal Steering
> Zero Steering
> Force Zero (set current position as zero)

Vehicle Diagnostics
Logout

Communications
> IP (wired IP)
> Wi (WiFi IP)
> SSID (WiFI SSID)
> PassW (Wifi password phrase)

Configure IP Addr
> IP1 (set 1st octet; default 192)
> IP2 (set 2nd octet; default 168)
> IP3 (set 3rd octet; default 200)
> IP4 (set 4th octet; default 2)
> NM1 (set 1st subnet octet; default 255)
> NM2 (set 2nd subnet octet; default 255)
> NM3 (set 3rd subnet octet; default 0)
> NM4 (set 4th subnet octet; default 0)

Configure IP Ports
> Local Port (set local port; 0-99999; default 4000)
> Remote Port (set local port; 0-99999; default 4000)

Select Interface
> Use Ethernet
> Use WiFi
> Use ZigBee
> Use Ext Serial

Select Wifi SSID

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Serial Port Config

        Baudrate ([9600|38400|57600|115200]; default 115200)
        DataBits ([5|6|7|8]; default 8)
        Parity ([Even|Odd|None|Mark|Space]; default None)
        StopBits ([1|1.5|2], default 1)
        Flow Control ([Off|Hardware|Xon/Xoff]; default Off)

Tools/Config/Diag

    System Functions

        Backlight On
        Backlight Off
        Backlight Auto
        Save Parameters
        Load Parameters
        View GPS

    System Activity

        SL (transmit and receive link count)
        ID (transmit and receive ID count)
        ES (transmit and receive E-Stop count)
        GPS Scan (GPS count)

    System Lists

        SLi (inbound shared links)
        SLo (outbound shared links)
        ShV (shared variables)
        Swi (option switches)
        Pip (pipe structure information)
        Prt (serial port data)

    GPS

        Time (timestamp)
        Lat (latitude)
        Lon (longitude)
        Vel (velocity)
        Head (heading)
        RefS (references)
        Qual (quality)

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Orientation

    Gyro Roll
    Gyro Pitch
    Gyro Yaw
    Accel X
    Accel Y
    Accel Z
    Mag X
    Mag Y
    Mag Z

Sensors

    Temp
    Light
    Current
    Voltage
    ID # (32-bit EEPROM identifier)

Inputs/Outputs

    User Controls
    JyLV (joystick Left Vertical – in hex)
    JyLH (joystick Left Horizontal – in hex)
    JyRV (joystick Right Vertical – in hex)
    JyRH (joystick Right Horizontal – in hex)
    Digitals (Bit state of digital input 1)
    Config (onboard configuration jumpers)
    LftJoy Vert
    LftJoy Horz
    RgtJoy Vert
    RgtJoy Horz
    Left Joy Switch (joysticks as buttons)
    Rght Joy Switch
    E-Stop Switch
    Pause Switch
    Left Motion Enb (buttons on underside of joysticks)
    Rght Motion Enb
    Spare Input (as of 2014-02-27 not used)
    Analog # (analog output of I2C sensor devices)
    Quad (Quadrature encoder input)

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Output Test

        Vibration Alert
        Audio Alert
        E-Stop Indicator

LCD/Keypad Test
        Key
        Top LED
        Mid1 LED
        Mid2 LED
        Bot LED
        LCD Test

USB/Ethernet/Serial
        IP (controller)

RAM Contents
        memory (hex data dump)

Pri SEEPROM Dump
        seeprom (primary SEEPROM hex data dump)

Sec SEEPROM Dump
        seeprom (secondary SEEPROM hex data dump)

Shared Variables
        gps3_latitude
        gps3_longitude
        gps3_velocity
        gps3_heading

Shared Link

        in:gps3_latitude (vehicle)
                [NOTE: scroll with left/right buttons.]
        out:gps3_latitude (controller)
                [NOTE: scroll with left/right buttons.]

System Tests

        Function Tests
        Backlight On
        Backlight Off

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Entry Tests

Decimal
EnumStr
Enum#
Range0-4
Range100
Switch

Pipe Tests

Send Pipe Command
Start Engine

Controller Connectors and Pin-outs

Ethernet Pin-out

Pin 1 = ETx2+
Pin 2 = ETX2-
Pin 3 = ERx2+
Pin 4 = ETHV
Pin 5 = ETHV
Pin 6 = ERx2-
Pin 7 = ETHGND
Pin 8 = ETHGND
Ethernet LEDs are non-functional

USB

Pin 1 = VCC
Pin 2 = DN
Pin 3 = DP
Pin 4 = GND

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Power-in

Center = PWRIN
Barrel = GND

CBL-147: Safety Direct Power+Ethernet with Military Connector Cable

Signal:	P83:	P84:	P85:	Color:
ERx1+	A	1		White/Orange
ERx1-	B	2		Orange
ETx1	C	3		White/Green
ETx1-	D	6		Green
+10 to +14 VDC	E		1	Red
GND	F		2	Black
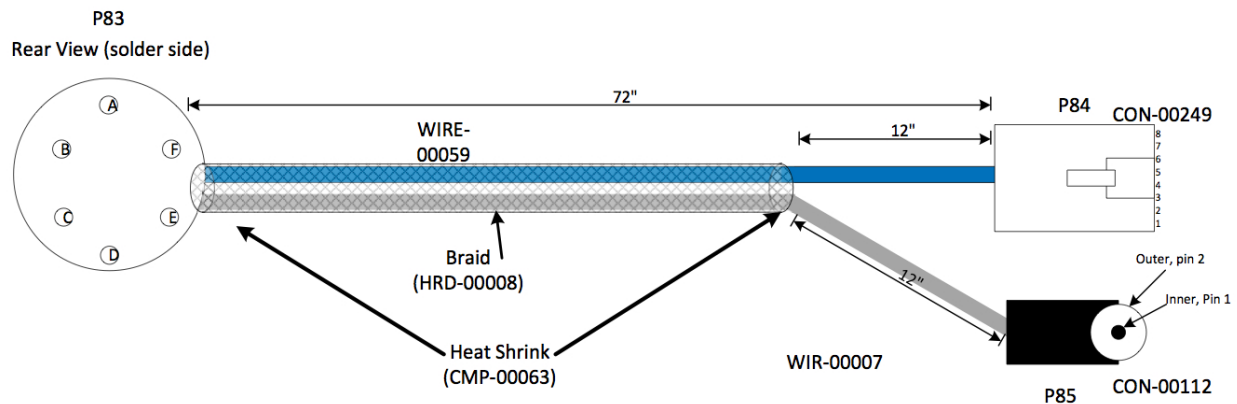
Technical Support

Kairos Autonomi offers telephone support for hardware issues. We are available from 8 a.m. to 5 p.m., M-F, MST. Many days we are available outside of these hours (but that is not guaranteed). You can reach us at 801-255-2950.

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