



Kairos Autonomi
498 W. 8360 S.
Sandy, Utah 84070
801-255-2950 (office)
801-907-7870 (fax)
www.kairosautonomi.com

**BULLETIN
BUL-059**

Vehicle Pre-Installation Questionnaire

This document is intended to provide a brief introduction to the Pronto4 Series 4 Mini installation, and gather required vehicle and operating information to streamline the installation process.

Information Kairos is requesting may not be available, or may be difficult to obtain. If you encounter a situation where specific information is not easily obtained, please make the best estimate, and provide details about the specific situation. The more descriptive you are in your answers, the more prepared our installation team can be while onsite.

The information contained herein is not a replacement for system specific documentation, and care should be taken to reference your system manuals after installation. This document covers most available Pronto4 Series 4 components and options. Images may differ from your order. If an order has already been placed, and you wish to change components (e.g., upgrade from a standard Steering Ring to a Right-Angle Steering Ring), or add components (e.g., additional cameras), please contact Kairos Sales at sales@kairosautonomi.com or call 801-255-2950.

P4S4 Mini Mounting Location

The Pronto4 Series 4 Mini requires a mounting location footprint of approximately 18" x 16" x 10", which includes room for electrical and mechanical cable connections. The mechanical cables for the brake and transmission exit on one side of the P4S4 Mini, while the throttle exits from the other side. All mechanical cables route away from the P4S4 in the same direction. Electrical connections are made on both ends of the unit. Care should be taken to ensure all mechanical and electrical cables could be routed to their destinations with minimal bends, constrictions, and kinking.

Please ensure the mounting location can accept bolting of the bracket to the vehicle





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(refer to the P4S4 Mini Mounting Bracket Diagram). If bolting to the vehicle itself is unacceptable, please provide an alternative means to secure the P4S4 unit in place.

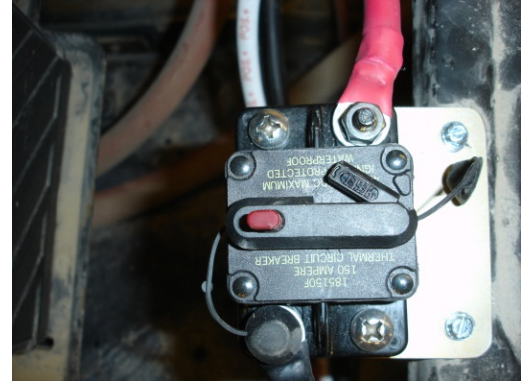
The footprint measurements above allow sufficient clearance for cable routing & management of the cables entering the unit. When measuring for cables, please use the most direct or shortest routing path from the P4S4 to all appropriate mechanical and electrical connections. Mechanical cables (brake, throttle, shift) should not have a bend radius of less than six inches. Plan cable lengths accordingly.

If the P4S4 is in a confined or sealed space, it will need ventilation.

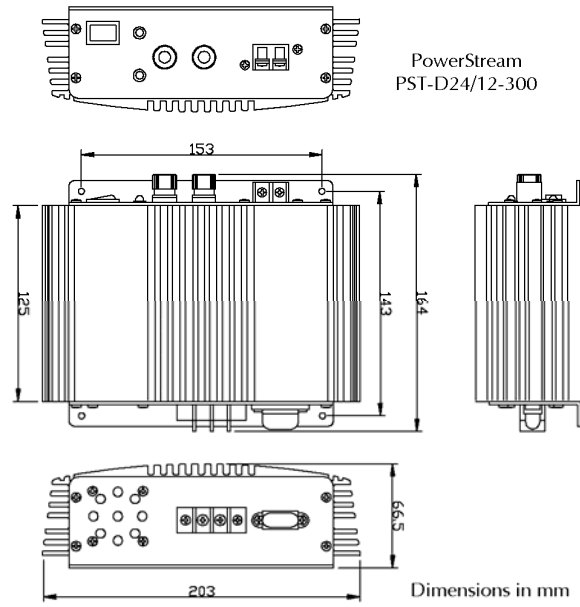
Does your proposed mounting location meet all of the Mini mounting requirements?	• Yes • No, details:
Is it acceptable to bolt or screw the mounting bracket to the vehicle? If not, please provide suggestions for alternative means to mount the system?	• Yes • No, suggestions:
Is there sufficient air circulation around the P4S4 Mini, or does the mounting location need to be ventilated?	• Yes • No, needs ventilation

Main Power Cable & Circuit Breaker Installation

The main power for the P4S4 Mini comes directly from the main battery in the vehicle. This circuit is protected by a fuse or circuit breaker, which is normally located in close proximity to the main battery. However, in some installations, the crew may require direct access to the circuit breaker from the cabin.



If the vehicle is 24VDC nominal, a DC to DC converter will be required to reduce the voltage from 24VDC to 12VDC. This converter can be located in any convenient mounting location, between the vehicle's main battery and the P4S4 Mini.





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What is the required cable length from the battery to the proposed circuit breaker mounting location?	Length _____
Will your installation require a 24VDC to 12VDC power converter? If so, please select and indicate a suitable mounting location for this device.	• No • Yes, mount location:
What is the required cable length from the circuit breaker to the power converter?	Length _____
What is the required cable length from the power converter to the P4S4 Mini?	Length _____

Throttle Cable Installation

The throttle control for a P4S4 Mini system is accomplished by pulling a housed wire rope cable mounted to the vehicle's throttle pedal, or connected directly to the throttle body on the engine of the vehicle. By using a light duty actuator to pull down the throttle pedal (or throttle body), the spring return mechanism provides an additional level of safety to the system. In the event of a complete power loss, the vehicle's spring return mechanism will pull the throttle actuator in the throttle 'closed' position. Because the throttle actuator is light duty, an assessment of required force to operate the throttle pedal must be made.

A separate document describes the P4S4 mechanical actuator cables and the calculation of their length. Please refer to the Pronto4 Actuator Cables Description document to answer the following questions.



Specify the length of the throttle cable for your vehicle.	Length _____
The throttle cable requires a pulley be mounted to the floor of the vehicle, just below the throttle pedal. Is there sufficient room for this pulley, and can the pulley be bolted to the floor of the vehicle?	<ul style="list-style-type: none"> • Yes • No, details:



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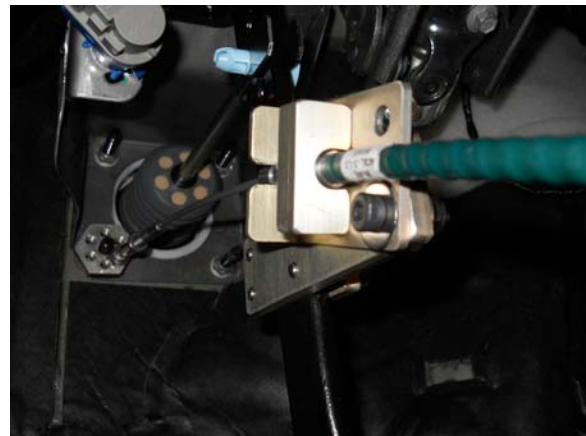
What is the required throttle pedal travel to meet or exceed your maximum speed requirements? Measure this distance from the center of the throttle pedal, starting with the pedal fully released and measuring the centerline linear distance to where the pedal stops when fully depressed.	Length _____
Is the required torque to fully engage the throttle excessive (>5 lbs of foot pressure)?	• • 5 lbs • > 5 lbs

Brake Cable Installation

Brake actuation is also accomplished by pressing the vehicle's brake pedal with a wire rope. This wire rope is a heavier gauge to provide the necessary strength to manipulate the brake.

The brake cable is normally mounted to a bracket that holds the wire rope housing, which is mounted to the brake pedal in the vehicle. The termination of the wire rope is mounted to the vehicle's floorboard or firewall. The actuation is accomplished by pulling on the wire rope, effectively shortening the distance between the pedal mounted housing and the floor of the vehicle.

Please refer to the Pronto4 Actuator Cables Description document to answer the following questions.





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Specify the length of the brake cable for your vehicle.	Length _____
Is there an area below the brake pedal on the floorboard or firewall to secure the wire rope termination bracket?	<input type="checkbox"/> Yes <input type="checkbox"/> No, details:
What is the required brake pedal travel to meet or exceed your maximum braking requirements? Measure this distance from the center of the brake pedal, starting with the pedal fully released and measuring the centerline linear distance to where the pedal stops when fully depressed.	Length _____
Is the required torque to fully engage the brake excessive (>50 lbs foot pressure)?	<input type="checkbox"/> 50 lbs <input type="checkbox"/> > 50 lbs

Transmission Cable Installation

The typical method of actuating the shift mechanism in a passenger vehicle is via a push-pull mechanical cable. This cable is actuated by a motor in the P4S4 Mini, and provides bidirectional motion control to the vehicle's shift lever. Normal shift positions accomplished by a P4S4 Mini are Park, Reverse, Neutral, and Drive.

The P4S4 Mini system also has an optional electronic control (dry contact switch) module for controlling electronic shift vehicles. Using this method, there is no mechanical cable linkage between the P4S4 Mini and the transmission shifter.

Please refer to the Pronto4 Actuator Cables Description document to answer the following questions.



Is your vehicle transmission shift accomplished through a mechanical linkage to the transmission, or through an electronic connection?

- Mechanical linkage
- Electronic connection



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<p>If the vehicle is electronically shifted, would you prefer to mechanically actuate the transmission shift lever (and disconnect the cable for manual operations)?</p>	<ul style="list-style-type: none"> • Standard electrical connection • Mechanical actuation • Not applicable
<p>If using mechanical shift lever actuation, specify the length of the transmission cable for your vehicle.</p>	<p>Length _____</p>
<p>Is the shift handle gated or does it require an operator release? If so, can the gate or release be removed or bypassed?</p>	<ul style="list-style-type: none"> • No • Yes, bypass details:
<p>What are the desired vehicle gears for system operation (e.g. P, N, R, D)?</p>	<ul style="list-style-type: none"> • P • N • R • D • Other/s:
<p>What is the maximum travel for the shift lever? Measure this distance from the center of the shift lever while in Park, to the center of the shift lever while in the lowest desired gear.</p>	<p>Length _____</p>

Steering Installation

The Pronto4 system has a very unique method of controlling steering on a vehicle. Kairos has created a patent pending ring that rotates the actual vehicle's steering wheel in the same manner that a human operator does while manually driving the vehicle. The Steering Ring is installed behind the steering wheel, and surrounds the steering column.

The Steering Ring can be driven with a direct motor (inline with the steering column), or a motor that is mounted at a right angle to the steering column. The decision on which design to use is made primarily on how much space exists behind and around the column. Inline Steering Rings are standard. Right Angle Steering Rings can be ordered for an additional fee.



The steering ring also requires a method to stabilize the drive motor against the force required to turn the steering wheel. This 'anti-torque' is accomplished via a RAM mount to a non-moving and secure point close to the Steering Ring. This mount is most effective when it is in a parallel plane to the steering wheel itself.



What is the actual steering column diameter?	Diameter _____
Which Steering Ring motor design makes the most sense for your installation? Direct or right angle?	<ul style="list-style-type: none"> • Direct • Right angle
How much space is behind steering wheel for mounting a steering ring? Are there any other protruding operational levers of concern?	Useable depth _____ Additional details:
Please select an anti-torque mounting location. How far is this location from the steering wheel outer diameter?	Distance _____

Vehicle Integration Module Installation

The VIM, or Vehicle Integration Module, is the primary interface between a human operator and the P4S4 Mini system. This module provides switches for turning the system power on and off and for placing the system in a manual or 'auto' operational mode. There is also an emergency stop button, and an operator's Run/Pause switch. LEDs indicate system status.

The VIM also provisions the connections between the vehicle's electronic circuits (Ignition, Engine Start, Headlights, Accessories, Brake Pedal application, etc.) and the P4S4 Mini.

The VIM module should be located within a human operator's reach while seated in the driver's seat. In this manner, a 'safety operator' can monitor the vehicle's operation while in tele-op or autonomous mode, while still being able to stop the system and control the vehicle in an emergency.



<p>Please select a mounting location for the VIM module. Can the VIM module be secured with Velcro or similar mounting materials?</p>	<ul style="list-style-type: none"> • Yes • No, details:
<p>Do you require headlights, cabin climate, or other system controls to vehicle accessories? If so, please provide vehicle circuit ID(s) and wiring locations.</p>	<ul style="list-style-type: none"> • High beam • Low beam • Cabin climate • Other, details:



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What is the vehicle Start circuit ID and wire location?	Start circuit ID: _____ Wire location:
What is the vehicle Ignition circuit ID and wire location?	Ignition circuit ID: _____ Wire location:
What is the Key On circuit ID and wire location? Is this a 12V or 24V circuit?	KeyOn circuit ID: _____ Wire location:
What is the Brake light switch circuit ID and wire location?	Brake Light circuit ID: _____ Wire location:

RPM Sensor Installation

The P4S4 Mini system can accommodate many different RPM sensing technologies. Analog input, OBD-II, and inductive sensing are just some of the possibilities.

To simplify installations, an inductive RPM sensor is the default sensing technology provided with the P4S4. While this method does not provide very accurate RPM measurements, it does allow the system operator to know if the vehicle engine is running. The inductive sensor is placed on the battery charge leads coming from the vehicle alternator, as close to the alternator as possible.

Some vehicles have crankcase or alternator sensors that can be tapped into for analog RPM sensing. If your vehicle has easily accessible RPM sensor leads that can provide more accurate RPM measurement, Kairos may be able to utilize them.



<p>Does the vehicle have a crankcase sensor or other analog RPM sensor available for use in the system? If so, what is the circuit ID and wire location for that sensor? Please provide a detailed description of the sensor, and its type of output (e.g. 5V analog, OBD-II, etc.).</p>	<p>• No • Yes, details: RMP Sensor circuit ID: _____ Wire location: _____ Sensor description: _____ Sensor output type: _____</p>
<p>What is the cable length (routed as desired) from the P4S4 to any available RPM sensor, or to the placement of the inductive sensor?</p>	<p>Length _____</p>



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Roof Rack Installation

Equipment that is installed outside the vehicle (e.g., antennas, cameras, GPS receiver) is combined into an assembly called the Roof Rack. It is outfitted with magnetic feet to provide an easy installation and safe removal if the vehicle comes into contact with external structures or foliage.

The Roof Rack requires a 16 x 14 x 6” mounting area (not including additional height for the radio antennas), which should be flat and high on the vehicle roof. Installing the antennas as high and clear of other vehicle components is ideal. The mounting surface should be steel or ferrous to ensure the magnetic feet will hold the rack in place. Magnetic mounting of the Roof Rack can be augmented with either straps or ties. If magnetic mounting is not an option, then either straps or ties can be used as the primary mounting method.

There is one cable bundle that runs from the P4S4 Mini to the Roof Rack, which will need to be routed through the vehicle body or through an open port such that no damage will occur to the cables.



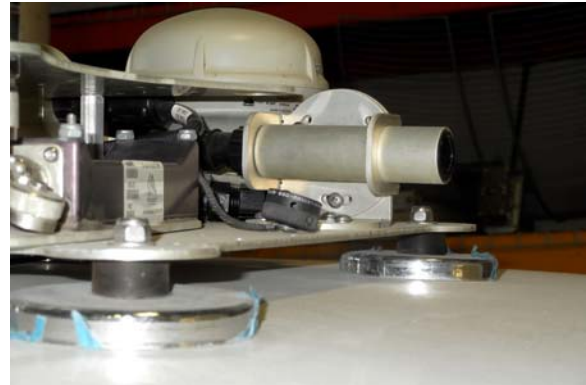
Is there sufficient means to route cables from the P4S4 Mini to the roof rack?	• Yes • No, details:
What is an estimated length for the cable bundle from the P4S4 Mini to the roof rack mounting location?	Length _____
Is the roof of the vehicle steel? Will straps or ties be used to secure, or augment, the roof rack?	• Steel roof • No steel roof • Straps/ties, details:

Camera Installation

The default camera delivered with a P4S4 Mini is mounted to the Roof Rack on an adjustable bracket. The bracket allows for vertical and horizontal adjustment of the camera view. The camera has a 70° field of view with the included lens.

If the roof rack mounting location is towards the rear or one side of the vehicle such that it does not allow a proper view forward from the camera, the camera can be removed from the roof rack and mounted independently. The camera can then be secured with RAM ball mounts, magnetic mounts, clamps, etc.

In addition, some systems can optionally be outfitted with more than one camera, to afford rear or side views in the operator's software.





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<p>Please indicate your desired camera placement(s), if the camera is NOT to be mounted on the integrated roof rack.</p>	<ul style="list-style-type: none"> • Front (standard) • Rear • Other, details:
<p>If NOT mounted on the roof rack, what is the cable length (routed as desired) from the P4S4 Mini to the camera location? Is the desired location steel, or will an alternative mounting method be required?</p>	<ul style="list-style-type: none"> • Not applicable • Alternative mounting, details: Length _____ Mounting method:
<p>Do you require additional cameras? If so, what are their locations, mounting types, and cable lengths?</p>	<ul style="list-style-type: none"> • No additional cameras • Additional cameras, details:



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External Safety Installation

The Pronto4 Series 4 system has the optional ability to incorporate external safety systems. These can include external emergency stop buttons (E-Stop), radio broadcasts, etc.

If external E-Stop button(s) are desired for your installation, a cable will need to run in series to each location. Also, a means to attach each E-Stop button housing will need to be provisioned. The buttons come supplied with a magnetic mount, so if the exterior of the vehicle is steel, mounting is simplified and the device can be removed for storage.



<p>Do you require a rear E-Stop? Is there a steel exterior area available for magnetic mounting of a rear external E-Stop button, within reach of external personnel? What is the cable length requirement to reach from the P4S4 Mini to the rear of the vehicle?</p>	<p>• Yes • No • Yes • No, details: Length _____</p>
<p>Do you require additional external safety (E-Stop) items? If so, please provide details.</p>	<p>• No • Yes, details:</p>



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Communications Frequencies

Pronto4 radio systems typically ship with commercially available frequencies in the 900MHz, 2.4GHz, and 5.8GHz bands. A single band, or combinations of these frequencies, can be installed as part of your radio system procurement.

Other, non-commercial frequencies are also available for purchase from Kairos. If you need alternative radio bands, please indicate your top three choices on this questionnaire.

Is communication from the operator’s control station to the vehicle on commercial bands acceptable for your installation?	• Yes • No, details:
Are there any other radio transmissions installed at your facility that could interfere with our communications on the 900MHz, 2.4GHz, or 5.8GHz bands?	Possible interference on: <ul style="list-style-type: none"> • 900MHz • 2.4GHz • 5.8GHz
If you require alternative frequencies, what are your first three choices?	a) b) c)
Provide details about the expected terrain between the operator’s control station and the vehicle operation area, including elevations, obstructions (e.g., sporadic CONEX boxes, pine forest), and other known factors.	
What is the expected range of distances between the operator’s control station and the vehicle operation area?	

Operator Control Unit (OCU) Installation

Also known as a Ground Control Station (GCS), the operator control unit (OCU) is the primary interface between the operator and the vehicle when it is being utilized. The OCU consists of a computer running installation specific software, a remote controller for tele-op functions, an E-Stop module, and a communications radio system.

The OCU computer is a laptop or All-in-One computer installed on a bench, desk, table or other suitable location to provide a comfortable position for the operator. If using a steering wheel joystick, the desk or table must accommodate the joystick's mounting clamps, and a non-rolling chair must be available. Standard household power (i.e., 120V nominal) must be supplied to the OCU system (computer, joystick, and power injector for the radio). If permanent power is not available, a generator or inverter may be used.



The OCU radio system is typically mounted on the roof, tower, or other high structure near the OCU computer, such that the radio antennas have sufficient height to provide a strong radio link to the vehicle in the operational area.

What is the proposed physical location for the Operator Control Unit (OCU)?	
Is there nominal 120V A/C power available at that location, or can it be provided?	• Yes • No, details:
If the OCU location is inside, is there sufficient cable routing to the structure's exterior?	• Yes • No, details:



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Is there a tower or roof-top mast available for radio antennas?	• Yes • No, details:
Is there a table or desk available?	• Yes • No, details:



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Requested Vehicle Photos

To ensure the success of your installation, we request as much information as possible about your vehicle prior to our arrival. Photographic views of critical vehicle controls allow us to create brackets or clamps that may ease the installation. Please take as many views (top, front, side) as possible. We realize some views may be difficult to obtain, or that the vehicle may not be available to you for various reasons. Please collect the photos you can, with these items as a focus:

- Steering wheel
- Brake pedal
- Throttle pedal or control
- Transmission shift lever
- Main battery compartment
- RPM Sensor location
- Circuit breaker mounting location
- DC Converter mounting location (if required)
- P4S4 System mounting location
- External E-Stop location (rear of vehicle)
- Roof rack location
- Alternate camera locations
- OCU location
- OCU radio installation location

Complete Questionnaire Submission

Submit the completed Pre-Installation Questionnaire, along with the vehicle's make, model, and year, to Thomas Grover via:

E-mail: thomas_grover@kairosautonomi.com

Fax: 801-907-7870