Honda CR-V PACMod 3.0 System

Automated research development vehicle

Overview

The PACMod 3.0 System from Hexagon | AutonomouStuff delivers comprehensive drive by-wire control for the Honda CR-V automated research development vehicle. PACMod stands for Platform Actuation and Control Module, a proprietary system designed and built by our engineers. It provides precise by-wire control of core driving functions and ancillary components with intuitive safety features, such as immediate return to full manual control in urgent situations. Audible and visual signals from the PACMod 3.0 alert occupants to the vehicle's operational mode, as well as any faults in the by-wire platform and some stock vehicle components. The platform can be fully customised to accommodate a wide range of applications while also harnessing vehicle feedback for analysis. The range of available feedback expands with firmware updates, enhancing research potential.

Control and feedback

In AutonomouStuff's Honda CR-V, the PACMod 3.0 System allows by-wire driving control and other functions while generating vehicle feedback data.

Controlled by-wire:

- Accelerator
- Brake
- Hazard lights
- Headlights
- Horn
- Shifting
- Steering
- Turn signals
- Wipers

Feedback generated:

- Accelerator Pedal percentage (0-100%)
- Brake Pedal percentage (0-100%)
- Brake pressure
- Brake on/off
- Hazard light status
- Headlight status
- Horn status
- Steering wheel angle
- Steering wheel torque
- Steering rate
- Transmission (park, neutral, drive, reverse)
- Turn signal status
- Wheel speeds (rad/s)
- Wiper status
- Vehicle speed (m/s)
- Various PACMod System status reports

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Safety manoeuvres

AutonomouStuff prioritises safety and has designed safeguards for the AutonomouStuff Honda CR-V automated platform, triggered by a driver's natural reactions to hazards, allowing full manual control to be easily regained through some simple, intuitive manoeuvres. The system also automatically alerts operators to faults in a variety of stock and aftermarket components.

Operators can immediately regain manual control using the following safety takeovers:

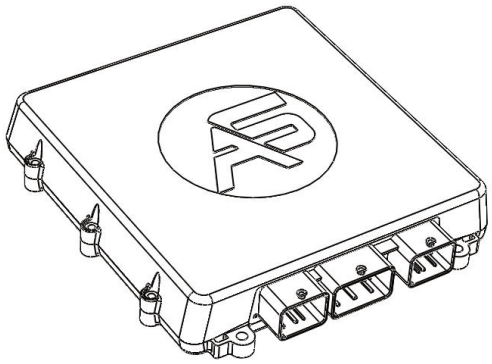
- Press the emergency stop (E-Stop) button.
- Push the brake pedal.
- Push the accelerator pedal.
- Turn the steering wheel.

The PACMod 3.0 System also detects certain faults and instantly communicates them to operators with audible and visual signals. Monitored functions include steering, acceleration, braking and shifting. Others may be monitored, but the system is not designed to be comprehensive.

Key features

AutonomouStuff's Honda CR-V and PACMod 3.0 System includes the following features and options.

- CAN interface
- Mode status indication
- Visual and audible fault alerts
- Joystick control interface under development
- Speed and steering controller available
- ROS node available
- DBC file
- Mute for audible alarms



The AutonomouStuff PACMod

What is the PACMod 3.0 System?

The AutonomouStuff Platform Actuation and Control Module (PACMod) 3.0 System provides drive by-wire control and can be installed into virtually any vehicle. At a minimum, PACMod will provide control of acceleration, braking, steering, shifting and turn signals. It can be customised to fit into any research and development platform.

Systems	Signal Description	Limit[1]	Overshoot[2]	Resolution[3]	Latency[4]
Steering	Steering wheel angle command (rads)	7.4 rad	< 0.2 rad[5]	0.002 rad[7]	< 50 ms[8]
	Steering wheel angle feedback (rads)	8.0 rad			
	Steering wheel angle rate (limit) command (rad/s)	6.5 rad/s[6]	-	0.087 rad/s[7]	
Throttle	Throttle command (percentage)	0% to 100%	0%[9]	0.1%[10]	< 50 ms[8]
	Throttle feedback position (percentage)			0.1%[11]	
Brake	Brake command (percentage)	0% to 100%	< 1%[12]	0.1%[11]	< 50 ms[8]
	Brake command feedback (percentage)				
Shift	Shift command (P/R/N/D)	-	-	-	< 50 ms[8]

The diagram below generally represents a vehicle system under by-wire control. The following notes reference this diagram.

1 This is the commanded value limit based on the physical limits of the operator control and other control considerations. Unless specified, the feedback limit may be the same as or somewhat larger than the command limit.

2 The overshoot is a characteristic of the dynamic physical response of the operator control. This is not the dynamic response of the vehicle.

3 This is the granularity of the command and the feedback.

4 Latency for the command is the time required for the command signal to travel from the user PC, through the PACMod System 3.0, to the ECU. Latency for the feedback is the time required for the feedback signal to travel from the ECU to the user PC.

5 Overshoot in the response of the steering wheel change varies with the size of the step command and the steering wheel angle rate limit command. This value is a nominal estimate and was measured with 90-degree steps and the steering wheel angle rate limit command set to 6 rad/s.

6 Steering rate limit commands set above 6.5 rad/s have little effect.

7 The command message resolution is 0.001 rad or 0.001 rad/s, but the actual resolution is limited by the ECU.

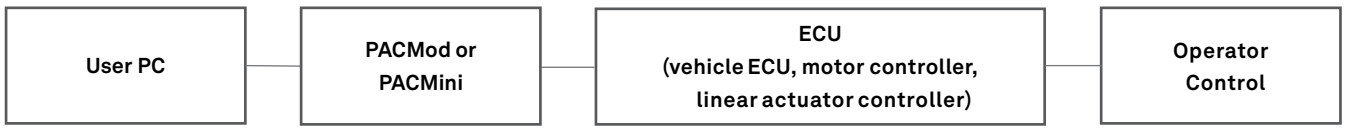
8 A response to a change in the command signal at the user PC can typically be measured in the system feedback message at the user PC within the time necessary to receive two user CAN feedback messages. The limiting factor is the asynchronous transmission rate of the command and feedback messages at a frequency of 30 Hz or a period of 33.3 ms. Therefore, the latency is < 33.3 ms to receive the first feedback message after the command message plus 33.3 ms for the next message, which adds up to < 66.6 ms. Dividing 66.6 ms by 2 gives an estimate for the latency of the command and feedback signals individually to the ECU and user PC respectively. 33.3 ms is rounded up to 50 ms.

9 The PACMod is not moving an operator control, but instead electrically overriding the operator control output signal. There is naturally no overshoot in direct electrical control.

10 Based on the resolution of the DAC.

11 Based on report message from ECU.

12 Overshoot in the response of the brake position change varies with the size of the step command and the position along brake pedal travel. This value is a nominal estimate and was measured as the largest overshoot observed with 10% travel incremental steps along the entirety of brake pedal travel.



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