

Percēv System

Intelligent Decisions Driven by Intelligent Sensors™

Civionics Percēv systems uniquely combine wireless sensor technologies and data analytics to protect the high value assets of businesses, public institutions, and the people operating and potentially affected by a failure of those assets to operate properly.



Civionics Percēv system

The Civionics Percēv system comprises three components: Percēv nodes, Percēv CloudGate nodes, and Percēv Decision Workshop. In typical deployments, one Percēv CloudGate services multiple Percēv leaf nodes.

Percēv Nodes can each interface with up to two dozen transducers that can analyze temperature, pressure, current, vibration, strain, light intensity, humidity, etc. Percēv Nodes have extensive, on-board processing capabilities, are typically battery powered, and communicate with each other using low-power wireless radios (ZigBee).

Percēv CloudGate (any node can serve as a CloudGate) provides a secure communication channel, either via WiFi or 3G, between Percēv Nodes and Civionics' cloud-based resources.

Percēv Decision Workshop provides a web-based interface to the system. A core value is its ability to provide actionable information that enables quick and confident responses to real-time situations.



Percev Decision Workshop

The Percēv Decision Workshop represents the graphical interface to the system. A core value is its ability to provide actionable information that enables quick and confident responses to real-time situations. From the web, a user can fully configure the system, see a snapshot of the current system status (image to the right), set alerts based on sensor readings, and generate reports. Some of the unique capabilities that Civionics offers include:

- Setting multiple levels of alerts per channel
- Providing user-specified remediation information with alert messages
- Performing basic statistical operations on sensing channels and providing these computed values within the dashboard
- Creating *virtual channels* as algorithmic combinations of one or more sensing channels and using these channels like any other sensing channel

Also available is an API that allows customers to build their own apps based on the data gathered from Percēv nodes.



Modular Design for Maximum Versatility

Percēv nodes employ modular sensor hardware interfaces to provide customers with the greatest amount of flexibility possible. Each Percēv node has an on-board thermistor and tri-axial accelerometer, and can additionally accommodate up to four Type A modules and two Type B modules. Available hardware interfaces are detailed on page 3.

Each Type A module can typically interface with two transducers with the output from the transducers being processed by the Percēv node's main processor.

There are four classes of type B modules:

Class 1: Modular radios, WiFi or 3G, for providing cloud access

Class 2: Digital interface cards providing a variety of capabilities

Class 3: 16 bit analog-to-digital converters that interface with analog signal processing input cards

Class 4: Floating point processors, with high speed, high accuracy analog-to-digital converter that optionally interface with analog signal processing input cards or Class 2 digital interface cards. (Percēv SPE, see page 4)





Alerts and Remediation Information

One product feature valued by customers is the ability to associate remediation information with alert messages. For facilities that operate 24/7, alerts can occur at any time, including times when engineers may not be available. Providing remediation guidance with the alert allows less experienced personnel to address the issue.

Configuring an alert, via the web-based interface is a three step process:

- 1. Inputting alert recipient information (name, email address and/or telephone number).
- 2. Defining the alerting condition, e.g., temperature greater than some value. This step also allows entering the remediation information, which comprises text and (optionally) pictures.
- 3. Assigning alerts and recipients to specific channels.

When an alert occurs, recipients receive a message that provides more information about the alert, including the remediation information (image to the left).



Available Interface Modules

Type A Modules

Module	Туре	Range	Resolution	Channels
Percēv A	Buffered voltage input	0-10 V	12-bit	2 SE/1 Diff
Percēv R	Buffered voltage w/ resistor divider		12-bit	2
Percēv D	Digital pass-through ¹			2x GPIO
Percēv H	Humidity	0-100%	12-bit	1
Percēv P	Pulse counter	up to 4 MHz		2

Type B Modules

Class 1 Modules	Туре			
Percēv 3GR	Modular 3G radio, Verizon			
Percēv WFR	Modular WiFi radio			
Class 2 Modules	Туре	Range	Resolution	Channels
Percēv RT+	Resistance temperature detector, 3-wire	PT1000 or PT100	0.03125 °C	3
Percēv TC+	Thermocouple input			3
Percēv RL+	Output relay ²			8
Percēv SD+	MicroSD card interface			
Percēv US+	USB input/output			
Percēv ET+	Ethernet input/output			
Class 3 Modules	Туре		Connectivi	ty
Percēv SPE	Stream processing engine	Two Class 2 Modules and/or Signal Processing cards		
	Time		Connectivit	
Class 4 Modules	Туре	Connectivity		
Percēv DAQ	Buffered voltage input and digital	One Signal Processing card		
Signal Processing	Туре	Range	Resolution	Channels
Percēv AN	Generic Analog Input	0-10 V	16-bit	6 SE/3 Diff
Percēv PA	Programmable Amplifier, up to 4096×	0-3.5 V	16-bit	3
Percēv ST	Strain Gauge with programmable amplification	120 Ω gauge	16-bit	3

1 - Software configurable pull-ups and pull-downs available

2 - A node with a Percēv RL module includes a Percēv external relay card and must be powered via the USB port

If the interface you need is not listed here, please contact us and ask.



Percev Stream Processing Engine (SPE)

Certain applications, for instance, structural health monitoring, may require sampling an accelerometer at kHz rate or higher for several seconds in order to determine vibrational modes (below left). To process these data in the cloud would require trasmitting tens of thousands of bytes, but the actual information content is only tens of bytes (below right).

The Percev Stream Processing Engine provides the means to perform these types of calculations at the node, which improves energy efficiency, scalability, and responsiveness; while reducing data glut.

The SPE can also be programmed by the customer, allowing them to embed capabilities of their own choosing without having to share their IP with Civionics, while still benefiting from the end-to-end Percev system architecture.



Statistical Over-Sampling

The sampling rate of a sensing system should be chosen to match the customer's needs. For example, if a customer is using a sensing system to look for long-term changes in the behavior of a piece of equipment, continuous sampling is probably not appropriate – as it requires significant energy, produces data glut, and clogs wireless transmission bands. A better approach is to sample infrequently.

However, there is an issue with periodic sampling: if the system being monitored has cyclic behavior, the sampled data may not represent actual system behavior (below left) and identifying trends is nearly impossible. With Percēv systems, customers can specify Statistical Over-Sampling: when sampling occurs, high sample rate data is collected over a period of time and the system reports the statistics of that sample (below right) which allows for identifying trends while obviating issues associated with continuous sampling.



Specifications

Node Specifications	Value		
Size	122 mm × 68 mm × 53 mm		
Modules	Type A: up to 4, Tybe B: up to 2		
Enclosure Rating	IP67		
Internode Radio	IEEE 802.15.4 (ZigBee)		
Power Specification	Val	Value	
Wall Supply	5 V, 2.1 A Micro-USB		
Battery	User replaceable, 3.7 V 5200 mAh Rechargeable Li-Ion		
Battery Life	Up to 7 years in certain applications ¹		
Processor Specification	Percēv Core	Percēv SPE	
	8-bit 32 MHz	32-bit 64 MHz w/ FPU	
Wireless Specification	Percēv 3GR	Percēv WFR	
	WCDMA band V	IEEE 802.11	

1 - Battery life is application dependent and is largely determined by the frequency of data transmissions



Example Application - Automotive Metal Stamping

Metal Stamping is a key operation for most automotive manufactures. Given the size and complexity of the parts produced by stamping, progressive stamping lines are typically custombuilt; can be as large as 60 m × 20 m × 20 m; may consist of six or more 300+ kW presses and eight or more large industrial robots; and can represent a capital investment of tens of millions of dollars. Because of their criticality to production, lost revenue due to stamping line downtime often exceeds US\$1M per hour; and due to the specialized nature of these machines, the replacement time for certain components can be as great as weeks. What automotive metal stamping plant managers need is a system that can monitor critical system parameters to provide current health status and predictions of future health status, thereby allowing the operators to deal with potential problems proactively.





A Civionics Percēv system can readily provide all of the functionality desired. Though each stamping line is unique, a Percēv system can be easily configured to monitor such lines and would typically comprise dozens of Percēv Nodes which communicate to each other via ZigBee. Some of the nodes would also include a secondary radio, either 3G or WiFI, to enable communications with the cloud. Other nodes could be used to monitor:

- the temperature of the electronic control panels and provide alerts should temperatures exceed tolerance
- the current of the various motors as increasing currents could be indicative of system degradation/impending bearing seizures
- the pressure in hydraulic lines as an indication of proper pump functioning
- the fundamental frequency of the main drive gear to provide early indications of crack propagation before they lead to gear failure
- strain in the support structure for ensuring the overall structural health of the system.

Such a system provides an indication of current health status and predictions of future health status, thereby allowing the manufacturer to deal with potential problems proactively, which greatly reduces the occurrences of unplanned downtime.

The above discussion is not hypothetical - Civionics has deployed a system in a stamping plant belonging to a global automotive OEM. During the system's first nine month's of operation, it allowed plant personnel to avoid three likely down-time situations, saving them more than ten times the cost of the Percev system.

The bottom line is simply this: *If there is signal that can be sensed, it can be measured, monitored, and analyzed by a Percev system.*



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Configuring a Percev System

A minimally configured Percev Systems comprises:

- 1. One Percev Node
- 2. One Percev CloudGate Module
- 3. A data access plan

Civionics recommends using at least one Percev Cloud-Gate Module per 10-20 Percev Nodes.

A Data Access Plan provides access to Civionics cloudbased resources, including data storage, and data analytics and visualization via Percēv Decision Workshop. Plan prices are based on the number of data channels (real and virtual) within a single facility. Plans include a generous allowance for storing data and are discounted for those who prepay for a year (or longer).

Also available are 3G data plans (which are provided in addition to the basic Data Access Plan). 3G data access is provided via Verizon and plans are priced on a per-Percēv 3GR module basis and the anticipated monthly data throughput rate.

Getting Started

Civionics offers a Percēv Starter Kit 1 (p/n Percēv SK1), which comprises a single Percēv node with the following modules: Percēv A (buffered voltage), Percēv R (buffered voltage with resistor divider), and Percēv WFR (WiFi). Also included is a current clamp (to be connected to the Percēv A module), a thermistor (to be connected to the Percēv R module), a USB power supply, hardware, etc. The end user can attach up to three more transducers to the node, such as those to measure current or pressure. Also included is one year of basic data access services, including visualization and alerting.



For those wanting to explore the Percev nodes' ability to communicate with each other, Civionics also offers Percev Starter Kit 2 (p/n Percev SK2). In addition to everything provided by Start Kit 1, this kit adds a second Percev node and a second USB power supply.

Also available are batteries (p/n: Percēv BTY) and battery chargers (p/n: Percēv BC).

With either Percev Starter Kit, you can be up-and-running in less than 15 minutes!

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