	Name	Signature	Last Updated On
Author of Template	Marketing	Eyal Shahar	2008
QA manager		<No need for soft copy>	

Approval Conformation

Dept.	Name	Date
R&D	Israel Kalman	01/02/2009

PureRF TAG's User Manual

Revision History

Document Version	Date	Author	Changes
1.0	02 February 2009	Zeev Lavi	Initial Draft
1.0.1	20 February 2009	Zeev Lavi	First Release

Table of Contents

1 System Introduction

1.1 What is PureRF?

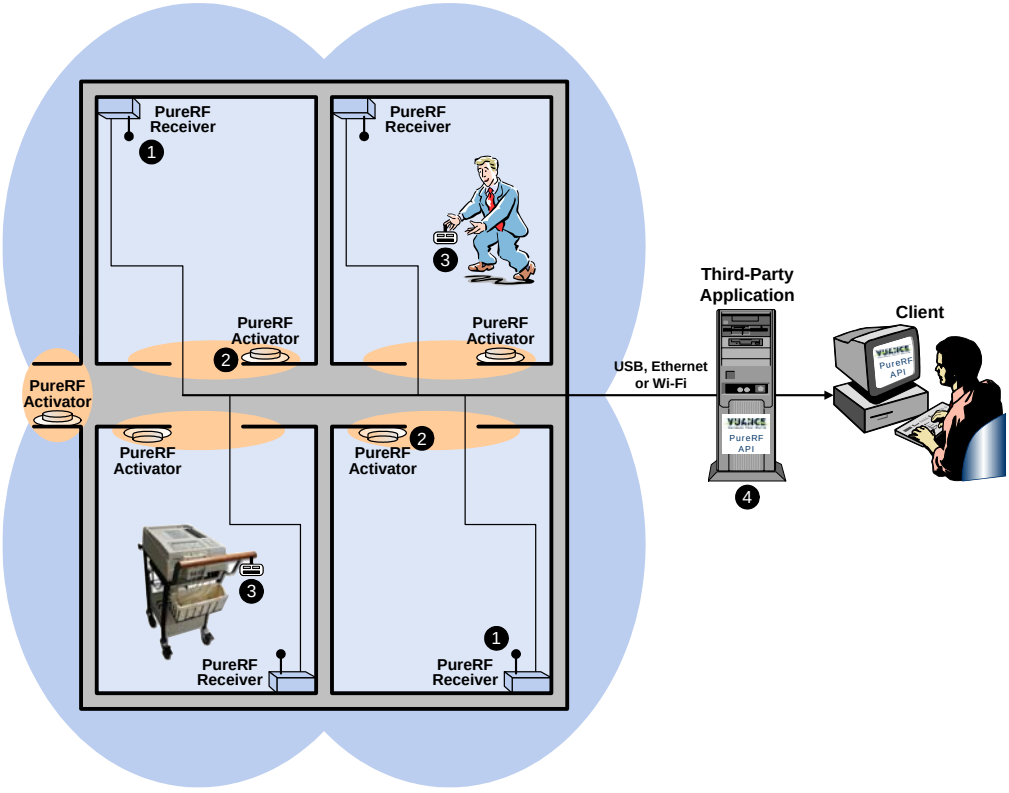
Vuance's innovative solutions enable organizations to monitor, track, locate, secure and manage multiple physical assets (key objects and personnel) that are either in motion or static. Vuance helps organizations alleviate wasted time and resources and provides the ultimate solution for authentication, validation, identification, location and real-time monitoring of its assets.

PureRF suite is an RFID hardware-software asset-tracking management platform, which streamlines asset management scenarios through the introduction of an integrated platform of realtime Identification, Movement Detection and Real Time Locating System (RTLS). It consists of Receivers, Activators, RFID tags and a variety of accessories and software tools for setup, management, monitoring and maintenance. PureRF can be used for access control, security, availability, inventory and incident management systems, as well as RFID solutions for public safety for the commercial and government sectors.

PureRF is operated through a secure, knowledge-based, interactive, user-friendly interface.

1.1.1 PureRF System Architecture

The following shows the architecture of a PureRF system.



The following describes the signal flow of a PureRF system:

A **PureRF receivers** are deployed throughout the monitored space in order to pick up the RF signals that are transmitted by PureRF tags that are installed on monitored assets (for example, in the drawing above, a person and a copy machine). The size of the monitored space can vary from a single door to an entire campus covering wide areas both indoors and outdoors. In the drawing above, the blue area designates the combined coverage of the four installed receivers. The receiver that picks up a PureRF tag indicates the tag's location because a PureRF tag must be in the vicinity of a receiver in order for the receiver to pick up its signal.

When covering a wide area, the receivers may overlap and therefore, several receivers may receive the same signal. In this case, the location of the tag is determined by the receiver that receives the highest signal strength (highest RSSI). The receiver that picks up the transmission adds its own unique ID to the tag's message that represents this tag's (asset's) current location. Additionally, the receiver can perform conversions between various commonly used interfaces/protocols. More information is provided in the *What is a PureRF Receiver?* section on page 7.

B **PureRF activators** are used for improving the accuracy of locating assets compared to what is provided by the receiver ID. For this purpose, PureRF activators are deployed throughout the monitored space wherever improved tag location measurement is required. The PureRF activators continually transmit a short-range uniquely identifying Low Frequency (LF) signal. Tags can read this signal when they are close to the activator (up to about 2 meters/6 feet). In the drawing above the pink area designates the activators' range. The activator ID that a tag reads is added to the message that the tag transmits to the receiver. An activator's ID indicates the location of a PureRF tag at that time because the tag must be physically close to this activator in order pick up its signal. More information is provided in the *What is a PureRF Activator?* section on page 8.

C **PureRF RFID tags** repeatedly (in a random timing to reduce interferences) transmit their unique ID and their status (Low Battery, Motion or Tamper/Panic). Whenever a tag is close enough to a PureRF activator to pick up its signal, the PureRF RFID tag adds the received activator's ID to its periodically transmitted message. These transmissions are picked up by the nearby receivers. More information is provided in the *What is a PureRF Tag?* section on page 6.

D The application that manages and controls the assets/personnel runs on a standard PC. This application can communicate with the connected receivers through the PureRF API (SDK) via the following interfaces/protocols: RS232, RS485, Wiegand, Ethernet and Wi-Fi. The application periodically collects the tags status messages that the receivers collect and records them in its database. Each tag message received contains the unique ID of the receiver that picked up its signal. The application can also analyze the database periodically to generate additional events based on status combinations.

NOTE:

The **PureRF Initializer** is a device used to configure tags and to set up their operational parameters, such as: Tag On/Off, Tag Type, Sensors On/Off, transmissions timings, alarms and so on. The Initializer is the only device that can perform two-way communication with tags using a combination of the RF and LF channels that are incorporated in each tag.

1.2 What is a PureRF Tag?

The PureRF Tag is Vuance's RFID tag. RFID stands for Radio Frequency Identification. An RFID tag is an electronic PCB combined with an antenna in a compact package. The packaging is structured to enable the RFID tag to be attached to an object or a person to be tracked. It can be attached to or incorporated into a product, animal or person for the purpose of identification and location detection using radio waves. Tags can be detected from varying distances depending on the surroundings influence on radio waves propagation.

After a PureRF tag is activated by a PureRF Initializer, it broadcasts at random timing a signal that contains its unique identifier that is picked up by one or more PureRF receivers. The current position of the tag is determined by the receiver that picks up the strongest RSSI (signal strength) value. More information is provided in the *What is a PureRF Receiver?* section on page 7.

PureRF tags also contain a short-range LF receiver that can pick up signals transmitted by PureRF activators and Initializers. PureRF activators are deployed throughout the monitored space and continually transmit a short-range uniquely identifying signal.

When an activator's ID is picked up by a PureRF tag, the activator's ID is included in the PureRF tag's message transmissions. This indicates the tag's location with more precise accuracy (compared to the RSSI method described earlier) because the PureRF tag must be physically very close (approximately within 2 meters/6 feet) to this activator in order to pick up the activator's signal.

1.2.1 PureRF Tag Events

A tag can broadcast a variety of types of PureRF messages which are picked up by the receivers, which transfers them to the user's application in response to its request. These messages are broadcasted by the tag repeatedly at random intervals as defined during setup, such as:

NOTE:

The location of a tag can be determined according to the receiver(s) that picks up the strongest signal.

- **Routine Transmissions:** The tag's routine transmissions are broadcasted at a random timing to indicate its ID and status. The timing of this message is random according to parameters defined during the tag's setup. The definition of these may vary according to the application requirements.

- **Tag Activator:** Whenever a tag enters into the range of an activator, the tag picks up the activator's unique ID and adds it to the transmitted message. This indicates that the tag is very close to that activator (approximately within 2 meters/ 6 feet).
- **Tag Sensors:** The tag can incorporate up to three types of internal sensors for indicating its status. Each sensor controls one bit in the transmitted message. Such sensors include:
  - **Low Battery:** Indicating that the tag's battery voltage is under a predefined threshold meaning that the tag must soon be replaced.
  - **Tag Motion:** The tag turns on the in-motion bit to indicate that it is in motion (being moved). These transmissions can be at regular routine timing or at an accelerated rate as alarm transmissions.
  - **Tag Tamper/Panic:** The tag turns on the tamper/panic bit to indicate that its tamper/panic switch has been activated.

Typically, a tag can be set with two transmission frequencies (timings), one set of frequency for the routine random timing transmissions and another timing (usually more often) for an alarm status, which is activated by a sensor. For example, the tag may be set to transmit in average every ten minutes, when it is static, and every one minute, if it is moving. The duration of alarm transmissions may vary from a single transmission and up to a time period as set for the tag (for example up to 5 seconds).

1.2.2 Tag Permission Events

In addition to the above, other types of events can be triggered for a tag as a result of the third-party user application that can be programmed to periodically analyze the received messages according to a set of defined rules in order to detect interesting combination events such as the following:

- **Tag Inside Authorized Zone:** The tag's signal was detected in an authorized zone.
- **Tag Outside Authorized Zone:** The tag's signal was detected in an unauthorized zone.
- **Tag Inside Homereceiver:** The tag's signal was detected inside its homereceiver.
- **Tag Outside Homereceiver:** The tag's signal was detected outside of its homereceiver.
- **Tag Authorized Timeout:** The tag's signal was detected in an authorized zone, but it is no longer transmitting.
- **Tag Homereceiver Timeout:** The tag's signal was detected in its home receiver zone, but it is no longer transmitting.
- **Tag Missing:** When no signal is detected for a defined period of time from a tag that was recently transmitting.
- **Tag Shock:** A tag that is undergoing a significant amount of movement.

1.3 What is a PureRF Receiver?

Each PureRF receiver picks up the messages transmitted by the PureRF tags in its vicinity and transfers tag and receiver events to the user application. The receiver(s) pick up each

tag's message (which contains its ID) and adds to it the received signal strength and its own (receiver's) ID. Thus enabling the PureRF system to determine the location of the tag (and the asset to which it is attached).

Each PureRF receiver has a defined coverage area and the receivers of a system must be deployed to cover the entire area in which tags are to be tracked.

Receivers store the messages of the received tags in a buffer, which they download periodically to the user application.

1.3.1 Receiver Events

The user application can generate the following receiver events:

- **Receiver OK:** The receiver is functioning normally.
- **Receiver Timeout:** A receiver that was transmitting is now not transmitting any signal at all. This may occur, for instance, when the receiver has no power.
- **Receiver Error:** The receiver is connected and powered up but is indicating an erroneous state.
- **Receiver in Upload:** This event is generated and displayed while new firmware is being uploaded to the receiver.

1.4 What is a PureRF Activator?

A PureRF activator is a device used for improving the accuracy of location measurement of tags as provided by receivers only and is used mainly for entrances and exits.

An RFID activator contains an electronic PCB combined with an antenna and it continuously transmits a unique identifier on a Low Frequency (LF) channel.

PureRF activators are deployed throughout the monitored space at key locations where the improved location measurement accuracy of assets is required. Whenever a PureRF tag enters in range of an activator (approximately within 2 meters/6 feet), the tag receives the activator's signal and adds the activator ID to the transmitted message indicating that the tag is located very close to that activator. Thus, a transmitted activator's ID indicates the location of a PureRF tag at a specific point in time because the tag must have been physically close to this activator in order pick up its signal.

The activator signal is received by the LF receiver incorporated in the tag. Such channel separation enables the tag to receive (activator ID) and transmit (to the receiver) simultaneously.

The activator is an independent device that does not need to communicate with the third-party application. The activator only needs power to operate.

1.5 What is a PureRF Initializer?

A PureRF Initializer is a device that integrates an LF transmitter and an RF receiver into the same device. This enables the Initializer to perform bi-directional communication with tags.

The Initializer is used for controlling a tag's mode of operation (on/off) and for setting or modifying a tag's operational parameters, such as: transmission frequency (timing), activated sensors and so on.

2 Scope

2.1 Overview

A PureRF Tag is VUANCE's RFID tag. RFID stands for Radio Frequency Identification. A PureRF RFID tag is a miniature electronic PCB combined with an antenna in a compact package. The packaging is structured to allow the PureRF tag to be attached to an object to be tracked. It can be attached to or incorporated into a product, animal, or person for the purpose of identification and location detection using radio waves. The PureRF tags can be detected from varying distances and beyond the line of sight of a PureRF Receiver.

After a PureRF tag is activated by a PureRF Initializer, it randomly and continually broadcasts a signal for identifying itself. The tag transmitted signals are picked up by one or more PureRF Receivers that are installed at various locations at the controlled site for providing the required radio coverage for the application.

A tag can broadcast a variety of types of PureRF messages which are picked up by the Receivers, which sends them to a third party server, system or any security application for analysis, identification, alarm and monitoring. These messages are broadcasted by the tag repeatedly at the intervals that the customer defines, such as:

- **Idle Mode Messages:** The tag sends random broadcasts to indicate its location and that it is functional.

NOTE:

The location of a tag can be determined according to the Receiver(s) that picks up the strongest signal.

- **Movement Messages:** The tag sends random broadcasts to indicate that it is in motion (being moved).
- **Tamper Messages:** The tag sends random broadcasts to indicate that its tamper switch has been triggered.

The PureRF TAG is fragmented in three categories such as:

VEHICLE IDENTIFICATION

Identify and track vehicles at airports, gated communities, truck and bus terminals, employee parking lots, military installations, etc.

ASSET PROTECTION

Identify and track laptop and desktop computers, office machines, tools, telephones, and other types of equipment in hospitals, office buildings, retail stores, warehouses, industrial facilities, etc.

PERSONNEL TRACKING

Identify and track employees and visitors in military bases, office buildings, mines, hospitals and warehouses for access control, emergency evacuation and mustering. Multiple Tags can be functionally linked to each other to match employees to laptops, drivers to vehicles and trucks to trailers, etc.

2.2 TAG's Model

PRF- VT	Long Range Tag for assets or vehicles
PRF- PT	Personnel Badge Tag
PRF- AT	Small form-factor Tag for assets or vehicles

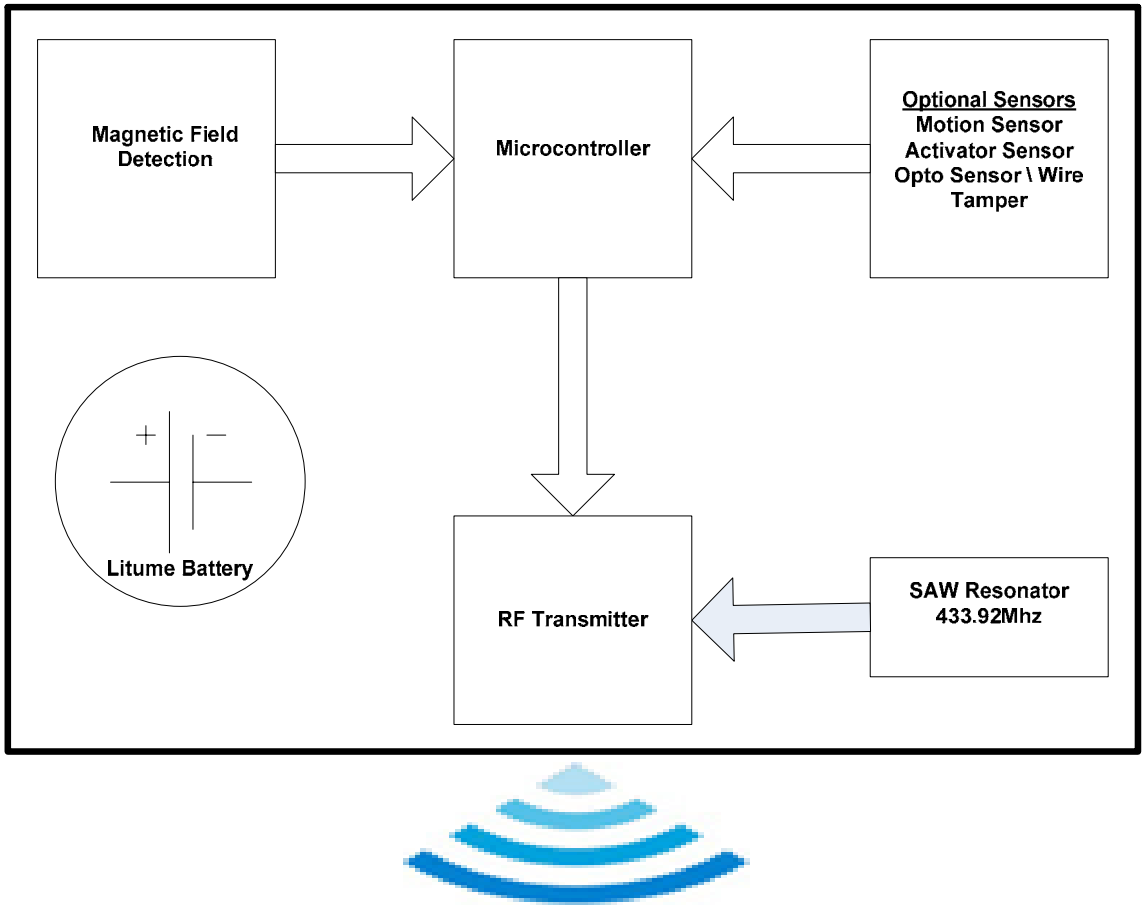
Every Tag incorporates a sensor detecting the status of its internal battery. Additionally, TAGs have the option to incorporate several additional types of sensors such as:

- **Motion Sensor** – for detecting tag (and attached asset) movements
- **Opto-Sensor** – for detecting attempts to remove tag from asset (based on optical technology)
- **Wire Tamper** - for detecting attempts to remove tag from asset (based on open/close circuit technology)
- **Panic Button** – incorporated in personnel tags
- **Activator** – for improving the location measurement of tags at key locations (to about 1-2 meters).

For all valid options of incorporating sensors into the tags - see Appendix A.

3 Technical Description

TAG components block diagram.



- **Battery:** Lithium Battery provides life-span of up to 5 years pending on battery usage profile that is determined by tag configuration and usage scenario.
- **SAW Resonator:** Resonator that supplies the RF frequency.
- **Magnetic Field Detection:** Channel that communicates with external device such as Initilaizer (to set and control the TAG) and Activator.
- **Microcontroller:** Handles communications and sensors.
- **Motion Sensor:** Detects and reports TAG movements.
- **Activator Sensor:** Detects and reports when TAG is receiving an Activator signal.
- **Opto-Sensor:** Detects and reports of every light intensity changes at the vicinity of TAG's PCB (inside the tag packaging).
- **Wire Tamper:** Detect and report of every open circuit (wire sensor break).
- **RF Transmitter:** Modulated ASK Radio signal transports data via a PCB printed antenna.

4 Main Features

- Reliable low power consumption. Battery life is estimated at 5 years*.
- Proprietary algorithm oversees communication between Tags and Readers
- Anti-Collision algorithm allows Reader identification of multiple Tags simultaneously
- TamperDetect™ feature can trigger alarm reports if Tags are removed from assets or vehicles
- Adjustable tag read range within 0.5 to 500 feet (0.15 to 150m) **
- AutoLocate™ beacon capability is standard in all Tags
- Push button feature can trigger distress or notification identification if pushed (for personal tags)
- MotionDetect™ feature can trigger alarm reports if Tags are moving
- PinpointDetect™ feature can notify the Tag's location within 0.5 to 6 feet (0.15 to 1.8m)*** when Activator feature is used.
- Feature rich and flexible operation, configurable settings include: Site ID, Tag ID, Transmission Repetition and Alarm Functions
- All Tags support 26 bit Wiegand protocol
- Option: Tag's Initializer device which activates/deactivates the Tags and also configures tamper/motion and other alarm features

* At a typical transmission interval of 6 sec. Battery life can be extended when the transmission intervals increases

** Using a Reader with 0dBi Omni antenna. The distance can be extended using directional antennas with higher gain. Read distances may also vary as a result of the presence of metal and other environmental propagation conditions

*** PureRF Activator is required to support this feature

5 Certification

5.1 FCC certification

All PRF-TAG's in this document conforms to the following certification specifications:

"This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

(1) This device may not cause harmful interference and

(2) This device must accept any interference received, including interference that may cause undesired operation."

6 Technical Specification

Compatibility: PureRF suite

Tags Types: PRF-VT, PRF-PT, PRF-AT

Performance:

Transmission range PRF-VT up to 500 feet (150m)**
PRF-PT up to 400 feet (120m)**
PRF-AT up to 350 feet (105m)**

Transmission rate: 38.4 Kbps

Communication:

Tx Frequency: 433.92 MHz ISM license free band

Modulation: ASK

Antenna: 50Ω Internal PCB antenna

Communication protocol: Proprietary

Transmission: Random, event based or demand

Optional Internal Sensors[1]: Activator, Motion Sensor, Opto Sensor, Tamper Wire, Panic Button

Electrical:

Power Supply: 3V DC Lithium battery

Output Power (ERP): 0.16 – 0.23 mW

Dimensions and Environment:

Physical:

Part	Size	Weight
PRF-VT	40mm x 110mm x 8mm	29 grams
PRF-PT	56mm x 88mm x 7mm	32 grams
PRF-AT	40mm x 72mm x 9mm	22 grams

Operating temperature: -30°C to +75°C

Storage Temperature: -30°C to +80°C

Humidity: 5% to 90% (non-condensing)

[1] Different sensors can be combined in a single tag

7 Appendix A

The tables below describe the sensor combination that can be added to each PRF TAG's

For PRF-VT- XX-XX, and PRF-AT-XX-XX Tag series:

	MO	MO-OPT	MO-A
☐ Motion Sensor ☐ Opto Sensor ☐ Activator ☐ Wire Tamper	☑ Motion Sensor ☐ Opto Sensor ☐ Activator ☐ Wire Tamper	☑ Motion Sensor ☑ Opto Sensor ☐ Activator ☐ Wire Tamper	☑ Motion Sensor ☐ Opto Sensor ☑ Activator ☐ Wire Tamper
MO-T	**MO-OPT-A**	**MO-T-A**	**OPT**
☑ Motion Sensor ☐ Opto Sensor ☐ Activator ☑ Wire Tamper	☑ Motion Sensor ☑ Opto Sensor ☑ Activator ☐ Wire Tamper	☑ Motion Sensor ☐ Opto Sensor ☑ Activator ☑ Wire Tamper	☐ Motion Sensor ☑ Opto Sensor ☐ Activator ☐ Wire Tamper
OPT-A	**A**	**T-A**	**T**
☐ Motion Sensor ☑ Opto Sensor ☑ Activator ☐ Wire Tamper	☐ Motion Sensor ☐ Opto Sensor ☑ Activator ☐ Wire Tamper	☐ Motion Sensor ☐ Opto Sensor ☑ Activator ☑ Wire Tamper	☐ Motion Sensor ☐ Opto Sensor ☐ Activator ☑ Wire Tamper

For PRF-PT- XX-XX Tag series:

	MO	MO-PB	MO-A
☐ Motion Sensor	☑ Motion Sensor	☑ Motion Sensor	☑ Motion Sensor
☐ Push Button	☐ Push Button	☑ Push Button	☐ Push Button
☐ Activator	☐ Activator	☐ Activator	☑ Activator
☐ Wire Tamper	☐ Wire Tamper	☐ Wire Tamper	☐ Wire Tamper

MO-T	MO-PB-A	MO-T-A	PB
☑ Motion Sensor	☑ Motion Sensor	☑ Motion Sensor	☐ Motion Sensor
☐ Push Button	☑ Push Button	☐ Push Button	☑ Push Button
☐ Activator	☑ Activator	☑ Activator	☐ Activator
☑ Wire Tamper	☐ Wire Tamper	☑ Wire Tamper	☐ Wire Tamper

PB-A	A	T-A	T
☐ Motion Sensor	☐ Motion Sensor	☐ Motion Sensor	☐ Motion Sensor
☑ Push Button	☐ Push Button	☐ Push Button	☐ Push Button
☑ Activator	☑ Activator	☑ Activator	☐ Activator
☐ Wire Tamper	☐ Wire Tamper	☑ Wire Tamper	☑ Wire Tamper

Note: The Opto Sensor and Wire Tamper cannot be together on the same tag because they are using the same CPU interrupt line.