2011

Strata Proximity Systems
Underground PAD Users Manual v1.0

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1 Overview

The Underground PAD is a component of the HazardAvert™ Proximity Detection System from Strata Proximity Systems (SPS). HazardAvert™ provides warnings to individuals and machinery to alert them that an individual wearing the PAD has entered too close to an operating piece of equipment and is in a dangerous situation. HazardAvert™ also warns when vehicles or other machinery are getting close enough that the possibility of a collision exists.

1.1 Theory of Operation

The Underground PAD is worn by an individual. The functions of the Underground PAD are:

- To detect the presence of a 73 kHz electromagnetic field generated by vehicles or machinery equipped with the HazardAvert™ system and to determine if the field strength level detected indicates that the individual is in or is approaching a dangerous situation.
- To provide an audible and visual indication to the wearer of the Underground PAD when they are approaching or are in a dangerous location as a result of the 73 kHz field strength level.
- To transmit a 916.48 MHz RF signal to vehicles or machinery equipped with the HazardAvert™ system signaling that the individual is entering or has entered into a dangerous area relative to the vehicle or machinery.

The Underground PAD has a 73 kHz receiver that is constantly on and monitoring the strength of fields emitted by vehicles and machinery equipped with the HazardAvert™ proximity and collision avoidance system. The Underground PAD monitors the strength of the 73 kHz fields in three axis and determines if the field strength has risen to a level that would indicate that the individual is approaching a “Warning Zone” or is in a “Danger Zone” due to being too close to the vehicle or machinery. If the Underground PAD determines that the individual is too close to the vehicle or machinery, it gives the individual both a visual and audible indication. At the same time, the PAD transmits a 916.48 MHz RF signal to inform the vehicle or machinery that the individual is approaching too close. If the Underground PAD determines that the field strength indicates that the individual is not in a Warning or Danger Zone area, it will transmit a data packet every ten (10) seconds via the 916.48 MHz with its status condition.

The Underground Pad is comprised of four systems each on a separate printed circuit board. The **PAD System Board** contains three magnetic field pick-up coils each in a physically different axis placed 90 degrees from each other. These pick-up coils along with their fixed value capacitors and amplifiers form a 73 kHz receiver for reception of fields generated by vehicles or machinery equipped with the HazardAvert™ system. The System Board also has a PIC microcontroller which receives the inputs from three detectors which independantly detect the inputs from the three 73 kHz pick-up coils. The PIC through an internal algorithm, determines if the 73 kHz field is above a pre-programmed threshold.

If the PIC determines that the received field is above the threshold level, it sends a logic signal and data to an internal **RF Transmitter Board**. The RF Transmitter Board contains a LINX TXM-916-ES transmitter Integrated Circuit. The TXM-916-ES generates and frequency modulates a 916.48 MHz carrier with the data sent from the PIC microcontroller on the PAD System Board. The RF Transmitter board has no alignment procedure as the TXM-916-ES treanmitter has a self contained crystal controlled PLL oscillator. This transmitted 916.48 MHz signal will alert the vehicle or machinery that generated the 73 kHz field that was received, that this particular Underground PAD unit is coming within an unsafe distance of the vehicle or machinery. If the PIC determines that the 73 kHz field strength is below the threshold level, it will cause the RF Transmitter to transmitt the unit's status and identification data once every 10 seconds.

Along with generating the RF signal to alert the machinery or device, the Underground PAD will also alert the person wearing the PAD with both an audible sound and a visual indicator that they are in an area that is too close to the vehicle or machinery. The audible and visual indicators are located on a **Warning Unit Board** which is also within the Underground PAD.

1.2 Frequency of Operation

The PAD will transmit as a frequency of 916.48 MHz in the ISM Band.

1.3 Approvals

1.3.1 MSHA Approval

The MSHA approval number is **HA-PAD-2100**.

1.3.2 Pennsylvania Approval

The Pennsylvania approval number is **BFE69-11**.

1.3.3 West Virginia Approval

The West Virginia approval is expected Q4 2011.

1.4 Label Information

The Underground PAD label is located on the front center of the unit. A picture of the Strata label and MSHA label is below:

The Strata label defined the Software (sw) version and Interface model number used inside the PAD. The MSHA label provides the MSHA approval number, specific MSHA certification, serial number and operational warning for fresh air charging only.

1.4.1.1 MSHA Blasting Distance

MSHA approval requires that a minimum of 40 inches shall be maintained between the Underground PAD and any blasting circuits, explosives or detonators.

1.4.1.2 Pennsylvania Blasting Distance

Pennsylvania approval requires that the Underground PAD must be installed at a minimum safe distance of 17 feet from blasting circuits, explosives, and detonators.

Note: Pennsylvania generates such requirements by multiplying the MSHA determined minimum distance of 40 inches by a factor of 5.

1.5 FCC Information

The FCC ID for the Underground PAD is **ZQ3-SPS-UTPAD**. When configured by Strata for underground use, the device complies with Part 15 of the FCC Rules. Operation is subject to the following conditions:

(1) This device may not cause harmful interference.
(2) This device must accept any interference received including interference that may cause undesired operation.

Any intentional or unintentional changes or modifications to the configuration of the Underground PAD not specifically detailed in this document could void the user's authority to operate the equipment.

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:
-- Reorient or relocate the receiving antenna.
-- Increase the separation between the equipment and receiver.
-- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
-- Consult the dealer or an experienced radio/TV technician for help.

2 Operation

2.1 Installation Information

The Underground PAD is to be worn on the hip of the employee. Metal near the PAD may impact the performance. The PAD should be at least 3 in or 75 mm from all other electronic devices such as Spotters, CO sensors, tracking devices, etc. After placing the PAD on the operator's hip, performance of the unit should be verified at the SPS Checkout Station.

2.1.1 Interoperability Warning

The Underground PAD may experience erratic responses when in *very* close proximity to some electronic devices. Electrical devices may transmit an electrical field and noise from these fields *may* cause interference with the PAD's reception. A safe guideline is to keep PAD *at least 75 mm away* from any electrical devices included but not limited to methane monitor, radio, mobile phone, PDA, battery charger and laptop.

2.2 Charging

The Underground PAD is powered from an internal rechargable Lithiun Ion battery that is connected to the other three boards through a **Battery Interface Board**. This Interface Board contains a PIC microcontroller which provides switching functions to control power application to the other boards as well as to determine when the PAD battery is being recharged. The Battery Interface Board also contains circuitry necessary to allow the device to meet the intrinsically safe requirements of mining equipment.

The PAD must be charged daily in an approved PAD charging station. The PAD will take approximately 8 hours to charge when completely discharged. The PAD will operate for approximately 48 hours after being fully charged.

2.3 Alerts

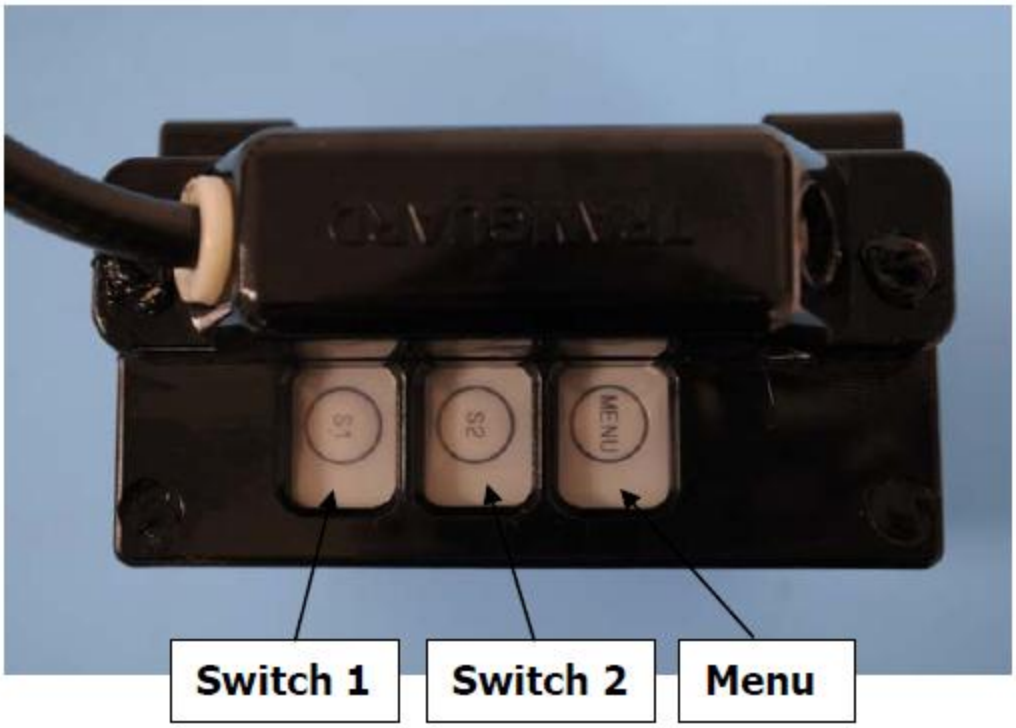
The Underground PAD will alert the user with both an audible sound and a visual indicator that they are in an area that is too close to the vehicle or machinery. Once the PAD has determined that the user is too close to the machine, it will begin to warn the user. Mulitple levels of warning are provided. The typical setting is to give a warning when the user enters the Warning Zone and as the machine aprroaches closer,the PAD crosses into the Danger Zone and will alarm continuosly. A photograph of a PAD with its LED is shown below.

2.4 Buttons

Any user can stop all machines in their line-of-sight by using the Remote Stop capability programmed into the Underground PAD. By *simultaneously* pressing any two of the three buttons on the PAD for at least one (1) second, the PAD will transmit a Remote Stop signal to all equipment in range of the PAD.

To cancel the Remote Stop, the operator must *simultaneously* press S1 and Menu on the PAD for one (1) second.

A photograph of the top of the PAD and buttons is below.



2.5 Maintenance

The Underground PAD should be cleaned after each use to ensure all buttons and connectors are free of all dust and dirt.

3 Warranty

Initial system hardware components will be warranted to be free of defects for a period of one (1) year from in service date. Subsequent component purchases will be warranted one (1) year from receipt acknowledgement. Warranted replacement or repair is not applicable in cases of physical damage or abuse as determined at the time of return or inspection.

4 Revision History

4.1 Version 1.0 – September 1, 2011

Original release. No revision history