

# Annex no. 5

# User Manual

## Personnel Proximity Detection System – PPD User Guide

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## 2 INTRODUCTION

Wherever large machine movements take place in the vicinity of personnel, danger lurks. In underground mining, this problem has conventionally been associated with Room & Pillar operations, where LHD vehicles and Continuous Miners often operate in very cramped conditions with relatively poor operator visibility due to the sheer size of vehicles and machines. The same dangers apply in longwall mining, despite the fact that movement of each roof support is signaled by an acoustic warning. But personnel often become 'complacent' when responding to warning tones heard often, so the onus is very much on the miner to be aware of surrounding danger.



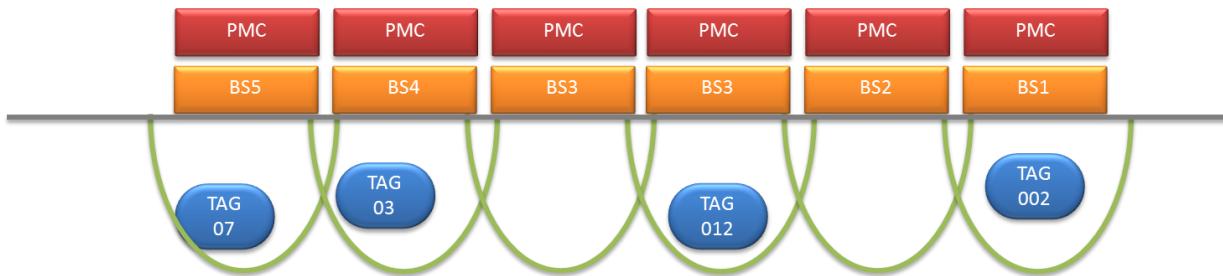
Miners are constantly required in the active longwall for maintenance and repair tasks, and an operator is always required for shearer longwalls. Closing down the entire longwall to carry out maintenance would cause an unacceptable loss of production, so work is carried out with the longwall in full operation. Optimal safety requires a careful balance between ensuring workplace safety and minimizing disruption of production. But these safety features require the miner to take the action – something easily forgotten, or, indeed, sometimes deliberately not taken to speed work. And the identity of the miner is not known.

After the shearer or plow has passed, the longwall advances automatically. If a miner were still under a moving roof support, there would be a great risk of injury or even death. A longwall equipped with the Personnel Proximity Detection (PPD) system automatically detects the presence of the person and reports this directly to the local Control System, which then responds in real time, preventing motion while the person is present as long as the person is wearing a tag.

The goal of a longwall Personnel Proximity Detection System is to clearly identify the presence or absence of personnel with a high degree of repetitive accuracy, and to transmit this information in real time to the local control system to allow appropriate action to be taken in order to prevent injury.

The Personnel Proximity Detection System uses a dual-frequency system and a special antenna setup to enhance reception in mining environments containing large amounts of steel.

The PPD system essentially comprises local readers (transceivers) and RFID tags worn by personnel. When a miner enters a marker field, the reader is immediately aware of their presence and reports this to the controller, as shown in the following figure.



In the Longwall Personnel Proximity Detection system, each roof support in the longwall is equipped with its own reader. These connect directly to the local roof support controller (PMC), allowing real-time response

Each roof support is surrounded by its own marker field, similar to a cell in mobile communication networks. As a result, the system can track a person moving along a longwall and identify exactly where they are at any time.

There is constant communication between the individual readers and between each reader and any tag in its marker field. The combination of the tag's active and passive response means that it is impossible for a tag-wearer to be located within a marker field and not be detected.

## 3 DECLARATION OF CONFORMITY

Manufacturer/auth. Representative: Scemtec Automation GmbH declare under our sole responsibility that the following products

Trade name: PPD READER Revision: D/E	Trade name: PPD TAG Revision: D/E
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comply 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.

is in conformity with the essential requirements and other relevant requirements of the R&TTE Directive (1999/5/EC).

The product is in conformity with the following standards and/or normative documents as described in the declaration of conformity which is available from the manufacturer.

The device are intended to be used in an end application with a control unit.

## 4 SAFETY INSTRUCTIONS

The reader is designed for operation ambient temperature ranging from –20°C to + 70°C. The TAGs operating temperature range is from -20°C to +40 °C

Cables, power supply, control units and other equipment to operate the reader is not within the scope of supply and is provided by the end-customer.

Installation and bringing into service of the reader and TAG has to be done by a skilled qualified field service personell.

Usage the reader and TAG is only allowed after personell training.

On system malfunctioning the affected components are to be replaced by original equipment by skilled personell only. The erroneous devices are to be sent to the manufacturer.

Modifications to the reader and tag are not allowed under no circumstances because approvals get invalidated. Do not open the reader with pressure.

The reader is only operateable with a higher control system which is not part of the PPD system itself. Please follow the operational and user guide of the control unit.

At the connectors of the reader only approved plugs, cables and devices of the superior control system are permitted and to be installed by trained personell. Pay attention to the labeling of the plugs.

Personell has to be familiar with the warning signals of the superior control systems and is capable of shut down the control system in dangerous situations..

The safety instructions in this user guide and the general safety rules have to be observed.

## 5 INSTALLATION, MAINTENANCE AND OPERATION

The safety, installation, operation and maintenance instructions in this user guide and the general safety rules have to be observed.

The reader is to be installed, repaired and maintained by trained personnel only. If more than one person is attended to a repair process the workflow has to be clearly communicated and admitted.

The assignment is to be delivered to any personnel who is in charge for the repair process by the supervisor after training.

Knowledge about the behaviour of the superior control unit is very important for maintaining sub devices like the reader. Manual and operation guide of the control unit is to follow.

Do not use any caustic liquids to clean the reader and/or Tag.

Remove protection cap just before connecting the reader to the host system. Please attach the protection caps to unused plugs and receptacles.

Repair defect seals immediately.

Reader and TAG are to be transported in their provided boxes – avoid unnecessary shocks and damages  
Please ask supplier about storage conditions.

The reader is designed for operation ambient temperature ranging from -20°C to + 70°C. The TAGs operating temperature range is from -20°C to +40 °C

Do not replace the primary cells of the TAG.

The (hose) cable is connected to the same (ground) potential as the reader

## 6 PPD READER

The Reader operates at 12V (<250mA) and is intrinsically safe, meaning fewer power supply units and that no costly, heavy flameproof housings are required.

On the front there are four connectors for power supply and data connection to control systems: the outer connectors (OS4) are internally connected (path-through) and allow a daisy-chain of several readers with one power supply feed. The two inner connectors (OS8) are used to connect additional control systems.

A data-cable cannot be attached to the power-supply connectors and vice-versa. See chapter 6.3 for a more detailed description.

The window in the top cover allows the view on five signal LEDs which indicate the operation mode of the reader, see 6.1 for a detailed description.

After power on reset (POR) by connecting the reader to a power supply the reader's bootloader starts the firmware with default configuration values. Afterwards the firmware runs a system-self-test and changes to the maintenance operation mode indicated by an active orange signal LED.

To operate the reader – meaning to active LF field creation and therefore tracking functionality – a control unit connected to the reader is necessary. When set to operating mode by the control unit the reader may create 125KHz LF fields as configured for detection of TAGs nearby within the field. The TAGs are woken up by the LF Field as they detect the LF Field and then send a notification to the Reader via HF (2.4GHz) with the id of the reader and the id of the TAG as identification data.

The PPD Reader takes the task of the controlled or automatic creation of LF fields with two integrated LF-Exciters which orthogonal arranged antennas (see 6.1). The output power of the LF field is configurable by a pulselwidth relationship, range and average current consumption therefore differ.

The field strength and therefore detection rate and distance are dependent on many factors and may vary over time due to different voltages, component aging and operation environment.



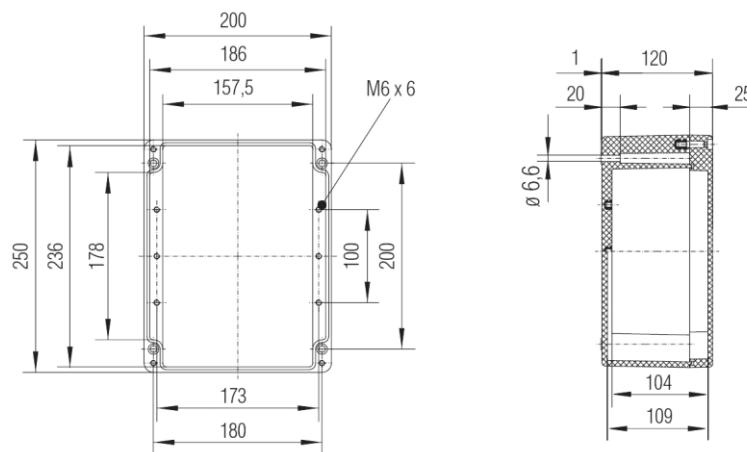
Figure 6-1 Intrinsically safe reader with mine duty OS (o-ring sealed) sockets

## 6.1 MECHANICAL CONSTRUCTION

The case is safe by IP 66/67 acc. to IEC 529, most electronic parts within are moulded.

The reader contains 2 LF Transmission antennas (125 KHz) which are arranged orthogonal as shown in the following picture.

The used case dimensions are 250 x 200 x 120 mm at weight of 2320g.



Technical facts	
Basic Material	Fiber Polyester, EN 60079-0
	Surface impedance < 109 Ω, halogenfree
Color	RAL 9005, black
Sealing	EPDM -20 °C bis +100 °C
Mech.strength EN 60079-0	7 Nm
Protection class EN 60529/IEC 60529	IP 66/67

## 6.2 SIGNAL

Operationmodes are signalled via LEDs as described in the following table with the symbol meaning:



static orangene LED



green flashing LED

FAILURE	MAINTENANCE	OPERATING		PPD	PPD	Description
						Bootloader active
						Startup
						System OK State
						LF-Pulse
						TAG detection.
						Error
						Maintenance

## 6.3 INTERFACE / CONNECTORS

The power supply is connected to the VIN connector (12VDC in) of the reader. Serial communication with separate power supply is done via connection SER or/and PMCR.

Connector	Type	Description	
VIN	OS4	Supply Voltage DC 12V	
PMC/R	OS8	Control Unit	
SER	OS8	Extensions	
VOUT	OS4	Pass Through of VIN	

The shield (e.g. or metallic connector of a hose cable) of the cable is connected to the same ground potential as the reader.

#### 6.4 TECHNICAL SPECIFICATION

<b>Operational Temperature (max.)</b>	-20°C ... +70°C
<b>Input Voltage (DC)</b>	9.5VDC ... 13.2VDC (typ. 12 VDC )
<b>Average Power consumption</b>	< 3W (see Note 1)
<b>LF Middle Frequency</b>	125 KHz OOK (On-Off-Keying)
<b>LF Antenna resonance voltageLF ( Note 4 )</b>	800 Vpp
<b>LF-signal strength @ 10m distance ( Note 2 )</b>	66 db $\mu$ A/m
<b>LF-Exciter Maximum Outputpower</b>	4.9W
<b>HF Middle Frequency</b>	2400-2483,5 MHz (see Note 3)
<b>HF Channels</b>	11-26 / 2 MHz Bandwidth
<b>Output Power</b>	50 $\Omega$ / 18dBm (22 dBm max.)
<b>HF Range Extender</b>	Yes

Note 1: The average current consumption depends on the quantity of radio transmissions (LF, HF) and operation modes.

Note 2: according EN 300 330.

Note 3: Based on standard IEEE 802.15.4.

Note 4: This voltage is only available within the moulded antenna and is not available outside of the antenna.

## 7 PPD TAG

Each miner or visitor wears intrinsically safe battery-powered tag. This compact unit can be mounted on a helmet or worn on clothing or a belt. The tag has low power consumption, resulting in a battery life of two years. Battery status information routinely transmitted by each tag is captured by the visualization software, allowing personnel to be warned



when their tag needs replacing. When it enters a marker field, the tag transmits its ID, the marker field number and additional status information back to the reader.

Figure 7-1 The PPD TAG for helmet/belt and a variant for screw fixture

Each tag ID is unique worldwide. The tag is software-configured, allowing tag ID assignment to be decided based on user preference, for example permanently assigned to a particular person, assigned per shift to a person in a particular role (operator, hydraulic maintenance, electrical maintenance, or visitor), or simply left unassigned to identify the presence of a person.

This flexibility also allows the safety response of the system to the various roles to be programmed accordingly, for example with greater safety margins for visitors than for experienced miners.

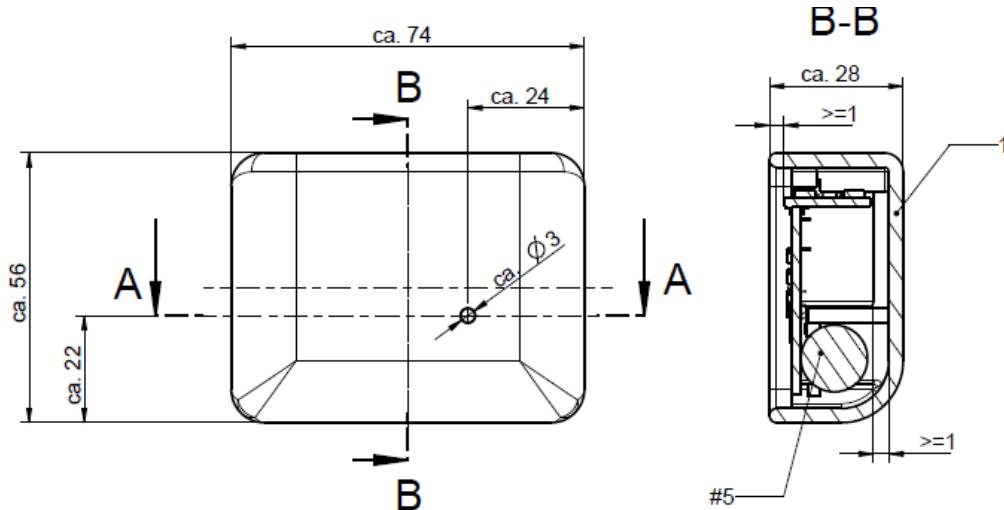
The PPD tag uses two frequencies: low frequency (LF) and high frequency (HF). LF is used for standard RFID identification as described above. HF is used for detailed communication back to the reader, including providing data on battery status and marker field number.

The TAG is battery powered with two primary cells and is normally in a deep sleep mode. The TAG is moulded.

The field strength and therefore detection rate and distance are dependent on many factors and may vary over time due to different voltages, component aging and operation environment.

## 7.1 MECHANICAL CONSTRUCTION

The following drawing shows a typical Tag case. There may be slight different variants with different possibilities to fix the TAG to helmet or wall



### Technical facts

Basic Material	PA2200
Color	black
Protection class EN 60529/IEC 60529	IP 66/67

The case is safe by IP 66/67 acc. to IEC 60 529, electronic parts within are moulded. The TAG contains 1 LF receiver antenna (125 KHz). The material is.

## 7.2 SIGNAL

LED	LED 1	Description
		The reception of the LF-Signal was successful and tag-data were sent.
		Failure Detected, Battery Low, LF could not be decoded

## 7.3 TECHNICAL SPECIFICATION

<b>Operational Temperature (max.)</b>	-20°C ... +40°C
<b>Input Voltage (DC)</b>	3.6 VDC +- 15%
<b>Batteries</b>	2 Primary Cells (3.6V, total 3.7Ah) included
<b>LF Middle Frequency</b>	125 KHz OOK (On-Off-Keying)
<b>HF Middle Frequency</b>	2400-2483,5 MHz
<b>HF Channels</b>	11-26 / 2 MHz Bandwidth
<b>HF Output power</b>	57.54uW 50 Ω
<b>HF Range Extender</b>	No
<b>LF-Antennatype</b>	3 axis

## 8 GLOSSARY

Begriff	Erläuterung
LF	Low Frequency – 125kHz
HF	High Frequency – 2.4 GHz
TAG	Mobile battery powered unit with radio contact to reader
Tacking Generator	Unit within the reader which creates the LF field
Reader	Consists of 2 TGRs and 2 HF Communication modules with a central processing unit to localize TAGs.
PPD	Personnel Proximity Detection
TGR	Tacking Generator
AP	AccessPoint
BS	Reader
Reader	Reader