Integration of Personal Protective Equipment Checks in Access Control

BE
Beams Department

Authors : P. Pok, F. Havart, T. Ladzinski
CERN, Geneva, Switzerland

Abstract

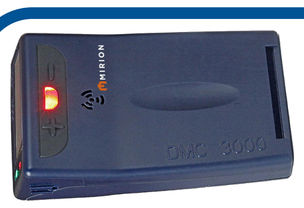
Access to the interlocked zones of the CERN accelerator complex is allowed only for personnel wearing standard personal protective equipment. This equipment is complemented by specialised personal protective devices in case of specific hazards related to the remnant radiation or the presence of cryogenic fluids. These complex devices monitor the environment in the vicinity of the user and warn the user of the presence of hazards such as radiation or oxygen deficiency. The use of the devices is mandatory, but currently only enforced by procedures. In order to improve the safety of the personnel it has been proposed to verify that users are carrying their devices switched on when entering.
This paper describes the development of a specialised multi-protocol terminal, based on Texas Instruments digital signal processor and integrated in the personnel protection system. The device performs local checks of the presence and status of operational dosimeter prior to allowing access to the interlocked zones.

Objective

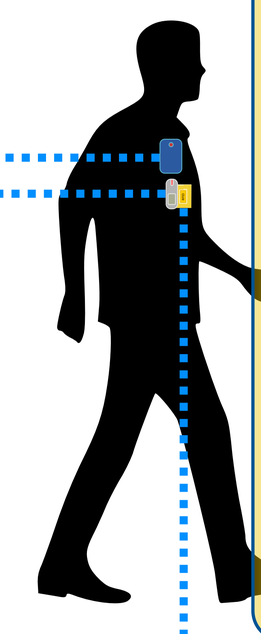
Designing a multi-protocol terminal capable of communicating with a large set of devices in a wireless way and meeting every criterion of the access system both mechanically and electronically, and not hindering the access process itself.

The devices providing active personal protection are very specialised and their use is not common outside CERN. Hands-on training is provided to the users and reminders posted on the obligation of wearing the equipment at the access points and in the elevators. However, a systematic check to ensure in an automatic way that everyone is in possession of the necessary active protective equipment when entering a beam facility has not been provided so far.

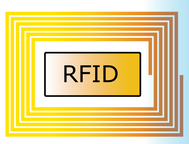
The proposed solution is a terminal unit capable of tracking the protective equipment and communicating with the access system. The terminal unit can be triggered by the programmable logic controller (PLC) of the access booth, once a person steps in. During the access control verification process, the terminal unit is commanded to execute reading cycles to check the presence and the status of the personal protective devices. If the equipment is not present or not correctly set, the access system notifies the person to wear it properly and refuses access into the given interlocked zone. In particular, the objective for the terminal unit is to the check for the presence of operational dosimeters and oxygen detectors.



Operational dosimeters are provided by the Dosimetry Service at CERN. They are mandatory for everyone working in Limited Stay, High Radiation and Controlled Radiation areas [1]. The dosimeter displays the amount of dose and it has alarm functions when thresholds for dose or dose rates are exceeded. Before entering a hazardous area, the person has to read out and reset the dosimeter via a contactless reader terminal from the same manufacturer.

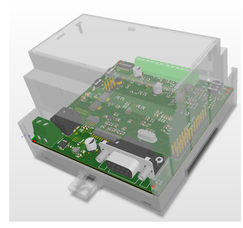


Oxygen level detectors are used in cryogenic facilities to cover the risk of oxygen deficiency hazard (ODH). Their use is mandatory in the Large Hadron Collider (LHC) tunnel areas. The device displays oxygen levels and sounds an alarm when a threshold value is reached. There are no terminal readers provided and the device does not offer native contactless communication mechanism.



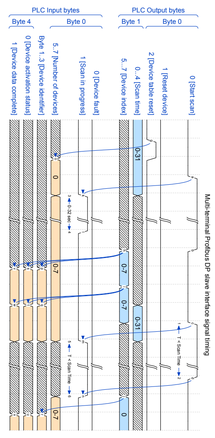
Two cases were taken into consideration: the devices that natively communicate with their terminal units wirelessly, and the devices that do not provide any wireless interface. In the first case, the objective was to use the existing communication mechanism and in the second case to add an RFID tag to the equipment.

Multi-protocol terminal



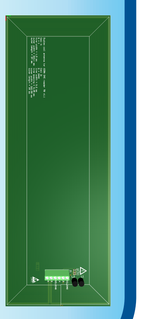
The terminal unit was designed to be installed inside the access booth known as Personnel Access Device (PAD). Thus, it is powered from a common 24V DC supply voltage rail of the PAD and connected to its controller via Profibus [9] as a Decentralised Peripheral (DP) slave device [10].

The functionalities of the device are based on a Texas Instruments TMS320F28062 C2000 core Digital Signal Controller (DSC) [11], which samples and processes the filtered antenna signals, drives the reader antenna driver circuit, and handles the Profibus interface chip. It communicates with the master PLC via the output and input bytes that are assigned to the device according to its General Station Description (GSD) file [12].



A PLC controls the terminal via the Profibus DP-V1 protocol, with two output bytes that contain three individual bits and two groups of command bits. With the help of these command signals, the PLC can start and stop the reading process, can assign a time interval for the scanning process, reset the terminal, and index the table of the successfully read devices. Four input bytes serve for signalling to the PLC, two bit signals to indicate faults and the state of the reading process, three bits to indicate the number of successfully read devices and four bytes that contain the identifier digits and parameters of the read devices.

Two antennas are used in a time division multiplexed way, i.e. only one reader antenna is active during the transmission process. Thus, the maximal supply current can be applied to one antenna, meaning greater transmitted power. Due to size restrictions, in the smaller PAD model, the antennas have to be hidden behind the sidewall, which requires small cut-out modifications, but the antenna efficiency is very high. In bigger models, the mechanical installation is easier, but due to steel surrounding, the efficiency of the antenna is slightly decreased.



Conclusions

A multiprotocol terminal device capable of detecting the presence of personal protective equipment was designed and developed. It was installed in the LHC and PS type of PADs in a laboratory setup and successfully tested with the operational dosimeters in use at CERN. On-site installation in one of the PS accelerator access points is pending conclusive tests at the beginning of the next shutdown period, where a large number of accesses will take place.

References

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JACOW ID THPHA100

peter.pok@cern.ch

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