



SIAP+MICROS

# ALMOND-F

Alarm and Monitoring system for Debris-Flow

In collaboration with:







The monitoring and alert system ALMOND-F (Alarm and Monitoring System for Debris-Flow), which has been designed by **SIAP + MICROS** and **CNR IRPI Torino**, is mainly devoted to:

- the issue of warnings for protection from debris and mud flows,
- the Multi-parametric integrated monitoring of debris flows for documentation and research purposes.

The ALMOND-F consists of an innovative detecting system that, thanks to the integrated use of 3 geophones and 1 level sensor, placed along a reach of the torrent to be monitored, allows to retrieve the following parameters for the characterization of the phenomena:

- height of the main front and of possible further waves,
- mean front velocity,
- peak discharge (a stable section must be present),
- total volume of the debris flow (a stable section must be present),
- wave form.

The precision of any monitoring system depends on its calibration to better fit the features of the installation site. The ALMOND-F makes no exception and, in order to get a higher reliability of the retrieved information, we warmly SUGGEST a detailed evaluation about the choice of sensors, sampling and recording frequencies, signal amplification level, a careful choice of the method of installation of the geophones, a correct choice of the method for signal processing, a correct choice of the algorithm used for alarm issuing. The more these evaluation will be customized on the specific installation site, the more the recorded data will be accurate and meaningful and the same for the issued warnings.

The main advantages given by the ALMOND-F when it's used as an alarm system compared to the traditional one using trip wires, pendulums or stage sensors are the following:

- It uses passive type sensors (geophones) which don't need any power supply, and this allows its use in sites where there's no power supply and/or low insulation conditions,
- It doesn't need any suspension structure, as required by other sensors, since the geophones can be installed directly in the terrain. This makes the installation easier and safer, because there's no risk of collapse for the retaining structures due to bank erosion,
- It's not affected by torrent deviation generated by erosion and/or deposition, which instead could jeopardize the functionality of other types of monitoring systems. This appears particularly remarkable when the debris-flow monitoring is carried out for warning purpose,
- It doesn't need to be installed in the close proximity of the torrent banks. This could be an essential advantage where the banks are extremely steep or subjected to landslide and collapse. The ALMOND-F System permits to vary the amplification of the geophonic signal, allowing the sensor installation even dozens of meters far from the torrent, granting great versatility to the system itself,
- It detects the ground vibration generated by the debris flow before the arrival of the debris flow front at the cross section where the sensors are placed (often the sensors have to be installed very downstream- for logistic needs). Thanks to its versatility, the ALMOND-F system can be placed very close to the triggering zone (usually in very inaccessible places) giving the warning alert many dozens of seconds earlier than other monitoring systems,
- It allows to retrieve a larger quantity of monitoring data compared to other monitoring systems. It's possible to measure the intensity of soil vibration, its frequency and the shape of the debris-flow wave. The availability of a larger number of parameters permits the identification of more robust algorithms, able to reduce the number of false alarms.



The ALMOND-F system installed in Gadoria torrent (Lasa, BZ - Italy) for the research activities in SedAlp project (picture by L. Marchi)



Equipped site of Gadoria Torrent (Lasa, Bolzano - Italy) for debris flow monitoring and the instruments experimentation (by autonomous Province of Bolzano; <http://gadoria.wildbachhero.org:8002/Gadoria/>). Event date d July 18th, 2013.



The ALMOND-F is based on last version of SIAP+MICROS DA9000 data logger equipped with OS WIN CE embedded. The data logger is able to acquire and elaborate a very huge number of data, thus it's very adaptable to different purpose. The ALMOND-F with geophones can be customized according to different needs. The standard version of the ALMOND-F has got the following configuration:

#### Product:

- N. 3 single axis geophones with support
- N. 3 signal conditioning boards
- Connecting cables
- N. 2 ultrasonic level sensors with support
- DA9000 acquisition system
- Power supply system by photovoltaic panel and battery
- Video Camera to be turn on just in case
- Communication system: GSM/GPRS/UMTS
- Alert system composed by a light and a siren
- Synoptic check up with siren alert
- Software for Data Display and Management.

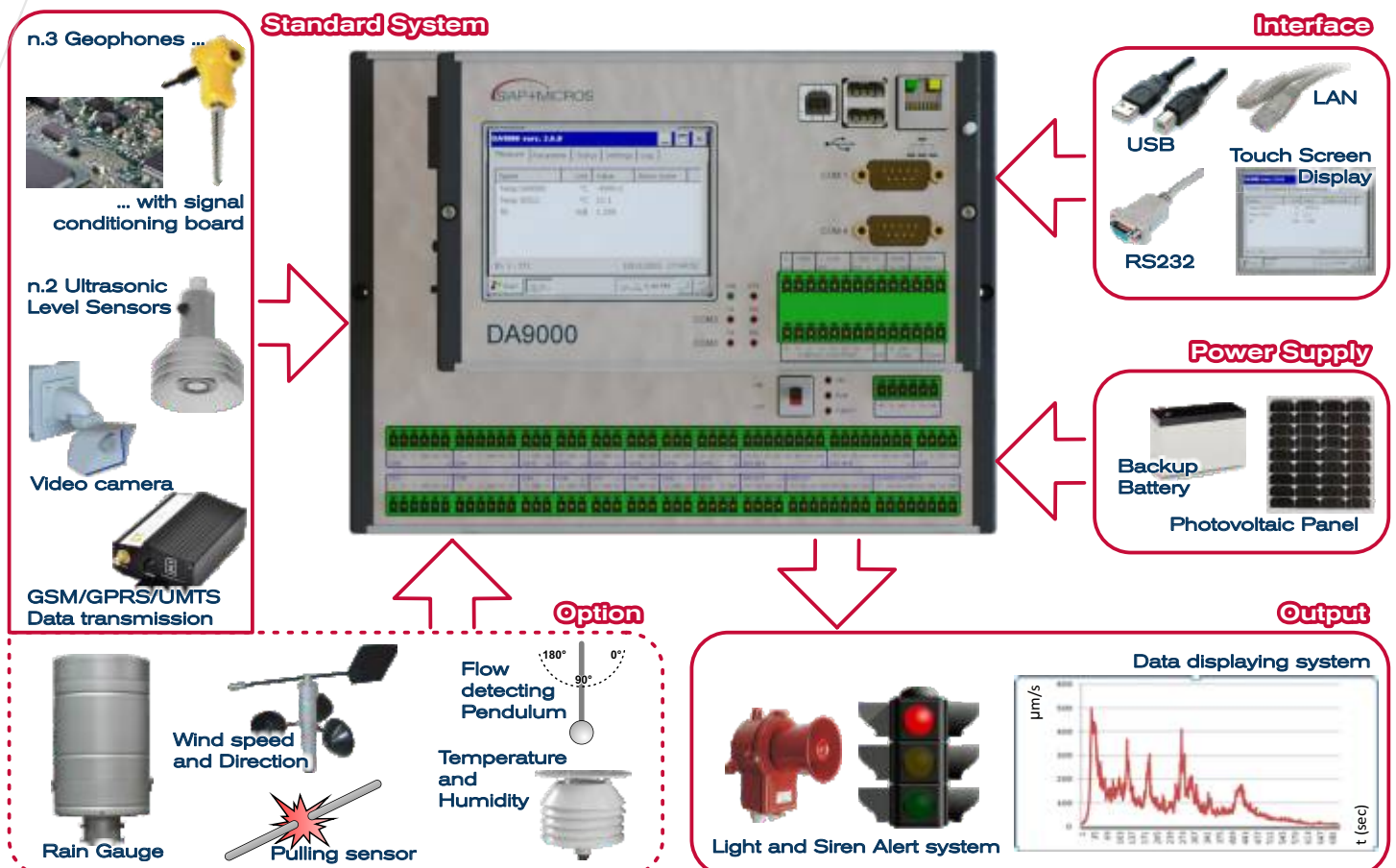
#### Service :

- Preliminary SITE VISIT
- DESIGNING completed with draws and connection scheme
- CIVIL WORKS
- INSTALLATION
- CALIBRATION and TESTING for the monitoring system
- System CALIBRATION for 12 months period in order to adjust it to the features of the basin to be monitored
- 12 months MAINTENANCE during the calibration period.

#### Option:

The ALMOND-F is open and modular, such as to permit a variety of customization in order to make it interesting for different purpose. For example, the system could be integrated with the following hardware:

- Rain gauge (for monitoring the activated precipitation),
- Pulling sensors (for detecting the flow transit),
- Pendulums (for detecting the flow transit),
- Temperature and Humidity sensor,
- Snow level sensor,
- Anemometric sensor,
- UHF, Satellite, Wi-Fi Communication system, .... Other.







**Siap+Micros s.r.l.**

Via del lavoro, 1  
31020 - Castello Roganzuolo  
di San Fior (TV) - Italy

Tel.: +39 0438 491411  
Fax: +39 0438 401573

[info@siapmicros.com](mailto:info@siapmicros.com)

---

[www.siapmicros.com](http://www.siapmicros.com)

**CNR Irpi**

Istituto di Ricerca per la Protezione Idrogeologica  
(*Institute for Research of Hydro-geological Protection*)

Headquarter and Direction: Via della Madonna Alta, 126  
06128 - Perugia (PG) - Italy

Tel.: +39 075 5014411  
Fax: +39 075 5014420

Offices in Turin: strada delle Cacce, 73  
10135 - Torino (TO) - Italy

Tel.: +39 011 3977834  
Fax: +39 011 3977821

[segreteria@irpi.cnr.it](mailto:segreteria@irpi.cnr.it)

---

[www.irpi.cnr.it](http://www.irpi.cnr.it)