

# MHASTER DATALOGGER

Over 40 years of experience in the specific field of environmental monitoring led CAE to develop the most advanced and reliable **multi-risk monitoring system** dedicated to man-made and natural phenomena currently available on the market: the Multi Hazard System (MHAS). The MHAS responds perfectly to the need for integration into a single monitoring network of all elements related to several risk factors in large areas. The core of this system is the new **Mhaster datalogger**, capable of monitoring multiple environmental risk scenarios such as landslides, fires, storm surges, floods, avalanches, severe weather conditions...

The Mhaster is the unit of acquisition to which they referred all the management tasks of the equipment in the field. A powerful hardware has been built based on **embedded Linux operating system** to best achieve all these activities, while ensuring high flexibility.

Mhaster stations, implemented as the remote unit within automatic monitoring networks, can be configured in different ways and include different modules:

- **Open** acquisition unit, to perform controls, elaborations and data logging;
- **Smart** for input/output expansion, to collect data from a virtually unlimited number of sensors;
- **NRG** module for advanced consumption control and management of different power systems;
- Date Touch Screen user interface (**DTS**) 7" LCD, for the local management of the station.

The strong **modularity** allows the tailoring of the remote station architecture on the Client's needs, high degree of **flexibility**, easiness to **customize** and respond more promptly to future developments. The high computing capacity made available by Mhaster allows a complete multitasking, i.e. operation allows users to perform multiple tasks simultaneously. Communication activities and the elaboration by the datalogger happen, in normal conditions, few seconds. This allows the optimization of the operation, with a consequent limitation in energy consumption.



The high computing capacity of the data logger also allows the user to choose different ways of communication, due to the full implementation of the TCP/IP stack and advanced **Web-based services**, to offer compression and encryption of data by means of standard procedures, as well as allowing development of applications by the Client or third parties. The **standard protocols** implemented in the Mhaster datalogger are varied: in addition to the most common ones such as ftp, http, ntp, ddns (and more), CAE also attempted to develop protocols that are specifically optimised for the monitoring field, which are becoming more and more common in the **IoT** world, such as **CoAP** and **MQTT**. All this while trying to maintain a very high level of security compliant with the latest standards, implementing the most secure encryption protocols: https, ftps, sftp, CoAPs, ssh, OpenVPn, etc.

Among possible developments, we mention also the implementation of complex computational algorithms, which may activate alarms locally or remotely when certain events happen.

## OPEN ACQUISITION UNIT



The **Open** form, the real brains of the data logger, directly manages both the high-end devices that can be used with the data logger, for example Ethernet modules, removable SD memory, serial ports, etc. and communication modules for sending data in the operation centre, such as **UHF radio, UMTS/GPRS modem, satellite modem**, etc.

The characteristics of the system are at the forefront: a powerful 500 MHz Cortex A8 processor combines high performance with low power

consumption. The data logger has a large amount of RAM (256 MB of DD3 SDRAM type) and use different forms of Flash memory to optimize its operation.

In particular, the larger memory space is 1 GB, with random access time of 25  $\mu$  s and a duration of more than 100,000 erase/program cycles.



## SMART FOR INPUT/OUTPUT EXPANSION

It is possible to connect to the data logger one or more **Smart** modules designed for high-speed capture a large number of sensors by using a processor ARM Cortex-M3 to 120 MHz dedicated to these acquisitions. The distinct modules-based solution allows you to scale your consumption and the possibilities of expansion according to the needs of your system. Finally, an A/D converter at 24 bits allows to handle both high levels of frequency quantization and high frequency of real-world data.

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## THE NRG POWER MANAGEMENT MODULE



Mhaster data logger can be powered both by means of mains power supply and solar panels; in both cases an electronic device manages the automatic recharging of the buffer battery. This specific Mhaster power supply module, called **NRG**, has been developed by CAE with algorithms that optimise the battery life and recharging (based on MPPT technology ("Maximum Power Point Tracking")). This provides continuous monitoring of the battery voltage, performs self-diagnosis functions and issues alarms under critical charging conditions. The module is also already suitable to manage alternative sources of auxiliary energy such as wind or fuel cells.

## THE DATA TOUCH SCREEN (DTS) USER INTERFACE

The local interface between the operator and the Mhaster station is **DTS**, a large terminal display from 7" which is totally touch screen. This display can be viewed locally or remotely and allows fully viewing the datalogger activities: internal operation, data acquisition, display of charts and tables, connection with external modules. It not only allows displaying operations but also performing a wizard to configure the station, maintaining its integrity. The capacitive display also allows for greater definition and visibility under any circumstances. The operations is water-proof, resistant to extreme cold up to  $-20^{\circ}\text{C}$  and intense heat up to  $60^{\circ}\text{C}$ .



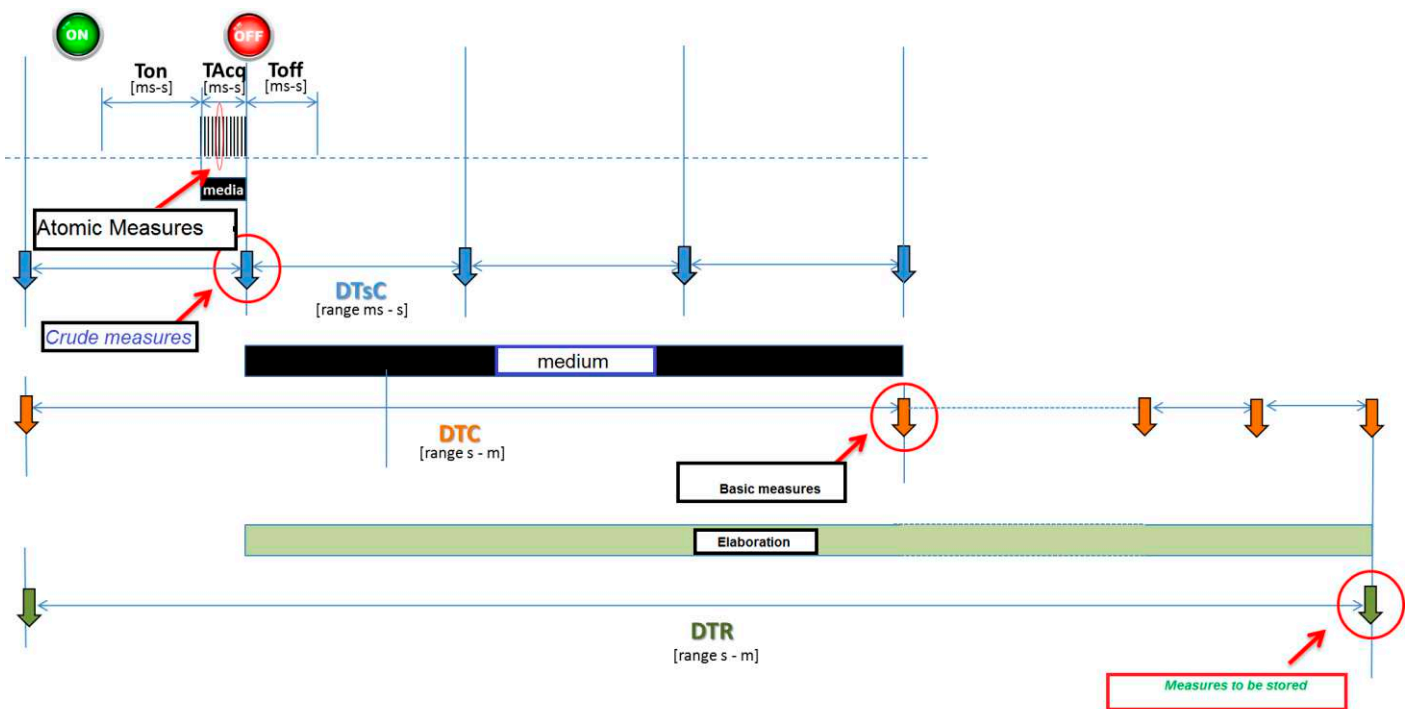
Through the DTS virtual keyboard (**Touch Screen Display**) the operator, once accessed to the station, can enter a password, through which the station will be able to recognize the type of operator. Each type of operator can be authorized to perform certain kinds of activities on the station, to be selected by the owner of the system itself for security reasons.

## THE EMBEDDED OPERATING SYSTEM LINUX

The Mhaster operating system implements a version of **Linux** for embedded use as its kernel. The original Linux source has been configured with additional features and enhancements related to the supporting hardware, for purposes such as energy conservation, reduction of loading time and management of standby mode.

## DATA AVAILABILITY AND ACQUISITION LOGIC

Mhaster units implement very advanced acquisition logics; due to the high frequency of the A/D converter, measures are sampled at very high speed. On the basis of these measurements (Atomic Measures) the unit makes subsequent medium (Crude and Basic Measures), processing and conversions in engineered units until the final result to be sent to the operation centre (measures to be stored). All this makes it possible to attach



"basic Measures" to each and every second and use "crude Measures and "atomic Measures" related to a millisecond scale.

Even though all measurements can be used for further processing, only basic measures are stored in the memory of the data logger for further processing in compliance with WMO provisions.

**Data are saved without encryption** and without having to purchase special software, are easily accessed through standard formats both for physical users and machines. The machine to machine (M2M) interaction is provided by a **WebService** on board the Mhaster, allowing the clients to use data as they prefer.

## OPERATING MODE

The client can customise the Mhaster datalogger as he likes, using different types of tools, including an open source **SDK (Software Development Kit)**, useful, for example, to create **custom processing or drivers** for specific devices. Languages that can be used for customisation include **Python, C, Shell Script**.

The Mhaster datalogger can operate in different modes according to the type of customisation and the impact the client wants it to have on the standard operation.

- **STANDARD mode:** the station is configured to perform the traditional monitoring and alert functions included in the specialised programs developed by CAE;
- **BARE METAL mode:** the operation of the station is fully dependant on the programs created by the client and loaded onto the station; it ignores the specialised programs by CAE;
- **MIXED MODE:** it integrates the customisation independently created by the client with the specialised programs by CAE.

