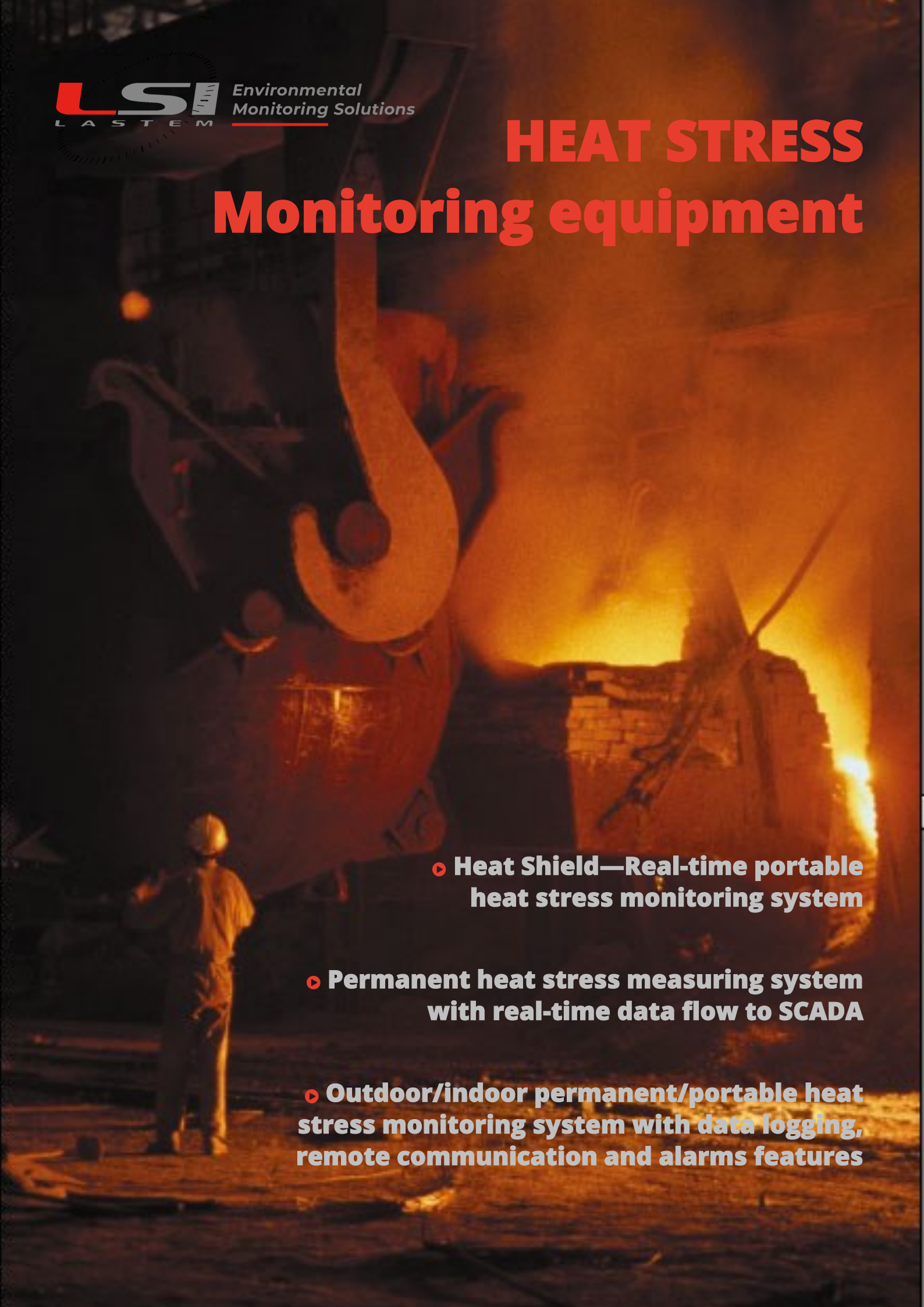


LSI LASTEM Environmental Monitoring Solutions

HEAT STRESS Monitoring equipment

- **Heat Shield—Real-time portable heat stress monitoring system**
- **Permanent heat stress measuring system with real-time data flow to SCADA**
- **Outdoor/indoor permanent/portable heat stress monitoring system with data logging, remote communication and alarms features**

Environmental Monitoring Solutions

Heat stress negatively affects productivity and can lead to accidents, illness and even death. Prolonged exposure to high temperatures provokes fluid loss, muscular cramp, shock or heat stroke; it increases human error, reduces mental and physical activities. Heat stress monitoring in workplaces (thanks to WBGT, Heat Index and Humidex indexes), evaluating operative thermal conditions and define exposure limit, is of primary importance to organize the work flows.
A variety of indices were introduced for the evaluation of heat stress in hot environments. WBGT index (Wet Bulb Globe Temperature) is one of the best known and most widely used. It contains important environmental factors such as dry bulb temperature, wet bulb temperature and black globe temperature. In the calculation of this index, factors such as clothing, level of metabolism and acclimatization are used to define exposure limits.

Heat Shield—Real-time portable heat stress monitoring system

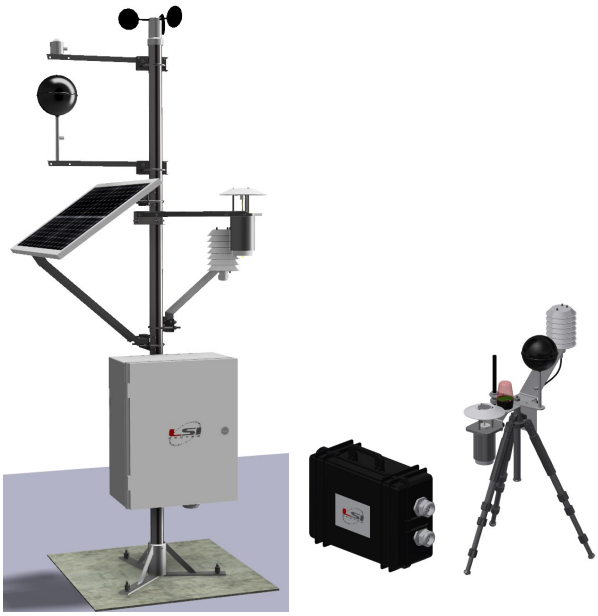
Heat shield is a portable system for real-time WBGT, Humidex and Heat index calculations. It can be held in hand or fixed on a tripod for short-term monitoring campaign. It can be used indoor or outdoor and can be connected to satellites for measurements in different points. It is supplied with a software for data downloading, assessment and reporting.

Permanent heat stress measuring system with real-time data flow to SCADA

System for real-time connection to local SCADA by RS2232-485 Modbus. Real-time permanent assessment of WBGT index including WBGT Effective and WBGT Reference values to assess the heat stress conditions according to the exposure limits given by the ISO-7243 standard. Heat Index calculation capability.

Outdoor/indoor permanent/ portable heat stress monitoring system with data logging, remote communication and alarms features

For monitoring and real-time warning the health and safety of workers in severe outdoor high thermal stress conditions. Two different assembling, one for outdoor permanent heat stress monitoring application, one for indoor and outdoor portable application. The system consists of sensors, data logger and mounting accessories. Data Logger can calculate WBGT and other heat stress indexes, generate local and remote alarms and send the real-time data to remote PCs.



Heat Shield—Real-time portable heat stress monitoring system

- Few minutes for system installation and set-up
- Real-time calculation of: WBGT index (ISO7243:2017 edition), Humidex, Heat index
- WBGT with/without solar load, WBGT Effective and WBGT Reference for acclimatized/not acclimatized subjects
- PMV-PPD (ISO7730) thermal comfort indexes calculation
- HS Manager program included for data downloading, data assessment and data reporting
- Verification probe for assessment of the system calibration

Heat Shield meter calculates, stores and displays on-line WBGT (with/without solar load version) plus Heat Index and Humidex indices. Entering CAV (Clothing Adjustment Value) and Metabilic rate by keyboard, Heat Shield can produce WBGT Effective and distance to WBGT Reference value which corresponds to the exposure limit given by the ISO7243:2017 standard. Furthermore, if ESV125A anemometer is connected, Heat Shield can calculate directly the PMV-PPD comfort index (ISO7730). Heat shield can be used for indoor applications (hot workplaces, factories, industrial plants, etc.) or outdoor (construction sites, outdoor workplaces, etc.), it can be held in hand or fixed on a tripod for short-term monitoring periods (such as one day).

Thanks to its built-in radio technology, Heat Shield can support up to two satellite units to assess analysis at three different locations or heights.

It is possible to download the stored data using HS Manager PC program included with Heat Shield. From HS Manager it is also possible to export the data to GIDAS TEA program, used for further thermal environments analysis as Predicted Heat Strain (PHS), Insulation Required (IREQ), Duration Limit of the exposition (Dlim). GIDAS-TEA program will also allow in-depth analysis of WBGT, PMV and PPD indexes (read Gidas-TEA catalogue MW9006-ENG-06).

Portable Heat shield Kit

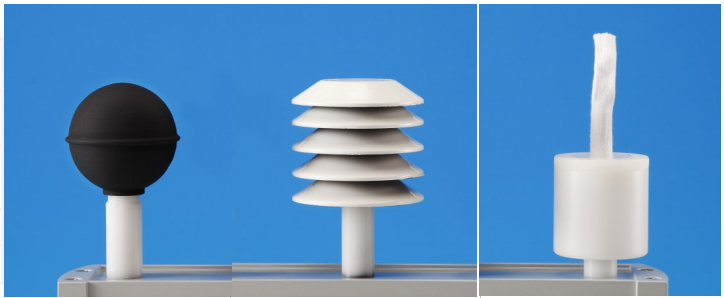
The kit is composed by the **Heat Shield (1)** unit. **Different Heat Shield** models are available: with/without built-in radio technology and 5 or 15 cm diameter black globe temperature size. Radio technology can support up to **two satellite units (2)** to calculate WBGT in different locations.

The system can be fixed on a **tripod (3)** or held in hand for fast scanning of thermal situation.

Using the high accuracy **reference temperature probe (4)** connected to Heat Shield, it is possible to assess the measurement differences between this reference sensor and the three temperature sensors (Ta, Tg, Tnw) values.

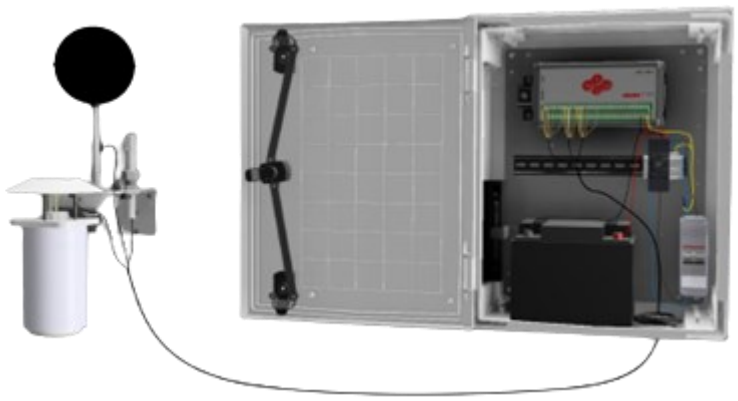
Drw. Ref.	PN	Description	Qt	Ref. Notes
		Heat shield models without built-in radio (see catalogue MW9002-ENG-00)		
1	**ELR600M**	Heat Shield/Charger+USB+SW+ Casea/5cm globe	1	
	ELR605M	Heat Shield/Charger+USB+SW+ Case/15cm globe	Altern. To ELR600M	A
		Heat shield models with built-in radio (see catalogue MW9002-ENG-00)	Optional	
	ELR610M	Heat Shield/Base module/Charger+USB+SW+ Casea/5cm globe	1	B
	ELR615M	Heat Shield/Base module/Charger+USB+SW+ Case/15cm globe	Altern. to ELR610M	A
		Heat Shield Satellite modules with built-in radio	Optional	
2	**ELR610S**	Heat Shield/n.2 Satellites/Case/5cm globe	1	B
	ELR615S	Heat Shield/n.2 Satellites/Case/15cm globe	Altern. to ELR610S	A
		Accessories (see catalogue MW9005-ENG-07)	Optional	C
3	**BVA304**	Tripod	1	
	BWA314	Mounting for HeatShield on tripod	1	
		Verification probe (see catalogue MW9002-ENG-00)	Optional	
4	**DMA033.3**	Sensor/Reference Temp./Pt100/HeatShield	1	D

NOTES	
A	5 or 15 cm diameter Black Globe Temperature sensor according to local regulations
B	Built-in radio technology, for multi-points measurements.
C	Needed for mounting on tripod
D	To verify sensor's accuracy



Radiant Temperature | **Air temperature & Relatve Humidity** | **Wet bulb temperature**

Permanent heat stress measuring system with real-time data flow to SCADA



- Connection to Dry Bulb temperature, Wet Bulb temperature, Black Globe temperature, Relative Humidity sensors
- WBGT index, Heat Index calculation with real-time data flow to SCADA by RS232-485 Modbus RTU or Modbus TCP
- Possibility of indoor and outdoor assessment in different positions using several sets of sensors
- Calculation of WBGT with/without solar load, WBGT Effective and WBGT Reference for acclimatized/not acclimatized subjects
- Ready to connection to other sensors as: air speed, CO, CO_2, meteorological sensors, etc.
- N.7 electrical outputs to trigger local devices in case of programmable events/alarms
- Possibility of dashboard on PC with real-time data

For real-time assessment of the health and safety in high thermal stress conditions, portable systems are not suitable. In these cases real-time permanent monitoring is required. LSI LASTEM has developed a system suitable for industrial plants (indoor or outdoor) where it is necessary to permanently produce a data flow to a local SCADA by Modbus RTU/TCP. System consists in one or more sets of sensors for the measurement of air temperature, relative humidity, radiant temperature, wet temperature. Using these parameters the system calculates WBGT (ISO7243:17) and Heat Index. WBGT calculation includes with/without solar load WBGT formula versions, WBGT Effective and WBGT Reference for acclimatized/not acclimatized subjects. Using these values, the system can produce calculation of difference between WBGT Reference and WBGT Effective values which corresponds to the distance to the dangerous condition according to ISO7243:2017 standard.

WBGT measurement point

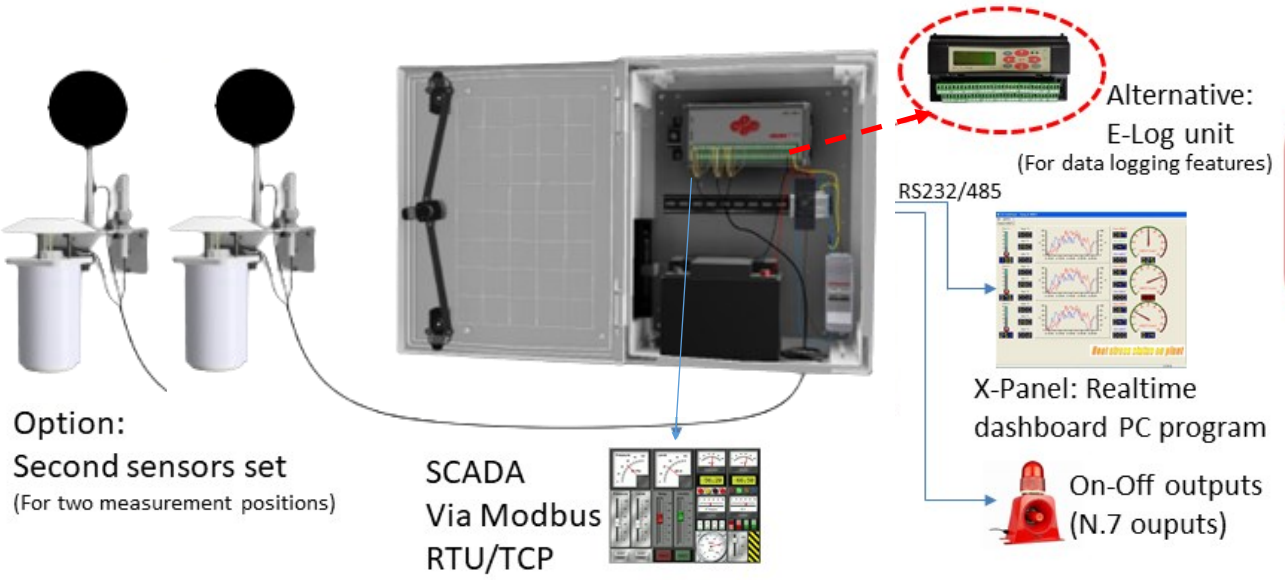
ALIEM module (1)	
WBGT index (with/without solar load)	According to ISO7243 (2017)
WBGT Eff (using CAV) WBGT Ref-Eff (Delta To Limit)	According to ISO7243 (2017)
Heat index	According to 1990 National Weather Service (NWS) Technical Attachment (SR 90-23)

DMA672.1 Temperature and RH sensor (3)	
Type (Temperature)	RTD Pt100 1/3 DIN
Type (RH%)	Capacitive
Range (Temperature)	-50...100°C
Range (RH%)	0...100%
Accuracy (Temperature)	0.1°C (@0°C)
Accuracy (RH%)	±1% (@5...95%)

DMA122.1 Wet Temperature Natural Ventilation sensor (4)	
Type	Pt100 1/2 DIN-A
Range	0...80°C
Accuracy	0.15°C (@0°C)
Water capacity	1 liter
Water duration	About 2 months

DMA131.1 Black Globe Temperature sensor (2)	
Type	Pt100 1/3 DIN-A
Range	-20...120°C
Accuracy	0.1°C (@0°C)

ALIEM converter or E-Log data logger



ALIEM module is an analogue/digital interface between a wide range of sensors and a Modbus Master unit through RS232/485. Using the measured values, ALIEM can produce local calculations as heat stress indexes. ALIEM has been explicitly designed for environmental/meteorological applications. Robust, reliable, well protected from electrical interferences, ALIEM makes measurements possible even in the most severe environments.

Data communication protocol (Modbus)

Data delivery to Modbus Master devices via:

- Modbus RTU: on RS232 or RS485 (see PN)
- Modbus TCP over Ethernet (using DEA509 adapter)

Inputs for analog and digital sensors

- N.8 analog differential inputs (N.16 single-ended)
- N.4 digital inputs (Pulse/Frequency)

Derived and calculated quantities

Internal library of derived environmental quantities. These calculations use acquired quantities, constant values and other calculated quantities. Example:

- WBGT with/without solar load
- WBGT Effective. Using CAV (Clothing Adjustment Value)
- WBGT Reference: set as threshold value
- Heat Index

Statistical elaboration and time base

The data flow transmitted by Modbus protocol can include instantaneous values, but also mobile statistical values, as:

- Mobile Average/Min/Max/Standard Deviation
- Mobile Totals

Data storing option

ALIEM module cannot store any data. In case of data storing needs, it is possible to replace ALIEM module with E-Log data logger. E-Log can store data and send them to a local PC for data reporting and analysis.

Switched power supply outputs

N.7 independent electrical outputs to supply power to external device (8...30 Vdc @ 1.1 A each output).

Any independent switched power supply output can be used to switch-on/off external devices using configurable alarm logics. Each output can have different AND/OR alarm logics. These outputs become relay outputs with an external module (MG3023).

Installation

Sensors are mounted on a stand fixed on the wall or on tripod. ALIEM module is housed in a IP66 box (ELFnnn) together with power system.

Power supply

ALIEM module runs at 8...30 Vdc. 18A/h and 40 A/h rechargeable batteries are available and housed in the ELFnnn boxes.

Permanent heat stress measuring system with real-time data flow to SCADA

Kit 1 - WBGT measure-

Drw. Ref.	PN	Description	Qt	Ref. Notes
		N.2 WBGT measurement points		A
		Radiant temperature sensor (see catalogue MW9000-ENG-02)		
1	**DMA131.1**	Black globe radiant temperature sensor. Cable L. 5 m+conn	2	
	DWA510A	Cable/L=10m/sensors	2	D
		Wet temperature sensor (see catalogue MW9000-ENG-03)		
2	**DMA122.1**	Sensor/TNW Temp/IP65/Cable L=5 m+conn	2	
	DWA510A	Cable/L=10m/sensors	2	D
		Temperature and RH% sensor (see catalogue MW9000-ENG-05)		
3	**DMA672.5**	Temperature and RH% sensor, cable L. 3 m free wires+conn	2	
	DWA910	Cable/L=10m/DMA672.5	2	D
		Accessories		
	BVA320	Stand for sensors installation	2	
		Data Logger / Converter (see catalogues MW9005-ENG-01/04, MW9008-ENG-05)		
4	**MDMMB1110.1**	ALIEM/Inputs extension/N.8 Analog.+4 Digitals/RS485-Modbus		B
	ELO3305.1	E-Log/N.12 inputs/8MB/display/N.1 RS485	Altern. to ALIEM	B
	DEA509	RS232-422-485->Modbus TCP gateway/DIN bar	Optional	C
5	**ELF340**	Box IP66/50x40x16cm/230V->13,8V/50W/batt.2Ah		
	DYA072	Arm/ELFxxx/to wall		
6		**Meteorological sensors (outdoor)**	Optional	E
		Temperature and RH sensor (see catalogue MW9000-ENG-05)		
	DMA875	Sensor/T+RH% meteo/2x4÷20mA/10÷30V		
	DYA049	Collar/for sensor arm to D=45÷65mm pole		
	DWA526A	Cable/L=50m/sensors		
		Class B ISO9060 pyranometer (see catalogue MW9000-ENG-11)		
	DPA863	Sensor/Pyranometer/Second Class/4-20mA		
	DYA034	Arm/DPA863 to DYA049		
	DYA049	Collar/for sensor arm to D=45÷65mm pole		
	DWA426A	Cable/L=50m/sensors		

NOTES	
A	Number of measurement points depends on WBGT "With" or "Without" Solar load version requirement. ALIEM module can be connected up to 4 measurement points in case of "Without solar load" WBGT version, where Air Temperature and RH% sensor is not required.
B	ALIEM module for real-time data to SCADA by RS485 (Modbus). E-Log data logger has also data storing feature
C	DEA509 gateway is required for Modbus TCP
D	Different cable extension lengths are available: L= 5, 10, 25, 50 m
E	Additional meteorological sensors and air quality sensors are available

Outdoor/indoor permanent/portable heat stress monitoring system with data logging, remote communication and alarms features

- According to ISO7243:2017 standard
- Monitoring system: wet temperature, black globe temperature, air temperature (and RH%) sensors. Additional meteorological and air quality sensors available
- Calculation of WBGT with/without solar load, WBGT Effective and WBGT Reference for acclimatized/not acclimatized subjects. Calculation of Universal Thermal Climate Index and Humidex index
- Two configuration types: stand alone for outdoor use, and portable for outdoor and indoor uses
- Made to stand in severe environments
- Data storing and data communication to remote PC for data analysis and data reporting
- Real-time dashboard in remote control room via MQTT broker server
- SMS and e-mail alarms
- Electrical outputs for local alarm activations

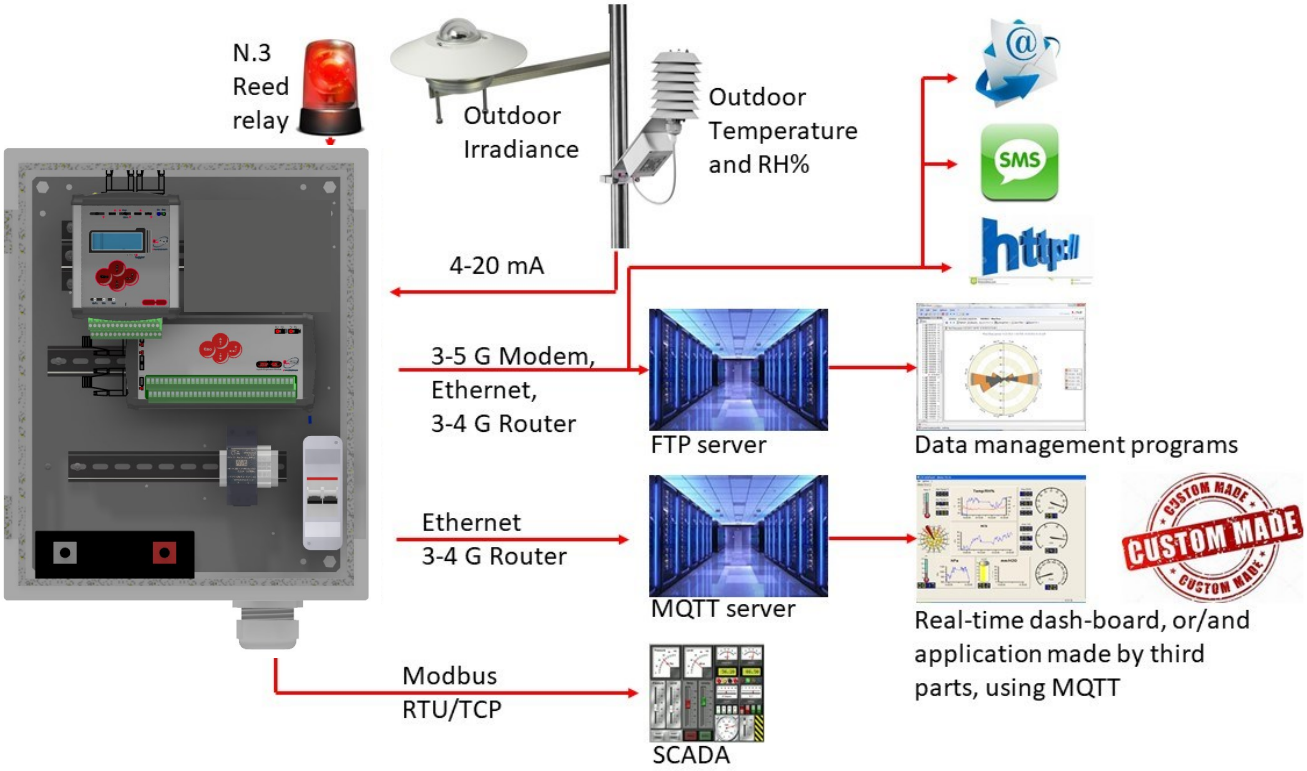
For monitoring and real-time warning the health and safety of workers in severe outdoor or indoor high thermal stress conditions, LSI LASTEM has developed two solutions. A standalone monitoring station for outdoor application and one transportable monitoring station for non permanent both outdoor and indoor applications. Both stations are made to asses the heat stress conditions. Systems consist of sensors, data logger and mounting accessories, for the measurement of air temperature, relative humidity, radiant temperature, wet temperature. Other sensors as weather sensors or air quality sensors, are available. Data Logger calculates WBGT according to the ISO-7243 standard, and other heat stress indexes. Data logger send the stored measurements and calculations as well as the instantaneous values remotely via modem. Data logger produces alarms via SMS, e-mail, and can active local alarm systems.

DMA672.1 Temperature and RH sensor (1)	
Type (Temperature)	RTD Pt100 1/3 DIN
Type (RH%)	Capacitive
Range (Temperature)	-50...100°C
Range (RH%)	0...100%
Accuracy (Temperature)	0.1°C (@0°C)
Accuracy (RH%)	±1% (@5...95%)
PRTEA4922 Globe Temperature sensor (2)	
Type	Pt100 1/3 DIN-A
Range	-20...120°C
Accuracy	0.1°C (@0°C)
DMA122 Wet Temperature Natural Ventilation sensor (3)	
Type	Pt100 1/2 DIN-A
Range	0...80°C
Accuracy	0.15°C (@0°C)
Water capacity/duration	1 liter/about 2 months

Heat Stress calculation	
WBGT (indoor) index WBGT (outdoor) index	According to ISO7243:2017
WBGT Eff (with CAV) WBGT Ref-Eff (DTTL)	According to ISO7243:2017
Heat index	According to 1990 National Weather Service (NWS) Technical Attachment (SR 90-23)

Outdoor/indoor permanent/portable heat stress monitoring system with data logging, remote communication and alarms features

Alpha-Log data logger: data communication layout



Realtime remote data communication and alarms

Data communication by GPRS modem or wireless router to remote PC, directly or through MQTT broker server and FTP servers.

Data communication

LSI LASTEM provides the following software applications:

- GIDAS-Viewer to produce charts, tables and report of the measurements.
- X-Panel to produce real-time dynamic dashboards.
- ENVIRO CUBE for data analysis and alarms using cloud web application.

Internal web-server

Alpha-Log data logger has an internal web-server.
Using any Internet browser, the following information are available:

- Diagnostic information (system date/hr, IP address, battery status, events/alarms log, output status, etc.
- Instant values.
- Data downloading from memory (ASCII, CSV, Excel, ZIP).

Switched power supply outputs

N.3 independent electrical outputs that can be activated with configurable logics. Outputs are usefull to trigger external devices such as acustic/visual alarms.

Modbus RTU and TCP outputs

It is possible to connect the Master data logger to a SCADA by Modbus (RTU or TCP).

Alarms by SMS, E-mail and MQTT

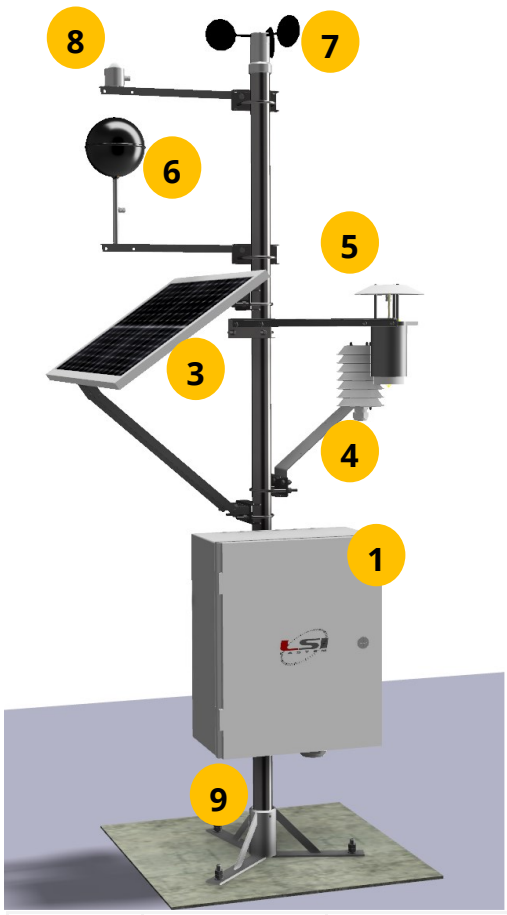
Notifications/alarms delivery:

- E-mail: with editable text, scheduling and distribution lists. E-mail attachment contains the file with the data that generated the event.
- SMS: with editable text, scheduling and distribution lists up to 5 users. Active only when the device is working in low-power mode and connected through 4 G modem.
- MQTT: data delivery to a MQTT Broker server: instant values, elaborations and alarm notifiations. LSI LASTEM provides software application (X-Panel) to get real-time dash bord of the online values.

Additional sensors

The system is open to receive different kind of sensors wired connected to the data logger. LSI LASTEM provides a wide range of sensors for indoor (thermal environments) and outdoor applications (meteorological).

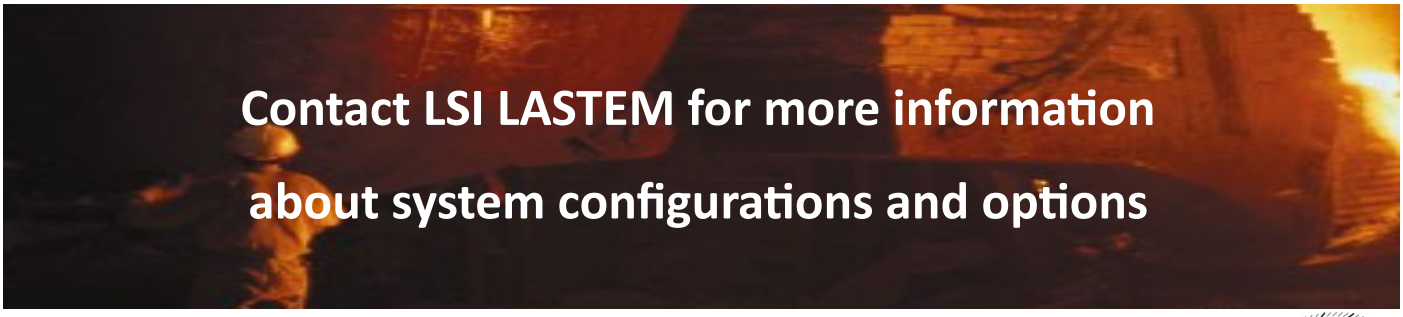
Systems assembling



NOTES	
A	Data communication from data logger depends on the user's requirements (4G modem, 4G Router, Ethernet, Wi-Fi)
B	For permanent outdoor application, the system can be mounted on pole and enclosure for data logger is fixed on the same pole. For portable application, portable enclosure is suggested and sensors are mounted on tripod using a stand.
C	40 Ah battery, inside ELF340 box, required with solar panel.
D	Solar panel can be used if main power supply is not available
E	Data management programs depends on user's requirements
F	These accessories are not required when sensors are mounted on tripod and stand

Drw. Ref.	PN	Description	Qt	Ref. Notes
		Alpha-Log data Logger (see catalogue MW9005-ENG-01)		
	DLALB0100	Alpha-Log/7GB/n.2 RS232/n.1 RS485/n.2 USB/n.1 Ethernet	1	
		GPRS modem (see catalogue MW9005-ENG-07)		
	TXCMA2200	Modem 4G/LTE/HSPA/WCDMA/GPRS/Antenna+cable/5-36 V		A
	DEA611	External antenna 2DB/5 m cable/support		
		IP66 enclosure for outdoor permanent installation (see catalogue MW9005-ENG-07)		B
1	**ELF340**	IP65 box 500x400 mm. Includes 230VAC/24-13,8 V (50W) power pack, 2Ah battery	1	
	DYA074	Pole mounting diam. 50 mm for IP65 XLF3xx boxes	1	
2		**Portable enclosure for data logger in temporary installation (see catalogue MW9005-ENG-07)**		
	ELF432	Portable case IP66/230V->13.8V/batt.15Ah	Altern. to ELF340	B, C
3		**Solar panel (see catalogue MW9005-ENG-07)**	Optional	D
	DYA101	Solar pannel/50W/cable L=5m	1	
	DYA064	Arm/Solar panel/to D=45÷65mm pole	1	
	MG0560	Battery 12V/40Ah	1	C
4		**Temperature and RH% sensor (see catalogue MW9000-ENG-05)**		
	DMA672.1	Temperature and RH% sensor, cable L. 3 m free wires	1	
	DYA230	Natural ventilation radiant shield	1	
	DYA049	Collar for fixing arms to meteo pole diam. 45-65 mm	1	F

Drw. Ref.	PN	Description	Qt	Ref. Notes
5		**Wet temperature sensor (see catalogue MW9000-ENG-03)**		
	DMA122	Natural vendition wet temperature sensor for outdoor use. Cable L. 5 m free wires	1	
	DYA032.1	Horizontal arm for fixing DMA122 to DYA049 collar	1	F
	DYA049	Collar for fixing arms to meteo pole diam. 45-65 mm	1	F
6		**Radiant temperature sensor (see catalogue MW9000-ENG-02)**		
	PRTEA4922	Black globe radiant temperature sensor for outdoor use. Cable L. 5 m free wires	1	
	DYA032	Horizontal arm for fixing DMA131 to DYA049 collar	1	F
	DYA049	Collar for fixing arms to meteo pole diam. 45-65 mm	1	F
7		**Wind speed sensor (see catalogue MW9000-ENG-09)**	Optional permanent inst. only	
	DNA202.1	Sensor/Cup-anem.-Compact/WS/Hz/7pin	1	
	DWA505A	Cable/L=5m/sensors	1	
8		**Solar Radiation sensor (Second Class pyranometer) (see catalogue MW9000-ENG-11)**	Optional permanent inst. only	
	DPA983	Sensor/Pyranometer/Second Class/RS485/10÷30V	1	
	DYA034.1	Arm/983/Horiz./to DYA049 L=650mm	1	F
	DYA049	Collar/for sensor arm to D=45÷65mm pole	1	F
9		**Pole H.2 m (see catalogue MW9007-ENG-01)**		
	DYA006.1	Mast H=2m. Ø 50 mm	1	F
	DYA020	Base for meteo poles Ø 50 mm fitted onto cement plinth	1	F
	DYA020.1	Set of n.3 anchoring bolt for DYA020 base on concrete plinth	1	F
10		**Portable tripod for temporary installation**	Altern. to pole	B
	BVA304	Tripod	1	
	BVA320	Stand for sensors on tripod or wall	1	
		PC programs (see catalogue MW9006-ENG-04/05)		E
	BSZ311	SW Gidas Viewer/PC		
	BSZ411	SW XPanel		
		Web application (see catalogue MW9006-ENG-16)		E
	SWCLA3100	Enviro-CUBE/Yearly subscription (Price 1st data logger)		



LSI LASTEM Srl
Via Ex SP. 161 Dosso, 9
20049 Settala (MI)
Italy

Tel. +39 02 954141
Fax +39 02 95770594
Email info@lsi-lastem.com
www.lsi-lastem.com