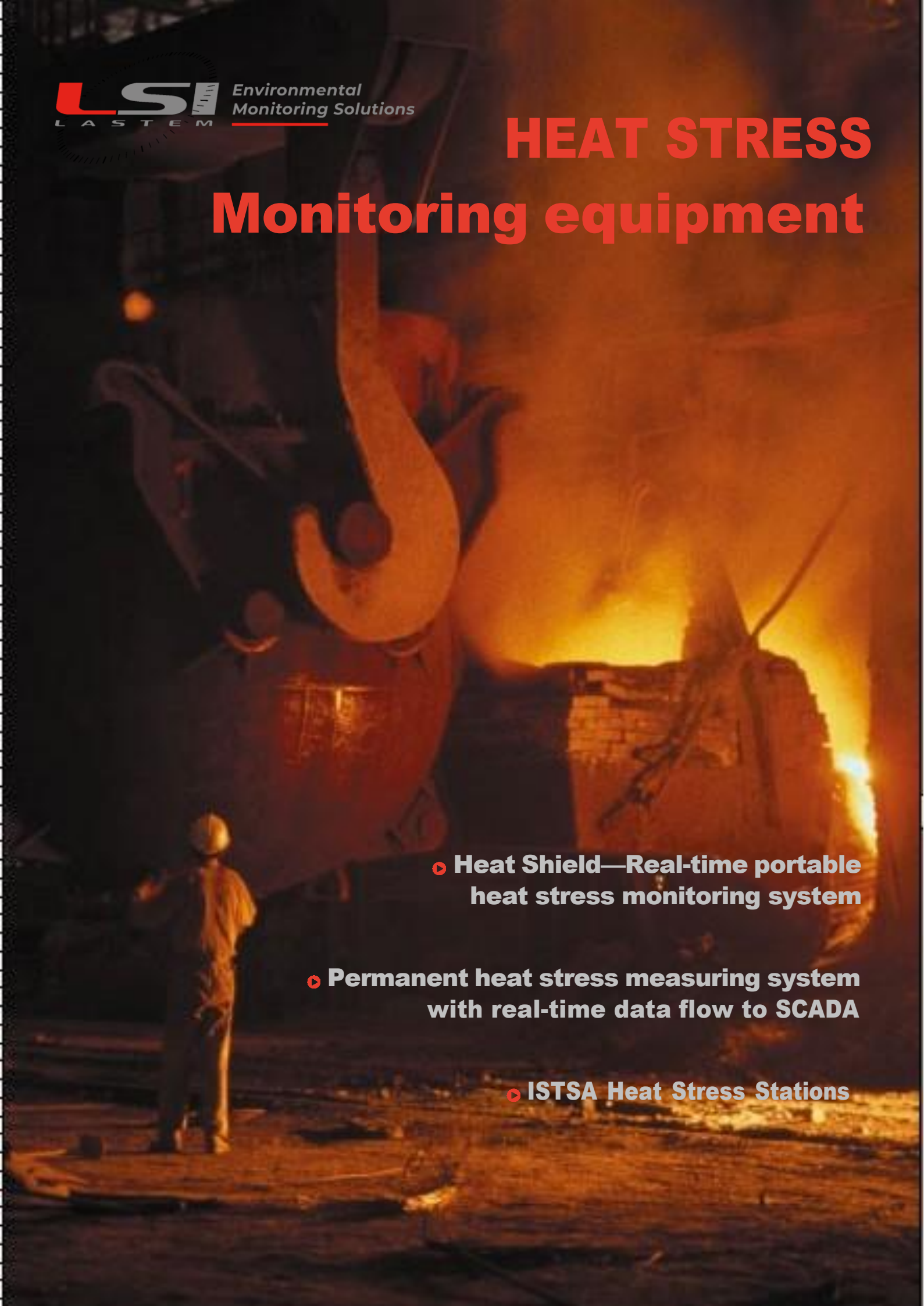


LSI LASTEM Environmental Monitoring Solutions

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
- ISTSA Heat Stress Stations

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 defining exposure limit, is of primary importance to organizing 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

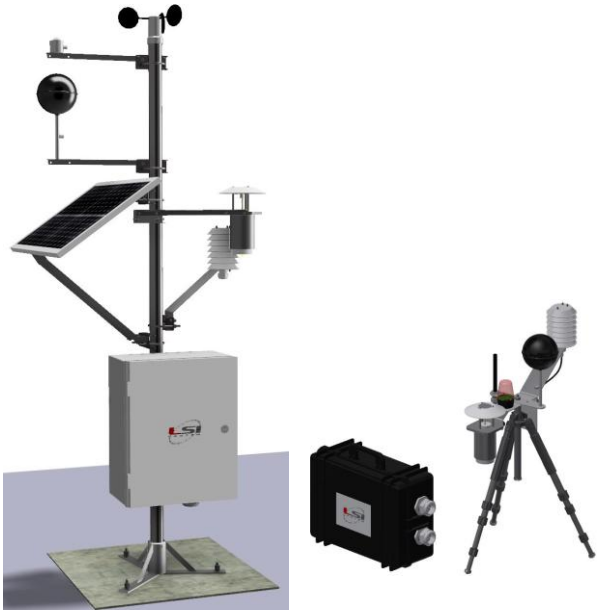
Heat shield is a portable system for real-time WBGT, Humidex and Heat index calculations. It can be held hand or fixed on a tripod for short-term monitoring campaign. It can be used indoor or outdoor and can be connected to satellites for measurements in different points. It is supplied with software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

ISTSA heat stress stations

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 Metabolic 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.

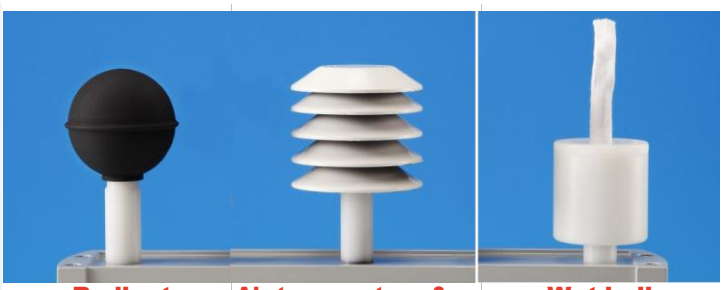
It is possible to download the stored data using HS Manager PC program included with Heat Shield. From HS Manager it is also possible to export the data to GIDAS TEA program, used for further thermal environments analysis as Predicted Heat Strain (PHS), Insulation Required (IREQ), Duration Limit of the 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 measure differences between this reference sensor and the three temperature sensors (Ta, Tg, Tnw) values.
A **hot-wire anemometer (5)** can be connected for the calculation of microclimate indices such as PMV-PPD.

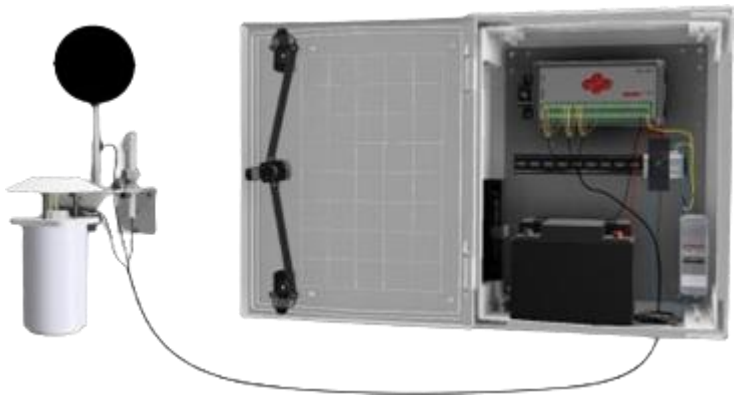
Drw. Ref.	PN	Description	Qt	Ref. Notes
		Heat shield models without built-in radio (see catalogue MW9002-ENG-00)		
1	**ELR600M**	Heat Shield/Charger+USB+SW+ Casea/5cm globe	1	
	ELR605M	Heat Shield/Charger+USB+SW+ Case/15cm globe	Altern. To ELR600M	A
		Heat shield models with built-in radio (see catalogue 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
		Hot wire anemometer (see catalogue MW9001-ENG-08)	Optional	E
5	**ESV126**	Sensor/Air speed/Hot-wire/HeatShield/Cable STD DIN47100/ Connector/Replaceable head	1	

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
E	For measurements in moderate environments



Radiant Temperature | **Air temperature & Relative 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 connect 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, permanent real-time 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 of 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

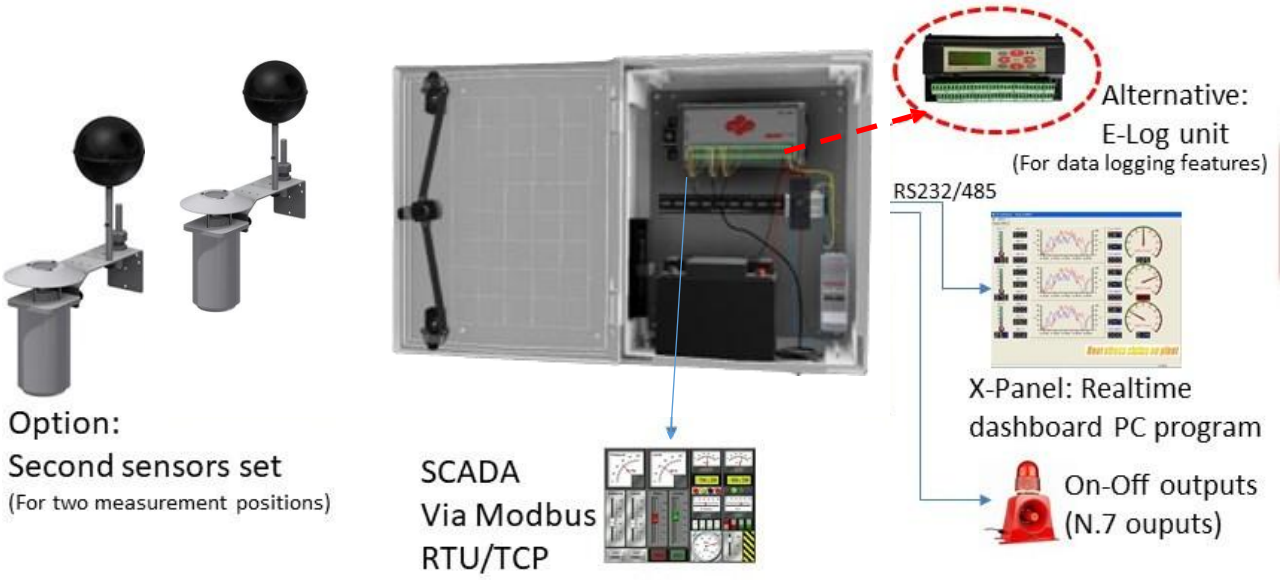
ALIEM module (1)	
WBGT index (with/without solar load)	According to ISO7243 (2017)
WBGT Eff (using CAV) WBGT Ref-Eff (Delta To Limit)	According to ISO7243 (2017)
Heat index	According to 1990 National Weather Service (NWS) Technical Attachment (SR 90-23)

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, such 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 devices (8...30 V DC @ 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).

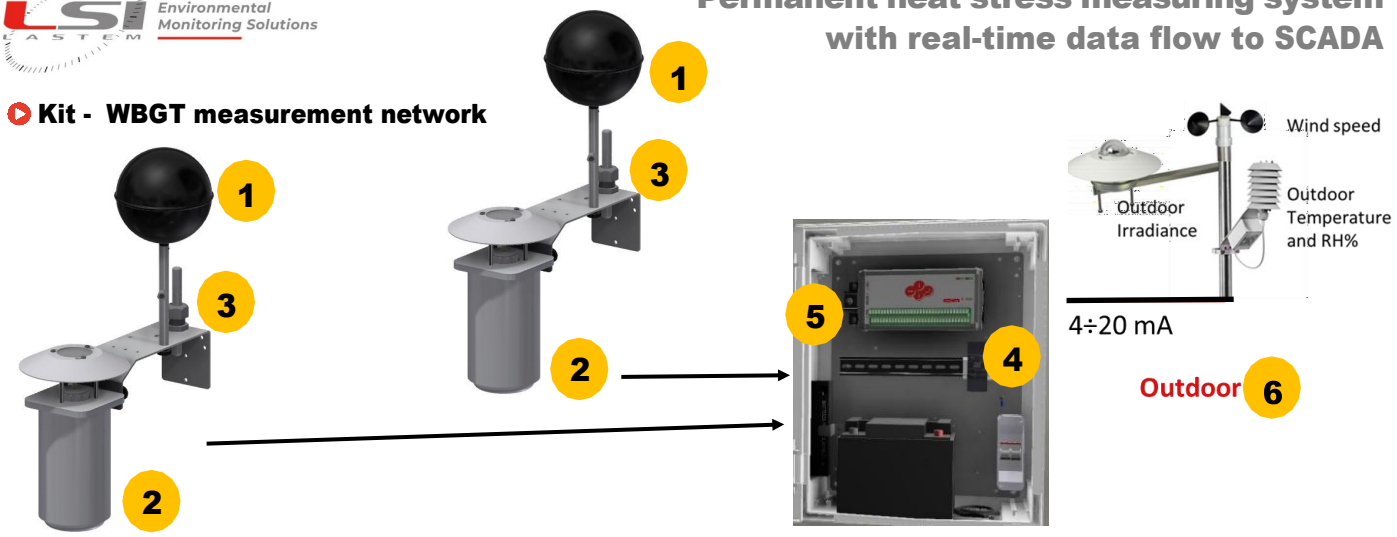
Installation

Sensors are mounted on a stand fixed on the wall or on tripod. ALIEM module is housed in an 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.

Kit - WBGT measurement network



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 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

ISTSA Heat Stress Stations

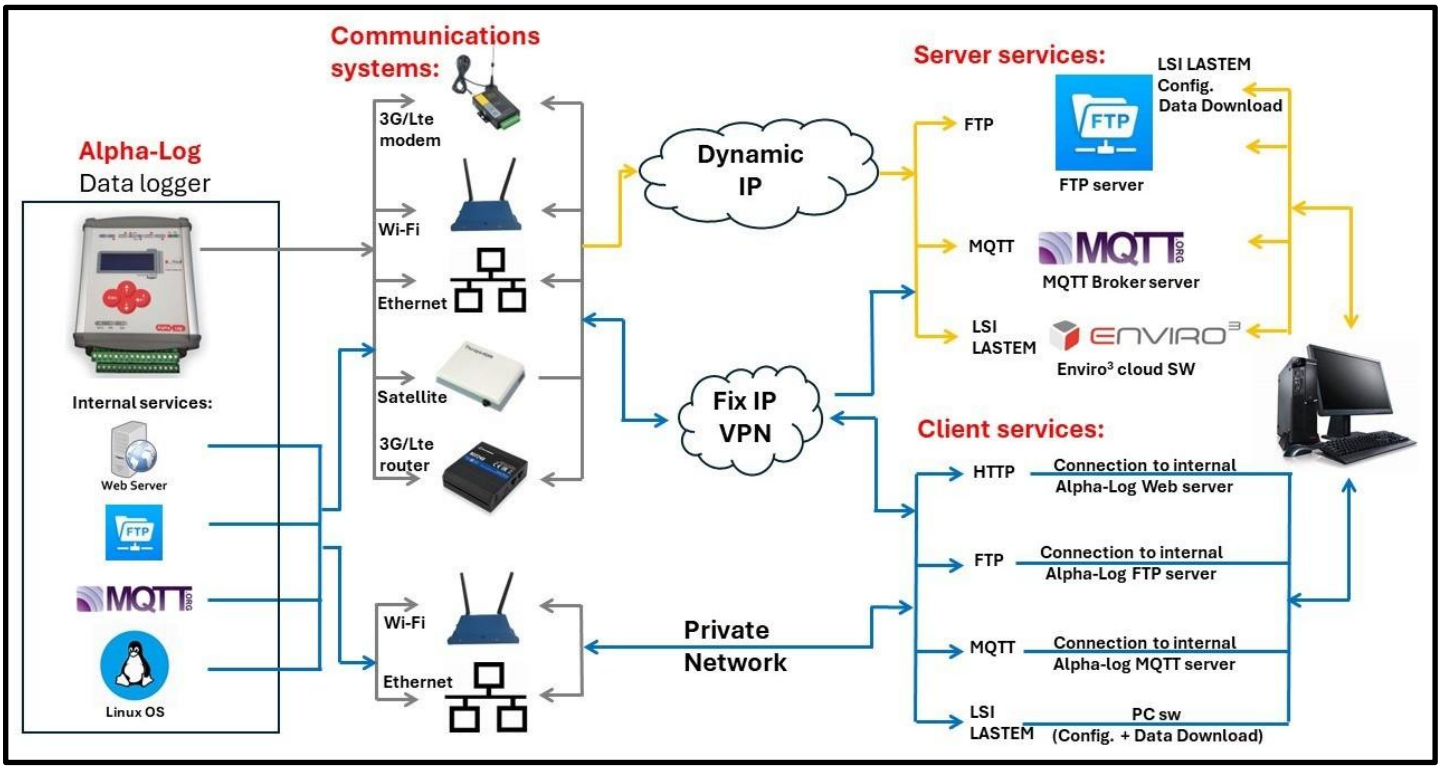
- According to ISO7243:2017 standard
- Monitoring system: wet temperature, black globe temperature, air temperature (and RH%) sensors. Additional meteorological and air quality sensors available
- Calculation of WBGT with/without solar load, WBGT Effective and WBGT Reference for acclimatized/not acclimatized subjects. Calculation of Uni-versal 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 applications and one transportable monitoring station for non-permanent both outdoor and indoor applications. Both stations are made to assess the conditions of heat stress. Systems consist of sensors, data logger and mounting accessories, for the measurement of air temperature, relative humidity, radiant temperature, wet temperature. Other sensors like 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 stored measurements and calculations as well as the instantaneous values remotely via modem. Data logger produces alarms via SMS and 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

Alpha-Log data logger: communication layout



Depending on the type of communication equipment chosen and the possibility of having communications only outgoing from the data logger (Dynamic IP) or also incoming (Fix IP, VPN, Private Network), it will be possible to choose how and where the data will be available within the network.

Directly calculated microclimate indices

The Alpha-log data logger calculates, stores and transmits the following heat stress indices:

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)
Universal Thermal Climate Index (UTCI)	International Society of Biometeorology ISB

Real-time remote data communication and alarms

Data communication via GPRS modem, Wi-Fi, Ethernet, Satellite or Wireless Router to remote PC, directly or via MQTT broker server and FTP server.

Data management applications

LSI LASTEM provides the following software applications (not included):

- GIDAS-Viewer: graphs, tables, measurement reports.
- X-Panel: dynamic real-time dashboards.
- ENVIRO CUBE: data analysis and alarms via web application (annual subscription).

Internal web-server

Using an Internet browser, present in Alpha-Log, the following information is available:

- Diagnostic information (system date/time, IP address).
- Battery status, event/alarm history, output status, etc.
- Instantaneous values.
- Data download from memory (ASCII, CSV, Excel, ZIP).

Output actuators

N.3 independent electrical outputs that can be activated with configurable logic. The outputs are useful for activation of local external devices such as alarm devices.

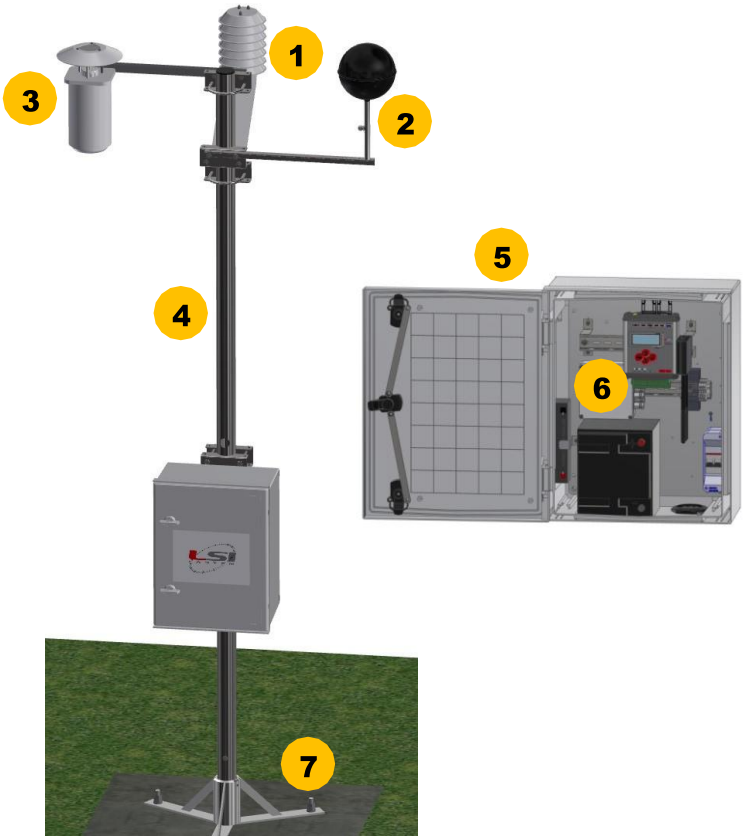
Alerts via SMS, E-mail and MQTT

Notification/alarm delivery:

- E-mail: with editable text, scheduling and distribution lists. The e-mail attachment contains the file with the data that generated the event.
- SMS: with editable text, scheduling and distribution lists for up to 5 users. Active only via 4G modem.
- MQTT: delivery of messages to an MQTT Broker server.

For more information, see Alpha-Log datasheet (MW9005-ENG-01)

Kit 1 - ISTSA Heat Stress Fix Station



#	ISTSA2100—Included items
1	DMA672.1+DYA230+DYA049 Temperature + RH%
2	PRTEA4922+DYA032+DYA049 Globe temperature
3	DMA122+DYA032.1+DYA049 Wet bulb temperature
4	DYA006 Pole H.2 m
5	ELK001 IP66 Box and 18 Ah battery
6	DLALB0100 Alpha-Log
7	DYA020+DYA021 Base + pullers

NOTES	
A	If power grid is not available
B	If remote communication is needed
C	For UTCI Index calculation

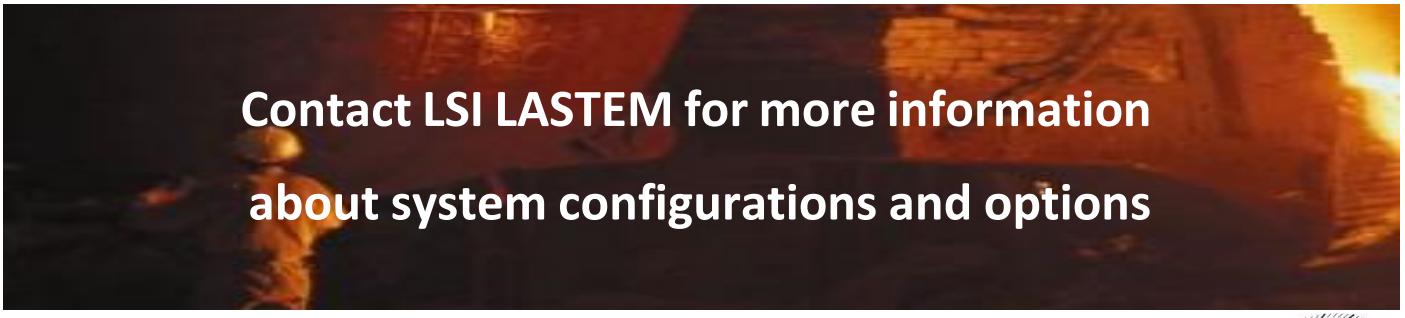
Drw. Ref.	PN	Description	Qt	Ref. Notes
		ISTSA Heat stress station (see catalogue MW9044-ENG-03)		
	ISMMA2100	Complete fix measuring system for WBGT calculation	1	
		Solar panel 80 W and battery (see catalogue MW9005-ENG-07)	Optional	A
	DYA109	Solar panel/80W/cable L=5m	1	
	DYA064	Arm/Solar panel/to D=45÷65mm pole	1	
		Modem 4G (see catalogue MW9005-ENG-07)	Optional	B
	TXCMA2200	Modem 4G/LTE/HSPA/WCDMA/GPRS/Antenna+cable/5-36 V	1	
		4G Router LTE (see catalogue MW9005-ENG-07)	Altern. to Modem	B
	TXCRB2200	4G LTE cat. 4 Global router, Wi-Fi, 1 Ethernet port, antennas, power 9… 30 Vdc, DIN rail mount	1	
	TXCRB2210	4G LTE cat. 4 Global router, Wi-Fi, 4 Ethernet ports, antennas, power 9… 30 Vdc, DIN rail mount	Altern. to TXCRB2200	
	TXCRB2200.1	ROUTER 4G LTE cat. 4, Wi-Fi, 1 Ethernet, antennas, power. 9..30 V DC, mounting DIN rail Router 4G LTE, 9…30 V DC	Altern. to TXCRB2200	
		Class C Pyranometer (see catalogue MW9000-ENG-11)	Optional	C
	DPA983	Sensor/Pyranometer/Second Class/RS485/10÷30V	1	
	DWA405A	Cable STD/L=5 m/DPA855-863-873-817-822	1	
	DYA034	Arm/DPA154-855-870-863-873-252-952-817- 822/Horiz./to DYA049/ L.440mm	1	
	DYA049	Arm/DPA154-855-870-863-873-252-952-817- 822/Horiz./to DYA049 L=650mm		
		Cup Anemometer (see catalogue MW9000-ENG-09)	Optional	C
	DNA202.1	Sensor/Cup-anem.-Compact/WS/Hz/7pin	1	
	DWA505A	Cable STD/L=5m/sensors	1	

Kit 2 - ISTSA Heat Stress Portable Station

#	ISTSA1100—Included items
1	DMK672.1+DYA230 Temperature + RH%
2	PRTEA4922 Globe temperature
3	DMK122 Wet bulb temperature
4	BVA304+BVA320 tripod + stand
5	ELK003 IP66 case, 18 Ah battery, power charger
6	DLALB0100 Alpha-Log
7	DYK001 Solar panel

NOTES	
A	If remote communication is needed
B	For UTCI Index calculation

Drw. Ref.	PN	Description	Qt	Ref. Notes
		ISTSA Heat stress station (see catalogue MW9044-ENG-03)		
	ISMMA1100	Complete portable measuring system for WBGT calculation	1	
		Modem 4G (see catalogue MW9005-ENG-07)	Optional	A
	TXCMA2200	Modem 4G/LTE/HSPA/WCDMA/GPRS/Antenna+cable/5-36 V	1	
		4G Router LTE (see catalogue MW9005-ENG-07)	Altern. to Modem	A
	TXCRB2200	4G LTE cat. 4 Global router, Wi-Fi, 1 Ethernet port, antennas, power 9…30 Vdc, DIN rail mount	1	
	TXCRB2210	4G LTE cat. 4 Global router, Wi-Fi, 4 Ethernet ports, antennas, power 9…30 Vdc, DIN rail mount	Altern. to TXCRB2200	
	TXCRB2200.1	ROUTER 4G LTE cat. 4, Wi-Fi, 1 Ethernet, antennas, power. 9..30 V DC, mounting DIN rail Router 4G LTE, 9…30 V DC	Altern. to TXCRB2200	
		Class C Pyranometer (see catalogue MW9000-ENG-11)	Optional	B
	DPA983	Sensor/Pyranometer/Second Class/RS485/10÷30V	1	
	DWA405A	Cable STD/L=5 m/DPA855-863-873-817-822	1	
	DYA034	Arm/DPA154-855-870-863-873-252-952-817- 822/Horiz./to DYA049/ L.440mm	1	
	DYA049	Arm/DPA154-855-870-863-873-252-952-817- 822/Horiz./to DYA049 L=650mm		
		Cup Anemometer (see catalogue MW9000-ENG-09)	Optional	B
	DNA202.1	Sensor/Cup-anem.-Compact/WS/Hz/7pin	1	
	DWA505A	Cable STD/L=5m/sensors	1	



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