MS5000
Smart grid medium voltage sensor

- **Reliable online detection of all types of faults and earthing systems including solid-grounded, floating neutral, SWER and Petersen coil**
- **Reduces the average interruption duration (SAIDI)**
- **Reducing number of faults by identifying weak spots (SAIFI)**
- **Powerful cyber security capabilities**
- **Unique proprietary algorithms to detect high impedance faults with high accuracy**
- **Power harvesting for line currents as low as 1.5A**
- **Radio communication for rural areas with no cellular coverage**
- **Connection to existing DMS systems**
- **Provides online grid visibility of currents, power flow etc.**
- **Reduces wildfire risk, increases safety**
- **Fast and easy installation**

DESCRIPTION

MS5000 is an online wireless system for medium voltage overhead lines which complements distribution management systems and provides online information about faults and grid operations. The MS5000 is designed to operate in power grids with solid grounding and any other type of earthing including Petersen coil compensation.

By identifying weak spots, predictive maintenance, prioritization, and the overall improvement of the grid's efficiency can be realized.

The installation can be easily done with grip all hot stick or insulated gloves.

The system is modular: once sensors are deployed, they automatically create a secured mesh network among themselves. When required, additional routers and sensors automatically and effortlessly connect to the network. The sensors report abnormal events such as surges, current/voltage drops and can be accessed at any time by the MetryView5000.

The measurements of different sensors are synchronized with high precision by the radio and marked with timestamps.

The system sensors constantly measure current and electrical field waveforms and calculates the voltage and various power quality parameters. The data is transmitted periodically (e.g. every 15 minutes) to the server.

The MS5000 is available in two versions:

- MS5000-SU: Sensor unit with radio communications. The unit can be connected to MS5000-GS sensor/ gateway or to other MS5000/MS5200 sensors units or to MS3010 gateway or routers)
- MS5000-GS: Sensor unit with integrated gateway

Typically, a set of sensors includes three sensors for installation on three phases, with the following options:

- 1 x MS5000-GS + 2x MS5000-SU
- 3 x MS5000-SU sensor where the first MS5000-SU in the set is functioning as a main unit (MU) and communicating by mesh radio with other sets of sensors, routers and gateways

The network size starts with three sensors and can include up to hundreds of sensors.

APPLICATIONS

- FLISR (Fault location, isolation, and service restoration)
- Grid analytics
- Power quality and flow monitoring

MS5000
Smart grid medium voltage sensor

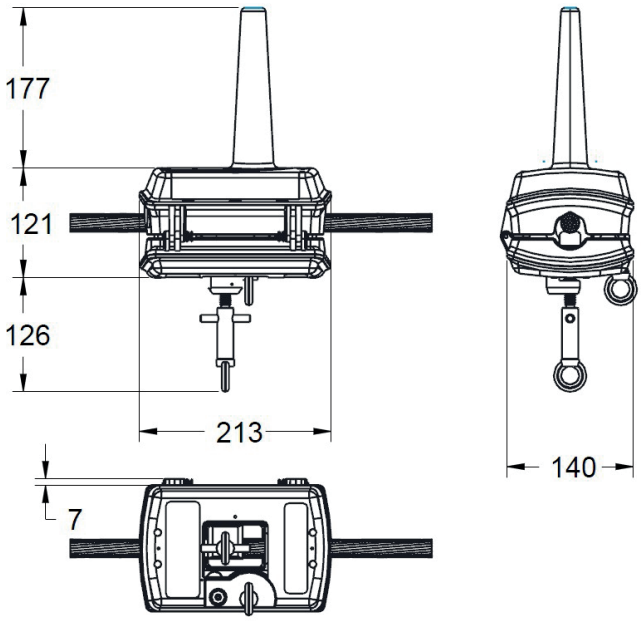
FEATURES

- **Extremely low power:**
  - Inductively powered from currents as low as 1.5A in low power mode
  - Backup batteries last for up to 3 years in low power mode
- **Maintenance-free operation for more than 10 years**
- **Robust design:**
  - Aluminum combined with glass filled polymeric material
  - IP67 rating
  - Operating temperature range of -40 to 70 °C
- **Supports voltage from 4 kV up to 140kV**
- **Provides online grid visibility**
  - Currents and Voltages
  - Power flow (real and reactive)
  - Power quality
    - Power factor
    - Phase angle
    - Zero sequence data
    - Harmonics (measured up to 30th harmonic, presented: up to 5th)
    - Transient events
  - Arcs waveforms
- **Supports IPv6 mesh Radio (6LoWPAN), and combined cellular & mesh**
- **Communication range between sensors: up to 10km, can be increased to tens of km with high gain antennas**
- **Supports cellular 2G/3G/4G**
- **Scalable and flexible Radio Network**
- **Connects to the utility's communication infrastructure**

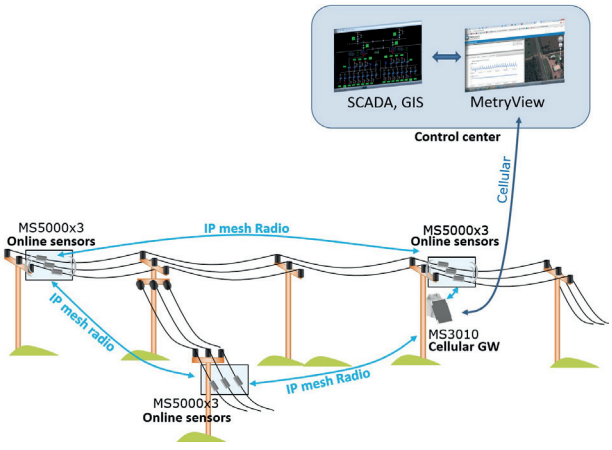
OPTIONAL OPERATION WITHOUT CELLULAR COVERAGE

A mesh radio network can be used to extend the communication range to tens of km, and thus reach remote sensors which are not covered by cellular networks and located far away from the nearest access point of the utilities' communication infrastructure. One gateway can access a single sensor, a small group of sensors (e.g. 3 - one for each phase), or up to hundreds of sensors over a range of tens of km when there is a requirement to reach sensor in remote rural areas. The gateway can connect with the server via cellular communication or alternatively by interfacing directly with the substation's communication infrastructure.

PHYSICAL DIMENSIONS IN MM



EXAMPLE OF MESH RADIO NETWORK



MS5000
Smart grid medium voltage sensor

TECHNICAL DATA

Installation options and power line parameters

Installation options	Grip-all hot-stick Insulated gloves
Conductor diameter	6 - 32 mm
Line voltage	140kV ph-to-ph (for voltages above 70kV use the MS5000-AC-HV clamp screw)
Grounding options	Solid Grounding, Floating grounding, compensated grounding, SWER
Conductor external material	Aluminum (Default) Copper (with MS5000-AC-CP clamp) Insulated (with MS5000-AC-IN bracket)
Conductor temperature	100 °C Max
Short current	20kA (2sec) Max

CONTROL INTERFACES

Led indication	Indicates communication and fault status
Push button	Controls power and triggers led indication
USB interface	Control interface for configuration

POWER OPTIONS

Power Feeding	1.5A for sensor (SU) in low power mode 3A for sensor (SU) with full functionality 5A for cellular sensor (GS) with full functionality
Typical Battery Life	10-20 years
Typical Backup time	3 years in low power mode (for MS5000-SU)

FAULT DETECTION

Events detected	Surge current (transient or permanent fault) Phase to GND fault ncluding high impedance
Remote configuration	Threshold levels for fault detection Multiple optional parameters
Inrush current blocking time afte reenergizing	3 sec (configurable) time after reenergizing
Adjacent conducators	Indifferent to surge according to IEEE 495 4.4.8

PHYSICAL AND ENVIRONMENTAL

Chassis body dimensions	12.1 x 14.0 x 21.3 cm (4.76 x 44.9 x 8.39 inch)
Antenna length	17.7 cm (6.97 inch) - See figure above.
Mounting-screw length	12.6 cm (4.96 inch) - See figure above.
Weight	3.55 kg
Casing	Upper and lower covers: Aluminum, Body: Glass filled polymeric material Mounting Screw: Stainless Steel IP67
Temperature range	-40 de °C to +70 °C

MEASUREMENTS

Load Current	Up to 600A nominal
Precision	0.5% Typical at 100A 600A 0.5A Typical at 20A 100A 0.25A Typical at 0A 20A 0.1A resolution at 0A 100A
Periodic Measurements	Current and Voltage Power factor Phase angle Harmonics measured up to 30'th (Presented: up to 5'th)
Measurement interval	Each 15 minutes typical (programmable)
Waveform Sampling	4.096ksps, 8.192ksps Max Current and Voltage
Waveform trigger events	Phase to phase faults Phase to ground faults Current changes Voltage changes
Alarms	Power Down Heavy load current Overload current LED Blinking Low power mode Wait for reset mode Low backup battery Low Secondary Battery Charging from backup
Phase synchronization	30µs Typical
Sampling Buffer	8 seconds

CELLULAR COMMUNICATION

	LTE -TDD B34/B38/B39/B40/B41
	LTE-FDD B1/B2/B3/B4/B5/B7/B8/B12/B13/ B18/B19/B20/B25/B26/B28/B66
	UMTS/HSPA + B1/B2/B4/B5/B6/B8/B19
	GSM/GPRS/EDGE 850/900/1800/1900 MHz
Cyber Hardening	End-to-end TLS/SSL, certificates enrollment, encrypted local radio communication between sensors, private APN and RADIUS, encrypted firmware upload, three levels of local access permissions

IPV6 MESH RADIO COMMUNICATIONS

Protocols	6LoWPAN, RPL Routing
Modulation Type	GFSK, Frequency hopping
433 MHz Radio Option	
Frequency	433 MHz
Range[1]	2 km
Carrier Power	10 dBm (10mW) Max

MS5000
Smart grid medium voltage sensor

915HI MHz RADIO OPTION

Frequency	921 - 928 MHz
Range[2]	10km (tens of km with high gain antenna
Carrier Power	30dBm (1W) Max

Notes:

(1) Range is estimated for high installation and direct line of sight. The radio range specification is for communication between MS5000 SU sensors.

Range of MS5000 SU to a MS3010 gateway/router can be increased to tens of km using MS3010 with high gain antennas. Cellular sensor MS5000 GS includes a smaller internal antenna and supports a radio range of at least 50m to nearby MS5000 SU sensors.

Accessories:

MS5000-AC-HV	Clamp screw accessory used for line voltages above 70kV phase to phase. Replaces the standard main clamp screw which is supplied with MS5000. The MS5000-AC-HV clamp screw cannot be connected to a hot stick and must be installed by hand.
MS5000-AC-IN	Bracket accessory which can be attached to the sensor for installation on insulated wires – used to improve the voltage measurement performance of MS5000.
MS5000-AC-CP	Contact clamp for Copper wires – made of Brass, replaces the Aluminum clamp which is supplied with MS5000. Warning: MS5000-AC-CP must be used ONLY for copper wires. Using it for installation on an Aluminum wire can cause galvanic corrosion which can damage the aluminum wire.

ORDERING INFO

Product part number format: MS5000

MS5000 - XX - XXXX

Unit Type

SU	Sensor unit
GS	Sensor with Radio a cellular gateway

Radio Frequency option

433	433 MHz (EMEA, Asia, China)
915HI	915 MHz (Americas, Australia)

SALES OFFICE
Megger Limited
Archcliffe Road Dover
CT17 9EN England
T +44 (0) 1304 502101
E UKsales@megger.com

MS5000_DS_EN_V04
www.megger.com
ISO 9001

Megger