

Sigma[®]

Integrated Maintenance Management System SIGMA

SIGMA is the monitoring system for transformers and reactors, by TreeTech, SIGMA is a tool for the maintenance engineer. The system performs the acquisition, storage, and treatment of data from the measurements made on the transformer or reactor. The system also generates diagnostics and prognosis of eventual problems that may lead to interruptions in the electric power supply.

SIGMA is a Windows based platform and utilizes specialized sensors of IED-type (Intelligent Electronic Device), by TreeTech (sensors from other manufacturers can be integrated). Each device has the autonomy to make local control and protection decisions, creating a decentralized data acquisition system. All the IED devices by Tree Tech can be utilized in a SIGMA system. The following is an example of a possible grouping of IED-type devices:

- Temperature Monitors TM1, TM2 or TM (oil, winding, ambient and load tap-changer temperatures);
- Voltage Regulator Relay AVR (line voltage and current, power factor, active, reactive and apparent power, etc.);
- Gas and Moisture Monitor GMM (hydrogen, relative humidity, temperature and water content in oil);
- Bushing Monitor BM (capacitance and tangent delta of capacitive bushings);
- And other devices, including ones outside the transformer (on disconnecting switches, circuit breakers, etc.).

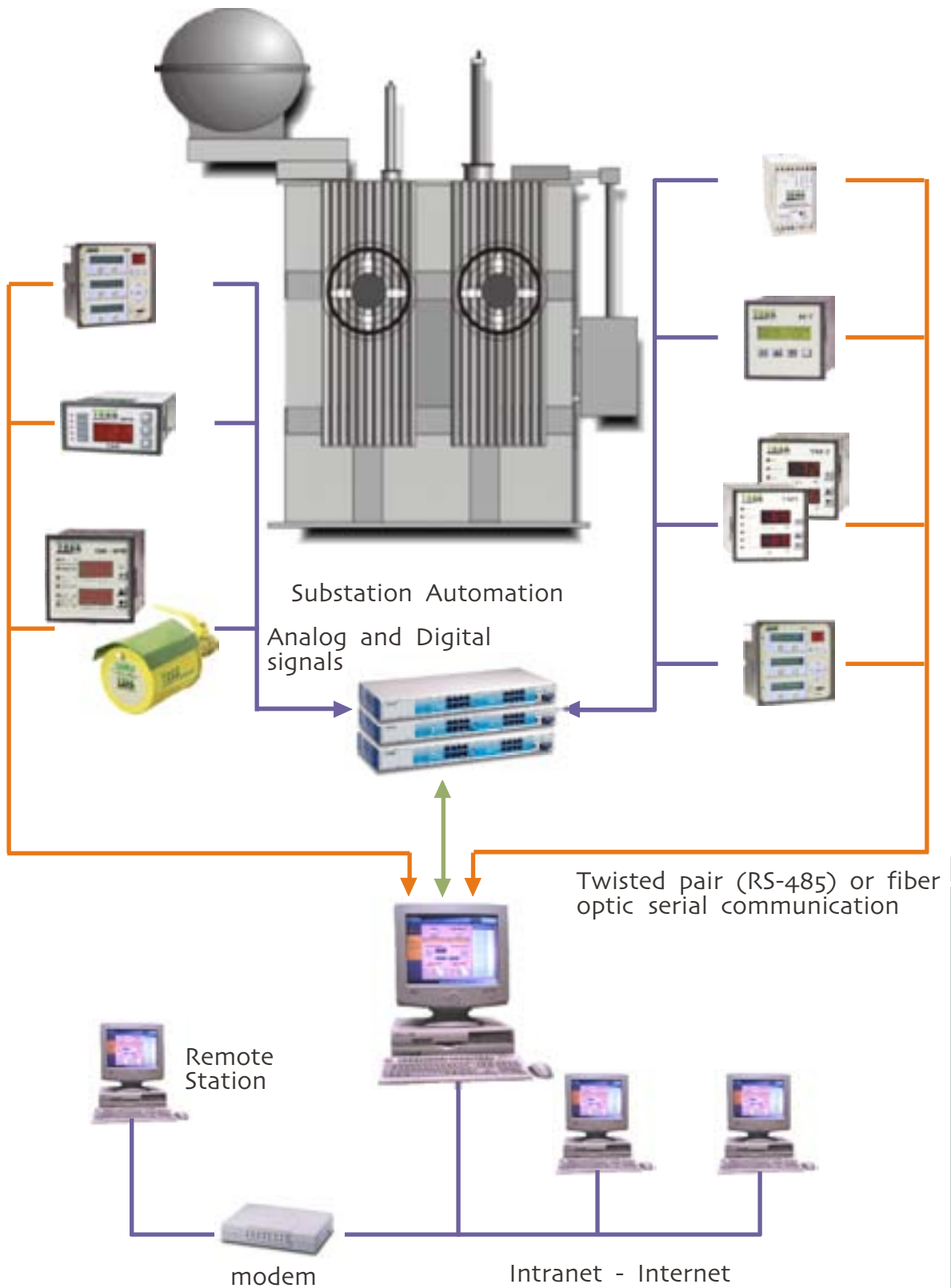
These devices are interconnected in an RS-485 network, providing data that will be transmitted to SIGMA (in the control room) through a twisted-pair cable (RS-485 standard), or through fiber optics.

SIGMA is comprised of two modules, the Management Module and the Engineering Module.



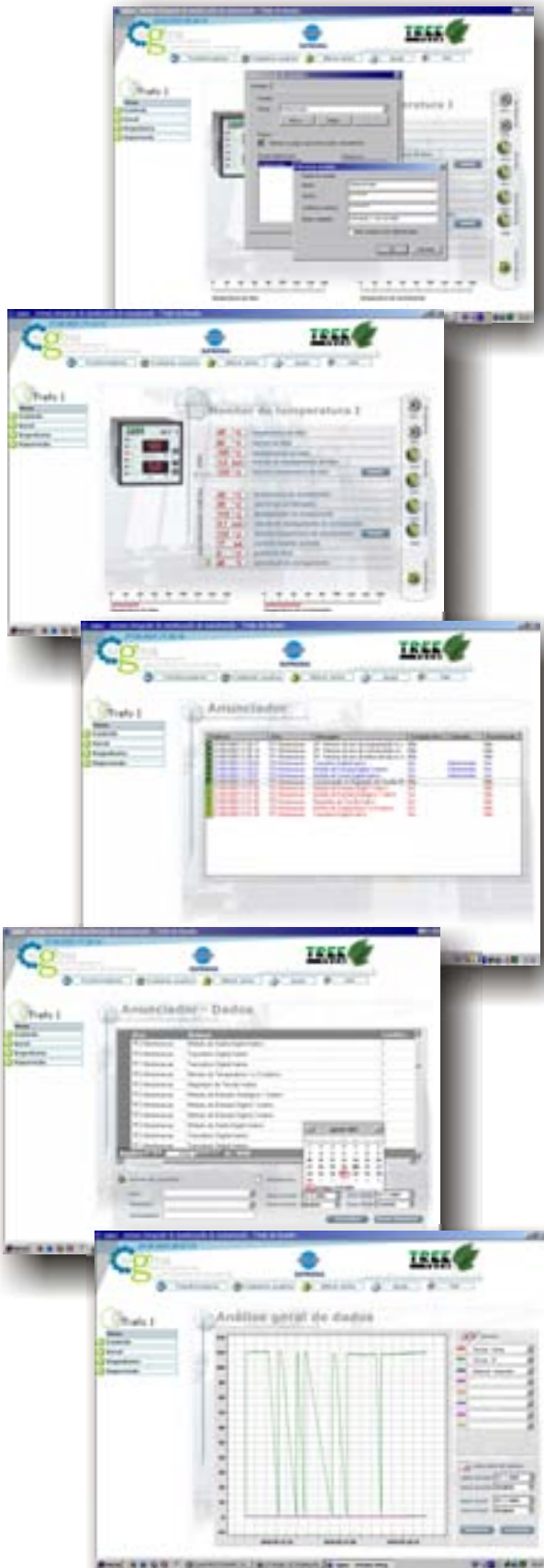
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Basic System Architecture



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Management Module



It has the following features and functions:

- Control of access and rights for each user in the system, by user names and passwords;
- Complete remote access to the system from any point on the Intranet or Internet using just a standard browser (e.g. Internet Explorer);
- On-line visualization of measurements (temperatures, tap position, voltage, current, gases, moisture, etc.);
- On-line visualization and acknowledgment of alarm and trip events in the software Events Annunciator;
- Recording of measurements and events in historical databanks. Easy consult to databanks by graphs, tables and export of databanks to text files;
- Remote parametering and command of devices on the transformer (forced cooling, parallelism, load tap-changer);
- Integration with sensors from other manufacturers using standard protocols (Modbus, DNP3.0, etc.);
- Configurable and adaptable system for each application regarding the number of transformers and data acquisition devices;
- Expandable system from the transformer to other equipment of the substation such as Disconnecting Switches, Circuit Breakers, Surge Arresters, Voltage Regulators, Battery Banks, among others;
- Optional integration with supervisory systems using standard protocols (Modbus, DNP3.0, etc.).



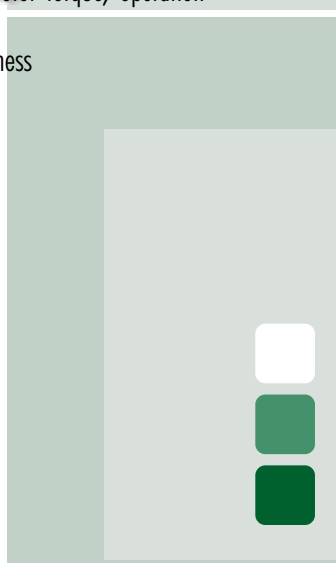
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Engineering Module



The Engineering Module performs the treatment of collected data, so as to extract useful information for the diagnostics and prognosis of the transformer status by means of mathematic models and logical algorithms. These can be expanded by the system user with his own models and algorithms, based on the knowledge and experience of his own specialists. Among more than 20 models and algorithms currently available in SIGMA, the following are a few examples

- Calculation of insulation aging
- Forecast of the final oil-winding temperature gradient
- Cooling efficiency
- Humidity in oil and in insulation
- Load tap-changer: Temperature differential, motor torque, operation time, number of operations and contact thickness
- And much more . . .



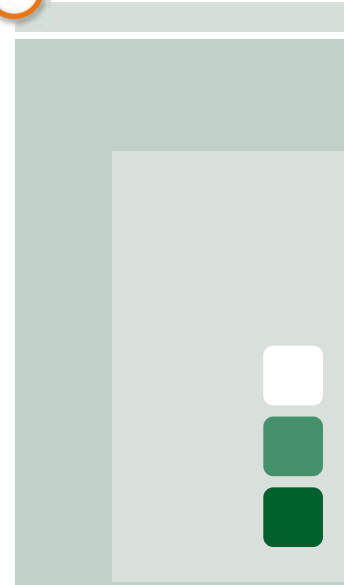
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Off-Line Module



This module offers tools such as:

- Maintenance manual of the transformer in electronic format;
- Informations on the transformers and other equipment installed in the substation;
- Historic where the user can make manual annotations and maintain the control of all the events that happened with the equipment;
- Consultation to the historic annotations.





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