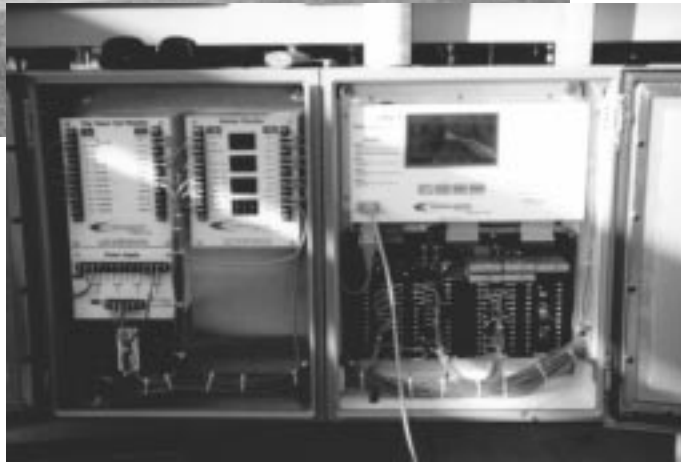


SM6™ Series Circuit Breaker Monitors



 **CONSOLIDATED**
Electronics, Inc.

MONITORING THE FUTURE™

Why SF₆ Gas Density Monitors?

Cut Maintenance Costs

Your capital investment may be recovered with the elimination of one false alarm!

**Have you calculated your maintenance costs lately?
Consider the man-hour cost spent in one month for:**

- ⌋ Unnecessary trips
- ⌋ Overtime hours
- ⌋ False alarms
- ⌋ Investigating alarms
- ⌋ Repeated call-outs
- ⌋ Tracking and documenting breaker performance
- ⌋ Re-calibrating gauges
- ⌋ Scheduling and planning maintenance.

Benefits

Install Density Monitors to provide:

- ⌋ Real-time monitoring
- ⌋ Elimination of false alarms
- ⌋ Leak trending data
- ⌋ Employee safety
- ⌋ Accurate density calculations
- ⌋ Remote access to data
- ⌋ Prediction of future alarms
- ⌋ Equipment safety
- ⌋ Maintenance planning.

Features

Base Unit Features:

- ⌋ Works accurately under extreme cold and hot weather conditions
- ⌋ Easily retrofits to existing breaker equipment
- ⌋ Microprocessor controlled
- ⌋ Density monitors are not affected by electromagnetic interference
- ⌋ Stores data for up to nine years
- ⌋ Accurately calculates density readings
- ⌋ Eliminates conventional gauge instruments.

SF₆ Gas Density Monitors

US Patent Number 5,388,451

Products

The SM6™ series consists of two base unit options, the **SM6™** and the **SM6-1™**, and enhancement modules.

Overview

All SM6™ Monitors work on the same basic principle. These monitors gather data, store it and provide calculated information that provides a timely and accurate means of making informed decisions regarding the operational state of the breaker.

The base units and modules can withstand harsh substation environments. They can provide accurate monitoring of sulfur hexafluoride (SF₆) gas pressure and temperature in spite of environmental extremes, avoiding the need to rely on mechanical measuring instruments, graphs or operator interpretations. These base units have been tested successfully from minus 50° C (-58° F) to 60° C (140° F), and have withstood repeated electrical discharges of one million volts.

SM6-0

The SM6™ is a microprocessor-based gas density monitor for SF₆ gas-filled, high voltage equipment. It continuously displays the density of SF₆ gas in percentage (%) form on the LCD.

Information is continuously updated, recorded and stored in memory for up to nine years. Data can be provided in graphic or numeric form to trend the performance of the equipment being monitored. Alarm levels that are determined by the user can alert operators of low gas levels and provide advanced notice of SF₆ liquefaction due to low temperatures.

SM6-1

The SM6-1™ base unit operates on the same principle as the SM6™. The SM6-1™ can employ enhancement modules for additional monitoring capabilities. This allows the purchaser to build a highly adaptive system configured to satisfy the user's requirements.

Modules

Abbreviation and Name		Base Unit Required
MM	Motor Monitor	SM6-1 or SM6-0
HM	Heater Monitor	SM6-1
OCM	Operation Current Monitor	SM6-1
PHPM	Pneumatic/Hydraulic Pressure Monitor	SM6-1
TCM	Trip/Close Coil Monitor	SM6-1

Information

All base unit information can be accessed in the field by a PC, or remotely through your communication system.

Services

Field Installation Engineers are available for initial installation of monitors.

Motor Monitor Module

Developed in conjunction with the Electric Power Research Institute (EPRI)

For use with the SM6-1™ and SM6-0™ Models

Description

The Motor Monitor (MM) is designed to provide ongoing data regarding the health of spring charging motors, air compressors or hydraulic pumps associated with the breaker. The MM Module provides an operational check on energy accumulation and detailed information about motor behavior. The user can detect deterioration in the health of the system over time if the motor's runtime per breaker operation lengthens dramatically.

Function

The MM Module attaches to the motor by a simple electrical connection from the base unit to the motor terminals. The MM Module calculates and analyzes a number of observed values and stores data for future downloading.

Features

- ◀ Provides number and length of run times
- ◀ Provides adjustable maximum and minimum run times
- ◀ Provides variance of run times from last start
- ◀ Provides run time to full charge
- ◀ Provides "average run times" and "starts per month".

Benefits

- ◀ Identifies system deterioration
- ◀ Identifies hours/days remaining before scheduled maintenance.

Data

Parameters, defined by the user, may be used to set alarms based upon breaker operating specifications or observed data. The time of each result is noted and stored for use in the base unit's software.

Alarms

Alarm parameters may be set by the user. Alarms may be enabled or disabled at the user's discretion.

Heater Monitor

For use with the SM6-1™ Model

Description

The Heater Monitor (HM) Module is designed to actively test circuit breaker heaters and associated power supplies to ensure proper operation. It is mounted in the auxiliary module enclosure. The HM Module tests heaters by turning them on for five seconds at intervals set by the user. It may also be used for controlling the heaters, automatically turning them on if the temperature drops below a point defined by the user.

Function

The HM Module uses an auxiliary relay operated by output from the base unit to energize the heater at pre-set intervals. Current to the heater is then measured and when the current is outside the ranges specified by the customer, an alarm is generated. Users may set the module to test heaters on a regular basis to evaluate their current functional state.

The HM Module can access the temperature reading from the base unit to operate up to four tank heaters. Both thermostatically and non-thermostatically controlled heaters are constantly monitored. The relay is wired in parallel to the existing thermostat in order to energize the heater.

Features

- ⌋ Periodic testing of the heaters
- ⌋ Notification of actual failure
- ⌋ "Intelligent" response to changing temperatures
- ⌋ Alarms on failure of operation.

Benefits

- ⌋ Reduce maintenance and cost of replacement parts
- ⌋ Reduce energy usage from heater testing.

Alarms

All module and base unit alarm parameters may be set by the user. Alarms may be enabled or disabled at user discretion.

Operation Current Monitor

For use with the SM6-1™ Model

Developed in conjunction with the Electric Power Research Institute (EPRI)

Description

The Operation Current Monitor (OCM) Module is designed to measure current interruption and the time required for the breaker to calculate I²T information. This module employs the OPTImizer™ by INCON® to provide real-time operation and wear information.

Function

The module employs three split-core measuring devices to monitor the output of existing relays or metering CTs. Operating time information is gathered from the auxiliary switch of the circuit breaker and compared with previous operating information to determine any degradation.

The base unit uses a dedicated RS232 port and a standard nine-pin serial computer cable to interface with the OPTImizer™.

Features

- Provides cumulative I²T information for each operation per phase
- Excessive arc time detection
- Measurement of mechanism timing.

Benefits

- Re-strike detection (per IEEE definition)
- Quantitative information for scheduling maintenance.

Data

All information is recorded by and stored in the OPTImizer™. The SMSmart™ Program in the SM6-1™ unit provides easy access to and download of this information.

Alarms

All module and base unit alarm parameters may be set by the user. Alarms may be enabled or disabled at user discretion.

Pneumatic/Hydraulic Pressure Monitor

For use with the SM6-1™ Model

Description

The Pneumatic/Hydraulic Pressure Monitor (PHPM) Module is designed to continuously monitor the air or hydraulic pressure required to trip or close the operating mechanism of the circuit breaker. It measures a drop in pressure and the recharge time for the compressor or pump for each operation and provides trending information on performance.

Function

A pressure transducer, similar to that used by the base unit, is installed on the high pressure pneumatic or hydraulic system to be monitored. The PHPM Module may be set to display an alarm if the pressure drops below the preset operational limit.

Features

- ◀ Provides leakage rate trending
- ◀ Provides loss of pressure alarm
- ◀ Provides accurate pressure monitoring.

Benefits

- ◀ Eliminates the need for continual adjustment of pressure switches.

Data

Parameters, defined by the user, may be used to graph data and set alarms for breaker operating characteristics or observed data. The time each result is noted is stored for use in the base unit's software graphing and trending programs.

Alarms

Alarms may be enabled or disabled at user discretion.

Trip/Close Coil Monitor

For use with the SM6-1™ Model

Description

The Trip/Close Coil Module (TCM) monitors the readiness of circuit breaker trip or close coils by continuously monitoring the coil's electrical flow. The TCM has the ability to monitor as many as four coil circuits simultaneously.

Function

The TCM provides four form "C" dry contacts, one for each channel monitored. If the coil system has continuity, the contact is held in the closed position. Each channel is connected in series and forms a closed circuit that, with the use of station DC or AC power, sends an energized signal to the base unit.

Features

- Ensures that the trip/close coils are functional
- Monitors up to four trip or close coils simultaneously.

Benefits

- Eliminates the need for periodic coil checks
- Reduces system down-time by alarming coil failures.

Alarms

In the event that any channel loses continuity or the power supply fails, the digital input to the base unit becomes de-energized, creating an event. A base unit auxiliary alarm may be wired to a station annunciator.

SMSOFT™ SOFTWARE PACKAGE

For use with the SM6-0™ Model

Description

The SMSOft™ software is a DOS based program which allows the user to program the unit with settings particular to the breaker being monitored. Providing current readout, and density information a to PC or remote location. SMSOft™ includes a graphing package to visually display, pressure, temperature, temperature compensated pressure, density and project of service requirements.

Function

Through the use of specific alarm levels configured in the installation setup, the SM6™ software can forecast the next incidence of low gas, and provide to the user the number of days until the gas level reaches each alarm setting .

Features

- ◀ Database storage for up to nine years
- ◀ Graphing capabilities to show trends
- ◀ Functional testing of monitor.

Benefits

- ◀ Real time monitoring
- ◀ Leak trending capabilities
- ◀ Accurate density calculation
- ◀ Flexibility of customer set alarms.

SMSMART™ SOFTWARE PACKAGE

For use with the SM6-1™ Model

Description

The SMSmart™ software program used by the SM6-1™ is a sophisticated, Windows-based program designed to offer users as much information as possible about the current and predicted status of the equipment being monitored. The flexible sampling rates for gathering information give users control of the amount of data stored in the memory each day, allowing either general overviews of operational trends or minute-by-minute information on specific functions.

Function

The SMSmart™ software allows remote on-site access to all or any part of the stored information. Long and short term breaker protection trends can be identified. Downloading of stored information can be compared over different time periods.

Features

- ⌄ Database storage for up to nine years
- ⌄ Graphing capabilities to show trends
- ⌄ Flexible sampling rates
- ⌄ Ease in adding additional protection modules.

Benefits

- ⌄ Real time monitoring
- ⌄ Leak trending
- ⌄ Accurate density calculation
- ⌄ Flexibility in customer set alarms.

SM6-0™ Technical Specifications

Physical Description

Enclosure Dimensions	25.4 x 20.3 x 15.2 cm (10 x 8 x 6 inches)
Enclosure Rating	NEMA 4X
Display	Liquid Crystal

Electrical Requirements

Operating Power	85 to 265 Vac or 100 to 370 Vdc (20 to 70 Vdc optional)
Relay Contact Rating	0.1 Amperes, 125 Vdc resistive
Internal Heater	100 Watts, 100 to 125 Vac only
Grounding	Must be bonded to circuit breaker
DC Isolation	1500 Volts

Temperature Ratings

Ambient <i>Maximum</i> Temperature	60° C (140° F)
Ambient <i>Minimum</i> Temperature	-50° C (-58° F)
SF ₆ Temperature Range	-50° C to +60° C (-58° F to +140° F)
Temperature Scales Available	Celsius and Fahrenheit

Pressure Ratings

SF ₆ Pressure Absolute <i>Maximum</i>	400 psia (27.6 Bar)
SF ₆ Pressure Range	0 to 150 psia (0 to 10.3 Bar)
Pressure Scales Available	psi, Bar, Kg-f/Cm ² , MPa
Pressure Port Fittings	¼ inch Tubing

Density Functions

Density % Range	0-200%
Density Accuracy	1%
Humidity Range	0-100 (non condensing)
Nitrogen (CF4) Content Range	0-100%
SF ₆ Normalized Temperature Range	10° to 40° C (50° to 104° F)
SF ₆ Liquefaction Proximity Warning	2 to 6 C° (4 to 11 F°) above liquefaction

Hardware

Temperature Sensors

Materials	Brass
Mounting	SF ₆ Tank Surface Mount
Cable Run	5 meters (16.4 feet)

Pressure Transducers

Materials	316 Stainless Steel
Mounting	Bulkhead
Cable Run	None
Port Fitting	¼ inch Tubing

Communications

RS232 Ports	1
RS485 Ports	1
Fiber Optics	None
Baud Rate	1200 to 19.2K bps

SM6-1™ Technical Specifications

Developed in conjunction with the Electric Power Research Institute (EPRI)

Physical Description

Enclosure Dimensions	20" x 16" x 6"
Enclosure Rating	NEMA 4
Display	Liquid Crystal

Electrical Requirements

Operating Power	85 to 265 Vac or 100 to 370 Vdc
Relay Contact Rating	0.1 Amperes, 125 Vdc resistive
Internal Heater	200 Watts, 100 to 125 or 200 to 250 Volts AC only
SF6 Circuit Breaker Heater Amperage Maximum	30 Amperes AC per heater circuit
DC Isolation	1500 Volts

Temperature Ratings

Ambient <i>Maximum</i> Temperature	60° C (140° F)
Ambient <i>Minimum</i> Temperature	-50° C (-58° F)
SF6 Temperature Range (tested)	-50° C to +60° C (-58° F to +140° F)
Temperature Scales Available	Rankin, Kelvin, Celsius, Fahrenheit

Pressure Ratings

SF6 Pressure Absolute <i>Maximum</i>	400 psia (27.6 Bar)
SF6 Pressure Range (tested)	0 to 150 psia (0 to 10.3 Bar)
Pressure Scales Available	psi, Bar, Kg/cm ² , kPa
Pressure Port Fittings	¼ inch USA national pipe thread male

Density Functions

Density % Range	0-200%
Density Accuracy	± 1%
Humidity Range	0-100 (non condensing)
Nitrogen (CF4) Content Range	0-100%
SF6 Normalized Temperature Range	10° to 40° C (50° to 104° F)
SF6 Liquefaction Proximity Warning	2 to 6 C° (4 to 11 F°) above liquefaction

Hardware

Temperature Sensors

Materials	Heat conductive epoxy
Mounting	SF ₆ Tank Surface Mount
Cable Run	15 meters (50 feet) Max

Pressure Transducers

Materials	316 Stainless Steel
Mounting	Pipe
Cable Run	15 meters (50 feet) Max
Port Fitting	¼ inch USA national pipe thread male

Inputs - Outputs

Digital	8 digital form "C" relay contacts 8 digital 70 to 290 Volt AC/DC inputs
Analog	6 analog transducer

Communications

RS232 Ports	2
RS485 Ports	2
Fiber Optics	One pair
Baud Rate	1200 to 19.2K bps