



MONITRA

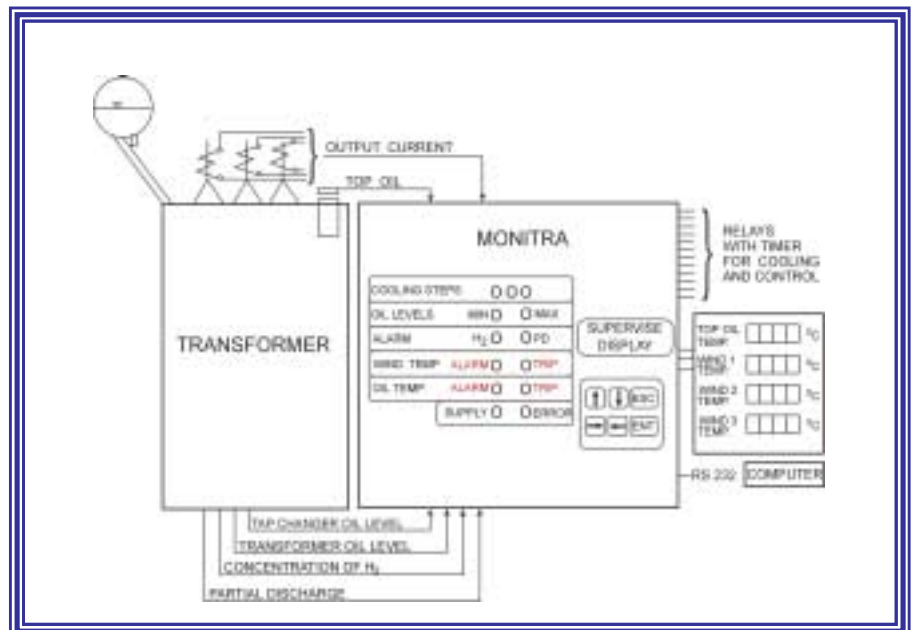
MICROPROCESSOR EQUIPMENT INTENDED FOR POWER TRANSFORMER PROTECTION AND OPERATION MONITORING

Taking into account that the power transformer is the major item of equipment in power systems, its correct functioning is vital to system operation. It is well known that the transformer failures are sometimes catastrophic and almost always include irreversible internal damage.

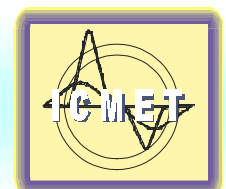
The monitoring of power transformers makes possible to obtain the maximum practicable operating efficiency and optimum life of power transformers, minimizing the risk of premature failures and providing potential for changing the maintenance strategies.

Research, Development and Testing National Institute for Electrical Engineering – ICMET Craiova has developed and designed **Microprocessor equipment for power transformer protection and operation monitoring, type MONITRA.**

MONITRA equipment is intended to protect and monitor the power transformer Operation; it measures the oil temperature, phase current and oil level in transformer, partial discharge level; calculates the winding temperature according to IEC 60354; monitors partial discharge level and dissolved hydrogen concentration. The equipment is mounted in the control room.



RESEARCH, DEVELOPMENT AND TESTING NATIONAL INSTITUTE FOR ELECTRICAL ENGINEERING
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Advantages of continuous monitoring:

- Prevention of failures and downtimes of transformer
- Transformer life extension leading to the delay of investment for a new transformer
- Optimization of transformer use by means of condition – based maintenance instead of time – based maintenance

Because of its modularity, the equipment can easily be focused on the customers needs and the requirements of the monitored transformer, any configuration being available when requested.

TECHNICAL CHARACTERISTICS

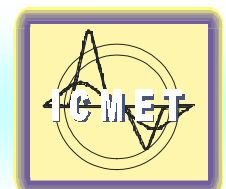
The standard version has the following configuration:

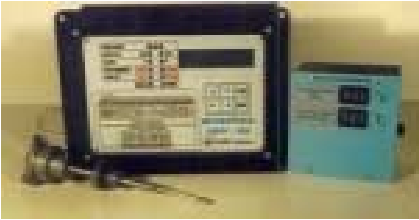
Inputs

- Three inputs for currents (0 to 1 A or 0 to 5A)
- One input for PT 100 oil temperature transducer
- Inputs for pumps and fans monitoring
- One input for partial discharge level from DUDP-2N (PD Acoustic Emission Detector)
- Two optional inputs

Outputs

- A. Control relays (10 A; 250 V AC):**
1. One contact for first cooling unit starting, when the preset value of the winding temperature is exceeded
 2. One contact for second cooling unit starting when the preset value of the winding temperature is exceeded
 3. One contact for third cooling unit starting
 4. One contact for alarm in case of accidental voltage drop or faulty equipment
 5. One contact for signaling the winding temperature increase over a prescribed temperature
 6. One contact for signaling the oil temperature increase over a prescribed temperature
 7. One safety contact for disconnecting the transformer when the oil temperature exceeds the maximum allowable temperature
 8. One contact for transformer disconnecting, when the maximum allowable temperature of the winding is exceeded
 9. Two contacts for monitoring the partial discharge level exceeding
 10. Two reserve contacts
- Note:** Alarm temperature values can be easily set and changed from the keyboard





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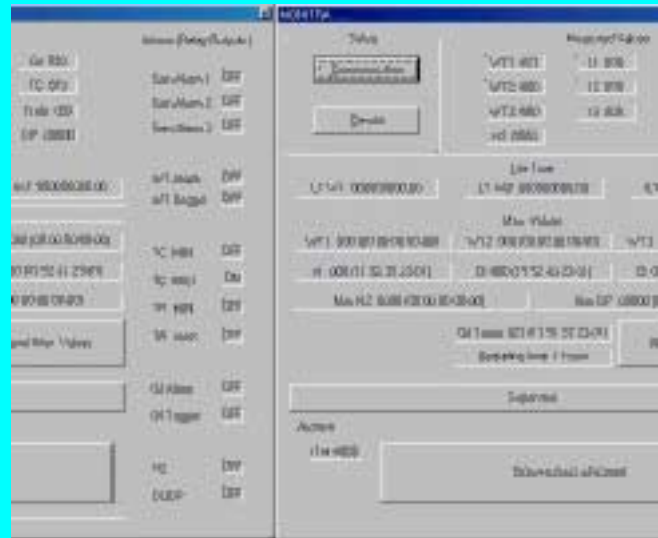
B. Eight channels for monitoring in the control room (placed at a distance of max. 1 km from the transformer), with analog devices:

- three winding temperatures
- oil temperature
- partial discharge level
- dissolved hydrogen concentration
- two oil level

Remote connection: serial interface RS 232 allows the remote transmission (1 km max.) of the monitored and stored data to an IBM-PC compatible equipment.

Software: the winding temperature Indicator is delivered with the software necessary to send the stored data through the serial interface RS 232 or RS 485. The software analyses the following quantities: currents, winding temperature, hot spot for each winding, oil level, partial discharge level or other options.

Analysis software allows the rapid interpretation of the stored data, and their arrangement as tables

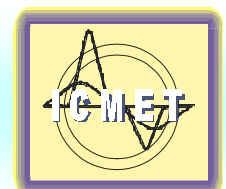


Window for computer communication with MONITRA

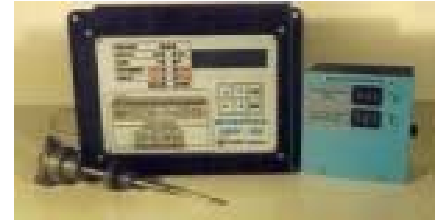


Window for transformer parameter setting

The device is provided with a keyboard and a local display, allowing the programming (prescribing the temperature thresholds, delays at relay connection and disconnection, constants specific to transformer) and local or remote display of the quantities monitored. Additionally, the relay condition is locally signaled, by LEDs, and the good operation condition is locally signaled in an optical way, by intermittent lighting of a LED. **Note:** All the values introduced from the equipment keyboard can be introduced and coded also from the computer keyboard.



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The main menu is accessible by pressing any key and gives the possibility to visualize the monitored quantities (**SUPERVISE**), to set the transformer parameters and the quantities required for operation (**CONFIG**), to calibrate the input quantities (**CALIBRATE**) and to simulate the operation (**SIMULATE**).

IMT equipment is provided with a real - time clock and a battery allowing autonomous operation for 10 years.

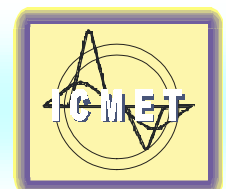
It is possible to store the value of currents, oil temperature and other calculated quantities, at programmable time intervals, for a period of about 2 months. The stored data can be transmitted by the RS 232 interface to IBM-PC compatible equipment. When the buffer is 90% filled, it is necessary to save the stored data.

Window with display of oil and winding temperature values

Index	Time	Date	Oil Temp	I1	WT1	I2	WT2	I3	WT3	DUDP
01984.	14:00:31	15-01-2002	021	000	021	000	021	000	021	00000
01985.	14:10:31	15-01-2002	020	000	021	000	021	000	021	00000
01986.	14:20:31	15-01-2002	021	000	021	000	021	000	021	00000
01987.	14:30:31	15-01-2002	021	000	021	000	021	000	021	00000
01988.	14:40:31	15-01-2002	020	000	020	000	020	000	020	00000
01989.	14:50:31	15-01-2002	021	000	021	000	021	000	020	00000
01990.	15:00:31	15-01-2002	020	000	021	000	021	000	021	00000
01991.	15:10:31	15-01-2002	020	000	021	000	021	000	021	00000
01992.	15:20:31	15-01-2002	021	000	021	000	020	000	020	00000
01993.	15:30:31	15-01-2002	021	000	021	000	021	000	021	00000
01994.	15:40:31	15-01-2002	021	000	020	000	020	000	020	00000
01995.	10:10:43	30-01-2002	019	000	019	000	019	000	019	00000
01996.	10:20:43	30-01-2002	020	000	020	000	020	000	020	00000
01997.	10:41:09	30-01-2002	022	000	021	000	021	000	021	00000
01998.	09:33:54	05-02-2002	016	000	016	000	016	000	016	00000
01999.	11:18:30	13-02-2002	020	000	020	000	020	000	020	00000



The monitored quantities can be visualized on the display, as virtual instruments





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Monitored and Displayed quantities

Domain

•	Oil pumps condition	
•	Fans condition	
•	Oil and winding temperature	0 to 150 ⁰ C or -35 to 120 ⁰ C
•	Current (percentage of rated current)	0 to 200%
•	Working time	hours
•	Oil level (percentage of maximum value)	0 to 200%
•	Spent life time	hours
•	Dissolved hydrogen concentration (optionally)	0 to 2048 ppm
•	Partial discharge level (optionally)	0 to 10000pC

Programming range for the protection levels

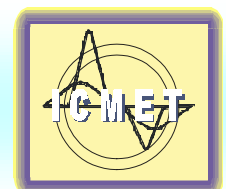
•	Oil and winding temperature:- range	0 to 150 ⁰ C or -35 to 120 ⁰ C
	- difference	0 to 30 ⁰ C
	- alarm delay	0 to 40 minutes
•	Oil level (percentage of maximum value)	
	- range	0 to 200%
	- difference	0 to 50%
	- alarm delay	0 to 40 minutes
•	Partial discharge level	
	- range	0 to 10000 pC
	- difference	0 to 500 pC
	- alarm delay	0 to 40 minutes
•	Dissolved hydrogen concentration (optionally)	
	- range	0 to 2048 ppm
	- difference	0 to 100 ppm
	- alarm delay	0 to 40 minutes

Transformer parameters range :

•	Temperature gradient - for each winding and cooling level	0 to 50 ⁰ C
•	Current exponent (specific to the cooling type)	1 to 2
•	Thermal time constant - for winding	1 to 30 min

Mains supply:

•	90 to 264 V AC, 50 Hz ; 120 to 370 V DC (optionally)
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Measurement accuracy:

• Oil temperature	$\pm 1^{\circ}\text{C}$
• Winding temperature	$\pm 2^{\circ}\text{C}$
• Currents in the current transformer secondary	1%
• Oil level	1%

Environmental conditions:

• Range of operating temperatures	$-5^{\circ}\text{C} \dots + 50^{\circ}\text{C}$
• Protection degree	IP 50
• Maximum altitude	1000 m

Overall dimensions:

• MONITRA:	W x H x D = 283 x 180 x 110 mm
• Device for temperature remote displaying:	W x H x D = 170 x 270 x 165 mm
• DUDP – 2N:	W x H x D = 290 x 200 x 100 mm

Accessories:

- Sensor for oil temperature: PT 100 thermal resistance
- Accessories for local or remote connection of the equipment

Tests

• Immunity	- power frequency electromagnetic field	IEC 61000-4-8
	- voltage interruptions or supply voltage variations	IEC 61000-4-11
	- surge	IEC 61000-4-5
	- electrostatic discharge	SR EN 61000-4-2
• Measurement	- conducted disturbance	CISPR 22

Options

- The equipment monitors:
 - the position of the on-load tap changer contact studs and is able to meter the switching on each step
 - the concentration of the hydrogen dissolved in oil, based on the information offered by the device for dissolved gas measuring
 - partial discharge level, based on Acoustic Emission Partial Discharge Detector (see the leaflet of DUDP-2N)

