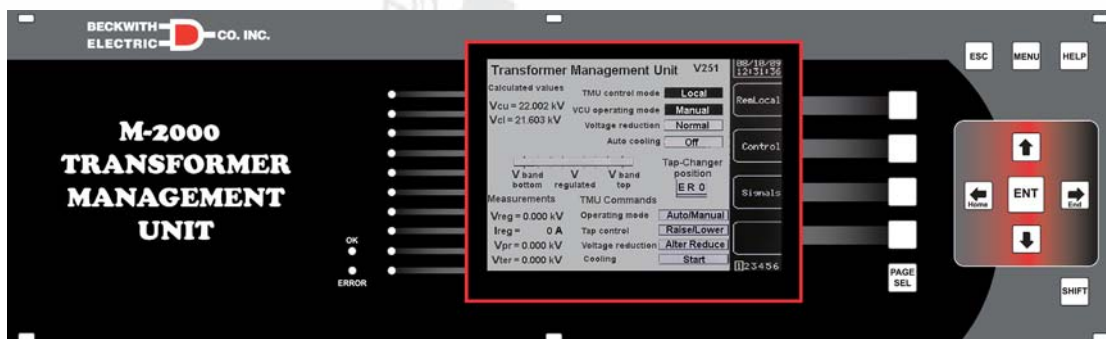


# M-2000 Transformer Management Unit



**The M-2000 Transformer Management Unit is designed to monitor and control power transformer functions, while also maintaining the transformer in top operating condition.**

**The M-2000 can be configured via the serial port or by the graphic LCD HMI (Human Machine Interface), using front panel pushbuttons to configure, and also for data inquiry.**

## **Feature Information**

### **Top Oil Temperature Monitoring**

The M-2000 monitors the two transformer top oil sensors for temperature difference. If the temperature difference exceeds the set temperature difference the unit will indicate a possible sensor, sensor wiring or measurement input circuit failure.

The M-2000 Transformer Management Unit is also able to detect a short circuit in its own measuring circuit.

### **LTC Main Temperature Monitoring**

The M-2000 monitors the temperature difference between the LTC (Load Tap Changer) oil and the main tank top oil. If the temperature difference exceeds a set value, with the LTC oil being the higher of the two temperatures, then the M-2000 will indicate a possible arcing condition and a continuing temperature rise in the LRC compartment.

The setpoint is based on transformer type, load, and ambient temperature. Detecting low level arcing alerts maintenance before high level arcing occurs.

### **Transformer Cooling Fan Control**

By monitoring the internal top oil temperature, the M-2000 controls the on and off operation of the cooling fans as needed.

### **Cooler Temperature Monitoring**

The M-2000 monitors the temperature difference between the transformer cooling inlets and cooling outlets. If the temperature difference exceeds a set value, the M-2000 will indicate a partial or full cooling failure.

The cooler temperature monitoring feature is also aided by the monitoring of load conditions and/or low ambient temperature, so the resulting measured value does not initiate a false alarm.

Failure of the transformer cooling system must be identified and resolved before high oil and winding temperatures force a load reduction or the transformer protection trips the transformer off-line.

### **LTC Motor Operation Monitoring**

When a command is given to the LTC motor to raise or lower, the operation is expected to conclude within a given length of time. The M-2000 monitors this time and if LTC motor operation is faster or slower than set time, then an indication of possible partial or full LTC mechanism or control circuit failure is given.

To achieve this the M-2000 monitors LTC motor current, tap position changing time, and raise and lower commands.

An alarm is actuated by the unit if the monitored values are not within the set parameter. An improperly working LTC motor can be blocked by the M-2000, so that further damage can be avoided to the tapchange mechanism.

### **Excessive Tapchanger Operation Monitoring**

The M-2000 monitors and records the number of tapchanger operations and actuates an alarm if the setpoint value is exceeded. Monitoring excessive tapchanger operations can help in discovering malfunctioning controls as well as setting issues.

### **Cabinet Ambient Temperature Alarm**

If the cabinet that houses the M-2000 Transformer Management Unit is equipped with a heater, it can employ the M-2000 to monitor cabinet ambient temperature and actuate a M-2000 alarm if the temperature drops below a set value.

### Hot Spot Alarm

The transformer hot spot temperature is monitored. If the temperature exceeds the set limit the M-2000 signals an alarm to the operator to immediately reduce the load and preserve the unit.

### LTC Predictive Maintenance

LTC contacts are rated for maximum operation at a rated current. If switching currents are lower or higher, the number of allowable LTC operations can increase or decrease before maintenance inspections.

By monitoring the current and recording the I<sup>2</sup>t during each tapchange operation, it is possible to compare the accumulated data to the allowable rating and determine future maintenance intervals.

### Display and Configuration

- The graphic LCD displays 6 different screens for monitoring status and real time values.
- The M-2000 is configurable with the communications software or through the access code protected front panel HMI. Accuracy of the entered data is checked immediately internally.
- Front panel LEDs indicate the status of the M-2000 Transformer Management Unit.
- Manual control of the M-2000 is possible using the front panel HMI when the unit is in manual mode.

### Applications

- Drive status can be read in binary, BCD, or analog (4-20 mA) format.
- Handling either from the substation- or bay-level HMI, remote control workstation or from individual wired switches.
- Single or three-phase drive control.
- Operation either as stand-alone unit or as part of the substation control system.
- The 19" housing is tested and approved for substation applications.

### Backup Control Function

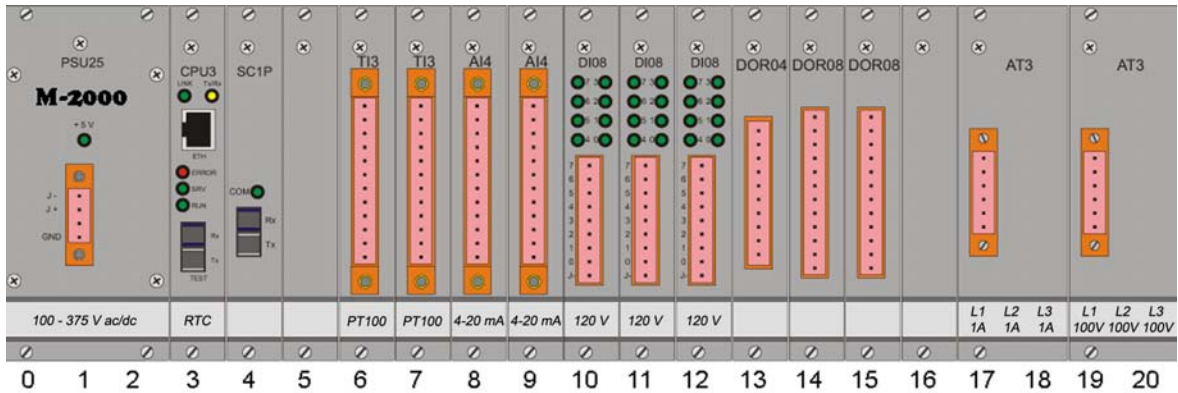
The M-2000 Transformer Management Unit can serve as a Backup Control and provides the extra protection that can save customers from the hazards and inconvenience of excessively high or low voltage. Defective LTC tapchanger controls can cause either too high or too low a voltage along the line, possibly damaging customer motors, computers or televisions. Even when the control is operating properly, customers close to the transformer may receive dangerously high voltage as the line drop compensator attempts to maintain a constant voltage under heavy load at a central point on the distribution line. The Beckwith Electric M-2000 can be installed as a solution to both of these problems.

The M-2000 will prevent a defective LTC tapchanger control from running the voltage outside the upper and lower voltage limits and, in addition, will prevent the line drop compensator from raising the voltage too high under full load or overload conditions. Setting the voltage bands on the M-2000 slightly wider than the transformer control limits will assure that a failed control will not result in a runaway LTC transformer. Under full or overload conditions, the control automatically takes over as an upper voltage limit control, not affected by load current, to prevent damage to equipment close to the transformer. While the Block Raise contact prevents a raise operation, a Lower contact forces the tapchanger to lower if the primary voltage should subsequently rise.

# M-2000 Transformer Management Unit

## External Connections

For detailed wiring diagrams see the M-2000 Transformer Management Unit Instruction Book.



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Figure 1 M-2000 External Connections

## Technical Specifications

### Power Supply

Nominal Voltage ( $V_n$ )	12 V, 24 V, 48 V, 60 V, 110 V, 220 V, AC or DC
Supply Voltage Range	-20% to +10% $V_n$
Allowed Voltage Break Down	50 mS (220 V dc)
Power Consumption	10 W to 20 W (depending on configuration, number of cards)

### Current Transformers

Nominal Current ( $I_n$ )	1 A or 5 A
Rated Frequency	50 Hz or 60 Hz
Measuring Range	0 to 1.5 x $I_n$
Accuracy	< 0.5% in range 0.2 to 1.4 x $I_n$
Continuous Overload	10 A ( $I_n = 1$ A); 20 A ( $I_n = 5$ A)
Rated Short-time Withstand Current ( $I_{cw}$ )	25 x $I_n$ for 1 sec
Rated Peak Withstand Current ( $I_{pk}$ )	100 A ( $I_n = 1$ A); 300 A ( $I_n = 5$ A)
Power Consumption	< 0.4 VA

### Voltage Transformers

Nominal Voltage ( $V_n$ )	30 V, 100 V, 110 V, 220 V, or specified
Rated Frequency	50 Hz or 60 Hz
Measuring Range	0 to 1.5 $V_n$ (line)
Accuracy	< 0.5% from 0.6 to 1.4 x $V_n$
Continuous Overload	2 x $V_n$ (line)
Power Consumption	< 0.2 VA

### Digital Input Lines

Nominal Voltage ( $V_n$ )	12 V, 24 V, 48 V, 60 V, 110 V, 220 V
Rated Frequency	DC, 50 Hz or 60 Hz
Perception Level	Max. 0.8 x $V_n$
Power Consumption	Max. 2.8 mA / input line in case $V_{in} = V_n$
Permanent Overload	1.1 x $V_n$
Length of the Shorter Impulse	1 to 254 mS, configurable
Event Time Accuracy	$\pm 1$ mS

### Digital Output Lines

Nominal Voltage ( $V_n$ )	12 V, 24 V, 48 V, 60 V, 110 V, 220 V
Rated Frequency	DC, 50 Hz or 60 Hz
Type of Output Relays	SCHRACK RP 110005

### Local Data Transmission

Serial Connection	Fiber (HFBR1523/2523), ST, or isolated RS-485 or RS-232
Layout	star / bus / loop
Speed	2400 to 19200 bps

### Mechanical Characteristics

Protection	IP 20
Dimensions	19" x 5.20" x 9"
Weight	9.92 lbs

### Atmospheric Environment (Temperature)

Cold	-20° C
Dry Heat	+70° C
Damp Heat	+40° C @ 93% RH

## Tests and Standards

M-2000 Transformer Management Unit complies with the following tests and standards.

### ***Voltage Withstand***

#### *Dielectric Withstand*

IEC 60255-5                    2,800 V dc

#### *Impulse Voltage*

IEC 60255-5                     $\pm 5,000$  V pk

### ***Electrical Environment***

#### *Electrostatic Discharge Test*

IEC 61000-4-2                Level 3 ( $\pm 6$  kV) - Point contact discharge

IEC 61000-4-2                Level 3 ( $\pm 8$  kV) - Air discharge

#### *Radiated Field Immunity ( spot frequency tests )*

IEC 60255-22-3                10 V/m - 74.330 MHz, 160.150 MHz, 468.510 MHz

#### *Fast Transient Disturbance Test*

IEC 61000-4-4                Level 3 ( 2 kV, 5 kHz )

#### *Surge Immunity*

IEC 61000-4-5                 $\pm 2$  kV Common mode

IEC 61000-4-5                 $\pm 1$  kV Differential mode

#### *Conducted Field Immunity*

IEC 61000-4-6                10 Vemf

#### *Power Frequency Magnetic Field Immunity*

IEC 61000-4-8                30 A/m continuous

1000 A/m 2 sec.

#### *Damped Oscillatory Wave Immunity*

IEC 61000-4-12                 $\pm 2.5$  kV Common mode

IEC 61000-4-12                 $\pm 1$  kV Differential mode

#### *Power Frequency Disturbance Test*

IEC 61000-4-16                150 V Differential mode

300 V Common mode

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**ISO 9001:2008**