



Dynamic Rating, Monitoring, Control and  
Communications

# ***DRMCC-T2***

# **TECHNICAL SPECIFICATION**

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## REVISION HISTORY

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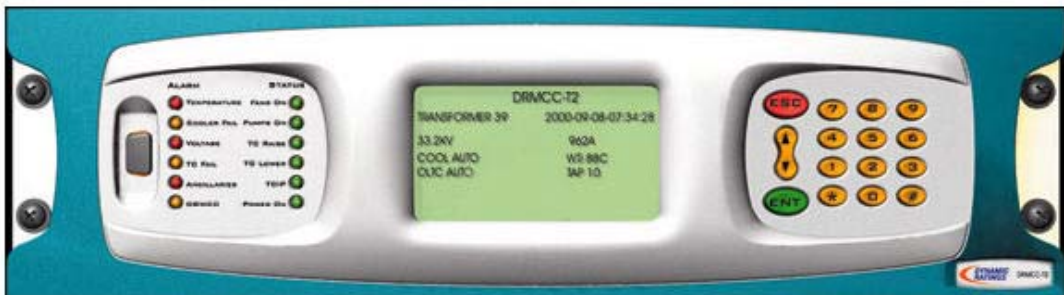
## INTRODUCTION

The DRMCC<sup>1</sup>-T2 is a microprocessor-based monitoring and control system for power transformers. The DRMCC-T2 provides the following main functions:

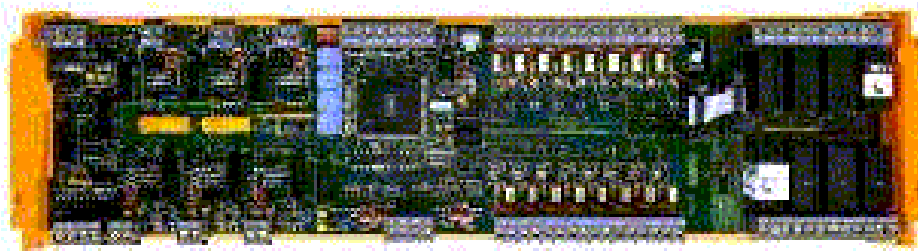
- Dynamic rating to optimise safe loading of a transformer
- Measurement and display of field data for operating and diagnostic purposes
- Insulation aging according to IEC and ANSI/IEEE standards.
- Support of third-party condition monitoring probes
- A wide range of manual and automatic voltage control modes
- Cooling control with alarms and trips
- Automatic cooling test and fail-safe cooling control
- Comprehensive alarm capability
- 52-week data log and time-stamped event recording
- Remote monitoring from SCADA RTUs, Substation Control Computers, modems, WANs, using Modbus, DNP3.0, http on physical connections such as EIA-232, EIA-485, optic fibre and Ethernet.

The system includes:

- A UIM (user interface module), which includes a display, screen, pushbuttons, status LEDs and communications interface. It may be mounted in a transformer marshalling cubicle or a remote control room, in a standard 19" rack or flush mounted on a panel.



- One or more SICMs<sup>1</sup> (Serial Interface Communication Modules), which interface to CTs, VTs, and sensors. The SICMs are mounted on a standard 35-mm DIN rail in a transformer control cubicle.



- An optional communications converter, which interfaces to the SICMs using standard full duplex EIA-485 multi-drop connections and converts to optic fibre to interface to the UIM if required.

The DRMCC-T2 can be fitted to new transformers in the factory or to old transformers in the field provided that the required auxiliary equipment is fitted – refer section **Additional Equipment Required**.

## FUNCTIONALITY

### ***DYNAMIC RATING***

Dynamic rating takes advantage of the fact that a transformer may be loaded beyond nameplate rating under certain circumstances without damage. Long time emergency (cyclic) loading is defined as a load that causes an ageing rate greater than 1 pu, but can be permitted to continue for long periods, a day or more, without danger to the transformer. Short time emergency loading occurs if the ultimate steady state winding or oil temperatures or the load current exceed their respective long time limits, and may only be permissible for a few minutes or hours. The static thermal rating is commonly used to load a transformer close to its limits based on assumed conditions. Dynamic rating does not rely on assumptions but is based on actual measure conditions at the time, giving much greater accuracy.

The DRMCC-T2 continuously calculates how long the transformer can carry its load under the current conditions. If the present temperature is above the long time limit, calculations allow for the time since the limit was exceeded. It also provides a "What-if" utility that allows the user to calculate how long a given load can be carried, and what is the maximum load that can be carried for a given time. These values can then be used under emergency conditions without fear of exceeding user-defined limits. The basis of the calculation is a thermal model such as the ones described in IEC 60354 and IEEE-Std C57.91. The model uses transformer parameters entered into the DRMCC-T2 during initial configuration. The calculations use present values of ambient, oil and winding temperatures.

### ***MONITORING***

Raw data is gathered from sensors and probes connected to the SICM(s). The standard system monitors operating, status and condition data such as:

- Secondary voltage and current, watts and vars.
- LTC status (tap position, remote/local switch, TC in progress, motor trip)
- Ambient & top oil temperatures
- Cooling contactors, circuit breakers and selector switches
- Third-party condition monitoring instruments such as those for dissolved gas in oil, water

in oil, etc have been programmed into the UIM and may be selected as options  
Information calculated from the raw data may include:

- Winding hot spot insulation ageing rate per unit and accumulated ageing, years.
- Number of tap changes and current switched from each tap position, and cumulative total.
- Fan and pump operating hours (optionally used for duty cycling stand-by coolers).

### **DATA LOGGER AND EVENT RECORDER**

- The data may be logged and analysed. The results may be used for dynamic rating, diagnostics and control. All raw data and calculated values are available at the user interface and can be downloaded remotely. The data can be easily imported to customer computer program for analysis, charting, reporting etc.
- An event recorder records and shows the date and time when the status of each alarm changed.

### **OPERATIONAL STATUS INDICATORS**

A set of coloured LED indicators on the front panel of UIM that is driven by alarms, trips and etc. signals will show the operational status of transformer by Green, Yellow or Red colours.

### **SELF-TESTING**

The UIM performs various self-checks at power on and continually monitors DRMCC functions to make sure the control system is in a healthy condition.

### **CONTROL**

#### **COOLING CONTROL**

- Manual and automatic control of coolers (fans and pumps).
- 1 or 2 pump groups, duty cycled.
- 1 or 2 fan groups, each with separate control settings.
- Variable Speed drives for fan control (optional).
- Smart cooling which acts on predicted need.
- Fail safe control, which turns on if communications to the SICM fails.

## OLTC CONTROL:

- Manual & Auto OLTC control.
  - Independent Manual
  - Independent Auto \*
  - Master Manual
  - Master Auto \*
  - Follower
  - Reverse Reactance \*
  - VARs sharing \*
  - Circulating current \*
- \* LDC - Load Drop Compensation (optional).
- AVC with definite and inverse time delay modes.
- Settings are provided for control modes, operating set points, alarm set points, time delays.

## COMMUNICATIONS

A combination of EIA-232, EIA-485, 10baseT and fibre optic ports are provided in the UIM - refer Section **Number of Ports**. Electrical or fibre optic connection will be applied to low or high RFI environment respectively. EIA-232 and fibre optic are used for point to point connection while EIA-485 and 10baseT may be used for multidrop connection.

Applications include:

- Communication between UIM and SICMs using a subset of DNP 3.0 protocol
- Communications between UIMs for parallel control of transformers.
- Communication with SCADA RTU using DNP 3.0 Level 2, Modbus RTU or Modbus ASCII protocols, max 19,200 bps
- Ethernet connection via optional Ethernet 10base T card provides Telnet, FTP and HTTP facilities.
- Changing settings and downloading data from PC directly or via modem -- Modems tested:
  - 1) Net Comm Smart medium 336
  - 2) 3 Com USRobotics 56K Vice/Fax/Modem

## SCOPE OF SUPPLY

### EQUIPMENT INCLUDED

The following equipment is included in one standard DRMCC-T2 system, to monitor and control one power transformer:

- One User Interface Module - Model: UIM-T2
- One SICM2B - 8 relay
- One SICM3B - 8 relay
- One or three auxiliary CTs 5A/5 mA—mount near SICM2B
- Software for configuration of UIM
- **Optional:** If UIM is situated remote from SICMs: One EIA-485 to fibre optic converter with ST connectors for glass fibre
- **Optional:** 10baseT Ethernet card for connection to WAN/LAN.

It may be possible to configure non-standard systems to accommodate special requirements – please check with your supplier.

### ADDITIONAL EQUIPMENT REQUIRED

The following equipment is required for a standard system but is not included in the scope of supply (can):

- VT on load side with 110 V secondary
- Load side CTs, 1A, 2A or 5A secondaries
- 2 Pt100 RTDs for ambient & top oil temperatures
- Weather shield & bracket for ambient RTD
- 2 transducers (4-20 mA) for 2 Pt100 RTDs -40 °C to +120 °C to 4 to 20mA DC
- Tap position transducer (analog, binary or BCD)
- Fibre optic thermometers (optional)
- Condition monitoring instruments (optional) like DGA, H<sub>2</sub>O etc.
- DIN rails in weatherproof cubicle at transformer
- 19" rack (at transformer or indoor cubicle)
- Auxiliary power supply 24 V DC
- Auxiliary status contacts & control contactors on OLTC, fans & pumps
- Wiring and cabling

## USER INTERFACE MODULE

### GENERAL

Main and sub-menus and individual items are selected from the displayed menu using pushbuttons. Menu functions include:

- Display of measured and calculated data
- Change of settings (PIN protected)
- Manual control of coolers and tap-changer
- Dynamic rating information
- Alarms display and event record

Status LEDs indicate:

• Alarm	• Status
• Temperature	• Fans on
• Cooler fail	• Pumps on
• Voltage	• TC Raise
• TC fail	• TC Lower
• Ancillaries	• TCIP
• DRMCC	• Power on

### DIMENSIONS & MASS

19 inch rack mounting.  
W x D x H = 483 x 185 x 133 mm  
Mass = 3.3 kg

### FEATURES AND OPTIONS

#### DISPLAY

LCD Liquid Crystal Display 16 x 40 (standard)

#### OPERATING TEMPERATURE

-40 to + 80 °C. Note: the LCD is switched off in the range -40 to -20 °C and 70 to 80 °C

#### NUMBER OF PORTS

Up to 8 communication ports can be used, including 0 - 7 x EIA-232, 1 - 8 x EIA-485 and 0 or 1 x 10 Base T (10 Base FL with adapter), to be specified with inquiries and orders.

EIA-232 & EIA-485 cards include ST connector for glass fibre optics.

Front EIA-232 for communications to laptop for setup, configuration and data downloads.

#### POWER SUPPLY

24 VDC  $\pm$ 15% (converters available: 48 VDC, 125 VDC, 250 VDC, 85 - 265 Vrms 45 - 65 Hz)

## SICMS AND CONVERTER

### GENERAL

SICM2B and SICM3B are used for analog and digital input and output. They communicate with the UIM directly if nearby, or else via the EIA-485 to fibre optic converter mounted with the SICM power supply. All external electrical connections to the SICMs are via numbered screw terminal connections. The terminal blocks can be unplugged to speed replacement of the unit for maintenance. For mounting details, terminal numbers and standard connection diagrams refer to the supporting documentation.

### DIMENSIONS AND MASS

Weidmuller RS100 profile, 35 mm DIN rail mounting

- SICM2B: 350 x 110 mm 0.90 kg
- SICM3B: 375 x 110 mm 1.00 kg
- Converter: 124 x 110 mm 0.32 kg

### SICM POWER SUPPLY

24 VDC  $\pm$ 15% (converters available: 48 VDC, 125 VDC, 250 VDC, 85 - 265 Vrms 45 - 65 Hz)

### SICM RELAY OUTPUTS

- Contacts: Changeover (8-relay module)
- Relay output can be continuous or in the form of 2 Sec. pulse
- LED indication on each relay
- Contact rating 10 A at 250 V AC or 30 V DC
- Isolation to earth & between circuits 2 kV AC.

### SICM DIGITAL INPUTS

Quantity	16
Optical isolation	2,000 Vrms
Input voltage range for signal "1"	10 – 140V DC OR 30 – 140V AC
Input current	250 $\mu$ A to 4.25 mA
Indication	LED on each input
Filtering	Input filters to eliminate external noise and software debouncing.
Software debounce	Min 20 msec DC input
Protection	150 MOV across each input, reverse polarity protection

## SICM2B ANALOG INPUTS

Number of channels	7
VT Inputs 1 – 3	0 – 150 V rms
CT Inputs 4 - 6	0 – 10 mA rms
Analog Input 7	0 – 10 mA rms
Resolution	12 bit
Accuracy @ 20 °C -40 °C to +85 °C	$\pm 0.5\%$ of range $> \pm 1\%$ of range
Protection on inputs 1-3	150 V MOV
Protection on inputs 4-7	5 V MOV
Filtering	1100 Hz & EMC
Opto-isolation to earth	2 kV rms 60 Sec.
Isolation between inputs	None (common)
Input sampling rate	3000/Sec.
Output refresh interval	1.4 Sec. approx

### Internal analogs:

- SICM board temperature
- MW, MVAR, frequency (use inputs 1-6).  
Calculation methods depend on class:
  - 3-phase, VT star, earthed neutral
  - 3-phase, VT delta or V, B-phase earthed
  - Single Phase to Phase
  - Single Phase to Neutral

## SICM3B ANALOG INPUTS

Number of channels	8
Ranges, plug selectable	0 – 24 mA DC 0 – 10 V DC
Resolution	12 bit
Accuracy @ 20 °C -40 °C to +85 °C	$\pm 0.5\%$ of range $> \pm 1\%$ of range
Protection	12 Volt Transorb
Filtering	1100 Hz & EMC
Opto-isolation to earth	2 kV rms 60 Sec.
Output refresh interval	1.4 Sec. approx

### Internal analogs:

- SICM board temperature

## SICM3B ANALOG OUTPUTS

- Number of channels: 4 (no isolation between)
- Range: 4 to 20 mA DC into 400 $\Omega$  maximum
- Resolution: 12 bits
- Accuracy: 1%
- Updating: every second
- Isolation to earth: 2kV rms 60 Sec.

## EIA-485 COMMUNICATIONS

The EIA-485 interface on each SICM and Converter has 2 pair full duplex EIA-485 multi-drop capability with LED indicators – red for Rx, green for Tx. The EIA-485 lines have 120 ohm terminating resistors and transient suppressors. On the SICMs the terminating resistors are link-selectable (shall be in circuit if the SICM is at one end of the EIA-485 bus). The converter shall be at one end of the EIA-485 bus and has its terminating resistors permanently in circuit. It has ST glass fibre connectors standard.

The data rate is pre-selected. The protocol used is DNP 3.00 - Level 1 with report by exception subset.

## COMMON SPECIFICATIONS

The equipment is designed to comply with the following specifications. Some tests are pending.

### **TEMPERATURE**

- IEC 60068-2-1 Test Ad: Cold -40 °C
- IEC 60068-2-2 Test Bd Dry heat 16 hours at +80 °C
- IEC 60068-2-30 Damp heat 50 °C, 90% RH  
6 cycles of 12 + 12 hours

### **INSULATION**

- IEC 60255-5:
- 2 kV rms 60 Sec., 5 kV impulse to earth for power supply circuits rate > 75 V DC.
- 350V rms 60 Sec. to earth for power supply circuits rate < 75 V DC.

### **VIBRATIONS**

- IEC 60255-21-1 Endurance Class 1
- IEC 60255-21-1 Response Class 1

### **SHOCK AND BUMP**

- IEC 60255-21-2 Withstand Class 1
- IEC 60255-21-2 Response Class 1

### **SEISMIC**

- IEC 60255-21-3 Withstand Class 1
- IEC 60255-21-3 Response Class 1

### **ELECTRICAL DISTURBANCE**

- IEC 60255-22-1 / IEC 61000-4-4  
1 MHz burst Withstand Class 1
- IEC 60255-22-2 / IEC 61000-4-2  
Electrostatic discharge Level 4
- IEC 60255-22-3 / IEC 61000-4-3  
Radiated field immunity
- IEC 60255-22-4 / IEC 61000-4-4  
Fast transient

<sup>i</sup> Note: The names SICM and DRMCC are registered trademarks of Energex Limited and Dynamic Ratings Pty Ltd respectively.