



Dynamic Rating, Monitoring, Control and Communications

TECHNICAL SPECIFICATION

CONTENTS

1	INTRODUCTION.....	1
2	FUNCTIONALITY	2
2.1	DYNAMIC RATING.....	2
2.2	MONITORING	2
2.3	CONTROL	2
2.4	COMMUNICATIONS.....	2
3	SCOPE OF SUPPLY	2
3.1	EQUIPMENT INCLUDED	2
3.2	EQUIPMENT NOT INCLUDED .	2
4	USER INTERFACE MODULE	3
4.1	GENERAL.....	3
4.2	DIMENSIONS & MASS.....	3
4.3	FEATURES AND OPTIONS	3
5	SICMS AND CONVERTER	3
5.1	GENERAL.....	3
5.2	DIMENSIONS AND MASS	3
5.3	SICM POWER SUPPLY.....	3
5.4	SICM RELAY OUTPUTS.....	3
5.5	SICM DIGITAL INPUTS.....	3
5.6	SICM2 ANALOG INPUTS	4
5.7	SICM3 ANALOG INPUTS	4
5.8	SICM3 ANALOG OUTPUTS..	4
5.9	EIA-485 COMMUNICATIONS	4
6	COMMON SPECIFICATIONS	4
6.1	TEMPERATURE.....	4
6.2	INSULATION.....	4
6.3	VIBRATIONS	4
6.4	SHOCK AND BUMP	4
6.5	SEISMIC	4
6.6	ELECTRICAL DISTURBANCE.	4
7	DRMCC ORDER DATA.....	5



Dynamic Ratings Pty Ltd
P.O. Box 5, Glen Waverley
Melbourne Vic 3150 Australia
Telephone +61 3 9560 0665
Fax +61 3 9560 0599
e-mail drmcc@dynamicratings.com

PURPOSE AND SCOPE

This technical specification describes the main functions and specifies the components of DRMCC systems.

1 INTRODUCTION

The DRMCC¹ has the following main functions:

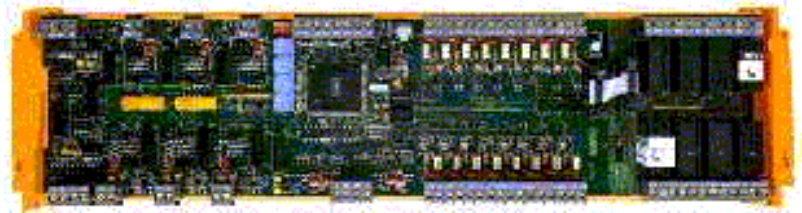
- Dynamic rating to optimise safe loading of a transformer
- Monitoring of field data for operating and diagnostic purposes
- Control of voltage and cooling with alarms and trips
- Communications between the various modules and external systems

The system includes:

- A UIM (user interface module) which includes a display screen, pushbuttons, status LEDs and provision for SCADA 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 SICMs¹ (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 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 3.2.

¹ Note: The names SICM and DRMCC are registered trade marks of Energen Limited and Dynamic Ratings Co Pty Ltd respectively.

2 FUNCTIONALITY

2.1 Dynamic Rating

Dynamic rating takes advantage of the fact that a transformer may be loaded beyond nameplate rating under certain circumstances without harm. 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 DRMCC calculates how long a given load can be carried, and what is the maximum load that can be carried for a given time, without 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 during initial customisation. The calculations use present values of ambient, oil and winding temperatures. If the present temperature is above the long time limit, calculations allow for the time since the limit was exceeded.

2.2 Monitoring

Raw data is gathered from sensors and probes connected to the SICM(s).

- The standard system monitors operating data such as transformer secondary voltage and current, watts and vars, tap position, ambient, top oil and winding hot-spot temperatures.
- As suitable condition monitoring instruments become available for data such as dissolved gas in oil, water in oil, etc, they will be programmed into the UIM and may then be selected as options.

Data calculated from the raw data may include:

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

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 optionally remotely.

Alarms and trips for abnormal “Yellow or Red” conditions may be set, displayed and acknowledged. An event record shows the data and time when the status of each alarm changed.

2.3 Control

- Manual and automatic control of coolers (fans and pumps), with optional VS drives, including *Smart* control which acts on predicted need.

- OLTC control: Manual & Auto. AVC with definite and inverse time delay modes and optional load drop compensation (LDC). Parallel control using reverse reactance method. (Master-follower and circulating current modes under development.)
- Settings are provided for control modes, operating set points, alarm set points, time delays

2.4 Communications

A combination of EIA-232, EIA-485 and fibre optic ports are provided in the UIM - refer Section 4.3.5. Applications include:

- Communication between UIM and SICMs using a subset of DNP 3.0 protocol
- Communications between UIMs (in development)
- Communication with SCADA RTU using Modbus RTU or Modbus ASCII protocols, max 19,200 bps
- Changing settings and downloading data from PC directly or via modem

3 SCOPE OF SUPPLY

3.1 Equipment included

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

- One User Interface Module -
Model: UIM - T1 - LCD-GF-4P-DC150
- One SICM2 3-phase (Class 11) - 4 relay
- One SICM3 - 8 relay
- One fibre optic converter with ST connectors for glass fibre and 110 V DC power supply
- Three auxiliary CTs 5 A / 5 mA
- Software for customisation of UIM

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

3.2 Equipment not included

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

- 3-phase VT on load side with 110 V secondary
- 3 load side CTs, 1A, 2.5A or 5A secondaries
- 2 Pt100 RTDs for ambient & top oil temperatures
- 2 Pt100 RTD / 4-20 mA transducers
- Tap position transducer
- Fibre optic thermometers (optional)
- Condition monitoring instruments (optional)
- DIN rails in weatherproof cubicle at transformer
- 19” rack (at transformer or indoor cubicle)
- Auxiliary power supply
- Auxiliary status contacts & control contactors on OLTC, fans & pumps
- Wiring and cabling

4 USER INTERFACE MODULE

4.1 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:

- Temperature alarm
- Voltage high / low alarm
- Cooler fail alarm
- Voltage control failure
- Fans On
- Tap change pending
- Pump On
- Tap change in progress
- Transformer alarm
- Power on
- DRMCC alarm
- DRMCC healthy

4.2 Dimensions & Mass

19 inch rack mounting.

W x D x H = 483 x 280 x 133 mm 3.0 kg

4.3 Features and Options

4.3.1 Option Code

The code denotes the options selected.

Example: UIM - T1 - LCD-GF-4P-DC150

4.3.2 Display option

- LCD Liquid Crystal Display 16 x 40 (standard)
- VFD Vacuum Fluorescent Display 4 x 20 (future)

4.3.3 Optic Fibre Comms

- GF: ST Glass fibre connectors (standard)
- PF: HP Versatile Plastic fibre connectors (future)

4.3.4 Operating temperature

- -20 to + 70 °C if LCD or PF (standard)
- -40 to + 80 °C if VFD and GF (future)

4.3.5 Number of Ports

- 4P: 2 x EIA-485, 2 x EIA-232, 4 x optic fibre (std)
- 8P: 4 x EIA-485, 4 x EIA-232, 8 x optic fibre

4.3.6 Power Supply

Code	Nominal	Minimum	Maximum	Input ♦
DC24	24 V DC	18 V DC	36 V DC	12 W
DC48	48 V DC	36 V DC	75 V DC	12 W
DC150	120 V DC (std)	100 V DC	200 V DC	15 W
DC300	240 V DC	200 V DC	400 V DC	15 W
AC	115 / 230 V AC 1ϕ 47 - 63 Hz	85 V AC	265 V AC	15 VA

♦ Plus 1.25x external load on 24 V DC output (max 10 W)

5 SICMS AND CONVERTER

5.1 General

(Based on Energex specifications Rev B 7-Aug-00)
SICM2 and SICM3 are used for analog and digital input and output. They communicate with the UIM directly if nearby, 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.

5.2 Dimensions and Mass

Weidmuller RS100 profile, 35 mm DIN rail mounting

- SICM2 + 4 relays: 235 x 110 mm 0.82 kg
- SICM2 + 8 relays: 300 x 110 mm 0.90 kg
- SICM3 + 4 relays: 310 x 110 mm 0.94 kg
- SICM3 + 8 relays: 375 x 110 mm 1.00 kg
- Converter & p/s: 124 x 110 mm 0.32 kg

5.3 SICM Power Supply

SICMs requires a stable DC supply. They shall be powered from the switch mode 10-watt **SICM Power Supply** provided. No other load shall be supplied from it. Note that the power supply output is not isolated from the EIA-485 communication circuit. Maximum input 12.5 W, output 10W total (converter and SICMs). There are two input voltage options:

- 55 V DC to 150 V DC, or 110 V AC 50 or 60 Hz, 2,000 V isolation from input to output (standard)
- 17 V DC to 75 V DC, 1,000 V isolation from input to output

5.4 SICM Relay Outputs

- Option: quantity per SICM: 4 or 8
- Contacts: Normally-open (4-relay module)
- Contacts: Changeover (8-relay module)
- LED indication on each relay
- Contact rating 6 A at 240 V AC or 30 V DC
- Isolation to earth & between circuits 2 kV AC

5.5 SICM Digital Inputs

Quantity	16
Optical isolation	2,000 Vrms 60s to earth and between inputs
Input voltage range	10 V DC / 30 V AC to 140 V AC or DC
Input current	600 µA to 4.25 mA
Indication	LED on each input
Filtering	Input filters to eliminate external noise
Software de-bounce	Min 20 msec DC input
Protection	150 MOV across each input, reverse polarity protection

5.6 SICM2 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
Offset & gain errors	± 3 LSB each
Accuracy	$\pm 0.5\%$ 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 s
Isolation between inputs	None (common)
Sampling interval	1.4 sec approx

Internal analogs:

- SICM board temperature
- MW, MVAR, MVA, frequency (use inputs 1-6). Calculation methods depend on class:
 - Class 11 - 3-phase, VT star, earthed neutral
 - Class 13 - 3-phase, VT delta, B-phase earthed
 - Class 15 - 1-phase, Vac, Ia, Ic
 - Class 25 - 1-phase, Vab, Ic
 - Class 26 - 1-phase, Van, Ia

5.7 SICM3 Analog Inputs

Number of channels	6
Ranges, plug selectable	0 – 24 mA DC 0 – 10 V DC
Resolution	12 bit
Offset & gain errors	± 3 LSB each
Accuracy	$\pm 0.5\%$ of range
Protection	suitable MOV
Filtering 1100 Hz & EMC	✓
Opto-isolation to earth and between inputs	2 kV rms 60 s
Sampling interval	1.4 sec approx

Internal analogs:

- SICM board temperature

5.8 SICM3 Analog Outputs

- Number of channels: 2 (no isolation between)
- Range: 0 to 20 mA DC into 1 k Ω maximum
- Resolution: 12 bits
- Updating: Every 1.4 seconds

5.9 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 potentially has two options for type of optic fibre:

- ST glass fibre connectors (standard)
- HP Versatile Link plastic fibre connectors (future)

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

6 COMMON SPECIFICATIONS

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

6.1 Temperature

- IEC 60068-2-1 Test Ad: Cold -40 °C (-20 °C for LCD / PF)
- IEC 60068-2-2 Test Bd Dry heat 16 hours at +80 °C (+70° LCD / PF)
- IEC 60068-2-30 Damp heat 50 °C, 90% RH 6 cycles of 12 + 12 hours

6.2 Insulation

- IEC 60255-5: 2 kV AC, 5 kV impulse except for power supply circuits rated up to 75 V DC.

6.3 Vibrations

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

6.4 Shock And Bump

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

6.5 Seismic

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

6.6 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



7 DRMCC ORDER DATA		DR Ref		
Choose one option in each category. Choosing standard options marked* may reduce price and delivery lead times.		Customer / site		
		Customer ref		
Number of DRMCC systems required (one per transformer to be monitored & controlled)				
User Interface Module UIM-T1 options		SICM Power Supply & Optic Fibre Converter		
DR Item Number	Option Code	DR Item Number	Input Voltage	
134-0144 N10	LCD-GF-4P-DC24 <input type="checkbox"/>	134-0145 N10	55-150 V DC or 110 V AC * <input type="checkbox"/>	
134-0152 N10	LCD-GF-4P-DC48 <input type="checkbox"/>	134-0146 N10	18 - 75 V DC <input type="checkbox"/>	
134-0153 N10	LCD-GF-4P-DC150 * <input type="checkbox"/>	SICM2 : V, A, W, VAR, Tap#, OLTC		
134-0154 N10	LCD-GF-4P-DC300 <input type="checkbox"/>	DR Item Number	Options	
134-0155 N10	LCD-GF-4P-AC <input type="checkbox"/>	134-0127 N10	4 relays - class 11 (3 phase yn) * <input type="checkbox"/>	
134-0156 N10	LCD-GF-8P-DC24 <input type="checkbox"/>	134-0128 N10	8 relays - class 11 (3 phase yn) <input type="checkbox"/>	
134-0157 N10	LCD-GF-8P-DC48 <input type="checkbox"/>		<input type="checkbox"/>	
134-0158 N10	LCD-GF-8P-DC150 <input type="checkbox"/>	SICM3 : θ °C, Condition Monitoring, Cooling		
134-0159 N10	LCD-GF-8P-DC300 <input type="checkbox"/>	DR Item Number	Options	
134-0160 N10	LCD-GF-8P-AC <input type="checkbox"/>	134-0139 N10	4 relays <input type="checkbox"/>	
	LCD-GF- <input type="checkbox"/>	134-0140 N10	8 relays * <input type="checkbox"/>	
134-0151 N10	Interposing CT <input type="checkbox"/>		<input type="checkbox"/>	
◆ SICM2 16 Digital inputs:		◆ SICM3 16 Digital inputs:		
#1 OLTC on Remote	#9 <i>Reserved</i>	#1 Fans in service	#9	
#2 TC in progress	#10 <i>Reserved</i>	#2 Fans in manual test	#10	
#3 OLTC motor trip	#11 TPI bit 0	#3 Fans On (contactor)	#11	
#4 Aux power fail	#12 TPI bit 1	#4 Any fan CB trip	#12	
#5	#13 TPI bit 2	#5 Pump in service	#13 Oil flow low	
#6	#14 TPI bit 3	#6 Pump in manual test	#14	
#7	#15 TPI bit 4	#7 Pump On (contactor)	#15	
#8	#16 TPI bit 5	#8 Pump CB trip	#16	
◆ SICM2 relay outputs		◆ SICM3 relay outputs		
#1 Raise tap	#5	#1 Switch fans on N/O	#5 Temperature alarm	
#2 Lower tap	#6	#2 Switch fans off N/C	#6 Temperature trip	
#3 Voltage alarm	#7	#3 Switch pumps on N/O	#7 Cooling fail alarm	
#4 OLTC fail alarm	#8	#4 Sw pumps off N/C	#8 General Alarm	
SICM2 Analog inputs # 1 - 6: 3 x AC volts, 3 x AC amps		♣ SICM3 6 Analog inputs (0 – 10 V DC or 0 – 24 mA DC):		
♣ SICM2 Analog input #7: TPI (0 - 10 mA DC)		#1 ♣ Not available	#5 Cooler top oil temp	
UIM Port Allocation: 4P = #0, 2, 5, 7 8P add #1, #3, #4, #6		#2 ♣ Not available	#6 Cooler bot oil temp	
#0 DNP - SICMs, #2	, #5	, #7 PC	#7 Ambient temperature	
#1	, #3	, #4	, #6	#8 Top oil temperature

- ◆ Standard I/O allocation as shown. Write in special requirements for digital inputs (for alarms).
Digital (relay) outputs and SICM3 analog inputs & outputs may be selected from a list of those available or customised on special request.
- ♣ SICM3: Present model has 6 analog inputs. Future upgrade will be 8 analog inputs.
- ♣ SICM2 - Analog input #7 - TPI (0 - 10 mA DC) is standard. Alternately: Circulating current 5 mA AC (future - needs digital TPI)

Issued by:

Date:

Remarks: