

# PM-DMCCM

## Detective Multimeter with Communication

### 1. INTRODUCTION

Company production requirements of today are being fulfilled by the use of existing machineries and equipments while on the other side an intensive effort to reduce production and operation costs is vitally necessary. Some of the most common and cost effective expenditures are those being resulted with the consequences of “unplanned organizations and operations” and there of the maintenances. Only way to minimize such costs and expenses or to prevent them happening is mainly based on detecting mechanical and electrical failures at their very early stages.

PM-DMCCM is a micro-process controller monitoring and measuring frequency of line, current and voltage values of three phase systems.

State of the art micro-processing technology built in Detective Multimeter (PM-DMCCM) is designed to sense, detect and inform impending mechanical and electrical failures in 3 phase motors and motor run - operating systems at the early stages of fault occurrence while its panel multimeter function enables 3 phase current readings, phase to phase voltage and frequency readings.

3 phase currents and voltages are the only measurements used by the technology within the framework of “Model Based Fault Detection Logic”. Thanking to power of Detective Multimeter Technology with the capability of fault detection at early stage which provides an excellently reliable system monitoring advantages, a remarkable productivity of quality production, minimized maintenance and repair costs and extended life of machinery and equipment in use.

Here are some of the electrical and mechanical breakdowns / faults that PM-DMCCM can determine / detect.

- a- Ball Bearing Problems
- b- Misalignment Errors
- c- Unbalanced Load
- d- Rotor and Stator faults
- e- Unbalanced Power
- f- Pump, Compressor, Gear Box, Fan Problems

The measured max./min. current values are saved in memory and can be displayed upon request. Moreover, PM-DMCCM has features of adjustable over/under current and voltage protection limits with adjustable time delay settings prior to producing contact output for alert.

### 2. OPERATIONAL SET UP AND ADJUSTMENTS

Connection must be performed due to wiring diagram (pls. see figure 1). After having the connection of and energizing the device completed, PM-DMCCM learning process onto some certain characteristics/data of the system in where used is proceeded. For this reason, once the device energized, the measured values are displayed via on LEDs while on the other side, the required datas and informations about the system are received. PM-DMCCM determines the status of learning by checking whether the received and then the saved data on system would be enough or not before proceeding into a very next step at each time of energizing. User can monitor the status of device thr the 7<sup>th</sup> menu (pls. see 8). A current reading should be displayed first once the device energized. The CT ratio and the required settings should be correctly entered in order to obtain a reliable reading.

L, L2, L3 indicate 3 phase connection; N corresponds to neutral. Outer terminals of the main CT should be connected into k1-11, k2-12 and k2-13.

## ***2.1. SETTING CURRENT TRANSFORMER RATIO***

Press SET button, “CTR” and “ENTER” will be displayed on the lower side of display consequently. Press “ENTER” button again. The lowest display will show current CTR value (default is 5). Pressing “UP” or “DOWN” buttons enable user to adjust the desired CTR value. Once “ENTER” button is pressed again the adjusted value will be saved in non-volatile memory.

Press “UP” button until “ESC” appears on the lowest display. Press “ENTER” button again. After a short time device will start displaying current, voltage and frequency values on display.

## ***2.2. SETTING OVER VOLTAGE PROTECTION LEVEL***

Press “ENTER” button. Press “UP” button until “UuL” and “SET” appears on display. Pressing “ENTER” button again will indicate “Over Voltage Limit” on the lowest display adjust the desired value and press “ENTER” button to save. Press “UP” button until “ESC” appears on lowest display. Press “ENTER” button to Escape. After a short time device will start displaying current, voltage and frequency values on display.

## ***2.3. SETTING UNDER VOLTAGE PROTECTION LEVEL***

Press “ENTER” button. Press “UP” button until “UdL” and “ENTER” appears on display. Pressing “ENTER” button again will indicate “Under Voltage Limit” on the lowest display adjust the desired value and press “ENTER” button to save. Press “UP” button until “ESC” appears on lowest display. Press “ENTER” button to Escape. After a short time device will start displaying current, voltage and frequency values on display.

## ***2.4. SETTING OVER CURRENT PROTECTION LEVEL***

Press “ENTER” button. Press “UP” button until “IuL” and “SET” appears on display. Press “ENTER” button again the lowest display will show “Over Current Limit” adjust the desire value and then press “ENTER” button to save. Press “UP” button until “ESC” appears on lowest display. Press “ENTER” button to Escape. After a short time device will start displaying current, voltage and frequency values on display.

## ***2.5. SETTING UNDER CURRENT PROTECTION LEVEL***

Press “ENTER” button. Keep pressed until “IdL” and “SET” texts are displayed. Under Current Protection values can be seen on the bottom LED once “ENTER” pressed. Set the protection value of request and save it by pressing “ENTER”. Press “UP” button until “ESC” appears on lowest display. Press “ENTER” button to Escape.

## ***2.6. SETTING TIME DELAY***

Press “ENTER” button. Press “UP” button until “dEt” and “SET” appears on display. By pressing “ENTER” button again the lowest display will show the delay time of contact output for both current and voltage. Adjust the desired value and press “ENTER” button again. Adjusted value will be stored into memory. Press “UP” button until “ESC” appears on lowest display. Press “ENTER” button to escape. After a short time device will start displaying current, voltage and frequency values on display. Delay time will be activated prior to switching the relay on but in time of current/voltage failure occurrence.

## ***2.7. RESET / UPDATE OPERATION MODE***

Press “ENTER” button. Keep “UP” button pressed until “ISP” and “UPP” and “SET” texts are displayed. After having “ENTER” button pressed again, “k” LED on the left corner of “RESET” command is turned on by indicating that the device is in “RESET” mode. With the use of “UP” button, update operation can

be performed within active “UPA” or passive “Rsp” position. Hence, the device can be reseted. Pressing “ENTER” button one more time “RESET” can be activated or passivated while the LED “k” is turned on at a second time of which shall indicate that the device is in update mode. With the use of update button, update operation can be performed within active “uPA” or passive “uPP” position. Hence the device can be reseted respectively. Make sure that the device should be at “St4” position in order to activate an update operation. Once the activated commands are processed, all will shift into passive position accordingly. After the completion of the required adjustments, hold “UP” button pressed until the “ESC” text is displayed on the lower LED. Pressing “ENTER” should revert the program back to the menu on where the last measurement executed.

Reset command; shall be used for a radical or substantial change on the operating system of the network. Using “RESET” button will clear / delete all the formerly saved informations and then, will shift into learning mode in such a way to start learning and saving from the very beginning.(from “st1” to “st4”).

Update Command; is a short time based learning mode and shall be used for to let the system or network changes be introduced into the device. Once “UPDATE” command activated, data changes pertained on the system shall be sensed and gathered at “st5” mode and then the device will revert back to “st4” mode to proceed the operation.

## **2.8. PROGRAMING RELAY OUTPUT**

Press “ENTER” button. Keep “UP” button pressed until “rLy” on the top display and “SET” on the bottom display are displayed. After having “ENTER” button pressed again, “k” LED on the left corner of top display is turned on by indicating that the device is in relay output programming mode. By using UP and DOWN button, relay output can be assigned desired options explained below. These options can be activated or deactivated separately.

When “Cur” text is displayed on the middle display, push the ENTER button. “PAS” or “Act” text will be shown on the middle display. If “PAS” option is selected, relay output will never be affected from any condition which is related with currents. If “Act” option is selected, the relay output will be affected from failure condition which is related with currents. After selecting necessary option, user must push ENTER button to accept changes. This option is related with only current failure condition. If one of the over current protection or under current protection failures or both of them are occurred, relay will be energized and relay will change contact position.

When “UoI” text is displayed on the middle display, push the ENTER button. “PAS” or “Act” text will be shown on the middle display. If “PAS” option is selected, relay output will never be affected from any condition which is related with voltages. If “Act” option is selected, the relay output will be affected from failure condition which is related with voltages. After selecting necessary option, user must push ENTER button to accept changes. This option is related with only voltage failure condition. If one of the over voltage protection or under voltage protection failures or both of them are occurred, relay will be energized and relay will change contact position.

“dEd” Relay output will be activated for system warnings of Detective Multimeter. If this option is chosen by SET button, user must select which warning of Detective Multimeter will activate relay output. After selecting necessary warning option, “PAS” or “Act” text will be shown on the middle display for the selected option. “PAS” means that relay output will never be activated for any condition which is related with selected option. “Act” option means that the relay output will be affected any condition which is related with selected option. These warnings are explained below.

“Lod” If the system has overload or WATCH LOAD warning, the devices will activate relay output.

“Lin” If the system has an electrical failure or WATCH LINE warning, the devices will activate relay output.

“En1” If the system has a failure beginning or device gives PERFORM MAINTENANCE warning, the devices will activate relay output.

“En2” If the system has a improved failure or device gives STOP warning, the devices will activate relay output.

After the completion of the required adjustments, press “UP” or “DOWN” button until the “ESC” text is displayed on the middle display. Pressing “ENTER” button, device will turn back to main setting menu, press “UP” or “DOWN” button until the “ESC” text is displayed on the lowest display. Press “ENTER” button, device will turn back to main program menu on where the last measurement executed.

## **2.9. SETTING COMMUNICATION**

Press “ENTER” button. Keep “UP” button pressed until “rS-” and “485” texts are displayed on the screen in a sequence. After having “ENTER” button pressed again, “brt” (Baud Rate) and preset value for baud rate will be displayed on screen in a sequence. To change this value press “ENTER” button and change value of the baud rate by using UP and DOWN button. To save set value, press “ENTER” button again.

To set parity, puss the “UP” button once. “Prt” (Parity) and preset value for parity will be displayed on screen in a sequence. To change this value press “ENTER” button and change value of the baud rate by using UP and DOWN button. To save set value, press “ENTER” button again.

To set ID number of the device, puss the “UP” button once when the “Prt” (Parity) text is displayed on the screen and “Id” text (ID number) and preset value for ID number will be displayed on screen in a sequence. To change this value press “ENTER” button and change value of the ID number by using UP and DOWN button. To save set value, press “ENTER” button again.

To turn back to main screen of the device, press “UP” or “DOWN” button until the “ESC” text is displayed on the display. Press “ENTER” button, device will turn back to main program menu on where the last measurement executed.

## **3. DISPLAY OF CURRENT READING**

Current values of 3 phase are displayed simultaneously with an amp rating up to 10000 A. If current readings of phases exceed 1000A a point after number is companied as of “x1000” of which shall be symbolized by the LED “k” is on. A direct connection of up to 5A can be performed while a CT shall be needed above 5 Amp. “I(A)” on the front top indicates this reading.

## **4. PHASE – NEUTRAL VOLTAGE READING**

Pressing “UP” button in time of displaying current reading, phase–neutral voltage readings of phases are displayed simultaneously within the range of 0 -280 V “V L-N (V)” indicates this reading.

## **5. PHASE –PHASE VOLTAGE READING**

Pressing “UP” button in time of displaying phase neutral voltage reading phase–phase voltage reading are displayed simultaneously within the range of 0-450 V “V L-L (V)” indicates this reading.

## 6. FREQUENCY READING

Pressing “UP” button in time of phase-phase voltage reading the frequency of phase being connected into terminal “R” is displayed within the range of 45-70 Hz. “FRQ (Hz)” indicates this reading.

## 7. DEVICE STATUS INDICATION

It is a menu giving information about the operational status of device. Each stage of the below given demonstrates system / network informations and their updates.

- a-** “st1” Control Mode (Check Mode): Used for the verification of terminal connections and application correctness at an initial period of operation or in following to “RESET” application.
- b-** “st2” (Learning Mode) : Used for collection of data (informations) for the system recognition by learning. This application is a composition of ever repeated number of signal measuring operations and their cyclic analysis. After the completion of this stage, a data base containing typical characteristic of system in use is formed by the consequences of analytical process.
- c-** “st3” (Improvement) : After “Learning Stage” completed. Device shall automatically start trying to improve the system relevant to modeling. All informations and data are processed so as to be used for making decision on system. The main difference in between this operation and learning mode is that of the system status evaluation within the mode of improvement.
- d-** “st4” (Monitoring) : After “improving stage” completed, monitoring mode is auto shifted. As it would already known, informations and data were received, processed and the parameters to be required were determined. At monitoring stage, system should be monitored and input data be tested via the receipt of current and voltage signals.
- e-** “st5”(Update) : While the changes on system are on stage of re-introduction, update mode is activated. Update activation is recommended in every after maintenance for better performance. At the end of update stage. Monitoring will be followed in “st4” mode.

## 8. CONTACT POSITION ACCORDING TO THE FAILURE

Protection relay (NC1, C1, NO1) will be non-energized if provided that the current and voltage values of all phase are in between adjusted protection limit and no dedective warning at a time of initial energizing.

For Dedective Proterty : If one of the early warning condition occurs, relay output will change contact position.

For Voltage Protection : Voltage protection relay will be energized and its relay contact will change the position at the end of the adjusted time delay if one of the measured value of voltage go over or under the voltage protection limit.

For Current Protection : Current protection relay will be energized and its relay contact will change the position at the end of the adjusted delay time if one of the measured values of current goes over or under the current protection limit.

Current and voltage protection relays are independently switched on/off. As shown on figure 1, NC1, C1, NO1 indicate relay contacts aimed for the display of current/ voltage failures. If alarm LED is lightening continuously, it means that there is a current or voltage failure conditions. If alarm LED is making blink, it means that Detective Multimeter can not take data from the system or system is stopped.

## 9. ERROR INDICATION

Faults indication with the LEDs built on the front right corner are displayed under a real time-clock precision. LEDs statuses are here below explained as.

- a-** “NORMAL” LED “ON” indicates system works O.K and matches data as per the referred model.
- b-** “WATCH LINE” LED “ON” indicates a difference in between data being obtained and the referred model. Hence a variation probability on the system network line in use may be possible and this may be not introduced to the device.
- c-** “WATCH LOAD” LED “ON” indicates a substantial difference in between data being obtained and the referred model. Hence a variation probability on the system load in use may be considered and this may be not introduced to the device.
- d-** “PERFORM MAINTENANCE” LED “ON” indicates a serious difference in between data being obtained and the referred model due to development of a fault on the running system. A technician must be called to perform maintenance.
- e-** “STOP” LED “ON” indicates a severe difference in between the datas being obtained and the referred model due to development of a serious error occurrence. System should have to be stopped.
- g-** None of any LED “ON” indicates no sufficient data’s been received. In case of continuity of problem, getting in contact with the manufacturer is essential.

### Detective Multimeter Communication Protocol

PM-DMCMC with Communication port needs two items;

1. Two pieces RS485 communication port which are not synchronous.
2. Modbus Protocol - RTU (Remote Terminal Unit) Mode.

Byte format in RTU Mode is described below.

**Coding System:** 8 bit binary, Hexadecimal 0-9, A-F is hexadecimal character which is in place of every 8 bits of message.

**Bits in every bytes:** 1 starting bit, 8 data bit (least significant bit is send as most priority), 1 finishing bit are sent.

**Error Control :** Cyclical Redundancy Check (CRC)

Device has two serial transmission speed which are not synchronous. (9600 bps)

Every messages are transmitted according to the format which is explained below.

<b>Device Address</b>	<b>Function Code</b>	<b>Data</b>	<b>CRC</b>
1 Byte	1 Byte	n Byte	2 Byte

Acceptable device addresses are in a range 1 - 255.

Broadcast messaging is not supported.

The Format of float variable must be according to the IEEE 754 standard.

The total data length of the message which includes Device address, CRC must be smaller that 64 bytes.

Supported ModBus Function:

**03 (0x03)** Reading Function for Internal Register

**06 (0x06)** Writing Function for Single Register

## MODBUS REGISTER TABLE

Register Address	Register Explanation	Data Format	Access Type (O:Read, Y:Write)	Detailed Explanation
0-47	Reserved	-	-	Not used
48	VLN1	Float	O	First Line Phase Voltage
52	VLN2	Float	O	Second Line Phase Voltage
56	VLN3	Float	O	Third Line Phase Voltage
60	VLL1	Float	O	Phase to phase voltage for First and Second Line
64	VLL2	Float	O	Phase to phase voltage for Second and Third Line
68	VLL3	Float	O	Phase to phase voltage for First and Third Line
72	I1	Float	O	First Line Phase Current
76	I2	Float	O	Second Line Phase Current
80	I3	Float	O	Third Line Phase Current
84	Frequency	Unsigned Long	O	Frequency
86	Ctr	Unsigned Long	O/Y	Current Transformer Ratio (1/9500)
88	VuL	Unsigned Long	O/Y	Over Voltage Level (Max 500V)
90	VdL	Unsigned Long	O/Y	Under Voltage Level
92	IuL	Unsigned Long	O/Y	Over Current Level (Max 9500A)
94	IdL	Unsigned Long	O/Y	Under Current Level
96	det	Unsigned Long	O/Y	Relay Delay (0-60sec.)
98	rS	Unsigned Long	O/Y	<b>Situation of MCM Reset Command</b> 0=Reset Command is Passive 1=Reset Command is Active
100	uP	Unsigned Long	O/Y	<b>Situation of MCM Update Command</b> 0=Update Command is Passive 1=Update Command is Active
102	urS	Unsigned Long	O	Version of software
104	Status1	Unsigned Long	O	<b>Binary Value Map:00000000ttttxxbx</b> <b>Parameter index tttt:</b> 1000:Type1 Con (Connection Error) 0100:Type2 ApL (Application Error) 0010:Type3 hrd (Hardware Error) 0001:Type4 EnC (EMC Error) <b>Parameter index x:</b> Not important <b>Parameter index b:</b> MCM Busy (Busy)
106	Status2	Unsigned Long	O	<b>Binary Value Map:00000000sss0mmm</b> <b>Parameter index sss:</b> 000:No Data 001:Motor OK 010:Line Change 011:Load Change 100:Examine 1 101:Examine 2 <b>Parameter index mmm:</b> 001:Check Mode 010:Learn Mode

				011:Improve Mode 100:Monitor Mode 101:Update Mode
108	Relay Cur	Unsigned Long	O/Y	Relay Alarm For Current 0=Current Alarm Passive 1=Current Alarm Active
110	Relay VoL	Unsigned Long	O/Y	Relay Alarm For Voltage 0=Voltage Alarm Passive 1=Voltage Alarm Active
112	Relay Lin	Unsigned Long	O/Y	Relay Alarm For Line Change 0=Line Change Alarm Passive 1=Line Change Alarm Active
114	Relay Lod	Unsigned Long	O/Y	Relay Alarm For Load Change 0=Load Change Alarm Passive 1=Load Change Alarm Active
116	Relay En1	Unsigned Long	O/Y	Relay Alarm For Examine1 0=Examine1 Alarm Passive 1=Examine1 Alarm Active
118	Relay En2	Unsigned Long	O/Y	Relay Alarm For Examine2 0=Examine2 Alarm Passive 1=Examine2 Alarm Active
120	Relay Condition	Unsigned Long	O	Relay Position 0=Relay is Energized 1=Relay is not Energized
122	Id.	Unsigned Long	O	Device Address
124	brt	Unsigned Long	O	Baud Rate Speed
126	Prt	Unsigned Long	O	Parity Bit 0=There is Parity Bit 1=There is no Parity Bit
128	Relay Switch	Unsigned Long	Y	Relay Command 0=Relay is switched on 1=Relay is switched off

# Digital Condition Monitor/True RMS Multimeter (With CT)

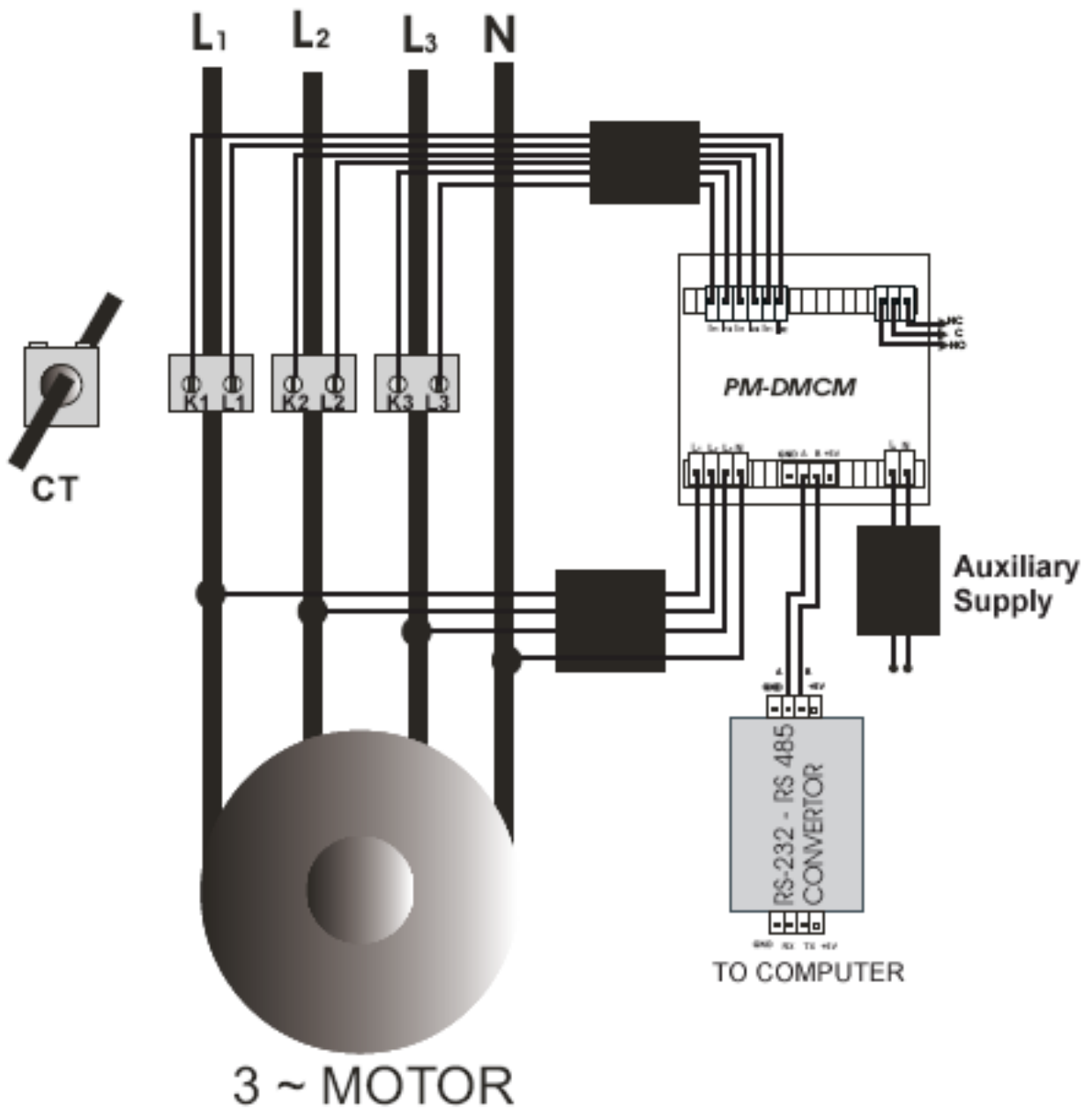
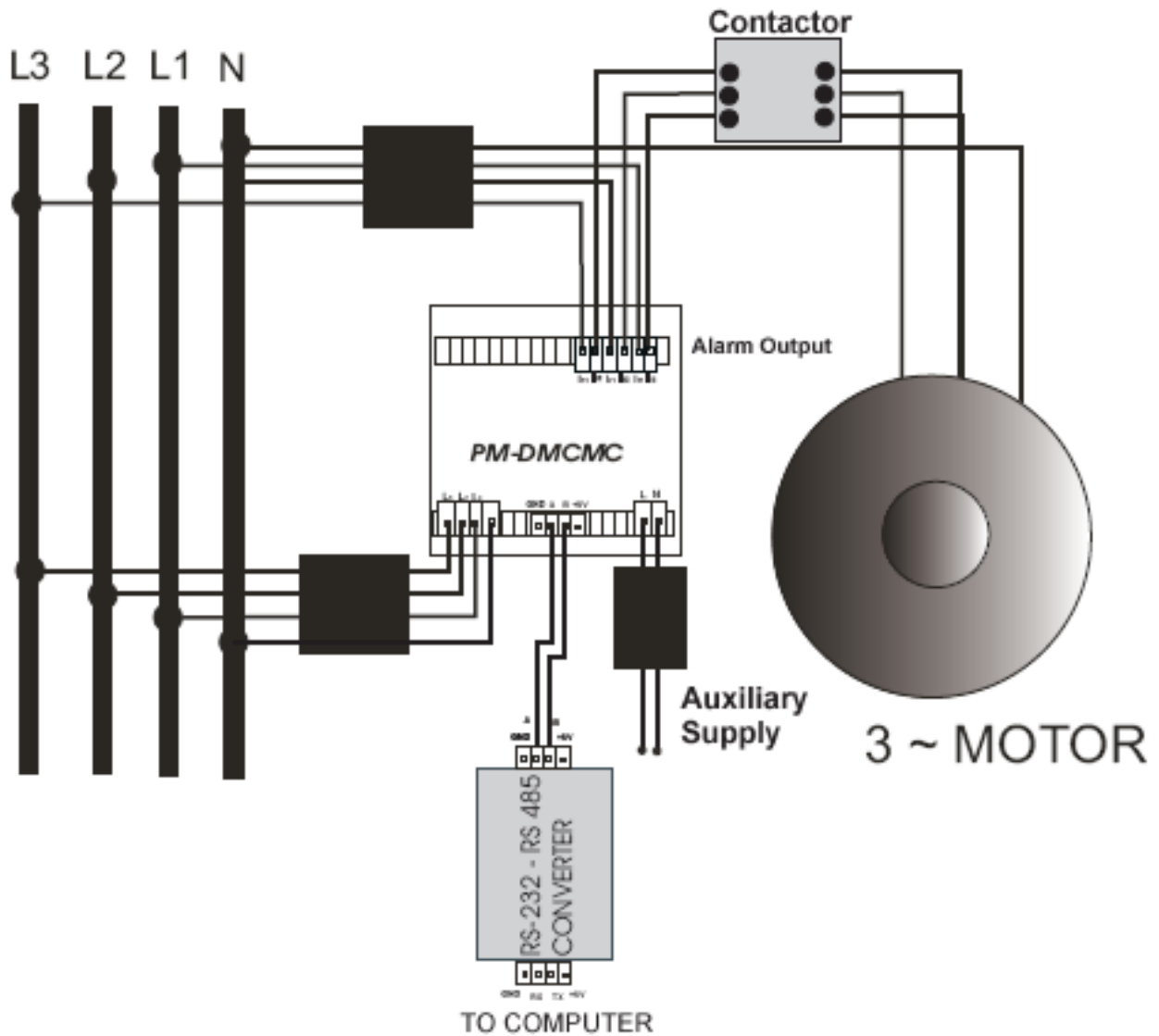


Figure1: Connection Diagram with CT

## Digital Condition Monitor/True RMS Multimeter (With CT)



This connection is valid up to 5A.

Figure 2 : Connection Diagram without CT