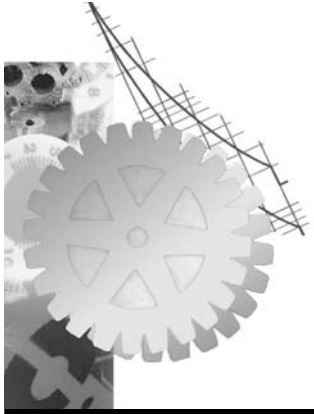


NEW ELEC
MOTOR PROTECTION & CONTROL TECHNOLOGY

MA LV Motor Protection and Control Relay

INSTALLATION AND SETTING UP PROCEDURE

1. Protection Features

- Overload protection for both cyclic and sustained overload conditions
- Locked rotor
- Running stall (jam protection)
- Overheating (thermistor inputs)
- Unbalance and phase loss
- Underload
- Overvoltage
- Undervoltage
- Phase rotation
- Earth leakage
- Short circuit
- Frozen contactor detection

2. Description of Operation

The MA range of motor protection and control relays with built-in real time clock have been designed to benefit the user by allowing the maximum flexibility in terms of protection features, offering a choice of communications protocol and enhanced input/output control functions. The relay is ideal for both stand-alone applications or for integrating into a BUS / SCADA system. For the budget conscious customer the communications module may be added at a later stage. Since the relay is designed for chassis mounting, two separate door-mounted devices may be considered for inclusion into the MCC design.

The current transformers are an integral part of the MA relay range and permit direct connection of the three main line conductors to be connected from the main contactor through the current transformer apertures (single-turn feed-through) for up to 21mm diameter conductors (250 Amp) without breaking the main circuit to the motor. An added advantage is that the core balance current transformer needed for earth leakage protection is included within the same housing. When protecting motors with full load currents in excess of 250 Amp, it is necessary to use interposing current transformers having a 5 Amp secondary output. The secondary of these current transformers will then be wired through the current transformer module block on a MA 5 relay. Input terminals 50 and 51 are provided on the relay for connection to an external core balance current transformer when interposing current transformers are used. In the latter case, a shorting link between terminals 52 and 51 would be removed. Terminal pairs 54,55; 56,57 and 58,59 provide input connections for three RTD (thermistor input). Note that more than 1 thermistor may be connected in series with each individual RTD input. In order for the protection relay to provide protection against overvoltage, undervoltage and phase rotation protection each main line phase voltage needs to be connected to terminals 60,61 and 62 in the phase sequence red, white and blue.

It is recommended that a 2 Amp fuse be fitted in line with each phase input to provide additional protection to the relay. An auxiliary power supply needs to be connected to the relay which is achieved through terminals 11 and 12 for a 110 Volt a.c supply or terminals 10 and 12 for a 220 Volt a.c supply. In order to assign functions to the 5 digital inputs which are available on the relay, it is necessary to connect terminals 20 and 21 to the field supply voltage of your choice in the range 24 to 220 Volt a.c OR d.c. Terminals 25 to 29 inclusive, make provision for connections to the digital inputs, while terminals 22, 23 and 24 are common and facilitate the closure of the field voltage circuit which is to be monitored by the relay. Terminals 30 to 41 inclusive, relate to four potential free changeover contacts whose detailed functions will be elaborated on later. An RS 232 communications module port is situated on the relay face and can be connected to either:-

* A DIN rail mounted communications module
* A laptop computer
* A hand-held or door-mounted LCD display unit (NewElec RDU216) which can also be used as a relay programming tool on stand-alone applications in conjunction with a removable security dongle.

In addition, the relay has a FIRMWARE programming port to enable NewElec to update the relay internal software and a UTP port to accommodate an economical door-mounted LED display which duplicates the fault diagnostic LED display on the relay face. It also provides an indication of motor thermal utilisation and is fitted with a relay reset facility which permits the user to see the previous trip condition.

On a stand-alone application the relay will continuously record the four most recent trip events with accompanying time and date stamping, monitor the motor running hours, the number of starts and the number of trip occurrences. In addition, the NewElec stand-alone software which is supplied free with the relay has a utility which enables the recording of each true phase RMS load pattern and the motor thermal capacity while the motor is running. Once the recording is completed, the data may be loaded into a Microsoft Excel spread sheet and graphically printed out.

Overload protection is provided against cyclic and sustained overloads. Pre-loading with thermal memory, utilising accurate hot and cold thermal curves to IEC 255-8 specifications provides this protection. The cold thermal IDMT curves are user-selectable in the range Class 5 to 35, while the hot curve selections are automatically chosen at 30 % of the cold curve selection. If correctly selected, the curves will provide adequate protection in the event of the protected motor stalling, both during starting or running conditions. Should the motor load exceed the thermal capacity allowed by the selected thermal IDMT curve, the motor overload LED indicator will be illuminated, the relay healthy LED indication extinguished while the main trip relay (Output relay 1) de-energized to trip the motor. In the event of a motor overload trip, the entire thermal capacity of the motor has been utilised. If the AUTO reset mode has been selected the motor overload LED will flash at a one second rate until 30% of the motor thermal capacity has been regained. At this point the overload LED will extinguish and the relay healthy LED will illuminate to indicate that the motor can be returned to service. The relay will effectively reset at the calculated 33% of the user selected cold curve selection. It is important to note that, as an added precaution, the MA range of relays will only tolerate 3 auto resets per hour. Should this frequency be exceeded the MA relay will revert to manual reset. If the MANUAL reset mode has been selected, the motor overload LED will remain consistently lit until the control panel-mounted reset button is pressed. If the reset button is pressed while the thermal capacity has not integrated downwards by 60% the auto reset sequence described above will be initiated.

If, on the other hand, the thermal capacity has in fact integrated downwards by more than 60% then the overload LED will extinguish, the relay healthy LED will illuminate and the main trip relay will be re-energised so that the motor can be returned to service.

In order to limit or avoid any possible damage that could occur to driven components connected to the motor output shaft in the way of impact torque, the MA range of relays will disrupt the supply to the motor by means of the main trip contact (Output relay 1) in 1 second if the motor full load current peaks above 3 times the maximum motor load current setting. The facility is activated as soon as the motor starting sequence has been completed. The facility described provides effective running stall or jam protection. (An example may be a rag stuck inside an impeller housing). The MA relay however does permit the user to disable this feature when it is expected that the mechanical load to the motor will vary greatly while in normal use, such as for example, a crusher application.

Phase unbalance and phase loss protection is provided independent of motor load. In the event of the three line currents becoming unbalanced by more than the user selected % acceptable level (this can be set from 5 to 50%) a trip delay will be initiated that will correspond to the user selected trip delay (this can be set from 1 to 10 seconds). It is important to note that the unbalanced phase currents condition must be consistently present during the entire trip delay period if the trip timer is not to reset. The MA relay permits the disabling of both unbalance currents and phase loss detection separately. The latter may be desirable when protecting single phase motors. Upon trip initiation, the phase unbalance LED will be illuminated, the relay healthy LED extinguished and the main trip relay (output relay 1) de-energised in order to stop the motor. The motor may be brought back into service by pressing the control panel-mounted reset button which will cause the unbalance LED to extinguish, the relay healthy LED to illuminate and the main trip relay to re-energise so as to permit the motor to be re-started.

Should the motor load current, during normal operation, drop below the minimum load user selected % level setting (this can be set between 20 and 100 % of the motor full load current setting) a trip delay corresponding to the user selected trip delay (this can be set from 1 to 10 seconds) will be initiated. At this point, the minimum load LED will be illuminated, the relay healthy LED extinguished and the main trip relay (relay output 1) de-energised to stop the motor. It is important to observe that the underload condition has to be consistently present during the trip delay for the trip delay timer not to reset. If the motor load current drops below 20% of the motor full load current setting, the motor is considered "not running" and the minimum load trip function disabled. As an option, it is possible to link the minimum load protection feature to a solid state minimum load restart timer which may be set to manual only, 10 seconds, 5 minutes, 10 minutes, 20 minutes, 30 minutes, 45 minutes, 1 hour, 3 hours OR 6 hours delay. The facility permits the MA relay to restart the protected motor automatically through relay output number 2 (BUT ONLY IF NO OTHER FAULT CONDITION IS PRESENT). On expiry of the user-selected time delay, the main trip relay (output relay 1) will be re-energised while the normally open contact of relay output 2 (which should be connected in parallel with the START pushbutton of the motor starter) will energise so as to start the motor. Once the MA relay detects current in the main circuit, relay output 2 will de-energise and the contactor held by the usual retaining starter circuit. The facility excels on sump pump applications and obviates the need for level sensing probes. PLEASE NOTE THAT IF THE USER HAS SELECTED RELAY OUTPUT 2 FOR ANOTHER FUNCTION THIS FACILITY WILL BE EXCLUDED AUTOMATICALLY.

Earth leakage protection is provided with a user-selectable sensitivity ranging from 50 mA to 1000 mA and a user-selectable trip delay settable from 100 milli seconds to 1 second. The earth leakage sensing is achieved by means of the built in core balance current transformer OR by means of a separate core if one has been installed. In the event of the relay detecting an earth leakage fault under 1 Amp, the main trip relay (relay output 1) will de-energise so as to stop the motor, the relay healthy LED will extinguish and the earth leakage LED will be illuminated. The main trip relay will re-energise once the control panel mounted reset button is pressed. In order to protect the main contactor from opening on a potentially high energy fault current, relay output 4 of the MA relay will de-energise INSTEAD OF RELAY OUTPUT 1 when the earth fault current detected by the MA relay is in excess of 2 Amp. It is recommended that the normally open contact (terminals 40 and 41) on relay output 4 be connected to the shunt operating mechanism of the back up circuit breaker. The latter device being more appropriate for interrupting such faults. To describe such a scenario, when the MA relay detects an earth fault current of 2 Amp or more, relay output 4 will de-energise in 100 milli seconds, the relay healthy LED extinguished, the earth leakage LED will be illuminated and 1 second later the main trip relay will also de-energise.

Subject to the main lines phase voltages being terminated in the correct phase sequence to terminals 60, 61 and 62, the MA relay will provide phase rotation, overvoltage and undervoltage protection. The phase rotation LED will extinguish as soon as the phase sequence red, white and blue are correctly terminated on the designated relay terminals. Incorrect phase rotation will result in the phase rotation LED being illuminated, the relay healthy LED extinguished and the main trip relay being de-energised. This will prevent the motor being started in the wrong direction with possible damage to equipment.

Once the phase rotation has been corrected, the phase rotation LED will extinguish, the relay healthy LED will illuminate and the main trip relay re-energised.

In the event of an overvoltage condition where the main circuit voltage is more than 15 % of the nominal reference voltage applied to the relay situated in the MCC, a 10 second trip delay will be initiated. The condition must persist for the entire trip delay period for the time delay timer not to reset. Upon a trip being initiated as a result of an overvoltage condition, the main trip relay (relay output 1) will de-energise, the relay healthy LED will extinguish and the phase rotation LED pulsed at a 75 % duty over a 4 second period. Once the main circuit voltage reduces to less than 115 % of the nominal reference voltage, the flashing phase rotation LED will extinguish, the relay healthy LED will illuminate and the main trip relay will re-energise to permit the motor to be brought back into service.

In the event of an undervoltage condition where the main circuit voltage reduces by 10 % of the nominal reference voltage applied to the relay in the MCC, a 10 second trip delay will be initiated. The condition must persist for the entire trip delay period for the time delay timer not to reset. Upon a trip being initiated as a result of an under-voltage condition, the main trip relay (relay output 1) will de-energise, the relay healthy LED will extinguish and the phase rotation LED pulsed at a 25 % duty over a 4 second period. Once the main circuit voltage increases to above 90 % of the nominal reference voltage, the flashing phase rotation LED will extinguish, the relay healthy LED will illuminate and the main trip relay will re-energise to permit the motor to be brought back into service.

Note: Over and undervoltage detection are initiated ONLY after a successful motor start sequence.

Three independent RTD over temperature detection circuits are provided. Terminals 54 to 59 inclusive refer. Each circuit is designed to accept PTC type devices each of which has a resistance value of less than 50 Ohm for temperatures up to ± 5° C below the specified switching temperature and will increase to above 2 K Ohm for ± 5° C above the rated switching temperature. The MA relay RTD trip detection level can be set between 100 Ohm and 5,2 K Ohm in 20 Ohm steps. This allows for multiple sensors to be connected in series and linked into any of the three available sensor circuits. The RTD trip delay is also user-selectable in the range of 1 to 10 seconds. However, the over-temperature condition must persist over the entire trip delay selected period for the time delay timer not to reset. In the event of an RTD over- temperature condition, the main trip relay (output relay 1) will de-energise, the relay healthy LED will extinguish and the RTD LED will illuminate. NOTE IT WILL NOT BE POSSIBLE TO RESET THIS FAULT UNLESS THE OVER-TEMPERATURE CONDITION IS REMOVED OR THE RELEVANT RTD INPUT IS DISABLED. On removal of the RTD over temperature condition, pressing the reset button will re-energise the main trip relay, the relay healthy LED will illuminate and the RTD LED will be extinguished.

Short circuit protection is provided by the MA relay. In the eventuality of the detection of a current (phase to phase OR phase to earth) exceeding 10 times motor full load setting, a 1 second trip delay will be initiated on relay output 4. Terminals 40 and 41 would typically be wired in series with a shunt trip mechanism on a back-up circuit breaker. One second later, the main trip relay will also be de-energised, the relay healthy LED will extinguish and the overload LED will be illuminated. Once the fault has been identified and cleared, pressing the control panel reset button will re-energise the main trip contact, the relay healthy LED will be illuminated, the overload LED will extinguish and relay output 4 will re-energise.

Frozen contactor protection is provided by the MA relay. If during normal operation the protection relay continues to detect current flow to the protected motor 1 second after the initiation by the relay of a main trip command, relay output 4 will be de-energised so as to back trip the main circuit breaker by means of a shunt trip mechanism through terminals 40 and 41 of relay output 4. In such an instance the relay healthy LED will be extinguished, and the related fault LED upon which the initial command to trip was initiated will illuminate.

Digital inputs 1 to 4 on the MA relay are dedicated for use by the customer. On stand-alone applications, digital input number 5 has been pre-allocated for remote reset and is not otherwise available. All digital inputs automatically become available if the MA relay is connected to an integrated communications BUS PROTOCOL. Similarly, on stand-alone applications, NewElec has pre-assigned functions to all four available output contacts. However, two output contacts can be configured to customer preferences when the MA relay is connected and integrated to a communications BUS PROTOCOL. Similarly, two of the output relays (2 and 3) may be re-assigned functions by the user on stand-alone applications.

SUMMARY OF RESERVED INPUT AND OUTPUT MA RELAY FUNCTIONS
WHEN USED ON STAND-ALONE APPLICATIONS

Digital input No. 5	Reserved for remote reset
Output relay 1	Main trip relay
Output relay 2	Underload re-start contact UNLESS otherwise configured by the user
Output relay 3	Slaved to relay 1
Output relay 4	Will de-energise under the following conditions:

* Any earth fault detection exceeding 1 Amp with a 100 milli second trip delay.

* Short circuit faults (interpreted as such at 10 times motor full load setting) with a 100 milli-second trip delay.

* Frozen contactor detection with a 1 second trip delay.

The main trip relay output 1 will de-energise 1 second after relay output 4 in all the above cases.

Descriptive LED indications have been provided for ease of fault diagnosis and information:

* Green - relay healthy
* Red - overload/running stall/short circuit
* Red - phase unbalance/loss
* Red - minimum load
* Red - phase rotation/overvoltage/ undervoltage
* Red - RTD over temperature
* Red - earth leakage/severe earth fault
* Yellow - in service

3. Information Required for Initial Settings

There are three ways of setting up the MA range of NewElec motor protection relays. These are either through the chosen communications BUS Protocol, by means of a laptop computer using the NewElec front end software OR by using the NewElec remote LCD display unit (RDU 216). The setting-up procedure discussed in this documentation relates to using a laptop computer. If the customer has purchased a NewElec RDU 216, reference must be made to that units documentation which is supplied with it. If the setting up is to be achieved through a communications BUS Protocol the customer must obtain the necessary electronic files for downloading into that systems software. After which, the customer will use the generic software provided by the PLC manufacturer for setting up the MA relays. Whichever setting up tool or method used to facilitate the setting up of the MA relays, the following preliminaries will need to be addressed:

CURRENT TRANSFORMER INPUTS, CURRENT RANGE AND GENERAL RELAY CONNECTIONS

First ensure that the selected MA relay does in fact cover the full load current range of the protected motor and that if interposing current transformers are being used, that the secondary of these are 5 Amp. In the latter case, care should be exercised to ensure that the current polarity of all interposing current transformers used are the same and in a similar manner that the polarity of current flow from the secondary of these current transformers passing through the current transformer module of the MA 5 are equally all in the same direction.

If interposing current transformers are being used, an external core balance current transformer should be connected to terminals 50 and 51 of the MA relay while also removing the connecting link between terminals 52 and 51. In order to avoid nuisance trips it is important to ensure that the MA relay motor current sensing is achieved via the main line and NOT THE DELTA loop of measuring phase currents.

If RTD thermistors are going to be used to monitor temperature, it is important to ensure that these circuits are accommodated and terminated to terminals 54, 55; 56, 57, 58 and 59 of the MA relay for the three available independent inputs respectively.

The main line phase voltages should be terminated to the MA relay by means of terminals 60, 61 and 62 in the sequence Red, White and Blue as indicated on the relay. In order to assist, the MA relay phase rotation LED will remain illuminated for as long as the connected phase sequence continues to be incorrect. It is recommended to insert 2 Amp rated fuses on each line for added relay protection.

Depending on the chosen auxiliary supply voltage, either connect terminals 11 and 12 to a 110 Volt a.c supply OR terminals 10 and 12 for a 220 Volt a.c supply.

Digital inputs 1 to 5 will require a field supply voltage in the range 24 to 220 Volt a.c OR d.c to be connected to terminals 20 and 21. Now proceed to terminate your digital input circuits in accordance to your application requirements. REMEMBER that digital input 5 on stand-alone applications has been pre-allocated by factory default to a remote reset function. By example, let us assume you wish to connect digital input 1 to the N.O contact of a limit switch. You would then proceed to connect terminal 21 to one side of the N.O contact and then connect the other side to one of terminals 22, 23 OR 24 which are all common. When the N.O contact of the limit switch closes, digital input 1 will be HIGH or true. The I/O map described later, will then permit you to allocate relay output 2 OR 3 to de-energise after a programmable time period once digital input 1 becomes true. In similar manner, continue to connect the digital inputs whose terminals are numbered 26 to 29 inclusive in accordance with your preferences and complete the circuits by means of the common terminals 22 to 24 inclusive.

Relay output 1 is the main trip output contact intended to remove the supply from the main contactor holding coil on any fault condition so that terminals 31 and 32 should be wired in series with the main contactor holding coil. Note that relay 1 is energised on MA relay "power up" to ensure a fail to safety operation in the eventuality of a power supply loss. Relay output 4 will be de-energised on the following fault conditions only:

* An earth leakage current exceeding 2 Amp. (100 milli second trip delay) followed with a 1 second delay on the main trip relay output 1.
* Short circuit fault detected at 10 times motor full load setting with a 100 milli second trip delay followed with a 1 second delay on the main trip relay output 1.
* The detection of a frozen contactor condition where current flow to the motor is still detected by the protection relay 1 second after a trip command has been given to the main trip relay output 1.

Relay output 4 MUST, of necessity, be connected to the shunt trip mechanism of a backup circuit breaker via the N.O contact terminals 40 and 41 to ensure that the main contactor is never opened on a potentially high energy fault which is in excess of its rupturing capacity (type 2 co-ordination).

By default, relay output 2 is used to provide an automatic re-start facility for the protected motor following an underload trip condition and a user-selectable time delay period. The protection relay will only permit such an automatic re-start to occur IF NO OTHER FAULT CONDITION IS PRESENT! Used in this configuration, the main trip relay (output relay 1) will be re-energised while the normally open contact of relay output 2, terminals 34 and 35 (which should be connected in parallel with the START pushbutton of the motor starter) will energise so as to start the motor. Once the MA relay detects current in the main circuit, relay output 2 will de-energise and the contactor held by the usual retaining starter circuit. The facility excels on sump pump applications and obviates the need for level sensing probes. PLEASE NOTE THAT IF THE USER HAS SELECTED RELAY OUTPUT 2 FOR ANOTHER FUNCTION THIS FACILITY WILL BE EXCLUDED AUTOMATICALLY.

In a similar manner, and if required, relay output 3 may be allocated a particular function in conjunction with the digital inputs. See I/O map discussed later in this document. If not, it will be slaved to relay output 1.

On running the NewElec MA front end software with your laptop you will gain access to the relay settings menu. The laptop must be connected to the MA relay serial port by means of the NewElec RS 232 male to female DB 9 communications cable (stock code CAB 0004).

Note: THAT IT WILL BE NECESSARY TO PRESS THE "ENTER" KEY ON YOUR LAP TOP FOR EVERY SELECTED SETTING IN ORDER FOR THE SETTING TO BE TRANSMITTED AND SET ON THE MA RELAY. THIS APPLIES EQUALLY TO THE DROP DOWN MENU SELECTION ITEMS.

4. Setting up Procedure

Maximum Load Current Setting

This allows the motor full load current value to be set between 10 to 100 % of the MA relay model number.

Example: A 100 kW 400 Volt a.c motor has a motor full load value of 202 Amp. What would the motor full load current setting be on an MA 250 relay?

Answer: The motor full load setting % = (202/250) X 100 = 80,8 % OR 81%

Voltage Selection

This allows you to tell the relay the mains voltage at which the motor is running. It is selectable at values of 0, 110, 380 OR 525 Volt a.c.

Thermal Curve Class Setting

You are requested to select a safe cold thermal curve based on 6 times motor full load current for the protected motor. This is usually the safe cold stall time for the protected motor and is available from your motor manufacturer. As a guide line you could refer to pages 44 and 45 of your NewElec product catalogue. The relay will allocate a corresponding hot thermal curve whose value will be 30 % of the selected cold thermal curve. The hot thermal curve will be reached after running the motor at load levels in excess of 80 % of the motor full load current setting for a time period related to at least 5 times the curve class time constant. The cold thermal curve selection is selectable between 5 to 35 seconds.

Minimum Load Setting

This allows the selection and setting of the minimum load for the motor in the range 20 to 100% of the motor full load current setting. Considering the above sited example, if we know that the selected motor is running under no load at 175 Amp, the minimum load setting would be calculated as:

(175/202) X 100 = 86,6 % OR 87 %.

Note: If the load current drops to below 20 % of the motor full load current setting the function will be disabled.

Minimum Load Trip Delay

This allows you to set the trip delay period for the minimum load condition. It is selectable in the range 1 to 10 seconds. Note that the minimum load condition must be persistent for the entire trip delay period for a trip to initiate. Should the minimum load condition momentarily disappear while timing out the minimum trip delay timer, the timer will reset to zero and begin counting again on the next occurrence.

Minimum Load Reset Delay

This optional facility will permit the MA motor protection relay to re-start the protected motor after an underload OR minimum load trip condition. The re-start time delay period is user selectable as MANUAL, 10 seconds, 5, 10, 20, 30, 45 minutes and 1, 3, 6 hours. Provided no other fault conditions exist, the feature will reset the main trip relay and energise relay output 2 whose N.O contact would be connected in parallel with the start pushbutton in order to re-start the motor. Once the MA relay detects current in the main motor circuit it will de-energise relay output 2 leaving the usual retaining circuit to hold the main contactor in.

Note: This feature will be inoperative if relay output 2 is allocated to another function by the user.

Unbalance Trip Level

Normally, the three phase load currents drawn by the motor should be balanced on all phases but due to supply voltage fluctuations these can become unbalanced. This menu item allows you to select the permissible unbalance % threshold between phases which is selectable between 5 to 50 % of the maximum load current value.

Setting up Procedure contd.

Unbalance Trip Delay

The trip delay period for unbalanced load current conditions can be selected between 1 to 10 seconds. The unbalanced load must persist for the entire time delay period for the trip condition to be initiated. Should the unbalanced load current condition momentarily disappear while the trip delay timer is in progress, it will reset to zero and begin timing out again on the next occurrence of the condition.

Earth Leakage Trip Level

The earth leakage trip detection threshold is selectable between 50 to 1000 mA and is detected by means of the internally mounted core balance current transformer OR optional external core balance current transformer with active low pass filters. Earth leakage currents in excess of 2 Amp are considered as earth faults that should not be interrupted by means of the main contactor. In the latter case, relay output 4 will be used by the MA relay to energise the back-up circuit breaker by means of a shunt tripping mechanism and the main trip relay 1 will de-energise 1 second later. This is done to maintain type 2 co-ordination. Earth leakage faults will be interrupted by the main trip relay 1.

Earth Leakage Trip Delay

The trip delay period for an earth leakage condition is user-selectable from 100 milli seconds to 1 second and must be sustained for the entire trip time delay period to initiate a trip. Should the earth leakage condition momentarily disappear while the timing out period is in progress, the timing out timer will reset to zero and restart upon the following earth leakage detection.

RTD Trip Level

Three independent RTD over-temperature detection circuits are provided. These are designed to accept PTC type devices. A single PTC device has a resistance value of less than 50 Ohm for temperatures up to ± 5° C below their specified switching temperature and will increase to above 2 K Ohm for ± 5° C above their switching temperature. The RTD trip level can be set between 100 Ohm and 5 K Ohm in 20 Ohm steps. This permits multiple sensors to be connected in series and linked into any one of the three RTD sensing circuits.

RTD Trip Delay

The trip delay period for RTD over temperature conditions is user-selectable from 1 to 10 seconds. The over-temperature condition must be sustained for the entire duration of the selected trip time delay period for a trip to be initiated. Should the over-temperature condition momentarily disappear while the trip delay timer is in operation it will reset to zero and restart on the next over- temperature occurrence.

Input/ Output Map and Truth Table

Configuration of Output Relays

Digital field inputs 1,2,3,4, output relay 2 and 3, with independent time delays can be used in the stand-alone mode to provide sequence starting or inter tripping. Digital field input 5 is fixed as remote RESET.

Input 4	Input 3	Input 2	Input 1	Relay 2	Relay 3
0	0	0	0	0	0
0	0	0	1	0	0
0	0	1	0	0	0
0	0	1	1	0	0
0	1	0	0	0	0
0	1	0	1	0	0
0	1	1	0	0	0
0	1	1	1	0	0
1	0	0	0	0	0
1	0	0	1	0	0
1	0	1	0	0	0
1	0	1	1	0	0
1	1	0	0	0	0
1	1	0	1	0	0
1	1	1	0	0	0
1	1	1	1	0	0

Time delay	0 to 3000 seconds
Relay 2	0
Relay 3	0

Relay 2 and 3 will energise after the specified time delay for the digital input pattern opposite the column in which a "1" has been entered

Example:

Input 4	Input 3	Input 2	Input 1	Relay 2	Relay 3
0	0	0	0	1	0
0	0	0	1	0	0
0	0	1	0	0	0
0	0	1	1	0	1
0	1	0	0	0	0
0	1	0	1	0	0

Time delay	0 to 3000 seconds
Relay 2	15
Relay 3	45

In the above configuration selection:

* Relay 2 will energise 15 seconds after all digital field inputs go to "0" or are not present.
* Relay 3 will energise 45 seconds after digital inputs 1 and 2 go to "1" or are present.

Setting up Procedure contd.

Input	Value
1	1
2	1
3	0
4	0

NOTE: If the I/O configuration is left on the factory default values then the following functions have been assigned with the relay time delays still functional even though the default value is set to 0 seconds. A useful application of this could be to set a time delay longer than the Thermal Reset time of the MA relay, set the Overload Thermal reset to Auto. If the MA relay trips on Thermal the Thermal capacity recovers to 30% and resets the main trip relay without having to energise relay 3, but should the relay not reset on thermal, it indicates that maintenance personnel are required to investigate the reason for the trip.

Relay	Function
2	Minimum Load Restart Relay
3	Main Trip Relay Slave of Relay 1

NOTE: Configurations and control functionality may depend on the software revision being used.

5. Adding or Removing Features on Site

Function Enable/Disable Selections

Overload Auto/Manual selection

If set to AUTO mode the MA relay will reset the main trip relay as soon as the thermal capacity has integrated downwards by 30 % (or the motor has regained 30 % thermal capacity). This is equivalent to the Hot Thermal Curve. This implies that 30 % of the selected Cold Thermal Curve will be available for starting the motor and accelerating it to speed and may be too short a period on some applications carrying high innertial loads. The MA relay will only tolerate three auto resets per hour after which the setting will revert to manual.

If in the MANUAL mode the MA relay will wait for a reset input which could be via the control panel mounted reset pushbutton OR a reset signal via a PLC communications loop OR the NewElec RDU 216. If upon receipt of this input, the thermal capacity has integrated downwards by 30 % or more, the MA relay will reset the main trip relay and permit the motor to be re-started. Alternatively, if at the time the MA relay receives this input, the thermal capacity has not integrated downwards by at least 30 %, the auto reset procedure described above will be initiated. In this latter case the overload LED will begin flashing at a 1 second pulse to acknowledge the reset instruction it has received.

Note that even when selected in the AUTO mode, if a frozen contactor condition was the cause of the trip being initiated, a manual reset will be required to bring the motor back into service.

Minimum Load Disable

Allows a rapid and convenient method to disable the minimum load (underload) trip function to be temporarily or permanently disabled without having to adjust the Minimum Load Trip threshold and trip delay levels.

Minimum Load Auto Reset Disable

Allows a rapid and convenient method to disable the Minimum Load Trip Auto Reset OR Restart function temporarily or permanently without having to adjust the Minimum Load Auto Reset timer selection.

Undervoltage Trip Disable

Allows a rapid and convenient method of disabling the Undervoltage trip function temporarily or permanently while still maintaining Overvoltage and Phase rotation protection.

MTR Fail Safe Disable

When enabled, the Main trip relay output 1, will de-energise to trip. This is the factory default setting which will result in the MA relay tripping the motor on loss of auxiliary supply to the relay.

When disabled, the Main trip relay output 1, will energise to trip which will result in the MA relay NOT tripping the motor if the auxiliary supply to the relay is removed.

Unbalance Disable

When disabled the three phase load currents will be permitted to become unbalanced without the MA relay tripping the motor BUT the MA relay will still trip the motor on a phase loss when unbalanced load currents can be expected to be greater than 90 % which only occurs when the motor is single phasing.

Phase Rotation Disable

When this feature is enabled, the motor will be prevented from starting should the phase sequence of the supply voltage to the motor be incorrect. Phase sequence to the motor is only monitored when the motor is not in service. Once the load being drawn by the motor is in excess of 20 % of motor full load setting, the function is automatically disregarded.

When the feature is disabled the three phase supply to the motor may be reversed without the MA relay tripping on phase rotation.

Run Stall Disable

When disabled the MA relay will still provide effective thermal protection to the motor including running stall protection based on the remaining thermal capacity of the motor at the time the condition arises. Although the motor will still be adequately protected based on the IDMT thermal curve, it will expose the driven mechanical components to severe mechanical torque excesses (impact torque) with possible adverse consequences such as damage to gearbox, coupling, screw conveyor, bucket elevator etc.

When enabled, the supply to the motor will be interrupted by the MA relay in 1 second should the load to the motor (after the initial start of the motor) exceed three times the motor full load setting. This jamming protection feature will disconnect the mechanical operation of the driven components attached to the motor in the event of impact torque conditions. We recommend the feature only be disabled on applications where the motor load is severely oscillating between low and high current values such as in a crusher application for instance.

Earth Leakage Disable

When disabled, it will cause the MA relay to ignore ALL earth leakage fault conditions less than 1 Amp.

RTD 1,2 and 3 Disable

The facility permits each individual RTD (PTC thermistor input for measuring over-temperature) circuits 1,2 and 3 respectively to be temporarily or permanently disabled individualy if required to do so. This is useful only, if attention for example, is required for a bearing replacement, and such attention needs to be deferred to an alternative time period as a result of daily production requirements.

Overvoltage Disable

Allows a rapid and convenient method to disable the overvoltage trip function either temporarily or permanently while still providing undervoltage and phase rotation protection.

Single Phase Trip Disable

When enabled, will allow the MA relay to be used to protect single-phase motors or two phase loads against overloading and earth leakage faults.

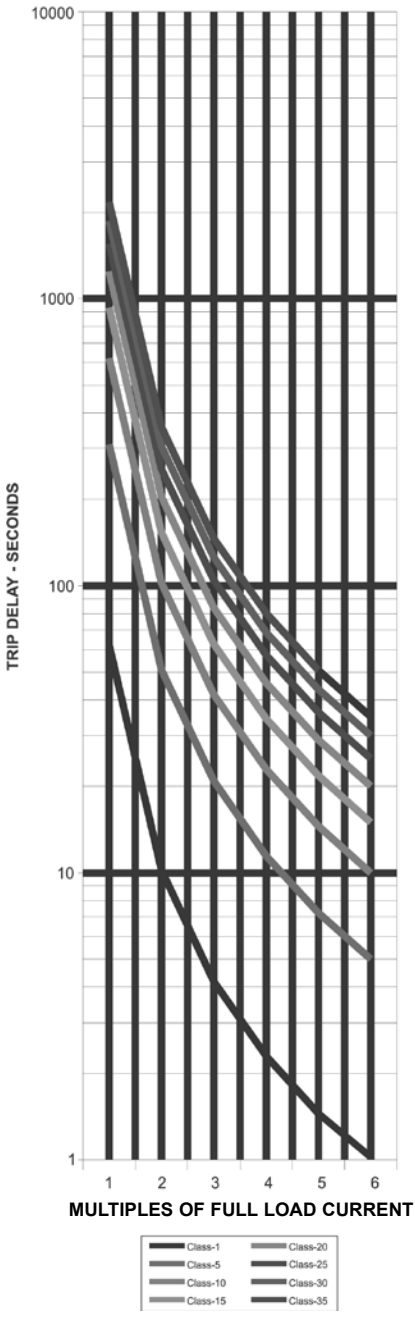
Earth Fault Disable

If disabled, the MA relay will not respond to earth fault conditions greater than 1 Amp.

Short Circuit Disable

When disabled will cause the MA relay to ignore possible short circuit faults (detected at 10 times motor full load setting) resulting in relay output 4 not to trip on such faults.

6. Thermal Trip Curves



7. Specifications

DISPLAY

Green LED	: "Relay healthy"
Yellow LED	: "In service", main circuit current flowing > 20% Ie.
Red LED	: Fault indication
	Overload
	Unbalance
	Earth leakage
	Min load
	RTD 1 - 3
	Phase rotation

CURRENT SENSOR WITHSTAND AND ACCURACY

100 x rated current	: 10 sec
10 x rated current	: 5 min
3 x rated current	: Cont.
Current range	: 10% to 100% Range
Calibration	: Amperes RMS
Response	: Filter peak value of 3 line currents
Current detection level	: +2%
Current operation level	: 104%
Repeatability	: 2%
Current setting accuracy	: 2%
Overload curve accuracy	: ± 5%
Overload reset delay	: ± 5%

OUTPUT RELAYS

Number	: 4 mono stable
Rating	: 5 amp 220 Vac
Isolation	: 3 kV coil/contacts
	: 2,5 kV separate outputs
	: 1 kV across N/O contact

DIGITAL INPUTS

Number	: 5, field power supply rectified, create common potential for process signals
Field voltage supply	: 24 volt – 230 volt ac/dc 0,5 VA
Burden	: 0,5 VA at 230 volt
Isolation	: 3 kV to other circuits

ENVIRONMENTAL WITHSTAND

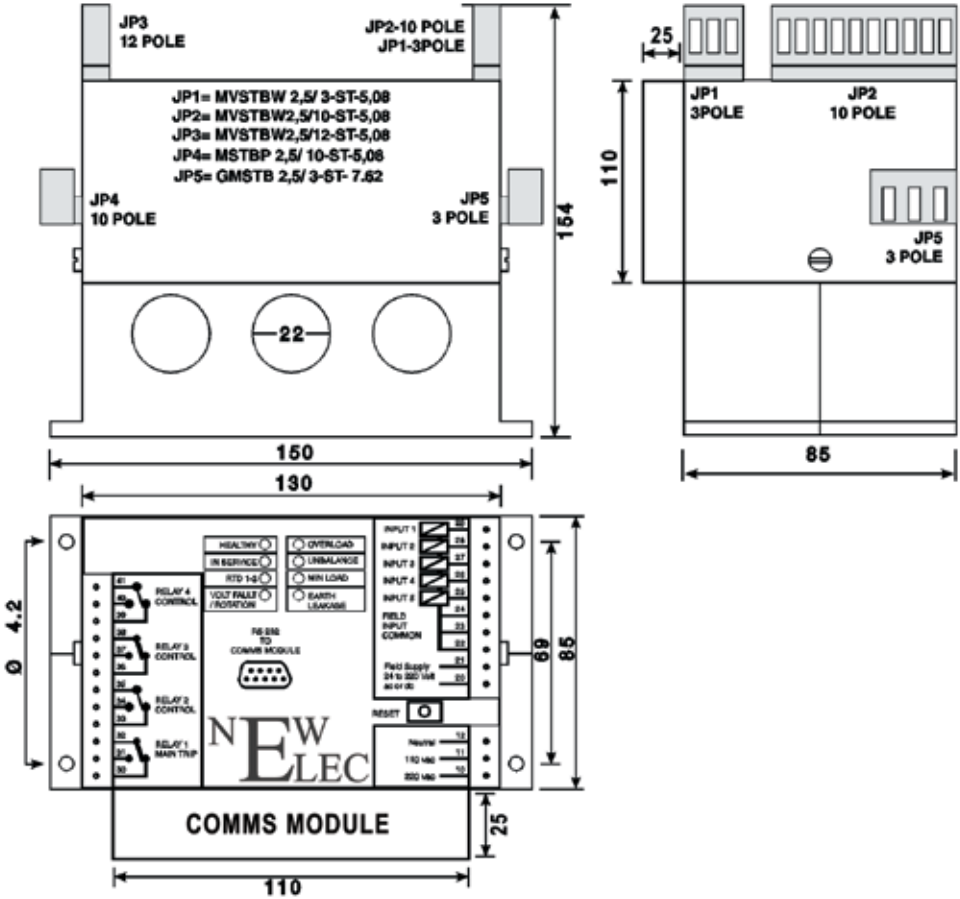
Insulation	: IEC 60255-5/A between separate circuits
Impulse voltage	: IEC 60255-5/D between separate circuits

INTERFERENCE

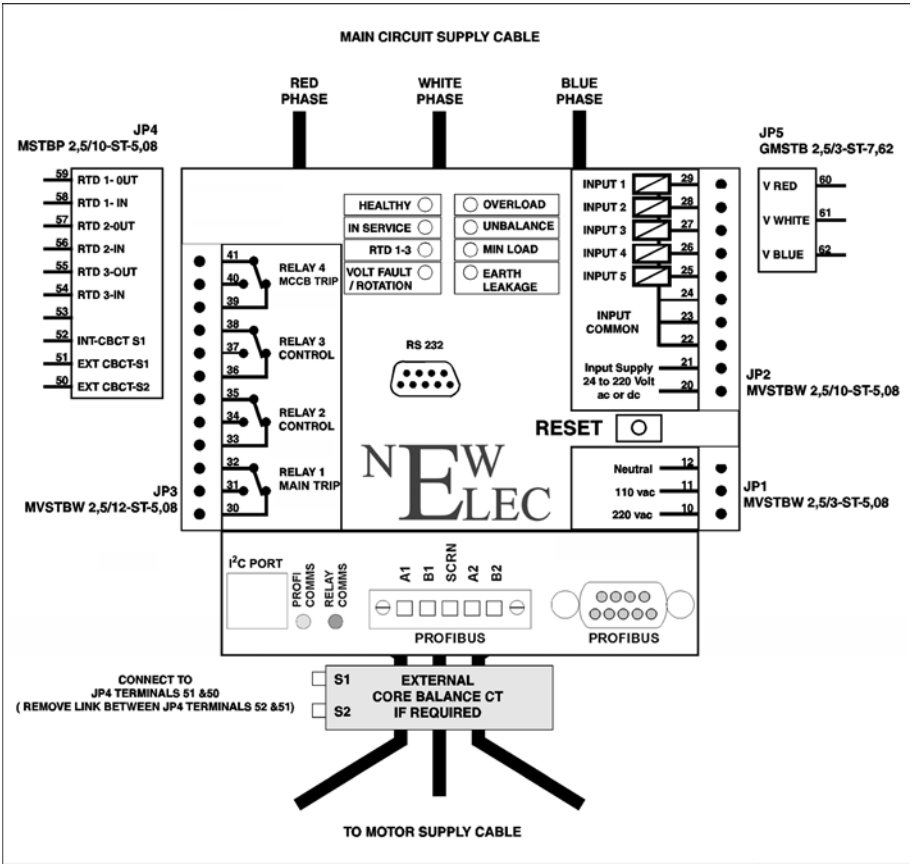
High frequency : IEC 60255-22-1
Electromagnetic : IEC 60255-22-3

System interface : RS232 for connection to PC with MA relay parameterization software alternatively Profibus DP module with relay parameterization and control over Profibus DP fieldbus MA relay GSD file

8. Dimensional Diagram



9. Electrical Connection Diagram



Notes

10. Ordering Information

MODEL	AMPERAGE RANGE
MA 5	0.5 to 5 Amp
MA 10	1 to 10 Amp
MA 50	5 to 50 Amp
MA 100	10 to 100 Amp
MA 250	25 to 250 Amp

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