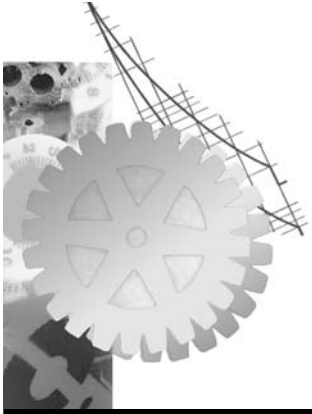


MOTOR PROTECTION & CONTROL TECHNOLOGY

320 to 327 M Series Low and Medium Voltage Motor Protection Relays

INSTALLATION AND SETTING UP PROCEDURE

1. Protection Features

- Overloading (for both cyclic and sustained overload conditions)
- Start stall
- Running stall
- Phase unbalance / single phasing
- Repetitive starts - cyclic loading
- Earth fault (optional)
- Short circuit (optional)

The protection features 1 to 5 are adjustable and can be set to the specifications of the machine on all four dials mounted on the control panel.

2. Description of Operation

The NewElec motor protection models 320 to 327 inclusive are designed for flush door mounting OR chassis mounting in accordance with the ordered preference of the user. Each model, from the 320 to 326 inclusive, caters for a specific Amp range and should be paired with their specified required current transformer ratios. With the latter models the maximum load setting dials and maximum unbalance setting dials are Amp calibrated. The 327 model is a more flexible relay in that it can accommodate any current range. This is achieved by pairing the 327 relay with user-selectable current transformers which would be chosen specifically to cover the full load rating of the protected motor. As such, the 327 model is an excellent choice for keeping as a stock commodity (spares) OR in order to maintain uniformity of relay choice in a plant. Because of the foregoing explanation the maximum load setting dial and the maximum unbalance setting dial are % calibrated on the 327 model. The input current from the current transformer secondary into the relay CAN BE 1 AMP OR 5 AMP BUT MUST MATCH THE ORDERED RELAY REQUIREMENT. The 5 Amp units will usually be identified as such by means of a yellow 5 Amp input sticker on the front of the relay control panel.

The overload setting threshold can be set and adjusted by means of the "Maximum Load Current - Amp" setting dial OR in the case of the 327 relay, the "Maximum Load %" setting dial. The thermal IDMT curve is a FIXED curve set at 7 seconds for 6 times motor full load current and 200 seconds at 1.01 times motor full load current setting for sustained overloading conditions.

The implication of the foregoing statements (on their own) would imply that a motor taking longer than 7 seconds to accelerate would never be able to reach its designated operational speed, due to the prolonged acceleration time, as the supply to the motor would be removed through the relay main trip contact terminals 10 and 11 which would be in the N.C condition with the connected auxiliary power supply to the relay after a 7 second delay.

In order to permit longer acceleration times and protect the motor against start stall conditions, a control panel mounted "Maximum start time – seconds" dial setting should be set at a time interval coinciding with the ON SITE time measured interval PLUS 1 second required to accelerate the load to operational speed. The effect of this setting (which should never exceed the maximum safe hot stall time of the protected motor) is to shift the IDMT thermal curve to the right of the "TRIP TIME – SECONDS" axis during the starting up sequence of the motor for the time duration selected. On expiry of this "Maximum start time – seconds" selected time period, the thermal IDMT curve will automatically revert to its original position.

If, at this point, the relay continues to detect a main line current which is in excess of the "Maximum Load Current" setting dial the main trip relay will de-energize so as to disconnect the supply to the motor, the overload trip LED will be illuminated and latched, the start LED will illuminate to indicate a load starting problem, the cooling on LED will be illuminated and latched, and the trip LED will pulse. The interpretation of this state of events would be that, for the selected setting conditions on the relay control panel, the motor's thermal capacity would have been exceeded. Pressing the localised reset pushbutton situated on the right hand side of the relay or a remote reset pushbutton (which can be connected to terminals 5 and 6 of the relay) would result in the overload and start LEDs to extinguish. However, the cooling on LED will remain lit and the trip LED will continue to pulse. The cooling on LED will remain lit until the motor has regained its full thermal capacity as dictated by the motor manufacturers tolerable maximum starts per hour for the protected motor. This setting selection is accommodated on the "Maximum Starts Per Hour" setting dial. For example, if the motor manufacturer considers that a given motor can safely tolerate 4 starts per hour (set the maximum starts per hour dial to 4), the relay cooling on LED will remain lit for 60 minutes / 4 = 15 minutes. After which the cooling on LED will extinguish and permit the operator to bring the motor back into service by pressing the reset pushbutton of one of the two available reset circuits. This will reset the main trip relay. Note that it is normal for the overload and start LEDs to illuminate during the start sequence since both conditions are true.

During normal running conditions, the actual load current is the greatest true RMS load value measured on the three line currents. Its value is compared with the value set on the "Maximum Load" setting dial of the relay. If the actual load current is determined to be greater than that set on the "Maximum Load" setting dial, a trip delay proportional to the overload level and co-inciding with the IDMT curve will be initiated. After this time, the main trip relay will de-energize so as to interrupt the supply to the motor, the overload LED will illuminate and latch, the cooling on LED will illuminate and the trip LED will be pulsed. Pressing a reset pushbutton will extinguish the overload LED but the cooling on LED will remain lit until the cooling time determined by the "Maximum Starts Per Hour" setting dial is over. At this point, the cooling on LED will extinguish and the motor will be able to be brought back to service by pressing a reset pushbutton.

As an optional extra the relay may be fitted with an auto reset facility which would obviate the need to press the reset pushbutton after the cooling period has expired. The auto reset facility is only active on the overload trip circuit of the relay and is disabled for all other fault conditions.

The relay also permits the protection of mechanical components driven by the motor from impact torque exposure. The running stall protection feature, if selected, becomes active as soon as the motor starting sequence is completed and incorporates a trip delay of 1 second. It is possible to set the running stall protection detection threshold from as low as 150 % to a maximum of 300 % of motor full load current setting in steps of 50 %. Alternatively, or if the application under consideration requires it, it is possible to disable this feature. Unless otherwise instructed the factory activates this feature and is set to provide impact torque protection at 3 times motor full load setting with a 1 second fixed trip delay.

The relay consistently monitors the thermal capacity used by the motor. The thermal protection envelope for the protected motor is affected by the user selected settings on the "Max Load", "Max Starts Per Hour" and "Max Start Time" dials. During normal running operations the motor load is consistently monitored and compared with the "Max Load" setting dial. The thermal memory stores all overload values and this value increases with magnitude and duration of overload conditions. If an overload condition is removed before the relay is able to trip and another overload condition is applied to the motor at a later stage, the actual tripping time of the relay would be a function of the cumulative effect of the second overload condition and the contents of the thermal memory from the first overload condition.

The thermal memory is decayed at one of two rates depending on whether the motor, while in an overload condition, is still running and gaining some benefit from its cooling fan OR whether it has stopped running. Repetitive or consecutive starts of the protected motor will only be permitted by the relay for as long as these occur within the constraints of the selected thermal envelope. Once this boundary is exceeded either by repetitive starts OR by cyclic overloading patterns, the relay will trip the motor on overload. Whenever this occurs, it is only possible to bring the motor back into service once the cooling off period is completed.

Phase unbalance and phase loss protection is provided by the relay. Unbalanced load conditions exist when the three line currents (irrespective of actual motor load) become unbalanced by more than the user selected "Max Unbalance Current – Amps" OR "Max Unbalance Current - %" dial setting. On detection of a phase unbalance OR phase loss condition, a 5 second trip delay will be initiated. The condition must persist for the entire trip delay period for the trip delay timer not to reset. On expiry of the trip delay period, the main trip relay will de-energize so as to disrupt the supply to the motor, the unbalance LED will illuminate and the trip LED will pulse. Once the fault condition has been addressed the motor may be brought back to service by pressing the reset pushbutton which will reset the main trip contact and cause the unbalance trip LED to extinguish.

Earth fault and short circuit protection features are additional options which may be fitted to the relay. Each of these protection features can be potentially destructive to the main contactor if such a device is used to interrupt high energy faults. When such protection features are desirable it is suggested that the interruption of the supply to the motor be achieved by means of the back-up circuit breaker. In order to facilitate this task, an extra auxiliary trip relay can be fitted internally on the 320 to 327 range of motor protection relays.

This internal relay would have a changeover potential free contact. Depending on your switchgear choice, back-up protection with shunt tripping facilities or under-volt trip coil can be accommodated.

NewElec offer the following possibilities:

	Current Detection Threshold	Additional Auxiliary Relay Trip Time	Main Trip Relay
Earth Fault	10% of motor running load	100 milli seconds	with 1 second delay
Short Circuit	11 times motor full load setting	100 milli seconds	with 1 second delay

If the user elects not to fit the additional auxiliary trip relay but does in fact still require the relay with earth fault and short circuit protection features, a 1 second trip delay on the main trip contact will be selected by factory default. The client may, at his discretion, override the factory default by calling for a 100 milli second trip delay on the main trip relay on the detection of such faults. On initiation of a trip condition as a result of the detection of any of the above fault conditions during the normal running of the motor, the relay will disrupt the supply to the motor, the earth fault OR short circuit LED will be illuminated and latched, the trip LED will pulse and in the case of a short circuit fault, the overload LED will also be illuminated and latched. Should either of these fault conditions occur during the motor starting mode, the overload and start LEDs will be illuminated and latched as well. After a complete examination and test of the motor and related circuits have been completed and any repairs attended to, the motor may be brought back to service by pressing the local or remote reset pushbutton which will re-energize the main trip contact. Note that the auxiliary trip relay provides a fleeting change-over contact condition which returns to it's previous state immediately.

To assist maintenance personnel in the diagnosis of fault conditions control panel mounted LEDs have been installed to cover:-

(a) Unbalance
(b) Overload
(c) Start
(d) Short circuit (when this option has been fitted to the relay)
(e) Earth fault (when this option has been fitted to the relay)
(f) Trip
(g) Cooling on
(h) Auxiliary power on

The indication is latched on tripping and in this way displays the cause of the trip condition. The motor can only be restarted once the relay indication has been cleared by pressing the reset button mounted on the motor protection relay or remote reset button connected between terminals 5 & 6.

3. Information required for Initial Settings

1. Motor nameplate full load current
2. Maximum number of starts per hour allowed (from motor manufacturer)
3. Maximum number of consecutive starts allowed (from motor manufacturer)
4. Machine safe hot stall time (from motor manufacturer)

4. Setting up Procedure

First check that the selected current transformers for models 320 to 326 have the appropriate ratios and that these are installed in such a manner that the measured current polarities are the same on each phase. Since the 327 model can accommodate any CT ratio, check and insure that the secondary current matches the relay current input. When a model is not fitted with earth fault and short circuit protection features class 1, 5VA rated current transformers are adequate BUT if earth fault and short circuit protection features have been fitted to the relay class 5P10- 5VA current transformers should be used. Then check and ensure that the NewElec 320 to 327 relay has been connected in accordance with NewElec DWG 320 M EC wiring diagram. Note that the auxiliary relay shown in the schematic is an optional extra. In such a configuration terminals 7 and 8 would usually be connected to the shunt mechanism of the back up breaker. This normally open contact would close on the relay detecting either an earth fault OR a short circuit fault (fleeting action only). Note also that the schematic displays the two normally closed change-over contacts 10,11 and 13,14 with the supply power connected across terminals 15 and 16 in order to make the relay fail safe. Non fail safe configurations are also available but must be ordered as such when an order is placed.

Four settings will now require attention. These are the hand setting dials located on the front of the relay control panel. These will now be discussed from left to right as you face the relay:

1. Maximum Load Setting – Amps OR % Setting Dial

   Set this dial to the motor nameplate full load current value. In the case of the models 320 to 326 inclusive the calibration is directly in Amps. In the case of the 327 the percentage motor full load setting should be derived as follows:-

$$\frac{\text{MOTOR NAMEPLATE FULL LOAD CURRENT}}{\text{CURRENT TRANSFORMER RATIO}} \times 100 = \%\ \text{setting}$$

Note: If the motor load current is of a non oscillating nature and the actual mechanical load drawn by the motor is less than the motor full load rating it is suggested that once the motor is running, the user turns the dial anti-clockwise until the overload LED illuminates. Once this point is reached, turn the dial clockwise once again until the overload LED extinguishes and leave as a final setting. In so doing it will be possible for the relay to trip on overload if the motor is exposed to unusual frictional forces (such as bearing failure) in the normal course of operation.

2. Maximum Unbalance Current – Amps OR % Setting Dial

This dial setting enables the user to select a phase current unbalance detection threshold. In the case of the models 320 to 326 inclusive, the calibration is directly in Amps. In the case of the 327 the calibration is in %. Initially set this dial at the maximum setting. Once the motor is running and on load, slowly turn this dial in an anti clockwise direction until the unbalance LED illuminates. At that point, the relay would have indicated the inherent phase unbalance of the protected motor (it can happen that the unbalance LED does not illuminate at all – particularly with new motors that may have never been rewound). Now turn the dial clockwise again until the unbalance LED extinguishes and leave as a final setting. If an unbalance trip condition is to be avoided while the motor is running on load ensure not to allow the unbalance LED to remain persistently lit for more than 5 seconds!

3. Maximum Starts Per Hour Setting Dial

This dial setting is the maximum permissible number of starts per hour that the machine can accept. Set the dial to the maximum number of starts per hour allowed by the motor manufacturer. This setting will ultimately control the relay calculated motor cooling time after an overload trip. If for example, the motor manufacturer has dictated that a given motor should not be started more than 4 times per hour and as a consequence a setting of 4 is selected on this dial, the relay will prevent the motor from being re-started after an overload trip until a period of 60/4 = 15 minutes has lapsed.

4. Maximum Start Time Seconds Setting Dial

This dial setting sets the maximum time that the machine is permitted to draw its starting inrush current. The start timer is automatically activated on detection of the start inrush current and will continue to time while the motor current is above the value set on the maximum load current dial. If the set time on the maximum start time dial is exceeded, the machine will be tripped on start stall fault condition. Always ensure that the dial is set to a value less than the safe hot stall time specified by the motor manufacturer for the protected motor. This is the initial setting we recommend for the first start. Models 320 to 326 inclusive have a setting range from 4 to 84 seconds while the 327 model has a setting range from 1 to 21 seconds. On the latter model, the setting range may be extended to 4 to 84 seconds by manipulation of an internally set dip switch setting.

When the control supply is applied to the relay, the "power on" LED will light up. Simultaneously the main trip relay inside the motor protection relay will energise and allow the motor main contactor to be closed.

All initial settings have now been completed and the motor protection relay is ready for the first start. On its initiation it will be important to take a stop watch in order to measure the actual start time taken by the motor to reach full acceleration speed. This is facilitated by means of the control panel mounted "start LED" which will illuminate immediately the motor is started and extinguish as soon as the inrush current falls below the maximum motor load setting. Take note of this time period as it will be required to complete the final adjustments to the relay.

FINAL ADJUSTMENTS

Returning to the MAXIMUM LOAD SETTING DIAL, you may now leave the setting at the motor full load rating (as per motor nameplate) or if the motor load is relatively stable proceed to adjust the setting as per instructions in 1 above.

Proceed to adjust the unbalance detection level by adjusting the MAXIMUM UNBALANCE – CURRENT SETTING DIAL as per instructions in 2 above.

In as far as the MAXIMUM STARTS PER HOUR DIAL SETTING is concerned ensure that it is set as per the motor manufacturers recommendations or less. Do not tamper with the setting for the purpose of trying to obtain a faster thermal reset after an overload trip condition as this will impact on the motor life expectancy in the longer term.

In order to ensure that we respect and meet the motor manufacturers permissible consecutive start attempts for the protected motor we now need to conduct final adjustments to the MAXIMUM START TIME SETTINGS DIAL. Firstly let us establish our lower and upper limits for the setting. The least permissible time setting would be the time taken to accelerate the motor to full speed. In order to ensure a correct evaluation this would typically be the ON SITE measured time period PLUS 1 second. Any setting below this value would cause the relay to trip the motor before it could reach full operating speed. The SAFE upper limit would coincide with the motor manufacturers safe hot stall time for the motor. Should your setting not exceed this safe hot stall time period, the motor will always be protected against any possible locked rotor condition on start-up at the worst possible thermal condition. Now consider the following example:

* Actual site measured acceleration time required by motor - 5 seconds.
* Safe hot stall time of motor (from motor manufacturer) - 16 seconds.
* Motor manufacturers permissible consecutive start attempts - 2 times only.

Your final setting would then be calculated as:

Actual site measured acceleration time PLUS 1 second	5 + 1	= 6 seconds.
Multiplied by 2 permissible consecutive start attempts		= 12 seconds.

Thus, the final setting would be 12 seconds. As can be seen, this setting would permit an operator to do up to 2 consecutive start attempts within the safe thermal envelope of the protected motor and still provide more than adequate protection against a locked rotor during start up. Should it happen that the calculated value is greater than the safe hot stall time of the motor then set the setting at the safe hot stall time of the motor OR allow for less consecutive start attempts. In both instances, the setting would simply reduce the number of consecutive start attempts to a safe tolerable level and within the motor's thermal capabilities. In the example given above, if a third consecutive start attempt had been tried, a trip would have occurred after 12 – (5 + 5) = 2 seconds! The relay would have tripped on START, OVERLOAD and the COOLING LED would also be lit. The relay would have then kept the motor out of service for a period calculated on the MAXIMUM START PER HOUR DIAL.

5. Adding or Removing Features on Site

In the event of the motor protection relay tripping a motor on earth fault during start-up, and at the same time having established the insulation integrity of the circuit, carry out the procedure set out below:

1. Temporarily disable earth fault protection by pressing the relay reset pushbutton for the duration of the start period.
2. Release the reset pushbutton when the motor has reached normal operating speed.
3. Should the relay trip on earth fault at this point, inrush current stability problems have been excluded. Check again for a possible earth fault or reverse polarity connected current transformer.
4. Should the relay not trip the motor at this point, an inrush current stability problem has been identified. Check that protection class 5 P10 5 VA current transformers have been installed. Should the current transformers be correct the problem is overcome by cutting the 47 Ohm , 10 Watt stabilisation resistor bypass link situated on the stabilisation resistor printed circuit board located on the left hand side of the protection relay when viewing the relay from the front.

Being a very flexible and versatile motor protection relay, additional protection options may be added or excluded from the relay by means of enabling/disabling a number of OPTION SELECTOR SWITCH functions on the inside of the relay. Two banks of such switches labelled PSS1 and PSS2 are accessible by removing the 4 screws on the relay base and slowly pulling the base of the relay from its surrounding sleeve. The tabulation below explains the switch functions for each bank BUT NOTE THAT MANIPULATION OF THESE SWITCHES SHOULD BE CARRIED OUT BY QUALIFIED PERSONNEL ONLY. Some functions become available at the expense of the loss of other functions while tripping times may also be altered or critical protection features inadvertently disabled by unqualified personnel.

PSS1

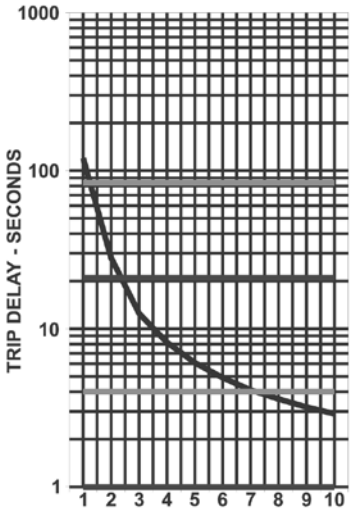
FUNCTION	1	2	3	4	5	6	7	8	OPTION
Run Stall Disable	Off	Off	Off	x	x	x	x	x	E
Run Stall 300%	On	Off	Off	x	x	x	x	x	A
Run Stall 250%	On	Off	On	x	x	x	x	x	B
Run Stall 200%	On	On	Off	x	x	x	x	x	C
Run Stall 150%	On	On	On	x	x	x	x	x	D
Earth Fault	x	x	x	Off	x	x	x	x	G
Disable Earth Fault	x	x	x	On	x	x	x	x	
Short Circuit		x	x	x	Off	x	x	x	H
Disable Short Circtuit	x	x	x	x	On	x	x	x	
Immediate O/L Warning with Auxiliary Relay	x	x	x	x	x	On	Off	x	F
Transfer S/C & E/F to Auxiliary Relay	x x	x	x	x	x	Off	On	x	I
0.100 Trip Delay S/C & E/F								Off	J
Additional 1 sec trip delay	x	x	x	x	x	x	x	On	

PSS2

FUNCTION	1	2	3	4	5	6	7	8	OPTION
Start Timer 1 - 21 sec	On	x	x	x	x	x	x	x	
Start Timer 4 - 84 sec	Off	x	x	x	x	x	x	x	x 4
Limited Start Attempt Disable	x	Off	x	x	x	x	x	x	
3 Consecutive Start Attempts	x	On	Off	Off	x	x	x	x	N3
2 Consecutive Start Attempts	x	On	On	Off	x	x	x	x	N2
1 Consecutive Start Attempt	x	On	On	On	x	x	x	x	N1
Slave Auxiliary Relay with Main Trip Relay	x	x	x	x	x	On	Off	On	P
Unbalance Trip Only	x	x	x	x	x	Off	Off	On	
Unbalance Alarm Only with Auxiliary Relay	x	x	x	x	x	Off	On	Off	O

MAIN TRIP RELAY CONFIGURATION
LINK: LK1
FAIL SAFE: 2-3 OR 5-6
NON FAIL SAFE: 1-2 OR 4-5

6. Thermal Trip Curves



7. Specifications

INPUT CONVERTER

Overload capacity : 6 times maximum load current setting, continuous
: 8 times maximum load control setting for 5 minutes

Frequency response : 42 to 66 Hz

MAXIMUM LOAD CURRENT SENSOR

Level setting accuracy : ± 4%

Linearity : ± 4%

Repeatability : ± 1%

Detection level : ± 1%

Calibration : Amp R.M.S

Range : 21: 1 continuous

Response : Related to average of 3 input line current transformers

STARTS PER HOUR LIMITER

Level setting accuracy : ± 4%

Linearity : ± 4%
Repeatability : ± 1%
Calibration : Starts per hour
Range : 1 to 12 starts per hour

SHORT CIRCUIT SENSOR

Tripping level : 10,5 to 11,2 times max load current dial setting

Tripping delay : 100ms

OVERLOAD TRIP DELAY

* See NewElec 320 Series running curve

Accuracy : ± 5% for 125 to 1100% overload ± 10% for 102 to 124% overload ± 1% for 101% overload

MAIN TRIP RELAY CONTACTS

Ratings : 5 Amp at 220 Volt a.c
Configuration : 1-Form C common, n/o, n/c 1- n/c

MAXIMUM UNBALANCE CURRENT SENSOR

Level setting accuracy : ± 4%
Linearity : ± 4%
Repeatability : ± 1%
Detection level : ± 1%
Calibration : Amp R.M.S
Range : 2 to 20% In continuous
Trip delay : 5s

START TIMER

Start detection : Inrush current to rise from 10%
101% of max load current dial setting within 1s

Start range : 4 to 84s

Automatic transfer from start to running curve : Occurs when input current falls below max. load current dial setting

EARTH FAULT SENSOR

Tripping level : 10% of motor running load
Tripping delay : 100ms

RESET LOCKOUT TIME ON OVERLOAD TRIP

Monitor Control Power On — Lock Out Time (Min)

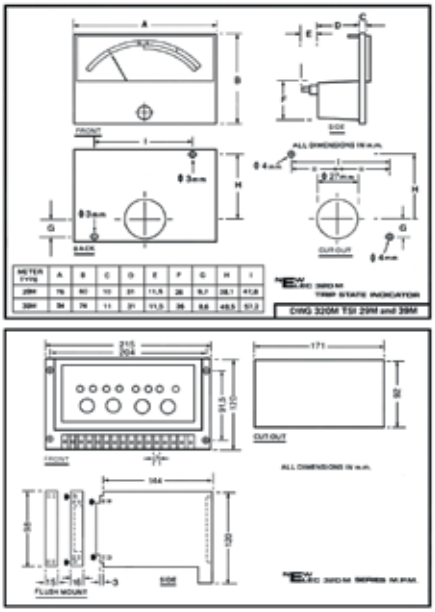
Starts per hour calibration selected (Ns) — (60 / (Ns)) Min ± 5%

Monitor Control Power Off — 25 min ± 15%

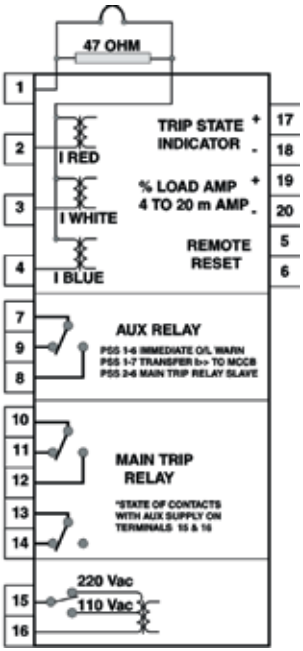
AUXILIARY RELAY CONTACTS

Ratings : 5 Amp at 220 Volt a.c
Configuration : 1-Form C
Common n/o, n./c

8. Dimensional Diagram



9. Electrical Connection Diagram



10. Ordering Information

NEWELEC 323 MF 220 A 1

C.T. RATIO	RECOMMENDED RANGE (AMPS)	CODE
20:1	0,8 to 12	0
50:1	12 to 30	1
100:1	30 to 80	2
200:1	80 to 160	3
500:1	160 to 400	4
1000:1	400 to 800	5
2000:1	800 to 1680	6
XXX:1	30% to 115%	7

CODE	RUNNING STALL
A	3 x MLC Setting
B	2,5 x MLC Setting
C	2 x MLC Setting
D	1,5 x MLC Setting
E	Not selected

CODE	CONTROL SUPPLY
110	110 Volt AC 5 VA
220	220 Volt AC 5 VA

MOUNTING	CODE
Flush	F
Chassis	C

CURRENT TRANSFORMER	CODE
1A Secondary	1
5A Secondary	5

CODE OPTIONS

F	:	Immediate overload warning (option I, O and P disallowed)
G	:	Earth fault
H	:	Short circuit
I	:	Transfer options G and H to auxiliary relay (option F and O disallowed) with 1s delay on main trip relay
J	:	100ms trip time for options G and H (if not selected, 1s delay will be selected)
K	:	Thermal memory override facility
L	:	Motor load and thermal memory analog indication meter (29m or 39m)
M	:	Auto-manual overload trip reset facility
N	:	Programmed limitation of start attempts (1,2 or 3)
O	:	Phase unbalanced alarm - trip function disabled (option I, O and P disallowed)
P	:	Slave auxiliary relay with main trip relay (option I, O and P disallowed)

OPTIONS

To select options, list the option code after the standard monitor code.

EXAMPLE : NEWELEC 324 MC 110 D1GHK

NEW ELEC
MOTOR PROTECTION & CONTROL TECHNOLOGY

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