KD LV Motor Protection Relay

1. ***Protection Features***

- Overload (for both cyclic and sustained overload conditions)
- Locked rotor by vectorial stall
- Running stall / jam
- Single phasing / Unbalance
- Earth leakage with harmonics filtering ideally suited for VSD and large D.O.L applications
- Insulation failure prestart lock-out
- Undercurrent / Load loss / cavitation]
- Under Power [Cos Ø measurement]
- Phase rotation / Over voltage and Under voltage protection
- Short circuit protection trip threshold power factor level dependent
- Over / Under Frequency protection
- Starts per hour with selectable 1-3 consecutive start attempts

2. Description of Operation

Overload protection is provided against cyclic and sustained overloads. Pre-loading with thermal memory, utilising accurate hot and cold thermal curve characteristics to IEC 255-8 provides this protection. The thermal IDMT curves are selectable Class 5 to class 40. These curves will provide adequate protection for the widest range of motors & applications requirements.

Should the motor load exceed the thermal capacity allowed by the thermal IDMT curve selected, the motor overload LED indicator will be illuminated, the relay healthy indicator switched off and the main trip relay de-energised to stop the motor.

The same motor overload LED can be used to read the actual load current being drawn by the motor during normal running conditions. This is achieved by pressing and holding the control panel-mounted reset pushbutton, while trimming back the maximum load current dial, until the motor overload LED switches on. The calibration on the maximum load current dial where this occurs, is the actual load current being drawn by the motor.

In the event of a motor overload trip, the entire **thermal capacity** of the motor has been utilised. If auto reset has been selected the motor overload LED will flash at a one second rate until the thermal capacity has integrated to 30% or, if dynamic reset is being used, integrated to sufficient capacity for a worst case thermal capacity requirement start. At this point the overload LED will switch off and the relay healthy LED will switch on to indicate that the motor can be returned to service. Note that in the auto reset will be limited to 3 per hour only. If this is exceeded a manual reset wil be required before the relay returns to the auto mode.

If manual reset is selected the motor overload LED will remain on until the control panel-mounted reset button is pressed. If the reset pushbutton is pressed and the thermal capacity has not integrated to 30% or the desirable reset point calculated by the dynamic reset feature, the auto reset sequence is initiated. If the thermal capacity has integrated back to a suitable level the overload LED will switch off, the relay healthy LED will switch on, and the main trip relay will be re-energised allowing the motor to be returned to service.

Locked rotor protection during start has been enhanced by monitoring the power factor of the motor while starting. This is automatically done by the KD relay and will result in a faster trip time if the power factor fails to improve in conjunction with the acceleration of the motor. The user selected thermal curve is monitored at the same time.

In order to limit any possible damage that could occur to driven components attached to the motor output shaft in the way of impact torque, the KD range of relays will disrupt the supply to the motor in 1 second if the motor full load current peaks above a level designated by the setting up engineer in the range 110 to 300% of motor full load current setting. Thus providing effective **running stall or jam protection.** (An example may be a rag stuck in an impellor).

Phase **unbalance** protection is provided independent of motor load. In the event of the three line currents becoming unbalanced by more than the user set % level the main trip relay will de-energize after a user defined period. After tripping, the phase unbalance LED will be illuminated, the relay healthy indicator switched off, and the main trip relay de-energised to stop the motor.

Should the motor load current, during normal operation, drop below the **minimum load** % MLC dial setting, while still being >10% of the maximum load current dial value for the full permissible user set period, the minimum load LED will be illuminated, the relay healthy indicator switched off and the main trip relay de-energised to stop the motor. If, during this time period, the motor load current increases above minimum load % MLC dial setting, and then once more drops below the minimum load % MLC dial setting value, a new trip timing delay will be initiated. Linked to the minimum load protection feature is a user-selectable minimum load restart timer dial which may be set to manual start or auto start after 10 seconds, 5 minutes, 10 minutes, 20 minutes, 30 minutes, 45 minutes, 1 hour, 3 hours OR 6 hours delay. The facility permits the KD relay to restart the protected motor automatically through the re-start contact present on terminals 11-13 which should be wired in parallel with the start circuit. The facility is ideal in sump pump applications and could eliminate the need for probes. NOTE THAT THE AUTO/MANUAL TOGGLE SWITCH SELECTOR HAS NO BEARING ON THE MINIMUM LOAD FUNCTION. In cases where there is a negligible difference in measured load currents between full and no load it will be incumbent on the setting up engineer to select the power factor method for detection of load loss. In such a case the % calibrated minimum load setting dial revert to a 0 to 1 power factor calibration.

Phase rotation protection will be operative provided terminals 19, 20 and 21 have been connected in the phase sequence red, white and blue as indicated on the label. The phase rotation LED will extinguish as soon as the sequence is correct. Incorrect **phase rotation** will result in the phase rotation LED being illuminated, the relay healthy indicator switched off, and the main trip relay de-energised. This will prevent motor operation with incorrect phase sequence and resultant damage to driven equipment. Once the phase rotation has been corrected the phase rotation LED will be switched off, the relay healthy LED switched on, and the main trip relay re-energised. This will then allow the motor to be started.

In the event of an **overvoltage** condition where the main circuit voltage becomes greater than 115 % of the rated supply, a 10 second trip delay is initiated. After this, the phase rotation LED is illuminated and pulsed at a 75% duty over a 4 second period, the relay healthy LED is switched off, and the main trip relay de-energised. Once the main circuit voltage level reduces to below 115%, the flashing phase rotation LED will switch off, the relay healthy LED is switched on, and

the main trip relay re-energised. This will then allow the motor to be started. This is subject to terminals 19, 20 and 21 being connected.

In the event of an **under voltage** condition where the main circuit voltage becomes less than 90% of the rated supply, a 10 second trip delay is initiated. After this, the phase rotation LED is illuminated and pulsed at a 25% duty over a 4 second period, the relay healthy LED is switched off, and the main trip relay de-energised. Once the main circuit voltage level increases to above 90% the flashing phase rotation LED is switched off, the relay healthy LED is switched on and the main trip relay re-energised. This will then allow the motor to be started. This is all subject to terminals 19, 20 and 21 being connected.

Short circuit protection is an advanced feature that is co-ordinated to back-trip into a back up circuit breaker in 100 ms. The trip threshold is dynamic in that it could vary between 350% and 950% of motor full load current depending once again on the power factor measured at the time of the fault occurring. Once relay output 2 has energized the main trip relay will de-energize a second later.

The addition of an earth leakage core balance CT connected to terminals 24 & 25 of the KD relay will allow the setting up engineer to introduce **earth leakage** protection. The software provided will allow the selection of either a Definite Minimum Time curve selection [instantaneous] or Inverse Definite Minimum Time curve selection as well as set the required trip sensitivity threshold of 30 to 1000 mA. In a similar fashion the introduction of the NewElec **earth insulation** lock out module connected to terminals 22 & 23 will result in the isolation of the start sequence if the KD relay does not measure a minimum of 20 kΩ resistance across the motor windings to earth.

The setting up engineer will need to set the permissible **starts per hour** for the protected motor and decide on the allowed **consecutive start attempts** [1 to 3] that will be permitted in the defined selected time frame.

Descriptive **LED indications** have been provided for ease of fault diagnosis and information. The following red LED trip indicators with clear descriptive fault conditions have been mounted on the control panel to assist maintenance personnel in determining the exact cause of a trip.

3. *Information required for Initial Settings*

This user-friendly relay requires only that you set the motor full load current on the “Max Load Current Amp” dial to coincide with the protected motor’s full load capability. Prior knowledge of the no load current value of the protected motor, if known, will be useful. However it is not necessary as a procedure will be outlined below to determine this value. If the motor is to be auto re-started in accordance with the under current protection features described earlier, you will need to know the time period required for re-starting the motor after an under load trip condition.

4. ***Setting up Procedure***

Ensure that the selected KD relay does in fact cover the full load current range of the protected motor. Note that the models KD 1; KD 5; KD 10 and KD25 and KD 50 do not require any additional current transformers. The relay MUST be installed in the MAIN CIRCUIT of the starter. Being compact in design the built-in single-turn feed-through primary winding transformers permit the main circuit cable conductors of up to 8 mm to pass through the protection relay. In the case of the models KD 100 and KD 200 and KD 400 interposing current transformers of 100:5, 200:5 and 400:5 respectively are required. The secondary winding of these interposing current transformers are then wired through the single-turn feed-through primary winding transformers at the rear of the relay.

The KD range of relays require an auxiliary supply voltage of either 110 OR 220 Volt a.c to be connected to terminals 17 and 18 OR 16 and 18 as appropriate. In addition and in order to activate ALL voltage sensitive protection features each main phase must be connected to terminals 19, 20 and 21 in the sequence red, white and blue as depicted on the relay label. The nominal supply voltage will be auto detected by the relay. For this reason we recommend the insertion of a 2 Amp fuse on each line to afford some protection to possible high surge voltages. The phase rotation LED will extinguish the moment the rotation is correct. The measurements of these phase voltages will automatically incorporate phase rotation, overvoltage and undervoltage protection features. When it is required to use the KD relay with 1000 V a.c motors, it is necessary to add an interposing voltage transformer in the circuit 950 : 525 Volt obtainable from NewElec.

If it is intended to provide earth insulation and earth leakage protection to the circuit the user needs to install a NewElec earth insulation lockout module connected to terminals 22 & 23 of the KD relay and in like manner an earth leakage core balance CT to terminals 24 & 25 of the KD relay.

Connect the N.C contact in series with your trip circuit, (usually the main contactor holding coil) and, if required the N.O contact can be used for signalling or control purposes. Terminals 9 and 10 AS WELL AS terminals 7 and 8 respectively will refer.

Proceed to set the motor full load current on the “MAX LOAD CURRENT AMPS” dial.

Approximate (unless you already know) the percentage drop in load the fully loaded motor will experience during a no load condition and set that % value on the “MIN LOAD % MLC AMPS” dial.

Select either auto OR manual reset in respect of the overload trip thermal lock out period.

If it is required that the relay re-start the motor after an underload trip condition connect terminals 11 and 13 in parallel with the start circuit and set the appropriate time delay on the “MINIMUM LOAD RE-START” dial to suit your own particular application.

The motor protection relay is now ready.

5. ***Adding or Removing Features on Site***

The KD relay may optionally be fitted with an earth insulation lockout module and a core balance CT. The relay settings may be adjusted by means of a laptop with an installed NewElec application for altering relay parameters. An MMI is available for more discerning clients not wishing to use a laptop.

6. ***Specifications***

INPUT CONVERTER

Class	: Class 1
Rating	: 0,1 VA
Frequency response	: 40 – 66 Hz

OVERLOAD TRIP DELAY CURVES

Refer Curves above

UNBALANCE / SINGLE PHASING SETTING

Level setting	: 5 to 50 % Ie (motor full load)
Trip delay	: 1 to 10 seconds

FAULT INDICATION

Operation	: Latch on trip
Resetting fault indication	: Latch

ENVIRONMENTAL SPECIFICATIONS

Reference standards IEC 255

Isolation N/O contact

1 kV for 1 minute To IEC 255-5 C

Isolation separate contacts

1 kV for 1 minute To IEC 255-5 C

Impulse withstand

5 kV To IEC 255-4 EIII

High frequency

IEC 255-4 C III

OVERLOAD THERMAL LOCK-OUT TIME TO RECOVER 30% CAPACITY

Example shown for a 15 second curve selection

T reset = Curve [2.33 (35,49 x 2) 15 log (100/70)] – Motor running

MAXIMUM LOAD CURRENT SETTING

Level setting accuracy	: ± 2%
Linearity	: ± 2%
Repeatability	: ± 1%
Detection level	: ± 2%
Calibration	: Amps

MAIN TRIP RELAY

Current rating	: 5 Amps 220 Volt a.c
Configuration	: 1n/o + 1n/c
Terminals	n/c 7 and 8
	: n/o 9 and 10

UNDERLOAD DETECTION

Range	: 10 to 100% of maximum load setting dial
Trip delay	: 1 to 10 seconds
Priming Time available	: 1 to 200 seconds
Power Factor settings	: 0.1 to 1 on minimum load dial

RESTART TIMER

User-selectable range: Manual only, 10s,

RUNNING STALL PROTECTION

Detection level: 110 to 300% of maximum load dial setting with a 1s trip delay

AUTO RESET LIMITER

Auto reset limited to only 3 times per hour

2 min, 10 min, 20 min, 30 min, 45 min, 1 hr,
3 hrs OR 6 hrs delay.T reset = Curve [2.33 (35,49 x 4) 15 log (100/70)] – Motor standstill

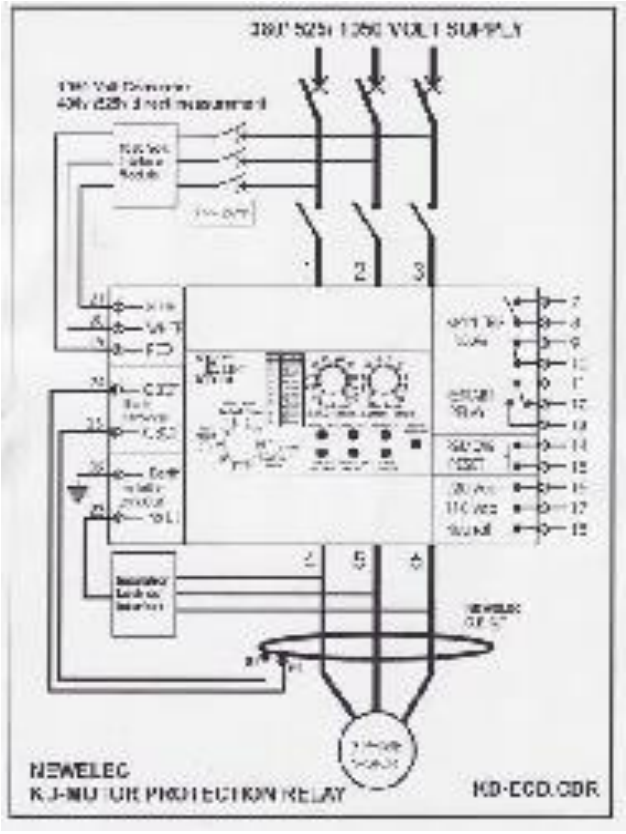
Fault Diagnostic Interpretation LEDs

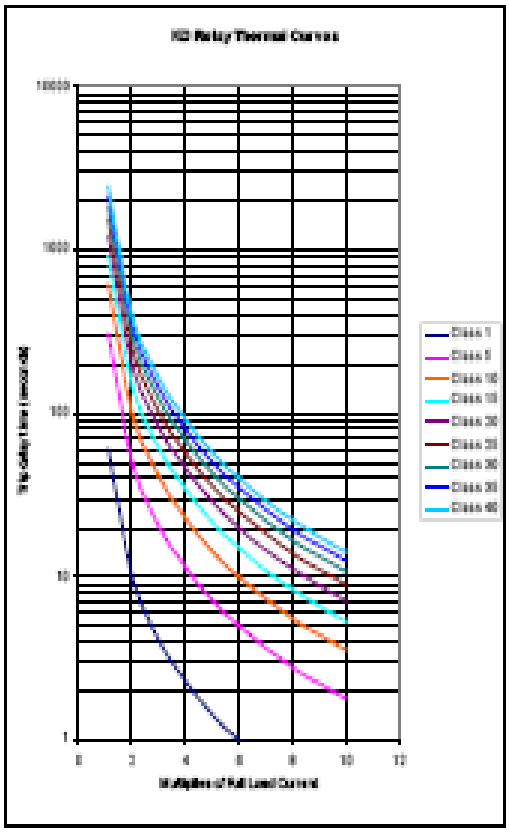
Name Of Fault	Indication LED Used	Display Mode
Over Current	Overload	Solid On
Short Circuit	Overload	Solid On
Minimum Load	Min Load	Solid On
Phase Rotation	Phase Rotation	Solid On
Unbalanced Phase Currents	Unbalance	Solid On
Single Phasing	Unbalance	Solid On
Insulation Failure	Insulation Failure	Solid On
Run Stall	Overload	Solid On
Vectorial Stall	Overload	Solid On
Earth Leakage	Earth Leakage	Solid On
Earth Fault	Earth Leakage	Solid On
Over Voltage	Phase Rotation	3 seconds ON – 1 second OFF
Under Voltage	Phase Rotation	1 second ON – 3 seconds OFF
Voltage Symmetry	Phase Rotation	1 second ON -1 second OFF
Starts per hour	Overload & Healthy	Both 1 second ON and OFF
High Frequency	Unbalance	3 seconds ON – 1 second OFF
Low Frequency	Unbalance	1 second ON – 3 seconds OFF

7. Dimensions

Din Rail Mounting. Footprint 100 mm long X 60 mm wide by 150 mm high

8. Electrical Connection Diagram and Thermal Curves





9. *Ordering Information*

Relay Model	Current setting range	Current transformer ratio where required
KD 5	0,5 to 5 Amp	Not required
KD 10	1 to 10 Amp	Not required
KD 25	2,5 to 25 Amp	Not required
KD 50	5 to 50 Amp	not required
KD 100	10 to 100 Amp	100:5 Class 1 2,5 VA
KD 200	25 to 200 Amp	200:5 Class 1 2,5 VA
KD 400	40 to 400 Amp	400:5 Class 1 2,5 VA