NHP
100 percent Australian Owned

TECHNICAL NEWS

Issue 35 March 2002

Please circulate to

_____
_____
_____
_____
_____

Quarterly Technical Newsletter of Australia's leading supplier of low-voltage motor control and switchgear.

IN THIS ISSUE

IMPROVING STAR-DELTA PROTECTION

Written by Bill Mairs
Technical Manager, NHP Electrical Engineering Products Pty Ltd

There are several options when providing overload and short circuit protection for a star-delta motor starter. Understanding these options can provide improved protection of the motor and in some cases can permit a reduction in cable size. The cable must be provided with both short circuit and overload protection. The requirements for this protection are covered by the Wiring Rules (AS/NZS 3000:2000).

1. Protection of motors with direct-on-line starting

A normal three-phase motor is sufficiently protected by the combination of a contactor and a circuit breaker with motor protective characteristic. As the full rated current of the motor flows through the circuit breaker, the current setting of the thermal release is equal to the motor rated current. The cables are rated according to the motor current / circuit breaker setting.

2. Protection of motors with star-delta starting

2.1 With one circuit breaker

In the case of a star-delta starter, the upstream circuit breaker can takeover the motor protective function and thermal overloads fitted to the contactors are not required. The circuit breaker also provides the overload and short circuit protection

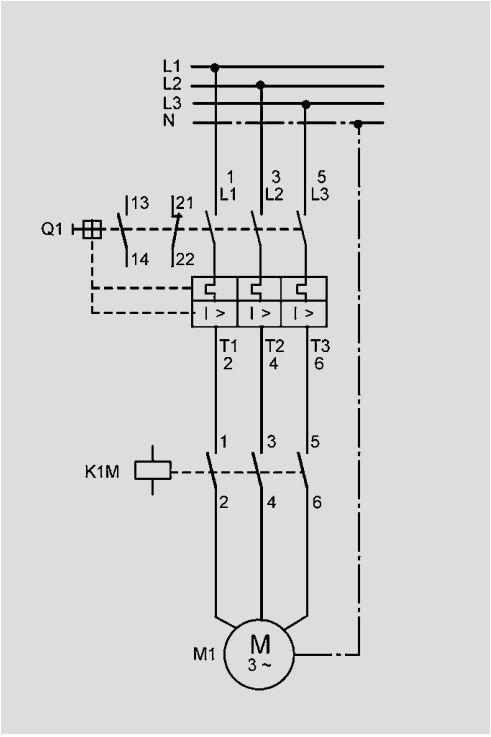

Fig. 1: *Starter for direct-on-line starting with circuit breaker*

required for the cables. The cross-section of the connecting leads to the motor must be selected on the basis of the current setting of the circuit breaker for overload protection and for short circuit protection the energy let through of the circuit breaker during a fault. The current setting of the thermal release of the circuit breaker (motor protection style) is to be equal to the actual rated current of the motor.

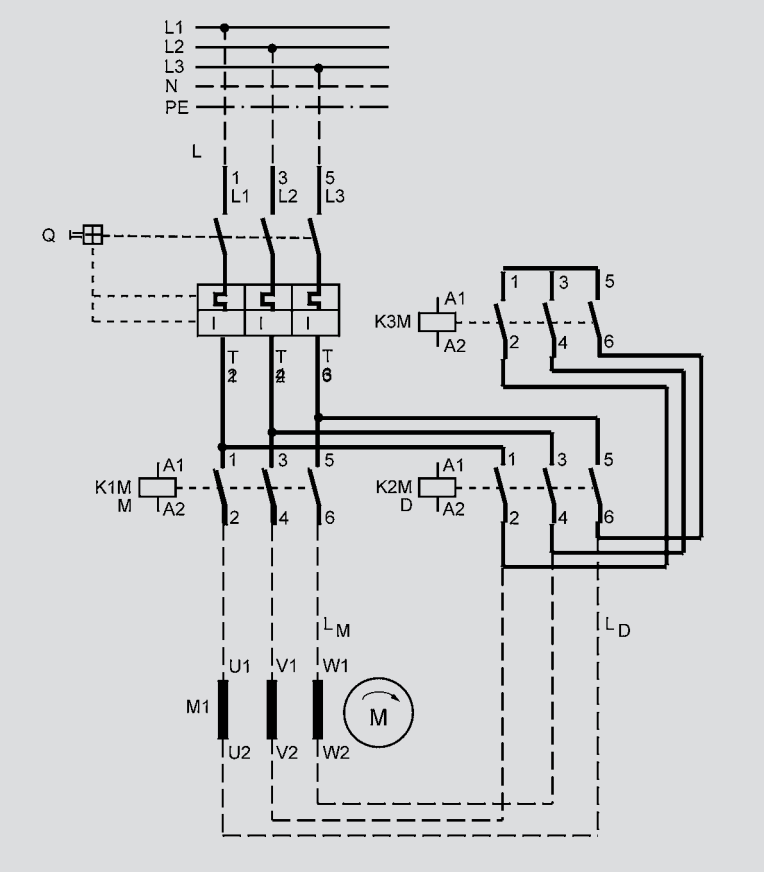

Fig. 2: *Starter for star-delta starting with one circuit breaker*

breaker would be say 1.2 times the motor rated current. A distribution type circuit breaker could also be used with a suitable current setting to prevent it tripping before a thermal overload.

As cable thermal overload protection is now provided for a current of 0.58 times Ie the cables can be selected on this basis. For long cable runs this can produce a worthwhile saving. In addition the motor is now protected against failure of the starter to sequence to delta.

While the same protection would be provided with one thermal overload relay the Wiring Rules requirements suggest two would be required to take advantage of the possible reduction in the size of both L_M and L_D cables.

The six connecting wires however, will normally only carry 0.58 x rated motor current (Ie). A cable (L_M and L_D) selected for this current would be protected against overload in run or delta connection but not in the star connection, so it must be rated for the full motor current.

If the starter fails to change over from star to delta the motor can run with the windings overloaded without the circuit breaker detecting an overload. The current needs to exceed 1.7 times the rating of the winding before it starts looking like an overload.

2.2 With one circuit breaker and two thermal overload relays

For economical reasons, it can be justifiable to use even two thermal overload relays in the motor winding circuits to realise a reduction of the cross-section of the motor connecting leads. The current setting of the thermal overload relays would be 0.58 times Ie whereas the setting of the current dial of the circuit

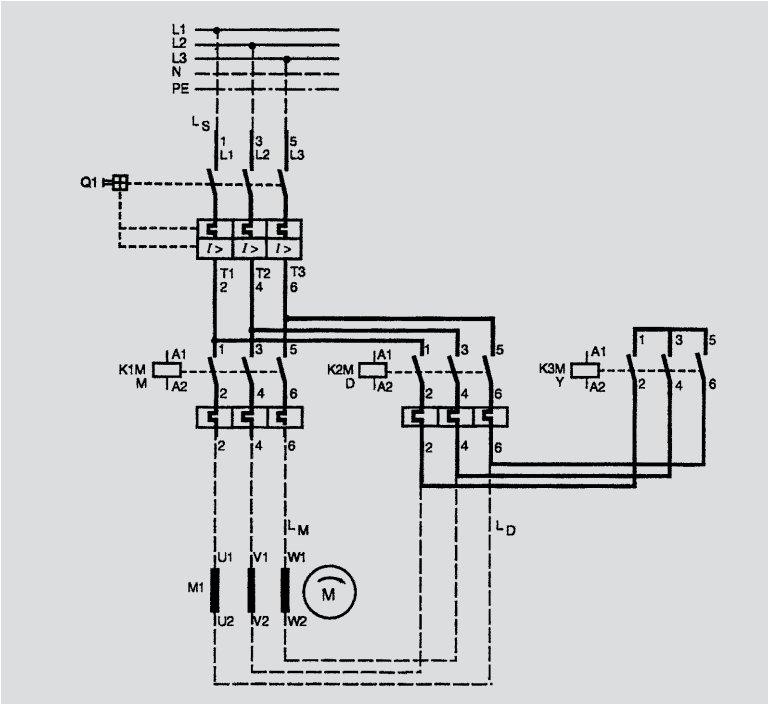

Fig. 3: *Starter for star-delta starting with one circuit breaker and two thermal overload relays*

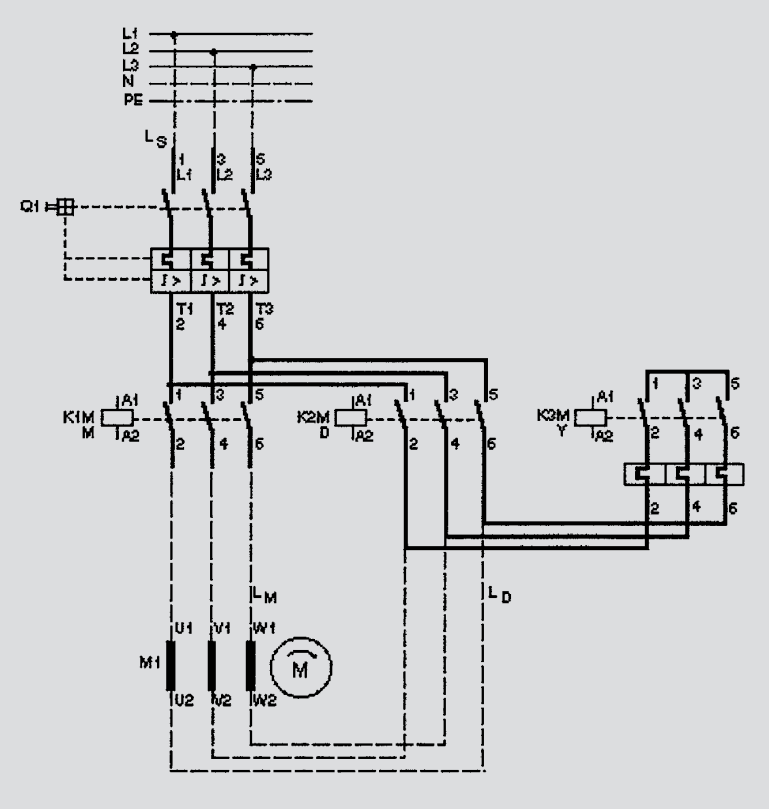

Fig. 4: Starter for star-delta starting with one circuit breaker and one additional thermal overload relay in series with the star-contactor during the running-up phase.

current in delta-connection (0.58 x Ie). The relay should be connected to control K1M and not K3M. The relay could also be fitted to K1M and remain in circuit after the initial star connected run up but in this position it is less suitable for heavy duty starting.

2.4 With two circuit breakers

A star-delta starter with two circuit breakers permits a reduction in the cross section of the motor connecting leads and is suitable for heavy-duty

2.3 With one circuit breaker and one thermal overload relay

During the period when the starter is connected in star, the current is equal to one third of what would flow in the delta connection. The current setting of the circuit breaker is, however, equal to Ie. If the rotor is locked during starting, a current of about twice Ie may flow through the circuit breaker. Thus, the circuit breaker will trip with a relatively long time delay in the case of locked-rotor during starting. This may damage the motor.

Fitting an additional thermal overload relay connected in series with the star-contactor takes over the protective function during the run-up phase of the motor. The maximum current setting of this relay should be equal to the phase

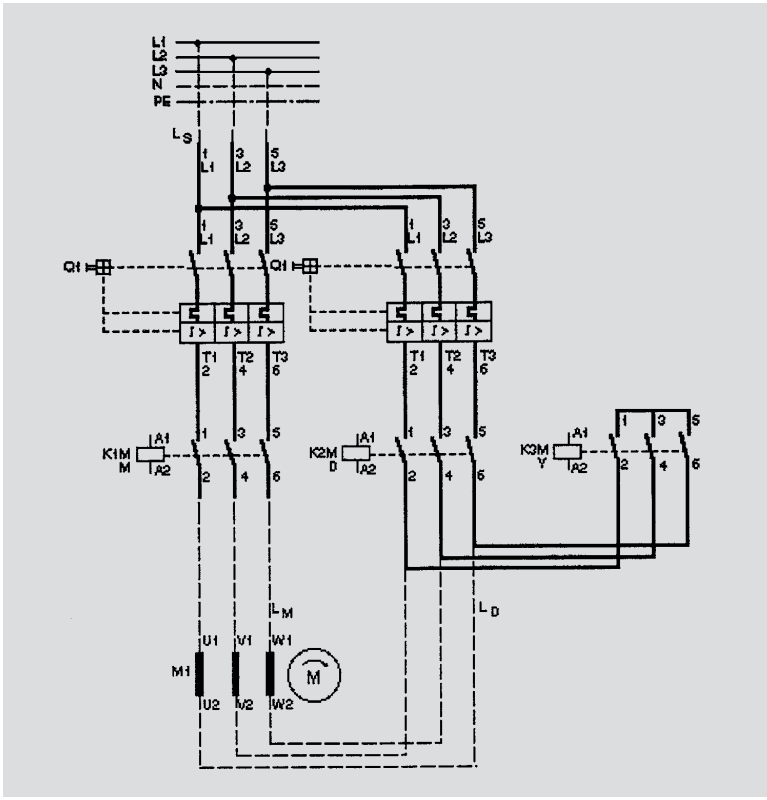

Fig. 5: Starter for star-delta starting with two circuit breakers for reduced cross-section of the motor connecting leads and suitable for heavy-duty starting.

starting with relatively long run up time.

The current setting of the breakers would normally be 0.58 x Ie, but for heavy duty starting the circuit breaker connected above K1M can have a higher setting to allow a longer run up time. The cables L_M would need to be sized to this setting.

3. Conclusion

The placement of the protection on a star delta starter can give varying degrees of protection and also alter the permissible minimum cable sizes. In critical applications and in cases of long cable runs careful consideration should be given to the protection arrangement. Some advanced electronic relays can allow for the change from star to delta and may permit the use of cables based on the smaller currents inside the delta loop.

If you would like previous copies of Technical News, please complete the following form and **fax to NHP on (03) 9429 1075** marked to the attention of the **Marketing Services Department.**

Name:.....Title:.....

Company: .....

Address: .....

Telephone: ( ).....Fax: ( ).....

☐ **Part A**

Other titles currently available. Please tick those you would like to receive.

☐ Controlling high short circuit currents with current limiting circuit breakers (short circuit co-ordination KT 7)

☐ EMC - what's all the noise about (understanding EMC)

☐ How does electrical equipment rate (Understanding ratings of electrical equipment)

☐ The quality Switchboard (Switchgear and protection devices for Switchboards)

☐ RCDs are saving lives (Earth leakage protection; RCDs)

☐ Terminations, good or bad? (Terminals)

☐ Power factor what is it?(Power factor and correction equipment)

☐ Set the protection (MCCB breakers and application)

☐ IP ratings what do they mean? (IP Ratings, use and meaning)

☐ Utilisation categories (Electrical life of switches)

☐ Don't forget the motor protection (Motor protection devices and application)

☐ Electrical life of contactors (How and why contactors are tested)

☐ Taking the 'hiss' out of DC switching (DC switching principles)

☐ Start in the correct gear (Application of different motor starters)

☐ Application guide to lamp selection (Industrial pushbutton controls)

☐ Electrical surges can be expensive (Electrical surges)

☐ The thinking contactor (The development of the contactor)

☐ Some don't like it hot (Temperature rise in electrical switchgear)

☐ Pollution of the airwaves (Unwanted signals and their effects on motor protection devices)

☐ What's the difference about safety (Safety devices and their application)

☐ Talk about torque (Motors and torque)

☐ Keep Cool (Derating)

Editorial content: - Please address all enquiries to 'The Editor - 'NHP Technical News' PO Box 199, Richmond, Victoria, 3121.

NHP Electrical ☐
Engineering Products ☐
Pty Ltd A.B.N. 84 004 304 812
www.nhp.com.au☐
AUSTRALIA ☐
VICTORIA☐
MELBOURNE☐
43-67 River Street
Richmond VIC 3121☐
Phone (03) 9429 2999
Fax (03) 9429 1075
NEW SOUTH WALES☐
SYDNEY
30-34 Day Street North,
Silverwater NSW 2128
Phone (02) 9748 3444
Fax (02) 9648 4353
NEWCASTLE
575 Maitland Road
Mayfield West NSW 2304
Phone (02) 4960 2220
Fax (02) 4960 2203
QUEENSLAND
BRISBANE
25 Turbo Drive
Coorparoo QLD 4151
Phone (07) 3891 6008
Fax (07) 3891 6139
TOWNSVILLE
62 Leyland Street
Garbutt QLD 4814
Phone (07) 4779 0700
Fax (07) 4775 1457☐
ROCKHAMPTON
14 Robison Street
Rockhampton QLD 4701
Phone (07) 4927 2277
Fax (07) 4922 2947
TOOWOOMBA
Cnr Carroll St & Struan Crt
Toowoomba QLD 4350
Phone (07) 4634 4799
Fax (07) 4633 1796☐
CAIRNS
14/128 Lyons Street
Bungalow QLD 4870
Phone (07) 4035 6888
Fax (07) 4035 6999
SOUTH AUSTRALIA☐
ADELAIDE
50 Croydon Road
Keswick SA 5035
Phone (08) 8297 9055
Fax (08) 8371 0962
WESTERN AUSTRALIA☐
PERTH ☐
38 Belmont Ave
Rivervale WA 6103
Phone (08) 9277 1777
Fax (08) 9277 1700
NORTHERN TERRITORY☐
DARWIN
3 Steele Street
Winnellie NT 0820
Phone (08) 8947 2666
Fax (08) 8947 2049☐
TASMANIA ☐
HOBART
2/65 Albert Road
Moonah Tasmania 7009
Phone (03) 6228 9575
Fax (03) 6228 9757
NEW ZEALAND☐
NHP Electrical Engineering
Products (NZ) Limited☐
7 Lockhart Place
Mt Wellington Auckland 1006 NZ☐
Phone 64 9 276 1967☐
Fax 64 9 276 1992

Version 5