

Press release: T-R4 time relay in delta-star start-up system

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Many drives with inductive cage motors are still based upon classic solutions such as switching at rated voltage, reduced voltage or non-symmetrical voltage system. Due to economical reasons, it is often necessary to use more cost-effective and simpler solutions. In such situations the semi-conductor start-up devices (soft starters, etc.) may be replaced with the control methods based on electromagnetic relays and contactors.

Connecting a still cage motor to the supply causes the occurrence of the problem of a high current flowing in the motor coils. The current surge of the direct connection of the motor exceeds the values of the rated current by 5 to 8 times. Such current does not damage the motor but results in significant voltage drops in the supply line, more power loss of the motor and temperature increments in coils upon start-up. Thus, the classic methods of "connection at reduced voltage" are applied. They consist in reduction of the voltage applied to the motor terminals on start-up, which reduces the start-up current and the torque. This negatively affects the mechanical properties of the motor as the load moment is significantly reduced. Thus, the torque should tend to reach a higher value than the load moment.

One of the methods of "connection at reduced voltage" is the delta-star connection. It must be borne in mind that the delta-star connection may only be used in low-voltage motors whose stator's windings are delta-connected at the rated voltage so that the line-to-line voltage be equal to the phase rated voltage of the motor. At the initial stage of the start-up, the phase windings are star-connected. Thus, the current from the mains and the torque are three times lower than in the motor which is delta-connected. The start-up time is very important as switching to delta-star shall be made at the moment when the star-connected motor reaches the rotational speed close to the rated

speed, see Point "b", Fig. 1. In case of earlier switching, a disadvantageous current surge may occur, see Point "a", Fig. 1. Manual delta-star switches are used whose task is to switch the motor windings appropriately. Normally, it is the machine operator who decides on the time of switching, and this brings about some unwanted inaccuracies on switching. Many drive applications, however, use automatic switching of the motor windings with contactors controlled with a time relay system. In such cases, the simple, single-function T-R4 relay of RELPOL is an excellent choice.

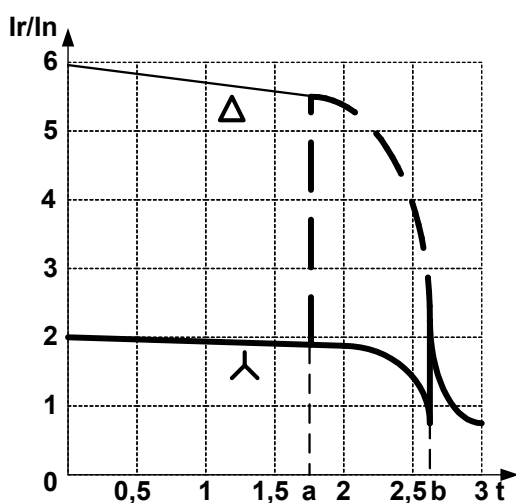


Fig. 1 Course of start-up current in delta-star start-up

As shown in the drawing below, the delta-star switching is performed directly by contactors: S1 (responsible for connecting the motor to the mains), S2 (responsible for star connection of the windings), and S3 (responsible for delta connection of the windings).

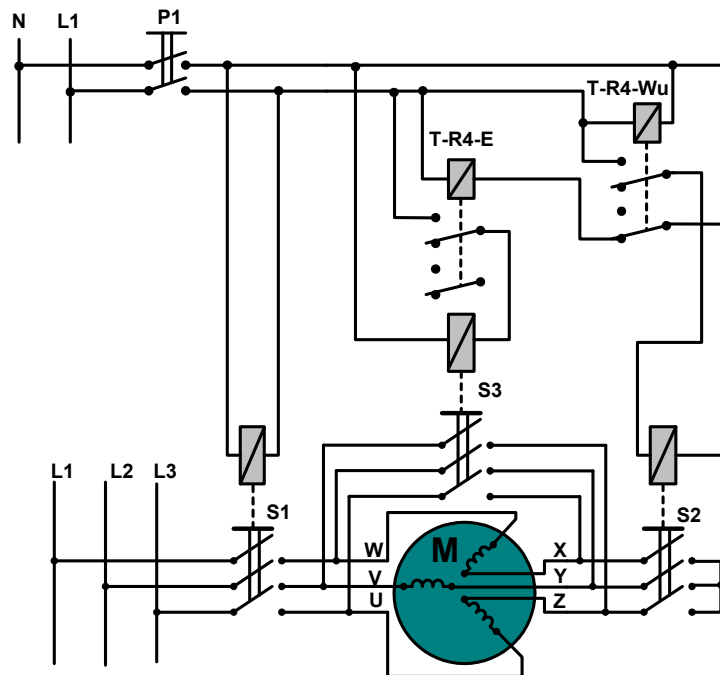
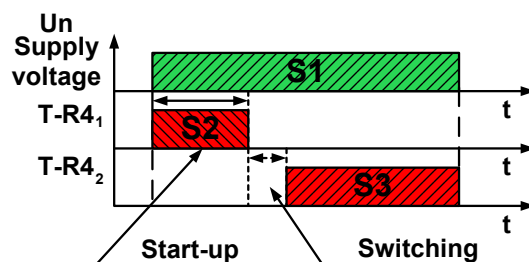


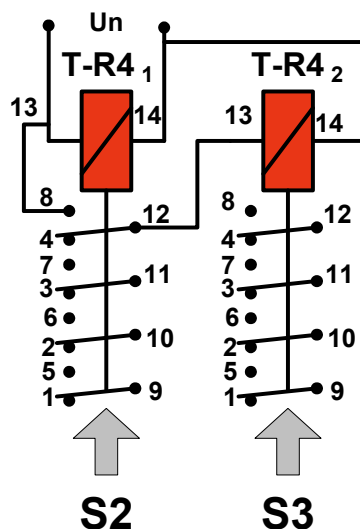
Fig. 2 Diagram of delta-star start-up system

Two time relays T-R4 may be used in the contactor-control system. One may control the operation delay of the motor with star-connected windings. Such delay may range from a few to more than ten seconds, which depends on the motor power and the load moment. The other T-R4 relay would be responsible for the gap between the switch from star to delta connection. For different drive types to use the delta-star start-up, a short delay between switching S2 and S3 relays must be taken into account (50-100ms). This is to eliminate such transient states as electric arc.



Figs.3 Time course of delta-star start-up

T-R4 relays are manufactured in four versions, i.e. T-R4-E – delay on make; T-R4-Wu – measurement of the pre-set make time; T-R4-Bi – cyclic operation on make; T-R4-Bp – cyclic operation on break. For the delta-star start-up, the delay on make or measurement of the make time are the appropriate types.



Figs. 4 Example of connecting two T-R4 relays to control start-up contactors

T-R4 time relay has four changeover contacts as the operating circuit is fitted with the known and appreciated by the market R4 relay included in the offer of RELPOL. It is appropriately controlled by an electronic time module which operates the time functions. The wide range of time setting selections and the accuracy of the electronic time module allows adapting the start-up system to various types of drive. The number of contacts in T-R4 provides the control of start-up contactors for the maximum of three drives which start simultaneously and whose start-up characteristics (system of pumps, compressors, etc.) are similar. This provides for much lower costs of the start-up system in case of a few drives to be started simultaneously.

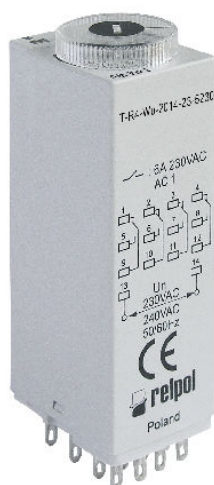


Fig.5 RELPOL'S single-function time relay T-R4 with GZM4 socket

The T-R4 time relay is widely applied in classic control of drive systems which require high quality and accuracy in line with economic benefits. It should be noted that the delta-star start-up with the use of T-R4 relays presented above is not the only example of the application of T-R4 in simple systems of electric motor control.