

Use of two-phase control for soft starter applications



Application

Eaton's DS6 and DS7 soft start controllers are two-phase control soft starters used to accomplish motor starting by means of the reduced voltage method. During the ramp start sequence, two phases are controlled by modulating SCRs that are installed anti-parallel in two phases, while the remaining phase is directly connected from line to load. At the completion of the ramp time, internal bypass relays are closed to achieve a lower circuit resistance, just as they are in a high-end three-phase controlled soft starter.

Overview

To achieve acceptable service life, it is important to maintain the strength of the rotating magnetic fields that are present in the three phases, and to keep the uniformity as close as possible to minimize electrical stresses and mechanical vibrations in the motor. While it is highly desired that all phases in any system are perfectly balanced by possessing exactly the same rotating field strength at any given time, in actuality this is rarely the case. Hence, electric devices are designed to accommodate small levels of phase imbalance during the course of normal operation. Many reduced voltage soft starters are equipped with phase monitoring features designed to interrupt motor operation during the start sequence and/or during normal operation if the imbalance becomes excessive.

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Two-phase control

While two-phase control is a straightforward process, it is not a matter of merely eliminating control on one phase without considering the effect of this action on all three phases. In Wye or Delta motors, each of the three field winding circuits consists of an electrical relationship between the two controlled phases and the third. This third phase is a direct connection passing through the soft start controller. As such, control of the SCRs will indirectly control current flow (rotating field) in the uncontrolled phase.

The asymmetrical trigger control developed and patented (PCT/EP00/12938, 19.12.2000) by Moeller, an Eaton brand, makes it possible. This control avoids DC components, which normally result on a two-phase-controlled soft start controller. Asymmetrical trigger control suppresses the formation of an elliptical rotating field, which leads to uneven stresses in the motor and extended acceleration times. On DS6 and DS7 series devices, this asymmetric trigger control is active during the start and stop ramp.

The two-phase control power structure is optimized to produce a slightly lower torque value than that of a three-phase controlled soft starter when comparing similar initial and start ramp voltages. This is ideal for variable torque applications. The smooth running characteristics of the DS6 and DS7 soft start controllers are comparable with those of a three-phase-controlled soft starter.

Isolation

Under normal circumstances, SCRs are known to transmit a level of voltage potential and thus current in the non-conducting state, regardless of the system being two-phase or three-phase control. Never, under any circumstances, depend solely on SCRs for complete isolation of mains voltage. Lockout-tagout procedure is required before working on the system. Isolation may be accomplished by adding an isolation switch on the line side of the soft start controller. Please do not assume that a three-phase control device is safer as compared to a two-phase control device.

In the event of any activity, including inspection, maintenance or troubleshooting activities, it is imperative that the power source be properly isolated with lock-out and tag-out procedures.

Supporting Documentation

Manuals	Reference Number
DS6 instructional leaflet	IL03901001E
DS6 catalog	CA03901001E

Additional help

In the event that additional help is needed, please contact the Technical Resource Center at 1-877-ETN-CARE, Option 2, Sub Option 2.

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