

# TechTopics No. 103

## Medium-voltage controllers – fixed-mounted contactors compared to drawout contactors

For several decades, Siemens has offered Series 81000™ medium-voltage controllers incorporating drawout construction. With the introduction of the SIMOVAC™ family of medium-voltage controllers, Siemens has departed from the drawout construction, and adopted construction with a fixed-mounted contactor and a structure-mounted isolating switch. This has resulted in a number of questions from customers and specifiers, and this issue of TechTopics is intended to address the features of fixed-mounted contactors with an isolating switch as compared to drawout construction.

First, what do the standards require? The governing standard is UL 347, “Medium-Voltage AC Contactors, Controllers, and Control Centers”. This is a tri-national standard, also identified as ANCE NMX-J-564/106 in Mexico and CSA C22.2 No. 253 in Canada. The present UL 347 is the fifth edition, and the revision (the sixth edition) is in ballot as this is written. With respect to the discussion in this issue of TechTopics, the revisions in the upcoming edition are not material. The historic NEMA ICS 3 standard is obsolete and no longer maintained. The essential content of NEMA ICS 3 has been reflected in UL 347.

UL 347 specifies that the isolating means can be any of these:

- A three-pole switch
- A three-pole switch integrated with primary fuses (e.g., hinged fuse mounting)
- A drawout assembly, which may or may not include the primary fuses or the contactor.

The drawout construction of the Series 81000 design used the last of the allowed options.

For the most common 360 A controllers, the drawout carriage included the contactor, the primary (main circuit) fuses, a control power transformer (CPT) with its primary fuses, and primary disconnects (stabs) plus a means to connect secondary and control circuits. The drawout function served the role of an isolating means. For larger controllers rated 720 A, the drawout carriage included the primary (main circuit) fuses, the CPT with its primary fuses, and primary disconnects. The contactor itself was fixed mounted. The large size of the main circuit fuses and the heat generated by the fuses were the reasons for not locating these elements on a drawout carriage including the contactor in the Series 81000 design.

In the SIMOVAC design, all elements are fixed-mounted. The isolating switch is fixed-mounted, with a shutter that prevents access to line side connections when the isolating switch is open. The switch also includes a grounding function when the switch is open. The primary (main circuit) fuses are bolt-in type, and along with the CPT and its primary fuses, and the contactor, are fixed-mounted in the structure.

Why did Siemens make this fundamental change? There are a number of reasons.

- By removing the fuses and the CPT with its fuses from the drawout carriage, the elements that vary from controller to controller were separated, which resulted in non-interchangeable drawout carriages. The main circuit fuses vary by motor or load size and type, and the size of the CPT often varies. Thus, each drawout carriage becomes a unique device and interchangeability at the installation is reduced.
- By removing the main circuit fuses from the drawout carriage, a major source of heat is transferred to the structure from the drawout carriage.

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- By having the contactor as a separate element, interchangeability is vastly increased. Contactors are fundamentally uniform across an installation, with only a few variations (e.g., magnetically-held contactors, mechanically-latched contactors, and 400 A versus 720 A). Variations of CPT size, CPT fuse size, and main circuit fuse size do not affect the interchangeability of the basic contactor.
- Contactors are largely maintenance free, and therefore the perceived advantage of a drawout contactor for ease of maintenance is of lesser importance.

The contactor itself seldom needs maintenance, and most maintenance (primarily cleaning of insulation) can be performed with the contactor in place in the unit. For those users who wish to have a more readily removed contactor, for the 400 A rating, a plug-in contactor configuration can be offered, so that no bolts in the primary circuit need removal in order to remove the contactor. Removal consists of disengaging the secondary circuit connector plug, turning the handle-type bolts to loosen the clamps that secure the contactor mechanically, and then simply pulling the contactor out. For a fixed-contactor installation, the procedure is the same except for the additional step of unbolting the line- and load-side primary connections.

The photo shows the plug-in 400 A contactor ready for removal from the enclosure. The clamping knobs have been loosened to release the clamps that secure the contactor in the enclosure. The secondary disconnect plug is ready for removal. The process of removal or insertion of the 400 A contactor requires no tools.



In either the drawout configuration of the Series 81000 or the fixed-mount installation of SIMOVAC, the required functionality and interlocks required by the UL 347 standard are maintained.

Briefly summarized, they are:

- A. The isolating switch cannot be opened unless the contactor is open.
- B. The contactor cannot be closed unless the isolating switch is closed (except as in F below).
- C. The position of the isolating switch (and the shutter) can be visually observed through a window in the exterior of the enclosure without the need to open any door or cover of the enclosure.
- D. When the isolating switch is open, a shutter covers the openings to the cubicle line side bus system.
- E. The contactor cell door cannot be opened unless the isolating switch is open (which also grounds the load side of the switch).
- F. The control power circuit is disconnected when the isolating switch is open, so that maintenance testing with an external control power source cannot back-energize the CPT and the high voltage portions of the controller.

The redesign to use a fixed-mounted contactor configuration results in a greatly simplified and modular motor controller structure, easier to specify and use, and easier to install. As a result, this is the configuration adopted for use in the SIMOVAC family of controllers.

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