



FUSELOGIC™ Application Guide

QUESTIONS AND ANSWERS

What is the FUSELOGIC System?

FUSELOGIC (patent pending) is an ingenious new system available on Square D medium voltage HVL metal-enclosed switchgear. It is designed to act in case of single-phase conditions that can result from blown fuses. FUSELOGIC is available in a variety of configurations from simple blown fuse indicating auxiliary contacts to more elaborate systems that automatically open the switch in the event of single-phasing.

Why FUSELOGIC?

FUSELOGIC reduces the complexity of present day designs for medium voltage blown fuse detection, indication or tripping.

Single phasing on a three phase system generally results in serious motor winding damage. FUSELOGIC's quick and efficient tripping alone warrants it's use on any medium voltage three phase system where blown fuse single phasing is a concern.

Currently, blown fuse detection, indication or tripping requires instrument transformers, protective relays, timing relays and trip coils or motor operators. These types of detection and protection schemes also require uninterruptable control power. All of these components add to the complexity and cost of the equipment. Consequently, reliability may be sacrificed and maintenance costs are increased.

Depending on the particular scheme employed by the user or switchgear supplier, relay protection may provide loss of phase detection instead of blown fuse detection. The difference being that the switch may open as the result of a utility loss of phase or a power outage. This would be a nuisance if a number of switches opened and all had to be reset.

FUSELOGIC, on the other hand, is operated by the stored energy available from the blown fuse indicator of Square D medium voltage fuses. FUSELOGIC helps provide anti-single-phase protection directly via this stored energy. Therefore, auxiliary power is not required for blown fuse indication or direct switch tripping.

NOTE: For fuse ratings above those published for direct acting tripping, control power is required only to operate a time delay relay and the shunt trip coil.

FUSELOGIC has been tested in accordance with IEC 420 criteria for opening a switch after a short circuit has occurred.

Why test to IEC 420?

Current ANSI, NEMA, and IEEE standards do not address test criteria for operating a load interrupter switch immediately after a fuse has cleared. In general, fuses only operate after they have been subjected to a short circuit or an extreme overload condition.

On phase to ground faults, when a fuse on a given phase clears, the currents in the other two phases can rise significantly. If the switch attempts to open and clear the circuit with these abnormal currents in the other phases it may exceed its interrupting rating of 600 amperes.

IEC 420 requires that the switch be tested on the basis of the operating time of the switch and the current required to open the fuse at that time. This test needs to be conducted on all three phase to phase combinations ($\emptyset A$ to $\emptyset B$, $\emptyset B$ to $\emptyset C$ and $\emptyset A$ to $\emptyset C$). The switch must not be called upon to exceed its interrupting rating at a 20% power factor.

It must be confirmed that enough time has elapsed for all three of the fuses to interrupt any fault current which exceeds the interrupting rating of the switch in any phase at a 20% power factor. For example, it can be determined that a 15 kV 100E fuse in combination with a switch which has an opening time of 100 ms must be able to interrupt 1400 Amps at a 20% power factor.

This can be confirmed by examining the minimum melt time current curves for the Square D fuses (figure 1). On the time axis select 100 ms (0.1 sec) and go across to where the 100E fuse curve intersects. The corresponding current is approximately 1400 amperes.

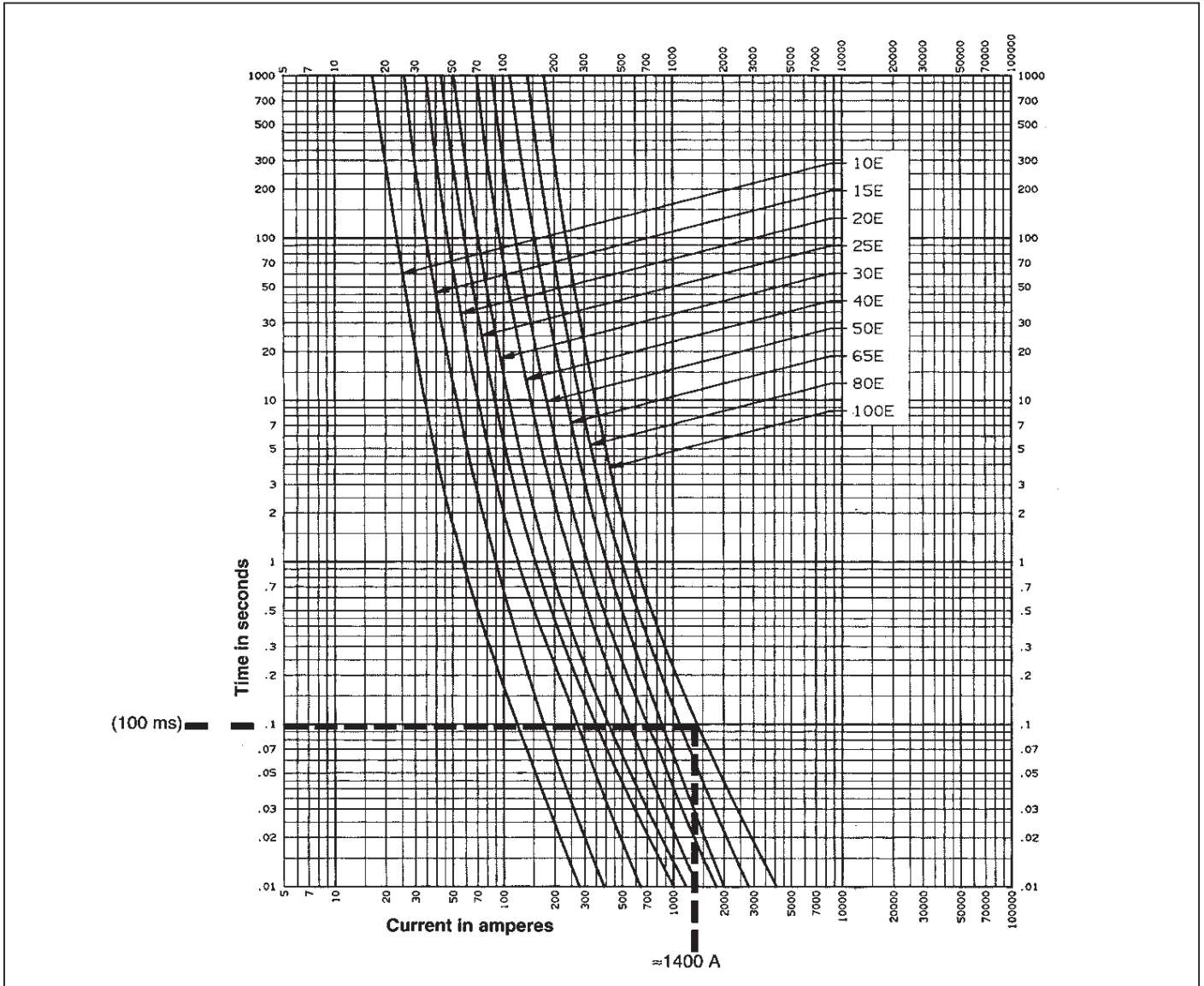


Figure 1: Minimum Melting Time Current Data 15.5 kV

Because the switch can only interrupt 600 Amps, in this example we need to use indirect tripping of the switch. A time delay relay is required to delay the opening of the switch and allow the fault current to decay to steady state conditions.

IEC also requires that the switch be subjected to a three phase test in a similar manner.

Whereas conventional schemes in the USA have not been tested in this manner, the HVL load interrupter switch, with FUSELOGIC, has now been tested for performance exceeding the requirements of the ANSI/IEEE standards.

FUSELOGIC FEATURES

FUSELOGIC Dual Trip Mechanism

The FUSELOGIC mechanism is a dual spring stored energy mechanism with separate closing and opening springs. Operation of this mechanism is similar to that of the standard manually operated HVL load interrupter switch. The sequence of operation is as follows:

1. The opening spring is charged by pulling the spring charging handle downward.
2. The closing spring is charged by returning the charging handle to the vertical position.
3. The switch is closed by pulling the open/close lever.
4. The switch is opened by pushing the open/close lever.

This FUSELOGIC dual trip sequence of operation charges the opening spring before the closing spring is charged. This makes the mechanism ready to trip with a single action after the switch is closed, as required by the National Electrical Code.

NEC Clause (710-21) (e) (5) states:

“Stored Energy for Opening. *The stored energy operator shall be permitted to be left in the uncharged position after the switch has been closed if a single movement of the operating handle charges the operator and opens the switch.”*

Traditional stored energy opening (shunt open) mechanisms manufactured in the USA utilize a one spring mechanism to both close and manually open/shunt open the switch. The sequence of operation for this type of mechanism is:

1. To close the switch, the manual operating handle is moved upward to charge the spring. Once the spring reaches top dead center it toggles over and closes the load interrupter switch.
2. To charge the mechanism for an opening operation, the manual operating handle is moved downward charging the spring. Once the spring reaches top dead center and begins to toggle over, it is caught and set on a latch. The mechanism is now armed and the switch is ready for opening either manually or by an electrical opening coil.
3. Manual operation is generally accomplished mechanically by a manual opening lever or pushbutton.

This traditional type of shunt open mechanism does not comply with the intent of the NEC code because two movements are required to open the switch—one movement to charge and latch the opening springs in the mechanism and another to operate the opening mechanism.

Blown/Missing Fuse Lockout

With the blown fuse/missing fuse lockout feature the switch will not close if a fuse is blown or if a fuse has been removed and not replaced. This mechanical interlock is activated by the blown fuse indicator of the Square D medium voltage fuse or, in the case of the missing fuse, by a fuse position sensor. This particular feature reduces the chance of operator error where inadvertent closing of the switch could result in a single phase condition.

Blown/Missing Fuse Indication

This optional feature can be added to either the standard HVL load interrupter switch mechanism or to the FUSELOGIC dual trip mechanism. The blown/missing fuse lockout feature is included with this option.

Blown/missing fuse indication is available in two versions:

- Individual phases blown fuse indication. Three sets of form-C contacts, one per phase, for operating indicating lights or to be used as contacts for an alarm system.
- Common blown fuse indication. One form-C contact for all three phases to operate an indicating light or to be used for an alarm system.

These contacts can be used to open a motor operated HVL load interrupter switch.

Direct Acting Fuse Tripping

This feature allows direct tripping of an HVL load interrupter switch equipped with the FUSELOGIC dual trip mechanism for fuse ratings that fall within the specifications. The dual trip mechanism, with its pre-charged opening spring, receives a mechanical signal from the Square D medium voltage fuse and opens the switch when a fuse blows.

The "blown/missing fuse lockout" is standard with this feature, but the "blown/missing fuse indication contacts" are optional.

Indirect Acting Fuse Tripping

This feature can be provided when the fuse rating exceeds that for direct acting trip. The FUSELOGIC mechanism is then equipped with a shunt trip coil and a time delay relay. For this feature the FUSELOGIC system has an auxiliary contact that first activates a time delay relay which in turn operates the shunt trip coil. The HVL load interrupter switch is then opened and the single phase condition is eliminated.

The "blown/missing fuse lockout" is standard with this feature, but the "blown/missing fuse indication contacts" are optional.

Shunt Trip Applications

The HVL load interrupter switch is, by definition and standards, only required to interrupt its continuous current nameplate rating. In other words, a 15 kV 600 ampere HVL can only interrupt 600 amperes and no more. Below are several applications in which it is appropriate to use a shunt trip coil as well as applications in which it should not be used.

Ground Fault Protection on Solidly Grounded Systems

Occasionally, to avoid the expense of VESI/VAC® circuit interrupter switchgear or metal-clad switchgear, specifications are written to incorporate ground fault protection. Metal-enclosed switchgear is frequently used with solidly grounded systems where the available short circuit current is 12.5 kA or more.

The HVL load interrupter switch cannot be considered or utilized for ground fault protection on solidly grounded systems because the available fault current is far greater than its 600 or 1200 ampere load interrupting rating.

Ground Fault Protection on Resistively Grounded Systems

Frequently, three phase electrical systems have a grounding resistor. The grounding resistor limits the level of the ground fault current and consequently reduces the potential damage to the equipment.

If the system is resistively grounded with a nominally rated 400 ampere grounding resistor, then it may be possible to use HVL metal-enclosed switchgear. Please consult our nearest field office to determine if this is an appropriate application.

Transformer Overload Protection Applications

Medium voltage fuses are designed as short circuit protective devices and generally do not provide adequate overload protection for transformers.

To improve the overall protection scheme with an HVL load interrupter switch for a transformer, overcurrent (IEEE 51) relays may be used to provide precise overload protection in addition to the short circuit protection provided by the fuses.

In this application, to avoid the risk of personal injury or property damage, the selection of the CT ratio and the highest ampere tap rating of the 51 overload (overcurrent) relay does not exceed the interrupting rating of the switch.

Under-voltage Protection With FUSELOGIC

FUSELOGIC is well suited where under/over voltage protection is required. The shunt trip coil, actuated by voltage sensing relays, can be used to open the switch with the loss of incoming line voltage. This application requires optional VT's and voltage sensing relays.

Automatic Transfer Schemes With FUSELOGIC

The FUSELOGIC dual trip mechanism is a stored energy mechanism that can be optionally equipped with both opening and closing coils. It has independent closing and opening springs. When the switch has been prepared for closing, both the closing and opening springs have been charged.

Today, only a "single shot" automatic transfer scheme between two dual trip mechanism HVL switches can be accomplished. The motor operator is still under development. One switch can be closed (with the opening spring charged and ready to open with a signal from the loss of voltage relay) and the other (with both springs charged) would be ready to close. Once closed, the other switch would have to be manually reset before transferring back.

FUSELOGIC and a Motor Operated HVL Switch (with Conventional Spring Mechanism)

FUSELOGIC and all of the interlocks are available for use with the motor operated HVL switch equipped with the conventional over-toggle single spring mechanism.

Interlocks are provided to help prevent inadvertent closing of the motor operated switch, both electrical and mechanical interlocks are used.

The mechanical interlock impedes closing the switch manually. The electrical interlock opens the motor closing circuit with a blown/missing fuse auxiliary contact.

The conventional over-toggle single spring mechanism equipped with a motor operator operates in approximately two seconds.

The dual spring mechanism operates in approximately 100 milliseconds. The future motor operator will recharge the springs in approximately 10 seconds and prepare the switch for any reclose operations that might be required.

SQUARE D, VISI/VAC, and  are Registered Trademarks of Square D Company.
FUSELOGIC is a trademark of Square D Company.

© 1996 Square D All Rights Reserved

Square D Company
330 Weakley Road
Smyrna, TN 37167 USA



Order No. 6040PD9601 1M FP 10/96

Printed in USA