

GAMBICA Position Paper

Variable Speed Drives and earth faults

3rd July 2013

A Variable Speed Drive's (VSD) primary function is to control the speed of an electric motor. It is not intended to be used as a circuit protection device in the case of an earth fault. The installation of a VSD to a correctly protected circuit will not change the effectiveness of the protection.

If an earth fault occurs in the motor circuit of a VSD then the VSD overcurrent protection will remove its output within a very short time, typically less than 1 ms. This function is built in to all VSDs in order to protect them from damage caused by short circuits. This is however only internal VSD protection and is not intended as general circuit protection or as personal protection.

The VSD internal protection uses power semiconductor devices and complex electronic circuits to fulfil this function. Therefore consideration must be given to the effect of a failure of the function.

If a failure occurs, the final effect will be either:

- (a) The semiconductor device fails in an open circuit state in less than 0.4s
- (b) The semiconductor device fails in the short circuit state for longer than 0.4s

The semiconductor device does not have any failure mode which restricts the current, other than the open circuit state, because this would result in a high power dissipation in the semiconductor resulting in its rapid destruction.

For case (a) the earth fault is interrupted in less than 0.4s as required

For case (b) the earth current continues uninterrupted by the VSD, but this current also flows in the protection device upstream of the VSD. This device is selected by the installer to achieve the required interruption time, according to the usual procedure.

Therefore the requirement for disconnection of an earth fault is achieved, provided that the circuit protection is chosen so as to protect the entire motor circuit. In other words, if the protection is correctly designed as if the VSD were not present, the addition of a VSD does not change the effectiveness of the protection. The responsibility for specifying the correct overall circuit protection lies with the designer of the system, in order to meet the local regulations and approvals.