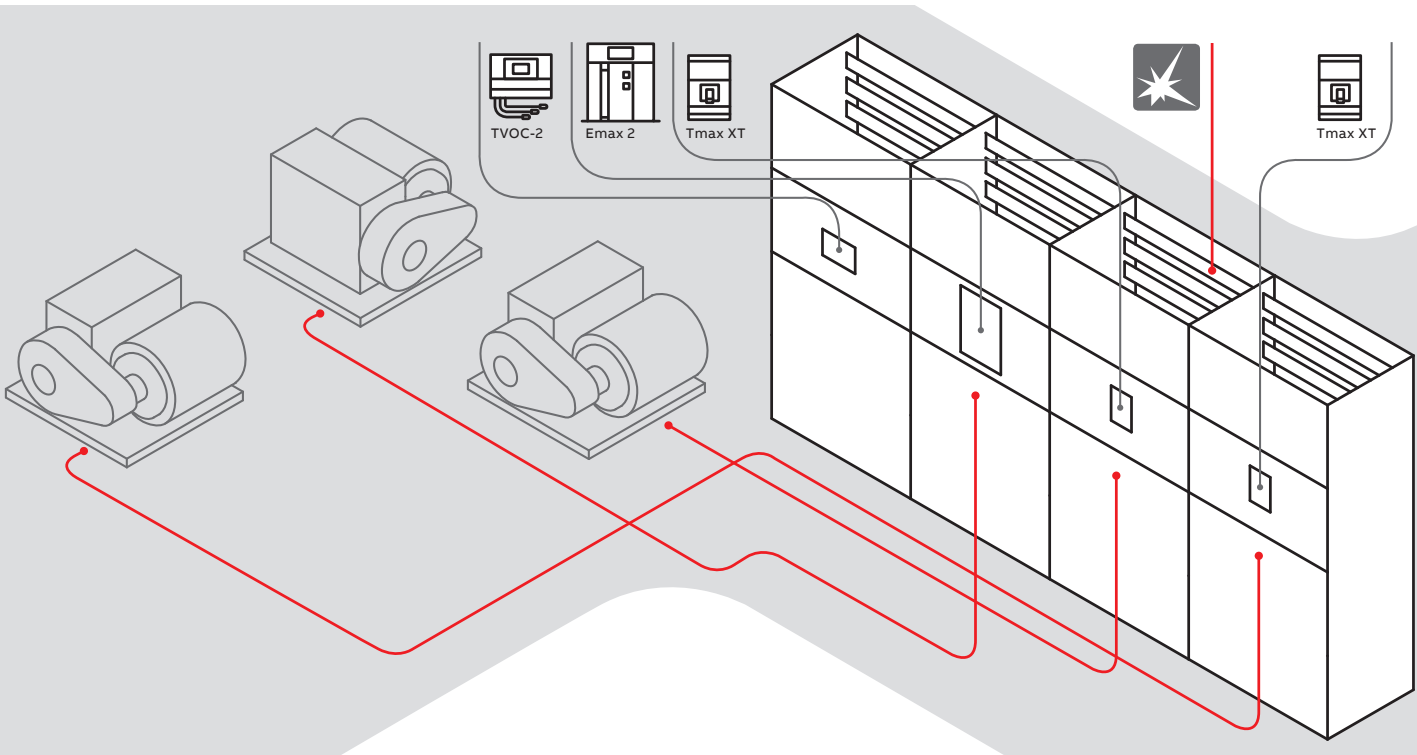


SAFETY FOR OPERATORS

Protection against electric arc

Integration between Arc Guard System™ TVOC-2 and ABB low-voltage circuit breakers



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01
TVOC-2

02
Tmax XT

03
Emax 2

In the last years, a lot of users have raised the question of safety in electrical assemblies with reference to one of the most severe and destructive electro-physical phenomenon: the electric arc.

Such phenomenon generates internal overpressures and results in local overheating which may cause high mechanical and thermal stress in the equipment.

It is necessary to make clear that such phenomenon is an absolutely anomalous and rare event, but since low-voltage switchgear assemblies are the components of the electric installation most subject to maintenance, it is necessary to take safety measures to prevent it.

The arc guard system is therefore a natural part of a modern switchgear design.

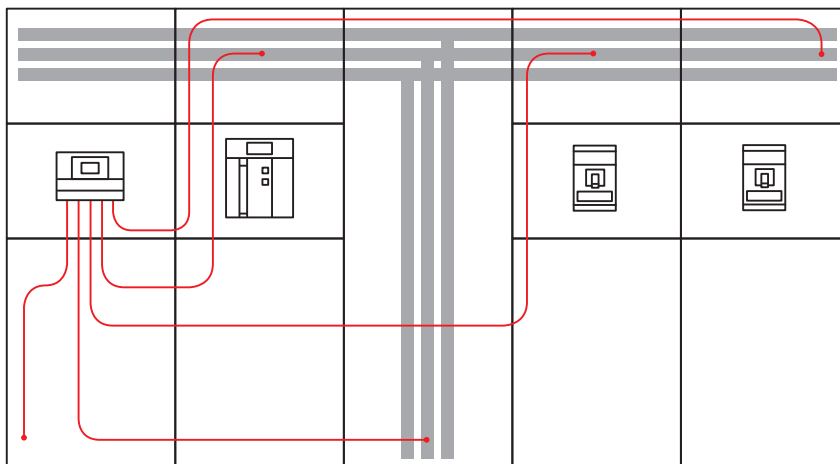
The operating logic of an arc detector is based on the detection of the light radiation associated with the occurrence of an arc inside the switchboard.

The arcing control system detects the event and sends a tripping signal to the circuit breaker; reaction time of detection is less than 1 ms.



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04

The figure shows the areas where this device can be positioned inside a switchboard. The ideal solution is to provide the installation with at least one detector for each column, with the consequent reduction to a minimum of the length of the optical fibers carrying the signal.

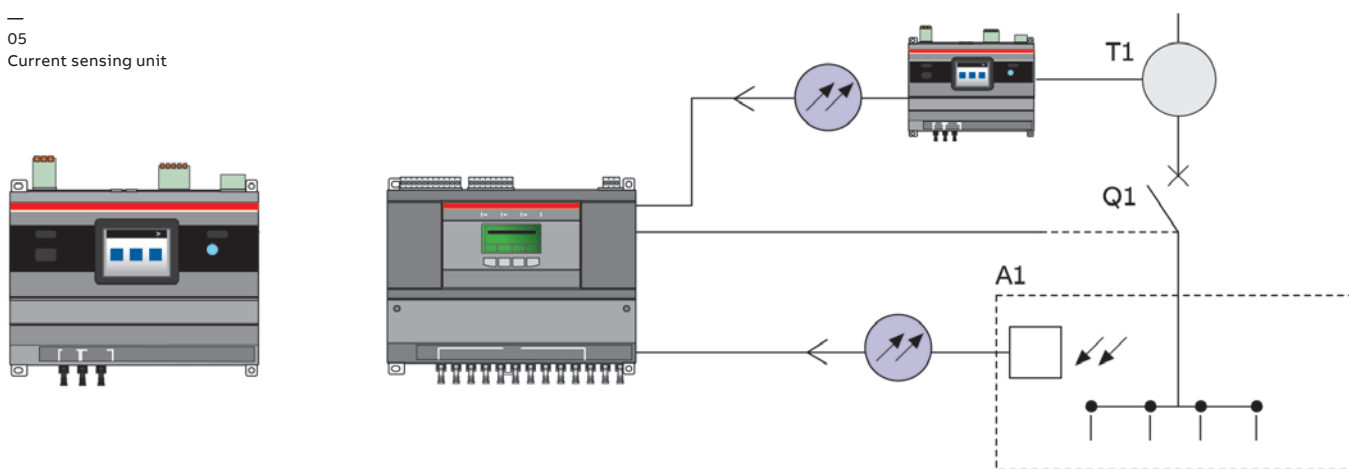


In cases where the detectors can be exposed to an intensive light (camera flash, direct sunlight, etc.), an additional current sensor can be positioned at the incoming of the main circuit breaker. The current sensing unit CSU-2 adds a current condition to the system. In the event of an arc, both

the current sensing unit - which detects an "anomalous" current due to the arc fault, as well as the sensor detecting the light radiation associated with the arc, enable the system to intervene and allow the consequent opening of the circuit breaker.

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05

Current sensing unit



The tripping time of the Arc Guard system, which consists mainly of the circuit breaker and of the unit TVOC-2, is few milliseconds, since it by-passes the tripping of the overcurrent protection of the circuit breaker.

In fact, such protection may be usually delayed due to several installation needs, among which:

1. selectivity requirements
2. connections of capacitor banks
3. electrical components with high inrush currents.

To reduce this tripping time is necessary to use Ekip Signalling 2K or RELT 2K-3 modules installed on Emax 2 and Tmax XT.

In this case, it is possible to associate the opening of the circuit breaker to each 24V DC signal arriving to the input contact of the module.

This alternative allows the total times to be remarkably reduced since, in this way, they no longer depend on the shunt opening release (SOR), but on the tripping commanded directly by the electronic unit.

Examples of manageable operation logic

TVOC-2 can command up to three different circuit-breakers since it gives the chance to associate a defined number of light sensors to each circuit breaker.

This makes it possible to use arc monitoring in any applications where, due to different plant engineering reasons and in the event of an arc, it is not sufficient the opening of the main circuit breaker (or even of all the three circuit-breakers), but a logic strictly connected to the plant engineering configuration is required.

The following schemes report some examples of these applications.

As indicated in the previous pages, the Arc Guard System remarkably reduces the trip times in the event of an electric arc.

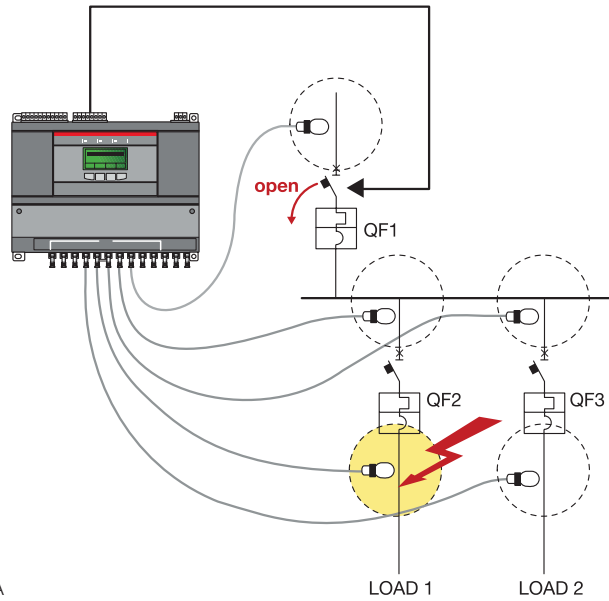
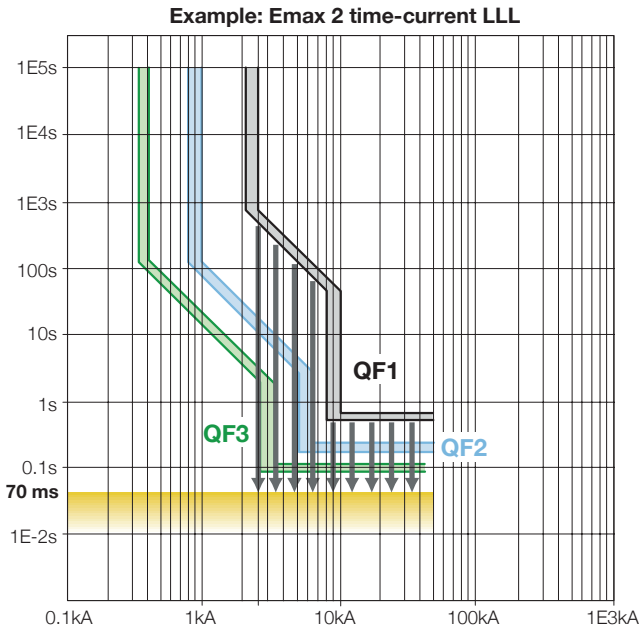
As a consequence, it is evident that under these conditions it is not possible to obtain selectivity in the event of internal arc even if the arc is on the load side of an outgoing feeder. The following example illustrates the above.

Figure 6 shows the trip curves of three circuit breakers, one on the supply side (QF1) selective with the two outgoing feeders (QF2-QF3).

As shown, since each light sensor commands the main circuit breaker, in case of an internal arc there shall be a downtime for the whole plant.

Practically, it is as if the circuit breaker on the supply side had a protection function which would make tripping instantaneous, thus making useless all the settings and time delays based on the selectivity study.

06



QF1: open → LOAD 1 and LOAD 2 **not supplied**

The following table shows the components and the relevant total breaking times.

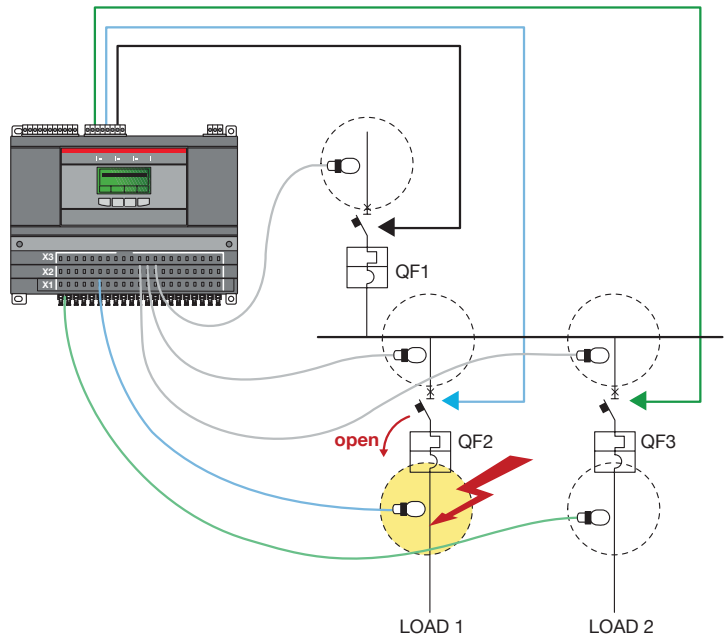
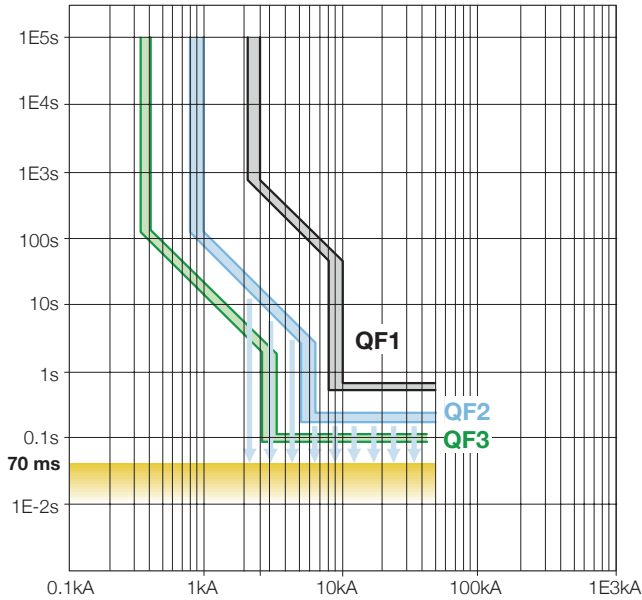
Circuit breaker	Trip unit	Accessory	Arc monitor	Total breaking time*
XT7, E1.2-E6.2	Ekip Touch Ekip Hi-Touch	YO		70 ms
		Ekip 2K	TVOC-2	45 ms (1)
		RELT Ekip 2K-3		45 ms

* Total breaking time defined according to test conditions of the product standard IEC 60947-2
(1) ATTENTION: remember to manually setup delay to zero during configuration

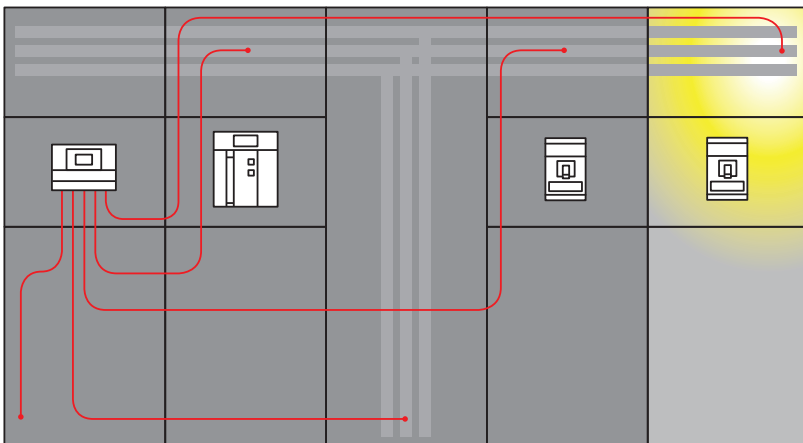
In order to avoid downtime of all the plant, when selectivity represents a fundamental requirement also under electric arcing conditions, it is possible to exploit the ability of commanding up to three circuit breakers through a single TVOC-2, by assigning to each light sensor the task of opening one of them.

In this way, the system is selective also in the event of an electric arc on the load side of an outgoing feeder (in the example on the load side of QF2). The following figure illustrates the above (to simplify, only 5 light sensors of the 30 available have been represented).

Example: Emax 2 time-current LLL



QF1 and QF3 closed: LOAD 2 **supplied**
QF2 opened



To get a selective system, each light sensor must not be influenced by the light fluxes which do not affect its area. Then, it is necessary that some obstacles are positioned between the sensors (typically the metal enclosure of the cubicles) as shown in the figure.

Furthermore, the light sensors must be positioned in a “strategic” way (after a thorough analysis and not accidentally) to define the affected areas and the operating zones.

This is much easier in large power distribution switchboards where the internal dimensions and the metalwork structure allow the separation of the sensors according to their relevant operating areas.

For additional information, please refer to the White Paper code 1SDC007407G0203 “Protection Against Electric Arc”