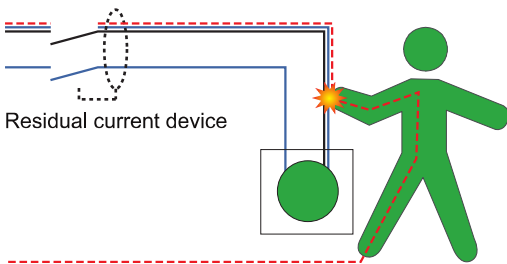


Earth Leakage Protection

Response Time of High-Sensitivity Residual Current Devices

All the high-sensitivity residual current devices (30 mA) in the Acti9 range conform to the IEC/EN 61008 and IEC/EN 61009 standards. The response times defined by these standards guarantee their effectiveness in protecting people against direct contacts.



Response time

The response time of a residual current device is the time between the appearance of a dangerous leakage current and the interruption of the circuit.

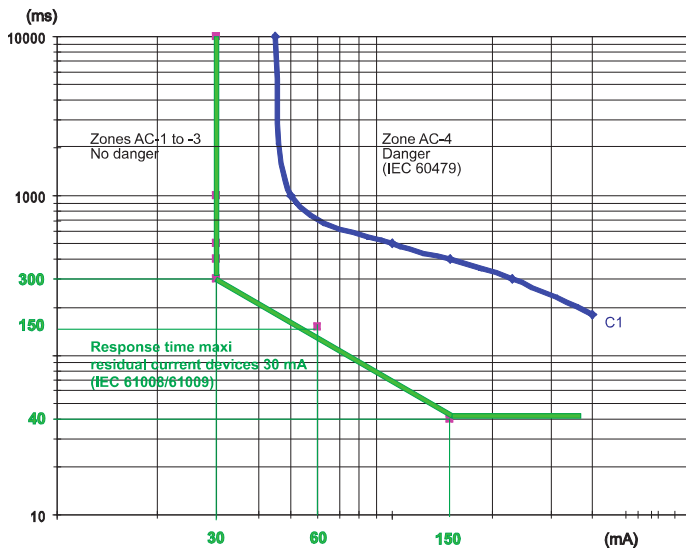
For a residual current device with a sensitivity of $I\Delta n$ 30 mA

Fault current (mA)	Maximum response time (ms)
$I\Delta n/2$ 15 mA	No tripping
$I\Delta n$ 30 mA	300 ms
$2 \times I\Delta n$ 60 mA	150 ms
$5 \times I\Delta n$ 150 mA	40 ms

These response times conform to the specifications of the IEC/EN 61008 and IEC/EN 61009 standards.

They guarantee protection of people against direct contacts for the following reasons :

- when a person comes into direct contact with a live conductor, the current passes directly through the human body
- this current, with the same magnitude, is detected by the residual current device.



- the IEC 60479 technical report studies the sensitivity of the human body to the electric current. Curve c1 defines for each current value the maximum time before the current causes injury to a person

- superimposing the two curves shows that the above response times protects the users.

Measuring the response time

If the user wishes to check the response time of his residual current devices, he should follow a specific procedure to:

- establish a leakage current of calibrated magnitude
- measure the exact response time.

Procedure

The measuring instruments must conform to IEC/EN 61557-6.

Carry out the operations in the following order according to the safety instructions:

- disconnect the loads
- install the measuring instrument downstream of the residual current device to be tested (for example on a power outlet)
- perform the measurement.

Earth Leakage Protection

Response Time of Medium-Sensitivity Residual Current Devices

Response time of iC60 Vigi and iLD60 residual current devices

The medium-sensitivity residual current devices (100...1000 mA) in the Acti9 range conform to IEC/EN 61008 and 61009:

- their response time guarantees personal protection against indirect contacts and fire risks
- in the case of selective versions (S), a "non-tripping time" guarantees discrimination with the residual current devices installed downstream.

Instantaneous residual current devices

		Sensitivity (I Δ n)			
		100 mA	300 mA	500 mA	
Fault current (mA)	I Δ n/2	50	150	250	No tripping
	Max. response time				
	I Δ n	100	300	500	300 ms
	2 x I Δ n	200	600	1000	150 ms
	5 x I Δ n	500	1500	2500	40 ms
500 A					40 ms

Selective (S) and time-delayed (R) residual current devices

Residual current device	Sensitivity (I Δ n)	Sensitivity (I Δ n)				Type			
		100 mA	300 mA	500 mA	1000 mA	Selective (S)		Time-delayed (R)	
Fault current (mA)	I Δ n/2	50	150	250	500	No tripping		No tripping	
						Non-tripping time	Response time	Non-tripping time	Response time
	I Δ n	100	300	500	1000	130 ms	500 ms	300 ms	1000 ms
	2 x I Δ n	200	600	1000	2000	60 ms	200 ms	150 ms	500 ms
	5 x I Δ n	500	1500	2500	5000	50 ms	150 ms	150 ms	300 ms
500 A					40 ms	150 ms	150 ms	300 ms	

Definitions

Response time

Time between the appearance of a hazardous leakage current and circuit power down.

Non-tripping time

For selective and time-delayed devices, the non-tripping time is the time between the appearance of a hazardous leakage current and the device tripping.

If the leakage current disappears before this time, the device does not trip.

This fast disappearance of the leakage current can be due to:

- the transient nature of the fault (e.g. the current generated by a switching surge)
- the interruption of the fault current by another faster residual current device situated downstream.

Selective and time-delayed devices therefore afford the user:

- better immunity against nuisance tripping
- total discrimination between residual current devices.

Earth Leakage Protection

Response Time of Medium-Sensitivity Residual Current Devices

Discrimination of residual current devices

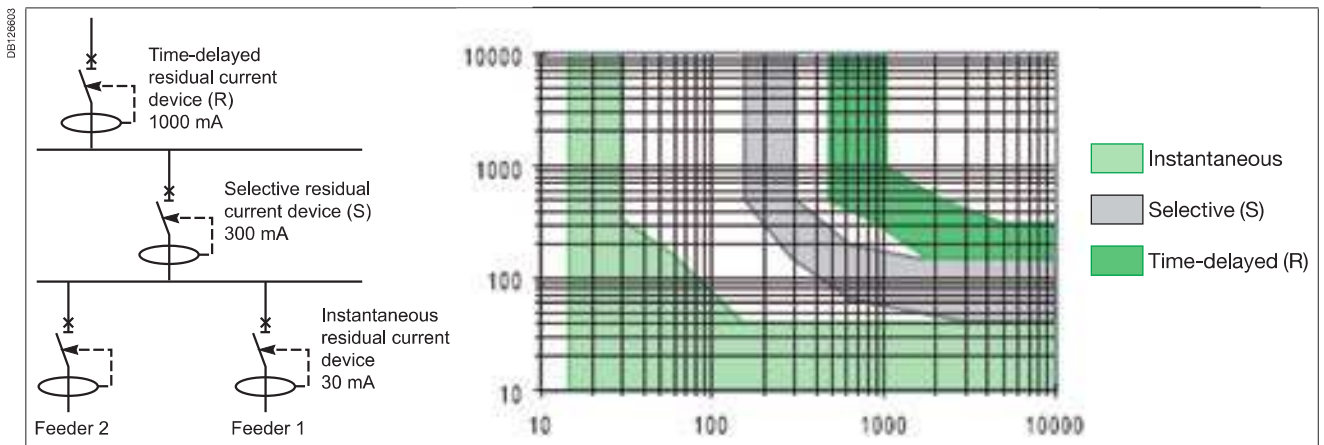
The non-tripping times of type (S) and (R) residual current devices ensure discrimination with the residual current devices located downstream.

Combination rules

To ensure discrimination between two cascading residual current devices, the following two conditions must be met simultaneously:

- the sensitivity of the upstream device must be at least 3 times the sensitivity of the downstream residual current device
- the upstream residual current device must be one of the following types:
 - selective (S) if the downstream residual current device is instantaneous
 - time-delayed (R) if the downstream residual current device is selective (S).

The figure below shows how compliance with these rules provides discrimination on three levels: whatever the value of the fault current, it will be interrupted by the device situated immediately upstream of the fault and only by this device.



Example:

In the above diagram for a fault current of 1000 mA:

- if the fault occurs downstream of the 30 mA residual current device, the latter will interrupt the current in less than 40 ms, whereas type S and R devices "wait" for 80 ms and 200 ms respectively. Therefore, neither of the two devices trips
- if the fault occurs downstream of the type S residual current device, the latter will interrupt the current in less than 175 ms, whereas the type R device "wait" for 200 ms and therefore does not trip.

If these cascading combination rules are complied with, the level of continuity of service provided to the user depends on the way in which the "horizontal discrimination" is implemented: the terminal feeders must be divided into as many circuits as necessary, each protected by a residual current device.