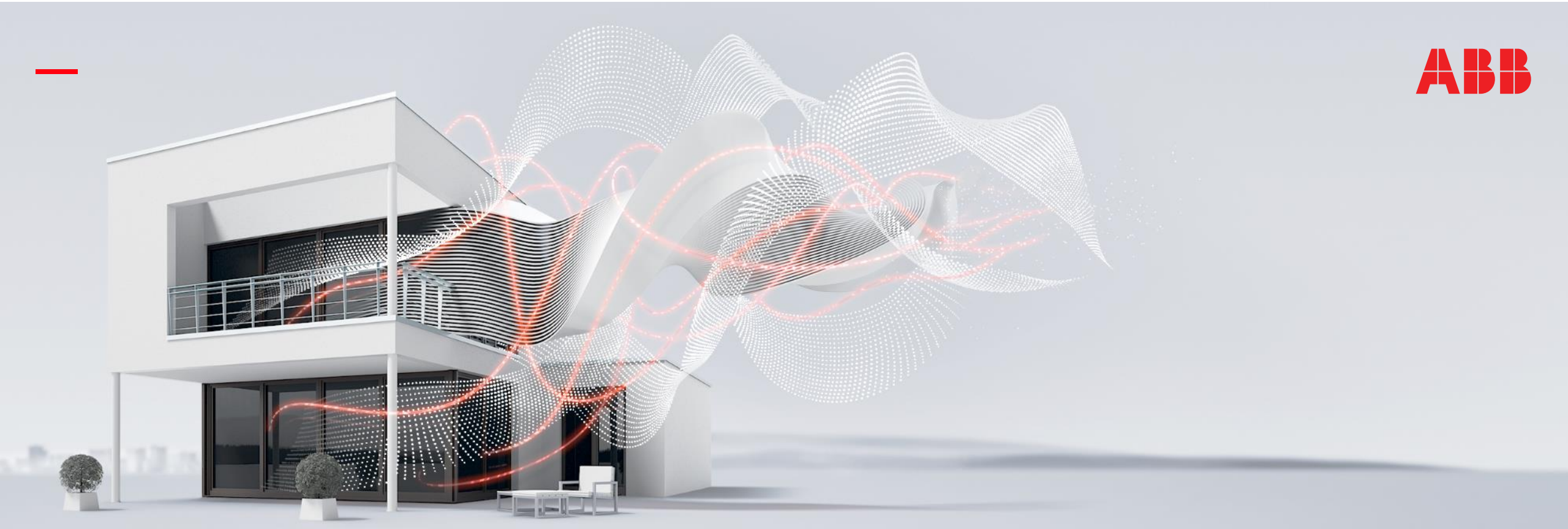


ABB : EL05 Residual Current Devices - Product overview, tips and techniques in selection

Veerachai Rattanasomchok / PMM

Residual Current Devices (RCDs)

What is RCD?

Residual Current Device

- RCCB => IEC 61008 / มอก.2425-2552

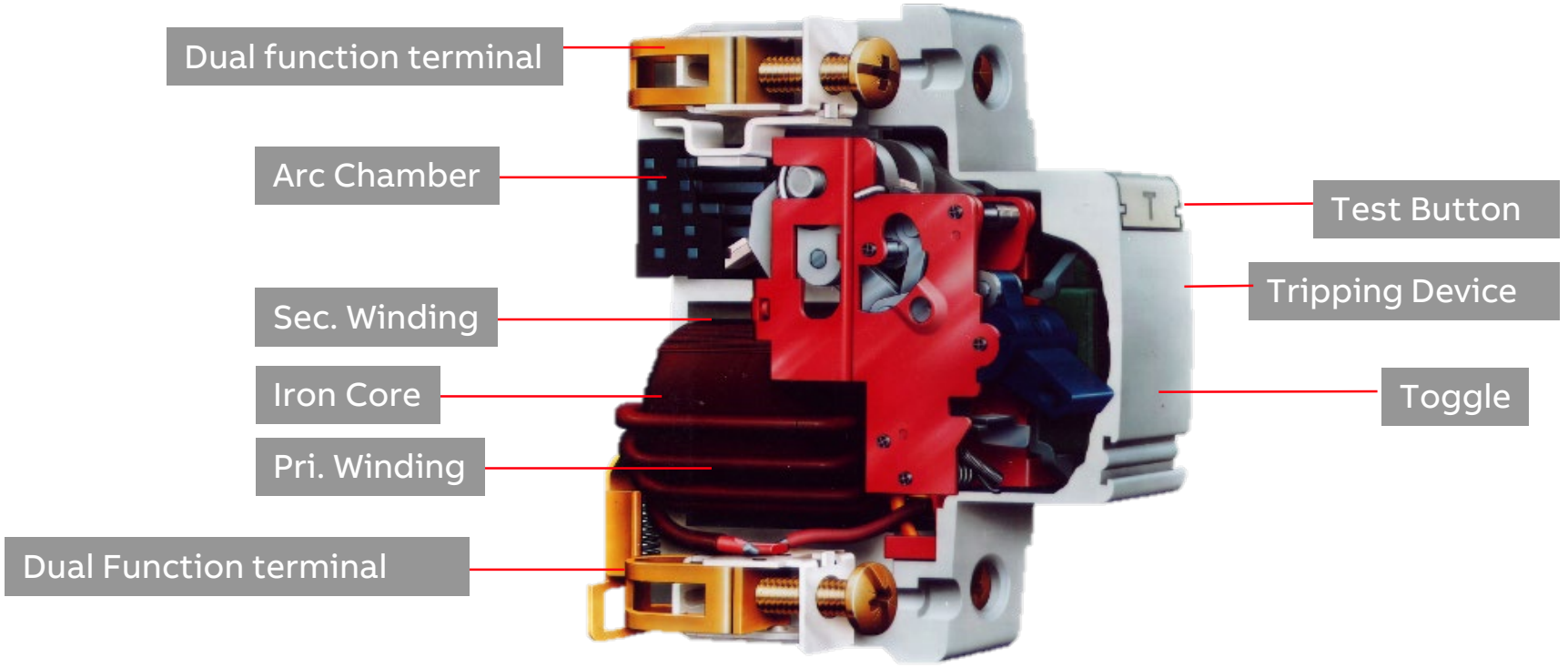
  Residual Current Circuit Breaker

- RCBO => IEC 61009 / มอก. 909-2548

  Residual Current Circuit Breaker

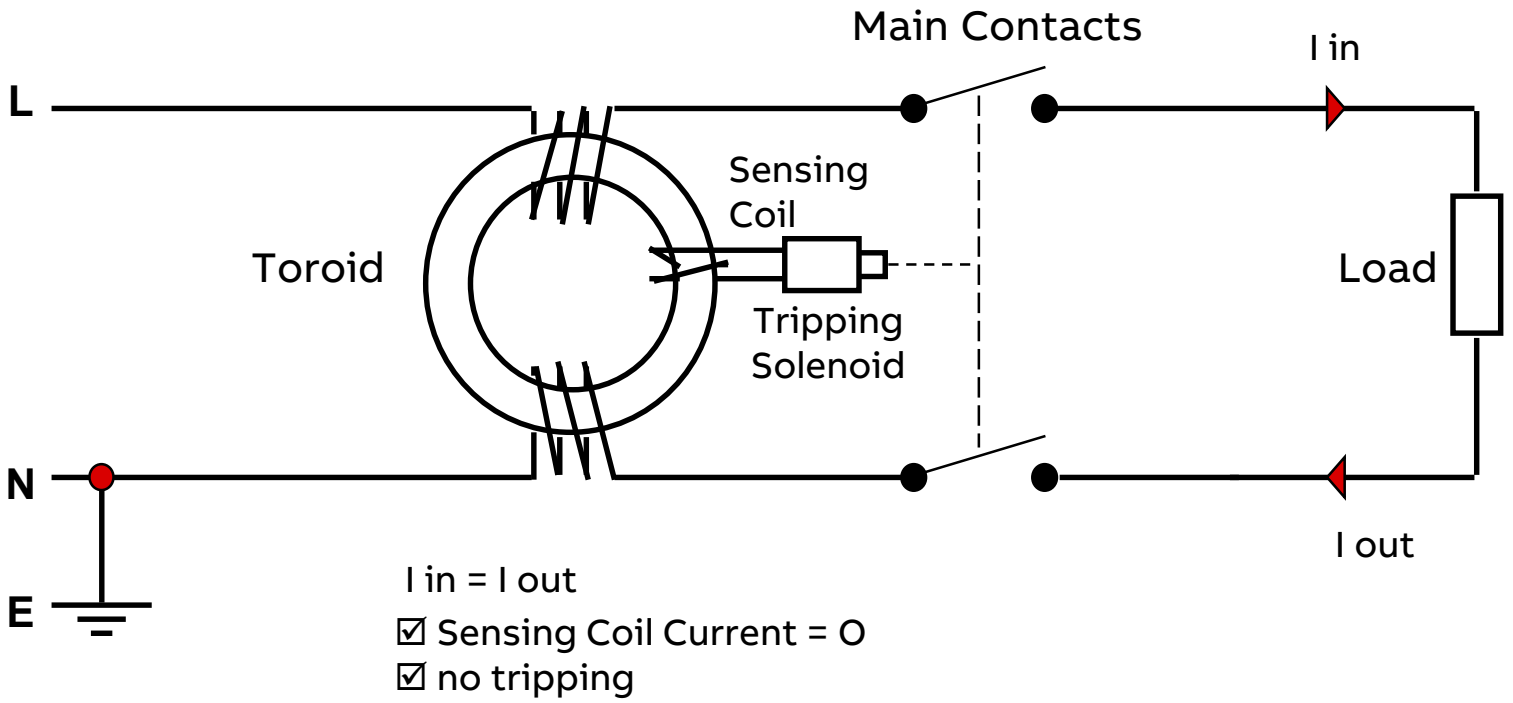
  with overcurrent protection

Residual Current Operated Circuit Breaker



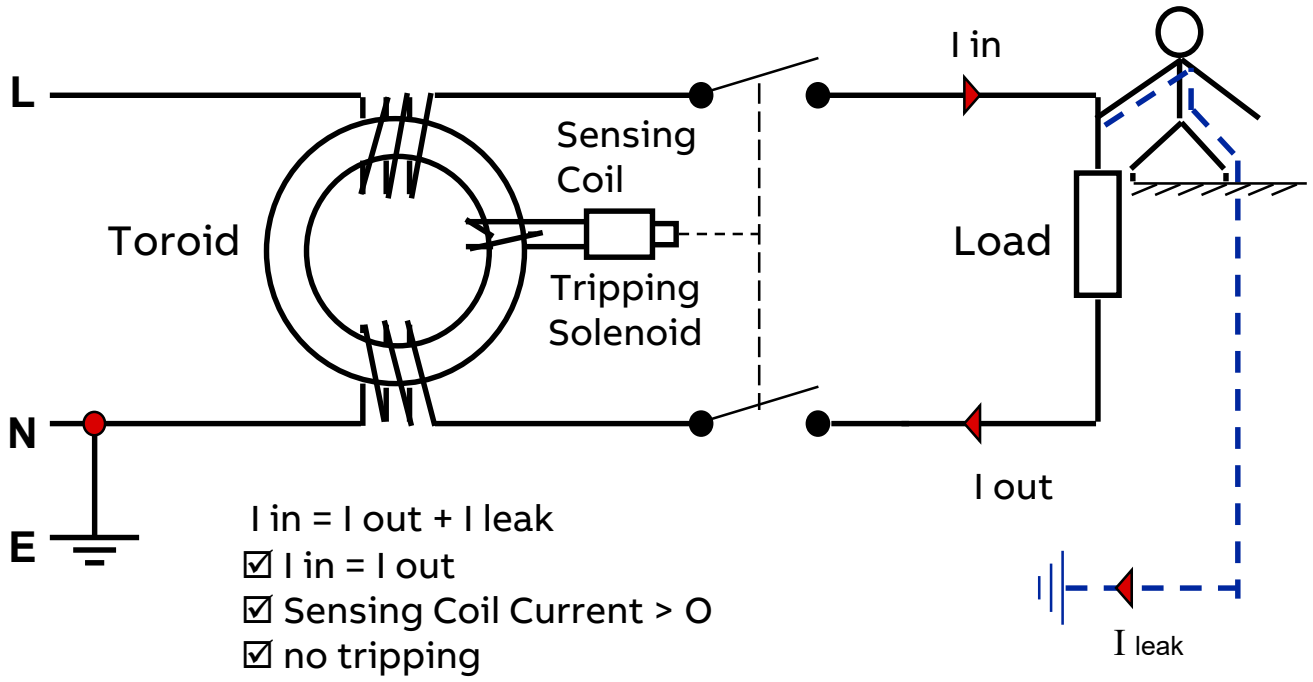
Operating principle of RCCB

(A) NO EARTH FAULT



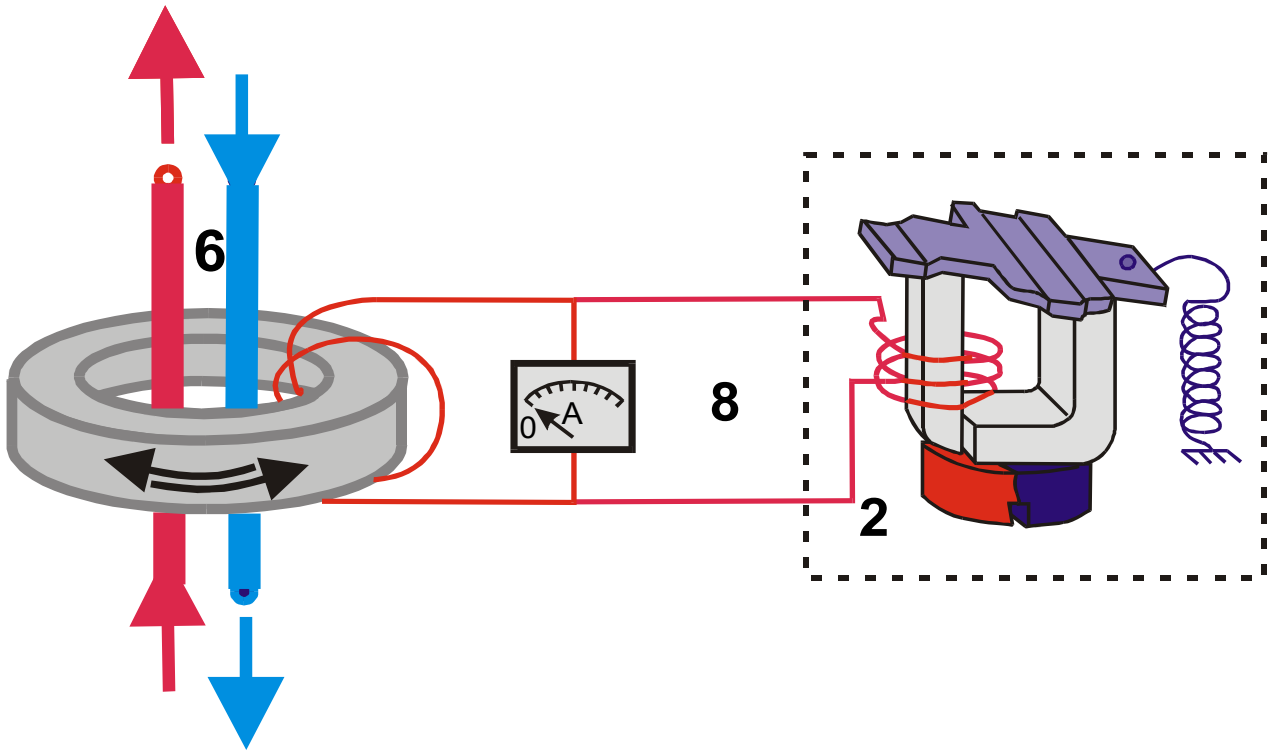
Operating principle of RCCB

(B) WITH EARTH FAULT



Core-balance transformer in principle (ON-Position)

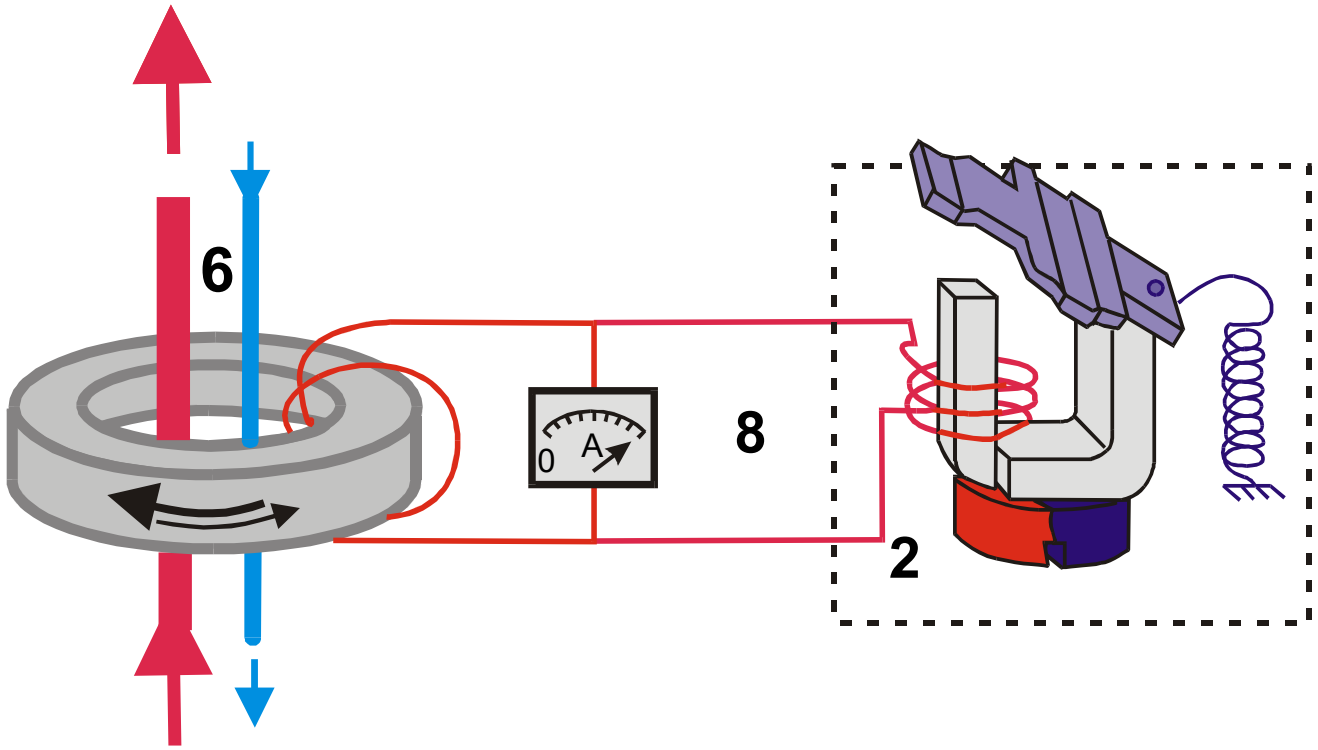
balanced core:



Equal primary currents = Non-residual current = Non-tripping RCD

Core-balance transformer in principle (TRIP-Position)

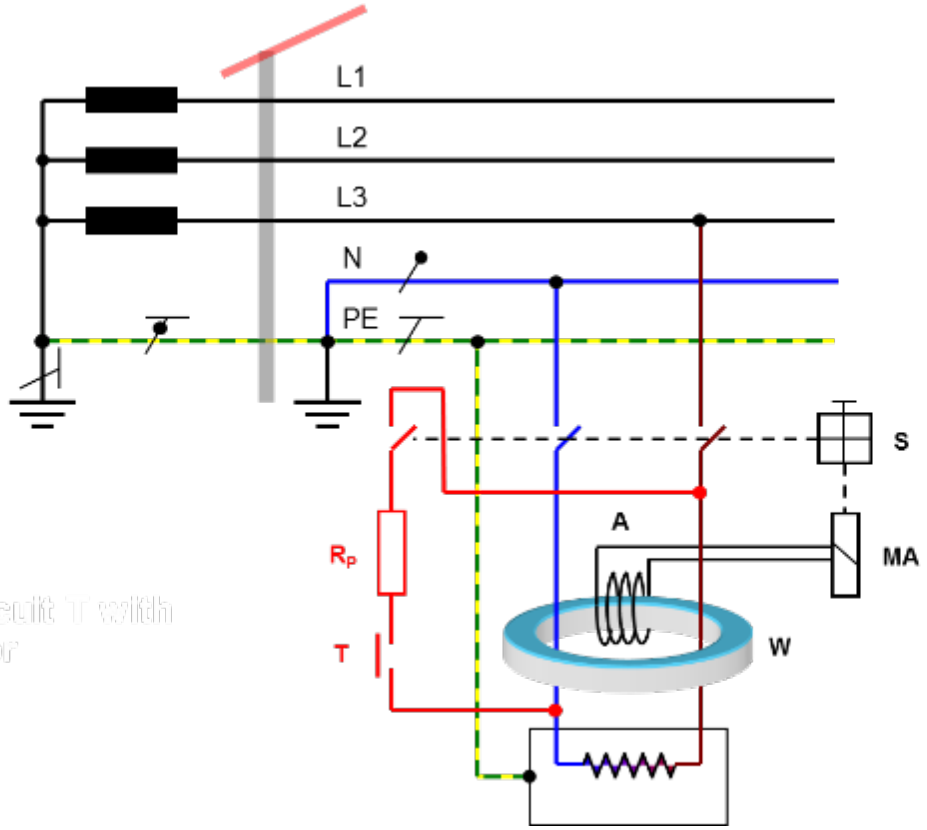
unbalanced core:



Unequal primary currents = residual current = tripping RCD

Operating principle of RCCB

Testing circuit:



Test circuit T with resistor

Method of operation (acc.to IEC61008/61009)

RCCB => FH200, F200

RCBO => DS201, DS203NC

4.1.1. functionally Voltage Independent (VI)	**4.1.2** functionally Voltage Dependent (VD)			
	4.1.2.1 Opening automatically in case of failure of the line voltage without or with delay		**4.1.2.2** NOT opening automatically in case of failure of the line voltage	
	4.1.2.1.a Reclosing automatically when the line voltage is restored	**4.1.2.1.b** NOT reclosing automatically when the line voltage is restored	**4.1.2.2.a** Able to trip in case of hazardous situation arising on failure of the voltage	**4.1.2.2.b** **Not able to trip in case of hazardous situation arising on failure of the line voltage**

RCBO => DSE201, DSE201M

Why electromechanical RCDs?

EN 61008/61009 and IEC 364 do not admit electronic RCDs as main protection

- because the interruption of the neutral will cause the non functioning of electronic RCDs (they always need an auxiliary supply source)

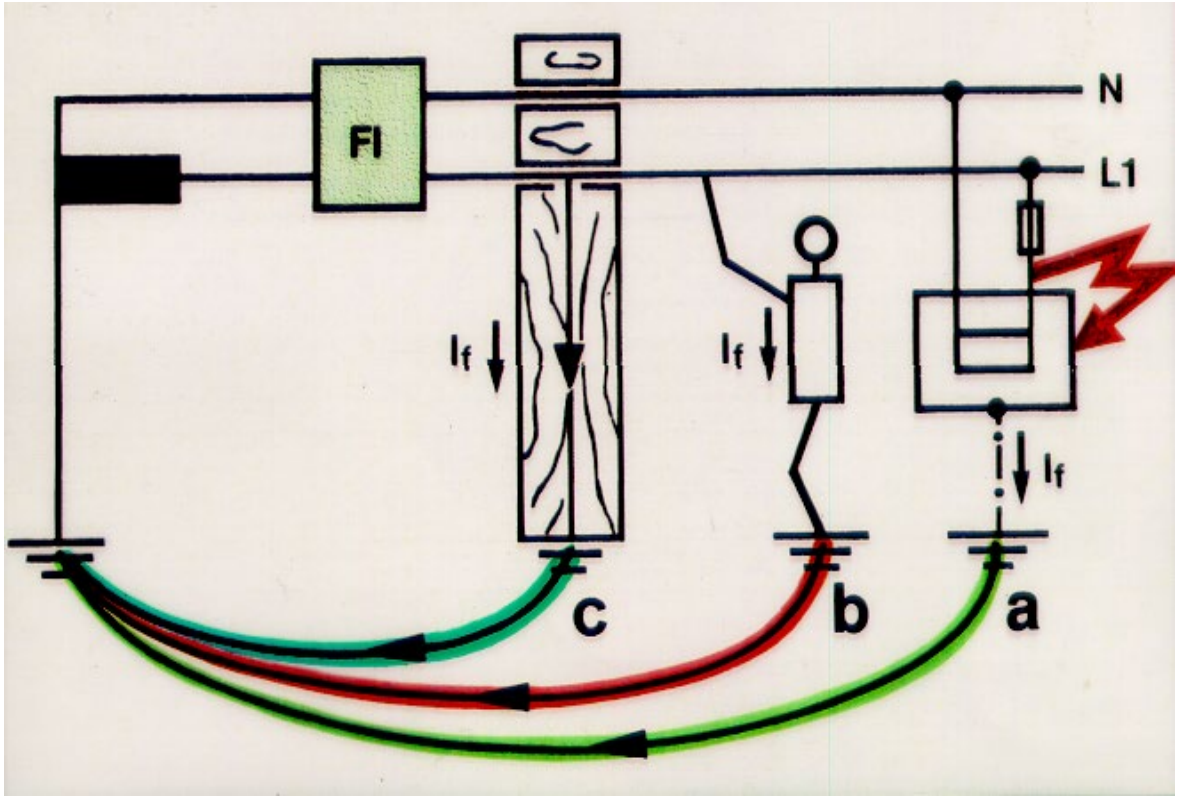
- because there are no sure data to measure the reliability of electronic components

ABB RCD

Almost all ABB RCDs are electromechanical voltage independent

– Only DSE201 and DSE201M RCBOs 1 module are electronic voltage dependent RCDs NOT opening automatically in case of failure of the line voltage. Not able to trip in case of hazardous situation arising on failure of the voltage (Lost connection both of N and G cable)

Type of protection by RCDs



a. Protection against indirect contact

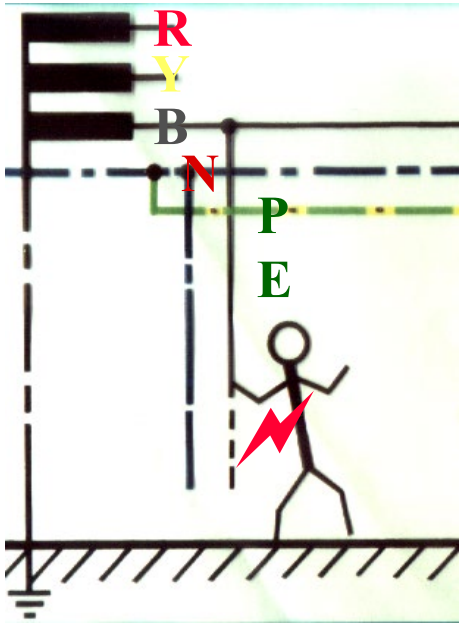
b. Protection against direct contact

c. Protection against fire risks

Application of different Sensitivity

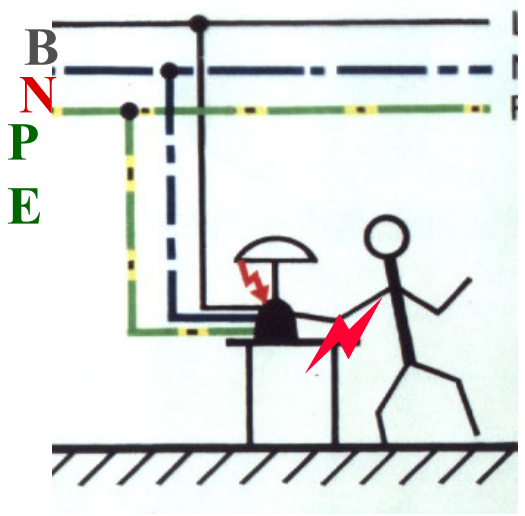
Sensitivity	Where and what purpose
- 30mA	- Protect direct contact with live parts (Human & Animals)
- 300mA	- Discrimination Protect against fire risks and equipment

Types of electric shock



Direct contact

Electric shock in normal service

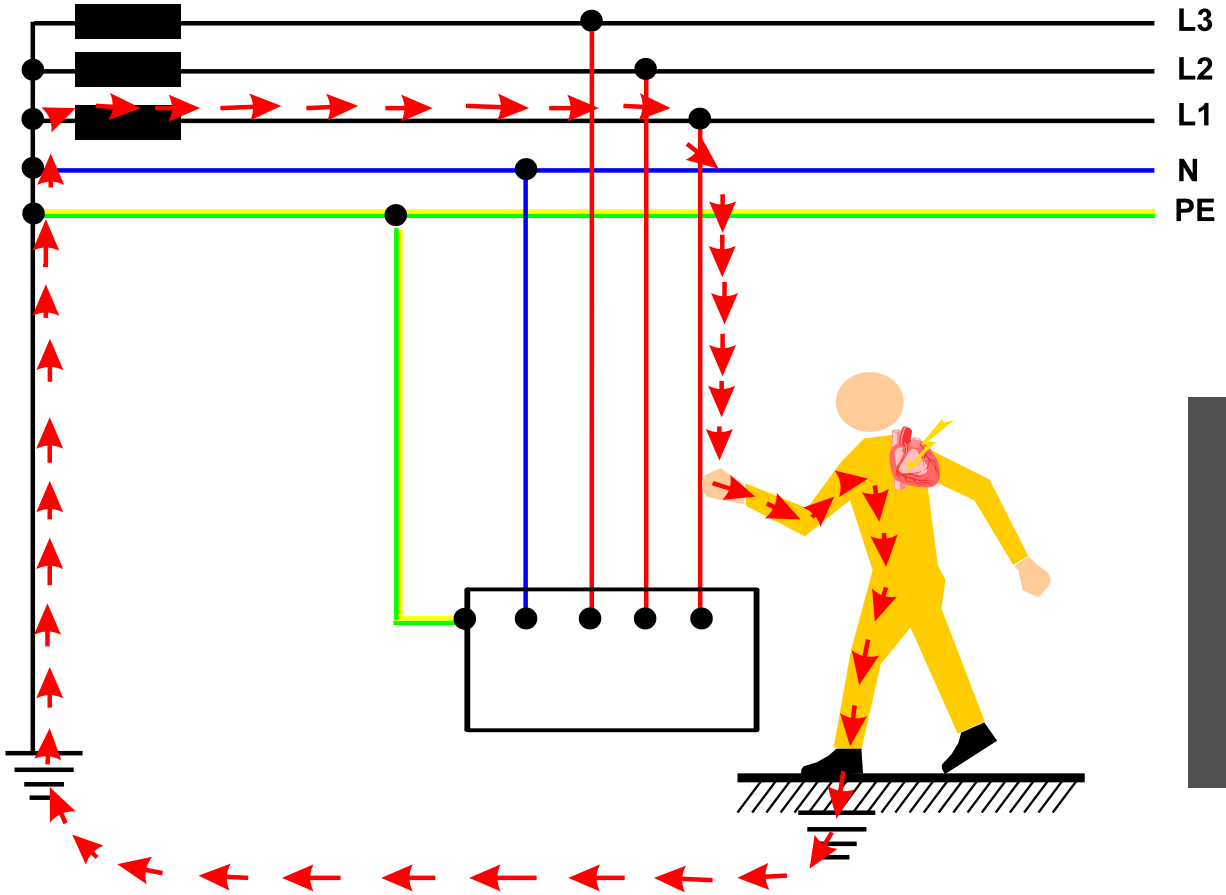


Indirect contact

Electric shock in case of a fault

Direct contact with live parts cve parts Direct

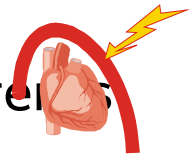
by contacting usually live parts, such as uninsulated conductors, equipment terminals etc.

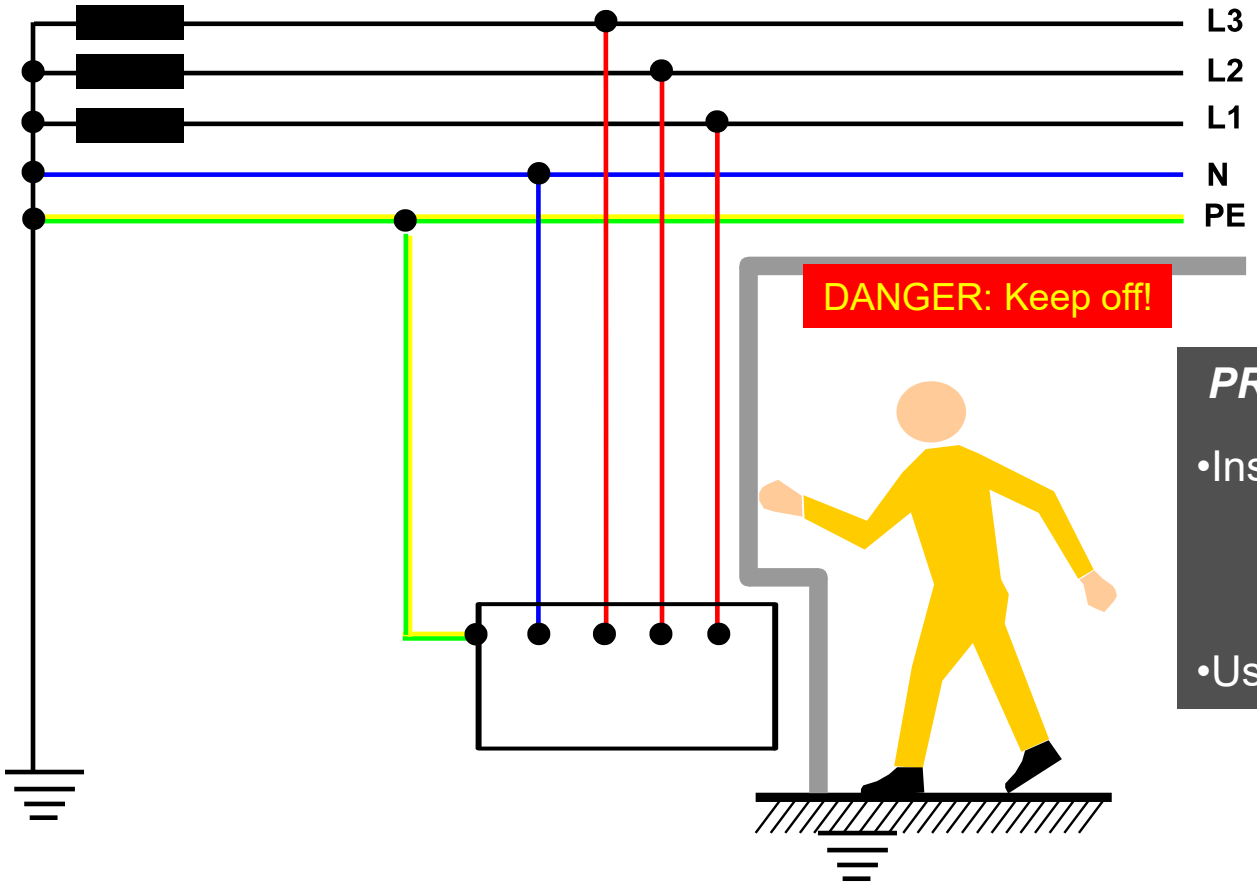


NO PROTECTION
against lethal effects of hazardous body currents

Direct contact with live parts cve parts Direct

PROTECTION against lethal effects due to hazardous body currents



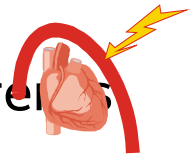


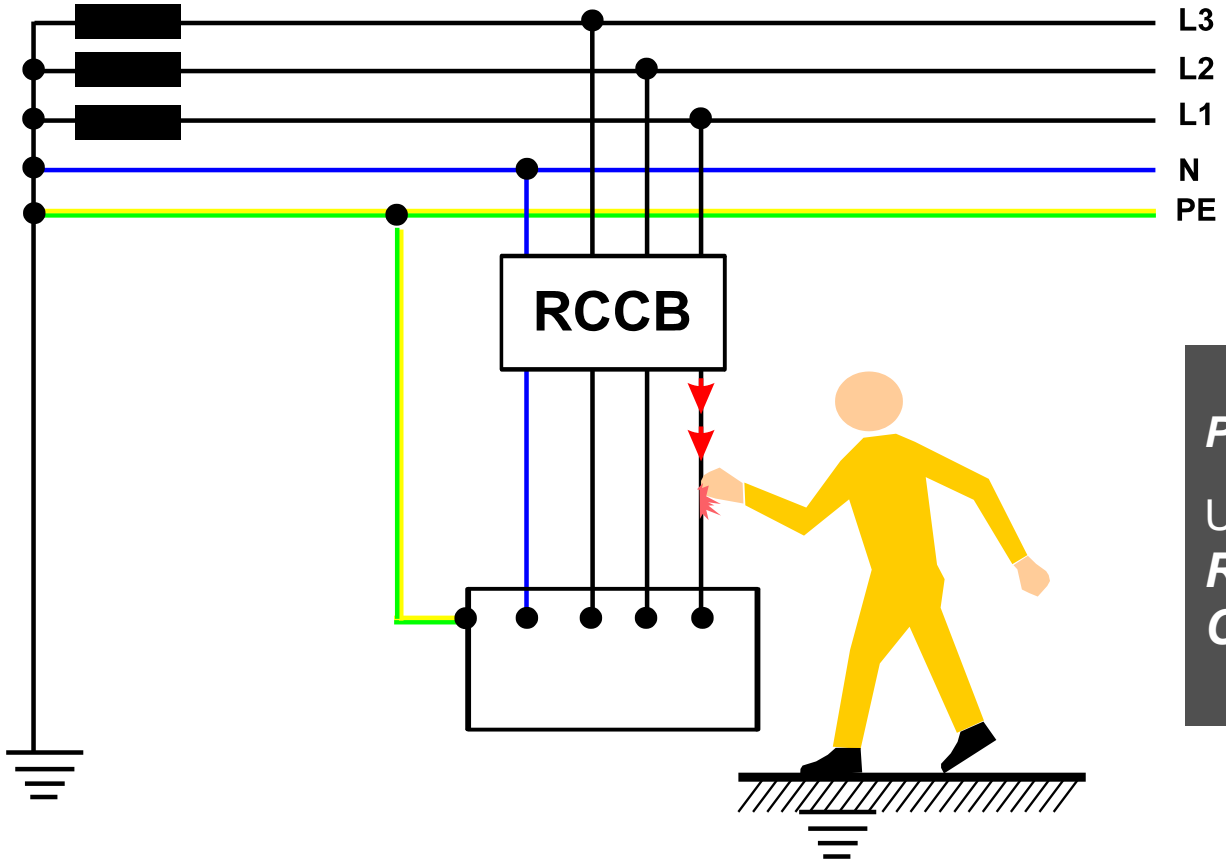
PROTECTION by:

- Insulation of live parts:
  - insulating rooms
  - double insulation
  - housings...
- Using safety voltages

Direct contact with live parts cve parts Direct

PROTECTION against lethal effects due to hazardous body currents





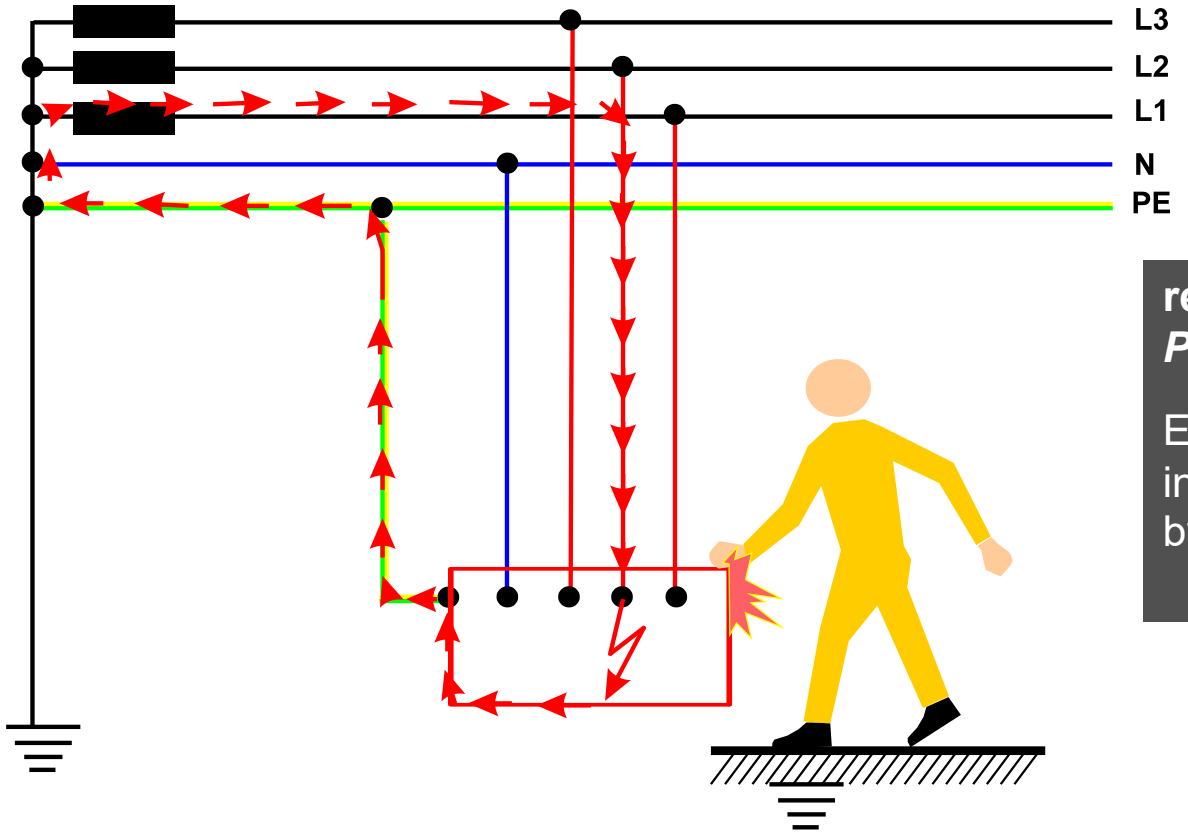
PROTECTION by:

Use of:

Residual Current Circuit Breaker

Indirect contact with live parts

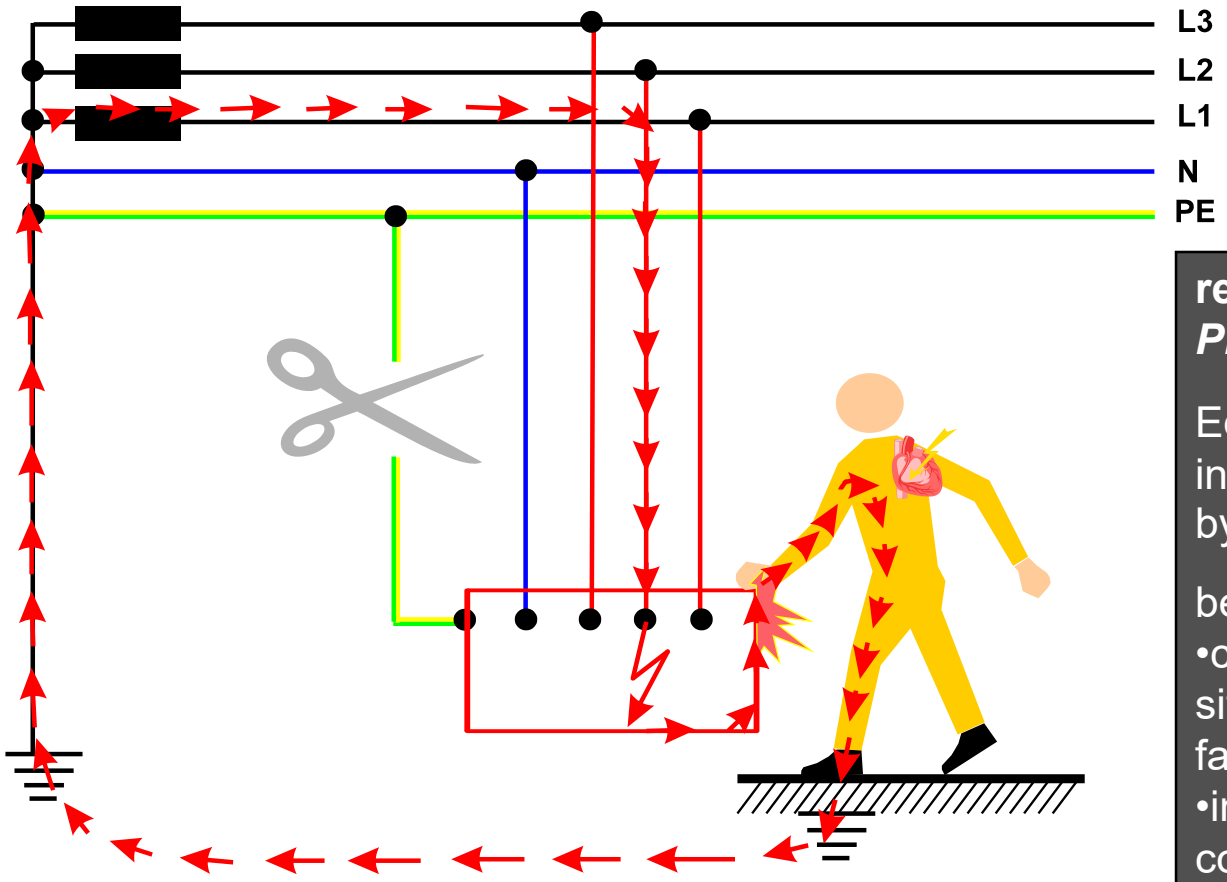
by contacting accidentially live parts, due to faults or installation failure



restricted
PROTECTION by:

Equipotentialisation and interruption of fault circuits by MCB´s

Indirect contact with live parts



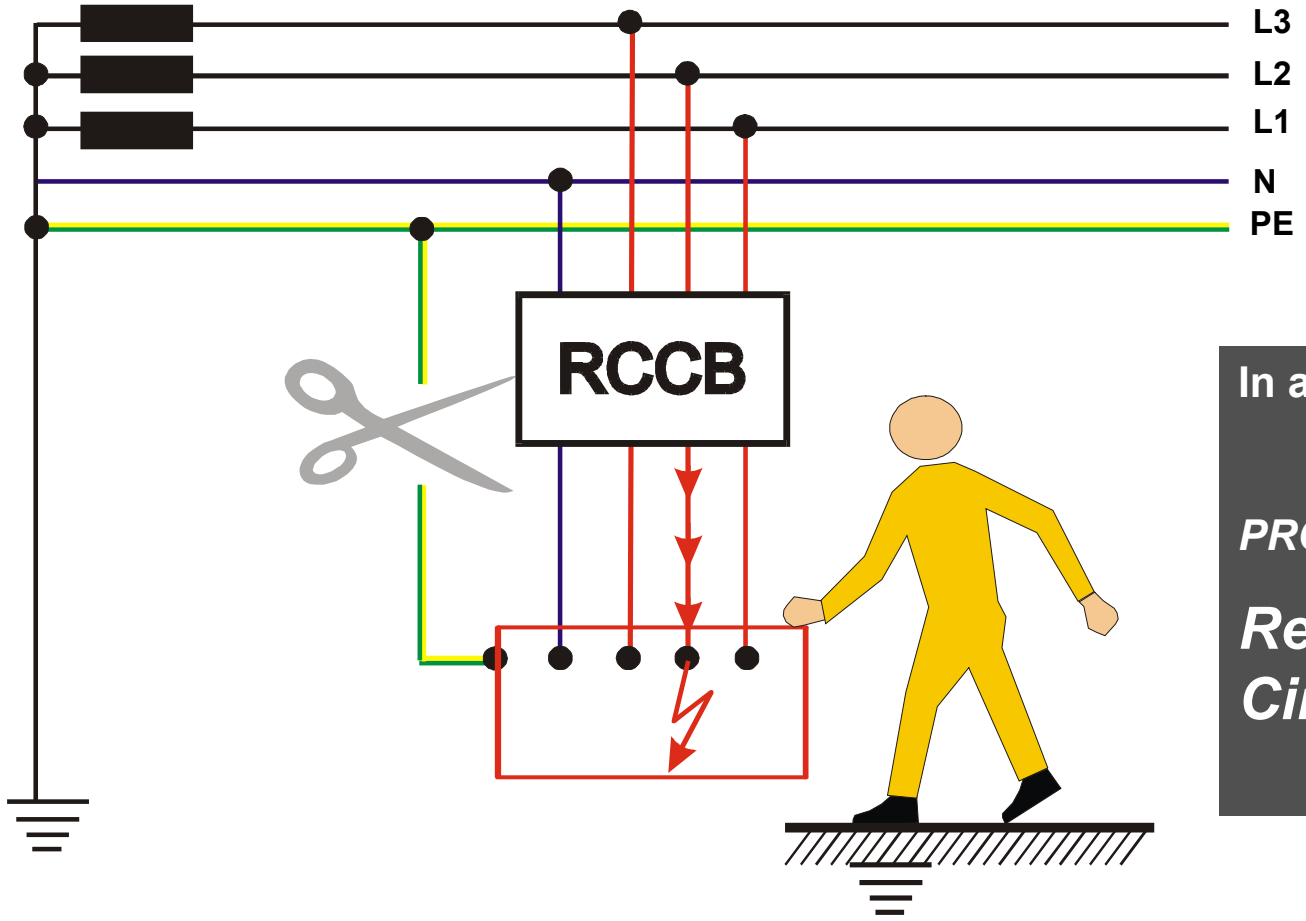
restricted
PROTECTION by:

Equipotentialisation and interruption of fault circuits by MCB´s

because of:
•continued dangerous situation due to small faults currents
•interruption of protection conductor

Indirect contact with live parts

PROTECTION against lethal effects due to hazardous body currents



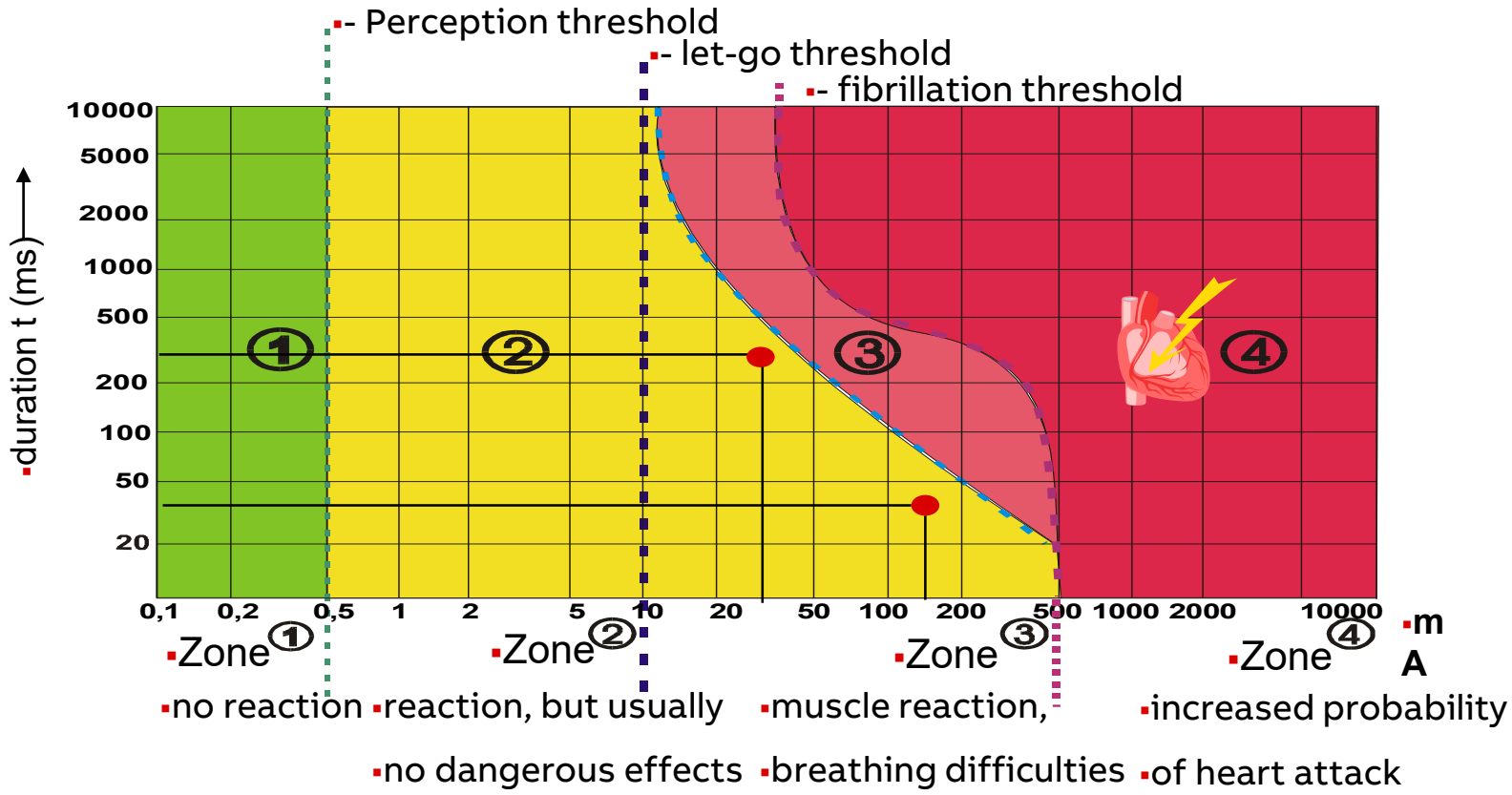
In any case:

PROTECTION by:

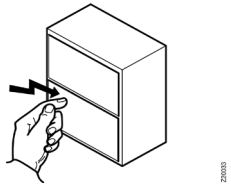
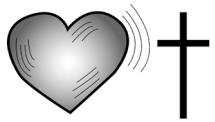
Residual Current Circuit Breaker

Effects of electrical current to the human body (IEC 479-2)

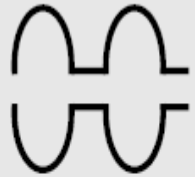
AC currents 50/60Hz at various body currents and durations;



Effect of electric current on the human body

Body current	Perception	Effect
▪0.5 mA 	Not perceivable Exceptions: - Finger tips - Tongue - Current through a wound	Harmless
▪3 mA 	Feels like ants crawling	Not dangerous
▪15 mA 	Touched part can no longer be released	Unpleasant, but not dangerous
▪40 mA 	Body cramp, diaphragm cramp	Danger of suffocation within a few minutes
▪80 mA 	Ventricle vibration	Extremly dangerous, leads to death within minutes

Application and waveform of residual current

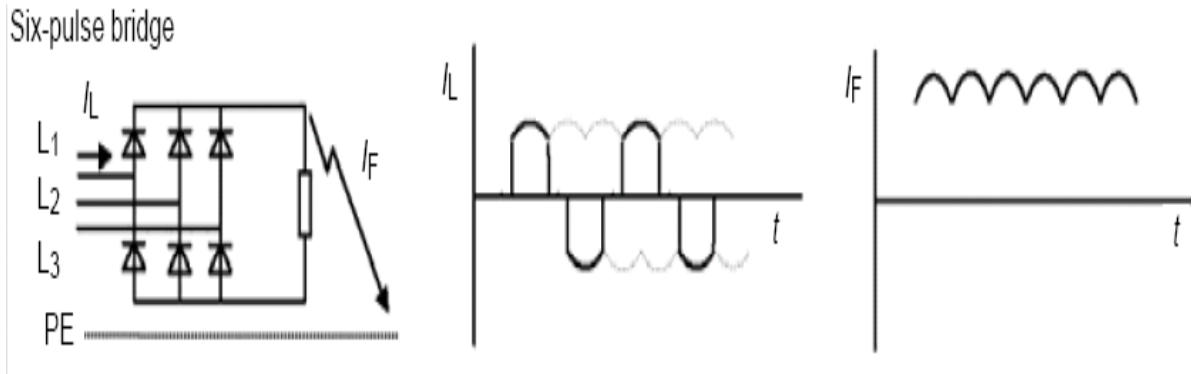
	Stromform	Ordnungsgemäße Funktion von FI-Schutzeinrichtungen des Typs		
		AC	A	B
AC residual current		•	•	•
Pulsed DC residual current		–	•	•
Cutted halfwaves - degree 90° - degree 135°		–	• •	• •
Halfwave + 6 mA		–	•	•
Only DC residual current		–	–	•

Application notes of RCD Type B

1.Three-phase a.c./d.c. Converters where, in absence of double insulation, insulation defect or earth faults can occur in the d.c. part of the circuit (downstream the rectifier)

These devices can be found in:

- Charge-batteries
- Machine tools
- Elevators for high buildings
- Motors for railway applications
- Cranes
- Welding machines

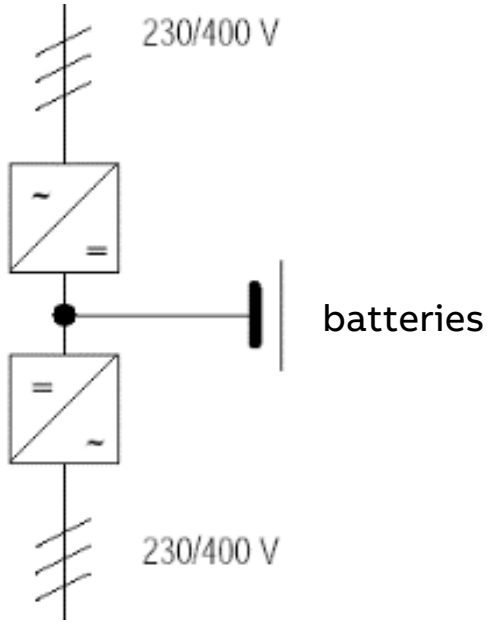


Application notes of RCD Type B

2.Three-phase UPS where, in absence of double insulation, insulation defect or earth faults can occur in the d.c. part of the circuit (downstream the rectifier).

The most typical applications are:

- Hospitals
- Telecommunication installations and applications generally related to public utility services
- Data Processing Centers
- Alarm systems
- Safety systems
- Machine tools



Application notes of RCD Type B

3.Electro-medical devices where a.c./d.c converters inside the instruments are often used

Electro-medical equipments with a.c./d.c. converters inside are:

- X-ray generators
- Magnetic resonance
- Computerized tomography

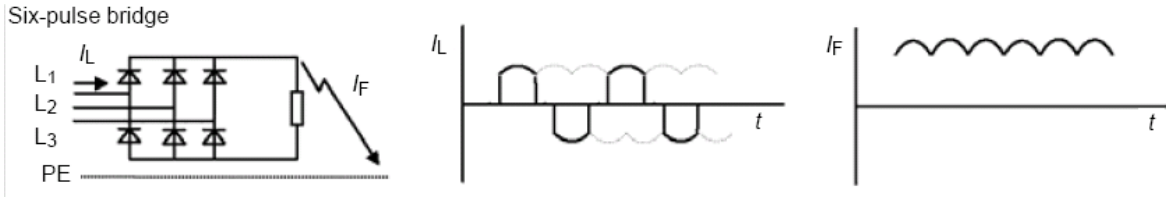
Application notes of RCD Type B

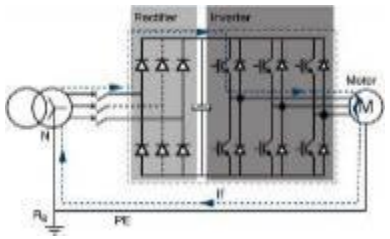
4.Three-phase Frequency Converters (drives)

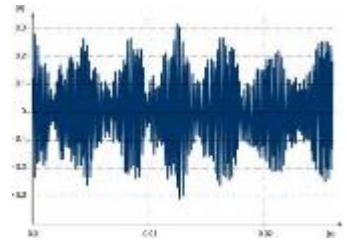
Drives include a rectifier section and an inverter section

The earth fault can occur:

- Downstream the rectifier (as already mentioned)
- Downstream the inverter, producing an earth fault current with high frequency components or elevated harmonic distortion.







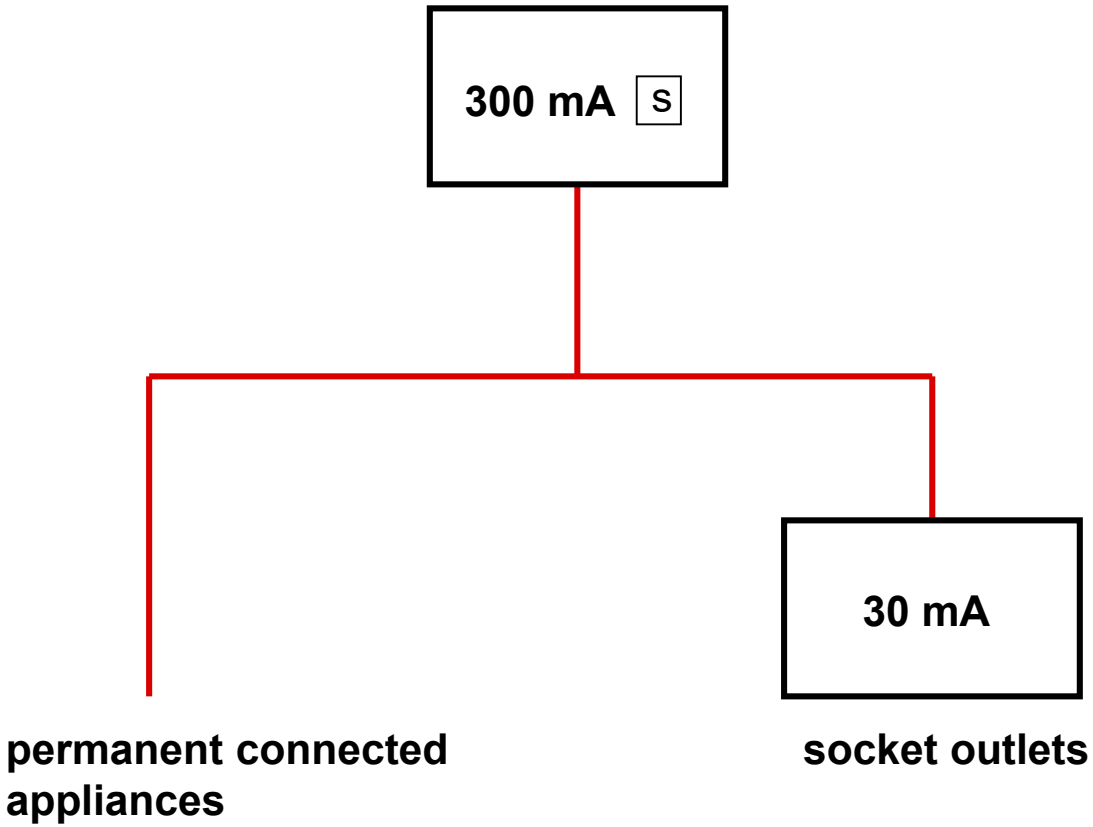
Application notes of RCD Type B

EV Changer

Application notes of RCD Type B

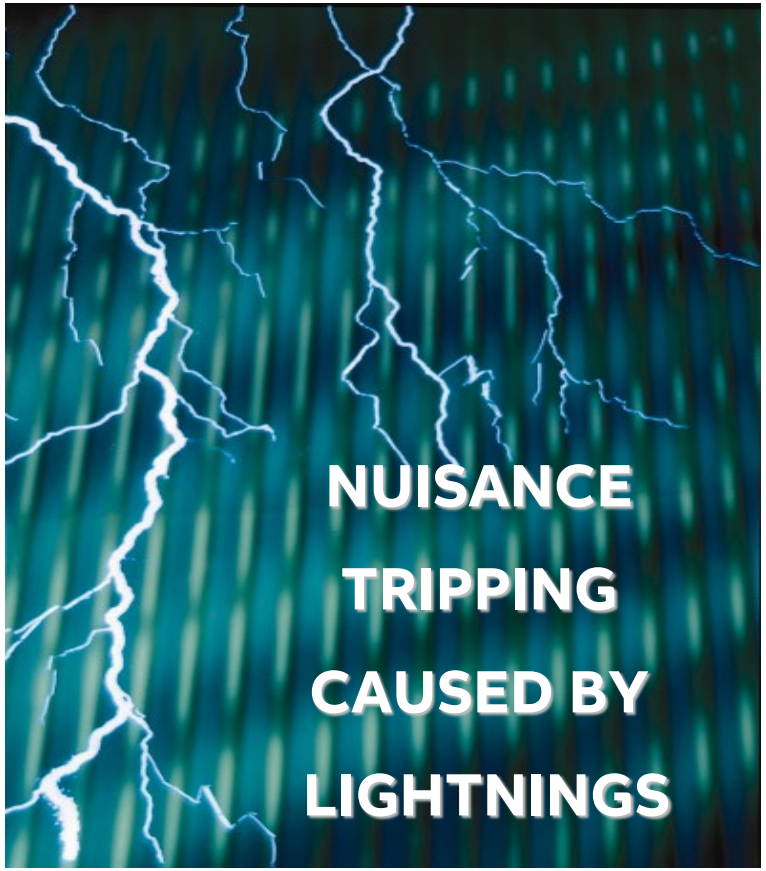
Solar application

Use of selective RCD‘s in electrical installations



Against nuisance tripping special ranges : AP-R

Problem: unwanted tripping



The causes

- Atmospheric discharges (lightnings)
- Operational discharges (switch-off in MV)

Consequences in RCDs

- Sudden and unjustified tripping (out of service)

Against nuisance tripping special ranges : AP-R

Problem: unwanted tripping

APR types suit all applications where it is necessary to ensure safety and continuity of supply while preventing unwanted tripping.

Typical examples of this can be found in these situations:

- Environments subjected to overvoltage due to lightning
- Simultaneous switching on of fluorescent lamps with electronic ballasts
- Simultaneous switching of IT apparatus (computers or electronic devices)
- Devices with capacitors which connect phases to the earth installed in long circuits
- Switching on of motor softstarter/speed variator.

RCD Selection

- Application =>Type AC / A /B / Selective / AP-R and Sensitivity for RCCB and RCBO
  => B and C characteristic for RCBO

- Rated current of Circuit Breaker / Fuse => AF for RCCB

- Rated current of Load => AT for RCBO
  => AT for MCB + AF RCCB

- Short circuit current => Icn for RCBO
  => Icn for MCB + RCCB

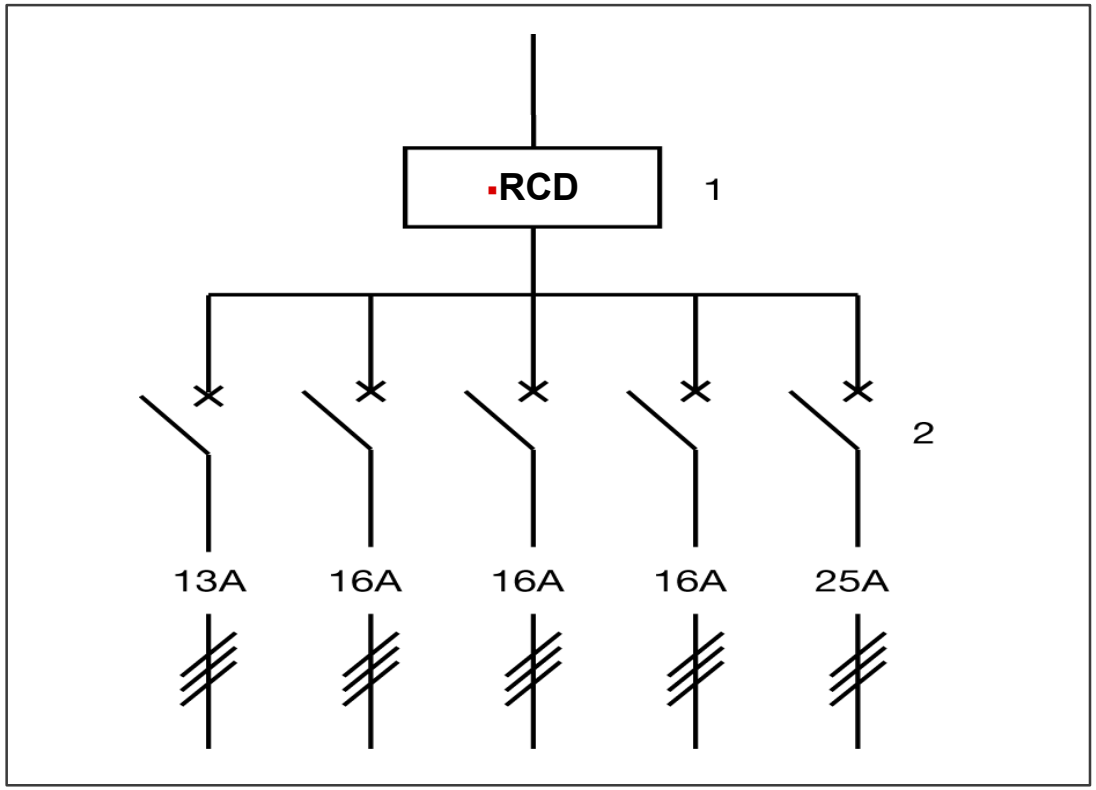
RCD Selection

Overcurrent protection with downstream installed circuit breakers

Conditions:

RCD and miniature circuit breakers are installed in the same panel or, if they are installed separatly

The connection cable between the RCD and the miniature circuit breakers has a length of ≤ 1m.



Overcurrent protection of RCD‘s

Overcurrent protection with downstream installed circuit breakers

Example:

In=13A+(3x16A)+25A=86A
number of circuits 5
diversity factor 0.7
Current to be considered for overload
protection of RCD
I ’ = In x f = 86A x 0.7 = 60.2A
Overload protection of RCD 63A is fullfilled

Number of circuits	diversity factor acc. to IEC 439-3
n	**f**
2 and 3	0.8
4 and 5	0.7
6 to 9	0.6
10 and more	0.5

ABB RCD range

FH 200

- RCCB => Voltage independent (VI)
- มอก.2425-2552 / IEC61008
- No. of poles: 2 (1 phase), 4-pole (3phase)
- Sizes: 25,40 and 63 A (AF)
- Sensitivity thresholds: 0.03,0.1, 0.3, 0.5 and 1 A
- Types/classes: AC

F 200

- RCCB => Voltage independent (VI)
- มอก.2425-2552 / IEC61008
- No. of poles: 2 (1 phase), 4-pole (3phase)
- Sizes: 25,40, 63, 80, 100 and 125 A (AF)
- Sensitivity thresholds: 0.03,0.1 and 0.3 A
- Types/classes: AC / A / B / Selective and AP-R

ABB RCD range

DSE201

- RCBO => Voltage Dependent (VD)
- `ùÍ .909-2548 / IEC61009
- No. of poles: 1P
- B and C characteristic: 6, 10, 16, 20, 25, 32, 40 and 50 A (AT)
- Sensitivity thresholds: 0.03 A
- Types/classes: AC and A
- Breaking Capacity: 6kA

DSE201M

- RCBO => Voltage Dependent (VD)
- `ùÍ .909-2548 / IEC61009
- No. of poles: 1P
- B and C characteristic: 6, 10, 16, 20, 25, 32 and 40 A (AT)
- Sensitivity thresholds: 0.03 A
- Types/classes: AC and A
- Breaking Capacity: 10kA

ABB RCD range

DS201

- RCBO => Voltage Independent (VI)
- `ùÍ .909-2548 / IEC61009
- No. of poles: 1P+N
- B and C characteristic: 6, 10, 16, 20, 25, 32 and 40 A (AT)
- Sensitivity thresholds: 0.03, 0.1, 0.3 and 1A
- Types/classes: AC, A, AP-R, Selective
- Breaking Capacity: 6kA

DS203NC

- RCBO => Voltage Independent (VI)
- `ùÍ .909-2548 / IEC61009
- No. of poles: 3P+N
- B and C characteristic: 6, 10, 16, 20, 25 and 32 A (AT)
- Sensitivity thresholds: 0.03, 0.1, 0.3 A
- Types/classes: AC, A, AP-R, Selective
- Breaking Capacity: 6kA

Range of System pro *M* / pro *M* compact

RCCBs F200

Protection against:
- Earth leakage
- Indirect contact

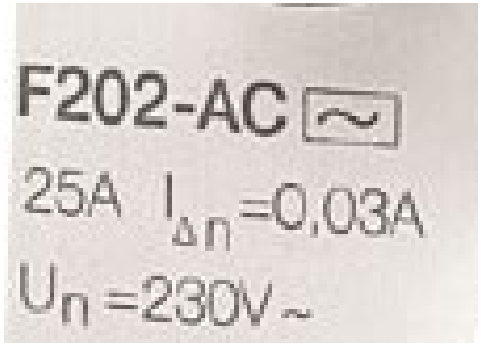
RCBOs DS200

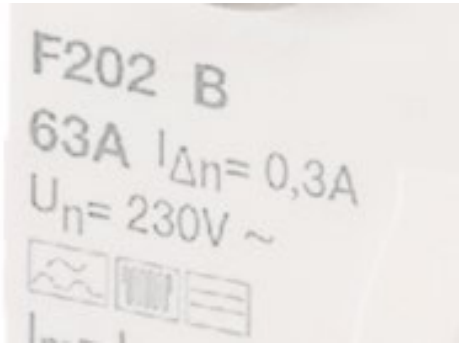
Protection against:
- Overload
- Short circuit
- Earth leakage
- Indirect contact

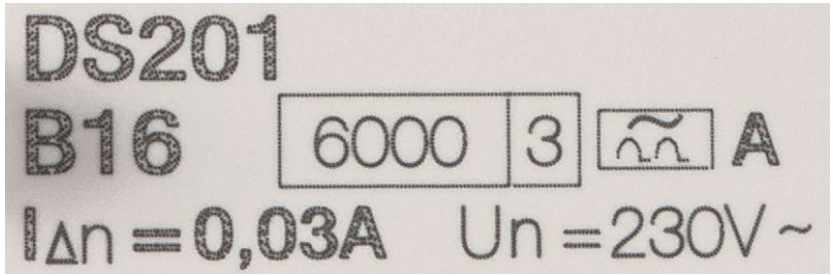
Blocks DDA200

Protection against:
(with MCB's)
- Overload
- Short circuit
- Earth leakage
- Indirect contact

How to know type of RCD ?

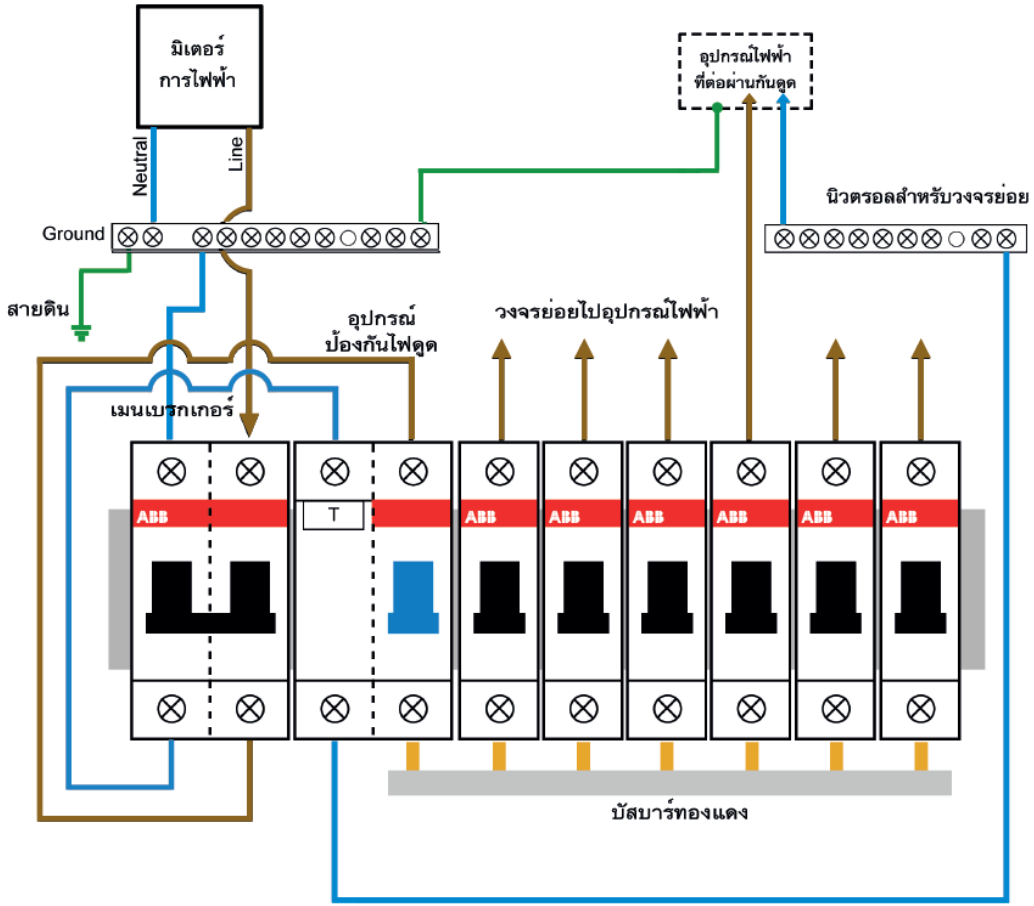






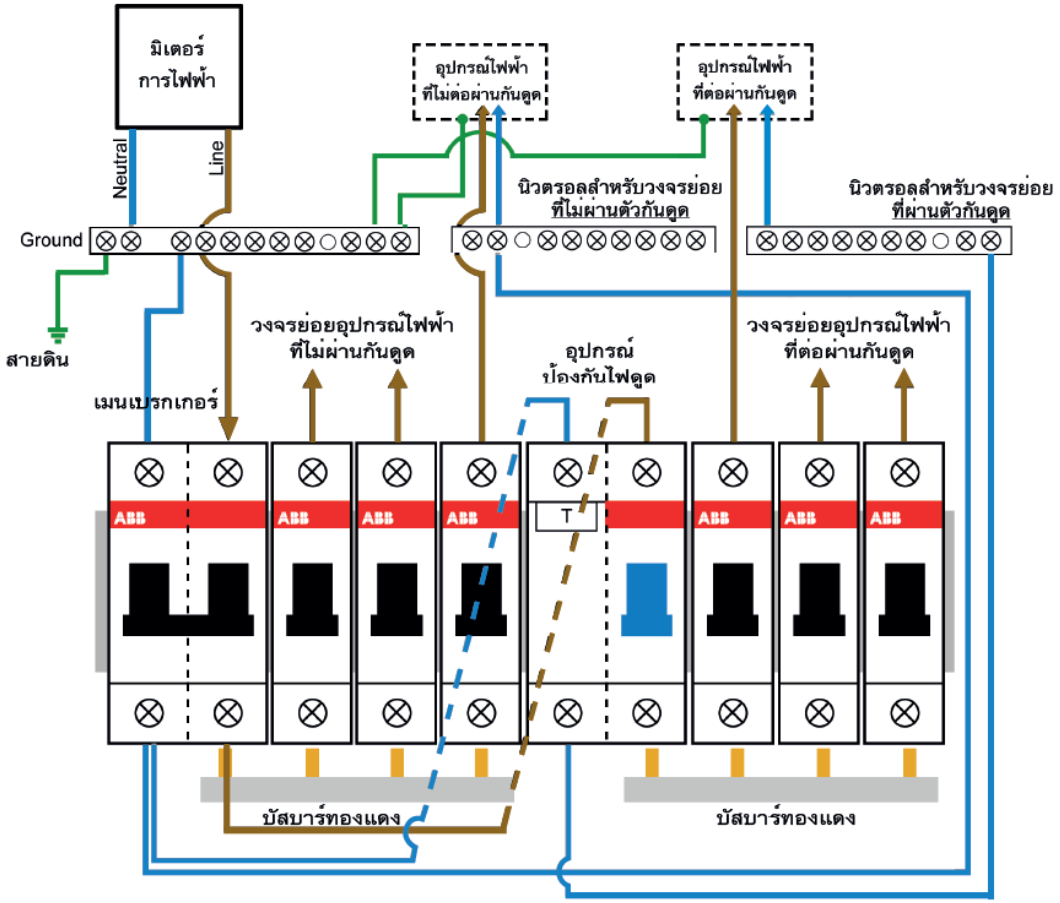
Installation

MCB + RCCB



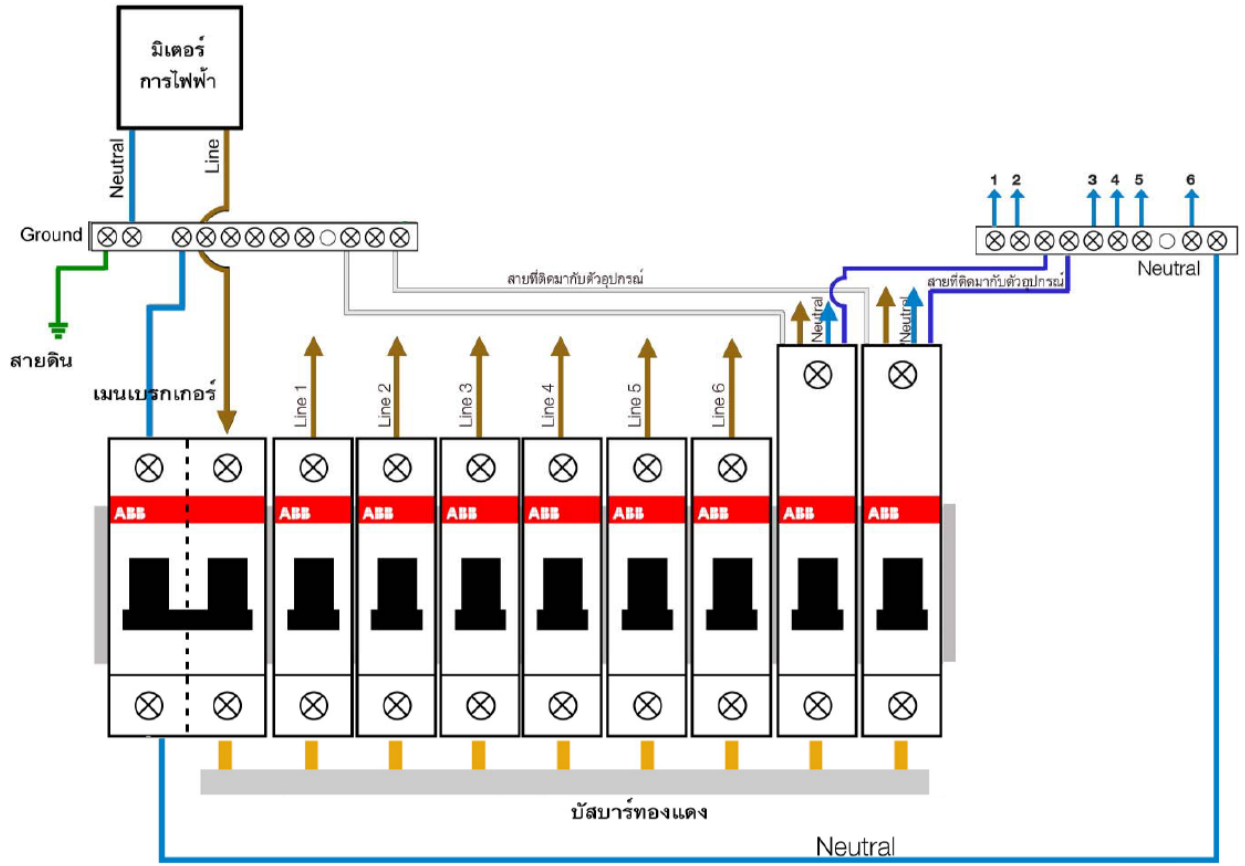
Installation

MCB + RCCB (Separated circuit)



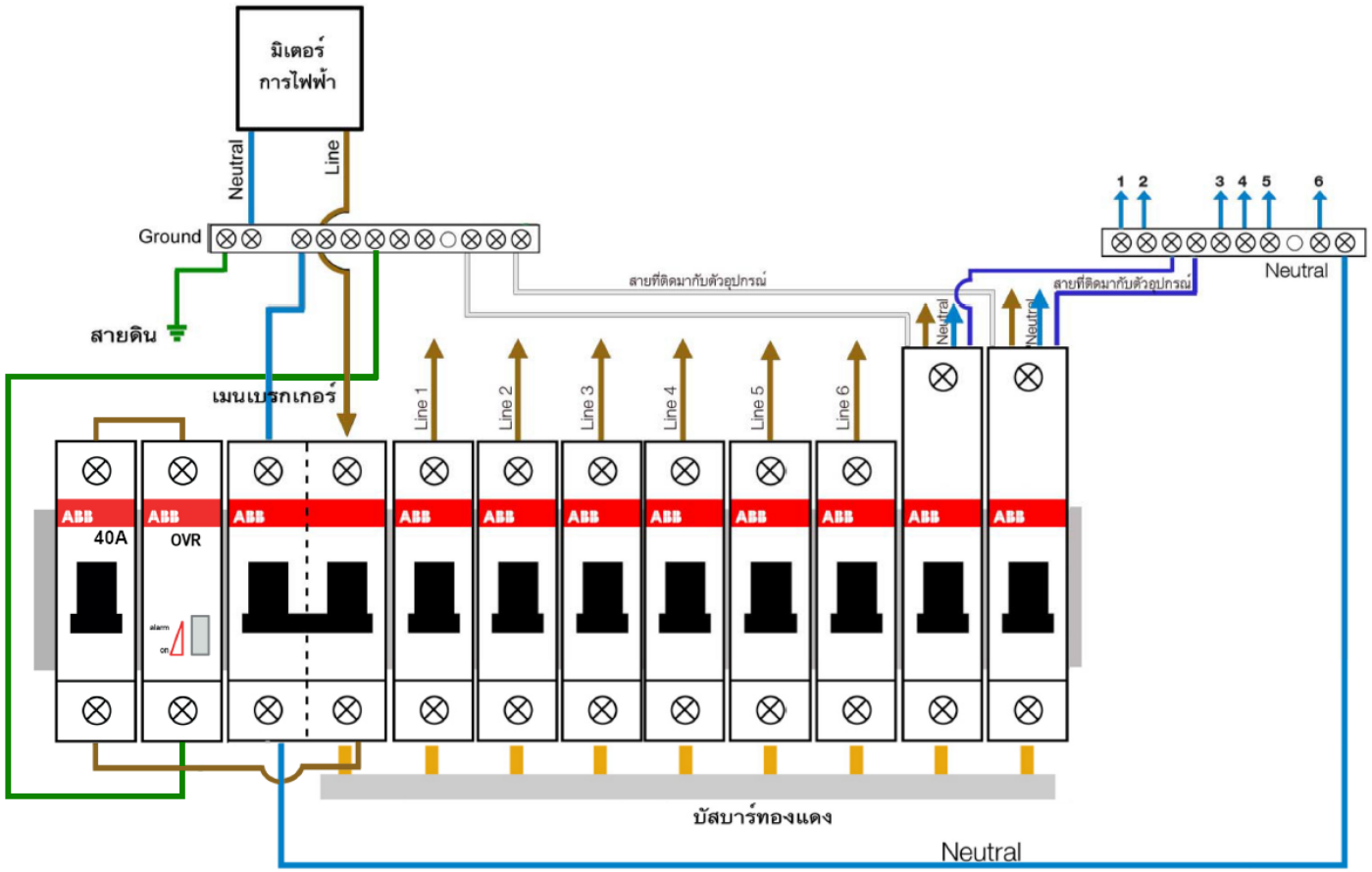
Installation

MCB + RCBO 1pole



Installation

MCB + SPD + RCBO 1pole

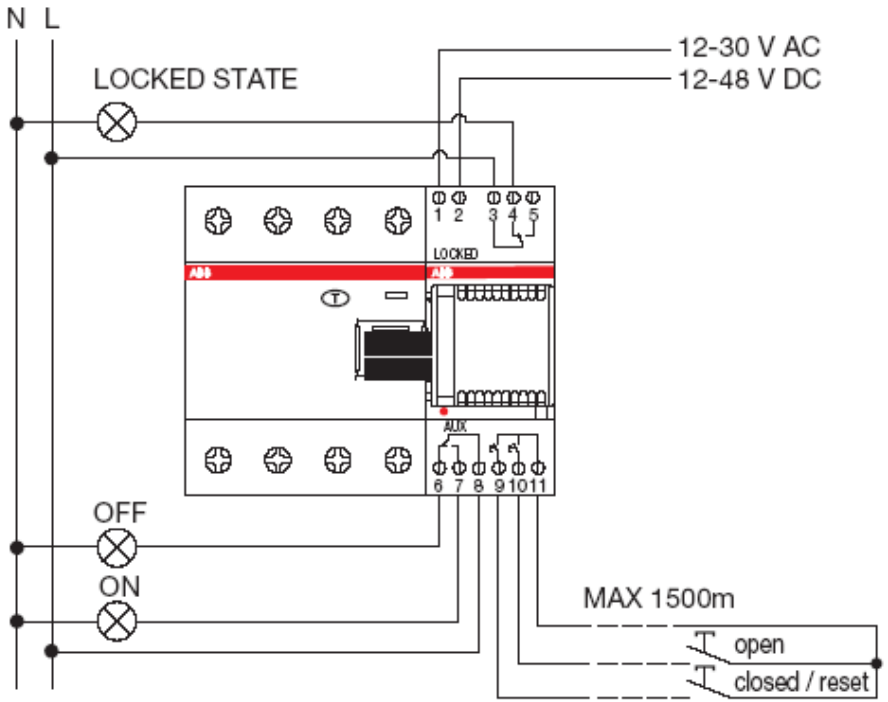


Auto Reclosing

MULTIPURPOSE DEVICE F2C-ARI

- For the RCCBs up to 100A is available the F2C-ARI which, in addition to the automatic reclosing, allows the remote control of the customer fitted RCCB.
- This device ensures complete personal and system safety in case of faults and improves reliability and continuity of service in case of unwanted tripping.

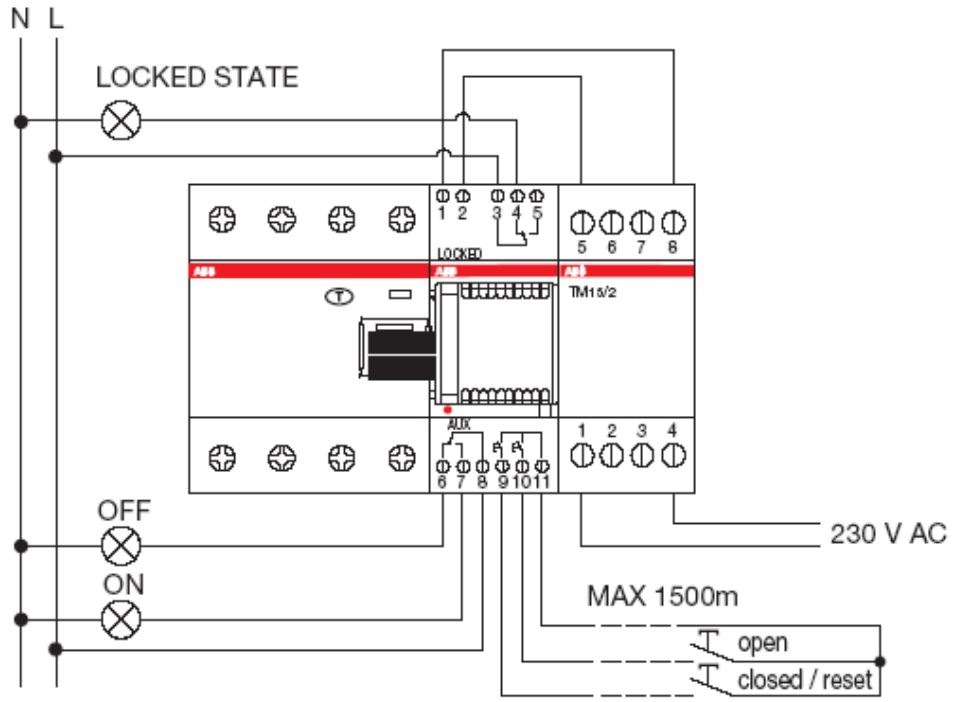
Product overview
Autoreclosing unit F2C-ARI



Wiring diagram for the remote opening and closing/ reset of the coupled RCCB.

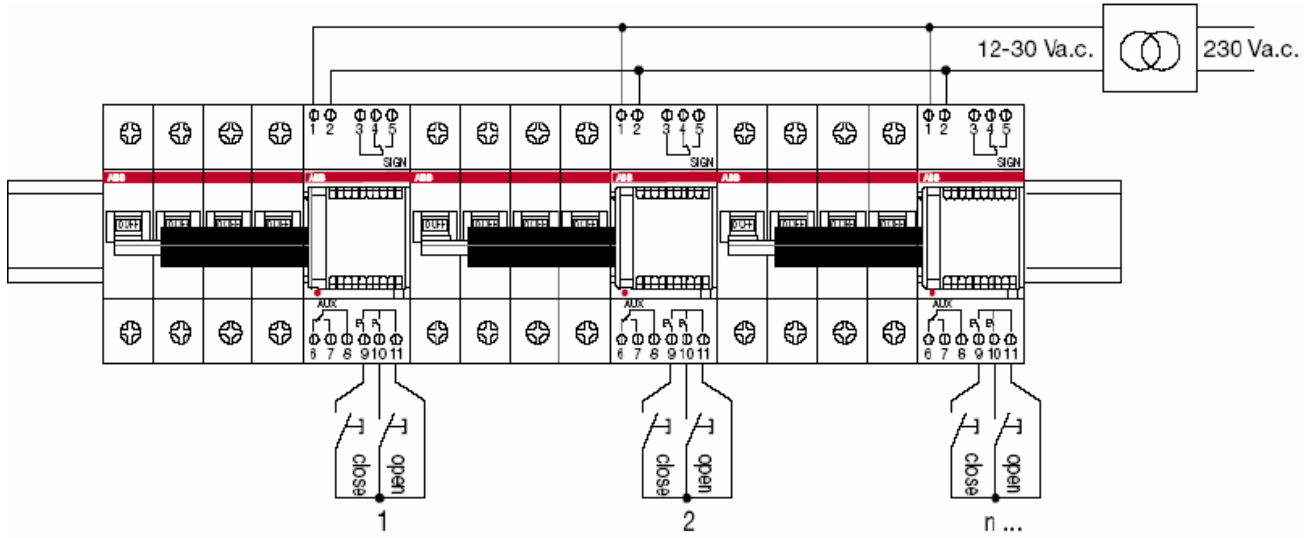
Low voltage use: 12...30 V AC, 12...48 V DC

Product overview
Autoreclosing unit F2C-ARI



Use at 230 V AC via a TM15/12 – TS 16/12 bell transformer

Product overview
Autoreclosing unit F2C-ARI



Significant space saving thanks to the reduced power consumption with the possibility to feed several devices by means of a single transformer.

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