

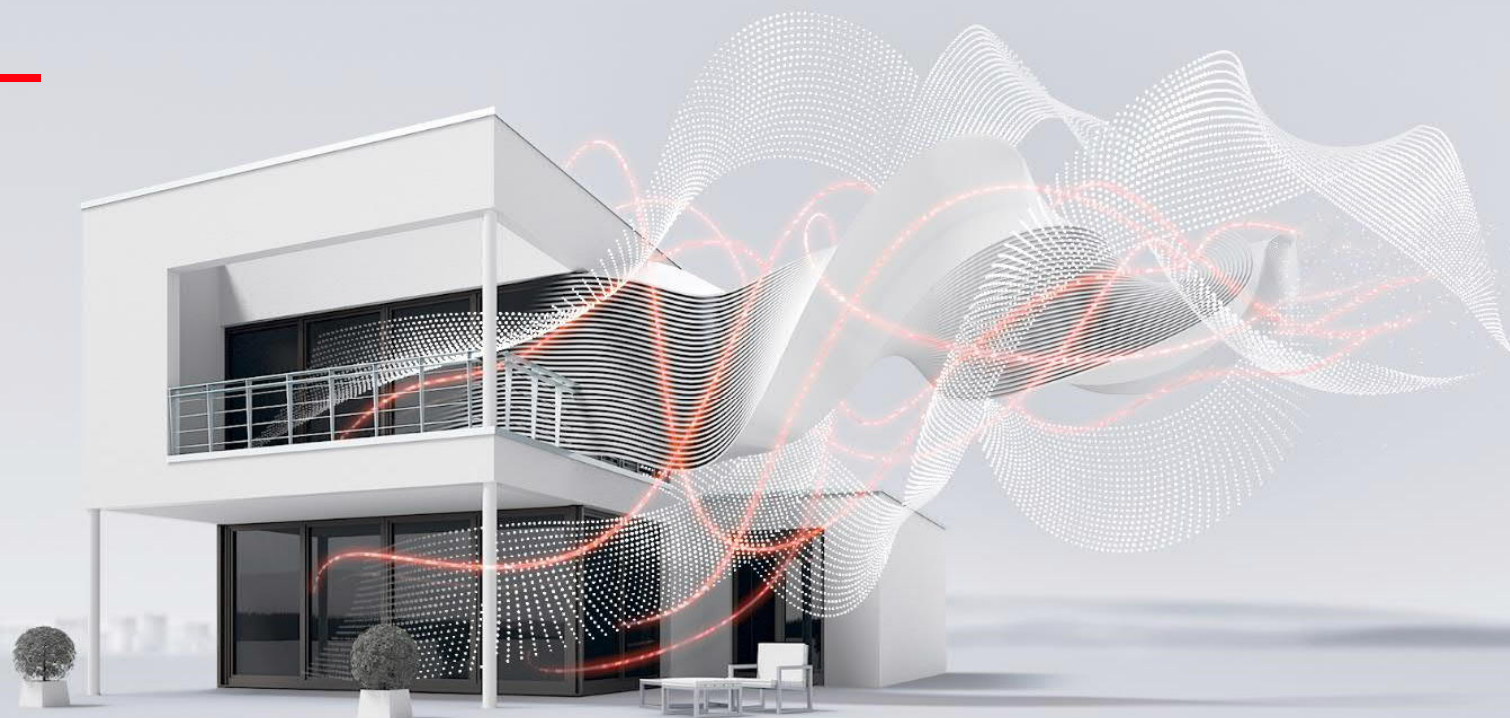


ABB : เทคโนโลยี และการเลือกใช้อุปกรณ์ป้องกันไฟรั่วไฟดูด

Veerachai Rattanasomchok / PMM

Residual Current Devices (RCDs)



What is RCD?

Residual Current Device

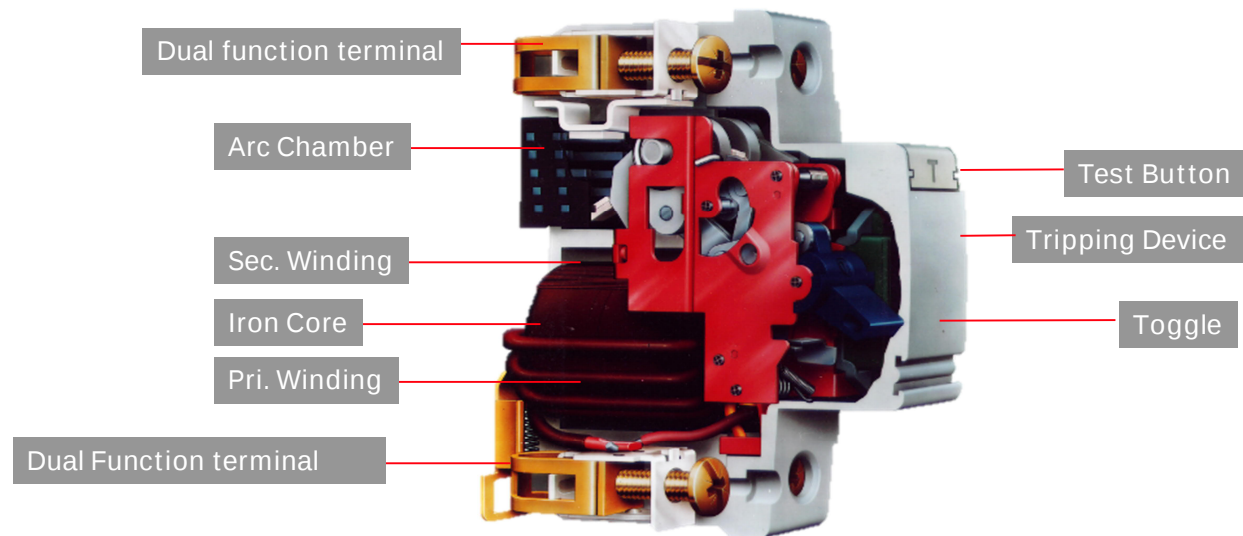
- RCCB => IEC 61008 / มอก. 2425-2560

Residual Current Circuit Breaker

- RCBO => IEC 61009 / มอก. 909-2548

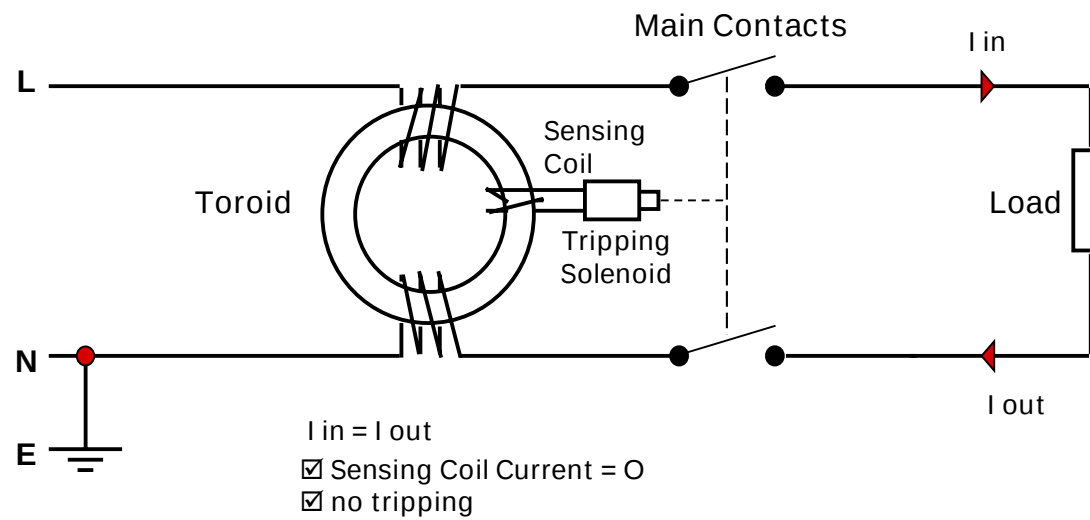
Residual Current Circuit Breaker with overcurrent protection

Residual Current Operated Circuit Breaker



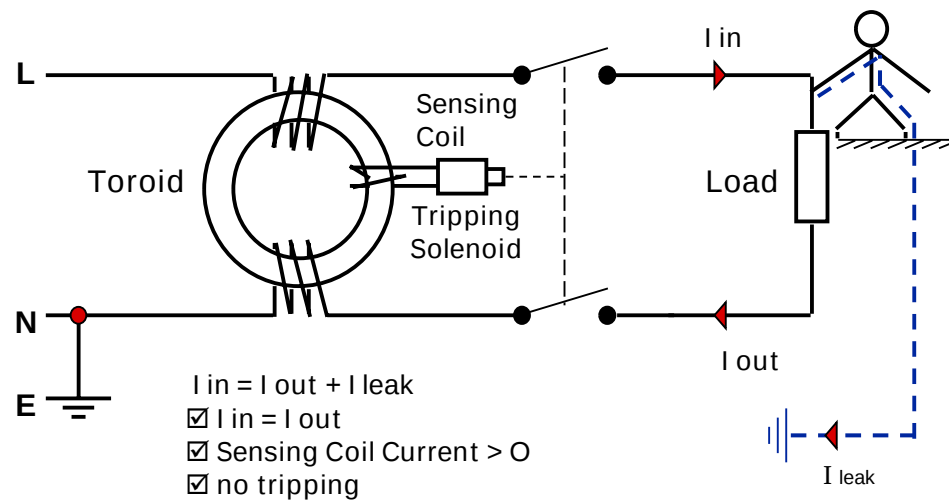
Operating principle of RCCB

(A) NO EARTH FAULT



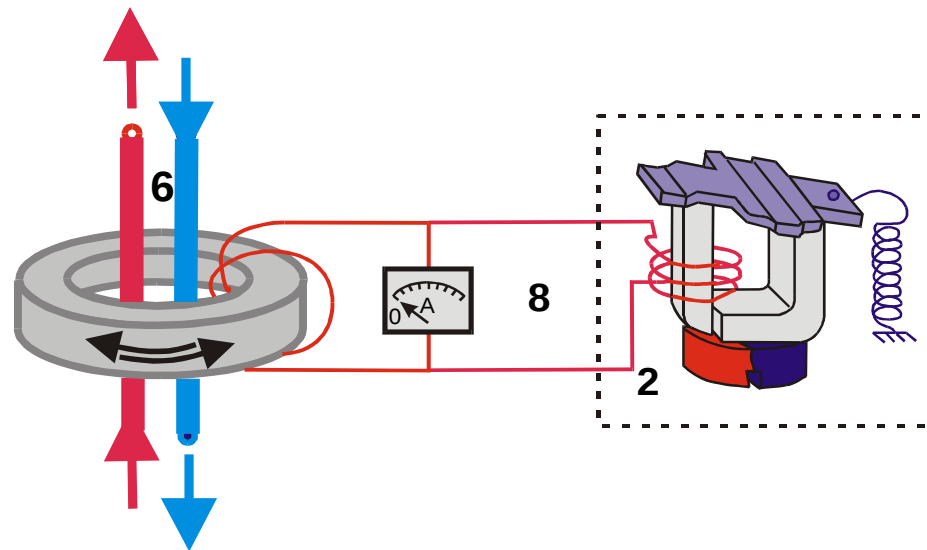
Operating principle of RCCB

(B) WITH EARTH FAULT



Core-balance transformer in principle (ON-Position)

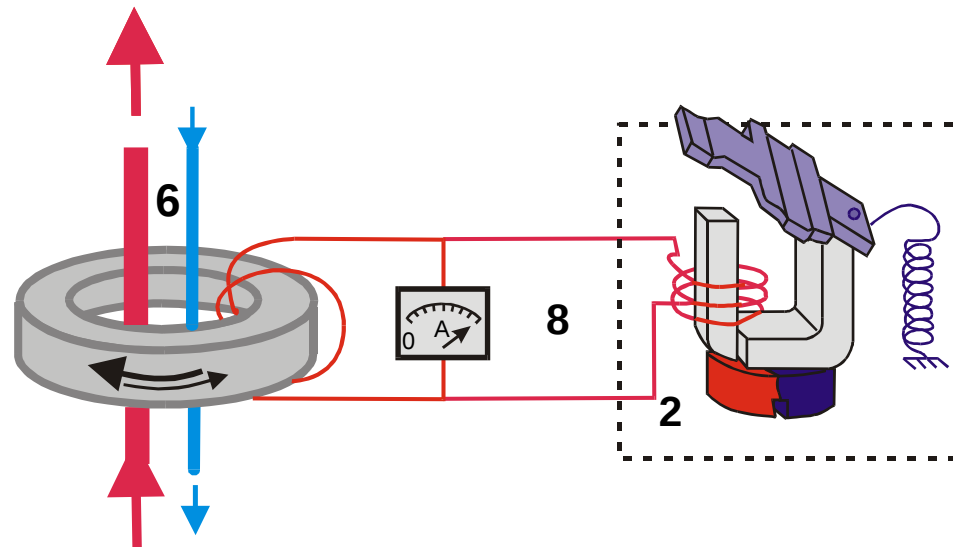
balanced core:



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

Core-balance transformer in principle (TRIP-Position)

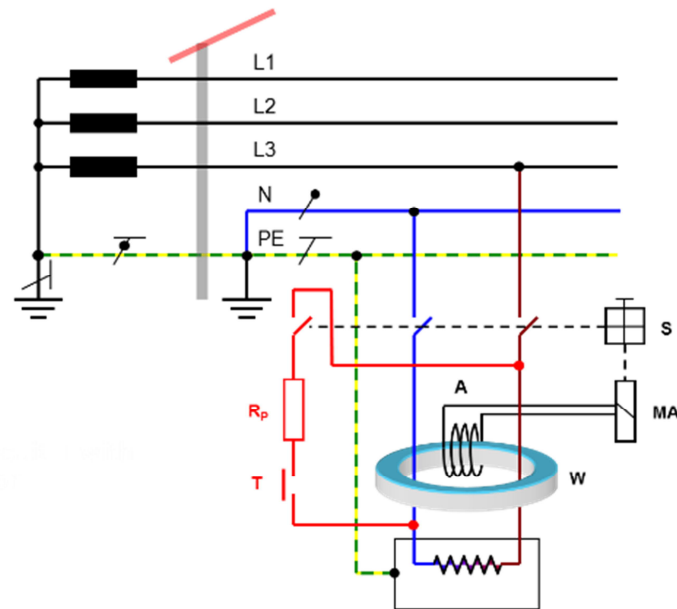
unbalanced core:



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

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

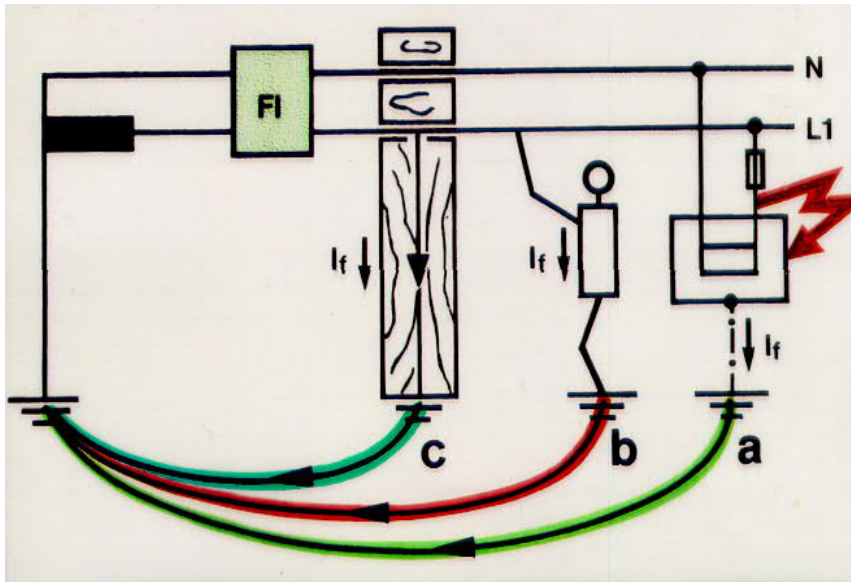
ABB RCD

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

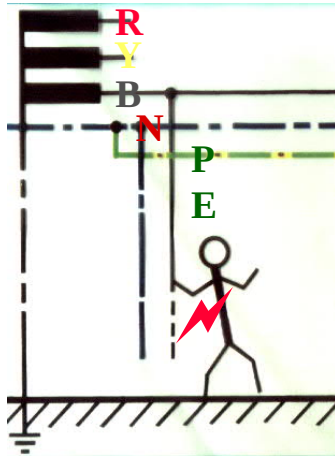
- 30mA
- 300mA

equipment

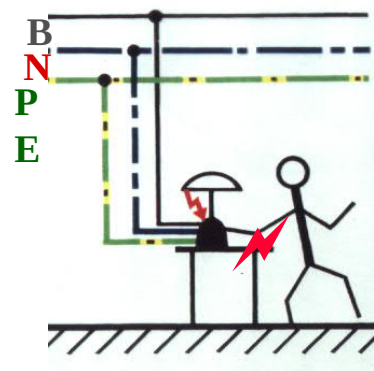
Where and what purpose

- Protect direct contact with live parts
(Human & Animals)
- Discrimination
Protect against fire risks and

Types of electric shock



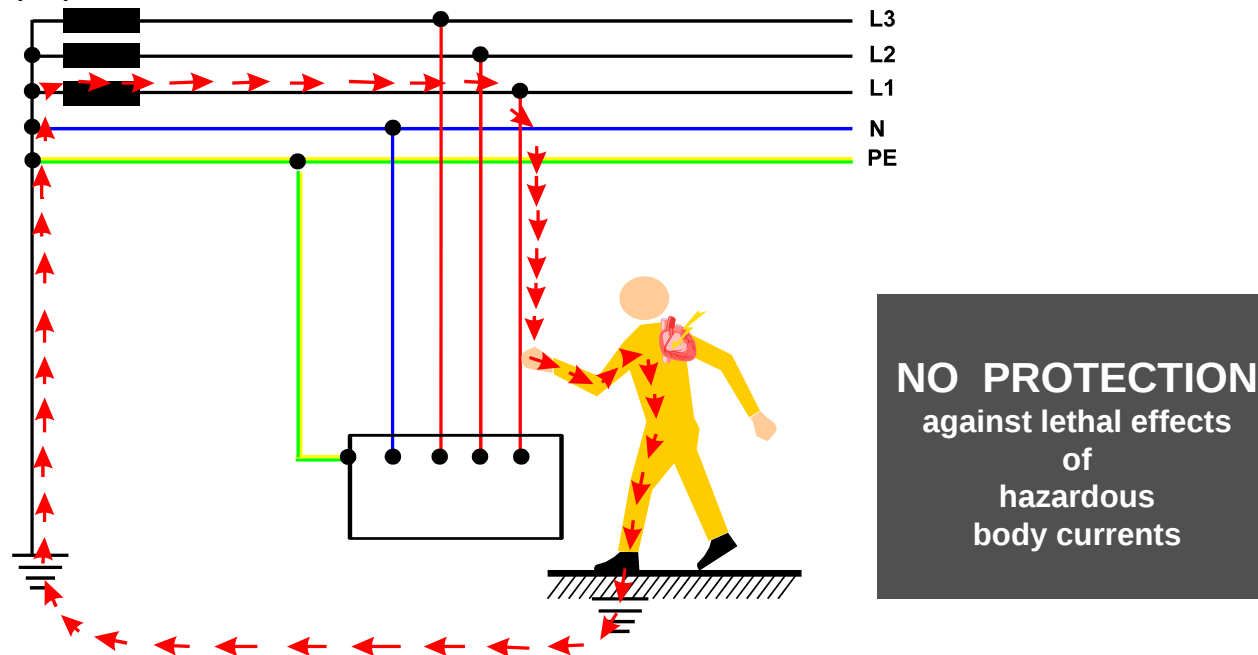
Direct contact
Electric shock in normal service



Indirect contact
Electric shock in case of a fault

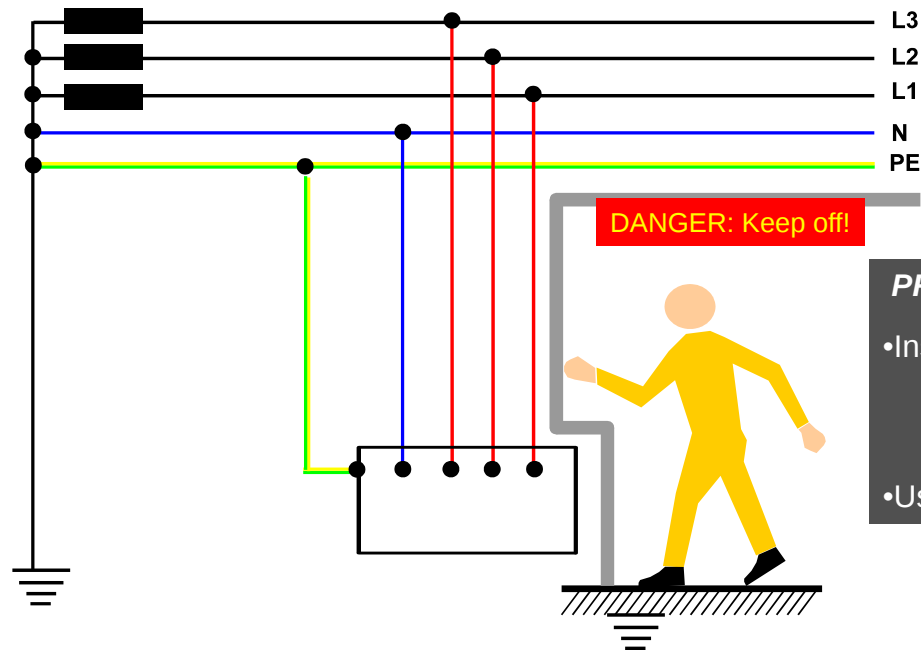
Direct contact with live parts cve parts Direct

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



Direct contact with live parts cve parts Direct

PROTECTION against lethal effects due to hazardous body currents

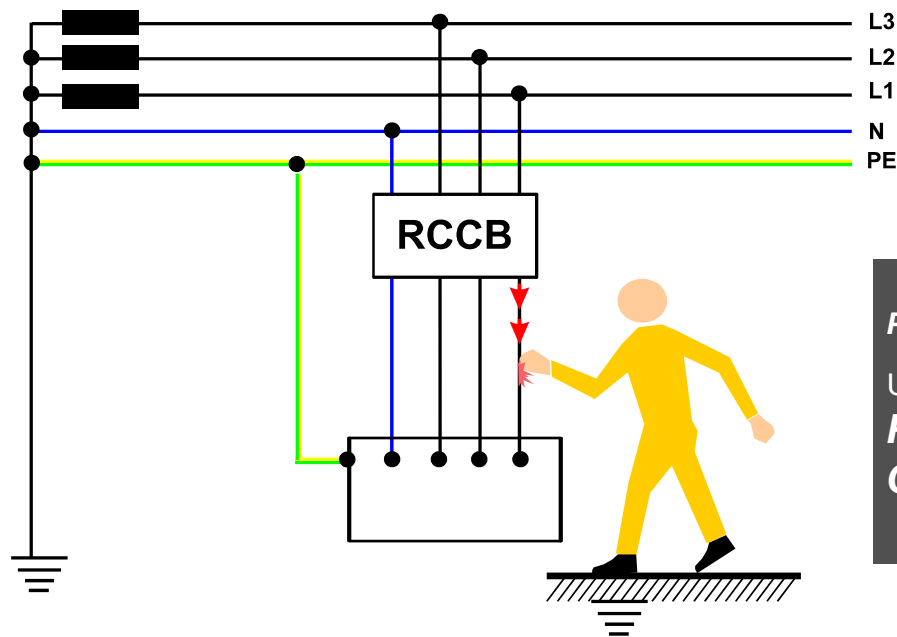


PROTECTION by:

- 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



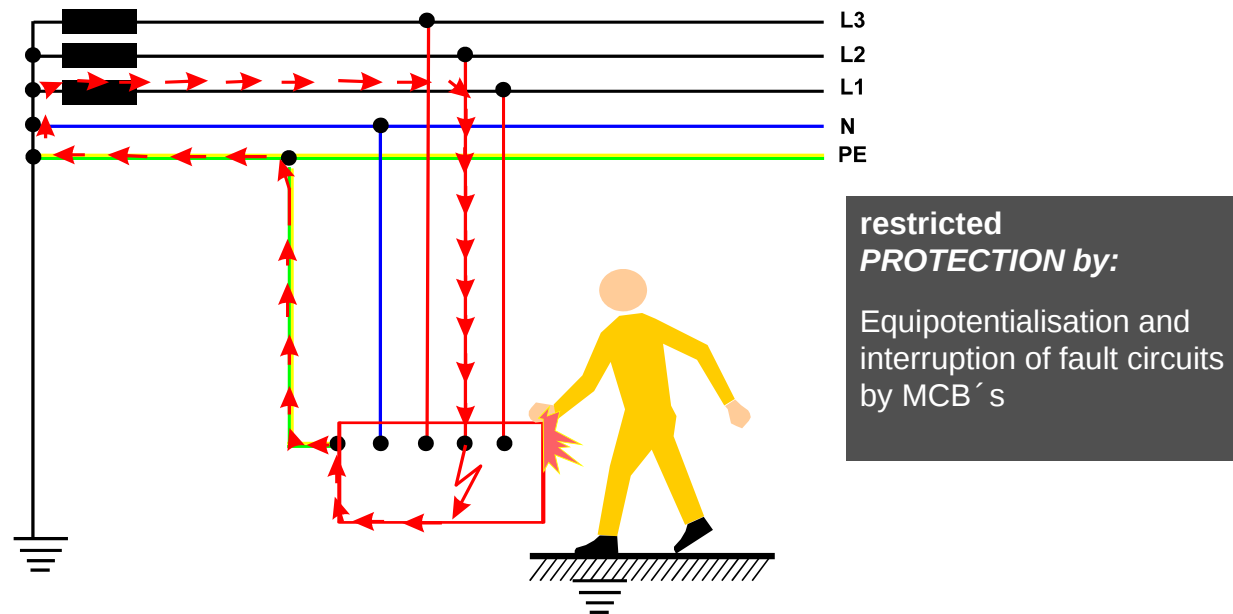
PROTECTION by:

Use of:

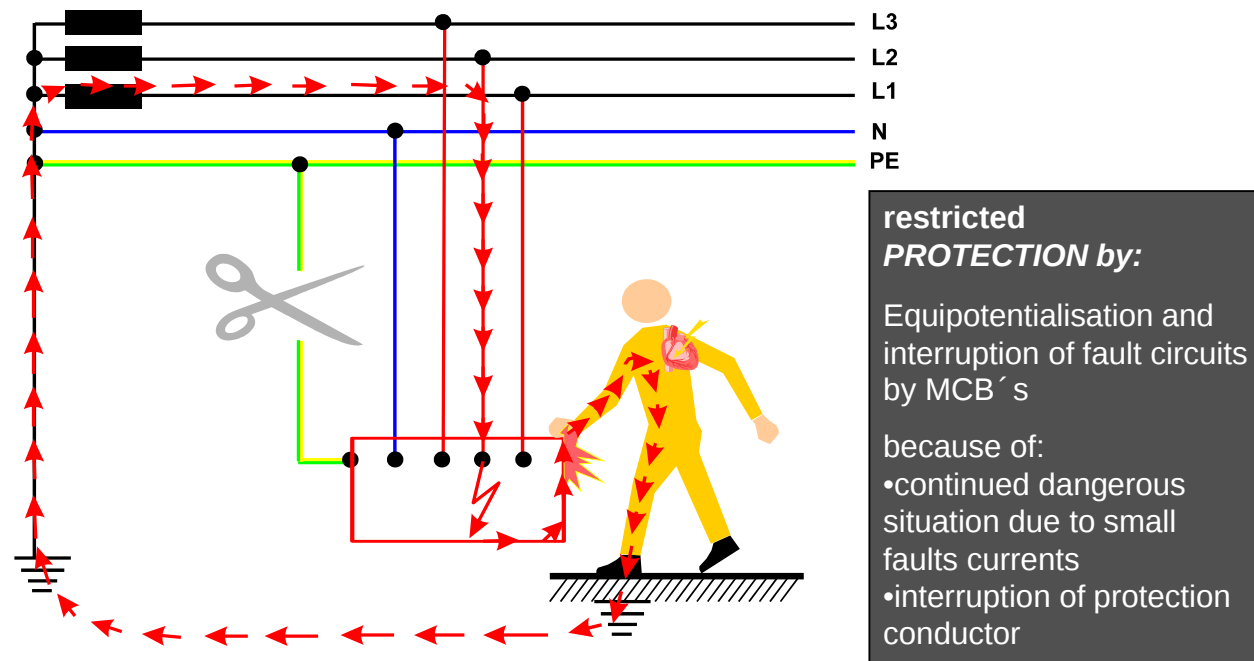
***Residual Current
Circuit Breaker***

Indirect contact with live parts

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

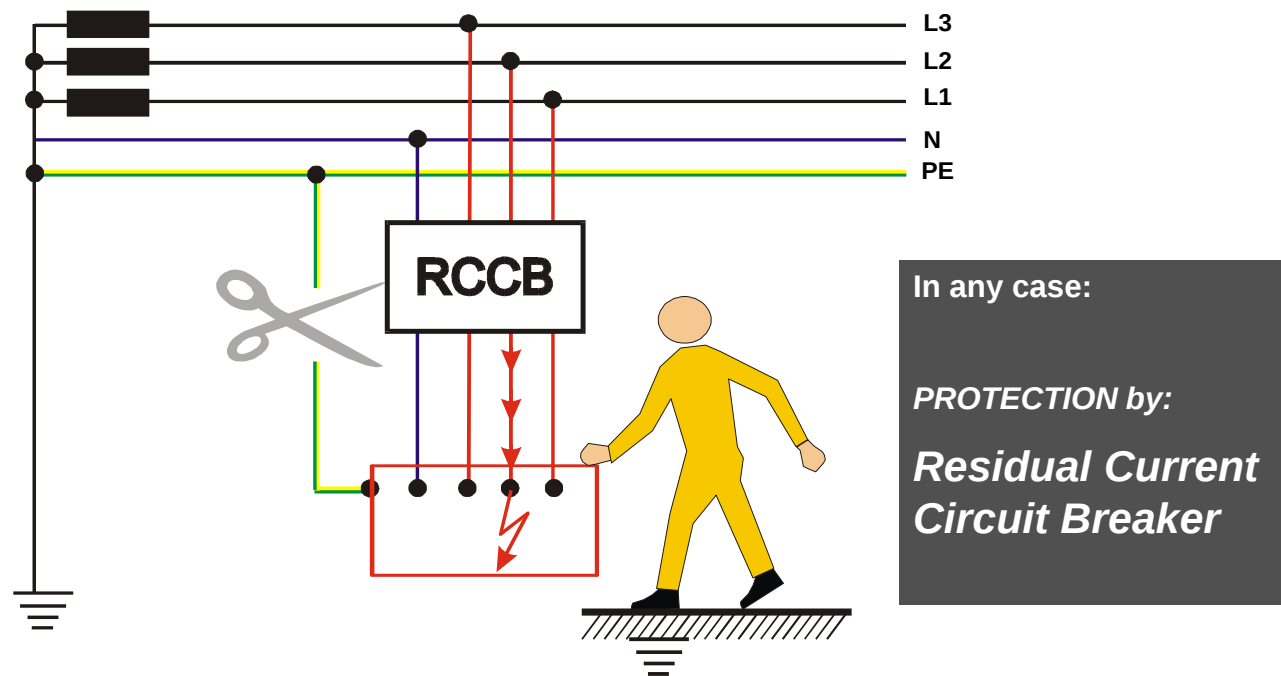


Indirect contact with live parts



Indirect contact with live parts

PROTECTION against lethal effects due to hazardous body currents

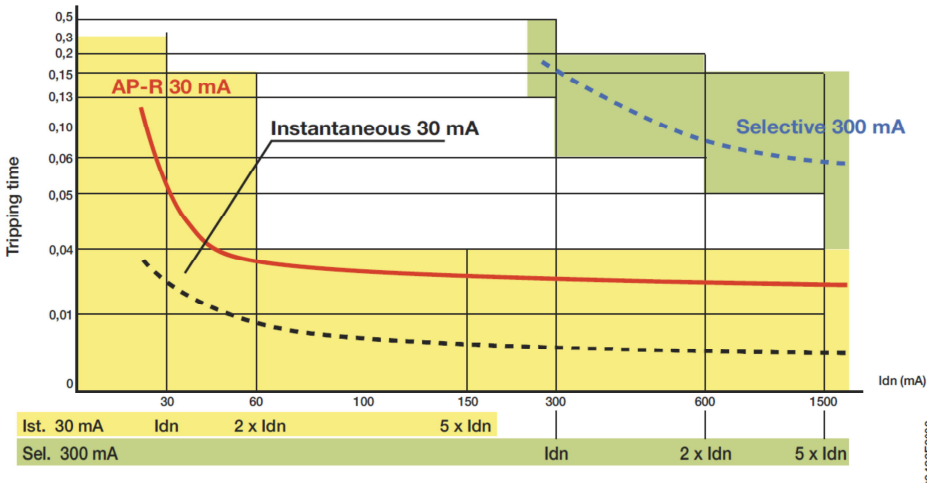




RCD Tripping time

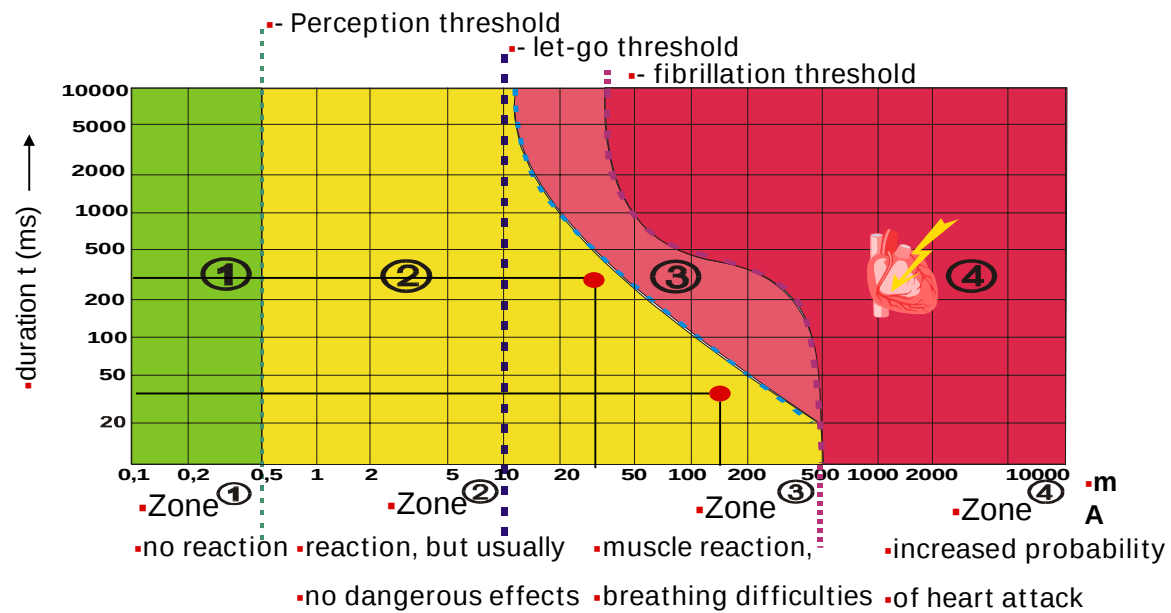
According to IEC 61008 and IEC61009

Type AC	I _n [A]	I Δ [A]	Tripping times (s)xcurrents			
			1xI Δ	2xI Δ	5xI Δ	500A
Generic	Any	Any	0.3	0.15	0.04	0.04
S (selective)	Any	>0.030	0.13-0.5	0.06-0.2	0.05-0.15	0.04-0.15

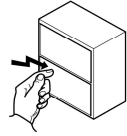


Effects of electrical current to the human body (IEC 479-2)

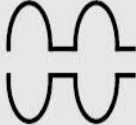
AC currents 50/60Hz at various body currents and durations;



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	Extremely 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		—	•	•
Cuttet halfwaves - degree 90° - degree 135°		—	• •	• •
Halfwave + 6 mA		—	•	•
Only DC residual current		—	—	•

Current waveform	Proper functioning of residual current protective devices of type				Tripping current
	AC	A	F	B	
					
	■	■	■	■	0.5 to 1.0 I _{Δn}
	-	■	■	■	0.35 to 1.4 I _{Δn}
	-	■	■	■	Current delay angle 90°: 0.25 to 1.4 I _{Δn}
	-	■	■	■	Current delay angle 135°: 0.11 to 1.4 I _{Δn}
	-	■	■	■	max. 1.4 I _{Δn} + 6 mA
	-	-	■	■	max. 1.4 I _{Δn} + 10 mA
	-	-	■	■	0.5 to 1.4 I _{Δn}
	-	-	-	■	0.5 to 2.0 I _{Δn}
					
					
	-	-	-	■	Current frequency 150 Hz 0.5 to 2.4 I _{Δn}
	-	-	-	■	Current frequency 400 Hz 0.5 to 6 I _{Δn}
	-	-	-	■	Current frequency 1000 Hz 0.5 to 14 I _{Δn}

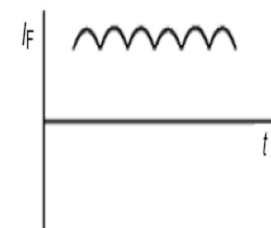
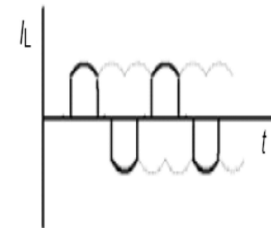
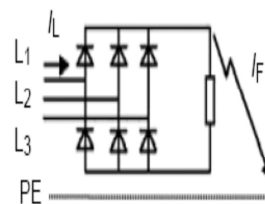
Application notes of RCD Type B

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

Six-pulse bridge

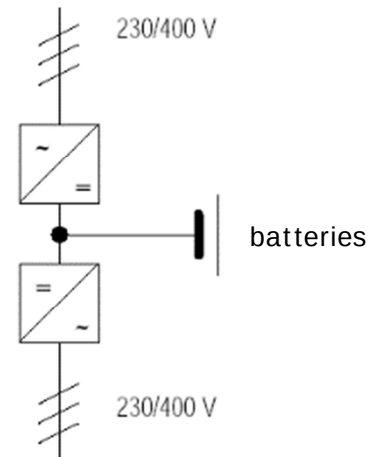


Application notes of RCD Type B

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



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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



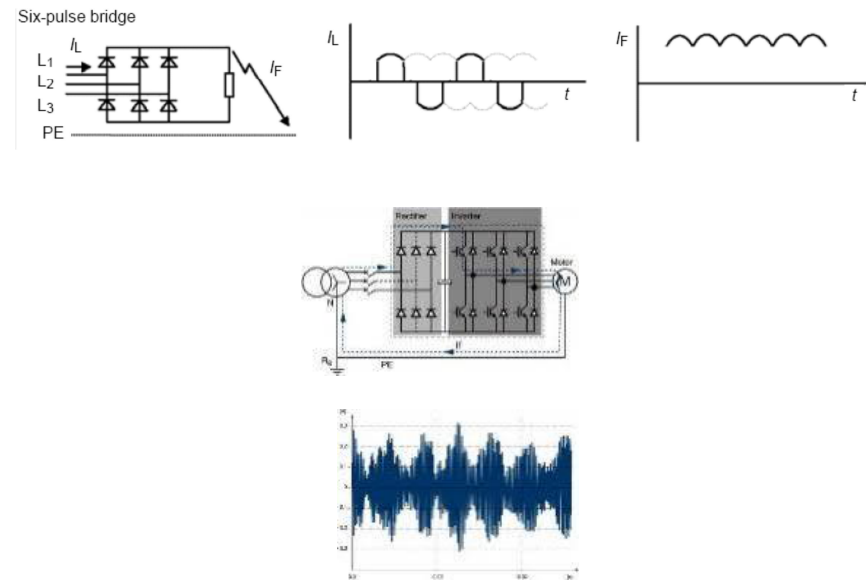
Application notes of RCD Type B

4. Three-phase Frequency Converters (drives)

Drives include a rectifier section and an inverter section

The earth fault can occur:

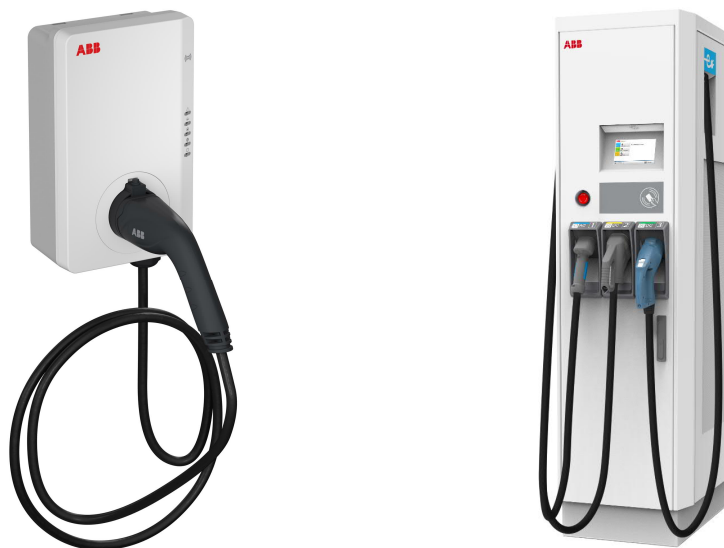
- Downstream the rectifier (as already mentioned)
- Downstream the inverter, producing an earth fault current with high frequency components or elevated harmonic distortion.



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Application notes of RCD Type B

EV Changer



Application notes of RCD Type B

Solar application



RCD Selection

- Application => Type AC / A / B Sensitivity for RCCB and RCBO
- Type of Protection (Human or Fire risk) => Sensitivity for RCCB and RCBO
- Rated current of Circuit Breaker / Fuse => AF for RCCB
- Rated current of Load and cable size => AT for RCBO
 => AT for MCB + AF RCCB
- Short circuit current => I_{cn} for RCBO
 => I_{cn} for MCB + RCCB

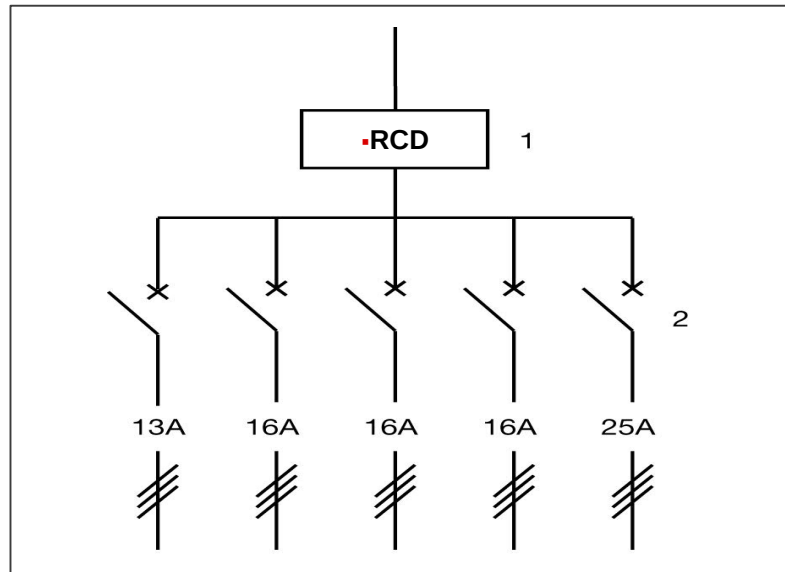
RCD Selection

Overcurrent protection with downstream installed circuit breakers

Conditions:

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

The connection cable between the RCD and the miniature circuit breakers has a length of $\leq 1\text{m}$.



Overcurrent protection of RCD's

Overcurrent protection with downstream installed circuit breakers

Example:

$I_n = 13A + (3 \times 16A) + 25A = 86A$

number of circuits 5

diversity factor 0.7

Current to be considered for
overload

protection of RCD

$I' = I_n \times f = 86A \times 0.7 = 60.2A$

Overload protection of RCD 63A is
fulfilled

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.2425-2560 / IEC61008
- No. of poles: 2 (1 phase), 4-pole (3phase)
- Sizes: 25,40 and 63 A (AF)
- Sensitivity thresholds: 0.03,0.1 and 0.3
- Types/classes: AC

F 200



- RCCB => Voltage independent (VI)
- มอก.2425-2560 / IEC61008
- No. of poles: 2 (1 phase), 4-pole (3phase)
- Sizes: 25,40, 63, 80 and 100(AF)
- Sensitivity thresholds: 0.03,0.1* and 0.3 A
- Types/classes: AC / B

*only for 80 and 100AF

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ABB RCD range

DSE201



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

DSE201M



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

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ABB RCD range

DS201



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

DS201M



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

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ABB RCD range

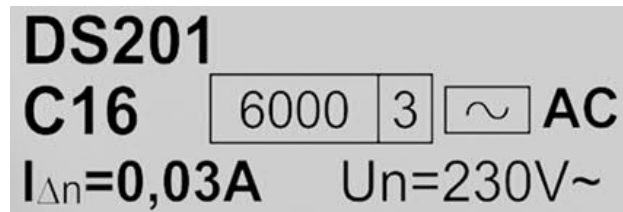
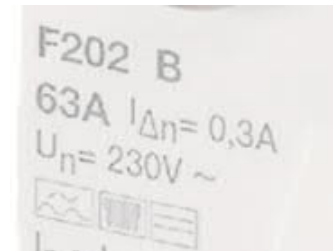
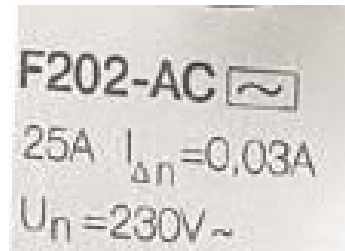
DS203NC



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

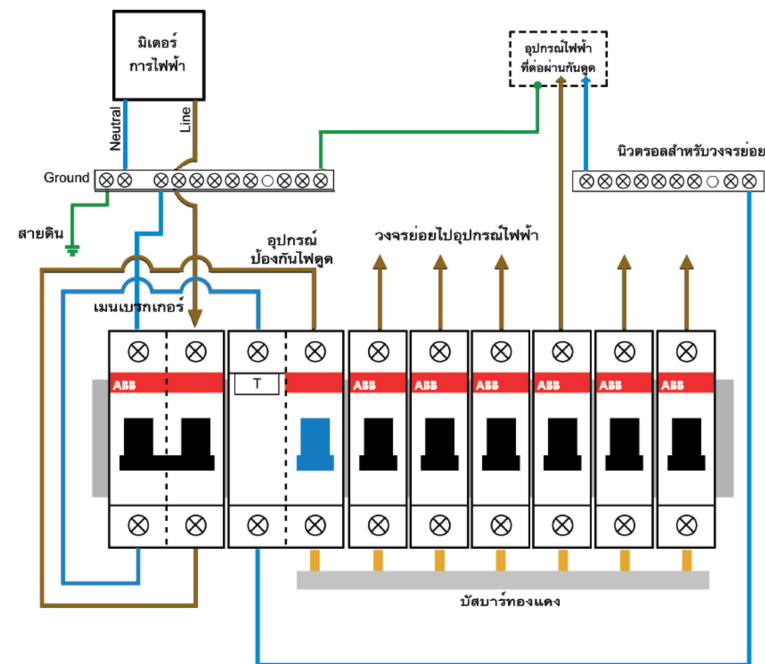
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How to know type of RCD ?



Installation

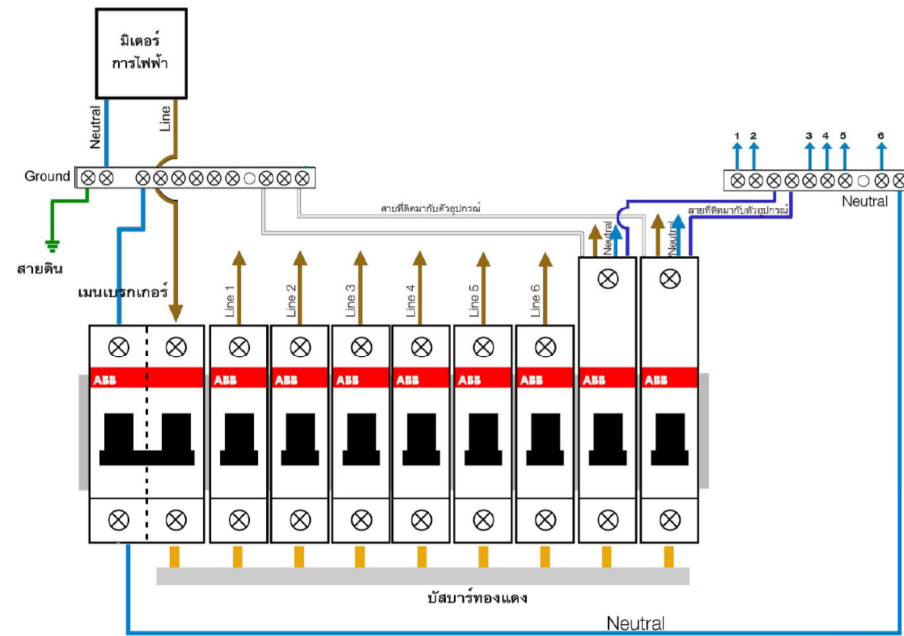
MCB + RCCB





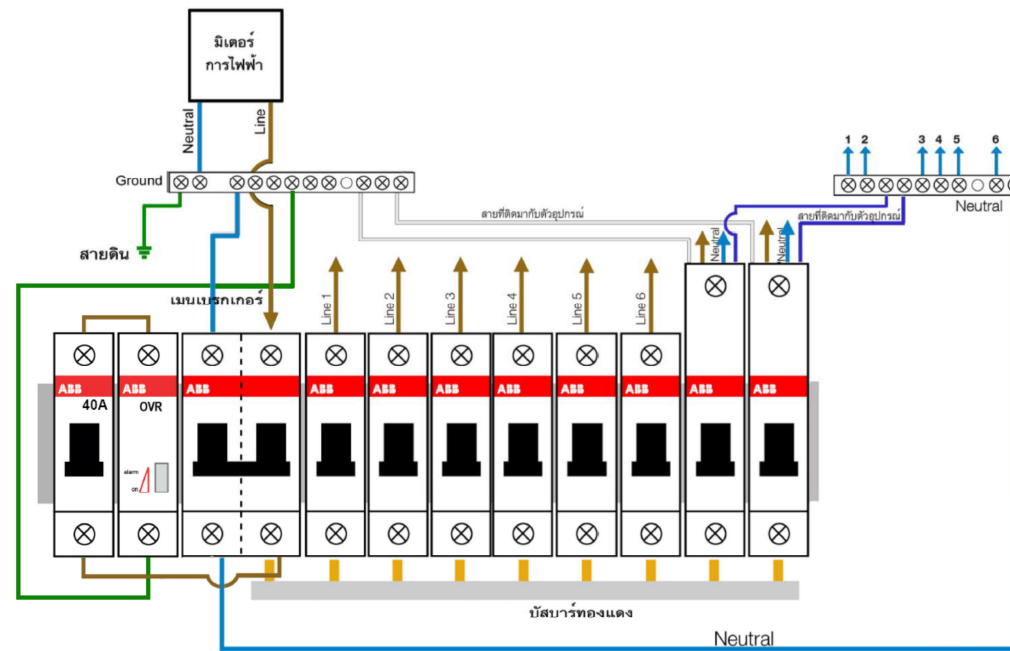
Installation

MCB + RCBO 1pole



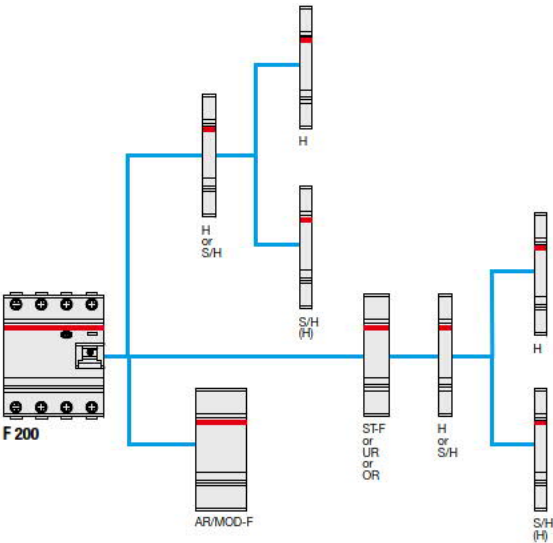
Installation

MCB + SPD + RCBO 1pole



Accessories

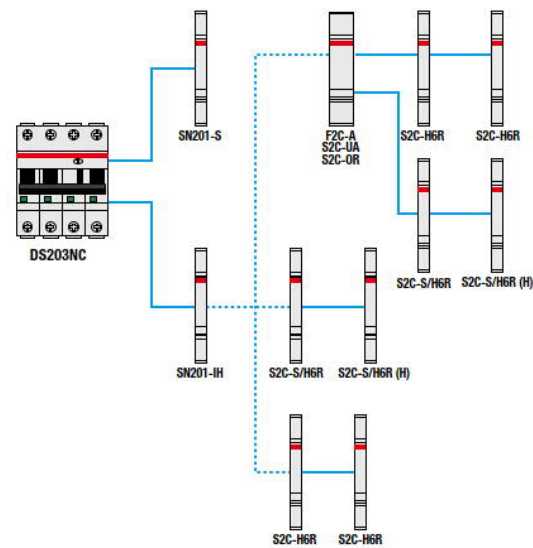
RCCB ; F200 series



H	Auxiliary contact	S2C-H6R
S/H	Signal/Auxiliary contact	S2C-S/H6R
S/H (H)	Signal/Auxiliary contact used as auxiliary contact	S2C-S/H6R
UR	Undervoltage release	S2C-UA
OR	Overvoltage release	S2C-OVP
AR	Auto reclosing unit	F2C-ARI
MOD-F	Motor operating device	F2C-CM
ST-F	Shunt trip for F 200 RCCB	F2C-A

Accessories

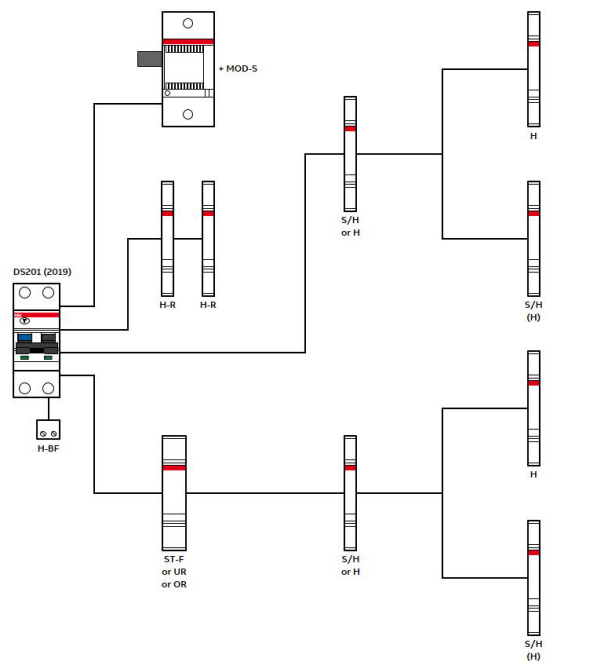
RCBO : DS203NC



SN201-IH	coupling interface / auxiliary contact
SN201-S	signal contact
S2C-H6R	auxiliary contact
S2C-S/H6R	signal/ auxiliary contact
S2C-S/H6R (H)	signal/ auxiliary contact used as auxiliary contact
F2C-A	shunt trip
S2C-UA	undervoltage release
S2C-OR	overvoltage release

Accessories

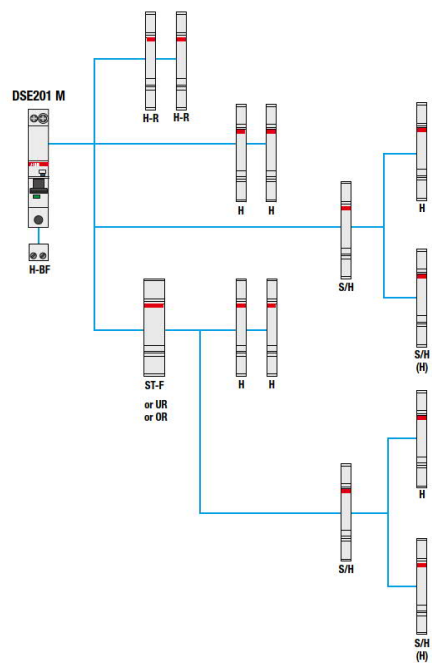
RCBO : DS201



H	Auxiliary contact	S2C-H6R
H-R	Auxiliary contact	S2C-H6-xxR
S/H	Signal / auxiliary contact	S2C-S/H6R
S/H (H)	Signal / auxiliary contact used as auxiliary contact	S2C-S/H6R
ST-F	Shunt Trip	F2C-A
UR	Undervoltage release	S2C-UA
OR	Overvoltage release	S2C-OVP
H-BF	Auxiliary contact for bottom fitting (only DS201 (2019))	S2C-H01 / S2C-H10
MOD-S	Motor operating device (for DS201 (2019))	S2C-CM2/3
MOD-S	Motor operating device (for DS201 and DS202C)	DS2C-CM

Accessories

RCBO : DSE201M



H	Auxiliary contact	S2C-H6R
H-R	Auxiliary contact	S2C-H6R / S2C-H6-xxR
S/H	Signal/Auxiliary contact	S2C-S/H6R
S/H (H)	Signal/Auxiliary contact used as auxiliary contact	S2C-S/H6R
ST-F	Shunt trip for RCD	F2C-A
UR	Undervoltage release	S2C-UA
OR	Overvoltage release	S2C-OVP
H-BF	Auxiliary contact for bottom fitting	S2C-H01 / S2C-H10

Auto Reclosing

MULTIPURPOSE DEVICE F2C-ARI

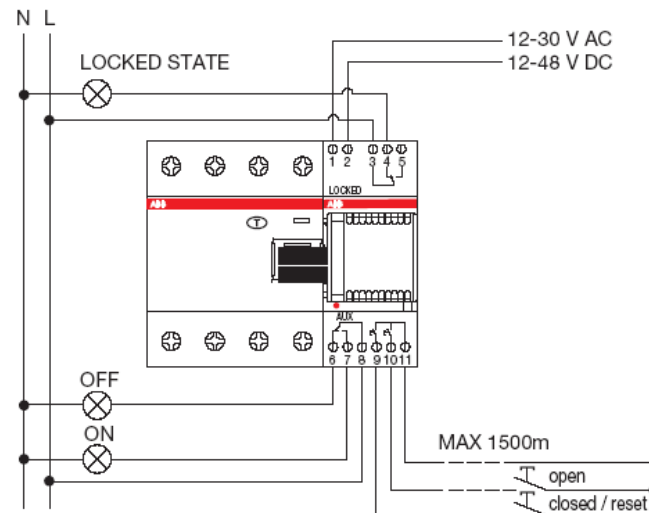
- For the RCCBs up to 100A is available the F2C-ARI which, in addition to the automatic reclosing, allows the remote control of the customer fitted RCCB.
- This device ensures complete personal and system safety in case of faults and improves reliability and continuity of service in case of unwanted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



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Product overview

Autoreclosing unit F2C-ARI

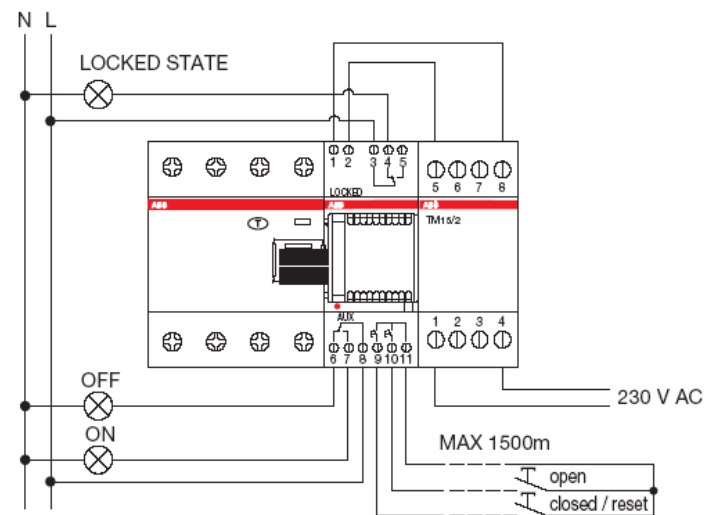


Wiring diagram for the remote opening and closing/ reset of the coupled RCCB.

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

Product overview

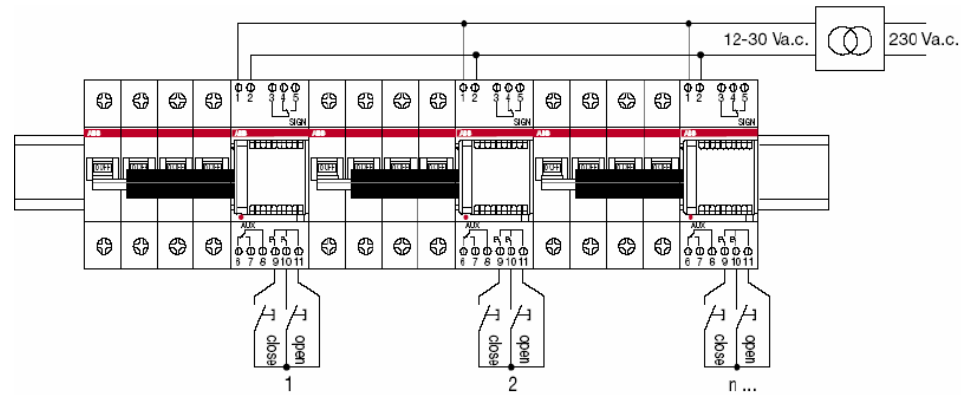
Autoreclosing unit F2C-ARI



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.

Q & A

ABB on social media

Website: www.abb.co.th



Facebook: ABB Thailand



Line official: @askabb





ABB