HD4/R

MV SF6 circuit-breakers for secondary distribution

1

DESCRIPTION

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General information

HD4/R medium voltage circuit-breakers for indoor installation use sulphur hexafluoride gas (SF6) to extinguish the electric arc and as the insulating medium between the main fixed and moving contacts. They are constructed using the separate pole technique.
The operating mechanism is the ESH type with stored energy and free release, with opening and closing operations independent of the operator. Remote control of the circuit-breaker is possible by means of applying special electrical accessories (geared motor, shunt opening release, etc.).
The operating mechanism, the three poles and any accessories are mounted on a metallic frame without wheels. Construction is particularly compact, sturdy and of limited weight.
The circuit-breakers in the HD4/R series are maintenance-free “sealed for life” pressure systems (IEC 60056 and CEI 71-6 Standards).

Versions available

HD4/R circuit-breakers are available in the fixed version with right lateral operating mechanism.
The circuit-breakers with rated voltage up to 24 kV are fitted with current sensors and with PR521 microprocessor-based overcurrent release.
N.B. In the 24 kV versions with 230 mm pole centre distance, only two current sensors can be mounted (on the lateral poles).

Fields of application

The circuit-breakers in the HD4/R series are used in all applications for medium voltage secondary distribution and in MV/LV transformer substations in factories, workshops in the industrial sector in general, and in the service sector.
Thanks to application (on request) of the PR521 self-supplied microprocessor-based overcurrent release, HD4/R circuit-breakers are suitable for use in unmanned MV/LV transformer substations without auxiliary power supply.

Protection relay

On request, the circuit-breakers in the HD4/R series with rated voltage up to 24 kV can be fitted with self-supplied PR521 type microprocessor-based overcurrent relays, available in the following types:

– **PR521 (50-51):** provides the protection function against overload (51) and against instantaneous and delayed short-circuit (50);
– **PR521 (50-51-51N):** provides the protection function against overload (51), against instantaneous and delayed short-circuit (50) and against earth fault (51N).

The release current sensors are available in four rated current values and cover all the circuit-breaker fields of application (for the protection fields, please see chap. 3).

N.B. In the 24 kV versions with 230 mm pole centre distance, only two current sensors can be mounted (on the lateral poles).

Other important characteristics of the PR521 releases are:

– trip precision
– wide setting range
– operation guaranteed even with single-phase power supply
– constancy of characteristics and operating reliability even in highly polluted ambients
– single and simultaneous setting of all three phases
– no limit to the rated breaking capacity of the circuit-breaker short-time withstand current even for rated currents lower than the relay.

For further information, please consult chapter 3.

- Complete range of accessories and ample possibilities for personalisation.
- Wide range of electrical accessory power supply voltages .
- Gas pressure control device (on request).
- Insulation withstand voltage even at zero relative pressure.
- Breaking up to 30% of the rated breaking capacity even at zero SF6 gas relative pressure.
- Maintenance-free.
- High number of operations.
- Long electrical and mechanical life.
- Remote control.
- Suitable for installation in substations and prefabricated switchboards.

DESCRIPTION

Standards and approvals

The HD4/R circuit-breakers comply with the IEC 60056, CEI 17-1 file 1375 and CENELEC HD 348 S6 Standards, as well as those of the major industrialised countries. They have undergone the tests indicated below and ensure service safety and reliability of the apparatus in all installations.

- **Type tests:** heating, withstand insulation at industrial frequency and atmospheric impulse, short-time and peak withstand current, mechanical life, making and breaking capacity of short-circuit currents.
- **Individual tests**: insulation with voltage at industrial frequency in the main circuits, insulation of the auxiliary and control circuits, measurement of the main circuit resistance and mechanical and electrical operation.

Service Safety

Thanks to the complete range of mechanical and electrical locks (on request), safe distribution switchboards can be constructed with the HD4/R circuit-breakers.
The locking devices have been studied to prevent incorrect operations and carry out inspection of the installations whilst guaranteeing maximum operator safety.
All the operating, control and signalling devices are located on the front of the circuit-breaker.
The anti-pumping device is always provided on the actuator.

Accessories

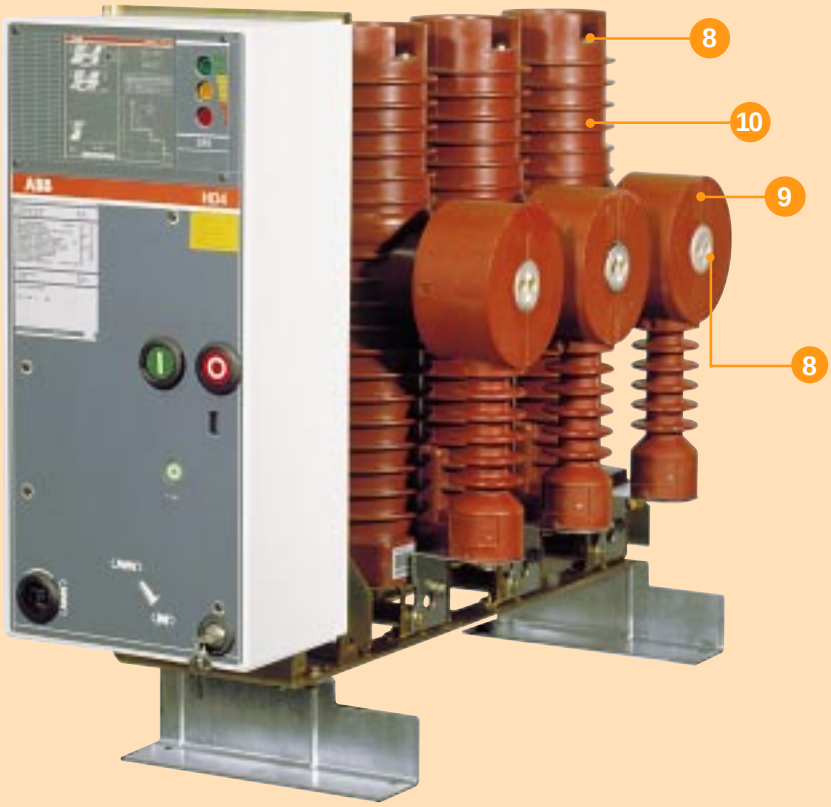
The HD4/R circuit-breakers have a complete range of accessories which means all installation requirements can be satisfied.
The operating mechanism is of the same type for the whole series and has a standardised range of accessories and spare parts which are easy to identify and order. Use, maintenance and service of the apparatus are simple and require limited use of resources.

ESH operating mechanism

- Single operating mechanism for the whole series.
- The same accessories for all the types of circuit-breaker.
- Fixed reference points to simplify assembly and replacement of the accessories.
- Accessory cabling with socket and plug.

SF6 gas pressure state indicator (on request).

Circuit-breaker characteristics nameplate placed on the front panel.



1 PR521 protection relay (on request)
2 Shaft for manual charging of closing springs
3 Closing pushbutton
4 Opening pushbutton
5 Signalling device for closing springs charged (yellow) and discharged (white)
6 SF6 gas pressure state locking and signalling device (applied on request only onto circuit-breakers with pressure switch)
7 Circuit-breaker open/closed signalling device
8 Medium voltage terminals
9 Current sensor (for PR521 release - if provided)
10 Circuit-breaker pole
11 Key lock
12 Operation counter.

SF6 gas presence device (available on request).

Electrical accessories with simplified assembly.

Self-supplied PR521 relay (on request) co-ordinated with the circuit-breaker and with the current sensors.

Current sensors (on request), easily replaced.

Mechanical anti-pumping device.

DESCRIPTION

Technical documentation

To go into technical and application aspects of the HD4/R circuit-breakers in depth, ask for the following publications:

– UniAir switchboards ITSCB 649223
– SD-View systems ITSCB 649227
– REF 542 unit ITSCB 649262
– PR512 relay ITSCB 649092.

Quality Assurance System

Certified by an independent organization as complying with ISO 9001 Standards.

Environmental Management System

Certified by an independent organization as complying with ISO 14001 Standards.

Test laboratory

Accredited by an independent organization as complying with ISO 45001 Standards.

Electrical characteristics

Circuit-breaker		**HD4/R 12**	**HD4/R 17**	**HD4/R 24**	**HD4/R 36**
Rated voltage	[kV]	**12**	**17.5**	**24**	**36**
Rated normal current	[A]	**630/800/1250**	**630/800/1250**	**630/800/1250**	**630/800/1250**
Rated breaking capacity	[kA]	**12.5 ... 25**	**12.5 ... 25**	**12.5 ... 20**	**12.5 ... 16**

2

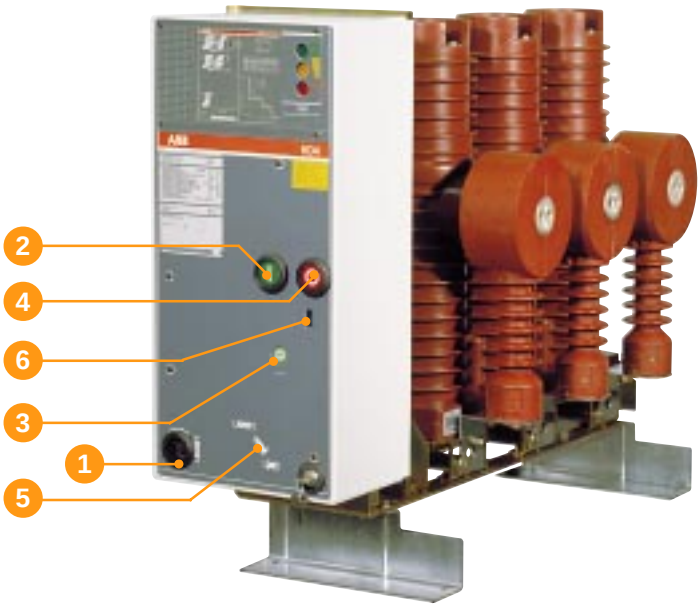
CIRCUIT-BREAKER SELECTION AND ORDERING

General characteristics of fixed circuit-breakers with right lateral operating mechanism

Circuit-breaker		
Pole centre distance	P = 230 mm	
	P = 300 mm	
	P = 350 mm	
Standards	**IEC pub. 60056**	
	CEI 17-1 (File 1375)	
	CENELEC HD 348 S6	
Rated voltage	**Ur** [kV]	
Rated insulation voltage	**Us** [kV]	
Withstand voltage at 50 Hz	**Ud (1 min)** [kV]	
Impulse withstand voltage	**Up** [kV]	
Rated frequency	**fr** [Hz]	
Rated normal current (40 °C)	**Ir** [A]	
Rated breaking capacity	**Isc** [kA]	
Rated short-time withstand current (3 s)	**Ik** [kA]	
Making capacity	**Ip** [kA]	
Operation sequence	[O-0.3min-CO-3min-CO]	
	[O-0.3s-CO-15s-CO]	
Opening time	[ms]	
Arcing time	[ms]	
Total breaking time	[ms]	
Closing time	[ms]	
Application of protection relay	**PR521**	
with current sensors	(1) **In** [A]	
Maximum overall dimensions	**H** [mm]	
	L [mm]	
	P [mm]	
Weight (2)	[Kg]	
SF6 gas absolute pressure (3)	[kPa]	
Operating temperature	[°C]	
Tropicalization	**IEC: 60068-2-30, 721-2-1**	
Electromagnetic compatibility	**IEC: 60694, 61000-6-2, 61000-6-4**	

(1) Rated current of the current sensors
(2) For circuit-breakers with protection releases and current sensors, increase the weight indicated by 20 kg.
(3) Rated service value
(4) In the 24 kV versions with 230 mm pole centre distance, only two current sensors can be mounted on the lateral poles.

	HD4/R 12			HD4/R 17			HD4/R 24			HD4/R 36		
	■			■			■			–		
	■			■			■			–		
	–			–			–			■		
	■			■			■			■		
	■			■			■			■		
	■			■			■			■		
	12			17.5			24			36		
	12			17.5			24			36		
	28			38			50			70		
	75			95			125			170		
	50-60			50-60			50-60			50-60		
	630	800	1250	630	800	1250	630	800	1250	630	800	1250
	12.5	–	–	12.5	–	–	12.5	–	–	12.5	12.5	12.5
	16	16	16	16	16	16	16	16	16	16	16	16
	20	20	20	20	20	20	20	20	20	–	–	–
	25	25	25	–	–	25	–	–	–	–	–	–
	12.5	–	–	12.5	–	–	12.5	–	–	12.5	12.5	12.5
	16	16	16	16	16	16	16	16	16	16	16	16
	20	20	20	20	20	20	20	20	20	–	–	–
	25	25	25	–	–	25	–	–	–	–	–	–
	31.5	–	–	31.5	–	–	31.5	–	–	31.5	31.5	31.5
	40	40	40	40	40	40	40	40	40	40	40	40
	50	50	50	50	50	50	50	50	50	–	–	–
	63	63	63	–	–	63	–	–	–	–	–	–
	■			■			■			■		
	■			■			■			■		
	45			45			45			45		
	10-15			10-15			10-15			10-15		
	55-60			55-60			55-60			55-60		
	80			80			80			80		
	■			■			■			–		
	40 80 250 1250			40 80 250 1250			40 80 250 1250 (4)			–		
	770			770			770			770		
	286.5			286.5			286.5			286.5		
	1049 (P=230 mm) / 1189 (P=300 mm)			1049 (P=230 mm) / 1189 (P=300 mm)			1049 (P=230 mm) / 1189 (P=300 mm)			1348 (P=350 mm)		
	103			103			103			110		
	380			380			380			380		
	– 5 °C ... + 40 °C			– 5 °C ... + 40 °C			– 5 °C ... + 40 °C			– 5 °C ... + 40 °C		
	■			■			■			■		
	■			■			■			■		



Standard fittings

The basic coded version of the fixed circuit-breakers is always three-pole with right lateral operating mechanism and it is fitted with:

1 manual spring charging handle coupling
2 closing pushbutton
3 mechanical signalling device for circuit-breaker open/closed
4 opening pushbutton
5 mechanical signalling device for closing springs charged/ discharged
6 operation counter.

It is also fitted with terminal box, basic cabling, spring charging handle and the following **accessories to be personalised at the time of ordering (see Kits A, B and C indicated below):**

– set of five auxiliary open/closed contacts or, alternatively and against payment, ten or fifteen auxiliary contacts. The shunt opening release uses one of the five standard auxiliary contacts to cut its power supply with the circuit-breaker open
– shunt opening release
– key lock.

Kit A

Contacts signalling open/closed

Set of ten or fifteen auxiliary contacts **(on request and with additional cost)** as an alternative to the set of five contacts provided as standard.

Electrical characteristics of the contact

Un	Icu	cosφ	T
400 V~	15 A	0.4	–
220 V–	1,5 A	–	10 ms

Ordering codes

Kit	Description	UXAB
A1	Set of 10 additional contacts (1)	349800152
A2	Set of 14 additional contacts (2)	349800153

(1) Cabled to terminal box.
(2) Ten contacts cabled to terminal box and five to be cabled directly to the terminals of the contacts themselves.

Kit B

Instantaneous shunt opening release (YO1)

Specify the power supply voltage. The shunt opening release, power supply voltage must always coincide with that of the shunt closing release (and that of the lamps if provided) when the circuit-breaker locking device for insufficient pressure is required.

Electrical characteristics

Inrush power	250 VA/W

Ordering codes

Kit	Un	F	UXAB
B	24 V–	–	349702902
B	30 V–	–	349702903
B	48 V–	–	349702904
B	60 V–	–	349702905
B	110 V–	–	349702909
B	125 V–	–	349702912
B	220 V–	–	349702918

Kit	Un	F	UXAB
B	48 V~	50 Hz	349702934
B	110 V~	50 Hz	349702939
B	127 V~	50 Hz	349702943
B	220 V~	50 Hz	349702948
B	240 V~	50 Hz	349702951
B	110 V~	60 Hz	349702969
B	127 V~	60 Hz	349702973
B	220 V~	60 Hz	349702978
B	240 V~	60 Hz	349702981

Kit C

Key lock in open position

Specify the type of lock required:
C1 Lock with different keys
C2 Lock with identical keys.

Ordering codes

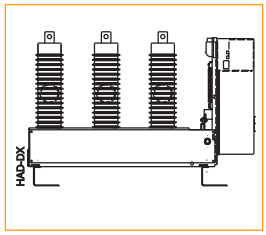
Kit	UXAB
C1	349700381
C2	349700382

Ordering codes for fixed circuit-breakers with right lateral operating mechanism

CAUTION!

- The circuit-breaker selected must be completed with the accessories specified in the standard fittings (see Kits A, B and C on page 12). The optional accessories are indicated on page 14.
- **Should the pressure switch accessory be required, specify the request at the time of ordering the circuit-breaker as subsequent application is not possible by the customer.**
  The pressure switch is always provided with two intervention thresholds. The first threshold intervention for low pressure is signalled by contact B63 changing over (see electrical diagram, fig. 11). The second threshold intervenes for insufficient pressure and intervention is signalled by the second contact B63 closing (see electrical diagram, fig. 11).
  The control circuit has to be made by the customer.

HD4/R 12 - 17 - 24 - 36



				Pole centre distance		
				P 230 mm	P 300 mm	P 350 mm
U [kV]	In [A]	Isc [kA]	Descrizione	UXAB	UXAB	UXAB
12	630	12.5	HD4/R 12.06.12	348111112	348111113	—
		16	HD4/R 12.06.16	348111122	348111123	—
		20	HD4/R 12.06.20	348111132	348111133	—
		25	HD4/R 12.06.25	348111142	348111143	—
	800	16	HD4/R 12.08.16	348111222	348111223	—
		20	HD4/R 12.08.20	348111232	348111233	—
		25	HD4/R 12.08.25	348111242	348111243	—
	1250	16	HD4/R 12.12.16	348111322	348111323	—
		20	HD4/R 12.12.20	348111332	348111333	—
		25	HD4/R 12.12.25	348111342	348111343	—
17.5	630	12.5	HD4/R 17.06.12	348113112	348113113	—
		16	HD4/R 17.06.16	348113122	348113123	—
		20	HD4/R 17.06.20	348113132	348113133	—
	800	16	HD4/R 17.08.16	348113222	348113223	—
		20	HD4/R 17.08.20	348113232	348113233	—
	1250	16	HD4/R 17.12.16	348113322	348113323	—
		20	HD4/R 17.12.20	348113332	348113333	—
		25	HD4/R 17.12.25	348113342	348113343	—
24	630	12.5	HD4/R 24.06.12	348114112	348114113	—
		16	HD4/R 24.06.16	348114122	348114123	—
		20	HD4/R 24.06.20	348114132	348114133	—
	800	16	HD4/R 24.08.16	348114222	348114223	—
		20	HD4/R 24.08.20	348114232	348114233	—
	1250	16	HD4/R 24.12.16	348114322	348114323	—
		20	HD4/R 24.12.20	348114332	348114333	—
36	630	12.5	HD4/R 36.06.12	—	—	348115114
		16	HD4/R 36.06.16	—	—	348115124
	800	12.5	HD4/R 36.08.12	—	—	348115214
		16	HD4/R 36.08.16	—	—	348115224
	1250	12.5	HD4/R 36.12.12	—	—	348115314
		16	HD4/R 36.12.16	—	—	348115324

Ordering codes for optional accessories

Standard fittings
- Manual operating mechanism
- Closing springs charged/discharged mechanical signalling device
- Circuit-breaker open/closed mechanical signalling device
- Operation counter
- Closing pushbutton
- Opening pushbutton
- Terminal box
- Basic cabling
- Shunt opening release
- Five open/closed auxiliary contacts or, alternatively and with payment, ten or fifteen auxiliary contacts
- Key lock
- Spring charging handle.

Possible combinations of accessories
The locking circuit of the circuit-breaker in the state it is found in due to insufficient gas pressure is incompatible with the undervoltage release (Kit no. 5) and with the PR521 relay (Kit no. 12).
Should one of the above-mentioned accessories be required, it is possible (on request) to have just the automatic opening circuit and lock in the open position for insufficient SF6 gas pressure.

KIT 1 ... 2	**Spring charging motor application**
KIT 3	**Shunt closing release (YC)**
KIT 4	**Additional shunt opening release (YO2) (1)**
KIT 5 ... 8	**Undervoltage release application**
KIT 9	**Closing springs charged/discharged signalling contact (S33M)**
KIT 10	**Opening pushbutton lock**
KIT 11	**Closing pushbutton lock**
KIT 12 ... 16	**Protection release application**
KIT 17 ... 19	**Application to make the circuit-breaker removable type**
KIT 20	**Pressure switch**
KIT 22	**Connection terminals (2)**

(1) Not compatible with PR521 protection release and with YO3 opening solenoid.
(2) For 36 kV circuit-breakers, the terminals are part of the standard fittings.

KIT 1	Spring charging motor (M)
KIT 2	Geared motor protection circuit-breaker (Q60) with signalling contact

KIT 5	Undervoltage release (YU)
KIT 6	Electronic time delay device (this accessory must be mounted outside the circuit-breaker)
KIT 7	Mechanical override of the release
KIT 8	Electrical signalling for undervoltage trip

KIT 12	PR521 protection release
+	
KIT 13	Opening solenoid (YO3)
+	
KIT 14	Current sensors (in the 24 kV versions with 230 mm pole centre distance, only two current sensors can be mounted on the lateral poles)

KIT 15	External toroidal transformer for 51N low threshold protection
KIT 16	TT2 test unit

KIT 17	Set of wheels
KIT 18	Socket and plug connector (cabling to be carried out by the customer)
KIT 19	Release lever

KIT 21	SF6 gas insufficient pressure circuit-breaker locking device (only for circuit-breakers with pressure switch)

Accessory	By customer	By ABB
1		■
2		■
3	■	■
4	■	■
5	■	■
6	■	
7		■
8		■
9		■
10	■	■
11	■	■
12		■
13		■
14		■
15	■	
16	■	
17	■	
18	■	
19	■	■
20		■
21		■
22	■	■

Kit 1

Spring charging geared motor (M)

This automatically charges the operating mechanism springs after the closing operating.
The 24 V d.c. geared motor is always supplied with the thermomagnetic protection circuit-breaker.

Electrical characteristics

Inrush power	1500 VA / W
Continuous power	400 VA / W
Charging time	from 7 to 10 sec.

Ordering codes

Kit	Un	F	UXAB
1 (*)	24 V–	–	349700902
1	30 V–	–	349700903
1	48 V–	–	349700904
1	60 V–	–	349700905
1	110 V–	–	349700909
1	125 V–	–	349700912
1	220 V–	–	349700918
1	24 V~	50 Hz	349700932
1	48 V~	50 Hz	349700934
1	110 V~	50 Hz	349700939
1	127 V~	50 Hz	349700943
1	220 V~	50 Hz	349700948
1	240 V~	50 Hz	349700951
1	110 V~	60 Hz	349700969
1	127 V~	60 Hz	349700973
1	220 V~	60 Hz	349700978
1	240 V~	60 Hz	349700981

Kit 2

Geared motor thermomagnetic protection circuit-breaker (Q60)

This protects the spring charging motor in the case of an overload. It is always provided with a signalling contact.
It is available in two versions:
2A Protection circuit-breaker with signalling contact for circuit-breaker closed
2A Protection circuit-breaker with signalling contact for circuit-breaker open

Electrical characteristics of the contact

Un	In	cosφ	T
110 V~	4 A	0.3	–
220 V~	3 A	0.3	–
110 V–	0.25 A	–	10 ms
220 V–	0.13 A	–	10 ms

Ordering codes

Kit	Un	F	UXAB
2A	24/60 V–	–	349800241
2A	110/127 V~/V–	50-60 Hz	349800242
2A	220/240 V~/V–	50-60 Hz	349800243
2B	24/60 V–	–	349800244
2B	110/127 V~/V–	50-60 Hz	349800245
2B	220/240 V~/V–	50-60 Hz	349800246

Kit 3

Shunt closing release (YC)

This is an electromechanical device which, following energisation of an electromagnet, activates the operating mechanism release lever making the circuit-breaker close.
The circuit-breaker operating mechanism is provided with an anti-pumping device as standard.

Electrical characteristics

Inrush power:	250 VA / W
Continuous power:	5 VA / W

N.B. In the case where a circuit-breaker is ordered with a pressure switch and with locking for insufficient gas pressure, the power supply voltage of the shunt opening release, shunt closing release and lamps (if provided) must always be the same.

Ordering codes

Kit	Un	F	UXAB
3	24 V–	–	349708902
3	30 V–	–	349708903
3	48 V–	–	349708904
3	60 V–	–	349708905
3	110 V–	–	349708909
3	125 V–	–	349708912
3	220 V–	–	349708918
3	24 V~	50 Hz	349708932
3	48 V~	50 Hz	349708934
3	110 V~	50 Hz	349708939
3	127 V~	50 Hz	349708943
3	220 V~	50 Hz	349708948
3	240 V~	50 Hz	349708951
3	110 V~	60 Hz	349708969
3	127 V~	60 Hz	349708973
3	220 V~	60 Hz	349708978
3	240 V~	60 Hz	349708981

Kit 4

Additional shunt opening release (YO2)

This is an electromechanical device which, following energisation of an electromagnet, activates the operating mechanism release lever making the circuit-breaker open.
The additional shunt opening release is not compatible with the PR521 protection release or with the opening solenoid YO3.
This application uses one of the auxiliary contacts to cut off its power supply with the circuit-breaker open.

Electrical characteristics

Inrush power	125 VA / W

Ordering codes

Kit	Un	F	UXAB
4	24 V–	–	349703902
4	30 V–	–	349703903
4	48 V–	–	349703904
4	60 V–	–	349703905
4	110 V–	–	349703909
4	125 V–	–	349703912
4	220 V–	–	349703918
4	48 V~	50 Hz	349703934
4	110 V~	50 Hz	349703939
4	127 V~	50 Hz	349703943
4	220 V~	50 Hz	349703948
4	240 V~	50 Hz	349703951
4	110 V~	60 Hz	349703969
4	127 V~	60 Hz	349703973
4	220 V~	60 Hz	349703978
4	240 V~	60 Hz	349703981

Kit 5

Undervoltage release (YU)

This makes the circuit-breaker open when the relative power supply voltage drops or is cut off. It is only available in the version for power supply branched on the supply side of the circuit-breaker.

Electrical characteristics:

Inrush power	250 VA / W
Continuous power	5 VA / W

Notes

– The undervoltage release is incompatible with the locking circuit of the circuit-breaker in the state it is found in for insufficient gas pressure, but it is compatible with the opening circuit and lock of the circuit-breaker in the open position for insufficient gas pressure.
– The undervoltage release can be combined with the electronic time delay device (see Kit no. 6).
– The undervoltage release can be fitted with mechanical override (see Kit no. 8).
– The undervoltage release can be fitted with electrical signalling of release energised or release de-energised (see Kit no. 7).

Ordering codes

Kit	Un	F	UXAB
5	24 V–	–	349722902
5	30 V–	–	349722903
5	48 V–	–	349722904
5	60 V–	–	349722905
5	110 V–	–	349722909
5	125 V–	–	349722912
5	220 V–	–	349722918
5	24 V~	50 Hz	349722932
5	48 V~	50 Hz	349722934
5	110 V~	50 Hz	349722939
5	127 V~	50 Hz	349722943
5	220 V~	50 Hz	349722948
5	240 V~	50 Hz	349722951
5	110 V~	60 Hz	349722969
5	127 V~	60 Hz	349722973
5	220 V~	60 Hz	349722978
5	240 V~	60 Hz	349722981

Kit 6

Electronic time delay device for undervoltage release with power supply branched on the supply side of the circuit-breaker

This allows circuit-breaker opening to be delayed (from 0.5 s to 3 s) when the power supply voltage drops or is cut off.
It consists of a device (to be mounted outside the circuit-breaker by the customer) which is interposed on the undervoltage release power supply.

N.B. The electronic time delay device must be supplied between terminals 1 and 2. The undervoltage release must be connected to terminals 3 and 4. The delay is selected (by the customer) as follows:
– 0.5 s bridge between terminals 6 and 7;
– 1 s bridge between terminals 6 and 8;
– 1.5 s bridge between terminals 6 and 9;
– 2 s bridge between terminals 6 and 10;
– 3 s no bridge.

Ordering codes

Kit	Un	F	UXAB
6	24/30 V –	–	369828902
6	48 V – / ~	50-60 Hz	369828904
6	60 V – / ~	50-60 Hz	369828905
6	110/127 V – / ~	50-60 Hz	369828909
6	220/240 V – / ~	50-60 Hz	369828918

Kit 7

Signalling contact for undervoltage release energised or de-energised

Inserted in an electric circuit, this indicates the state of the undervoltage release.
It is available in two alternative versions:

7A Signalling undervoltage release energised
7B Signalling undervoltage release de-energised.

Electrical characteristics of the contact

Un	In	cosφ	T
110 V~	4 A	0.3	–
220 V~	3 A	0.3	–
380 V~	1.5 A	0.3	–
110 V–	0.25 A	–	10 ms
220 V–	0.13 A	–	10 ms

Ordering codes

Kit	UXAB
7A	349800251
7B	349800252

Kit 8

Mechanical override for undervoltage release

This overrides the mechanical action of the undervoltage release (5) allowing closure of the circuit-breaker with the undervoltage release de-energised. It is always fitted with electrical signalling of release excluded.

Ordering codes

Kit	UXAB
8	349700321

Kit 9

Signalling contact for closing springs charged or discharged (S33M)

Inserted in an electric circuit, this signals the state of the operating mechanism closing springs. It is available in two alternative versions:

9A Contact signalling springs charged
9B Contact signalling springs discharged.

Electrical characteristics of the contact

Un	In	cosφ	T
110 V~	4 A	0.3	–
220 V~	3 A	0.3	–
380 V~	1.5 A	0.3	–
110 V–	0.25 A	–	10 ms
220 V–	0.13 A	–	10 ms

Ordering codes

Kit	UXAB
9A	349700341
9B	349700342

Kit 10 - Kit 11

Locks on operating pushbuttons

These allow the circuit-breaker operating mechanism knobs to be locked.
They are available in the following versions:
10A Opening pushbutton without padlock
10B Opening pushbutton with padlock
11A Closing pushbutton without padlock
11B Closing pushbutton with padlock.

Ordering codes

Kit	UXAB
10 A	349700351
10 B	349700352
11 A	349700361
11 B	349700362

Notes
– For locks 10A and 11A the padlocks are to be provided by the customer (hook diameter = 4 mm).
– If the device for signalling the state of the SF6 gas pressure for intervention due to insufficient pressure with automatic circuit-breaker opening is ordered, the lock on the closing push-button is always provided.
– If the device for signalling the state of the SF6 gas pressure for intervention due to insufficient pressure with lock of the circuit-breaker in the position it is found in is ordered, both the locks on the closing and opening push-buttons are always provided.

Kit 12

PR521 microprocessor-based protection relay

This controls circuit-breaker tripping due to:
– overload (51)
– short-circuit (50)
– earth fault (51N).

Ordering codes

Kit	Relay	Functions	UXAB
12A	PR 521	51-50	379602203
12B	PR 521	51-50-51N	379602204

Notes
– Application of the PR521 relay does not allow application of the locking circuit for the circuit-breaker in the state it is found in for insufficient pressure. It is possible to ask for just the automatic circuit-breaker opening circuit for insufficient gas pressure.
– Application of the PR521 relay is not possible for 36 kV circuit-breakers.
– With the PR521 relay, the transparent anti-tampering protection is always supplied.
– Please see chapter 3 for the technical and trip characteristics of the PR521 relay.
– For operation of the relay, the circuit-breaker must be fitted with:
– YO3 opening solenoid (Kit no. 13);
- solenoide di apertura YO3 (Kit no. 13);
- two or three T1/L… current sensors (Kit no. 14). Three current sensors are necessary to carry out function 51N for vectorial summation of the phase currents. Should function 51N be carried out with an external toroidal current transformer, only two current sensors can be installed.
  In the 24 kV versions with 230 mm pole centre distance, only two current sensors can be mounted (on the lateral poles).

Please see page 35 for the minimum 51N function threshold values which can be set with three sensors or with an external toroidal transformer.

Kit 13

Opening solenoid (YO3)

This makes the circuit-breaker open if the PR521 overcurrent release installed on the circuit-breaker, or the PR512 installed in a switchboard trips.

N.B. The opening solenoid can only be used combined with an ABB PR521 and PR512 series device.

Ordering codes

Kit	UXAB
13	349700311

Kit 14

Current sensors for PR521 overcurrent relay (T1/L1…T1/L3)

The current sensors transmit the current signal to be processed to the relay and supply the power to supply the relay and the opening solenoid in the case of tripping.

The kit includes all the accessories for mounting the sensors except the connection cabling to the relay.

N.B. In the 24 kV versions with 230 mm pole centre distance, only two current sensors can be mounted on the lateral poles.

Ordering codes

Kit	In	UXAB
14A	No. 2 sensors In = 40 A	349800275
14B	No. 3 sensors In = 40 A	349800271
14C	No. 2 sensors In = 80 A	349800276
14D	No. 3 sensors In = 80 A	349800272
14E	No. 2 sensors In = 250 A	349800277
14F	No. 3 sensors In = 250 A	349800273
14G	No. 2 sensors In = 1250 A	349800278
14H	No. 3 sensors In = 1250 A	349800274

Kit 15

External toroidal transformer

The external toroidal transformer allows the earth fault current to be detected.

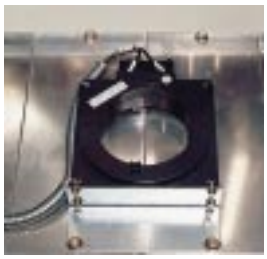
It is available in the following versions:

16A Closed core with 110 mm internal diameter

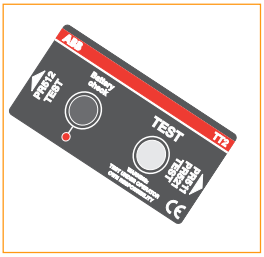
16B Openable core with 110 mm internal diameter.

Ordering codes

Kit	In	UXAB
15A	50/1 A	379602301
15B	50/1 A	379602302



Kit 16



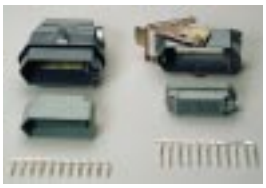
TT2 test unit

This portable device allows circuit-breaker opening to check operation of the PR521 relay "release chain" and the opening solenoid (YO3). It also allows the bistable alarm signalling device of the PR521 relay to be reset.

Ordering codes

Kit	UXAB
16	379602231

Kit 17 - Kit 18 - Kit 19



Accessories for making the fixed circuit-breaker removable

This set of accessories helps to transform the fixed circuit-breaker into removable version. The accessories can be ordered separately.

17 Set of wheels
The kit consists of the set of front and rear wheels in replacement of the fixing brackets for mounting the fixed circuit-breaker.
N.B. Assembly is to be carried out by the customer.

18 Socket and plug
The kit consists of a 58-pole connector, male (mobile plug) and female (fixed socket) and the pins needed for cabling.
N.B. The cables, sheath and assembly are to be carried out by the customer.

Ordering codes

Kit	Un	UXAB
17	12 - 17 - 24 kV	379602019
18	12 - 17 - 24 - 36 kV	379602101
19	12 - 17 - 24 kV	349800311

19 Release lever
The kit consists of the lever which allows the circuit-breaker to be hooked up with and locked into the unit.
N.B. The release lever only prevents translation of the circuit-breaker. Its activation does not automatically cause opening of the circuit-breaker.

Kit 20

Two-level pressure switch

First level - intervention for low pressure: the indication is given when the gas pressure drops from 380 kPa absolute to a value under 310 kPa absolute.
Second level - intervention for insufficient pressure: the indication is given when the gas pressure drops to below 280 kPa absolute.

N.B. The pressure switch must be requested at the time of ordering because it must be mounted and tested in the factory.

Ordering codes

Kit	UXAB
20	349801999

Kit 21

Circuit-breaker locking device (with/without lamps) for insufficient SF6 gas pressure

This device can only be supplied for circuit-breakers provided with a pressure switch (accessory 21). The locking circuit is an optional application and can only be installed by ABB.
The following configurations are available:

21A Circuit for automatic circuit-breaker opening (by means of YO1 shunt opening release) and lock in the open position (by means of prevention of power supply to the YC shunt closing release and mechanical lock on the closing pushbutton); version **without signalling lamps**.

21B Circuit for locking the circuit-breaker in the position it is found in (by means of preventing power supply activation of the shunt opening and closing releases and with mechanical locks on the opening and closing pushbuttons); version **without signalling lamps.**

21C Circuit for automatic circuit-breaker opening (by means of YO1 shunt opening release) and lock in the open position (by means of prevention of power supply to the YC shunt closing release and mechanical lock on the closing pushbutton); version **with three signalling lamps.**

21D Circuit for locking the circuit-breaker in the position it is found in (by means of preventing power supply activation of the YO1 shunt opening and YC shunt closing releases and with mechanical locks on the opening and closing pushbuttons); version **with three signalling lamps**.

Ordering codes

Kit	Un	F	UXAB
21A	24 V–	–	349802902
21A	30 V–	–	349802903
21A	48 V–	–	349802904
21A	60 V–	–	349802905
21A	110 V–	–	349802909
21A	125 V–	–	349802912
21A	220 V–	–	349802918
21A	48 V~	50 Hz	349802934
21A	110 V~	50 Hz	349802939
21A	127 V~	50 Hz	349802943
21A	220 V~	50 Hz	349802948
21A	240 V~	50 Hz	349802951
21A	110 V~	60 Hz	349802969
21A	127 V~	60 Hz	349802973
21A	220 V~	60 Hz	349802978
21A	240 V~	60 Hz	349802981

Kit	Un	F	UXAB
21B	24 V–	–	349803902
21B	30 V–	–	349803903
21B	48 V–	–	349803904
21B	60 V–	–	349803905
21B	110 V–	–	349803909
21B	125 V–	–	349803912
21B	220 V–	–	349803918
21B	48 V~	50 Hz	349803934
21B	110 V~	50 Hz	349803939
21B	127 V~	50 Hz	349803943
21B	220 V~	50 Hz	349803948
21B	240 V~	50 Hz	349803951
21B	110 V~	60 Hz	349803969
21B	127 V~	60 Hz	349803973
21B	220 V~	60 Hz	349803978
21B	240 V~	60 Hz	349803981

Kit	Un	F	UXAB
21C	24 V–	–	349804902
21C	30 V–	–	349804903
21C	48 V–	–	349804904
21C	60 V–	–	349804905
21C	110 V–	–	349804909
21C	125 V–	–	349804912
21C	220 V–	–	349804918
21C	48 V~	50 Hz	349804934
21C	110 V~	50 Hz	349804939
21C	127 V~	50 Hz	349804943
21C	220 V~	50 Hz	349804948
21C	240 V~	50 Hz	349804951
21C	110 V~	60 Hz	349804969
21C	127 V~	60 Hz	349804973
21C	220 V~	60 Hz	349804978
21C	240 V~	60 Hz	349804981

Kit	Un	F	UXAB
21D	24 V–	–	349805902
21D	30 V–	–	349805903
21D	48 V–	–	349805904
21D	60 V–	–	349805905
21D	110 V–	–	349805909
21D	125 V–	–	349805912
21D	220 V–	–	349805918
21D	48 V~	50 Hz	349805934
21D	110 V~	50 Hz	349805939
21D	127 V~	50 Hz	349805943
21D	220 V~	50 Hz	349805948
21D	240 V~	50 Hz	349805951
21D	110 V~	60 Hz	349805969
21D	127 V~	60 Hz	349805973
21D	220 V~	60 Hz	349805978
21D	240 V~	60 Hz	349805981

Kit 22

Connection terminals

The set includes the three upper and three lower terminals.
The terminals allow connection to the power circuit of the fixed circuit-breaker.

N.B. For 36 kV circuit-breakers, the terminals are part of the standard fittings.

Ordering codes

Kit	In	UXAB
22	630 A	349800301
22	1250 A	349800302

3

SPECIFIC PRODUCT CHARACTERISTICS

Resistance to vibrations

The HD4/R circuit-breakers are unaffected by mechanical vibrations or those due to electromagnetic effect.

Electromagnetic compatibility

The HD4/R circuit-breakers fitted with PR521 microprocessor-based electronic relay ensure operation free of unwarranted trips, even in the presence of interference caused by electronic apparatus, by atmospheric disturbances or by electrical discharges.
Furthermore, the apparatus does not generate interference with other electronic equipment in the vicinity of the installation. The above is in compliance with the EN 50081-2, 50082-2 and 60694 Standards, as well as with the European EEC 89/336 and subsequent Directives regarding electromagnetic compatibility (EMC), and the releases are EC marked as complying with these.

Tropicalization

The HD4/R circuit-breakers are manufactured in compliance with the strictest regulations for use in hot-humid-saline climates.
All the most important metal components are treated against corrosive factors according to UNI 3564-65 Standards environmental class C.
Galvanisation is carried out in accordance with UNI ISO 2081 Standards, classification code Fe/Zn 12, with a thickness of $12x10^{-6}$ m, protected by a conversion layer mainly consisting of chromates in compliance with the UNI ISO 4520 Standards.
These construction characteristics mean the HD4/R series of circuit-breakers comply with climate graph 8 of the IEC 60721-2-1 Standards.

Altitude

It is a known fact that the insulating property of air decreases as the altitude increases.
This phenomenon must therefore always be taken into account during the design stage of the insulating components of apparatus to be installed over 1000 m above sea level. In this case a correction coefficient must be considered, which can be taken from the graph to the side, built up on the basis of the indications in the IEC 60694 Standards.
The following example is a clear interpretation of the indications given above.

Example

- Installation altitude: 2000 m
- Rated service voltage of 12 kV
- Industrial frequency withstand voltage: 28 kV rms
- Impulse withstand voltage: 75 kVp
- Ka factor, which can be taken from the graph = 1.13.

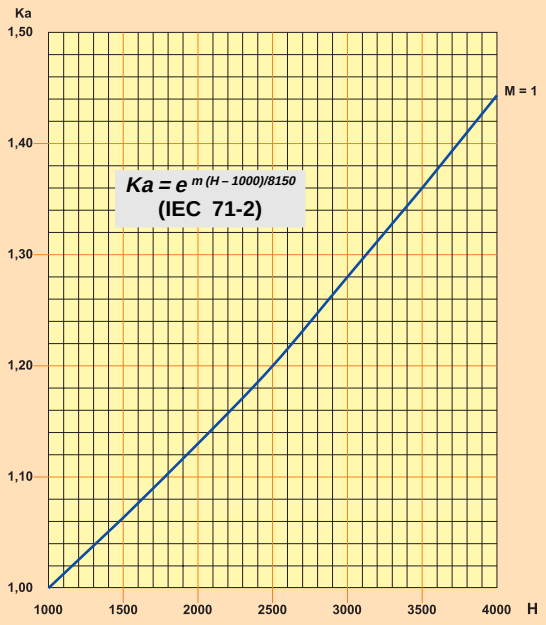
Considering the above parameters, the apparatus must withstand (on test at zero altitude, i.e. at sea level):
– industrial frequency withstand voltage:
28 x 1.13 = 31.6 kVrms

– impulse withstand voltage:
75 x 1.13 = 84.7 kVp.

From the above, it can be deduced that for installations at an altitude of 2000 m above sea level, with 12 kV service voltage, apparatus must be provided with 17.5 kV rated voltage, characterised by insulation levels at industrial frequency of 38 kVrms with 95 kVp impulse withstand voltage.

Graph for determining the Ka correction factor according to the altitude

H = altitude in metres;
m = value referred to industrial frequency and to the atmospheric impulse and between phase withstand voltages.



Environmental protection programme

The HD4/R circuit-breakers are manufactured in accordance with the ISO 14000 Standards (Guidelines for environmental management).
The production processes are carried out in compliance with the Standards for environmental protection in terms of reduction in energy consumption as well as in raw materials and production of waste materials. All this is thanks to the medium voltage apparatus manufacturing facility environmental management system, certified by RINA.
Assessment of the environmental impact of the life cycle of the product (LCA - Life Cycle Assessment), obtained by minimising energy consumption and overall raw materials of the product, became a concrete matter during the design stage by means of targeted selection of the materials, processes and packing.
Production techniques which prepare the products for simple dismantling and separation of the components are used during manufacture of the circuit-breakers. This is to allow maximum recycling at the end of the useful life cycle of the apparatus.

Anti-pumping device

The ESH operating mechanism on HD4/R circuit-breakers (in all versions) is fitted with a mechanical anti-pumping device which prevents re-closing due to either electrical or mechanical commands. Should both the closing command and any one of the opening commands be active at the same time, there would be a continuous succession of opening and closing operations.
The anti-pumping device avoids this situation, ensuring that each closing operation is only followed by a single opening operation and that there is no closing operation after this. To obtain a further closing operation, the closing command must be released and then relaunched.
Furthermore, the anti-pumping device only allows circuit-breaker closure if the following conditions are present at the same time:
– operating mechanism springs fully charged
– opening pushbutton and/or shunt opening release (YO1) not enabled
– main circuit-breaker contacts open and at their run end.

Spare parts

– Opening springs (*)
– Closing springs (*)
– Complete pole (*)
– Basic operating mechanism (*)
– Geared motor
– Shunt opening release
– Additional shunt opening release
– Shunt closing release
– Circuit-breaker locking device complete with signalling lamps
– Key lock
– Geared motor limit contact
– K63 instantaneous relay
– K163 instantaneous relay
– Opening pushbutton
– Closing pushbutton

Ordering: for availability and ordering of spare parts, please contact our Service, specifying the circuit-breaker serial number.

(*) Replacement can only be carried out by trained personnel and/or in our workshops.

PR521 protection relay

The PR521 unit carries out the following functions:

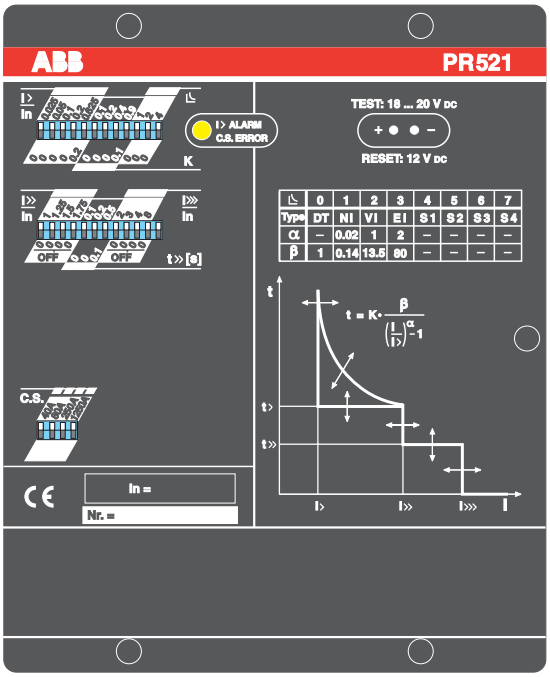
- **PR521 - LSI:** overcurrent protection (code ANSI 50-51), two-phase or three-phase according to the whether it is connected to two or three current sensors;
- **PR521 - LSIG:** like PR521-LSI plus earth fault protection (code ANSI 51N) (by means of vectorial summation inside the three phase sensors or by means of an external earth fault toroid and two or three current sensors).

Apart from supplying the current signal, the current sensors also provide the energy required for operation of the unit.

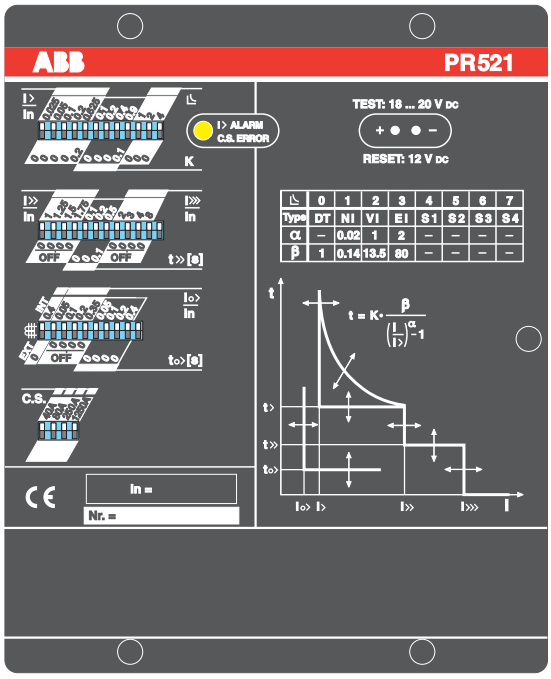
The unit is self-supplied and its correct operation is guaranteed in the presence of a current higher than or equal to 20% of the rated value on at least one of the phases fitted with current sensors (0.2 x In).

Microprocessor-based digital technology is used in its construction.

The unit causes the circuit-breaker, in which it is integrated, to open, by means of an opening solenoid (YO3 - see accessory kit no. 13), which acts directly on the operating mechanism of the apparatus.



PR521 with LSI protection functions.



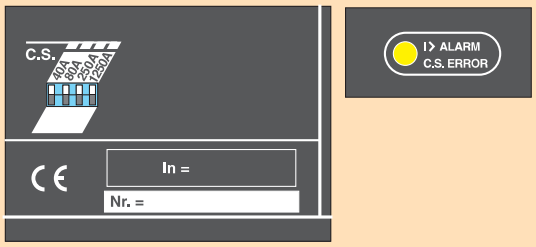
PR521 with LSIG protection functions.

Current sensors (C.S.)

The PR521 unit can be used with current sensors supplied by ABB with the following characteristics:

Rated primary current	In = 40 A
	In = 80 A
	In = 250 A
	In = 1250 A
Rated secondary current	In = 1 A.

To select the sensor, enable the corresponding dip-switch. If, by chance, several sensors are selected, the alarm LED flashes to provide an error signal.
The current sensors can be mounted on board the HD4/R circuit-breakers with rated voltage up to 24 kV. The 24 kV circuit-breakers with 230 mm pole centre distance can only mount two current sensors on board.



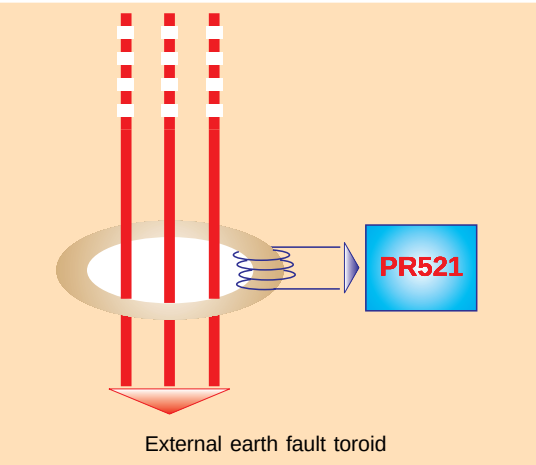
Selection of the primary current of the current sensors

External earth fault toroid

The PR521 unit can be used with any external toroid to determine the earth fault current as long as it has the following characteristics:

Rated primary current	any
Rated secondary current	1 A
Performance	1 VA
Class of precision, ultimate precision factor	Cl. 3 or higher

Use of the external toroid for determining the earth fault current is recommended when very low setting values of the 51N threshold are required (less than 0.45 times the rated current - In - of the current sensors).
The use of the above-mentioned toroid is compulsory when protection 51N is to be provided with 24 kV circuit-breakers and 230 mm pole centre distance.



External earth fault toroid

Release actuator

The PR521 release unit carries out release of the operating mechanism in the case of the protection functions tripping, by means of an opening solenoid (YO3 - see accessory kit no. 13).

Self-supply

Operation of the PR521 unit is guaranteed by the self-supply circuit. The minimum value of phase current needed for operation is 0.2 x In.
This circuit is able to withstand:
– overload: 1.5 x In continuous
– overload: 6 x In for 200 sec.
– overload: 25 kA for 1 sec. (short-time withstand overcurrent of the circuit-breaker).

MTBF

An MTBF of 15 years at an operating temperature of 40°C is expected.

Ambient conditions

Ambient temperature	– 5 °C ... +40 °C
Storage temperature	– 40 °C ... +90 °C
Relative humidity without condensation	90%
Degree of protection (mounted on the circuit-breaker and with front protection)	IP42

Operating frequency

From 45 Hz to 66 Hz.

Inputs

Analogue inputs

- Inputs for current sensors.
  The current sensors which supply the signals proportional to the current circulating in the phases and the energy required for self-supply of the apparatus are connected to the PR521 unit by means of these three inputs.
- Input for external earth fault toroid.
  The external earth fault toroid whose signal is directly proportional to the earth fault current is connected to the PR521 unit by means of this input. This transformer does not supply the energy for self-supplied operation of the relay. That input must be made using a braided screened telephone cable whose braiding must be earthed on the metallic box of the PR521 (please refer to the wiring diagram enclosed with the circuit-breaker).
  Because of EMC problems, the earthing connection of the braiding must be as solid and short as possible.

Binary input for control function

- Input for circuit-breaker remote opening. This input makes it possible to open the circuit-breaker remotely, exploiting the energy, if available, supplied by the current sensors. This input must be made using a screen telephone cable whose braiding must be earthed on the metallic box of the PR521 (please refer to the wiring diagram enclosed with the circuit-breaker).
  By connecting an external contact without potential (e.g. the contact of a Buchholz relay) to the special input connector, it is possible to control circuit-breaker opening remotely through the PR521 release when the primary current exceeds the value of 0.2 x In on at least one phase fitted with a current sensor.

Outputs

Power output

This output controls the specific opening solenoid for PR521 (YO3 - see kit no. 13).

Signalling output by means of closing contact

An output made by means of a bistable relay is available (it keeps the state even with a power cut and until the RESET operation), with closing contacts without potential, through which the relay trip signal is supplied.
After protection trip and circuit-breaker opening, this contact can be reset in two different ways:

– with phase current higher than 0.2 x In, automatic resetting takes place when the circuit-breaker closes;
– with phase current lower than 0.2 x In and the protection unit off (even with the circuit-breaker open), by means of the front bushing for RESET as defined in the “Test and reset function”.

N.B. This signalling contact is not enabled if a remote circuit-breaker opening command is given or for the Test operation of release functionality.

Function	Protection tripped
Type	Bistable
Maximum change-over power	150 W / 1250 VA (resistive load)
Maximum change-over voltage	220 V– / 250 V ~
Maximum change-over current	5 A
Breaking capacity (UL/CSA):	
– at 30 Vdc (resistive load)	5 A
– at 250 Vac (resistive load)	5 A
– at 250 Vac (cosφ = 1.0)	5 A
– at 250 Vac (cosφ = 0.4)	3 A
Mechanical life (at 180 operations/minute)	5×10^7
Electrical life	1×10^5
Insulation:	
– between open contacts	1000 Veff (50 Hz / 1 min.)
– between contact and coil	3000 Veff (50 Hz / 1 min.)

Protection functions

The PR521 unit carries out the following protections:

- **PR521 - LSI:** phase overcurrent protection (instantaneous, with adjustable delay, with definite and fixed time)
- **PR521 - LSIG:** like PR521-LSI plus earth fault overcurrent protection (with adjustable delay).

The thresholds and trip times an be selected directly by setting some Dip-switches on the front of the unit.

For fixed time protection, the trip time is given by the following relationship:

$$t = K \times \beta$$

For definite time protection, the relationship between trip time and overcurrent is given by the following formula:

$$t = K \times \frac{\beta}{\left[\frac{I}{I>}\right]^{\alpha} - 1}$$

Caption

t = trip time
k = parameter which can be set by the user to select the required trip curve
α, β = pair of parameters depending on the type of protection which can be selected by the user
I = fault current
I> = trip threshold which can be selected by the user.

Overcurrent protection with fixed time

A family of protection curves is available, defined as “Fixed time with adjustable delay DT” (in accordance with the IEC 60255-3 Standards).
The following settings are possible:

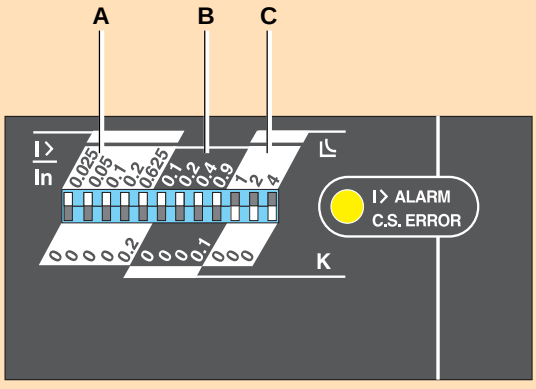
- **32 current threshold values (I>)** (1)

0.200	0.225	0.250	0.275	
0.300	0.325	0.350	0.375	
0.400	0.425	0.450	0.475	
0.500	0.525	0.550	0.575	
—	0.625	0.650	0.675	
0.700	0.725	0.750	0.775	
0.800	0.825	0.850	0.875	
0.900	0.925	0.950	0.975	
1.000	—	—	—	**x In**

- **16 trip times (t>), (with b = 1, K = 0.1...1.6 with steps of 0.1) (2)**

0.1	0.2	0.3	0.4	0.5	—
0.6	0.7	0.8	0.9	1.0	—
1.1	1.2	1.3	1.4	1.5	1.6 **s**

The protection **cannot be excluded.**
The I> protection for the DT curve processes the peak value over the whole interval 0.2 … 20 x In.



A Dip-switch for setting the threshold value.

B Dip-switch for setting trip time.

C Position Dip-switches 1, 2 and 4 down to set the I> protection with fixed time.

Overcurrent protection with definite time

Three different families of protection curves are available (in accordance with the IEC 255-3 Standards), defined as follows:
- Normally inverse time NI
- Very inverse time VI
- Extremely inverse time EI.

The following settings are possible:

- **32 current threshold values (I>)** (1)

0.200	0.225	0.250	0.275	
0.300	0.325	0.350	0.375	
0.400	0.425	0.450	0.475	
0.500	0.525	0.550	0.575	
—	0.625	0.650	0.675	
0.700	0.725	0.750	0.775	
0.800	0.825	0.850	0.875	
0.900	0.925	0.950	0.975	
1.000	—	—	—	x **In**

- **16 trip curves for each family, defined as follows** (3)

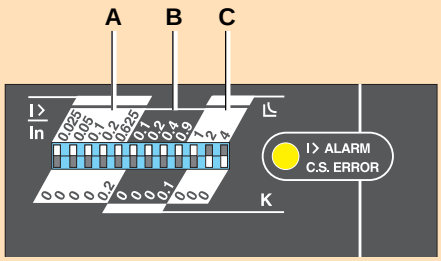
a) Curves with normally inverse time (with α = 0.02, β = 0.14, **K** = 0.1...1.6 with steps of 0.1)

b) Curves with very inverse time (with α = 1, β = 13.5, **K**= 0.1...1.6 with steps of 0.1)

c) Curves with extremely inverse time (with α = 2, β = 80, **K**= 0.1...1.6 with steps of 0.1)

The protection **cannot be excluded**. The trip curves move as the current thresholds change.
The I> protection for the NI, VI, EI curves processes the true effective value of the phase current.

(1) The unit guarantees that it does not enter the threshold for currents under 1.05 x I> set to guarantee threshold entry for currents higher than 1.30 x I> set.
(2) The tolerance over the trip times with three-phase power supply is ± 15% or ± 30 ms.
(3) The tolerance over the trip times is ± 20% or ± 150 ms.

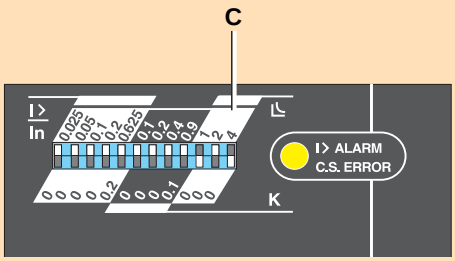


Curves with normally inverse time

A Dip-switch for setting threshold value.

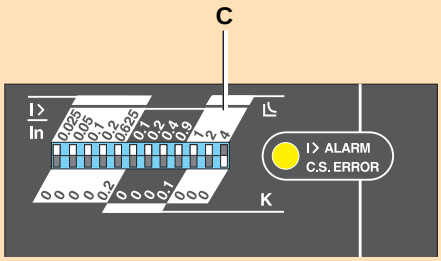
B Dip-switch for setting trip curve.

C Position Dip-switch 1 up and Dip-switches 2 and 4 down to set protection I> to normally inverse time.



Curves with very inverse time

C Position Dip-switches 1 and 4 down and Dip-switch 2 up to set protection I> to very inverse time.



Curves with extremely inverse time

C Position both Dip-switches 1 and 2 up and Dip-switch 4 down to set protection I> to extremely inverse time.

Overcurrent protection with adjustable delay

The following settings are possible:

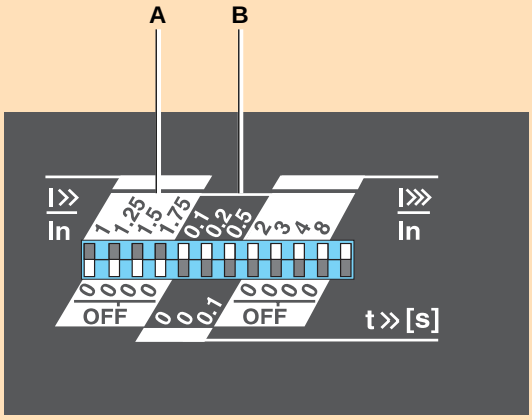
- **14 current threshold values (I>>)** (1)

1.00	1.25	1.50	1.75	
—	2.25	2.50	2.75	
3.00	3.25	—	3.75	
4.00	4.25	4.50	—	
—	—	5.50	—	**x In**

- **8 trip times (t>>)** (2)

0.10	0.20	0.30	0.40	
0.50	0.60	0.70	0.80	**s**

The protection **can be excluded.**
The I>> protection processes the peak value over the whole interval 1 … 20 x In.



A Position all the Dip-switches down to exclude the protection. The trip threshold is set by positioning the Dip-switches appropriately.

B Dip-switch for setting the trip time.

(1) The tolerance over the threshold values is ± 10%.

(2) The tolerance over the trip times is ± 15% or ± 30 ms.

Instantaneous overcurrent protection

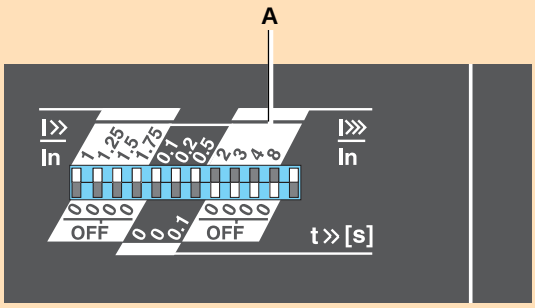
The following settings are possible:

- **15 current threshold values (I>>>)** (1)

2,	3,	4,	5,	6,	7,	8,	9,	10,	11,	12,	13,	14,	15,	17 x **In**

- **Instantaneous trip time not adjustable (curve with intentional delay nil added)**

The protection **can be excluded.**
The I>>> protection processes the peak value over the whole interval 2 … 20 x In.



A Position all the Dip-switches down to exclude the protection. The trip threshold is set by positioning the Dip-switches appropriately.

Earth fault overcurrent protection with adjustable delay (internal vectorial sum)

The earth fault current is calculated as the vectorial sum of the three phase currents. The apparatus must therefore be fitted with three current sensors (this solution is not possible for 24 kV circuit-breakers with 230 mm pole centre distance).
This sum is made by means of an internal toroid (which processes the secondary phase currents of the current sensors). Selection of this method is carried out by means of the front Dip-switches.
The following settings are possible:

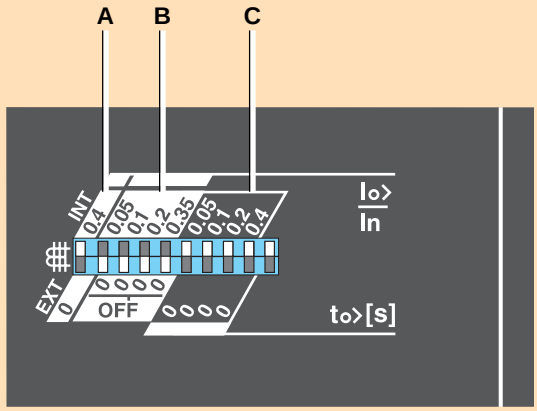
- **14 current threshold values (Io>)** (1)

0.45	0.50	0.55	0.60	
0.65	0.70	0.75	0.80	
0.85	0.90	0.95	1.00	
1.05	1.10			**x In**

- **16 trip times (to>)** (2)

0.00 (3)	0.05	0.10	0.15
0.20	0.25	0.30	0.35
0.40	0.45	0.50	0.55
0.60	0.65	0.70	0.75 **s**

The protection **can be excluded.**
The Io> protection processes the peak value of the earth fault current over the whole interval 0 … 2.5 x In.



A Position all the Dip-switches up to select the internal toroid. This setting defines the trip threshold equal to 0.4 + the threshold set (see note B).

B Position all the Dip-switches down to exclude the protection. The trip threshold is set by positioning the Dip-switches appropriately.

C Dip-switch for setting the trip time.

N.B. The Io> protection function is activated if the current exceeds the value of 0.2 x In on at least two phases or the value of 0.4 x In in single phase, whereas it is automatically excluded when the phase overcurrent exceeds the value of 2.5 x In.

(1) The tolerance over the threshold values is ± 20%.
(2) The tolerance over the trip times is ± 20% or ± 30 ms.
(3) Curve with intentional delay nil added.

Earth fault overcurrent protection with adjustable delay (External Toroid)

The earth fault current is calculated as the vectorial sum of the three primary phase currents. This sum is made by means of an external toroid (which processes the primary phase currents) installed directly on the power cables and therefore, it is only possible to mount two current sensors on board the apparatus (with network with insulated neutral). This solution is compulsory for 24 kV circuit-breakers with 230 mm pole centre distance. Selection of this method is carried out by means of front Dip-switches.
The following settings are possible:

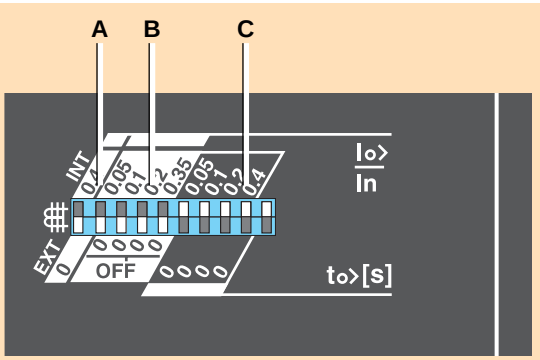
- **14 current threshold values (Io>)** (1)

0.05	0.10	0.15	0.20	
0.25	0.30	0.35	0.40	
0.45	0.50	0.55	0.60	
0.65	0.70			**x In**

- **16 trip times (to>)** (2)

0.00 (3)	0.05	0.10	0.15	
0.20	0.25	0.30	0.35	
0.40	0.45	0.50	0.55	
0.60	0.65	0.70	0.75	**s**

The protection **can be excluded.** The Io> protection processes the peak value of the earth fault current over the whole operating interval.



A Position the Dip-switch down to select the external toroid. This setting defines the trip threshold equal to 0 + the threshold set (see note B).

B Position all the Dip-switches down to exclude the protection. The trip threshold is set by positioning the Dip-switches appropriately.

C Dip-switch for setting the trip time.

N.B. The Io> protection function is activated if the current exceeds the value of 0.2 x In on at least two phases or the value of 0.4 x In in single phase.

(1) The tolerance over the threshold values is ± 15%.
(2) The tolerance over the trip times is ± 20% or ± 30 ms.
(3) Curve with intentional delay nil added.

Self-protection curve with fixed time

A self-protection curve of the electronic relay is available which intervenes at 20 x In with a fixed time of 1 sec. The self-protection processes the peak value of the phase current.

No type of adjustment is possible and the protection **cannot be excluded**. This means that self-protection of the unit is carried out for phase currents over 20 x In without limiting the circuit-breaker breaking capacity (short-time withstand current of 1 s).

Rated setting currents

Current sensor	Protection function				
In [A]	I> (0.2...1xIn) [A]	I>> (1...5.5xIn) [A]	I>>> (2...17xIn) [A]	Io> (0.05...0.7xIn) [A] External toroid (*)	Io> (0.45...1.1xIn) [A] Internal toroid
40	8 ... 40	40 ... 220	80 ... 680	2.5 ... 35	18 ... 44
80	16 ... 80	80 ... 440	160 ... 1360	2.5 ... 35	36 ... 88
250	50 ... 250	250 ... 1375	500 ... 4250	2.5 ... 35	112.5 ... 275
1250	250 ... 1250	1250 ... 6875	2500 ... 21250	2.5 ... 35	562.5 ... 1375

In = rated current of the current sensor
I> = overload current setting value (51)
I>> = short-circuit current setting value (50)
I>>> = instantaneous short-circuit current setting value (50)
Io> = earth fault current setting value (51N)
(*) = If an external toroid is used (kit no. 16) with In = 50/1 A.

LED optical signalling function

The release has an optical indicator on the front (operating from 0.22 x In of phase), able to signal the events shown in the table.

Current sensor setting error	Protection I> under timing	LED
No	No	Off
No	Yes	On
Yes	No	Flashes
Yes	Yes	Flashes

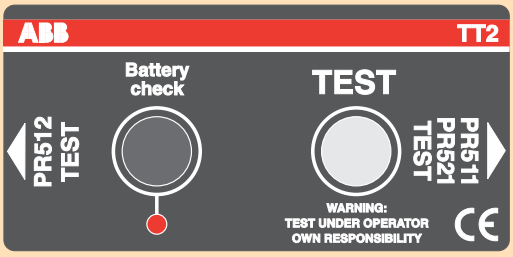
N.B. An error in current sensor setting is made when 2 or more sizes are selected simultaneously.

TEST and RESET function

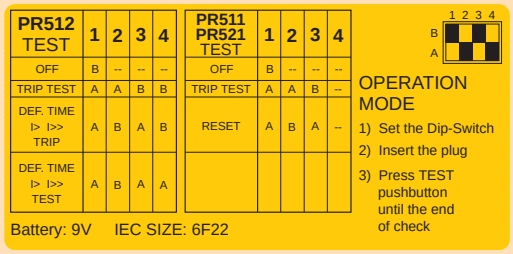
By means of the TT2 accessory (Test Unit which can be supplied on request), it is possible to carry out the overall test of relay release operation (electronic part and YO3 opening solenoid) as well as RESET of the “release tripped due to overcurrent signalling contact”. The latter function is only enabled when the protection unit is completely off.

Auto-reset

The auto-reset function (automatic reset) for release tripped signalling takes place on re-closing of the circuit-breaker with primary current equal to or higher than 0.2 x In on at least one phase fitted with a current sensor.



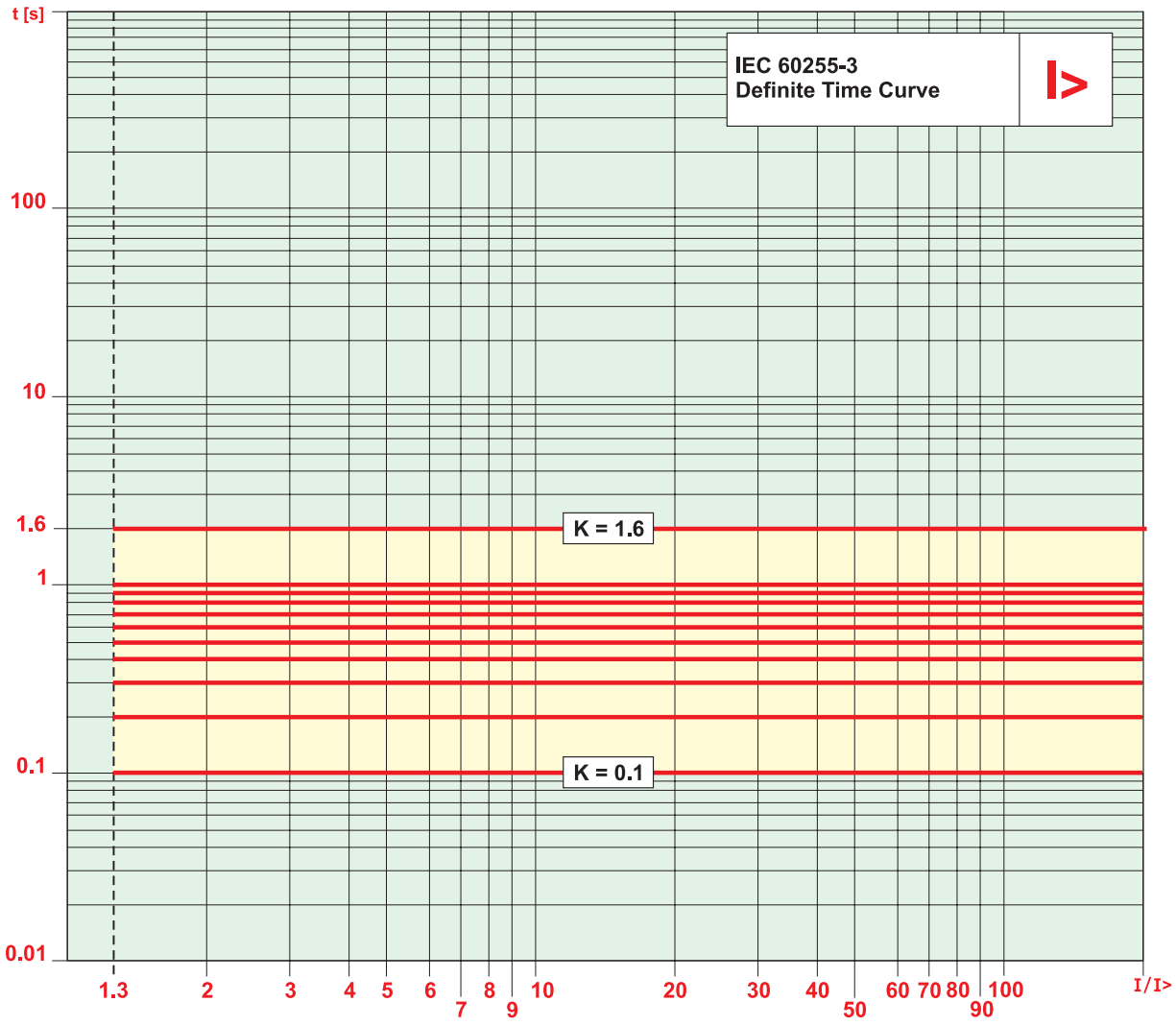
Front view of the TT2 Test Unit.



Rear view of the TT2 Test Unit.

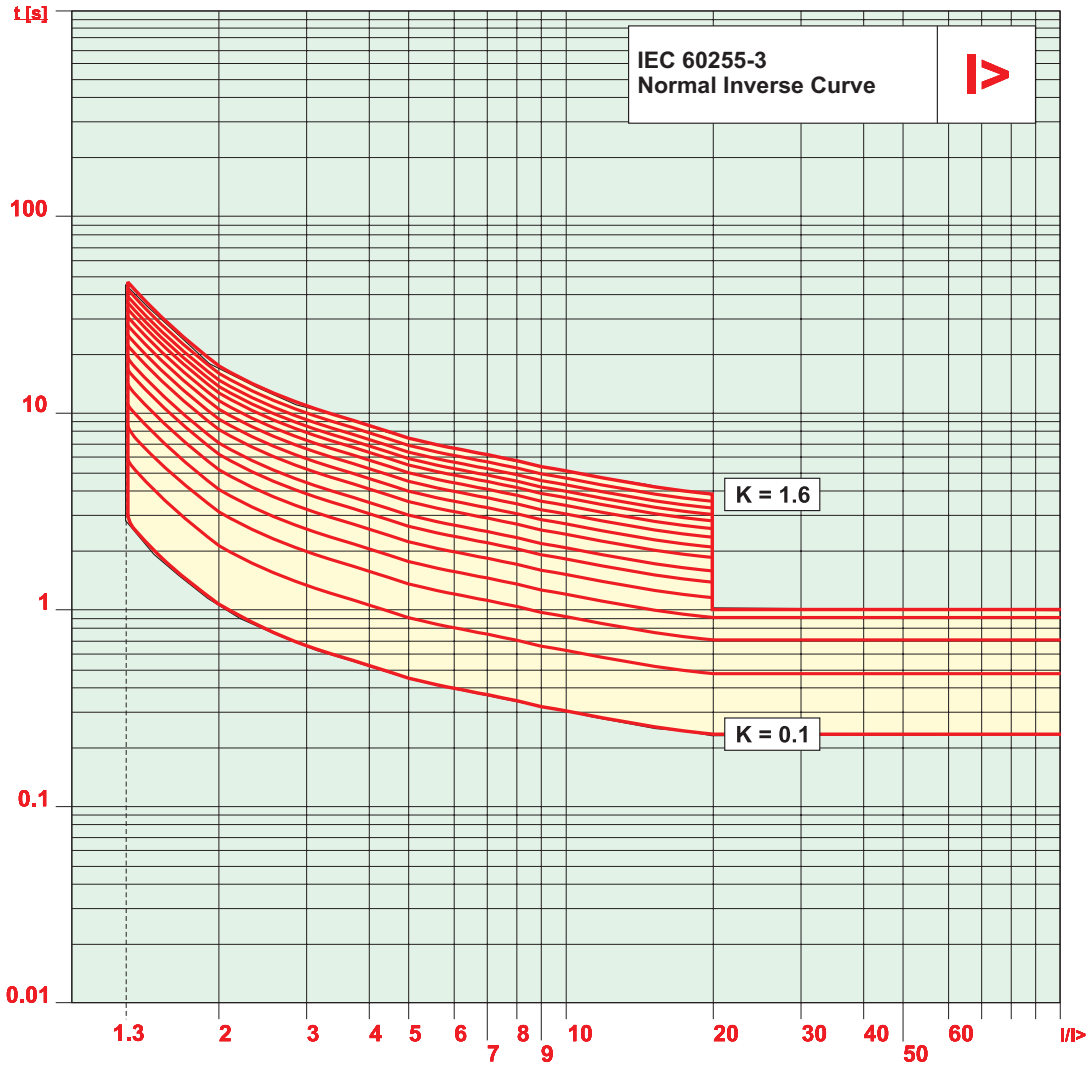
- By positioning Dip-switch 1 in position A, the TT2 unit is active (the Battery Check can be carried out).
- By positioning Dip-switches 1 and 2 in position A and 3 in B, the TT2 unit carries out the circuit-breaker opening test by means of the YO3 opening solenoid.
- By positioning Dip-switches 1 and 3 in position A and 2 in B, the TT2 unit resets the alarm (internal signalling relay).

Trip curve with fixed time (DT) for overcurrent protection



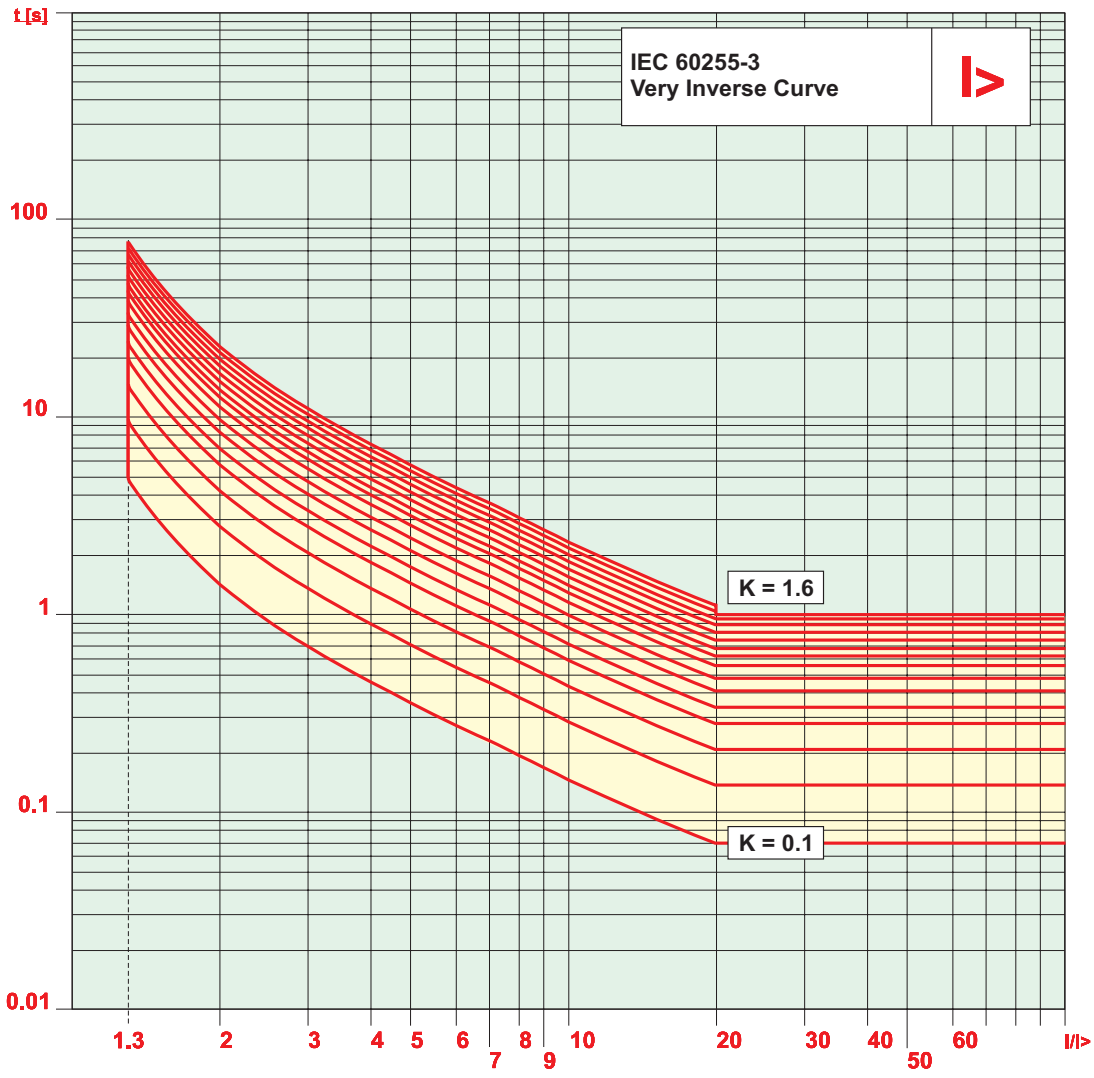
$$t = K \times 1$$

Trip curve with normally inverse time (NI) for overcurrent protection



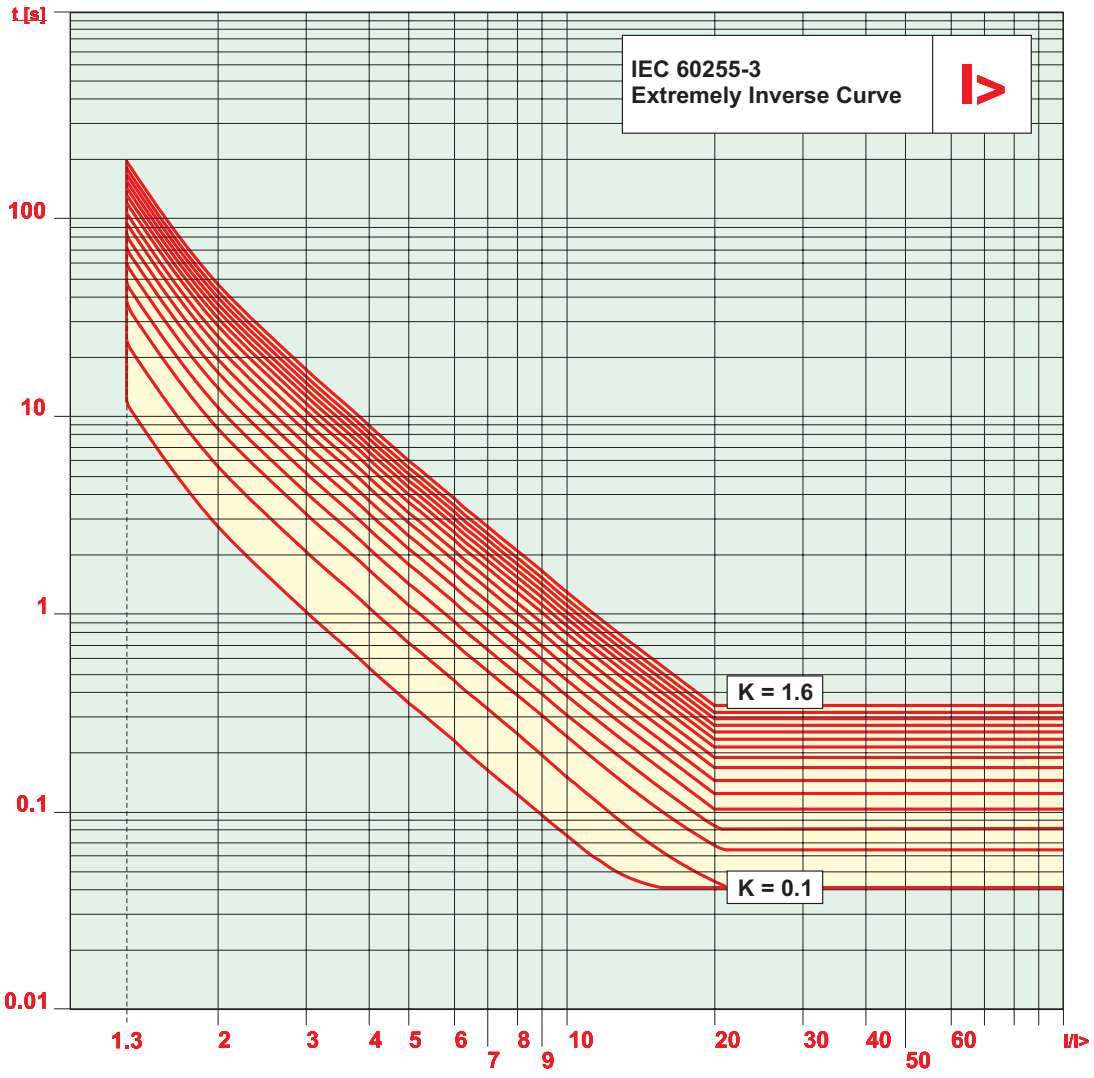
$$t = K \times \frac{0.14}{\left[\frac{I}{I>}\right]^{0.02} - 1}$$

Trip curve with very inverse time (VI) for overcurrent protection



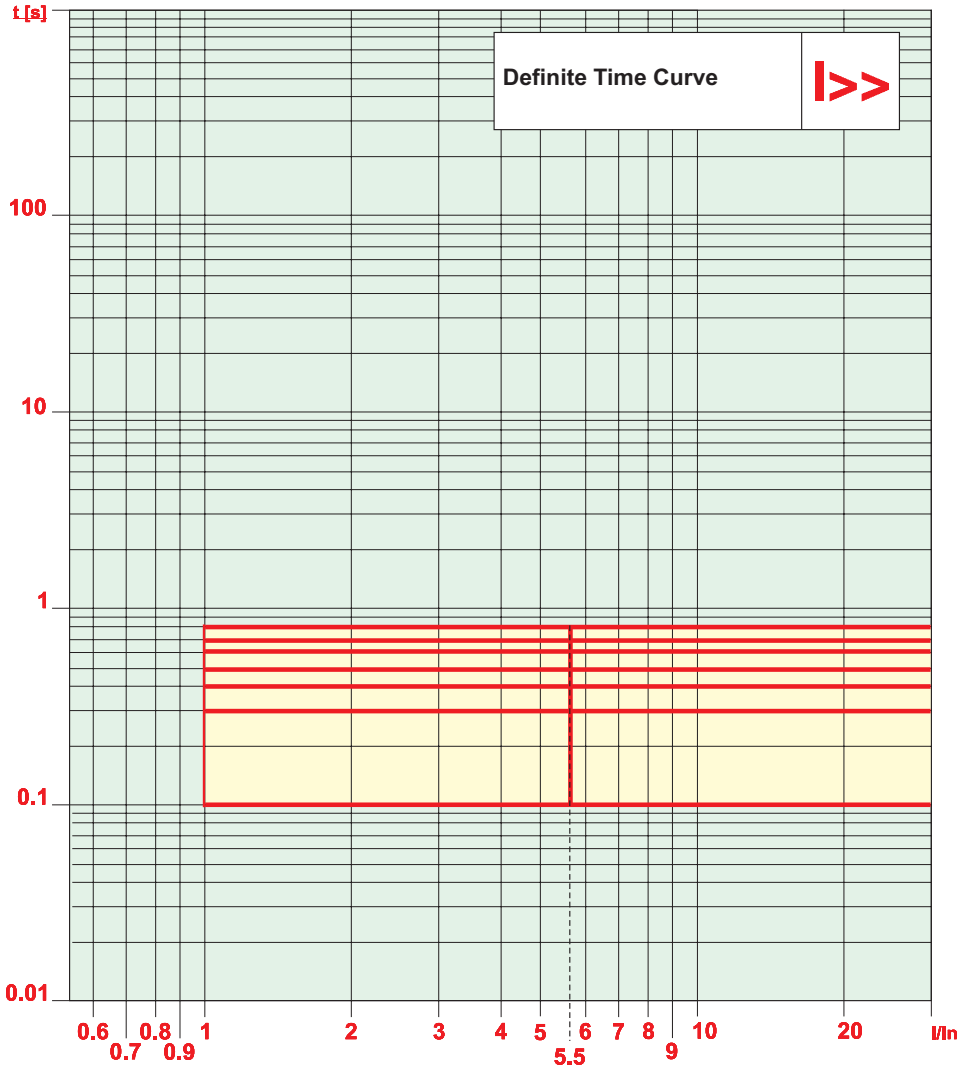
$$t = K \times \frac{13.5}{\left[\frac{I}{I>}\right] - 1}$$

Trip curve with extremely inverse time (EI) for overcurrent protection



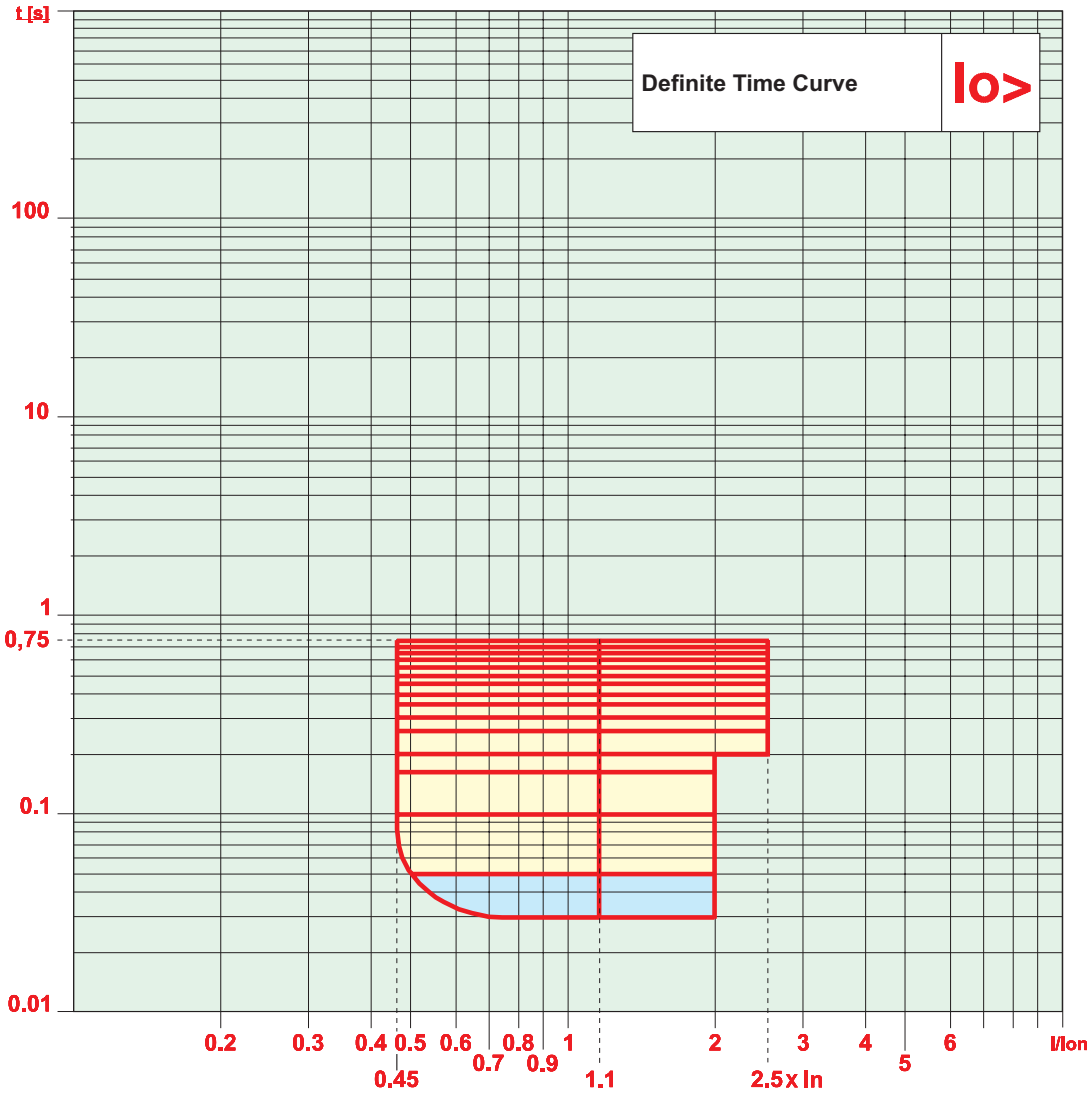
$$t = K \times \frac{80}{\left[\frac{I}{I>}\right]^2 - 1}$$

Trip curve with fixed time for short-circuit protection with adjustable delay



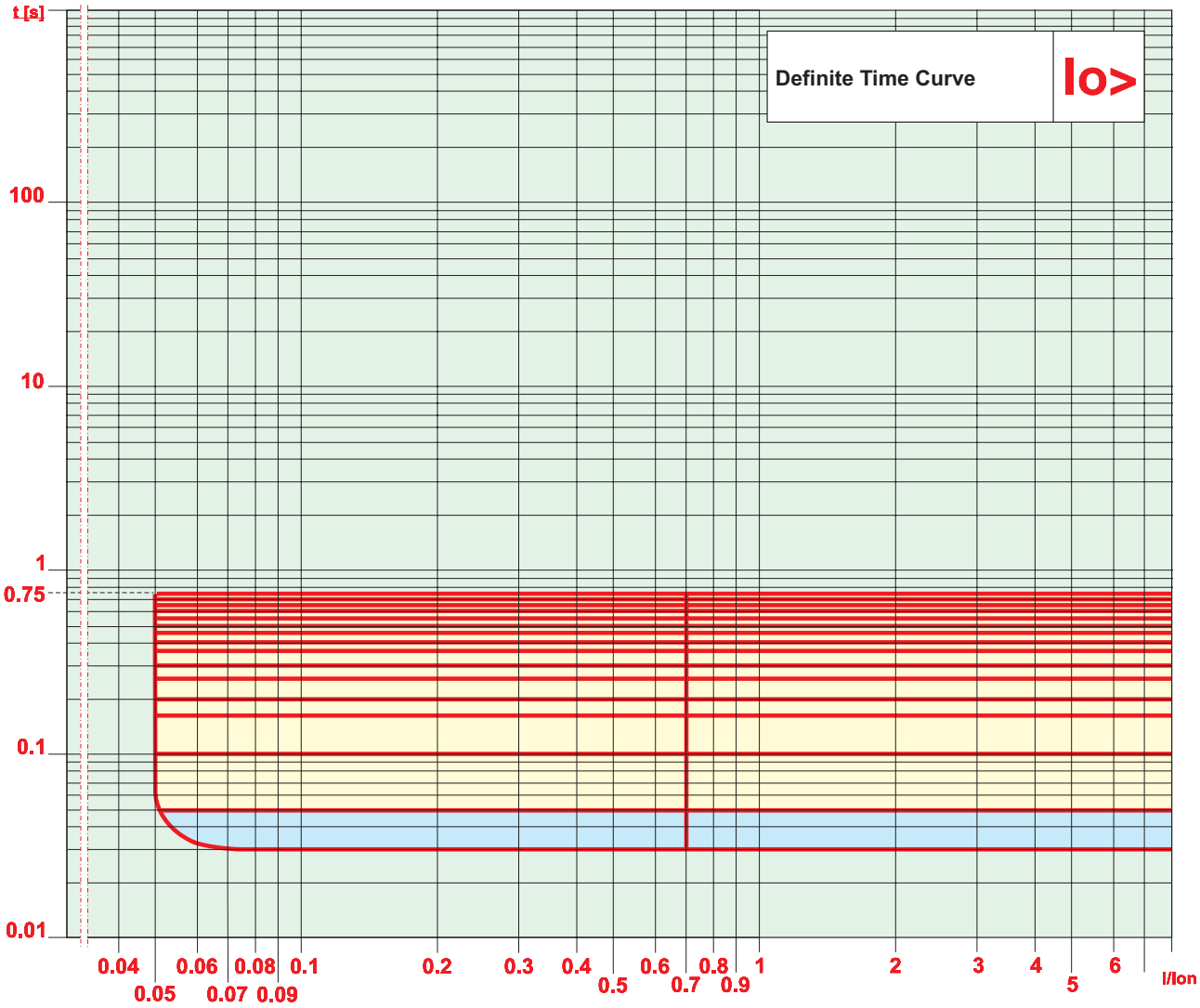
$t = t >>$

Trip curve with fixed time for earth fault protection by means of internal toroid



t = to >

Trip curve with fixed time for earth fault protection by means of external toroid

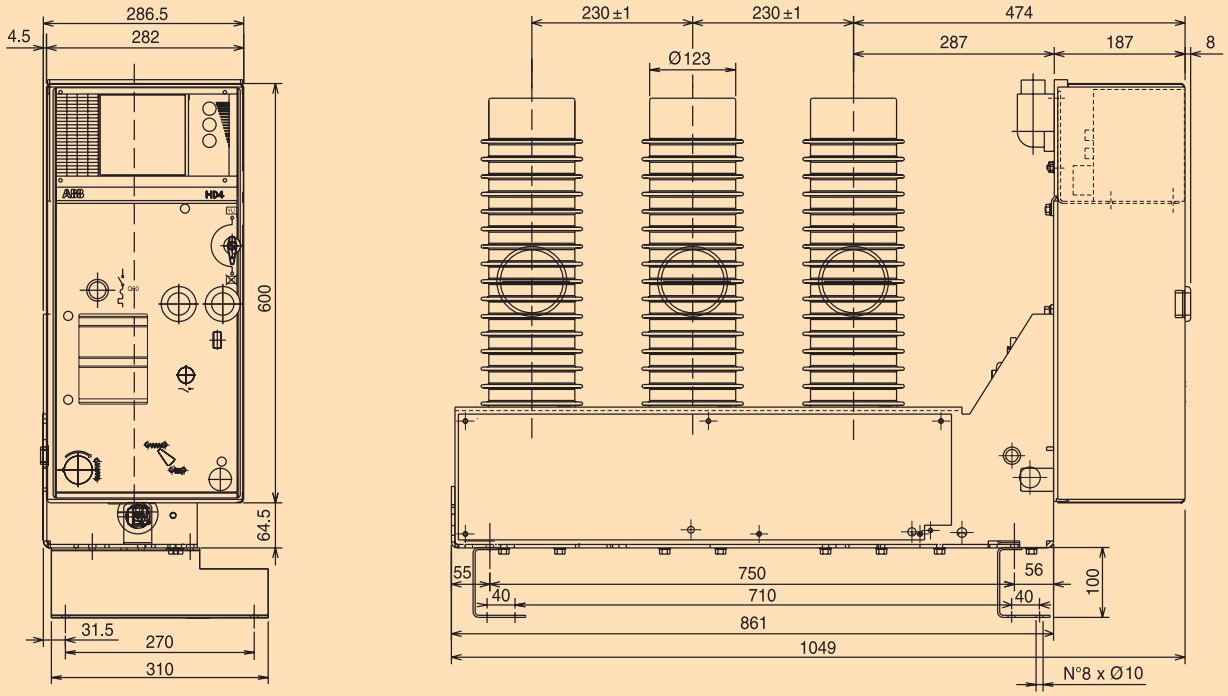


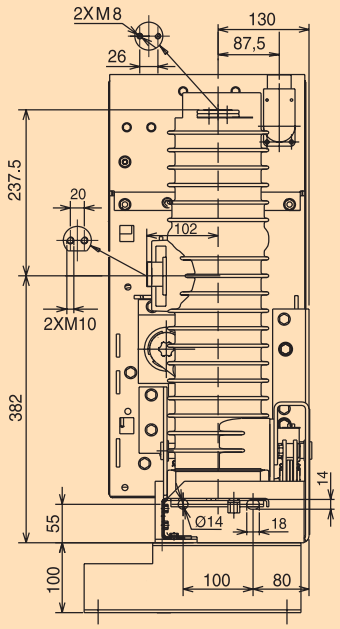
$t = to>$

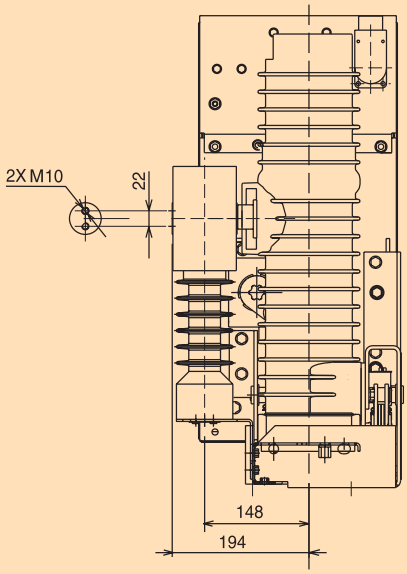
4

OVERALL DIMENSIONS

Fixed circuit-breaker - right lateral operating mechanism - 12-17.5-24 kV - pole centre distance P = 230 mm







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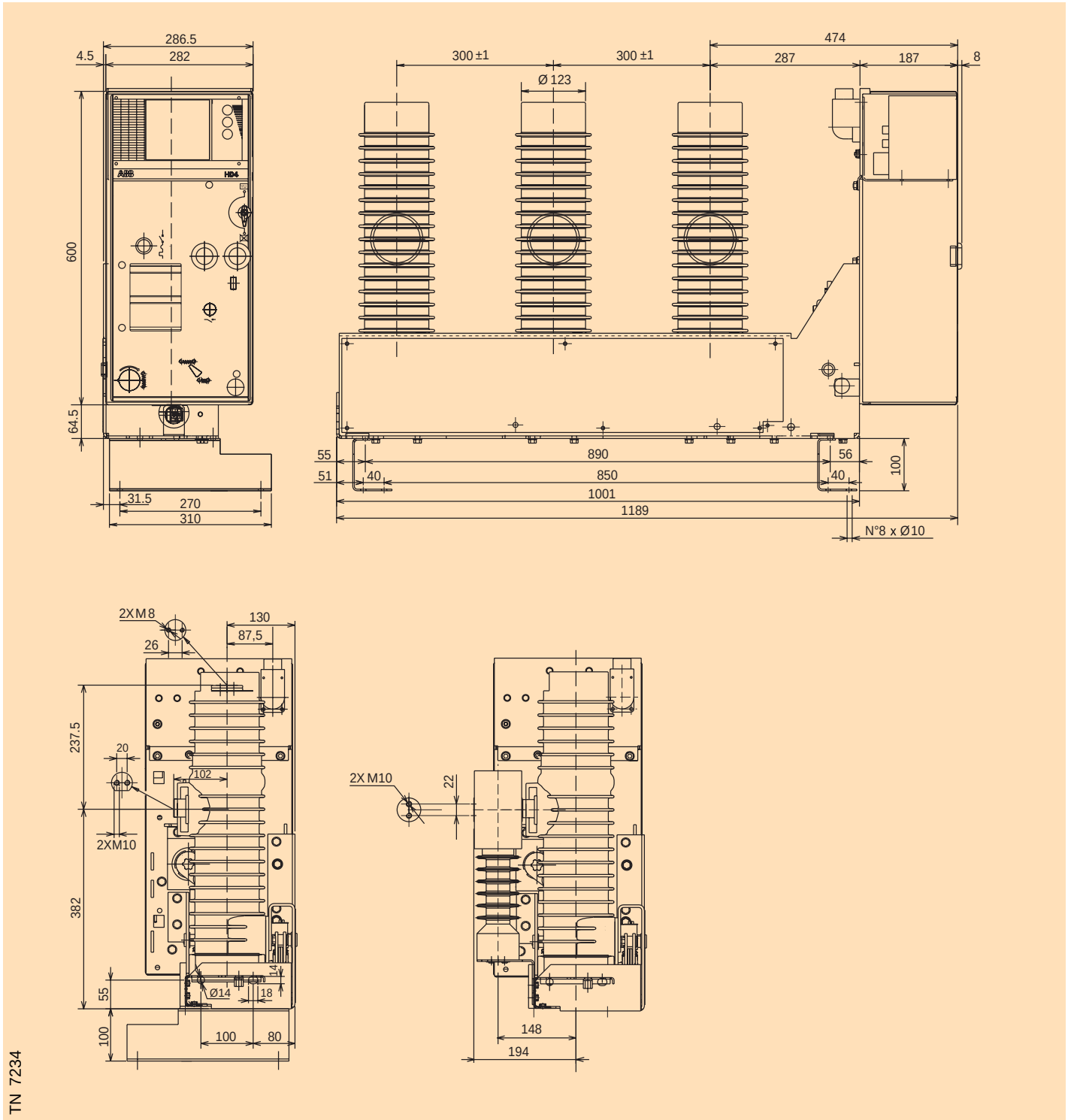
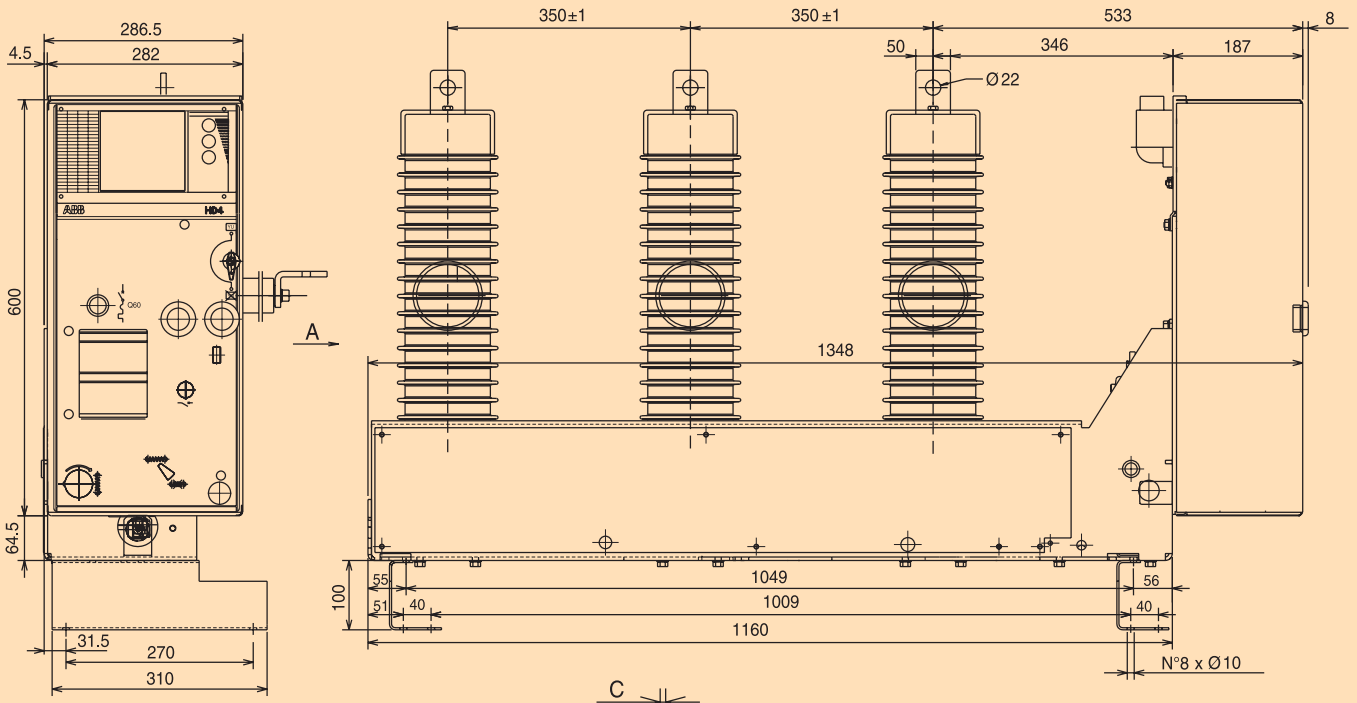
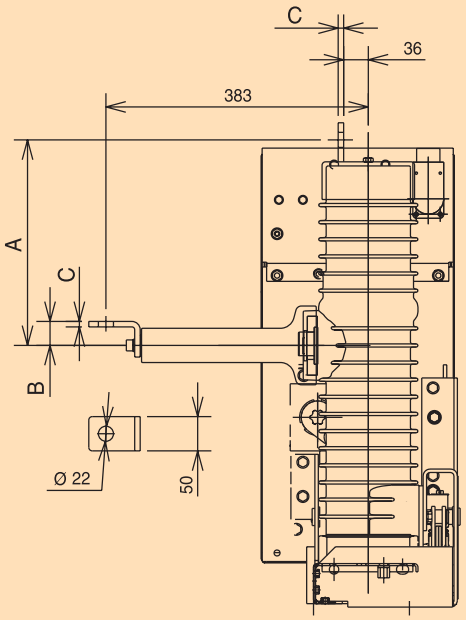
Fixed circuit-breaker - right lateral operating mechanism - 12-17.5-24 kV - pole centre distance P = 300 mm



OVERALL DIMENSIONS

Fixed circuit-breaker - right lateral operating mechanism - 36 kV - pole centre distance P = 350 mm





In	A	B	C
630 A	307,5	35	8
800 A 1250 A	302,5	40	10

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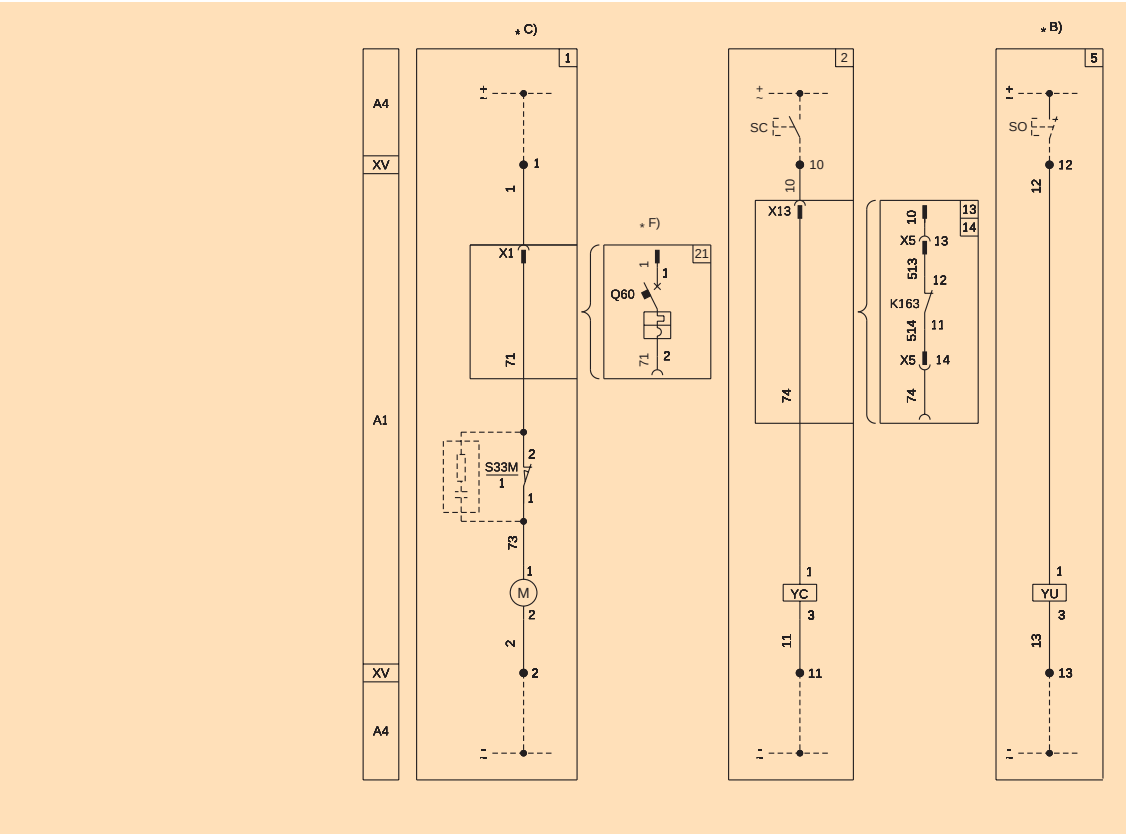
5

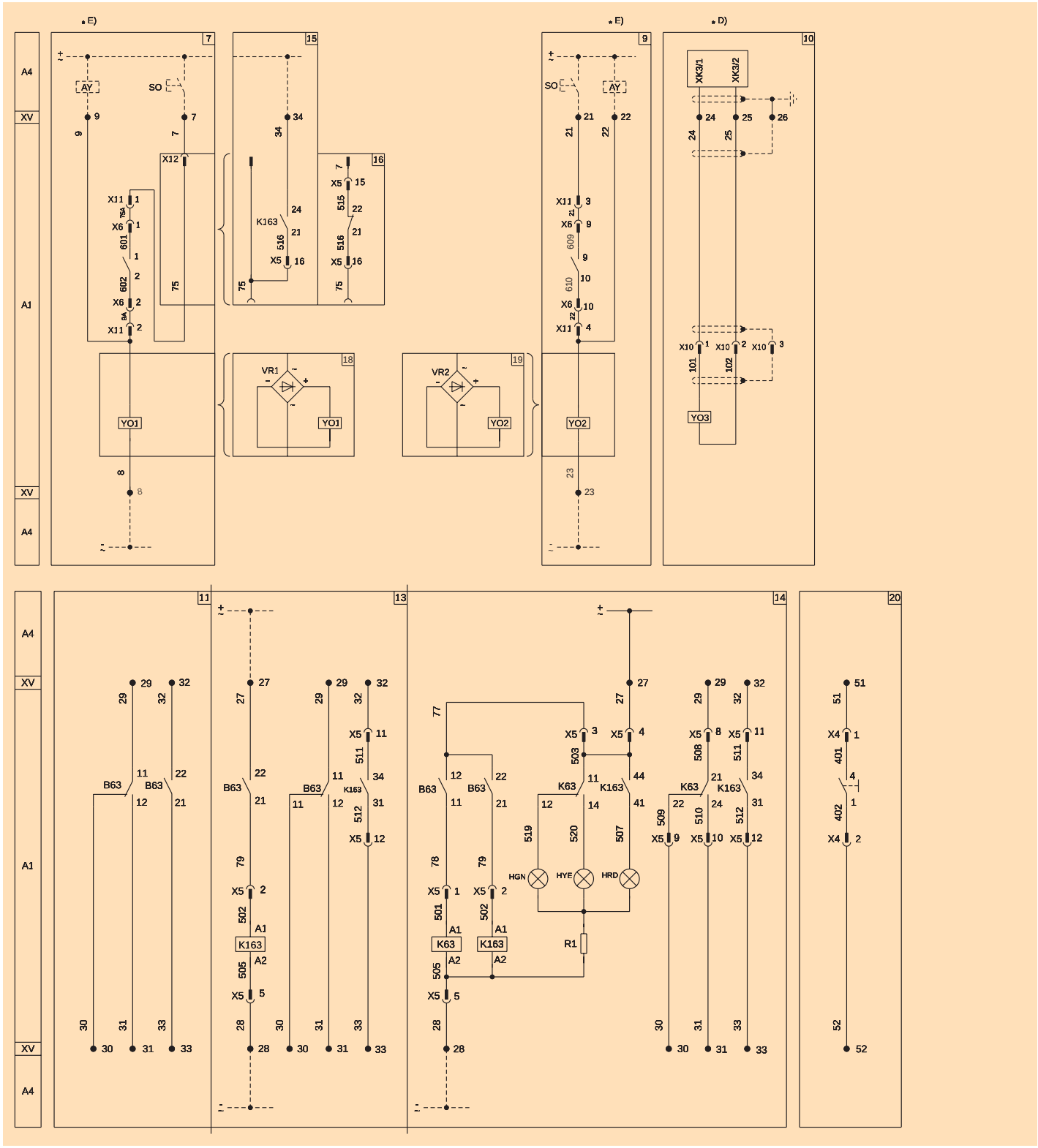
ELECTRIC CIRCUIT DIAGRAM

Diagrams of the applications

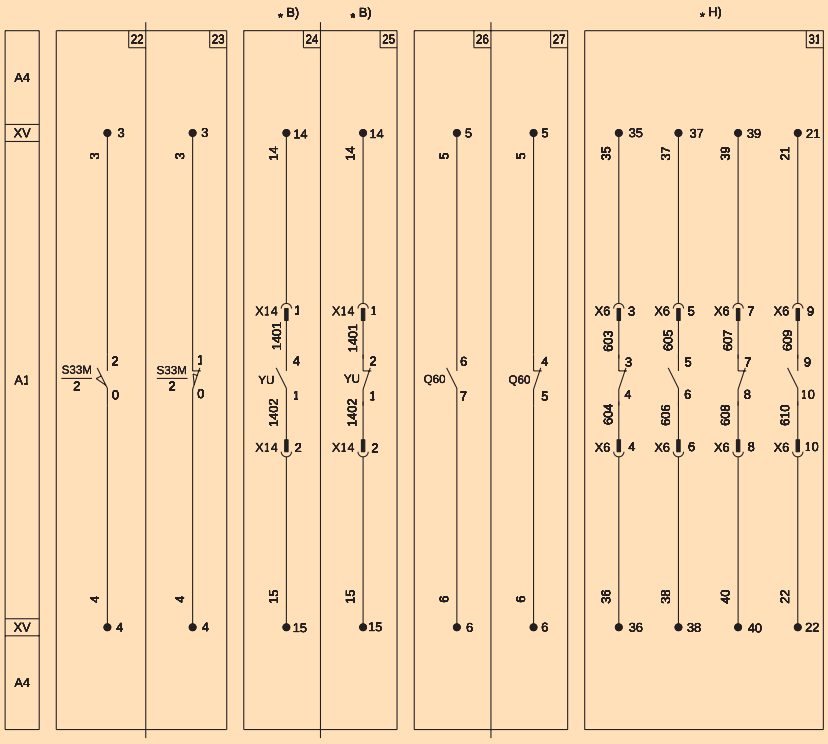
N.B. The following diagrams show the fixed circuit-breaker circuits, delivered to the customer by means of the “XV” terminal box.

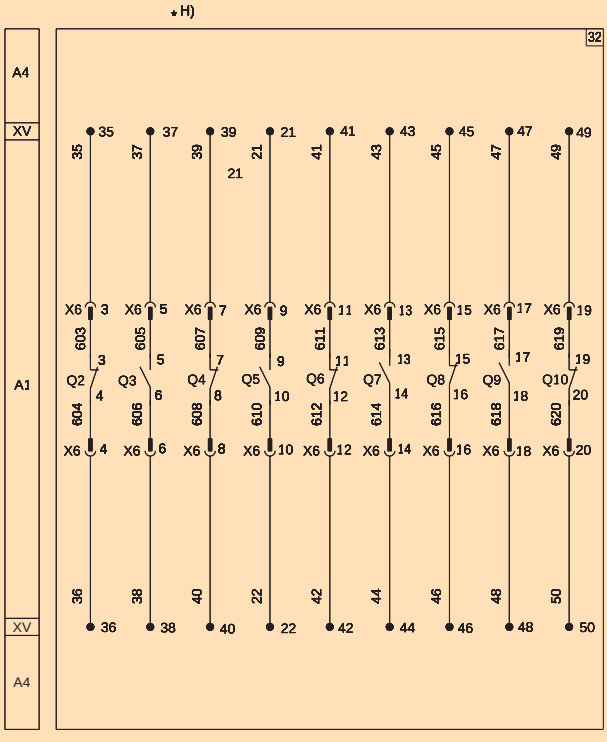
However, to take into account product development, it is always necessary to refer to the circuit diagram supplied with each circuit-breaker.

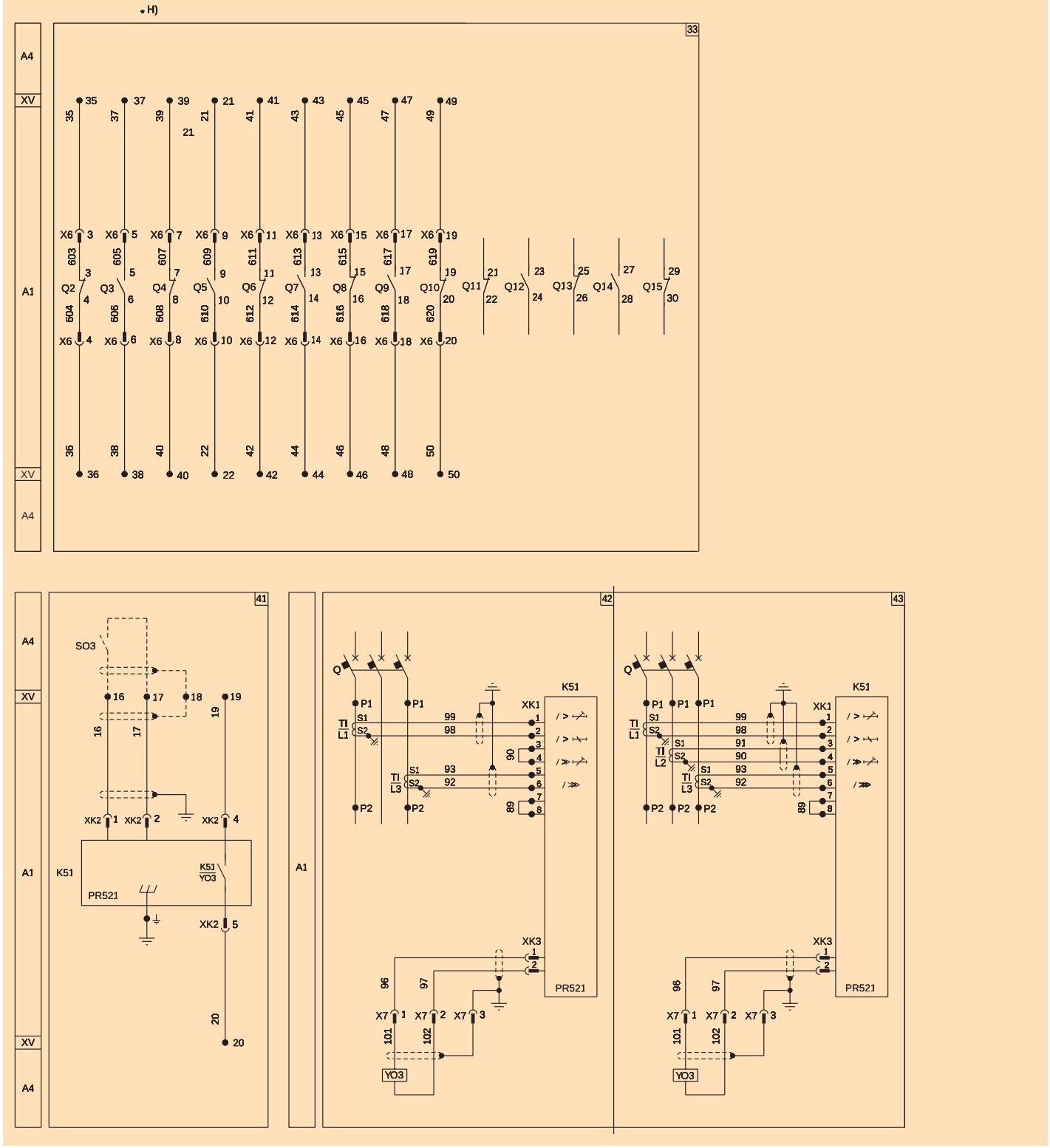



A4
XV
A1
XV
A4
7
15
16
9
10
18
19
AY
SO
X12
X11
X6
K163
VR1
VR2
YO1
YO2
YO3
XK3/1
XK3/2
X10
11
13
14
20
B63
K63
HGN
HYE
HRD
R1
X4
X5

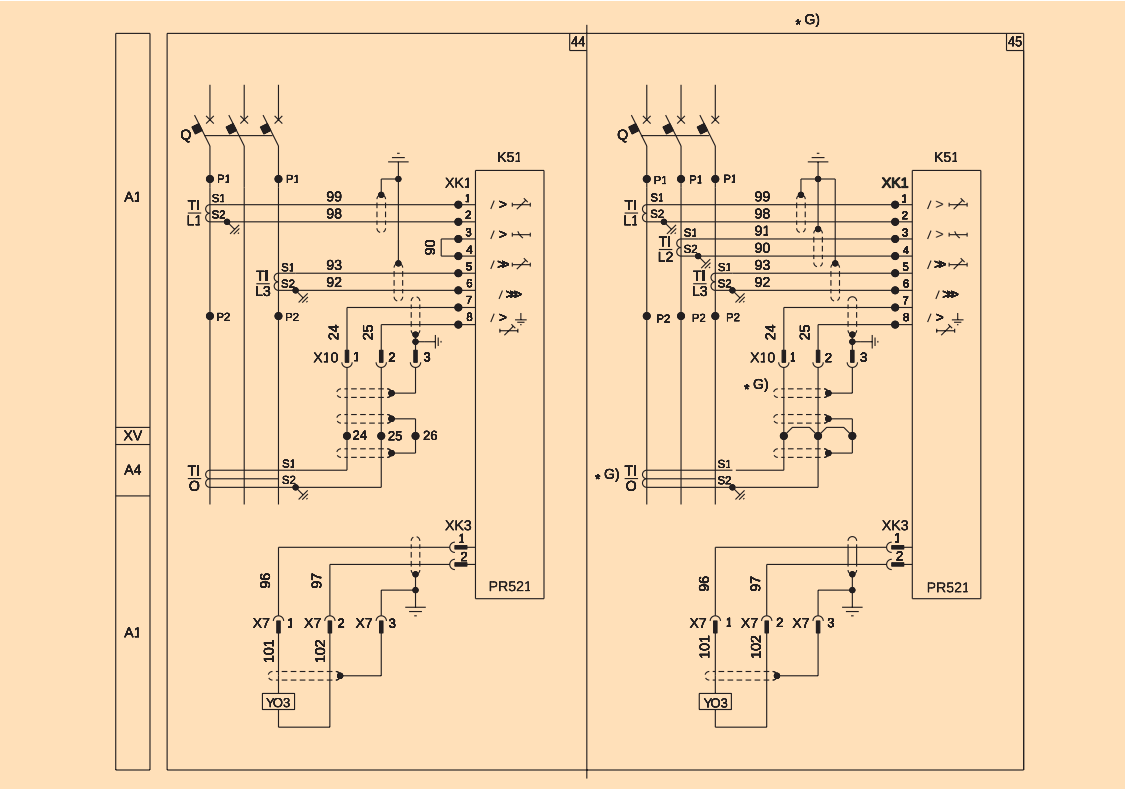
ELECTRIC CIRCUIT DIAGRAM






*H)
A4
XV
A1
XV
A4
33
35 37 39 21 41 43 45 47 49
Q2 Q3 Q4 Q5 Q6 Q7 Q8 Q9 Q10 Q11 Q12 Q13 Q14 Q15
36 38 40 22 42 44 46 48 50
41
SO3
16 17 18 19
XK2 1 XK2 2 XK2 4
K51
PR521
K51/YO3
XK2 5
20
42
43
Q
P1 P1
TI L1
S1 S2
99 98
TI L3
93 92
P2 P2
90 89
K51
XK1
XK3
PR521
96 97
X7 1 X7 2 X7 3
101 102
YO3
TI L2
91

ELECTRIC CIRCUIT DIAGRAM



State of operation shown

The diagram indicates the following conditions:
– circuit-breaker open
– circuits de-energized
– closing springs discharged
– releases not tripped
– gas pressure at rated service value (380 kPa absolute).

Caption

□	=	Reference number of diagram figure
*	=	See note indicated by the letter
A1	=	Operating mechanism accessories
A4	=	Switchboard accessories (indicative devices and connections for control and signallings)
AY	=	Device for control of shunt opening release coil continuity (see note E)
B63	=	Pressure-switch with two intervention thresholds:
		– intervention for low gas pressure. Contact 11-12-14 changes over - in relation to the position indicated in the diagram - If rated pressure is restored, this contact changes over again when, starting from a value of less than 220 kPa absolute, the value of 250 kPa absolute is reached.
		– intervention for insufficient gas pressure. Contact 21-22 changes over when the gas pressure reaches a value of less than 170 kPa absolute from 380 kPa absolute. If rated pressure is restored, this contact changes over again when, starting from a value of less than 170 kPa absolute, the value of 200 kPa absolute is reached.
HGN	=	Green lamp indicating normal gas pressure

HRD = Red lamp indicating insufficient gas pressure
HYE = Yellow lamp indicating low gas pressure
K51 = Microprocessor-based type PR512 overcurrent release with the following protection functions (for PR512 release outside the circuit-breaker - see note D):
– against overload with long definite, inverse, very inverse or extremely inverse trip time-delay
– against short-circuit with short definite trip time-delay
– against short-circuit with instantaneous trip time
– against earth fault with short definite trip time-delay (on request)
K51/YO3 = Contact for electrical signalling of circuit-breaker open due to overcurrent
K63 = Auxiliary relay for doubling the B63 pressure switch contact with intervention for low gas pressure
K163 = Auxiliary relay for doubling the B63 pressure switch contacts with intervention for insufficient gas pressure
M = Closing spring charging motor (see note C)
Q = Main circuit-breaker
Q/1...12 = Circuit-breaker auxiliary contacts
Q60 = Thermomagnetic circuit-breaker for protection of the spring-charging motor (see note F)
R1 = Resistor (not provided with 24V voltage supply)
S27 = Contact for electrical signalling of undervoltage release disabled
S33M/1-2 = Spring charging motor limit contacts
SC = Pushbutton or contact for circuit-breaker closing
SO = Pushbutton or contact for circuit-breaker opening
SO3 = Contact for circuit-breaker opening by means of the YO3 solenoid
TI/L1...L3 = Current transformers located on phases L1-L2-L3 to supply the PR521 microprocessor-based release with power
TI/O = Homopolar current transformer, outside the circuit-breaker and with connections to be made by the customer, for the PR521 microprocessor-based release (see note G)
VR1, VR2 = Rectifiers for the YO1 and YO2 releases supplied in AC
X3...X5 = Connectors of the accessories
XK1 = PR521 microprocessor-based relay current circuit terminal board
XK2, XK3 = PR521 microprocessor-based relay auxiliary circuit connectors
XV = Delivery terminal board of circuit-breaker circuits
YC = Shunt closing release
YO1 = Shunt opening release (see note E)
YO3 = PR512 microprocessor-based relay opening solenoid (for PR512 relay outside the circuit-breaker - see note D)
YU = Instantaneous undervoltage release or with pneumatic time-delay device (see note B)
Z = Filter (only provided with 220 V d.c. power supply voltage)

Description of figures

Fig. 1 = Closing spring charging motor circuit (see note C).
Fig. 2 = Shunt closing release (anti-pumping is mechanical).
Fig. 5 = Instantaneous undervoltage release or with time-delay device (see note B).
Fig. 7 = Shunt opening release circuit with possibility of continuous control of the winding (see note E).
Fig. 9 = Second shunt opening release circuit with possibility of continuous control of the winding (see note E).
Fig. 10 = Opening solenoid for PR512 microprocessor-based relay outside the circuit-breaker see note D).
Fig. 11 = Gas pressure control circuit. It includes the contacts for remote signalling of normal, low and insufficient gas pressure. For the B63 pressure switch intervention values, please see the caption.
Fig. 13 = Gas pressure control circuit. It includes:
– contacts for remote signalling of normal, low and insufficient gas pressure.
– lock on circuit-breaker closing by means of an auxiliary contact of relay K163 in case of insufficient gas pressure.
Select fig. 15 or 16 to make the automatic opening circuit and the

lock in the open position or the circuit for locking the circuit-breaker in the position it is in respectively, in case of insufficient gas pressure.
Provide the same power supply of the circuit of the first shunt opening release (fig. 7).
For the B63 pressure switch intervention values, please see the caption.

Fig. 14 = Gas pressure control circuit. It includes:
- 3 lamps for local indication of normal, low and insufficient gas pressure.
- contacts for remote signalling of normal, low and insufficient gas pressure.
- lock on circuit-breaker closing by means of an auxiliary contact of relay K163 in case of insufficient gas pressure.

Select fig. 15 or 16 to make the automatic opening circuit and the lock in the open position or the circuit for locking the circuit-breaker in the position it is in respectively, in case of insufficient gas pressure.
Provide the same power supply of the circuit of the first shunt opening release (fig. 7).
For the B63 pressure switch intervention values, please see the caption.

Fig. 15 = Circuit for automatic circuit-breaker opening in the case of insufficient gas pressure (only available if fig. 13 or 14 is provided).

Fig. 16 = Circuit for locking circuit-breaker opening in the case of insufficient gas pressure (only available if fig. 13 or 14 is provided).

Fig. 18 = Completion to the first shunt opening release circuit for power supply in a.c. and ≥ 220 V in d.c.

Fig. 19 = Completion to the second shunt opening release circuit for power supply in a.c. and ≥ 220 V in d.c.

Fig. 20 = Contact for electric signalling of undervoltage release disabled

Fig. 21 = Thermomagnetic spring charging motor protection circuit-breaker (see note F).

Fig. 22 = Contact for electrical signalling of springs charged.

Fig. 23 = Contact for electrical signalling of undervoltage release energised (see note B).

Fig. 25 = Contact for electrical signalling of undervoltage release de-energised (see note B).

Fig. 26 = Contact for electrical signalling of motor protection circuit-breaker closed.

Fig. 27 = Contact for electrical signalling of motor protection circuit-breaker open.

Fig. 31 = Set of five available circuit-breaker auxiliary contacts (see note H).

Fig. 32 = Set of ten available circuit-breaker auxiliary contacts (see note H).

Fig. 33 = Set of fifteen available circuit-breaker auxiliary contacts (see note H).

Fig. 41 = PR521 microprocessor-based release auxiliary circuits.

Fig. 42 = PR521 microprocessor-based relay current circuits supplied by two current transformers (can only be used with networks with insulated neutral and negligible earth fault currents).

Fig. 43 = PR521 microprocessor-based relay current circuits supplied by three current transformers.

Fig. 44 = PR521 microprocessor-based relay current circuits supplied by two current transformers and by a homopolar current transformer.

Fig. 45 = PR521 microprocessor-based relay current circuits with protection against earth fault, supplied by three current transformers and (if provided, by the customer) by a homopolar current transformer (see note G).

Incompatibility

The combinations of circuits given in the figures below are not possible on the same c. breaker:

5 - 16	9 - 16	9 - 10
10 - 41	10 - 16 - 12 - 43 - 44 - 45	22 - 23
10 - 16 - 41	11 - 13 - 14	24 - 25
31 - 32 - 33	11 - 15 - 16	26 - 27

Notes

A) The circuit-breaker is only fitted with the accessories listed in the order acknowledgement. To make out the order, please consult the catalogue of the apparatus.

B) The undervoltage release can be supplied in the version for power supply with voltage branched on the supply side of the circuit-breaker or from an independent source.
The use of both the instantaneous and electronic time-delay device undervoltage release is allowed (outside the circuit-breaker).
Circuit-breaker closing is only allowed with the release energised (the lock on closing is achieved mechanically).
On request, the contact in fig. 24 or the one in fig. 25 is available (signalling is permanent).
Should there be the same power supply for the shunt closing and undervoltage releases and automatic circuit-breaker closing on return of the auxiliary voltage is required, it is necessary to introduce a delay of at least 50 ms between the moment of undervoltage release consent and energisation of the shunt closing release. This can be done by means of a circuit outside the circuit-breaker including a permanent closing contact, the contact indicated in fig. 24 and a time-delay relay.

C) Check the power available on the auxiliary circuit to verify the possibility of starting several motors for charging the closing springs at the same time. To avoid excessive absorption, it is necessary to charge the springs manually before supplying the auxiliary circuit with voltage.

D) Please see diagram 401530 for the connections between the circuit-breaker auxiliary circuits and the PR512 relay located in the switchboard.

E) The circuit for controlling continuity of the shunt opening release winding must only be used for this function.
With power supply of less than 220V, connect the “Control Coil Continuity” device or a relay or signalling lamp which absorbs a current not exceeding 20 mA.
With power supply at or higher than 220V, connect a relay or signalling lamp which absorbs a current not exceeding 10 mA.
Other uses jeopardise soundness of the release.

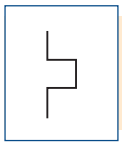
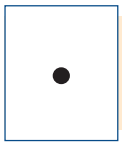
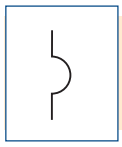
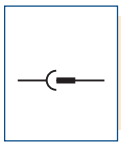
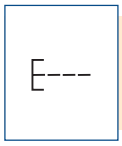
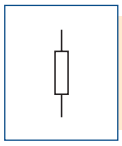
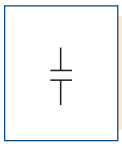
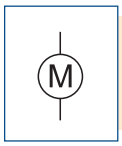
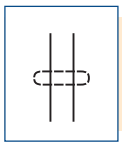
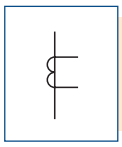
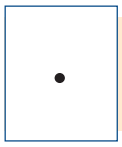
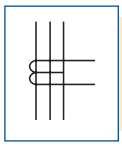
F) The Q60 circuit-breaker in fig. 21 must always be provided when there is a spring-charging motor supplied at 24V d.c. In the case of opening caused by a fault in the motor, it is always necessary to complete spring charging by means of the special handle before carrying out manual resetting.

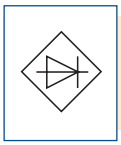
G) If you want to use the TI/O transformer, remove the bridges 24-25-26 of terminal board XV.

H) When fig. 9 is required, contact Q/15 is no longer available for figs. 31-32-33.

ELECTRIC CIRCUIT DIAGRAM

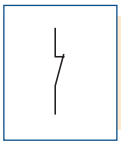
Graphic symbols for electric diagrams

	Thermal effect		Terminal or clamp
	Electromagnetic effect		Socket and plug (female and male)
	Pushbutton control		Resistor (general symbol)
	Earth (general symbol)		Capacitor (general symbol)
	Mass, frame		Motor (general symbol)
	Conductors in shielded cable (e.g. two conductors)		Current transformer
	Conductor connections		Current transformer with wound secondary and primary consists of three through conductors

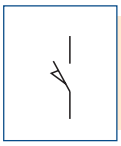


Rectifier with two half-waves

Make contact



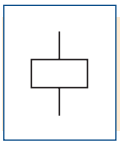
Break contact



Closing position contact (limit switch)

Opening position switch (limit switch)

Circuit-breaker with automatic release



Control coil (general symbol)

Overcurrent relay with adjustable long time delay characteristic

Overcurrent relay with inverse long time delay characteristic

Overcurrent relay with adjustable short time delay characteristic

Instantaneous overcurrent relay

Earth fault overcurrent relay with long adjustable time delay characteristic

Lamp (general symbol)

The data and illustrations are not binding. We reserve the right to make changes in the course of technical development of the product.

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ABB Trasmissione & Distribuzione S.p.A.
Divisione Sace T.M.S.
Via Friuli, 4
I-24044 Dalmine
Tel: +39 035 395111
Fax: +39 035 395874
E-mail: sacetms.tipm@it.abb.com
Internet://www.abb.com

ABB Calor Emag Mittelspannung GmbH
Oberhausener Strasse, 33
D-40472 Ratingen
Tel: +49(0)2102/12-0
Fax: +49(0)2102/12-1777
E-mail: calor.info@de.abb.com
Internet://www.abb.com