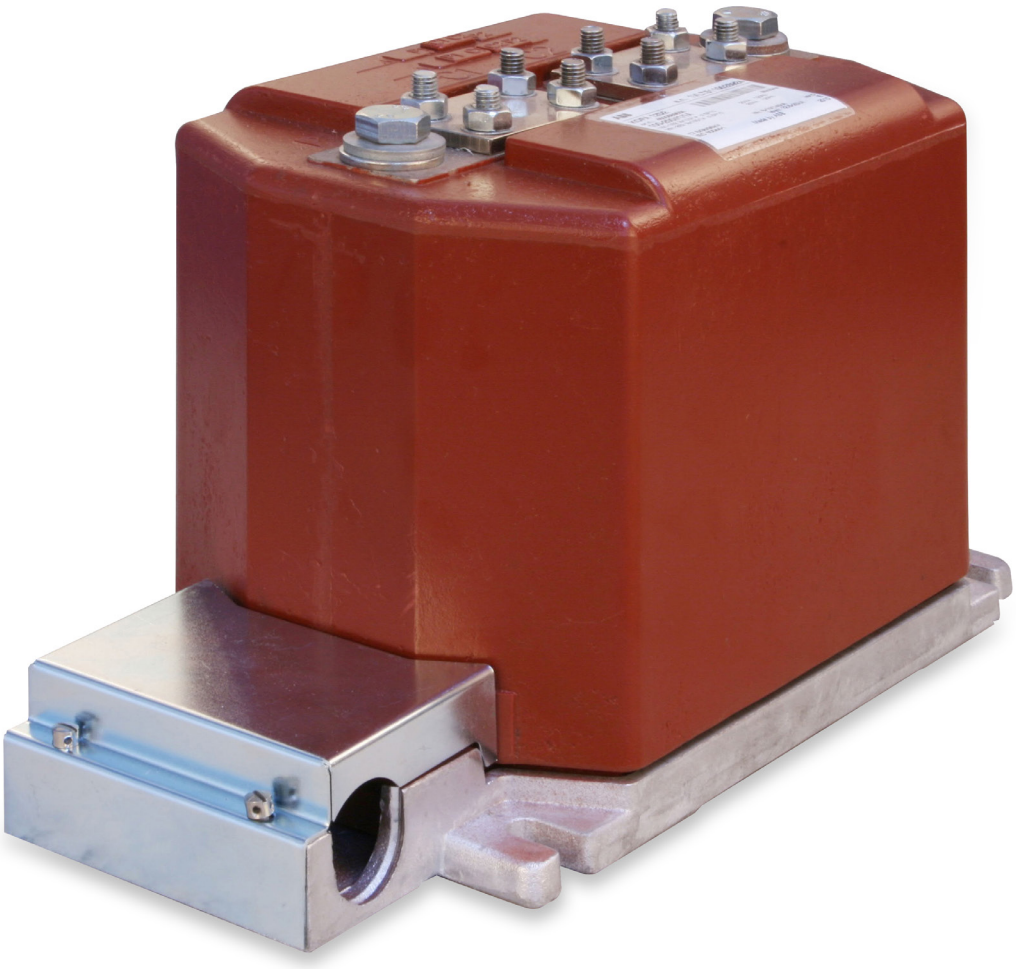
MEDIUM VOLTAGE PRODUCT

KOFA

Indoor current transformers



Technical parameters	Value
Rated frequency	50; 60 Hz
Rated secondary current	5 (1.2) A
Rated burdens	2.5; 5; 7.5; 10; 15 ; 20; 25; 30 VA
Accuracy class	0.2; 0.5; 1; 5P10; 5P20
Mechanical strength of primary terminals	5 kN
Standards other data will be offered on request	IEC, BS, ANSI, ...

Description
The primary winding, core and secondary winding of the transformer are encapsulated in cast-resin.

Secondary conductors
The fixing screws in the light alloy base are positioned within easy reach also from above. The conduit used for the secondary conductors can be fixed into a U-shape slot entry in the secondary terminal box. This design obviates the drawing of the secondary conductor through an entrance hole into the terminal box.When specified on order the box can be provided with a threaded entry for cable termination accessories. One 2.5...10 sq. mm or two 2.5...6 sq. mm (in case of three core transformer one 2.5...6 sq. mm) conductors can be directly connected to the secondary terminals. The terminal cover is sealable. Degree of protection by enclosure is IP 30.

Primary terminals
M12 size screws are used in primary terminals. Primary connection can be changed without removing the already fitted primary conductors.

The transformer specification can in such a case be for example:

Type	KOFA 24 D2
Service voltage	17.5 kV
Test voltages	38 kV 1 min./95 kV impulse

The normal transformer type KOFA 24 D2 would have been suitable if used below 1 000 m.

Permissable torques for screw connections		
M5	max 3.5 Nm	min 2.8 Nm
M8	max 20 Nm	min 16 Nm
M12	max 70 Nm	min 56 Nm

Environment and altitudes
The KOFA transformers are made for indoor mounting. IEC recommandation gives requirement for ambient temperature between -5°C and +40°C. The transformers, however, may be used at a temperature as low as -40°C. The transformers must be protected against unusually heavy deposits of dust or similar pollution, as well as against direct sunshine.

In mountaineous areas the height above sea level may be higher than the height specified in the IEC standards as design criteria (1 000 m). The thin air at high altitudes affects the cooling of the transformers as well as the required creepage & free air distance to earth and between phases. The manufacturer should be consulted in such cases.

The problem with creepage and free air distance can be solved by choosing a transformer type designed for higher voltages. The requirement for impulse test voltage (BIL-level) should preferably NOT be higher than normal for the service voltage used as this may have a negative effect on the available output from the secondaries.

Isulation levels for KOFA models
12/28/75 kV
17.5/38/95 kV
24(25)/50/125 kV

Preferred transformers for 12; 17.5 and 24 kV

Technical data and ordering information

Description for preferred transformers
A limited selection of the KOFA-type current transformers are available as preferred types, which gives two advantages:

1. Having factory documentation and material ready for the most frequent ratings thus offering short delivery times for urgent needs.

2. Simplifying the choice and ordering by giving each standard c.t. a specific order code. On ordering transformers according to the table below please give only the order code, observing the voltage code.

Available preferred current transformers:

Type:	KOFA 12 D 2 for 12 kV KOFA 24 D 2 for 24 kV
Secondary current:	5 A
Number of cores:	2
Weight:	17 and 19 kg
Standards:	International standard IEC 60044-1
Normally not labelled:	R_{ct} (winding resistance at 75°C), U_k (knee-point voltage) and I_o (exciting current).

Example how to order:

Requirements: 6.6 kV, stand. IEC 60044-1
I_{th}/I_{dyn} = 10-20/25-50 kA
100-200/5/5 A
Core 1: 15 VA cl. 0.5, Fs = 5
Core 2: 15 VA cl. 10P10
Frequency: 50Hz
Gives the ordering code:
KOFA 12 D2 - L01

Selection of custom designed transformers

Technical data and ordering information 50 Hz (60 Hz)

Highest system voltage
The transformer design is for 12 kV and 17.5 kV types KOFA 12_ and for 24 kV types KOFA 24_.

Short circuit strength, primary current, core selection symbol
The primary table on page 6 shows the available short circuit strengths and rated primary currents. The table also gives the core selection symbol. The larger the chosen core symbol, the smaller the cores and transformers become in size. In case of transformers with two primary connections the table is applicable for the lower rated current.

At the double rated current the thermal and dynamic strengths are also doubled.

The cores
The core selection tables on page 7 and 8 show how the core size is determined by the chosen core symbol, burden and accuracy. Only the most common accuracy classes and burdens are indicated in the table, the secondary current being 5 A. The core size obtained from the table, decides the size of transformer frame lenghtwise. For both 12 and 24 kV are three different transformer lenghts available: types KOFA _ 1, KOFA _ 2 and KOFA _ 3 which can accommondate number of cores as shown on page 6. **Cantilever strength: 5 kN**

Frequency
The transformers can be manufactured for different frequencies. The tables here are made for 50 Hz. The same tables may be used also for 60 Hz taking into account that the FS-value of measuring cores will be 20 % higher at 60 Hz.

PREFERRED CURRENT TRANSFORMERS, 50 Hz										**Commercial code**
Rated primary current	**Short-circuit strength**		**Core S1**			**Core S2**				
	Short-time current, 1 s	**Surge current**	**Class 0.5**			**Class 5P10**				12 kV 12
[A]	[kA] r.m.s.	[kA] peak		F_s	R_{ct} Ω	VA	R_{ct} Ω	U_k	I_o m	24 kV 24 ▼
50-100	11-22	30-60	15	5	0.16	15	0.07	25.0	145	KOFA _ D2-H01
50-100	20-40	50-100	5	15	0.04	5	0.03	12.0	290	KOFA _ D2-H02
75-150	11-22	30-60	15	5	0.18	15	0.19	34.0	100	KOFA _ D2-J01
75-150	20-40	50-100	15	10	0.14	10	0.05	17.0	195	KOFA _ D2-J02
100-200	11-22	30-60	15	5	0.16	15	0.07	25.0	145	KOFA _ D2-L01
100-200	20-40	50-100	15	5	0.16	15	0.07	25.0	145	KOFA _ D2-L02
150-300	16-32	40-80	15	5	0.18	15	0.28	34.0	100	KOFA _ D2-N01
150-300	27-54	68-136	15	5	0.18	15	0.19	34.0	100	KOFA _ D2-N02
200-400	20-40	50-100	15	5	0.16	15	0.07	25.0	145	KOFA _ D2-R01
200-400	27-54	68-136	15	5	0.16	15	0.07	25.0	145	KOFA _ D2-R02
300-600	26-5	65-13	158		05.1	18	00.2	30	10	KOFA _ D2-S01
400-800	26-5	65-13	154		05.2	11	00.3	35	7	KOFA _ D2-T01

Custom designed transformers
Primary and type selection tables
Selection tables

Primary table 12, 17.5 and 24 kV

1

I_{th}/kA 1 s I_{dyn}/kA peak	Connections for two primary currents					Single ratio	I_{th}/kA 1 s I_{dyn}/kA peak
	6.7-13.4 17-34	11-22 30-60	16-32 40-80	20-40 50-100	27-54 68-136	90 250	
Rated primary current I_{pn}/A	Core selection symbol						Rated primary current I_{pn}/A
						(1) 2 500 (2) 2 000 1 500 1 250	2 500 (only 12 kV) 2 000 1 500 1 250
400-800 300-600					800 600	1 000 800 600	1 000 800 600
250-500 200-400 150-300			800 600	800 600	500 800 600	500 400 300	500 400 300
125-250 100-200 2 75-150	800 750	750 800 600	750 600 450	500 400 300	500 400 300	250 200 150	250 200 150
60-120 50-100 40-80	720 800 640	480 400 320	360 300 240	240 200 160	240 200 160		
30-60 25-50 20-40	480 400 320	240 200 160	180 150 120	120 100			
15-30 10-20	240 160	120					

Max. continuous current

(1) at 12 kV1.0 x 2 500 A

(2) at 24 kV1.2 x 2 000 A

(1) and (2) only with 5 A secondary current

Type selection 12, 17.5 and 24 kV

4

	12, 17.5 kV				24 k V			
	Core size total	No. of cores	Type K O F A	Weight kg	Core size total	No. of cores	Type K O F A	Weight kg
Transformers for two primary current connections	30...71	1 2	12 B 1 12 D 1	11, 2	30...6	1 2	24 B 1 24 D 1	14
	...122	1 2 3	12 B 2 12 D 2 12 F 2	12, 7	...11	1 2 3	24 B 2 24 D 2 24 F 2	19
	...184	1 2 3	12 B 3 12 D 3 12 F 3	24, 2	...17	1 2 3	24 B 3 24 D 3 24 F 3	25
Single ratio transformers	30...140 ...112 (1)	1 2 3	12 A 3 12 C 3 12 E 3	22, 1	30...11	1 2 3	24 A 3 24 C 3 24 E 3	24

(1) for primary currents 2 000 A and 2 500 A

Custom designed transformers
Core selection table 12, 17.5 and 24 kV
Selection tables

Rated burden ▶		2.5 VA		5 VA		7.5 VA		10 VA		3 15 VA		20 VA		25 VA		30 VA	
Selecti-on	Class	Size	Fs <	Size	Fs <	Size	Fs <	Size	Fs <	Size	Fs <	Size	Fs <	Size	Fs <	Size	Fs <
2 500	0.2	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10
	0.5	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10
	1.0	30	30	30	25	30	25	30	20	30	15	30	15	30	15	30	10
	5P10	30		30		30		30		30		30		46		46	
	5P20	30		46		46		46		46		56		56		61	
2 000	0.2	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10
	0.5	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10
	1.0	30	25	30	25	30	20	30	20	30	15	30	15	30	10	30	10
	5P10	30		30		30		30		30		46		46		46	
	5P20	30		46		46		46		56		56		61		72	
1 500	0.2	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10
	0.5	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10
	1.0	30	20	30	20	30	15	30	15	30	10	30	10	30	10	30	10
	5P10	30		30		30		30		46		46		46		56	
	5P20	46		46		46		56		61		72		82		102	
1 250	0.2	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10
	0.5	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10
	1.0	30	25	30	20	30	15	30	15	30	10	30	10	30	10	30	10
	5P10	30		30		30		30		46		46		46		56	
	5P20	46		46		46		56		61		72		92		102	
1 000	0.2	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	5
	0.5	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	5
	1.0	30	20	30	15	30	15	30	10	30	10	30	10	30	10	30	5
	5P10	30		30		46		46		46		56		56		61	
	5P20	46		46		56		61		72		97		107		117	
800	0.2	30	15	30	10	30	10	30	10	30	10	30	10	46	10	46	10
	0.5	30	10	30	10	30	10	30	10	30	10	30	10	30	5	30	5
	1.0	30	20	30	15	30	15	30	10	30	10	30	10	30	5	30	5
	5P10	30		30		46		46		46		56		72		72	
	5P20	46		56		61		72		97		117		122		154	
750	0.2	30	10	30	10	30	10	30	10	30	10	30	10	46	10	46	10
	0.5	30	10	30	10	30	10	30	10	30	10	30	5	30	5	30	5
	1.0	30	20	30	15	30	10	30	10	30	10	30	5	30	5	30	5
	5P10	30		30		46		46		56		56		72		72	
	5P20	46		56		61		72		72		102		117		133	
720	0.2	30	10	30	10	30	10	30	10	46	10	46	10	46	10	46	10
	0.5	30	10	30	10	30	10	30	10	30	10	30	5	30	5	30	5
	1.0	30	20	30	15	30	10	30	10	30	10	30	5	30	5	30	5
	5P10	30		30		46		46		56		61		72		82	
	5P20	46		56		61		72		82		107		122		143	
640	0.2	30	10	30	10	30	10	30	10	46	10	46	10	46	10	56	10
	0.5	30	10	30	10	30	10	30	10	30	10	30	5	30	5	30	5
	1.0	30	15	30	15	30	10	30	10	30	10	30	5	30	5	30	5
	5P10	30		46		46		46		56		61		72		82	
	5P20	46		56		56		72		82		107		128		143	
600	0.2	30	10	30	10	30	10	30	10	46	10	46	10	46	10	56	10
	0.5	30	10	30	10	30	10	30	10	30	10	30	5	30	5	30	5
	1.0	30	15	30	15	30	10	30	10	30	10	30	5	30	5	30	5
	5P10	30		46		46		46		56		72		72		92	
	5P20	46		56		72		82		107		122		154		179	
500	0.2	30	15	30	10	46	10	46	10	46	10	56	10	61	10	72	10
	0.5	30	10	30	10	30	10	30	10	30	5	30	5	46	10	46	5
	1.0	30	15	30	10	30	10	30	10	30	5	30	5	30	5	30	5
	5P10	30		46		46		56		61		72		82		102	
	5P20	56		72		72		82		112		143		169		184	

Custom designed transformers
Core selection table 12, 17.5 and 24 kV
Selection tables

Rated burden ▶		2.5 VA		5 VA		7.5 VA		10 VA		15 VA		20 VA		25 VA		30 VA	
Selecti-on	Class	Size	Fs <	Size	Fs <	Size	Fs <	Size	Fs <	Size	Fs <	Size	Fs <	Size	Fs <	Size	Fs <
480	0.2 0.5 1.0 5P10 5P20	30 30 30 30 46	15 10 15	30 30 30 46 56	10 10 10	46 30 30 46 72	10 10 10	46 30 30 56 82	10 10 10	56 30 30 61 107	10 5 5	56 30 30 72 133	10 5 5	72 46 30 82 163	10 10 5	82 46 30 102	10 5 5
450	0.2 0.5 1.0 5P10 5P20	46 30 30 30 46	15 10 15	30 30 30 46 56	10 10 10	46 30 30 46 72	10 10 10	46 30 30 56 82	10 10 10	61 30 30 61 112	10 5 5	72 46 30 72 143	10 10 5	82 46 30 92 169	10 10 5	97 46 30 102	10 5 5
400	0.2 0.5 1.0 5P10 5P20	46 30 30 30 46	20 10 15	46 30 30 46 56	15 10 10	46 30 30 46 72	10 10 10	61 30 30 56 82	10 10 10	97 46 30 72 117	10 10 5	112 46 30 82 154	10 10 5	154 46 30 97 184	10 5 5	179 56 30 112	10 10 5
360	0.2 0.5 1.0 5P10 5P20	72 30 30 30 46	20 10 15	46 30 30 46 61	15 10 10	56 30 30 46 72	15 10 10	72 30 30 56 97	15 5 5	92 46 30 72 128	15 10 5	102 46 30 92 163	15 10 5	128 56 30 107	15 10 5	143 56 46 122	15 5 5
320	0.2 0.5 1.0 5P10 5P20	61 30 30 30 56	25 10 15	46 30 30 46 61	15 10 10	72 30 30 56 82	15 10 10	92 46 30 56 102	15 10 5	143 46 30 82 143	15 10 5	143 56 30 97 184	15 10 5	163 61 46 117	20 10 5	72 46 133	10 5
300	0.2 0.5 1.0 5P10 5P20	72 30 30 30 46	25 10 15	61 30 30 46 61	15 10 10	82 46 30 56 82	15 10 10	112 46 30 61 107	15 10 5	143 56 30 82 143	20 10 5	154 61 46 102	20 10 5	184 72 46 122	20 10 5	82 46 143	10 5
250	0.2 0.5 1.0 5P10 5P20	107 30 30 46 56	35 10 15	72 46 30 46 82	20 10 10	102 46 30 56 107	20 10 5	133 56 30 72 128	20 10 5	72 46 97	10 5	82 46 122	10 5	102 46	10 5	112 56	10 5
240	0.2 0.5 1.0 5P10 5P20	72 30 30 46 56	40 10 15	82 46 30 46 72	25 10 10	107 46 30 56 102	25 10 5	154 56 30 72 128	25 10 5	82 46 97 179	10 5	97 46 122	10 5	112 56 143	10 5	143 56 174	10 5
200	0.2 0.5 1.0 5P10 5P20	107 30 30 46 56	50 10 15	112 56 30 56 82	35 10 10	72 46 61 112	10 10	102 46 82 143	10 10	56 112	10	72 143	10	82 174	10	102	10
180	0.2 0.5 1.0 5P10 5P20	133 56 30 46 56	60 10 10	154 82 30 56 92	35 10 10	82 46 72 122	15 10	107 46 82 154	15 10	72 117	10	92 154	10	112	10	133	10
160	0.2 0.5 1.0 5P10 5P20	46 30 46 56	15 10	82 46 56 97	15 10	112 46 72	15 10	61 97	10								
150	0.2 0.5 1.0 5P10 5P20	46 30 46 61	15 10	92 46 56 102	15 10	143 56 82	15 10	72 102	10								

Rated burden ▶		2.5 VA		5 VA		7.5 VA		10 VA		15 VA		20 VA		25 VA		30 VA	
Selecti-on	Class	Size	Fs <	Size	Fs <	Size	Fs <	Size	Fs <	Size	Fs <	Size	Fs <	Size	Fs <	Size	Fs <
120	0.2 0.5 1.0 5P10 5P20 10P10 10P20	82 30 46 72 46 72	20 10	154 61 72 122 72 117	20 10	97 97 92	10	133 117	10								
100	0.2 0.5 1.0 5P10 5P20 10P10 10P20	107 72 56 82 46 82	35 15	122 72		122 107											

Example

Requirements: 6.6 kV
100/5/5 A
I_{th} (1 sec) = 10 kA, I_{dyn} = 25 kA

Core 1: 15 VA, class 0.5

Core 2: 15 VA, class 10P10

1. The primary table shows that a transformer having
   I_{pn} = 100-200 A, I_{th} = 11-22 kA and I_{dyn} = 30-60 kA will meet the set requirements for I_{th} and I_{dyn}.

2. Hence the core selection symbol at 100-200 A rated current will be 800. The core sizes are obtained from the core selection table which for core symbol 800 are:

3. Core 1: 15 VA, class 0.5 30
   Core 2: 15 VA, class 5P10 46

   Total 76

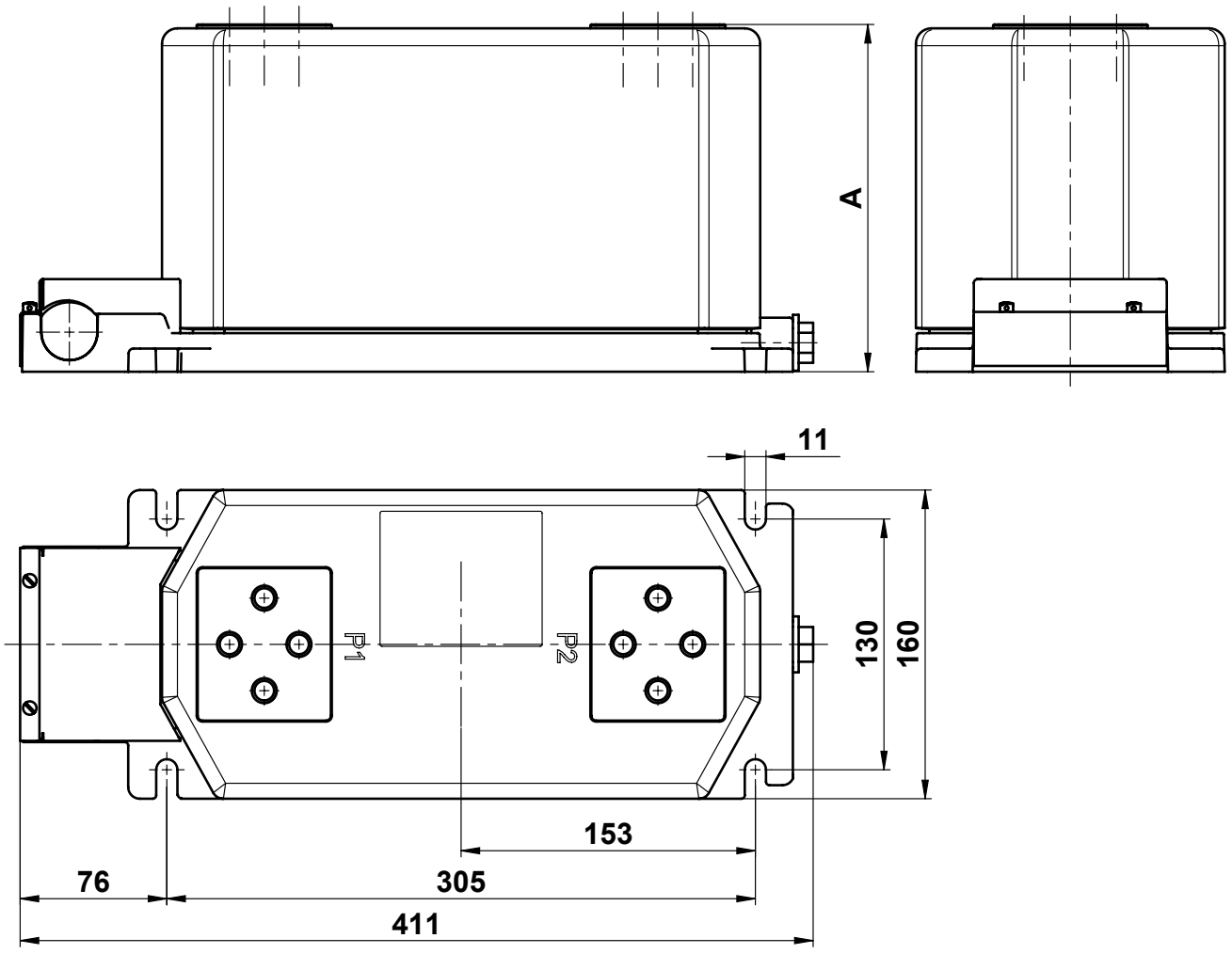
   (5P10 acc. the table gives better accuracy than 10P10)

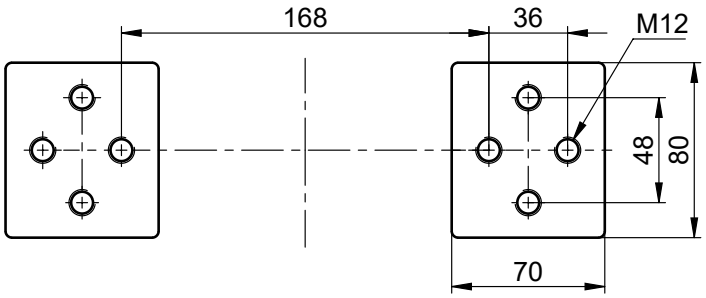
4. 12 kV transformer, type KOFA 12__, will be used at 6.6 kV.

The type selection table gives type KOFA 12 D2 for the transformer size. If the transformer is later connected to a ratio 200/5/5 A the corresponding short circuit strengths are
I_{th} = 22 kA and I_{dyn} = 60 kA. It is not advisable to choose unnecessarily high values for I_{th} (and I_{dyn}). The higher short circuit strength decreases the available burden and increases transformer price.

Dimensional Drawings

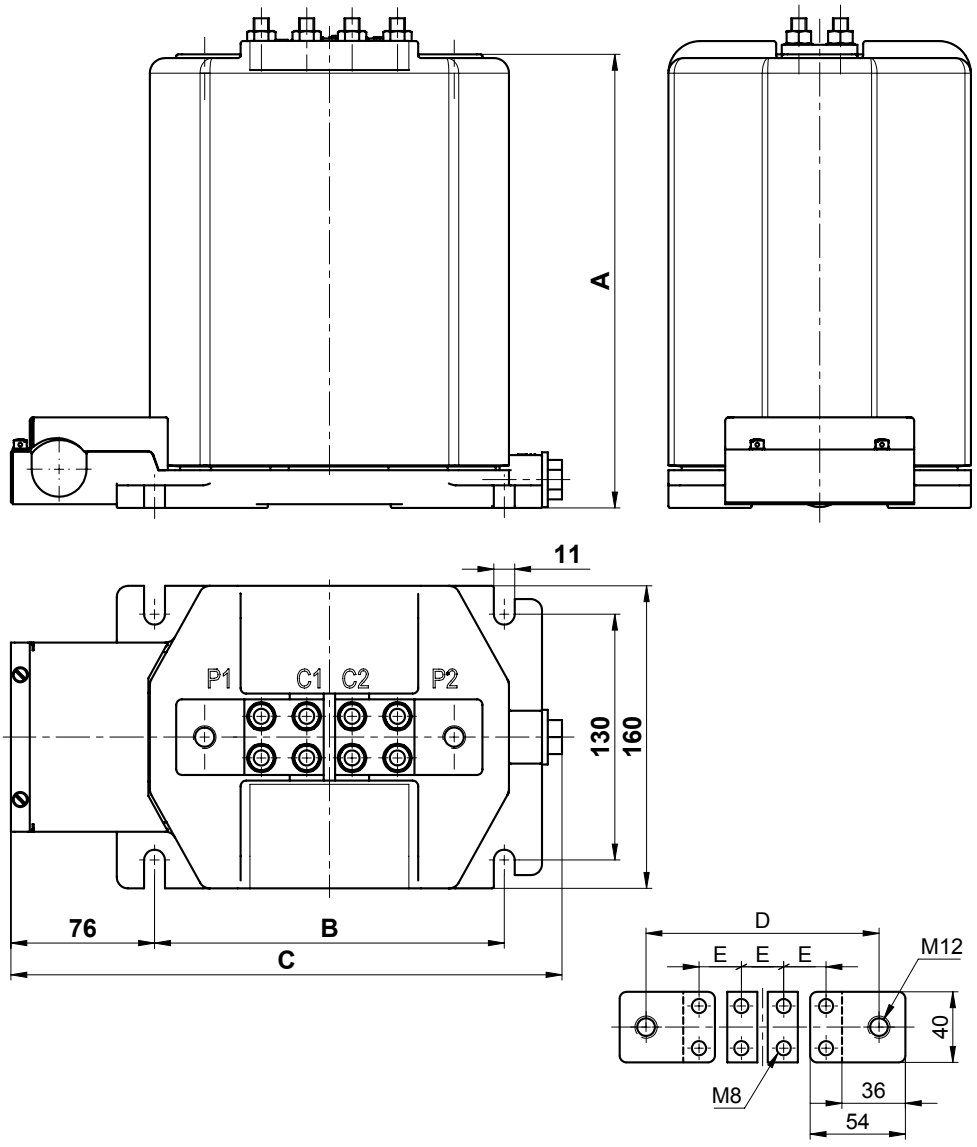
KOFA A, C, E





	KOFA 12 A, C, E	KOFA 24 A, C, E
A [mm]	194	240

KOFA B, D, F



	KOFA 12 B1, D1	KOFA 12 B2, D2, F2	KOFA 12 B3, D3, F3	KOFA 24 B1, D1	KOFA 24 B2, D2, F2	KOFA 24 B3, D3, F3
A [mm]	180	180	180	240	240	240
B [mm]	185	245	305	185	245	305
C [mm]	292	352	412	292	352	412
D [mm]	132	192	252	132	192	252
E [mm]	24	44	64	24	44	64

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