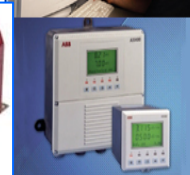


Product presentation

Milos Dvorak
Product manager
CZELS

PPMV Instrument transformers



Instrument transformers

General information

Current transformers

Voltage transformers

Outdoor transformers

Sensors

Application, arguments



ABB CZELS Instrument transformers

Electric values (currents and voltages) in power supply systems are extensive. This is why it is necessary to match the respective currents and voltages to those values which shall be appropriate to the connected measuring, protection and control instrument.



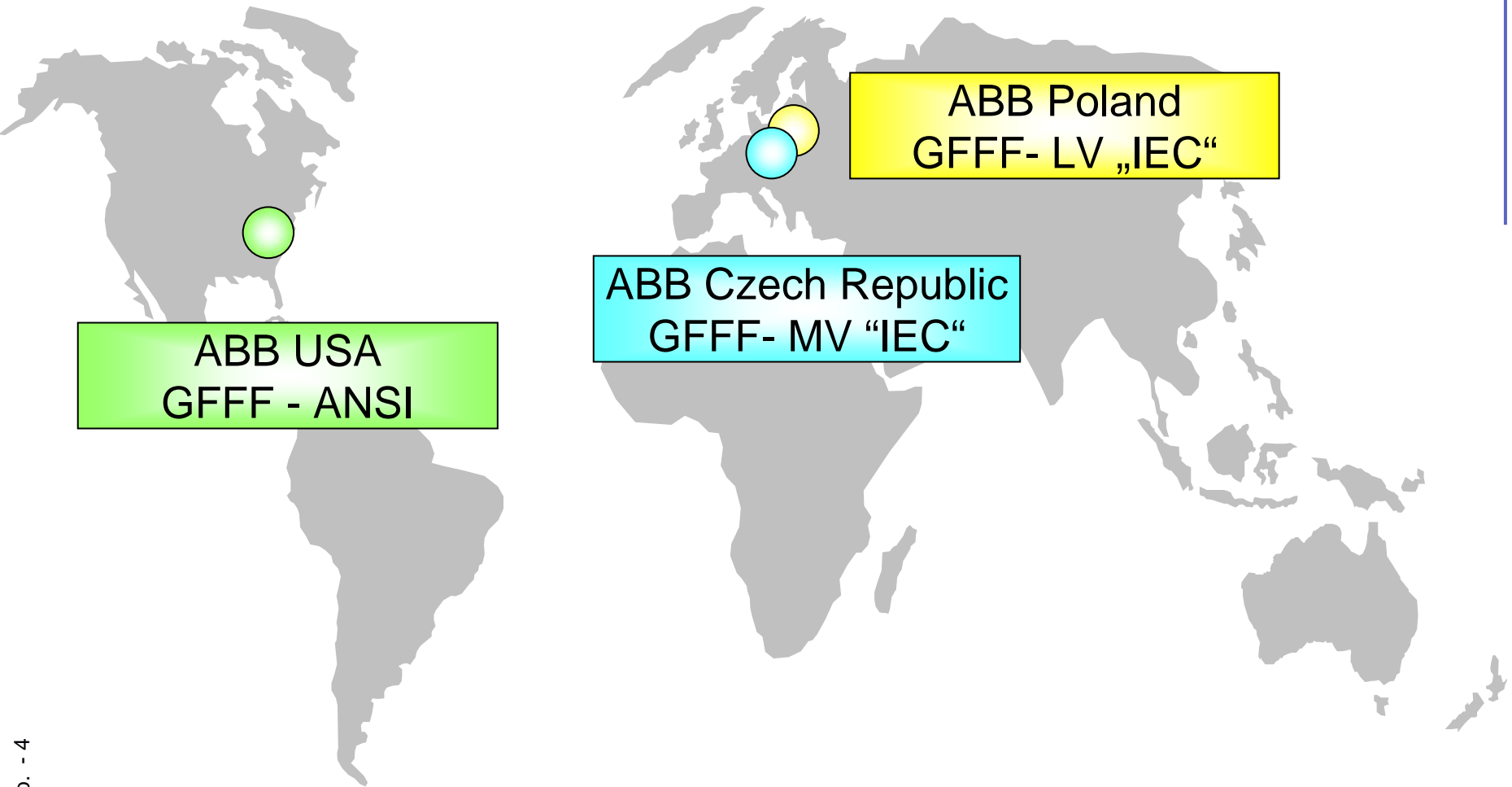
MV Instrument transformers are used for

- **current and voltage measurements**
- **insulation level from 0,72 kV to 40,5 kV**
- **both indoor and outdoor use**

The transformers comply with IEC, DIN, BS, GOST, AS and other standards or with customer specific requirements.



Instrument transformers - product focus



Czech Republic – country in the heart of Europe

- Area: 78,864 km²
- Shares borders with Germany, Poland, Austria, Slovakia
- Length of state border: 2,303 km
- Largest cities: Prague, Brno, Ostrava



Instrument transformers history

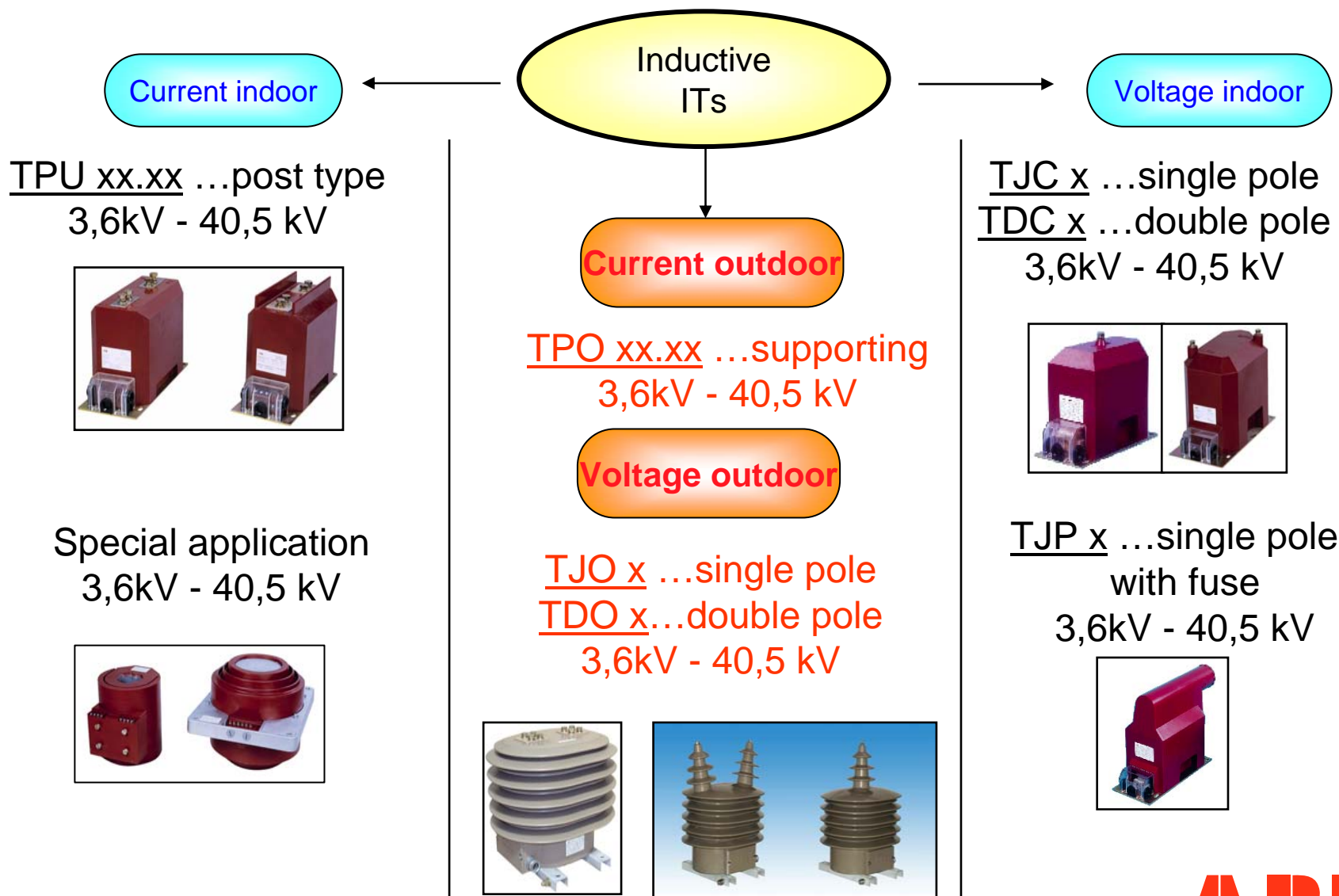
- 1887 Foundation of factory
- 1919 Production of instrument transformers with oil insulation
- 1952 Production of instrument transformers with epoxy insulation
- 1983 Technology of automatic pressured gelation (APG) implemented
- 1993 100% of shares was purchased by Asea Brown Boveri Ltd.
- 1997 New production plant erected, new production technology and testing equipment
- 2002 CZELS was appointed as Global focused feeder factory (GFFF) for both indoor and outdoor MV Instrument transformers up to 40,5 kV
- 2003 CZELS was appointed as Global focused feeder factory (GFFF) for MV Instrument transformers



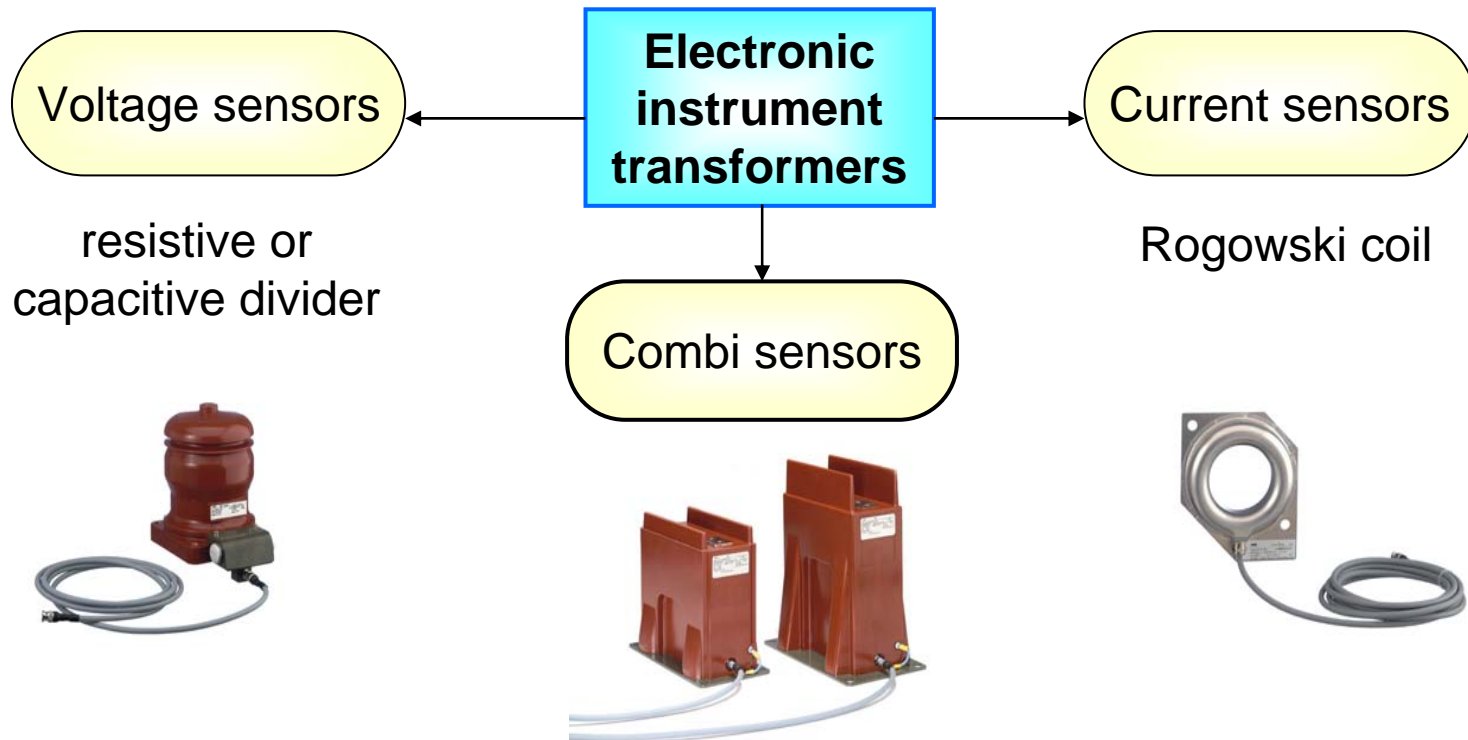
responsibility worldwide

ABB

Inductive Instrument transformers



Electronic Instrument transformers (Sensors)



General application with REF_ – OEM, ..



Special application to ABB switchgear or apparatus



Instrument transformers according to IEC standards

IEC 60044-1...Current transformers

IEC 60044-2...Inductive voltage transformers

IEC 60044-3...Combined transformers

IEC 60044-5...Capacitor voltage transformers

IEC 60044-6...Protective current transformers
for transient performance

IEC 60044-7...Electronic voltage transformers

IEC 60044-8...Electronic current transformers

IEC TC 38 - discussion to change structure of ITs norms



Instrument transformers

General information

Current transformers

Voltage transformers

Outdoor transformers

Sensors

Application, arguments



Current Transformers



- Wide range of types fits to many various applications
- El. ratings provided as per individual client's needs.
- Electrical standards IEC, DIN, BS, GOST, AS.
- Many metrology certificates & approvals available.

Un	.. 40,5 kV
In	.. 8000 A
I _{thn} (1s)	.. 100 kA



Product Overview - Indoor Current ITs

Support (post) type CTs

TPU 4x.xx.....up to 12 kV

TPU 5x.xx.....up to 17,5 kV

TPU 6x.xx.....up to 24 kV

TPU 7x.xx.....up to 36 kV - 40,5 kV

Main line CTs



Bar primary bushing type CTs

TTR 4x.xx..... up to 12 kV

TTR 6x.xx.... up to 24kV

Bus type CTs

KOKS.....up to 17,5 kV

KOKSup to 24 kV



Cable „ring“ core LV type for MV application

KOLMA, KOLA....0,72 kV (in PLZWA)



Special CTs

IP 24.....for circuit breaker (in PLZWA)

KOLT....for power transformers (in PLZWA)



Technical Information – MV CTs

Current transformers (CT) – ratings, wide range of application

Primary (rated) currents **10 A up to 8000 A (In according to CT type)**

Secondary currents..... **1A, 2 A, 5 A**

Frequency **50 or 60 Hz**

Rated short-time thermal current I_{thn} (1sec.)

4;6.3;8;12;16;20;25;31.5;40;50;63;80;100 kA

Highest voltage for equipment **up to 40.5 kV** (1min..10-95 kV, BIL..20-200kV)

Accuracy: measuring winding: **0.1; 0.2; 0.2S; 0.5; 0.5S; 1; 3...**



factor security (FS): **5;10**

protective winding: **5P;10P;....** over current factor : **5;10;15;20**

special classes **PX (IEC 60044-1) - U_K , R_{CT} , I_K**

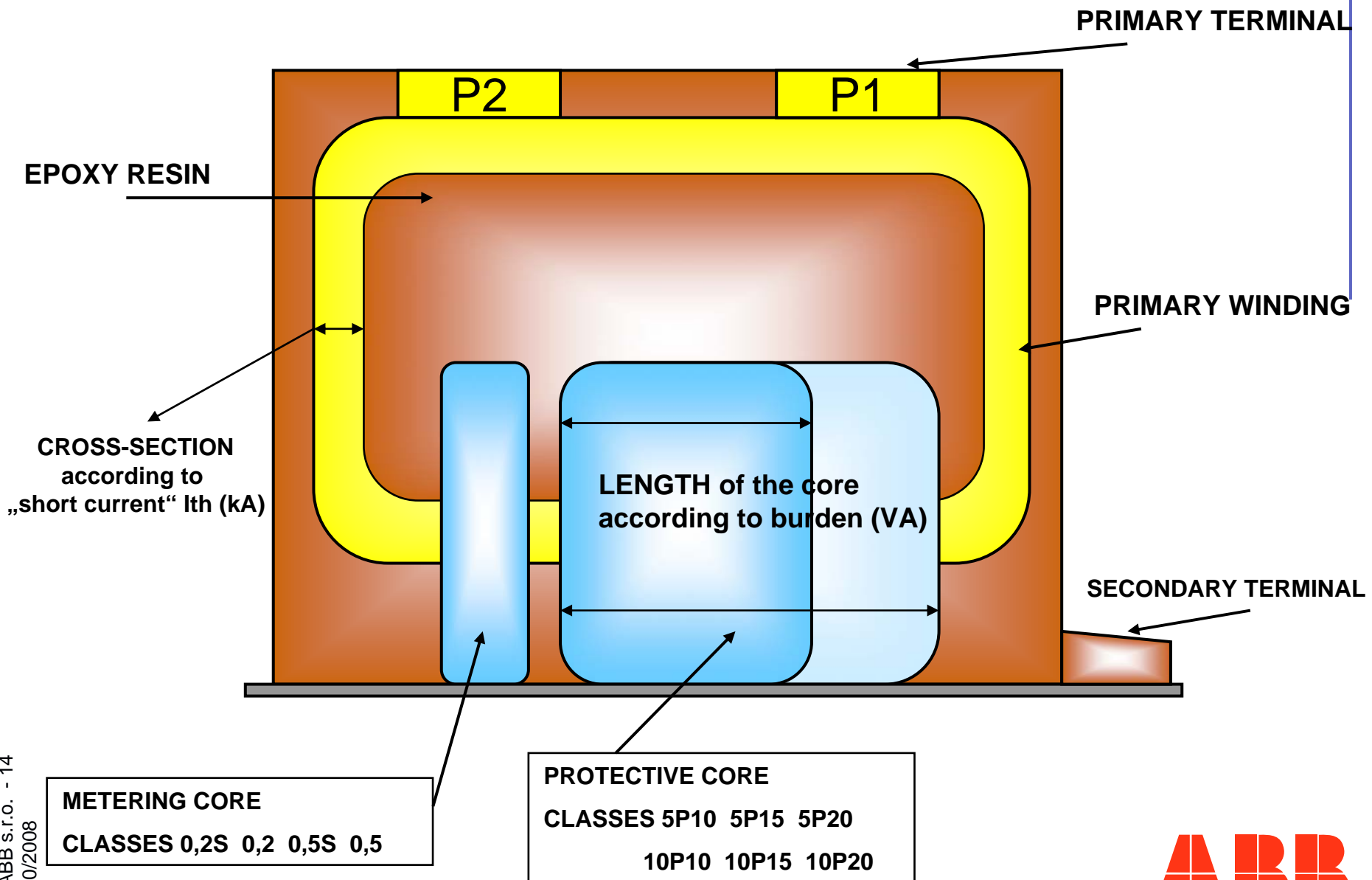
Indoor or outdoor dry type, cast resin insulated, up to 6 secondary windings

Secondary or primary **reconnectable** versions

Electrical standards **IEC, DIN, BS, GOST, AS**, etc.available



Inductive Current transformer



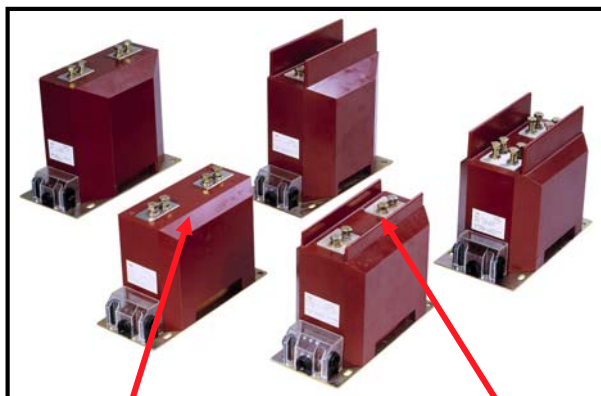
Current transformers TPU xx.xx - 3,6...25kV

Support (post) type current transformer

for MV applications, indoor type

Definition:

A current transformer so arranged that it acts as a support for the conductor in the primary circuit



without ribs

with ribs

Transformer type		TPU 4x.xx	TPU 5x.xx	TPU 6x.xx
Highest voltage for equipment	kV	3,6 7,2 12	13,8 17,5	24 25
Power frequency test voltage	kV	up to 28 kV	up to 42 kV	up to 55 kV
Lighting impuls test voltage	kV	up to 75 kV	up to 95 kV	up to 125 kV
Primary current	A	10 A-3200 A	10 A-3200 A	10 A-3200 A
Rated short time thermal current	kA-1sec	4 kA-100 kA	4 kA-100 kA	4 kA-100 kA
Burden, classes	VA/cl	5-30/0,2-1 5-30/5P..10P..	5-30/0,2-1 5-30/5P..10P..	5-30/0,2-1 5-30/5P..10P..
Secondary terminals		12 terminals (max. 6sec.)	12 terminals (max. 6sec.)	12 terminals (max. 6sec.)
Dimensional standard		DIN (148mm) wide(184mm)	DIN (148mm) wide(184mm)	DIN (178mm)
Electrical standards		IEC, DIN, BS, GOST,ANSI,	IEC, DIN, BS, GOST,ANSI,	IEC, DIN, BS, GOST, ANSI,
Reconnectable (primary 400-800 A)		prim. or sec.	prim. or sec.	prim. or sec.

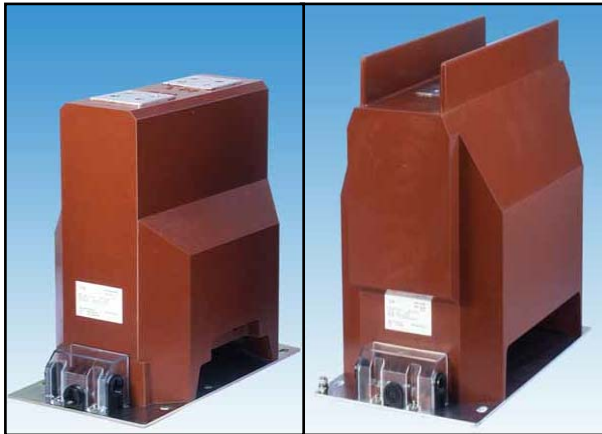
Current transformers TPU xx.xx – 36..40,5 kV

Support (post) type current transformer

for MV applications, indoor type

Definition:

A current transformer so arranged that it acts as a support for the conductor in the primary circuit



TPU 7x.5x

TPU 7x.6x

Transformer type		TPU 7x.5x, TPU 7x.6x
Highest voltage for equipment	kV	36 38,5 40,5
Power frequency test voltage, 1 min.	kV	max 95
Lighting impuls test voltage (BIL)	kV	max 200
Primary current	A	10 A – 2500 A
Rated short – time thermal current	kA (1sec)	4 kA – 100 kA
Burden, classes	VA, cl	5-30/0,2-1 5-30/5P..-10P..
Secondary terminals		12 terminals.... max. 6 sec.
Dimensional standard		Non standard
Electrical standards		IEC, DIN, BS, GOST, ANSI,..
Reconnectable (primary till 400-800 A)		prim. or sec.

Current transformers TTR xx.xx - 3,6...25kV

Bar primary bushing type current transformer

for MV applications, indoor

Definition:

A current transformer with bar primary conductor so constructed that it can be used as a bushing



TTR 6x.xx

Transformer type		TTR 4x.xx	TTR 6x.xx
Highest voltage for equipment	kV	3,6 7,2 12	17,5 24 25
Power frequency test voltage, 1 min.	kV	max 28	max 55
Lighting impuls test voltage (BIL)	kV	max 75	max 125
Primary current	A	100, 200, 300, 400, 500, 600, 750, 1000, 1250, 1500, 2000, 2500	
Rated short – time thermal current	kA (1sec)	50 63 80 100	
Burden, classes	VA, cl	5-30/0,2-1	5-30/5P..-10P..
Secondary terminals		4 terminals.... max. 2 sec.	
Dimensional standard		Non standard	
Electrical standards		IEC, DIN, BS, GOST, ANSI,..	
Reconnectable		Secondary – 1 winding only	

Current transformers BB - 3,6...25 kV

Bushing type current transformer

for MV applications, indoor

Definition:

A current transformer without primary conductor, but with primary insulation of its own which can be used as a bushing



Transformer type		BB 103	BB 104 (BBO)	BB 223
Highest voltage for equipment	kV	3,6 7,2 12	3,6 7,2 12	17,5 24 25
Power frequency test volt. 1 min.	kV	up to 28 kV	up to 28 kV	up to 55 kV
Lighting impuls test voltage (BIL)	kV	up to 75 kV	up to 75 kV	up to 125 kV
Primary current	A	max 4000 A	max 5000 A	max 4000 A
Rated short – time thermal current	kA (1sec)	max 63	max 63	max 63
Burden, classes	VA, cl	5-60/0,2-1 5-60/5P..- 10P..	5-60/0,2-1 5-60/5P..- 10P..	5-60/0,2-1 5-60/5P..- 10P..
Secondary terminals		4 terminals... (max. 2 sec.)	6 terminals... (max. 3 sec.)	4 terminals... (max. 2 sec.)
Dimensional standard		Non standard	Non standard	Non standard
Electrical standards		IEC, DIN, BS, GOST, ANSI,..	IEC, DIN, BS, GOST, ANSI,..	IEC, DIN, BS, GOST, ANSI,..
Reconnectable		secondary	secondary	secondary

Current transformers KOKS - 3,6...24 kV

Bus type current transformer

for MV applications,
indoor

Definition:

A current transformer without primary conductor, but with primary insulation, which can be fitted directly over a conductor or busbar



KOKS 12
KOKS 17,5

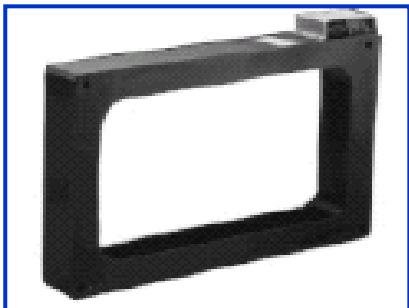
KOKS 24

Transformer type		KOKS 12	KOKS 17,5	KOKS 24
Highest voltage for equipment	kV	12	17,5	up to 24
Power frequency test voltage, 1 min.	kV	28	42	max 50
Lighting impuls test voltage (BIL)	kV	75	95	max 125
Primary current	A	1000, 1250, 1500, 2000, 3000, 4000, (5000, 6000, 7000, 8000-KOKS 24 only)		
Rated short – time thermal current	kA (1sec)	up to 100xIn		
Burden, classes	VA, cl	5-30/0,2-1	5-30/5P..-10P..	
Secondary terminals		8 terminals.... max. 4 sec.		
Dimensional standard		Non standard		
Electrical standards		IEC, DIN, BS, GOST, ANSI,..		
Reconnectable		Secondary		

LV Cable Current Transformers for MV applicatin (in PLZWA)

type KOKM 06 J

WINDOW TYPE

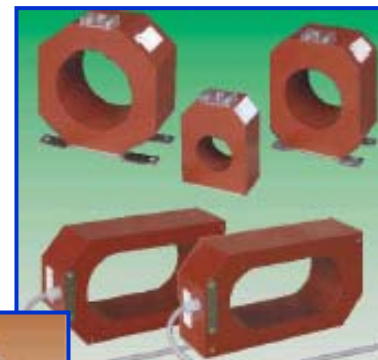


- Voltage system 0.72 kV
- Rated primary current: $I_{pn} = 50$ up to 2000 A
- Rated secondary current: $I_{sn} = 1$ or 5 A
- Mainly for protection (10P; 5P)
- Number of cores: 1
- Window size 300×200 mm 650×450 mm

KOKM / KOLA / KOLMA

For medium voltage systems

- Wide range of products (standard and customer's designed)
- Indoor application
- Intended for ABB and OEM's MV panels
- For AIS and GIS

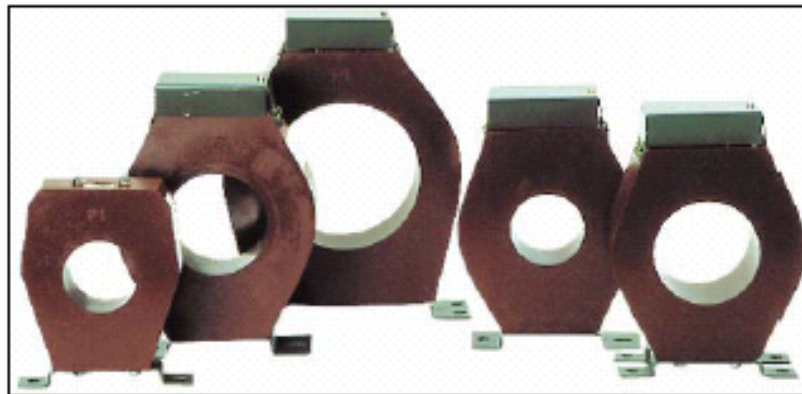


KOKM – indoor type

KOKU – outdoor type

CUSTOMER DESIGNED

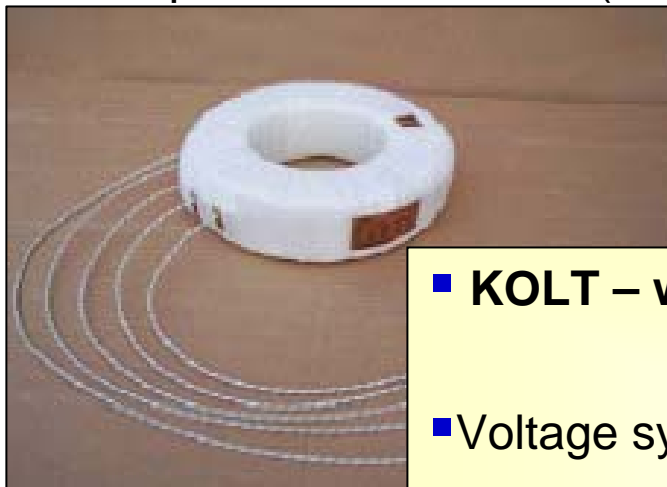
- Voltage system 1.2 kV
- Rated primary current: I_{pn} = up to 10 000 A
- Rated secondary current: I_{sn} = 1 or 5 A
- All accuracy classes for measurement and protection
- Number of cores: up to 4;
- ID \varnothing 33 - 500 mm



LV Instrument transformers – special applications (in PLZWA)

New designed products

- For power transformers (KOLT); full range of products (cast resin and uncasted)



■ **KOLT – without casting** **KOMSH – epoxy cast resin**

- Voltage system 1.2 kV
- Rated primary current: I_{pn} = up to 15 000 A
- Rated secondary current: I_{sn} = 1 or 5 A
- For protection and measurement
- Number of cores: up to 6; ID \varnothing 105 -600 mm



Instrument transformers

General information

Current transformers

Voltage transformers

Outdoor transformers

Sensors

Application, arguments



Voltage Transformers



- For fixed and withdrawable solutions
- Single and double pole versions
- Special types for supply of aux. power.
- Electrical standards IEC, DIN, BS, GOST, AS.
- Many metrology certificates & approvals available.

Un	.. 40,5 kV
Pn	.. 2000 VA
	.. 3 secondaries



Product Overview - Indoor Voltage ITs

Single pole insulated VTs

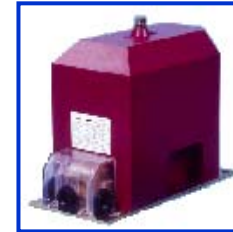
TJC 4 up to 12 kV

TJC 5 up to 17,5 kV

TJC 6 up to 24 kV

TJC 7 or 7.1..up to 36 kV - 40,5 kV

Main line VTs



Single pole insulated VTs with fuses

TJP 4.x up to 12 kV

TJP 5.x up to 17,5 kV

TJP 6.x up to 24 kV

TJP 7.1 or 7.2..up to 36 kV - 40,5 kV

Double pole insulated VTs

TDC 4 up to 12 kV

TDC 5 up to 17,5 kV

TDC 6 up to 24 kV

TDC 7.....up to 36 kV

Technical Information – MV VTs

Voltage transformers (VT) – ratings, wide range of application

Main primary (rated) voltages U_n ..3;6;10;15;20;30;33;35kV
(phase to earth $U_n/\sqrt{3}$)

Secondary voltages...100;110;100/ $\sqrt{3}$;110/ $\sqrt{3}$;100/3;110/3 V

Frequency 50 or 60 Hz

Highest voltage for equipment

3.6 kV up to 40.5 kV(1min..10-95 kV, BIL..20-200kV)

Accuracy class: measuring winding 0.1;0.2;0.5;1

protective winding 3P;6P

auxiliary winding 6P



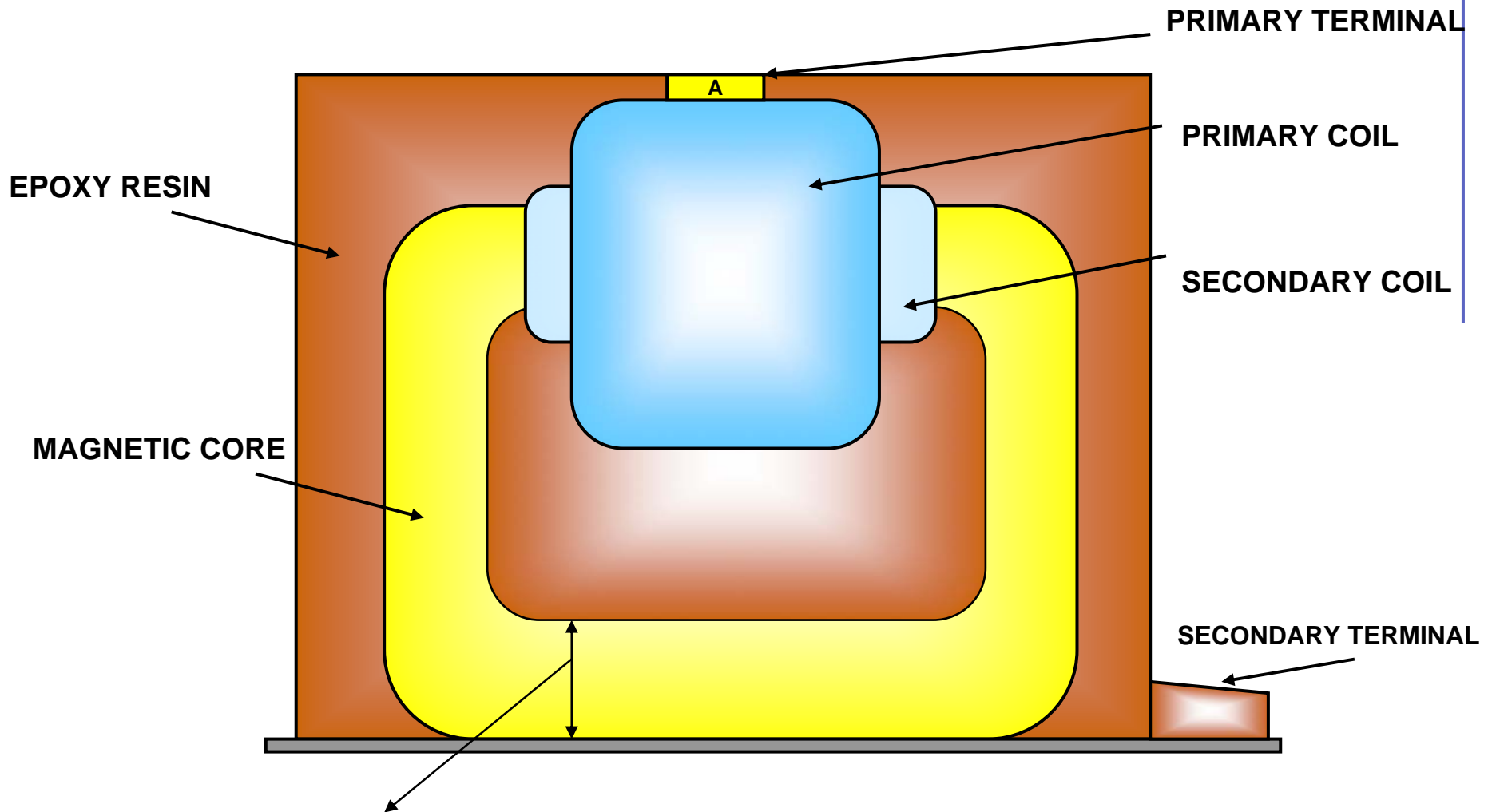
Indoor or outdoor dry type, cast resin insulated, **up to 3 secondary** windings

Secondary **reconnectable** versions

Electrical standards **IEC, DIN, BS, GOST, AS**, etc.available

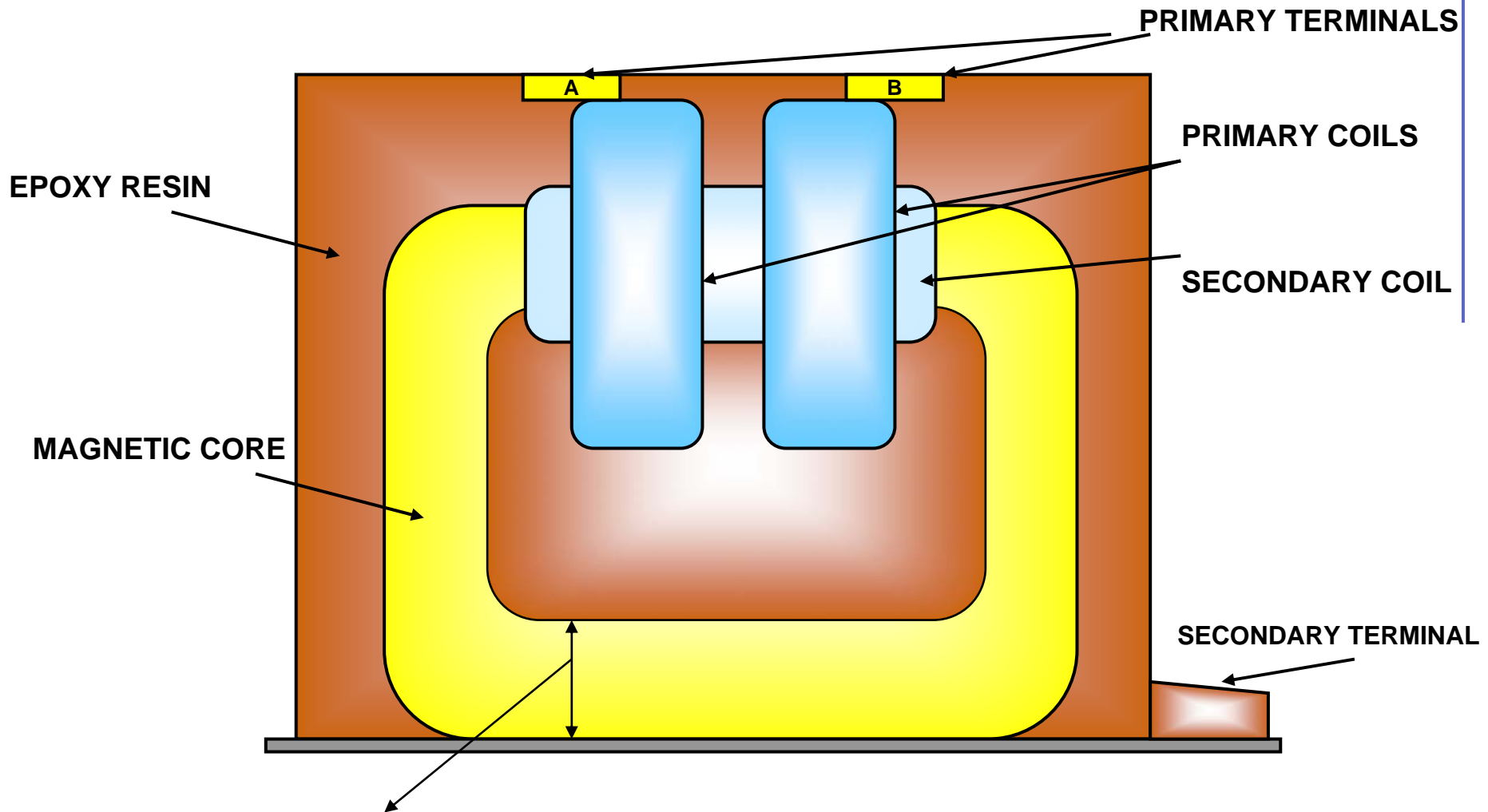


Inductive Voltage transformer



CROSS-SECTION of the core
-important for max. nominal burden
(VA)
and classes 0,2, 0,5 1 3P 6P

Inductive Voltage transformer



CROSS-SECTION of the core
-important for max. nominal burden
(VA)
and classes 0,2, 0,5 1 3P 6P

Voltage transformers TJC x,TJP x.x - 3,6...25kV

Earthed voltage transformer (single pole or one pole insulated)

for MV applications, indoor type

Definition:

A single phase voltage transformer which is intended to have one end of its primary winding directly earthed



TJP 4.1



TJC 6

Transformer type without fuse with fuse holder		TJC 4 TJP 4.x	TJC 5 TJP 5.x	TJC 6 TJP 6.x
Highest voltage for equipment	kV	3,6 7,2 12	13,8 17,5	24 25
Rated voltage	kV	3/V3 6/V3 10/V3	11/V3 15/V3	20/V3 22/V3
Power frequency test voltage, 1 min.	kV	up to 28	up to 38	up to 50
Lighting impuls test voltage (BIL)	kV	up to 75	up to 95	up to 125
Max. rated burden/classes	VA, cl	20/0,2 50/0,5 100/1	20/0,2 50/0,5 100/1	30/0,2 75/0,5 120/1
Residual winding	VA, cl	50 – 200/6P	50 – 200/6P	50 – 200/6P
Secondary winding		2	2	2
Dimensional standard		DIN	DIN	DIN
Electrical standards		IEC,BS, GOST,..	IEC,BS, GOST,..	IEC,BS, GOST,..

Voltage transformers TJC x, TJP x.x - 36...40,5 kV

Earthed voltage transformer (single pole or one pole insulated)

for MV applications, indoor type

Definition:

A single phase voltage transformer which is intended to have one end of its primary winding directly earthed



TJC 7



TJP 7.1

Transformer type		TJC 7 TJC 7.1	TJP 7.1 TJP 7.2
Highest voltage for equipment	kV	36 38,5 40,5	36 38,5
Rated voltage	kV	30/V3,33/V3 35/V3	30/V3,33/V3 35/V3
Power frequency test voltage, 1 min.	kV	max 95	max 80
Lighting impuls test voltage (BIL)	kV	max 200	max 180
Max. rated burden/classes	VA, cl	50/0,2 150/0,5 250/1	30/0,2 75/0,5 150/1
Residual winding	VA, cl	50 – 200/6P	50 – 200/6P
Secondary winding		2	2
Dimensional standard		non standard	non standard
Electrical standards		IEC,BS, GOST,..	IEC,BS, GOST,..

Voltage transformers TDC x - 3,6...25kV

**Unearthed voltage
transformer
(double pole
or two pole insulated)**

for MV applications, indoor type

Definition:

A voltage transformer which has all parts of its primary winding, including terminals, insulated from the earth at a level corresponding to its rated insulation level



TDC 6

Transformer type		TDC 4	TDC 5	TDC 6
Highest voltage for equipment	kV	3,6 7,2 12	13,8 17,5	24 25
Rated voltage	kV	3 6 10	11 15	20 22
Power frequency test voltage, 1 min.	kV	up to 28	up to 38	up to 50
Lighting impuls test voltage (BIL)	kV	up to 75	up to 95	up to 125
Max. rated burden/classes	VA, cl	20/0,2 50/0,5 100/1	20/0,2 50/0,5 100/1	30/0,2 75/0,5 120/1
Secondary winding		2	2	2
Dimensional standard		DIN	DIN	DIN
Electrical standards		IEC,BS, GOST,..	IEC,BS, GOST,..	IEC,BS, GOST,..

Voltage transformers TDC x, KGUG - 36...40,5 kV

Unearthed voltage transformer (double pole or two pole insulated transformer)

for MV applications

Definition:

A voltage transformer which has all parts of its primary winding, including terminals, insulated from the earth at a level corresponding to its rated insulation level



TDC 7



KGUG

Transformer type		TDC 7	KGUG
Highest voltage for equipment	kV	36 40,5	24 36
Rated voltage	kV	30 33 35	20 30 35
Power frequency test voltage, 1 min.	kV	max 80	up to 70 kV
Lighting impuls test voltage (BIL)	kV	max 180	up to 170 kV
Max. rated burden/classes	VA, cl	50/0,2 150/0,5 250/1	80/0,2 300/0,5 600/1
Secondary winding		2 secondary w.	2 secondary w.
Dimensional standard		no	no
Electrical standards		IEC,BS,GOST,..	IEC,BS,GOST,..

Instrument transformers

General information

Current transformers

Voltage transformers



Outdoor transformers



Sensors

Application, arguments

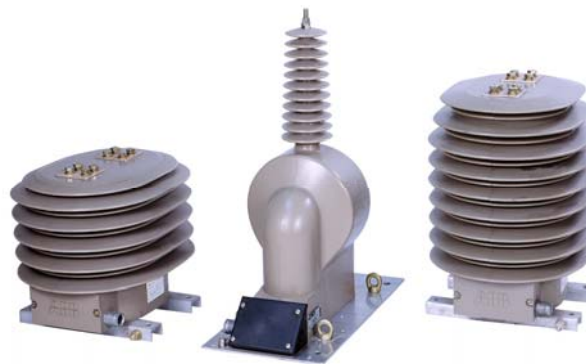


Outdoor Instrument Transformers



- El. ratings provided as per individual client's needs.
- Advanced epoxy resin material – HCEP
- VTs – single and double pole
- Electrical standards IEC, DIN, BS, GOST, AS.
- Many metrology certificates & approvals available.

Un	.. 40,5 kV
In	.. 2500 A
I _{thn} (1s)	.. 100 kA



Main line outdoor current transformers TPO xx.xx

Outdoor current transformer

for MV applications

Definition:

Current transformer which can be used under outdoor service conditions (ambient air temperature, humidity, pollution,...)



TPO 6x.xx



TPO 7x.xx

Transformer type		TPO 6x.xx	TPO 7x.xx
Highest voltage for equipment	kV	12 17,5 24 25	36 38,5 40,5
Power frequency test volt., 1 min.	kV	max 55	max 95
Lighting impuls test voltage (BIL)	kV	max 125	max 200
Primary current	A	10 A – 2500 A	
Rated short – time thermal current	kA (1sec)	4 kA – 100 kA	
Burden, classes	VA, cl	5-30/0,2-1 5-30/5P..-10P..	
Secondary terminals		8 terminals.... max. 4 sec.	
Dimensional standard		Non standard	
Electrical standards		IEC, DIN, BS, GOST, ANSI,..	
Reconnectable (primary till 600-1200 A)		prim. or sec.	

Main line outdoor voltage transformers TJO 6, TDO 6

Outdoor voltage transformers

for MV applications

Definition:

Voltage transformers which can be used under outdoor service conditions (ambient air temperature, humidity, pollution,...)



TDO 6

TJO 6

Transf. type-single pole -double pole		TJO 6 TDO 6
Highest voltage for equipment	kV	12 17,5 24 25
Rated voltage single pole double pole	kV	10/V3, 13,8/V3, 15/V3 20/V3 22/V3 10 13,8 15 20 22
Power frequency test voltage, 1 min.	kV	max 55
Lighting impuls test voltage (BIL)	kV	max 125
Max. rated burden/classes	VA, cl	50/0,2 150/0,5 250/1
Residual winding (for single pole VTs only)	VA, cl	50 – 200/6P
Secondary terminals		max. 3 secondaries
Dimensional standard		Non standard
Electrical standards		IEC, DIN, BS, GOST, ANSI,...

Main line outdoor voltage transformer TJO 7

Outdoor voltage transformer

for MV applications

Definition:

Voltage transformer which can be used under outdoor service conditions (ambient air temperature, humidity, pollution,...)



Transformer type—single pole		TJO 7
Highest voltage for equipment	kV	36 38,5 40,5
Rated voltage	kV	30/V3 33/V3 35/V3
Power frequency test voltage, 1 min.	kV	max 95
Lighting impuls test voltage (BIL)	kV	max 200
Max. rated burden/classes	VA, cl	50/0,2 150/0,5 250/1
Residual winding	VA, cl	50 – 200/6P
Secondary terminals		max. 3 secondaries
Dimensional standard		Non standard
Electrical standards		IEC, DIN, BS, GOST, ANSI,...

Instrument transformers

General information

Current transformers

Voltage transformers



Outdoor transformers

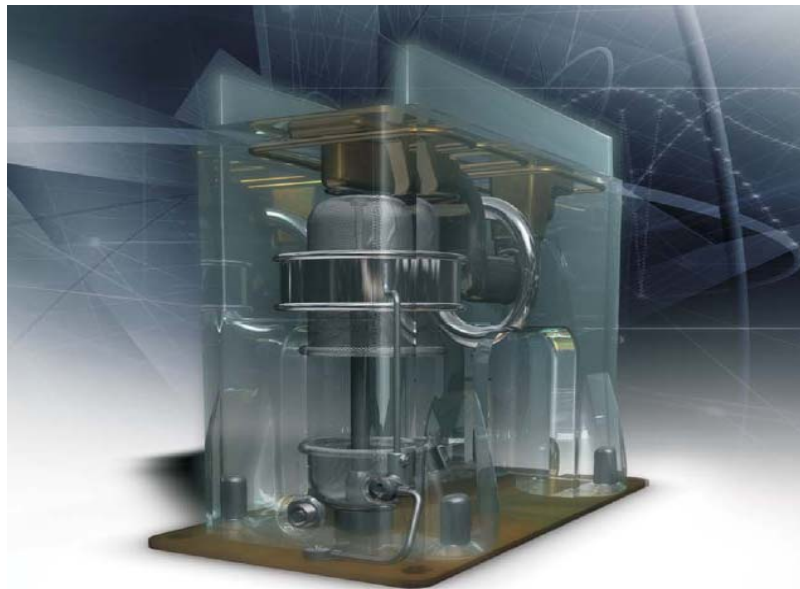


Sensors

Application, arguments



Sensors ...Electronic instrument transformers



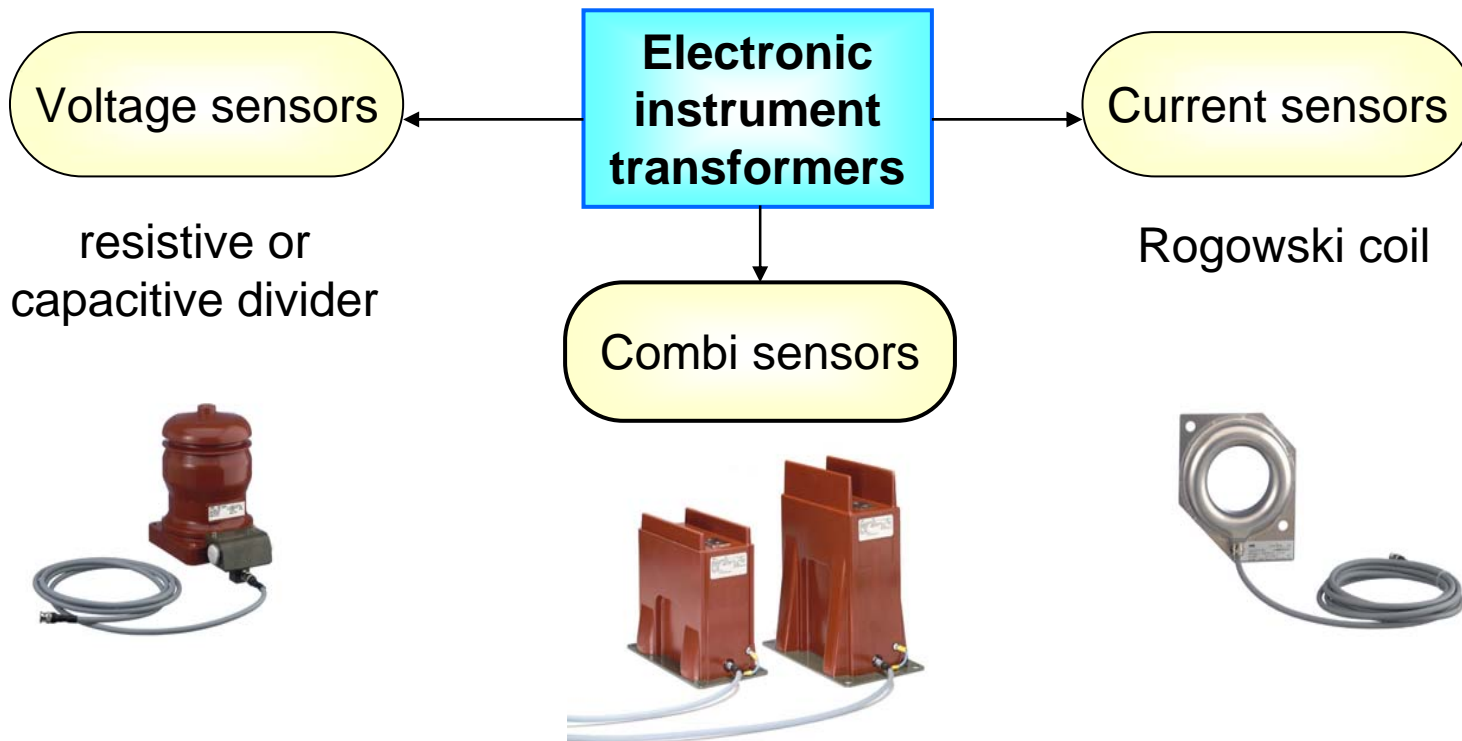
*Advanced technology for
Integrated Solutions!*

Un	.. 24 kV
In	.. 3200 A
I _{thn} (1s)	.. 63 kA

- KEVCD types easily fit into OEMs' panels (DIN42600)
- Both protection and metering done with one double rated sec. winding
- One single standard sensor for wide range of currents and voltages.
- Comply with IEC 60044-3,7,8 (Combi, I, U Sensors)



Sensors ...Electronic instrument transformers



General application with REF_ – OEM, ..



Special application to ABB switchgear or apparatus



Instrument transformers according to IEC standards

IEC 60044-1...Current transformers

IEC 60044-2...Inductive voltage transformers

IEC 60044-3...Combined transformers

IEC 60044-5...Capacitor voltage transformers

IEC 60044-6...Protective current transformers
for transient performance

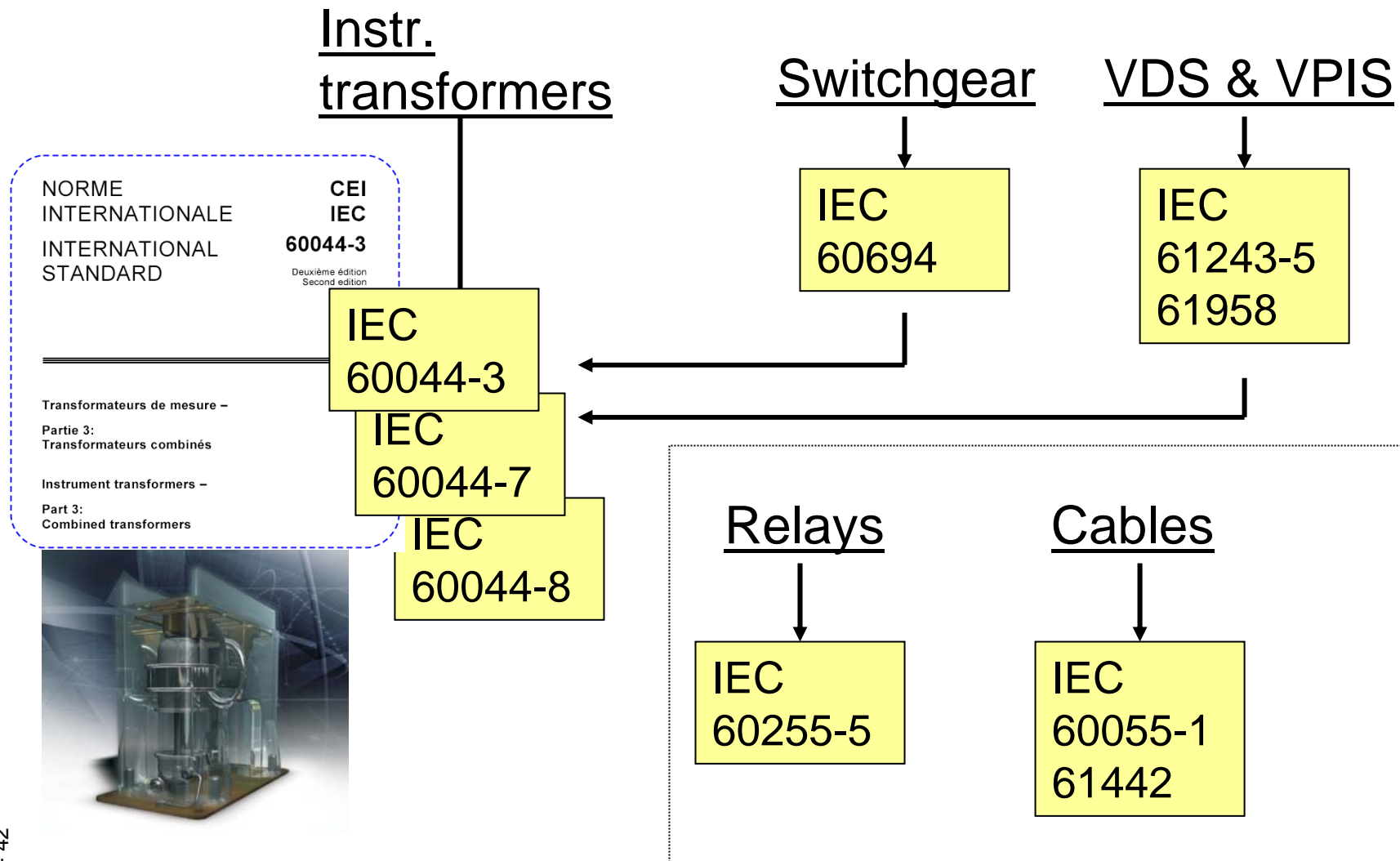
IEC 60044-7...Electronic voltage transformers

IEC 60044-8...Electronic current transformers

IEC TC 38 - discussion to change structure of ITs norms



Related standards to electronic instrument transformers



Standards:



Accessories - Adapters



Sensor



Cable



Adapter



IED

The adapter enables to utilize the full functionality of sensor + relay system. The adapter is adjusting sensor output signal to the level suitable for different applications of IED.

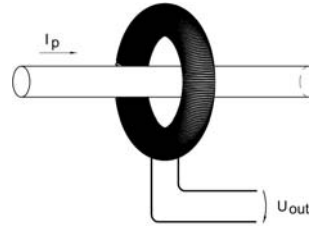
The criterion of selection is based on the system current:

- No adapter: $I_r = 80 - 160 \text{ A}$
- Adapter 240A/150mV: $I_r = 160 - 480 \text{ A}$
- Adapter 640A/150mV: $I_r = 480 - 1250 \text{ A}$

Current Sensors



KECA 80 A1
KECA 300 A1
KECA 800 A1



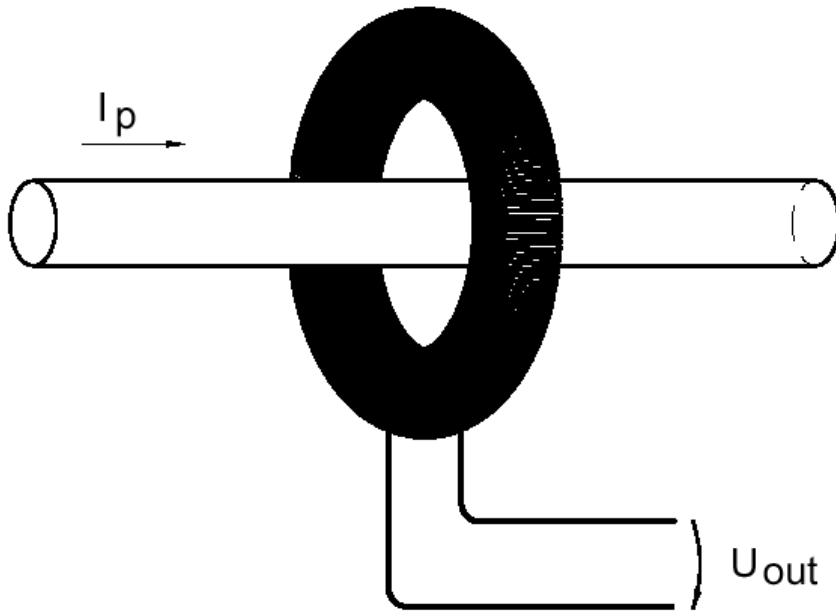
$$u_{out} = M \frac{di_p}{dt}$$



KECR 17,5 AC1

- Uniformly wound coil with **non-magnetic core**
- Output signal is proportional to the derivate of primary current
- IEC 60044-8
- Nominal primary current
KECA 80, 300 or 800 A
KECR 180 A
- Current sensor cl. 1.0

Current sensor principle: Rogowski coil



■ **ABB** Rogowski

- $U_{\text{nominal}} = 0,150\text{V (50Hz)}$
- $I_{\text{nominal}} = 80\text{A}$
- $Z_{\text{input}} = >4\text{M}\Omega$

■ Safe

- $U_{\text{output@50kA}} = 94\text{V}$
- $P = U^2/R = 5,6 \times 10^{-9}\text{ W}$

$$u_{\text{out}} = M \frac{di_p}{dt}$$

$$\underline{U}_{\text{out}} = M \cdot j \cdot \omega \cdot \underline{I}_p$$

Rated current: KEVCD current range calculation

Example: Combination suitable for 200 A, 50 Hz switchgear:

Adapter	Transm. ratio	Us at Ip = 0,05x200 A	Ip at Us = 7,5 V
No adapter	80 A / 0,150 V	18,8 mV (OK)	4 000 A (Too small)
Adapter 1	240 A / 0,150 V	6,3 mV (OK)	12 000 A (OK)
Adapter 2	640 A / 0,150 V	2,3 mV (Too small)	32 000 A (OK)

Sensor

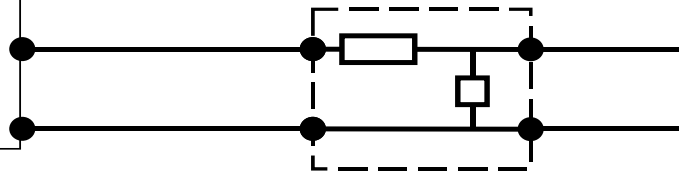
$I_{pr} =$
80-1250 A

Adapter

REF 542+ :

$U_{smax} = 7,5 \text{ V}$

$U_{smin} = 5 \text{ mV}$

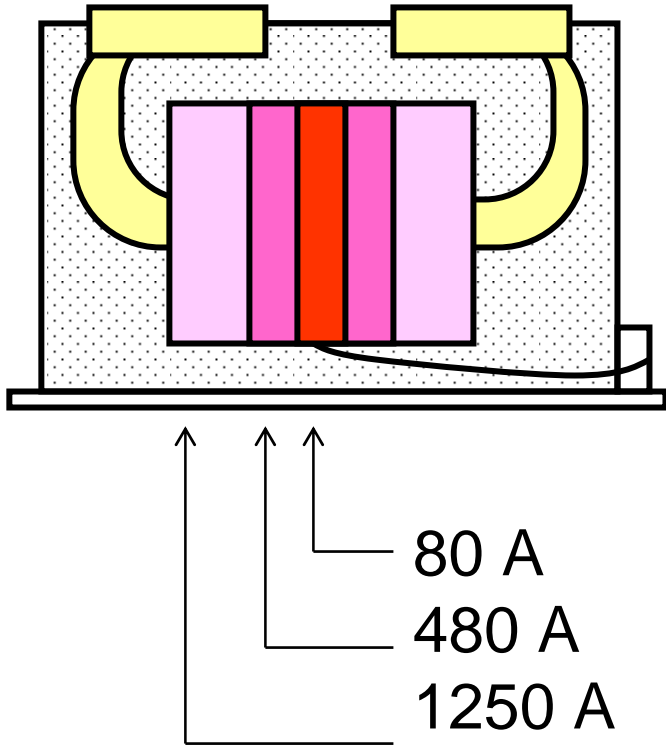


KEVCD

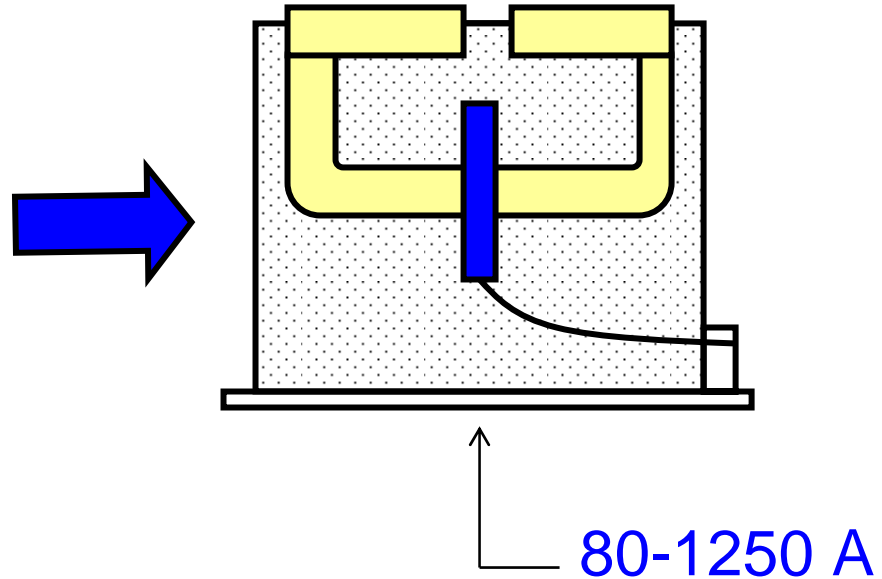


Sensors: Fewer rated currents

Current transformers



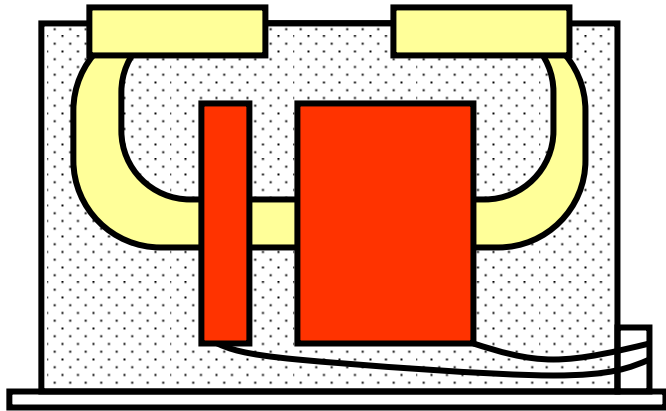
Current sensor



One single standard sensor can be used for a range of switchgear rating currents.

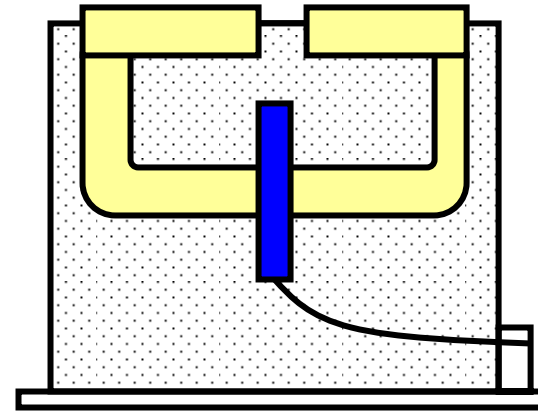
Sensors: Fewer cores

Current transformer



Measurement
Protection

Multi-purpose sensor



M & P

Measurement and protection can be realised with one single secondary winding with double ratings.

Technical Information – current sensors

Current sensors – parameters

Primary currents **4 A up to 3200 A** (according to sensor type)

Secondary signal..... **150 mV...50 HZ 160 mV...60 Hz**

Rated short-time thermal current I_{thn} (1sec.) ...

4;6.3;8;12;16;20;25;31.5;40;50kA

Highest voltage for equipment

3.6 kV up to 24 kV (1min..10-50 kV, BIL..20-125)

Accuracy classes:

measuring or protection: 1;3 (without correction factor)

Indoor epoxi resin - KEVCD, KEVCY_RE, KECR, KEVA

(or dry type – KECA)

Different length of **cable** 5m, 6,5 and 7,5 m for KEVCD,

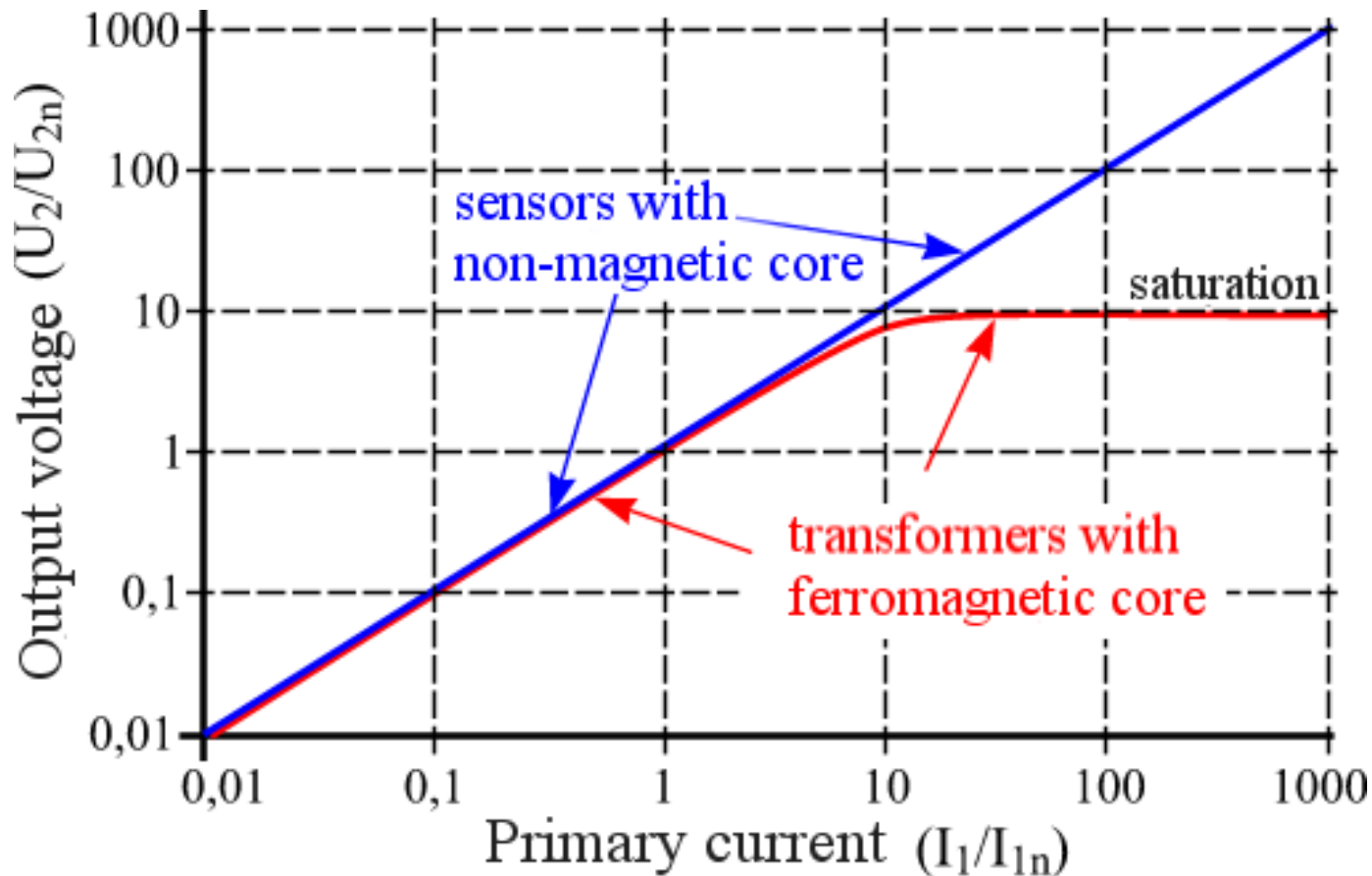
Adaptors for 3 different rated currents (KEVCD)

Sensors must be connected to **ABB relay** only

(RE_ family – REF, REM, etc.)



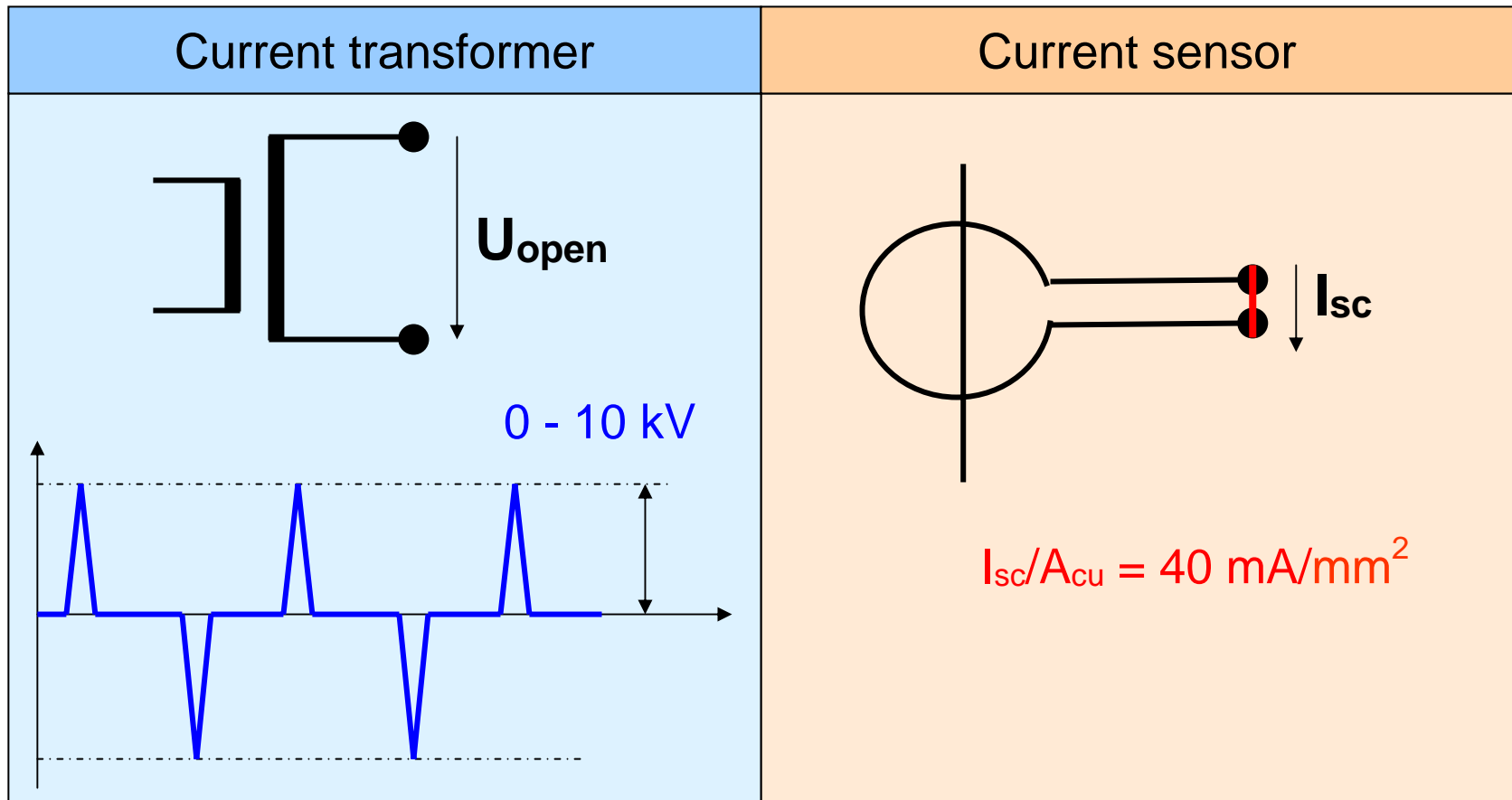
Electronic CTs (sensors) versus Inductive CTs



Sensors → absence of iron

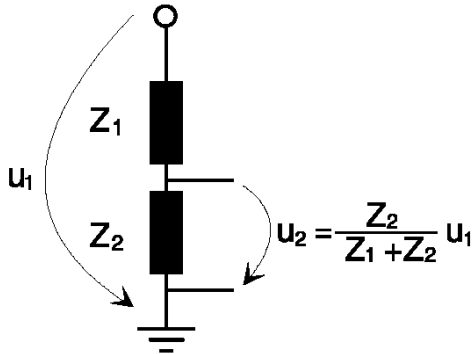
Electronic CTs (sensors) versus Inductive CTs

Open secondary (CT)



Voltage Sensors (electronic VTs)

KEVI 24A1 , 24 kV (GIS)



Resistive divider

- Matched resistor pair
 - 1:10 000 divider ratio
- Accuracy up to class 1

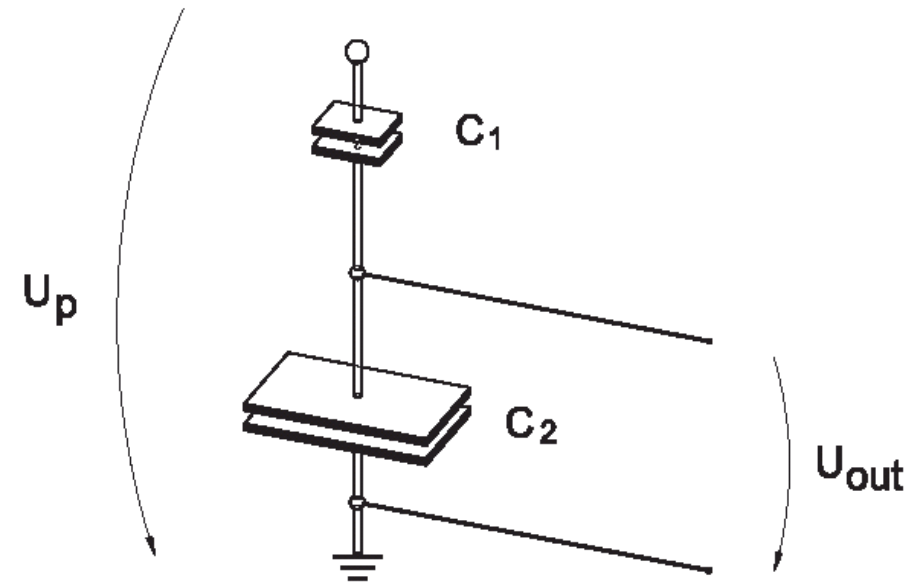
KEVA 24A __ , 24 kV (AIS)



Capacitive divider

- $Z_C = 1/\omega C$
 - 1:10 000 divider ratio
- Accuracy up to class 3
- Small size ideal for bushings

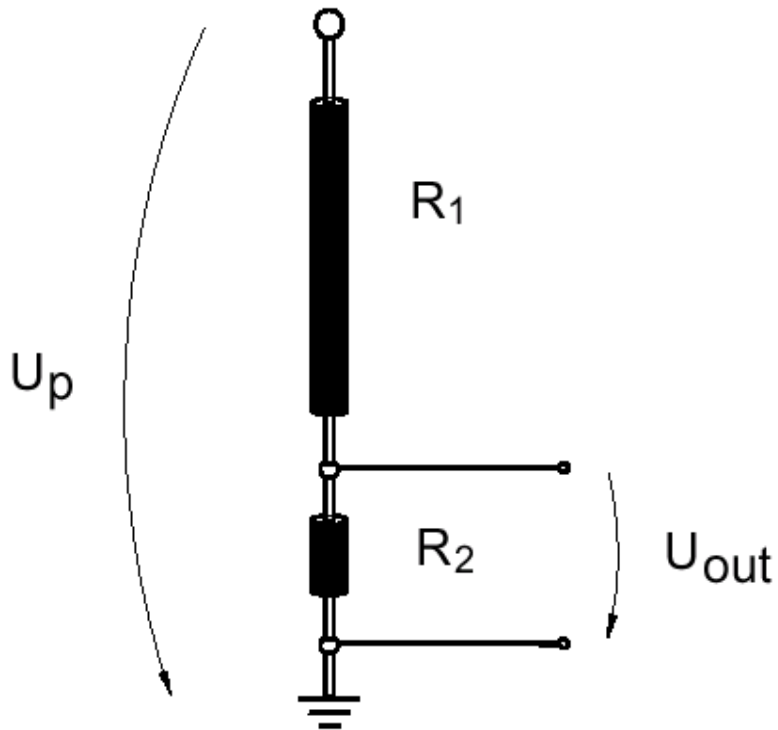
Voltage sensor principle: Capacitive divider



- **ABB** Capacitive voltage sensor
 - $C_1 = 15\text{pF}$
 - $C_2 = 150\text{nF}$
 - 1:10 000 divider ratio
- Passive element
- Accuracy up to class 3
- Small size ideal for bushings

$$u_{out} = \frac{C_1}{C_1 + C_2} u_p$$

Voltage sensor principle: Resistive divider

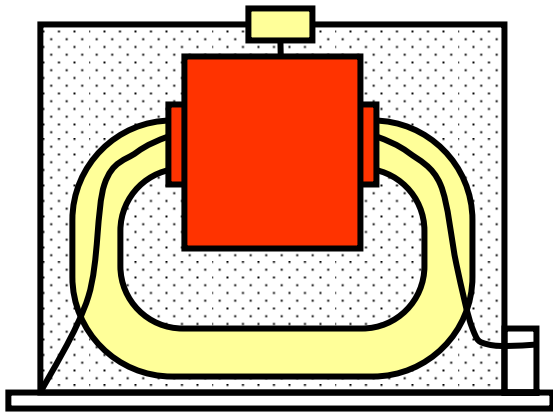


- **ABB** Resistive voltage sensor
 - $R_1 = 250 \text{ MOhm}$
 - $R_2 = 25 \text{ kOhm}$
 - 1:10 000 divider ratio
- Divider accuracy up to class 1
- Passive element
- < 10 meters cable

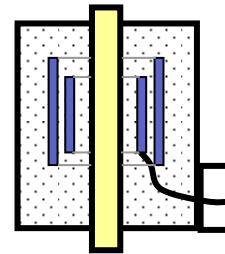
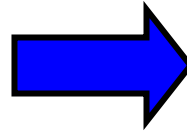
$$u_{out} = \frac{R_2}{R_1 + R_2} u_p$$

Voltage sensors: smaller space needed

Voltage transformer



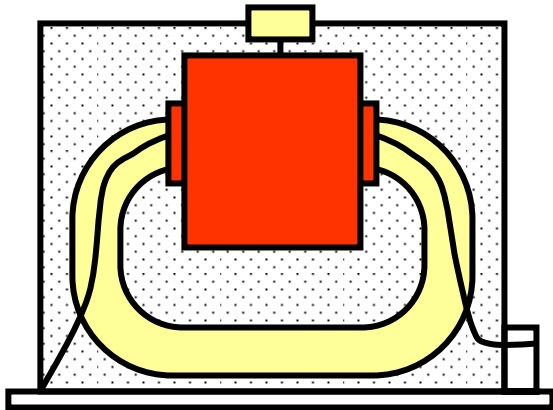
Voltage sensor



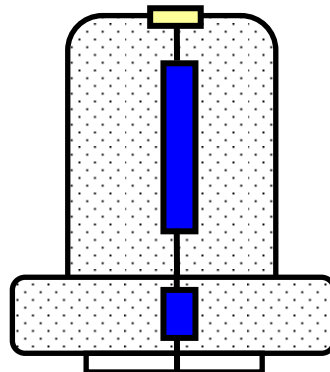
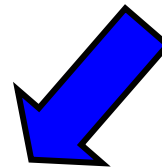
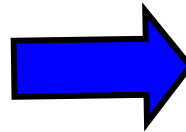
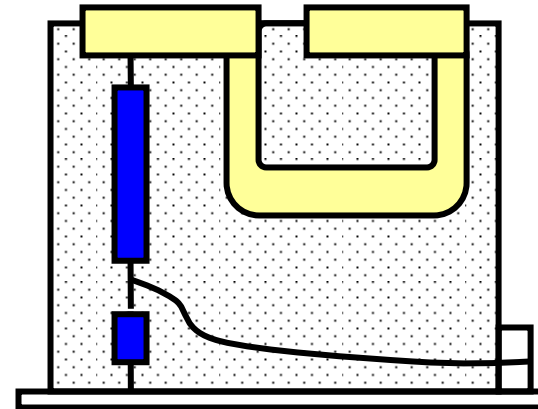
- Very small size
- Very low weight

Voltage sensors: smaller space needed

Voltage transformer



Voltage sensor



- Small volume
- Low weight

Technical Information – voltage sensors

Voltage sensor – parameters

Primary voltages U_n ..

3;6;10;15;20kV (phase to earth $U_n/\sqrt{3}$)

Secondary voltages (signal)...according to primary voltage level,
ratio always 10 000 :1

Highest voltage for equipment

3.6 kV up to 24 kV (1min..10-50kV, BIL..20-125kV)

Accuracy class:

measuring or protection: 1;3 ;3P 6P;
according to the type of voltage divider
(better accuracy for resistive divider)

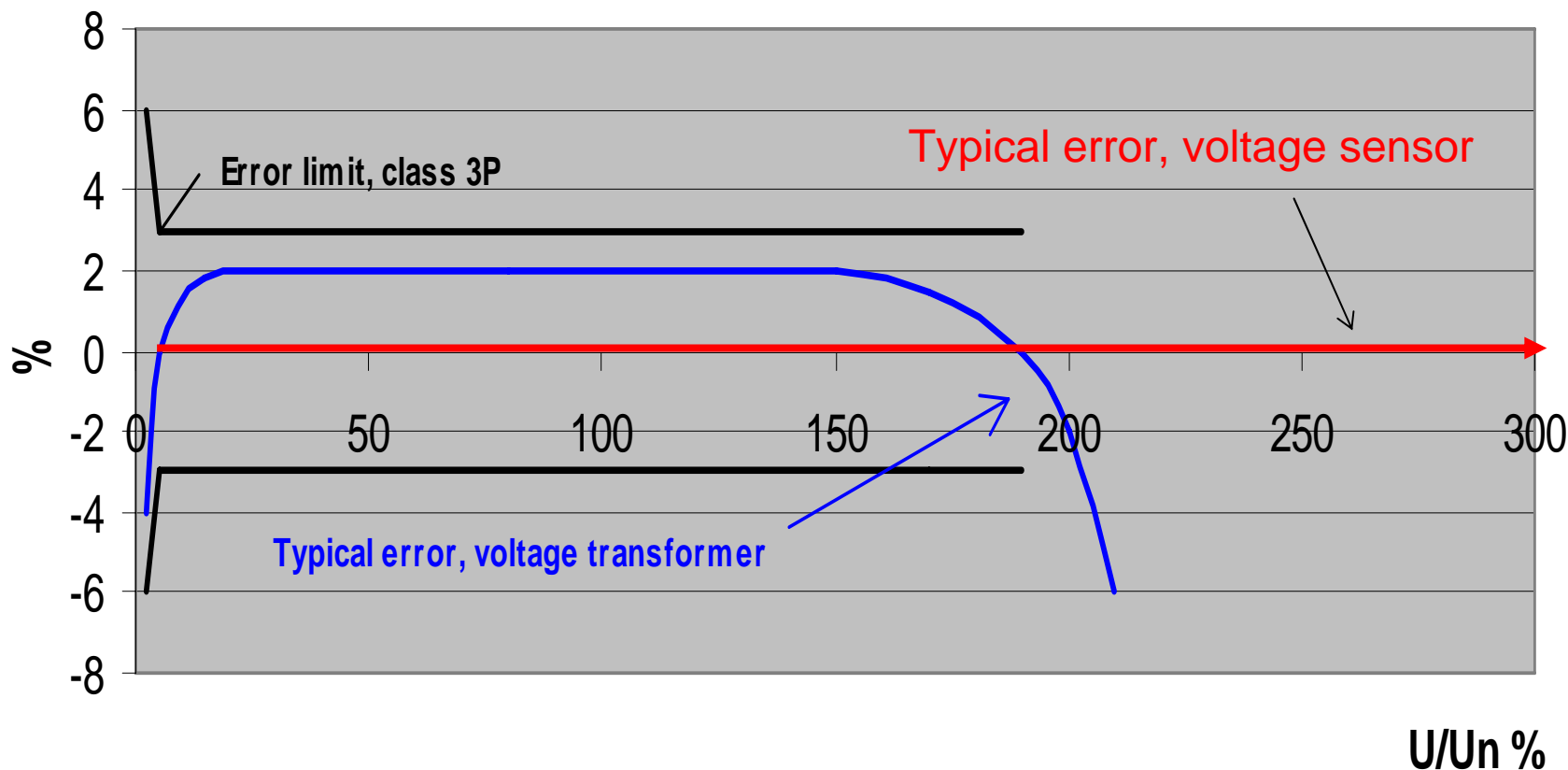
Sensors must be connected to **ABB relay** only
(RE_ family – REF, REM, etc.)



Sensors (Electronic VTs) versus Inductive VTs

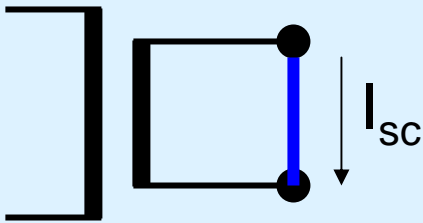
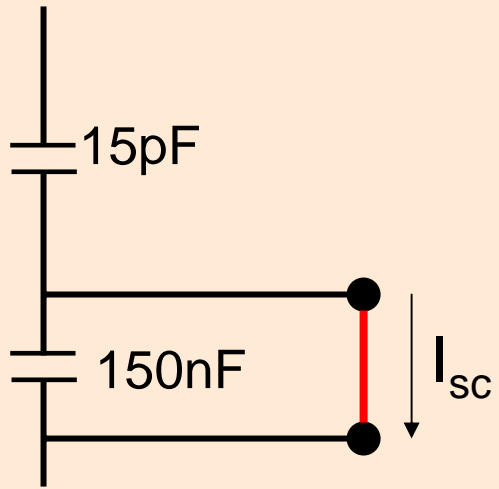
Linearity

Voltage error



Sensors (Electronic VTs) versus Inductive VTs

Short-circuited secondary (VT)

Voltage transformer	Voltage sensor
 <p>$I_{sc}/A_{cu} = 160 \text{ A/mm}^2$ Temp. $\rightarrow 500 \text{ }^\circ\text{C}$ Explosion within 30 s</p>	 <p>$I_{sc} = I_{normal}$</p>

Combi Sensors (Electronic transformers)



The most frequent type

**KEVCD_AE3
KEVCD_AG3
KEVCD_BE2
KEVCD_BG2**

- **Current and voltage sensors in the same block**
- Measurement and protection by one sensor
- Dimensions and primary connections same as DIN-type CTs (DIN 42600)
- **12, 17.5, 24 kV, two types:**
 - A. ≤ 1250 A
 - B. > 1250 A (max. 3200 A)



**24kV, 630A
Current sensor (cl 3)
Voltage sensor (cl 5)**

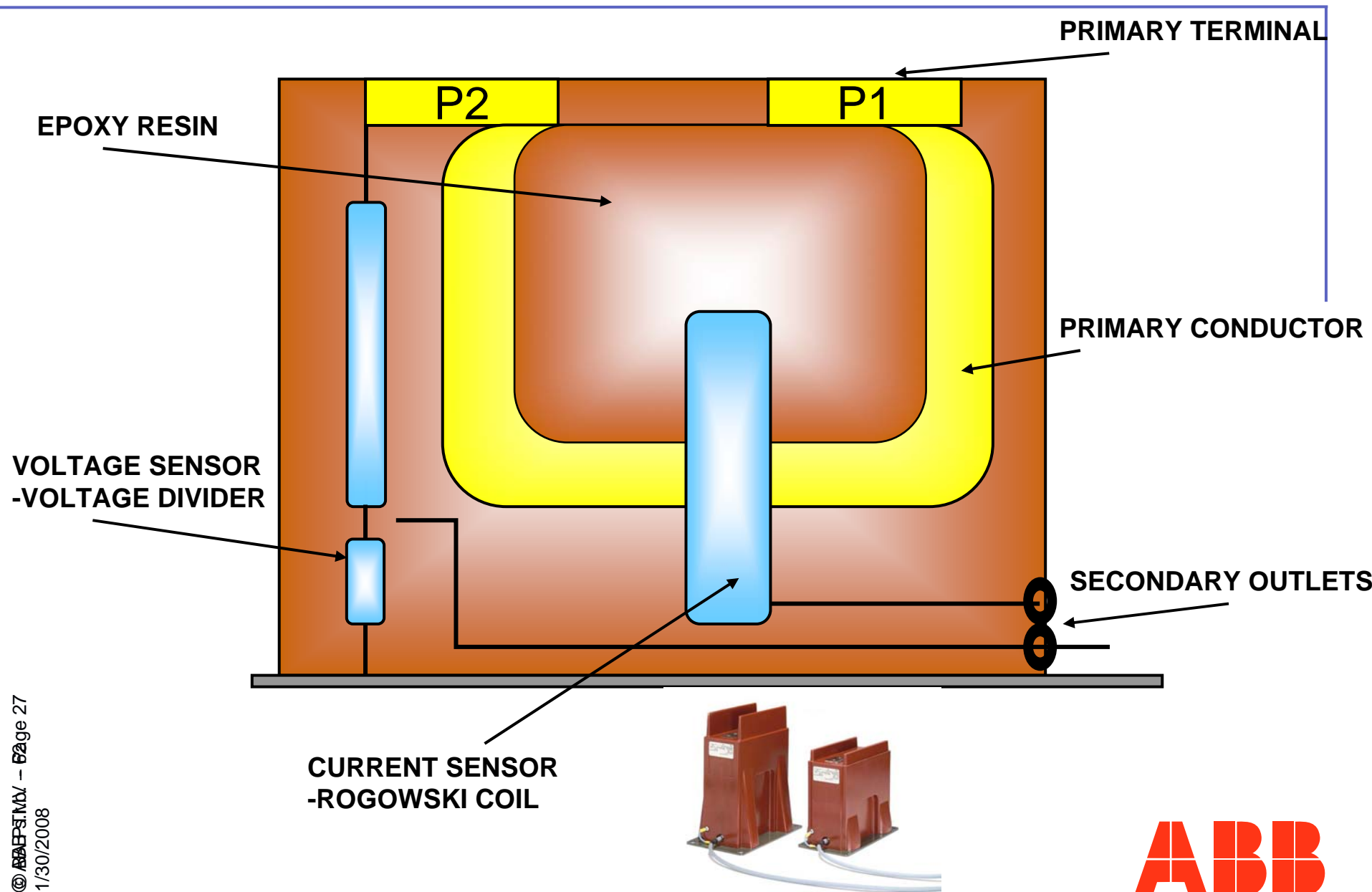
KEVCY 24 RE1



**24kV, 630A
Current sensor (cl 3)
Voltage sensor (cl 5)**

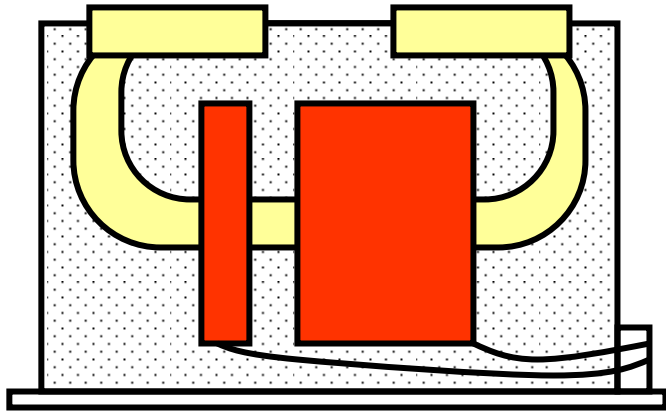
**KEVCY 24 SA
KEVCY 24 SB**

Combi sensor

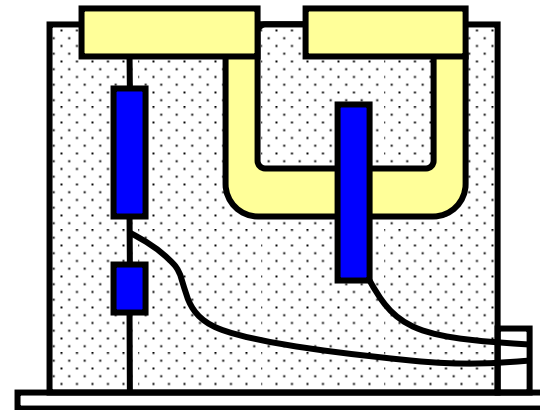


Sensors: compactness

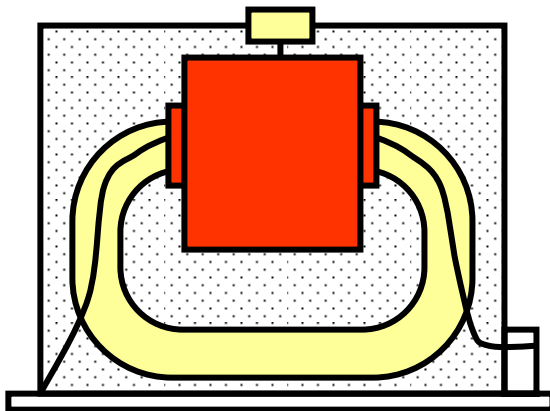
Current transformer



Combined sensor



Voltage transformer



Technical Information –combi sensors

Combi sensor

voltage and current sensors in one block – parameters

Primary voltages Un..

3;6;10;15;20kV (phase to earth $U_n/\sqrt{3}$)



Highest voltage for equipment

3.6 kV up to 24 kV (1min..10-50kV, BIL..20-125kV)

Primary currents

4 A up to 3200 A (according to sensor type)

Sensors must be connected to **ABB relay** only

(RE_ family – REF, REM, etc.)



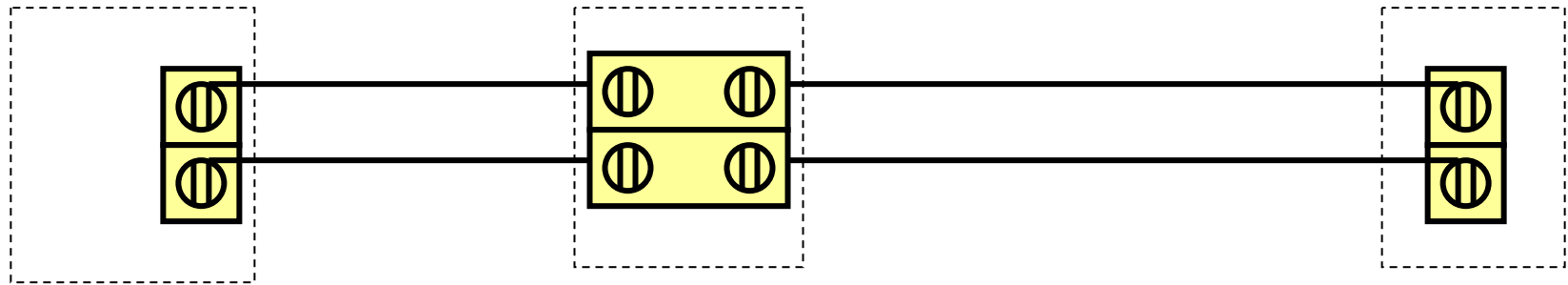
Electronic ITs(Sensors) versus Inductive ITs

Secondary wiring I

Instr. transf.

Terminal blocks

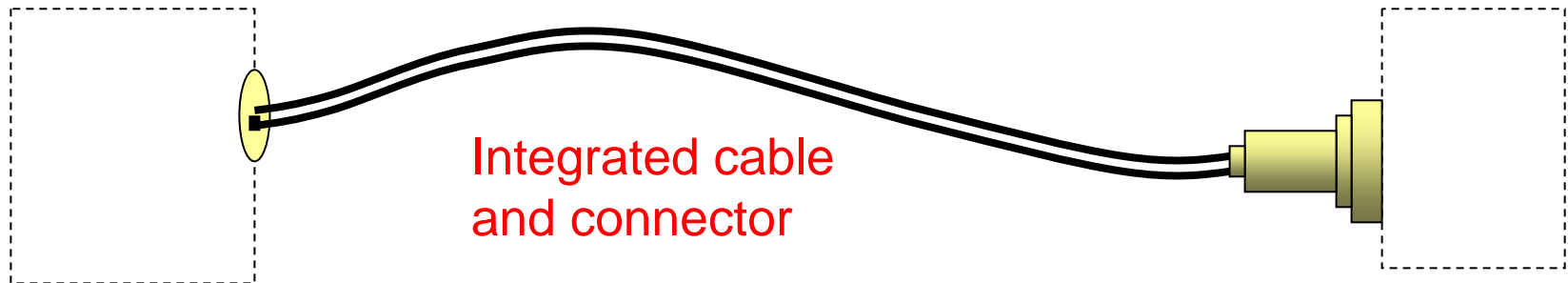
Relay



Wiring and
screw connections

Sensor

IED



Integrated cable
and connector

Sensors - advantages

Max. secondary signal	Safe
Secondary wiring	Integrated
Burden calculations	No
Short-circuited secondary	Safe
Open secondary	Safe
Frequency response	10 - 1000 Hz
Voltage test 50 Hz	Yes
Remanence	No
DC-test of cables	Yes
Ferroresonance	No
Weight	2 - 15 kg
Standardisation	Yes

Minimum energy losses reduces the need for cooling aggregates in the switchgear or in the apparatus.



Electronic ITs(Sensors) versus Inductive ITs

3 combi sensors



3 CTs and 3 VTs



Savings in material and installation

All you need with sensors is...

Sensor /
phase

Integrated cable and connector
(included with sensor)

IED



Instrument transformers

General information

Current transformers

Voltage transformers

Outdoor transformers

Sensors

Application, arguments



Applications of indoor Instrument transformers

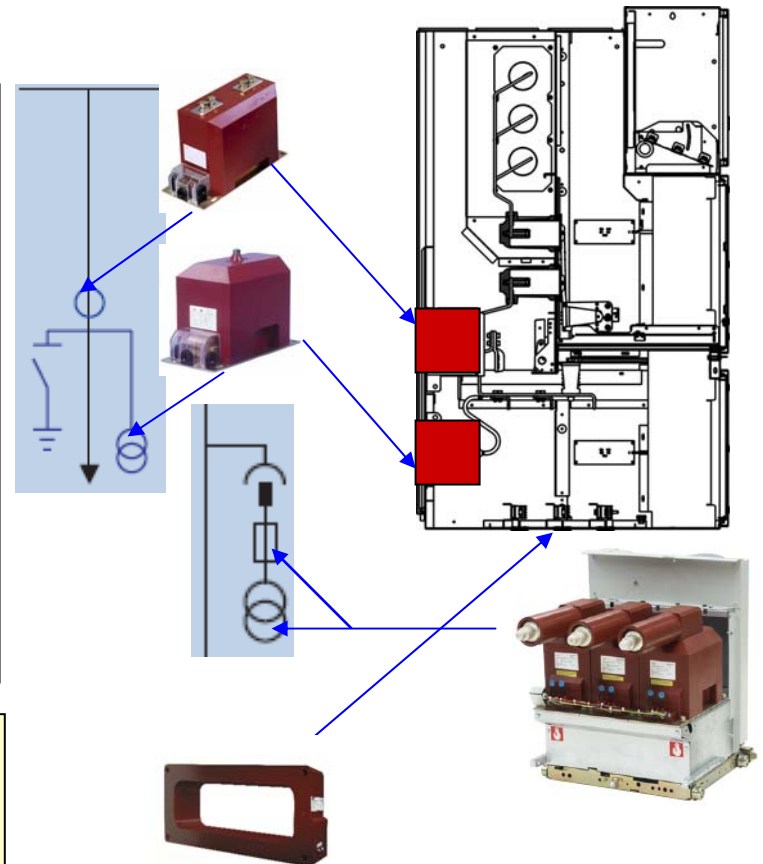
The instrument transformers are intended for panels and installations of ABB, but also for OEMs, Utilities and the loose market outside ABB.

MV ITs in the different business areas:

- Air and gas insulated switchgears
 - AIS primary distribution
 - AIS secondary distribution
 - GIS primary distribution
 - GIS secondary distribution
- Railway traction

LV ITs in the different business areas:

- MV AIS or GIS (on the cable)
- LV switchgear



Application of outdoor MV Instrument transformers

MV ITs in the different business areas:

- *Outdoor substation*
with outdoor CBs
disconnectors
CTs, VTs
- *Railway traction*
both CTs, VTs
mainly 27 kV
- *Overhead line*
with switches
mainly double pole VTs
- *Generally*
Replacement of old outdoor
ITs worldwide

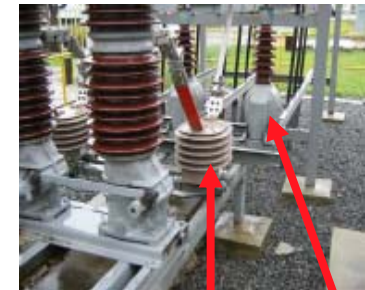
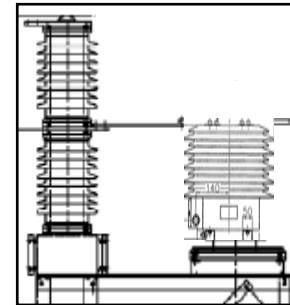
with old PVB



with new TPO



OHB CB, TPO CTs



New CTs, old VTs



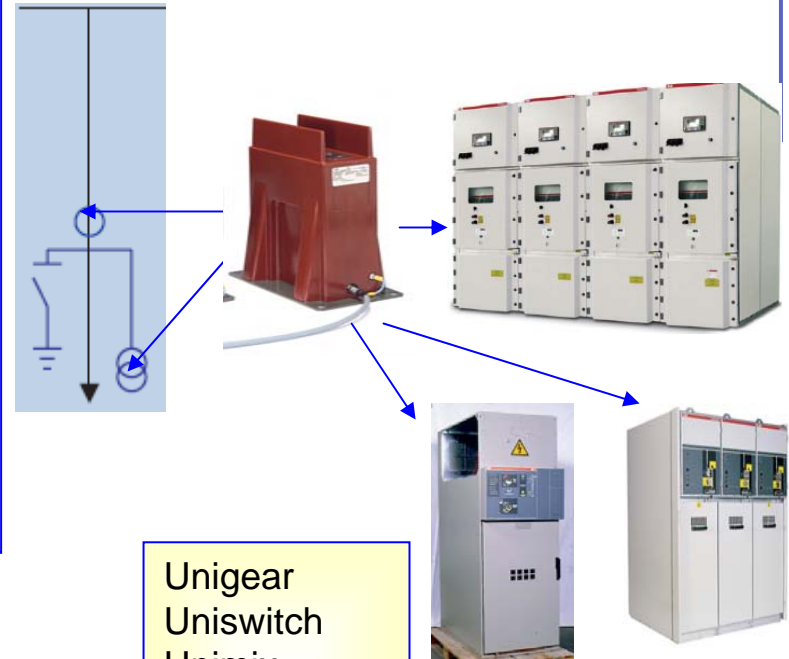
ABB

Application of electronic transformers-sensors

The sensors are intended for panels and installations of ABB, but also (with ABB relays) for OEMs, Utilities and the loose market outside ABB.

MV sensors in the different business areas:

- Air and gas insulated switchgears
 - AIS primary distribution (KEVCD)
 - AIS secondarydistribution (KEVCD)
- *another apparatus*
 - with indoor CBs



Application of electronic transformers-sensors

MV sensors in the different business areas:

-Air and gas insulated switchgears

- AIS primary distribution (KEVCD)
- AIS secondarydistribution (KEVCD)
- GIS secondary distribution (KEVCY_RE)

- another *apparatus*

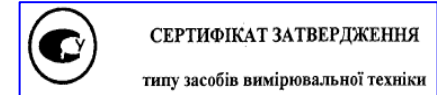
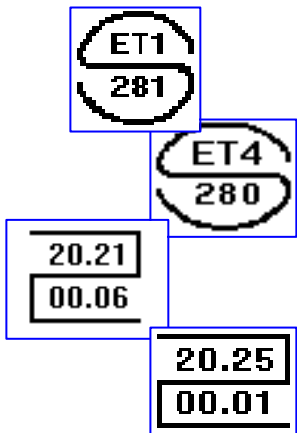
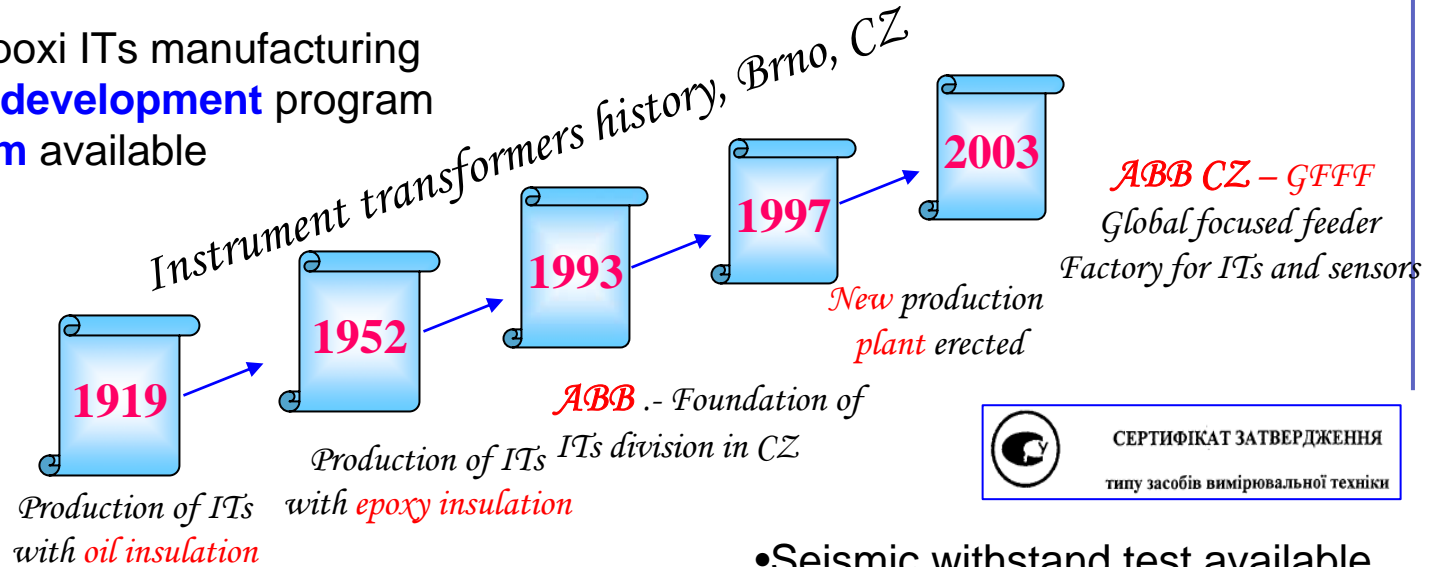
- with indoor CBs

-with SECTOS
(KEVCY 24 SA or SB)



Sales Arguments: certification, experiences, technology

- **Over 50 years** of epoxi ITs manufacturing
- Continues **product development** program
- **CVT+ calc. program** available
- APG technology
- Modern design

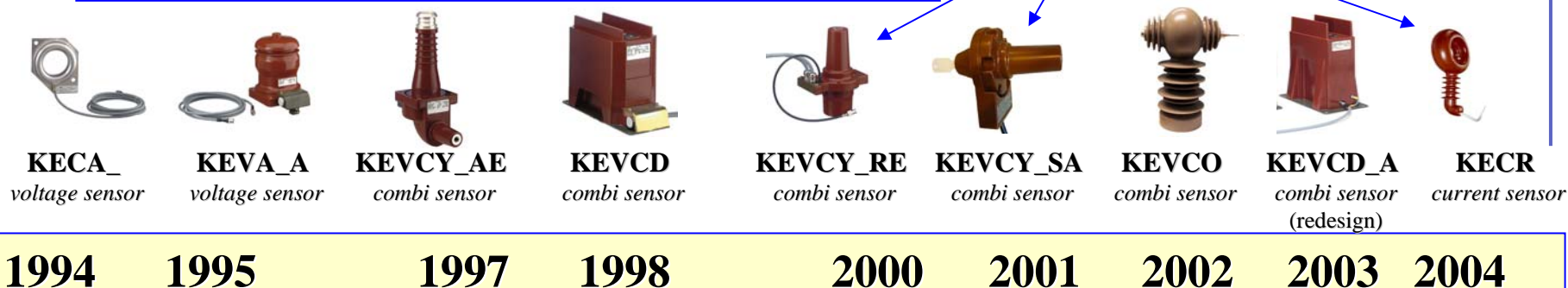


- Seismic withstand test available
- Tested and **certified** according to different standards including GOST
- **Metrology approvals** from different countries available DE, CH, PL, SI, HU, SK, RO, RU, UA, LT, LV, BG, BH, etc.
- ITs fully comply with various customer requirements, **DIN design** available
- References in more than **85 countries worldwide**, in all continents, more than 600 000 units in service



Applications of Electronic ITs (sensors), arguments

- **Over 10 years** of sensors manufacturing
- Continues **product development** program
- **Modern design**



- Sensors fully comply with various customer requirements, **DIN design** available
- References in more than **35 countries**, in all continents, more than **50 000 units in service**

Some advantages obtained with the use of sensors:

- **Savings in material and installation**
- Losses negligible
- Short delivery times.
- **Linearity** over a wide range of current and/or voltage, logistic process is short.
- **Versatile** protection and control solutions.
- The sensors are linear up to the highest currents and voltages with a good dynamic performance.

- Overvoltage and disturbance withstand. Voltage sensors do not need to be disconnected for voltage testing
- They can not cause ferroresonance and are **not sensitive to ferroresonance** and DC-voltages.
- A broken circuit or short-circuit in the signal cable will cause no hazards or damage.
- Sensors - **savings in project lead times**

Instrument transformers into OEM panels



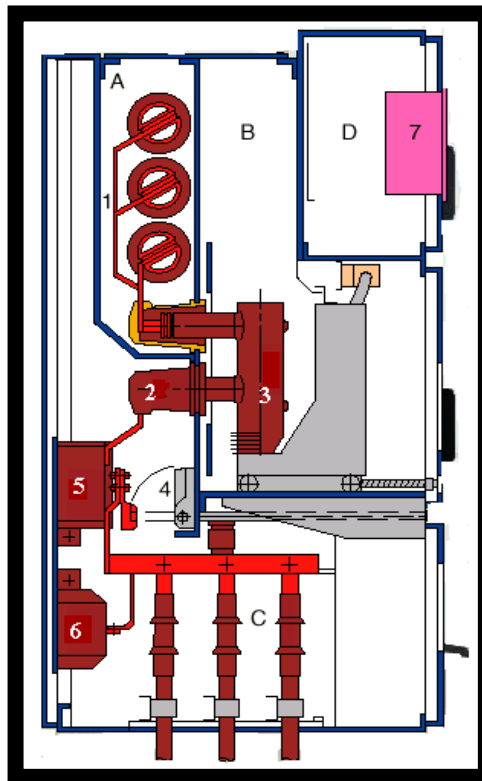
TPU xx.xx...3,6 up to 36 kV



Combi sensor
KEVCD xx x...3,6 up to 24 kV



Current and Voltage sensors
KECA xx ..3,6 up to 24 kV
KEVA xx . 3,6 up to 24 kV



Low voltage „cable“ CTs
KOLA, KOLMA, KOKM
(PLZWA)



TJC x .. 3,6 up to 36 kV

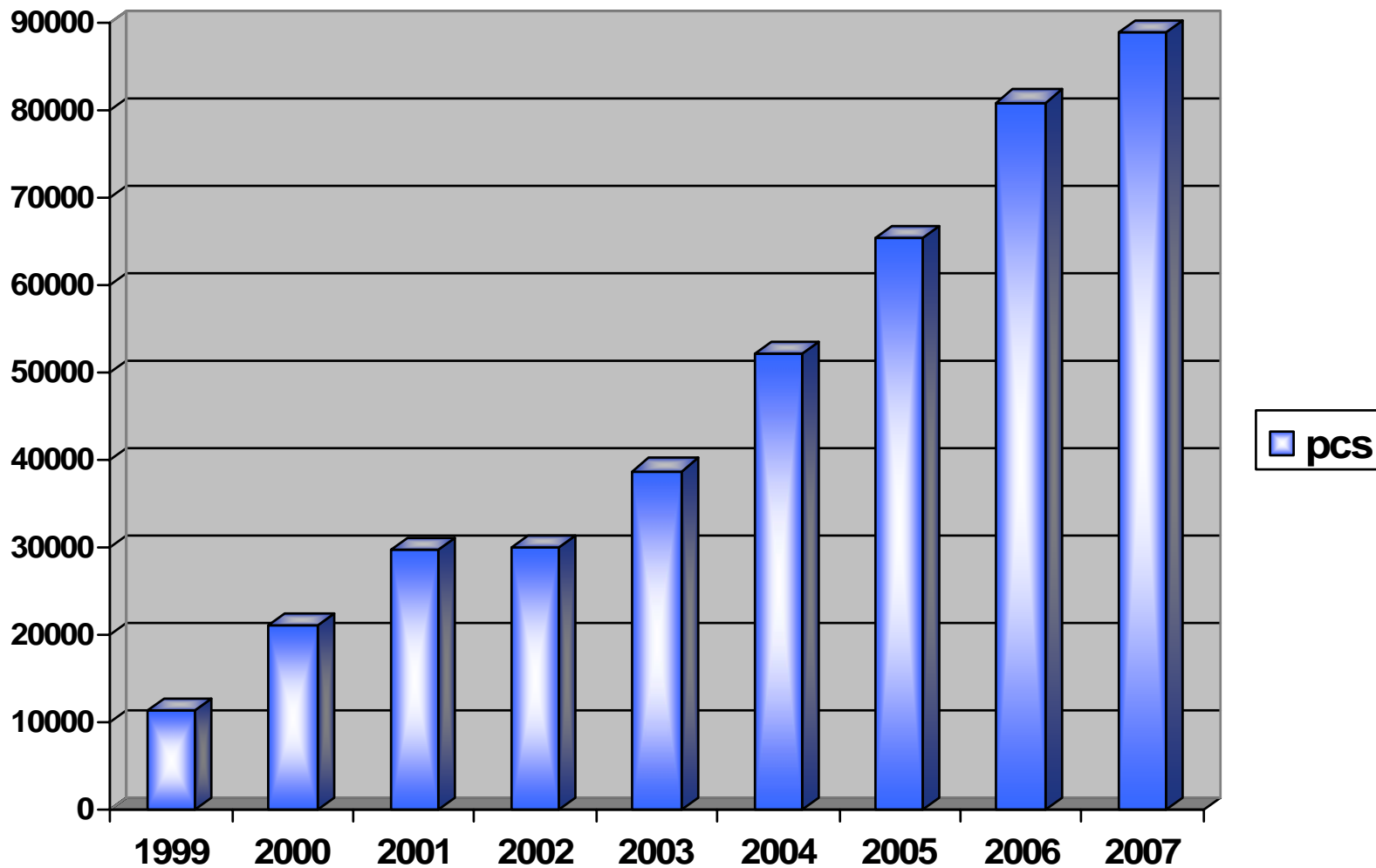


TJP x.x.... 3,6 up to 36 kV

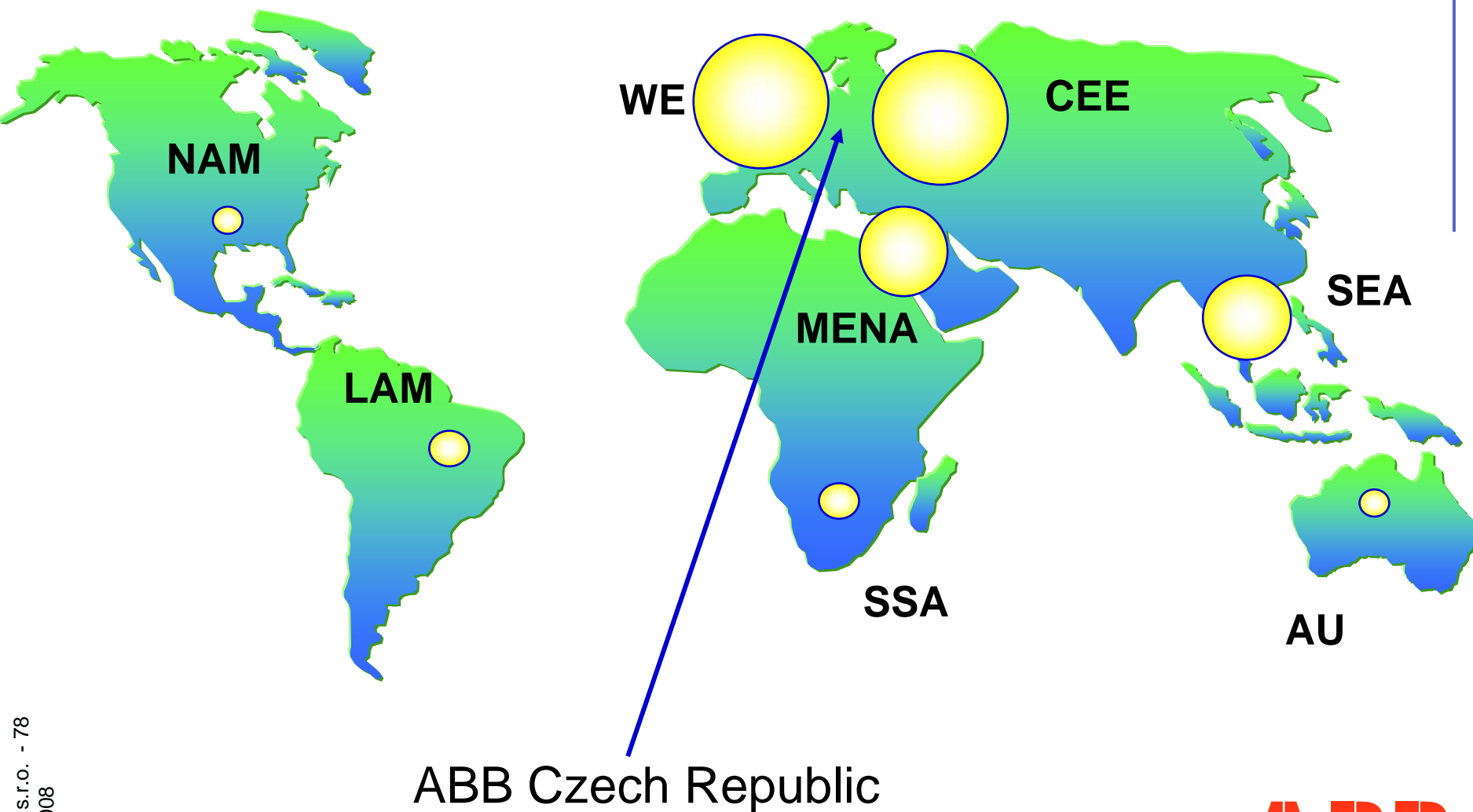


TDC x .. 3,6 up to 36 kV

Trend of Instrument transformers in ABB CZEJF

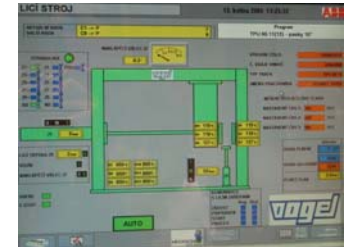
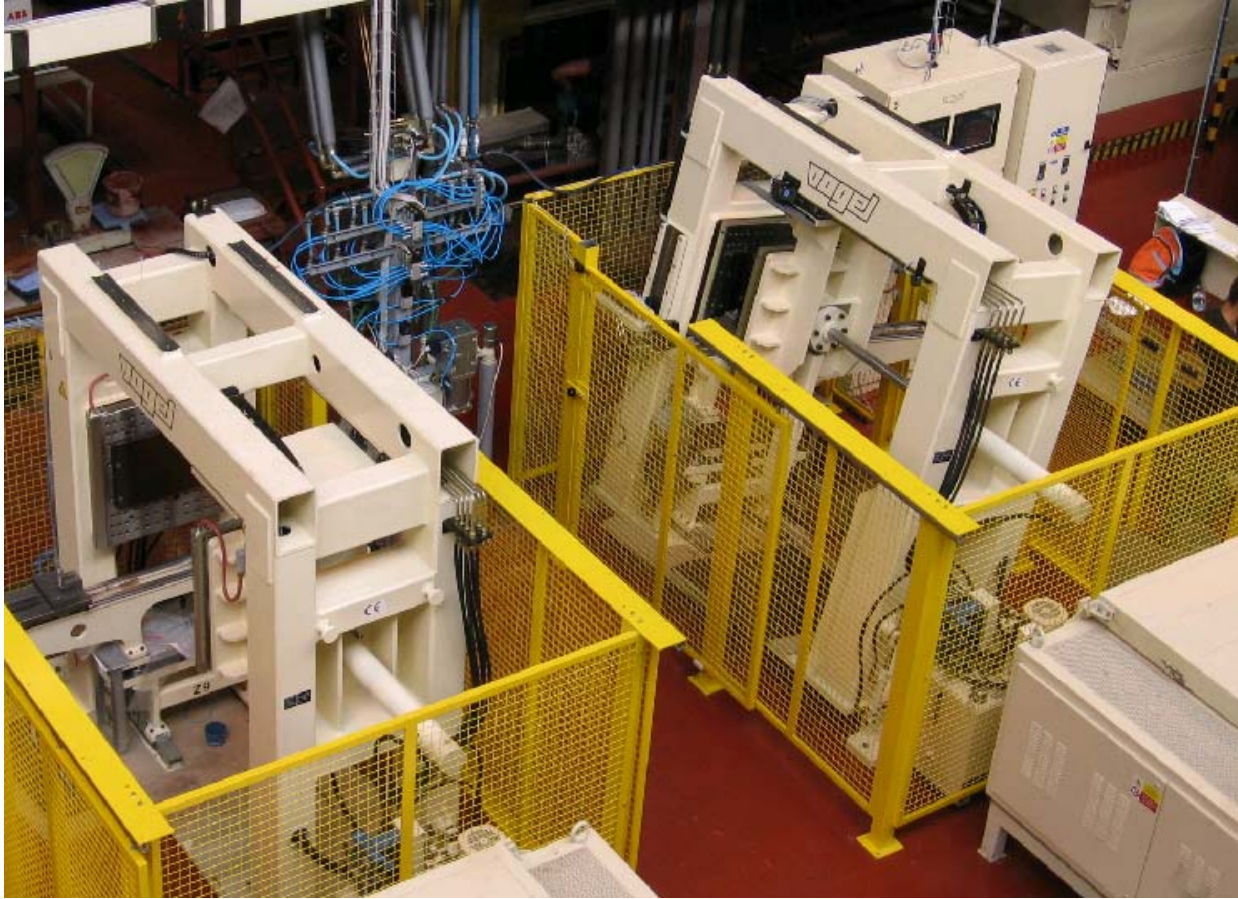


Export of Instrument transformers



Modern, the newest technology

APG technology



AAB