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Data Sheet 3.64/4

# Connection Point for Impulse Test System, Type CP

## Application

The Connection Point is beside the generator the main component of a complete impulse test system which fulfills the following functions:

- Measuring of all relevant testing wave shapes:
  - lightning impulses (LI) 1.2/50 µs,
  - chopped lightning impulses (LIC),
  - switching impulses (SI) 250/2500 µs and
  - alternating voltages (AC).
- Chopping of lightning impulses and
- Compensation of overshoots

According to the listed functions, the Connection Point integrates the components of measurement divider, chopping gap and overshoot compensation in one single base frame. If one component is not required, the Connection Point can be realized also in a reduced configuration. The main advantage in relation to a traditional test system arrangement is based on omitted copper connections between the mentioned components. Therefore, the Connection Point is recommended for saving ground space in testing halls and for easier handling during test procedures. The Connection Point can be installed in series with the generator and the test object or in parallel to the test object as shown in figure 1 and 2.

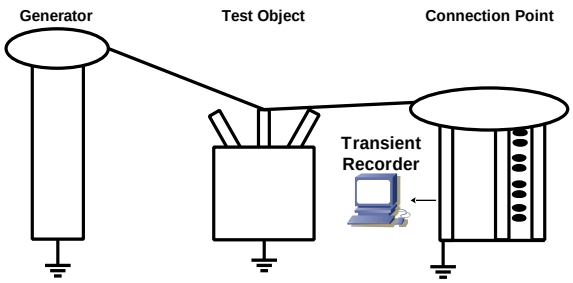


*Figure 1: Configuration of an impulse test system with Connection Point connected in parallel*

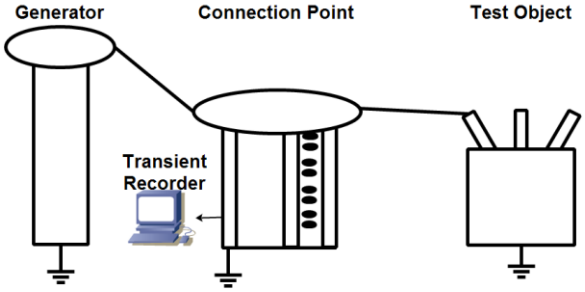


*Figure 2: Configuration of an impulse test system with Connection Point connected in series*

## Components of the Connection Point

### Voltage divider

The low-damped capacitive voltage divider converts the high voltage (up to 3600 kV) into a measureable and for a transient recorder or peak voltmeter processable voltage signal of 1000 V. In special applications, the maximum output voltage can be adapted to other voltages as an option. The mentioned test voltages of full LI, LIC, SI and AC voltage can be measured. All requirements of the standards IEC 60060-1 and -2 are fulfilled, in particular those which are related to measuring accuracy and step response. The high-voltage capacitor is made of single units of oil impregnated capacitors. Single capacitor packages are connected in series with the inserted damping resistors. The mentioned components are housed in glass-fiber-reinforced plastic (GRP) cylinders with metal flanges. For higher voltages several high-voltage capacitors are connected in series.

The low voltage capacitor is located at the lower end of the capacitor column. Its compact design with the parallel configuration of low-voltage capacitors provides the necessary low inductance value. The terminating resistor for the connection of a 50 Ω measuring cable is included. The divider has to be connected to a high-impedance measuring unit (transient recorder or peak voltmeter ≥ 1 MΩ, ≤ 100 pF). The capacitor column is mechanically stabilized with fiber-reinforced plastic (FRP) struts. A copper foil high-voltage connection can be mounted on the connection terminal at the top electrode. A spring-tensioned metal rope realizes the grounding. The divider can be equipped with additional taps for partial operation. This item allows the optimum adaptation to the relevant test voltage level.

### Chopping multiple spark gaps

The chopping gap consists of a capacitor, a separate GRP column and an isolating ladder with the mounted spark gaps. The adjustment of the space between the gaps is effected by motor drive and can be controlled via the operator device. The trigger signal from the control is transmitted to the ignition generator of the spark gap by a fiber-optic link. A specific chopping time can be realized ($T_C$ = 0.5 – 6 µs) depending on the particular test object.

### Overshoot compensation

HIGHVOLT impulse generators have a low inductive design. Impulse tests with higher peak voltages than $U_P$ = 2000 kV require longer dielectric distances between the components of the test circuit. Assuming that the connections between the test circuit components have a specific inductivity of L = 1 µH/m, the effective parasite inductance of the entire test circuit cannot be neglected. Depending on the load of the test object an overshoot with a value of more than β = 5 % can appear. An additional overshoot compensation, integrated in the chopping gap, reduces the overshoot and allows the test of high-capacitive load by keeping the allowed overshoot and the permitted front time $T_1$. Due to the compact design of the Connection Point, the circuit inductance is lower in comparison with a traditional impulse test system with a separate divider and chopping gap.
The shown example explains the effectiveness of the integrated overshoot compensation. A load with $C_{Load}$ = 5 nF has to be tested with a peak voltage of $U_{Peak}$ = 1800 kV. The length of the example test circuit is assumed with of l = 25 m, hence the parasite inductance of the test circuit is L = 25 µH. In practice, the length depends on the detailed test bay arrangement. However, the Connection Point allows omitting of one high-voltage connection. The lightning impulse with an overshoot of β = 7.5 % and a front time of $T_1$ = 1.66 µs would be out of the tolerance. The overshoot compensation reduces the overshoot of < β = 5 % and allows a front time within the tolerances, see figure 3 and table 4.

*Table 1: Main parameters – Types with the included components: Divider, overshoot compensation and chopping gap*

| Type | Rated LI voltage 1.2/50 | Rated SI voltage[1] 250/2500 | Rated AC voltage[2] 50/60 Hz (RMS) | Series | Capa-citance | Height[3] | Base frame[4] Length x Width (approx.) | Weight |
|---|---|---|---|---|---|---|---|---|
| | kV | kV | kV | | pF | mm | mm | kg |
| CP 1330/1200 DOC | 1200 | 950 | 300 | M | 1330 | 4500 | 4200 x 2000 | 1400 |
| CP 890/1800 DOC | 1800 | 1425 | 450 | M | 890 | 6700 | 5600 x 3000 | 2200 |
| CP 1780/1800 DOC | 1800 | 1425 | 450 | G | 1780 | 6700 | 5600 x 3000 | 2200 |
| CP 1330/2400 DOC | 2400 | 1850 | 600 | G | 1330 | 9000 | 6800 x 4000 | 3000 |
| CP 1070/3000 DOC | 3000 | data on request | 750 | G | 1070 | 12000 | 8000 x 5000 | 3500 |
| CP 890/3600 DOC | 3600 | data on request | 900 | G | 890 | 15500 | 9400 x 6000 | 4200 |

*Table 2: Main parameters – Types with the included components: Divider and chopping gap*

| Type | Rated LI voltage 1.2/50 | Rated SI voltage[1] 250/2500 | Rated AC voltage[2] 50/60 Hz (RMS) | Series | Capa-citance | Height[3] | Base frame[4] Length x Width (approx.) | Weight |
|---|---|---|---|---|---|---|---|---|
| | kV | kV | kV | | pF | mm | mm | kg |
| CP 1330/1200 DC | 1200 | 950 | 300 | M | 1330 | 4500 | 4200 x 2000 | 1400 |
| CP 890/1800 DC | 1800 | 1425 | 450 | M | 890 | 6700 | 5600 x 3000 | 2200 |
| CP 1780/1800 DC | 1800 | 1425 | 450 | G | 1780 | 6700 | 5600 x 3000 | 2200 |
| CP 1330/2400 DC | 2400 | 1850 | 600 | G | 1330 | 9000 | 6800 x 4000 | 3000 |
| CP 1070/3000 DC | 3000 | data on request | 750 | G | 1070 | 12000 | 8000 x 5000 | 3500 |
| CP 890/3600 DC | 3600 | data on request | 900 | G | 890 | 15500 | 9400 x 6000 | 4200 |

[1] Positive SI: The given values require a special top electrode.
[2] 1h in operation
[3] Depending on the rated switching impulse
[4] Dimension depending on the divisibility of the base frame

*Table 3: Overshoot compensation*

| | $T_1$ | β |
|---|---|---|
| | µs | % |
| $U_{Peak}$ = 1800 kV / $C_{Load}$ =5 nF | | |
| Without compensation | 1.66 | 7.5 |
| With compensation | 1.52 | 4.2 |
| $U_{Peak}$ = 2400 kV / $C_{Load}$ =4 nF | | |
| Without compensation | 1.74 | 8.5 |
| With compensation | 1.52 | 5.0 |

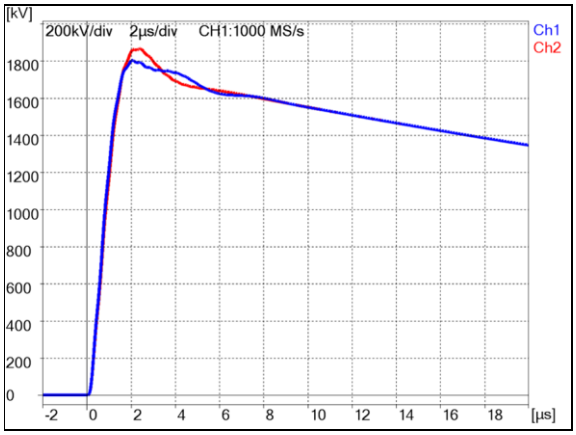


*Figure 3: Comparison of two LI impulses.*
*The red line has an overshoot of 7.5 %.*
*The integrated overshoot compensation (blue line) reduces the overshoot of < 5 %.*

*Figure 4: The Connection Point CP 1070/3000 DOC with divisible base frame and top electrode can be moved by air cushions.*

### Additional component features

In order to use the components separately, the Connection Point can be equipped with divisible top electrode and base frame. The Connection Point can be moved in the test hall on air cushions or rollers.

### Accessories

Impulse voltage measuring / load capacitor consisting of:

- Measuring cable (Z = 50 Ω, l = 25 m)
- Preparation for Record of Performance

### Options

- Adapted LV capacitors for different output voltages
- Divisible construction of the Connection Point
- Air cushion or rollers
- Different lengths of measuring cable
- DKD calibration certificate

### Type designation

CP a/b z
a = capacitance in pF
b = rated LI voltage in kV
z = included components
Every letter indicates the component which is included in the Connection Point. The Connection Point can be configured according to the individual test requirements:
D Divider
O Overshoot compensation
C Chopping gap
Available combinations are: CP a/b DOC, CP a/b DO and CP a/b DC