



Reyrolle
Protection
Devices

7XG21

Capacitor Cone Adapter Unit for NVD protection

Energy Management

SIEMENS

7XG21

Capacitor Cone Adaptor Unit for NVD protection



Application

Capacitor Cones are used in 11 and 33 kV Sub/Stations to provide a Neutral Voltage Displacement (NVD) level where conventional Voltage Transformers are too large or too expensive. This voltage level is too high for use by numeric relays, being at system primary levels, and so an Adapter Unit must be used to step it down. The input capacitance of the Adapter can be configured by means of DIL switches to determine the step-down ratio.

The Adapter Unit can be used with any Reyrolle numeric relay with an input for NVD measurement.

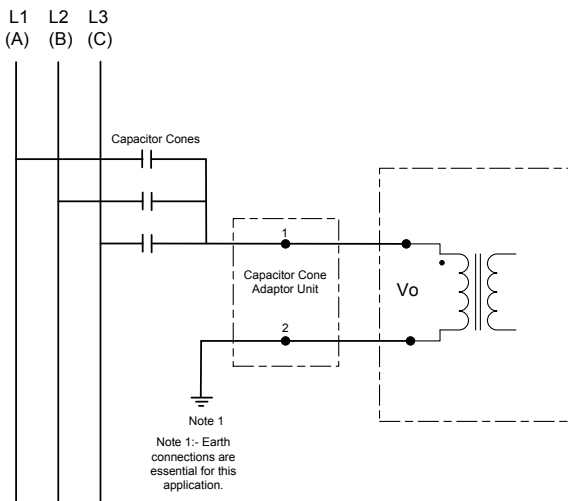
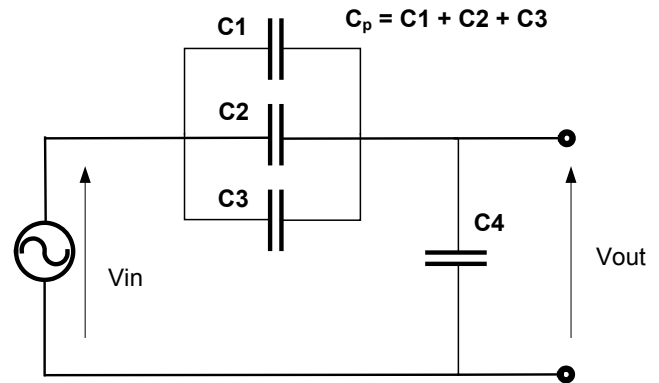


Fig 1. Connection of Capacitor Cone to Reyrolle protection relay

Technical information

Different manufacturers fit Capacitor Cones with different values of capacitance, C1, C2 and C3. The capacitance of the Adaptor Unit, C4, must therefore be settable to achieve the required step-down effect. The available setting range is 1 to 201.9nF, with discrete steps of 1, 2.2, 4.7, 10, 22, 47, 47 and 68nF.



$$\begin{aligned}
 V_{out} &= V_{in} \times X_{c4} / ((X_{cp} \times X_{c4}) / (X_{cp} + X_{c4})) \\
 &= V_{in} \times X_{c4} \times (X_{cp} + X_{c4}) / (X_{cp} \times X_{c4}) \\
 &= V_{in} \times (X_{cp} + X_{c4}) / X_{cp} \\
 &= V_{in} \times X_{c4} / X_{cp} \quad (X_{c4} \gg X_{cp}) \\
 &= V_{in} \times C_p / C_4 \\
 C_4 &= (V_{in} / V_{out}) \times C_p
 \end{aligned}$$

Fig 2. Equivalent circuit of Capacitor Cones and Adaptor Unit

The voltage input impedance of the Reyrolle numeric relays is high enough not to load this circuit. However allowance must be made for the capacitance of the voltage input (5.7nF) of the relay.

$$\text{Setting} = ((V_{in} / V_{out}) \times C_p \text{ in nF}) - 5.7\text{nF}$$

Example: 150pF capacitor cones used on a 33kV system.

As a guideline, Primary NVD pick-up level is 25% of the Primary P-N voltage = $33\text{kV} \times 0.25 / \sqrt{3} = 5\text{kV}$

Choose a relay NVD pick-up of, say, 25V

$$\begin{aligned}
 \text{Adaptor Unit setting} &= (V_{in}/V_{out}) \times C_p \\
 &= (5\text{kV}/25\text{V}) \times (3 \times 150\text{pF}) = 90\text{nF}
 \end{aligned}$$

Allowing for the voltage input impedance of the relay
 $= 90\text{nF} - 5.7\text{nF} = 84.3\text{nF}$

Note that allowance should also be made for the capacitance of cabling if this is significant.

Setting the "3Vo VT Primary" to 5kV, and the "3Vo VT Secondary" to 25V will give correct primary and secondary NVD meters

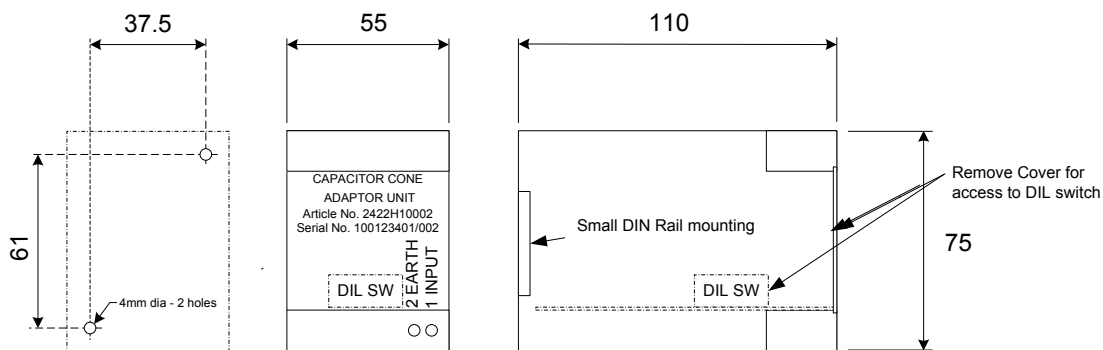
The Adaptor Unit provides a secure housing and has the advantage that it can be fine tuned on site – by means of direct primary injection - to allow for variations in the actual capacitance of the Capacitor cones. It provides a reduced voltage level, V_{out} , and surge suppression; clamping switch-on or lightning-induced spikes to less than 250 V AC.



Fig 3. Capacitor Cone Adaptor Unit construction

NOTE: Capacitor Cones must be considered as current sources for maintenance purposes. Current levels will be low but the high voltage levels pose a danger to personnel and plant. The Cones should therefore be short-circuited to EARTH and NOT open-circuited.

Case Drawing



- Switch 1 ON = 1nF
- Switch 2 ON = 2.2 nF
- Switch 3 ON = 4.7 nF
- Switch 4 ON = 10nF
- Switch 5 ON = 22nF
- Switch 6 ON = 47nF
- Switch 7 ON = 47 nF
- Switch 8 ON = 68nF

Setting = SUM of the Capacitance of all On Switches

Ordering Information – Capacitor Cone Adapter Unit 7XG21

Product description	Variants	Order No.
Capacitor Cone Adaptor Unit		7 X G 2 1 0 0 - 1 A A 0 0 - 0 A A 0

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