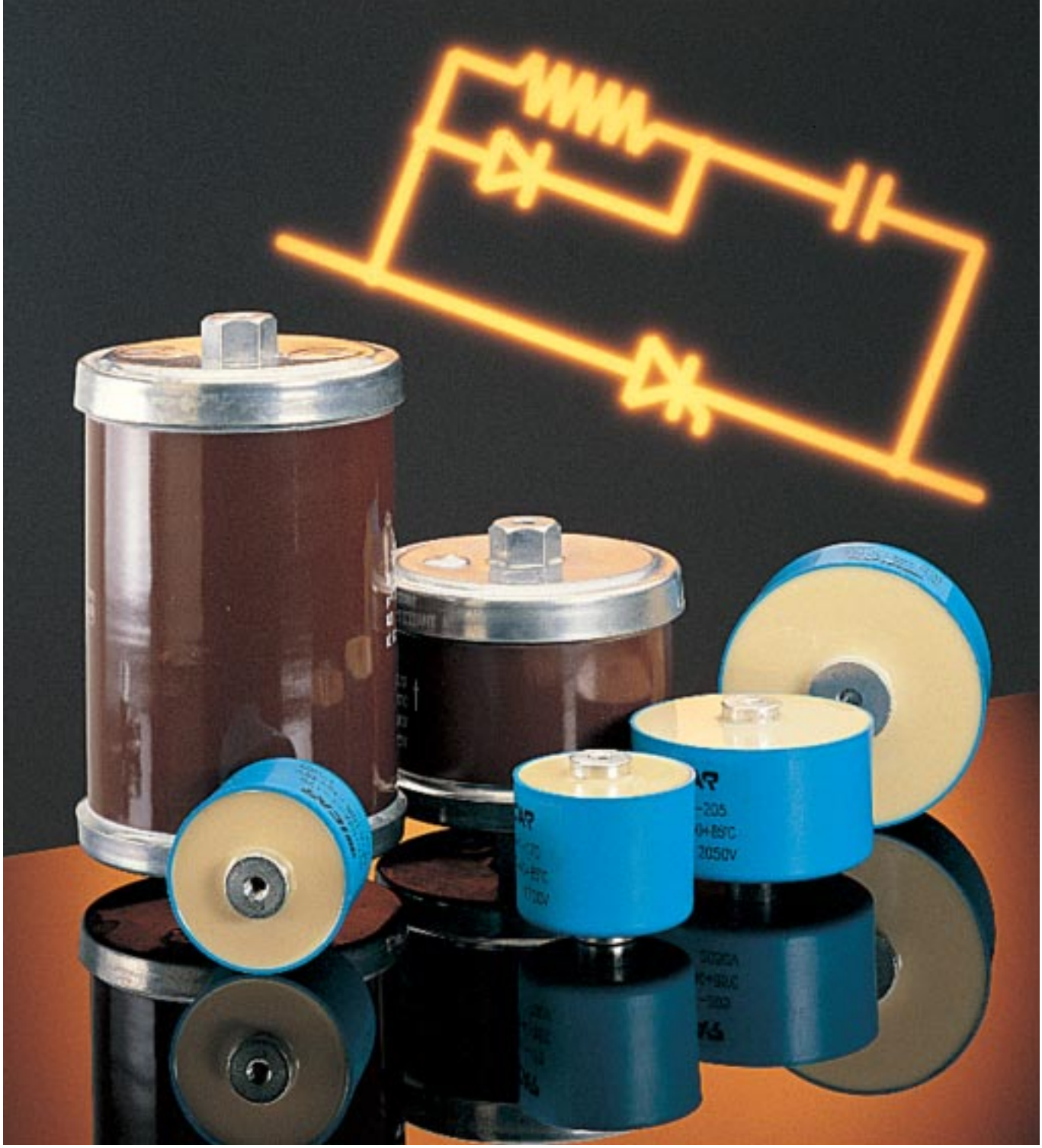

# THY–CLP

## CAPACITORS FOR GTO THYRISTORS

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capacità & sicurezza

# THY

## SNUBBER CAPACITORS FOR GATE TURN-OFF THYRISTORS

THY capacitors are characterized by low losses, high peak voltage, high current handling capability and a very low inductance. They are cilindrical, axial terminals. THY D series consists of dry metallized polypropylene capacitors, self-headling type. THY W series consists of all polypropylene film dielectric capacitos, metal foil, impregnated with oil. Standards of reference: IEC 384-1, IEC 68-2, IEC 1071-1.

### DEFINITIONS

$C_N$ Rated capacitance.

$U_N$ Rated D.C. voltage.

$U_{max}$ Periodic peak voltage.

$U_S$ Surge peak voltage (the dielectric must withstand the peak off-state voltage of the associated G.T.O.:$U_S = U_{GTO}$).

Urms Rated A.C. voltage.

$I_{max}$ Maximum current: is the maximum r.m.s. value for continuous operation.

$\tau$ Pulse width.

T Duration of the fundamental oscillation, according to which all processes are repeated cyclically.

F Fundamental frequency F = 1/T.

$R_s$ Series resistance: is the resistance produced by the current heat losses ($I^2 R_s$) in the capacitor.

$Tan\delta_0$ Dielectric dissipation factor may be regarded as constant in the frequency range in which it is employed. Typical for polypropylene is $2.10^{-4}$.

Tanδ Dissipation factor is calculatd as follows: $tan\delta = tan\delta_0 + 2.\pi. C.F.R_s$.

dv/dt The dv/dt value is the maximum slope of the voltage waveshape during charging or discharging of the capacitor and is espressed in V/ µs. The consequent peak current can be calculated as follows:

$$Ipk = C \cdot \frac{dv}{dt}$$

P Sum of all the actual power generated in the capacitor.

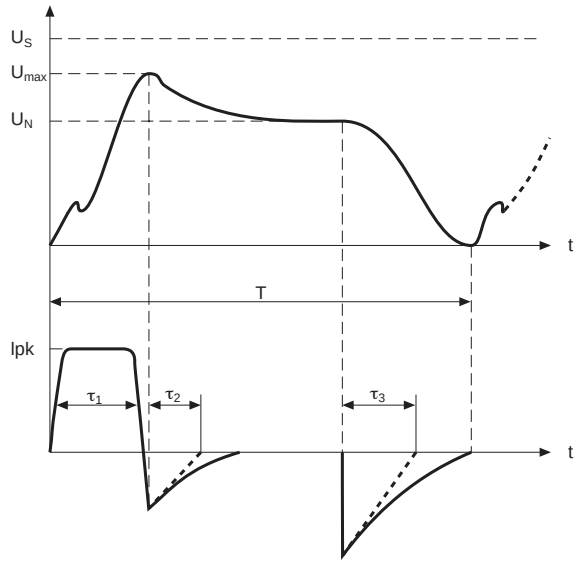
Rth Thermal resistance between the hot-spot in the winding and the environment. The following formula is valid:
$(\vartheta h - \vartheta o) / Rth = P$.

$\vartheta h$ Hottest point in the capacitor winding.

$\vartheta o$ Operating ambient temperature. It is the temperature of the air (or freon) under steady state conditions measured at approximately 0.1m away from the capacitor case.

Rthf Thermal resistance with freon or FG 72 cooling.

L Self inductance of the capacitors: is due to internal connections, terminals, winding characteristics and physical dimensions.




### SELECTING THE CORRECT CAPACITORS (OPERATING LIMITS)

1. VOLTAGE
The surge peak voltage $U_S$, the rated D.C. voltage $U_N$ and the periodic peak voltage $U_{max}$ must be no higher than the operating values.

2. dv/dt LIMITATION
The dv/dt must not exceed the rated value $\frac{dv}{dt} \le \frac{U_{max}}{\tau_1}$

In other words, the peak current must be: $Ipk \le C \cdot \frac{U_{max}}{\tau_1}$

3. CURRENT LIMITATION
The Irms current must not exceed the maximum current Imax.
Irms current can be calculated as follows:

$$I_{rms} = \sqrt{\frac{C^2}{T} \cdot \left( \frac{U_{max}^2}{\tau_1} + \frac{(U_{max} - U_N)^2}{2 \cdot \tau_2} + \frac{U_N^2}{2 \cdot \tau_3} \right)}$$

4. THERMAL CHECK
The power losses are composed of the dielectric losses and the series losses ($R_S I^2_{rms}$) in the metal electrodes, the connections and the contact zone metallization.
The total power dissipated can be calculated as follows:

$$P = \frac{C}{\pi \cdot T} \cdot \left( U_{max}^2 + \frac{(U_{max} - U_N)^2}{2} + \frac{U_N^2}{2} \right) \cdot tan\delta_0 + R_S I^2_{rms}$$

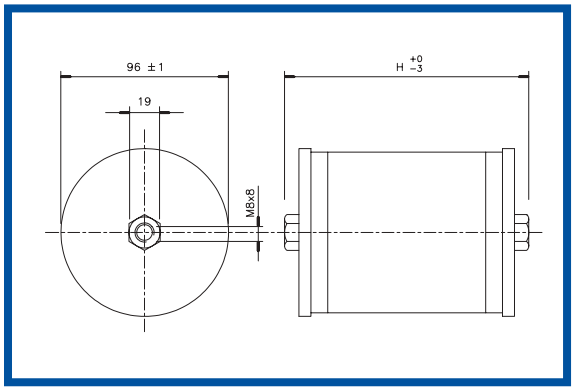
$$\simeq \frac{1}{2} \cdot C \cdot \frac{U^2}{T} tan\delta_0 + R_S I^2_{rms}$$

The hot spot temperature can be calculated with the formula:
$\vartheta h = Rth \cdot P + \vartheta_0$.
The hottest point in the capacitor winding cannot exceed 85°C.

REMARKS
Thermal check supposes that only the heat generated in the capacitor is trasmitted into the environment via the surface of the case. In the case of over heating (poor connections, proximity of the diode etc.) a premature failure is very probable.

# THY W SERIES

THY W series consist of all film dielectric capacitors, impregnated with a synthetic oil without environmental or toxicological problems.
The case is ceramic and the shape is cilindrical.
A special arrangement assures very low series resistance and high capability to withstand inrush currents. The capacitors can operate with freon atmosphere.
Mechanical fixing consists of threaded holes M8.

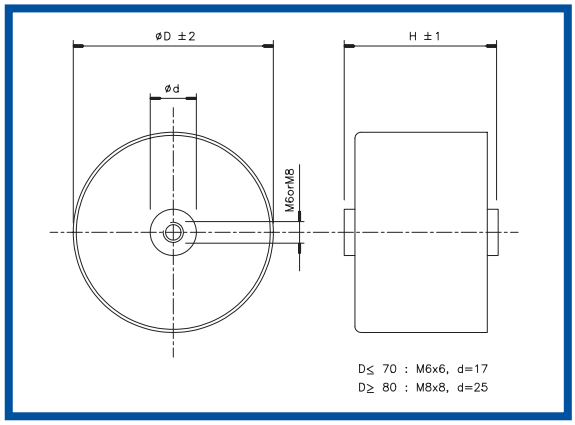



## GENERAL CHARACTERISTICS

| | |
|---|---|
| Self inductance | ≤ 10 nH |
| Time constant between terminals (Rt · C) | > 3000 s |
| Tanδ at 1 kHz | ≤ 5 · $10^{-4}$ |
| Temperature coefficent of capacitance | – 300 ppm/°C |
| Climatic category ϑ min. - 25°C | ϑ max + 85°C |
| Storage temperature ϑ min. - 55°C | ϑ max + 85°C |

| $U_{GTO}$ = 4500V $U_N$ = 3000V $U_{rms}$ = 1250V $U_{max}$ = 3600V $U_S$ = 4500V Voltage Test = 6000 VDC x 10s | | | | | | |
|---|---|---|---|---|---|---|
| MODEL:THY -W 4 X- | 0.5 – 450 | 1 – 450 | 2 – 450 | 3 – 450 | 4 – 450 | 6 – 450 |
| $C_N$ ±10% (µ F), ±5% on request | 0.5 | 1 | 2 | 3 | 4 | 6 |
| $I_{max}$ (A) | 100 | 100 | 100 | 150 | 150 | 150 |
| $R_S$ (mΩ) | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 |
| dv/dt (V/µ s) | 4000 | 3000 | 2000 | 2000 | 1500 | 1000 |
| I peak (A) | 2000 | 3000 | 4000 | 6000 | 6000 | 6000 |
| R th (°C/W) | 10 | 8.5 | 7 | 4.5 | 4 | 3 |
| R thf (°C/W) | 7.5 | 6 | 5 | 3 | 3 | 2 |
| H (mm) | 93 | 93 | 93 | 143 | 143 | 163 |
| Max Tighten Torque (Nm) | 12 | 12 | 12 | 12 | 12 | 12 |

# THYD SERIES




THY D series consists of dry metallized dielectric capacitors, self healing type, with axial terminals. The capacitor winding is enclosed in a plastic can filled with resin. Both are self-extinguishing.
A special arrangement assures a very low series resistance and high capability to withstand inrush currents.
Mechanical fixing consists of threaded holes M6 or M8.

## GENERAL CHARACTERISTICS

| | |
|---|---|
| Self inductance | ≤ 10 nH |
| Time constant between terminals (Rt · C) | > 3000 s |
| Tanδ at 1 kHz | ≤ $3 \cdot 10^{-4}$ |
| Temperature coefficent of capacitance | – 250 ppm/°C |
| Climatic category ϑ min. - 40°C | ϑ max + 85°C |
| Storage temperature ϑ min. - 55°C | ϑ max + 85°C |

| $U_{GTO}$ = 1700V $U_N$ = 1200V $U_{rms}$ = 550V $U_{max}$ = 1350V $U_S$ = 1700V Voltage Test = 1700 VDC x 10s | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| MODEL:THY -D 3 X - | 0.5 –170 | 1 – 170 | 2 – 170 | 3 – 170 | 4 – 170 | 5 – 170 | 6 – 170 | 8 – 170 | 10 – 170 |
| $C_N$ ±5% (µ F) | 0.5 | 1 | 2 | 3 | 4 | 5 | 6 | 8 | 10 |
| $I_{max}$ (A) | 15 | 20 | 40 | 55 | 70 | 75 | 80 | 65 | 75 |
| $R_S$ (mΩ) | 3 | 1.6 | 1 | 0.7 | 0.6 | 0.5 | 0.5 | 0.6 | 0.6 |
| dv/dt (V/µ s) | 750 | 750 | 750 | 750 | 750 | 750 | 750 | 500 | 500 |
| I peak (A) | 400 | 750 | 1500 | 2300 | 3000 | 3800 | 4500 | 4000 | 5000 |
| R th (°C/W) | 18 | 10.7 | 6 | 4.2 | 3.2 | 2.7 | 2.2 | 3.5 | 2.9 |
| Ø (mm) | 40 | 50 | 58 | 70 | 80 | 90 | 90 | 90 | 90 |
| H (mm) | 49 | 49 | 49 | 49 | 52 | 52 | 52 | 62 | 62 |
| Terminals | M6 | M6 | M6 | M6 | M8 | M8 | M8 | M8 | M8 |
| Max Tighten Torque (Nm) | 6 | 6 | 6 | 6 | 10 | 10 | 10 | 10 | 10 |

| $U_{GTO}$ = 2050V $U_N$ = 1600V $U_{rms}$ = 650V $U_{max}$ = 1650V $U_S$ = 2050V Voltage Test = 2200 VDC x 10s | | | | | | | |
|---|---|---|---|---|---|---|---|
| MODEL:THY -D 3 X - | 0.5-205 | 1 – 205 | 2 – 205 | 3 – 205 | 4 – 205 | 5 – 205 | 6 – 205 |
| $C_N$ ±5% (µ F) | 0.5 | 1 | 2 | 3 | 4 | 5 | 6 |
| $I_{max}$ (A) | 15 | 25 | 50 | 65 | 80 | 50 | 65 |
| $R_S$ (mΩ) | 2.4 | 1.4 | 0.8 | 0.7 | 0.6 | 0.5 | 0.7 |
| dv/dt (V/µ s) | 750 | 750 | 750 | 750 | 750 | 500 | 500 |
| I peak (A) | 400 | 750 | 1500 | 2300 | 3000 | 2500 | 3000 |
| R th (°C/W) | 14.2 | 8.3 | 4.6 | 3.2 | 2.4 | 4 | 3.4 |
| Ø (mm) | 40 | 50 | 70 | 80 | 90 | 90 | 90 |
| H (mm) | 49 | 49 | 49 | 52 | 52 | 62 | 62 |
| Terminals | M6 | M6 | M6 | M8 | M8 | M8 | M8 |
| Max Tighten Torque (Nm) | 6 | 6 | 6 | 10 | 10 | 10 | 10 |

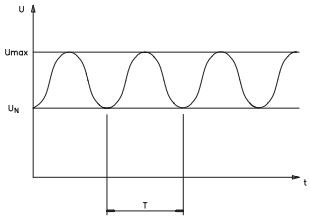
| $U_{GTO}$ = 1400V $U_N$ = 800V $U_{rms}$ = 600V $U_{max}$ = 1100V $U_S$ = 1400V Voltage Test = 1400 VDC x 10s | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| MODEL:THY -D 3 X - | 1–140 | 2–140 | 2,5-140 | 4–140 | 5–140 | 6–140 | 8–140 | 12–140 |
| $C_N$ ±5% (µ F) | 1 | 2 | 2,5 | 4 | 5 | 6 | 8 | 12 |
| $I_{max}$ (A) | 15 | 25 | 30 | 50 | 60 | 70 | 80 | 80 |
| $R_S$ (mΩ) | 1.4 | 0.9 | 0.7 | 0.5 | 0.3 | 0.4 | 0.4 | 0.4 |
| dv/dt (V/µ s) | 750 | 750 | 750 | 750 | 500 | 750 | 500 | 500 |
| I peak (A) | 750 | 1500 | 1800 | 3000 | 2500 | 4500 | 4000 | 6000 |
| R th (°C/W) | 12 | 9 | 3 | 5 | 4,5 | 4 | 3,5 | 3 |
| Ø (mm) | 40 | 50 | 58 | 70 | 70 | 70 | 80 | 90 |
| H (mm) | 49 | 49 | 49 | 49 | 49 | 59 | 59 | 62 |
| Terminals | M6 | M6 | M6 | M6 | M6 | M6 | M8 | M8 |
| Max Tighten Torque (Nm) | 6 | 6 | 6 | 6 | 6 | 6 | 10 | 10 |

| $U_{GTO}$ = 2600V $U_N$ = 2000V $U_{rms}$ = 750V $U_{max}$ = 2100V $U_S$ = 2600V Voltage Test = 2700 VDC x 10s | | | | | | |
|---|---|---|---|---|---|---|
| MODEL:THY -D 3 X | 0.5 – 260 | 1 – 260 | 2 – 260 | 2.5 – 260 | 3 – 260 | 4 – 260 |
| $C_N$ ±5% (µ F) | 0.5 | 1 | 2 | 2.5 | 3 | 4 |
| $I_{max}$ (A) | 20 | 40 | 35 | 40 | 50 | 65 |
| $R_S$ (mΩ) | 2 | 1.1 | 1.2 | 1 | 0.9 | 0.7 |
| dv/dt (V/µ s) | 750 | 750 | 500 | 500 | 500 | 500 |
| I peak (A) | 400 | 750 | 1000 | 1300 | 1500 | 2000 |
| R th (°C/W) | 10.8 | 6.1 | 6.5 | 5.5 | 4.7 | 3.7 |
| Ø (mm) | 50 | 58 | 70 | 80 | 80 | 90 |
| H (mm) | 49 | 49 | 59 | 62 | 62 | 62 |
| Terminals | M6 | M6 | M6 | M8 | M8 | M8 |
| Max Tighten Torque (Nm) | 6 | 6 | 6 | 10 | 10 | 10 |

# CLP

## CLAMPING CAPACITORS (SECONDARY SNUBBER) FOR GATE TURN-OFF THYRISTORS

CLP capacitors have the same mechanical execution of THY but intended for use with a D.C. voltage with superimposed a ripple voltage.
CLP D SERIES consist of dry metallized polypropylene capacitors, self healing type.
CLP W SERIES consist of mixed dielectric (paper - polypropylene) capacitors, metal foil, impregnated with oil.
Standards of reference: IEC 384-1, IEC 68-2, IEC 1071-1.




**THERMAL CHECK** (for definitions and operating limits see also THY explanations)

$$P = \frac{\pi \cdot C}{T} \cdot \frac{(U_{max} - U_N)^2}{4} \cdot \tan \delta_0 + R_s I^2_{rms}$$

$\tan \delta_0 = (4 + F/kHz)\ 10^{-4}$ for CLP W
$\tan \delta_0 = 2 \cdot 10^{-4}$ for CLP D
The hot spot temperature in the capacitor winding cannot exceed 85°C, calculated with following formula: $\vartheta h = Rth \cdot P + \vartheta o$.

## CLP D SERIES

CLP D series consists of dry metallizes dielectric capacitors, self healing type, with axial terminals. The capacitors winding is enclosed in a plastic can filled with resin. Both are self-extinguishing. A special arrangement assures a very low series resistance and high capability to withstand inrush currents. Mechanical fixing consists of threaded holes M8.

### GENERAL CHARACTERISTICS

| | |
|---|---|
| Self inductance | ≤ 10 nH |
| Time constant between terminals (Rt · C) | > 3000 s |
| Tan δ at 1 kHz | $3 \cdot 10^{-4}$ |
| Temperature coefficent of capacitance | – 250 ppm/°C |
| Climatic category ϑ min. - 40°C | ϑ max + 85°C |
| Storage temperature ϑ min. - 55°C | ϑ max + 85°C |

| $U_{GTO}$ =1500V $U_N$ =1000V $U_{rms}$ =450V $U_{max}$ =1200V $U_S$ =1500V Voltage Test =1700 VDC x 10s | | | |
|---|---|---|---|
| MODEL:CLP - D3X - | 13 – 150 | 17 – 150 | 25 – 150 |
| $C_N$ ±10% (µ F) | 13 | 17 | 25 |
| $I_{max}$ (A) | 65 | 75 | 60 |
| $R_S$ (mΩ) | 0.7 | 0.6 | 0.7 |
| dv/dt (V/µ s) | 35 | 35 | 25 |
| I peak (A) | 450 | 600 | 600 |
| R th (°C/W) | 2.9 | 2.3 | 3.0 |
| Ø (mm) | 80 | 90 | 90 |
| H (mm) | 52 | 52 | 62 |
| Terminals | M8 | M8 | M8 |
| Max Tighten Torque (Nm) | 10 | 10 | 10 |

| $U_{GTO}$ =2000V $U_N$ =1350V $U_{rms}$ =500V $U_{max}$ =1600V $U_S$ =2000V Voltage Test =2200 VDC x 10s | | | |
|---|---|---|---|
| MODEL:CLP -D3X - | 9 – 200 | 12 – 200 | 18 – 200 |
| $C_N$ ±10% (µ F) | 9 | 12 | 18 |
| $I_{max}$ (A) | 55 | 80 | 55 |
| $R_S$ (mΩ) | 0.8 | 0.7 | 0.8 |
| dv/dt (V/µ s) | 40 | 40 | 25 |
| I peak (A) | 360 | 480 | 450 |
| R th (°C/W) | 3.1 | 2.4 | 3.2 |
| Ø (mm) | 80 | 90 | 90 |
| H (mm) | 52 | 52 | 62 |
| Terminals | M8 | M8 | M8 |
| Max Tighten Torque (Nm) | 10 | 10 | 10 |

| $U_{GTO}$ =2500V $U_N$ =1650V $U_{rms}$ =550V $U_{max}$ =2000V $U_S$ =2500V Voltage Test =2700 VDC x 10s | | | |
|---|---|---|---|
| MODEL:CLP - D3X - | 5 – 250 | 6.5 – 250 | 10 – 250 |
| $C_N$ ±10% (µ F) | 5 | 6.5 | 10 |
| $I_{max}$ (A) | 50 | 70 | 50 |
| $R_S$ (mΩ) | 0.9 | 0.8 | 0.9 |
| dv/dt (V/µ s) | 55 | 55 | 35 |
| I peak (A) | 250 | 350 | 350 |
| R th (°C/W) | 3.4 | 2.6 | 3.5 |
| Ø (mm) | 80 | 90 | 90 |
| H (mm) | 52 | 52 | 62 |
| Terminals | M8 | M8 | M8 |
| Max Tighten Torque (Nm) | 10 | 10 | 10 |

## CLP W SERIES

CLP W series consits of mixed dielectric capacitors, impregnated with a synthetic oil without environmental or toxicologic problems.
The case is ceramic and the shape is cilindrical. A special arrangement assures very low series resistance and high capability to withstand inrush currents. The capacitors can operate with freon atmosphere. Mechanical fixing consists of threaded holes M8.

### GENERAL CHARACTERISTICS

| | |
|---|---|
| Self inductance | ≤ 10 nH |
| Time constant between terminals (Rt · C) | > 3000 s |
| Tan δ at 1 kHz | $1 \cdot 10^{-3}$ |
| Temperature coefficent of capacitance | – 200 ppm/°C |
| Climatic category ϑ min. - 25°C | ϑ max + 85°C |
| Storage temperature ϑ min. - 55°C | ϑ max + 85°C |

| CLP W | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $U_{GTO}$ 4500V | $U_N$ 3000V | $U_{rms}$ 1000V | $U_{max}$ 3600 | $U_S$ 4500V | | | | |
| MODEL: CLP - W4X - 10 - 450 Voltage Test: 5000 VDC x 10s | | | | | | | | |
| $C_N$ ±10%(µ F) | $I_{max}$(A) | $R_S$(mΩ) | dv/dt(V/µ s) | I peak(A) | R th(°C/W) | R thf(°C/W) | H(mm) | Ø(mm) |
| 10 | 100 | 0,15 | 600 | 6000 | 3 | 2 | 183 | 96 |
| Different capacitance on request | | | | | | | | |

# ICAR PRODUCTS

ICAR provides a first class service in the following products:

- power electronics capacitors
- metallized capacitors for A.C. application, with metal or plastic case, and overpressure disconnector;
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- coupling capacitors and capacitor voltage transformers;
- energy storage and pulse capacitors;
- high voltage D.C. generators;
- radio interference suppression filters;
- delay and pulse networks.

capacità & sicurezza

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THY-CLP 92