

THY-CLP

CAPACITORS FOR GTO THYRISTORS

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capacità & sicurezza

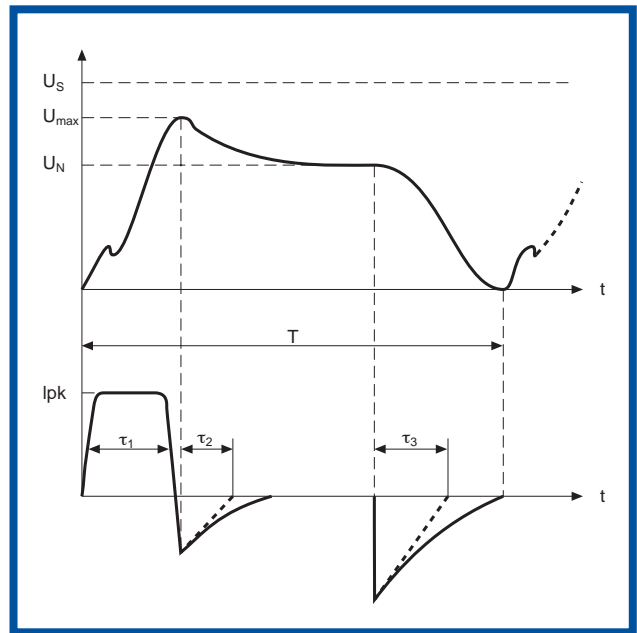
THY

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 cylindrical, axial terminals. THY D series consists of dry metallized polypropylene capacitors, self-healing type. THY W series consists of all polypropylene film dielectric capacitors, 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.
τ	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 $2 \cdot 10^{-4}$.
$\tan\delta$	Dissipation factor is calculated as follows: $\tan\delta = \tan\delta_0 + 2 \cdot \pi \cdot C \cdot F \cdot R_s$.
dv/dt	The dv/dt value is the maximum slope of the voltage wave-shape during charging or discharging of the capacitor and is expressed in V/ μ s. The consequent peak current can be calculated as follows: $I_{pk} = C \cdot \frac{dv}{dt}$
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: $(\vartheta_h - \vartheta_0) / R_{th} = P$.
ϑ_h	Hottest point in the capacitor winding.
ϑ_0	Operating ambient temperature. It is the temperature of the air (or freon) under steady state conditions measured at approximately 0.1 m 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 $\frac{dv}{dt} \leq \frac{U_{max}}{\tau_1}$

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

3. CURRENT LIMITATION

The rms current must not exceed the maximum current I_{max} . rms 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 ($R_s I_{rms}^2$) in the metal electrodes, the connections and the contact zone metallization.

The total power dissipated can be calculated as follows:

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

$$\approx \frac{1}{2} \cdot C \cdot \frac{U^2}{T} \tan\delta_0 + R_s I_{rms}^2$$

The hot spot temperature can be calculated with the formula:

$$\vartheta_h = R_{th} \cdot P + \vartheta_0$$

The hottest point in the capacitor winding cannot exceed 85°C.

REMARKS

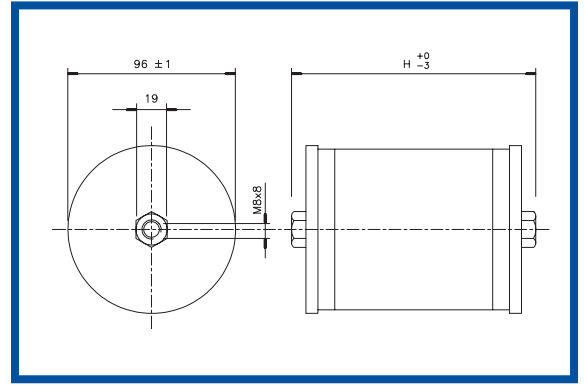
Thermal check supposes that only the heat generated in the capacitor is transmitted into the environment via the surface of the case. In the case of over heating (poor connections, proximity of the diode etc.) a premature failure is very probable.

THYW 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 cylindrical. 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 ($R_t \cdot C$)	> 3000 s
Tan δ at 1 kHz	$\leq 5 \cdot 10^{-4}$
Temperature coefficient of capacitance	$- 300$ ppm/ $^{\circ}$ C
Climatic category ϑ min. - 25 $^{\circ}$ C	ϑ max + 85 $^{\circ}$ C
Storage temperature ϑ min. - 55 $^{\circ}$ C	ϑ max + 85 $^{\circ}$ C



$U_{GTO} = 4500V$ $U_{II} = 3000V$ $U_{rms} = 1250V$ $U_{max} = 3600V$ $U_{\zeta} = 4500V$ Voltage Test = 6000 VDC x 10s							
MODEL:THY -W 4 X-	0.5 - 450	1 - 450	2 - 450	3 - 450	4 - 450	6 - 450	
$C_{II} \pm 10\%$ (μ F), $\pm 5\%$ on request	0.5	1	2	3	4	6	
I_{max} (A)	100	100	100	150	150	150	
R_{ζ} (m Ω)	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 ($^{\circ}$ C/W)	10	8.5	7	4.5	4	3	
R thf ($^{\circ}$ 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	

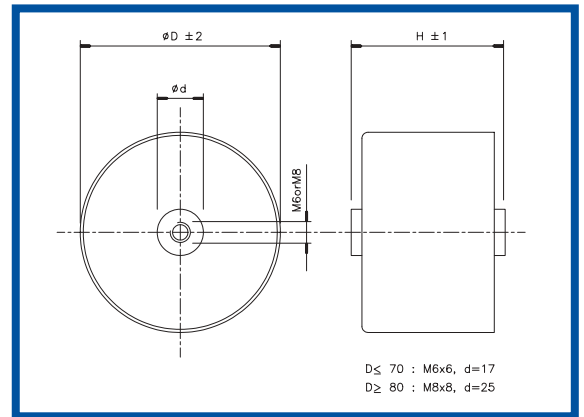


THYD SERIES

THY D series consists of dry metallized dielectric capacitors, self heating 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 $\leq 3 \cdot 10^{-4}$
 Temperature coefficient 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
$C_N \pm 5\%$ (μF)	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/μs)	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
$C_N \pm 5\%$ (μF)	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/μs)	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		
$C_N \pm 5\%$ (μF)	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/μs)	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
$C_N \pm 5\%$ (μF)	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/μs)	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



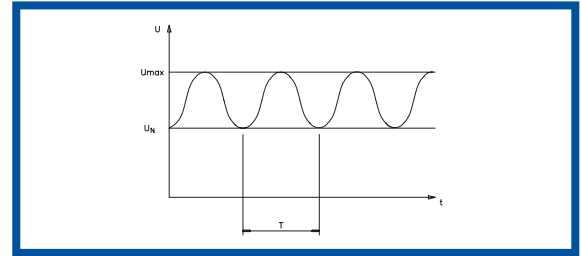
CLP

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)

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

$\tan \delta_0 = (4 + f/\text{kHz}) \cdot 10^{-4}$ 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: $\vartheta_h = R_{th} \cdot P + \vartheta_0$.

CLP D SERIES

CLP D series consists of dry metallized 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 · 10 ⁻⁴
Temperature coefficient 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

CLP W SERIES

CLP W series consists of mixed dielectric capacitors, impregnated with a synthetic oil without environmental or toxicologic problems. The case is ceramic and the shape is cylindrical. 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 · 10 ⁻³
Temperature coefficient 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%(μF)	I _{max} (A)	R _s (mΩ)	dv/dt(V/μs)	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									

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% (μF)		13	17	25
I _{max}	(A)		65	75	60
R _s	(mΩ)		0.7	0.6	0.7
dv/dt	(V/μs)		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% (μF)		9	12	18
I _{max}	(A)		55	80	55
R _s	(mΩ)		0.8	0.7	0.8
dv/dt	(V/μs)		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% (μF)		5	6.5	10
I _{max}	(A)		50	70	50
R _s	(mΩ)		0.9	0.8	0.9
dv/dt	(V/μs)		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



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 disconnectors;
- low and high voltage, medium and high frequency, power factor correction capacitors and automatically switched banks with harmonic filtering systems;
- coupling capacitors and capacitor voltage transformers;
- energy storage and pulse capacitors;
- high voltage D.C. generators;
- radio interference suppression filters;
- delay and pulse networks.



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