

T-25-19

ORDERING CODE

The full thyristor code identifies the current and voltage rating, dv/dt and turn off time.

HR 220	CH	06	F	H	O
	1	2	3	4	5

1. Gives the basic thyristor type based on the current rating to be selected from the tables.
2. This place is occupied by 2 digits, which when multiplied by 100 gives the VRRM of the thyristor in which against 06 represents 600 volts VRRM.
3. Gives the dv/dt as follows:

dv/dt table

C=20	volts per micro second
D=50	volts per micro second
E=100	volts per micro second
F=200	volts per micro second
H=400	volts per micro second
K=750	volts per micro second
L=1000	volts per micro second

4. Gives the turn-off time as follows:

Turn off time table

N=10	micro seconds
L=15	micro seconds
K=20	micro seconds
J=25	micro seconds
H=30	micro seconds
F=50	micro seconds

5. This is a spare position used for any special parameters such as matching for parallel series operations.

PHASE CONTROL: TOP HAT

Thyristor Type	Available Voltage Grades (V)	$I_T(AV)$ at T_{CASE}		$I_T(RMS)$ (A)	I_{TSM} (A)	I_t^2 10ms (A ² secs × 10 ³)	V_{peak} at I_{peak}		$R_{TH(J-C)}$ dc & 180° 120° Rect sine	
		(A)	(C°)				(V)	(A)	(°C/W)	(°C/W)
H500T	200-1500	500	65	785	14000	975	1.55	1570	0.08*	0.09
H450T	200-1500	450	75	706	13500	911	1.50	1420	0.08*	0.09
H400T	200-1500	400	75	628	13000	845	1.56	1260	0.08*	0.09
H350T	200-1500	350	85	550	12650	800	1.51	1090	0.08*	0.09
H300T	200-1500	300	85	470	10120	512	1.65	1000	0.08*	0.09
H250T	200-1500	250	78	392	5120	131	1.70	785	0.12	0.14
H175T	200-1500	175	85	330	4620	107	1.76	550	0.12	0.14
H150T	200-1500	150	70	235	3000	45	1.80	470	0.21	0.26
H125T	200-1500	125	70	195	2500	31	2.00	400	0.21	0.26
H110T	200-1500	110	75	173	2100	22	2.15	390	0.21	0.26
H 85T	200-1500	85	85	133	1850	17	2.15	265	0.21	0.26
H 65T	200-1500	65	75	100	1100	6.05	2.20	200	0.35	0.40
H 55T	200-1500	55	75	86	1000	5.00	2.15	172	0.40	0.45
H 45T	200-1500	45	85	70	863	3.72	2.22	140	0.45	0.52
H 30T	200-1500	30	85	47	550	1.52	1.93	94	0.60	0.68
H 25T	200-1500	25	85	40	450	1.02	1.80	78	0.85	1.00
H 20T	200-1500	20	85	31	350	0.162	2.05	63	1.00	1.20
H 16T	200-1500	16	95	25	250	0.312	1.90	50	1.00	1.20
H 10T	200-1500	10	95	16	200	0.200	1.70	32	1.00	1.20

* For flat base

PHASE CONTROL: CAPSULE

Thyristor Type	Available Voltage Grades (V)	$I_T(AV)$ at T_{sink}		$I_T(RMS)$ (A)	I_{TSM} (A × 10 ³)	I_t^2 10ms (A ² S)	V_{peak} at I_{peak}		di/dt Non-Rep /Rep (A/MS)
		(A)	(C°)				(V)	(A)	
HN105CHX	200-1500	256	55	500	2695	36.3 × 10 ³	1.89	550	1000/500
HN195CHX	200-1500	390	55	780	5120	131 × 10 ³	1.75	840	1000/500
HN281CHX	200-1800	680	55	1350	8300	345 × 10 ³	2.0	1550	1000/500
HN330CHX	1600-2400	690	55	1370	8800	387 × 10 ³	1.94	1480	500/300
HN350CHX	200-1800	820	55	1640	12650	800 × 10 ³	1.75	1700	1000/500
HN390CHX	2200-3800	940	55	1870	14300	1.0 × 10 ⁶	2.08	1830	400/200
HN450CHX	1400-2400	1080	55	2140	17600	1.6 × 10 ⁶	1.9	2300	500/300
HN540CHX	200-1800	1400	55	2840	22600	2.5 × 10 ⁶	1.41	2550	1000/500

FAST SWIT

R _{TH(J-HS)} (°C/W)	V _o (V)	r (mΩ)	I _{GT} /V _{GT} (mA/V at 25°C)	V _{FGM} (V)	I _{FGM} (A)	P _{GM} (W)	P _G (W)	T _{bd} (°C)	I _D (mA)	I _R (mA)	I _L (mA)	Wt (gm)	Torque (Kg-M)	Fig No.
-	1.06	0.31	300/3	32	20	120	2	-30 +125	60	60	1000	750	1.65-2.07	6
-	1.00	0.35	300/3	32	20	120	2	-30 +125	60	60	1000	750	1.65-2.07	6
-	1.08	0.40	300/3	32	20	120	2	-30 +125	60	60	1000	750	1.65-2.07	5
-	1.00	0.50	300/3	32	20	120	2	-30 +125	60	60	1000	750	1.65-2.07	5
-	1.04	0.61	300/3	32	20	120	2	-30 +125	60	60	1000	750	1.65-2.07	5
0.04	0.92	0.99	150/3	18	20	100	2	-30 +125	20	20	600	250	2.50-2.77	4
0.04	1.08	1.30	150/3	18	20	100	2	-30 +125	20	20	600	250	2.50-2.77	4
0.08	0.90	1.80	150/3	18	20	100	2	-30 +125	15	15	250	150	1.38-1.45	3
0.08	1.20	1.90	150/3	18	20	100	2	-30 +125	15	15	250	150	1.38-1.45	3
0.08	1.35	2.05	150/3	18	20	100	2	-30 +125	15	15	250	150	1.38-1.45	3
0.08	1.57	2.29	150/3	18	20	100	2	-30 +125	15	15	250	150	1.38-1.45	3
0.10	0.89	6.10	100/3	25	5	20	1	-30 +125	15	15	200	40	0.41-0.48	2
0.10	0.97	6.80	100/3	25	5	20	1	-30 +125	15	15	200	40	0.41-0.48	2
0.10	1.10	7.90	100/3	25	5	20	1	-30 +125	15	15	200	40	0.41-0.48	2
0.10	1.17	8.10	100/3	20	5	20	1	-30 +125	15	15	150	30	0.41-0.48	1
0.10	1.20	8.30	100/3	20	5	20	1	-30 +125	15	15	150	30	0.41-0.48	1
0.10	1.30	9.50	100/3	20	5	20	1	-30 +125	15	15	150	30	0.41-0.48	1
0.10	1.35	10.20	100/3	20	5	20	1	-30 +125	15	15	150	30	0.41-0.48	1
0.10	0.40	12.50	100/3	20	5	20	1	-30 +125	15	15	75	30	0.41-0.48	1

devices the figures given are R_{TH} (J-HS)

R _{TH(J-HS)} dc & 180° Sine (°C/W)	R _{TH(J-HS)} 120° Rect (°C/W)	V _o (V)	r (mΩ)	I _{GT} /V _{GT} (mA/v) at 25°C	P _{GM} (W)	V _{FGM} (V)	I _{FGM} (A)	P _G (W)	T _{bd} (°C)	I _D (mA)	I _R (mA)	I _L (mA)	Wt. (gm)	Torque (Kg-M)	Fig No.
0.135	0.19	0.9	1.79	150/3	100	18	20	2	-30 +125	20	20	600	70	330 - 550	7
0.095	0.11	0.92	0.99	150/3	100	18	20	2	-30 +125	20	20	600	70	330 - 550	7
0.05	0.058	1.09	0.587	150/3	100	18	20	2	-30 +125	40	40	500	80	530 - 1000	8
0.047	0.06	1.04	0.61	300/3	120	32	20	2	-30 +125	60	60	1000	340	1000 - 2000	9
0.044	0.05	1.08	0.4	300/3	120	32	20	2	-30 +125	60	60	1000	340	1000 - 2000	9
0.03	0.0366	1.15	0.51	300/3	120	32	20	2	-30 +125	100	100	1000	510	1900 - 2600	10
0.03	0.0366	1.03	0.39	300/3	120	32	20	2	-30 +125	100	100	1000	510	1900 - 2600	10
0.03	0.0366	0.97	0.17	300/3	120	32	20	2	-30 +125	100	100	1000	510	1900 - 2600	10

HIGH FREQ

Thyristor Type	V _{DR} V _{RRM} (V)
HR220CHx	200 -
HR305CHx	1200 -
HR395CHx	1200 -
HR400CHx	200 -

FAST SWIT

Thyristor Type	Average V _G
HP095CHX	200
HP205CHX	200
HP300CHX	200

Thyristor Type	Average V _G
HP036PHX	200 800
HP095PHX	200
HP205PHX	200
HP300KHx	200

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CHING: TOP HAT

Available Voltage Grades (V)	T _q (μSec)	I _{T(AV)} at T _{CASE}		I _{T(RMS)} (A)	I _{T(SM)} (A)	I _t ² (A ² Sec)	di/dt Non-Rep/Rep (A/μs)	Q _{rr} (μctyp)	V _{peak} at I _{peak}		R _{TH(J-HS)} dc & 180° sine	R _{TH(J-C)} 120° Rect	R _{TH(C-HS)}	V _o (V)
		(A)	(°C)						(°C/W)	(°C/W)	(°C/W)			
- 600 - 1000 200	10 - 25 20 - 35 35	40	85	100	690	2380	400/200	10	2.29	126	0.45	0.52	0.1	1.5
- 1200	25 - 40	85	85	175	2035	20.7 × 10 ³	1000/500	13	1.92	280	0.23	0.28	0.08	1.35
- 1200	30 - 40	205	85	355	3960	78.4 × 10 ³	1000/500	32	1.72	600	0.12	0.14	0.04	1.17
- 1200	25 - 35	300	*	550	10450	546 × 10 ³	1000/500	80	1.75	1025	0.08	0.09	-	1.43

* at 85°C T_{sink}

CHING: CAPSULE

Available Voltage Grades (V)	T _q (μSec)	I _{T(AV)} at T _{sink}		I _{T(RMS)} (A)	I _{T(SM)} (A)	I _t ² (A ² Sec)	di/dt Non-Rep/Rep (A/μs)	Q _{rr} (μctyp)	V _{peak} at I _{peak}		R _{TH(J-HS)} 180° sine	R _{TH(J-HS)} 120° Rect	V _o (V)	r (m Ω)
		(A)	(°C)						(°C/W)	(°C/W)				
- 1200	25 - 40	220	55	428	2035	20.7 × 10 ³	1000/500	13	2.23	430	0.135	0.19	1.35	2.04
- 1200	30 - 40	370	55	740	3960	78.4 × 10 ³	1000/500	32	1.83	715	0.095	0.11	1.17	0.92
- 1200	20 - 35	745	55	1535	10450	546 × 10 ³	1000/500	80	1.83	1300	0.047	0.06	1.43	0.31

FREQUENCY DISTRIBUTED GATE: CAPSULE

V _m / V _{im}	T _q (200V/μs) (μsec)	I _{Tav} T _{hs} 55°C (A)	I _{TRM(A)} 50% Duty Cycle T _{sink} 55°C sine wave square wave 100A/μsec						di/dt Rep/Non rep (A/μsec)	I _{TRMS} 25°C (A)	I _T 25°C (A)	I _{TSM(1)} V _{R<50%} V _{RRM} 10m sec (A)	I _{TSM(2)} V _{R<10V} 10m sec (A)	I _t ² 10m sec (A ² s)	Recovered Charge Typ, Max., at I _T & di/dt				I _{DRM} I _{RRM} (mA)
			1KHz	5KHz	10KHz	1KHz	5KHz	10KHz							(μc)	(μc)	(A)	(A/μsec)	
1200	30 - 40	715	2000	1750	1450	1450	1200	1050	1000/1500	1475	1135	9400	10800	580 × 10 ³	150	100	1000	80	70
1800	60 - 70	915	2800	1900	1350	1650	1350	1050	1000/1500	1860	1480	13500	15000	1130 × 10 ³	400	330	1000	80	100
1800	65 - 75	1050	3100	2050	1600	1950	1450	1200	1000/1500	2140	1720	15500	17000	1450 × 10 ³	420	340	1000	80	100
1200	25 - 35	1162	3600	2500	1900	2200	1750	1500	1000/1500	2390	1870	19500	21500	2300 × 10 ³	170	130	1000	80	100

r	I _{GT} / V _{GT}	V _{FGM}	I _{FGM}	P _{GM}	P _G	T _{bd}	I _b	I _R	I _L	Wt.	Torque	Fig No.
(m Ω)	mA/v at 25° C	(V)	(A)	(W)	(W)	(°C)	(mA)	(mA)	(mA)	(gm.)	(Kg-M)	
6.3	100/3	25	5	20	1	-40 +125	10	10	400	33	0.41-0.48	2
2.04	200/3	20	14	60	1.5	-40 +125	20	20	600	130	1.45	3
0.92	200/3	12	18	60	1.5	-40 +125	30	30	600	280	2.5-2.77	4
0.31	300/3	18	20	120	2.0	-40 +125	75	75	1000	1000	1.65-2.07	5

I _{GT} / V _{GT}	V _{FGM}	I _{FGM}	P _{GM}	P _G	T _{bd}	I _b	I _R	I _L	Wt.	Torque	Fig No.
mA/v at 25° C	(V)	(A)	(W)	(W)	(°C)	(mA)	(mA)	(mA)	(gm.)	(Kg-M)	
200/3	20	14	60	1.5	-40 +125	20	20	600	70	330 - 550	7
200/3	12	18	60	1.5	-40 +125	30	30	600	70	330 - 550	7
300/3	18	20	120	2.0	-40 +125	75	75	1000	340	1000 - 2000	9

I _{GT} / V _{GT}	I _{FGM}	V _{FGM}	P _{G av}	P _{GM}	V _{TM} at I _{TM}	V _o	r	R _{th} j-sink d.c & 180° 120° sine Rect		Wt.	Torque	Fig No	
(mA/V)	(A)	(V)	(W)	(W)	(V)	(A)	(V)	(m Ω)	(°C/W)	(°C/W)	(gm)	(Kg-M)	
300/3	36	16	2.0	120	1.96	1400	1.50	0.33	0.047	0.06	340	1000/2000	9
300/3	36	16	2.0	120	2.3	2000	1.55	0.375	0.032	0.039	510	1900/2600	10
300/3	36	16	2.0	120	1.9	2000	1.30	0.30	0.032	0.039	510	1900/2600	10
300/3	36	16	2.0	120	1.7	2000	1.30	0.20	0.032	0.039	510	1900/2600	10

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MEAN CURRENT RATINGS

Power loss of a thyristor for a given I_T (AV) is calculated with the help of this formula:

$$W = V_o \cdot I_T + (I_{RMS})^2 \cdot r$$

Where

- W = Power loss ; to be calculated.
- V_o = Threshold Voltage ; taken from the table.
- r = Slope resistance ; taken from the table.
- I_{RMS} = I_T (AV) . Form factor .

Form factors mostly used are:

- For D.C. = 1.00
- For single phase, 180° conduction = 1.572
- For three phase, 120° conduction = 1.73
- For six phase, 60° conduction = 2.44

First, you choose a device with suitable I_T (AV) safety margin. You ensure that the chosen device has an I_T² rating which meets with the fusing requirements of the circuit.

Thermal impedance can be calculated using this formula:

$$T_j = T_{\text{ambient}} + [R_{TH}(J-C) + R_{TH}(C-HS) + R_{TH}(H-A)] \cdot W$$

Where;

T_j = junction temperature 125 deg.; we, with safety margin take it as 122°C.

- T_{ambient} = working temperature ; say 55°C.
- W = power loss ; already calculated.
- R_{TH}(J-C) = thermal impedance from junction to case ; taken from the table.
- R_{TH}(C-HS) = thermal impedance from the case to heat sink ; taken from the table.
- R_{TH}(HS-A) = thermal impedance from the heat sink to ambient ; to be calculated.

Consider the following example:

A single phase full wave bridge at 180° conduction, fully controlled, giving an output of 500 amps at 55°C ambient is required. The thyristor which could be selected is H400T(x).

Now, I_T(AV) per device in the bridge = 250 amps.

$$\therefore I_{RMS} = 1.572 \times 250 \text{ amps} = 393 \text{ amps.}$$

For H 400T (x);

$$V_o = 1.08 \text{ volts.}$$

$$r = 0.4 \text{ m}\Omega = 0.0004 \Omega$$

$$W = (1.08) \cdot (250) + (393) \cdot (0.0004)$$

$$\therefore W = 332 \text{ Watts (approx.)}$$

Hence, R_{TH}(HS-A) would be;

$$122 = 55 + (332) [(0.08 + R_{TH}(HS-A))]$$

$$67 = (332) [(0.08 + R_{TH}(HS-A))]$$

$$\therefore R_{TH}(HS-A) = 0.12^\circ\text{C/W}$$

Thus, an user must select a heat sink whose thermal impedance from heat sink to ambient is less than 0.12°C/W. Hirect's heat sink, TH80, has 0.1°C/W as its R_{TH}(HS-A) with a forced air cooling of 5 m/sec.

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