

### Phase Control Thyristors

#### FEATURES

- Amplified gate structure
- Qualified for industrial level
- International standard case TO-200AB
- Metal case with ceramic insulator

#### TYPICAL APPLICATIONS

- Controlled DC power supplies
- AC controllers
- DC motor controls
- AC switches

MAJOR RATINGS AND CHARACTERISTICS			
PARAMETER	TEST CONDITIONS	VALUES	UNITS
$I_{T(AV)}$		650	A
	$T_{Case}$	70	°C
$I_{T(RMS)}$		1020	A
	$T_{Case}$	70	°C
$I_{TSM}$	50 Hz	11470	A
	60 Hz	12500	A
$I^2t$	50 Hz	595	kA <sup>2</sup> s
	60 Hz	649	kA <sup>2</sup> s
$V_{DRM}/V_{RRM}$		200 to 1600	V
$t_q$	Typical	100	µs
$T_J$		-40 to 125	°C

#### ELECTRICAL SPECIFICATIONS

VOLTAGE RATINGS				
SERIES	VOLTAGE CODE	$V_{DRM}/V_{RRM}$ , MAX. RE- PETITIVE PEAK AND OFF-STATE VOLTAGE	$V_{RSM}$ , MAX. NON- REPETITIVE PEAK VOLTAGE (V)	$I_{DRM}/I_{RRM}$ , MAX. at $T_J$ = $T_{J(Max.)}$ (mA)
N650/...	02	200	300	40
N650/...	04	400	500	
N650/...	06	600	700	
N650/...	08	800	900	
N650/...	10	1000	1100	
N650/...	12	1200	1300	
N650/...	14	1330	1500	
N650/...	16	1520	1700	

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MAXIMUM ALLOWABLE RATINGS					
SYMBOL	DESCRIPTION	TEST CONDITIONS		VALUE	UNITS
$I_{T(AV)}$	Maximum average on-state current at heatsink temperature	180° conduction, half sine wave, double side cooled		650	A
				70	°C
$I_{T(RMS)}$	Maximum RMS on-state current	DC at 25°C heatsink temperature, double side cooled		1020	A
$I_{TSM}$	Maximum peak, one-cycle non-repetitive surge current	t = 10 ms	100% $V_{RRM}$ reapplied	Sinusoidal half wave, initial $T_j = T_j \text{ max.}$	kA
		t = 8.3 ms			
		t = 10 ms	No voltage reapplied		
		t = 8.3 ms			
$I^2t$	Maximum $I^2t$	t = 10 ms	100% $V_{RRM}$ reapplied		kA <sup>2</sup> s
		t = 8.3 ms			
		t = 10 ms	No voltage reapplied		
		t = 8.3 ms			
$I^2t^{1/2}$	Maximum $I^2t^{1/2}$	t = 0.1 to 10 ms, no voltage reapplied		7110	kA <sup>2</sup> s <sup>1/2</sup>
$V_{T(TO)}$	Low level threshold voltage	(16.7% $\times \pi \times I_{T(AV)} < I < \pi \times I_{T(AV)}$ ), $T_j = T_j \text{ max.}$		0.879	V
$r_T$	Low level on-state slope resistance			0.490	mΩ
$V_{TM}$	Maximum on-state voltage	$I_{pk} = 2040A$ , 50Hz half sine pulse, $T_j = T_j \text{ max.}$		1.82	V
$I_H$	Maximum holding current	$T_j = 25^\circ C$ , anode supply 12V resistive load		500	mA
$I_L$	Typical latching current			400	

SWITCHING					
SYMBOL	DESCRIPTION	TEST CONDITIONS		VALUE	UNITS
dI/dt	Maximum non-repetitive rate of rise of turned-on current	Gate drive 20 V, 20 Ω, $t_r \leq 1 \mu s$ , $T_j = T_j \text{ max.}$ , anode voltage $\leq 80\% V_{DRM}$		800	A/ $\mu s$
$t_d$	Typical delay time	Gate current 1 A, $dI_g/dt = 1 A/\mu s$ , $V_d = 0.67\% V_{DRM}$ , $T_j = 25^\circ C$		0.7	$\mu s$
$t_q$	Typical turn-off time			100	

BLOCKING					
SYMBOL	DESCRIPTION	TEST CONDITIONS		VALUE	UNITS
dV/dt	Maximum critical rate of rise of off-state voltage	$T_j = T_j \text{ max.}$ Linear to 80% rated $V_{DRM}$		1000	V/ $\mu s$
$I_{RRM}, I_{DRM}$	Maximum peak reverse and off-state leakage current	$T_j = T_j \text{ max.}$ , rated $V_{DRM}/V_{RRM}$ applied		40	mA

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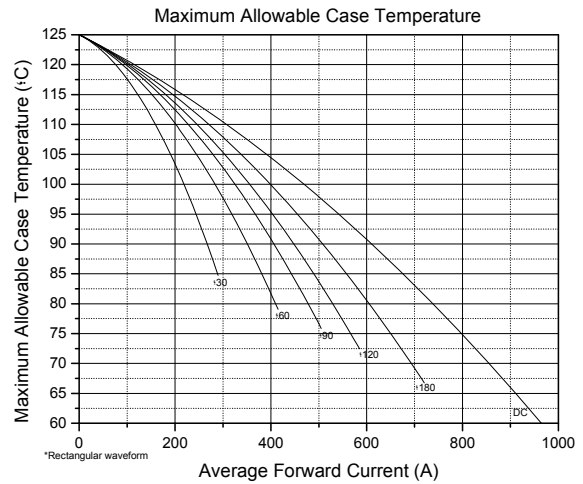
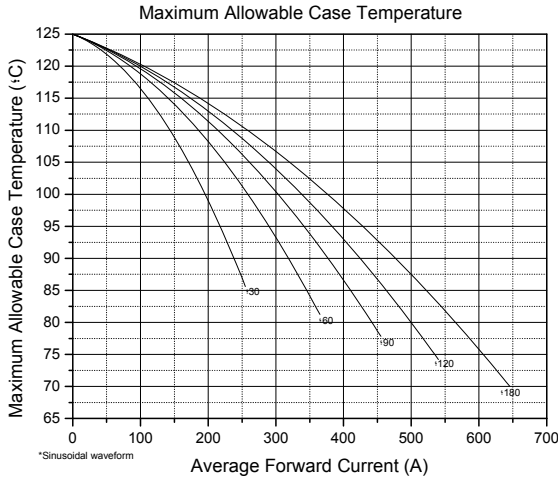
TRIGGERING						
SYMBOL	DESCRIPTION	TEST CONDITIONS	VALUE		UNITS	
			TYP.	MAX.		
$P_{GM}$	Maximum peak gate power	$T_J = T_J \text{ max.}, t_p \leq 5\text{ms}$	16		W	
$P_{G(AV)}$	Maximum average gate power	$T_J = T_J \text{ max.}, f = 50\text{Hz}, d\% = 50$	3			
$I_{GM}$	Maximum peak gate current	$T_J = T_J \text{ max.}, t_p \leq 5\text{ms}$	2		A	
$-V_{GM}$	Maximum negative gate voltage	$T_J = T_J \text{ max.}, t_p \leq 5\text{ms}$	5		V	
$I_{GT}$	DC gate current to trigger	$T_J = -40^\circ\text{C}$	Maximum required gate trigger/current/voltage are the lowest values which will trigger all units, 12V anode to cathode applied	-	360	mA
		$T_J = 25^\circ\text{C}$		80	180	
$V_{GT}$	DC gate voltage to trigger	$T_J = -40^\circ\text{C}$		-	6	V
		$T_J = 25^\circ\text{C}$		1.3	3	
$V_{GD}$	DC gate voltage not to trigger	$T_J = T_J \text{ max.}$	0.3		V	

THERMAL AND MECHANICAL SPECIFICATIONS						
SYMBOL	DESCRIPTION	TEST CONDITIONS	VALUE	UNITS		
$T_J$	Maximum operating junction temperature	-	-40 to 125	°C		
$T_{Stg}$	Maximum storage temperature	-	-40 to 150			
$R_{thJ-hs}$	Maximum thermal resistance, junction to heatsink	DC, double side cooled	0.04	°C/W		
		180° sine wave, double side cooled	0.052			
		120° rectangular wave, double side cooled	0.053			
$R_{thC-hs}$	Maximum thermal resistance, case to heat-sink	Mtg. Surface smooth, flat, greased, double side cooled	0.02			
-	Mounting force, ± 10%	-	900			kgf
-	Approximate weight	-	85			g
-	Case style	-	TO-200AB	JEDEC		

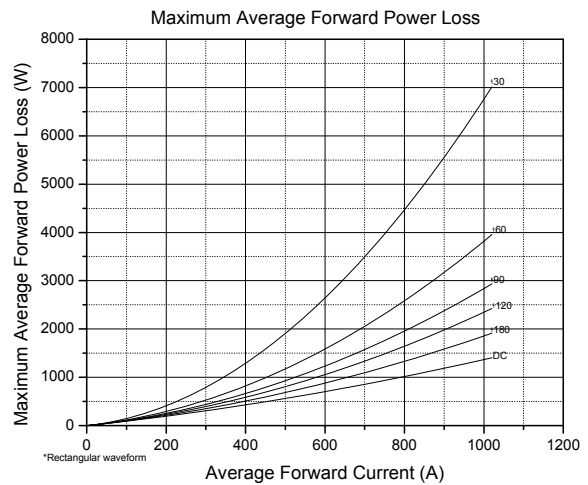
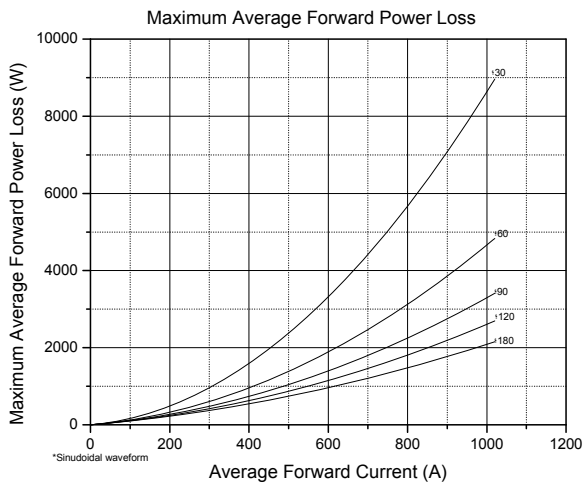
CURRENT FORM FACTOR								
FORM FACTOR	CONDUCTION ANGLE	15°	30°	45°	60°	90°	120°	180°
		Sine wave		31.956	15.832	10.452	7.721	4.933
Rectangular wave		24.000	12.000	8.000	6.000	4.000	3.000	2.000

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#### CURRENT RATINGS CHARACTERISTICS

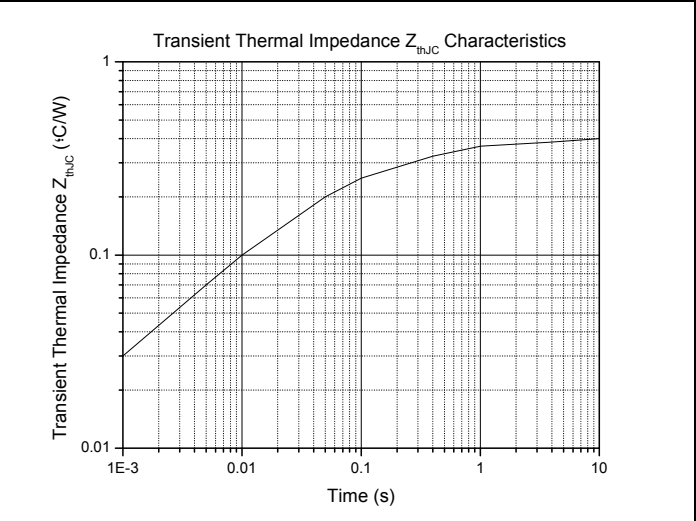
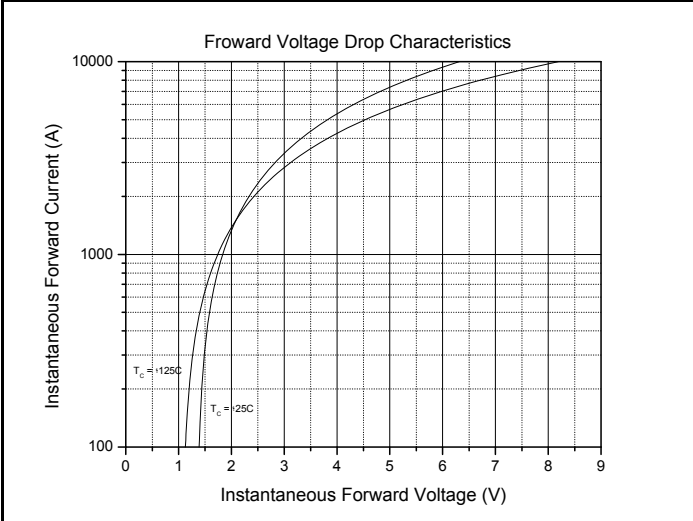


#### ON-STATE POWER LOSS CHARACTERISTICS

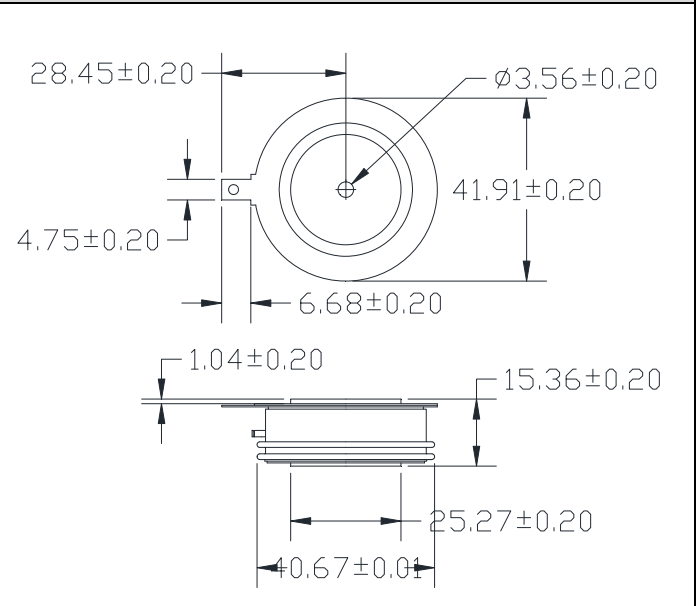
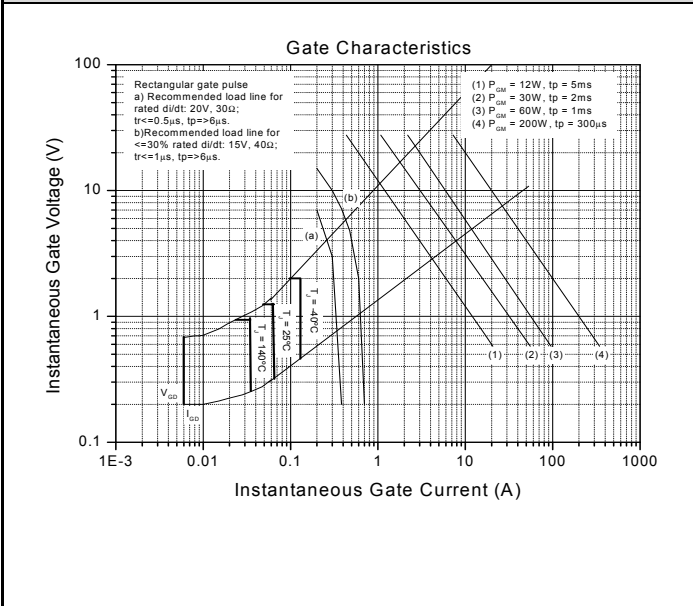


### Phase Control Thyristors

#### FORWARD VOLTAGE DROP / THERMAL IMPEDANCE CHARACTERISTICS



#### GATE TRIGGER / OUTLINE CHARACTERISTICS



### Phase Control Thyristors

**ORDERING INFORMATION**

**Device code**

N	650	/	16	-	-	-
①	②	③	④	⑤	⑥	⑦

- ① - N = Phase Control Thyristors
- F = Fast Thyristors (inverter grade)
- D = Normal Recovery Diodes
- DF = Fast Recovery Diodes
- DD = Module (diode-diode)
- DT = Module (diode-thyristor)
- TD = Module (thyristor-diode)
- TT = Module (thyristor-thyristor)
- P = Press-fit diode
- ② - Average Current Code
- ③ - Essential Part Number
- ④ - Voltage Code x 100 =  $V_{RRM}$
- ⑤ - Turn-off time (fast thyristors only)
- Reverse Recovery Time (fast diodes only)
- ⑥ - M = Metric Thread
- I = Inch Thread
- ⑦ - None = Anode to stud (stud diodes only)
- R = Cathode to stud (stud diodes only)

#### Disclaimer

All product specifications and data are subject to change without notice.

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