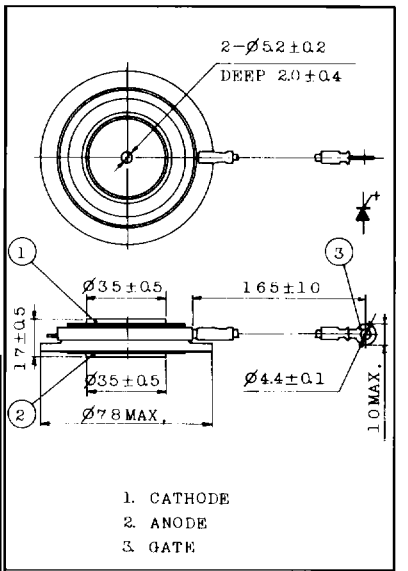
GATE TURN-OFF THYRISTOR
SILICON DIFFUSED TYPE

SG600(J, R)21
SG800(J, R)21

CHOPPER, INVERTER APPLICATION

FEATURES:
- Repetitive Peak Off-State Voltage : V_{DRM}=600, 1300V
- Repetitive Peak Reverse Voltage : V_{RRM}=300, 600V
- R.M.S On-State Current : $I_{T(RMS)}$=400A
- Peak Turn-Off Current : I_{TGQM}=600, 800A
- Critical Rate of Rise of On-State Current : di/dt=100A/μs
- Critical Rate of Rise of Off-State Voltage : dv/dt=350V/μs
- Flat Package

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	13-78B1A

Weight : 260g

MAXIMUM RATINGS

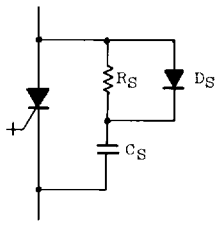
CHARACTERISTIC		SYMBOL	RATING	UNIT
Repetitive Peak Off-State Voltage	SG600J21 SG800J21	V_{DRM}	600	V
	SG600R21 SG800R21		1300	
Repetitive Peak Reverse Voltage	SG600J21 SG800J21	V_{RRM}	300	V
	SG600R21 SG800R21		650	
Peak Turn-Off Current (Note 2)	SG600J21 SG600R21	I_{TGQM}	600	A
	SG800J21 SG800R21		800	
R.M.S On-State Current		$I_{T(RMS)}$	400	A
Peak One Cycle Surge On-State Current (Non-Repetitive)		I_{TSM}	6000(50Hz)	A
			6600(60Hz)	
Critical Rate of Rise of On-State Current (Note 1)		di/dt	100	A/μs
Peak Forward Gate Power Dissipation		P_{FGM}	20	W
Peak Reverse Gate Power Dissipation		P_{RGM}	8	kW
Average Forward Gate Power Dissipation		$P_{G(AV)}$	4	W
Peak Forward Gate Current		I_{FGM}	10	A
Peak Reverse Gate Voltage		V_{RGM}	10	V
Storage Temperature Range		T_{stg}	-40~115	°C
Operating Junction Temperature Range		T_j	-40~115	°C
Mounting Force		-	1200±120	kg

Note.1 : V_D=1/2 Rated, Gate Supply (I_G=5A, $t_r \leq 1\mu s$), f=50Hz

ELECTRICAL CHARACTERISTICS

CHARACTERISTIC	SYMBOL	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Repetitive Peak Off-State Current	I_{DRM}	V_{DRM}, V_{RRM}=Rated R_{GK}=20Ω, T_j=115°C		-	-	50	mA
Repetitive Peak Reverse Current	I_{RRM}			-	-	50	mA
Peak On-State Voltage	V_{TM}	I_{TM}=600A, Tc=25°C		-	-	2.0	V
Gate Trigger Voltage	V_{GT}	V_D=12V R_L=2Ω	Tc=-40°C	-	1.0	-	V
			Tc=25°C	-	0.65	2.0	
Gate Trigger Current	I_{GT}		Tc=-40°C	-	400	-	mA
			Tc=25°C	-	120	350	
Gate Non-Trigger Voltage	V_{GD}	V_D=1/2 Rated, Tc=115°C		0.3	-	-	V
Gate Non Trigger Current	I_{GD}			10	-	-	mA
Delay Time	t_d	V_D=1/2 Rated, Tc=25°C Gate Supply (I_G=5A, t_r≤1μs)		-	-	4	μs
Gate Turn-On Time	t_{gt}			-	-	12	
Critical Rate of Rise of Off-State Voltage	dv/dt	V_{DRM}=2/3 Rated T_j=115°C, V_G=-4V Exponential Rise R_{GK}=20Ω		350	-	-	V/μs
Holding Current	I_H	Tc=25°C, R_{GK}=20Ω, R_L=2Ω		-	2	-	A
Gate Turn-Off Voltage	V_{GQ}	I_T=600A, V_{DRM}=2/3 Rated dv/dt=350V/μs Tc=110°C		-	25	-	V
Gate Turn-Off Current	I_{GQ}			-	180	-	A
Storage Time (Note. 2)	t_s	diRG/dt=30A/μs I_T=600A, I_{RG}=200A dv/dt=350V/μs V_{DRM}=2/3 Rated, Tc=110°C		-	-	15	μs
Gate Turn-Off Time (Note. 2)	t_{gq}			-	-	18	
Thermal Resistance	$R_{th(j-f)}$	Junction to Fin		-	-	0.04	°C/W

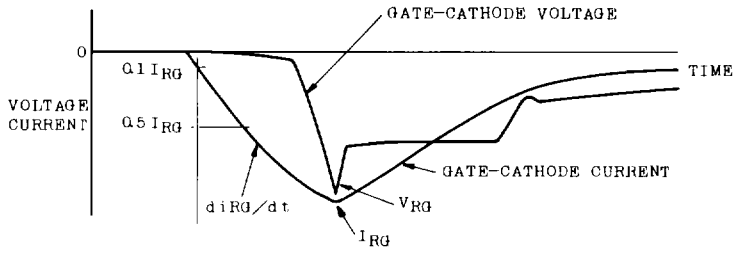
Note 2 : Snubber Circuit



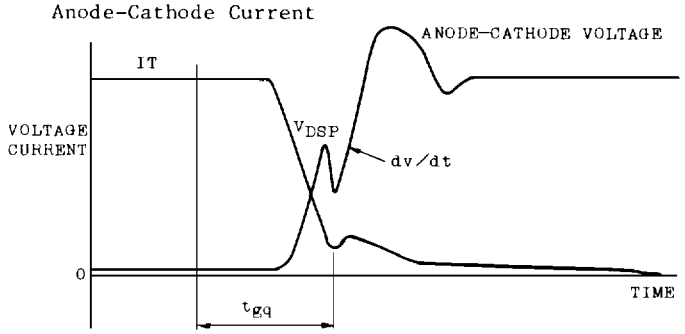
R_S : 20Ω

C_S : 2μF

Waveforms of Voltage and Current During Turn-Off



Anode-Cathode Current



di/dt PROTECTION

For di/dt protection, inductance is needed especially on high frequency operation to decrease the power dissipation during turn-on.

But inductance in the main circuit causes instantaneous over-voltage on GTO during turn-off, so the suppressor of the voltage, for example the fly-wheeling diode of inductance, is needed to decrease the power dissipation during turn-off.

dv/dt PROTECTION

Because the GTO dose not adopt the shorted-emitter structure, dv/dt capability is not so high.

Gate-cathode reverse bias should be applied to prevent dv/dt triggering during turn-off. And optimum snubber circuit is needed for the same purpose.

RECOMMENDED SNUBBER CIRCUIT

The following conditions should be maintained during turn-off

: $V_{DSP} \leqq 200V$ for SG600J21, SG800J21 (See Fig.2)

$V_{DSP} \leqq 400V$ for SG600R21, SG800R21 (See Fig.2)

To satisfy the above condition the snubber circuit is necessary.

The recommended valuses of capacitance and resistance of snubber circuit are as follows

: C_S .....$2\mu F$

R_S.....20Ω

and Fast Recovery Diode is desirable for Ds.

And the wire lensth of the snubber circuit loop should be minimized. (See Fig.1)

RECOMMENDED GATE-CATHODE WAVE FORMS

The following conditions are desirable

: to minimize turn-on and turn-off power dissipation

to keep continuous on-state

to prevent dv/dt triggring during turn-off

to supply high peak gate turn-off current

$t_r \leqq 1\mu s$

$I_{FGM} \geqq 5A$

$t_{w1} \geqq 20\mu s$

$I_{FG} \geqq 2A$

diRG/dt=20 ~ 30A/μs

I_{RG}=180 ~ 220A

V_{RG}=20 ~ 35V

t_{w2}=30μs

t_{w3}=120μs

VR=5V

Fig. 1 TEST CIRCUIT

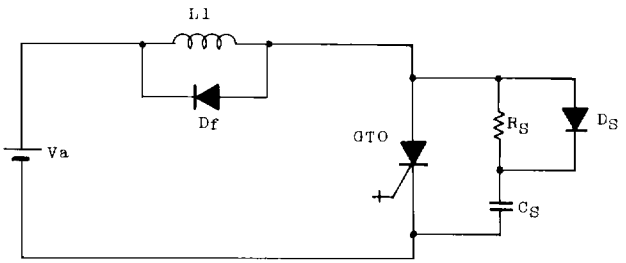


Fig. 2 TYPICAL WAVEFORMS OF ANODE-CATHODE VOLTAGE AND CURRENT

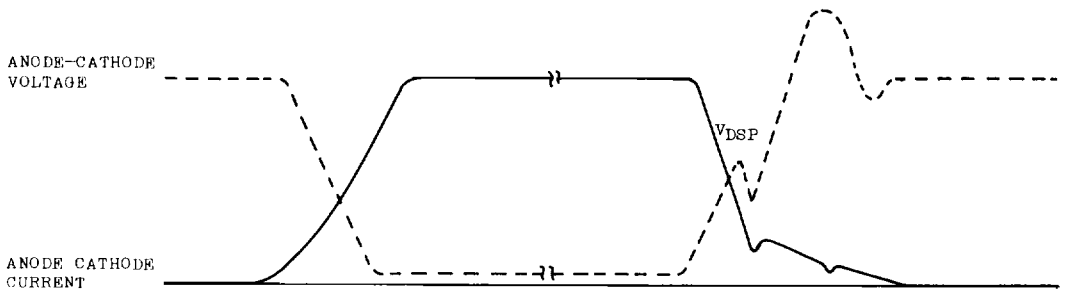
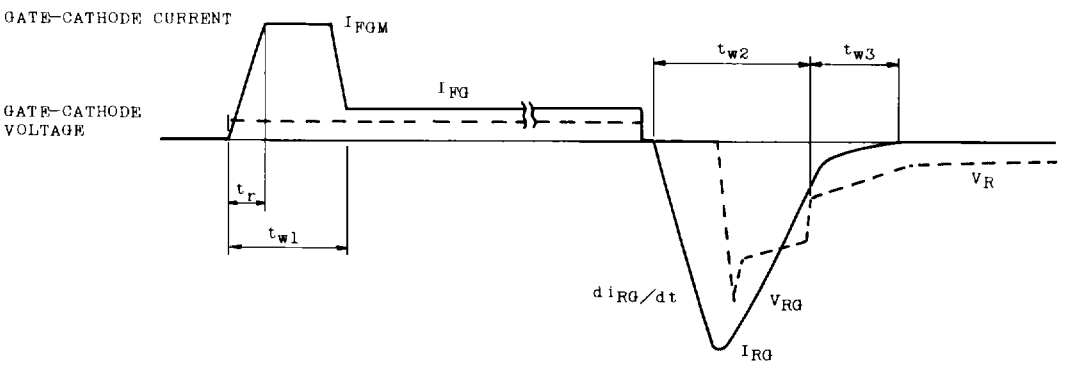
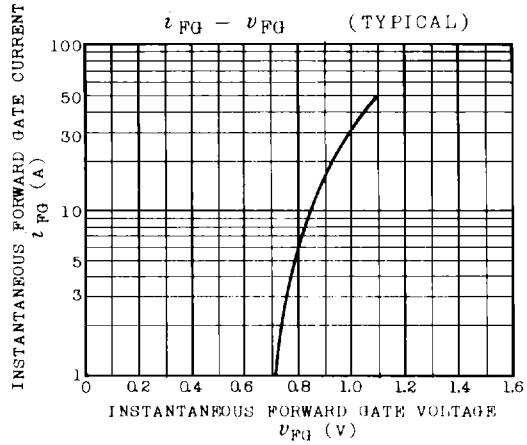
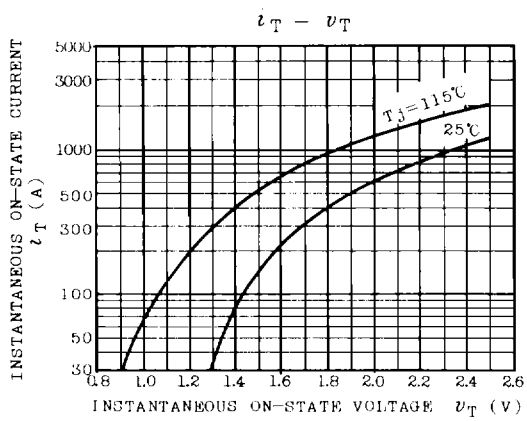
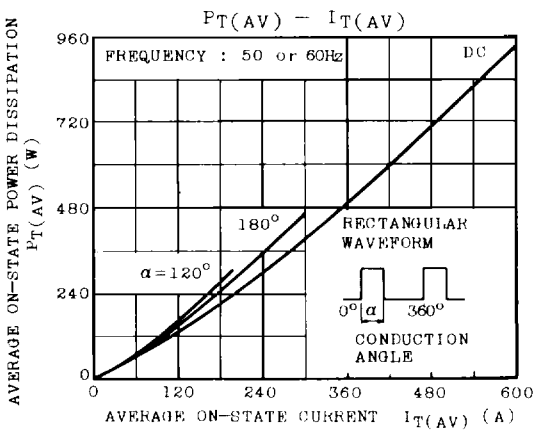


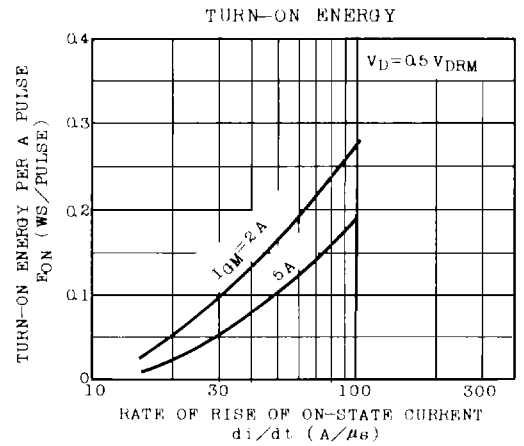
Fig. 3 TYPICAL WAVEFORMS OF GATE-CATHODE VOLTAGE AND CURRENT

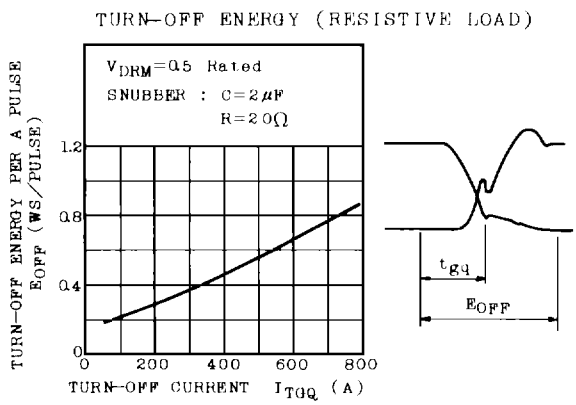


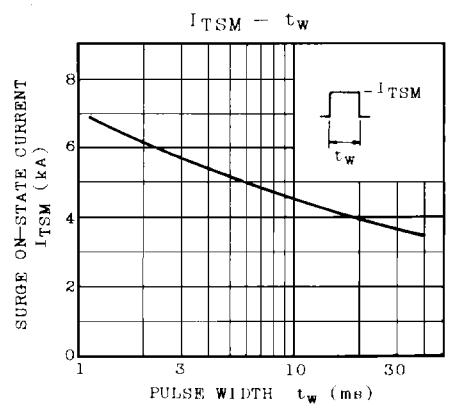

$i_{FG} - v_{FG}$ (TYPICAL)
INSTANTANEOUS FORWARD GATE CURRENT i_{FG} (A)
100
50
30
10
5
3
1
0 0.2 0.4 0.6 0.8 1.0 1.2 1.4 1.6
INSTANTANEOUS FORWARD GATE VOLTAGE v_{FG} (V)


$i_T - v_T$
INSTANTANEOUS ON-STATE CURRENT i_T (A)
5000
3000
1000
500
300
100
50
30
T_J=115℃
25℃
0.8 1.0 1.2 1.4 1.6 1.8 2.0 2.2 2.4 2.6
INSTANTANEOUS ON-STATE VOLTAGE v_T (V)

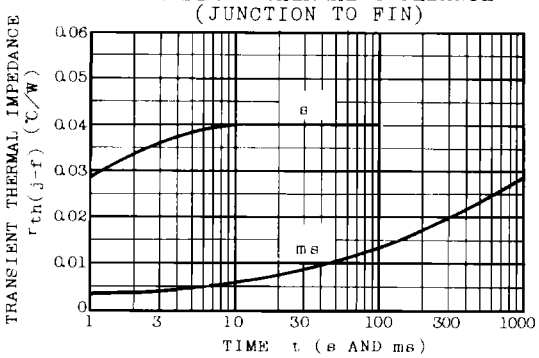

$P_{T(AV)} - I_{T(AV)}$
AVERAGE ON-STATE POWER DISSIPATION $P_{T(AV)}$ (W)
960
720
480
240
0
FREQUENCY : 50 or 60Hz
DC
180°
α=120°
RECTANGULAR WAVEFORM
0° α 360°
CONDUCTION ANGLE
0 120 240 360 480 600
AVERAGE ON-STATE CURRENT $I_{T(AV)}$ (A)


TURN-ON ENERGY
TURN-ON ENERGY PER A PULSE E_{ON} (WS/PULSE)
0.4
0.3
0.2
0.1
0
V_D=0.5 V_{DRM}
I_{GM}=2A
5A
10 30 100 300
RATE OF RISE OF ON-STATE CURRENT di/dt (A/μs)

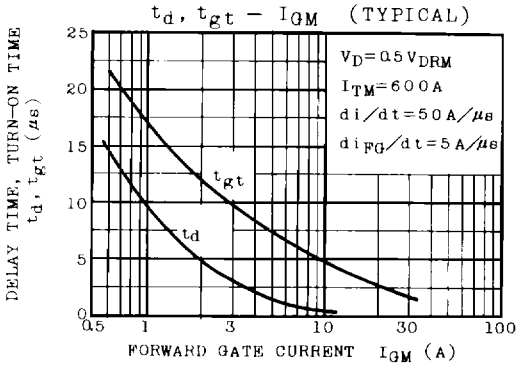

TURN-OFF ENERGY (RESISTIVE LOAD)
TURN-OFF ENERGY PER A PULSE E_{OFF} (WS/PULSE)
V_{DRM}=0.5 Rated
SNUBBER : C=2μF
R=20Ω
1.2
0.8
0.4
0
0 200 400 600 800
TURN-OFF CURRENT I_{TGQ} (A)
t_{gq}
E_{OFF}


$I_{TSM} - t_w$
SURGE ON-STATE CURRENT I_{TSM} (kA)
8
6
4
2
0
I_{TSM}
t_w
1 3 10 30
PULSE WIDTH t_w (ms)

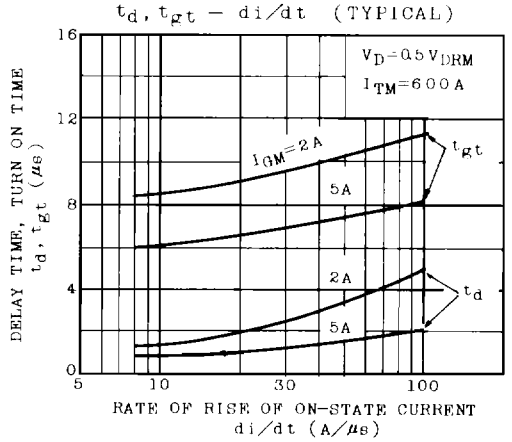
TRANSIENT THERMAL IMPEDANCE
(JUNCTION TO FIN)



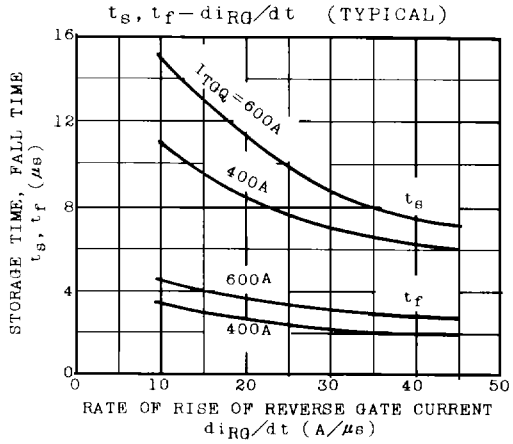
t_d, t_{gt} — I_{GM} (TYPICAL)



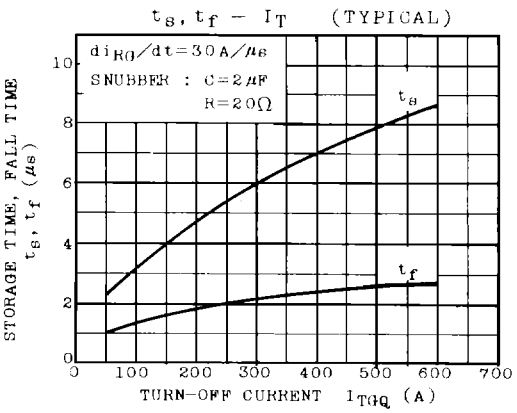
t_d, t_{gt} — di/dt (TYPICAL)



t_s, t_f — di_{RG}/dt (TYPICAL)



t_s, t_f — I_T (TYPICAL)



t_s, t_f — T_j (TYPICAL)