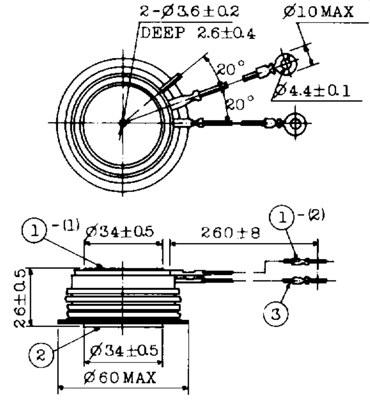
SG1000(R,U,W,EX)23

GATE TURN-OFF THYRISTOR

CHOPPER, INVERTER APPLICATION

- Repetitive Peak Off-State Voltage : V_{DRM}=1300, 1600, 1800, 2500V
- R.M.S On-State Current : $I_{T(RMS)}$=400A
- Peak Turn-Off Current : I_{TGQM}=1000A
- Critical Rate of Rise of On-State Current : di/dt=250A/μs
- Critical Rate of Rise of Off-State Voltage : dv/dt=900V/μs

Unit in mm



①-(1) CATHODE
①-(2) CATHODE (BLACK)
② ANODE
③ GATE (WHITE)

JEDEC	—
EIAJ	—
TOSHIBA	13-60E1A

Weight : 290g

MAXIMUM RATINGS

CHARACTERISTIC		SYMBOL	RATING	UNIT
Repetitive Peak Off-State Voltage	SG1000R23	V_{DRM}	1300	V
	SG1000U23		1600	
	SG1000W23		1800	
	SG1000EX23		2500	
Repetitive Peak Reverse Voltage		V_{RRM}	15	V
Peak Turn-Off Current (Note 1)		I_{TGQM}	1000	A
R.M.S On-State Current (Note 2)		$I_{T(RMS)}$	400	A
Peak One Cycle Surge On-State Current (Non-Repetitive)		I_{TSM}	6500(50Hz)	A
			7100(60Hz)	
Critical Rate of Rise of On-State Current (Note 3)		di/dt	250	A/μs
Peak Forward Gate Current (Note 4)		I_{FGM}	40	A
Average Forward Gate Power Dissipation		$P_{G(AV)}$	8	W
R.M.S Reverse Gate Current		$I_{RG(RMS)}$	50	A
Peak Reverse Gate Power Dissipation (Note 5)		P_{RGM}	8	kW
Peak Reverse Gate Voltage		V_{RGM}	15	V
Storage Temperature Range		Tstg	-40~125	°C
Operating Junction Temperature Range		Tj	-40~125	°C
Mounting Force		-	1200±120	kg

Note 1 : V_D=1/2 Rated, V_{DM}=2/3 Rated, C_S=2μF, R_S=20Ω, di_{RG}/dt=30A/μs
$I_{RG} \doteqdot 240A$, Tj=125°C, ($V_{DSP} \leq 500V$)

Note 2 : Half sine waveform, Tf=70°C

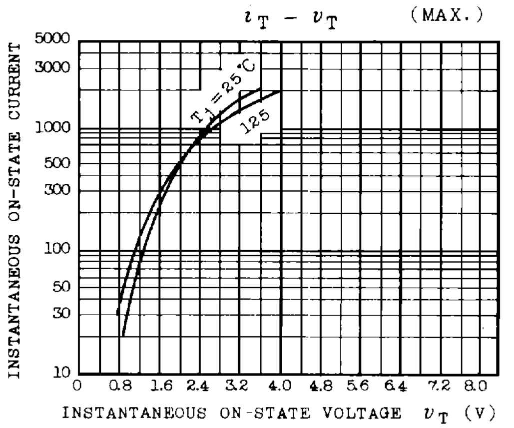
Note 3 : V_D=1/2 Rated, I_{TM}=1000A, I_G=18A, t_r=1μs, f=50Hz, Tj=125°C

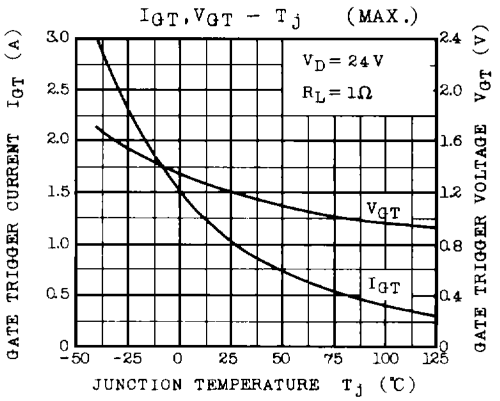
Note 4 : Pulse width : Max. 20μs, Duty : Max. 20%

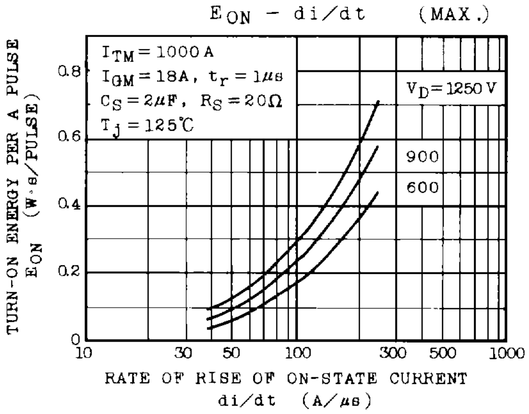
Note 5 : Pulse width : Max. 20μs, Duty : Max. 2%

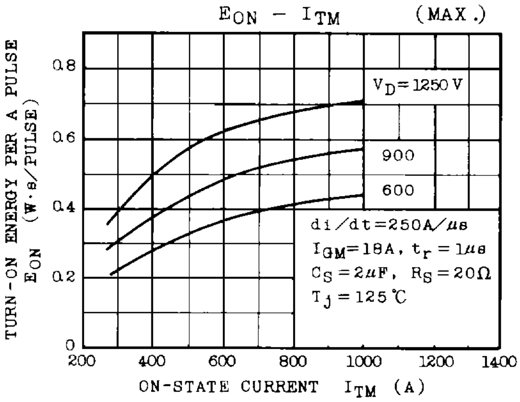
ELECTRICAL CHARACTERISTICS

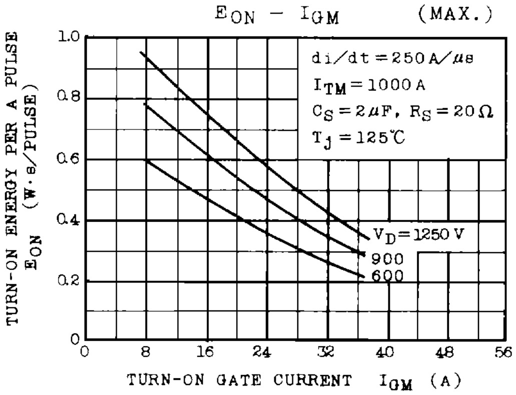
CHARACTERISTIC	SYMBOL	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Repetitive Peak Off-State Current	I_{DRM}	V_{DRM}=Rated, R_{GK}=20Ω Tj=125°C		-	-	20	mA
Repetitive Peak Reverse Current	I_{RRM}	V_{RRM}=Rated, Tj=125°C		-	-	100	mA
Repetitive Peak Reverse Gate Current	I_{RGM}	V_{RGM}=Rated, Tj=125°C		-	-	100	mA
Peak On-State Voltage	V_{TM}	I_{TM}=1000A, Tc=25°C		-	-	2.5	V
Gate Trigger Voltage	V_{GT}	V_D=24V R_L=1Ω	Tc=−40°C	-	-	1.7	V
			Tc=25°C	-	0.85	1.2	
Gate Trigger Current	I_{GT}		Tc=−40°C	-	-	3000	mA
			Tc=25°C	-	600	1000	
Gate Non-Trigger Voltage	V_{GD}	V_D=1/2 Rated, Tc=125°C		0.3	-	-	V
Gate Non-Trigger Current	I_{GD}			5	-	-	mA
Delay Time	t_d	V_D=1/2 Rated di/dt=250A/μs I_{TM}=1000A, I_G=18A tr=1μs, Tc=25°C		-	-	2	μs
Turn-On Time	t_{gt}			-	-	8	μs
Critical Rate of Rise of Off-State Voltage	dv/dt	V_{DRM}=2/3 Rated Tj=125°C, V_{GK}=−4V Exponential Rise		900	-	-	V/μs
Holding Current	I_H	Tc=25°C, R_L=1Ω		-	10	-	A
Storage Time	t_s	I_T=1000A, V_D=1/2 Rated V_{DM}=2/3 Rated, C_S=2μF diRG/dt=−30A/μs Tc=120°C		-	-	16	μs
Gate Turn-Off Time	t_{gq}			-	-	18	μs
Tail Time	t_{tail}			-	-	60	μs
Turn-Off Gate Current	I_{RG}			-	240	280	A
Thermal Resistance	$R_{th(j-f)}$	Junction to Fin		-	-	0.05	°C/W

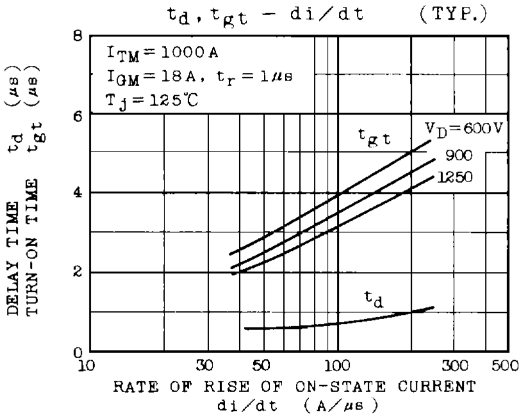

i_T − v_T (MAX.)
INSTANTANEOUS ON-STATE CURRENT
5000
3000
1000
500
300
100
50
30
10
T_j=25°C
125
0
0.8
1.6
2.4
3.2
4.0
4.8
5.6
6.4
7.2
8.0
INSTANTANEOUS ON-STATE VOLTAGE v_T (V)

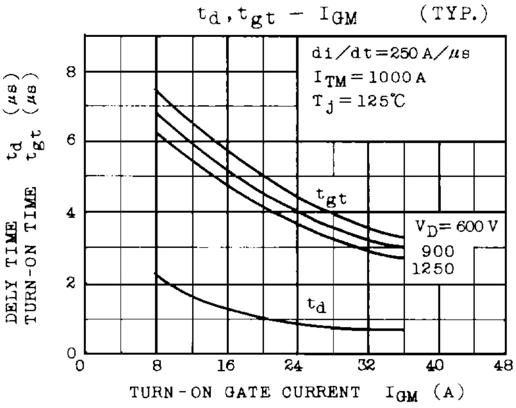

I_{GT}, V_{GT} − T_j (MAX.)
GATE TRIGGER CURRENT I_{GT} (A)
3.0
2.5
2.0
1.5
1.0
0.5
0
V_D = 24 V
R_L = 1Ω
V_{GT}
I_{GT}
2.4
2.0
1.6
1.2
0.8
0.4
0
GATE TRIGGER VOLTAGE V_{GT} (V)
−50
−25
0
25
50
75
100
125
JUNCTION TEMPERATURE T_j (℃)

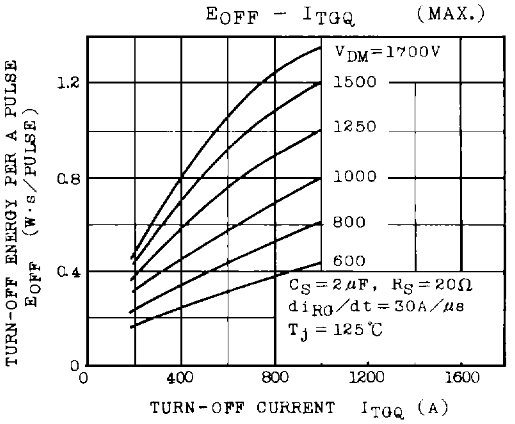

E_{ON} − di/dt (MAX.)
TURN-ON ENERGY PER A PULSE E_{ON} (W·s/PULSE)
0.8
0.6
0.4
0.2
0
I_{TM} = 1000 A
I_{GM} = 18A, t_r = 1μs
C_S = 2μF, R_S = 20Ω
T_j = 125℃
V_D= 1250 V
900
600
10
30
50
100
300
500
1000
RATE OF RISE OF ON-STATE CURRENT
di/dt (A/μs)

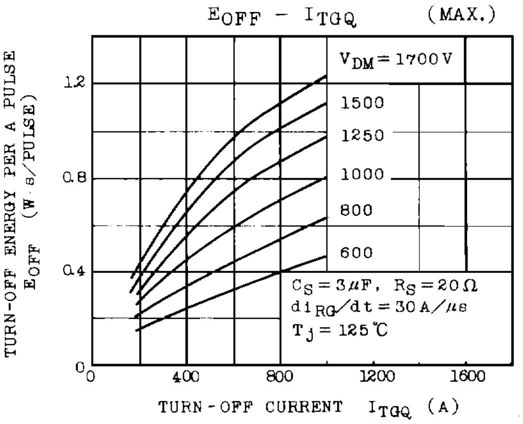

E_{ON} − I_{TM} (MAX.)
TURN-ON ENERGY PER A PULSE E_{ON} (W·s/PULSE)
0.8
0.6
0.4
0.2
0
V_D= 1250 V
900
600
di/dt=250A/μs
I_{GM}= 18A, t_r = 1μs
C_S = 2μF, R_S = 20Ω
T_j = 125℃
200
400
600
800
1000
1200
1400
ON-STATE CURRENT I_{TM} (A)

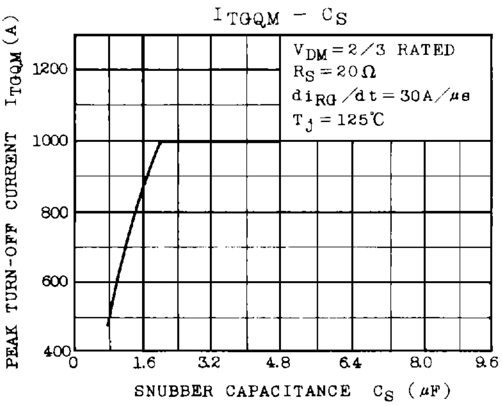

E_{ON} − I_{GM} (MAX.)
TURN-ON ENERGY PER A PULSE E_{ON} (W·s/PULSE)
1.0
0.8
0.6
0.4
0.2
0
di/dt = 250 A/μs
I_{TM} = 1000 A
C_S = 2μF, R_S = 20Ω
T_j = 125℃
V_D= 1250 V
900
600
0
8
16
24
32
40
48
56
TURN-ON GATE CURRENT I_{GM} (A)

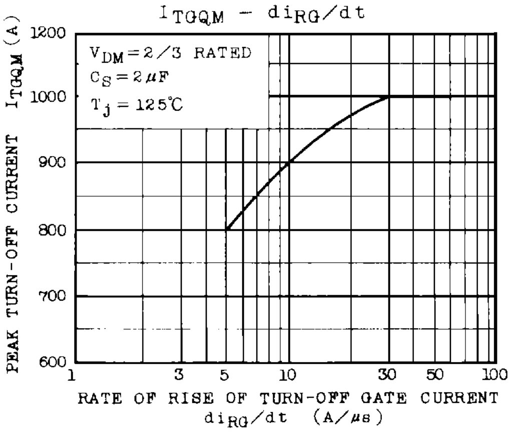

td , tgt − di/dt (TYP.)
ITM = 1000 A
IGM = 18 A , tr = 1μs
Tj = 125℃
tgt
VD = 600 V
900
1250
td
DELAY TIME td (μs)
TURN-ON TIME tgt (μs)
0
2
4
6
8
10
30
50
100
300
500
RATE OF RISE OF ON-STATE CURRENT
di/dt (A/μs)

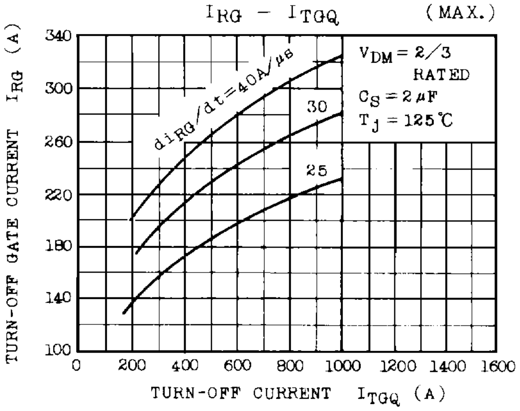

td , tgt − IGM (TYP.)
di/dt = 250 A/μs
ITM = 1000 A
Tj = 125℃
tgt
VD = 600 V
900
1250
td
DELY TIME td (μs)
TURN-ON TIME tgt (μs)
0
2
4
6
8
0
8
16
24
32
40
48
TURN-ON GATE CURRENT IGM (A)

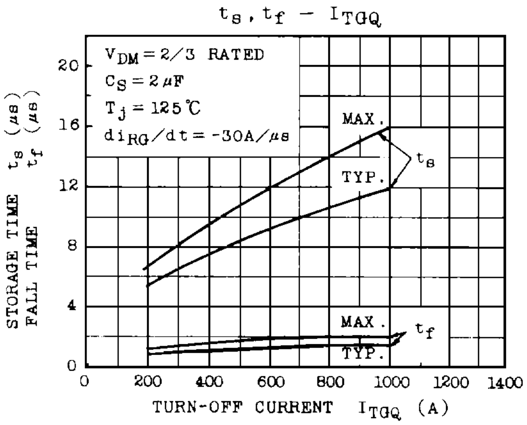

EOFF − ITGQ (MAX.)
VDM = 1700 V
1500
1250
1000
800
600
CS = 2μF , RS = 20Ω
diRG/dt = 30 A/μs
Tj = 125℃
TURN-OFF ENERGY PER A PULSE
EOFF (W·s/PULSE)
0
0.4
0.8
1.2
0
400
800
1200
1600
TURN-OFF CURRENT ITGQ (A)

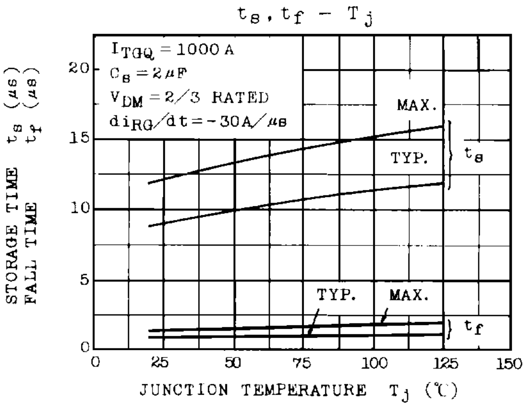

EOFF − ITGQ (MAX.)
VDM = 1700 V
1500
1250
1000
800
600
CS = 3μF , RS = 20Ω
diRG/dt = 30 A/μs
Tj = 125℃
TURN-OFF ENERGY PER A PULSE
EOFF (W·s/PULSE)
0
0.4
0.8
1.2
0
400
800
1200
1600
TURN-OFF CURRENT ITGQ (A)

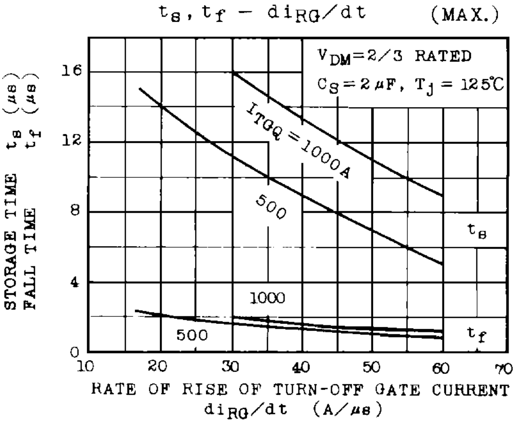

ITGQM − CS
VDM = 2/3 RATED
RS = 20Ω
diRG/dt = 30 A/μs
Tj = 125℃
PEAK TURN-OFF CURRENT ITGQM (A)
400
600
800
1000
1200
0
1.6
3.2
4.8
6.4
8.0
9.6
SNUBBER CAPACITANCE CS (μF)

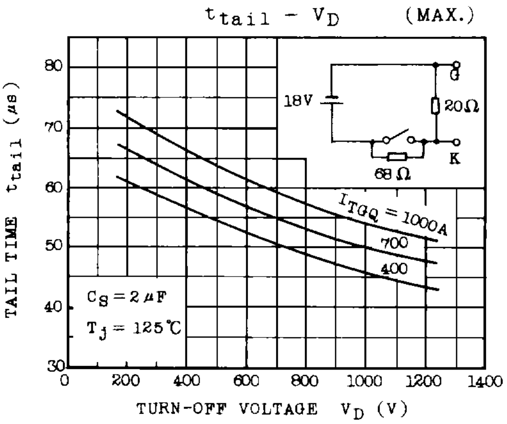

ITGQM − diRG/dt
VDM = 2/3 RATED
CS = 2μF
Tj = 125℃
PEAK TURN-OFF CURRENT ITGQM (A)
600
700
800
900
1000
1200
1
3
5
10
30
50
100
RATE OF RISE OF TURN-OFF GATE CURRENT
diRG/dt (A/μs)

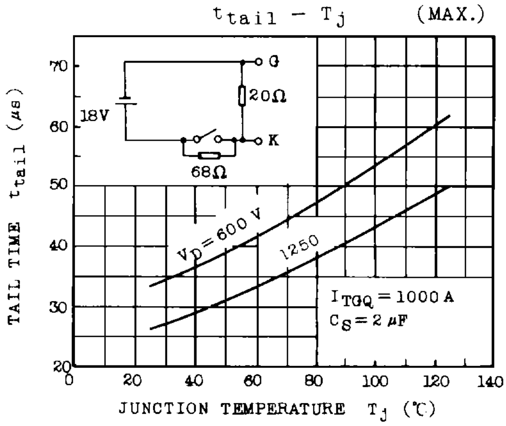

I_RG − I_TGQ (MAX.)
V_DM = 2/3 RATED
C_S = 2 μF
T_j = 125 ℃
di_RG/dt=40A/μs
30
25
TURN-OFF GATE CURRENT I_RG (A)
340
300
260
220
180
140
100
0
200
400
600
800
1000
1200
1400
1600
TURN-OFF CURRENT I_TGQ (A)

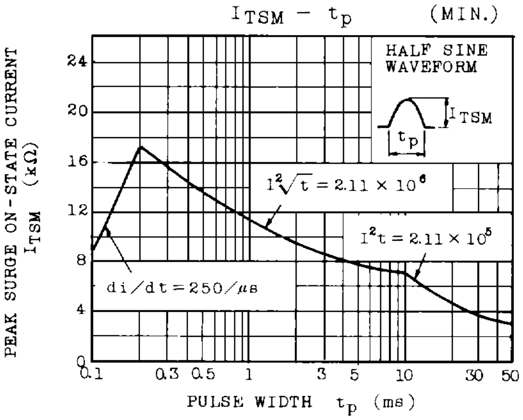

t_s, t_f − I_TGQ
V_DM = 2/3 RATED
C_S = 2 μF
T_j = 125 ℃
di_RG/dt = -30A/μs
MAX.
TYP.
t_s
MAX.
TYP.
t_f
STORAGE TIME t_s (μs)
FALL TIME t_f (μs)
20
16
12
8
4
0
0
200
400
600
800
1000
1200
1400
TURN-OFF CURRENT I_TGQ (A)

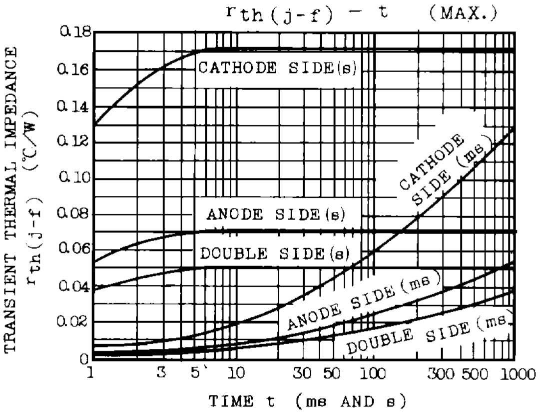

t_s, t_f − T_j
I_TGQ = 1000 A
C_s = 2 μF
V_DM = 2/3 RATED
di_RG/dt = -30A/μs
MAX.
TYP.
t_s
TYP.
MAX.
t_f
STORAGE TIME t_s (μs)
FALL TIME t_f (μs)
20
15
10
5
0
0
25
50
75
100
125
150
JUNCTION TEMPERATURE T_j (℃)


t_s, t_f − di_RG/dt (MAX.)
V_DM=2/3 RATED
C_S=2 μF, T_j = 125℃
I_TGQ = 1000A
500
t_s
1000
500
t_f
STORAGE TIME t_s (μs)
FALL TIME t_f (μs)
16
12
8
4
0
10
20
30
40
50
60
70
RATE OF RISE OF TURN-OFF GATE CURRENT
di_RG/dt (A/μs)


t_tail − V_D (MAX.)
18V
G
20Ω
68Ω
K
I_TGQ = 1000A
700
400
C_S = 2 μF
T_j = 125℃
TAIL TIME t_tail (μs)
80
70
60
50
40
30
0
200
400
600
800
1000
1200
1400
TURN-OFF VOLTAGE V_D (V)


t_tail − T_j (MAX.)
G
18V
20Ω
K
68Ω
V_D = 600 V
1250
I_TGQ = 1000 A
C_S = 2 μF
TAIL TIME t_tail (μs)
70
60
50
40
30
20
0
20
40
60
80
100
120
140
JUNCTION TEMPERATURE T_j (℃)





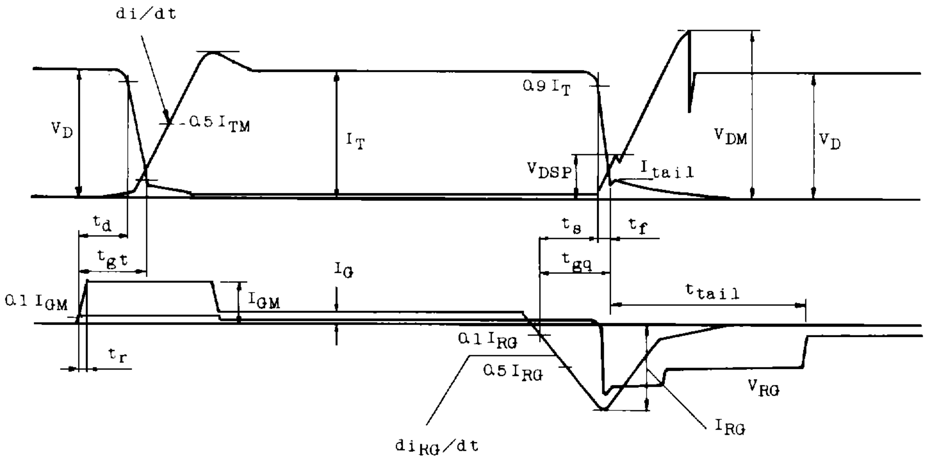


Fig.1 TURN-ON AND TURN-OFF CHARACTERISTIC OF GTO