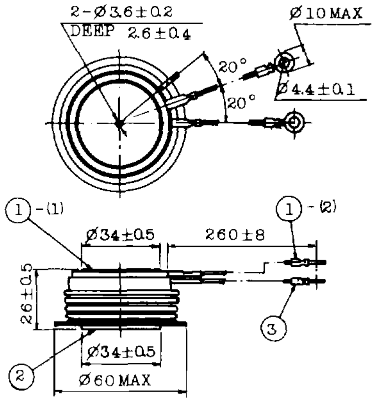
# SG1200(R,U,W,EX)23

## 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 : $I_{TGQM}$=1200A
- 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

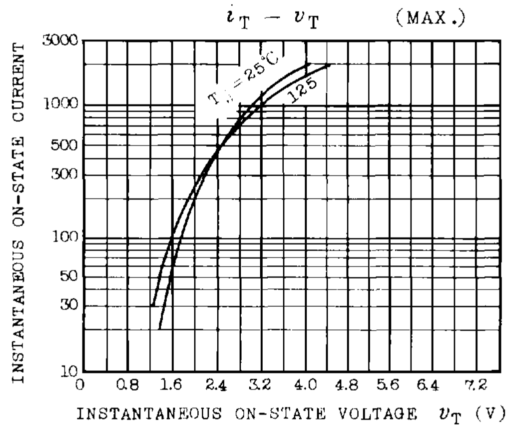
MAXIMUM RATINGS

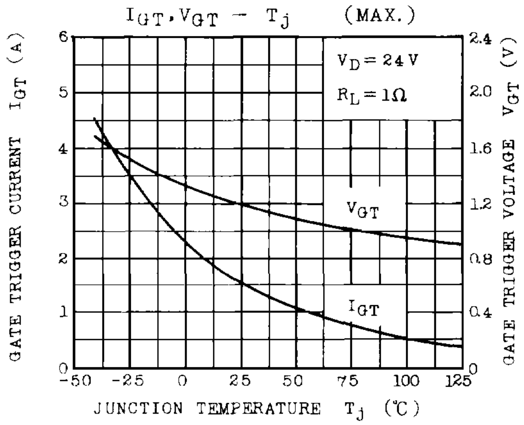
| CHARACTERISTIC | | SYMBOL | RATING | UNIT |
|---|---|---|---|---|
| Repetitive Peak Off-State Voltage | SG1200R23 | $V_{DRM}$ | 1300 | V |
| | SG1200U23 | | 1600 | |
| | SG1200W23 | | 1800 | |
| | SG1200EX23 | | 2500 | |
| Repetitive Peak Reverse Voltage | | $V_{RRM}$ | 15 | V |
| Peak Turn-Off Current (Note 1) | | $I_{TGQM}$ | 1200 | 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)<br>7100(60Hz) | A |
| 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 |

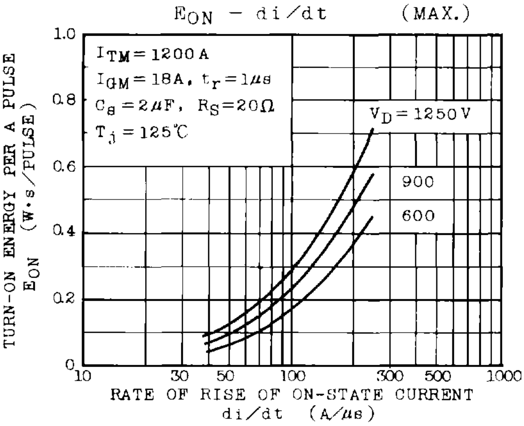
Note 1 : $V_D$=1/2 Rated, $V_{DM}$=2/3 Rated, $C_S$=2μF, $R_S$=20Ω, $di_{RG}/dt$=30A/μs
$I_{RG}$ ≒260A, Tj=125°C, ($V_{DSP}$≦450V)
Note 2 : Half sine waveform, Tf=70°C
Note 3 : $V_D$=1/2 Rated, $I_{TM}$=1200A, $I_G$=18A, $t_r$=1μs, f=50Hz, Tj=125°C
Note 4 : Pulse width : Max. 20μs, Duty : Max. 20%
Note 5 : Pulse width : Max. 20μs, Duty : Max. 2%

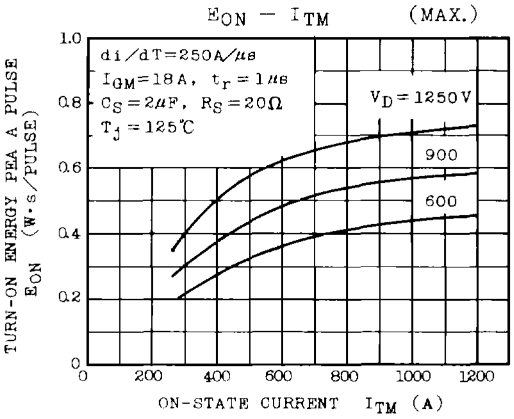
ELECTRICAL CHARACTERISTICS

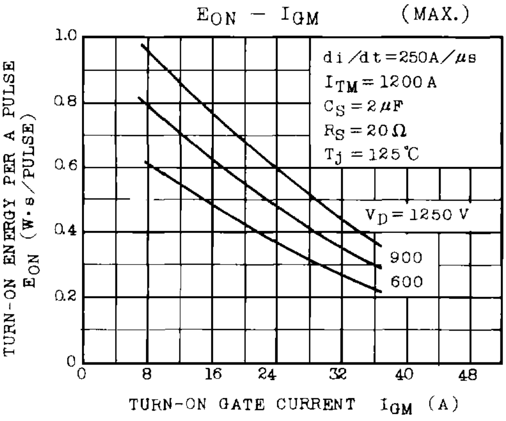
| CHARACTERISTIC | SYMBOL | TEST CONDITION | | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|---|
| Repetitive Peak Off-State Current | $I_{DRM}$ | $V_{DRM}$=Rated, $R_{GK}$=20Ω<br>$T_j$=125°C | | - | - | 20 | mA |
| Repetitive Peak Reverse Current | $I_{RRM}$ | $V_{RRM}$=Rated, $T_j$=125°C | | - | - | 100 | mA |
| Repetitive Peak Reverse Gate Current | $I_{RGM}$ | $V_{RGM}$=Rated, $T_j$=125°C | | - | - | 100 | mA |
| Peak On-State Voltage | $V_{TM}$ | $I_{TM}$=1000A, $T_c$=25°C | | - | - | 3.0 | V |
| Gate Trigger Voltage | $V_{GT}$ | $V_D$=24V<br>$R_L$=1Ω | $T_c$=-40°C | - | - | 1.7 | V |
| | | | $T_c$=25°C | - | 0.85 | 1.2 | |
| Gate Trigger Current | $I_{GT}$ | | $T_c$=-40°C | - | - | 4000 | mA |
| | | | $T_c$=25°C | - | 700 | 1500 | |
| Gate Non-Trigger Voltage | $V_{GD}$ | $V_D$=1/2 Rated, $T_c$=125°C | | 0.3 | - | - | V |
| Gate Non-Trigger Current | $I_{GD}$ | | | 5 | - | - | mA |
| Delay Time | $t_d$ | $V_D$=1/2 Rated<br>di/dt=250A/μs<br>$I_{TM}$=1200A, $I_G$=18A<br>tr=1μs, $T_c$=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<br>$T_j$=125°C, $V_{GK}$=-4V<br>Exponential Rise | | 900 | - | - | V/μs |
| Holding Current | $I_H$ | $T_c$=25°C, $R_L$=1Ω | | - | 20 | - | A |
| Storage Time | $t_s$ | $I_T$=1200A, $V_D$=1/2 Rated<br>$V_{DM}$=2/3 Rated, $C_S$=2μs<br>$di_{RG}/dt$=-30A/μs<br>$T_c$=120°C | | - | 15 | 18 | μs |
| Gate Turn-Off Time | $t_{gq}$ | | | - | - | 20 | μs |
| Tail Time | $t_{tail}$ | | | - | - | 60 | μs |
| Gate Turn-Off Current | $I_{RG}$ | | | - | 260 | 300 | A |
| Thermal Resistance | $R_{th(j-f)}$ | Junction to Fin | | - | - | 0.05 | °C/W |

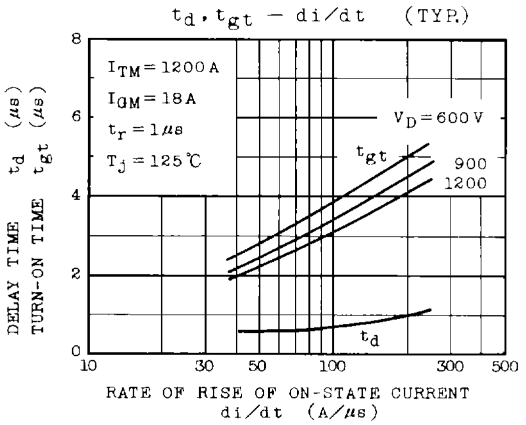

$i_T - v_T$ (MAX.)
INSTANTANEOUS ON-STATE CURRENT
3000
1000
500
300
100
50
30
10
$T_j = 25$℃
125
0
0.8
1.6
2.4
3.2
4.0
4.8
5.6
6.4
7.2
INSTANTANEOUS ON-STATE VOLTAGE $v_T$ (V)

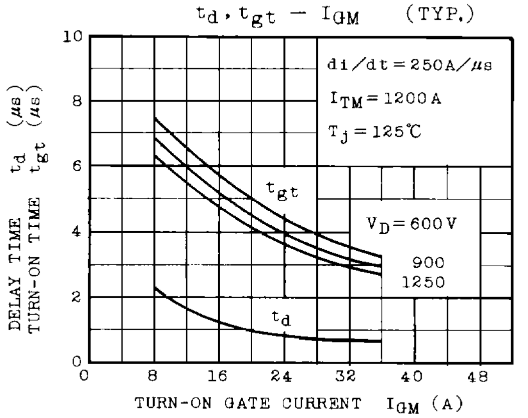

$I_{GT}, V_{GT} - T_j$ (MAX.)
GATE TRIGGER CURRENT $I_{GT}$ (A)
GATE TRIGGER VOLTAGE $V_{GT}$ (V)
$V_D = 24$ V
$R_L = 1\Omega$
$V_{GT}$
$I_{GT}$
6
5
4
3
2
1
0
2.4
2.0
1.6
1.2
0.8
0.4
0
-50
-25
0
25
50
75
100
125
JUNCTION TEMPERATURE $T_j$ (℃)

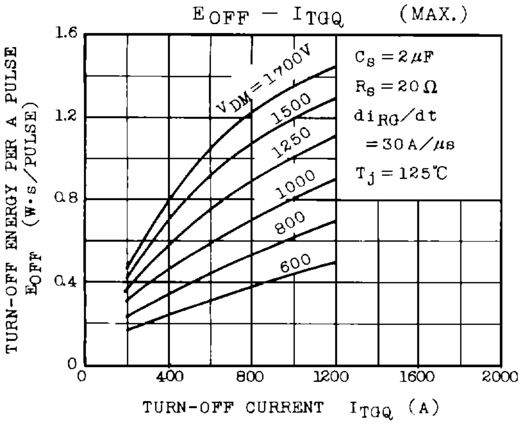

$E_{ON}$ − di/dt (MAX.)
TURN-ON ENERGY PER A PULSE $E_{ON}$ (W·s/PULSE)
$I_{TM} = 1200$ A
$I_{GM} = 18$ A, $t_r = 1\mu s$
$C_s = 2\mu F$, $R_S = 20\Omega$
$T_j = 125$℃
$V_D = 1250$ V
900
600
1.0
0.8
0.6
0.4
0.2
0
10
30
50
100
300
500
1000
RATE OF RISE OF ON-STATE CURRENT
di/dt (A/μs)

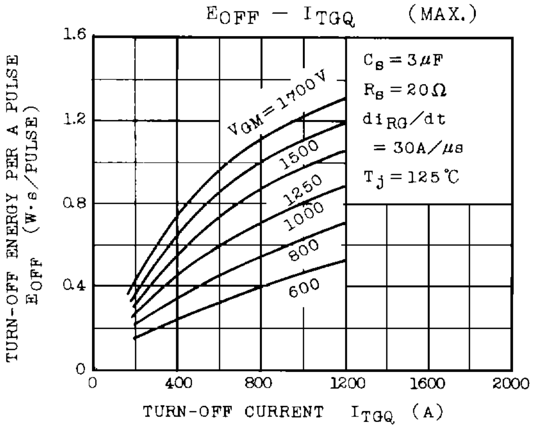

$E_{ON} - I_{TM}$ (MAX.)
TURN-ON ENERGY PEA A PULSE $E_{ON}$ (W·s/PULSE)
di/dT=250A/μs
$I_{GM} = 18$ A, $t_r = 1\mu s$
$C_S = 2\mu F$, $R_S = 20\Omega$
$T_j = 125$℃
$V_D = 1250$ V
900
600
1.0
0.8
0.6
0.4
0.2
0
0
200
400
600
800
1000
1200
ON-STATE CURRENT $I_{TM}$ (A)

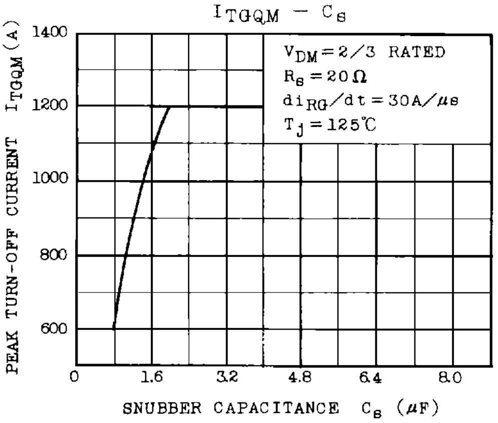

$E_{ON} - I_{GM}$ (MAX.)
TURN-ON ENERGY PER A PULSE $E_{ON}$ (W·s/PULSE)
di/dt=250A/μs
$I_{TM} = 1200$ A
$C_S = 2\mu F$
$R_S = 20\Omega$
$T_j = 125$℃
$V_D = 1250$ V
900
600
1.0
0.8
0.6
0.4
0.2
0
0
8
16
24
32
40
48
TURN-ON GATE CURRENT $I_{GM}$ (A)

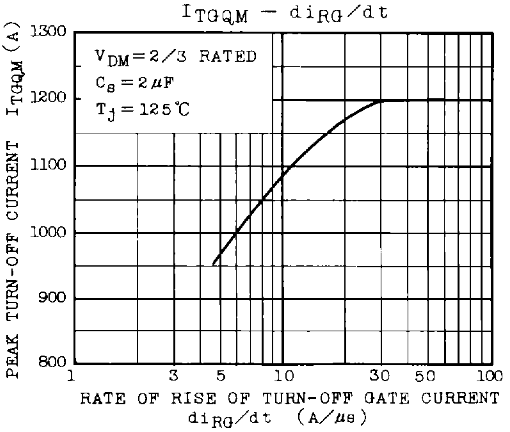

$t_d, t_{gt}$ — di/dt (TYP.)
$I_{TM}$ = 1200 A
$I_{GM}$ = 18 A
$t_r$ = 1 μs
$T_j$ = 125 ℃
$V_D$ = 600 V
$t_{gt}$
900
1200
$t_d$
DELAY TIME $t_d$ (μs)
TURN-ON TIME $t_{gt}$ (μs)
0
2
4
6
8
10
30
50
100
300
500
RATE OF RISE OF ON-STATE CURRENT
di/dt (A/μs)


$t_d, t_{gt}$ — $I_{GM}$ (TYP.)
di/dt = 250 A/μs
$I_{TM}$ = 1200 A
$T_j$ = 125 ℃
$V_D$ = 600 V
900
1250
$t_{gt}$
$t_d$
DELAY TIME $t_d$ (μs)
TURN-ON TIME $t_{gt}$ (μs)
0
2
4
6
8
10
0
8
16
24
32
40
48
TURN-ON GATE CURRENT $I_{GM}$ (A)

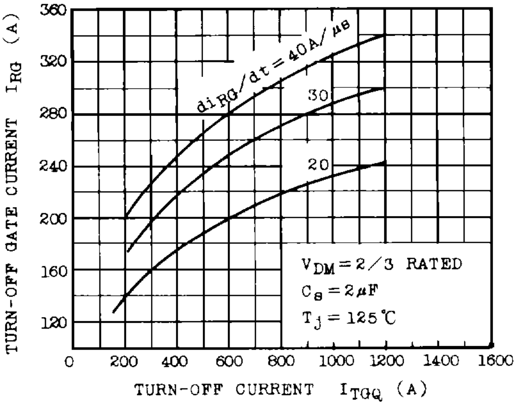

$E_{OFF}$ — $I_{TGQ}$ (MAX.)
$C_s$ = 2 μF
$R_s$ = 20 Ω
$di_{RG}/dt$
= 30 A/μs
$T_j$ = 125 ℃
$V_{DM}$ = 1700 V
1500
1250
1000
800
600
TURN-OFF ENERGY PER A PULSE
$E_{OFF}$ (W·s/PULSE)
0
0.4
0.8
1.2
1.6
0
400
800
1200
1600
2000
TURN-OFF CURRENT $I_{TGQ}$ (A)


$E_{OFF}$ — $I_{TGQ}$ (MAX.)
$C_s$ = 3 μF
$R_s$ = 20 Ω
$di_{RG}/dt$
= 30 A/μs
$T_j$ = 125 ℃
$V_{GM}$ = 1700 V
1500
1250
1000
800
600
TURN-OFF ENERGY PER A PULSE
$E_{OFF}$ (W·s/PULSE)
0
0.4
0.8
1.2
1.6
0
400
800
1200
1600
2000
TURN-OFF CURRENT $I_{TGQ}$ (A)

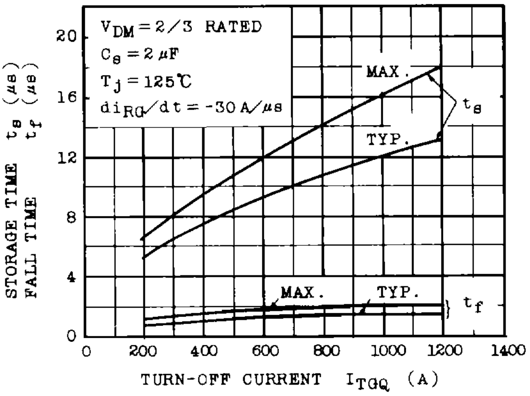

$I_{TGQM}$ — $C_s$
$V_{DM}$ = 2/3 RATED
$R_s$ = 20 Ω
$di_{RG}/dt$ = 30 A/μs
$T_j$ = 125 ℃
PEAK TURN-OFF CURRENT $I_{TGQM}$ (A)
600
800
1000
1200
1400
0
1.6
3.2
4.8
6.4
8.0
SNUBBER CAPACITANCE $C_s$ (μF)


$I_{TGQM}$ — $di_{RG}/dt$
$V_{DM}$ = 2/3 RATED
$C_s$ = 2 μF
$T_j$ = 125 ℃
PEAK TURN-OFF CURRENT $I_{TGQM}$ (A)
800
900
1000
1100
1200
1300
1
3
5
10
30
50
100
RATE OF RISE OF TURN-OFF GATE CURRENT
$di_{RG}/dt$ (A/μs)

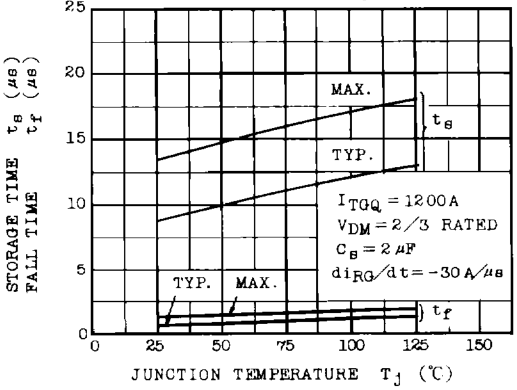
$I_{RG} - I_{TGQ}$ (MAX.)



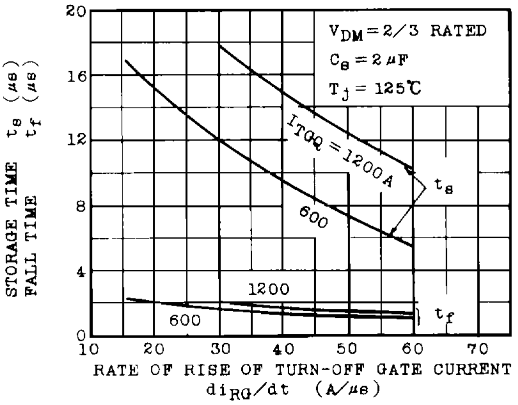
$t_s, t_f - I_{TGQ}$



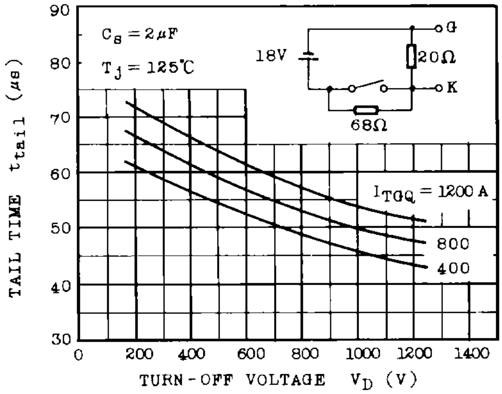
$t_s, t_f - T_j$



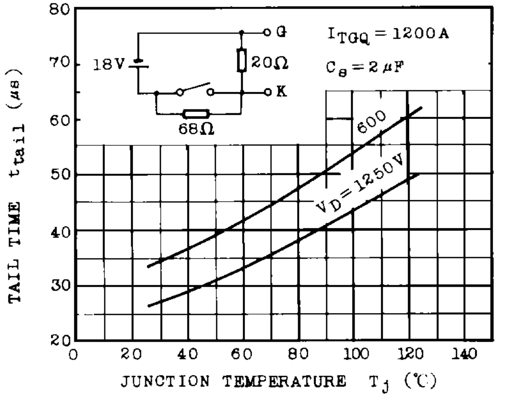
$t_s, t_f - di_{RG}/dt$ (MAX.)

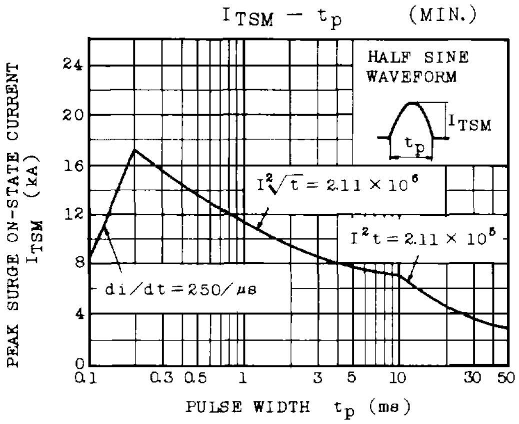


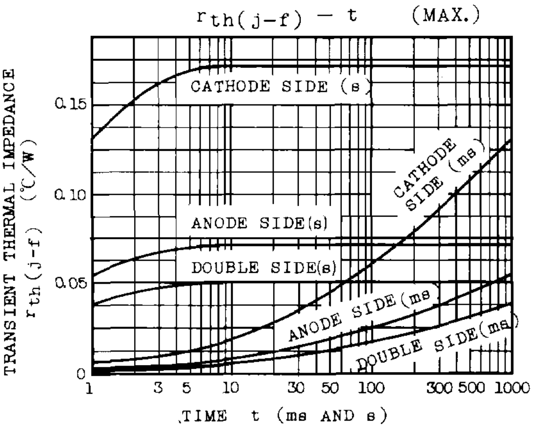
$t_{tail} - V_D$ (MAX.)



$t_{tail} - T_j$ (MAX.)







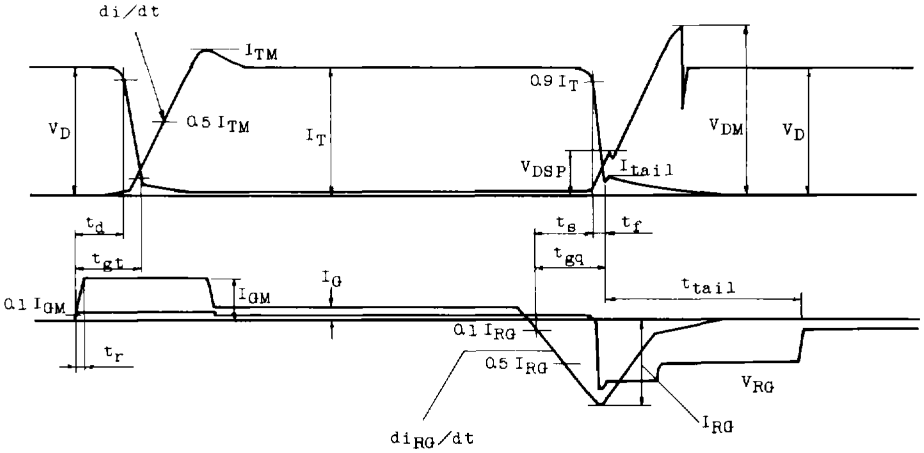


Fig. 1 TURN-ON AND TURN-OFF CHARACTERISTIC OF GTO