# 7MBR25XKA120-50

IGBT Modules

## Power Module(X series)
## 1200V / 25A / PIM

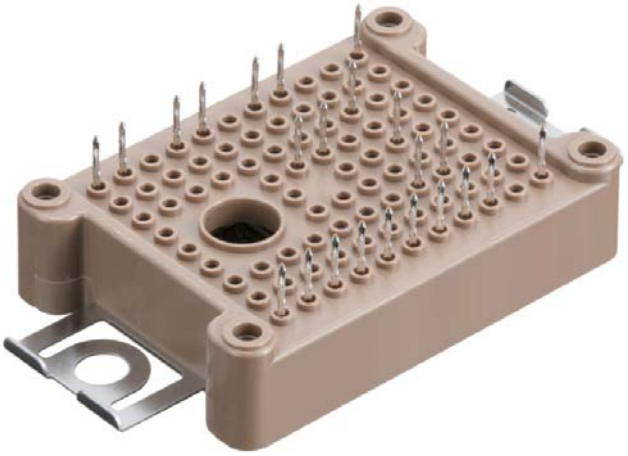
### □ Features

Low $V_{CE(sat)}$
Compact Package
P.C.Board Mount Module
Converter Diode Bridge Dynamic Brake Circuit
RoHS compliant Product

### □Applications

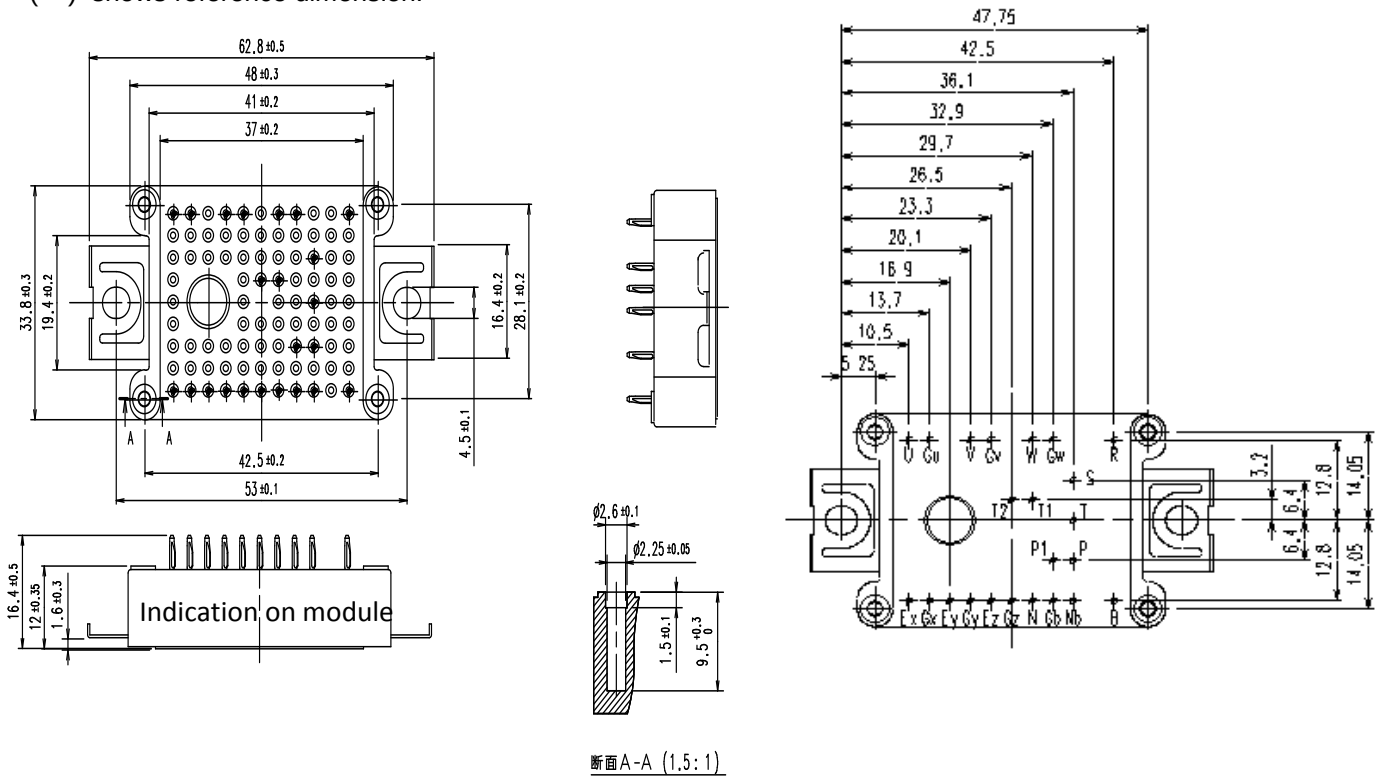
Inverter for Motor Drive
AC and DC Servo Drive Amplifier
Uniterruptible Power Supply

### □ Typical appearance



### □ Outline drawing ( Unit : mm )

shows theoretical dimension.
( ) shows reference dimension.

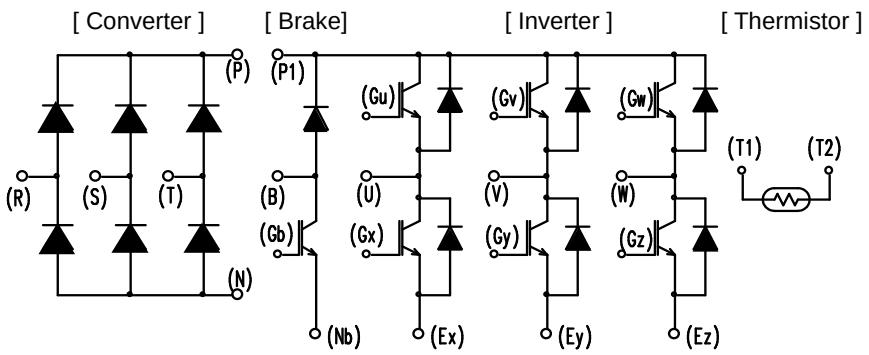



断面A-A (1.5:1)
SECTION A-A

Weight: 25 g (typ.)

PIN POSITIONS WITH TOLERANCE ⌖ φ0.4

### □ Equivalent circuit



## □ Maximum ratings ( at $T_c$ = 25°C unless otherwise specified )

| | Items | | Symbols | Conditions | | Maximum ratings | Units |
|---|---|---|---|---|---|---|---|
| Inverter | Collector-emitter voltage, gate-emitter short-circuited | | $V_{CES}$ | | | 1200 | V |
| | Gate-emitter voltage, collector-emitter short-circuited | | $V_{GES}$ | | | ±20 | V |
| | Collector current | | $I_C$ | Continuous | $T_c$=100°C | 25 | A |
| | Repetitive peak collector current | | $I_{CRM}$ | 1ms | | 40 | |
| | Forward current | | $I_F$ | Continuous | | 25 | |
| | Repetitive peak forward current | | $I_{FRM}$ | 1ms | | 40 | |
| | Total power dissipation | | $P_{tot}$ | 1 device | | 155 | W |
| Brake IGBT | Collector-emitter voltage, gate-emitter short-circuited | | $V_{CES}$ | | | 1200 | V |
| | Gate-emitter voltage, collector-emitter short-circuited | | $V_{GES}$ | | | ±20 | V |
| | Collector current | | $I_C$ | Continuous | $T_c$=100°C | 25 | A |
| | Repetitive peak collector current | | $I_{CRM}$ | 1ms | | 40 | |
| | Total power dissipation | | $P_{tot}$ | 1 device | | 155 | W |
| Brake FWD | Forward current | | $I_F$ | Continuous | | 10 | A |
| | Repetitive peak forward current | | $I_{FRM}$ | 1ms | | 20 | |
| | Repetitive peak reverse voltage | | $V_{RRM}$ | | | 1200 | V |
| Converter | Repetitive peak reverse voltage | | $V_{RRM}$ | | | 1600 | V |
| | Average output current | | $I_O$ | Three-phase full wave rectified | $T_c$=80°C | 25 | A |
| | Surge forward current (Non-Repetitive) (*1) | | $I_{FSM}$ | $t$=10ms, Half sine wave form | $T_{vj}$=25°C | 350 | A |
| | | | | | $T_{vj}$=150°C | 300 | |
| | $I^2t$ (Non-Repetitive) (*1) | | $I^2t$ | | $T_{vj}$=25°C | 615 | $A^2s$ |
| | | | | | $T_{vj}$=150°C | 450 | |
| Virtual Junction temperature | | | $T_{vj}$ | Inverter, Brake | | 175 | °C |
| | | | | Converter | | 150 | |
| Operating Virtual junction temperature (under switching conditions) | | | $T_{vjop}$ | Inverter, Brake | | 175 | |
| | | | | Converter | | 150 | |
| Case temperature | | | $T_c$ | | | 125 | |
| Storage temperature | | | $T_{stg}$ | | | -40 ~ 125 | |
| Isolation voltage | between terminals and copper base (*2)<br>between thermistor and others (*3) | | $V_{isol}$ | A.C. : 1min. | | 2500 | Vrms |
| Screw torque (*4) | Mounting torque of screws to heat sink | | $M_s$ | M4 | | 1.7 | N·m |

(*1) $T_{vj}$ : Temperature at test start.
(*2) All terminals should be connected together during the test.
(*3) Two thermistor terminals should be connected together, other terminals should be connected together and shorted to base plate during the test.
(*4) Recommendable value : Mounting 1.3 ~ 1.7 N·m (M4)

## □ Electrical characteristics ( at $T_{vj}$ = 25°C unless otherwise specified)

| | Items | Symbols | Conditions | | Characteristics min. | Characteristics typ. | Characteristics max. | Units |
|---|---|---|---|---|---|---|---|---|
| Inverter | Collector-emitter cut-off current, gate-emitter short-circuited | $I_{CES}$ | $V_{GE}$ = 0V<br>$V_{CE}$ = 1200V | | - | - | 50 | μA |
| | Gate leakage current, collector-emitter short-circuited | $I_{GES}$ | $V_{CE}$ = 0V $V_{GE}$ = +20/-20V | | - | - | 100 | nA |
| | Gate-Emitter threshold voltage | $V_{GE(th)}$ | $V_{CE}$ = 20V<br>$I_C$ = 25mA | | 6.0 | 6.5 | 7.0 | V |
| | Collector-Emitter saturation voltage | $V_{CE(sat)}$ (terminal) | $V_{GE}$ = 15V<br>$I_C$ = 25A | $T_{vj}$=25°C | - | 1.90 | 2.40 | V |
| | | $V_{CE(sat)}$ (chip) | | $T_{vj}$=25°C | - | 1.70 | 2.15 | |
| | | | | $T_{vj}$=125°C | - | 2.20 | - | |
| | | | | $T_{vj}$=150°C | - | 2.30 | - | |
| | | | | $T_{vj}$=175°C | - | 2.40 | - | |
| | Internal Gate resistance | $r_g$ | - | | - | 0 | - | Ω |
| | Capacitance | $C_{ies}$ | $V_{CE}$ = 10V, $V_{GE}$ =0V, $f$ = 1MHz | | - | 2.0 | - | nF |
| | | $C_{oes}$ | | | - | 0.07 | - | |
| | | $C_{res}$ | | | - | 0.02 | - | |
| | Gate charge | $Q_G$ | $V_{CC}$ = 600V $V_{GE}$=-15 → +15V<br>$I_C$ = 25A | | - | 130 | - | nC |
| | Forward voltage | $V_F$ (terminal) | $I_F$ = 25A | $T_{vj}$=25°C | - | 2.90 | 3.40 | V |
| | | $V_F$ (chip) | | $T_{vj}$=25°C | - | 2.70 | 3.15 | |
| | | | | $T_{vj}$=125°C | - | 2.95 | - | |
| | | | | $T_{vj}$=150°C | - | 2.90 | - | |
| | | | | $T_{vj}$=175°C | - | 2.90 | - | |
| | Switching time (*1) | $t_{d(on)}$ | $V_{CC}$ = 600V<br>$I_C$,$I_F$ = 25A $L_s$ = 30nH<br>$V_{GE}$ = +15/-15 V<br>$R_G$ = 20 Ω | $T_{vj}$=25°C | - | 0.04 | - | μs |
| | | | | $T_{vj}$=125°C | - | 0.04 | - | |
| | | | | $T_{vj}$=150°C | - | 0.04 | - | |
| | | | | $T_{vj}$=175°C | - | 0.04 | - | |
| | | $t_r$ | $V_{CC}$ = 600V<br>$I_C$,$I_F$ = 25A $L_s$ = 30nH<br>$V_{GE}$ = +15/-15 V<br>$R_G$ = 20 Ω | $T_{vj}$=25°C | - | 0.02 | - | |
| | | | | $T_{vj}$=125°C | - | 0.03 | - | |
| | | | | $T_{vj}$=150°C | - | 0.03 | - | |
| | | | | $T_{vj}$=175°C | - | 0.03 | - | |
| | | $t_{d(off)}$ | $V_{CC}$ = 600V<br>$I_C$,$I_F$ = 25A $L_s$ = 30nH<br>$V_{GE}$ = +15/-15 V<br>$R_G$ = 20 Ω | $T_{vj}$=25°C | - | 0.15 | - | |
| | | | | $T_{vj}$=125°C | - | 0.19 | - | |
| | | | | $T_{vj}$=150°C | - | 0.20 | - | |
| | | | | $T_{vj}$=175°C | - | 0.20 | - | |
| | | $t_f$ | $V_{CC}$ = 600V<br>$I_C$,$I_F$ = 25A $L_s$ = 30nH<br>$V_{GE}$ = +15/-15 V<br>$R_G$ = 20 Ω | $T_{vj}$=25°C | - | 0.15 | - | |
| | | | | $T_{vj}$=125°C | - | 0.17 | - | |
| | | | | $T_{vj}$=150°C | - | 0.20 | - | |
| | | | | $T_{vj}$=175°C | - | 0.21 | - | |
| | Reverse recovery time | $t_{rr}$ | $V_{CC}$ = 600V<br>$I_C$,$I_F$ = 25A $L_s$ = 30nH<br>$V_{GE}$ = +15/-15 V<br>$R_G$ = 20 Ω | $T_{vj}$=25°C | - | 0.06 | - | |
| | | | | $T_{vj}$=125°C | - | 0.11 | - | |
| | | | | $T_{vj}$=150°C | - | 0.13 | - | |
| | | | | $T_{vj}$=175°C | - | 0.16 | - | |

(*1) Turn on time ($t_{on}$) = $t_{d(on)}$ + $t_r$ , Turn off time ($t_{off}$) = $t_{d(off)}$ + $t_f$

| | Items | Symbols | Conditions | | Characteristics min. | Characteristics typ. | Characteristics max. | Units |
|---|---|---|---|---|---|---|---|---|
| Inverter | Switching loss (per pulse) | $E_{on}$ | $V_{CC}$ = 600V, $I_C$,$I_F$ = 25A, $L_s$ = 30nH, $V_{GE}$ = +15/-15 V, $R_G$ = 20 Ω | $T_{vj}$=25°C | - | 1.51 | - | mJ |
| | | | | $T_{vj}$=125°C | - | 1.95 | - | |
| | | | | $T_{vj}$=150°C | - | 2.07 | - | |
| | | | | $T_{vj}$=175°C | - | 2.19 | - | |
| | | $E_{off}$ | $V_{CC}$ = 600V, $I_C$,$I_F$ = 25A, $L_s$ = 30nH, $V_{GE}$ = +15/-15 V, $R_G$ = 20 Ω | $T_{vj}$=25°C | - | 1.79 | - | |
| | | | | $T_{vj}$=125°C | - | 2.30 | - | |
| | | | | $T_{vj}$=150°C | - | 2.43 | - | |
| | | | | $T_{vj}$=175°C | - | 2.54 | - | |
| | | $E_{rr}$ | $V_{CC}$ = 600V, $I_C$,$I_F$ = 25A, $L_s$ = 30nH, $V_{GE}$ = +15/-15 V, $R_G$ = 20 Ω | $T_{vj}$=25°C | - | 1.00 | - | |
| | | | | $T_{vj}$=125°C | - | 1.27 | - | |
| | | | | $T_{vj}$=150°C | - | 1.47 | - | |
| | | | | $T_{vj}$=175°C | - | 1.66 | - | |
| Brake | Collector-emitter cut-off current, gate-emitter short-circuited | $I_{CES}$ | $V_{GE}$ = 0V, $V_{CE}$ = 1200V | | - | - | 50 | μA |
| | Gate leakage current, collector-emitter short-circuited | $I_{GES}$ | $V_{CE}$ = 0V, $V_{GE}$ = +20/-20V | | - | - | 100 | nA |
| | Collector-Emitter saturation voltage | $V_{CE(sat)}$ (terminal) | $V_{GE}$ = 15V, $I_C$ = 25A | $T_{vj}$=25°C | - | 1.90 | 2.40 | V |
| | | $V_{CE(sat)}$ (chip) | | $T_{vj}$=25°C | - | 1.70 | 2.15 | |
| | | | | $T_{vj}$=125°C | - | 2.20 | - | |
| | | | | $T_{vj}$=150°C | - | 2.30 | - | |
| | | | | $T_{vj}$=175°C | - | 2.40 | - | |
| | Internal Gate resistance | $r_g$ | - | | - | 0 | - | Ω |
| | Switching time (*1) | $t_{d(on)}$ | $V_{CC}$ = 600V, $I_C$ = 25A, $L_s$ = 30nH, $V_{GE}$ = +15/-15 V, $R_G$ = 20 Ω | $T_{vj}$=25°C | - | 0.04 | - | μs |
| | | | | $T_{vj}$=125°C | - | 0.04 | - | |
| | | | | $T_{vj}$=150°C | - | 0.04 | - | |
| | | | | $T_{vj}$=175°C | - | 0.04 | - | |
| | | $t_r$ | $V_{CC}$ = 600V, $I_C$ = 25A, $L_s$ = 30nH, $V_{GE}$ = +15/-15 V, $R_G$ = 20 Ω | $T_{vj}$=25°C | - | 0.02 | - | |
| | | | | $T_{vj}$=125°C | - | 0.03 | - | |
| | | | | $T_{vj}$=150°C | - | 0.03 | - | |
| | | | | $T_{vj}$=175°C | - | 0.03 | - | |
| | | $t_{d(off)}$ | $V_{CC}$ = 600V, $I_C$ = 25A, $L_s$ = 30nH, $V_{GE}$ = +15/-15 V, $R_G$ = 20 Ω | $T_{vj}$=25°C | - | 0.15 | - | |
| | | | | $T_{vj}$=125°C | - | 0.19 | - | |
| | | | | $T_{vj}$=150°C | - | 0.20 | - | |
| | | | | $T_{vj}$=175°C | - | 0.20 | - | |
| | | $t_f$ | $V_{CC}$ = 600V, $I_C$ = 25A, $L_s$ = 30nH, $V_{GE}$ = +15/-15 V, $R_G$ = 20 Ω | $T_{vj}$=25°C | - | 0.15 | - | |
| | | | | $T_{vj}$=125°C | - | 0.17 | - | |
| | | | | $T_{vj}$=150°C | - | 0.20 | - | |
| | | | | $T_{vj}$=175°C | - | 0.21 | - | |
| | Reverse current | $I_{RRM}$ | $V_R$ = 1200V | | - | - | 50 | μA |
| | Forward voltage | $V_F$ (terminal) | $I_F$ = 10A | $T_j$=25°C | - | 2.10 | 2.60 | V |
| | | $V_F$ (chip) | $I_F$ = 10A | $T_{vj}$=25°C | - | 1.90 | 2.35 | |
| | | | | $T_{vj}$=125°C | - | 1.95 | - | |
| | | | | $T_{vj}$=150°C | - | 1.90 | - | |
| | | | | $T_{vj}$=175°C | - | 1.85 | - | |
| Converter | Reverse current | $I_{RRM}$ | $V_R$ = 1600V | | - | - | 50 | μA |
| | Continuous (direct) forward voltage | $V_F$ | $I_F$ = 25A | terminal | - | 1.25 | 1.75 | V |
| Thermistor | Resistance | $R$ | $T$ = 25°C | | - | 5000 | - | Ω |
| | | | $T$ = 100°C | | 465 | 495 | 520 | |
| | B value | $B$ | $T$ = 25/ 50°C | | 3305 | 3375 | 3450 | K |

(*1) Turn on time ($t_{on}$) = $t_{d(on)}$ + $t_r$ , Turn off time ($t_{off}$) = $t_{d(off)}$ + $t_f$

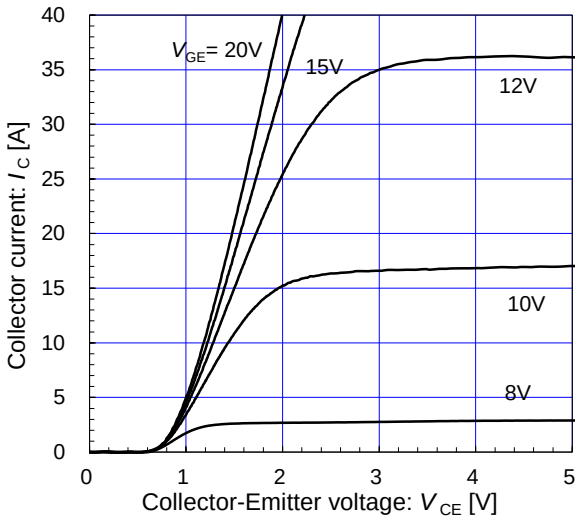
**NOTICE:**
The external gate resistance ($R_G$) shown above is one of our recommended value for the purpose of minimum switching loss. However the optimum $R_G$ depends on circuit configuration and/or environment. We recommend that the $R_G$ has to be carefully chosen based on consideration if IGBT module matches design criteria, for example, switching loss, EMC/EMI, spike voltage, surge current and no unexpected oscillation and so on.

## □Thermal resistance characteristics

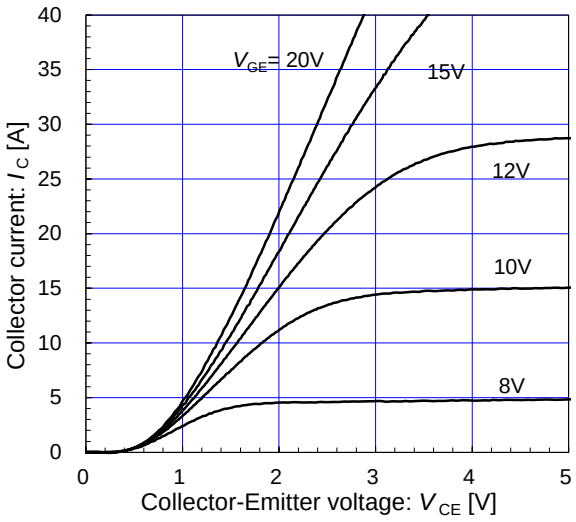
| Items | Symbols | Conditions | Characteristics | | | Units |
|---|---|---|---|---|---|---|
| | | | min. | typ. | max. | |
| Thermal resistance junction to case (1 device) | $R_{th(j-c)}$ | Inverter IGBT | - | - | 0.94 | °C/W |
| | | Inverter FWD | - | - | 1.75 | |
| | | Brake IGBT | - | - | 0.94 | |
| | | Brake FWD | - | - | 1.75 | |
| | | Converter Diode | - | - | 0.97 | |
| Thermal resistance case to heat sink(*1) (1 device) | $R_{th(c-s)}$ | Inverter IGBT | - | 0.74 | - | |
| | | Inverter FWD | - | 0.92 | - | |
| | | Brake IGBT | - | 0.78 | - | |
| | | Brake FWD | - | 0.75 | - | |
| | | Converter Diode | - | 0.78 | - | |

(*1) This is the value which is defined mounting on the additional cooling fin with 1 W/(m･K) thermal grease.

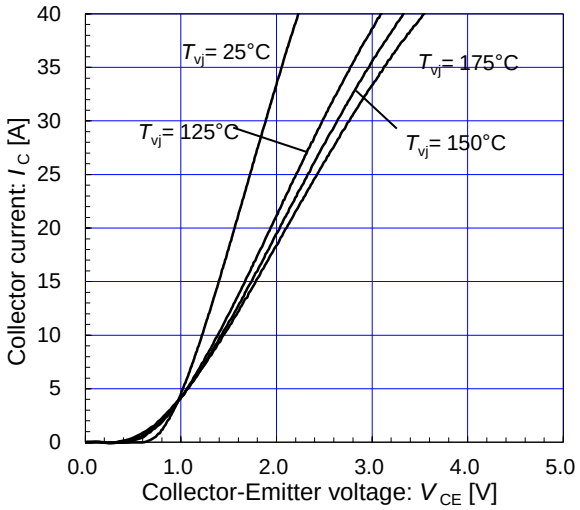
[ Inverter ]
Collector current vs. Collector-Emitter voltage (typ.)
$T_{vj}$= 25°C / chip



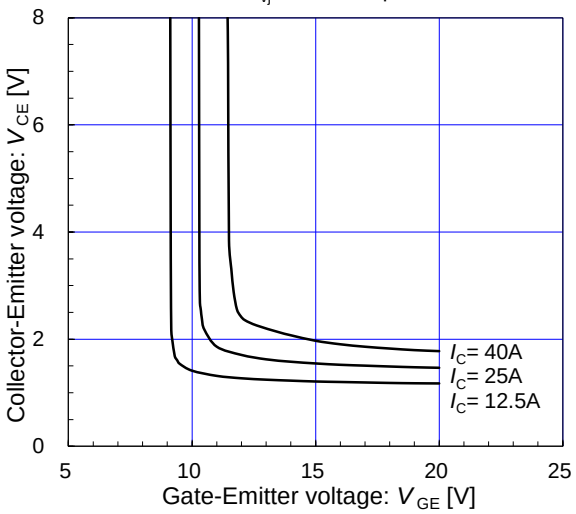

[ Inverter ]
Collector current vs. Collector-Emitter voltage (typ.)
$T_{vj}$= 175°C / chip



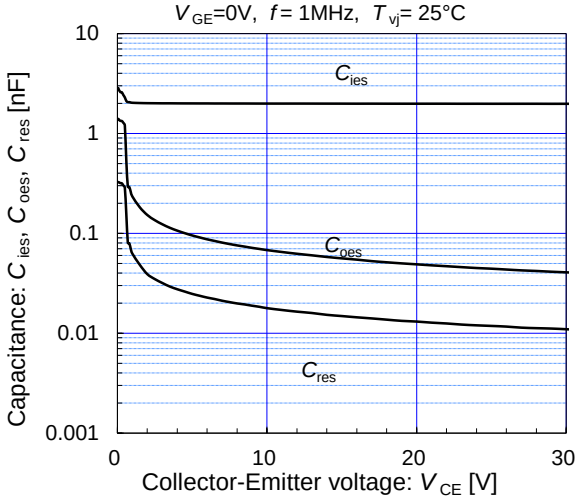

[ Inverter ]
Collector current vs. Collector-Emitter voltage (typ.)
$V_{GE}$=15V / chip



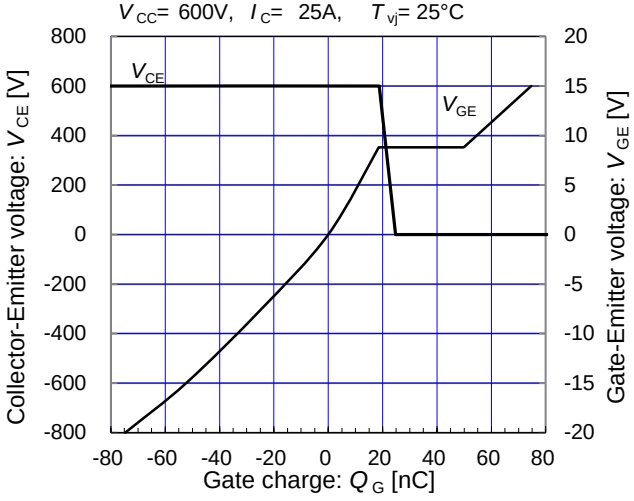

[ Inverter ]
Collector-Emitter voltage vs. Gate-Emitter voltage (typ.)
$T_{vj}$= 25°C / chip




[ Inverter ]
Capacitance vs. Collector-Emitter voltage (typ.)
$V_{GE}$=0V, $f$= 1MHz, $T_{vj}$= 25°C



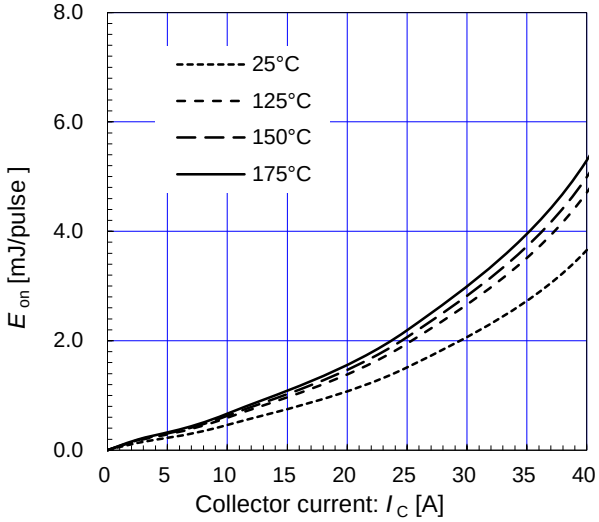

[ Inverter ]
Dynamic Gate charge (typ.)
$V_{CC}$= 600V, $I_C$= 25A, $T_{vj}$= 25°C



[ Inverter ]

$E_{on}$ vs. Collector current (typ.)

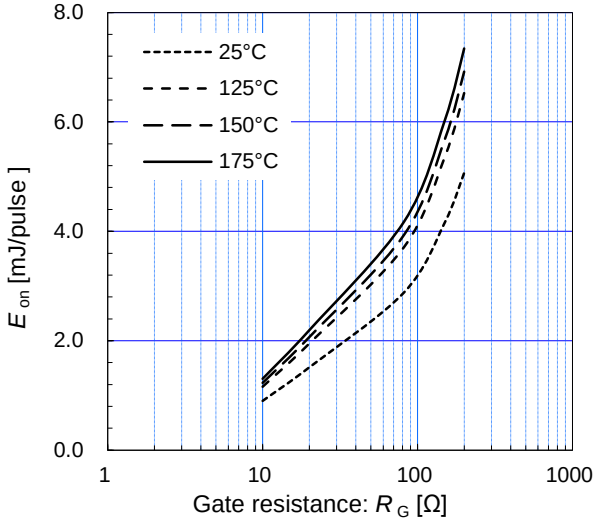
$V_{CC}$= 600V, $V_{GE}$ = +15/-15 V $R_G$= 20 Ω




[ Inverter ]

$E_{on}$ vs. Gate resistance (typ.)

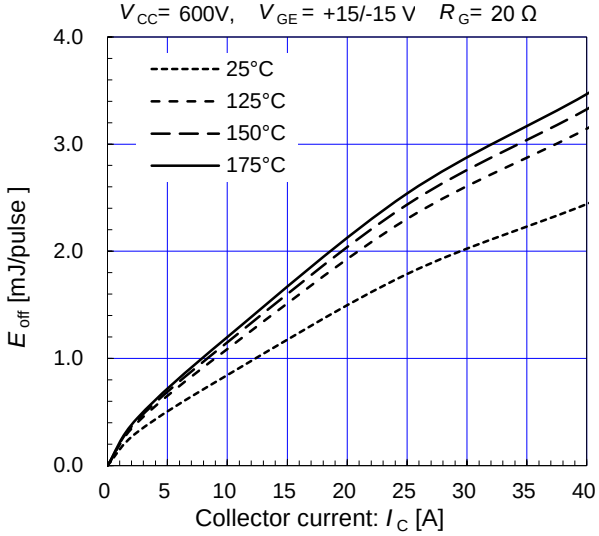
$V_{CC}$= 600V, $V_{GE}$ = +15/-15 V $I_C$= 25A




[ Inverter ]

$E_{off}$ vs. Collector current (typ.)

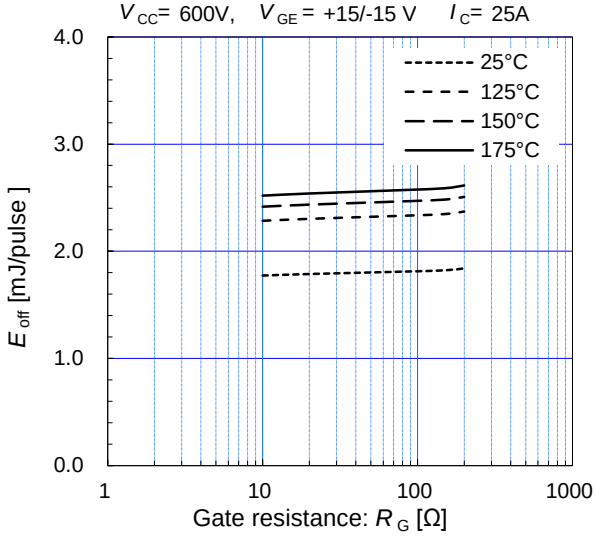
$V_{CC}$= 600V, $V_{GE}$ = +15/-15 V $R_G$= 20 Ω




[ Inverter ]

$E_{off}$ vs. Gate resistance (typ.)

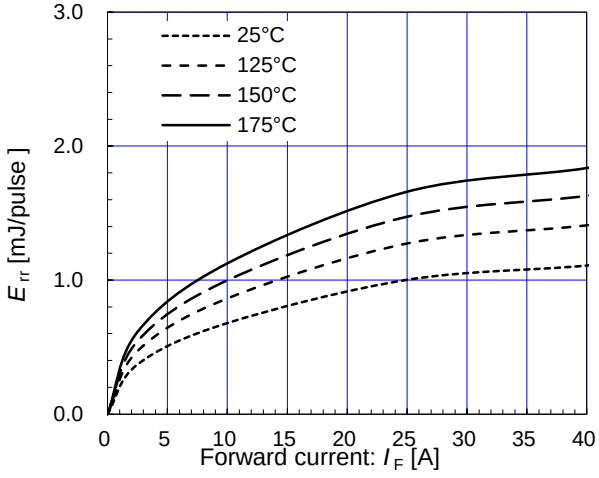
$V_{CC}$= 600V, $V_{GE}$ = +15/-15 V $I_C$= 25A




[ Inverter ]

$E_{rr}$ vs. Forward current (typ.)

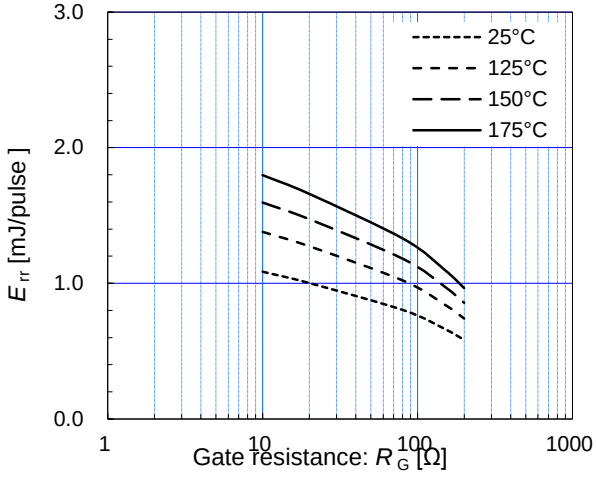
$V_{CC}$= 600V, $V_{GE}$ = +15/-15 V $R_G$= 20 Ω




[ Inverter ]

$E_{rr}$ vs. Gate resistance (typ.)

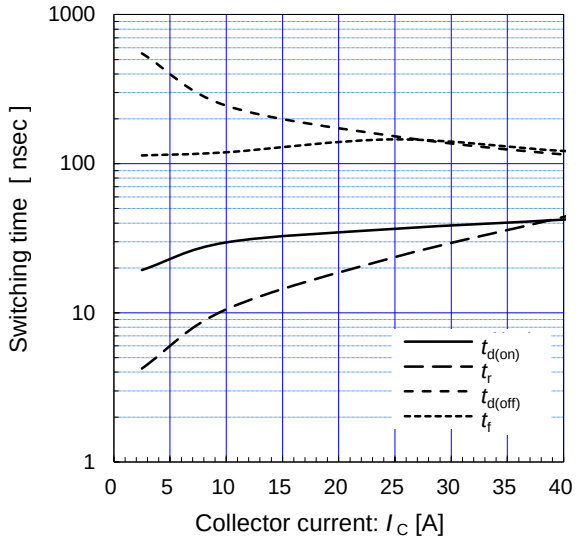
$V_{CC}$= 600V, $V_{GE}$ = +15/-15 V $I_C$= 25A



[ Inverter ]

Switching time vs. Collector current (typ.)

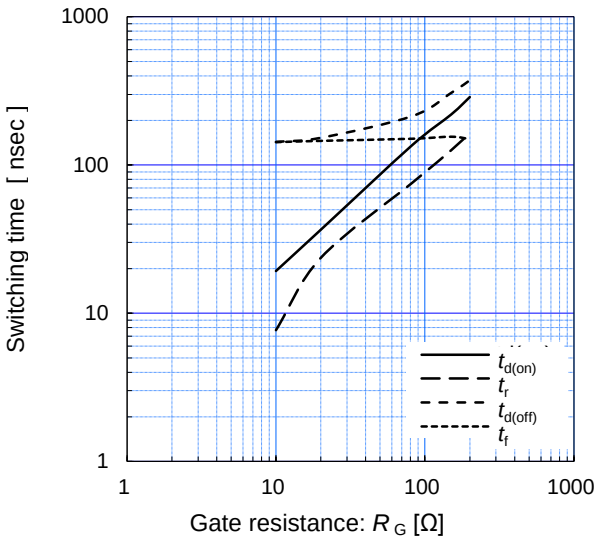
$V_{CC}$= 600V, $R_G$= 20Ω $V_{GE}$= +15/-15 V, $T_{vj}$= 25°C




[ Inverter ]

Switching time vs. Gate resistance (typ.)

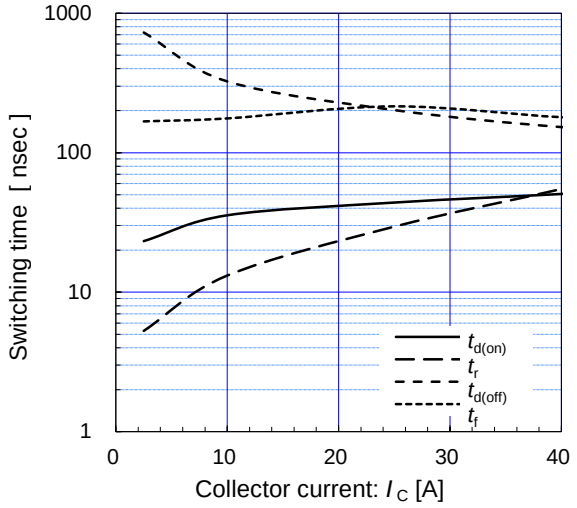
$V_{CC}$= 600V, $I_C$= 25A, $V_{GE}$= +15/-15 V, $T_{vj}$= 25°C




[ Inverter ]

Switching time vs. Collector current (typ.)

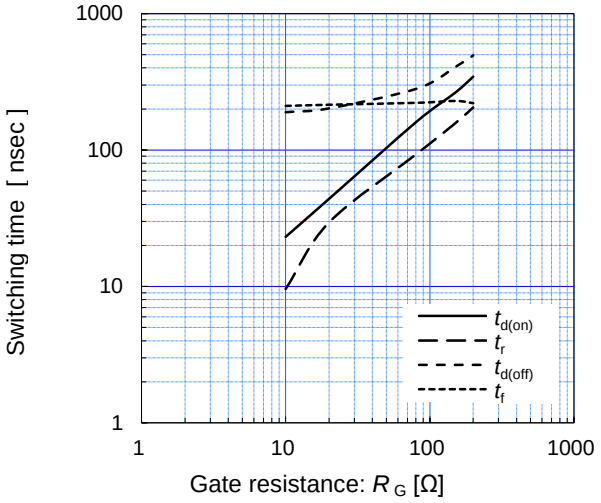
$V_{CC}$= 600V, $R_G$= 20Ω $V_{GE}$= +15/-15 V, $T_{vj}$= 175°C




[ Inverter ]

Switching time vs. Gate resistance (typ.)

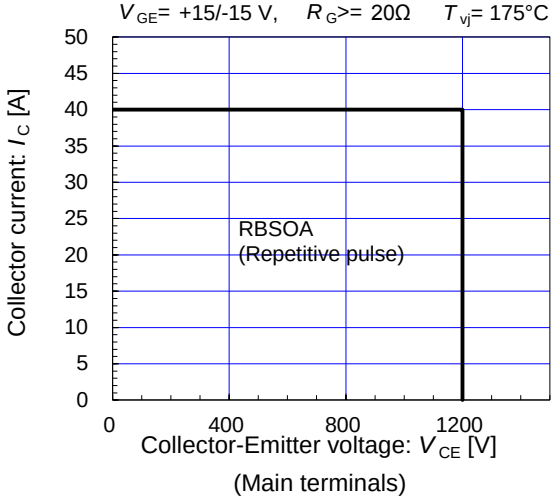
$V_{CC}$= 600V, $I_C$= 25A, $V_{GE}$= +15/-15 V, $T_{vj}$= 175°C




[ Inverter ]

Reverse bias safe operating area (max.)

$V_{GE}$= +15/-15 V, $R_G$>= 20Ω $T_{vj}$= 175°C

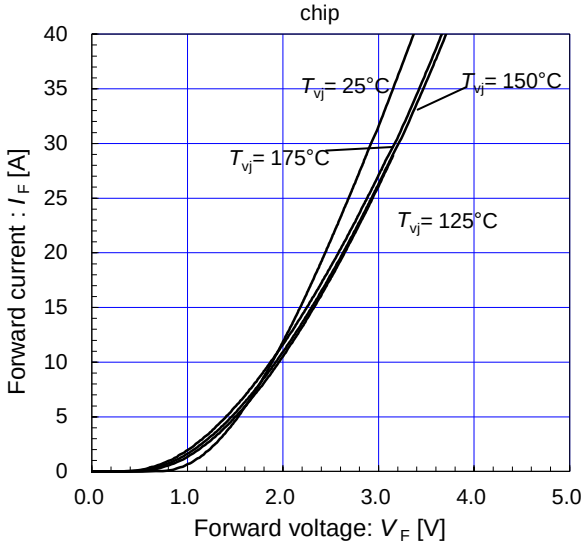



(Main terminals)

[ Inverter ]

Forward current vs. Forward voltage (typ.)

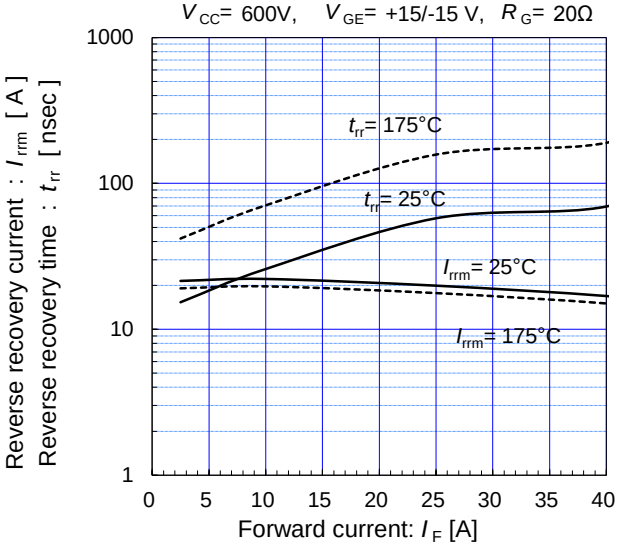
chip




[ Inverter ]

Reverse recovery characteristics (typ.)

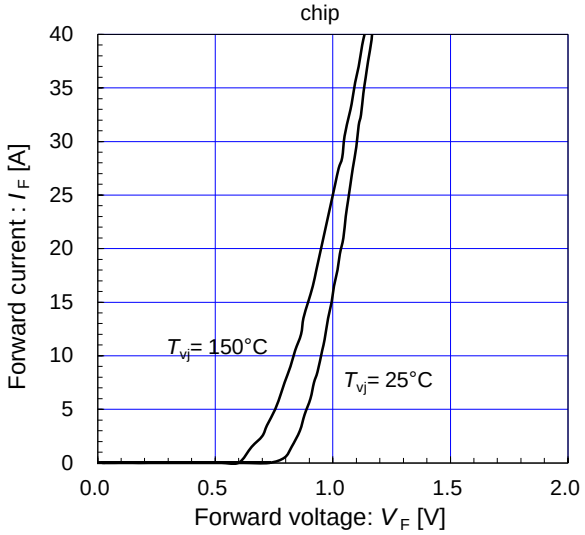
$V_{CC}$= 600V, $V_{GE}$= +15/-15 V, $R_G$= 20Ω



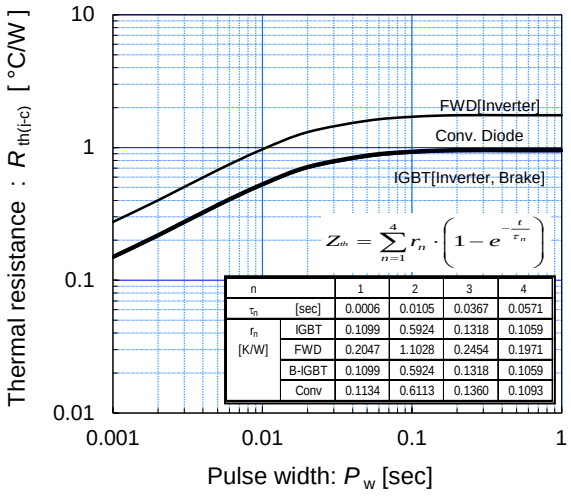

[ Converter ]

Forward current vs. Forward voltage (typ.)

chip



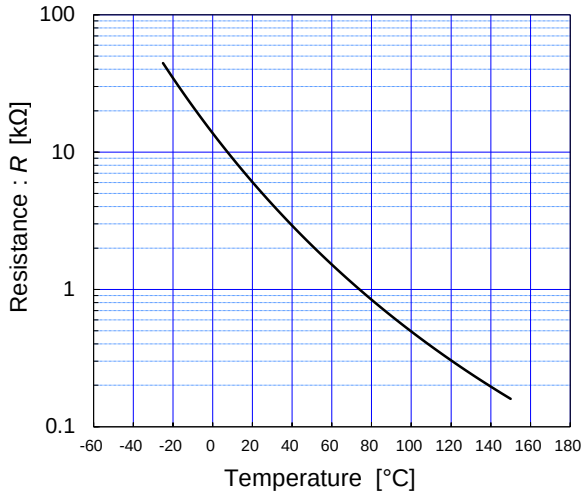

Transient thermal resistance (max.)



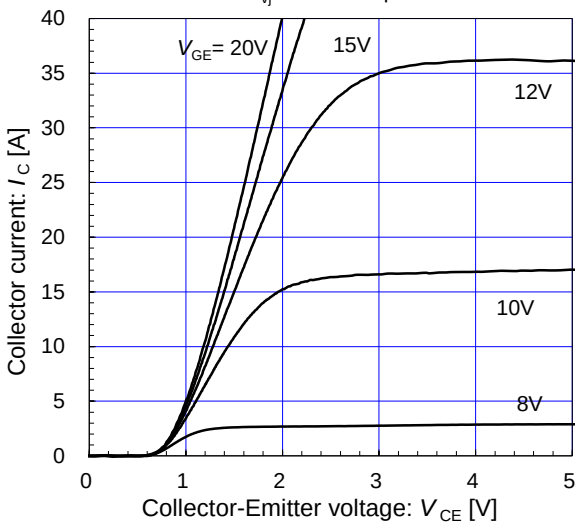

| n | | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| $\tau_n$ | [sec] | 0.0006 | 0.0105 | 0.0367 | 0.0571 |
| $r_n$ [K/W] | IGBT | 0.1099 | 0.5924 | 0.1318 | 0.1059 |
| | FWD | 0.2047 | 1.1028 | 0.2454 | 0.1971 |
| | B-IGBT | 0.1099 | 0.5924 | 0.1318 | 0.1059 |
| | Conv | 0.1134 | 0.6113 | 0.1360 | 0.1093 |

[ Thermistor ]

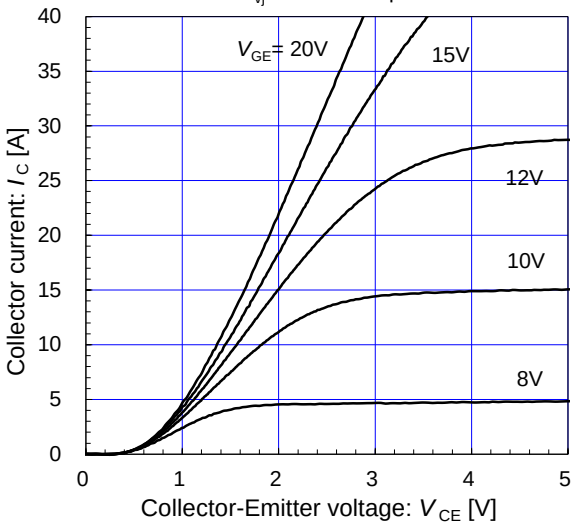
Temperature characteristic (typ.)



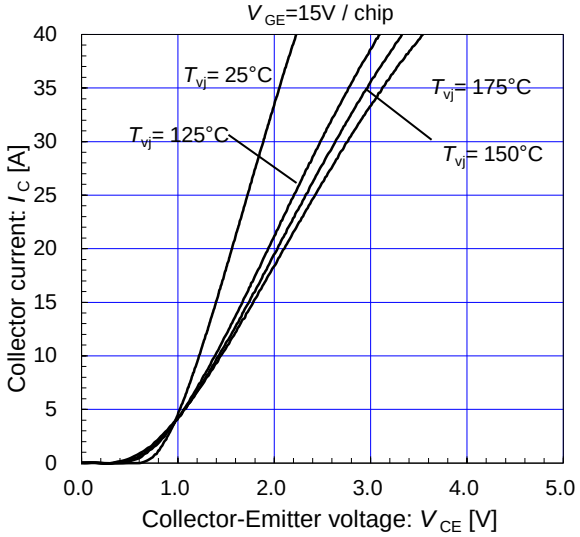
[ Brake ]
Collector current vs. Collector-Emitter voltage (typ.)
$T_{vj}$= 25°C / chip



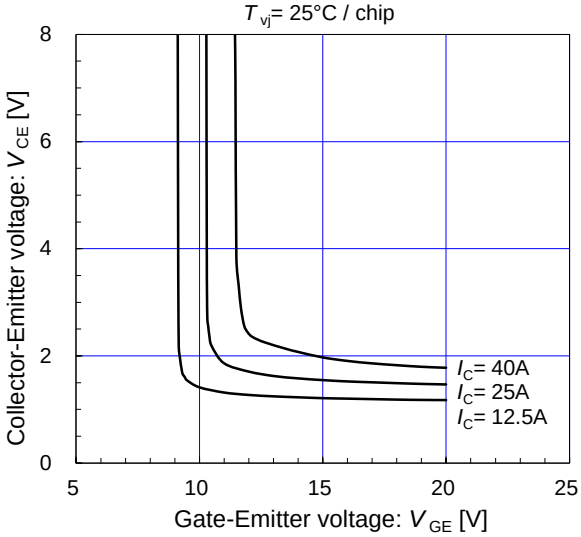

[ Brake ]
Collector current vs. Collector-Emitter voltage (typ.)
$T_{vj}$= 175°C / chip



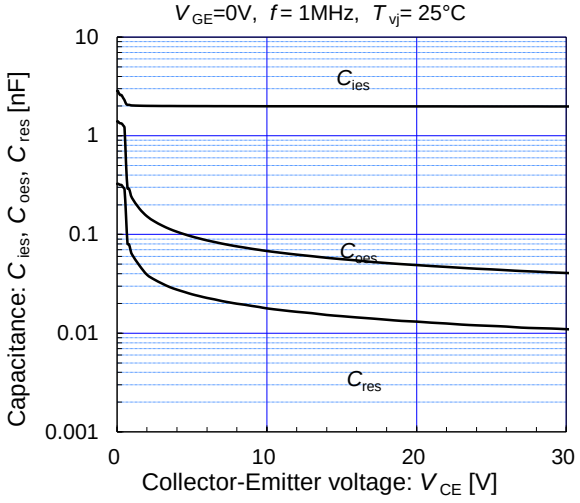

[ Brake ]
Collector current vs. Collector-Emitter voltage (typ.)
$V_{GE}$=15V / chip



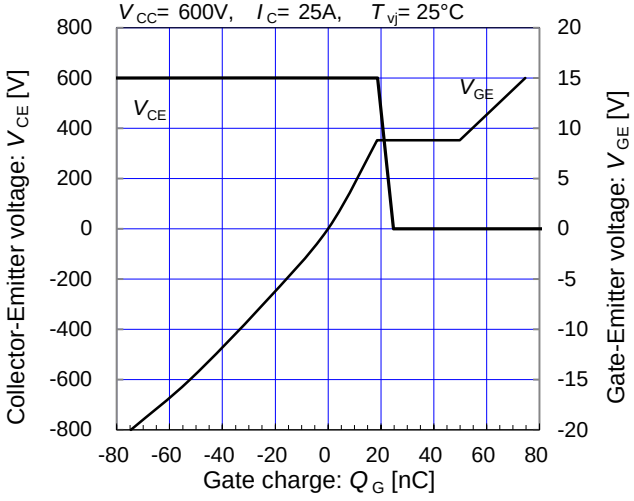

[ Brake ]
Collector-Emitter voltage vs. Gate-Emitter voltage (typ.)
$T_{vj}$= 25°C / chip




[ Brake ]
Capacitance vs. Collector-Emitter voltage (typ.)
$V_{GE}$=0V, $f$= 1MHz, $T_{vj}$= 25°C




[ Brake ]
Dynamic Gate charge (typ.)
$V_{CC}$= 600V, $I_C$= 25A, $T_{vj}$= 25°C



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1. This Catalog contains the product specifications, characteristics, data, materials, and structures as of 1/2018. The contents are subject to change without notice for specification changes or other reasons. When using a product listed in this Catalog, be sure to obtain the latest specifications.

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・Traffic-signal control equipment ・Gas leakage detectors with an auto-shut-off feature
・Emergency equipment for responding to disasters and anti-burglary devices ・Safety devices ・Medical equipment

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7. 

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IGBT Modules

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