# 2MSI400VE-170-53

**Hybrid Modules**

## Power Module (Vseries IGBT&SiC SBD Hybrid type)
## 1700V / 400A / 2-in-1 package

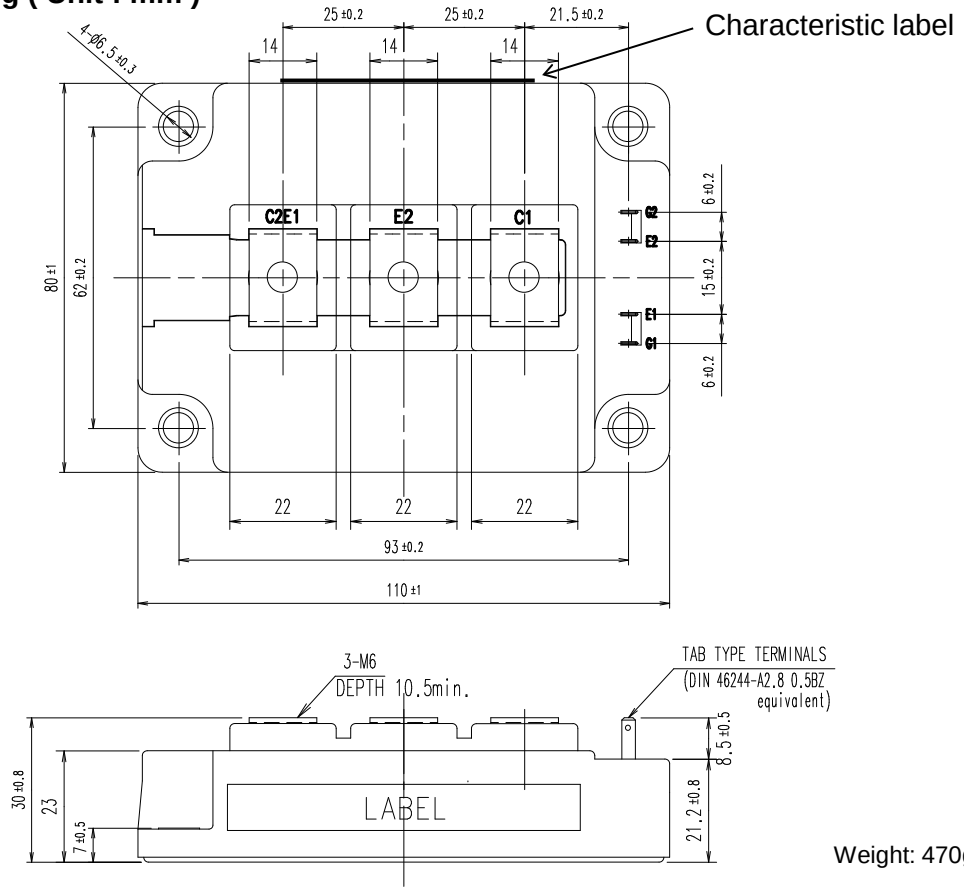
### ■ Features

High speed switching
Voltage drive
Low switching loss
Low Inductance module structure

### ■ Applications

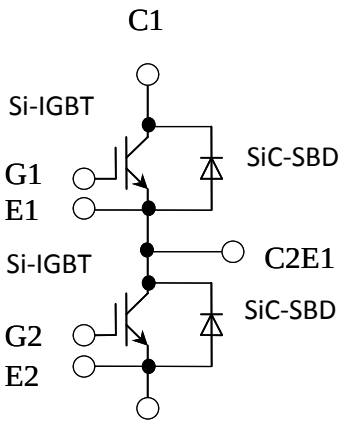
Inverter for Motor Drive
AC and DC Servo Drive Amplifier
Uninterruptible Power Supply
Active Front End

### ■ Outline drawing ( Unit : mm )




Weight: 470g (typ.)

### ■ Equivalent Circuit



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## ■ Absolute Maximum Ratings (at Tc= 25°C unless otherwise specified)

| Items | | Symbols | Conditions | | Maximum Ratings | Units |
|---|---|---|---|---|---|---|
| Collector-Emitter voltage | | VCES | | | 1,700 | V |
| Gate-Emitter voltage | | VGES | | | ±20 | V |
| Collector current | | Ic | Continuous | Tc=100°C | 400 | A |
| | | | | Tc=25°C | 520 | |
| | | Ic pulse | 1ms | | 800 | |
| | | -Ic | | | 400 | |
| | | -Ic pulse | 1ms | | 800 | |
| Collector power dissipation | | Pc | 1 device | | 4,540 | W |
| $I^2t$ (*1) | | $I^2t$ | 1 device VCE=0V,tw=10ms | Tj=125°C | 14,240 | $A^2s$ |
| | | | | Tj=150°C | 11,760 | |
| Junction temperature | | Tj | | | 175 | °C |
| Operating junction temperature (under switching conditions) | | Tjop | | | 150 | |
| Case temperature | | Tc | | | 125 | |
| Storage temperature | | Tstg | | | -40 ~ 125 | |
| Isolation | between terminal and copper base (*2) | Viso | AC: 1min. | | 4,000 | VAC |
| Screw Torqu | Mounting (*3) | - | | | 6.0 | N m |
| | Terminals (*4) | - | | | 5.0 | |

(* Non-repetitive
(* All terminals should be connected together during the test.
(* Recommendable Value : 3.0-6.0 Nm (M5 or M6)
(* Recommendable Value : 2.5-5.0 Nm (M6)

## ■ Electrical characteristics (at Tj= 25°C unless otherwise specified)

**NOTICE:**
The external gate resistance (Rg_on, Rg_off) shown in below is one of our recommend value for the purpose of minimum switching loss. However the optimum Rg depends on circuit configuration and/or environment.
We recommend that the Rg 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. Especially, we recommend to choose Rg_on value shown in below or more.

| Items | Symbols | Conditions | | Characteristics min. | Characteristics typ. | Characteristics max. | Units |
|---|---|---|---|---|---|---|---|
| Zero gate voltage Collector current | ICES | VGE=0V, VCE=1700V | | - | - | 10.0 | mA |
| Gate-Emitter leakage current | IGES | VCE=0V, VGE=±20V | | - | - | 800 | nA |
| Gate-Emitter threshold voltage | VGE(th) | VCE=20V, Ic=400mA | | 6.0 | 6.5 | 7.0 | V |
| Collector-Emitter saturation voltage | VCE(sat) (terminal) | VGE=15V, Ic=400A | Tj=25°C | - | 2.15 | 2.60 | V |
| | | | Tj=125°C | - | 2.55 | - | |
| | | | Tj=150°C | - | 2.60 | - | |
| | VCE(sat) (chip) | VGE=15V, Ic=400A | Tj=25°C | - | 2.00 | 2.25 | |
| | | | Tj=125°C | - | 2.40 | - | |
| | | | Tj=150°C | - | 2.45 | - | |
| Internal gate resistance | Rg(int) | - | | - | 5.6 | - | Ω |
| Input capacitance | Cies | VCE=10V, VGE=0V, *f*=1MHz | | - | 38 | - | nF |
| Turn-on time | ton | Vcc=900V, Ic=400A,VGE=±15V, Rg_on=1Ω, Rg_off=0.5Ω, Tj=125°C, Ls=30nH | | - | 1050 | - | nsec |
| | tr | | | - | 450 | - | |
| | tr(i) | | | - | - | - | |
| Turn-off time | toff | | | - | 1950 | - | |
| | tf | | | - | 90 | - | |
| Forward on voltage | VF (terminal) | VGE=0V, IF=400A | Tj=25°C | - | 1.70 | 2.15 | V |
| | | | Tj=125°C | - | 2.25 | - | |
| | | | Tj=150°C | - | 2.45 | - | |
| | VF (chip) | VGE=0V, IF=400A | Tj=25°C | - | 1.60 | 1.90 | |
| | | | Tj=125°C | - | 2.15 | - | |
| | | | Tj=150°C | | 2.35 | - | |

### 5. Thermal resistance characteristics

| Items | Symbols | Conditions | Characteristics min. | Characteristics typ. | Characteristics max. | Units |
|---|---|---|---|---|---|---|
| Thermal resistance(1device) | Rth(j-c) | IGBT | - | - | 0.033 | °C/W |
| | | FWD(SiC-SBD) | - | - | 0.070 | |
| Contact thermal resistance (1device) (*1) | Rth(c-f) | with Thermal Compound | - | 0.0125 | - | |

(*1) This is the value which is defined mounting on the additional cooling fin with thermal compound.

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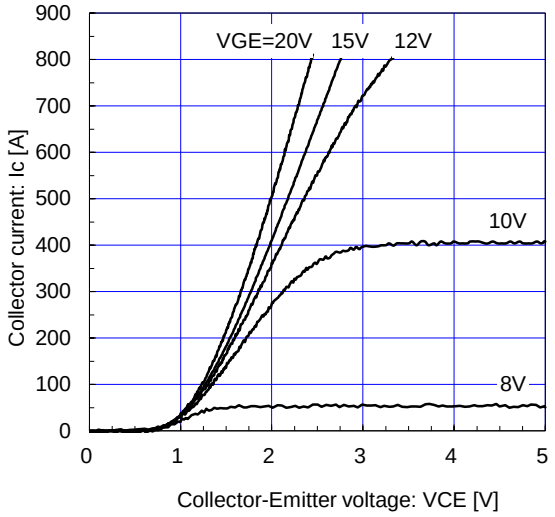
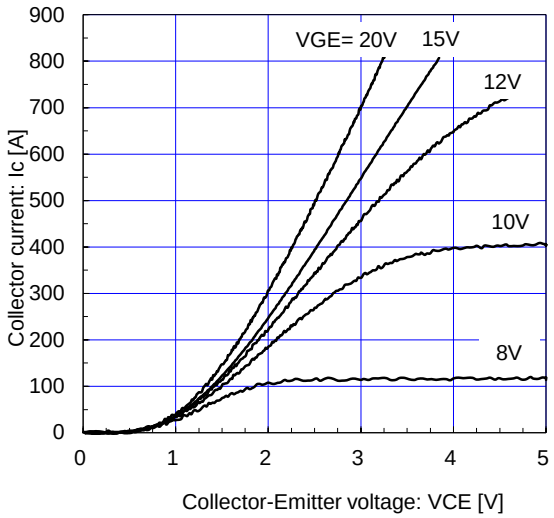
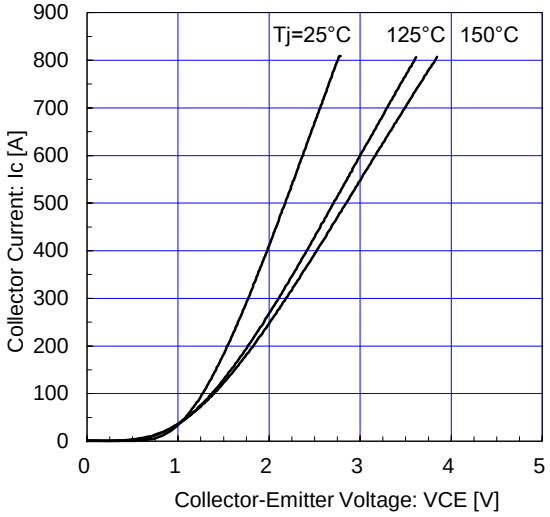
Collector current vs. Collector-Emitter voltage
Tj= 25°C / chip



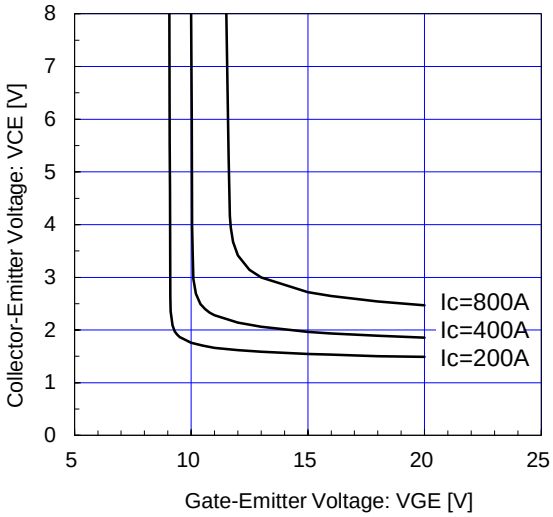

Collector current vs. Collector-Emitter voltage (typ.)
Tj= 150°C / chip



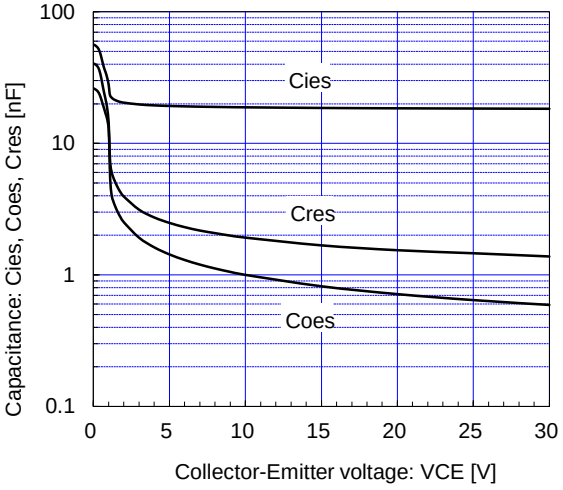

Collector current vs. Collector-Emitter voltage
VGE= 15V / chip



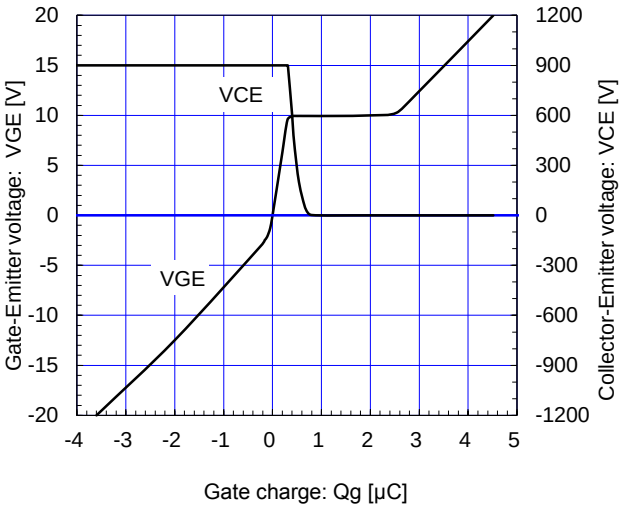

Collector-Emitter voltage vs. Gate-Emitter voltage
Tj= 25°C / chip




Capacitance vs. Collector-Emitter Voltage (typ.)
VGE= 0V, *f* = 1MHz, Tj= 25°C




Dynamic Gate Charge (typ.)
Vcc=900V, Ic=400A, Tj= 25°C



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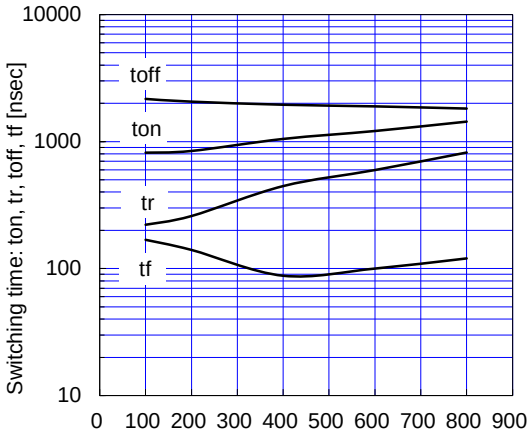
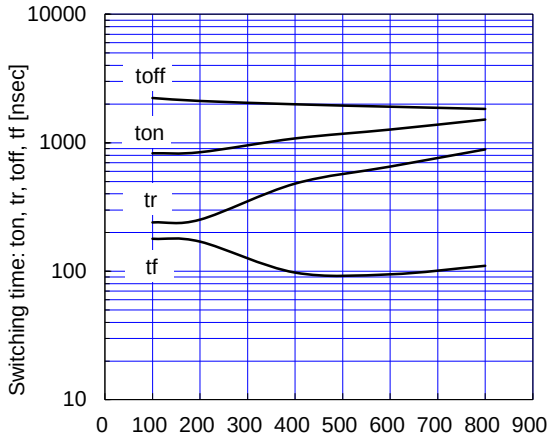
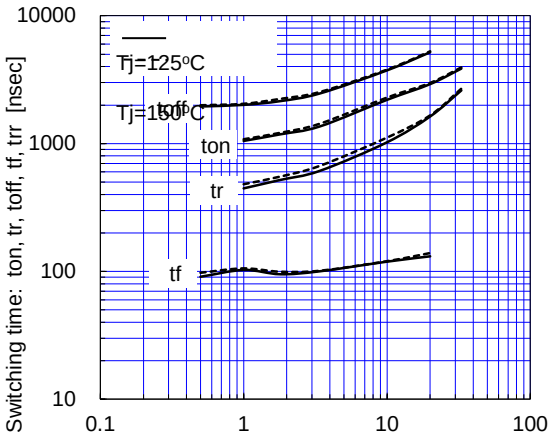
Switching time vs. Collector current (typ.)
Vcc=900V, VGE=±15V, Rg_on=1Ω, Rg_off=0.5Ω, Tj=125°C



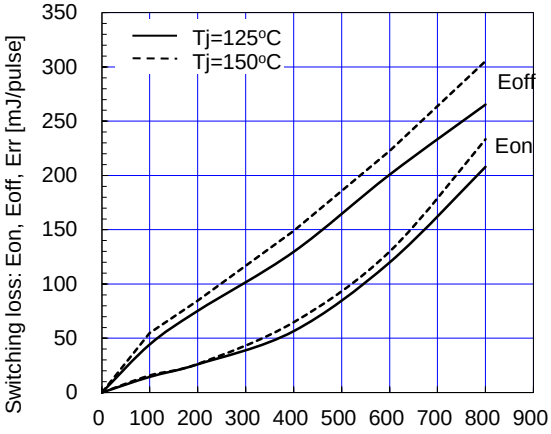

Switching time vs. Collector current (typ.)
Vcc=900V, VGE=±15V, Rg_on=1Ω, Rg_off=0.5Ω, Tj=150°C



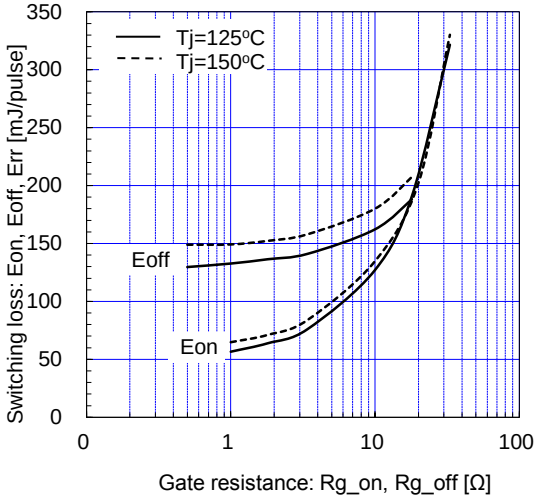

Switching time vs. Gate resistance (typ.)
Vcc=900V, Ic=IF=400A, VGE=±15V



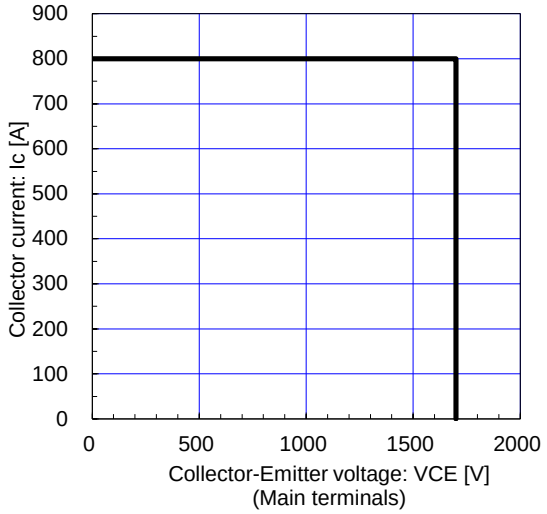

Switching loss vs. Collector current (typ.)
Vcc=900V, VGE=±15V, Rg_on=1Ω, Rg_off=0.5Ω




Switching loss vs. Gate resistance (typ.)
Vcc=900V, Ic=IF=400A, VGE=±15V




Reverse bias safe operating area (max.)
+VGE=15V, -VGE=15V, Rg_off=0.5Ω, Tj=150°C



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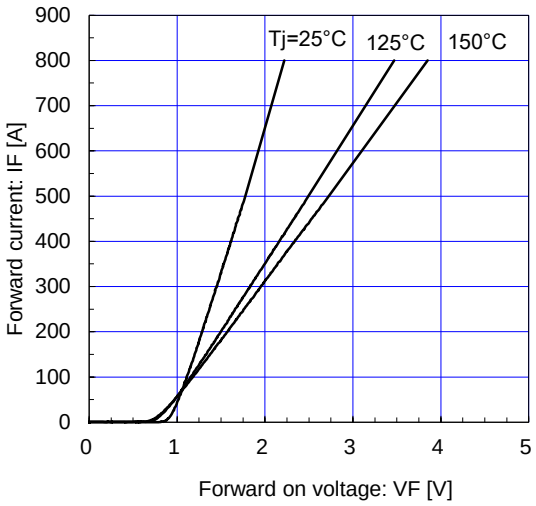
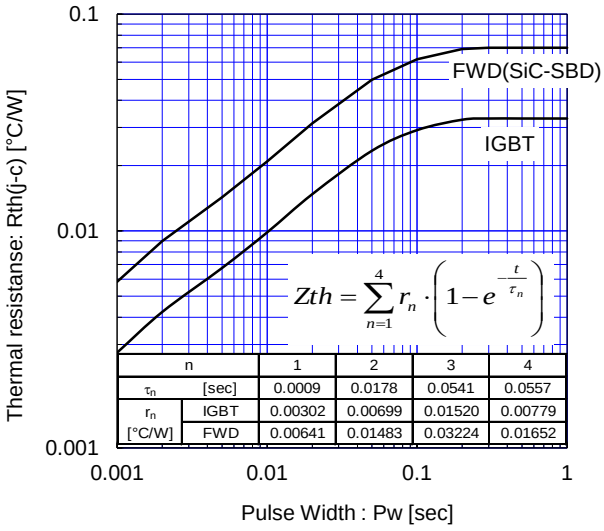
Forward Current vs. Forward Voltage (typ.)
chip




Transient Thermal Resistance (max.)




| n | | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| $\tau_n$ | [sec] | 0.0009 | 0.0178 | 0.0541 | 0.0557 |
| $r_n$ [°C/W] | IGBT | 0.00302 | 0.00699 | 0.01520 | 0.00779 |
| | FWD | 0.00641 | 0.01483 | 0.03224 | 0.01652 |

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