MBL400E33D

Silicon N-channel IGBT

FEATURES

- High thermal fatigue durability.(delta Tc=70oC, N>30,000cycles)
- High speed, low loss IGBT module.
- Low noise due to built-in free-wheeling diode
  – ultra soft fast recovery diode(USFD).
- Low driving power due to low input capacitance MOS gate.
- High reliability, high durability module.
- Isolated heat sink (terminal to base).

ABSOLUTE MAXIMUM RATINGS (T_C=25°C)

Item		Symbol	Unit	MBL400E33D
Collector Emitter Voltage		V_{CES}	V	3,300
Gate Emitter Voltage		V_{GES}	V	±20
Collector Current	DC	I_C	A	400
	1ms	I_{CRM}		800
Forward Current	DC	I_F	A	400
	1ms	I_{FRM}		800
Junction Temperature		$T_{vj\ op}$	°C	-40 ~ +125
Storage Temperature		T_{stg}	°C	-40 ~ +125
Isolation Voltage		V_{ISO}	V_{RMS}	6,000(AC 1 minute)
Screw Torque	Terminals (M4/M8)	-	N·m	2/22 (1)
	Mounting (M6)	-		6 (2)

Notes: (1) Recommended Value 1.8±0.2/22±1N·m (2) Recommended Value 5.5±0.5N·m

ELECTRICAL CHARACTERISTICS

1)IGBT+FWD

Item		Symbol	Unit	Min.	Typ.	Max.	Test Conditions
Collector Emitter Cut-Off Current		I_{CES}	mA	-	-	12	V_{CE}=3,300V, V_{GE}=0V, T_{vj}=25°C
Gate Emitter Leakage Current		I_{GES}	nA	-500	-	+500	V_{GE}=±20V, V_{CE}=0V, T_{vj}=25°C
Collector Emitter Saturation Voltage		V_{CEsat}	V	3.5	4.2	5.0	I_C=400A, V_{GE}=15V, T_{vj}=125°C
Gate Emitter Threshold Voltage		$V_{GE(th)}$	V	4.5	6.0	7.0	V_{CE}=10V, I_C=400mA, T_{vj}=25°C
Input Capacitance		C_{ies}	nF	-	35	-	V_{CE}=10V, V_{GE}=0V, f=100kHz, T_{vj}=25°C
Internal Gate Resistance		$R_{G(int)}$	Ω	-	3.6	-	V_{CE}=10V, V_{GE}=0V, f=100kHz, T_{vj}=25°C
Turn On Delay Time		$t_{d(on)}$	μs	-	0.5	-	V_{CC}=1,650V, I_C=400A
Rise Time		t_r		1.0	1.9	3.1	L_S=150nH
Turn Off Delay Time		$t_{d(off)}$		1.5	2.0	2.6	R_G=10Ω (3)
Fall Time		t_f		0.5	1.0	2.5	V_{GE}=±15V, T_{vj}=125°C
Forward Voltage Drop		V_F	V	2.0	2.5	3.0	I_F=400A, V_{GE}=0V, T_{vj}=125°C
Reverse Recovery Time		t_{rr}	μs	-	0.6	-	V_{CC}=1,650V, I_F=400A, (4) L_S=150nH, T_{vj}=125°C
Thermal Impedance	IGBT	$R_{th(j-c)}$	K/W	-	-	0.026	Junction to case
	FWD	$R_{th(j-c)}$		-		0.052	
Contact Thermal Impedance		$R_{th(c-f)}$	K/W	-	-	0.016	Case to fin

2) Chopper Diode

Item	Symbol	Unit	Min.	Typ.	Max.	Test Conditions
Collector Emitter Cut-Off Current	I_{AKS}	mA	-	-	12	V_{AK}=3,300V, T_{vj}=25°C
Forward Voltage Drop	V_F	V	2.2	2.7	3.2	I_F=400A,T_{vj}=125°C at main terminals (Terminal resistance:0.5mΩ typical)
Reverse Recovery Time	t_{rr}	μs	0.2	0.6	1.1	V_{CC}=1,650V, I_F=400A, (4) L_S=150nH, T_{vj}=125°C
Thermal Impedance	$R_{th(j-c)}$	K/W	-	-	0.052	Junction to case
Contact Thermal Impedance	$R_{th(c-f)}$	K/W	-	-	0.016	Case to fin

Notes: (3) R_G value is a test condition value for evaluation, not recommended value.
Please, determine the suitable R_G value after the measurement of switching waveforms (overshoot voltage, etc.)with appliance mounted.
(4)Counter arm IGBT VGE=-15V

* Please contact our representatives at order.
* For improvement, specifications are subject to change without notice.
* For actual application, please confirm this spec sheet is the newest revision.

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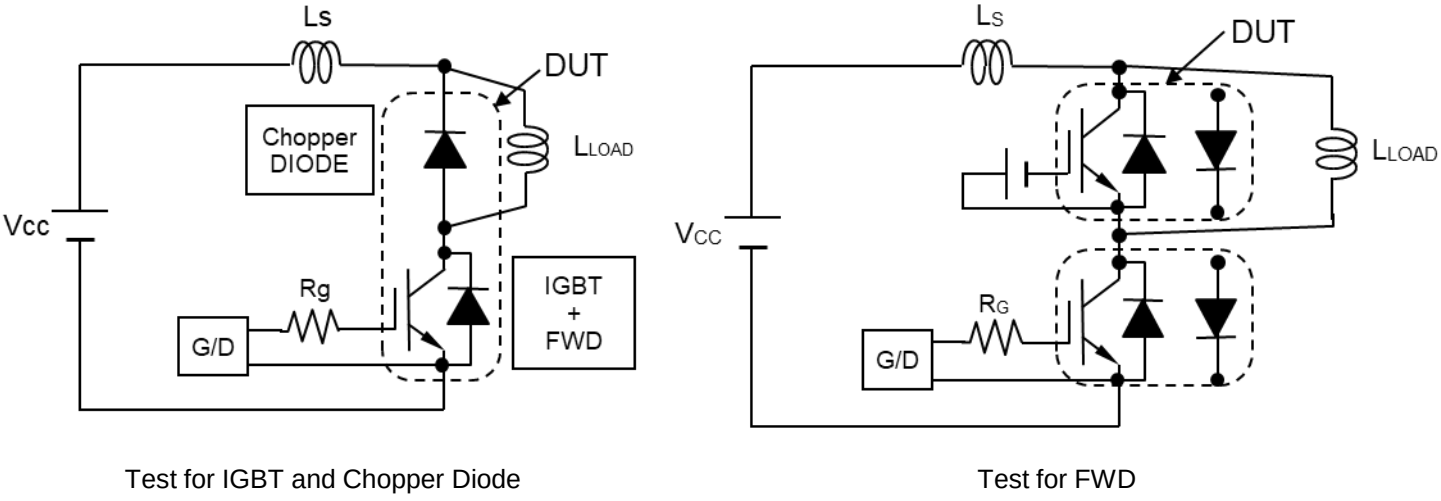
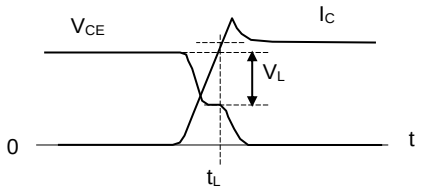
DEFINITION OF TEST CIRCUIT



Test for IGBT and Chopper Diode

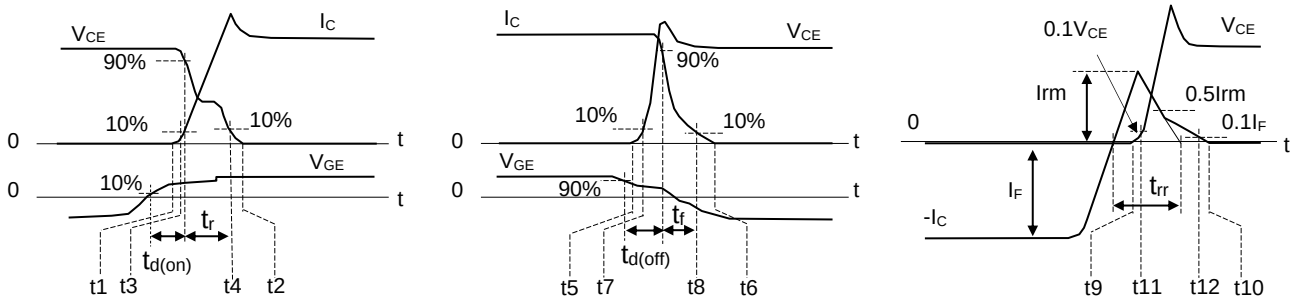
Test for FWD

Fig.1 Switching test circuit



$$L_S = \frac{V_L}{\left(\frac{dI_C}{dt}\right)_{t=t_L}}$$

Fig.2 Definition of stray inductance



$$E_{on(10\%)} = \int_{t3}^{t4} I_C \cdot V_{CE}\, dt \qquad E_{off(10\%)} = \int_{t7}^{t8} I_C \cdot V_{CE}\, dt \qquad E_{rr(10\%)} = \int_{t11}^{t12} I_F \cdot V_{CE}\, dt$$

$$E_{on(Full)} = \int_{t1}^{t2} I_C \cdot V_{CE}\, dt \qquad E_{off(Full)} = \int_{t5}^{t6} I_C \cdot V_{CE}\, dt \qquad E_{rr(Full)} = \int_{t9}^{t10} I_F \cdot V_{CE}\, dt$$

Fig.3 Definition of switching loss

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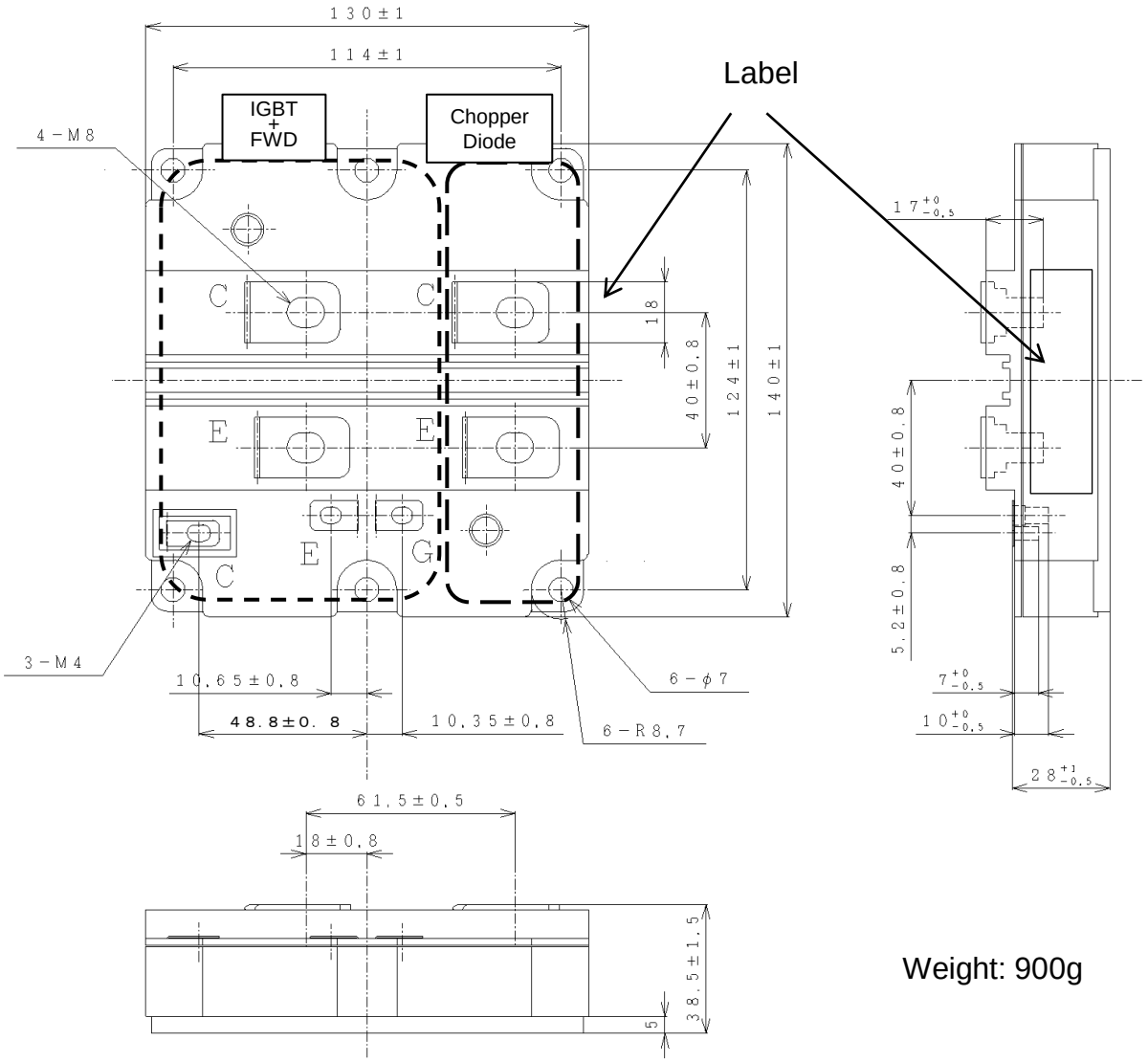
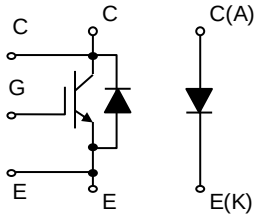
OUTLINE DRAWING

Unit in mm



Weight: 900g

CIRCUIT DIAGRAM



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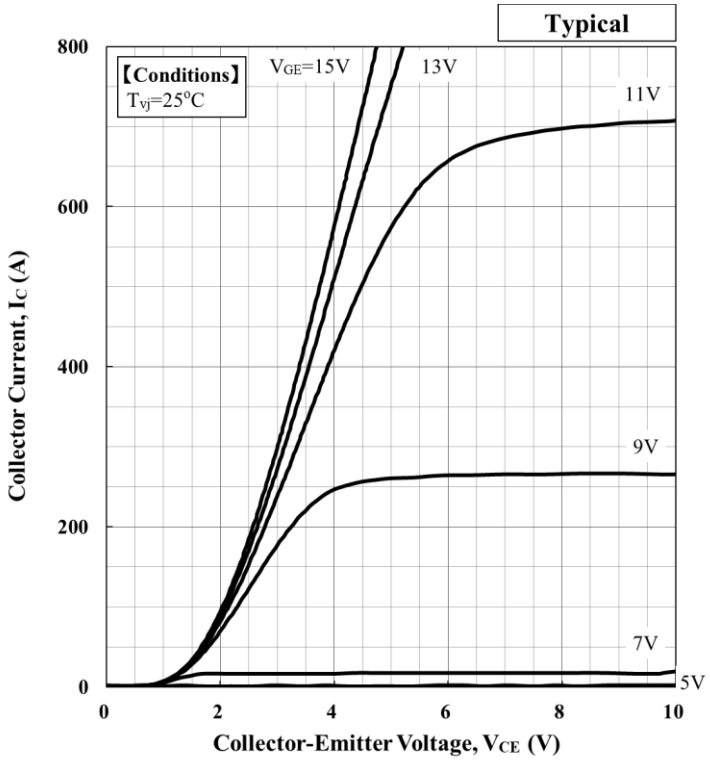
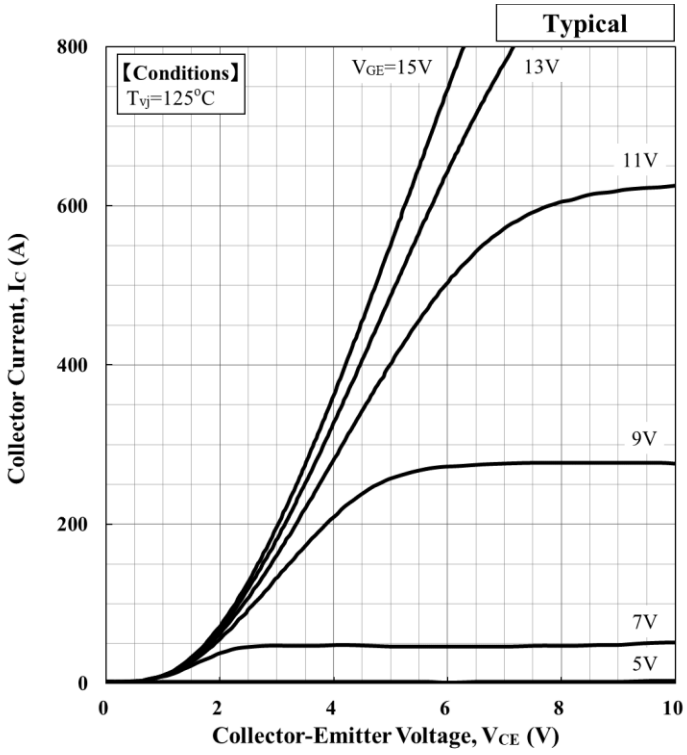


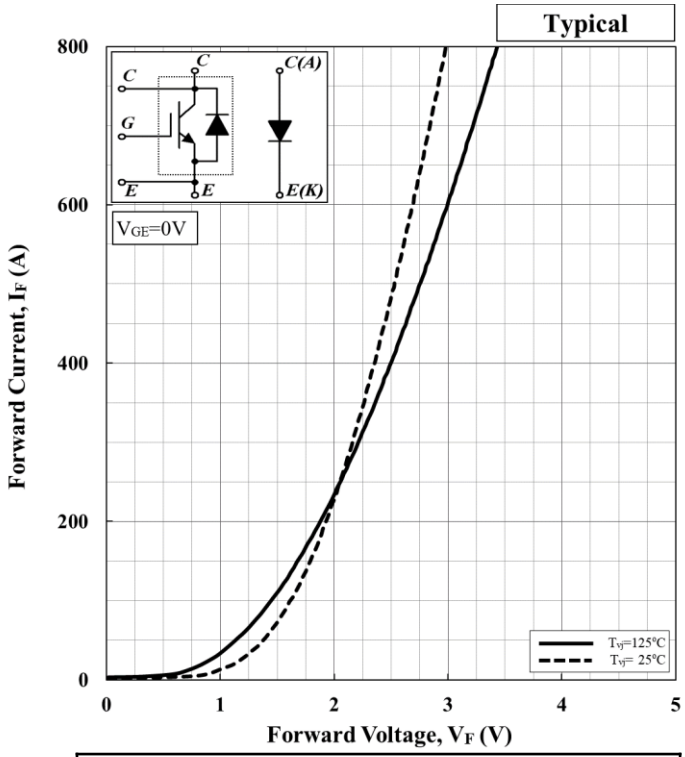
$V_{CE}(sat)[V] = a_3 \cdot \lvert I_c \rvert^3 + a_2 \cdot \lvert I_c \rvert^2 + a_1 \cdot \lvert I_c \rvert + a_0$					
Temp.[°C]	V_{GE}[V]	a_3	a_2	a_1	a_0
25	15	4.31E-09	-7.35E-06	7.41E-03	1.33E+00

Collector Current vs. Collector Emitter Voltage



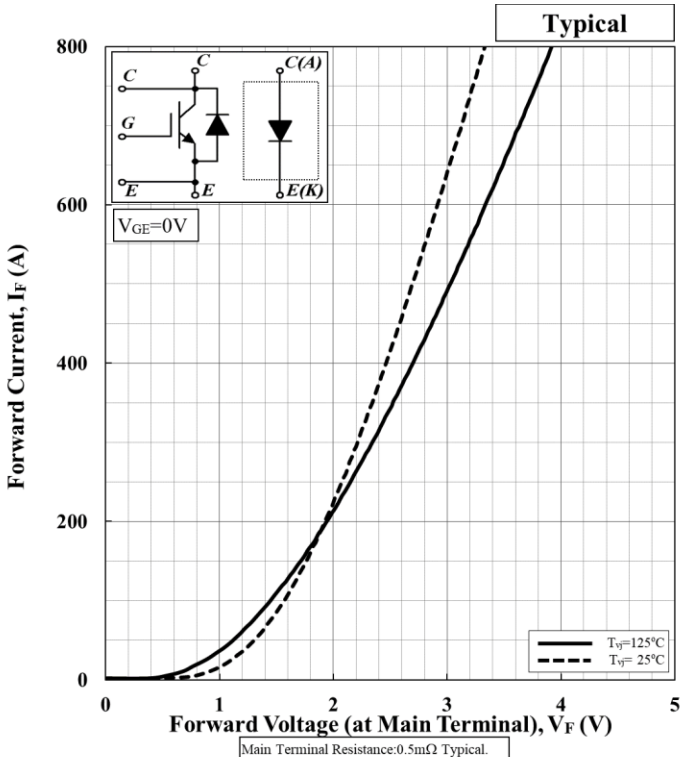
$V_{CE}(sat)[V] = a_3 \cdot \lvert I_c \rvert^3 + a_2 \cdot \lvert I_c \rvert^2 + a_1 \cdot \lvert I_c \rvert + a_0$					
Temp.[°C]	V_{GE}[V]	a_3	a_2	a_1	a_0
125	15	6.25E-09	-1.02E-05	1.04E-02	1.28E+00

Collector Current vs. Collector Emitter Voltage



$V_F[V] = a_3 \cdot \lvert I_F \rvert^3 + a_2 \cdot \lvert I_F \rvert^2 + a_1 \cdot \lvert I_F \rvert + a_0$				
Temp.[°C]	a_3	a_2	a_1	a_0
25	3.06E-09	-5.35E-06	4.60E-03	1.19E+00
125	3.42E-09	-6.22E-06	5.99E-03	8.92E-01

Forward Voltage of free-wheeling diode



Main Terminal Resistance:0.5mΩ Typical.

$V_F[V] = a_3 \cdot \lvert I_F \rvert^3 + a_2 \cdot \lvert I_F \rvert^2 + a_1 \cdot \lvert I_F \rvert + a_0$				
Temp.[°C]	a_3	a_2	a_1	a_0
25	2.70E-09	-4.82E-06	4.93E-03	1.10E+00
125	3.24E-09	-5.94E-06	6.56E-03	8.29E-01

Forward Voltage of Chopper diode

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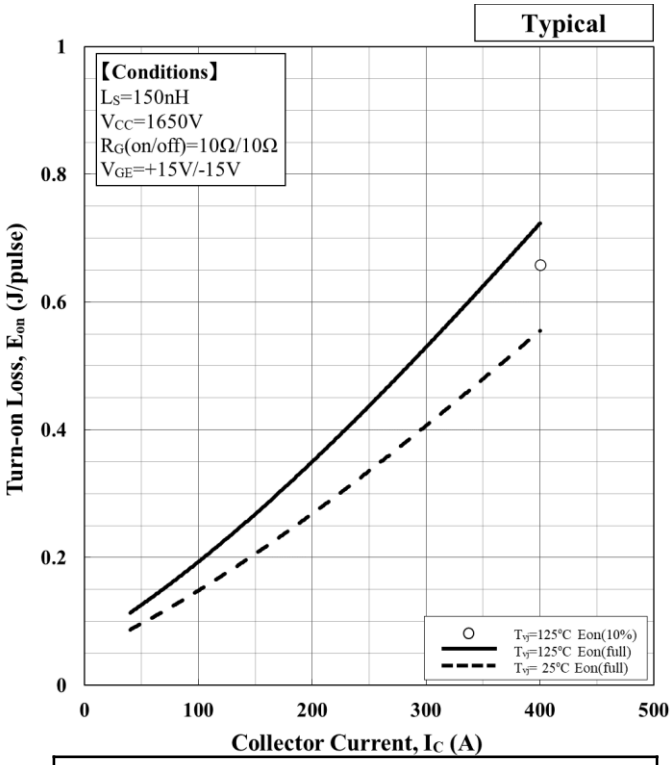
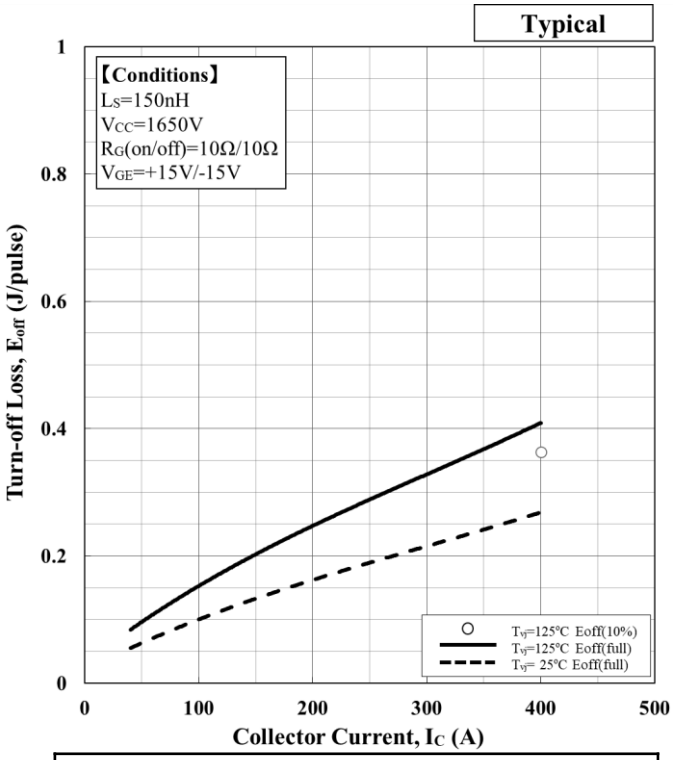


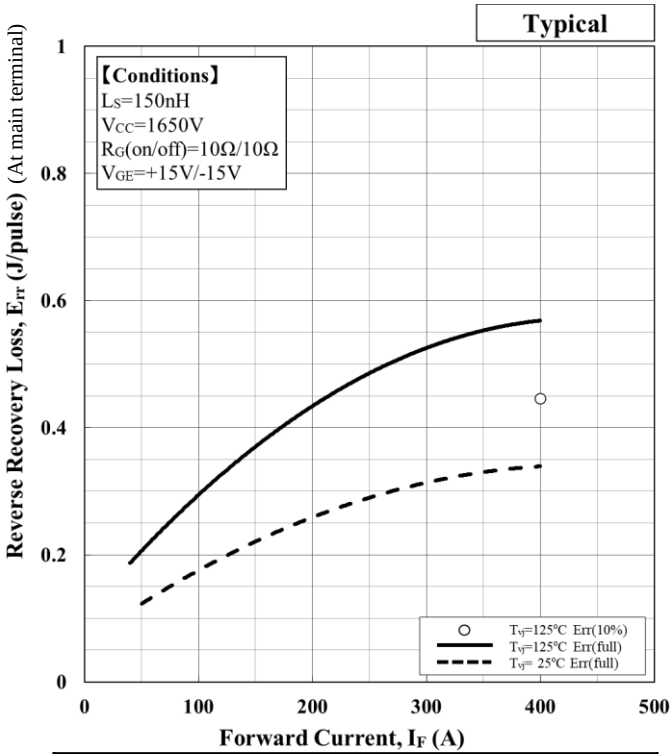
$E\,[J] = a_3 \cdot \lvert I_c \rvert^3 + a_2 \cdot \lvert I_c \rvert^2 + a_1 \cdot \lvert I_c \rvert + a_0$				
Temp.[°C]	a_3	a_2	a_1	a_0
25	-1.07E-09	1.51E-06	8.25E-04	5.18E-02
125	-1.40E-09	1.97E-06	1.08E-03	6.75E-02

Turn-on loss vs. Collector current



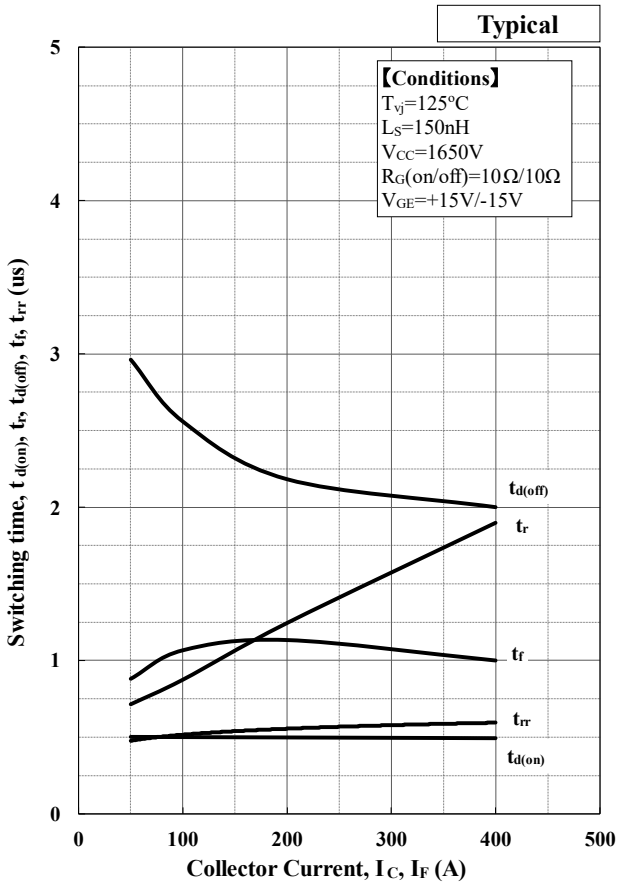
$E\,[J] = a_3 \cdot \lvert I_c \rvert^3 + a_2 \cdot \lvert I_c \rvert^2 + a_1 \cdot \lvert I_c \rvert + a_0$				
Temp.[°C]	a_3	a_2	a_1	a_0
25	1.48E-09	-1.34E-06	9.17E-04	2.05E-02
125	2.26E-09	-2.04E-06	1.40E-03	3.12E-02

Turn-off loss vs. Collector current



$E\,[J] = a_3 \cdot \lvert I_F \rvert^3 + a_2 \cdot \lvert I_F \rvert^2 + a_1 \cdot \lvert I_F \rvert + a_0$				
Temp.[°C]	a_3	a_2	a_1	a_0
25	0.00E+00	-1.45E-06	1.27E-03	6.33E-02
125	0.00E+00	-2.42E-06	2.12E-03	1.06E-01

Recovery loss vs. Forward Current(Chopper Diode)



Switching time vs. Collector Current

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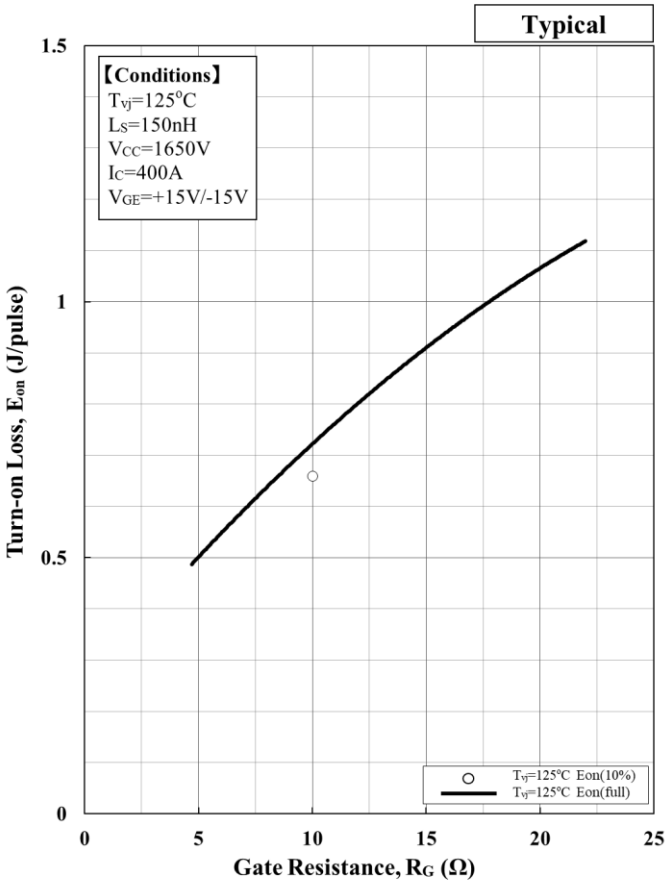
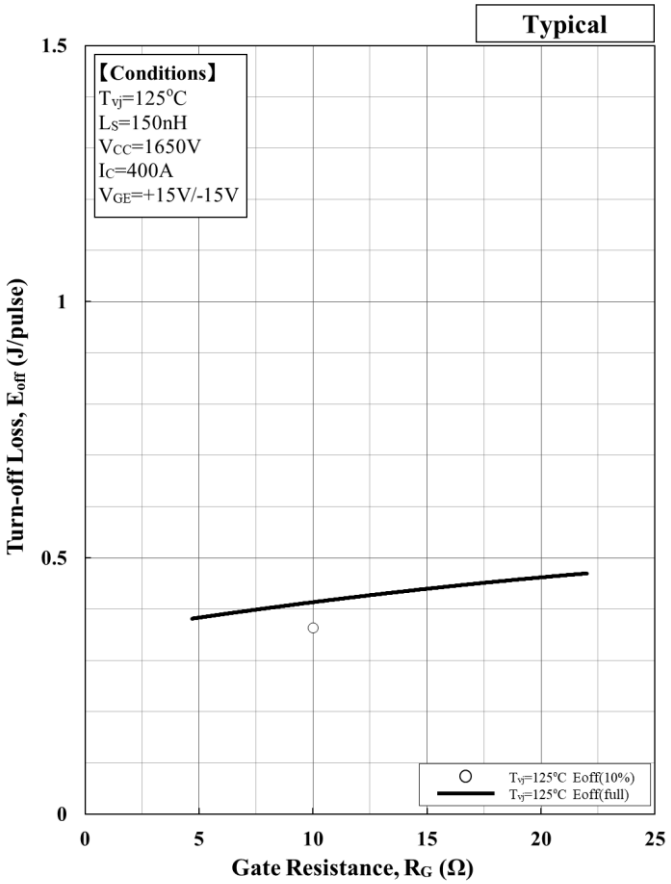
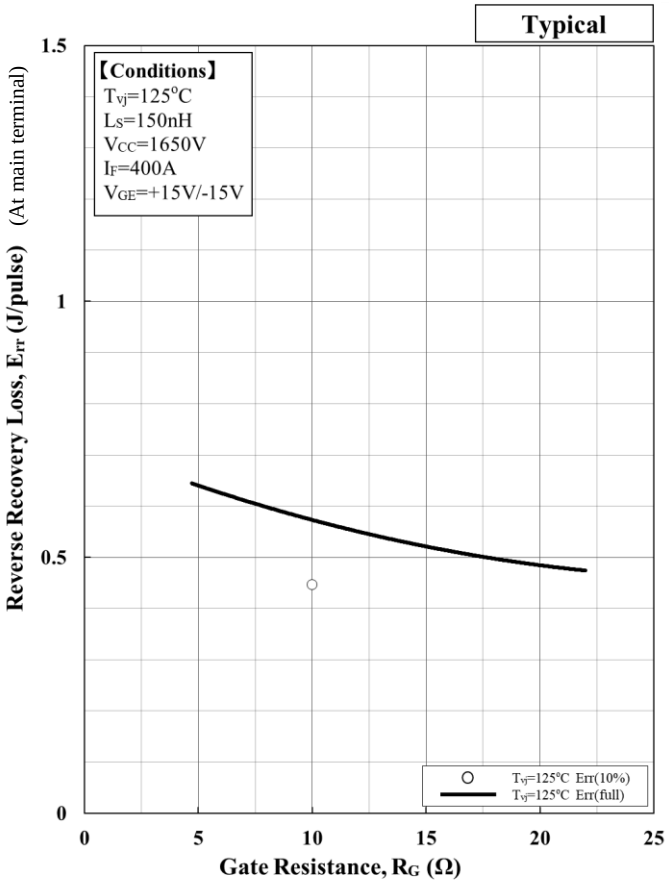


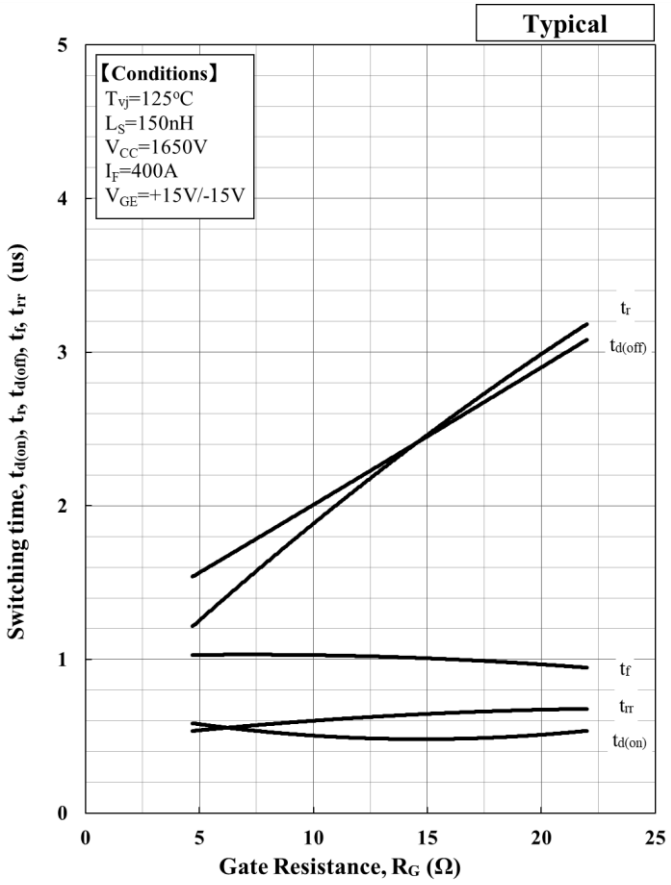
Turn-on loss vs. Gate Resistance



Turn-off loss vs. Gate Resistance



Reverse Recovery loss vs. Gate Resistance (Chopper Diode)



Switching time vs. Gate Resistance

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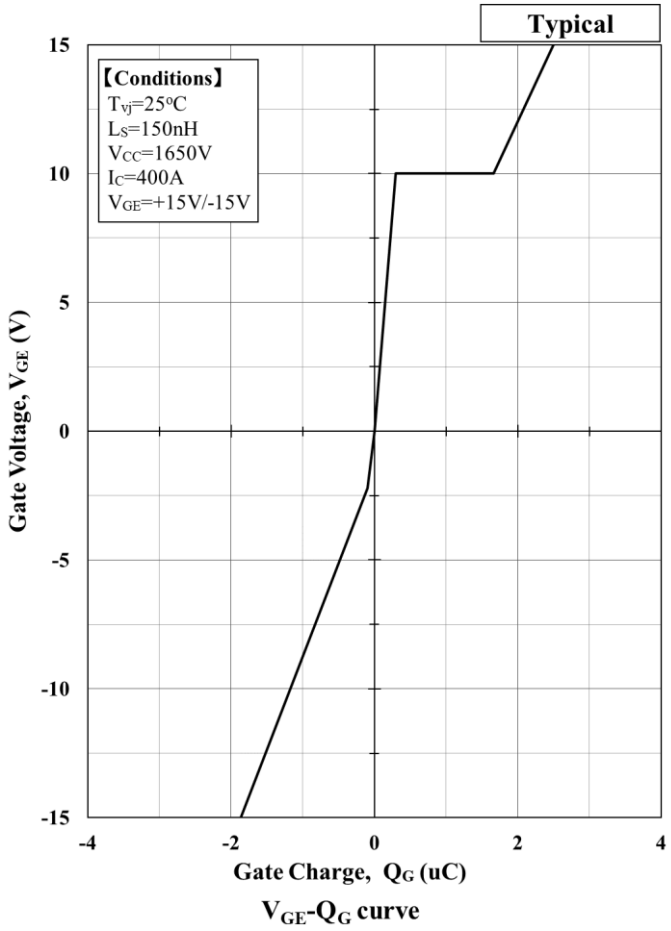
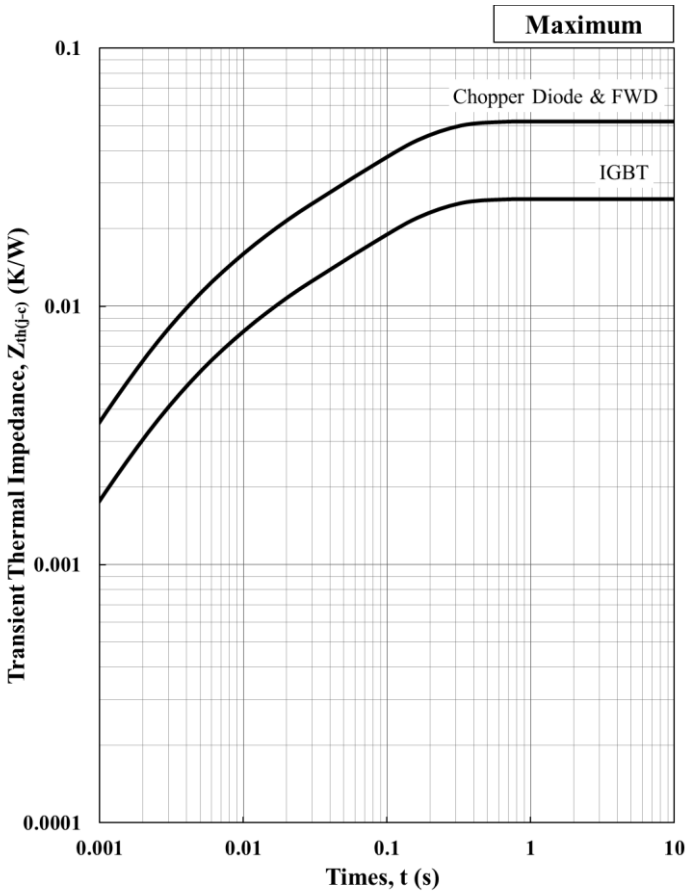


V_{GE}-Q_G curve



Transient Thermal Impedance Curve

Foster model lumped circuit constant

n	1	2	3	4
R th, IGBT [n]	1.73E-02	2.67E-03	6.98E-05	6.00E-03
C th, IGBT [n]	6.43E+00	8.25E-01	2.23E+00	1.67E+00
R th, Diode [n]	3.46E-02	5.53E-03	1.29E-04	1.17E-02
C th, Diode [n]	3.20E+00	3.99E-01	1.21E+00	8.53E-01

Cauer model lumped circuit constant

n	1	2	3	4
R th, IGBT [n]	1.67E-03	4.95E-03	6.20E-03	1.32E-02
C th, IGBT [n]	4.14E-01	1.52E-01	1.47E+00	6.10E+00
R th, Diode [n]	3.53E-03	9.69E-03	1.24E-02	2.64E-02
C th, Diode [n]	2.07E-01	7.23E-02	7.50E-01	3.02E+00

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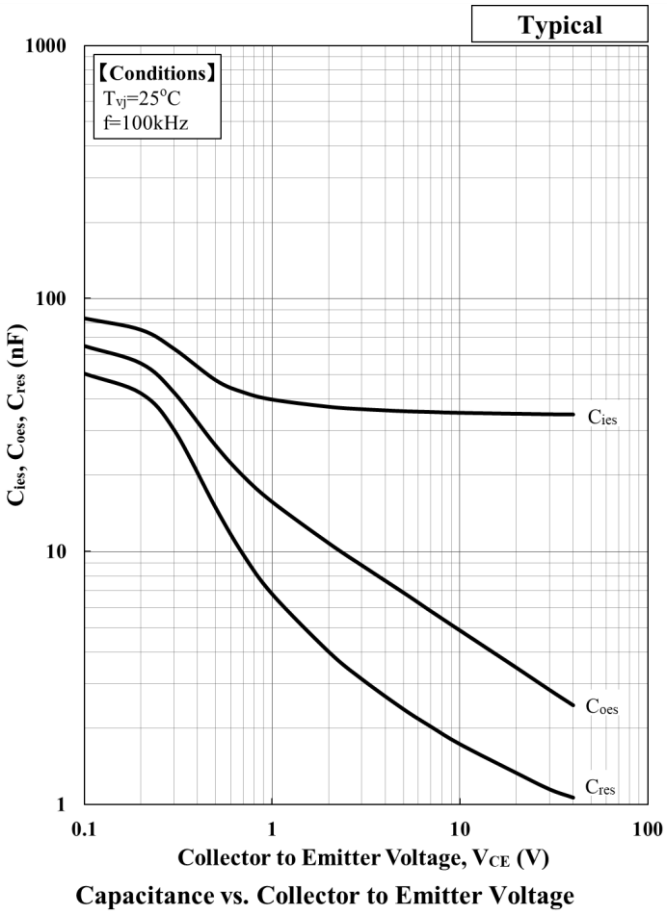

Capacitance vs. Collector to Emitter Voltage

Material declaration

Please note the following materials are contained in the product, in order to keep characteristic and reliability level.

Material	Contained part
Lead (Pb) and its compounds	Solder

MBL400E33D

Minebea POWER SEMICONDUCTORS

Notices

1. Since mishandling of semiconductor devices may cause malfunctions, please be sure to read "Precautions for Safe Use and Notices" in the individual brochure before use.
2. When designing an electronic circuit using semiconductor devices, please do not exceed the absolute maximum rating specified for the device under any external fluctuations. And for pulse applications, please also do not exceed the "Safe Operating Area (SOA)".
3. Semiconductor devices may sometimes break down by accidental or unexpected surge voltage, so please be careful about the safety design such as redundant design and malfunction prevention design which don't cause the damage expand even if they break down.
4. In cases where extremely high reliability is required (such as use in nuclear power control, aerospace and aviation, traffic equipment, life-support-related medical equipment, fuel control equipment and various kinds of safety equipment), safety should be ensured by using semiconductor devices that feature assured safety or by means of users' fail-safe precautions or other arrangement. Or consult with MPSD's sales department staff. (When semiconductor devices fail, as a result the semiconductor devices or wiring, wiring pattern may smoke, ignite, or the semiconductor devices themselves may burst.)
5. A semi-processed article is done now using solder which contains lead inside the semiconductor devices. There is possibility of the regulation substance depend on the applied models, so please check before using.
6. This specification is a material for component selection, which describes specifications of power semiconductor devices (hereinafter referred to as products), characteristic charts, and external dimension drawings.
7. The information given herein, including the specifications and dimensions, is subject to change without prior notice to improve product characteristics. Before ordering, purchasers are advised to contact with Minebea power semiconductor sales department for the latest version of this data sheets.
8. For handling other than described in this manual, follow the handling instructions (IGBT-HI-00002).

■ For inquiries relating to the products, please contact nearest representatives that is located "Inquiry" portion on the top page of a home page.

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Minebea POWER SEMICONDUCTORS

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