



BYD Microelectronics Co., Ltd.

BG50B12UX3-I

IGBT Power Module

$V_{CE}=1200V$ $I_C=50A$

Preliminary

General Description

BYD IGBT Power Module BG50B12UX3-I provides low switching loss as well as high short circuit capability, which introduce the advanced IGBT chip/FWD and improved connection.

Features

- Half-bridge
- Low inductance
- Standard package
- High short circuit capability
- Ultra low conduction and switching loss
- Including ultra fast & soft recovery anti-parallel FWD

Applications

- AC motor control
- Inverters
- Servo
- UPS (Uninterruptible Power Supplies)
- Electric welding



Characteristic Values

Parameter	Symbol	Conditions	Temperature	Value	Unit
Absolute Maximum Ratings					
Collector-emitter voltage	V_{CES}	$V_{GE}=0V$	$T_J=25^{\circ}C$	1200	V
Continuous collector current	I_C	—	$T_c=80^{\circ}C$	50	A
Peak collector current	I_{CRM}	$I_{CRM}=2I_C$	—	100	A
Gate-emitter voltage	V_{GES}	—	—	+/-20	V
Total power dissipation	P_{tot}	per switch (IGBT)	$T_c=25^{\circ}C$	429	W
IGBT short circuit SOA	t_{psc}	$V_{CC}=800V, V_{GE}\leq 15V$ $V_{CEM}\leq 1200V$	$T_{vj}\leq 25^{\circ}C$	10	us
Max. junction temperature	$T_{vj\ max}$	—	—	175	$^{\circ}C$
Operation junction temperature	$T_{vj\ op}$	—	—	-40~150	$^{\circ}C$
Storage temperature range	T_{stg}	—	—	-40~125	$^{\circ}C$
Diode DC forward current	I_F	—	$T_c=80^{\circ}C$	50	A
Peak forward current	I_{FRM}	$I_{FRM}=2I_F$	—	100	A
I^2t -value, Diode	I^2t	$V_R=0V, t=10ms$	$T_J=125^{\circ}C$	—	A^2s
Isolation voltage	V_{isol}	$t=1min, f=50Hz$	—	AC2500	V



Parameter	Symbol	Conditions	Temperature	Value			Unit
Characteristics							
IGBT				min.	typ.	max.	
Gate-emitter threshold voltage	$V_{GE(th)}$	$V_{GE}=V_{CE}$	$T_{vj}=25^{\circ}\text{C}$	4.8	5.7	6.8	V
Collector-emitter cut-off current	I_{CES}	$V_{CE}=1200\text{V}, V_{GE}=0\text{V}$	$T_{vj}=25^{\circ}\text{C}$	—	—	1.0	mA
			$T_{vj}=125^{\circ}\text{C}$	—	—	—	mA
Gate-emitter cut-off current	I_{GES}	$V_{CE}=0\text{V}, V_{GE}=\pm 20\text{V}$	$T_{vj}=25^{\circ}\text{C}$	-300	—	300	nA
Collector-emitter saturation voltage	$V_{CE(sat)}$	$I_c=50\text{A}, V_{GE}=15\text{V}$	$T_{vj}=25^{\circ}\text{C}$	—	2.3	—	V
			$T_{vj}=125^{\circ}\text{C}$	—	2.5	—	V
Integrated gate resistor	R_{Gint}	—	$T_{vj}=25^{\circ}\text{C}$	—	10	—	Ω
Total Gate Charge	Q_g	$V_{CE}=600\text{V}, I_c=50\text{A},$ $V_{GE}=-10\text{V}\dots+15\text{V}$	—	—	0.33	—	μC
Gate-Emitter Charge	Q_{ge}		—	—	0.14	—	μC
Gate-Collector Charge	Q_{gc}		—	—	0.16	—	μC
Input capacitance	C_{ies}	$V_{CE}=25\text{V}, V_{GE}=0\text{V},$ $f=1\text{MHz}$	$T_{vj}=25^{\circ}\text{C}$	—	2.85	—	nF
Output capacitance	C_{oes}			—	0.24	—	nF
Reverse transfer capacitance	C_{res}			—	0.19	—	nF
Turn-on delay time	$t_{d(on)}$	$V_{CC}=600\text{V}, I_c=50\text{A},$ $R_{Gon}=R_{Goff}=5.1\Omega,$ $V_{GE}=\pm 15\text{V},$ $L_{\sigma}=80\text{nH},$ Inductive load	$T_{vj}=25^{\circ}\text{C}$	—	109	—	ns
			$T_{vj}=125^{\circ}\text{C}$	—	118	—	ns
Rise time	t_r		$T_{vj}=25^{\circ}\text{C}$	—	39	—	ns
			$T_{vj}=125^{\circ}\text{C}$	—	37	—	ns
Turn-off delay time	$t_{d(off)}$		$T_{vj}=25^{\circ}\text{C}$	—	189	—	ns
			$T_{vj}=125^{\circ}\text{C}$	—	207	—	ns
Fall time	t_f		$T_{vj}=25^{\circ}\text{C}$	—	220	—	ns
			$T_{vj}=125^{\circ}\text{C}$	—	385	—	ns
Energy dissipation during turn-on time	E_{on}	$V_{CC}=600\text{V}, I_c=50\text{A},$ $R_{Gon}=5.1\Omega,$ $V_{GE}=\pm 15\text{V}, L_{\sigma}=80\text{nH},$ Inductive load	$T_{vj}=25^{\circ}\text{C}$	—	1.9	—	mJ
			$T_{vj}=125^{\circ}\text{C}$	—	2.8	—	mJ
Energy dissipation during turn-off time	E_{off}	$V_{CC}=600\text{V}, I_c=50\text{A},$ $R_{Goff}=5.1\Omega,$ $V_{GE}=\pm 15\text{V}, L_{\sigma}=80\text{nH},$ Inductive load	$T_{vj}=25^{\circ}\text{C}$	—	2.8	—	mJ
			$T_{vj}=125^{\circ}\text{C}$	—	4.4	—	mJ

Parameter	Symbol	Conditions		min.	typ.	Max.	Unit
Diode				min.	typ.	max.	
Forward voltage	V _F	I _F =50A	T _{vj} =25℃	—	2.0	—	V
			T _{vj} =125℃	—	1.9	—	V
Peak reverse recovery current	I _{RR}	I _F =50A, V _R =600V, di _F /dt=900A/us	T _{vj} =125℃	—	32	—	A
Recovered charge	Q _{rr}		T _{vj} =125℃	—	7.2	—	uC
Reverse recovery time	t _{rr}		T _{vj} =125℃	—	420	—	ns
Reverse recovery energy	E _{rec}		T _{vj} =125℃	—	2.7	—	mJ
Thermal-Mechanical Specifications							
IGBT thermal resistance junction to case	R _{th(j-c)}	per IGBT		—	—	0.35	K/W
Diode thermal resistance junction to case	R _{th(j-c)}	per diode		—	—	0.58	K/W
Thermal resistance case to heat-sink	R _{th(c-s)}	per module		—	0.03	—	K/W
Dimensions	L x W x H	Typical , see outline drawing		94×34×30.5			mm
Clearance distance in air	da	according to IEC 60664-1 and EN 50124-1	Term. to base:	—	—	17	mm
			Term. to term:	—	—	9.5	
Surface creepage distance	ds	according to IEC 60664-1 and EN 50124-1	Term. to base:	—	—	17	mm
			Term. to term:	—	—	20	
Mass	m	—	—	—	160	—	g

Thermal and mechanical properties according to IEC 60747 – 15

Specification according to the valid application note.

Characterization Curves

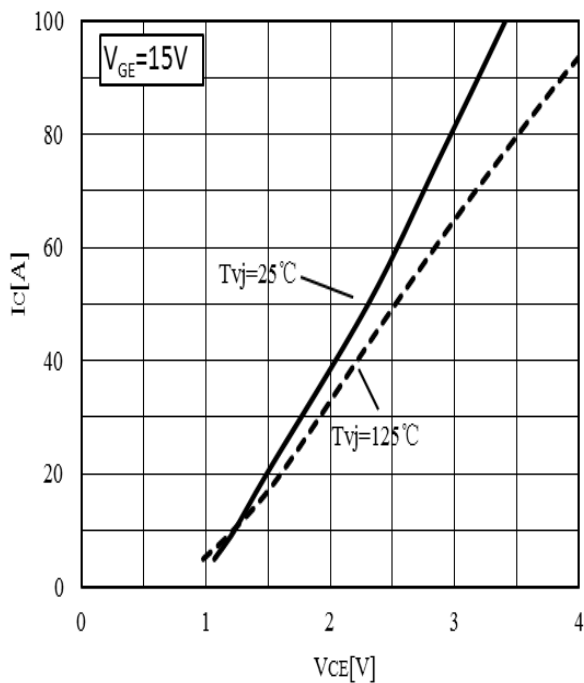


Fig.1 Typ. On-state Characteristics

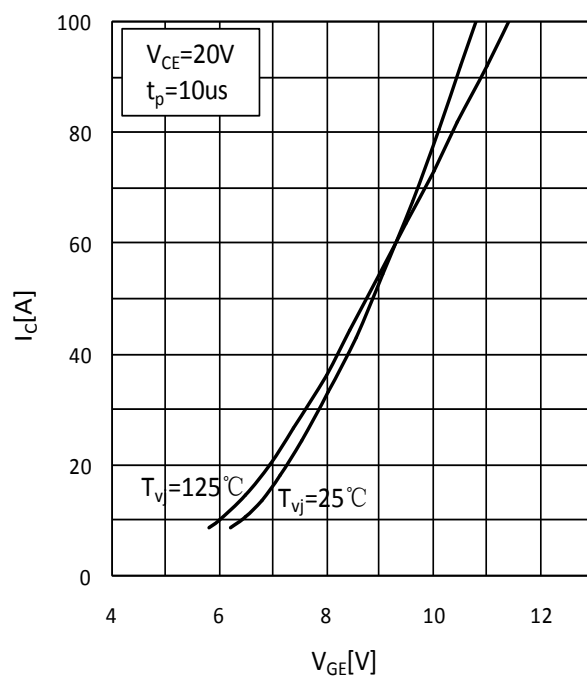


Fig.2 Typ. Transfer Characteristics

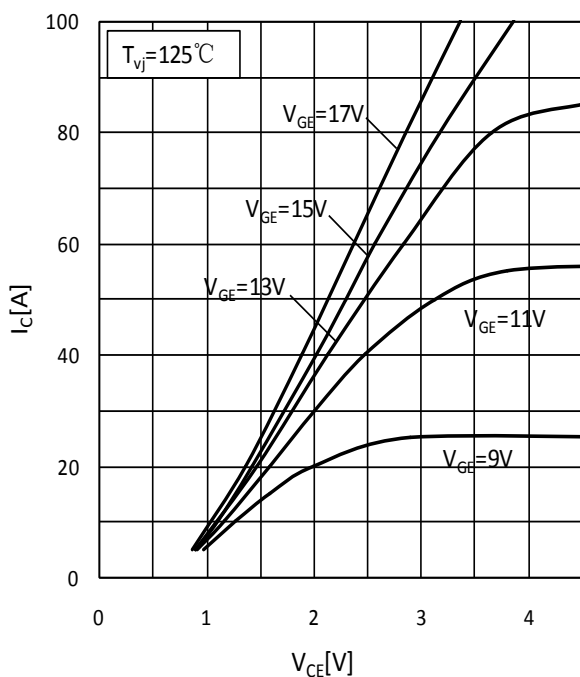


Fig.3 Typ. Output Characteristics

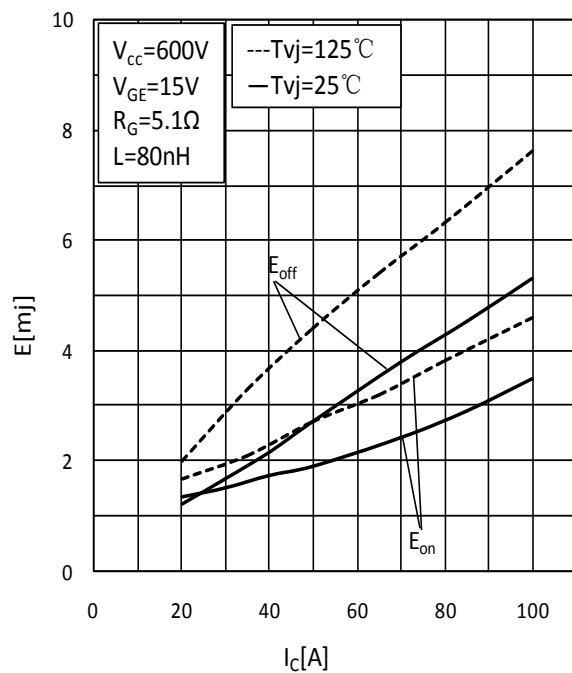


Fig.4 Switching Loss vs. Collector Current

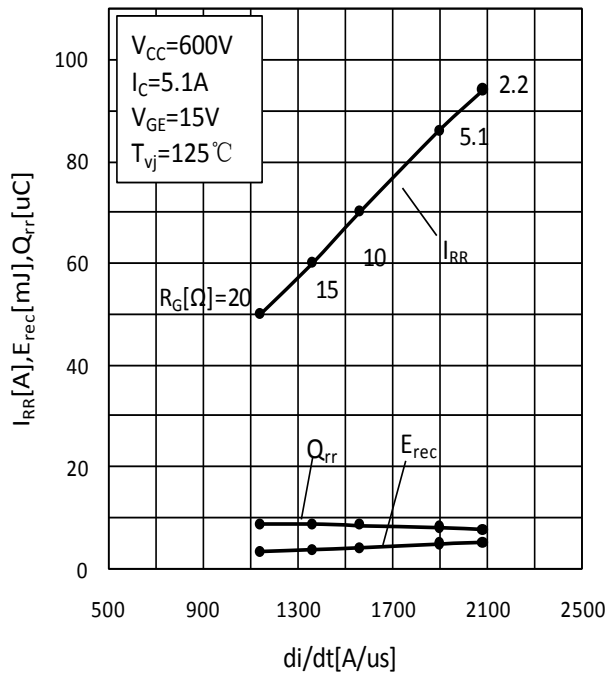


Fig.5 Typ. Reverse Recovery Characteristics vs di/dt

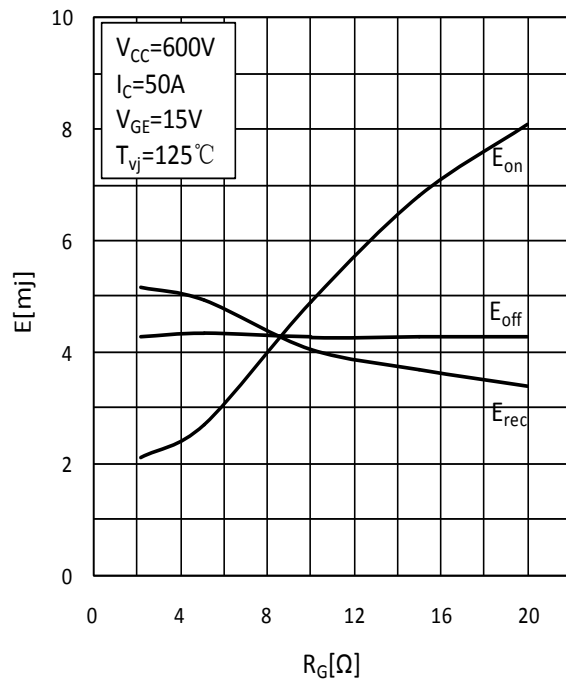


Fig.6 Switching Loss vs. Gate Resistor

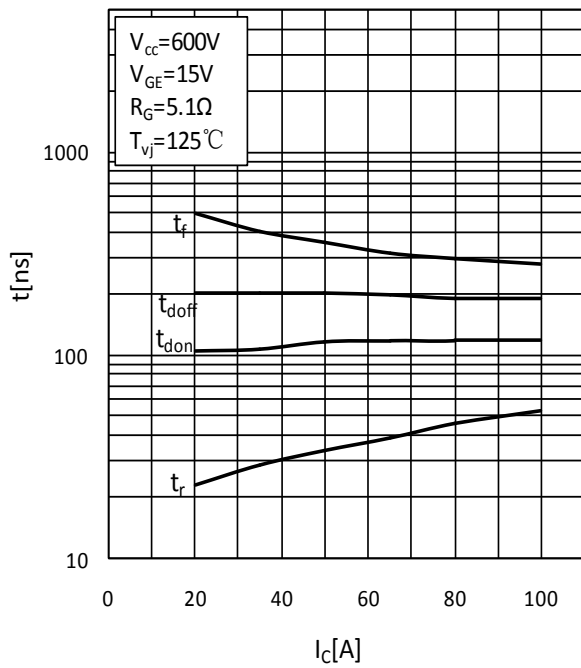


Fig.7 Typ. Switching Times vs. I_c

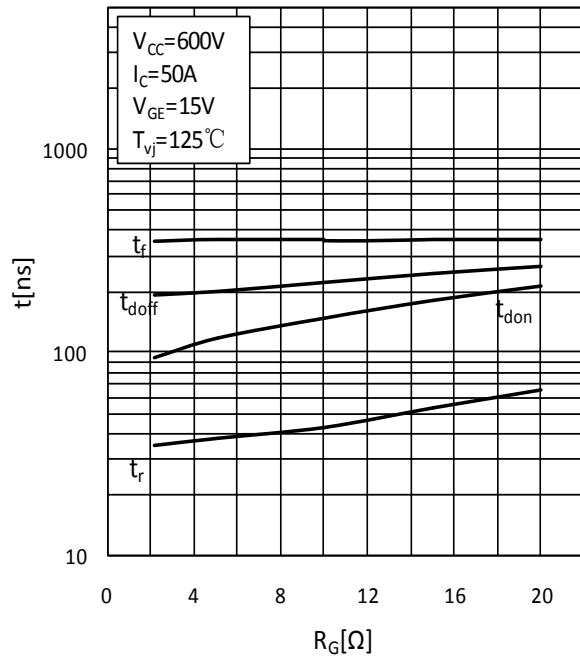
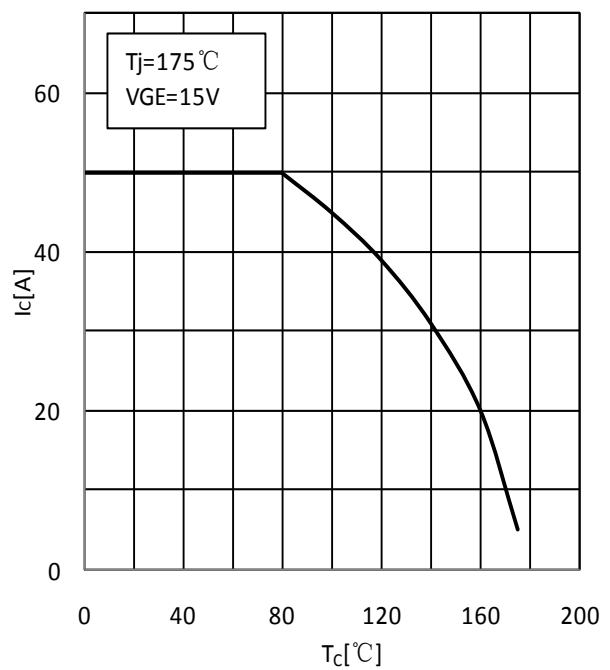
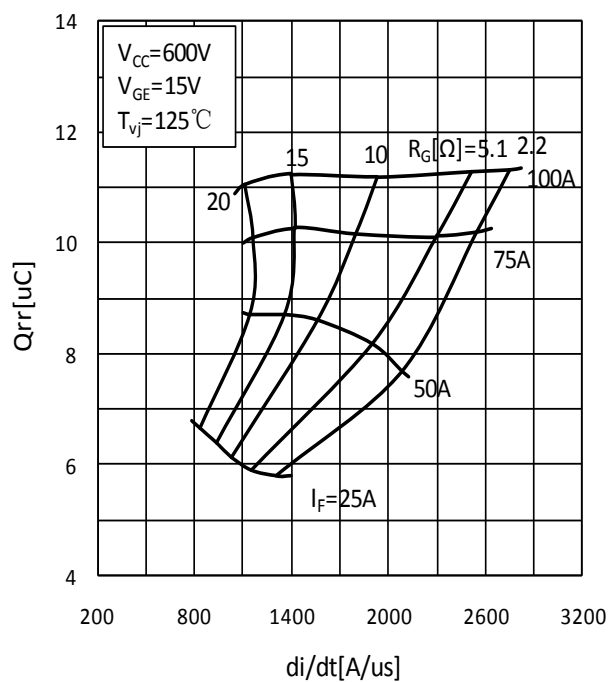
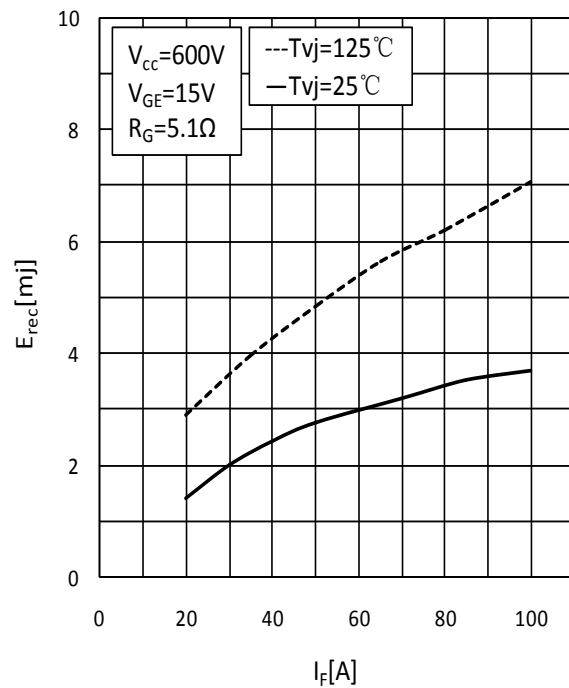
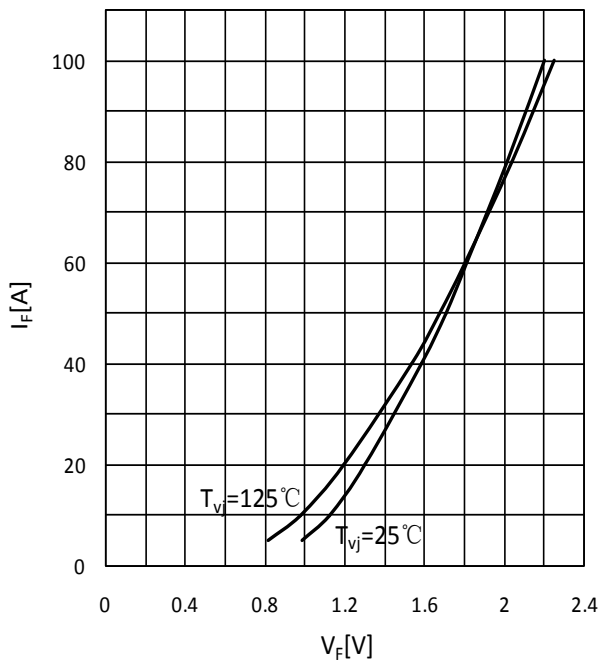


Fig.8 Typ. Switching Times vs. Gate resistor R_G



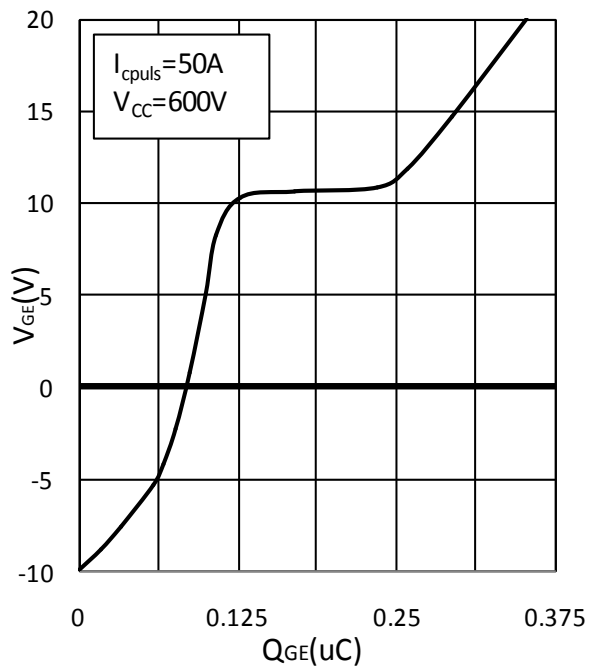


Fig.13 Typ. Gate Charge Characteristics

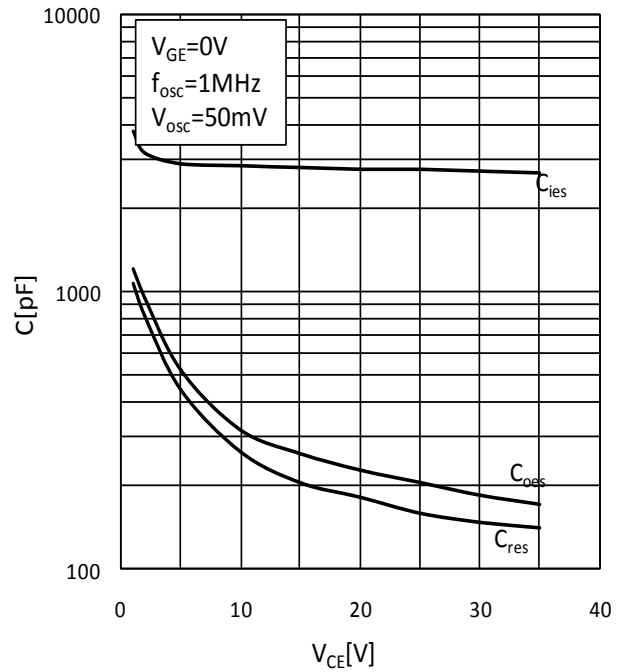


Fig.14 Typ. Capacitances vs Collector-Emitter Voltage

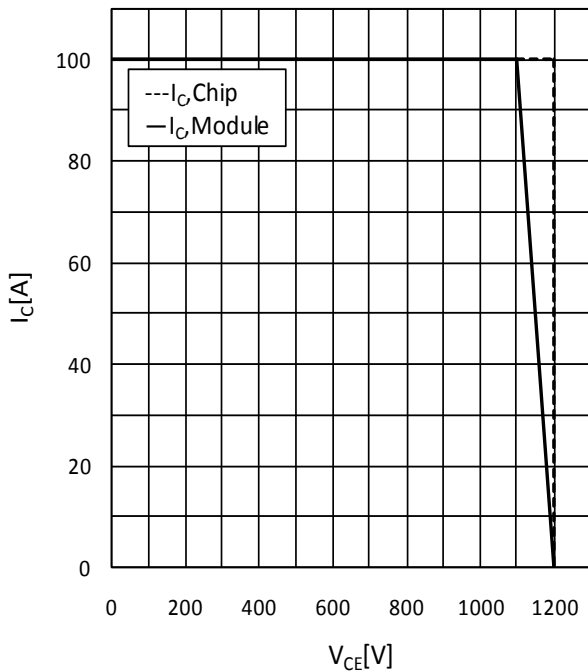


Fig.15 Reverse Bias Safe Operating Area
IGBT-inv.(RBSOA)

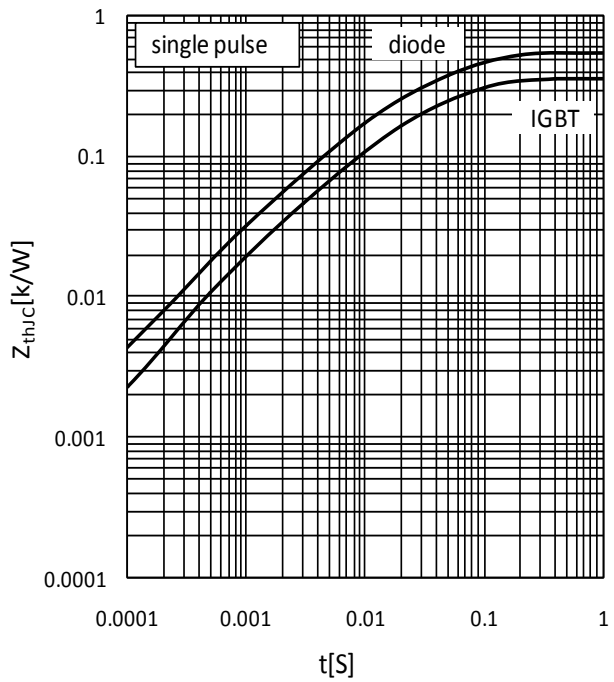
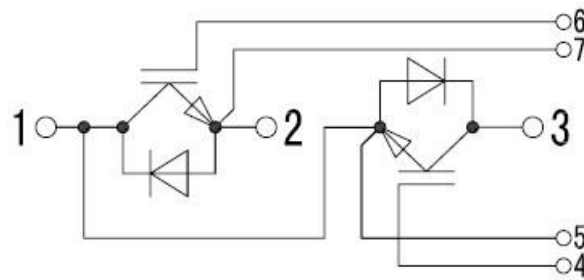


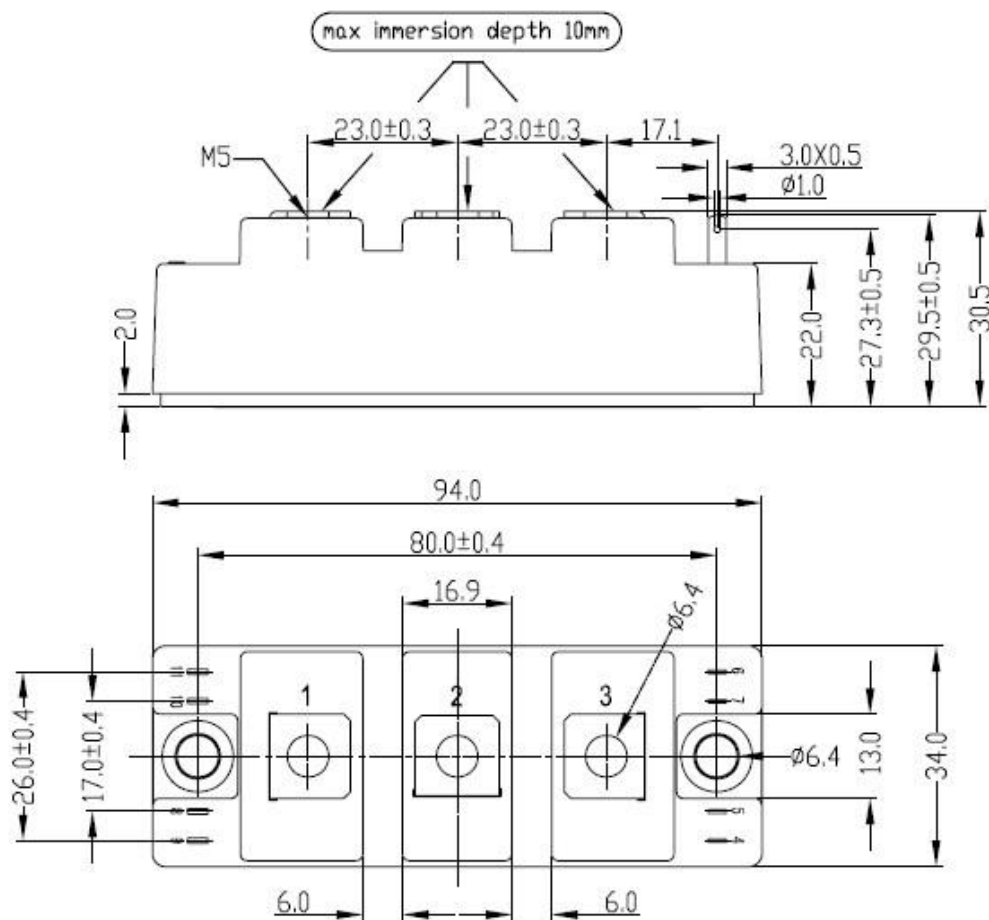
Fig.16 Typ. Transient Thermal Impedance

Circuit Diagram



Package Outlines

Dimensions in mm



**Attached (recommended torque):** M_s : (to heat sink M6) 3~5 Nm M_t : (to terminals M5) 2.5~4 Nm**Attention**

1. In order to reduce the contact resistance, we suggest add thermal grease between base and heat-sink, which thickness is about 0.1mm.
2. When installing the module, please wear a electrostatic bracelet to prevent the gate breakdown and the imbalance power may damage the internal chip, even to damage the module.
3. This is an electrostatic sensitive device, please observe the international standard IEC 60747-1, chap. IX.

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