

LEGM50BE120E2HL

IGBT Power Module

Features:

- $V_{CE}=1200V$ $I_C=50A$
- Low $V_{CE(sat)}$
- V_{CEsat} with positive temperature coefficient
- Maximum junction temperature 150°C
- Isolation Type Package

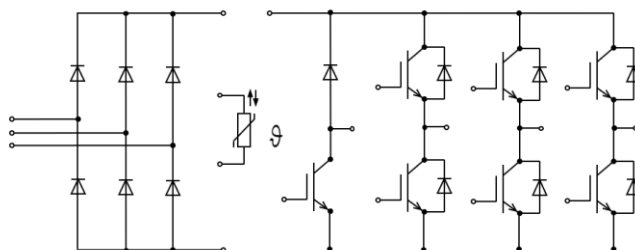
Applications:

- The inverter
- Motor control and drives

Package Type & Internal Circuit



E2



Internal Circuit

Maximum Rated Values (IGBT, Inverter)

Symbol	Parameter	Conditions	Ratings	Unit
V_{CES}	Collector-emitter voltage	$V_{EC}=0V, I_C=1mA, T_{vj}=25^\circ C$	1200	V
I_C	Continuous Collector Current	$T_C=80^\circ C, T_{vjmax}=150^\circ C$	50	A
I_{CRM}	Peak Collector Current	$I_{CRM}=2I_C$	100	A
V_{GES}	Gate-Emitter Voltage	$T_{vj}=25^\circ C$	± 30	V
P_{tot}	Total Power Dissipation	$T_C=25^\circ C, T_{vjmax}=150^\circ C$	200	W

Characteristics Values (IGBT Inverter)

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	$I_C=50\text{ A}, V_{GE}=15\text{ V}, T_{vj}=25\text{ }^{\circ}\text{C}$		1.80	2.25	V
		$I_C=50\text{ A}, V_{GE}=15\text{ V}, T_{vj}=125\text{ }^{\circ}\text{C}$		2.05	2.7	V
$V_{GE(th)}$	Gate Threshold Voltage	$I_C=2\text{ mA}, V_{CE}=V_{GE}, T_{vj}=25\text{ }^{\circ}\text{C}$	5	6	6.5	V
I_{CES}	Collector-Emitter Cut-off Current	$V_{CE}=1200\text{ V}, V_{GE}=0\text{ V}, T_{vj}=25\text{ }^{\circ}\text{C}$			4.0	mA
I_{GES}	Gate-Emitter Leakage Current	$V_{CE}=0\text{ V}, V_{GE}=15\text{ V}, T_{vj}=25\text{ }^{\circ}\text{C}$			450	nA
C_{ies}	Input Capacitance	$V_{CE}=25\text{ V}, V_{GE}=0\text{ V},$ $f=1\text{ MHz}$	-	5.19	-	nF
C_{oes}	Output Capacitance		-	225	-	pF
C_{res}	Reverse Transfer Capacitance		-	189	-	pF
$t_{d(on)}$	Turn-on Delay Time, Inductive Load	$I_C=50\text{ A}, V_{CE}=600\text{ V}$ $V_{GE}=\pm 15\text{ V}$ $R_{Gon}=15\text{ }\Omega$ $T_{vj}=25\text{ }^{\circ}\text{C}$		76		ns
t_r	Rise Time, Inductive Load			62		ns
$t_{d(off)}$	Turn-off Delay Time, Inductive Load			278		ns
t_f	Fall Time, Inductive Load			196		ns
E_{on}	Turn-on Energy Loss per Pulse			5.2		mJ
E_{off}	Energy Loss per Pulse			3.1		mJ
$t_{d(on)}$	Turn-on Delay Time, Inductive Load	$I_C=50\text{ A}, V_{CE}=600\text{ V}$ $V_{GE}=\pm 15\text{ V}$ $R_{Gon}=15\text{ }\Omega$ $T_{vj}=125\text{ }^{\circ}\text{C}$		80		ns
t_r	Rise Time, Inductive Load			64		ns
$t_{d(off)}$	Turn-off Delay Time, Inductive Load			326		ns
t_f	Fall Time, Inductive Load			284		ns
E_{on}	Turn-on Energy Loss per Pulse			5.4		mJ
E_{off}	Energy Loss per Pulse			4.5		mJ
R_{thJC}	Thermal resistance, junction to case	pro IGBT / per IGBT			0.47	K/W
$T_{vj\text{ op}}$	Temperature under switching conditions		-40		125	$^{\circ}\text{C}$
I_{SC}	SC data	$V_{GE}\leq 15\text{ V}, V_{CC}=600\text{ V}$ $V_{CEmax}=V_{CES}-L_{sCE}\cdot di/dt$ $t_p\leq 10\text{ }\mu\text{s}, T_{vj}=125\text{ }^{\circ}\text{C}$		250		A

Maximum Rated Values (Diode Inverter)

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
V_{RRM}	Repetitive Peak Reverse Voltage	$T_{vj} = 25\text{ }^{\circ}\text{C}$		1200		V
I_F	Continuous DC Forward Current			40		A
I_{FRM}	Repetitive Peak Forward Current	$t_p = 1\text{ ms}$		80		A
I^2t	I^2t Value	$V_R = 0\text{ V}$, $t_p = 10\text{ ms}$, $T_{vj} = 125\text{ }^{\circ}\text{C}$		220		A^2s

Characteristic Values (Diode Inverter)

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
V_F	Forward Voltage	$I_F = 40\text{ A}$, $V_{CE} = 0\text{ V}$, $T_{vj} = 25\text{ }^{\circ}\text{C}$		1.9	2.5	V
		$I_F = 40\text{ A}$, $V_{CE} = 0\text{ V}$, $T_{vj} = 125\text{ }^{\circ}\text{C}$		1.9		V
t_{rr}	Reverse Recovery time	$I_F = 40\text{ A}$, $V_R = 600\text{ V}$ $-di/dt = 100\text{ A/us}$ $T_{vj} = 25\text{ }^{\circ}\text{C}$, $V_{GE} = -15\text{ V}$		170		ns
Q_r	Recovered Charge			0.98		μC
E_{rec}	Reverse Recovery Energy			0.35		mJ
t_{rr}	Reverse Recovery time	$I_F = 40\text{ A}$, $V_R = 600\text{ V}$ $-di/dt = 100\text{ A/us}$ $T_{vj} = 125\text{ }^{\circ}\text{C}$ $V_{GE} = -15\text{ V}$		205		ns
Q_r	Recovered Charge			1.09		μC
E_{rec}	Reverse Recovery Energy			0.36		mJ
R_{thJC}	Thermal resistance, junction to case	per Diode			1.0	K/W
$T_{vj\text{ op}}$	Temperature under switching conditions		-40		125	$^{\circ}\text{C}$

Maximum Rated Values (Diode Rectifier)

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
V_{RRM}	Repetitive peak reverse voltage	$T_{vj}=25\text{ }^{\circ}\text{C}$		1800		V
I_{FRMSM}	Maximum RMS forward current per chip	$T_c=80\text{ }^{\circ}\text{C}$		70		A
I_{RMSM}	Maximum RMS current at rectifier chip	$T_c=80\text{ }^{\circ}\text{C}$		70		A
I_{FSM}	Surge forward current	$t_p=10\text{ms}$ $T_{vj}=25\text{ }^{\circ}\text{C}$		420		A
I^2t	I^2t -value	$t_p=10\text{ms}$ $T_{vj}=25\text{ }^{\circ}\text{C}$		880		A^2S
I_{FSM}	Surge forward current	$t_p=10\text{ms}$ $T_{vj}=125\text{ }^{\circ}\text{C}$		360		A
I^2t	I^2t -value	$t_p=10\text{ms}$ $T_{vj}=125\text{ }^{\circ}\text{C}$		600		A^2S

Characteristic Values (Diode Rectifier)

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
V_F	Forward voltage	$T_c=25\text{ }^{\circ}\text{C}$		0.9		V
I_R	Reverse current	$T_{vj}=125\text{ }^{\circ}\text{C}$ $V_R=1800\text{V}$		1.1		mA
R_{thjc}	Thermal resistance junction to case	$T_c=25\text{ }^{\circ}\text{C}$			1.5	K/W
T_{vjop}	Temperature under switching conditions		-40		125	$^{\circ}\text{C}$

Maximum Rated Values (IGBT Brake-Chopper)

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
V_{CES}	Collector-emitter voltage	$T_{vj}=25^{\circ}\text{C}$		1200		V
I_C	Continuous Collector Current	$T_C=80^{\circ}\text{C}, T_{vjmax}=150^{\circ}\text{C}$		40		A
I_{CRM}	Peak Collector Current	$I_{CRM}=2I_C$		80		A
V_{GES}	Gate-Emitter Voltage	$T_{vj}=25^{\circ}\text{C}$	-20		20	V

Characteristic Values (IGBT Brake-Chopper)

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	$I_C=40\text{ A}, V_{GE}=15\text{ V}, T_{vj}=25^{\circ}\text{C}$		1.83	2.5	V
		$I_C=40\text{ A}, V_{GE}=15\text{ V}, T_{vj}=125^{\circ}\text{C}$		2.13	2.7	V
$V_{GE(th)}$	Gate Threshold Voltage	$I_C=2\text{ mA}, V_{CE}=V_{GE}, T_{vj}=25^{\circ}\text{C}$	5.2	6.2	7.0	V
C_{ies}	Input capacitance	$f=1\text{ MHz}, T_{vj}=25^{\circ}\text{C},$			3.11	nF
C_{res}	Reverse transfer capacitance	$V_{CE}=25\text{ V}, V_{GE}=0\text{ V}$			103	pF
I_{CES}	Collector-Emitter Cut-off Current	$V_{CE}=1200\text{ V}, V_{GE}=0\text{ V}, T_{vj}=25^{\circ}\text{C}$			1.2	mA
I_{GES}	Gate-Emitter Leakage Current	$V_{CE}=0\text{ V}, V_{GE}=20\text{ V}, T_{vj}=25^{\circ}\text{C}$			410	nA
$t_{d(on)}$	Turn-on Delay Time, Inductive Load	$I_C=40\text{ A}, V_{CE}=600\text{ V}$ $V_{GE}=\pm 15\text{ V}$ $R_G=15\Omega$ $T_{vj}=25^{\circ}\text{C}$		50		ns
t_r	Rise Time, Inductive Load			48		ns
$t_{d(off)}$	Turn-off Delay Time, Inductive Load			200		ns
t_f	Fall Time, Inductive Load			156		ns
E_{on}	Turn-on Energy Loss per Pulse			2.64		mJ
E_{off}	Turn-off Energy Loss per Pulse			1.87		mJ
$t_{d(on)}$	Turn-on Delay Time, Inductive Load	$I_C=40\text{ A}, V_{CE}=600\text{ V}$ $V_{GE}=\pm 15\text{ V}$ $R_G=15\Omega$ $T_{vj}=125^{\circ}\text{C}$		55		ns
t_r	Rise Time, Inductive Load			60		ns
$t_{d(off)}$	Turn-off Delay Time, Inductive Load			240		ns
t_f	Fall Time, Inductive Load			240		ns
E_{on}	Turn-on Energy Loss per Pulse			3.22		mJ
E_{off}	Turn-off Energy Loss per Pulse			3.01		mJ
R_{thJC}	Thermal resistance, junction to case	per IGBT			0.65	K/W
$T_{vj op}$	Temperature under switching conditions		-40		125	$^{\circ}\text{C}$
I_{sc}	SC	$V_{GE}\leq 15\text{ V}, V_{CE}=600\text{ V}, t_p\leq 10\mu\text{S},$ $T_{vj}=125^{\circ}\text{C},$ $V_{CEmax}=V_{CES}-L_{sCE}\cdot di/dt$		160		A

Maximum Rated Values (Diode Brake-Chopper)

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
V_{RRM}	Repetitive Peak Reverse Voltage	$T_{vj} = 25\text{ }^{\circ}\text{C}$		1200		V
I_F	Continuous DC Forward Current			15		A
I_{FRM}	Repetitive Peak Forward Current	$t_p = 1\text{ ms}$		30		A
I^2t	I^2t Value	$V_R = 0\text{ V}$, $t_p = 10\text{ ms}$, $T_{vj} = 125\text{ }^{\circ}\text{C}$		100		A ² s

Characteristics (Diode Brake-Chopper)

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
V_F	Forward Voltage	$I_F = 15\text{ A}$, $V_{CE} = 0\text{ V}$, $T_{vj} = 25\text{ }^{\circ}\text{C}$		1.9	2.5	V
		$I_F = 15\text{ A}$, $V_{CE} = 0\text{ V}$, $T_{vj} = 125\text{ }^{\circ}\text{C}$		1.90	2.5	V
t_{rr}	Reverse Recovery time	$I_F = 15\text{ A}$, $V_R = 600\text{ V}$ $-di/dt = 300\text{ A/us}$ $T_{vj} = 25\text{ }^{\circ}\text{C}$		220		ns
Q_r	Recovered Charge			0.8		μC
E_{rec}	Reverse Recovery Energy			0.2		mJ
t_{rr}	Reverse Recovery time	$I_F = 15\text{ A}$, $V_R = 600\text{ V}$ $-di/dt = 300\text{ A/us}$ $T_{vj} = 125\text{ }^{\circ}\text{C}$		370		ns
Q_r	Recovered Charge			1.4		μC
E_{rec}	Reverse Recovery Energy			0.4		mJ
R_{thJC}	Thermal resistance, junction to case	$I_F = 15\text{ A}$, $V_{CE} = 0\text{ V}$, $T_{vj} = 25\text{ }^{\circ}\text{C}$			1.75	K/W
$T_{vj\text{ op}}$	Temperature under switching conditions		-40		125	$^{\circ}\text{C}$

NTC-Thermistor (Characteristic Values)

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
R_{25}	Rated resistance	$T_c = 25\text{ }^{\circ}\text{C}$		5		$K\Omega$
$\Delta R/R$	Deviation of R100	$T_c = 100\text{ }^{\circ}\text{C}$	-5		5	%
P_{25}	Power dissipation	$T_c = 25\text{ }^{\circ}\text{C}$		20		mW
$B_{25/50}$	B-value	$R_2 = R_{25} \exp[B_{25/50}(1/T_2 - 1/(298,15K))]$		3380		K
$B_{25/100}$	B-value	$R_2 = R_{25} \exp[B_{25/100}(1/T_2 - 1/(298,15K))]$		3450		K

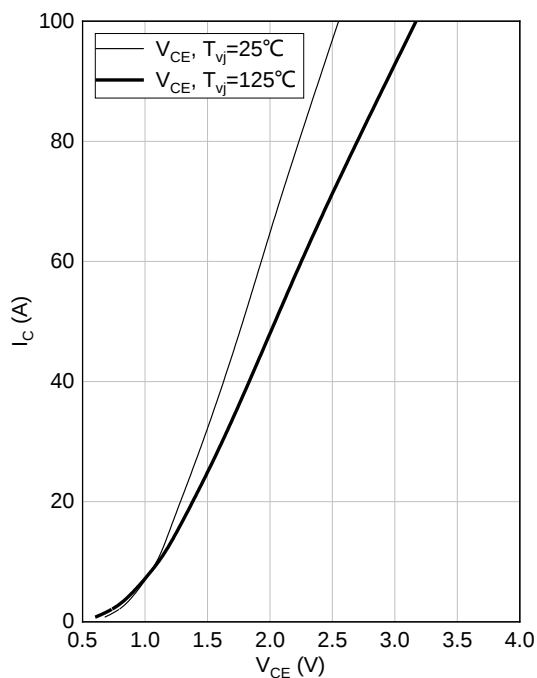
Module Characteristics

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
V_{isol}	Isolation voltage	$t = 1\text{ min}, f = 50\text{ Hz}$	2500			V
T_{stg}	Storage Temperature		-40		125	$^{\circ}\text{C}$
F	Mounting Force per Clamp		40		80	N
G	Weight of Module			40		g

Output characteristic of IGBT, Inverter (typical)

$$I_c = f(V_{CE})$$

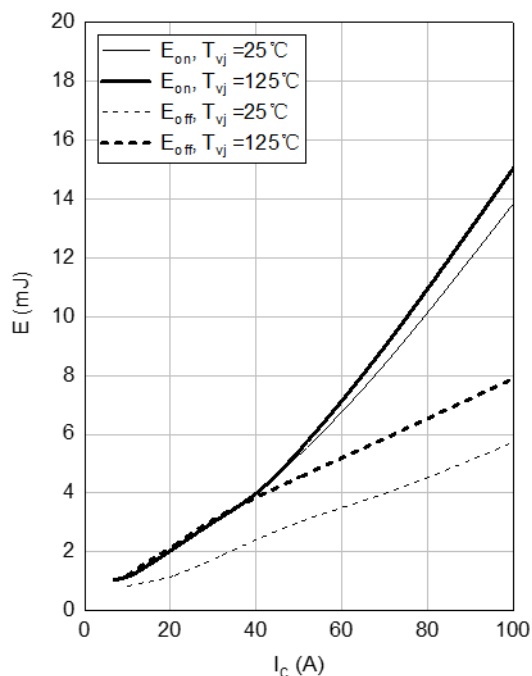
$$V_{GE} = 15V$$



Switching time of IGBT, Inverter (typical)

$$E_{on} = f(I_c), E_{off} = f(I_c)$$

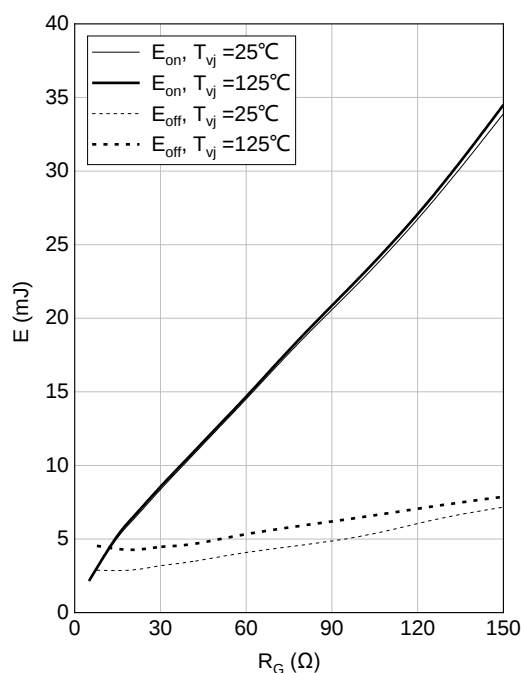
$$V_{GE} = \pm 15V, R_G = 15\Omega, V_{CE} = 600V$$



Switching loss of IGBT, Inverter (typical)

$$E_{on} = f(R_G), E_{off} = f(R_G)$$

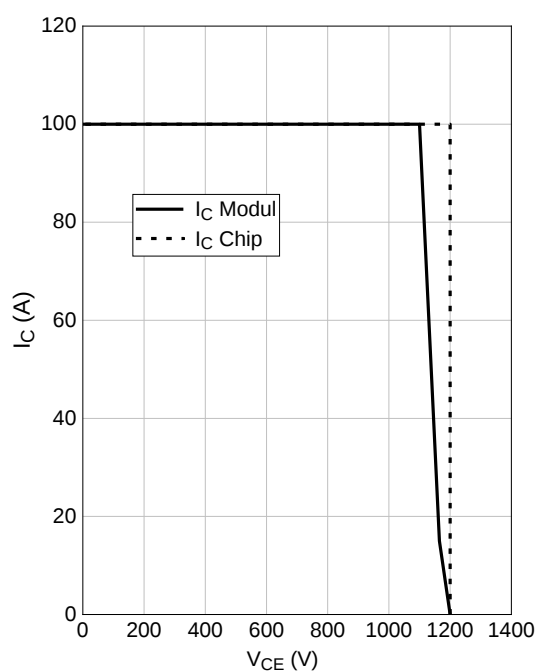
$$V_{GE} = \pm 15V, I_c = 50A, V_{CE} = 600V$$



RBSOA IGBT, Inverter (typical)

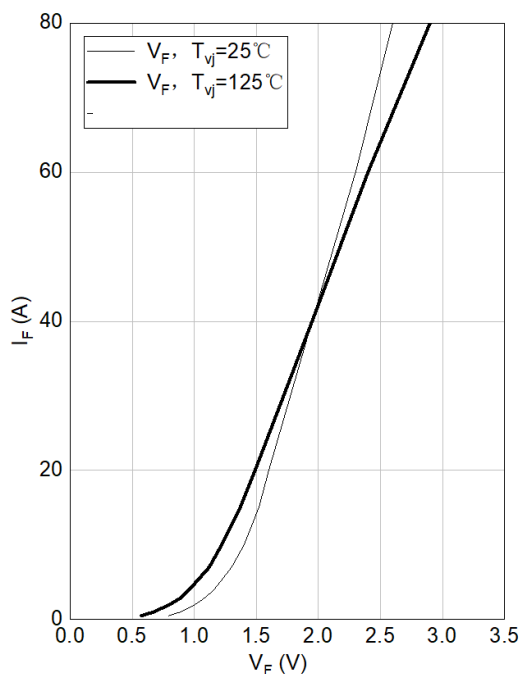
$$I_c = f(V_{CE})$$

$$V_{GE} = \pm 15V, R_{Goff} = 15\Omega, T_{vj} = 125^\circ\text{C}$$



Forward characteristic of Diode, Inverter (typical)

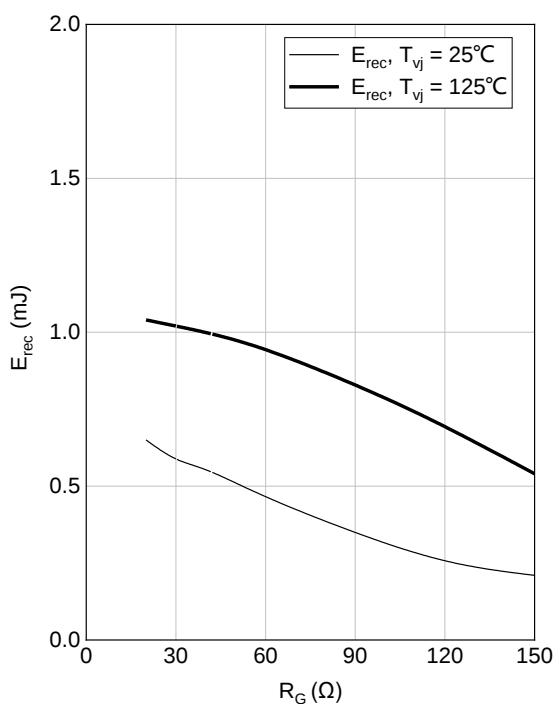
$$I_F = f(V_F)$$



Switching losses of Diode, Inverter (typical)

$$E_{rec} = f(R_G),$$

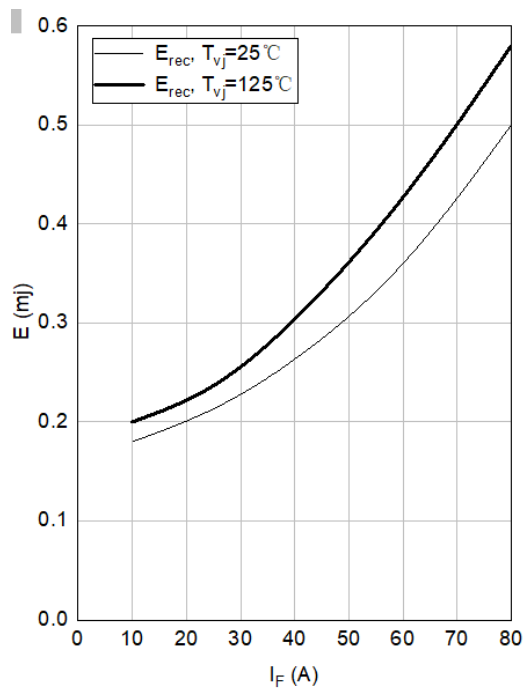
$$I_F = 40A, V_{CE} = 600V$$



Switching losses of Diode, Inverter (typical)

$$E_{rec} = f(I_F),$$

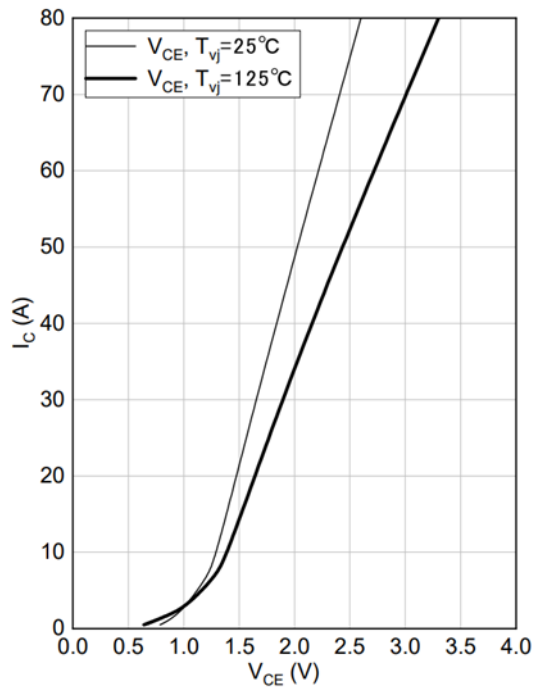
$$R_{Gon} = 15\Omega, V_{CE} = 600V$$



Output characteristic of IGBT, Brake-Chopper, (typical)

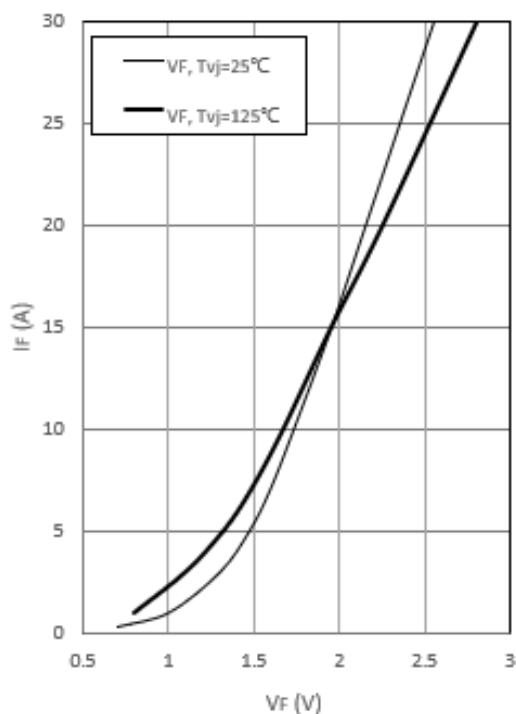
$$I_c = f(V_{CE})$$

$$V_{GE} = 15V$$



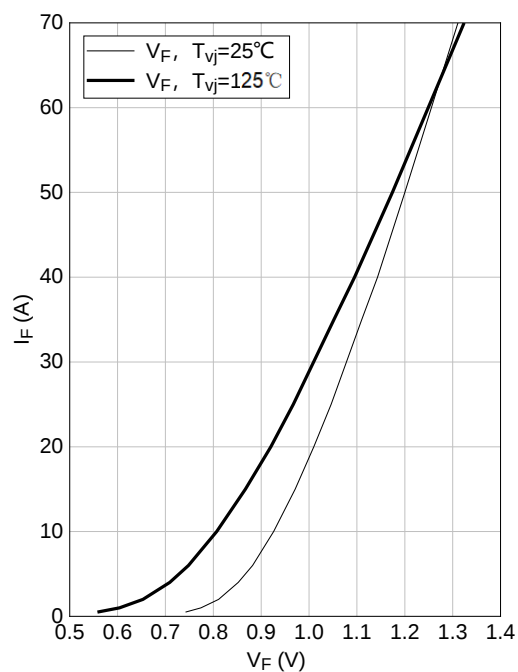
Forward characteristic of Diode, Brake-Chopper (typical)

$$I_F = f(V_F)$$



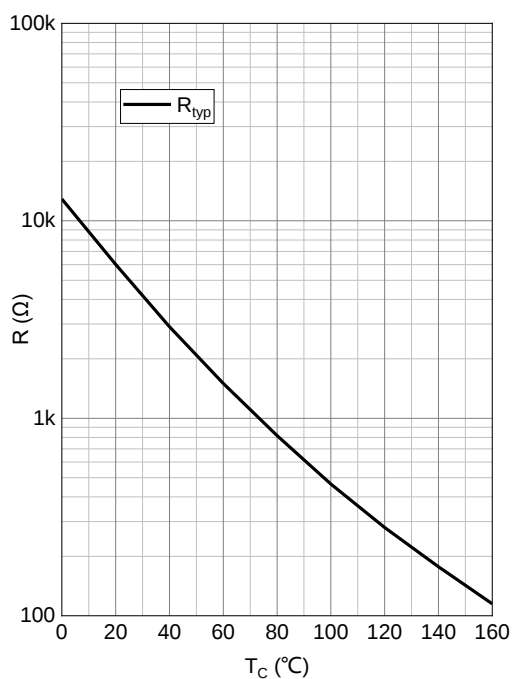
Forward characteristic of Diode, Rectifier (typical)

$$I_F = f(V_F)$$

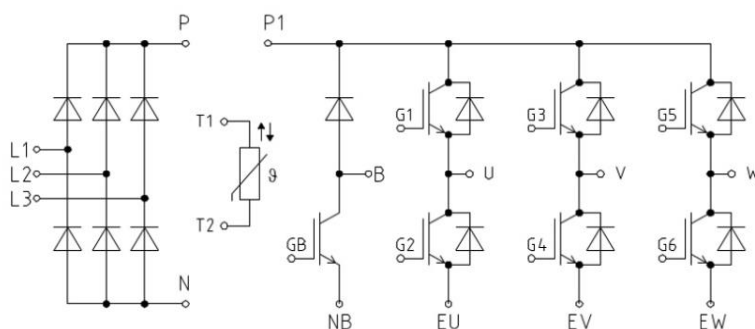


NTC-thermistor-temperature characteristic (typical)

$$R = f(T_{NTC}),$$

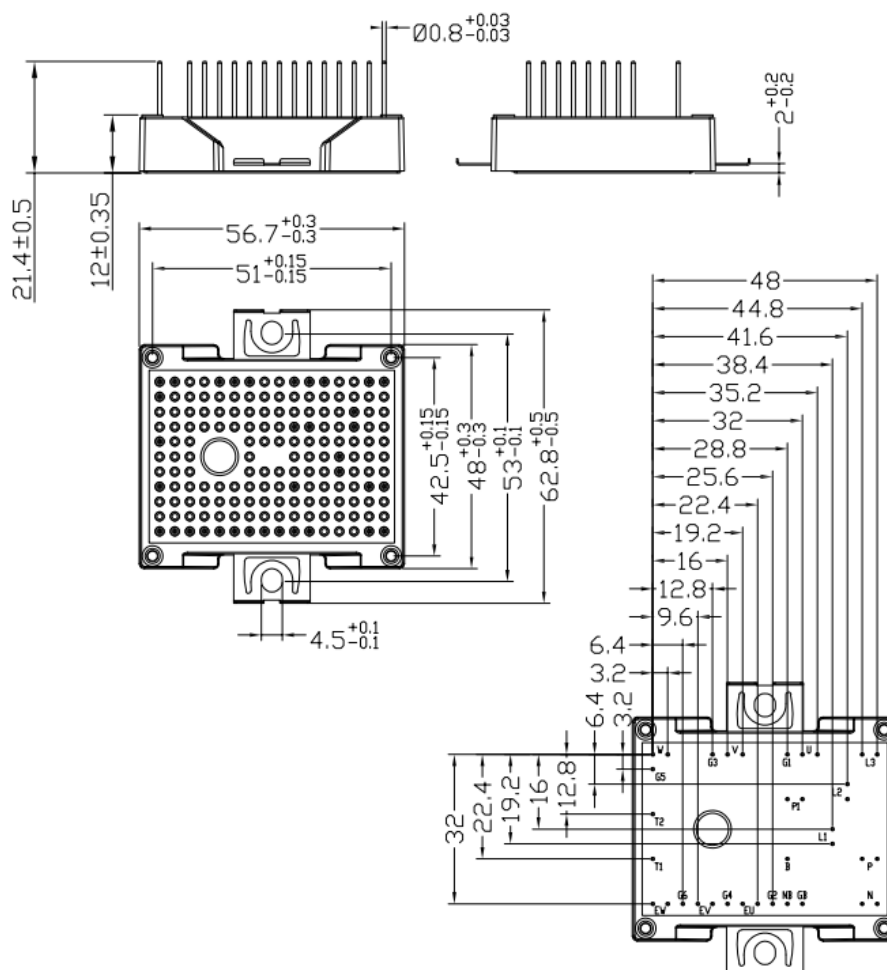


Circuit Diagram



Package Dimensions

(Dimensions in Millimeters)



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TO IMPROVE RELIABILITY, FUNCTION OR DESIGN OR OTHERWISE