

LEGM35BE120L4H

IGBT Power Module

Features:

- $V_{CE}=1200V$ $I_C=35A$
- Low $V_{CE(sat)}$
- V_{CEsat} with positive temperature coefficient
- Maximum junction temperature $175^{\circ}C$
- Isolation Type Package

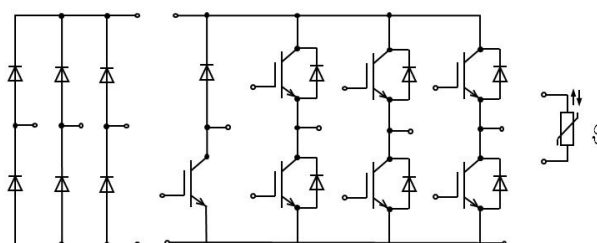
Applications:

- The inverter
- Motor control and drives

Package Type & Internal Circuit



L4



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	$T_C=100^{\circ}C$	35	A
I_{CRM}	Peak Collector Current	$I_{CRM}=2I_C$	70	A
V_{GES}	Gate-Emitter Voltage	$T_{vj}=25^{\circ}C$	± 30	V
P_{tot}	Total Power Dissipation	$T_C=25^{\circ}C, T_{vjmax}=175^{\circ}C$	200	W

Characteristics Values (IGBT Inverter)

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	$I_C=35\text{ A}, V_{GE}=15\text{ V}, T_{vj}=25\text{ }^{\circ}\text{C}$		2.00		V
		$I_C=35\text{ A}, V_{GE}=15\text{ V}, T_{vj}=150\text{ }^{\circ}\text{C}$		2.50		V
$V_{GE(th)}$	Gate Threshold Voltage	$I_C=5.0\text{ mA}, V_{CE}=V_{GE}, T_{vj}=25\text{ }^{\circ}\text{C}$		5.8		V
I_{CES}	Collector-Emitter Cut-off Current	$V_{CE}=1200\text{ V}, V_{GE}=0\text{ V}, T_{vj}=25\text{ }^{\circ}\text{C}$			1.2	mA
I_{GES}	Gate-Emitter Leakage Current	$V_{CE}=0\text{ V}, V_{GE}=15\text{ V}, T_{vj}=25\text{ }^{\circ}\text{C}$			410	nA
$t_{d(on)}$	Turn-on Delay Time, Inductive Load	$I_C=35\text{ A}, V_{CE}=600\text{ V}$ $V_{GE}=\pm 15\text{ V}$ $R_{Gon}=15\Omega$ $T_{vj}=25\text{ }^{\circ}\text{C}$		170		ns
t_r	Rise Time, Inductive Load			160		ns
$t_{d(off)}$	Turn-on Delay Time, Inductive Load			310		ns
t_f	Fall Time, Inductive Load			100		ns
E_{on}	Turn-on Energy Loss per Pulse			4.6		mJ
E_{off}	Energy Loss per Pulse			2.2		mJ
$t_{d(on)}$	Turn-on Delay Time, Inductive Load	$I_C=35\text{ A}, V_{CE}=600\text{ V}$ $V_{GE}=\pm 15\text{ V}$ $R_{Gon}=15\Omega$ $T_{vj}=150\text{ }^{\circ}\text{C}$		210		ns
t_r	Rise Time, Inductive Load			180		ns
$t_{d(off)}$	Turn-on Delay Time, Inductive Load			350		ns
t_f	Fall Time, Inductive Load			180		ns
E_{on}	Turn-on Energy Loss per Pulse			4.9		mJ
E_{off}	Energy Loss per Pulse			3.0		mJ
R_{thJC}	Thermal resistance, junction to case	per IGBT			0.75	K/W
$T_{vj\text{ op}}$	Temperature under switching conditions		-40		150	$^{\circ}\text{C}$
I_{sc}	SC	$V_{GE}\leq 15\text{ V}, V_{CE}=600\text{ V},$ $t_p\leq 10\mu\text{S}, T_{vj}=150\text{ }^{\circ}\text{C},$ $V_{CEmax}=V_{CES}-L_{sCE}\cdot di/dt$		172		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	$T_C=100\text{ }^{\circ}\text{C}$		35		A
I_{FRM}	Repetitive Peak Forward Current	$t_p=1\text{ ms}$		70		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 ² s

Characteristic Values (Diode Inverter)

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
V_F	Forward Voltage	$I_F=35\text{ A}$, $V_{CE}=0\text{ V}$, $T_{vj}=25\text{ }^{\circ}\text{C}$		2.38		V
		$I_F=35\text{ A}$, $V_{CE}=0\text{ V}$, $T_{vj}=150\text{ }^{\circ}\text{C}$		2.7		V
t_{rr}	Reverse Recovery time	$I_F=35\text{ A}$, $V_R=600\text{ V}$ -di/dt=100A/us $T_{vj}=25\text{ }^{\circ}\text{C}$		140		ns
Q_r	Recovered Charge			1.1		uC
E_{rec}	Reverse Recovery Energy			6.7		mJ
t_{rr}	Reverse Recovery time	$I_F=35\text{ A}$, $V_R=600\text{ V}$ -di/dt=100A/us $T_{vj}=150\text{ }^{\circ}\text{C}$		290		ns
Q_r	Recovered Charge			2.5		uC
E_{rec}	Reverse Recovery Energy			0.5		mJ
R_{thJC}	Thermal resistance, junction to case	per Diode			1.03	K/W
$T_{vj\text{ op}}$	Temperature under switching conditions		-40		150	$^{\circ}\text{C}$

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	$t_p=10\text{ms}$ $T_{vj}=150\text{ }^{\circ}\text{C}$		880		A ² S
I_{FSM}	Surge forward current	$t_p=10\text{ms}$ $T_{vj}=25\text{ }^{\circ}\text{C}$		360		A
I^2t	I^2t -value	$t_p=10\text{ms}$ $T_{vj}=150\text{ }^{\circ}\text{C}$		600		A ² S

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	$T_{vj}=150\text{ }^{\circ}\text{C}$ $V_R=1800\text{V}$		1.1		mA
R_{thjc}	Thermal resistance junction to case	$T_c=25\text{ }^{\circ}\text{C}$		0.76		K/W
T_{vjop}	Temperature under switching conditions	per diode	-40		150	$^{\circ}\text{C}$

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	$TC = 100^{\circ}\text{C}$, $T_{vj} \text{ max} = 175^{\circ}\text{C}$		25		A
I_{CRM}	Peak Collector Current	$I_{CRM}=2I_C$		50		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	$I_C=25\text{ A}$, $V_{GE}=15\text{ V}$, $T_{vj}=25^{\circ}\text{C}$		2.01		V
		$I_C=25\text{ A}$, $V_{GE}=15\text{ V}$, $T_{vj}=150^{\circ}\text{C}$		2.53		V
$V_{GE(th)}$	Gate Threshold Voltage	$I_C=5.0\text{ mA}$, $V_{CE}=V_{GE}$, $T_{vj}=25^{\circ}\text{C}$		5.8		V
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	$V_{CE}=0\text{ V}$, $V_{GE}=15\text{ V}$, $T_{vj}=25^{\circ}\text{C}$			410	nA
$t_{d(on)}$	Turn-on Delay Time, Inductive Load	$I_C=25\text{ A}$, $V_{CE}=600\text{ V}$ $V_{GE}=\pm 15\text{ V}$ $R_{Gon}=20\Omega$ $T_{vj}=25^{\circ}\text{C}$		170		ns
t_r	Rise Time, Inductive Load			160		ns
$t_{d(off)}$	Turn-off Delay Time, Inductive Load			170		ns
t_f	Fall Time, Inductive Load			150		ns
E_{on}	Turn-on Energy Loss per Pulse			3.7		mJ
E_{off}	Energy Loss per Pulse			1.4		mJ
$t_{d(on)}$	Turn-on Delay Time, Inductive Load	$I_C=25\text{ A}$, $V_{CE}=600\text{ V}$ $V_{GE}=\pm 15\text{ V}$ $R_{Gon}=20\Omega$ $T_{vj}=150^{\circ}\text{C}$		130		ns
t_r	Rise Time, Inductive Load			180		ns
$t_{d(off)}$	Turn-off Delay Time, Inductive Load			250		ns
t_f	Fall Time, Inductive Load			180		ns
E_{on}	Turn-on Energy Loss per Pulse			3.9		mJ
E_{off}	Energy Loss per Pulse			1.8		mJ
R_{thJC}	Thermal resistance, junction to case	per IGBT			0.89	K/W
$T_{vj op}$	Temperature under switching conditions		-40		150	$^{\circ}\text{C}$

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	$T_C = 100\text{ }^{\circ}\text{C}$		25		A
I_{FRM}	Repetitive Peak Forward Current	$t_p = 1\text{ ms}$		50		A
I^2t	I^2t Value	$V_R = 0\text{ V}$, $t_p = 10\text{ ms}$, $T_{vj} = 150\text{ }^{\circ}\text{C}$		100		A ² s

Characteristics (Diode Brake-Chopper)

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
V_F	Forward Voltage	$T_{vj} = 25\text{ }^{\circ}\text{C}$		2.03		V
		$T_{vj} = 150\text{ }^{\circ}\text{C}$		2.05		V
t_{rr}	Reverse Recovery time	$I_F = 25\text{ A}$, $V_R = 600\text{ V}$ -di/dt=250A/us $T_{vj} = 25\text{ }^{\circ}\text{C}$		220		ns
Q_r	Recovered Charge			0.8		uC
E_{rec}	Reverse Recovery Energy			0.2		mJ
t_{rr}	Reverse Recovery time	$I_F = 25\text{ A}$, $V_R = 600\text{ V}$ -di/dt=250A/us $T_{vj} = 150\text{ }^{\circ}\text{C}$		340		ns
Q_r	Recovered Charge			1.6		uC
E_{rec}	Reverse Recovery Energy			0.5		mJ
R_{thJC}	Thermal resistance, junction to case	$I_F = 25\text{ A}$, $V_{CE} = 0\text{ V}$, $T_{vj} = 25\text{ }^{\circ}\text{C}$			1.24	K/W
$T_{vj\text{ op}}$	Temperature under switching conditions		-40		150	$^{\circ}\text{C}$

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

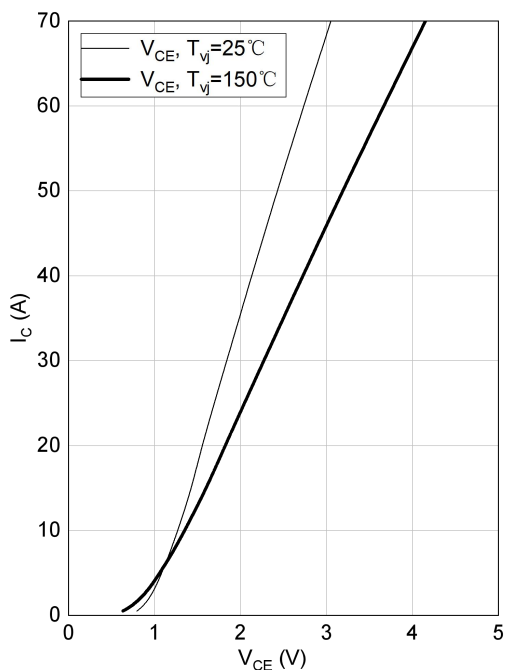
Module Characteristics

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		150	$^{\circ}\text{C}$
M_s	Module-to-Sink Torque	Recommended(M5)	3.0		6.0	N·m
G	Weight of Module			180		g

Output characteristic of IGBT, Inverter (typical)

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

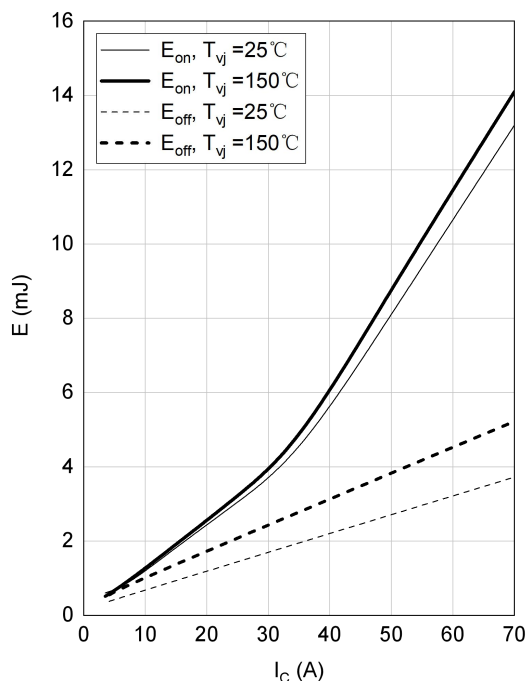
$$V_{GE} = 15V$$



Switching time of IGBT, Inverter (typical)

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

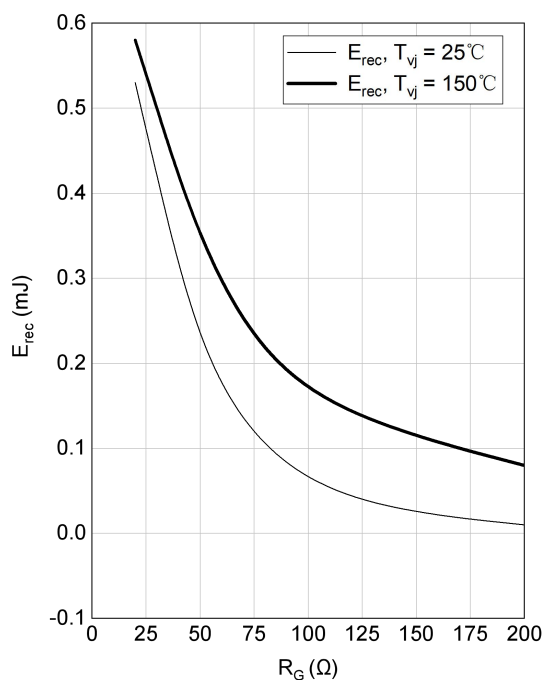
$$V_{GE} = \pm 15V, R_G = 15\Omega, V_{CE} = 600V$$



Switching loss of IGBT, Inverter (typical)

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

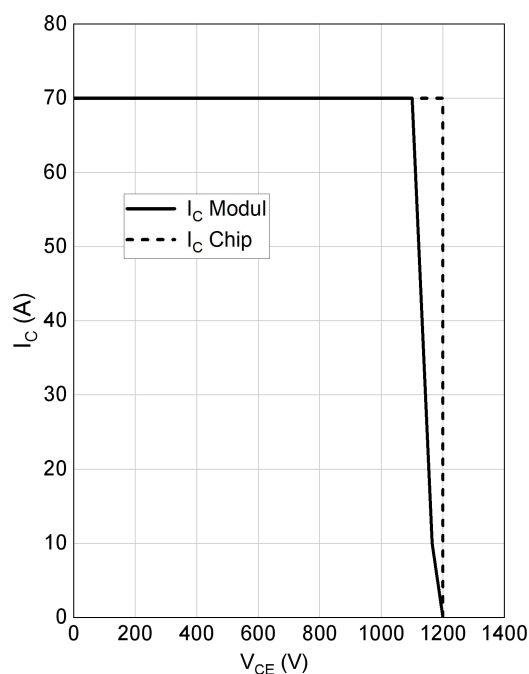
$$V_{GE} = \pm 15V, I_C = 35A, V_{CE} = 600V$$



RBSOA IGBT, Inverter (typical)

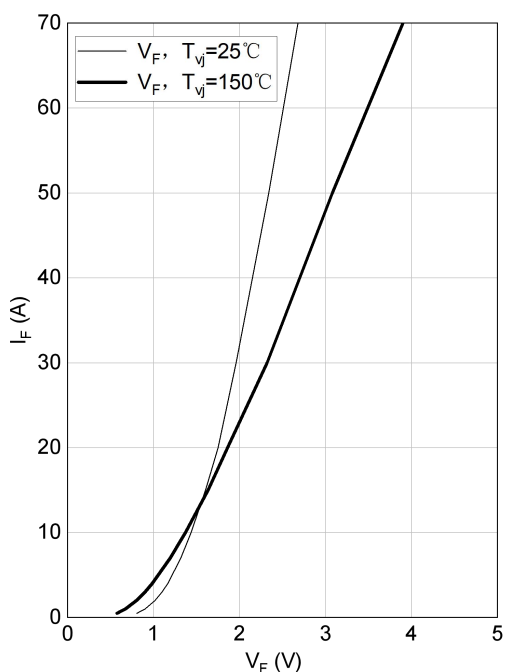
$$I_C = f(V_{CE})$$

$$V_{GE} = \pm 15V, R_{Goff} = 15\Omega, T_{vj} = 150^\circ C$$



Forward characteristic of Diode, Inverter (typical)

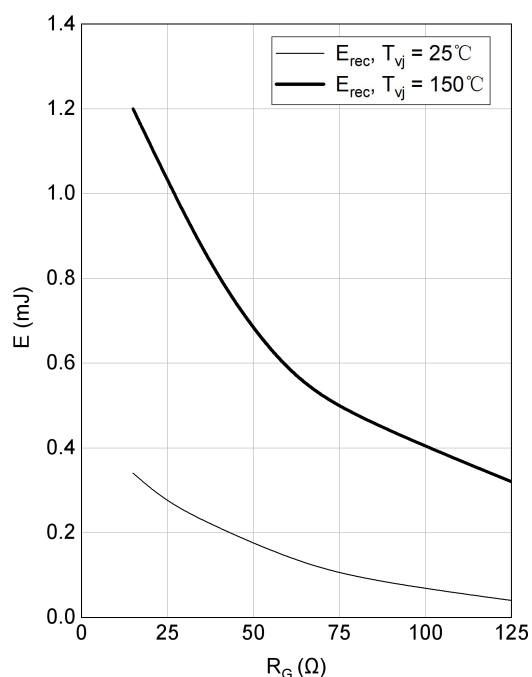
$$I_F = f(V_F)$$



Switching losses of Diode, Inverter (typical)

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

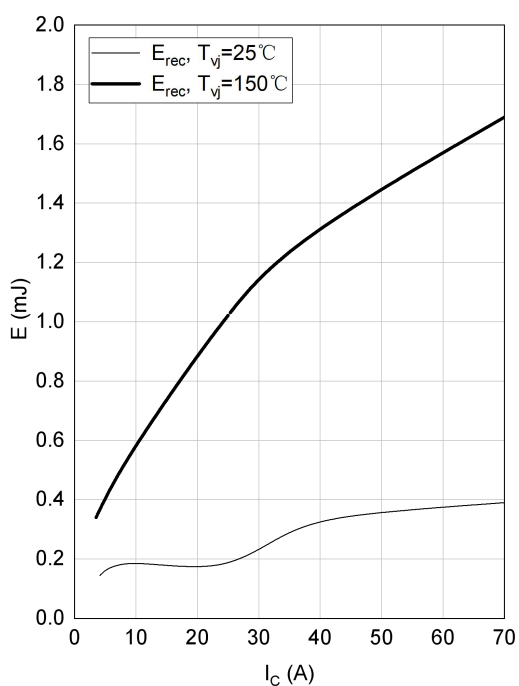
$$I_F = 35\text{A}, V_{CE} = 600\text{V}$$



Switching losses of Diode, Inverter (typical)

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

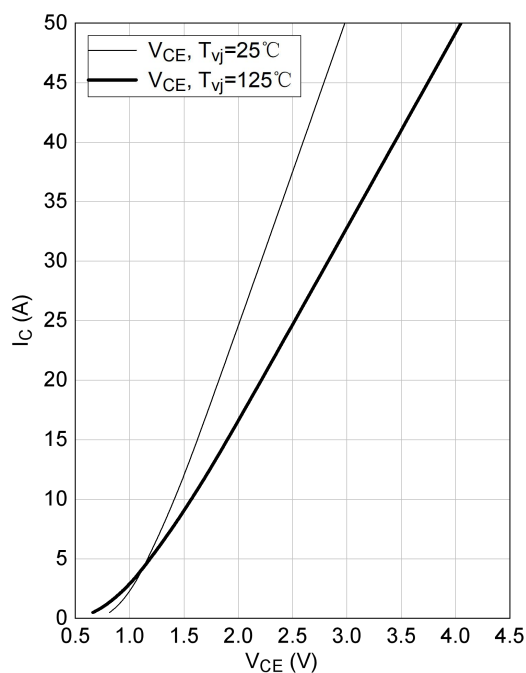
$$R_{Gon} = 15\Omega, V_{CE} = 600\text{V}$$



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

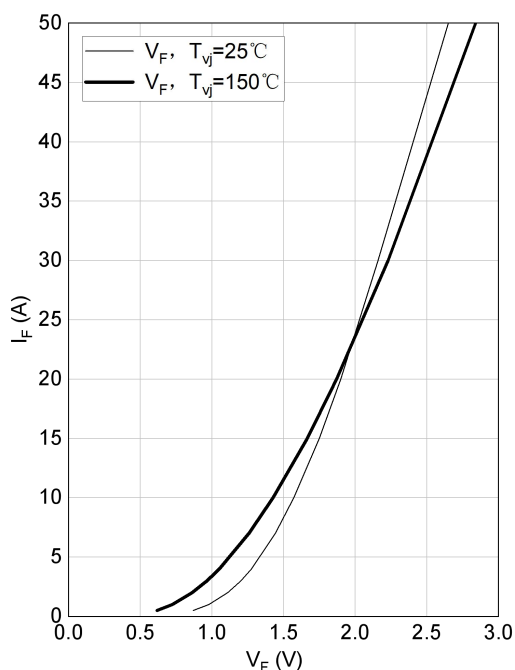
$$I_c = f(V_{CE})$$

$$V_{GE} = 15\text{V}$$



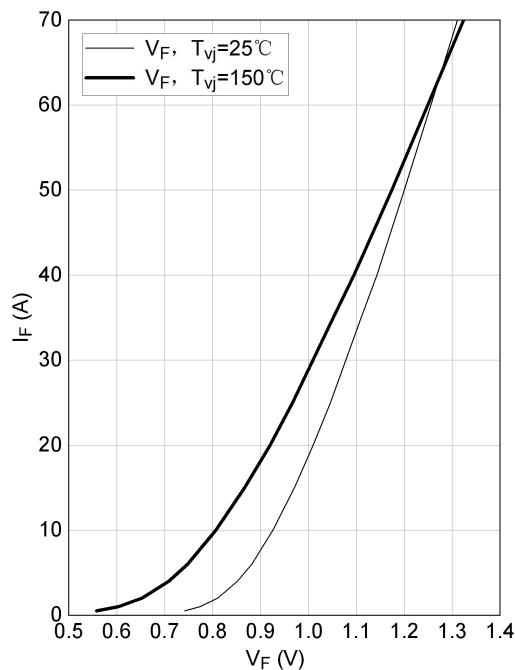
Forward characteristic of Diode,Brake-Chopper (typical)

$$I_F = f(V_F)$$



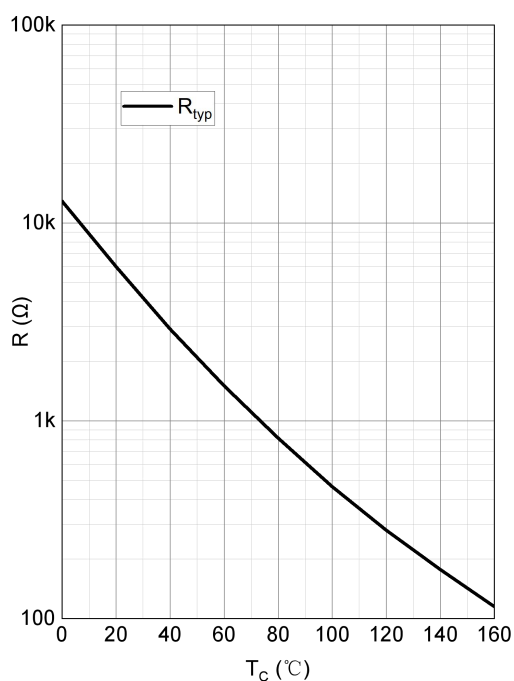
Forward characteristic of Diode, Rectifier(typical)

$$I_F = f(V_F)$$

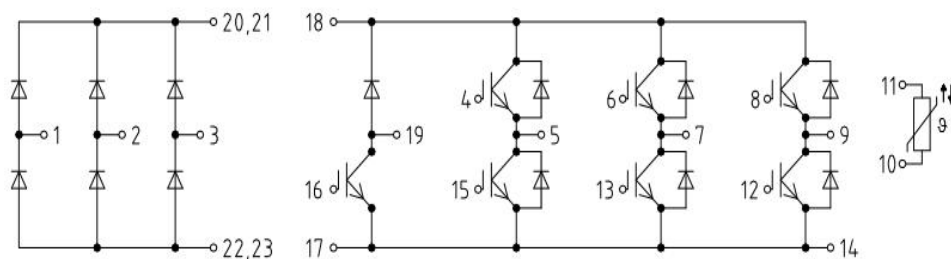


NTC-thermistor-temperature characteristic (typical)

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

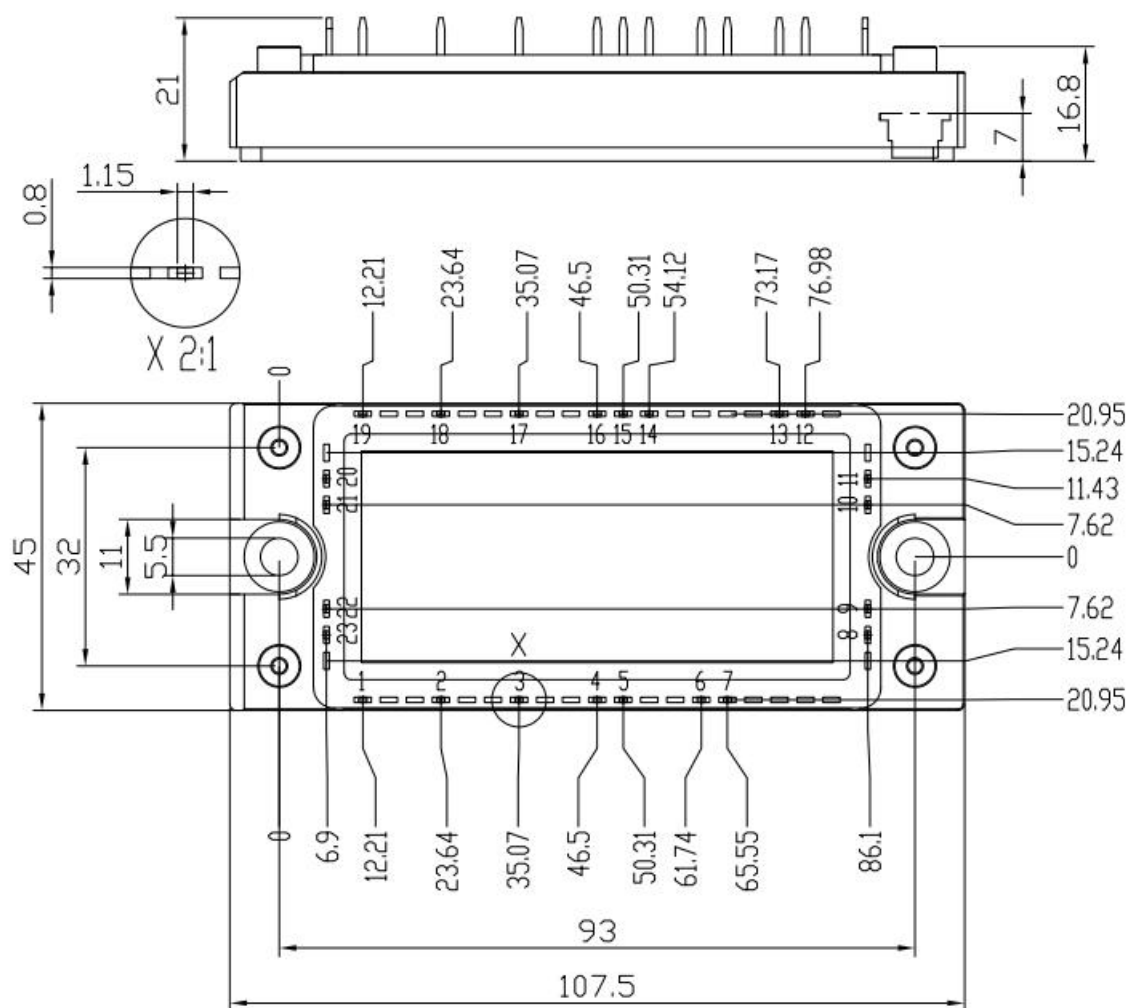


Circuit Diagram



Package Dimensions

(Dimensions in Millimeters)



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TO IMPROVE RELIABILITY, FUNCTION OR DESIGN OR OTHERWISE