

LCG50PI120E4E1B-01

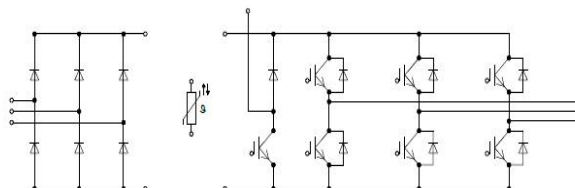
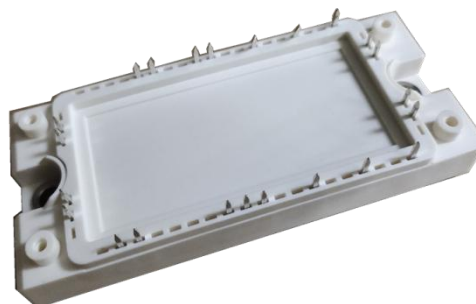
1200V, 50A PIM Module

Features

- $V_{CE(sat)}$ with positive temperature coefficient
- Low $V_{CE(sat)}$
- Low switching losses
- High current capability
- Short circuit rated

Typical Applications

- Motor drives
- Servo drives
- High frequency switching applications



Maximum Ratings / $T_J = 25^\circ\text{C}$, unless otherwise specified

Inverter IGBT

Parameter	Symbols	Conditions		Value	Unit
Collector to emitter voltage	V_{CES}			1200	V
Gate to emitter voltage	V_{GES}			± 20	V
Collector current DC	I_C	Continuous, $T_J = 175^\circ\text{C}$	$T_C = 25^\circ\text{C}$	80	A
		Continuous, $T_J = 175^\circ\text{C}$	$T_C = 100^\circ\text{C}$	50	A
Repetitive peak collector current	I_{CRM}	t_p is limited by T_{Jmax}		100	A
Turn off safe operating area (RBSOA)	I_{Cmax}	$V_{ce} \leq 1200\text{V}$, at chip level		100	A
Operating junction temperature	T_{Jop}	Switching mode		150	$^\circ\text{C}$
Maximum junction temperature	T_{Jmax}			175	$^\circ\text{C}$
Maximum power dissipation	P_D	$T_J = 175^\circ\text{C}$	$T_C = 25^\circ\text{C}$	300	W

Inverter FRD

Parameter	Symbols	Conditions		Value	Unit
Peak repetitive reverse voltage	V_{RRM}			1200	V
DC Forward Current	I_F			50	A
Repetitive forward current	I_{FRM}	t_p is limited by T_{Jmax}		100	A
Operating junction temperature	T_{Jop}			150	$^\circ\text{C}$
Maximum junction temperature	T_{Jmax}			175	$^\circ\text{C}$
Maximum power dissipation	P_D	$T_J = 175^\circ\text{C}$	$T_C = 25^\circ\text{C}$	176	W

Brake IGBT

Parameter	Symbols	Conditions		Value	Unit
Collector to emitter voltage	V_{CES}			1200	V
Gate to emitter voltage	V_{GES}			± 20	V
Collector current DC	I_C	Continuous, $T_J = 175^\circ\text{C}$	$T_C = 25^\circ\text{C}$	65	A
		Continuous, $T_J = 175^\circ\text{C}$	$T_C = 100^\circ\text{C}$	40	A
Repetitive peak collector current	I_{CRM}	t_p is limited by T_{Jmax}		80	A
Turn off safe operating area (RBSOA)	I_{Cmax}	$V_{ce} \leq 1200\text{V}$, at chip level		80	A
Operating junction temperature	T_{Jop}	Switching mode		150	$^\circ\text{C}$
Maximum junction temperature	T_{Jmax}			175	$^\circ\text{C}$
Maximum power dissipation	P_D	$T_J = 175^\circ\text{C}$	$T_C = 25^\circ\text{C}$	241	W

Brake FRD

Parameter	Symbols	Conditions		Value	Unit
Peak repetitive reverse voltage	V_{RRM}			1200	V
DC forward current	I_F			20	A
Repetitive forward current	I_{FRM}	t_p is limited by T_{Jmax}		40	A
Operating junction temperature	T_{Jop}			150	$^\circ\text{C}$
Maximum junction temperature	T_{Jmax}			175	$^\circ\text{C}$
Maximum power dissipation	P_D	$T_J = 175^\circ\text{C}$	$T_C = 25^\circ\text{C}$	120	W

Rectifier

Parameter	Symbols	Conditions		Value	Unit
Peak repetitive reverse voltage	V_{RRM}			1600	V
Average output current	I_O	50Hz/60Hz, sine wave		50	A
Surge forward current	I_{FSM}	$t_p = 10\text{ ms}$	$T_C = 25^\circ\text{C}$	360	A
I^2t – value	I^2t	$t_p = 10\text{ ms}$	$T_C = 25^\circ\text{C}$	648	A^2S
Operating junction temperature	T_{Jop}			150	$^\circ\text{C}$
Maximum power dissipation	P_D	$T_J = 150^\circ\text{C}$	$T_C = 25^\circ\text{C}$	164	W

Electrical Characteristics ($T_J = 25^\circ\text{C}$ unless otherwise specified)

Inverter IGBT

Parameter	Symbol	Test Conditions		Min	Typ	Max	Unit
Collector-emitter breakdown voltage	BV_{CES}	$V_{GE} = 0\text{ V}, I_C = 1\text{ mA}$		1200	-	-	V
Collector-emitter cutoff current	I_{CES}	$V_{GE} = 0\text{ V}, V_{CE} = 1200\text{ V}$		-	-	1	mA
Gate leakage current	I_{GES}	$V_{CE} = 0\text{ V}, V_{GE} = V_{GES}$		-	-	±400	nA
Gate emitter threshold Voltage	$V_{GE(th)}$	$V_{GE} = V_{CE}, I_C = 1.7\text{ mA}$		5.1	5.8	6.5	V
Internal gate resistor	R_{gint}	$f = 1\text{ MHz}$		-	5.5	-	Ω
Collector-emitter saturation voltage	$V_{CE(sat)}$	$I_C = 50\text{ A}, V_{GE} = 15\text{ V}$		-	1.70	2.05	V
		$I_C = 50\text{ A}, V_{GE} = 15\text{ V}$	$T_J = 150^{\circ}\text{C}$	-	2.05	-	V
Input capacitance	C_{ies}	$V_{GE} = 0\text{ V}, V_{CE} = 25\text{ V}, f = 100\text{ kHz}$		-	4.05	-	nF
Reverse transfer capacitance	C_{res}			-	0.04	-	
Total gate charge	Q_g	$V_{CE} = 600\text{ V}, I_C = 50\text{ A}, V_{GE} = 15\text{ V}$		-	0.36	-	μC
Turn-on delay time	$T_{d(on)}$	$V_{CC} = 600\text{ V}, I_C = 50\text{ A}$ $V_{GE} = +15/-15\text{ V},$ $R_{Gon}/R_{Goff} = 15\text{ }\Omega$	$T_J = 25^{\circ}\text{C}$	-	0.10	-	us
			$T_J = 150^{\circ}\text{C}$	-	0.11	-	us
Rise time	T_r		$T_J = 25^{\circ}\text{C}$	-	0.04	-	us
			$T_J = 150^{\circ}\text{C}$	-	0.04	-	us
Turn-off delay time	$T_{d(off)}$		$T_J = 25^{\circ}\text{C}$	-	0.31	-	us
			$T_J = 150^{\circ}\text{C}$	-	0.38	-	us
Fall time	T_f		$T_J = 25^{\circ}\text{C}$	-	0.11	-	us
			$T_J = 150^{\circ}\text{C}$	-	0.19	-	us
Turn-on switching loss	E_{on}		$T_J = 25^{\circ}\text{C}$	-	3.50	-	mJ
			$T_J = 150^{\circ}\text{C}$	-	6.35	-	mJ
Turn-off switching loss	E_{off}		$T_J = 25^{\circ}\text{C}$	-	3.30	-	mJ
			$T_J = 150^{\circ}\text{C}$	-	4.90	-	mJ
Short circuit data	I_{sc}	$V_{GE} = 15\text{ V}, V_{CC} = 600\text{ V}$ $V_{CEmax} = V_{CES} -$ $L_{sCE} \cdot di/dt$ $t_p \leq 10\text{ }\mu\text{s}$	$T_J = 150^{\circ}\text{C}$	-	195	-	A
Thermal resistance, junction to case	R_{thJC}	Per IGBT		-	-	0.5	K/W
Thermal resistance, case to heatsink	R_{thCH}	Per IGBT, $\lambda_{grease} = 1\text{ W/(m}\cdot\text{K)}$		-	0.2	-	K/W

Inverter FRD

Parameter	Symbol	Test Conditions		Min	Typ	Max	Unit
Forward voltage	V _F	I _F = 50 A	T _J = 25°C	-	2.05	2.5	V
			T _J = 150°C	-	1.70	-	V
Peak reverse recovery current	I _{rr}	I _F = 50 A, V _R = 800 V V _{GE} = -15 V, R _{Gon} = 15 Ω	T _J = 25°C	-	38.0	-	A
			T _J = 150°C	-	57.5	-	A
Reverse recovery charge	Q _{rr}		T _J = 25°C	-	1.80	-	μC
			T _J = 150°C	-	5.85	-	μC
Reverse recovery energy	E _{rec}		T _J = 25°C	-	1.00	-	mJ
			T _J = 150°C	-	2.65	-	mJ
Thermal resistance, junction to case	R _{thJC}	Per Diode		-	-	0.85	K/W
Thermal resistance, case to heatsink	R _{thCH}	Per IGBT, λ _{grease} = 1 W/(m·K)		-	0.32	-	K/W

Brake IGBT

Parameter	Symbol	Test Conditions		Min	Typ	Max	Unit
Collector-emitter breakdown voltage	BV_{CES}	$V_{GE} = 0\text{ V}, I_C = 1\text{ mA}$		1200	-	-	V
Collector-emitter cutoff current	I_{CES}	$V_{GE} = 0\text{ V}, V_{CE} = 1200\text{ V}$		-	-	1	mA
Gate leakage current	I_{GES}	$V_{CE} = 0\text{ V}, V_{GE} = V_{GES}$		-	-	±400	nA
Gate emitter threshold Voltage	$V_{GE(th)}$	$V_{GE} = V_{CE}, I_C = 1.2\text{ mA}$		5.1	5.8	6.5	V
Internal gate resistor	R_{gint}	$f = 1\text{ MHz}$		-	3.2	-	Ω
Collector-emitter saturation voltage	$V_{CE(sat)}$	$I_C = 40\text{ A}, V_{GE} = 15\text{ V}$		-	1.70	2.05	V
		$I_C = 40\text{ A}, V_{GE} = 15\text{ V}$	$T_J = 150^{\circ}\text{C}$	-	2.05	-	V
Input capacitance	C_{ies}	$V_{GE} = 0\text{ V}, V_{CE} = 25\text{ V}, f = 100\text{ kHz}$		-	3.45	-	nF
Reverse transfer capacitance	C_{res}			-	0.04	-	
Total gate charge	Q_g	$V_{CE} = 600\text{ V}, I_C = 40\text{ A}, V_{GE} = 15\text{ V}$		-	0.31	-	μC
Turn-on delay time	$T_{d(on)}$	$V_{CC} = 600\text{ V}, I_C = 40\text{ A}$ $V_{GE} = +15/-15\text{ V},$ $R_{Gon}/R_{Goff} = 28\text{ }\Omega$	$T_J = 25^{\circ}\text{C}$	-	0.11	-	μs
			$T_J = 150^{\circ}\text{C}$	-	0.10	-	μs
Rise time	T_r		$T_J = 25^{\circ}\text{C}$	-	0.07	-	μs
			$T_J = 150^{\circ}\text{C}$	-	0.07	-	μs
Turn-off delay time	$T_{d(off)}$		$T_J = 25^{\circ}\text{C}$	-	0.33	-	μs
			$T_J = 150^{\circ}\text{C}$	-	0.39	-	μs
Fall time	T_f		$T_J = 25^{\circ}\text{C}$	-	0.12	-	μs
			$T_J = 150^{\circ}\text{C}$	-	0.21	-	μs
Turn-on switching loss	E_{on}		$T_J = 25^{\circ}\text{C}$	-	4.20	-	mJ
			$T_J = 150^{\circ}\text{C}$	-	6.90	-	mJ
Turn-off switching loss	E_{off}		$T_J = 25^{\circ}\text{C}$	-	2.70	-	mJ
			$T_J = 150^{\circ}\text{C}$	-	4.00	-	mJ
Short circuit data	I_{sc}	$V_{GE} = 15\text{ V}, V_{CC} = 800\text{ V}$ $V_{CEmax} = V_{CES} -$ $L_{sCE} \cdot di/dt$ $tp \leq 10\text{ }\mu\text{s}$	$T_J = 150^{\circ}\text{C}$	-	140	-	A
Thermal resistance, junction to case	R_{thJC}	Per IGBT		-	-	0.62	K/W
Thermal resistance, case to heatsink	R_{thCH}	Per IGBT, $\lambda_{grease} = 1\text{ W/(m}\cdot\text{K)}$		-	0.26	-	K/W

Brake FRD

Parameter	Symbol	Test Conditions		Min	Typ	Max	Unit
Forward voltage	V _F	I _F = 20 A	T _J = 25°C	-	2.30	2.70	V
			T _J = 150°C	-	1.70	-	V
Peak reverse recovery current	I _{rr}	I _F = 15 A, V _R = 600 V V _{GE} = -15 V, R _{Gon} = 47 Ω	T _J = 25°C	-	19.5	-	A
			T _J = 150°C	-	29.5	-	A
Reverse recovery charge	Q _{rr}		T _J = 25°C	-	2.05	-	uC
			T _J = 150°C	-	6.90	-	uC
Reverse recovery energy	E _{rec}		T _J = 25°C	-	0.65	-	mJ
			T _J = 150°C	-	2.40	-	mJ
Thermal resistance, junction to case	R _{thJC}	Per Diode		-	-	1.25	K/W
Thermal resistance, case to heatsink	R _{thCH}	Per IGBT, λ _{grease} = 1 W/(m·K)		-	0.55	-	K/W

Rectifier

Parameter	Symbol	Test Conditions		Min	Typ	Max	Unit
Forward voltage	V_F	$I_F = 50\text{ A}$	$T_J = 25^\circ\text{C}$	-	1.10	-	V
Reverse current	I_R	$V_R = 1600\text{ V}$	$T_J = 25^\circ\text{C}$	-	-	1	mA
Thermal resistance, junction to case	R_{thJC}	Per Diode		-	-	0.76	K/W
Thermal resistance, case to heatsink	R_{thCH}	Per IGBT, $\lambda_{grease} = 1\text{ W/(m}\cdot\text{K)}$		-	0.32	-	K/W

NTC

Parameter	Symbol	Test Conditions		Min	Typ	Max	Unit
Rated resistance	R_{25}	$T_{NTC} = 25^\circ\text{C}$		-	5	-	$k\Omega$
Deviation of R_{100}	$\Delta R/R$	$R_{100} = 493\ \Omega$	$T_J = 100^\circ\text{C}$	-5	-	5	%
Power dissipation	P_{25}	$T_{NTC} = 25^\circ\text{C}$		-	-	20	mW
B-value	$B_{25/50}$	$R_2 = R_{25} \exp [B_{25/50}(1/T_2 - 1/(298.15\text{ K}))]$		-	3375	-	K

Module

Parameter	Symbol	Test Conditions	Value	Unit
Isolation test voltage	V_{ISOL}	RMS, $f = 50\text{ Hz}$, $t = 1\text{ min.}$	2.5	kV
Storage temperature	T_{Stg}		-40---125	$^\circ\text{C}$
Internal isolation		basic insulation (class 1, IEC 61140)	Al_2O_3	
Creepage distance		terminal to heatsink	10	mm
		terminal to terminal	10	
Clearance		terminal to heatsink	7.5	mm
		terminal to terminal	7.5	
Comperative tracking index	CTI		>200	
Stray inductance module	L_{sCE}		35	nH
Module lead resistance, terminals - chip	$R_{CC'+EE'}$	per switch	4	$m\Omega$
	$R_{AA'+CC'}$		3	
Mounting torque for module mounting	M	Screw M5	3~6	Nm
Weight	G		180	g

Fig 1, Output Characteristics IGBT, Inverter (typical)

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

$T_J = 25^\circ\text{C}$

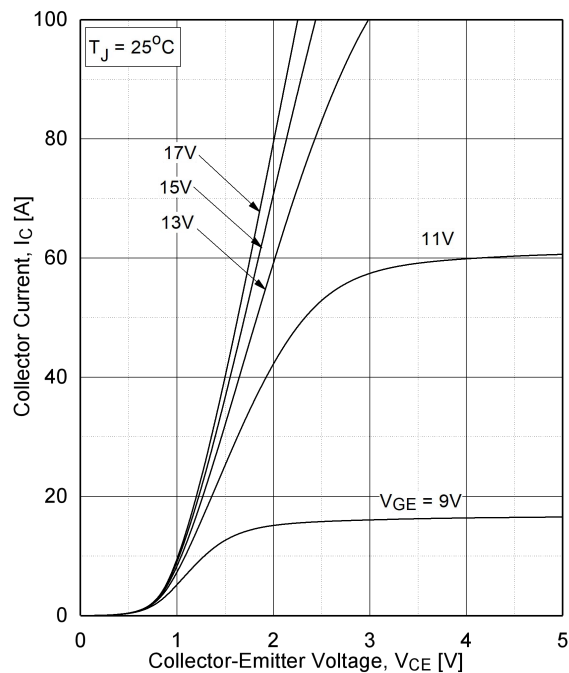


Fig 2, Output Characteristics IGBT, Inverter (typical)

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

$T_J = 150^\circ\text{C}$

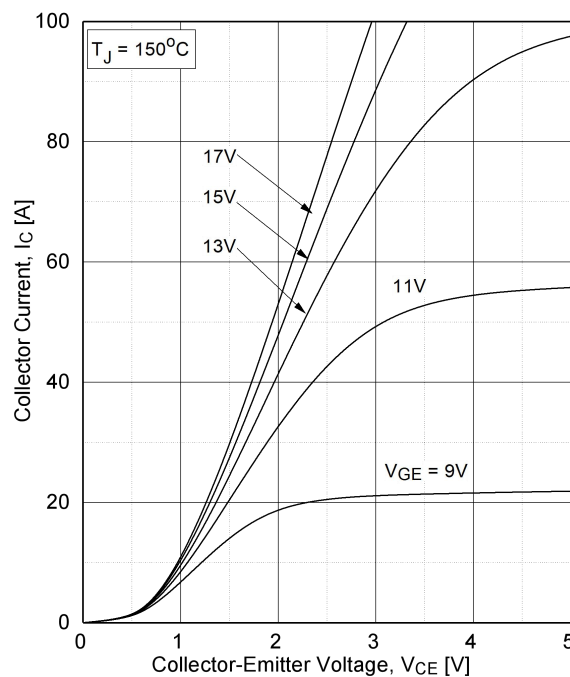


Fig 3, Transfer Characteristics IGBT, Inverter (typical)

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

$V_{CE} = 20\text{ V}$

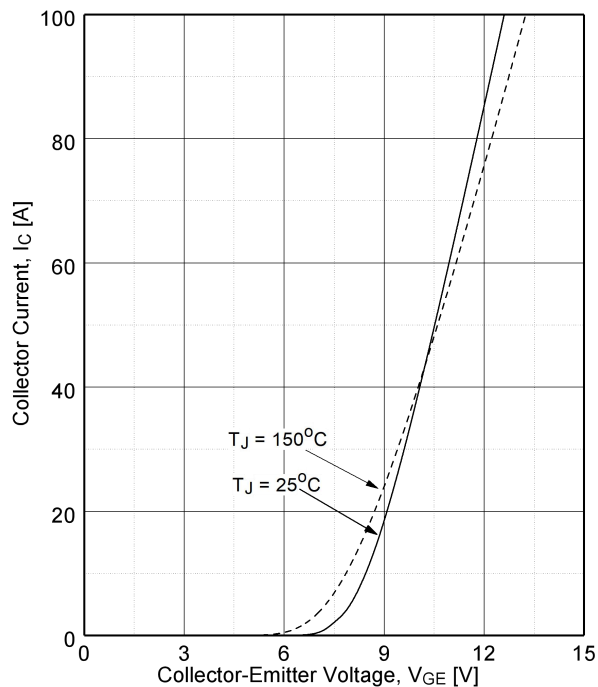


Fig 4, Switching Losses IGBT, Inverter (typical)

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

$V_{GE} = +15/-15\text{ V}, R_{Gon} = 15\ \Omega, R_{Goff} = 15\ \Omega, V_{CE} = 600\text{ V}$

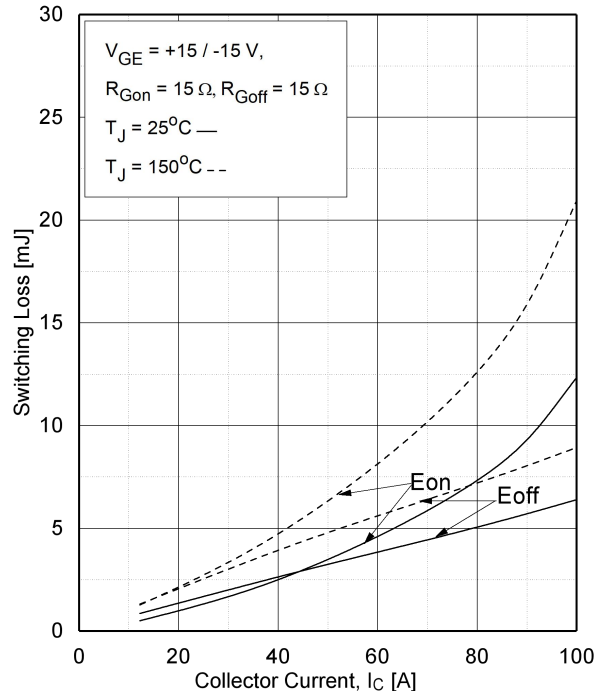


Fig 5, Switching Losses IGBT, Inverter (typical)

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

$$V_{GE} = +15/-15 \text{ V}, I_{CE} = 50 \text{ A}, V_{CE} = 600 \text{ V}$$

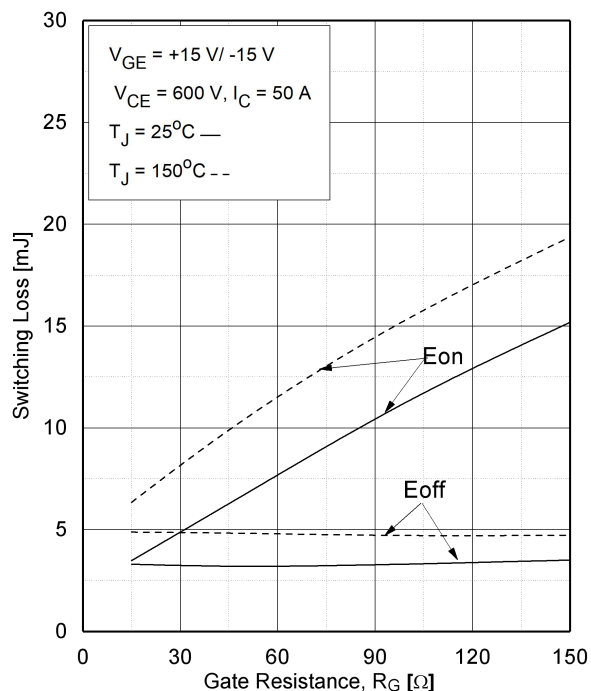


Fig 6, Transient Thermal Impedance IGBT, Inverter

$$Z_{thJC} = f(t)$$

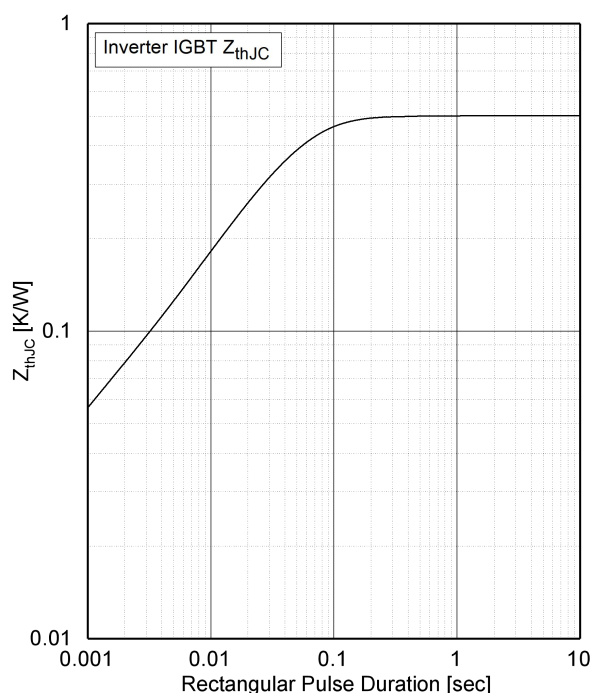


Fig 7, Reverse Bias Safe Operating Area IGBT, Inverter (RBSOA)

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

$$V_{GE} = +15/-15 \text{ V}, R_{Goff} = 15 \Omega, T_J = 150^\circ\text{C}$$

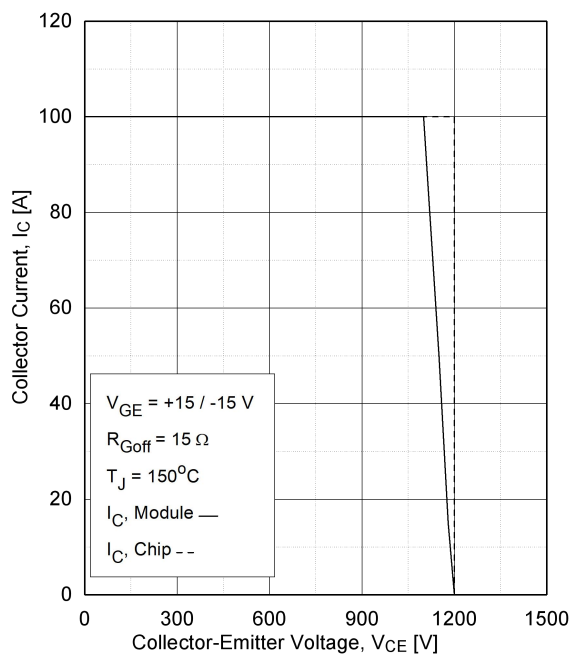


Fig 8, Forward Characteristics of Diode, Inverter (typical)

$$I_F = f(V_F)$$

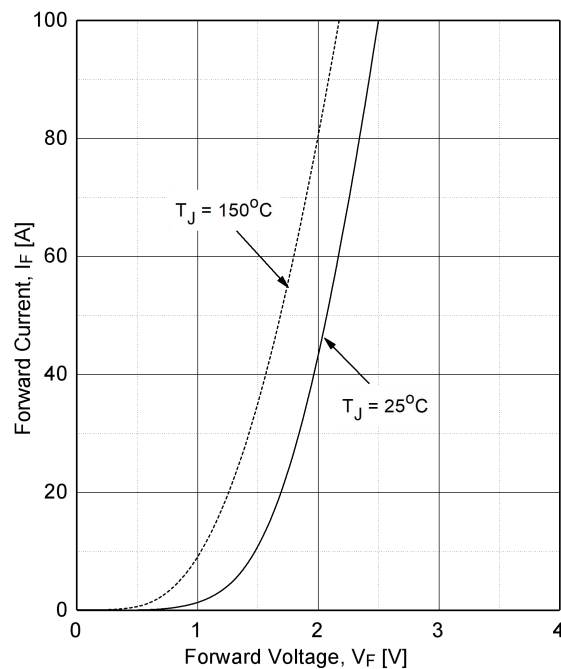


Fig 9, Switching Losses Diode, Inverter (typical)

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

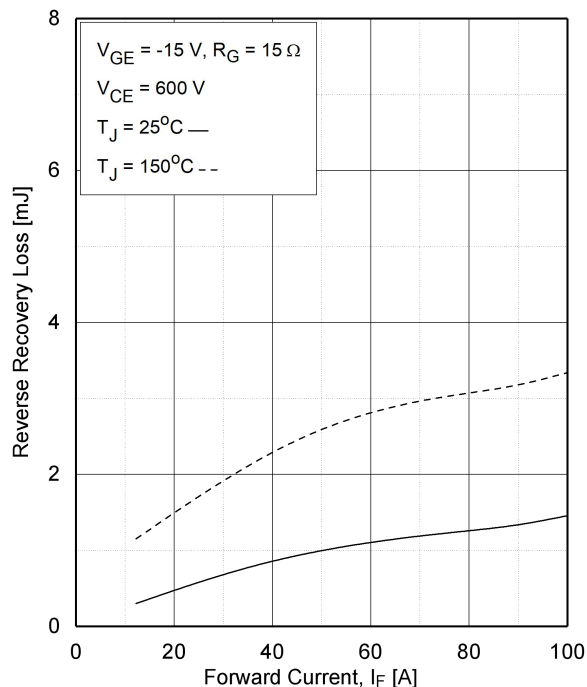


Fig 10, Switching Losses Diode, Inverter (typical)

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

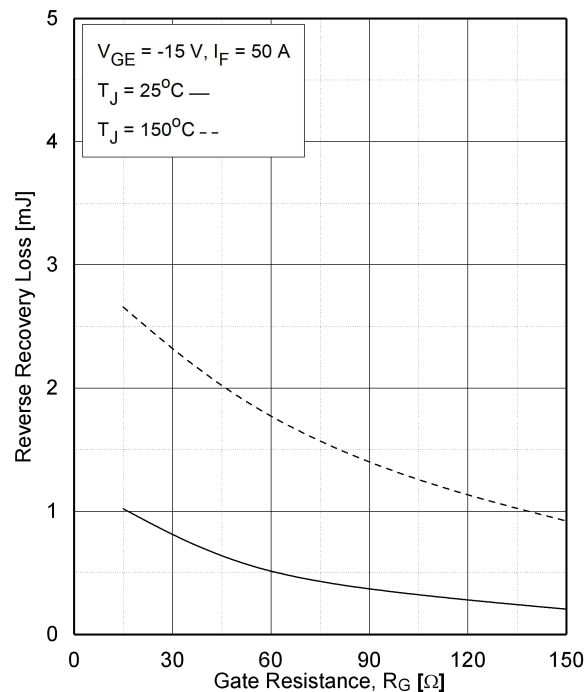


Fig 11, Transient Thermal Impedance Diode, Inverter

$$Z_{thJC} = f(t)$$

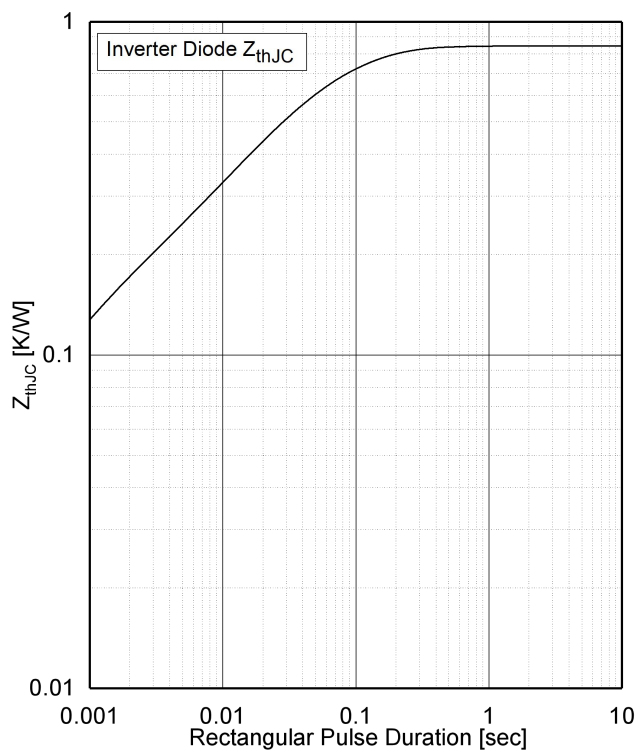


Fig 12, Forward Characteristics of Diode, Rectifier (typical)

$$I_F = f(V_F)$$

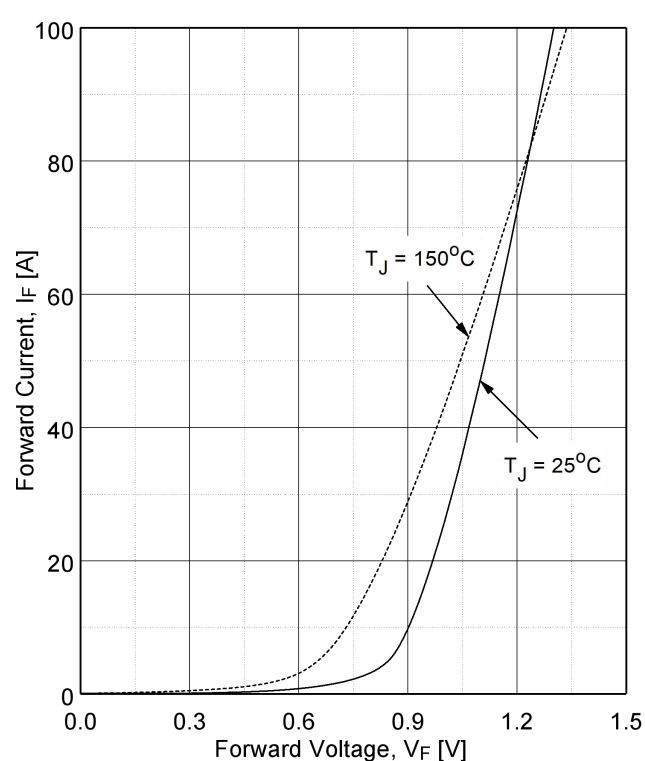


Fig 13, Output Characteristics IGBT, Brake (typical)

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

$T_J = 25^\circ\text{C}$

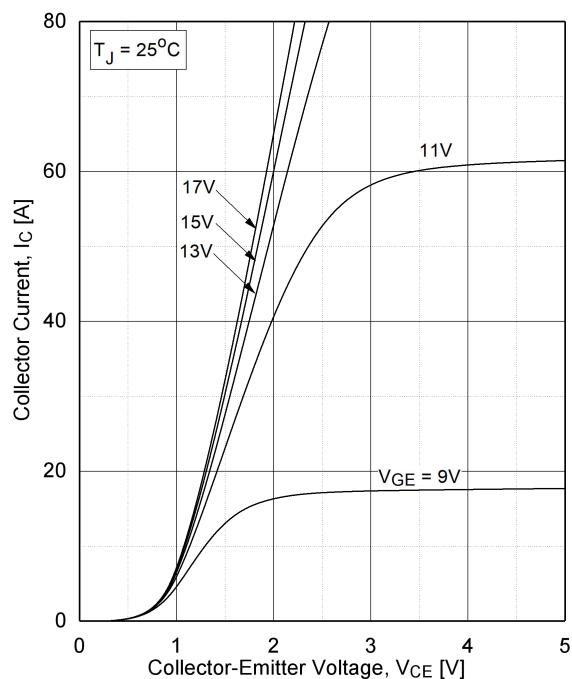


Fig 14, Output Characteristics IGBT, Brake (typical)

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

$T_J = 150^\circ\text{C}$

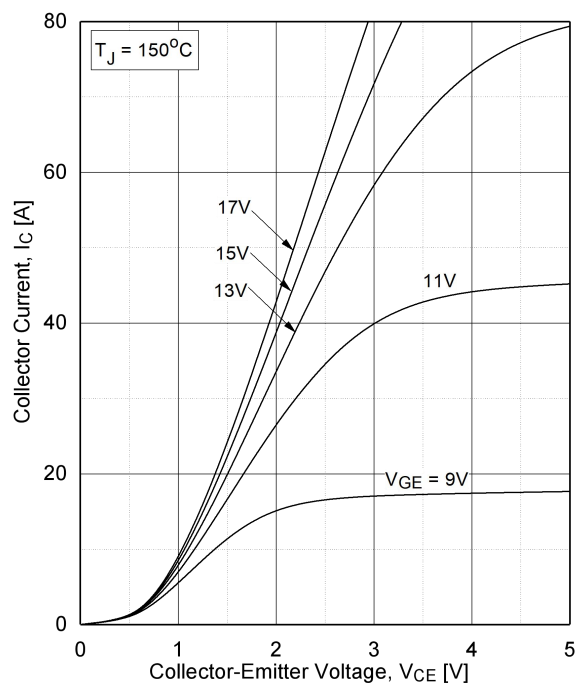


Fig 15, Forward Characteristics of Diode, Brake (typical)

$$I_F = f(V_F)$$

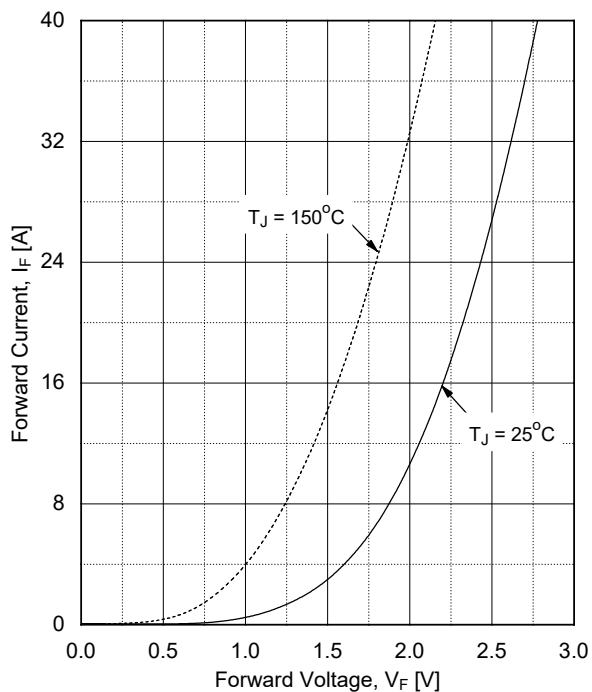
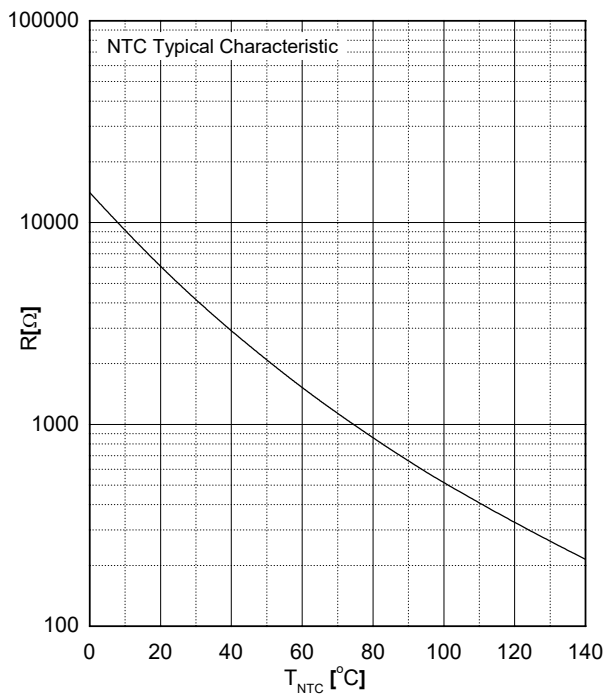
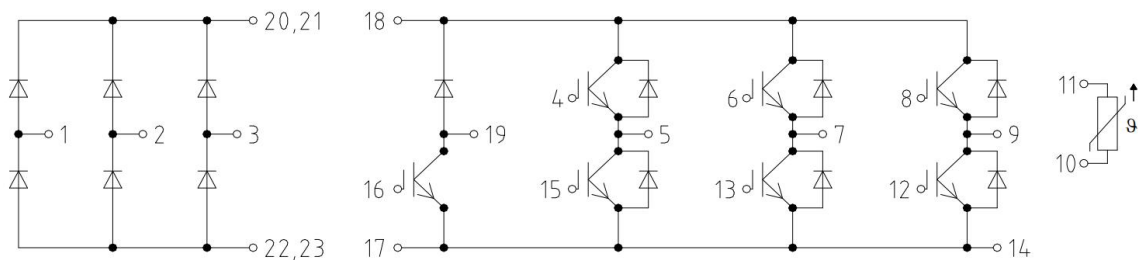


Fig 16, NTC Characteristics (typical)

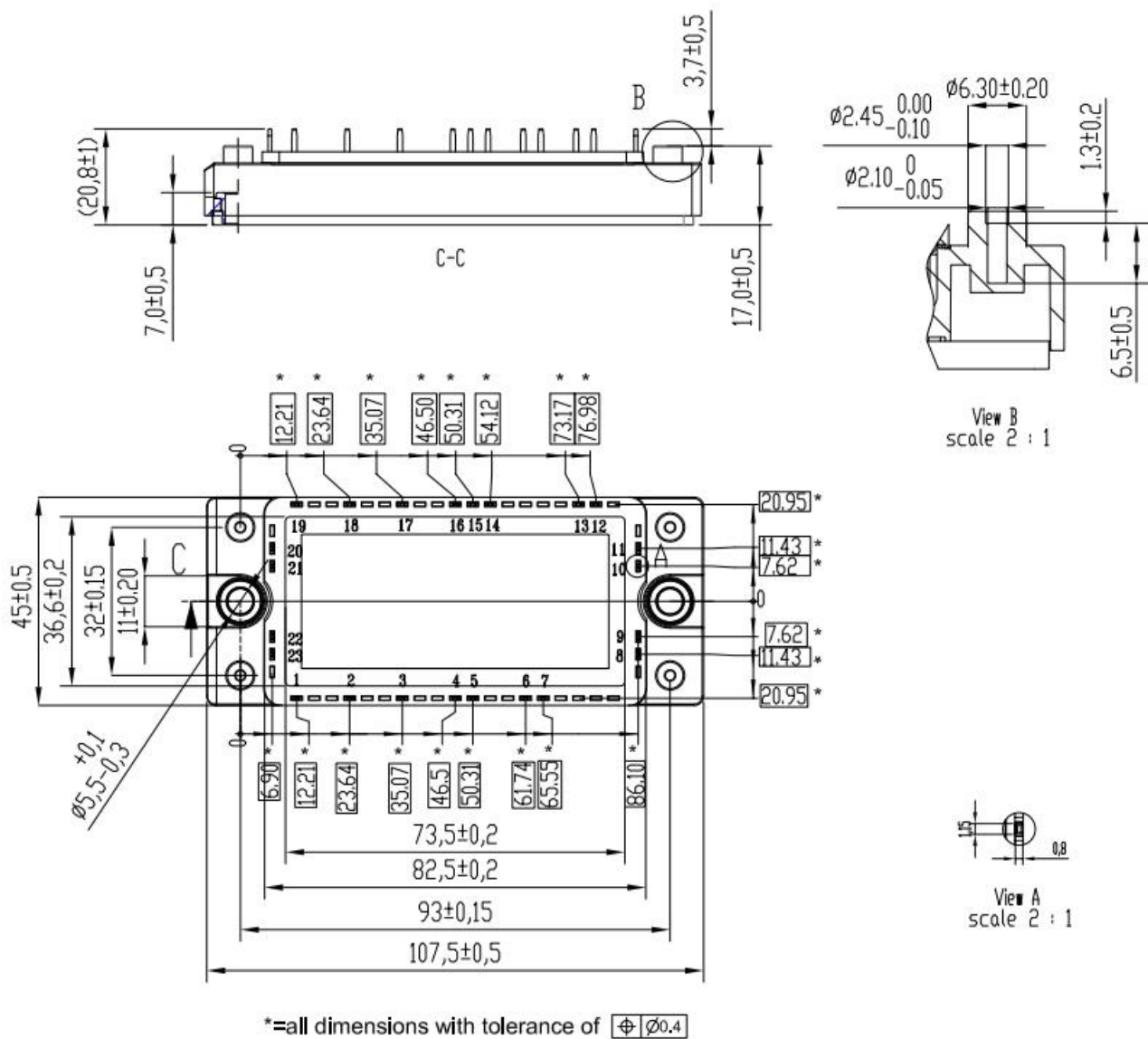
$$R = f(T)$$



Circuit Diagram



Package Outlines



Revisions History

Version	Description of Change	Date
V1.0	Final Datasheet	Nov.27.2023