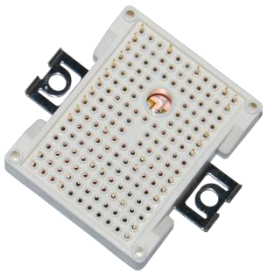
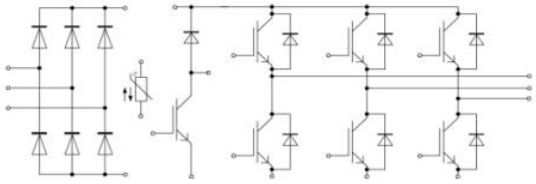
LCG50PI120E4B2-01

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
- Air conditioning
- Auxiliary inverters

Maximum Ratings /T_J = 25 °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°C	T_H = 25°C	65	A
		Continuous, T_J = 175°C	T_H = 80°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}	Vce≤1200V, at chip level		100	A
Operating junction temperature	T_{Jop}	Switching mode		150	°C
Maximum junction temperature	T_{Jmax}			175	°C
Maximum power dissipation	P_D	T_J = 175°C	T_H = 25°C	173	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	°C
Maximum junction temperature	T_{Jmax}			175	°C
Maximum power dissipation	P_D	T_J = 175°C	T_H = 25°C	130	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°C	T_H = 25°C	65	A
		Continuous, T_J = 175°C	T_H = 80°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}	Vce≤1200V, at chip level		100	A
Operating junction temperature	T_{Jop}	Switching mode		150	°C
Maximum junction temperature	T_{Jmax}			175	°C
Maximum power dissipation	P_D	T_J = 175°C	T_H = 25°C	173	W

Brake FRD

Parameter	Symbols	Conditions		Value	Unit
Peak repetitive reverse voltage	V_{RRM}			1200	V
DC forward current	I_F			25	A
Repetitive forward current	I_{FRM}	t_p is limited by T_{Jmax}		50	A
Operating junction temperature	T_{Jop}			150	°C
Maximum junction temperature	T_{Jmax}			175	°C
Maximum power dissipation	P_D	T_J = 175°C	T_H = 25°C	88	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 ms	T_H = 25°C	420	A
I^2t – value	I^2t	t_p = 10 ms	T_H = 25°C	882	A^2S
Operating junction temperature	T_{Jop}			150	°C
Maximum power dissipation	P_D	T_J = 150°C	T_H = 25°C	114	W

Electrical Characteristics (T_J = 25°C unless otherwise specified)

Inverter IGBT

Parameter	Symbol	Test Conditions		Min	Typ	Max	Unit
Collector-emitter breakdown voltage	BV_{CES}	V_{GE} = 0 V, I_C = 1 mA		1200	-	-	V
Collector-emitter cutoff current	I_{CES}	V_{GE} = 0 V, V_{CE} = 1200 V		-	-	1	mA
Gate leakage current	I_{GES}	V_{CE} = 0 V, V_{GE} = V_{GES}		-	-	±400	nA
Gate emitter threshold Voltage	$V_{GE(th)}$	V_{GE} = V_{CE}, I_C = 1.7 mA		5.0	5.8	6.6	V
Internal gate resistor	R_{gint}	f = 1 MHz		-	9.0	-	Ω
Collector-emitter saturation voltage	$V_{CE(sat)}$	I_C = 50 A, V_{GE} = 15 V		-	1.70	2.05	V
		I_C = 50 A, V_{GE} = 15 V	T_J = 150°C	-	2.05	-	V
Input capacitance	C_{ies}	V_{GE} = 0 V, V_{CE} = 25 V, f = 1 MHz		-	4.05	-	nF
Reverse transfer capacitance	C_{res}			-	0.04	-	
Total gate charge	Q_g	V_{CE} = 600 V, I_C = 50 A, V_{GE} = 15 V		-	0.36	-	uC
Turn-on delay time	$T_{d(on)}$	V_{CC} = 600 V, I_C = 50 A V_{GE} = +15/-15 V, R_{Gon} /R_{Goff} = 5.1 Ω	T_J = 25°C	-	0.11	-	us
			T_J = 150°C	-	0.12	-	us
Rise time	T_r		T_J = 25°C	-	0.04	-	us
			T_J = 150°C	-	0.05	-	us
Turn-off delay time	$T_{d(off)}$		T_J = 25°C	-	0.26	-	us
			T_J = 150°C	-	0.30	-	us
Fall time	T_f		T_J = 25°C	-	0.20	-	us
			T_J = 150°C	-	0.29	-	us
Turn-on switching loss	E_{on}		T_J = 25°C	-	4.30	-	mJ
			T_J = 150°C	-	8.30	-	mJ
Turn-off switching loss	E_{off}		T_J = 25°C	-	4.05	-	mJ
			T_J = 150°C	-	4.90	-	mJ
Short circuit data	I_{sc}	V_{GE} = 15 V, V_{CC} = 800 V V_{CEmax} = V_{CES} - L_{sCE} • di/dt tp ⩽ 10 us	T_J = 150°C	-	195	-	A
Thermal resistance, junction to heatsink	R_{thJH}	Per IGBT, λ_{grease} = 1W/(m·K)		-	0.864	-	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 = 600 V V_{GE} = -15 V, R_{Gon} = 5.1 Ω	T_J = 25°C	-	33.5	-	A
			T_J = 150°C	-	51.5	-	A
Reverse recovery charge	Q_{rr}		T_J = 25°C	-	4.15	-	uC
			T_J = 150°C	-	11.5	-	uC
Reverse recovery energy	E_{rec}		T_J = 25°C	-	1.75	-	mJ
			T_J = 150°C	-	4.50	-	mJ
Thermal resistance, junction to heatsink	R_{thJH}	Per Diode, λ_{grease} = 1 W/(m·K)		-	1.15	-	K/W

Brake IGBT

Parameter	Symbol	Test Conditions		Min	Typ	Max	Unit
Collector-emitter breakdown voltage	BV_{CES}	V_{GE} = 0 V, I_C = 1 mA		1200	-	-	V
Collector-emitter cutoff current	I_{CES}	V_{GE} = 0 V, V_{CE} = 1200 V		-	-	1	mA
Gate leakage current	I_{GES}	V_{CE} = 0 V, V_{GE} = V_{GES}		-	-	±400	nA
Gate emitter threshold Voltage	$V_{GE(th)}$	V_{GE} = V_{CE}, I_C = 1.7 mA		5.0	5.8	6.6	V
Internal gate resistor	R_{gint}	f = 1 MHz		-	9.0	-	Ω
Collector-emitter saturation voltage	$V_{CE(sat)}$	I_C = 50 A, V_{GE} = 15 V		-	1.70	2.05	V
		I_C = 50 A, V_{GE} = 15 V	T_J = 150°C	-	2.05	-	V
Input capacitance	C_{ies}	V_{GE} = 0 V, V_{CE} = 25 V, f = 1 MHz		-	4.05	-	nF
Reverse transfer capacitance	C_{res}			-	0.04	-	
Total gate charge	Q_g	V_{CE} = 600 V, I_C = 50 A, V_{GE} = 15 V		-	0.36	-	uC
Turn-on delay time	$T_{d(on)}$	V_{CC} = 600 V, I_C = 50 A V_{GE} = +15/-15 V, R_{Gon} /R_{Goff} = 5.1 Ω	T_J = 25°C	-	0.11	-	us
			T_J = 150°C	-	0.12	-	us
Rise time	T_r		T_J = 25°C	-	0.04	-	us
			T_J = 150°C	-	0.05	-	us
Turn-off delay time	$T_{d(off)}$		T_J = 25°C	-	0.26	-	us
			T_J = 150°C	-	0.30	-	us
Fall time	T_f		T_J = 25°C	-	0.20	-	us
			T_J = 150°C	-	0.29	-	us
Turn-on switching loss	E_{on}		T_J = 25°C	-	4.30	-	mJ
			T_J = 150°C	-	8.30	-	mJ
Turn-off switching loss	E_{off}		T_J = 25°C	-	4.05	-	mJ
			T_J = 150°C	-	4.90	-	mJ
Short circuit data	I_{sc}	V_{GE} = 15 V, V_{CC} = 800 V V_{CEmax} = V_{CES} - L_{sCE} • di/dt tp ⩽ 10 us	T_J = 150°C	-	195	-	A
Thermal resistance, junction to heatsink	R_{thJH}	Per IGBT, λ_{grease} = 1W/(m·K)		-	0.864	-	K/W

Brake FRD

Parameter	Symbol	Test Conditions		Min	Typ	Max	Unit
Forward voltage	V_F	I_F = 25 A	T_J = 25°C	-	2.45	2.9	V
			T_J = 150°C	-	1.8	-	V
Peak reverse recovery current	I_{rr}	I_F = 25 A, V_R = 600 V V_{GE} = -15 V, R_{Gon} = 22 Ω	T_J = 25°C	-	24.5	-	A
			T_J = 150°C	-	34.5	-	A
Reverse recovery charge	Q_{rr}		T_J = 25°C	-	1.90	-	uC
			T_J = 150°C	-	6.40	-	uC
Reverse recovery energy	E_{rec}		T_J = 25°C	-	0.35	-	mJ
			T_J = 150°C	-	1.60	-	mJ
Thermal resistance, junction to heatsink	R_{thJH}	Per Diode, λ_{grease} = 1 W/(m·K)		-	-	1.69	K/W

Rectifier

Parameter	Symbol	Test Conditions		Min	Typ	Max	Unit
Forward voltage	V_F	I_F = 50 A	T_J = 25°C	-	1.05	-	V
Reverse current	I_R	V_R = 1600 V	T_J = 25°C	-	-	1	mA
Thermal resistance, junction to heatsink	R_{thJH}	Per Diode, λ_{grease} = 1 W/(m·K)		-	1.09	-	K/W

NTC

Parameter	Symbol	Test Conditions		Min	Typ	Max	Unit
Rated resistance	R_{25}	T_{NTC} = 25°C		-	5	-	kΩ
Deviation of R_{100}	△R/R	R_{100} = 493 Ω	T_J = 100°C	-5	-	5	%
Power dissipation	P_{25}	T_{NTC} = 25°C		-	-	20	mW
B-value	$B_{25/50}$	$R_2 = R_{25}$ exp [$B_{25/50}$(1/T2 - 1/(298.15 K))]		-	3375	-	K

Module

Parameter	Symbol	Test Conditions	Value	Unit
Isolation test voltage	V_{ISOL}	RMS, f = 50 Hz, t = 1 min.	2.5	kV
Storage temperature	T_{Stg}		-40---125	°C
Internal isolation		basic insulation (class 1, IEC 61140)	Al_2O_3	
Creepage distance		terminal to heatsink	11.5	mm
		terminal to terminal	6.3	
Clearance		terminal to heatsink	10	mm
		terminal to terminal	5	
Comperative tracking index	CTI		>200	
Stray inductance module	L_{sCE}		35	nH
Module lead resistance, terminals - chip	$R_{CC'+EE'}$	per switch	5	mΩ
	$R_{AA'+CC'}$		6	
Weight	G		40	g

Fig 1, Output Characteristics IGBT, Inverter (typical)

$I_C = f(V_{CE})$

$T_J = 25°C$

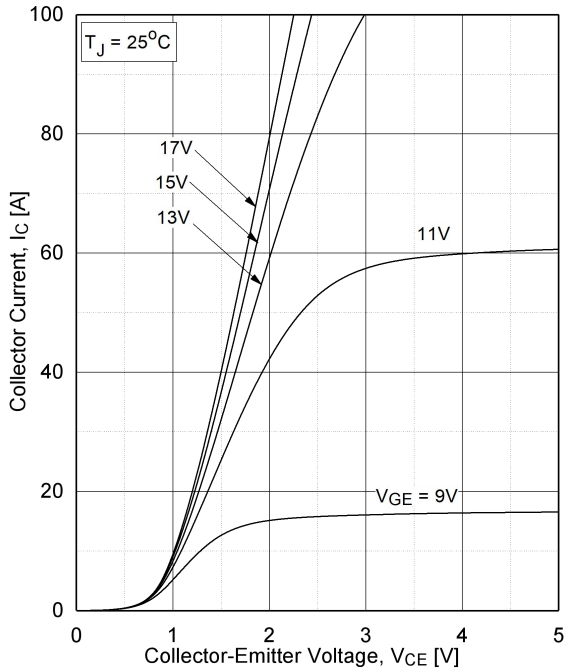


Fig 2, Output Characteristics IGBT, Inverter(typical)

$I_C = f(V_{CE})$

$T_J = 150°C$

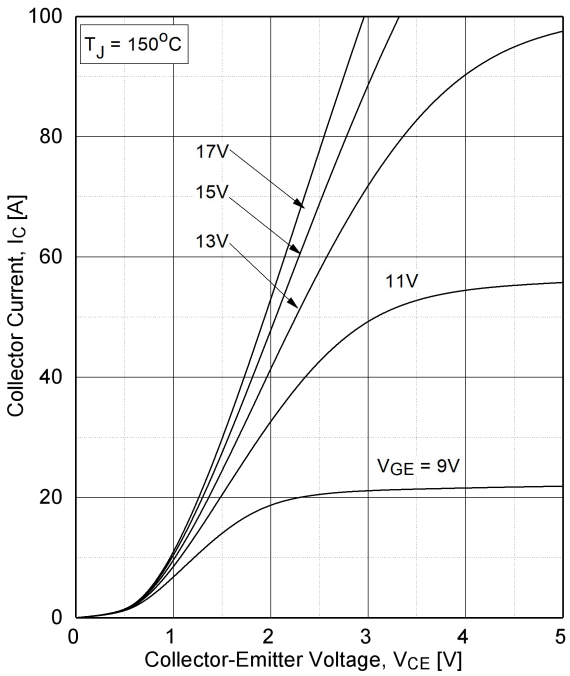


Fig 3, Transfer Characteristics IGBT, Inverter (typical)

$I_C = f(V_{GE})$

$V_{CE} = 20$ V

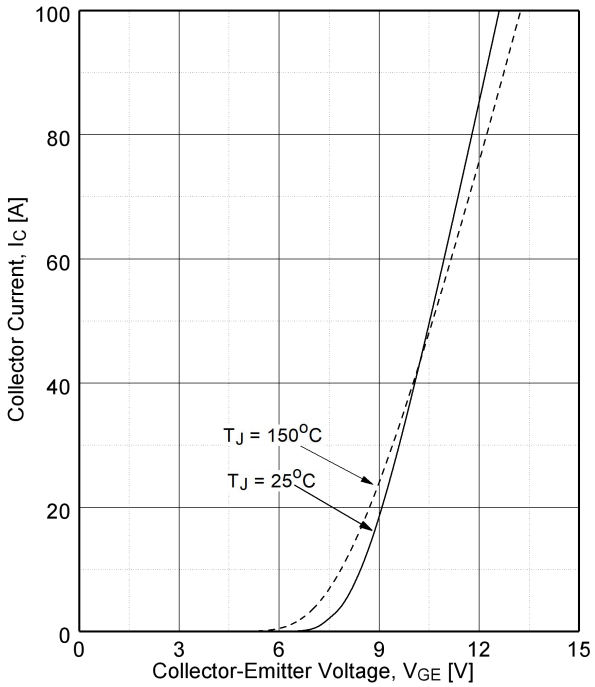


Fig 4, Switching Losses IGBT, Inverter (typical)

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

$V_{GE} = +15/-15$ V, $R_{Gon} = 5.1\ \Omega$, $R_{Goff} = 5.1\ \Omega$, $V_{CE} = 600$ V

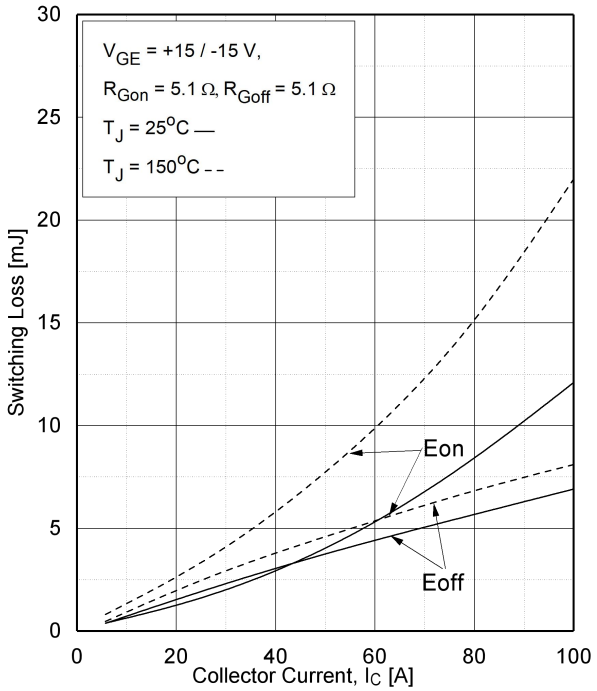


Fig 5, Switching Losses IGBT, Inverter (typical)

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

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

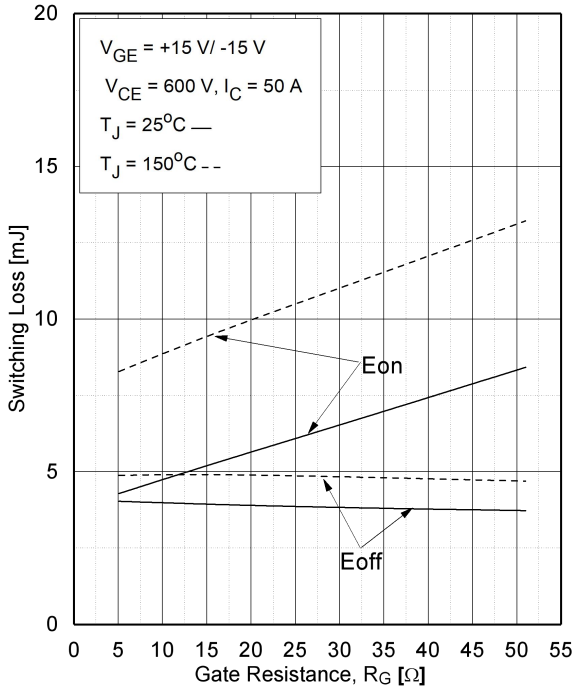


Fig 6, Transient Thermal Impedance IGBT, Inverter

$Z_{thJH} = f(t)$

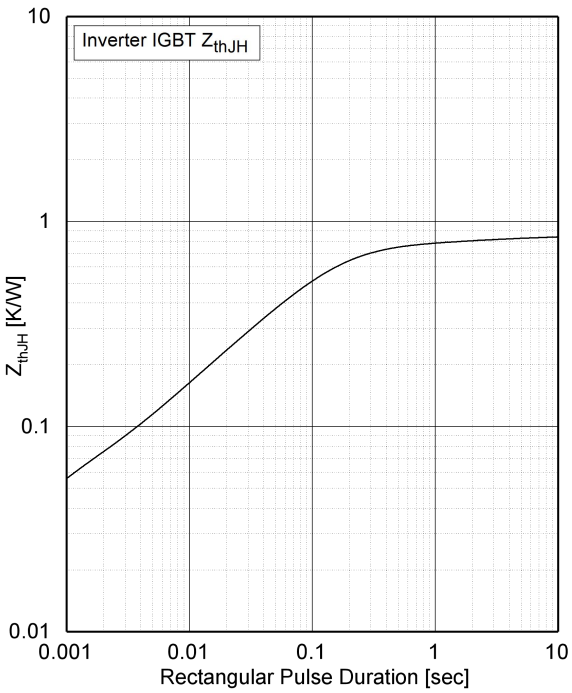


Fig 7, Reverse Bias Safe Operating Area IGBT, Inverter (RBSOA)

$I_C = f(V_{CE})$

V_{GE} = +15/-15V, R_{Goff} = 5.1 Ω, T_J = 150°C

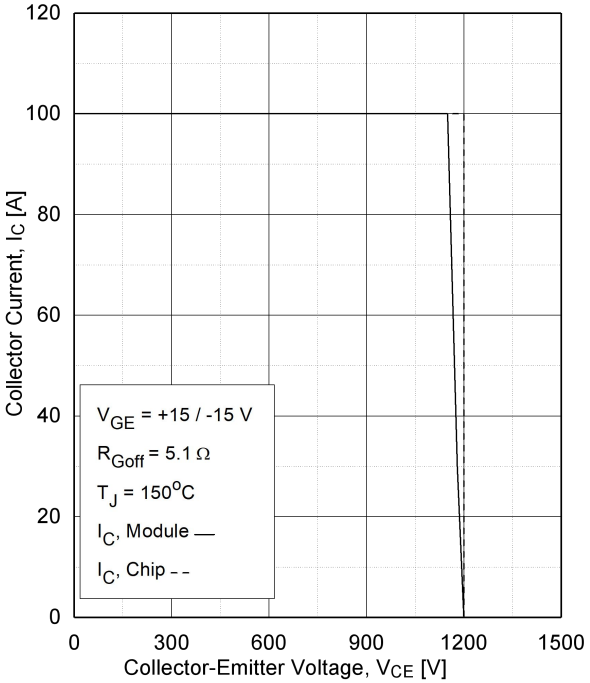


Fig 8, Forward Characteristics of Diode, Inverter (typical)

$I_F = f(V_F)$

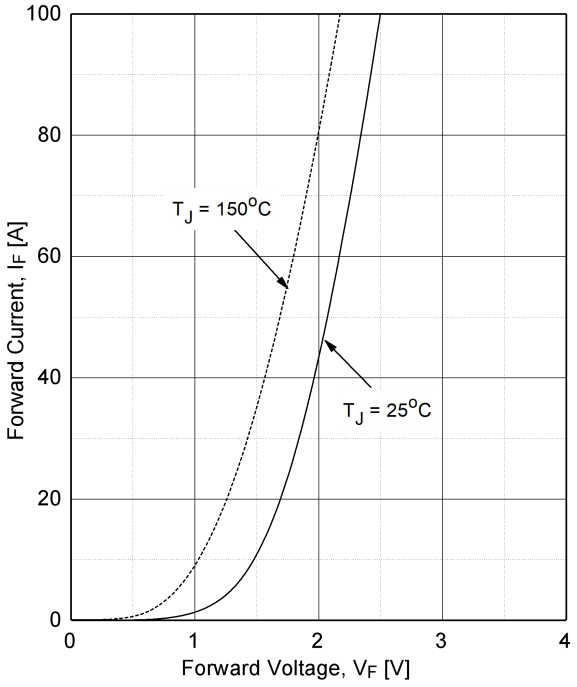


Fig 9, Switching Losses Diode, Inverter (typical)

$E_{rec} = f(I_F)$

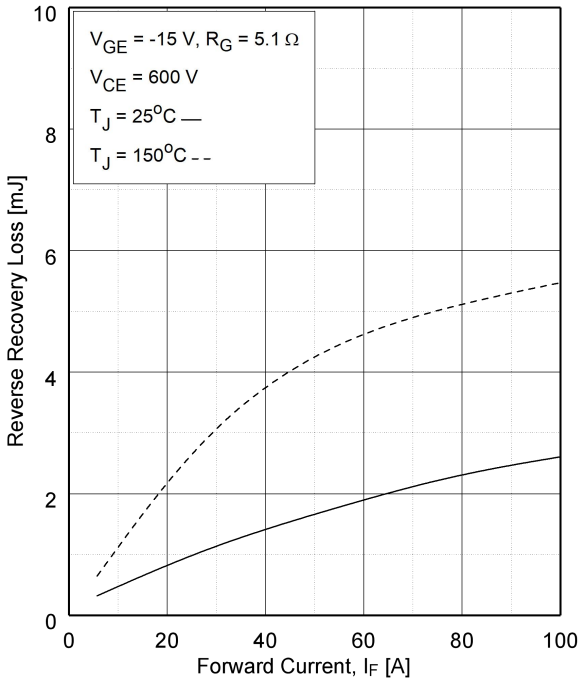


Fig 10, Switching Losses Diode, Inverter (typical)

$E_{rec} = f(R_G)$

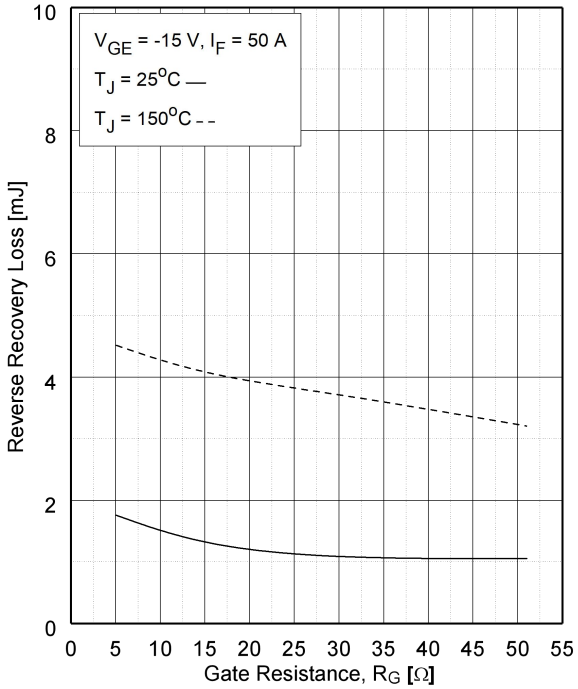


Fig 11, Transient Thermal Impedance Diode, Inverter

$Z_{thJH} = f(t)$

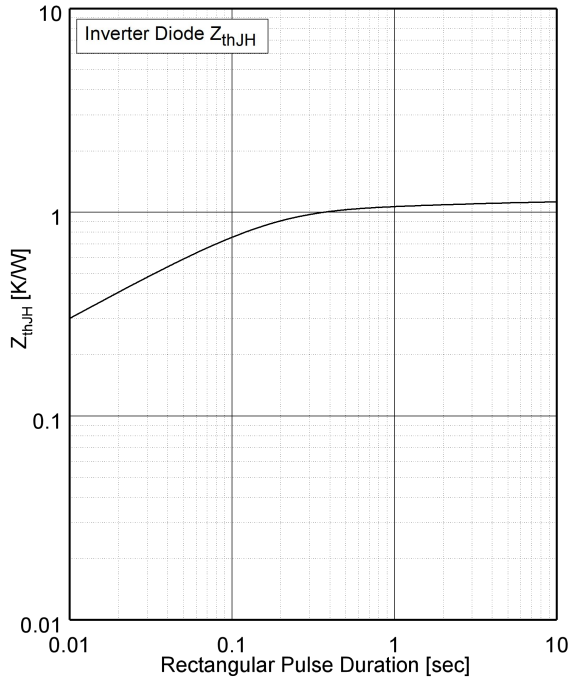


Fig 12, Forward Characteristics of Diode, Rectifier (typical)

$I_F = f(V_F)$

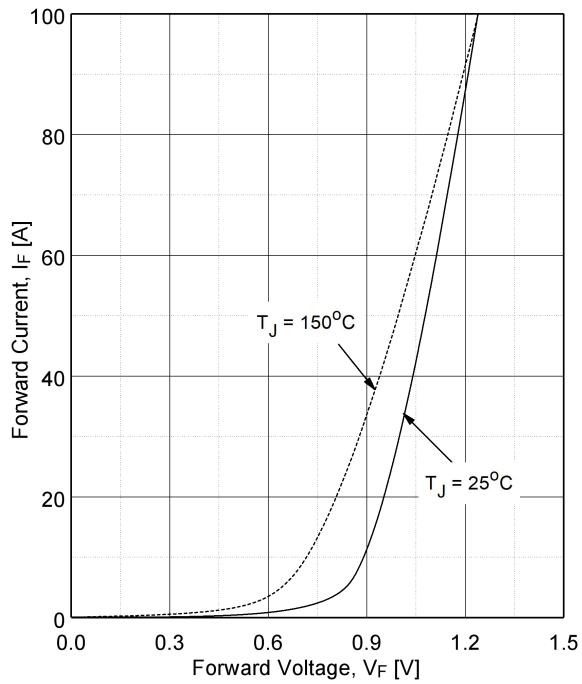


Fig 13, Output Characteristics IGBT, Brake (typical)

$I_C = f(V_{CE})$

$T_J = 25°C$

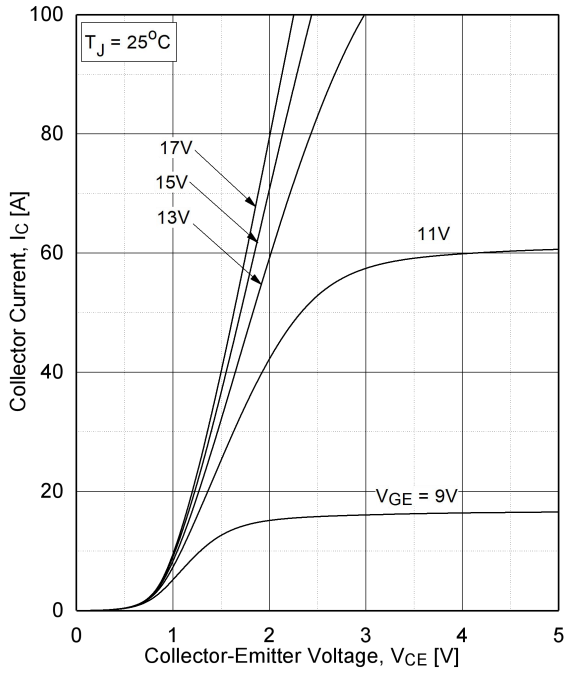


Fig 14, Output Characteristics IGBT, Brake (typical)

$I_C = f(V_{CE})$

$T_J = 150°C$

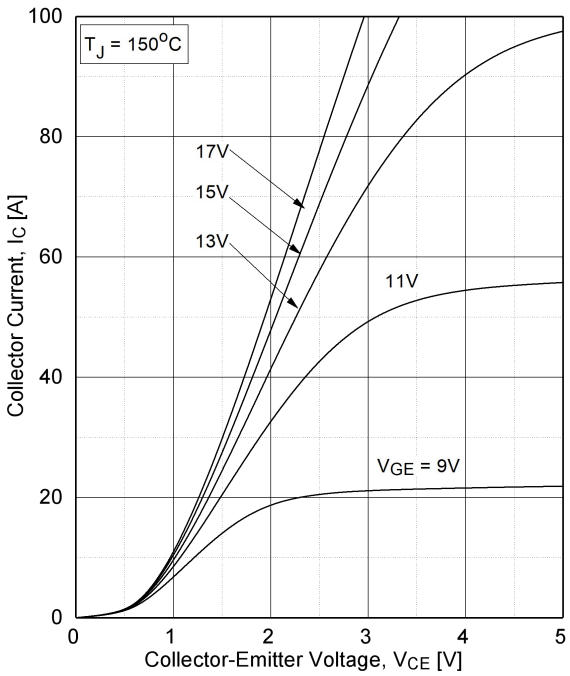


Fig 15, Forward Characteristics of Diode, Brake (typical)

$I_F = f(V_F)$

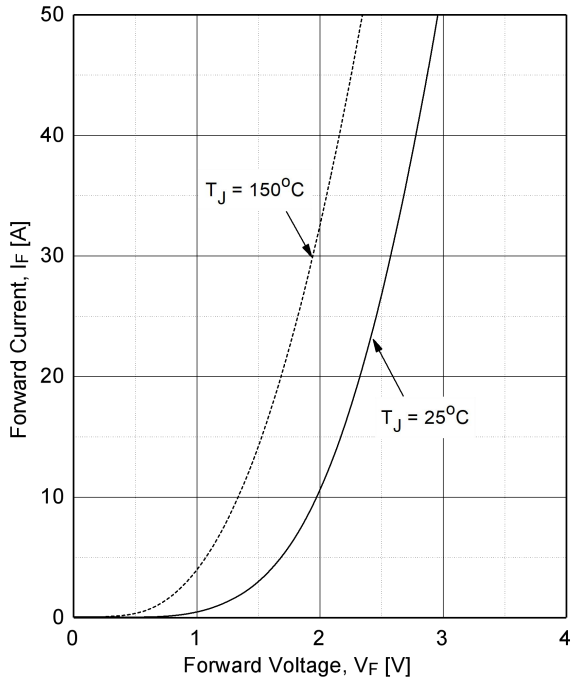
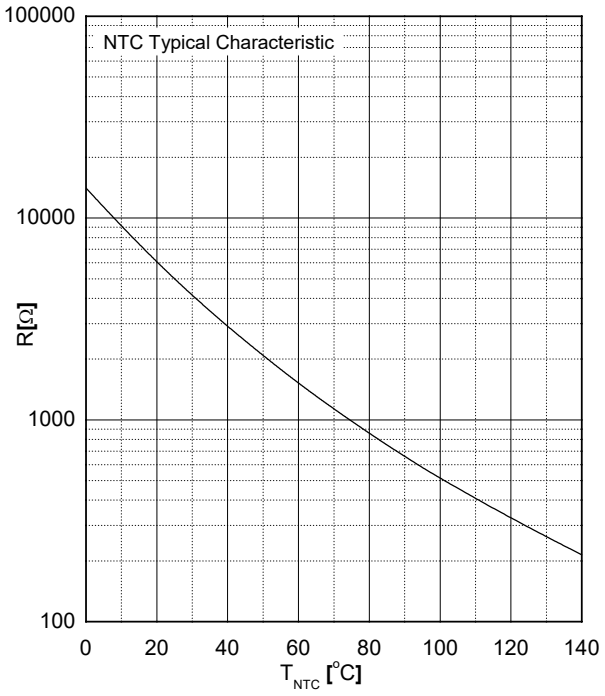
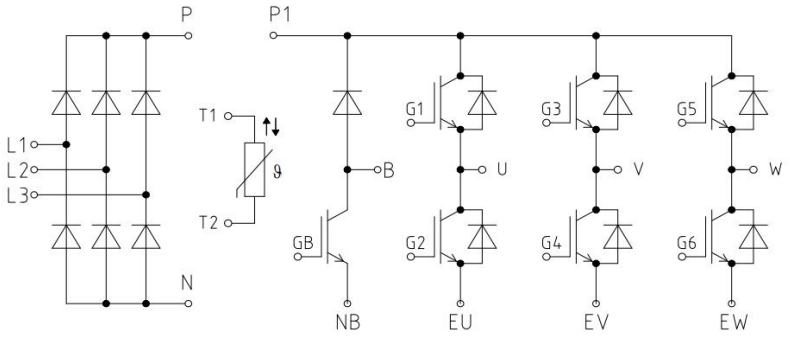


Fig 16, NTC Characteristics (typical)

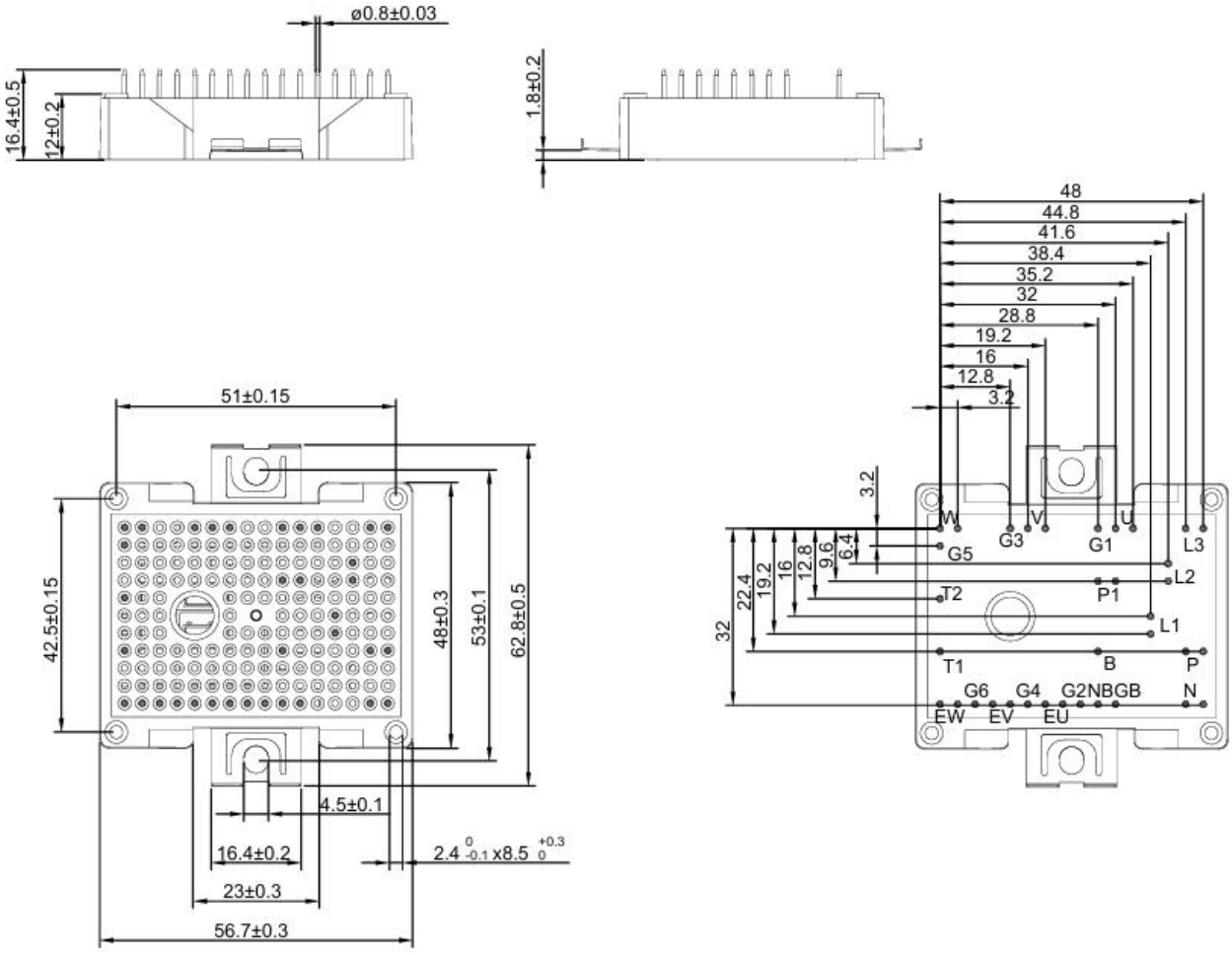
$R = f(T)$



Circuit Diagram



Package Outlines



Revisions History

Version	Description of Change	Date
V1.0	Final Datasheet	Jun.09.2024