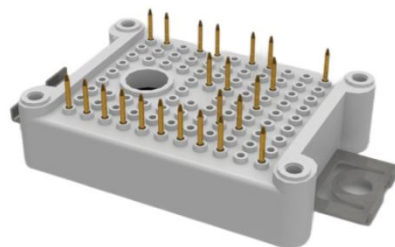


LCG10PI120E4B1-01

1200V, 10A PIM Module

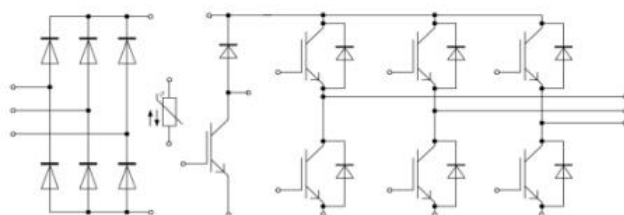


Features

- $V_{CE(sat)}$ 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 / $T_J = 25^\circ\text{C}$, 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, $T_J = 175^\circ\text{C}$	$T_H = 25^\circ\text{C}$	20	A
		Continuous, $T_J = 175^\circ\text{C}$	$T_H = 100^\circ\text{C}$	10	A
Repetitive peak collector current	I_{CRM}	t_p is limited by T_{Jmax}		20	A
Turn off safe operating area (RBSOA)	I_{Cmax}	$V_{CE} \leq 1200\text{V}$, at chip level		20	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	$T_J = 175^\circ\text{C}$	$T_H = 25^\circ\text{C}$	74	W

Inverter FRD

Parameter	Symbols	Conditions		Value	Unit
Peak repetitive reverse voltage	V_{RRM}			1200	V
DC Forward Current	I_F			10	A
Repetitive forward current	I_{FRM}	t_p is limited by T_{Jmax}		20	A
Operating junction temperature	T_{Jop}			150	$^\circ\text{C}$
Maximum junction temperature	T_{Jmax}			175	$^\circ\text{C}$
Maximum power dissipation	P_D	$T_J = 175^\circ\text{C}$	$T_H = 25^\circ\text{C}$	40	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, $T_J = 175^\circ\text{C}$	$T_H = 25^\circ\text{C}$	20	A
		Continuous, $T_J = 175^\circ\text{C}$	$T_H = 100^\circ\text{C}$	10	A
Repetitive peak collector current	I_{CRM}	t_p is limited by T_{Jmax}		20	A
Turn off safe operating area (RBSOA)	I_{Cmax}	$V_{CE} \leq 1200\text{V}$, at chip level		20	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	$T_J = 175^\circ\text{C}$	$T_H = 25^\circ\text{C}$	74	W

Brake FRD

Parameter	Symbols	Conditions		Value	Unit
Peak repetitive reverse voltage	V_{RRM}			1200	V
DC forward current	I_F			10	A
Repetitive forward current	I_{FRM}	t_p is limited by T_{Jmax}		20	A
Operating junction temperature	T_{Jop}			150	$^\circ\text{C}$
Maximum junction temperature	T_{Jmax}			175	$^\circ\text{C}$
Maximum power dissipation	P_D	$T_J = 175^\circ\text{C}$	$T_H = 25^\circ\text{C}$	40	W

Rectifier

Parameter	Symbols	Conditions		Value	Unit
Peak repetitive reverse voltage	V_{RRM}			1600	V
Average output current	I_O	50Hz/60Hz, sine wave		10	A
Surge forward current	I_{FSM}	$t_p = 10\text{ ms}$	$T_H = 25^\circ\text{C}$	220	A
I^2t – value	I^2t	$t_p = 10\text{ ms}$	$T_H = 25^\circ\text{C}$	242	A^2S
Operating junction temperature	T_{Jop}			150	$^\circ\text{C}$
Maximum power dissipation	P_D	$T_J = 150^\circ\text{C}$	$T_H = 25^\circ\text{C}$	59	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	$V_{GE(th)}$	$V_{GE} = V_{CE}, I_C = 0.5\text{ mA}$	5.0	5.8	6.8	V
Internal gate resistor	R_{Gint}	$f = 1\text{ MHz}$	-	3.5	-	Ω
Collector-emitter saturation voltage	$V_{CE(sat)}$	$I_C = 10\text{ A}, V_{GE} = 15\text{ V}$	-	1.50	1.90	V
		$I_C = 10\text{ A}, V_{GE} = 15\text{ V}, T_J = 150^\circ\text{C}$	-	1.65	-	V
Input capacitance	C_{ies}	$V_{GE} = 0\text{ V}, V_{CE} = 25\text{ V}, f = 100\text{ kHz}$	-	1.40	-	nF
Reverse transfer capacitance	C_{res}		-	0.01	-	
Total gate charge	Q_g	$V_{CE} = 600\text{ V}, I_C = 10\text{ A}, V_{GE} = 15\text{ V}$	-	0.13	-	μC
Turn-on delay time	$T_{d(on)}$	$V_{CC} = 600\text{ V}, I_C = 10\text{ A}$ $V_{GE} = +15/-15\text{ V},$ $R_{Gon}/R_{Goff} = 47\ \Omega$	$T_J = 25^\circ\text{C}$	0.05	-	μs
			$T_J = 150^\circ\text{C}$	0.06	-	μs
Rise time	T_r		$T_J = 25^\circ\text{C}$	0.03	-	μs
			$T_J = 150^\circ\text{C}$	0.04	-	μs
Turn-off delay time	$T_{d(off)}$		$T_J = 25^\circ\text{C}$	0.26	-	μs
			$T_J = 150^\circ\text{C}$	0.31	-	μs
Fall time	T_f		$T_J = 25^\circ\text{C}$	0.15	-	μs
			$T_J = 150^\circ\text{C}$	0.16	-	μs
Turn-on switching loss	E_{on}		$T_J = 25^\circ\text{C}$	0.80	-	mJ
			$T_J = 150^\circ\text{C}$	1.45	-	mJ
Turn-off switching loss	E_{off}		$T_J = 25^\circ\text{C}$	0.55	-	mJ
			$T_J = 150^\circ\text{C}$	0.75	-	mJ
Short circuit data	I_{sc}	$V_{GE} = 15\text{ V}, V_{CC} = 800\text{ V}$ $V_{CEmax} = V_{CES} -$ $L_{sCE} \cdot di/dt$ $t_p \leq 10\ \mu\text{s}$	$T_J = 150^\circ\text{C}$	-	60	A
Thermal resistance, junction to heatsink	R_{thJH}	Per IGBT, $\lambda_{grease} = 1\text{ W}/(\text{m}\cdot\text{K})$	-	-	2.01	K/W

Inverter FRD

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Forward voltage	V_F	$I_F = 10\text{ A}$	$T_J = 25^\circ\text{C}$	-	2.00	2.50 V
			$T_J = 150^\circ\text{C}$	-	1.70	- V
Peak reverse recovery current	I_{rr}	$I_F = 10\text{ A}, V_R = 600\text{ V}$ $V_{GE} = -15\text{ V}, R_{Gon} = 47\ \Omega$	$T_J = 25^\circ\text{C}$	-	9.50	A
			$T_J = 150^\circ\text{C}$	-	12.0	A
Reverse recovery charge	Q_{rr}		$T_J = 25^\circ\text{C}$	-	0.55	μC
			$T_J = 150^\circ\text{C}$	-	1.45	μC
Reverse recovery energy	E_{rec}		$T_J = 25^\circ\text{C}$	-	0.10	mJ
			$T_J = 150^\circ\text{C}$	-	0.40	mJ
Thermal resistance, junction to heatsink	R_{thJH}	Per Diode, $\lambda_{grease} = 1\text{ W}/(\text{m}\cdot\text{K})$	-	-	3.68	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 = 0.5 mA		5.0	5.8	6.8	V	
Internal gate resistor	R _{Gint}	f = 1 MHz		-	3.5	-	Ω	
Collector-emitter saturation voltage	V _{CE(sat)}	I _C = 10 A, V _{GE} = 15 V		-	1.50	1.90	V	
		I _C = 10 A, V _{GE} = 15 V	T _J = 150°C	-	1.65	-	V	
Input capacitance	C _{ies}	V _{GE} = 0 V, V _{CE} = 25 V, f = 100 kHz		-	1.40	-	nF	
Reverse transfer capacitance	C _{res}			-	0.01	-		
Total gate charge	Q _g	V _{CE} = 600 V, I _C = 10 A, V _{GE} = 15 V		-	0.13	-	uC	
Turn-on delay time	T _{d(on)}	V _{CC} = 600 V, I _C = 10 A V _{GE} = +15/-15 V, R _{Gon} /R _{Goff} = 47 Ω	T _J = 25°C	-	0.05	-	us	
			T _J = 150°C	-	0.06	-	us	
Rise time	T _r		T _J = 25°C	-	0.03	-	us	
			T _J = 150°C	-	0.04	-	us	
Turn-off delay time	T _{d(off)}		T _J = 25°C	-	0.26	-	us	
			T _J = 150°C	-	0.31	-	us	
Fall time	T _f		T _J = 25°C	-	0.15	-	us	
			T _J = 150°C	-	0.16	-	us	
Turn-on switching loss	E _{on}		T _J = 25°C	-	0.80	-	mJ	
			T _J = 150°C	-	1.45	-	mJ	
Turn-off switching loss	E _{off}		T _J = 25°C	-	0.55	-	mJ	
			T _J = 150°C	-	0.75	-	mJ	
Short circuit data	I _{sc}		V _{GE} = 15 V, V _{CC} = 600 V V _{CEmax} = V _{CES} - L _{sCE} • di/dt tp ≤ 10 us	T _J = 150°C	-	60	-	A
Thermal resistance, junction to heatsink	R _{thJH}		Per IGBT, λgrease = 1 W/(m·K)		-	-	2.01	K/W

Brake FRD

Parameter	Symbol	Test Conditions		Min	Typ	Max	Unit
Forward voltage	V _F	I _F = 10 A	T _J = 25°C	-	2.00	2.50	V
			T _J = 150°C	-	1.70	-	V
Peak reverse recovery current	I _{rr}	I _F = 10 A, V _R = 600 V V _{GE} = -15 V, R _{Gon} = 47 Ω	T _J = 25°C	-	9.50	-	A
			T _J = 150°C	-	12.0	-	A
Reverse recovery charge	Q _{rr}		T _J = 25°C	-	0.55	-	uC
			T _J = 150°C	-	1.45	-	uC
Reverse recovery energy	E _{rec}		T _J = 25°C	-	0.10	-	mJ
			T _J = 150°C	-	0.40	-	mJ
Thermal resistance, junction to heatsink	R _{thJH}	Per Diode, λ _{grease} = 1 W/(m·K)		-	-	3.68	K/W

Rectifier

Parameter	Symbol	Test Conditions		Min	Typ	Max	Unit
Forward voltage	V_F	$I_F = 10\text{ A}$	$T_J = 25^\circ\text{C}$	-	1.0	-	V
Reverse current	I_R	$V_R = 1600\text{ V}$	$T_J = 25^\circ\text{C}$	-	-	1	mA
Thermal resistance, junction to heatsink	R_{thJH}	Per Diode, $\lambda_{grease} = 1\text{ W/(m}\cdot\text{K)}$		-	-	2.1	K/W

NTC

Parameter	Symbol	Test Conditions		Min	Typ	Max	Unit
Rated resistance	R_{25}	$T_{NTC} = 25^\circ\text{C}$		-	5	-	k Ω
Deviation of R_{100}	$\Delta R/R$	$R_{100} = 493\ \Omega$	$T_{NTC} = 100^\circ\text{C}$	-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	-	

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	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}		30	nH
Module lead resistance, terminals - chip	$R_{CC'+EE'}$	per switch	8	m Ω
	$R_{AA'+CC'}$		6	
Weight	G		24	g

Fig 1, Output Characteristics IGBT, Inverter (typical)

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

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

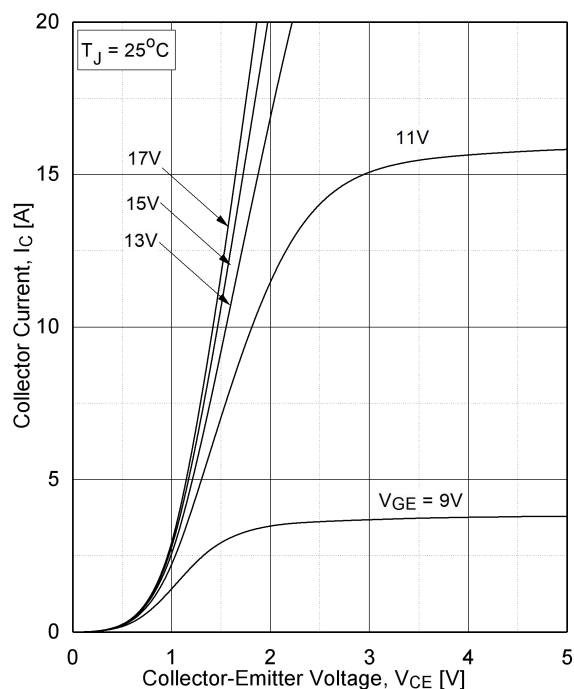


Fig 2, Output Characteristics IGBT, Inverter (typical)

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

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

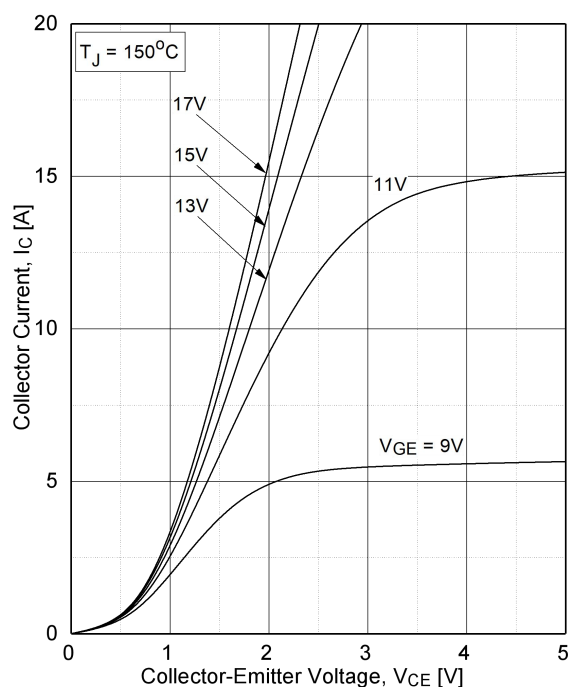


Fig 3, Transfer Characteristics IGBT, Inverter (typical)

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

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

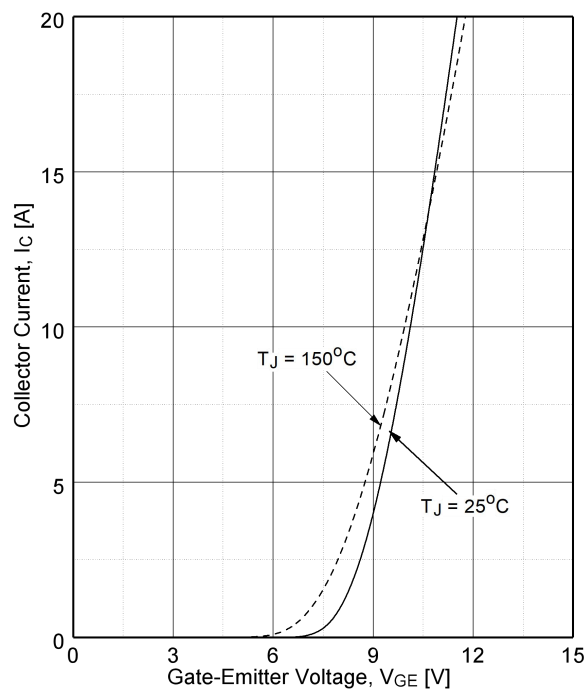


Fig 4, Switching Losses IGBT, Inverter (typical)

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

$V_{GE} = \pm 15\text{ V}, R_{Gon} = 47\ \Omega, R_{Goff} = 47\ \Omega, V_{CE} = 600\text{ V}$

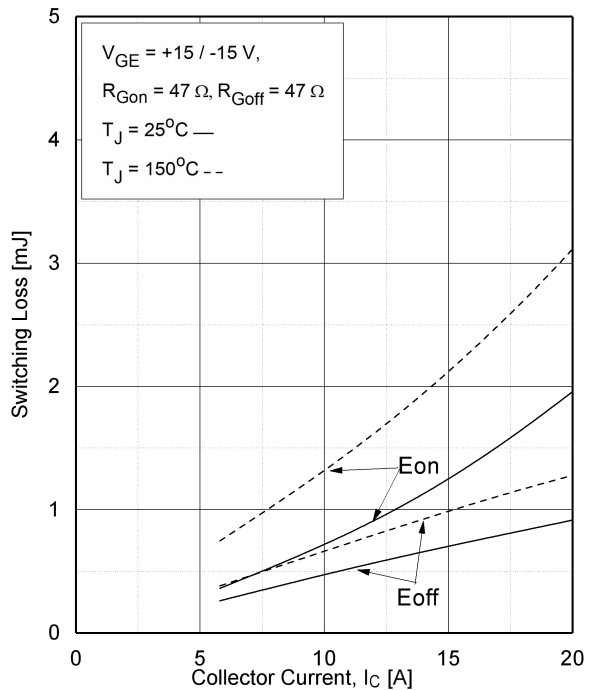


Fig 5, Switching Losses IGBT, Inverter (typical)

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

$$V_{GE} = +15/-15 \text{ V}, I_{CE} = 10 \text{ A}, V_{CE} = 600 \text{ V}$$

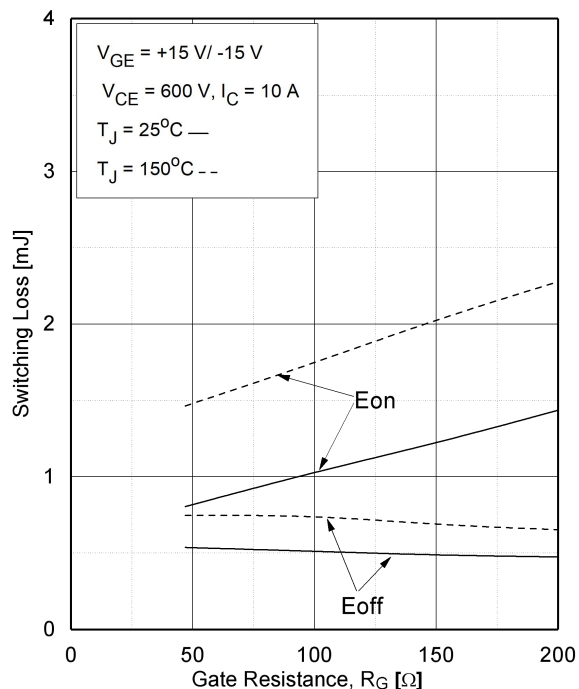


Fig 6, Transient Thermal Impedance IGBT, Inverter

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

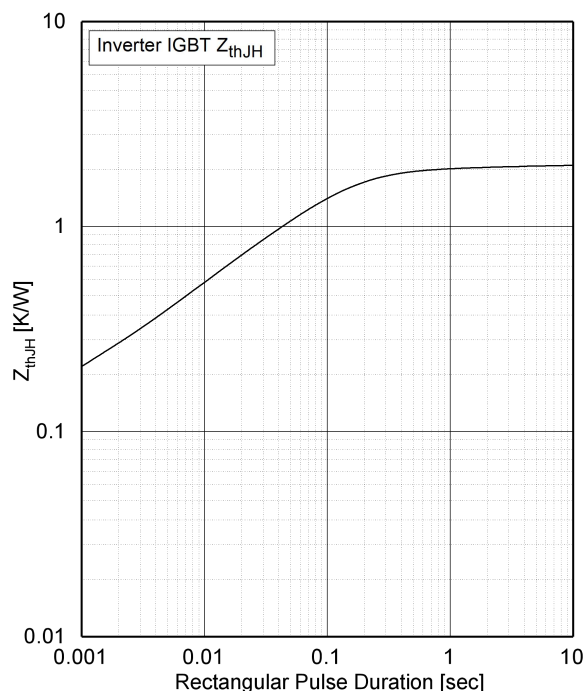


Fig 7, Reverse Bias Safe Operating Area IGBT, Inverter (RBSOA)

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

$$V_{GE} = +15/-15 \text{ V}, R_{Goff} = 47 \Omega, T_J = 150^\circ\text{C}$$

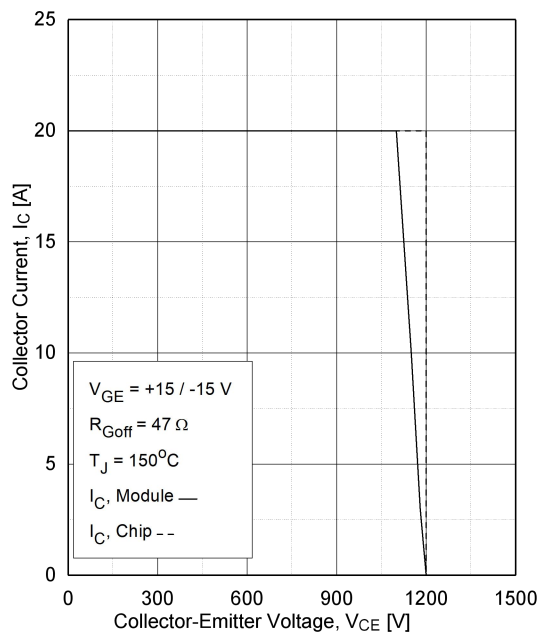


Fig 8, Forward Characteristics of Diode, Inverter (typical)

$$I_F = f(V_F)$$

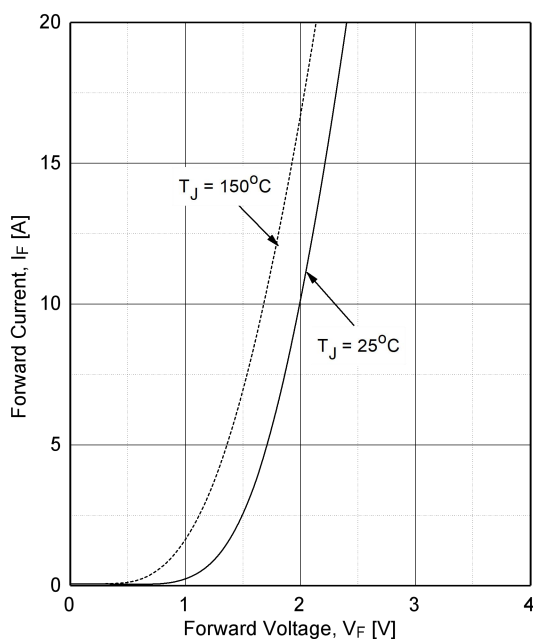


Fig 9, Switching Losses Diode, Inverter (typical)

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

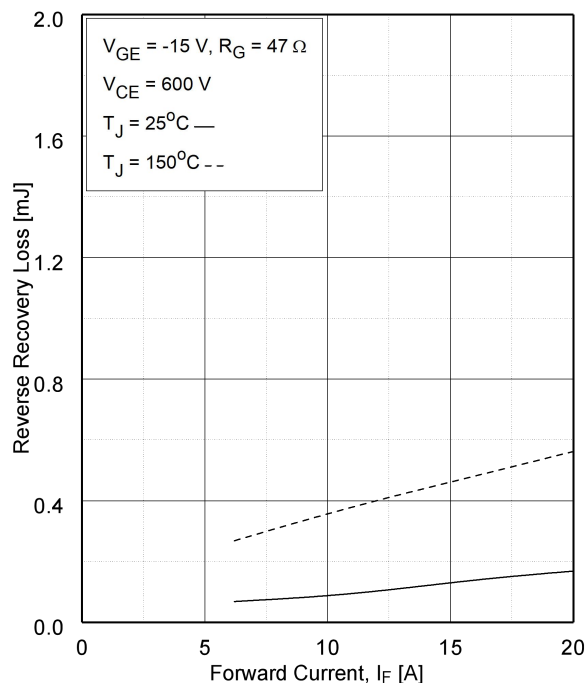


Fig 10, Switching Losses Diode, Inverter (typical)

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

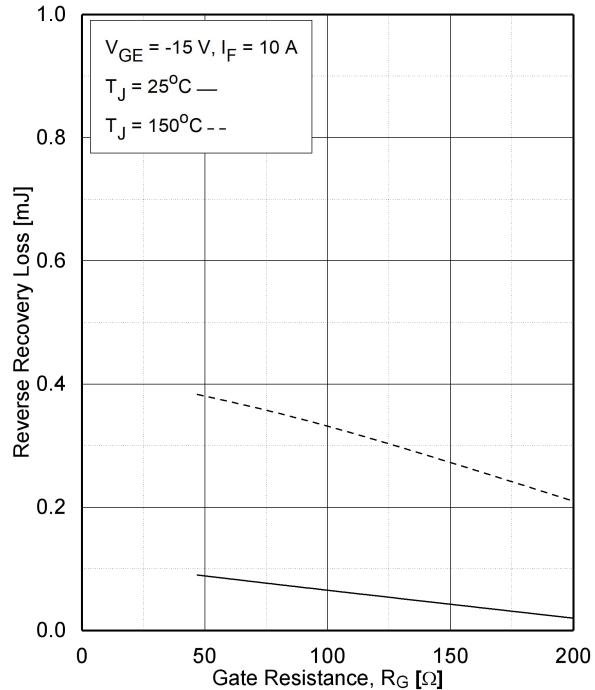


Fig 11, Transient Thermal Impedance Diode, Inverter

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

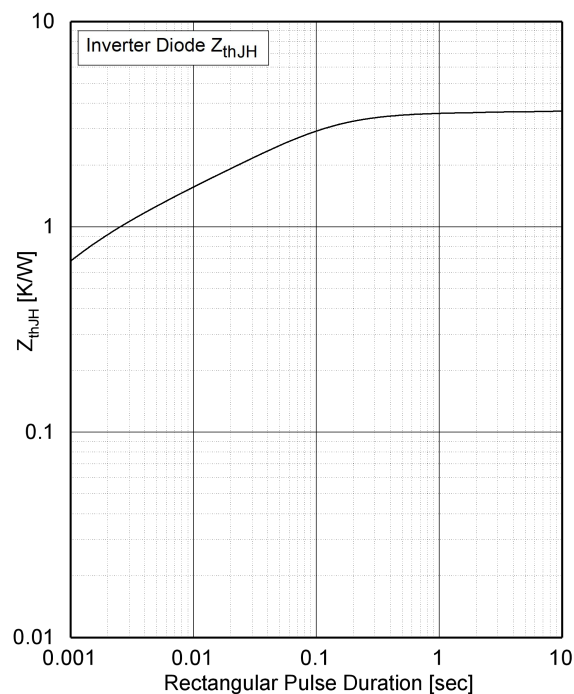


Fig 12, Forward Characteristics of Diode, Rectifier (typical)

$$I_F = f(V_F)$$

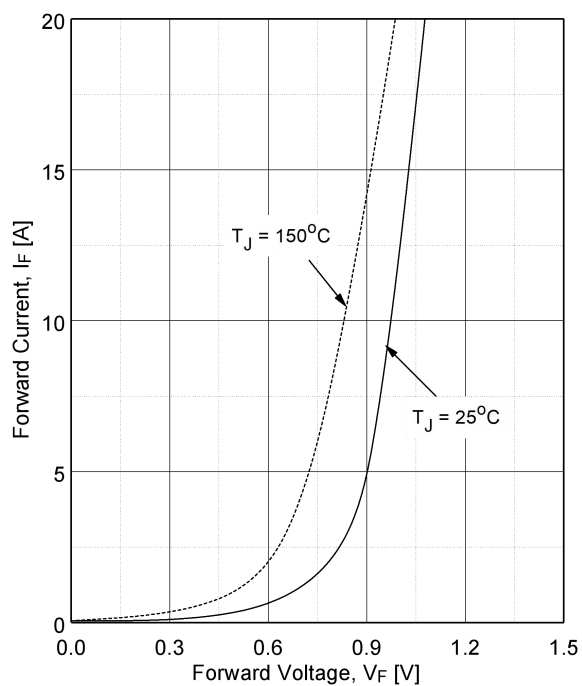


Fig 13, Output Characteristics IGBT, Brake (typical)

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

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

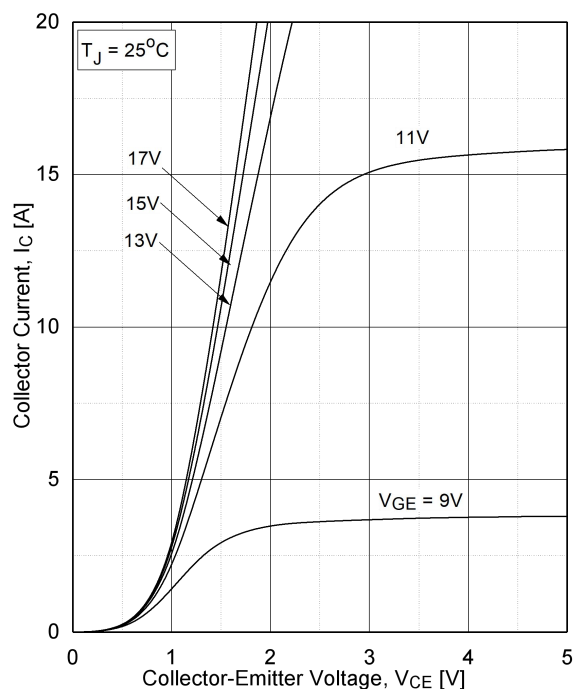


Fig 14, Output Characteristics IGBT, Brake (typical)

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

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

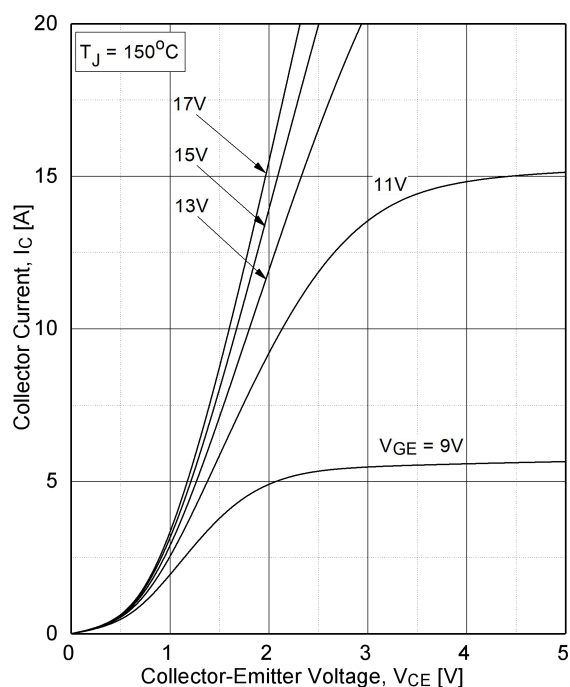


Fig 15, Forward Characteristics of Diode, Brake (typical)

$$I_F = f(V_F)$$

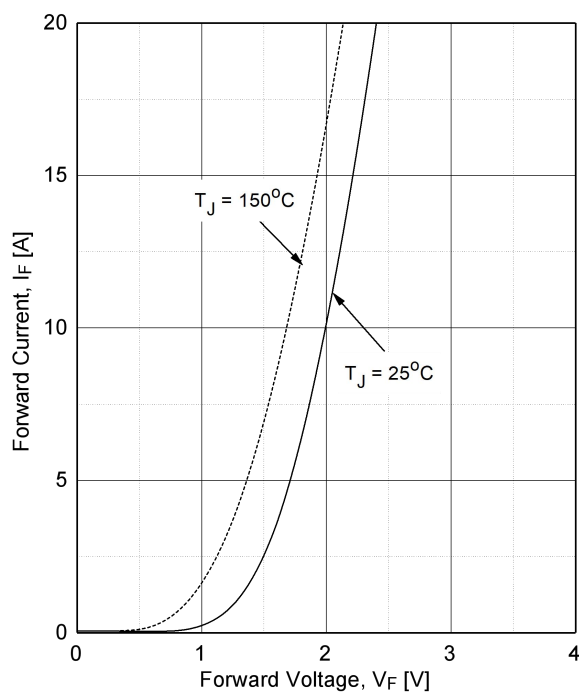
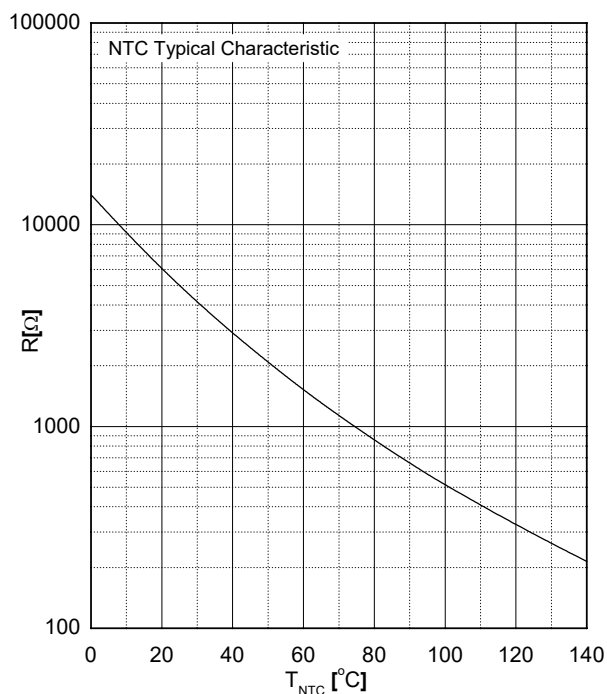
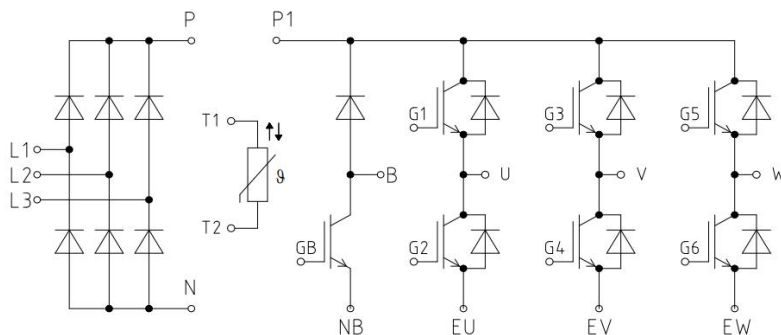


Fig 16, NTC Characteristics (typical)

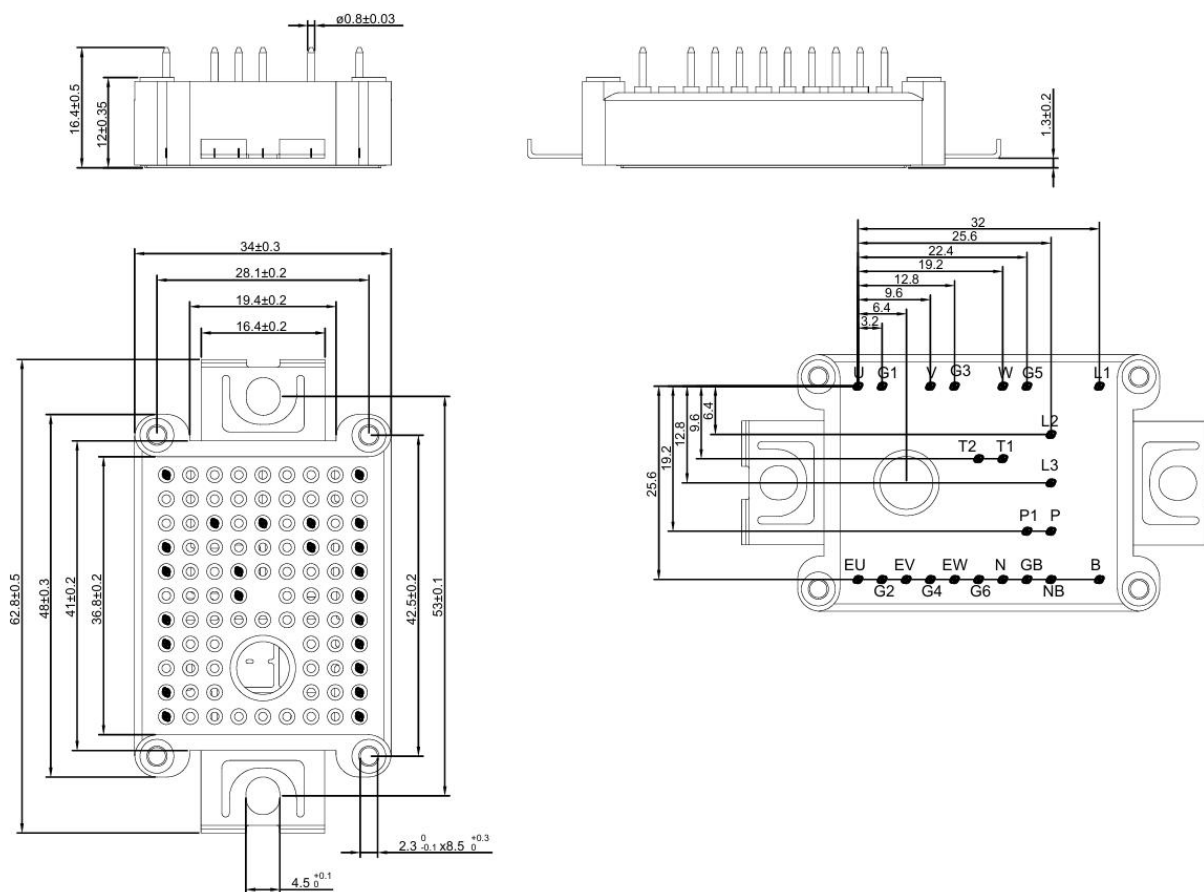
$$R = f(T)$$



Circuit Diagram



Package Outlines



Revisions History

Version	Description of Change	Date
V1.0	Final Datasheet	Oct.30.2023