Trench FS IGBT

Features

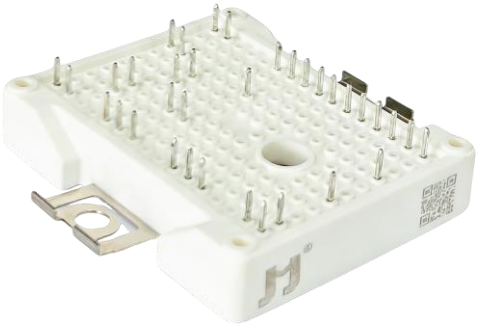
- High Power Density
- High mechanical robustness
- Compact design
- Isolated heatsink using DBC technology
- Very low forward voltage drops
- Fast & soft reverse recovery anti-parallel FWD

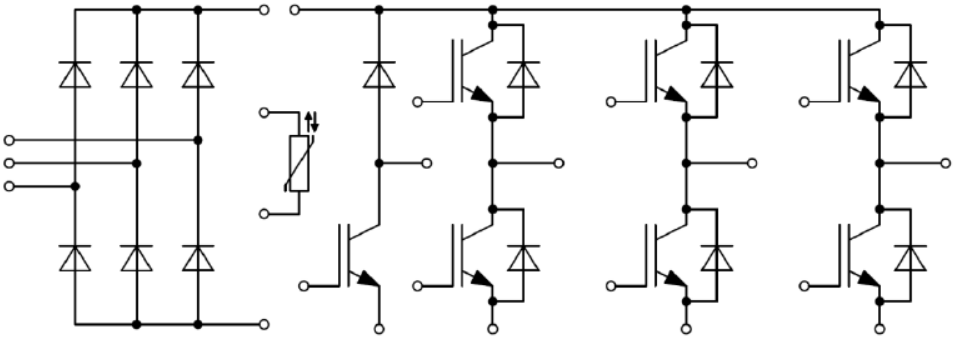
Product Summary

Parameter	Value	Unit
V_{CES}	1200	V
I_C(@ T_C= 100℃)	50	A
I_{CRM}(@ t_P= 1ms)	100	A
$V_{CE(sat)}$(Typ)	1.90	V

Applications

- Active Rectifier
- Air Conditioning
- Motor Drives





IGBT, Inverter Absolute Maximum Ratings (@ T_C = 25°C unless otherwise specified)

Parameter	Conditions	Symbol	Values	Unit
Collector-emitter voltage	T_{vj} = 25°C	V_{CES}	1200	V
Gate-emitter peak voltage		V_{GES}	±20	V
Continuous collector current	T_C = 100°C, T_{vj} = 175°C	$I_{C\ nom}$	50	A
Repetitive peak collector current	t_P = 1ms	I_{CRM}	100	A
Total power dissipation	T_C = 25°C, $T_{vj\ max}$ = 175°C	P_{tot}	333	W

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IGBT, Inverter Electrical Characteristics (@ T_C = 25°C unless otherwise specified)

Parameter	Conditions		Symbol	Values			Unit
				Min.	Typ.	Max.	
Collector-emitter saturation voltage	I_C = 50A, V_{GE} = 15V	T_{vj} = 25°C	$V_{CE(sat)}$		1.90	2.25	V
		T_{vj} = 125°C			2.30		
		T_{vj} = 150°C			2.40		
Gate threshold voltage	V_{CE}=V_{GE}, I_C=1.25mA		$V_{GE(th)}$	5.4	6.0	6.6	V
Gate-emitter leakage current	V_{CE} = 0V, V_{GE} = 20V		I_{GES}			400	nA
Collector leakage current	V_{CE}=1200V，V_{GE}=0V		I_{CES}			1	mA
Input capacitance	f = 1MHz, T_{vj} = 25°C, V_{CE} = 25 V, V_{GE} = 0 V		C_{ies}		7.29		nF
Reverse transfer capacitance			C_{res}		0.09		nF
Gate charge	V_{GE} = -15V…+15V		Q_G		0.57		uC
Internal gate resistor			R_{Gint}		1.68		Ω
Turn-on delay time, inductive load	V_{CE} = 600V, I_C = 50A, R_G = 20Ω, V_{GE} = ±15V, T_{vj} = 25℃		$t_{d(on)}$		115		ns
Rise time, inductive load			t_r		81		ns
Turn-off delay time, inductive load			$t_{d(off)}$		232		ns
Fall time, inductive load			t_f		134		ns
Turn-on energy loss per pulse			E_{on}		5.43		mJ
Turn-off energy loss per pulse			E_{off}		3.27		mJ
Turn-on delay time, inductive load	V_{CE} = 600V, I_C = 50A, R_G = 20Ω, V_{GE} = ±15V, T_{vj} = 125℃		$t_{d(on)}$		115		ns
Rise time, inductive load			t_r		84		ns
Turn-off delay time, inductive load			$t_{d(off)}$		259		ns
Fall time, inductive load			t_f		187		ns
Turn-on energy loss per pulse			E_{on}		7.57		mJ
Turn-off energy loss per pulse			E_{off}		4.25		mJ
SC data	tp≤10us， V_{GE}≤15V， V_{CC}=900V,V_{CEM}≤1200V, T_{vj}=125℃		I_{SC}		220		A
Thermal resistance, junction to case	per IGBT		$R_{th(j-c)}$			0.45	K/W
Temperature under switching conditions			$T_{vj\ op}$	-40		150	℃

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FRED, Inverter Absolute Maximum Ratings (@ T_C = 25°C unless otherwise specified)

Parameter	Conditions	Symbol	Values	Unit
Repetitive peak reverse voltage	T_{vj} = 25°C	V_{RRM}	1200	V
Continuous DC forward current		I_F	50	A
Repetitive peak forward current	t_P = 1ms	I_{FRM}	100	A
I^2t value for fusing	t = 10ms, V_R = 0V, T_{vj} =150°C,	I^2t	220	A^2s

FRED, Inverter Electrical Characteristics (@ T_C = 25°C unless otherwise specified)

Parameter	Conditions		Symbol	Values			Unit
				Min.	Typ.	Max.	
Forward voltage	I_F = 50A, V_{GE} = 0V	T_{vj} = 25°C	V_F		2.40	2.70	V
		T_{vj} = 125°C			2.10		
		T_{vj} = 150°C			2.00		
Peak reverse recovery current	I_F = 50A, di/dt = 500A/µs, V_R = 600V, V_{GE} = -15V	T_{vj} = 25°C	I_{RM}		15.5		A
		T_{vj} = 125°C			21.3		
Recovered charge		T_{vj} = 25°C	Q_{rr}		1.5		µC
		T_{vj} = 125°C			4.0		
Peak reverse recovery energy		T_{vj} = 25°C	Erec		0.43		mJ
		T_{vj} = 125°C			1.15		
Thermal resistance, junction to case	per diode		$R_{th(j-c)}$			0.90	K/W
Temperature under switching conditions			$T_{vj\ op}$	-40		150	°C

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Diode, Rectifier Absolute Maximum Ratings (@ T_C = 25°C unless otherwise specified)

Parameter	Conditions	Symbol	Values	Unit
Repetitive peak reverse voltage	T_{vj} = 25°C	V_{RRM}	1600	V
Maximum RMS forward current per chip	T_C = 80°C	I_{FRMSM}	50	A
Maximum RMS current at rectifier output	T_C = 80°C	I_{RMSM}	50	A
Repetitive peak forward current	t_P = 10 ms, T_{vj} = 25°C	I_{FSM}	450	A
I^2t value for fusing	t_P = 10 ms, T_{vj} = 25°C	I^2t	1012	A^2s

Diode, Rectifier Electrical Characteristics (@ T_C = 25°C unless otherwise specified)

Parameter	Conditions	Symbol	Values			Unit
			Min.	Typ.	Max.	
Forward voltage	T_{vj} = 150°C, I_F=50A	V_F		1.35		V
Reverse current	T_{vj} = 25°C, V_R=1600V	I_R			0.1	mA
	T_{vj} = 150°C, V_R=1600V				2	mA
Thermal resistance, junction to case	per diode	R_{thJC}			1.00	K/W
Temperature under switching conditions		T_{VjOP}	-40		150	°C

IGBT, Brake-Chopper Absolute Maximum Ratings (@ T_C = 25°C unless otherwise specified)

Parameter	Conditions	Symbol	Values	Unit
Collector-emitter voltage	T_{vj} = 25°C	V_{CES}	1200	V
Gate-emitter peak voltage		V_{GES}	±20	V
Continuous collector current	T_C = 100°C, T_{vj} = 175°C	$I_{C\ nom}$	25	
Repetitive peak collector current	t_P = 1ms	I_{CRM}	50	A
Total power dissipation	T_C = 25°C, $T_{vj\ max}$ = 175°C	P_{tot}	176	W

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IGBT, Brake-Chopper Electrical Characteristics (@ T_C = 25°C unless otherwise specified)

Parameter	Conditions		Symbol	Values			Unit
				Min.	Typ.	Max.	
Collector-emitter saturation voltage	I_C = 25A, V_{GE} = 15V	T_{vj} = 25°C	$V_{CE(sat)}$		2.00	2.30	V
		T_{vj} = 125°C			2.40		
		T_{vj} = 150°C			2.50		
Gate threshold voltage	V_{CE}=V_{GE}, I_C=0.70mA，		$V_{GE(th)}$	5.4	6.0	6.6	V
Gate-emitter leakage current	V_{CE} = 0V, V_{GE} = 20V		I_{GES}			400	nA
Collector leakage current	V_{CE}=1200V， V_{GE}=0V		I_{CES}			1.0	mA
Input capacitance	f = 1MHz, T_{vj} = 25°C, V_{CE} = 25 V, V_{GE} = 0 V		C_{ies}		4.28		nF
Reverse transfer capacitance			C_{res}		0.04		nF
Gate charge	V_{GE} = -15V…+15V		Q_G		0.29		uC
Internal gate resistor			R_{Gint}		1.68		Ω
Turn-on delay time, inductive load	V_{CC} = 600V, I_C = 25A, R_G = 27Ω, V_{GE} = ±15V, T_{vj} = 25℃		$t_{d(on)}$		81		ns
Rise time, inductive load			t_r		89		ns
Turn-off delay time, inductive load			$t_{d(off)}$		169		ns
Fall time, inductive load			t_f		81		ns
Turn-on energy loss per pulse			E_{on}		2.20		mJ
Turn-off energy loss per pulse			E_{off}		1.06		mJ
Turn-on delay time, inductive load	V_{CC} = 600V, I_C = 25A, R_G = 27Ω, V_{GE} = ±15V, T_{vj} = 125℃		$t_{d(on)}$		80		ns
Rise time, inductive load			t_r		88		ns
Turn-off delay time, inductive load			$t_{d(off)}$		188		ns
Fall time, inductive load			t_f		147		ns
Turn-on energy loss per pulse			E_{on}		3.25		mJ
Turn-off energy loss per pulse			E_{off}		1.43		mJ
SC data	tp≤10us， V_{GE}≤15V, V_{CE}=900V,V_{CEM}≤1200V, T_{vj}=125℃		I_{SC}		150		A
Thermal resistance, junction to case	per IGBT		$R_{th(j-c)}$			0.85	K/W
Temperature under switching conditions			$T_{vj\ op}$	-40		150	℃

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FRED, Brake-Chopper Absolute Maximum Ratings (@ T_C = 25°C unless otherwise specified)

Parameter	Conditions	Symbol	Values	Unit
Repetitive peak reverse voltage	T_{vj} = 25°C	V_{RRM}	1200	V
Continuous DC forward current		I_F	15	A
Repetitive peak forward current	t_P = 1ms	I_{FRM}	30	A
I^2t value for fusing	T_{vj} =150℃, t_P = 10ms, V_R = 0V	I^2t	16	A^2s

FRED, Brake-Chopper Electrical Characteristics (@ T_C = 25°C unless otherwise specified)

Parameter	Conditions		Symbol	Values			Unit
				Min.	Typ.	Max.	
Forward voltage	I_F = 15A, V_{GE} = 0V	T_{vj} = 25°C	V_F		2.00	2.30	V
		T_{vj} = 125°C			1.60		
		T_{vj} = 150°C			1.55		
Peak reverse recovery current	I_F = 15A, di/dt = 200A/µs, V_R = 600V, V_{GE} = -15V	T_{vj} = 25°C	I_{RM}		6.1		A
		T_{vj} = 125°C			9.5		
Recovered charge		T_{vj} = 25°C	Q_{rr}		1.1		µC
		T_{vj} = 125°C			2.4		
Peak reverse recovery energy		T_{vj} = 25°C	E_{rec}		0.37		mJ
		T_{vj} = 125°C			0.81		
Thermal resistance, junction to case	per diode		$R_{th(j-c)}$			1.90	K/W
Temperature under switching conditions			$T_{vj\ op}$	-40		150	℃

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NTC-Thermistor Characteristics (@ T_C = 25°C unless otherwise specified)

Parameter	Conditions	Symbol	Values			Unit
			Min.	Typ.	Max.	
Rated resistance	T_C=25℃	R_{25}		5		KΩ
Deviation of R100	T_C = 100°C, R_{100} = 493 Ω	△R/R	-5		5	%
Power dissipation	T_C = 25°C	P_{25}			20	mW
B-value	$R_2 = R_{25} \exp [B25/50(1/T2 - 1/(298,15\ K))]$	$B_{25/50}$		3375		K
B-value	$R_2 = R_{25} \exp [B25/80(1/T2 - 1/(298,15\ K))]$	$B_{25/80}$		3411		K
B-value	$R_2 = R_{25} \exp [B25/100(1/T2 - 1/(298,15\ K))]$	$B_{25/100}$		3433		K

Module Characteristics

Parameter	Conditions	Symbol	Values			Unit
			Min.	Typ.	Max.	
Isolation Voltage (All Terminals Shorted)	RMS, f = 50Hz,1minute	V_{iso}	2.5			KV
Thermal resistance, case to heatsink	per module	$R_{th(c-s)}$		0.037		K/W
Maximum Junction Temperature	Inverter, brake-chopper	$T_{vj\ max}$			175	℃
	rectifier				150	℃
Stray inductance module		L_{SCE}		30		nH
Module lead resistance, terminals - chip	per switch	$R_{CC'+EE'}$		5		mΩ
		$R_{AA'+CC'}$		6		mΩ
Storage Temperature		T_{stg}	-40		125	℃
Mounting force per clamp		F	40		80	N

Ordering Information

Device	Marking	Package	Weight	Inner Box	Per Carton
JMG50PM12E2S1	JMG50PM12E2S1	E2	42±3g/PCS	20PCS	100PCS

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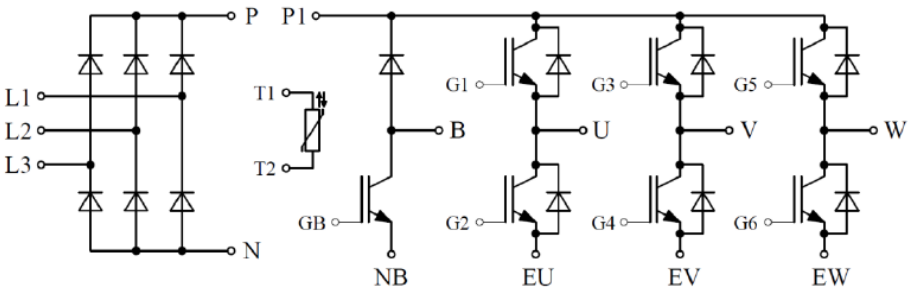
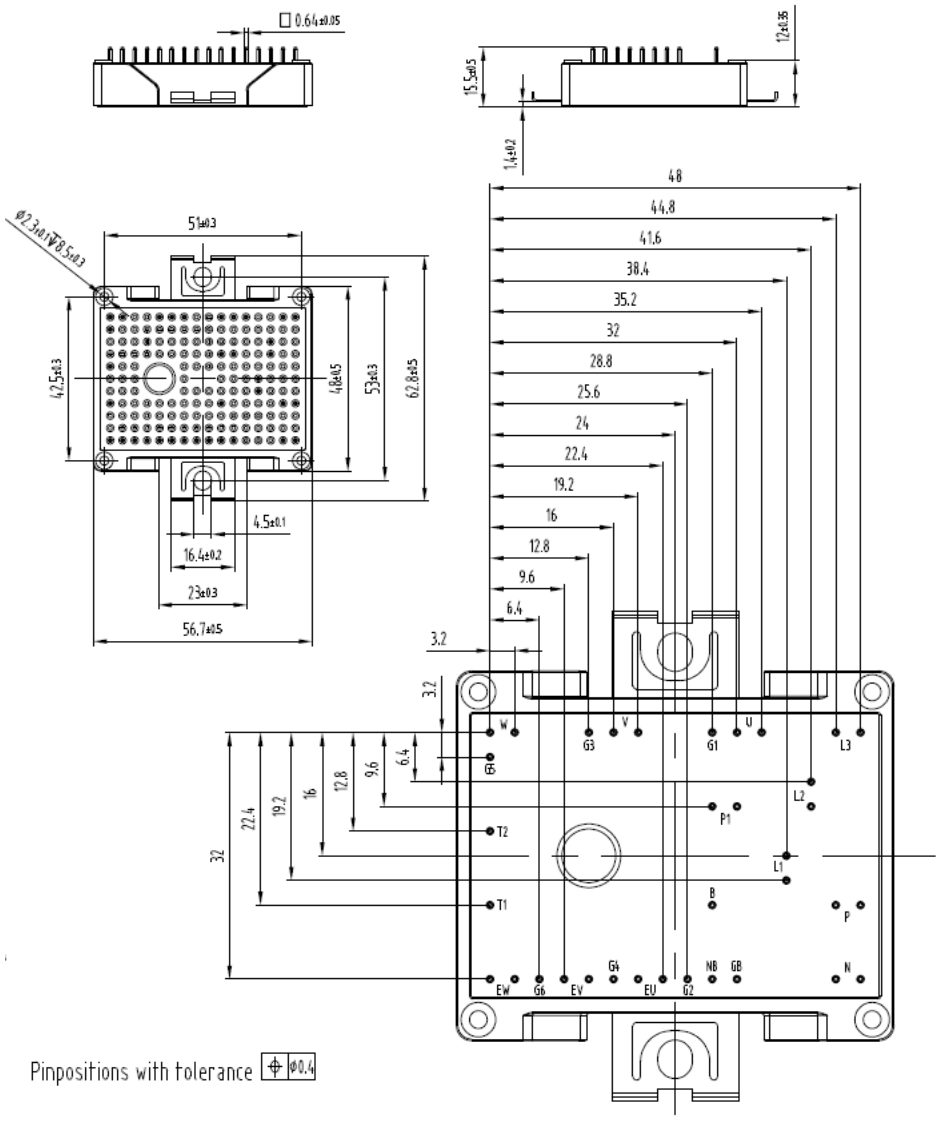
Circuit Diagram



Package Outlines (mm)



Unit of measurement: mm

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Typical Electrical & Thermal Characteristics

Fig 1. IGBT Output Characteristics
Inverter (typical) VGE=15 V

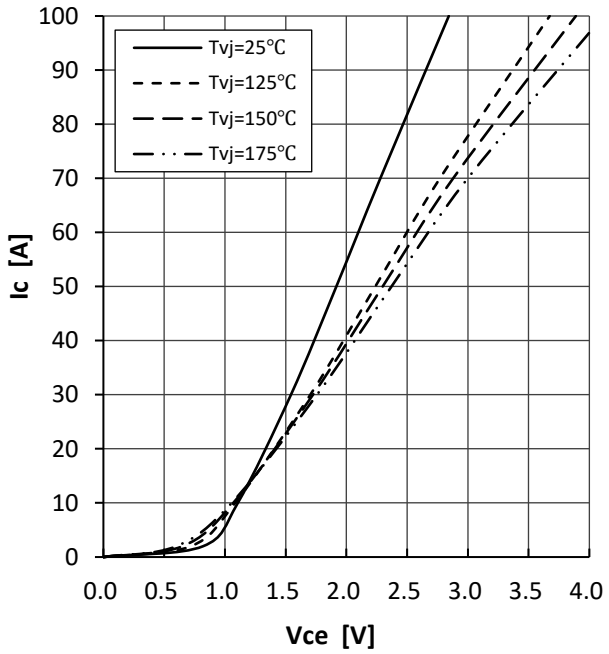

Fig 2. IGBT Output Characteristics
Inverter (typical)

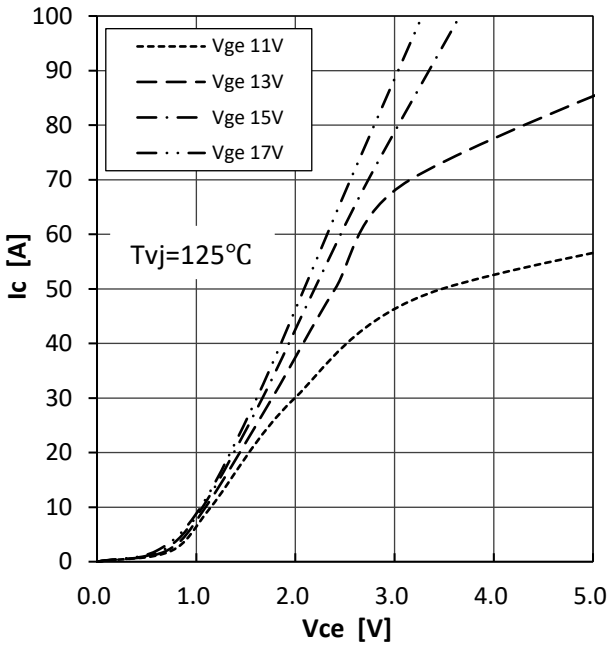

Fig 3. IGBT Transfer Characteristics
Inverter (typical) VCE = 20 V

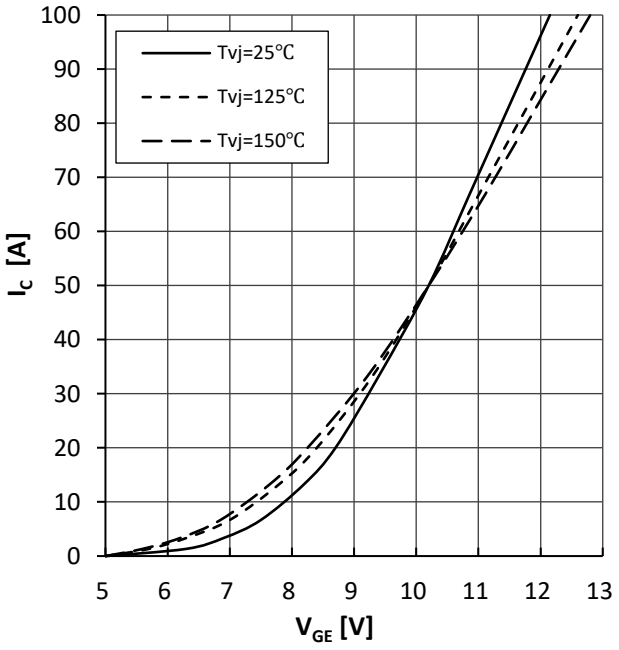

Fig 4. IGBT Switching Loss vs Ic
Inverter (typical)
Rg=20 Ω, VCE=600 V, VGE=±15 V

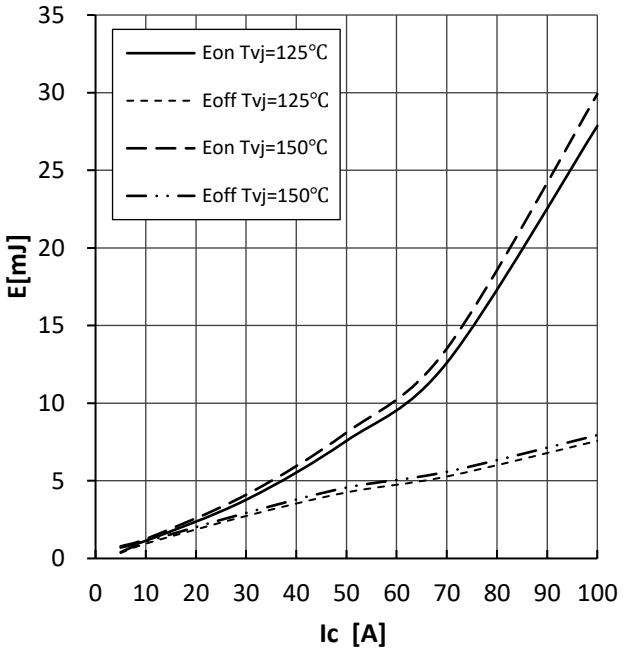

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Fig 5. IGBT Transient Thermal Impedance
Inverter

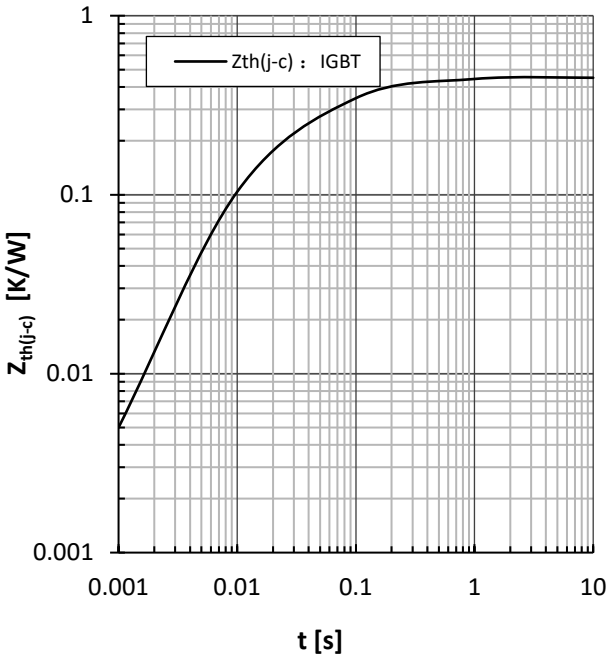

Fig 6. Reverse bias safe operating area
IGBT, Inverter (RBSOA)

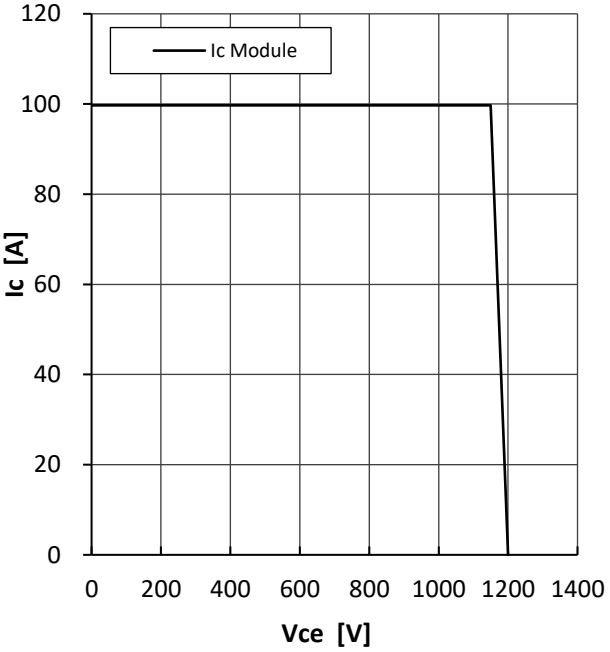

Fig 7. FRED Forward Characteristics
Inverter (typical)

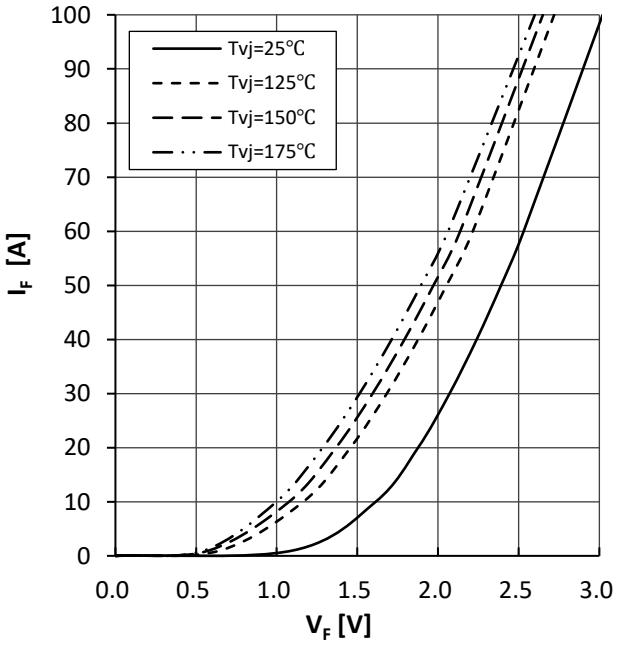

Fig 8. FRED Switching Loss vs. Ic
Inverter (typical)
Rg=20 Ω, VCE=600 V

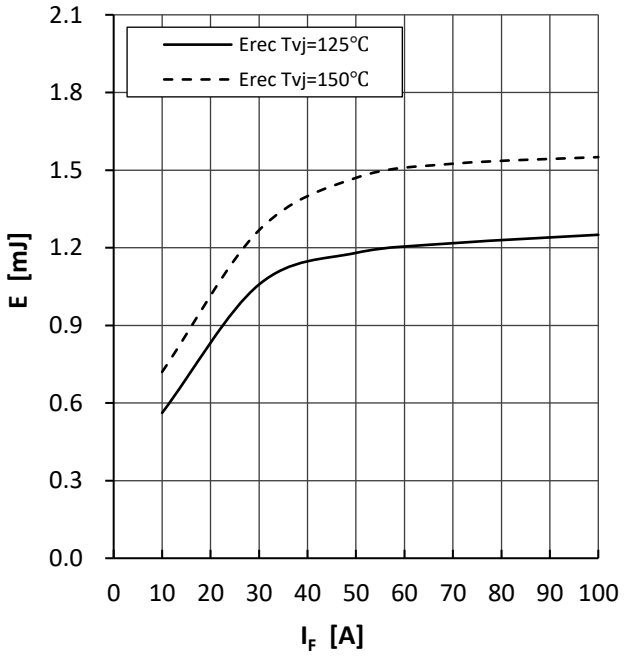

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Fig 9. FRED Transient Thermal Impedance Inverter

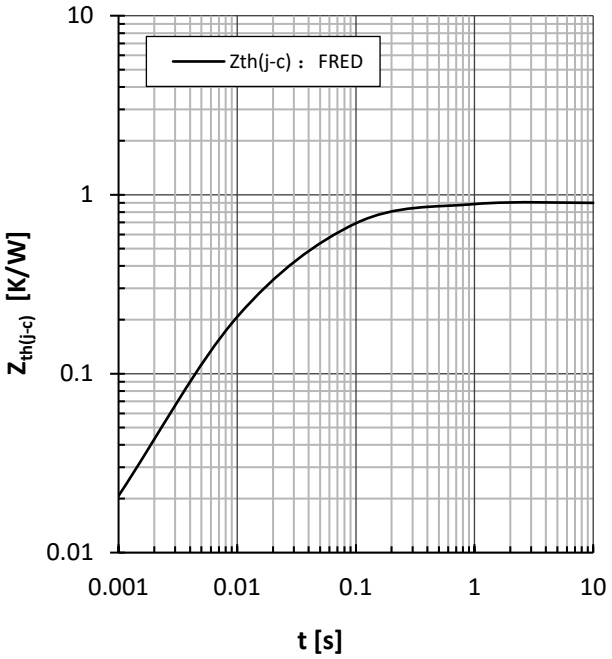

Fig 10. Diode Rectifier Forward Characteristics

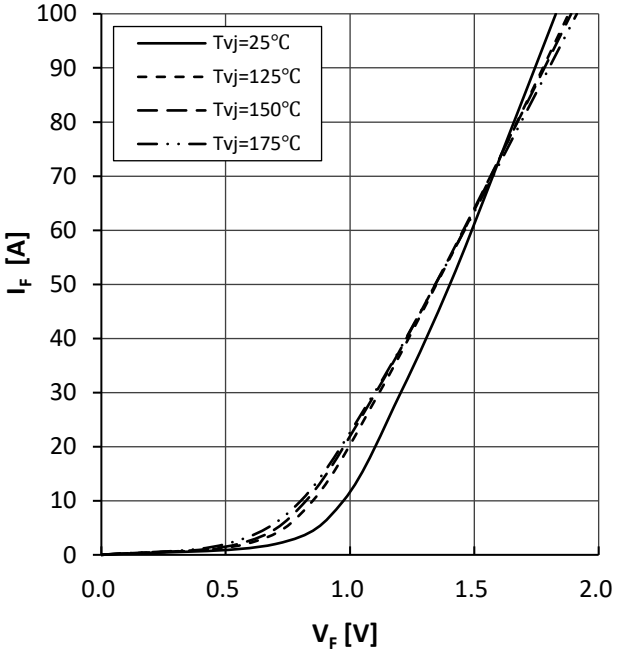

Fig 11. Diode Rectifier Transient Thermal Impedance

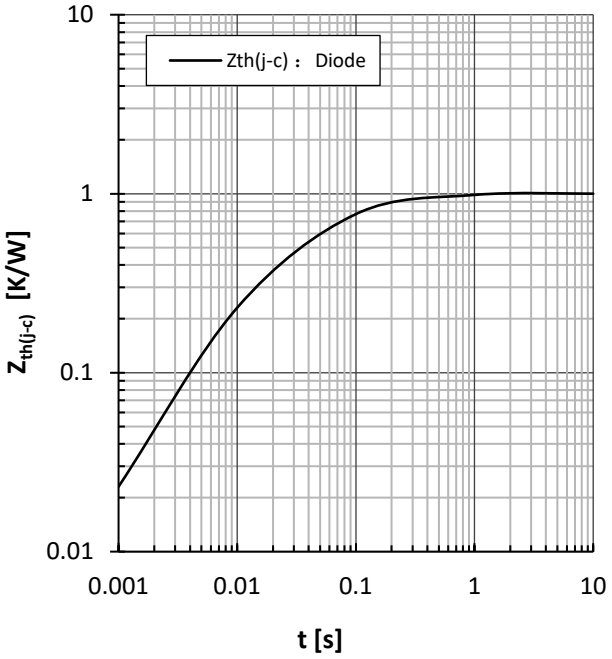

Fig 12. IGBT Output Characteristics，
Brake-Chopper (typical) VGE=15 V

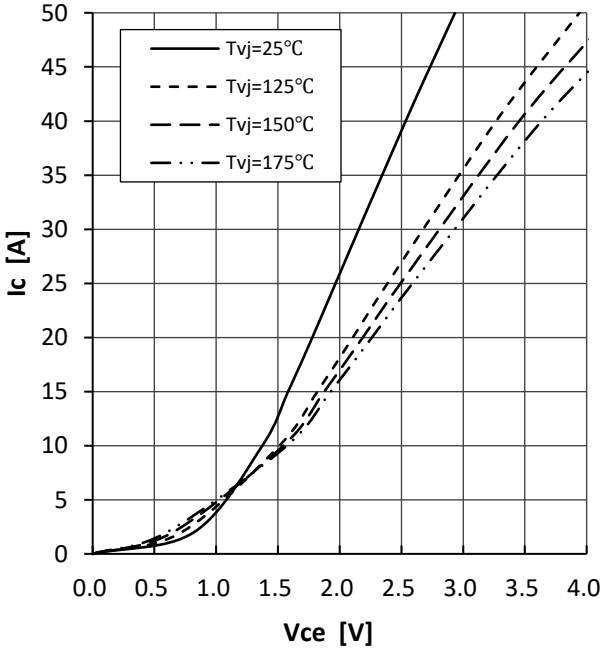

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Fig 13. FRED Forward Characteristics, Brake-Chopper (typical)

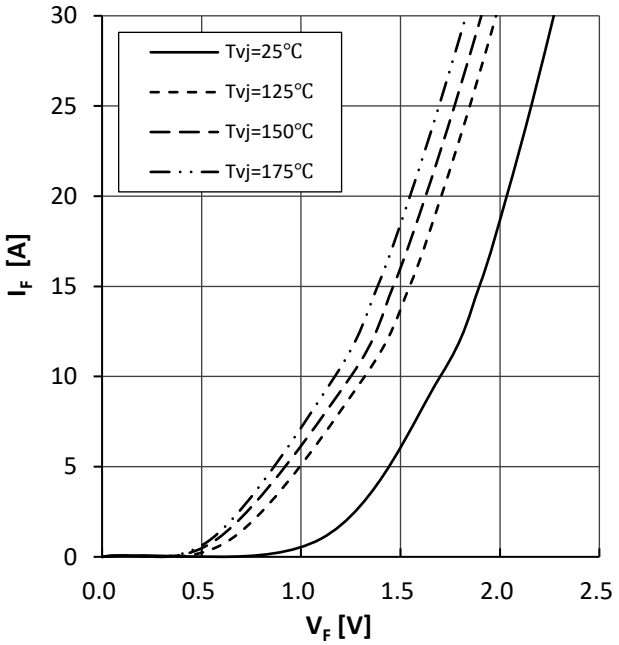
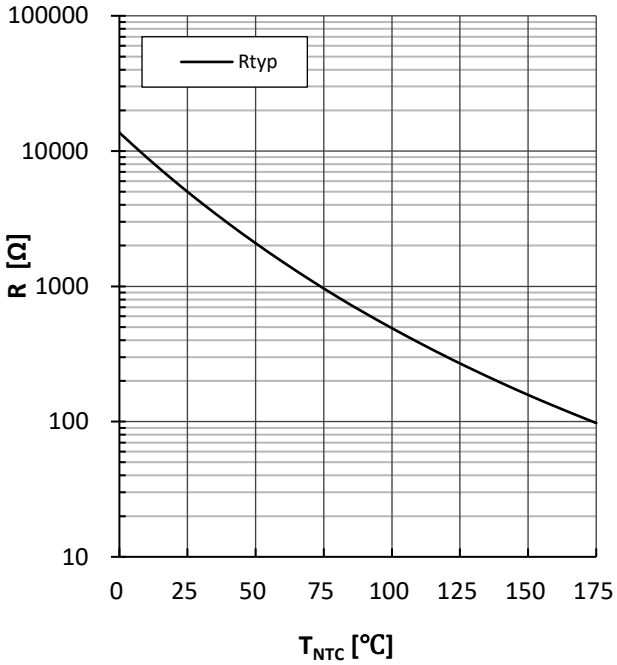


Fig 14. Temperature characteristics, NTC thermistor (typical)



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