Trench FS IGBT

Features

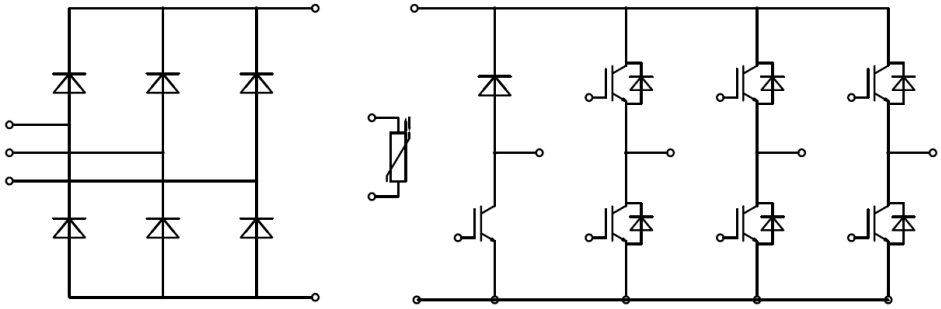
- High Power Density
- High mechanical robustness
- Compact design
- Isolated heatsink using DBC technology
- Very low forward voltage drops
- Fast & soft reverse recovery anti-parallel FWD

Product Summary

Parameter	Value	Unit
V_{CES}	1200	V
I_C(@ T_C= 100℃)	40	A
I_{CRM}(@ t_P= 1ms)	80	A
$V_{CE(sat)}$(Typ)	2.00	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, Tvj = 175°C	$I_{C\ nom}$	40	A
Repetitive peak collector current	t_P = 1ms	I_{CRM}	80	A
Total power dissipation	T_C = 25°C, $T_{vj\ max}$ = 175°C	P_{tot}	250	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 = 40A, V_{GE} = 15V	T_{vj} = 25°C	$V_{CE(sat)}$		2.00	2.35	V
		T_{vj} = 125°C			2.50		
		T_{vj} = 150°C			2.55		
Gate threshold voltage	V_{CE}=V_{GE}, I_C=0.88mA		$V_{GE(th)}$	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}		2.5		nF
Reverse transfer capacitance			C_{res}		0.09		nF
Gate charge	V_{GE} = -15V…+15V		Q_G		0.33		uC
Internal gate resistor			R_{Gint}		6.0		Ω
Turn-on delay time, inductive load	V_{CE} = 600V, I_C = 40A, R_G = 15Ω, V_{GE} = ±15V, T_{vj} = 25℃		$t_{d(on)}$		118		ns
Rise time, inductive load			t_r		89		ns
Turn-off delay time, inductive load			$t_{d(off)}$		174		ns
Fall time, inductive load			t_f		84		ns
Turn-on energy loss per pulse			E_{on}		4.91		mJ
Turn-off energy loss per pulse			E_{off}		1.92		mJ
Turn-on delay time, inductive load	V_{CE} = 600V, I_C = 40A, R_G =15Ω, V_{GE} = ±15V, T_{vj} = 125℃		$t_{d(on)}$		115		ns
Rise time, inductive load			t_r		107		ns
Turn-off delay time, inductive load			$t_{d(off)}$		198		ns
Fall time, inductive load			t_f		129		ns
Turn-on energy loss per pulse			E_{on}		7.27		mJ
Turn-off energy loss per pulse			E_{off}		2.48		mJ
SC data	tp≤10us， V_{GE}≤15V， V_{CC}=900V,V_{CEM}≤1200V, T_{vj}=125℃		I_{SC}		260		A
Thermal resistance, junction to case	per IGBT		$R_{th(j-c)}$			0.60	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	40	A
Repetitive peak forward current	t_P = 1ms	I_{FRM}	80	A
I^2t value for fusing	t = 10ms, V_R = 0V, T_{vj} =150℃,	I^2t	320	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 = 40A, 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 = 40A, di/dt = 300A/μs, V_R = 600V, V_{GE} = -15V	T_{vj} = 25°C	I_{RM}		9.37		A
		T_{vj} = 125°C			14.13		
Recovered charge		T_{vj} = 25°C	Q_{rr}		1.39		μC
		T_{vj} = 125°C			3.70		
Peak reverse recovery energy		T_{vj} = 25°C	E_{rec}		0.40		mJ
		T_{vj} = 125°C			1.04		
Thermal resistance, junction to case	per diode		$R_{th(j-c)}$			0.95	K/W
Temperature under switching conditions			$T_{vj\ op}$	-40		150	℃

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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}	40	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}	300	A
I^2t value for fusing	t_P = 10 ms, T_{vj} = 25°C	I^2t	450	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=40A	V_F		1.25		V
Reverse current	T_{vj} = 25°C, V_R=1600V	I_R			100	uA
	T_{vj} = 150°C, V_R=1600V				2	mA
Thermal resistance, junction to case	per diode	$R_{th(j-c)}$			1.0	K/W
Temperature under switching conditions		$T_{vj\ op}$	-40		150	℃

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	A
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}	125	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	$V_{CE(sat)}$		1.80	2.15	V
		T_{vj} = 125°C			2.25		
		T_{vj} = 150°C			2.35		
Gate threshold voltage	V_{CE}=V_{GE}, I_C=0.63mA，		$V_{GE(th)}$	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}		1.10		nF
Reverse transfer capacitance			C_{res}		0.04		nF
Gate charge	V_{GE} = -15V…+15V		Q_G		0.15		uC
Internal gate resistor			R_{Gint}		6.0		Ω
Turn-on delay time, inductive load	V_{CC} = 600V, I_C = 25A, R_G = 15Ω, V_{GE} = ±15V, T_{vj} = 25℃		$t_{d(on)}$		68		ns
Rise time, inductive load			t_r		50		ns
Turn-off delay time, inductive load			$t_{d(off)}$		134		ns
Fall time, inductive load			t_f		76		ns
Turn-on energy loss per pulse			E_{on}		1.61		mJ
Turn-off energy loss per pulse			E_{off}		1.17		mJ
Turn-on delay time, inductive load	V_{CC} = 600V, I_C = 25A, R_G = 15Ω, V_{GE} = ±15V, T_{vj} = 125℃		$t_{d(on)}$		67		ns
Rise time, inductive load			t_r		54		ns
Turn-off delay time, inductive load			$t_{d(off)}$		161		ns
Fall time, inductive load			t_f		147		ns
Turn-on energy loss per pulse			E_{on}		2.56		mJ
Turn-off energy loss per pulse			E_{off}		1.58		mJ
SC data	tp≤10us， V_{GE}≤15V， V_{CC}=900V,V_{CEM}≤1200V, T_{vj}=125℃		I_{SC}		105		A
Thermal resistance, junction to case	per IGBT		$R_{th(j-c)}$			1.20	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} =125°C, 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 = 400A/µs, V_R = 600V, V_{GE} = -15V	T_{vj} = 25°C	I_{RM}		12.74		A
		T_{vj} = 125°C			15.86		
Recovered charge		T_{vj} = 25°C	Q_{rr}		1.24		µC
		T_{vj} = 125°C			2.75		
Peak reverse recovery energy		T_{vj} = 25°C	E_{rec}		0.45		mJ
		T_{vj} = 125°C			0.97		
Thermal resistance, junction to case	per diode		$R_{th(j-c)}$			2.30	K/W
Temperature under switching conditions			$T_{vj\ op}$	-40		150	°C

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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	$R_{th(c-s)}$		0.02		K/W
Maximum Junction Temperature	Inverter, brake-chopper	$T_{vj\ max}$			175	℃
	rectifier				150	℃
Stray inductance module		L_{SCE}		35		nH
Module lead resistance, terminals - chip	per switch	$R_{CC'+EE'}$		4		mΩ
		$R_{AA'+CC'}$		3		mΩ
Storage Temperature		T_{stg}	-40		125	℃
Mounting torque	Module and heatsink fixed torque M5	M	3.0		6.0	N m

Ordering Information

Device	Marking	Package	Weight	Inner Box	Per Carton
JMG40PM12P2S1	JMG40PM12P2S1	P2	185g/PCS	15PCS	75PCS

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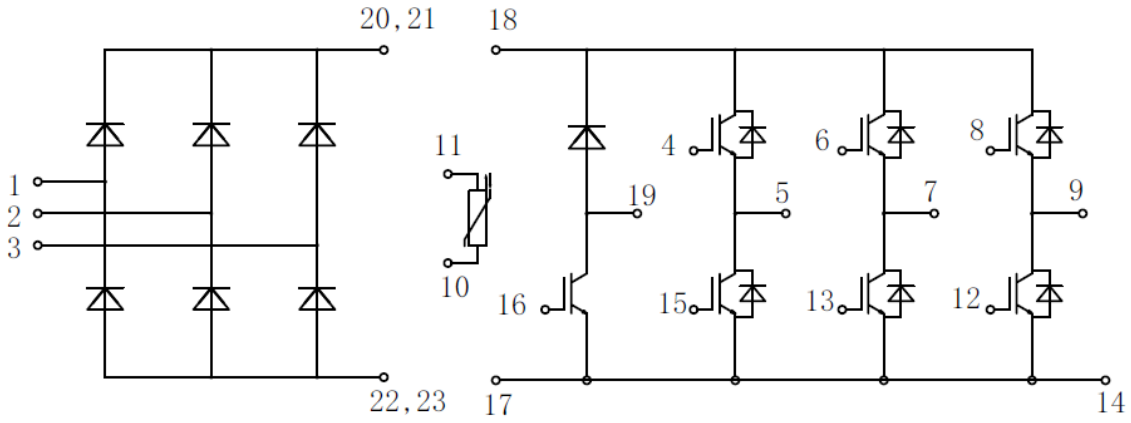
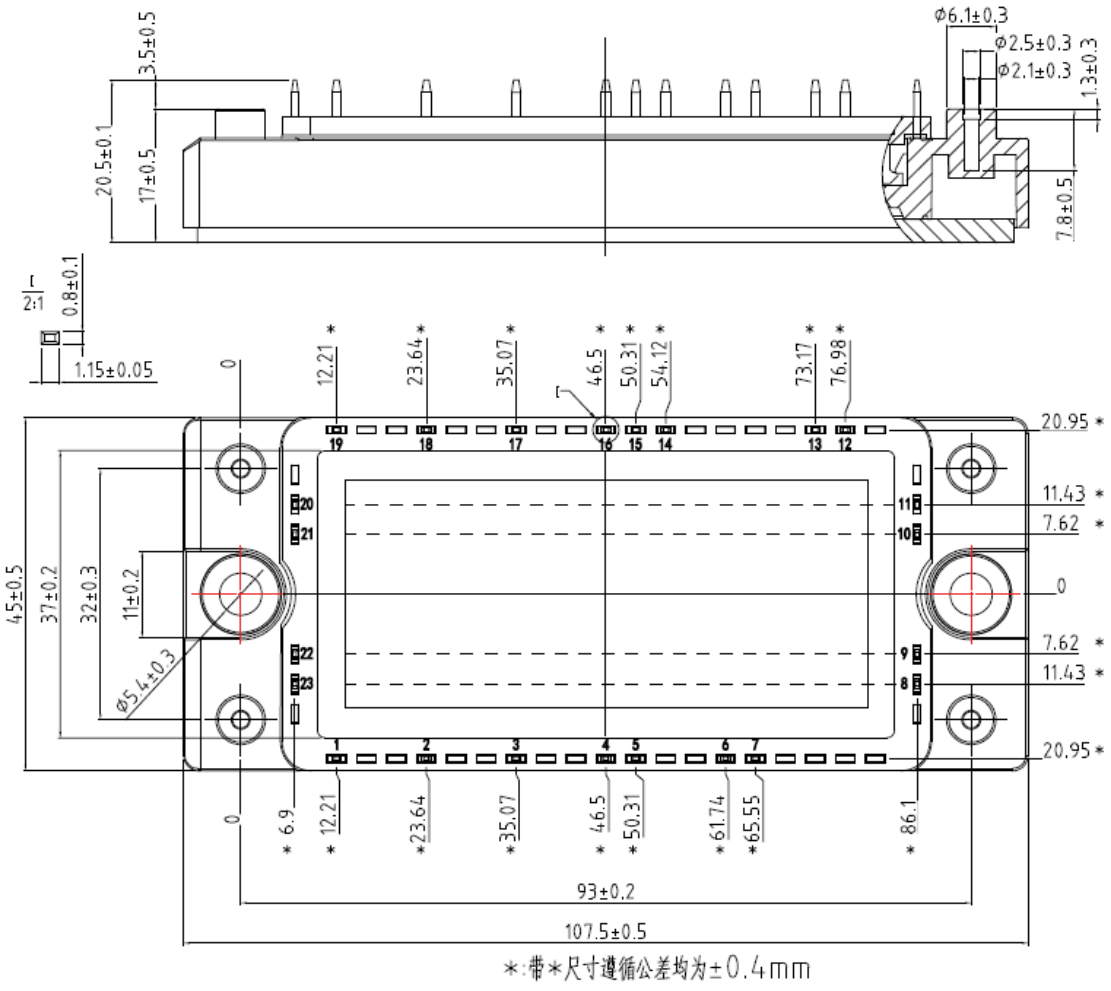
Circuit Diagram



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

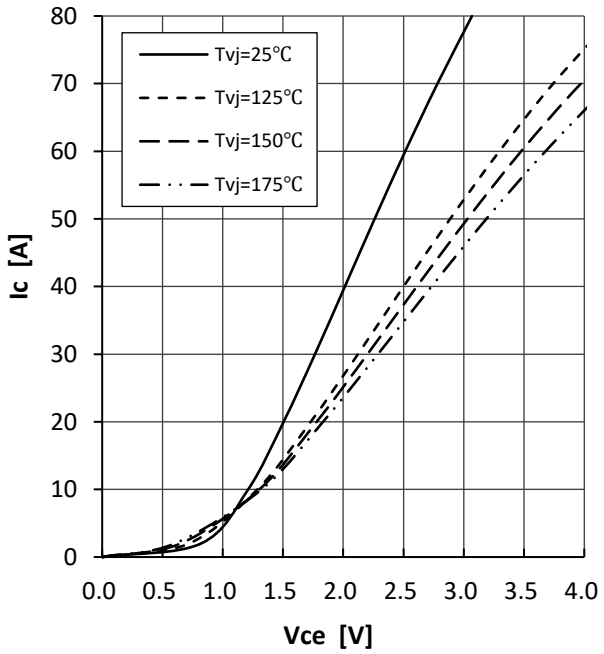

Fig 2. IGBT Output Characteristics
Inverter (typical)

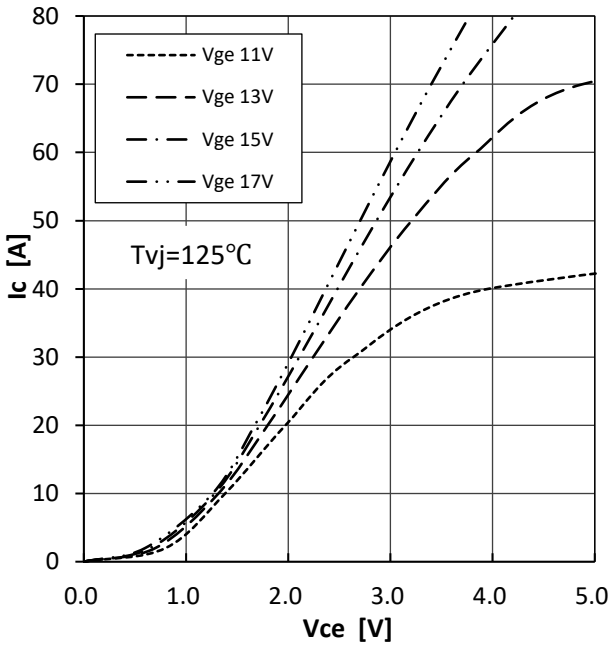

Fig 3. IGBT Transfer Characteristics
Inverter (typical) VCE=20 V

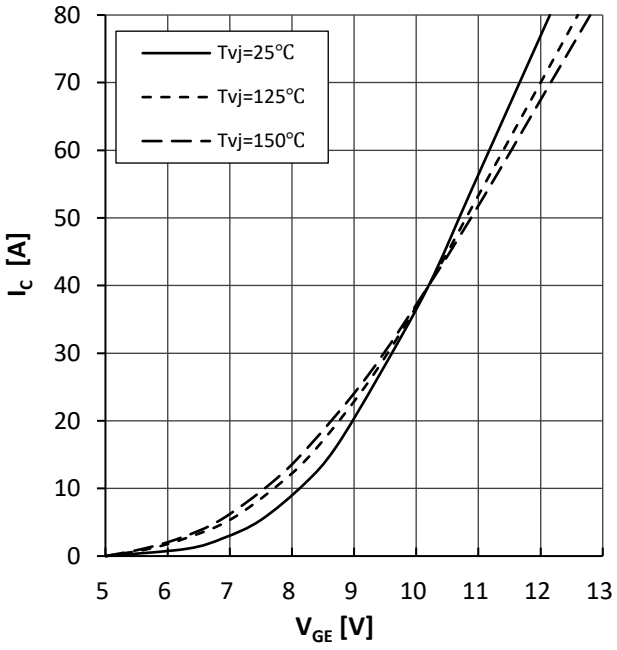

Fig 4. IGBT Switching Loss vs Ic
Inverter (typical)
Rg=15 Ω, VCE=600 V, VGE=±15 V

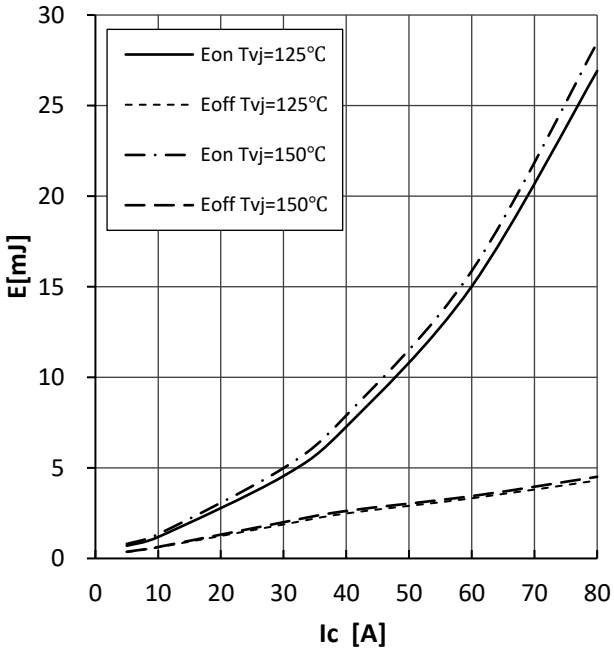

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Fig 5. IGBT Switching Loss vs. Rg,
Inverter (typical）
Ic=40 A, VCE=600 V, VGE=±15 V

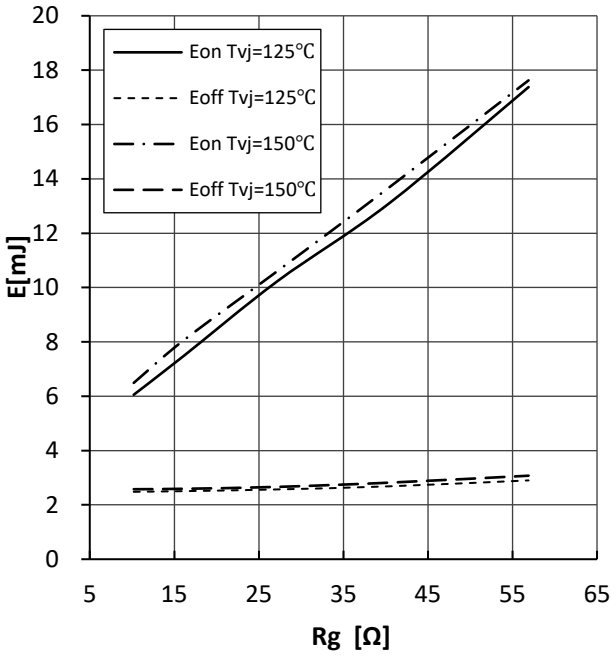

Fig 6. IGBT Transient Thermal Impedance
Inverter

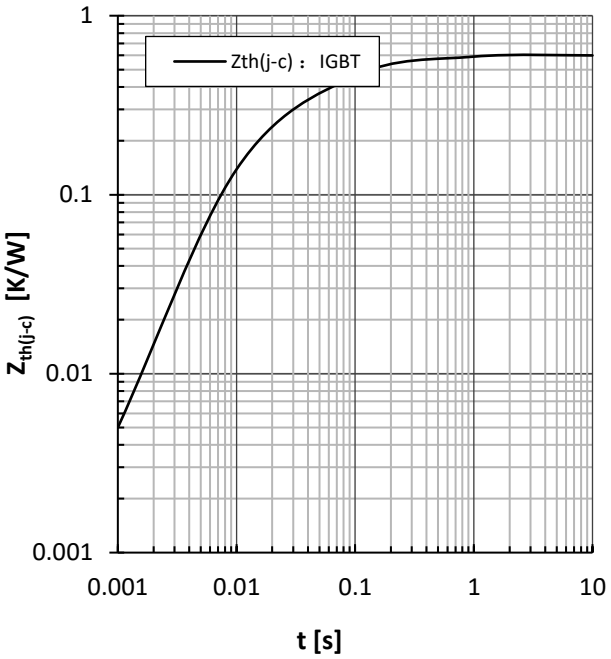

Fig 7. Reverse bias safe operating area
IGBT, Inverter (RBSOA)

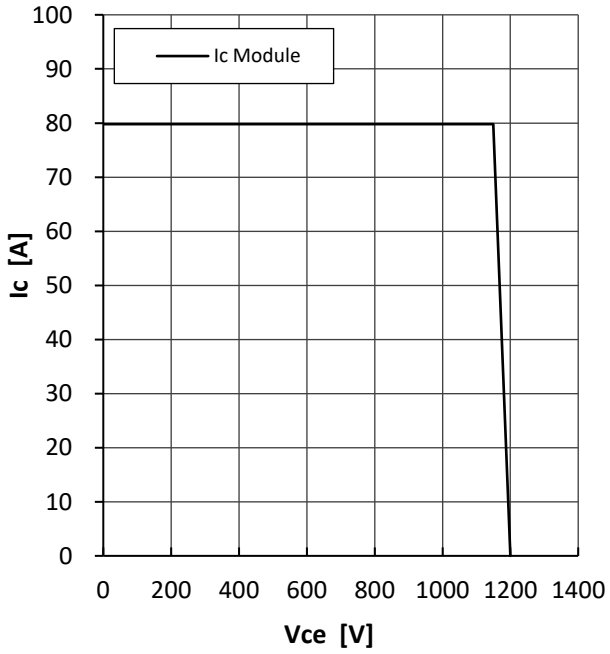

Fig 8. FRED Forward Characteristics,
Inverter (typical)

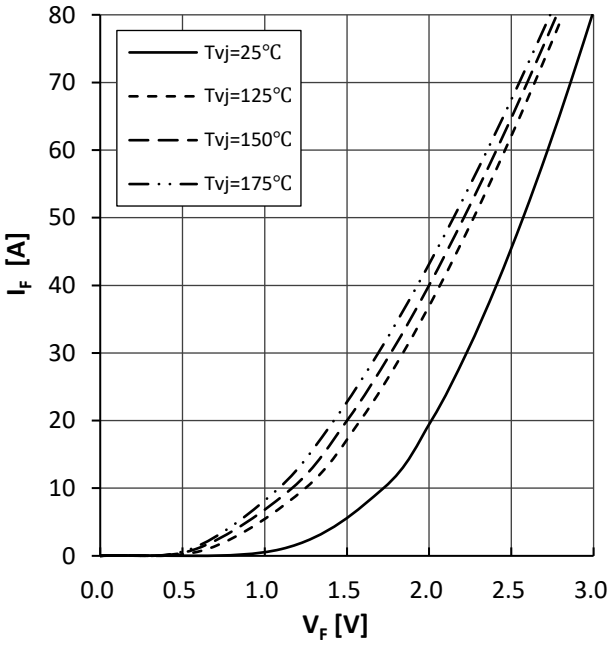

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Fig 9. FRED Switching Loss vs. Ic,
Inverter (typical)
Rg=15 Ω, VCE=600 V

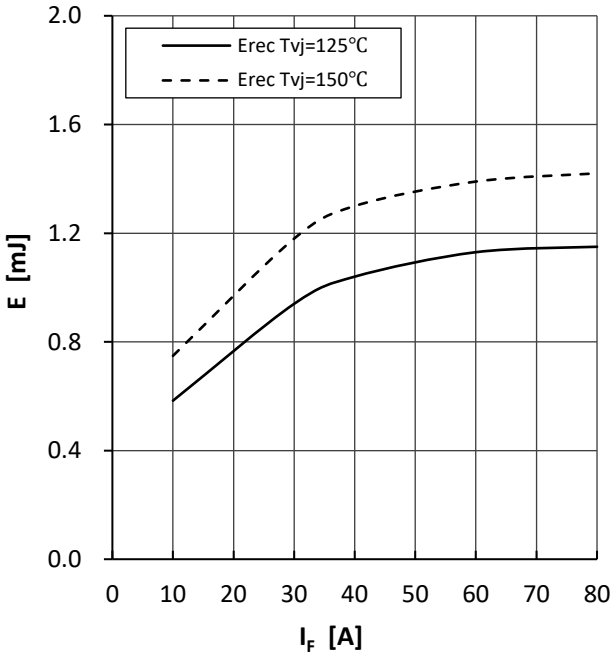

Fig 10. FRED Switching Loss vs. Rg,
Inverter (typical)
Ic=40 A, VCE=600 V

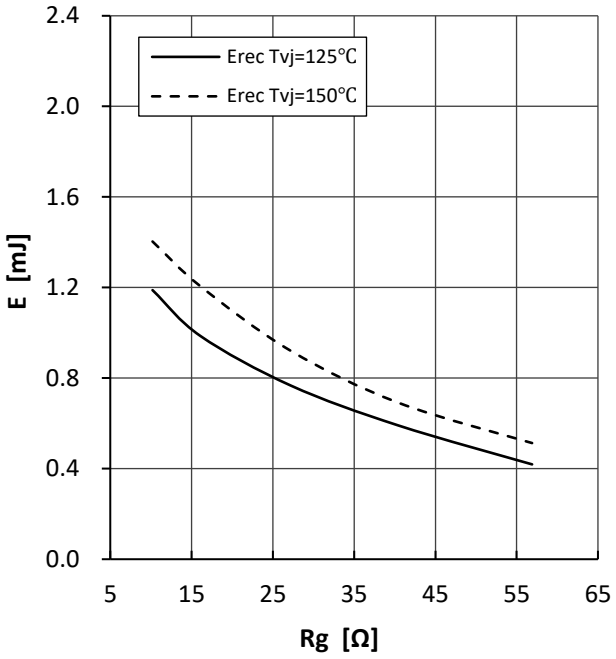

Fig 11. FRED Transient Thermal Impedance
Inverter

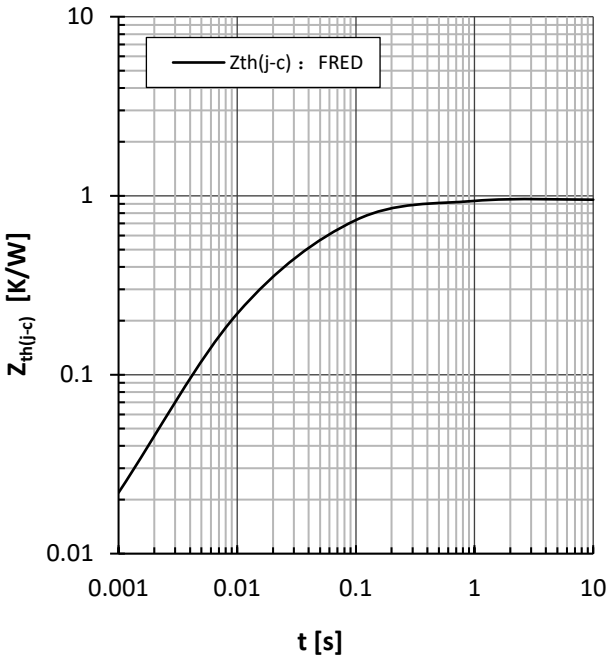

Fig 12. Diode Rectifier Forward Characteristics

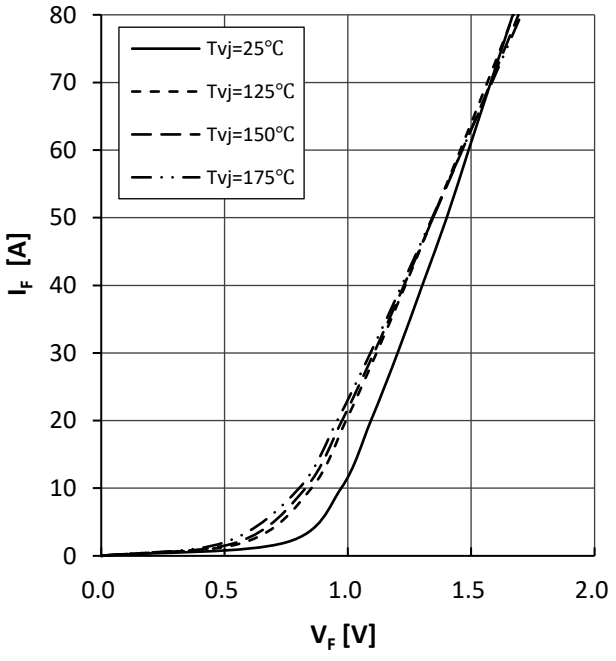

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Fig 13. Diode Rectifier Transient Thermal Impedance

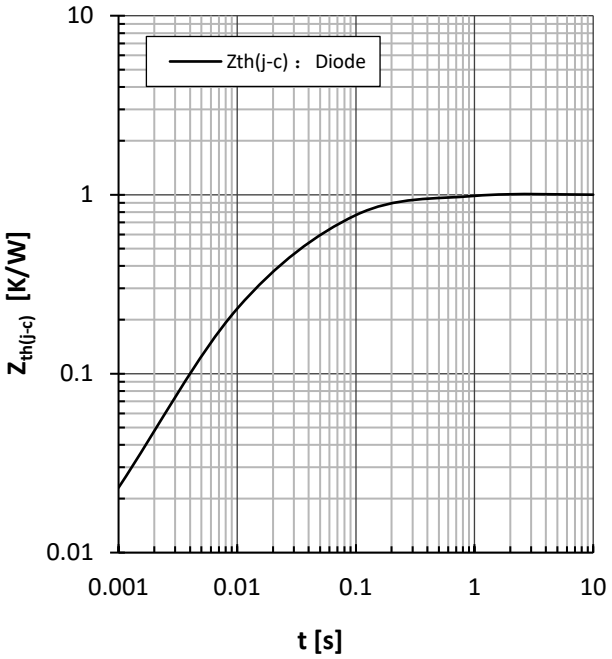


Fig 14. IGBT Output Characteristics，
Brake-Chopper (typical) VGE=15 V

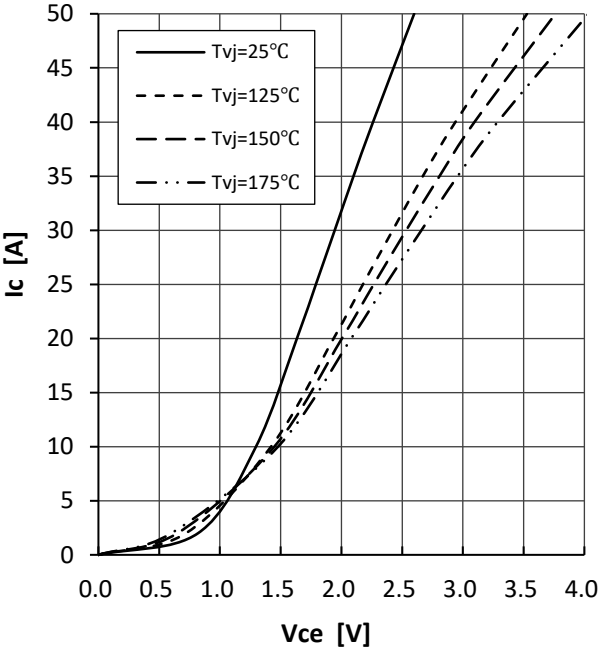


Fig 15. FRED Forward Characteristics,
Brake-Chopper (typical)

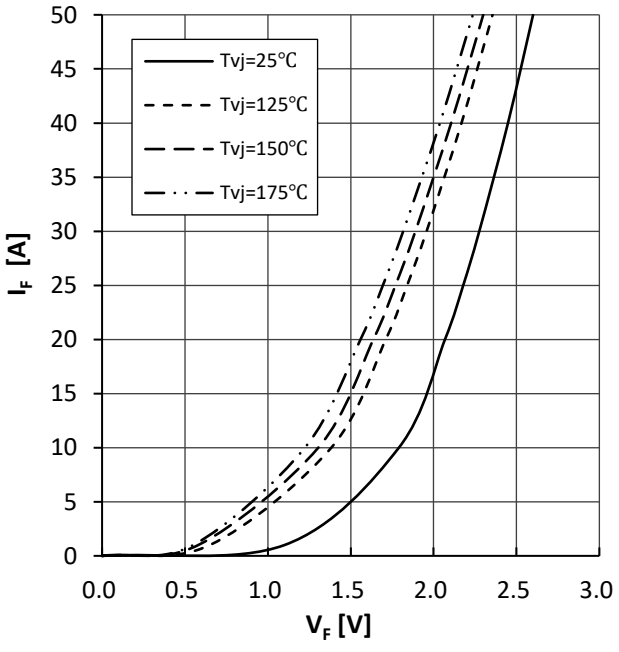
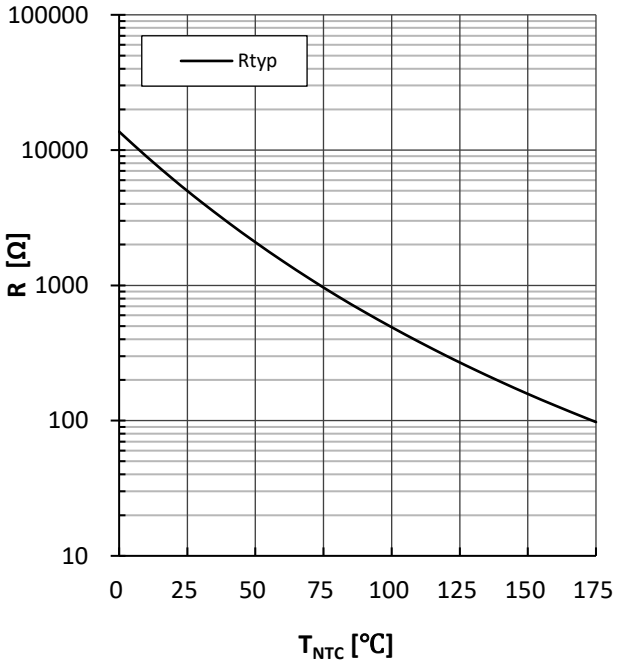


Fig 16. Temperature characteristics,
NTC thermistor (typical)



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