Trench FS IGBT

Features

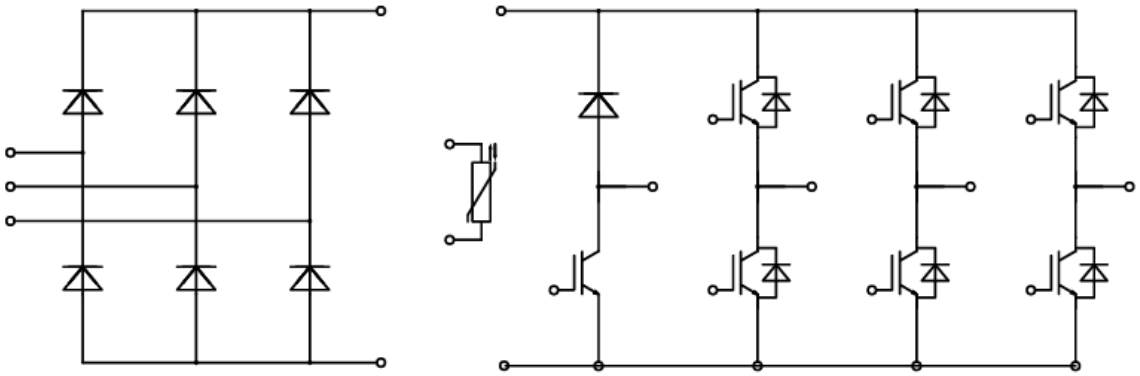
- High Power Density
- High mechanical robustness
- Compact design
- Isolated heatsink using DBC technology
- Very low forward voltage drop
- Fast & soft reverse recovery anti-parallel FWD

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)	1.80	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	I_C	50	A
Repetitive peak collector current	t_P = 1ms	I_{CRM}	100	A
Total power dissipation	T_C = 25°C, T_{vj} = 175°C	P_{tot}	380	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	$V_{CE(sat)}$		1.80	2.15	V
		T_{vj} = 125°C			2.10		
Gate threshold voltage	V_{CE}=V_{GE}, I_C=1mA		$V_{GE(th)}$	5.6	6.2	6.8	V
Gate-emitter leakage current	V_{CE} = 0V, V_{GE} = 20V		I_{GES}			400	nA
Collector-emitter cut-off 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}		7.76		nF
Output capacitance			C_{oes}		0.22		nF
Gate charge	V_{GE} = -15V…+15V		Q_G		0.58		μC
Internal gate resistor			R_{Gint}		5.0		Ω,
Turn-on delay time, inductive load	V_{CE} = 600V, I_C = 50A, R_G =15Ω, V_{GE} = ±15V, T_{vj} = 25℃		$t_{d(on)}$		158		ns
Rise time, inductive load			t_r		94		ns
Turn-off delay time, inductive load			$t_{d(off)}$		208		ns
Fall time, inductive load			t_f		142		ns
Turn-on energy loss per pulse			E_{on}		5.60		mJ
Turn-off energy loss per pulse			E_{off}		2.84		mJ
Turn-on delay time, inductive load	V_{CE} = 600V, I_C = 50A, R_G =15Ω, V_{GE} = ±15V, T_{vj} = 125℃		$t_{d(on)}$		152		μs
Rise time, inductive load			t_r		104		μs
Turn-off delay time, inductive load			$t_{d(off)}$		248		μs
Fall time, inductive load			t_f		179		μs
Turn-on energy loss per pulse			E_{on}		8.30		mJ
Turn-off energy loss per pulse			E_{off}		3.70		mJ
SC Data	tp≤10us，V_{GE}≤15V， V_{CC}=900V，T_{vj}=125℃		I_{SC}		300		A
Thermal resistance, junction to case	per IGBT		$R_{th(j-c)}$			0.60	K/W
Temperature under switching conditions			$T_{vj\ op}$	-40		175	℃

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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

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		2.10	2.30	V
		T_{vj} = 125°C			1.80		
Peak reverse recovery current	I_F=50A, V_R=600V, V_{GE}=-15V, di/dt=400A/μs	T_{vj} = 25°C	I_{RM}		11.7		A
		T_{vj} = 125°C			18.5		
Recovery charge		T_{vj} = 25°C	Q_{rr}		1.60		μC
		T_{vj} = 125°C			4.74		
Peak reverse recovery energy		T_{vj} = 25°C	E_{rec}		0.45		mJ
		T_{vj} = 125°C			1.30		
Thermal resistance, junction to case	per diode		$R_{th(j-c)}$			1.06	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
Bridge output current	T_C = 80℃	$I_{D(AV)}$	50	A
Repetitive peak forward current	t_P = 10 ms, T_{vj} = 25°C	I_{FSM}	600	A
	t_P = 10 ms, T_{vj} = 150°C		470	
I^2t value for fusing	t_P = 10 ms, T_{vj} = 25°C	I^2t	1800	A^2s
	t_P = 10 ms, T_{vj} = 150°C		1100	

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		1.0		V
Reverse current	T_{vj} = 150°C, V_R=1600V	I_R		2.0		mA
Thermal resistance, junction to case	per diode	$R_{th(j-c)}$			0.65	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	I_C	40	A
Repetitive peak collector current	t_P = 1ms	I_{CRM}	80	A
Total power dissipation	T_C = 25°C, T_{vj} = 175°C	P_{tot}	308	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 = 40A, V_{GE} = 15V	T_{vj} = 25°C	$V_{CE(sat)}$		1.80	2.15	V
		T_{vj} = 125°C			2.25		
Gate threshold voltage	V_{CE}=V_{GE}, I_C=0.7mA，		$V_{GE(th)}$	5.6	6.2	6.8	V
Gate-emitter leakage current	V_{CE} = 0V, V_{GE} = 20V		I_{GES}			400	nA
Collector-emitter cut-off 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}		5.18		nF
Output capacitance			C_{oes}		0.15		nF
Gate charge	V_{GE} = -15V…+15V		Q_G		0.39		μC
Internal gate resistor			R_{Gint}		0		Ω
Turn-on delay time, inductive load	V_{CC} = 600V, I_C = 40A, R_G = 15Ω, V_{GE} = ±15V, T_{vj} = 25℃		$t_{d(on)}$		104		ns
Rise time, inductive load			t_r		89		ns
Turn-off delay time, inductive load			$t_{d(off)}$		188		ns
Fall time, inductive load			t_f		62		ns
Turn-on energy loss per pulse			E_{on}		3.50		mJ
Turn-off energy loss per pulse			E_{off}		1.68		mJ
Turn-on delay time, inductive load	V_{CC} = 600V, I_C = 40A, R_G = 15Ω, L_σ = 35 nH, V_{GE} = ±15V, T_{vj} = 125℃		$t_{d(on)}$		102		ns
Rise time, inductive load			t_r		100		ns
Turn-off delay time, inductive load			$t_{d(off)}$		211		ns
Fall time, inductive load			t_f		136		ns
Turn-on energy loss per pulse			E_{on}		5.39		mJ
Turn-off energy loss per pulse			E_{off}		2.30		mJ
SC Data	tp≤10us， V_{GE}≤15V， V_{CC}=900V， T_{vj}=125℃		I_{SC}		250		A
Thermal resistance, junction to case	per IGBT		$R_{th(j-c)}$			0.90	K/W
Temperature under switching conditions			$T_{vj\ op}$	-40		150	℃

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FRED, Brake-Chopper Absolute Maximum Ratings (@ TC = 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	35	A
Repetitive peak forward current	t_P = 1ms	I_{FRM}	70	A

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

Parameter	Conditions		Symbol	Values			Unit
				Min.	Typ.	Max.	
Forward voltage	I_F = 35A, V_{GE} = 0V	T_{vj} = 25°C	V_F		2.00	2.30	V
		T_{vj} = 125°C			1.70		
Peak reverse recovery current	I_F = 35A, V_R = 600V, V_{GE} = -15V, di/dt =300A/µs	T_{vj} = 25°C	I_{RM}		9.5		A
		T_{vj} = 125°C			15.7		
Recovered charge		T_{vj} = 25°C	Q_{rr}		1.36		µC
		T_{vj} = 125°C			3.57		
Peak reverse recovery energy		T_{vj} = 25°C	E_{rec}		0.45		mJ
		T_{vj} = 125°C			1.12		
Thermal resistance, junction to case	per diode		$R_{th(j-c)}$			1.43	K/W
Temperature under switching conditions			$T_{vj\ op}$	-40		175	℃

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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	$R_{th(c-s)}$		0.009		K/W
Maximum Junction Temperature	Inverter, brake-chopper	$T_{vj\ max}$			175	℃
	rectifier				150	℃
Stray inductance module		L_{SCE}		25		nH
Module lead resistance, terminals - chip	per switch	$R_{CC'+EE'}$		1.6		mΩ
		$R_{AA'+CC'}$		1.1		mΩ
Storage Temperature		T_{stg}	-40		125	℃
Mounting force per clamp		F	3.0		6.0	N

Ordering Information

Device	Marking	Package	Weight	Inner Box	Per Carton
JMG50PM12P3S1	JMG50PM12P3S1	P3	300g/PCS	10PCS	50PCS

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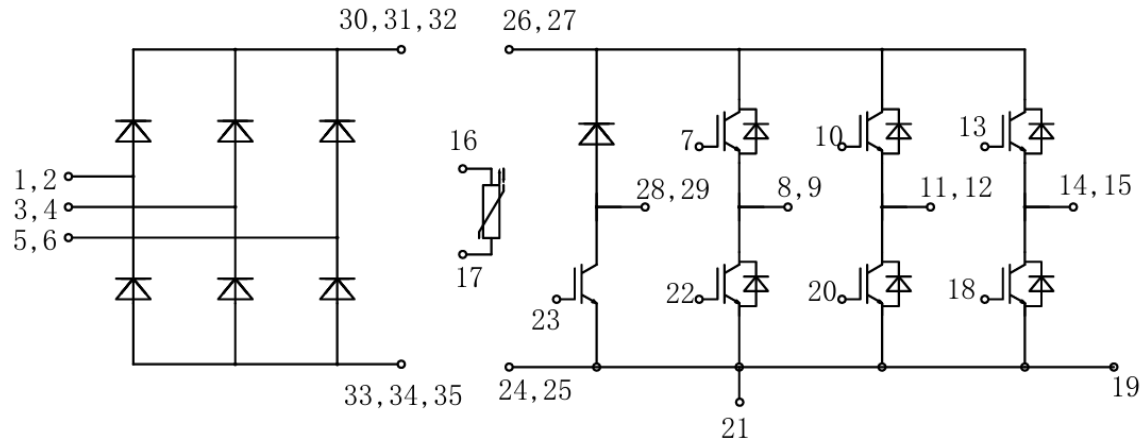
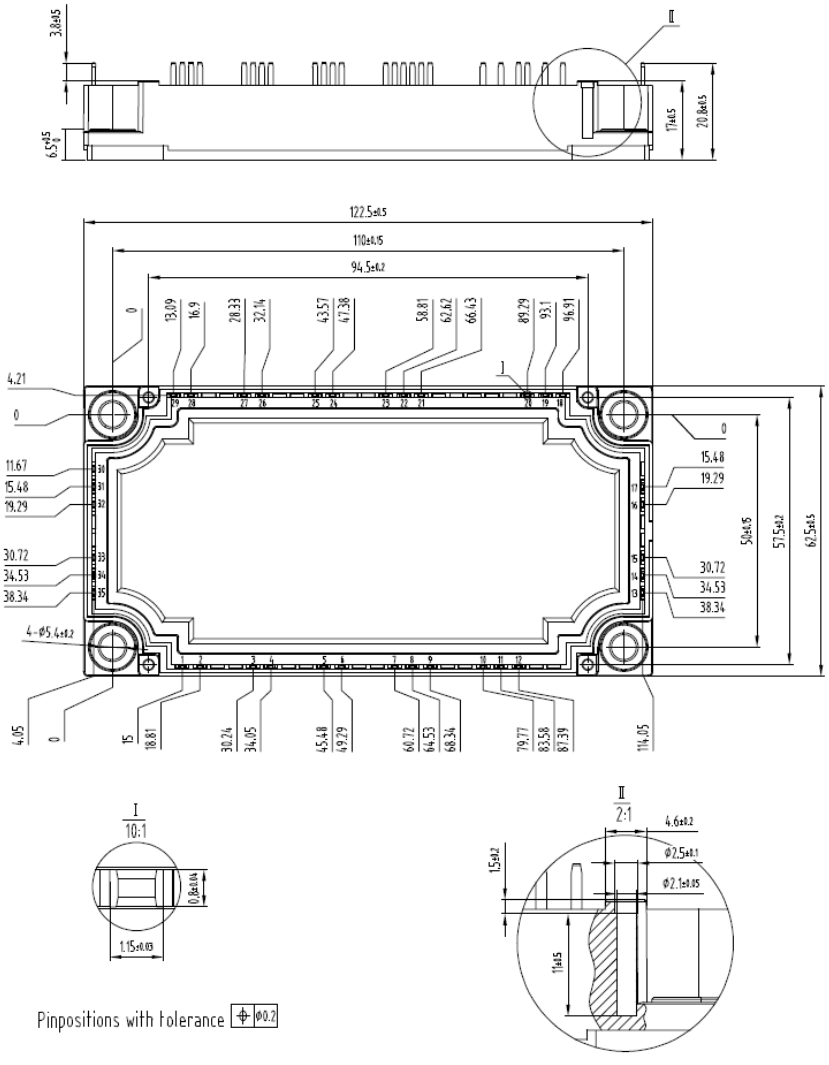
Circuit Diagram



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

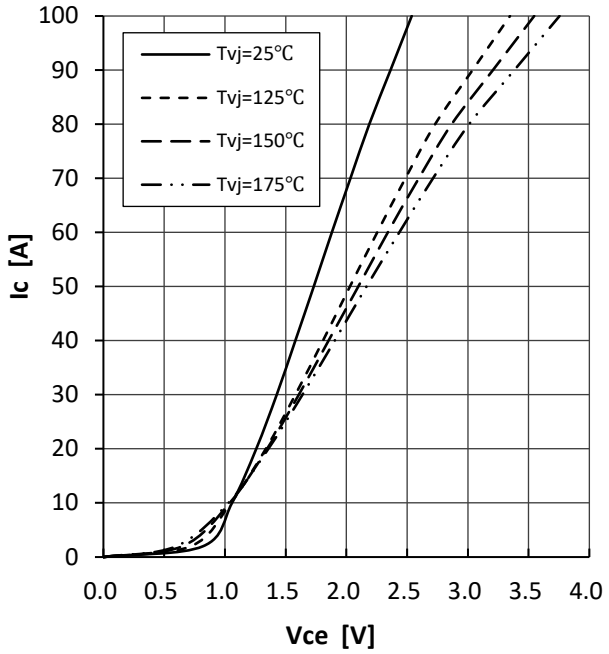

Fig 2. IGBT Output Characteristics
Inverter (typical)

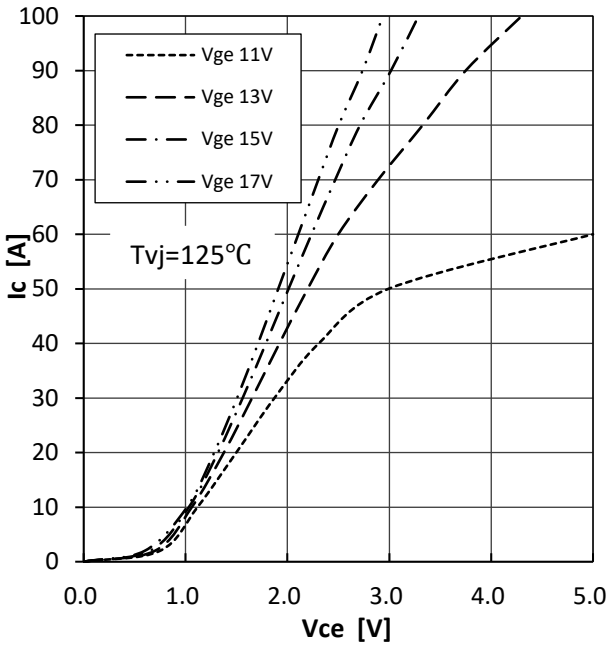

Fig 3. IGBT Transfer Characteristics
Inverter (typical) VCE=20 V

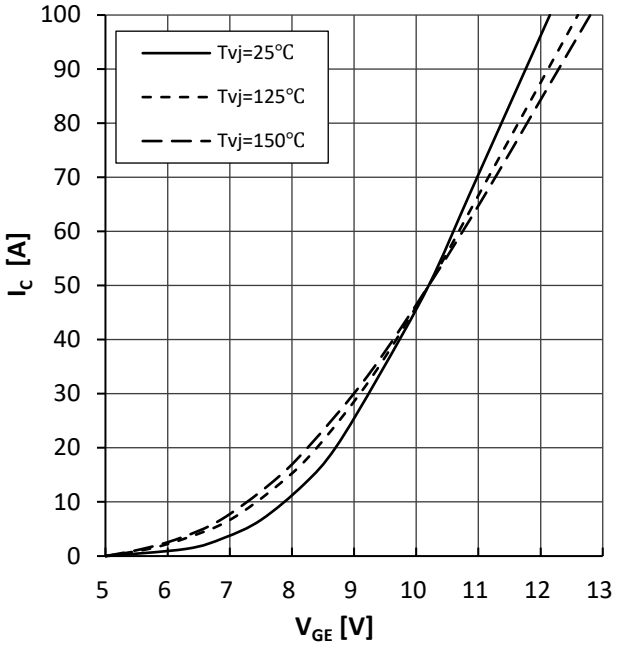

Fig 4. IGBT Switching Loss vs Ic
Inverter (typical)
Rg=15 Ω, VCE=600 V, VGE=±15 V

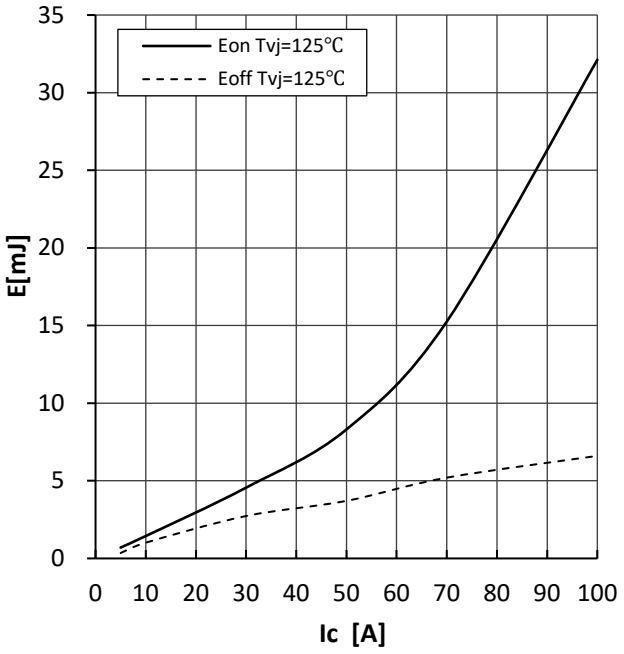

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Fig 5. IGBT Switching Loss vs. Rg,
Inverter (typical）
Ic=50 A, VCE=600 V, VGE=±15 V

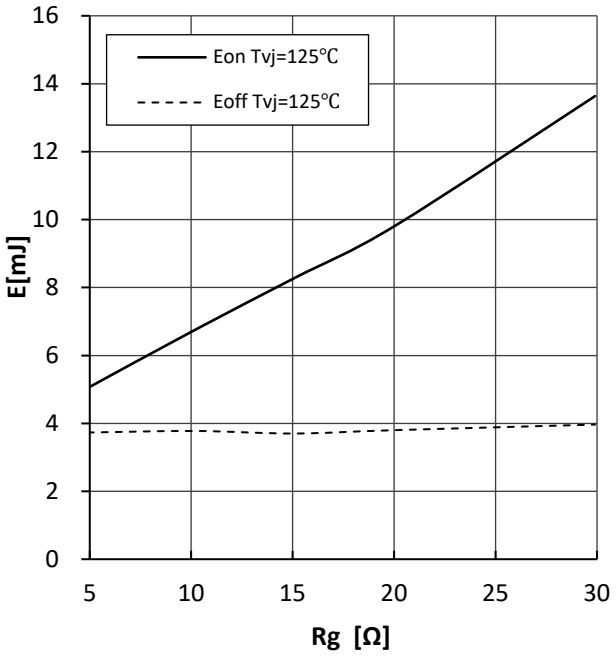

Fig 6. Reverse bias safe operating area
IGBT, Inverter (RBSOA)

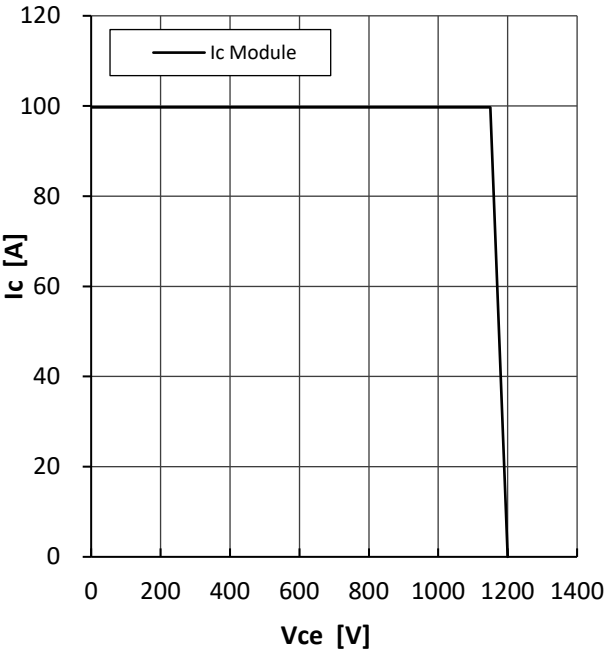

Fig 7. FRED Forward Characteristics,
Inverter (typical)

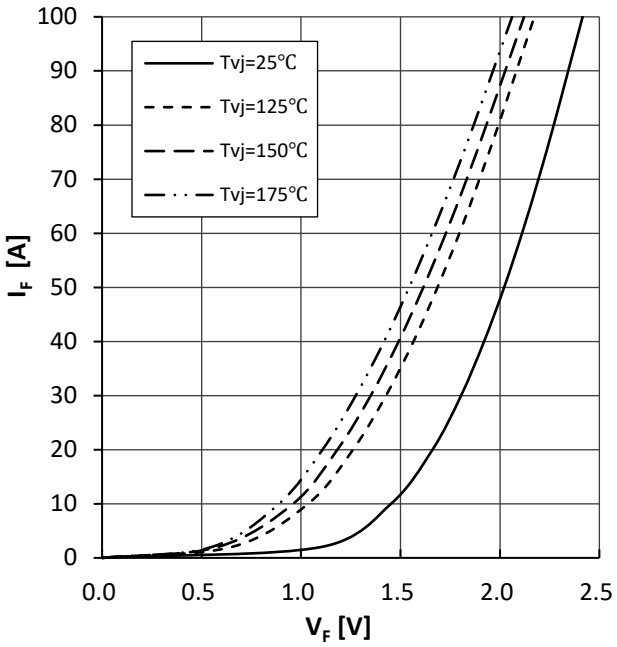

Fig 8. FRED Switching Loss vs. Ic,
Inverter (typical)
Rg=15 Ω, VCE=600 V

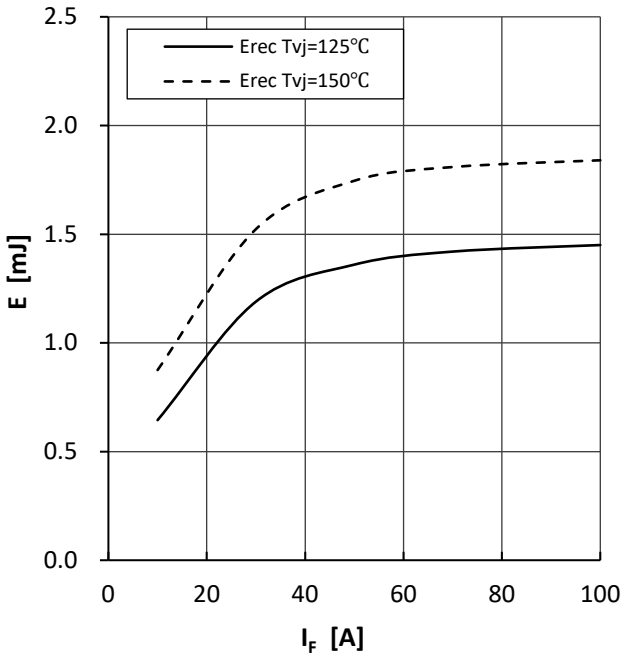

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Fig 9. FRED Switching Loss vs. Rg,
Inverter (typical)
Ic=50 A, VCE=600 V

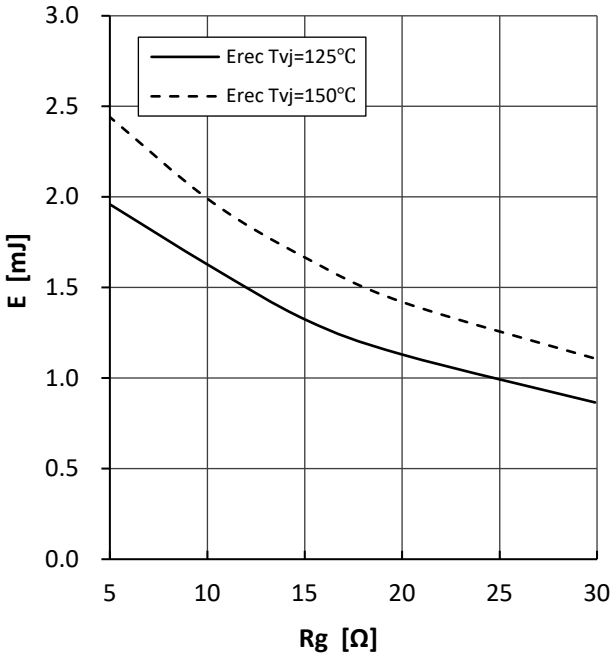

Fig 10. Diode Rectifier Forward Characteristics

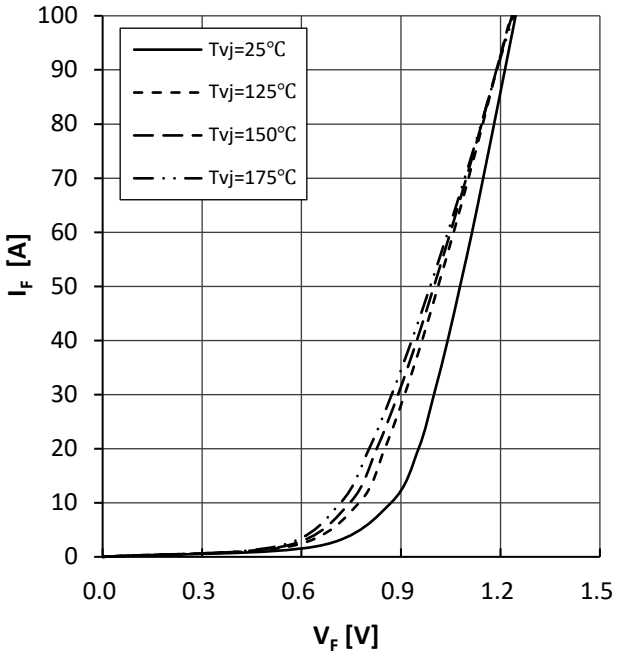

Fig 11. IGBT Output Characteristics，
Brake-Chopper (typical) VGE=15 V

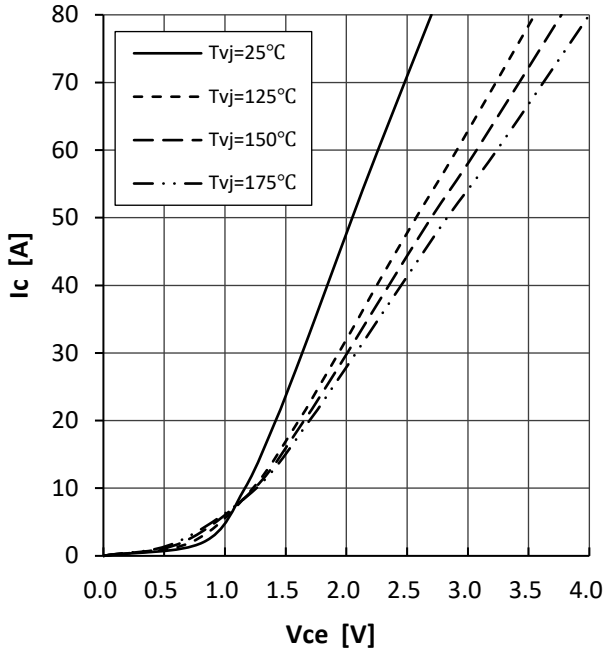

Fig 12. FRED Forward Characteristics,
Brake-Chopper (typical)

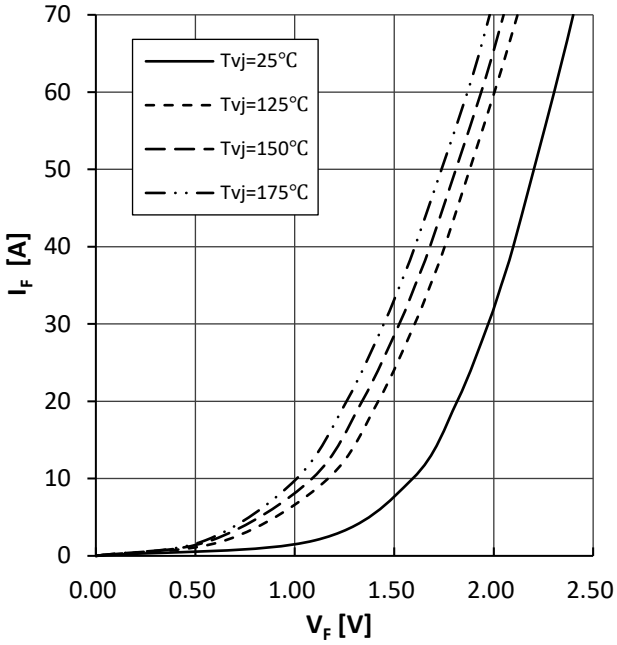

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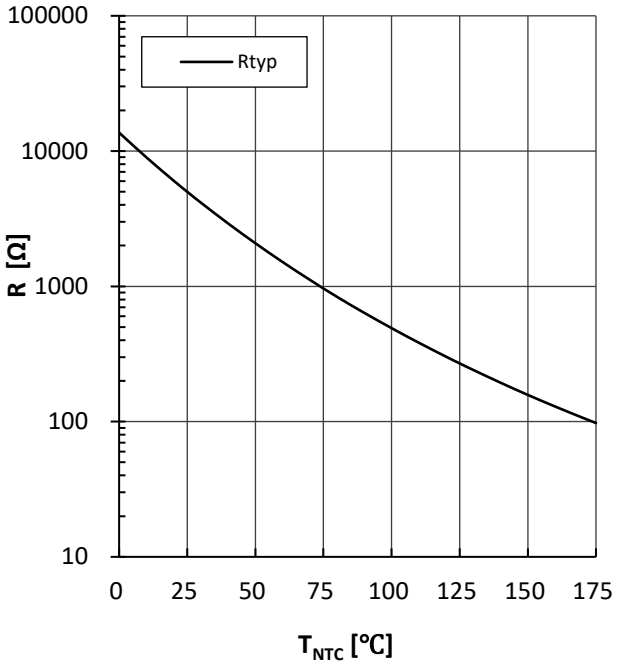
Fig 13. Temperature characteristics,
NTC thermistor (typical)



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