



JMG50PM12E2S1

Trench FS IGBT

Features

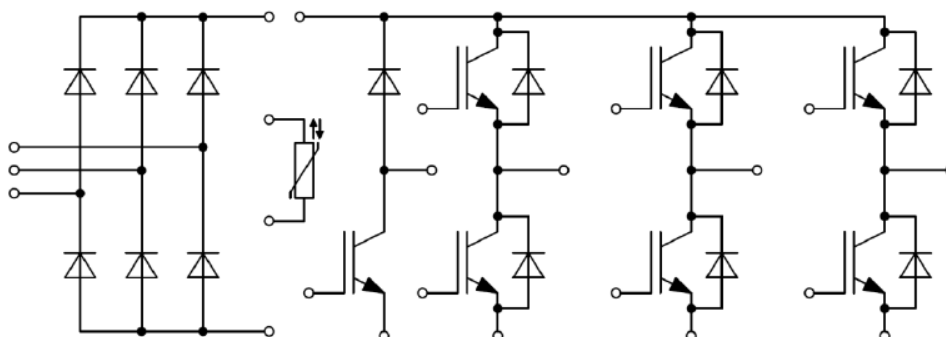
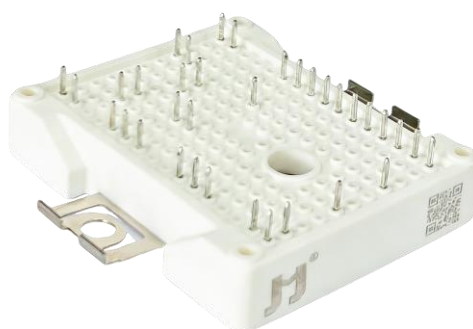
- High Power Density
- High mechanical robustness
- Compact design
- Isolated heatsink using DBC technology
- Very low forward voltage drop
- Fast & soft reverse recovery anti-parallel FWD

Product Summary

Parameter	Value	Unit
V_{CES}	1200	V
$I_C(@ T_C = 100^\circ\text{C})$	50	A
$I_{CRM}(@ t_p = 1\text{ms})$	100	A
$V_{CE(sat)}(\text{Typ})$	1.90	V

Applications

- Active Rectifier
- Air Conditioning
- Motor Drives



IGBT, Inverter Absolute Maximum Ratings (@ $T_C = 25^\circ\text{C}$ unless otherwise specified)

Parameter	Conditions	Symbol	Values	Unit
Collector-emitter voltage	$T_{vj} = 25^\circ\text{C}$	V_{CES}	1200	V
Gate-emitter peak voltage		V_{GES}	± 20	V
Continuous collector current	$T_C = 100^\circ\text{C}, T_{vj} = 175^\circ\text{C}$	$I_{C\text{ nom}}$	50	A
Repetitive peak collector current	$t_p = 1\text{ms}$	I_{CRM}	100	A

**IGBT, Inverter Electrical Characteristics (@ $T_C = 25^\circ\text{C}$ unless otherwise specified)**

Parameter	Conditions		Symbol	Values			Unit
				Min.	Typ.	Max.	
Collector-emitter saturation voltage	$I_C = 50\text{A}$, $V_{GE} = 15\text{V}$	$T_{vj} = 25^\circ\text{C}$	$V_{CE(sat)}$		1.90	2.25	V
		$T_{vj} = 125^\circ\text{C}$			2.30		
Gate threshold voltage	$V_{CE}=V_{GE}$, $I_C=1\text{mA}$		$V_{GE(th)}$	5.2	6.0	6.4	V
Gate-emitter leakage current	$V_{CE} = 0\text{V}$, $V_{GE} = 20\text{V}$		I_{GES}			400	nA
Collector leakage current	$V_{CE}=1200\text{V}$, $V_{GE}=0\text{V}$		I_{CES}			1	mA
Input capacitance	$f = 1\text{MHz}$, $T_{vj} = 25^\circ\text{C}$, $V_{CE} = 25\text{V}$, $V_{GE} = 0\text{V}$		C_{ies}		4.42		nF
Output capacitance			C_{oes}		0.04		nF
Gate charge	$V_{GE} = -15\text{V} \dots +15\text{V}$		Q_G		0.32		uC
Turn-on delay time, inductive load	$V_{CE} = 600\text{V}$, $I_C = 50\text{A}$, $R_G = 20\Omega$, $V_{GE} = \pm 15\text{V}$, $T_{vj} = 25^\circ\text{C}$		$t_{d(on)}$		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	$V_{CE} = 600\text{V}$, $I_C = 50\text{A}$, $R_G = 20\Omega$, $V_{GE} = \pm 15\text{V}$, $T_{vj} = 125^\circ\text{C}$		$t_{d(on)}$		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	$t_p \leq 10\mu\text{s}$, $V_{GE} \leq 15\text{V}$, $V_{CC} = 800\text{V}$, $V_{CEM} \leq 1200\text{V}$, $T_{vj} = 125^\circ\text{C}$		I_{SC}		150		A
Thermal resistance, junction to case	per IGBT		$R_{th(j-c)}$		0.60	0.70	K/W
Temperature under switching conditions			$T_{vj op}$	-40		150	$^\circ\text{C}$

**FRED, Inverter Absolute Maximum Ratings (@ $T_C = 25^\circ\text{C}$ unless otherwise specified)**

Parameter	Conditions	Symbol	Values	Unit
Repetitive peak reverse voltage	$T_{vj} = 25^\circ\text{C}$	V_{RRM}	1200	V
Continuous DC forward current		I_F	30	A
Repetitive peak forward current	$t_P = 1\text{ms}$	I_{FRM}	60	A
I^2t value for fusing	$t = 10\text{ms}$, $V_R = 0\text{V}$, $T_{vj} = 150^\circ\text{C}$,	I^2t	220	A^2s

FRED, Inverter Electrical Characteristics (@ $T_C = 25^\circ\text{C}$ unless otherwise specified)

Parameter	Conditions		Symbol	Values			Unit
				Min.	Typ.	Max.	
Forward voltage	$I_F = 30A$, $V_{GE} = 0V$	$T_{vj} = 25^{\circ}C$	V_F		2.10	2.50	V
		$T_{vj} = 125^{\circ}C$			1.70		
Peak reverse recovery current	$I_F = 30A$, $di/dt = 500A/\mu s$, $V_R = 600V$, $V_{GE} = -15V$	$T_{vj} = 25^{\circ}C$	I_{RM}		15.5		A
		$T_{vj} = 125^{\circ}C$			21.3		
Recovered charge		$T_{vj} = 25^{\circ}C$	Q_{rr}		1.5		μC
		$T_{vj} = 125^{\circ}C$			4.0		
Peak reverse recovery energy		$T_{vj} = 25^{\circ}C$	E_{rec}		0.43		mJ
		$T_{vj} = 125^{\circ}C$			1.15		
Thermal resistance, junction to case	per diode		$R_{th(j-c)}$		0.80	0.90	K/W
Temperature under switching conditions			$T_{vj\ op}$	-40		150	$^{\circ}C$

**Diode, Rectifier Absolute Maximum Ratings (@ $T_C = 25^\circ\text{C}$ unless otherwise specified)**

Parameter	Conditions	Symbol	Values	Unit
Repetitive peak reverse voltage	$T_{vj} = 25^\circ\text{C}$	V_{RRM}	1600	V
Maximum RMS forward current per chip	$T_C = 80^\circ\text{C}$	I_{FRMSM}	50	A
Maximum RMS current at rectifier output	$T_C = 80^\circ\text{C}$	I_{RMSM}	50	A
Repetitive peak forward current	$t_P = 10\text{ ms}$, $T_{vj} = 25^\circ\text{C}$	I_{FSM}	450	A
I^2t value for fusing	$t_P = 10\text{ ms}$, $T_{vj} = 25^\circ\text{C}$	I^2t	1000	A^2s

Diode, Rectifier Electrical Characteristics (@ $T_C = 25^\circ\text{C}$ unless otherwise specified)

Parameter	Conditions	Symbol	Values			Unit
			Min.	Typ.	Max.	
Forward voltage	$T_{vj} = 150^\circ\text{C}$, $I_F = 50\text{A}$	V_F		1.35		V
Reverse current	$T_{vj} = 150^\circ\text{C}$, $V_R = 1600\text{V}$	I_R		1.0		mA
Thermal resistance, junction to case	per diode	R_{thJC}		1.05	1.15	K/W
Temperature under switching conditions		T_{VJOP}	-40		150	$^\circ\text{C}$

IGBT, Brake-Chopper Absolute Maximum Ratings (@ $T_C = 25^\circ\text{C}$ unless otherwise specified)

Parameter	Conditions	Symbol	Values	Unit
Collector-emitter voltage	$T_{vj} = 25^\circ\text{C}$	V_{CES}	1200	V
Gate-emitter peak voltage		V_{GES}	± 20	V
Continuous collector current	$T_C = 100^\circ\text{C}$, $T_{vj} = 175^\circ\text{C}$	$I_{C\text{ nom}}$	25	
Repetitive peak collector current	$t_P = 1\text{ms}$	I_{CRM}	50	A

**IGBT, Brake-Chopper Electrical Characteristics (@ $T_C = 25^\circ\text{C}$ unless otherwise specified)**

Parameter	Conditions		Symbol	Values			Unit
				Min.	Typ.	Max.	
Collector-emitter saturation voltage	$I_C = 25\text{A}$, $V_{GE} = 15\text{V}$	$T_{vj} = 25^\circ\text{C}$	$V_{CE(sat)}$		2.00	2.30	V
		$T_{vj} = 125^\circ\text{C}$			2.40		
Gate threshold voltage	$V_{CE}=V_{GE}$, $I_C=0.70\text{mA}$,		$V_{GE(th)}$	5.4	5.2	7.0	V
Gate-emitter leakage current	$V_{CE} = 0\text{V}$, $V_{GE} = 20\text{V}$		I_{GES}			400	nA
Collector leakage current	$V_{CE}=1200\text{V}$, $V_{GE}=0\text{V}$		I_{CES}			1.0	mA
Input capacitance	$f = 1\text{MHz}$, $T_{vj} = 25^\circ\text{C}$, $V_{CE} = 25\text{V}$, $V_{GE} = 0\text{V}$		C_{ies}		3.09		nF
Output capacitance			C_{oes}		0.03		nF
Gate charge	$V_{GE} = -15\text{V} \dots +15\text{V}$		Q_G		0.22		uC
Turn-on delay time, inductive load	$V_{CC} = 600\text{V}$, $I_C = 25\text{A}$, $R_G = 27\Omega$, $V_{GE} = \pm 15\text{V}$, $T_{vj} = 25^\circ\text{C}$		$t_{d(on)}$		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	$V_{CC} = 600\text{V}$, $I_C = 25\text{A}$, $R_G = 27\Omega$, $V_{GE} = \pm 15\text{V}$, $T_{vj} = 125^\circ\text{C}$		$t_{d(on)}$		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	$t_p \leq 10\mu\text{s}$, $V_{GE} \leq 15\text{V}$, $V_{CE} = 800\text{V}$, $V_{CEM} \leq 1200\text{V}$, $T_{vj} = 125^\circ\text{C}$		I_{SC}		80		A
Thermal resistance, junction to case	per IGBT		$R_{th(j-c)}$		0.60	0.70	K/W
Temperature under switching conditions			$T_{vj op}$	-40		150	$^\circ\text{C}$

**FRED, Brake-Chopper Absolute Maximum Ratings (@ $T_C = 25^\circ\text{C}$ unless otherwise specified)**

Parameter	Conditions	Symbol	Values	Unit
Repetitive peak reverse voltage	$T_{vj} = 25^\circ\text{C}$	V_{RRM}	1200	V
Continuous DC forward current		I_F	15	A
Repetitive peak forward current	$t_P = 1\text{ms}$	I_{FRM}	30	A
I^2t value for fusing	$T_{vj} = 125^\circ\text{C}$, $t_P = 10\text{ms}$, $V_R = 0\text{V}$	I^2t	16	A^2s

FRED, Brake-Chopper Electrical Characteristics (@ $T_C = 25^\circ\text{C}$ 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		
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)}		1.75	1.90	K/W
Temperature under switching conditions			T _{vj op}	-40		150	°C

**NTC-Thermistor Characteristics (@ $T_C = 25^\circ\text{C}$ unless otherwise specified)**

Parameter	Conditions	Symbol	Values			Unit
			Min.	Typ.	Max.	
Rated resistance	$T_C = 25^\circ\text{C}$	R_{25}		5		K Ω
Deviation of R100	$T_C = 100^\circ\text{C}$, $R_{100} = 493 \Omega$	$\Delta R/R$	-5		5	%
Power dissipation	$T_C = 25^\circ\text{C}$	P_{25}			20	mW
B-value	$R_2 = R_{25} \exp [B_{25}/50(1/T_2 - 1/(298,15 \text{ K}))]$	$B_{25}/50$		3375		K
B-value	$R_2 = R_{25} \exp [B_{25}/80(1/T_2 - 1/(298,15 \text{ K}))]$	$B_{25}/80$		3411		K
B-value	$R_2 = R_{25} \exp [B_{25}/100(1/T_2 - 1/(298,15 \text{ K}))]$	$B_{25}/100$		3433		K

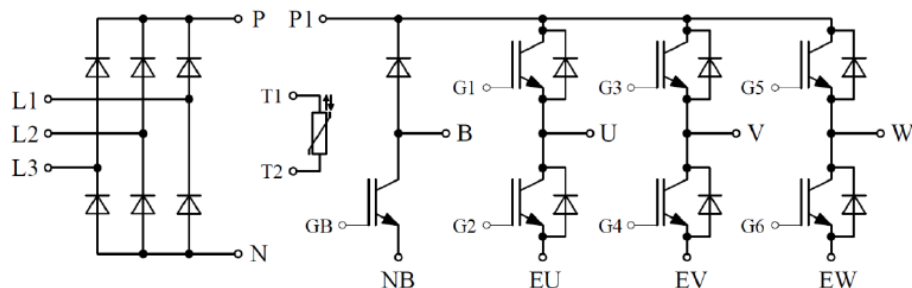
Module Characteristics

Parameter	Conditions	Symbol	Values			Unit
			Min.	Typ.	Max.	
Isolation Voltage (All Terminals Shorted)	RMS, $f = 50\text{Hz}$, 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	$^\circ\text{C}$
	rectifier				150	$^\circ\text{C}$
Stray inductance module		L_{SCE}		30		nH
Module lead resistance, terminals - chip	per switch	$R_{CC'+EE'}$		6		m Ω
		$R_{AA'+CC'}$		5		m Ω
Storage Temperature		T_{stg}	-40		125	$^\circ\text{C}$
Mounting force per clamp		F	40		80	N

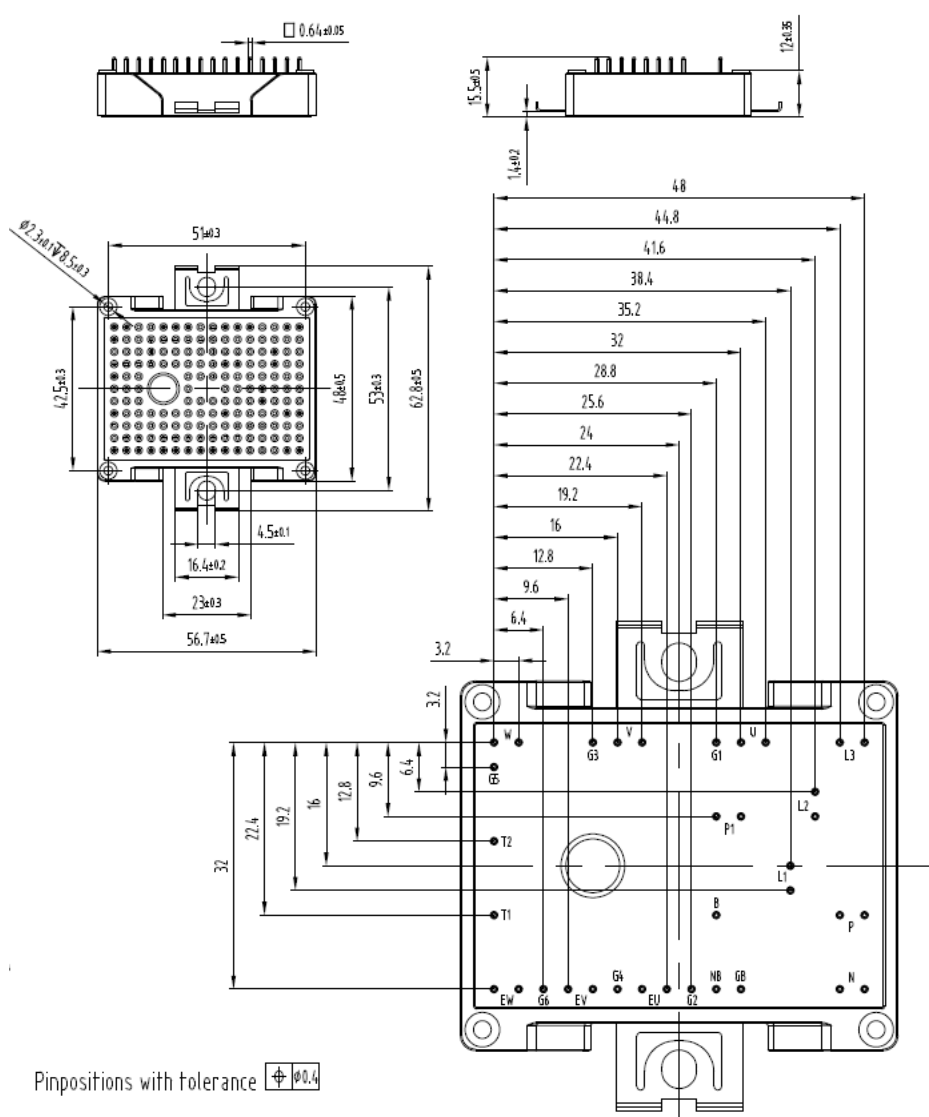
Ordering Information

Device	Marking	Package	Weight	Inner Box	Per Carton
JMG50PM12E2S1	JMG50PM12E2S1	E2	39g/PCS	20PCS	100PCS

Circuit Diagram



Package Outlines (mm)



Unit of measurement: mm

Typical Electrical & Thermal Characteristics

Fig 1. IGBT Output Characteristics,
Inverter(typical) $V_{GE}=15\text{ V}$

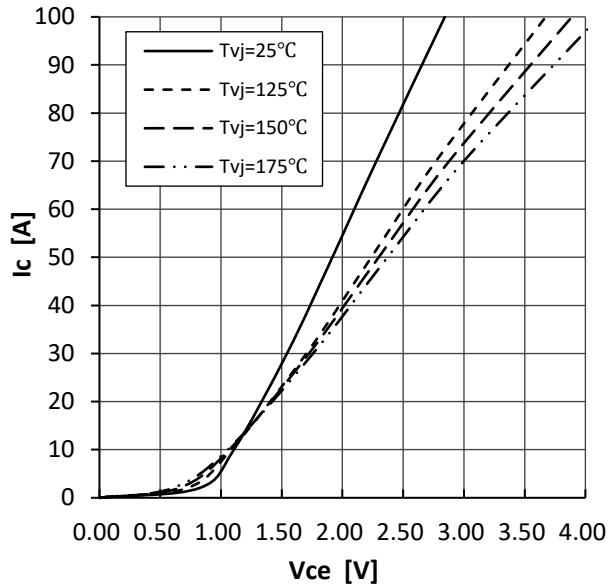


Fig 2. IGBT Output Characteristics,
Inverter(typical)

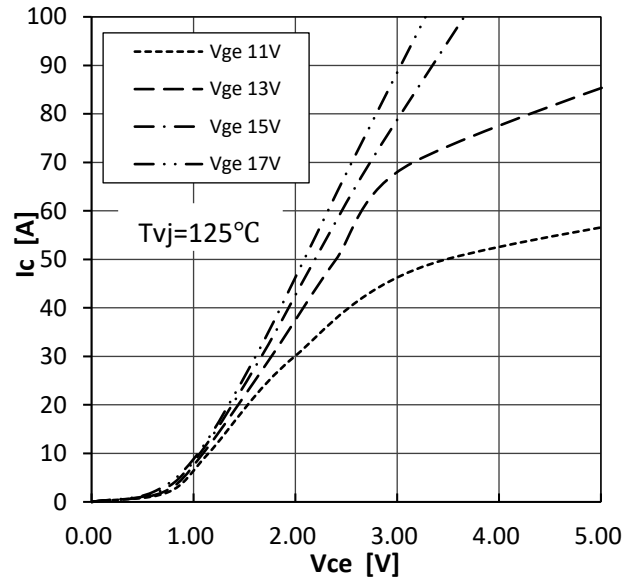


Fig 3. IGBT Switching Loss vs. I_c ,
Inverter(typical)
 $R_g=20\ \Omega$, $V_{CE}=600\text{ V}$, $V_{GE}=\pm 15\text{ V}$

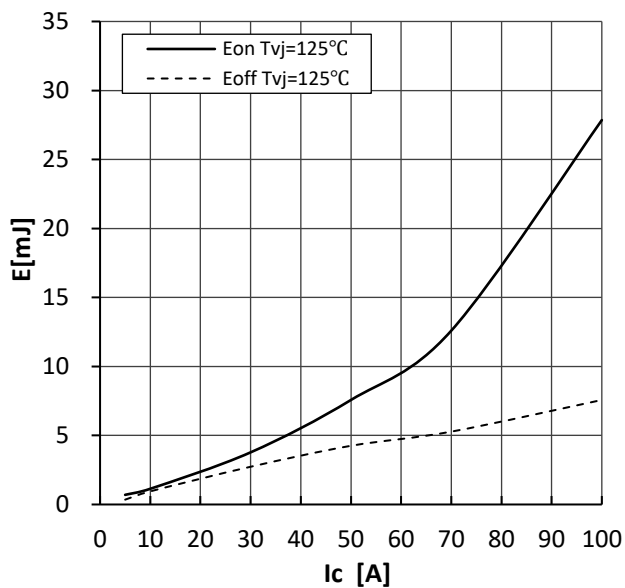


Fig 4. Reverse bias safe operating area,
IGBT, Inverter(RBSOA)

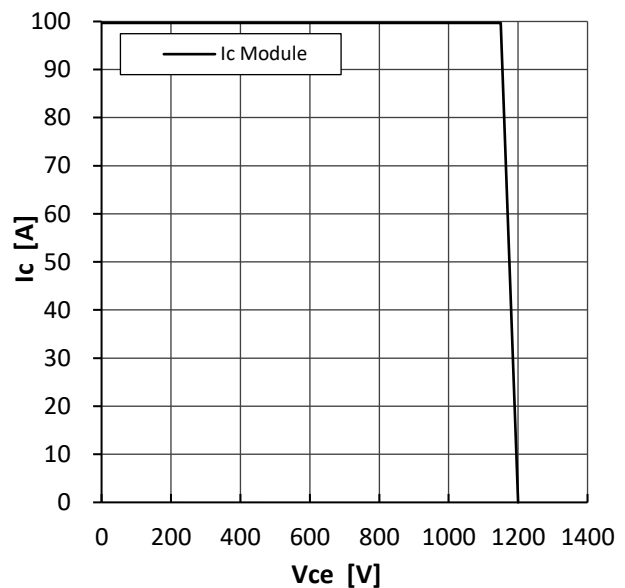


Fig 5. FRED Forward Characteristics,
Inverter(typcial)

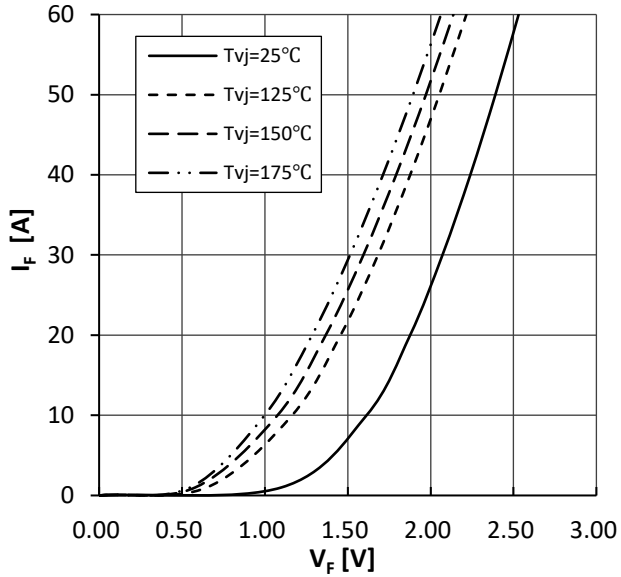


Fig 6. FRED Switching Loss vs. I_c ,
Inverter(typcial)
 $R_g=20\ \Omega$, $V_{CE}=600\ V$

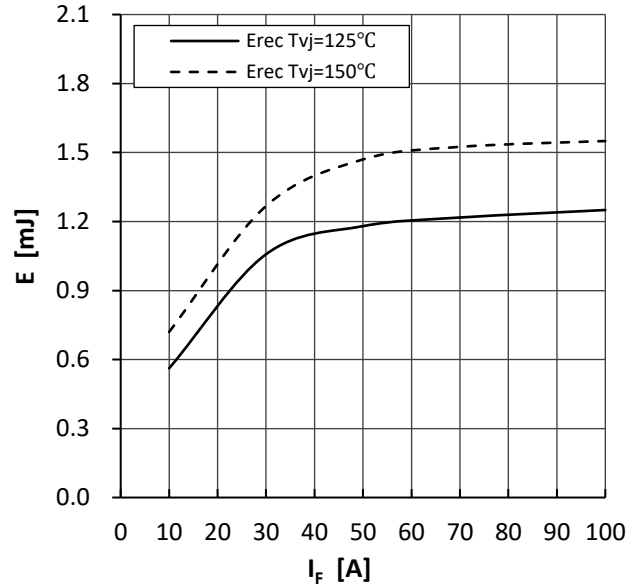
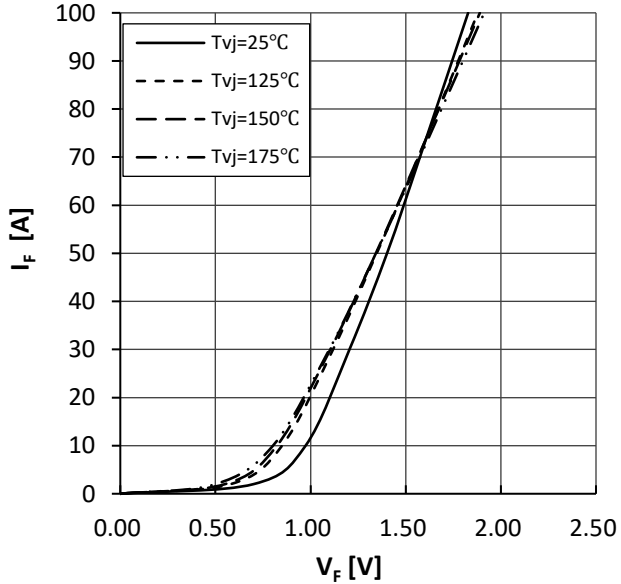


Fig 7. Diode Rectifier Forward Characteristics





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