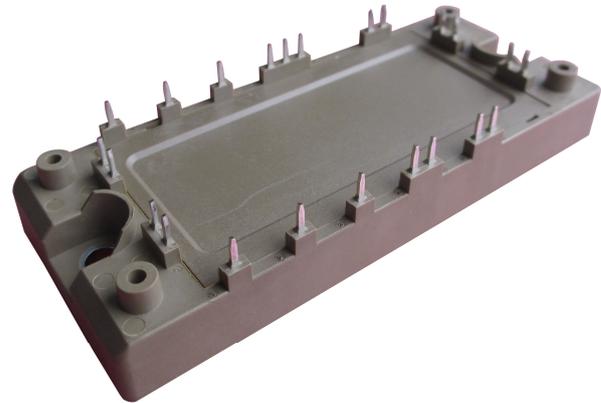


## PRODUCT FEATURES

- High level of integration
- CHIP(Trench+Field Stop IGBT4 and EmCon4 diode)
- Low saturation voltage and positive temperature coefficient
- Fast switching and short tail current
- Free wheeling diodes with fast and soft reverse recovery
- Industry standard package with insulated copper base plate and soldering pins for PCB mounting
- Temperature sense included



Rectifier+Brake+Inverter

## APPLICATIONS

- AC motor control
- Motion/servo control
- Inverter and power supplies

## IGBT-inverter

### ABSOLUTE MAXIMUM RATINGS( $T_C=25^\circ\text{C}$ unless otherwise specified)

Symbol	Parameter/Test Conditions		Values	Unit
$V_{CES}$	Collector Emitter Voltage	$T_J=25^\circ\text{C}$	1200	V
$V_{GES}$	Gate Emitter Voltage		$\pm 20$	
$I_C$	DC Collector Current	$T_C=25^\circ\text{C}$	73	A
		$T_C=95^\circ\text{C}$	50	
$I_{CM}$	Repetitive Peak Collector Current	$t_p=1\text{ms}$	100	
$P_{tot}$	Power Dissipation Per IGBT		280	W

## Diode-inverter

### ABSOLUTE MAXIMUM RATINGS ( $T_C=25^\circ\text{C}$ unless otherwise specified)

Symbol	Parameter/Test Conditions		Values	Unit
$V_{RRM}$	Repetitive Reverse Voltage	$T_J=25^\circ\text{C}$	1200	V
$I_{F(AV)}$	Average Forward Current	$T_C=25^\circ\text{C}$	50	A
$I_{FRM}$	Repetitive Peak Forward Current	$t_p=1\text{ms}$	100	
$i^2t$		$T_J=125^\circ\text{C}, t=10\text{ms}, V_R=0\text{V}$	560	$\text{A}^2\text{S}$

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## IGBT-inverter

ELECTRICAL CHARACTERISTICS ( $T_C=25^\circ\text{C}$  unless otherwise specified)

Symbol	Parameter/Test Conditions		Min.	Typ.	Max.	Unit	
$V_{GE(th)}$	Gate Emitter Threshold Voltage	$V_{CE}=V_{GE}, I_C=1.7\text{mA}$	5.2	5.8	6.4	V	
$V_{CE(sat)}$	Collector - Emitter Saturation Voltage	$I_C=50\text{A}, V_{GE}=15\text{V}, T_J=25^\circ\text{C}$		1.85	2.25		
		$I_C=50\text{A}, V_{GE}=15\text{V}, T_J=125^\circ\text{C}$		2.15			
		$I_C=50\text{A}, V_{GE}=15\text{V}, T_J=150^\circ\text{C}$		2.25			
$I_{CES}$	Collector Leakage Current	$V_{CE}=1200\text{V}, V_{GE}=0\text{V}, T_J=25^\circ\text{C}$			1	mA	
		$V_{CE}=1200\text{V}, V_{GE}=0\text{V}, T_J=150^\circ\text{C}$			10	mA	
$I_{GES}$	Gate Leakage Current	$V_{CE}=0\text{V}, V_{GE}=\pm 15\text{V}, T_J=25^\circ\text{C}$	-200		200	nA	
$R_{gint}$	Integrated Gate Resistor			4		$\Omega$	
$Q_g$	Gate Charge	$V_{CE}=600\text{V}, I_C=50\text{A}, V_{GE}=\pm 15\text{V}$		0.38		$\mu\text{C}$	
$C_{ies}$	Input Capacitance	$V_{CE}=25\text{V}, V_{GE}=0\text{V}, f=1\text{MHz}$		2.8		nF	
$C_{res}$	Reverse Transfer Capacitance				100		pF
$t_{d(on)}$	Turn on Delay Time	$V_{CC}=600\text{V}, I_C=50\text{A}$ $R_G=15\Omega,$ $V_{GE}=\pm 15\text{V},$ Inductive Load	$T_J=25^\circ\text{C}$	160		ns	
			$T_J=125^\circ\text{C}$	170		ns	
			$T_J=150^\circ\text{C}$	170		ns	
$t_r$	Rise Time		$T_J=25^\circ\text{C}$	30		ns	
			$T_J=125^\circ\text{C}$	40		ns	
			$T_J=150^\circ\text{C}$	40		ns	
$t_{d(off)}$	Turn off Delay Time	$T_J=25^\circ\text{C}$	330		ns		
		$T_J=125^\circ\text{C}$	430		ns		
		$T_J=150^\circ\text{C}$	450		ns		
$t_f$	Fall Time	$T_J=25^\circ\text{C}$	80		ns		
		$T_J=125^\circ\text{C}$	150		ns		
		$T_J=150^\circ\text{C}$	170		ns		
$E_{on}$	Turn on Energy	$V_{CC}=600\text{V}, I_C=50\text{A}$ $R_G=15\Omega,$ $V_{GE}=\pm 15\text{V},$ Inductive Load	$T_J=125^\circ\text{C}$	7.7		mJ	
			$T_J=150^\circ\text{C}$	8.4		mJ	
$E_{off}$	Turn off Energy		$T_J=125^\circ\text{C}$	4.3		mJ	
			$T_J=150^\circ\text{C}$	4.8		mJ	
$I_{sc}$	Short Circuit Current		$tpsc \leq 10\mu\text{s}, V_{GE}=15\text{V}$ $T_J=125^\circ\text{C}, V_{CC}=900\text{V}$		180		A
$R_{thJC}$	Junction to Case Thermal Resistance (Per IGBT)				0.54	K/W	

## Diode-inverter

ELECTRICAL CHARACTERISTICS ( $T_C=25^\circ\text{C}$  unless otherwise specified)

Symbol	Parameter/Test Conditions		Min.	Typ.	Max.	Unit
$V_F$	Forward Voltage	$I_F=50\text{A}, V_{GE}=0\text{V}, T_J=25^\circ\text{C}$		1.7	2.15	V
		$I_F=50\text{A}, V_{GE}=0\text{V}, T_J=125^\circ\text{C}$		1.65		
		$I_F=50\text{A}, V_{GE}=0\text{V}, T_J=150^\circ\text{C}$		1.65		
$I_{RRM}$	Max. Reverse Recovery Current	$I_F=50\text{A}, V_R=600\text{V}$		63		A
$Q_{RR}$	Reverse Recovery Charge	$di_F/dt=-1400\text{A}/\mu\text{s}$		10		$\mu\text{C}$
$E_{rec}$	Reverse Recovery Energy	$T_J=150^\circ\text{C}$		3.7		mJ
$R_{thJCD}$	Junction to Case Thermal Resistance (Per Diode)				0.81	K/W

**Diode-RECTIFIER****ABSOLUTE MAXIMUM RATINGS** ( $T_C=25^\circ\text{C}$  unless otherwise specified)

Symbol	Parameter/Test Conditions		Values	Unit
$V_{RRM}$	Repetitive Reverse Voltage	$T_J=25^\circ\text{C}$	1600	V
$I_{F(AV)}$	Average Forward Current Per Diode		50	A
$I_{FRMS}$	R.M.S. Forward Current Per Diode	$T_C=80^\circ\text{C}$	75	
$I_{RMS}$	R.M.S. Current at rectifier output		80	
$I_{FSM}$	Non Repetitive Surge Forward Current	$T_J=45^\circ\text{C}$ , $t=10\text{ms}$ , 50Hz	480	
		$T_J=45^\circ\text{C}$ , $t=8.3\text{ms}$ , 60Hz	527	
$I^2t$		$T_J=45^\circ\text{C}$ , $t=10\text{ms}$ , 50Hz	1152	A <sup>2</sup> S
		$T_J=45^\circ\text{C}$ , $t=8.3\text{ms}$ , 60Hz	1152	

**Diode-RECTIFIER****ELECTRICAL CHARACTERISTICS** ( $T_C=25^\circ\text{C}$  unless otherwise specified)

Symbol	Parameter/Test Conditions		Min.	Typ.	Max.	Unit
$V_F$	Forward Voltage	$I_F=50\text{A}$ , $T_J=25^\circ\text{C}$		1.1	1.25	V
		$I_F=50\text{A}$ , $T_J=150^\circ\text{C}$		1.05		V
$I_R$	Reverse Leakage Current	$V_R=1600\text{V}$ , $T_J=25^\circ\text{C}$			50	$\mu\text{A}$
		$V_R=1600\text{V}$ , $T_J=150^\circ\text{C}$			1	mA
$R_{thJCD}$	Junction to Case Thermal Resistance ( Per Diode )				0.8	K /W

**IGBT-Brake chopper****ABSOLUTE MAXIMUM RATINGS** ( $T_C=25^\circ\text{C}$  unless otherwise specified)

Symbol	Parameter/Test Conditions		Values	Unit
$V_{CES}$	Collector Emitter Voltage	$T_J=25^\circ\text{C}$	1200	V
$V_{GES}$	Gate Emitter Voltage		$\pm 20$	
$I_C$	DC Collector Current	$T_C=25^\circ\text{C}$	39	A
		$T_C=100^\circ\text{C}$	25	
$I_{CM}$	Repetitive Peak Collector Current	$t_p=1\text{ms}$	50	
$P_{tot}$	Power Dissipation Per IGBT		160	W

**Diode-Brake chopper****ABSOLUTE MAXIMUM RATINGS** ( $T_C=25^\circ\text{C}$  unless otherwise specified)

Symbol	Parameter/Test Conditions		Values	Unit
$V_{RRM}$	Repetitive Reverse Voltage	$T_J=25^\circ\text{C}$	1200	V
$I_{F(AV)}$	Average Forward Current	$T_C=25^\circ\text{C}$	15	A
$I_{FRM}$	Repetitive Peak Forward Current	$t_p=1\text{ms}$	30	
$I^2t$		$T_J=125^\circ\text{C}$ , $t=10\text{ms}$ , $V_R=0\text{V}$	48	A <sup>2</sup> S

## IGBT-Brake chopper

ELECTRICAL CHARACTERISTICS ( $T_C=25^\circ\text{C}$  unless otherwise specified)

Symbol	Parameter/Test Conditions		Min.	Typ.	Max.	Unit	
$V_{GE(th)}$	Gate Emitter Threshold Voltage	$V_{CE}=V_{GE}, I_C=0.85\text{mA}$	5.2	5.8	6.4	V	
$V_{CE(sat)}$	Collector - Emitter Saturation Voltage	$I_C=25\text{A}, V_{GE}=15\text{V}, T_J=25^\circ\text{C}$		1.85	2.25		
		$I_C=25\text{A}, V_{GE}=15\text{V}, T_J=125^\circ\text{C}$		2.15			
		$I_C=25\text{A}, V_{GE}=15\text{V}, T_J=150^\circ\text{C}$		2.25			
$I_{CES}$	Collector Leakage Current	$V_{CE}=1200\text{V}, V_{GE}=0\text{V}, T_J=25^\circ\text{C}$			1	mA	
		$V_{CE}=1200\text{V}, V_{GE}=0\text{V}, T_J=150^\circ\text{C}$			10	mA	
$I_{GES}$	Gate Leakage Current	$V_{CE}=0\text{V}, V_{GE}=\pm 15\text{V}, T_J=25^\circ\text{C}$	-200		200	nA	
$R_{gint}$	Integrated Gate Resistor			0		$\Omega$	
$Q_g$	Gate Charge	$V_{CE}=600\text{V}, I_C=25\text{A}, V_{GE}=\pm 15\text{V}$		0.2		$\mu\text{C}$	
$C_{ies}$	Input Capacitance	$V_{CE}=25\text{V}, V_{GE}=0\text{V}, f=1\text{MHz}$		1.45		nF	
$C_{res}$	Reverse Transfer Capacitance				50		pF
$t_{d(on)}$	Turn on Delay Time	$V_{CC}=600\text{V}, I_C=25\text{A}$ $R_G=37\Omega,$ $V_{GE}=\pm 15\text{V},$ Inductive Load	$T_J=25^\circ\text{C}$	50		ns	
			$T_J=125^\circ\text{C}$	60		ns	
			$T_J=150^\circ\text{C}$	60		ns	
$t_r$	Rise Time		$T_J=25^\circ\text{C}$	30		ns	
			$T_J=125^\circ\text{C}$	40		ns	
			$T_J=150^\circ\text{C}$	50		ns	
$t_{d(off)}$	Turn off Delay Time	$T_J=25^\circ\text{C}$	340		ns		
		$T_J=125^\circ\text{C}$	430		ns		
		$T_J=150^\circ\text{C}$	450		ns		
$t_f$	Fall Time	$T_J=25^\circ\text{C}$	50		ns		
		$T_J=125^\circ\text{C}$	70		ns		
		$T_J=150^\circ\text{C}$	80		ns		
$E_{on}$	Turn on Energy	$V_{CC}=600\text{V}, I_C=25\text{A}$ $R_G=37\Omega,$ $V_{GE}=\pm 15\text{V},$ Inductive Load	$T_J=125^\circ\text{C}$	2.65		mJ	
			$T_J=150^\circ\text{C}$	2.9		mJ	
$E_{off}$	Turn off Energy		$T_J=125^\circ\text{C}$	2.2		mJ	
			$T_J=150^\circ\text{C}$	2.4		mJ	
$I_{sc}$	Short Circuit Current		$t_{psc}\leq 10\mu\text{s}, V_{GE}=15\text{V}$ $T_J=125^\circ\text{C}, V_{CC}=900\text{V}$		90		A
$R_{thJC}$	Junction to Case Thermal Resistance (Per IGBT)				0.95	K /W	

## Diode-Brake chopper

ELECTRICAL CHARACTERISTICS ( $T_C=25^\circ\text{C}$  unless otherwise specified)

Symbol	Parameter/Test Conditions		Min.	Typ.	Max.	Unit
$V_F$	Forward Voltage	$I_F=25\text{A}, V_{GE}=0\text{V}, T_J=25^\circ\text{C}$		1.75	2.25	V
		$I_F=25\text{A}, V_{GE}=0\text{V}, T_J=125^\circ\text{C}$		1.75		
		$I_F=25\text{A}, V_{GE}=0\text{V}, T_J=150^\circ\text{C}$		1.75		
$I_{RRM}$	Max. Reverse Recovery Current	$I_F=25\text{A}, V_R=600\text{V}$		23		A
$Q_{RR}$	Reverse Recovery Charge	$dI_F/dt=-1000\text{A}/\mu\text{s}$		2.7		$\mu\text{C}$
$E_{rec}$	Reverse Recovery Energy	$T_J=150^\circ\text{C}$		1		mJ
$R_{thJCD}$	Junction to Case Thermal Resistance (Per Diode)				1.5	K /W

**NTC CHARACTERISTICS** ( $T_C=25^\circ\text{C}$  unless otherwise specified)

Symbol	Parameter/Test Conditions		Min.	Typ.	Max.	Unit
$R_{25}$	Resistance	$T_C=25^\circ\text{C}$		5		$\text{K}\Omega$
$B_{25/50}$	$R_2 = R_{25} \exp [B_{25/50}(1/T_2 - 1/(298.15 \text{ K}))]$			3375		K

**MODULE CHARACTERISTICS** ( $T_C=25^\circ\text{C}$  unless otherwise specified)

Symbol	Parameter/Test Conditions		Values	Unit
$T_{Jmax}$	Max. Junction Temperature	Inverter, Brake-Chopper	175	$^\circ\text{C}$
		Rectifier	150	
$T_{Jop}$	Operating Temperature		-40~150	
$T_{stg}$	Storage Temperature		-40~125	
$V_{isol}$	Isolation Breakdown Voltage	AC, 50Hz(R.M.S), t=1minute	3000	V
CTI	Comparative Tracking Index		>200	
Md	Mounting Torque	Recommended (M5)	2.5~5	Nm
Weight			180	g

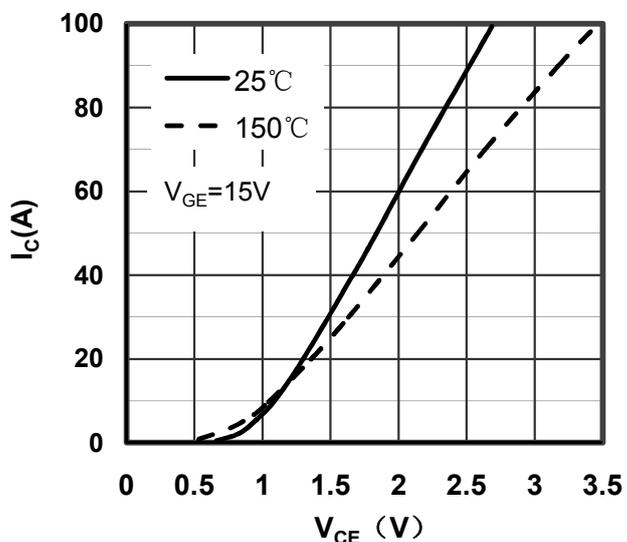


Figure 1. Typical Output Characteristics IGBT-inverter

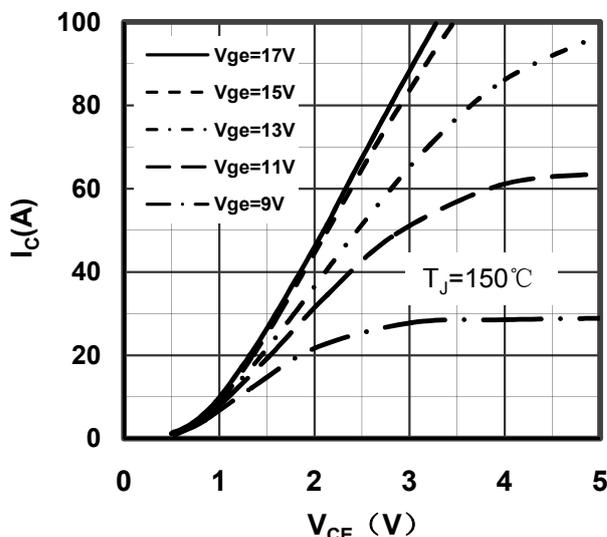


Figure 2. Typical Output Characteristics IGBT-inverter

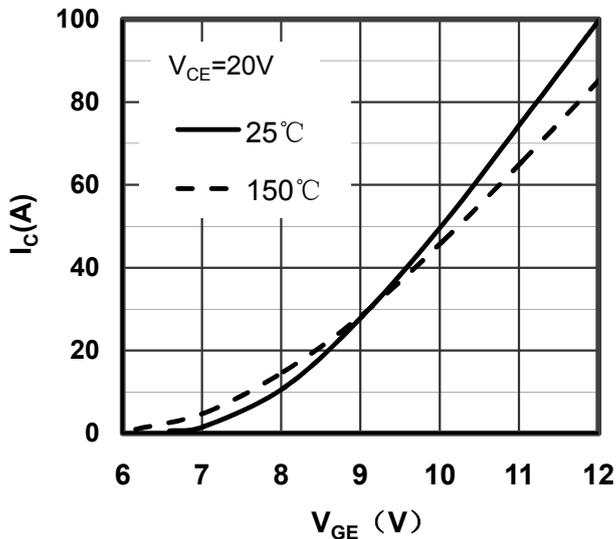


Figure 3. Typical Transfer Characteristics IGBT-inverter

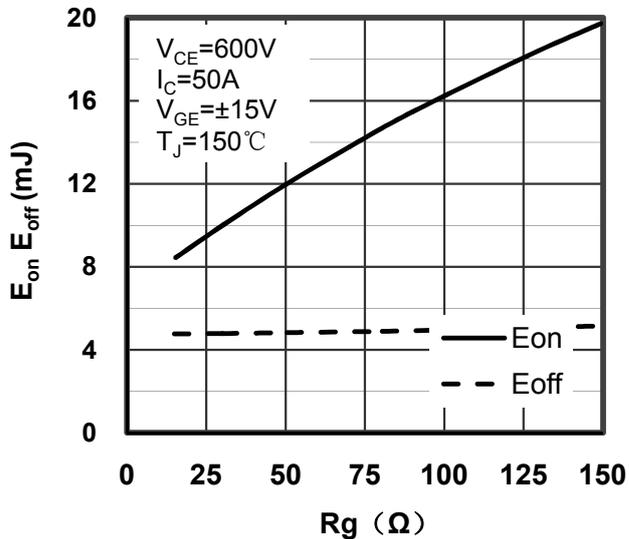


Figure 4. Switching Energy vs Gate Resistor IGBT-inverter

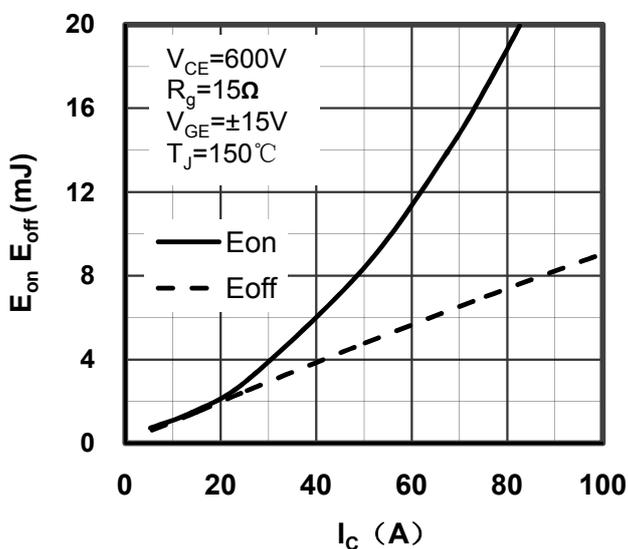


Figure 5. Switching Energy vs Collector Current IGBT-inverter

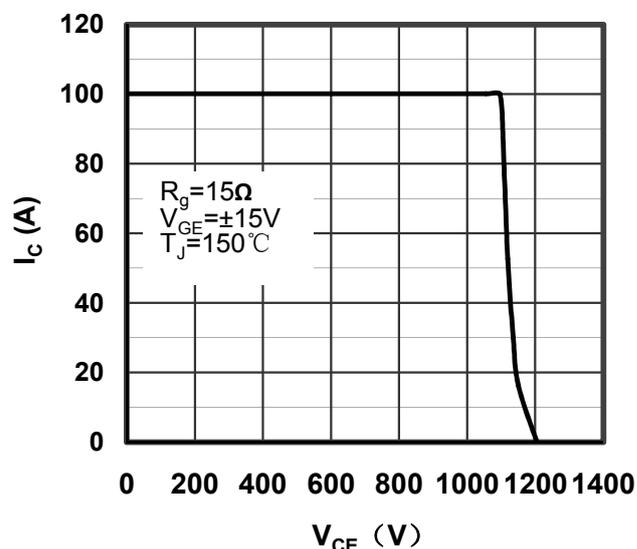


Figure 6. Reverse Biased Safe Operating Area IGBT-inverter

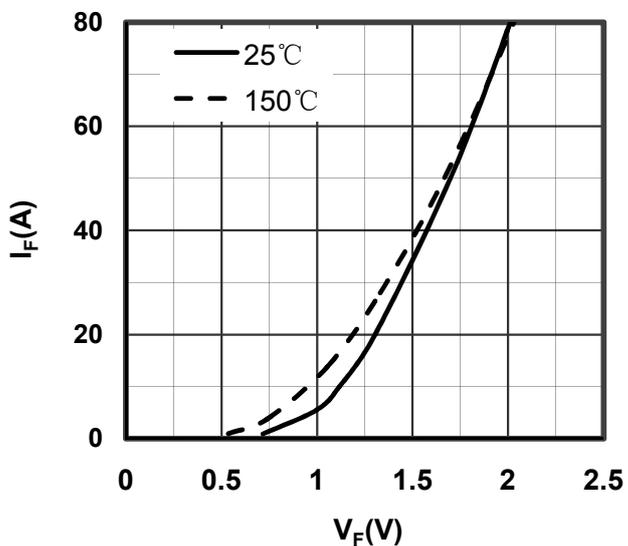


Figure 7. Diode Forward Characteristics Diode -inverter

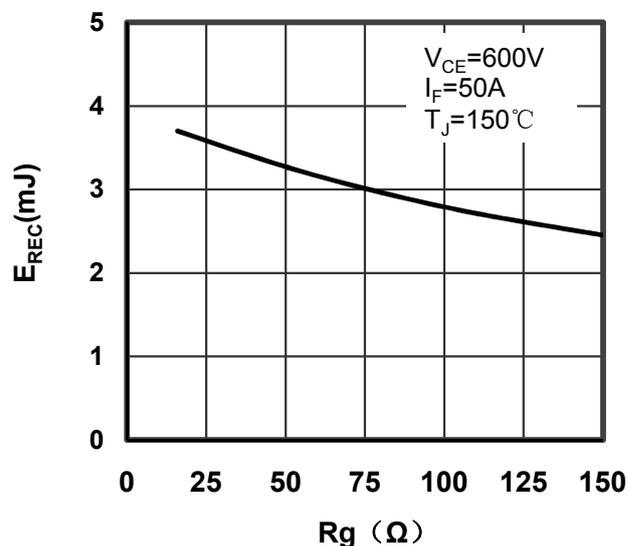


Figure 8. Switching Energy vs Gate Resistor Diode -inverter

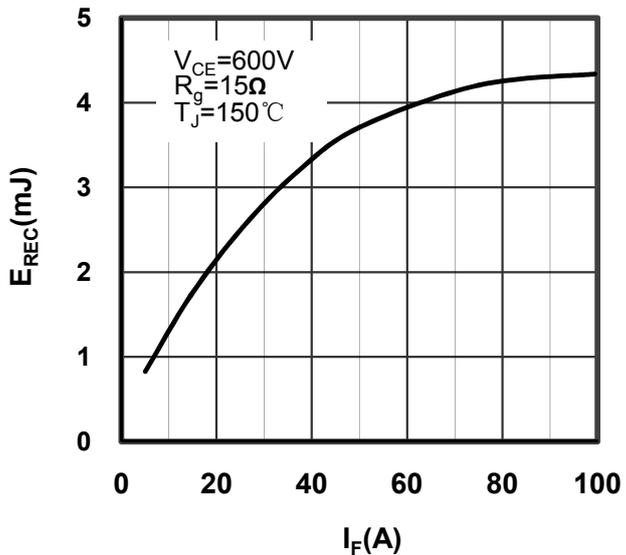


Figure 9. Switching Energy vs Forward Current Diode-inverter

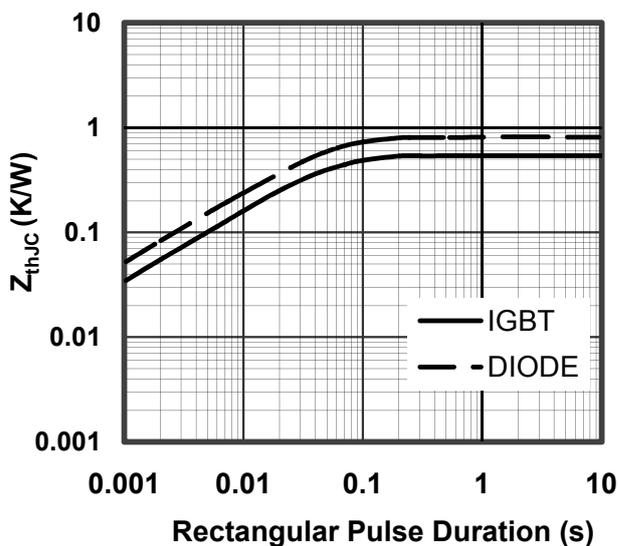


Figure 10. Transient Thermal Impedance of Diode and IGBT-inverter

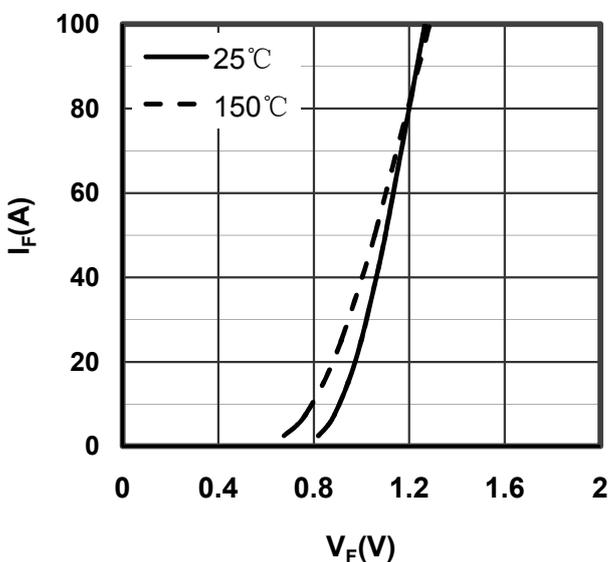


Figure 11. Diode Forward Characteristics Diode-rectifier

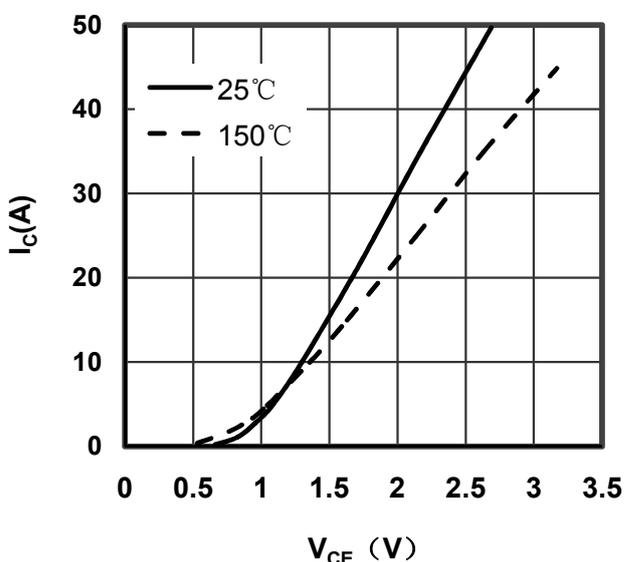


Figure 12. Typical Output Characteristics IGBT-brake chopper

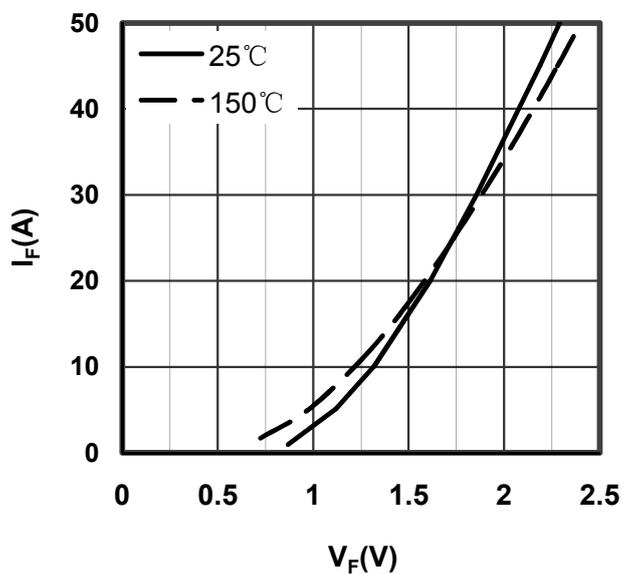


Figure 13. Diode Forward Characteristics Diode-brake chopper

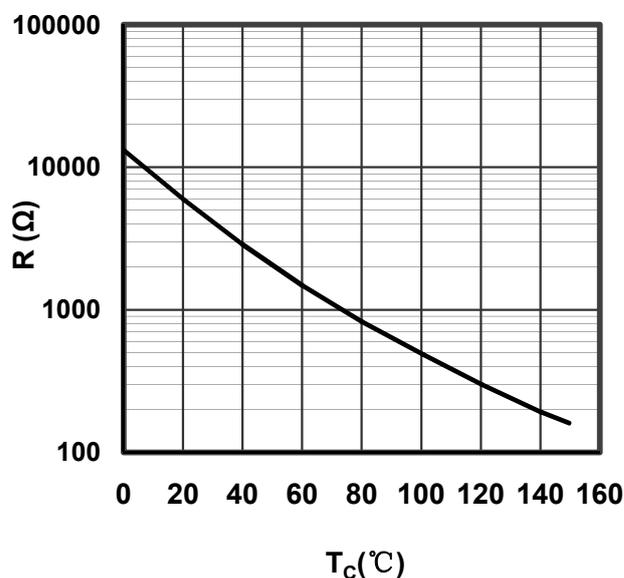


Figure 14. NTC Characteristics

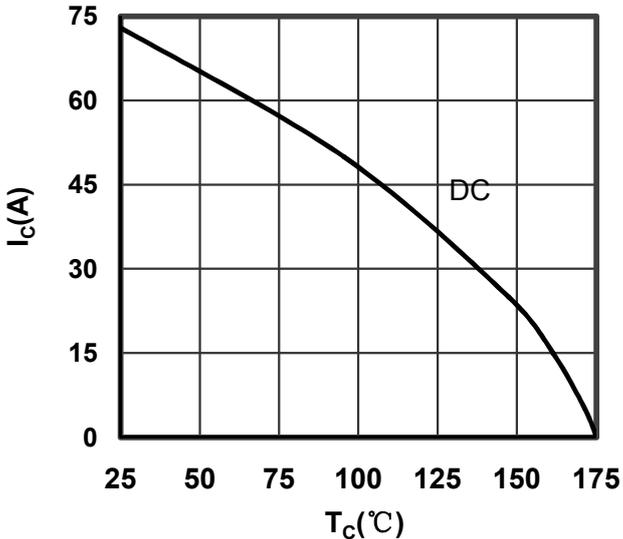


Figure 15. Collector Current vs Case temperature IGBT -inverter

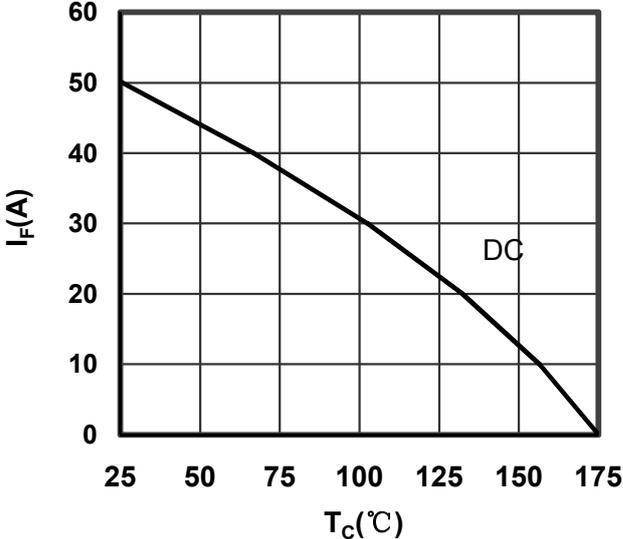


Figure 16. Forward current vs Case temperature Diode -inverter

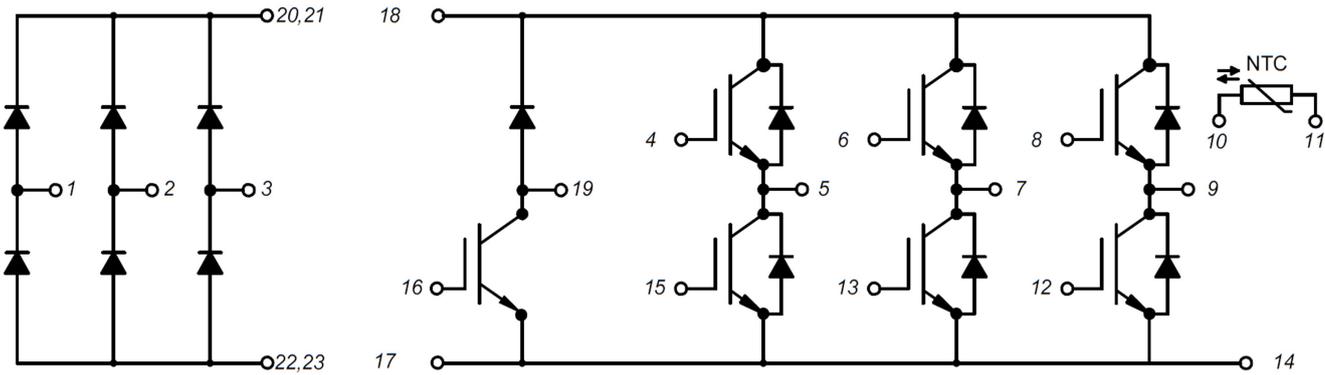


Figure 17. Circuit Diagram

