

STARPOWER

SEMICONDUCTOR

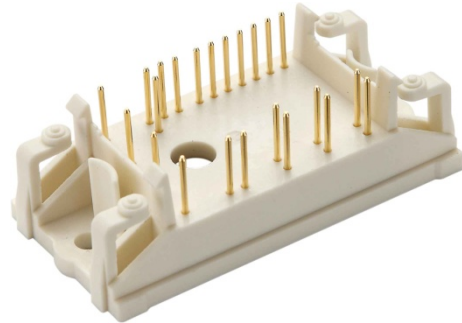
IGBT

GD10PJT60F3S

600V/10A PIM in one-package

General Description

STARPOWER IGBT Power Module provides ultra low conduction loss as well as short circuit ruggedness. They are designed for the applications such as general inverters and UPS.



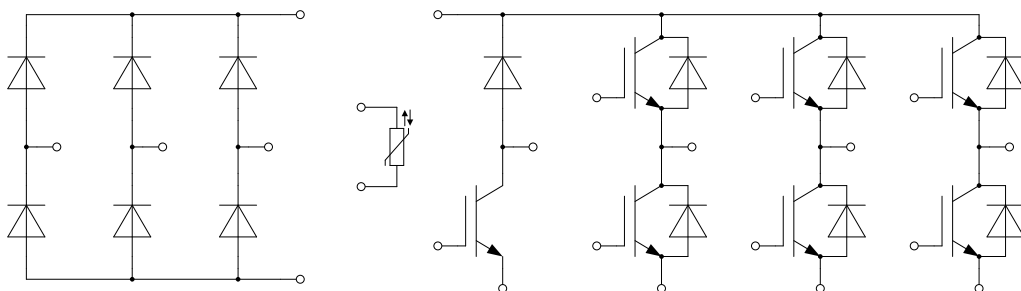
Features

- Low $V_{CE(sat)}$ Trench IGBT technology
- 5 μ s short circuit capability
- $V_{CE(sat)}$ with positive temperature coefficient
- Maximum junction temperature 175°C
- Low inductance case
- Fast & soft reverse recovery anti-parallel FWD
- Isolated heatsink using DBC technology

Typical Applications

- Inverter for motor drive
- AC and DC servo drive amplifier
- Uninterruptible power supply

Equivalent Circuit Schematic



Absolute Maximum Ratings $T_C=25^{\circ}\text{C}$ unless otherwise noted**IGBT-inverter**

Symbol	Description	Value	Unit
V_{CES}	Collector-Emitter Voltage	600	V
V_{GES}	Gate-Emitter Voltage	± 20	V
I_C	Collector Current @ $T_C=25^{\circ}\text{C}$	23	A
	@ $T_C=100^{\circ}\text{C}$	10	
I_{CM}	Pulsed Collector Current $t_p=1\text{ms}$	20	A
P_D	Maximum Power Dissipation @ $T_j=175^{\circ}\text{C}$	79	W

Diode-inverter

Symbol	Description	Value	Unit
V_{RRM}	Repetitive Peak Reverse Voltage	600	V
I_F	Diode Continuous Forward Current	10	A
I_{FM}	Diode Maximum Forward Current $t_p=1\text{ms}$	20	A

Diode-rectifier

Symbol	Description	Value	Unit
V_{RRM}	Repetitive Peak Reverse Voltage	1600	V
I_O	Average Output Current 50Hz/60Hz,sine wave	15	A
I_{FSM}	Surge Forward Current $V_R=0\text{V}, t_p=10\text{ms}, T_j=45^{\circ}\text{C}$	270	A
I^2t	I^2t -value, $V_R=0\text{V}, t_p=10\text{ms}, T_j=45^{\circ}\text{C}$	360	A^2s

IGBT-brake

Symbol	Description	Value	Unit
V_{CES}	Collector-Emitter Voltage	600	V
V_{GES}	Gate-Emitter Voltage	± 20	V
I_C	Collector Current @ $T_C=25^{\circ}\text{C}$	23	A
	@ $T_C=100^{\circ}\text{C}$	10	
I_{CM}	Pulsed Collector Current $t_p=1\text{ms}$	20	A
P_D	Maximum Power Dissipation @ $T_j=175^{\circ}\text{C}$	79	W

Diode-brake

Symbol	Description	Value	Unit
V_{RRM}	Repetitive Peak Reverse Voltage	600	V
I_F	Diode Continuous Forward Current	10	A
I_{FM}	Diode Maximum Forward Current $t_p=1\text{ms}$	20	A

Module

Symbol	Description	Value	Unit
T_{jmax}	Maximum Junction Temperature(inverter,brake)	175	$^{\circ}\text{C}$
	Maximum Junction Temperature(rectifier)	150	
T_{jop}	Operating Junction Temperature	-40 to +150	$^{\circ}\text{C}$
T_{STG}	Storage Temperature Range	-40 to +125	$^{\circ}\text{C}$
V_{ISO}	Isolation Voltage RMS, $f=50\text{Hz}, t=1\text{min}$	4000	V

IGBT-inverter Characteristics $T_C=25^\circ\text{C}$ unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit	
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage	$I_C=10\text{A}, V_{GE}=15\text{V}, T_j=25^\circ\text{C}$		1.45	1.90	V	
		$I_C=10\text{A}, V_{GE}=15\text{V}, T_j=125^\circ\text{C}$		1.70			
		$I_C=10\text{A}, V_{GE}=15\text{V}, T_j=150^\circ\text{C}$		1.75			
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$I_C=0.35\text{mA}, V_{CE}=V_{GE}, T_j=25^\circ\text{C}$	4.0	5.5	6.5	V	
I_{CES}	Collector Cut-Off Current	$V_{CE}=V_{CES}, V_{GE}=0\text{V}, T_j=25^\circ\text{C}$			1.0	mA	
I_{GES}	Gate-Emitter Leakage Current	$V_{GE}=V_{GES}, V_{CE}=0\text{V}, T_j=25^\circ\text{C}$			400	nA	
R_{Gint}	Internal Gate Resistance			0		Ω	
C_{ies}	Input Capacitance	$V_{CE}=30\text{V}, f=1\text{MHz}, V_{GE}=0\text{V}$		0.77		nF	
C_{res}	Reverse Transfer Capacitance				0.02		nF
Q_G	Gate Charge	$V_{GE}=-15\dots+15\text{V}$		0.02		μC	
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=300\text{V}, I_C=10\text{A}, R_G=15\Omega, V_{GE}=\pm 15\text{V}, T_j=25^\circ\text{C}$		49		ns	
t_r	Rise Time			30		ns	
$t_{d(off)}$	Turn-Off Delay Time			90		ns	
t_f	Fall Time			106		ns	
E_{on}	Turn-On Switching Loss			0.37		mJ	
E_{off}	Turn-Off Switching Loss			0.07		mJ	
$t_{d(on)}$	Turn-On Delay Time		$V_{CC}=300\text{V}, I_C=10\text{A}, R_G=15\Omega, V_{GE}=\pm 15\text{V}, T_j=125^\circ\text{C}$		56		ns
t_r	Rise Time				35		ns
$t_{d(off)}$	Turn-Off Delay Time			92		ns	
t_f	Fall Time			127		ns	
E_{on}	Turn-On Switching Loss			0.43		mJ	
E_{off}	Turn-Off Switching Loss			0.09		mJ	
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=300\text{V}, I_C=10\text{A}, R_G=15\Omega, V_{GE}=\pm 15\text{V}, T_j=150^\circ\text{C}$			59		ns
t_r	Rise Time				36		ns
$t_{d(off)}$	Turn-Off Delay Time			95		ns	
t_f	Fall Time			132		ns	
E_{on}	Turn-On Switching Loss			0.46		mJ	
E_{off}	Turn-Off Switching Loss			0.11		mJ	
I_{SC}	SC Data		$t_p \leq 5\mu\text{s}, V_{GE}=15\text{V}, T_j=150^\circ\text{C}, V_{CC}=400\text{V}, V_{CEM} \leq 600\text{V}$		108		A

Diode-inverter Characteristics $T_C=25^\circ\text{C}$ unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_F	Diode Forward Voltage	$I_F=10\text{A}, V_{GE}=0\text{V}, T_j=25^\circ\text{C}$		1.20	1.65	V
		$I_F=10\text{A}, V_{GE}=0\text{V}, T_j=125^\circ\text{C}$		1.10		
		$I_F=10\text{A}, V_{GE}=0\text{V}, T_j=150^\circ\text{C}$		1.10		
Q_r	Recovered Charge	$V_R=300\text{V}, I_F=10\text{A},$ $-di/dt=700\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=25^\circ\text{C}$		0.5		μC
I_{RM}	Peak Reverse Recovery Current			16		A
E_{rec}	Reverse Recovery Energy			0.10		mJ
Q_r	Recovered Charge	$V_R=300\text{V}, I_F=10\text{A},$ $-di/dt=700\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=125^\circ\text{C}$		0.8		μC
I_{RM}	Peak Reverse Recovery Current			17		A
E_{rec}	Reverse Recovery Energy			0.19		mJ
Q_r	Recovered Charge	$V_R=300\text{V}, I_F=10\text{A},$ $-di/dt=700\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=150^\circ\text{C}$		0.9		μC
I_{RM}	Peak Reverse Recovery Current			19		A
E_{rec}	Reverse Recovery Energy			0.24		mJ

Diode-rectifier Characteristics $T_C=25^\circ\text{C}$ unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_F	Diode Forward Voltage	$I_F=10\text{A}, V_{GE}=0\text{V}, T_j=150^\circ\text{C}$		0.88		V
I_R	Reverse Current	$T_j=150^\circ\text{C}, V_R=1600\text{V}$			1.0	mA

IGBT-brake Characteristics $T_C=25^\circ\text{C}$ unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit	
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage	$I_C=10\text{A}, V_{GE}=15\text{V}, T_j=25^\circ\text{C}$		1.45	1.90	V	
		$I_C=10\text{A}, V_{GE}=15\text{V}, T_j=125^\circ\text{C}$		1.70			
		$I_C=10\text{A}, V_{GE}=15\text{V}, T_j=150^\circ\text{C}$		1.75			
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$I_C=0.35\text{mA}, V_{CE}=V_{GE}, T_j=25^\circ\text{C}$	4.0	5.5	6.5	V	
I_{CES}	Collector Cut-Off Current	$V_{CE}=V_{CES}, V_{GE}=0\text{V}, T_j=25^\circ\text{C}$			1.0	mA	
I_{GES}	Gate-Emitter Leakage Current	$V_{GE}=V_{GES}, V_{CE}=0\text{V}, T_j=25^\circ\text{C}$			400	nA	
R_{Gint}	Internal Gate Resistance			0		Ω	
C_{ies}	Input Capacitance	$V_{CE}=30\text{V}, f=1\text{MHz}, V_{GE}=0\text{V}$		0.77		nF	
C_{res}	Reverse Transfer Capacitance				0.02		nF
Q_G	Gate Charge	$V_{GE}=-15\dots+15\text{V}$		0.02		μC	
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=300\text{V}, I_C=10\text{A}, R_G=15\Omega, V_{GE}=\pm 15\text{V}, T_j=25^\circ\text{C}$		49		ns	
t_r	Rise Time			30		ns	
$t_{d(off)}$	Turn-Off Delay Time			90		ns	
t_f	Fall Time			106		ns	
E_{on}	Turn-On Switching Loss			0.37		mJ	
E_{off}	Turn-Off Switching Loss			0.07		mJ	
$t_{d(on)}$	Turn-On Delay Time		$V_{CC}=300\text{V}, I_C=10\text{A}, R_G=15\Omega, V_{GE}=\pm 15\text{V}, T_j=125^\circ\text{C}$		56		ns
t_r	Rise Time				35		ns
$t_{d(off)}$	Turn-Off Delay Time			92		ns	
t_f	Fall Time			127		ns	
E_{on}	Turn-On Switching Loss			0.43		mJ	
E_{off}	Turn-Off Switching Loss			0.09		mJ	
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=300\text{V}, I_C=10\text{A}, R_G=15\Omega, V_{GE}=\pm 15\text{V}, T_j=150^\circ\text{C}$			59		ns
t_r	Rise Time				36		ns
$t_{d(off)}$	Turn-Off Delay Time			95		ns	
t_f	Fall Time			132		ns	
E_{on}	Turn-On Switching Loss			0.46		mJ	
E_{off}	Turn-Off Switching Loss			0.11		mJ	
I_{SC}	SC Data		$t_p \leq 5\mu\text{s}, V_{GE}=15\text{V}, T_j=150^\circ\text{C}, V_{CC}=400\text{V}, V_{CEM} \leq 600\text{V}$		108		A

Diode-brake Characteristics $T_C=25^\circ\text{C}$ unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_F	Diode Forward Voltage	$I_F=10\text{A}, V_{GE}=0\text{V}, T_j=25^\circ\text{C}$		1.20	1.65	V
		$I_F=10\text{A}, V_{GE}=0\text{V}, T_j=125^\circ\text{C}$		1.10		
		$I_F=10\text{A}, V_{GE}=0\text{V}, T_j=150^\circ\text{C}$		1.10		
Q_r	Recovered Charge	$V_R=300\text{V}, I_F=10\text{A},$ $-di/dt=700\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=25^\circ\text{C}$		0.5		μC
I_{RM}	Peak Reverse Recovery Current			16		A
E_{rec}	Reverse Recovery Energy			0.10		mJ
Q_r	Recovered Charge	$V_R=300\text{V}, I_F=10\text{A},$ $-di/dt=700\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=125^\circ\text{C}$		0.8		μC
I_{RM}	Peak Reverse Recovery Current			17		A
E_{rec}	Reverse Recovery Energy			0.19		mJ
Q_r	Recovered Charge	$V_R=300\text{V}, I_F=10\text{A},$ $-di/dt=700\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=150^\circ\text{C}$		0.9		μC
I_{RM}	Peak Reverse Recovery Current			19		A
E_{rec}	Reverse Recovery Energy			0.24		mJ

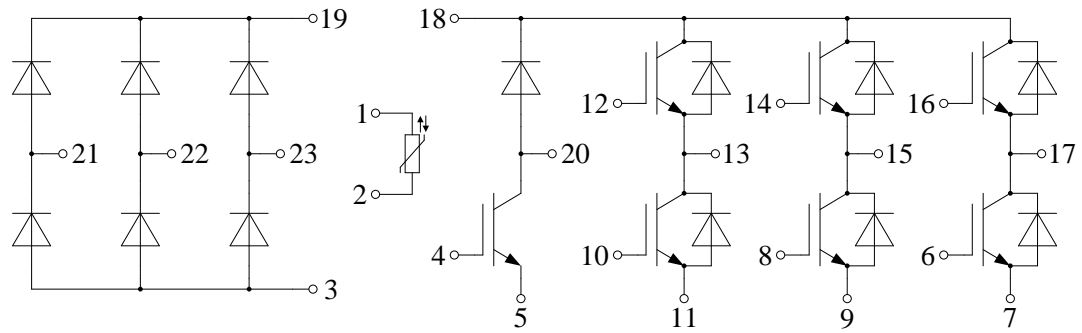
NTC Characteristics $T_C=25^\circ\text{C}$ unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
R_{25}	Rated Resistance			22.0		$\text{k}\Omega$
$\Delta R/R$	Deviation of R_{100}	$T_C=100^\circ\text{C}, R_{100}=1486.1\Omega$	-5		5	%
P_{25}	Power Dissipation				200	mW
$B_{25/50}$	B-value	$R_2=R_{25}\exp[B_{25/50}(1/T_2-1/(298.15\text{K}))]$		4000		K

Module Characteristics $T_C=25^\circ\text{C}$ unless otherwise noted

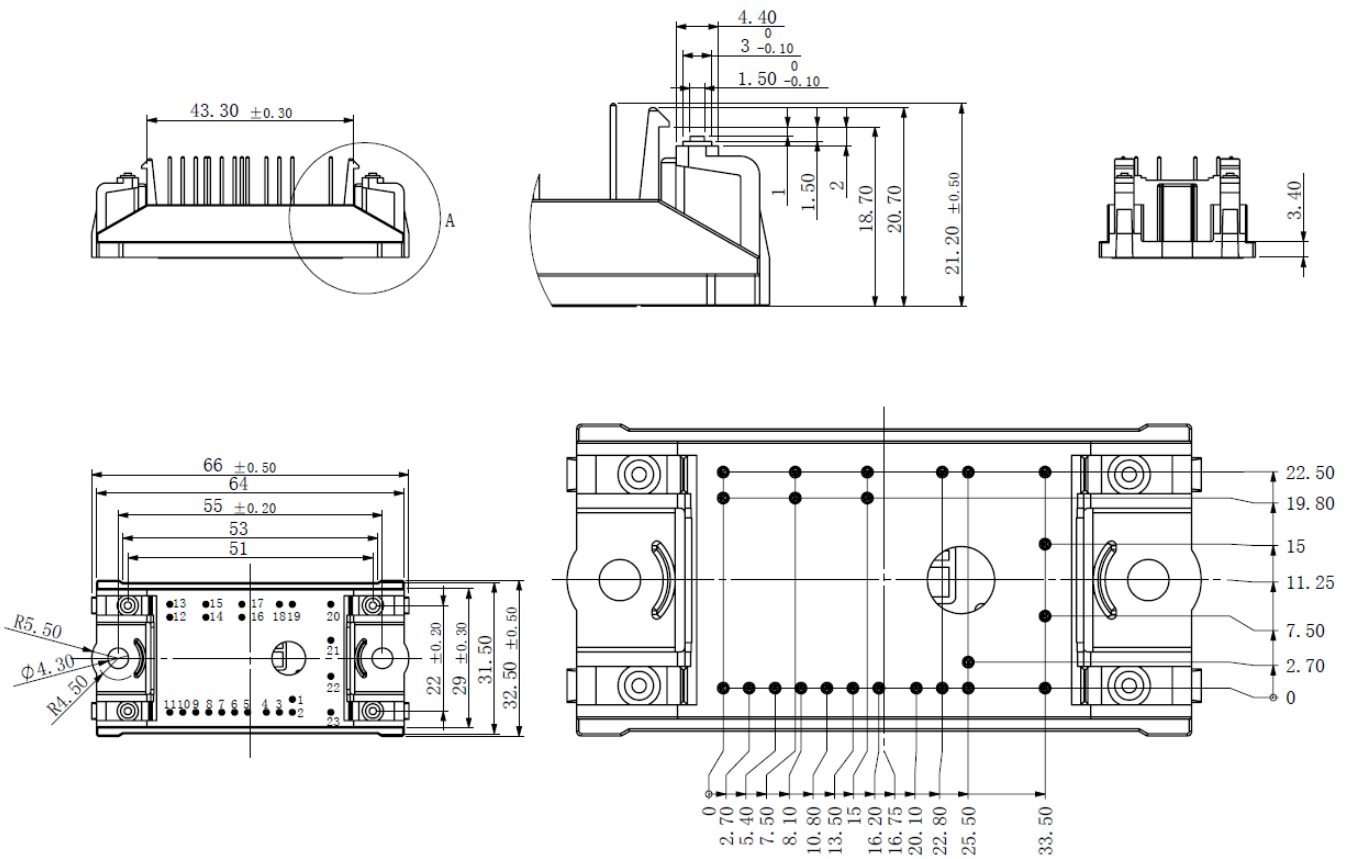
Symbol	Parameter	Min.	Typ.	Max.	Unit
R_{thJC}	Junction-to-Case (per IGBT-inverter)		1.721	1.893	K/W
	Junction-to-Case (per Diode-inverter)		3.090	3.399	
	Junction-to-Case (per Diode-rectifier)		1.475	1.623	
	Junction-to-Case (per IGBT-brake)		1.721	1.893	
	Junction-to-Case (per Diode-brake)		3.090	3.399	
R_{thCH}	Case-to-Heatsink (per IGBT-inverter)		0.644		K/W
	Case-to-Heatsink (per Diode-inverter)		1.157		
	Case-to-Heatsink (per Diode-rectifier)		0.552		
	Case-to-Heatsink (per IGBT-brake)		0.644		
	Case-to-Heatsink (per Diode-brake)		1.157		
	Case-to-Heatsink (per Module)		0.036		

Circuit Schematic



Package Dimensions

Dimensions in Millimeters



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