

# STARPOWER

SEMICONDUCTOR

**IGBT**

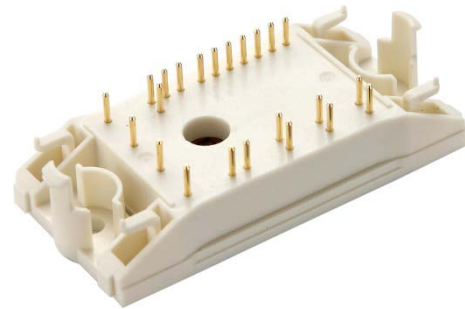
## GD10PJK60F1S

Molding Type Module

**600V/10A PIM in one-package**

### General Description

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



### Features

- Low  $V_{CE(sat)}$  NPT IGBT technology
- 10 $\mu$ s short circuit capability
- Square RBSOA
- $V_{CE(sat)}$  with positive temperature coefficient
- Fast & soft reverse recovery anti-parallel FWD

### Typical Applications

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

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

Symbol	Description	GD10PJK60F1S	Units
$V_{CES}$	Collector-Emitter Voltage @ $T_j=25^\circ\text{C}$	600	V
$V_{GES}$	Gate-Emitter Voltage @ $T_j=25^\circ\text{C}$	$\pm 20$	V
$I_C$	Collector Current @ $T_C=25^\circ\text{C}$ @ $T_C=80^\circ\text{C}$	20 10	A
$I_{CM}$	Pulsed Collector Current $t_p=1\text{ms}$	20	A
$P_{tot}$	Total Power Dissipation @ $T_j=150^\circ\text{C}$	79	W

**Off Characteristics**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
$V_{(BR)CES}$	Collector-Emitter Breakdown Voltage	$T_j=25^\circ\text{C}$	600			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

**On Characteristics**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$I_C=250\mu\text{A}, V_{CE}=V_{GE},$ $T_j=25^\circ\text{C}$	3.5	4.5	5.5	V
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage	$I_C=10\text{A}, V_{GE}=15\text{V},$ $T_j=25^\circ\text{C}$		1.80	2.25	V
		$I_C=10\text{A}, V_{GE}=15\text{V},$ $T_j=150^\circ\text{C}$		2.20		

**Switching Characteristics**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units	
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=400V, I_C=10A,$ $R_G=47\Omega, V_{GE}=\pm 15V,$ $T_j=25^\circ C$		30		ns	
$t_r$	Rise Time			20		ns	
$t_{d(off)}$	Turn-Off Delay Time			230		ns	
$t_f$	Fall Time			23		ns	
$E_{on}$	Turn-On Switching Loss				0.14		mJ
$E_{off}$	Turn-Off Switching Loss				0.25		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=400V, I_C=10A,$ $R_G=47\Omega, V_{GE}=\pm 15V,$ $T_j=150^\circ C$		30		ns	
$t_r$	Rise Time			20		ns	
$t_{d(off)}$	Turn-Off Delay Time			250		ns	
$t_f$	Fall Time			26		ns	
$E_{on}$	Turn-On Switching Loss				0.23		mJ
$E_{off}$	Turn-Off Switching Loss				0.35		mJ
$C_{ies}$	Input Capacitance	$V_{CE}=30V, f=1Mhz,$ $V_{GE}=0V$		620		pF	
$C_{res}$	Reverse Transfer Capacitance			22		pF	
$Q_G$	Gate Charge	$V_{CC}=400V, I_C=10A,$ $V_{GE}=15V$		38		nC	
$R_{Gint}$	Internal Gate Resister			/		$\Omega$	
$I_{SC}$	SC Data	$t_p \leq 10\mu s, V_{GE}=15V,$ $T_j=125^\circ C, V_{CC}=400V,$ $V_{CEM} \leq 600V$		90		A	

**Diode-inverter**  $T_C=25^\circ\text{C}$  unless otherwise noted**Maximum Rated Values**

Symbol	Description	GD10PJK60F1S	Units
$V_{RRM}$	Repetitive Peak Reverse Voltage @ $T_j=25^\circ\text{C}$	600	V
$I_F$	DC Forward Current	10	A
$I_{FRM}$	Repetitive Peak Forward Current $t_p=1\text{ms}$	20	A

**Characteristics Values**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
$V_F$	Diode Forward Voltage	$I_F=10\text{A}, V_{GE}=0\text{V}, T_j=25^\circ\text{C}$		1.20	1.60	V
		$I_F=10\text{A}, V_{GE}=0\text{V}, T_j=125^\circ\text{C}$		1.25		
$Q_r$	Recovered Charge	$V_R=300\text{V}, I_F=10\text{A}, R_G=47\Omega, V_{GE}=-15\text{V}, T_j=25^\circ\text{C}$		0.6		$\mu\text{C}$
$I_{RM}$	Peak Reverse Recovery Current			15		A
$E_{rec}$	Reverse Recovery Energy			0.14		mJ
$Q_r$	Recovered Charge			1.0		$\mu\text{C}$
$I_{RM}$	Peak Reverse Recovery Current	$V_R=300\text{V}, I_F=10\text{A}, R_G=47\Omega, V_{GE}=-15\text{V}, T_j=125^\circ\text{C}$		19		A
			$E_{rec}$	Reverse Recovery Energy		0.25

**Diode-rectifier**  $T_C=25^\circ\text{C}$  unless otherwise noted**Maximum Rated Values**

Symbol	Description	GD30PIK60C5S	Units
$V_{RRM}$	Repetitive Peak Reverse Voltage @ $T_j=25^\circ\text{C}$	1600	V
$I_{F(AV)}$	Average On-state Current @ $T_C=100^\circ\text{C}$	20	A
$I_{RMSM}$	Maximum RMS Current At Rectifier Output @ $T_C=80^\circ\text{C}$	40	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	$\text{A}^2\text{s}$

**Characteristics Values**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
$V_F$	Diode Forward Voltage	$I_F=10\text{A}, T_j=150^\circ\text{C}$		0.90		V
$I_R$	Reverse Current	$T_j=150^\circ\text{C}, V_R=1600\text{V}$			1.0	mA

**IGBT-brake-chopper**  $T_C=25^\circ\text{C}$  unless otherwise noted**Maximum Rated Values**

Symbol	Description	GD10PJK60F1S	Units
$V_{CES}$	Collector-Emitter Voltage @ $T_j=25^\circ\text{C}$	600	V
$V_{GES}$	Gate-Emitter Voltage @ $T_j=25^\circ\text{C}$	$\pm 20$	V
$I_C$	Collector Current @ $T_C=25^\circ\text{C}$ @ $T_C=80^\circ\text{C}$	20 10	A
$I_{CM}$	Pulsed Collector Current $t_p=1\text{ms}$	20	A
$P_{tot}$	Total Power Dissipation @ $T_j=175^\circ\text{C}$	79	W

**Off Characteristics**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
$V_{(BR)CES}$	Collector-Emitter Breakdown Voltage	$T_j=25^\circ\text{C}$	600			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

**On Characteristics**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$I_C=250\mu\text{A}, V_{CE}=V_{GE},$ $T_j=25^\circ\text{C}$	3.5	4.5	5.5	V
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage	$I_C=10\text{A}, V_{GE}=15\text{V},$ $T_j=25^\circ\text{C}$		1.80	2.25	V
		$I_C=10\text{A}, V_{GE}=15\text{V},$ $T_j=150^\circ\text{C}$		2.20		

**Switching Characteristics**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units	
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=400V, I_C=10A,$ $R_G=47\Omega, V_{GE}=\pm 15V,$ $T_j=25^\circ C$		30		ns	
$t_r$	Rise Time			20		ns	
$t_{d(off)}$	Turn-Off Delay Time			230		ns	
$t_f$	Fall Time			23		ns	
$E_{on}$	Turn-On Switching Loss				0.14		mJ
$E_{off}$	Turn-Off Switching Loss				0.25		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=400V, I_C=10A,$ $R_G=47\Omega, V_{GE}=\pm 15V,$ $T_j=150^\circ C$		30		ns	
$t_r$	Rise Time			20		ns	
$t_{d(off)}$	Turn-Off Delay Time			250		ns	
$t_f$	Fall Time			26		ns	
$E_{on}$	Turn-On Switching Loss				0.23		mJ
$E_{off}$	Turn-Off Switching Loss				0.35		mJ
$C_{ies}$	Input Capacitance	$V_{CE}=30V, f=1Mhz,$ $V_{GE}=0V$		620		pF	
$C_{res}$	Reverse Transfer Capacitance			22		pF	
$Q_G$	Gate Charge	$V_{CC}=400V, I_C=10A,$ $V_{GE}=15V$		38		nC	
$R_{Gint}$	Internal Gate Resister			/		$\Omega$	
$I_{SC}$	SC Data	$t_p \leq 10\mu s, V_{GE}=15V,$ $T_j=125^\circ C, V_{CC}=400V,$ $V_{CEM} \leq 600V$		90		A	

**Diode-brake-chopper**  $T_C=25^\circ\text{C}$  unless otherwise noted**Maximum Rated Values**

Symbol	Description	GD10PJK60F1S	Units
$V_{RRM}$	Repetitive Peak Reverse Voltage @ $T_j=25^\circ\text{C}$	600	V
$I_F$	DC Forward Current	10	A
$I_{FRM}$	Repetitive Peak Forward Current $t_p=1\text{ms}$	20	A

**Characteristics Values**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
$V_F$	Diode Forward Voltage	$I_F=10\text{A}, V_{GE}=0\text{V}, T_j=25^\circ\text{C}$		1.20	1.60	V
		$I_F=10\text{A}, V_{GE}=0\text{V}, T_j=125^\circ\text{C}$		1.25		
$Q_r$	Recovered Charge	$V_R=300\text{V}, I_F=10\text{A}, R_G=47\Omega, V_{GE}=-15\text{V}, T_j=25^\circ\text{C}$		0.6		$\mu\text{C}$
$I_{RM}$	Peak Reverse Recovery Current			15		A
$E_{rec}$	Reverse Recovery Energy			0.14		mJ
$Q_r$	Recovered Charge	$V_R=300\text{V}, I_F=10\text{A}, R_G=47\Omega, V_{GE}=-15\text{V}, T_j=125^\circ\text{C}$		1.0		$\mu\text{C}$
			$I_{RM}$	Peak Reverse Recovery Current		19
$E_{rec}$	Reverse Recovery Energy			0.25		mJ

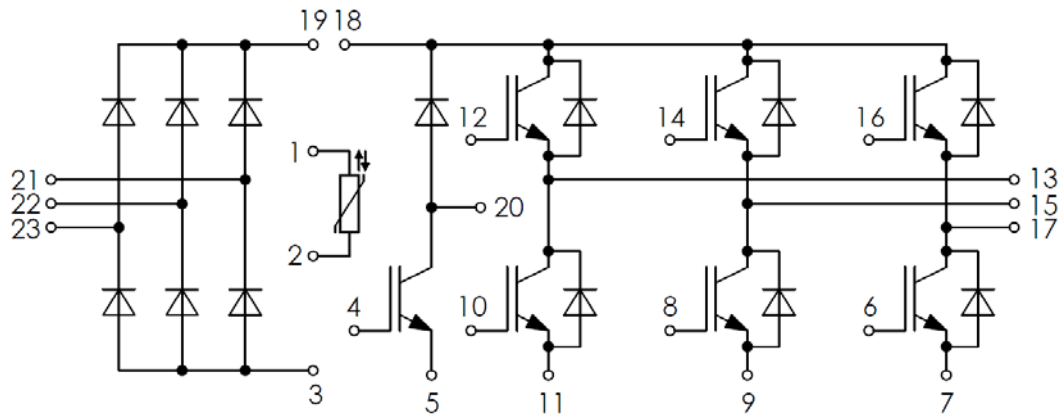
**NTC**  $T_C=25^\circ\text{C}$  unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
$R_{25}$	Rated Resistance			22.0		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

**IGBT Module**

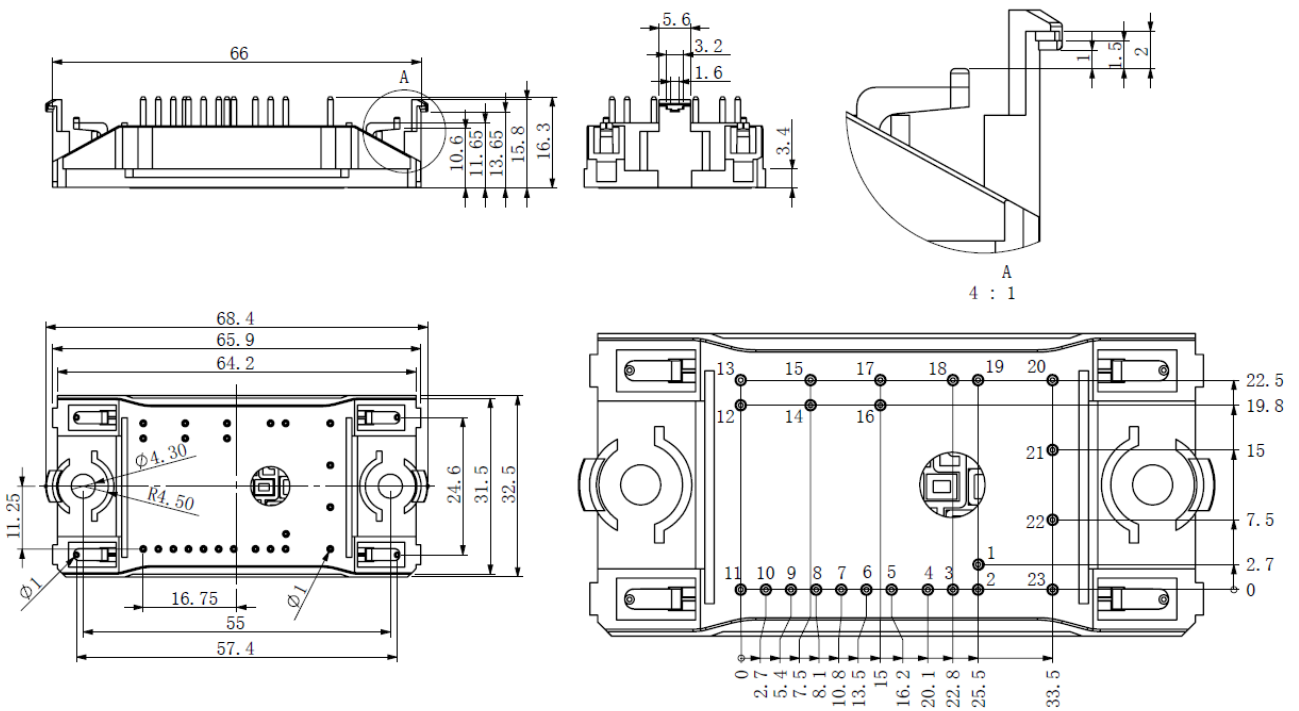
Symbol	Parameter	Min.	Typ.	Max.	Units
$V_{ISO}$	Isolation Voltage RMS, $f=50\text{Hz}, t=1\text{min}$	4000			V
$R_{\theta JC}$	Junction-to-Case (per IGBT-inverter)			1.571	K/W
	Junction-to-Case (per Diode-inverter)			3.096	
	Junction-to-Case (per Diode-rectifier)			1.624	
	Junction-to-Case (per IGBT-brake-chopper)			1.768	
	Junction-to-Case (per Diode-brake-chopper)			3.394	
$R_{\theta CS}$	Case-to-Sink (Conductive grease applied)		0.035		K/W
$T_{jmax}$	Maximum Junction Temperature			150	$^\circ\text{C}$
$T_{jop}$	Operating Junction Temperature	-40		125	$^\circ\text{C}$
$T_{STG}$	Storage Temperature Range	-40		125	$^\circ\text{C}$

### Equivalent Circuit Schematic



### Package Dimensions

Dimensions in Millimeters





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