

# STARPOWER

SEMICONDUCTOR

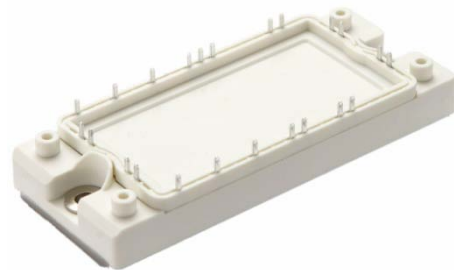
**IGBT**

## GD50PIT60C5SN

**Molding Type Module****600V/50A 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 $\mu$ 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 copper baseplate using DBC technology

### 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	GD50PIT60C5SN	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 @ $T_C=25^\circ\text{C}$ @ $T_C=75^\circ\text{C}$	66 50	A
$I_{CM}$	Pulsed Collector Current $t_p=1\text{ms}$	100	A
$P_{tot}$	Total Power Dissipation @ $T_j=175^\circ\text{C}$	190	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	$V_{CE}=V_{CES}, V_{GE}=0\text{V},$ $T_j=25^\circ\text{C}$			5.0	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	$I_C=1.4\text{mA}, V_{CE}=V_{GE},$ $T_j=25^\circ\text{C}$	4.0	4.9	6.5	V
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage	$I_C=50\text{A}, V_{GE}=15\text{V},$ $T_j=25^\circ\text{C}$		1.65	2.10	V
		$I_C=50\text{A}, V_{GE}=15\text{V},$ $T_j=125^\circ\text{C}$		1.90		

### Switching Characteristics

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=300V, I_C=50A,$ $R_G=3.3\Omega, V_{GE}=\pm 15V,$ $T_j=25^\circ C$		58		ns
$t_r$	Rise Time			31		ns
$t_{d(off)}$	Turn-Off Delay Time			80		ns
$t_f$	Fall Time			100		ns
$E_{on}$	Turn-On Switching Loss			0.41		mJ
$E_{off}$	Turn-Off Switching Loss			0.42		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=300V, I_C=50A,$ $R_G=3.3\Omega, V_{GE}=\pm 15V,$ $T_j=125^\circ C$		64		ns
$t_r$	Rise Time			37		ns
$t_{d(off)}$	Turn-Off Delay Time			90		ns
$t_f$	Fall Time			117		ns
$E_{on}$	Turn-On Switching Loss			0.69		mJ
$E_{off}$	Turn-Off Switching Loss			0.69		mJ
$C_{ies}$	Input Capacitance	$V_{CE}=30V, f=1Mhz,$ $V_{GE}=0V$		3.03		nF
$C_{res}$	Reverse Transfer Capacitance			0.09		nF
$Q_G$	Gate Charge	$V_{CC}=400V, I_C=50A,$ $V_{GE}=15V$		99		nC
$I_{SC}$	SC Data	$t_p \leq 5\mu s, V_{GE}=15V,$ $T_j=125^\circ C, V_{CC}=360V,$ $V_{CEM} \leq 600V$		450		A

### Diode-inverter $T_C=25^\circ C$ unless otherwise noted

#### Maximum Rated Values

Symbol	Description	GD50PIT60C5SN	Units
$V_{RRM}$	Repetitive Peak Reverse Voltage @ $T_j=25^\circ C$	600	V
$I_F$	DC Forward Current	50	A
$I_{FRM}$	Repetitive Peak Forward Current $t_p=1ms$	100	A

#### Characteristics Values

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units	
$V_F$	Diode Forward Vd tage	$I_F=50A, V_{GE}=0V$	$T_j=25^\circ C$		1.35	1.75	V
			$T_j=125^\circ C$		1.37		
$Q_r$	Recovered Charge	$I_F=50A,$ $V_R=300V,$ $R_G=3.3\Omega,$ $V_{GE}=-15V$	$T_j=25^\circ C$		2.3		$\mu C$
			$T_j=125^\circ C$		4.3		
$I_{RM}$	Peak Reverse Recovery Current	$I_F=50A,$ $V_R=300V,$ $R_G=3.3\Omega,$ $V_{GE}=-15V$	$T_j=25^\circ C$		33		A
			$T_j=125^\circ C$		58		
$E_{rec}$	Reverse Recovery Energy	$I_F=50A,$ $V_R=300V,$ $R_G=3.3\Omega,$ $V_{GE}=-15V$	$T_j=25^\circ C$		0.56		mJ
			$T_j=125^\circ C$		1.11		

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

Symbol	Description	GD50PIT60C5SN	Units
$V_{RRM}$	Repetitive Peak Reverse Voltage @ $T_j=25^\circ\text{C}$	1600	V
$I_{F(AV)}$	Average On-state Current	50	A
$I_{FSM}$	Surge Forward Current $V_R=0V, t_p=10\text{ms}, T_j=45^\circ\text{C}$	600	A
$I^2t$	$I^2t$ -value, $V_R=0V, t_p=10\text{ms}, T_j=45^\circ\text{C}$	1800	$\text{A}^2\text{s}$

**Characteristics Values**

Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Units
$V_F$	Diode Forward Voltage	$I_F=50\text{A}$	$T_j=150^\circ\text{C}$		1.14		V
$I_R$	Reverse Current	$T_j=150^\circ\text{C}, V_R=1600\text{V}$				3.0	mA

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

Symbol	Description	GD50PIT60C5SN	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 @ $T_C=25^\circ\text{C}$ @ $T_C=70^\circ\text{C}$	64 50	A
$I_{CM}$	Pulsed Collector Current $t_p=1\text{ms}$	100	A
$P_{tot}$	Total Power Dissipation @ $T_j=175^\circ\text{C}$	179	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	$V_{CE}=V_{CES}, V_{GE}=0V,$ $T_j=25^\circ\text{C}$			5.0	mA
$I_{GES}$	Gate-Emitter Leakage Current	$V_{GE}=V_{GES}, V_{CE}=0V,$ $T_j=25^\circ\text{C}$			400	nA

**On Characteristics**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$I_C=1.4\text{mA}, V_{CE}=V_{GE},$ $T_j=25^\circ\text{C}$	4.0	4.9	6.5	V
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage	$I_C=50\text{A}, V_{GE}=15\text{V},$ $T_j=25^\circ\text{C}$		1.65	2.10	V
		$I_C=50\text{A}, V_{GE}=15\text{V},$ $T_j=125^\circ\text{C}$		1.90		

### Switching Characteristics

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=300V, I_C=50A,$ $R_G=3.3\Omega, V_{GE}=\pm 15V,$ $T_j=25^\circ C$		58		ns
$t_r$	Rise Time			31		ns
$t_{d(off)}$	Turn-Off Delay Time			80		ns
$t_f$	Fall Time			100		ns
$E_{on}$	Turn-On Switching Loss			0.41		mJ
$E_{off}$	Turn-Off Switching Loss			0.42		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=300V, I_C=50A,$ $R_G=3.3\Omega, V_{GE}=\pm 15V,$ $T_j=125^\circ C$		64		ns
$t_r$	Rise Time			37		ns
$t_{d(off)}$	Turn-Off Delay Time			90		ns
$t_f$	Fall Time			117		ns
$E_{on}$	Turn-On Switching Loss			0.69		mJ
$E_{off}$	Turn-Off Switching Loss			0.69		mJ
$C_{ies}$	Input Capacitance	$V_{CE}=30V, f=1Mhz,$ $V_{GE}=0V$		3.03		nF
$C_{res}$	Reverse Transfer Capacitance			0.09		nF
$Q_G$	Gate Charge	$V_{CC}=400V, I_C=50A,$ $V_{GE}=15V$		99		nC
$I_{SC}$	SC Data	$t_p \leq 5\mu s, V_{GE}=15V,$ $T_j=125^\circ C, V_{CC}=360V,$ $V_{CEM} \leq 600V$		450		A

### Diode-brake-chopper $T_C=25^\circ C$ unless otherwise noted

#### Maximum Rated Values

Symbol	Description	GD50PIT60C5SN	Units
$V_{RRM}$	Repetitive Peak Reverse Voltage @ $T_j=25^\circ C$	600	V
$I_F$	DC Forward Current	30	A
$I_{FRM}$	Repetitive Peak Forward Current $t_p=1ms$	60	A

#### Characteristics Values

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
$V_F$	Diode Forward Vd t age	$I_F=30A, V_{GE}=0V$	$T_j=25^\circ C$	1.45	1.90	V
			$T_j=125^\circ C$	1.43		
$Q_r$	Recovered Charge	$I_F=30A$	$T_j=25^\circ C$	1.6		$\mu C$
			$T_j=125^\circ C$	2.3		
$I_{RM}$	Peak Reverse Recovery Current	$V_R=300V,$ $R_G=15\Omega,$ $V_{GE}=-15V$	$T_j=25^\circ C$	29		A
			$T_j=125^\circ C$	30		
$E_{rec}$	Reverse Recovery Energy		$T_j=25^\circ C$	0.33		mJ
			$T_j=125^\circ C$	0.40		

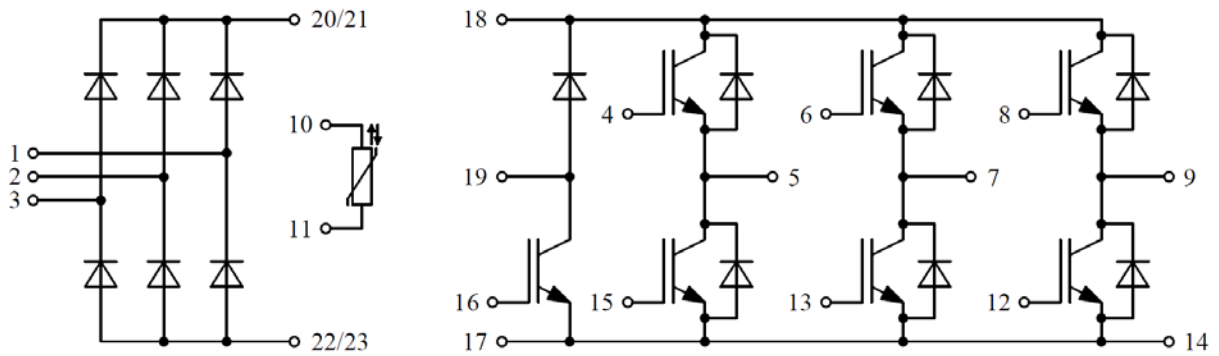
**Electrical Characteristics of NTC**  $T_C=25^{\circ}\text{C}$  unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
$R_{25}$	Rated Resistance			5.0		$\text{k}\Omega$
$\Delta R/R$	Deviation of $R_{100}$	$T_C=100^{\circ}\text{C}, R_{100}=493.3\Omega$	-5		5	%
$P_{25}$	Power Dissipation				20.0	mW
$B_{25/50}$	B-value	$R_2=R_{25}\exp[B_{25/50}(1/T_2-1/(298.15\text{K}))]$		3375		K

**IGBT Module**

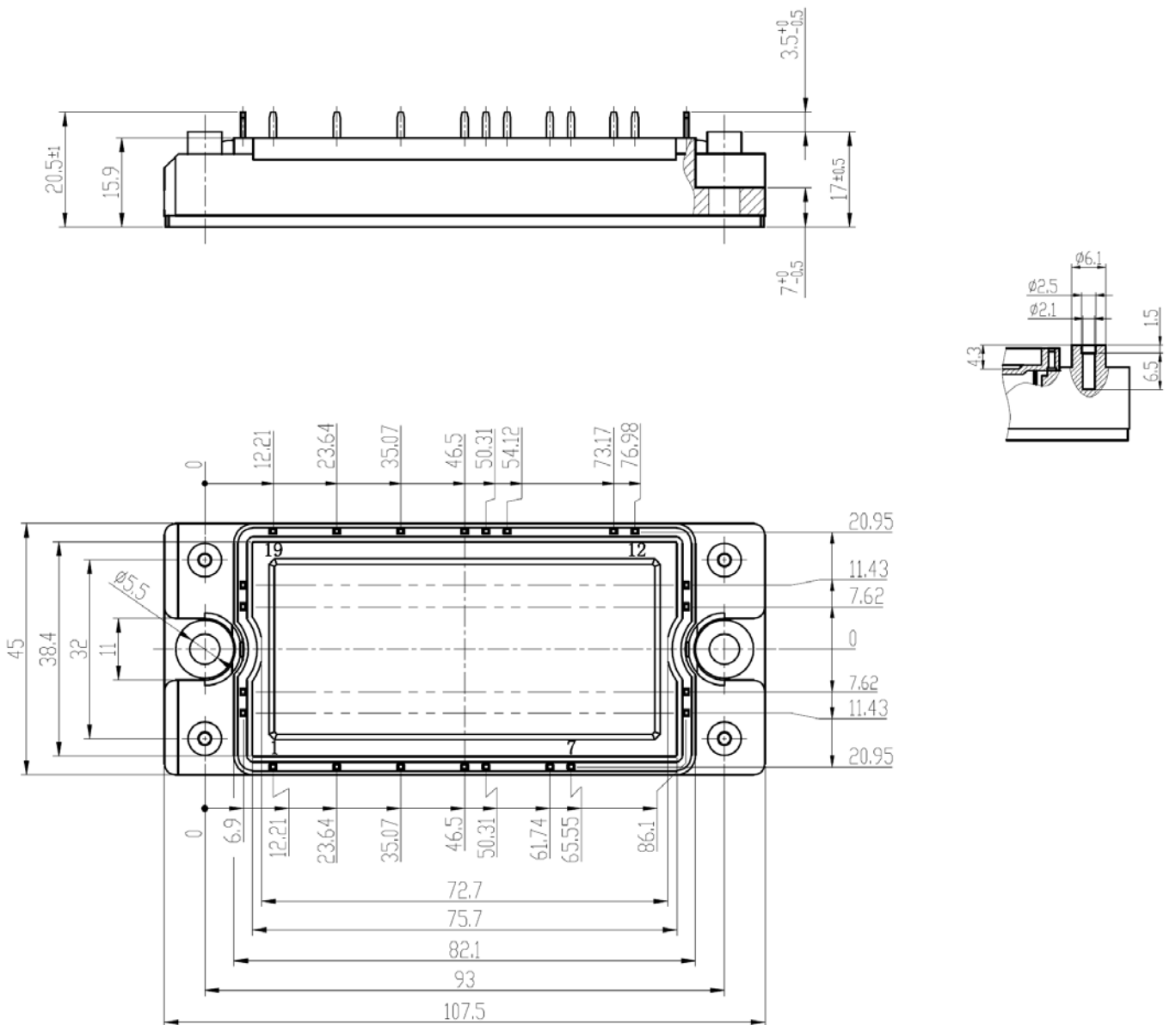
Symbol	Parameter	Min.	Typ.	Max.	Units
$V_{\text{ISO}}$	Isolation Voltage RMS, $f=50\text{Hz}, t=1\text{min}$	4000			V
$L_{\text{CE}}$	Stray Inductance		35		nH
$R_{\text{CC}'+\text{EE}'}$ $R_{\text{AA}'+\text{CC}'}$	Module Lead Resistance, Terminal to Chip @ $T_C=25^{\circ}\text{C}$		4.00 3.00		$\text{m}\Omega$
$R_{\theta\text{JC}}$	Junction-to-Case (per IGBT-inverter) Junction-to-Case (per Diode-inverter) Junction-to-Case (per Diode-rectifier) Junction-to-Case (per IGBT-brake-chopper) Junction-to-Case (per Diode-brake-chopper)			0.789 1.158 0.919 0.839 1.662	K/W
$R_{\theta\text{CS}}$	Case-to-Sink (Conductive grease applied)		0.02		K/W
$T_{\text{jmax}}$	Maximum Junction Temperature (inverter, brake) Maximum Junction Temperature(rectifier)			175 150	$^{\circ}\text{C}$
$T_{\text{jop}}$	Operating Junction Temperature	-40		150	$^{\circ}\text{C}$
$T_{\text{STG}}$	Storage Temperature Range	-40		125	$^{\circ}\text{C}$
M	Mounting Torque, Screw:M5	3.0		6.0	N.m
G	Weight of Module		200		g

**Equivalent Circuit Schematic**



**Package Dimensions**

Dimensions in Millimeters



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