

# STARPOWER

SEMICONDUCTOR™

# IGBT

## GD40PIK120C6S

## Preliminary

**Molding Type Module****1200V/40A 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
- $V_{CE(sat)}$  with positive temperature coefficient
- Square RBSOA
- 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	GD40PIK120C6S	Units
$V_{CES}$	Collector-Emitter Voltage @ $T_j=25^\circ\text{C}$	1200	V
$V_{GES}$	Gate-Emitter Voltage @ $T_j=25^\circ\text{C}$	$\pm 20$	V
$I_C$	Collector Current @ $T_C=25^\circ\text{C}$	70	A
	@ $T_C=80^\circ\text{C}$	40	
$I_{CM}$	Pulsed Collector Current $t_p=1\text{ms}$	80	A
$P_{tot}$	Total Power Dissipation @ $T_j=150^\circ\text{C}$	313	W
$T_{SC}$	Short Circuit Withstand Time @ $T_j=150^\circ\text{C}$	10	$\mu\text{s}$

**Off Characteristics**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
$V_{(BR)CES}$	Collector-Emitter Breakdown Voltage	$T_j=25^\circ\text{C}$	1200			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	$I_C=250\mu\text{A}, V_{CE}=V_{GE},$ $T_j=25^\circ\text{C}$	4.0	4.8	6.0	V
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage	$I_C=40\text{A}, V_{GE}=15\text{V},$ $T_j=25^\circ\text{C}$		2.50	2.80	V
		$I_C=40\text{A}, V_{GE}=15\text{V},$ $T_j=125^\circ\text{C}$		2.90		

**Switching Characteristics**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
$E_{on}$	Turn-On Switching Loss	$V_{CC}=600\text{V}, I_C=40\text{A},$ $R_G=10\Omega, V_{GE}=\pm 15\text{V},$ $T_j=25^\circ\text{C}$		3.13		mJ
$E_{off}$	Turn-Off Switching Loss			3.01		mJ
$E_{tot}$	Total Switching Loss				6.14	mJ
$E_{on}$	Turn-On Switching Loss	$V_{CC}=600\text{V}, I_C=40\text{A},$ $R_G=10\Omega, V_{GE}=\pm 15\text{V},$ $T_j=125^\circ\text{C}$		4.27		mJ
$E_{off}$	Turn-Off Switching Loss			4.15		mJ
$E_{tot}$	Total Switching Loss				8.42	mJ

$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600V, I_C=40A,$ $R_G=10\Omega, V_{GE}=\pm 15V,$ $T_J=125^\circ C$	55		ns
$t_r$	Rise Time		38		ns
$t_{d(off)}$	Turn-Off Delay Time		420		ns
$t_f$	Fall Time		250		ns
$C_{ies}$	Input Capacitance	$V_{CE}=30V, f=1Mhz,$ $V_{GE}=0V$	3.10		nF
$C_{oes}$	Output Capacitance		0.28		nF
$C_{res}$	Reverse Transfer Capacitance		0.12		nF
$Q_G$	Gate charge	$V_{CC}=600V, I_C=35A,$ $V_{GE}=-15\dots+15V$	255		nC
$I_{SC}$	SC Data	$T_P \leq 10\mu s, V_{GE}=15V,$ $T_J=125^\circ C, V_{CC}=900V,$ $V_{CEM} \leq 1200V$	TBD		A

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

#### Maximum Rated Values

Symbol	Description	GD40PIK120C6S	Units
$V_{RRM}$	Repetitive Peak Reverse Voltage @ $T_J=25^\circ C$	1200	V
$I_F$	DC Forward Current	40	A
$I_{FRM}$	Repetitive Peak Forward Current $t_p=1ms$	80	A
$I^2t$	$I^2t$ -value, $V_R=0V, t_p=10ms, T_J=125^\circ C$	320	$A^2s$

#### Characteristics Values

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
$V_F$	Diode Forward Voltage	$I_F=40A, V_{GE}=0V$	$T_J=25^\circ C$	2.00	2.45	V
			$T_J=125^\circ C$		1.80	
$Q_{rr}$	Recovered Charge	$I_F=40A,$	$T_J=25^\circ C$	4.3		$\mu C$
			$T_J=125^\circ C$	8.2		
$I_{RM}$	Peak Reverse Recovery Current	$V_R=600V,$ $di/dt=-1000A/\mu s,$	$T_J=25^\circ C$	44		A
			$T_J=125^\circ C$	45		
$E_{rec}$	Reverse Recovery Energy	$V_{GE}=-15V$	$T_J=25^\circ C$	1.50		mJ
			$T_J=125^\circ C$	3.00		

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

Symbol	Description	GD40PIK120C6S	Units
$V_{RRM}$	Repetitive Peak Reverse Voltage @ $T_j=25^\circ\text{C}$	1600	V
$I_{F(AV)}$	Average On-state Current @ $T_C=100^\circ\text{C}$	40	A
$I_{RMSM}$	Maximum RMS Current at Rectifier Output @ $T_C=80^\circ\text{C}$	50	A
$I_{FSM}$	Surge Forward Current $V_R=0\text{V}, t_p=10\text{ms}, T_j=45^\circ\text{C}$	600	A
$I^2t$	$I^2t$ -value, $V_R=0\text{V}, t_p=10\text{ms}, T_j=45^\circ\text{C}$	1800	$\text{A}^2\text{s}$

**Characteristics Values**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
$V_F$	Diode Forward Voltage	$I_F=80\text{A}$ $T_j=150^\circ\text{C}$			1.31	V
$I_R$	Reverse Current	$T_j=150^\circ\text{C}, V_R=1600\text{V}$			3	mA

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

Symbol	Description	GD40PIK120C6S	Units
$V_{CES}$	Collector-Emitter Voltage @ $T_j=25^\circ\text{C}$	1200	V
$V_{GES}$	Gate-Emitter Voltage @ $T_j=25^\circ\text{C}$	$\pm 20$	V
$I_C$	Collector Current @ $T_C=25^\circ\text{C}$ @ $T_C=80^\circ\text{C}$	50 25	A
$I_{CM}$	Pulsed Collector Current $t_p=1\text{ms}$	50	A
$P_{tot}$	Total Power Dissipation @ $T_j=150^\circ\text{C}$	240	W
$T_{SC}$	Short Circuit Withstand Time @ $T_j=150^\circ\text{C}$	10	$\mu\text{s}$

**Off Characteristics**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
$V_{(BR)CES}$	Collector-Emitter Breakdown Voltage	$T_j=25^\circ\text{C}$	1200			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	$I_C=250\mu A, V_{CE}=V_{GE},$ $T_j=25^\circ C$	4.4	5.2	6.0	V
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage	$I_C=25A, V_{GE}=15V,$ $T_j=25^\circ C$		2.35	2.75	V
		$I_C=25A, V_{GE}=15V,$ $T_j=125^\circ C$		2.75		

## Switching Characteristics

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
$E_{on}$	Turn-On Switching Loss	$V_{CC}=600V, I_C=25A,$ $R_G=5\Omega, V_{GE}=\pm 15V,$ $T_j=25^\circ C$		1.07		mJ
$E_{off}$	Turn-Off Switching Loss			1.49		mJ
$E_{tot}$	Total Switching Loss			2.56		mJ
$E_{on}$	Turn-On Switching Loss	$V_{CC}=600V, I_C=25A,$ $R_G=5\Omega, V_{GE}=\pm 15V,$ $T_j=125^\circ C$		1.66		mJ
$E_{off}$	Turn-Off Switching Loss			2.12		mJ
$E_{tot}$	Total Switching Loss			3.78		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600V, I_C=25A,$ $R_G=5\Omega, V_{GE}=\pm 15V,$ $T_j=125^\circ C$		50		ns
$t_r$	Rise Time			25		ns
$t_{d(off)}$	Turn-Off Delay Time			210		ns
$t_f$	Fall Time			60		ns
$C_{ies}$	Input Capacitance	$V_{CE}=30V, f=1Mhz,$ $V_{GE}=0V$		2.20		pF
$C_{oes}$	Output Capacitance			0.21		pF
$C_{res}$	Reverse Transfer Capacitance			0.09		pF
$Q_G$	Gate charge	$V_{CC}=600V, I_C=25A,$ $V_{GE}=-15\dots+15V$		169		nC
$I_{SC}$	SC Data	$T_P \leq 10\mu s, V_{GE}=15V,$ $T_j=125^\circ C, V_{CC}=900V,$ $V_{CEM} \leq 1200V$		TBD		A

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

Symbol	Description	GD40PIK120C6S	Units
$V_{RRM}$	Repetitive Peak Reverse Voltage @ $T_j=25^\circ\text{C}$	1200	V
$I_F$	DC Forward Current	25	A
$I_{FRM}$	Repetitive Peak Forward Current $t_p=1\text{ms}$	50	A
$I^2t$	$I^2t$ -value, $V_R=0\text{V}$ , $t_p=10\text{ms}$ , $T_j=125^\circ\text{C}$	170	$\text{A}^2\text{s}$

**Characteristics Values**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
$V_F$	Diode Forward Voltage	$I_F=25\text{A}$ , $V_{GE}=0\text{V}$	$T_j=25^\circ\text{C}$	1.78	2.10	V
			$T_j=125^\circ\text{C}$		1.90	
$Q_r$	Recovered Charge	$I_F=25\text{A}$ ,	$T_j=25^\circ\text{C}$	2.75		$\mu\text{C}$
			$T_j=125^\circ\text{C}$	4.95		
$I_{RM}$	Peak Reverse Recovery Current	$V_R=600\text{V}$ , $di/dt=-700\text{A}/\mu\text{s}$ ,	$T_j=25^\circ\text{C}$	25		A
			$T_j=125^\circ\text{C}$	24		
$E_{rec}$	Reverse Recovery Energy	$V_{GE}=-15\text{V}$	$T_j=25^\circ\text{C}$	0.91		mJ
			$T_j=125^\circ\text{C}$	1.82		

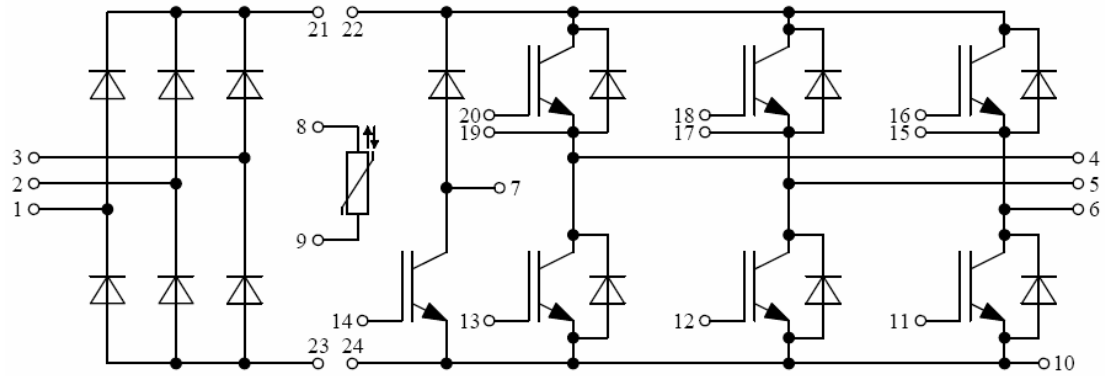
**Electrical Characteristics of NTC**  $T_C=25^\circ\text{C}$  unless otherwise noted

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**

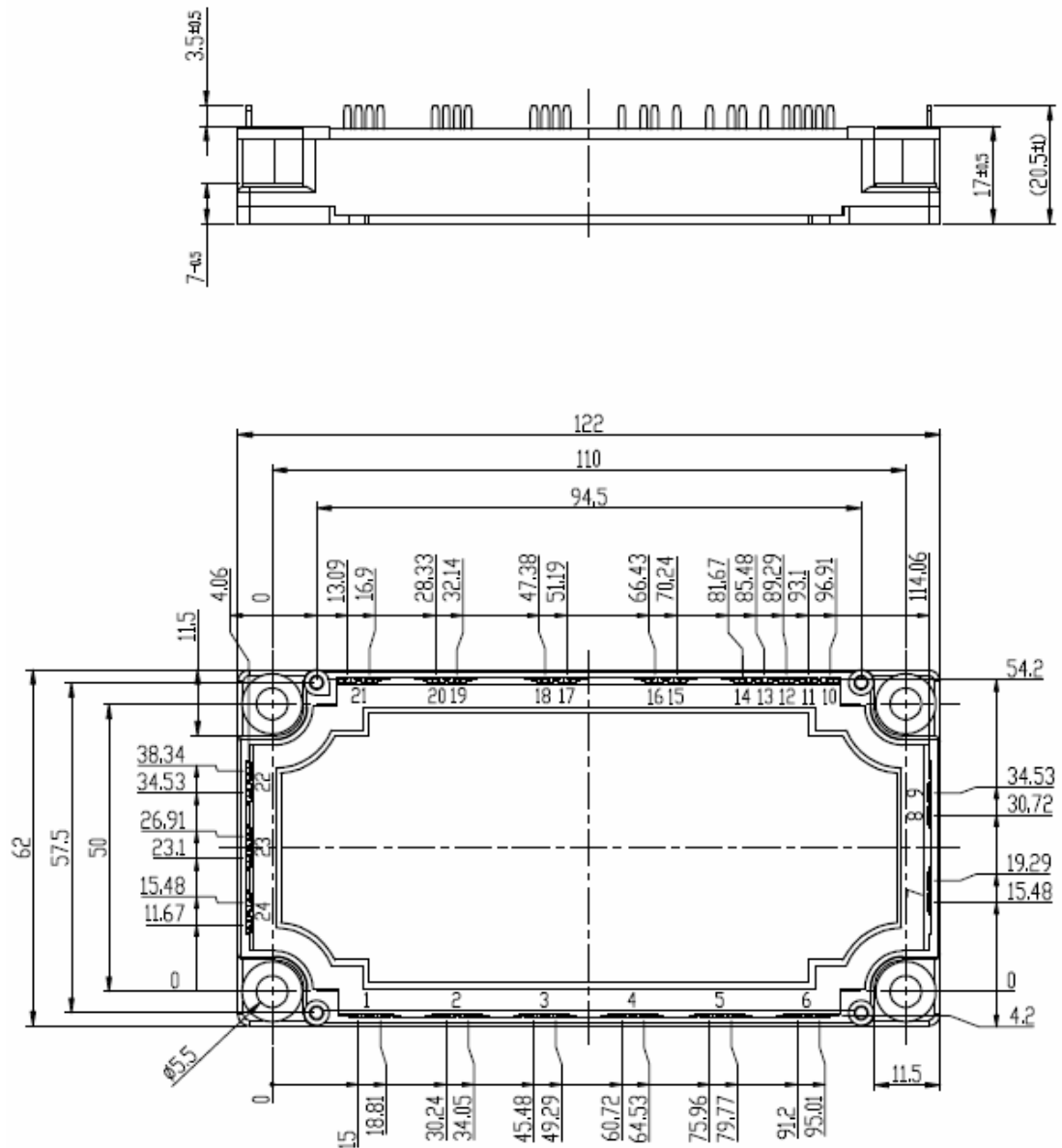
Symbol	Parameter	Min.	Typ.	Max.	Units
V <sub>ISO</sub>	Isolation Voltage RMS, f=50Hz, t=1min		2500		V
L <sub>CE</sub>	Stray Inductance		60		nH
R <sub>CC'+EE'</sub>	Module Lead Resistance, Terminal to Chip @ T <sub>C</sub> =25°C		4.00		mΩ
R <sub>θJC</sub>	Junction-to-Case (per IGBT-inverter)			0.40	K/W
	Junction-to-Case (per DIODE-inverter)			0.85	
	Junction-to-Case (per DIODE-rectifier)			0.71	
	Junction-to-Case (per IGBT-brake-chopper)			0.52	
	Junction-to-Case (per DIODE-brake-chopper)			0.84	
R <sub>θCS</sub>	Case-to-Sink (Conductive grease applied)		0.009		K/W
T <sub>j</sub>	Maximum Junction Temperature			150	°C
T <sub>STG</sub>	Storage Temperature Range	-40		125	°C
Mounting Torque	Mounting Screw:M5	3.0		6.0	N.m
G	Weight of Module		300		g

### Equivalent Circuit Schematic



### Package Dimension

Dimensions in Millimeters





## Terms and Conditions of Usage

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