

STARPOWER

SEMICONDUCTOR™

IGBT

GD15PIK60C5S

Preliminary

Molding Type Module**600V/15A 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 μ 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	GD15PIK60C5S	Units
V_{CES}	Collector-Emitter Voltage @ $T_j=25^\circ\text{C}$	600	V
V_{GES}	Gate-Emitter Voltage @ $T_j=25^\circ\text{C}$	± 20	V
I_C	Collector Current @ $T_C=25^\circ\text{C}$	30	A
	@ $T_C=80^\circ\text{C}$	15	
I_{CM}	Pulsed Collector Current $t_p=1\text{ms}$	30	A
P_{tot}	Total Power Dissipation @ $T_j=150^\circ\text{C}$	113	W
T_{SC}	Short Circuit Withstand Time @ $T_j=150^\circ\text{C}$	10	μs

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	$I_C=250\mu\text{A}, V_{CE}=V_{GE},$ $T_j=25^\circ\text{C}$	3.5	4.5	5.5	V
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage	$I_C=15\text{A}, V_{GE}=15\text{V},$ $T_j=25^\circ\text{C}$		1.80	2.25	V
		$I_C=15\text{A}, V_{GE}=15\text{V},$ $T_j=150^\circ\text{C}$		2.10		

Switching Characteristics

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units	
Q_G	Gate charge	$V_{CC}=400\text{V}, I_C=15\text{A},$ $V_{GE}=15\text{V}$		56		nC	
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=400\text{V}, I_C=15\text{A},$ $R_G=22\Omega, V_{GE}=15\text{V},$ $T_j=25^\circ\text{C}$		34		ns	
t_r	Rise Time			16		ns	
$t_{d(off)}$	Turn-Off Delay Time			184		ns	
t_f	Fall Time			20		ns	
E_{on}	Turn-On Switching Loss				0.22		mJ
E_{off}	Turn-Off Switching Loss				0.34		mJ

$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=400V, I_C=15A,$ $R_G=22\Omega, V_{GE}=15V,$ $T_J=150^\circ C$		34		ns
t_r	Rise Time			18		ns
$t_{d(off)}$	Turn-Off Delay Time			203		ns
t_f	Fall Time			28		ns
E_{on}	Turn-On Switching Loss			0.36		mJ
E_{off}	Turn-Off Switching Loss			0.49		mJ
C_{ies}	Input Capacitance	$V_{CE}=30V, f=1Mhz,$ $V_{GE}=0V$		850		pF
C_{oes}	Output Capacitance			75		pF
C_{res}	Reverse Transfer Capacitance			35		pF
I_{SC}	SC Data	$T_P \leq 10\mu s, V_{GE}=15V,$ $T_J=125^\circ C, V_{CC}=360V,$ $V_{CEM} \leq 600V$		TBD		A

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

Maximum Rated Values

Symbol	Description	GD15PIK60C5S	Units
V_{RRM}	Repetitive Peak Reverse Voltage @ $T_J=25^\circ C$	600	V
I_F	DC Forward Current @ $T_C=80^\circ C$	15	A
I_{FRM}	Repetitive Peak Forward Current $t_p=1ms$	30	A

Characteristics Values

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
V_F	Diode Forward Voltage	$I_F=15A, V_{GE}=0V$	$T_J=25^\circ C$	1.20	1.60	V
			$T_J=125^\circ C$	1.20		
t_r	Reverse Recovery Time	$V_R=600V,$	$T_J=25^\circ C$	/		ns
			$T_J=125^\circ C$	92		
I_{RM}	Peak Reverse Recovery Current	$I_F=15A,$ $R_G=22\Omega,$	$T_J=25^\circ C$	/		A
			$T_J=125^\circ C$	29		
E_{rec}	Reverse Recovery Energy	$V_{GE}=-15V$	$T_J=25^\circ C$	/		mJ
			$T_J=125^\circ C$	0.54		

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

Symbol	Description	GD15PIK60C5S	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 @ $T_C=80^\circ\text{C}$	38	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

Characteristics Values

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
V_F	Diode Forward Voltage	$I_F=30\text{A}$ $T_j=150^\circ\text{C}$			1.31	V
I_R	Reverse Current	$T_j=150^\circ\text{C}, V_R=1600\text{V}$			1.0	mA

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

Symbol	Description	GD15PIK60C5S	Units
V_{CES}	Collector-Emitter Voltage @ $T_j=25^\circ\text{C}$	600	V
V_{GES}	Gate-Emitter Voltage @ $T_j=25^\circ\text{C}$	± 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 @ $T_j=150^\circ\text{C}$	82	W
T_{SC}	Short Circuit Withstand Time @ $T_j=150^\circ\text{C}$	10	μs

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	$I_C=250\mu A, V_{CE}=V_{GE},$ $T_J=25^\circ C$	3.5	4.5	5.5	V
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage	$I_C=10A, V_{GE}=15V,$ $T_J=25^\circ C$		1.80	2.25	V
		$I_C=10A, V_{GE}=15V,$ $T_J=150^\circ C$		2.20		

Switching Characteristics

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units	
Q_G	Gate charge	$V_{CC}=400V, I_C=10A,$ $V_{GE}=15V$		38		nC	
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=400V, I_C=10A,$ $R_G=47\Omega, V_{GE}=15V,$ $T_J=25^\circ C$		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	$V_{CC}=400V, I_C=10A,$ $R_G=47\Omega, V_{GE}=15V,$ $T_J=150^\circ C$		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_{oes}	Output Capacitance			62		pF	
C_{res}	Reverse Transfer Capacitance			22		pF	
I_{SC}	SC Data	$T_P \leq 10\mu s, V_{GE}=15V,$ $T_J=125^\circ C, V_{CC}=360V,$ $V_{CEM} \leq 600V$		TBD		A	

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

Symbol	Description	GD15PIK60C5S	Units
V_{RRM}	Repetitive Peak Reverse Voltage @ $T_J=25^\circ\text{C}$	600	V
I_F	DC Forward Current @ $T_C=80^\circ\text{C}$	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
			$T_J=125^\circ\text{C}$	1.25		
t_r	Reverse Recovery Time	$V_R=600\text{V},$ $I_F=10\text{A},$ $R_G=47\Omega,$ $V_{GE}=-15\text{V}$	$T_J=25^\circ\text{C}$	/		ns
			$T_J=125^\circ\text{C}$	90		
I_{RM}	Peak Reverse Recovery Current	$I_F=10\text{A},$ $R_G=47\Omega,$ $V_{GE}=-15\text{V}$	$T_J=25^\circ\text{C}$	/		A
			$T_J=125^\circ\text{C}$	19		
E_{rec}	Reverse Recovery Energy	$I_F=10\text{A},$ $R_G=47\Omega,$ $V_{GE}=-15\text{V}$	$T_J=25^\circ\text{C}$	/		mJ
			$T_J=125^\circ\text{C}$	0.25		

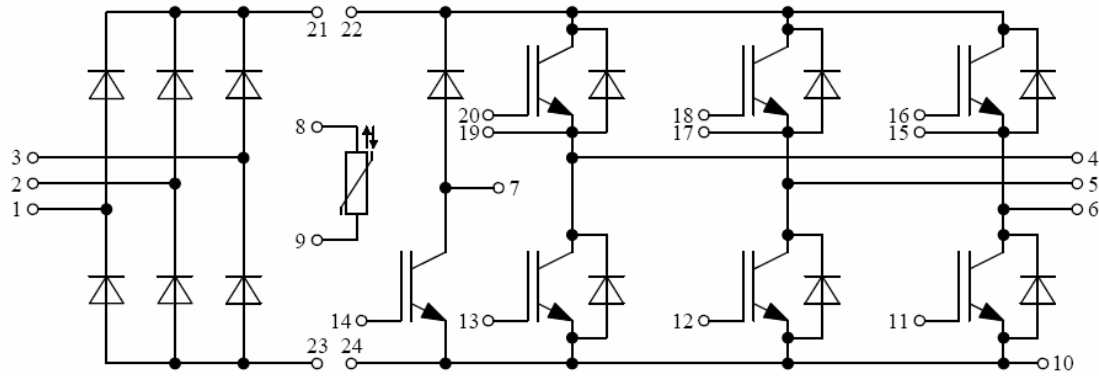
Electrical Characteristics of NTC $T_C=25^\circ\text{C}$ unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
R_{25}	Rated Resistance			5.0		k Ω
$\Delta R/R$	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

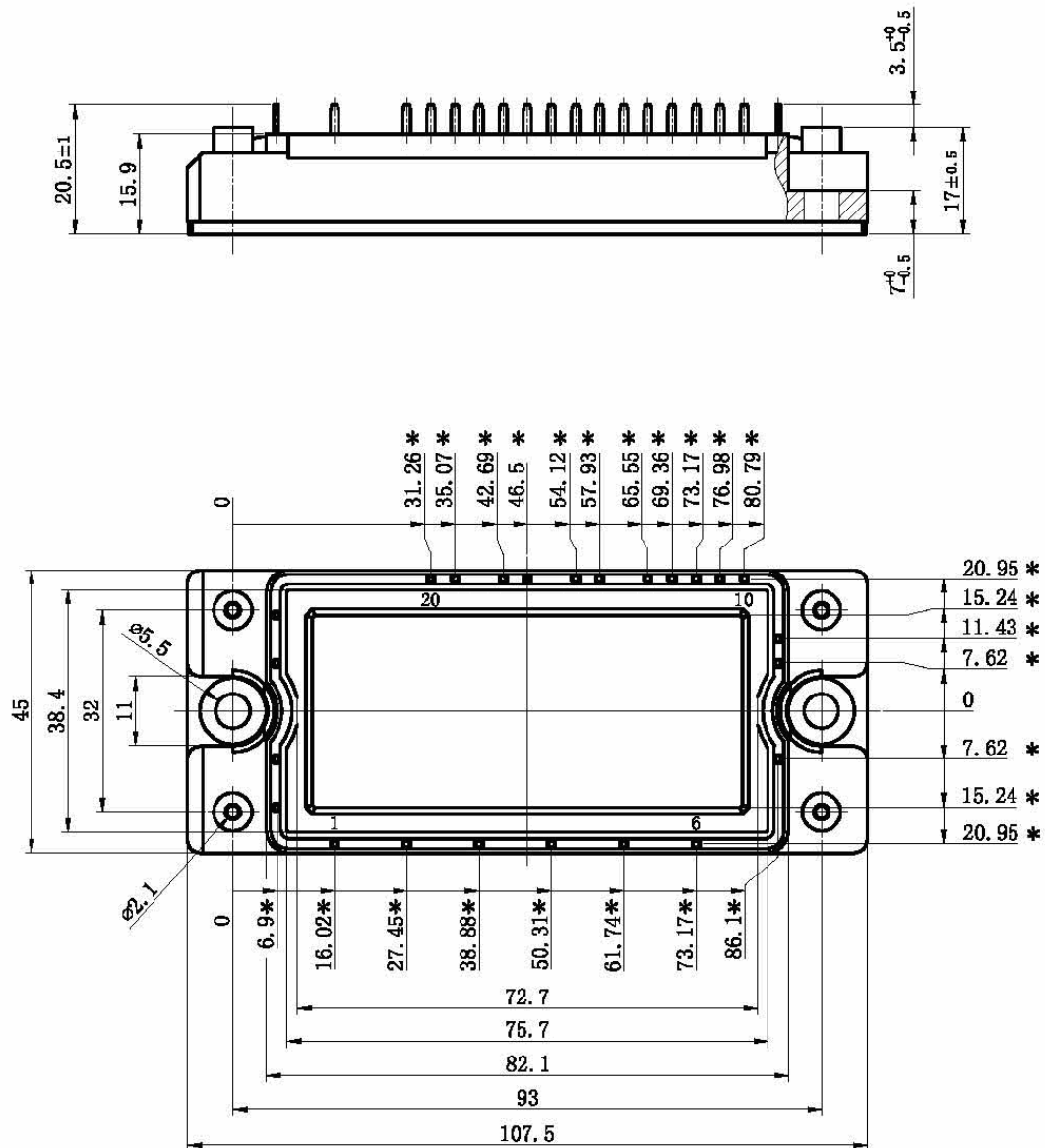
Symbol	Parameter	Min.	Typ.	Max.	Units
V _{ISO}	Isolation Voltage RMS, f=50Hz, t=1min		2500		V
L _{CE}	Stray Inductance		60		nH
R _{CC'+EE'}	Module Lead Resistance, Terminal to Chip @ T _C =25°C		4.00		mΩ
R _{θJC}	Junction-to-Case (per IGBT-inverter)			1.11	K/W
	Junction-to-Case (per DIODE-inverter)			1.90	
	Junction-to-Case (per DIODE-rectifier)			1.45	
	Junction-to-Case (per IGBT-brake-chopper)			1.53	
	Junction-to-Case (per DIODE-brake-chopper)			2.66	
R _{θCS}	Case-to-Sink (Conductive grease applied)		0.02		K/W
T _j	Maximum Junction Temperature			150	°C
T _{STG}	Storage Temperature Range	-40		125	°C
Mounting Torque	Mounting Screw:M5	3.0		6.0	N.m
G	Weight of Module		200		g

Equivalent Circuit Schematic



Package Dimension

Dimensions in Millimeters



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