

# STARPOWER

SEMICONDUCTOR

## Rectifier

### RD160PBS160C5S

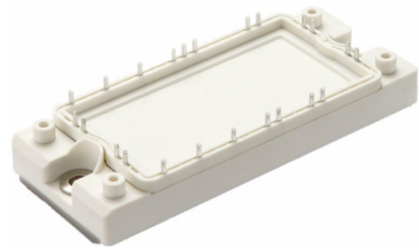
**1600V/160A in one-package**

#### General Description

STARPOWER Rectifier Power Module provides ultra low conduction loss. They are designed for the applications such as SMPS.

#### Features

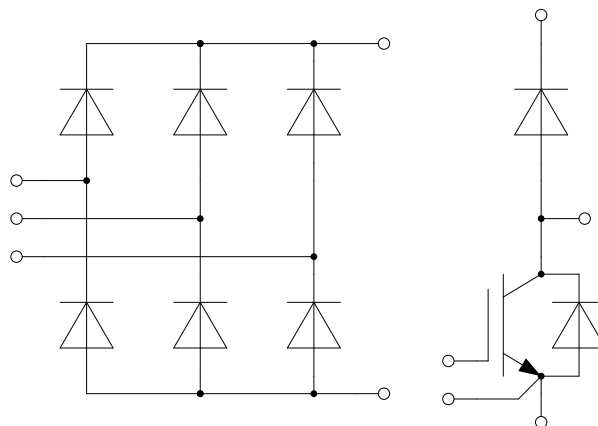
- Low forward voltage drop
- Small temperature coefficient
- High surge capacity
- Low inductance
- Isolated copper baseplate using DBC technology



#### Typical Applications

- Input bridge rectifier
- AC/DC motor control
- Power supply

#### Equivalent Circuit Schematic



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

Symbol	Description	Value	Unit
$V_{RRM}$	Repetitive Peak Reverse Voltage	1600	V
$I_O$	Average Output Current $T_C=80^{\circ}\text{C}$	160	A
$I_{FSM}$	Surge Forward Current $V_R=0\text{V}, t_p=10\text{ms}, T_j=25^{\circ}\text{C}$ $V_R=0\text{V}, t_p=10\text{ms}, T_j=150^{\circ}\text{C}$	1800	A
		1560	
$I^2t$	$I^2t$ -value $V_R=0\text{V}, t_p=10\text{ms}, T_j=25^{\circ}\text{C}$ $V_R=0\text{V}, t_p=10\text{ms}, T_j=150^{\circ}\text{C}$	16200	$\text{A}^2\text{s}$
		12168	

**Diode-chopper**

Symbol	Description	Value	Unit
$V_{RRM}$	Repetitive Peak Reverse Voltage	1200	V
$I_F$	Diode Continuous Forward Current	50	A
$I_{FM}$	Diode Maximum Forward Current $t_p=1\text{ms}$	100	A

**IGBT-chopper**

Symbol	Description	Value	Unit
$V_{CES}$	Collector-Emitter Voltage	1200	V
$V_{GES}$	Gate-Emitter Voltage	$\pm 30$	V
$I_C$	Collector Current @ $T_C=25^{\circ}\text{C}$ @ $T_C=100^{\circ}\text{C}$	127	A
		75	
$I_{CM}$	Pulsed Collector Current $t_p=1\text{ms}$	150	A
$P_D$	Maximum Power Dissipation @ $T_j=175^{\circ}\text{C}$	432	W

**Diode-chopper-reverse**

Symbol	Description	Value	Unit
$V_{RRM}$	Repetitive Peak Reverse Voltage	1200	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(rectifier)	150	$^{\circ}\text{C}$
	Maximum Junction Temperature(chopper)	175	
$T_{jop}$	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

**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	$I_F=160\text{A}$	$T_j=25^\circ\text{C}$		1.20	V
			$T_j=150^\circ\text{C}$		1.13	
$V_{(TO)}$	Threshold Voltage	$T_j=150^\circ\text{C}$			0.86	V
$r_T$	Forward Slope Resistance	$T_j=150^\circ\text{C}$			1.7	$\text{m}\Omega$
$I_R$	Diode Reverse Current	$V_R=V_{RRM}$	$T_j=25^\circ\text{C}$		0.1	mA
			$T_j=150^\circ\text{C}$		2.0	

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_F$	Diode Forward Voltage	$I_C=50\text{A}, V_{GE}=0\text{V}, T_j=25^\circ\text{C}$		1.70	2.15	V
		$I_C=50\text{A}, V_{GE}=0\text{V}, T_j=125^\circ\text{C}$		1.65		
		$I_C=50\text{A}, V_{GE}=0\text{V}, T_j=150^\circ\text{C}$		1.65		
$Q_r$	Recovered Charge	$V_R=600\text{V}, I_F=50\text{A},$ $-di/dt=1150\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=25^\circ\text{C}$		3.0		$\mu\text{C}$
$I_{RM}$	Peak Reverse Recovery Current			46		A
$E_{rec}$	Reverse Recovery Energy			1.72		mJ
$Q_r$	Recovered Charge	$V_R=600\text{V}, I_F=50\text{A},$ $-di/dt=1150\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=125^\circ\text{C}$		7.2		$\mu\text{C}$
$I_{RM}$	Peak Reverse Recovery Current			56		A
$E_{rec}$	Reverse Recovery Energy			3.15		mJ
$Q_r$	Recovered Charge	$V_R=600\text{V}, I_F=50\text{A},$ $-di/dt=1150\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=150^\circ\text{C}$		8.0		$\mu\text{C}$
$I_{RM}$	Peak Reverse Recovery Current			59		A
$E_{rec}$	Reverse Recovery Energy			3.47		mJ

**IGBT-chopper 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	$I_C=75\text{A}, V_{GE}=15\text{V}, T_j=25^\circ\text{C}$		1.70	2.20	V	
		$I_C=75\text{A}, V_{GE}=15\text{V}, T_j=125^\circ\text{C}$		1.95			
		$I_C=75\text{A}, V_{GE}=15\text{V}, T_j=150^\circ\text{C}$		2.00			
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$I_C=3.0\text{mA}, V_{CE}=V_{GE}, T_j=25^\circ\text{C}$	5.0	5.7	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	$V_{GE}=V_{GES}, V_{CE}=0\text{V}, T_j=25^\circ\text{C}$			100	nA	
$R_{Gint}$	Internal Gate Resistance			2.0		$\Omega$	
$C_{ies}$	Input Capacitance	$V_{CE}=30\text{V}, f=1\text{MHz}, V_{GE}=0\text{V}$		7.15		nF	
$C_{res}$	Reverse Transfer Capacitance				0.23		nF
$Q_G$	Gate Charge	$V_{GE}=15\text{V}$		0.48		$\mu\text{C}$	
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=75\text{A}, R_G=5.1\Omega, V_{GE}=\pm 15\text{V}, T_j=25^\circ\text{C}$		219		ns	
$t_r$	Rise Time			42		ns	
$t_{d(off)}$	Turn-Off Delay Time			271		ns	
$t_f$	Fall Time			261		ns	
$E_{on}$	Turn-On Switching Loss			2.95		mJ	
$E_{off}$	Turn-Off Switching Loss			4.70		mJ	
$t_{d(on)}$	Turn-On Delay Time		$V_{CC}=600\text{V}, I_C=75\text{A}, R_G=5.1\Omega, V_{GE}=\pm 15\text{V}, T_j=125^\circ\text{C}$		220		ns
$t_r$	Rise Time				46		ns
$t_{d(off)}$	Turn-Off Delay Time			289		ns	
$t_f$	Fall Time			397		ns	
$E_{on}$	Turn-On Switching Loss			4.00		mJ	
$E_{off}$	Turn-Off Switching Loss			7.65		mJ	
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=75\text{A}, R_G=5.1\Omega, V_{GE}=\pm 15\text{V}, T_j=150^\circ\text{C}$			222		ns
$t_r$	Rise Time				46		ns
$t_{d(off)}$	Turn-Off Delay Time			295		ns	
$t_f$	Fall Time			410		ns	
$E_{on}$	Turn-On Switching Loss			4.40		mJ	
$E_{off}$	Turn-Off Switching Loss			8.41		mJ	
$I_{SC}$	SC Data		$t_p \leq 10\mu\text{s}, V_{GE}=15\text{V}, T_j=150^\circ\text{C}, V_{CC}=900\text{V}, V_{CEM} \leq 1200\text{V}$		300		A

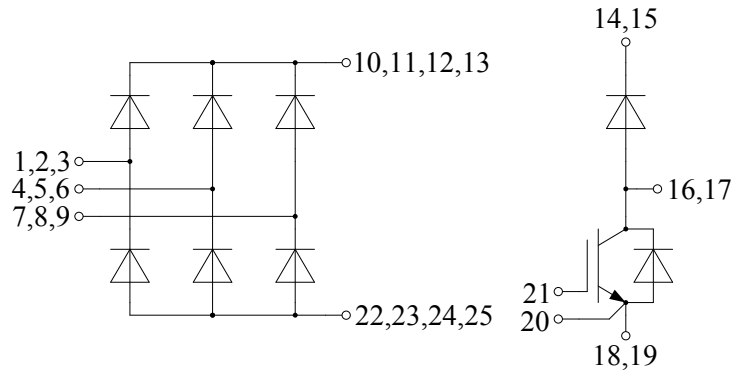
**Diode-chopper-reverse Characteristics**  $T_C=25^\circ\text{C}$  unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_F$	Diode Forward Voltage	$I_C=10\text{A}, V_{GE}=0\text{V}, T_j=25^\circ\text{C}$		1.90	2.35	V
		$I_C=10\text{A}, V_{GE}=0\text{V}, T_j=125^\circ\text{C}$		1.90		
		$I_C=10\text{A}, V_{GE}=0\text{V}, T_j=150^\circ\text{C}$		1.90		
$Q_r$	Recovered Charge			0.6		$\mu\text{C}$
$I_{RM}$	Peak Reverse Recovery Current	$V_R=600\text{V}, I_F=10\text{A},$ $-di/dt=250\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=25^\circ\text{C}$		9		A
$E_{rec}$	Reverse Recovery Energy			0.15		mJ
$Q_r$	Recovered Charge			1.3		$\mu\text{C}$
$I_{RM}$	Peak Reverse Recovery Current	$V_R=600\text{V}, I_F=10\text{A},$ $-di/dt=250\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=125^\circ\text{C}$		11		A
$E_{rec}$	Reverse Recovery Energy			0.35		mJ
$Q_r$	Recovered Charge			1.5		$\mu\text{C}$
$I_{RM}$	Peak Reverse Recovery Current	$V_R=600\text{V}, I_F=10\text{A},$ $-di/dt=250\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=150^\circ\text{C}$		12		A
$E_{rec}$	Reverse Recovery Energy			0.39		mJ

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

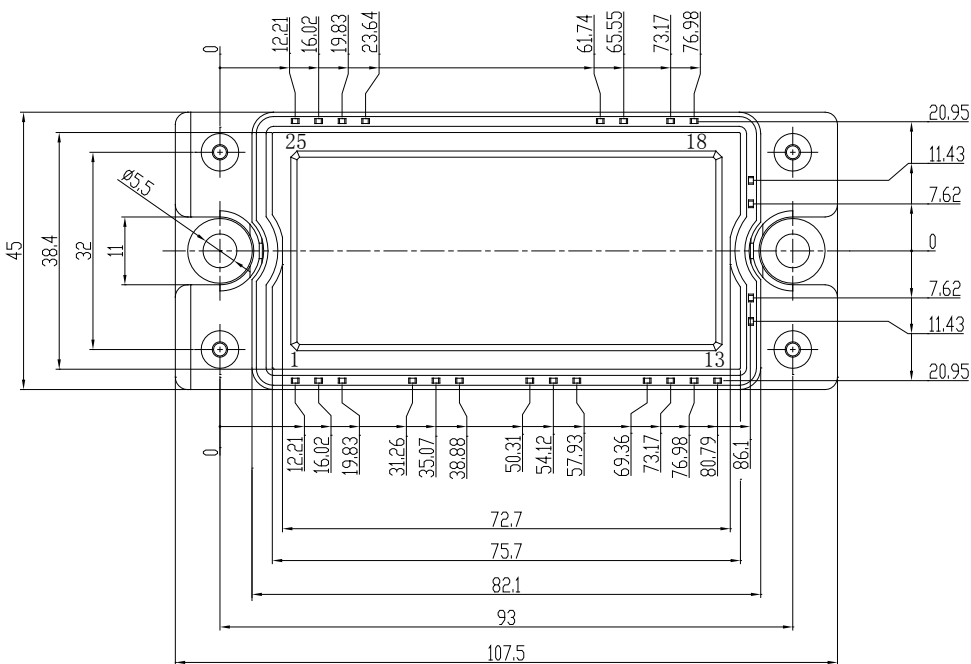
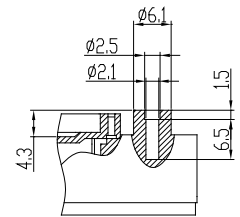
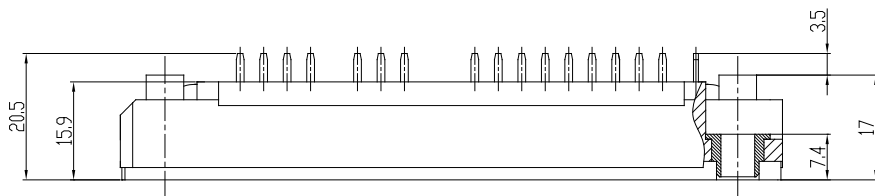
Symbol	Parameter	Min.	Typ.	Max.	Unit
$R_{thJC}$	Junction-to-Case (per Diode-rectifier)			0.382	K/W
	Junction-to-Case (per Diode-chopper)			0.736	
	Junction-to-Case (per IGBT-chopper)			0.347	
	Junction-to-Case (per Diode-chopper-reverse)			1.946	
$R_{thCH}$	Case-to-Heatsink (per Diode-rectifier)		0.156		K/W
	Case-to-Heatsink (per Diode-chopper)		0.301		
	Case-to-Heatsink (per IGBT-brake)		0.142		
	Case-to-Heatsink (per Diode-chopper-reverse)		0.796		
	Case-to-Heatsink (per Module)		0.02		
M	Mounting Torque, Screw M5	3.0		6.0	N.m
G	Weight of Module		200		g

**Circuit Schematic**



**Package Dimensions**

Dimensions in Millimeters



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