

## Vienna Rectifier MOSFET Power Module

### Super junction MOSFET:

$V_{DS} = 600V$

$R_{DSon} = 45m\Omega$  Max @  $T_j = 25^\circ C$

### Application

- Power supply

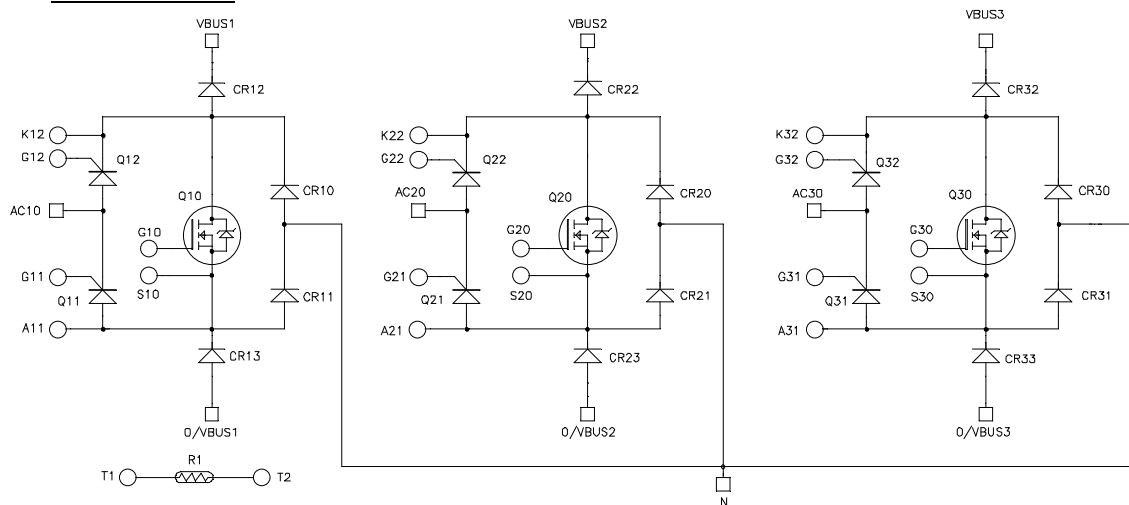
### Features

- **Super junction MOSFET**
  - Ultra low  $R_{DSon}$
  - Low Miller capacitance
  - Ultra low gate charge
  - Avalanche energy rated
  - Very rugged
- Kelvin emitter for easy drive
- Very low stray inductance
  - Symmetrical design
  - Lead frames for power connections
- Internal thermistor for temperature monitoring
- High level of integration

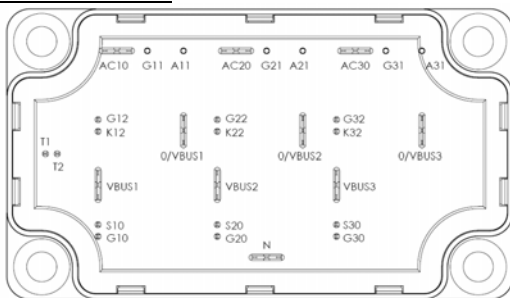
### Benefits


- AlN substrate for improved thermal performance
- Outstanding performance at high frequency operation
- Direct mounting to heatsink (isolated package)
- Low junction to case thermal resistance
- Solderable terminals both for power and signal for easy PCB mounting
- Low profile
- RoHS Compliant

### Electrical scheme:



### Pin out Location:



 **CAUTION:** These Devices are sensitive to Electrostatic Discharge. Proper Handling Procedures Should Be Followed.

All ratings @  $T_j = 25^\circ C$  unless otherwise specified

## 1. Absolute maximum ratings

**Thyristor** Absolute maximum ratings (per thyristor)

Symbol	Parameter	Max ratings	Unit
$V_{DRM}$	Repetitive Peak Reverse Voltage	1600	V
$I_{DRM}$	Repetitive Peak Reverse Current	3	mA
$I_{TRMS}$	RMS on – state current	$T_J = 100^{\circ}\text{C}$ 60	A
$I_{TSM}$	Surge on – state current	$t = 10\text{ms}$ $T_C = 45^{\circ}\text{C}$ 520	A
$V_{RGM}$	Peak Reverse Gate Voltage	10	V
$P_D$	Power Dissipation	$T_C = 25^{\circ}\text{C}$ 310	W

**Super junction MOSFET** Absolute maximum ratings (per MOSFET)

Symbol	Parameter	Max ratings	Unit
$V_{DSS}$	Drain - Source Voltage	600	V
$I_D$	Continuous Drain Current	$T_c = 25^{\circ}\text{C}$ 55	A
		$T_c = 80^{\circ}\text{C}$ 41	
$I_{DM}$	Pulsed Drain current	130	
$V_{GS}$	Gate - Source Voltage	$\pm 20$	V
$R_{DSon}$	Drain - Source ON Resistance	45	m $\Omega$
$P_D$	Power Dissipation	$T_c = 25^{\circ}\text{C}$ 357	W
$I_{AR}$	Avalanche current (repetitive and non repetitive)	15	A
$E_{AR}$	Repetitive Avalanche Energy	3	mJ
$E_{AS}$	Single Pulse Avalanche Energy	1900	

**FRED Diodes** CR12, CR13, CR22, CR23, CR32, CR33 Absolute maximum ratings (per diode)

Symbol	Parameter	Max ratings	Unit
$V_R$	DC reverse Voltage	600	V
$V_{RRM}$	Peak Repetitive Reverse Voltage		
$I_F$	DC Forward Current	$T_C = 60^{\circ}\text{C}$ 60	A
$I_{FSM}$	Non-Repetitive Forward Surge Current	$t = 8.3\text{ms}$ $T_J = 45^{\circ}\text{C}$ 600	
$P_D$	Power Dissipation	$T_C = 25^{\circ}\text{C}$ 160	W

**Rectifier diode** CR10, CR11, CR20, CR21, CR30, CR31 Absolute maximum ratings (per diode)

Symbol	Parameter	Max ratings	Unit
$V_R$	DC reverse Voltage	1600	V
$V_{RRM}$	Peak Repetitive Reverse Voltage		
$I_F$	DC Forward Current	$T_C = 100^{\circ}\text{C}$ 90	A
$I_{FSM}$	Non-Repetitive Forward Surge Current	$t=10\text{ms}$ $T_J = 45^{\circ}\text{C}$ 850	

## 2. Electrical Characteristics

### Thyristor Electrical Characteristics (per thyristor)

Symbol	Characteristic	Test Conditions		Min	Typ	Max	Unit
$V_T$	On – state Voltage	$I_T = 60A$	$T_J = 25^\circ C$		1.41		V
$V_{TO}$	Direct On state threshold Voltage		$T_J = 125^\circ C$		0.85		
$r_T$	On – state Slope resistance		$T_J = 125^\circ C$		10		m $\Omega$
$V_{GT}$	Gate Trigger Voltage		$T_J = 25^\circ C$		1.5		V
$I_{GT}$	Gate Trigger Current				50		mA
$R_{thJC}$	Junction to Case Thermal Resistance					0.40	$^\circ C/W$

### Super junction MOSFET Electrical Characteristics (per MOSFET)

Symbol	Characteristic	Test Conditions		Min	Typ	Max	Unit
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{GS} = 0V ; V_{DS} = 600V$				50	$\mu A$
$R_{DS(on)}$	Drain – Source on Resistance	$V_{GS} = 10V, I_D = 24.5A$			40	45	m $\Omega$
$V_{GS(th)}$	Gate Threshold Voltage	$V_{GS} = V_{DS}, I_D = 3mA$		2.1	3	3.9	V
$I_{GSS}$	Gate – Source Leakage Current	$V_{GS} = \pm 20V, V_{DS} = 0V$				140	nA
$C_{iss}$	Input Capacitance	$V_{GS} = 0V ; V_{DS} = 25V$			7.2		nF
$C_{oss}$	Output Capacitance	$f = 1MHz$			8.5		
$Q_g$	Total gate Charge	$V_{GS} = 10V$			150		nC
$Q_{gs}$	Gate – Source Charge	$V_{Bus} = 300V$			34		
$Q_{gd}$	Gate – Drain Charge	$I_D = 49A$			51		
$T_{d(on)}$	Turn-on Delay Time	<b>Inductive Switching (125<math>^\circ C</math>)</b> $V_{GS} = 10V$ $V_{Bus} = 400V$ $I_D = 49A$ $R_G = 5\Omega$			21		ns
$T_r$	Rise Time				30		
$T_{d(off)}$	Turn-off Delay Time				100		
$T_f$	Fall Time				45		
$E_{on}$	Turn-on Switching Energy	<b>Inductive switching @ 125<math>^\circ C</math></b> $V_{GS} = 10V ; V_{Bus} = 400V$ $I_D = 49A ; R_G = 5\Omega$			1100		$\mu J$
$E_{off}$	Turn-off Switching Energy				635		
$R_{thJC}$	Junction to Case Thermal Resistance					0.36	$^\circ C/W$

### FRED Diodes Electrical Characteristics CR12, CR13, CR22, CR23, CR32, CR33 (per diode)

Symbol	Characteristic	Test Conditions		Min	Typ	Max	Unit
V <sub>RRM</sub>	Peak Repetitive Reverse Voltage			600			V
I <sub>RM</sub>	Reverse Leakage Current	V <sub>R</sub> =600V				25	μA
V <sub>F</sub>	Diode Forward Voltage	I <sub>F</sub> = 60A			1.7	2.5	V
		I <sub>F</sub> = 120A			2		
		I <sub>F</sub> = 60 A	T <sub>j</sub> = 125°C		1.4		
t <sub>rr</sub>	Reverse Recovery Time	I <sub>F</sub> = 60A V <sub>R</sub> = 400V di/dt =200A/μs	T <sub>j</sub> = 25°C		70		ns
	T <sub>j</sub> = 125°C			140			
Q <sub>rr</sub>	Reverse Recovery Charge		T <sub>j</sub> = 25°C		100		nC
			T <sub>j</sub> = 125°C		690		
R <sub>thJC</sub>	Junction to Case Thermal Resistance					0.58	°C/W

## Rectifier diodes Electrical Characteristics CR10, CR11, CR20, CR21, CR30, CR31 (per diode)

Symbol	Characteristic	Test Conditions	Min	Typ	Max	Unit
$I_R$	Reverse Current	$V_R = 1600V$			50	$\mu A$
$V_F$	Forward Voltage	$I_F = 33A$		1		V
		$T_j = 25^\circ C$		0.9		
		$T_j = 125^\circ C$				
$V_T$	On – state Voltage				0.83	V
$r_T$	On – state Slope resistance				4.89	m $\Omega$
$R_{thJC}$	Junction to Case Thermal Resistance				0.66	$^\circ C/W$

## 3. Thermal and package characteristics

### Temperature sensor NTC (see application note APT0406 on www.microsemi.com for more information).

Symbol	Characteristic	Min	Typ	Max	Unit
$R_{25}$	Resistance @ 25 $^\circ C$		50		k $\Omega$
$\Delta R_{25}/R_{25}$			5		%
$B_{25/85}$	$T_{25} = 298.15 K$		3952		K
$\Delta B/B$	$T_C = 100^\circ C$		4		%

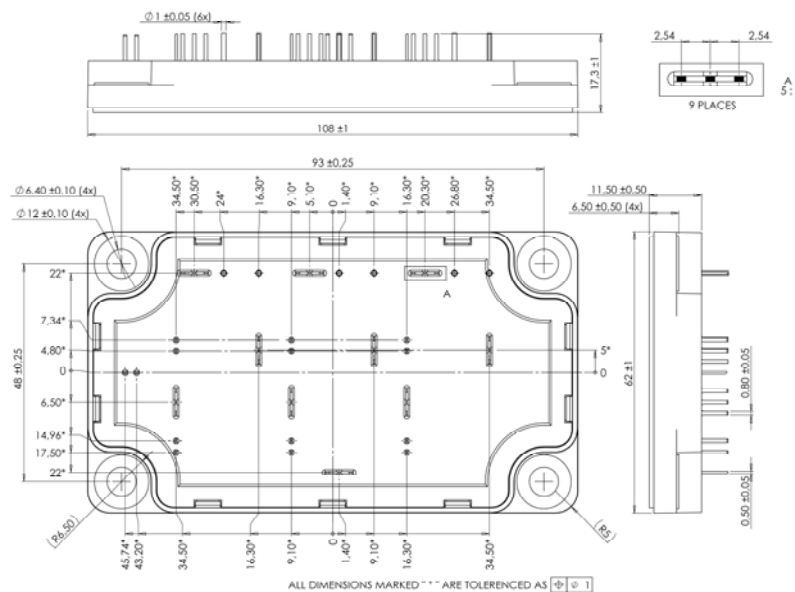
$$R_T = \frac{R_{25}}{\exp \left[ B_{25/85} \left( \frac{1}{T_{25}} - \frac{1}{T} \right) \right]}$$

T: Thermistor temperature  
R<sub>T</sub>: Thermistor value at T

## Package characteristics

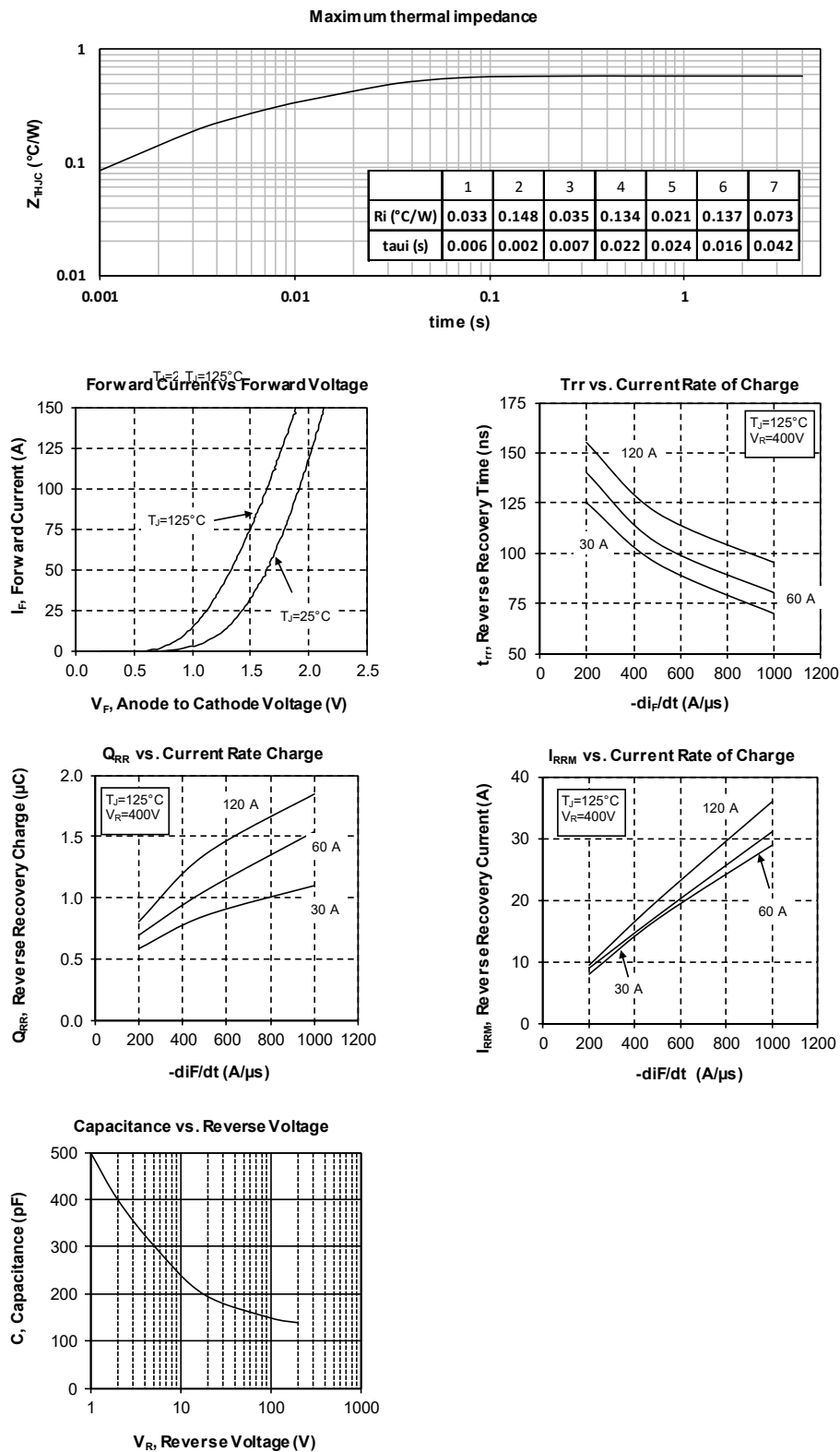
Symbol	Characteristic	Min	Typ	Max	Unit
$V_{ISOL}$	RMS Isolation Voltage, any terminal to case t=1 min, 50/60Hz	4000			V
$T_J$	Operating junction temperature range	-40		150	$^\circ C$
$T_{STG}$	Storage Temperature Range	-40		125	
$T_C$	Operating Case Temperature	-40		125	
Torque	Mounting torque	To Heatsink	M6	3	N.m
Wt	Package Weight			250	g

## Package outline (dimensions in mm)



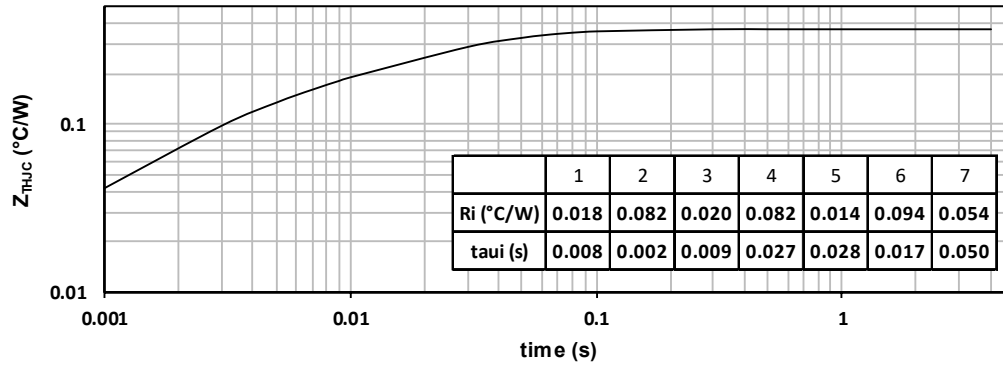
See application note 1902 - Mounting Instructions for SP6-P (12mm) Power Modules on [www.microsemi.com](http://www.microsemi.com)

## Typical FRED Performance Curve (per diode)

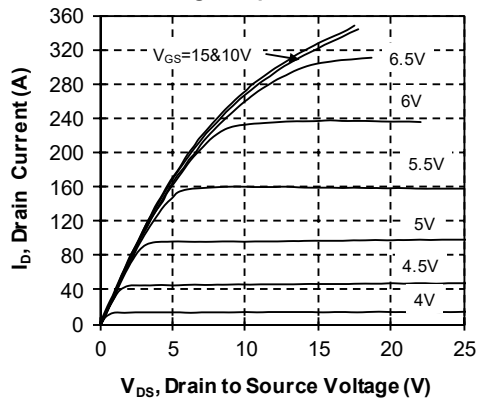


## Typical Super junction MOSFET Performance Curve (per MOSFET)

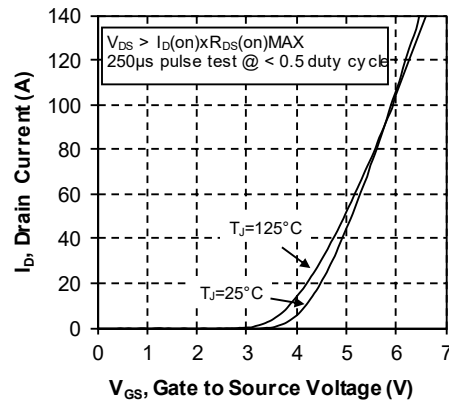
Maximum thermal impedance



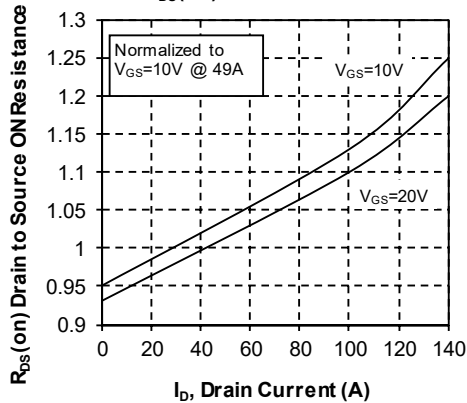
Low Voltage Output Characteristics



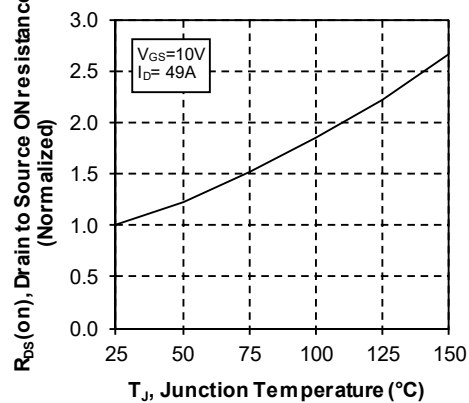
Transfer Characteristics

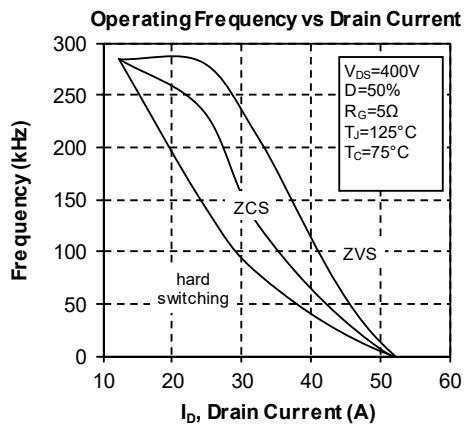
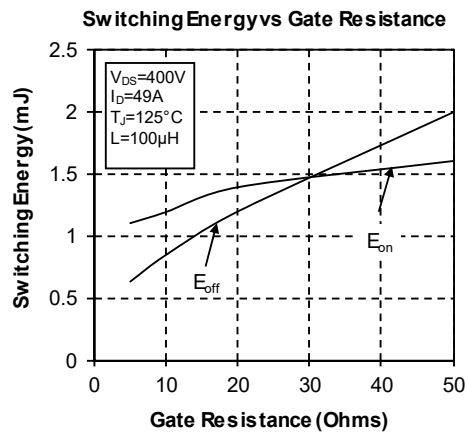
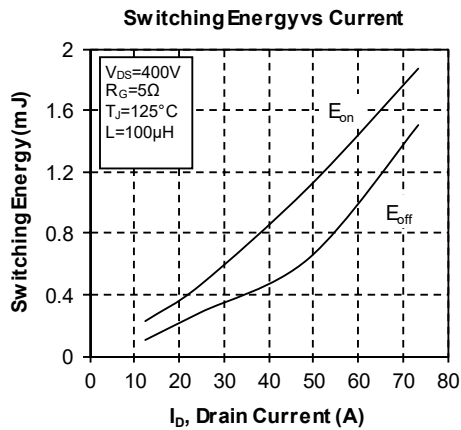
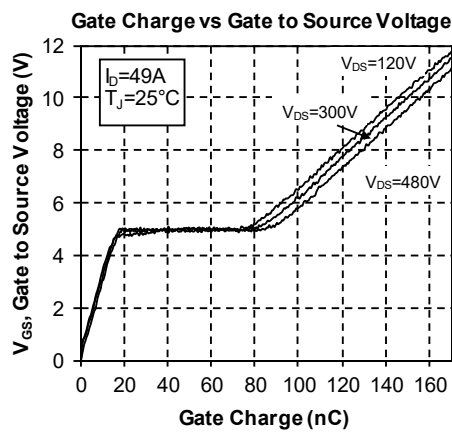
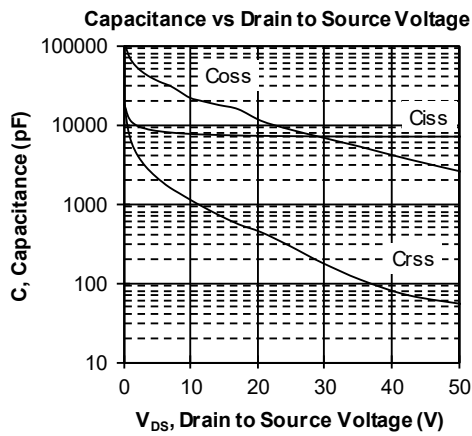


R\_DS(on) vs Drain Current

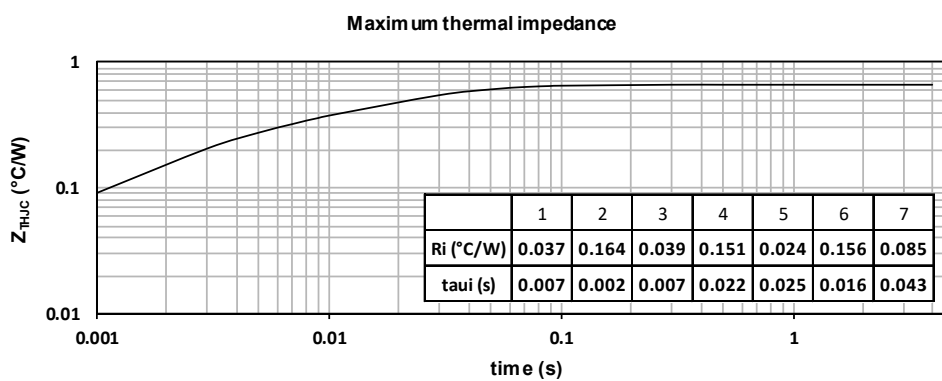
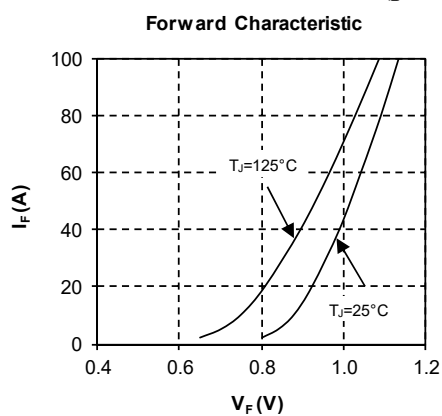


ON resistance vs Temperature





## Typical Rectifier Performance Curve (per diode)





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