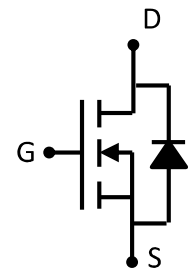


## Feature

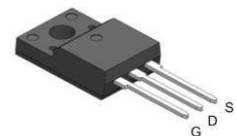
- 650V,20A  
 $R_{DS(ON)} < 190m\ \Omega @ V_{GS}=10V$
- Low FOM  $R_{DS(ON)} \times Q_G$
- Better EMI
- 100% UIS and Isolation tested
- RoHs compliant
- Halogen-free



Schematic diagram

## Application

- Switch Mode Power Supply (SMPS )
- Uninterruptible Power Supply (UPS )
- Power Factor Correction (PFC)
- Charge



TO-220F

## Package Marking and Ordering Information

Device Marking	Device	Device Package	Reel Size	Tape width	Quantity (PCS)
65R190FM	APC65R190FM	TO-220F	-	-	1000

## ABSOLUTE MAXIMUM RATINGS ( $T_a=25^\circ\text{C}$ unless otherwise noted)

Parameter	Symbol	Value	Unit
Drain-Source Voltage	$V_{DS}$	650	V
Gate-Source Voltage	$V_{GSS}$	$\pm 30$	V
Continuous Drain Current ( $T_a = 25^\circ\text{C}$ ) <sup>(1)</sup>	$I_D$	20	A
Continuous Drain Current ( $T_a = 100^\circ\text{C}$ ) <sup>(1)</sup>		13	A
Pulsed Drain Current <sup>(1) (2)</sup>	$I_{DM}$	60	A
Single Pulsed Avalanche Energy <sup>(3)</sup>	$E_{AS}$	390	mJ
Power Dissipation	$P_D$	26.8	W
Mosfet dV/dT ruggedness	dV/dT	50	V/ns
Reverse diode dV/dT		24	V/ns
Thermal Resistance from Junction to Ambient <sup>(4)</sup>	$R_{\theta JA}$	50.6	$^\circ\text{C}/\text{W}$
Junction Temperature	$T_J$	150	$^\circ\text{C}$
Storage Temperature	$T_{STG}$	-55~ +150	$^\circ\text{C}$

**MOSFET ELECTRICAL CHARACTERISTICS(T<sub>a</sub>=25°C unless otherwise noted)**

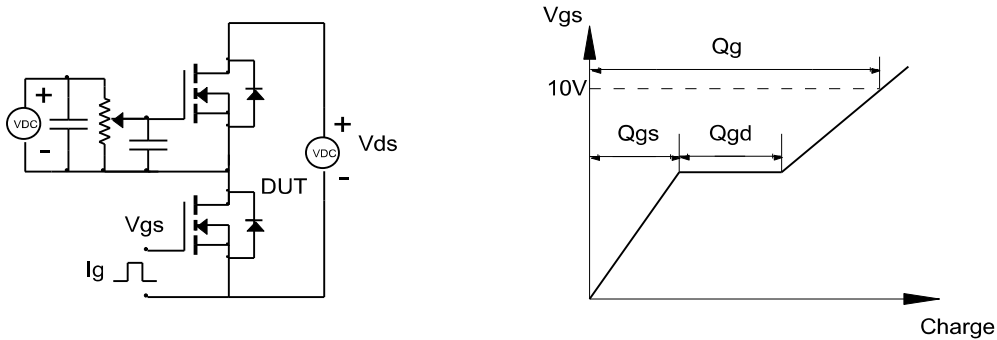
Parameter	Symbol	Test Condition	Min	Type	Max	Unit
<b>Static Characteristics</b>						
Drain-source breakdown voltage	V <sub>(BR)DSS</sub>	V <sub>GS</sub> = 0V, I <sub>D</sub> =250uA	650	-	-	V
Zero gate voltage drain current	I <sub>DSS</sub>	V <sub>DS</sub> =650V, V <sub>GS</sub> = 0V,T <sub>J</sub> =25°C	-	-	1	uA
		V <sub>DS</sub> =100V, V <sub>GS</sub> = 0V,T <sub>J</sub> =150°C	-	100	-	
Gate-body leakage current	I <sub>GSS</sub>	V <sub>GS</sub> =±30V,V <sub>DS</sub> = 0V	-	-	±100	nA
Gate threshold voltage	V <sub>GS(th)</sub>	V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> =250uA	2.6	3.3	4.0	V
Drain-source on-resistance	R <sub>DS(on)</sub>	V <sub>GS</sub> =10V, I <sub>D</sub> =10A	-	145	190	mΩ
Forward Transconductance	g <sub>FS</sub>	V <sub>DS</sub> =10V, I <sub>D</sub> =10A	-	9	-	S
Gate Resistance	R <sub>G</sub>	f=1.0MHZ open drain	-	20	-	Ω
<b>Dynamic characteristics</b>						
Input Capacitance	C <sub>iss</sub>	V <sub>DS</sub> =100V, V <sub>GS</sub> =0V, f =100KHz	-	1670	-	pF
Output Capacitance	C <sub>oss</sub>		-	83.1	-	
Reverse Transfer Capacitance	C <sub>rss</sub>		-	0.8	-	
<b>Switching characteristics</b>						
Turn-on delay time	t <sub>d(on)</sub>	V <sub>DS</sub> =520V, I <sub>D</sub> =20A, R <sub>G</sub> =25Ω,V <sub>GS</sub> =10V	-	49.8	-	ns
Turn-on rise time	t <sub>r</sub>		-	61.4	-	
Turn-off delay time	t <sub>d(off)</sub>		-	195.8	-	
Turn-off fall time	t <sub>f</sub>		-	55.8	-	
Total Gate Charge	Q <sub>g</sub>	V <sub>DS</sub> =520V, I <sub>D</sub> =10A, V <sub>GS</sub> =10V	-	44	-	nC
Gate-Source Charge	Q <sub>gs</sub>		-	9	-	
Gate-Drain Charge	Q <sub>gd</sub>		-	18	-	
<b>Source-Drain Diode characteristics</b>						
Diode Forward voltage	V <sub>SD</sub>	V <sub>GS</sub> =0V, I <sub>S</sub> =10A	-	-	1.3	V
Maximum Continuous Body-Diode Forward Current	I <sub>S</sub>		-	-	8	A
Maximum Pulsed Body-Diode Forward Current <sup>(5)</sup>	I <sub>SM</sub>		-	-	32	A
Peak Reverse Recovery Current	I <sub>rrm</sub>	V <sub>R</sub> =400v,I <sub>F</sub> =40A,di <sub>F</sub> /dt=100A/us	-	36	-	A
Reverse Recovery Time	Q <sub>rr</sub>		-	6.2	-	uC
Reverse Recovery Charge	T <sub>rr</sub>		-	350	-	ns

**Notes:**

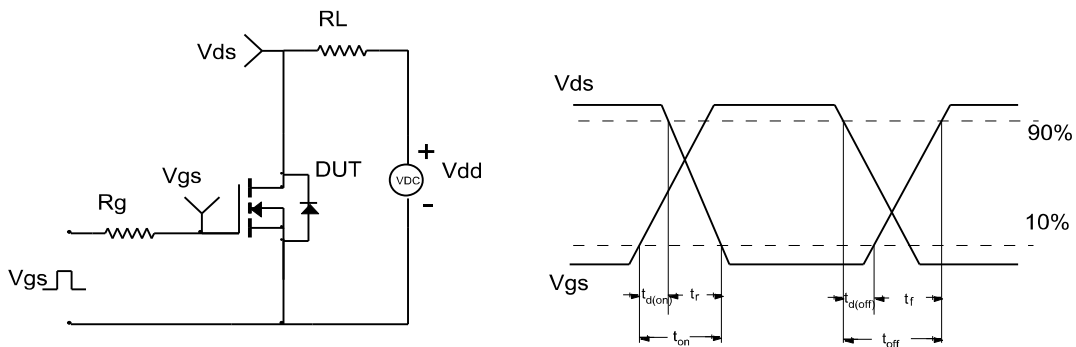
1. The max drain current rating limited by package and maximum junction temperature
2. Repetitive Rating: pulse width limited by maximum junction temperature
3. EAS Condition:T<sub>J</sub>=25°C,V<sub>DD</sub>=150V,R<sub>G</sub>=25Ω,L=10.8mH,I<sub>AS</sub>=8.5A
4. Mount on minimum PCB layout
5. Pulse Test:Pulse width ≤300us,Duty ≤2%
6. Essentially independent of operating temperature

**Test Circuit and Waveform**

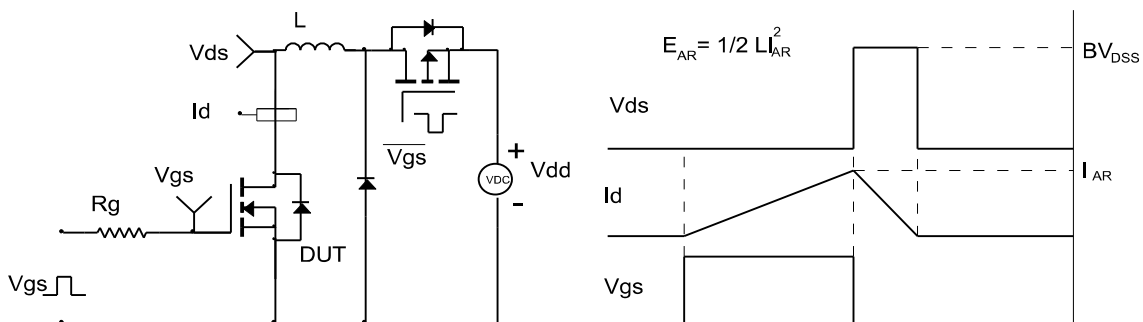
Gate Charge Test Circuit & Waveform



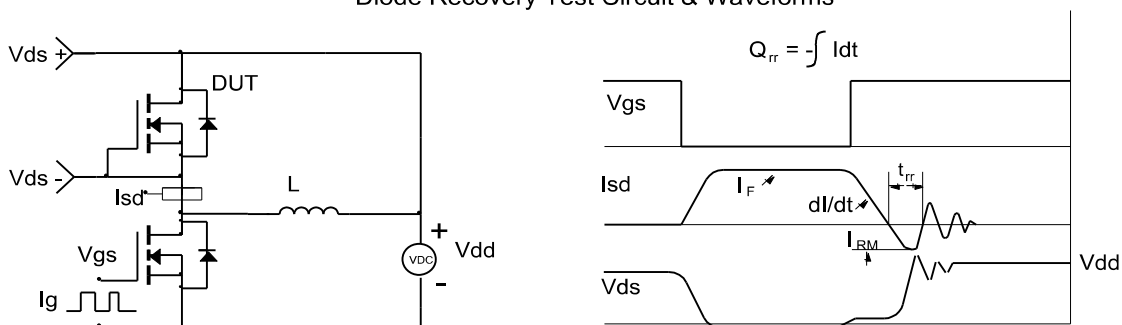
Resistive Switching Test Circuit & Waveforms



Unclamped Inductive Switching (UIS) Test Circuit & Waveforms



Diode Recovery Test Circuit & Waveforms



**Electrical Characteristics Diagrams**

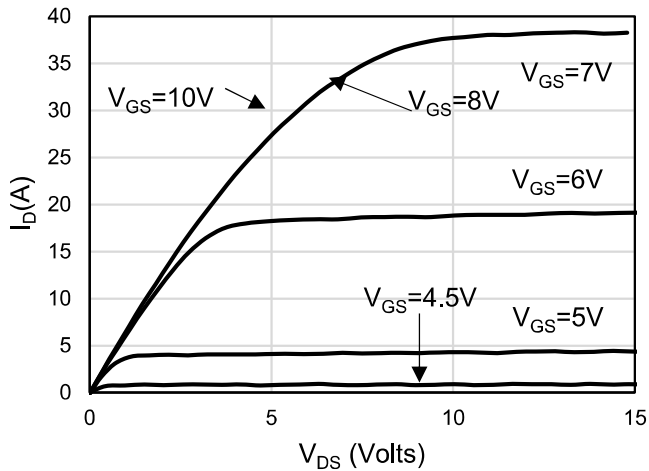


Figure 1: On-Region Characteristics

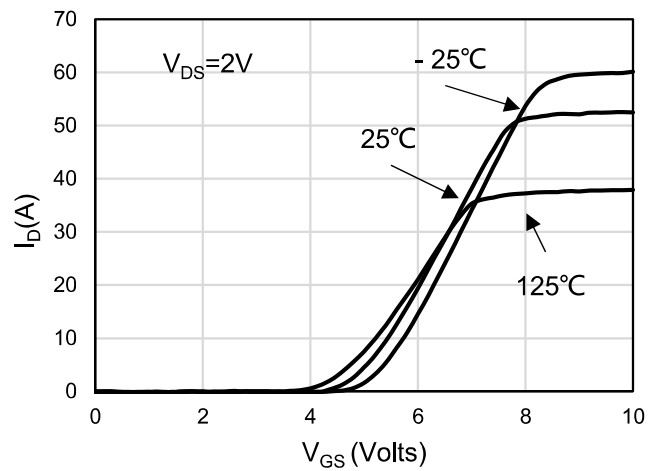


Figure 2: Transfer Characteristics

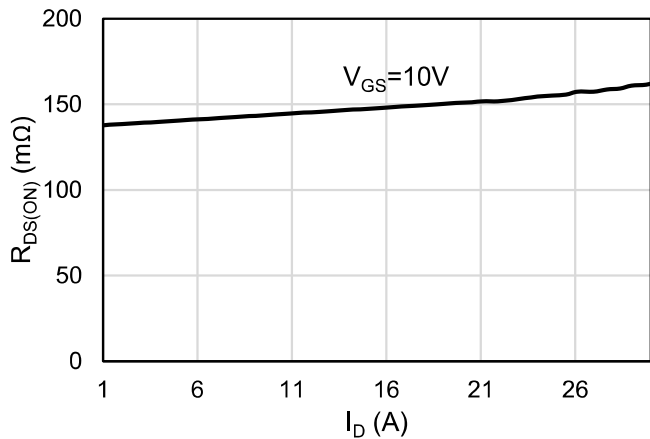


Figure 3: On-Resistance vs. Drain Current and Gate Voltage

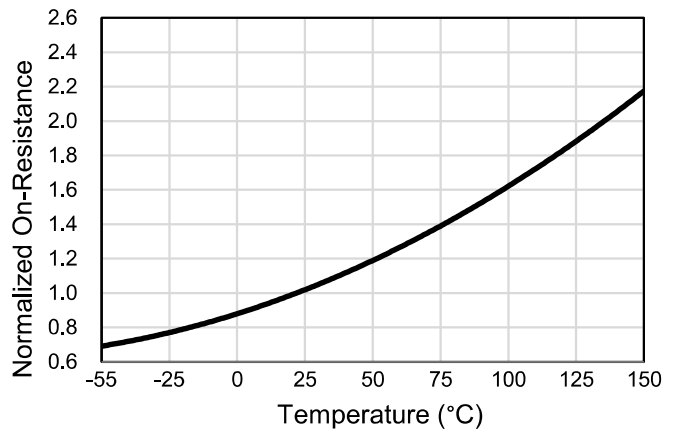


Figure 4: On-Resistance vs. Junction Temperature

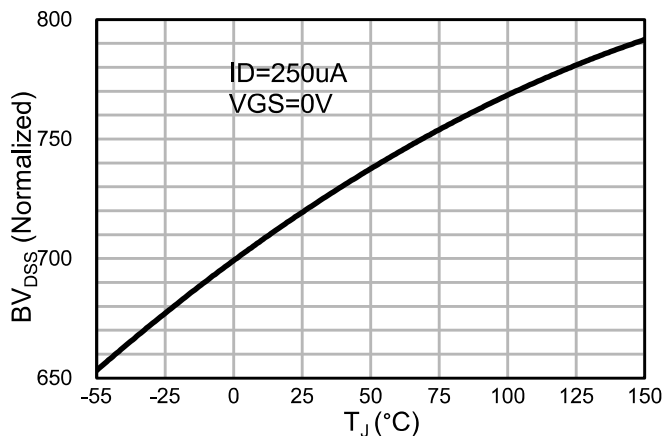


Figure 5: Break Down vs. Junction Temperature

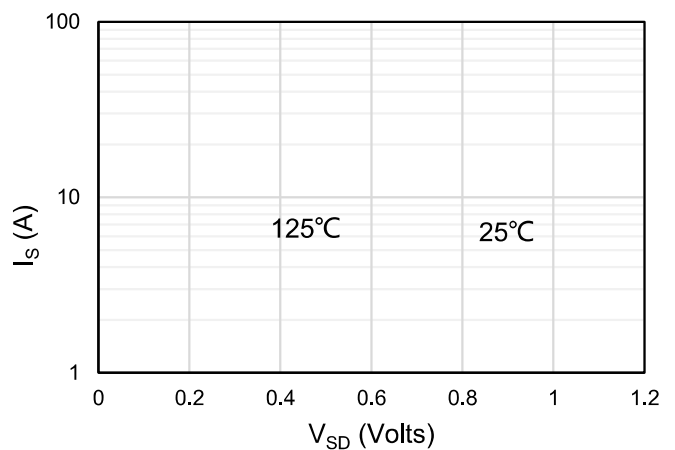


Figure 6: Body-Diode Characteristics

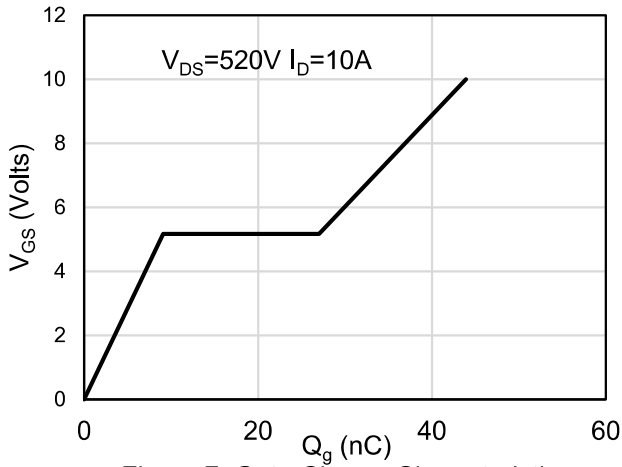


Figure 7: Gate-Charge Characteristics

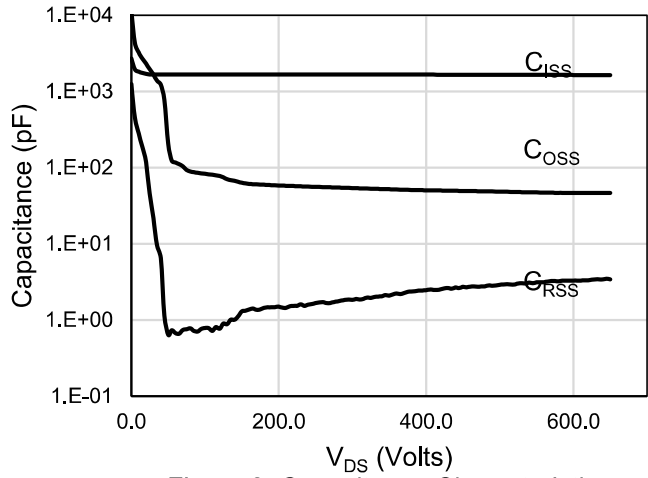


Figure 8: Capacitance Characteristics

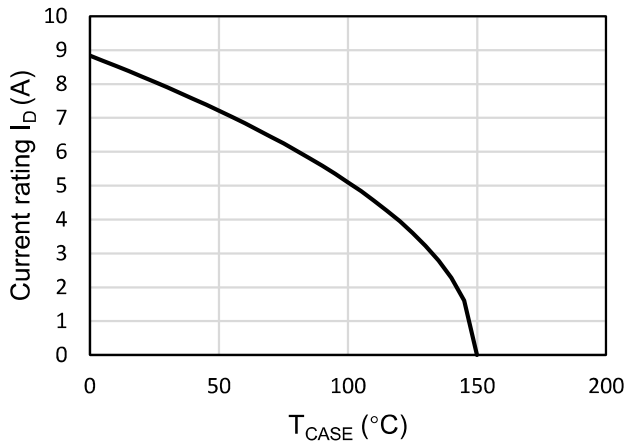


Figure 9: Current De-rating

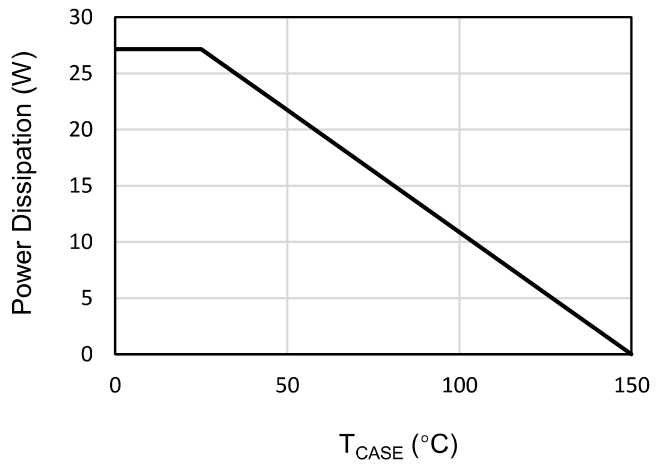


Figure 10: Power De-rating

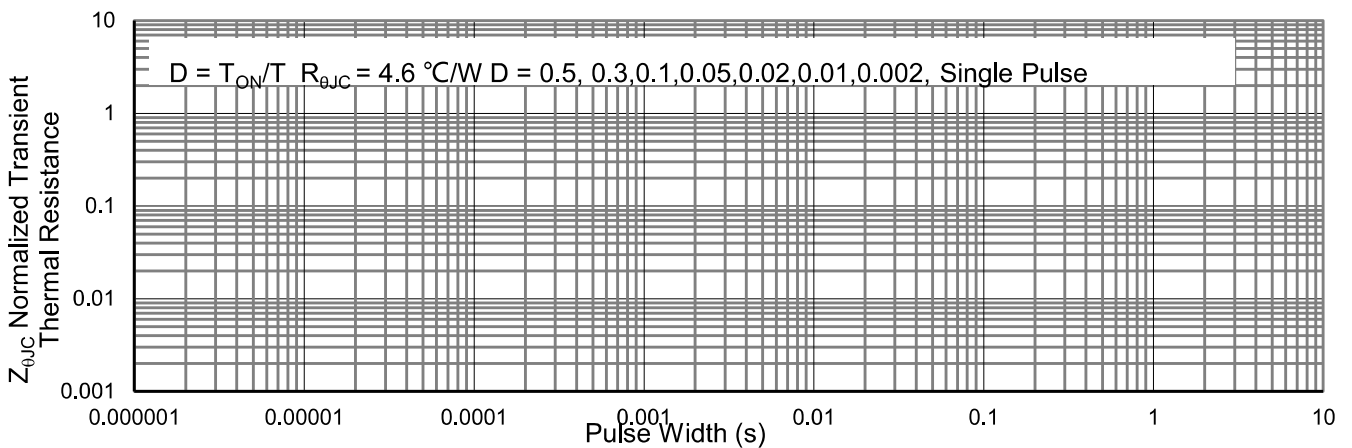
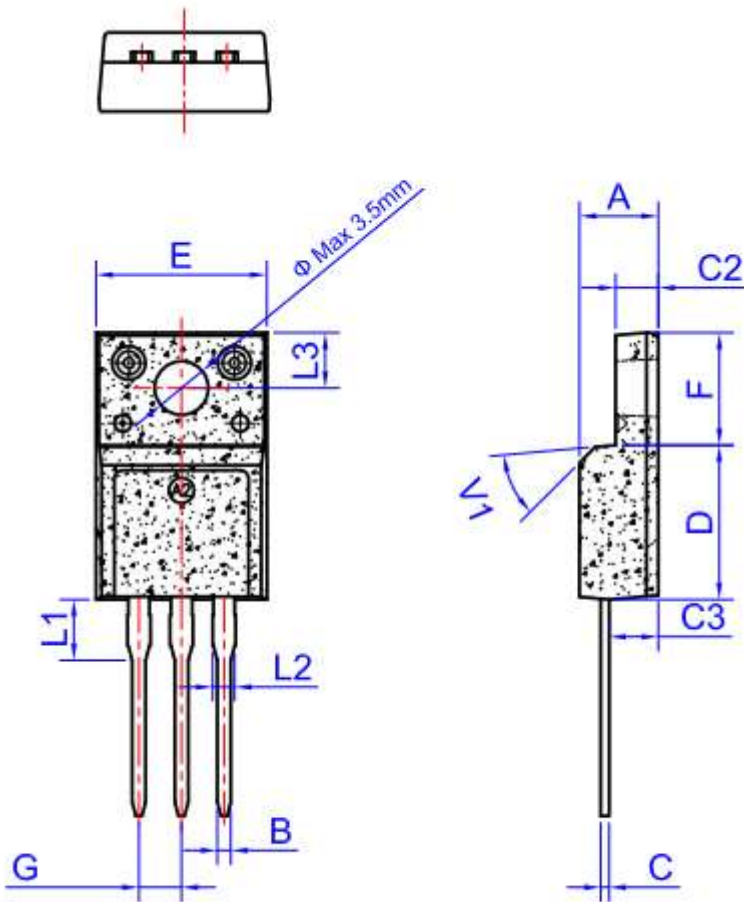


Figure 11: Normalized Maximum Transient Thermal Impedance

**Package Outlines**



Ref.	Dimensions					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	4.50		4.90	0.177		0.193
B	0.74	0.80	0.83	0.029	0.031	0.033
C	0.47		0.65	0.019		0.026
C2	2.45		2.75	0.096		0.108
C3	2.60		3.00	0.102		0.118
D	8.80		9.30	0.346		0.366
E	9.80		10.4	0.386		0.410
F	6.40		6.80	0.252		0.268
G		2.54			0.1	
H	28.0		29.8	1.102		1.173
L1		3.63			0.143	
L2	1.14		1.70	0.045		0.067
L3		3.30			0.130	
V1		45°			45°	

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