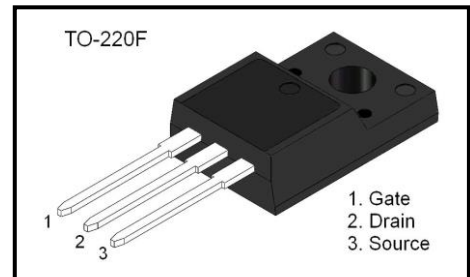
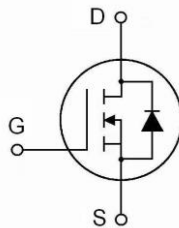


General Description

The ZH4N65F is a high voltage power MOSFET designed to have better characteristics, such as fast switching time, low gate charge, low on-state resistance and have a high rugged avalanche characteristic. This power MOSFET is usually used in high speed switching applications including power supplies, PWM motor controls, high efficient DC to DC converters and bridge circuits

Features

- V_{DS} 650V
- I_D 4A
- $R_{DS(ON)}$ ($V_{GS} = 10V$) $< 3.0\Omega$
- Fast Switching Capability
- Avalanche Energy Specified
- Improved dv/dt Capability, High Ruggedness



Absolute Maximum Ratings ($T_A = 25^\circ\text{C}$)

Parameter		Symbol	Ratings	Units
Gate-Drain Voltage		V_{DSS}	650	V
Gate-Source Voltage		V_{GSS}	± 30	V
Continuous Drain Current	$T_A = 25^\circ\text{C}$	I_D	4	A
	Pulsed (Note 1)	I_{DM}	16	
Power Dissipation		P_D	35	W
Avalanche Energy	Single Pulsed (Note 2)	E_{AS}	260	mJ
	Repetitive	E_{AR}	5.6	mJ
Peak Diode Recovery dv/dt (Note 3)		dv/dt	3.6	V/ns
Junction Temperature		T_J	150	$^\circ\text{C}$
Storage Temperature		T_{STG}	-55~155	$^\circ\text{C}$

Note: Absolute maximum ratings are those values beyond which the device could be permanently damaged.

Absolute maximum ratings are stress ratings only and functional device operation is not implied.

Thermal Characteristic

Parameter	Symbol	Value	Units
Maximum Thermal Resistance, Junction-case	$R_{\theta JC}$	5.5	$^\circ\text{C/W}$
Maximum Thermal Resistance, Junction-Ambient	$R_{\theta JA}$	62.5	$^\circ\text{C/W}$

Electrical Characteristics ($T_j = 25^\circ\text{C}$ unless otherwise specified)

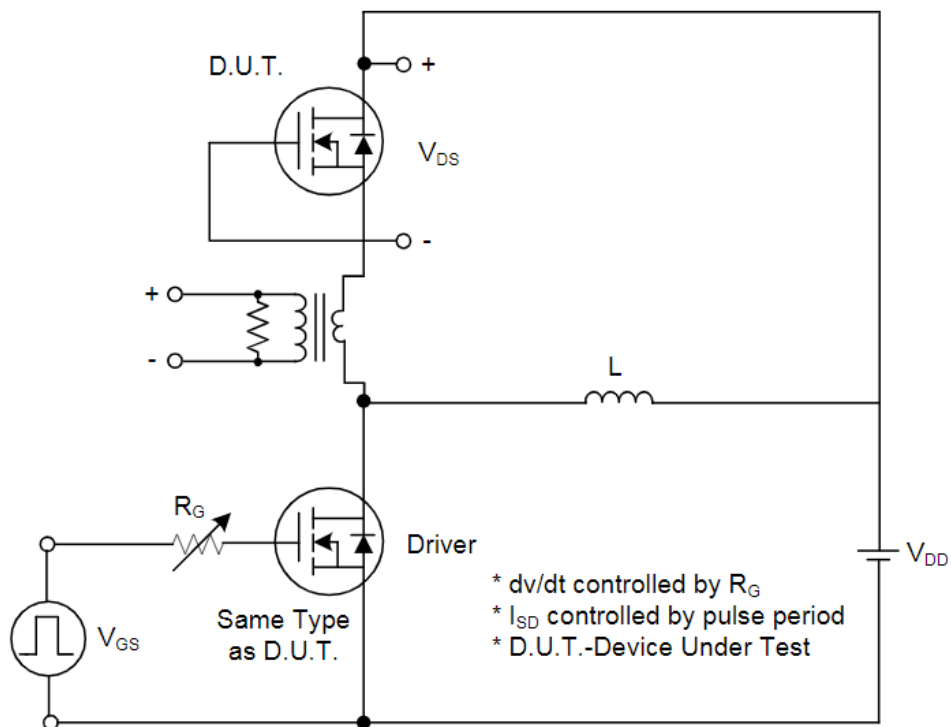
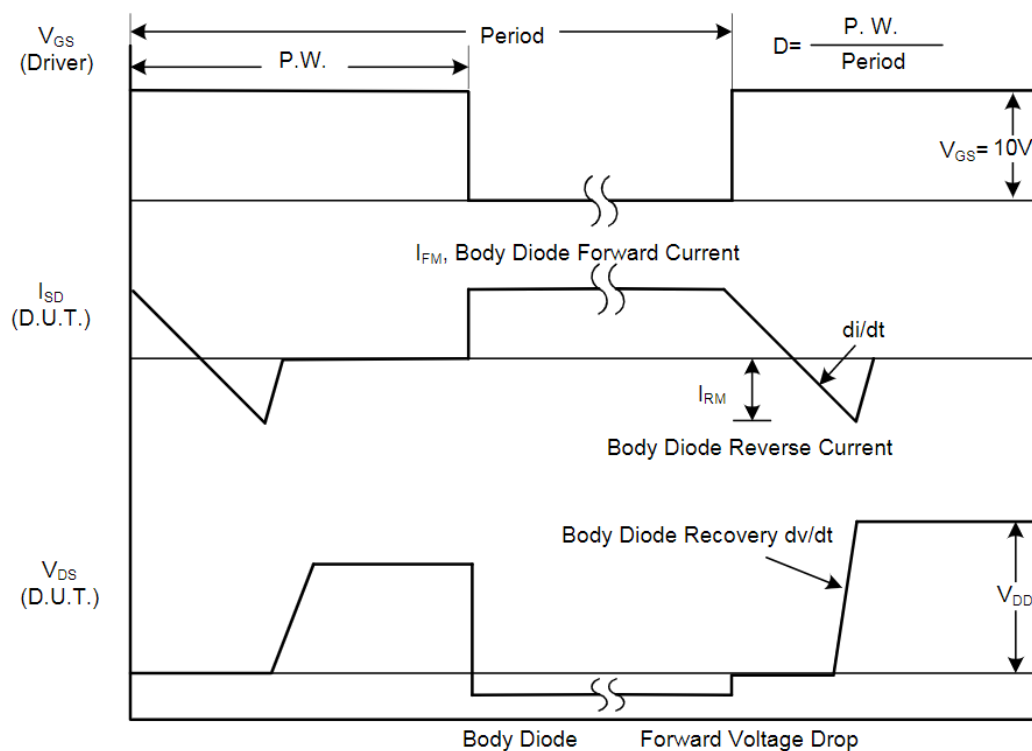
Parameter		Symbol	Test Conditions	Min.	Typ	Max.	Units
Off Characteristics							
Drain-Source Breakdown Voltage		BV _{DSS}	V _{GS} =0V, I _D = 250μA	650			V
Breakdown Voltage Temperature Coefficient		ΔBV _{DSS} /ΔT _J	I _D = 250μA, Referenced to 25 °C		0.6		V/°C
Zero Gate Voltage Drain Current		I _{DSS}	V _{DS} = 650V, V _{GS} = 0V			1	μA
Gate Leakage Current	Forward	I _{GSS}	V _{DS} =0V, V _{GS} =30V			100	nA
	Reverse		V _{DS} =0V, V _{GS} =-30V			-100	nA
On Characteristics							
Gate Threshold Voltage		V _{GS(th)}	V _{DS} =V _{GS} , I _D =250μA	2.0		4.0	V
Drain-source On-Resistance		R _{DS(ON)}	V _{GS} = 10V, I _D = 2A			3.0	Ω
Dynamic Characteristics							
Input Capacitance		C _{iss}	V _{DS} = 25V, V _{GS} = 0V, f = 1.0MHz		700	780	pF
Output Capacitance		C _{oss}			100	120	
Reverse Transfer Capacitance		C _{rss}			53	60	
Switching Characteristics)							
Turn-On Delay Time		t _{d(on)}	V _{DS} = 325V, I _D = 4.0A R _G = 25Ω (Note4, 5)		30	70	ns
Turn-on Rise Time		t _r			100	140	
Turn-Off elay Time		t _{d(off)}			150	190	
Turn-Off Fall		t _f			140	180	
Total Gate Charge		Q _g	V _{DS} =520V, I _D = 4.0A V _{GS} = 10V (Note4, 5)		110	130	nC
Gate-Source Charge		Q _{gs}			9	15	
Gate-Drain Charge		Q _{gd}			5	11	
Drain-Source Diode Characteristics							
Diode Forward Voltage ²		V _{SD}	V _{GS} =0V, I _S =4A			1.4	V
Diode Forward Current		I _S	-			4	A
Pulsed Diode Forward Current		I _{SM}				16	A
Reverse Recovery Time		t _{rr}	I _S =4.4A, V _{GS} = 0V		260		ns
Reverse Recovery Charge		Q _{rr}	dI _F /dt =100A/μs (Note 1)		2.5		nC

Note 1. Repeativity rating: pulse width limited by junction temperature

2. $L=25\text{mH}$, $I_{AS}=4A$, $R_G=25\Omega$, Starting $T_j=25^\circ\text{C}$ 3. $I_{SD}\leq 4A$, $di/dt\leq 300A/\mu s$, $V_{DD}\leq BV_{DSS}$, Starting $T_j=25^\circ\text{C}$ 4. Pulse Test: Pulse Width $\leq 300\mu s$, Duty Cycle $\leq 2\%$

5. Essentially independent of operating temperature.

Test Circuits and Waveforms

Figure 1. Peak Diode Recovery dv/dt Test CircuitFigure 2. Peak Diode Recovery dv/dt Waveforms

Test Circuits and Waveforms

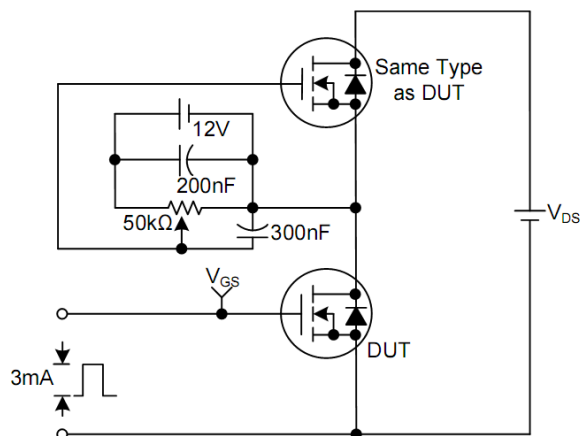


Figure 3. Gate Charge Test Circuit

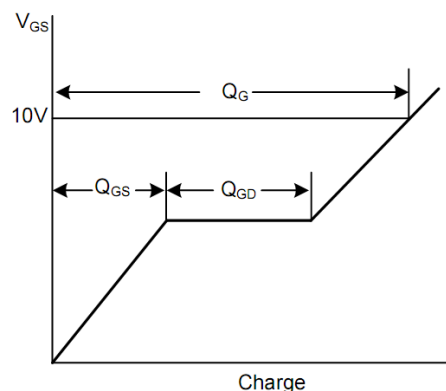


Figure 4. Gate Charge Waveforms

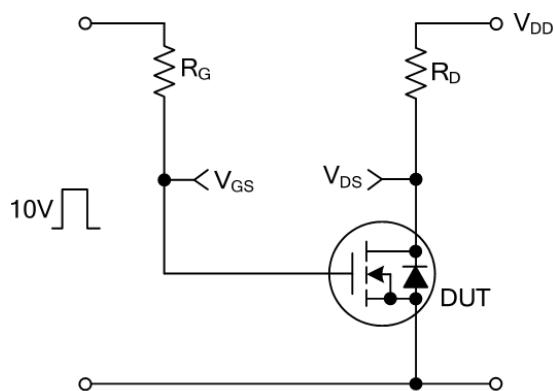


Figure 5. Resistive Switching Circuit

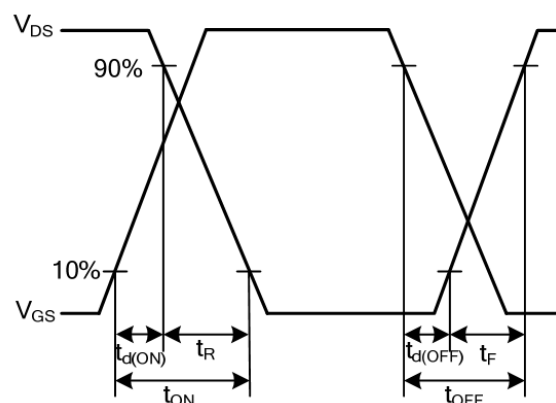


Figure 7. Resistive Switching Waveforms

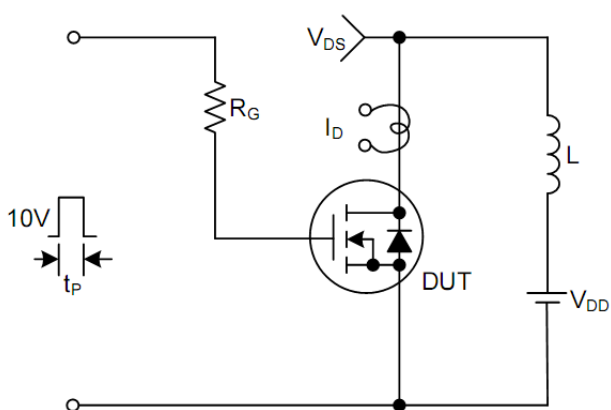


Figure 7. Unclamped Inductive Switching Test Circuit

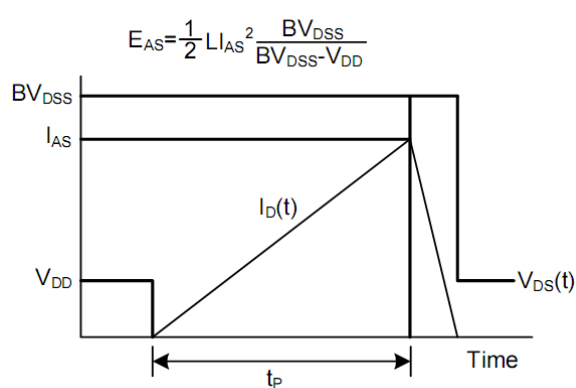


Figure 8. Unclamped Inductive Switching Waveforms

Typical Characteristics

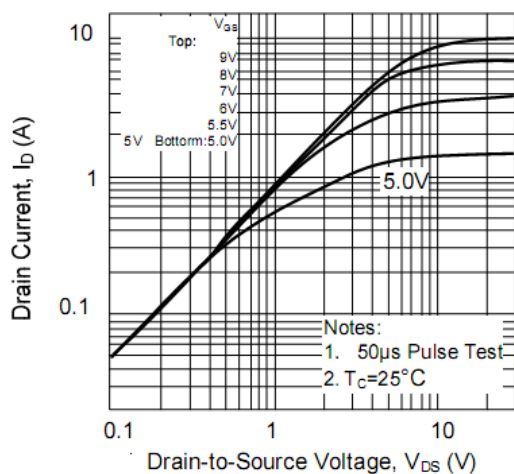


Figure 1 Output Characteristics

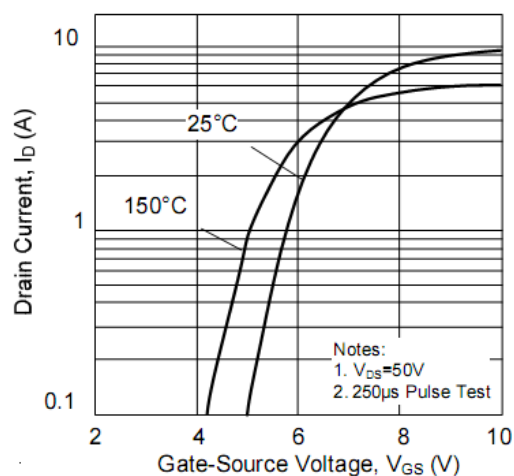


Figure 2. Transfer Characteristics

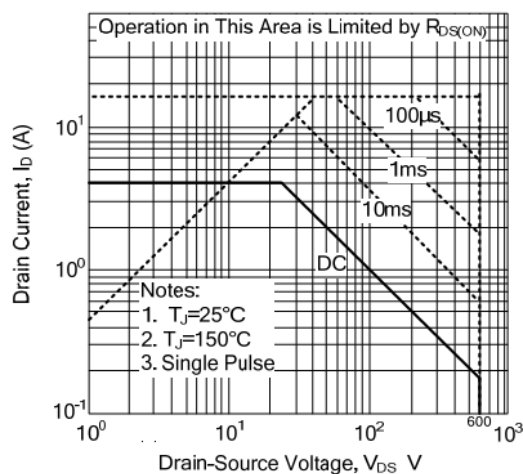


Figure 3. Safe Operating Area

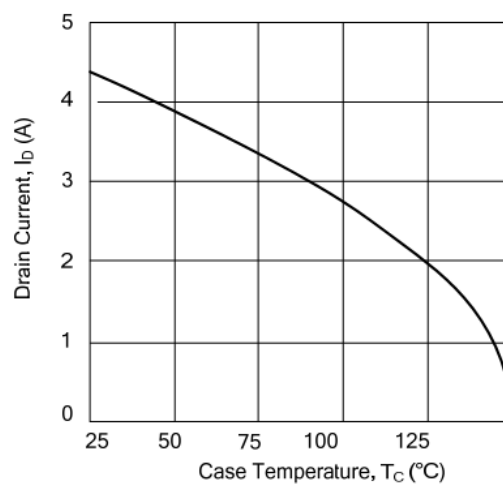


Figure 4. Maximum Drain-to-Source Current vs. Case Temperature

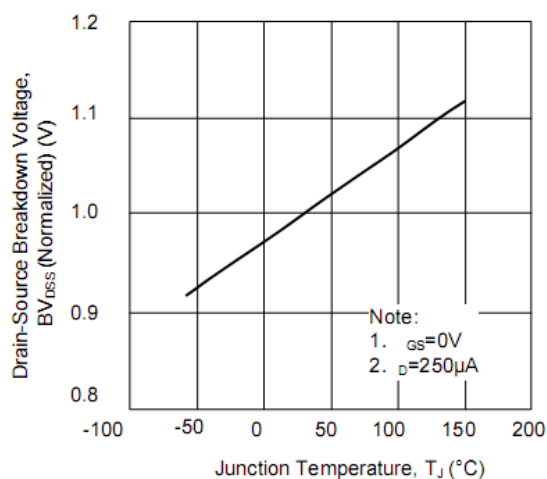


Figure 5. Breakdown Voltage Variation vs. Temperature

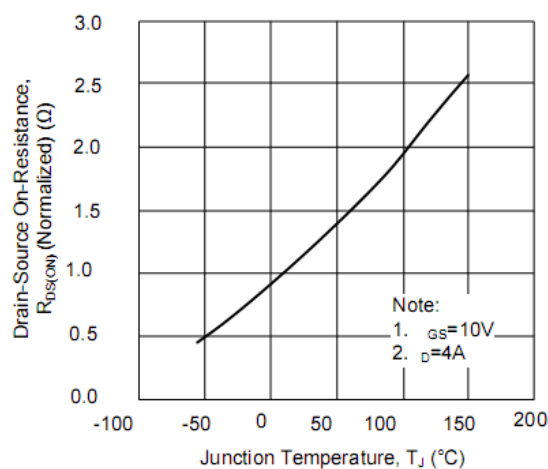


Figure 6. On-Resistance Junction Temperature

Typical Characteristics

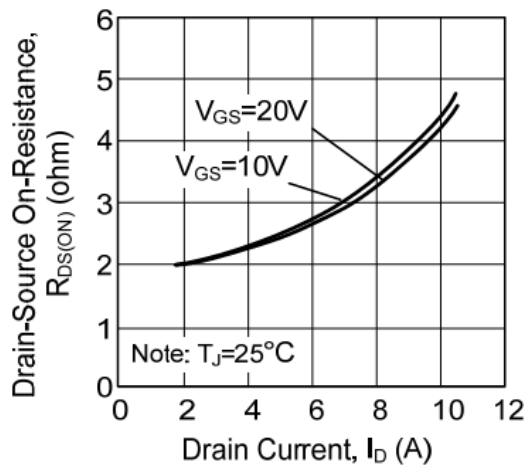


Figure 7 Output Characteristics

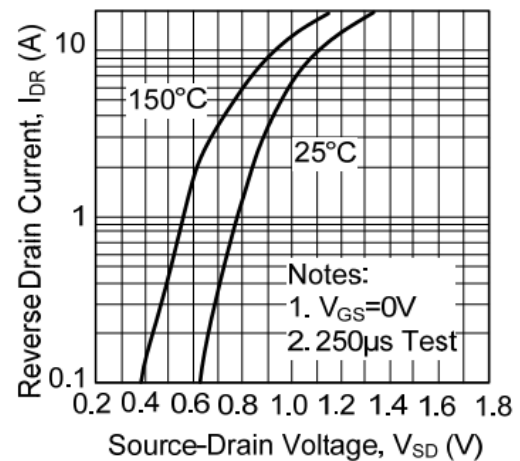


Figure 8. On State Current vs. Allowable Case Temperature

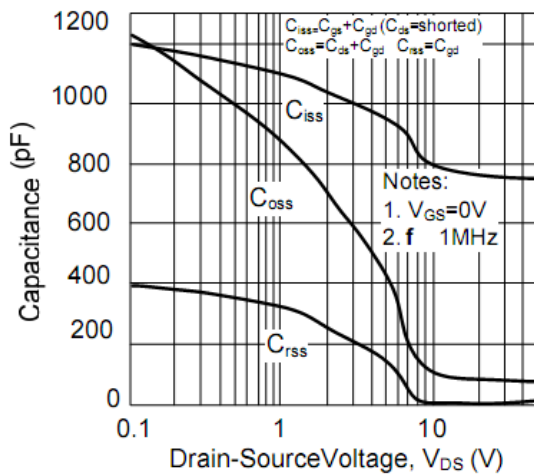


Figure 9. Capacitance Characteristics

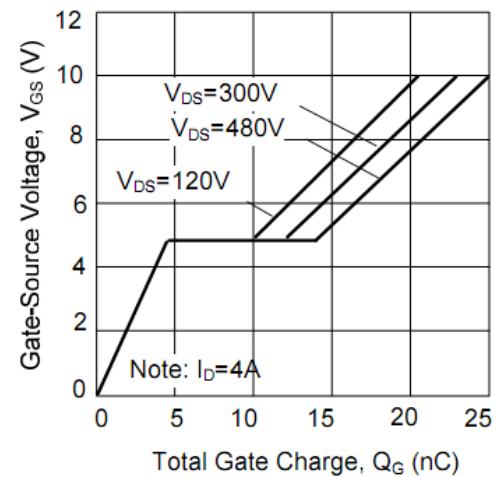


Figure 10. Gate Charge Characteristics

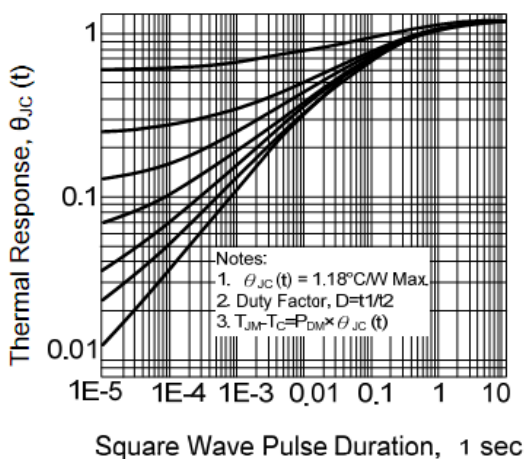


Figure 11. Maximum Effective Transient Thermal Impedance, Junction-to-Case

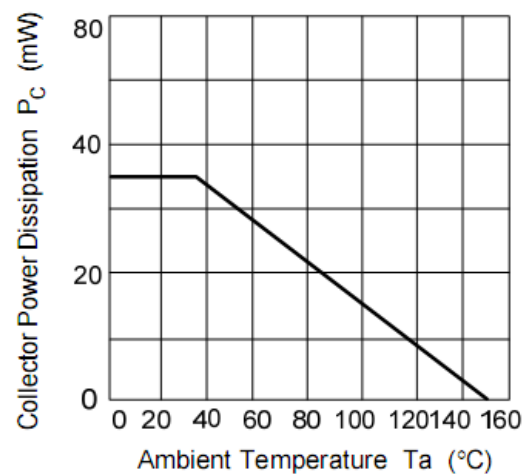


Figure 12. Maximum Dissipation Curve

Package Dimensions

Symbol	Millimeter		Inches	
	Min.	Max.	Min.	Max.
A	4.50	4.90	0.177	0.193
A1	2.34	2.74	0.092	0.108
A2	2.66	2.86	0.105	0.113
b	0.75	0.85	0.030	0.033
b1	1.24	1.44	0.049	0.057
c	0.40	0.60	0.016	0.024
D	10.00	10.32	0.394	0.406
E	15.75	16.05	0.620	0.632
e	2.44	2.64	0.096	0.104
e1	4.88	5.28	0.192	0.208
F	3.10	3.5	0.122	0.138
L	12.90	13.50	0.508	0.531
L1	2.90	3.30	0.114	0.130
Φ	3.10	3.30	0.122	0.130