EPC7014UBSH

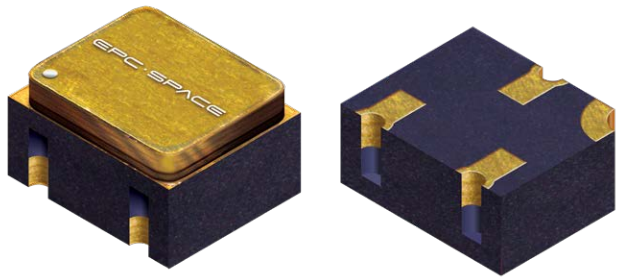
60 V Radiation Hardened Power eGaN® Datasheet

Features

- Ultra-low Q_G For High Efficiency
- Logic Level
- Light Weight
- No Wire Bond for Higher Reliability and Low Inductance
- Total Ionizing Dose LDR Immune
- Total Ionizing Dose HDR Immune
- Single Event Effect (SEE) Hardened
  - SEE immunity for LET of 84 MeV/(mg/cm²) with V_{DS} up to 100% of rated Breakdown
- Neutron
  - Maintains Pre-Rad specification for up to 4 x 10^{15} Neutrons/cm²

Application

- Commercial Satellite EPS & Avionics
- Deep Space Probes
- High Speed Rad-Hard DC-DC Conversion
- Rad-Hard Motor Controllers
- Nuclear Facilities



EPC7014UBSH

Rad-Hard eGaN® 60 V, 1 A, 580 mΩ Surface Mount (UB)

Description

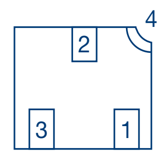
EPC Space Rad-Hard eGaN® power switching HEMTs have been specifically designed for critical applications in Space and other the high reliability environments. These devices have exceptionally high electron mobility and a low temperature coefficient resulting in very low $R_{DS(on)}$ values. The lateral structure of the die provides for very low gate charge (Q_G) and extremely fast switching times. These features enable faster power supply switching frequencies resulting in higher power densities, higher efficiencies and more compact packaging.

Thermal Characteristics

Symbol	Parameter-Conditions	Value	Units
$R_{\theta JA}$	Thermal Resistance Junction to Ambient (Note 3)	200	°C/W
$R_{\theta JC}$	Thermal Resistance Junction to Case	35	

I/O Pin Assignment *(Bottom View)*

Pin	Symbol	Description
1	G	Gate
2	D	Drain
3	S	Source
4	L	Lid Pad Connection



Absolute Maximum Rating *(T_C = 25°C unless otherwise noted)*

Symbol	Parameter-Conditions	Value	Units
V_{DS}	Drain to Source Voltage (Note 1)	60	V
	Drain-to-Source Voltage (up to 10,000 5 ms pulses at 150°C)	72	
I_D	Continuous Drain Current ID @ V_{GS} = 5 V, T_C = 25°C	1	A
I_{DM}	Single-Pulse Drain Current $t_{pulse} \leq$ 80 µs	4	
V_{GS}	Gate to Source Voltage (Note 2)	+6 / -4	V
T_J , T_{STG}	Operating and Storage Junction Temperature Range	-55 to +150	°C
T_{sol}	Package Mounting Surface Temperature	260	
ESD	ESD Class	1A(ΔA)	
Weight	Device Weight	0.058	g

Electrical Characteristics *(T_C = 25°C unless otherwise noted. Typical (TYP) values are for reference only.)*

Parameter	Symbol	Test Conditions		MIN	TYP	MAX	Units
Drain to Source Voltage	B_{VDSS}	V_{GS} = 0 V		60			V
Drain to Source Leakage	I_{DSS}	V_{DS} = 60 V, V_{GS} = 0 V	T_C = 25°C		0.17	100	µA
			T_C = 125°C		0.35	180	
Gate to Source Forward Leakage	I_{GSSF}	V_{GS} = 5 V	T_C = 25°C		2	500	
Gate to Source Reverse Leakage	I_{GSSR}	V_{GS} = -3 V	T_C = 25°C		0.27	100	
Gate to Source Threshold Voltage	$V_{GS(th)}$	V_{DS} = V_{GS} , I_D = 0.14 mA	T_C = 25°C	0.8	1.8	2.5	V
Gate to Source Threshold Voltage Temperature Coefficient	$\Delta V_{GS(th)}/\Delta T$	V_{DS} = V_{GS} , I_D = 0.14 mA	-55°C < T_A < 150°C		|2.34|		mV/°C
Drain to Source Resistance (Note 4)	$R_{DS(on)}$	I_D = 1 A, V_{GS} = 5 V	T_C = 25°C		340	580	mΩ
Source to Drain Forward Voltage	V_{SD}	I_S = 0.5 A, V_G = 0 V	T_C = 25°C		2.5	3	V

Dynamic Characteristics *(T_C = 25°C unless otherwise noted. Typical (TYP) values are for reference only.)*

Parameter	Symbol	Test Conditions	MIN	TYP	MAX	Units
Input Capacitance	C_{ISS}	V_{DS} = 30 V, V_{GS} = 0 V		18	22	pF
Output Capacitance	C_{OSS}			17	30	
Reverse transfer Capacitance	C_{RSS}			0.1	2	
Gate Resistance (Note 5)	R_G	f = 1 MHz, V_{DS} = V_{GS} = 0 V		12.6		Ω
Total Gate Charge (Note 6)	Q_G	V_{DS} = 30 V, I_D = 0.5 A		142	184	pC
Gate to Source Charge (Note 6)	Q_{GS}			20	35	
Gate to Drain Charge (Note 6)	Q_{GD}			30	50	
Output Charge (Note 5)	Q_{OSS}	V_{GS} = 0 V, V_{DS} = 30 V		764	1145	
Source to Drain Recovery Charge (Note 5)	Q_{RR}	I_D = 1 A, V_{DS} = 30 V		0		

Radiation Characteristics

EPC Space eGaN® HEMTs are tested according to MIL-STD-750 Method 1019 for total ionizing dose validation. Every manufacturing lot is tested for total ionizing dose of 1 Mrad of Gamma radiation exposure with an in-situ bias for the following conditions:

ON | V_{GS} = 5 V
NO BIAS | V_{DS} = V_{GS} = 0 V
OFF | V_{DS} = 80% B_{VDSS}

Electrical Characteristics up to 1000 krads *(T_C = 25°C unless otherwise noted. Typical (TYP) values are for reference only.)*

Parameter	Symbol	Test Conditions	MIN	TYP	MAX	Units
Drain to Source Voltage	B_{VDSS}	V_{GS} = 0 V, I_D = 0.1 mA	60			V
Gate to Source Threshold Voltage	$V_{GS(th)}$	V_{DS} = V_{GS} , I_D = 0.14 mA	0.8	1.8	2.5	V
Drain to Source Leakage	I_{DSS}	V_{DS} = 60 V, V_{GS} = 0 V		0.35	100	µA
Gate to Source Forward Leakage	I_{GSSF}	V_{GS} = 5 V		2	500	µA
Gate to Source Reverse Leakage	I_{GSSR}	V_{GS} = -4 V		0.27	100	µA
Drain to Source Resistance (Note 4)	$R_{DS(on)}$	I_D = 1 A, V_{GS} = 5 V		365	580	mΩ

Typical Single Event Effect Safe Operating Area

Note : All Radiation Single Event Effects testing are performed in heavy ion environments such as the K-500 Cyclotron at Texas A&M.

Test	Environment				V_{DS} Voltage (V)	
	Ion	LET MeV/mg/cm^2	Range µm	Energy MeV	V_{GS} = 0 V	V_{GS} = -4V
See SOA	Xe	50	131	1653	60	60
	Au	84	130	2482	60	60

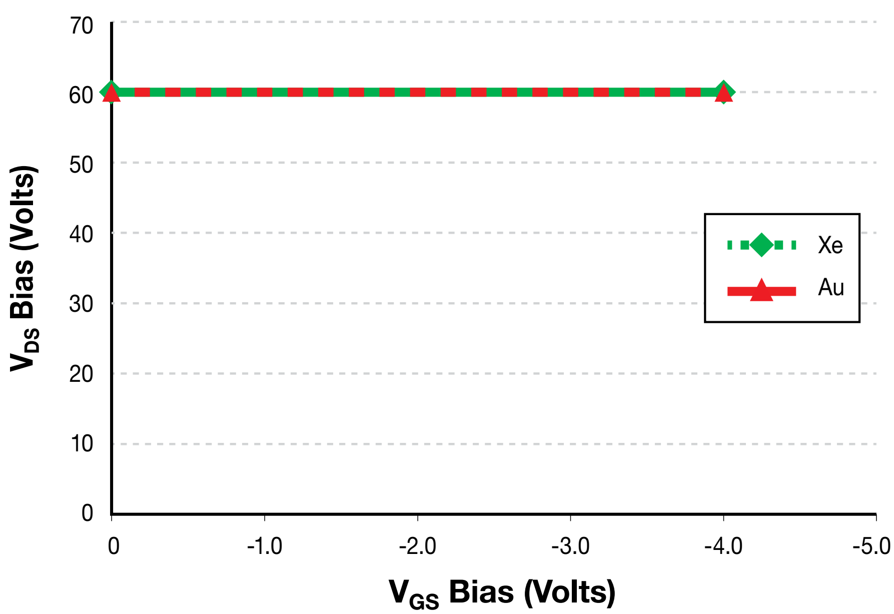


Figure 1. Typical Single Event Effect Safe Operating Area

Figure 2: Typical Gate-Source Leakage Current vs. Ambient Temp.

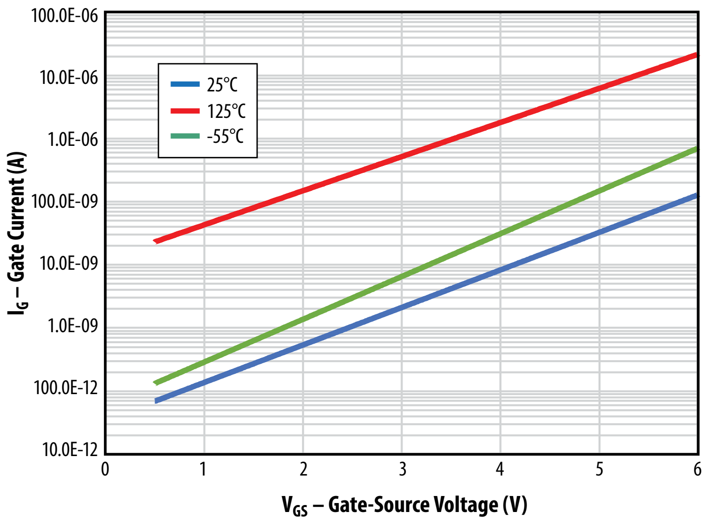


Figure 3: Typical Drain-Source Leakage Current vs. Ambient Temp.

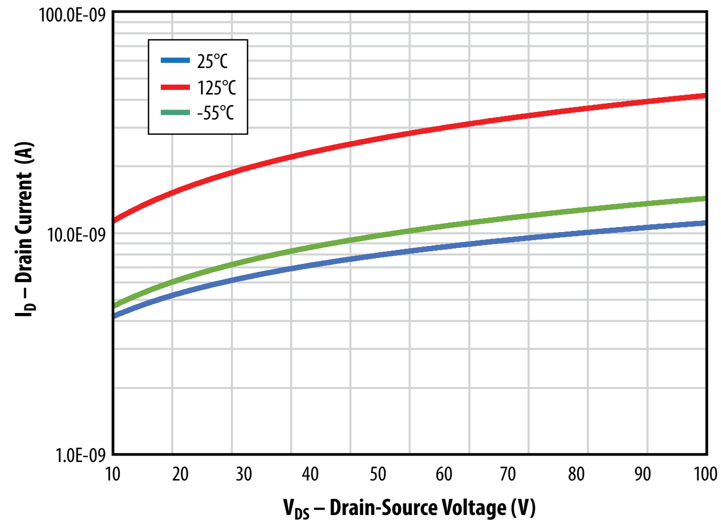


Figure 4: Typical Output Characteristics at 25°C

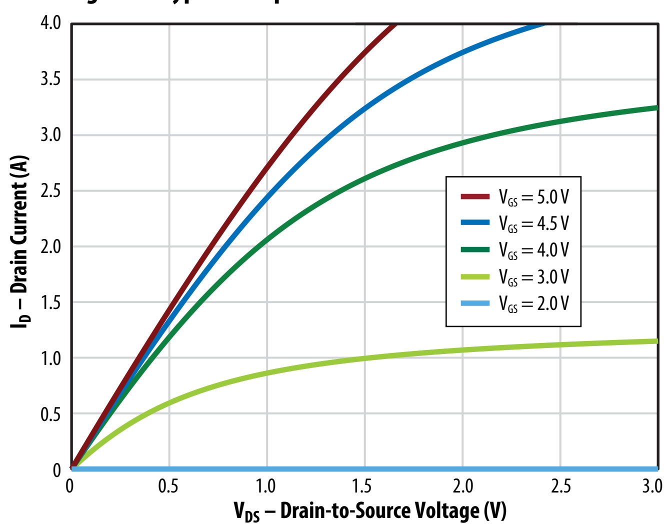


Figure 5: Typical Output Characteristics at 25°C

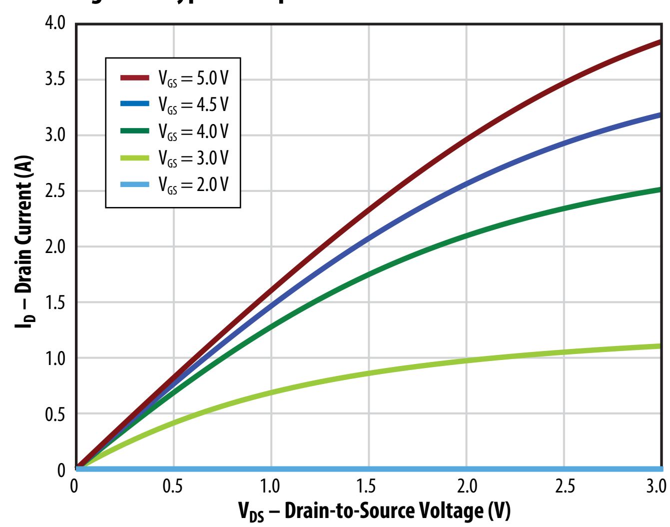


Figure 6: Transfer Characteristics

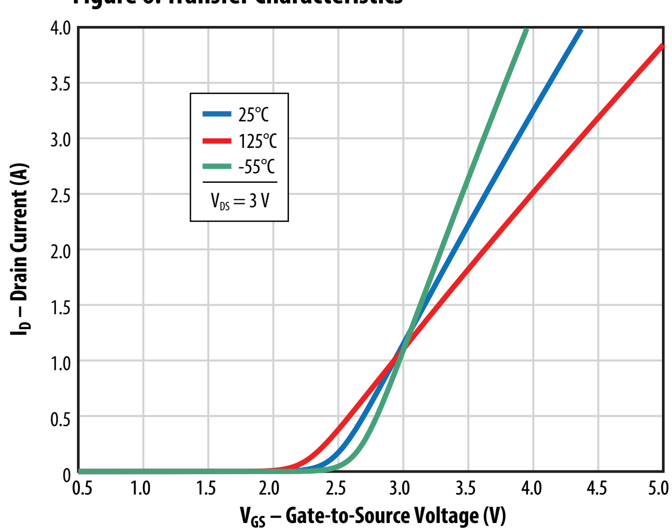


Figure 7: Reverse Drain-Source Characteristics

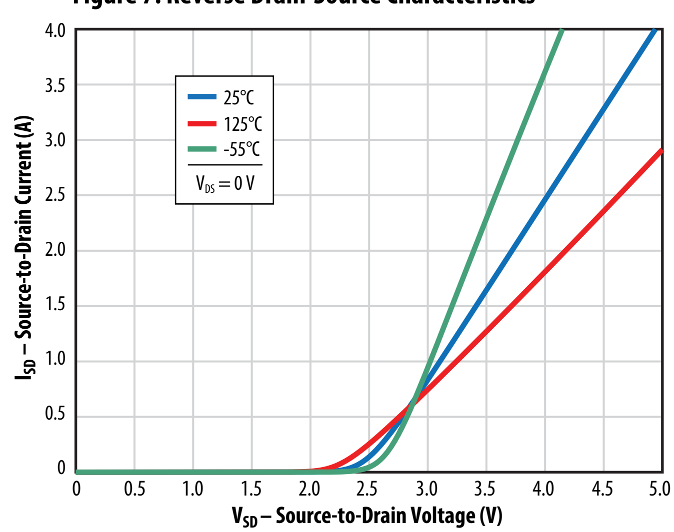


Figure 8: $R_{DS(on)}$ vs. V_{GS} for Various Drain Currents

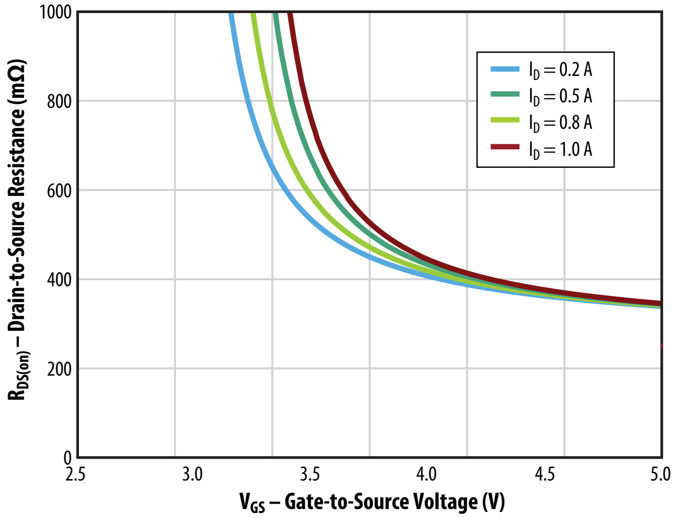


Figure 9: $R_{DS(on)}$ vs. V_{GS} for Various Temperatures

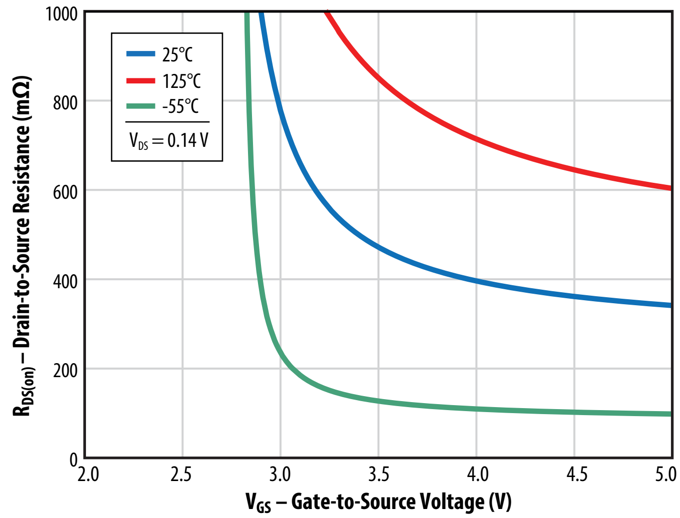


Figure 10: Normalized On-State Resistance vs. Temperature

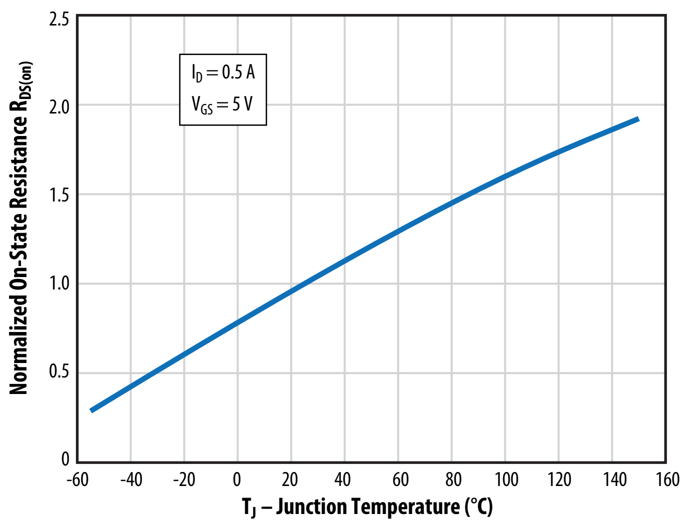


Figure 11: Normalized Threshold Voltage vs. Temperature

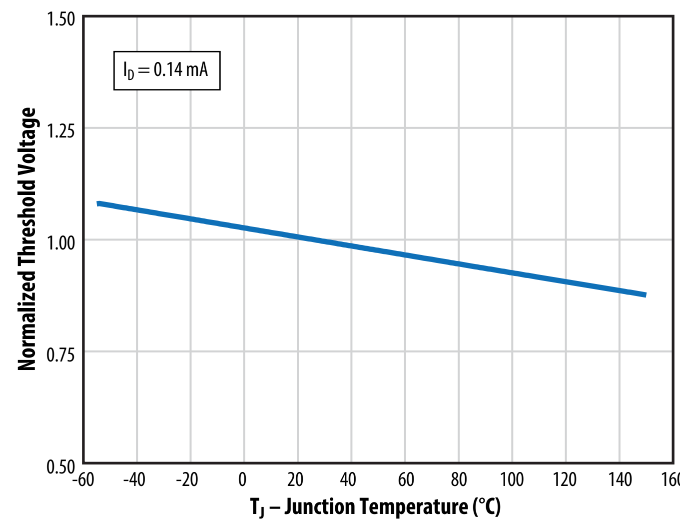


Figure 12: Capacitance (Linear Scale)

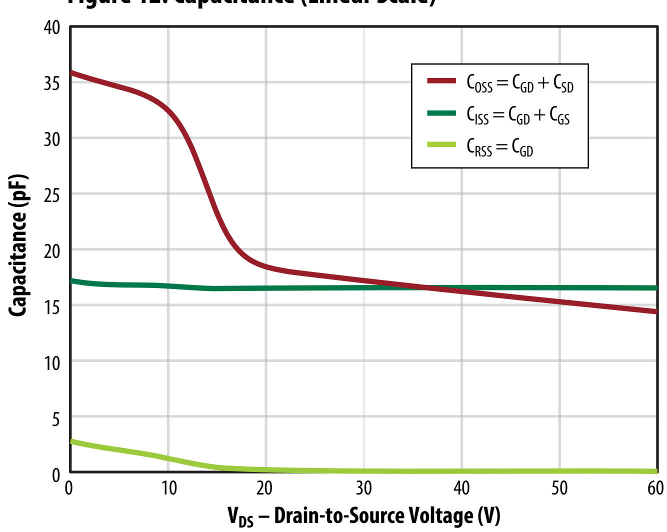


Figure 13: Output Charge and C_{OSS} Stored Energy

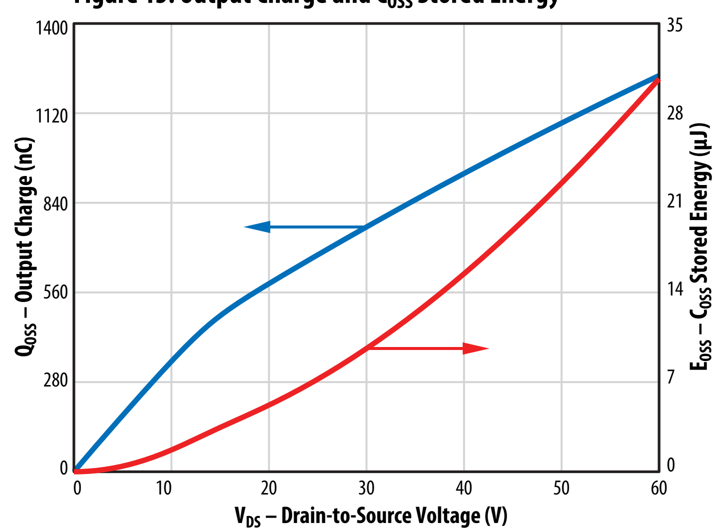


Figure 14: Gate Charge

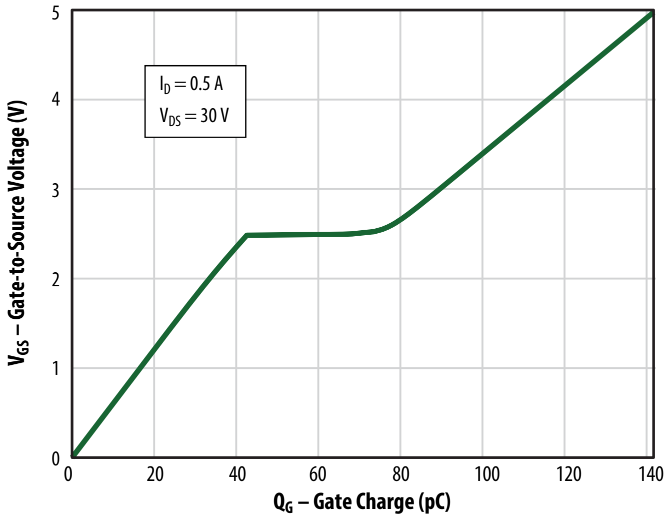


Figure 15: Safe Operating Area

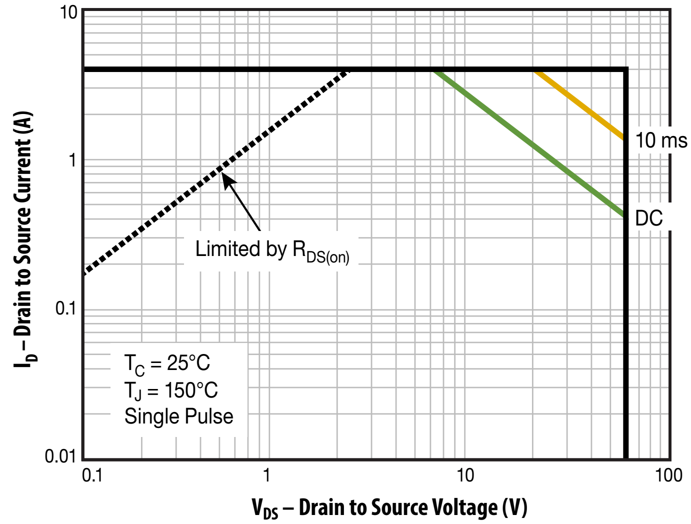
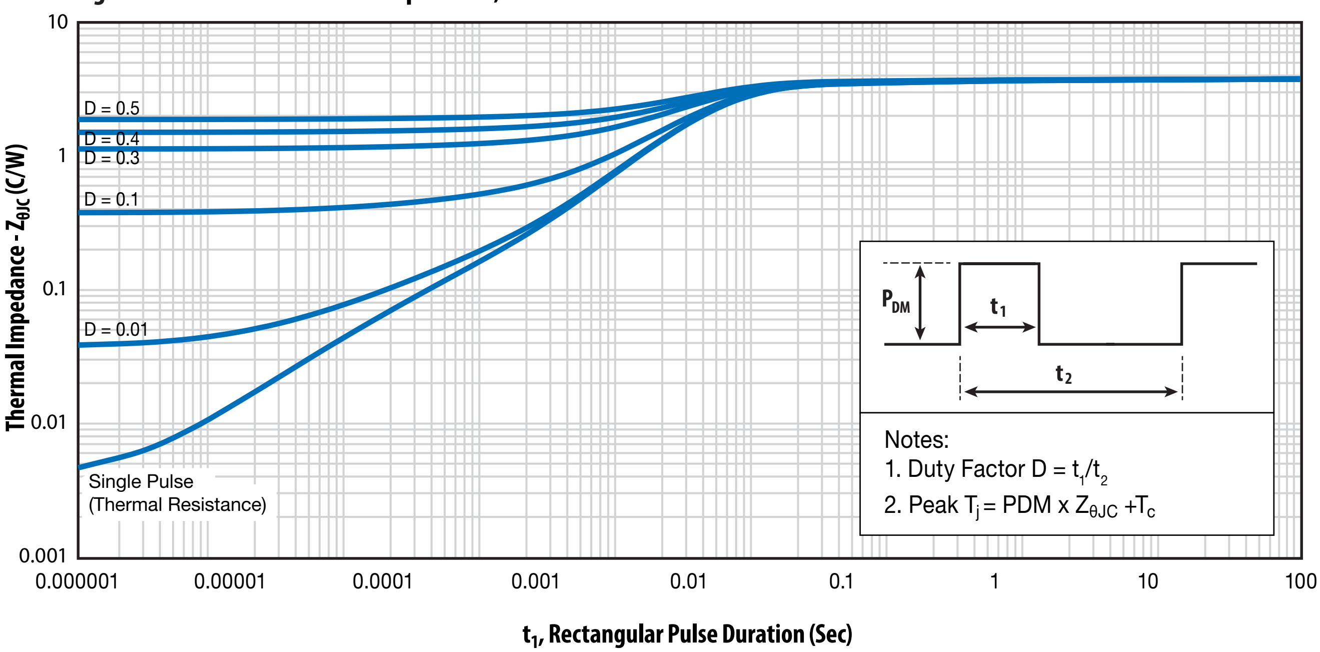
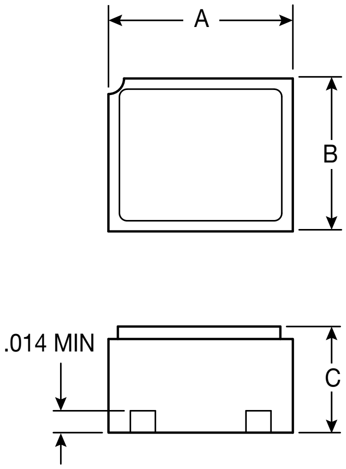
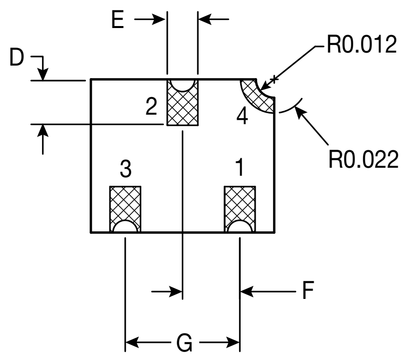


Figure 16: Transient Thermal Impedance, Junction-to-Case



Package Outline and Dimensions

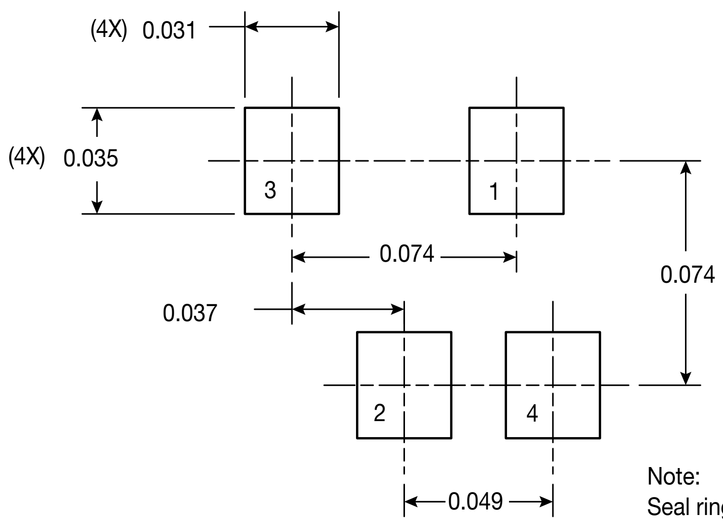




Symbol	Inches		Millimeters	
	MIN	MAX	MIN	MAX
A	0.115	0.128	2.921	3.251
B	0.095	0.108	2.413	2.743
C	0.064	0.082	1.625	2.083
D	0.024	0.036	0.610	0.910
E	0.016	0.024	0.410	0.610
F	0.035	0.039	0.889	0.991
G	0.071	0.079	1.803	2.006

Standard Terminal Pad finish is a solder alloy of 63%Sn 37%Pb.

UB Footprint for Printed Circuit Board Design



Note:
Seal ring/lid ground optional (pin/pad 4)

Notes

Note 1. Never exceed the absolute maximum V_{DS} of the device otherwise permanent damage/destruction may result.

Note 2. Never exceed the absolute maximum V_{GS} of the device otherwise permanent damage/destruction may result. We recommend a V_{GS} of 5V for optimum operation across life and radiation.

Note 3. $R_{θJA}$ measured with LCC3 package mounted to double-sided PCB, 0.063” thickness with 1.0 square inches of copper area on the top (mounting side) and a flood etch (3 square inches) on the bottom side.

Note 4. Measured using four wire (Kelvin) sensing and pulse measurement techniques. Measurement pulse width is 80 µs and duty cycle is 1%, maximum.

Note 5. Guaranteed by design/device construction. Not tested.

Note 6. The gate charge parameters are measured based on the MIL-STD-750.3471 Condition B. A high speed constant gate current (I_{const}) is provided to the Gate of the DUT during the time that the ground switch (G_S) is OFF (t_{off}). The DUT is switched ON and OFF using ground-sensed switch G_S. The gate current is adjusted to yield the desired charge per unit time (I_{const} · time per division) on the measuring oscilloscope. The G_S pulse drive ON time (t_{on}) is adjusted for the desired observability of the gate-source voltage (V_{GS}) waveform. The maximum duty cycle of the ground switch (t_{off} /t_{on}) should be set to 1% maximum. Please note that all gate-related signals are referenced to the “Source Sense” pin on the package. At all times during the measurement, the maximum gate-source voltage is clamped to 5 V_{DC}.

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