Features

- Low $R_{DS(on)}$
- Ultra-low Q_G For High Efficiency
- Logic Level
- Light Weight
- Compact Hermetic Package
- Source Sense Pin
- Total Ionizing Dose LDR Immune
- Total Ionizing Dose HDR Immune
- Single Event Effect (SEE) Hardened
  - SEE immunity up to LET of 83.3 MeV/mg/cm^2 with V_{DS} up to 100% of rated Breakdown
- Neutron
  - Maintains Pre-Rad specification for up to 4 x 10^{15} Neutrons/cm^2

Applications

- Satellite and Avionics
- Deep Space Probes
- High Speed Rad-Hard DC-DC Conversion
- Rad-Hard Motor Controllers

EPC7003ASH

Rad-Hard eGaN® 100 V, 10 A,
52 mΩ Surface Mount (FSMD-A)

Description

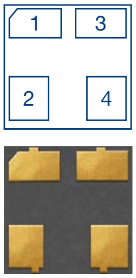
EPC Space FSMD-A series of eGaN® power switching HEMTs have been specifically designed for critical applications in Space and other the high reliability environments. These devices have exceptionally high electron mobility and a low temperature coefficient resulting in very low $R_{DS(on)}$ values. The 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)	62	°C/W
$R_{\theta JC}$	Thermal Resistance Junction to Case	10.6	

I/O Pin Assignment *(Bottom View)*

Pin	Symbol	Description
1	G	Gate
2	D	Drain
3	SS	Source Sense
4	S	Source



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

Symbol	Parameter-Conditions	Value	Units
V_{DS}	Drain to Source Voltage (Note 1)	100	V
	Drain-to-Source Voltage (up to 10,000 5ms pulses at 150˚C)	120	
I_D	Continuous Drain Current ID @ V_{GS} = 5 V	10	A
I_{DM}	Single-Pulse Drain Current $t_{pulse} \leq 80$ µs	38	
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	0.068	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	BV_{DSS}	V_G = 0 V	100			V
Drain to Source Leakage	I_{DSS}	V_{DS} = 100 V, V_{GS} = 0 V		1	60	µA
		V_{DS} = 100 V, V_{GS} = 0 V, T_J = 125˚C		10	150	
Gate to Source Forward Leakage	I_{GSSF}	V_{GS} = 6 V		1	300	
		V_{GS} = 5 V, T_J = 125˚C		40	600	
Gate to Source Reverse Leakage	I_{GSSR}	V_{GS} = -4 V		0.07	60	
Gate to Source Threshold Voltage	$V_{GS(th)}$	V_{DS} = V_{GS} , I_D = 2 mA	0.8	1.6	2.5	V
Gate to Source Threshold Voltage Temperature Coefficient	$\Delta V_{GS(th)}$			|0.57|		mV/°C
Drain to Source Resistance (Note 4)	$R_{DS(on)}$	I_D = 10 A, V_{GS} = 5 V		42	52	mΩ
Source to Drain Forward Voltage	V_{SD}	I_S = 0.5 A, V_G = 0 V		2	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} = 50 V, V_{GS} =0 V		168	233	pF
Reverse transfer Capacitance	C_{RSS}			0.3	20	
Output Capacitance	C_{OSS}			92	170	
Total Gate Charge (Note 6)	Q_G	V_{DS} = 50 V, V_{GS} = 5 V, I_D = 10 A		1.8	2.2	nC
Gate-to-Source Charge (Note 6)	Q_{GD}			0.5	1.2	
Gate-to-Drain Charge (Note 6)	Q_{GS}			0.67	1	
Output Charge (Note 5)	Q_{OSS}	V_{GS} = 0 V, V_{DS} = 50 V		8.5		
Source-Drain Recovery Charge (Note 5)	Q_{RR}	I_D = 10 A, V_{DS} = 100 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
Maximum Drain to Source Voltage	V_{DSMAX}	V_{GS} = 0 V	100			V
Gate to Source Threshold Voltage	$V_{GS(th)}$	V_{DS} = V_{GS} , I_D = 2 mA	0.8	1.6	2.5	
Drain to Source Leakage	I_{DSS}	V_{DS} = 100 V, V_{GS} = 0 V		1	5	µA
Gate to Source Forward Leakage	I_{GSSF}	V_{GS} = 5 V		10	100	
Gate to Source Reverse Leakage	I_{GSSR}	V_{GS} = -4 V		0.07	5	
Drain to Source Resistance (Note 4)	$R_{DS(on)}$	I_D = 10 A, V_{GS} = 5 V		42	52	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. The ion LET is based on the K-500 Cyclotron as it enters the device and is used as a reference to penetrating silicon devices.

Test	Environment				V_{DS} Voltage (V)	
See SOA	Ion	LET (in Si) MeV/mg/cm²	Range µm	Energy MeV	V_{GS} = 0 V	V_{GS} = -4V
	Xe	63	71.3	962	100	100
	Au	83.3	121	2256	100	100

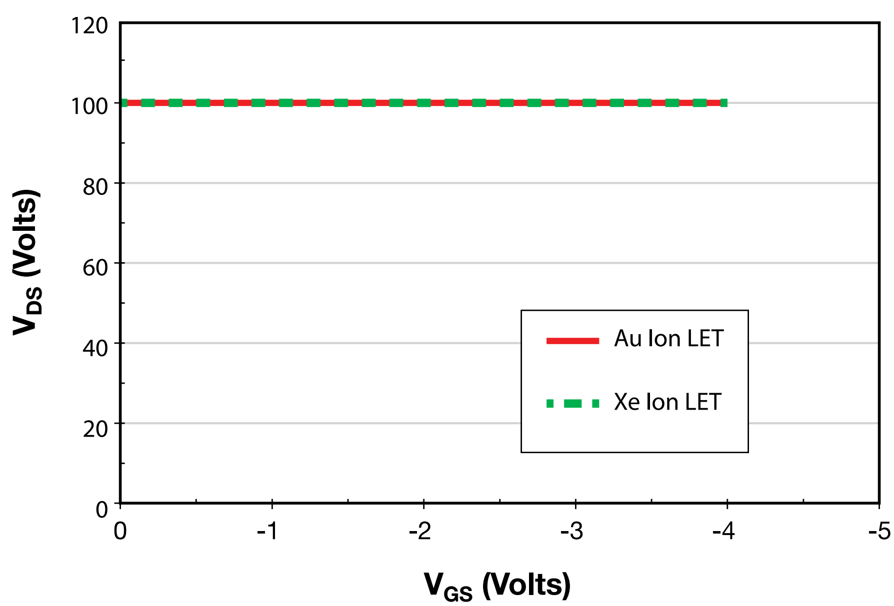


Figure 1. Typical Single Event Effect Safe Operating Area

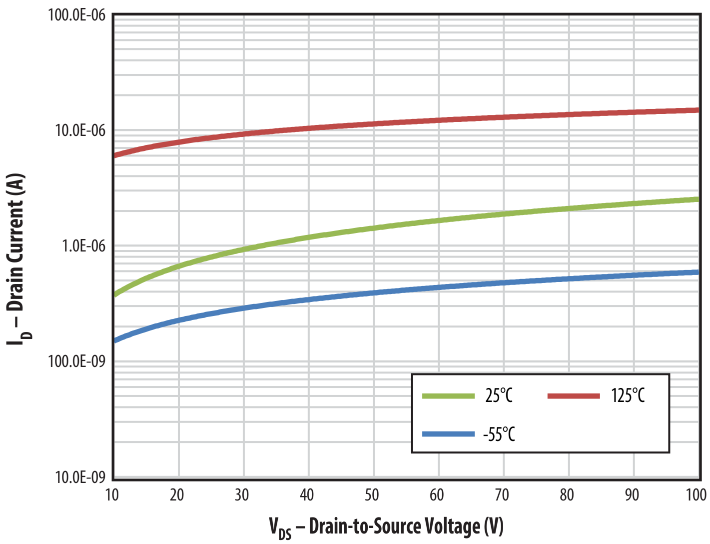


Figure 2. Typical Drain-Source Leakage Current vs. Ambient Temperature

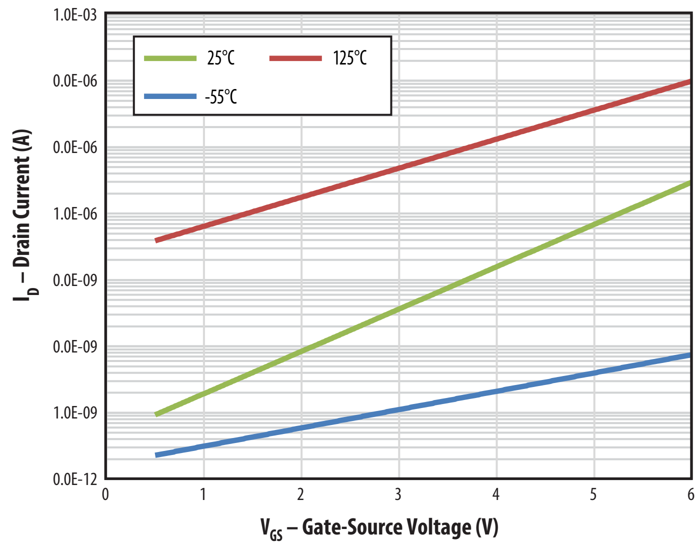


Figure 3. Typical Gate-Source Leakage Current vs. Ambient Temperature

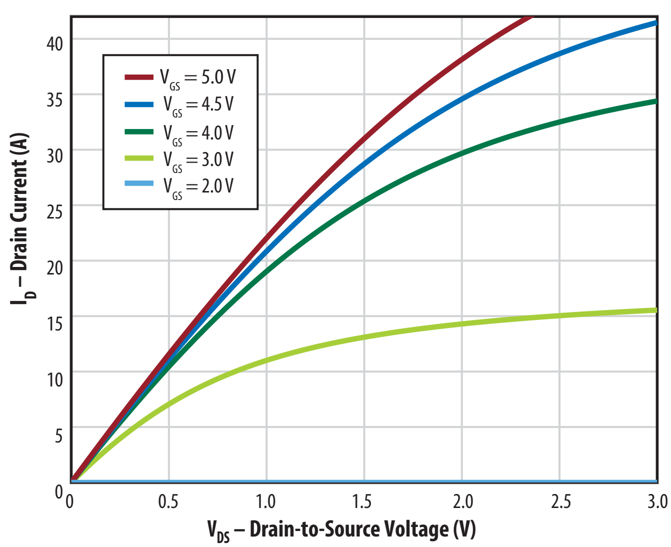


Figure 4. Typical Output Characteristics at 25°C

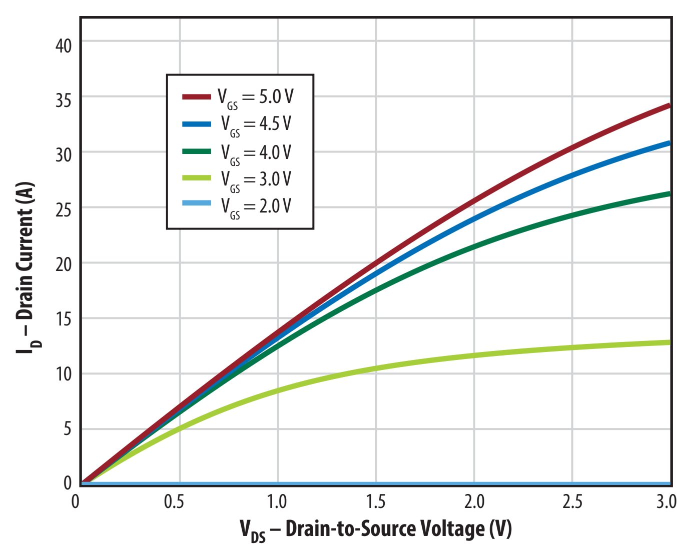


Figure 5. Typical Output Characteristics at 125°C

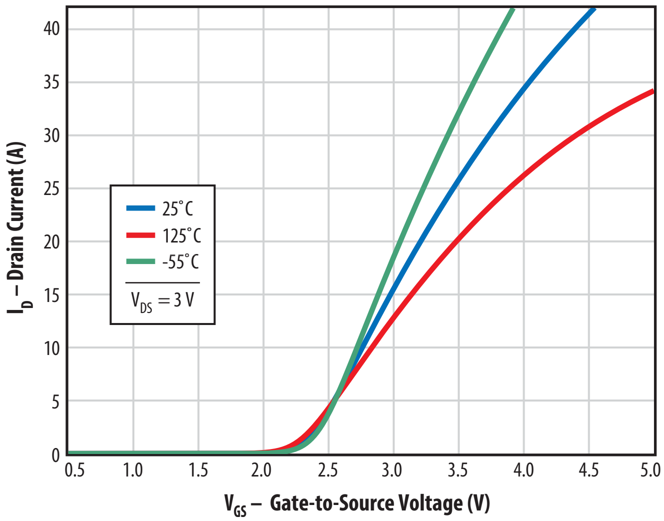


Figure 6. Typical Transfer Characteristics

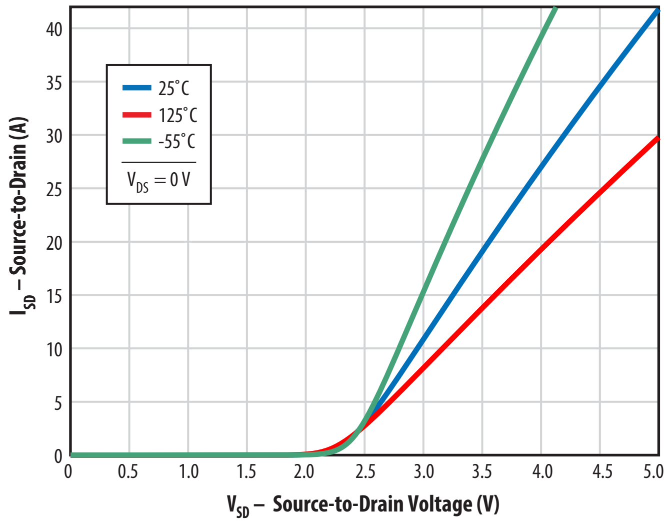


Figure 7: Reverse Drain-Source Characteristics

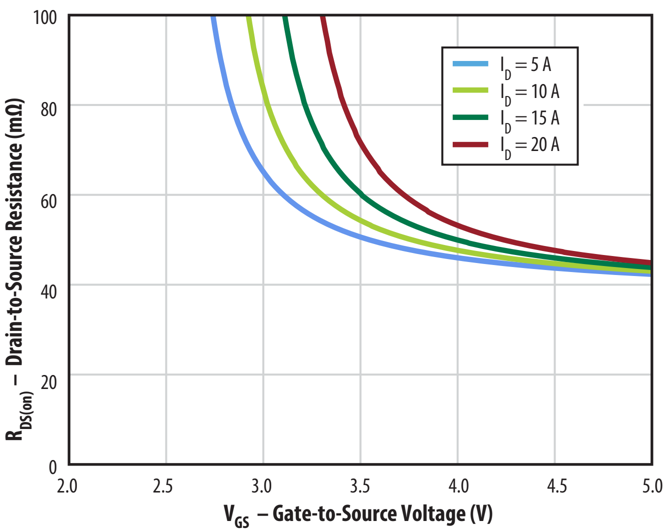


Figure 8. RDS(on) vs. VGS for Various Drain Currents

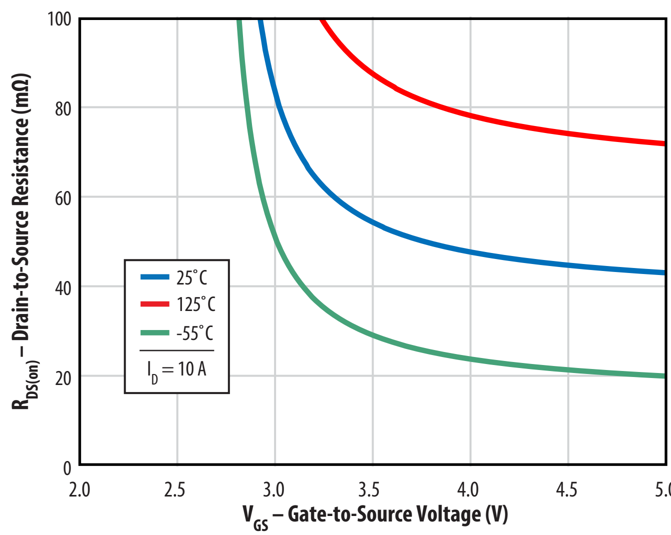


Figure 9. RDS(on) vs. VGS for Various Temperatures

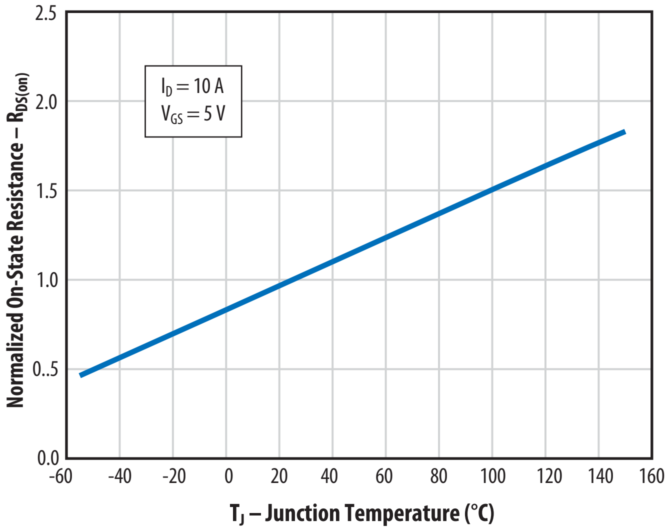


Figure 10. Normalized On-State Resistance vs. Temperature

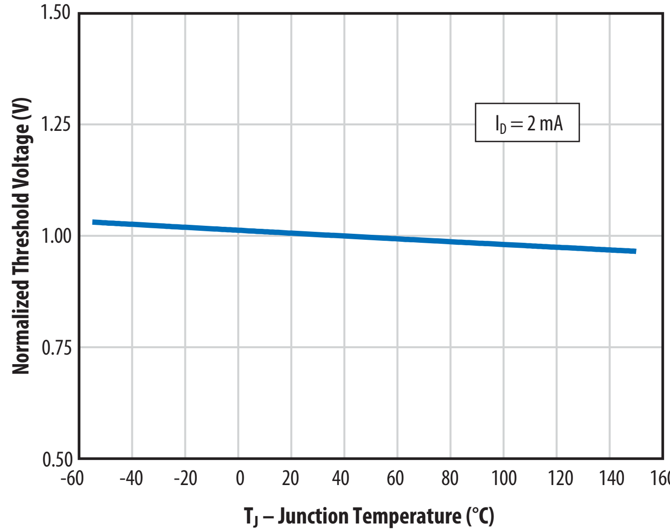


Figure 11. Normalized Threshold Voltage vs. Temperature

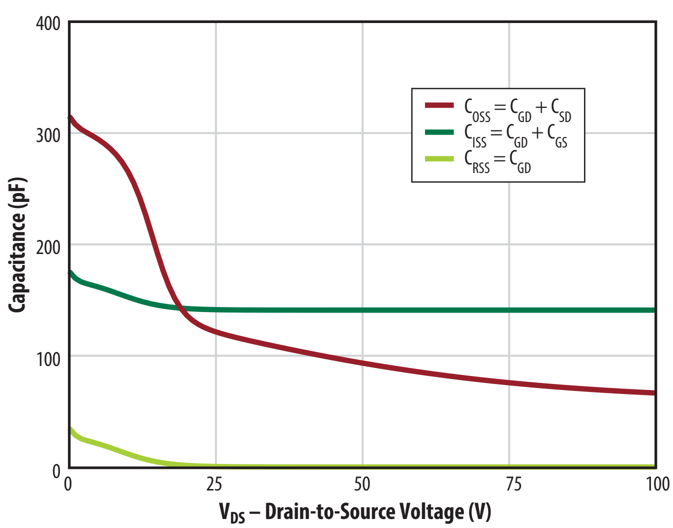


Figure 12. Typical Gate Charge

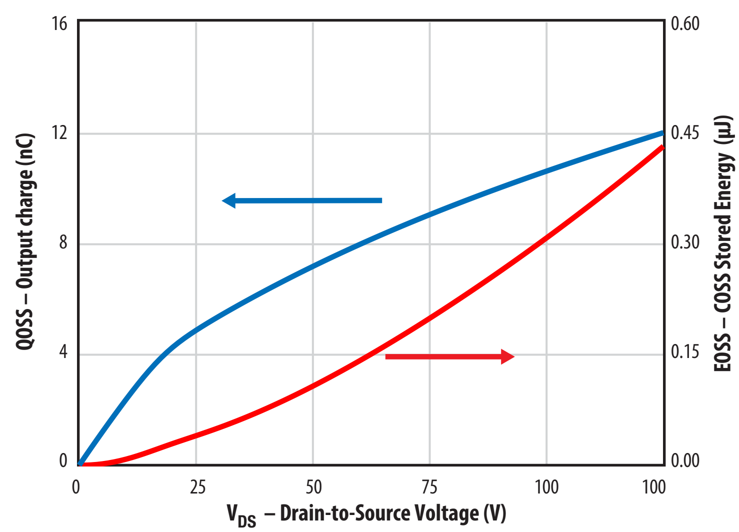


Figure 13. Typical Output Charge and C_{OSS} Stored Energy

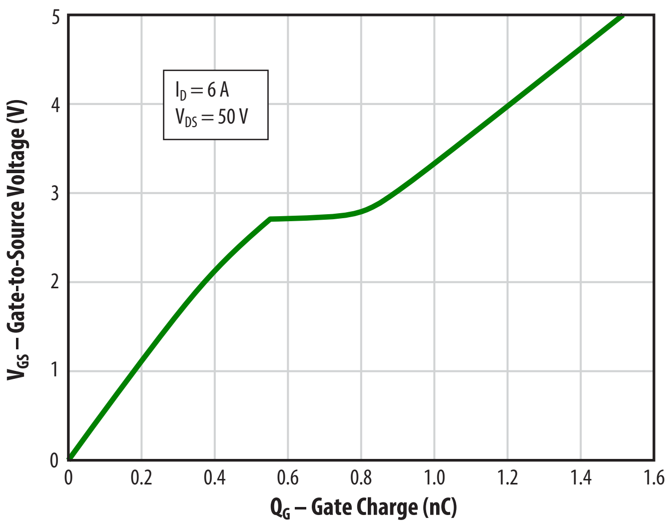


Figure 14. Typical Gate Charge

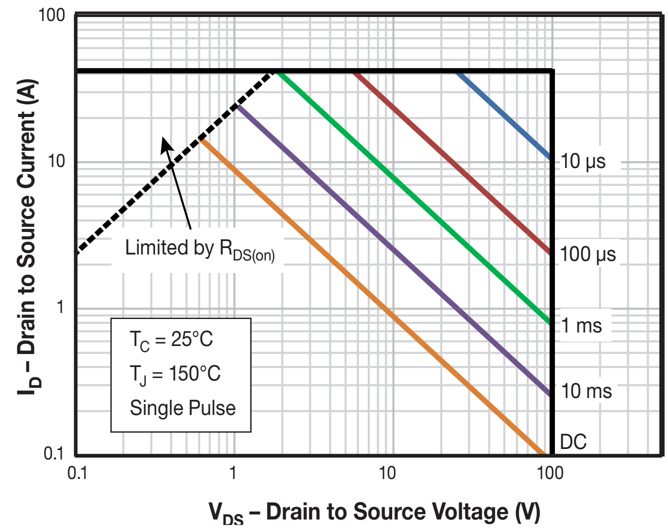


Figure 15. Safe Operating Area

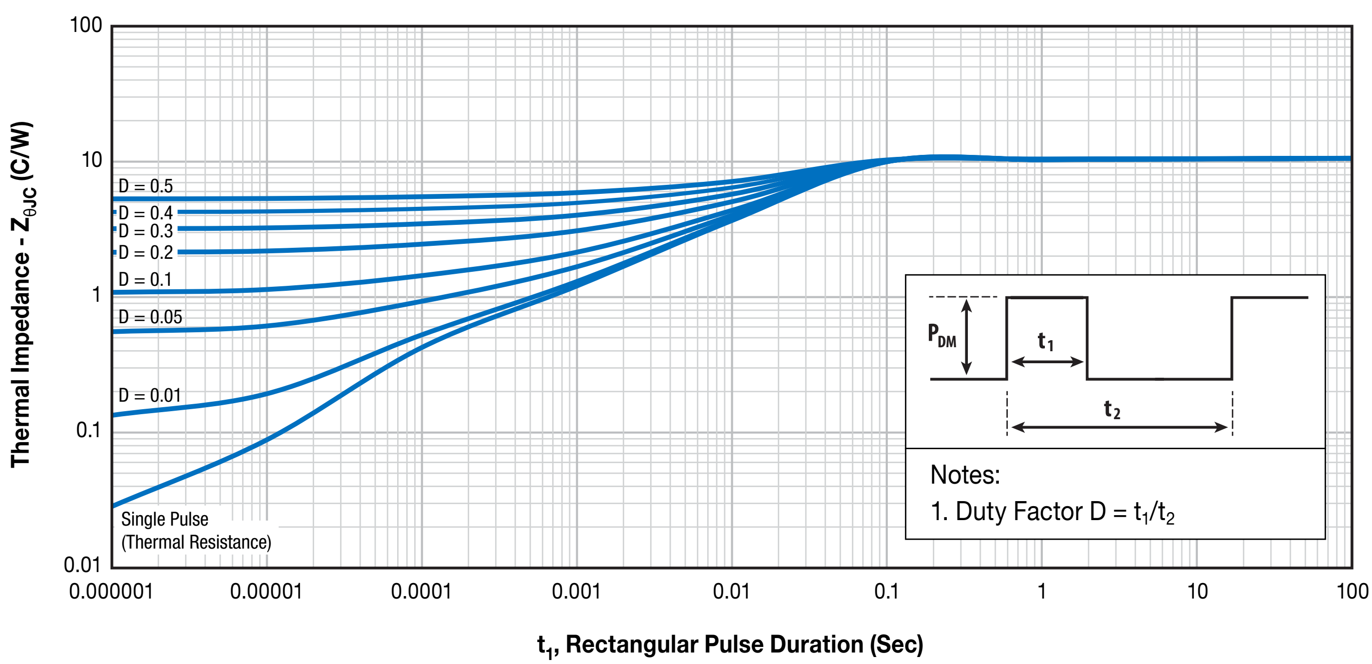
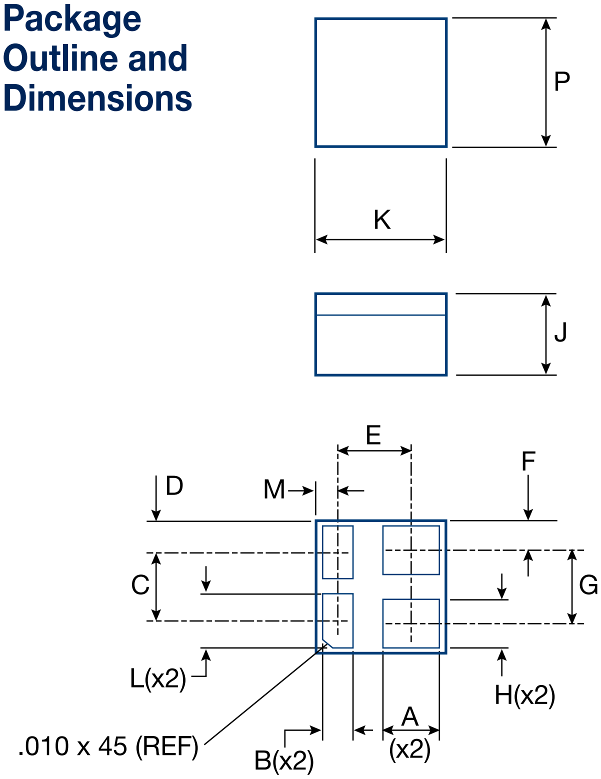


Figure 16. Transient Thermal Impedance, Junction to Case

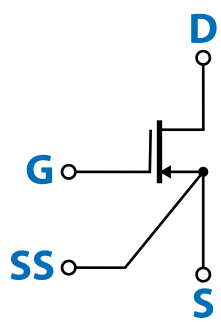
Package Outline and Dimensions



Symbol	Dimensions Nominal in	Dimensions Nominal mm	Note
A	0.062	1.5748	
B	0.032	0.8128	
C	0.068	1.7272	
D	0.031	0.7874	(REF)
E	0.074	1.8796	
F	0.026	0.6604	(REF)
G	0.076	1.9304	
H	0.045	1.1430	
J	0.083	2.1082	(REF)
K	0.130	3.3020	
L	0.053	1.346	
M	0.021	0.5334	(REF)
P	0.130	3.3020	

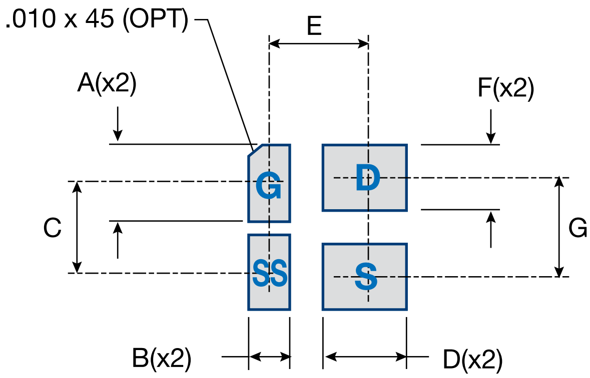
1. Standard tolerances:
   Length: ±0.005" / ±0.127mm
2. Standard Terminal Pad finish is a solder alloy of 63%Sn 37%Pb.

Package Connections



NOTE: SS pin is connected directly to source of internal die.

FSMD-A Footprint for Printed Circuit Board Design



Symbol	Dimensions Nominal in	Dimensions Nominal mm	Note
A	0.057	1.4478	
B	0.036	0.9144	
C	0.063	1.600	
D	0.066	1.6764	
E	0.074	1.8796	
F	0.047	1.1938	
G	0.076	1.9304	

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 5 V for optimum operation across life and radiation.

Note 3. $R_{\theta JA}$ measured with FSMD-A 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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