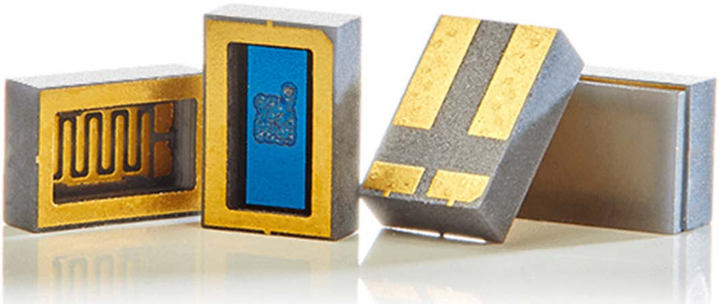
EPC7004B Datasheet

Features

- Ultra-low Q_G For High Efficiency
- Logic Level
- Light Weight
- New Compact Hermetic Package with Dual Gate
- Source Sense Pin
- Total Dose
  - Rated to 1000 krad
- Single Event
  - SEE immunity for LET of 85 MeV/mg/cm^2 with V_{DS} up to 100% of rated Breakdown
- Low Dose Rate at 100 mRad/sec
  - Maintains Pre-Rad specification
- Neutron
  - Maintains Pre-Rad specification for up to 3 x 10^{15} Neutrons/cm^2

Applications

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



EPC7004B

Rad Hard e-GaN® 100 V, 30 A, 15 mΩ typ Surface Mount (FSMD-B)

Description

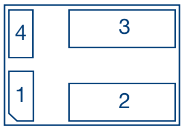
EPC Space FSMD-B series of eGaN® power switching HEMTs have been specifically designed for critical applications in the high reliability or commercial satellite space environments. These devices have exceptionally high electron mobility and a low temperature coefficient resulting in very low $R_{DS(on)}$ 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)	35	°C/W
$R_{\theta JC}$	Thermal Resistance Junction to Case	2.25	

I/O Pin Assignment *(Bottom View)*

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



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, T_C = 25°C	30	A
I_{DM}	Single-Pulse Drain Current $t_{pulse} \leq 80$ µs	160	
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	1 (ΔA)	

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

Symbol	Parameter	Test Conditions	MIN	TYP	MAX	Units
V_{DSMAX}	**Drain to Source Voltage**	$V_G = 0$ V, I_D = TBD	100			V
I_{DSS}	Drain to Source Leakage	$V_{GS} = 0$ V, $V_{DS} = 100$ V		0.36	5	µA
		$V_{GS} = 0$ V, $V_{DS} = 100$ V, $T_J = 125$°C		3.1	10	
I_{GSS}	Gate to Source Forward Leakage	$V_{GS} = 5$ V		10	30	
I_{GSS}	Gate to Source Forward Leakage#	$V_{GS} = 5$ V, $T_J = 125$°C		20	60	
I_{GSS}	Gate to Source Reverse Leakage	$V_{GS} = -4$ V		0.36	5	
$V_{GS(th)}$	Gate to Source Threshold Voltage	$V_{DS} = V_{GS}$, $I_D = 7$ mA	0.8	1.4	2.5	V
$\Delta V_{GS(th)}/\Delta T$	Gate to Source Threshold Voltage Temperature Coefficient			-1.26		mV/°C
$R_{DS(on)}$	Drain to Source Resistance (Note 4)	$V_{GS} = 5$ V, $I_D = 30$ A		13	15	mΩ
V_{SD}	Source to Drain Forward Voltage (Note 5)	$V_{GS} = 0$ V, $I_S = 0.5$ A		1.7	2.5	V

Defined by design. Not subject to production test.

Dynamic Characteristics *(Note 6. T_C = 25°C unless otherwise noted. Typical (TYP) values are for reference only.)*

Symbol	Parameter	Test Conditions	MIN	TYP	MAX	Units
C_{ISS}	**Input Capacitance**	$V_{DS} = 50$ V, $V_{GS} = 0$ V		797	1000	pF
C_{RSS}	Reverse transfer Capacitance			1.8	20	
C_{OSS}	Output Capacitance			411	700	
$C_{OSS(ER)}$	Effective Output Capacitance, Energy Related	$V_{DS} = 0$ to 50 V, $V_{GS} = 0$ V		522		
$C_{OSS(TR)}$	Effective Output Capacitance, Time Related			690		
Q_G	Total Gate Charge	$V_{DS} = 50$ V, $V_{GS} = 5$ V, $I_D = 30$ A		7	11	nC
Q_{GS}	Gate to Source Charge	$V_{DS} = 50$ V, $I_D = 30$ A		2.4	3.5	
Q_{GD}	Gate to Drain Charge			1.7	3	
Q_{OSS}	Output Charge	$V_{DS} = 50$ V, $V_{GS} = 0$ V		35		
Q_{RR}	Source to Drain Recovery Charge			0		

All measurements were done with substrate shorted to source.

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 Gamma radiation with an in-situ bias for (i) V_{GS} = 5 V, (ii) V_{DS} = V_{GS} = 0 V and (iii) V_{DS} = 80% B_{VDSS}.

Electrical Characteristics up to 300 krads *(T_C = 25°C unless otherwise noted. Typical (TYP) values are for reference only.)*

Symbol	Parameter	Test Conditions	MIN	TYP	MAX	Units
V_{DSMAX}	Maximum Drain to Source Voltage	V_{GS} = 0 V, I_D = TBD	100			V
$V_{GS(th)}$	Gate to Source Threshold Voltage	V_{DS} = V_{GS} , I_D = 7 mA	0.8	1.4	2.5	
I_{DSS}	Drain to Source Leakage	V_{GS} = 0 V, V_{DS} = 100 V		0.36	5	µA
I_{GSS}	Gate to Source Forward Leakage	V_{GS} = 5 V		10	30	
I_{GSS}	Gate to Source Reverse Leakage	V_{GS} = -4 V		0.36	5	
$R_{DS(on)}$	Drain to Source Resistance (Note 4)	I_D = 30 A, V_{GS} = 5 V		13	15	mΩ

Typical Single Event Effect Safe Operating Area

Note : All Single Event Effect testing is performed on the K-500 Cyclotron at Texas A&M University

Test	Environment				V_{DS} Voltage (V)	
See SOA	Ion	LET MeV/mg/cm²	Range µm	Energy MeV	V_{GS} = 0 V*	V_{GS} = -4V*
	Xe	50.8	125	1583	100	100
	Au	84.6	124	2365	100	100

*pending qualification

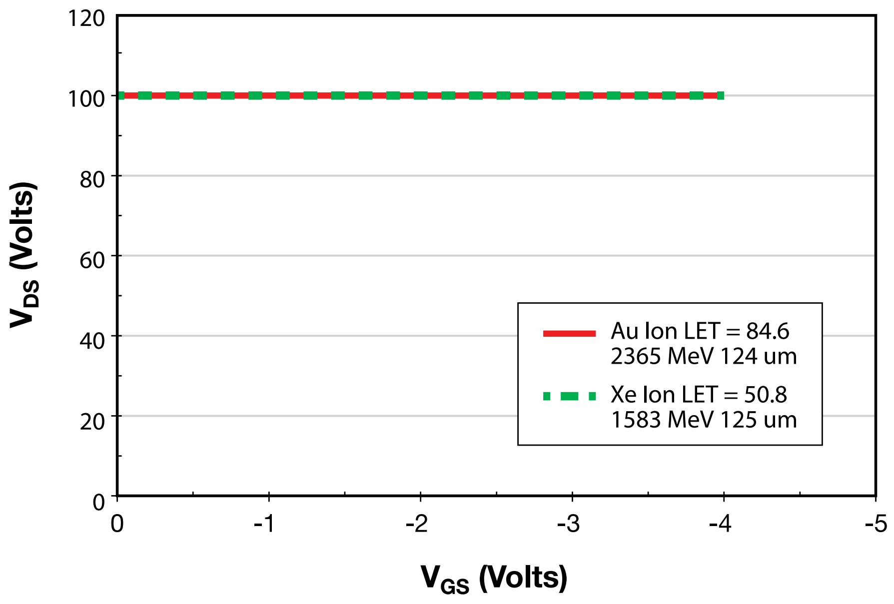


Figure 1. Typical Single Event Effect Safe Operating Area

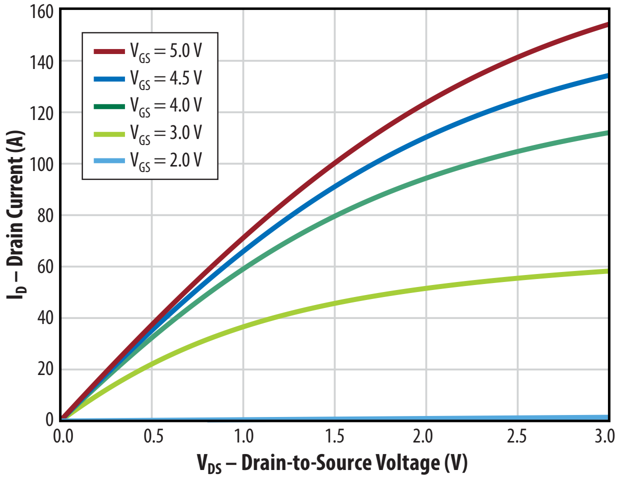


Figure 2. Typical Output Characteristics at 25°C

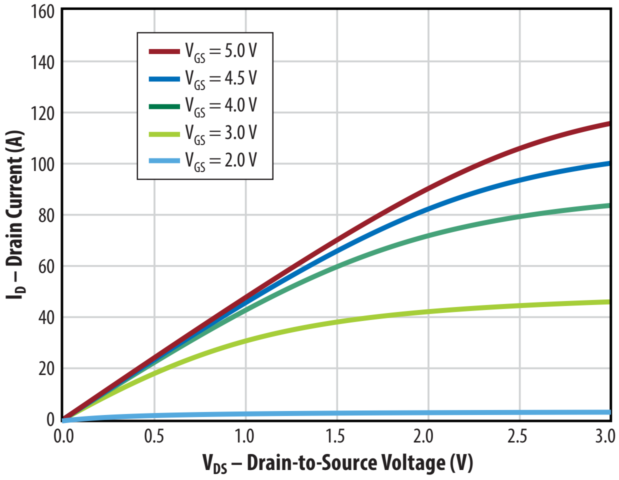


Figure 3. Typical Output Characteristics at 125°C

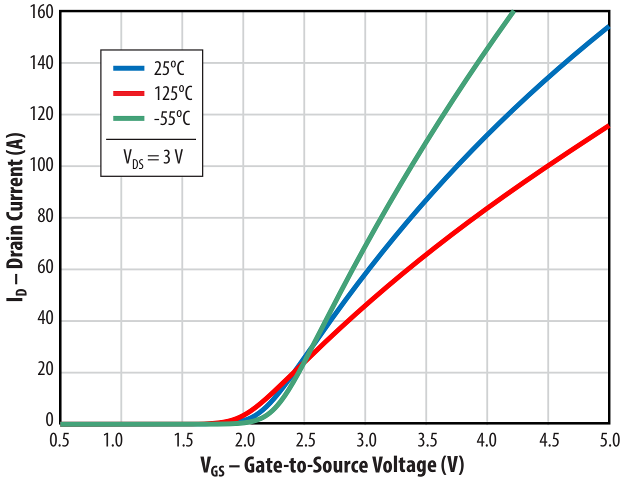


Figure 4. Typical Transfer Characteristics

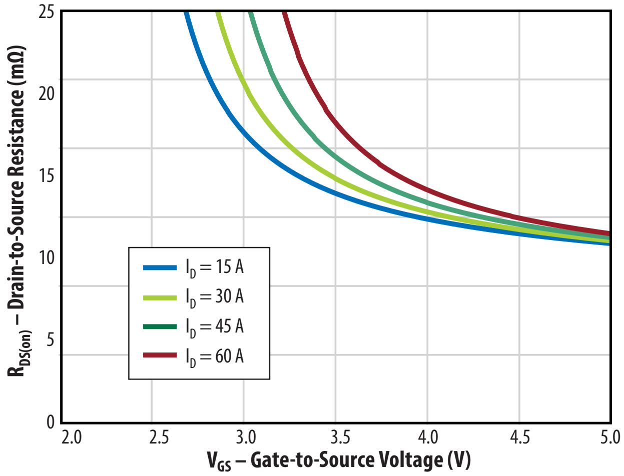


Figure 5. $R_{DS(on)}$ vs. V_{GS} for Various Drain Currents

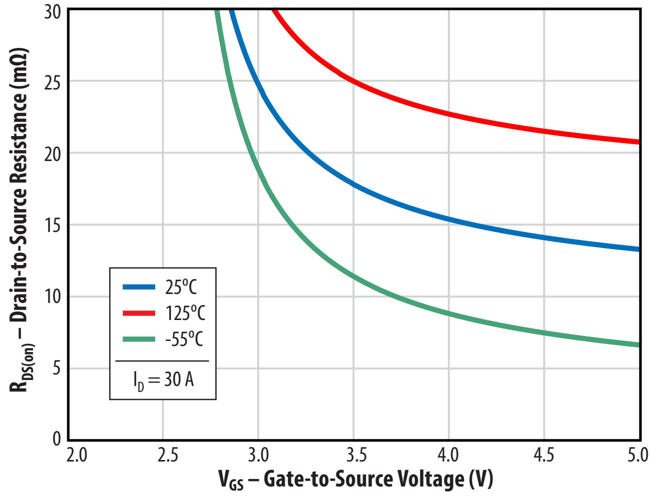


Figure 6. $R_{DS(on)}$ vs. V_{GS} for Various Temperatures

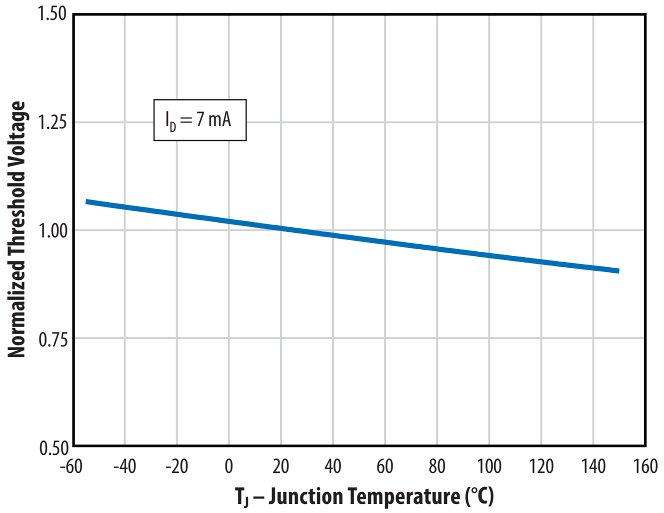


Figure 7. Normalized Threshold Voltage vs. Temperature

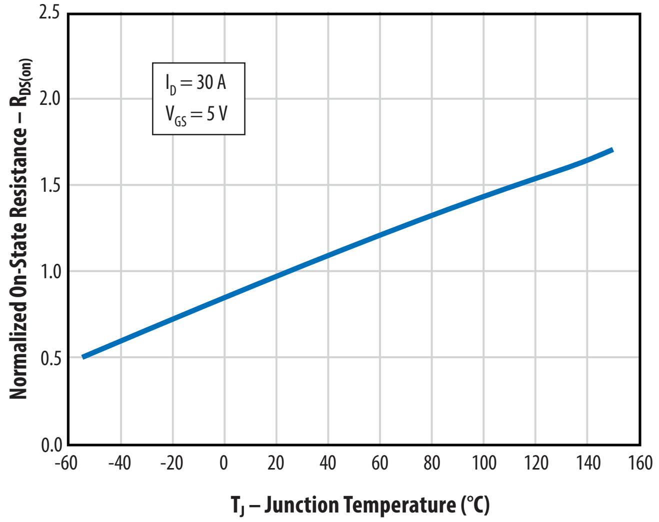


Figure 8. Normalized On-State Resistance vs. Temperature

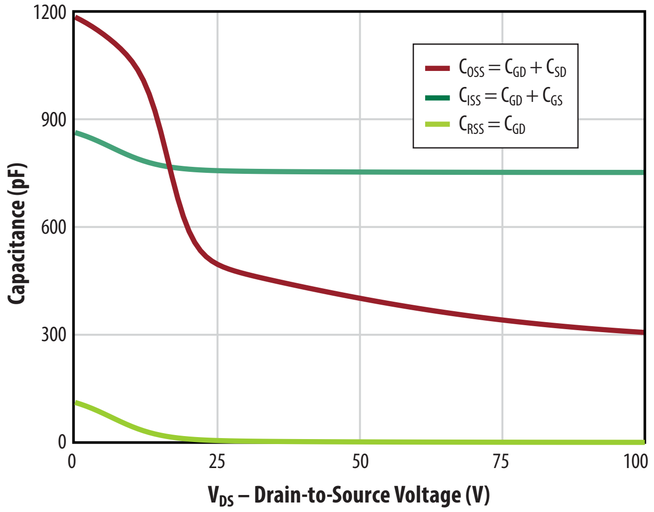


Figure 9. Typical Capacitance

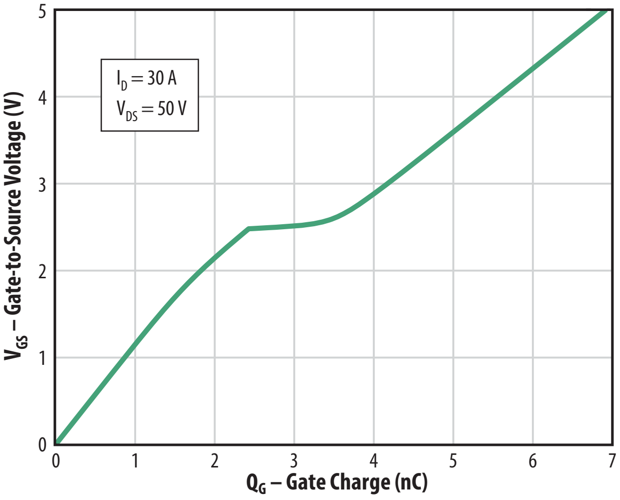


Figure 10. Typical Gate Charge

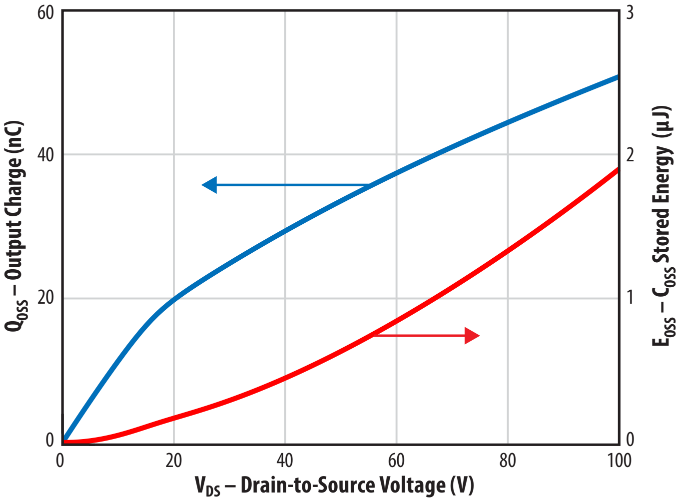


Figure 11. Typical Output Charge and C_{OSS} Stored Energy

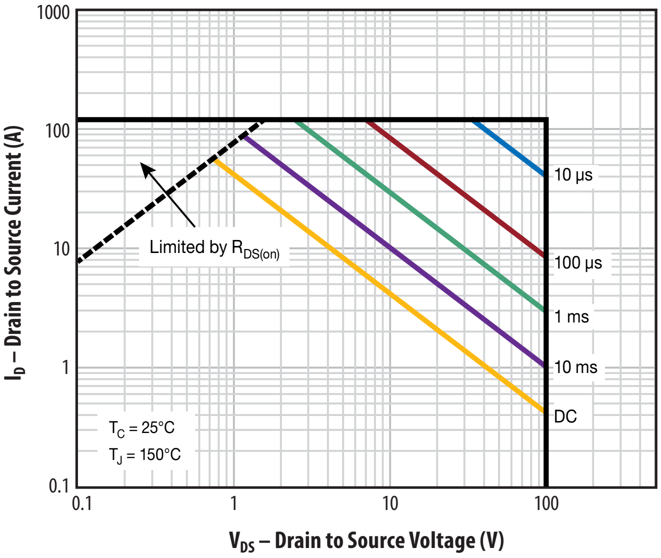
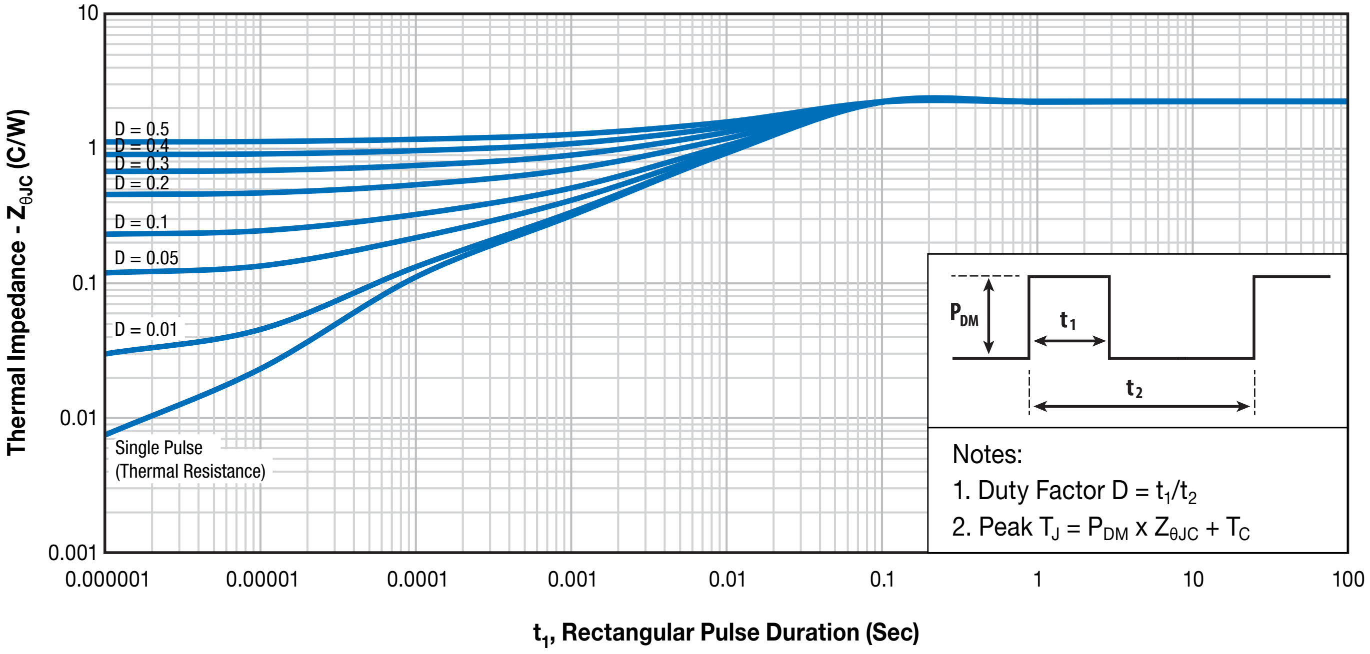


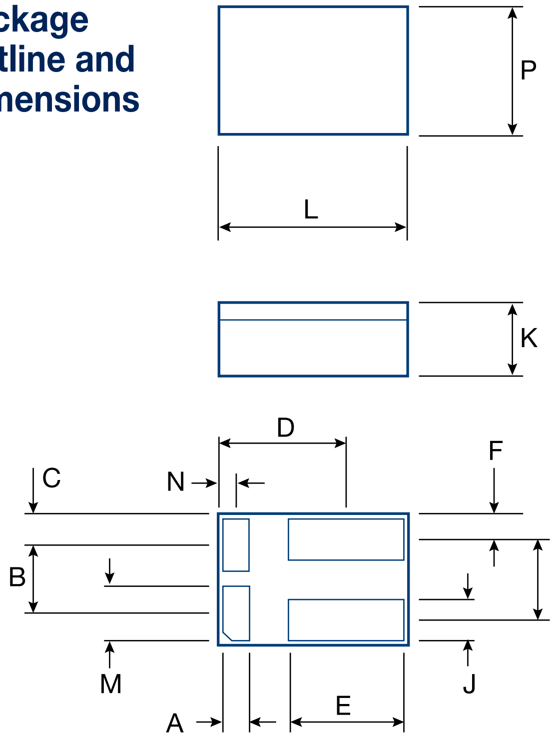
Figure 12. Safe Operating Area



Notes:
1. Duty Factor $D = t_1/t_2$
2. Peak $T_J = P_{DM} \times Z_{\theta JC} + T_C$

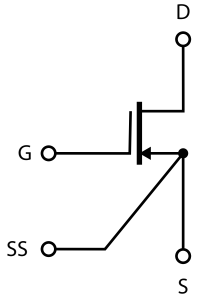
Figure 13. Transient Thermal Impedance, Junction to Case

Package Outline and Dimensions



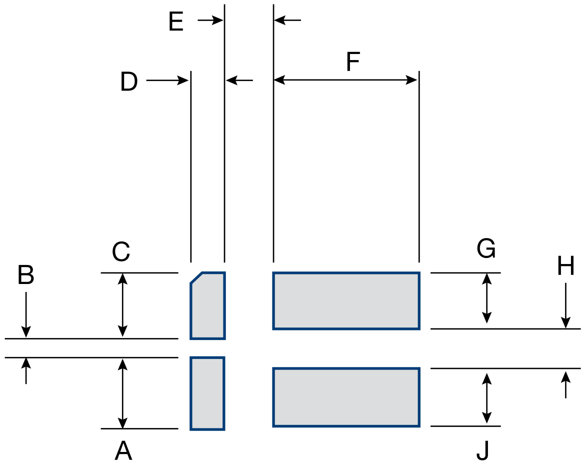
Symbol	Inches		Millimeters		Note
	MIN	MAX	MIN	MAX	
A	0.027	0.037	0.685	0.939	
B	0.073	0.083	1.854	2.108	
C	0.031	0.041	0.784	1.041	
D	0.143	0.153	3.632	3.886	
E	0.129	0.139	3.277	3.531	
F	0.027	0.037	0.686	0.940	
G	0.082	0.092	2.083	2.337	
J	0.050	0.060	1.270	1.524	
K	0.078	0.088	1.981	2.235	Ref. only
L	0.215	0.225	5.461	5.715	
M	0.058	0.068	1.473	1.727	
N	0.016	0.026	0.406	0.660	
P	0.145	0.155	3.683	3.937	

Package Connections



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

FSMD-B Footprint for Printed Circuit Board Design



Symbol	Inches		Millimeters		Note
	MIN	MAX	MIN	MAX	
A	0.064	0.074	1.626	1.880	
B	0.010	0.020	0.254	0.508	
C	0.064	0.074	1.626	1.880	
D	0.036	0.046	0.914	1.168	
E	0.034	0.044	0.864	1.118	
F	0.135	0.145	3.429	3.683	
G	0.059	0.069	1.499	1.753	
H	0.020	0.030	0.508	0.762	
J	0.059	0.069	1.499	1.753	

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 use at no greater than +5 V as the HEMT is fully conducting at this point.

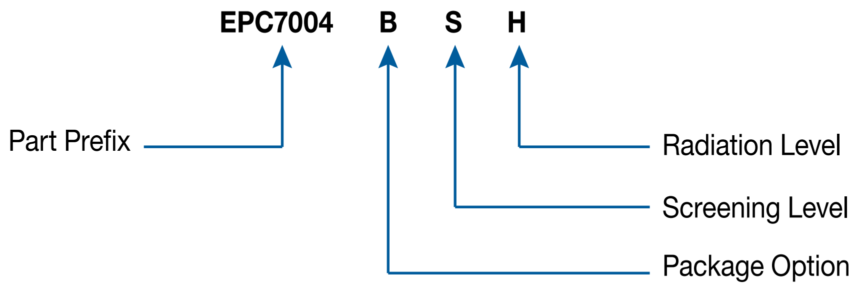
Note 3. $R_{\theta JA}$ measured with FSMD-B package mounted to double-sided PCB, 0.063” thickness with 1.0 square inches of copper area on the top (mounting side) and a flood etch (3 square inches) on the bottom side.

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. With pulse measurement width 100–380 µs.

Note 6. Guaranteed by design/device construction. Not tested.

EPC Space Part Number Information



Ordering Information Availability

Screening Options	Rad Assurance Options
1 character	**1 character**
C = Developmental Unit S = Space Level[1]	H = 1000 krad, LET = 84

Part Number	Screening Level	Shipping
EPC7004BC	Developmental Units	Waffle trays
EPC7004BSH	Space Level	

[1] Screening and qualification consistent to an equivalent MIL-PRF-19500 specification.

EPC7004BC devices are intended for engineering development purposes only and are NOT intended to be used as flight units.

EPC Space Rad Hard HEMT are not sensitive to Total Ionizing Dose as such the H level covers the R,F,G radiation levels.

Screening Flow Equivalent to a MIL-PRF-19500 General Specification

EPC SPACE Qual Flow Equivalent to a MIL-PRF-19500 Specification

Operation	Test	Test Methods Per Mil STD 750	Sample Size	Space Level	COT
Pre-Assembly	Probe Testing	EPC SPACE Internal	100%	✓	✓
	Visual inspection	EPC SPACE Internal	100%	✓	✓
Post-Assembly	Die Shear	2,017	5	✓	✓
	X-Ray	2076	5	✓	✓
Screening	Serilialization		100%	✓	
	Electricals	3411,3413,3421,3404	100%	✓	✓
	Temp Cycling	1051	100%	✓	
	Constant Acceleration	2006	100%	✓	
	PIND	2052	100%	✓	
	Initial Electricals (Read and Record)	3411,3413,3421,3404	100%	✓	
	HTGB	1042 Condition B	100%	✓	
	Interim Electricals (Read and Record)	3411,3413,3421,3404	100%	✓	
	HTRB	1042 Condition A 240 Hours	100%	✓	
	Final Electricals (Read and Record)	3411,3413,3421,3404	100%	✓	
	Final Electricals (High and Low Temperatures)	3411,3413,3421,3404	100%	✓	
	Deltas	Per Procurement Specification	100%	✓	
	Percent Defective Allowable	Per Procurement Specification	100%	✓	
	Dynamic RDSON	EPC SPACE Internal	100%	✓	
	OutLiers Removal	EPC SPACE Internal	100%	✓	
	X-RAY	2076	100%	✓	
	Tinning		100%	✓	
	Hermetic Seal, Fine & Gross Leak	1071	100%	✓	
	Final Electricals	3411,3413,3421,3404	100%	✓	
Group A Inspection (Conformance)	A-2 DC Static Tests at 25°C	3411,3413,3421,3404	116	✓	
	A-3 High & Low Temp DC Static Tests	3411,3413,3421,3404	116	✓	
	A-7 Gate Charges	3471 Condition B	45	✓	
	A-7 Capacitance	3473	45	✓	
Group B Inspection (Conformance)	B-1, B-2, B-3, B-4, B-5	Sample base equivalent to a MIL-PRF-19500 flow or as required by procurement specificcation			
Group C Inspection (Conformance)	C-1, C-2, C-3, C-4, C-6, C-7	Sample base performed yearly per package style equivalent to a MIL-PRF-19500 flow or as required by procurement specification			
Group D Inspection (Conformance)	TID	1019	15	✓	
	SEE	1080	5	✓	
Group E Inspection (Qualification Inspection)	E-1, E-2, E-5, E-6 E-7	Performed during product introduction or a major process change equivalent to a MIL-PRF-19500 flow or as required by procurement specification			
	E8 Switching				

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Patents

EPC Corporation and EPC Space hold numerous worldwide patents. Any that apply to the product(s) listed in this document are identified by markings on the product(s) or on internal components of the product(s) in accordance with local patent laws.

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Revisions

Datasheet Revision	Product Status
REV P#	Proposal/development
REV Q#	Characterization and Qualification
M-700-006-E	Production Released

Information subject to change without notice.
Revised August, 2023