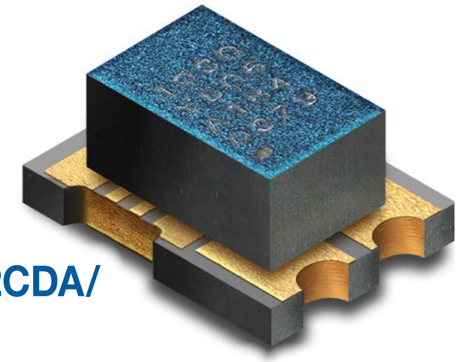
Features

- Low $R_{DS(on)}$
- Ultra-low Q_G For High Efficiency
- Logic Level
- Light Weight
- New Compact Die Adaptor Assembly
- Source Sense Pin
- Total Ionizing Dose LDR and HDR Immune
- Single Event
  - SEE immunity for LET of 83.7 MeV/mg/cm^2 with V_{DS} up to 100% of rated Breakdown
- Neutron
  - Maintains Pre-Rad specification for up to 1 x 10^{15} Neutrons/cm^2



EPC7002CDA/ 2N6782

Rad Hard e-GaN® 40 V, 10 A, 15 mΩ
Die Adaptor Product (CDA2)

Application

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

Description

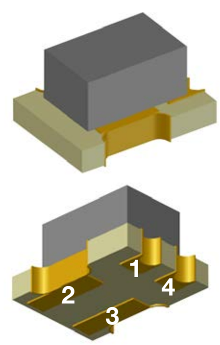
EPC Space CDA series of eGaN® power switching HEMTs have been specifically designed for critical applications in the high reliability or commercial satellite space environments. These devices have exceptionally high electron mobility and a low temperature coefficient resulting in very low $R_{DS(on)}$ 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 circuitry.

Thermal Characteristics

Symbol	Parameter-Conditions	Value	Units
$R_{θJA}$	Thermal Resistance Junction to Ambient (Note 3)	80	°C/W
$R_{θJC}$	Thermal Resistance Junction to Case	9.8	

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)	40	V
I_D	Continuous Drain Current I_D @ V_{GS} = 5 V, T_C = 25°C, $R_{θJA}$ < 40 °C/W	10	A
I_{DM}	Single-Pulse Drain Current t_{pulse} ≤ 80 µs	62	
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	

Electrical Characteristics *(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_G = 0 V				40	V
Drain to Source Leakage	I_{DSS}	V_{DS} = 40 V, V_{GS} = 0 V	T_C = 25°C		10	125	µA
			T_C = 125°C			400	
Gate to Source Forward Leakage	I_{GSSF}	V_{GS} = 5 V	T_C = 25°C		0.01	0.3	mA
Gate to Source Reverse Leakage	I_{GSSR}	V_{GS} = -4 V	T_C = 25°C		50	100	µA
Gate to Source Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}$, I_D = 2 mA	T_C = 25°C	0.8	1.4	2.5	V
Gate to Source Threshold Voltage Temperature Coefficient	$\Delta V_{GS(th)}/\Delta T$	$V_{DS} = V_{GS}$, I_D = 2 mA	-55°C < T_A < 125°C		|3.5|		mV/°C
Drain to Source Resistance (Note 4)	$R_{DS(on)}$	I_D = 10 A, V_{GS} = 5 V	T_C = 25°C		9	15	mΩ
Source to Drain Forward Voltage	V_{SD}	I_S = 1 A, V_G = 0 V	T_C = 25°C		2.0		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}	f = 1 MHz, V_{DS} = 20 V, V_{GS} = 0 V		283	312	pF
Output Capacitance	C_{OSS}			170	270	
Reverse Transfer Capacitance	C_{RSS}			20	25	
Gate Resistance (Note 5)	R_G	f = 1 MHz, $V_{DS} = V_{GS}$ = 0 V		0.4		Ω
Total Gate Charge (Note 6)	Q_G	I_D = 10 A, V_{GS} = 5 V, V_{DS} = 20 V		2.2	3	nC
Gate to Drain Charge (Note 6)	Q_{GD}	I_D = 10 A, V_{GS} = 5 V, V_{DS} = 20 V		0.1	0.6	
Gate to Source Charge (Note 6)	Q_{GS}	I_D = 10 A, V_{GS} = 5 V, V_{DS} = 20 V		0.8	1	
Output Charge (Note 5)	Q_{OSS}	V_{GS} = 0 V, V_{DS} = 20 V		6		
Source to Drain Recovery Charge (Note 5)	Q_{RR}	I_D = 10 A, V_{DS} = 20 V		<1		

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 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 300 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			40	V
Gate to Source Threshold Voltage	$V_{GS(th)}$	V_{DS} = V_{GS} , I_D = 2 mA	0.8	1.0	2.5	
Drain to Source Leakage	I_{DSS}	V_{DS} = 40 V, V_{GS} = 0 V		10	125	µA
Gate to Source Forward Leakage	I_{GSSF}	V_{GS} = 5 V		0.01	2	mA
Gate to Source Reverse Leakage	I_{GSSR}	V_{GS} = -4 V		10	100	µA
Drain to Source Resistance (Note 4)	$R_{DS(on)}$	I_D = 10 A, V_{GS} = 5 V		9	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)	
	Ion	LET MeV/mg/cm^2	Range µm	Energy MeV	V_{GS} = 0 V	V_{GS} = -4V
See SOA	Xe	50	131	1653	40	40
	Au	83.7	130	2482	40	40

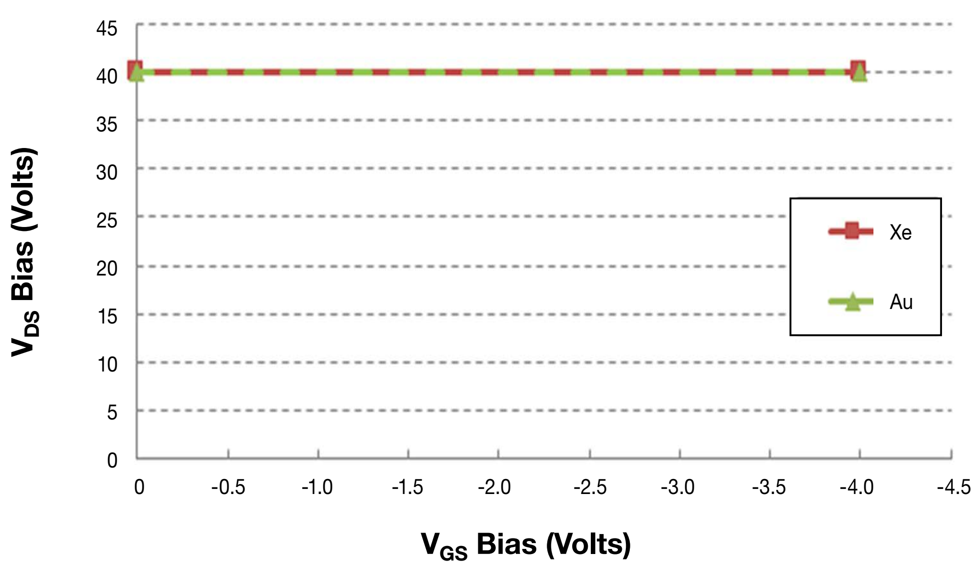


Figure 1. Typical Single Event Effect Safe Operating Area

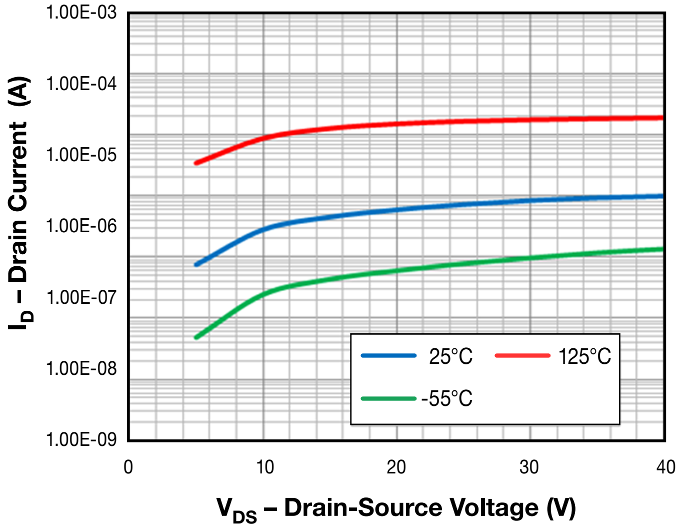


Figure 2. Typical Drain-Source Leakage Current vs. Ambient Temperature

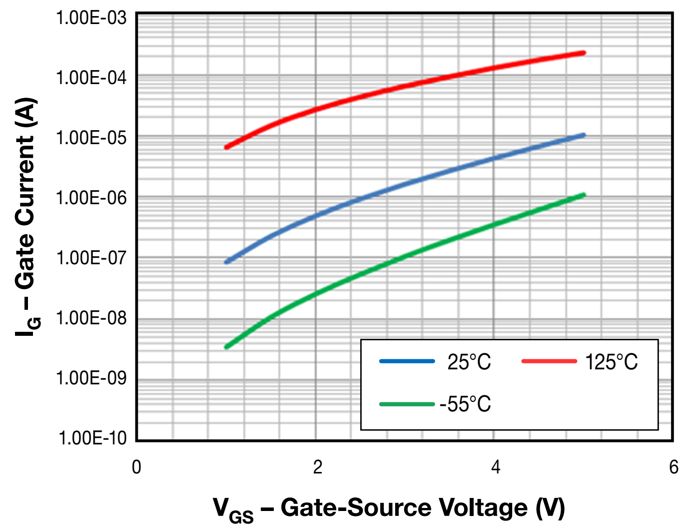


Figure 3. Gate-Source Leakage Current vs. Ambient Temperature

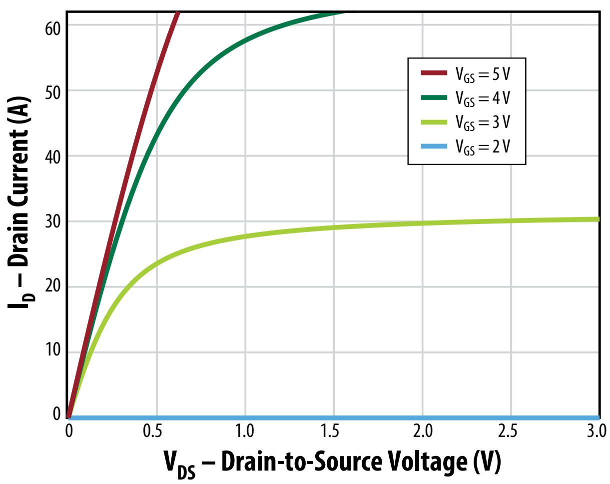


Figure 4. Typical Output Characteristics at 25°C

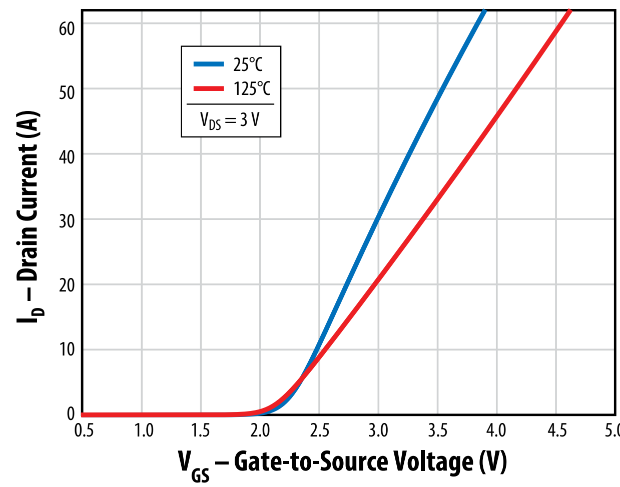


Figure 5. Typical Transfer Characteristics

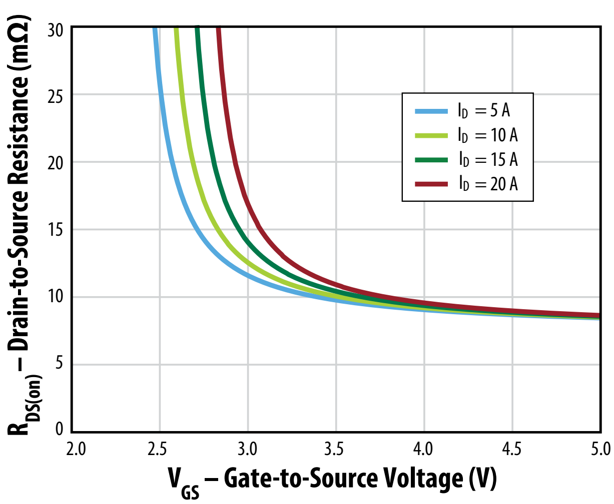


Figure 6. $R_{DS(on)}$ vs. V_{GS} for Various Drain Currents

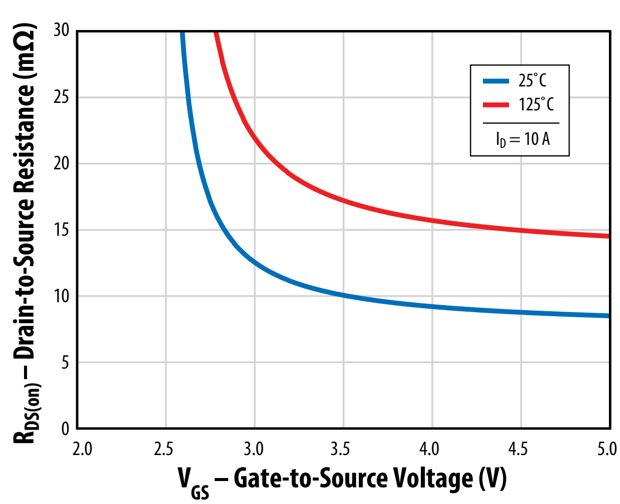


Figure 7. $R_{DS(on)}$ vs. V_{GS} for Various Temperatures

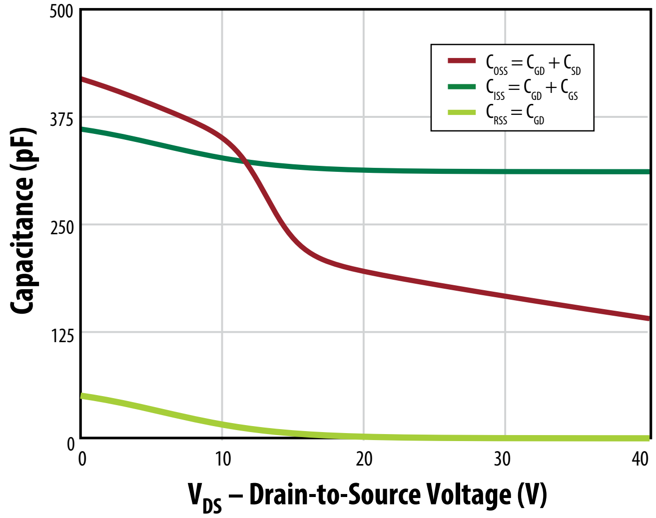


Figure 8. Typical Capacitance (Linear Scale)

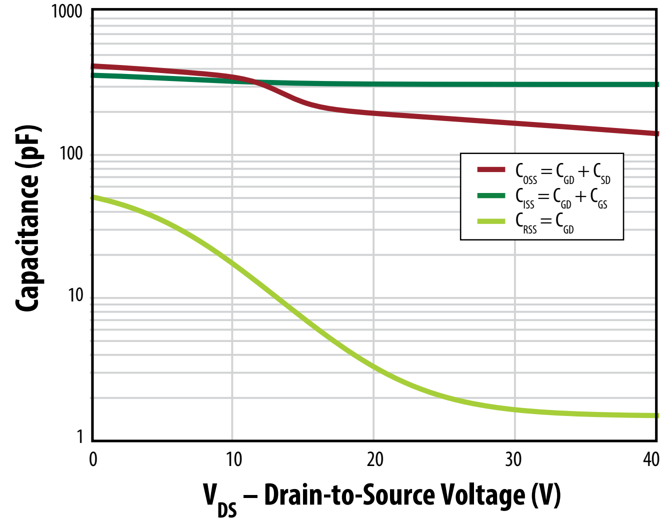


Figure 9. Typical Capacitance (Log Scale)

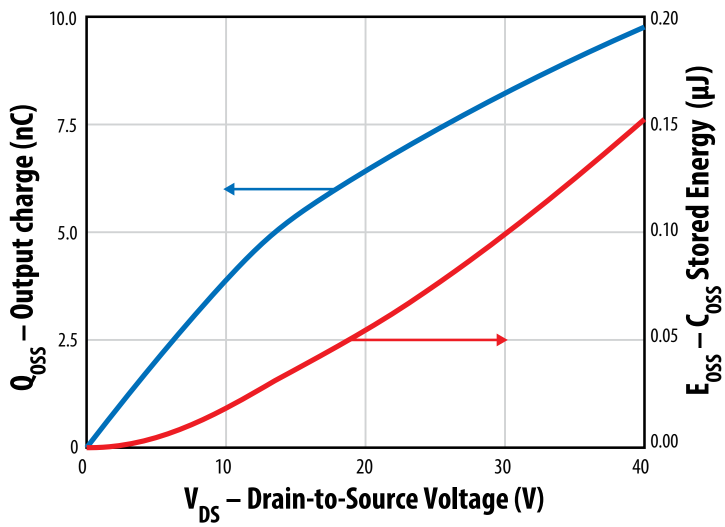


Figure 10. Typical Output Charge and C_{OSS} Stored Energy

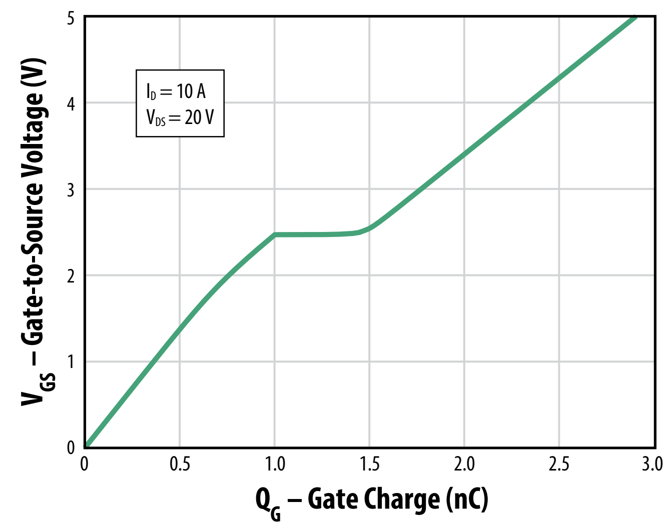


Figure 11. Typical Gate Charge

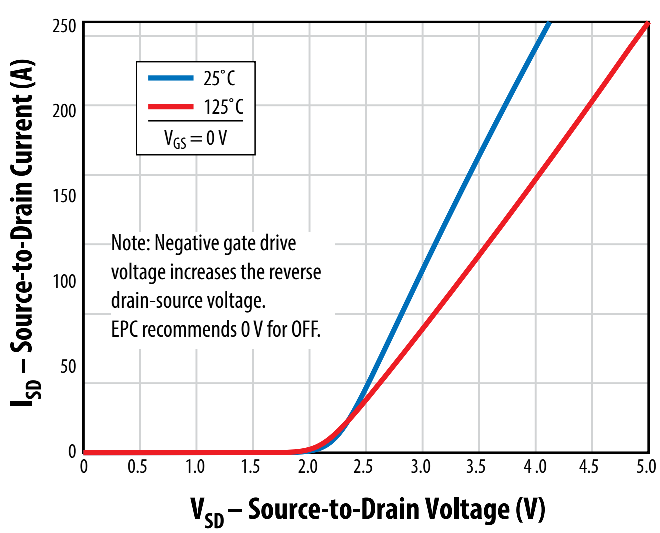


Figure 12. Reverse Drain-Source Characteristics

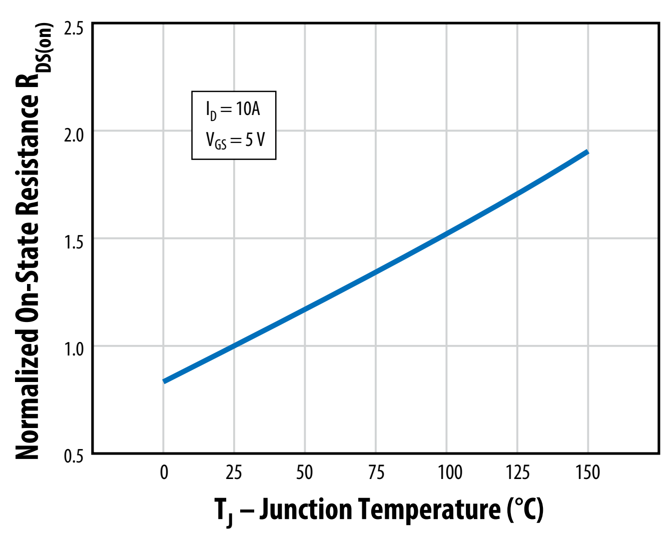


Figure 13. Normalized On-State Resistance vs. Temperature

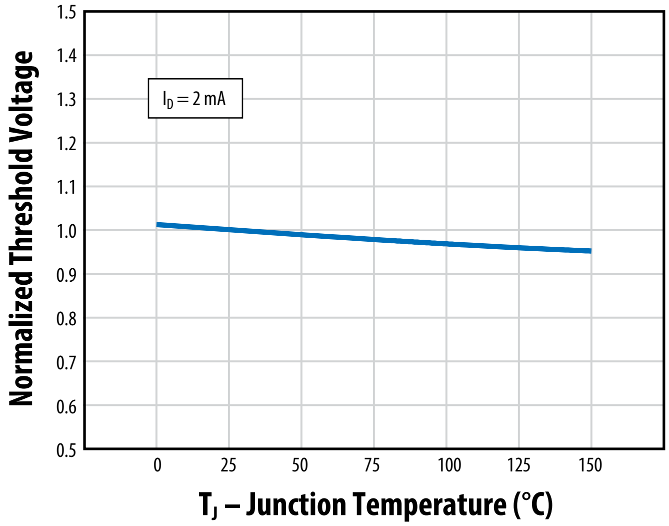
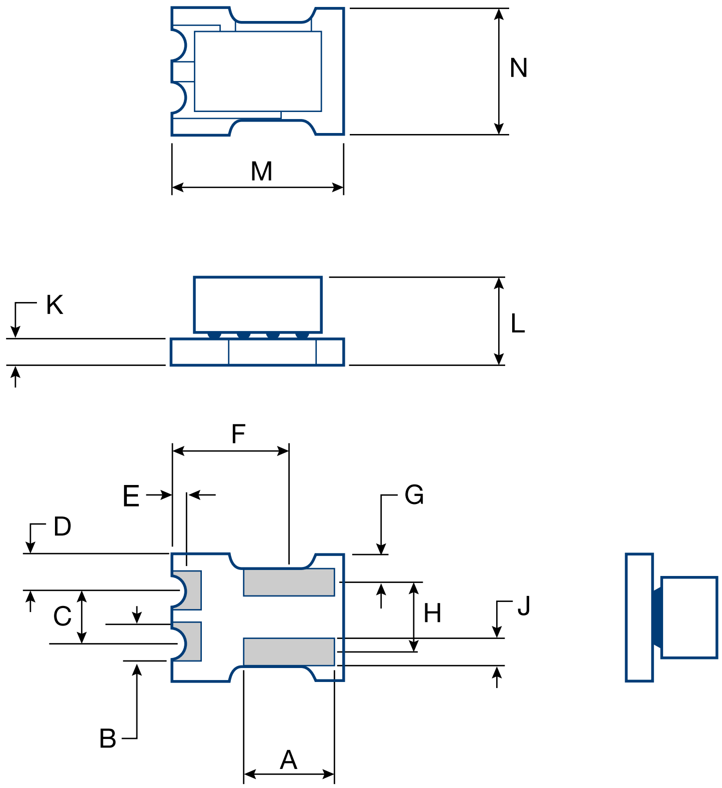


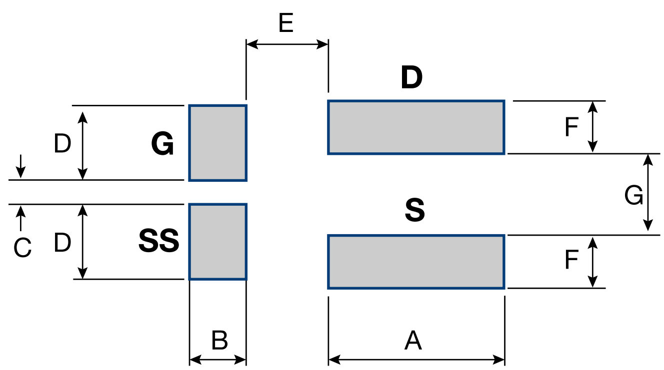
Figure 14. Normalized Threshold Voltagevs. Temperature

Package Outline and Dimensions



Symbol	Inches	Millimeters	Note
A	0.047	1.193	
B	0.020	0.508	
C	0.028	0.711	
D	0.020	0.508	
E	0.008	0.203	
F	0.063	1.600	
G	0.016	0.406	
H	0.036	0.914	
J	0.015	0.381	
K	0.015	0.381	
L	0.047	1.194	Ref.only
M	0.091	2.311	
N	0.067	1.702	

CDA2 Footprint for Printed Circuit Board Design



Symbol	Inches	Millimeters	Note
A	0.051	1.295	
B	0.019	0.483	
C	0.008	0.203	
D	0.020	0.508	
E	0.032	0.813	
F	0.020	0.508	
G	0.024	0.610	
H	0.037	0.940	

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 CDA1 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 using the circuit shown in Figure 14. Qs and associated components BT1, P1 and C1 form a high speed current source that serves as the test load for the DUT. A constant gate current (I_{const}) of 1.5-3 mA 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 GS. The gate current is adjusted to yield the desired charge per unit time (I_{const} · time per division) on the measuring oscilloscope. The GS 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}.

Ordering Information Availability

Part Number	Screening Level	Radiation Level	Shipping
EPC7002CDAC	Engineering Samples	SEE not Guaranteed	Waffle Trays Tape and Reel
EPC7002CDASH	Space Level	1 Mrad and LET = 83.7	
2N7682	K Level		

Data Package Order Detail
Consistent to MIL-PRF-19500 general specification

SPACE Screen

1. EPC7002CDASH – OPTIONAL DATA PACKAGE

A. Certificate of Compliance

B. Serialization Records

C. Preconditioning – Attributes Data Sheet (Lot Sample)

– HTGB - Hi Temp Gate Stress Post Reverse Bias Data

– HTRB - Hi Temp Drain Stress Post Reverse Bias Data

D. Group A – Attributes Data Sheet

E. Group B – Selected Mechanical Stress Test

F. Group D – Attributes Data Sheet

Disclaimers

ALL PRODUCT, PRODUCT SPECIFICATIONS AND DATA ARE SUBJECT TO CHANGE WITHOUT NOTICE TO IMPROVE RELIABILITY, FUNCTION OR DESIGN OR OTHERWISE. EPC Space Corporation, its affiliates, agents, employees, and all persons acting on its or their behalf (collectively, "EPC Space"), disclaim any and all liability for any errors, inaccuracies or incompleteness contained in any datasheet or in any other disclosure relating to any product. EPC Space makes no warranty, representation or guarantee regarding the suitability of the products for any particular purpose. To the maximum extent permitted by applicable law, EPC Space disclaims (i) any and all liability arising out of the application or use of any product, (ii) any and all liability, including without limitation special, consequential or incidental damages, and (iii) any and all implied warranties, including warranties of fitness for particular purpose, non-infringement and merchantability. Statements regarding the suitability of products for certain types of applications are based on EPC Space market knowledge of typical requirements that are often placed on similar technologies in generic applications. Product specifications do not expand or otherwise modify EPC Space terms and conditions of purchase, including but not limited to the warranty expressed therein. Except as expressly indicated in writing, EPC Space products are not designed for use in medical, life-saving, or life-sustaining applications or for any other application in which the failure of the EPC Space product could result in personal injury or death. Customers using EPC Space products not expressly indicated for use in such applications do so at their own risk. Please contact authorized EPC Space personnel to obtain written terms and conditions regarding products designed for such applications. No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document or by any conduct of EPC Space. Product names and markings noted herein may be trademarks of their respective owners.

Export Administration Regulations (EAR)

The products described in this datasheet are subject to the U.S. Export Administration Regulations (EAR), 15 C.F.R. Pts 730-774, and are classified in ECCN 9A515.e. These products may not be exported, reexported, or transferred (in country) to any foreign country, or foreign entity, by any means, except in accordance with the requirements of such regulations.

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.

eGaN® is a registered trademark of Efficient Power Conversion Corporation, Inc. Data and specification subject to change without notice.

Revisions

Datasheet Revision	Product Status
REV P#	Proposal/development
REV Q#	Characterization and Qualification
M-701-001-D	Production Released

Information subject to change without notice.
Revised January, 2024