

## 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 Dose
  - Rated to 300 krad
- Single Event
  - SEE immunity for LET of 83.7 MeV/mg/cm<sup>2</sup> 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  $1 \times 10^{13}$  Neutrons/cm<sup>2</sup>

## Application

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

## 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	9.8	

## CDA10N05X2

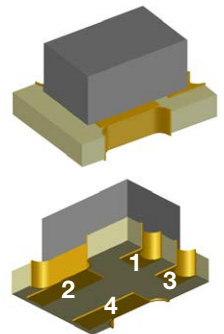
**Rad Hard e-GaN® 100 V, 5 A, 30 mΩ Die Adaptor Product (CDA2)**

## 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.

## 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 ( $T_C = 25^\circ\text{C}$ unless otherwise noted)

Symbol	Parameter-Conditions	Value	Units
$V_{DS}$	Drain to Source Voltage (Note 1)	100	V
$I_D$	Continuous Drain Current $I_D$ @ $V_{GS} = 5\text{ V}$ , $T_C = 25^\circ\text{C}$ , $R_{\theta JA} < 62^\circ\text{C/W}$	5	A
$I_{DM}$	Single-Pulse Drain Current $t_{pulse} \leq 80\ \mu\text{s}$	20	
$V_{GS}$	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** ( $T_C = 25^\circ\text{C}$  unless otherwise noted. Typical (TYP) values are for reference only.)

Parameter	Symbol	Test Conditions		MIN	TYP	MAX	Units
Maximum Drain to Source Voltage	$V_{DSMAX}$	$V_G = 0\text{ V}$		-	-	100	V
Drain to Source Leakage	$I_{DSS}$	$V_{DS} = 100\text{ V}$ $V_{GS} = 0\text{ V}$	$T_C = 25^\circ\text{C}$	-	10	60	$\mu\text{A}$
			$T_C = 125^\circ\text{C}$	-	100	150	
Gate to Source Forward Leakage	$I_{GSS}$	$V_{GS} = 5\text{ V}$	$T_C = 25^\circ\text{C}$	-	0.25	2	mA
Gate to Source Reverse Leakage	$I_{GSS}$	$V_{GS} = -4\text{ V}$	$T_C = 25^\circ\text{C}$	-60	-20		$\mu\text{A}$
Gate to Source Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}$ , $I_D = 1.2\text{ mA}$	$T_C = 25^\circ\text{C}$	0.8	1.2	2.5	V
Gate to Source Threshold Voltage Temperature Coefficient	$\Delta V_{GS(th)}/\Delta T$	$V_{DS} = V_{GS}$ , $I_D = 1.2\text{ mA}$	$-55^\circ\text{C} < T_A < 25^\circ\text{C}$	-	3.8	-	mV/°C
Drain to Source Resistance (Note 4)	$R_{DS(on)}$	$I_D = 5\text{ A}$ , $V_{GS} = 5\text{ V}$	$T_C = 25^\circ\text{C}$	-	26	30	m $\Omega$
Source to Drain Forward Voltage (Note 5)	$V_{SD}$	$I_S = 1\text{ A}$ , $V_G = 0\text{ V}$	$T_C = 25^\circ\text{C}$		2.5		V

**Dynamic Characteristics** ( $T_C = 25^\circ\text{C}$  unless otherwise noted. Typical (TYP) values are for reference only.)

Parameter	Symbol	Test Conditions	MIN	TYP	MAX	Units
Input Capacitance	$C_{ISS}$	$f = 1\text{ MHz}$ , $V_{DS} = 50\text{ V}$ , $V_{GS} = 0\text{ V}$ (Note 6)		207	233	pF
Output Capacitance	$C_{OSS}$			133	170	
Reverse Transfer Capacitance	$C_{RSS}$			19	23	
Gate Resistance	$R_G$	$f = 1\text{ MHz}$ , $V_{DS} = V_{GS} = 0\text{ V}$		0.4		$\Omega$
Total Gate Charge (Note 7)	$Q_G$	$I_D = 5\text{ A}$ , $V_{GS} = 5\text{ V}$ , $V_{DS} = 50\text{ V}$		1.7	2.2	nC
Gate to Drain Charge (Note 7)	$Q_{GD}$	$I_D = 5\text{ A}$ , $V_{GS} = 5\text{ V}$ , $V_{DS} = 50\text{ V}$		0.2	0.6	
Gate to Source Charge (Note 7)	$Q_{GS}$	$I_D = 5\text{ A}$ , $V_{GS} = 5\text{ V}$ , $V_{DS} = 50\text{ V}$		0.5	1.0	
Output Charge (Note 8)	$Q_{OSS}$	$V_{GS} = 0\text{ V}$ , $V_{DS} = 50\text{ V}$		9.1	-	
Source to Drain Recovery Charge	$Q_{RR}$	$I_D = 5\text{ A}$ , $V_{DS} = 50\text{ V}$		<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 (i)  $V_{GS} = 5\text{ V}$ , (ii)  $V_{DS} = V_{GS} = 0\text{ V}$  and (iii)  $V_{DS} = 80\% B_{VDSS}$ .

**Electrical Characteristics up to 300 krad** ( $T_C = 25^\circ\text{C}$  unless otherwise noted. Typical (TYP) values are for reference only.)

Parameter	Symbol	Test Conditions	MIN	TYP	MAX	Units
Maximum Drain to Source Voltage	$V_{DSMAX}$	$V_{GS} = 0\text{ V}$	-	-	100	V
Gate to Source Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}$ , $I_D = 1.2\text{ mA}$	0.8	1.2	2.5	V
Drain to Source Leakage	$I_{DSS}$	$V_{DS} = 100\text{ V}$ , $V_{GS} = 0\text{ V}$	-	10	60	$\mu\text{A}$
Gate to Source Forward Leakage	$I_{GSS}$	$V_{GS} = 5\text{ V}$	-	0.25	2	$\text{mA}$
Gate to Source Reverse Leakage	$I_{GSS}$	$V_{GS} = -4\text{ V}$	-	-20	-60	$\mu\text{A}$
Drain to Source Resistance (Note 4)	$R_{DS(on)}$	$I_D = 5\text{ A}$ , $V_{GS} = 5\text{ V}$	-	-	30	$\text{m}\Omega$

## 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 $\text{MeV/mg/cm}^2$	Range $\mu\text{m}$	Energy $\text{MeV}$	$V_{GS} = 0\text{ V}$	$V_{GS} = -4\text{ V}$
See SOA	Xe	50	131	1653	100	100
	Au	83.7	130	2482	100	100

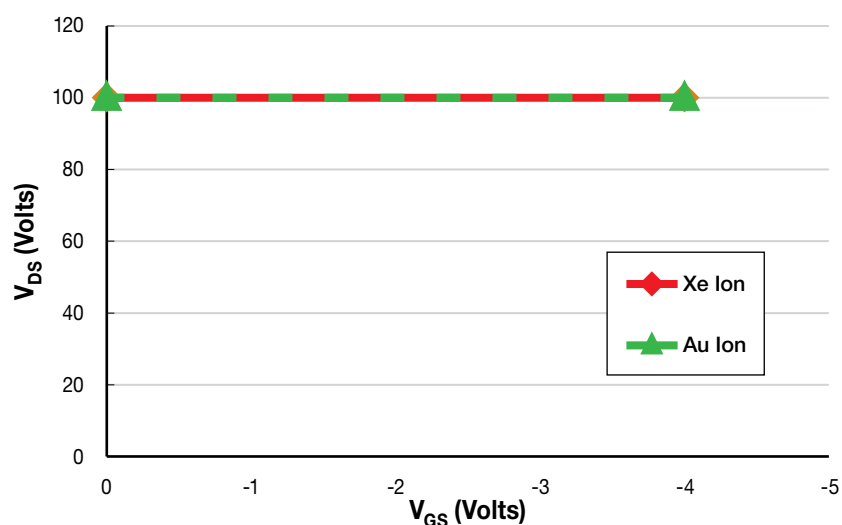


Figure 1. Typical Single Event Effect Safe Operating Area

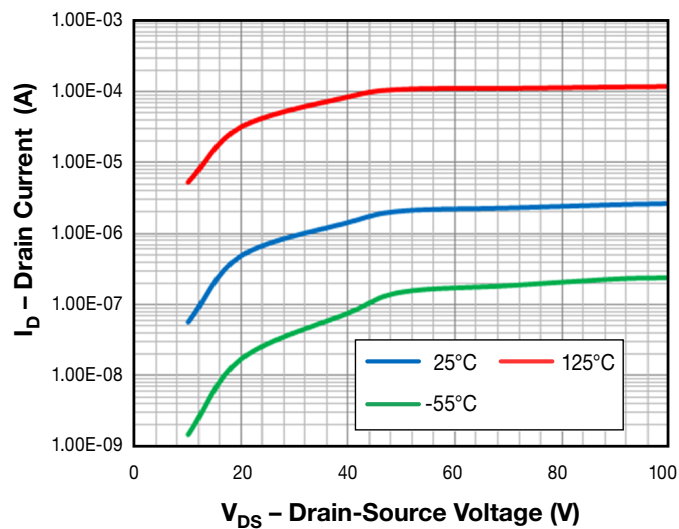


Figure 2. Typical Drain-Source Leakage Current vs. Ambient Temperature

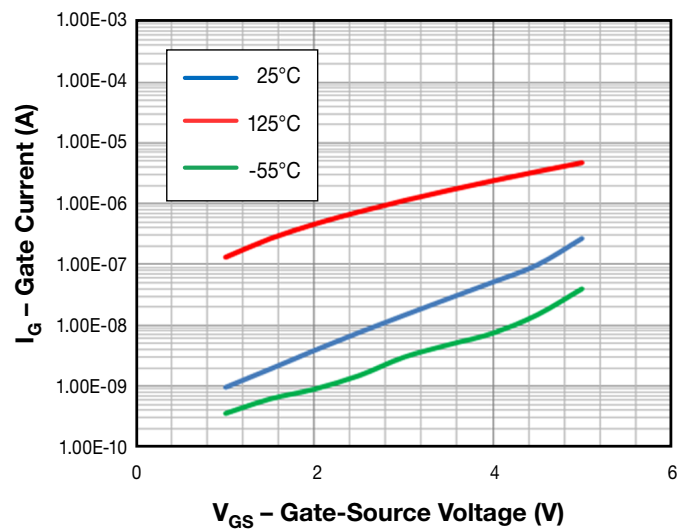


Figure 3. Gate-Source Leakage Current vs. Ambient Temperature

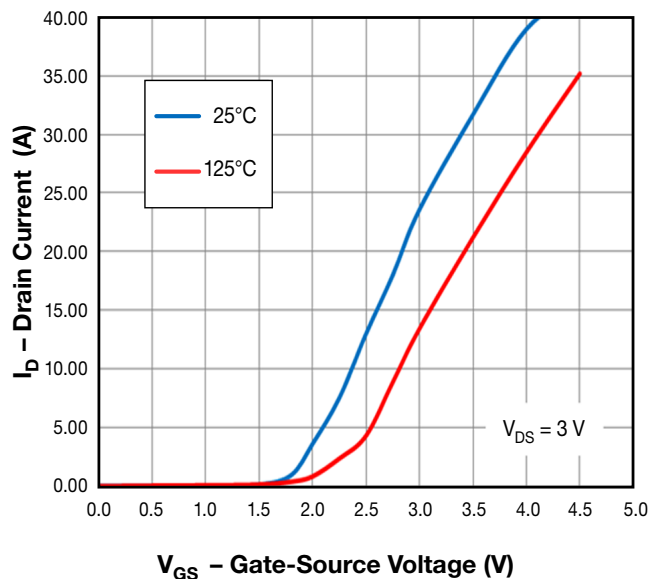


Figure 4. Typical Gate-Drain Transfer Characteristic ( $V_{DS} = 3$  V)

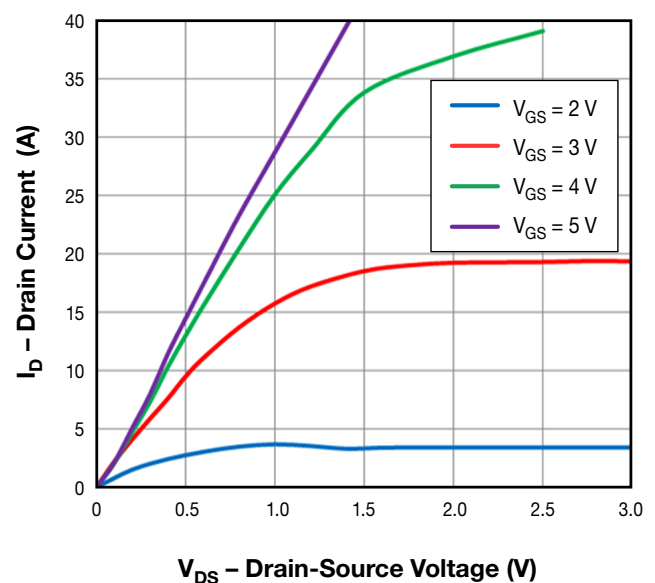


Figure 5. Typical Output Characteristics

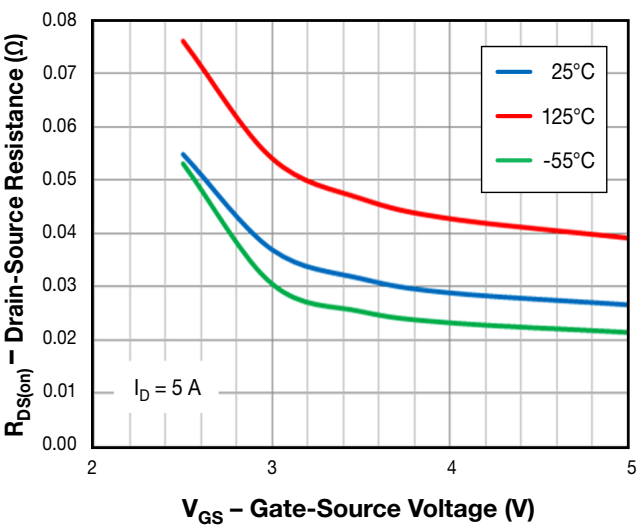


Figure 6. Typical Drain-Source ON Resistance vs. Gate-Source Voltage vs. Ambient Temperature

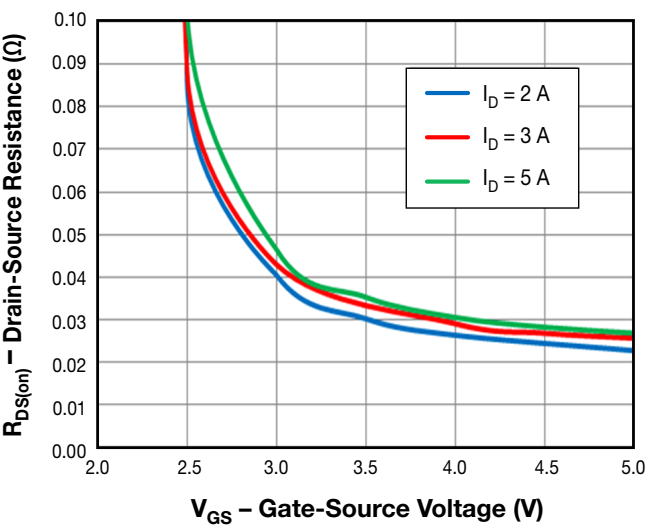


Figure 7. Typical Drain-Source ON Resistance vs. Gate-Source Voltage vs. Drain Current

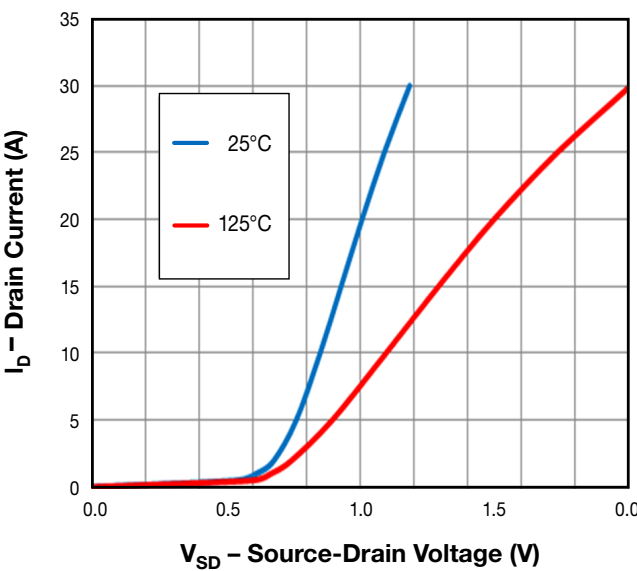


Figure 8. Typical Source-Drain Voltage vs. Temperature

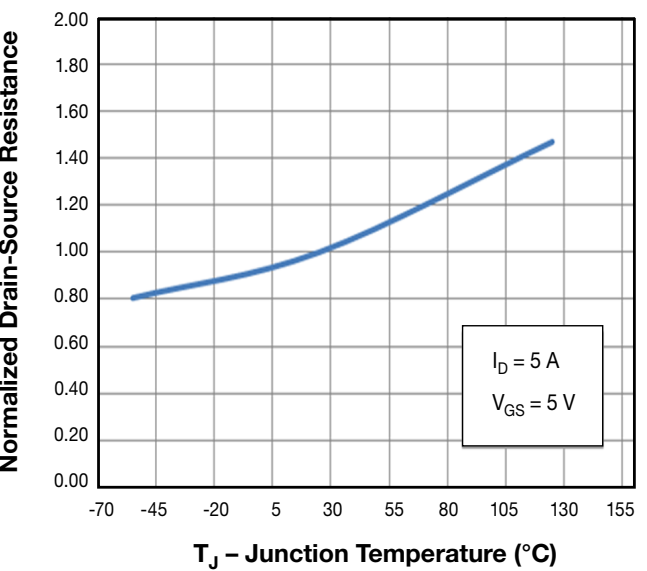


Figure 9. Normalized Drain-Source ON Resistance vs. Ambient Temperature

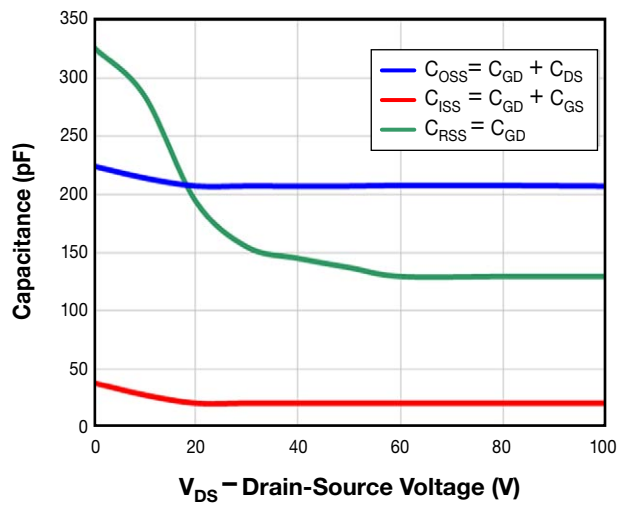


Figure 10. Typical Inter-Electrode Capacitance vs. Drain-Source Voltage

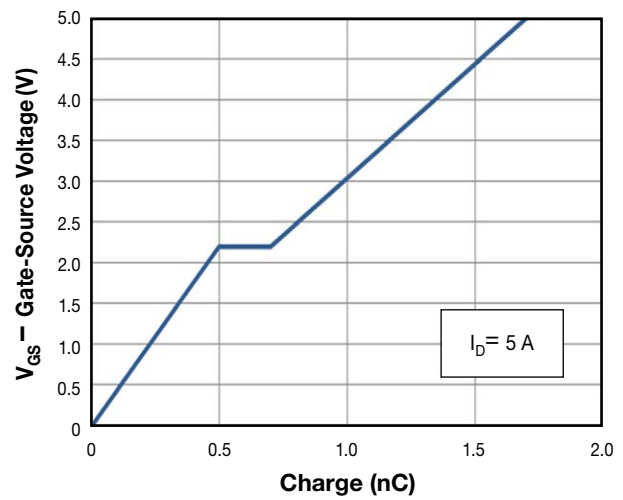


Figure 11. Typical Gate Charge vs. Drain Current

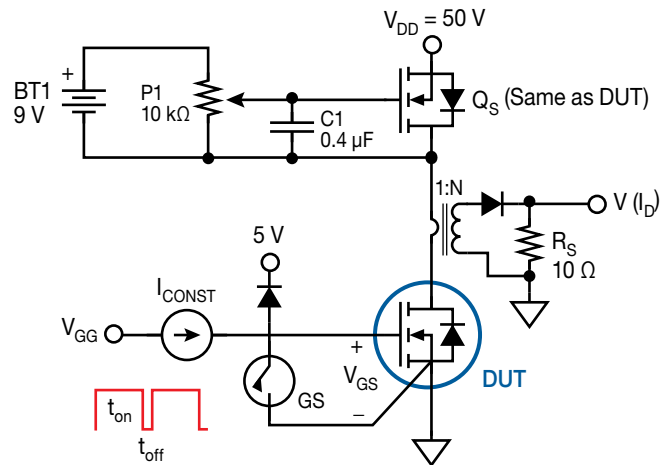


Figure 12. Charge Test Circuit

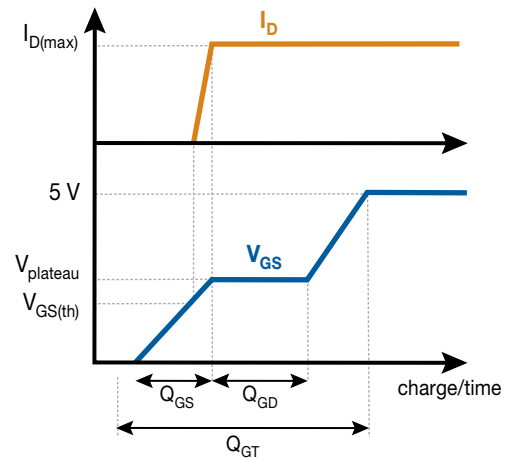
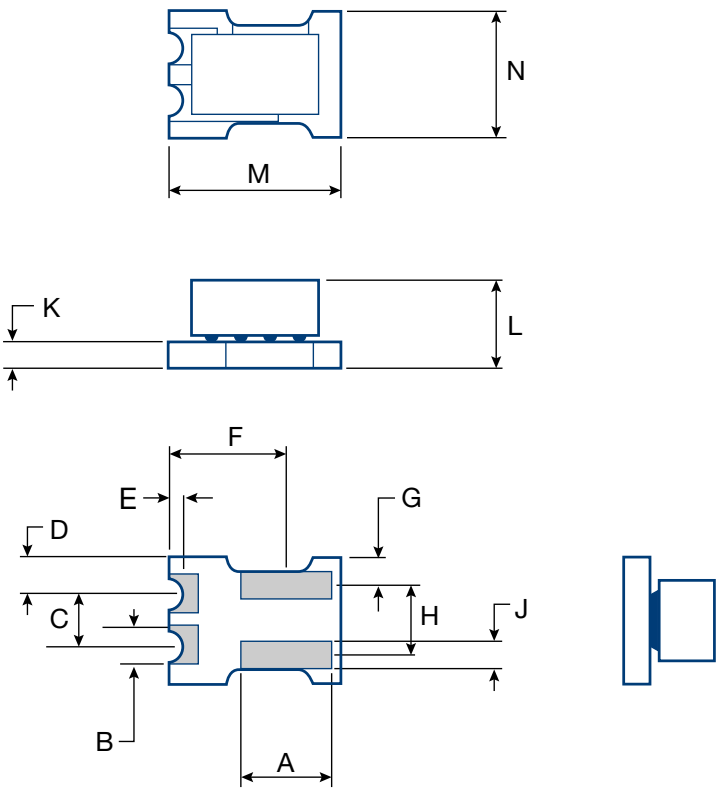


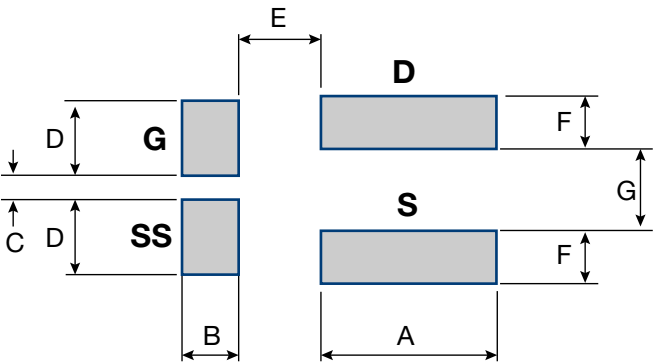
Figure 13. Typical Gate Charge Test Waveform

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



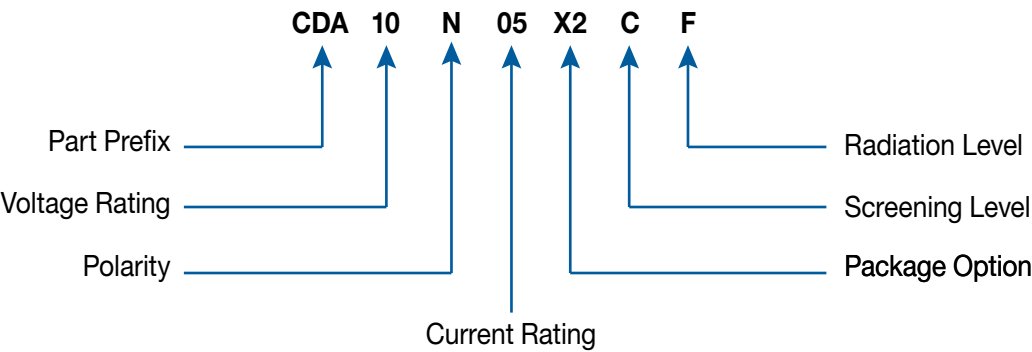
Symbol	Inches	Millimeters	Note
A	0.052	1.32	
B	0.012	0.305	
C	0.008	0.203	
D	0.028	0.711	
E	0.024	0.61	
F	0.020	0.508	
G	0.024	0.61	

## 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 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  $\mu s$  and duty cycle is 1%, maximum.
- Note 5. With pulse measurement width 100–380  $\mu s$ .
- Note 6.  $C_{ISS} = C_{GS} + C_{GD}$  with  $C_{DS}$  shorted.  $C_{OSS} = C_{DS} + C_{GD}$ .  $C_{RSS} = C_{GD}$ .
- Note 7. 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 ( $I_{const} \cdot \text{time per division}$ ) 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  $V_{DC}$ .
- Note 8. 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 V = Lite Screened	R = 100 krad, LET = 64 F = 300 krad, LET = 64 G = 500 krad, LET = 64 H = 1000 krad, LET = 64 Z = 1000 krad, LET = 84

Part Number	Screening Level	Shipping
CDA10N05X2*C	Engineering Samples	Waffle Trays
CDA10N05X2*S	Space Level	

<sup>1</sup> Screening and qualification consistent to an equivalent MIL-PRF-19500 specification (KC).

C version CDA units are intended for engineering development purposes only and NOT supplied with radiation performance guarantees nor supplemental data packages

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

**SPACE Screen**

**1. CDA10N05X2\*S – 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

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