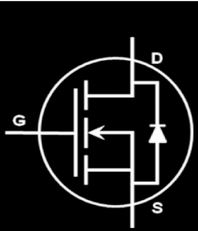
EPC8009 – Enhancement Mode Power Transistor

V_{DS} , 65 V
$R_{DS(ON)}$, 130 mΩ
I_D , 2.7 A

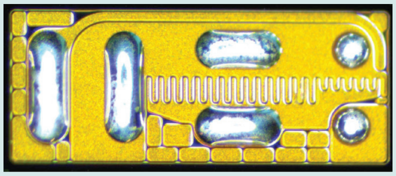
New Product



EFFICIENT POWER CONVERSION

RoHS Halogen-Free

Gallium Nitride is grown on Silicon Wafers and processed using standard CMOS equipment leveraging the infrastructure that has been developed over the last 55 years. GaN's exceptionally high electron mobility and low temperature coefficient allows very low $R_{DS(ON)}$, while its lateral device structure and majority carrier diode provide exceptionally low Q_G and zero Q_{RR}. The end result is a device that can handle tasks where very high switching frequency, and low on-time are beneficial as well as those where on-state losses dominate.



EPC8009 eGaN FETs are supplied only in passivated die form with solder bars

Applications

- Ultra High Speed DC-DC Conversion
- RF Envelope Tracking
- Wireless Power Transfer
- Game Console and Industrial Movement Sensing (LiDAR)

Benefits

- Ultra High Efficiency
- Ultra Low $R_{DS(on)}$
- Ultra Low Q_G
- Ultra Small Footprint

Maximum Ratings			
V_{DS}	Drain-to-Source Voltage (Continuous)	65	V
	Drain-to-Source Voltage (up to 10,000 5 ms pulses at 125° C)	78	
I_D	Continuous (T_A = 25˚C, θ_{JA} = 73)	2.7	A
	Pulsed (25˚C, T_{Pulse} = 300 µs)	7.5	
V_{GS}	Gate-to-Source Voltage	6	V
	Gate-to-Source Voltage	-4	
T_J	Operating Temperature	-40 to 150	˚C
T_{STG}	Storage Temperature	-40 to 150	

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
Static Characteristics (T_J= 25˚C unless otherwise stated)						
BV_{DSS}	Drain-to-Source Voltage	V_{GS} = 0 V, I_D = 125 µA	65			V
I_{DSS}	Drain Source Leakage	V_{GS} = 0 V, V_{DS} = 52 V, T = 25˚C		50	100	µA
I_{GSS}	Gate-Source Forward Leakage	V_{GS} = 5 V		100	500	µA
	Gate-Source Reverse Leakage	V_{GS} = -4 V		50	100	
$V_{GS(TH)}$	Gate Threshold Voltage	V_{GS} = V_{DS}, I_D = 0.25 mA	0.8	1.4	2.5	V
$R_{DS(ON)}$	Drain-Source On Resistance	V_{GS} = 5 V, I_D = 0.5 A		90	130	mΩ
V_{SD}	Source-Drain Forward Voltage	I_S = 0.5 A, V_{GS} = 0 V		2.2		V

Specifications are with substrate shorted to source where applicable.

Thermal Characteristics			
		TYP	**UNIT**
$R_{\theta JC}$	Thermal Resistance, Junction to Case	8.2	˚C/W
$R_{\theta JB}$	Thermal Resistance, Junction to Board	16	˚C/W
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient (Note 1)	82	˚C/W

Note 1: $R_{\theta JA}$ is determined with the device mounted on one square inch of copper pad, single layer 2 oz copper on FR4 board.
See http://epc-co.com/epc/documents/product-training/Appnote_Thermal_Performance_of_eGaN_FETs.pdf for details.

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
Dynamic Characteristics (T_J= 25˚C unless otherwise stated)						
C_{ISS}	Input Capacitance	V_{GS} = 0 V, V_{DS} = 32.5 V		45	52	pF
C_{OSS}	Output Capacitance			19	28	
C_{RSS}	Reverse Transfer Capacitance			0.5	0.8	
R_G	Gate Resistance			0.3		Ω
Q_G	Total Gate Charge	V_{DS} = 32.5 V, I_D = 1 A		370	450	pC
Q_{GS}	Gate to Source Charge			120		
Q_{GD}	Gate to Drain Charge			55	94	
$Q_{G(TH)}$	Gate Charge at Threshold			96		
Q_{OSS}	Output Charge	V_{GS} = 0 V, V_{DS}= 32.5 V		940	1400	
Q_{RR}	Source-Drain Recovery Charge			0		

Specifications are with substrate shorted to source where applicable.

Figure 1: Typical Output Characteristics at 25°C

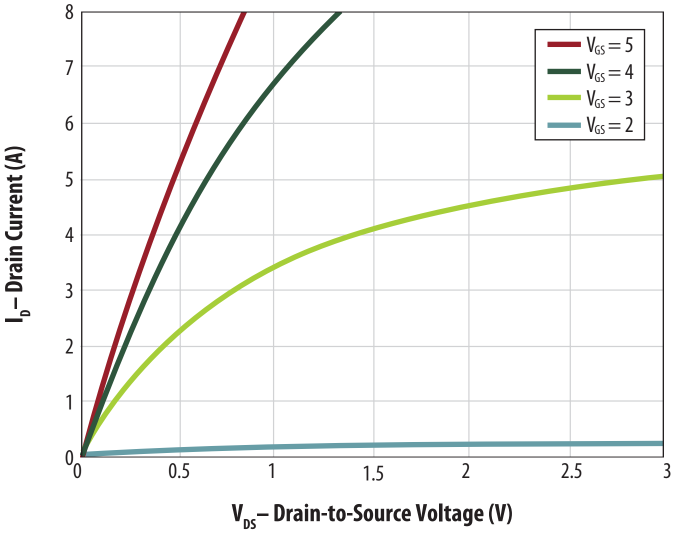


Figure 2: Transfer Characteristics

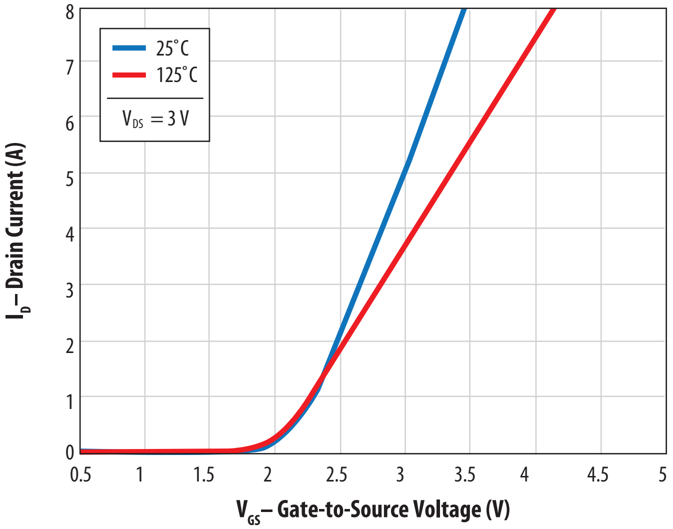


Figure 3: $R_{DS(ON)}$ vs V_{GS} for Various Drain Currents

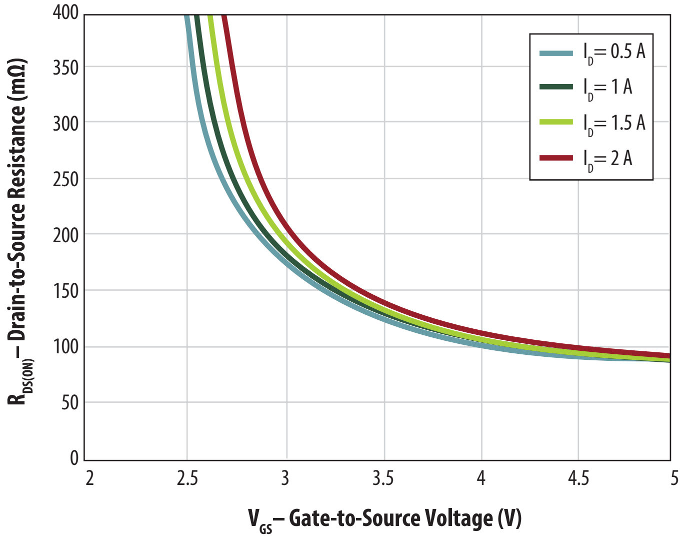


Figure 4: $R_{DS(ON)}$ vs V_{GS} for Various Temperatures

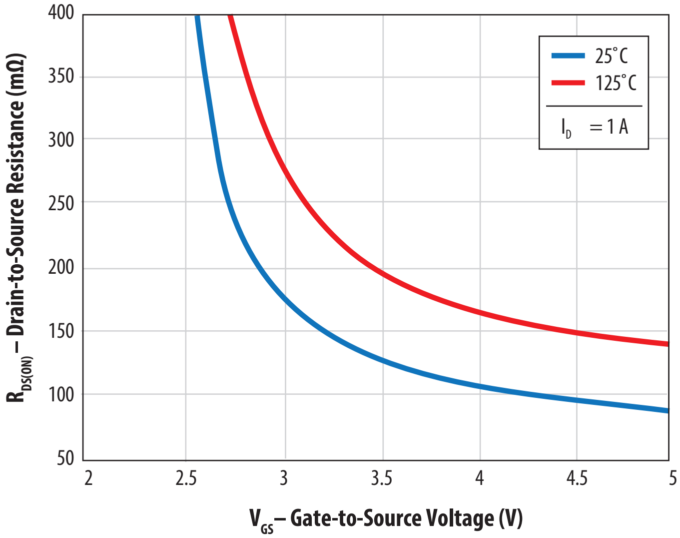


Figure 5: Capacitance (Linear Scale)

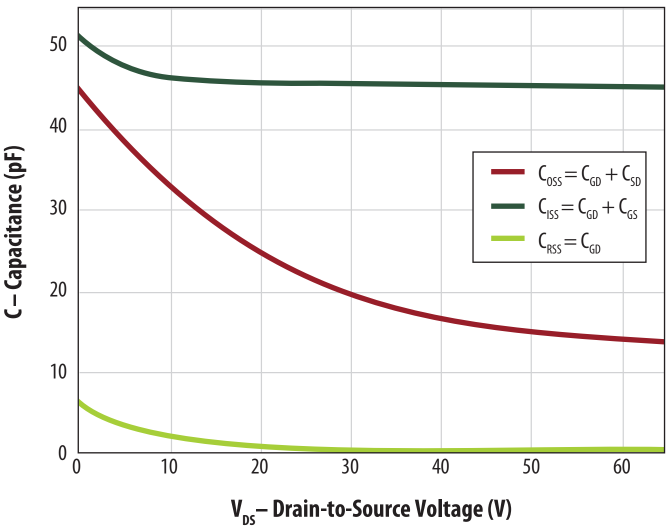


Figure 5A: Capacitance (Log Scale)

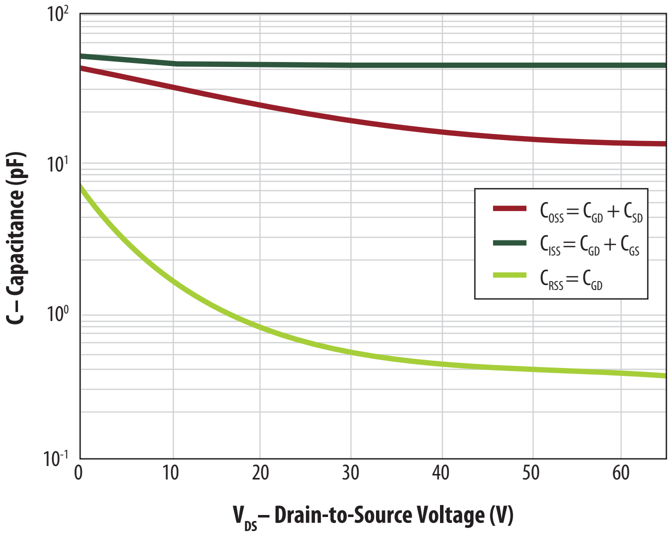


Figure 6: Gate Charge

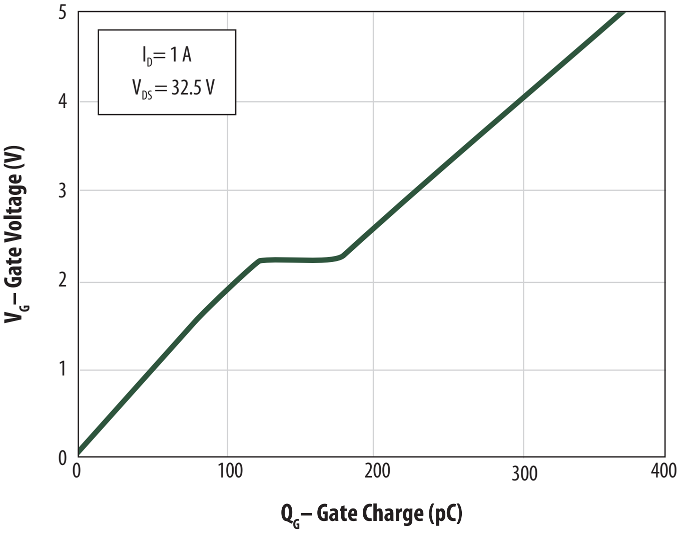


Figure 7: Reverse Drain-Source Characteristics

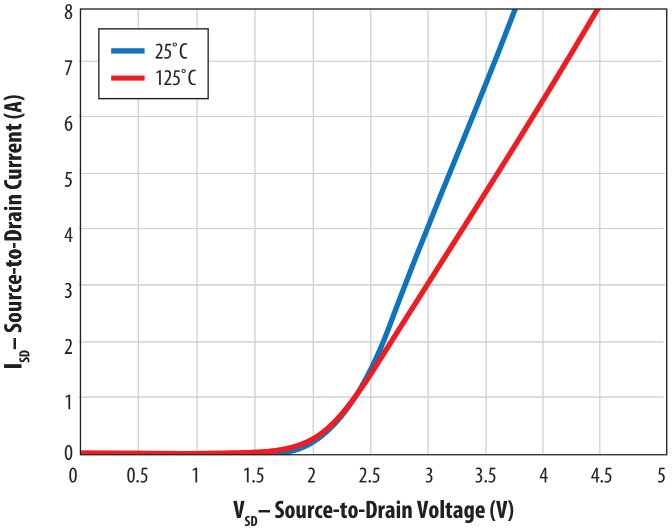


Figure 8: Normalized $R_{DS(ON)}$

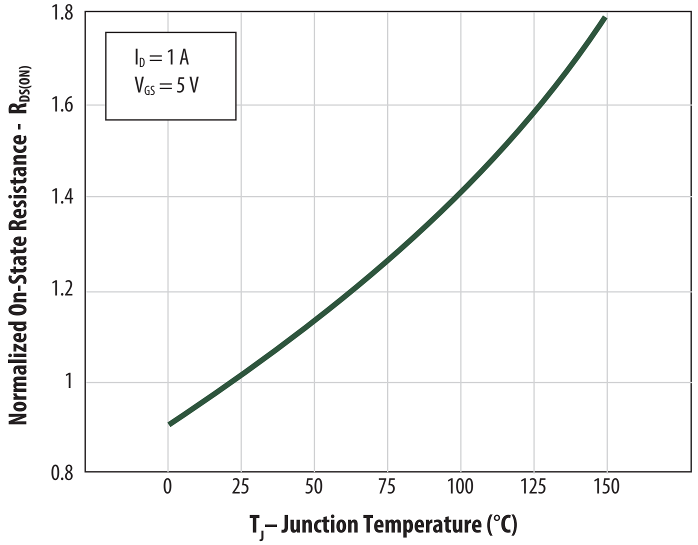


Figure 9: Normalized Threshold Voltage vs Temperature

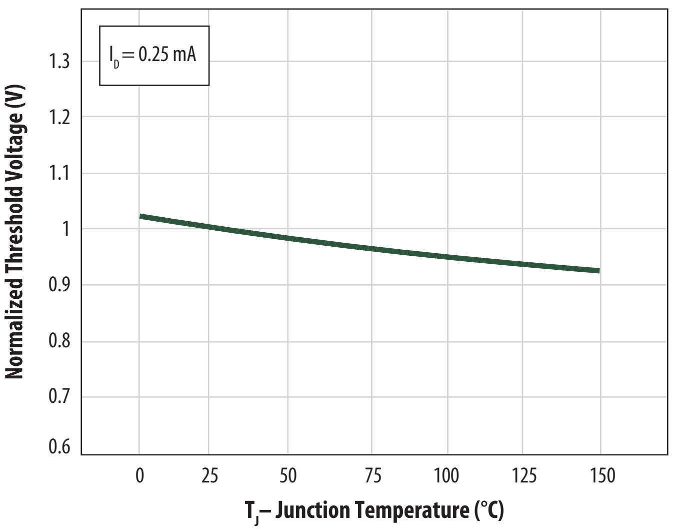
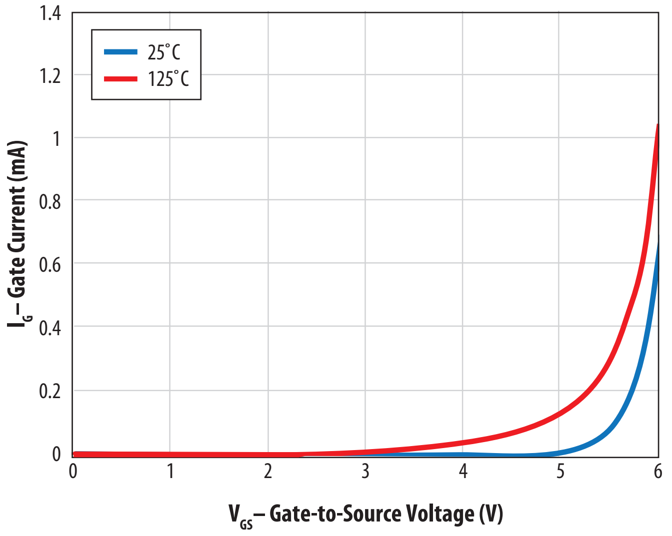


Figure 10: Gate Current



All measurements were done with substrate shortened to source.

Figure 11: Smith Chart

S-Parameter Characteristics
V_{GSQ} = 2.36 V, V_{DSQ} = 30 V, I_{DQ} = 0.50 A
Pulsed Measurement, Heat-Sink Installed, Z_0 = 50 Ω

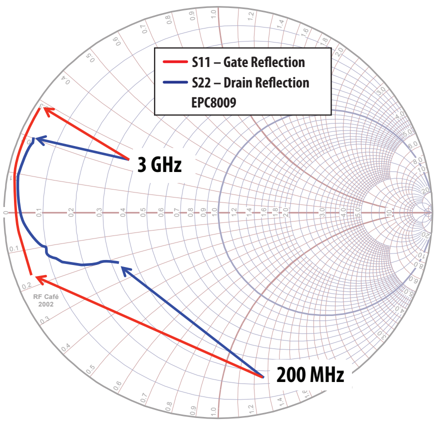


Figure 12: Gain Chart

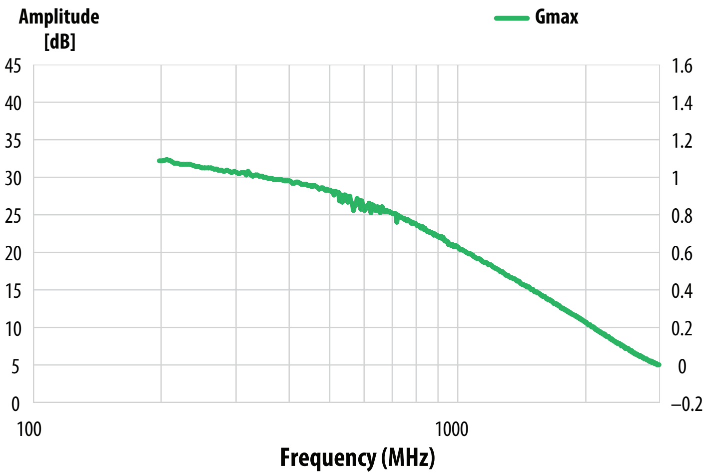
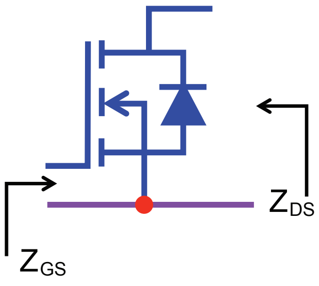


Figure 13: Device Reflection



Frequency [MHz]	Gate (Z_{GS}) [Ω]	Drain (Z_{DS}) [Ω]
200	1.98 – j8.58	16.83 – j11.29
500	1.87 – j2.15	10.69 – j9.69
1000	1.39 + j2.14	5.22 – j5.45
1200	1.21 + j3.56	3.53 – j3.42
1500	1.01 + j4.96	2.35 – j0.81
2000	0.83 + j7.83	1.57 + j3.52
2400	0.73 + j10.14	1.54 + j6.19
3000	0.58 + j14.27	1.84 + j10.20

S-Parameter Table - Download S-parameter files at ***www.epc-co.com***

Figure 14: Taper and Reference Plane details – Device Connection

Micro-Strip design: 2-layer
½ oz (17.5 µm) thick copper
30 mil thick RO4350 substrate

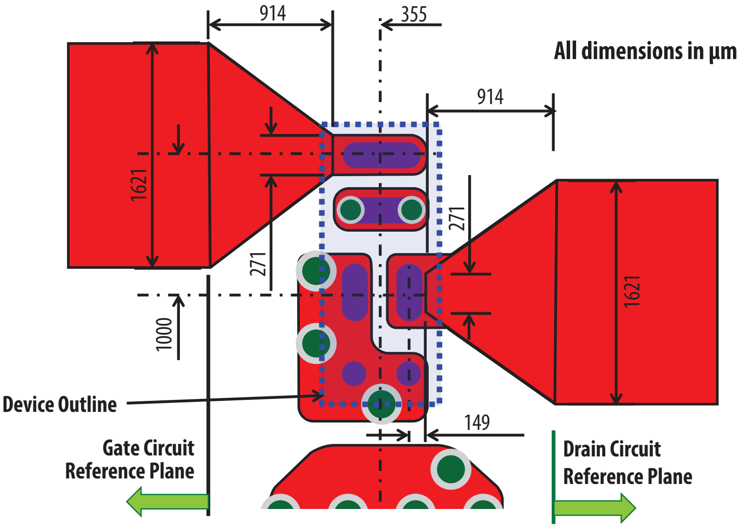
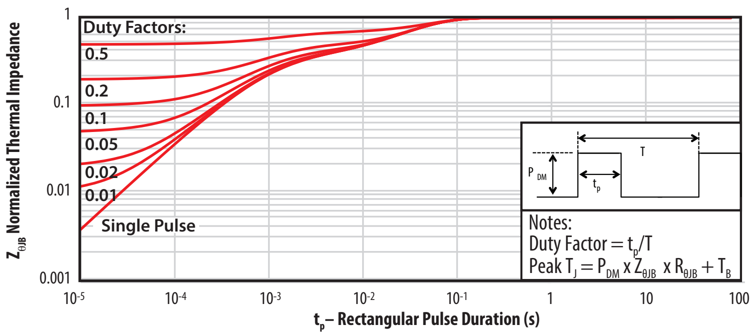


Figure 15: Transient Thermal Response Curves

Junction-to-Board



Junction-to-Case

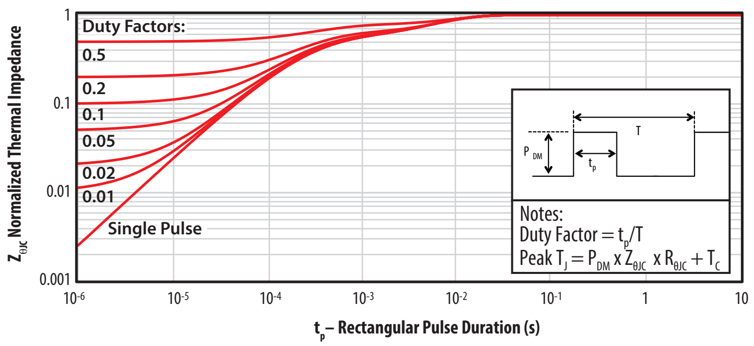
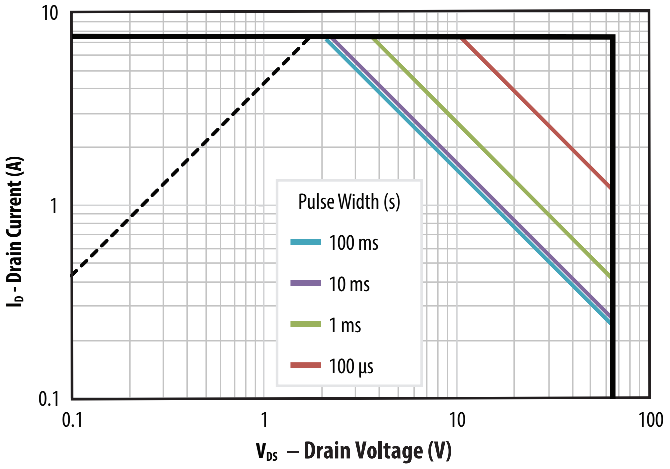
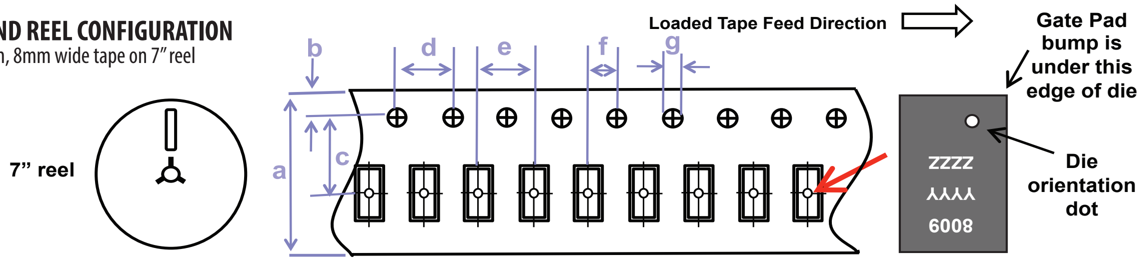


Figure 16: Safe Operating Area



TAPE AND REEL CONFIGURATION

4mm pitch, 8mm wide tape on 7” reel



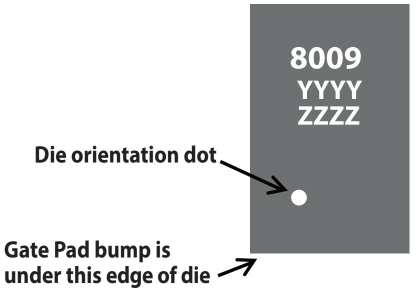
Die is placed into pocket bump side down (face side down)

	EPC8009 (Note 1)		
Dimension (mm)	target	min	max
a	8	7.9	8.3
b	1.75	1.65	1.85
c (see note 2)	3.5	3.45	3.55
d	4	3.9	4.1
e	4	3.9	4.1
f (see note 2)	2	1.95	2.05
g	1.5	1.5	1.6

Note 1: MSL1 (moisture sensitivity level 1) classified according to IPC/JEDEC industry standard.

Note 2: Pocket position is relative to the sprocket hole measured as true position of the pocket, not the pocket hole.

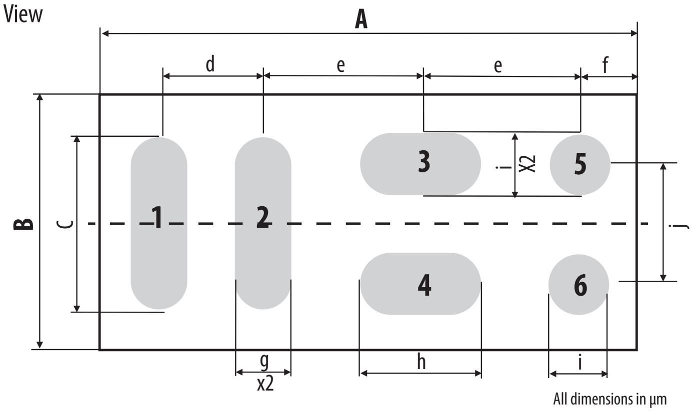
DIE MARKINGS



Part Number	Laser Markings		
	Part # Marking Line 1	Lot_Date Code Marking line 2	Lot_Date Code Marking Line 3
EPC8009	8009	YYYY	ZZZZ

DIE OUTLINE

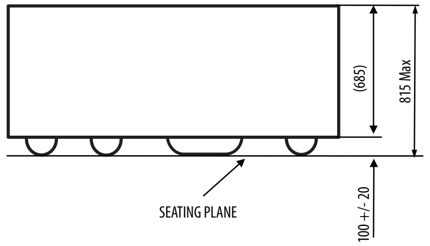
Solder Bar View



Dim	Micrometers		
	Min	Nominal	Max
A	2020	2050	2080
B	820	850	880
C	555	580	605
D	400	400	400
E	600	600	600
F	200	225	250
G	175	200	225
H	425	450	475
I	175	200	225
J	400	400	400

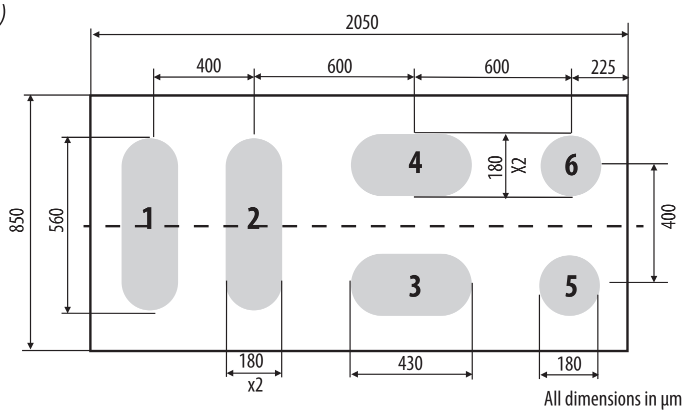
Pad no. 1 is Gate
Pad no. 2 is Source Return for Gate Driver
Pad no. 3 and 5 are Source
Pad no. 4 is Drain
Pad no. 6 is Substrate

Side View



RECOMMENDED LAND PATTERN

(units in µm)



Pad no. 1 is Gate
Pad no. 2 is Source Return for Gate Driver
Pad no. 3 and 5 are Source
Pad no. 4 is Drain
Pad no. 6 is Substrate

The land pattern is solder mask defined.
Solder mask opening is 10 µm smaller per side than bump.

Additional assembly resources available at:
http://epc-co.com/epc/DesignSupport/AssemblyBasics.aspx

U.S. Patents 8,350,294; 8,404,508; 8,431,960; 8,436,398; 8,785,974; 8,890,168; 8,969,918; 8,853,749; 8,823,012

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