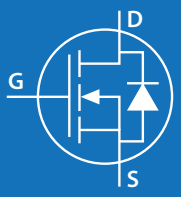
EPC8004 – Enhancement Mode Power Transistor

V_{DS}, 40 V
$R_{DS(on)}$, 110 mΩ
I_D, 4 A



EFFICIENT POWER CONVERSION

RoHS Halogen-Free

Revised July 7, 2023

Gallium Nitride'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.

Questions: Ask a GaN Expert

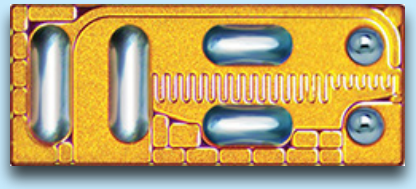
Maximum Ratings			
PARAMETER		**VALUE**	**UNIT**
V_{DS}	Drain-to-Source Voltage (Continuous)	40	V
	Drain-to-Source Voltage (up to 10,000 5 ms pulses at 125°C)	48	
I_D	Continuous (T_A = 25°C, $R_{\theta JA}$ = 39°C/W)	4	A
	Pulsed (25°C, T_{PULSE} = 300 µs)	7.5	
V_{GS}	Gate-to-Source Voltage	6	V
	Gate-to-Source Voltage	–4	
T_J	Operating Temperature	–40 to 150	°C
T_{STG}	Storage Temperature	–40 to 150	

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

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 https://epc-co.com/epc/documents/product-training/Appnote_Thermal_Performance_of_eGaN_FETs.pdf for details

Static Characteristics (T_J = 25°C unless otherwise stated)						
PARAMETER		**TEST CONDITIONS**	**MIN**	**TYP**	**MAX**	**UNIT**
BV_{DSS}	Drain-to-Source Voltage	V_{GS} = 0 V, I_D = 125 µA	40			V
I_{DSS}	Drain-Source Leakage	V_{GS} = 0 V, V_{DS} = 32 V		50	100	µA
I_{GSS}	Gate-to-Source Forward Leakage	V_{GS} = 5 V		100	500	µA
	Gate-to-Source Reverse Leakage	V_{GS} = -4 V		50	100	
$V_{GS(TH)}$	Gate Threshold Voltage	V_{DS} = V_{GS}, 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		80	110	mΩ
V_{SD}	Source-Drain Forward Voltage#	V_{GS} = 0 V, I_S = 0.5 A		2.2		V

Defined by design. Not subject to production test.
All measurements were done with substrate connected to source.
Specifications are with substrate connected to source where applicable.



Die size: 2.1 x 0.85 mm

EPC8004 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

Scan QR code or click link below for more information including reliability reports, device models, demo boards!

https://l.ead.me/EPC8004

Dynamic Characteristics# (T_J = 25°C unless otherwise stated)						
PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
C_{ISS}	Input Capacitance	V_{GS} = 0 V, V_{DS} = 20 V		45	52	pF
C_{OSS}	Output Capacitance			23	34	
C_{RSS}	Reverse Transfer Capacitance			0.8	1.3	
R_G	Gate Resistance			0.34		Ω
Q_G	Total Gate Charge	V_{GS} = 5 V, V_{DS} = 20 V, I_D = 1 A		370	450	pC
Q_{GS}	Gate-to-Source Charge			120		
Q_{GD}	Gate-to-Drain Charge			47	80	
$Q_{G(TH)}$	Gate Charge at Threshold			95		
Q_{OSS}	Output Charge	V_{GS} = 0 V, V_{DS} = 20 V		630	940	
Q_{RR}	Source-Drain Recovery Charge			0		

Defined by design. Not subject to production test.
All measurements were done with substrate connected to source.
Note 2: $C_{OSS(ER)}$ is a fixed capacitance that gives the same stored energy as C_{OSS} while V_{DS} is rising from 0 to 50% BV_{DSS}.
Note 3: $C_{OSS(TR)}$ is a fixed capacitance that gives the same charging time as C_{OSS} while V_{DS} is rising from 0 to 50% BV_{DSS}.

Figure 1: Typical Output Characteristics at 25°C

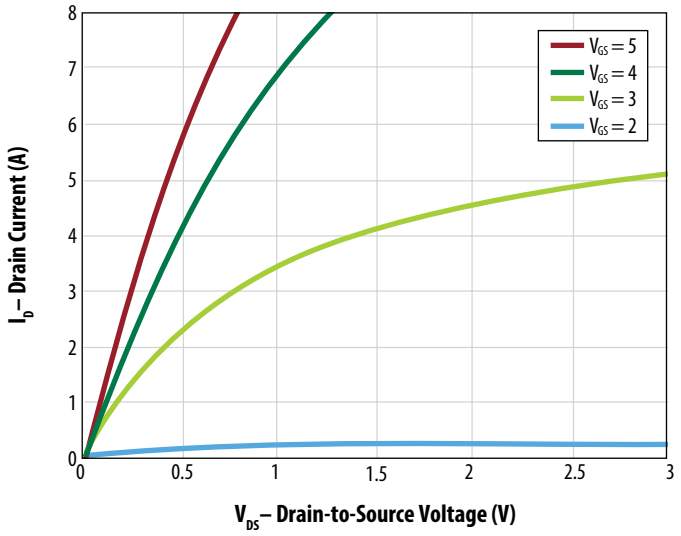


Figure 2: Typical Transfer Characteristics

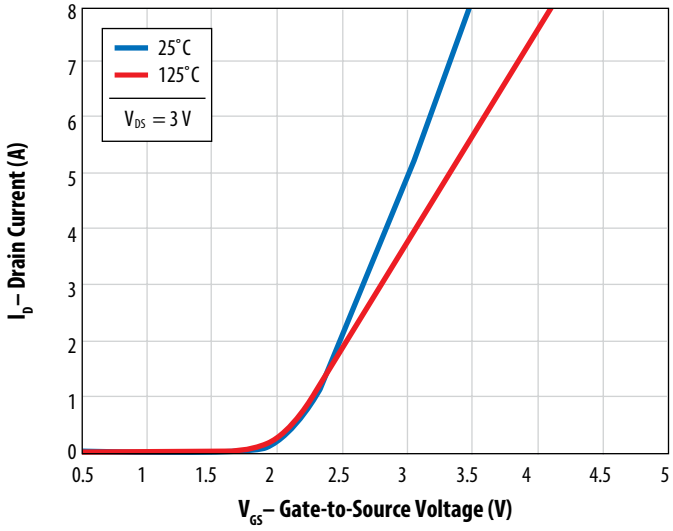


Figure 3: Typical $R_{DS(ON)}$ vs V_{GS} for Various Drain Currents

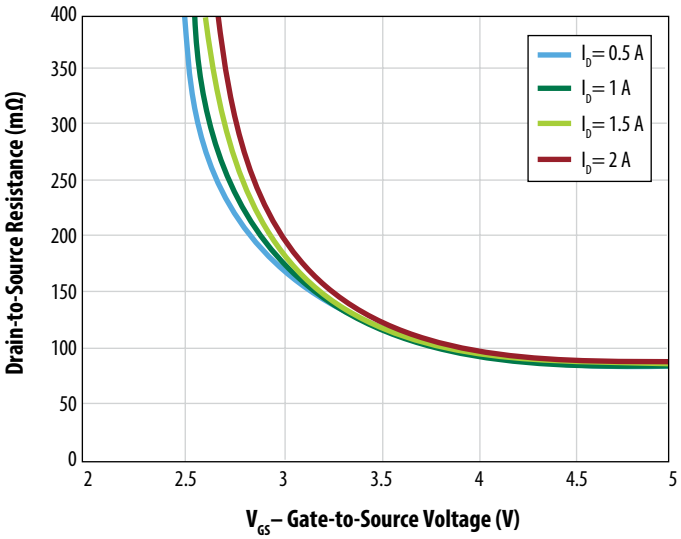


Figure 4: Typical $R_{DS(ON)}$ vs V_{GS} for Various Temperatures

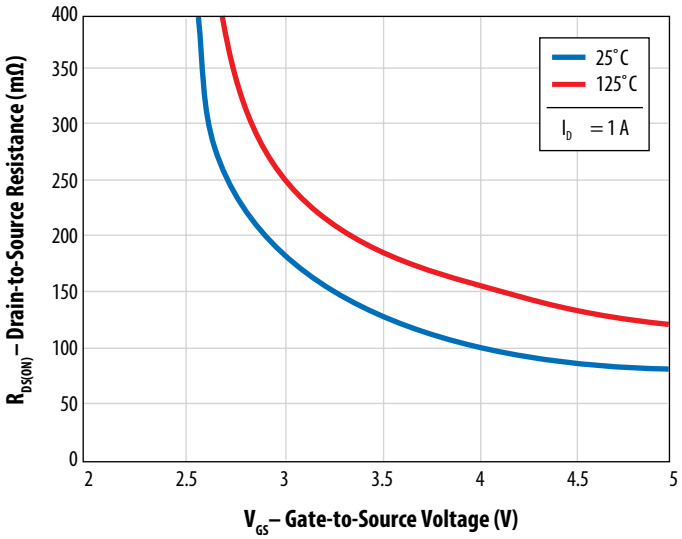


Figure 5: Typical Capacitance (Linear Scale)

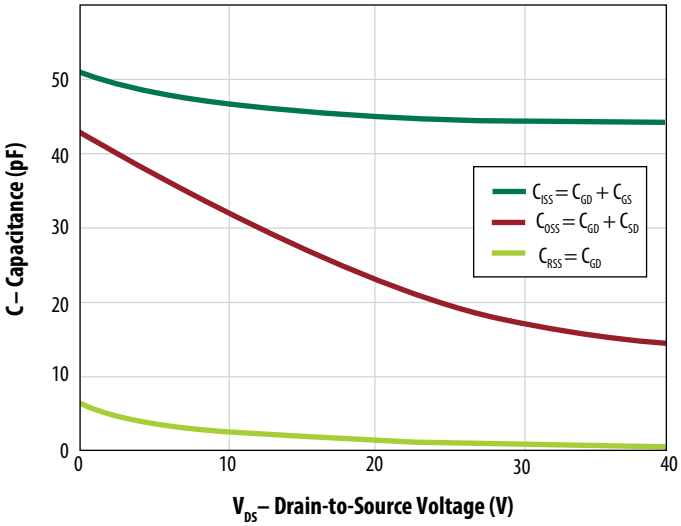


Figure 5A: Typical Capacitance (Log Scale)

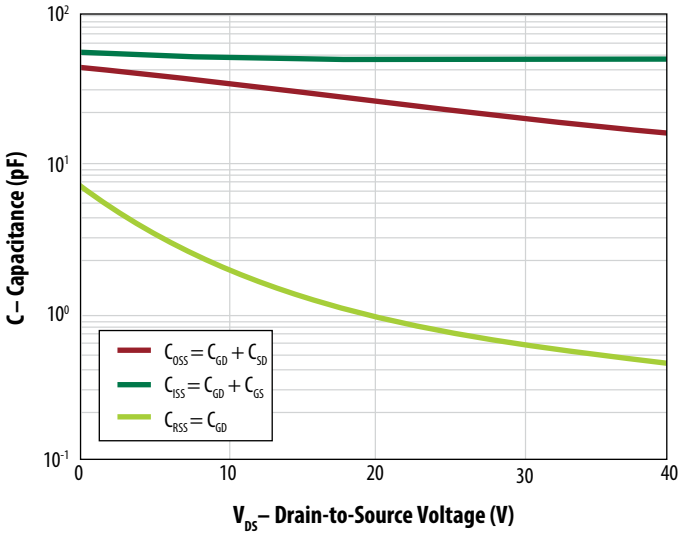


Figure 6: Typical Gate Charge

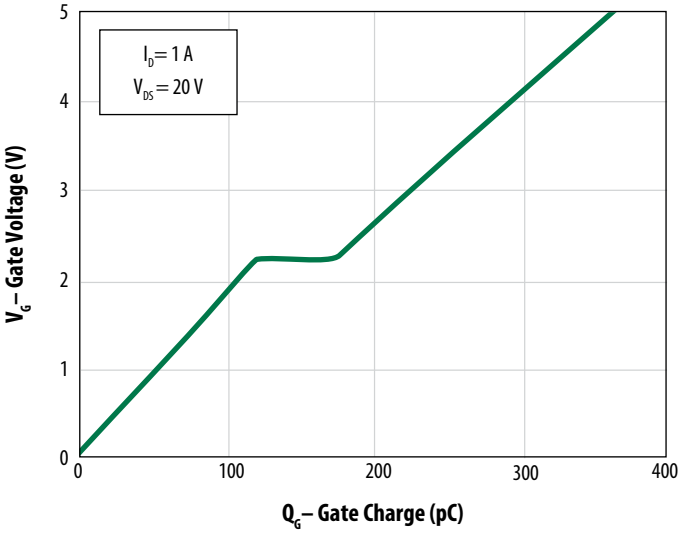
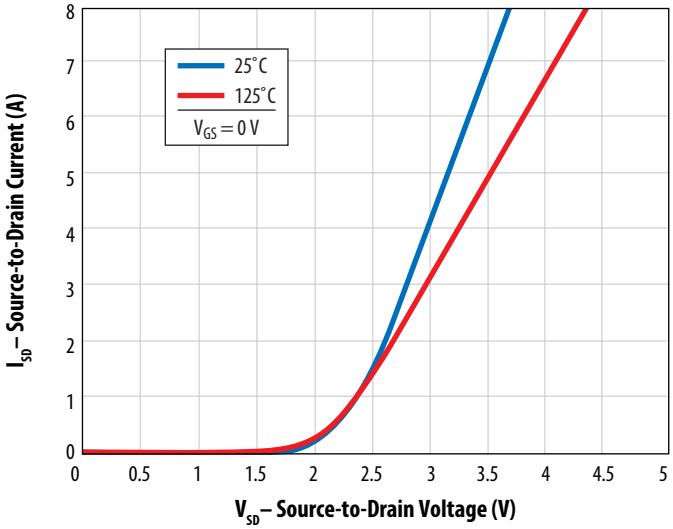


Figure 7: Typical Reverse Drain-Source Characteristics



Note: Negative gate drive voltage increases the reverse drain-source voltage. EPC recommends 0 V for OFF.

Figure 8: Typical Normalized On Resistance vs Temperature

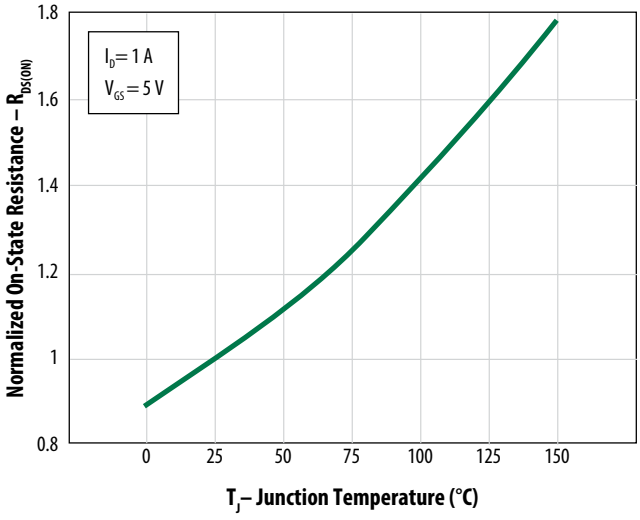


Figure 9: Typical Normalized Threshold Voltage vs Temperature

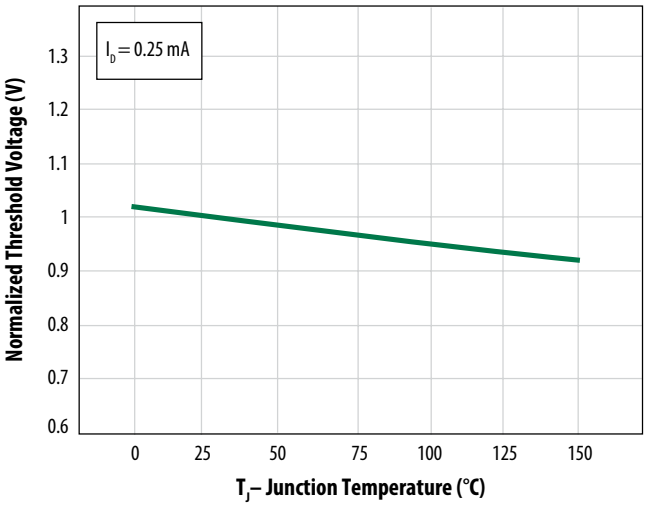


Figure 10: Typical Gate Current

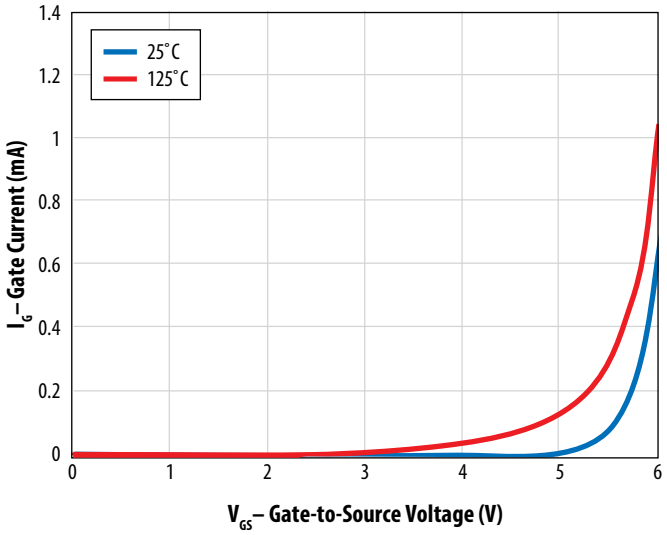


Figure 11: Smith Chart

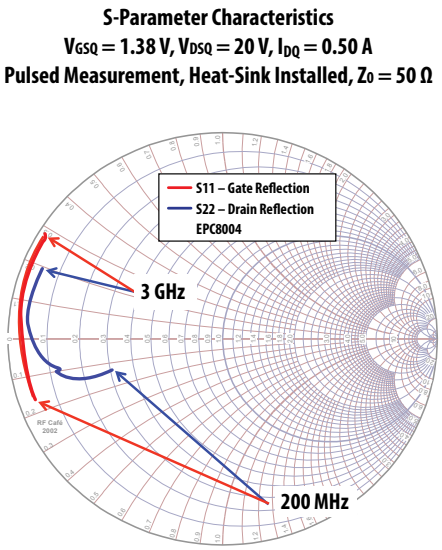


Figure 12: Gain Chart

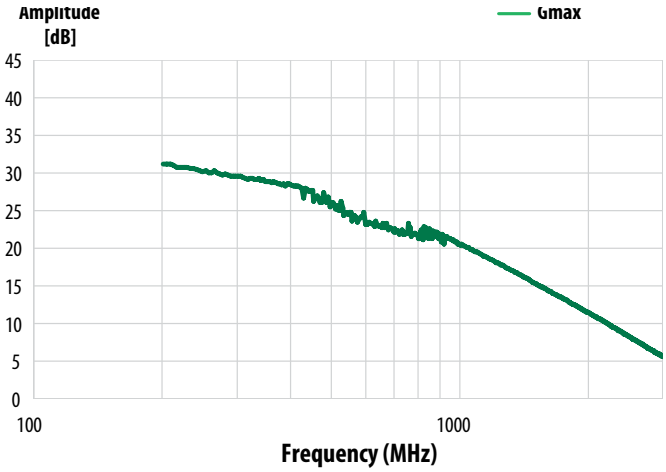
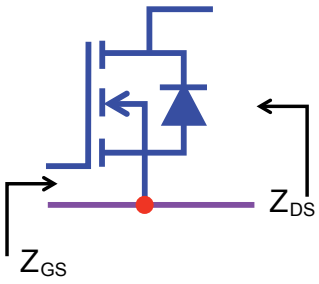


Figure 13: Device Reflection



Frequency	Gate (Z_{GS})	Drain (Z_{DS})
[MHz]	[Ω]	[Ω]
200	2.00 – j8.07	15.27 – j6.36
500	1.74 – j2.18	10.78 – j7.01
1000	1.41 + j1.60	5.98 – j4.42
1200	1.30 + j3.20	4.52 – j3.07
1500	1.11 + j4.75	3.19 – j0.98
2000	0.84 + j8.32	2.14 + j3.07
2400	0.70 + j10.24	1.95 + j5.86
3000	0.65 + j14.17	2.17 + j10.24

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

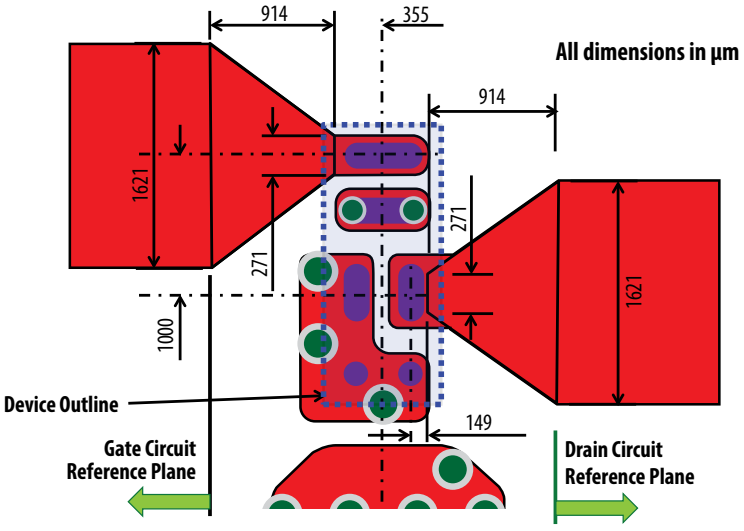


Figure 15: Typical Transient Thermal Response Curves

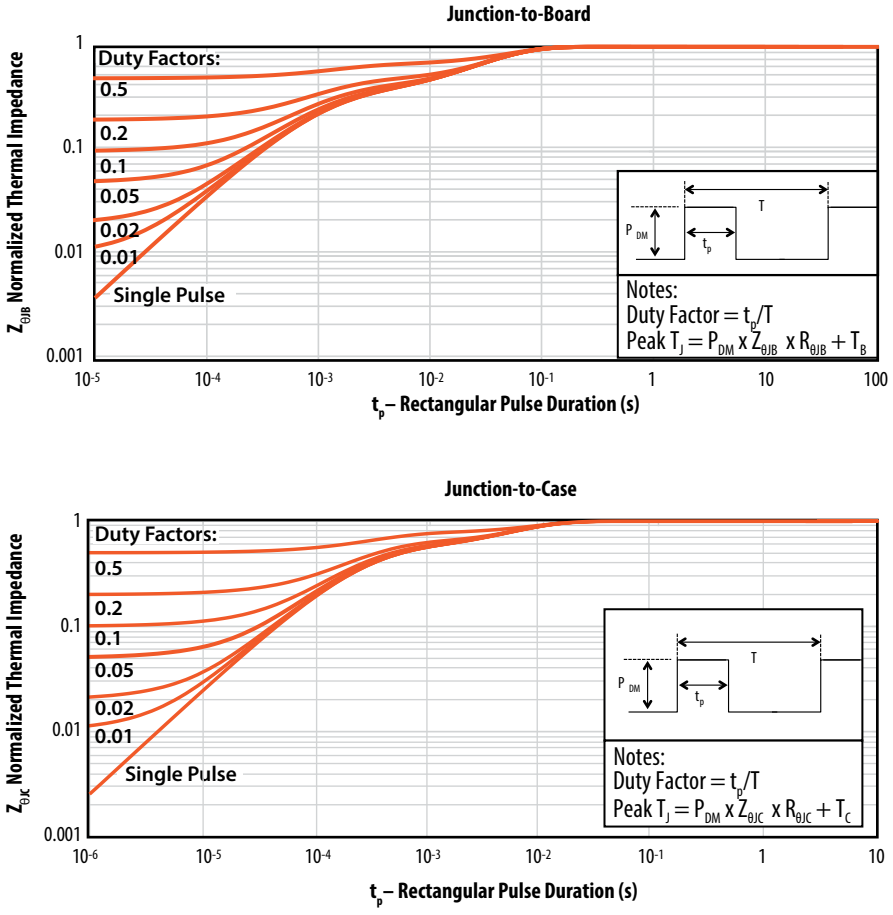
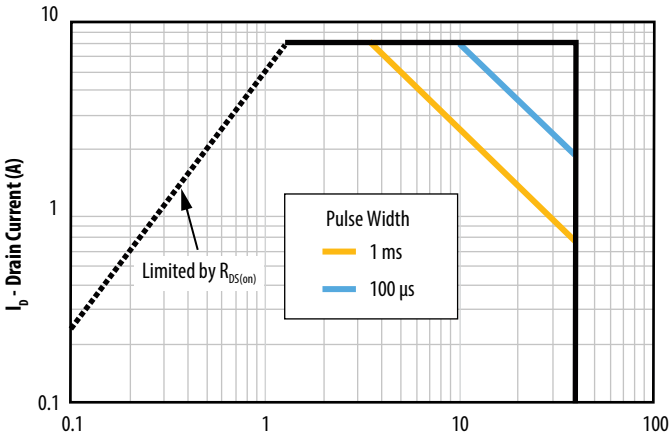
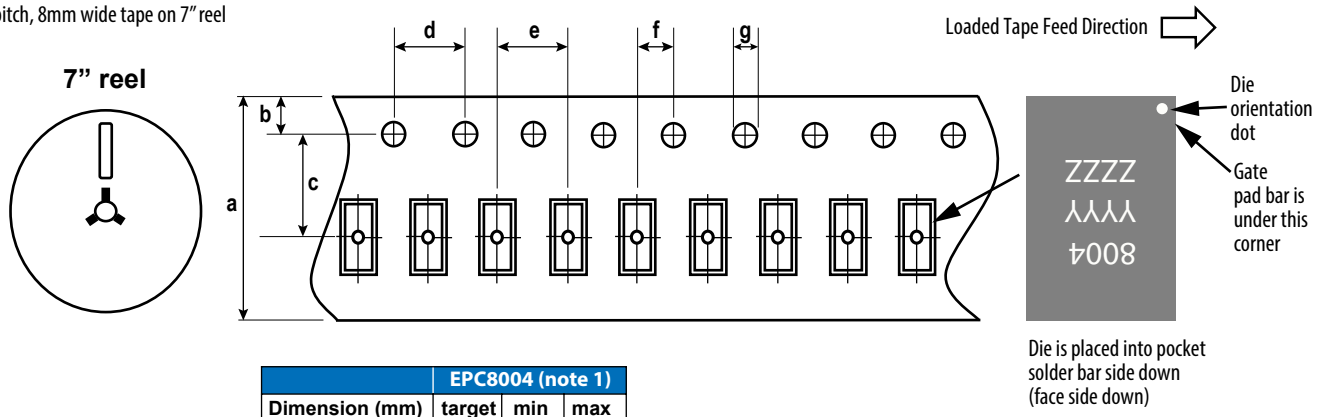


Figure 16: Safe Operating Area



TAPE AND REEL CONFIGURATION

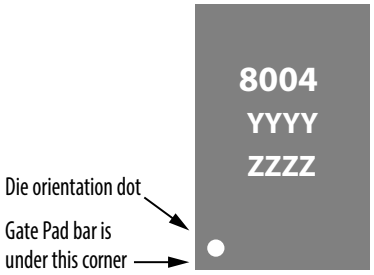
4mm pitch, 8mm wide tape on 7" reel



	EPC8004 (note 1)		
Dimension (mm)	target	min	max
a	8.00	7.90	8.30
b	1.75	1.65	1.85
c (see note)	3.50	3.45	3.55
d	4.00	3.90	4.10
e	4.00	3.90	4.10
f (see note)	2.00	1.95	2.05
g	1.5	1.5	1.6

Note 1: MSL 1 (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.

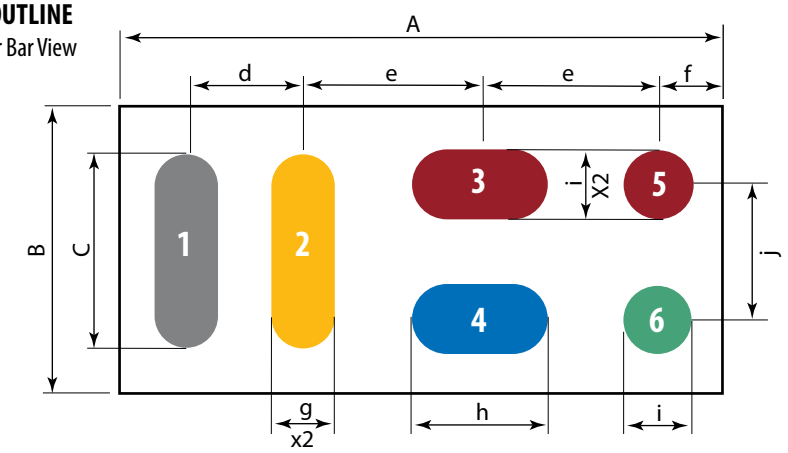
DIE MARKINGS



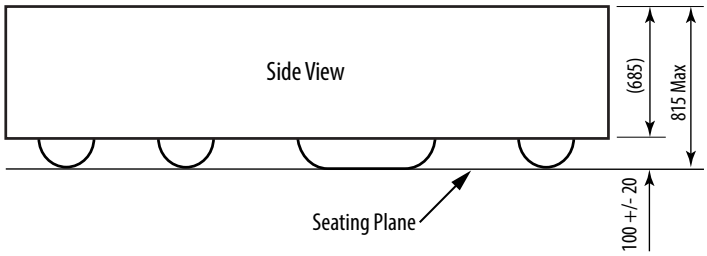
Part Number	Laser Markings		
	Part # Marking Line 1	Lot_Date Code Marking line 2	Lot_Date Code Marking Line 3
EPC8004	8004	YYYY	ZZZZ

DIE OUTLINE

Solder Bar View



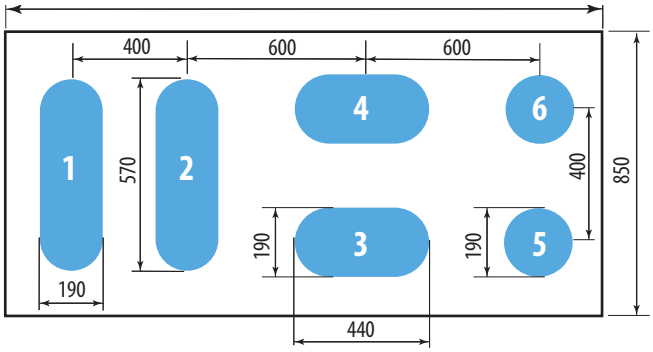
Dim	Micrometers		
	Min	Nominal	Max
A	2020	2050	2080
B	820	850	880
C	555	580	605
d	400	400	400
e	600	600	600
f	200	225	250
g	175	200	225
h	425	450	475
i	175	200	225
j	400	400	400



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*

*Substrate pin should be connected to Source

RECOMMENDED LAND PATTERN *(measurements in µm)*

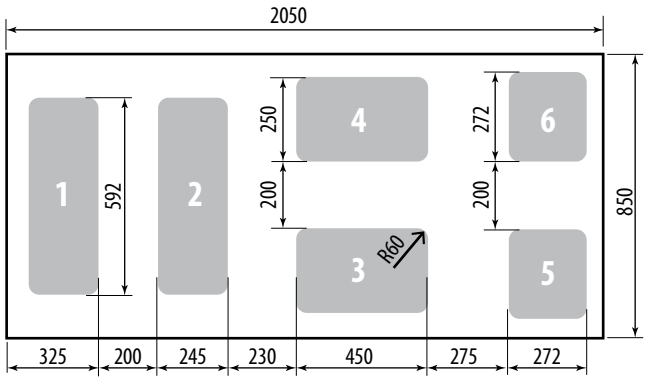


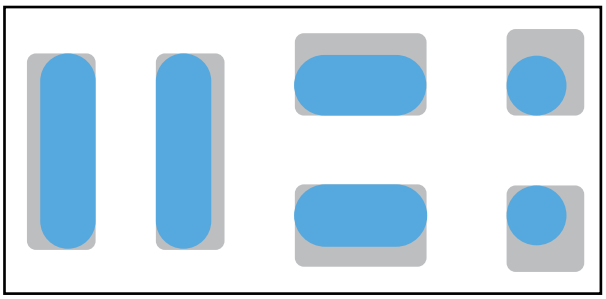
The land pattern is solder mask defined.

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*

*Substrate pin should be connected to Source

RECOMMENDED STENCIL DRAWING *(measurements in µm)*





Blue = bump, Gray = stencil

Recommended stencil should be 4 mil (100 µm) thick, must be laser cut, openings per drawing. Intended for use with SAC305 Type 4 solder, reference 88.5% metals content.

Additional assembly resources available at: https://epc-co.com/epc/design-support

Efficient Power Conversion Corporation (EPC) reserves the right to make changes without further notice to any products herein to improve reliability, function or design. EPC does not assume any liability arising out of the application or use of any product or circuit described herein; neither does it convey any license under its patent rights, nor the rights of others. eGaN® is a registered trademark of Efficient Power Conversion Corporation.

EPC Patent Listing: https://epc-co.com/epc/about-epc/patents

Information subject to change without notice.