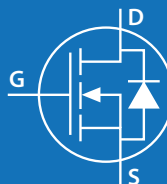


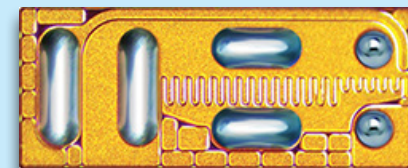
EPC8004 – Enhancement Mode Power Transistor

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

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



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://lead.me/EPC8004>

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 ($T_A = 25^\circ\text{C}$, $R_{\theta JA} = 39^\circ\text{C/W}$)	4	A
	Pulsed (25°C, $T_{PULSE} = 300 \mu\text{s}$)	7.5	
V_{GS}	Gate-to-Source Voltage	6	V
	Gate-to-Source Voltage	-4	
T_J	Operating Temperature	-40 to 150	$^\circ\text{C}$
T_{STG}	Storage Temperature	-40 to 150	

Thermal Characteristics

PARAMETER		TYP	UNIT
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case	8.2	$^\circ\text{C/W}$
$R_{\theta JB}$	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 ($T_J = 25^\circ\text{C}$ 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.

Dynamic Characteristics[#] ($T_J = 25^\circ\text{C}$ unless otherwise stated)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
C_{ISS}	Input Capacitance	$V_{GS} = 0\text{ V}, V_{DS} = 20\text{ V}$		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	$V_{GS} = 5\text{ V}, V_{DS} = 20\text{ V}, I_D = 1\text{ A}$		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	$V_{GS} = 0\text{ V}, V_{DS} = 20\text{ V}$		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} .

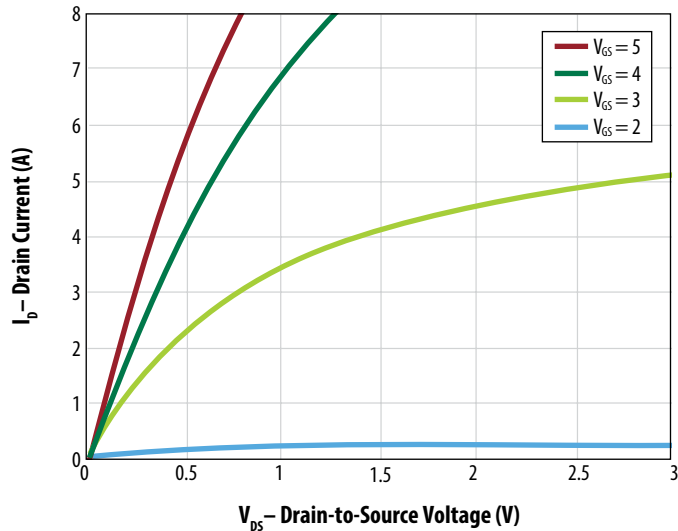
Figure 1: Typical Output Characteristics at 25°C 

Figure 2: Typical Transfer Characteristics

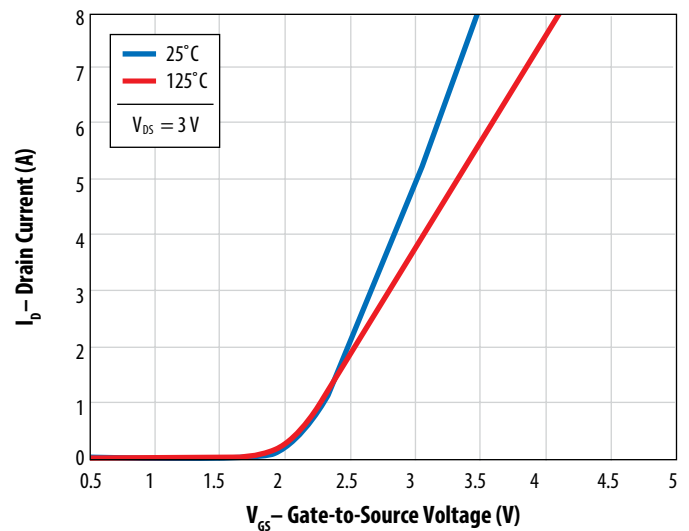
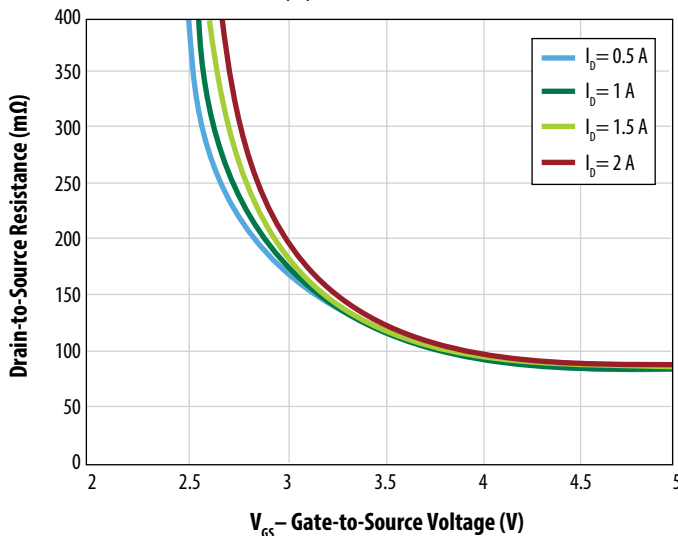
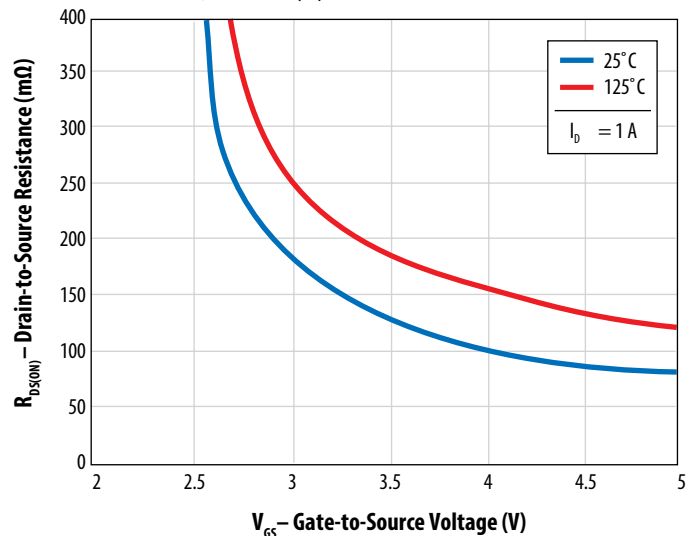
Figure 3: Typical $R_{DS(ON)}$ vs V_{GS} for Various Drain CurrentsFigure 4: Typical $R_{DS(ON)}$ vs V_{GS} for Various Temperatures

Figure 5: Typical Capacitance (Linear Scale)

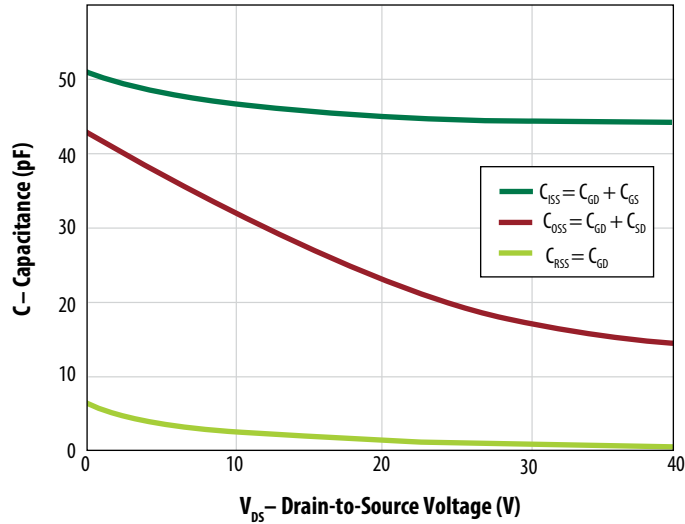


Figure 5A: Typical Capacitance (Log Scale)

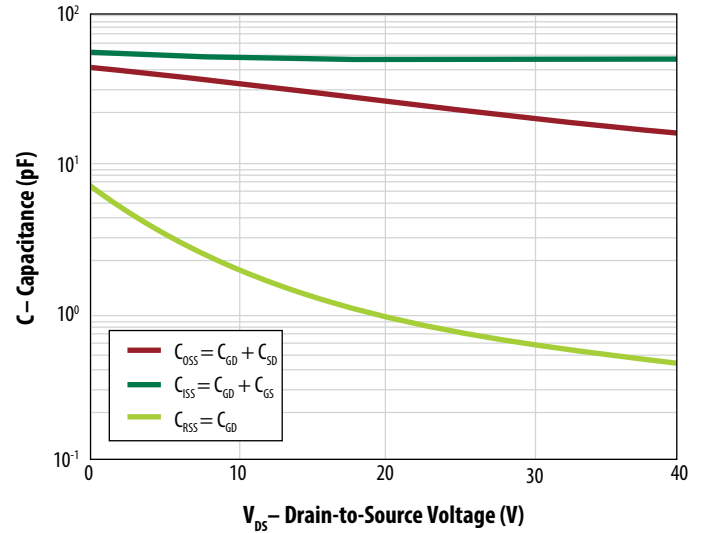


Figure 6: Typical Gate Charge

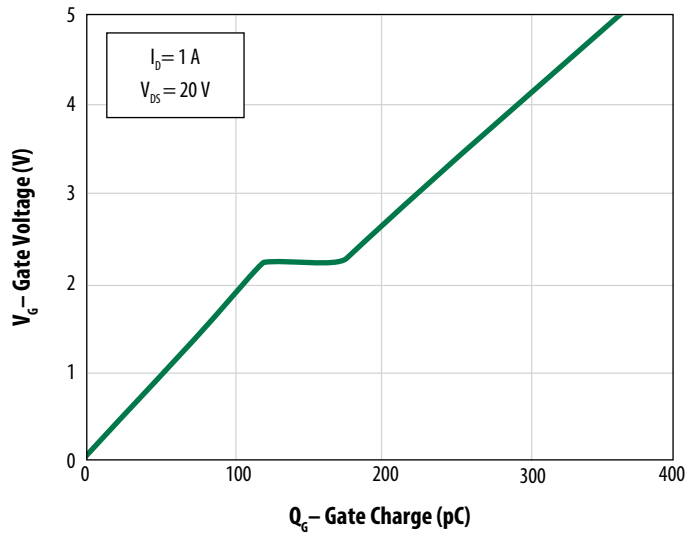
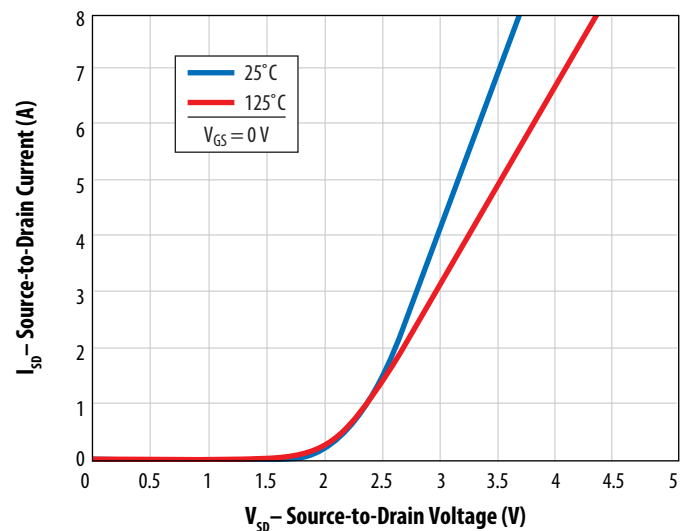


Figure 7: Typical Reverse Drain-Source Characteristics



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

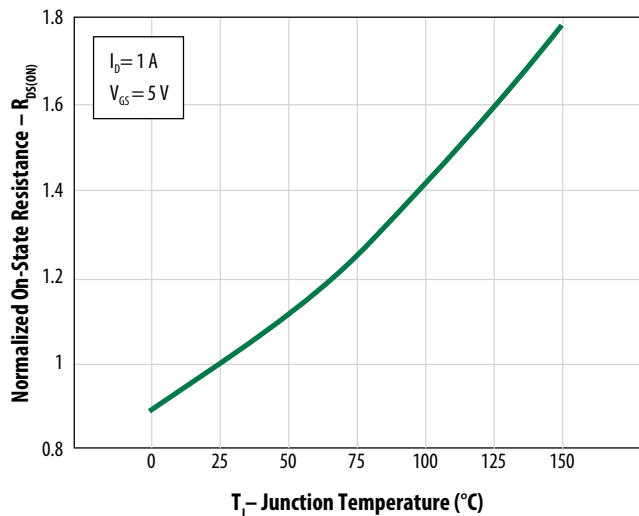


Figure 9: Typical Normalized Threshold Voltage vs Temperature

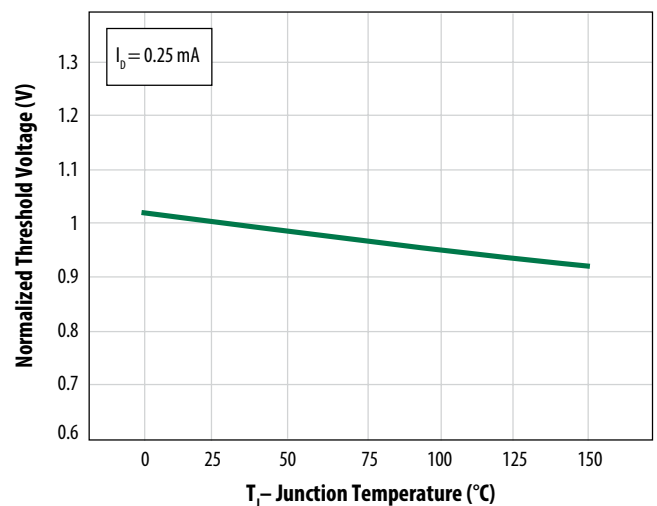


Figure 10: Typical Gate Current

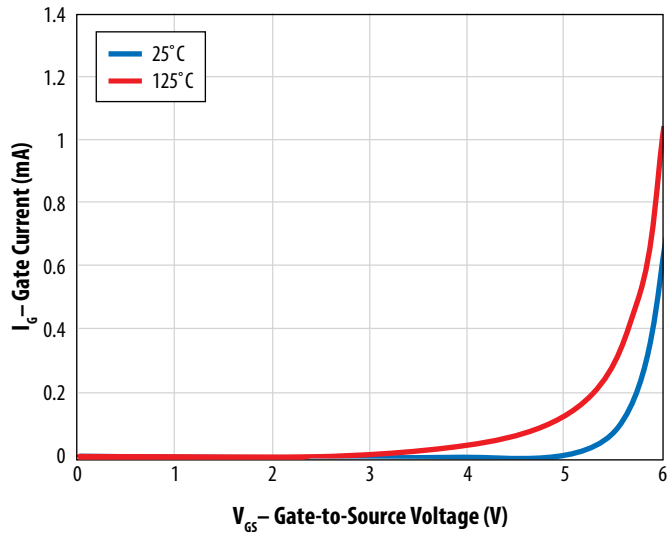


Figure 11: Smith Chart

S-Parameter Characteristics
 $V_{GSQ} = 1.38 \text{ V}$, $V_{DSQ} = 20 \text{ V}$, $I_{DQ} = 0.50 \text{ A}$
 Pulsed Measurement, Heat-Sink Installed, $Z_0 = 50 \Omega$

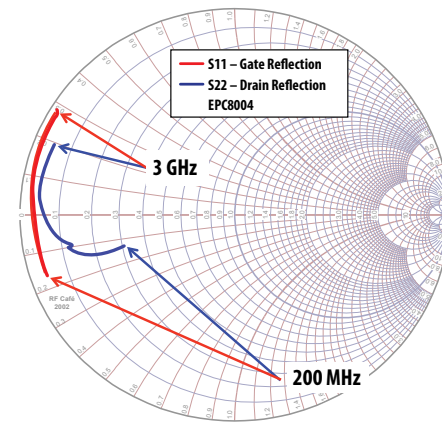


Figure 12: Gain Chart

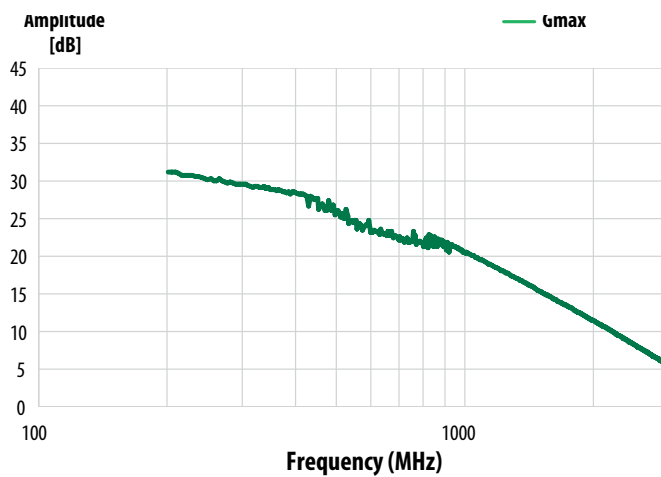


Figure 13: Device Reflection

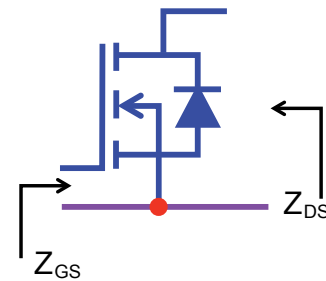
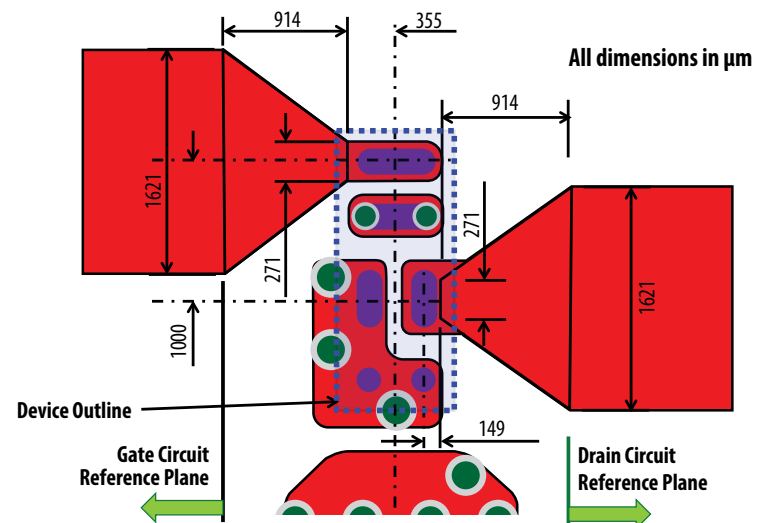


Figure 14: Taper and Reference Plane details – Device Connection

Micro-Strip design: 2-layer
 ½ oz (17.5 μm) thick copper
 30 mil thick R04350 substrate



Frequency [MHz]	Gate (Z_{GS}) [Ω]	Drain (Z_{DS}) [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 15: Typical Transient Thermal Response Curves

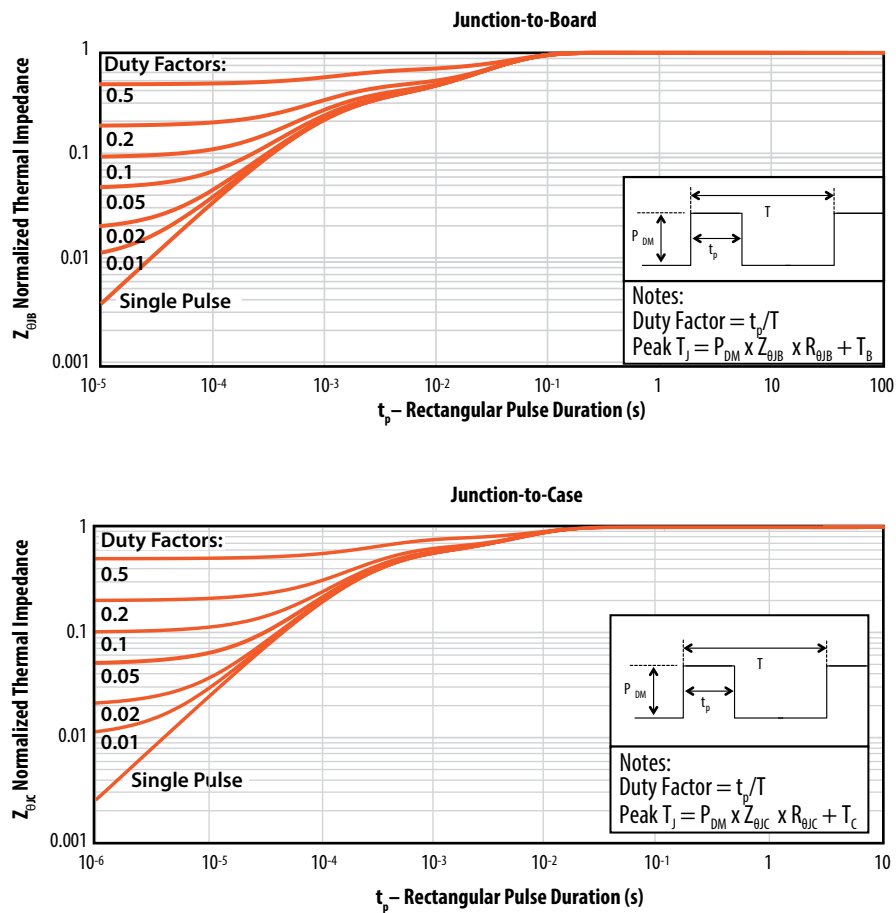
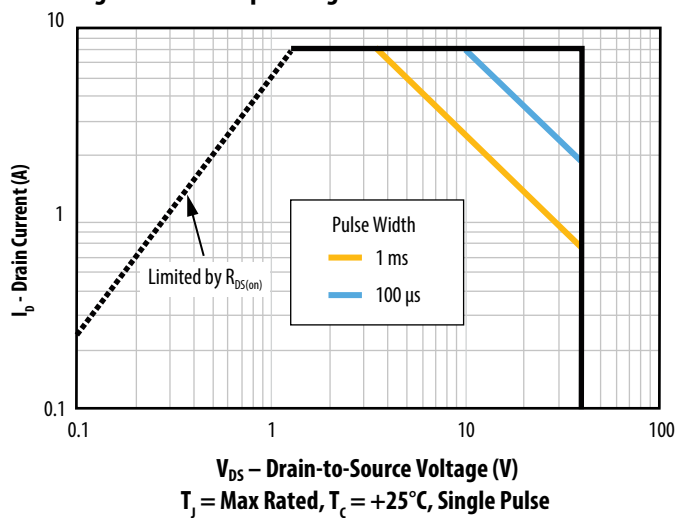
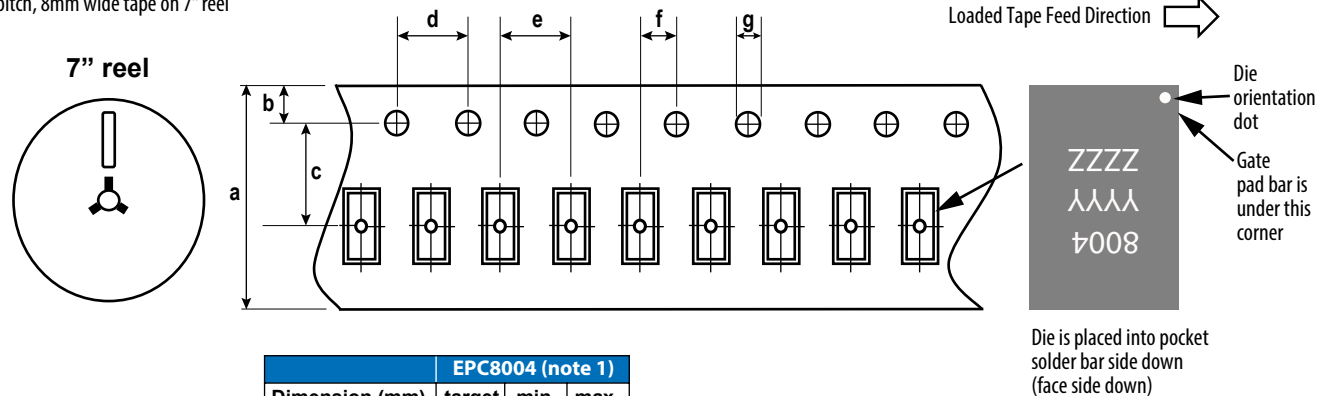


Figure 16: Safe Operating Area



TAPE AND REEL CONFIGURATION

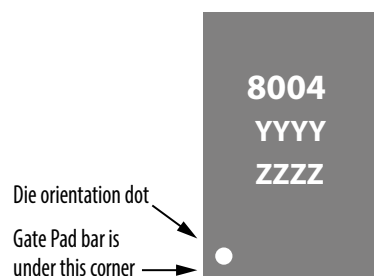
4mm pitch, 8mm wide tape on 7" reel



Dimension (mm)	EPC8004 (note 1)		
	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.

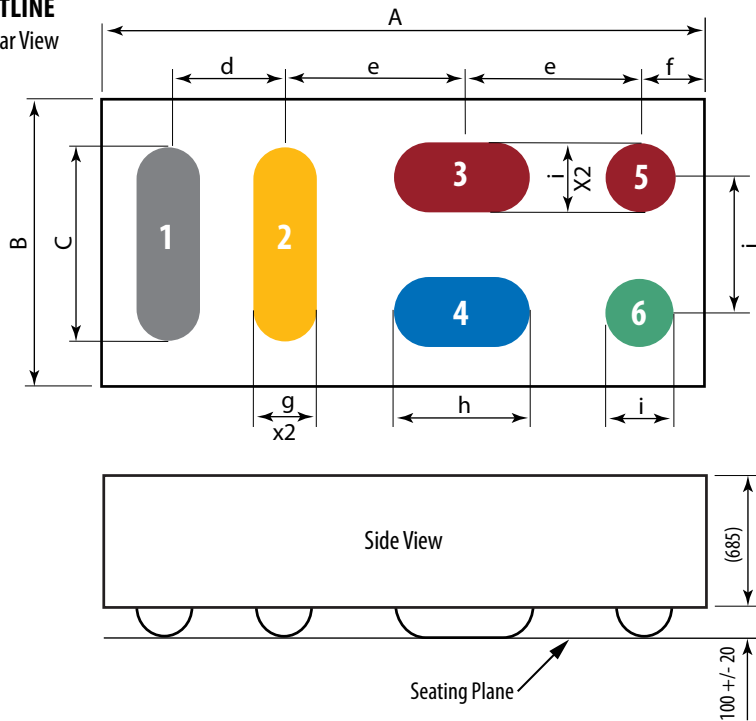
DIE MARKINGS



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

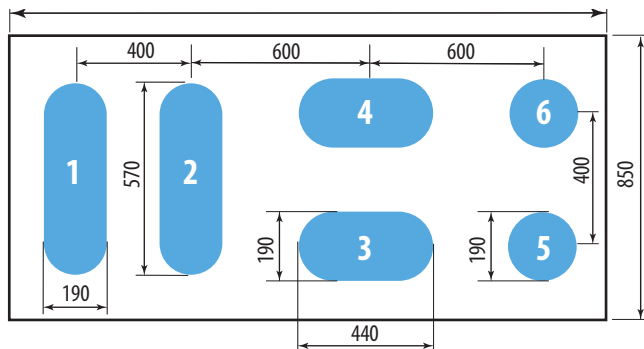
Pad no. 2 is Source Return for Gate Driver

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

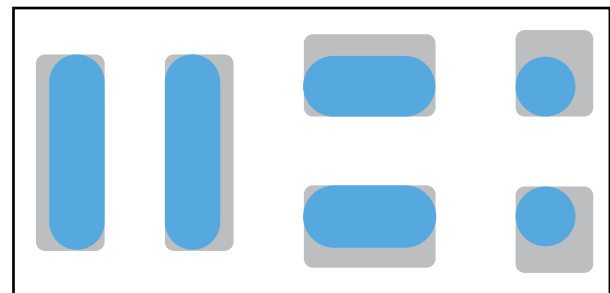
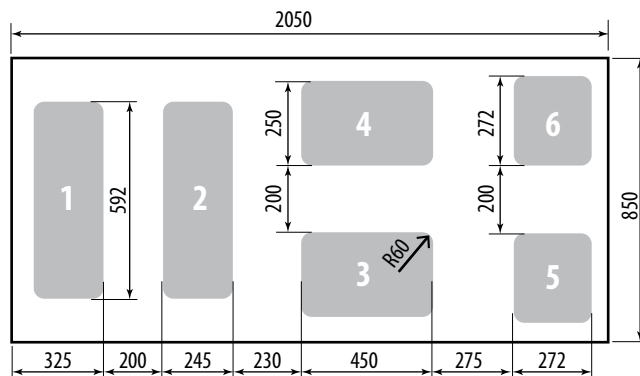
Pad no. 2 is Source Return for Gate Driver

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>

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