EPC2104 – Enhancement-Mode GaN Power Transistor Half Bridge
Preliminary Specification Sheet

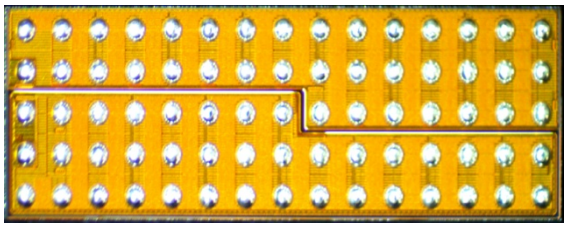
Status: Engineering

Features:

- Greater than 97% System Efficiency at 22 A
  - 48 V_{IN} to 12 V_{OUT}, 300 kHz
  - Includes driver, inductor, and output filter
- High Frequency Operation
- High Density Footprint
- Low Inductance Package
- Pb-Free (RoHS Compliant), Halogen Free

Applications:

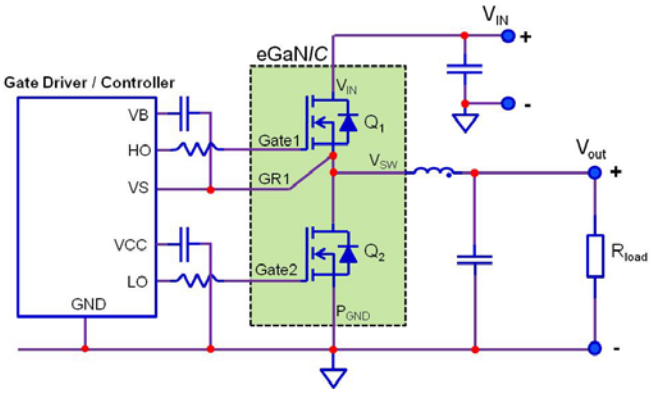
- High Frequency DC-DC Conversion
- Motor Drive



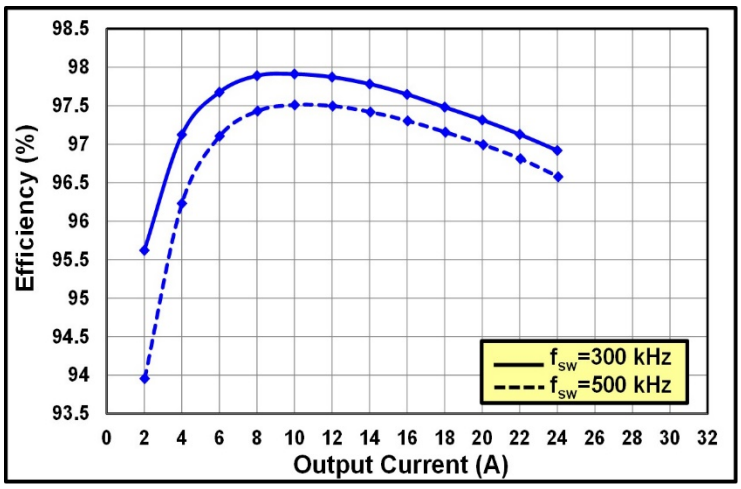
EPC2104 devices are supplied only in passivated die form with solder balls

Die Size: 6.05 mm x 2.3 mm

Typical Circuit



Typical System Efficiency



V_{IN} = 48 V, V_{OUT} = 12 V

MAXIMUM RATINGS

Parameter	Value
Maximum Drain – Source Voltage (V_{SW} to P_{GND}, V_{IN} to V_{SW})	100 V
Maximum Gate – Source Voltage Range (Gate 1 to V_{SW}, Gate 2 to P_{GND})	-4 V < V_{GS} < 6 V
Continuous Drain Current, 25 °C, $R_{\theta JA}$ = 21 °C/W	23 A
Maximum Pulsed Drain Current, 25 °C, T_{pulse} = 300 µs	165 A
Optimum Temperature Range	-40 °C < T_J < 150 °C

STATIC CHARACTERISTICS

Parameter	Conditions	Value
Maximum Drain – Source Voltage (BV_{DSS})	V_{GS} = 0 V, I_D = 400 µA	100 V
Maximum Drain – Source Leakage	V_{DS} = 80 V, V_{GS} = 0 V	320 µA
Maximum $R_{DS(on)}$	V_{GS} = 5 V, I_D = 20 A	6.3 mΩ
Typical $R_{DS(on)}$	V_{GS} = 5 V, I_D = 20 A	5 mΩ
Gate – Source Threshold Voltage	I_D = 5.5 mA, V_{DS} = V_{GS}	0.8 V < $V_{GS(TH)}$ < 2.5 V
Gate – Source Maximum Positive Leakage	V_{GS} = 5 V	5 mA
Gate – Source Maximum Negative Leakage	V_{GS} = -4 V	-320 µA

T_J = 25 °C unless otherwise stated

DYNAMIC CHARACTERISTICS

Parameter	Conditions	Typical Value		
		Q1 Control FET	Q2 Sync FET	Unit
C_{ISS} (Input Capacitance)	V_{DS} = 50 V, V_{GS} = 0 V	800		pF
C_{OSS} (Output Capacitance)		450	600	
C_{RSS} (Reverse Transfer Capacitance)		7		
Q_G (Total Gate Charge)	V_{DS} = 50 V, I_D = 20 A, V_{GS} = 5 V	7		nC
Q_{GS} (Gate to Source Charge)	V_{DS} = 50 V, I_D = 20 A	2		
Q_{GD} (Gate to Drain Charge)		1.2		
$Q_{G(TH)}$ (Gate Charge at Threshold)		1.4		
Q_{OSS} (Output Charge)	V_{DS} = 50 V, V_{GS} = 0 V	35	47	
Q_{RR} (Source-Drain Recovery Charge)		0		

T_J = 25 °C unless otherwise stated

THERMAL CHARACTERISTICS

		TYPICAL		
		Q1 Control FET	Q2 Sync FET	
$R_{\theta JC}$	Thermal Resistance, Junction to Case	0.4		°C/W
$R_{\theta JB}$	Thermal Resistance, Junction to Board (Note 2)	1.8	1.9	°C/W
$R_{\theta 12}$	Thermal Resistance, Cross-Coupling	1.3		°C/W
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient (Note 1)	42		°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.
Note 2: ΔT is determined by the following matrix equation:

$$\begin{pmatrix} \Delta T_{Q1} \\ \Delta T_{Q2} \end{pmatrix} = \begin{bmatrix} 1.8 & 1.3 \\ 1.3 & 1.9 \end{bmatrix} \cdot \begin{pmatrix} P_{Q1} \\ P_{Q2} \end{pmatrix}$$

This matrix equation lets you calculate the temperature rise of each FET, given the power dissipated in each FET.
Thermal models for EPC devices available at http://epc-co.com/epc/DesignSupport/DeviceModels.aspx

Figure 1a: EPC2104-Q1 Typical Output Characteristics at 25°C

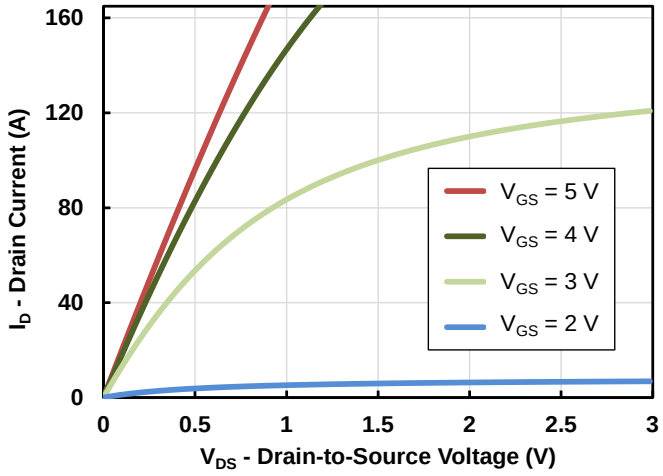


Figure 1b: EPC2104-Q2 Typical Output Characteristics at 25°C

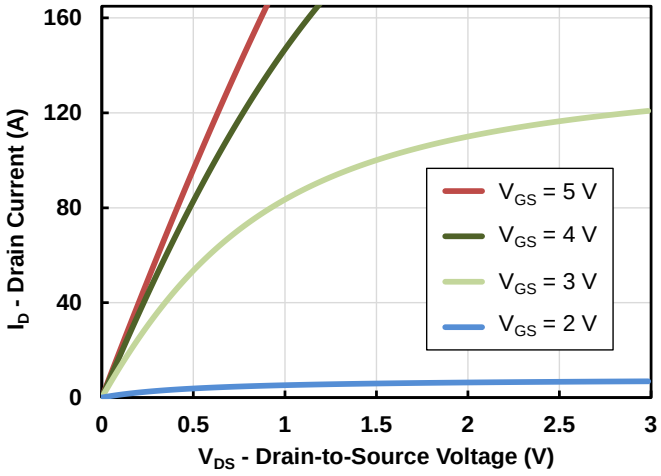


Figure 2a: EPC2104-Q1 Transfer Characteristics

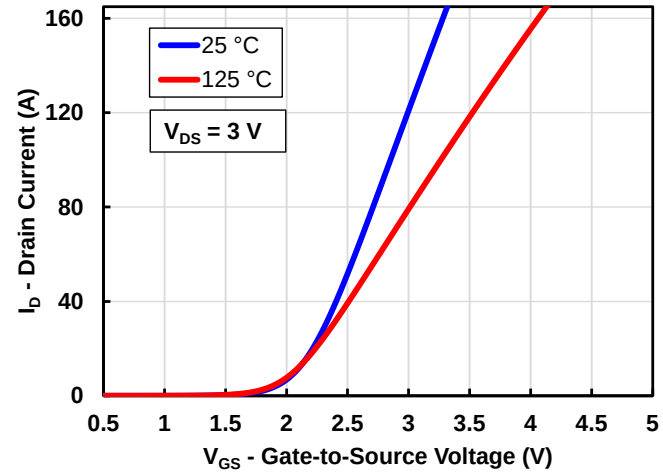


Figure 2b: EPC2104-Q2 Transfer Characteristic

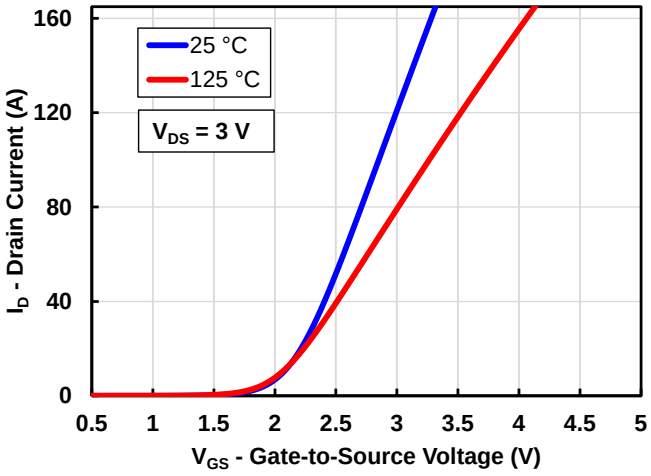


Figure 3a: EPC2104-Q1: $R_{DS(on)}$ vs. V_{GS} for Various Drain Currents

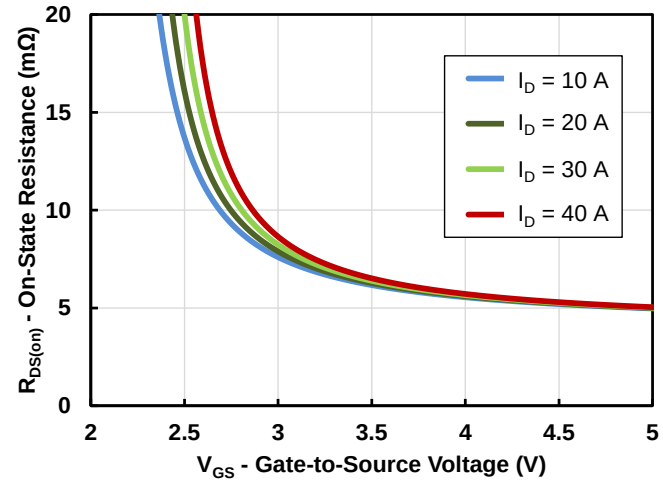


Figure 3b: EPC2104-Q2: $R_{DS(on)}$ vs. V_{GS} for Various Drain Currents

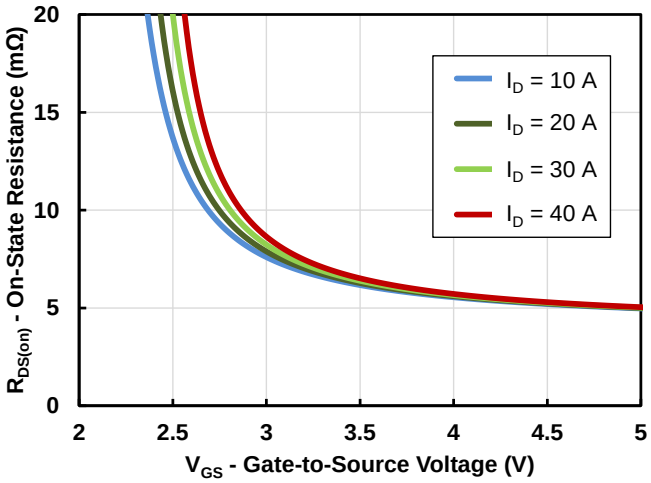


Figure 4a: EPC2104-Q1: $R_{DS(on)}$ vs. V_{GS} for Various Temperatures

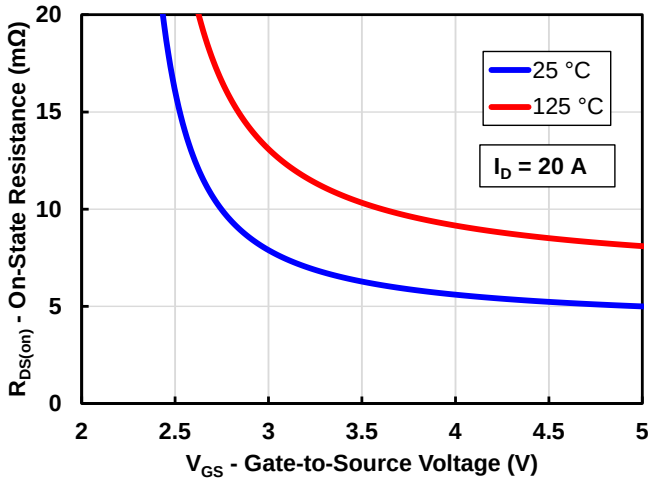


Figure 4b: EPC2104-Q2: $R_{DS(on)}$ vs. V_{GS} for Various Temperatures

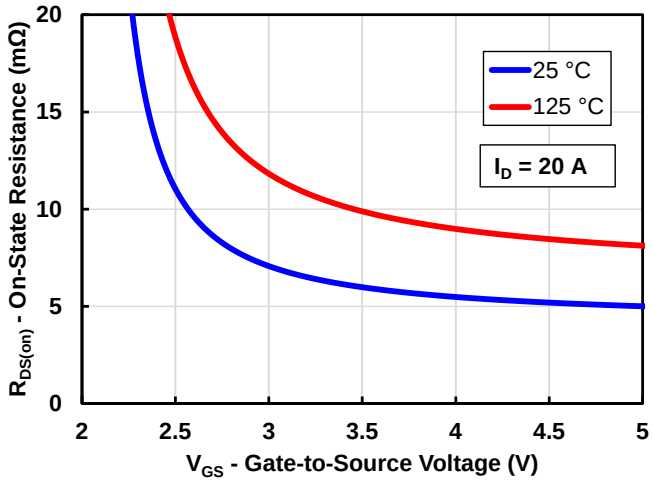


Figure 5a: EPC2104-Q1: Capacitance (Linear Scale)

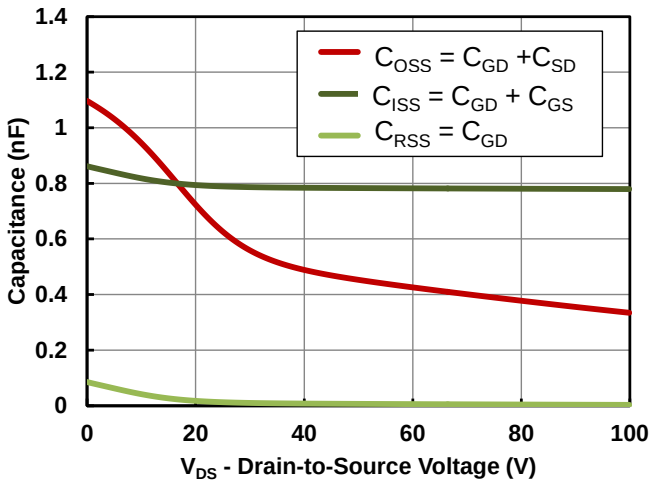


Figure 5b: EPC2104-Q2: Capacitance (Linear Scale)

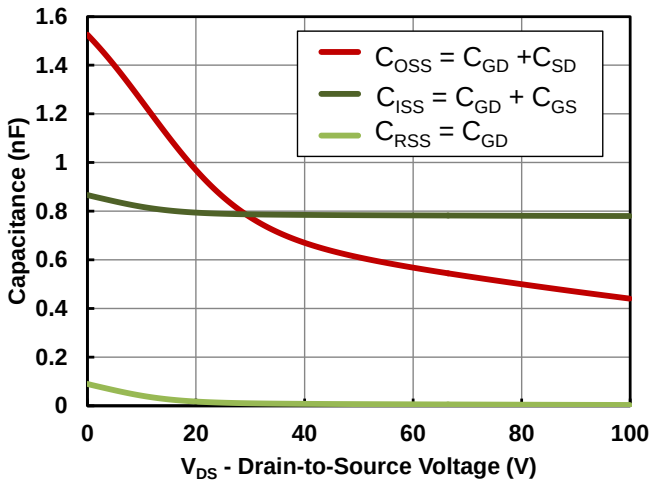


Figure 5c: EPC2104-Q1: Capacitance (Log Scale)

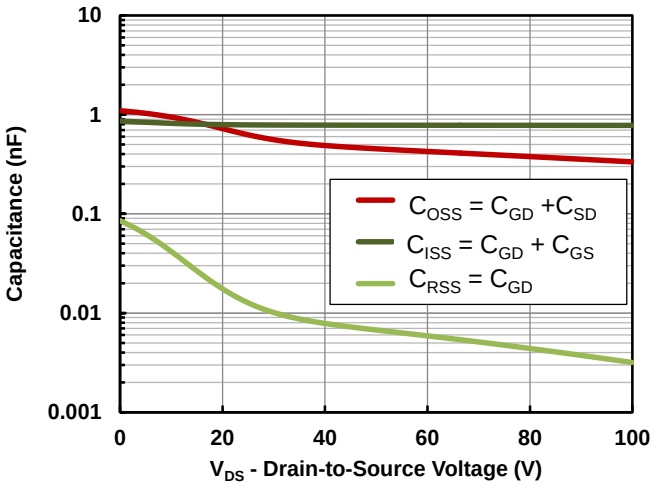


Figure 5d: EPC2104-Q2: Capacitance (Log Scale)

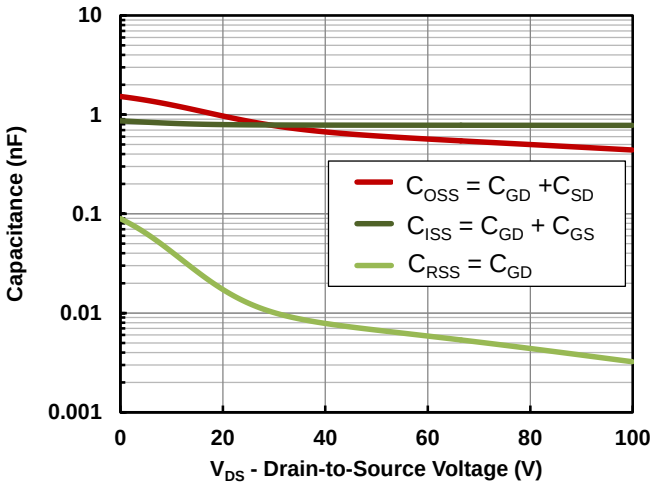


Figure 6a: EPC2104-Q1: Gate Charge

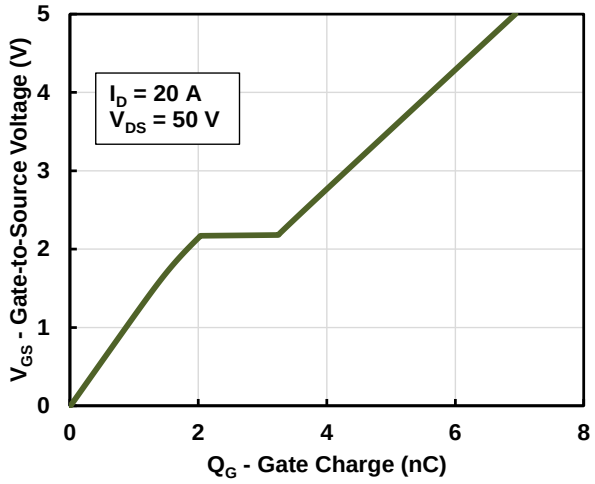


Figure 6b: EPC2104-Q2: Gate Charge

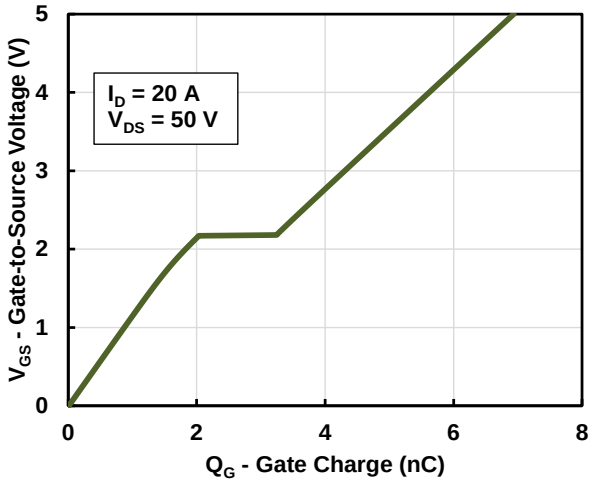


Figure 7a: EPC2104-Q1: Reverse Drain-Source Characteristics

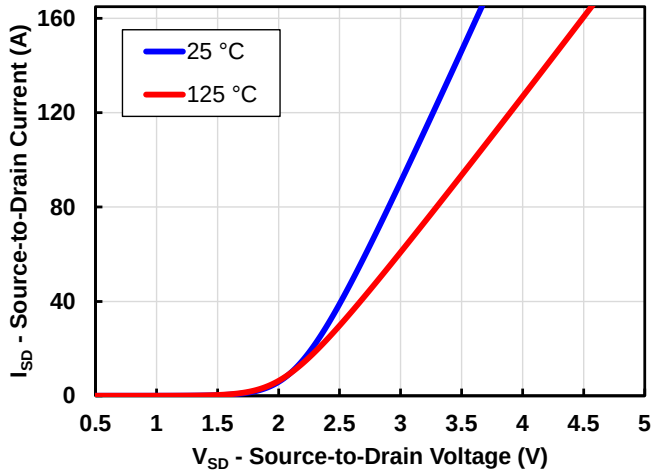


Figure 7b: EPC2104-Q2: Reverse Drain-Source Characteristics

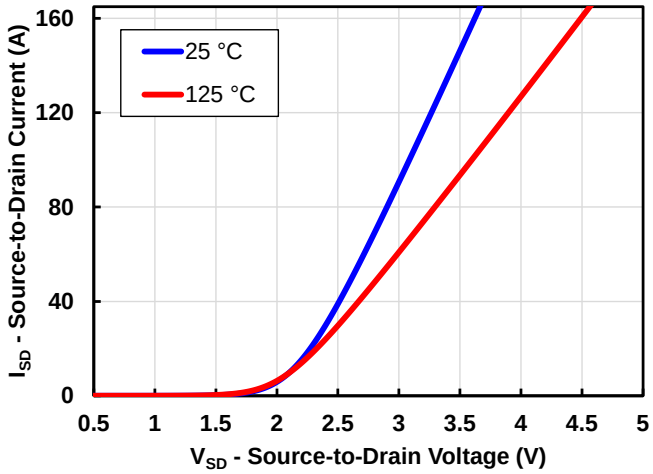


Figure 8a: EPC2104-Q1: Normalized On Resistance vs. Temperature

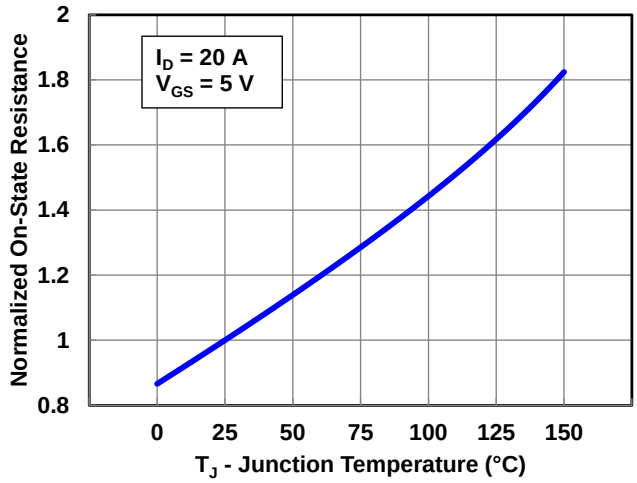


Figure 8b: EPC2104-Q2: Normalized On Resistance vs. Temperature

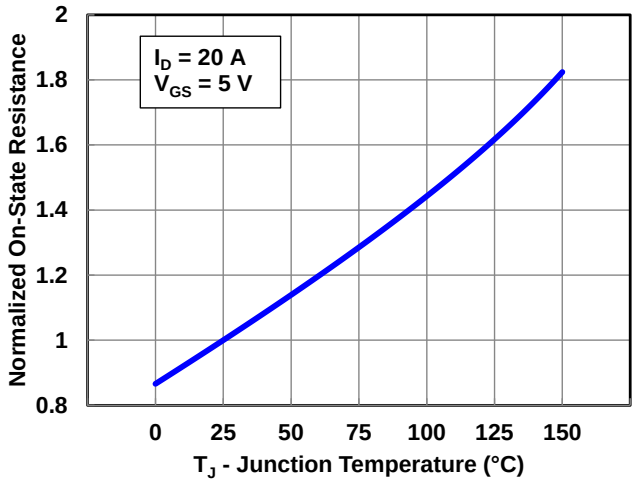


Figure 9a:
EPC2104-Q1: Normalized Threshold Voltage vs. Temperature

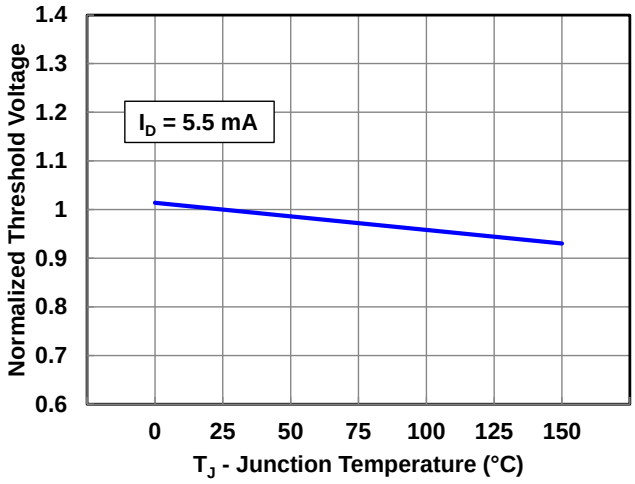
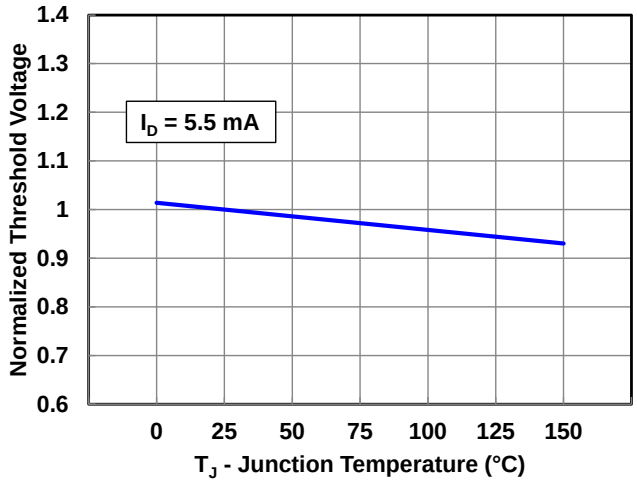
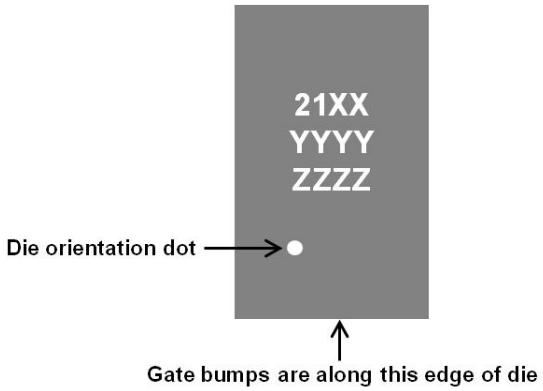


Figure 9b:
EPC2104-Q2: Normalized Threshold Voltage vs. Temperature



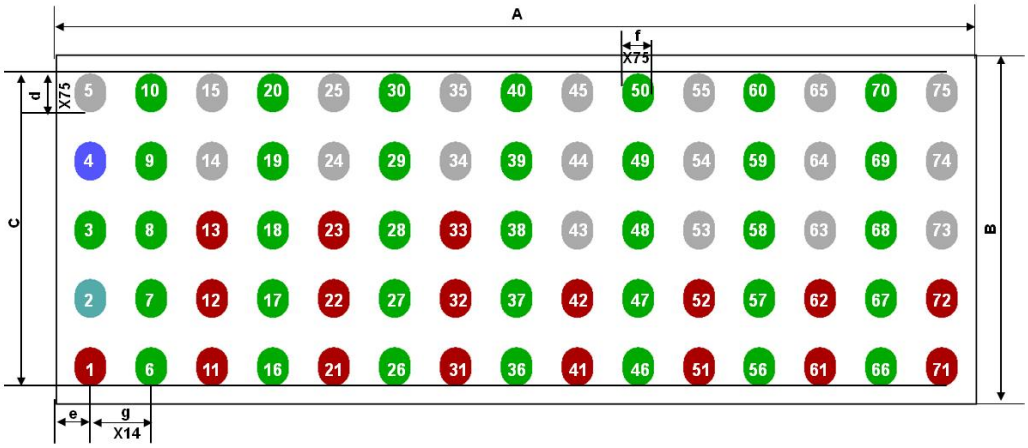
DIE MARKINGS



Part Number	Laser Marking		
	Part # Marking Line 1	Lot_Date Code Marking Line 2	Lot_Date Code Marking Line 3
EPC2104ENGR	21XX	YYYY	ZZZZ

DIE OUTLINE

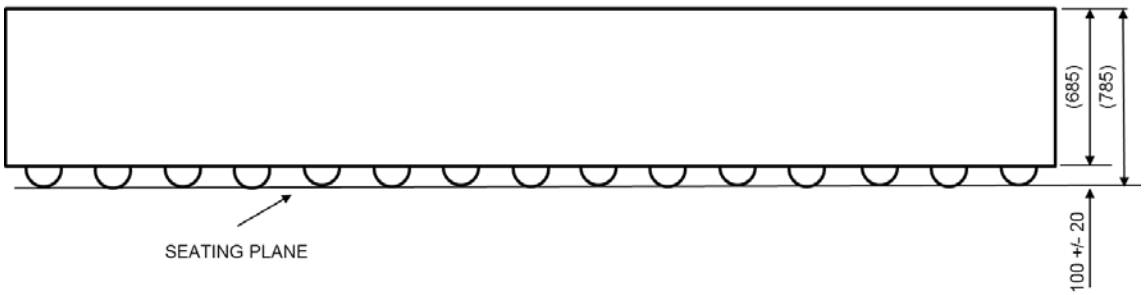
Solder Bar View



DIM	MICROMETERS		
	MIN	Nominal	MAX
A	6020	6050	6080
B	2270	2300	2330
c	2047	2050	2053
d	247	250	253
e	210	225	240
f	195	200	205
g	400	400	400

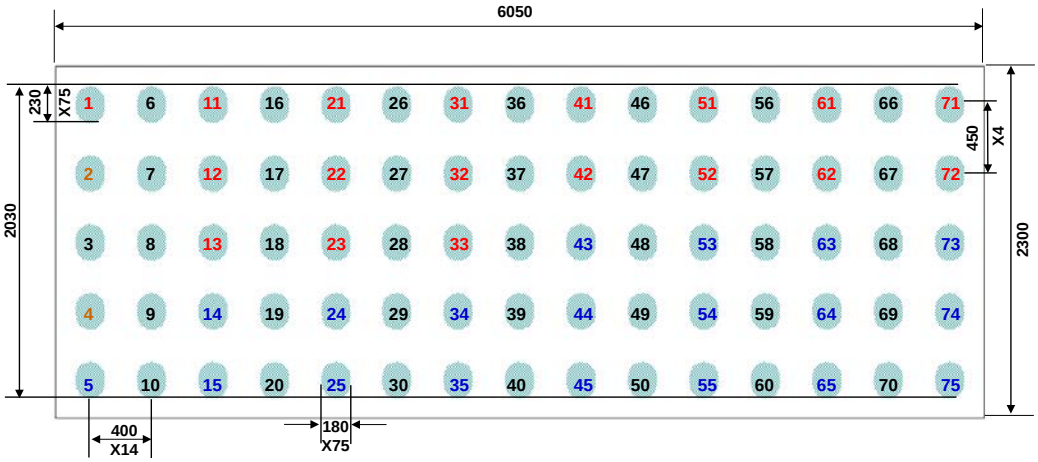
Pad 2 is Gate1 (high side); Pad 4 is Gate2 (low side); Pad 3 is HS Gate Return;
Pads 5, 14, 15, 24, 25, 34, 35, 43, 44, 45, 53, 54, 55, 63, 64, 65, 73, 74, 75 are Ground
Pads 1, 11, 12, 13, 21, 22, 23, 31, 32, 33, 41, 42, 51, 52, 61, 62, 71, 72 are V_{IN}
Pads 3, 6, 7, 8, 9, 10, 16, 17, 18, 19, 20, 26, 27, 28, 29, 30, 36, 37, 38, 39, 40, 46, 47, 48, 49, 50, 56, 57, 58, 59, 60, 66, 67, 68, 69, 70 are switch node.

Side View



RECOMMENDED LAND PATTERN

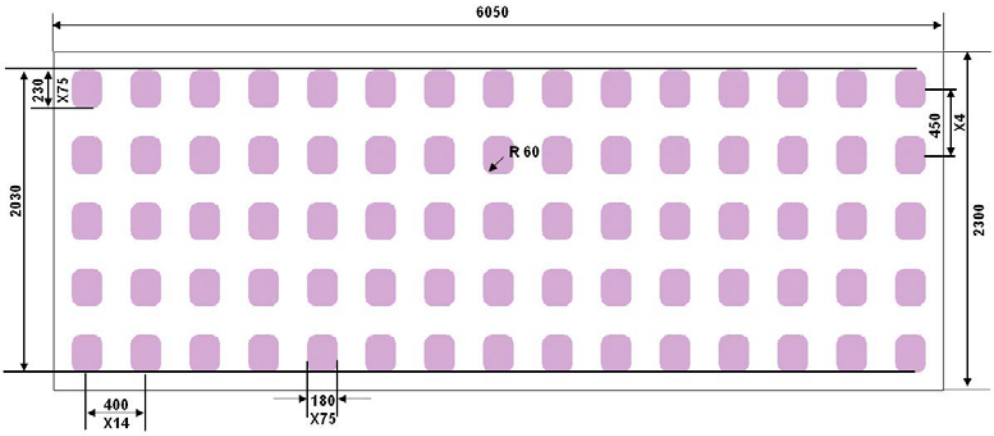
(Units in µm)



Pad 2 is Gate1 (high side); Pad 4 is Gate2 (low side); Pad 3 is HS Gate Return;
Pads 5, 14, 15, 24, 25, 34, 35, 43, 44, 45, 53, 54, 55, 63, 64, 65, 73, 74, 75 are Ground
Pads 1, 11, 12, 13, 21, 22, 23, 31, 32, 33, 41, 42, 51, 52, 61, 62, 71, 72 are VIN
Pads 3, 6, 7, 8, 9, 10, 16, 17, 18, 19, 20, 26, 27, 28, 29, 30, 36, 37, 38, 39, 40, 46, 47, 48, 49, 50, 56, 57, 58, 59, 60, 66, 67, 68, 69, 70 are switch node.

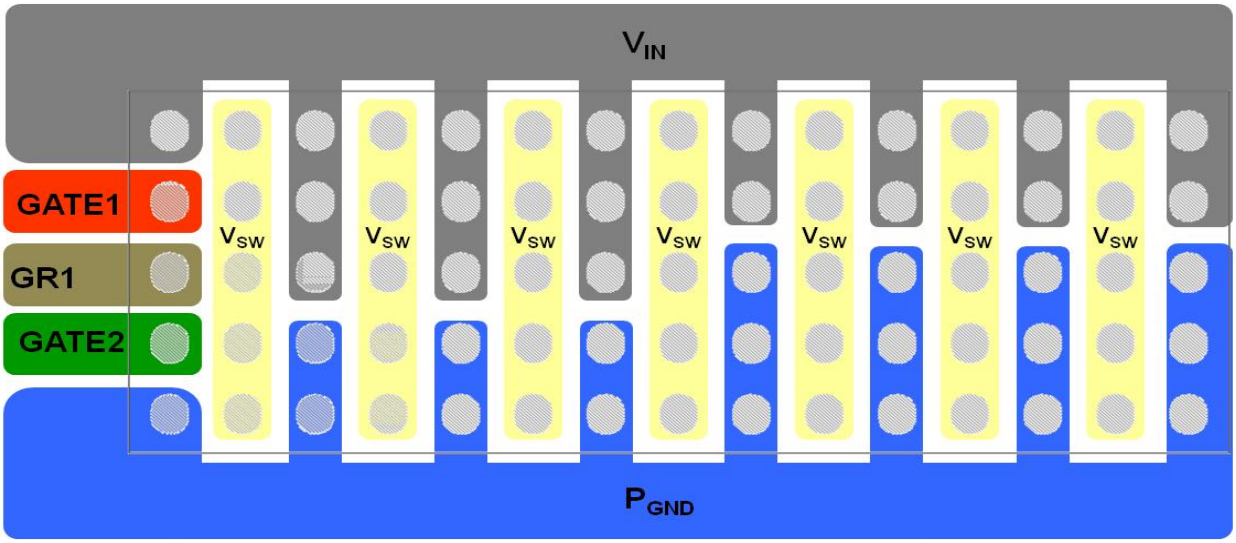
RECOMMENDED STENCIL DESIGN

(Units in µm)



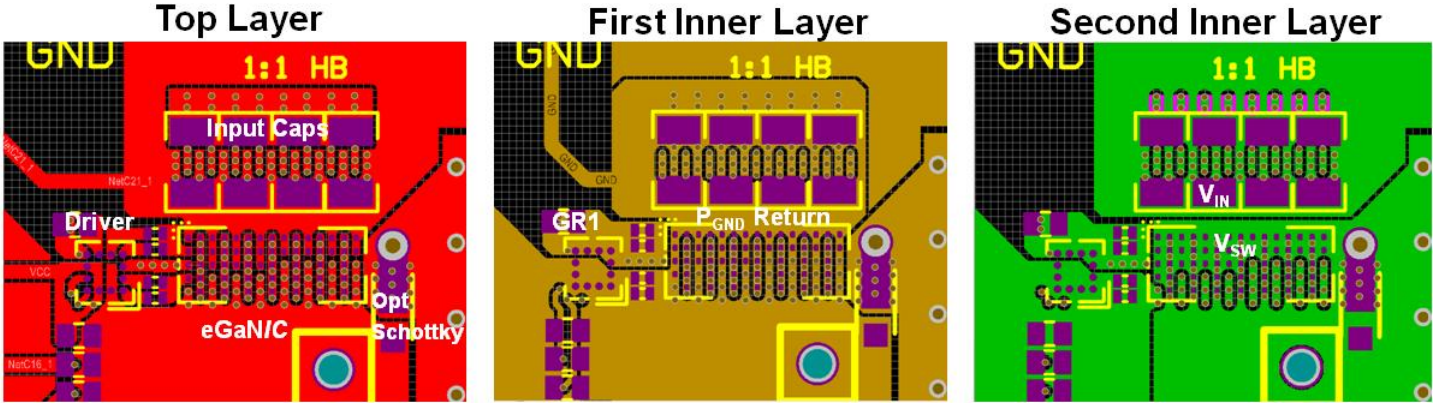
Recommended stencil should be 4mil (100µm) thick, must be laser cut, openings per drawing.
Intended for use with SAC305 Type 4 solder, reference 88.5% metals content
Additional assembly resources available at http://epc-co.com/epc/DesignSupport/AssemblyBasics.aspx

RECOMMENDED PCB LAYOUT



Land pattern is solder mask defined

PCB LAYOUT EXAMPLE



Recommended PCB Layout

Gerber Files available at:
http://epc-co.com/epc/documents/gerber-files/EPC9039%20Development%20Board%20Gerbers.zip
Assembly Resources at: http://epc-co.com/epc/DesignSupport/AssemblyBasics.aspx

Revised December, 2015