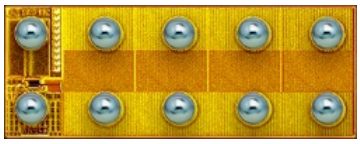
EPC2112 – 200 V, 10 A Integrated Gate Driver eGaN® IC

Preliminary Datasheet

FEATURES:

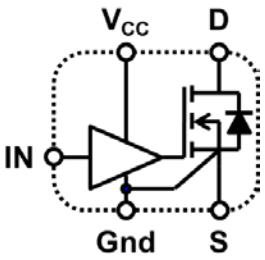
- Integrated Gate Driver
  - – Low Propagation Delay
  - – Up to 7 MHz Operation
  - – Operates from 5 V Supply
- 200 V, 40-mΩ eGaN FET
- Low Inductance 2.9 mm x 1.1 mm BGA



EPC2112 devices are supplied only in passivated die form with solder balls

Die Size: 2.9 mm x 1.1 mm

Schematic Diagram



APPLICATIONS:

- Wireless Power (Highly Resonant and Inductive)
- High Frequency DC-DC Conversion

DESCRIPTION

The EPC2112 enhancement-mode gallium-nitride (eGaN®) integrated driver and FET consists of a 40-mΩ, 200 V eGaN power transistor and an optimized gate driver in a low inductance 2.9 mm by 1.1 mm surface-mount BGA.

The EPC2112 monolithic IC enables designers to improve efficiency, save space, and lower costs compared to silicon-based solutions. The ultra-low capacitance and zero reverse recovery of the eGaN FET enables efficient operation in many topologies. The integrated driver is specifically matched to the GaN device to yield optimal performance under various operating conditions. Performance further enhanced due to the small, low inductance footprint. Monolithic integration eliminates interconnect inductances for higher efficiency at high frequency. This is especially important for high frequency applications such as resonant wireless power.

ABSOLUTE MAXIMUM RATINGS

Maximum Ratings			
V_{DS}	Drain-to-Source Voltage (Continuous)	200	V
I_D	Continuous (T_A = 25˚C, $R_{\theta JA}$= 18 ˚C/W)	10	A
	Pulsed (25˚C, T_{PULSE} 300 µs)	40	
V_{IN}	Input Signal Voltage	6	V
T_J	Operating Temperature	-40 to 150	˚C
T_{STG}	Storage Temperature	-40 to 150	
V_{CC}	Supply Voltage	6	V

RECOMMENDED OPERATING CONDITIONS

Recommended Operating Conditions					
PARAMETER	**Description**	**MIN**	**TYP**	**MAX**	**UNIT**
V_{DS}	Drain-Source voltage			160	V
V_{CC}	Driver Supply voltage	4.5	5	5.5	V
I_{CC}	External driver supply current[1]			50	mA
$V_{IN,Off}$	Input signal for turn-off			0.5	V
$V_{IN,On}$	Input signal for turn-on	4.5			V
$V_{IN,slew}$	Input signal slew rate	0.25			V/ns
T_J	Operating Temperature	-40		150	°C

[1] For up to maximum operating frequency

THERMAL INFORMATION

Thermal Characteristics			
		TYP	**Unit**
$R_{\theta JC}$	Thermal Resistance, Junction to Case	1.7	˚C/W
$R_{\theta JB}$	Thermal Resistance, Junction to Board	20	˚C/W
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient[2]	66	˚C/W

[2] $R_{\theta JA}$ is determined with the device mounted on one square inch of copper pad, single layer 2 oz copper on FR4 board.
Thermal models for EPC devices available at http://epc-co.com/epc/DesignSupport/DeviceModels.aspx

ELECTRICAL CHARACTERSTICS

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	Unit
eGaN POWER TRANSISTOR						
BV_{DSS}	Drain-to-Source Voltage	V_{CC} = 0 V, V_{IN} = 0 V, I_D = 125 µA	200			V
I_{DSS}	Drain -Source Leakage	V_{DS} = 160 V, T_J = 25 °C		20	100	µA
$R_{DS(ON)}$	Drain-Source On-Resistance	V_{CC} = 5 V, T_J = 25 °C		32	40	mΩ
V_{SD}	Source-Drain Forward Voltage	V_{CC} = 5 V, V_{IN} = 0 V, I_{SD} = 0.5 A		2		V
C_{OSS}	Output Capacitance	V_{IN} = 0 V, V_{CC} = 5 V, V_{DS} = 100 V, f = 1 MHz		150		pF
$C_{OSS(ER)}$	Energy Output Capacitance, Energy Related [3]	V_{IN} = 0 V, V_{CC} = 5 V, V_{DS} = 0 to 100 V		175		
$C_{OSS(TR)}$	Energy Output Capacitance, Energy Related [4]			233		
Q_{OSS}	Output Charge	V_{IN} = 0 V, V_{CC} = 5 V, V_{DS} = 100 V, V_{GS} = 0 V		24		nC
Q_{RR}	Source-Drain Recovery Charge			0		

[3] $C_{OSS(ER)}$ is a fixed capacitance that gives the same stored energy as C_{OSS} while V_{DS} is rising from 0 to 50% BV_{DSS}

[4] $C_{OSS(TR)}$ is a fixed capacitance that gives the same charging time as C_{OSS} while V_{DS} is rising from 0 to 50% BV_{DSS}

ELECTRICAL CHARACTERSITCS

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	Unit
DRIVER SUPPLY						
$I_{VCC, ON}$	Quiescent current (average)	V_{IN} = 5 V, V_{CC} = 5 V, V_{DS} = 0 V		4		mA
$I_{VCC, OFF}$	Quiescent current (average)	V_{IN} = 0 V, V_{CC} = 5 V, V_{DS} = 0 V		4		
$I_{VCC, OP}$	Operating Current	50% duty cycle, V_{CC} = 5 V, f_{SW} = 1 MHz		6.5		
V_{IH}	Turn-on Input pin, logic high	V_{CC} = 5 V	4.0			V
V_{IL}	Turn-off Input pin, logic low	V_{CC} = 5 V			0.7	

SWITCHING CHARACTERISTICS

Switching Characteristics						
PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
DRIVER[5]						
$t_{pd,on}$	Propagation delay, turn on	V_{CC} = 5 V, V_{DS} = 160 V, I_L = 4 A		2.7		ns
t_{rise}	Rise Time			2.7		ns
t_{on}	Total turn-on time			8.5		ns
$t_{pd,off}$	Propagation delay, turn off			16.9		ns
t_{fall}	Fall Time			5.5		ns
t_{off}	Total turn-off time			26.5		ns
t_{MIN}	Minimum on-time	V_{CC} = 5 V, V_{BUS} = 160 V		9.2		ns
t_{MAX}	Maximum on-time	V_{CC} = 5 V, I_{DS} = 0.5 A		40		ms

[5] See application circuit, Figure 4 & 5

TYPICAL CHARACTERSITCS

Figure 1: Normalized On-State Resistance vs Temperature

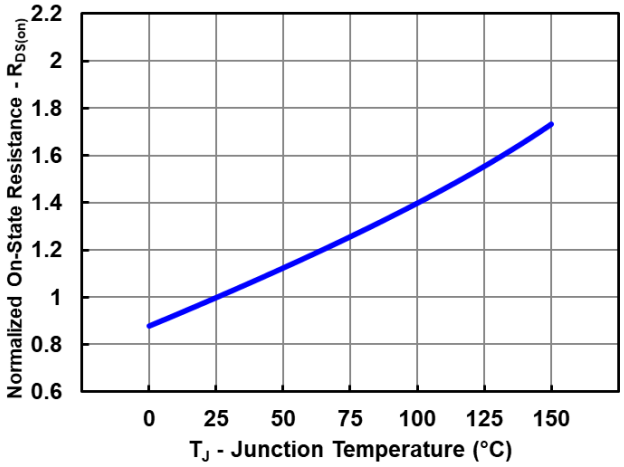


Figure 2: Capacitance (Linear Scale)

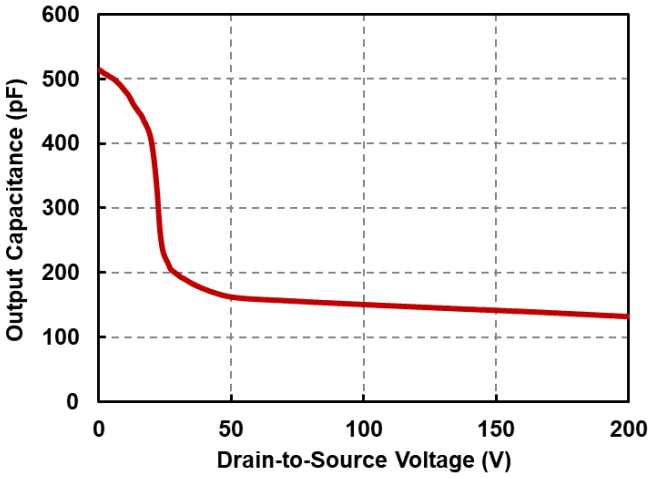


Figure 3: Output Charge and C_{OSS} Stored Energy

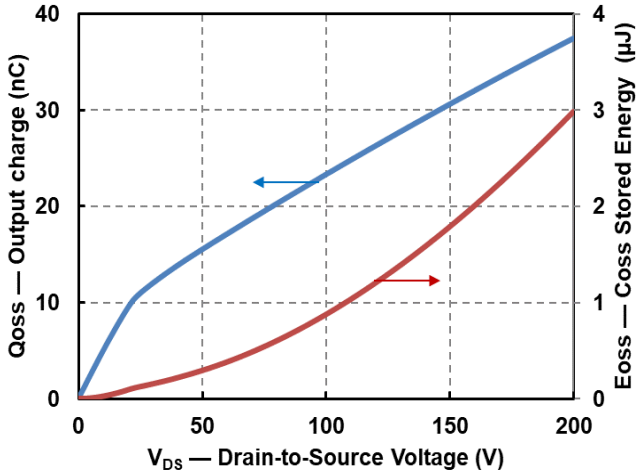


Figure 4: Double pulse Test Definitions

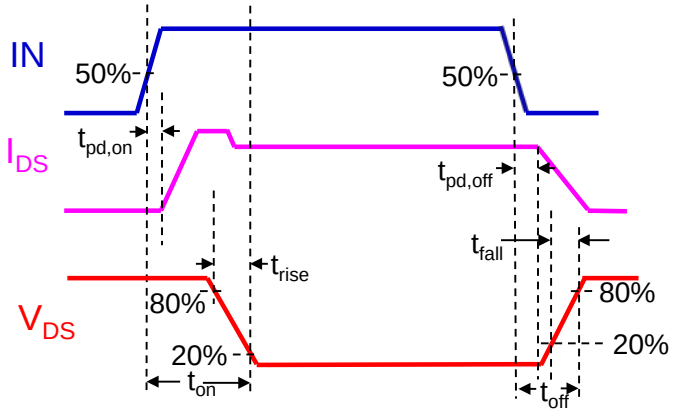
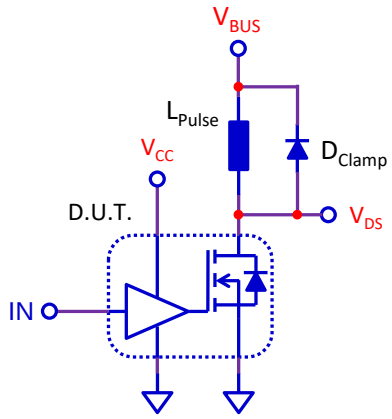
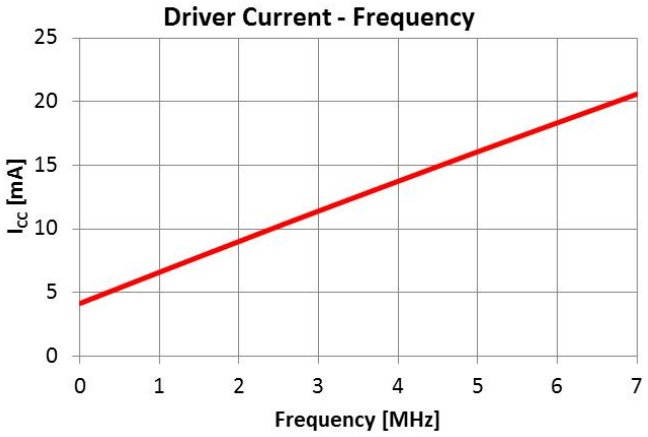


Figure 5: Double pulse Test Circuit



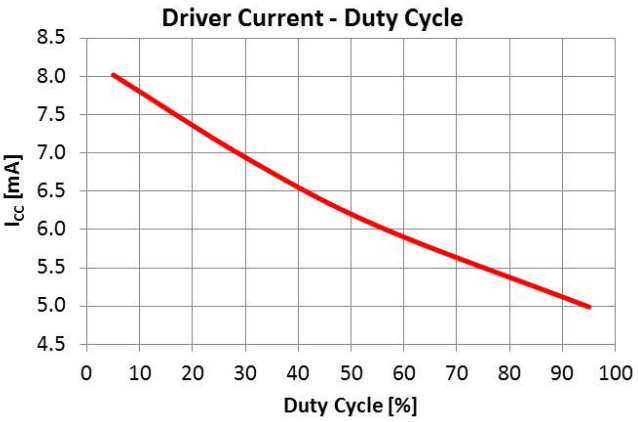
L_{Pulse} = 33 µH
D_{Clamp} = MBR2H200SFT3G (OnSemi)

Figure 6: Driver quiescent current as function of frequency



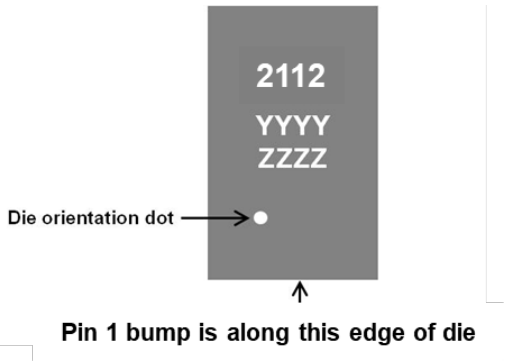
(50% duty cycle, V_{CC}= 5 V, V_{DS} = 0 V)

Figure 7: Driver quiescent current as function of duty cycle



(1 MHz, V_{CC}= 5 V, V_{DS} = 0 V)

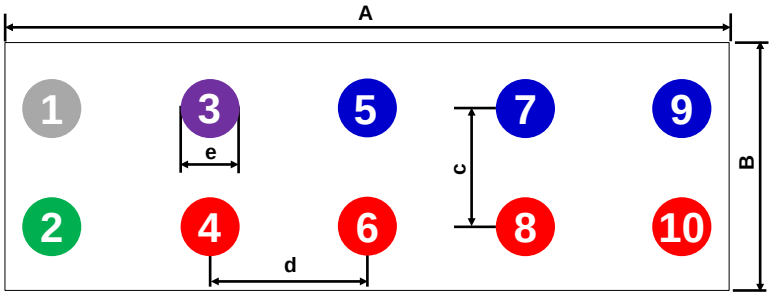
DIE MARKINGS



Part Number	Laser Marking		
	Part # Marking Line 1	Lot Date Code Marking Line 2	Lot Date Code Marking Line 3
EPC2112ENGRT	2112	YYYY	ZZZZ

DIE OUTLINE

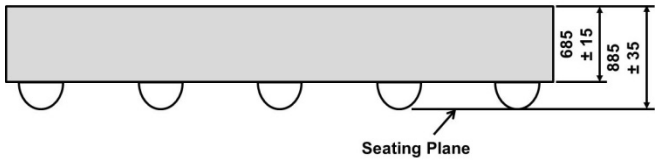
Solder Bump View



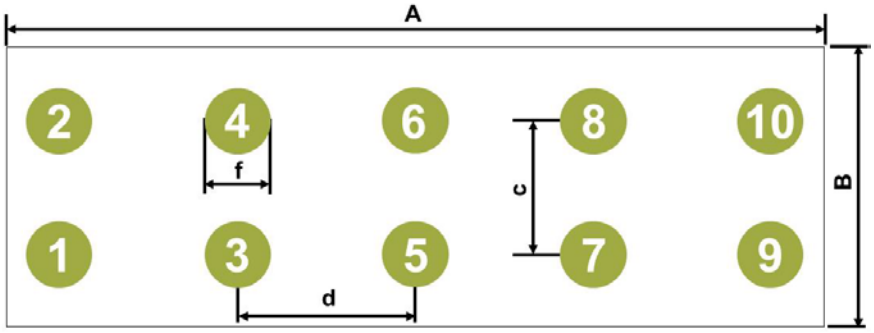
DIM	MICROMETERS		
	MIN	Nominal	MAX
A	2870	2900	2930
B	1070	1100	1130
c		600	
d		600	
e	238	264	290

Pad 1 is Input;
Pad 2 is V_{CC};
Pad 3 is Gnd;
Pads 4, 6, 8, 10 are Drain;
Pads 5, 7, 9 are Source

Side View



RECOMMENDED LAND PATTERN
(Units in µm)

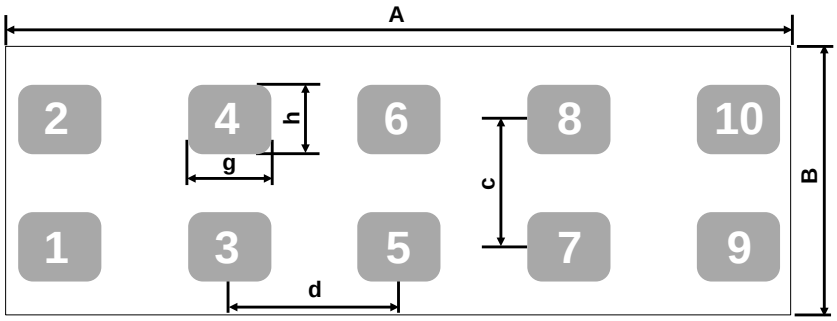


DIM	MICROMETERS
A	2900
B	1100
c	600
d	600
f	230

The land pattern is solder mask defined. Copper is larger than the solder mask opening.

RECOMMENDED STENCIL DESIGN
(Units in µm)

Back Side View (Bump on Bottom)



DIM	MICROMETERS
A	2900
B	1100
c	600
d	600
g	300
h	250

Intended for use with SAC305 Type 4 solder, reference 88.5% metals content.

Recommended stencil should be 4mil (100µm) thick, laser cut. The corner has a radius of R60.

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

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