

Enhancement-Mode Gallium Nitride Technology



The End of the Road for Silicon...

Disruptive solutions offer a path to new levels of end product differentiation...*Gallium nitride is a disruptive solution!*

Advantages of GaN FETs and ICs vs. silicon in your power designs:

- **Faster switching speed**
- **Smaller size**
- **Higher efficiency**
- **Lower cost**

The Ascent of GaN

Redefining Power Conversion with Gallium Nitride Integrated Circuits



GaN Enables New Capabilities

- **Lower on resistance** – lower conductance losses
- **Faster devices** – less switching losses and no reverse recovery
- **Less capacitance** – less losses when charging and discharging devices
- **Less power** needed to drive the circuit
- **Smaller devices** take up less space on the printed circuit board
- **Lower cost**

GaN is Easy To Use

- **Works like an N-channel MOSFET only MUCH faster**
- **Integration** – saves space, improves efficiency, simplifies design, AND lowers cost.
- **Comprehensive design support** – device models, application notes, demo boards, technical articles

GaN is Cost Effective

- **GaN on silicon** – inexpensive substrate
- **Built in existing CMOS fab** – mature, low cost process
- **Lowers system cost** – smaller and fewer passive components

GaN is Reliable

Automotive (AEC-Q101) Qualified

- **Proven technology** - Hundreds of billions of hours of field operation with performance unmatched by silicon power devices
- **Secure supply chain**
- **GaN is inherently radiation tolerant**

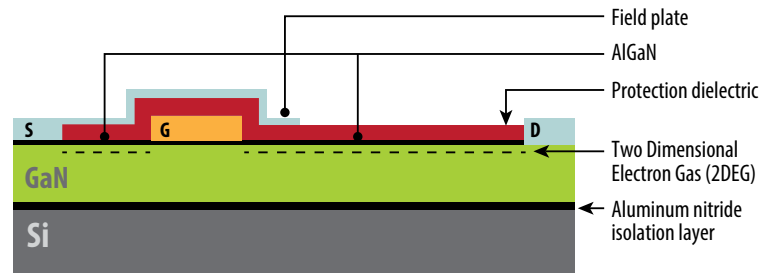
Enhancement-Mode Gallium Nitride (eGaN®) Transistors and Integrated Circuits

A GaN transistor is a wide bandgap device with superior conductivity compared to traditional silicon transistors resulting in smaller devices and lower capacitance for the same $R_{DS(on)}$.

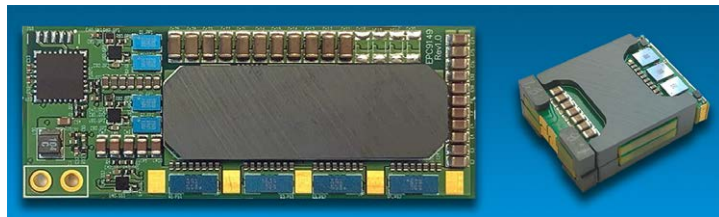
Enhancement-mode (normally-off) operation allows power designers to take advantage of the performance benefits of gallium nitride in a switching application.

Capacitance and inductance impede switching speed. eGaN FETs' small size and lateral structure give ultra low capacitance while the chip-scale packaging gives low inductance enabling unprecedented switching performance in terms of speed, voltage overshoot and ringing. Zero Q_{RR} also reduces losses at high frequency.

The switching performance of eGaN FETs and ICs enables higher power density, higher frequency, higher switching precision, higher bus voltage, and less voltage overhead. The technology can be scaled over many power and voltage levels.



eGaN transistors and ICs are faster
Smaller, more efficient, and lower cost.

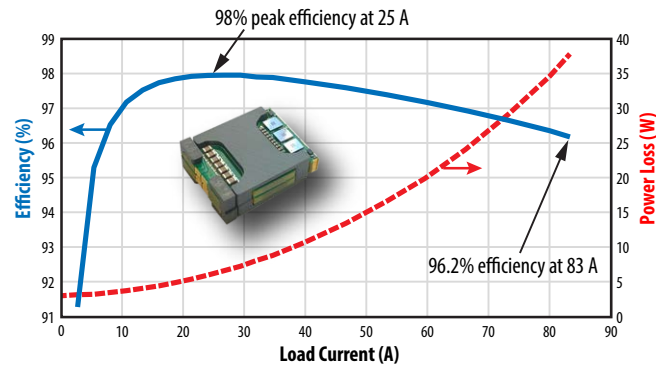


1 kW LLC - Circa 2021
1266 W/in³

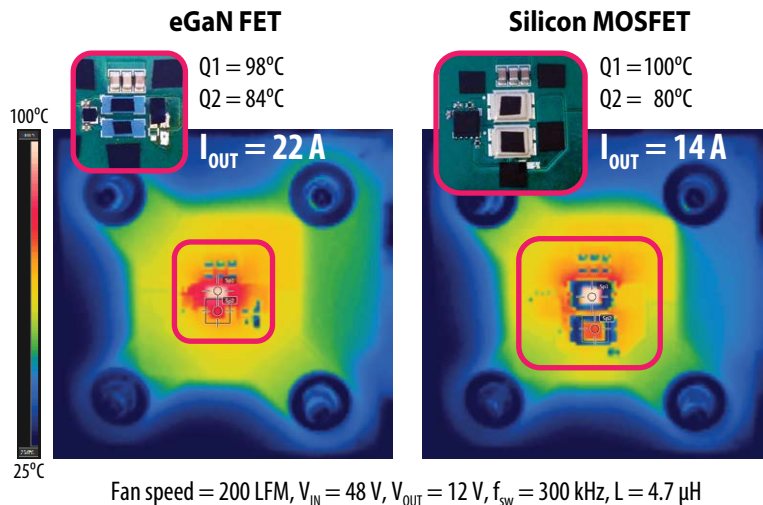
1 kW LLC - Circa 2023
5130 W/in³

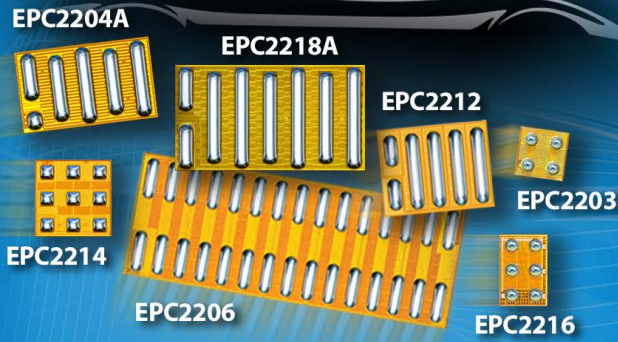
Faster transistors ... smaller systems

eGaN transistors and ICs are more efficient
Increased efficiency AND power.



eGaN transistors and ICs are more thermally efficient for unmatched power density
eGaN FET design delivers 60% more output power in less than half the board area.





1st GaN Chip-Scale AEC-Q101 Qualified FETs in the World!

eGaN FETs and ICs

Table data subject to change. Please visit: www.epc-co.com/epc/products/gan-fets-and-ics

(15 V – 80 V)

Part Number	Configuration	V _{DS}	Max R _{DS(on)} (mΩ) @ 5 V _{GS}	Q _G typ (nC)	Q _{GS} typ (nC)	Q _{GD} typ (nC)	Q _{OSS} typ (nC)	Q _{RR} (nC)	I _D (A)	Pulsed I _D (A)	Package (mm)	Development Board
EPC2216	Single – AEC-Q101	15	26	0.87	0.21	0.13	0.53	0	3.4	28	BGA 0.85 x 1.2	EPC9144
EPC2111	Half Bridge	30	19 8	1.7 4.5	0.6 1.4	0.3 0.8	3.3 9.6	0	16	50 140	BGA 3.5 x 1.5	EPC9086
EPC2100	Half Bridge	30	8.2 2.1	3.6 15	1.3 4.8	0.6 2.7	6.1 29	0	10 40	100 400	BGA 6.05 x 2.3	EPC9036
EPC2014C	Single	40	16	2	0.7	0.3	4	0	10	60	LGA 1.7 x 1.1	EPC9005C
EPC2055	Single	40	3.6	6.6	2.3	0.7	13	0	29	161	LGA 2.5 x 1.5	EPC90132
EPC2067	Single	40	1.55	17.1	5.3	2	37	0	69	409	LGA 2.85 x 3.25	EPC90138
EPC2066	Single	40	1.1	25	8.9	3.2	59	0	90	639	LGA 6.05 x 2.3	EPC90149
EPC2035	Single	60	45	0.88	0.25	0.16	2.6	0	1.7	24	BGA 0.9 x 0.9	EPC9049
EPC2102	Half Bridge	60	4.9	8	2.5	1.5	26 31	0	30	220	BGA 6.05 x 2.3	EPC9038
EPC2031	Single	60	2.6	16	5	3.2	48	0	48	450	BGA 4.6 x 2.6	EPC9061
EPC2101	Half Bridge	60	11.5 2.8	3.3 13	1.1 3.9	0.5 2.2	9.3 45	0	10 40	80 350	BGA 6.05 x 2.3	EPC9037
EPC2219	Single with Gate Diode – AEC-Q101	65	3300	0.044	0.02	0.004	0.104	0	0.5	0.5	BGA 0.9 x 0.9	n/a
EPC8002	Single	65	480	0.133	0.057	0.015	0.344	0	2	2	LGA 2.05 x 0.85	EPC9022
EPC2203	Single – AEC-Q101	80	80	0.67	0.22	0.12	3.6	0	1.7	17	BGA 0.9 x 0.9	n/a
EPC2214	Single – AEC-Q101	80	20	1.8	0.5	0.3	8	0	10	47	BGA 1.35 x 1.35	n/a
EPC2252	Single – AEC-Q101	80	11	3.5	1	0.5	15	0	8.2	75	BGA 1.5 x 1.5	EPC9179
EPC2103	Half Bridge	80	5.5	6.5	2.2	1.1	30 / 34	0	30	195	BGA 6.05 x 2.3	EPC9039
EPC2204A	Single – AEC-Q101	80	6	5.7	1.8	0.8	25	0	29	125	LGA 2.5 x 1.5	n/a
EPC2065	Single	80	3.6	9.4	2.6	1.7	33	0	60	215	LGA 3.5 x 2	EPC90137
EPC2218A	Single – AEC-Q101	80	3.2	10.5	3.2	1.5	46	0	60	231	LGA 3.5 x 1.95	n/a
EPC2105	Half Bridge	80	14.5 3.6	2.7 11	0.9 3	0.5 2.1	11 51	0	10 40	70 300	BGA 6.05 x 2.3	EPC9041
EPC2206	Single – AEC-Q101	80	2.2	15	4.1	3	72	0	90	390	LGA 6.05 x 2.3	EPC90122
UP1966E	Half Bridge Driver IC	80									BGA 1.6 x 1.6	EPC90123

(100 V – 350 V)

Part Number	Configuration	V _{DS}	Max R _{DS(on)} (mΩ) @ 5 V _{GS}	Q _G typ (nC)	Q _{GS} typ (nC)	Q _{GD} typ (nC)	Q _{OSS} typ (nC)	Q _{RR} (nC)	I _D (A)	Pulsed I _D (A)	Package (mm)	Development Board
EPC2038	Single with Gate Diode	100	3300	0.044	0.02	0.004	0.134	0	0.5	0.5	BGA 0.9 x 0.9	EPC9507
EPC2037	Single	100	550	0.115	0.032	0.025	0.6	0	1.7	2.4	BGA 0.9 x 0.9	EPC9061
EPC2107	Dual with Sync Boot	100	390 3300	0.19 0.044	0.077 0.02	0.041 0.004	0.9/1.25 0.134	0	1.7 0.5	3.8 0.5	BGA 1.35 x 1.35	EPC9063
EPC2036	Single	100	73	0.7	0.17	0.14	3.9	0	1.7	18	BGA 0.9 x 0.9	EPC9050
EPC2106	Half Bridge	100	70	0.73	0.24	0.140	3.96 / 4.68	0	1.7	18	BGA 1.35 x 1.35	EPC9055
EPC2221	Dual Common Source – AEC-Q101	100	58	0.85	0.27	0.19	4.7	0	5	20	BGA 1.35 x 1.35	n/a

eGaN FETs and ICs (continued)

(100 V – 350 V) continued

Part Number	Configuration	V _{DS}	Max R _{DS(on)} (mΩ) @ 5 V _{GS}	Q _G typ (nC)	Q _{GS} typ (nC)	Q _{GD} typ (nC)	Q _{OSS} typ (nC)	Q _{RR} (nC)	I _D (A)	Pulsed I _D (A)	Package (mm)	Development Board
EPC2051	Single	100	25	1.8	0.6	0.3	7.3	0	1.7	37	BGA 1.3 x 0.85	EPC9091
EPC2212	Single – AEC-Q101	100	13.5	3.2	0.9	0.6	18	0	18	75	BGA 1.5 x 1.5	EPC9092
EPC2044	Single	100	10.5	4.3	1.3	0.5	15	0	9.4	89	BGA 2.5 x 1.5	EPC90128
EPC2104	Half Bridge	100	6.8	6.8	2.3	1.4	35/41	0	30	180	BGA 6.05 x 2.3	EPC9040
EPC2204	Single	100	6	5.7	1.8	0.8	25	0	29	125	LGA 2.5 x 1.5	EPC9097
EPC2306	Single	100	3.8	11.0		1.1	41	0	48	197	QFN 3 x 5	EPC90145
EPC2619	Single	100	3.3	8.3	2.1	1	27	0	164	150	LGA 2.5 x 1.5	EPC90153
EPC2088	Single	100	3.2	12.5	4.4	1.4	47	0	60	231	LGA 3.5 x 1.95	EPC90123
EPC2071	Single	100	2.2	18	6	1.8	71	0	64	350	LGA 4.45 x 2.3	EPC90146
EPC2302	Single	100	1.8	23	8	2.3	85	0	101	408	QFN 3 x 5	EPC90142
EPC2361	Single	100	1.0 (typ)	28	7.2	2.5	86	0	101	408	QFN 3 x 5	EPC90156
EPC2110	Dual Common Source	120	110	0.8	0.25	0.18	4	0	101	519	QFN 3 x 5	EPC90156
EPC2308	Single	150	6	11	3.8	1.3	50	0	48	157	QFN 3 x 5	EPC90148
EPC2305	Single	150	4	21	6.3	2.6	105	0	80	329	QFN 3 x 5	EPC90143
EPC2234	Single	160	8	11.1	3.8	2.0	96	0	48	213	BGA 4.6 x 2.6	n/a
EPC2059	Single	170	9	5.7	1.3	0.9	35	0	24	102	LGA 2.8 x 1.4	EPC9098
EPC2012C	Single	200	100	1	0.3	0.2	10	0	5	22	LGA 1.7 x 0.9	EPC9004C
EPC2054	Single	200	43	2.9	0.9	0.30	15	0	3.0	32	BGA 1.3 x 1.3	EPC9094
EPC2207	Single	200	22	4.5	1.3	0.7	23	0	14	54	LGA 2.8 x 0.9	EPC90124
EPC2307	Single	200	10	10.6		1.3	58	0	48	130	QFN 3 x 5	EPC90150
EPC2215	Single	200	8	13.6	3.3	2.1	69	0	32	162	LGA 4.6 x 1.6	EPC9099
EPC2304	Single	200	5	21	0.0	2.6	115	0	102	260	QFN 3 x 5	EPC90140
EPC2050	Single	350	80	2.9	1.3	0.3	35	0	6.2	26	BGA 1.95 x 1.95	EPC90121

Rad Hard GaN FETs

Part Number	Configuration	V _{DS}	Max R _{DS(on)} (mΩ) @ 5 V _{GS}	Q _G typ (nC)	Q _{GS} typ (nC)	Q _{GD} typ (nC)	Q _{OSS} typ (nC)	Q _{RR} (nC)	I _D (A)	Pulsed I _D (A)	Package (mm)	Development Board
EPC7019	Single – Rad Hard	40	1.5	22	7.6	3.4	51	0	530	150	LGA 6.05 x 2.3	n/a
EPC7001	Single – Rad Hard	40	4	11	3.6	1.7	26	0	60	250	LGA 4.1 x 1.6	n/a
EPC7002	Single – Rad Hard	40	14.5	2.9	1	0.4	6.6	0	10	62	LGA 1.7 x 1.1	n/a
EPC7014	Single – Rad Hard	60	340	142	43	25	764	0	2	4	BGA 0.9 x 0.9	n/a
EPC7003	Single – Rad Hard	100	30	1.8	0.6	0.3	9.4	0	10	42	LGA 1.7 x 1.1	n/a
EPC7004	Single – Rad Hard	100	7	6.4	2.2	1.1	37	0	60	150	LGA 4.1 x 1.6	n/a
EPC7018	Single – Rad Hard	100	3.9	15.2	4	2.6	77	0	90	345	LGA 6.05 x 2.3	n/a
EPC7007	Single – Rad Hard	200	25	5.4	1.5	1	37	0	20	80	LGA 3.6 x 1.6	n/a
EPC7020	Single – Rad Hard	200	11	11.7	3.5	2.2	76	0	39	170	BGA 4.6 x 2.6	n/a

eGaN® Integrated Circuits

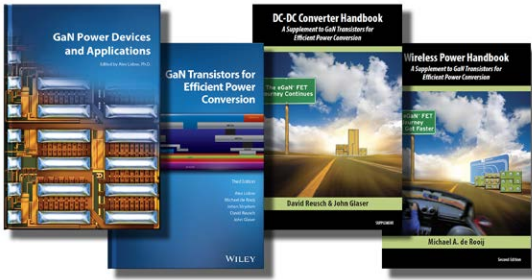
ePower™ Stage

Part Number	Configuration	Function	VPwr	I _{OUT}	I _{OUT} Peak	V _{DD}	Input Logic	F (Max)	UVLO	Package (mm)	Development Board
EPC2152	Half-Bridge ePower™ Stage	ePower™ Stage	80	12.5	90	12	3.3 V	3 MHz	7.5	LGA 3.9 x 2.6	EPC90120
EPC23101	HS FET + Driver + Level Shift	ePower™ Stage	100	65	240	6	5.5 V	3 MHz	0.5–4	QFN 3.5 x 5	EPC90142
EPC23102	HS FET + Driver + Level Shift	ePower™ Stage	100	35	140	6	5.5 V	3 MHz	0.5–4	QFN 3.5 x 5	EPC90147
EPC23103	HS FET + Driver + Level Shift	ePower™ Stage	100	25	61	6	3.3 V or 5 V	3 MHz		QFN 3.5 x 5	EPC90151
EPC23104	HS FET + Driver + Level Shift	ePower™ Stage	100	15	44	6	3.3 V or 5 V	3 MHz		QFN 3.5 x 5	EPC90152

eToF™ Laser Driver IC

Part Number	Configuration	Function	VPwr	I _{OUT}	I _{OUT} Peak	V _{DD}	Input Logic	F (Max)	UVLO	Package (mm)	Development Board
EPC21601	Single	eToF™ Laser Driver	40	3.7	10	5	3.3 V	200 MHz	0	BGA 1 x 1.5	EPC9154
EPC21603	Single	eToF™ Laser Driver	40	3.7	10	5	LVDS	200 MHz	0	BGA 1 x 1.5	EPC9156
EPC21701	Single	eToF™ Laser Driver	80	7.2	15	5	3.3 V	50 MHz	0	BGA 1.7 x 1	EPC9172
EPC21702	Single	eToF™ Laser Driver	100	7.2	30	5 and 10	3.3 V	10 MHz	0	BGA 1.66 x 1.46	n/a

Advancing the Learning Curve



Applications

- **Automotive** – AEC-Q101 Qualified FETs
- **DC-DC Converter** – higher power density
- **Lidar** – Short pulse width at high current equal high resolution imaging
- **Class-D Audio** – smaller with better sound quality
- **Wireless Power** – eGaN FETs and ICs are perfect for 6.78 MHz frequency
- **Envelope Tracking** – Double the efficiency of RF power amplifier
- **Motor Drive** – higher frequency reduces motor size
- **Medical** – enhanced image resolution at lower cost
- **LED Lighting** – higher power density and better control
- **Solar** – Increased efficiency, reduced size, long life time

Demonstration Boards for eGaN FETs and IC's Available:

Part Number	Description	Focus Application	Featured Product
EPC9163	Synchronous, buck or boost, digital controller	DC-DC	EPC2218
EPC9165	Synchronous, buck or boost, digital controller, QFN-packaged GaN FETs	DC-DC	EPC2302
EPC9170	Synchronous, buck, digital controller, GaN power IC	DC-DC	EPC23101, EPC2302
EPC9174	Small (1/8 th brick), LLC, fixed ratio 1:4, bi-directional, for servers	DC-DC	EPC2071, EPC2066
EPC9159	Small, High-Power-Density, Bi-directional LLC, for servers	DC-DC	EPC2619, EPC2067
EPC9158	Small, synchronous buck, analog controller	DC-DC	EPC2218
EPC90135	Parallel, half-bridge (4 parallel FETs)	DC-DC	EPC2218
EPC9166	Boost, analog controller	DC-DC	EPC2218
EPC9157	Small (1/16 th brick), synchronous buck, analog controller, with motherboard	DC-DC	EPC2218
EPC9143	Small (1/16 th brick), synchronous buck, digital controller, with motherboard	DC-DC	EPC2053
EPC9151	Small (1/16 th brick), synchronous buck or boost, featuring Power Stage GaN IC, digital controller, with motherboard	DC-DC	EPC2152
EPC9195	High efficiency, small, single-phase, buck converter	DC-DC	EPC2619
EPC9153	Thin, 1-phase buck	DC-DC	EPC2218
EPC9177	Synchronous, buck, digital controller, GaN power IC	DC-DC	EPC23102
EPC9148	Ultra-thin, multi-level, synchronous, buck	DC-DC	EPC2053
EPC9160	Dual output, analog controller, synchronous, buck	DC-DC	EPC2055
EPC9162	Boost or buck, synchronous	DC-DC	EPC2052
EPC9144	Laser Diode Driver Demo Board, 28 A Pulse Capable	Lidar	EPC2216
EPC9154	Laser Diode Driver Demo Board, 10 A Pulse Capable	Lidar	EPC21601
EPC9156	Laser Diode Driver Demo Board, 10 A Pulse Capable	Lidar	EPC21603
EPC9172	Laser Diode Driver Demo Board, 15 A Pulse Capable	Lidar	EPC21701
EPC9179	Laser Diode Driver Demo Board, 75 A Pulse Capable	Lidar	EPC2252
EPC9181	Laser Diode Driver Demo Board, 125 A Pulse Capable	Lidar	EPC2204A
EPC9180	Laser Diode Driver Demo Board, 230 A Pulse Capable	Lidar	EPC2218A
EPC9150	Laser Diode Driver Demo Board, 220 A Pulse Capable	Lidar	EPC2034C
EPC9176	20 A _{RMS} 3-Phase BLDC Motor Drive Reference Design Board	Motor Drive	EPC23102
EPC9193	20 A _{RMS} 3-Phase BLDC Motor Drive Reference Design Board	Motor Drive	EPC2619
EPC9193HC	40 A _{RMS} 3-Phase BLDC Motor Drive Reference Design Board	Motor Drive	EPC2619
EPC9194	40 A _{RMS} 3-Phase BLDC Motor Drive Reference Design Board	Motor Drive	EPC2302
EPC9173	35 A _{RMS} 3-Phase BLDC Motor Drive Reference Design Board	Motor Drive	EPC23101
EPC9186	150 A _{RMS} 3-Phase BLDC Motor Drive Reference Design Board	Motor Drive	EPC2302
EPC9171	90–265 V _{RMS} Universal AC Input to 15 V–48 V _{DC} , 5 A Output USB PD3.1	AC-DC	EPC2218

See the full listing of available boards at: www.epc-co.com/epc/Products/demo-boards



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For More Information

Please contact info@epc-co.com or your local sales representative
 Visit our website: epc-co.com / Sign-up to receive
 EPC updates at bit.ly/EPCupdates



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GaN POWER BENCH™



EPC's GaN Power Bench™ gives you instant access to cross reference and replace many competitors' silicon-based power management devices with eGaN® FETs. Easily compare parametric differences without opening a single datasheet to identify the eGaN FET to increase your design efficiency. Enter a competitor's part number to find a suggested replacement. This tool is intended to provide cross reference for N-channel MOSFETs from 15 V–350 V.

<https://epc-co.com/epc/design-support/part-cross-reference-search>

