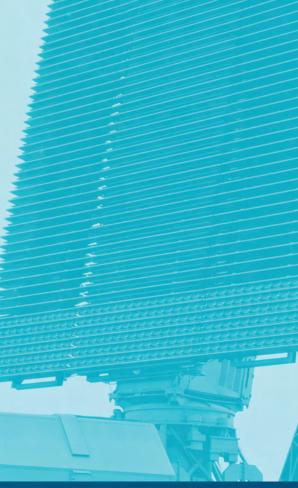




# RF High Power GaN Portfolio





www.macom.com

#### **GaN RF Power Products**

## Next generation high power semiconductor technology

MACOM continues to develop industry-leading gallium nitride (GaN) RF power products. Our product portfolio leverages MACOM's more than 60-year heritage of providing best-in-class standard, application specific and custom solutions for our radar, EW and communications customers.

MACOM GaN products are offered as unmatched transistors, internally matched power transistors, and fully matched power pallets and modules. Using high performance GaN HEMT processes and leveraging our proprietary die layout and assembly techniques, these products exhibit robust thermal properties and excellent RF performance with respect to power, gain, gain-flatness, efficiency and ruggedness for applications up to 3.5 GHz.

MACOM's high power GaN in space-saving plastic is setting the standard for applications where SMT manufacturing, small size and light weight are required. 3 x 6 mm DFN packaged transistors are available in 10, 15, 50, and 90 W power levels. These DFN transistors are also offered in fully matched, high gain, power modules which provide highly integrated, compact solutions.

## Why choose GaN?

MACOM GaN RF transistors improve upon the high power handling and voltage operation of LDMOS with the high frequency performance of GaAs. Improved efficiency, power, density and bandwidth give your applications enhanced performance in a smaller footprint.

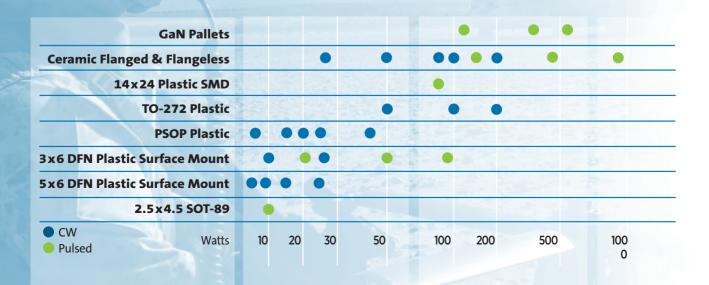
GaN advantages include:

- High breakdown voltage
- Superior power density
- High RF gain and efficiency
- Superior broadband capability
- High frequency operation
- Excellent thermal conductivity

Leveraging deep experience in RF, MACOM engineers are expanding our power transistor family to fuel the future of military and commercial radars. These rugged devices deliver greater flexibility and multi-function capability in your radar communications.

Our growing GaN portfolio includes 5 W-90 W transistors in SOT-89 or DFN plastic packaging, 1000 W ceramic packages and L-, S-band fully matched modules.

Turn to MACOM today and in the future for superior performance, high power GaN solutions. Learn more at www.macom.com





## Radar

GaN in plastic surface mount modules enable SWAP improvements and speed time-to-market for next generation AESA radar systems

#### **Features and Benefits**

- Fully matched over wide bandwidths enables new multifunction system capability with broad frequency operation and complex waveforms
- Small size, SMT enables system SWAP and faster time-to-market through standard surface mount assembly
- High gain and 50 V operation significantly reduces the size of energy storage capacitors and current draw
- · Engineered for SMT assembly with low thermals and low pulse droop

## Description

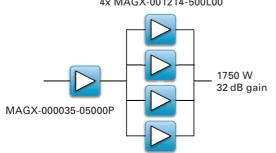
MACOM's portfolio of surface mount, GaN in plastic power modules affords radar system designers a common platform and pin-out architecture to leverage across a growing range of frequency bands. These fully matched, 2-stage GaN power modules deliver 90 W typical output power in a lightweight, 14 x 24 mm package, and deliver breakthrough power performance.

Optimized for commercial air traffic control and military radar applications, the new SMT laminate packaged modules deliver GaN power performance while enabling significant application and manufacturing efficiencies. Supporting standard surface mount assembly, the module leverages commercial best practices for high-volume manufacturing, ensuring additional benefits including improved assembly yield, lower component count, and reduced touch labor. The 2-stage module is internally matched to 50 ohms, which requires no external matching components, and allows reduction in overall part count, further streamlining assembly processes.

Supporting voltage operation from 28 to 50 V with high gain to reduce input power requirements, the module maximizes power and cooling efficiency and provides robust performance over a wide range of input voltages. Flexible voltage operation equips system operators to optimize the module for different power requirements and dynamically manage their total system power budget.

## **Block Diagrams**





 MAGX-001214-125L00
 MAGX-00035-01500P

 MAGX-001214-250L00
 MAGX-000035-01500S

 MAGX-001214-500L00
 MAGX-000035-030000

 MAGX-000035-01500P
 MAGX-000035-045000

 MAGX-000035-01000P
 MAGX-000035-05000P

 MAGX-000035-015000
 MAGX-000035-09000P

 MAGX-000035-015000
 MAGX-000035-015000P

## **Avionics and Air Traffic Control**

MACOM's high power GaN is leading the future of next generation power in Avionics systems.

#### **Features and Benefits**

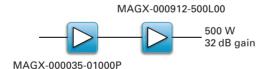
- · High power allows customer to upgrade systems for increased range and performance
- High efficiency reduces the power consumption and cooling requirements of systems
- Increased *ruggedness* provides greater tolerance under demanding operating conditions and improves the reliability of the system
- High *voltage* operation enhances the system performance and reduces the bias current load of power supplies and distribution network

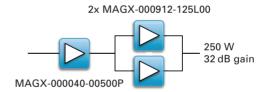
## **Description**

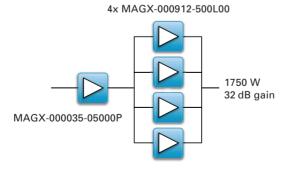
MACOM's high power GaN power transistors optimized for avionics applications offer customers greater performance, flexibility and functionality through the benefits of GaN on SiC technology. A growing family of leading power GaN transistors offer high pulsed power operation of up to 600 W for Avionics applications in the 960-1215 MHz and 1030-1090 MHz bands. The GaN technology offers the customer higher power and efficiency operation in a similar size and footprint compared to LDMOS or Si Bipolar technologies. Furthermore, the inherent higher thermal performance and higher breakdown voltage of GaN benefit the customer with great flexibility in wider-band operation, increased power handling leading to longer pulse lengths and duty cycles and increased ruggedness under load mismatch conditions.

## **Block Diagrams**

#### 960-1215 MHz Line-ups







#### **Avionics Devices**

MAGX-000912-125L00
MAGX-000912-250L00
MAGX-000912-500L00
MAGX-000912-500L00
MAGX-001090-600L00
MAGX-000035-01000P
MAGX-000035-015000
MAGX-000035-015000
MAGX-000035-015000
MAGX-000035-015000
MAGX-000035-030000
MAGX-000035-030000
MAGX-000035-05000P
MAGX-000035-05000P
MAGX-000035-09000P



## ISM / Multi-Market

## MACOM—the first choice for GaN in communications, multi-market and ISM applications

#### **Features and Benefits**

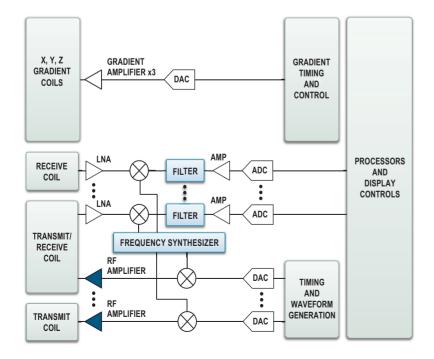
- Broadband, unmatched transistors can be used for a variety of applications including communications, instrumentation and industrial, scientific and medical (ISM)
- Very rugged-allows GaN transistors to withstand high VSWR mismatches during power on/start up and during operation without damaging the transistor
- · High voltage-reduces bias current load on power supply allowing for reduced cost power supplies
- Excellent thermal performance-allows reduced heat sink costs for easier PCB designs
- High RF gain and efficiency
- MTTF of 600 years (channel temperature < 200°C)
- EAR99 export classification

## **Description**

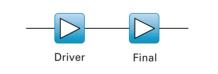
As Gallium Nitride moves from its initial uses in Military and Radar applications to broader classes of products, MACOM is uniquely positioned to enable those markets. With more than a decade of GaN experience and the industry's only dual source wafer fabrication agreement in place for GaN, MACOM satisfies many of the commercial requirements that have limited GaN penetration in broader markets. Packaging choices from ceramic flanged and flangeless to discrete plastic, including plastic laminate modules that enable traditional SMT PCB production techniques. The portfolio of 10, 14, 25, 30, 50, 100 W CW devices allows customers a wide set of options to build line ups for their ISM applications.

## **Block Diagrams**

#### MRI



#### **Small Cell**



 Pout
 Driver
 Final

 1-5 W
 MMIC
 MAGX-00035-01000X

 10-20 W
 MAGX-000040-00500P
 MAGX-000035-030000

 10-20 W
 MAGX-000035-01000X
 MAGX-000035-030000

#### **ISM Devices**

MAGX-000025-150000 MAGX-000035-01000X MAGX-000035-015000 MAGX-000035-01500S MAGX-000035-030000 MAGX-000035-045000 MAGX-000040-00500P MAGX-000245-014000 MAGX-000245-025000



MATR-GCHJ04-022050       1       4000         MATR-GCHJ04-066050       1       4000         MAGX-000025-150000       1       2500         MAGX-000040-00500P       1       4000         MAGX-000035-01000P       1       3500         MAGX-000035-01500P       1       3500         MAGX-000035-05000P       1       3500         MAGX-000035-015000       1       3500         MAGX-000035-015000       1       3500         MAGX-000035-045000       1       3500         MAGX-000912-125L00       960       1215         MAGX-000912-250L00       960       1215	50 50 50 50 50 50 50	15 50 60 150 5 10 15 50	15 11.3 18 18 13 11 14.8 14 19.5 14.2 18	3000 1000 300 1000 3000 1000 3000 1000	10 10 20 10 20 10 20 10 20	1200-1400 27 00 - 3500 1030 - 1090 1200-1400 1600 1600	29.0 × 17.8 × 4.8 4.5 × 4.0 × 1.5 6.0 × 3.0 × 0.9
MAGX-000025-150000       1       2500         MAGX-000040-00500P       1       4000         MAGX-000035-01000P       1       3500         MAGX-000035-01500P       1       3500         MAGX-000035-05000P       1       3500         MAGX-000035-09000P       1       3500         MAGX-000035-015000       1       3500         MAGX-000035-015000       1       3500         MAGX-000035-045000       1       3500         MAGX-000035-045000       1       3500         MAGX-000035-045000       1       3500	50 50 50 50 50	60 150 5 10 15	18 18 13 11 14.8 14 19.5 14.2	300 1000 3000 1000 3000 1000 3000	20 10 20 10 20 10	1030 - 1090 1200 - 1400 1600 1600	4.5 x 4.0 x 1.5 6.0 x 3.0 x 0.9
MAGX-000040-00500P       1       4000         MAGX-000035-01000P       1       3500         MAGX-000035-01500P       1       3500         MAGX-000035-05000P       1       3500         MAGX-000035-09000P       1       3500         MAGX-000035-015000       1       3500         MAGX-000035-01500S       1       3500         MAGX-000035-045000       1       3500         MAGX-000035-045000       1       3500         MAGX-000912-125L00       960       1215	50 50 50 50	5 10 15 50	13 11 14.8 14 19.5 14.2	1000 3000 1000 3000 1000 3000	10 20 10 20 10	1600 1600	4.5 × 4.0 × 1.5 6.0 × 3.0 × 0.9
MAGX-000035-01000P       1       3500         MAGX-000035-01500P       1       3500         MAGX-000035-05000P       1       3500         MAGX-000035-09000P       1       3500         MAGX-000035-015000       1       3500         MAGX-000035-01500S       1       3500         MAGX-000035-045000       1       3500         MAGX-000035-045000       1       3500         MAGX-000912-125L00       960       1215	50 50 50	10 15 50	11 14.8 14 19.5 14.2	3000 1000 3000 1000 3000	20 10 20 10	1600	6.0 x 3.0 x 0.9
MAGX-000035-01500P 1 3500  MAGX-000035-05000P 1 3500  MAGX-000035-09000P 1 3500  MAGX-000035-015000 1 3500  MAGX-000035-01500S 1 3500  MAGX-000035-045000 1 3500  MAGX-000035-045000 1 3500	50	15	14 19.5 14.2	3000 1000 3000	20	1600	
MAGX-000035-05000P 1 3500  MAGX-000035-09000P 1 3500  MAGX-000035-015000 1 3500  MAGX-000035-01500S 1 3500  MAGX-000035-045000 1 3500  MAGX-000035-045000 1 3500	50	50	14.2	3000			60 4 70 4 00
MAGX-000035-09000P 1 3500  MAGX-000035-015000 1 3500  MAGX-000035-01500S 1 3500  MAGX-000035-045000 1 3500  MAGX-0000912-125L00 960 1215				1000		2600	6.0 x 3.0 x 0.9
MAGX-000035-015000 1 3500  MAGX-000035-01500S 1 3500  MAGX-000035-045000 1 3500  MAGX-000912-125L00 960 1215	50	90		1000 3000	10	1600	6.0 x 3.0 x 0.9
MAGX-000035-01500S 1 3500  MAGX-000035-045000 1 3500  MAGX-000912-125L00 960 1215		90	17.5 16.6	1000 3000	10	1600 1300	6.0 x 3.0 x 0.9
MAGX-000035-045000 1 3500 MAGX-000912-125L00 960 1215	50	15	15.5 15	1000 3000	10	12 00 - 1400	14.0 x 8.1 x 3.3
MAGX-000912-125L00 960 1215	50	15	15.5 15	1000 3000	10 20	1200 - 1400	5.6 x 8.1 x 2.4
	50	50 60	11.3 18	1000	10	2700-3500 1030-1090	20.3 × 10.9 × 4.0
MAGX-000912-250L00 960 1215	50	125	20	128	10		20.3 x 15.0 x 4.1
	50	250	19	128	10		20.3 x 15.0 x 4.1
MAGX-000912-500L00 960 1215	50	500	19.8	128	10		34.0 x 19.4 x 3.7
MAGX-000912-500L0S 960 1215	50	500	19.8	128	10		20.6 x 19.4 x 3.7
MAGX-001090-600L00 1030 1090	50	600	21.4	32	2		34.0 x 19.4 x 3.7
MAGX-001090-600L0S 1030 1090	50	600	21.4	32	2		20.6 x 19.4 x 3.7
MAGX-001214-125L00 1200 1400	50	125	19	300	10		20.3 x 15.0 x 4.1
MAGX-001214-250L00 1200 1400	50	250	19	300	10		20.3 x 15.0 x 4.1
MAGX-001214-500L00 1200 1400	50	500	19.2	300	10		34.0 x 19.4 x 3.7
MAGX-001214-500LOS 1200 1400	50	500	19.2	300	10		20.6 x 19.4 x 3.7
MAGX-001214-650L00 1200 1400	50	650	19	300	10		20.6 x 19.4 x 3.7
MAGX-001220-100L00 1200 2000	50	100	14	300	10		20.3 x 10.9 x 4.0
MAGX-002731-100L00 2700 3100	50	100	12	500	10		20.3 x 10.9 x 4.0
MAGX-002731-180L00 2700 3100	50	180	11	300	10		20.3 x 10.9 x 4.0
MAGX-002731-180L0S 2700 3100	50	180	11	300	10		9.7 x 10.9 x 3.5
MAGX-003135-120L00 3100 3500		120	11.8	300	10		20.3 x 10.9 x 4.0

GaN on SiC RF Power Transistors: CW								
Part Number	Min Freq (MHz)	Max Freq (MHz)	Operating Voltage (V)	Output Power (W)	Min. Gain (dB)	Test Freq (MHz)	Package Size (mm)	
MATR-GCHJ04-022050	1	2450	50	14	15.2	2450	Die (0.75 x 0.90 x 0.10)	
MATR-GCHJ04-066050	1	2450	28	25	12	2450	Die (0.75 x 1.70 x 0.10)	
MAGX-000245-014000	1	2450	50	14	15.2	2450	14.0 x 8.1 x 3.3	
MAGX-000245-025000	1	2450	28	25	12	2450	20.3 x 10.9 x 4.0	
MAGX-000035-01000P	1	3500	50	10	14.5	1650	6.0 x 3.0 x 0.9	
MAGX-000035-010000	1	3500	50	10	19	1300	14.0 × 8.1 × 3.3	
MAGX-000035-01000S	1	3500	50	10	19	1300	5.6 x 8.1 x 2.4	
MAGX-000040-00500P	1	4000	50	4	10	2700	4.5 x 4.0 x 1.5	



GaN on SiC Module	es and Palle	ets	_	_	_	_	_	_
Part Number	Min Freq (MHz)	Max Freq (MHz)	Operating Voltage (V)	Output Power (W)	Min. Gain (dB)	Pulse Width (µs)	Duty Cycle (%)	Package Size (mm)
MAMG-000912-090PSM	960	1215	50	90	30	300	10	24.0 x 14.0 x 3.2
MAMG-001214-090PSM	1200	1400	45	90	30.5	1000	10	24.0 x 14.0 x 3.2
MAMG-002735-085PSM	PSM 2700 3500 50	50	50 85	23	1000	10	24.0 × 14.0 × 3.2	
11A110 002733 003F311	2700	3300	30	05	23	750	20	24.0 X 14.0 X 3.2
MAMG-002735-030PSM	2700	3500	50	30	25.5	1000	10	7.0 × 7.0 × 1.4
1 IAI 10 002/33 030F 3PI	2700	3300	30	30	20	750	20	7.0 A 7.0 A 1.4
MAPG-002729-350L00	2700	2900	50	350	11.5	300	10	50.8 x 22.9 x 5.8

GaN Bias Module	es									
Part Number	Positive Supply V <sub>DS1</sub> (V)	Positive Supply V <sub>DS2</sub> (V)	Negative Supply V <sub>GS</sub> (V)	Pulse Enable TTL (V)	Positive Supply I <sub>DS1</sub> (mA)	Positive Supply I <sub>DS2</sub> (mA)	Negative Supply I <sub>GS</sub> (mA)	Peak Output Gate I <sub>GC</sub> (mA)	Open Drain ON/OFF Prop Delay (ns)	Package Size (mm)
MABC-001000-000DPM	10 to 60	N/A	-8 to 0	0/3.3	2.3	N/A	-3	50	100/70	22.5 x 6.5 x 5.0
MABC-001000-00SDPM	10 to 60	4.4 to 5.6	-8 to 0	0/3.3	0	2.2	-3	50	100/70	22.5 x 6.5 x 5.0

GaN on Si RF Po	wer Transistoi	s: CW						
Part Number	Min Freq (MHz)	Max Freq (MHz)	Operating Voltage (V)	Test Freq (MHz)	Output Power P <sub>SAT</sub> (W)	Small Signal Gain (dB)	R <sub>TH</sub> (°C/W)	Package
NPA1006	30	1000	28	500	15	15	4.6	6 x 5 mm DFN-8
NPT1007	0	1200	28	900	200	18	1.0	AC780B-4
NPA1003	20	1500	28	1000	5	18	12	4 x 4 mm QFN-16
NPT1010B	0	2000	28	900	100	20	1.4	AC360B-2
NPT2010	0	2200	48	2100	100	17	1.7	AC360B-2
NPT2022	0	2200	48	900	100	19	1.3	TO272-2
NPT2021	0	2500	48	2100	50	17	1.9	TO272-2
NPA1007	30	2500	28	2000	10	11	7	6 x 5 mm DFN-8
NPA1008	30	2700	28	2500	5	13	17	4 x 4 mm QFN-24
NPT25100B	0	2700	28	2500	90	16	1.8	AC780B-2
NPT1015B	0	3500	28	2500	45	14	2.1	AC360B-2
NPT2020	0	3500	48	2100	50	17	2.3	AC360B-2
NPT35050AB	3300	3800	28	3500	50	13	2.0	AC780B-2
NPT1012B	0	4000	28	3000	25	13	4.0	AC200B-2
NPTB00025B	0	4000	28	3000	25	13	5.3	AC200B-2
16NPTB00004D	0	6000	28	2500	5	17	23.0	SOIC-8
NPTB00004A	0	6000	28	2500	5	17	15.0	SOIC-8
MAGX-011086	0	6000	28	2500	5	17	17.0	4 x 4 mm QFN-24
NPT2018	0	6000	48	2500	12.5.	17.5	6.5	3 x 6 mm DFN-14

GaN on Si RF Power	Transistor	s: Linear	_	_	_	_	_	_
Part Number	Min Freq (MHz)	Max Freq (MHz)	Operating Voltage (V)	Test Freq (MHz)	Output Power P <sub>SAT</sub> (W)	Small Signal Gain (dB)	RTH (°C/W)	Package
NPT25015D	0	3000	28	2500	23*	14	6.3	SOIC-8
NPT1004D	0	3000	28	2500	45*	13	4.3	SOIC-8
NPT35015D	3000	4000	28	3500	18*	11	6.3	SOIC-8
NPT2019	Λ	6000	48	2500	25*	16	3.8	3 x 6 mm DFN-14

 $<sup>^*</sup>$ Typical peak power in linear or pulse applications

## GaN Package Guide



Package by Part Number	Approximate Dimensions (mm)	Package Type	Approximate Dimensions (mm)				
MAGX-000040-00500P	4.5 × 4.0 × 1.5	QFN4x4-24	4.0 × 4.0 × 0.9				
MAGX-000035-01000P MAGX-000035-01500P MAGX-000035-05000P MAGX-000035-09000P	6.0 x 3.0 x 0.9	SOIC-8NE	4.9 × 6.1 × 1.47				
MAMG-001214-090PSM MAMG-000912-090PSM MAMG-002735-085PSM	24.0 × 14.0 × 3.2	DFN3x6-14  TO272-2	6.0 × 3.0 × 1.0				
1AGX-000035-01000S 1AGX-000035-01500S	24.0 × 14.0 × 3.2	AC200B-2	13.97 × 8.13 × 3.1				
MAGX-000035-010000 MAGX-000245-014000 MAGX-000035-015000	13.97 x 8.12 x 3.25	AC360B-2	20.32 × 10.92 × 3.86				
MAGX-000035-045000 MAGX-000245-025000 MAGX-000245-050000 MAGX-000245-100000 MAGX-002731-180L00	20.32 x 10.92 x 3.99	AC360P-2	9.65 x 10.92 x 3.86				
1AGX-000025-150000	28.96 × 17.78 × 4.78	AC780P-2	20.57 x 19.43 x 3.6				
//AGX-000912-125L00 //AGX-000912-250L00 //AGX-001214-125L00 //AGX-001214-250L00	20.32 x 14.96 x 4.11	<u> </u>	масом.				
1AGX-001214-500L0S 1AGX-000912-500L0S 1AGX-001090-600L0S	20.57 x 19.44 x 3.74	AC780B-2	34.04 x 19.43 x 3.6				
1AGX-001214-500L00 1AGX-000912-500L00 1AGX-001090-600L00	34.04 × 19.44 × 3.74	AC780B-4	34.04 × 19.43 × 3.6				
MAGX-001090-1KW000 MAGX-000245-014000 MAGX-000035-015000	41.15 × 16.62 × 5.13		MACOM.				



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