



GaN-on-Si

Product
Selection
Guide

MACOMTM

Partners from RF to Light

www.macom.com

GaN RF Power Products

Next generation high power RF 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: radar, electronic warfare, ISM, RF energy, and wireless communications customers.

MACOM's portfolio of cost-effective RF power products uses our unique GaN-on-Silicon technology to deliver the cost, bandwidth, power density, and efficiency advantages of GaN in a variety of form factors, including unmatched transistors, internally matched power transistors, and full matched power pallets and modules. Power levels of these devices range from 2 W to 500 W P2db CW.

Using our high-performance GaN HEMT processes and our proprietary die layout and assembly techniques, MACOM's products exhibit robust thermal properties and RF performance with respect to power, gain, gain-flatness, efficiency, and ruggedness for applications up to 6 GHz.

MACOM delivers GaN performance at silicon cost structures. Our GaN-on-Silicon transistors and amplifiers improve upon the high power and efficiency performance of LDMOS while also providing the high frequency performance of GaAs.

Why choose GaN?

GaN advantages include:

- > High breakdown voltage
- > Superior power density
- > High RF gain and efficiency
- > GaN performance at silicon cost structures
- > Multi-octave bandwidth
- > High frequency operation
- > Excellent thermal conductivity

For over 45 years, MACOM engineers have been redefining RF power and are now applying their GaN expertise to an array of commercial, industrial, scientific, medical, and wireless applications.

Turn to MACOM for superior performance, high power GaN solutions.

	LDMOS	MACOM GaN on Silicon	Benefits
Power Efficiency	-	>10% Improvement	Lower Operating Costs, Simpler Cooling
Power Density	1-1.5 W/mm	4-6 W/mm	Smaller Footprint and Lower Costs
Easy Matching	difficult	easy	Time-to-Market and Smaller Footprint
Cost and Capacity	Silicon	Silicon	Competitive Cost and Capacity
Linearity	DPD friendly	DPD friendly	Competitive Bill of Materials
Support all ISM Bands	Limited to 2.45 GHz	Can be used at >2.45 GHz	Broader Choice for Your Applications

RF Energy

MACOM GaN enables RF Energy applications with exceptional efficiency and gain

Features and Benefits

- > Higher efficiency and therefore reliability
- > Excellent gain and power in smaller footprint resulting in a lower cost structure
- > Power levels from 2–1000 W
- > Frequencies from 10 MHz to 5.5 GHz
- > Variety of packages to fit different applications from QFN to TO-272 (plastic), ceramic air cavity, and copper air cavity
- > Increased precision and control with our easy to use controllers

Description

Radio frequency (RF) energy applications use controlled electromagnetic radiation to heat items or to power all kinds of processes. Today, magnetron tubes commonly generate this energy. Tomorrow, it will be generated by an all solid-state semiconductor chain.

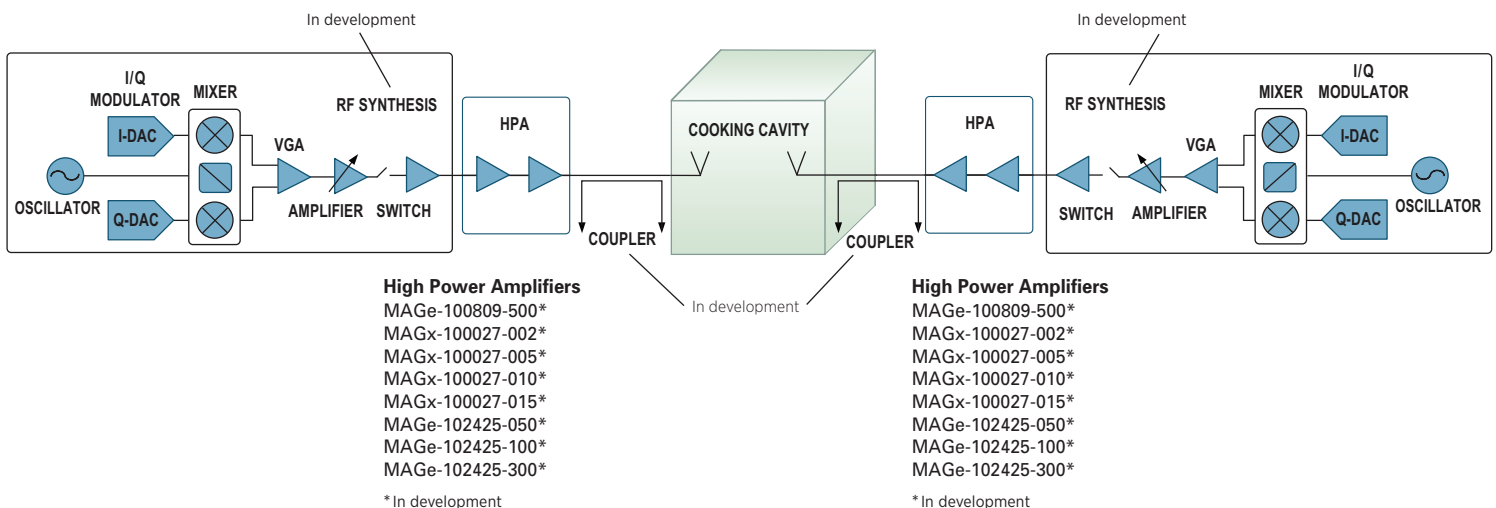
Solid-state RF energy is ideal for applications including low-voltage drive, semiconductor-type reliability, smaller form factor, and an “all-solid-state electronics” footprint. Perhaps its most compelling attributes are fast frequency, phase- and power-agility complemented by hyper-precision. Collectively, the technology’s attributes yield an unprecedented process control range, even energy distribution, and fast adaption to changing load conditions. Ideal for applications including automotive ignition, industrial cooking, industrial heating, welding and drying, medical ablation and skin treatment, plasma street lighting, and plasma surface activation.

As a member of the RF Energy Alliance, MACOM brings GaN technology into mainstream applications such as RF ignition systems, solid-state cooking, and high-lumen plasma lighting.



Block Diagram

RF Energy Cooking System



Basestation

MACOM GaN transforms the network with ease of use and cost effectiveness

Features and Benefits

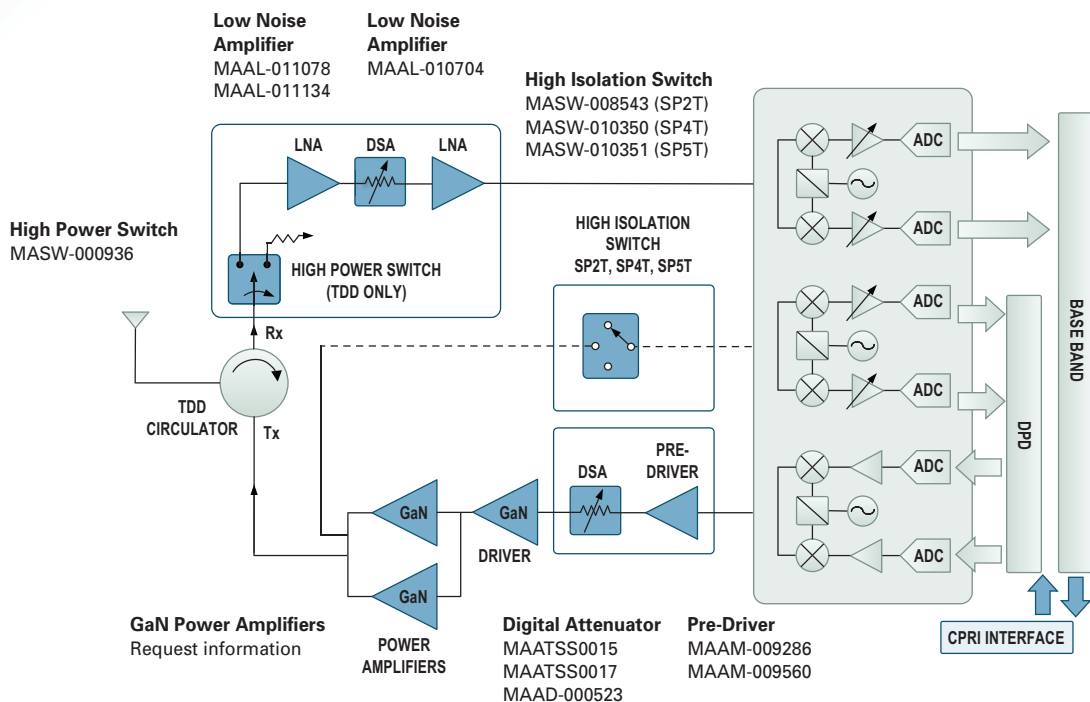
- > Optimized to meet the most demanding bandwidth, performance, and efficiency needs
- > Multi-band system: single radio supporting > 100 MHz of bandwidth
- > High frequency: enables 0.7 GHz to 6 GHz
- > Compact and lightweight: higher power density with smaller package, higher efficiency with smaller heat sink
- > Easy to linearize and correct with standard digital pre-distortion (DPD) systems
- > CapEx savings: smaller PCBs, lower heat sink cost, single GaN device replaces multiple LDMOS devices
- > OpEx Savings: high efficiency reduces utility bill
- > Massive MIMO pre-5G sets new standard for integration with high efficiency and high power density
- > Faster time to market: simpler devices lead to shorter development times, broadband means fewer PAs to deal with when covering all bands, excellent applications support

Description

MACOM's new **MAGb** series is the industry's first commercial basestation-optimized family of GaN transistors to achieve leadership efficiency, bandwidth and power gain with the linearity and cost structure like LDMOS, with a path to better than LDMOS cost. Leveraging MACOM's Gen4 GaN technology, this new series enables wireless carriers to deploy the latest LTE releases and significantly reduce operating expenses at highly competitive price points, with robust and scalable CMOS-like supply chain combined with MACOM's best in class applications and design support team with decades of experience.

Block Diagram

Wireless Access TDD



ISM, Communications & Instrumentation

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

Features and Benefits

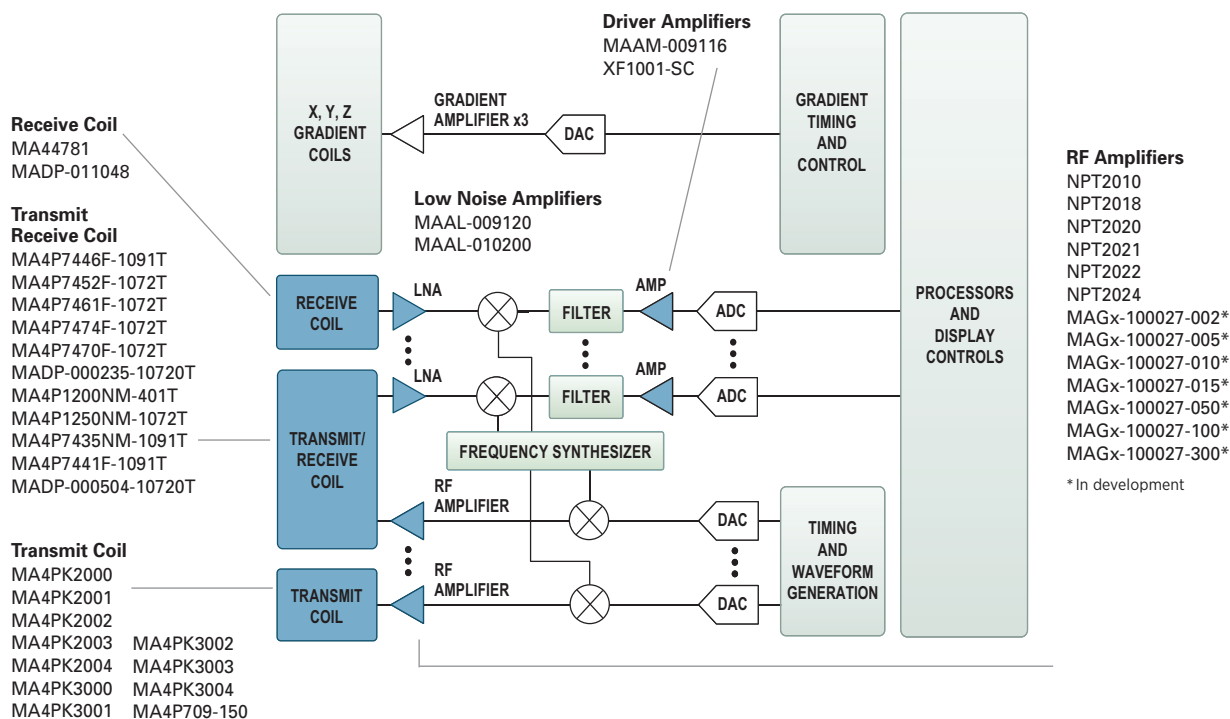
- > Broadband, unmatched transistors can be used for a variety of pulsed and CW applications including communications, instrumentation and industrial, scientific and medical (ISM)
- > Very rugged, allowing GaN transistors to withstand high VSWR mismatches during power on/start up and during operation 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 100 year+ (channel temperature < 200°C)
- > EAR99 export classification

Description

As gallium nitride grows from its initial role in Aerospace & Defense applications to expand into commercial markets, MACOM is uniquely positioned to enable those demanding applications. Leveraging our GaN experience and supply chain, MACOM satisfies many of the commercial requirements that have limited GaN penetration in broader markets. Packaging choices range from ceramic flanged and earless, to discrete plastic, including plastic laminate modules that enable traditional SMT PCB production techniques. The portfolio of 5–600 W devices allows customers a wide set of options to build line-ups for their ISM applications such as: laser and plasma generations, medical, and particle accelerators.

Example Block Diagram

MRI



Aerospace & Defense / MILCOM

MACOM's GaN solutions offer customers the flexibility in designing systems to fit their unique requirements

Features and Benefits

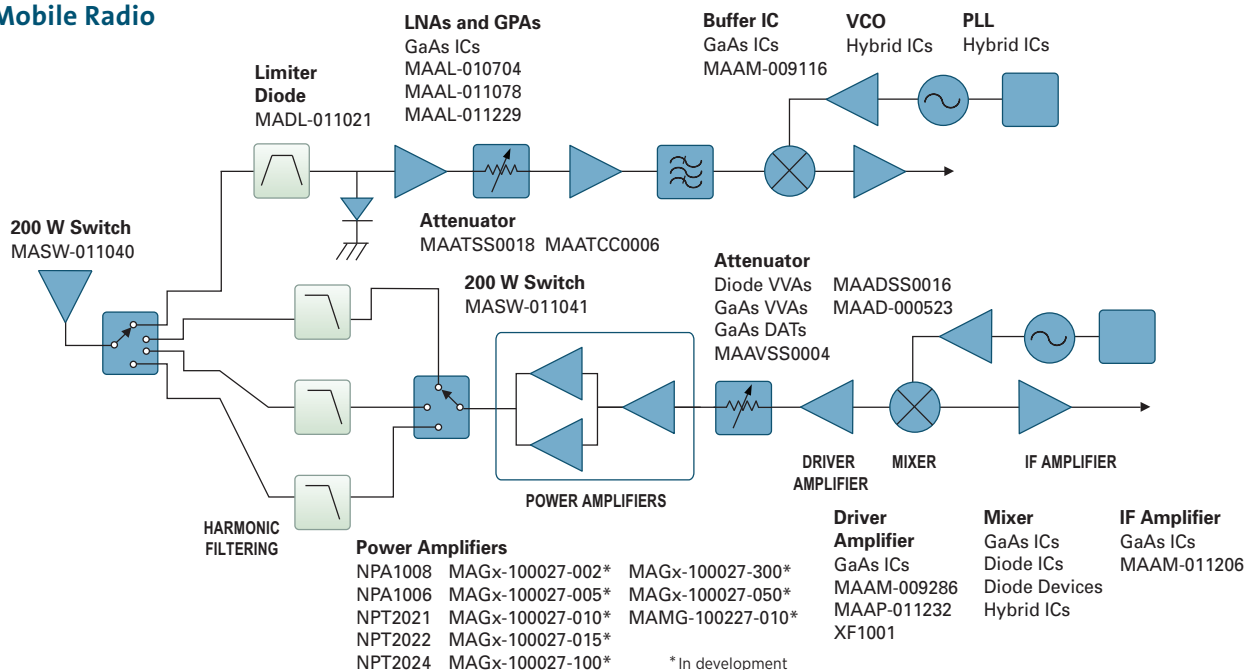
- > Rich heritage in supporting Aerospace & Defense and MILCOM radios for over 65 years and still going strong
- > Extensive portfolio of RF Power Products enable the right system choices
- > GaN-on-Si Power Amplifiers are the best performance-to-cost ratio in the industry
- > Proven track record of high quality and reliability
- > High efficiency for Avionics, L and S-band systems. Same performance as GaN-on-SiC with Silicon-like cost structure.
- > Wideband products enable new multifunction system capabilities requiring complex waveforms and efficient, economical designs
- > Small size, easy to match products enable fast time-to-market
- > High gain and 50 V operation provide efficient operation and significantly reduce size of matching networks
- > MACOM GaN is mature technology, inexpensive, leverages readily available Si process services, and delivers consistent quality
- > Proven track record in non-obsolescence of the legacy Power MOSFET for the last 30-40 years, helping customers to support the A&D market

Description

MACOM's GaN portfolio of plastic power transistors afford Aerospace & Defense and MILCOM system designers the most cost effective solutions across a growing range of frequency bands while not compromising performance. Supporting voltage operation at 50 V with high gain to reduce input power requirements, the transistors maximize power and cooling efficiency and provide robust performance. Engineered using leading edge power transistor packaging techniques and innovative semiconductor designs, MACOM's high power transistor products provide optimal operation for CW and pulsed applications.

Example Block Diagram

Land Mobile Radio



Part Number	Min Freq (MHz)	Max Freq (MHz)	Operating Voltage (V)	Output Power Psat (W)	Gain (dB)	Efficiency (%)	Test Freq (MHz)	Package
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Multipurpose / RF Power Transistors GaN-on-Si: CW and Pulsed

NPA1006	20	1000	28	12.5	14	>45	900	6 x 5 mm DFN-8
NPT2022	1	2000	50	100	20	>60	900	TO-272
NPT2021	1	2500	50	4	17	>55	2500	TO-272
NPA1003QA	20	1500	28	5	18	>50	1000	4 x 4 mm PQFN-16
NPA1007	30	2500	28	10	14	>50	2000	6 x 5 mm DFN-8
NPA1008	20	2700	28	5	12	>45	1900	4 x 4 mm PQFN-24
NPT2024	1	2700	50	200	22	65	900	TO-272-4
NPT1012B	1	4000	28	25	13	>50	3000	AC360B-2
NPTB00025B	1	4000	28	25	13	>50	3000	AC360B-2
MAGx-011086	1	6000	28	4	9	>50	5800	4 x 4 mm QFN-24
NPT2018	1	3500	50	12.5	17.5	>50	2500	6 x 3 mm PDFN-14
NPTB00004A	1	6000	28	5	17	>50	2500	SOIC-8NE
MAGx-100027-002*	10	2700	50	2	16	68	2000	6 x 3 mm PDFN-14
MAGx-100027-005*	10	2700	50	5	16	68	2000	6 x 3 mm PDFN-14
MAGx-100027-010*	10	2700	50	10	16	70	2000	6 x 3 mm PDFN-14
MAGx-100027-015*	10	2700	50	15	16	70	2000	6 x 3 mm PDFN-14
MAGx-100027-050*	1	2700	50	50	17	65	2700	TO-272S-2
MAGx-100027-100*	1	2700	50	100	17	65	2700	TO-272S-2
MAGx-100027-300*	1	2700	50	300	16	63	2700	TO-272S-4

RF Energy / RF Power Transistors GaN-on-Si: CW

MAGe-100809-500*	896	928	50	500	19	75	915	AC-780S-4
MAGx-100027-002*	10	2700	50	2	16	68	2000	6 x 3 mm PDFN-14
MAGx-100027-005*	10	2700	50	5	16	68	2000	6 x 3 mm PDFN-14
MAGx-100027-010*	10	2700	50	10	16	70	2000	6 x 3 mm PDFN-14
MAGx-100027-015*	10	2700	50	15	16	70	2000	6 x 3 mm PDFN-14
MAGe-102425-050*	2400	2500	50	50	17	70	2450	TO-272S-2
MAGe-102425-100*	2400	2500	50	100	17	70	2450	TO-272S-2
MAGe-102425-200*	2400	2500	50	200	17	70	2450	TO-272S-4
MAGe-102425-300*	2400	2500	50	300	16	70	2450	AC-780S-2/ACu-780S-2

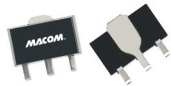
Aerospace & Defense Power Transistors, Pallets, and Modules GaN-on-Si

MAGx-100027-002*	10	2700	50	2	16	68	2000	6 x 3 mm PDFN-14
MAGx-100027-005*	10	2700	50	5	16	68	2000	6 x 3 mm PDFN-14
MAGx-100027-010*	10	2700	50	10	16	70	2000	6 x 3 mm PDFN-14
MAGx-100027-015*	10	2700	50	15	16	70	2000	6 x 3 mm PDFN-14
MAGx-100027-050*	10	2700	50	50	17	70	2000	TO-272S-2
MAGx-100914-125*	900	1400	50	125	17	>71	1400	AC-400B-2/AC-400S-2
MAGx-100914-250*	900	1400	50	250	17	>68	1400	AC-400B-2/AC-400S-2
MAGx-100912-500*	900	1215	50	500	>16	>69	1215	AC-780B-2/AC-780S-2
MAGx-101214-500*	1200	1400	50	500	>15.5	>69	1400	AC-780B-2/AC-780S-2
MAGx-103135-145*	3100	3500	50	145	14	55	3500	AC-360B-2/AC-360S-2
MAGx-102731-180*	2700	3100	50	180	15	55	3100	AC-360B-2/AC-360S-2
MAPG-102729-400	2700	2900	50	400	15	57	2900	Pallet
MAMG-102933-030*	2900	3300	32	30	20.5	51	3300	7 x 7 mm PQFN-28
MAMG-102733-085*	2700	3300	50	85	25	50	3300	14 x 24 mm SMT
MAMG-103135-085*	3100	3500	50	85	25	50	3500	14 x 24 mm SMT
MAMG-100227-010*	225	2600	28	14	12	45	2600	14 x 18 mm

*In development

Package Type: Plastic Packages

SOT89-3LD
(4.5 x 4 x 1.5 mm)



SOIC-EP
(4.9 x 6.1 x 1.47 mm)



3 x 6 mm PDFN-14LD
(6 x 3 x 1 mm)



4 mm PQFN-24LD
(4 x 4 mm)



5 x 6 mm PDFN-8LD
(5 x 6 mm)



7 mm PQFN-20LD
(7 x 7 x mm)



TO-272-2
(23.62 x 11.18 x 2.59 mm)



TO-272-4
(23.62 x 14.1 x 2.59 mm)



TO-272S-2
(17.25 x 11.18 x 2.59 mm)



TO-272S-2B
(17.25 x 11.18 x 2.59 mm)



TO-272S-4
(17.25 x 11.18 x 2.59 mm)



PO-780S-2
(20.57 x 19.43 x 3.81 mm)



PO-780S-4
(20.57 x 19.43 x 3.81 mm)



Package Type: Ceramic Air Cavity (AC) and Copper Air Cavity (ACu)

AC-200B-2
(13.97 x 8.13 x 3.1 mm)



AC-200S-2
(5.18 x 8.13 x 3.1 mm)



AC-360B-2
(20.32 x 10.92 x 3.86 mm)



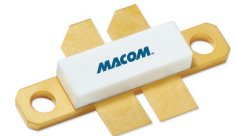
AC-360S-2
(9.65 x 10.92 x 3.86 mm)



AC-400S-2
(10.16 x 14.96 x 4.11 mm)



AC-650B-4
(28.95 x 17.78 x 4.85 mm)



AC-780B-2
(34.04 x 19.43 x 3.6 mm)



AC-780S-2
(20.57 x 19.43 x 3.6 mm)



ACu-780S-2
(20.57 x 19.43 x 3.6 mm)



AC-780B-4
(34.04 x 19.43 x 3.6 mm)



AC-780S-4
(20.57 x 19.43 x 3.6 mm)



AC-1230B-4
(41.28 x 19.61 x 4.42 mm)



AC-1230S-4
(32.26 x 19.61 x 4.42 mm)



ACu-1230S-4
(32.26 x 19.61 x 4.42 mm)



See back side for additional package styles.



Additional product information can be found on our website at:

www.macom.com

Contact our worldwide sales offices, authorized representatives, and industry-leading distributors to request samples, test boards, and application support.

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