

1416GN-120E/EL/EP Datasheet
120 W DME/L-Band Radar Driver GaN Power
Transistor





Microsemi Corporate Headquarters
One Enterprise, Aliso Viejo,
CA 92656 USA
Within the USA: +1 (800) 713-4113
Outside the USA: +1 (949) 380-6100
Sales: +1 (949) 380-6136
Fax: +1 (949) 215-4996
E-mail: sales.support@microsemi.com
www.microsemi.com

Microsemi makes no warranty, representation, or guarantee regarding the information contained herein or the suitability of its products and services for any particular purpose, nor does Microsemi assume any liability whatsoever arising out of the application or use of any product or circuit. The products sold hereunder and any other products sold by Microsemi have been subject to limited testing and should not be used in conjunction with mission-critical equipment or applications. Any performance specifications are believed to be reliable but are not verified, and Buyer must conduct and complete all performance and other testing of the products, alone and together with, or installed in, any end-products. Buyer shall not rely on any data and performance specifications or parameters provided by Microsemi. It is the Buyer's responsibility to independently determine suitability of any products and to test and verify the same. The information provided by Microsemi hereunder is provided "as is, where is" and with all faults, and the entire risk associated with such information is entirely with the Buyer. Microsemi does not grant, explicitly or implicitly, to any party any patent rights, licenses, or any other IP rights, whether with regard to such information itself or anything described by such information. Information provided in this document is proprietary to Microsemi, and Microsemi reserves the right to make any changes to the information in this document or to any products and services at any time without notice.

About Microsemi

Microsemi Corporation (Nasdaq: MSCC) offers a comprehensive portfolio of semiconductor and system solutions for communications, defense & security, aerospace and industrial markets. Products include high-performance and radiation-hardened analog mixed-signal integrated circuits, FPGAs, SoCs and ASICs; power management products; timing and synchronization devices and precise time solutions, setting the world's standard for time; voice processing devices; RF solutions; discrete components; enterprise storage and communication solutions, security technologies and scalable anti-tamper products; Ethernet solutions; Power-over-Ethernet ICs and midspans; as well as custom design capabilities and services. Microsemi is headquartered in Aliso Viejo, Calif., and has approximately 4,800 employees globally. Learn more at www.microsemi.com.

©2016 Microsemi Corporation. All rights reserved. Microsemi and the Microsemi logo are registered trademarks of Microsemi Corporation. All other trademarks and service marks are the property of their respective owners.

Revision History

1.1 Revision 1.0

Revision 1.0 was the first publication of this document.

Contents

Revision History.....	3
1.1 Revision 1.0.....	3
2 Product Overview	7
2.1 Applications	7
2.1.1 Key Features	8
3 Electrical Specifications.....	9
3.1 Absolute Maximum Ratings	9
3.2 Electrical Characteristics at 25 °C.....	9
3.3 Functional Characteristics at 25 °C	9
3.4 Typical Broadband Performance Data (300 μ S, 10% Pulsing)	10
4 Transistor Impedance Information.....	11
5 Transistor Test Information	12
5.1 Transistor Test Circuit Diagram	12
6 Package Outline and Pin Information	13
6.1 55-QQ Common Source Package Dimensions and Terminal Information.....	13
6.2 55-QQP Common Source Package Dimensions and Terminal Information.....	14
6.3 Overall Pallet Dimensions	15

List of Figures

Figure 1 Case Outline 55-QQ Common Source (0.160" × 0.550").....	7
Figure 2 Case Outline 55-QQP Common Source (0.160" × 0.230").....	7
Figure 3 Pallet Outline 50 Ω IN/OUT (0.600" × 1.200" × 0.150")	7
Figure 4 Typical Broadband Performance Data Graphs.....	10
Figure 5 Impedance Definition.....	11
Figure 6 Transistor Test Circuit	12
Figure 7 55-QQ Package Dimensions and Terminal Information.....	13
Figure 8 55-QQP Package Dimensions and Terminal Information.....	14
Figure 9 Pallet Package Dimensions	15

List of Tables

Table 1 Absolute Maximum Ratings	9
Table 2 Typical Electrical Characteristics at 25 °C.....	9
Table 3 Typical Functional Characteristics at 25 °C.....	9
Table 4 Typical Broadband Performance Data (300 μS, 10% Pulsing)	10
Table 5 Component List 1416GN-120E/EL.....	12
Table 6 55-QQ Package Dimensions	13
Table 7 55-QQP Package Dimensions	14

2 Product Overview

The 1416GN-120E/EL/EP is an internally matched, common source, Class AB, GaN on SiC HEMT transistor capable of providing over 17 dB typical power gain, 120 W of pulsed RF output power under 300 μ S pulse width and 10% long term duty cycle pulsing across the 1400 MHz to 1600 MHz band. The transistor has an internal pre-match for optimal performance. The hermetically sealed transistor is available in two package types, both the bolt-down flange 55-QQ package and the solder-down earless flange 55-QQP package. It is also available mounted in a 50 Ω IN/OUT pallet. These three products are specifically designed for use as drivers in DME (Distance Measuring Equipment) and L-Band pulsed radar transmit power amplifiers, and they utilize all-gold metallization and eutectic die attach to provide the highest reliability and superior ruggedness. Export Classification: EAR-99.

Figure 1 Case Outline 55-QQ Common Source (0.160" × 0.550")



Figure 2 Case Outline 55-QQP Common Source (0.160" × 0.230")

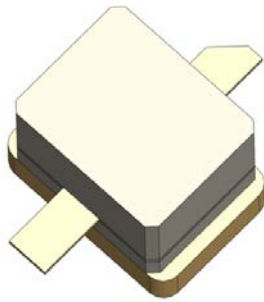
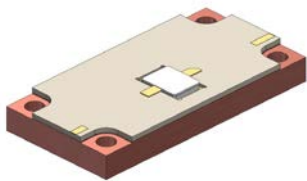


Figure 3 Pallet Outline 50 Ω IN/OUT (0.600" × 1.200" × 0.150")



2.1 Applications

The 1416GN-120E and the 1416GN-120EL transistors and the 1416GN-120EP pallet are specifically designed for radar, L-Band avionics, and communications applications.

2.1.1 Key Features

The following are the key features of the 1416GN-120E/EL/EP E-Class Earless/Eared GaN transistor products:

- 1400 MHz–1600 MHz, 120 W pulsed output power, 300 μ S-10% pulsing
- Common source, Class AB, 50 V_{DD} bias voltage
- High efficiency: >60% typical across the frequency band
- Extremely compact size
- High power gain: 17 dB typical
- Excellent gain flatness: 0.1 dB typical
- Ideal for radar, L-Band avionics, and communications applications
- Utilizes all-gold metallization and eutectic die attach for highest reliability
- 50 Ω IN/OUT lumped element, very small footprint, plug-and-play pallets available

3 Electrical Specifications

3.1 Absolute Maximum Ratings

The following table shows the absolute maximum ratings at 25 °C unless otherwise specified.

Table 1 Absolute Maximum Ratings

Rating		Value	Units
Maximum power dissipation	Device dissipation at 25 °C	265	W
Maximum voltage and current	Drain-Source voltage (V_{DSS})	125	V
	Gate-Source voltage (V_{GS})	-8 to 0	V
Maximum temperatures	Storage temperature (T_{STG})	-55 to 125	°C
	Operating junction temperature	200	°C

3.2 Electrical Characteristics at 25 °C

The following table shows the typical electrical characteristics at 25 °C

Table 2 Typical Electrical Characteristics at 25 °C

Symbol	Characteristics	Test Conditions	Min	Typ	Max	Units
P_{OUT}	Output power	$P_{IN} = 2.5$ W, Freq = 1400, 1500, 1600 MHz	120	130		W
G_P	Power gain	$P_{IN} = 2.5$ W, Freq = 1400, 1500, 1600 MHz	16.8	17.2		dB
η_D	Drain efficiency	$P_{IN} = 2.5$ W, Freq = 1400, 1500, 1600 MHz	57	65		%
Dr	Droop	$P_{IN} = 2.5$ W, Freq = 1400, 1500, 1600 MHz		0.3	0.6	dB
VSWR-T	Load mismatch tolerance	$P_{OUT} = 2.5$ W, Freq = 1500 MHz, 100 μ S-10%			5:1	
Θ_{JC}	Thermal resistance	300 μ S, 10% duty cycle			1.25	°C/W

Bias Condition: $V_{DD} = 50$ V, $I_{DQ} = 30$ mA constant current ($V_{GS} = -2.0$ to -4.5 V typical)

3.3 Functional Characteristics at 25 °C

Table 3 Typical Functional Characteristics at 25 °C

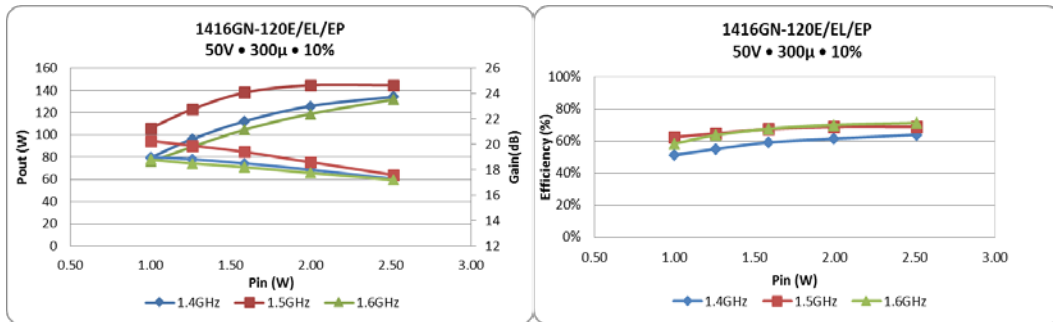
Symbol	Characteristics	Test Conditions	Min	Typ	Max	Units
$I_{D(Off)}$	Drain leakage current	$V_{GS} = -8$ V, $V_D = 125$ V			12	mA
$I_{G(Off)}$	Gate leakage current	$V_{GS} = -8$ V, $V_D = 0$ V			4	mA

3.4 Typical Broadband Performance Data (300 μS, 10% Pulsing)

Table 4 Typical Broadband Performance Data (300 μS, 10% Pulsing)

Frequency	P _{IN} (W)	P _{OUT} (W)	I _D (mA)	IRL (dB)	η _D (%)	G _P (dB)	Droop (dB)
1400 MHz	2.5	134	460	-6.0	64	17.3	0.35
1500 MHz	2.5	144	450	-12.0	69	17.6	0.30
1600 MHz	2.5	132	410	-6.0	71	17.2	0.20

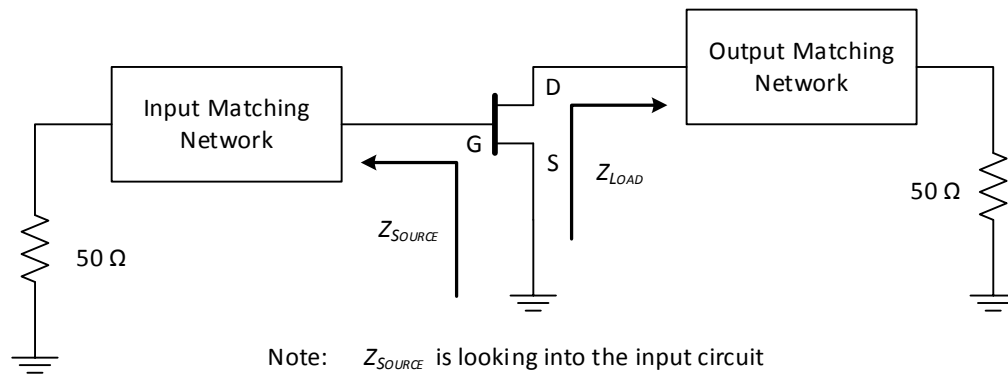
Figure 4 Typical Broadband Performance Data Graphs



4 Transistor Impedance Information

The following diagram shows the transistor impedance information for 1416GN-120E/EL/EP.

Figure 5 Impedance Definition



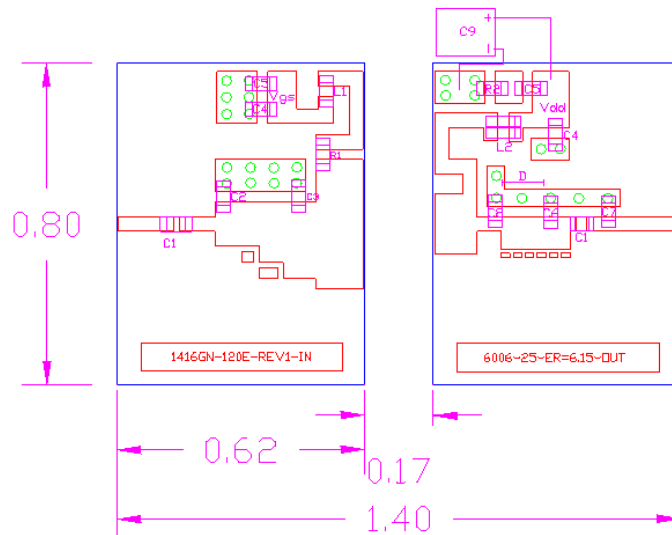
Note: Z_{SOURCE} is looking into the input circuit
 Z_{LOAD} is looking into the output circuit

For information about source and load impedances for 1416GN-120E/EL/EP, contact your Microsemi representative.

5 Transistor Test Information

5.1 Transistor Test Circuit Diagram

Figure 6 Transistor Test Circuit



Note: Distance (D) = 0.090"–0.0950"

The board material is Rogers Duroid 6006, 0.250" thickness, and $\epsilon_r = 6.15$.

The following table lists the components for 1416GN-120E/EL.

Table 5 Component List 1416GN-120E/EL

Item	Description	Value
C1	Chip capacitor A size – ATC600S series	68 pF
C2	Chip capacitor A size – ATC600S series	4.7 pF
C3	Chip capacitor A size – ATC600S series	0.9 pF
C4 ¹	Chip capacitor A size	470 pF
C5 ¹	Chip capacitor 1210 size	4.7 uF
C6	Chip capacitor A size – ATC600S series	3 pF
C7	Chip capacitor A size – ATC600S series	0.5 pF to 0.7 pF
C8	Chip capacitor A size – ATC600S series	1 pF
C9	Electrolytic capacitor (63 V)	470 uF
C10	Chip capacitor A size – ATC600S series	82 pF
R1	Chip resistor size 0805	10 Ω
R2	Chip resistor size 0805	5.1 Ω
L1	Chip inductor size 0603	47 nH
L2 ¹	Chip inductor size 1608 (500 mA current)	1.2 nH

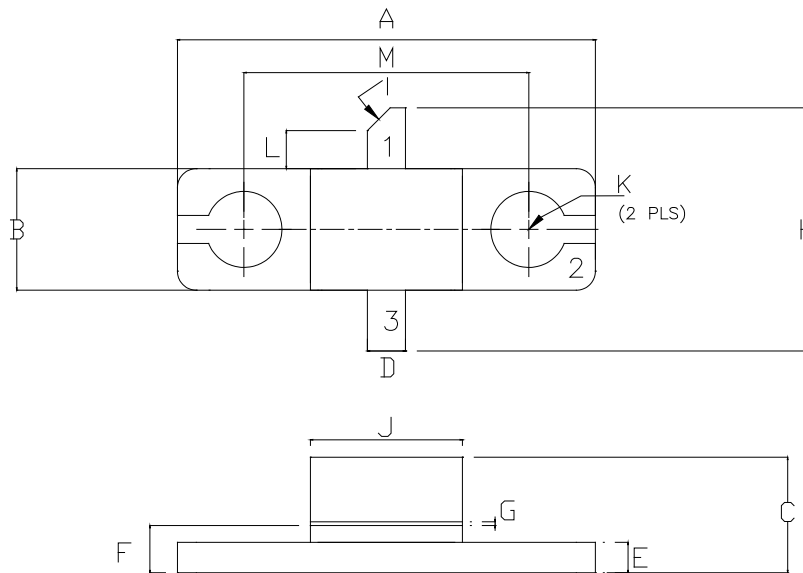
1. Two of these are needed

6 Package Outline and Pin Information

The 1416GN-125E transistor is available in the 55-QQP case outline and the 1416GN-125EL transistor is available in the 55-QQP case outline. The 1416GN-125EP is available in the 90-1416GN-250EP pallet outline. All three products are configured for common source operation.

6.1 55-QQ Common Source Package Dimensions and Terminal Information

Figure 7 55-QQ Package Dimensions and Terminal Information



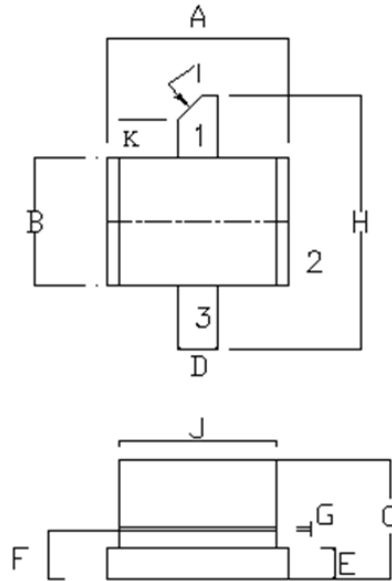
Pin 1: Drain, Pin 2: Source, Pin 3: Gate

Table 6 55-QQ Package Dimensions

Dim	Millimeters	Tol (mm)	Inches	Tol (in.)
A	13.970	0.250	0.550	0.010
B	4.570	0.250	0.160	0.010
C	3.860	0.330	0.152	0.013
D	1.270	0.130	0.050	0.005
E	1.020	0.130	0.040	0.005
F	1.700	0.130	0.067	0.005
G	0.130	0.025	0.005	0.001
H	8.130	0.250	0.320	0.010
I	45°	5°	45°	5°
J	5.080	0.250	0.200	0.010
K	2.54 DIA	0.130	0.100 DIA	0.005
L	1.270	0.130	0.050	0.005
M	9.530	0.130	0.375	0.005

6.2 55-QQP Common Source Package Dimensions and Terminal Information

Figure 8 55-QQP Package Dimensions and Terminal Information



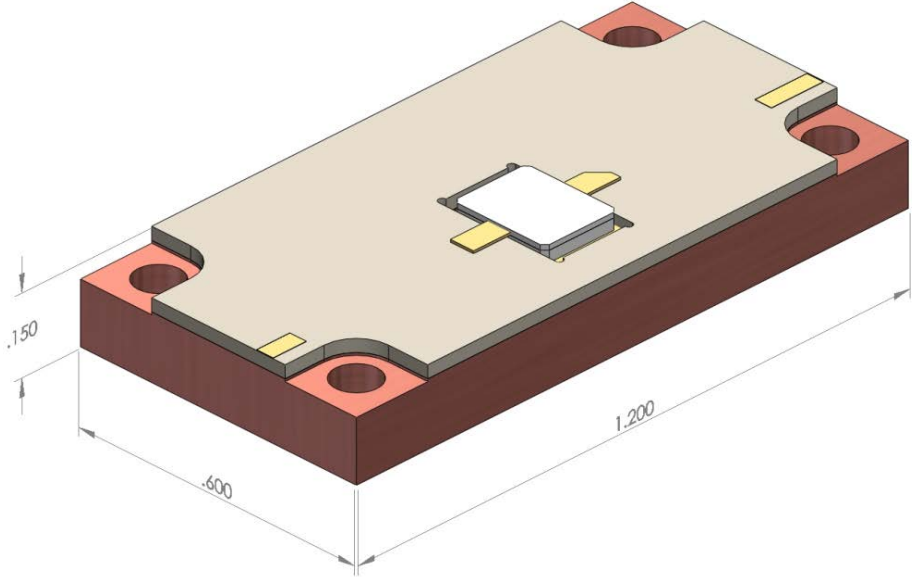
Pin 1: Drain, Pin 2: Source, Pin 3: Gate

Table 7 55-QQP Package Dimensions

Dim	Millimeters	Tol (mm)	Inches	Tol (in.)
A	5.840	0.250	0.230	0.010
B	4.060	0.250	0.160	0.010
C	3.170	0.050	0.125	0.002
D	1.270	0.130	0.050	0.005
E	1.020	0.130	0.040	0.005
F	1.570	0.130	0.062	0.005
G	0.130	0.020	0.005	0.001
H	8.120	0.250	0.320	0.010
I	45°	5°	45°	5°
J	5.080	0.250	0.200	0.010
K	1.400	0.130	0.055	0.005

6.3 Overall Pallet Dimensions

Figure 9 Pallet Package Dimensions



Dimensions 1.200" × 0.600" × 0.150"