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MICROWAVE CORPORATION v04.0614



# HMC659LC5

## GaAs PHEMT MMIC POWER AMPLIFIER, DC - 15 GHz

### Typical Applications

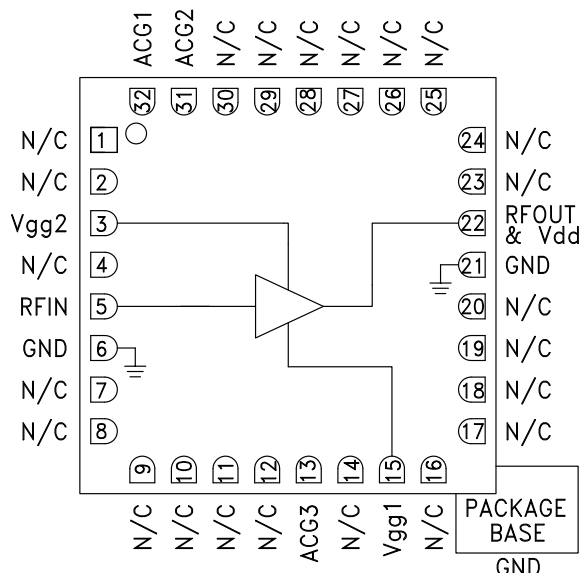
The HMC659LC5 wideband PA is ideal for:

- Telecom Infrastructure
- Microwave Radio & VSAT
- Military & Space
- Test Instrumentation
- Fiber Optics

### Features

- P1dB Output Power: +27.5 dBm
- Gain: 19 dB
- Output IP3: +35 dBm
- Supply Voltage: +8V @ 300 mA
- 50 Ohm Matched Input/Output
- 32 Lead Ceramic 5 x 5 mm SMT Package: 25 mm<sup>2</sup>

### Functional Diagram



### General Description

The HMC659LC5 is a GaAs MMIC pHEMT Distributed Power Amplifier which is housed in a leadless 5 x 5 mm RoHS compliant ceramic SMT package operating between DC and 15 GHz. The amplifier provides 19 dB of gain, +35 dBm output IP3 and +27.5 dBm of output power at 1 dB gain compression, while requiring 300mA from a +8V supply. Gain flatness is excellent at  $\pm 1.4$  dB from DC - 15 GHz making the HMC659LC5 ideal for EW, ECM, Radar and test equipment applications. The HMC659LC5 amplifier I/Os are internally matched to 50 Ohms with no external components. The HMC659LC5 is compatible with high volume surface mount manufacturing techniques.

### Electrical Specifications, $T_A = +25^\circ\text{C}$ , $V_{dd} = +8\text{V}$ , $V_{gg2} = +3\text{V}$ , $I_{dd} = 300\text{ mA}^*$

| Parameter                                        | Min.   | Typ.      | Max. | Min.   | Typ.      | Max. | Min.    | Typ.      | Max. | Units                |
|--------------------------------------------------|--------|-----------|------|--------|-----------|------|---------|-----------|------|----------------------|
| Frequency Range                                  | DC - 6 |           |      | 6 - 11 |           |      | 11 - 15 |           |      | GHz                  |
| Gain                                             | 16     | 19        |      | 15     | 18        |      | 14      | 17        |      | dB                   |
| Gain Flatness                                    |        | $\pm 0.7$ |      |        | $\pm 0.4$ |      |         | $\pm 0.7$ |      | dB                   |
| Gain Variation Over Temperature                  |        | 0.015     |      |        | 0.019     |      |         | 0.022     |      | dB/ $^\circ\text{C}$ |
| Input Return Loss                                |        | 20        |      |        | 18        |      |         | 17        |      | dB                   |
| Output Return Loss                               |        | 19        |      |        | 20        |      |         | 15        |      | dB                   |
| Output Power for 1 dB Compression (P1dB)         | 23.5   | 26.5      |      | 24.5   | 27.5      |      | 23.5    | 26.5      |      | dBm                  |
| Saturated Output Power (Psat)                    |        | 28.0      |      |        | 28.5      |      |         | 27.5      |      | dBm                  |
| Output Third Order Intercept (IP3)               |        | 35        |      |        | 32        |      |         | 29        |      | dBm                  |
| Noise Figure                                     |        | 3.0       |      |        | 2.5       |      |         | 3.5       |      | dB                   |
| Supply Current (Idd) (Vdd= 8V, Vgg1= -0.8V Typ.) |        | 300       |      |        | 300       |      |         | 300       |      | mA                   |

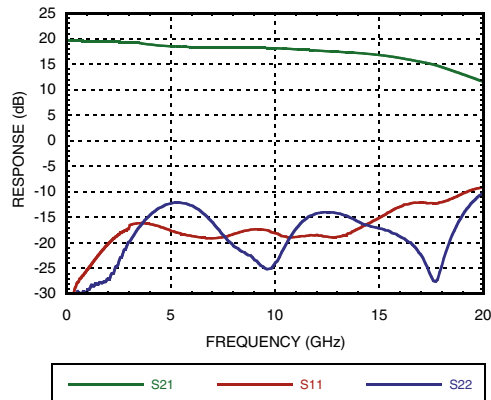
\*Adjust Vgg1 between -2 to 0V to achieve Idd= 300 mA typical.

For price, delivery and to place orders: Hittite Microwave Corporation, 2 Elizabeth Drive, Chelmsford, MA 01824

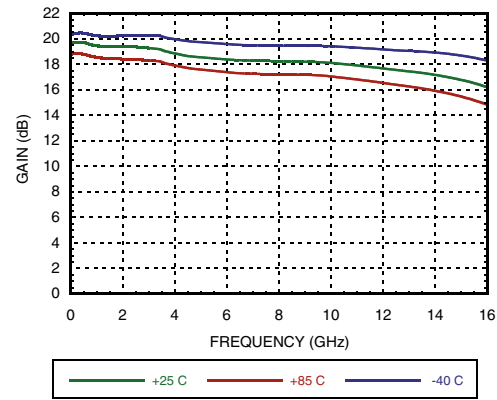
Phone: 978-250-3343 Fax: 978-250-3373 Order On-line at [www.hittite.com](http://www.hittite.com)

Application Support: Phone: 978-250-3343 or [apps@hittite.com](mailto:apps@hittite.com)

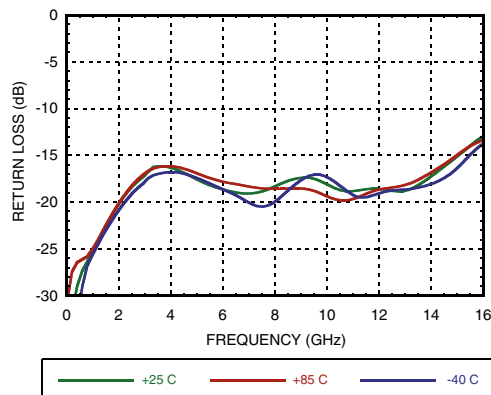
### Gain & Return Loss



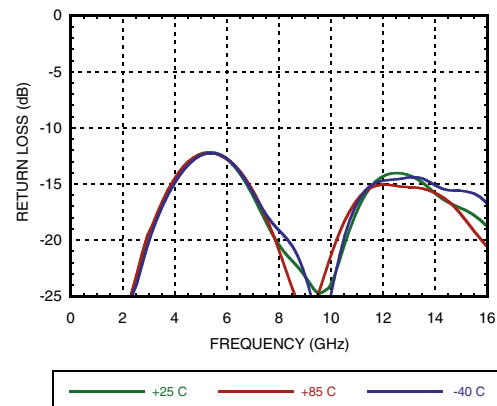
### Gain vs. Temperature



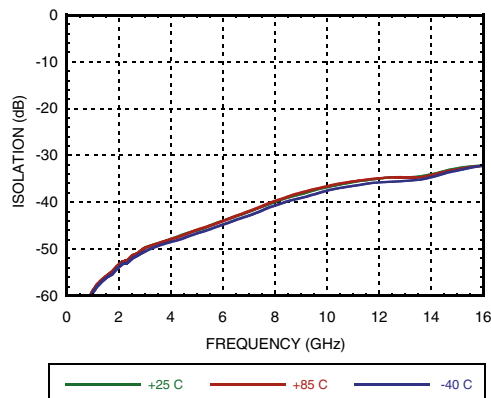
### Input Return Loss vs. Temperature



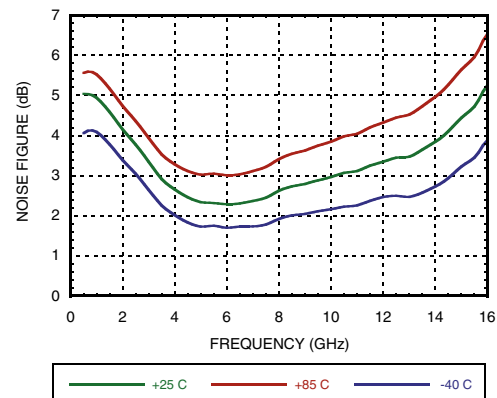
### Output Return Loss vs. Temperature



### Reverse Isolation vs. Temperature



### Noise Figure vs. Temperature





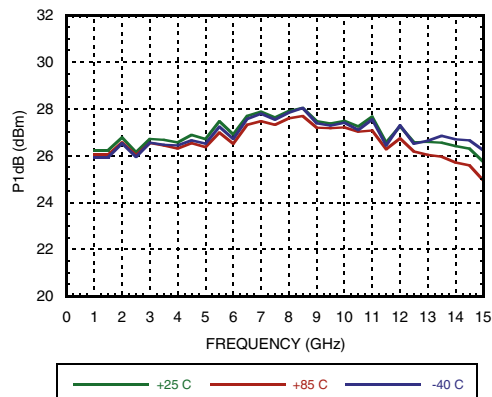
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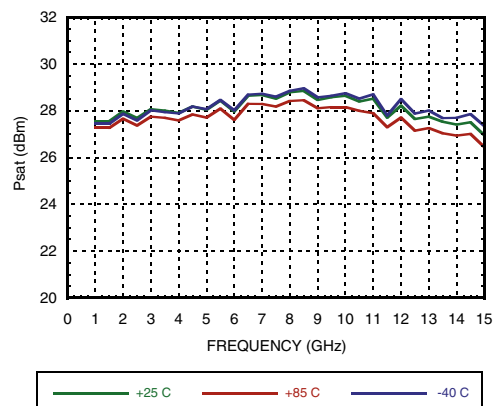
# HMC659LC5

## GaAs PHEMT MMIC POWER AMPLIFIER, DC - 15 GHz

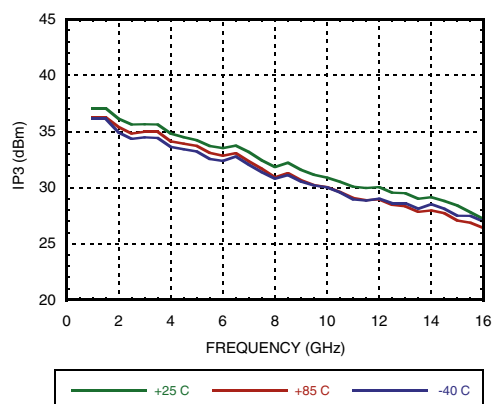
**Output P1dB vs. Temperature**



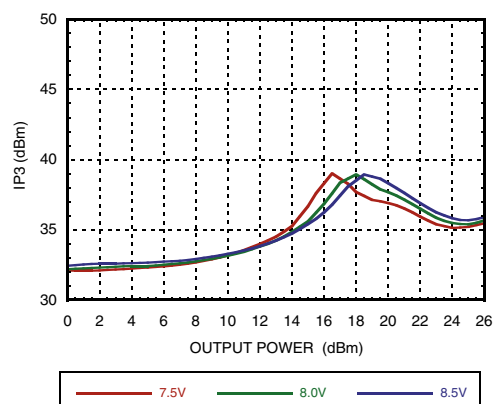
**Psat vs. Temperature**



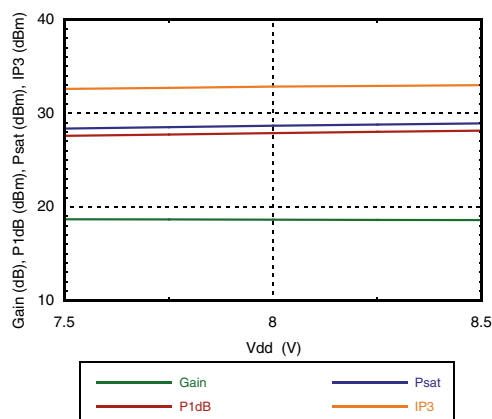
**Output IP3 vs. Temperature**



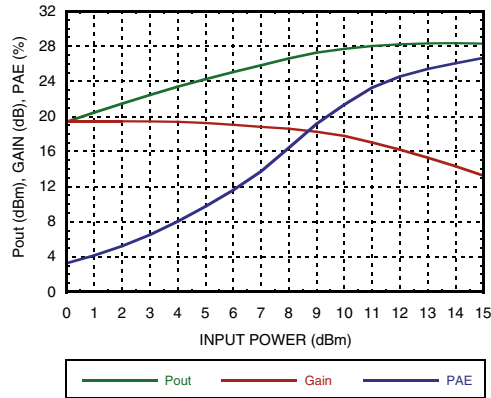
**Output IP3 vs. Output Power @ 5GHz**



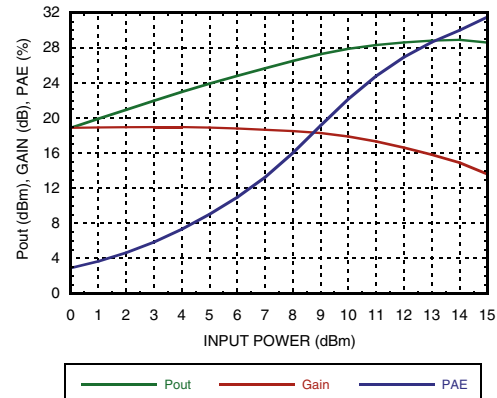
**Gain, Power & Output IP3 vs.  
Supply Voltage @ 7 GHz, Fixed Vgg**



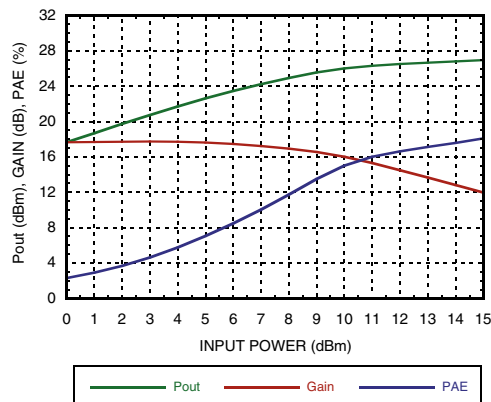
### Power Compression @ 2 GHz



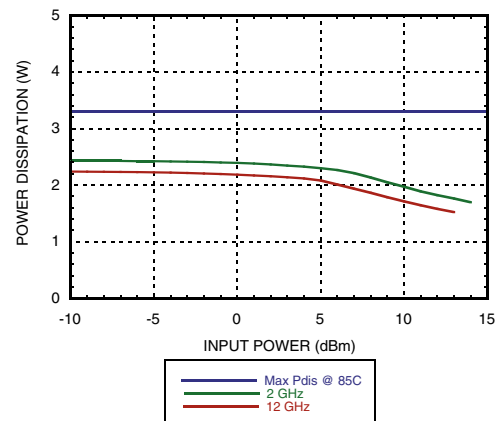
### Power Compression @ 7 GHz



### Power Compression @ 15 GHz



### Power Dissipation



### Absolute Maximum Ratings

|                                                             |               |
|-------------------------------------------------------------|---------------|
| Drain Bias Voltage (Vdd)                                    | 9 Vdc         |
| Gate Bias Voltage (Vgg1)                                    | -2 to 0 Vdc   |
| Gate Bias Voltage (Vgg2)                                    | +2V to +4V    |
| RF Input Power (RFIN)(Vdd = +8 Vdc)                         | +20 dBm       |
| Channel Temperature                                         | 175 °C        |
| Continuous Pdis (T= 85 °C)<br>(derate 37 mW/°C above 85 °C) | 3.3 W         |
| Thermal Resistance<br>(channel to ground paddle)            | 27.3 °C/W     |
| Storage Temperature                                         | -65 to 150 °C |
| Operating Temperature                                       | -40 to 85 °C  |
| ESD Sensitivity (HBM)                                       | Class 1A      |

### Typical Supply Current vs. Vdd

| Vdd (V) | Idd (mA) |
|---------|----------|
| 7.5     | 299      |
| 8.0     | 300      |
| 8.5     | 301      |



ELECTROSTATIC SENSITIVE DEVICE  
OBSERVE HANDLING PRECAUTIONS



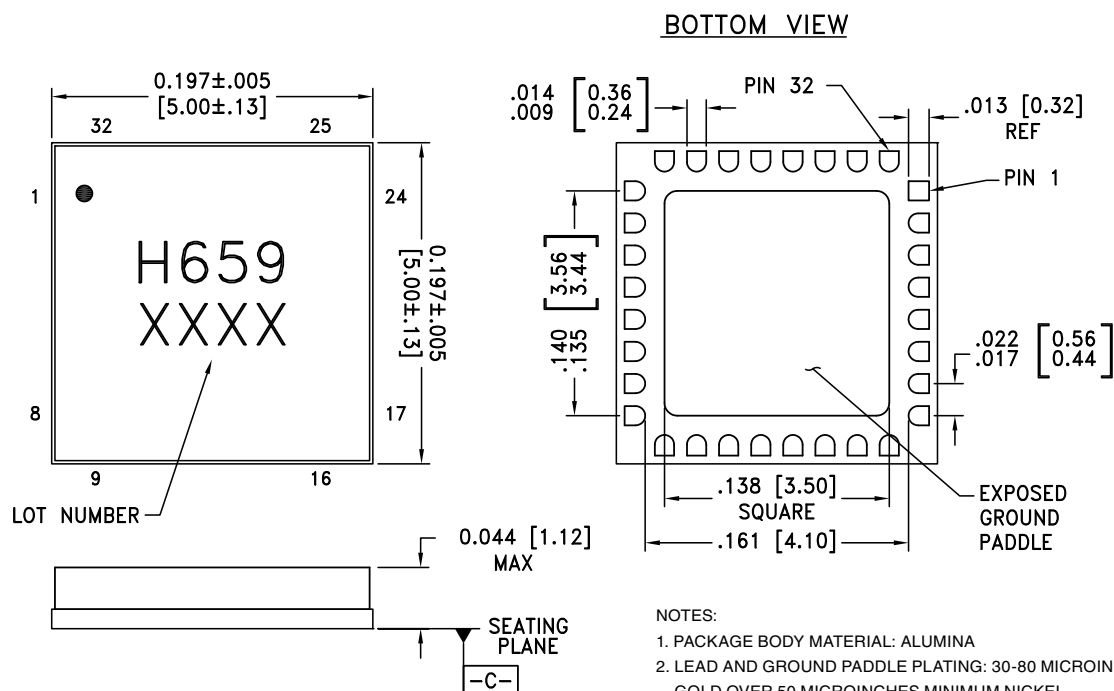
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# HMC659LC5

## GaAs PHEMT MMIC POWER AMPLIFIER, DC - 15 GHz

### Outline Drawing



#### NOTES:

1. PACKAGE BODY MATERIAL: ALUMINA
2. LEAD AND GROUND PADDLE PLATING: 30-80 MICROINCHES GOLD OVER 50 MICROINCHES MINIMUM NICKEL.
3. DIMENSIONS ARE IN INCHES [MILLIMETERS].
4. LEAD SPACING TOLERANCE IS NON-CUMULATIVE.
5. CHARACTERS TO BE LASER MARKED WITH .018" MIN to .030" MAX HEIGHT REQUIREMENTS. UTILIZE MAXIMUM CHARACTER HEIGHT BASED ON LID DIMENSIONS AND BEST FIT. LOCATE APPROX. AS SHOWN.
6. PACKAGE WARP SHALL NOT EXCEED 0.05 mm DATUM -C-
7. ALL GROUND LEADS AND GROUND PADDLE MUST BE SOLDERED TO PCB RF GROUND.

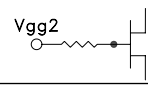
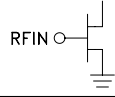
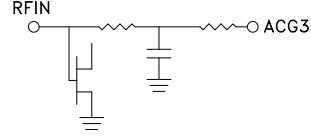
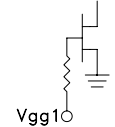
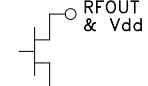
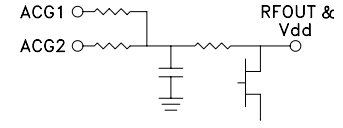
### Package Information

| Part Number | Package Body Material | Lead Finish      | MSL Rating          | Package Marking <sup>[2]</sup> |
|-------------|-----------------------|------------------|---------------------|--------------------------------|
| HMC659LC5   | Alumina, White        | Gold over Nickel | MSL3 <sup>[1]</sup> | H659<br>XXXX                   |

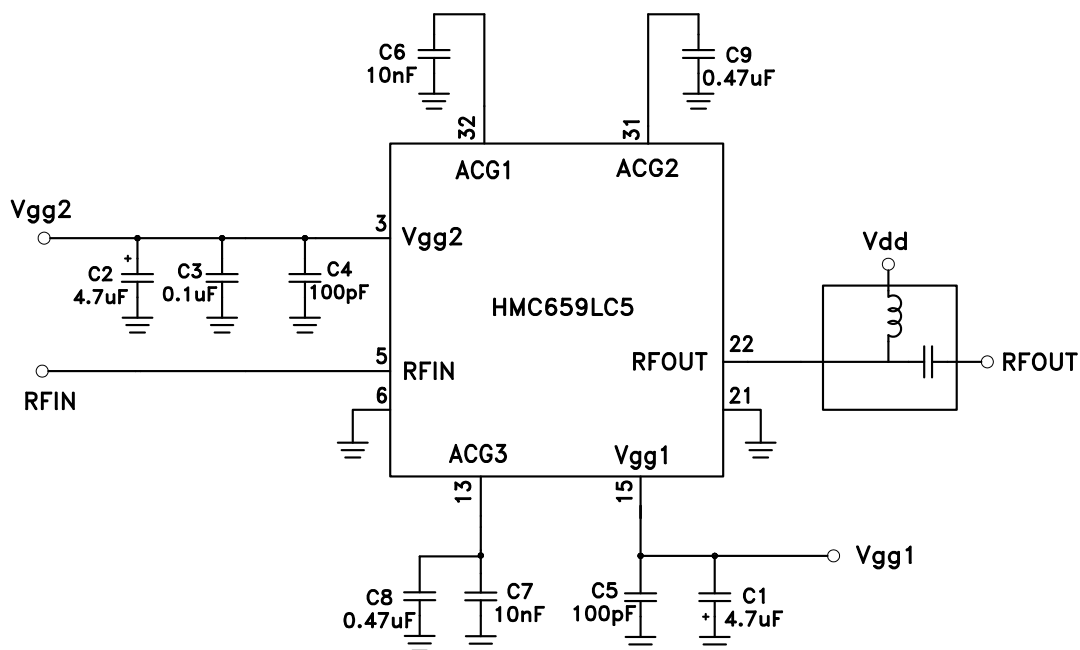
[1] Max peak reflow temperature of 260 °C

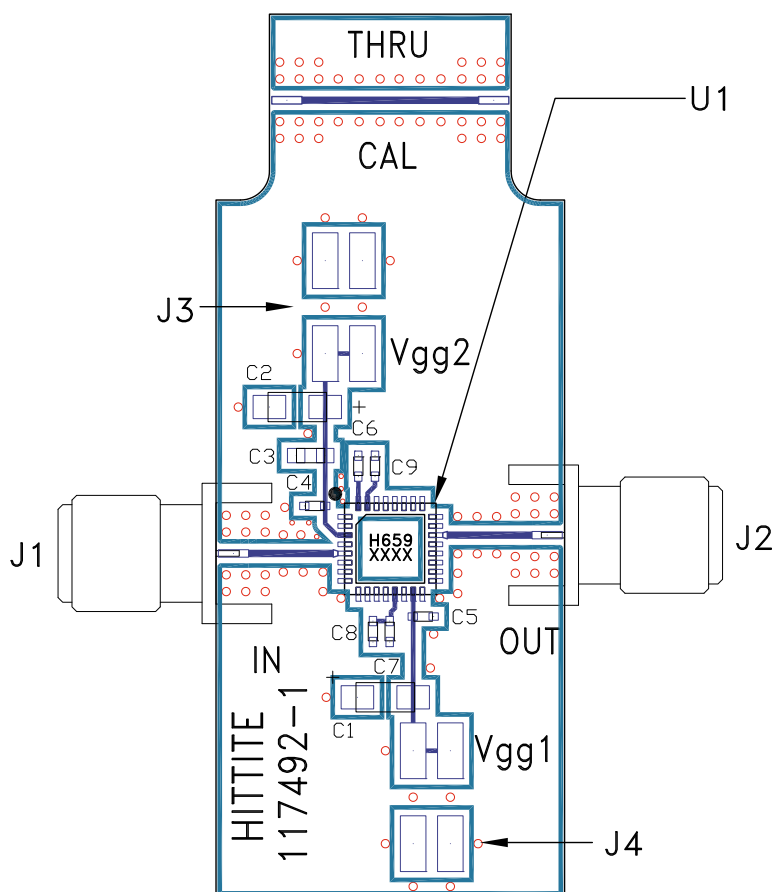
[2] 4-Digit lot number XXXX

### Pin Descriptions

| Pin Number                            | Function    | Description                                                                                                                | Interface Schematic                                                                   |
|---------------------------------------|-------------|----------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| 1, 2, 4, 7 - 12, 14, 16 - 20, 23 - 30 | N/C         | No connection. These pins may be connected to RF ground. Performance will not be affected.                                 |                                                                                       |
| 3                                     | Vgg2        | Gate Control 2 for amplifier. +3V should be applied to Vgg2 for nominal operation.                                         |    |
| 5                                     | RFIN        | This pad is DC coupled and matched to 50 Ohms.                                                                             |    |
| 13                                    | ACG3        | Low frequency termination. Attach bypass capacitor per application circuit herein.                                         |    |
| 15                                    | Vgg1        | Gate Control 1 for amplifier.                                                                                              |   |
| 22                                    | RFOUT & Vdd | RF output for amplifier. Connect the DC bias (Vdd) network to provide drain current (Idd). See application circuit herein. |  |
| 31                                    | ACG2        | Low frequency termination. Attach bypass capacitor per application circuit herein.                                         |  |
| 32                                    | ACG1        |                                                                                                                            |                                                                                       |
| 6, 21<br>Ground Paddle                | GND         | Ground paddle must be connected to RF/DC ground.                                                                           |  |

## Application Circuit



**Evaluation PCB**

**List of Materials for Evaluation PCB 117494 [1]**

| Item    | Description                      |
|---------|----------------------------------|
| J1, J2  | SMA-SRI-NS                       |
| J3, J4  | 2 mm Molex Header                |
| C1, C2  | 4.7 $\mu$ F Capacitor            |
| C3      | 0.1 $\mu$ F Capacitor, 0603 Pkg. |
| C4, C5  | 100 pF Capacitor, 0402 Pkg.      |
| C6, C7  | 10k pF Capacitor, 0402 Pkg.      |
| C8, C9  | 0.47 $\mu$ F Capacitor, 0402 Pkg |
| U1      | HMC659LC5                        |
| PCB [2] | 117492 Evaluation PCB            |

[1] Reference this number when ordering complete evaluation PCB

[2] Circuit Board Material: Rogers 4350

The circuit board used in the final application should use RF circuit design techniques. Signal lines should have 50 Ohm impedance while the package ground leads and package bottom should be connected directly to the ground plane similar to that shown. A sufficient number of via holes should be used to connect the top and bottom ground planes. The evaluation board should be mounted to an appropriate heat sink. The evaluation circuit board shown is available from Hittite upon request.

Компания «Океан Электроники» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

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- Поставка сложных, дефицитных, либо снятых с производства позиций;
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- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
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- Поставка специализированных компонентов военного и аэрокосмического уровня качества (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Actel, Aeroflex, Peregrine, VPT, Syfer, Eurofarad, Texas Instruments, MS Kennedy, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

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