

Enhancement Mode pHEMT Technology (E-pHEMT) High Linearity Amplifier

The MMG15241H is a high dynamic range, low noise amplifier MMIC, housed in a SOT-89 standard plastic package. It is ideal for cellular, PCS, LTE, TD-SCDMA, W-CDMA base station, wireless LAN and other systems in the 500 to 2800 MHz frequency range. With high OIP3 and low noise figure, it can be utilized as a driver amplifier in the transmit chain and as a second stage LNA in the receive chain.

Features

- Frequency: 500–2800 MHz
- Noise Figure: 1.6 dB @ 2140 MHz
- P1dB: 24 dBm @ 2140 MHz
- Small-Signal Gain: 15.9 dB @ 2140 MHz
- Third Order Output Intercept Point: 39.4 dBm @ 2140 MHz
- Single 5 V Supply
- Supply Current: 85 mA
- 50 Ohm Operation (some external matching required)
- Cost-effective SOT-89 Surface Mount Plastic Package
- In Tape and Reel. T1 Suffix = 1,000 Units, 12 mm Tape Width, 7-inch Reel.

MMG15241HT1

**500–2800 MHz, 15.9 dB
24 dBm
E-pHEMT LNA/GPA**



SOT-89

Table 1. Typical Performance (1)

| Characteristic | Symbol | 900 MHz | 2140 MHz | 2600 MHz | Unit |
|------------------------------------|----------------|---------|----------|----------|------|
| Noise Figure | NF | 1.2 | 1.6 | 1.3 | dB |
| Input Return Loss (S11) | IRL | -11.8 | -21.3 | -16.9 | dB |
| Output Return Loss (S22) | ORL | -13.4 | -16.2 | -20.9 | dB |
| Small-Signal Gain (S21) | G _p | 20.5 | 15.9 | 14.4 | dB |
| Power Output @ 1dB Compression | P1db | 24 | 24 | 24 | dBm |
| Third Order Input Intercept Point | IIP3 | 18.2 | 23.5 | 26.2 | dBm |
| Third Order Output Intercept Point | OIP3 | 38.7 | 39.4 | 40.6 | dBm |

1. V_{DD} = 5 Vdc, T_A = 25°C, 50 ohm system, application circuit tuned for specified frequency.

Table 2. Maximum Ratings

| Rating | Symbol | Value | Unit |
|---------------------------|------------------|-------------|------|
| Supply Voltage | V _{DD} | 6 | V |
| Supply Current | I _{DD} | 130 | mA |
| RF Input Power | P _{in} | 23 | dBm |
| Storage Temperature Range | T _{stg} | -65 to +150 | °C |
| Junction Temperature | T _J | 175 | °C |

Table 3. Thermal Characteristics

| Characteristic | Symbol | Value (2) | Unit |
|--|------------------|-----------|------|
| Thermal Resistance, Junction to Case Case Temperature 85°C, 5 Vdc, 84 mA, no RF applied | R _{θJC} | 59 | °C/W |

2. Refer to AN1955, *Thermal Measurement Methodology of RF Power Amplifiers*. Go to <http://www.freescale.com/rf>. Select Documentation/Application Notes - AN1955.

Table 4. Electrical Characteristics ($V_{DD} = 5$ Vdc, 2140 MHz, $T_A = 25^\circ\text{C}$, 50 ohm system, in Freescale Application Circuit)

| Characteristic | Symbol | Min | Typ | Max | Unit |
|------------------------------------|----------|-----|-------|-----|------|
| Small-Signal Gain (S21) | G_p | 14 | 15.9 | — | dB |
| Input Return Loss (S11) | IRL | — | -21.3 | — | dB |
| Output Return Loss (S22) | ORL | — | -16.2 | — | dB |
| Power Output @ 1dB Compression | P1dB | — | 24 | — | dBm |
| Third Order Input Intercept Point | IIP3 | — | 23.5 | — | dBm |
| Third Order Output Intercept Point | OIP3 | — | 39.4 | — | dBm |
| Reverse Isolation (S12) | S12 | — | -22.5 | — | dB |
| Noise Figure | NF | — | 1.6 | — | dB |
| Supply Current | I_{DD} | 65 | 85 | 105 | mA |
| Supply Voltage | V_{DD} | — | 5 | — | V |

Table 5. Functional Pin Description

| Pin Number | Pin Function |
|------------|------------------------------|
| 1 | RF _{in} |
| 2 | Ground |
| 3 | RF _{out} /DC Supply |

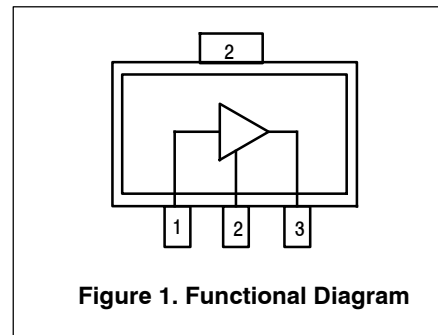


Table 6. ESD Protection Characteristics

| Test Methodology | Class |
|--|-------|
| Human Body Model (per JESD 22-A114) | 1A |
| Machine Model (per EIA/JESD 22-A115) | A |
| Charge Device Model (per JESD 22-C101) | IV |

Table 7. Moisture Sensitivity Level

| Test Methodology | Rating | Package Peak Temperature | Unit |
|--------------------------------------|--------|--------------------------|------------------|
| Per JESD22-A113, IPC/JEDEC J-STD-020 | 1 | 260 | $^\circ\text{C}$ |

50 OHM TYPICAL CHARACTERISTICS

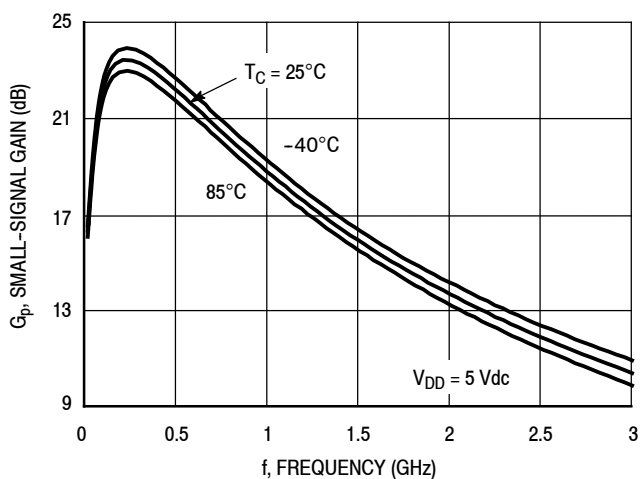


Figure 2. Small-Signal Gain (S21) versus Frequency (1)

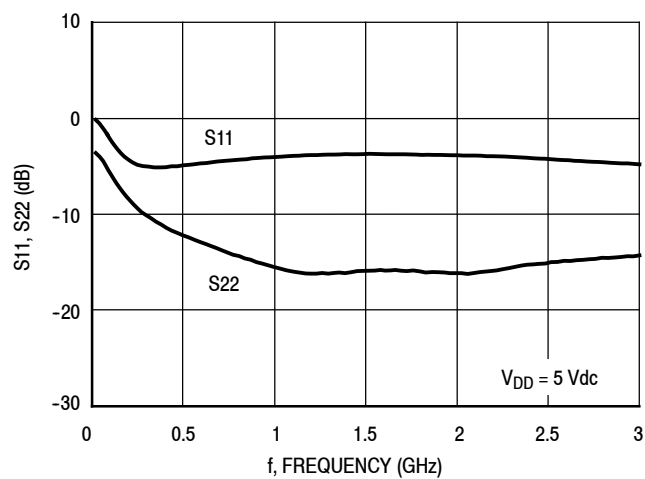


Figure 3. Input/Output Return Loss versus Frequency (1)

1. Test fixture characteristics have been mathematically removed from the graphical data.

50 OHM APPLICATION CIRCUIT: 2140 MHz

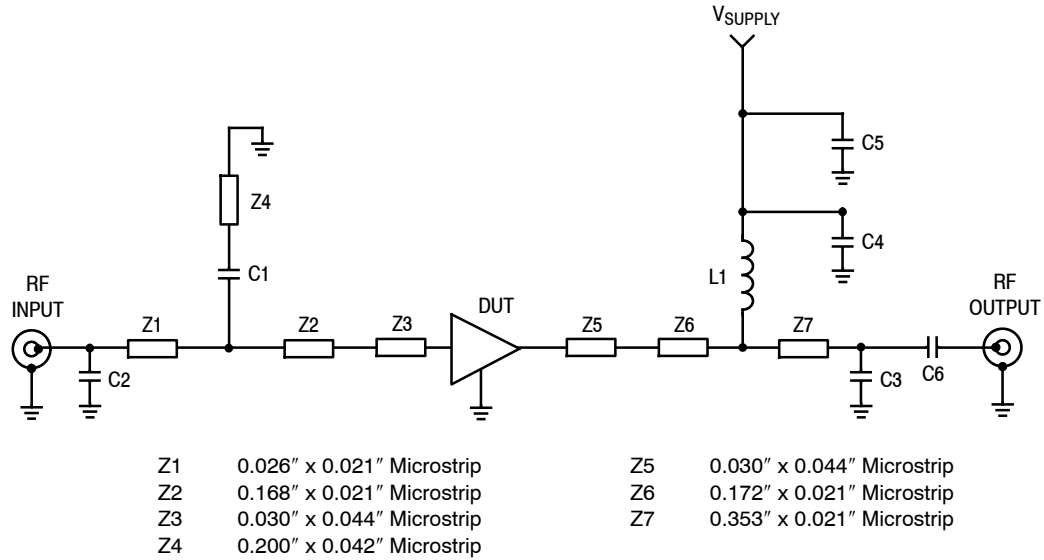


Figure 4. MMG15241HT1 Test Circuit Schematic

Table 8. MMG15241HT1 Test Circuit Component Designations and Values

| Part | Description | Part Number | Manufacturer |
|------|--|--------------------|--------------|
| C1 | 1.5 pF Chip Capacitor | GJM1555C1H1R5CB01D | Murata |
| C2 | 0.8 pF Chip Capacitor | GJM1555C1HR80BB01D | Murata |
| C3 | 0.7 pF Chip Capacitor | GJM1555C1HR70BB01D | Murata |
| C4 | 56 pF Chip Capacitor | GRM188RC1H560GA01D | Murata |
| C5 | 0.1 μ F Chip Capacitor | GRM188R71H104KA93D | Murata |
| C6 | 5.6 pF Chip Capacitor | GJM1555C1H5R6DB01D | Murata |
| L1 | 30 nH Chip Inductor | 0603CS-30NXJLW | Coilcraft |
| PCB | 0.010", $\epsilon_r = 3.38$, Multilayer | IS680-338 | Isola |

50 OHM APPLICATION CIRCUIT: 2140 MHz

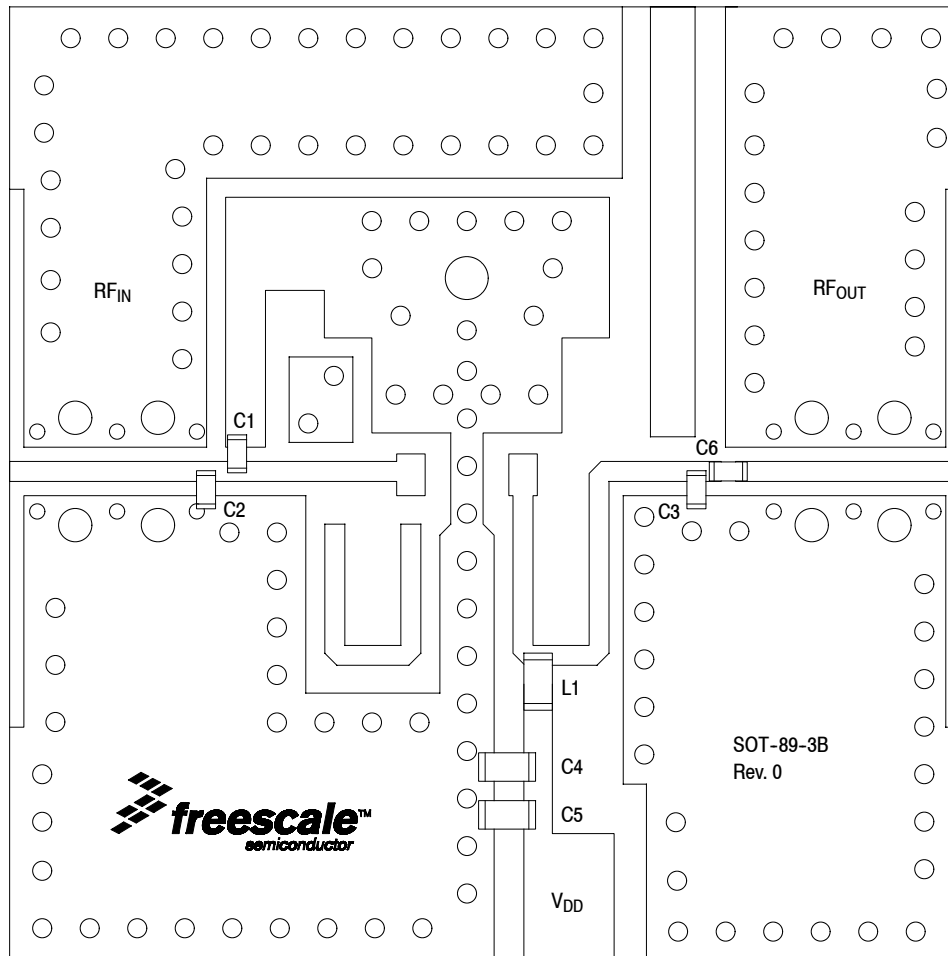


Figure 5. MMG15241HT1 Test Circuit Component Layout

Table 8. MMG15241HT1 Test Circuit Component Designations and Values

| Part | Description | Part Number | Manufacturer |
|------|--|--------------------|--------------|
| C1 | 1.5 pF Chip Capacitor | GJM1555C1H1R5CB01D | Murata |
| C2 | 0.8 pF Chip Capacitor | GJM1555C1HR80BB01D | Murata |
| C3 | 0.7 pF Chip Capacitor | GJM1555C1HR70BB01D | Murata |
| C4 | 56 pF Chip Capacitor | GRM188RC1H560GA01D | Murata |
| C5 | 0.1 μ F Chip Capacitor | GRM188R71H104KA93D | Murata |
| C6 | 5.6 pF Chip Capacitor | GJM1555C1H5R6DB01D | Murata |
| L1 | 30 nH Chip Inductor | 0603CS-30NXJLW | Coilcraft |
| PCB | 0.010", $\epsilon_r = 3.38$, Multilayer | IS680-338 | Isola |

(Component Designations and Values table repeated for reference.)

50 OHM TYPICAL CHARACTERISTICS: 2140 MHz

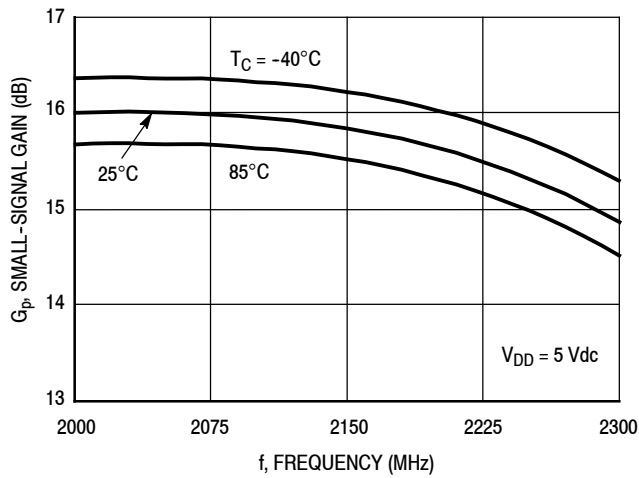


Figure 6. Small-Signal Gain (S21) versus Frequency

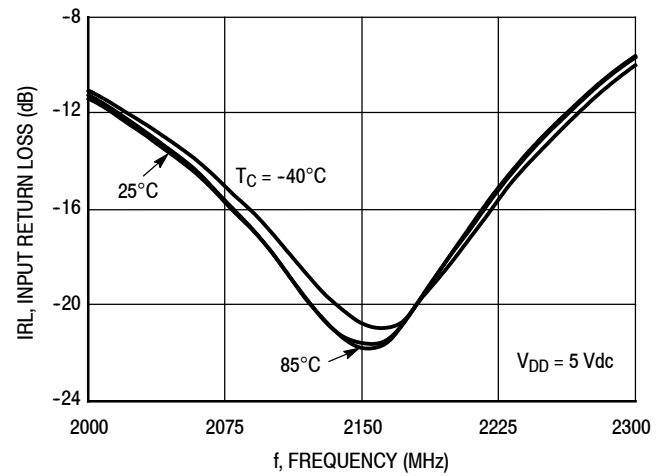


Figure 7. Input Return Loss (S11) versus Frequency

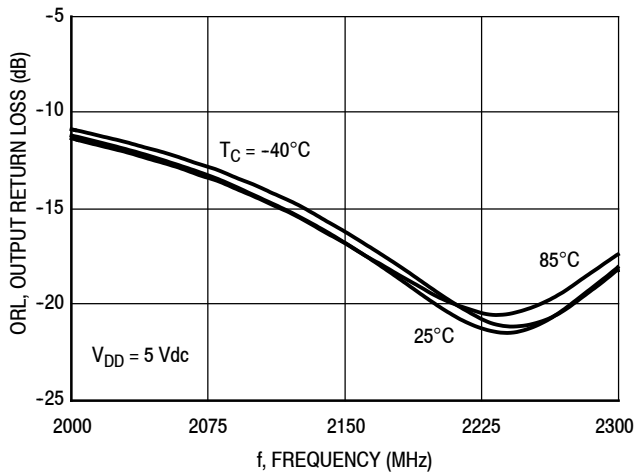


Figure 8. Output Return Loss (S22) versus Frequency

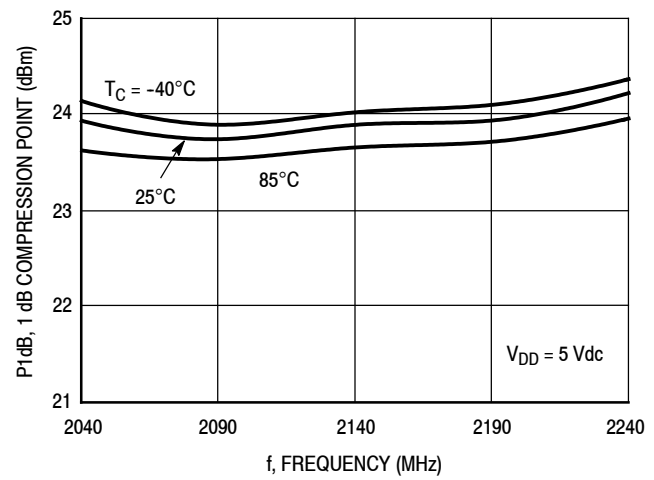


Figure 9. P1dB versus Frequency

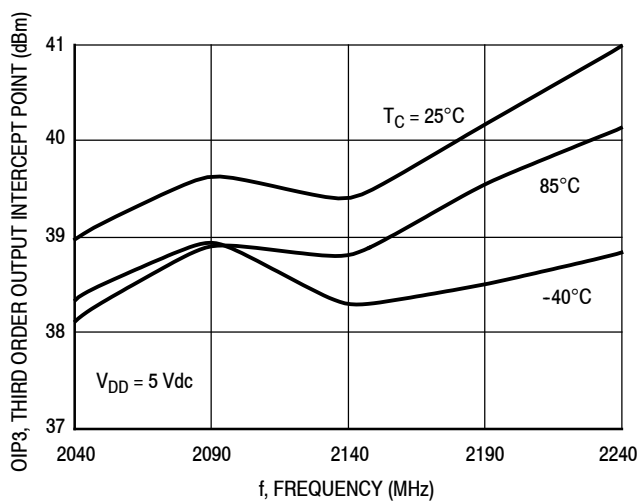


Figure 10. Third Order Output Intercept Point versus Frequency

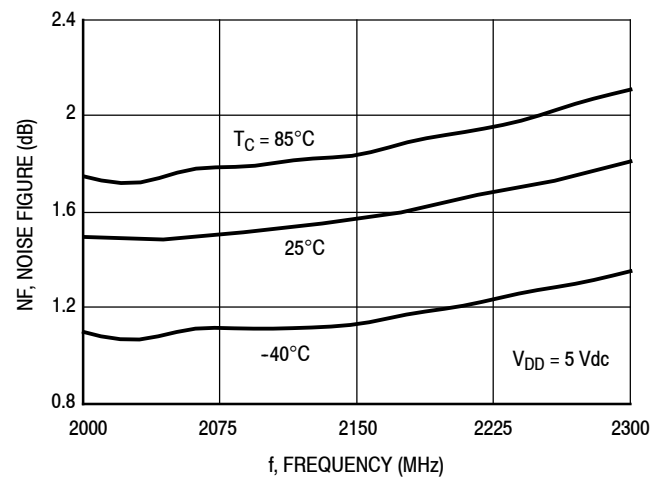


Figure 11. Noise Figure versus Frequency

50 OHM TYPICAL CHARACTERISTICS: 2140 MHz

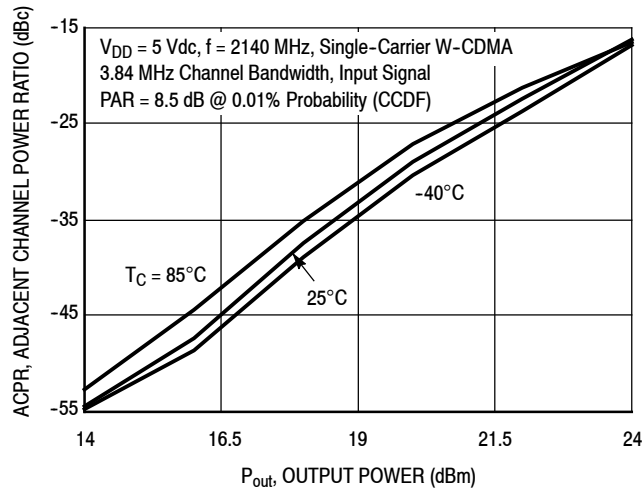


Figure 12. Single-Carrier W-CDMA Adjacent Channel Power Ratio versus Output Power

50 OHM APPLICATION CIRCUIT: 900 MHz

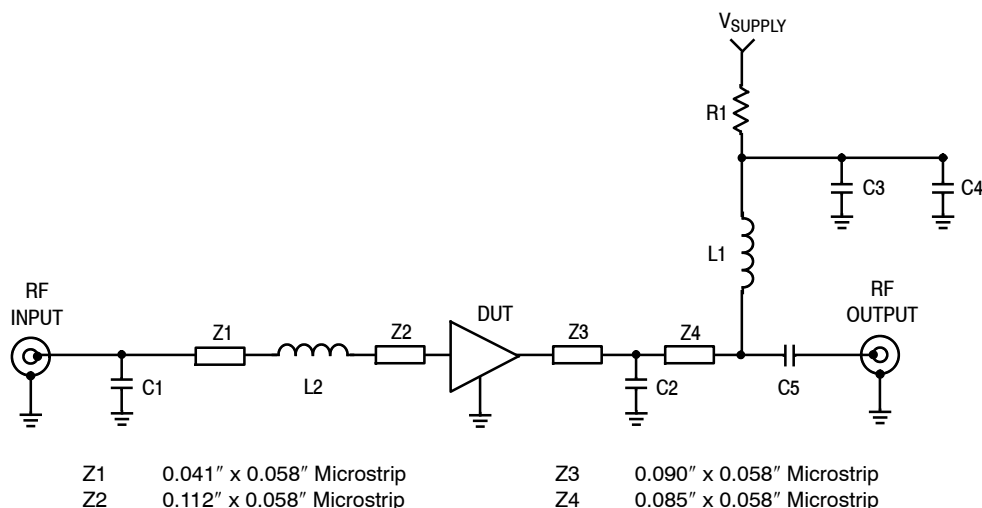


Figure 13. MMG15241HT1 Test Circuit Schematic

Table 9. MMG15241HT1 Test Circuit Component Designations and Values

| Part | Description | Part Number | Manufacturer |
|--------|--------------------------------|--------------------|---------------------|
| C1 | 3.9 pF Chip Capacitor | GQM1885C2A3R9CB01 | Murata |
| C2 | 0.6 pF Chip Capacitor | GQM1885C2AR60CB01 | Murata |
| C3, C5 | 56 pF Chip Capacitors | GRM188RC1H560GA01D | Murata |
| C4 | 0.1 μ F Chip Capacitor | GRM188R71H104KA93D | Murata |
| L1 | 30 nH Chip Inductor | 0603CS-30NXJLW | Coilcraft |
| L2 | 6.8 nH Chip Inductor | 0603CS-6N8XJLW | Coilcraft |
| R1 | 0 Ω , 1 A Chip Resistor | ERJ3GEY0R00V | Panasonic |
| PCB | 0.031", $\epsilon_r = 4.1$ | Getek Grade ML200C | GE Electromaterials |

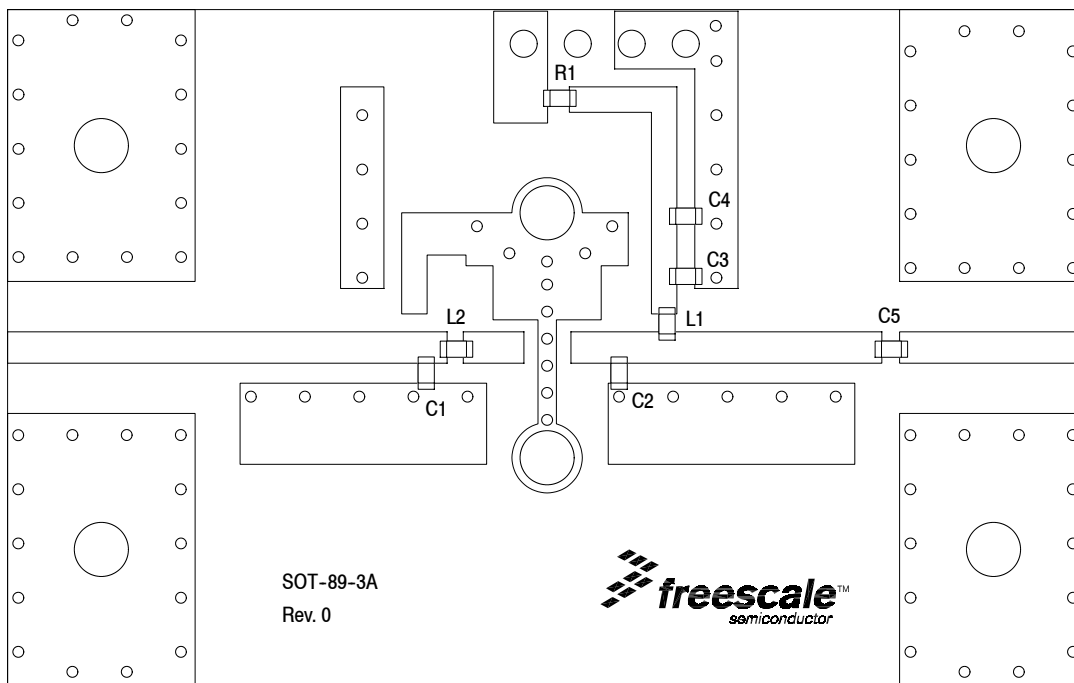


Figure 14. MMG15241HT1 Test Circuit Component Layout

50 OHM TYPICAL CHARACTERISTICS: 900 MHz

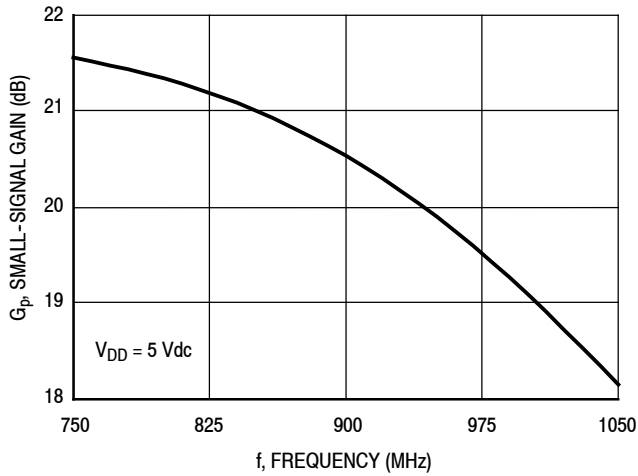


Figure 15. Small-Signal Gain (S21) versus Frequency

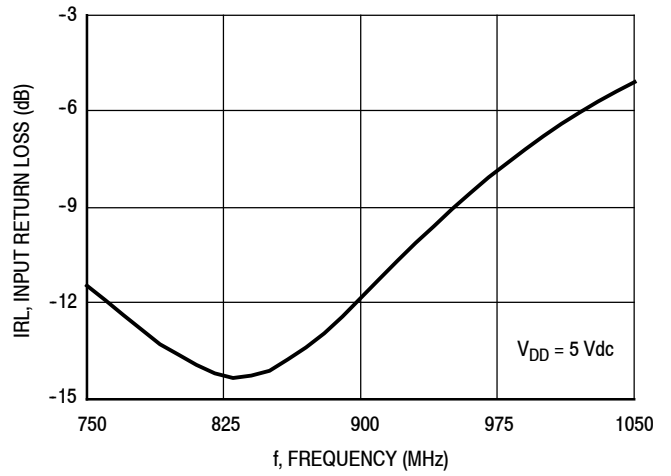


Figure 16. Input Return Loss (S11) versus Frequency

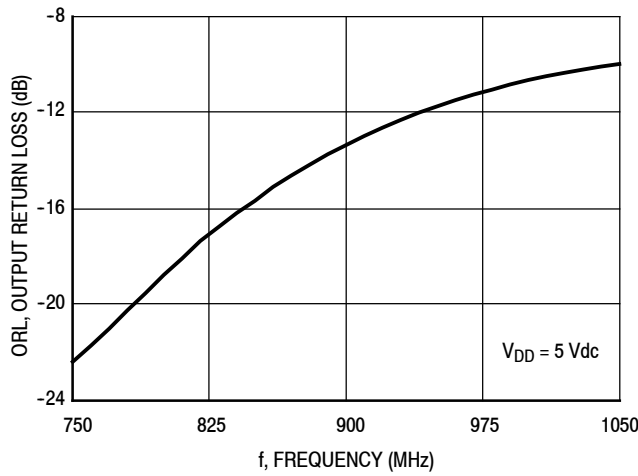


Figure 17. Output Return Loss (S22) versus Frequency

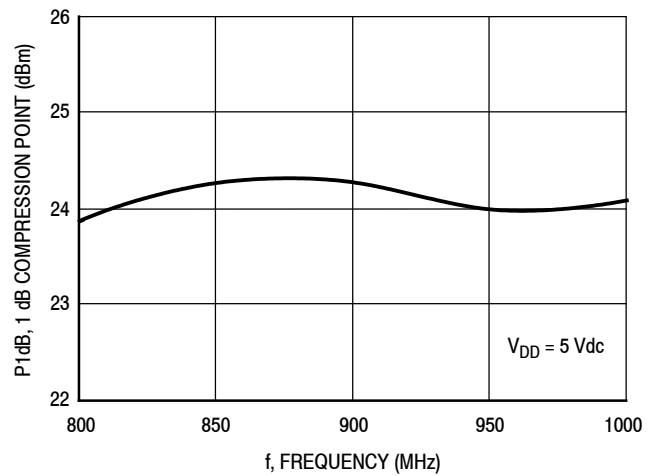


Figure 18. P1dB versus Frequency

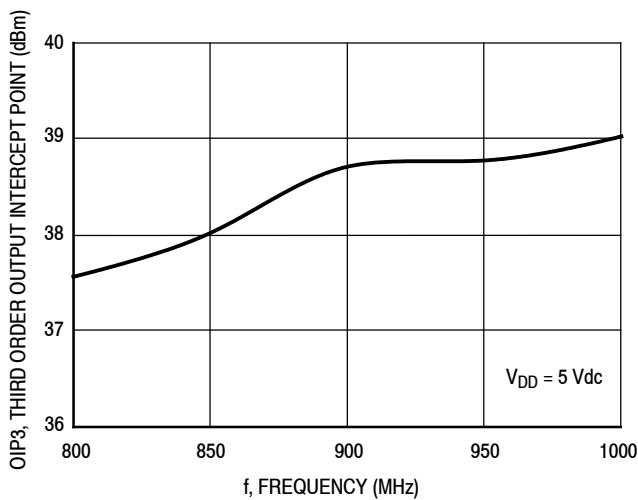


Figure 19. Third Order Output Intercept Point versus Frequency

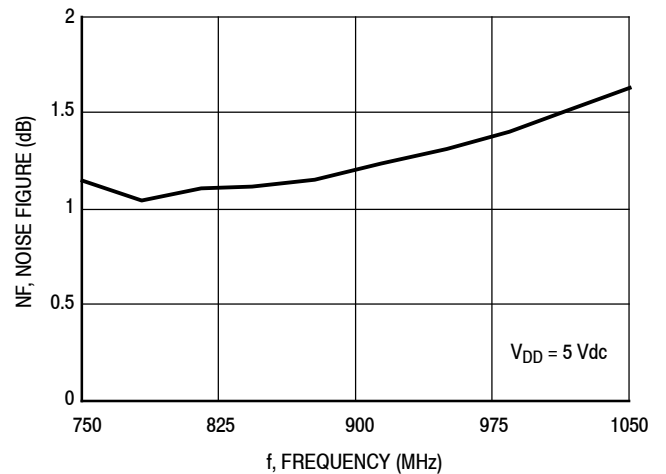


Figure 20. Noise Figure versus Frequency

50 OHM APPLICATION CIRCUIT: 2600 MHz

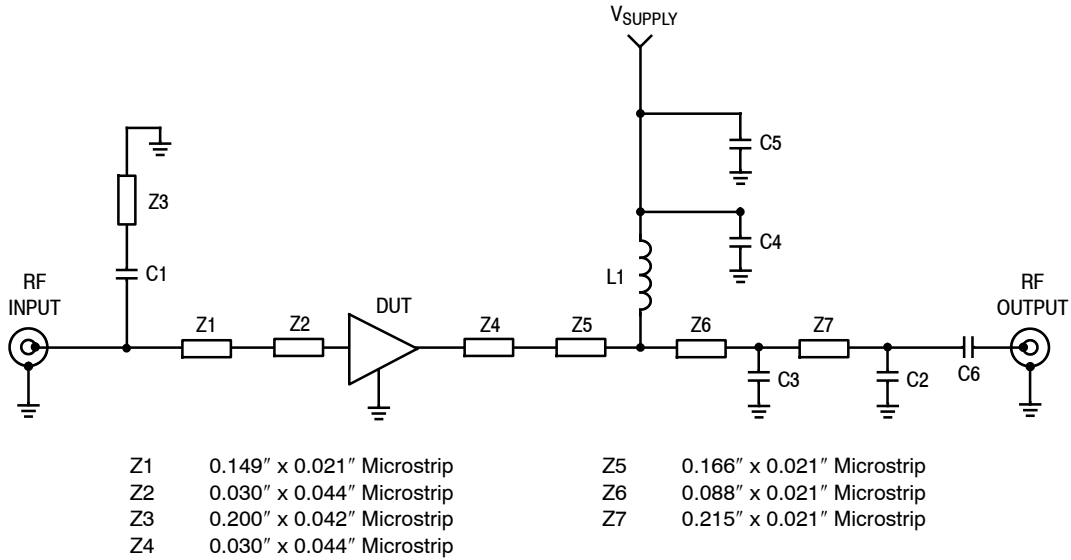


Figure 21. MMG15241HT1 Test Circuit Schematic

Table 10. MMG15241HT1 Test Circuit Component Designations and Values

| Part | Description | Part Number | Manufacturer |
|------|--|--------------------|--------------|
| C1 | 1.0 pF Chip Capacitor | GJM1555C1H1R0CB01D | Murata |
| C2 | 0.4 pF Chip Capacitor | GJM1555C1HR40BB01D | Murata |
| C3 | 0.2 pF Chip Capacitor | GJM1555C1HR20BB01D | Murata |
| C4 | 56 pF Chip Capacitor | GRM188RC1H560GA01D | Murata |
| C5 | 0.1 μ F Chip Capacitor | GRM188R71H104KA93D | Murata |
| C6 | 10 pF Chip Capacitor | GJM1555C1H100JB01D | Murata |
| L1 | 30 nH Chip Inductor | 0603CS-30NXJLW | Coilcraft |
| PCB | 0.010", $\epsilon_r = 3.38$, Multilayer | IS680-338 | Isola |

50 OHM APPLICATION CIRCUIT: 2600 MHz

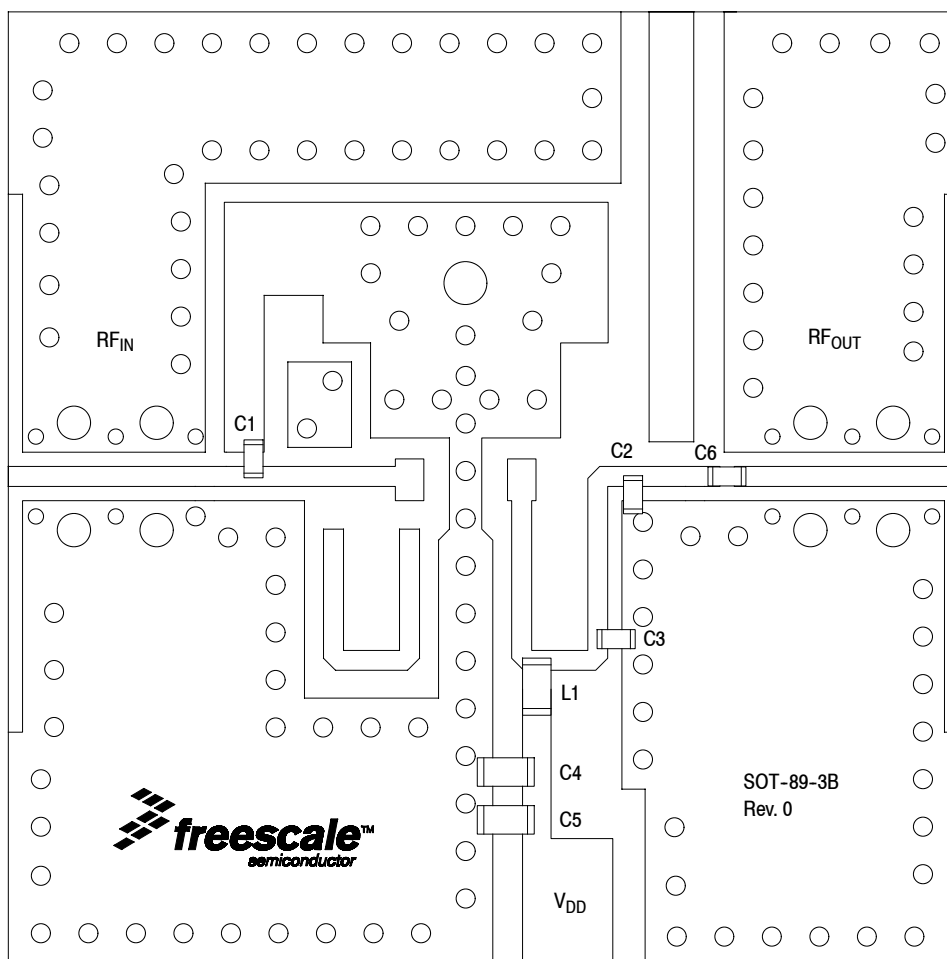


Figure 22. MMG15241HT1 Test Circuit Component Layout

Table 10. MMG15241HT1 Test Circuit Component Designations and Values

| Part | Description | Part Number | Manufacturer |
|------|--|--------------------|--------------|
| C1 | 1.0 pF Chip Capacitor | GJM1555C1H1R0CB01D | Murata |
| C2 | 0.4 pF Chip Capacitor | GJM1555C1HR40BB01D | Murata |
| C3 | 0.2 pF Chip Capacitor | GJM1555C1HR20BB01D | Murata |
| C4 | 56 pF Chip Capacitor | GRM188RC1H560GA01D | Murata |
| C5 | 0.1 μ F Chip Capacitor | GRM188R71H104KA93D | Murata |
| C6 | 10 pF Chip Capacitor | GJM1555C1H100JB01D | Murata |
| L1 | 30 nH Chip Inductor | 0603CS-30NXJLW | Coilcraft |
| PCB | 0.010", $\epsilon_r = 3.38$, Multilayer | IS680-338 | Isola |

(Component Designations and Values table repeated for reference.)

50 OHM TYPICAL CHARACTERISTICS: 2600 MHz

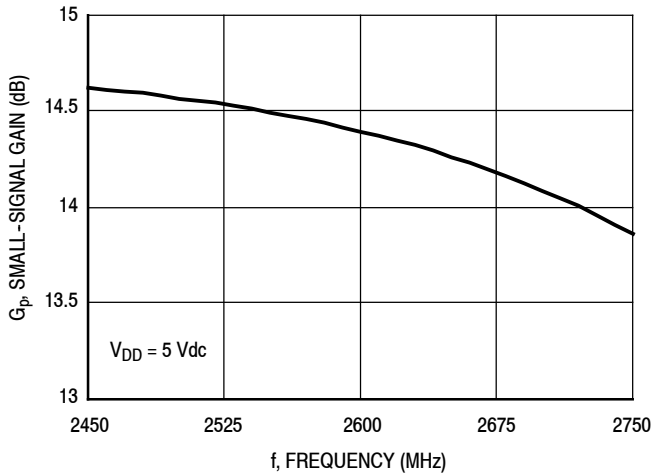


Figure 23. Small-Signal Gain (S21) versus Frequency

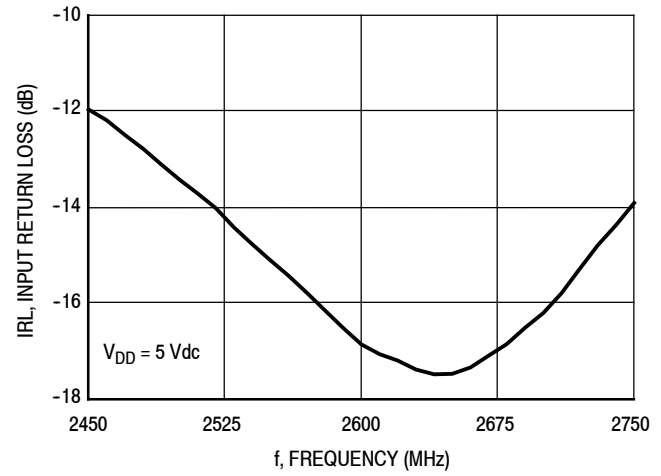


Figure 24. Input Return Loss (S11) versus Frequency

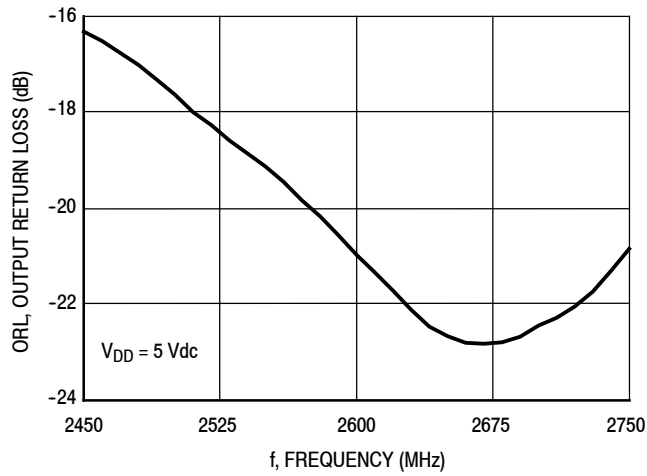


Figure 25. Output Return Loss (S22) versus Frequency

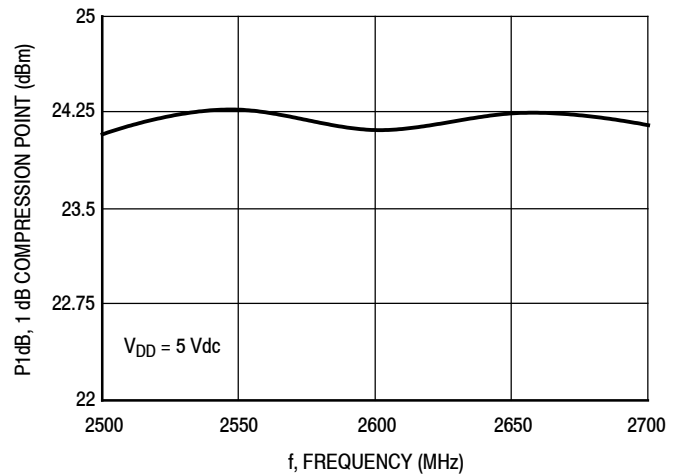


Figure 26. P1dB versus Frequency

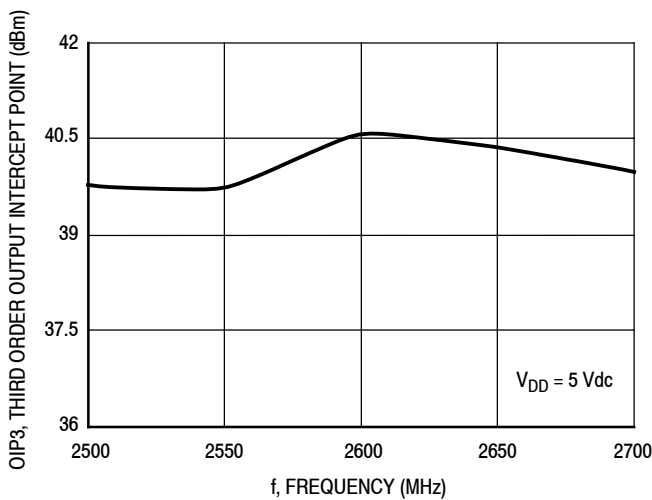


Figure 27. Third Order Output Intercept Point versus Frequency

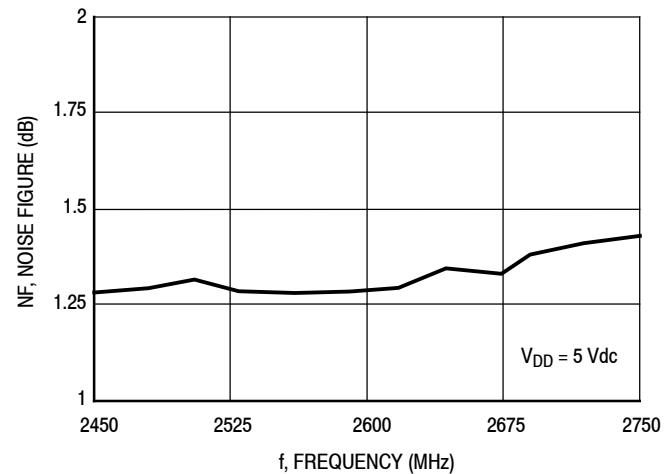


Figure 28. Noise Figure versus Frequency

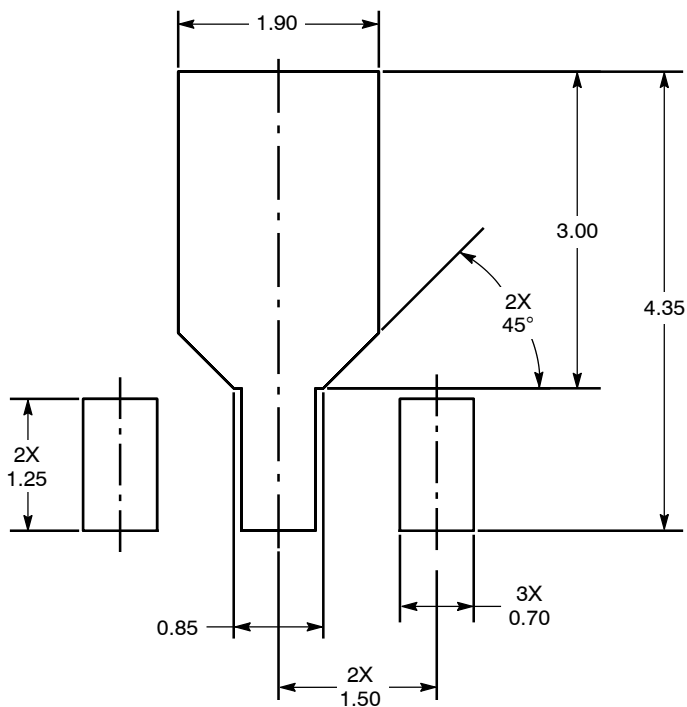


Figure 29. PCB Pad Layout for SOT-89A

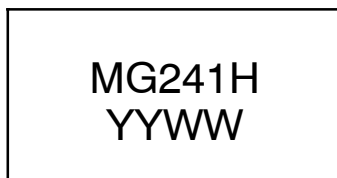
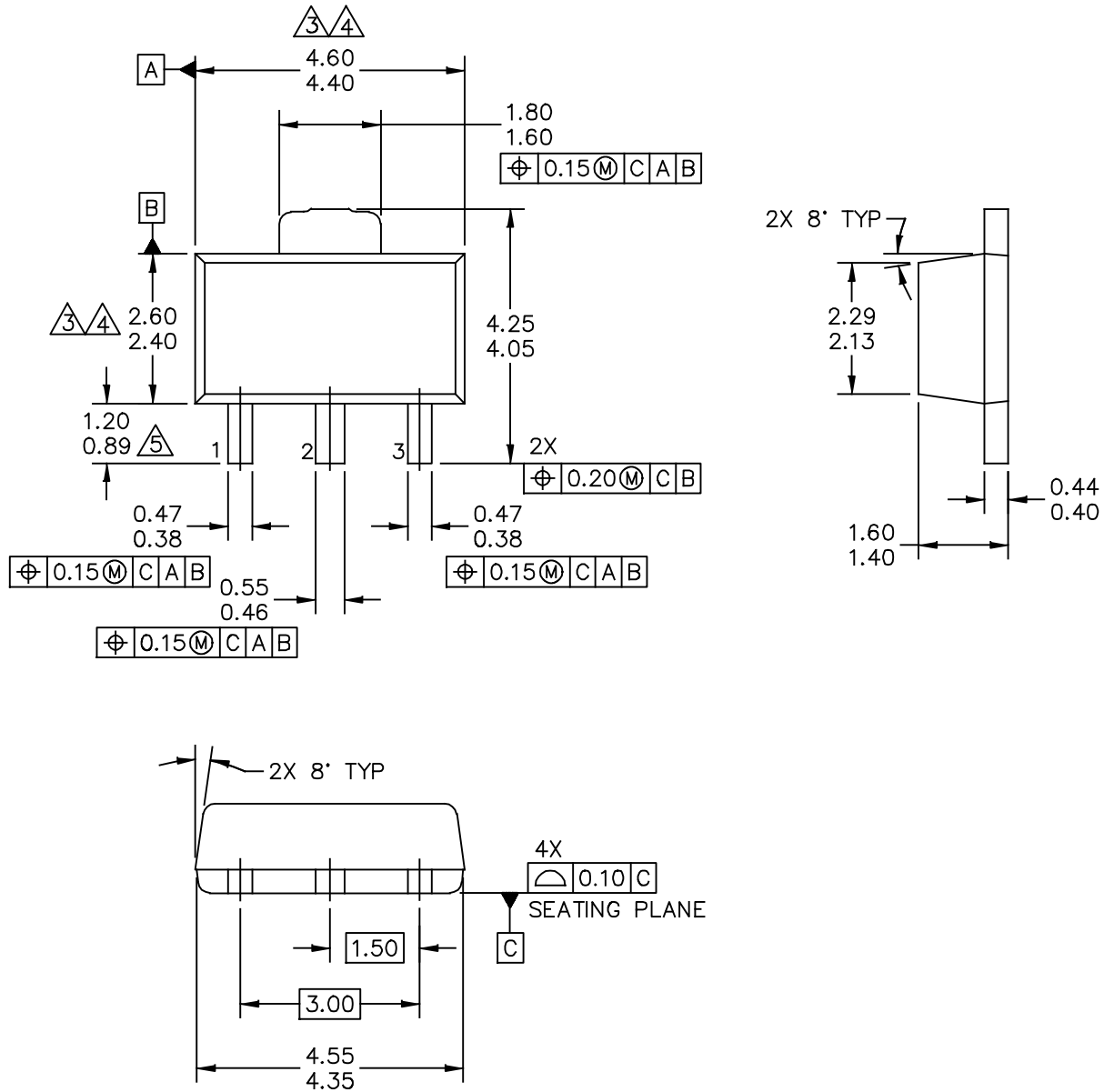
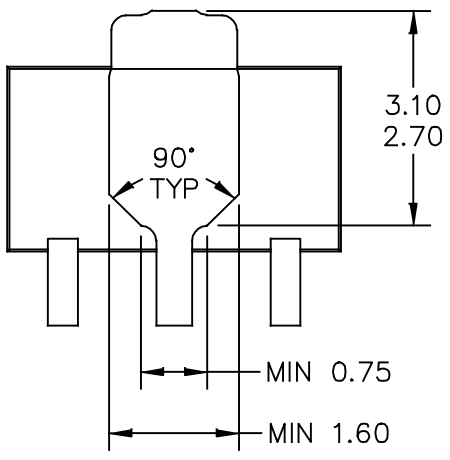


Figure 30. Product Marking

PACKAGE DIMENSIONS



| | | | | | |
|---|--|--------------------------|--|----------------------------|--|
| © FREESCALE SEMICONDUCTOR, INC. ALL RIGHTS RESERVED. | | MECHANICAL OUTLINE | | PRINT VERSION NOT TO SCALE | |
| TITLE: SOT-89A, 3 LEAD, 4.5 X 2.5 PKG, 1.5 MM PITCH | | DOCUMENT NO: 98ASA00241D | | REV: 0 | |
| | | CASE NUMBER: 2142-01 | | 15 JUL 2010 | |
| | | STANDARD: NON-JEDEC | | | |



BOTTOM VIEW

| | | | |
|---|--------------------------|----------------------------|--|
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| TITLE: SOT-89A, 3 LEAD, 4.5 X 2.5 PKG, 1.5 MM PITCH | DOCUMENT NO: 98ASA00241D | REV: 0 | |
| | CASE NUMBER: 2142-01 | 15 JUL 2010 | |
| | STANDARD: NON-JEDEC | | |

NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M – 1994.

2. ALL DIMENSIONS ARE IN MILLIMETERS.

3. DIMENSIONS DOES NOT INCLUDE MOLD FLASH. PROTRUSIONS OR GATE BURRS. MOLD FLASH, PROTRUSIONS OR GATE BURRS SHALL NOT EXCEED 0.5 MM PER END. DIMENSION DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.5 MM PER SIDE.

4. DIMENSION ARE DETERMINED AT THE OUTMOST EXTREMES OF THE PLASTIC BODY EXCLUSIVE OF MOLD FLASH, TIE BAR BURRS, GATE BURRS AND INTERLEAD FLASH, BUT INCLUDING ANY MISMATCH BETWEEN THE TOP AND BOTTOM OF THE PLASTIC BODY.

5. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.

| | | | |
|---|--------------------------|----------------------------|-------------|
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| TITLE: SOT-89A, 3 LEAD, 4.5 X 2.5 PKG, 1.5 MM PITCH | DOCUMENT NO: 98ASA00241D | | REV: 0 |
| | CASE NUMBER: 2142-01 | | 15 JUL 2010 |
| | STANDARD: NON-JEDEC | | |

Refer to the following resources to aid your design process.

Application Notes

- AN1955: Thermal Measurement Methodology of RF Power Amplifiers

Software

- .s2p File

Development Tools

- Printed Circuit Boards

For Software and Tools, do a Part Number search at <http://www.freescale.com>, and select the “Part Number” link. Go to Software & Tools on the part’s Product Summary page to download the respective tool.

FAILURE ANALYSIS

At this time, because of the physical characteristics of the part, failure analysis is limited to electrical signature analysis. In cases where Freescale is contractually obligated to perform failure analysis (FA) services, full FA may be performed by third party vendors with moderate success. For updates contact your local Freescale Sales Office.

REVISION HISTORY

The following table summarizes revisions to this document.

| Revision | Date | Description |
|-----------------|-------------|---|
| 0 | Dec. 2010 | <ul style="list-style-type: none"> • Initial Release of Data Sheet |
| 1 | Apr. 2011 | <ul style="list-style-type: none"> • Table 2, Maximum Ratings, updated RF Input Power from 13 dBm to 23 dBm as a result of new measurements done over temperature and bias, p. 1 |
| 2 | Sept. 2014 | <ul style="list-style-type: none"> • Table 2, Maximum Ratings: updated Junction Temperature from 150°C to 175°C to reflect recent test results of the device, p. 1 • Table 6, ESD Protection Characteristics: Changed ESD Human Body Model rating from 2 to 1A and Machine Model rating from B to A to reflect recent ESD test results of the device; removed the word “Minimum” after the ESD class rating. ESD ratings are characterized during new product development but are not 100% tested during production. ESD ratings provided in the data sheet are intended to be used as a guideline when handling ESD sensitive devices, p. 2 • Revised Failure Analysis information, p. 17 |

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- Поставка более 17-ти миллионов наименований электронных компонентов;
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- Лицензия ФСБ на осуществление работ с использованием сведений, составляющих государственную тайну;
- Поставка специализированных компонентов (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Aeroflex, Peregrine, Syfer, Eurofarad, Texas Instrument, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

Помимо этого, одним из направлений компании «ЭлектроПласт» является направление «Источники питания». Мы предлагаем Вам помощь Конструкторского отдела:

- Подбор оптимального решения, техническое обоснование при выборе компонента;
- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.



Как с нами связаться

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