*Surface Mount*

# Dual Matched MMIC Amplifier MPGA-105+

50Ω 0.04 to 3 GHz

CASE STYLE: DL1020

## The Big Deal

- Excellent gain flatness, ±0.5 dB
- Dual matched amplifier for push-pull & balanced amplifiers
- High dynamic range, High OIP3 & Low NF

## Product Overview

MPGA-105+ is a dual matched wideband amplifier fabricated using advanced E-PHEMT technology, offering high dynamic range (High IP3 and Low NF) for use in 50 and 75 ohm applications. This model has demonstrated exceptionally high IP2 in wideband 50 and 75 ohm amplifier evaluation boards. Combining this performance with low noise figure makes it suitable for use in very high dynamic range amplifiers.

## Key Features

| Feature | Advantages |
|---|---|
| Broadband | Covers many communication bands including cellular, cable TV, PCS, SATCOM, WiMAX, and more. |
| Excellent Gain Flatness: ±0.5 dB over 0.1-2 GHz | Requires no gain compensation in most wideband applications. |
| Matched pair for use in high IP3 and IP2 amplifiers | Typical gain match of 0.2 dB and phase match of 0.7°, enables it to be used in push-pull amplifiers. Outstanding IP2. |
| High IP3, up to 40 dBm | Ideal for suppressing unwanted intermods in the presence of multiple carriers, now common in many communication systems. |
| High P1dB, Up to 21 dBm | High P1dB enables the amplifier to operate in linear region in the presence of strong interfering signals. |
| Low Noise Figure: 1.7-1.9 dB typical | Together with High OIP3/P1dB, results in high dynamic range |

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# Dual Matched MMIC Amplifier 0.04-3GHz

## Product Features

- Two matched amplifiers in one package
- High IP3, +37.5 dBm at 0.9 GHz
- High IP2, +59 dBm at 0.9 GHz in push-pull configuration
- Gain, 14.4 dB typ. at 0.9 GHz
- Excellent Gain Flatness, ±0.5 dB (0.1-2 GHz)
- P1dB, +21 dBm typ. at 0.9 GHz
- Low noise figure, 1.9 dB typ. at 0.9 GHz

*Generic photo used for illustration purposes only*

**MPGA-105+**

CASE STYLE: DL1020

***+RoHS Compliant***

*The +Suffix identifies RoHS Compliance. See our web site for RoHS Compliance methodologies and qualifications*

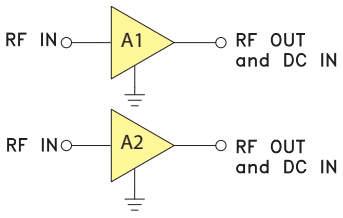
## Typical Applications

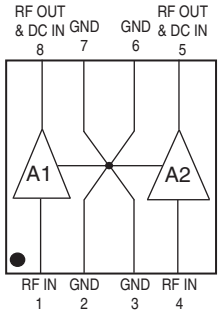
- SATCOM
- CATV
- FTTH
- Optical networks
- Base station infrastructure
- Balanced amplifiers
- 75 Ohm push-pull and balanced amplifiers

## General Description

MPGA-105+ (RoHS compliant) is an advanced ultra-flat gain amplifier fabricated using E-PHEMT technology and offers extremely high dynamic range over a broad frequency range and with low noise figure. In addition, the MPGA-105+ has good input and output return loss over a broad frequency range without the need for external matching components. It is enclosed in a 4.9 x 6 mm MCLP package for good thermal performance.

***simplified schematic (each of A1, A2) and pad description***




| Function | Pad Number | Description |
|---|---|---|
| RF IN, A1 | 1 | RF input pin. This pin requires the use of an external DC blocking capacitor chosen for the frequency of operation. (see Application circuit, Fig 2.) |
| RF-OUT and DC-IN, A1 | 8 | RF output and bias pin. DC voltage is present on this pin; therefore a DC blocking capacitor is necessary for proper operation. An RF choke is needed to feed DC bias without loss of RF signal due to the bias connection, as shown in "Recommended Application Circuit", Fig 2 |
| RF IN, A2 | 4 | RF input pin. This pin requires the use of an external DC blocking capacitor chosen for the frequency of operation. (see Application circuit, Fig 2.) |
| RF-OUT and DC-IN, A2 | 5 | RF output and bias pin. DC voltage is present on this pin; therefore a DC blocking capacitor is necessary for proper operation. An RF choke is needed to feed DC bias without loss of RF signal due to the bias connection, as shown in "Recommended Application Circuit", Fig 2 |
| GND | 2,3,6,7 & paddle | Connections to ground. Use via holes as shown in "Suggested Layout for PCB Design" to reduce ground path inductance for best performance. |

* Enhancement mode pseudomorphic High Electron Mobility Transistor.

## Electrical Specifications[1] at 25°C, Zo=50Ω and Device Voltage 5V, unless noted

*(Specifications other than Matching or where defined as push-pull are for each of the two matched amplifiers in the package)*

| Parameter | | Condition (GHz) | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|
| Frequency Range | | | 0.04 | | 3.0 | GHz |
| Gain | | 0.04 | 13.0 | 16.0 | 15.9 | dB |
| | | 0.5 | | 14.6 | | |
| | | 0.9 | | 14.4 | | |
| | | 2.0 | | 14.1 | | |
| | | 2.6 | | 14.3 | | |
| | | 3.0 | | 14.0 | | |
| Gain Flatness | | 0.1-2.0 | | ±0.5 | | dB |
| Input Return Loss | | 0.04 | 15.0 | 11.3 | | dB |
| | | 0.5 | | 24.3 | | |
| | | 0.9 | | 20.6 | | |
| | | 2.0 | | 19.0 | | |
| | | 2.6 | | 11.6 | | |
| | | 3.0 | | 10.5 | | |
| Output Return Loss | | 0.04 | | 12.6 | | dB |
| | | 0.5 | | 20.5 | | |
| | | 0.9 | | 15.1 | | |
| | | 2.0 | | 8.2 | | |
| | | 2.6 | | 7.4 | | |
| | | 3.0 | | 7.9 | | |
| Output Power @1 dB compression [2,6] | | 0.04 | | 21.0 | | dBm |
| | | 0.5 | | 20.5 | | |
| | | 0.9 | | 21.0 | | |
| | | 2.0 | | 19.8 | | |
| | | 2.6 | | 19.8 | | |
| | | 3.0 | | 20.1 | | |
| Output IP3 [6] | | 0.04 | 35.5 | 35.9 | | dBm |
| | | 0.5 | | 37.6 | | |
| | | 0.9 | | 37.8 | | |
| | | 2.0 | | 34.1 | | |
| | | 2.6 | | 32.5 | | |
| | | 3.0 | | 32.1 | | |
| Noise Figure | | 0.04 | | 1.7 | | dB |
| | | 0.5 | | 1.9 | | |
| | | 0.9 | | 1.9 | | |
| | | 2.0 | | 1.8 | | |
| | | 2.6 | | 1.7 | | |
| | | 3.0 | | 1.8 | | |
| Matching between A1, A2 | Amplitude Unbalance | 0.04 | | 0.0 | | dB |
| | | 0.5 | | 0.1 | | |
| | | 0.9 | | 0.1 | | |
| | | 2.0 | | 0.2 | | |
| | | 2.6 | | 0.3 | | |
| | | 3.0 | | 0.2 | | |
| | Phase Unbalance | 0.04 | | 0.7 | | deg. |
| | | 0.5 | | 0.4 | | |
| | | 0.9 | | 0.8 | | |
| | | 2.0 | | 1.6 | | |
| | | 2.6 | | 1.4 | | |
| | | 3.0 | | 0.8 | | |
| Device Operating Voltage | | | 4.8 | 5.0 | 5.2 | V |
| Device Operating Current (each amplifier) | | | | 63 | 77 | mA |
| Device Current Variation vs. Temperature | | | | 80 | | µA/°C |
| Device Current Variation vs Voltage | | | | 0.014 | | mA/mV |
| Thermal Resistance, junction-to-ground lead [7] | | | | 47 | | °C/W |

### Absolute Maximum Ratings[4]

| Parameter | Ratings |
|---|---|
| Operating Temperature | -40°C to 85°C |
| Storage Temperature | -65°C to 150°C |
| Operating Current at 5V[6] | 94 mA |
| Power Dissipation[6] | 0.47 W |
| Input Power (CW)[6] | 23 dBm (5 minutes max, 17 dBm (continuous) |
| DC Voltage (pads 5, 8) | 5.5V |

### Push-Pull Amplifier Typical Performance[3]

| Frequency (GHz) | Gain (dB) | Output IP3 (dBm) | Output IP2 (dBm) |
|---|---|---|---|
| 0.04 | 12.2 | 34.4 | 66.6 |
| 0.5 | 12.3 | 35.8 | 58.7 |
| 0.9 | 11.4 | 43.3 | 59.4 |
| 2.0 | 10.4 | 35.1 | 55.3 |
| 2.6 | 8.7 | 35.0 | 66.9 |
| 3.0 | 8.1 | 34.9 | 67.8 |

(1) Measured on Mini-Circuits Test Board TB-561-105+, see characterization circuit, Fig 1.
(2) Current increases at P1dB
(3) Measured on evaluation boards (push-pull amplifiers) TB-666-50-105+. See characterization Test Circuit (Fig 1b)
(4) Permanent damage may occur if any of these limits are exceeded.
(5) Defined with reference to ground pad temperature.
(6) Per single ended amplifier.
(7) Θjc= (Junction Temperature - 85°C) / (Voltage X sum of current in A1 & A2)

## Characterization Test Circuit

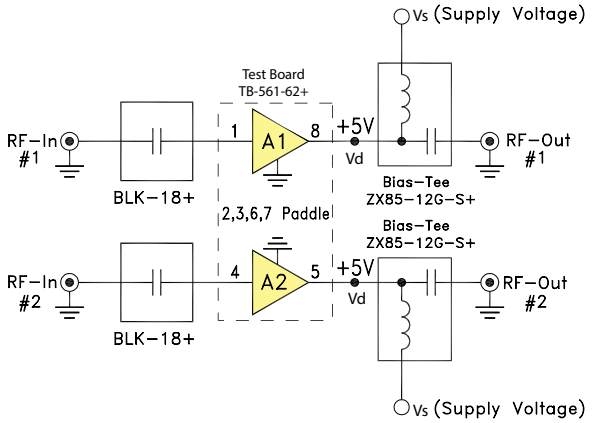
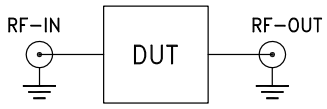



**Fig 1a**. Block Diagram of Test Circuit used for characterization. (DUT tested in Mini-Circuits Test board TB-561-105+, except for IP2).
Gain, Return loss, Output power at 1dB compression (P1 dB) , output IP3 (OIP3) and noise figure measured using Agilent's N5242A PNA-X microwave network analyzer.

**Conditions:**
1. Gain and Return loss: Pin= -25dBm
2. Output IP3 (OIP3): Two tones, spaced 1MHz apart, 0 dBm/tone at output.

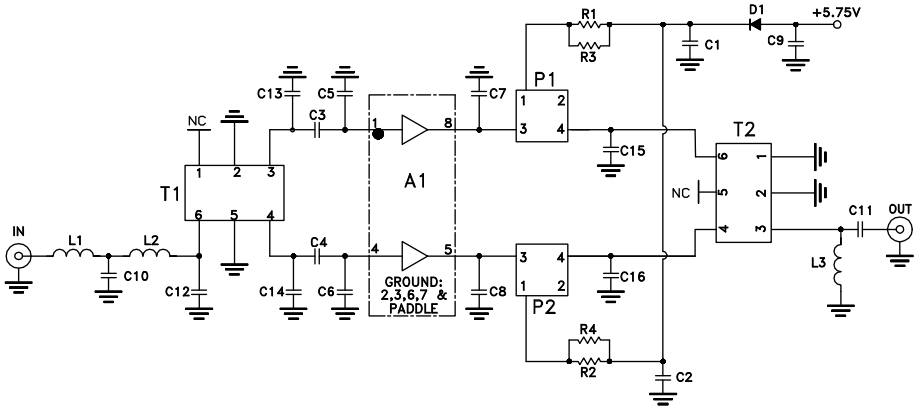



Mini-Circuits Evaluation Boards, 50Ω Push-Pull Amplifiers
TB-666-50-105+ (MPGA-105+ inside)

**Fig 1b**. Block Diagram of Test Set up used for characterization of Gain, IP2, IP3 of push-pull amplifier. Measured using Agilent's signal generators E8527D and Spectrum analyzer N9020A.

**Conditions:**
1. Gain and Return loss: Pin= -25dBm
2. Output IP3 & IP2: Two tones, spaced 1MHz apart, 8 dBm/tone at output. IP2 is measured at the sum frequency of the tones.

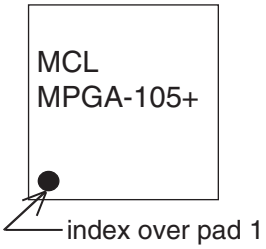
## Recommended Application Circuit




| COMPONENT | VALUE | SIZE |
|---|---|---|
| A1 | Mini-Circuits MPGA-105+ | PER DATA SHEET |
| C1,C2 | .039 uF | 0805 |
| C3,C4 | .001 uF | 0402 |
| C5,C6 | .2 pF | 0402 |
| C7,C8 | 1.1 pF | 0402 |
| C9 | 1.0 uF | 1311 |
| C10 | .4 pF | 0603 |
| C11 | 270 pF | 0805 |
| C12 | .4 pF | 0402 |
| C13 | .7 pF | 0402 |
| C14 | .3 pF | 0402 |
| C15 | .6 pF | 0402 |
| C16 | 1.0 pF | 0402 |
| D1 | Diode, Schottky Rectifier Vf=.385V @ .5A, Vr=10V MAX | – |
| L1,L2 | 1.1 nH | .073"X.054" |
| L3 | 1.5 uH | 1008 |
| R1,R2 | 5.11 Ohm | 1206 |
| R3,R4 | 7.50 Ohm | 1206 |
| T1 | Mini-Circuits TCM2-33WX+ | PER DATA SHEET |
| T2 | Mini-Circuits TCM2-43X+ | PER DATA SHEET |
| P1,P2 | Mini-Circuits TCBT-6G+ | PER DATA SHEET |

**Fig 2.** Recommended Application Circuit. Mini-Circuits Evaluation Board 50Ω: TB-666-50-105+

## Product Marking



| Additional Detailed Technical Information<br>*additional information is available on our dash board. To access this information click here* | |
|---|---|
| **Performance Data** | Data Table |
| | Swept Graphs |
| | S-Parameter (S4P Files) Data Set (.zip file) |
| **Case Style** | DL1020 *Plastic package, exposed paddle*<br>*lead finish: Matte-Tin* |
| **Tape & Reel**<br>**Standard quantities available on reel** | F68<br>*7" reels with 20, 50, 100, 200, 500 or 1K devices* |
| **Suggested Layout for PCB Design** | PL-322 |
| **Evaluation Board** | TB-666-50-105+ |
| **Environmental Ratings** | ENV08T2 |

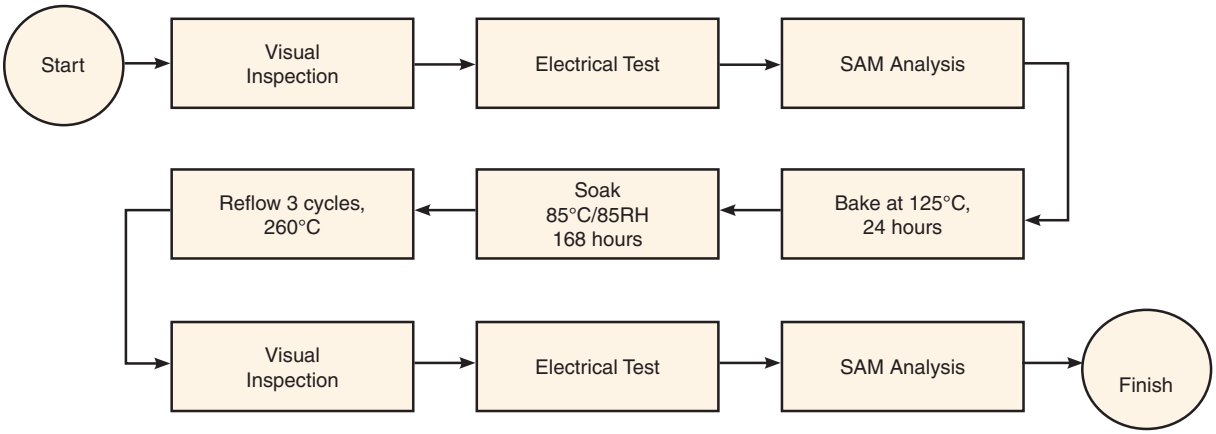
## ESD Rating

Human Body Model (HBM): Class 1A (250 to <500V) in accordance with ANSI/ESD STM 5.1 - 2001
Machine Model (MM): Class M1 (pass 25V) in accordance with ANSI/ESD STM5.2-1999

## MSL Rating

Moisture Sensitivity: MSL1 in accordance with IPC/JEDEC J-STD-020D

### MSL Test Flow Chart




**Additional Notes**

A. Performance and quality attributes and conditions not expressly stated in this specification document are intended to be excluded and do not form a part of this specification document.

B. Electrical specifications and performance data contained in this specification document are based on Mini-Circuit's applicable established test performance criteria and measurement instructions.

C. The parts covered by this specification document are subject to Mini-Circuits standard limited warranty and terms and conditions (collectively, "Standard Terms"); Purchasers of this part are entitled to the rights and benefits contained therein. For a full statement of the Standard Terms and the exclusive rights and remedies thereunder, please visit Mini-Circuits' website at www.minicircuits.com/MCLStore/terms.jsp

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