



MMIC SURFACE MOUNT

Low Noise Amplifier

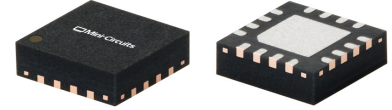
PMA3-10203+

Mini-Circuits

50Ω 12.5 to 20 GHz Shutdown Feature

THE BIG DEAL

- Low Noise Figure, Typ. 1.5 dB
- High OIP3, Typ. +24 dBm
- High P1dB, Typ. +16 dBm
- Shutdown Feature
- Single +5 V Supply Voltage
- 3x3 mm, 16-Lead QFN-Style Package

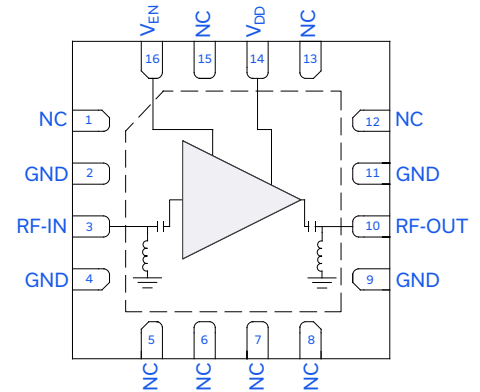


Generic photo used for illustration purposes only

APPLICATIONS

- Test & Measurement Equipment
- Back Haul Radio Systems
- Satellite Communications
- Radar, EW, and ECM Defense Systems

FUNCTIONAL DIAGRAM



PRODUCT OVERVIEW

The PMA3-10203+ is a pHEMT-based wideband, ultra-low noise MMIC amplifier with high IP3, flat gain, and voltage-controlled shutdown capability. Operating from 12.5 to 20 GHz, this amplifier features high dynamic range with typical 1.5 dB noise figure, 21 dB gain, +16 dBm P1dB, and +24 dBm OIP3. This combination of characteristics makes it ideal for sensitive, high dynamic range receiver applications. The device is internally DC blocked, and a DC path to ground is present at the RF input and output ports for ESD protection. PMA3-10203+ operates on a single +5 V supply, is well matched to 50Ω, and comes in a small, low profile 3x3 mm QFN-style package for easy integration into dense circuit board layouts.

KEY FEATURES

| Features | Advantages |
|---|--|
| Low Noise Figure, Typ. 1.5 dB | This ultra-low noise MMIC device enables low system noise figure performance without the need for complicated discrete-based solutions. |
| High Dynamic Range <ul style="list-style-type: none"> • Gain, Typ. 21 dB • OIP3, Typ. +24 dBm • P1dB, Typ. +16 dBm | The MMIC amplifier's unique combination of low noise figure, high gain, high P1dB, and high OIP3 enables optimum performance in sensitive high dynamic range receivers. |
| Shutdown Feature | A shutdown feature allows the part to be quickly disabled to conserve power when not in use. |
| 3x3mm 16-Lead QFN-Style Package | Small footprint saves space in dense layouts while providing low inductance, repeatable transitions, and excellent thermal contact to the PCB. Industry-standard packaging allows for ease of assembly in high-volume manufacturing processes. |





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ELECTRICAL SPECIFICATIONS¹ AT +25°C, V_{DD} = +5 V, V_{EN} = +5 V UNLESS NOTED OTHERWISE

| Parameter | Condition (GHz) | Min. | Typ. | Max. | Units |
|---|-----------------|-------|-------|-------|-------|
| Frequency Range | | 12.5 | | 20 | GHz |
| Gain | 12.5 | 17.5 | 20.8 | | dB |
| | 14 | 18.0 | 21.3 | | |
| | 16 | 19.2 | 22.2 | | |
| | 18 | 17.8 | 20.7 | | |
| | 20 | 15.5 | 18.8 | | |
| Input Return Loss | 12.5 | | 13 | | dB |
| | 14 | | 9 | | |
| | 16 | | 8 | | |
| | 18 | | 8 | | |
| | 20 | | 9 | | |
| Output Return Loss | 12.5 | | 19 | | dB |
| | 14 | | 15 | | |
| | 16 | | 12 | | |
| | 18 | | 20 | | |
| | 20 | | 15 | | |
| Isolation | 12.5 - 20 | | 48 | | dB |
| Output Power at 1 dB Compression (P _{1dB}) | 12.5 | | +15.2 | | dBm |
| | 14 | | +16.0 | | |
| | 16 | | +16.1 | | |
| | 18 | | +16.4 | | |
| | 20 | | +15.7 | | |
| Output Third-Order Intercept (P _{OUT} = +5 dBm/Tone) | 12.5 | | +23 | | dBm |
| | 14 | | +25 | | |
| | 16 | | +25 | | |
| | 18 | | +24 | | |
| | 20 | | +23 | | |
| Noise Figure | 12.5 | | 1.4 | | dB |
| | 14 | | 1.3 | | |
| | 16 | | 1.4 | | |
| | 18 | | 1.5 | | |
| | 20 | | 2.1 | | |
| FALL Time (90% RF to 10% RF) ² | | | 13 | | ns |
| RISE Time (10% RF to 90% RF) ² | | | 108 | | ns |
| Device Operating Voltage (V _{DD}) | | +4.75 | +5 | +5.25 | V |
| Device Operating Current (I _{DD}) ³ | | | 56 | | mA |
| Enable Voltage (V _{EN}) ⁴ | | +4.75 | +5 | +5.25 | V |
| Enable Current (I _{EN}) at V _{EN} = +5 V | | | 0.86 | | mA |
| DC Current Variation vs. Temperature ⁵ | | | -86.7 | | μA/°C |
| DC Current Variation vs. Voltage ⁶ | | | 0.004 | | mA/mV |

1. Tested on Mini-Circuits Characterization Test Board TB-PMA3-10203C+. See Figure 2. Board loss de-embedded to the device.

2. Measured with bypass capacitors C2 and C4 removed from TB-PMA3-10203C+.

3. Current at P_N = -25 dBm. Increases to 61 mA at P_{1dB}.4. V_{EN} ≤ V_{DD} under nominal operating conditions.

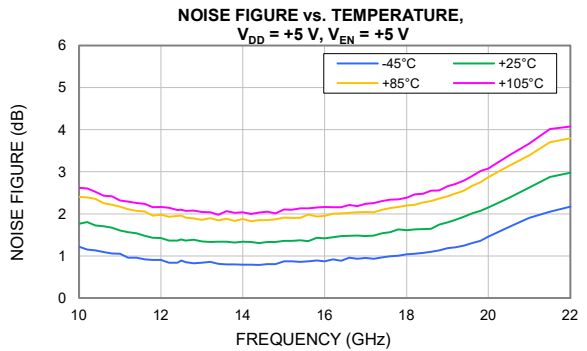
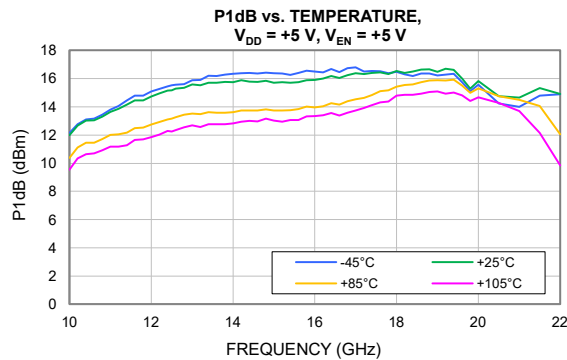
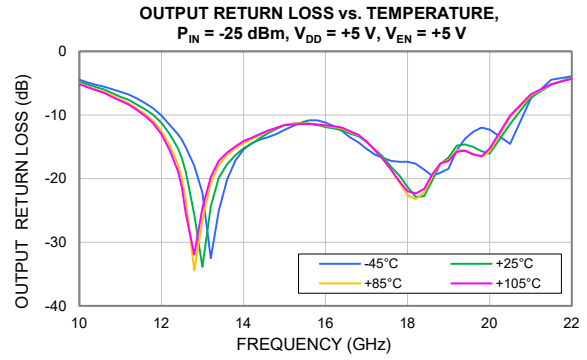
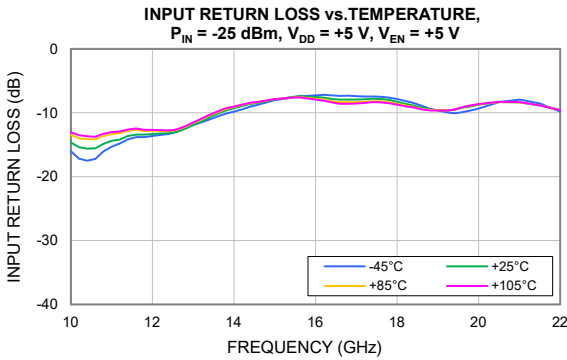
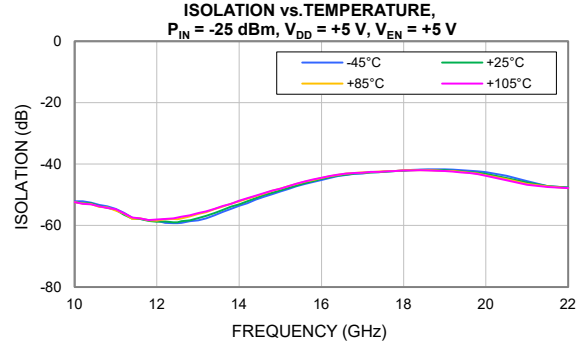
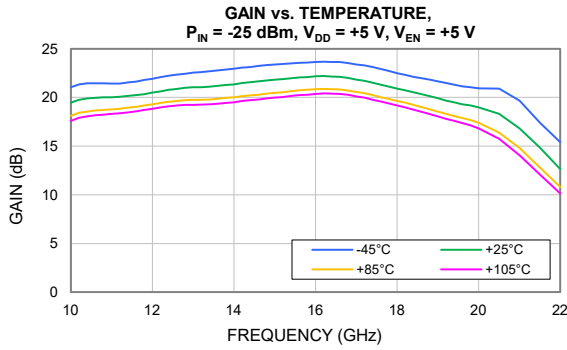
5. (Current at +105°C - Current at -45°C) / (+150°C)

6. (Current at +5.25 V - Current at +4.75 V) / (+5.25 V - +4.75 V)



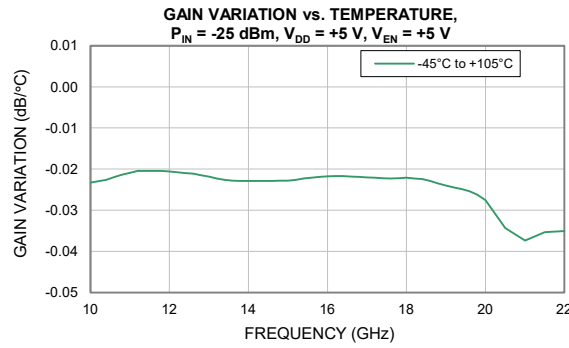
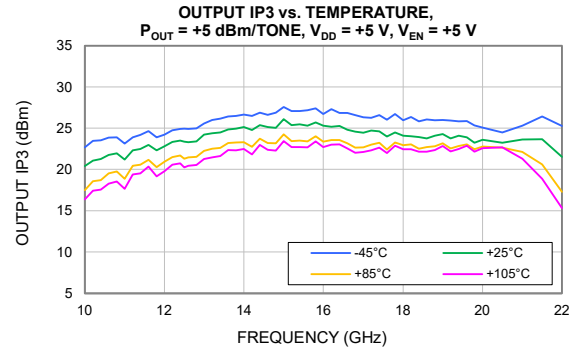
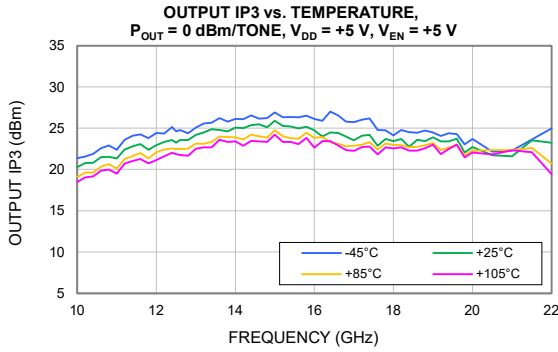


TYPICAL PERFORMANCE GRAPHS





TYPICAL PERFORMANCE GRAPHS





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50Ω 12.5 to 20 GHz Shutdown Feature

ABSOLUTE MAXIMUM RATINGS⁷

| Parameter | Ratings |
|--|-----------------|
| Operating Temperature | -45°C to +105°C |
| Storage Temperature | -65°C to +150°C |
| Junction Temperature ⁸ | +150°C |
| Total Power Dissipation | 0.7 W |
| Input Power (CW), V _{DD} = +5 V | +19 dBm |
| DC Voltage at V _{DD} | +7 V |
| Current I _{DD} | 100 mA |
| DC Voltage at V _{EN} | +7 V |

7. Permanent damage may occur if any of these limits are exceeded. Maximum ratings are not intended for continuous normal operation.

8. Peak temperature on top of Die.

ENABLE VOLTAGE (V_{EN})

| | Min. | Typ. | Max. | Units |
|---------------|-------|------|-------|-------|
| Amplifier-ON | +4.75 | +5.0 | +5.25 | V |
| Amplifier-OFF | 0 | - | +1.5 | V |

THERMAL RESISTANCE

| Parameter | Ratings |
|--|----------|
| Thermal Resistance (Θ _{JC}) ⁹ | 61.1°C/W |

9. Θ_{JC} = (Hot Spot Temperature on Die - Temperature at Ground Lead)/Dissipated Power

ESD RATING

| | Class | Voltage Range | Reference Standard |
|-----|-------|--------------------|-----------------------------|
| HBM | 1C | 1000 V to < 2000 V | ANSI/ESDA/JEDEC JS-001-2017 |
| CDM | C3 | ≥1000 V | JESD22-C101F |



ESD HANDLING PRECAUTION: This device is designed to be Class 1C for HBM. Static charges may easily produce potentials higher than this with improper handling and can discharge into DUT and damage it. As a preventive measure Industry standard ESD handling precautions should be used at all times to protect the device from ESD damage.

MSL RATING

Moisture Sensitivity: MSL1 in accordance with IPC/JEDEC J-STD-020E /JEDEC J-STD-033C





FUNCTIONAL DIAGRAM

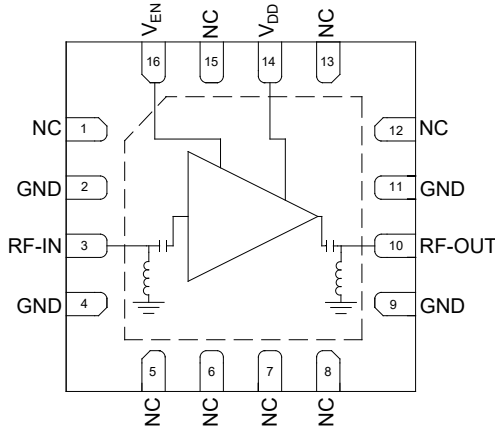


Figure 1. PMA3-10203+ Functional Diagram

PAD DESCRIPTION

| Function | Pad Number | Description (Refer to Figure 2) |
|-----------------|----------------------|--|
| RF-IN | 3 | RF-IN Pad connects to RF Input port. |
| RF-OUT | 10 | RF-OUT Pad connects to RF Output port. |
| V _{DD} | 14 | DC Input Pad connects to voltage input port V _{DD} . |
| V _{EN} | 16 | DC Input Pad connects to enable voltage input port V _{EN} . |
| GND | 2, 4, 9, 11 & Paddle | Connects to ground. |
| NC | 1, 5-8, 12, 13, 15 | Not used internally. Connected to ground on test board. |

CHARACTERIZATION TEST BOARD

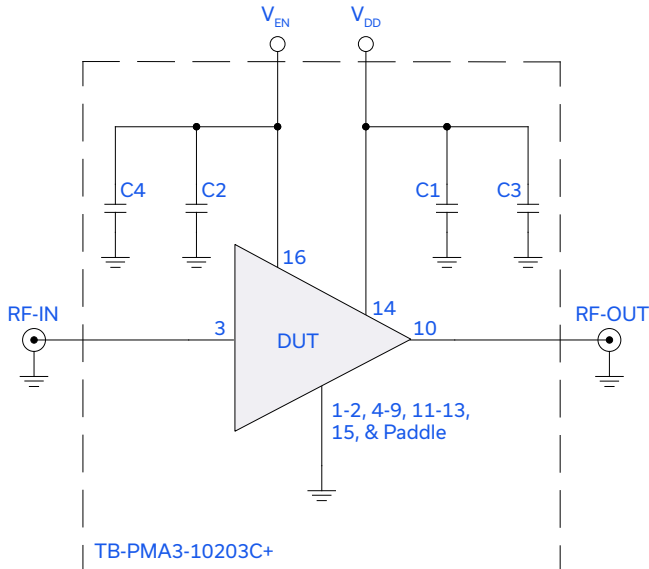


Figure 2. PMA3-10203+ Characterization and Application Circuit.

Electrical Parameters and Conditions

Gain, Return Loss, Output Power at 1dB Compression (P1dB), Output IP3 (OIP3), and Noise Figure measured using N5242A PNA-X Microwave Network Analyzer. For Switching Speed measurements, bypass capacitors C2 and C4 were removed from TB-PMA3-10203C+.

Conditions:

- Gain and Return Loss: P_{IN} = -25 dBm
- Output IP3 (OIP3): Two tones, spaced 1 MHz apart, +5 dBm/Tone at output.
- V_{DD} = +5 V

| Component | Vendor | Vendor P/N | Value | Size |
|-----------|--------|--------------------|--------|------|
| C1, C2 | Murata | GRM1555C1H101JA01D | 100 pF | 0402 |
| C3, C4 | Murata | GRM155R71H104KE14J | 0.1 μF | 0402 |

Power ON/Power OFF Sequence:

Parts are not sensitive to power ON/OFF sequence. V_{DD} and V_{EN} can be applied in any order.



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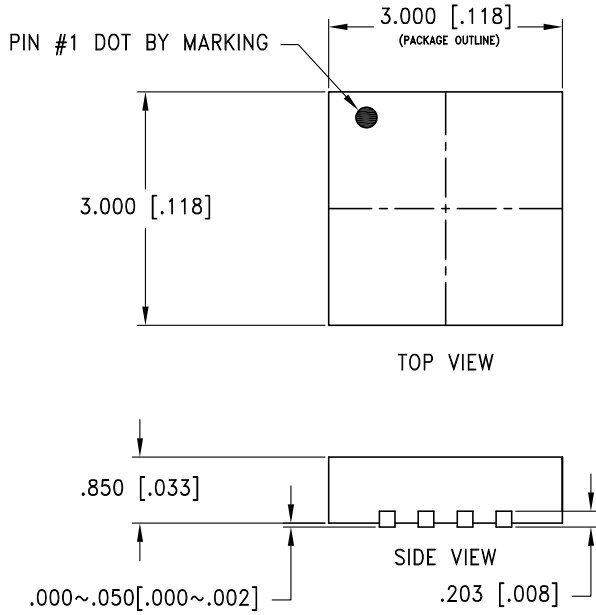
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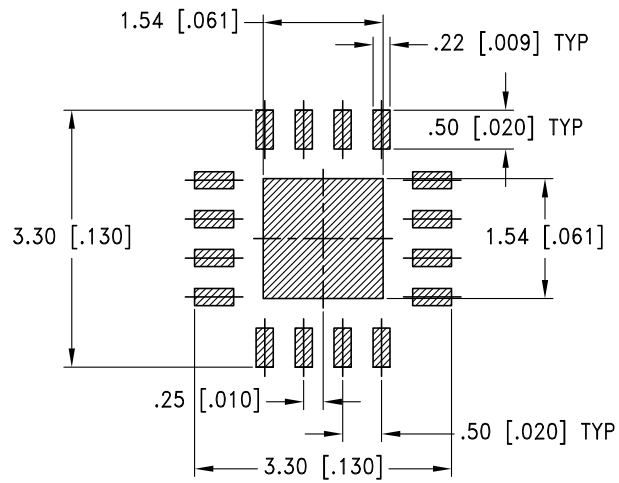
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CASE STYLE DRAWING

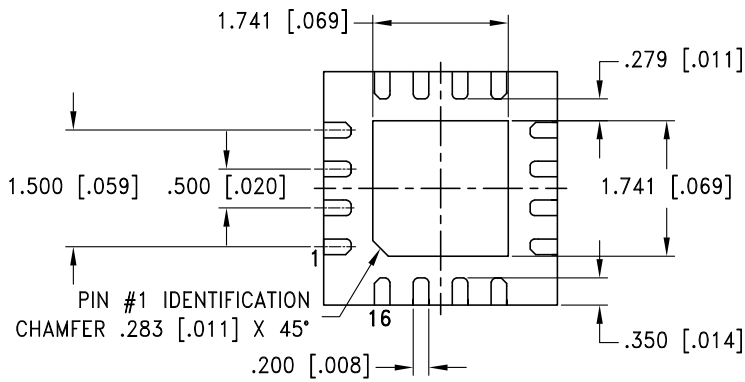


PCB Land Pattern



Suggested Layout

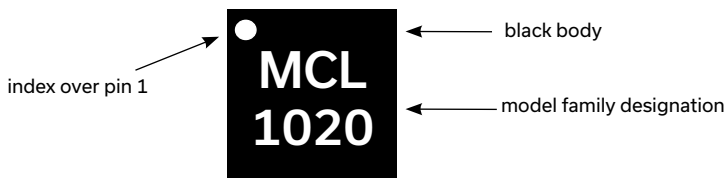
Tolerances to be within ± 0.05 [.002]



Weight: .02 grams

Dimensions are in mm [Inches]. Tolerances: 3 Pl. ± 0.05 [.002]

PRODUCT MARKING



Marking may contain other features or characters for internal lot control



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ADDITIONAL DETAILED INFORMATION IS AVAILABLE ON OUR DASH BOARD [CLICK HERE](#)

| | |
|---|--|
| Performance Data | Data Graphs S-Parameter (S2P Files) Data Set (.zip file) |
| Case Style | DQ3005. Plastic package, exposed paddle, lead finish: Matte-Tin |
| RoHS Status | Compliant |
| Tape & Reel Standard quantities available on reel | F104 7" reels with 20, 50, 100, 200, 500, 1000, or 2000 devices |
| Suggested Layout for PCB Design | PL-784 |
| Evaluation Board | TB-PMA3-10203C+ Gerber File |
| Environmental Ratings | ENV08T1 |



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.
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