

Broadband Low Noise Gain Block Amplifier

0.03 - 8 GHz



MAAM-011252

Rev. V1

Features

- 19.5 dB flat Broadband Gain to 8 GHz
- Low Noise Figure:
 - 1.2 dB Noise Figure to 1.5 GHz
 - 1.7 dB Noise Figure @ 6.0 GHz
 - 2.3 dB Noise Figure @ 8.0 GHz
- High Linearity OIP3:
 - 34 dBm @ 2.5 GHz
 - 32 dBm @ 6.0 GHz
 - 27 dBm @ 8.0 GHz
- Internal Matching to 50 Ω
- Single Voltage Bias: 3 - 5 V
- Integrated Active Bias Circuit
- Current Adjustable 20 - 90 mA
- Lead-Free 2 mm 8-LD PDFN Package
- RoHS* Compliant

Applications

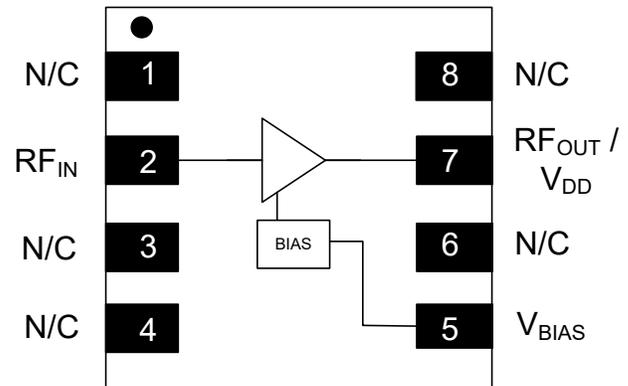
- ISM
- Multi Market

Description

The MAAM-011252 is a broadband, low noise, high dynamic range, single stage MMIC amplifier assembled in a lead-free 2 mm 8-LD PDFN plastic package. The amplifier is internally matched to provide flat gain and good return losses to 8 GHz without any external matching components. Use of external matching could extend usable frequency range beyond 8 GHz.

This amplifier has an integrated active bias circuit allowing direct connection to 3 V or 5 V bias and minimizing variations over temperature and process. The bias current can be set by an optional external resistor, so the user can customize the power consumption to fit the application. V_{BIAS} can be utilized as an enable pin to power the device up and down during operation.

Functional Block Diagram



Pin Configuration^{1,2}

| Pin # | Pin Name | Description |
|---------------|-------------------------------------|---------------------------|
| 1, 3, 4, 6, 8 | N/C | No Connection |
| 2 | RF _{IN} | RF Input |
| 5 | V _{BIAS} | Bias Voltage |
| 7 | RF _{OUT} / V _{DD} | RF Output / Drain Voltage |

1. MACOM recommends connecting all No Connection (N/C) pins to ground.
2. The exposed pad centered on the package bottom must be connected to RF, DC and thermal ground.

Ordering Information^{3,4}

| Part Number | Package |
|--------------------|-----------------|
| MAAM-011252-SMB | Sample Board |
| MAAM-011252-TR1000 | 1000 piece reel |
| MAAM-011252-TR3000 | 3000 piece reel |

3. Reference Application Note M513 for reel size information.
4. All sample boards include 5 loose parts.

* Restrictions on Hazardous Substances, compliant to current RoHS EU directive.

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Electrical Specifications: $V_{DD} = 5\text{ V}$, $+25^{\circ}\text{C}$, $Z_0 = 50\ \Omega$

| Parameter | Test Conditions | Units | Min. | Typ. | Max. |
|-------------------------|---|-------|------|-------------------|------|
| Gain | 0.03 - 8 GHz | dB | 17.0 | 19.5 | — |
| Gain Variation vs. Freq | 0.03 - 8 GHz | dB | — | ± 0.4 | — |
| Noise Figure | 0.1 - 1.5 GHz 6.0 GHz 8.0 GHz | dB | — | 1.2 1.7 2.3 | — |
| Input Return Loss | 0.03 - 8 GHz | dB | — | 12 | — |
| Output Return Loss | 0.03 - 8 GHz | dB | — | 12 | — |
| Output IP3 | $P_{IN} = -15\text{ dBm}$ per tone, 6 MHz spacing 0.03 - 2.5 GHz 6 GHz 8 GHz | dBm | — | 34 32 27 | — |
| Output IP2 | $P_{IN} = -15\text{ dBm}$ per tone, 6 MHz spacing 0.03 - 3 GHz 6 GHz 8 GHz | dBm | — | 40 47 52 | — |
| Output P1dB | 0.03 - 3 GHz 6 GHz 8 GHz | dBm | — | 19.5 17 12 | — |
| Current | I_{DD} | mA | — | 56 | 75 |

Maximum Operating Ratings

| Parameter | Maximum |
|-------------------------------------|----------------|
| RF Input Power CW | 5 dBm |
| V_{DD} | 6 V |
| I_{DQ} | 100 mA |
| Junction Temperature ^{5,6} | +150°C |
| Operating Temperature | -40°C to +85°C |

5. Operating at nominal conditions with $T_J \leq 150^{\circ}\text{C}$ will ensure $\text{MTTF} > 1 \times 10^6$ hours.
6. Junction Temperature (T_J) = $T_C + \Theta_{JC} * ((V * I) - (P_{OUT} - P_{IN}))$
 Typical thermal resistance (Θ_{JC}) = 43°C/W
- For $T_C = +25^{\circ}\text{C}$,
 $T_J = 37^{\circ}\text{C}$ @ 5 V, 56 mA
 - For $T_C = +85^{\circ}\text{C}$,
 $T_J = 97^{\circ}\text{C}$ @ 5 V, 56 mA

Absolute Maximum Ratings^{7,8}

| Parameter | Absolute Maximum |
|---------------------|------------------|
| RF Input Power CW | 22.5 dBm |
| V_{DD} | 7 V |
| Storage Temperature | -55°C to +150°C |

7. Exceeding any one or combination of these limits may cause permanent damage to this device.
8. MACOM does not recommend sustained operation near these survivability limits.

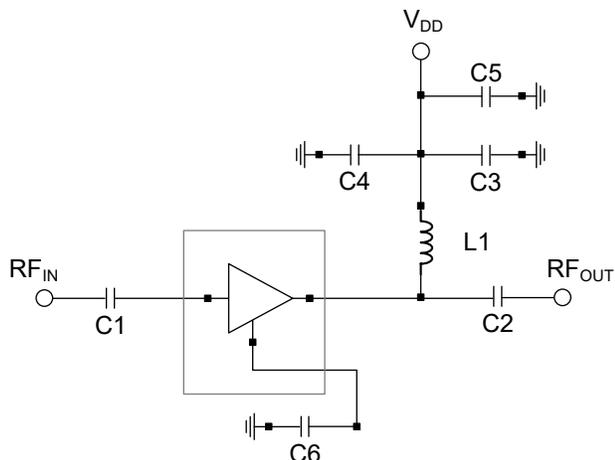
Handling Procedures

Please observe the following precautions to avoid damage:

Static Sensitivity

These electronic devices are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these HBM 1C devices.

Typical Application Circuit



Typical Parts List, $V_{DD} = 5\text{ V}$

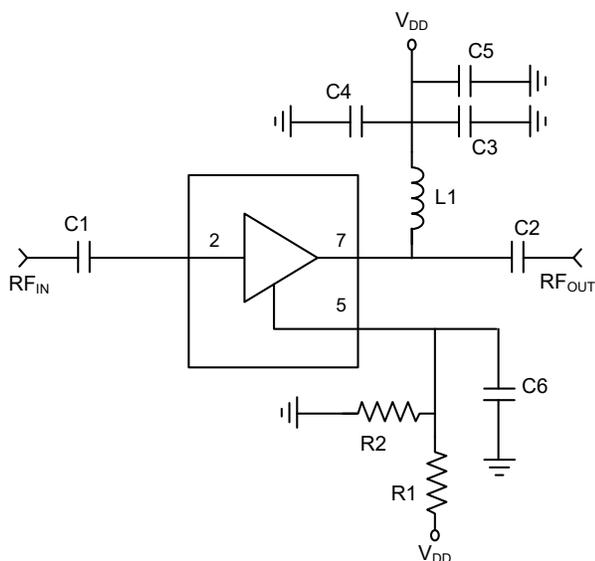
| Component | Value | Package |
|-------------|---------------------------|---------|
| C1 - C3, C6 | 1000 pF | 0402 |
| C4 | 47 pF | 0402 |
| C5 | 0.1 μF | 0402 |
| L1 | Ferrite Bead ⁹ | 0402 |

9. Murata, part number BLM15HD182SN.

Current Adjust Options

The V_{BIAS} (pin 5) of MAAM-011252 may be used to adjust the DC operating current by placing either R1 or R2 as shown the schematic below. Placing resistor R2 to ground will reduce the current from typical application level. When using R2 to reduce current do not place (DNP) R1. To increase current from typical application circuit install resistor R1 and connect to V_{DD} .

The table below shows values of R1 and R2 for a range of operating currents for $V_{DD} = 5\text{ V}$.



| I (mA) | $V_{DD} = 5\text{ V}$ | |
|-----------|---------------------------------------|-----------------|
| | R1 | R2 |
| 30 | DNP | 2.74 k Ω |
| 40 | DNP | 5.1 k Ω |
| 56 | Typical application without R1 and R2 | |
| 70 | 18 k Ω | DNP |
| 90 | 6.2 k Ω | DNP |

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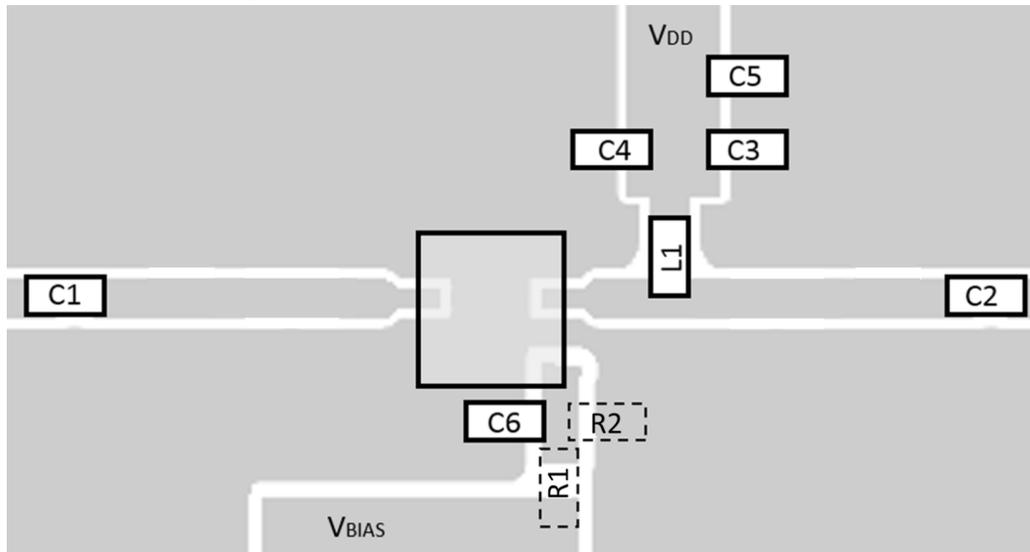
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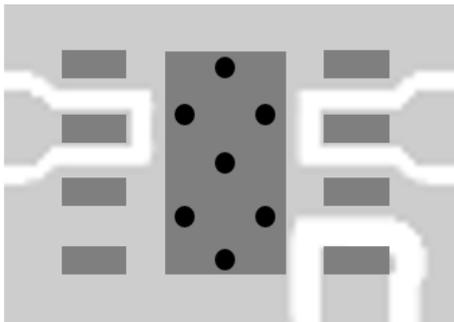
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Recommended PCB Layout



FR4, RF Layer Thickness = 0.711 mm, Trace = 0.55 mm, Gap = 0.18 mm

PCB Land Pattern



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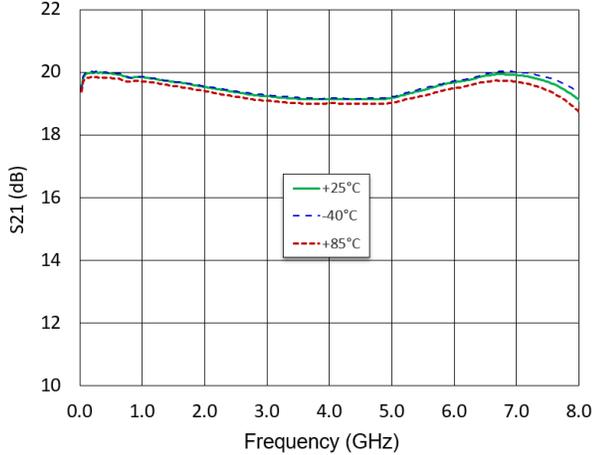


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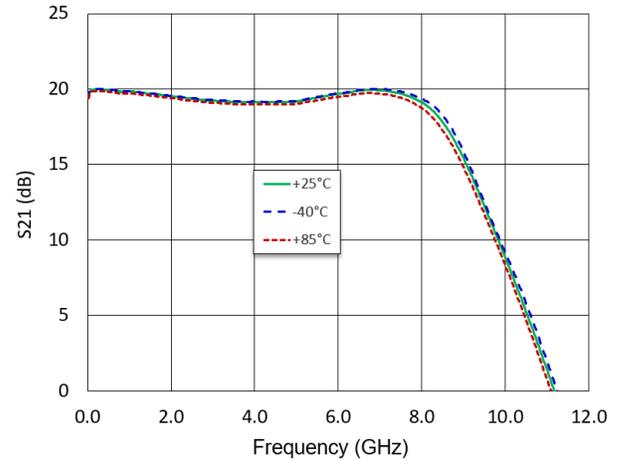
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Typical Performance Curves @ 5 V / 56 mA, $Z_0 = 50 \Omega$

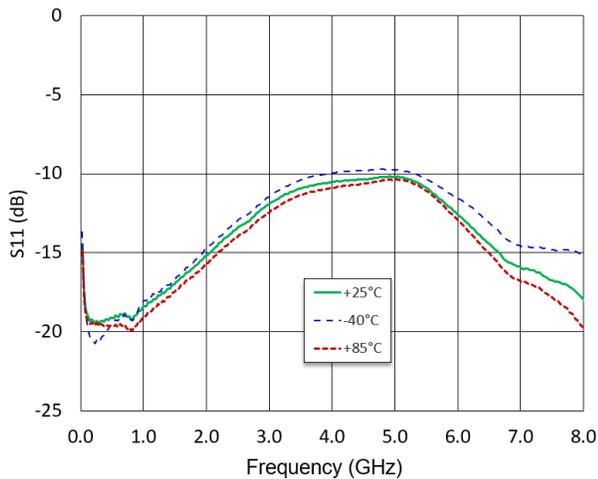
Gain



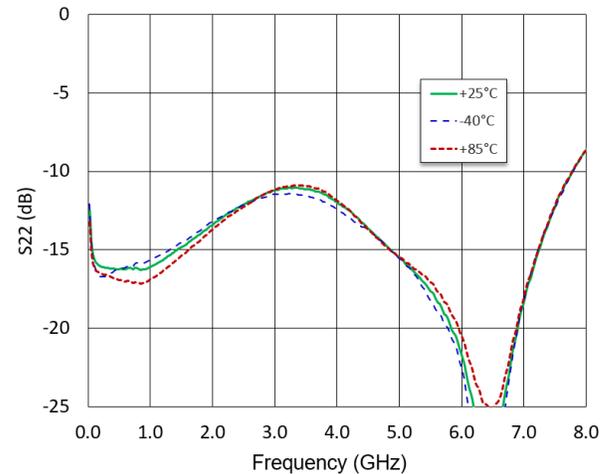
Gain to 12 GHz



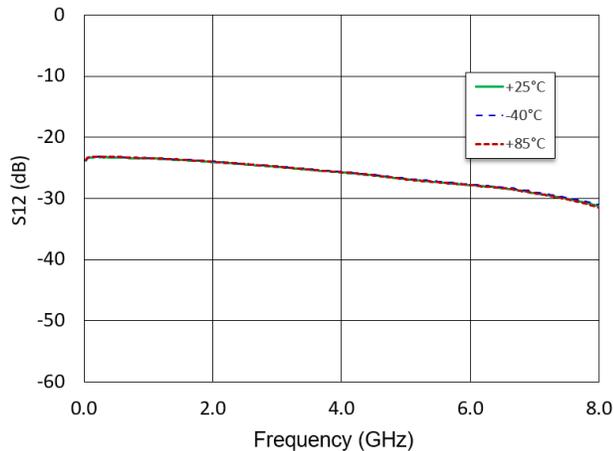
Input Return Loss



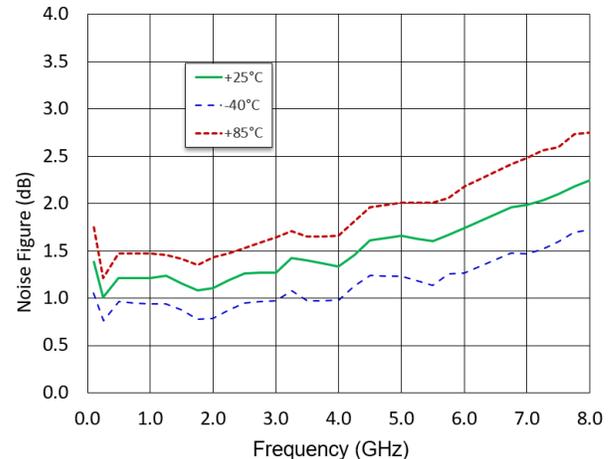
Output Return Loss



Reverse Isolation



Noise Figure



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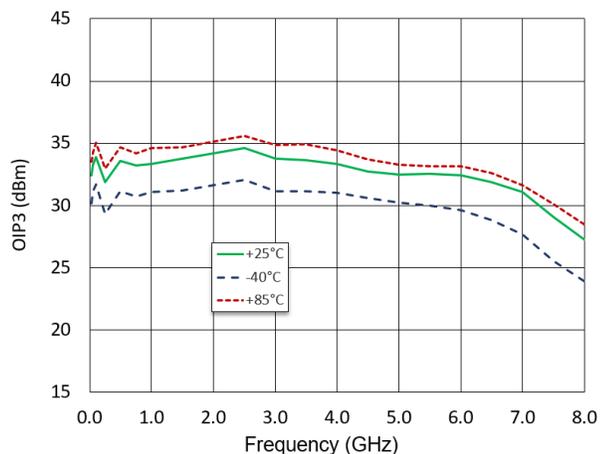


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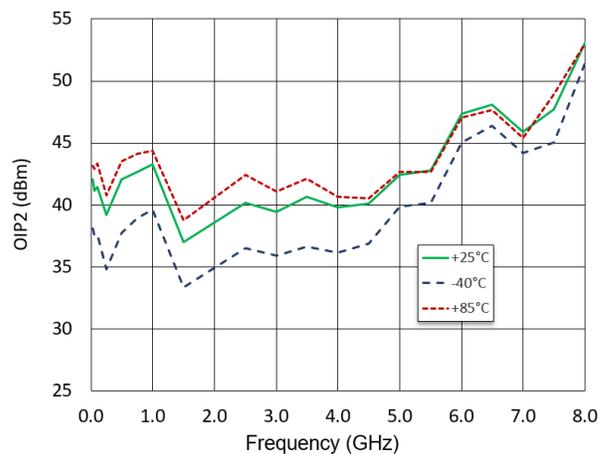
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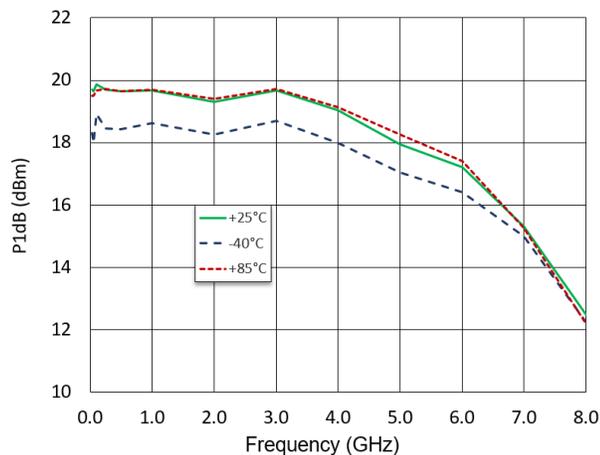
OIP3 @ $P_{IN} = -15$ dBm/tone, 10 MHz Spacing



OIP2 @ $P_{IN} = -15$ dBm/tone, 10 MHz Spacing



P1dB



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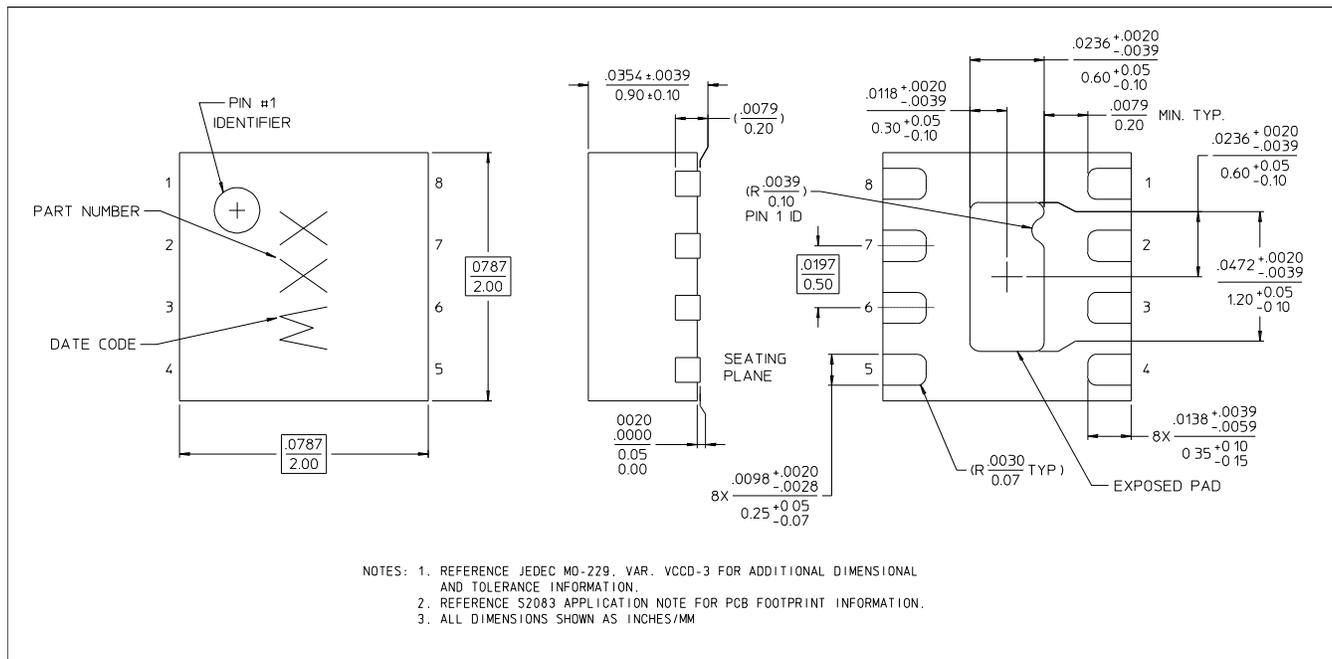
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Lead-Free 2 mm 8-Lead PDFN[†]



[†] Reference Application Note M2083 for lead-free solder reflow recommendations.
 Meets JEDEC moisture sensitivity level (MSL) 1 requirements.
 Plating is 100% matte tin over copper.

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