# BGS8H2

## SiGe:C low-noise amplifier MMIC with bypass switch for LTE

Rev. 4 — 20 August 2018 Product data sheet

## 1 General description

The BGS8H2 is a Low-Noise Amplifier (LNA) with bypass switch for LTE receiver applications, available in a small plastic 6-pin extremely thin leadless package. The BGS8H2 requires one external matching inductor.

The BGS8H2 delivers system-optimized gain for both primary and diversity applications where sensitivity improvement is required. The high linearity of these low noise devices ensures the required receive sensitivity independent of cellular transmit power level in FDD (Frequency Division Duplex) systems. When receive signal strength is sufficient, the BGS8H2 can be switched off to operate in bypass mode at a 1 µA current, to lower power consumption.

The BGS8H2 is optimized for 2300 MHz to 2690 MHz.

## 2 Features and benefits

- Operating frequency from 2300 MHz to 2690 MHz
- Noise figure = 1.0 dB
- Gain 12.5 dB
- Bypass switch insertion loss of 2.3 dB
- High input 1 dB compression point of -1.5 dBm
- High in band $IP3_i$ of 4.0 dBm
- Supply voltage 1.5 V to 3.1 V
- Self-shielding package concept
- Integrated supply decoupling capacitor
- Optimized performance at a supply current of 5.8 mA
- Power-down mode current consumption < 1 µA
- Integrated temperature stabilized bias for easy design.
- Requires only one input matching inductor
- Input and output DC decoupled
- ESD protection on all pins (HBM > 2 kV)
- Integrated matching for the output
- Available in 6-pins leadless package 1.1 mm x 0.7 mm x 0.37 mm; 0.4 mm pitch: SOT1232
- 180 GHz transit frequency - SiGe:C technology
- Moisture sensitivity level 1

## 3 Applications

- LNA for LTE reception in smart phones
- Feature phones
- Tablet PCs
- RF front-end modules


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# 4 Quick reference data

**Table 1. Quick reference data**

*f = 2350 MHz, $V_{CC}$ = 2.8 V, $V_{I(CTRL)}$ ≥ 0.8 V, and $T_{amb}$ = 25 °C. Input matched to 50 Ω using a 2.7 nH inductor in series. Unless otherwise specified.*

| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $V_{CC}$ | supply voltage | RF input AC coupled | [1] | 1.5 | - | 3.1 | V |
| $I_{CC}$ | supply current | in gain mode | | 3.8 | 5.8 | 7.8 | mA |
| | | in bypass mode; $V_{I(CTRL)}$ < 0.3 V | | - | - | 1 | µA |
| $G_p$ | power gain | in gain mode; f = 2350 MHz | [2][3] | 10.5 | 12.5 | 14.5 | dB |
| | | in bypass mode; f = 2350 MHz | [2][3] | -3.8 | -2.3 | -0.8 | dB |
| NF | noise figure | in gain mode; f = 2350 MHz | [2][3][4] | - | 1.0 | 1.5 | dB |
| $P_{i(1dB)}$ | input power at 1 dB gain compression | in gain mode; f = 2350 MHz | [2][3] | -5.5 | -1.5 | - | dBm |
| $IP3_i$ | input third-order intercept point | in gain mode; f = 2350 MHz | [2][3] | −1.0 | +4.0 | - | dBm |

[1] Stressed with pulses of 1 s in duration. $V_{CC}$ connected to a power supply of 2.8 V with 500 mA current limit.
[2] E-UTRA operating band 40 (2300 MHz to 2400 MHz).
[3] Guaranteed by device design; not tested in production.
[4] PCB losses are subtracted.

# 5 Ordering information

**Table 2. Ordering information**

| Type number | Package | | |
|---|---|---|---|
| | Name | Description | Version |
| BGS8H2 | XSON6 | plastic extremely thin small outline package; no leads; 6 terminals; body 1.1 x 0.7 x 0.37 mm | SOT1232 |
| OM17007 | EVB | BGS8H2 evaluation board | - |

# 6 Marking

**Table 3. Marking code**

| Type number | Marking code |
|---|---|
| BGS8H2 | P |


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# 7 Block diagram

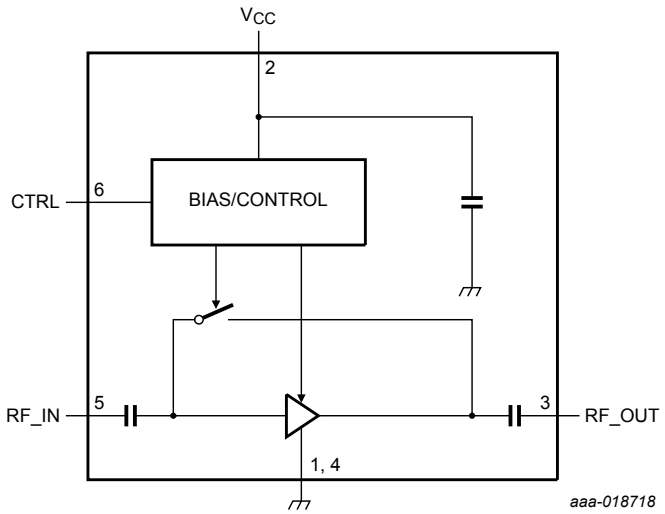


**Figure 1. Block diagram**


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# 8 Pinning information

## 8.1 Pinning

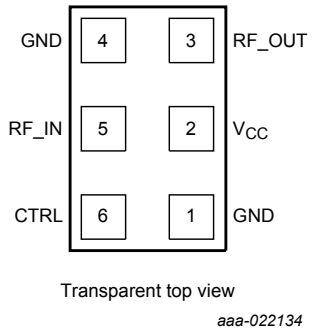


**Figure 2. Pin configuration**

## 8.2 Pin description

**Table 4. Pinning**

| Symbol | Pin | Description |
|---|---|---|
| GND | 1 | ground |
| $V_{CC}$ | 2 | supply voltage |
| RF_OUT | 3 | RF out |
| GND_RF | 4 | ground RF |
| RF_IN | 5 | RF in |
| CTRL | 6 | gain control, switch between gain and bypass mode |


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# 9 Limiting values

**Table 5. Limiting values**

*In accordance with the Absolute Maximum Rating System (IEC 60134).*
*See legal section: "disclaimers" paragraph "Limiting values".*

| Symbol | Parameter | Conditions | | Min | Max | Unit |
|---|---|---|---|---|---|---|
| $V_{CC}$ | supply voltage | RF input AC coupled | [1] | -0.5 | +5.0 | V |
| $V_{I(CTRL)}$ | input voltage on pin CTRL | $V_{I(CTRL)} < V_{CC} + 0.6$ V | [1][2] | -0.5 | +5.0 | V |
| $V_{I(RF_IN)}$ | input voltage on pin RF_IN | DC; $V_{I(RF_IN)} < V_{CC} + 0.6$ V | [1][2] | -0.5 | +5.0 | V |
| $V_{I(RF_OUT)}$ | input voltage on pin RF_OUT | DC; $V_{I(RF_OUT)} < V_{CC} + 0.6$ V | [1][2][3] | -0.5 | +5.0 | V |
| $P_i$ | input power | | [1] | - | 26 | dBm |
| $P_{tot}$ | total power dissipation | $T_{sp} \leq 130$ °C | | - | 55 | mW |
| $T_{stg}$ | storage temperature | | | -65 | +150 | °C |
| $T_j$ | junction temperature | | | - | 150 | °C |
| $V_{ESD}$ | electrostatic discharge voltage | Human Body Model (HBM) according to ANSI/ESDA/JEDEC standard JS-001 | | - | ±2 | kV |
| | | Charged Device Model (CDM) according to JEDEC standard JESD22-C101C | | - | ±1 | kV |

[1] Stressed with pulses of 1 s in duration. $V_{CC}$ connected to a power supply of 2.8 V with 500 mA current limit.
[2] Warning: Due to internal ESD diode protection, to avoid excess current, the applied DC voltage must not exceed $V_{CC}$ + 0.6 V or 5.0 V.
[3] The RF input and RF output are AC coupled through internal DC blocking capacitors.

# 10 Recommended operating conditions

**Table 6. Operating conditions**

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $V_{CC}$ | supply voltage | [1] | 1.5 | - | 3.1 | V |
| $T_{amb}$ | ambient temperature | | -40 | +25 | +85 | °C |
| $V_{I(CTRL)}$ | input voltage on pin CTRL | OFF state | - | - | 0.3 | V |
| | | ON state | 0.8 | - | $V_{cc}$ | V |

[1] Stressed with pulses of 1 s in duration. $V_{CC}$ connected to a power supply with 500 mA current limit.

# 11 Thermal characteristics

**Table 7. Thermal characteristics**

| Symbol | Parameter | Conditions | Typ | Unit |
|---|---|---|---|---|
| $R_{th(j-sp)}$ | thermal resistance from junction to solder point | | 225 | K/W |


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# 12 Characteristics

**Table 8. Characteristics at $V_{CC}$ = 1.8 V**

*2300 MHz ≤ f ≤ 2690 MHz, $V_{CC}$ = 1.8 V, $V_{I(CTRL)}$ ≥ 0.8 V and $T_{amb}$ = 25 °C. Input matched to 50 Ω using a 2.7 nH inductor in series. Unless otherwise specified.*

| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| Δφ | phase variation | between gain mode and bypass mode | | | | | |
| | | f = 2350 MHz | [1] | -8 | - | +8 | deg |
| | | f = 2655 MHz | | - | - | - | deg |
| **Gain mode** | | | | | | | |
| $I_{CC}$ | supply current | | | 3.6 | 5.6 | 7.6 | mA |
| $G_p$ | power gain | f = 2350 MHz | [1] [2] | 10.0 | 12.0 | 14.0 | dB |
| | | f = 2500 MHz | | 9.3 | 11.3 | 13.3 | dB |
| | | f = 2655 MHz | [1] [3] | 8.5 | 10.5 | 12.5 | dB |
| $RL_{in}$ | input return loss | f = 2350 MHz | [2] | - | 7.5 | - | dB |
| | | f = 2655 MHz | [3] | - | 8.0 | - | dB |
| $RL_{out}$ | output return loss | f = 2350 MHz | [2] | - | 9.0 | - | dB |
| | | f = 2655 MHz | [3] | - | 7.0 | - | dB |
| ISL | isolation | f = 2350 MHz | [2] | - | 22.0 | - | dB |
| | | f = 2655 MHz | [3] | - | 22.0 | - | dB |
| NF | noise figure | f = 2350 MHz | [1] [2] [4] | - | 1.05 | 1.5 | dB |
| | | f = 2655 MHz | [1] [3] [4] | - | 1.15 | 1.6 | dB |
| $P_{i(1dB)}$ | input power at 1 dB gain compression | f = 2350 MHz | [1] [2] | -9.5 | -5.5 | - | dBm |
| | | f = 2655 MHz | [1] [2] | -8.5 | -4.5 | - | dBm |
| $IP3_i$ | input third-order intercept point | f = 2350 MHz | [1] [2] | -2 | +3.0 | - | dBm |
| | | f = 2655 MHz | [1] [3] | -2 | +3.0 | - | dBm |
| K | Rollett stability factor | | | 1 | - | - | - |
| $t_{on}$ | turn-on time | time from $V_{I(CTRL)}$ ON, to 90 % of the gain | | - | - | 1.7 | µs |
| $t_{off}$ | turn-off time | time from $V_{I(CTRL)}$ OFF, to 10 % of the gain | | - | - | 0.6 | µs |
| **Bypass mode** | | | | | | | |
| $I_{CC}$ | supply current | $V_{I(CTRL)}$ < 0.3 V | | - | - | 1 | µA |
| $G_p$ | power gain | f = 2350 MHz | [1] [2] | -3.9 | -2.4 | -0.9 | dB |
| | | f = 2500 MHz | [1] | -4.5 | -2.6 | -1.1 | dB |
| | | f = 2655 MHz | [1] [2] | -4.2 | -2.7 | -1.2 | dB |
| $RL_{in}$ | input return loss | f = 2350 MHz | [2] | - | 12.0 | - | dB |
| | | f = 2655 MHz | [3] | - | 11.0 | - | dB |
| $RL_{out}$ | output return loss | f = 2350 MHz | [2] | - | 11.0 | - | dB |
| | | f = 2655 MHz | [3] | - | 11.0 | - | dB |


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[1] Guaranteed by device design; not tested in production.
[2] E-UTRA operating band 40 (2300 MHz to 2400 MHz).
[3] E-UTRA operating band 7 (2620 MHz to 2690 MHz).
[4] PCB losses are subtracted.

### Table 9. Characteristics at $V_{CC}$ = 2.8 V

*2300 MHz ≤ f ≤ 2690 MHz, $V_{CC}$ = 2.8 V, $V_{I(CTRL)}$ ≥ 0.8 V and $T_{amb}$ = 25 °C. Input matched to 50 Ω using a 2.7 nH inductor in series. Unless otherwise specified.*

| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| Δφ | phase variation | between gain mode and bypass mode | | | | | |
| | | f = 2350 MHz | [1] | -8 | - | +8 | deg |
| | | f = 2655 MHz | | - | - | - | deg |
| **Gain mode** | | | | | | | |
| $I_{CC}$ | supply current | | | 3.8 | 5.8 | 7.8 | mA |
| $G_p$ | power gain | f = 2350 MHz | [1][2] | 10.5 | 12.5 | 14.5 | dB |
| | | f = 2500 MHz | | 9.9 | 11.9 | 13.9 | dB |
| | | f = 2655 MHz | [1][3] | 9.2 | 11.2 | 13.2 | dB |
| $RL_{in}$ | input return loss | f = 2350 MHz | [2] | - | 8.0 | - | dB |
| | | f = 2655 MHz | [3] | - | 8.5 | - | dB |
| $RL_{out}$ | output return loss | f = 2350 MHz | [2] | - | 10.0 | - | dB |
| | | f = 2655 MHz | [3] | - | 7.0 | - | dB |
| ISL | isolation | f = 2350 MHz | [2] | - | 23.0 | - | dB |
| | | f = 2655 MHz | [3] | - | 23.0 | - | dB |
| NF | noise figure | f = 2350 MHz | [1][2][4] | - | 1.00 | 1.5 | dB |
| | | f = 2655 MHz | [1][3][4] | - | 1.10 | 1.6 | dB |
| $P_{i(1dB)}$ | input power at 1 dB gain compression | f = 2350 MHz | [1][2] | -5.5 | -1.5 | - | dBm |
| | | f = 2655 MHz | [1][3] | -4.0 | 0.0 | - | dBm |
| $IP3_i$ | input third-order intercept point | f = 2350 MHz | [1][2] | -1.0 | +4.0 | - | dBm |
| | | f = 2655 MHz | [1][3] | -1.0 | +4.0 | - | dBm |
| K | Rollett stability factor | | | 1 | - | - | |
| $t_{on}$ | turn-on time | time from $V_{I(CTRL)}$ ON, to 90 % of the gain | | - | - | 1.3 | µs |
| $t_{off}$ | turn-off time | time from $V_{I(CTRL)}$ OFF, to 10 % of the gain | | - | - | 0.3 | µs |


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| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| **Bypass mode** | | | | | | | |
| $I_{CC}$ | supply current | $V_{I(CTRL)}$ < 0.3 V | | - | - | 1 | µA |
| $G_p$ | power gain | f = 2350 MHz | [1][2] | -3.8 | -2.3 | -0.8 | dB |
| | | f = 2500 MHz | [1] | -4.5 | -2.4 | -0.9 | dB |
| | | f = 2655 MHz | [1][3] | -4.0 | -2.5 | -1.0 | dB |
| $RL_{in}$ | input return loss | f = 2350 MHz | [2] | - | 12.0 | - | dB |
| | | f = 2655 MHz | [3] | - | 12.0 | - | dB |
| $RL_{out}$ | output return loss | f = 2350 MHz | [2] | - | 12.0 | - | dB |
| | | f = 2655 MHz | [3] | - | 12.0 | - | dB |

[1] Guaranteed by device design; not tested in production.
[2] E-UTRA operating band 40 (2300 MHz to 2400 MHz).
[3] E-UTRA operating band 7 (2620 MHz to 2690 MHz).
[4] PCB losses are subtracted.


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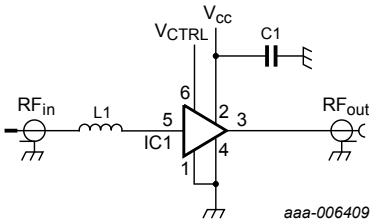
# 13 Application information

## 13.1 LTE LNA




For a list of components, see Table 10.

**Figure 3. Schematics LTE LNA evaluation board**

**Table 10. List of components**

*For schematics, see Figure 3.*

| Component | Description | Value | Remarks |
|---|---|---|---|
| C1 | decoupling capacitor | 1 µF | to suppress power supply noise |
| IC1 | BGS8H2 | - | NXP Semiconductors |
| L1 | high-quality matching inductor | 2.7 nH | Murata LQW15A |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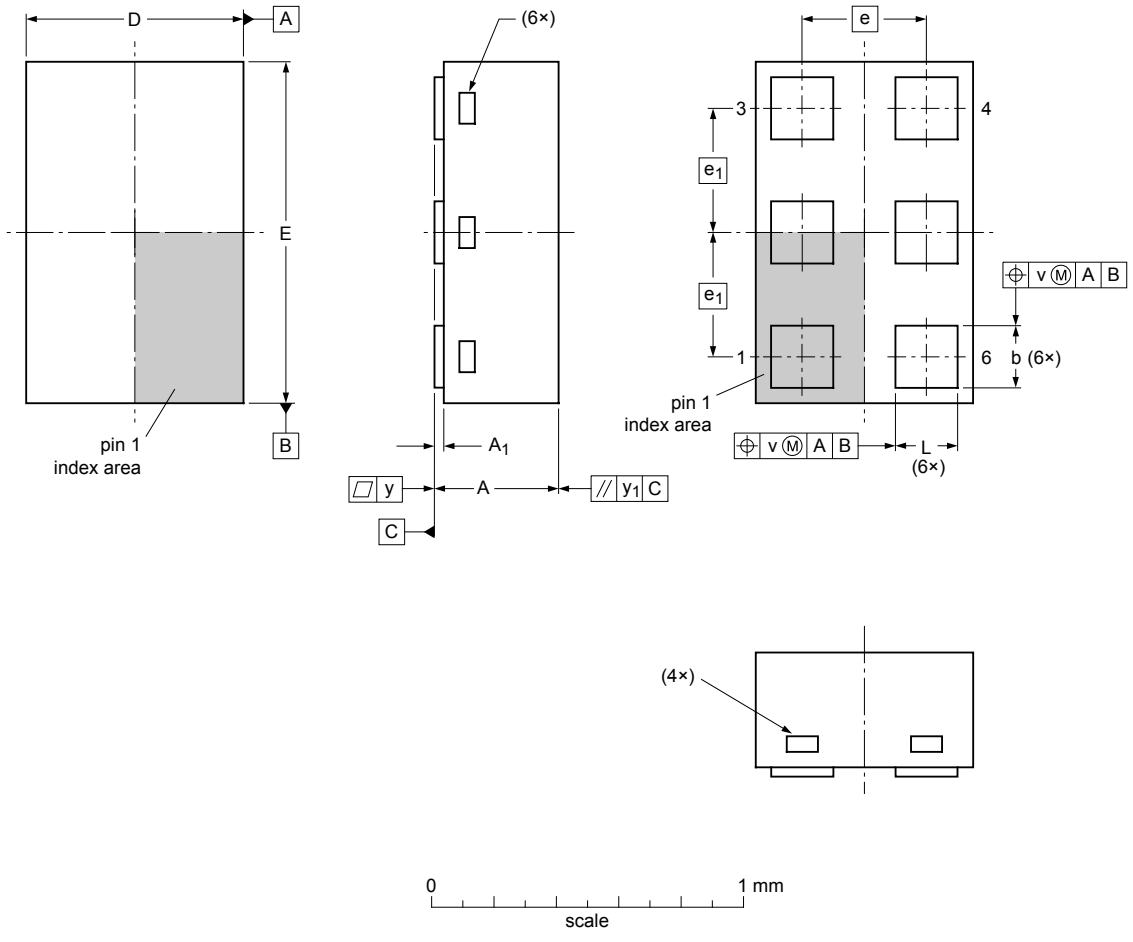
## 14 Package outline

**XSON6: plastic extremely thin small outline package; no leads; 6 terminals; body 1.1 x 0.7 x 0.37 mm** **SOT1232**




Dimensions (mm are the original dimensions)

| Unit | | A | $A_1$ | D | E | $e_1$ | e | b | L | V | Y | $Y_1$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | min | 0.34 | | 0.65 | 1.05 | | | 0.17 | 0.17 | | | |
| mm | nom | 0.37 | | 0.70 | 1.10 | 0.4 | 0.4 | 0.20 | 0.20 | 0.1 | 0.05 | 0.1 |
| | max | 0.40 | 0.04 | 0.75 | 1.15 | | | 0.25 | 0.25 | | | |

Note
1. Dimension A is including plating thickness.

*sot1232_po*

| Outline version | References | | | | European projection | Issue date |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| SOT1232 | | | | | | ~~13-04-12~~ 13-11-08 |

**Figure 4. Package outline SOT1232 (XSON6)**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# 15 Handling information

| CAUTION | |
|---|---|
| msc896 | This device is sensitive to ElectroStatic Discharge (ESD). Observe precautions for handling electrostatic sensitive devices.<br>Such precautions are described in the *ANSI/ESD S20.20*, *IEC/ST 61340-5*, *JESD625-A*, or equivalent standards. |

# 16 Abbreviations

**Table 11. Abbreviations**

| Acronym | Description |
|---|---|
| ESD | ElectroStatic Discharge |
| HBM | Human Body Model |
| LTE | Long-Term Evolution |
| MMIC | Monolithic Microwave Integrated Circuit |
| PCB | Printed-Circuit Board |
| SiGe:C | Silicon Germanium Carbon |

# 17 Revision history

**Table 12. Revision history**

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|---|---|---|---|---|
| BGS8H2 v.4 | 20180820 | Product data sheet | - | BGS8H2 v.3 |
| Modifications: | changed status from company confidential to public | | | |
| BGS8H2 v.3 | 20180629 | Product data sheet | - | BGS8H2 v.2 |
| Modifications: | changed $V_{I(CTRL)}$ Max ON state value to $V_{cc}$ at recommended operating conditions | | | |
| BGS8H2 v.2 | 20160404 | Product data sheet | - | BGS8H2 v.1 |
| Modifications: | • added phase variation Table 8 on page 5 and Table 9 on page 6 | | | |
| BGS8H2 v.1 | 20151222 | Product data sheet | - | - |


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# 18 Legal information

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| Document status[1][2] | Product status[3] | Definition |
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| Preliminary [short] data sheet | Qualification | This document contains data from the preliminary specification. |
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