ANALOG DEVICES

# 6 GHz to 26 GHz Wideband I/Q Mixer

Preliminary Technical Data

# HMC8191

## FEATURES

**Passive, wideband I/Q mixer**
**RF and local oscillator (LO) range: 6 GHz to 26.5 GHz**
**Wide IF of dc to 5 GHz**
**Single-ended RF, LO, and IF**
**Conversion loss: −10 dB**
**Input IP3: 24 dBm (typical)**
**Image rejection: 25 dBm (typical)**
**High LO to RF isolation: 35 dB**
**High LO to IF isolation: 37 dB**
**Phase balance: ±5°**
**Exposed paddle, 4 mm × 4 mm, 24-lead LFCSP package**

## APPLICATIONS

**Test and measurement instrumentation**
**Military, aerospace, and defense applications**
**Microwave point-to-point base stations**

## FUNCTIONAL BLOCK DIAGRAM

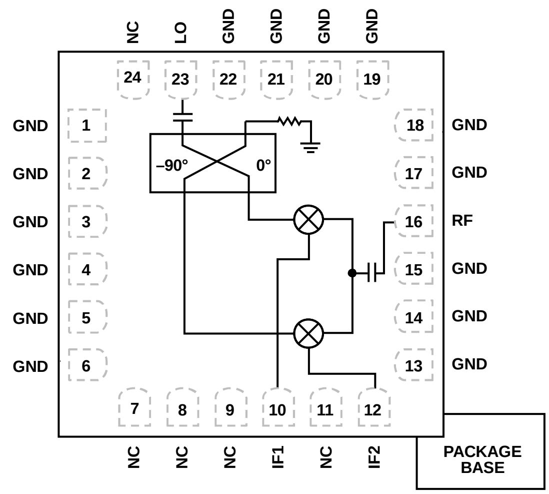


*Figure 1.*

## GENERAL DESCRIPTION

HMC8191 is a passive wideband I/Q MMIC mixer that can be used either as an image reject mixer for receiver operations or as a single sideband upconverter for transmitter operations. With an RF and LO range of 6 GHz to 26.5 GHz, and an IF bandwidth of dc to 5 GHz, the HMC8191 is ideal for applications requiring wide frequency range, excellent RF performance, and a simpler design with fewer parts and a smaller printed circuit board (PCB) footprint. A single HMC8191 can replace multiple narrowband mixers in a design.

The inherent I/Q architecture of the HMC8191 offers excellent image rejection and thereby eliminates the need for expensive filtering for unwanted sidebands. The mixer also provides excellent LO to RF and LO to IF isolation and reduces the effect of LO leakage to ensure signal integrity

Being a passive mixer, the HMC8191 does not require any dc power sources. It offers a lower noise figure compared to an active mixer, ensuring superior dynamic range for high performance and precision applications.

The HMC8191 is fabricated on a GaAs MESFET process and uses Analog Devices, Inc., mixer cells and a 90-degree hybrid. It is available in a compact 4 mm × 4 mm, 24-lead LFCSP package and operates over a −40°C to +85°C temperature range. An evaluation board for this device is also available.


**Rev. PrB** **Document Feedback**




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# SPECIFICATIONS

$f_{IF\ OUT} = f_{RF\ IN} - f_{LO}$ (downconverter, upper sideband), $f_{RF\ IN}$ = 0.1 GHz to 5 GHz, $P_{RF\ IN}$ = −10 dBm, $P_{LO}$ = 18 dBm, $T_A$ = 25°C.

**Table 1.**

| Parameter | Test Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| RF INPUT INTERFACE | | | | | |
| Return Loss | | 7 | 10 | | dB |
| Input Impedance | | | 50 | | Ω |
| RF Input Frequency Range | | 6000 | | 26,500 | MHz |
| IF INTERFACE | | | | | |
| Return Loss | | 7 | 10 | | dB |
| IF Impedance | | | 50 | | Ω |
| IF Frequency Range | | DC | | 5000 | MHz |
| LO INTERFACE | | | | | |
| LO Power | | | 18 | | dBm |
| Return Loss | | 9 | 10 | | dB |
| Input Impedance | | | 50 | | Ω |
| LO Frequency Range | | 6000 | | 26,500 | MHz |
| DOWNCONVERTER DYNAMIC PERFORMANCE at $f_{IF\ OUT}$ = 100 MHz | | | | | |
| Conversion Loss | | | 10 | | dB |
| Input Third-Order Intercept | | 19 | 25 | | dBm |
| Image Rejection | | 18 | 26 | | dB |
| LO to RF Isolation[1] | | | 35 | | dB |
| LO to IF Isolation[1] | | | 35 | | dB |
| RF to IF Isolation[1] | | | 18 | | dB |
| Phase Balance | | | TBD | | Degrees |
| Amplitude Balance | | | TBD | | dB |
| DOWNCONVERTER DYNAMIC PERFORMANCE at $f_{IF\ OUT}$ = 2.5 GHz | | | | | |
| Conversion Loss | | | 10 | | dB |
| Input Third-Order Intercept | | 20 | 24 | | dBm |
| Image Rejection | | 25 | 30 | | dB |
| LO to RF Isolation[1] | | | 35 | | dB |
| LO to IF Isolation[1] | | | 35 | | dB |
| RF to IF Isolation[1] | | | 18 | | dB |
| Phase Balance | | −10 | | | Degrees |
| Amplitude Balance | | −0.5 | 0 | +0.6 | dB |
| DOWNCONVERTER DYNAMIC PERFORMANCE at $f_{IFout}$ = 5 GHz | | | | | |
| Conversion Loss | | | 11 | | dB |
| Input Third-Order Intercept | | 20 | 25 | | dBm |
| Image Rejection | | 18 | 24 | | dB |
| LO to RF Isolation[1] | | | 35 | | dB |
| LO to IF Isolation[1] | | | 35 | | dB |
| RF to IF Isolation[1] | | | 18 | | dB |
| Balance | | | TBD | | Degrees |
| Amplitude Balance | | | TBD | | dB |

[1] See the Typical Performance Characteristics section.

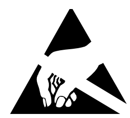
# ABSOLUTE MAXIMUM RATINGS

**Table 2.**

| Parameter | Rating |
|---|---|
| RFIN Power | TBD |
| LO Drive | TBD |
| Channel Temperature | TBD |
| Continuous $P_{DISS}$ (T = 85°C) (Derate 9.8 mW/°C above 85°C) | TBD |
| Thermal Resistance ($R_{TH}$) (Junction to Die Bottom) | TBD |
| Operating Temperature Range | −40°C to +85°C |
| Storage Temperature Range | −65°C to +150°C |
| ESD Sensitivity (HBM) | TBD |

Stresses above those listed under Absolute Maximum Ratings may cause permanent damage to the device. This is a stress rating only; functional operation of the device at these or any other conditions above those indicated in the operational section of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

## ESD CAUTION



**ESD (electrostatic discharge) sensitive device.** Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

# PIN CONFIGURATION AND FUNCTION DESCRIPTIONS

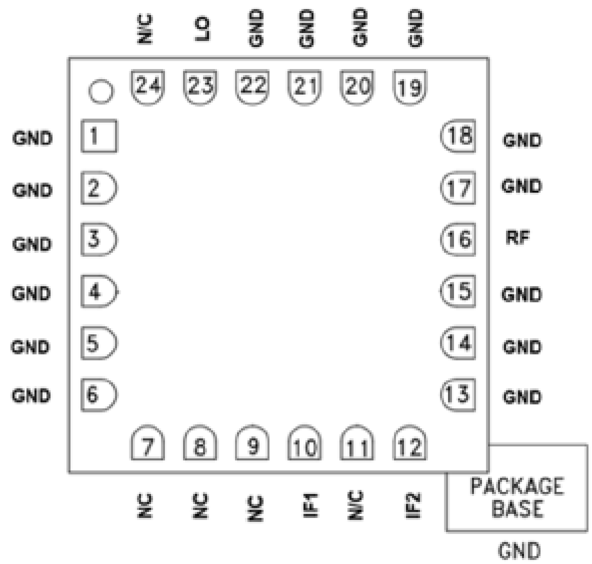



*Figure 2. Pin Configuration*

**Table 3. Pin Function Descriptions**

| Pin No. | Mnemonic | Description |
|---|---|---|
| 7 to 9, 11, 24 | NC | No Connect. These pins may be connected to RF/dc ground without affecting performance. |
| 1 to 6, 13, 14, 17 to 22 | GND | Ground. These pins and package bottom must be connected to RF/dc ground. |
| 10, 12 | IF1, IF2 | These pins are dc-coupled. For applications not requiring operations to dc, this port should be dc blocked externally using a series capacitor whose value is selected to pass the necessary IF frequency range. For operations to dc, this pin must not source/sink more than 3 mA of current, otherwise, the device does not function and may fail. |
| 16 | RF | This pin is dc-coupled and matched to 50 Ω. |
| 23 | LO | This pin is dc-coupled and matched to 50 Ω. |

# TYPICAL PERFORMANCE CHARACTERISTICS

### $f_{RF\ IN}$ at 100 MHz

$f_{IF\ OUT} = f_{LO} - f_{RF\ IN}$ (downconverter, lower sideband), $f_{RF\ IN}$ = 100 MHz, $P_{RF\ IN}$ = −10 dBm, $P_{LO}$ = 18 dBm, $T_A$ = 25°C.

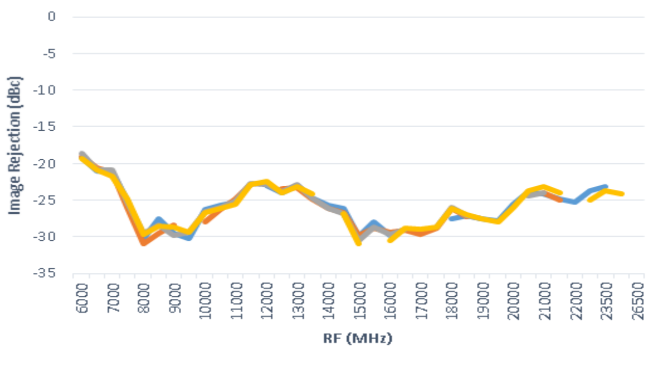



*Figure 3. Image Rejection, Downconverter*

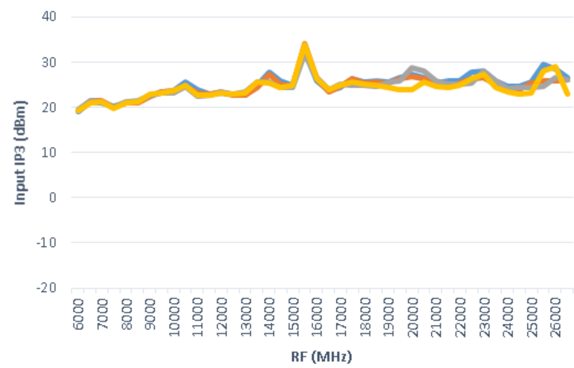



*Figure 5. Input IP3, Downconverter*

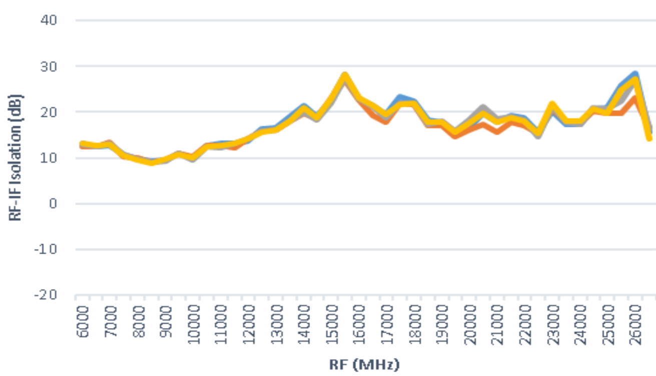



*Figure 4. RF to IF Isolation, Downconverter*

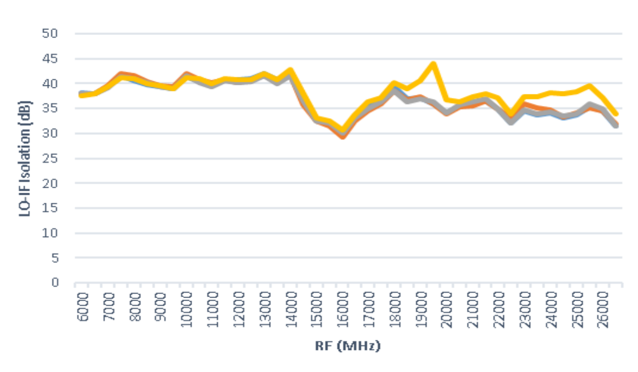



*Figure 6. LO to IF Isolation, Downconverter*

## $f_{RF\ IN}$ at 2.5 GHz

$f_{IF\ OUT} = f_{LO} - f_{RF\ IN}$ (downconverter, lower sideband), $f_{RF\ IN}$ = 2.5 GHz, $P_{RF\ IN}$ = −10dBm, $P_{LO}$ = 14 dBm, 16 dBm, 18 dBm, 20 dBm, $T_A$ = 25°C.

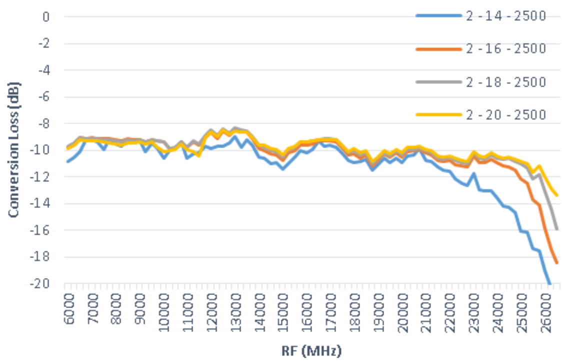



*Figure 7. Conversion Loss, Downconverter*

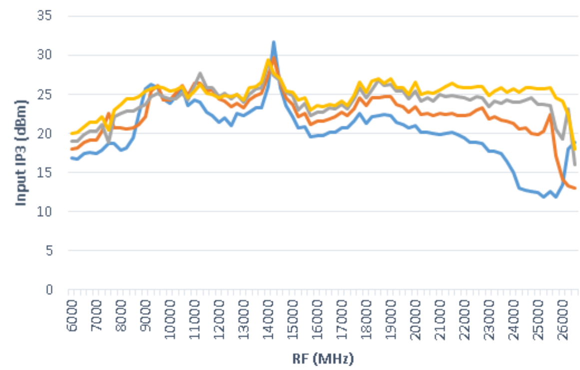



*Figure 10. Input IP3, Downconverter*

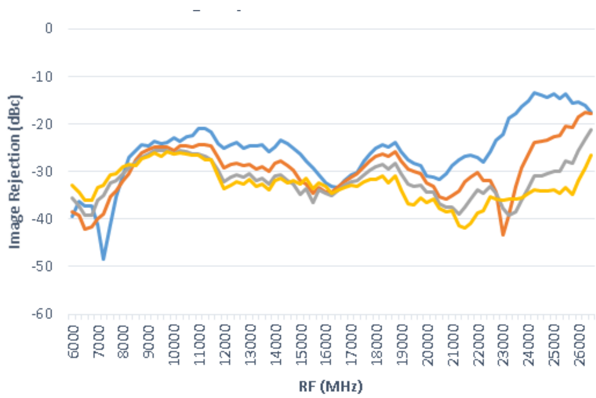



*Figure 8. Image Rejection, Downconverter*

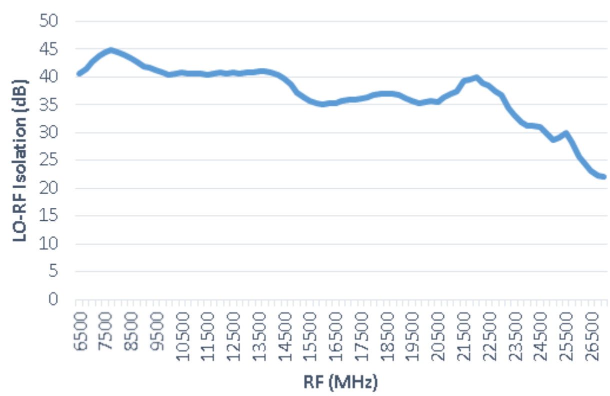



*Figure 11. LO to RF Isolation, Downconverter*

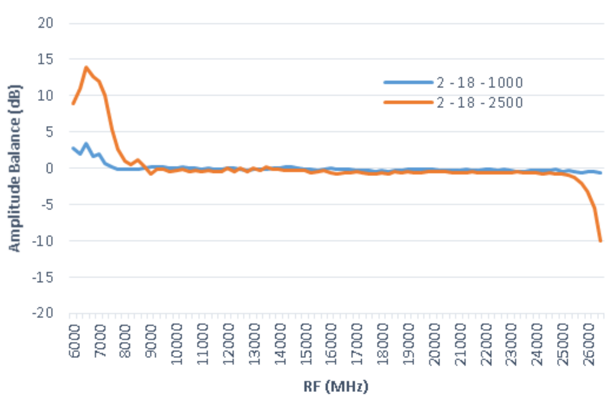



*Figure 9.Amplitude Balance, Downconverter*

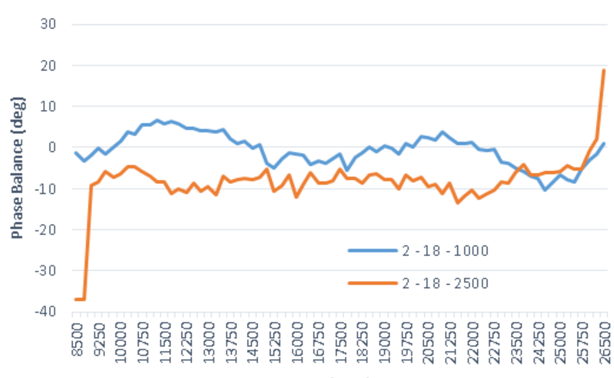



*Figure 12. Phase Balance, Downconverter*

## $f_{RF\ IN}$ at 5 GHz

$f_{IF\ OUT} = f_{LO} - f_{RF\ IN}$ (downconverter, lower sideband), $f_{RF\ IN}$ = 5 GHz, $P_{RF\ IN}$ = −10dBm, $P_{LO}$ = 14 dBm, 16 dBm, 18 dBm, 20 dBm, $T_A$ = 25°C.

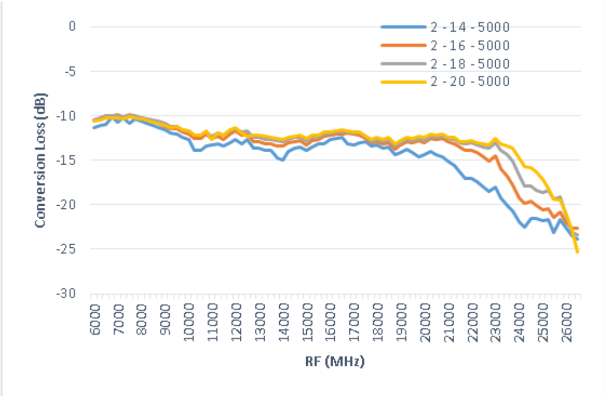



Figure 13. Conversion Loss, Downconverter

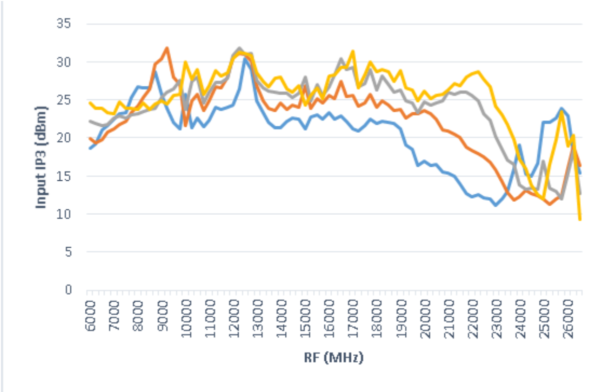



Figure 15. Input IP3, Downconverter

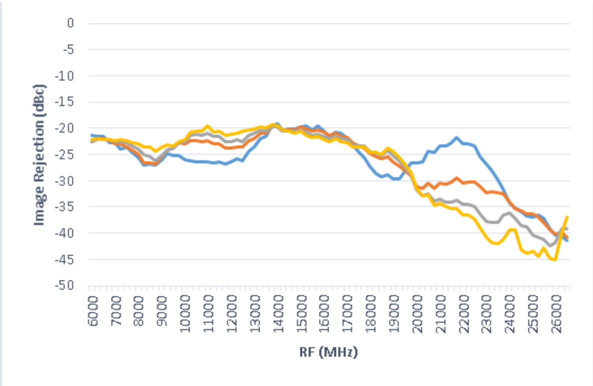



Figure 14. Image Rejection, Downconverter

## EVALUATION BOARD

An evaluation board is available for the HMC8191. The standard evaluation board is fabricated using Rogers® RO4003C material. The schematic for the evaluation board is shown in Figure 16.

TBD

*Figure 16. Evaluation Board Schematic*

TBD

*Figure 17. Evaluation Board, Top Layer*

TBD

*Figure 18. Evaluation Board, Bottom Layer*

Table 4 describes the various configuration options for the evaluation board. Layouts for the board are shown in Figure 17 and Figure 18.

**Table 4. Evaluation Board Configuration**

| Components | Function | Default Conditions |
|---|---|---|
| TBD | | |

# OUTLINE DIMENSIONS

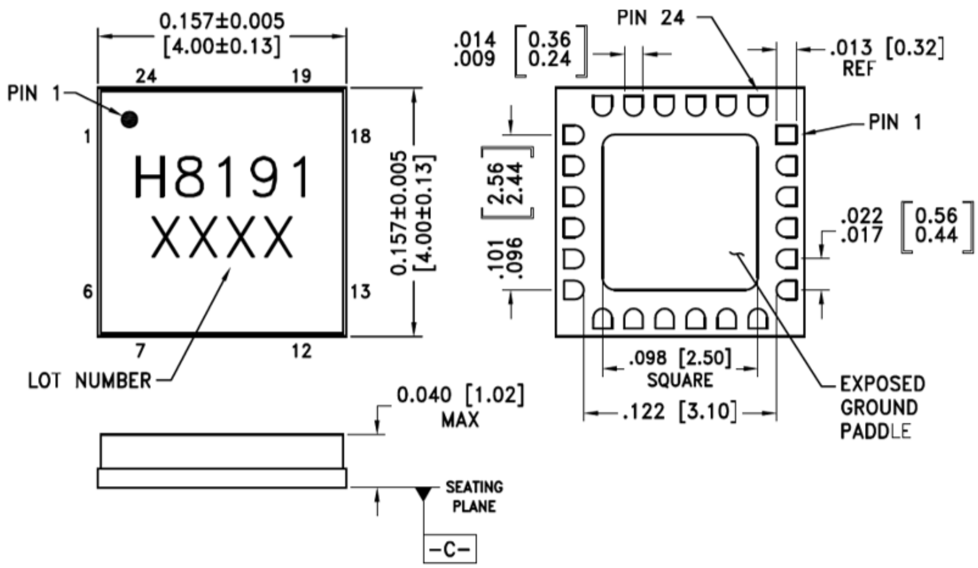



*Figure 19. HMC8191 Outline Drawing and Dimensions*