# MIC7211/7221

## IttyBitty™ Rail-to-Rail Input Comparator

**Preliminary Information**

## General Description

The MIC7211 and MIC7221 are micropower comparators featuring rail-to-rail input performance in Micrel's IttyBitty™ SOT-23-5 package. The MIC7211/21 is ideal for systems where small size is a critical consideration.

The MIC7211/21 is optimized for single supply operation from 2.4V to 15V power supplies.

The MIC7211 features a conventional push-pull output while the MIC7221 has an open-drain output for mixed-voltage applications with an external pull-up resistor.

The MIC7211/21 benefits small battery-operated portable electronic devises where small size and the ability to place the comparator close to the signal source are primary design concerns.

## Features

- Small footprint SOT-23-5 package
- Guaranteed performance at 2.4V, 2.7V, 5V, and 15V
- 7µA typical supply current at 5V
- <4µs response time at 5V
- Push-pull output (MIC7211)
- Open-drain output (MIC7221)
- Supply ±200mV input common-mode range
- 150mA typical sink or source

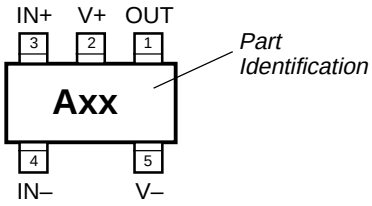
## Applications

- Battery-powered products
- Notebook computers and PDAs
- PCMCIA cards
- Cellular and other wireless communication devices
- Alarm and security circuits
- Direct sensor interface

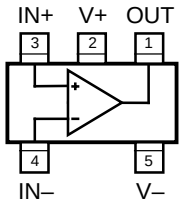
## Ordering Information

| Part Number | Temp. Range | Package | Mark |
|---|---|---|---|
| MIC7211BM5 | –40°C to +85°C | SOT-23-5 | A14 |
| MIC7221BM5 | –40°C to +85°C | SOT-23-5 | A15 |

## Pin Configuration




## Functional Configuration




**SOT-23-5 (M5)**

## Pin Description

| Pin Number | Pin Name | Pin Function |
|---|---|---|
| 1 | OUT | Amplifier Output |
| 2 | V+ | Positive Supply |
| 3 | IN+ | Noninverting Input |
| 4 | IN– | Inverting Input |
| 5 | V– | Negative Suppy |

## Absolute Maximum Ratings

Supply Voltage ($V_{V+} – V_{V–}$) ..... 1.8V to 16V
Differential Input Voltage ($V_{IN+}$, $V_{IN–}$) V+ + 0.3V, V– – 0.3V
Input Current ($I_{IN+}$, $I_{IN–}$) .....±5mA
Output Current ($I_{OUT}$) .....±300mA
Junction Temperature ($T_J$), **Note 1** ..... +150°C
ESD, **Note 2** ..... 2kV

## Operating Ratings

Supply Voltage ($V_{V+} – V_{V–}$) ..... 2.2V to 15V
Ambient Temperature ($T_J$) ..... –40°C to +85°C
Package Thermal Resistance ($\theta_{JA}$) .....325°C/W

## DC Electrical Characteristics (2.4V)

$V_V$+ = +2.4V, V– = 0V, $V_{CM} = V_{OUT} = V_{V+}/2$; $T_J$ = 25°C, **bold** values indicate –40°C ≤ $T_J$ ≤ +85°C; unless noted

| Symbol | Parameter | Condition | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| $V_{OS}$ | Input Offset Voltage | | | 3 | 5 | mV |
| $TCV_{OS}$ | Input Offset Voltage Temperature Drift | | | 1 | | µV/°C |
| $TCV_{OS}$ | Input Offset Voltage Drift Over Time | | | 1 | | µV/month |
| $I_B$ | Input Bias Current | | | 0.04 | | pA |
| $I_{OS}$ | Input Offset Current | | | 0.02 | | pA |
| CMRR | Common-Mode Rejection Ratio | 0V ≤ $V_{CM}$ ≤ 2.4V | | 75 | | dB |
| PSRR | Positive Power Supply Rejection Ratio | V+ = 2.4V to 5V | | 80 | | dB |
| $A_{VOL}$ | Gain | | | 125 | | dB |
| $V_{CM}$ | Input Common Mode Range | CMRR > 55dB | 2.6 | 2.7 | | V |
| | | CMRR > 55dB | | –0.3 | –0.2 | V |
| $V_{OH}$ | Output Voltage (High) | MIC7211, $I_{LOAD}$ = 2.5mA | 2.3 | 2.36 | | V |
| $V_{OL}$ | Output Voltage (Low) | $I_{LOAD}$ = 2.5mA | | 0.04 | 0.1 | V |
| $I_S$ | Supply Current | $V_{OUT}$ = low | | 7 | 12 | µA |

## DC Electrical Characteristics (2.7V)

$V_V$+ = +2.7V, V– = 0V, $V_{CM} = V_{OUT} = V_{V+}/2$; $T_J$ = 25°C, **bold** values indicate –40°C ≤ $T_J$ ≤ +85°C; unless noted

| Symbol | Parameter | Condition | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| $V_{OS}$ | Input Offset Voltage | | | 3 | 5 | mV |
| $TCV_{OS}$ | Input Offset Voltage Temperature Drift | | | 1 | | µV/°C |
| $TCV_{OS}$ | Input Offset Voltage Drift Over Time | | | 3.3 | | µV/month |
| $I_B$ | Input Bias Current | | | 0.04 | | pA |
| $I_{OS}$ | Input Offset Current | | | 0.02 | | pA |
| CMRR | Common-Mode Rejection Ratio | 0V ≤ $V_{CM}$ ≤ 2.7V | | 75 | | dB |
| PSRR | Positive Power Supply Rejection Ratio | V+ = 2.7V to 5V | | 80 | | dB |
| $A_{VOL}$ | Gain | | | 125 | | dB |
| $V_{CM}$ | Input Common Mode Range | CMRR > 55dB | 2.9 | 3.0 | | V |
| | | CMRR > 55dB | | –0.3 | –0.2 | V |
| $V_{OH}$ | Output Voltage (High) | MIC7211, $I_{LOAD}$ = 2.5mA | 2.6 | 2.66 | | V |
| $V_{OL}$ | Output Voltage (Low) | $I_{LOAD}$ = 2.5mA | | 0.4 | 0.1 | V |
| $I_S$ | Supply Current | $V_{OUT}$ = low | | 7 | 12 | µA |

## DC Electrical Characteristics (5V)

$V_V+$ = +5.0V, V– = 0V, $V_{CM} = V_{OUT} = V_{V+}/2$; $T_J$ = 25°C, **bold** values indicate –40°C ≤ $T_J$ ≤ +85°C; unless noted

| Symbol | Parameter | Condition | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| $V_{OS}$ | Input Offset Voltage | | | 3 | 5 | mV |
| $TCV_{OS}$ | Input Offset Voltage Temperature Drift | | | 1 | | µV/°C |
| $TCV_{OS}$ | Input Offset Voltage Drift Over Time | | | 3.3 | | µV/month |
| $I_B$ | Input Bias Current | | | 0.04 | | pA |
| $I_{OS}$ | Input Offset Current | | | 0.02 | | pA |
| CMRR | Common-Mode Rejection Ratio | 0V ≤ $V_{CM}$ ≤ 5.0V | | 75 | | dB |
| PSRR | Positive Power Supply Rejection Ratio | V+ = 5.0V to 10V | | 80 | | dB |
| $A_{VOL}$ | Gain | | | 125 | | dB |
| $V_{CM}$ | Input Common Mode Range | CMRR > 55dB | 5.2 | 5.3 | | V |
| | | CMRR > 55dB | | –0.3 | –0.2 | V |
| $V_{OH}$ | Output Voltage (High) | MIC7211, $I_{LOAD}$ = 2.5mA | 4.8 | 4.9 | | V |
| $V_{OL}$ | Output Voltage (Low) | $I_{LOAD}$ = 5mA | | 0.1 | 0.2 | V |
| $I_S$ | Supply Current | $V_{OUT}$ = low | | 7 | 14 | µA |
| $I_{SC}$ | Short Circuit Current | MIC7211, sourcing | | 150 | | mA |
| | | sinking | | 150 | | mA |

## DC Electrical Characteristics (15V)

$V_V+$ = +15V, V– = 0V, $V_{CM} = V_{OUT} = V_{V+}/2$; $T_J$ = 25°C, **bold** values indicate –40°C ≤ $T_J$ ≤ +85°C; unless noted

| Symbol | Parameter | Condition | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| $V_{OS}$ | Input Offset Voltage | | | 3 | 5 | mV |
| $TCV_{OS}$ | Input Offset Voltage Temperature Drift | | | 1 | | µV/°C |
| $TCV_{OS}$ | Input Offset Voltage Drift Over Time | | | 3.3 | | µV/month |
| $I_B$ | Input Bias Current | | | 0.04 | | pA |
| $I_{OS}$ | Input Offset Current | | | 0.02 | | pA |
| CMRR | Common-Mode Rejection Ratio | 0V ≤ $V_{CM}$ ≤ 15V | | 82 | | dB |
| PSRR | Positive Power Supply Rejection Ratio | V+ = 5.0V to 10V | | 80 | | dB |
| $A_{VOL}$ | Gain | | | 125 | | dB |
| $V_{CM}$ | Input Common Mode Range | CMRR > 55dB | 15.2 | 15.3 | | V |
| | | CMRR > 55dB | | –0.3 | –0.2 | V |
| $V_{OH}$ | Output Voltage (High) | MIC7211, $I_{LOAD}$ = 5mA | 14.6 | 14.8 | | V |
| $V_{OL}$ | Output Voltage (Low) | $I_{LOAD}$ = 5mA | | 0.1 | 0.2 | V |
| $I_S$ | Supply Current | $V_{OUT}$ = low | | 7 | 14 | µA |
| $I_{SC}$ | Short Circuit Current | MIC7211, sourcing | | 200 | | mA |
| | | sinking | | 200 | | mA |

## AC Electrical Characteristics

$V_{V-}$ = 0V, $V_{CM}$ = $V_{OUT}$ = $V_{V+}$/2; $T_J$ = 25°C, **bold** values indicate –40°C ≤ $T_J$ ≤ +85°C; unless noted

| Symbol | Parameter | Condition | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| $t_{RISE}$ | Rise Time | $V_{V+}$ = 5.0V, f = 10kHz, $C_{LOAD}$ = 50pF overdrive = 10mV, **Note 3** | | 0.3 | | µs |
| $t_{FALL}$ | Fall Time | $V_{V+}$ = 5.0V, f = 10kHz, $C_{LOAD}$ = 50pF overdrive = 10mV, **Note 3** | | 0.3 | | µs |
| $t_{PHL}$ | Propagation Delay-High to Low | $V_{V+}$ = 2.4V, f = 10kHz, $C_{LOAD}$ = 50pF overdrive = 10mV, **Note 3** | | 10 | | µs |
| $t_{PHL}$ | Propagation Delay-High to Low | $V_{V+}$ = 2.4V, f = 10kHz, $C_{LOAD}$ = 50pF overdrive = 100mV, **Note 3** | | 4 | | µs |
| $t_{PHL}$ | Propagation Delay-High to Low | $V_{V+}$ = 5.0V, f = 10kHz, $C_{LOAD}$ = 50pF overdrive = 10mV, **Note 3** | | 10 | | µs |
| $t_{PHL}$ | Propagation Delay-High to Low | $V_{V+}$ = 5.0V, f = 10kHz, $C_{LOAD}$ = 50pF overdrive = 100mV, **Note 3** | | 4 | | µs |
| $t_{PLH}$ | Propagation Delay-Low to High | $V_{V+}$ = 2.4V, f = 10kHz, $C_{LOAD}$ = 50pF overdrive = 10mV, **Note 3** | | 10 | | µs |
| $t_{PLH}$ | Propagation Delay-Low to High | $V_{V+}$ = 2.4V, f = 10kHz, $C_{LOAD}$ = 50pF overdrive = 100mV, **Note 3** | | 4 | | µs |
| $t_{PLH}$ | Propagation Delay-Low to High | $V_{V+}$ = 5.0V, f = 10kHz, $C_{LOAD}$ = 50pF overdrive = 10mV, **Note 3** | | 10 | | µs |
| $t_{PLH}$ | Propagation Delay-Low to High | $V_{V+}$ = 5.0V, f = 10kHz, $C_{LOAD}$ = 50pF overdrive = 100mV, **Note 3** | | 4 | | µs |

**General Note:** Devices are ESD protected; however, handling precautions are recommended.

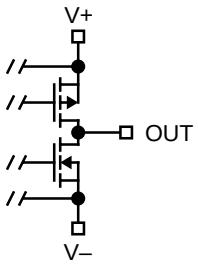
**General Note:** All limits guaranteed by testing on statistical analysis.

**Note 1:** Maximum power dissipation at $T_A$ is $P_D = (T_{J(max)} - T_A)/\theta_{JA}$. Values apply to device solder to printed circuit board.

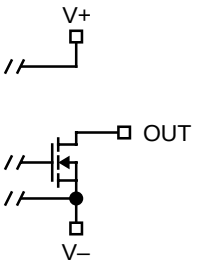
**Note 2:** Human body model, 1.5k in series with 100pF.

**Note 3:** MIC7221 requires 5k pull-up resistor.

## Partial Functional Diagrams

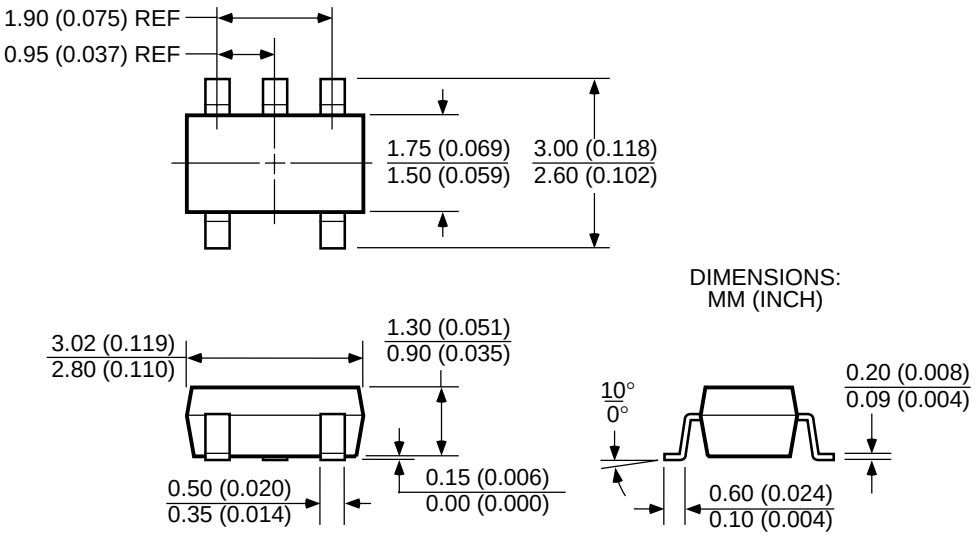



**MIC7211 Push-Pull Output**




**MIC7221 Open-Drain Output**

## Package Information




**SOT-23-5 (M5)**

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