MIC7101

Low-Power Operational Amplifier

Preliminary Information

General Description

The MIC7101 is a high-performance, low-power, operational amplifier. It features rail-to-rail input and output performance in Micrel's IttyBitty™ SOT-23-5 package.

The MIC7101 is a 1.0MHz gain bandwidth amplifier designed to operate from 2.4V to 15.5V single-ended power supplies with guaranteed performance at supply voltages of 2.4V, 2.7V, 3V, 5V, and 15V.

This op amp's input common-mode range includes ground and extends 300mV beyond the supply rails. For example, the common-mode range is –0.03V to +5.3V with a 5V supply.

Features

- Small footprint SOT-23-5 package
- Guaranteed 2.4V, 2.7V, 3V, 5V, and 15V performance
- 1.0MHz gain-bandwidth
- 0.01% total harmonic distortion at 10kHz (5V, 10kΩ)
- 0.5mA typical supply current at 5V
- Unity-gain stable for capacitive loads up to 1000pF
- 140mA output sink and source

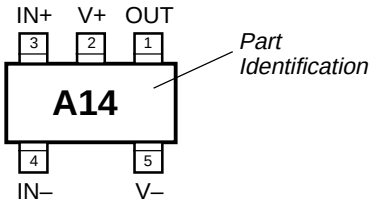
Applications

- Mobile communications, cellular phones, pagers
- Battery-powered instrumentation
- PCMCIA, USB
- Portable computers and PDAs

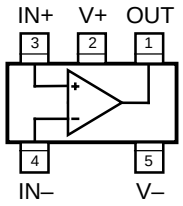
Ordering Information

Part Number	Temperature Range	Package
MIC7101BM5	–40°C to +85°C	5-lead SOT-23-5

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 Supply: Negative supply for split supply application or ground for single supply application.

Absolute Maximum Ratings (Note 1)

Supply Voltage ($V_{V+} – V_{V–}$) 16V
Differential Input Voltage ($V_{IN+} – V_{IN–}$) ..... $\pm(V_{V+} – V_{V–})$
Input Voltage (V_{IN+}, $V_{IN–}$) ..... V_{V+} + 0.3V, $V_{V–}$ – 0.3V
Output Voltage (V_{OUT}) ..... V_{V+} + 0.3V, $V_{V–}$ – 0.3V
Input Current (I_{IN+}, $I_{IN–}$) ..... ±5mA
Output Current (I_{OUT}), **Note 2** ..... ±35mA
Supply Current (I_S) 35mA
Storage Temperature (T_A) ..... –65°C to +150°C
Junction Temperature (T_J), **Note 3** ..... 150°C
ESD, **Note 4** 2kV

Operating Ratings (Note 1)

Supply Voltage ($V_{V+} – V_{V–}$) ..... +2.4V to +15.5V
Ambient Temperature (T_A) ..... –40°C to +85°C
Package Thermal Resistance (θ_{JA}) ..... 325°C/W

Electrical Characteristics (2.4V)

V+ = +2.4V, V– = 0V, $V_{CM} = V_{OUT} = V+/2$; $R_L > 1M\Omega$; $T_J = 25°C$, **bold** values indicate $–40°C \le T_J \le +85°C$; unless noted

Symbol	Parameter	Condition	Min	Typ	Max	Units
V_{OS}	Input Offset Voltage				6	mV
TCV_{OS}	Input Offset Voltage Average Drift			1.0		µV/°C
I_B	Input Bias Current			1.0	**60**	pA
I_{OS}	Input Offset Current			0.5	**30**	pA
R_{IN}	Input Resistance			>1		TΩ
CMRR	Common-Mode Rejection Ratio	$0V \le V_{CM} \le 2.4V$	55	70		dB
V_{CM}	Input Common-Mode Voltage	input low, CMRR ≥ 50dB	0.0	–0.3		V
		input high, CMRR ≥ 50dB		2.7	2.4	V
PSRR	Power Supply Rejection Ratio	V+ = 1.05V to 1.35V, V– = –1.05V to –1.35V, V_{CM} = 0	45	60		dB
C_{IN}	Common-Mode Input Capacitance			3		pF
V_O	Output Swing	output high, R_L = 2kΩ	2.15	2.325		V
		output low, R_L = 2kΩ		0.075	0.5	V
		output high, R_L = 10kΩ	2.385	2.394		V
		output low, R_L = 10kΩ		0.006	0.06	V
I_S	Supply Current			.450	.75	mA
SR	Slew Rate			0.7		V/µs
GBW	Gain-Bandwidth Product			1.0		MHz

Electrical Characteristics (2.7V)

V+ = +2.7V, V– = 0V, $V_{CM} = V_{OUT} = V+/2$; $R_L > 1M\Omega$; $T_J = 25°C$, **bold** values indicate $–40°C \le T_J \le +85°C$; unless noted

Symbol	Parameter	Condition	Min	Typ	Max	Units
V_{OS}	Input Offset Voltage				6	mV
TCV_{OS}	Input Offset Voltage Average Drift			1.0		µV/°C
I_B	Input Bias Current			1.0	**64**	pA
I_{OS}	Input Offset Current			0.5	**32**	pA
R_{IN}	Input Resistance			>1		TΩ
CMRR	Common-Mode Rejection Ratio	$0V \le V_{CM} \le 2.7V$	55	70		dB
V_{CM}	Input Common-Mode Voltage	input low, CMRR ≥ 50dB	0.0	–0.3		V
		input high, CMRR ≥ 50dB		3.0	2.7	V
PSRR	Power Supply Rejection Ratio	V+ = 1.2V to 1.5V, V– = –1.2V to –1.5V, $V_{CM} = 0$	50	60		dB
C_{IN}	Common-Mode Input Capacitance			3		pF
V_O	Output Swing	output high, R_L = 2k	2.6	2.625		V
		output low, R_L = 2k		0.075	0.1	V
		output high, R_L = 10k	2.685	2.694		V
		output low, R_L = 10k		0.006	0.015	V
I_S	Supply Current			0.5	0.81 **0.95**	mA mA
SR	Slew Rate			0.7		V/µs
GBW	Gain-Bandwidth Product			0.6		MHz

Electrical Characteristics (3.0V)

V+ = +3.0V, V– = 0V, $V_{CM} = V_{OUT} = V+/2$; $R_L > 1M\Omega$; $T_J = 25°C$, **bold** values indicate $–40°C \le T_J \le +85°C$; unless noted

Symbol	Parameter	Condition	Min	Typ	Max	Units
V_{OS}	Input Offset Voltage				4	mV
TCV_{OS}	Input Offset Voltage Average Drift			1.0		µV/°C
I_B	Input Bias Current			1.0	**64**	pA
I_{OS}	Input Offset Current			0.5	**32**	pA
R_{IN}	Input Resistance			>1		TΩ
CMRR	Common-Mode Rejection Ratio	$0V \le V_{CM} \le 3.0V$	64	74		dB
V_{CM}	Input Common-Mode Voltage	input low, CMRR ≥ 50dB	–0.2	–0.3		V
		input high, CMRR ≥ 50dB		3.3	3.2	V
PSRR	Power Supply Rejection Ratio	V+ = 1.35V to 1.65V, V– = –1.35V to –1.65V, $V_{CM} = 0$	68	80		dB
C_{IN}	Common-Mode Input Capacitance			3		pF
V_{OUT}	Output Swing	output high, R_L = 2k	2.9	2.95		V
		output low, R_L = 2k		0.05	0.1	V
		output high, R_L = 600Ω	2.85	2.9		V
		output low, R_L = 600Ω		0.1	0.15	V
I_S	Supply Current			0.5	0.81 **0.95**	mA mA

Electrical Characteristics—DC (5V)

V+ = +5.0V, V– = 0V, V_{CM} = 1.5V, V_{OUT} = V+/2; R_L > 1MΩ; 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	mV
TCV_{OS}	Input Offset Voltage Average Drift			1.0		µV/°C
I_B	Input Bias Current			1.0	**64**	pA
I_{OS}	Input Offset Current			0.5	**32**	pA
R_{IN}	Input Resistance			>1		TΩ
CMRR	Common-Mode Rejection Ratio	0V ≤ V_{CM} ≤ 5V	65 **60**	82		dB dB
V_{CM}	Input Common-Mode Voltage	input low, CMRR ≥ 50dB	–0.20 **0.00**	–0.3		V V
		input high, CMRR ≥ 50dB		5.3	5.20 **5.00**	V V
+PSRR	Positive Power Supply Rejection Ratio	V+ = 4.85V to 5.15V, V– = 0V, V_{OUT} = 2.5V	70 **65**	82		dB dB
–PSRR	Negative Power Supply Rejection Ratio	V+ = 0V, V– = –4.85V to –5.15V, V_{OUT} = –2.5V	70 **65**	82		dB dB
C_{IN}	Common-Mode Input Capacitance			3		pF
V_{OUT}	Output Swing	output high, R_L = 2k	4.95 **4.93**	4.95		V V
		output low, R_L = 2k		0.03	0.05 **0.075**	V V
		output high, R_L = 600Ω	4.83 **4.8**	4.9		V V
		output low, R_L = 600Ω		0.085	0.16 **0.20**	V V
I_{SC}	Output Short Circuit Current	sourcing (V_{OUT} = 0V) or sinking (V_{OUT} = 5V)	120 **80**	200		mA mA
I_S	Supply Current			0.5	0.85 **1.0**	mA mA

Electrical Characteristics—DC (15V)

V+ = +15V, V– = 0V, V_{CM} = 1.5V, V_{OUT} = V+/2; R_L > 1MΩ; 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				9	mV
TCV_{OS}	Input Offset Voltage Average Drift			1.0		µV/°C
I_B	Input Bias Current			1.0	**64**	pA
I_{OS}	Input Offset Current			0.5	**32**	pA
R_{IN}	Input Resistance			>1		TΩ
CMRR	Common-Mode Rejection Ratio	0V ≤ V_{CM} ≤ 15V	70 **65**	82		dB dB
V_{CM}	Input Common-Mode Voltage	input low, V+ = 15V, CMRR ≥ 50dB	–0.20 **0.00**	–0.3		V V
		input high, V+ = 15V, CMRR ≥ 50dB		15.3	15.2 **15.0**	V V
+PSRR	Positive Power Supply Rejection Ratio	V+ = 14.85V to 15.15V V– = 0V, V_{OUT} = 7.5V	70 **65**	82		dB
–PSRR	Negative Power Supply Rejection Ratio	V+ = 0, V– = –14.85V to –15.15V, V_{OUT} = –7.5	70 **65**	82		dB dB
A_V	Large Signal Voltage Gain	sourcing or sinking, R_L = 2k, **Note 5**	80 **40**	340		V/mV V/mV
		sourcing or sinking, R_L = 600Ω, **Note 5**	34 **34**	300		V/mV V/mV
C_{IN}	Common-Mode Input Capacitance			3		pF
V_{OUT}	Output Swing	output high, V+ = 15V, R_L = 2k	14.9 **14.87**	14.94		V V
		output low, V+ = 15V, R_L = 2k,		0.06	0.10 **0.13**	V V
		output high, V+ = 15V, R_L = 600Ω	14.73 **14.65**	14.8		V V
		output low, V+ = 15V, R_L = 600Ω		0.20	0.27 **0.35**	V V
I_{SC}	Output Short Circuit Current	sourcing (V_{OUT} = 0V) or sinking (V_{OUT} = 12V), **Note 6**	200 **120**	300		mA mA
I_S	Supply Current			0.8	1.5 **1.71**	mA mA

Electrical Characteristics—AC (5V)

V+ = 5V, V– = 0V, V_{CM} = 1.5V, V_{OUT} = V+/2; R_L = 1MΩ; T_J = 25°C, **bold** values indicate –40°C ≤ T_J ≤ +85°C; unless noted

Symbol	Parameter	Condition	Min	Typ	Max	Units
THD	Total Harmonic Distortion	f = 10kHz, A_V = –2, R_L = 10kΩ, V_{OUT} = 4.0 V_{PP}		0.01		%
SR	Slew Rate			1.0		V/µs
GBW	Gain Bandwidth Product			1.0		MHz

Electrical Characteristics—AC (15V)

V+ = 15V, V– = 0V, V_{CM} = 1.5V, V_{OUT} = V+/2; R_L = 1MΩ; T_J = 25°C, **bold** values indicate –40°C ≤ T_J ≤ +85°C; unless noted

Symbol	Parameter	Condition	Min	Typ	Max	Units
THD	Total Harmonic Distortion	f = 10kHz, A_V = –2, R_L = 10k, V_{OUT} = 8.5 V_{PP}		0.01		%
SR	Slew Rate	V+ = 15V, **Note 7**	0.5 **0.4**	1.1		V/µs V/µs
GBW	Gain Bandwidth Product	V+ = 15V		1.1		MHz
ϕ_m	Phase Margin			45		°
G_m	Gain Margin			10		dB
e_n	Input-Referred Voltage Noise	f = 1kHz, V_{CM} = 1V		37		nV/$\sqrt{Hz}$
i_n	Input-Referred Current Noise	f = 1kHz		1.5		fA/$\sqrt{Hz}$

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

General Note: All limits guarenteed by testing on statistical analysis.

Note 1: Specified performance is not guaranteed outside the operating ratings.

Note 2: Single-supply and split-supply operation. Continuous short circuit may exceed absolute maximum T_J under some conditions.

Note 3: Maximum power dissipation at T_A is $P_D = (T_{J(max)} - T_A)/\theta_{JA}$. Values apply to device soldered to printed circuit board.

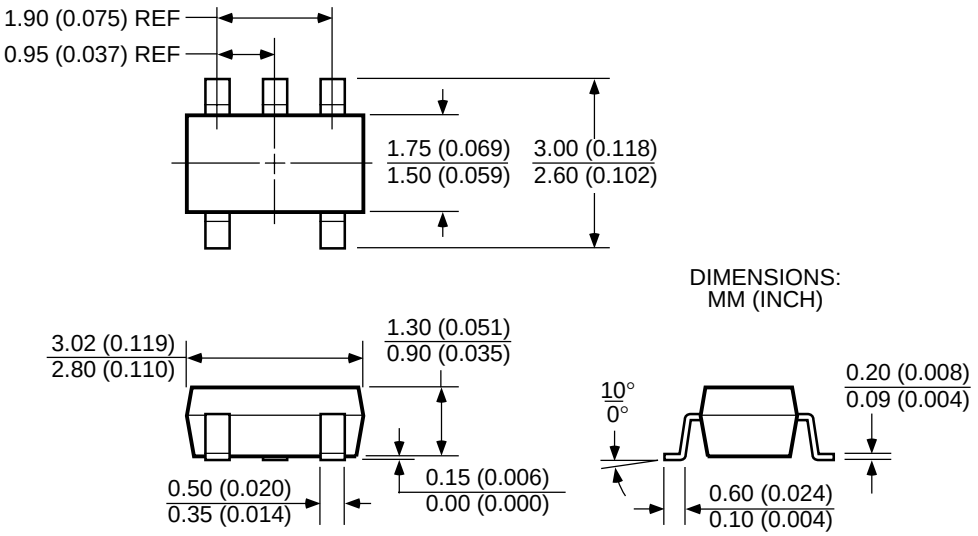
Note 4: Human body model, 1.5kΩ in series with 100pF.

Note 5: R_L connected to +7.5V. Sourcing: 7.5V ≤ V_{OUT} ≤ 12.5V. Sinking: 2.5V ≤ V_{OUT} ≤ 7.5V.

Note 6: Shorting OUT to V+ when V+ > 12V may damage the device.

Note 7: Device connected as a voltage follower with a 10V step input. The value is the positive or negative slew rate, whichever is slower.

Package Information



SOT-23-5 (M5)

MICREL INC. 1849 FORTUNE DRIVE SAN JOSE, CA 95131 USA

TEL + 1 (408) 944-0800 FAX + 1 (408) 944-0970 WEB http://www.micrel.com