

## Single and Dual Single Supply Ultra-Low Noise, Ultra-Low Distortion, Rail-to-Rail Output, Op Amp

The ISL28190 and ISL28290 are tiny single and dual ultra-low noise, ultra-low distortion operational amplifiers. Fully specified to operated down to +3V single supply. These amplifiers have outputs that swing rail-to-rail, and an input common mode voltage that extends below ground (ground sensing).

The ISL28190 and ISL28290 are unity gain stable with an input referred voltage noise of  $1\text{nV}/\sqrt{\text{Hz}}$ . Both parts feature 0.00017% THD+N @ 1kHz.

The ISL28190 is available in the space-saving 6 Ld  $\mu$ TDFN (1.6mmx1.6mm) and 6 Ld SOT-23 packages. The ISL28290 is available in the 10 Ld  $\mu$ TQFN (1.8mmx1.4mm) and 10 Ld MSOP packages. All devices are guaranteed over  $-40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$ .

### Ordering Information

PART NUMBER	PART MARKING	PACKAGE (Pb-free)	PKG. DWG. #
ISL28190FHZ-T7* (Note 1)	GABH	6 Ld SOT-23	MDP0038
ISL28190FRUZ-T7* (Note 2)	M7	6 Ld $\mu$ TDFN	L6.1.6x1.6A
ISL28290FUZ (Note 1)	8290Z	10 Ld MSOP	MDP0043
ISL28290FUZ-T7* (Note 1)	8290Z	10 Ld MSOP	MDP0043
ISL28290FRUZ-T7* (Note 2)	E	10 Ld $\mu$ TQFN	L10.1.8x1.4A
ISL28290FBZ (Note 1)	28290 FBZ	8 Ld SOIC	MDP0027
ISL28290FBZ-T7* (Note 1)	28290 FBZ	8 Ld SOIC	MDP0027
ISL28290EVAL1Z	Evaluation Board		

\*Please refer to TB347 for details on reel specifications.

#### NOTES:

1. These Intersil Pb-free plastic packaged products employ special Pb-free material sets, molding compounds/die attach materials, and 100% matte tin plate plus anneal (e3 termination finish, which is RoHS compliant and compatible with both SnPb and Pb-free soldering operations). Intersil Pb-free products are MSL classified at Pb-free peak reflow temperatures that meet or exceed the Pb-free requirements of IPC/JEDEC J STD-020.
2. These Intersil Pb-free plastic packaged products employ special Pb-free material sets; molding compounds/die attach materials and NiPdAu plate - e4 termination finish, which is RoHS compliant and compatible with both SnPb and Pb-free soldering operations. Intersil Pb-free products are MSL classified at Pb-free peak reflow temperatures that meet or exceed the Pb-free requirements of IPC/JEDEC J STD-020.

### Features

- $1\text{nV}/\sqrt{\text{Hz}}$  input voltage noise
- 1kHz THD+N typical 0.00017% at  $2V_{P-P}$   $V_{OUT}$
- Harmonic Distortion -87dBc, -90dBc,  $f_o = 1\text{MHz}$
- 170MHz -3dB bandwidth
- $50\text{V}/\mu\text{s}$  slew rate
- 700 $\mu\text{V}$  maximum offset voltage
- 10 $\mu\text{A}$  typical input bias current
- 103dB typical CMRR
- 3V to 5.5V single supply voltage range
- Rail-to-rail output
- Ground sensing
- Enable pin (not available in the 8 Ld SOIC package option)
- Pb-free (RoHS compliant)

### Applications

- Low noise signal processing
- Low noise microphones/preamplifiers
- ADC buffers
- DAC output amplifiers
- Digital scales
- Strain gauges/sensor amplifiers
- Radio systems
- Portable equipment
- Infrared detectors

**Absolute Maximum Ratings** ( $T_A = +25^\circ\text{C}$ )

Supply Voltage	5.5V
Supply Turn On Voltage Slew Rate	1V/ $\mu\text{s}$
Differential Input Current	5mA
Differential Input Voltage	0.5V
Input Voltage	V- - 0.5V to V+ + 0.5V
ESD Tolerance	
Human Body Model	.3kV
Machine Model	.300V
Charged Device Model	1200V

**Thermal Information**

Thermal Resistance (typical, Note 3)	$\theta_{JA}$ ( $^\circ\text{C/W}$ )
6 Ld SOT-23 Package	230
6 Ld $\mu\text{TDFN}$ Package	125
10 Ld MSOP Package	150
10 Ld $\mu\text{TQFN}$ Package	180
8 Ld SOIC Package	125
Ambient Operating Temperature Range	-40 $^\circ\text{C}$ to +125 $^\circ\text{C}$
Storage Temperature Range	-65 $^\circ\text{C}$ to +150 $^\circ\text{C}$
Operating Junction Temperature	+125 $^\circ\text{C}$
Pb-free Reflow Profile	see link below
<a href="http://www.intersil.com/pbfree/Pb-FreeReflow.asp">http://www.intersil.com/pbfree/Pb-FreeReflow.asp</a>	

*CAUTION: Do not operate at or near the maximum ratings listed for extended periods of time. Exposure to such conditions may adversely impact product reliability and result in failures not covered by warranty.*

**NOTE:**

- $\theta_{JA}$  is measured with the component mounted on a high effective thermal conductivity test board in free air. See Tech Brief TB379 for details.

*IMPORTANT NOTE: All parameters having Min/Max specifications are guaranteed. Typical values are for information purposes only. Unless otherwise noted, all tests are at the specified temperature and are pulsed tests, therefore:  $T_J = T_C = T_A$*

**Electrical Specifications**  $V_+ = 5.0\text{V}$ ,  $V_- = \text{GND}$ ,  $R_L = \text{Open}$ ,  $R_F = 1\text{k}\Omega$ ,  $A_V = -1$  unless otherwise specified. Parameters are per amplifier. Typical values are at  $V_+ = 5\text{V}$ ,  $T_A = +25^\circ\text{C}$ . **Boldface limits apply over the operating temperature range, -40 $^\circ\text{C}$  to +125 $^\circ\text{C}$ , temperature data established by characterization.**

PARAMETER	DESCRIPTION	CONDITIONS	MIN (Note 4)	TYP	MAX (Note 4)	UNIT
<b>DC SPECIFICATIONS</b>						
$V_{OS}$	Input Offset Voltage		-1100	240	700 <b>900</b>	$\mu\text{V}$
$\frac{\Delta V_{OS}}{\Delta T}$	Input Offset Drift vs Temperature	See Figure 21		1.9		$\mu\text{V}/^\circ\text{C}$
$I_{IO}$	Input Offset Current			40	500 <b>900</b>	nA
$I_B$	Input Bias Current			10	16 <b>18</b>	$\mu\text{A}$
$V_{CM}$	Common-Mode Voltage Range		<b>0</b>		<b>3.8</b>	V
CMRR	Common-Mode Rejection Ratio	$V_{CM} = 0\text{V}$ to 3.8V	78	103		dB
PSRR	Power Supply Rejection Ratio	$V_S = 3\text{V}$ to 5V	74	80		dB
$A_{VOL}$	Large Signal Voltage Gain	$V_O = 0.5\text{V}$ to 4V, $R_L = 1\text{k}\Omega$	94 <b>90</b>	102		dB
$V_{OUT}$	Maximum Output Voltage Swing	Output low, $R_L = 1\text{k}\Omega$		20	50 <b>80</b>	mV
		Output high, $R_L = 1\text{k}\Omega$ , $V_+ = 5\text{V}$	4.95 <b>4.92</b>	4.97		V
$I_{S,ON}$	Supply Current per Channel, Enabled			8.5	11 <b>13</b>	mA
$I_{S,OFF}$	Supply Current, Disabled			26	35 <b>52</b>	$\mu\text{A}$
$I_{O+}$	Short-Circuit Output Current	$R_L = 10\Omega$	95 <b>90</b>	144		mA
$I_{O-}$	Short-Circuit Output Current	$R_L = 10\Omega$	95 <b>90</b>	135		mA
$V_{SUPPLY}$	Supply Operating Range	V+ to V-	<b>3</b>		<b>5.5</b>	V
$\overline{V_{ENH}}$	$\overline{EN}$ High Level	Referred to V-	<b>2</b>			V

# ISL28190, ISL28290

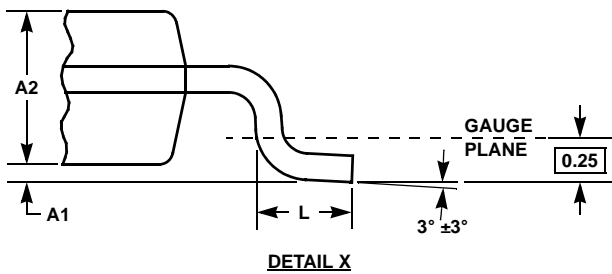
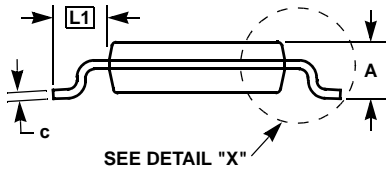
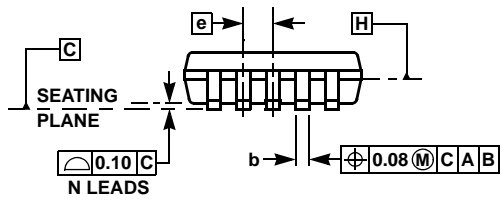
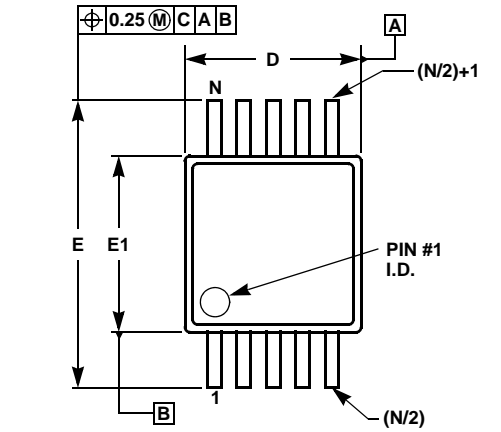
**Electrical Specifications**  $V_+ = 5.0V$ ,  $V_- = GND$ ,  $R_L = \text{Open}$ ,  $R_F = 1k\Omega$ ,  $A_V = -1$  unless otherwise specified. Parameters are per amplifier. Typical values are at  $V_+ = 5V$ ,  $T_A = +25^\circ C$ . **Boldface limits apply over the operating temperature range,  $-40^\circ C$  to  $+125^\circ C$ , temperature data established by characterization. (Continued)**

PARAMETER	DESCRIPTION	CONDITIONS	MIN (Note 4)	TYP	MAX (Note 4)	UNIT
$\overline{V_{ENL}}$	$\overline{EN}$ Low Level	Referred to $V_-$			<b>0.8</b>	V
$\overline{I_{ENH}}$	$\overline{EN}$ Pin Input High Current	$\overline{V_{EN}} = V_+$		0.8	1.2 <b>1.4</b>	$\mu A$
$\overline{I_{ENL}}$	$\overline{EN}$ Pin Input Low Current	$\overline{V_{EN}} = V_-$		20	80 <b>100</b>	nA
<b>AC SPECIFICATIONS</b>						
GBW	-3dB Unity Gain Bandwidth	$R_F = 0\Omega$ , $C_L = 20pF$ , $A_V = 1$ , $R_L = 10k\Omega$		170		MHz
THD+N	Total Harmonic Distortion + Noise	$f = 1kHz$ , $V_{OUT} = 2V_{P-P}$ , $A_V = +1$ , $R_L = 10k\Omega$		0.00017		%
HD (1MHz)	2nd Harmonic Distortion	$V_{OUT} = 2V_{P-P}$ , $A_V = 1$		-87		dBc
	3rd Harmonic Distortion			-90		dBc
ISO	Off-state Isolation $f_O = 100kHz$	$A_V = +1$ ; $V_{IN} = 100mV_{P-P}$ ; $R_F = 0\Omega$ , $C_L = 20pF$ , $A_V = 1$ , $R_L = 10k\Omega$		-38		dB
X-TALK ISL28290	Channel-to-Channel Crosstalk $f_O = 100kHz$	$V_S = \pm 2.5V$ ; $A_V = +1$ ; $V_{IN} = 1V_{P-P}$ , $R_F = 0\Omega$ , $C_L = 20pF$ , $A_V = 1$ , $R_L = 10k\Omega$		-105		dB
PSRR	Power Supply Rejection Ratio $f_O = 100kHz$	$V_S = \pm 2.5V$ ; $A_V = +1$ ; $V_{SOURCE} = 1V_{P-P}$ , $R_F = 0\Omega$ , $C_L = 20pF$ , $A_V = 1$ , $R_L = 10k\Omega$		-70		dB
CMRR	Common Mode Rejection Ratio $f_O = 100kHz$	$V_S = \pm 2.5V$ ; $A_V = +1$ ; $V_{CM} = 1V_{P-P}$ , $R_F = 0\Omega$ , $C_L = 20pF$ , $A_V = 1$ , $R_L = 10k\Omega$		-65		dB
$e_n$	Input Referred Voltage Noise	$f_O = 1kHz$		1		nV/ $\sqrt{Hz}$
$i_n$	Input Referred Current Noise	$f_O = 10kHz$		2.1		pA/ $\sqrt{Hz}$
<b>TRANSIENT RESPONSE</b>						
SR	Slew Rate		30 <b>25</b>	50		V/ $\mu s$
$t_{pd}$	Propagation Delay 10% $V_{IN}$ - 10% $V_{OUT}$	$A_V = 1$ , $V_{OUT} = 100mV_{P-P}$ , $R_F = 0\Omega$ , $C_L = 1.2pF$		1.0		ns
$t_r$ , $t_f$ , Small Signal	Rise Time, $t_r$ 10% to 90%	$A_V = +1$ , $V_{OUT} = 0.1V_{P-P}$ , $R_F = 0\Omega$ , $C_L = 1.2pF$		3.3		ns
	Fall Time, $t_f$ 10% to 90%			6.3		ns
$t_r$ , $t_f$ Large Signal	Rise Time, $t_r$ 10% to 90%	$A_V = +2$ , $V_{OUT} = 1V_{P-P}$ , $R_F = R_G = 499\Omega$ , $R_L = 10k\Omega$ , $C_L = 1.2pF$		44		ns
	Fall Time, $t_f$ 10% to 90%			51		ns
	Rise Time, $t_r$ 10% to 90%	$A_V = +2$ , $V_{OUT} = 4.7V_{P-P}$ , $R_F = R_G = 499\Omega$ , $R_L = 10k\Omega$ , $C_L = 1.2pF$		190		ns
	Fall Time, $t_f$ 10% to 90%			187		ns
$t_s$	Settling Time to 0.1% 90% $V_{OUT}$ to 0.1% $V_{OUT}$	$A_V = 1$ , $V_{OUT} = 1V_{P-P}$ , $R_F = 0\Omega$ , $C_L = 1.2pF$		45		ns
$t_{EN}$	ENABLE to Output Turn-on Delay Time; 10% $\overline{EN}$ - 10% $V_{OUT}$	$A_V = 1$ , $V_{OUT} = 1V_{DC}$ , $R_L = 10k\Omega$ , $C_L = 1.2pF$		330		ns
	ENABLE to Output Turn-off Delay Time; 10% $\overline{EN}$ - 10% $V_{OUT}$	$A_V = 1$ , $V_{OUT} = 0V_{DC}$ , $R_L = 10k\Omega$ , $C_L = 1.2pF$		50		ns

NOTE:

- Parameters with MIN and/or MAX limits are 100% tested at  $+25^\circ C$ , unless otherwise specified. Temperature limits established by characterization and are not production tested.

Mini SO Package Family (MSOP)



MDP0043

MINI SO PACKAGE FAMILY

SYMBOL	MILLIMETERS		TOLERANCE	NOTES
	MSOP8	MSOP10		
A	1.10	1.10	Max.	-
A1	0.10	0.10	±0.05	-
A2	0.86	0.86	±0.09	-
b	0.33	0.23	+0.07/-0.08	-
c	0.18	0.18	±0.05	-
D	3.00	3.00	±0.10	1, 3
E	4.90	4.90	±0.15	-
E1	3.00	3.00	±0.10	2, 3
e	0.65	0.50	Basic	-
L	0.55	0.55	±0.15	-
L1	0.95	0.95	Basic	-
N	8	10	Reference	-

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NOTES:

1. Plastic or metal protrusions of 0.15mm maximum per side are not included.
2. Plastic interlead protrusions of 0.25mm maximum per side are not included.
3. Dimensions "D" and "E1" are measured at Datum Plane "H".
4. Dimensioning and tolerancing per ASME Y14.5M-1994.