

## Dual and Quad Channel Micropower, Single Supply, Rail-to-Rail Input and Output (RRIO) Instrumentation Amplifiers

The ISL28270 and ISL28273 are dual channel micropower instrumentation amplifiers (in-amps) and the ISL28470 is a quad channel in-amp optimized for single supply operation over the +2.4V to +5.5V range.

All three devices feature an Input Range Enhancement Circuit (IREC) which maintains CMRR performance for input voltages equal to the positive supply and down to 50mV above the negative supply rail. The input signal is capable of swinging above the positive supply rail and to 10mV above the negative supply with only a slight degradation of the CMRR performance. The output operation is rail-to-rail.

The ISL28273 is compensated for a minimum gain of 10 or more. For higher gain applications, the ISL28270 and ISL28470 are compensated for a minimum gain of 100. The in-amps have bipolar input devices for best offset and excellent 1/f noise performance. The amplifiers can be operated from one lithium cell or two Ni-Cd batteries.

### Ordering Information

PART NUMBER (Note)	PART MARKING	PACKAGE (Pb-Free)	PKG. DWG. #
ISL28270IAZ	28270 IAZ	16 Ld QSOP	MDP0040
ISL28270IAZ-T13*	28270 IAZ	16 Ld QSOP	MDP0040
ISL28273FAZ	28273 FAZ	16 Ld QSOP	MDP0040
ISL28273FAZ-T7*	28273 FAZ	16 Ld QSOP	MDP0040
ISL28470FAZ	ISL28470 FAZ	28 Ld QSOP	MDP0040
ISL28470FAZ-T7 *	ISL28470 FAZ	28 Ld QSOP	MDP0040
ISL28270INEVAL1Z	Evaluation Platform		
ISL28273INEVAL1Z	Evaluation Platform		
ISL28470EVAL1Z	Evaluation Platform		

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

NOTE: Intersil Pb-free plus anneal products employ special Pb-free material sets; molding compounds/die attach materials and 100% matte tin plate termination finish, which are 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

- 150 $\mu$ V max offset voltage (ISL28270, ISL28470)
- 600 $\mu$ V max offset voltage (ISL28273)
- 2.5nA max input bias current (ISL28270, ISL28470)
- 110dB CMRR
- 0.7 $\mu$ V/ $^{\circ}$ C offset voltage temperature coefficient
- 240kHz -3dB bandwidth (G = 100) ISL28270, ISL28470
- 230kHz -3dB bandwidth (G = 10) ISL28273
- Single supply operation
- Rail-to-rail input and output (RRIO)
- Pb-free plus anneal available (RoHS compliant)

### Applications

- Battery or solar-powered systems
- Strain gauge
- Sensor signal conditioning
- Medical devices
- Industrial instrumentations

### Related Literature

- AN1289, ISL28470EVAL1Z Evaluation Board User's Guide
- AN1290, ISL2827xINEVAL1Z Evaluation Board User's Guide
- AN1298, Instrumentation Amplifier Application Note

# ISL28270, ISL28273, ISL28470

## Absolute Maximum Ratings (T<sub>A</sub> = +25°C)

Supply Voltage	5.5V
Supply Turn On Voltage Slew Rate	1V/μs
Input Current (IN, FB) ISL28270, ISL28470	5mA
Differential Input Voltage (IN, FB) ISL28270, ISL28470	0.5V
Input Current (IN, FB) ISL28273	5mA
Differential Input (IN, FB) Voltage ISL28273	1.0V
Input Voltage	V <sub>-</sub> - 0.5V to V <sub>+</sub> + 0.5V
ESD Rating	
Human Body Model	3kV
Machine Model	300V

## Thermal Information

Thermal Resistance	θ <sub>JA</sub> (°C/W)
16 Ld QSOP Package	112
28 Ld QSOP Package	79
Output Short-Circuit Duration	Indefinite
Ambient Operating Temperature Range	-40°C to +125°C
Storage Temperature Range	-65°C to +150°C
Operating Junction Temperature	+125°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.

**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<sub>J</sub> = T<sub>C</sub> = T<sub>A</sub>

**Electrical Specifications** V<sub>+</sub> = +5V, V<sub>-</sub> = 0V V<sub>CM</sub> = 1/2V<sub>+</sub>, V<sub>EN</sub> = V<sub>-</sub>, R<sub>L</sub> = Open, T<sub>A</sub> = +25°C, unless otherwise specified.  
**Boldface limits apply over the operating temperature range, -40°C to +125°C.**

PARAMETER	DESCRIPTION	CONDITIONS	MIN (Note 1)	TYP	MAX (Note 1)	UNIT
<b>DC SPECIFICATIONS</b>						
V <sub>OS</sub>	Input Offset Voltage	ISL28270, ISL28470	-150 <b>-225</b>	±35	150 <b>225</b>	μV
		ISL28273	-600 <b>-1000</b>	±12	600 <b>1000</b>	μV
TCV <sub>OS</sub>	Input Offset Voltage Temperature Coefficient	Temperature = -40°C to +125°C		0.7		μV/°C
I <sub>OS</sub>	Input Offset Current between IN+ and IN-, and between FB+ and FB-	ISL28270	-1 <b>-1.5</b>	±0.25	1 <b>1.5</b>	nA
		ISL28470	-1.5 <b>-2.0</b>	±0.25	1.5 <b>2</b>	nA
		ISL28273	-1 <b>-1.5</b>	±0.2	1 <b>1.5</b>	nA
I <sub>B</sub>	Input Bias Current (IN+, IN-, FB+, and FB- terminals)	ISL28270	-2.0 <b>-2.5</b>	±0.5	2.0 <b>2.5</b>	nA
		ISL28470	-2.5 <b>-3.0</b>	±0.5	2.5 <b>3.0</b>	nA
		ISL28273	-2.5 <b>-3.0</b>	±1	2.5 <b>3.0</b>	nA
R <sub>IN</sub>	Input Resistance	ISL28270, ISL28470		3		MΩ
		ISL28273		15		MΩ
V <sub>IN</sub>	Input Voltage Range		<b>0</b>		<b>5</b>	V
CMRR	Common Mode Rejection Ratio	ISL28270	V <sub>CM</sub> = 0.05V to 5V	90	110	dB
		ISL28273		<b>85</b>	110	
		ISL28470		90 <b>85</b>	110	
PSRR	Power Supply Rejection Ratio	ISL28270	V <sub>+</sub> = 2.4V to 5V	90	110	dB
		ISL28273		80 <b>75</b>	95	
		ISL28470		90 <b>65</b>	110	

## ISL28270, ISL28273, ISL28470

**Electrical Specifications**  $V_+ = +5V$ ,  $V_- = 0V$   $V_{CM} = 1/2V_+$ ,  $V_{EN} = V_-$ ,  $R_L = \text{Open}$ ,  $T_A = +25^\circ\text{C}$ , unless otherwise specified.  
**Boldface limits apply over the operating temperature range,  $-40^\circ\text{C}$  to  $+125^\circ\text{C}$ . (Continued)**

PARAMETER	DESCRIPTION	CONDITIONS		MIN (Note 1)	TYP	MAX (Note 1)	UNIT
E <sub>G</sub>	Gain Error	ISL28270, ISL28470	R <sub>L</sub> = 100kΩ to V <sub>CM</sub>		+0.5		%
		ISL28273			+0.12		%
V <sub>OUT</sub>	Maximum Voltage Swing	Output low, 100kΩ to 2.5V			4	10	mV
		Output low, 1kΩ to 2.5V			130	250 <b>300</b>	mV
		Output high, 100kΩ to 2.5V		4.990	4.996		V
		Output high, 1kΩ to GND		4.75 <b>4.70</b>	4.88		V
I <sub>S,EN</sub>	Supply Current, Enabled	ISL28270, ISL28273 - Both A and B Channels enabled, $\overline{\text{EN}} = V_-$			120	156 <b>195</b>	μA
		ISL28470 - A, B, C and D Channels enabled, $\overline{\text{EN}} = V_-$			260	335	μA
I <sub>S,DIS</sub>	Supply Current, Disabled	ISL28270, ISL28273- Both A and B Channels disabled, $\overline{\text{EN}} = V_+$			4	7 <b>9</b>	μA
		ISL28470 - A, B, C and D Channels disabled, $\overline{\text{EN}} = V_+$			10	12 <b>15</b>	μA
V <sub>ENH</sub>	$\overline{\text{EN}}$ Pin for Shut-down			<b>2</b>			V
V <sub>ENL</sub>	$\overline{\text{EN}}$ Pin for Power-On					<b>0.8</b>	V
I <sub>ENH</sub>	$\overline{\text{EN}}$ Input Current High	$\overline{\text{EN}} = V_+$			0.8	1 <b>1.3</b>	μA
I <sub>ENL</sub>	$\overline{\text{EN}}$ Input Current Low	$\overline{\text{EN}} = V_-$			26	50 <b>100</b>	nA
V <sub>SUPPLY</sub>	Supply Operating Range	V <sub>+</sub> to V <sub>-</sub> (Note 2)		2.4		5.5	V
I <sub>SC</sub>	Short Circuit Output Current	V <sub>+</sub> = 5V, R <sub>LOAD</sub> = 10Ω		±20 <b>±18</b>	±29		mA
<b>AC SPECIFICATIONS</b>							
SR	Slew Rate	R <sub>L</sub> = 1kΩ to GND, ISL28270, ISL28470		0.3 <b>0.25</b>	0.5	0.7 <b>0.75</b>	V/μs
		R <sub>L</sub> = 1kΩ to GND, ISL28273		0.35 <b>0.3</b>	0.6	0.75 <b>0.8</b>	
-3dB BW	-3dB Bandwidth	ISL28270, ISL28470	Gain = 100		240		kHz
			Gain = 200		84		kHz
			Gain = 500		30		kHz
			Gain = 1000		13		kHz
		ISL28273	Gain = 10		265		kHz
			Gain = 20		100		kHz
			Gain = 50		25		kHz
			Gain = 100		13		kHz
e <sub>N</sub>	Input Noise Voltage	ISL28270, ISL28470	f = 0.1Hz to 10Hz		3.5		μV <sub>P-P</sub>
		ISL28273			3.5		μV <sub>P-P</sub>
	Input Noise Voltage Density	ISL28270, ISL28470	f <sub>0</sub> = 1kHz		60		nV/√Hz
		ISL28273			210		nV/√Hz

# ISL28270, ISL28273, ISL28470

**Electrical Specifications**  $V_+ = +5V$ ,  $V_- = 0V$ ,  $V_{CM} = 1/2V_+$ ,  $V_{EN} = V_-$ ,  $R_L = \text{Open}$ ,  $T_A = +25^\circ\text{C}$ , unless otherwise specified.  
**Boldface limits apply over the operating temperature range,  $-40^\circ\text{C}$  to  $+125^\circ\text{C}$ . (Continued)**

PARAMETER	DESCRIPTION	CONDITIONS		MIN (Note 1)	TYP	MAX (Note 1)	UNIT
$i_N$	Input Noise Current Density	ISL28270, ISL28470	$f_o = 1\text{kHz}$		0.37		pA/ $\sqrt{\text{Hz}}$
		ISL28273			0.75		pA/ $\sqrt{\text{Hz}}$
CMRR @ 60Hz	Input Common Mode Rejection Ratio	ISL28270, ISL28470	$V_{CM} = 1V_{P-P}$ $R_L = 10k\Omega$ to $V_{CM}$		100		dB
		ISL28273			83		
PSRR+ @ 120Hz	Power Supply Rejection Ratio ( $V_+$ )	ISL28270, ISL28470	$V_+, V_- = \pm 1.2V, \pm 2.5V$ , $V_{SOURCE} = 1V_{P-P}$ $R_L = 10k\Omega$ to $V_{CM}$		96		dB
		ISL28273			77		dB
PSRR- @ 120Hz	Power Supply Rejection Ratio ( $V_-$ )	ISL28270, ISL28470	$V_+, V_- = \pm 1.2V, \pm 2.5V$ , $V_{SOURCE} = 1V_{P-P}$ $R_L = 10k\Omega$ to $V_{CM}$		105		dB
		ISL28273			84		dB

NOTE:

- Parts are 100% tested at  $+25^\circ\text{C}$ . Over temperature limits established by characterization and are not production tested.
- $V_{SUPPLY} = +5.25V$  max when  $V_{ENL} = +V$  (device in disable state).

**Typical Performance Curves**  $V_+ = +5V$ ,  $V_- = 0V$ ,  $V_{CM} = 1/2V_+$ ,  $V_{EN} = V_-$ ,  $R_L = \text{Open}$ ,  $T_A = +25^\circ\text{C}$ , unless otherwise specified.

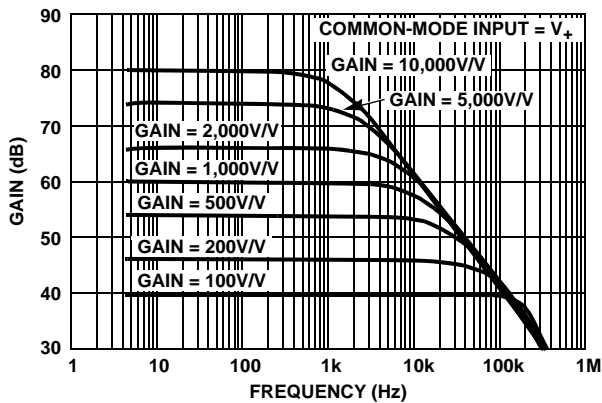


FIGURE 1. ISL28270, ISL28470 FREQUENCY RESPONSE vs CLOSED LOOP GAIN,  $V_{CM} = V_+ = 5V$

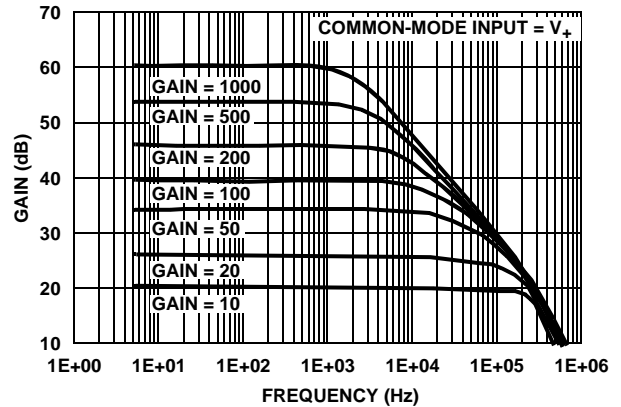


FIGURE 2. ISL28273 FREQUENCY RESPONSE vs CLOSED LOOP GAIN,  $V_{CM} = V_+ = 5V$

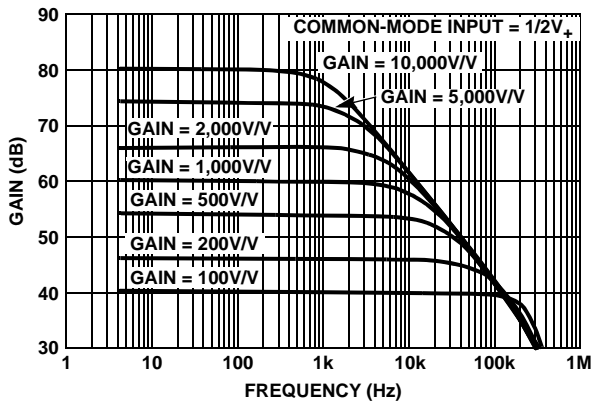


FIGURE 3. ISL28270, ISL28470 FREQUENCY RESPONSE vs CLOSED LOOP GAIN.  $V_+ = 5V$ ,  $V_{CM} = 1/2V_+$

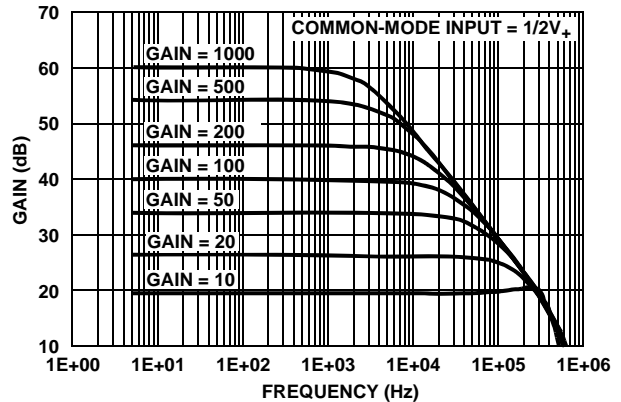
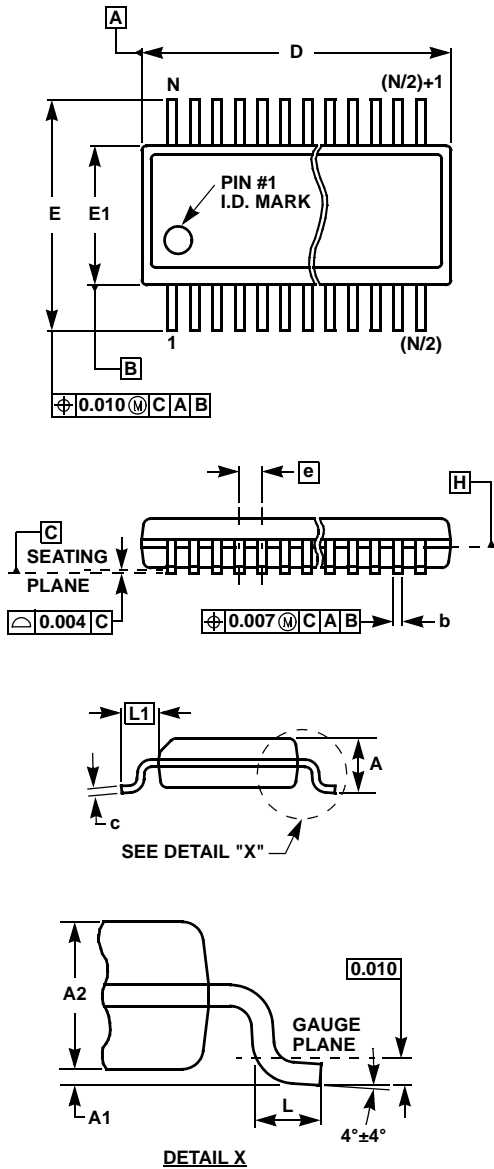


FIGURE 4. ISL28273 FREQUENCY RESPONSE vs CLOSED LOOP GAIN.  $V_+ = 5V$ ,  $V_{CM} = 1/2V_+$

Quarter Size Outline Plastic Packages Family (QSOP)



MDP0040

QUARTER SIZE OUTLINE PLASTIC PACKAGES FAMILY

SYMBOL	INCHES			TOLERANCE	NOTES
	QSOP16	QSOP24	QSOP28		
A	0.068	0.068	0.068	Max.	-
A1	0.006	0.006	0.006	±0.002	-
A2	0.056	0.056	0.056	±0.004	-
b	0.010	0.010	0.010	±0.002	-
c	0.008	0.008	0.008	±0.001	-
D	0.193	0.341	0.390	±0.004	1, 3
E	0.236	0.236	0.236	±0.008	-
E1	0.154	0.154	0.154	±0.004	2, 3
e	0.025	0.025	0.025	Basic	-
L	0.025	0.025	0.025	±0.009	-
L1	0.041	0.041	0.041	Basic	-
N	16	24	28	Reference	-

Rev. F 2/07

NOTES:

1. Plastic or metal protrusions of 0.006" maximum per side are not included.
2. Plastic interlead protrusions of 0.010" 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.