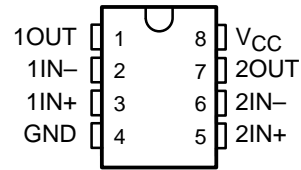


LM158, LM258, LM358, LM158A LM258A, LM358A, LM358Y, LM2904, LM2904Q DUAL OPERATIONAL AMPLIFIERS

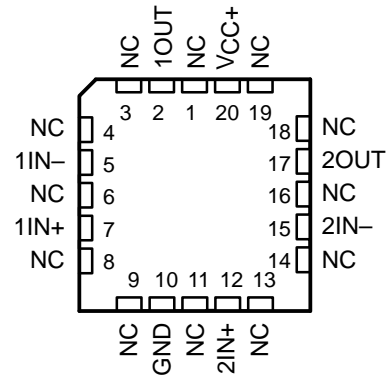
SLOS068 – JUNE 1976 – REVISED JULY 1991

- **Wide Range of Supply Voltages:**
Single Supply . . . 3 V to 30 V
(LM2904 and LM2904Q
3 V to 26 V) or Dual Supplies
- **Low Supply Current Drain Independent of Supply Voltage . . . 0.7 mA Typ**
- **Common-Mode Input Voltage Range Includes Ground Allowing Direct Sensing Near Ground**
- **Low Input Bias and Offset Parameters:**
Input Offset Voltage . . . 3 mV Typ
A Versions . . . 2 mV Typ
Input Offset Current . . . 2 nA Typ
Input Bias Current . . . 20 nA Typ
A Versions . . . 15 nA Typ
- **Differential Input Voltage Range Equal to Maximum-Rated Supply Voltage . . . ± 32 V (± 26 V for LM2904 and LM2904Q)**
- **Open-Loop Differential Voltage Amplification . . . 100 V/mV Typ**
- **Internal Frequency Compensation**

D, DB, JG, P, OR PW PACKAGE
(TOP VIEW)

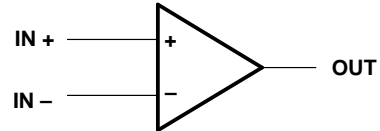


LM158, LM158A . . . FK PACKAGE
(TOP VIEW)



NC – No internal connection

symbol (each amplifier)



description

These devices consist of two independent, high-gain, frequency-compensated operational amplifiers that were designed specifically to operate from a single supply over a wide range of voltages. Operation from split supply is also possible so long as the difference between the two supplies is 3 V to 30 V (3 V to 26 V for the LM2904 and LM2904Q), and V_{CC} is at least 1.5 V more positive than the input common-mode voltage. The low supply current drain is independent of the magnitude of the supply voltage.

Applications include transducer amplifiers, dc amplification blocks, and all the conventional operational amplifier circuits that now can be more easily implemented in single-supply-voltage systems. For example, these devices can be operated directly off of the standard 5-V supply that is used in digital systems and will easily provide the required interface electronics without requiring additional ± 5 -V supplies.

The LM2904Q is manufactured to demanding automotive requirements.

The LM158 and LM158A are characterized for operation over the full military temperature range of -55°C to 125°C . The LM258 and LM258A are characterized for operation from -25°C to 85°C , the LM358 and LM358A from 0°C to 70°C , and the LM2904 and LM2904Q from -40°C to 105°C .

LM158, LM258, LM358, LM158A LM258A, LM358A, LM358Y, LM2904, LM2904Q DUAL OPERATIONAL AMPLIFIERS

SLOS068 – JUNE 1976 – REVISED JULY 1991

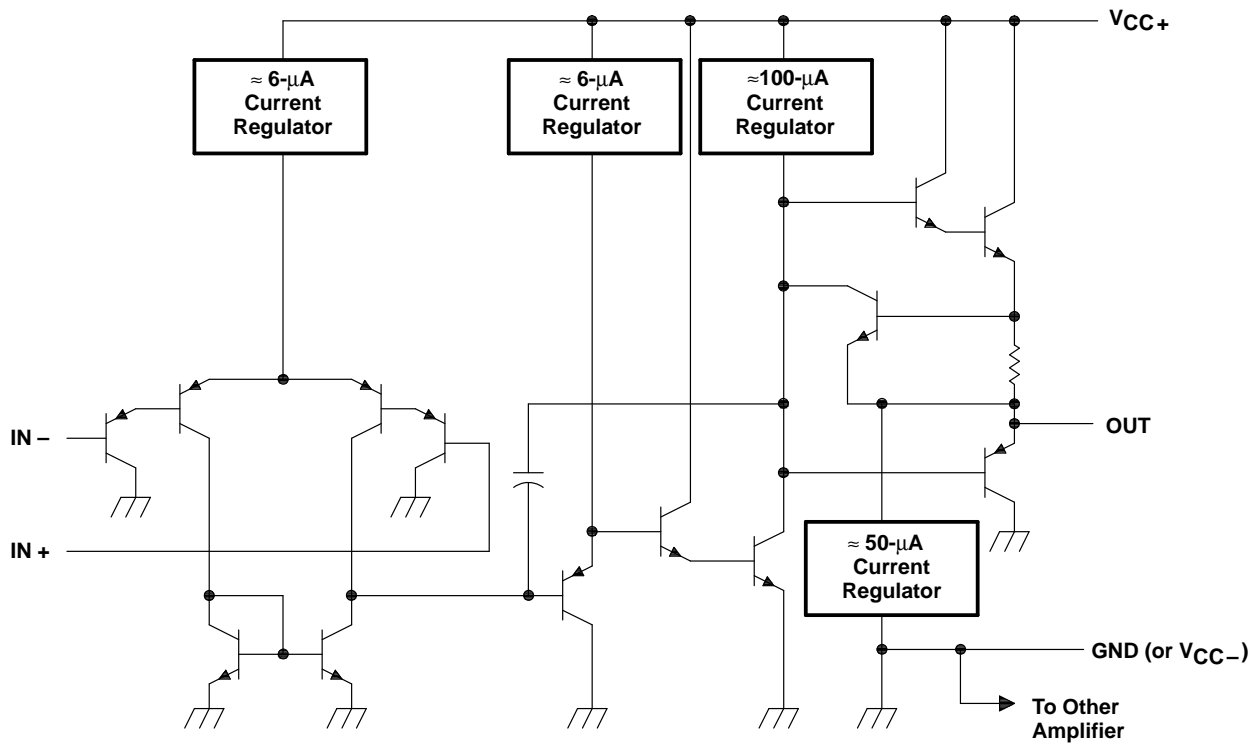
AVAILABLE OPTIONS

T _A	V _{IO} max AT 25°C	PACKAGED DEVICES						CHIP FORM (Y)
		SMALL OUTLINE (D) [†]	SSOP (DB) [‡]	CHIP CARRIER (FK)	CERAMIC DIP (JG)	PLASTIC DIP (P)	TSSOP (PW) [‡]	
0°C to 70°C	7 mV 3 mV	LM358D	LM358DB			LM358P LM358AP	LM358PW	LM358Y
-25°C to 85°C	5 mV 3 mV	LM258D				LM258P LM258AP		
-40°C to 105°C	7 mV	LM2904D LM2904QD	LM2904DB —			LM2904P LM2904QP	LM2904PW —	
-55°C to 125°C	5 mV 2 mV	LM158D		LM158FK LM158AFK	LM158JG LM158AJG	LM158P		

[†] The D package is available taped and reeled. Add the suffix R to the device type (e.g., LM358DR).

[‡] The DB and PW packages are only available left-end taped and reeled. Add the suffix LE to the device type (e.g., LM358DBLE).

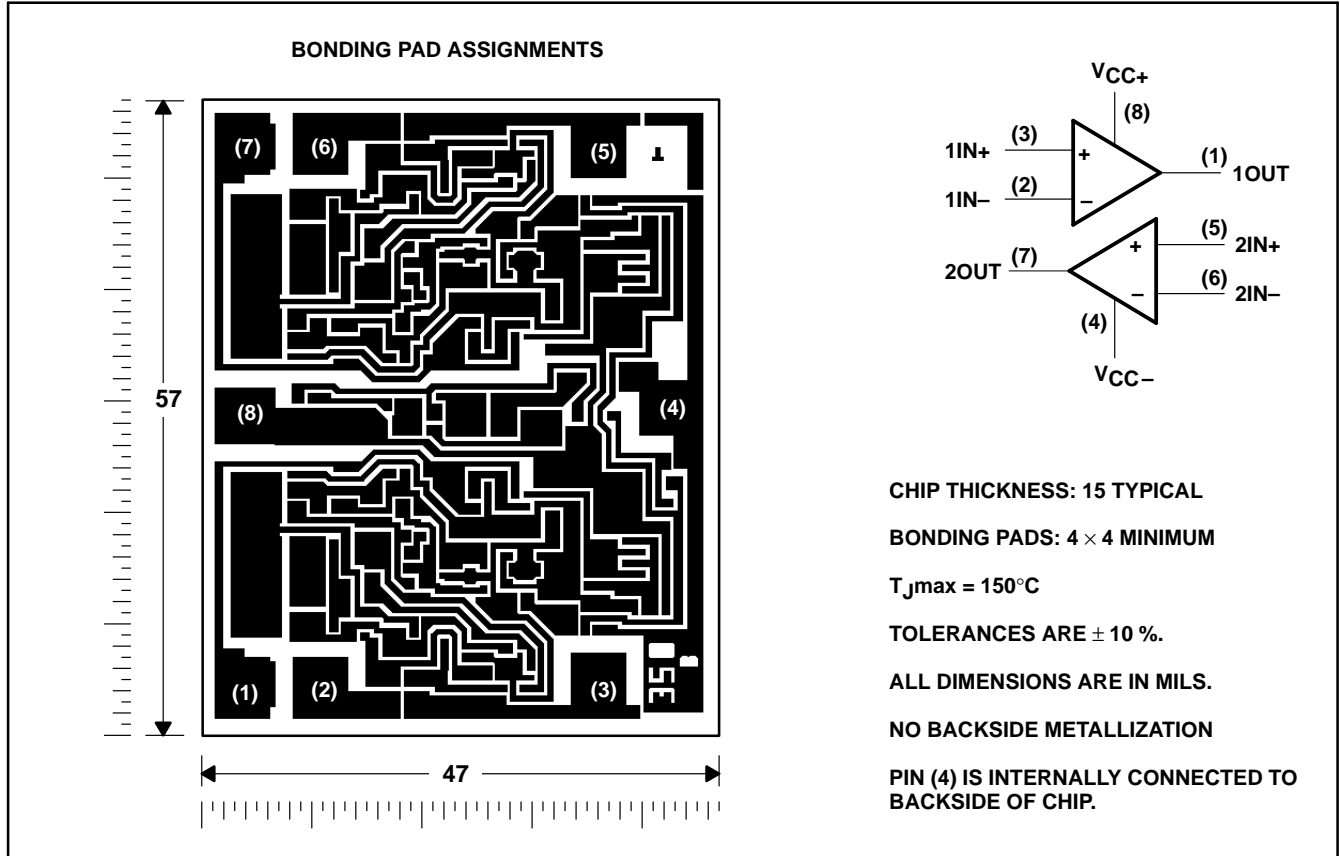
schematic (each amplifier)



COMPONENT COUNT	
Epi-FET	1
Diodes	2
Resistors	7
Transistors	51
Capacitors	2

LM358Y chip information

These chips, when properly assembled, display characteristics similar to the LM358. Thermal compression or ultrasonic bonding may be used on the doped-aluminum bonding pads. Chips may be mounted with conductive epoxy or a gold-silicon preform.



**LM158, LM258, LM358, LM158A
LM258A, LM358A, LM358Y, LM2904, LM2904Q
DUAL OPERATIONAL AMPLIFIERS**

SLOS068 – JUNE 1976 – REVISED JULY 1991

absolute maximum ratings over operating free-air temperature range (unless otherwise noted)

		LM158, LM158A LM258, LM258A LM358, LM358A	LM2904, LM2904Q	UNIT
Supply voltage V_{CC} (see Note 1)		32	26	V
Differential input voltage (see Note 2)		± 32	± 26	V
Input voltage (either input)		0.3 to 32	0.3 to 26	V
Duration of output short circuit (one amplifier) to ground at (or below) 25°C free-air temperature ($V_{CC} \leq 15$ V) (see Note 3)		unlimited	unlimited	
Continuous total dissipation		See Dissipation Rating Table		
Operating free-air temperature range	LM158, LM158A	-55 to 125		°C
	LM258, LM258A	-25 to 85		
	LM358, LM358A	0 to 70		
	LM2904, LM2904Q		-40 to 105	
Storage temperature range		-65 to 150	-65 to 150	°C
Case temperature for 60 seconds	FK package	260		°C
Lead temperature 1,6 mm (1/16 inch) from case for 60 seconds	JG package	300	300	°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds	D, DB, P, or PW package	260	260	°C

- NOTES: 1. All voltage values, except differential voltages and V_{CC} specified for measurement of I_{OS} , are with respect to the network ground terminal.
 2. Differential voltages are at $IN+$ with respect to $IN-$.
 3. Short circuits from outputs to V_{CC} can cause excessive heating and eventual destruction.

DISSIPATION RATING TABLE

PACKAGE	$T_A \leq 25^\circ\text{C}$ POWER RATING	DERATING FACTOR ABOVE $T_A = 25^\circ\text{C}$	$T_A = 70^\circ\text{C}$ POWER RATING	$T_A = 85^\circ\text{C}$ POWER RATING	$T_A = 125^\circ\text{C}$ POWER RATING
D	725 mW	5.8 mW/°C	464 mW	377 mW	145 mW
DB	525 mW	4.2 mW/°C	336 mW	273 mW	–
FK	1375 mW	11.0 mW/°C	880 mW	715 mW	275 mW
JG	1050 mW	8.4 mW/°C	672 mW	546 mW	210 mW
P	1000 mW	8.0 mW/°C	640 mW	520 mW	200 mW
PW	525 mW	4.2 mW/°C	336 mW	273 mW	–

LM158, LM258, LM358, LM2904, LM2904Q
LM258A, LM358A, LM358Y, LM2904, LM2904Q
DUAL OPERATIONAL AMPLIFIERS

SLOS068 – JUNE 1976 – REVISED JULY 1991

electrical characteristics at specified free-air temperature, $V_{CC} = 5\text{ V}$ (unless otherwise noted)

PARAMETER	TEST CONDITION†	LM158, LM258			LM358			LM2904, LM2904Q			UNIT
		MIN	TYP‡	MAX	MIN	TYP‡	MAX	MIN	TYP‡	MAX	
V_{IO} Input offset voltage	$V_{CC} = 5\text{ V to MAX}$, $V_{IC} = V_{ICR\text{min}}$, $V_O = 1.4\text{ V}$	25°C	3	5	3	7	3	7	3	7	mV
		Full range		7		9		10		10	
α_{VIO} Average temperature coefficient of input offset voltage	Full range		7			7			7		$\mu\text{V}/^\circ\text{C}$
I_{IO} Input offset current	$V_O = 1.4\text{ V}$	25°C	2	30	2	50	2	50	2	50	nA
		Full range		100		150		200		200	
α_{IIO} Average temperature coefficient of input offset current	Full range		10			10			10		$\text{pA}/^\circ\text{C}$
		25°C	-20	-150	-20	-250	-20	-250	-20	-250	nA
I_{IB} Input bias current	$V_O = 1.4\text{ V}$	Full range		-300		-500		-500		-500	nA
		25°C	0 to $V_{CC}-1$		0 to $V_{CC}-1$		0 to $V_{CC}-1$		0 to $V_{CC}-1$		
V_{ICR} Common-mode input voltage range	$V_{CC} = 5\text{ V to MAX}$	25°C	0 to $V_{CC}-1$		0 to $V_{CC}-1$		0 to $V_{CC}-1$		0 to $V_{CC}-1$		V
		Full range	0 to $V_{CC}-2$		0 to $V_{CC}-2$		0 to $V_{CC}-2$		0 to $V_{CC}-2$		
V_{OH} High-level output voltage	$R_L \geq 2\text{ k}\Omega$	25°C									V
		Full range	26		26		26		26		
		25°C	27	28	27	28	27	28	23	24	
V_{OL} Low-level output voltage	$R_L \leq 10\text{ k}\Omega$	25°C	5	20	5	20	5	20	5	100	mV
		Full range									
A _{VD} Large-signal differential voltage amplification	$V_{CC} = 15\text{ V}$, $V_O = 1\text{ V to }11\text{ V}$, $R_L = \geq 2\text{ k}\Omega$	25°C	50	100	25	100	25	100	100		V/mV
		Full range	25		15		15		15		
CMRR Common-mode rejection ratio	$V_{CC} = 5\text{ V to MAX}$, $V_{IC} = V_{ICR\text{min}}$	25°C	70	80	65	80	65	80	50	80	dB
k _{SVR} Supply-voltage rejection ratio ($\Delta V_{DD}/\Delta V_{IO}$)	$V_{CC} = 5\text{ V to MAX}$	25°C	65	100	65	100	65	100	65	100	dB
V_{O1}/V_{O2} Crosstalk attenuation	$f = 1\text{ kHz to }20\text{ kHz}$	25°C	120		120		120		120		dB

† All characteristics are measured under open-loop conditions with zero common-mode input voltage unless otherwise specified. MAX V_{CC} for testing purposes is 26 V for LM2904 and 30 V for others. Full range is -55°C to 125°C for LM158, -25°C to 85°C for LM258, 0°C to 70°C for LM358, and -40°C to 85°C for LM2904 and LM2904Q.
‡ All typical values are at $T_A = 25^\circ\text{C}$.



LM158, LM258, LM358, LM2904, LM2904Q
 LM258A, LM358A, LM358Y, LM2904, LM2904Q

DUAL OPERATIONAL AMPLIFIERS

SLOS068 – JUNE 1976 – REVISED JULY 1991

electrical characteristics at specified free-air temperature, $V_{CC} = 5\text{ V}$ (unless otherwise noted) (continued)

PARAMETER	TEST CONDITION†	LM158, LM258		LM358		LM2904, LM2904Q		UNIT
		MIN	TYP‡	MAX	MIN	TYP‡	MAX	
I_O Output current	$V_{CC} = 15\text{ V}$, $V_{ID} = 1\text{ V}$, $V_O = 0$	-20	-30	-20	-30	-20	-30	mA
	Full range	-10	-10	-10	-10	-10	-10	
	$V_{CC} = 15\text{ V}$, $V_{ID} = -1\text{ V}$, $V_O = 15\text{ V}$	10	20	10	20	10	20	
I_{OS} Short-circuit output current	Full range	5	5	5	5	5	5	mA
	$V_{ID} = -1\text{ V}$, $V_O = 200\text{ mV}$	12	30	12	30	12	30	
I_{CC} Supply current (two amplifiers)	V_{CC} at 5 V, GND at -5 V, $V_O = 0$	± 40	± 60	± 40	± 60	± 40	± 60	mA
	Full range	0.7	1.2	0.7	1.2	0.7	1.2	
I_{CC} Supply current (two amplifiers)	$V_O = 2.5\text{ V}$, No load	1	2	1	2	1	2	mA
	Full range	0.7	1.2	0.7	1.2	0.7	1.2	

† All characteristics are measured under open-loop conditions with zero common-mode input voltage unless otherwise specified. MAX V_{CC} for testing purposes is 26 V for LM2904 and 30 V for others. Full range is -55°C to 125°C for LM158, -25°C to 85°C for LM258, 0°C to 70°C for LM358, and -40°C to 85°C for LM2904 and LM2904Q.
 ‡ All typical values are at $T_A = 25^\circ\text{C}$.



LM158, LM258, LM358, LM2904, LM2904Q
LM258A, LM358A, LM358Y, LM2904, LM2904Q
DUAL OPERATIONAL AMPLIFIERS

SLOS068 – JUNE 1976 – REVISED JULY 1991

electrical characteristics at specified free-air temperature, $V_{CC} = 5\text{ V}$ (unless otherwise noted)

PARAMETER	TEST CONDITION [†]	LM158A			LM258A			LM359A			UNIT
		MIN	TYP [‡]	MAX	MIN	TYP [‡]	MAX	MIN	TYP [‡]	MAX	
V_{IO} Input offset voltage	$V_{CC} = 5\text{ V to }30\text{ V}$, $V_{IC} = V_{ICRmin}$, $V_O = 1.4\text{ V}$	25°C		2	2	3		2	2	3	mV
		Full range		4		4				5	
α_{VIO} Average temperature coefficient of input offset voltage	Full range	25°C	7	15	7	15	7	15	7	20	$\mu\text{V}/^\circ\text{C}$
		Full range	2	10	2	15	2	30	2	30	
I_{IO} Input offset current	$V_O = 1.4\text{ V}$	25°C		10	10	200		10	10	300	pA/°C
		Full range		30		30				75	
α_{IIO} Average temperature coefficient of input offset current	Full range	25°C	-15	-50	-15	-80	-15	-80	-15	-100	nA
		Full range		-100		-100				-200	
I_{IB} Input bias current	$V_O = 1.4\text{ V}$	25°C	0 to V_{CC-1}		0 to $V_{CC-1.5}$		0 to $V_{CC-1.5}$		0 to $V_{CC-1.5}$		V
		Full range	0 to V_{CC-2}		0 to V_{CC-2}		0 to V_{CC-2}		0 to V_{CC-2}		
V_{ICR} Common-mode input voltage range	$V_{CC} = 30\text{ V}$	25°C									V
		Full range									
V_{OH} High-level output voltage	$R_L \geq 2\text{ k}\Omega$	25°C	26		26		26		26		V
		Full range	27	28	27	28	27	28	27	28	
V_{OL} Low-level output voltage	$R_L \leq 10\text{ k}\Omega$	25°C	5	20	5	20	5	20	5	100	mV
		Full range	50	100	50	100	50	100	25	100	
A _V D Large-signal differential voltage amplification	$V_{CC} = 15\text{ V}$, $V_O = 1\text{ V to }11\text{ V}$, $R_L = \geq 2\text{ k}\Omega$	25°C	25		25		25		15		V/mV
		Full range	70	80	70	80	70	80	65	80	
CMRR Common-mode rejection ratio		25°C	65	100	65	100	65	100	65	100	dB
kSVR Supply-voltage rejection ratio ($\Delta V_{DD}/\Delta V_{IO}$)		25°C	120		120		120		120		dB
V_{O1}/V_{O2} Crosstalk attenuation	$f = 1\text{ kHz to }20\text{ kHz}$	25°C									dB

[†] All characteristics are measured under open-loop conditions with zero common-mode input voltage unless otherwise specified. Full range is -55°C to 125°C for LM158A, -25°C to 85°C for LM258A, and 0°C to 70°C for LM358A.

[‡] All typical values are at $T_A = 25^\circ\text{C}$.



LM158, LM258, LM358, LM2904, LM2904Q
 LM258A, LM358A, LM358Y, LM2904, LM2904Q
 DUAL OPERATIONAL AMPLIFIERS

SLOS068 – JUNE 1976 – REVISED JULY 1991

electrical characteristics at specified free-air temperature, $V_{CC} = 5\text{ V}$ (unless otherwise noted) (continued)

PARAMETER	TEST CONDITION [†]	LM158A			LM258A			LM359A			UNIT	
		MIN	TYP [‡]	MAX	MIN	TYP [‡]	MAX	MIN	TYP [‡]	MAX		
I_O Output current	$V_{CC} = 15\text{ V}$, $V_{ID} = 1\text{ V}$, $V_O = 0$	25°C	-20	-30	-60	-20	-30	-60	-20	-30	-60	mA
		Full range	-10			-10			-10			
		25°C	10	20		10	20		10	20		
I_{OS} Short-circuit output current	$V_{CC} = 15\text{ V}$, $V_{ID} = -1\text{ V}$, $V_O = 15\text{ V}$	25°C	5			5			5			mA
		Full range										
		25°C	12	30		12	30		12	30		
I_{CC} Supply current (two amplifiers)	$V_{ID} = -1\text{ V}$, $V_O = 200\text{ mV}$ V_{CC} at 5 V, GND at -5 V, $V_O = 0$	25°C	±40	±60		±40	±60		±40	±60		mA
		Full range	0.7	1.2		0.7	1.2		0.7	1.2		
		Full range	1	2		1	2		1	2		

[†] All characteristics are measured under open-loop conditions with zero common-mode input voltage unless otherwise specified. Full range is -55°C to 125°C for LM158A, -25°C to 85°C for LM258A, and 0°C to 70°C for LM358A.

[‡] All typical values are at $T_A = 25^\circ\text{C}$.

LM158, LM258, LM358, LM158A
LM258A, LM358A, LM358Y, LM2904, LM2904Q
DUAL OPERATIONAL AMPLIFIERS

SLOS088 – JUNE 1976 – REVISED JULY 1991

electrical characteristics $V_{CC} = 5\text{ V}$, $T_A = 25^\circ\text{C}$ (unless otherwise noted)

PARAMETER	TEST CONDITIONST	LM358Y			UNIT
		MIN	TYP	MAX	
V_{IO} Input offset voltage	$V_{CC} = 5\text{ V to MAX}$, $V_{IC} = V_{ICRmin}$, $V_O = 1.4\text{ V}$		3	7	mV
I_{IO} Input offset current			2	50	nA
I_{IB} Input bias current			-20	-250	nA
V_{ICR} Common-mode input voltage range	$V_{CC} = 5\text{ V to MAX}$	0 to $V_{CC}-1.5$			V
V_{OH+} High-level output voltage	$R_L \geq 10\text{ k}\Omega$	$V_{CC}-1.5$			V
A_{VD} Large-signal differential voltage amplification	$V_{CC} = 15\text{ V}$, $V_O = 1\text{ V to }11\text{ V}$, $R_L = \geq 2\text{ k}\Omega$	15	100		V/mV
CMRR Common-mode rejection ratio	$V_{IC} = V_{ICR}\text{ min}$	65	80		dB
k_{SVR} Supply-voltage rejection ratio ($\Delta V_{CC\pm}/\Delta V_{IO}$)		65	100		dB
I_O Output current	$V_{CC} = 15\text{ V}$, $V_{ID} = 1\text{ V}$, $V_O = 0$	-20	-30	-60	mA
	$V_{CC} = 15\text{ V}$, $V_{ID} = -1\text{ V}$, $V_O = 15\text{ V}$	10	20		
	$V_{ID} = 1\text{ V}$, $V_O = 200\text{ mV}$	12	30		
I_{OS} Short-circuit output current	V_{CC} at 5 V, GND at -5 V, $V_O = 0$		± 40	± 60	mA
I_{CC} Supply current (four amplifiers)	$V_O = 2.5\text{ V}$, No load		0.7	1.2	mA
	$V_{CC} = \text{MAX}$, $V_O = 0.5\text{ V}$, No load		1	2	

† All characteristics are measured under open-loop conditions with zero common-mode input voltage unless otherwise specified. MAX V_{CC} for testing purposes is 30 V.



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