LM258, LM358, LM358A, LM2904, LM2904A, LM2904V, NCV2904, NCV2904V

Single Supply Dual Operational Amplifiers

Utilizing the circuit designs perfected for Quad Operational Amplifiers, these dual operational amplifiers feature low power drain, a common mode input voltage range extending to ground/V_{EE}, and single supply or split supply operation. The LM358 series is equivalent to one−half of an LM324.

These amplifiers have several distinct advantages over standard operational amplifier types in single supply applications. They can operate at supply voltages as low as 3.0 V or as high as 32 V, with quiescent currents about one−fifth of those associated with the MC1741 (on a per amplifier basis). The common mode input range includes the negative supply, thereby eliminating the necessity for external biasing components in many applications. The output voltage range also includes the negative power supply voltage.

Features

- Short Circuit Protected Outputs
- True Differential Input Stage
- Single Supply Operation: 3.0 V to 32 V
- Low Input Bias Currents
- Internally Compensated
- Common Mode Range Extends to Negative Supply
- Single and Split Supply Operation
- ESD Clamps on the Inputs Increase Ruggedness of the Device without Affecting Operation
- NCV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC−Q100 Qualified and PPAP Capable
- These Devices are Pb−Free, Halogen Free/BFR Free and are RoHS Compliant

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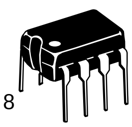
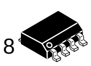


1

PDIP−8
N, AN, VN SUFFIX
CASE 626

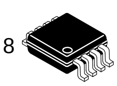
8



1

SOIC−8
D, VD SUFFIX
CASE 751

8



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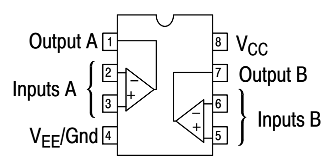
Micro8™
DMR2 SUFFIX
CASE 846A

PIN CONNECTIONS



(Top View)

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 10 of this data sheet.

DEVICE MARKING INFORMATION

See general marking information in the device marking section on page 11 of this data sheet.

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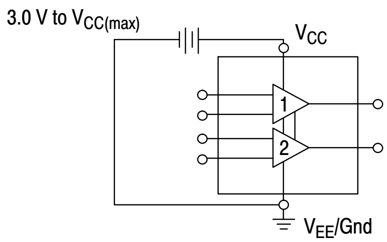
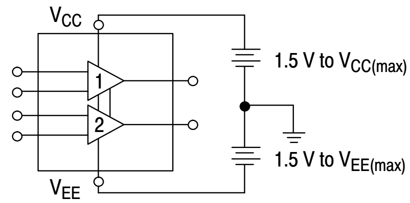
January, 2015 − Rev. 28
Publication Order Number:
LM358/D



Single Supply



Split Supplies

Figure 1.

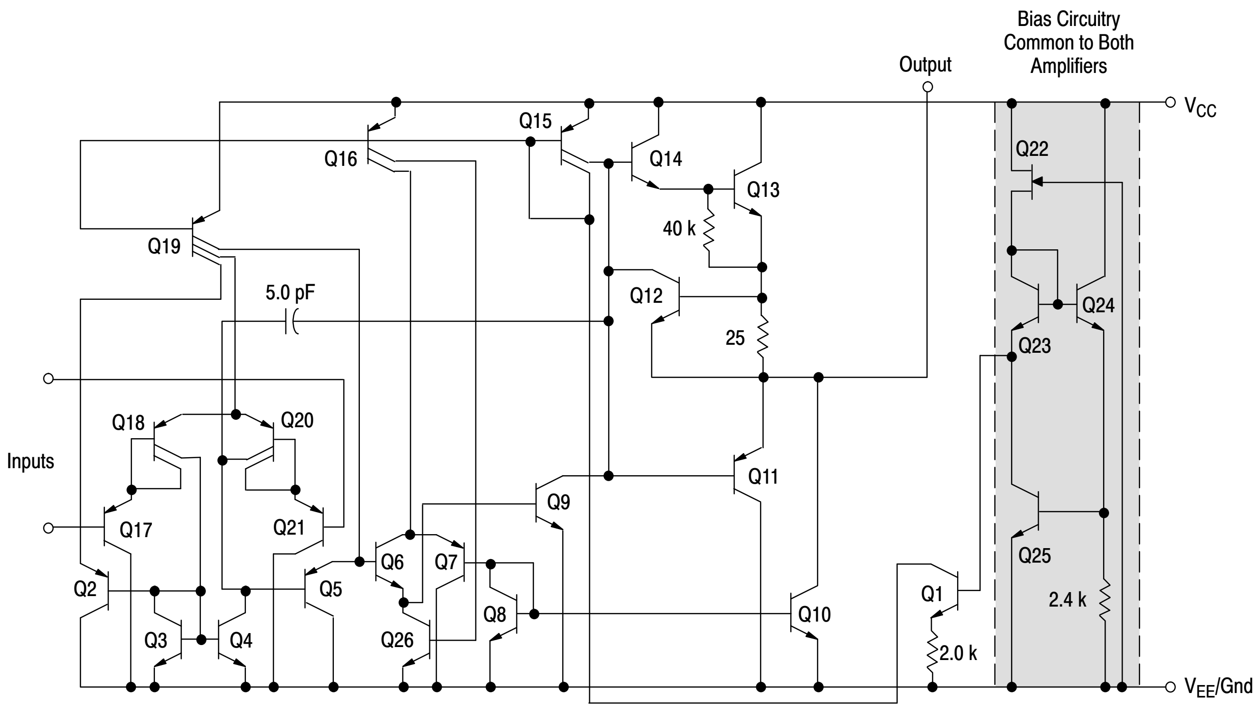


Figure 2. Representative Schematic Diagram
(One−Half of Circuit Shown)

MAXIMUM RATINGS (T_A = +25°C, unless otherwise noted.)

Rating		Symbol	Value	Unit
Power Supply Voltages Single Supply Split Supplies		 V_{CC} V_{CC}, V_{EE}	 32 ±16	Vdc
Input Differential Voltage Range (Note 1)		V_{IDR}	±32	Vdc
Input Common Mode Voltage Range		V_{ICR}	−0.3 to 32	Vdc
Output Short Circuit Duration		t_{SC}	Continuous	
Junction Temperature		T_J	150	°C
Thermal Resistance, Junction−to−Air (Note 2)	Case 846A Case 751 Case 626	$R_{\theta JA}$	238 212 161	°C/W
Storage Temperature Range		T_{stg}	−65 to +150	°C
ESD Protection at any Pin Human Body Model Machine Model		V_{esd}	 2000 200	V
Operating Ambient Temperature Range	 LM258 LM358, LM358A LM2904/LM2904A LM2904V, NCV2904 (Note 3) NCV2904V (Note 3)	T_A	 −25 to +85 0 to +70 −40 to +105 −40 to +125 −40 to +150	°C

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. Split Power Supplies.
2. All $R_{\theta JA}$ measurements made on evaluation board with 1 oz. copper traces of minimum pad size. All device outputs were active.
3. *NCV2904 and NCV2904V are qualified for automotive use.*

ELECTRICAL CHARACTERISTICS (V_{CC} = 5.0 V, V_{EE} = GND, T_A = 25°C, unless otherwise noted.)

Characteristic	Symbol	LM258			LM358			LM358A			Unit
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
Input Offset Voltage V_{CC} = 5.0 V to 30 V, V_{IC} = 0 V to V_{CC} −1.7 V, V_O ≃ 1.4 V, R_S = 0 Ω T_A = 25°C $T_A = T_{high}$ (Note 4) $T_A = T_{low}$ (Note 4)	V_{IO}	 − − −	 2.0 − −	 5.0 7.0 7.0	 − − −	 2.0 − −	 7.0 9.0 9.0	 − − −	 2.0 − −	 3.0 5.0 5.0	mV
Average Temperature Coefficient of Input Offset Voltage $T_A = T_{high}$ to T_{low} (Note 4)	$\Delta V_{IO}/\Delta T$	−	7.0	−	−	7.0	−	−	7.0	−	μV/°C
Input Offset Current $T_A = T_{high}$ to T_{low} (Note 4) Input Bias Current $T_A = T_{high}$ to T_{low} (Note 4)	I_{IO} I_{IB}	− − − −	3.0 − −45 −50	30 100 −150 −300	− − − −	5.0 − −45 −50	50 150 −250 −500	− − − −	5.0 − −45 −50	30 75 −100 −200	nA
Average Temperature Coefficient of Input Offset Current $T_A = T_{high}$ to T_{low} (Note 4)	$\Delta I_{IO}/\Delta T$	−	10	−	−	10	−	−	10	−	pA/°C
Input Common Mode Voltage Range (Note 5), V_{CC} = 30 V V_{CC} = 30 V, $T_A = T_{high}$ to T_{low}	V_{ICR}	0 0	− −	28.3 28	0 0	− −	28.3 28	0 0	− −	28.5 28	V
Differential Input Voltage Range	V_{IDR}	−	−	V_{CC}	−	−	V_{CC}	−	−	V_{CC}	V
Large Signal Open Loop Voltage Gain R_L = 2.0 kΩ, V_{CC} = 15 V, For Large V_O Swing, $T_A = T_{high}$ to T_{low} (Note 4)	A_{VOL}	 50 25	 100 −	 − −	 25 15	 100 −	 − −	 25 15	 100 −	 − −	V/mV
Channel Separation 1.0 kHz ≤ f ≤ 20 kHz, Input Referenced	CS	−	−120	−	−	−120	−	−	−120	−	dB
Common Mode Rejection R_S ≤ 10 kΩ	CMR	70	85	−	65	70	−	65	70	−	dB
Power Supply Rejection	PSR	65	100	−	65	100	−	65	100	−	dB
Output Voltage−High Limit $T_A = T_{high}$ to T_{low} (Note 4) V_{CC} = 5.0 V, R_L = 2.0 kΩ, T_A = 25°C V_{CC} = 30 V, R_L = 2.0 kΩ V_{CC} = 30 V, R_L = 10 kΩ	V_{OH}	 3.3 26 27	 3.5 − 28	 − − −	 3.3 26 27	 3.5 − 28	 − − −	 3.3 26 27	 3.5 − 28	 − − −	V
Output Voltage−Low Limit V_{CC} = 5.0 V, R_L = 10 kΩ, $T_A = T_{high}$ to T_{low} (Note 4)	V_{OL}	−	5.0	20	−	5.0	20	−	5.0	20	mV
Output Source Current V_{ID} = +1.0 V, V_{CC} = 15 V $T_A = T_{high}$ to T_{low} (LM358A Only)	I_{O+}	 20	 40	 −	 20	 40	 −	 20 10	 40 −	 − −	mA
Output Sink Current V_{ID} = −1.0 V, V_{CC} = 15 V $T_A = T_{high}$ to T_{low} (LM358A Only) V_{ID} = −1.0 V, V_O = 200 mV	I_{O-}	 10 12	 20 50	 − −	 10 12	 20 50	 − −	 10 5.0 12	 20 − 50	 − − −	 mA mA μA
Output Short Circuit to Ground (Note 6)	I_{SC}	−	40	60	−	40	60	−	40	60	mA
Power Supply Current (Total Device) $T_A = T_{high}$ to T_{low} (Note 4) V_{CC} = 30 V, V_O = 0 V, R_L = ∞ V_{CC} = 5 V, V_O = 0 V, R_L = ∞	I_{CC}	 − −	 1.5 0.7	 3.0 1.2	 − −	 1.5 0.7	 3.0 1.2	 − −	 1.5 0.7	 2.0 1.2	mA

4. LM258: T_{low} = −25°C, T_{high} = +85°C; LM358, LM358A: T_{low} = 0°C, T_{high} = +70°C
   LM2904/LM2904A: T_{low} = −40°C, T_{high} = +105°C; LM2904V & NCV2904: T_{low} = −40°C, T_{high} = +125°C
   NCV2904 and NCV2904V are qualified for automotive use. NCV2904V: T_{low} = −40°C, T_{high} = +150°C
5. The input common mode voltage or either input signal voltage should not be allowed to go negative by more than 0.3 V. The upper end of the common mode voltage range is V_{CC} − 1.7 V.
6. Short circuits from the output to V_{CC} can cause excessive heating and eventual destruction. Destructive dissipation can result from simultaneous shorts on all amplifiers.

ELECTRICAL CHARACTERISTICS (V_{CC} = 5.0 V, V_{EE} = Gnd, T_A = 25°C, unless otherwise noted.)

Characteristic	Symbol	LM2904			LM2904A			LM2904V, NCV2904 NCV2904V			Unit
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
Input Offset Voltage V_{CC} = 5.0 V to 30 V, V_{IC} = 0 V to V_{CC} −1.7 V, V_O ≃ 1.4 V, R_S = 0 Ω	V_{IO}										mV
T_A = 25°C		–	2.0	7.0	–	2.0	7.0	–	–	7.0	
T_A = T_{high} (Note 7)		–	–	10	–	–	10	–	–	13	
T_A = T_{low} (Note 7)		–	–	10	–	–	10	–	–	10	
Average Temperature Coefficient of Input Offset Voltage T_A = T_{high} to T_{low} (Note 7)	$\Delta V_{IO}/\Delta T$	–	7.0	–	–	7.0	–	–	7.0	–	μV/°C
Input Offset Current	I_{IO}	–	5.0	50	–	5.0	50	–	5.0	50	nA
T_A = T_{high} to T_{low} (Note 7)		–	45	200	–	45	200	–	45	200	
Input Bias Current	I_{IB}	–	−45	−250	–	−45	−100	–	−45	−250	
T_A = T_{high} to T_{low} (Note 7)		–	−50	−500	–	−50	−250	–	−50	−500	
Average Temperature Coefficient of Input Offset Current T_A = T_{high} to T_{low} (Note 7)	$\Delta I_{IO}/\Delta T$	–	10	–	–	10	–	–	10	–	pA/°C
Input Common Mode Voltage Range (Note 8), V_{CC} = 30 V	V_{ICR}	0	–	28.3	0	–	28.3	0	–	28.3	V
V_{CC} = 30 V, T_A = T_{high} to T_{low}		0	–	28	0	–	28	0	–	28	
Differential Input Voltage Range	V_{IDR}	–	–	V_{CC}	–	–	V_{CC}	–	–	V_{CC}	V
Large Signal Open Loop Voltage Gain	A_{VOL}										V/mV
R_L = 2.0 kΩ, V_{CC} = 15 V, For Large V_O Swing,		25	100	–	25	100	–	25	100	–	
T_A = T_{high} to T_{low} (Note 7)		15	–	–	15	–	–	15	–	–	
Channel Separation 1.0 kHz ≤ f ≤ 20 kHz, Input Referenced	CS	–	−120	–	–	−120	–	–	−120	–	dB
Common Mode Rejection R_S ≤ 10 kΩ	CMR	50	70	–	50	70	–	50	70	–	dB
Power Supply Rejection	PSR	50	100	–	50	100	–	50	100	–	dB
Output Voltage−High Limit T_A = T_{high} to T_{low} (Note 7)	V_{OH}										V
V_{CC} = 5.0 V, R_L = 2.0 kΩ, T_A = 25°C		3.3	3.5	–	3.3	3.5	–	3.3	3.5	–	
V_{CC} = 30 V, R_L = 2.0 kΩ		26	–	–	26	–	–	26	–	–	
V_{CC} = 30 V, R_L = 10 kΩ		27	28	–	27	28	–	27	28	–	
Output Voltage−Low Limit V_{CC} = 5.0 V, R_L = 10 kΩ, T_A = T_{high} to T_{low} (Note 7)	V_{OL}	–	5.0	20	–	5.0	20	–	5.0	20	mV
Output Source Current V_{ID} = +1.0 V, V_{CC} = 15 V	I_{O+}	20	40	–	20	40	–	20	40	–	mA
Output Sink Current	I_{O-}										
V_{ID} = −1.0 V, V_{CC} = 15 V		10	20	–	10	20	–	10	20	–	mA
V_{ID} = −1.0 V, V_O = 200 mV		–	–	–	–	–	–	–	–	–	μA
Output Short Circuit to Ground (Note 9)	I_{SC}	–	40	60	–	40	60	–	40	60	mA
Power Supply Current (Total Device) T_A = T_{high} to T_{low} (Note 7)	I_{CC}										mA
V_{CC} = 30 V, V_O = 0 V, R_L = ∞		–	1.5	3.0	–	1.5	3.0	–	1.5	3.0	
V_{CC} = 5 V, V_O = 0 V, R_L = ∞		–	0.7	1.2	–	0.7	1.2	–	0.7	1.2	

7. LM258: T_{low} = −25°C, T_{high} = +85°C
   LM2904/LM2904A: T_{low} = −40°C, T_{high} = +105°C
   NCV2904 and NCV2904V are qualified for automotive use.
   LM358, LM358A: T_{low} = 0°C, T_{high} = +70°C
   LM2904V & NCV2904: T_{low} = −40°C, T_{high} = +125°C
   NCV2904V: T_{low} = −40°C, T_{high} = +150°C
8. The input common mode voltage or either input signal voltage should not be allowed to go negative by more than 0.3 V. The upper end of the common mode voltage range is V_{CC} − 1.7 V.
9. Short circuits from the output to V_{CC} can cause excessive heating and eventual destruction. Destructive dissipation can result from simultaneous shorts on all amplifiers.

CIRCUIT DESCRIPTION

The LM358 series is made using two internally compensated, two−stage operational amplifiers. The first stage of each consists of differential input devices Q20 and Q18 with input buffer transistors Q21 and Q17 and the differential to single ended converter Q3 and Q4. The first stage performs not only the first stage gain function but also performs the level shifting and transconductance reduction functions. By reducing the transconductance, a smaller compensation capacitor (only 5.0 pF) can be employed, thus saving chip area. The transconductance reduction is accomplished by splitting the collectors of Q20 and Q18. Another feature of this input stage is that the input common mode range can include the negative supply or ground, in single supply operation, without saturating either the input devices or the differential to single−ended converter. The second stage consists of a standard current source load amplifier stage.

Each amplifier is biased from an internal−voltage regulator which has a low temperature coefficient thus giving each amplifier good temperature characteristics as well as excellent power supply rejection.

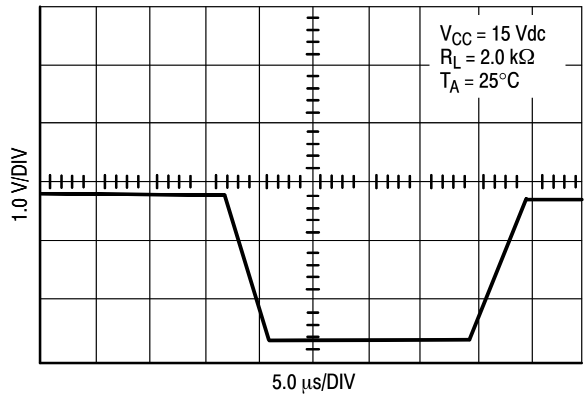


Figure 3. Large Signal Voltage Follower Response

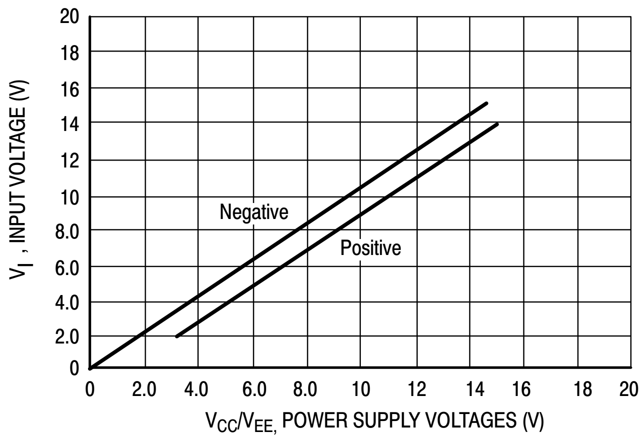


Figure 4. Input Voltage Range

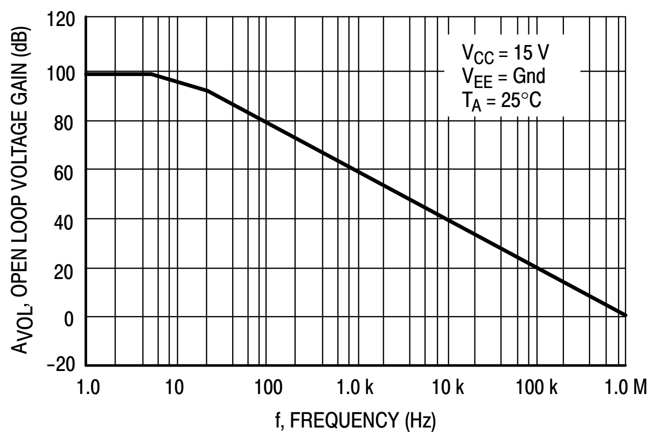


Figure 5. Large−Signal Open Loop Voltage Gain

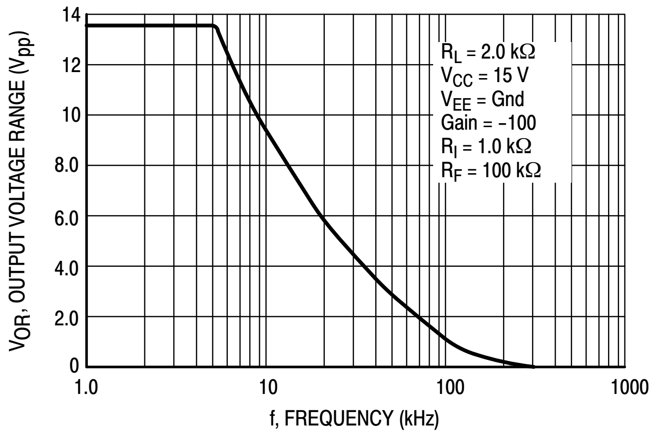


Figure 6. Large−Signal Frequency Response

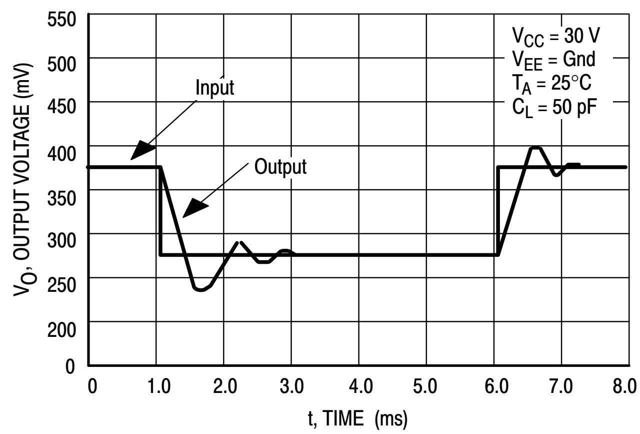


Figure 7. Small Signal Voltage Follower Pulse Response (Noninverting)

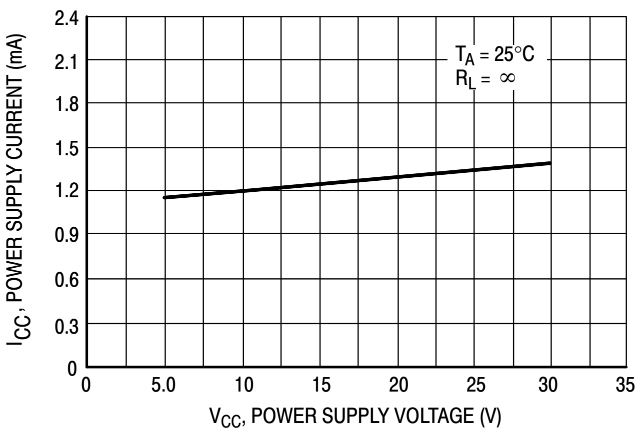


Figure 8. Power Supply Current versus Power Supply Voltage

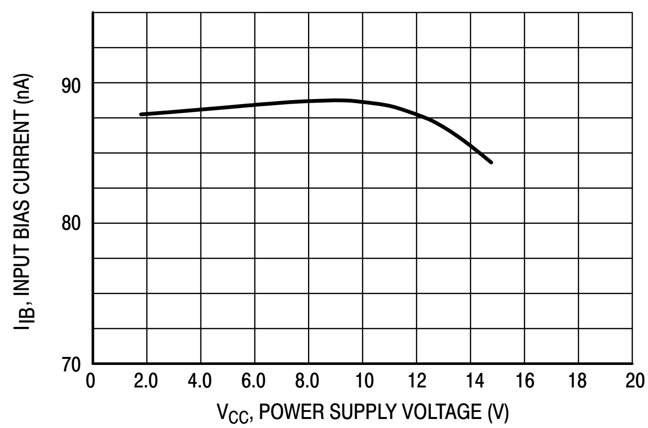
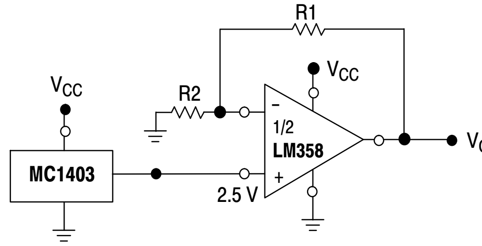


Figure 9. Input Bias Current versus Supply Voltage



$$V_O = 2.5\ V\left(1 + \frac{R1}{R2}\right)$$

Figure 10. Voltage Reference

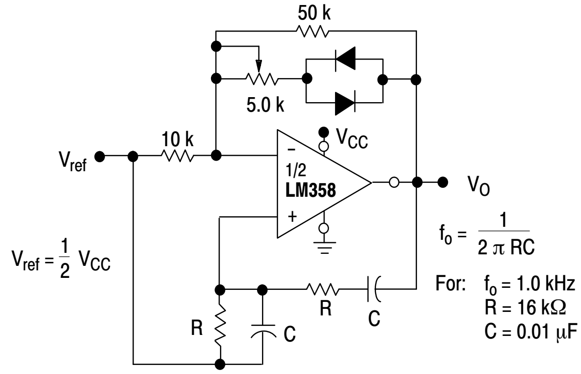
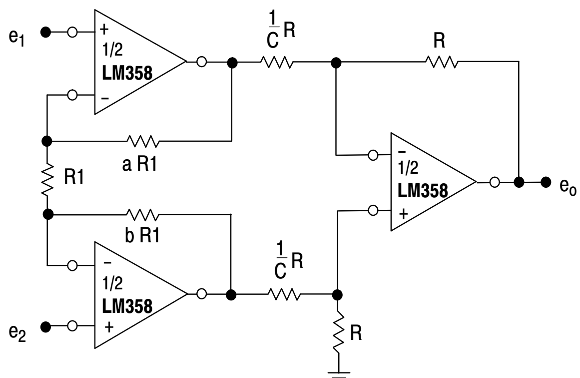
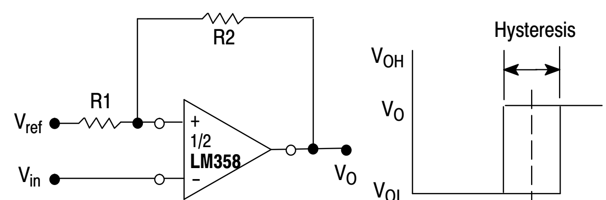


Figure 11. Wien Bridge Oscillator



$$e_o = C\,(1 + a + b)\,(e_2 - e_1)$$

Figure 12. High Impedance Differential Amplifier



$$V_{inL} = \frac{R1}{R1 + R2}\,(V_{OL} - V_{ref}) + V_{ref}$$

$$V_{inH} = \frac{R1}{R1 + R2}\,(V_{OH} - V_{ref}) + V_{ref}$$

$$H = \frac{R1}{R1 + R2}\,(V_{OH} - V_{OL})$$

Figure 13. Comparator with Hysteresis

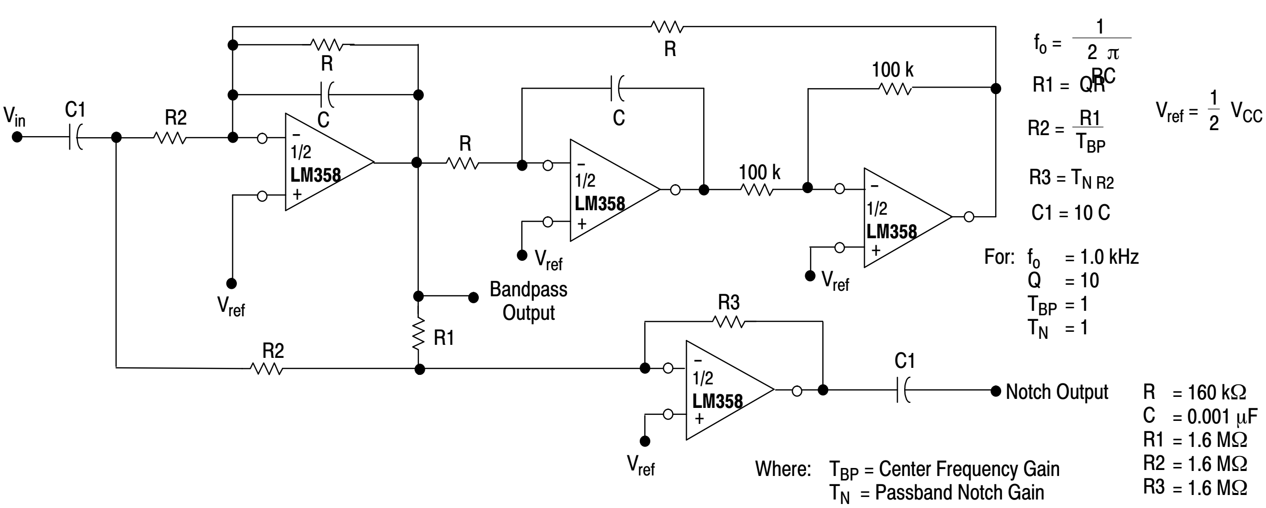
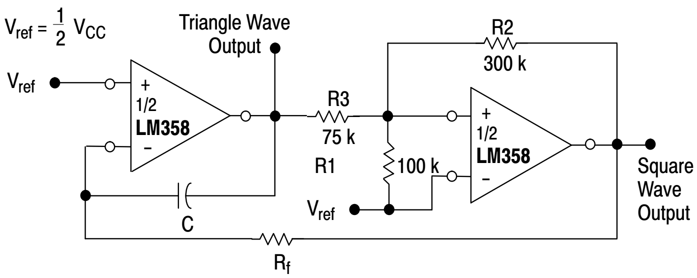
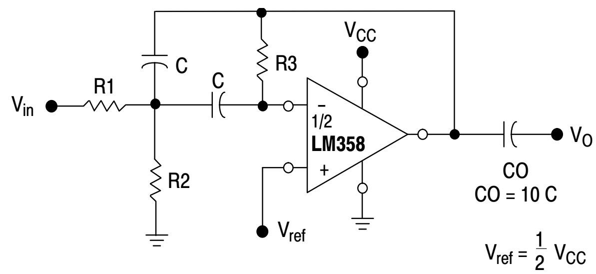


Figure 14. Bi−Quad Filter



$$f = \frac{R1 + R_C}{4\ CR_f\ R1} \qquad \text{if,}\ \ R3 = \frac{R2\ R1}{R2 + R1}$$

Figure 15. Function Generator



Given: f_o = center frequency

$A(f_o)$ = gain at center frequency

Choose value f_o, C

Then: $R3 = \frac{Q}{\pi f_o C}$

$R1 = \frac{R3}{2\ A(f_o)}$

$R2 = \frac{R1\ R3}{4Q^2 R1 - R3}$

For less than 10% error from operational amplifier. $\frac{Q_o f_o}{BW} < 0.1$

Where f_o and BW are expressed in Hz.

If source impedance varies, filter may be preceded with voltage follower buffer to stabilize filter parameters.

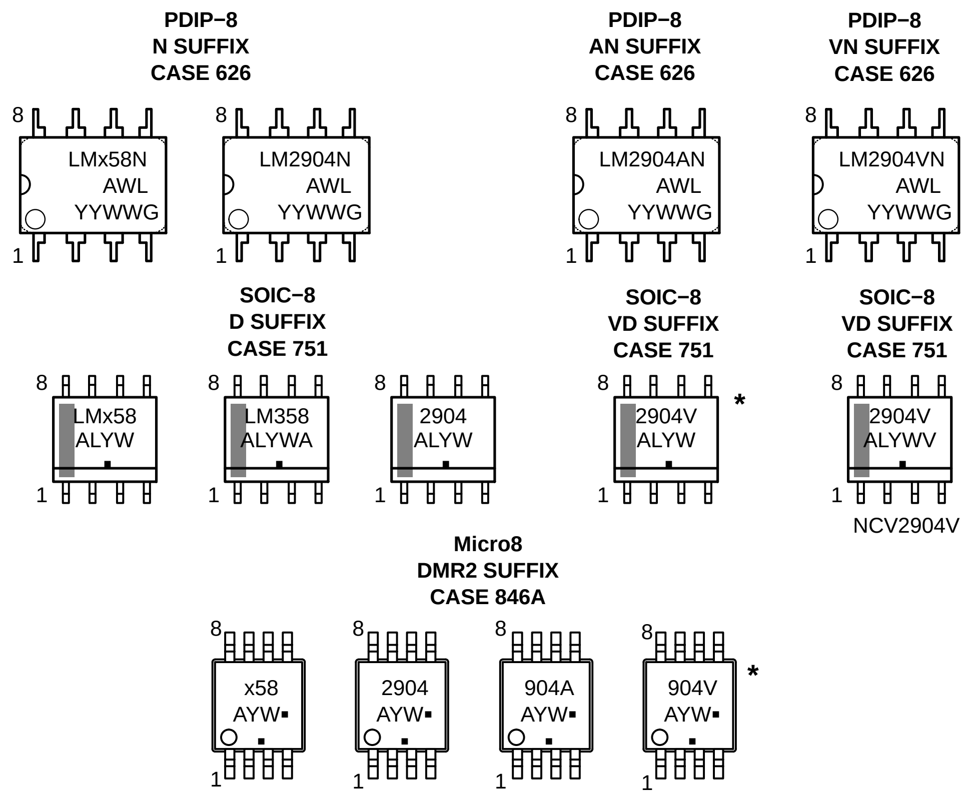
Figure 16. Multiple Feedback Bandpass Filter

ORDERING INFORMATION

Device	Operating Temperature Range	Package	Shipping†
LM358ADR2G	0°C to +70°C	SOIC−8 (Pb−Free)	2500 / Tape & Reel
LM358DG	0°C to +70°C	SOIC−8 (Pb−Free)	98 Units / Rail
LM358DR2G	0°C to +70°C	SOIC−8 (Pb−Free)	2500 / Tape & Reel
LM358DMR2G	0°C to +70°C	Micro8 (Pb−Free)	4000 / Tape & Reel
LM358NG	0°C to +70°C	PDIP−8 (Pb−Free)	50 Units / Rail
LM258DG	−25°C to +85°C	SOIC−8 (Pb−Free)	98 Units / Rail
LM258DR2G	−25°C to +85°C	SOIC−8 (Pb−Free)	2500 / Tape & Reel
LM258DMR2G	−25°C to +85°C	Micro8 (Pb−Free)	4000 / Tape & Reel
LM258NG	−25°C to +85°C	PDIP−8 (Pb−Free)	50 Units / Rail
LM2904DG	−40°C to +105°C	SOIC−8 (Pb−Free)	98 Units / Rail
LM2904DR2G	−40°C to +105°C	SOIC−8 (Pb−Free)	2500 / Tape & Reel
LM2904DMR2G	−40°C to +105°C	Micro8 (Pb−Free)	2500 / Tape & Reel
LM2904NG	−40°C to +105°C	PDIP−8 (Pb−Free)	50 Units / Rail
LM2904ADMG	−40°C to +105°C	Micro8 (Pb−Free)	4000 / Tape & Reel
LM2904ADMR2G	−40°C to +105°C	Micro8 (Pb−Free)	4000 / Tape & Reel
LM2904ANG	−40°C to +105°C	PDIP−8 (Pb−Free)	50 Units / Rail
LM2904VDG	−40°C to +125°C	SOIC−8 (Pb−Free)	98 Units / Rail
LM2904VDR2G	−40°C to +125°C	SOIC−8 (Pb−Free)	2500 / Tape & Reel
LM2904VDMR2G	−40°C to +125°C	Micro8 (Pb−Free)	4000 / Tape & Reel
LM2904VNG	−40°C to +125°C	PDIP−8 (Pb−Free)	50 Units / Rail
NCV2904DR2G*	−40°C to +125°C	SOIC−8 (Pb−Free)	2500 / Tape & Reel
NCV2904DMR2G*	−40°C to +125°C	Micro8 (Pb−Free)	4000 / Tape & Reel
NCV2904VDR2G*	−40°C to +150°C	SOIC−8 (Pb−Free)	2500 / Tape & Reel

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.
*NCV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC−Q100 Qualified and PPAP Capable.

MARKING DIAGRAMS

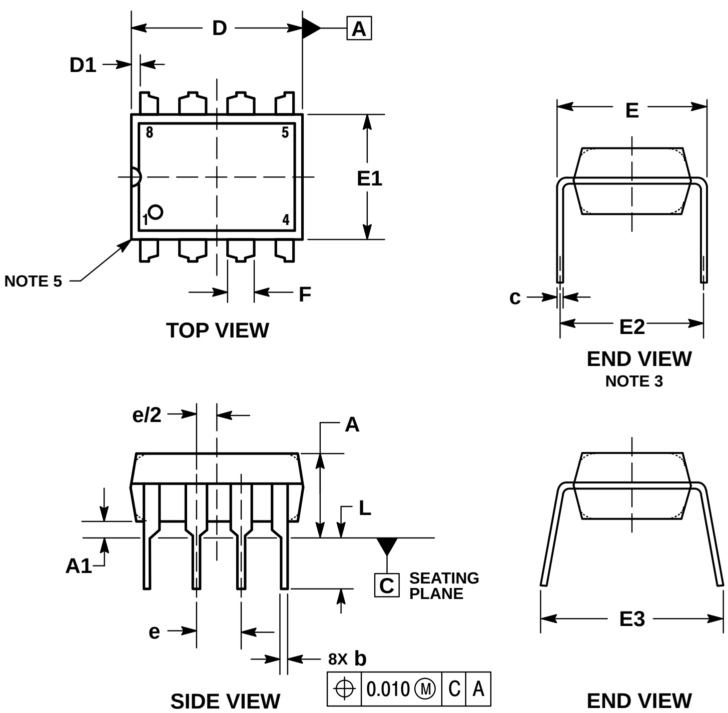


*This diagram also applies to NCV2904

x = 2 or 3
A = Assembly Location
WL, L = Wafer Lot
YY, Y = Year
WW, W = Work Week
G = Pb−Free Package
▪ = Pb−Free Package − (Note: Microdot may be in either location)

PACKAGE DIMENSIONS

PDIP−8
N, AN, VN SUFFIX
CASE 626−05
ISSUE M

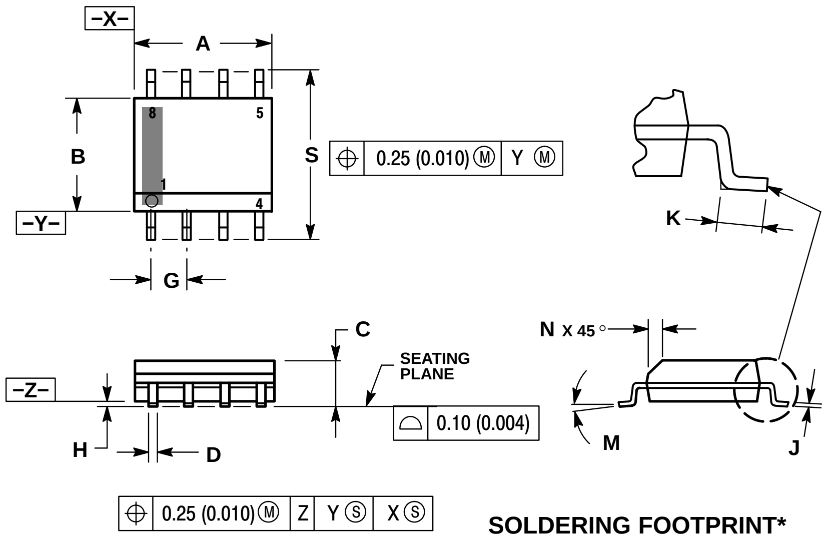


NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: INCHES.
3. DIMENSION E IS MEASURED WITH THE LEADS RESTRAINED PARALLEL AT WIDTH E2.
4. DIMENSION E1 DOES NOT INCLUDE MOLD FLASH.
5. ROUNDED CORNERS OPTIONAL.

	INCHES			MILLIMETERS		
DIM	MIN	NOM	MAX	MIN	NOM	MAX
A	----	----	0.210	----	----	5.33
A1	0.015	----	----	0.38	----	----
b	0.014	0.018	0.022	0.35	0.46	0.56
C	0.008	0.010	0.014	0.20	0.25	0.36
D	0.355	0.365	0.400	9.02	9.27	10.02
D1	0.005	----	----	0.13	----	----
E	0.300	0.310	0.325	7.62	7.87	8.26
E1	0.240	0.250	0.280	6.10	6.35	7.11
E2	0.300 BSC			7.62 BSC		
E3	----	----	0.430	----	----	10.92
e	0.100 BSC			2.54 BSC		
L	0.115	0.130	0.150	2.92	3.30	3.81

PACKAGE DIMENSIONS

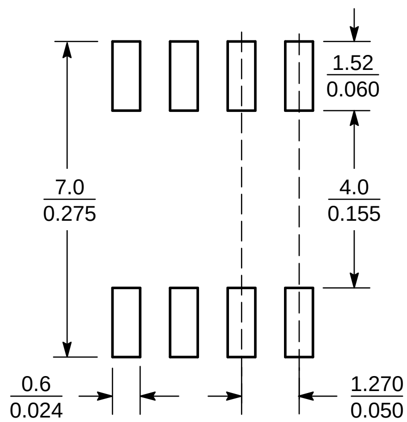
SOIC−8 NB
CASE 751−07
ISSUE AK



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.
6. 751−01 THRU 751−06 ARE OBSOLETE. NEW STANDARD IS 751−07.

	MILLIMETERS		INCHES	
DIM	**MIN**	**MAX**	**MIN**	**MAX**
A	4.80	5.00	0.189	0.197
B	3.80	4.00	0.150	0.157
C	1.35	1.75	0.053	0.069
D	0.33	0.51	0.013	0.020
G	1.27 BSC		0.050 BSC	
H	0.10	0.25	0.004	0.010
J	0.19	0.25	0.007	0.010
K	0.40	1.27	0.016	0.050
M	0 °	8 °	0 °	8 °
N	0.25	0.50	0.010	0.020
S	5.80	6.20	0.228	0.244

SOLDERING FOOTPRINT*

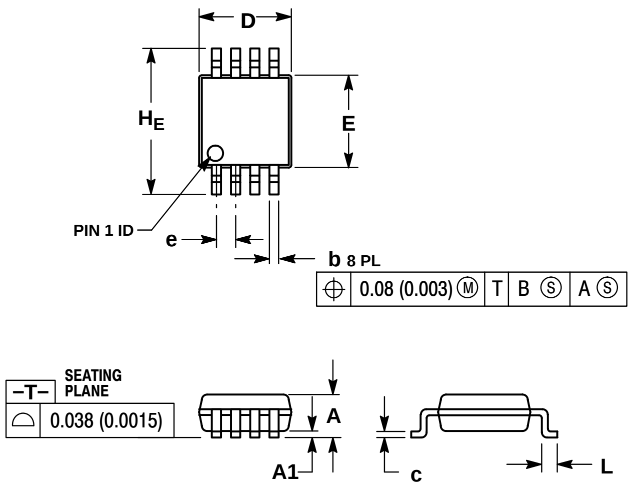


SCALE 6:1 $\left(\frac{\text{mm}}{\text{inches}}\right)$

*For additional information on our Pb−Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

PACKAGE DIMENSIONS

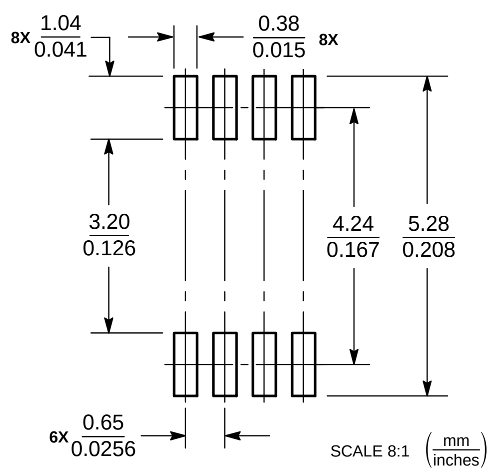
Micro8™
CASE 846A−02
ISSUE H



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH, PROTRUSIONS OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 (0.010) PER SIDE.
5. 846A-01 OBSOLETE, NEW STANDARD 846A-02.

DIM	MILLIMETERS			INCHES		
	MIN	NOM	MAX	MIN	NOM	MAX
A	−−	−−	1.10	−−	−−	0.043
A1	0.05	0.08	0.15	0.002	0.003	0.006
b	0.25	0.33	0.40	0.010	0.013	0.016
c	0.13	0.18	0.23	0.005	0.007	0.009
D	2.90	3.00	3.10	0.114	0.118	0.122
E	2.90	3.00	3.10	0.114	0.118	0.122
e	0.65 BSC			0.026 BSC		
L	0.40	0.55	0.70	0.016	0.021	0.028
H_E	4.75	4.90	5.05	0.187	0.193	0.199

SOLDERING FOOTPRINT*



*For additional information on our Pb−Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

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