Single Supply Dual Operational Amplifiers

GENERAL DESCRIPTION

Utilizing the circuit designs perfected for recently introduced Quad Operational Amplifiers, these dual operational 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 Volts or as high as 32 Volts with quiescent currents about one fifth of those associated with the LM741 (on a pet amplifier basis). The common mode input range includes the negative supply, thereby eliminating the necessity for external biasing components in many applications. The TS358 is equivalent to one half of TS324, and output voltage range also includes the negative supply voltage.

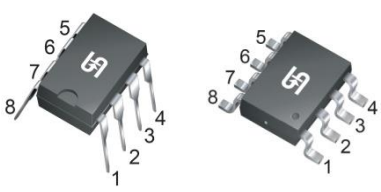
FEATURES

- Short circuit protected outputs
- True differential input stage
- Single supply operation: 3V to 32V
- Low input bias currents
- Internally compensated
- Common mode range extends to negative supply
- Single and split supply operation
- Similar performance to the popular MC1558
- RoHS compliant
- Halogen-free

APPLICATION

- Power supply
- Home appliance
- Uninterruptible power supplies

DIP-8 **SOP-8**

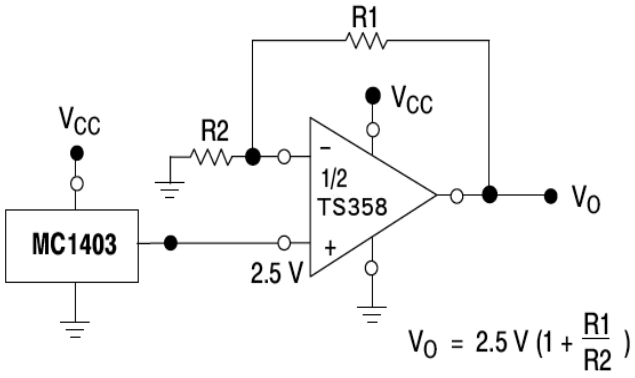


Pin Definition:

1. Output A
2. Input A (-)
3. Input A (+)
4. Gnd
5. Input B (+)
6. Input B (-)
7. Output B
8. V_{CC}

Notes: SOP-8 MSL 3 (Moisture sensitivity level) per J-STD-020

TYPICAL APPLICATIN CIRCUIT



Voltage Reference

ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	LIMIT	UNIT
Supply Voltage	V_{CC}	+32 or ±16	V
Differential Input Voltage (Split Power Supplies)	V_{IDR}	32	V
Input Common Mode Voltage Range (Note 1)	V_{ICR}	-0.3 to 32	V
Input Forward Current (Note 2)	I_{IF}	50	mA
Output Short Circuit Duration	T_{SC}	Continuous	
Junction Temperature	T_J	0 ~ +70	°C
Storage Temperature Range	T_{STG}	-65 ~ +150	°C

THERMAL PERFORMANCE

PARAMETER		SYMBOL	TYP	UNIT
Junction to Case Thermal Resistance	DIP-8	$R_{\Theta JC}$	64	°C/W
	SOP-8		73	
Junction to Ambient Thermal Resistance	DIP-8	$R_{\Theta JA}$	137	°C/W
	SOP-8		210	

ELECTRICAL CHARACTERISTICS (V_{CC} = 5V, T_A = 25°C unless otherwise specified)

CHARACTERISTICS	SYMBOL	MIN	TYP	MAX	UNIT
Input Offset Voltage V_{CC} = 5.0V to 30V, V_{IC} = 0V to V_{CC}-1.7V, V_O = 1.4V, R_S = 0Ω , $T_{LOW} \le T_A \le T_{HIGH}$	V_{IO}	-- --	2.0 --	7.0 9.0	mV
Average Temperature Coefficient of input Offset Voltage	$\Delta I_{IO}/\Delta T$	--	7.0	--	µV/°C
Input Offset Current $T_{LOW} \le T_A \le T_{HIGH}$	I_{IO}	-- --	5.0 --	50 150	nA
Average Temperature Coefficient of input Offset Current	$\Delta I_{IO}/\Delta T$	--	10	--	pA/°C
Input Bias Current $T_{LOW} \le T_A \le T_{HIGH}$	I_{IB}	-- --	-45 -50	-250 -500	nA
Input Common-Mode Voltage Range V_{CC} = 30V (Note 3) V_{CC} = 30V, $T_{LOW} \le T_A \le T_{HIGH}$	V_{ICR}	0 0	-- --	28.3 28	V
Differential Input Voltage Range	V_{IDR}	--	--	V_{CC}	V
Large Signal Open-Loop Voltage Gain R_L = 2kΩ, V_{CC} = 15V, For Large V_O Swing, $T_{LOW} \le T_A \le T_{HIGH}$	A_{VOL}	25 15	100 --	-- --	V/mV
Channel Separation 1.0 kHz to 20kHz	--	--	-120	--	dB
Common Mode Rejection Ratio, $R_S \le$ 10kΩ	CMRR	65	70	--	dB
Power Supply Rejection Ratio	PSRR	65	100	--	dB
Output Voltage Range, RL = 2kΩ	V_{OR}	0	--	3.3	V

ELECTRICAL CHARACTERISTICS (V_{CC} = 5V, T_A = 25°C unless otherwise specified)					
CHARACTERISTICS	**SYMBOL**	**MIN**	**TYP**	**MAX**	**UNIT**
Output Voltage – High Limit V_{CC} = 30V, R_L = 2 kΩ V_{CC} = 30V, R_L = 10 kΩ	V_{OH}	26 27	-- 28	-- --	V
Output Voltage – Low Limit V_{CC} = 5.0V, R_L = 10kΩ	V_{OL}	--	5.0	20	mV
Output Source Current, V_{ID} = +1.0V, V_{CC} = 15V	I_{O+}	20	40	--	mA
Output Sink Current V_{ID} = -1.0V, V_{CC} = 15V V_{ID} = -1.0V, V_O = 200mV	I_{O-}	10 12	20 50	-- --	mA µA
Output Short Circuit to Ground (Note 4)	I_{OS}	--	40	60	mA
Power Supply Current , V_{CC} = 30V, V_O = 0 V, R_L = ∞ V_{CC} = 5.0V, V_O = 0 V, R_L = ∞	I_{CC}	-- --	1.5 0.7	3.0 1.2	mA

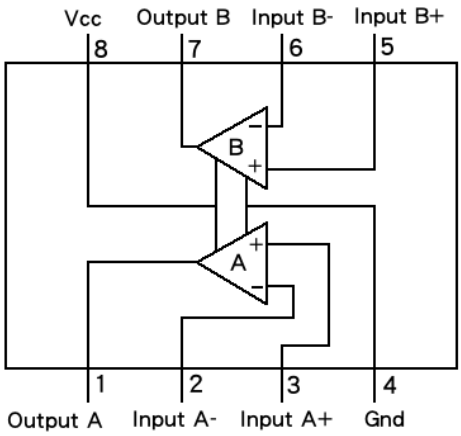
Note:

1. For supply, voltages less than 32V for the TS358 the absolute maximum input voltage is equal to the supply voltage.
2. This input current will only exist when the voltage is negative at any of the input leads. Normal output states will reestablish when the input voltage returns to a voltage greater than -0.3V.
3. 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} 17V, but either or both inputs can go to +32V.
4. Short circuits from the output to V_{CC} can cause excessive heating and eventual destruction. Destructive dissipation can recruit from simultaneous shorts on all amplifiers.

ORDERING INFORMATION

ORDERING CODE	PACKAGE	PACKING
TS358CD C3G	DIP-8	50pcs / Tube
TS358CS RLG	SOP-8	2,500pcs / 13” Reel

BLOCK DIAGRAM



ELECTRICAL CHARACTERISTICS CURVES

(T_C = 25°C unless otherwise specified)

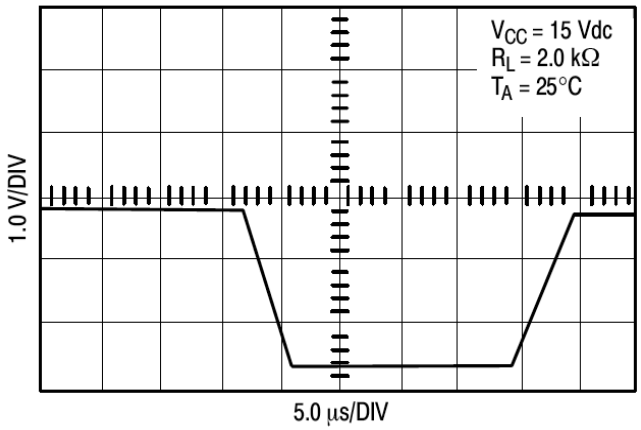


Figure 1. Large Signal Voltage Follower Response

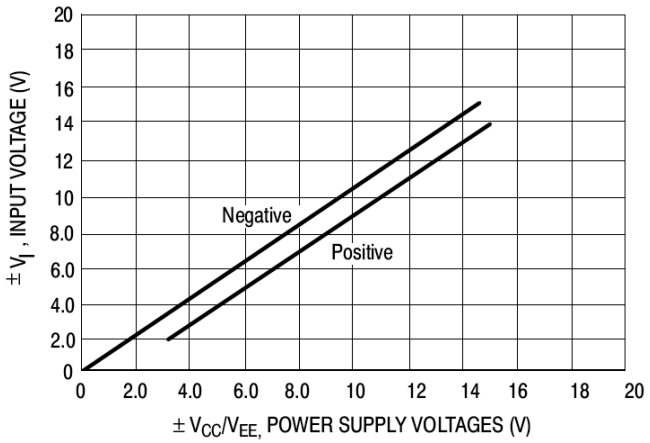


Figure 2. Input Voltage Range

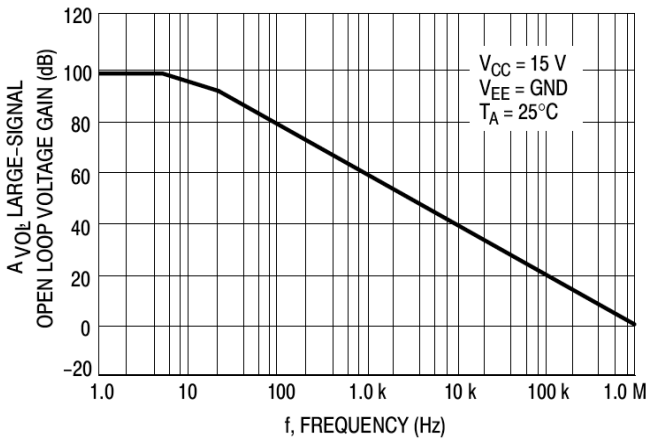


Figure 3. Open Loop Frequency

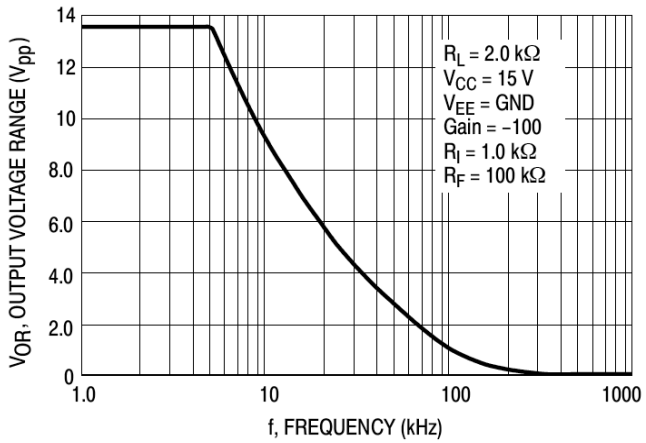


Figure 4. Large Signal Frequency Response

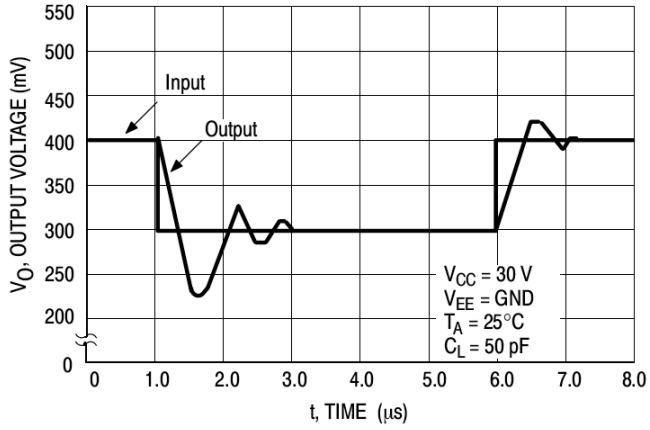


Figure 5. Small-Signal Voltage Follower Pulse Response (Non-inverting)

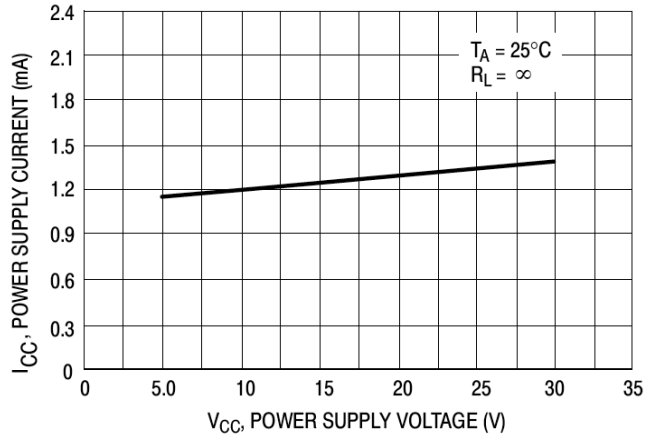


Figure 6. Power Supply Current vs. Supply Voltage

APPLICATION DESCRIPTION

The TS358 made using two internally compensated, two-stage operational amplifiers. 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 5.0pF) can be employed, thus saving chip area. 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, and which has a low temperature coefficient thus giving each amplifier good temperature characteristics as well as excellent power supply rejection.

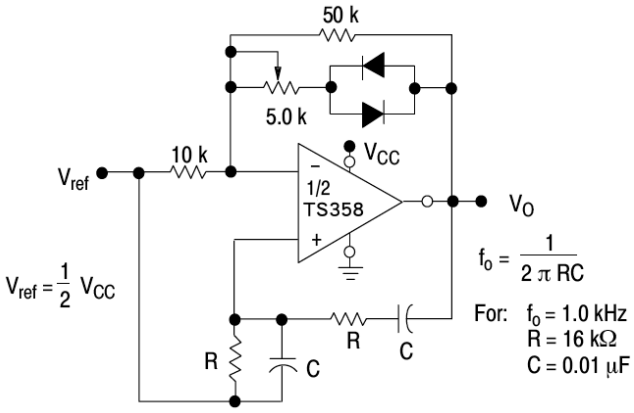


Figure 7. Wien Bridge Oscillator

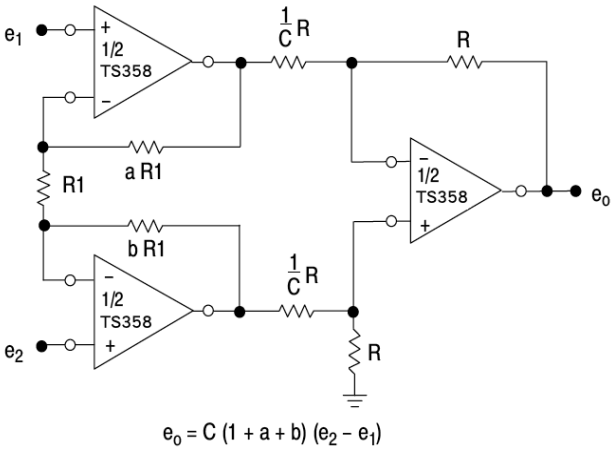


Figure 8. High Impedance Differential Amplifier

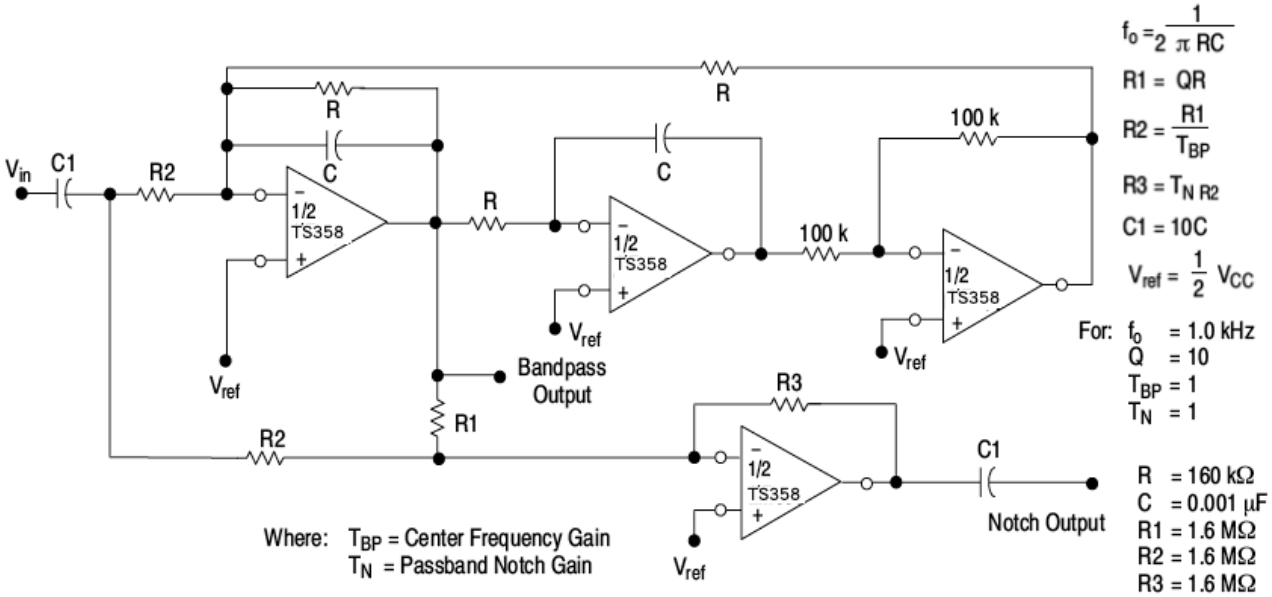
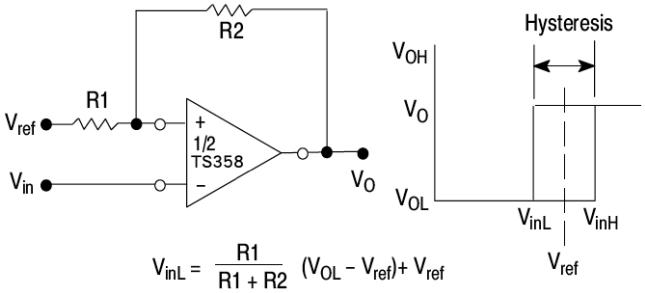


Figure 9. Bi-Quad Filter

APPLICATION DESCRIPTION (CONTINUES)

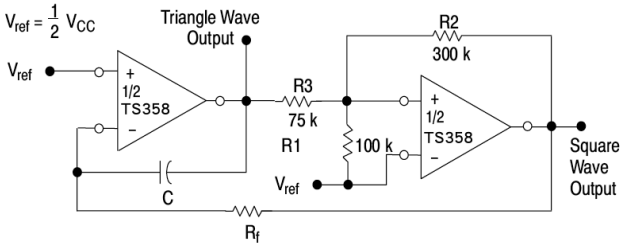


$$V_{inL} = \frac{R1}{R1 + R2}(V_{OL} - V_{ref}) + V_{ref}$$

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

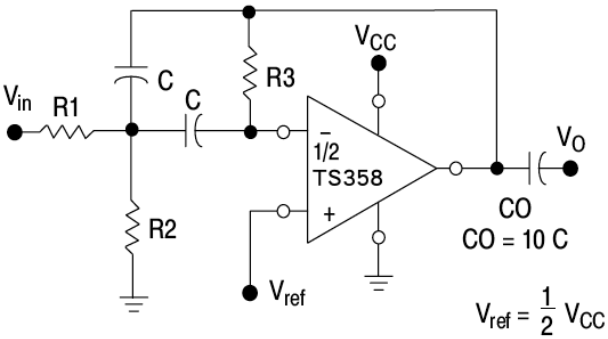
$$H = \frac{R1}{R1 + R2}(V_{OH} - V_{OL})$$

Figure 10. Comparator With Hysteresis



$$f = \frac{R1 + R_C}{4 C R_f R1} \quad \text{if, } R3 = \frac{R2\,R1}{R2 + R1}$$

Figure 11. 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. $\frac{Q_o f_o}{BW} < 0.1$

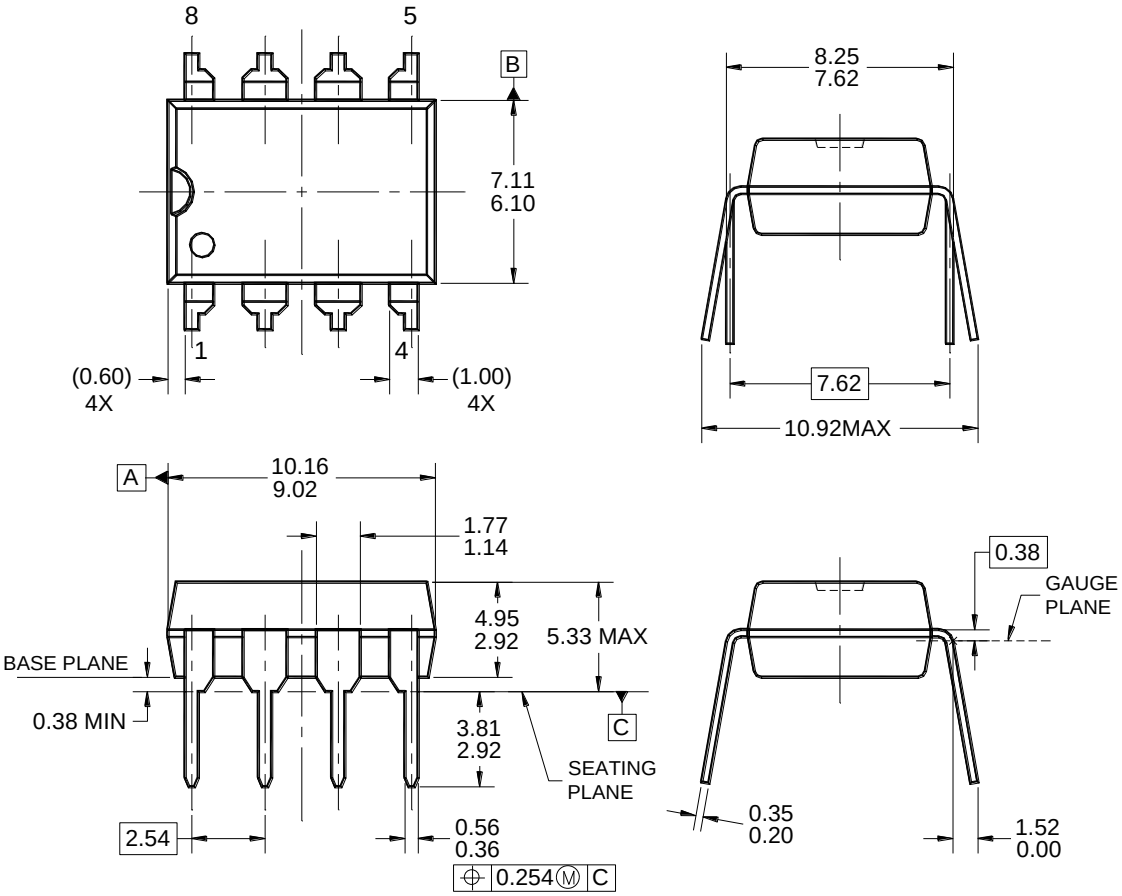
Where f_o and BW are expressed in Hz.

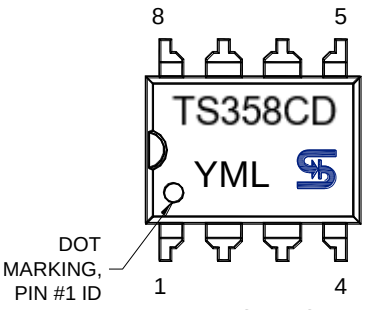
If source impedance varies, filter may be preceded with voltage follower buffer to stabilize filter parameters.

Figure 12. Multiple Feedback Band pass Filter

PACKAGE OUTLINE DIMENSIONS

DIP-8





MARKING DIAGRAM

P/N = MARKING CODE

Y = YEAR CODE

M = MONTH CODE FOR HALOGEN FREE PRODUCT

O =JAN	P =FEB	Q=MAR	R = APR
S =MAY	T =JUN	U=JUL	V = AUG
W =SEP	X =OCT	Y=NOV	Z = DEC

L = LOT CODE

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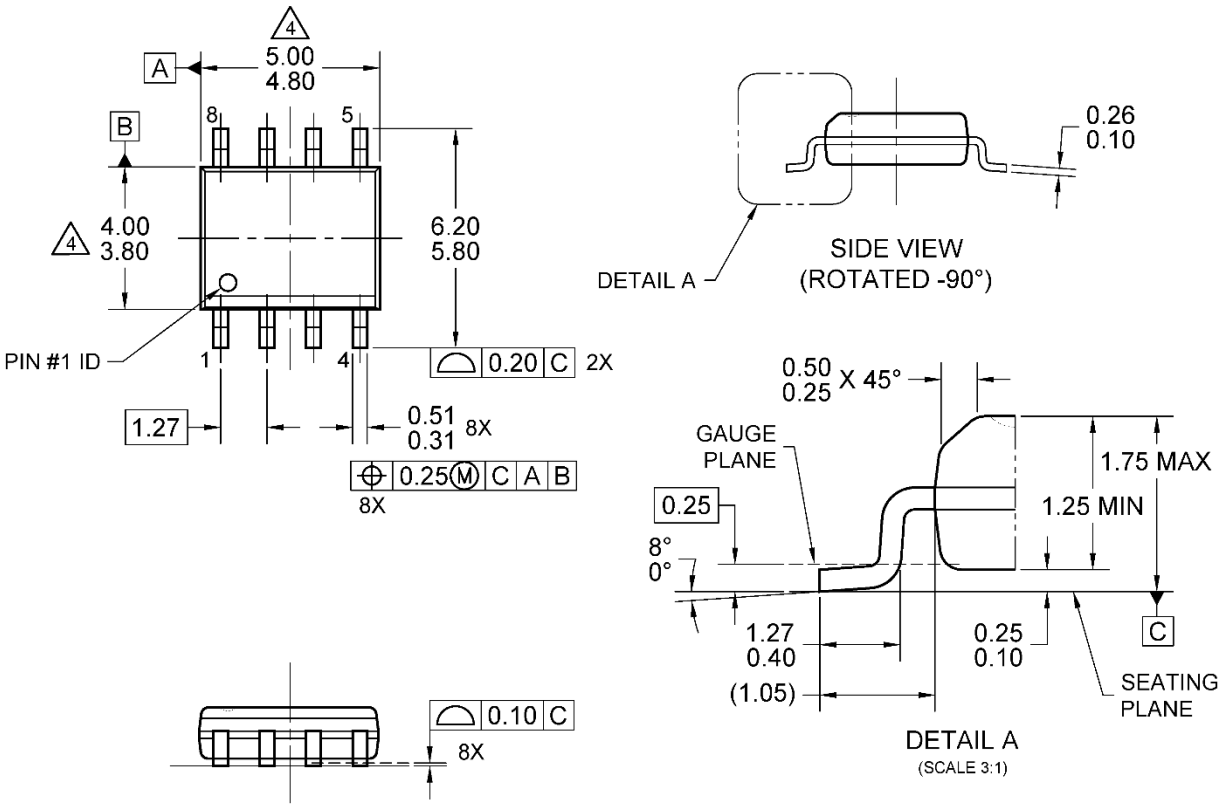
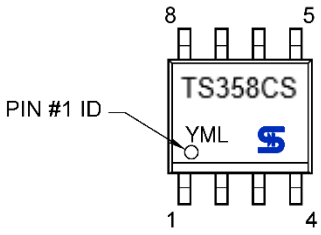
2. DIMENSIONING AND TOLERANCING PER ASME Y14.5M-1994.
3. THIS CONFORM TO JEDEC PACKAGE REGISTRATION MS-001, VARIATION BA, ISSUE D.
4. DWG NO. REF: HQ2SD07-DIP8-014 REV A.

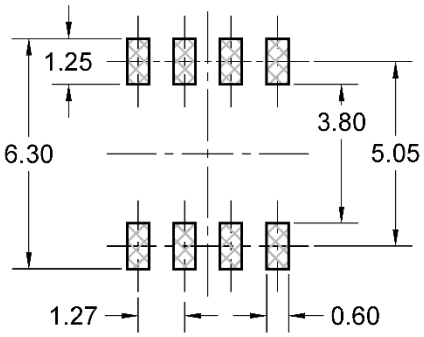
PACKAGE OUTLINE DIMENSIONS

SOP-8





MARKING DIAGRAM



SUGGESTED PAD LAYOUT
(REFERENCE ONLY)

P/N = PRODUCT DEVICE CODE
Y = YEAR CODE
M = MONTH CODE FOR HALOGEN FREE PRODUCT

O =JAN	P =FEB	Q=MAR	R = APR
S =MAY	T =JUN	U=JUL	V = AUG
W =SEP	X =OCT	Y=NOV	Z = DEC

L = LOT CODE

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