WA3358(H)

LOW POWER DUAL OPERATIONAL AMPLIFIERS

1. General Description

The WA3358(H) brings performance and economy to low power systems. With a high unity gain frequency and a specified 0.2V/μs slew rate, the quiescent current is only 500μA/amplifier (5V). The input common mode range includes ground and the device is able to operate in single supply applications as well as in dual supply applications.

The WA3358(H) is available in SOP-8 and MSOP-8 packages

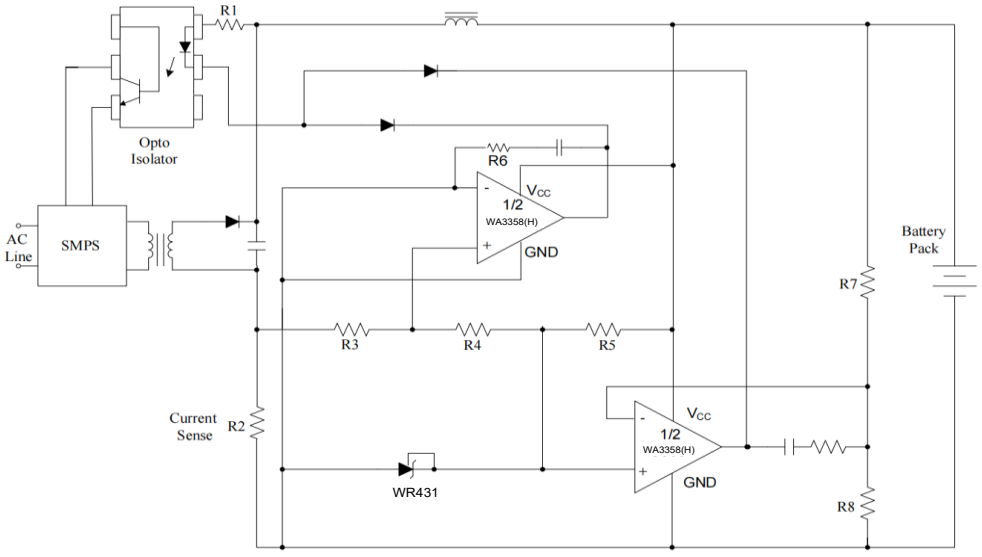
2. Features

- Internally Frequency Compensated for Unity Gain
- Large Voltage Gain: 100dB (Typical)
- Low Input Bias Current: 20nA (Typical)
- Low Input Offset Voltage: ±2mV; 5mV
- Low Supply Current: 0.5mA (Typical)
- Wide Power Supply Voltage:
  Single Supply: 3V to 36V
  Dual Supplies: ±1.5V to ±18V
- Input Common Mode Voltage Range Includes Ground
- Large Output Voltage Swing: 0V to V_{CC} -1.5V

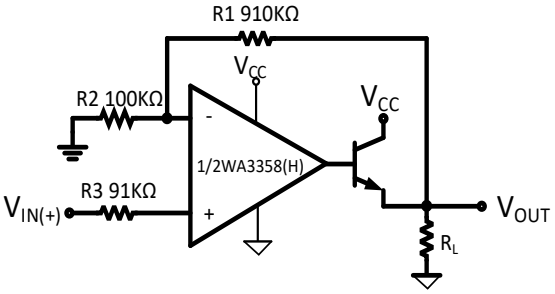
3. Applications

- Battery Chargers
- Mobile Phones
- Switching Power Supplies

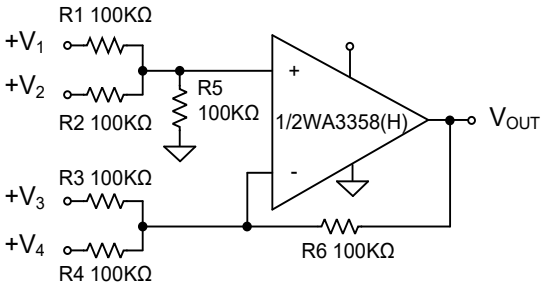
4. Typical Application Circuit



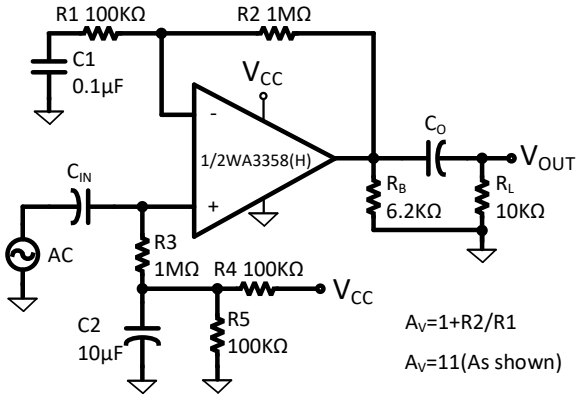
Battery Charger



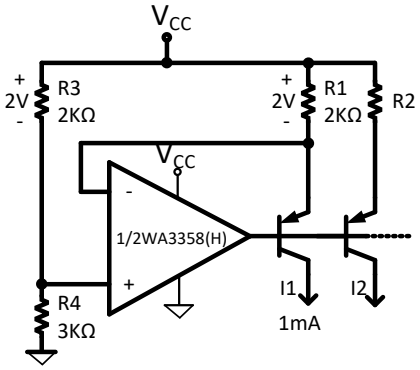
Power Amplifier



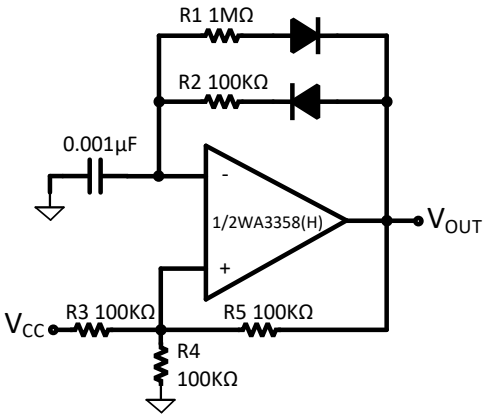
DC Summing Amplifier



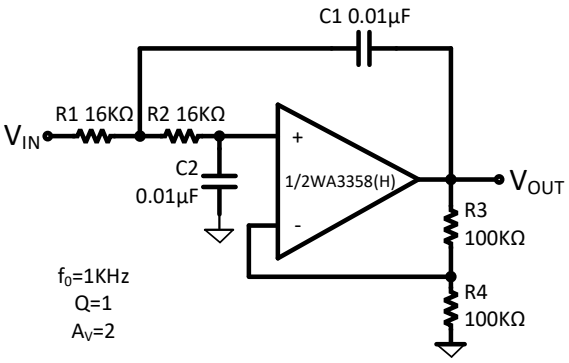
AC Coupled Non-Inverting Amplifier



Fixed Current Sources

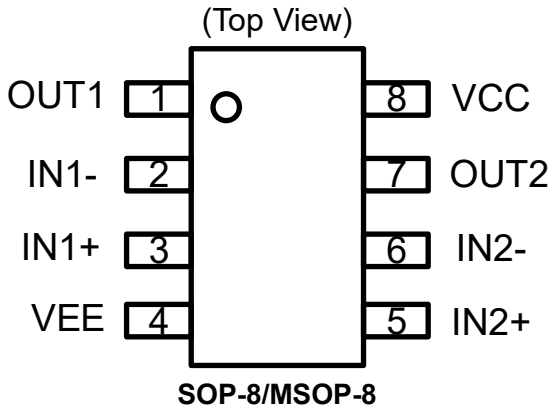


Pulse Generator



DC Coupled Low-Pass Active Filter

5. Pin Configuration



SOP-8/MSOP-8

6. Pin Description

PIN NUMBER	PIN NAME	I/O	PIN FUNCTION
1	OUT1	O	Output 1
2	IN1-	I	Negative input 1
3	IN1+	I	Positive input 1
4	V_{EE}	-	Negative (lowest) supply or ground (for single supply operation)
5	IN2+	I	Positive input 2
6	IN2-	I	Negative input 2
7	OUT2	O	Output 2
8	V_{CC}	-	Positive (highest) Supply

7. Absolute Maximum Ratings [1]

SYMBOL	PARAMETER	RATING	UNIT
$V_S=V_{CC}-V_{EE}$	Power Supply Voltage	40	V
$V_{ID}=V_{IN+} - V_{IN-}$	Differential Input Voltage	40	V
V_{CM}	Input Common-Mode Voltage	-0.3 to 40	V
T_J	Junction Temperature	150	°C
T_{STG}	Storage Temperature Range	-65 to +150	°C
T_{LEAD}	Lead Temperature Range (Soldering 10 sec)	+260	°C

NOTE 1: Stresses beyond those listed under absolute maximum ratings may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under recommended operating conditions. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

8. Recommended Operating Conditions

SYMBOL	PARAMETER	MIN	MAX	UNIT
V_{CC}	Supply Voltage	3	36	V
T_A	Ambient Operating Temperature Range	-40	+125	°C

9. Electrical Characteristics [2]

(V_{CC}=5V, V_{EE}=0V, T_A=25°C, unless otherwise specified.)

SYMBOL	PARAMETER	TEST CONDITIONS		MIN	TYP.	MAX	UNIT
V_{OS}	Input Offset Voltage	V_O = 1.4V, R_S =0Ω, V_{CC} = 5V to 30V	WA3358H	-2		2	mV
			WA3358		2	5	
		T_A = -40°C to +125°C				7	
$\Delta V_{OS}/\Delta T$	Average Temperature Coefficient of Input Offset Voltage	T_A = -40°C to +125°C			7		μV/°C
I_{BIAS}	Input Bias Current	I_{IN+} or I_{IN-}, V_{CM} = 0V			20	200	nA
						200	
I_{OS}	Input Offset Current	I_{IN+} - I_{IN-}, V_{CM} = 0V			5	30	nA
						100	
V_{CM} [3]	Input Common Mode Voltage Range	V_{CC}=30V		0		V_{CC}-1.5	V
I_{CC}	Supply Current	T_A = -40°C to +125°C, R_L = ∞, V_{CC} = 30V			0.7	2	mA
		T_A = -40°C to +125°C, R_L = ∞, V_{CC} = 5V			0.5	1.2	
G_V	Large Signal Voltage Gain	V_{CC} = 15V, V_O = 1V to 11V, R_L ≥ 2kΩ		85	100		dB
CMRR	Common Mode Rejection Ratio	DC, V_{CM} = 0V to (V_{CC}-1.5) V		60	70		dB
PSRR	Power Supply Rejection Ratio	V_{CC} = 5V to 30V		70	100		dB
Output Current	I_{SOURCE}	V_{IN+} = 1V, V_{IN-} = 0V, V_{CC} = 15V, V_O = 2V		20	40		mA
	I_{SINK}	V_{IN+} = 0V, V_{IN-} = 1V, V_{CC} = 15V, V_O = 2V		9	15		
		V_{IN+} = 0V, V_{IN-} = 1V, V_{CC} = 15V, V_O = 0.2V		12	65		μA

SYMBOL	PARAMETER	TEST CONDITIONS	MIN	TYP.	MAX	UNIT
I_{SC}	Output Short Circuit Current to Ground	V_{CC} = 15V		30	60	mA
V_{OH}	Output Voltage Swing	V_{CC} = 30V, R_L = 2kΩ	26			V
		V_{CC} = 30V, R_L = 10kΩ	27	28		
V_{OL}		V_{CC} = 5V, R_L = 10kΩ		1	20	mV

NOTE 2: Limits over the full temperature are guaranteed by design, but not tested in production.

NOTE 3: The input common-mode voltage of either input signal voltage should not be allowed to go negatively by more than 0.3V (at +25°C). The upper end of the common-mode voltage range is V_{CC}-1.5V (at +25°C), but either or both inputs can go to +36V without damages, independent of the magnitude of the V_{CC}.

10. Typical Performance Characteristics

(V_{CC}=5V, V_{EE}=0V, T_A=25°C, unless otherwise specified.)

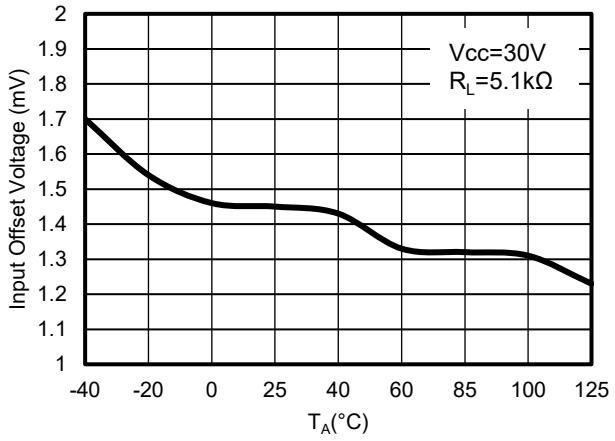


Figure 1. Input Offset Voltage vs. Temperature

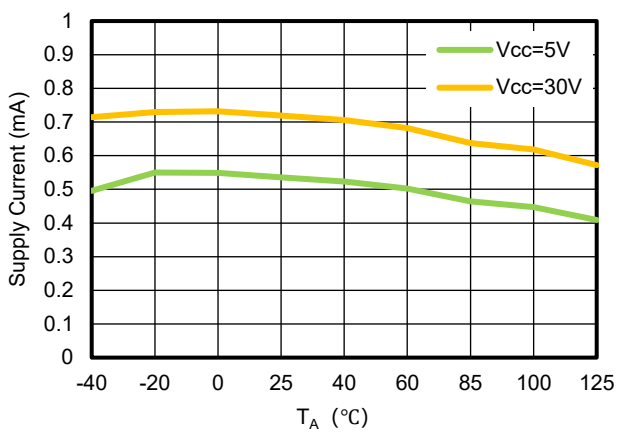


Figure 2. Supply Current vs. Temperature

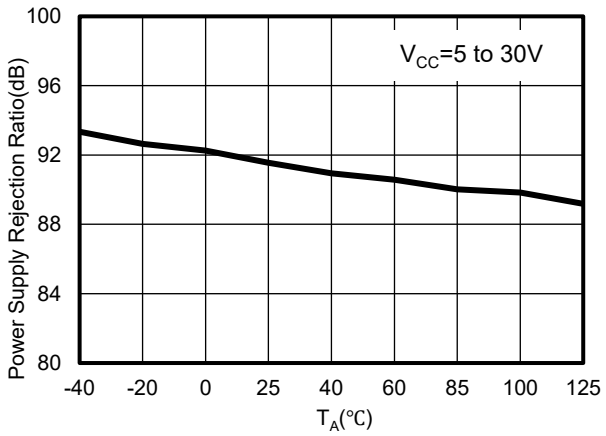


Figure 3. PSRR vs. Temperature

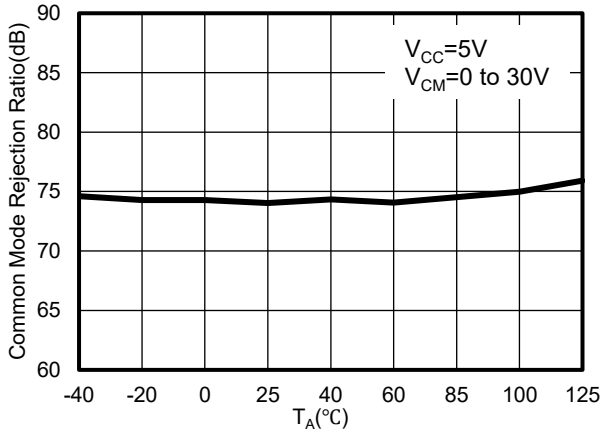


Figure 4. CMRR vs. Temperature

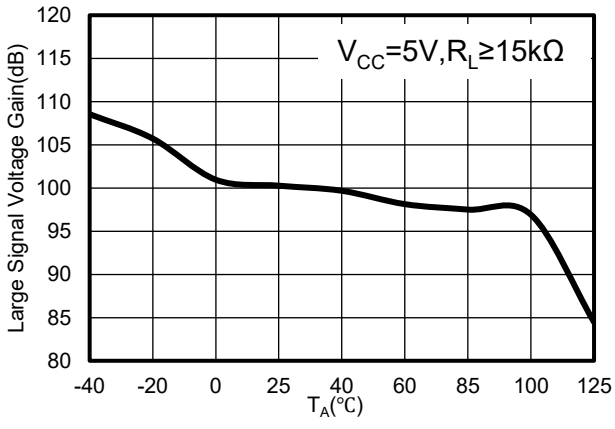


Figure 5. G_V vs. Temperature

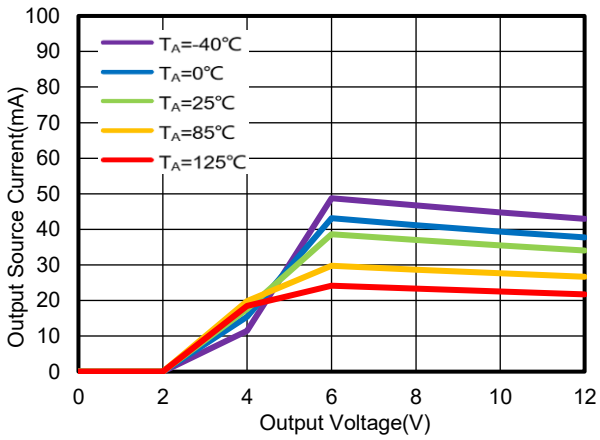


Figure 6. Source Current vs. Output Voltage

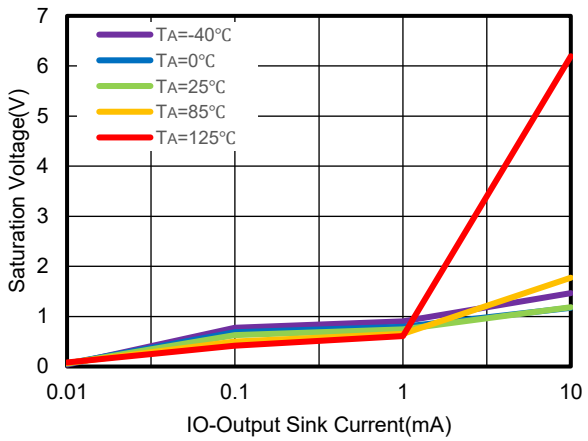


Figure 7. Saturation Voltage vs. Output Sink Current

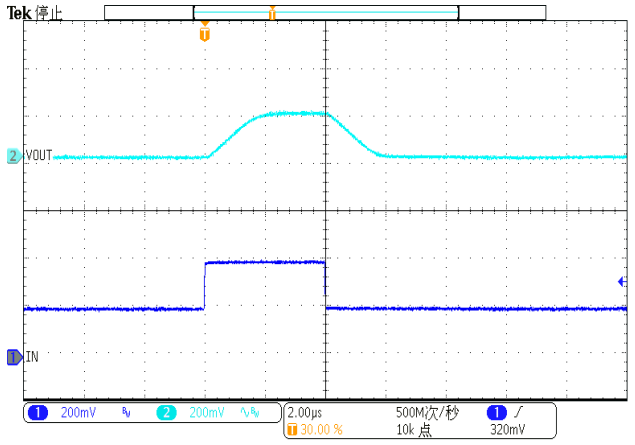


Figure 8. Voltage Follower Pulse Response (Small Signal)

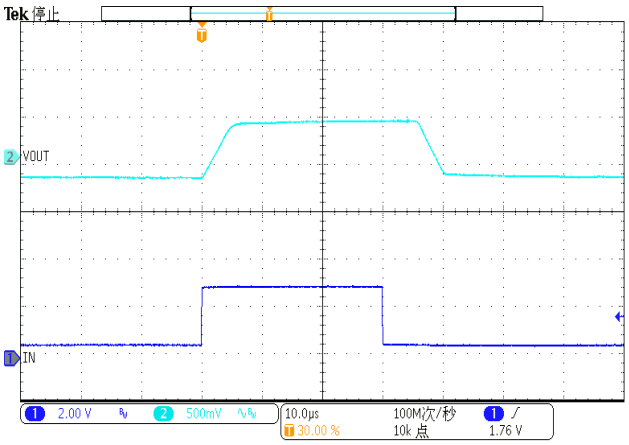


Figure 9. Voltage Follower Pulse Response (Large Signal)

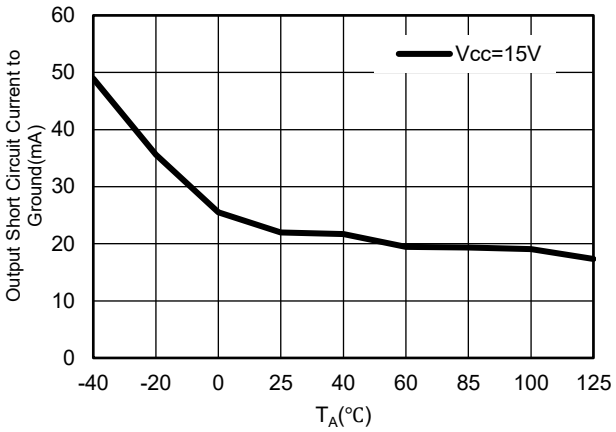


Figure 10. Output Short Circuit Current to Ground vs. Temperature

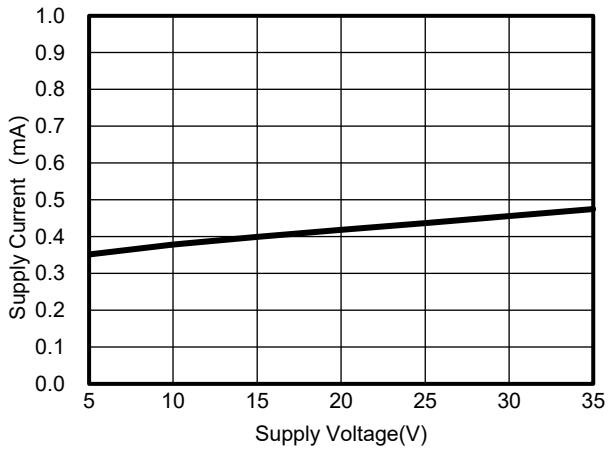


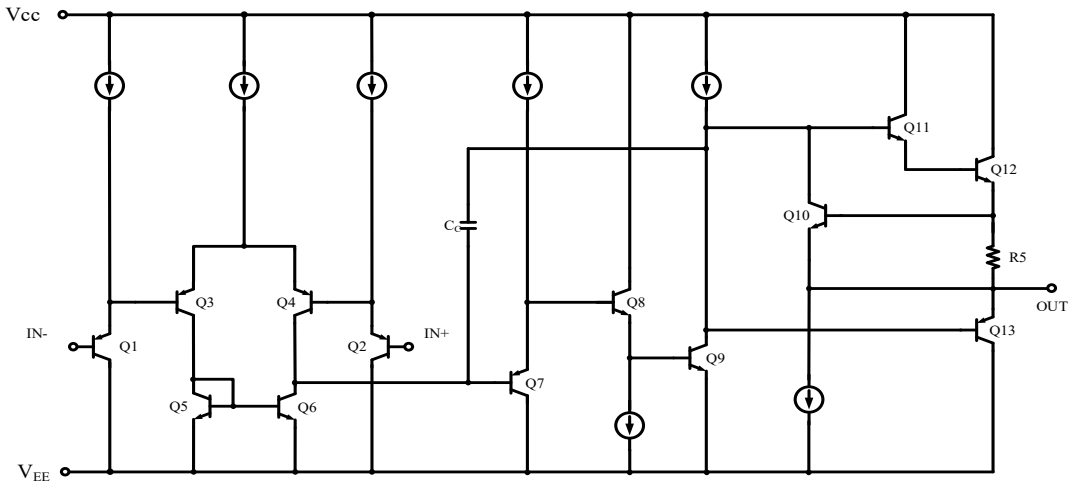
Figure 11. Supply Current vs. Supply Voltage

11. Function Description

11.1 Overview

The WA3358(H) is a high gain and internally frequency compensated operational amplifiers. The low power supply current drain is independent of the magnitude of the power supply voltages. The input common mode range includes ground and therefore the device is able to operate in single supply applications as well as in dual supply applications. Typical applications include battery charger, active filters, general purpose controllers and most conventional operational amplifier circuits.

11.2 Functional Block Diagram



11.3 Function Description

11.3.1 Unity-Gain Bandwidth

Gain bandwidth product is found by multiplying the measured bandwidth of an amplifier by the gain at which that bandwidth was measured. The WA3358(H) have a high gain bandwidth of 1MHz.

11.3.2 Slew Rate

The slew rate is the rate at which an operational amplifier can change its output when there is a change on the input. These devices have a 0.2 V/μs slew rate.

11.3.3 Input Common Mode Range

The valid common mode range is from device ground to V_{CC} – 1.5 V (V_{CC} – 2 V across temperature). Inputs may exceed V_{CC} up to the maximum V_{CC} without device damage. At least one input must be in the valid input common mode range for output to be correct phase. If both inputs exceed valid range then output phase is undefined. If either input is less than –0.3V, then input current should be limited to 1 mA and output phase is undefined.

11.4 Device Functional Modes

These devices are powered on when the supply is connected. This device can be operated as a single supply operational amplifier or dual supply amplifier depending on the application.

12. Application and Implementation

Note: The information in the Applications section below is not part of WAY-ON's product specifications and WAY-ON does not guarantee its accuracy or completeness. The customer is responsible for determining the suitability of the component for its intended use and should verify and test its design implementation to confirm system functionality.

12.1 Application Information

The WA3358(H) operational amplifiers are useful in a wide range of signal conditioning applications. Inputs can be powered before V_{CC} for flexibility in multiple supply circuits.

13. Power Supply Recommendations

Supply voltages larger than 36 V for a single supply, or outside the range of ±18 V for a dual supply can permanently damage the device (see the Absolute Maximum Ratings).

Place 0.1 μF bypass capacitors close to the power-supply pins to reduce errors coupling in from noisy or high impedance power supplies. For more detailed information on bypass capacitor placement, refer to the Layout.

14. Evaluation Modules

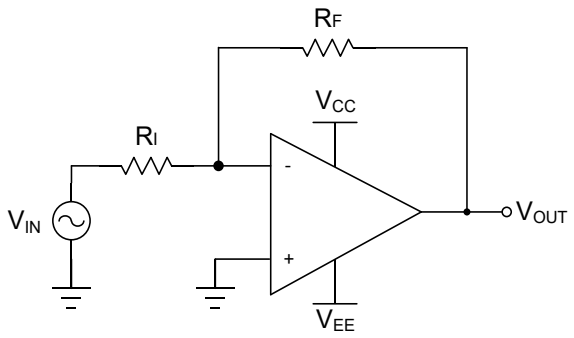
Evaluation Modules (EVMs) are available to help evaluate initial circuit performance. We have evaluation modules for different packages, you can contact us to get the evaluation module or schematic.

The module names are listed in the following table.

Name	Package	Evaluation Module
WA3358(H)	SOP-8	WAYON OPA_EVM_SOP-8_V1.1
WA3358(H)	MSOP-8	WAYON OPA_EVM_MSOP-8_V1.0

14.1 Typical Application

A typical application for an operational amplifier in an inverting amplifier. This amplifier takes a positive voltage on the negative input through a resistor, and get a negative voltage on the output of the amplifier. So does the negative voltage input.



The supply voltage must be larger than the input voltage range and output range.

14.2 Detailed Design Procedure

Determine the gain required by the inverting amplifier using Equation 1

$$A_V = \frac{V_{OUT}}{V_{IN}} \quad (1)$$

$$A_V = -\frac{1.8}{0.5} = -3.6 \quad (2)$$

Once the desired gain is determined, R_I and R_F should be in kilohm range in case too much current is drawn away. For example, R_I is 10 kΩ and R_F is 36 kΩ, the gain is determined by Equation 3.

$$A_V = -\frac{R_F}{R_I} \quad (3)$$

14.3 Layout of Typical Application Circuits

Layout Guidelines

1.Connect low-ESR, 0.1 μF ceramic bypass capacitors between each supply pin and ground, placed as close to the device as possible.

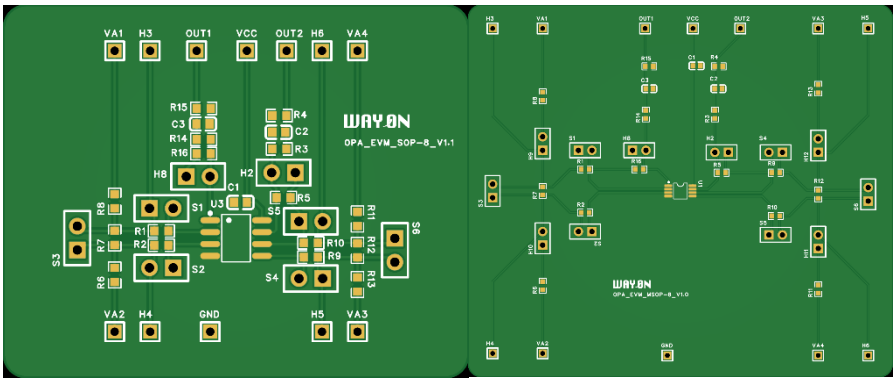
2. Separate grounding for analog and digital portions.

3. Run the input traces as far away from the supply or output traces as possible.

4. Place the external components as close to the device as possible.

5. Keep the length of input traces as short as possible.

Layout Example：



15. Naming Conventions

WA B CCC(H)-DDD E

WA: WAYON Analog signal chain

B: 3 - operational amplifier

CCC(H): serial number

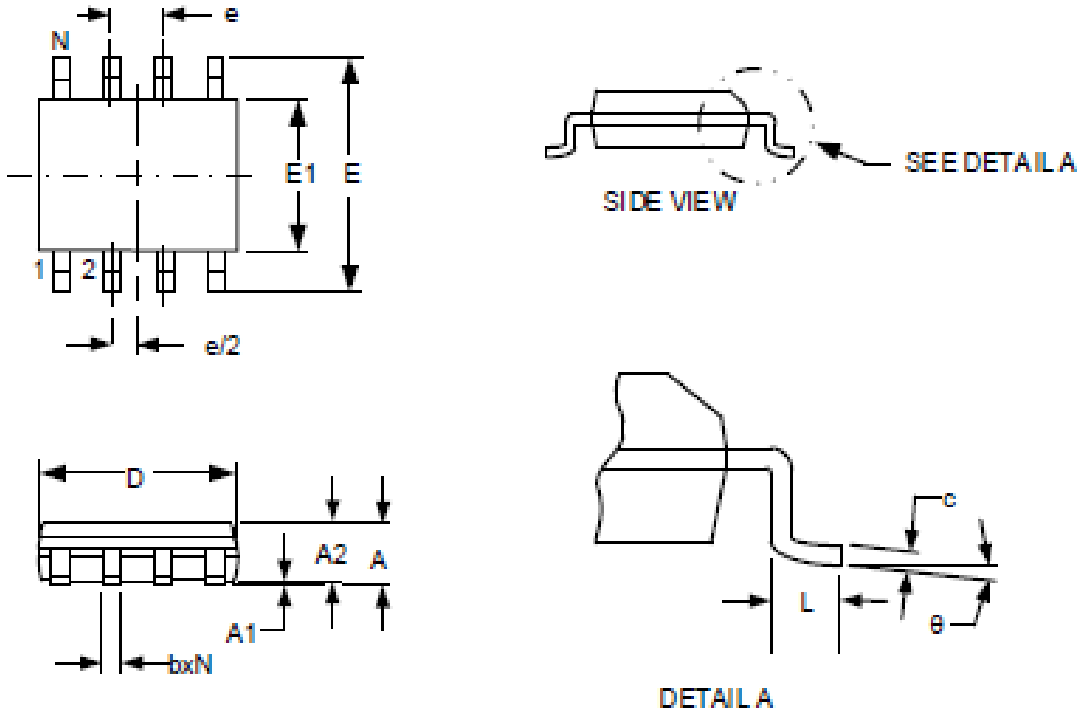
DDD: S80-Package, SOP-8

M80-Package, MSOP-8

E: R-Reel & T-tube

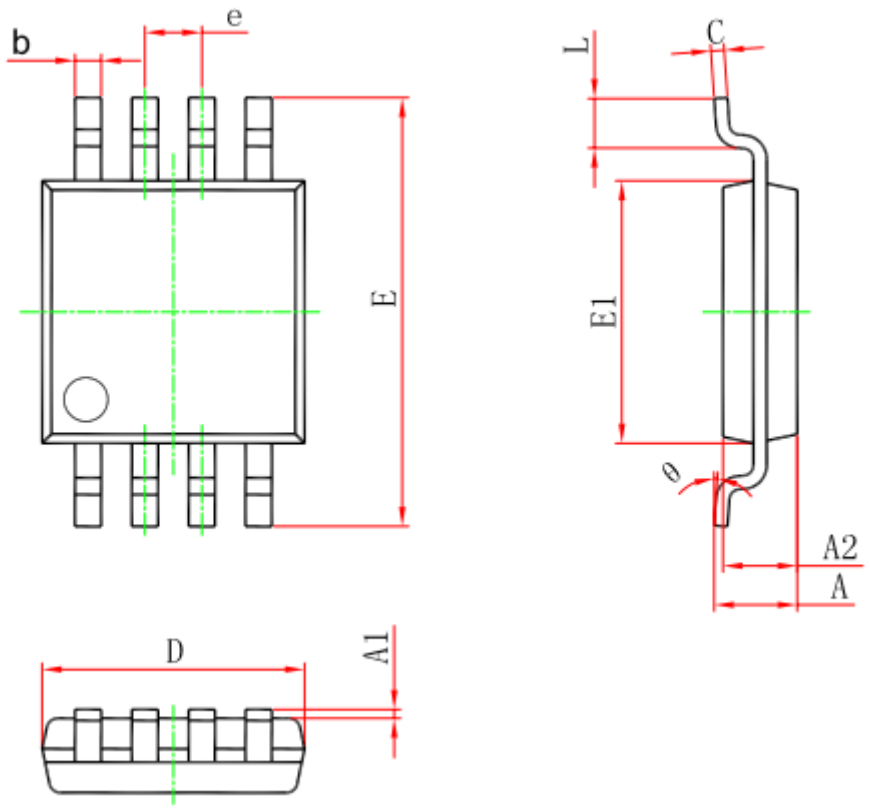
16. Package Information

SOP-8



SYMBOL	DIMENSIONS IN MILLIMETERS	
	MIN	MAX
A	1.25	1.90
A1	0.00	0.25
A2	1.25	1.65
b	0.31	0.51
c	0.15	0.30
D	4.70	5.20
E1	3.70	4.10
E	5.75	6.25
e	1.27BSC	
L	0.4	1.27
θ	0°	8°
N	8	

MSOP8



SYMBOL	DIMENSIONS IN MILLIMETERS	
	MIN	MAX
A	-	1.100
A1	0.020	0.150
A2	0.750	0.950
b	0.250	0.380
c	0.090	0.230
D	2.900	3.100
E1	2.900	3.100
E	4.700	5.100
e	0.650BSC	
L	0.400	0.800
θ	0°	8°

17. Ordering Information

PART NUMBER	PACKAGE	PACKING QUANTITY	MARKING*
WA3358-S80R	SOP-8	4k/Reel	WA3358 XXXX
WA3358-M80R	MSOP-8	3k/Reel	WA3358 XXXX
WA3358H-S80R	SOP-8	4k/Reel	WA3358 XXXX
WA3358H-M80R	MSOP-8	3k/Reel	WA3358 XXXX

* XXXX is variable.

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For additional information, please contact your local Sales Representative.
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Product Specification Statement

1.The product specification aims to provide users with a reference regarding various product parameters, performance, and usage. It presents certain aspects of the product's performance in graphical form and is intended solely for users to select product and make product comparisons, enabling users to better understand and evaluate the characteristics and advantages of the product. It does not constitute any commitment, warranty, or guarantee.

2.The product parameters described in the product specification are numerical values, characteristics, and functions obtained through actual testing or theoretical calculations of the product in an independent or ideal state. Due to the complexity of product applications and variations in test conditions and equipment, there may be slight fluctuations in parameter test values. WAYON shall not guarantee that the actual performance of the product when installed in the customer's system or equipment will be entirely consistent with the product specification, especially concerning dynamic parameters. It is recommended that users consult with professionals for product selection and system design. Users should also thoroughly validate and assess whether the actual parameters and performance when installed in their respective systems or equipment meet their requirements or expectations. Additionally, users should exercise caution in verifying product compatibility issues, and WAYON assumes no responsibility for the application of the product.

3.WAYON strives to provide accurate and up-to-date information to the best of our ability. However, due to technical, human, or other reasons, WAYON cannot guarantee that the information provided in the product specification is entirely accurate and error-free. WAYON shall not be held responsible for any losses or damages resulting from the use or reliance on any information in these product specifications. WAYON reserves the right to revise or update the product specification and the products at any time without prior notice, and the user's continued use of the product specification is considered an acceptance of these revisions and updates. Prior to purchasing and using the product, users should verify the above information with WAYON to ensure that the product specification is the most current, effective, and complete. If users are particularly concerned about product parameters, please consult WAYON in detail or request relevant product test reports. Any data not explicitly mentioned in the product specification shall be subject to separate agreement.

4.Users are advised to pay attention to the parameter limit values specified in the product specification and maintain a certain margin in design or application to ensure that the product does not exceed the parameter limit values defined in the product specification. This precaution should be taken to avoid exceeding one or more of the limit values, which may result in permanent irreversible damage to the product, ultimately affecting the quality and reliability of the system or equipment.

5.The design of the product is intended to meet civilian needs and is not guaranteed for use in harsh environments or precision equipment. It is not recommended for use in systems or equipment such as medical devices, aircraft, nuclear power, and similar systems, where failures in these systems or equipment could reasonably be expected to result in personal injury. WAYON shall assume no responsibility for any consequences resulting from such usage.

6.Users should also comply with relevant laws, regulations, policies, and standards when using the product specification. Users are responsible for the risks and liabilities arising from the use of the product specification and must ensure that it is not used for illegal purposes. Additionally, users should respect the intellectual property rights related to the product specification and refrain from infringing upon any third-party legal rights. WAYON shall assume no responsibility for any disputes or controversies arising from the above-mentioned issues in any form.