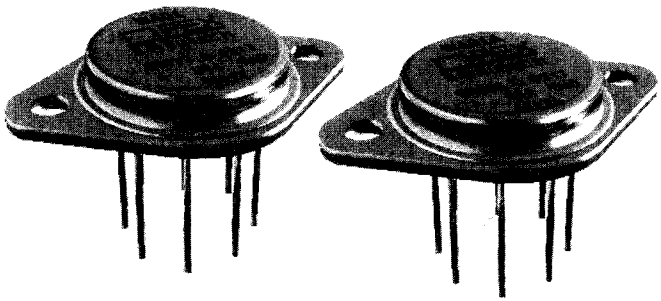
FEATURES

- SUPER SLEW — 5000V/μs
- HIGH BANDWIDTH — 100MHz
- OUTPUT CURRENT TO 400mA
- PIN COMPATIBILITY WITH 3554
- HIGH DC ACCURACY — ±5mV Vos
- LOW DISTORTION — 70dB at 100kHz

APPLICATIONS

- LINE DRIVERS
- DATA ACQUISITION SYSTEMS
- SAMPLE AND HOLD CIRCUITS
- VIDEO PROCESSING
- FUNCTION GENERATIONS
- ATE PIN DRIVER



PATENT PENDING

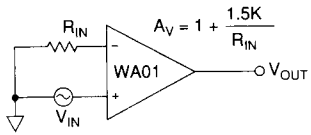
DESCRIPTION

The WA01 uses low impedance push-pull circuits to achieve high speed amplification. The output node of each amplifier stage consists of two transistors, with the first transistor driving the signal in one direction and the second in the other direction. As a result, speed is enhanced, and a lower, much more linear output impedance, is obtained. This technique also exhibits low input impedance which is more compatible with high speed signal processing.

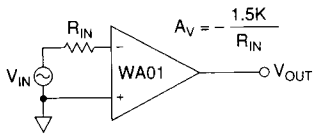
Unlike conventional op amps, the feedback resistor is included in the package. At 1.5K ohms, it provides a transimpedance function of 1.5V/1mA. Standard inverting and non-inverting op amp configurations may be implemented using fewer external components than would otherwise be required. The resultant feedback path is much shorter than when using a conventional external feedback element. As a result, summing node capacitance to ground is lower, and, thus, high frequency characteristics are very stable. To enhance the input characteristics of this wideband amplifier, sophisticated bias current cancellation and voltage offset trim networks have been added to the input stage.

This hybrid circuit utilizes thick film (cermet) resistors, ceramic capacitors, and silicon semiconductor chips to maximize reliability, minimize size, and give top performance. Ultrasonically bonded aluminum wires provide reliable interconnections at all operating temperatures. The 8-pin TO-3 package is hermetically sealed and electrically isolated. The use of compressible thermal washers and/or improper mounting torque will void the product warranty. Please see "General Operating Considerations".

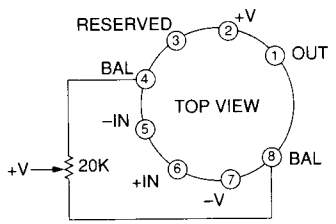
NONINVERTING GAIN



INVERTING GAIN

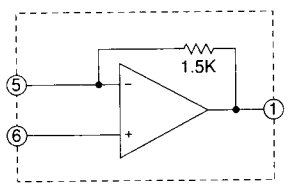


EXTERNAL CONNECTIONS



OFFSET POTENTIOMETER (OPTIONAL)

EQUIVALENT SCHEMATIC



ABSOLUTE MAXIMUM RATINGS

SUPPLY VOLTAGE, $+V_S$ to $-V_S$	32V
OUTPUT CURRENT, within SOA	400mA
POWER DISSIPATION, internal	10.5W
INPUT VOLTAGE, differential	±6V
INPUT VOLTAGE, common mode	$\pm V_S$
TEMPERATURE, pin solder - 10s	300°C
TEMPERATURE, junction[1]	175°C
TEMPERATURE RANGE, storage	–65 to +150°C
OPERATING TEMPERATURE RANGE, case	–25 to +85°C

SPECIFICATIONS

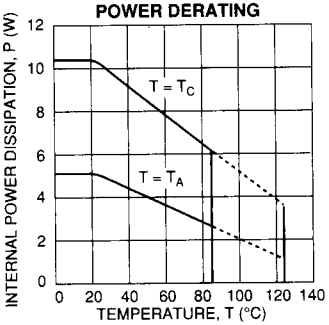
PARAMETER	TEST CONDITIONS[2]	WA01 MIN	WA01 TYP	WA01 MAX	WA01A MIN	WA01A TYP	WA01A MAX	UNITS
INPUT								
OFFSET VOLTAGE, Initial	T_C = 25°C		±4	±10		±2	5	mV
OFFSET VOLTAGE, vs. Temperature	Full temperature range		15	50		10	25	µV/°C
OFFSET VOLTAGE, vs. Supply	T_C = 25°C		5	10		*	*	mV/V
OFFSET VOLTAGE, vs. Power	Full temperature range		20			10		µV/W
BIAS CURRENT, initial, +IN	T_C = 25°C		5	20		3	10	µA
BIAS CURRENT, vs. Supply	T_C = 25°C		.01			*		pA/V
INPUT IMPEDANCE, DC	T_C = 25°C		200			*		kΩ
INPUT CAPACITANCE	T_C = 25°C		6			*		pF
COMMON MODE VOLTAGE RANGE[3]	Full temperature range		$\pm V_S$–7.5		*	*		V
COMMON MODE REJECTION, DC[3]	Full temp. range, V_{CM} = ±5V	48	54		*	*		dB
POWER SUPPLY REJECTION, DC[3]	Full temp. range, V_S = 24 to 30	60	75					dB
GAIN								
ACCURACY	T_C = 25°C, F = DC		2	5		1	2	%
POWER BANDWIDTH	T_C = 25°C, I_O = .4A, V_O = $20V_{PP}$		40			*		MHz
	T_C = 25°C, I_O = .05A, V_O = $4V_{PP}$		80			*		MHz
GAIN FLATNESS	DC to 75MHz, A_V = –10		1			*		dB
OUTPUT								
VOLTAGE SWING[3]	T_C = 25°C, I_O = .4A	$\pm V_S$–4.5			*			V
VOLTAGE SWING[3]	Full temp. range, I_O = .2A	$\pm V_S$–4			*			V
VOLTAGE SWING[3]	Full temp. range, I_O = .1A	$\pm V_S$–3.5			*			V
CURRENT, limit	T_C = 25°C		.6			*		A
SETTLING TIME to .1%	T_C = 25°C, 10V step		20			*		ns
SLEW RATE	T_C = 25°C		5000			*		V/µs
CAPACITIVE LOAD	Full temperature range, A_V = 1	22			*			pF
CAPACITIVE LOAD	Full temperature range, A_V = 30	47			*			pF
PROPAGATION DELAY	T_C = 25°C, A_V = 1		2.9			*		ns
POWER SUPPLY								
VOLTAGE	Full temperature range	±12	±15	±16		*	*	V
CURRENT, quiescent	T_C = 25°C		28	30		*	*	mA
THERMAL								
RESISTANCE, AC, junction to case[4]	Full temp. range, F > 60Hz		9	10		*	*	°C/W
RESISTANCE, DC, junction to case	Full temp. range, F < 60Hz		12	14		*	*	°C/W
RESISTANCE, junction to air	Full temp range		30			*		°C/W
TEMPERATURE RANGE, case	Meets full range specifications	–25		+85	*		*	°C

NOTES: * The specification of WA01A is identical to the specification for WA01 in same category column to the left.

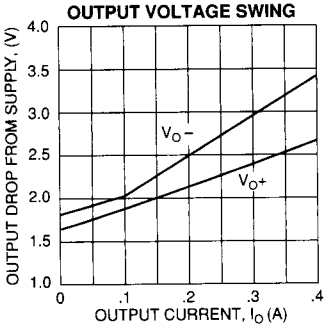
1. Long term operation at the maximum junction temperature will result in reduced product life. Derate internal power dissipation to achieve high MTTF.
2. The power supply voltage for all specifications is the TYP rating unless noted as a test condition.
3. $+V_S$ and $-V_S$ denote the positive and negative supply rail respectively. Total V_S is measured from $+V_S$ to $-V_S$.
4. Rating applies if the output current alternates between both output transistors at a rate faster than 60Hz.

CAUTION The internal substrate contains beryllia (BeO). Do not break the seal. If accidentally broken, do not crush, machine, or subject to temperatures in excess of 850°C to avoid generating toxic fumes.

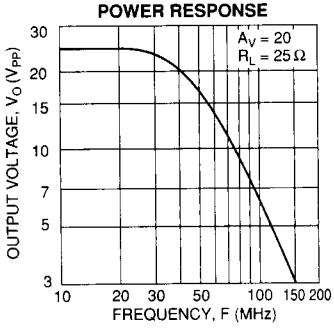
POWER DERATING



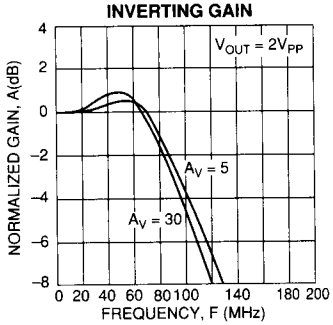
OUTPUT VOLTAGE SWING



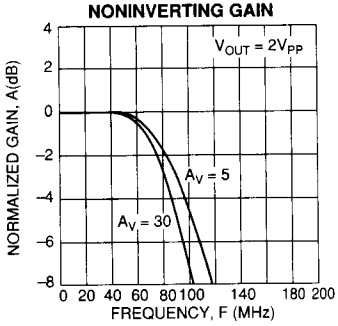
POWER RESPONSE



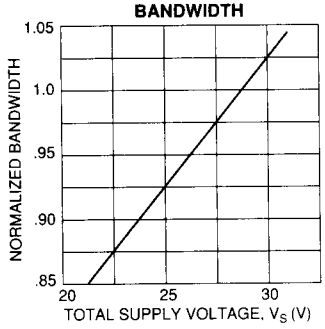
INVERTING GAIN



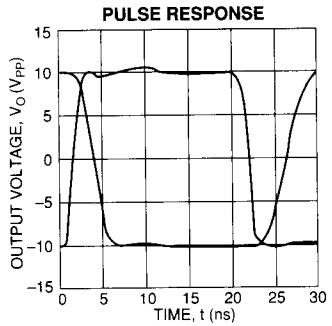
NONINVERTING GAIN



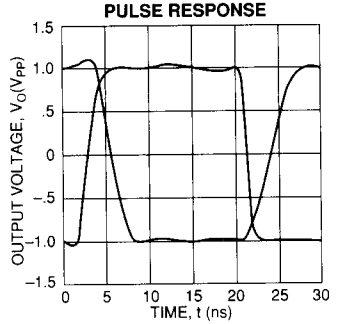
BANDWIDTH



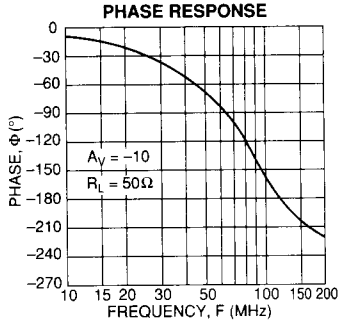
PULSE RESPONSE



PULSE RESPONSE



PHASE RESPONSE



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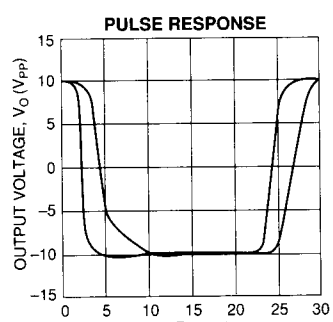
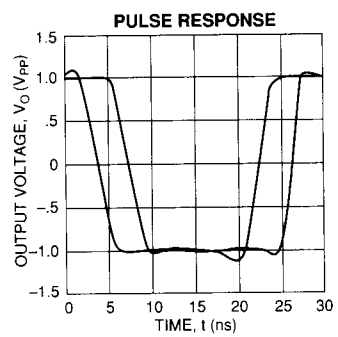
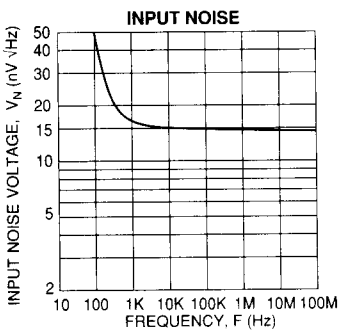


PULSE RESPONSE



INPUT NOISE



GENERAL

Please read the "General Operating Considerartions" section, which covers stability, supplies, heatsinking, mounting, current limit, SOA interpretation, and specification interpretation. Additional information can be found in the application notes. For information on the package outline, heatsinks, and mounting hardware, consult the "Accessory and Package Mechanical Data" section of the handbook.

BYPASSING OF SUPPLIES

Each rail must be bypassed to common with a tantalum capacitor in parallel with a ceramic capacitor directly connected from the power supply pins to the ground plane. The ceramic bypass capacitor should have leads as short as possible, be mounted as close to the supply pin as possible, and have a series resonant frequency above 200MHz, including lead inductance. A typical range would be 2.2 to 10μF for the tantalum and 500pF to 3000pF for the ceramic.

LEADS

Keep the output, supply, and bypass leads as short as possible. In the video frequency range, even a few inches of wire has significant inductance, raising the interconnection inpedance and limiting the output current slew rate. Furthermore, the skin effect increases the resistance of heavy wires at high frequencies. Multistrand Litz wire is recommended for high frequency use with low losses.

GROUNDING

Single point grounding of the input resistors and input signal to a common ground plane will prevent undesired current feedback which can cause errors and/or instabilities. Also, the case is electrically isolated (floating) with respect to the internal circuit. It is recommended that the case be connected to the same common ground plane as the inputs.

SAFE OPERATING AREA (SOA)

The bipolar output stage of this wideband amplifier has two distinct limitations:

1. The internal current limit limits maximum available output current.
2. The junction temperature of the output devices.

Compliance within the power derating curve guarantees maximum junction temperature is met.

CURRENT LIMIT

Internal current limit is set using a 1.2Ω ±20% resistor and one transistor VBE drop. Nominal current limit at T_C = 25°C is:

$$I_{LIM} = V_{BE}/R_{CL};\ .54A = .65V/1.2\Omega.$$

Temperature variance of the current limit is dominated by the VBE temperature coefficient of –2mV/°C. For a case temperature of +85°C, the nominal current limit is:

$$.442A = [.65 - (60°C)(2mV/°C)]/[1.2\Omega].$$

GAIN SETTING

Unlike other APEX amplifiers, the WA01's feedback resistor is inside the package. This reduces external part count as well as increases performance. To determine the value of the resistor required to achieve the desired gain, the following formulas are necessary:

NONINVERTING	$R_{IN} = 1.5K/(A_V-1)$
INVERTING	$R_{IN} = 1.5K/A_V$

BALANCE CONTROL

The voltage offset of the WA01 is laser trimmed at the factory. To externally zero residual errors in applications where offset is critical, a 20K ohm potentiometer may be installed between pins 4 and 8, and the wiper arm connected to the positive supply. If the optional adjust provision is not used, and setting time is important, tie pin 8 to AC ground with 100–150pF.

STABILITY

The use of an internal feedback resistor of low impedance insures ease of use and stability of the WA01. Additionally, the architecture provides for a constant bandwidth at different gain settings without the need for external compensation. Although the WA01 is stable and well behaved at high frequency, a good PC layout is essential for optimum performance. A layout that keeps inductances, capacitances, and trace lengths to a minimum will prevent oscilliations. To avoid peaking at high frequency when driving a capacitive load, a small resistor (1 to 22 ohms) may be placed between the output and the load to lower the Q of any parasitic resonant circuit that might occur.

WA01U REV. G SEPTEMBER 1993