HARRIS SEMICONDUCTOR
A DIVISION OF HARRIS CORPORATION

HA-2060/2065/ 2060A/2065A

Wide Band F.E.T. Input Operational Amplifier

FEATURES

- GAIN BANDWIDTH PRODUCT 100MHz
- HIGH INPUT IMPEDANCE 10^{12} OHMS
- LOW BIAS CURRENT 1pA
- HIGH SLEW RATE 35V/μs
- WIDE POWER BANDWIDTH 600kHz
- TRUE OP AMP – CAN BE OPERATED INVERTING OR NON-INVERTING

APPLICATIONS

- SIGNAL CONDITIONING
- ACTIVE FILTERS
- SIGNAL GENERATORS

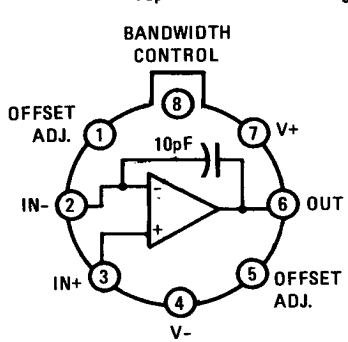
DESCRIPTION

The HA-2060/2065 is an operational amplifier combining the advantages of very wide bandwidth and high slew rate with ultra-low input current and high input resistance. These devices are ideal for use in sample-and-hold circuits, active filters, wide band amplifiers, high gain amplifiers with superior bandwidth, and wherever very low closed loop gain and phase shift errors are required. The device may be operated inverting or noninverting; and external compensation is required only when operating at closed loop gains less than five. An internal feedback capacitor is provided to cancel phase shift in the feedback loop due to input capacitance.

The HA-2060 is guaranteed for operation from -55°C to +125°C and the HA-2065 is guaranteed from 0°C to +75°C.

PINOUT

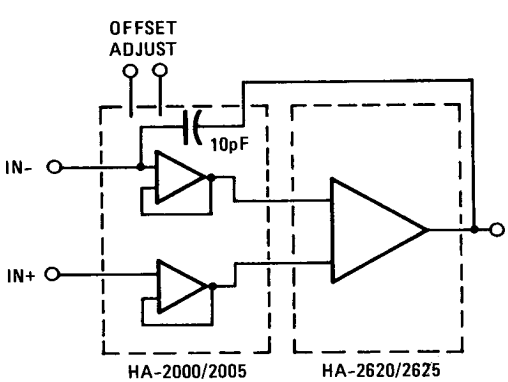
TO-99 Top View **Package Code 2A**



Case Connected to V+

CAUTION: These devices are sensitive to electrostatic discharge. Users should follow IC Handling Procedures specified on pg. 1-4.

FUNCTIONAL DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Voltage Between V+ and V- Terminals	35.0V	Internal Power Dissipation (Note 10)	300mW
Differential Input Voltage	±12V	Operating Temp. Range	$-55^{\circ}C \leq T_A \leq +125^{\circ}C$ (HA-2060)
Output Current / Full Short Circuit Protection			$0^{\circ}C \leq T_A \leq +75^{\circ}C$ (HA-2065)
		Storage Temp. Range	$-65^{\circ}C \leq T_A \leq +150^{\circ}C$

ELECTRICAL CHARACTERISTICS

Test Conditions: $V_{Supply} = \pm 15.0V$ unless otherwise specified.

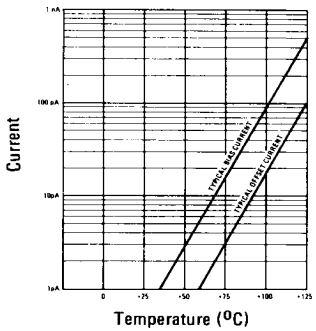
PARAMETER	TEMP.	HA-2060/HA-2060A -55°C to +125°C LIMITS MIN.	TYP.	MAX.	HA-2065/HA-2065A 0°C to +75°C LIMITS MIN.	TYP.	MAX.	UNITS
INPUT CHARACTERISTICS								
* Offset Voltage (Note 1)								
HA-2060 / HA-2065	+25°C		15	25		15	60	mV
	Full			30			65	mV
HA-2060A / HA-2065A	+25°C		7	12		7	12	mV
	Full			15			15	mV
Bias Current	+25°C		1	20		1	20	pA
* (125°C)	Full		0.5	10		0.02	1	nA
Offset Current	+25°C		0.5	20		0.5	20	pA
* (125°C)	Full		0.1	5		.005	.5	nA
Input Resistance	+25°C		10^{12}			10^{12}		Ω
Input Capacitance	+25°C		5			5		pF
Common Mode Range	Full	±10.0			±10.0			V
TRANSFER CHARACTERISTICS								
* Large Signal Voltage Gain (Note 2 5)	+25°C	80K	150K		80K	150K		V/V
	Full	60K			70K			V/V
* Common Mode Rejection Ratio (Note 3)	Full	74	90		70	90		dB
Gain Bandwidth Product (Note 4)	+25°C		100			100		MHz
OUTPUT CHARACTERISTICS								
* Output Voltage Swing (Note 2)	Full	±10	±12		±10	±12		V
* Output Current	+25°C	±10	±18		±10	±18		mA
Full Power Bandwidth (Note 5)	+25°C		600			600		kHz
TRANSIENT RESPONSE (NOTES 2, 8, 9)								
Rise Time (Note 6)	+25°C		50			50		ns
Overshoot (Note 6)	+25°C		25			25		%
Slew Rate (Note 5)	+25°C		35			35		V/μs
POWER SUPPLY CHARACTERISTICS								
* Supply Current	+25°C		4.0	6.0		4.0	6.0	mA
* Power Supply Rejection Ratio (Note 7)	Full	74	90		70	90		dB

NOTES:
1. Adjustable to zero with 100K Ω pot between pins 1 and 5; wiper to V+.
2. $R_L = 2K$
3. $V_{CM} = \pm 5.0V$
4. $A_V > 10$
5. $V_O = \pm 10V$
6. $V_O = \pm 200mV$
7. $\Delta V = \pm 5.0V$
8. $C_L = 50 pF$
9. $A_V = +5$, See transient response test circuits and waveforms, page 4.
10. Derate by 6.6mW/°C above 105°C

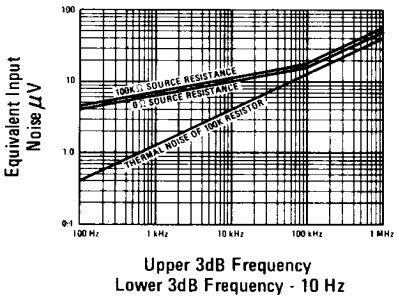
*100% Tested for DASH 8

V+ = 15VDC, V- = 15VDC, T_A = 25°C UNLESS OTHERWISE STATED

INPUT BIAS AND OFFSET CURRENT VS. TEMPERATURE

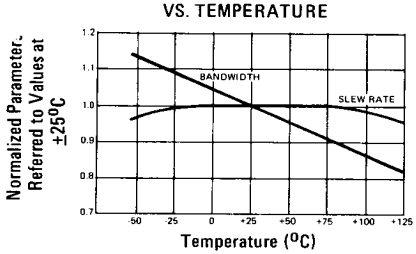


EQUIVALENT INPUT NOISE VS. BANDWIDTH

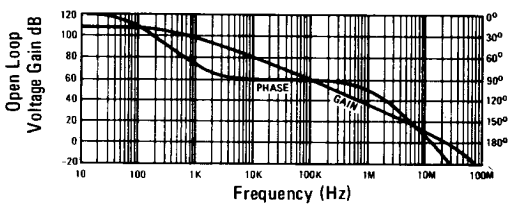


Upper 3dB Frequency
Lower 3dB Frequency - 10 Hz

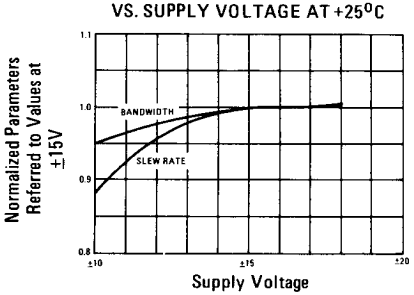
NORMALIZED AC PARAMETERS VS. TEMPERATURE



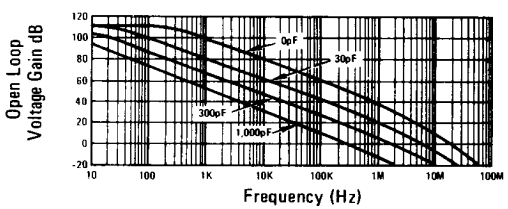
OPEN-LOOP FREQUENCY AND PHASE RESPONSE



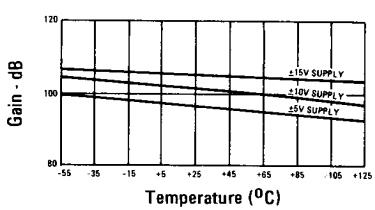
NORMALIZED AC PARAMETERS VS. SUPPLY VOLTAGE AT +25°C



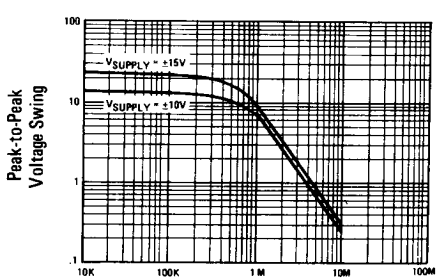
OPEN LOOP FREQUENCY RESPONSE FOR VARIOUS VALUES OF CAPACITORS FROM BANDWIDTH CONTROL PIN TO GROUND



OPEN LOOP VOLTAGE GAIN VS. TEMPERATURE

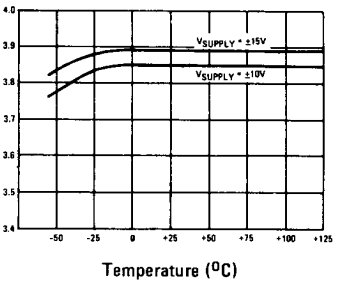


OUTPUT VOLTAGE SWING VS. FREQUENCY AT +25°C

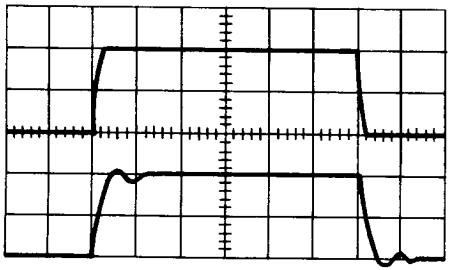


PERFORMANCE CURVES (continued)

POWER SUPPLY CURRENT VS. TEMPERATURE

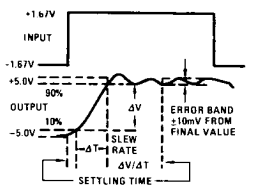


TRANSIENT RESPONSE; A_V= +5

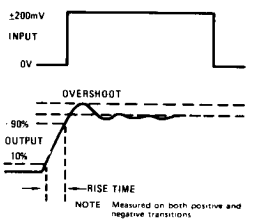


R_L = 2K Ohms, C_L = 50pF
Upper Trace: Input; 20mV/Div.
Lower Trace: Output; 100mV/Div.
Horizontal = 100ns/Div.
T_A = +25°C, V_S = ±15V

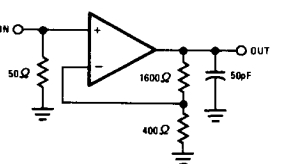
SLEW RATE AND SETTLING TIME



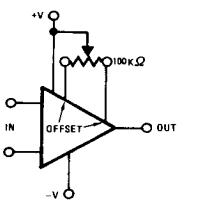
TRANSIENT RESPONSE



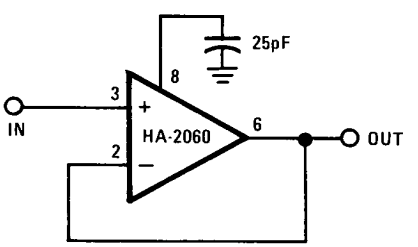
SLEW RATE AND TRANSIENT RESPONSE



SUGGESTED OFFSET ZERO ADJUST HOOK-UP



TYPICAL APPLICATIONS



COMPENSATION CIRCUIT FOR UNITY GAIN

SLEW RATE ≈ 5 V/μs

BANDWIDTH ≈ 10 MHz