May 1990

Operational Amplifiers

For Commercial, Industrial, and Military Applications

Features:

- *Short-circuit protection and latch-free operation*
- *Unity-gain phase compensation with a single 30-pF capacitor*
- *Replacement for industry types 101, 201, 301A*
- *CA301A Slew Rate (Summing ampl.) 10 V/µs*

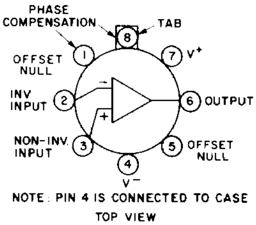
Applications:

- *Long-interval integrator*
- *Timers*
- *Sample-and-hold circuits*
- *Summing amplifiers*
- *Multivibrators*
- *Comparators*
- *Instrumentation*
- *AC/DC converters*
- *Inverting amplifiers*
- *Sine- & square-wave generators*
- *Capacitance multipliers & simulated inductors*

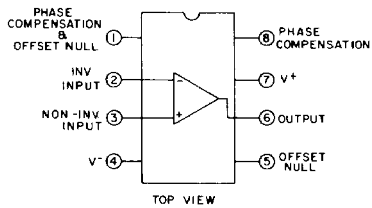
The CA101, CA201, and CA301A are general-purpose, high-gain operational amplifiers for use in military, industrial, and commercial applications.

These types, which are externally phase compensated, permit a choice of operation for optimum high-frequency performance at a selected gain; unity-gain compensation can be obtained with a single 30-pF capacitor.

All types are available in 8-lead TO-5 style packages with standard leads (T suffix), and with dual-in-line formed leads ("DIL-CAN", S suffix). The CA301A is also available in the 8-lead dual-in-line plastic package ("MINI-DIP", E suffix), and in chip form (H suffix).



(a) TO-5 Style package for all types
T-Suffix
S-Suffix



(b) Plastic package for CA301A
E-Suffix

Figure 1 - Functional diagrams.

*Technical Data on LM Branded types is identical to the corresponding CA Branded types.

Maximum Ratings, *Absolute Maximum Values at T_A = 25° C:*

DC SUPPLY VOLTAGE (Between V+ and V⁻ Terminals):	
CA101, CA201	44 V
CA301A	36 V
DC INPUT VOLTAGE	±15 V
(For supply voltages less than ±15 V, the Input Voltage rating is equal to the DC Supply Voltage)	
DIFFERENTIAL INPUT VOLTAGE	±30 V
OUTPUT SHORT-CIRCUIT DURATION	Indefinite*
DEVICE DISSIPATION:	
UP TO T_A = 75° C	500 mW
Above T_A = 75° C Derate linearly at	6.67 mW/° C
AMBIENT TEMPERATURE RANGE:	
Operating —	
CA101	-55 to +125° C
CA201, CA301A	0 to +70° C
Storage (All types)	-65 to +150° C
LEAD TEMPERATURE (During Soldering):	
At a distance 1/16" ± 1/32" (1.59 ± 0.79 mm) from case for 10 seconds max.	+265° C

* At $T_A \leq 70°$ C and $T_C \leq 125°$ C (CA101); $T_A \leq 55°$ C and $T_C \leq 70°$ C (CA201, CA301A).

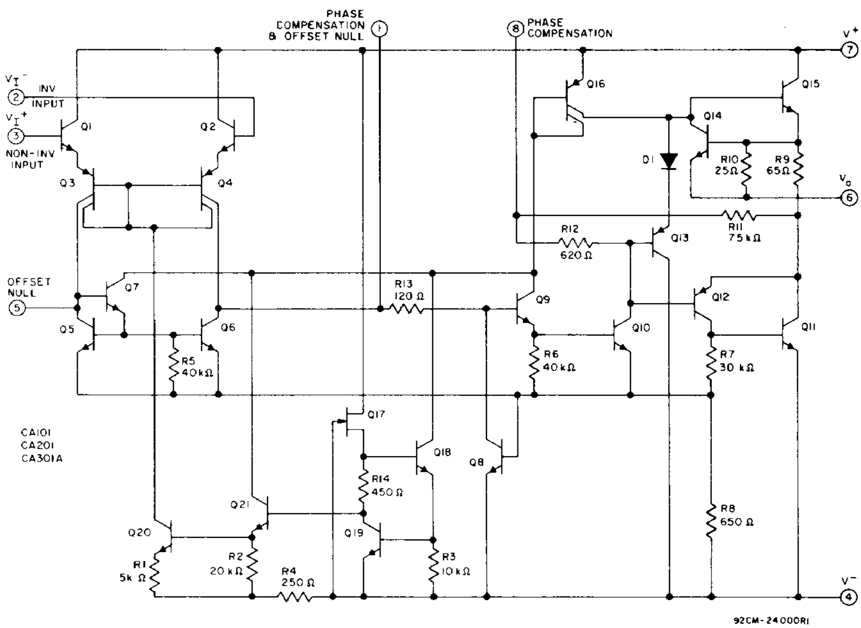


Fig. 2 - Schematic diagram.

ELECTRICAL CHARACTERISTICS

CHARACTERISTICS	TEST CONDITIONS Δ Supply Voltage (V±) = 5 to 15 V	LIMITS CA101 Min.	CA101 Typ.	CA101 Max.	CA201 Min.	CA201 Typ.	CA201 Max.	CA301A Min.	CA301A Typ.	CA301A Max.	UNITS
Input Offset Voltage V_{IO}	T_A=25° C R_S≤10kΩ	—	1	5	—	2	7.5	—	—	—	mV
	R_S≤50kΩ	—	—	—	—	—	—	—	2	7.5	
	R_S≤10kΩ	—	—	6	—	—	10	—	—	—	
	R_S≤50kΩ	—	—	—	—	—	—	—	—	10	
Average Temperature Coefficient of Input Offset Voltage αV_{IO}	R_S≤10kΩ	—	6	—	—	10	—	—	—	—	μV/° C
	R_S≤50Ω	—	3	—	—	6	—	—	—	—	
		—	—	—	—	—	—	—	6	30	
Average Temperature Coefficient of Input Offset Current αI_{IO}	-55° C to +25° C	—	—	—	—	—	—	—	—	—	nA/° C
	0° C to +25° C	—	—	—	—	—	—	—	0.02	0.6	
	+25° C to +70° C	—	—	—	—	—	—	—	0.01	0.3	
	+25° C to +125° C	—	—	—	—	—	—	—	—	—	
Input Offset Current I_{IO}	T_A = 0° C	—	—	—	—	150	750	—	—	—	nA
	T_A = 25° C	—	40	200	—	100	500	—	3	50	
	T_A = 70° C	—	—	—	—	50	400	—	—	—	
	T_A = 125° C	—	10	200	—	—	—	—	—	—	
		—	—	—	—	—	—	—	—	70	
	T_A = -55° C	—	100	500	—	—	—	—	—	—	
Input Bias Current I_{IB}	T_A = -55° C	—	0.28	1.5	—	—	—	—	—	—	μA
	T_A = 0° C	—	—	—	—	0.32	2	—	—	—	
	T_A = 25° C	—	0.12	0.5	—	0.25	1.5	—	0.07	0.25	
		—	—	—	—	—	—	—	—	0.3	
Supply Current I±	T_A=25° C V±=15V	—	—	—	—	—	—	—	1.8	3	mA
	V±=20V	—	1.8	3	—	1.8	3	—	—	—	
	T_A=125° C V±=20V	—	1.2	2.5	—	—	—	—	—	—	
Open-Loop Differential Voltage Gain A_{OL}	T_A=25° C V±=15V V_O=±10V R_L≥2kΩ	50	160	—	20	150	—	25	160	—	V/mW
	V±=15V V_O=±10V R_L≥2kΩ	25	—	—	15	—	—	15	—	—	
Input Resistance R_I	T_A=25° C	0.3	0.8	—	0.1	0.4	—	0.5	2	—	MΩ
Output Voltage Swing V_{OPP}	V±=15V R_L=10kΩ	±12	±14	—	±12	±14	—	±12	±14	—	V
	V±=15V R_L=2kΩ	±10	±13	—	±10	±13	—	±10	±13	—	
Common-Mode Input-Voltage Range V_{ICR}	V±=15V	±12	—	—	±12	—	—	±12	—	—	V
	V±=20V	—	—	—	—	—	—	—	—	—	
Common-Mode Rejection Ratio CMRR	R_S≤10kΩ	70	90	—	65	90	—	—	—	—	dB
	R_S≤50kΩ	—	—	—	—	—	—	70	90	—	
Supply-Voltage Rejection Ratio PSRR	R_S≤10kΩ	70	90	—	70	90	—	—	—	—	dB
	R_S≤50kΩ	—	—	—	—	—	—	70	90	—	

Δ Characteristics applicable over operating temperature range (T_A) as shown below, unless otherwise specified:
CA101: -55 to +125° C; CA201, CA301A: 0 to 70° C

TYPICAL STATIC CHARACTERISTICS

TYPE CA101

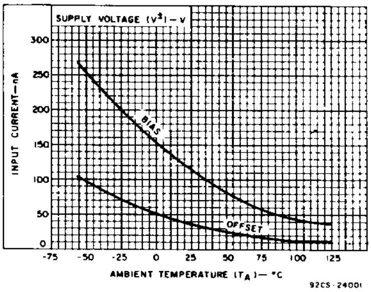


Fig. 3 - Input current (IIO, IIB) vs. temperature.

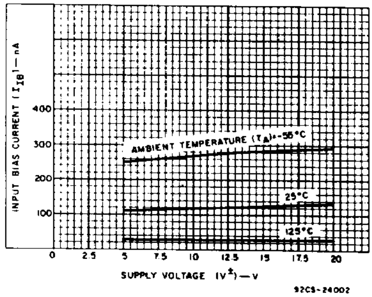


Fig. 4 - Input bias current vs. supply voltage.

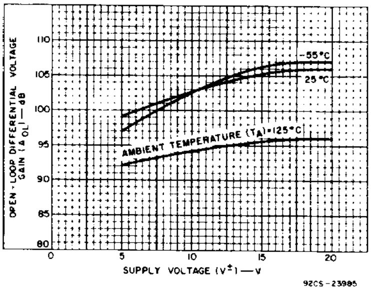


Fig. 5 - Voltage gain vs. supply voltage.

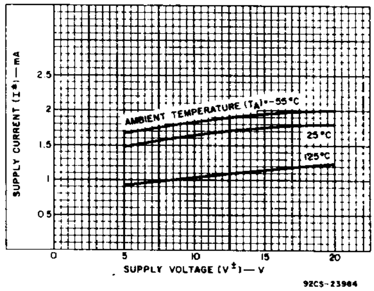


Fig. 6 - Supply characteristics.

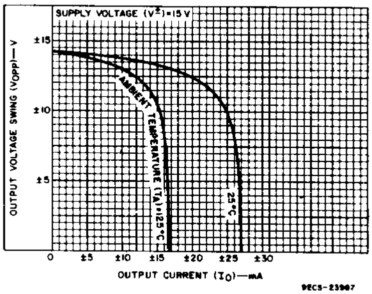


Fig. 7 - Output characteristics.

TYPE CA201

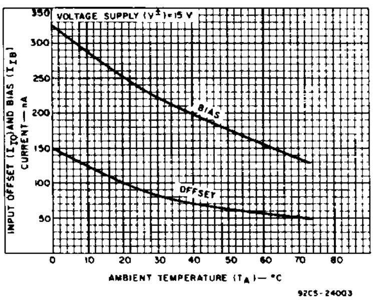


Fig. 8 - Input current (IIO, IIB) vs. temperature.

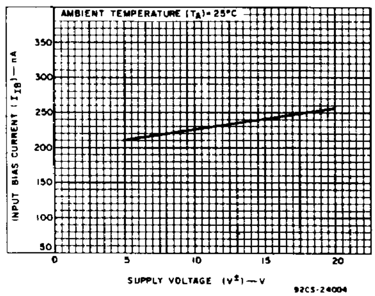


Fig. 9 - Input bias current (IIB) vs. supply voltage.

TYPICAL STATIC CHARACTERISTICS (Cont'd)

TYPE CA201

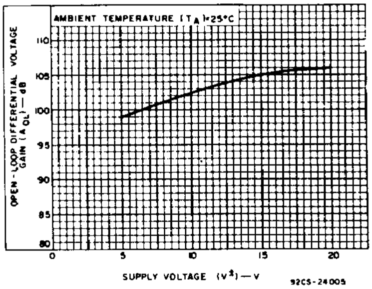


Fig. 10 - Voltage gain vs. supply voltage.

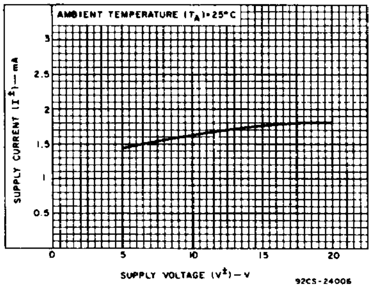


Fig. 11 - Supply characteristics.

TYPE CA301A

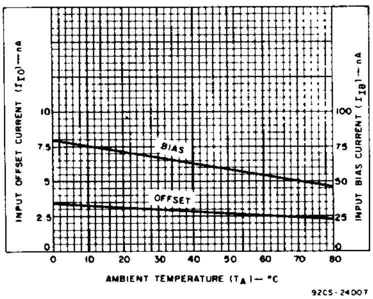


Fig. 12 - Input current (IIO, IIB) vs. temperature.

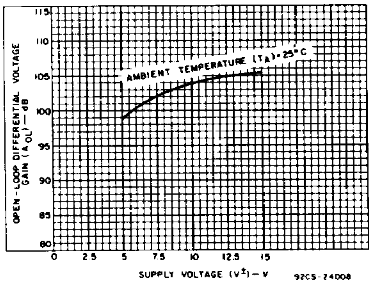


Fig. 13 - Voltage gain vs. supply voltage.

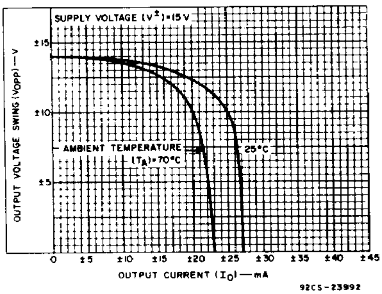


Fig. 14 - Output characteristics.

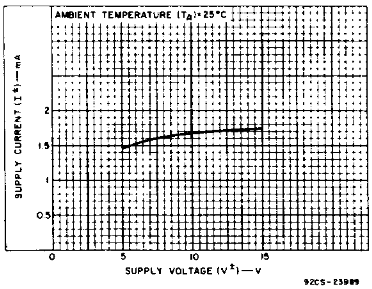


Fig. 15 - Supply characteristics.

TYPICAL DYNAMIC CHARACTERISTICS

TYPES CA101, CA201, CA301A

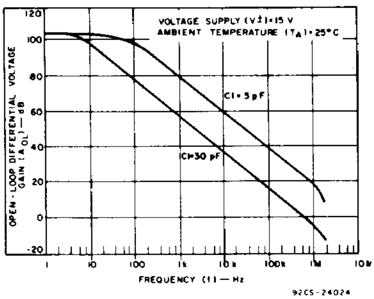


Fig. 16 - Voltage gain vs. frequency.

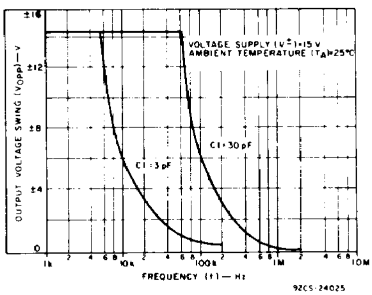


Fig. 17 - Output voltage swing vs. frequency.

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OPERATIONAL AMPLIFIERS

TYPICAL DYNAMIC CHARACTERISTICS (Cont'd) FOR TYPES CA101, CA201 AND CA301A

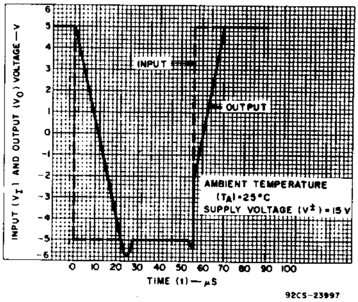


Fig. 18 - Voltage follower pulse response.

TYPE CA301A

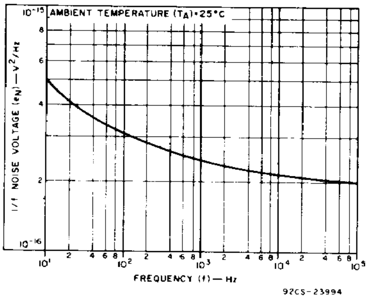


Fig. 19 - 1/f noise voltage vs. frequency.

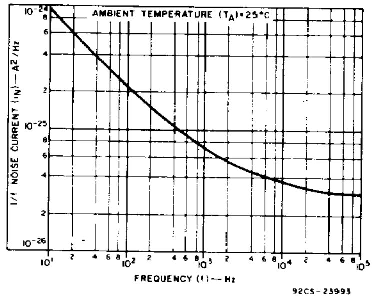
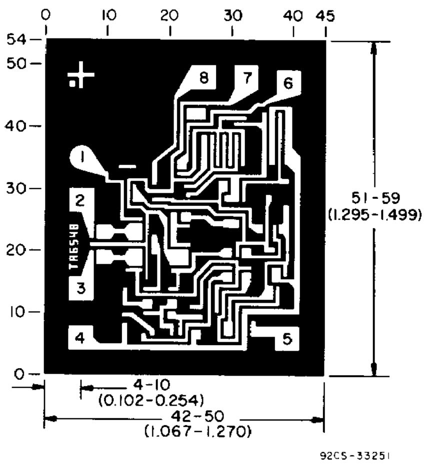


Fig. 20 - 1/f noise current vs. frequency.



Dimensions and pad layout for CA301H.

Dimensions in parentheses are in millimeters and are derived from the basic inch dimensions as indicated. Grid graduations are in mils (10^{-3} inch).