① Operational Amplifiers

Typical Characteristics of Linear IC Operational Amplifiers

Features	Micropower (OTA'S)★ Single			Micropower (OTA'S)★ Triple				Micropower (OTA'S)★ Triple		Single Op. Amp.			High-Current		
RCA Type No.	CA3080, F, S	CA3080A, AF, AS	CA3080A, AF, AS	CA3060BD	CA3060AD, BD, E	CA3060D, H		CA3078F, H, S, T CA6078AH, AS, AT ■		CA3078AF, AS, AT			CA3033 CA3047	CA3033A CA3047A	CA3094AS, AT, BS, BT, S, T
Characteristics / Operating Conditions	$V^+, V^- = \pm 15$ V $I_{ABC} = 500\ \mu A$		$V^+, V^- = \pm 15$ V $I_{ABC} = 5\ \mu A$	$V^+, V^- = \pm 15$ V $I_{ABC} = 1\ \mu A$	$V^+, V^- = \pm 15$ V $I_{ABC} = 100\ \mu A$	$V^+, V^- = \pm 6$ V $I_{ABC} = 1\ \mu A$	$V^+, V^- = \pm 6$ V $I_{ABC} = 100\ \mu A$	$V^+, V^- = \pm 6$ V $I_Q = 100\ \mu A$	$V^+, V^- = \pm 0.75$ V $I_Q = 1\ \mu A$	$V^+, V^- = \pm 6$ V $I_Q = 20\ \mu A$	$V^+, V^- = \pm 0.75$ V $I_Q = 1\ \mu A$	$V^+, V^- = \pm 15$ V $I_Q = 20\ \mu A$	$V^+, V^- = \pm 12$ V	$V^+, V^- = \pm 15$ V	$V^+, V^- = \pm 15$ V Dual Supply $V^+ = 30$ V Single Supply $I_{ABC} = 100\ \mu A$
Static Conditions (at $T_A = 25°C$)															
Input Offset Voltage — mV max (V_{IO})	5	2	2	5	5	5	5	4.5	1.5 typ.	3.5	0.90 typ.	3.5	5	5	5
Input Offset Current — nA max (I_{IO})	600	600	1.2 typ.	14	1000	14	1000	32	0.5 typ.	2.5	0.054 typ.	2.7	35	25	200
Input Bias Current — nA max (I_I)	5000	5000	40 typ.	70	5000	70	5000	170	1.3 typ.	12	0.45 typ.	14	350	180	500
Input Offset Voltage Temperature Coefficient — $\mu V/°C$ typ. ($V_{IO}/\Delta T$)	1.0	1.0	0.5	1.1	1.1	1.1	1.1	6	6	5	5	5	6.6	6.6	4
Peak-to-Peak Output Voltage — V min. (V_{OM})	24	24	28.3 typ.	24	24	10.6	10.2	10	0.30 typ.	10	0.3 typ.	27	18	23	25.95 (Dual Supply Term. 6)
	Load Resistance (R_L) = ∞							R_L = 10 kΩ	R_L = 20 kΩ	--	--	--	R_L = 0.5 kΩ	R_L = 0.3 kΩ	
Peak-to-Peak Output Current — mA min. (I_{OM})	0.700	0.700	0.006	0.0026	0.300	0.0026	0.300	13 Typ.	1.0 typ.	13 Typ.	1	13 Typ.	35	76	—
Device Dissipation — mW max (P_D)	36	36	0.300	0.42	42	0.170	14.5	1.56	0.0015 typ.	0.30	0.0015 typ.	0.75	180	300	—
Maximum Supply Voltage — V^+, V^-	±18	±18	±18	±16	±16	±7	±7	±7	±7	±18	±18	±18	±13	±19	‡
Minimum Output Voltage for Single-Supply Operation (neg. gnd.) — V typ. (V_O)	0.6	0.6	0.5	0.050	0.100	0.050	0.100	0.7	0.7	0.7	0.7	0.7	0.05	0.05	26 @ $V^+ = 30$ (Term. 6)
Common Mode Input Voltage Range V min (V_{ICR})	±12	±12	+14, -14.5 typ.	+12, -12	+12, -12	+4.4, -5.1	+4.3, -5.0	±5	+0.5, -0.2 typ.	-5, +5	-0.2, +0.5 typ.	-14, +14 typ.	+3.5, -7.5	+4.7, -9.7	+12, -14 (Dual Supply)

★ Operational Transductance Amplifiers (OTA'S)

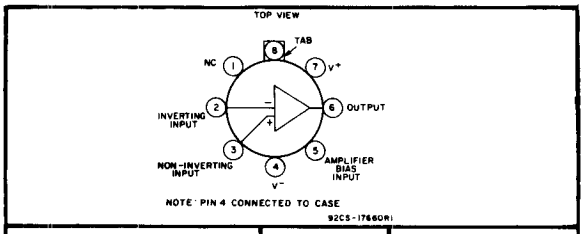
■ Low-noise premium version of the CA3078T that is virtually free of "popcorn" (burst) noise.

‡ Types CA3094T, CA3094AT, and CA3094BT differ only in supply-voltage rating:
CA3094 = ± 12V dual supply, 24 single supply
CA3094AT = ± 18V dual supply, 36 single supply
CA3094BT = ± 22V dual supply, 44 single supply

Features	Micropower (OTA's)★ Single			Micropower (OTA's)★ Triple						Single Op. Amp.			High-Current		
RCA Type No.	CA3080, F, S	CA3080A, AF, AS	CA3080A, AF, AS	CA3060BD	CA3060AD, BD, E	CA3060D, H		CA3078F, H, S, T CA6078AH, AS, AT■		CA3078AF, AS, AT			CA3033 CA3047	CA3033A CA3047A	CA3094AS, AT, BS, BT, S, T‡
Characteristics — Operating Conditions	$V^+, V^- = \pm 15$ V $I_{ABC} = 500\ \mu A$		$V^+, V^- = \pm 15$ V $I_{ABC} = 5\ \mu A$	$V^+, V^- = \pm 15$ V $I_{ABC} = 1\ \mu A$	$V^+, V^- = \pm 15$ V $I_{ABC} = 100\ \mu A$	$V^+, V^- = \pm 6$ V $I_{ABC} = 1\ \mu A$	$V^+, V^- = \pm 6$ V $I_{ABC} = 100\ \mu A$	$V^+, V^- = \pm 6$ V $I_Q = 100\ \mu A$	$V^+, V^- = \pm 0.75$ V $I_Q = 1\ \mu A$	$V^+, V^- = \pm 6$ V $I_Q = 20\ \mu A$	$V^+, V^- = \pm 0.75$ V $I_Q = 1\ \mu A$	$V^+, V^- = \pm 15$ V $I_Q = 20\ \mu A$	$V^+, V^- = \pm 12$ V	$V^+, V^- = \pm 15$ V	$V^+, V^- = \pm 15$ V Dual Supply $V^+ = 30$ V Single Supply $I_{ABC} = 100\ \mu A$
Dynamic Conditions (at $T_A = 25°C$)															
Forward Transconductance — μmho (gm)															To Term. 1
Min.	6700	7700	—	300	30,000	300	30,000	—	—	—	—	—	—	—	1650
Max	13,000	12,000	96 typ.	—	—	—	—								2750
Open-Loop Voltage Gain (A_{OL})	$R_L = \infty$							R_L = 10 kΩ	R_L = 20 kΩ	R_L = 10 kΩ			R_L 500Ω		R_L 2kΩ
volts/volt min.	150,000	150,000	150,000	200,000	200,000	200,000	200,000	25,000	1000 typ.	40,000	1,780 typ.	40,000	15,800	22,400	20,000 (Single Supply)
dB min.	104	104	104	106	106	106	106	88	60 typ.	92	65	92	84	87	86 (Single Supply)
Slew Rate (Non-Inverting Unity Gain) — V/μs typ. (SR)	50 R_L = 1MΩ C_L = 5pF	50 R_L = 1MΩ C_L = 5pF	0.5	0.1	8.0	0.1	8.0	0.4	0.001	0.027	0.001		2.7	3.0	0.7 @ R_L 2 kΩ I_{ABC} 500 μA
Common-Mode Rejection Ratio — dB min. (CMRR)	80	80	110 typ.	80	70	80	70	80	90 typ.	80	90 typ.	80	84	93	70
Gain-Bandwidth Product (Unity Gain Non-Inverting Comp.) MHz typ. (f_T (op-amp))	3.5	3.5	0.01	1.0	1.0	0.01	1.0	0.2	0.003	200 Hz	0.003		0.3	0.5	—
Special Features															
Short Circuit Protection	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	no	no	—
Frequency Compensation	ext.	ext.	ext.	ext.	ext.	ext	ext.	ext.	ext.	ext.	ext.	ext.	ext.	ext.	—
Adaptable to Single-Supply Operation	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Offset Adjustment	no	no	no	no	no	no	no	yes	yes	yes	yes	yes	yes	yes	—

Operational Transconductance Amplifiers

CA3080
CA3080A



Package	Suffix	T_A (°C)
8-Lead TO-5	None	0 to 70
8-Lead "MINI-DIP" (CA3080)	E	0 to 70
8-Lead Frit Seal	F	−55 to 125
8-Lead TO-5 DIL-CAN	S	−55 to 125
Chip (CA3080)	H	Page 59

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High-Reliability Versions, Page 41

Applications and Features

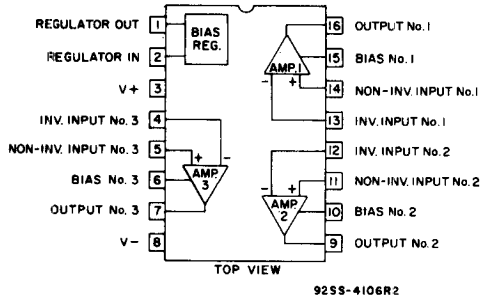
Slew rate (unity gain, compensated, non-inverting): 50 V/μs at C_L = 5pF, R_L = 1MΩ
Adjustable power consumption: <10μW to 30 mW
Flexible supply—voltage range: ±2V to ±15V
Fully adjustable gain: 0 to limit of $g_m R_L$ (103dB)
g_M linearity: over 3 decades of amplifier bias current
Output short-circuit protection
Multiplier, Comparator, AGC functions
Sample and hold, Multiplex, Voltage follower

Electrical Characteristics at T_A = 25°C, V^+ = 15, V^- = −15V

	CA3080 I_{ABC} = 500μA	CA3080A I_{ABC} = 500 μA	
Input Offset Voltage	5	2 (I_{ABC} = 5 μA)	mV max.
Input Offset Current	600	600	nA max.
Forward Transconductance	6700	7700	μmho min.
	13000	12000	μmho max.
Common-Mode Rejection Ratio	80	80	dB min.
Slew Rate at C_L = 5pF, R_L = 1MΩ (unity gain, non-inverting, input compensated)	50	50	V/μs typ.
Open-Loop Bandwidth	2	2	MHz typ.
Output Current	±500	±500	μA typ.
Input Resistance	10	10	kΩ min.
Output Resistance	15	15	MΩ typ.
Differential Input Voltage	±5	±5	V max.
Common-Mode Input Voltage	±12	±12	V min.
Common-Mode Input Voltage Range (Single Supply, V^+ = 15V)	+12 to +3		V
Open-Loop Voltage Gain (R_L = ∞)	103	103	dB typ.
Output Voltage Swing (R_L = ∞)	±12	±12	V min.

Triple Operational Transconductance Amplifier Array [OTA]

CA3060
CA3060A
CA3060B



Package	Suffix	T_A (°C)
16-Lead DIC	D	−55 to 125
16-Lead DIP (CA3060)	E	−55 to 125
Chip (CA3060)	H	Page 59

File No. 537*

Applications and Features

- Output short-circuit protection
- Low power consumption: as low as 100 μW per ampl.
- Independent biasing for each amplifier
- High forward transconductance
- Broad adjustable range of input characteristics
- Low input bias and output offset current
- High input and output impedance
- Zener-diode bias regulator
- 3 independent identical amplifiers on one chip
- For low-power conventional operational amplifier applications
- Active filters
- Gyrators
- Mixers
- Modulators
- Multipliers
- Strobing and gating functions
- Sample-and-hold functions

Electrical Characteristics at T_A = 25°C, I_{ABC} = 100μA

	CA3060D	CA3060AD, CA3060BD, CA3060E	
Input Offset Voltage	5	5	mV max.
Forward Transconductance	30	30	mmho min.
Input Impedance	10	10	kΩ min.
Output Impedance	2	2	MΩ typ.
Supply Current (Each Ampl.)	1200	1200	μA max.
Common-Mode Rejection Ratio	70	70	dB min.
3dB Bandwidth (Open-Loop)	110	110	kHz typ.
Output Current (Source or Sink)	150	150	μA min.
Common-Mode Input Voltage Range	+12 to −12 (Except CA3060D)		V min.
Open-Loop Voltage Gain (R_L = ∞)	106	106	dB typ.
Supply Voltage:			
Single Supply	14	36	V max.
Dual Supply	±7	±18	V max.

Indicated Devices Characterized for Amplifier Bias Currents (I_{ABC}) of:
I_{ABC} = 1, 10, 100μA (CA3060D, CA3060BD); I_{ABC} = 100μA (CA3060AD, CA3060E)

*Refer to indicated File No. for data bulletin and where given to indicated ICAN No. for application note.