National Semiconductor

May 1998

LM741
Operational Amplifier

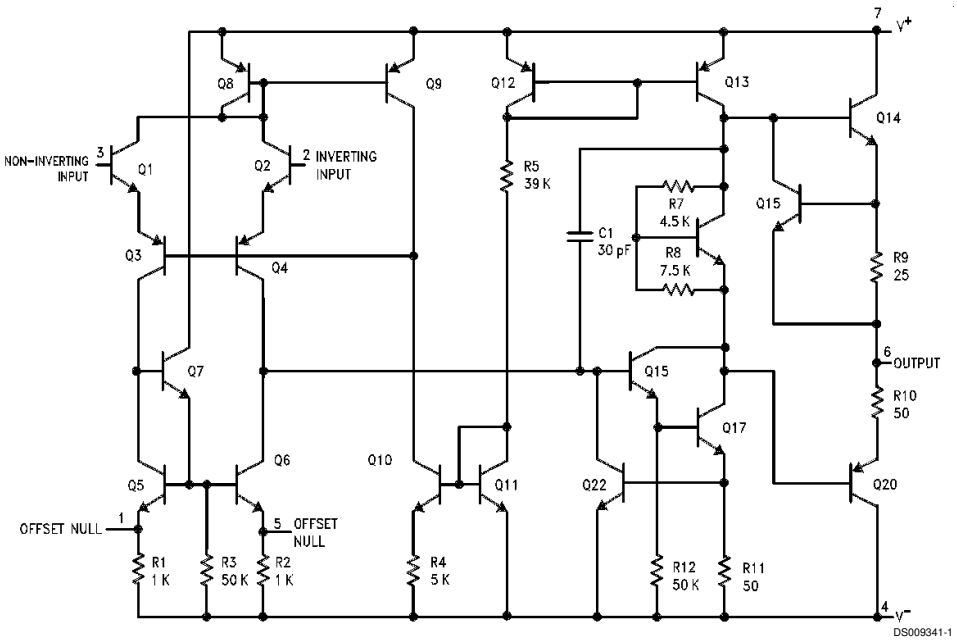
General Description

The LM741 series are general purpose operational amplifiers which feature improved performance over industry standards like the LM709. They are direct, plug-in replacements for the 709C, LM201, MC1439 and 748 in most applications.

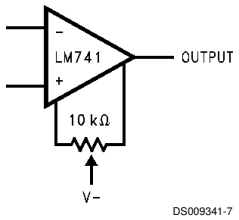
The amplifiers offer many features which make their application nearly foolproof: overload protection on the input and output, no latch-up when the common mode range is exceeded, as well as freedom from oscillations.

The LM741C/LM741E are identical to the LM741/LM741A except that the LM741C/LM741E have their performance guaranteed over a 0˚C to +70˚C temperature range, instead of −55˚C to +125˚C.

Schematic Diagram



Offset Nulling Circuit



Absolute Maximum Ratings (Note 1)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/ Distributors for availability and specifications.

(Note 6)

	LM741A	LM741E	LM741	LM741C
Supply Voltage	±22V	±22V	±22V	±18V
Power Dissipation (Note 2)	500 mW	500 mW	500 mW	500 mW
Differential Input Voltage	±30V	±30V	±30V	±30V
Input Voltage (Note 3)	±15V	±15V	±15V	±15V
Output Short Circuit Duration	Continuous	Continuous	Continuous	Continuous
Operating Temperature Range	−55˚C to +125˚C	0˚C to +70˚C	−55˚C to +125˚C	0˚C to +70˚C
Storage Temperature Range	−65˚C to +150˚C	−65˚C to +150˚C	−65˚C to +150˚C	−65˚C to +150˚C
Junction Temperature	150˚C	100˚C	150˚C	100˚C
Soldering Information				
N-Package (10 seconds)	260˚C	260˚C	260˚C	260˚C
J- or H-Package (10 seconds)	300˚C	300˚C	300˚C	300˚C
M-Package				
Vapor Phase (60 seconds)	215˚C	215˚C	215˚C	215˚C
Infrared (15 seconds)	215˚C	215˚C	215˚C	215˚C
See AN-450 “Surface Mounting Methods and Their Effect on Product Reliability” for other methods of soldering surface mount devices.				
ESD Tolerance (Note 7)	400V	400V	400V	400V

Electrical Characteristics (Note 4)

Parameter	Conditions	LM741A/LM741E			LM741			LM741C			Units
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
Input Offset Voltage	T_A = 25˚C										
	$R_S \le 10\ k\Omega$					1.0	5.0		2.0	6.0	mV
	$R_S \le 50\Omega$		0.8	3.0							mV
	$T_{AMIN} \le T_A \le T_{AMAX}$										
	$R_S \le 50\Omega$			4.0							mV
	$R_S \le 10\ k\Omega$						6.0			7.5	mV
Average Input Offset Voltage Drift				15							µV/˚C
Input Offset Voltage Adjustment Range	T_A = 25˚C, V_S = ±20V	±10				±15			±15		mV
Input Offset Current	T_A = 25˚C		3.0	30		20	200		20	200	nA
	$T_{AMIN} \le T_A \le T_{AMAX}$			70		85	500			300	nA
Average Input Offset Current Drift				0.5							nA/˚C
Input Bias Current	T_A = 25˚C		30	80		80	500		80	500	nA
	$T_{AMIN} \le T_A \le T_{AMAX}$			0.210			1.5			0.8	µA
Input Resistance	T_A = 25˚C, V_S = ±20V	1.0	6.0		0.3	2.0		0.3	2.0		MΩ
	$T_{AMIN} \le T_A \le T_{AMAX}$, V_S = ±20V	0.5									MΩ
Input Voltage Range	T_A = 25˚C							±12	±13		V
	$T_{AMIN} \le T_A \le T_{AMAX}$				±12	±13					V

Electrical Characteristics (Note 4) (Continued)

Parameter	Conditions	LM741A/LM741E			LM741			LM741C			Units
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
Large Signal Voltage Gain	T_A = 25˚C, $R_L \geq 2$ kΩ										
	V_S = ±20V, V_O = ±15V	50									V/mV
	V_S = ±15V, V_O = ±10V				50	200		20	200		V/mV
	$T_{AMIN} \leq T_A \leq T_{AMAX}$,										
	$R_L \geq 2$ kΩ,										
	V_S = ±20V, V_O = ±15V	32									V/mV
	V_S = ±15V, V_O = ±10V				25			15			V/mV
	V_S = ±5V, V_O = ±2V	10									V/mV
Output Voltage Swing	V_S = ±20V										
	$R_L \geq 10$ kΩ	±16									V
	$R_L \geq 2$ kΩ	±15									V
	V_S = ±15V										
	$R_L \geq 10$ kΩ				±12	±14		±12	±14		V
	$R_L \geq 2$ kΩ				±10	±13		±10	±13		V
Output Short Circuit	T_A = 25˚C	10	25	35		25			25		mA
Current	$T_{AMIN} \leq T_A \leq T_{AMAX}$	10		40							mA
Common-Mode	$T_{AMIN} \leq T_A \leq T_{AMAX}$										
Rejection Ratio	$R_S \leq 10$ kΩ, V_{CM} = ±12V				70	90		70	90		dB
	$R_S \leq 50$Ω, V_{CM} = ±12V	80	95								dB
Supply Voltage Rejection	$T_{AMIN} \leq T_A \leq T_{AMAX}$,										
Ratio	V_S = ±20V to V_S = ±5V										
	$R_S \leq 50$Ω	86	96								dB
	$R_S \leq 10$ kΩ				77	96		77	96		dB
Transient Response	T_A = 25˚C, Unity Gain										
Rise Time			0.25	0.8		0.3			0.3		µs
Overshoot			6.0	20		5			5		%
Bandwidth (Note 5)	T_A = 25˚C	0.437	1.5								MHz
Slew Rate	T_A = 25˚C, Unity Gain	0.3	0.7			0.5			0.5		V/µs
Supply Current	T_A = 25˚C					1.7	2.8		1.7	2.8	mA
Power Consumption	T_A = 25˚C										
	V_S = ±20V		80	150							mW
	V_S = ±15V					50	85		50	85	mW
LM741A	V_S = ±20V										
	$T_A = T_{AMIN}$			165							mW
	$T_A = T_{AMAX}$			135							mW
LM741E	V_S = ±20V										
	$T_A = T_{AMIN}$			150							mW
	$T_A = T_{AMAX}$			150							mW
LM741	V_S = ±15V										
	$T_A = T_{AMIN}$					60	100				mW
	$T_A = T_{AMAX}$					45	75				mW

Note 1: "Absolute Maximum Ratings" indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is functional, but do not guarantee specific performance limits.

Electrical Characteristics (Note 4) (Continued)

Note 2: For operation at elevated temperatures, these devices must be derated based on thermal resistance, and T_j max. (listed under "Absolute Maximum Ratings"). $T_j = T_A + (\theta_{jA} P_D)$.

Thermal Resistance	Cerdip (J)	DIP (N)	HO8 (H)	SO-8 (M)
θ_{jA} (Junction to Ambient)	100˚C/W	100˚C/W	170˚C/W	195˚C/W
θ_{jC} (Junction to Case)	N/A	N/A	25˚C/W	N/A

Note 3: For supply voltages less than ±15V, the absolute maximum input voltage is equal to the supply voltage.

Note 4: Unless otherwise specified, these specifications apply for V_S = ±15V, −55˚C ≤ T_A ≤ +125˚C (LM741/LM741A). For the LM741C/LM741E, these specifications are limited to 0˚C ≤ T_A ≤ +70˚C.

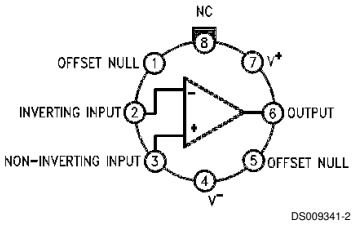
Note 5: Calculated value from: BW (MHz) = 0.35/Rise Time(µs).

Note 6: For military specifications see RETS741X for LM741 and RETS741AX for LM741A.

Note 7: Human body model, 1.5 kΩ in series with 100 pF.

Connection Diagram

Metal Can Package

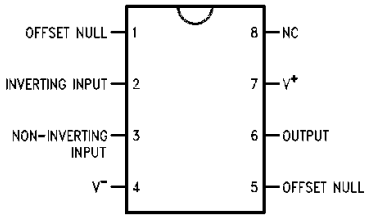


DS009341-2

Note 8: LM741H is available per JM38510/10101

Order Number LM741H, LM741H/883 (Note 8)**, LM741AH/883 or LM741CH**
See NS Package Number H08C

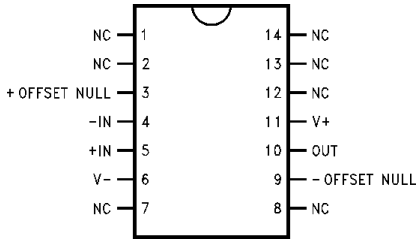
Dual-In-Line or S.O. Package



DS009341-3

Order Number LM741J, LM741J/883, LM741CM, LM741CN or LM741EN
See NS Package Number J08A, M08A or N08E

Ceramic Dual-In-Line Package



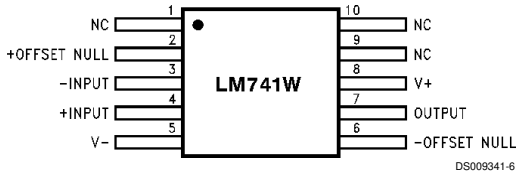
DS009341-5

Note 9: also available per JM38510/10101

Note 10: also available per JM38510/10102

Order Number LM741J-14/883 (Note 9)**, LM741AJ-14/883** (Note 10)
See NS Package Number J14A

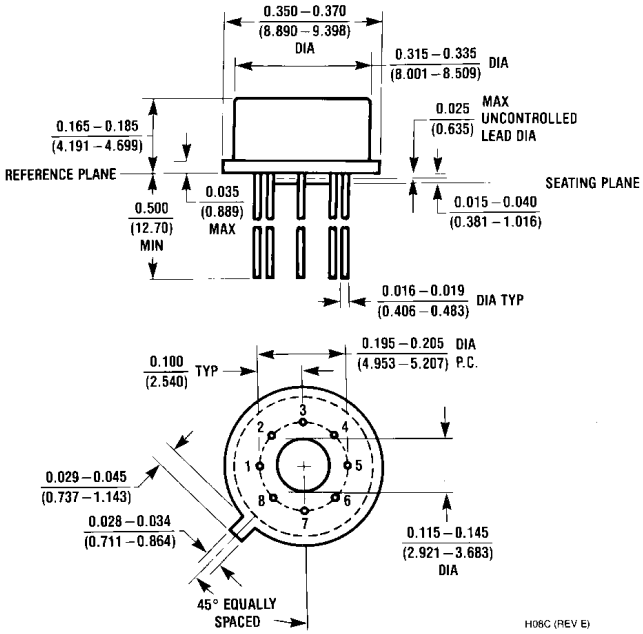
Ceramic Flatpak



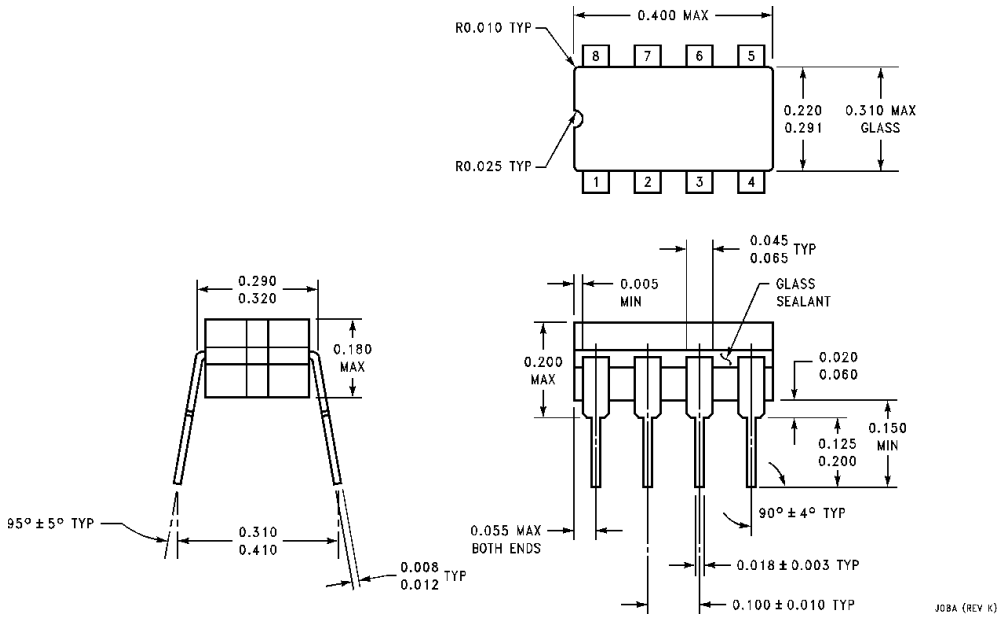
DS009341-6

Order Number LM741W/883
See NS Package Number W10A

Physical Dimensions inches (millimeters) unless otherwise noted

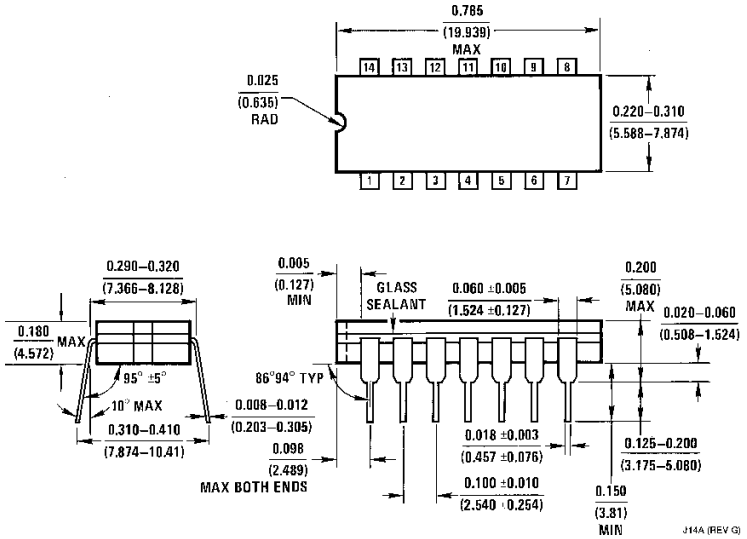


Metal Can Package (H)
Order Number LM741H, LM741H/883, LM741AH/883, LM741CH or LM741EH
NS Package Number H08C

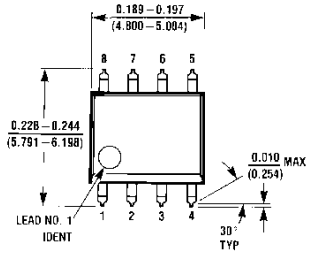


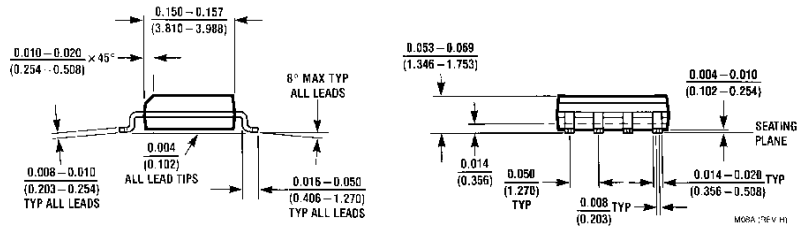
Ceramic Dual-In-Line Package (J)
Order Number LM741CJ or LM741J/883
NS Package Number J08A

Physical Dimensions inches (millimeters) unless otherwise noted (Continued)



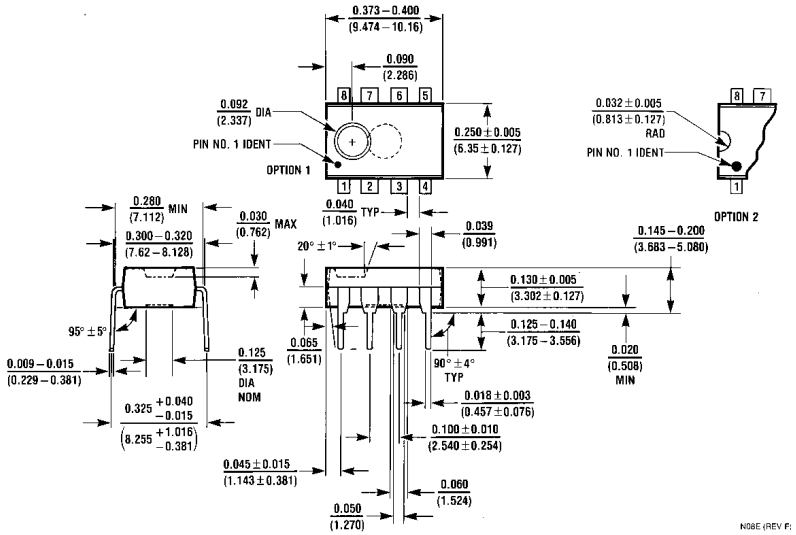
Ceramic Dual-In-Line Package (J)
Order Number LM741J-14/883 or LM741AJ-14/883
NS Package Number J14A





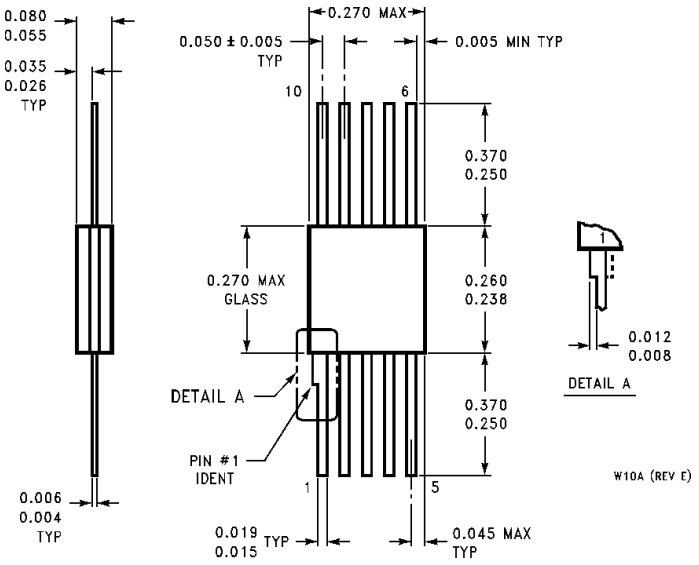
Small Outline Package (M)
Order Number LM741CM
NS Package Number M08A

Physical Dimensions inches (millimeters) unless otherwise noted (Continued)



Dual-In-Line Package (N)
Order Number LM741CN or LM741EN
NS Package Number N08E

Physical Dimensions inches (millimeters) unless otherwise noted (Continued)



10-Lead Ceramic Flatpak (W)
Order Number LM741W/883
NS Package Number W10A

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LM741 Operational Amplifier

See Also: LM107 - less noise & better accuracy

Generic P/N 741

Contents

Parametric Table	
Channels (Channels)	1
Input Output Type	Not Rail to Rail
Bandwidth, typ (MHz)	1
Slew Rate, typ (Volts/usec)	.50
Supply Current per Channel, typ (mA)	1.70
Minimum Supply Voltage (Volt)	10
Maximum Supply Voltage (Volt)	36,44
Offset Voltage, Max (mV)	6,5,3
Input Bias Current, Temp Max (nA)	800,1500,210
Output Current, typ (mA)	25
Voltage Noise, typ (nV/Hz)	30
Shut down	No
Special Features	Vos Adj

General Description

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Datasheet

Title	Size (in Kbytes)	Date	View Online	Download	Receive via Email
LM741 Operational Amplifier	213 Kbytes	24-Jun-99	View Online	Download	Receive via Email
LM741 Mil-Aero Datasheet MNLM741-X	320 Kbytes		View Online	Download	Receive via Email
LM741 Mil-Aero Datasheet MNLM741A-X	20 Kbytes		View Online	Download	Receive via Email

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Package Availability, Models, Samples & Pricing

Part Number	Package		Status	Models		Samples & Electronic Orders	Budgetary Pricin	
	Type	# pins		SPICE	IBIS		Quantity	$US ea
LM741CN	MDIP	8	Full production	LM741.MOD	N/A	.	2500+	$0.232
LM741CH	TO-5	8	Full production	LM741.MOD	N/A	.	1K+	$0.934
LM741H	TO-5	8	Full production	LM741.MOD	N/A	.	250+	$1.450
LM741AH-MIL	TO-5	8	Preliminary	LM741.MOD	N/A	.		
LM741AH/883	TO-5	8	Full production	LM741.MOD	N/A	.	50+	$5.100

LM741H/883	TO-5	8	Full production	LM741.MOD	N/A	.	50+	$2.050
LM741J/883	Cerdip	8	Full production	LM741.MOD	N/A	.	50+	$1.450
LM741W/883	Cerpack	10	Full production	LM741.MOD	N/A	.	50+	$9.600
LM741WG/883	Ceramic SOIC	10	Full production	LM741.MOD	N/A	.	50+	$9.100
LM741WG-MPR	Ceramic SOIC	10	Preliminary	LM741.MOD	N/A	.		
JM38510/10101BG	TO-5	8	Full production	N/A	N/A	.	50+	$5.100
JM38510/10101BP	Cerdip	8	Full production	N/A	N/A	.	50+	$5.100
JM38510/10101BC	Cerdip	14	Full production	N/A	N/A	.	50+	$5.200
JM38510/10101BH	Cerpack	10	Full production	N/A	N/A	.	50+	$23.000
JM38510/10101SG	TO-5	8	Full production	N/A	N/A	.	50+	$163.00
JM38510/10101SP	Cerdip	8	Full production	N/A	N/A	.	50+	$195.00
LM741C MDC	die		Full production	LM741.MOD	N/A	.		

LM741C MWC	wafer	Full production	LM741.MOD	N/A	.		
LM741 MDS	die	Full production	LM741.MOD	N/A	.		
LM741 MW8	wafer	Full production	LM741.MOD	N/A	.		

Design Tools

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AP-SO: Reliability Reports Update Small Outline (SO) Package	109 Kbytes	4-Nov-95	View Online	Download	Rec via Ema
AN-127: LM 143 Monolithic High Voltage Operational Amplifier Applications	248 Kbytes	4-Nov-95	View Online	Download	Rec via Ema
AN-79: IC Preamplifier Challenges Choppers on Drift	173 Kbytes	4-Nov-95	View Online	Download	Rec via Ema
LB-19: Predicting OP Amp Slew Rate Limited Response	89 Kbytes	28-Jun-96	View Online	Download	Rec via Ema
AN-184: References for A/D Converters	98 Kbytes	4-Nov-95	View Online	Download	Rec via Ema
References for A/D Converters (**JAPANESE**)	124 Kbytes				

AN-210: New Phase-Locked-Loops Have Advantages as Frequency to Voltage Converters (and more)	183 Kbytes	4-Nov-95	View Online	Download	Rece via Ema
AN-227: Applications of Wide-Band Buffer Amplifiers	311 Kbytes	4-Nov-95	View Online	Download	Rece via Ema
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AN-711: Application Note 711 LM78S40 Switching Voltage Regulator Applications	346 Kbytes	2-Mar-99	View Online	Download	Rece via Ema
AN-71: Micropower Circuits Using the LM4250 Programmable Op Amp	195 Kbytes	4-Nov-95	View Online	Download	Rece via Ema
AN-D: Versatile Monolithic V/Fs Can Compute as Well as Convert with High Accuracy	169 Kbytes	4-Nov-95	View Online	Download	Rece via Ema
LB-17: LM118 Op Amp Slews 70V/microsecond	83 Kbytes	28-Jun-96	View Online	Download	Rece via Ema
LB-42: Get Fast Stable Response From Improved Unity-Gain Followers	83 Kbytes	28-Jun-96	View Online	Download	Rece via Ema

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