



August 1989

## LM733/LM733C Differential Amplifier

### General Description

The LM733/LM733C is a two-stage, differential input, differential output, wide-band video amplifier. The use of internal series-shunt feedback gives wide bandwidth with low phase distortion and high gain stability. Emitter-follower outputs provide a high current drive, low impedance capability. Its 120 MHz bandwidth and selectable gains of 10, 100 and 400, without need for frequency compensation, make it a very useful circuit for memory element drivers, pulse amplifiers, and wide band linear gain stages.

The LM733 is specified for operation over the  $-55^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$  military temperature range. The LM733C is specified for operation over the  $0^{\circ}\text{C}$  to  $+70^{\circ}\text{C}$  temperature range.

### Features

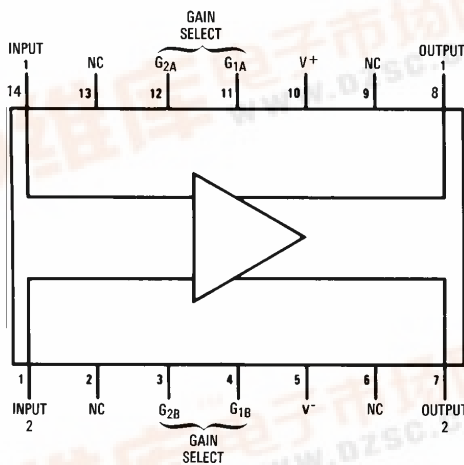
- 120 MHz bandwidth
- 250 k $\Omega$  input resistance
- Selectable gains of 10, 100, 400
- No frequency compensation
- High common mode rejection ratio at high frequencies

### Applications

- Magnetic tape systems
- Disk file memories
- Thin and thick film memories
- Woven and plated wire memories
- Wide band video amplifiers

### Connection Diagrams

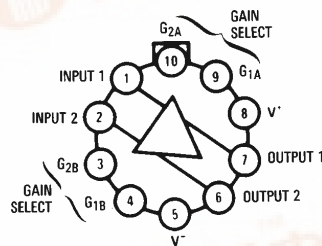
Dual-In-Line Package



TL/H/7866-1

**Top View**  
Order Number LM733CN  
See NS Package Number N14A

Metal Can Package



TL/H/7866-2

Note: Pin 5 connected to case.

**Top View**  
Order Number LM733H or LM733CH  
See NS Package Number H10D

LM733/LM733C Differential Amplifier



## Absolute Maximum Ratings

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

Differential Input Voltage	±5V	Power Dissipation (Note 1)	500 mW
Common Mode Input Voltage	±6V	Junction Temperature	+150°C
V <sub>CC</sub>	±8V	Storage Temperature Range	-65°C to +150°C
Output Current	10 mA	Operating Temperature Range	
		LM733	-55°C to +125°C
		LM733C	0°C to +70°C
		Lead Temperature (Soldering, 10 sec.)	260°C

## Electrical Characteristics (T<sub>A</sub> = 25°C, unless otherwise specified, see test circuits, V<sub>S</sub> = ±6.0V)

Characteristics	Test Circuit	Test Conditions	LM733			LM733C			Units
			Min	Typ	Max	Min	Typ	Max	
Differential Voltage Gain									
Gain 1 (Note 2)	1	R <sub>L</sub> = 2 kΩ V <sub>OUT</sub> = 3 Vp-p	300	400	500	250	400	600	
Gain 2 (Note 3)			90	100	110	80	100	120	
Gain 3 (Note 4)			9.0	10	11	8.0	10	12	
Bandwidth									
Gain 1	2			40			40		MHz
Gain 2				90			90		MHz
Gain 3				120			120		MHz
Rise Time									
Gain 1	2	V <sub>OUT</sub> = 1 Vp-p		10.5			10.5		ns
Gain 2				4.5	10		4.5	12	ns
Gain 3				2.5			2.5		ns
Propagation Delay									
Gain 1	2	V <sub>OUT</sub> = 1 Vp-p		7.5			7.5		ns
Gain 2				6.0	10		6.0	10	ns
Gain 3				3.6			3.6		ns
Input Resistance									
Gain 1			20	4.0			4.0		kΩ
Gain 2				30		10	30		kΩ
Gain 3				250			250		kΩ
Input Capacitance		Gain 2		2.0			2.0		pF
Input Offset Current				0.4	3.0		0.4	5.0	μA
Input Bias Current				9.0	20		9.0	30	μA
Input Noise Voltage		BW = 1 kHz to 10 MHz		12			12		μVrms
Input Voltage Range	1		±1.0			±1.0			V
Common Mode Rejection Ratio									
Gain 2	1	V <sub>CM</sub> = ±1V f ≤ 100 kHz	60	86		60	86		dB
Gain 2		V <sub>CM</sub> = ±1V f = 5 MHz		60			60		dB
Supply Voltage Rejection Ratio									
Gain 2	1	ΔV <sub>S</sub> = ±0.5V	50	70		50	70		dB
Output Offset Voltage									
Gain 1	1	R <sub>L</sub> = ∞		0.6	1.5		0.6	1.5	V
Gain 2 and 3				0.35	1.0		0.35	1.5	V
Output Common Mode Voltage	1	R <sub>L</sub> = ∞	2.4	2.9	3.4	2.4	2.9	3.4	V
Output Voltage Swing	1	R <sub>L</sub> = 2k	3.0	4.0		3.0	4.0		
Output Sink Current			2.5	3.6		2.5	3.6		mA
Output Resistance				20			20		Ω
Power Supply Current	1	R <sub>L</sub> = ∞		18	24		18	24	mA

## Electrical Characteristics (Continued)

(The following specifications apply for  $-55^{\circ}\text{C} < T_A < 125^{\circ}\text{C}$  for the LM733 and  $0^{\circ}\text{C} < T_A < 70^{\circ}\text{C}$  for the LM733C,  $V_S = \pm 6.0\text{V}$ )

Characteristics	Test Circuit	Test Conditions	LM733			LM733C			Units
			Min	Typ	Max	Min	Typ	Max	
Differential Voltage Gain									
Gain 1	1	$R_L = 2\text{ k}\Omega$ , $V_{OUT} = 3\text{ V}_{p-p}$	200		600	250		600	
Gain 2			80		120	80		120	
Gain 3			8.0		12.0	8.0		12.0	
Input Resistance Gain 2			8			8		$\text{k}\Omega$	
Input Offset Current					5		6	$\mu\text{A}$	
Input Bias Current					40		40	$\mu\text{A}$	
Input Voltage Range	1		$\pm 1$			$\pm 1$		V	
Common Mode Rejection Ratio									
Gain 2	1	$V_{CM} = \pm 1\text{ V}$ $f \leq 100\text{ kHz}$	50			50		dB	
Supply Voltage Rejection Ratio									
Gain 2	1	$\Delta V_S = \pm 0.5\text{ V}$	50			50		dB	
Output Offset Voltage									
Gain 1	1	$R_L = \infty$			1.5		1.5	V	
Gain 2 and 3					1.2		1.5	V	
Output Voltage Swing	1	$R_L = 2\text{ k}\Omega$	2.5			2.8		$V_{pp}$	
Output Sink Current			2.2			2.5		mA	
Power Supply Current	1	$R_L = \infty$			27		27	mA	

**Note 1:** The maximum junction temperature of the LM733 is  $150^{\circ}\text{C}$ , while that of the LM733C is  $100^{\circ}\text{C}$ . For operation at elevated temperatures devices in the TO-100 package must be derated based on a thermal resistance of  $150^{\circ}\text{C}/\text{W}$  junction to ambient or  $45^{\circ}\text{C}/\text{W}$  junction to case. Thermal resistance of the dual-in-line package is  $90^{\circ}\text{C}/\text{W}$ .

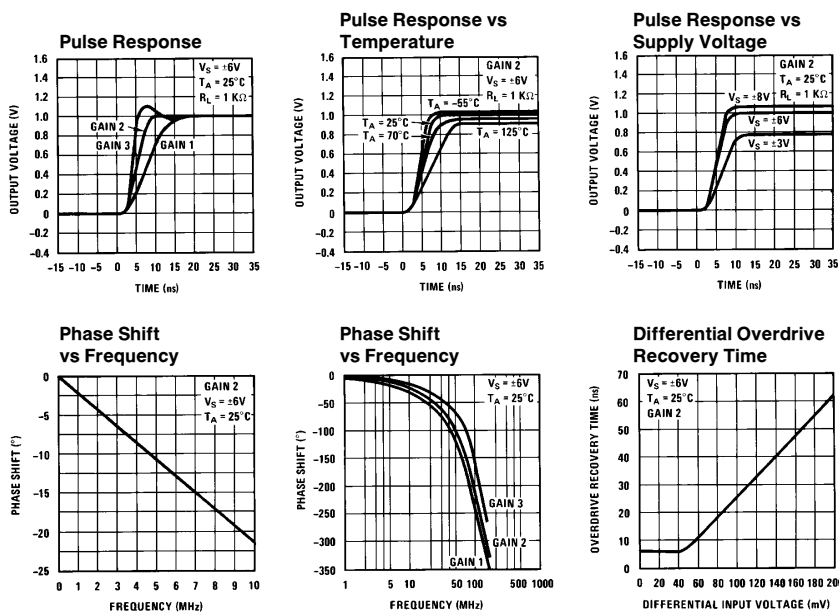
**Note 2:** Pins G1A and G1B connected together.

**Note 3:** Pins G2A and G2B connected together.

**Note 4:** Gain select pins open.

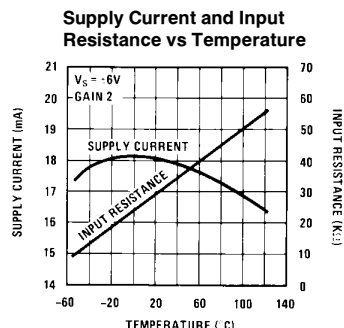
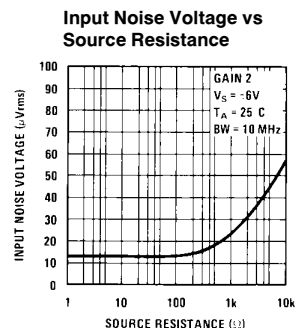
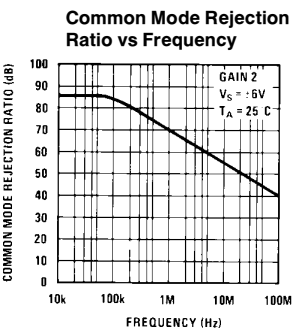
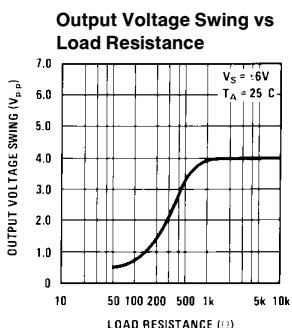
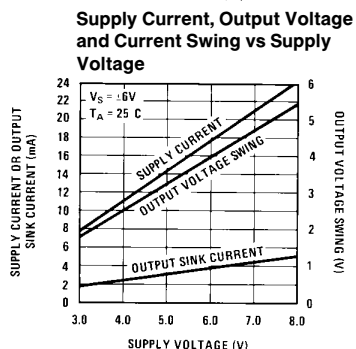
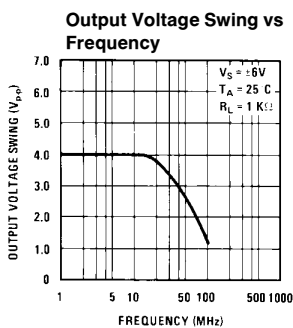
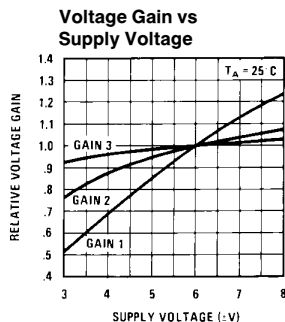
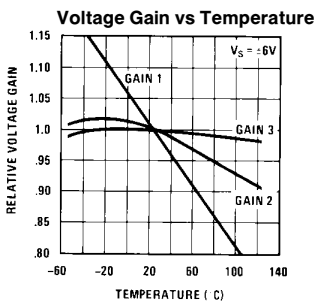
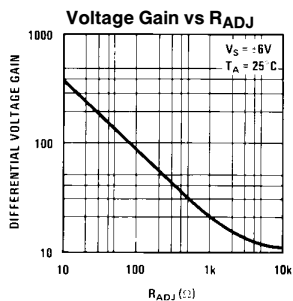
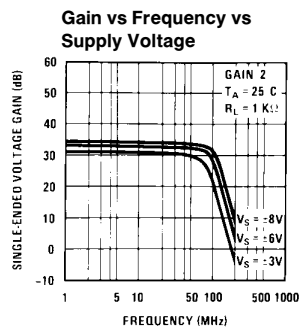
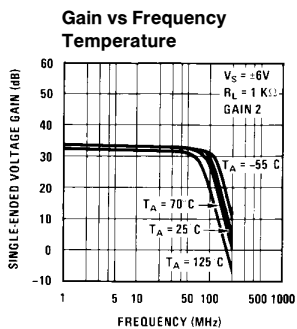
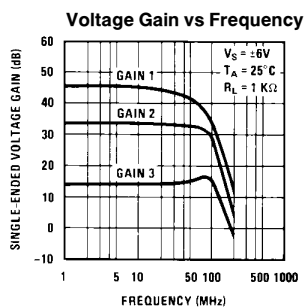
**Note 5:** Refer to RETS733X drawing for specifications of LM733H version.

## Typical Performance Characteristics

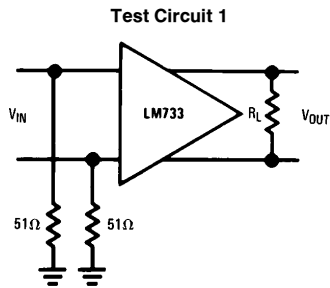


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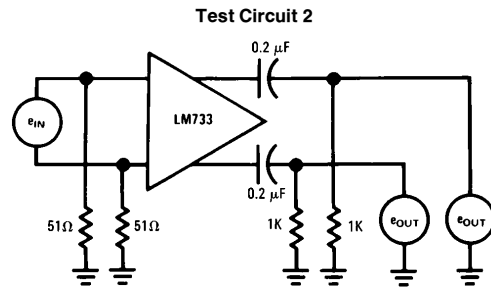
# Typical Performance Characteristics (Continued)



## Test Circuits

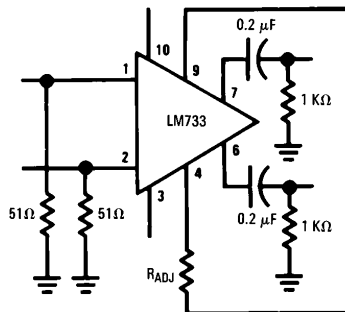


TL/H/7866-3



TL/H/7866-4

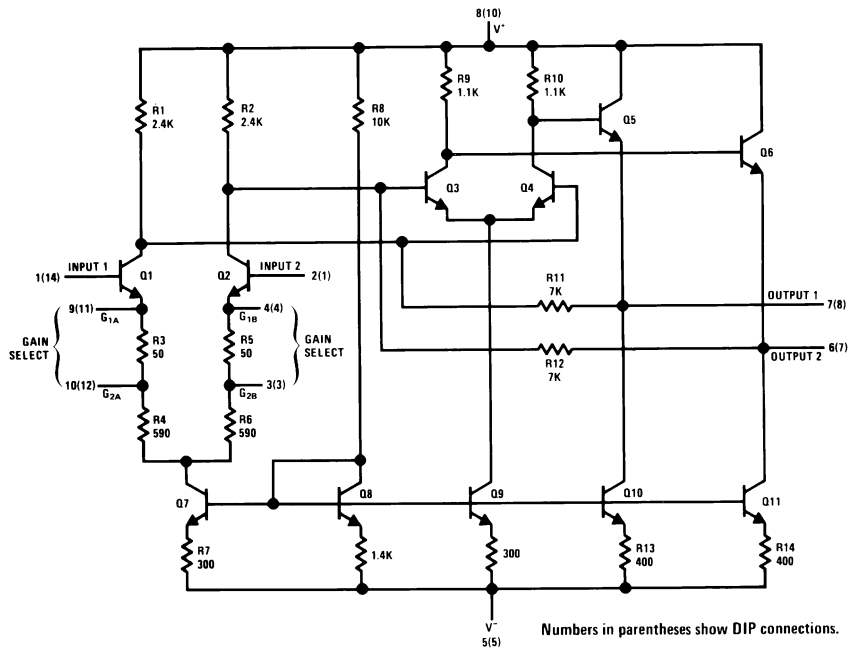
### Voltage Gain Adjust Circuit



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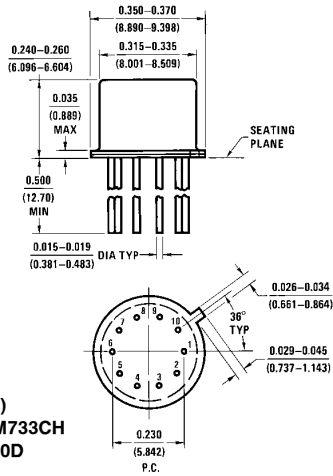
$V_S = 6V, T_A = 25^\circ C$   
(Pin numbers apply to TO-5 package)

## Schematic Diagram

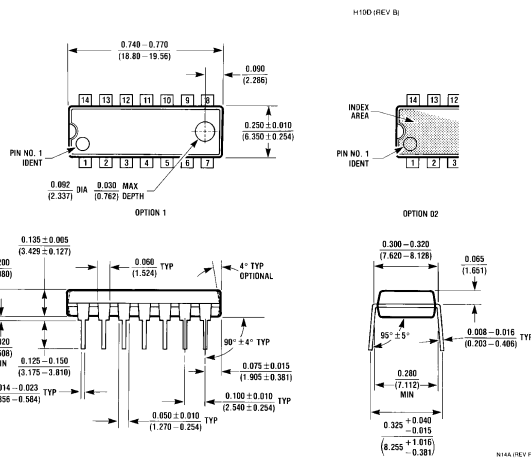


TL/H/7866-8

**Physical Dimensions** inches (millimeters)



**Metal Can Package (H)**  
**Order Number LM733H or LM733CH**  
**NS Package Number H10D**



**Molded Dual-In-Line Package (N)**  
**Order Number LM733CN**  
**NS Package Number N14A**

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