



## 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

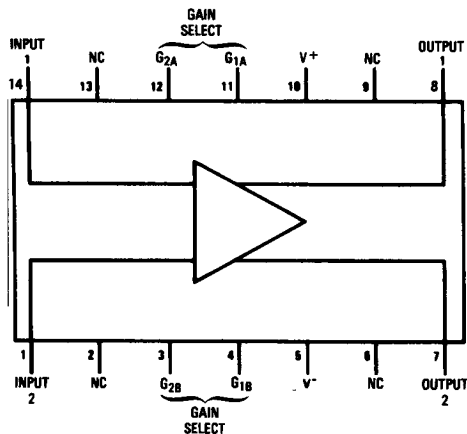
- 120 MHz bandwidth
- 250 k $\Omega$  input resistance
- Selectable gains of 10, 100, 400
- No frequency compensation
- High common mode rejection ratio at high frequencies

### Applications

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

### Connection Diagrams

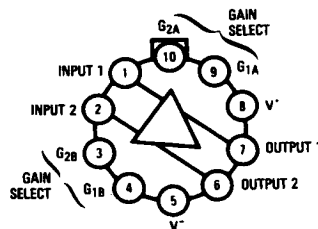
Dual-In-Line Package



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

## 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  |
| Common Mode Input Voltage  | ± 6V  |
| V <sub>CC</sub>            | ± 8V  |
| Output Current             | 10 mA |

|                                       |                  |
|---------------------------------------|------------------|
| Power Dissipation (Note 1)            | 500 mW           |
| Junction Temperature                  | + 150°C          |
| Storage Temperature Range             | −65°C to + 150°C |
| 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 V <sub>p-p</sub> | 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 V <sub>p-p</sub>                       |       | 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 V <sub>p-p</sub>                       |       | 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  |     | 10     | 4.0  |     | kΩ                |
| Gain 2                         |              |                                                             |       | 30   |     |        | 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   |     | μV <sub>rms</sub> |
| 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             | 1            | $R_L = 2\text{ k}\Omega$ , $V_{OUT} = 3\text{ V}_{p-p}$ | 200     |     | 600  | 250     |     | 600  |                  |
| Gain 1                                |              |                                                         | 80      |     | 120  | 80      |     | 120  |                  |
| Gain 2                                |              |                                                         | 8.0     |     | 12.0 | 8.0     |     | 12.0 |                  |
| Gain 3                                |              |                                                         |         |     |      |         |     |      |                  |
| 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                 | 1            | $R_L = \infty$                                          |         |     | 1.5  |         |     | 1.5  | V                |
| Gain 1                                |              |                                                         |         |     | 1.2  |         |     | 1.5  | V                |
| Gain 2 and 3                          |              |                                                         |         |     |      |         |     |      | 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  $90^{\circ}\text{C}/\text{W}$ .

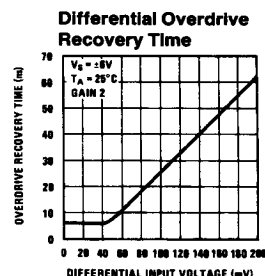
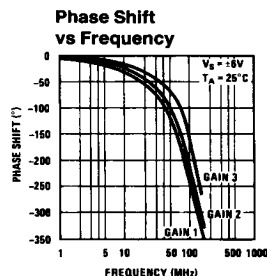
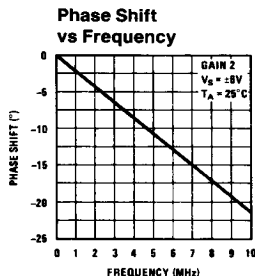
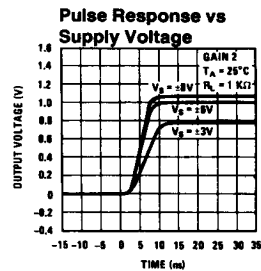
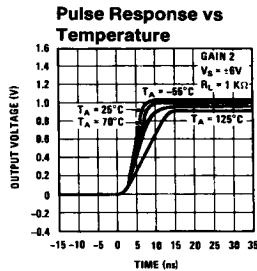
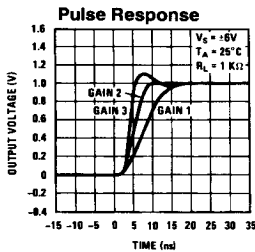
**Note 2:** Pins G1A and G1B connected together.

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

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

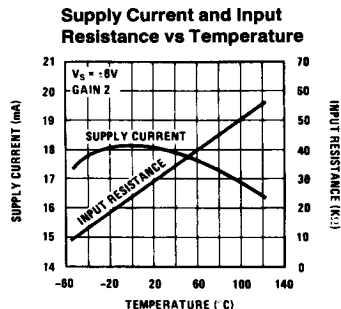
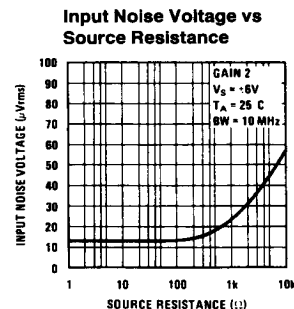
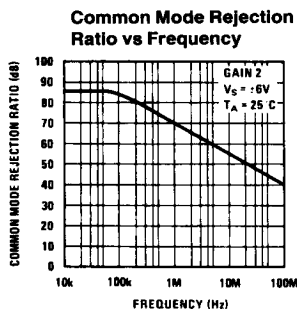
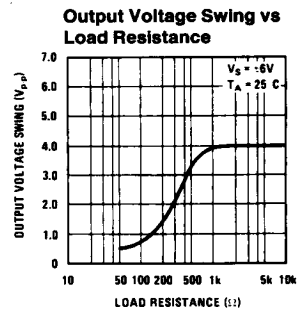
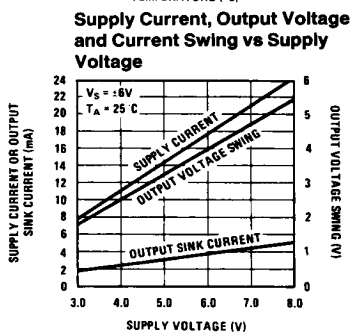
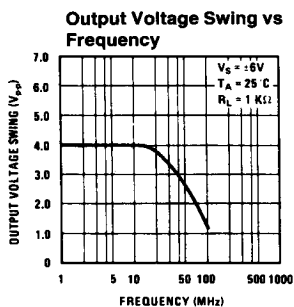
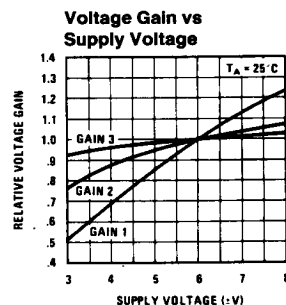
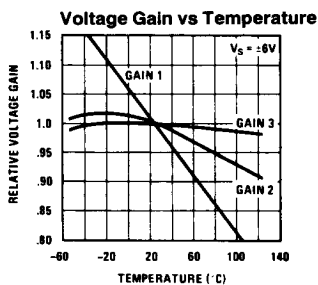
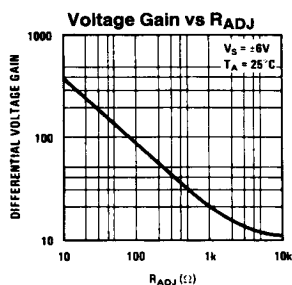
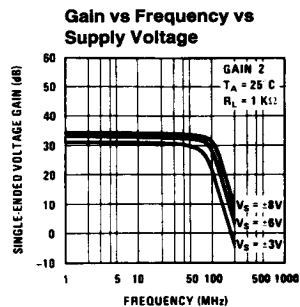
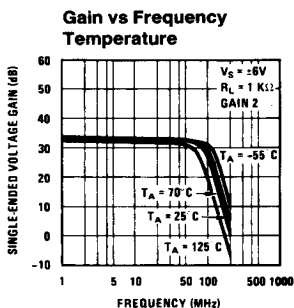
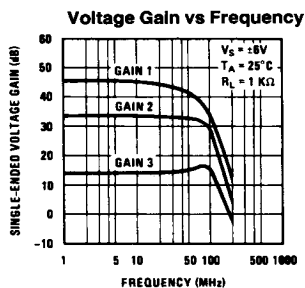
**Note 5:** Refer to RETS733X drawing for specifications of LM733H version.

## Typical Performance Characteristics



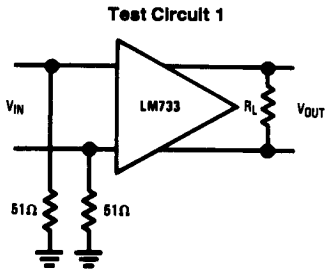
TL/H/7866-6

## Typical Performance Characteristics (Continued)

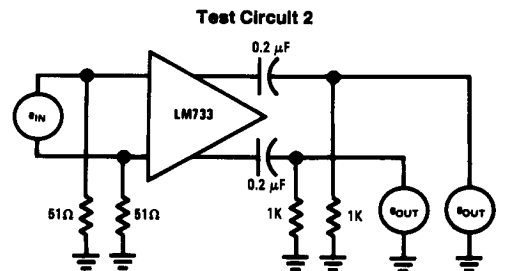


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## Test Circuits

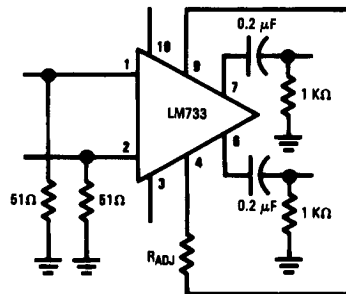


TL/H/7866-3



TL/H/7866-4

### Voltage Gain Adjust Circuit

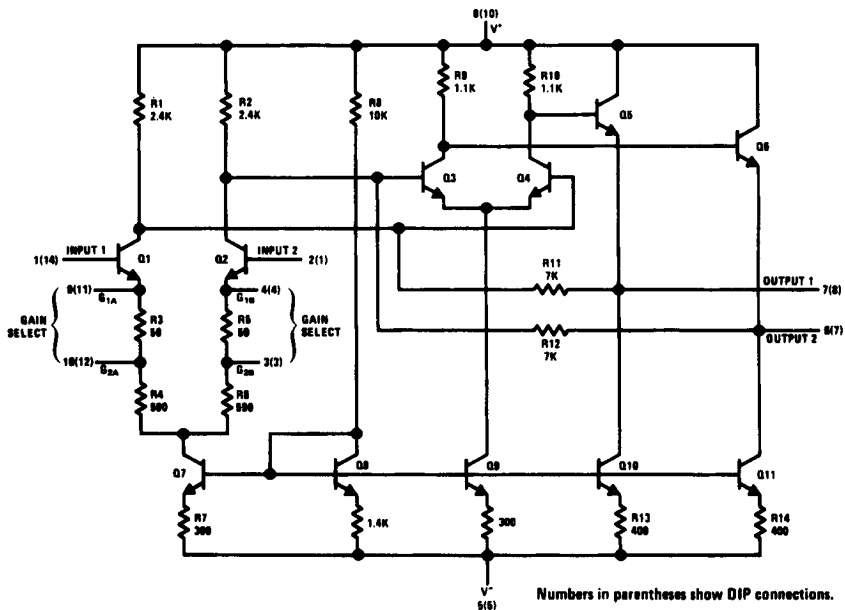


TL/H/7866-5

 $V_S = 6V, T_A = 25^\circ C$ 

(Pin numbers apply to TO-5 package)

## Schematic Diagram



TL/H/7866-8