LM710 Voltage Comparator

General Description

The LM710 series are high-speed voltage comparators intended for use as an accurate, low-level digital level sensor or as a replacement for operational amplifiers in comparator applications where speed is of prime importance. The circuit has a differential input and a single-ended output, with saturated output levels compatible with practically all types of integrated logic.

The device is built on a single silicon chip which insures low offset and thermal drift. The use of a minimum number of stages along with minority-carrier lifetime control (gold doping) makes the circuit much faster than operational amplifiers in saturating comparator applications. In fact, the low stray and wiring capacitances that can be realized with monolithic construction make the device difficult to duplicate with discrete components operating at equivalent power levels.

The LM710 series are useful as pulse height discriminators, voltage comparators in high-speed A/D converters or go, no-go detectors in automatic test equipment. They also have applications in digital systems as an adjustable-threshold line receiver or an interface between logic types. In addition, the low cost of the units suggests them for applications replacing relatively simple discrete component circuitry.

Schematic and Connection Diagrams

[Diagram of LM710 Voltage Comparator]

Ceramic Flatpak Package

Order Number LM710AMW/883
See NS Package Number W10A

Metal Can Package

Order Number LM710AMH/883*, LM710H,
LM710H/883 or LM710CH
See NS Package Number H08C

Dual-In-Line Package

Order Number LM710AMJ/883* or LM710CN
See NS Package Number N14A or J14A

*Also available per JM98510/10301
Absolute Maximum Ratings

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

Positive Supply Voltage: +14V
Negative Supply Voltage: –7V
Peak Output Current: 10 mA
Output Short Circuit Duration: 10 seconds
Differential Input Voltage: ±5V
Input Voltage: ±7V

Power Dissipation
TO-99 (Note 1) 700 mW
Plastic Dual-In-Line Package (Note 2) 950 mW

Operating Temperature Range
LM710 –55°C to +125°C
LM710C 0°C to +70°C

Storage Temperature Range
–65°C to +150°C

Lead Temperature (Soldering, 10 sec.) 260°C

Electrical Characteristics (Note 3)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Conditions</th>
<th>LM710</th>
<th>LM710C</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Offset Voltage</td>
<td>R_S ≤ 200Ω, V_CM = 0V, T_A = 25°C</td>
<td>0.6</td>
<td>2.0</td>
<td>1.6</td>
</tr>
<tr>
<td>Input Offset Current</td>
<td>V_OUT = 1.4V, T_A = 25°C</td>
<td>0.75</td>
<td>3.0</td>
<td>1.8</td>
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<tr>
<td>Input Bias Current</td>
<td>T_A = 25°C</td>
<td>13</td>
<td>20</td>
<td>16</td>
</tr>
<tr>
<td>Voltage Gain</td>
<td>T_A = 25°C</td>
<td>1250</td>
<td>1700</td>
<td>1000</td>
</tr>
<tr>
<td>Output Resistance</td>
<td>T_A = 25°C</td>
<td>200</td>
<td>200</td>
<td></td>
</tr>
<tr>
<td>Output Sink Current</td>
<td>V_OUT = 0, T_A = 25°C, ΔVIN ≥ 5 mV, ΔVIN ≥ 10 mV</td>
<td>2.0</td>
<td>2.5</td>
<td>1.6</td>
</tr>
<tr>
<td>Response Time</td>
<td>T_A = 25°C (Note 4)</td>
<td>40</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>Average Temperature Coefficient</td>
<td>T_MIN ≤ T_A ≤ T_MAX, R_S ≤ 50Ω</td>
<td>3.0</td>
<td>10</td>
<td>5.0</td>
</tr>
<tr>
<td>of Input Offset Voltage</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input Offset Current</td>
<td>T_A = T_A_MAX, T_A = T_A_MIN</td>
<td>0.25</td>
<td>3.0</td>
<td>7.5</td>
</tr>
<tr>
<td>Average Temperature Coefficient</td>
<td>T_MIN ≤ T_A ≤ T_MAX, T_MIN = T_A = 25°C</td>
<td>5.0</td>
<td>25</td>
<td>15</td>
</tr>
<tr>
<td>of Input Offset Current</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input Bias Current</td>
<td>T_A = T_MIN</td>
<td>27</td>
<td>45</td>
<td>25</td>
</tr>
<tr>
<td>Input Voltage Range</td>
<td>V_− = –7V</td>
<td>±5.0</td>
<td>±5.0</td>
<td>±5.0</td>
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<tr>
<td>Common-Mode Rejection Ratio</td>
<td>R_S ≤ 200Ω</td>
<td>80</td>
<td>100</td>
<td>70</td>
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<tr>
<td>Differential Input Voltage Range</td>
<td></td>
<td>±5.0</td>
<td>±5.0</td>
<td>±5.0</td>
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<tr>
<td>Voltage Gain</td>
<td></td>
<td>1000</td>
<td>800</td>
<td>V/V</td>
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<tr>
<td>Positive Output Level</td>
<td>–5 mA ≤ I_OUT ≤ 0, V_IN ≥ 5 mV, V_IN ≥ 10 mV</td>
<td>2.5</td>
<td>3.2</td>
<td>4.0</td>
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<tr>
<td>Negative Output Level</td>
<td>V_IN ≥ 5 mV, V_IN ≥ 10 mV, T_A = 125°C</td>
<td>–1.0</td>
<td>–0.5</td>
<td>0</td>
</tr>
<tr>
<td>Output Sink Current</td>
<td>V_IN ≥ 5 mV, V_OUT = 0, T_A = 125°C</td>
<td>0.5</td>
<td>1.7</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td>V_IN ≥ 10 mV, V_OUT = 0, 0°C ≤ T_A ≤ +70°C</td>
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</tbody>
</table>
### Electrical Characteristics (Note 3) (Continued)

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<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Min</td>
<td>Typ</td>
<td>Max</td>
</tr>
<tr>
<td>Pos. Supply Current</td>
<td>$V_{IN} \geq 5 \text{ mV}$</td>
<td>5.2</td>
<td>9.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$V_{IN} \geq 10 \text{ mV}$</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Neg. Supply Current</td>
<td>$V_{IN} \geq 5 \text{ mV}$</td>
<td>4.6</td>
<td>7.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$V_{IN} \geq 10 \text{ mV}$</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Power Consumption</td>
<td>$I_{OUT} = 0$</td>
<td>90</td>
<td>150</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$V_{IN} \geq 5 \text{ mV}$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$V_{IN} \geq 10 \text{ mV}$</td>
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</tr>
</tbody>
</table>

**Note 1:** Rating applies for ambient temperatures of 25°C; derate linearly at 5.6 mW/°C for ambient temperatures above 25°C.

**Note 2:** Derate linearly at 9.5 mW/°C for ambient temperatures above 25°C.

**Note 3:** These specifications apply for $V^+ = 12\text{ V}$, $V^- = 6\text{ V}$, $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$ for LM710 and $0^\circ\text{C} \leq T_A \leq +70^\circ\text{C}$ for LM710C unless otherwise specified. The input offset voltage and input offset current (see definitions) are specified for a logic threshold voltage of 1.8V at $-55^\circ\text{C}$, 1.4V at 25°C, and 1V at $125^\circ\text{C}$ for LM710 and 1.9V at 0°C, 1.4V at 25°C, and 1.2V at 70°C for LM710C.

**Note 4:** The response time specified (see definitions) is for a 100 mV input step with 5 mV overdrive (LM710) or a 10 mV overdrive (LM710C).

### Typical Applications

**Schmitt Trigger**

![Schmitt Trigger diagram](TL/H/10410-4)

**Line Receive with Increased Output Sink Current**

![Line Receive diagram](TL/H/10410-5)

**Pulse Width Modulator**

![Pulse Width Modulator diagram](TL/H/10410-6)

**Level Detector with Lamp Driver**

![Level Detector diagram](TL/H/10410-7)
Typical Performance Characteristics

- **Transfer Function**
  - Voltage Gain
  - Input Bias Current
  - Input Offset Current
  - Supply Current

- **Response Time**
  - Various Input Overdrives

- **Output Voltage Level**

- **Output Sink Current**

- **Maximum Power Dissipation**
  - Metal Can Package
  - Plastic DIP
**Physical Dimensions** inches (millimeters)

**Metal Can Package**
Order Number LM710AMH/883, LM710H, LM710H/883 or LM710CH
NS Package Number H08C

**Ceramic Dual-In-Line Package**
Order Number LM710AMJ/883
NS Package Number J14A
Molded Dual-In-Line Package (N)
Order Number LM710CN
NS Package Number N14A
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