

**MJLM723-X REV 0B0**

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## PRECISION VOLTAGE REGULATOR

### General Description

The LM723 is a voltage regulator designed primarily for series regulator applications. By itself, it will supply output currents up to 150 mA, but external transistors can be added to provide any desired load current. The circuit features extremely low standby current drain, and provision is made for either linear or foldback current limiting.

The LM723 is also useful in a wide range of other applications such as a shunt regulator, a current regulator or a temperature controller.

### Industry Part Number

LM723

### NS Part Numbers

 JL723BCA  
 JL723BIA  
 JL723SCA  
 JL723SIA

### Prime Die

LM723

### Controlling Document

38510/10201, AMEND. 1 REV B

### Processing

MIL-STD-883, Method 5004

### Quality Conformance Inspection

MIL-STD 883, Method 5005

| Subgrp | Description         | Temp ( °C) |
|--------|---------------------|------------|
| 1      | Static tests at     | +25        |
| 2      | Static tests at     | +125       |
| 3      | Static tests at     | -55        |
| 4      | Dynamic tests at    | +25        |
| 5      | Dynamic tests at    | +125       |
| 6      | Dynamic tests at    | -55        |
| 7      | Functional tests at | +25        |
| 8A     | Functional tests at | +125       |
| 8B     | Functional tests at | -55        |
| 9      | Switching tests at  | +25        |
| 10     | Switching tests at  | +125       |
| 11     | Switching tests at  | -55        |

**Features**

- 150mA output current without external pass transistor
- Output currents in excess of 10A possible by adding external transistors
- Input voltage 40V max
- Output voltage adjustable from 2V to 37V
- Can be used as either a linear or a switching regulator

**(Absolute Maximum Ratings)**

(Note 1)

|                                                                    |                     |
|--------------------------------------------------------------------|---------------------|
| Pulse Voltage V+ to V <sup>-</sup> (50ms)                          | 50V                 |
| Continuous Voltage from V+ to V <sup>-</sup>                       | 40V                 |
| Input-Output Voltage Differential                                  | 40V                 |
| Differential Input Voltage                                         | ±5V                 |
| Voltage Between Non Inverting Input and V <sup>-</sup>             | +8V                 |
| Current from Vz                                                    | 25mA                |
| Current from Vref                                                  | 15mA                |
| Maximum Junction Temperature                                       | 175 C               |
| Internal Power Dissipation<br>(Note 2)                             |                     |
| Metal Can                                                          | 350mW at TA = 125 C |
| Cavity DIP                                                         | 400mW at TA = 125 C |
| Storage Temperature Range                                          |                     |
| Metal Can                                                          | -65 C to +150 C     |
| Cavity DIP                                                         | -65 C to +150 C     |
| Lead Temperature<br>(Soldering, 10 seconds)                        | 300 C               |
| ESD Tolerance<br>(Human body model, 1.5K Ohm in series with 100pF) | 1200V               |

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. For guaranteed specifications and test conditions, see the Electrical Characteristics. The guaranteed specifications apply only for the test conditions listed. Some performance characteristics may degrade when the device is not operated under the listed test conditions.

Note 2: The maximum power dissipation must be derated at elevated temperatures and is dictated by Tjmax (maximum junction temperature), ThetaJA (package junction to ambient thermal resistance), and TA (ambient temperature). The maximum allowable power dissipation at any temperature is Pdmax = (Tjmax - TA)/ThetaJA or the number given in the Absolute Maximum Ratings, whichever is lower.

**Recommended Operating Conditions**

|                                     |                 |
|-------------------------------------|-----------------|
| Input Voltage Range                 | 9.5V to 40V dc  |
| Output Voltage Range                | 2V to 37V dc    |
| Input-Output Voltage Differential   | 2.5V to 38V dc  |
| Ambient Operating Temperature Range | -55 C to +125 C |

## Electrical Characteristics

### DC PARAMETERS

| SYMBOL | PARAMETER             | CONDITIONS                                                          | NOTES | PIN-NAME | MIN   | MAX  | UNIT  | SUB-GROUPS |
|--------|-----------------------|---------------------------------------------------------------------|-------|----------|-------|------|-------|------------|
| Vrline | Line Regulation       | $12V \leq V_{in} \leq 15V$ , $V_{out} = 5V$ , $I_L = 1mA$           |       |          | -0.1  | 0.1  | %Vout | 1          |
|        |                       | $12V \leq V_{in} \leq 15V$ , $V_{out} = 5V$ , $I_L = 1mA$           |       |          | -0.2  | 0.2  | %Vout | 2          |
|        |                       | $12V \leq V_{in} \leq 15V$ , $V_{out} = 5V$ , $I_L = 1mA$           |       |          | -0.3  | 0.3  | %Vout | 3          |
|        |                       | $12V \leq V_{in} \leq 40V$ , $V_{out} = 2V$ , $I_L = 1mA$           |       |          | -0.2  | 0.2  | %Vout | 1          |
|        |                       | $9.5V \leq V_{in} \leq 40V$ , $V_{out} = 5V$ , $I_L = 1mA$          |       |          | -0.3  | 0.3  | %Vout | 1          |
|        |                       | $12V \leq V_{in} \leq 15V$ , $V_{out}=5V$ , $I_L = 1mA$             |       |          | -10   | +10  | mV    | 1          |
|        |                       | $12V \leq V_{in} \leq 15V$ , $V_{out}=5V$ , $I_L = 1mA$             |       |          | -20   | +20  | mV    | 2          |
|        |                       | $12V \leq V_{in} \leq 15V$ , $V_{out}=5V$ , $I_L = 1mA$             |       |          | -30   | +30  | mV    | 3          |
| Vrload | Load Regulation       | $1mA \geq I_L \geq 50mA$ , $V_{in} = 12V$ , $V_{out} = 5V$          |       |          | -0.15 | 0.15 | %Vout | 1          |
|        |                       | $1mA \geq I_L \geq 50mA$ , $V_{in} = 12V$ , $V_{out} = 5V$          |       |          | -0.4  | 0.4  | %Vout | 2          |
|        |                       | $1mA \geq I_L \geq 50mA$ , $V_{in} = 12V$ , $V_{out} = 5V$          |       |          | -0.6  | 0.6  | %Vout | 3          |
|        |                       | $1mA \leq I_L \leq 10mA$ , $V_{in} = 40V$ , $V_{out} = 37V$         |       |          | -0.5  | 0.5  | %Vout | 1          |
|        |                       | $6mA \leq I_L \leq 12mA$ , $V_{in} = 10V$ , $V_{out} = 7.5V$        |       |          | -0.2  | 0.2  | %Vout | 1          |
|        |                       | $1mA \leq I_L \leq 50mA$ , $V_{in}=12V$ , $V_{out} = 5V$            |       |          | -15   | 15   | mV    | 1          |
|        |                       | $1mA \leq I_L \leq 50mA$ , $V_{in}=12V$ , $V_{out} = 5V$            |       |          | -40   | 40   | mV    | 2          |
|        |                       | $1mA \leq I_L \leq 50mA$ , $V_{in}=12V$ , $V_{out} = 5V$            |       |          | -60   | 60   | mV    | 3          |
| Vref   | Reference Voltage     | $I_{ref} = 1mA$ , $V_{in} = 12V$                                    |       |          | 6.95  | 7.35 | V     | 1          |
|        |                       |                                                                     |       |          | 6.9   | 7.4  | V     | 2, 3       |
| Iscd   | Standby Current Drain | $V_{in} = 30V$ , $I_L = I_{ref} = 0$ , $V_{out} = V_{ref}$          |       |          | 0.5   | 3    | mA    | 1          |
|        |                       |                                                                     |       |          | 0.5   | 2.4  | mA    | 2          |
|        |                       |                                                                     |       |          | 0.5   | 3.5  | mA    | 3          |
| Ios    | Short Circuit Current | $V_{out} = 5V$ , $V_{in} = 12V$ , $R_{sc} = 10\ \Omega$ , $R_L = 0$ |       |          | 45    | 85   | mA    | 1          |
| Vz     | Zener Voltage         | $I_z = 1mA$                                                         | 1     |          | 5.58  | 6.82 | V     | 1          |
| Vout   | Output Voltage        | $V_{in} = 12V$ , $I_L = 1mA$ , $V_{out} = 5V$                       | 2     |          | 4.5   | 5.5  | V     | 1, 2, 3    |

## Electrical Characteristics

### DC PARAMETERS(Continued)

| SYMBOL               | PARAMETER                                         | CONDITIONS                                                                           | NOTES | PIN-NAME | MIN    | MAX   | UNIT  | SUB-GROUPS |
|----------------------|---------------------------------------------------|--------------------------------------------------------------------------------------|-------|----------|--------|-------|-------|------------|
| Delta Vout /Delta T  | Average Temperature Coefficient of Output Voltage | 25 C ≤ TA ≤ +125 C, Vin = 12V, Vout = 5V, Il = 1mA                                   | 3     |          | -0.01  | 0.01  | %/ C  | 8A         |
|                      |                                                   | -55C ≤ TA ≤ 25C, Vin = 12V, Vout = 5V, Il = 1mA                                      | 3     |          | -0.015 | 0.015 | %/ C  | 8B         |
| Delta Vout/Delta Vin | Ripple Rejection                                  | f = 10KHz, Cref = 0F, Vins = 2Vrms                                                   | 4     |          | 64     |       | dB    | 4          |
|                      |                                                   | f = 10KHz, Cref = 5uF, Vins = 2Vrms                                                  | 4     |          | 76     |       | dB    | 4          |
| No                   | Output Noise Voltage                              | 100Hz ≤ f ≤ 10KHz, Vins = 0Vrms, Cref = 0                                            | 4     |          |        | 120   | uVrms | 4          |
|                      |                                                   | 100Hz ≤ f ≤ 10KHz, Vins = 0Vrms, Cref = 5uF                                          | 4     |          |        | 7     | uVrms | 4          |
| Delta Vout/Delta Vin | Line Transient Response                           | Vin = 12V, Vout = 5V, Il = 1mA, Cref = 5uF, Rsc = 0 Ohms, Delta Vin = 3V for 25usec  | 4     |          | 0      | 10    | mV/V  | 4          |
| Delta Vout/Delta Il  | Load Transient Response                           | Vin = 12V, Vout = 5V, Il = 40mA, Cref = 5uF, Rsc = 0 Ohm, Delta Il = 10mA for 25usec | 4     |          | -1.5   | 0     | mV/mA | 4          |

### DC PARAMETERS: DRIFT VALUES

(The following conditions apply to all the following parameters, unless otherwise specified.)  
 DC: "Delta calculations performed on JAN S and QMLV devices at group B, subgroup 5 only".

|        |                       |                                                                            |  |  |     |    |    |   |
|--------|-----------------------|----------------------------------------------------------------------------|--|--|-----|----|----|---|
| Vrline | Line Regulation       | 12V ≤ Vin ≤ 15V, Vout = 5V, Il = 1mA, ±1mV or ±15% (whichever is greater)  |  |  | -1  | 1  | mV | 1 |
| Vrload | Load Regulation       | 1mA ≤ Il ≤ 50mA, Vin = 12V, Vout = 5V, ±1mV or ±20% (whichever is greater) |  |  | -1  | 1  | mV | 1 |
| Vref   | Reference Voltage     | Iref = 1mA, Vin = 12V                                                      |  |  | -15 | 15 | mV | 1 |
| Iscd   | Standby Current Drain | Vin = 30V, Il = Iref = 0, Vout = Vref                                      |  |  | -10 | 10 | %  | 1 |

Note 1: Tested for 14-Lead DIP Only.  
 Note 2: Setup test for Temp. Coeff.  
 Note 3: Calculated parameter.  
 Note 4: Bench tested.