# LM119QML High Speed Dual Comparator

**Check for Samples: LM119QML**

## FEATURES

- **Available with radiation ensured**
  - **High Dose Rate 100 krad(Si)**
  - **ELDRS Free 100 krad(Si)**
- **Two independent comparators**
- **Operates from a single 5V supply**
- **Typically 80 ns response time at ±15V**
- **Minimum fan-out of 2 each side**
- **Maximum input current of 1 µA over temperature**
- **Inputs and outputs can be isolated from system ground**
- **High common mode slew rate**

## DESCRIPTION

The LM119 is a precision high speed dual comparator fabricated on a single monolithic chip. It is designed to operate over a wide range of supply voltages down to a single 5V logic supply and ground. Further, it has higher gain and lower input currents than devices like the LM710. The uncommitted collector of the output stage makes the LM119 compatible with RTL, DTL and TTL as well as capable of driving lamps and relays at currents up to 25 mA.

Although designed primarily for applications requiring operation from digital logic supplies, the LM119 is fully specified for power supplies up to ±15V. It features faster response than the LM111 at the expense of higher power dissipation. However, the high speed, wide operating voltage range and low package count make the LM119 much more versatile than older devices like the LM711.

## Connection Diagrams

**CDIP Package**

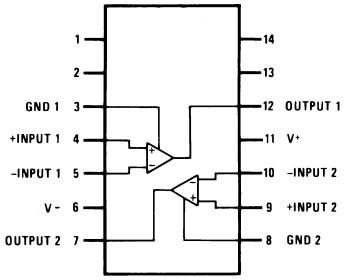



**Figure 1. Top View**
**Package Number J0014A**

**LCCC Package**

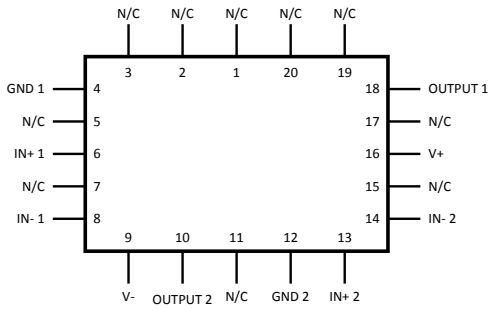
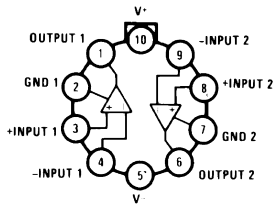



**Figure 2. Top View**
**Package Number NAJ0020A**

**TO-100 Package**




Case is connected to pin 5 ($V^-$).

**Figure 3. Top View**
**Package Number LME0010C**

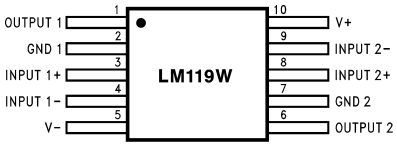



**Figure 4. Top View**
**Package Number NAD0010A, NAC0010A**

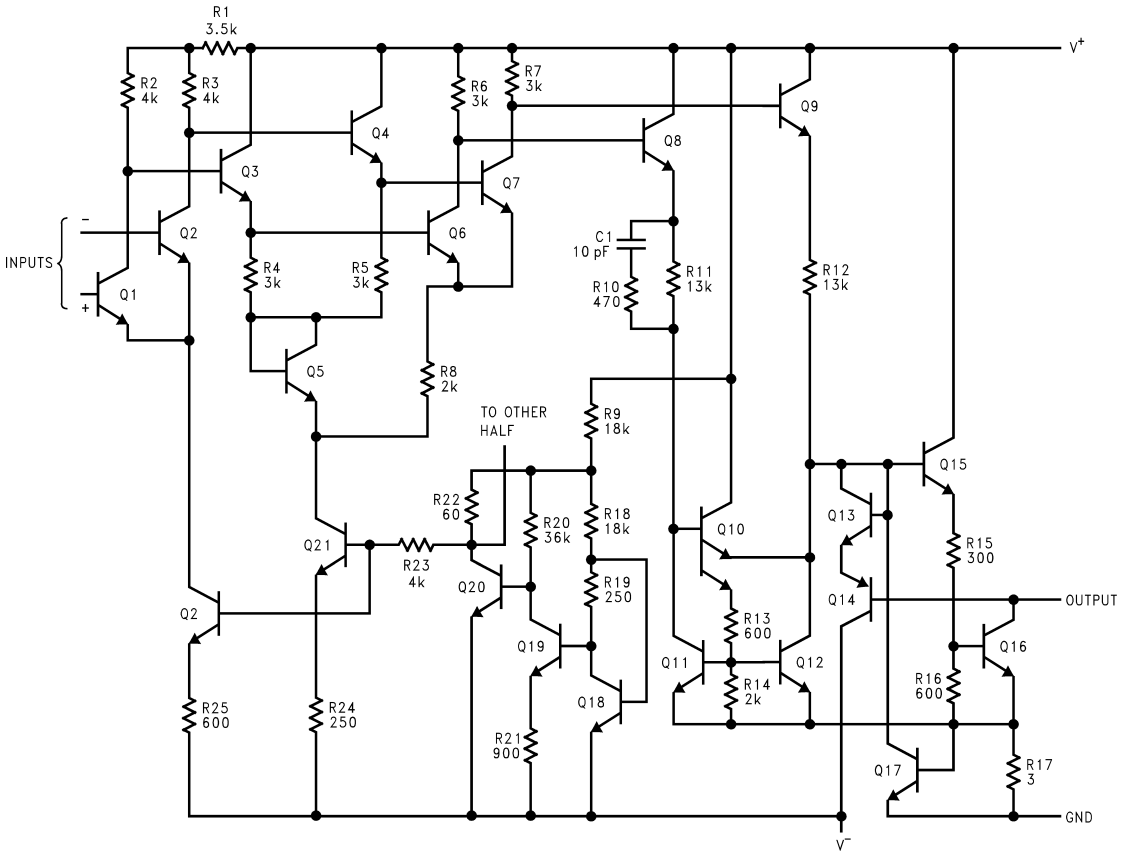
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## Schematic Diagram




*Do not operate the LM119 with more than 16V between GND and $V^+$

These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.


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## Absolute Maximum Ratings (1)

| | |
|---|---|
| Total Supply Voltage | 36V |
| Output to Negative Supply Voltage | 36V |
| Ground to Negative Supply Voltage | 25V |
| Ground to Positive Supply Voltage | 18V |
| Differential Input Voltage | ±5V |
| Input Voltage (2) | ±15V |
| Power Dissipation (3) | 500 mW |
| Output Short Circuit Duration | 10 sec |
| Storage Temperature Range | $-65°C \le T_A \le 150°C$ |
| Operating Ambient Temperature Range | $-55°C \le T_A \le 125°C$ |
| Maximum Junction Temperature ($T_J$) | 150°C |
| Lead Temperature (Soldering, 10 sec.) | 260°C |
| Thermal Resistance | |
| $\theta_{JA}$ | |
| LCCC Package (Still Air) | 89°C/W |
| LCCC Package (500LF/Min Air flow) | 63°C/W |
| TO-100 Package (Still Air) | 162°C/W |
| TO-100 Package (500LF/Min Air flow) | 88°C/W |
| CDIP Package (Still Air) | 94°C/W |
| CDIP Package (500LF/Min Air flow) | 52°C/W |
| CLGA Package (Still Air) | 215°C/W |
| CLGA Package (500LF/Min Air flow) | 132°C/W |
| CLGA Package (Still Air) | 215°C/W |
| CLGA Package (500LF/Min Air flow) | 132°C/W |
| $\theta_{JC}$ | |
| LCCC Package | 5°C/W |
| TO-100 Package | 31°C/W |
| CDIP Package | 11°C/W |
| CLGA Package | 13°C/W |
| CLGA Package | 13°C/W |
| Package Weight | |
| LCCC Package | TBD |
| TO-100 Package | TBD |
| CDIP Package | TBD |
| CLGA Package | TBD |
| CLGA Package | 225mg |
| ESD rating (4) | 800V |

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

(2) For supply voltages less than ±15V the absolute maximum input voltage is equal to the supply voltage.

(3) The maximum power dissipation must be derated at elevated temperatures and is dictated by $T_{Jmax}$ (maximum junction temperature), $\theta_{JA}$ (package junction to ambient thermal resistance), and $T_A$ (ambient temperature). The maximum allowable power dissipation at any temperature is $P_{Dmax} = (T_{Jmax} - T_A)/\theta_{JA}$ or the number given in the Absolute Maximum Ratings, whichever is lower.

(4) Human Body model, 1.5KΩ in series with 100pF.

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**Table 1. Quality Conformance Inspection(1)**

| Subgroup | 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 |
| 12 | Settling time at | 25 |
| 13 | Settling time at | 125 |
| 14 | Settling time at | -55 |

(1) Mil-Std-883, Method 5005 - Group 5


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## LM119/883 Electrical Characteristics DC Parameters

The following conditions apply, unless otherwise specified. $V_{CM}$ = 0V

| Symbol | Parameter | Conditions | Notes | Min | Max | Units | Sub-groups |
|---|---|---|---|---|---|---|---|
| $+I_{CC}$ | Positive Supply Current | $\pm V_{CC}$ = ±15V, $V_O$ = Low<br>$V^+$ = 5.6V thru 1.4KΩ | | | 11 | mA | 1 |
| | | | | | 11.5 | mA | 2 |
| $-I_{CC}$ | Negative Supply Current | $\pm V_{CC}$ = ±15V, $V_O$ = Low<br>$V^+$ = 5.6V thru 1.4KΩ | | -4.2 | | mA | 1 |
| | | | | -4.5 | | mA | 2 |
| $I_{Leak}$ | Output Leakage Current | $^+V_{CC}$ = 15V, $^-V_{CC}$ = -1V,<br>$V_{Gnd}$ = 0V, $V_O$ = 35V,<br>$V_I$ = 5mV | | | 1.8 | µA | 1 |
| | | | | | 9.5 | µA | 2 |
| | | | | | 10.0 | µA | 3 |
| $I_{IB}$ | Input Bias Current | $\pm V_{CC}$ = ±15V | | | 0.475 | µA | 1 |
| | | | | | 0.95 | µA | 2, 3 |
| | | $^+V_{CC}$ = 5V, $^-V_{CC}$ = 0V,<br>$V_{CM}$ = 1.5V | | | 0.475 | µA | 1 |
| | | | | | .95 | µA | 2, 3 |
| $V_{IO}$ | Input Offset Voltage | $^+V_{CC}$ = 5V, $^-V_{CC}$ = 0V,<br>$V_{CM}$ = 1V, $R_S$ ≤ 5KΩ | | -3.8 | 3.8 | mV | 1 |
| | | | | -6.8 | 6.8 | mV | 2, 3 |
| | | $^+V_{CC}$ = 5V, $^-V_{CC}$ = 0V,<br>$V_{CM}$ = 3V, $R_S$ ≤ 5KΩ | | -3.8 | 3.8 | mV | 1 |
| | | | | -6.8 | 6.8 | mV | 2, 3 |
| | | $\pm V_{CC}$ = ±15V, $V_{CM}$ = 12V,<br>$R_S$ ≤ 5KΩ | | -3.8 | 3.8 | mV | 1 |
| | | | | -6.8 | 6.8 | mV | 2, 3 |
| | | $\pm V_{CC}$ = ±15V, $V_{CM}$ = -12V,<br>$R_S$ ≤ 5KΩ | | -3.8 | 3.8 | mV | 1 |
| | | | | -6.8 | 6.8 | mV | 2, 3 |
| $I_{IO}$ | Input Offset Current | $^+V_{CC}$ = 5V, $^-V_{CC}$ = 0V, $V_{CM}$ = 1V | | -75 | 75 | nA | 1 |
| | | | | -100 | 100 | nA | 2, 3 |
| | | $^+V_{CC}$ = 5V, $^-V_{CC}$ = 0V, $V_{CM}$ = 3V | | -75 | 75 | nA | 1 |
| | | | | -100 | 100 | nA | 2, 3 |
| | | $\pm V_{CC}$ = ±15V, $V_{CM}$ = 12V | | -75 | 75 | nA | 1 |
| | | | | -100 | 100 | nA | 2, 3 |
| | | $\pm V_{CC}$ = ±15V, $V_{CM}$ = -12V | | -75 | 75 | nA | 1 |
| | | | | -100 | 100 | nA | 2, 3 |
| $V_{Sat}$ | Output Saturation Voltage | $\pm V_{CC}$ = ±15V, $I_O$ = 25mA,<br>$V_I$ = -5mV | | | 1.5 | V | 1 |
| | | $^+V_{CC}$ = 5V, $^-V_{CC}$ = 0V,<br>$I_O$= 4.0mA | (1) | | 0.4 | V | 1, 2 |
| | | | (1) | | 0.6 | V | 3 |
| $A_V$ | Voltage Gain | $\pm V_{CC}$ = ±15V, Delta $V_O$ = 12V,<br>$R_L$ = 1.4KΩ | (2), (3) | 10.5 | | K | 4 |
| | | | (2), (3) | 10 | | K | 5, 6 |
| | | $^+V_{CC}$ = 5V, $^-V_{CC}$ = 0V,<br>Delta $V_O$ = 4.5V, $R_L$ = 1.4KΩ | (2), (4) | 8.0 | | K | 4 |
| | | | (2), (4) | 5.0 | | K | 5 |
| | | | (2), (4) | 5.8 | | K | 6 |

(1) Output is monitored by measuring $V_I$ with limits from 0 to 6mV at all temperatures
(2) K = V/mV.
(3) Gain is computed with an output swing from +13.5V to +1.5V.
(4) Gain is computed with an output swing from +5.0V to +0.5V.

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## LM119-SMD Electrical Characteristics SMD 8601401 DC Parameters

The following conditions apply, unless otherwise specified. $V_{CM}$ = 0V

| Symbol | Parameter | Conditions | Notes | Min | Max | Units | Sub-groups |
|---|---|---|---|---|---|---|---|
| $+I_{CC}$ | Positive Supply Current | $\pm V_{CC}$ = ±15V, $V_O$ = Low<br>$V^+$ = 5.6V thru 1.4KΩ | | | 11 | mA | 1 |
| | | | | | 11.5 | mA | 2, 3 |
| $-I_{CC}$ | Negative Supply Current | $\pm V_{CC}$ = ±15V, $V_O$ = Low<br>$V^+$ = 5.6V thru 1.4KΩ | | -4.2 | | mA | 1 |
| | | | | -4.5 | | mA | 2 |
| | | | | -6.0 | | mA | 3 |
| $I_{Leak}$ | Output Leakage Current | $^+V_{CC}$ = 15V, $^-V_{CC}$ = -1V,<br>$V_{Gnd}$ = 0V, $V_O$ = 35V | (1) | | 1.8 | µA | 1 |
| | | | (1) | | 10 | µA | 2, 3 |
| $I_{IB}$ | Input Bias Current | $\pm V_{CC}$ = ±15V | | | 0.475 | µA | 1 |
| | | | | | 0.95 | µA | 2, 3 |
| | | $^+V_{CC}$ = 5V | (2) | | 0.475 | µA | 1 |
| | | | (2) | | .95 | µA | 2, 3 |
| $V_{IO}$ | Input Offset Voltage | $^+V_{CC}$ = 5V, $V_{CM}$ = 1V, $R_S$ ≤ 5KΩ | (2) | -3.8 | 3.8 | mV | 1 |
| | | | (2) | -6.8 | 6.8 | mV | 2, 3 |
| | | $^+V_{CC}$ = 5V, $V_{CM}$ = 3V,<br>$R_S$ ≤ 5KΩ | (2) | -3.8 | 3.8 | mV | 1 |
| | | | (2) | -6.8 | 6.8 | mV | 2, 3 |
| | | $\pm V_{CC}$ = ±15V, $V_{CM}$ = 12V,<br>$R_S$ ≤ 5KΩ | | -3.8 | 3.8 | mV | 1 |
| | | | | -6.8 | 6.8 | mV | 2, 3 |
| | | $\pm V_{CC}$ = ±15V, $V_{CM}$ = -12V,<br>$R_S$ ≤ 5KΩ | | -3.8 | 3.8 | mV | 1 |
| | | | | -6.8 | 6.8 | mV | 2, 3 |
| $I_{IO}$ | Input Offset Current | $^+V_{CC}$ = 5V, $V_{CM}$ = 1V | (2) | -75 | 75 | nA | 1 |
| | | | (2) | -100 | 100 | nA | 2, 3 |
| | | $^+V_{CC}$ = 5V, $V_{CM}$ = 3V | (2) | -75 | 75 | nA | 1 |
| | | | (2) | -100 | 100 | nA | 2, 3 |
| | | $\pm V_{CC}$ = ±15V, $V_{CM}$ = 12V | | -75 | 75 | nA | 1 |
| | | | | -100 | 100 | nA | 2, 3 |
| | | $\pm V_{CC}$ = ±15V, $V_{CM}$ = -12V | | -75 | 75 | nA | 1 |
| | | | | -100 | 100 | nA | 2, 3 |
| $V_I$ | Input Voltage Range | $^+V_{CC}$ = 5V | (2), (3) | 1.0 | 3.0 | V | 1, 2, 3 |
| | | $\pm V_{CC}$ = ±15V | (3) | -12 | 12 | V | 1, 2, 3 |
| $V_{Sat}$ | Output Saturation Voltage | $\pm V_{CC}$ = ±15V, $I_O$ = 25mA,<br>$V_I$ ≤ -5mV | (1) | | 1.5 | V | 1, 2, 3 |
| | | $^+V_{CC}$ = 3.5V, $^-V_{CC}$ = -1V,<br>$V_I$ ≤ -6mV, $I_O$ ≤ 3.2mA | | | 0.4 | V | 1, 2 |
| | | | | | 0.6 | V | 3 |
| $A_V$ | Voltage Gain | $\pm V_{CC}$ = ±15V, Delta $V_O$ = 12V,<br>$R_L$ = 1.4KΩ | (4) | 10.5 | | K | 4 |
| | | | (4) | 10 | | K | 5, 6 |
| | | $^+V_{CC}$ = 5V, $^-V_{CC}$ = 0V,<br>Delta $V_O$ = 4.5V, $R_L$ = 1.4KΩ | (2), (4) | 8.0 | | K | 4 |
| | | | (2), (4) | 5.0 | | K | 5 |
| | | | (2), (4) | 5.8 | | K | 6 |
| CMRR | Common Mode Rejection Ratio | $\pm V_{CC}$ = ±15V, $V_{CM}$ = ±12V | | 80 | | dB | 4 |

(1) $V_I$ ≥ 8mV at extremes for $I_{Leak}$ and $V_I$ ≤ −8mV at extremes for $V_{Sat}$ ($V_I$ to exceed $V_{OS}$.
(2) 5V differential across $+V_{CC}$ and $-V_{CC}$.
(3) Parameter ensured by $V_{IO}$ and $I_{IO}$ tests.
(4) K = V/mV.


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## LM119 Electrical Characteristics SMD 5962-9679801, HIGH DOSE RATE DC Parameters

The following conditions apply, unless otherwise specified. $V_{CM}$ = 0V

| Symbol | Parameter | Conditions | Notes | Min | Max | Units | Sub-groups |
|---|---|---|---|---|---|---|---|
| $+I_{CC}$ | Positive Supply Current | $\pm V_{CC}$ = ±15V, $V_O$ = Low<br>$V^+$ = 5.6V thru 1.4KΩ | | | 11 | mA | 1 |
| | | | | | 11.5 | mA | 2, 3 |
| $-I_{CC}$ | Negative Supply Current | $\pm V_{CC}$ = ±15V, $V_O$ = Low<br>$V^+$ = 5.6V thru 1.4KΩ | | -4.2 | | mA | 1 |
| | | | | -4.5 | | mA | 2 |
| | | | | -6.0 | | mA | 3 |
| $I_{Leak}$ | Output Leakage Current | $^+V_{CC}$ = 15V, $^-V_{CC}$ = -1V,<br>$V_{Gnd}$ = 0V, $V_O$ = 35V | (1) | | 1.8 | µA | 1 |
| | | | (1) | | 10 | µA | 2, 3 |
| $I_{IB}$ | Input Bias Current | $\pm V_{CC}$ = ±15V | | | 0.475 | µA | 1 |
| | | | | | 0.95 | µA | 2, 3 |
| | | $^+V_{CC}$ = 5V | (2) | | 0.475 | µA | 1 |
| | | | (2) | | .95 | µA | 2, 3 |
| $V_{IO}$ | Input Offset Voltage | $^+V_{CC}$ = 5V, $V_{CM}$ = 1V, $R_S \le 5K\Omega$ | (2) | -3.8 | 3.8 | mV | 1 |
| | | | (2) | -6.8 | 6.8 | mV | 2, 3 |
| | | $^+V_{CC}$ = 5V, $V_{CM}$ = 3V,<br>$R_S \le 5K\Omega$ | (2) | -3.8 | 3.8 | mV | 1 |
| | | | (2) | -6.8 | 6.8 | mV | 2, 3 |
| | | $\pm V_{CC}$ = ±15V, $V_{CM}$ = 12V,<br>$R_S \le 5K\Omega$ | | -3.8 | 3.8 | mV | 1 |
| | | | | -6.8 | 6.8 | mV | 2, 3 |
| | | $\pm V_{CC}$ = ±15V, $V_{CM}$ = -12V,<br>$R_S \le 5K\Omega$ | | -3.8 | 3.8 | mV | 1 |
| | | | | -6.8 | 6.8 | mV | 2, 3 |
| $I_{IO}$ | Input Offset Current | $^+V_{CC}$ = 5V, $V_{CM}$ = 1V | (2) | -75 | 75 | nA | 1 |
| | | | (2) | -100 | 100 | nA | 2, 3 |
| | | $^+V_{CC}$ = 5V, $V_{CM}$ = 3V | (2) | -75 | 75 | nA | 1 |
| | | | (2) | -100 | 100 | nA | 2, 3 |
| | | $\pm V_{CC}$ = ±15V, $V_{CM}$ = 12V | | -75 | 75 | nA | 1 |
| | | | | -100 | 100 | nA | 2, 3 |
| | | $\pm V_{CC}$ = ±15V, $V_{CM}$ = -12V | | -75 | 75 | nA | 1 |
| | | | | -100 | 100 | nA | 2, 3 |
| $V_I$ | Input Voltage Range | $^+V_{CC}$ = 5V | (2), (3) | 1.0 | 3.0 | V | 1, 2, 3 |
| | | $\pm V_{CC}$ = ±15V | (3) | -12 | 12 | V | 1, 2, 3 |
| $V_{Sat}$ | Output Saturation Voltage | $\pm V_{CC}$ = ±15V, $I_O$ = 25mA,<br>$V_I \le$ -5mV | (1) | | 1.5 | V | 1, 2, 3 |
| | | $^+V_{CC}$ = 3.5V, $^-V_{CC}$ = -1V,<br>$V_I \le$ -6mV, $I_O \le$ 3.2mA | | | 0.4 | V | 1, 2 |
| | | | | | 0.6 | V | 3 |
| $A_V$ | Voltage Gain | $\pm V_{CC}$ = ±15V, Delta $V_O$ = 12V,<br>$R_L$ = 1.4KΩ | (4) | 10.5 | | K | 4 |
| | | | (4) | 10 | | K | 5, 6 |
| | | $^+V_{CC}$ = 5V, $^-V_{CC}$ = 0V,<br>Delta $V_O$ = 4.5V, $R_L$ = 1.4KΩ | (2), (4) | 8.0 | | K | 4 |
| | | | (2), (4) | 5.0 | | K | 5 |
| | | | (2), (4) | 5.8 | | K | 6 |
| CMRR | Common Mode Rejection Ratio | $\pm V_{CC}$ = ±15V, $V_{CM}$ = ±12V | | 80 | | dB | 4 |

(1) $V_I \ge$ 8mV at extremes for $I_{Leak}$ and $V_I \le$ −8mV at extremes for $V_{Sat}$ ($V_I$ to exceed $V_{OS}$.
(2) 5V differential across $+V_{CC}$ and $-V_{CC}$.
(3) Parameter ensured by $V_{IO}$ and $I_{IO}$ tests.
(4) K = V/mV.

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## SMD 5962-9679801, HIGH DOSE RATE DC DELTA Parameters

The following conditions apply, unless otherwise specified.

$V_{CM}$ = 0V, Delta calculations performed on QMLV devices at group B, subgroup 5 only.

| Symbol | Parameter | Conditions | Notes | Min | Max | Units | Sub-groups |
|---|---|---|---|---|---|---|---|
| $+I_{CC}$ | Positive Supply Current | $\pm V_{CC}$ = ±15V, $V_O$ = Low<br>$V^+$ = 5.6V thru 1.4KΩ | | -1.0 | 1.0 | mA | 1 |
| $-I_{CC}$ | Negative Supply Current | $\pm V_{CC}$ = ±15V, $V_O$ = Low<br>$V^+$ = 5.6V thru 1.4KΩ | | -0.5 | 0.5 | mA | 1 |
| $V_{IO}$ | Input Offset Voltage | $^+V_{CC}$ = 5V, $V_{CM}$ = 1V, $R_S \leq$ 5KΩ | | -0.4 | 0.4 | mV | 1 |

## SMD 5962-9679801, High Dose Rate 100K Post Radiation Parameters @ 25°C (1)

The following conditions apply, unless otherwise specified. $V_{CM}$ = 0V

| Symbol | Parameter | Conditions | Notes | Min | Max | Units | Sub-groups |
|---|---|---|---|---|---|---|---|
| $I_{IB}$ | Input Bias Current | $\pm V_{CC}$ = ±15V | | | 1.0 | µA | 1 |
| | | $V_{CC}$ = 5V | | | 1.0 | µA | 1 |
| $V_{IO}$ | Input Offset Voltage | $^+V_{CC}$ = 5V, $V_{CM}$ = 1V, $R_S \leq$ 5KΩ | | -4.0 | 4.0 | mV | 1 |
| | | $^+V_{CC}$ = 5V, $V_{CM}$ = 3V, $R_S \leq$ 5KΩ | | -4.0 | 4.0 | mV | 1 |
| | | $\pm V_{CC}$ = ±15V, $V_{CM}$ = 12V, $R_S \leq$ 5KΩ | | -4.0 | 4.0 | mV | 1 |
| | | $\pm V_{CC}$ = ±15V, $V_{CM}$ = −12V, $R_S \leq$ 5KΩ | | -4.0 | 4.0 | mV | 1 |

(1) Pre and post irradiation limits are identical to those listed under AC and DC electrical characteristics except as listed in the Post Radiation Limits Table. These parts may be dose rate sensitive in a space environment and demonstrate enhanced low dose rate sensitivity. Radiation end point limits for the noted parameters are ensured only for the conditions as specified in MIL-STD-883, per Test Method 1019, Condition A.

## LM119 Electrical Characteristics SMD 5962-9679802, ELDRS FREE DC Parameters

The following conditions apply, unless otherwise specified. $V_{CM}$ = 0V

| Symbol | Parameter | Conditions | Notes | Min | Max | Units | Sub-groups |
|---|---|---|---|---|---|---|---|
| $+I_{CC}$ | Positive Supply Current | $\pm V_{CC}$ = ±15V, $V_O$ = Low<br>$V^+$ = 5.6V thru 1.4KΩ | | | 11 | mA | 1 |
| | | | | | 11.5 | mA | 2, 3 |
| $-I_{CC}$ | Negative Supply Current | $\pm V_{CC}$ = ±15V, $V_O$ = Low<br>$V^+$ = 5.6V thru 1.4KΩ | | -4.2 | | mA | 1 |
| | | | | -4.5 | | mA | 2 |
| | | | | -6.0 | | mA | 3 |
| $I_{Leak}$ | Output Leakage Current | $^+V_{CC}$ = 15V, $^-V_{CC}$ = -1V,<br>$V_{Gnd}$ = 0V, $V_O$ = 35V | (1) | | 1.8 | µA | 1 |
| | | | (1) | | 10 | µA | 2, 3 |
| $I_{IB}$ | Input Bias Current | $\pm V_{CC}$ = ±15V | | | 0.475 | µA | 1 |
| | | | | | 0.95 | µA | 2, 3 |
| | | $^+V_{CC}$ = 5V | (2) | | 0.475 | µA | 1 |
| | | | (2) | | .95 | µA | 2, 3 |

(1) $V_I \geq$ 8mV at extremes for $I_{Leak}$ and $V_I \leq$ −8mV at extremes for $V_{Sat}$ ($V_I$ to exceed $V_{OS}$.

(2) 5V differential across $+V_{CC}$ and $-V_{CC}$.


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## LM119 Electrical Characteristics SMD 5962-9679802, ELDRS FREE DC Parameters (continued)

The following conditions apply, unless otherwise specified. $V_{CM}$ = 0V

| Symbol | Parameter | Conditions | Notes | Min | Max | Units | Sub-groups |
|---|---|---|---|---|---|---|---|
| $V_{IO}$ | Input Offset Voltage | $^{+}V_{CC}$ = 5V, $V_{CM}$ = 1V, $R_S \le 5K\Omega$ | (2) | -3.8 | 3.8 | mV | 1 |
| | | | (2) | -6.8 | 6.8 | mV | 2, 3 |
| | | $^{+}V_{CC}$ = 5V, $V_{CM}$ = 3V, $R_S \le 5K\Omega$ | (2) | -3.8 | 3.8 | mV | 1 |
| | | | (2) | -6.8 | 6.8 | mV | 2, 3 |
| | | $\pm V_{CC}$ = ±15V, $V_{CM}$ = 12V, $R_S \le 5K\Omega$ | | -3.8 | 3.8 | mV | 1 |
| | | | | -6.8 | 6.8 | mV | 2, 3 |
| | | $\pm V_{CC}$ = ±15V, $V_{CM}$ = -12V, $R_S \le 5K\Omega$ | | -3.8 | 3.8 | mV | 1 |
| | | | | -6.8 | 6.8 | mV | 2, 3 |
| $I_{IO}$ | Input Offset Current | $^{+}V_{CC}$ = 5V, $V_{CM}$ = 1V | (2) | -75 | 75 | nA | 1 |
| | | | (2) | -100 | 100 | nA | 2, 3 |
| | | $^{+}V_{CC}$ = 5V, $V_{CM}$ = 3V | (2) | -75 | 75 | nA | 1 |
| | | | (2) | -100 | 100 | nA | 2, 3 |
| | | $\pm V_{CC}$ = ±15V, $V_{CM}$ = 12V | | -75 | 75 | nA | 1 |
| | | | | -100 | 100 | nA | 2, 3 |
| | | $\pm V_{CC}$ = ±15V, $V_{CM}$ = -12V | | -75 | 75 | nA | 1 |
| | | | | -100 | 100 | nA | 2, 3 |
| $V_I$ | Input Voltage Range | $^{+}V_{CC}$ = 5V | (3), (3) | 1.0 | 3.0 | V | 1, 2, 3 |
| | | $\pm V_{CC}$ = ±15V | (3) | -12 | 12 | V | 1, 2, 3 |
| $V_{Sat}$ | Output Saturation Voltage | $\pm V_{CC}$ = ±15V, $I_O$ = 25mA, $V_I \le$ -5mV | (1) | | 1.5 | V | 1, 2, 3 |
| | | $^{+}V_{CC}$ = 3.5V, $^{-}V_{CC}$ = -1V, $V_I \le$ -6mV, $I_O \le$ 3.2mA | | | 0.4 | V | 1, 2 |
| | | | | | 0.6 | V | 3 |
| $A_V$ | Voltage Gain | $\pm V_{CC}$ = ±15V, Delta $V_O$ = 12V, $R_L$ = 1.4KΩ | (4) | 10.5 | | K | 4 |
| | | | (4) | 10 | | K | 5, 6 |
| | | $^{+}V_{CC}$ = 5V, $^{-}V_{CC}$ = 0V, Delta $V_O$ = 4.5V, $R_L$ = 1.4KΩ | (5), (4) | 8.0 | | K | 4 |
| | | | (5), (4) | 5.0 | | K | 5 |
| | | | (5), (4) | 5.8 | | K | 6 |
| CMRR | Common Mode Rejection Ratio | $\pm V_{CC}$ = ±15V, $V_{CM}$ = ±12V | | 80 | | dB | 4 |

(3) Parameter ensured by $V_{IO}$ and $I_{IO}$ tests.
(4) K = V/mV.
(5) 5V differential across $+V_{CC}$ and $-V_{CC}$.

## SMD 5962-9679802, ELDRS FREE DC DELTA Parameters

The following conditions apply, unless otherwise specified.
$V_{CM}$ = 0V, Delta calculations performed on QMLV devices at group B, subgroup 5 only.

| Symbol | Parameter | Conditions | Notes | Min | Max | Units | Sub-groups |
|---|---|---|---|---|---|---|---|
| $+I_{CC}$ | Positive Supply Current | $\pm V_{CC}$ = ±15V, $V_O$ = Low $V^+$ = 5.6V thru 1.4KΩ | | -1.0 | 1.0 | mA | 1 |
| $-I_{CC}$ | Negative Supply Current | $\pm V_{CC}$ = ±15V, $V_O$ = Low $V^+$ = 5.6V thru 1.4KΩ | | -0.5 | 0.5 | mA | 1 |
| $V_{IO}$ | Input Offset Voltage | $^{+}V_{CC}$ = 5V, $V_{CM}$ = 1V, $R_S \le 5K\Omega$ | | -0.4 | 0.4 | mV | 1 |

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## SMD 5962-9679802, ELDRS FREE 100K Post Radiation Parameters @ 25°C (1)

The following conditions apply, unless otherwise specified. $V_{CM}$ = 0V

| Symbol | Parameter | Conditions | Notes | Min | Max | Units | Sub-groups |
|---|---|---|---|---|---|---|---|
| $I_{IB}$ | Input Bias Current | $\pm V_{CC}$ = ±15V | | | 1.0 | µA | 1 |
| | | $V_{CC}$ = 5V | | | 1.0 | µA | 1 |
| $V_{IO}$ | Input Offset Voltage | $^{+}V_{CC}$ = 5V, $V_{CM}$ = 1V, $R_S \leq 5K\Omega$ | | -4.0 | 4.0 | mV | 1 |
| | | $^{+}V_{CC}$ = 5V, $V_{CM}$ = 3V, $R_S \leq 5K\Omega$ | | -4.0 | 4.0 | mV | 1 |
| | | $\pm V_{CC}$ = ±15V, $V_{CM}$ = 12V, $R_S \leq 5K\Omega$ | | -4.0 | 4.0 | mV | 1 |
| | | $\pm V_{CC}$ = ±15V, $V_{CM}$ = −12V, $R_S \leq 5K\Omega$ | | -4.0 | 4.0 | mV | 1 |

(1) Pre and post irradiation limits are identical to those listed under AC and DC electrical characteristics except as listed in the Post Radiation Limits Table. Low dose rate testing has been performed on a wafer-by-wafer basis, per Test Method 1019, Condition D of MIL-STD-883, with no enhanced low dose rate sensitivity (ELDRS).


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## Typical Performance Characteristics

**Input Currents**

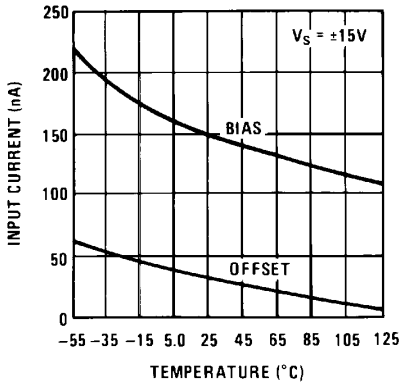



Figure 5.

**Common Mode Limits**

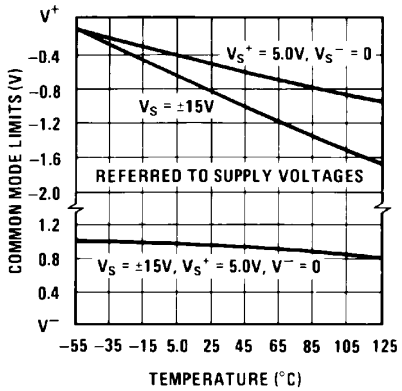



Figure 6.

**Transfer Function**

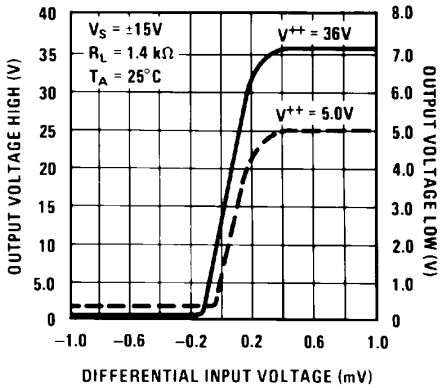



Figure 7.

**Response Time for Various Input Overdrives**

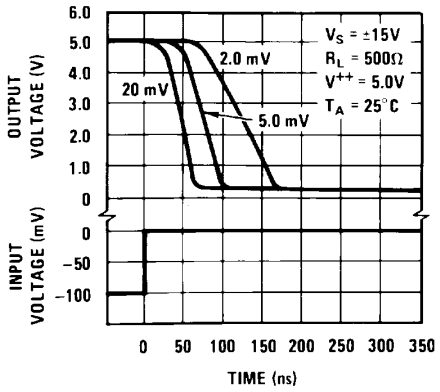



Figure 8.

**Response Time for Various Input Overdrives**

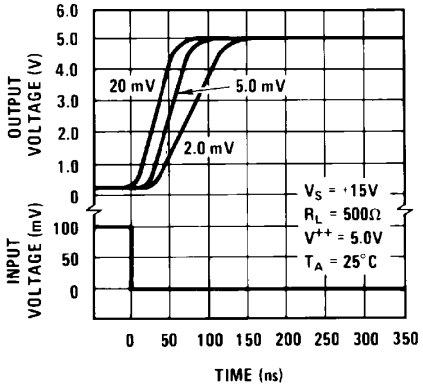



Figure 9.

**Input Characteristics**

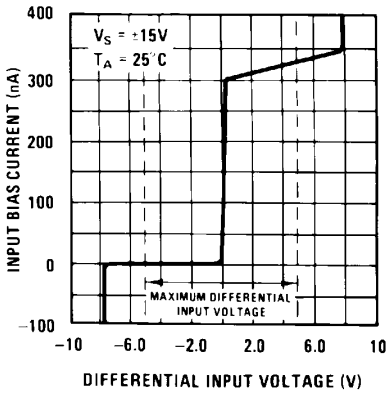



Figure 10.

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## Typical Performance Characteristics (continued)

**Response Time for Various Input Overdrives**

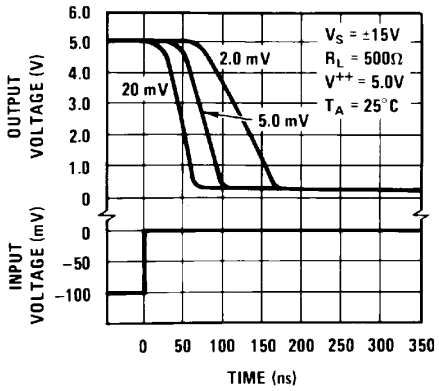



Figure 11.

**Response Time for Various Input Overdrives**

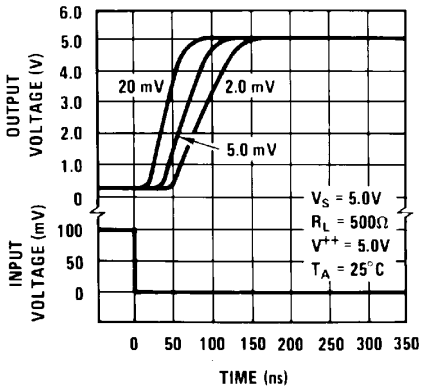



Figure 12.

**Output Saturation Voltage**

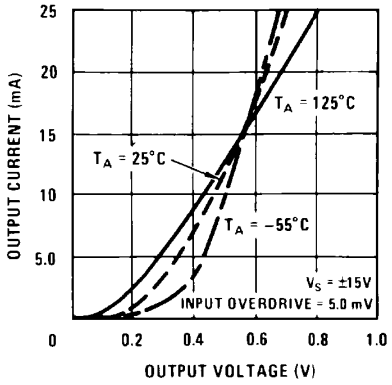



Figure 13.

**Supply Current**

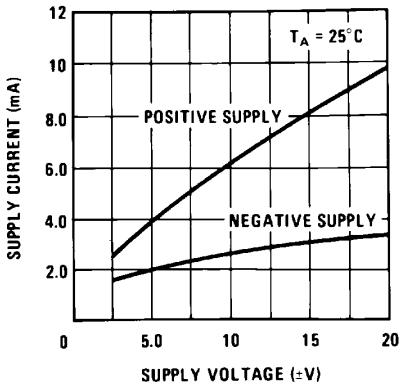



Figure 14.

**Supply Current**

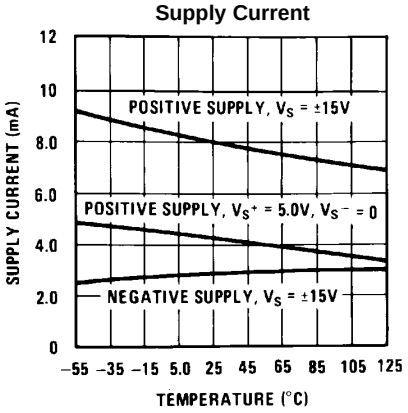



Figure 15.

**Output Limiting Characteristics**

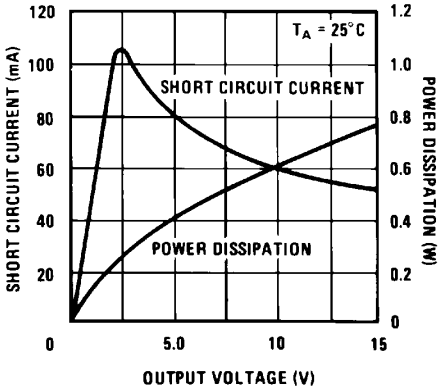
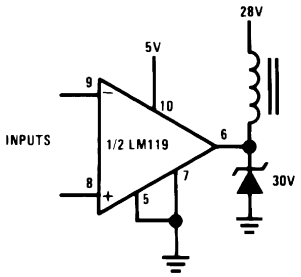



Figure 16.


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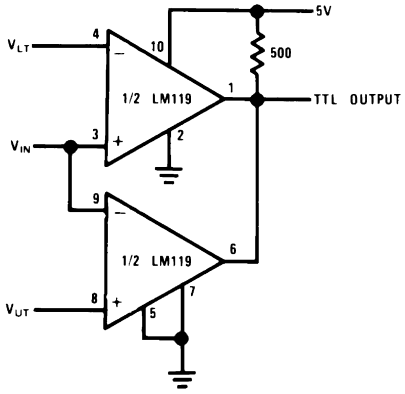
## TYPICAL APPLICATIONS

**Relay Driver**




Pin numbers are for LME0010C package.

**Window Detector**




$V_{OUT}$ = 5V for $V_{LT} \le V_{IN} \le V_{UT}$
$V_{OUT}$ = 0 for $V_{IN} \le V_{LT}$or $V_{IN} \ge V_{UT}$

## REVISION HISTORY

| Date Released | Revision | Section | Originator | Changes |
|---|---|---|---|---|
| 07/24/08 | A | New release to corporate format | L. Lytle | 2 MDS datasheets converted into one corporate data sheet format. Added Radiation information. MDS data sheets MNLM119-X Rev. 0F1 & MDLM119-X Rev 2A2 will be archived. |
| 01/13/09 | B | Features, Ordering Info., Electrical Section, Notes 13 and 14 | Larry McGee | Added reference to ELDRS and Die NSID's to data sheet. Correction from: 100k rd(Si) to 100 krad(Si) in ordering info. Changed wording in Notes 13 and 14 Revision A will be Archived. |
| 03/26/2013 | B | All Sections | | Changed layout of National Data Sheet to TI format |


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## PACKAGING INFORMATION

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead/Ball Finish | MSL Peak Temp (3) | Op Temp (°C) | Device Marking (4/5) | Samples |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 5962-9679801VCA | ACTIVE | CDIP | J | 14 | 25 | TBD | Call TI | Call TI | -55 to 125 | LM119J-QMLV 5962-9679801VCA Q | Samples |
| 5962-9679801VIA | ACTIVE | TO-100 | LME | 10 | 20 | TBD | Call TI | Call TI | -55 to 125 | LM119H-QMLV 5962-9679801VIA Q ACO 5962-9679801VIA Q >T | Samples |
| 5962R9679801V9A | ACTIVE | DIESALE | Y | 0 | 32 | Green (RoHS & no Sb/Br) | Call TI | Level-1-NA-UNLIM | | | Samples |
| 5962R9679801VCA | ACTIVE | CDIP | J | 14 | 25 | TBD | Call TI | Call TI | -55 to 125 | LM119JRQMLV 5962R9679801VCA Q | Samples |
| 5962R9679801VHA | ACTIVE | CFP | NAD | 10 | 19 | TBD | Call TI | Call TI | -55 to 125 | LM119W RQMLV Q 5962R96798 01VHA ACO 01VHA >T | Samples |
| 5962R9679801VIA | ACTIVE | TO-100 | LME | 10 | 20 | TBD | Call TI | Call TI | -55 to 125 | LM119HRQMLV 5962R9679801VIA Q ACO 5962R9679801VIA Q >T | Samples |
| 5962R9679801VXA | ACTIVE | CFP | NAC | 10 | 54 | TBD | Call TI | Call TI | -55 to 125 | LM119WG RQMLV Q 5962R96798 01VXA ACO 01VXA >T | Samples |
| 5962R9679802V9A | ACTIVE | DIESALE | Y | 0 | 32 | Green (RoHS & no Sb/Br) | Call TI | Level-1-NA-UNLIM | | | Samples |
| 5962R9679802VCA | ACTIVE | CDIP | J | 14 | 25 | TBD | Call TI | Call TI | -55 to 125 | LM119JRLQMLV 5962R9679802VCA Q | Samples |
| 5962R9679802VHA | ACTIVE | CFP | NAD | 10 | 19 | TBD | Call TI | Call TI | -55 to 125 | LM119W RLQMLV Q 5962R96798 02VHA ACO (LM111W ~ LM119W) 02VHA >T | Samples |

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead/Ball Finish | MSL Peak Temp (3) | Op Temp (°C) | Device Marking (4/5) | Samples |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 5962R9679802VIA | ACTIVE | TO-100 | LME | 10 | 20 | TBD | Call TI | Call TI | -55 to 125 | LM119HRLQMLV 5962R9679802VIA Q ACO 5962R9679802VIA Q >T | Samples |
| 5962R9679802VXA | ACTIVE | CFP | NAC | 10 | 54 | TBD | Call TI | Call TI | -55 to 125 | LM119WG RLQMLV Q 5962R96798 02VXA ACO 02VXA >T | Samples |
| 86014012A | ACTIVE | LCCC | NAJ | 20 | 50 | TBD | Call TI | Call TI | -55 to 125 | LM119E -SMD Q 5962-86014 012A ACO 012A >T | Samples |
| 8601401CA | ACTIVE | CDIP | J | 14 | 25 | TBD | Call TI | Call TI | -55 to 125 | LM119J-SMD 5962-8601401CA Q | Samples |
| 8601401HA | ACTIVE | CFP | NAD | 10 | 19 | TBD | Call TI | Call TI | -55 to 125 | LM119W -SMD Q 5962-86014 01HA ACO 01HA >T | Samples |
| 8601401IA | ACTIVE | TO-100 | LME | 10 | 20 | TBD | Call TI | Call TI | -55 to 125 | LM119H-SMD 5962-8601401IA Q A CO 5962-8601401IA Q > T | Samples |
| LM119 MDE | ACTIVE | DIESALE | Y | 0 | 32 | Green (RoHS & no Sb/Br) | Call TI | Level-1-NA-UNLIM | | | Samples |
| LM119 MDR | ACTIVE | DIESALE | Y | 0 | 32 | Green (RoHS & no Sb/Br) | Call TI | Level-1-NA-UNLIM | | | Samples |
| LM119E-SMD | ACTIVE | LCCC | NAJ | 20 | 50 | TBD | Call TI | Call TI | -55 to 125 | LM119E -SMD Q 5962-86014 012A ACO 012A >T | Samples |
| LM119E/883 | ACTIVE | LCCC | NAJ | 20 | 50 | TBD | Call TI | Call TI | -55 to 125 | LM119E /883 Q ACO /883 Q >T | Samples |

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead/Ball Finish | MSL Peak Temp (3) | Op Temp (°C) | Device Marking (4/5) | Samples |
|---|---|---|---|---|---|---|---|---|---|---|---|
| LM119H-QMLV | ACTIVE | TO-100 | LME | 10 | 20 | TBD | Call TI | Call TI | -55 to 125 | LM119H-QMLV 5962-9679801VIA Q ACO 5962-9679801VIA Q >T | Samples |
| LM119H-SMD | ACTIVE | TO-100 | LME | 10 | 20 | TBD | Call TI | Call TI | -55 to 125 | LM119H-SMD 5962-8601401IA Q A CO 5962-8601401IA Q > T | Samples |
| LM119H/883 | ACTIVE | TO-100 | LME | 10 | 20 | TBD | Call TI | Call TI | -55 to 125 | LM119H/883 Q ACO LM119H/883 Q >T | Samples |
| LM119HRLQMLV | ACTIVE | TO-100 | LME | 10 | 20 | TBD | Call TI | Call TI | -55 to 125 | LM119HRLQMLV 5962R9679802VIA Q ACO 5962R9679802VIA Q >T | Samples |
| LM119HRQMLV | ACTIVE | TO-100 | LME | 10 | 20 | TBD | Call TI | Call TI | -55 to 125 | LM119HRQMLV 5962R9679801VIA Q ACO 5962R9679801VIA Q >T | Samples |
| LM119J-QMLV | ACTIVE | CDIP | J | 14 | 25 | TBD | Call TI | Call TI | -55 to 125 | LM119J-QMLV 5962-9679801VCA Q | Samples |
| LM119J-SMD | ACTIVE | CDIP | J | 14 | 25 | TBD | Call TI | Call TI | -55 to 125 | LM119J-SMD 5962-8601401CA Q | Samples |
| LM119J/883 | ACTIVE | CDIP | J | 14 | 25 | TBD | Call TI | Call TI | -55 to 125 | LM119J/883 Q | Samples |
| LM119JRLQMLV | ACTIVE | CDIP | J | 14 | 25 | TBD | Call TI | Call TI | -55 to 125 | LM119JRLQMLV 5962R9679802VCA Q | Samples |
| LM119JRQMLV | ACTIVE | CDIP | J | 14 | 25 | TBD | Call TI | Call TI | -55 to 125 | LM119JRQMLV 5962R9679801VCA Q | Samples |
| LM119W-SMD | ACTIVE | CFP | NAD | 10 | 19 | TBD | Call TI | Call TI | -55 to 125 | LM119W -SMD Q 5962-86014 01HA ACO 01HA >T | Samples |
| LM119W/883 | ACTIVE | CFP | NAD | 10 | 19 | TBD | Call TI | Call TI | -55 to 125 | LM119W /883 Q ACO | Samples |

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead/Ball Finish | MSL Peak Temp (3) | Op Temp (°C) | Device Marking (4/5) | Samples |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | /883 Q >T | |
| LM119WGRLQMLV | ACTIVE | CFP | NAC | 10 | 54 | TBD | Call TI | Call TI | -55 to 125 | LM119WG<br>RLQMLV Q<br>5962R96798<br>02VXA ACO<br>02VXA >T | Samples |
| LM119WGRQMLV | ACTIVE | CFP | NAC | 10 | 54 | TBD | Call TI | Call TI | -55 to 125 | LM119WG<br>RQMLV Q<br>5962R96798<br>01VXA ACO<br>01VXA >T | Samples |
| LM119WRLQMLV | ACTIVE | CFP | NAD | 10 | 19 | TBD | Call TI | Call TI | -55 to 125 | LM119W<br>RLQMLV Q<br>5962R96798<br>02VHA ACO<br>(LM111W ~ LM119W)<br>02VHA >T | Samples |
| LM119WRQMLV | ACTIVE | CFP | NAD | 10 | 19 | TBD | Call TI | Call TI | -55 to 125 | LM119W<br>RQMLV Q<br>5962R96798<br>01VHA ACO<br>01VHA >T | Samples |

(1) The marketing status values are defined as follows:
**ACTIVE:** Product device recommended for new designs.
**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.
**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.
**OBSOLETE:** TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.
**TBD:** The Pb-Free/Green conversion plan has not been defined.
**Pb-Free (RoHS):** TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.
**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.
**Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

(3) MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

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**OTHER QUALIFIED VERSIONS OF LM119QML, LM119QML-SP :**

- Military: LM119QML
- Space: LM119QML-SP

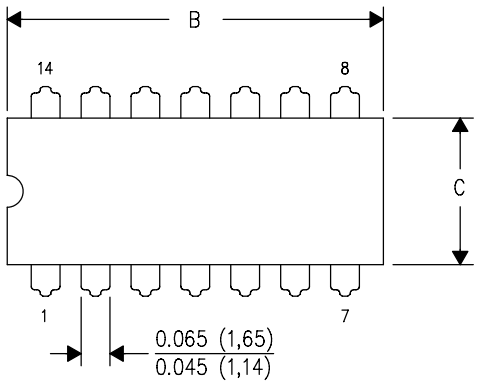
NOTE: Qualified Version Definitions:

- Military - QML certified for Military and Defense Applications
- Space - Radiation tolerant, ceramic packaging and qualified for use in Space-based application

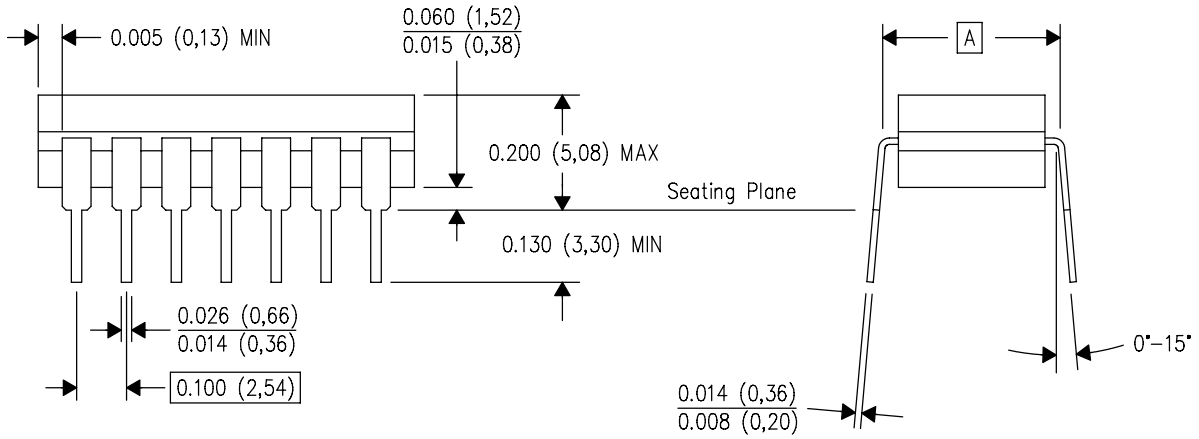
J (R–GDIP–T**)

14 LEADS SHOWN

# CERAMIC DUAL IN–LINE PACKAGE



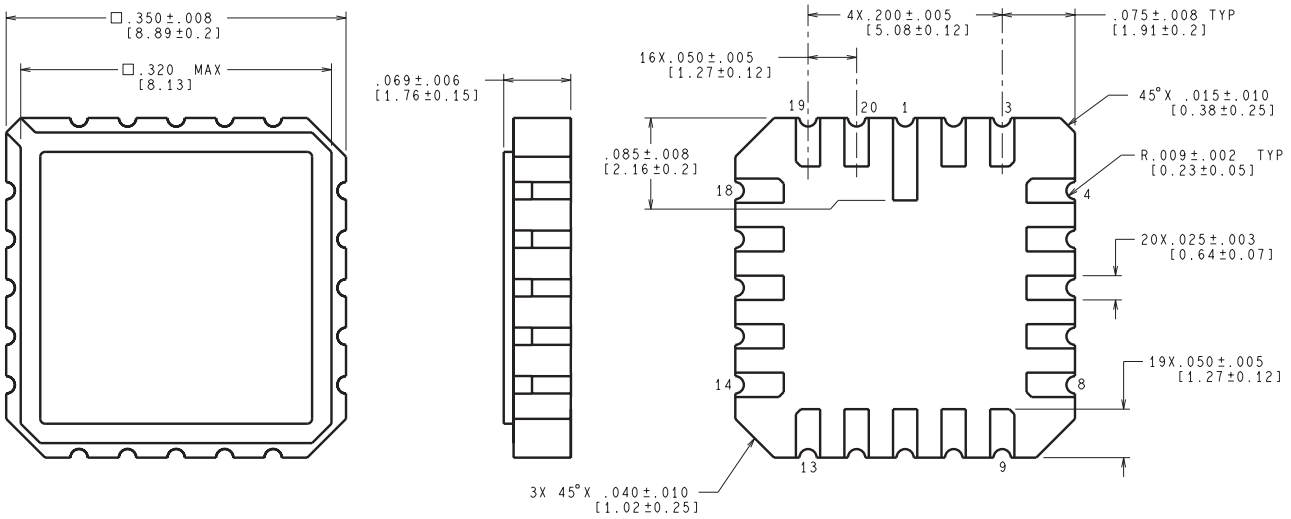

| DIM \ PINS ** | 14 | 16 | 18 | 20 |
|---|---|---|---|---|
| A | 0.300 (7,62) BSC | 0.300 (7,62) BSC | 0.300 (7,62) BSC | 0.300 (7,62) BSC |
| B MAX | 0.785 (19,94) | .840 (21,34) | 0.960 (24,38) | 1.060 (26,92) |
| B MIN | — | — | — | — |
| C MAX | 0.300 (7,62) | 0.300 (7,62) | 0.310 (7,87) | 0.300 (7,62) |
| C MIN | 0.245 (6,22) | 0.245 (6,22) | 0.220 (5,59) | 0.245 (6,22) |




4040083/F 03/03

NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. This package is hermetically sealed with a ceramic lid using glass frit.
D. Index point is provided on cap for terminal identification only on press ceramic glass frit seal only.
E. Falls within MIL STD 1835 GDIP1–T14, GDIP1–T16, GDIP1–T18 and GDIP1–T20.

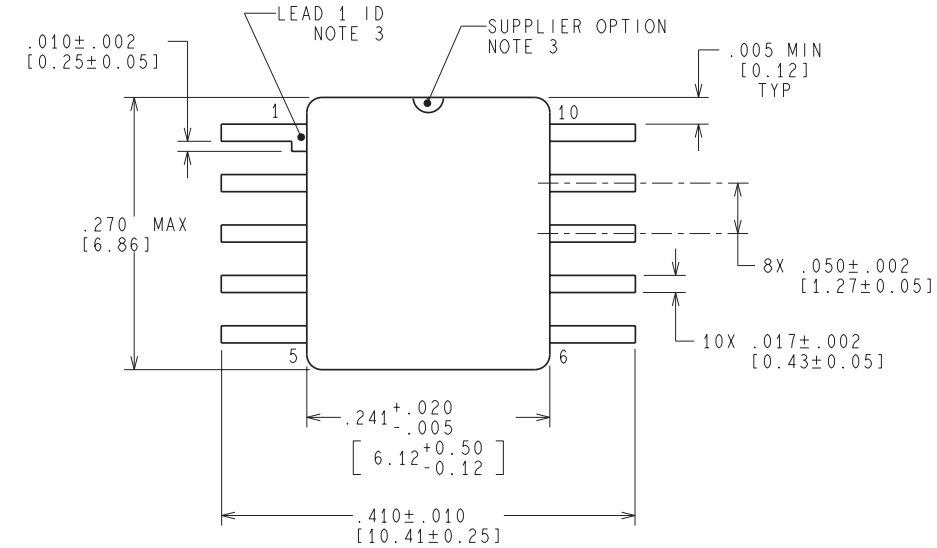
NAJ0020A

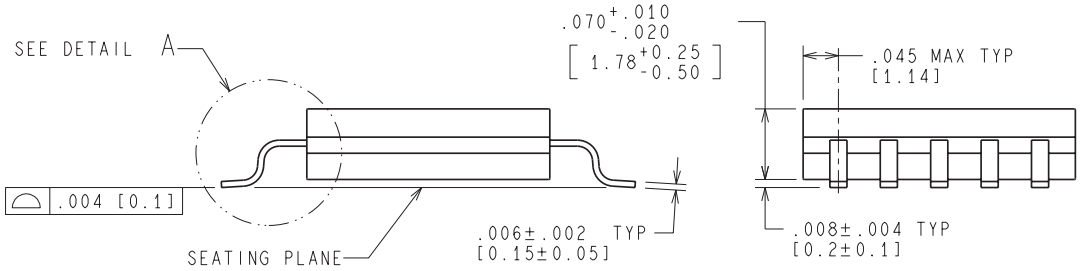


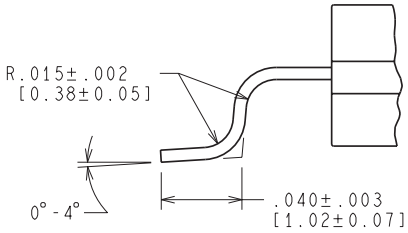

CONTROLLING DIMENSION IS INCH
VALUES IN [ ] ARE MILLIMETERS

E20A (Rev F)

# NAC0010A



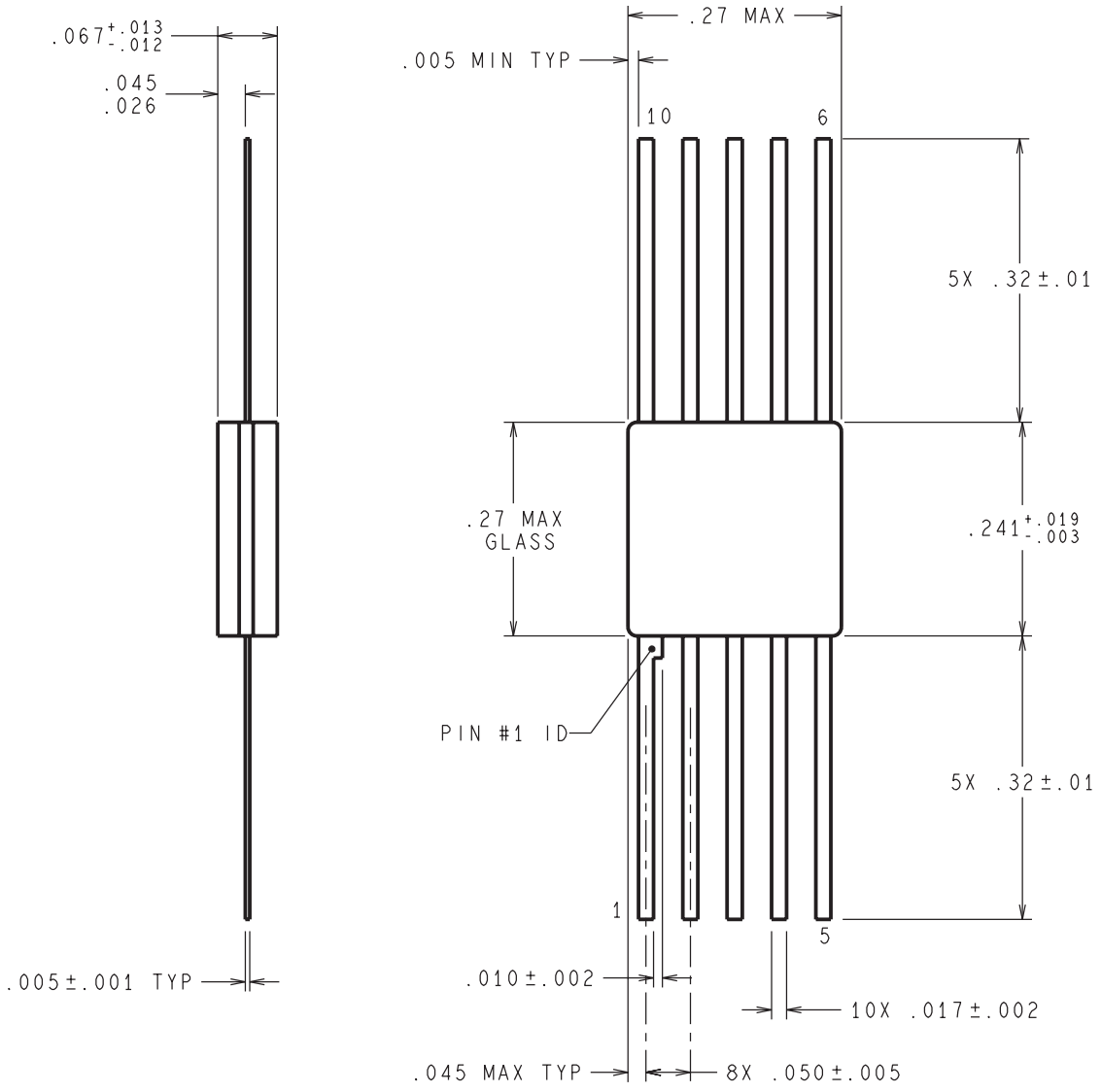




**DETAIL A**
TYPICAL

**MIL-PRF-38535**
**CONFIGURATION CONTROL**

WG10A (Rev H)

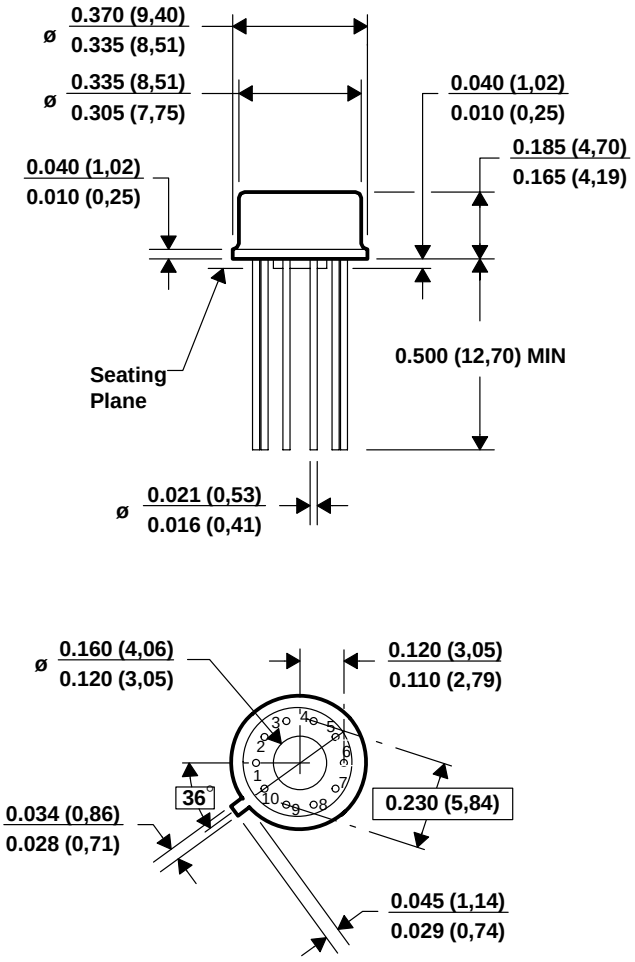
NAD0010A




DIMENSIONS ARE IN INCHES

W10A (Rev H)

**LME (O–MBCY–W10)** **METAL CYLINDRICAL PACKAGE**




4202488/A 03/01

NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Leads in true position within 0.010 (0,25) R @ MMC at seating plane.
D. Pin numbers shown for reference only. Numbers may not be marked on package.
E. Falls within JEDEC MO–006/TO-100.

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