

## LOW DROPOUT VOLTAGE REGULATOR

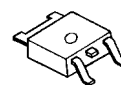
### ■ GENERAL DESCRIPTION

The NJM2391 is low dropout voltage regulators featuring high precision voltage.

It is suitable for Notebook PCs, PC cards and hard disks where 3.3V need to be generated from 5V supply.

A small TO-252 package is adopted for the space saving.

### ■ PACKAGE OUTLINE

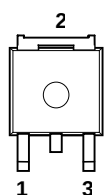


NJM2391DL1

### ■ FEATURES

- Output Current  $I_o(\text{max.})=1\text{A}$
- High Precision Output Voltage  $V_o \pm 1\%$
- Low Dropout Voltage  $\Delta V_{I-O} = 1.1\text{V typ. At } I_o=1\text{A}$
- Internal Excessive Voltage Protection Circuit
- Internal Short Circuit Current Limit
- Internal Thermal Overload Protection
- Bipolar Technology
- Package Outline TO-252

### ■ PIN CONFIGURATION



PIN FUNCTION

- 1.  $V_{IN}$
- 2. GND
- 3.  $V_{OUT}$

NJM2391DL1

### ■ ABSOLUTE MAXIMUM RATINGS

( $T_a=25^\circ\text{C}$ )

| PARAMETER             | SYMBOL    | RATINGS             | UNIT             |
|-----------------------|-----------|---------------------|------------------|
| Input Voltage         | $V^+$     | +10                 | V                |
| Power Dissipation     | $P_D$     | 900(*1)<br>2500(*2) | W                |
| Operating Temperature | $T_{opr}$ | $-40 \sim +85$      | $^\circ\text{C}$ |
| Storage Temperature   | $T_{stg}$ | $-50 \sim +125$     | $^\circ\text{C}$ |

(\*1): Mounted on glass epoxy board. (76.2 × 114.3 × 1.6mm:based on EIA/JDEC standard size, 2Layers, Cu area 100mm<sup>2</sup>)

(\*2): Mounted on glass epoxy board. (76.2 × 114.3 × 1.6mm:based on EIA/JDEC standard, 4Layers)

(For 4Layers: Applying 74.2 × 74.2mm inner Cu area and a thermal via hole to a board based on JEDEC standard JESD51-5)

### ■ OUTPUT VOLTAGE RANK LIST

| Device Name   | $V_{OUT}$ | Device Name   | $V_{OUT}$ |
|---------------|-----------|---------------|-----------|
| NJM2391DL1-25 | 2.5V      | NJM2391DL1-33 | 3.3V      |
| NJM2391DL1-26 | 2.6V      | NJM2391DL1-35 | 3.5V      |
| NJM2391DL1-28 | 2.85V     | NJM2391DL1-05 | 5.0V      |
| NJM2391DL1-03 | 3.0V      |               |           |

**■ ELECTRICAL CHARACTERISTICS ( $C_{IN}=0.1\mu F$ ,  $C_O=10\mu F$ ,  $T_J=25^\circ C$ )**

Measurement is to be conducted is pulse testing

| PARAMETER                          | SYMBOL                     | TEST CONDITION                                               | MIN.  | TYP. | MAX.  | UNIT    |
|------------------------------------|----------------------------|--------------------------------------------------------------|-------|------|-------|---------|
| Vo=2.5V Version<br>Output Voltage  | $V_O$                      | $V_{IN}=5.5V$ , $I_O=0.01A$                                  | 2.475 | 2.5  | 2.525 | V       |
| Line Regulation                    | $\Delta V_O/\Delta V_{IN}$ | $V_{IN}=4V\sim 9V$ , $I_O=1A$                                | –     | –    | 50    | mV      |
| Load Regulation                    | $\Delta V_O/\Delta I_O$    | $V_{IN}=5.5V$ , $I_O=0\sim 1A$                               | –     | –    | 50    | mV      |
| Quiescent Current                  | $I_Q$                      | $V_{IN}=5.5V$ , $I_O=0A$                                     | –     | 2.3  | 4.0   | mA      |
| Ripple Rejection                   | RR                         | $V_{IN}=5.5V$ , $e_{in}=2V_{P-P}$<br>$f=120Hz$ , $I_O=0.5A$  | 53    | 63   | –     | dB      |
| Dropout Voltage                    | $\Delta V_{I-O}$           | $I_O=1A$                                                     | –     | 1.1  | 1.2   | V       |
| Output Noise Voltage               | $V_{NO}$                   | $V_{IN}=5.5V$ , $I_O=0.5A$<br>$BW=10Hz\sim 100kHz$           | –     | 85   | 185   | $\mu V$ |
| Vo=2.6V Version<br>Output Voltage  | $V_O$                      | $V_{IN}=5.6V$ , $I_O=0.01A$                                  | 2.574 | 2.60 | 2.626 | V       |
| Line Regulation                    | $\Delta V_O/\Delta V_{IN}$ | $V_{IN}=4.1V\sim 9.1V$ , $I_O=1A$                            | –     | –    | 52    | mV      |
| Load Regulation                    | $\Delta V_O/\Delta I_O$    | $V_{IN}=5.6V$ , $I_O=0\sim 1A$                               | –     | –    | 52    | mV      |
| Quiescent Current                  | $I_Q$                      | $V_{IN}=5.6V$ , $I_O=0A$                                     | –     | 2.3  | 4.0   | mA      |
| Ripple Rejection                   | RR                         | $V_{IN}=5.6V$ , $e_{in}=2V_{P-P}$<br>$f=120Hz$ , $I_O=0.5A$  | 53    | 63   | –     | dB      |
| Dropout Voltage                    | $\Delta V_{I-O}$           | $I_O=1A$                                                     | –     | 1.1  | 1.2   | V       |
| Output Noise Voltage               | $V_{NO}$                   | $V_{IN}=5.6V$ , $I_O=0.5A$<br>$BW=10Hz\sim 100kHz$           | –     | 87   | 187   | $\mu V$ |
| Vo=2.85V Version<br>Output Voltage | $V_O$                      | $V_{IN}=5.85V$ , $I_O=0.01A$                                 | 2.82  | 2.85 | 2.88  | V       |
| Line Regulation                    | $\Delta V_O/\Delta V_{IN}$ | $V_{IN}=4.35V\sim 9.35V$ , $I_O=1A$                          | –     | –    | 57    | mV      |
| Load Regulation                    | $\Delta V_O/\Delta I_O$    | $V_{IN}=5.85V$ , $I_O=0\sim 1A$                              | –     | –    | 57    | mV      |
| Quiescent Current                  | $I_Q$                      | $V_{IN}=5.85V$ , $I_O=0A$                                    | –     | 2.3  | 4.0   | mA      |
| Ripple Rejection                   | RR                         | $V_{IN}=5.85V$ , $e_{in}=2V_{P-P}$<br>$f=120Hz$ , $I_O=0.5A$ | 53    | 63   | –     | dB      |
| Dropout Voltage                    | $\Delta V_{I-O}$           | $I_O=1A$                                                     | –     | 1.1  | 1.2   | V       |
| Output Noise Voltage               | $V_{NO}$                   | $V_{IN}=5.85V$ , $I_O=0.5A$<br>$BW=10Hz\sim 100kHz$          | –     | 90   | 190   | $\mu V$ |
| Vo=3V Version<br>Output Voltage    | $V_O$                      | $V_{IN}=6V$ , $I_O=0.01A$                                    | 2.97  | 3.00 | 3.03  | V       |
| Line Regulation                    | $\Delta V_O/\Delta V_{IN}$ | $V_{IN}=4.5V\sim 9.5V$ , $I_O=1A$                            | –     | –    | 60    | mV      |
| Load Regulation                    | $\Delta V_O/\Delta I_O$    | $V_{IN}=6V$ , $I_O=0\sim 1A$                                 | –     | –    | 60    | mV      |
| Quiescent Current                  | $I_Q$                      | $V_{IN}=6V$ , $I_O=0A$                                       | –     | 2.3  | 4.0   | mA      |
| Ripple Rejection                   | RR                         | $V_{IN}=6V$ , $e_{in}=2V_{P-P}$<br>$f=120Hz$ , $I_O=0.5A$    | 52    | 62   | –     | dB      |
| Dropout Voltage                    | $\Delta V_{I-O}$           | $I_O=1A$                                                     | –     | 1.1  | 1.2   | V       |
| Output Noise Voltage               | $V_{NO}$                   | $V_{IN}=6V$ , $I_O=0.5A$<br>$BW=10Hz\sim 100kHz$             | –     | 95   | 195   | $\mu V$ |

## ■ ELECTRICAL CHARACTERISTICS ( $C_{IN}=0.1\mu F$ , $C_O=10\mu F$ , $T_J=25^\circ C$ )

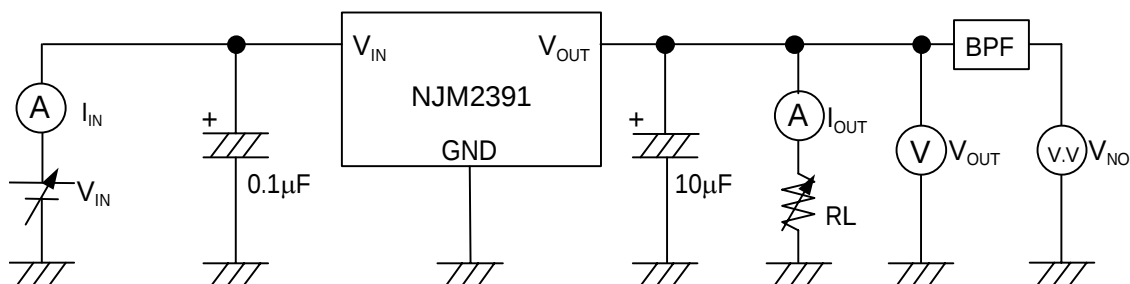
Measurement is to be conducted is pulse testing

| PARAMETER                         | SYMBOL                     | TEST CONDITION                                              | MIN.  | TYP. | MAX.  | UNIT    |
|-----------------------------------|----------------------------|-------------------------------------------------------------|-------|------|-------|---------|
| Vo=3.3V Version<br>Output Voltage | $V_O$                      | $V_{IN}=6.3V$ , $I_O=0.01A$                                 | 3.267 | 3.30 | 3.333 | V       |
| Line Regulation                   | $\Delta V_O/\Delta V_{IN}$ | $V_{IN}=4.8V\sim 9.8V$ , $I_O=1A$                           | –     | –    | 66    | mV      |
| Load Regulation                   | $\Delta V_O/\Delta I_O$    | $V_{IN}=6.3V$ , $I_O=0\sim 1A$                              | –     | –    | 66    | mV      |
| Quiescent Current                 | $I_Q$                      | $V_{IN}=6.3V$ , $I_O=0A$                                    | –     | 2.3  | 4.0   | mA      |
| Ripple Rejection                  | RR                         | $V_{IN}=6.3V$ , $e_{in}=2V_{P-P}$<br>$f=120Hz$ , $I_O=0.5A$ | 52    | 62   | –     | dB      |
| Dropout Voltage                   | $\Delta V_{I-O}$           | $I_O=1A$                                                    | –     | 1.1  | 1.2   | V       |
| Output Noise Voltage              | $V_{NO}$                   | $V_{IN}=6.3V$ , $I_O=0.5A$<br>$BW=10Hz\sim 100kHz$          | –     | 100  | 200   | $\mu V$ |
| Vo=3.5V Version<br>Output Voltage | $V_O$                      | $V_{IN}=6.5V$ , $I_O=0.01A$                                 | 3.465 | 3.50 | 3.535 | V       |
| Line Regulation                   | $\Delta V_O/\Delta V_{IN}$ | $V_{IN}=5V\sim 10V$ , $I_O=1A$                              | –     | –    | 70    | mV      |
| Load Regulation                   | $\Delta V_O/\Delta I_O$    | $V_{IN}=6.5V$ , $I_O=0\sim 1A$                              | –     | –    | 70    | mV      |
| Quiescent Current                 | $I_Q$                      | $V_{IN}=6.5V$ , $I_O=0A$                                    | –     | 2.3  | 4.0   | mA      |
| Ripple Rejection                  | RR                         | $V_{IN}=6.5V$ , $e_{in}=2V_{P-P}$<br>$f=120Hz$ , $I_O=0.5A$ | 52    | 62   | –     | dB      |
| Dropout Voltage                   | $\Delta V_{I-O}$           | $I_O=1A$                                                    | –     | 1.1  | 1.2   | V       |
| Output Noise Voltage              | $V_{NO}$                   | $V_{IN}=6.5V$ , $I_O=0.5A$<br>$BW=10Hz\sim 100kHz$          | –     | 105  | 205   | $\mu V$ |
| Vo=5V Version<br>Output Voltage   | $V_O$                      | $V_{IN}=8V$ , $I_O=0.01A$                                   | 4.95  | 5.00 | 5.05  | V       |
| Line Regulation                   | $\Delta V_O/\Delta V_{IN}$ | $V_{IN}=6.5V\sim 9.5V$ , $I_O=1A$                           | –     | –    | 60    | mV      |
| Load Regulation                   | $\Delta V_O/\Delta I_O$    | $V_{IN}=8V$ , $I_O=0\sim 1A$                                | –     | –    | 100   | mV      |
| Quiescent Current                 | $I_Q$                      | $V_{IN}=8V$ , $I_O=0A$                                      | –     | 2.3  | 4.0   | mA      |
| Ripple Rejection                  | RR                         | $V_{IN}=8V$ , $e_{in}=2V_{P-P}$<br>$f=120Hz$ , $I_O=0.5A$   | 50    | 60   | –     | dB      |
| Dropout Voltage                   | $\Delta V_{I-O}$           | $I_O=1A$                                                    | –     | 1.1  | 1.2   | V       |
| Output Noise Voltage              | $V_{NO}$                   | $V_{IN}=8V$ , $I_O=0.5A$<br>$BW=10Hz\sim 100kHz$            | –     | 150  | 260   | $\mu V$ |

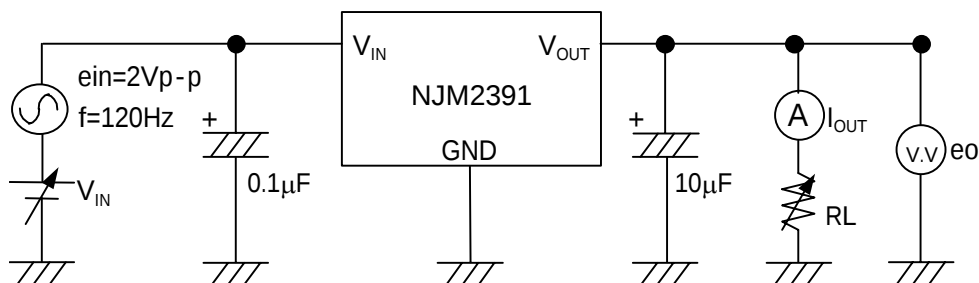
## ■ TEST CIRCUIT

### 1. Output Voltage / Line Regulation / Load Regulation

Quiescent Current / Dropout Voltage / Output Noise Voltage



### 2. Ripple Rejection



$$RR=20\log_{10}[e_{in}/e_o] \quad (dB)$$

#### \*Input Capacitor $C_{IN}$

Input Capacitor  $C_{IN}$  is required to prevent oscillation and reduce power supply ripple for applications when high power supply impedance or a long power supply line.

Therefore, use the recommended  $C_{IN}$  value (refer to conditions of ELECTRIC CHARACTERISTIC) or larger and should connect between GND and  $V_{IN}$  as shortest path as possible to avoid the problem.

#### \*Output Capacitor $C_O$

Output capacitor ( $C_O$ ) will be required for a phase compensation of the internal error amplifier.

The capacitance and the equivalent series resistance (ESR) influence to stable operation of the regulator.

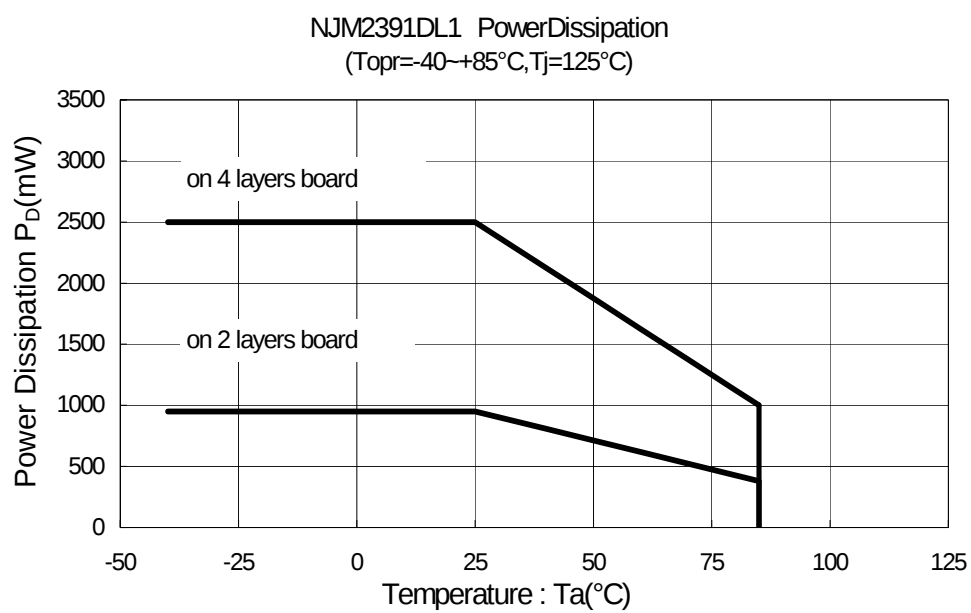
Use of a smaller  $C_O$  may cause excess output noise or oscillation of the regulator due to lack of the phase compensation.

On the other hand, Use of a larger  $C_O$  reduces output noise and ripple output, and also improves output transient response when rapid load change.

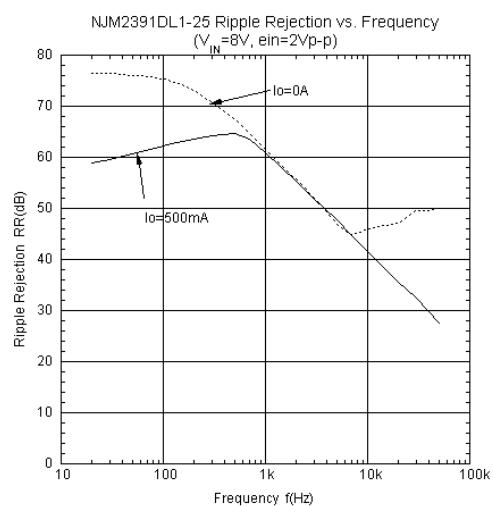
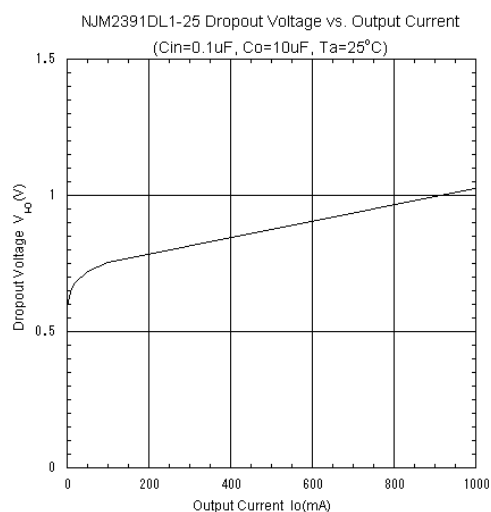
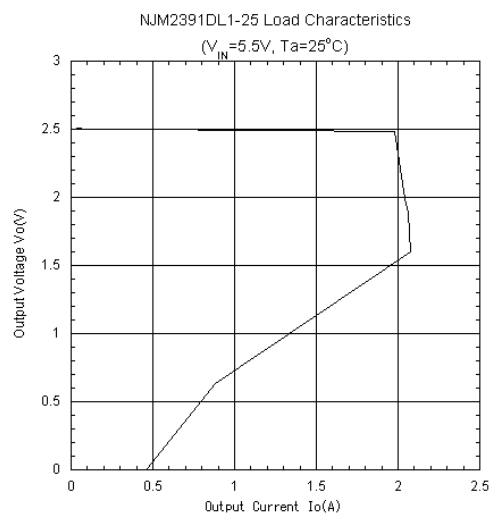
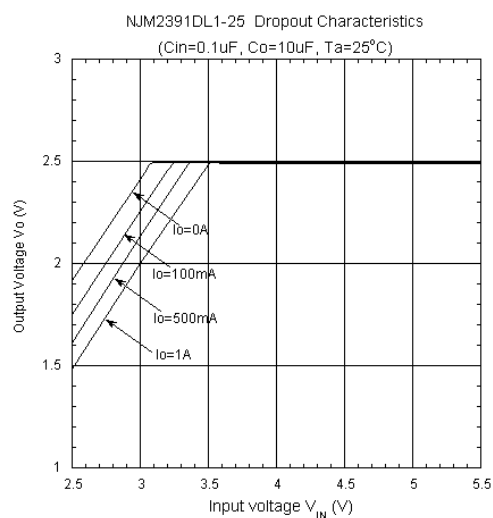
Therefore, use the recommended  $C_O$  value (refer to conditions of ELECTRIC CHARACTERISTIC) or larger and should connect between GND and  $V_{OUT}$  as shortest path as possible for stable operation

In addition, Please choose an appropriate capacitor in considering varied characteristics of capacitor (a frequency characteristic, a temperature characteristic, and so on) when selecting  $C_O$ .

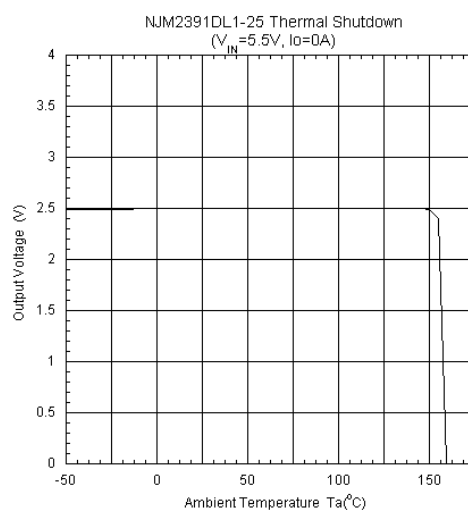
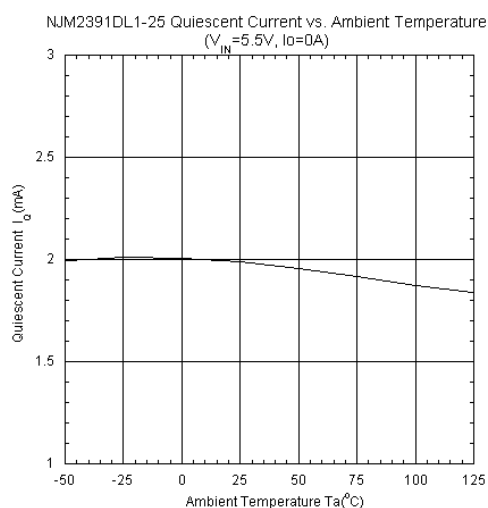
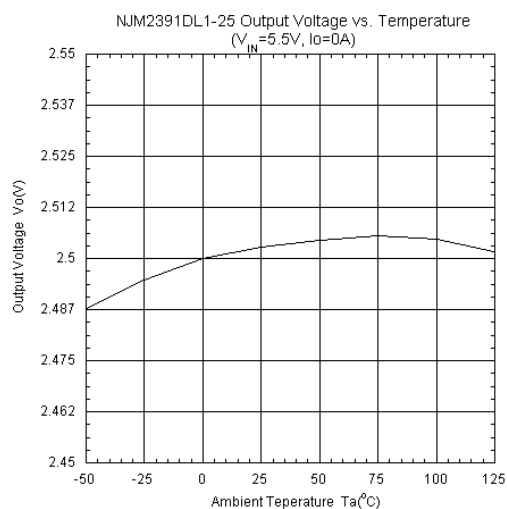
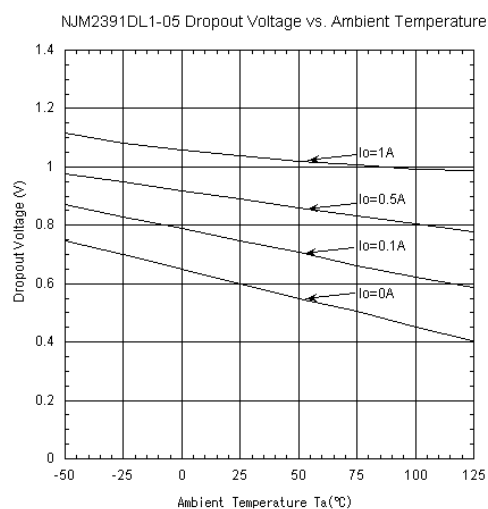
## ■ POWER DISSIPATION vs. AMBIENT TEMPERATURE



# ELECTRICAL CHARACTERISTICS



## ■ ELECTRICAL CHARACTERISTICS



**[CAUTION]**

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