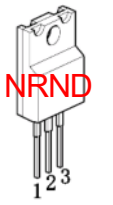
# NJM7800

## 3-TERMINAL POSITIVE VOLTAGE REGULATOR

## FEATURES

- Internal Short Circuit Current Limit
- Excellent Ripple Rejection
- Guaranteed 1.5A Output Current
- Package Outline TO-220F, TO-252
- Bipolar Technology

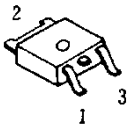
( TO-220F )




**NJM7800FA**

1. IN
2. GND
3. OUT

(TO-252)




**NJM7800DL1A**

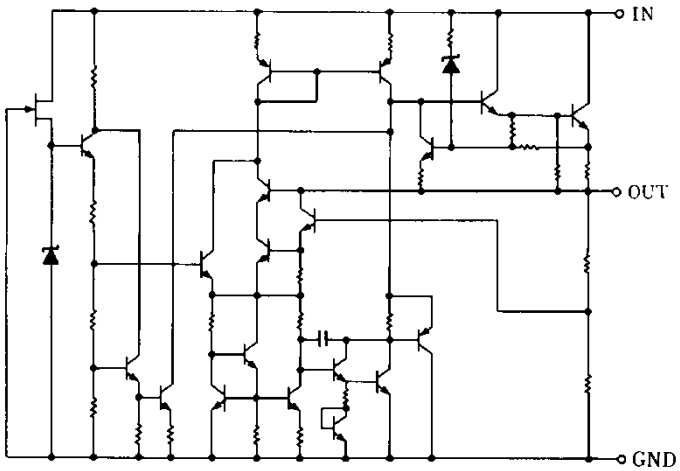
1. IN
2. GND
3. OUT

(note) The radiation fin is connected pin2.

## GENERAL DESCRIPTION

The NJM7800 series of monolithic 3-Terminal Positive Voltage Regulators is constructed using the Nisshinbo Micro Devices planar epitaxial process. These regulators employ internal current-limiting, thermal-shutdown and safe-area compensation making them essentially indestructible. If adequate heat sinking is provided, they can deliver over 1A output current. They are intended as fixed voltage regulators in a wide range of applications including local (on card) regulation for elimination of distribution problems associated with single point regulation. In addition to use as fixed voltage regulators, these devices can be used with external components to obtain adjustable output voltages and currents.

## EQUIVALENT CIRCUIT



## ■ ABSOLUTE MAXIMUM RATINGS (Ta=25ºC)

| PARAMETER | SYMBOL | MAXIMUM RATINGS | | UNIT |
|---|---|---|---|---|
| Input Voltage | $V_{IN}$ | 7805 to 7810<br>7812 to 7815<br>7818 to 7824 | 35<br>35<br>40 | V |
| Storage Temperature Range | $T_{stg}$ | -40 to +150 | | ºC |
| Operating Temperature Range | $T_{opr}$ | -40 to +85 | | ºC |
| Junction Temperature Range | $T_j$ | -40 to +150 | | ºC |
| Power Dissipation | $P_D$ | TO-220F 16($T_C$≤70ºC) *1<br>TO-252 10($T_C$=25ºC) *1 | | W |

*1) Infinite Heat Sink

## ■ THERMAL CHARACTERISTICS

| Package | Measurement Result | | Unit |
|---|---|---|---|
| | Thermal Resistance (θja) | Thermal Characterization Parameter (ψjt) | |
| TO-252 | 141 *2 / 35 *3 | 32 *2 / 10 *3 | °C/W |

θja: Junction-to-Ambient Thermal Resistance, ψjt: Junction-to-Top Thermal Characterization Parameter

*2) 2-Layer: Mounted on glass epoxy board (76.2 mm × 114.3 mm × 1.6 mm: based on EIA/JEDEC standard, 2-layer FR-4), Cu area: 100 $mm^2$

*3) 4-Layer: Mounted on glass epoxy board (76.2 mm × 114.3 mm × 1.6 mm: based on EIA/JEDEC standard, 4-layer FR-4).
(For 4-layer: Applying 74.2 mm × 74.2 mm inner Cu area and a thermal via hole to a board based on JEDEC standard JESD51-5.)

## ■ ELECTRICAL CHARACTERISTICS ($C_1$=0.33μF, $C_O$=0.1μF, $T_j$=25°C) Measurement is to be conducted in pulse testing.

| RAMETER | SYMBOL | TEST CONDITIONS | TO-220F | | | TO-252 | | | UNIT |
|---|---|---|---|---|---|---|---|---|---|
| | | | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. | |
| **NJM7805FA/DL1A** | | | | | | | | | |
| Output Voltage | $V_O$ | $V_{IN}$=10V, $I_O$=0.5A | 4.8 | 5.0 | 5.2 | 4.8 | 5.0 | 5.2 | V |
| Line Regulation | $\Delta V_O$ - $V_{IN}$ | $V_{IN}$=7 to 25V, $I_O$=0.5A | - | 3 | 50 | - | 3 | 100 | mV |
| Load Regulation | $\Delta V_O$ - $I_O$ | $V_{IN}$=10V, $I_O$=0.005 to 1.5A | - | 15 | 50 | - | 15 | 100 | mV |
| Quiescent Current | $I_Q$ | $V_{IN}$=10V, $I_O$=0mA | - | 4.2 | 6.0 | - | 4.2 | 6.0 | mA |
| Average Temperature Coefficient of Output Voltage | $\Delta V_O/\Delta T$ | $V_{IN}$=10V, $I_O$=5mA | - | -0.5 | - | - | -0.5 | - | mV/ºC |
| Ripple Rejection | RR | $V_{IN}$=10V, $I_O$=0.5A , $e_{in}$=2$V_{P-P}$, f=120Hz | 68 | 78 | - | 68 | 78 | - | dB |
| Output Noise Voltage | $V_{NO}$ | $V_{IN}$=10V, BW=10Hz to 100kHz, $I_O$=0.5A | - | 45 | - | - | 45 | - | μV |
| **NJM7806FA/DL1A** | | | | | | | | | |
| Output Voltage | $V_O$ | $V_{IN}$=11V, $I_O$=0.5A | 5.75 | 6.0 | 6.25 | 5.75 | 6.0 | 6.25 | V |
| Line Regulation | $\Delta V_O$ - $V_{IN}$ | $V_{IN}$=8 to 25V, $I_O$=0.5A | - | 5 | 60 | - | 5 | 120 | mV |
| Load Regulation | $\Delta V_O$ - $I_O$ | $V_{IN}$=11V, $I_O$=0.005 to 1.5A | - | 15 | 60 | - | 15 | 120 | mV |
| Quiescent Current | $I_Q$ | $V_{IN}$=11V, $I_O$=0mA | - | 4.3 | 6.0 | - | 4.3 | 6.0 | mA |
| Average Temperature Coefficient of Output Voltage | $\Delta V_O/\Delta T$ | $V_{IN}$=11V, $I_O$=5mA | - | -0.6 | - | - | -0.6 | - | mV/ºC |
| Ripple Rejection | RR | $V_{IN}$=11V, $I_O$=0.5A , $e_{in}$=2$V_{P-P}$, f=120Hz | 65 | 75 | - | 65 | 75 | - | dB |
| Output Noise Voltage | $V_{NO}$ | $V_{IN}$=11V, BW=10Hz to 100kHz, $I_O$=0.5A | - | 45 | - | - | 45 | - | μV |

■ ELECTRICAL CHARACTERISTICS ($C_1$=0.33μF, $C_O$=0.1μF, $T_j$=25°C)

Measurement is to be conducted in pulse testing.

| PARAMETER | SYMBOL | TEST CONDITIONS | TO-220F | | | TO-252 | | | UNIT |
|---|---|---|---|---|---|---|---|---|---|
| | | | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. | |
| **NJM7808FA/DL1A** | | | | | | | | | |
| Output Voltage | $V_O$ | $V_{IN}$=14V, $I_O$=0.5A | 7.7 | 8.0 | 8.3 | 7.7 | 8.0 | 8.3 | V |
| Line Regulation | $\Delta V_O$ - $V_{IN}$ | $V_{IN}$=10.5 to 25V, $I_O$=0.5A | - | 6 | 80 | - | 6 | 160 | mV |
| Load Regulation | $\Delta V_O$ - $I_O$ | $V_{IN}$=14V, $I_O$=0.005 to 1.5A | - | 15 | 80 | - | 15 | 160 | mV |
| Quiescent Current | $I_Q$ | $V_{IN}$=14V, $I_O$=0mA | - | 4.3 | 6.0 | - | 4.3 | 6.0 | mA |
| Average Temperature Coefficient of Output Voltage | $\Delta V_O/\Delta T$ | $V_{IN}$=14V, $I_O$=5mA | - | -0.8 | - | - | -0.8 | - | mV/ºC |
| Ripple Rejection | RR | $V_{IN}$=14V, $I_O$=0.5A , $e_{in}$=2$V_{P-P}$, f=120Hz | 62 | 72 | - | 62 | 72 | - | dB |
| Output Noise Voltage | $V_{NO}$ | $V_{IN}$=14V, BW=10Hz to 100kHz, $I_O$=0.5A | - | 55 | - | - | 55 | - | μV |
| **NJM7809FA/DL1A** | | | | | | | | | |
| Output Voltage | $V_O$ | $V_{IN}$=15V, $I_O$=0.5A | 8.65 | 9.0 | 9.35 | 8.65 | 9.0 | 9.35 | V |
| Line Regulation | $\Delta V_O$ - $V_{IN}$ | $V_{IN}$=11.5 to 25V, $I_O$=0.5A | - | 7 | 90 | - | 7 | 180 | mV |
| Load Regulation | $\Delta V_O$ - $I_O$ | $V_{IN}$=15V, $I_O$=0.005 to 1.5A | - | 15 | 90 | - | 15 | 180 | mV |
| Quiescent Current | $I_Q$ | $V_{IN}$=15V, $I_O$=0mA | - | 4.3 | 6.0 | - | 4.3 | 6.0 | mA |
| Average Temperature Coefficient of Output Voltage | $\Delta V_O/\Delta T$ | $V_{IN}$=15V, $I_O$=5mA | - | -0.9 | - | - | -0.9 | - | mV/ºC |
| Ripple Rejection | RR | $V_{IN}$=15V, $I_O$=0.5A , $e_{in}$=2$V_{P-P}$, f=120Hz | 62 | 72 | - | 62 | 72 | - | dB |
| Output Noise Voltage | $V_{NO}$ | $V_{IN}$=15V, BW=10Hz to 100kHz, $I_O$=0.5A | - | 60 | - | - | 60 | - | μV |
| **NJM7810FA/DL1A** | | | | | | | | | |
| Output Voltage | $V_O$ | $V_{IN}$=17V, $I_O$=0.5A | 9.60 | 10.0 | 10.4 | 9.6 | 10.0 | 10.4 | V |
| Line Regulation | $\Delta V_O$ - $V_{IN}$ | $V_{IN}$=12.5 to 25V, $I_O$=0.5A | - | 7 | 100 | - | 7 | 200 | mV |
| Load Regulation | $\Delta V_O$ - $I_O$ | $V_{IN}$=17V, $I_O$=0.005 to 1.5A | - | 15 | 130 | - | 15 | 200 | mV |
| Quiescent Current | $I_Q$ | $V_{IN}$=17V, $I_O$=0mA | - | 4.3 | 6.0 | - | 4.3 | 6.0 | mA |
| Average Temperature Coefficient of Output Voltage | $\Delta V_O/\Delta T$ | $V_{IN}$=17V, $I_O$=5mA | - | -0.9 | - | - | -1.0 | - | mV/ºC |
| Ripple Rejection | RR | $V_{IN}$=17V, $I_O$=0.5A , $e_{in}$=2$V_{P-P}$, f=120Hz | 62 | 72 | - | 62 | 72 | - | dB |
| Output Noise Voltage | $V_{NO}$ | $V_{IN}$=17V, BW=10Hz to 100kHz, $I_O$=0.5A | - | 60 | - | - | 65 | - | μV |

## ■ ELECTRICAL CHARACTERISTICS ($C_1$=0.33µF, $C_O$=0.1µF, $T_j$=25°C)

Measurement is to be conducted in pulse testing.

| PARAMETER | SYMBOL | TEST CONDITIONS | TO-220F | | | TO-252 | | | UNIT |
|---|---|---|---|---|---|---|---|---|---|
| | | | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. | |
| **NJM7812FA/DL1A** | | | | | | | | | |
| Output Voltage | $V_O$ | $V_{IN}$=19V, $I_O$=0.5A | 11.5 | 12.0 | 12.5 | 11.5 | 12.0 | 12.5 | V |
| Line Regulation | $\Delta V_O$ - $V_{IN}$ | $V_{IN}$=14.5 to 30V, $I_O$=0.5A | - | 10 | 120 | - | 10 | 240 | mV |
| Load Regulation | $\Delta V_O$ - $I_O$ | $V_{IN}$=19V, $I_O$=0.005 to 1.5A | - | 25 | 120 | - | 25 | 240 | mV |
| Quiescent Current | $I_Q$ | $V_{IN}$=19V, $I_O$=0mA | - | 4.3 | 6.0 | - | 4.3 | 6.0 | mA |
| Average Temperature Coefficient of Output Voltage | $\Delta V_O/\Delta T$ | $V_{IN}$=19V, $I_O$=5mA | - | -1.2 | - | - | -1.2 | - | mV/ºC |
| Ripple Rejection | RR | $V_{IN}$=19V, $I_O$=0.5A , $e_{in}$=2$V_{P-P}$, f=120Hz | 61 | 71 | - | 61 | 71 | - | dB |
| Output Noise Voltage | $V_{NO}$ | $V_{IN}$=19V, BW=10Hz to 100kHz, $I_O$=0.5A | - | 75 | - | - | 75 | - | µV |
| **NJM7815FA/DL1A** | | | | | | | | | |
| Output Voltage | $V_O$ | $V_{IN}$=23V, $I_O$=0.5A | 14.4 | 15.0 | 15.6 | 14.4 | 15.0 | 15.6 | V |
| Line Regulation | $\Delta V_O$ - $V_{IN}$ | $V_{IN}$=17.5 to 30V, $I_O$=0.5A | - | 11 | 150 | - | 11 | 300 | mV |
| Load Regulation | $\Delta V_O$ - $I_O$ | $V_{IN}$=23V, $I_O$=0.005 to 1.5A | - | 35 | 150 | - | 35 | 300 | mV |
| Quiescent Current | $I_Q$ | $V_{IN}$=23V, $I_O$=0mA | - | 4.4 | 6.0 | - | 4.4 | 6.0 | mA |
| Average Temperature Coefficient of Output Voltage | $\Delta V_O/\Delta T$ | $V_{IN}$=23V, $I_O$=5mA | - | -1.5 | - | - | -1.5 | - | mV/ºC |
| Ripple Rejection | RR | $V_{IN}$=23V, $I_O$=0.5A , $e_{in}$=2$V_{P-P}$, f=120Hz | 60 | 70 | - | 60 | 70 | - | dB |
| Output Noise Voltage | $V_{NO}$ | $V_{IN}$=23V, BW=10Hz to 100kHz, $I_O$=0.5A | - | 90 | - | - | 90 | - | µV |
| **NJM7818FA/DL1A** | | | | | | | | | |
| Output Voltage | $V_O$ | $V_{IN}$=27V, $I_O$=0.5A | 17.3 | 18.0 | 18.7 | 17.3 | 18.0 | 18.7 | V |
| Line Regulation | $\Delta V_O$ - $V_{IN}$ | $V_{IN}$=21 to 33V, $I_O$=0.5A | - | 15 | 180 | - | 15 | 360 | mV |
| Load Regulation | $\Delta V_O$ - $I_O$ | $V_{IN}$=27V, $I_O$=0.005 to 1.5A | - | 55 | 180 | - | 55 | 360 | mV |
| Quiescent Current | $I_Q$ | $V_{IN}$=27V, $I_O$=0mA | - | 4.5 | 6.0 | - | 4.5 | 6.0 | mA |
| Average Temperature Coefficient of Output Voltage | $\Delta V_O/\Delta T$ | $V_{IN}$=27V, $I_O$=5mA | - | -1.8 | - | - | -1.8 | - | mV/ºC |
| Ripple Rejection | RR | $V_{IN}$=27V, $I_O$=0.5A , $e_{in}$=2$V_{P-P}$, f=120Hz | 59 | 69 | - | 59 | 69 | - | dB |
| Output Noise Voltage | $V_{NO}$ | $V_{IN}$=27V, BW=10Hz to 100kHz, $I_O$=0.5A | - | 100 | - | - | 100 | - | µV |
| **NJM7820FA/DL1A** | | | | | | | | | |
| Output Voltage | $V_O$ | $V_{IN}$=29V, $I_O$=0.5A | 19.2 | 20.0 | 20.8 | 19.2 | 20.0 | 20.8 | V |
| Line Regulation | $\Delta V_O$ - $V_{IN}$ | $V_{IN}$=23 to 35V, $I_O$=0.5A | - | 16 | 200 | - | 16 | 400 | mV |
| Load Regulation | $\Delta V_O$ - $I_O$ | $V_{IN}$=29V, $I_O$=0.005 to 1.5A | - | 61 | 200 | - | 61 | 400 | mV |
| Quiescent Current | $I_Q$ | $V_{IN}$=29V, $I_O$=0mA | - | 4.5 | 6.0 | - | 4.5 | 6.0 | mA |
| Average Temperature Coefficient of Output Voltage | $\Delta V_O/\Delta T$ | $V_{IN}$=29V, $I_O$=5mA | - | -2.0 | - | - | -2.0 | - | mV/ºC |
| Ripple Rejection | RR | $V_{IN}$=29V, $I_O$=0.5A , $e_{in}$=2$V_{P-P}$, f=120Hz | 58 | 68 | - | 58 | 68 | - | dB |
| Output Noise Voltage | $V_{NO}$ | $V_{IN}$=29V, BW=10Hz to 100kHz, $I_O$=0.5A | - | 120 | - | - | 120 | - | µV |

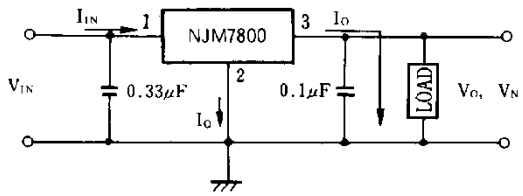
■ **ELECTRICAL CHARACTERISTICS** ($C_1$=0.33μF, $C_O$=0.1μF, $T_j$=25°C)

Measurement is to be conducted in pulse testing.

| PARAMETER | SYMBOL | TEST CONDITIONS | TO-220F | | | TO-252 | | | UNIT |
|---|---|---|---|---|---|---|---|---|---|
| | | | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. | |
| **NJM7824FA/DL1A** | | | | | | | | | |
| Output Voltage | $V_O$ | $V_{IN}$=33V, $I_O$=0.5A | 23.0 | 24.0 | 25.0 | 23.0 | 24.0 | 25.0 | V |
| Line Regulation | $\Delta V_O$ - $V_{IN}$ | $V_{IN}$=27 to 38V, $I_O$=0.5A | - | 18 | 240 | - | 18 | 480 | mV |
| Load Regulation | $\Delta V_O$ - $I_O$ | $V_{IN}$=33V, $I_O$=0.005 to 1.5A | - | 65 | 240 | - | 65 | 480 | mV |
| Quiescent Current | $I_Q$ | $V_{IN}$=33V, $I_O$=0mA | - | 4.6 | 6.0 | - | 4.6 | 6.0 | mA |
| Average Temperature Coefficient of Output Voltage | $\Delta V_O/\Delta T$ | $V_{IN}$=33V, $I_O$=5mA | - | -2.4 | - | - | -2.4 | - | mV/ºC |
| Ripple Rejection | RR | $V_{IN}$=33V, $I_O$=0.5A , $e_{in}$=2$V_{P-P}$, f=120Hz | 56 | 66 | - | 56 | 66 | - | dB |
| Output Noise Voltage | $V_{NO}$ | $V_{IN}$=33V, BW=10Hz to 100kHz, $I_O$=0.5A | - | 120 | - | - | 120 | - | μV |

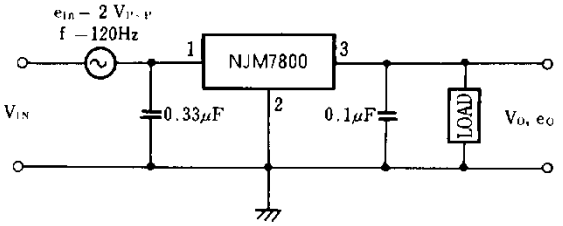
## ■ TEST CIRCUIT

1. Output Voltage, Line Regulation, Load Regulation, Quiescent Current, Average Temperature Coefficient of Output Voltage, Output Noise Voltage




$I_Q = I_{IN} - I_O$

2. Ripple Rejection




$RR = 20\log_{10}\left(\frac{e_{in}}{e_o}\right)$ [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.

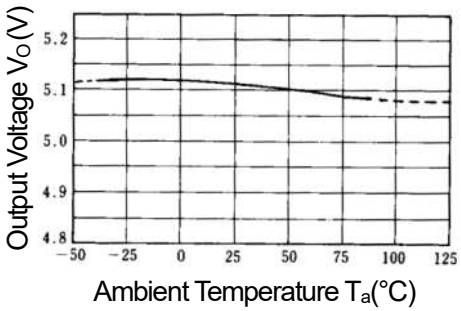
Therefore, use the recommended $C_O$ value (refer to conditions of ELECTRIC CHARACTERISTIC) or larger and should connect between GND and $V_{OUT}$ as shortest path as possible for stable operation

In addition, you should consider varied characteristics of capacitor (a frequency characteristic, a temperature characteristic, a DC bias characteristic and so on) and unevenness peculiar to a capacitor supplier enough.

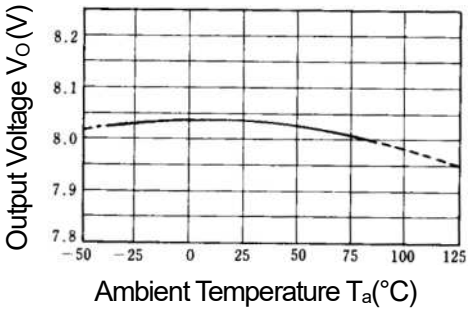
When selecting $C_O$, Nisshinbo recommend that have withstand voltage margin against output voltage and superior temperature characteristic though

## ■ TYPICAL CHARACTERISTICS

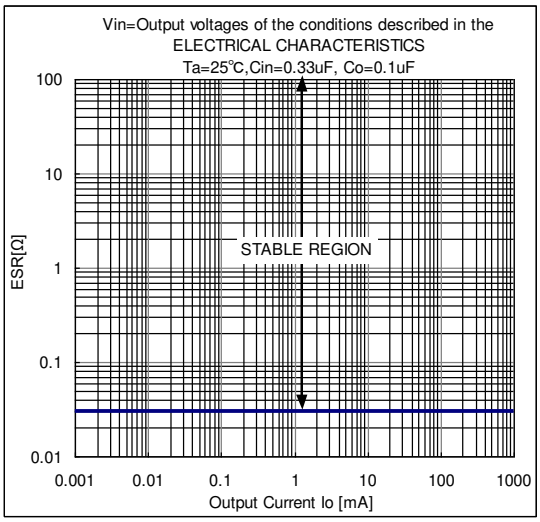
### NJM7805 Output Voltage vs. Temperature




### NJM7808 Output Voltage vs. Temperature



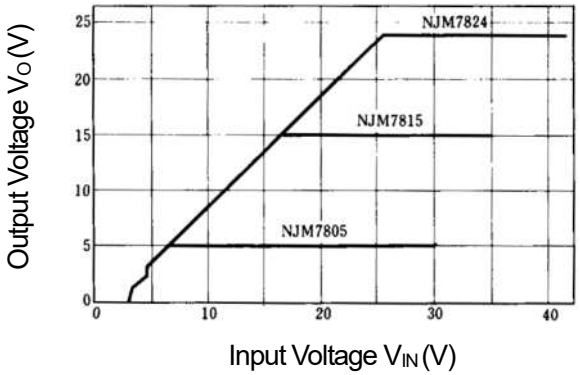

### NJM7800 Series Equivalent Series Resistance vs. Output Current



## ■ TYPICAL CHARACTERISTICS

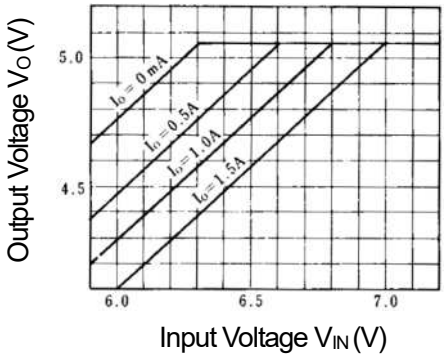
**NJM7805/15/24 Output Characteristics**

(Io=0.5A, Tj=25°C)



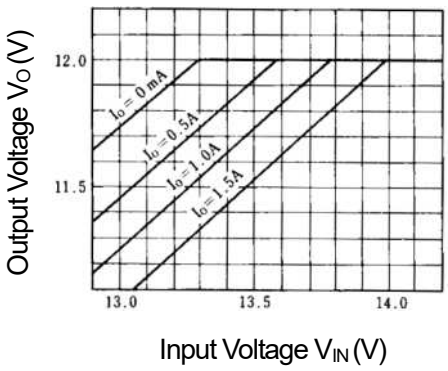

**NJM7805 Dropout Characteristics**

(Tj=25°C)



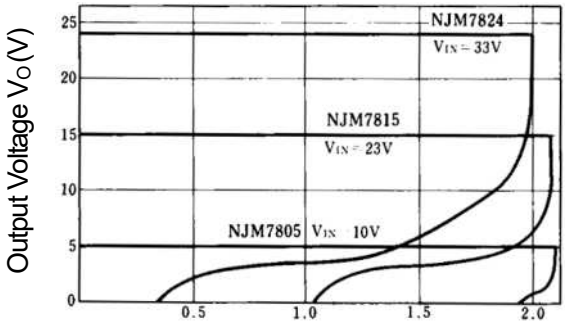

**NJM7812 Dropout Characteristics**

(Tj=25°C)




**NJM7805/15/24 Load Characteristics**

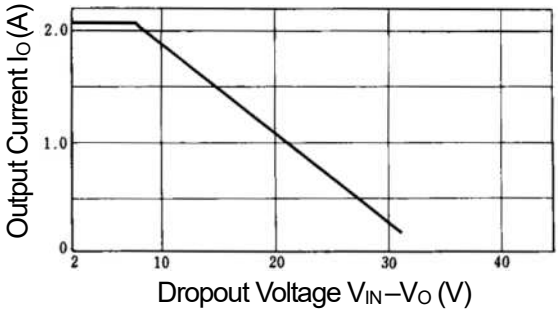
(Tj=25°C)



## ■ TYPICAL CHARACTERISTICS

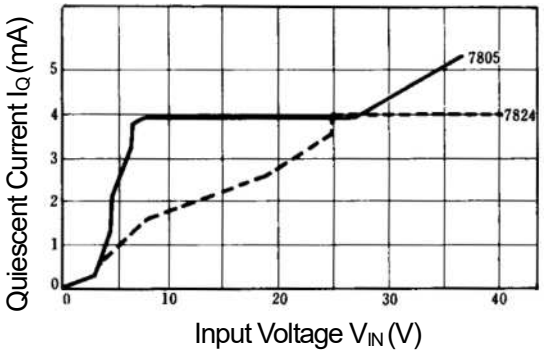
**NJM7800 Series Short Circuit Output Current**

(Tj=25°C, ∞ Heat Sink)

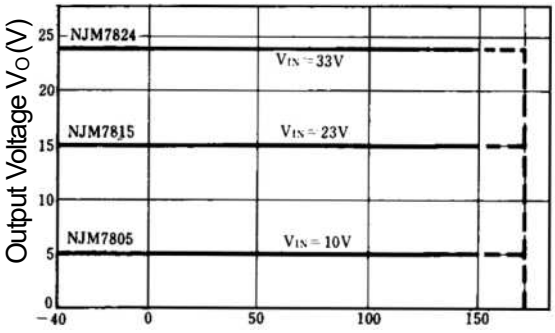



**NJM7805/24 Quiescent Current vs. Input Voltage**

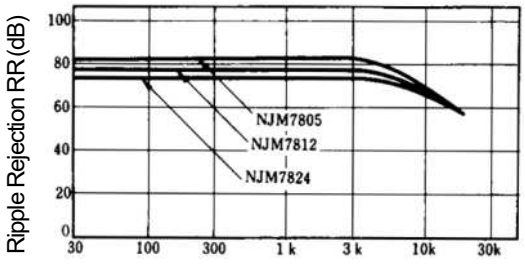
(Tj=25°C,)




**NJM7805/15/24 Output Voltage vs. Junction Temperature**




**NJM7805/15/24 Ripple Rejection vs. Frequency**




$V_{IN}$ = 10V (05)  $e_{in}$ = $2V_{P-P}$
19V (12)
33V (24)
Tj = 25°C

■ **REVISION HISTORY**

| Date | Revision | Changes |
|---|---|---|
| January 08,2023 | Ver. 1.0 | ・Change of company name and design form.<br>・Change of revision number (Ver.2019-11-14 → Ver.1.0)<br>・Added revision history |
| Feb.17.2025 | Ver. 1.1 | ・NJM7800FA is NRND<br>・Thermal characteristics added |
| July. 29.2025 | Ver. 1.2 | ・Correction of typos<br>・Thermal characteristics (graph) removed |

1. The products and the product specifications described in this document are subject to change or discontinuation of production without notice for reasons such as improvement. Therefore, before deciding to use the products, please refer to our sales representatives for the latest information thereon.
2. The materials in this document may not be copied or otherwise reproduced in whole or in part without the prior written consent of us.
3. This product and any technical information relating thereto are subject to complementary export controls (so-called KNOW controls) under the Foreign Exchange and Foreign Trade Law, and related politics ministerial ordinance of the law. (Note that the complementary export controls are inapplicable to any application-specific products, except rockets and pilotless aircraft, that are insusceptible to design or program changes.) Accordingly, when exporting or carrying abroad this product, follow the Foreign Exchange and Foreign Trade Control Law and its related regulations with respect to the complementary export controls.
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    - Aerospace Equipment
    - Equipment Used in the Deep Sea
    - Power Generator Control Equipment (nuclear, steam, hydraulic, etc.)
    - Life Maintenance Medical Equipment
    - Fire Alarms / Intruder Detectors
    - Vehicle Control Equipment (automotive, airplane, railroad, ship, etc.)
    - Various Safety Devices
    - Traffic control system
    - Combustion equipment

    In case your company desires to use this product for any applications other than general electronic equipment mentioned above, make sure to contact our company in advance. Note that the important requirements mentioned in this section are not applicable to cases where operation requirements such as application conditions are confirmed by our company in writing after consultation with your company.
6. We are making our continuous effort to improve the quality and reliability of our products, but semiconductor products are likely to fail with certain probability. In order to prevent any injury to persons or damages to property resulting from such failure, customers should be careful enough to incorporate safety measures in their design, such as redundancy feature, fire containment feature and fail-safe feature. We do not assume any liability or responsibility for any loss or damage arising from misuse or inappropriate use of the products.
7. The products have been designed and tested to function within controlled environmental conditions. Do not use products under conditions that deviate from methods or applications specified in this datasheet. Failure to employ the products in the proper applications can lead to deterioration, destruction or failure of the products. We shall not be responsible for any bodily injury, fires or accident, property damage or any consequential damages resulting from misuse or misapplication of the products.
8. Quality Warranty

    8-1. Quality Warranty Period

    In the case of a product purchased through an authorized distributor or directly from us, the warranty period for this product shall be one (1) year after delivery to your company. For defective products that occurred during this period, we will take the quality warranty measures described in section 8-2. However, if there is an agreement on the warranty period in the basic transaction agreement, quality assurance agreement, delivery specifications, etc., it shall be followed.

    8-2. Quality Warranty Remedies

    When it has been proved defective due to manufacturing factors as a result of defect analysis by us, we will either deliver a substitute for the defective product or refund the purchase price of the defective product.
    Note that such delivery or refund is sole and exclusive remedies to your company for the defective product.

    8-3. Remedies after Quality Warranty Period

    With respect to any defect of this product found after the quality warranty period, the defect will be analyzed by us. On the basis of the defect analysis results, the scope and amounts of damage shall be determined by mutual agreement of both parties. Then we will deal with upper limit in Section 8-2. This provision is not intended to limit any legal rights of your company.
9. Anti-radiation design is not implemented in the products described in this document.
10. The X-ray exposure can influence functions and characteristics of the products. Confirm the product functions and characteristics in the evaluation stage.
11. WLCSP products should be used in light shielded environments. The light exposure can influence functions and characteristics of the products under operation or storage.
12. Warning for handling Gallium and Arsenic (GaAs) products (Applying to GaAs MMIC, Photo Reflector). These products use Gallium (Ga) and Arsenic (As) which are specified as poisonous chemicals by law. For the prevention of a hazard, do not burn, destroy, or process chemically to make them as gas or power. When the product is disposed of, please follow the related regulation and do not mix this with general industrial waste or household waste.
13. Please contact our sales representatives should you have any questions or comments concerning the products or the technical information.

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