

## 3-TERMINAL POSITIVE VOLTAGE REGULATOR

### ■ GENERAL DESCRIPTION

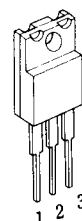
The NJM78M00 series of 3-Terminal Positive Voltage Regulators is constructed using the New JRC Planar epitaxial process. These regulators employ internal current-limiting, thermal-shutdown and safe-area compensation making them essentially indestructible. If adequate heat sinking is provided, they can deliver in excess of 500mA output current. They are intended as fixed voltage regulation in a wide range of applications including local or on-card regulation for elimination of noise and 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.

### ■ FEATURES

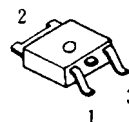
- Internal Short Circuit Current Limit
- Internal Thermal Overload Protection
- Excellent Ripple Rejection
- Guarantee'd 500mA Output Current
- Package Outline TO-220F, TO-252
- Bipolar Technology

### ■ PACKAGE OUTLINE

(TO-220F)



(TO-252)



#### NJM78M00FA

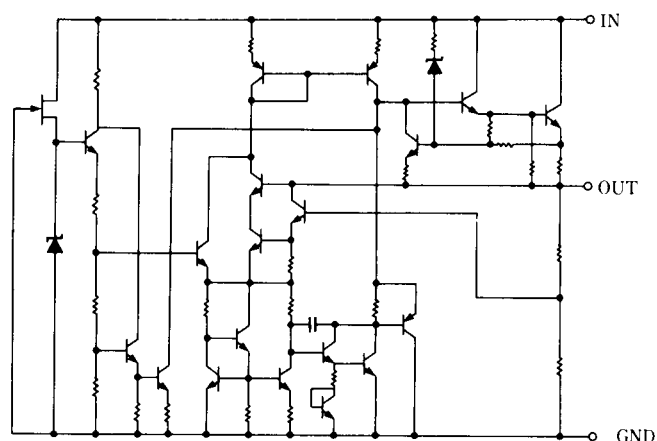
1. IN
2. GND
3. OUT

#### NJM78M00DL1A

1. IN
2. GND
3. OUT

(note) The radiation fin is connected pin2.

### ■ EQUIVALENT CIRCUIT



# NJM78M00

## ■ ABSOLUTE MAXIMUM RATINGS

(Ta=25°C)

| PARAMETER                   | SYMBOL                         | MAXIMUM RATINGS                                    |                                                                                                             | UNIT        |
|-----------------------------|--------------------------------|----------------------------------------------------|-------------------------------------------------------------------------------------------------------------|-------------|
| Input Voltage               | $V_{IN}$                       | 78M05 to 78M09<br>78M12 to 78M15<br>78M18 to 78M24 | 35<br>35<br>40                                                                                              | V           |
| Storage Temperature Range   | $T_{stg}$                      | -40 to +150                                        |                                                                                                             | °C          |
| Operating Temperature Range | Operating Junction Temperature |                                                    | $T_j$                                                                                                       | -40 to +150 |
|                             | Operating Junction Temperature |                                                    | $T_{opr}$                                                                                                   | -40 to +85  |
| Power Dissipation           | $P_D$                          | TO-220F<br>TO-252                                  | 7.5( $T_C \leq 75^\circ\text{C}$ )<br>7.5( $T_C \leq 56^\circ\text{C}$ )<br>1.0( $T_a = 25^\circ\text{C}$ ) | W           |

## ■ THERMAL CHARACTERISTICS

|                    |                                 |               | TO-220F | TO-252 | °C/W |
|--------------------|---------------------------------|---------------|---------|--------|------|
| Thermal Resistance | Junction-to-Ambient Temperature | $\theta_{ja}$ | 60      | 125    |      |
|                    | Junction-to-Case                | $\theta_{jc}$ | 7       | 12.5   |      |

## ■ ELECTRICAL CHARACTERISTICS ( $C_{IN}=0.33\mu\text{F}$ , $C_O=0.1\mu\text{F}$ , $T_j=25^\circ\text{C}$ )

Measurement is to be conducted in pulse testing.

| PARAMETER                                         | SYMBOL                | TEST CONDITION                                                                         | MIN. | TYP. | MAX. | UNIT          |
|---------------------------------------------------|-----------------------|----------------------------------------------------------------------------------------|------|------|------|---------------|
| <b>NJM78M05FA/DL1A</b>                            |                       |                                                                                        |      |      |      |               |
| Output Voltage                                    | $V_O$                 | $V_{IN}=10\text{V}$ , $I_O=350\text{mA}$                                               | 4.8  | 5.0  | 5.2  | V             |
| Line Regulation                                   | $\Delta V_O - V_{IN}$ | $V_{IN}=7$ to $25\text{V}$ , $I_O=200\text{mA}$                                        | -    | 3    | 50   | mV            |
| Load Regulation                                   | $\Delta V_O - I_O$    | $V_{IN}=10\text{V}$ , $I_O=5$ to $500\text{mA}$                                        | -    | 5    | 50   | mV            |
| Quiescent Current                                 | $I_Q$                 | $V_{IN}=10\text{V}$ , $I_O=0\text{mA}$                                                 | -    | 4    | 6    | mA            |
| Average Temperature Coefficient of Output Voltage | $\Delta V_O/\Delta T$ | $V_{IN}=10\text{V}$ , $I_O=5\text{mA}$                                                 | -    | -1   | -    | mV/°C         |
| Ripple Rejection                                  | RR                    | $V_{IN}=10\text{V}$ , $I_O=350\text{mA}$ , $e_{in}=1\text{V}_{P-P}$ , $f=120\text{Hz}$ | 60   | 80   | -    | dB            |
| Output Noise Voltage                              | $V_{NO}$              | $V_{IN}=10\text{V}$ , $BW=10\text{Hz}$ to $100\text{kHz}$ , $I_O=350\text{mA}$         | -    | 60   | -    | $\mu\text{V}$ |

## ■ ELECTRICAL CHARACTERISTICS (C<sub>IN</sub>=0.33μF, C<sub>O</sub>=0.1μF, T<sub>j</sub>=25°C)

Measurement is to be conducted in pulse testing.

| PARAMETER                                         | SYMBOL                            | TEST CONDITION                                                                            | MIN. | TYP. | MAX. | UNIT  |
|---------------------------------------------------|-----------------------------------|-------------------------------------------------------------------------------------------|------|------|------|-------|
| <b>NJM78M06FA/DL1</b>                             |                                   |                                                                                           |      |      |      |       |
| Output Voltage                                    | V <sub>O</sub>                    | V <sub>IN</sub> =11V, I <sub>O</sub> =350mA                                               | 5.75 | 6.0  | 6.25 | V     |
| Line Regulation                                   | ΔV <sub>O</sub> - V <sub>IN</sub> | V <sub>IN</sub> =8 to 25V, I <sub>O</sub> =200mA                                          | -    | 5    | 60   | mV    |
| Load Regulation                                   | ΔV <sub>O</sub> - I <sub>O</sub>  | V <sub>IN</sub> =11V, I <sub>O</sub> =5 to 500mA                                          | -    | 5    | 60   | mV    |
| Quiescent Current                                 | I <sub>Q</sub>                    | V <sub>IN</sub> =11V, I <sub>O</sub> =0mA                                                 | -    | 4    | 6    | mA    |
| Average Temperature Coefficient of Output Voltage | ΔV <sub>O</sub> /ΔT               | V <sub>IN</sub> =11V, I <sub>O</sub> =5mA                                                 | -    | -1   | -    | mV/°C |
| Ripple Rejection                                  | RR                                | V <sub>IN</sub> =11V, I <sub>O</sub> =350mA, e <sub>in</sub> =1V <sub>P-P</sub> , f=120Hz | 59   | 75   | -    | dB    |
| Output Noise Voltage                              | V <sub>NO</sub>                   | V <sub>IN</sub> =11V, BW=10Hz to 100kHz, I <sub>O</sub> =350mA                            | -    | 70   | -    | μV    |
| <b>NJM78M08FA/DL1</b>                             |                                   |                                                                                           |      |      |      |       |
| Output Voltage                                    | V <sub>O</sub>                    | V <sub>IN</sub> =14V, I <sub>O</sub> =350mA                                               | 7.7  | 8.0  | 8.3  | V     |
| Line Regulation                                   | ΔV <sub>O</sub> - V <sub>IN</sub> | V <sub>IN</sub> =10.5 to 25V, I <sub>O</sub> =200mA                                       | -    | 6    | 60   | mV    |
| Load Regulation                                   | ΔV <sub>O</sub> - I <sub>O</sub>  | V <sub>IN</sub> =14V, I <sub>O</sub> =5 to 500mA                                          | -    | 8    | 80   | mV    |
| Quiescent Current                                 | I <sub>Q</sub>                    | V <sub>IN</sub> =14V, I <sub>O</sub> =0mA                                                 | -    | 4    | 6    | mA    |
| Average Temperature Coefficient of Output Voltage | ΔV <sub>O</sub> /ΔT               | V <sub>IN</sub> =14V, I <sub>O</sub> =5mA                                                 | -    | -1   | -    | mV/°C |
| Ripple Rejection                                  | RR                                | V <sub>IN</sub> =14V, I <sub>O</sub> =350mA, e <sub>in</sub> =1V <sub>P-P</sub> , f=120Hz | 56   | 75   | -    | dB    |
| Output Noise Voltage                              | V <sub>NO</sub>                   | V <sub>IN</sub> =14V, BW=10Hz to 100kHz, I <sub>O</sub> =350mA                            | -    | 80   | -    | μV    |
| <b>NJM78M09FA/DL1</b>                             |                                   |                                                                                           |      |      |      |       |
| Output Voltage                                    | V <sub>O</sub>                    | V <sub>IN</sub> =15V, I <sub>O</sub> =350mA                                               | 8.65 | 9.0  | 9.35 | V     |
| Line Regulation                                   | ΔV <sub>O</sub> - V <sub>IN</sub> | V <sub>IN</sub> =11.5 to 25V, I <sub>O</sub> =200mA                                       | -    | 6    | 60   | mV    |
| Load Regulation                                   | ΔV <sub>O</sub> - I <sub>O</sub>  | V <sub>IN</sub> =15V, I <sub>O</sub> =5 to 500mA                                          | -    | 8    | 90   | mV    |
| Quiescent Current                                 | I <sub>Q</sub>                    | V <sub>IN</sub> =15V, I <sub>O</sub> =0mA                                                 | -    | 4.1  | 6    | mA    |
| Average Temperature Coefficient of Output Voltage | ΔV <sub>O</sub> /ΔT               | V <sub>IN</sub> =15V, I <sub>O</sub> =5mA                                                 | -    | -1   | -    | mV/°C |
| Ripple Rejection                                  | RR                                | V <sub>IN</sub> =15V, I <sub>O</sub> =350mA, e <sub>in</sub> =1V <sub>P-P</sub> , f=120Hz | 56   | 70   | -    | dB    |
| Output Noise Voltage                              | V <sub>NO</sub>                   | V <sub>IN</sub> =15V, BW=10Hz to 100kHz, I <sub>O</sub> =350mA                            | -    | 90   | -    | μV    |
| <b>NJM78M12FA/DL1</b>                             |                                   |                                                                                           |      |      |      |       |
| Output Voltage                                    | V <sub>O</sub>                    | V <sub>IN</sub> =19V, I <sub>O</sub> =350mA                                               | 11.5 | 12.0 | 12.5 | V     |
| Line Regulation                                   | ΔV <sub>O</sub> - V <sub>IN</sub> | V <sub>IN</sub> =14.5 to 30 V, I <sub>O</sub> =200mA                                      | -    | 8    | 60   | mV    |
| Load Regulation                                   | ΔV <sub>O</sub> - I <sub>O</sub>  | V <sub>IN</sub> =19V, I <sub>O</sub> =5 to 500mA                                          | -    | 8    | 120  | mV    |
| Quiescent Current                                 | I <sub>Q</sub>                    | V <sub>IN</sub> =19V, I <sub>O</sub> =0mA                                                 | -    | 4.1  | 6    | mA    |
| Average Temperature Coefficient of Output Voltage | ΔV <sub>O</sub> /ΔT               | V <sub>IN</sub> =19V, I <sub>O</sub> =5mA                                                 | -    | -1   | -    | mV/°C |
| Ripple Rejection                                  | RR                                | V <sub>IN</sub> =19V, I <sub>O</sub> =350mA, e <sub>in</sub> =1V <sub>P-P</sub> , f=120Hz | 55   | 70   | -    | dB    |
| Output Noise Voltage                              | V <sub>NO</sub>                   | V <sub>IN</sub> =19V, BW=10Hz to 100kHz, I <sub>O</sub> =350mA                            | -    | 100  | -    | μV    |

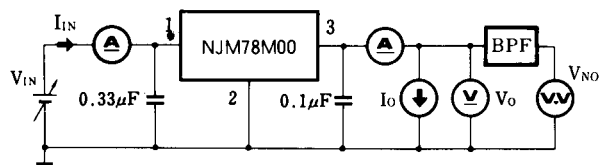
## ■ ELECTRICAL CHARACTERISTICS (C<sub>IN</sub>=0.33μF, C<sub>O</sub>=0.1μF, T<sub>j</sub>=25°C)

Measurement is to be conducted in pulse testing.

| PARAMETER                                         | SYMBOL                            | TEST CONDITION                                                                            | MIN. | TYP. | MAX. | UNIT  |
|---------------------------------------------------|-----------------------------------|-------------------------------------------------------------------------------------------|------|------|------|-------|
| <b>NJM78M15FA/DL1</b>                             |                                   |                                                                                           |      |      |      |       |
| Output Voltage                                    | V <sub>O</sub>                    | V <sub>IN</sub> =23V, I <sub>O</sub> =350mA                                               | 14.4 | 15.0 | 15.6 | V     |
| Line Regulation                                   | ΔV <sub>O</sub> - V <sub>IN</sub> | V <sub>IN</sub> =17.5 to 30V, I <sub>O</sub> =200mA                                       | -    | 10   | 60   | mV    |
| Load Regulation                                   | ΔV <sub>O</sub> - I <sub>O</sub>  | V <sub>IN</sub> =23V, I <sub>O</sub> =5 to 500mA                                          | -    | 10   | 150  | mV    |
| Quiescent Current                                 | I <sub>Q</sub>                    | V <sub>IN</sub> =23V, I <sub>O</sub> =0mA                                                 | -    | 4.1  | 6    | mA    |
| Average Temperature Coefficient of Output Voltage | ΔV <sub>O</sub> /ΔT               | V <sub>IN</sub> =23V, I <sub>O</sub> =5mA                                                 | -    | -1   | -    | mV/°C |
| Ripple Rejection                                  | RR                                | V <sub>IN</sub> =23V, I <sub>O</sub> =350mA, e <sub>in</sub> =1V <sub>P-P</sub> , f=120Hz | 54   | 70   | -    | dB    |
| Output Noise Voltage                              | V <sub>NO</sub>                   | V <sub>IN</sub> =23V, BW=10Hz to 100kHz, I <sub>O</sub> =350mA                            | -    | 120  | -    | μV    |
| <b>NJM78M18FA/DL1</b>                             |                                   |                                                                                           |      |      |      |       |
| Output Voltage                                    | V <sub>O</sub>                    | V <sub>IN</sub> =27V, I <sub>O</sub> =350mA                                               | 17.3 | 18.0 | 18.7 | V     |
| Line Regulation                                   | ΔV <sub>O</sub> - V <sub>IN</sub> | V <sub>IN</sub> =21 to 33V, I <sub>O</sub> =200mA                                         | -    | 10   | 60   | mV    |
| Load Regulation                                   | ΔV <sub>O</sub> - I <sub>O</sub>  | V <sub>IN</sub> =27V, I <sub>O</sub> =5 to 500mA                                          | -    | 15   | 180  | mV    |
| Quiescent Current                                 | I <sub>Q</sub>                    | V <sub>IN</sub> =27 V, I <sub>O</sub> =0mA                                                | -    | 4.2  | 6    | mA    |
| Average Temperature Coefficient of Output Voltage | ΔV <sub>O</sub> /ΔT               | V <sub>IN</sub> =27V, I <sub>O</sub> =5mA                                                 | -    | -1.1 | -    | mV/°C |
| Ripple Rejection                                  | RR                                | V <sub>IN</sub> =27V, I <sub>O</sub> =350mA, e <sub>in</sub> =1V <sub>P-P</sub> , f=120Hz | 53   | 65   | -    | dB    |
| Output Noise Voltage                              | V <sub>NO</sub>                   | V <sub>IN</sub> =27V, BW=10Hz to 100kHz, I <sub>O</sub> =350mA                            | -    | 140  | -    | μV    |
| <b>NJM78M20FA/DL1</b>                             |                                   |                                                                                           |      |      |      |       |
| Output Voltage                                    | V <sub>O</sub>                    | V <sub>IN</sub> =29V, I <sub>O</sub> =350mA                                               | 19.2 | 20.0 | 20.8 | V     |
| Line Regulation                                   | ΔV <sub>O</sub> - V <sub>IN</sub> | V <sub>IN</sub> =23 to 35V, I <sub>O</sub> =200mA                                         | -    | 10   | 60   | mV    |
| Load Regulation                                   | ΔV <sub>O</sub> - I <sub>O</sub>  | V <sub>IN</sub> =29V, I <sub>O</sub> =5 to 500mA                                          | -    | 20   | 200  | mV    |
| Quiescent Current                                 | I <sub>Q</sub>                    | V <sub>IN</sub> =29V, I <sub>O</sub> =0mA                                                 | -    | 4    | 6    | mA    |
| Average Temperature Coefficient of Output Voltage | ΔV <sub>O</sub> /ΔT               | V <sub>IN</sub> =29V, I <sub>O</sub> =5mA                                                 | -    | -1.1 | -    | mV/°C |
| Ripple Rejection                                  | RR                                | V <sub>IN</sub> =29V, I <sub>O</sub> =350mA, e <sub>in</sub> =1V <sub>P-P</sub> , f=120Hz | 53   | 65   | -    | dB    |
| Output Noise Voltage                              | V <sub>NO</sub>                   | V <sub>IN</sub> =29V, BW=10Hz to 100kHz, I <sub>O</sub> =350mA                            | -    | 150  | -    | μV    |
| <b>NJM78M24FA/DL1</b>                             |                                   |                                                                                           |      |      |      |       |
| Output Voltage                                    | V <sub>O</sub>                    | V <sub>IN</sub> =33V, I <sub>O</sub> =350mA                                               | 23.0 | 24   | 25.0 | V     |
| Line Regulation                                   | ΔV <sub>O</sub> - V <sub>IN</sub> | V <sub>IN</sub> =27 to 38V, I <sub>O</sub> =200mA                                         | -    | 10   | 60   | mV    |
| Load Regulation                                   | ΔV <sub>O</sub> - I <sub>O</sub>  | V <sub>IN</sub> =33V, I <sub>O</sub> =5 to 500mA                                          | -    | 20   | 240  | mV    |
| Quiescent Current                                 | I <sub>Q</sub>                    | V <sub>IN</sub> =33V, I <sub>O</sub> =0mA                                                 | -    | 4.2  | 6    | mA    |
| Average Temperature Coefficient of Output Voltage | ΔV <sub>O</sub> /ΔT               | V <sub>IN</sub> =33V, I <sub>O</sub> =5mA                                                 | -    | -1.2 | -    | mV/°C |
| Ripple Rejection                                  | RR                                | V <sub>IN</sub> =33V, I <sub>O</sub> =350mA, e <sub>in</sub> =1V <sub>P-P</sub> , f=120Hz | 50   | 60   | -    | dB    |
| Output Noise Voltage                              | V <sub>NO</sub>                   | V <sub>IN</sub> =33V, BW=10Hz to 100kHz, I <sub>O</sub> =350mA                            | -    | 160  | -    | μV    |

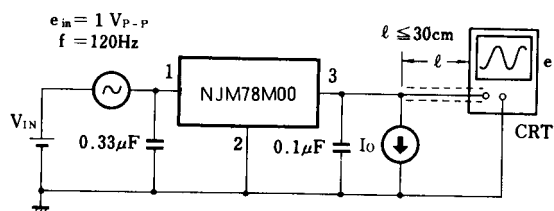
## TEST CIRCUIT

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



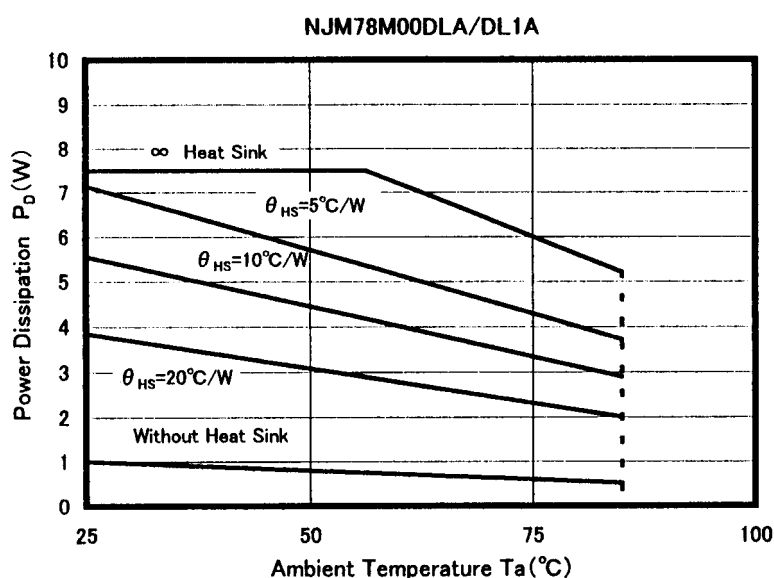
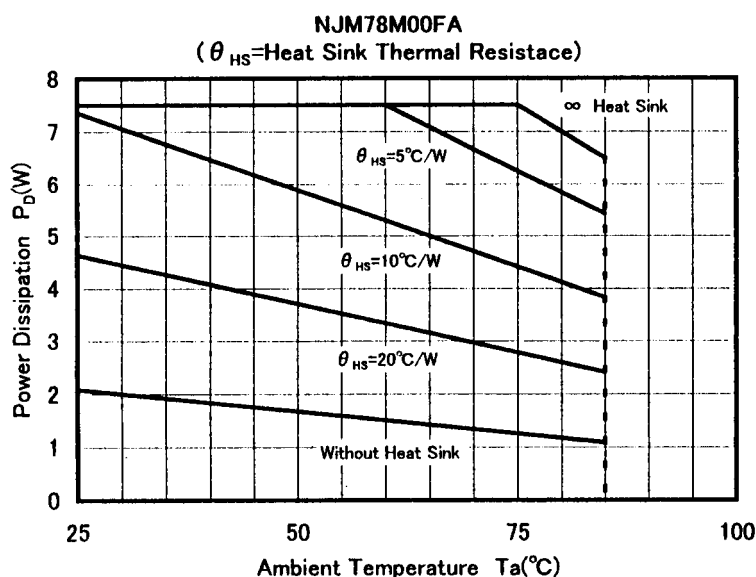
- Measurement is to be conducted
- $I_Q = I_{IN} - I_O$  in pulse testing

2. Ripple Rejection



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

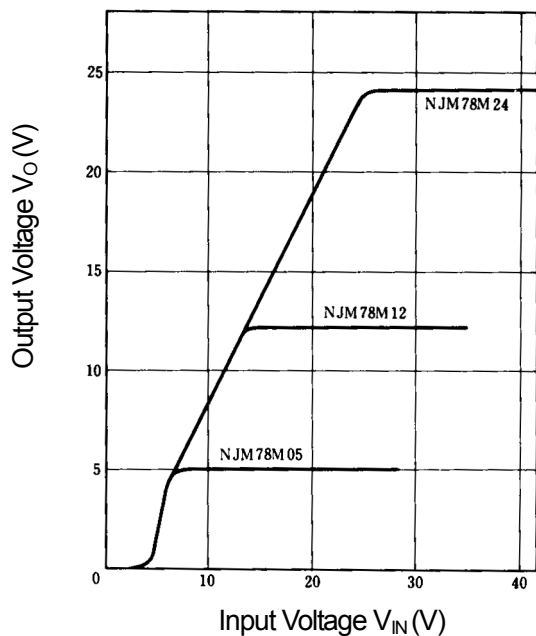
## POWER DISSIPATION VS. AMBIENT TEMPERATURE



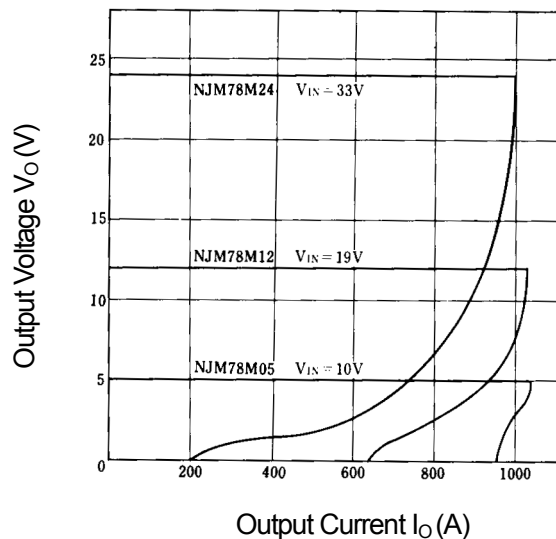
# NJM78M00

## ■ TYPICAL CHARACTERISTICS

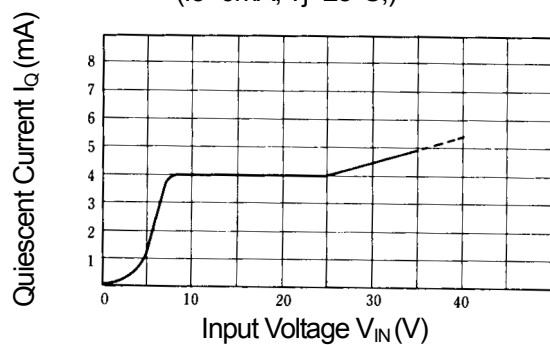
**NJM78M05/M15/M24 Output Characteristics**  
( $I_o=0.35A$ ,  $T_j=25^\circ C$ )



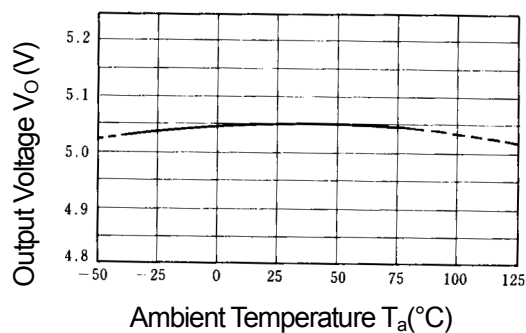
**NJM78M05/M15/M24 Output Characteristics**  
( $I_o=0.35A$ ,  $T_j=25^\circ C$ )



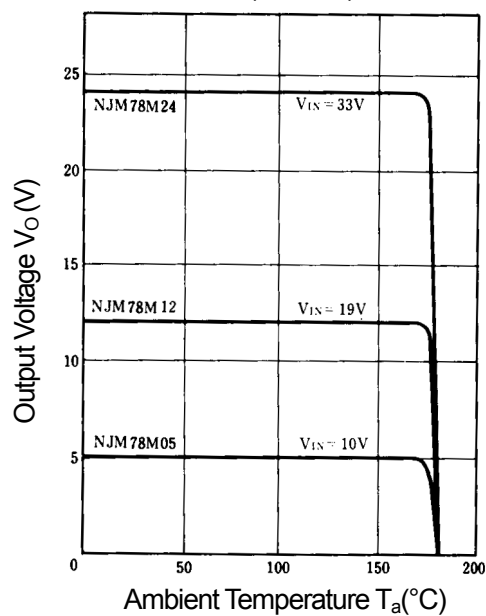
**NJM78M05 Quiescent Current vs. Input Voltage**  
( $I_o=0mA$ ,  $T_j=25^\circ C$ .)



**NJM78M05 Output Voltage vs. Temperature**



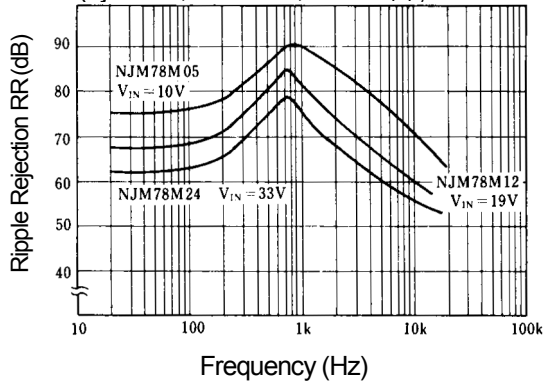
**NJM78M05/M15/M24 Thermal Shutdown Characteristics**  
( $I_o=0mA$ )



■ TYPICAL CHARACTERISTICS

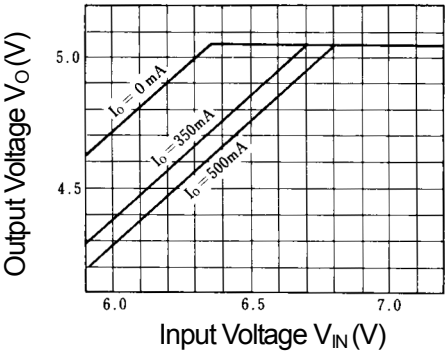
NJM78M05/15/24 Ripple Rejection

( $T_j=25^{\circ}\text{C}$ ,  $I_o=0.35\text{A}$ ,  $e_{in}=1\text{V}_{P-P}$ )



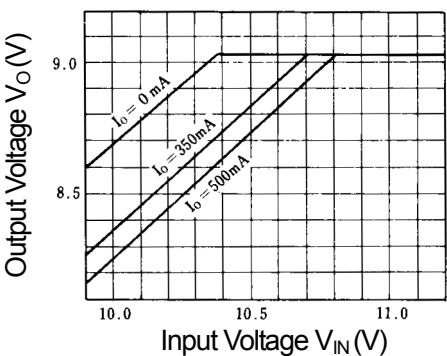
NJM78M05 Dropout Characteristics

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



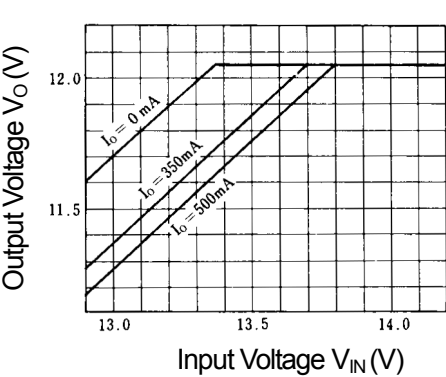
NJM78M09 Dropout Characteristics

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



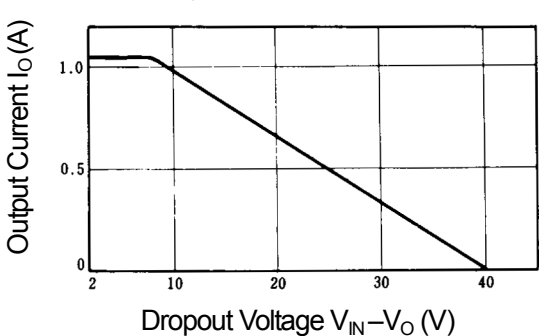
NJM78M12 Dropout Characteristics

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



NJM78M00 Series Short Circuit Output Current

( $T_j=25^{\circ}\text{C}$ ,  $\infty$  Heat Sink)



[CAUTION]

The specifications on this databook are only given for information, without any guarantee as regards either mistakes or omissions. The application circuits in this databook are described only to show representative usages of the product and not intended for the guarantee or permission of any right including the industrial rights.