# 3-TERMINAL POSITIVE VOLTAGE REGULATOR

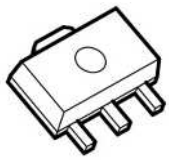
■ GENERAL DESCRIPTION

The NJM78L00S is a 100mA output 3-Terminal Positive Voltage regulator.

It has improvements in contrast with a conventional NJM78L00:

an output voltage accuracy, an operating temperature range and MLCC correspondence. Moreover, the NJM78L00s has 3.3V output voltage version.

■ PACKAGE OUTLINE

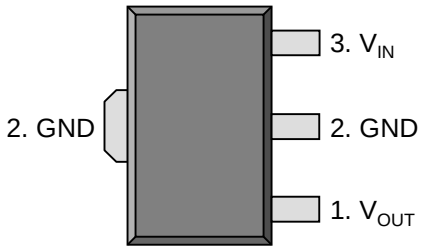


NJM78L00SU3
(SOT-89-3)

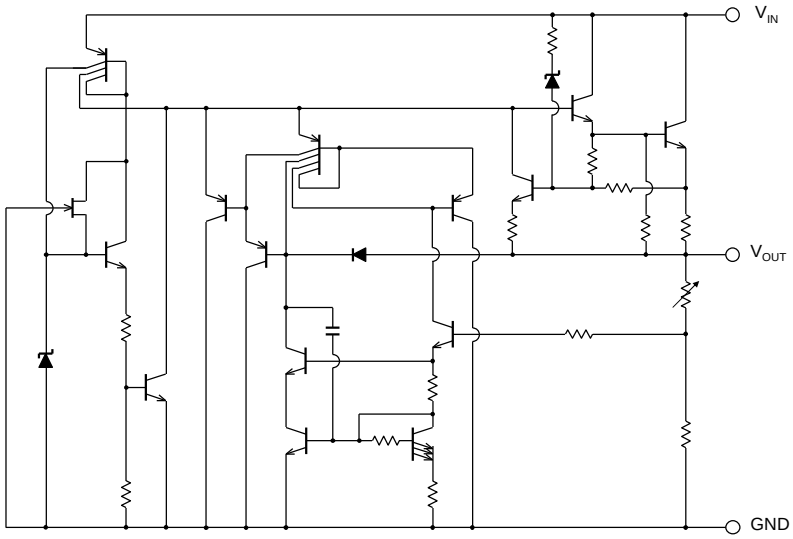
■ FEATURE

- Output Current 100 mA max.
- High Precision Output Voltage $V_O$±4.0%
- High Ripple Rejection
- Correspond to Low ESR Capacitor (MLCC)
- Over Current Protection Circuit
- Thermal Shutdown Circuit
- Output Voltage Lineup 3V, 3.3V, 5V, 6V, 8V, 10V, 12V, 15V
- Bipolar Technology
- Package SOT-89-3

■ PIN CONFIGURATION




■ EQUIVALENT CIRCUIT



■ ABSOLUTE MAXIMUM RATINGS

(Unless otherwise noted, $T_a$ = 25ºC)

| PARAMETER | SYMBOL | MAXIMUM RATINGS | UNIT |
|---|---|---|---|
| Input Voltage | $V_{IN}$ | NJM78L03S to NJM78L08S : 30<br>NJM78L10S to NJM78L15S : 35 | V |
| Power Dissipation | $P_D$ | 625 (*1)<br>2400 (*2) | mW |
| Junction Temperature Range | $T_j$ | - 40 to + 150 | °C |
| Operating Temperature Range | $T_{opr}$ | - 40 to + 125 | °C |
| Storage Temperature Range | $T_{stg}$ | - 50 to + 150 | °C |

(*1) Mounted on glass epoxy board. (76.2×114.3×1.6mm:EIA/JDEC standard size, 2Layers, copper area 100mm$^2$)

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

(4Layers inner foil: 74.2 ×74.2mm applying a thermal via hole to a board based on JEDEC standard JESD51-5)

■ ELECTRICAL CHARACTERISTICS

($C_{IN}$=0.33µF, $C_O$=0.1µF, $T_j$=25°C)Measurement is to be conducted is pulse testing.

| PARAMETER | SYMBOL | TEST CONDITION | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| NJM78L03SU3 | | | | | | |
| Output Voltage | $V_O$ | $V_{IN}$=9V, $I_O$=40mA | 2.88 | 3.0 | 3.12 | V |
| Line Regulation 1 | $\Delta V_O$-$V_{IN}$1 | $V_{IN}$=5V to 20V, $I_O$=40mA | - | - | 125 | mV |
| Line Regulation 2 | $\Delta V_O$-$V_{IN}$2 | $V_{IN}$=6V to 20V, $I_O$=40 mA | - | - | 100 | mV |
| Load Regulation 1 | $\Delta V_O$-$I_O$1 | $V_{IN}$=9V, $I_O$=1 to 40 mA | - | - | 25 | mV |
| Load Regulation 2 | $\Delta V_O$-$I_O$2 | $V_{IN}$=9V, $I_O$=1 to 100 mA | - | - | 50 | mV |
| Quiescent Current | $I_Q$ | $V_{IN}$=9V, $I_O$=0 mA | - | 2.0 | 6 | mA |
| Average Temperature Coefficient of Output Voltage | $\Delta V_O/\Delta T$ | $V_{IN}$=9V, $I_O$=1 mA | - | 0.2 | - | mV/ºC |
| Ripple Rejection | RR | 6V<$V_{IN}$<16V, $I_O$=40mA, $e_{in}$=1$V_{P-P}$, f=120Hz | 43 | 72 | - | dB |
| Output Noise Voltage | $V_{NO}$ | $V_{IN}$=9V, BW=10Hz to 100kHz, $I_O$=40mA | - | 40 | - | µVrms |
| Dropout Voltage | $\Delta V_{IO}$ | $I_O$=100mA | - | 1.7 | - | V |

| | | | | | | |
|---|---|---|---|---|---|---|
| NJM78L33SU3 | | | | | | |
| Output Voltage | $V_O$ | $V_{IN}$=9.3V, $I_O$=40mA | 3.17 | 3.3 | 3.43 | V |
| Line Regulation 1 | $\Delta V_O$-$V_{IN}$1 | $V_{IN}$=5.3V to 20V, $I_O$=40mA | - | - | 135 | mV |
| Line Regulation 2 | $\Delta V_O$-$V_{IN}$2 | $V_{IN}$=6.3V to 20V, $I_O$=40mA | - | - | 105 | mV |
| Load Regulation 1 | $\Delta V_O$-$I_O$1 | $V_{IN}$=9.3V, $I_O$=1 to 40mA | - | - | 26 | mV |
| Load Regulation 2 | $\Delta V_O$-$I_O$2 | $V_{IN}$=9.3V, $I_O$=1 to 100mA | - | - | 53 | mV |
| Quiescent Current | $I_Q$ | $V_{IN}$=9.3V, $I_O$=0mA | - | 2.0 | 6 | mA |
| Average Temperature Coefficient of Output Voltage | $\Delta V_O/\Delta T$ | $V_{IN}$=9.3V, $I_O$=1mA | - | 0.25 | - | mV/ºC |
| Ripple Rejection | RR | 6.3V<$V_{IN}$<16.3V, $I_O$=40mA, $e_{in}$=1$V_{P-P}$, f=120Hz | 42 | 71 | - | dB |
| Output Noise Voltage | $V_{NO}$ | $V_{IN}$=9.3V, BW=10Hz to 100kHz, $I_O$=40mA | - | 45 | - | µVrms |
| Dropout Voltage | $\Delta V_{IO}$ | $I_O$=100mA | - | 1.7 | - | V |

■ ELECTRICAL CHARACTERISTICS

($C_{IN}$=0.33µF, $C_O$=0.1µF, $T_j$=25°C)Measurement is to be conducted is pulse testing.

| PARAMETER | SYMBOL | TEST CONDITION | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| NJM78L05SU3 | | | | | | |
| Output Voltage | $V_O$ | $V_{IN}$=10V, $I_O$=40mA | 4.8 | 5.0 | 5.2 | V |
| Line Regulation 1 | $\Delta V_O$-$V_{IN}$1 | $V_{IN}$=7V to 20V, $I_O$=40mA | - | - | 200 | mV |
| Line Regulation 2 | $\Delta V_O$-$V_{IN}$2 | $V_{IN}$=8V to 20V, $I_O$=40mA | - | - | 150 | mV |
| Load Regulation 1 | $\Delta V_O$-$I_O$1 | $V_{IN}$=10V, $I_O$=1 to 40mA | - | - | 30 | mV |
| Load Regulation 2 | $\Delta V_O$-$I_O$2 | $V_{IN}$=10V, $I_O$=1 to 100mA | - | - | 60 | mV |
| Quiescent Current | $I_Q$ | $V_{IN}$=10V, $I_O$=0mA | - | 2.0 | 6 | mA |
| Average Temperature Coefficient of Output Voltage | $\Delta V_O/\Delta T$ | $V_{IN}$=10V, $I_O$=1mA | - | 0.4 | - | mV/ºC |
| Ripple Rejection | RR | 8V<$V_{IN}$<18V, $I_O$=40mA, $e_{in}$=1$V_{P-P}$, f=120Hz | 40 | 69 | - | dB |
| Output Noise Voltage | $V_{NO}$ | $V_{IN}$=10V, BW=10Hz to 100kHz, $I_O$=40mA | - | 70 | - | µVrms |
| Dropout Voltage | $\Delta V_{IO}$ | $I_O$=100mA | - | 1.7 | - | V |
| NJM78L06SU3 | | | | | | |
| Output Voltage | $V_O$ | $V_{IN}$=12V, $I_O$=40mA | 5.76 | 6.0 | 6.24 | V |
| Line Regulation 1 | $\Delta V_O$-$V_{IN}$1 | $V_{IN}$=8.5V to 20V, $I_O$=40mA | - | - | 200 | mV |
| Line Regulation 2 | $\Delta V_O$-$V_{IN}$2 | $V_{IN}$=9V to 20V, $I_O$=40mA | - | - | 150 | mV |
| Load Regulation 1 | $\Delta V_O$-$I_O$1 | $V_{IN}$=12V, $I_O$=1 to 40mA | - | - | 40 | mV |
| Load Regulation 2 | $\Delta V_O$-$I_O$2 | $V_{IN}$=12V, $I_O$=1 to 100mA | - | - | 80 | mV |
| Quiescent Current | $I_Q$ | $V_{IN}$=12V, $I_O$=0mA | - | 2.0 | 6 | mA |
| Average Temperature Coefficient of Output Voltage | $\Delta V_O/\Delta T$ | $V_{IN}$=12V, $I_O$=1mA | - | 0.5 | - | mV/ºC |
| Ripple Rejection | RR | 9V<$V_{IN}$<20V, $I_O$=40mA, $e_{in}$=1$V_{P-P}$, f=120Hz | 40 | 67 | - | dB |
| Output Noise Voltage | $V_{NO}$ | $V_{IN}$=12V, BW=10Hz to 100kHz, $I_O$=40mA | - | 80 | - | µVrms |
| Dropout Voltage | $\Delta V_{IO}$ | $I_O$=100mA | - | 1.7 | - | V |
| NJM78L08SU3 | | | | | | |
| Output Voltage | $V_O$ | $V_{IN}$=14V, $I_O$=40mA | 7.68 | 8.0 | 8.32 | V |
| Line Regulation 1 | $\Delta V_O$-$V_{IN}$1 | $V_{IN}$=10.5V to 23V, $I_O$=40mA | - | - | 225 | mV |
| Line Regulation 2 | $\Delta V_O$-$V_{IN}$2 | $V_{IN}$=11V to 23V, $I_O$=40mA | - | - | 175 | mV |
| Load Regulation 1 | $\Delta V_O$-$I_O$1 | $V_{IN}$=14V, $I_O$=1 to 40mA | - | - | 50 | mV |
| Load Regulation 2 | $\Delta V_O$-$I_O$2 | $V_{IN}$=14V, $I_O$=1 to 100mA | - | - | 100 | mV |
| Quiescent Current | $I_Q$ | $V_{IN}$=14V, $I_O$=0mA | - | 2.1 | 6 | mA |
| Average Temperature Coefficient of Output Voltage | $\Delta V_O/\Delta T$ | $V_{IN}$=14V, $I_O$=1mA | - | 0.6 | - | mV/ºC |
| Ripple Rejection | RR | 11V<$V_{IN}$<20V, $I_O$=40mA, $e_{in}$=1$V_{P-P}$, f=120Hz | 39 | 66 | - | dB |
| Output Noise Voltage | $V_{NO}$ | $V_{IN}$=14V, BW=10Hz to 100kHz, $I_O$=40mA | - | 115 | - | µVrms |
| Dropout Voltage | $\Delta V_{IO}$ | $I_O$=100mA | - | 1.7 | - | V |

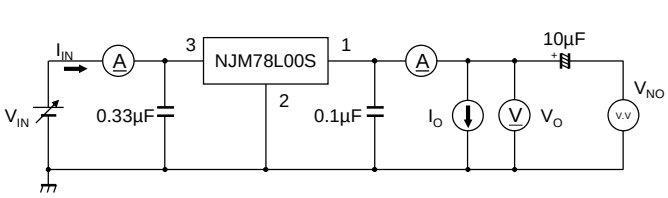
■ ELECTRICAL CHARACTERISTICS

($C_{IN}$=0.33µF, $C_O$=0.1µF, $T_j$=25°C)Measurement is to be conducted is pulse testing.

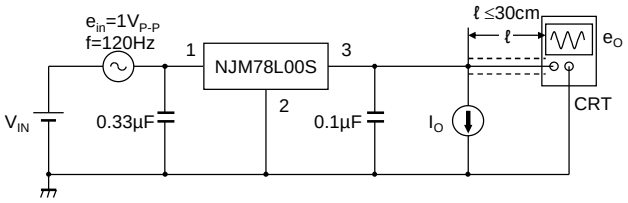
| PARAMETER | SYMBOL | TEST CONDITION | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| NJM78L10SU3 | | | | | | |
| Output Voltage | $V_O$ | $V_{IN}$=16V, $I_O$=40mA | 9.6 | 10.0 | 10.4 | V |
| Line Regulation 1 | $\Delta V_O$-$V_{IN}$1 | $V_{IN}$=13V to 25V, $I_O$=40mA | - | - | 250 | mV |
| Line Regulation 2 | $\Delta V_O$-$V_{IN}$2 | $V_{IN}$=14V to 25V, $I_O$=40mA | - | - | 200 | mV |
| Load Regulation 1 | $\Delta V_O$-$I_O$1 | $V_{IN}$=16V, $I_O$=1 to 40mA | - | - | 50 | mV |
| Load Regulation 2 | $\Delta V_O$-$I_O$2 | $V_{IN}$=16V, $I_O$=1 to 100mA | - | - | 100 | mV |
| Quiescent Current | $I_Q$ | $V_{IN}$=16V, $I_O$=0mA | - | 2.1 | 6 | mA |
| Average Temperature Coefficient of Output Voltage | $\Delta V_O/\Delta T$ | $V_{IN}$=16V, $I_O$=1mA | - | 0.7 | - | mV/ºC |
| Ripple Rejection | RR | 13V<$V_{IN}$<22V, $I_O$=40mA, $e_{in}$=1$V_{P-P}$, f=120Hz | 37 | 64 | - | dB |
| Output Noise Voltage | $V_{NO}$ | $V_{IN}$=16V, BW=10Hz to 100kHz, $I_O$=40mA | - | 135 | - | µVrms |
| Dropout Voltage | $\Delta V_{IO}$ | $I_O$=100mA | - | 1.7 | - | V |
| NJM78L12SU3 | | | | | | |
| Output Voltage | $V_O$ | $V_{IN}$=19V, $I_O$=40mA | 11.52 | 12.0 | 12.48 | V |
| Line Regulation 1 | $\Delta V_O$-$V_{IN}$1 | $V_{IN}$=14.5V to 27V, $I_O$=40mA | - | - | 250 | mV |
| Line Regulation 2 | $\Delta V_O$-$V_{IN}$2 | $V_{IN}$=16V to 27V, $I_O$=40mA | - | - | 200 | mV |
| Load Regulation 1 | $\Delta V_O$-$I_O$1 | $V_{IN}$=19V, $I_O$=1 to 40mA | - | - | 50 | mV |
| Load Regulation 2 | $\Delta V_O$-$I_O$2 | $V_{IN}$=19V, $I_O$=1 to 100mA | - | - | 100 | mV |
| Quiescent Current | $I_Q$ | $V_{IN}$=19V, $I_O$=0mA | - | 2.1 | 6.5 | mA |
| Average Temperature Coefficient of Output Voltage | $\Delta V_O/\Delta T$ | $V_{IN}$=19V, $I_O$=1mA | - | 0.9 | - | mV/ºC |
| Ripple Rejection | RR | 15V<$V_{IN}$<25V,$I_O$=40mA, $e_{in}$=1$V_{P-P}$, f=120Hz | 37 | 62 | - | dB |
| Output Noise Voltage | $V_{NO}$ | $V_{IN}$=19V, BW=10Hz to 100kHz,$I_O$=40mA | - | 160 | - | µVrms |
| Dropout Voltage | $\Delta V_{IO}$ | $I_O$=100mA | - | 1.7 | - | V |
| NJM78L15SU3 | | | | | | |
| Output Voltage | $V_O$ | $V_{IN}$=23V, $I_O$=40mA | 14.4 | 15.0 | 15.6 | V |
| Line Regulation 1 | $\Delta V_O$-$V_{IN}$1 | $V_{IN}$=17.5V to 30V, $I_O$=40mA | - | - | 300 | mV |
| Line Regulation 2 | $\Delta V_O$-$V_{IN}$2 | $V_{IN}$=20V to 30V, $I_O$=40mA | - | - | 250 | mV |
| Load Regulation 1 | $\Delta V_O$-$I_O$1 | $V_{IN}$=23V, $I_O$=1 to 40mA | - | - | 75 | mV |
| Load Regulation 2 | $\Delta V_O$-$I_O$2 | $V_{IN}$=23V, $I_O$=1 to 100mA | - | - | 150 | mV |
| Quiescent Current | $I_Q$ | $V_{IN}$=23V, $I_O$=0mA | - | 2.2 | 6.5 | mA |
| Average Temperature Coefficient of Output Voltage | $\Delta V_O/\Delta T$ | $V_{IN}$=23V, $I_O$=1mA | - | 1.0 | - | mV/ºC |
| Ripple Rejection | RR | 18.5V<$V_{IN}$<28.5V, $I_O$=40mA, $e_{in}$=1$V_{P-P}$, f=120Hz | 34 | 60 | - | dB |
| Output Noise Voltage | $V_{NO}$ | $V_{IN}$=23V, BW=10Hz to 100kHz, $I_O$=40mA | - | 190 | - | µVrms |
| Dropout Voltage | $\Delta V_{IO}$ | $I_O$=100mA | - | 1.7 | - | V |

■ TEST CIRCUIT

1. Output Voltage, Line Regulation, Load Regulation, Quiescent Current, Average, Output Noise Voltage, Temperature Coefficient of Output Voltage, Peak Output/Short Circuit Current




2. Ripple Rejection




▪ Measurement is to be conducted in pulse testing

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

▪ $I_Q = I_{IN} - I_O$

• 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.

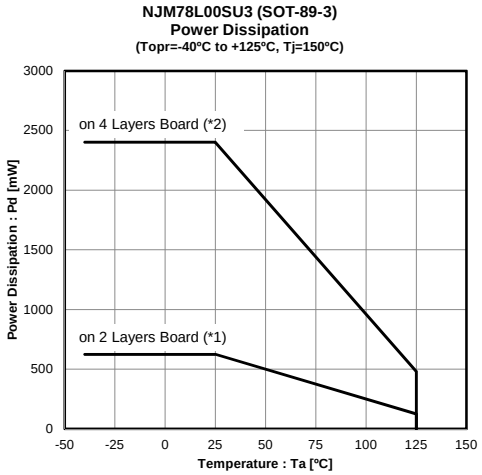
On the other hand, Use of a larger $C_O$ reduces output noise and ripple output, and also improves output transient response when rapid load change.

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 $C_O$, recommend that have withstand voltage margin against output voltage and superior temperature characteristic though this product is designed stability works with wide range ESR of capacitor including low ESR products.

■ POWER DISSIPATION vs. AMBIENT TEMPERATURE

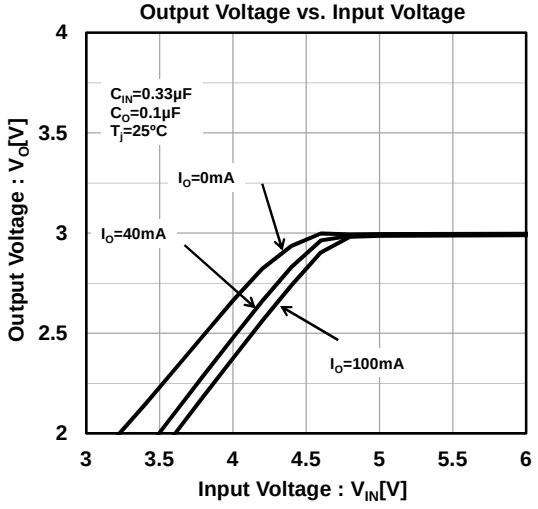



(*1) Mounted on glass epoxy board. (76.2×114.3×1.6mm:EIA/JDEC standard size, 2Layers, copper area 100mm$^2$)

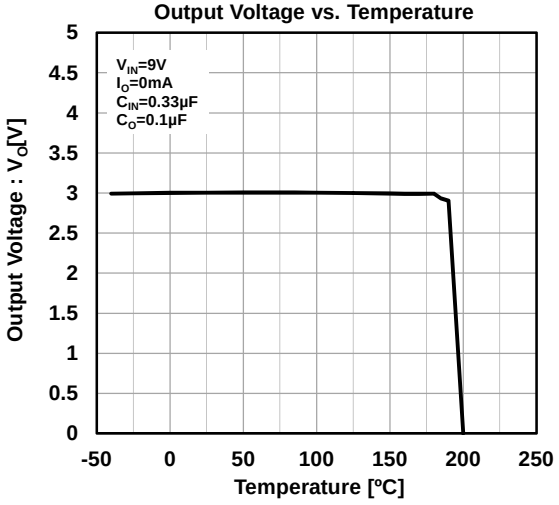
(*2) Mounted on glass epoxy board. (76.2×114.3×1.6mm:EIA/JDEC standard size, 4Layers)
(4Layers inner foil: 74.2 ×74.2mm applying a thermal via hole to a board based on JEDEC standard JESD51-5)

■ TYPICAL CHARACTERISTICS (3V)

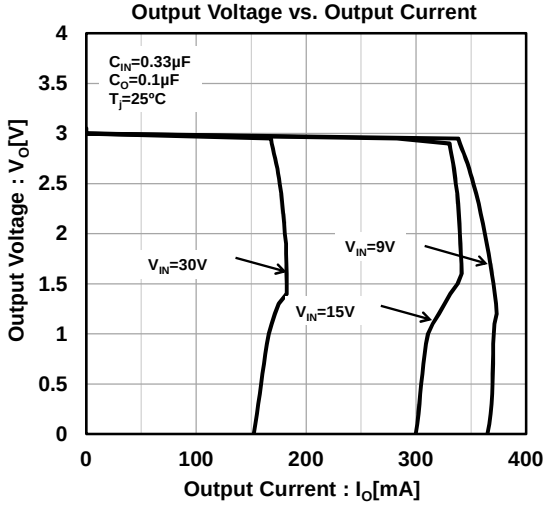
NJM78L03SU3
Output Voltage vs. Input Voltage



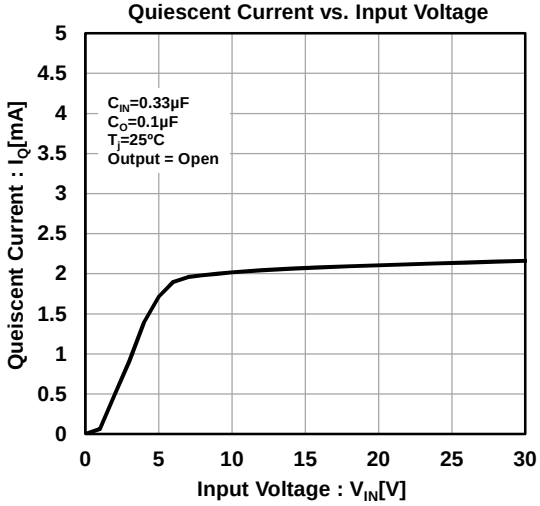

NJM78L03SU3
Output Voltage vs. Temperature



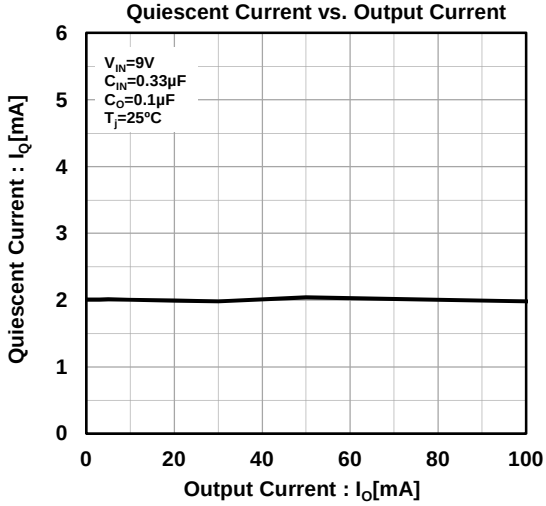

NJM78L03SU3
Output Voltage vs. Output Current



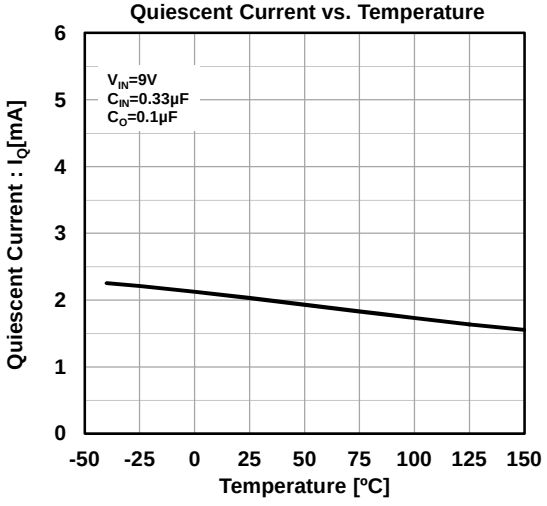

NJM78L03SU3
Quiescent Current vs. Input Voltage




NJM78L03SU3
Quiescent Current vs. Output Current

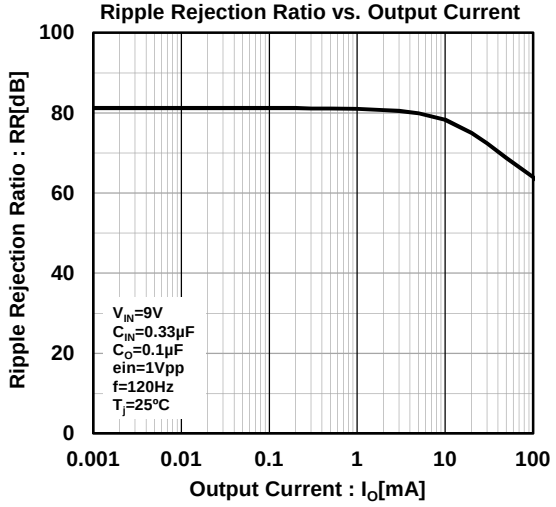



NJM78L03SU3
Quiescent Current vs. Temperature

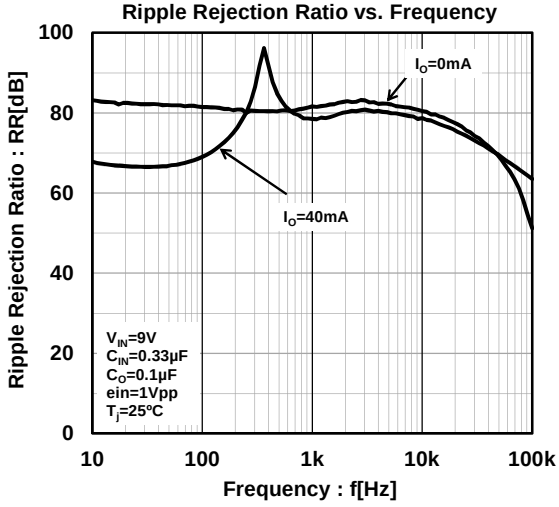


■ TYPICAL CHARACTERISTICS (3V)

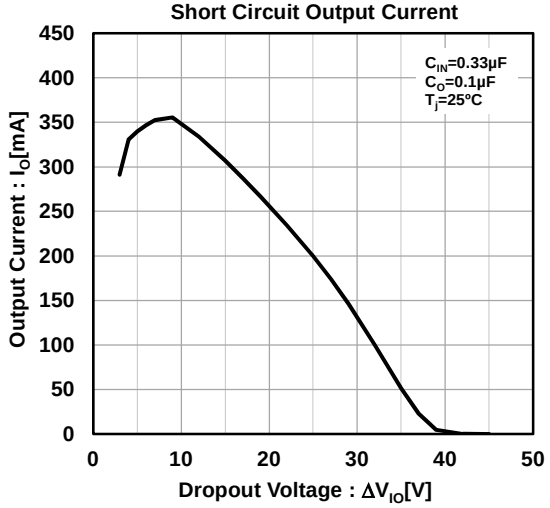
NJM78L03SU3
Ripple Rejection Ratio vs. Output Current



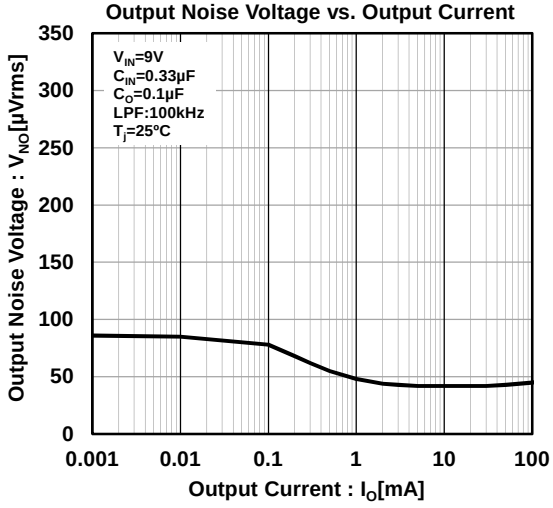

NJM78L03SU3
Ripple Rejection Ratio vs. Frequency



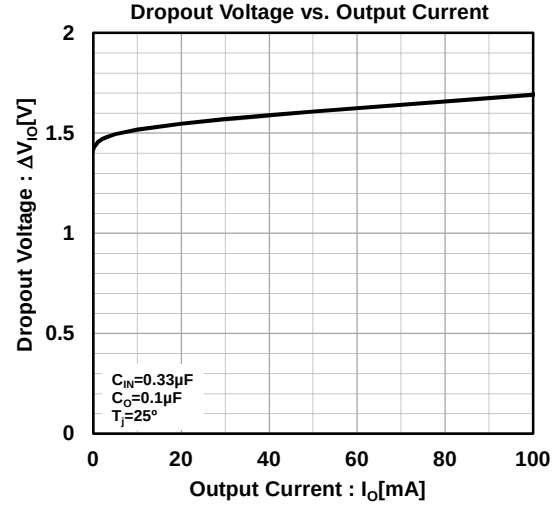

NJM78L03SU3
Short Circuit Output Current



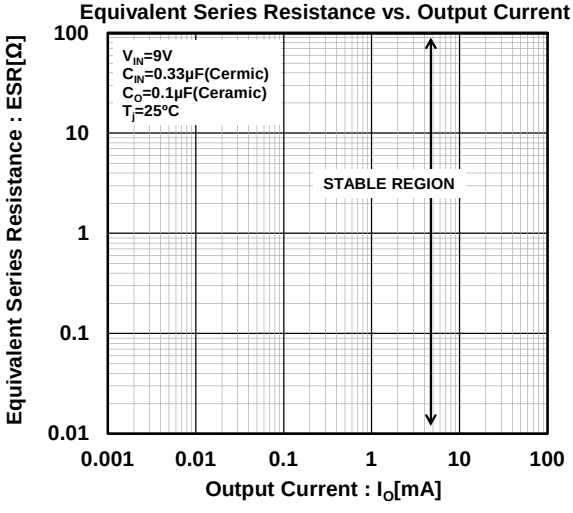

NJM78L03SU3
Output Noise Voltage vs. Output Current




NJM78L03SU3
Dropout Voltage vs. Output Current

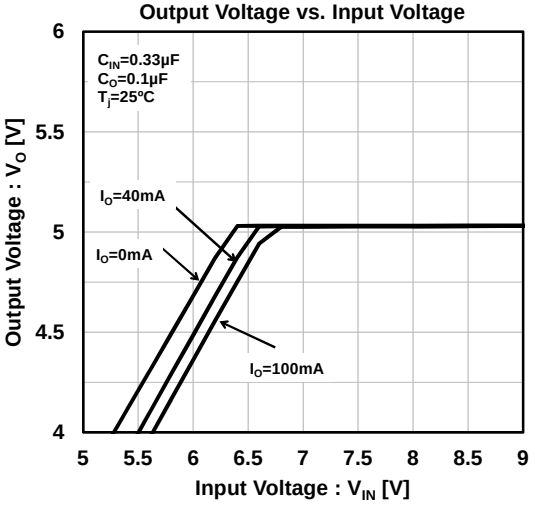



NJM78L03SU3
Equivalent Series Resistance vs. Output Current

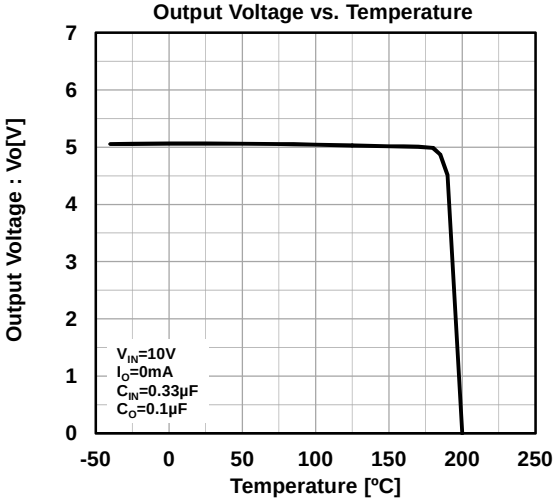


■ TYPICAL CHARACTERISTICS (5V)

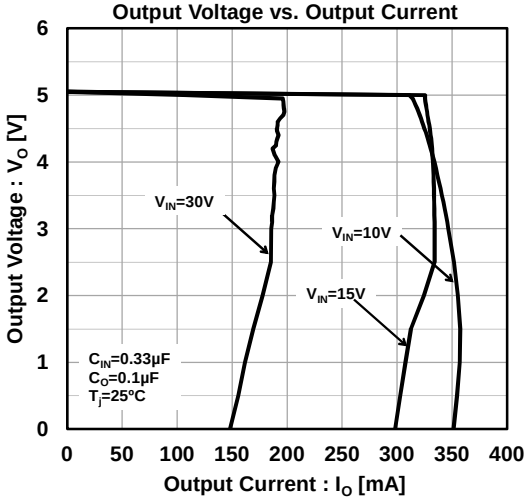
NJM78L05SU3
Output Voltage vs. Input Voltage



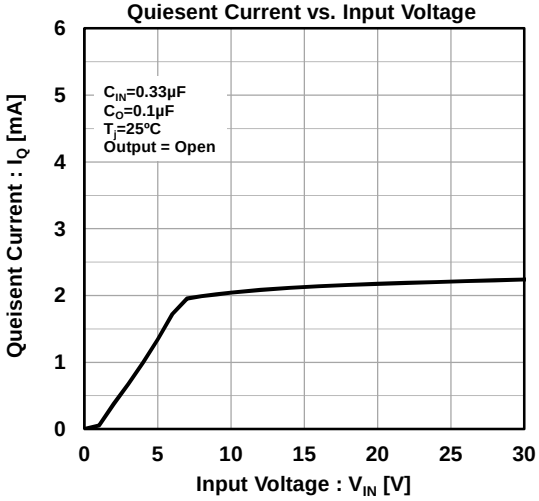

NJM78L05SU3
Output Voltage vs. Temperature



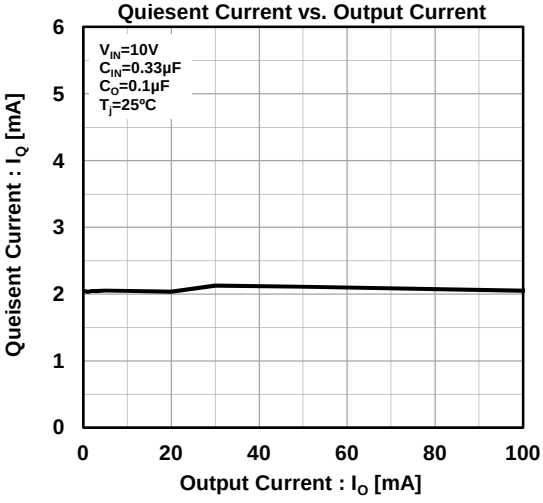

NJM78L05SU3
Output Voltage vs. Output Current



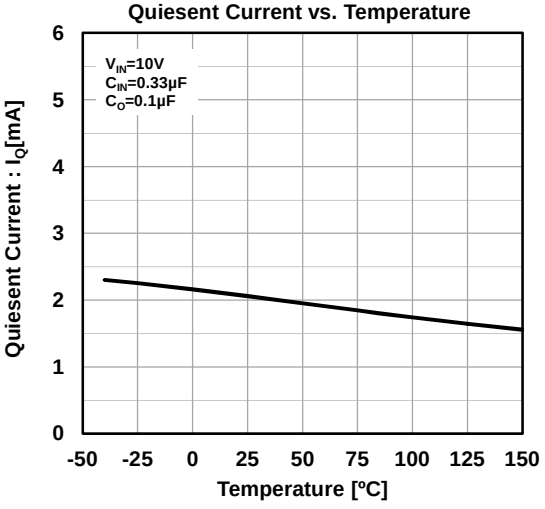

NJM78L05SU3
Quiesent Current vs. Input Voltage




NJM78L05SU3
Quiesent Current vs. Output Current

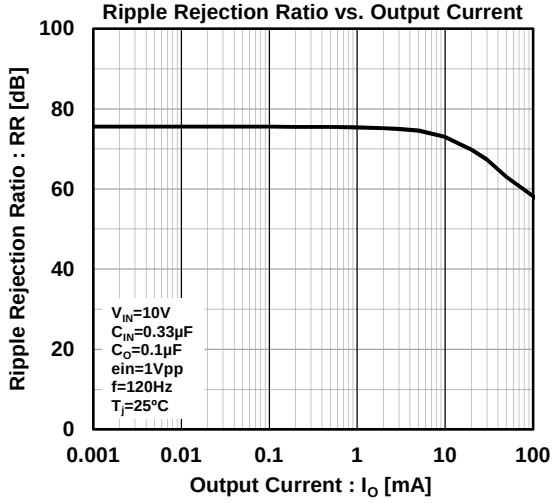



NJM78L05SU3
Quiesent Current vs. Temperature

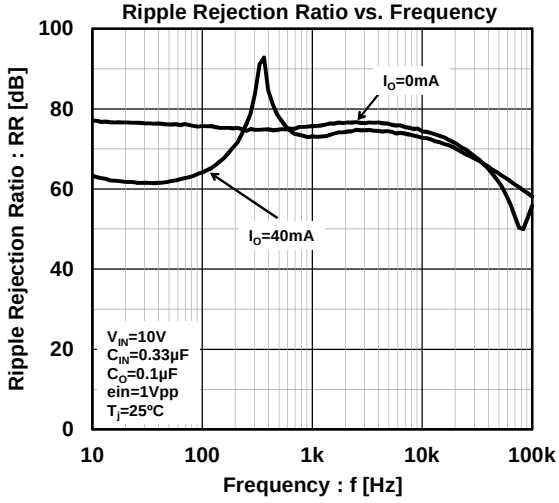


■ TYPICAL CHARACTERISTICS (5V)

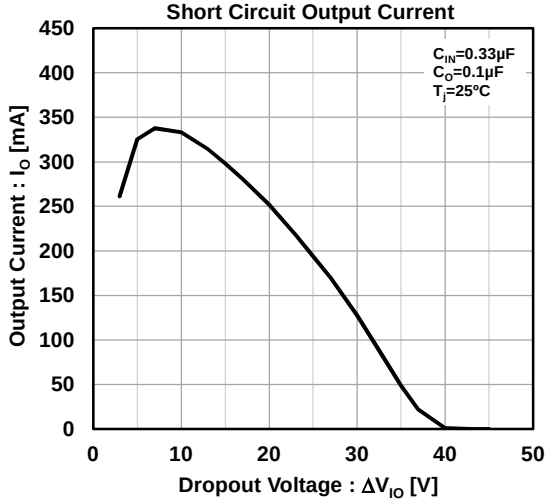
NJM78L05SU3
Ripple Rejection Ratio vs. Output Current



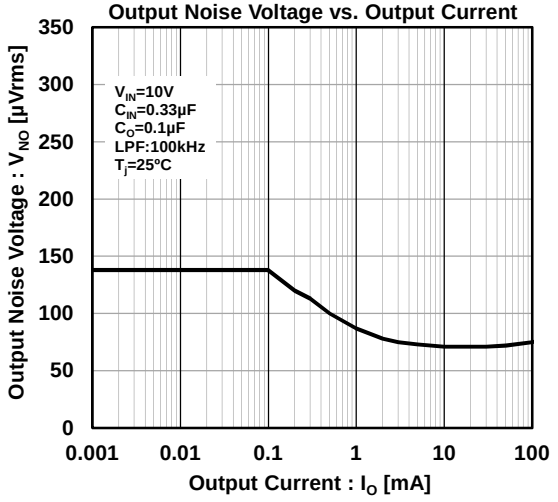

NJM78L05SU3
Ripple Rejection Ratio vs. Frequency



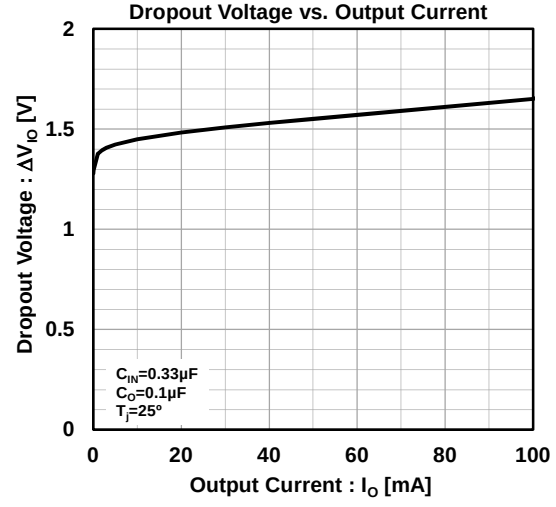

NJM78L05SU3
Short Circuit Output Current



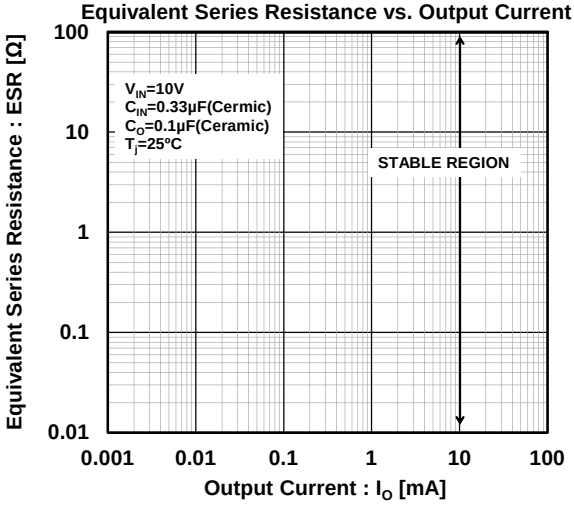

NJM78L05SU3
Output Noise Voltage vs. Output Current




NJM78L05SU3
Dropout Voltage vs. Output Current

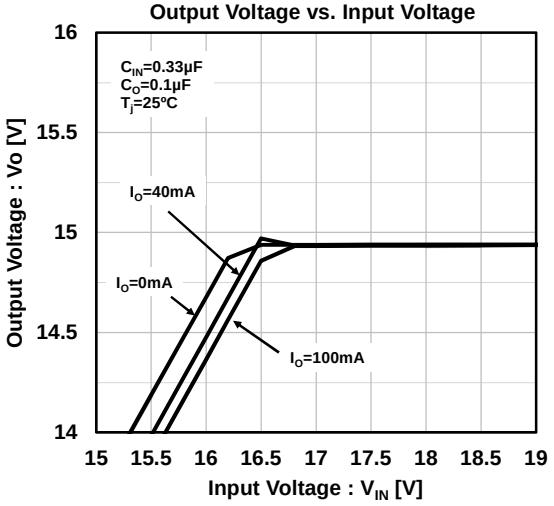



NJM78L05SU3
Equivalent Series Resistance vs. Output Current

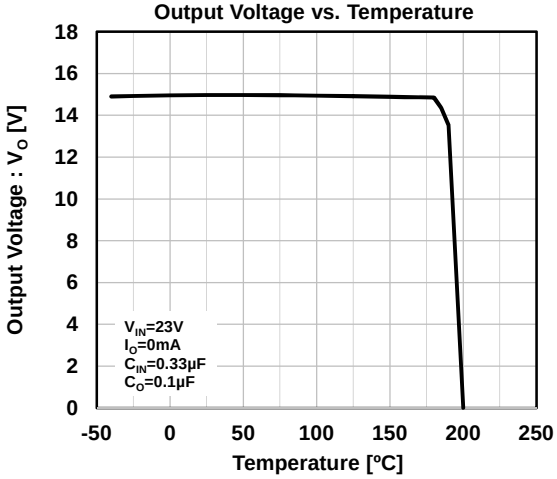


■ TYPICAL CHARACTERISTICS (15V)

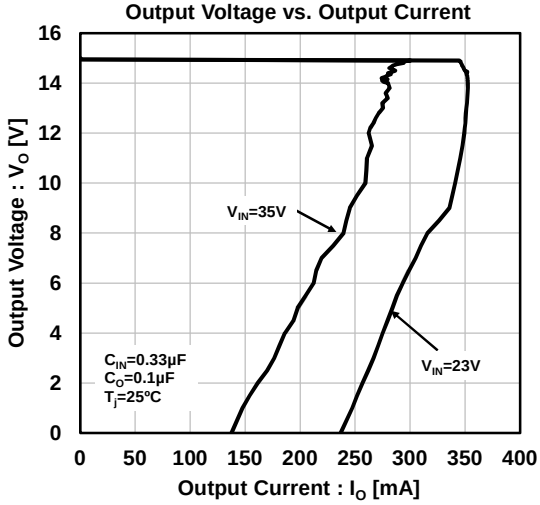
NJM78L15SU3
Output Voltage vs. Input Voltage



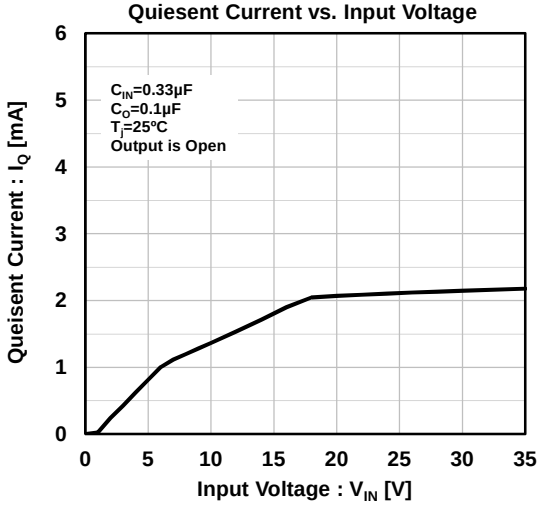

NJM78L15SU3
Output Voltage vs. Temperature



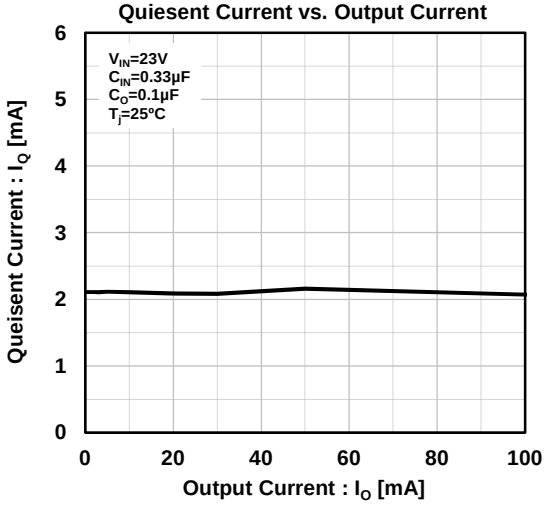

NJM78L15SU3
Output Voltage vs. Output Current



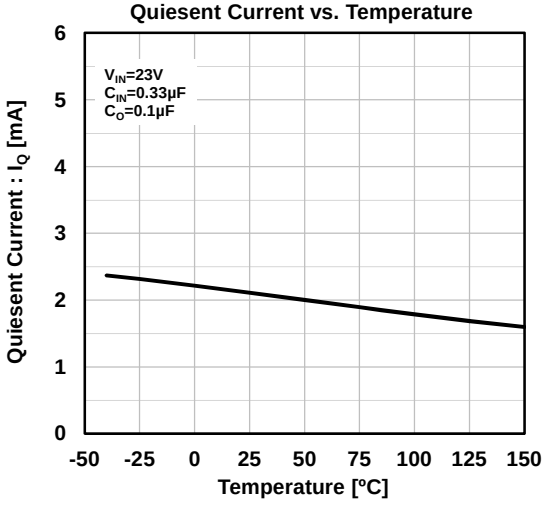

NJM78L15SU3
Quiesent Current vs. Input Voltage




NJM78L15SU3
Quiesent Current vs. Output Current

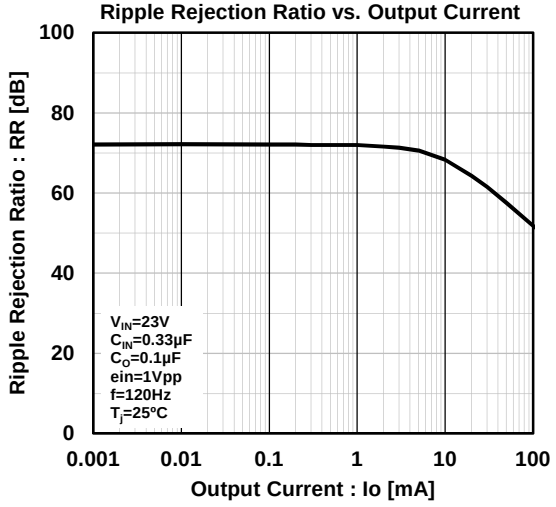



NJM78L15SU3
Quiesent Current vs. Temperature

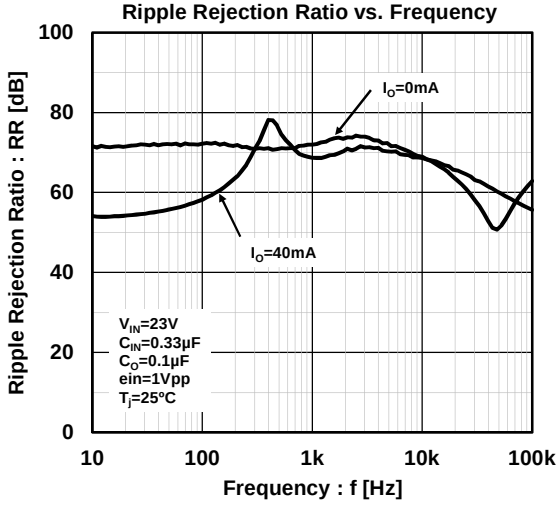


■ TYPICAL CHARACTERISTICS (15V)

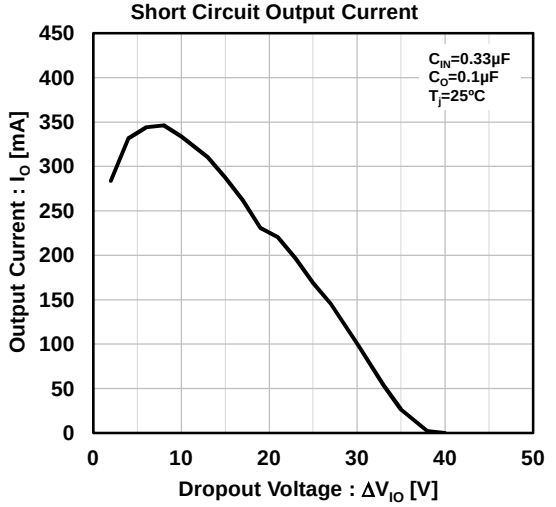
NJM78L15SU3
Ripple Rejection Ratio vs. Output Current



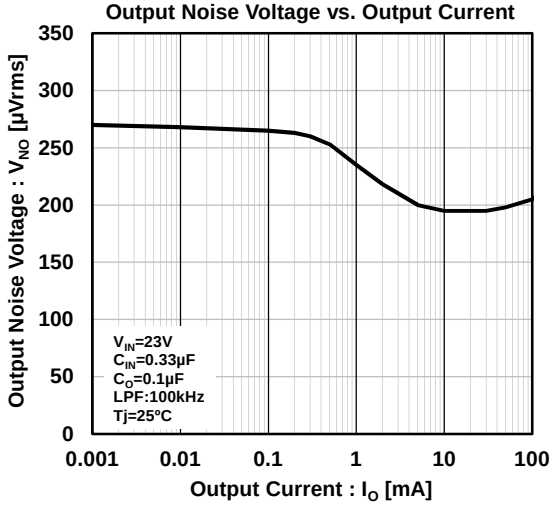

NJM78L15SU3
Ripple Rejection Ratio vs. Frequency



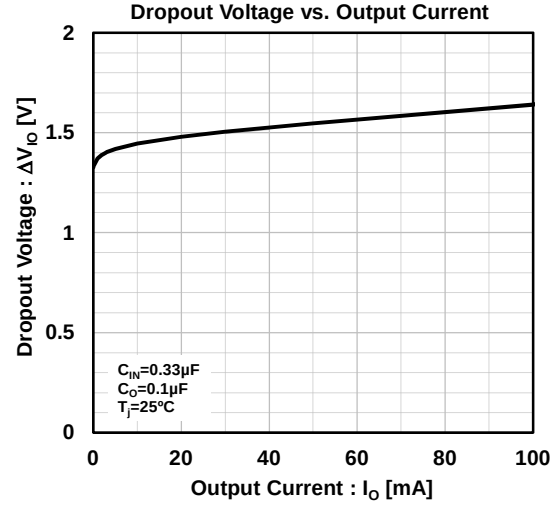

NJM78L15SU3
Short Circuit Output Current



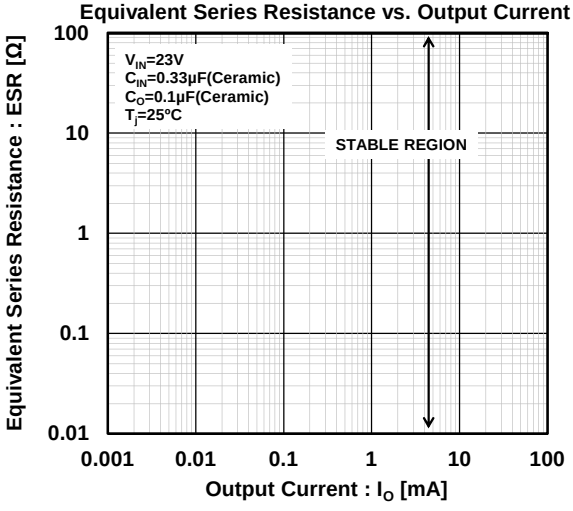

NJM78L15SU3
Output Noise Voltage vs. Output Current




NJM78L15SU3
Dropout Voltage vs. Output Current




NJM78L15SU3
Equivalent Series Resistance vs. Output Current



## MEMO

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