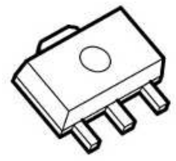
3-TERMINAL POSITIVE VOLTAGE REGULATOR

■ 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

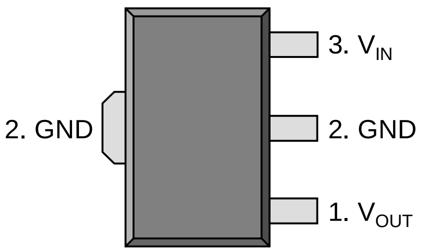


NJM78L00SU3
(SOT-89-3)

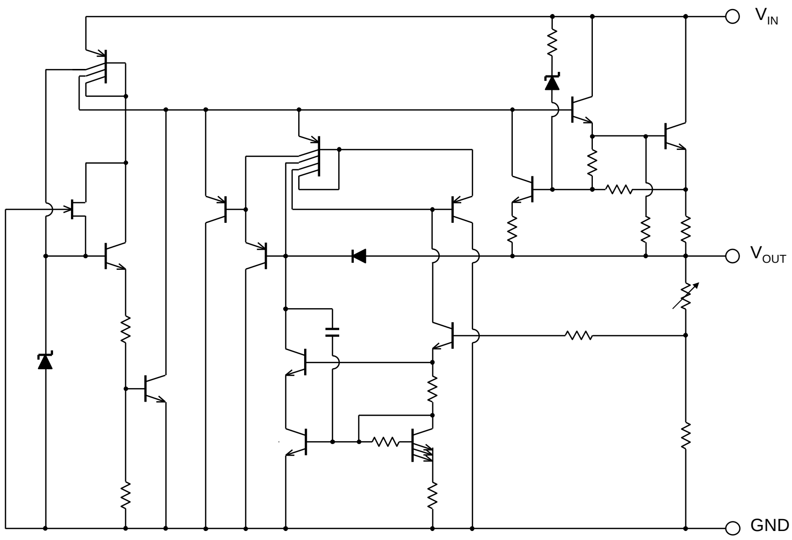
■ FEATURE

- 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 NJM78L10S to NJM78L15S : 35	V
Power Dissipation	P_D	625 (*1) 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	ΔV_O-V_{IN}1	V_{IN}=5V to 20V, I_O=40mA	-	-	125	mV
Line Regulation 2	ΔV_O-V_{IN}2	V_{IN}=6V to 20V, I_O=40 mA	-	-	100	mV
Load Regulation 1	ΔV_O-I_O1	V_{IN}=9V, I_O=1 to 40 mA	-	-	25	mV
Load Regulation 2	ΔV_O-I_O2	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}=1V_{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	ΔV_{IO}	I_O=100mA	-	1.7	-	V

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
NJM78L33SU3						
Output Voltage	V_O	V_{IN}=9.3V, I_O=40mA	3.17	3.3	3.43	V
Line Regulation 1	ΔV_O-V_{IN}1	V_{IN}=5.3V to 20V, I_O=40mA	-	-	135	mV
Line Regulation 2	ΔV_O-V_{IN}2	V_{IN}=6.3V to 20V, I_O=40mA	-	-	105	mV
Load Regulation 1	ΔV_O-I_O1	V_{IN}=9.3V, I_O=1 to 40mA	-	-	26	mV
Load Regulation 2	ΔV_O-I_O2	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}=1V_{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	ΔV_{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	ΔV_O-V_{IN}1	V_{IN}=7V to 20V, I_O=40mA	-	-	200	mV
Line Regulation 2	ΔV_O-V_{IN}2	V_{IN}=8V to 20V, I_O=40mA	-	-	150	mV
Load Regulation 1	ΔV_O-I_O1	V_{IN}=10V, I_O=1 to 40mA	-	-	30	mV
Load Regulation 2	ΔV_O-I_O2	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}=1V_{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	ΔV_{IO}	I_O=100mA	-	1.7	-	V

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
NJM78L06SU3						
Output Voltage	V_O	V_{IN}=12V, I_O=40mA	5.76	6.0	6.24	V
Line Regulation 1	ΔV_O-V_{IN}1	V_{IN}=8.5V to 20V, I_O=40mA	-	-	200	mV
Line Regulation 2	ΔV_O-V_{IN}2	V_{IN}=9V to 20V, I_O=40mA	-	-	150	mV
Load Regulation 1	ΔV_O-I_O1	V_{IN}=12V, I_O=1 to 40mA	-	-	40	mV
Load Regulation 2	ΔV_O-I_O2	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}=1V_{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	ΔV_{IO}	I_O=100mA	-	1.7	-	V

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
NJM78L08SU3						
Output Voltage	V_O	V_{IN}=14V, I_O=40mA	7.68	8.0	8.32	V
Line Regulation 1	ΔV_O-V_{IN}1	V_{IN}=10.5V to 23V, I_O=40mA	-	-	225	mV
Line Regulation 2	ΔV_O-V_{IN}2	V_{IN}=11V to 23V, I_O=40mA	-	-	175	mV
Load Regulation 1	ΔV_O-I_O1	V_{IN}=14V, I_O=1 to 40mA	-	-	50	mV
Load Regulation 2	ΔV_O-I_O2	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}=1V_{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	ΔV_{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.

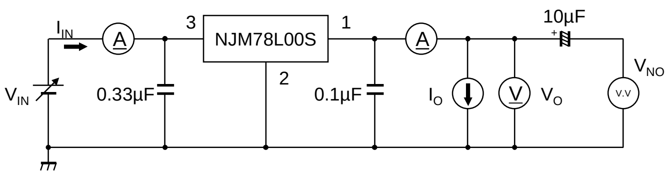
PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
NJM78L10SU3						
Output Voltage	V_O	V_{IN}=16V, I_O=40mA	9.6	10.0	10.4	V
Line Regulation 1	ΔV_O-V_{IN}1	V_{IN}=13V to 25V, I_O=40mA	-	-	250	mV
Line Regulation 2	ΔV_O-V_{IN}2	V_{IN}=14V to 25V, I_O=40mA	-	-	200	mV
Load Regulation 1	ΔV_O-I_O1	V_{IN}=16V, I_O=1 to 40mA	-	-	50	mV
Load Regulation 2	ΔV_O-I_O2	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}=1V_{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	ΔV_{IO}	I_O=100mA	-	1.7	-	V

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
NJM78L12SU3						
Output Voltage	V_O	V_{IN}=19V, I_O=40mA	11.52	12.0	12.48	V
Line Regulation 1	ΔV_O-V_{IN}1	V_{IN}=14.5V to 27V, I_O=40mA	-	-	250	mV
Line Regulation 2	ΔV_O-V_{IN}2	V_{IN}=16V to 27V, I_O=40mA	-	-	200	mV
Load Regulation 1	ΔV_O-I_O1	V_{IN}=19V, I_O=1 to 40mA	-	-	50	mV
Load Regulation 2	ΔV_O-I_O2	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}=1V_{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	ΔV_{IO}	I_O=100mA	-	1.7	-	V

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
NJM78L15SU3						
Output Voltage	V_O	V_{IN}=23V, I_O=40mA	14.4	15.0	15.6	V
Line Regulation 1	ΔV_O-V_{IN}1	V_{IN}=17.5V to 30V, I_O=40mA	-	-	300	mV
Line Regulation 2	ΔV_O-V_{IN}2	V_{IN}=20V to 30V, I_O=40mA	-	-	250	mV
Load Regulation 1	ΔV_O-I_O1	V_{IN}=23V, I_O=1 to 40mA	-	-	75	mV
Load Regulation 2	ΔV_O-I_O2	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}=1V_{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	ΔV_{IO}	I_O=100mA	-	1.7	-	V

■ TEST CIRCUIT

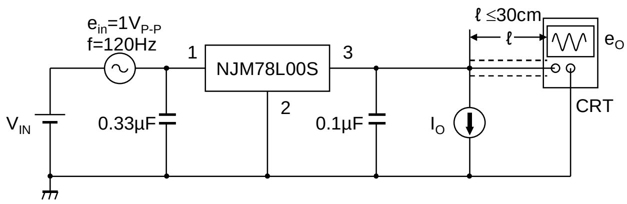
1. Output Voltage, Line Regulation, Load Regulation, Quiescent Current, Average, Output Noise Voltage, Temperature Coefficient of Output Voltage, Peak Output/Short Circuit Current



▪ Measurement is to be conducted in pulse testing

▪ $I_Q = I_{IN} - I_O$

2. Ripple Rejection



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

• 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.

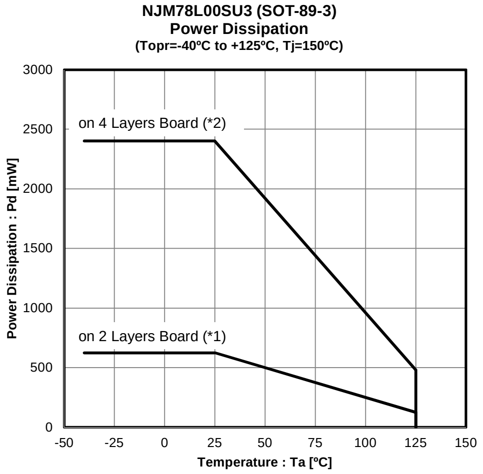
On the other hand, Use of a larger C_O reduces output noise and ripple output, and also improves output transient response when rapid load change.

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.

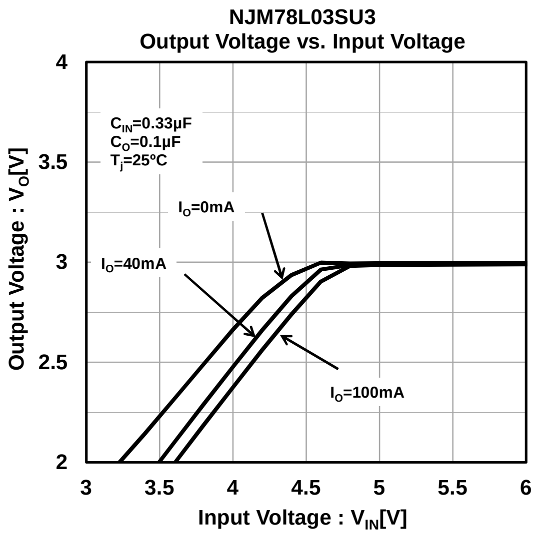
When selecting C_O, recommend that have withstand voltage margin against output voltage and superior temperature characteristic though this product is designed stability works with wide range ESR of capacitor including low ESR products.

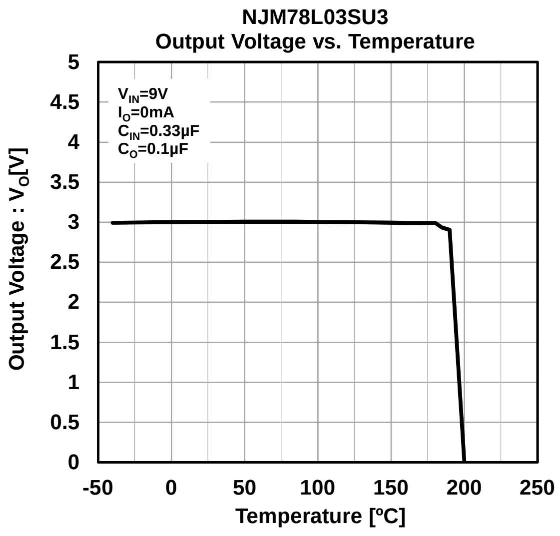
■ POWER DISSIPATION vs. AMBIENT TEMPERATURE

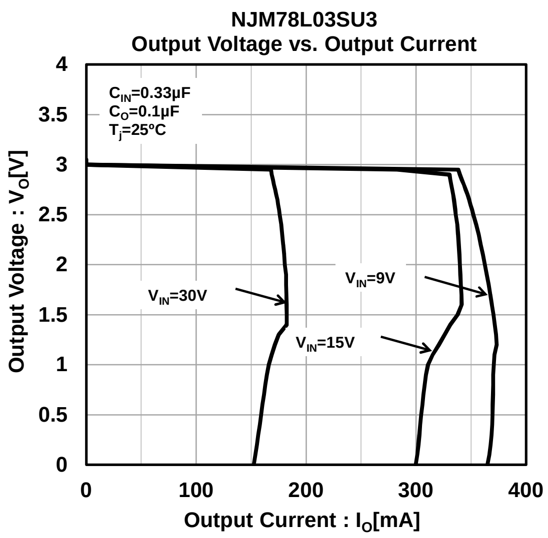


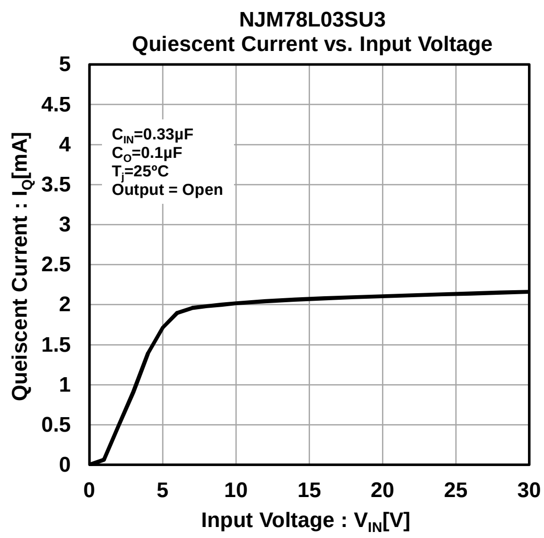
(*1) Mounted on glass epoxy board. (76.2×114.3×1.6mm:EIA/JDEC standard size, 2Layers, copper area 100mm^2)
(*2) Mounted on glass epoxy board. (76.2×114.3×1.6mm:EIA/JDEC standard size, 4Layers)
(4Layers inner foil: 74.2 ×74.2mm applying a thermal via hole to a board based on JEDEC standard JESD51-5)

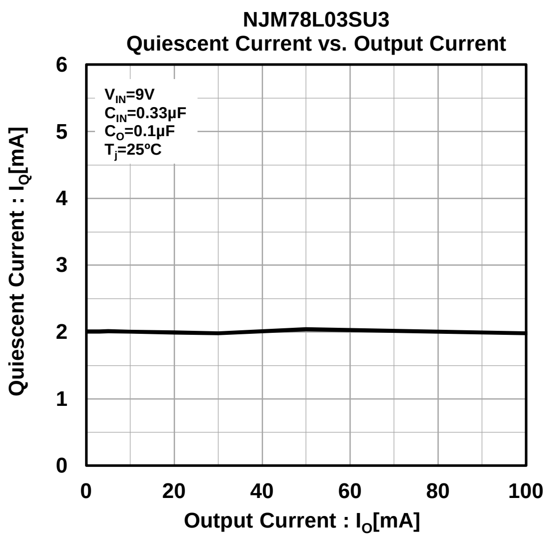
■ TYPICAL CHARACTERISTICS (3V)

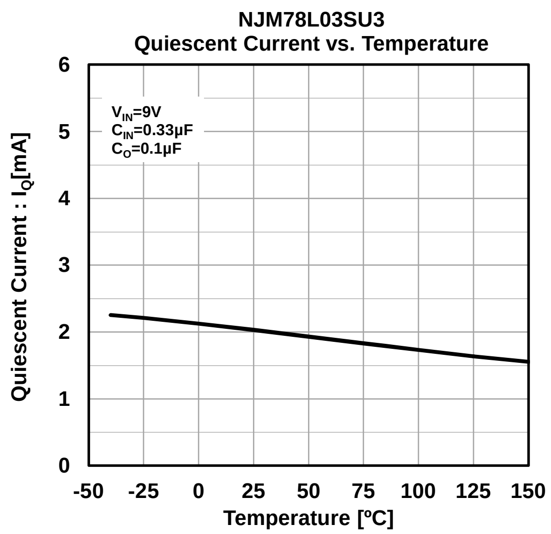




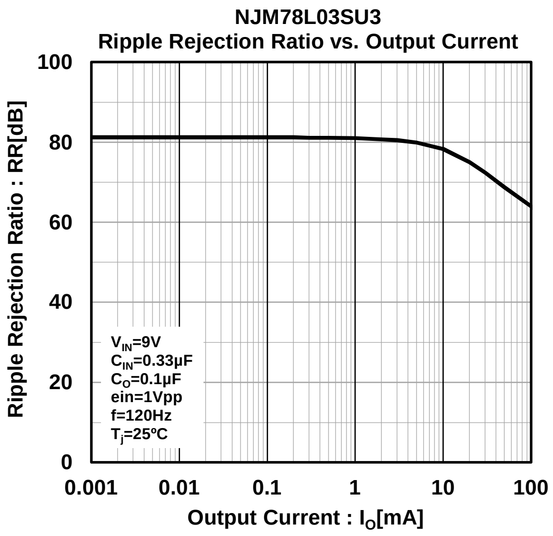


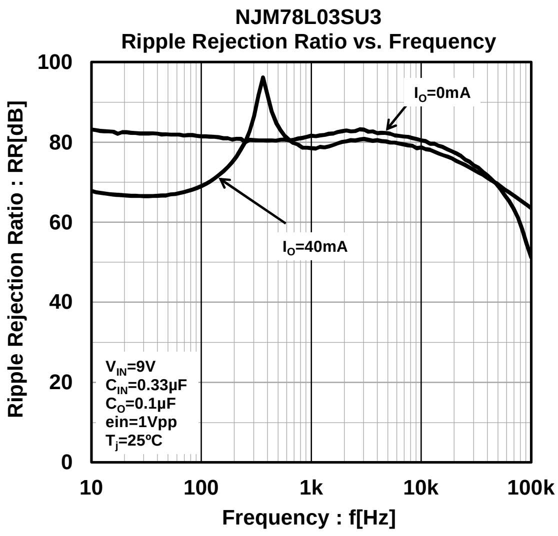


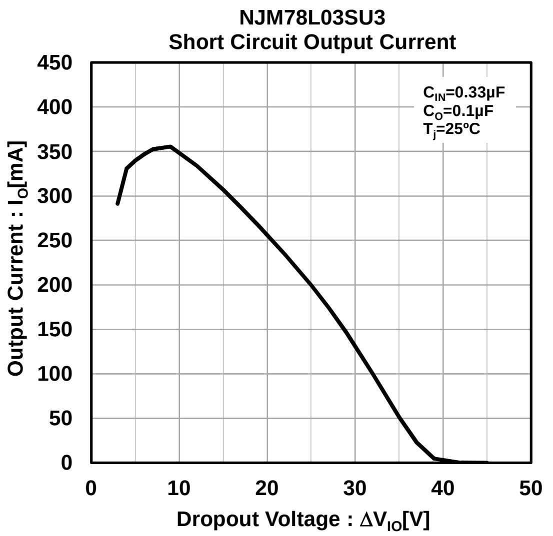


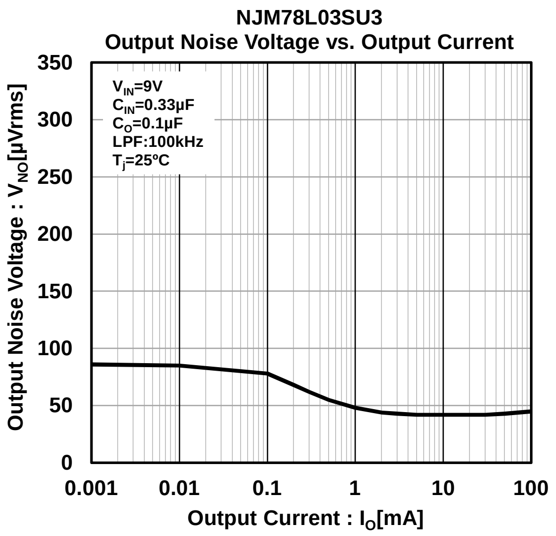


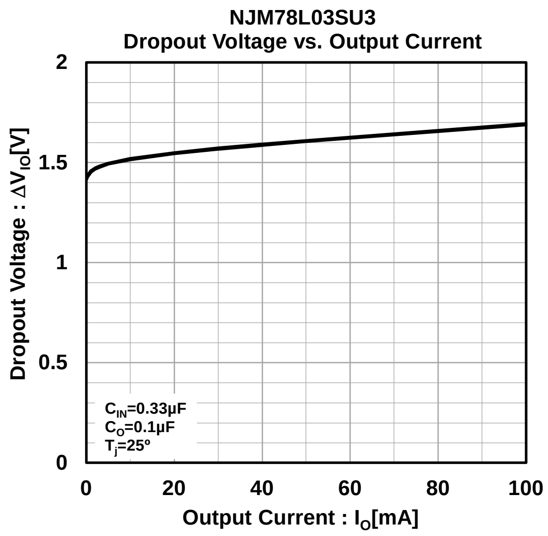
■ TYPICAL CHARACTERISTICS (3V)

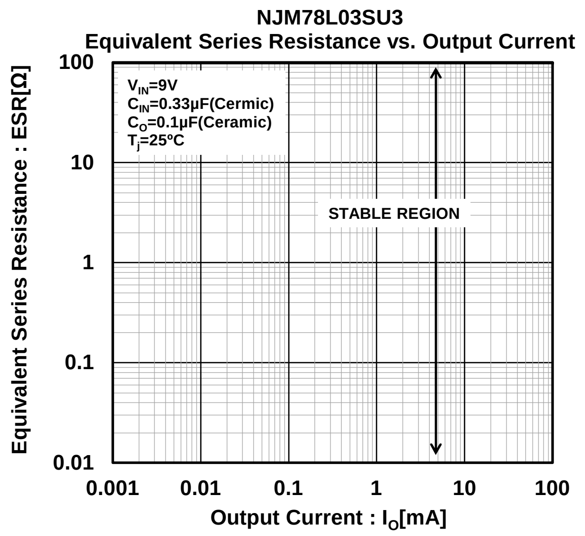




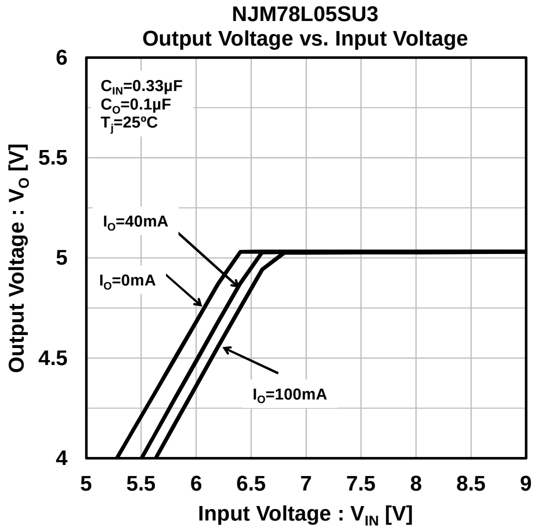


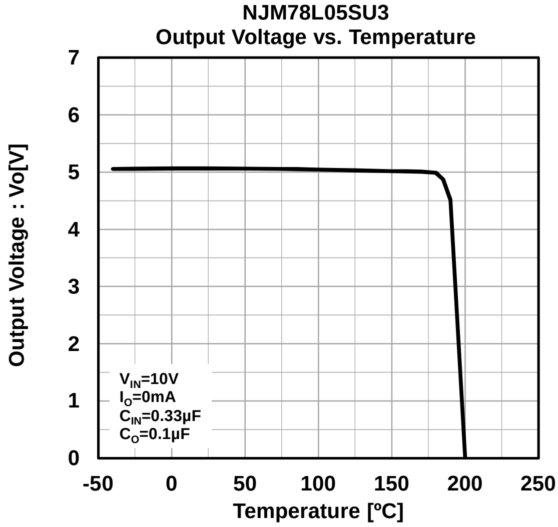


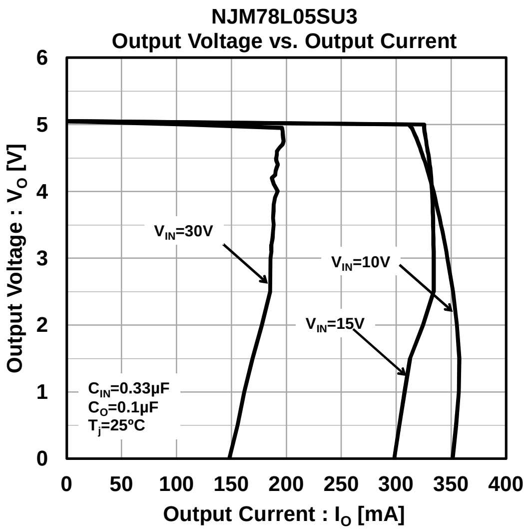


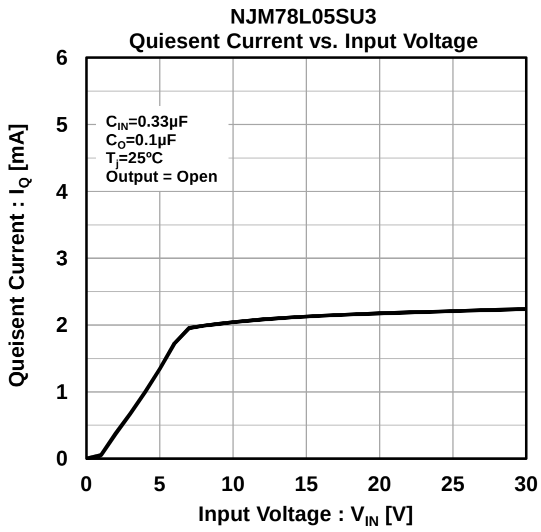


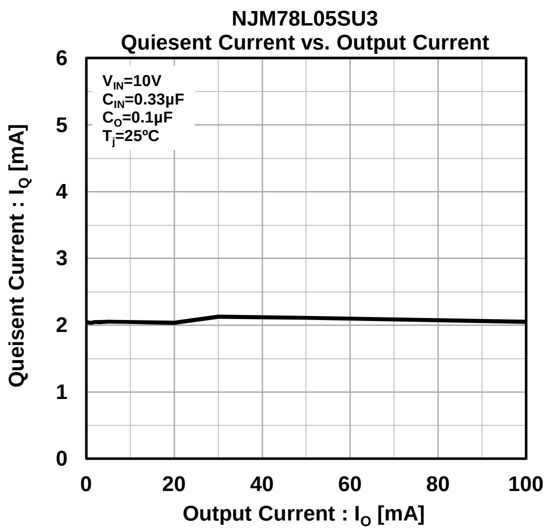
■ TYPICAL CHARACTERISTICS (5V)

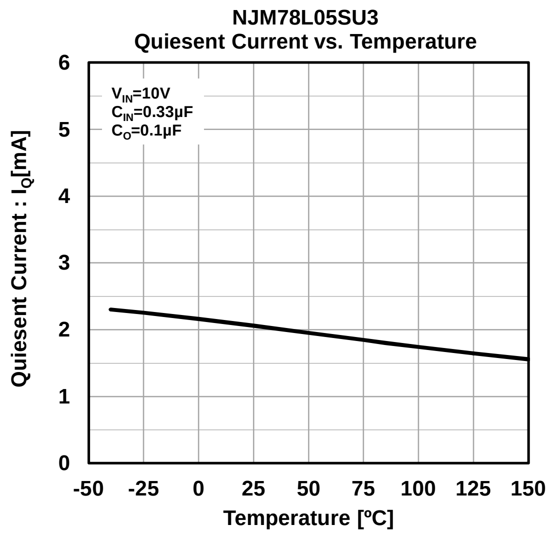




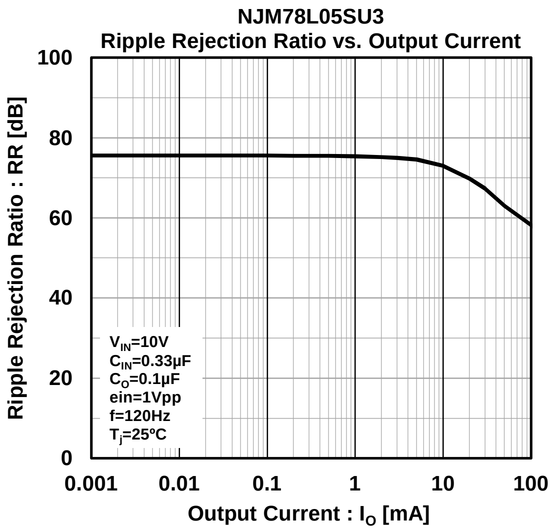


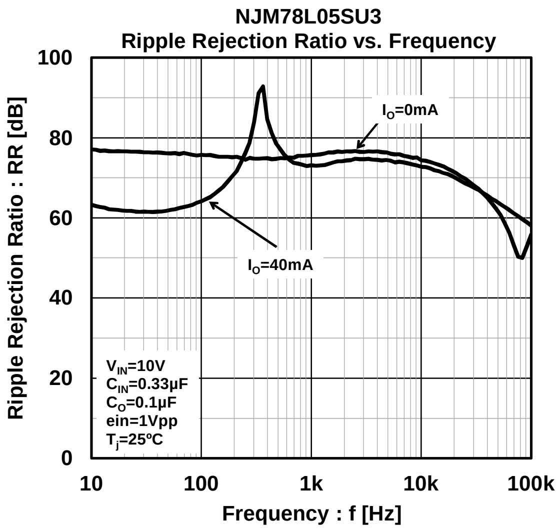


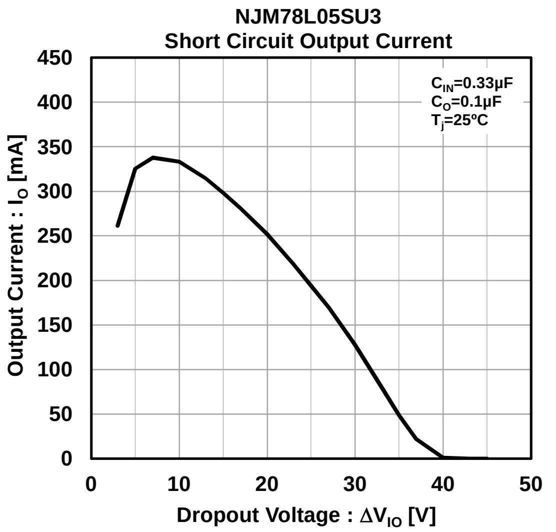


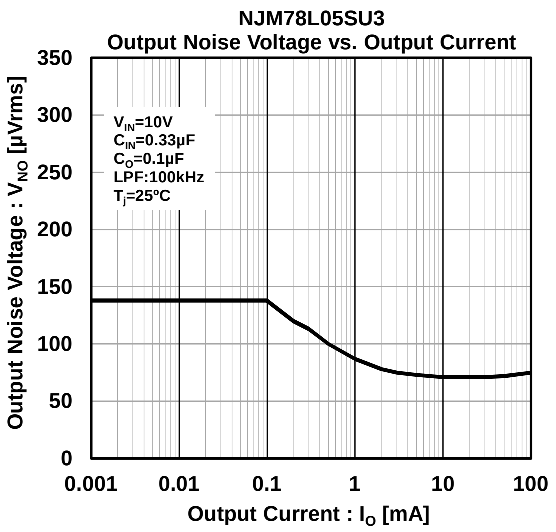


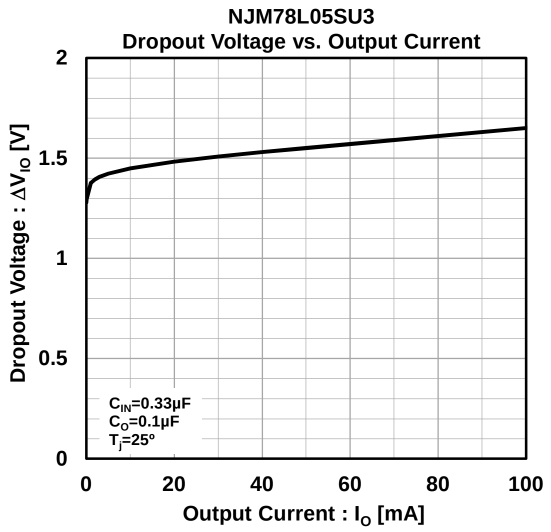
■ TYPICAL CHARACTERISTICS (5V)

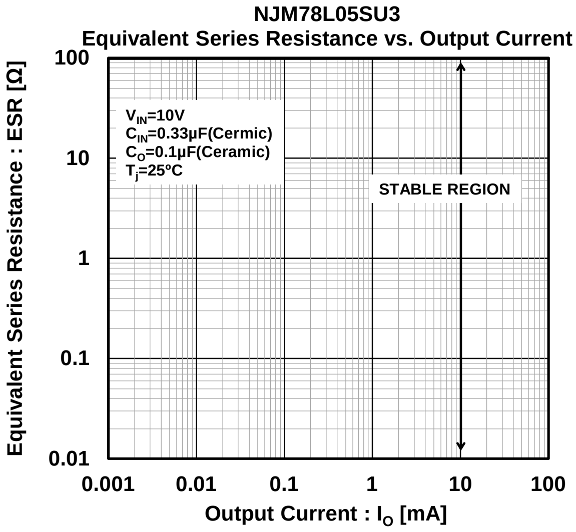




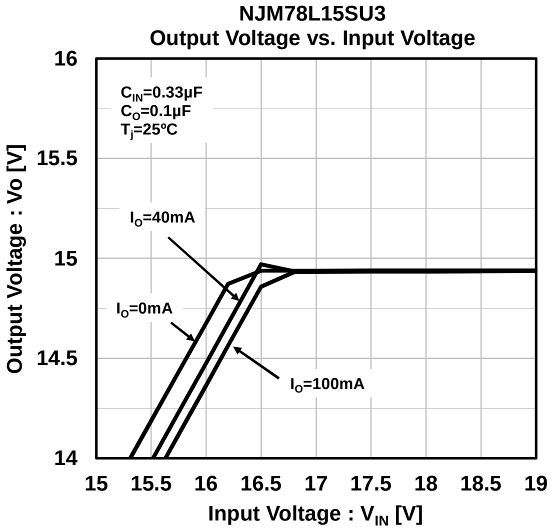


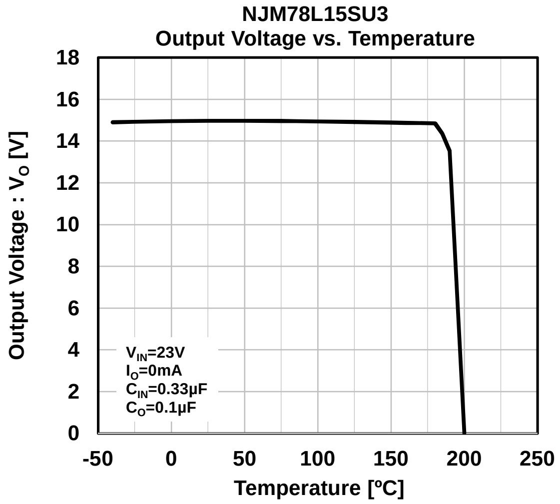


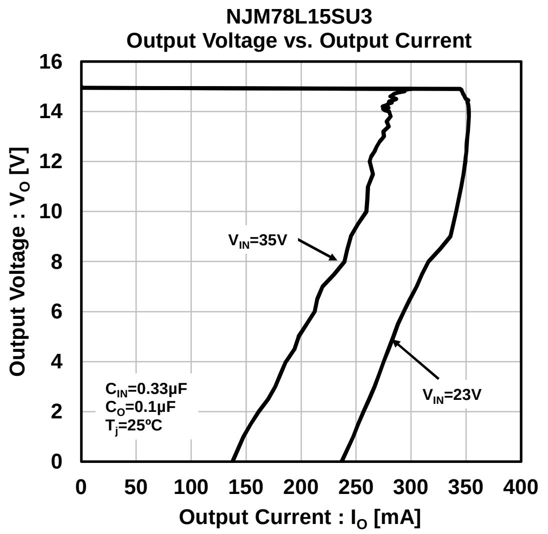


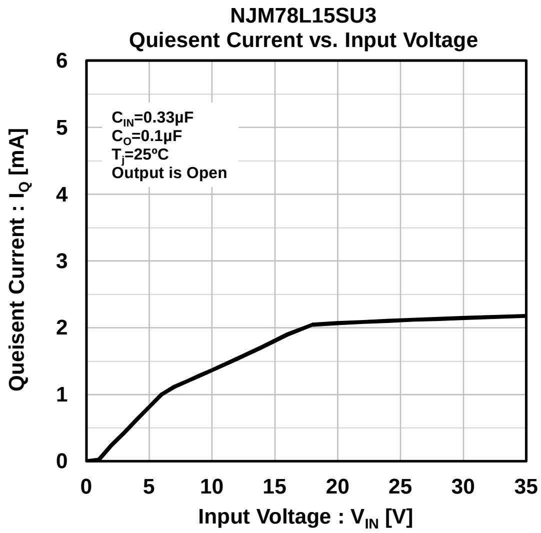


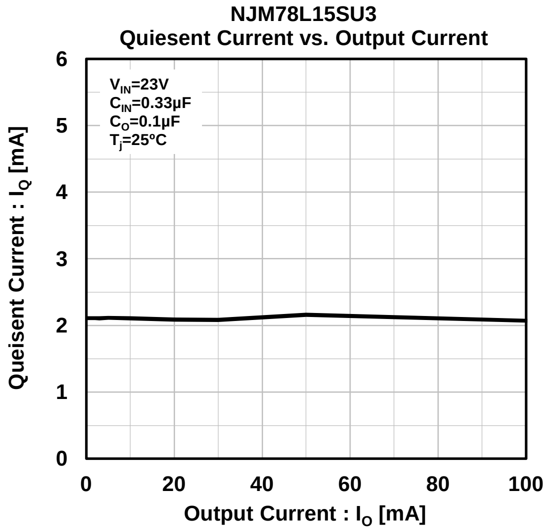
■ TYPICAL CHARACTERISTICS (15V)

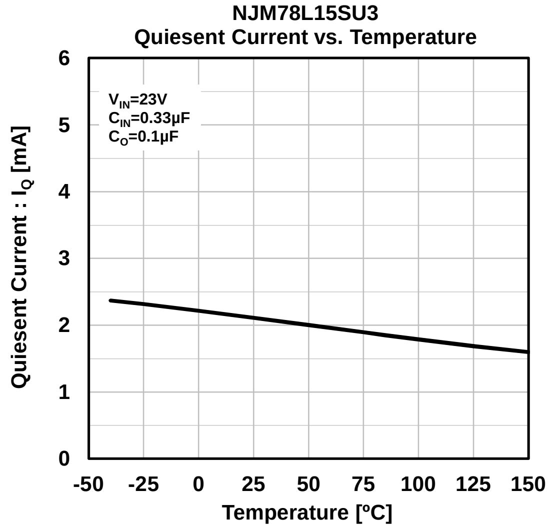




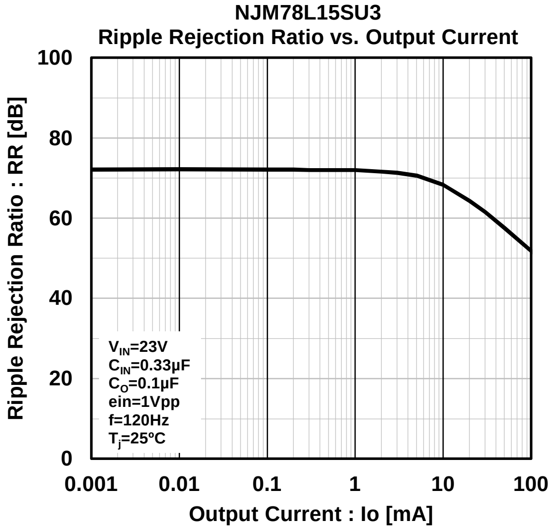


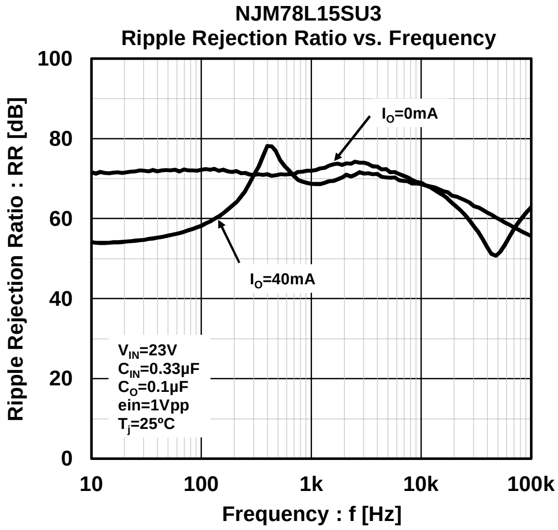


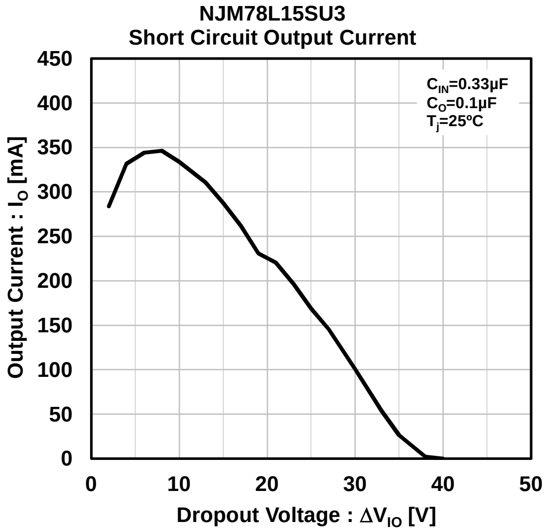


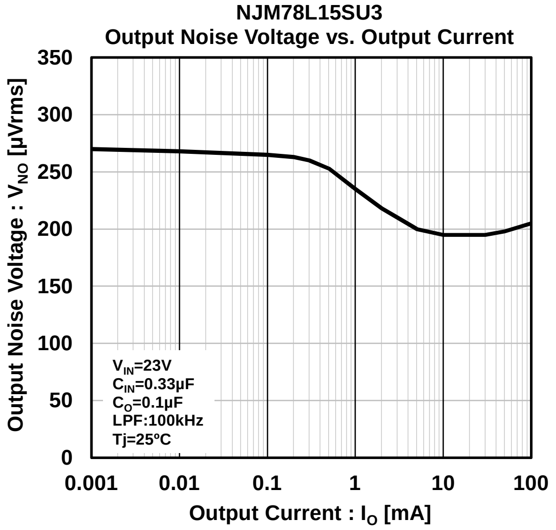


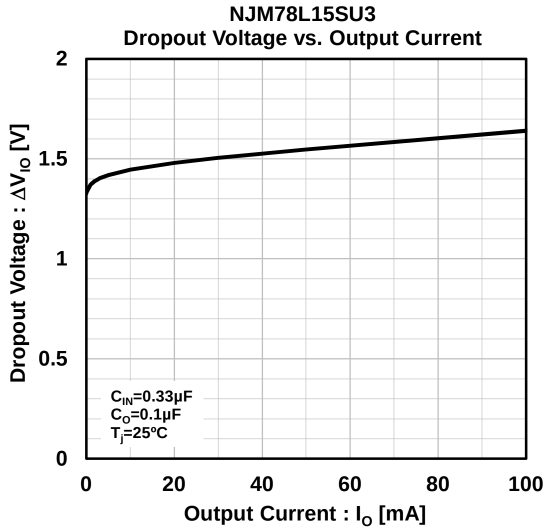
■ TYPICAL CHARACTERISTICS (15V)

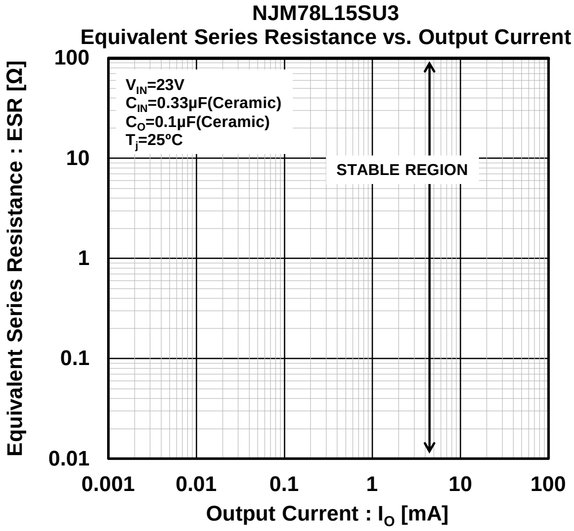












MEMO