

High Voltage $I_o=1000\text{mA}$ Low Dropout Regulator

■ GENERAL DESCRIPTION

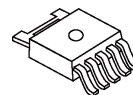
The NJW4187 is a high voltage and low current consumption low dropout regulator.

It has two lineups as A version (built-in ON/OFF function type) and B version (3-terminal / compatible with 78 series)

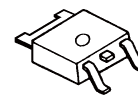
NJW4187 is mounted to TO-252-3/-5 packages and corresponded to Low ESR capacitor (MLCC).

The wide input range makes NJW4187 suitable for a Car accessory, industrial supplies, battery equipment and various applications.

■ PACKAGE OUTLINE



NJW4187DL3



NJW4187DL1

■ FEATURES

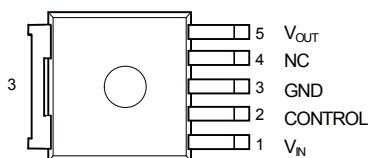
- Wide Operating Voltage Range 4.0V to 40V
- Low Current Consumption 55 μA typ. (A version)
48 μA typ. (B version)
- High Precision Output $V_o \pm 1.0\%$
- Output Current I_o (min.)=1000mA
- Output Voltage Range 2.0V to 15V
- Correspond to Low ESR capacitor (MLCC)
- ON/OFF Control (apply only the A version)
- Internal Thermal Overload Protection
- Internal Over Current Protection
- Package Outline A ver. TO-252-5
B ver. TO-252-3

■ PRODUCT CLASSIFICATION

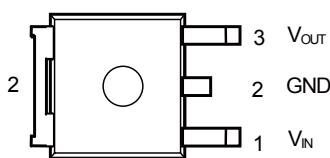
Device Name	Version	ON/OFF Function	Package
NJW4187DL3-xxA	A	Yes	TO-252-5
NJW4187DL1-xxB	B	-	TO-252-3

xx=Output Voltage ex) 33=3.3V 05=5.0V

■ PIN CONFIGURATION



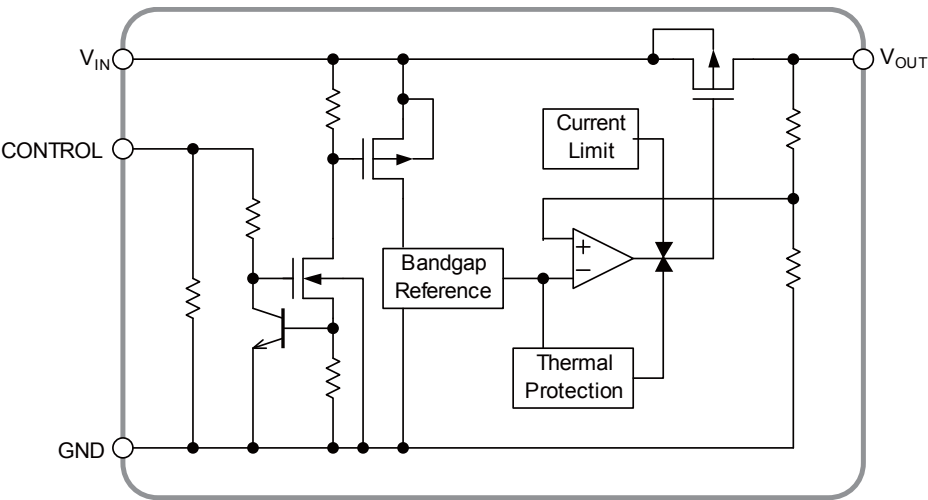
NJW4187DL3-A



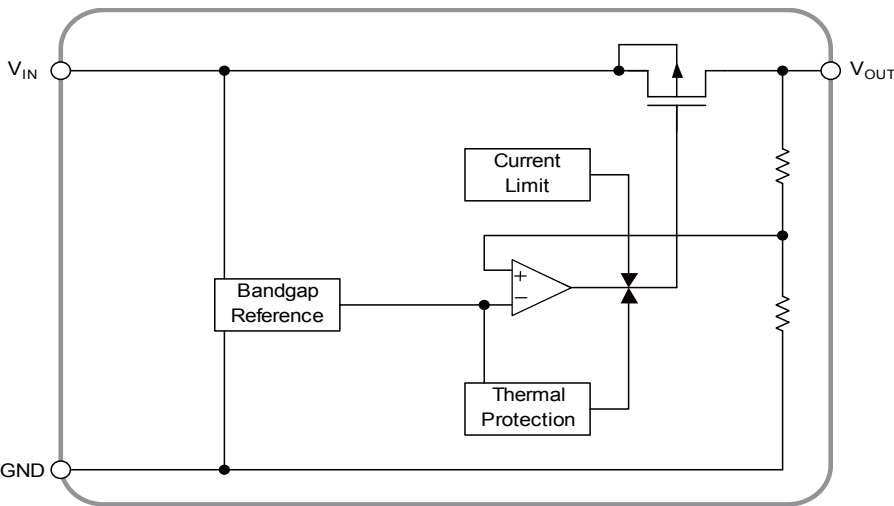
NJW4187DL1-B

■ BLOCK DIAGRAM

• A version



• B version



■ OUTPUT VOLTAGE RANK LIST

• A version

Device Name	Output Voltage
NJW4187DL3-33A	3.3V
NJW4187DL3-05A	5.0V

• B version

Device Name	Output Voltage
NJW4187DL1-33B	3.3V
NJW4187DL1-05B	5.0V

■ ABSOLUTE MAXIMUM RATINGS

(Ta=25°C)

PARAMETER	SYMBOL	RATINGS	UNIT
Input Voltage	V_{IN}	-0.3 to +45	V
Control Voltage(*1)	V_{CONT}	-0.3 to +45	V
Output Voltage	V_{OUT}	-0.3 to $V_{IN} \leq 17$	V
Power Dissipation	P_D	1190 (*2) 3125 (*3)	mW
Junction Temperature	T_j	-40 to +150	°C
Operating Temperature	T_{opr}	-40 to +125	°C
Storage Temperature	T_{stg}	-40 to +150	°C

(*1): Apply only the A version.

(*2): Mounted on glass epoxy board. (76.2×114.3×1.6mm:based on EIA/JDEC standard size, 2Layers, Cu area 100mm²)

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

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

■ INPUT VOLTAGE RANGE

V_{IN} =4.0V to 40V

■ ELECTRICAL CHARACTERISTICS

Unless otherwise noted, $V_{IN} = V_O + 1V$, $C_{IN} = 1.0\mu F$, $C_O = 4.7\mu F$ ($3V \leq V_O < 3.4V$: $C_O = 10\mu F$), $T_a = 25^\circ C$

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Output Voltage	V_O	$I_O = 200mA$	-1.0%	-	+1.0%	V
Quiescent Current	I_Q	A version, $I_O = 0mA$, except I_{CONT}	-	55	90	μA
		B version, $I_O = 0mA$	-	48	83	
Quiescent Current at Control OFF (*4)	$I_{Q(OFF)}$	$V_{CONT} = 0V$	-	-	1	μA
Output Current	I_O	$V_O \times 0.9$	1000	-	-	mA
Line Regulation	$\Delta V_O / \Delta V_{IN}$	$V_{IN} = V_O + 1V$ to 40V, $I_O = 200mA$	-	-	0.03	%/V
Load Regulation	$\Delta V_O / \Delta I_O$	$I_O = 0mA$ to 1000mA	-	-	0.004	%/mA
Ripple Rejection	RR	$V_{IN} = V_O + 1V$, $f_{in} = 200mV_{rms}$, $f = 1kHz$, $I_O = 10mA$, $V_O = 3.3V$	-	58	-	dB
		$V_O = 5.0V$	-	54	-	
Dropout Voltage (*5)	ΔV_{IO}	$I_O = 600mA$	-	0.27	0.42	V
Average Temperature Coefficient of Output Voltage	$\Delta V_O / \Delta T_a$	$T_a = 0$ to $85^\circ C$, $I_O = 200mA$	-	± 50	-	ppm/°C
Control Current (*4)	I_{CONT}	$V_{CONT} = 1.6V$	-	1	3	μA
Control Voltage for ON-state (*4)	$V_{CONT(ON)}$		1.6	-	-	V
Control Voltage for OFF-state (*4)	$V_{CONT(OFF)}$		-	-	0.6	V

(*4): Apply only the A version.

(*5): The output voltage excludes under 3.8V

The above specification is a common specification for all output voltages.

Therefore, it may be different from the individual specification for a specific output voltage.

* These parameters are tested by Pulse Measurement.

■ THERMAL CHARACTERISTICS

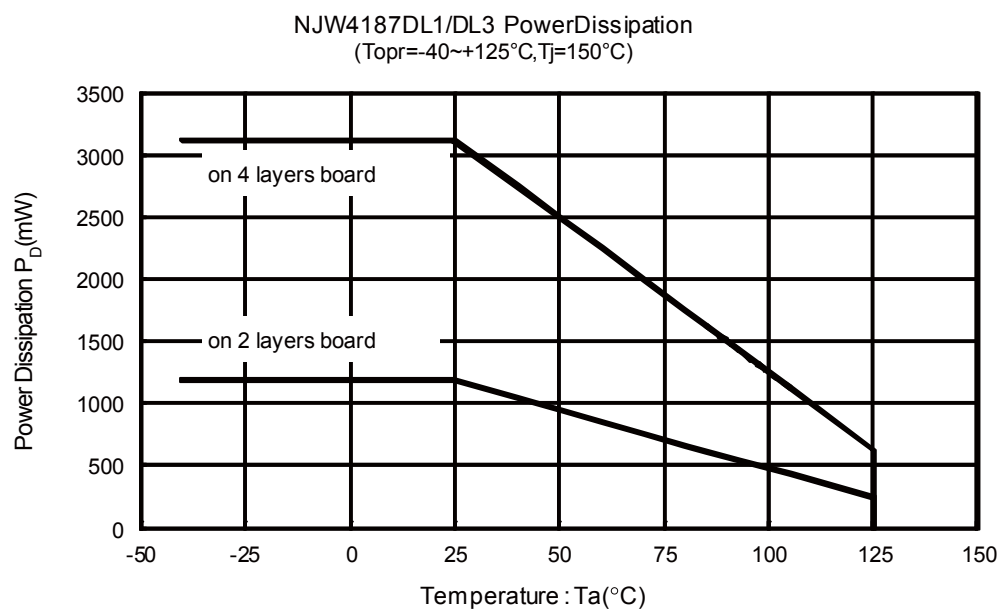
PARAMETER	SYMBOL	VALUE	UNIT
Junction-to-Ambient thermal resistance	θ_{ja}	105 (*6) 40 (*7)	°C/W
Junction-to-Top of package characterization parameter	ψ_{jt}	17 (*6) 12 (*7)	°C/W

(*6): Mounted on glass epoxy board. (76.2 × 114.3 × 1.6mm:based on EIA/JDEC standard size, 2Layers, Cu area 100mm²)

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

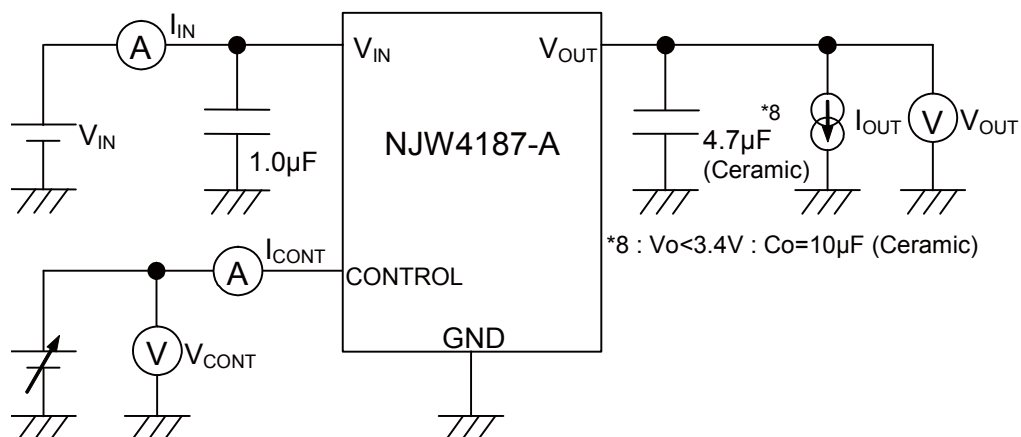
(For 4Layers: Applying 74.2 × 74.2mm inner Cu area and a thermal via hole to a board based on JEDEC standard JESD51-5)

■ POWER DISSIPATION vs. AMBIENT TEMPERATURE

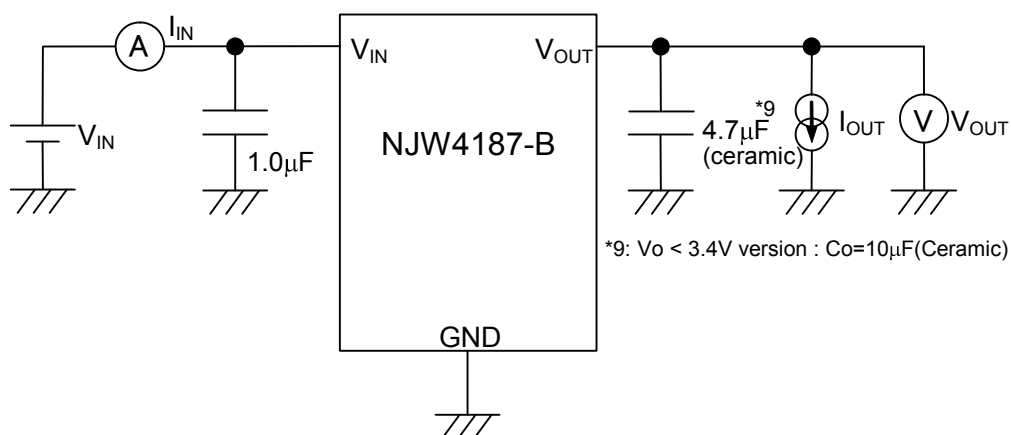


■ TEST CIRCUIT

· A version



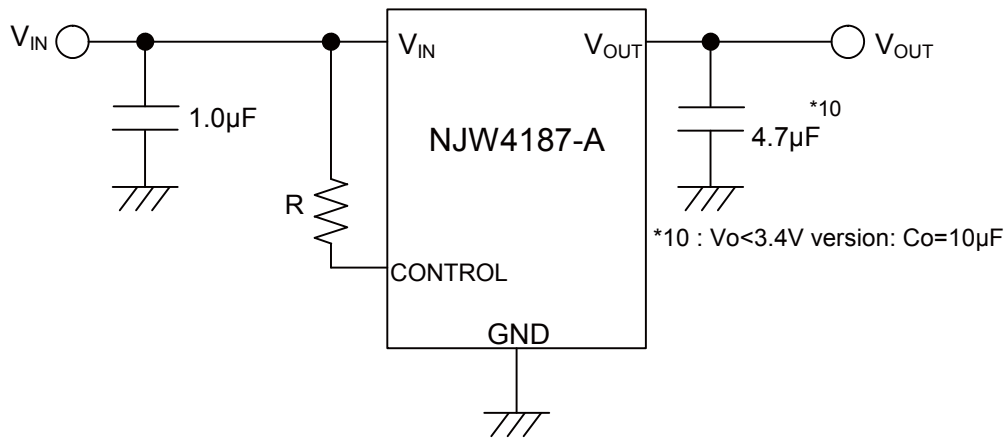
· B version



■ TYPICAL APPLICATION

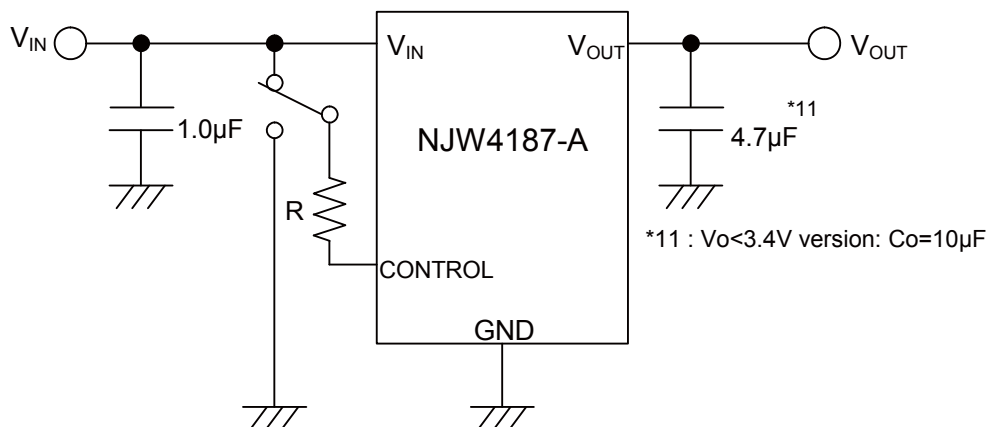
• A version

① In the case where ON/OFF Control is not required



Connect CONTROL pin to V_{IN} pin

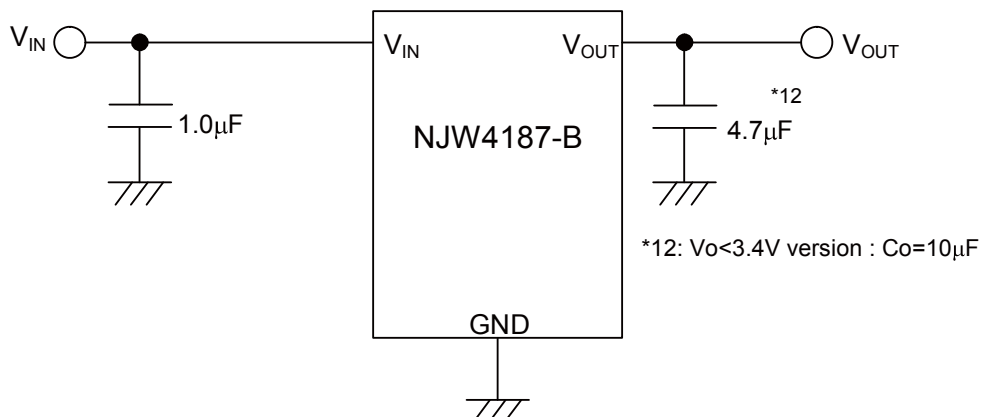
② In use of ON/OFF CONTROL



State of CONTROL pin:

- "H" → output is enabled.
- "L" or "open" → output is disabled.

• B version



*In the case of using a resistance "R" between V_{IN} and CONTROL.

If this resistor is inserted, it can reduce the control current when the control voltage is high.

The applied voltage to control pin should set to consider voltage drop through the resistor "R" and the minimum control voltage for ON-state.

The $V_{CONT(ON)}$ and I_{CONT} have temperature dependence as shown in the "Control Current vs. Temperature" and "Control Voltage vs. Temperature" characteristics. Therefore, the resistance "R" should be selected to consider the temperature characteristics.

*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

The recommended capacitance depends on the output voltage rank. Especially, low voltage regulator requires larger C_O value.

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.

*Transient response characteristic of Output Voltage

In general, overshoot or undershoot of output voltage may occur due to the transient response characteristic of an internal error amplifier.

Especially, low current consumption regulator may have overshoot or undershoot due to slow feedback caused by current saving design.

Therefore, design validation is important in the following cases:

1. Input voltage or output current change sharply
2. Output capacitors is small
3. Output load is light
4. A regulator starts up with very low dropout voltage operation.

Increasing the value of input and/or output capacitor is a common countermeasure for improving a transient response characteristic.

A transient response characteristic may vary with operating conditions and external components value.

Please check it with the actual environment.

*The notes of the evaluation when V_{OUT} pin is shorted to GND

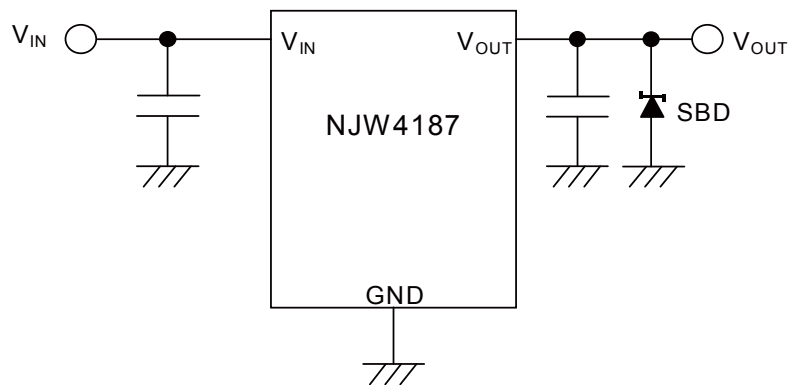
When evaluated short circuit test, the IC may break down because of regenerated energy by the parasitic inductance included in wiring pattern.

It phenomenon appears conspicuously when output voltage is high($V_{OUT}=8.0V$ or more)or connected to inductive load.

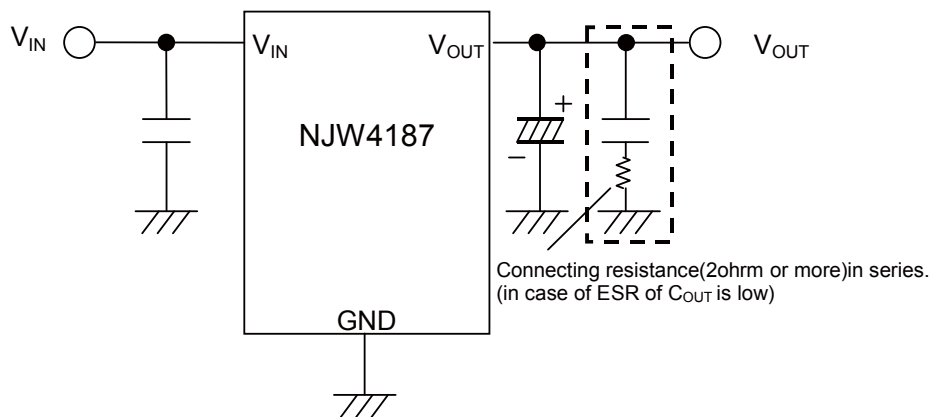
In case of short circuit in actual application, not likely to destruction of IC because of some of Resistance exist between load.

If happened above phenomenon by the short circuit test with the actual application, recommend connecting schottky barrier diode(SBD) between V_{OUT} pin and the GND or using output condensers that have ESR more than 2ohm like a tantalum or aluminum electrolytic capacitor.(see below figure)

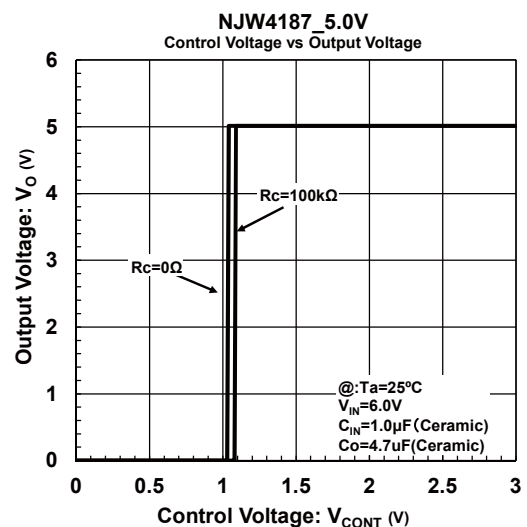
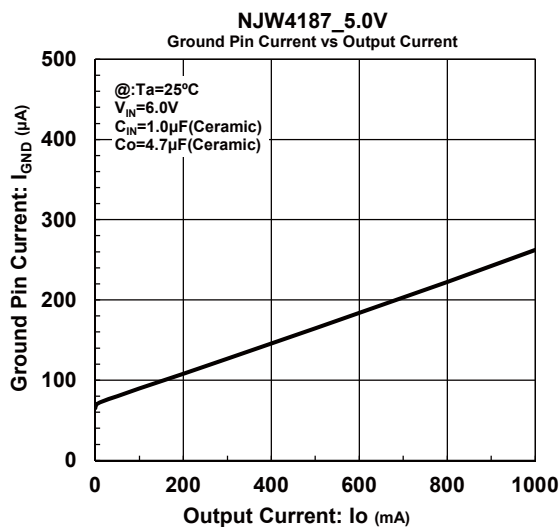
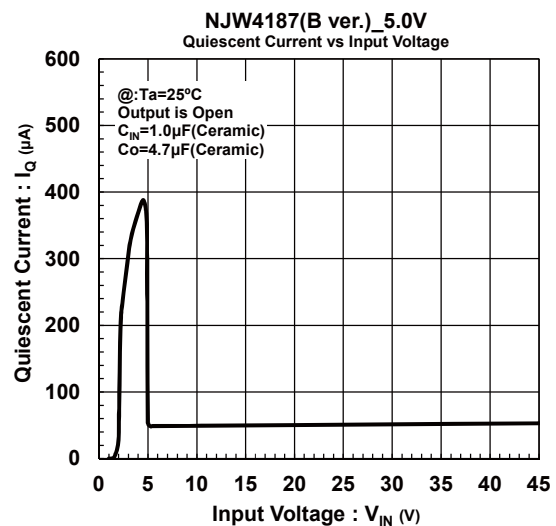
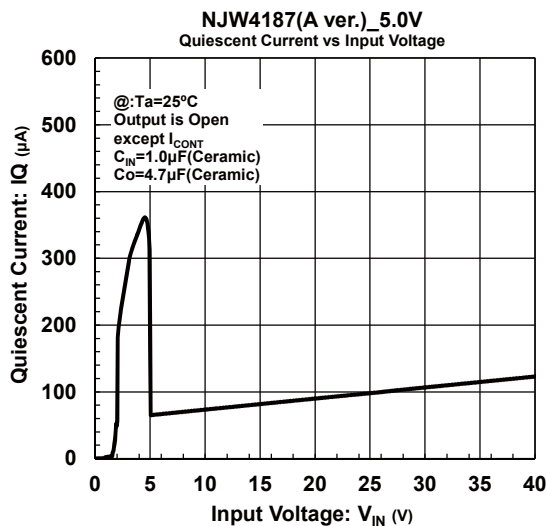
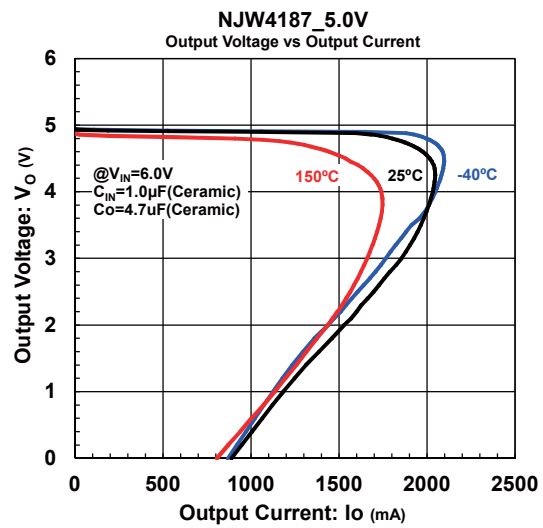
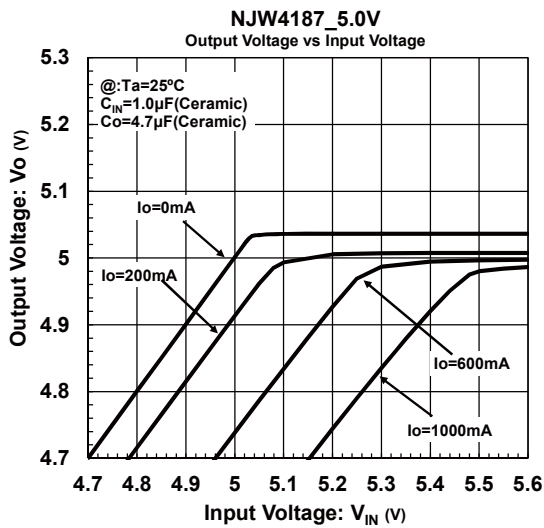
(a)In case of insert Schottky barrier diode between V_{OUT} pin - GND

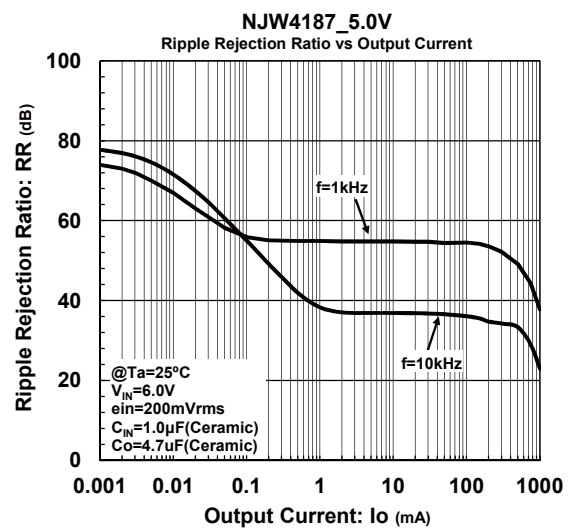
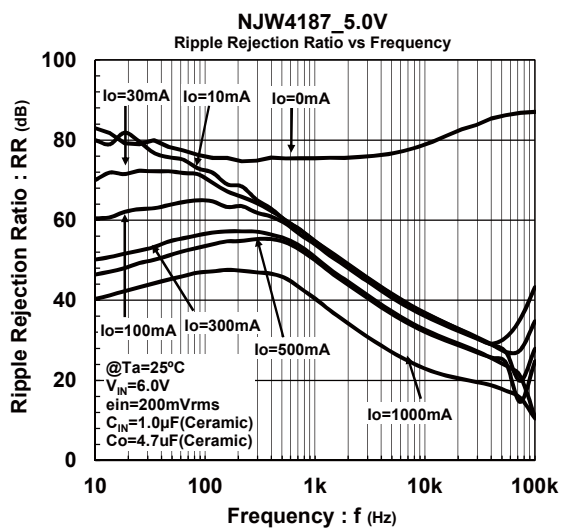
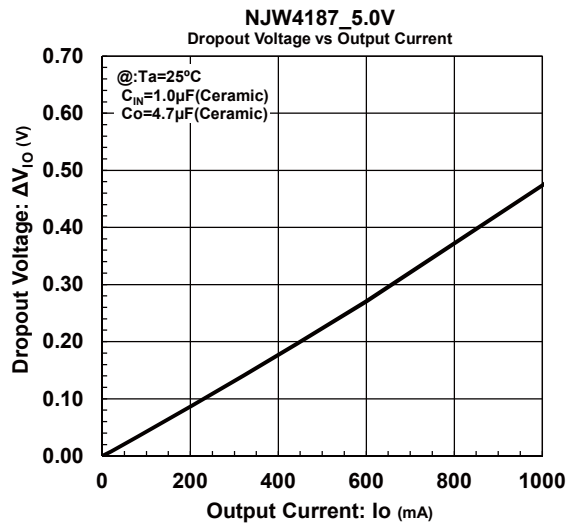
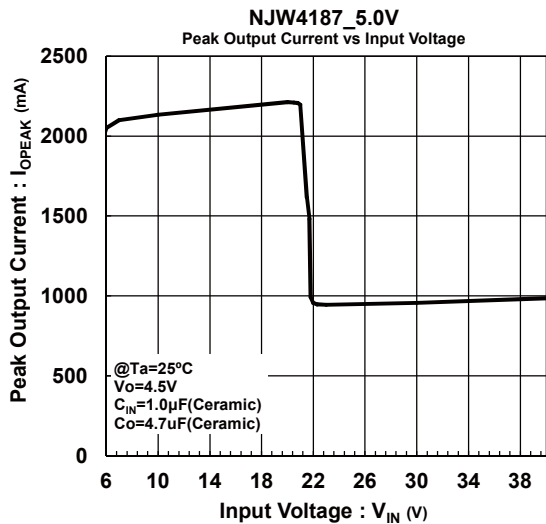
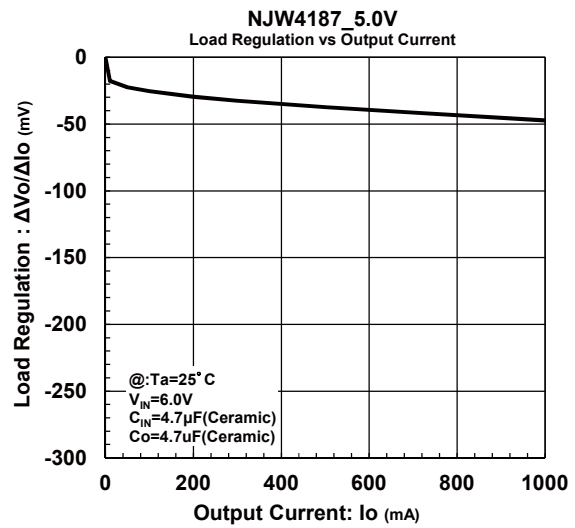
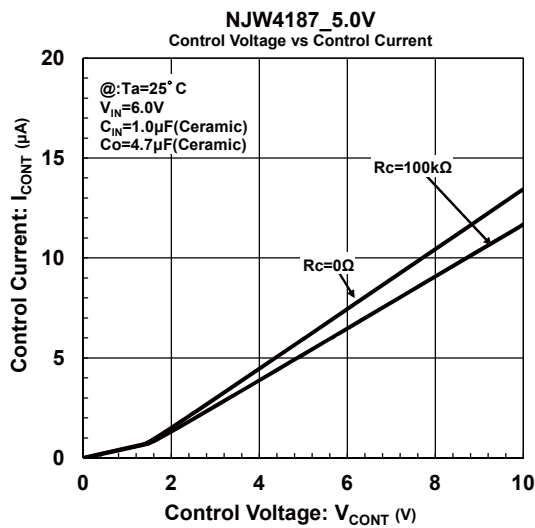


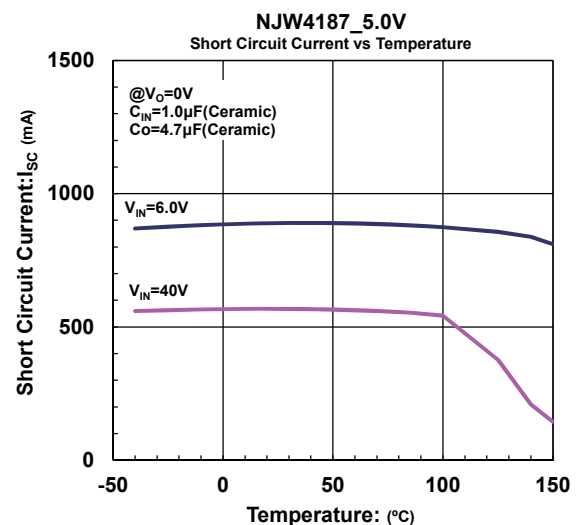
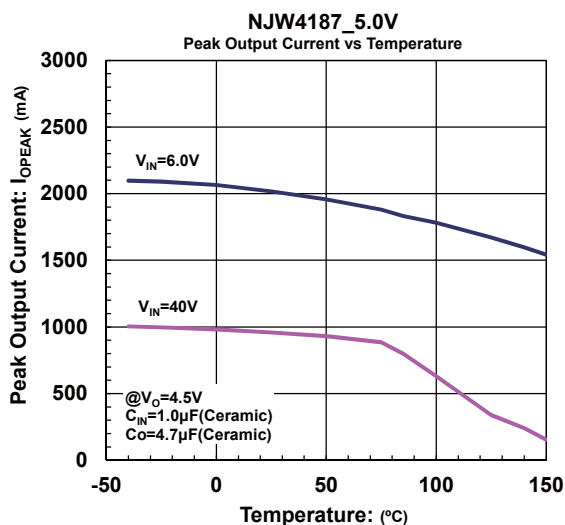
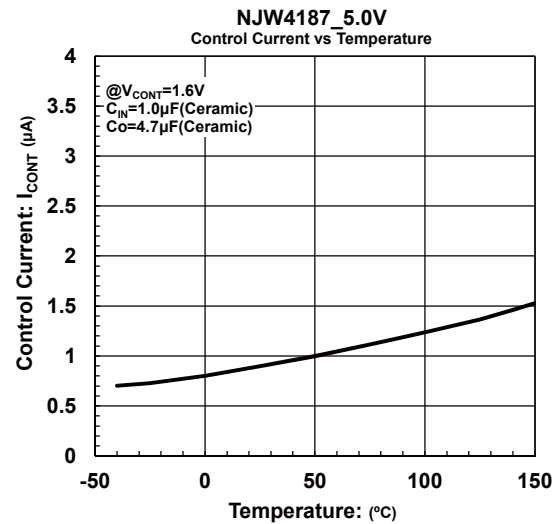
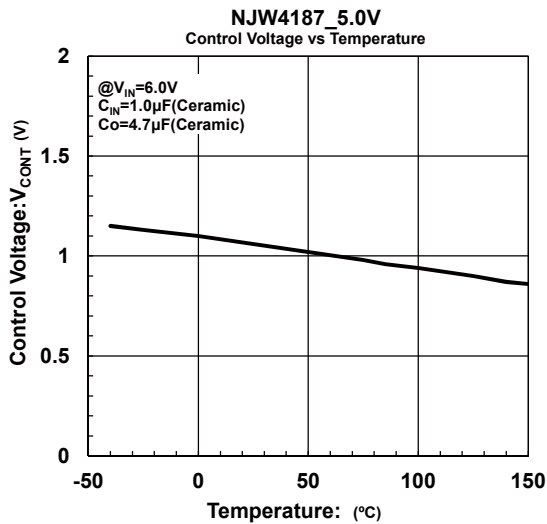
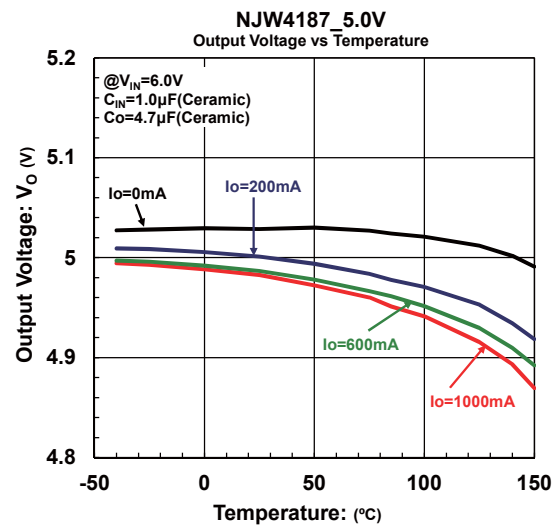
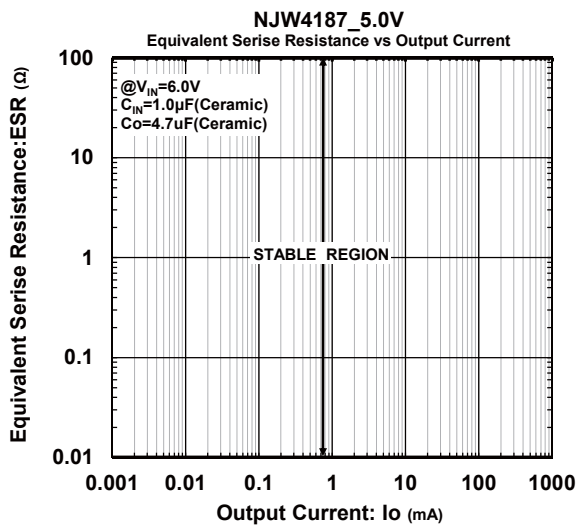
(b) In case of using the electrolysis condenser or insert series resistance

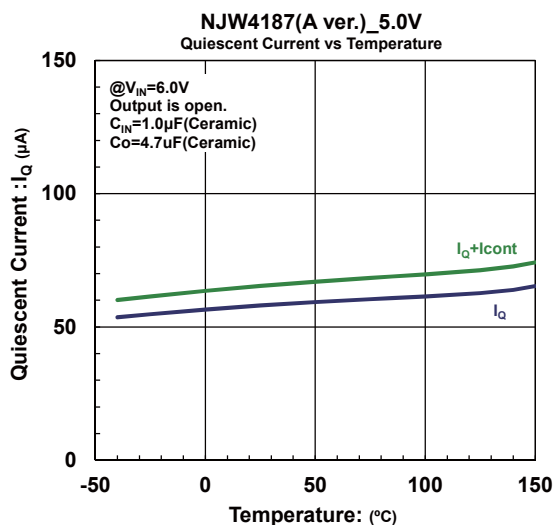
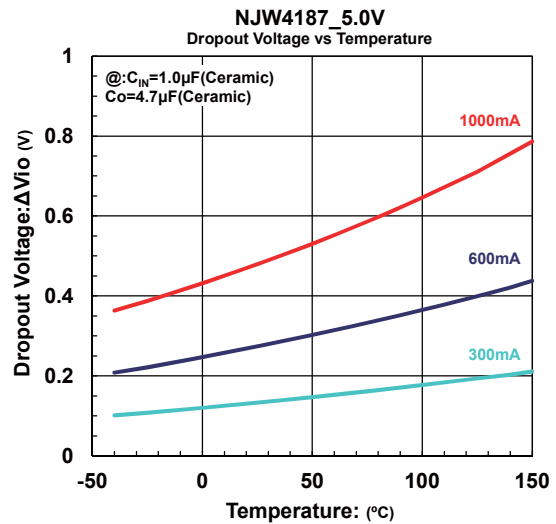
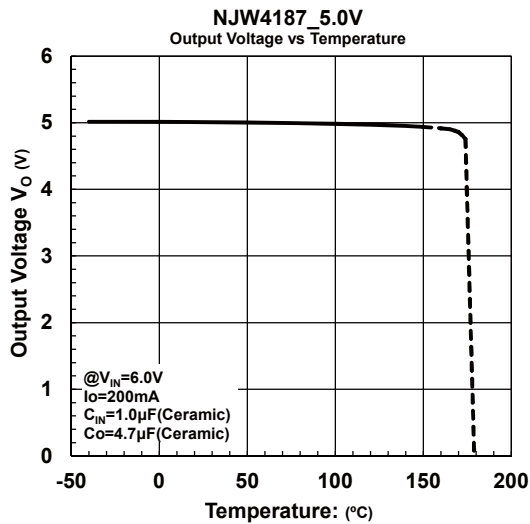
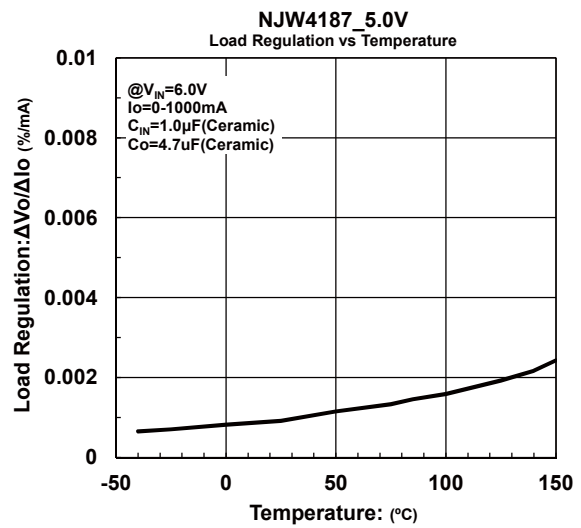
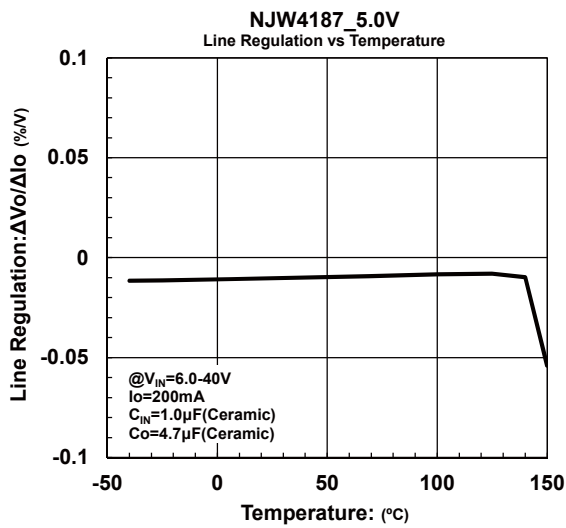


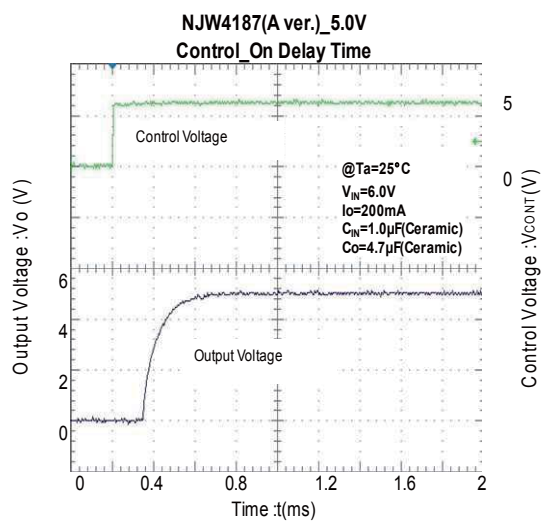
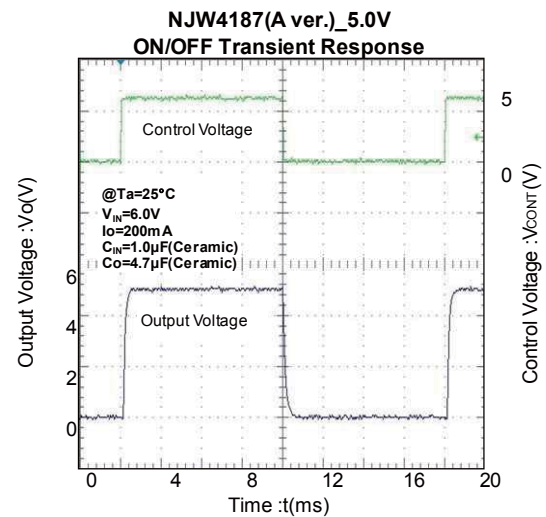
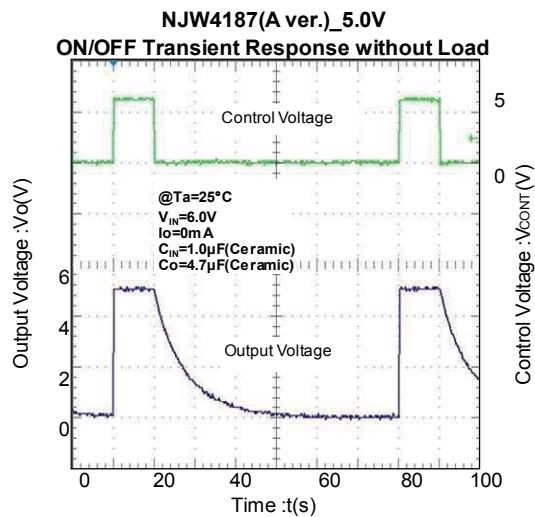
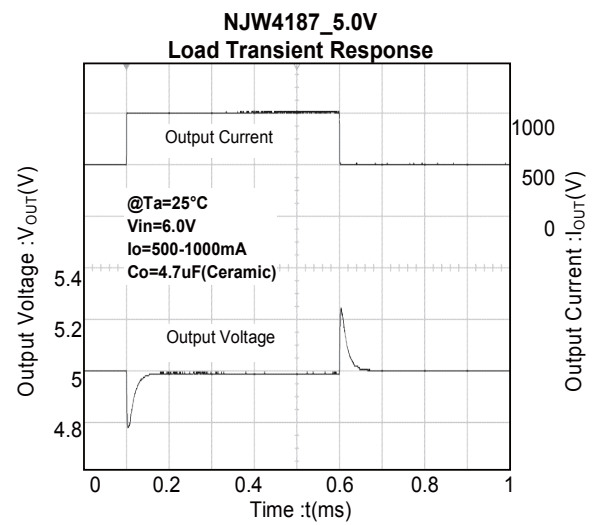
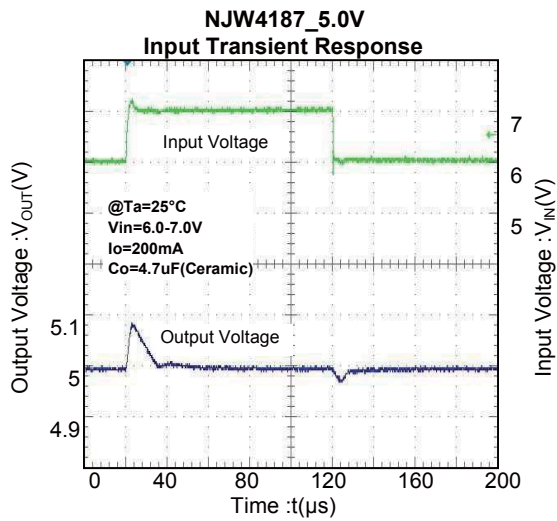
TYPICAL CHARACTERISTICS











[CAUTION]

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