High Voltage Io=300mA Low Dropout Regulator

■ GENERAL DESCRIPTION

The NJW4184 is a high voltage and low current consumption low dropout regulator.

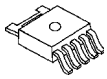
It have lineup as A version (built-in ON/OFF function type) and B version.(decreases current consumption type)

NJW4184 is mounted to SOT-89-3/5,TO252-3/5 package and corresponded to Low ESR capacitor (MLCC).

It makes NJW4184 suitable for a Car accessory, battery equipment and various applications.

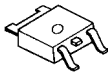
■ PACKAGE OUTLINE

NJW4184U2



NJW4184DL3

NJW4184U3



NJW4184DL1

■ FEATURES

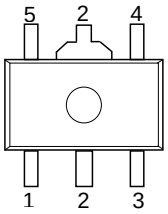
- Operating Voltage Range 4.0~35V(max.)
- Low Current Consumption 12μA (A version.)
  9μA (B version.)
- Correspond to Low ESR capacitor (MLCC)
- Output Current I_O(min.)=300mA
- Output Voltage Range V_O: 2.5V to 15.0V
- High Precision Output V_O ±1.0%
- ON/OFF function (apply only A ver.)
- Thermal Overload Protection
- Over Current Protection
- Package Outline A ver. : SOT-89-5 TO-252-5
  B ver. : SOT-89-3 TO-252-3

■ PRODUCT CLASSIFICATION

Device Name	Version	ON/OFF Function	Package
NJW4184U2-xxA	A	×	SOT-89-5
NJW4184DL3-xxA	A	×	TO-252--5
NJW4184U3-xxB	B	-	SOT-89-3
NJW4184DL1-xxB	B	-	TO-252-3

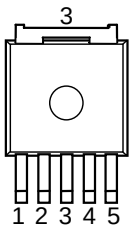
xx=Output Voltage ex) 33=3.3V 05=5.0V

■ PIN CONNECTION



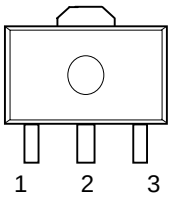
Pin Function
1.CONTROL
2.GND
3.N.C
4.V_{OUT}
5. V_{IN}

NJW4184U2-A



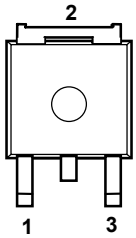
Pin Function
1.V_{IN}
2.CONTROL
3.GND
4.N.C
5. V_{OUT}

NJW4184DL3-A



Pin Function
1.V_{OUT}
2.GND
3.V_{IN}

NJW4184U3-B

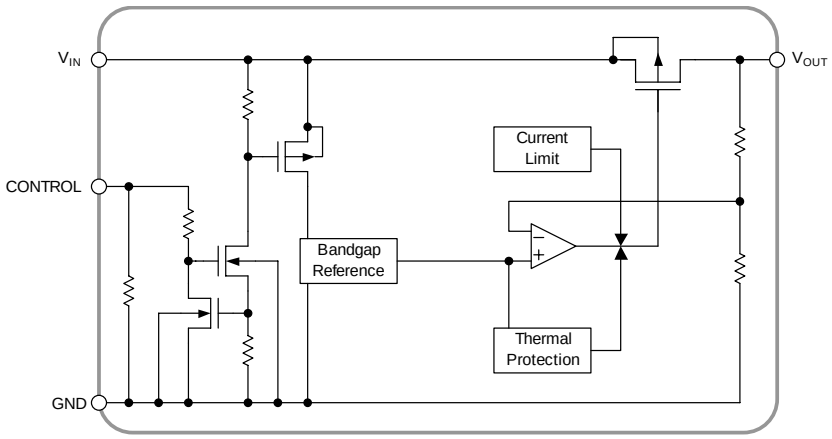


Pin Function
1.V_{IN}
2.GND
3.V_{OUT}

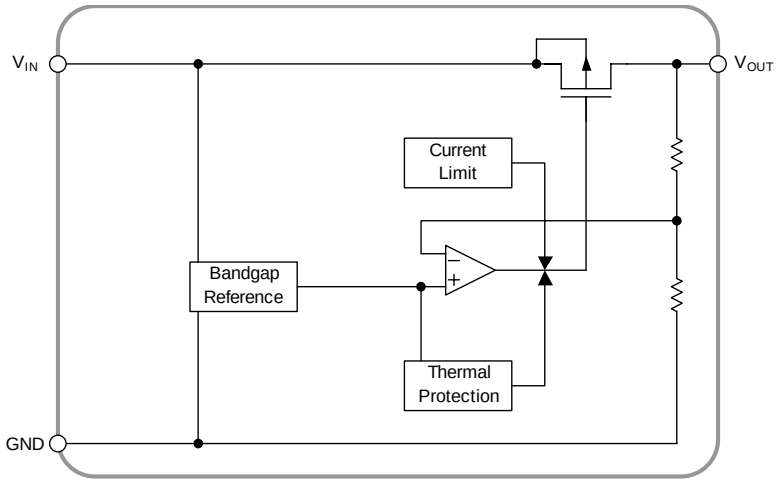
NJW4184DL1-B

■ BLOCK DIAGRAM

・A version



・B version



■ OUTPUT VOLTAGE LANK LIST

・A version

SOT-89-5 TO-252-5

Device Name	V_{OUT}	Device Name	V_{OUT}
NJW4184U2-25A	2.5V	NJW4184DL3-25A	2.5V
NJW4184U2-33A	3.3V	NJW4184DL3-33A	3.3V
NJW4184U2-05A	5.0V	NJW4184DL3-05A	5.0V
NJW4184U2-08A	8.0V	NJW4184DL3-08A	8.0V
NJW4184U2-09A	9.0V	NJW4184DL3-12A	12.0V
NJW4184U2-12A	12.0V	NJW4184DL3-15A	15.0V
NJW4184U2-15A	15.0V		

・B version

SOT-89-3 TO-252-3

Device Name	V_{OUT}	Device Name	V_{OUT}
NJW4184U3-25B	2.5V	NJW4184DL1-25B	2.5V
NJW4184U3-33B	3.3V	NJW4184DL1-33B	3.3V
NJW4184U3-05B	5.0V	NJW4184DL1-05B	5.0V
NJW4184U3-15B	15.0V	NJW4184DL1-15B	15.0V

■ ABSOLUTE MAXIMUM RATINGS (Ta=25°C)

PARAMETER	SYMBOL	RATINGS		UNIT
Input Voltage	V_{IN}	-0.3 to +40		V
Control Voltage(*1)	V_{CONT}	-0.3 to +40		V
Output Voltage	V_{OUT}	-0.3 to $V_{IN} \leq 17$		V
Power Dissipation	P_D	SOT89-3/5	625(*2) 2400(*3)	mW
		TO252-3/5	1190(*2) 3125(*3)	
Junction Temperature	Tj	-40~+150		°C
Operating Temperature	Topr	-40~+85		°C
Storage Temperature	Tstg	-40~+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 100mm^2)

(*3): 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)

■ ELECTRICAL CHARACTERISTICS

Unless otherwise noted, $V_O \geq 3.0V$: $V_{IN} = V_O + 1V$, $C_{IN} = 1.0\mu F$, $C_O = 4.7\mu F$, $T_a = 25°C$

$V_O < 3.0V$: $V_{IN} = 4.0V$, $C_{IN} = 1.0\mu F$, $C_O = 10\mu F$, $T_a = 25°C$

PARAMETER	SYMBOL	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage	V_O	I_O =30mA		-1.0%	-	+1.0%	V
Quiescent Current	I_Q	A version I_O =0mA, except I_{CONT}		-	12	22	μA
		B version I_O =0mA		-	9	19	
Quiescent Current at Control OFF(*4)	$I_{Q(OFF)}$	V_{CONT}=0V		-	-	1	μA
Output Current	I_O	$V_O \times 0.9$		300	-	-	mA
Line Regulation	$\Delta V_O/\Delta V_{IN}$	$V_{IN} = V_O$+1V~35V, I_O=30mA ($V_O \geq 3V$) V_{IN} = 4V~35V, I_O=30mA (V_O<3V)		-	-	0.05	%/V
Load Regulation	$\Delta V_O/\Delta I_O$	I_O=0mA ~ 300mA		-	-	0.01	%/A
Ripple Rejection	RR	V_{IN}= 5V ,ein=50mVrms, f=1kHz, I_O =10mA	V_O=2.5V	-	42	-	dB
		V_{IN}= V_O +2V ,ein=50mVrms, f=1kHz, I_O =10mA	V_O=3.3V	-	40	-	
			V_O=5.0V	-	36	-	
			V_O=8.0V	-	33	-	
			V_O=12.0V	-	30	-	
			V_O=15.0V	-	29	-	
Dropout Voltage (*5)	ΔV_{IO}	I_O=100mA		-	0.1	0.2	V
Control Current (*4)	I_{CONT}	V_{CONT}=1.6V		-	0.5	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
Average Temperature Coefficient of Output Voltage	$\Delta V_O/\Delta Ta$	Ta=0 ~ 85°C, I_O =30mA		-	±50	-	ppm/°C
Input Voltage	V_{IN}			4.0	-	35	V

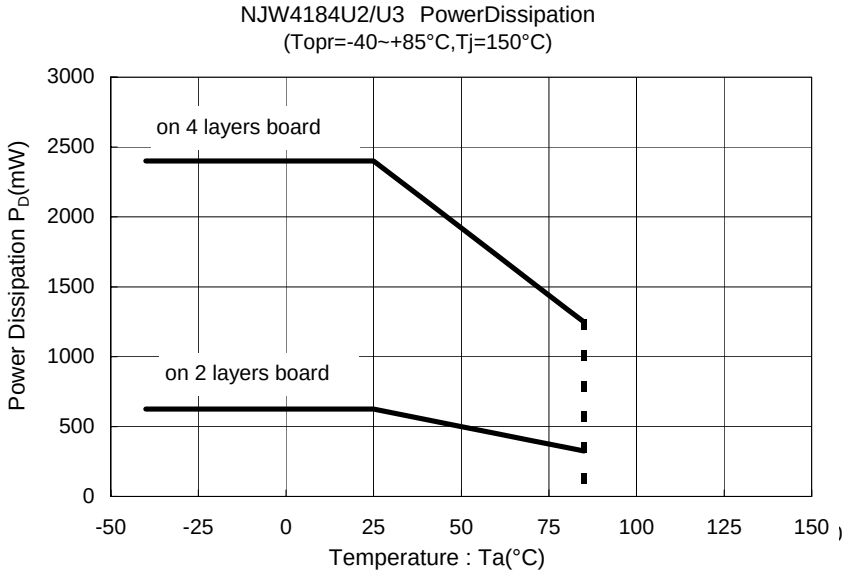
(*4): Apply only the A version.

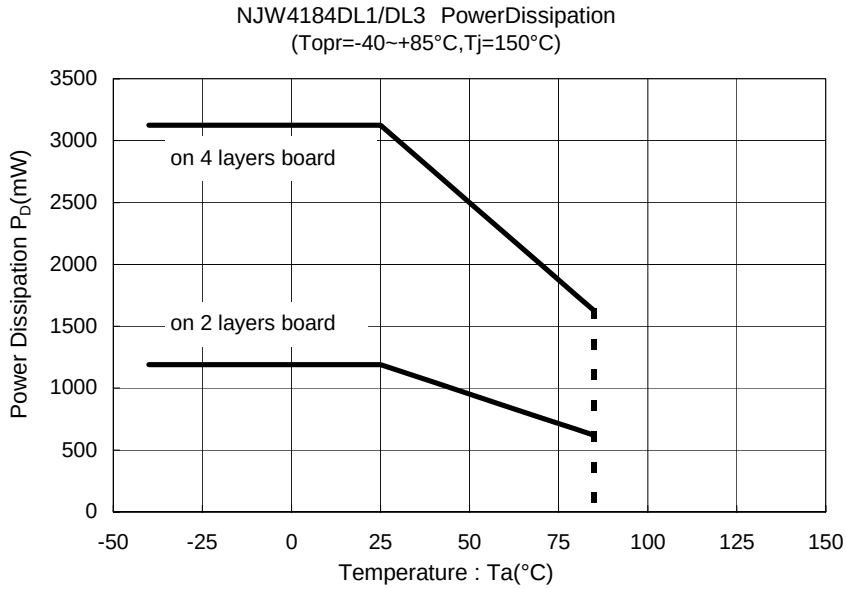
(*5): The output voltage excludes under 3.8V.

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.

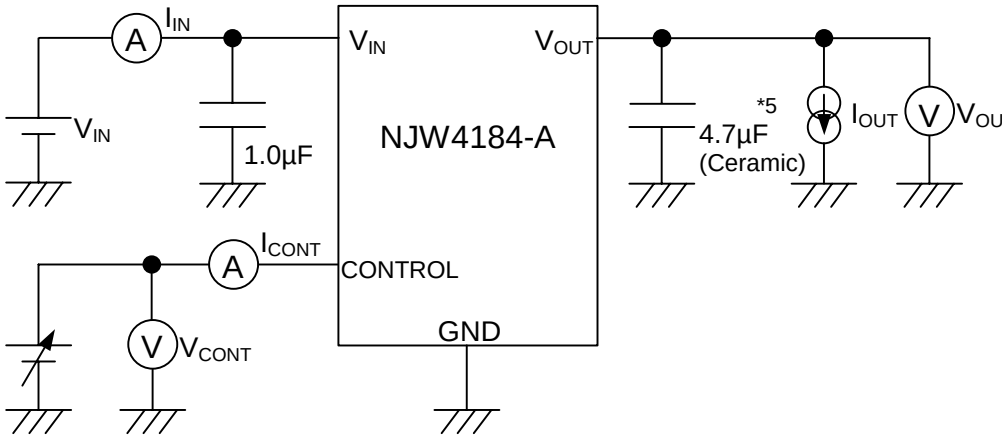
■ POWER DISSIPATION vs. AMBIENT TEMPERATURE





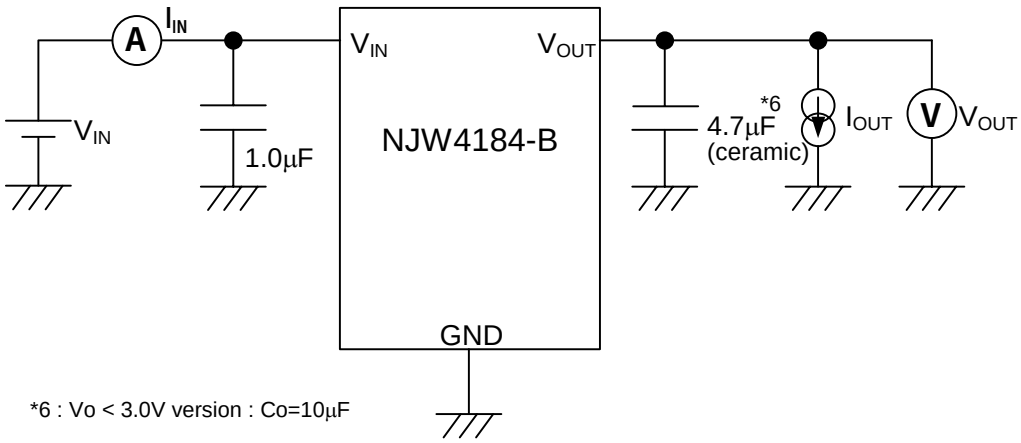
■ TEST CIRCUIT

・A version



*5 : Vo < 3.0V version : Co=10μF

・B version

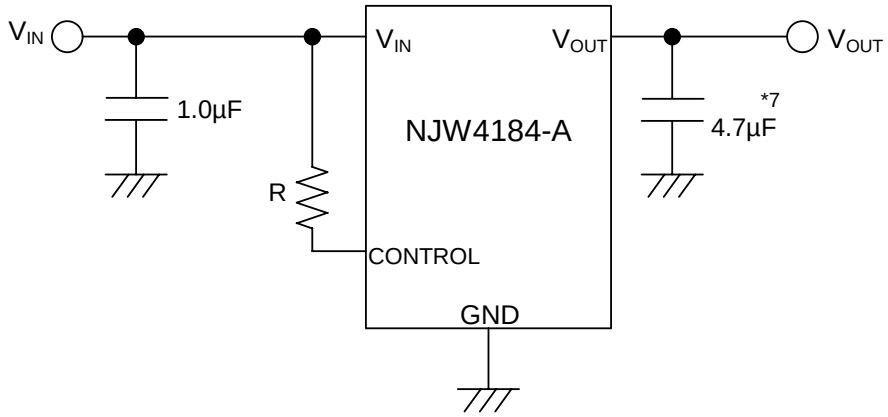


*6 : Vo < 3.0V version : Co=10μF

■ TYPICAL APPLICATION

・A version

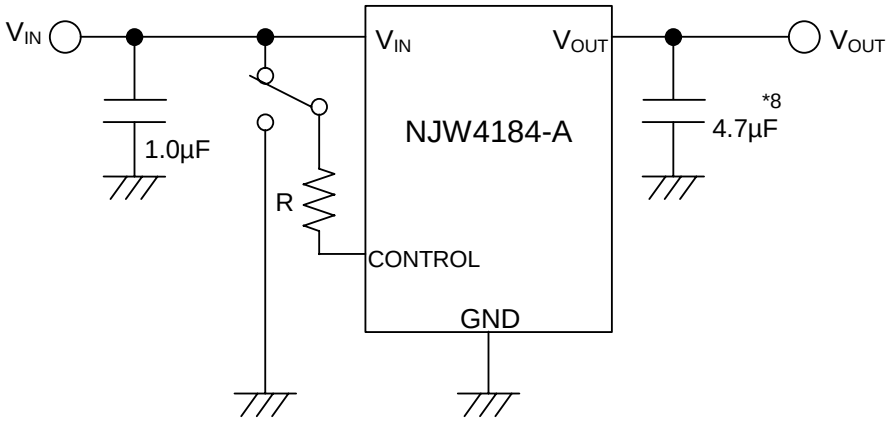
① In the case where ON/OFF Control is not required



*7 : Vo < 3.0V version : Co=10µF

Connect control terminal to V_{IN} terminal

② In use of ON/OFF CONTROL

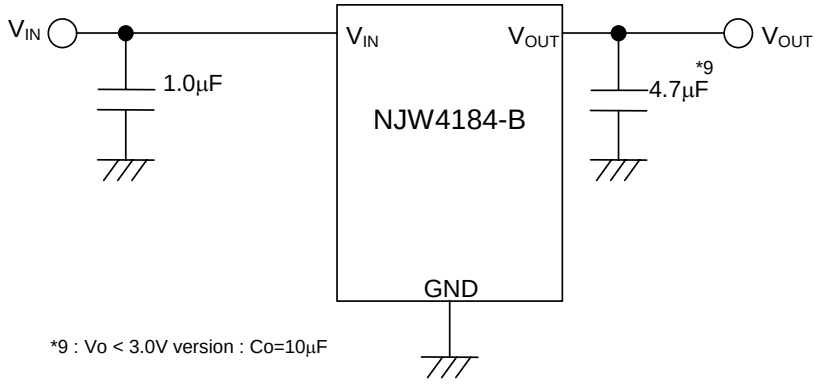


*8 : Vo < 3.0V version : Co=10µF

State of control terminal:

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

・B version



*9 : Vo < 3.0V version : Co=10µF

*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 terminal 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.

*The notes of the evaluation when output terminal is shorted to GND

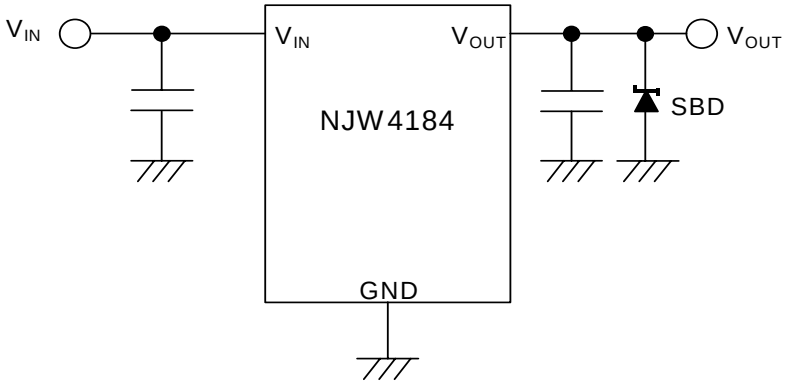
When evaluated short circuit test, the IC may break down because of regenerated energy by the parasitic inductance included in wiring pattern.

It phenomenon appears conspicuously when output voltage is high(Vo=8.0V or more)or connected to inductive load.

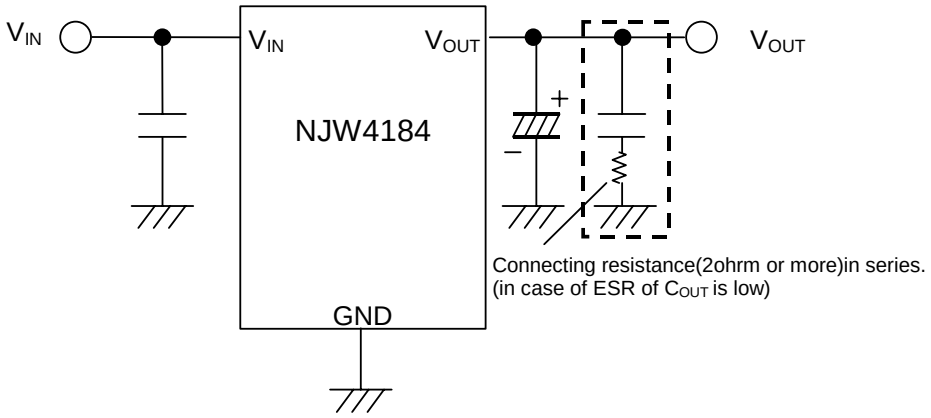
In case of short circuit in actual application, not likely to destruction of IC because of some of Resistance exist between load.

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

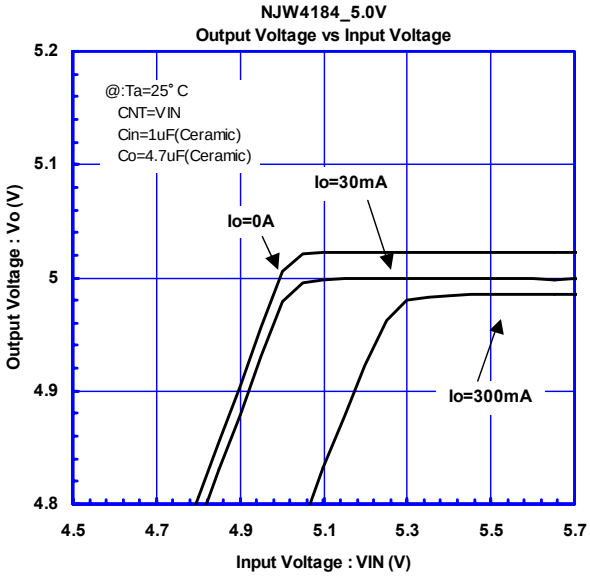
(a)In case of insert Schottky barrier diode between output terminal - GND

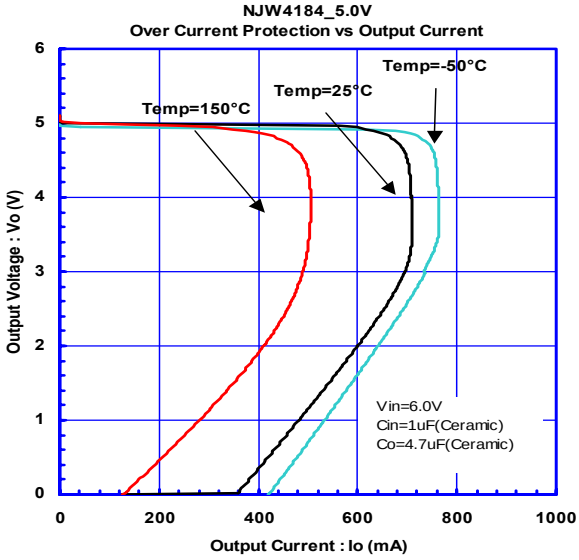


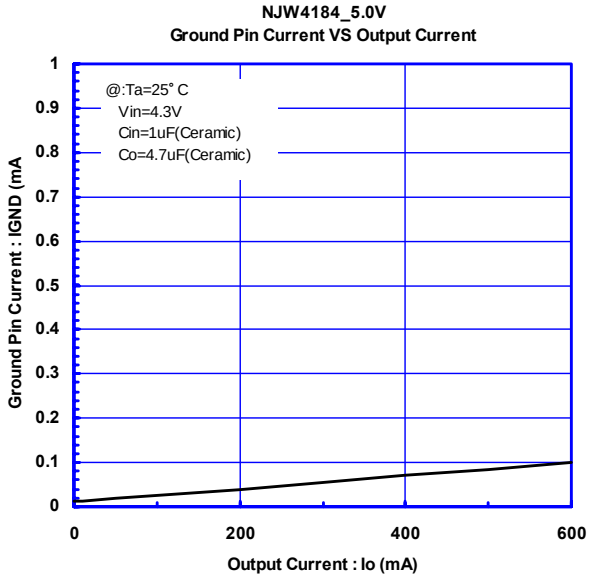
(b) In case of using the electrolysis condenser or insert series resistance

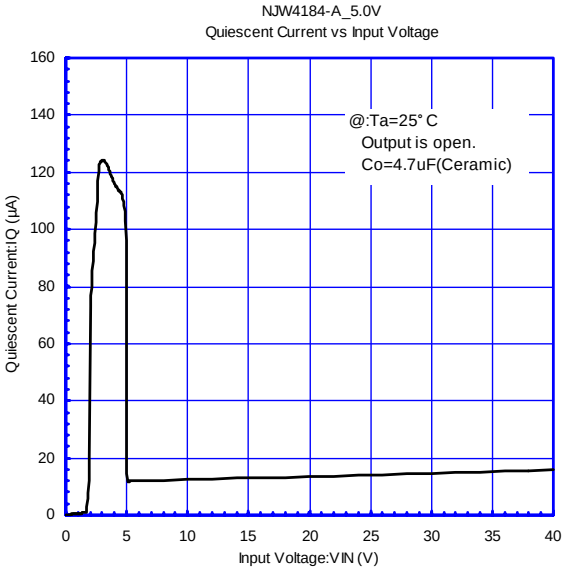


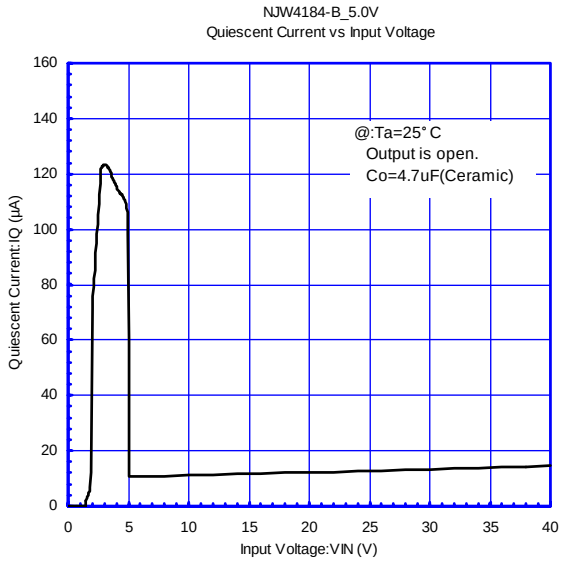
■ TYPICAL CHARACTERISTICS

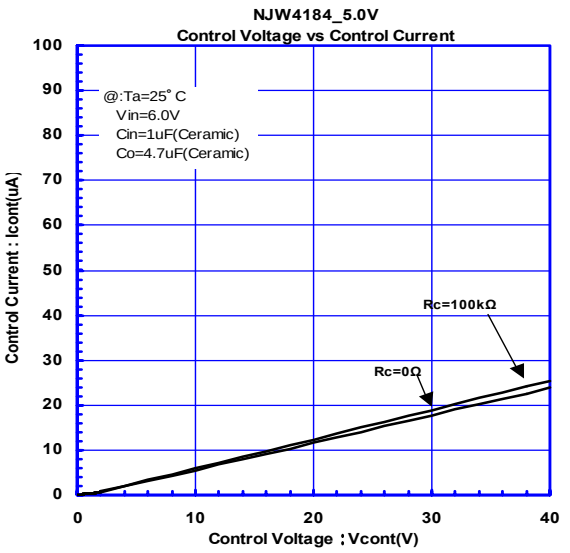


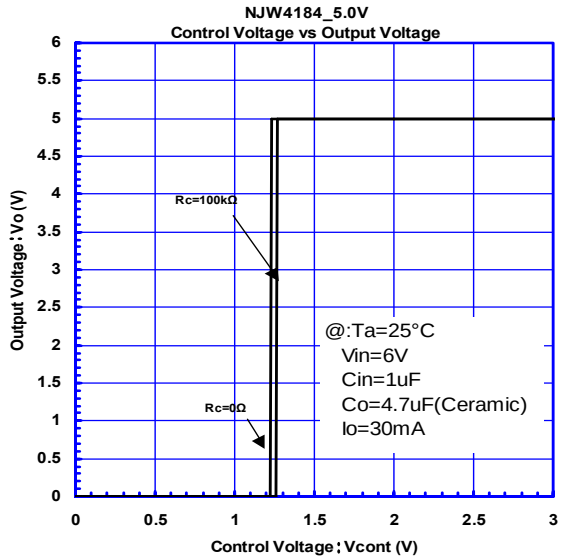


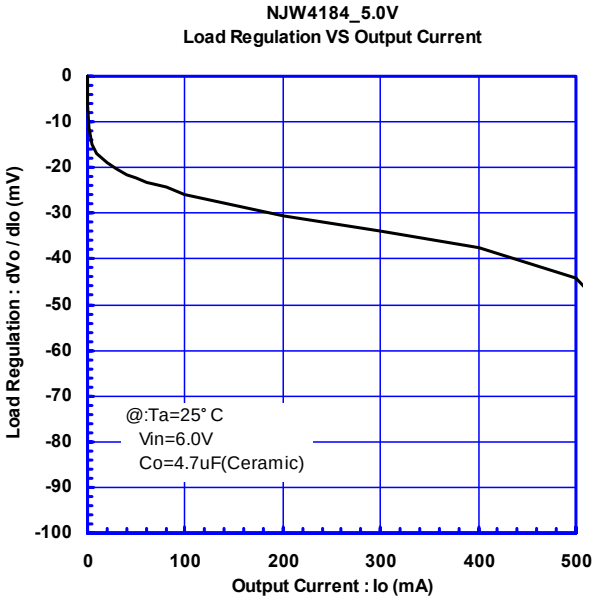


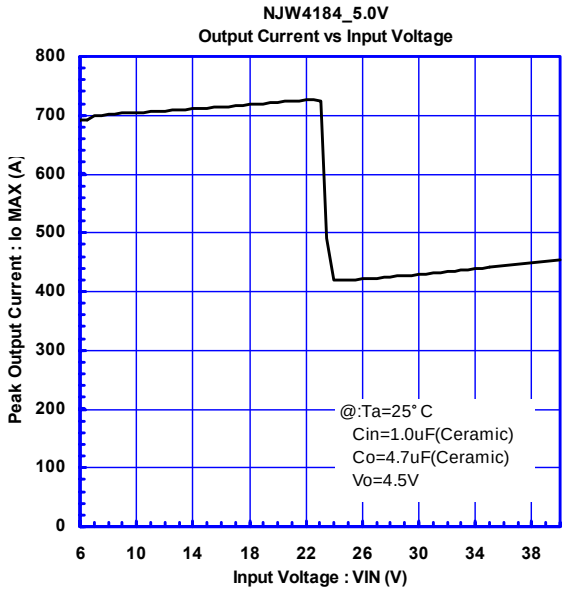


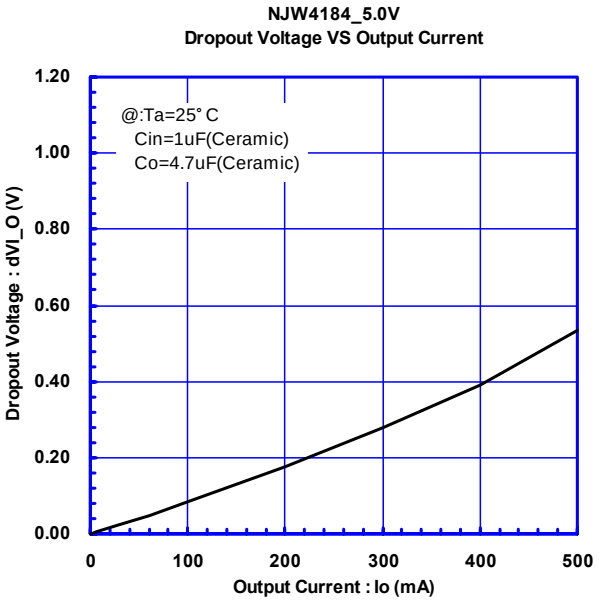


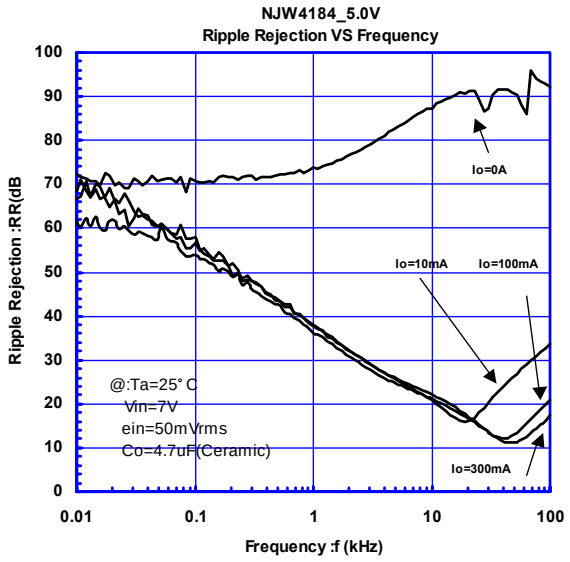


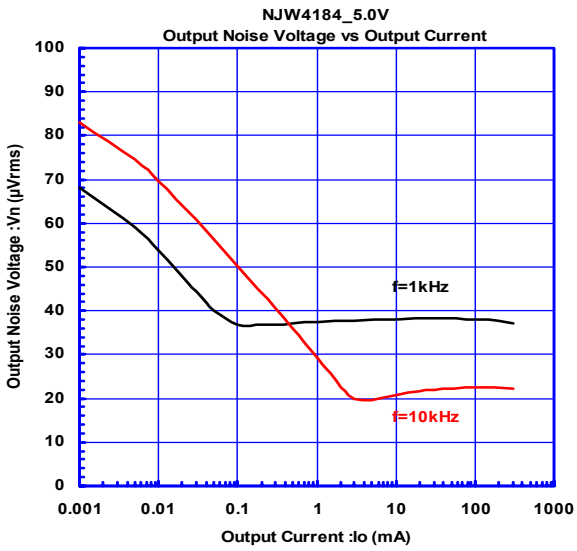

NJW4184_5.0V
Control Voltage vs Output Voltage
Output Voltage : Vo (V)
Control Voltage : Vcont (V)
Rc=100kΩ
Rc=0Ω
@:Ta=25°C
Vin=6V
Cin=1uF
Co=4.7uF(Ceramic)
Io=30mA

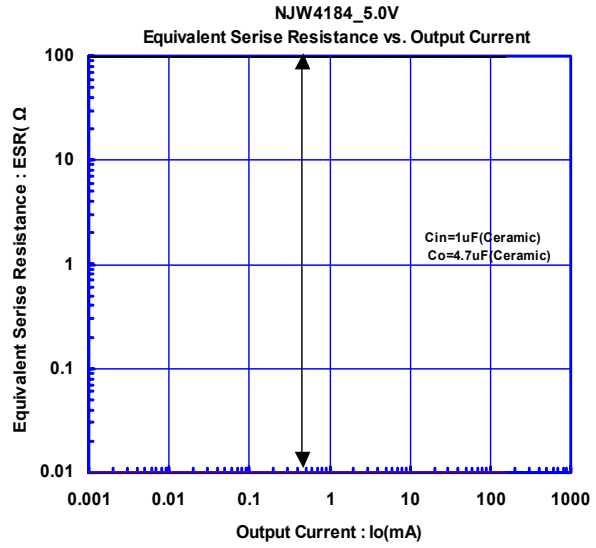

NJW4184_5.0V
Load Regulation VS Output Current
Load Regulation : dVo / dIo (mV)
Output Current : Io (mA)
@:Ta=25° C
Vin=6.0V
Co=4.7uF(Ceramic)

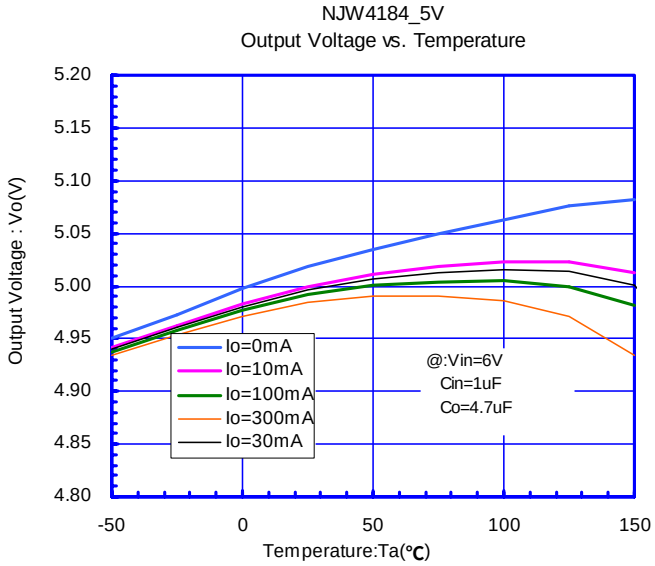

NJW4184_5.0V
Output Current vs Input Voltage
Peak Output Current : Io MAX (A)
Input Voltage : VIN (V)
@:Ta=25° C
Cin=1.0uF(Ceramic)
Co=4.7uF(Ceramic)
Vo=4.5V

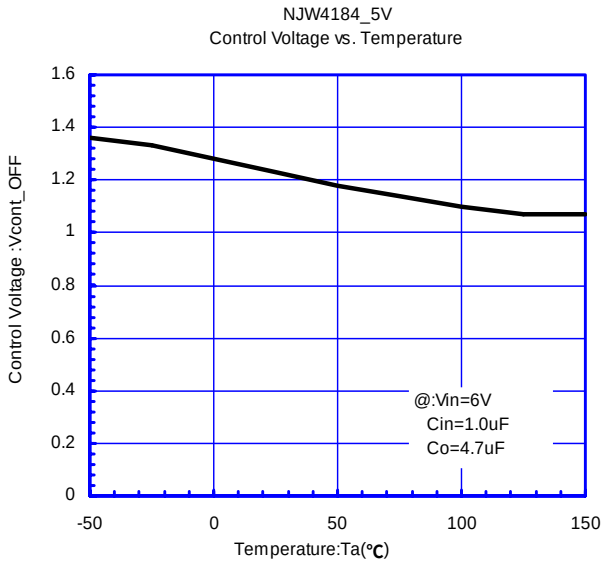

NJW4184_5.0V
Dropout Voltage VS Output Current
Dropout Voltage : dVI_O (V)
Output Current : Io (mA)
@:Ta=25° C
Cin=1uF(Ceramic)
Co=4.7uF(Ceramic)

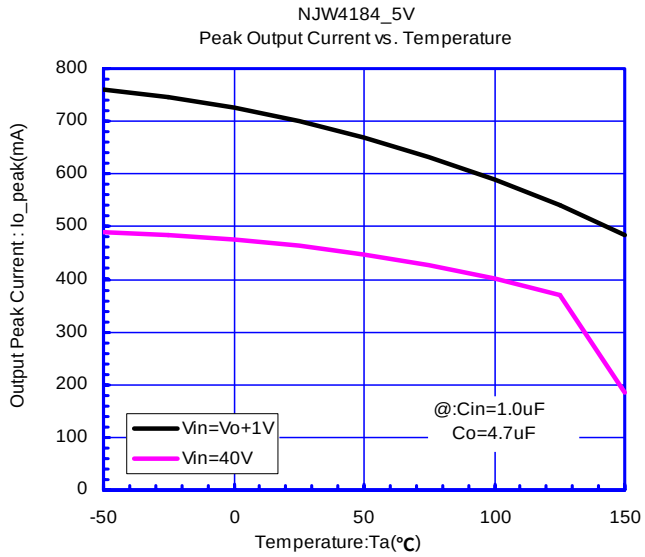

NJW4184_5.0V
Ripple Rejection VS Frequency
Ripple Rejection :RR(dB
Frequency :f (kHz)
Io=0A
Io=10mA
Io=100mA
Io=300mA
@:Ta=25° C
Vin=7V
ein=50mVrms
Co=4.7uF(Ceramic)

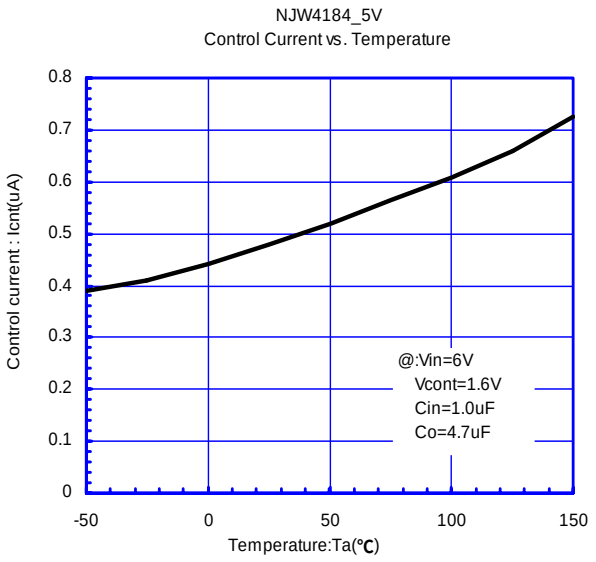

NJW4184_5.0V
Output Noise Voltage vs Output Current
Output Noise Voltage :Vn (μVrms)
Output Current :Io (mA)
f=1kHz
f=10kHz

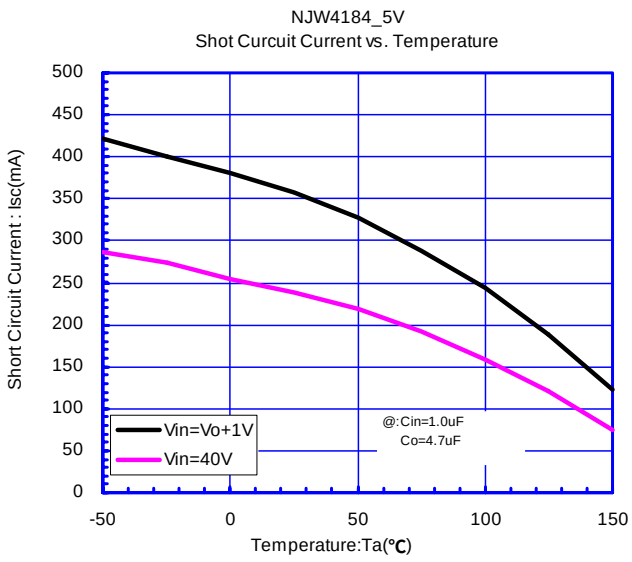

NJW4184_5.0V
Equivalent Serise Resistance vs. Output Current
Equivalent Serise Resistance : ESR(Ω
100
10
1
0.1
0.01
0.001
0.01
0.1
1
10
100
1000
Output Current : Io(mA)
Cin=1uF(Ceramic)
Co=4.7uF(Ceramic)


NJW4184_5V
Output Voltage vs. Temperature
Output Voltage : Vo(V)
5.20
5.15
5.10
5.05
5.00
4.95
4.90
4.85
4.80
-50
0
50
100
150
Temperature:Ta(℃)
Io=0mA
Io=10mA
Io=100mA
Io=300mA
Io=30mA
@:Vin=6V
Cin=1uF
Co=4.7uF

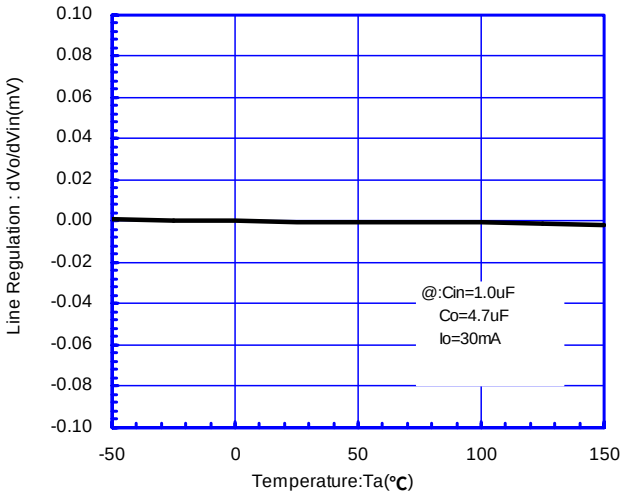

NJW4184_5V
Control Voltage vs. Temperature
Control Voltage :Vcont_OFF
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
-50
0
50
100
150
Temperature:Ta(℃)
@:Vin=6V
Cin=1.0uF
Co=4.7uF


NJW4184_5V
Peak Output Current vs. Temperature
Output Peak Current : Io_peak(mA)
800
700
600
500
400
300
200
100
0
-50
0
50
100
150
Temperature:Ta(℃)
Vin=Vo+1V
Vin=40V
@:Cin=1.0uF
Co=4.7uF

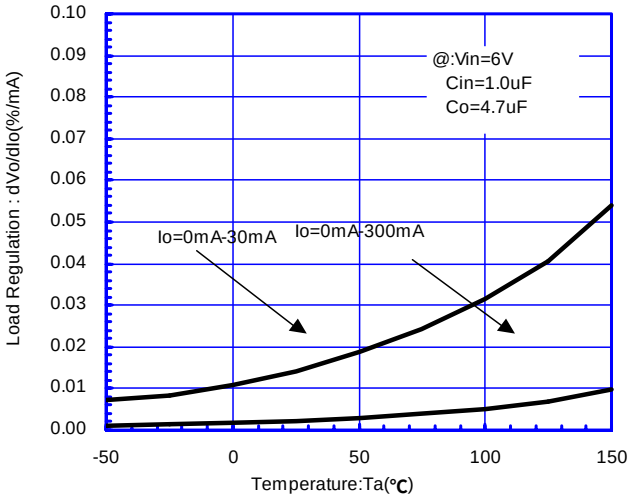

NJW4184_5V
Control Current vs. Temperature
Control current : Icnt(uA)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
-50
0
50
100
150
Temperature:Ta(℃)
@:Vin=6V
Vcont=1.6V
Cin=1.0uF
Co=4.7uF


NJW4184_5V
Shot Curcuit Current vs. Temperature
Short Circuit Current : Isc(mA)
500
450
400
350
300
250
200
150
100
50
0
-50
0
50
100
150
Temperature:Ta(℃)
Vin=Vo+1V
Vin=40V
@:Cin=1.0uF
Co=4.7uF

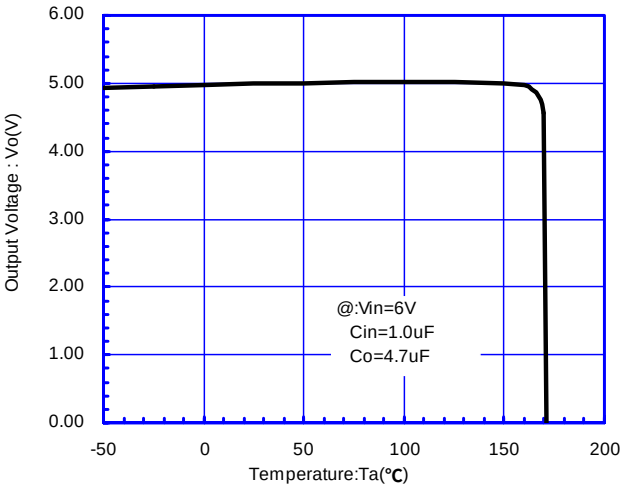
NJW4184_5V
Line Regulation vs. Temperature



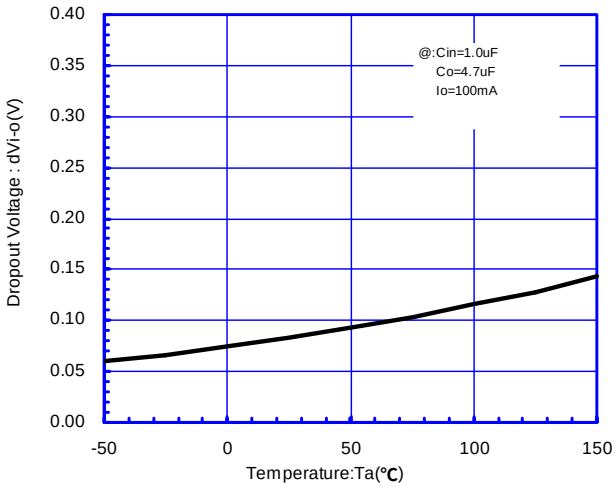
NJW4184_5V
Load Regulation vs. Temperature



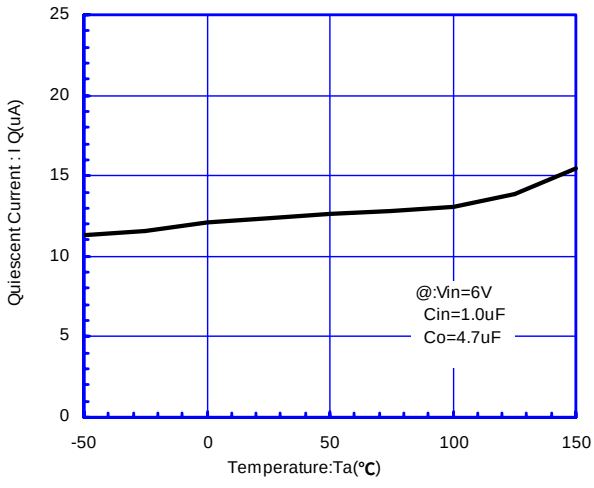
NJW4184_5V
Output Voltage vs. Temperature



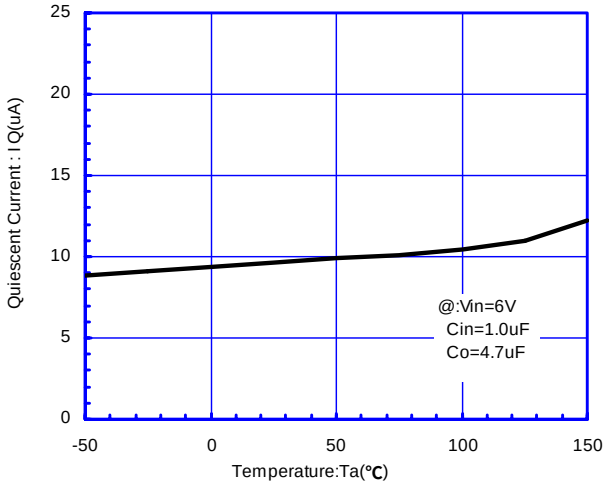
NJW4184_5V
Dropout Voltage vs. Temperature



NJW4184-A_5.0V
Quiescent Current vs. Temperature



NJW4184-B_5.0V
Quiescent Current vs. Temperature



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