LOW DROPOUT VOLTAGE REGULATOR

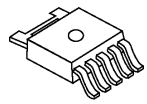
■ GENERAL DESCRIPTION

The NJM2857 is a low dropout voltage regulator.
This product has Reverse Current Protection without external SBD

Advanced Bipolar technology achieves low noise, high ripple rejection and high supply voltage.

1.5A output current capacity, 4.7µF small decoupling capacitor, built-in noise bypass capacitor make the NJM2857 suitable for various applications.

■ PACKAGE OUTLINE

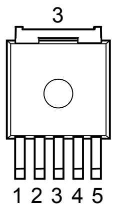


NJM2857DL3

■ FEATURES

- High Ripple Rejection 80dB typ. (f=1kHz, Vo=3V Version)
- Output Noise Voltage Vno=55µVrms typ. (Vo=3V Version)
- Output capacitor with ceramic capacitor
- Output Current Io(max.)=1.5A
- High Precision Output Vo ±1.0%
- Low Dropout Voltage 0.20V typ. (Io=1A)
- ON/OFF Control
- Internal Reverse Current Protection
- Internal Thermal Overload Protection
- Internal Over Current Protection
- Bipolar Technology
- Package Outline TO-252-5

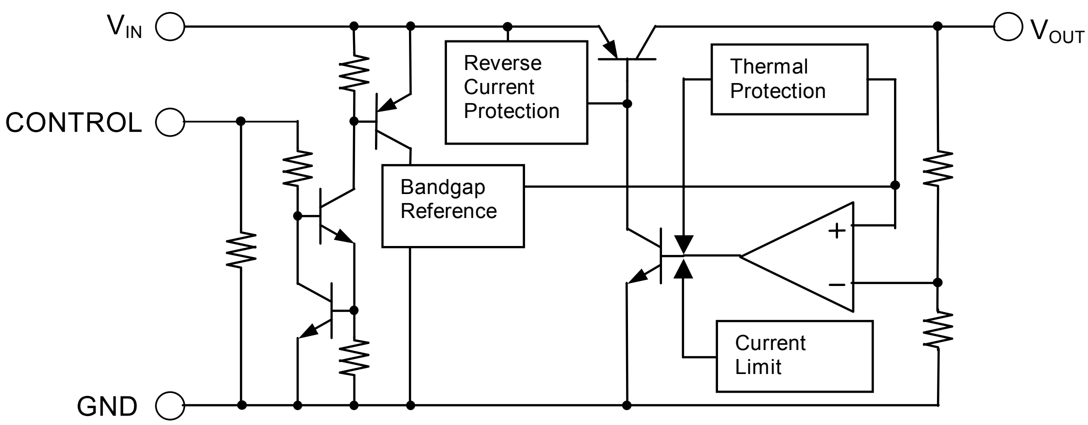
■ PIN CONFIGURATION



1.CONTROL
2.V_{IN}
3.GND
4.V_{OUT}
5.NC

NJM2857DL3

■ BLOCK DIAGRAM



■ OUTPUT VOLTAGE

Device Name	V_{OUT}
NJM2857DL3-15	1.5V
NJM2857DL3-25	2.5V
NJM2857DL3-03	3.0V
NJM2857DL3-33	3.3V
NJM2857DL3-05	5.0V

Output voltage options available : 1.5 ~ 5.0V (0.1V step)

■ ABSOLUTE MAXIMUM RATINGS (Ta=25°C)

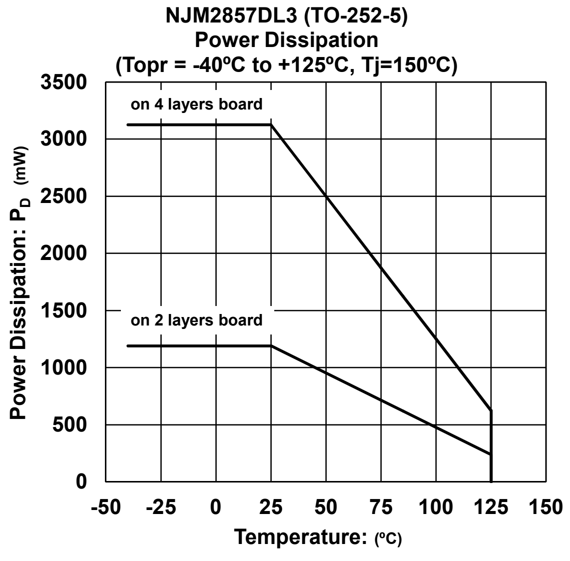
PARAMETER	SYMBOL	RATINGS	UNIT
Input Voltage	V_{IN}	+10	V
Control Voltage	V_{CONT}	+10	V
Output Terminal Voltage	$V_{o.max}$	Vo+1	V
Power Dissipation	P_D	1190(*1) 3125(*2)	mW
Operating Temperature	Topr	-40 ~ +125	°C
Storage Temperature	Tstg	-40 ~ +150	°C

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

■ Operating voltage

V_{IN}=+2.6V(In case of Vo<2.4V) ~ +8.0V

■ POWER DISSIPATION vs. AMBIENT TEMPERATURE



■ ELECTRICAL CHARACTERISTICS

(V_{IN}=Vo+1V(Vo<1.6V: V_{IN}=2.6V), C_{IN}=1.0µF, Co=4.7µF(1.7V<Vo≤2.4V: Co=10µF, Vo≤1.7V: Co=22uF), Ta=25°C)

PARAMETER	SYMBOL	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage	Vo	Io=30mA		-1.0%	-	+1.0%	V
Input Voltage	V_{IN}			-	-	8	V
Quiescent Current	I_Q	Io=0mA		-	500	750	µA
Quiescent Current at Control OFF	$I_{Q(OFF)}$	V_{CONT}=0V		-	-	100	nA
Output Current	Io	Vo×0.9V		1500	2000	-	mA
Line Regulation	$\Delta Vo/\Delta V_{IN}$	V_{IN}=Vo+1V ~ Vo+6V (Vo≤2V), V_{IN}=Vo+1V ~ +8V(Vo>2V), Io=30mA		-	-	0.10	%/V
Load Regulation	$\Delta Vo/\Delta Io$	Io=0 ~ 1500mA		-	-	0.003	%/mA
Dropout Voltage(*3)	ΔV_{I-O}	Io=1000mA		-	0.20	0.30	V
Ripple Rejection(*4)	RR	ein=200mVrms, f=1kHz, Io=10mA	Vo=1.5V	-	86	-	dB
			Vo=2.5V	-	82	-	
			Vo=3.0V	-	80	-	
			Vo=3.3V	-	79	-	
			Vo=5.0V	-	78	-	
Average Temperature Coefficient of Output Voltage	$\Delta Vo/\Delta Ta$	Ta=0 ~ 85°C, Io=10mA		-	±50	-	ppm/°C
Output Noise Voltage	V_{NO}	f=10Hz ~ 80kHz, Io=10mA,	Vo=1.5V	-	26	-	µVrms
			Vo=2.5V	-	41	-	
			Vo=3.0V	-	47	-	
			Vo=3.3V	-	51	-	
			Vo=5.0V	-	69	-	
Control Current	I_{CONT}	V_{CONT}=1.6V		-	3	12	µA
Control Voltage for ON-state	$V_{CONT(ON)}$			1.6	-	-	V
Control Voltage for OFF-state	$V_{CONT(OFF)}$			-	-	0.6	V

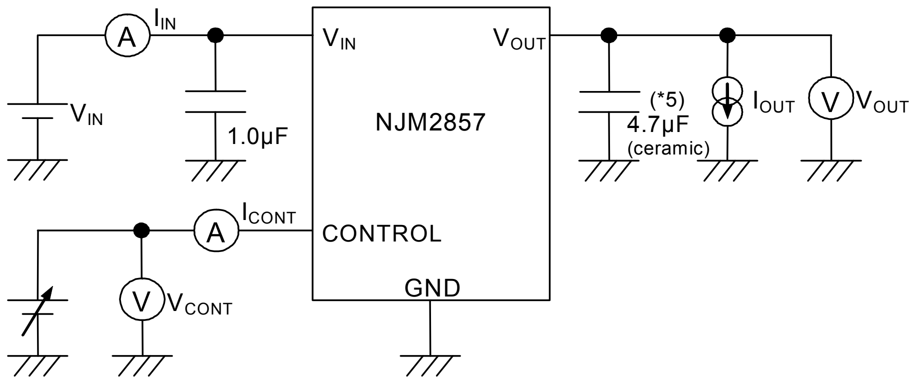
(*3): The output voltage excludes under 2.4V

(*4): Vo>2.0V:V_{IN}=Vo+1V, Vo≤2.0V:V_{IN}=3.0V

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.

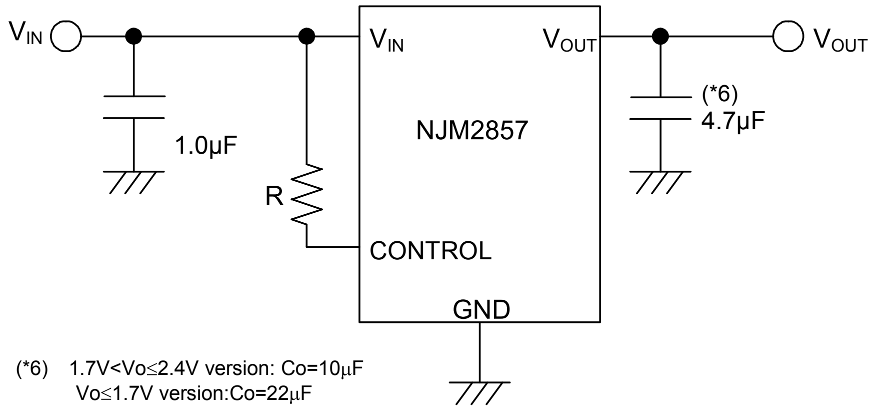
■ TEST CIRCUIT



(*5) 1.7V<Vo≤2.4V version:Co=10µF (ceramic)
Vo≤1.7V version:Co=22µF (ceramic)

■ TYPICAL APPLICATIONS

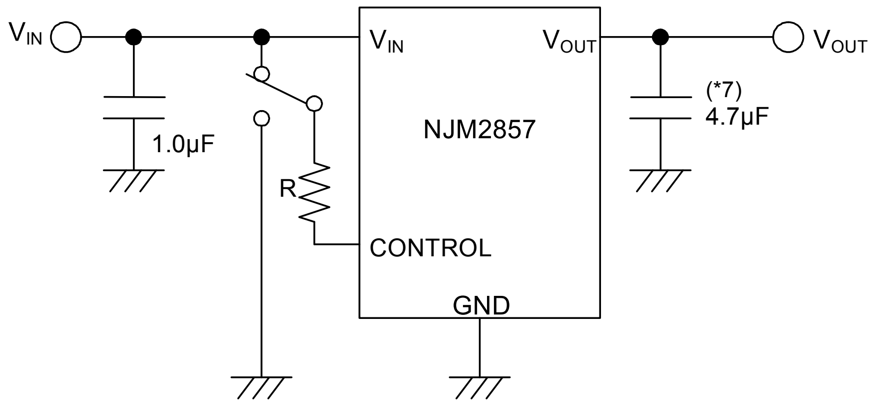
① In the case where ON/OFF Control is not required:



(*6) 1.7V<Vo≤2.4V version: Co=10µF
Vo≤1.7V version:Co=22µF

Connect CONTROL pin to V_{IN} pin.

② In use of ON/OFF CONTROL:



(*7) 1.7V<Vo≤2.4V version: Co=10µF
Vo≤1.7V version:Co=22µF

State of CONTROL pin: “H”→ output is enabled. “L” or “open” → output is disabled.

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

If this resistor is inserted, the control current could be reduced 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 resistor "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.

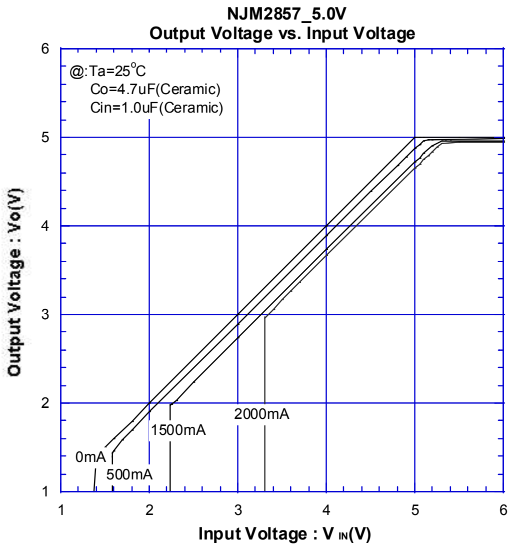
When selecting $C_{O,}$ recommend that have withstand voltage margin against output voltage and superior temperature characteristic though this product is designed stability works with wide range ESR of capacitor including low ESR products.

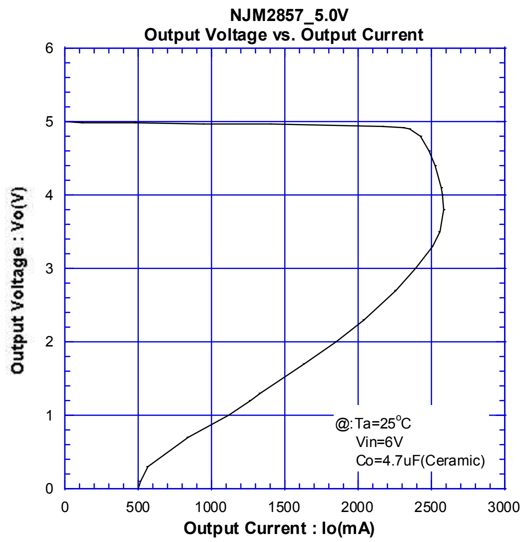
*Reverse Current Protection

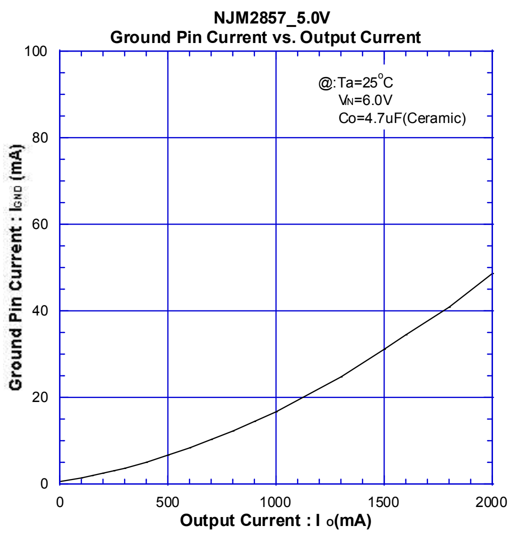
NJM2857 is built in Reverse Current Protection circuit.

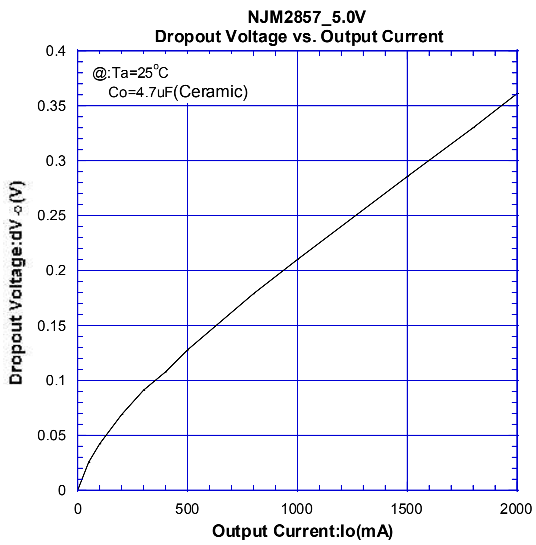
So external Schottky barrier diode(SBD) is not required that this circuit prevents the large reverse current due to the output voltage being higher than the input voltage.

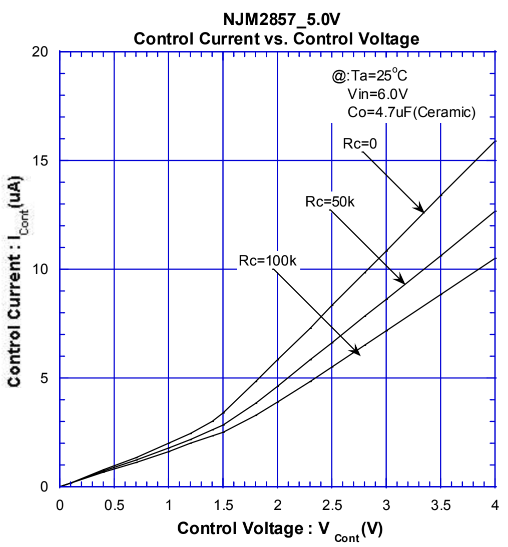
■ TYPICAL CHARACTERISTICS

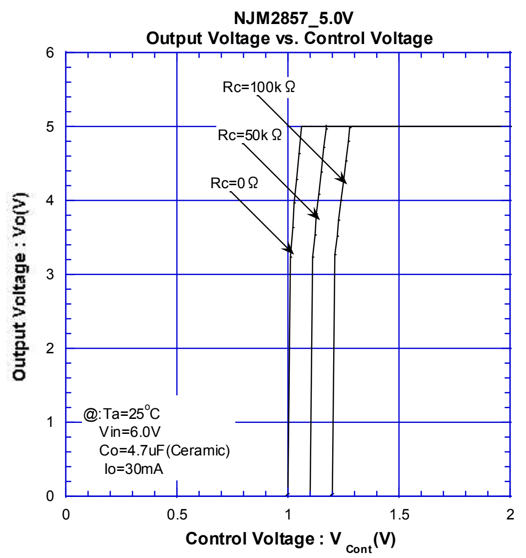


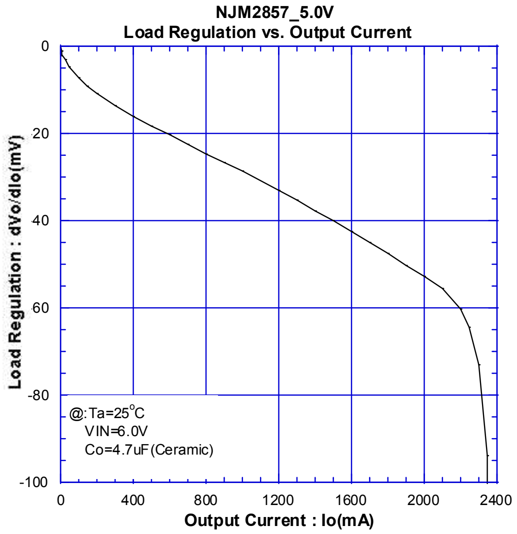


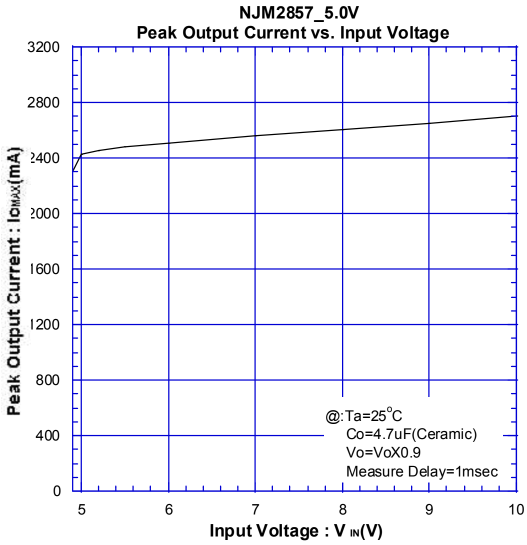


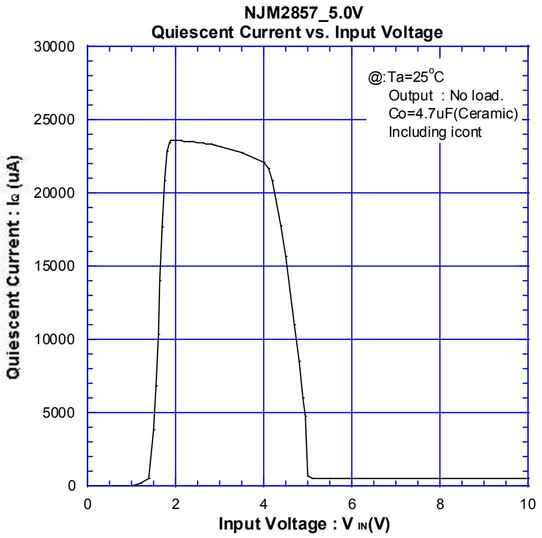


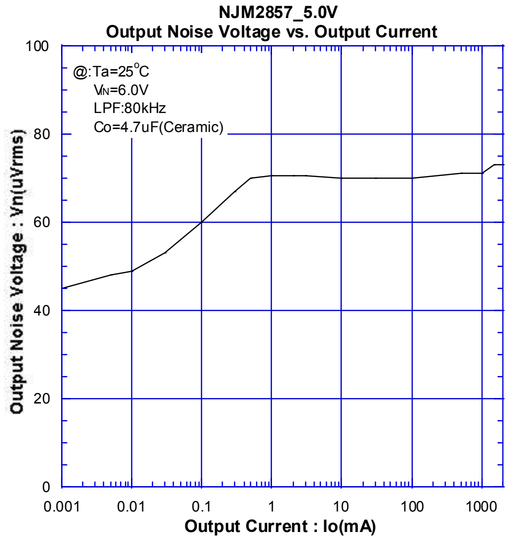


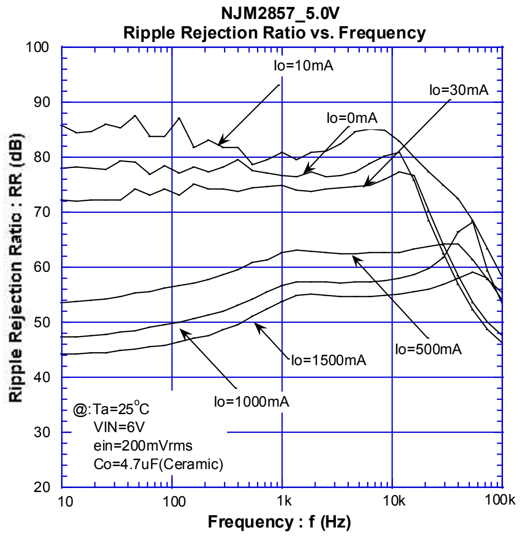


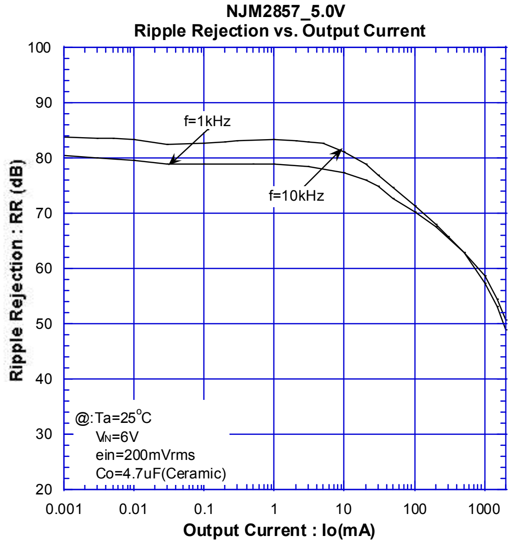

NJM2857_5.0V
Load Regulation vs. Output Current
Load Regulation : dVo/dIo(mV)
Output Current : Io(mA)
@:Ta=25°C
VIN=6.0V
Co=4.7uF(Ceramic)

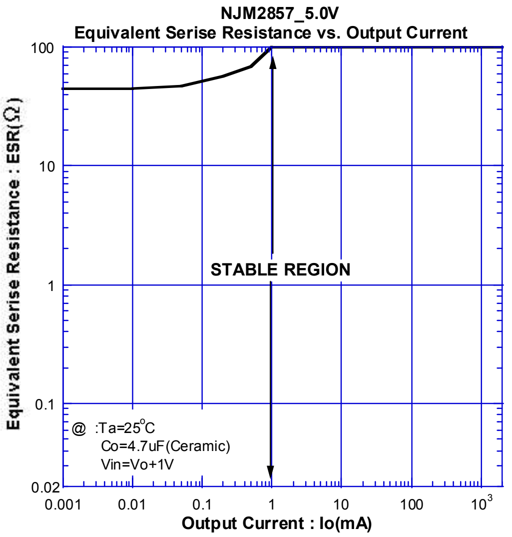

NJM2857_5.0V
Peak Output Current vs. Input Voltage
Peak Output Current : IoMAX(mA)
Input Voltage : VIN(V)
@:Ta=25°C
Co=4.7uF(Ceramic)
Vo=VoX0.9
Measure Delay=1msec

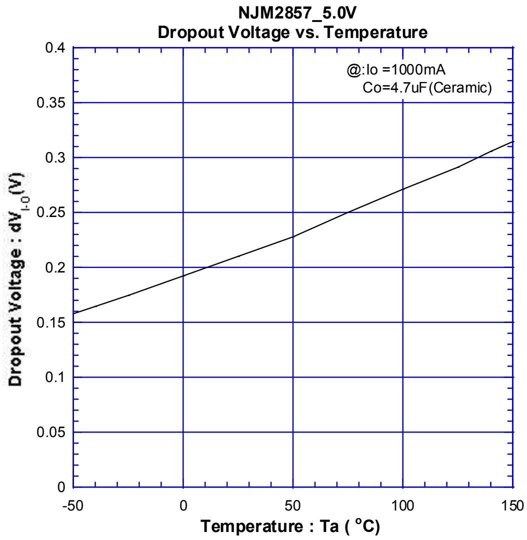

NJM2857_5.0V
Quiescent Current vs. Input Voltage
Quiescent Current : IQ (uA)
Input Voltage : VIN(V)
@:Ta=25°C
Output : No load.
Co=4.7uF(Ceramic)
Including icont

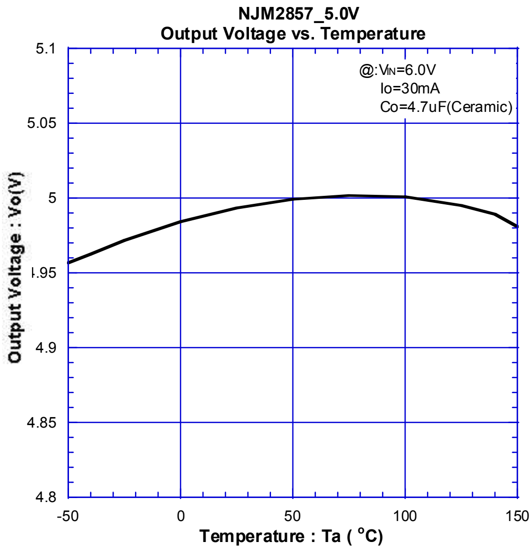

NJM2857_5.0V
Output Noise Voltage vs. Output Current
Output Noise Voltage : Vn(uVrms)
Output Current : Io(mA)
@:Ta=25°C
VIN=6.0V
LPF:80kHz
Co=4.7uF(Ceramic)

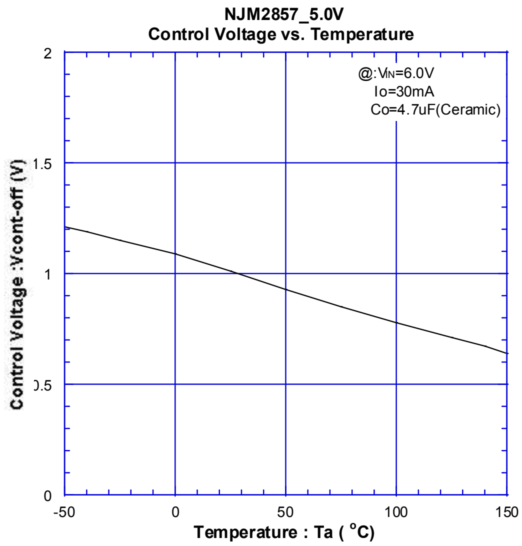

NJM2857_5.0V
Ripple Rejection Ratio vs. Frequency
Ripple Rejection Ratio : RR (dB)
Frequency : f (Hz)
Io=10mA
Io=30mA
Io=0mA
Io=500mA
Io=1500mA
Io=1000mA
@:Ta=25°C
VIN=6V
ein=200mVrms
Co=4.7uF(Ceramic)

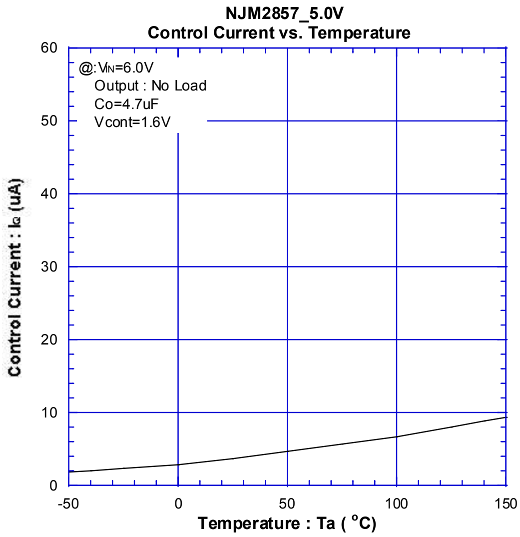

NJM2857_5.0V
Ripple Rejection vs. Output Current
Ripple Rejection : RR (dB)
Output Current : Io(mA)
f=1kHz
f=10kHz
@:Ta=25°C
VIN=6V
ein=200mVrms
Co=4.7uF(Ceramic)

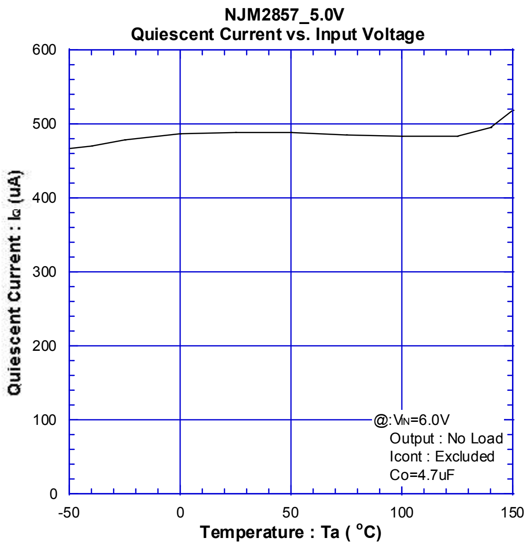

NJM2857_5.0V
Equivalent Serise Resistance vs. Output Current
Equivalent Serise Resistance : ESR(Ω)
Output Current : Io(mA)
STABLE REGION
@ :Ta=25°C
Co=4.7uF(Ceramic)
Vin=Vo+1V

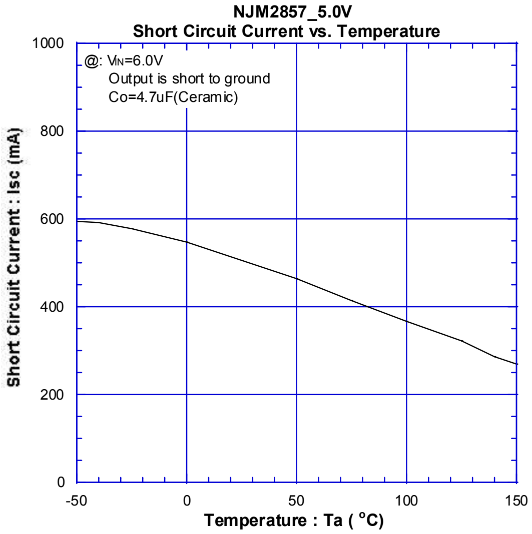

NJM2857_5.0V
Dropout Voltage vs. Temperature
@:Io =1000mA
Co=4.7uF(Ceramic)
Dropout Voltage : dVI-O (V)
Temperature : Ta (°C)

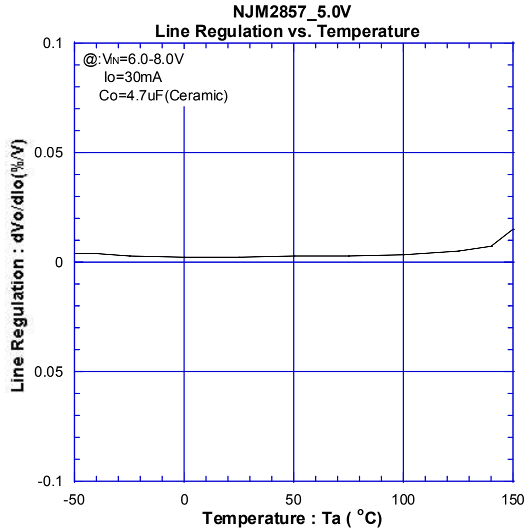

NJM2857_5.0V
Output Voltage vs. Temperature
@:VIN=6.0V
Io=30mA
Co=4.7uF(Ceramic)
Output Voltage : Vo(V)
Temperature : Ta (°C)

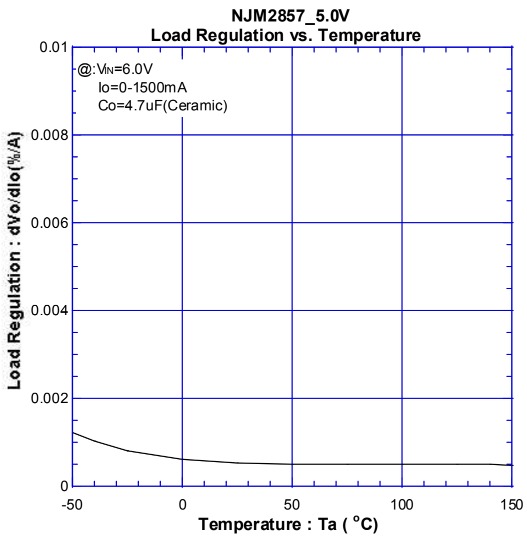

NJM2857_5.0V
Control Voltage vs. Temperature
@:VIN=6.0V
Io=30mA
Co=4.7uF(Ceramic)
Control Voltage :Vcont-off (V)
Temperature : Ta (°C)

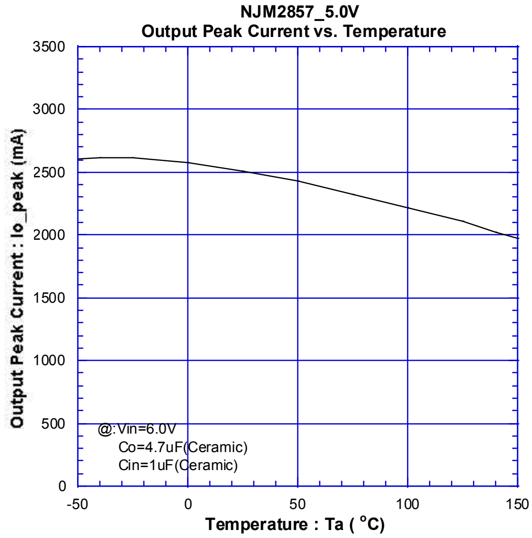

NJM2857_5.0V
Control Current vs. Temperature
@:VIN=6.0V
Output : No Load
Co=4.7uF
Vcont=1.6V
Control Current : IQ (uA)
Temperature : Ta (°C)

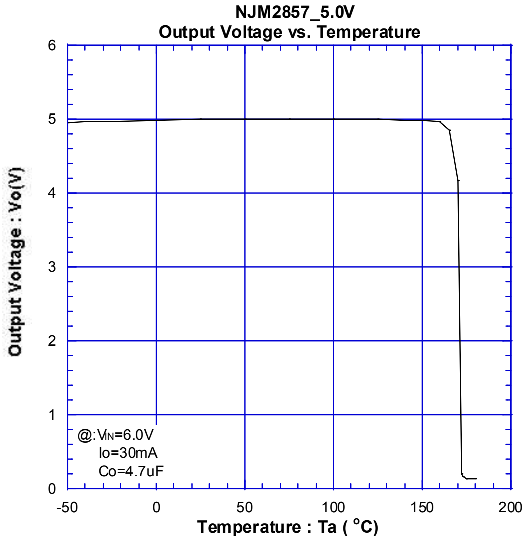

NJM2857_5.0V
Quiescent Current vs. Input Voltage
@:VIN=6.0V
Output : No Load
Icont : Excluded
Co=4.7uF
Quiescent Current : IQ (uA)
Temperature : Ta (°C)

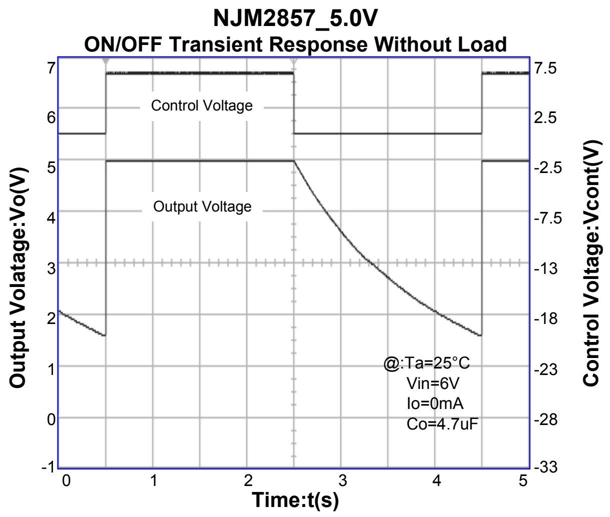

NJM2857_5.0V
Short Circuit Current vs. Temperature
@: VIN=6.0V
Output is short to ground
Co=4.7uF(Ceramic)
Short Circuit Current : Isc (mA)
Temperature : Ta (°C)
1000
800
600
400
200
0
-50
0
50
100
150

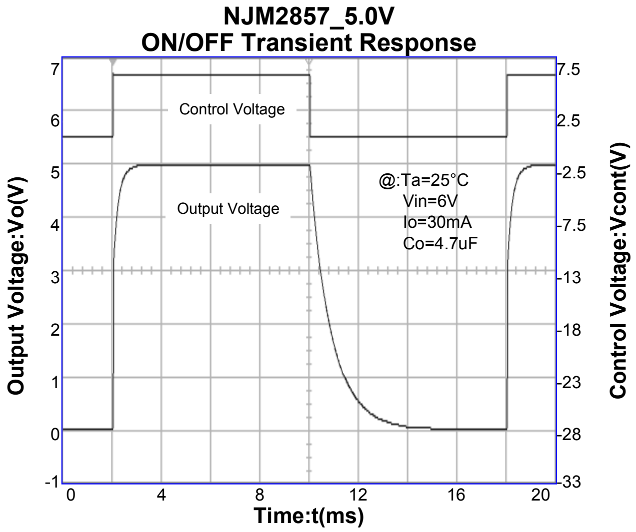

NJM2857_5.0V
Line Regulation vs. Temperature
@:VIN=6.0-8.0V
Io=30mA
Co=4.7uF(Ceramic)
Line Regulation : dVo/dIo(%/V)
Temperature : Ta (°C)
0.1
0.05
0
0.05
-0.1
-50
0
50
100
150

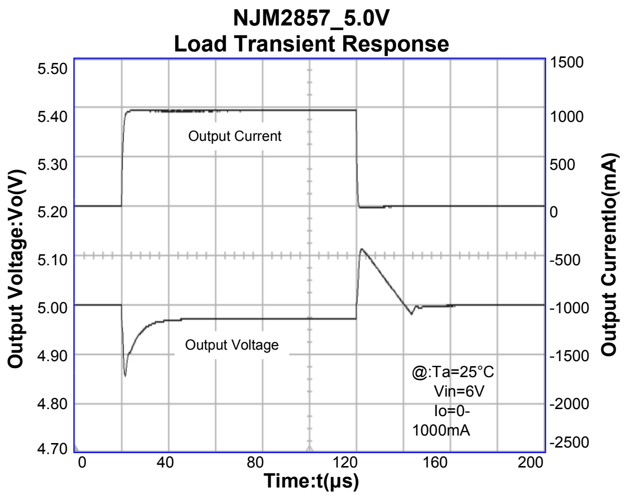

NJM2857_5.0V
Load Regulation vs. Temperature
@:VIN=6.0V
Io=0-1500mA
Co=4.7uF(Ceramic)
Load Regulation : dVo/dIo(%/A)
Temperature : Ta (°C)
0.01
0.008
0.006
0.004
0.002
0
-50
0
50
100
150

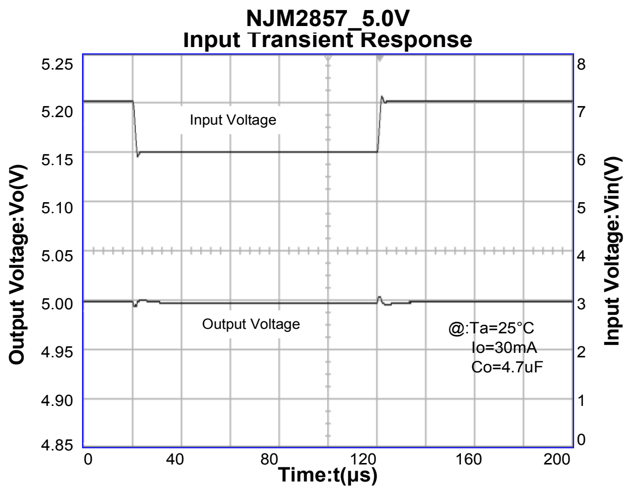

NJM2857_5.0V
Output Peak Current vs. Temperature
@:Vin=6.0V
Co=4.7uF(Ceramic)
Cin=1uF(Ceramic)
Output Peak Current : Io_peak (mA)
Temperature : Ta (°C)
3500
3000
2500
2000
1500
1000
500
0
-50
0
50
100
150


NJM2857_5.0V
Output Voltage vs. Temperature
@:VIN=6.0V
Io=30mA
Co=4.7uF
Output Voltage : Vo(V)
Temperature : Ta (°C)
6
5
4
3
2
1
0
-50
0
50
100
150
200


NJM2857_5.0V
ON/OFF Transient Response Without Load
Control Voltage
Output Voltage
@:Ta=25°C
Vin=6V
Io=0mA
Co=4.7uF
Output Volatage:Vo(V)
Control Voltage:Vcont(V)
Time:t(s)


NJM2857_5.0V
ON/OFF Transient Response
Control Voltage
Output Voltage
@:Ta=25°C
Vin=6V
Io=30mA
Co=4.7uF
Output Voltage:Vo(V)
Control Voltage:Vcont(V)
Time:t(ms)


NJM2857_5.0V
Load Transient Response
Output Current
Output Voltage
@:Ta=25°C
Vin=6V
Io=0-
1000mA
Output Voltage:Vo(V)
Output CurrentIo(mA)
Time:t(μs)


NJM2857_5.0V
Input Transient Response
Input Voltage
Output Voltage
@:Ta=25°C
Io=30mA
Co=4.7uF
Output Voltage:Vo(V)
Input Voltage:Vin(V)
Time:t(μs)