Low Output Voltage Low Dropout Regulator

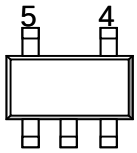
■ FEATURES

- Output Voltage Range 0.8V to 2.5V
- High Ripple Rejection 86 dB typ. (V_O=1.2V version)
- Output Noise Voltage V_{NO}=40μVrms(V_O=1.2V version)
- Output Current I_O(min)=500mA
- High Precision Output V_O±1.0% @Ta=25°C
  V_O±2.5% @Ta= -40°C to +125°C
- Dual Supply Voltage Type V_{IN}, V_{BIAS}(sequence free)
- Output Capacitor with 4.7μF ceramic capacitor
- Low Dropout Voltage 0.1V typ. @I_O=300mA
- ON/OFF Control
- Built-in Thermal Overload Protection and Over Current Protection
- Bipolar Technology
- Package Outline SOT-23-5
- AEC-Q100 "This product meets the reliability level required by AEC-Q100."

■ PACKAGE OUTLINE

NJM2841F

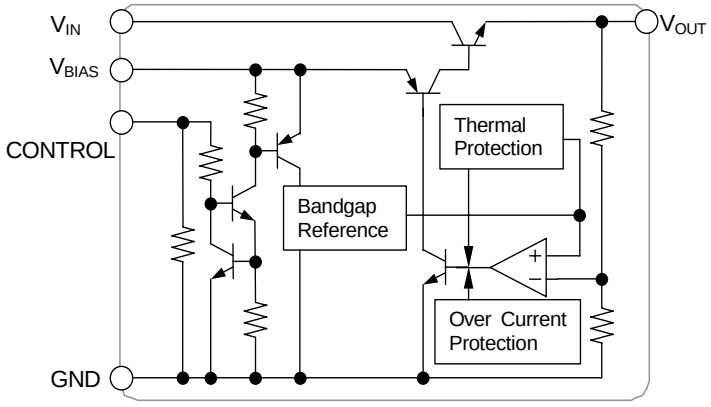
■ PIN CONNECTION



NJM2841F

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

■ BLOCK DIAGRAM



■ OUTPUT VOLTAGE RANK LIST

Device Name	V_{OUT}
NJM2841F012-T	1.2V

Output Voltage Range: 0.8V to 2.5V (0.1V step)

■ ABSOLUTE MAXIMUM RATINGS (Ta=25°C)

PARAMETER	SYNBOL	RATINGS		UNIT
Input Voltage	V_{IN}	+10		V
Bias Voltage	V_{BIAS}	+10		V
Control Voltage	V_{CONT}	+10		V
Power Dissipation	P_D	SOT-23-5	480(*1)	mW
			640(*2)	
Operating Temperature	Topr	-40 ~ +105		°C
Storage Temperature	Tstg	-50 ~ +150		°C

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

(*2): Mounted on glass epoxy board. (76.2 × 114.3 × 1.6mm:based on EIA/JDEC standard, 4Layers), internal Cu area: 74.2 × 74.2mm

■ BIAS VOLTAGE RANGE

V_{BIAS}= +2.5V to +10V (V_O<1.5V)

V_{BIAS}= V_O+1V to +10V (V_O≥1.5V)

■ ELECTRICAL CHARACTERISTICS

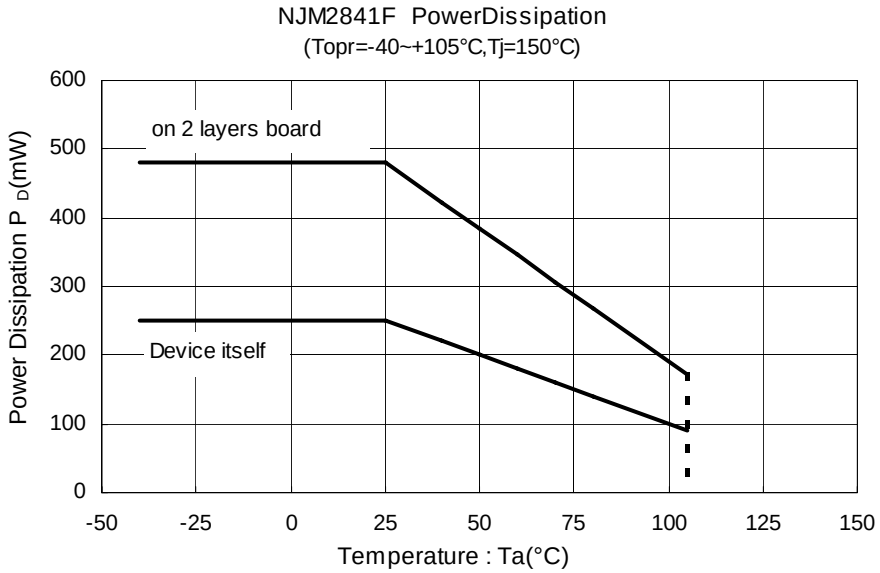
(V_{BIAS}=2.5V(Vo≥1.5V : V_{BIAS}=Vo+1V), V_{IN}=Vo+1V, C_{BIAS}=0.1μF, C_{IN}=4.7μF, Co=4.7μF, Ta=25°C)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Output Voltage	V_O	I_O=30mA	-1.0%	-	+1.0%	V
		I_O=30mA, Ta= -40°C to +105°C	-2.5%		+2.5%	
Unloaded Bias Current	I_{BIAS}	I_O=0mA, except I_{CONT}	-	180	300	μA
		I_O=0mA, except I_{CONT}, Ta= -40°C to +105°C	-	-	350	
Unloaded Input Current	I_{IN}	I_O=0mA, except I_{CONT}	-	-	20	μA
		I_O=0mA, except I_{CONT}, Ta= -40°C to +105°C	-	-	25	
Bias Current at Control OFF	$I_{BIAS(OFF)}$	V_{CONT}=0V	-	-	100	nA
		V_{CONT}=0V, Ta= -40°C to +105°C	-	-	500	
Input Current at Control OFF	$I_{IN(OFF)}$	V_{CONT}=0V	-	-	100	nA
		V_{CONT}=0V, Ta= -40°C to +105°C	-	-	500	
Output Current	I_O	V_O x 0.9V	500	650	-	mA
		V_O x 0.9V, Ta= -40°C to +105°C	500	-	-	
Line Regulation 1 (V_{BIAS})	$\Delta V_O/\Delta V_{BIAS}$	V_{BIAS}=2.5V to V_O+6V(V_O<1.5V) V_{BIAS}=V_O+1V to V_O+6V(V_O≥1.5V) I_O=30mA	-	-	0.10	%/V
Line Regulation 2 (V_{IN})	$\Delta V_O/\Delta V_{IN}$	V_{IN}=V_O+1V to V_O+6V, I_O=30mA	-	-	0.10	%/V
Load Regulation	$\Delta V_O/\Delta I_O$	I_O=30 to 500mA	-	-	0.002	%/mA
Dropout Voltage	ΔV_{I-O}	I_O=300mA	-	0.10	0.18	V
Ripple Rejection Ratio 1 (V_{BIAS})	RR1(V_{BIAS})	V_{BIAS}=3.5V, e_{BIAS}=200mVrms, f=1kHz, I_O=10mA	Refer to Table 1			dB
Ripple Rejection Ratio 2 (V_{IN})	RR2(V_{IN})	e_{IN}=200mVrms, f=1kHz, I_O=10mA	Refer to Table 1			dB
Average Temperature Coefficient of Output Voltage	$\Delta V_O/\Delta Ta$	Ta=0 to +85°C, I_O=10mA	-	±50	-	ppm/°C
Output Noise Voltage	V_{NO}	f=10Hz to 80kHz, I_O=10mA	Refer to Table 1			μVrms
Control Current	I_{CONT}	V_{CONT}=1.6V	-	3	12	μA
		V_{CONT}=2.0V, Ta= -40°C to +105°C	-	-	22	
Control Voltage for ON-state	$I_{CONT(ON)}$		1.6	-	-	V
		Ta= -40°C to +105°C	2.0	-	-	
Control Voltage for OFF-state	$V_{CONT(ON)}$		-	-	0.6	V
		Ta= -40°C to +105°C	-	-	0.5	
Bias Voltage	V_{BIAS}		-	-	10	V
		Ta= -40°C to +105°C	-	-	10	
Input Voltage	V_{IN}		-	-	9	V
		Ta= -40°C to +105°C	-	-	9	

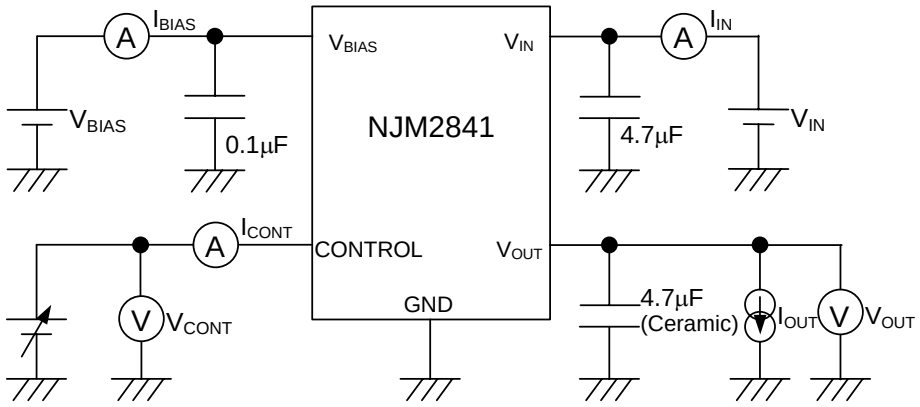
• Table1

PARAMETER	SYMBOL	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Ripple Rejection Ratio 1 (V_{BIAS})	RR(V_{BIAS})	V_{BIAS}=3.5V, e_{BIAS}=200mVrms, f=1kHz, Io=10mA	V_O=0.8V	-	80	-	dB
			V_O=0.9V	-	80	-	
			V_O=1.0V	-	79	-	
			V_O=1.2V	-	77	-	
			V_O=1.5V	-	75	-	
		V_{BIAS}=4.5V, e_{BIAS}=200mVrms, f=1kHz, Io=10mA	V_O=2.5V	-	70	-	
Ripple Rejection Ratio 2 (V_{IN})	RR(V_{IN})	e_{in}=200mVrms, f=1kHz, Io=10mA	V_O=0.8V	-	87	-	dB
			V_O=0.9V	-	87	-	
			V_O=1.0V	-	87	-	
			V_O=1.2V	-	86	-	
			V_O=1.5V	-	85	-	
			V_O=2.5V	-	75	-	
Output Noise Voltage	V_{NO}	f=10Hz~80kHz, Io=10mA,	V_O=0.8V	-	27	-	μVrms
			V_O=0.9V	-	30	-	
			V_O=1.0V	-	34	-	
			V_O=1.2V	-	40	-	
			V_O=1.5V	-	48	-	
			V_O=2.5V	-	75	-	

■ POWER DISSIPATION vs. AMBIENT TEMPERATURE

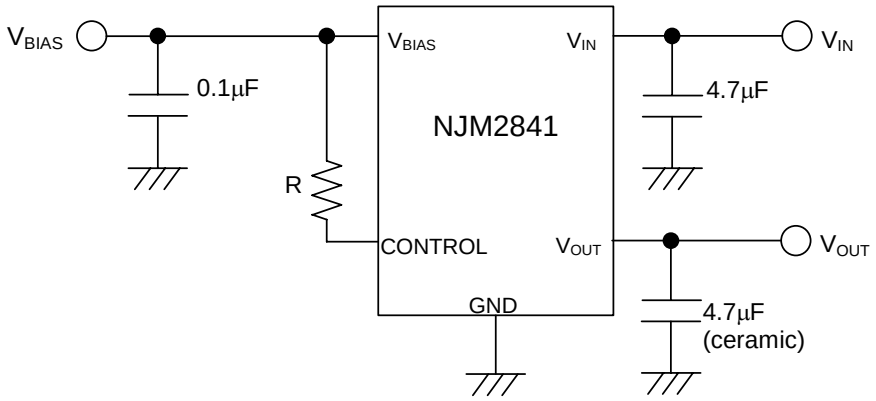


■ TEST CIRCUIT



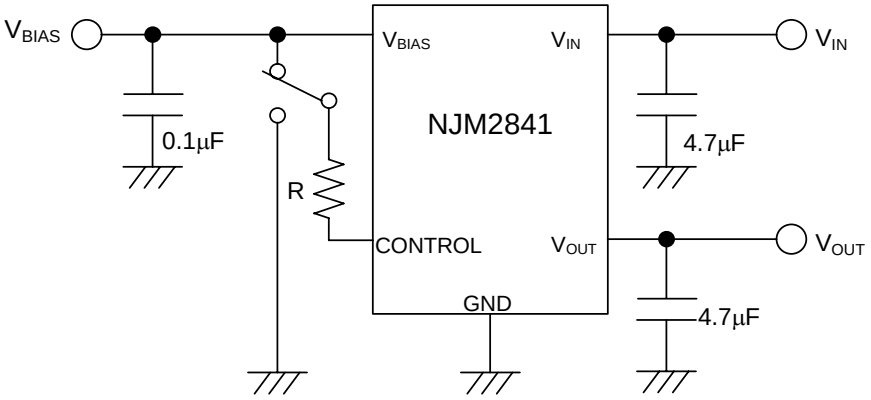
■ TYPICAL APPLICATION

a) In case of where ON/OFF control is not required:



Connect control pin to V_{BIAS} pin.
Though the I_{CONT} decreases by inserting "R" to between Control pin and V_{BIAS} pin, the minimum operating voltage is increased due to the resistor "R".

b) In use of ON/OFF control:



State of control pin:
"H" → output is enabled.
"L" or "open" → output is disabled.

* Bias Capacitor C_{BIAS} and an Input Capacitor C_{IN}

C_{BIAS} and C_{IN} are required to prevent oscillation and reduce power supply ripple for applications when high power supply impedance or a long power supply line.

Therefore, use recommended C_{BIAS} and C_{IN} value (refer to conditions of ELECTRIC CHARACTERISTIC) or larger and should connect between V_{BIAS} - GND, V_{IN} - GND 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.

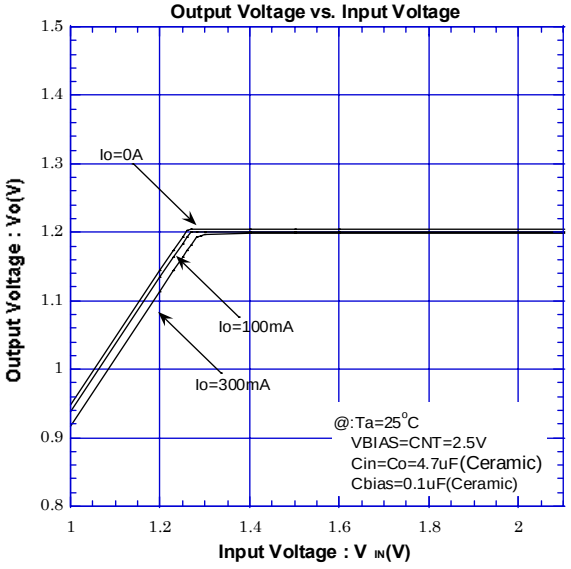
Therefore, use the recommended C_O value (refer to conditions of ELECTRIC CHARACTERISTIC) or larger and should connect between GND and V_{OUT} as shortest path as possible for stable operation

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.

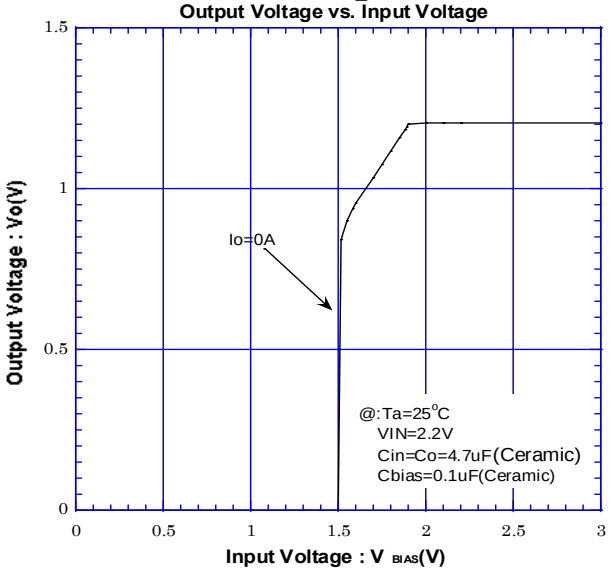
When selecting C_O, recommend that have withstand voltage margin against output voltage and superior temperature characteristic though this product is designed stability works with wide range ESR of capacitor including low ESR products.

■ TYPICAL CHRACTERISTICS

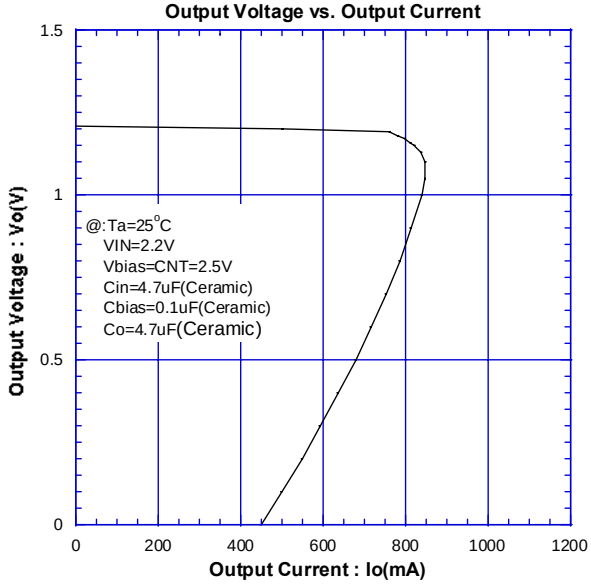
NJM2841_1.2V
Output Voltage vs. Input Voltage



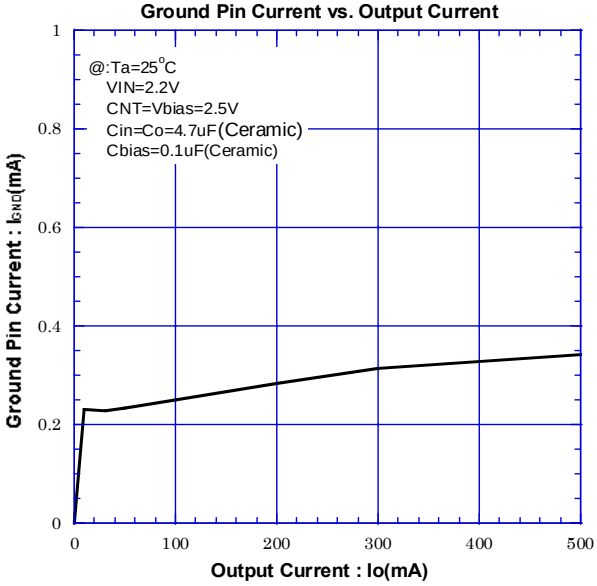
NJM2841_1.2V
Output Voltage vs. Input Voltage



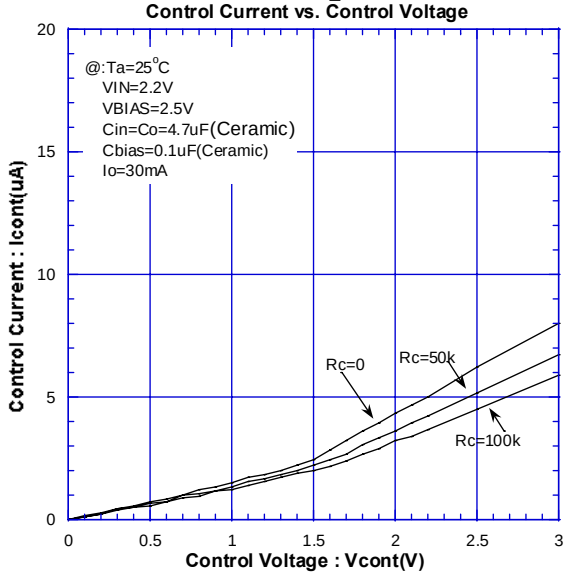
NJM2841_1.2V
Output Voltage vs. Output Current



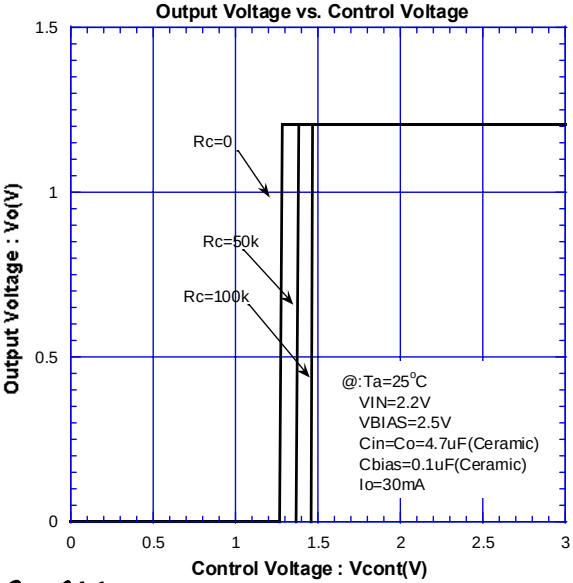
NJM2841_1.2V
Ground Pin Current vs. Output Current



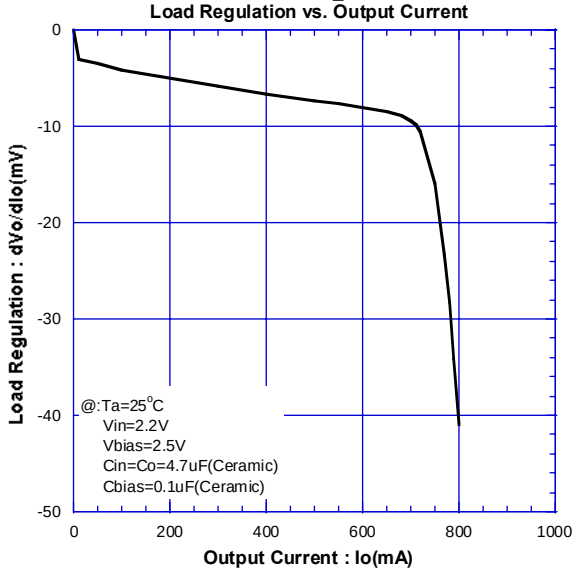
NJM2841_1.2V
Control Current vs. Control Voltage



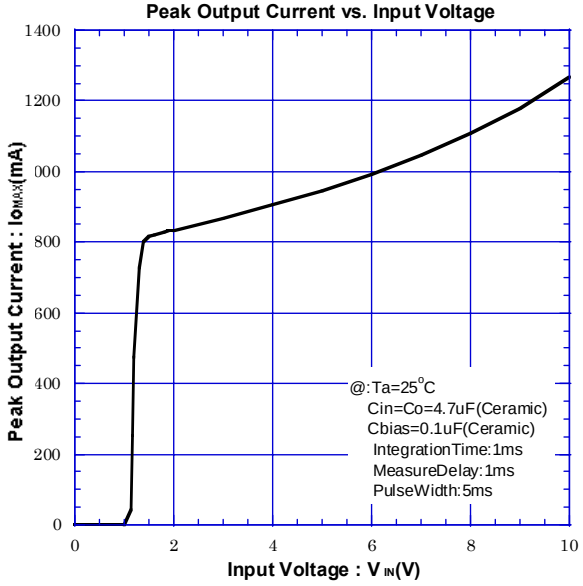
NJM2841_1.2V
Output Voltage vs. Control Voltage



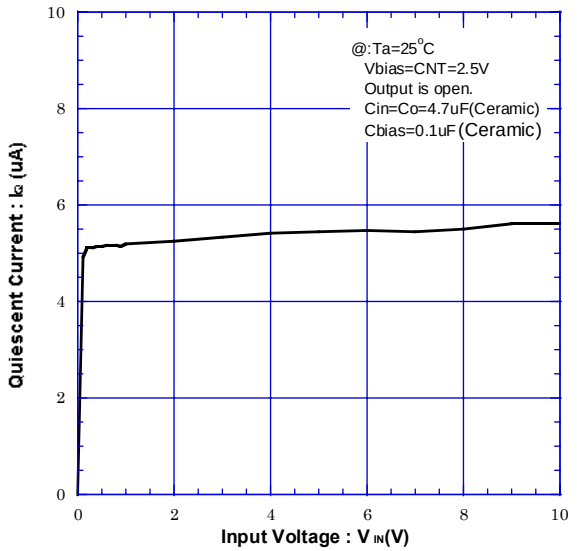
NJM2841_1.2V
Load Regulation vs. Output Current



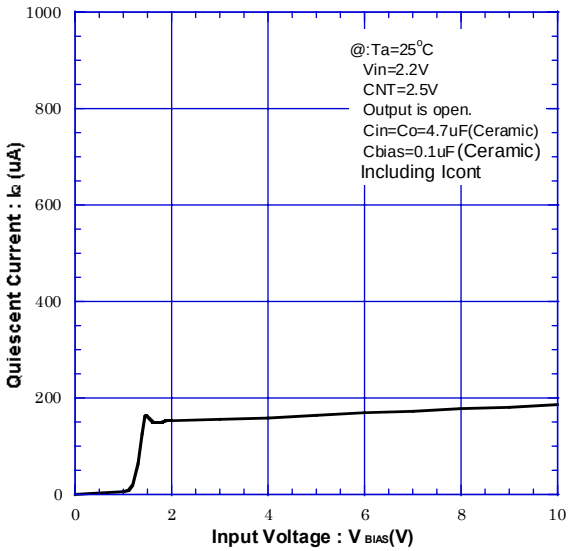
NJM2841_1.2V
Peak Output Current vs. Input Voltage



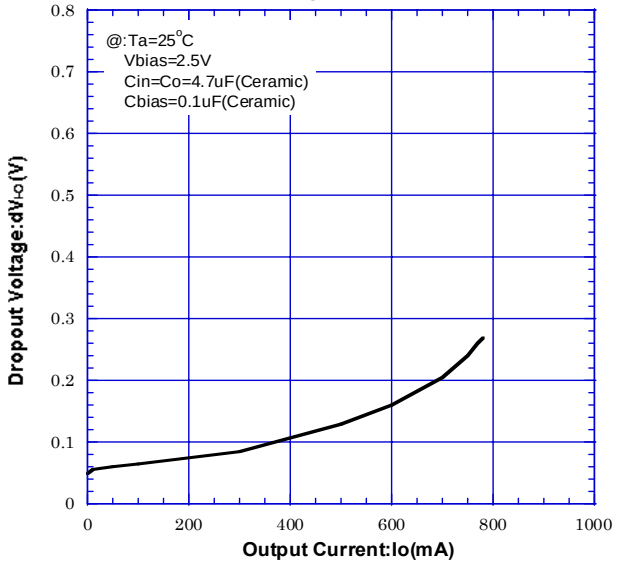
NJM2841_1.2V
Quiescent Current v.s. Input Voltage



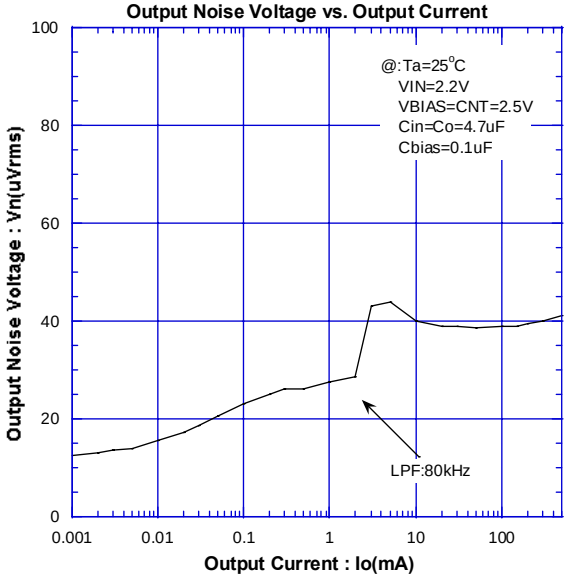
NJM2841_1.2V
Quiescent Current v.s. Input Voltage

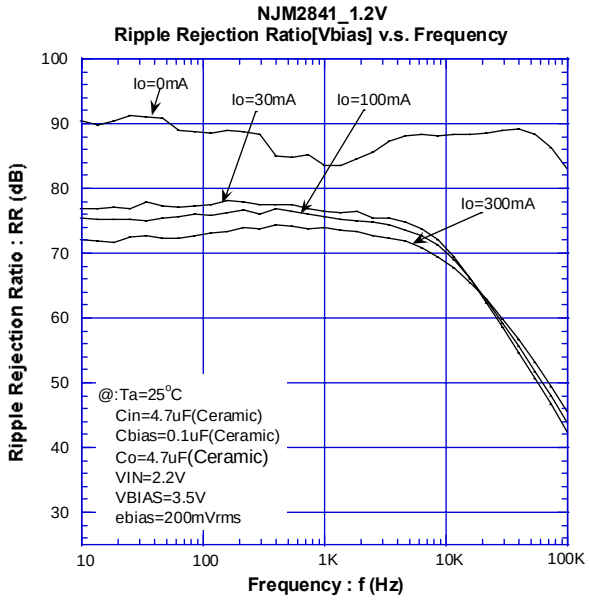


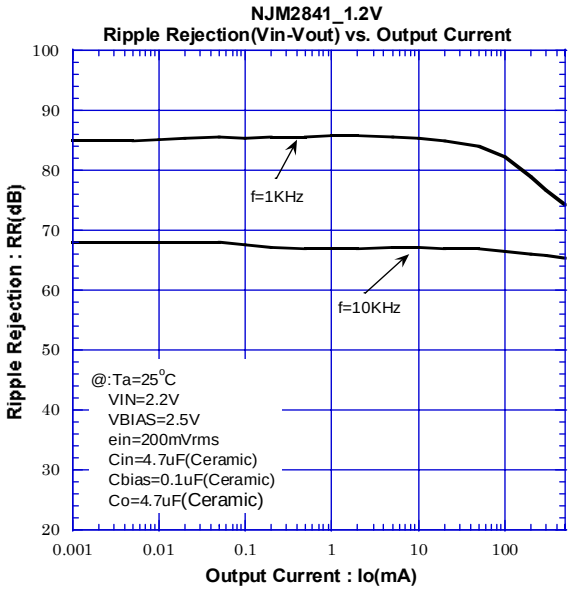
NJM2841_1.2V
Dropout Voltage vs. Output Current

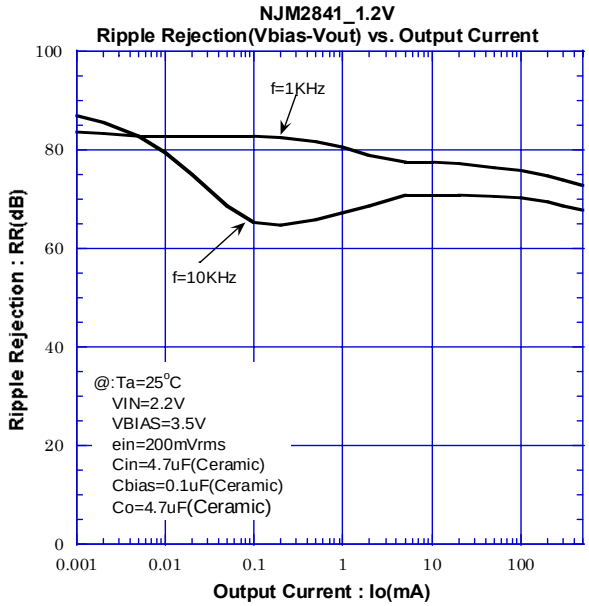


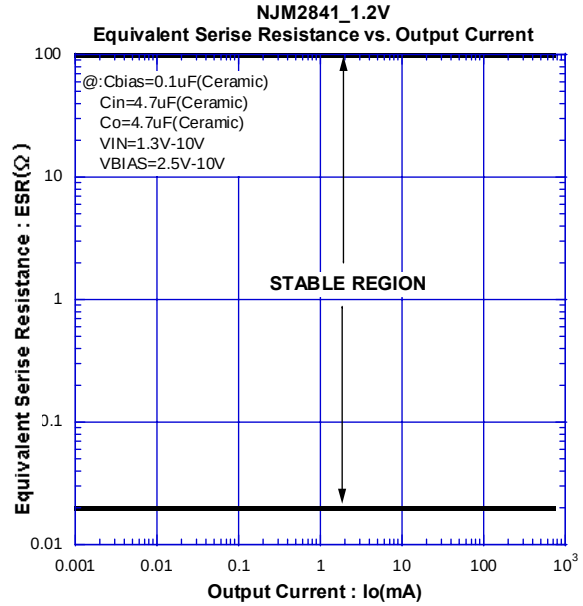
NJM2841_1.2V
Output Noise Voltage vs. Output Current

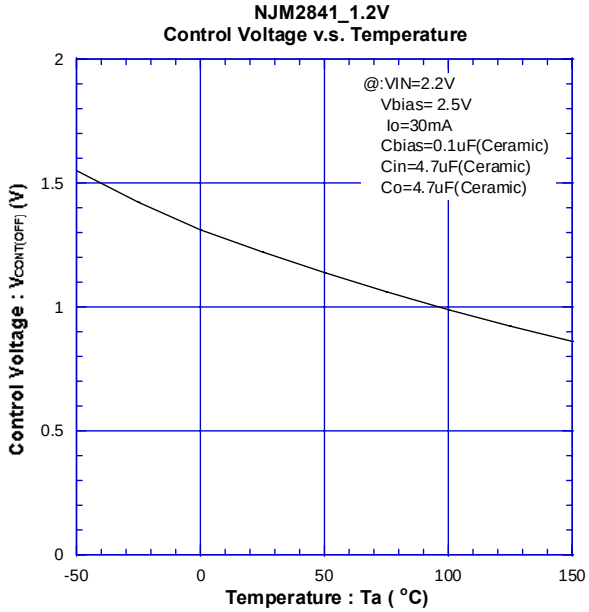


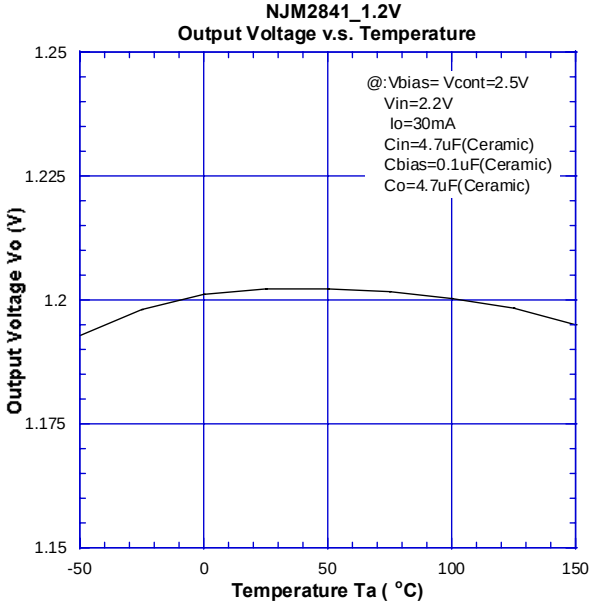

NJM2841_1.2V
Ripple Rejection Ratio[Vbias] v.s. Frequency
Io=0mA
Io=30mA
Io=100mA
Io=300mA
@:Ta=25°C
Cin=4.7uF(Ceramic)
Cbias=0.1uF(Ceramic)
Co=4.7uF(Ceramic)
VIN=2.2V
VBIAS=3.5V
ebias=200mVrms
Ripple Rejection Ratio : RR (dB)
Frequency : f (Hz)

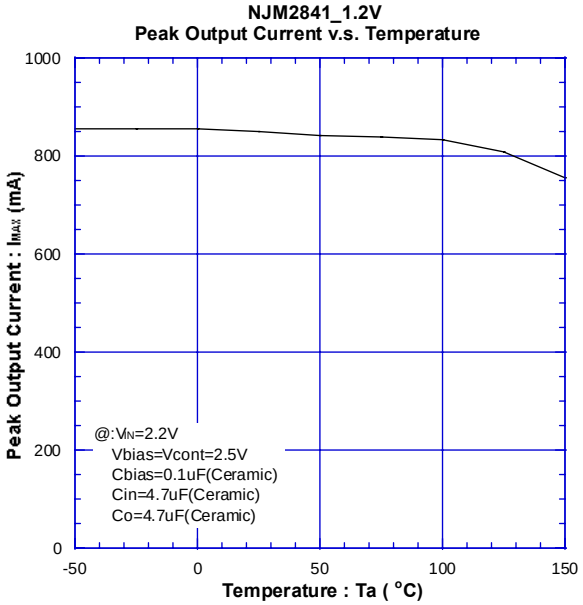

NJM2841_1.2V
Ripple Rejection(Vin-Vout) vs. Output Current
f=1KHz
f=10KHz
@:Ta=25°C
VIN=2.2V
VBIAS=2.5V
ein=200mVrms
Cin=4.7uF(Ceramic)
Cbias=0.1uF(Ceramic)
Co=4.7uF(Ceramic)
Ripple Rejection : RR(dB)
Output Current : Io(mA)

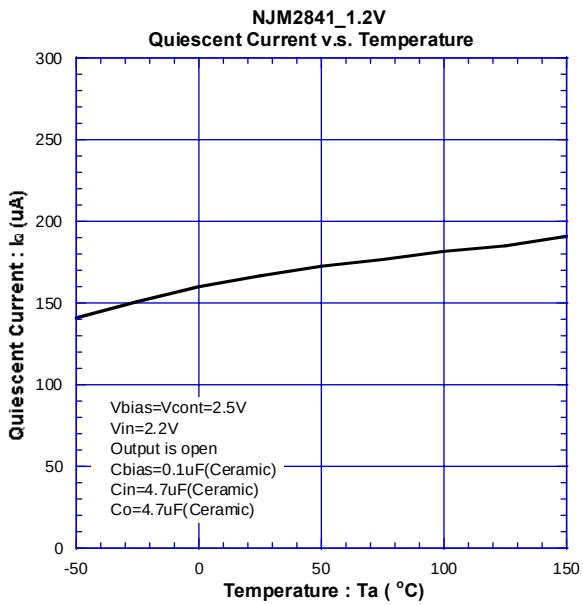

NJM2841_1.2V
Ripple Rejection(Vbias-Vout) vs. Output Current
f=1KHz
f=10KHz
@:Ta=25°C
VIN=2.2V
VBIAS=3.5V
ein=200mVrms
Cin=4.7uF(Ceramic)
Cbias=0.1uF(Ceramic)
Co=4.7uF(Ceramic)
Ripple Rejection : RR(dB)
Output Current : Io(mA)

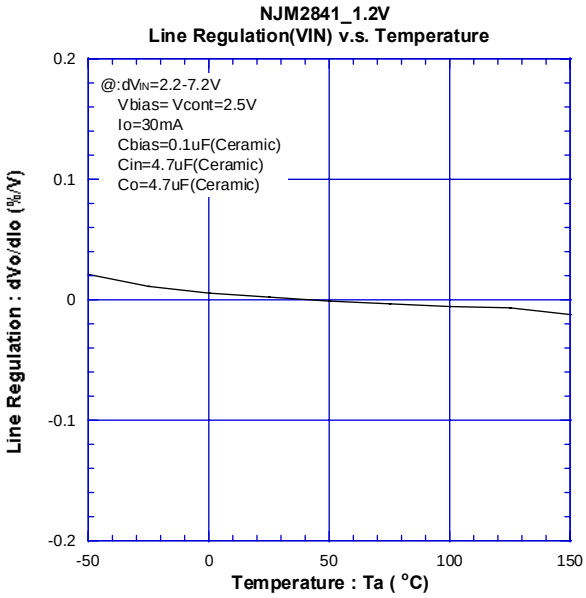

NJM2841_1.2V
Equivalent Serise Resistance vs. Output Current
@:Cbias=0.1uF(Ceramic)
Cin=4.7uF(Ceramic)
Co=4.7uF(Ceramic)
VIN=1.3V-10V
VBIAS=2.5V-10V
STABLE REGION
Equivalent Serise Resistance : ESR(Ω)
Output Current : Io(mA)

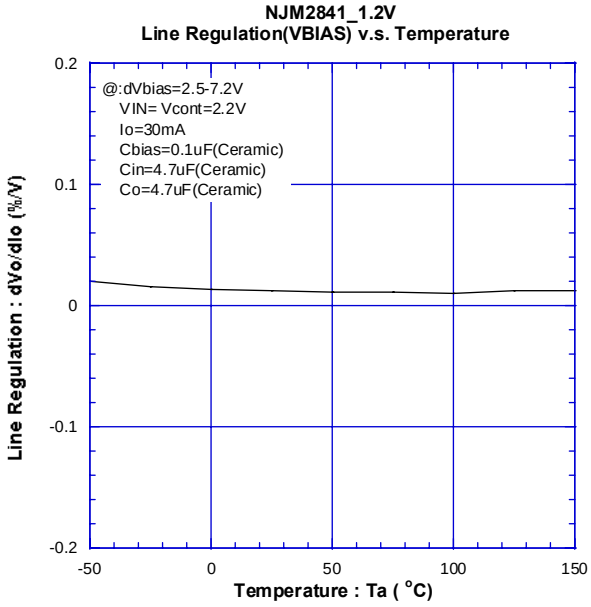

NJM2841_1.2V
Control Voltage v.s. Temperature
@:VIN=2.2V
Vbias= 2.5V
Io=30mA
Cbias=0.1uF(Ceramic)
Cin=4.7uF(Ceramic)
Co=4.7uF(Ceramic)
Control Voltage : VCONT(OFF) (V)
Temperature : Ta (°C)

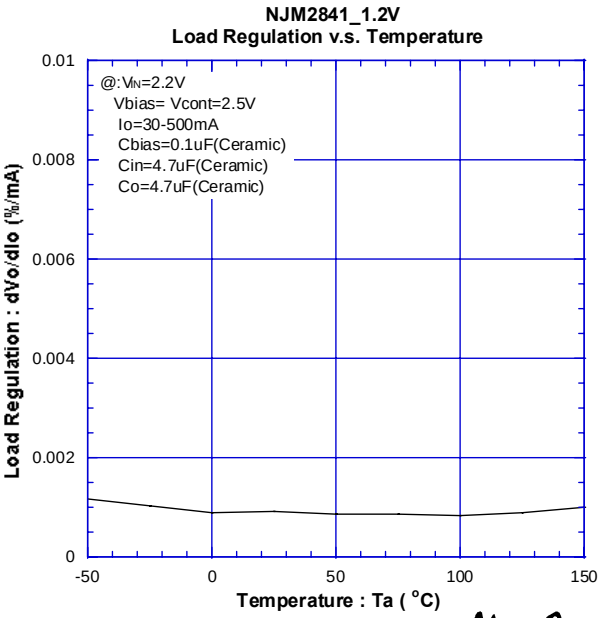

NJM2841_1.2V
Output Voltage v.s. Temperature
@:Vbias= Vcont=2.5V
Vin=2.2V
Io=30mA
Cin=4.7uF(Ceramic)
Cbias=0.1uF(Ceramic)
Co=4.7uF(Ceramic)
Output Voltage Vo (V)
Temperature Ta (°C)

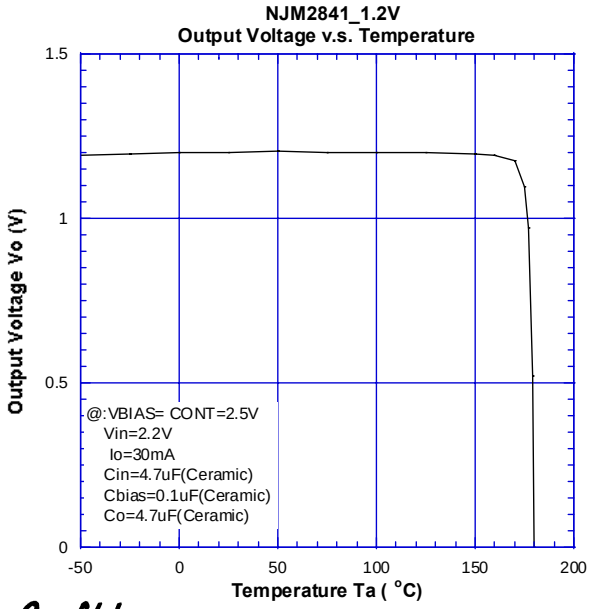

NJM2841_1.2V
Peak Output Current v.s. Temperature
Peak Output Current : IMAX (mA)
1000
800
600
400
200
0
-50
0
50
100
150
Temperature : Ta (°C)
@:VIN=2.2V
Vbias=Vcont=2.5V
Cbias=0.1uF(Ceramic)
Cin=4.7uF(Ceramic)
Co=4.7uF(Ceramic)

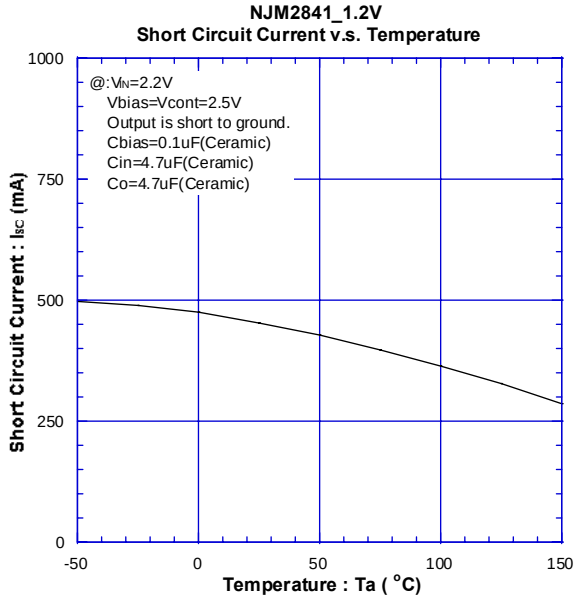

NJM2841_1.2V
Quiescent Current v.s. Temperature
Quiescent Current : IG (uA)
300
250
200
150
100
50
0
-50
0
50
100
150
Temperature : Ta (°C)
Vbias=Vcont=2.5V
Vin=2.2V
Output is open
Cbias=0.1uF(Ceramic)
Cin=4.7uF(Ceramic)
Co=4.7uF(Ceramic)

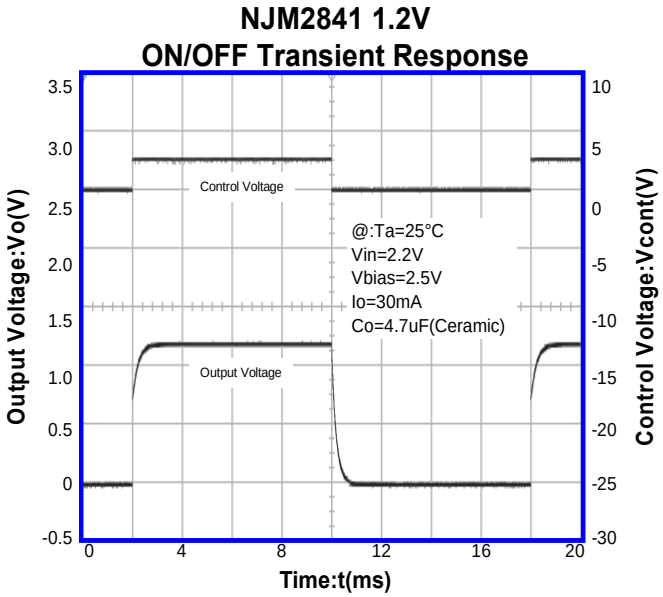

NJM2841_1.2V
Line Regulation(VIN) v.s. Temperature
Line Regulation : dVo/dIo (%/V)
0.2
0.1
0
-0.1
-0.2
-50
0
50
100
150
Temperature : Ta (°C)
@:dVIN=2.2-7.2V
Vbias= Vcont=2.5V
Io=30mA
Cbias=0.1uF(Ceramic)
Cin=4.7uF(Ceramic)
Co=4.7uF(Ceramic)

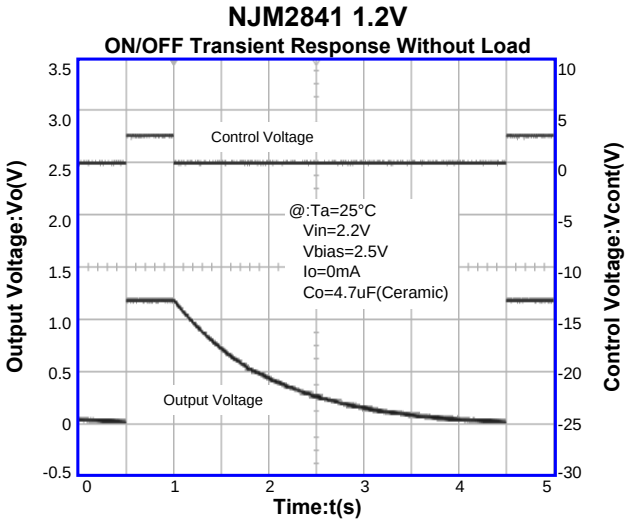

NJM2841_1.2V
Line Regulation(VBIAS) v.s. Temperature
Line Regulation : dVo/dIo (%/V)
0.2
0.1
0
-0.1
-0.2
-50
0
50
100
150
Temperature : Ta (°C)
@:dVbias=2.5-7.2V
VIN= Vcont=2.2V
Io=30mA
Cbias=0.1uF(Ceramic)
Cin=4.7uF(Ceramic)
Co=4.7uF(Ceramic)

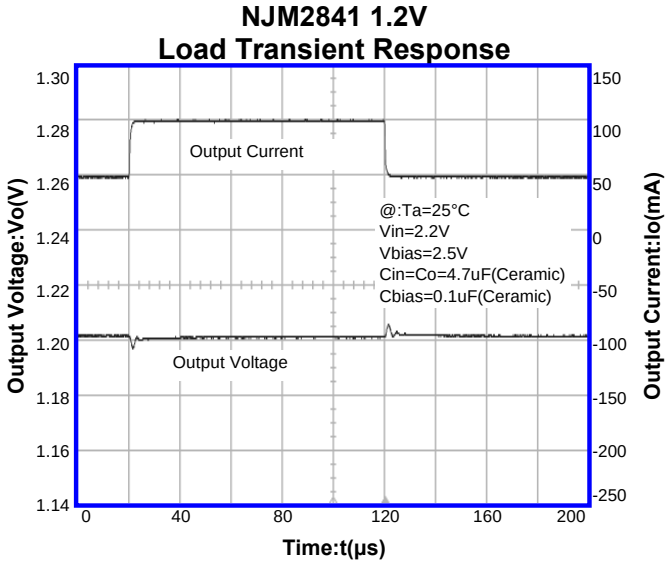

NJM2841_1.2V
Load Regulation v.s. Temperature
Load Regulation : dVo/dIo (%/mA)
0.01
0.008
0.006
0.004
0.002
0
-50
0
50
100
150
Temperature : Ta (°C)
@:VIN=2.2V
Vbias= Vcont=2.5V
Io=30-500mA
Cbias=0.1uF(Ceramic)
Cin=4.7uF(Ceramic)
Co=4.7uF(Ceramic)

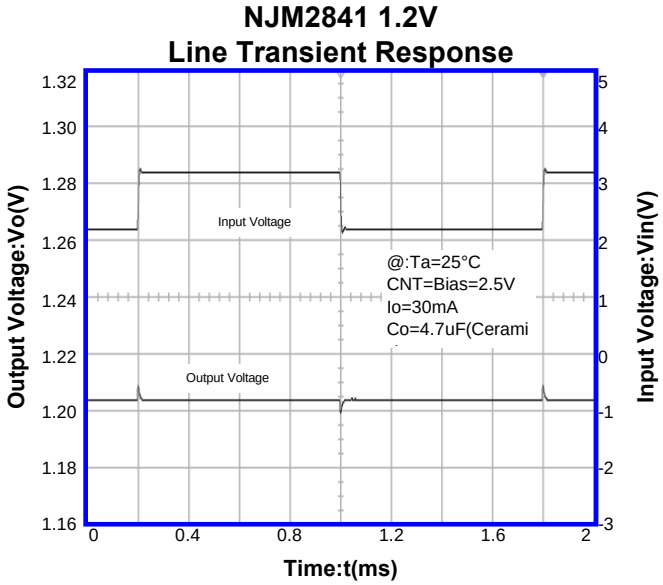

NJM2841_1.2V
Output Voltage v.s. Temperature
Output Voltage Vo (V)
1.5
1
0.5
0
-50
0
50
100
150
200
Temperature Ta (°C)
@:VBIAS= CONT=2.5V
Vin=2.2V
Io=30mA
Cin=4.7uF(Ceramic)
Cbias=0.1uF(Ceramic)
Co=4.7uF(Ceramic)

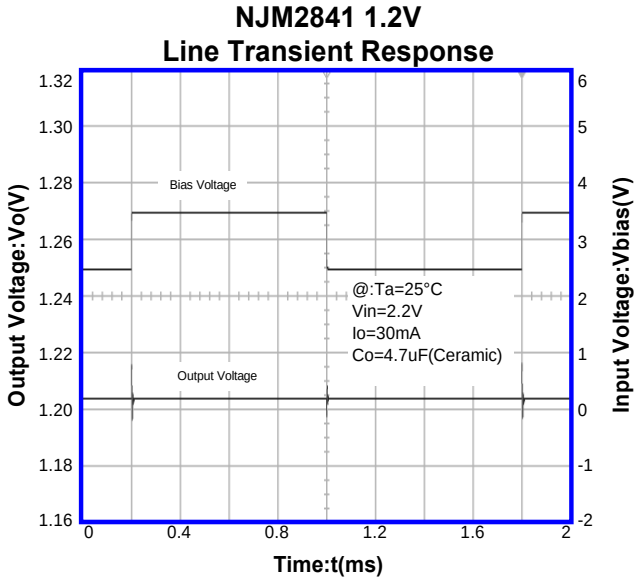

NJM2841_1.2V
Short Circuit Current v.s. Temperature
@:VIN=2.2V
Vbias=Vcont=2.5V
Output is short to ground.
Cbias=0.1uF(Ceramic)
Cin=4.7uF(Ceramic)
Co=4.7uF(Ceramic)
Short Circuit Current : Isc (mA)
Temperature : Ta (°C)


NJM2841 1.2V
ON/OFF Transient Response
Control Voltage
Output Voltage
@:Ta=25°C
Vin=2.2V
Vbias=2.5V
Io=30mA
Co=4.7uF(Ceramic)
Output Voltage:Vo(V)
Control Voltage:Vcont(V)
Time:t(ms)


NJM2841 1.2V
ON/OFF Transient Response Without Load
Control Voltage
Output Voltage
@:Ta=25°C
Vin=2.2V
Vbias=2.5V
Io=0mA
Co=4.7uF(Ceramic)
Output Voltage:Vo(V)
Control Voltage:Vcont(V)
Time:t(s)


NJM2841 1.2V
Load Transient Response
Output Current
Output Voltage
@:Ta=25°C
Vin=2.2V
Vbias=2.5V
Cin=Co=4.7uF(Ceramic)
Cbias=0.1uF(Ceramic)
Output Voltage:Vo(V)
Output Current:Io(mA)
Time:t(µs)


NJM2841 1.2V
Line Transient Response
Input Voltage
Output Voltage
@:Ta=25°C
CNT=Bias=2.5V
Io=30mA
Co=4.7uF(Cerami
Output Voltage:Vo(V)
Input Voltage:Vin(V)
Time:t(ms)


NJM2841 1.2V
Line Transient Response
Bias Voltage
Output Voltage
@:Ta=25°C
Vin=2.2V
Io=30mA
Co=4.7uF(Ceramic)
Output Voltage:Vo(V)
Input Voltage:Vbias(V)
Time:t(ms)

[CAUTION]
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