Io=500mA LDO with Reset function

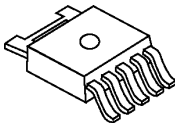
■ GENERAL DESCRIPTION

The NJW4116 is a 500mA output low dropout voltage regulator with reset function monitoring output voltage.

Reset Output Hold Time is adjustable by external capacitor.

Because of wide operate voltage range and wide temperature range, the NJW4113 suits for high reliability application such as automotive application.

■ PACKAGE OUTLINE

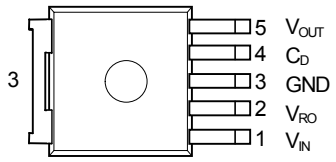


NJW4116DL3

■ FEATURES

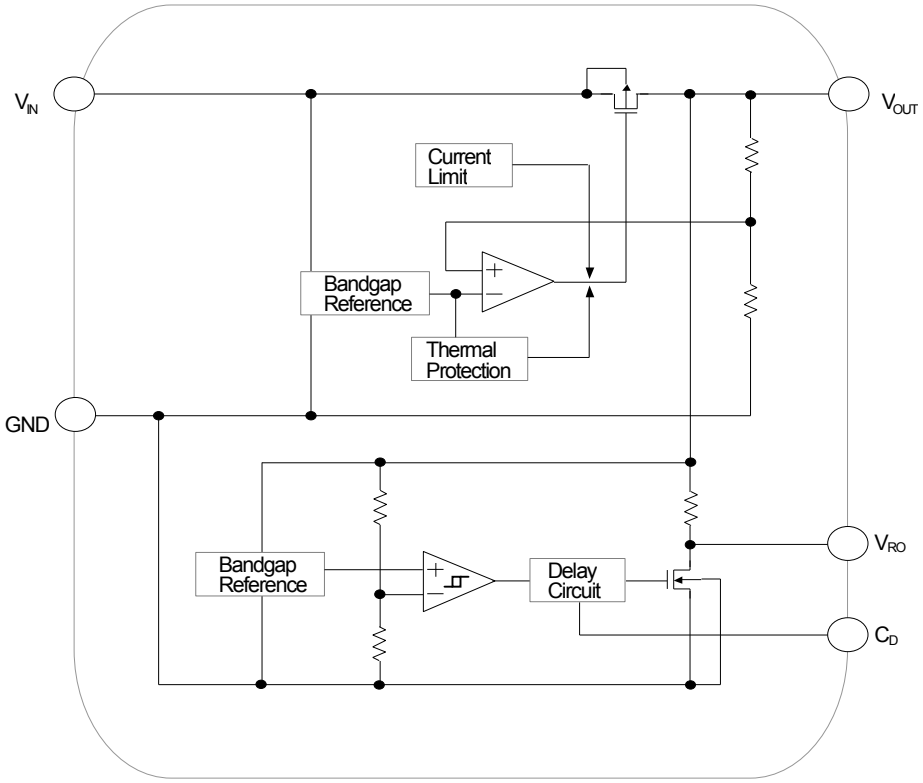
- Wide Operating Voltage Range 4.0V to 40V
- Low Current Consumption 55μA typ.
- High Precision Output Voltage Vo ±1.0%(Ta=25°C)
  Vo ±2.0%(Ta=-40 to +125°C)
- High Precision Detection Voltage V_{DET} ±1.0%(Ta=25°C)
  V_{DET} ±2.0%(Ta=-40 to +125°C)
- Output Current Io(min.)=500mA
- Adjustable RESET Output Delay Hold Time with external capacitor
- Correspond to Low ESR capacitor (MLCC)
- Thermal Shutdown Protection
- Over Current Protection
- Package Outline TO-252-5

■ PIN CONFIGURATION



1. V_{IN} Input Voltage Pin
2. V_{RO} Reset Output Pin
3. GND GND Pin
4. C_D External Capacitor Pin for setting RESET Output Delay Hold Time
5. V_{OUT} Output Voltage Pin

■ BLOCK DIAGRAM



■ PRODUCT CLASSIFICATION

Status	Device Name	Output Voltage	Detection Voltage
M.P.	NJW4116DL3-A46-T1	5.0V	4.6V
M.P.	NJW4116DL3-A41-T1	5.0V	4.1V
PLAN	NJW4116DL3-B03-T1	3.3V	3.0V

■ ABSOLUTE MAXIMUM RATINGS (Ta=25°C)

PARAMETER	SYNBOL	RATINGS	UNIT
Input Voltage	V_{IN}	-0.3 to +45	V
C_D pin Voltage	C_D	-0.3 to +6	V
Output Voltage	V_{OUT}	-0.3 to $V_{IN} \leq$ +6	V
RESET Output Voltage	V_{RO}	-0.3 to +6	V
Power Dissipation	P_D	1190(*1)	mW
		3125(*2)	
Junction Temperature	Tj	-40 to +150	°C
Operating Temperature	Topr	-40 to +125	°C
Storage Temperature	Tstg	-40 to +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 thermal via holes to a board based on JEDEC standard JESD51-5)

■ Operating Voltage Range

V_{IN}=4.0 to 40V

■ ELECTRICAL CHARACTERISTICS

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

(Regulator Block)

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 +125°C	-2.0%	-	+2.0%	
Output Current	I_O	$V_O \times 0.9$	500	-	-	mA
		$V_O \times 0.9$, Ta= -40°C to +125°C	500	-	-	
Line Regulation	$\Delta V_O/\Delta V_{IN}$	V_{IN}= V_O +1V to 40V, I_O =30mA	-	-	0.03	%/V
		V_{IN}= V_O +1V to 40V, I_O =30mA, Ta= -40°C /+125°C (*4)	-	-	0.03	
Load Regulation	$\Delta V_O/\Delta I_O$	I_O =0mA to 500mA	-	-	0.006	%/mA
		I_O =0mA to 500mA, Ta= -40°C /+125°C (*4)	-	-	0.008	
Ripple Rejection	RR	V_{IN}= V_O +1V, ein=200mVrms, f=1kHz, I_O =10mA, V_O=5.0V	-	55	-	dB
Dropout Voltage(*3)	ΔV_{IO}	I_O=300mA	-	0.27	0.42	V
		I_O=300mA, Ta= -40 to +125°C	-	-	0.54	
Average Temperature Coefficient of Output Voltage	$\Delta V_O/\Delta Ta$	Ta=0°C to 85°C, I_O =30mA	-	±50	-	ppm/°C

(Voltage Detector Block)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Detection Voltage	V_{DET}		-1.0%	-	+1.0%	V
		Ta= -40°C to +125°C	-2.0%	-	+2.0%	
Hysteresis Voltage	V_{HYS}		80	100	120	mV
		Ta= -40°C to +125°C	50	-	150	
Low level RESET Output Voltage	V_{ROL}	V_O= V_{DET} - 0.5V	-	0.2	0.4	V
		V_O= V_{DET} - 0.5V, Ta= -40°C to +125°C	-	-	0.4	
Average temperature coefficient of Detection Voltage	ΔV_{DET} / ΔTa	Ta=0°C to 85°C	-	±50	-	ppm/°C
Voltage Detector Block Operating Voltage	V_{OPL}		0.8	-	-	V
		Ta= -40°C to +125°C	0.8	-	-	
RESET Output Voltage at Start up	V_{ROUV}	V_{IN} start up	-	0.05	-	V
Pull up resistor	R_{PU}		-	100	-	kΩ
RESET Output Delay Hold Time	t_d	C_D=4.7nF, V_{RO}=L→H	8	10	12	ms
		C_D=4.7nF, V_{RO}=L→H, Ta= -40°C to +125°C	3	-	14	

(General Characteristics)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Quiescent Current	I_Q	I_O =0mA	-	55	90	μA
		I_O =0mA, Ta= -40°C to +125°C	-	-	90	

(*3):Except Output Voltage Rank less than 3.8V.

(*4):These parameter are guaranteed with only -40°C and +125°C.

The above specifications are common specifications 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

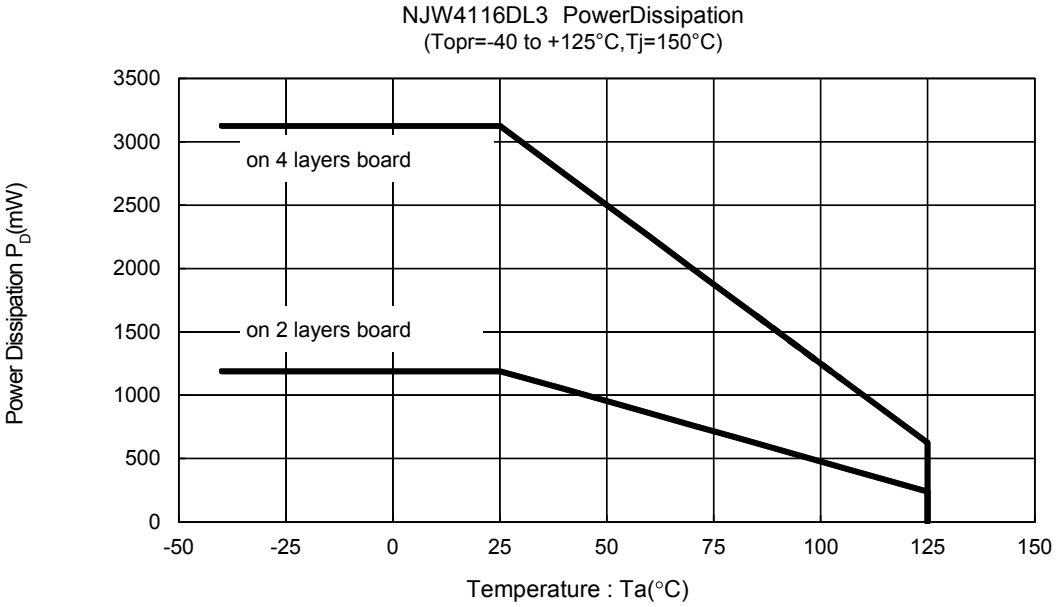
PARAMETER	SYMBOL	VALUE	UNIT
Junction-to-Ambient thermal resistance	θja	105 (*5) 40 (*6)	°C/W
Junction-to-Top of package characterization parameter	ψjt	17 (*5) 12 (*6)	°C/W

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

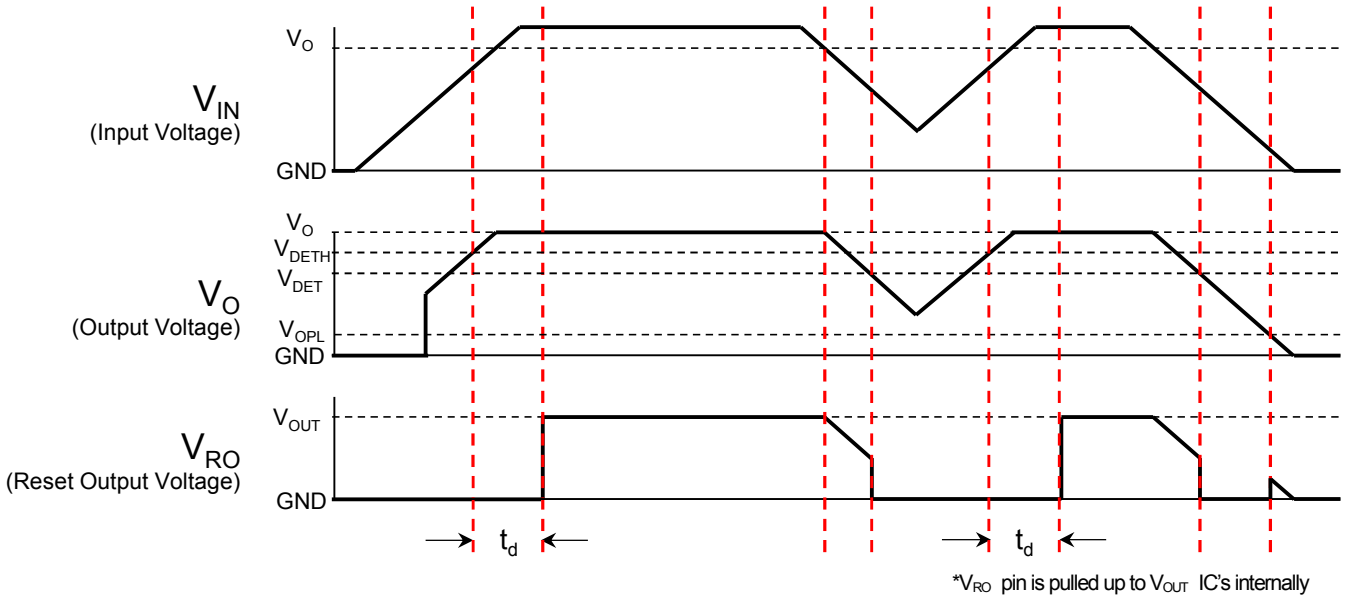
(*6): Mounted on glass epoxy board. (76.2 × 114.3 × 1.6mm:based on EIA/JDEC standard, 4Layers)

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

■ POWER DISSIPATION vs. AMBIENT TEMPERATURE



■ TIMING CHART



• RESET Output Delay Hold Time t_d

The NJW4116 has the RESET Output Delay Hold Time t_d till the RESET outputs "H" in order to prevent malfunction due to chattering after the Output Voltage V_O exceeds the RESET release voltage V_{DETH} (=V_{DET}+V_{HYS}).

The t_d is decided by capacitance connected to Cd pin as follows:

External delay capacitor [nF] = (Required) RESET Delay Hold Time t_d [ms] / 10[ms] x 4.7[nF]

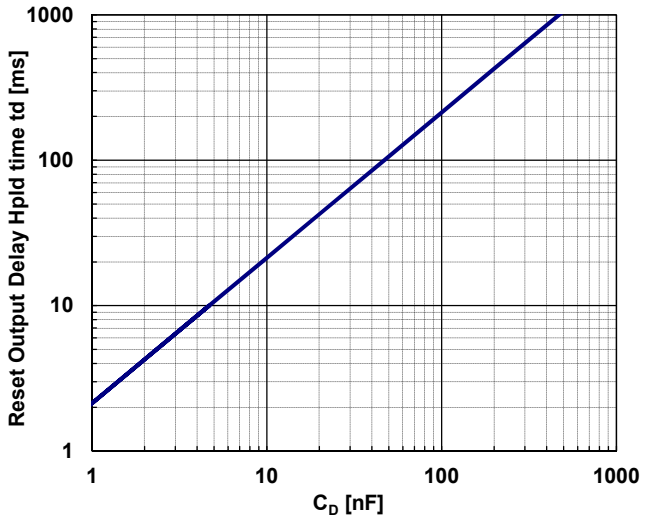
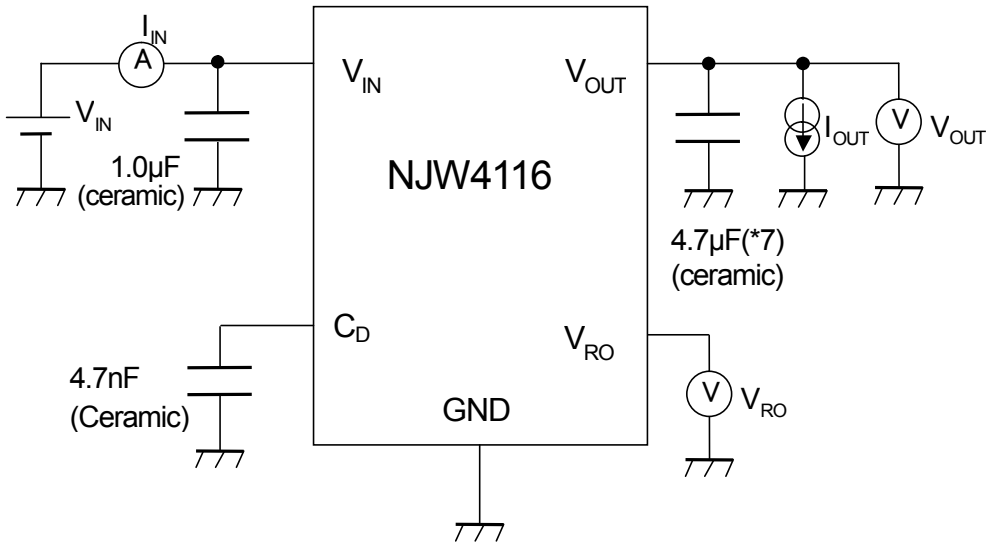


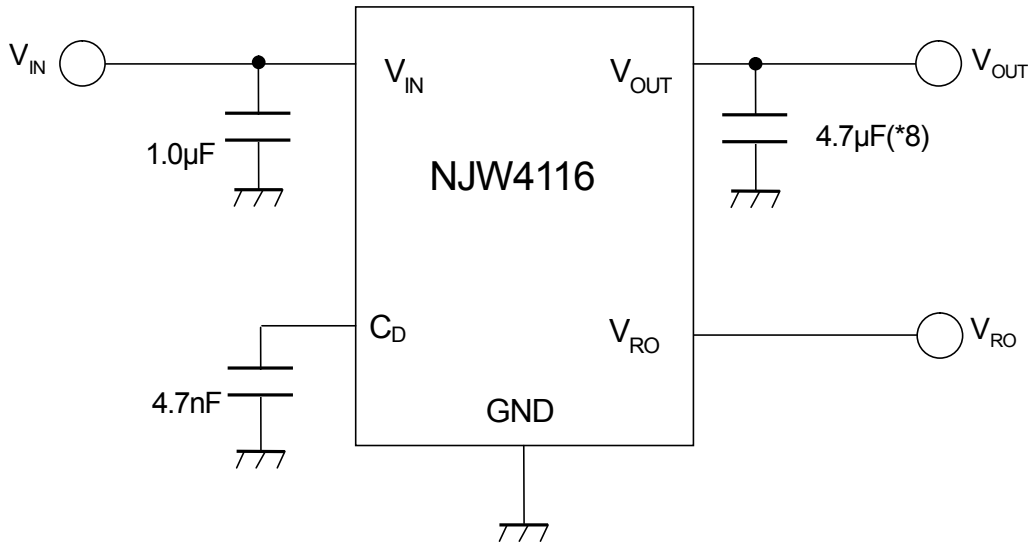
Fig.1) RESET Output Delay Hold Time vs External delay capacitor C_D

■ TEST CIRCUIT



(*7) Vo<3.4V version :Co=10uF

■ TYPICAL APPLICATION



(*8) Vo<3.4V version :Co=10uF

*Input Capacitor C_{IN}

The input capacitor C_{IN} is required in order to prevent oscillation and reduce power supply ripple of applications when high power supply impedance or a long power supply line.

Therefore, the recommended capacitance (refer to conditions of ELECTRIC CHARACTERISTIC) or larger input capacitor, connected between V_{IN} and GND as short path as possible, is recommended in order to avoid the problem.

*Output Capacitor C_O

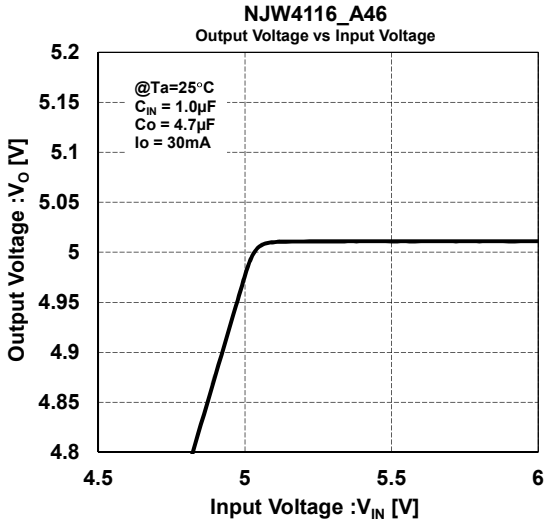
The output capacitor C_O is required for a phase compensation of the internal error amplifier, and the capacitance and the equivalent series resistance (ESR) influence stable operation of the regulator.

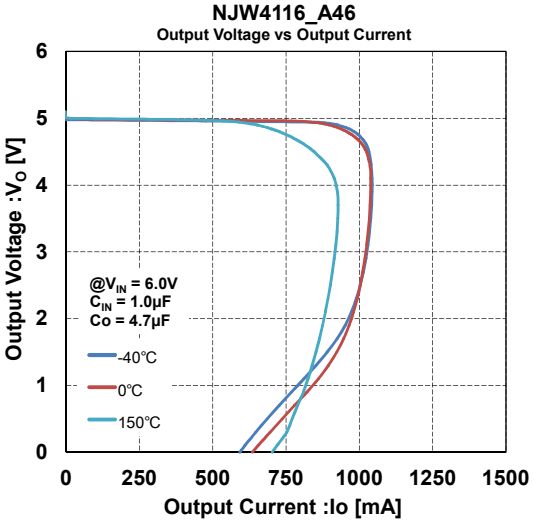
If use a smaller output capacitor than the recommended capacitance (refer to conditions of ELECTRIC CHARACTERISTIC), it may cause excess output noise or oscillation of the regulator due to lack of the phase compensation. Therefore, the recommended capacitance or larger output capacitor, connected between V_{OUT} and GND as short path as possible, is recommended for stable operation. The recommended capacitance may be different by output voltage, therefore confirm the recommended capacitance of the required output voltage.

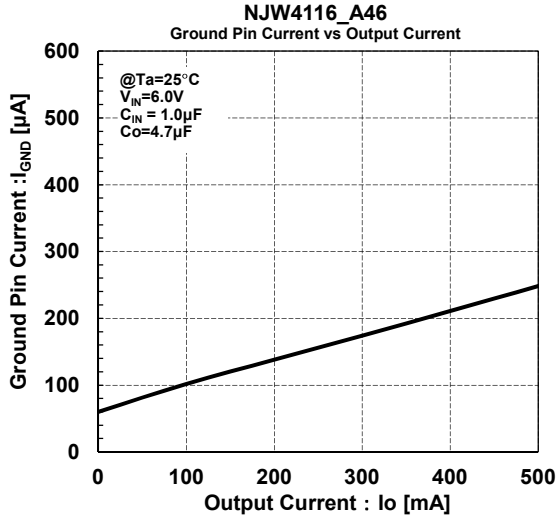
Furthermore, a larger output capacitor reduces output noise and ripple output, and also improves Output Transient Response when a load changes rapidly.

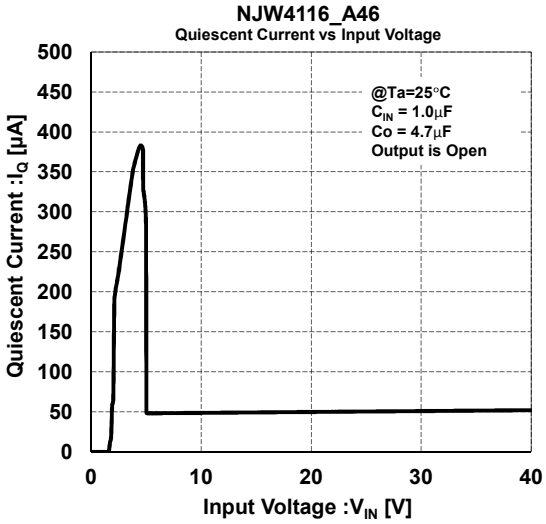
Selecting the output capacitor, should consider varied characteristics of a capacitor: frequency characteristics, temperature characteristics, DC bias characteristics and so on. Therefore, the capacitor that has a sufficient margin of the rated voltage against the output voltage and superior temperature characteristics, is recommended for C_O.

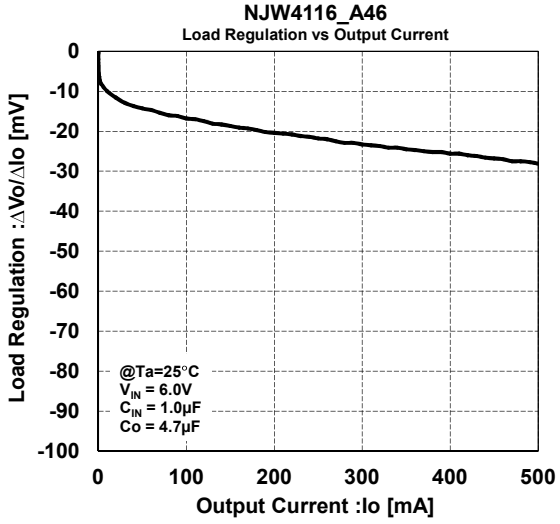
■ TYPICAL CHARACTERISTICS

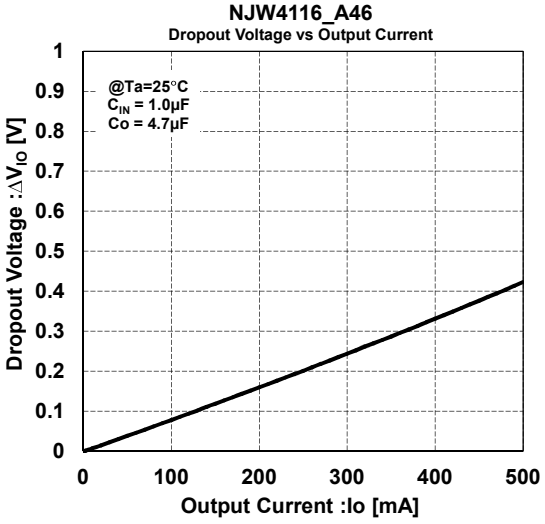




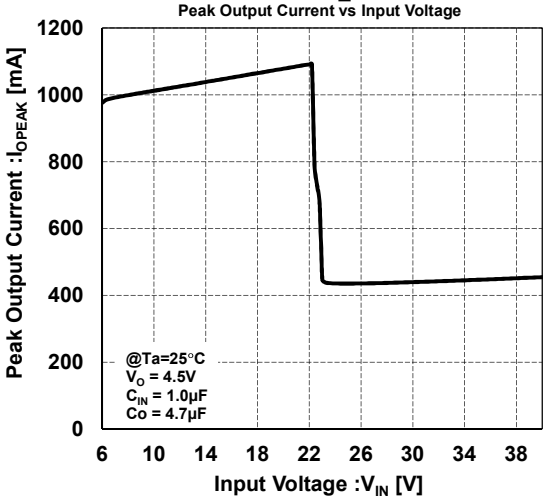




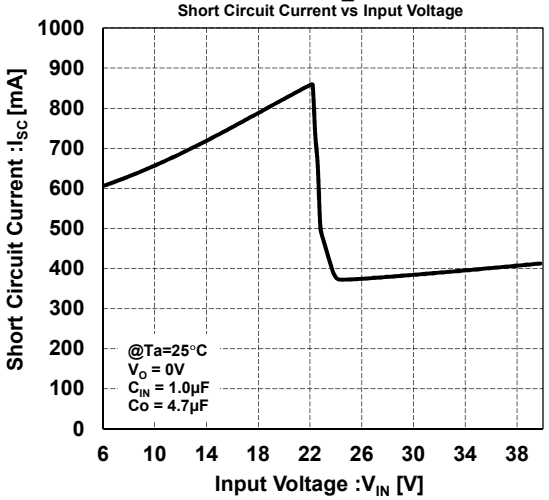




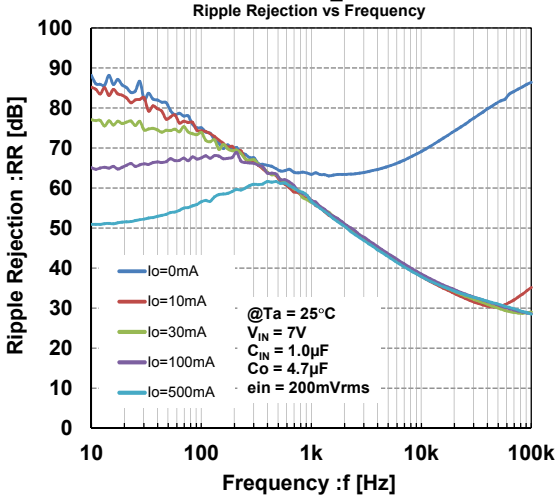
NJW4116_ A46
Peak Output Current vs Input Voltage



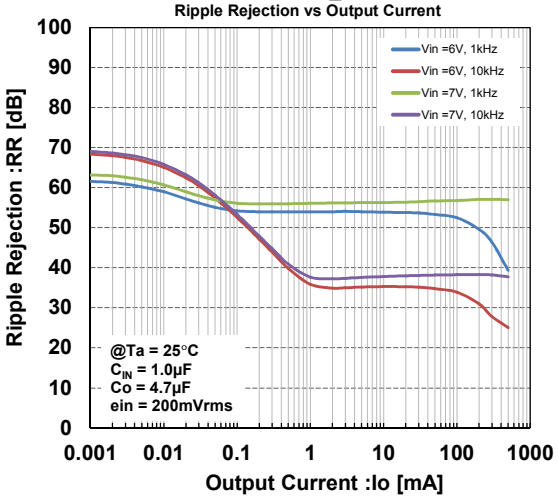
NJW4116_A46
Short Circuit Current vs Input Voltage



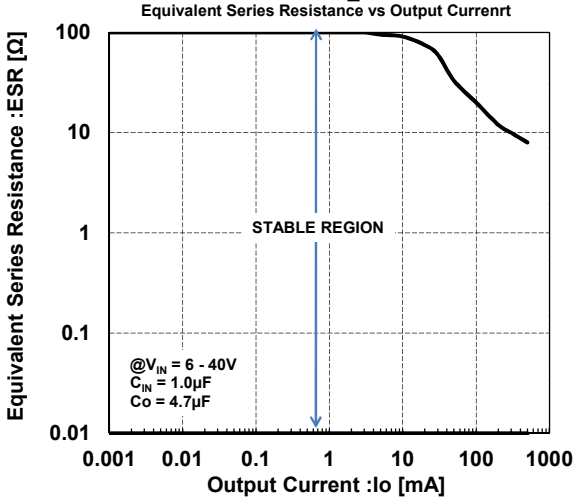
NJW4116_A46
Ripple Rejection vs Frequency



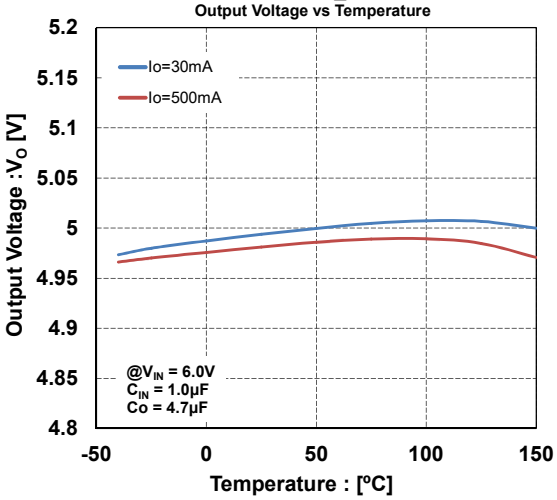
NJW4116_A46
Ripple Rejection vs Output Current

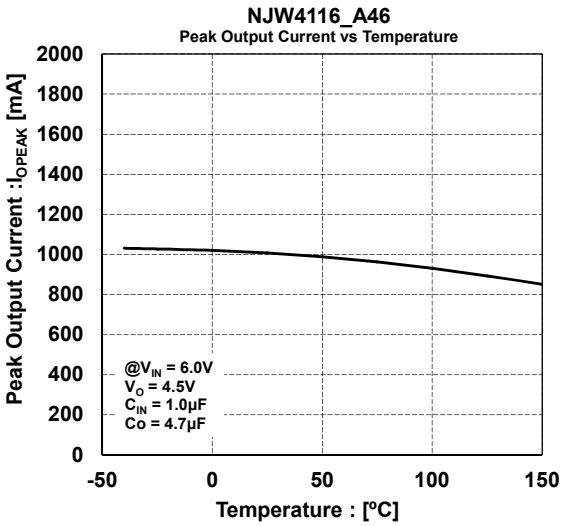


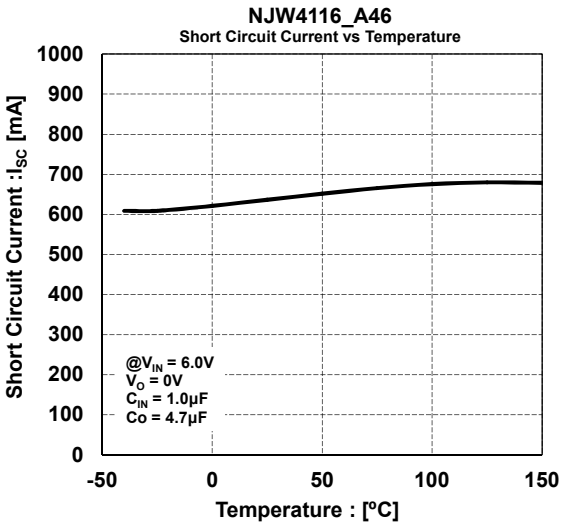
NJW4116_A46
Equivalent Series Resistance vs Output Currenrt

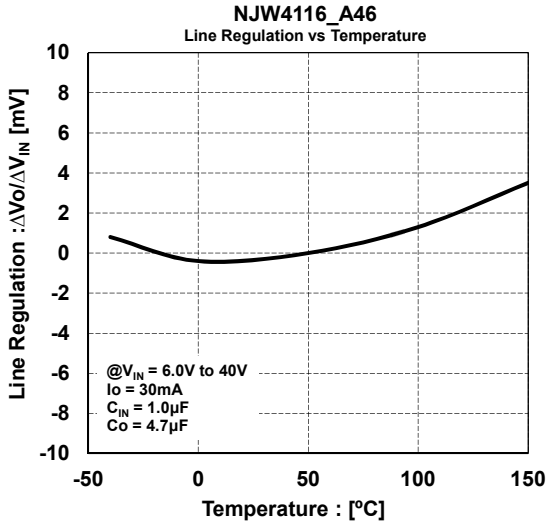


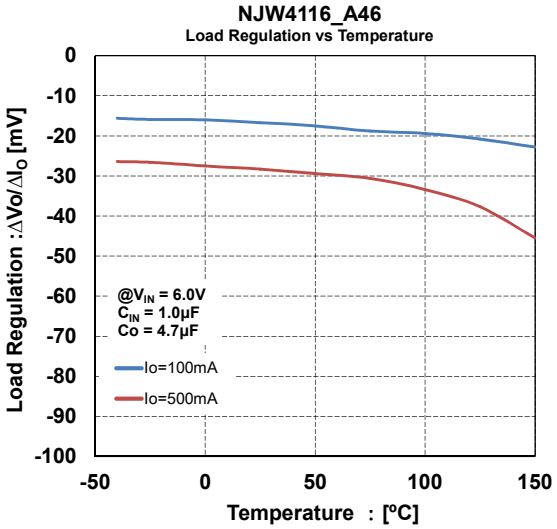
NJW4116_A46
Output Voltage vs Temperature

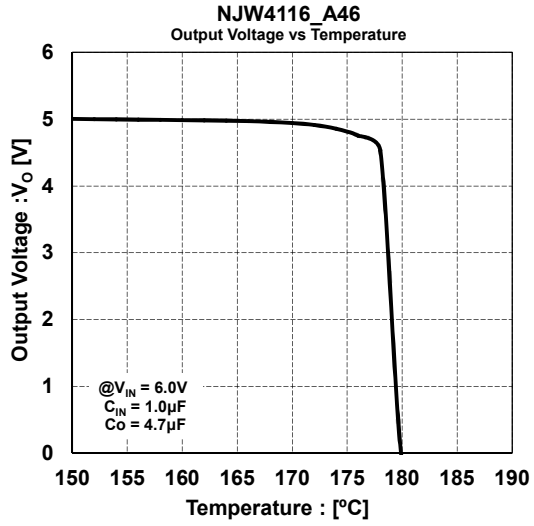


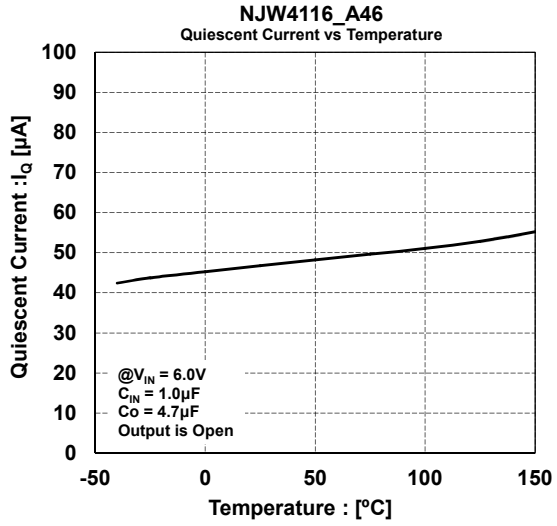

NJW4116_A46
Peak Output Current vs Temperature
Peak Output Current :I_{OPEAK} [mA]
2000
1800
1600
1400
1200
1000
800
600
400
200
0
-50
0
50
100
150
Temperature : [°C]
@V_{IN} = 6.0V
V_O = 4.5V
C_{IN} = 1.0µF
Co = 4.7µF


NJW4116_A46
Short Circuit Current vs Temperature
Short Circuit Current :I_{SC} [mA]
1000
900
800
700
600
500
400
300
200
100
0
-50
0
50
100
150
Temperature : [°C]
@V_{IN} = 6.0V
V_O = 0V
C_{IN} = 1.0µF
Co = 4.7µF

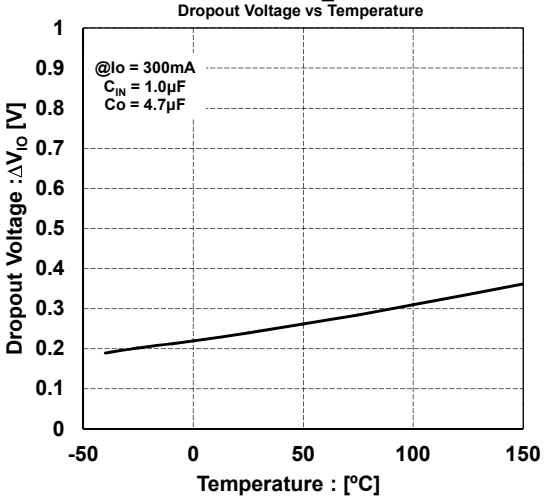

NJW4116_A46
Line Regulation vs Temperature
Line Regulation :ΔVo/ΔV$_{IN}$ [mV]
10
8
6
4
2
0
-2
-4
-6
-8
-10
-50
0
50
100
150
Temperature : [°C]
@V_{IN} = 6.0V to 40V
Io = 30mA
C_{IN} = 1.0µF
Co = 4.7µF


NJW4116_A46
Load Regulation vs Temperature
Load Regulation :ΔVo/ΔI$_O$ [mV]
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-50
0
50
100
150
Temperature : [°C]
@V_{IN} = 6.0V
C_{IN} = 1.0µF
Co = 4.7µF
Io=100mA
Io=500mA

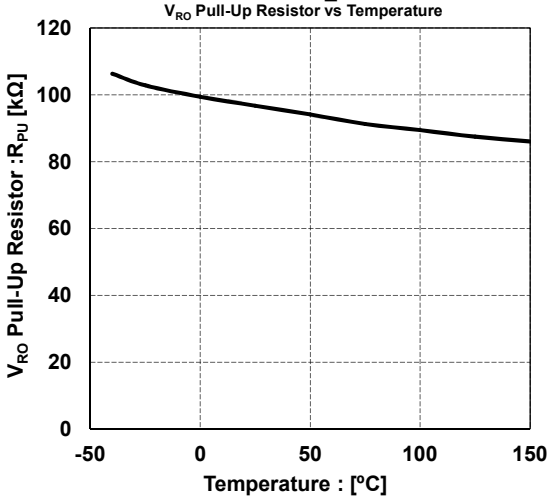

NJW4116_A46
Output Voltage vs Temperature
Output Voltage :V_O [V]
6
5
4
3
2
1
0
150
155
160
165
170
175
180
185
190
Temperature : [°C]
@V_{IN} = 6.0V
C_{IN} = 1.0µF
Co = 4.7µF


NJW4116_A46
Quiescent Current vs Temperature
Quiescent Current :I_Q [µA]
100
90
80
70
60
50
40
30
20
10
0
-50
0
50
100
150
Temperature : [°C]
@V_{IN} = 6.0V
C_{IN} = 1.0µF
Co = 4.7µF
Output is Open

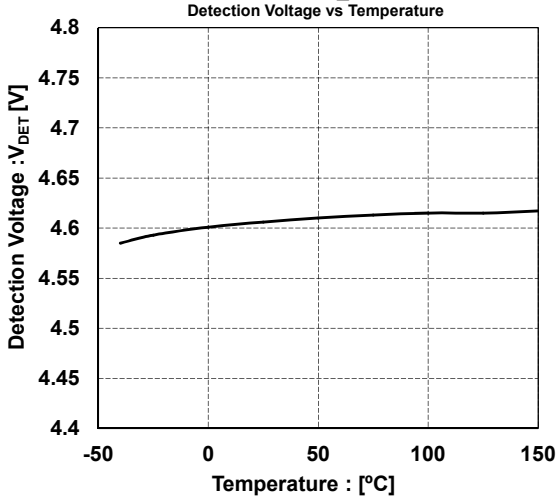
NJW4116_A46
Dropout Voltage vs Temperature



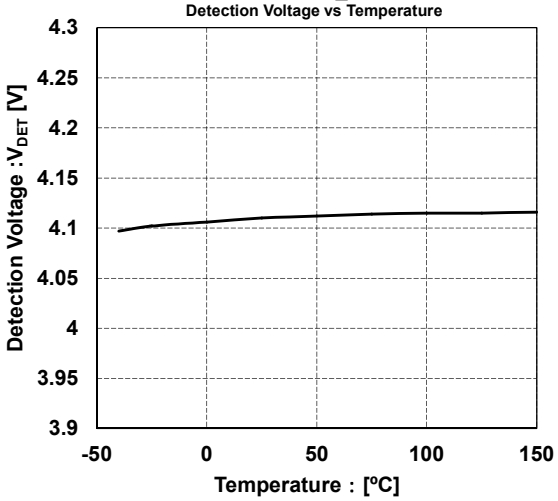
NJW4116_A46
VRO Pull-Up Resistor vs Temperature



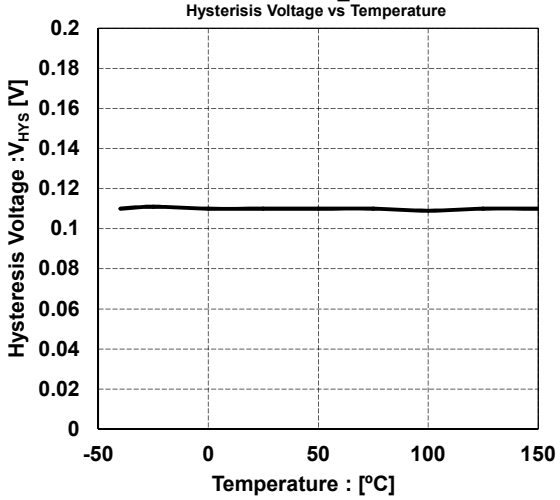
NJW4116_A46
Detection Voltage vs Temperature



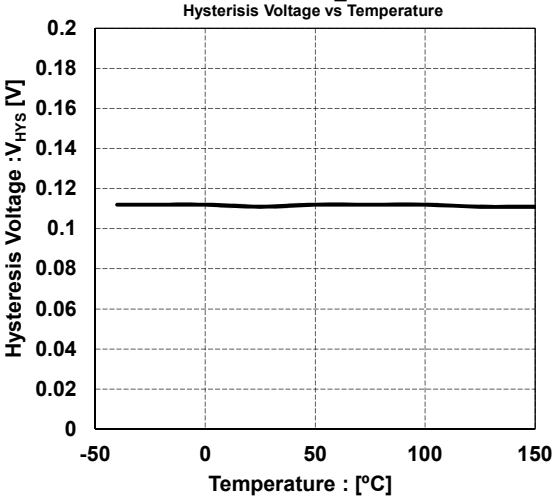
NJW4116_A41
Detection Voltage vs Temperature

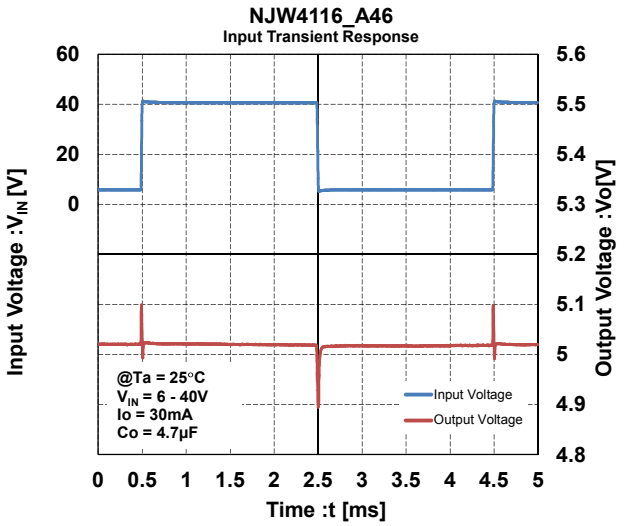


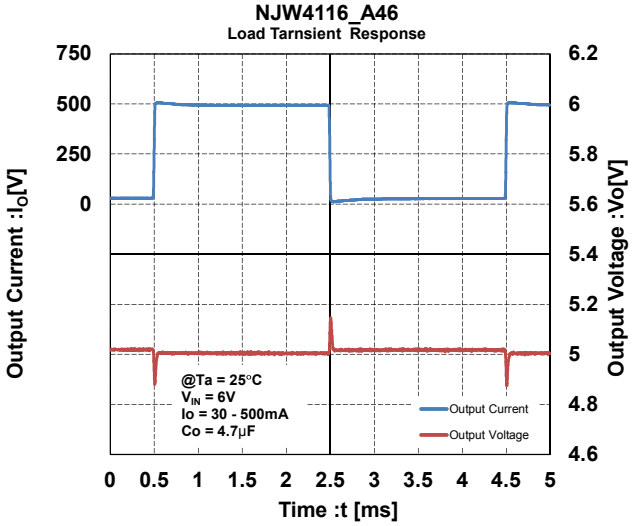
NJW4116_A46
Hysterisis Voltage vs Temperature



NJW4116_A41
Hysterisis Voltage vs Temperature




NJW4116_A46
Input Transient Response
Input Voltage :V_{IN} [V]
Output Voltage :Vo[V]
Time :t [ms]
@Ta = 25°C
V_{IN} = 6 - 40V
Io = 30mA
Co = 4.7µF
Input Voltage
Output Voltage


NJW4116_A46
Load Tarnsient Response
Output Current :I_O[V]
Output Voltage :Vo[V]
Time :t [ms]
@Ta = 25°C
V_{IN} = 6V
Io = 30 - 500mA
Co = 4.7µF
Output Current
Output Voltage

[CAUTION]
The specifications on this databook are only given for information , without any guarantee as regards either mistakes or omissions. The application circuits in this databook are described only to show representative usages of the product and not intended for the guarantee or permission of any right including the industrial rights.