NCV4269A

5.0 V Micropower 150 mA LDO Linear Regulator with DELAY, Adjustable RESET, and Sense Output

The NCV4269A is a 5.0 V precision micropower voltage regulator with an output current capability of 150 mA.

The output voltage is accurate within ±2.0% with a maximum dropout voltage of 0.5 V at 100 mA. Low quiescent current is a feature drawing only 240 μA with a 1.0 mA load. This part is ideal for any and all battery operated microprocessor equipment.

Microprocessor control logic includes an active reset output RO with delay and a SI/SO monitor which can be used to provide an early warning signal to the microprocessor of a potential impending reset signal. The use of the SI/SO monitor allows the microprocessor to finish any signal processing before the reset shuts the microprocessor down.

The active Reset circuit operates correctly at an output voltage as low as 1.0 V. The Reset function is activated during the power up sequence or during normal operation if the output voltage drops outside the regulation limits.

The reset threshold voltage can be decreased by the connection of an external resistor divider to the R_{ADJ} lead. The regulator is protected against reverse battery, short circuit, and thermal overload conditions. The device can withstand load dump transients making it suitable for use in automotive environments. The device has also been optimized for EMC conditions.

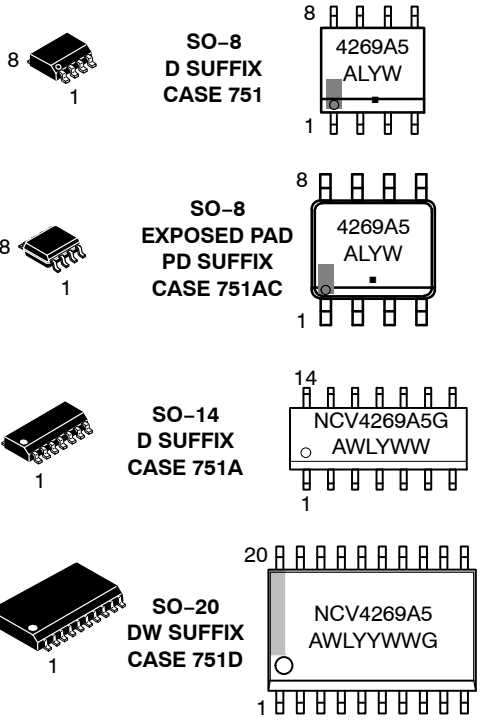
Features

- 5.0 V ± 2.0% Output
- Low 240 μA Quiescent Current
- Active Reset Output Low Down to V_Q = 1.0 V
- Adjustable Reset Threshold
- 150 mA Output Current Capability
- Fault Protection
  - +60 V Peak Transient Voltage
  - −40 V Reverse Voltage
  - Short Circuit
  - Thermal Overload
- Early Warning through SI/SO Leads
- Internally Fused Leads in SO−14 and SO−20 Packages
- Integrated Pullup Resistor at Logic Outputs (To Use External Resistors, Select the NCV4279A)
- Very Low Dropout Voltage
- Electrical Parameters Guaranteed Over Entire Temperature Range
- NCV Prefix for Automotive and Other Applications Requiring Site and Control Changes
- These are Pb−Free Devices

ON Semiconductor®

http://onsemi.com

MARKING DIAGRAMS



A = Assembly Location
WL, L = Wafer Lot
YY, Y = Year
WW, W = Work Week
G, ▪ = Pb Free

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 13 of this data sheet.

© Semiconductor Components Industries, LLC, 2009

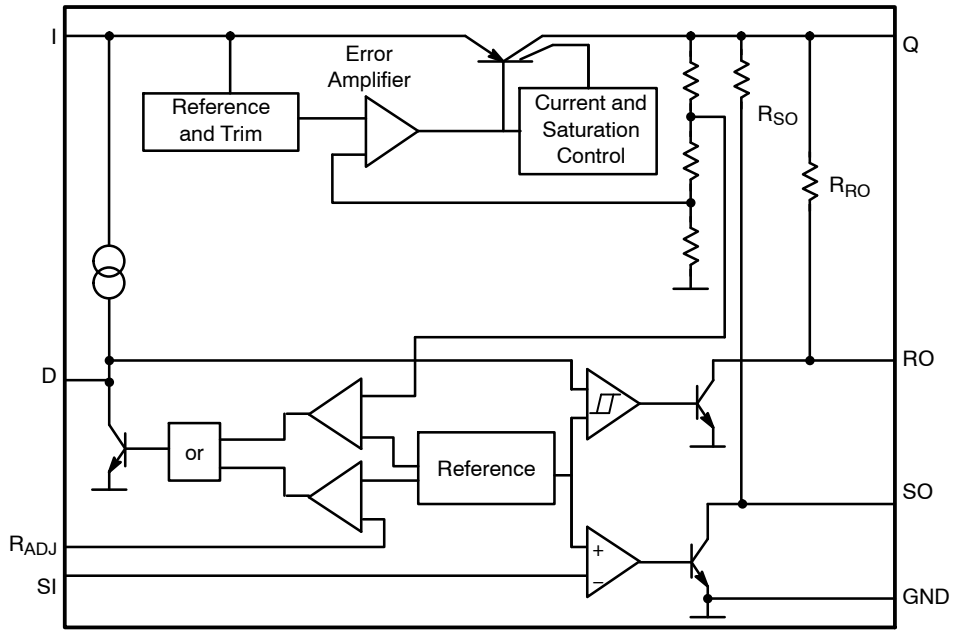
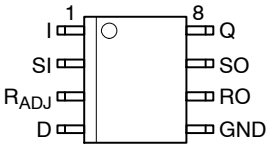
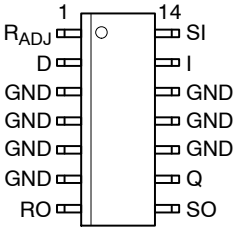


Figure 1. Block Diagram

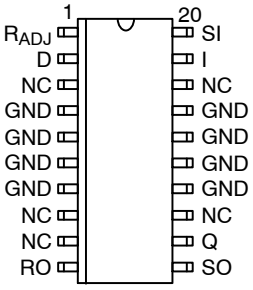
PIN CONNECTIONS



SO−8



SO−14



SO−20L

PACKAGE PIN DESCRIPTION

Package Pin Number				Pin Symbol	Function
SO−8	SO−8 EP	SO−14	SO−20L		
3	3	1	1	R_{ADJ}	Reset Threshold Adjust; if not used to connect to GND.
4	4	2	2	D	Reset Delay; To Set Time Delay, Connect to GND with Capacitor
5	5	3, 4, 5, 6, 10, 11, 12	4, 5, 6, 7, 14, 15, 16, 17	GND	Ground
–	–	–	3, 8, 9, 13, 18	NC	No connection to these pins from the IC.
6	6	7	10	RO	Reset Output; The Open−Collector Output has a 20 kΩ Pullup Resistor to Q. Leave Open if Not Used.
7	7	8	11	SO	Sense Output; This Open−Collector Output is Internally Pulled Up by 20 kΩ pullup resistor to Q. If not used, keep open.
8	8	9	12	Q	5 V Output; Connect to GND with a 10 μF Capacitor, ESR < 10 Ω.
1	1	13	19	I	Input; Connect to GND Directly at the IC with a Ceramic Capacitor.
2	2	14	20	SI	Sense Input; If not used, Connect to Q.
–	EPAD	–	–	EPAD	Connect to ground potential or leave unconnected

MAXIMUM RATINGS (T_J = −40°C to 150°C)

Parameter	Symbol	Min	Max	Unit
Input to Regulator	V_I I_I	−40 Internally Limited	45 Internally Limited	V
Input Transient to Regulator	V_I	–	60	V
Sense Input	V_{SI} I_{SI}	−40 −1	45 1	V mA
Reset Threshold Adjust	V_{RADJ} I_{RADJ}	−0.3 −10	7 10	V mA
Reset Delay	V_D I_D	−0.3 Internally Limited	7 Internally Limited	V
Ground	I_q	50	–	mA
Reset Output	V_{RO} I_{RO}	−0.3 Internally Limited	7 Internally Limited	V
Sense Output	V_{SO} I_{SO}	−0.3 Internally Limited	7 Internally Limited	V
Regulated Output	V_Q I_Q	−0.5 −10	7.0 –	V mA
Junction Temperature Storage Temperature	T_J T_{STG}	– −50	150 150	°C °C
Input Voltage Operating Range Junction Temperature Operating Range	V_I T_J	– −40	45 150	V °C

LEAD TEMPERATURE SOLDERING AND MSL

Parameter	Symbol	Value
MSL, 20−Lead LS Temperature 265°C Peak (Note 3)	MSL	3
MSL, 8−Lead, 14−Lead, LS Temperature 265°C Peak (Note 3)	MSL	1
MSL, 8−Lead EP, LS Temperature 260°C	MSL	2

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

1. This device series incorporates ESD protection and exceeds the following ratings:
   Human Body Model (HBM) ≤ 4.0 kV per AEC−Q100−002.
   Machine Model (MM) ≤ 200 V per AEC−Q100−003.
2. Latchup Current Maximum Rating: ≤ 150 mA per AEC−Q100−004.
3. +5°C/−0°C, 40 Sec Max−at−Peak, 60 – 150 Sec above 217°C.

THERMAL CHARACTERISTICS

Characteristic	Test Conditions (Typical Values)	Unit
SO−8 Package (Note 4)		
Junction−to−Pin 4 (Ψ − JL4, Ψ_{L4})	53.8	°C/W
Junction−to−Ambient Thermal Resistance ($R_{\theta JA}$, θ_{JA})	170.9	°C/W
SO−8 EP Package (Note 4)		
Junction−to−Pin 8 (Ψ − JL8, Ψ_{L8})	23.7	°C/W
Junction−to−Ambient Thermal Resistance ($R_{\theta JA}$, θ_{JA})	71.4	°C/W
Junction−to−Pad (Ψ − JPad)	7.7	°C/W
SO−14 Package (Note 4)		
Junction−to−Pin 4 (Ψ − JL4, Ψ_{L4})	18.4	°C/W
Junction−to−Ambient Thermal Resistance ($R_{\theta JA}$, θ_{JA})	111.6	°C/W
SO−20 Package (Note 4)		
Junction−to−Pin 4 (Ψ − JL4, Ψ_{L4})	21.8	°C/W
Junction−to−Ambient Thermal Resistance ($R_{\theta JA}$, θ_{JA})	95.3	°C/W

4. 2 oz copper, 50 mm^2 copper area, 1.5 mm thick FR4

ELECTRICAL CHARACTERISTICS ($T_J = -40°C \le T_J \le 125°C$, V_I = 13.5 V unless otherwise specified)

Characteristic	Symbol	Test Conditions	Min	Typ	Max	Unit
REGULATOR						
Output Voltage	V_Q	1 mA ≤ I_Q ≤ 100 mA 6 V ≤ V_I ≤ 16 V	4.90	5.00	5.10	V
Current Limit	I_Q	–	150	200	500	mA
Current Consumption; $I_q = I_I - I_Q$	I_q	I_Q = 1 mA, RO, SO High	–	190	250	μA
Current Consumption; $I_q = I_I - I_Q$	I_q	I_Q = 10 mA, RO, SO High	–	250	450	μA
Current Consumption; $I_q = I_I - I_Q$	I_q	I_Q = 50 mA, RO, SO High	–	2.0	3.0	mA
Dropout Voltage	V_{dr}	V_I = 5 V, I_Q = 100 mA	–	0.25	0.5	V
Load Regulation	ΔV_Q	I_Q = 5 mA to 100 mA	–	10	20	mV
Line Regulation	ΔV_Q	V_I = 6 V to 26 V I_Q = 1 mA	–	10	30	mV
RESET GENERATOR						
Reset Switching Threshold	V_{RT}	–	4.50	4.65	4.80	V
Reset Adjust Switching Threshold	$V_{RADJ,TH}$	V_Q > 3.5 V	1.26	1.35	1.44	V
Reset Pullup Resistance	$R_{SO,INT}$	–	10	20	40	kΩ
Reset Output Saturation Voltage	$V_{RO,SAT}$	$V_Q < V_{RT}$, $R_{RO,\ INT}$	–	0.1	0.4	V
Upper Delay Switching Threshold	V_{UD}	–	1.4	1.8	2.2	V
Lower Delay Switching Threshold	V_{LD}	–	0.3	0.45	0.60	V
Saturation Voltage on Delay Capacitor	$V_{D,SAT}$	$V_Q < V_{RT}$	–	–	0.1	V
Charge Current	$I_{D,C}$	V_D = 1 V	3.0	6.5	9.5	μA
Delay Time L → H	t_d	C_D = 100 nF	17	28	–	ms
Delay Time H → L	t_{RR}	C_D = 100 nF	–	3.15	–	μs
INPUT VOLTAGE SENSE						
Sense Threshold High	$V_{SI,High}$	–	1.24	1.31	1.38	V
Sense Threshold Low	$V_{SI,Low}$	–	1.16	1.20	1.28	V
Sense Output Saturation Voltage	$V_{SO,Low}$	V_{SI} < 1.20 V; V_Q > 3 V; R_{SO}	–	0.1	0.4	V
Sense Resistor Pullup	$R_{SO,INT}$	–	10	20	40	kΩ
Sense Input Current	I_{SI}	–	−1.0	0.1	1.0	μA

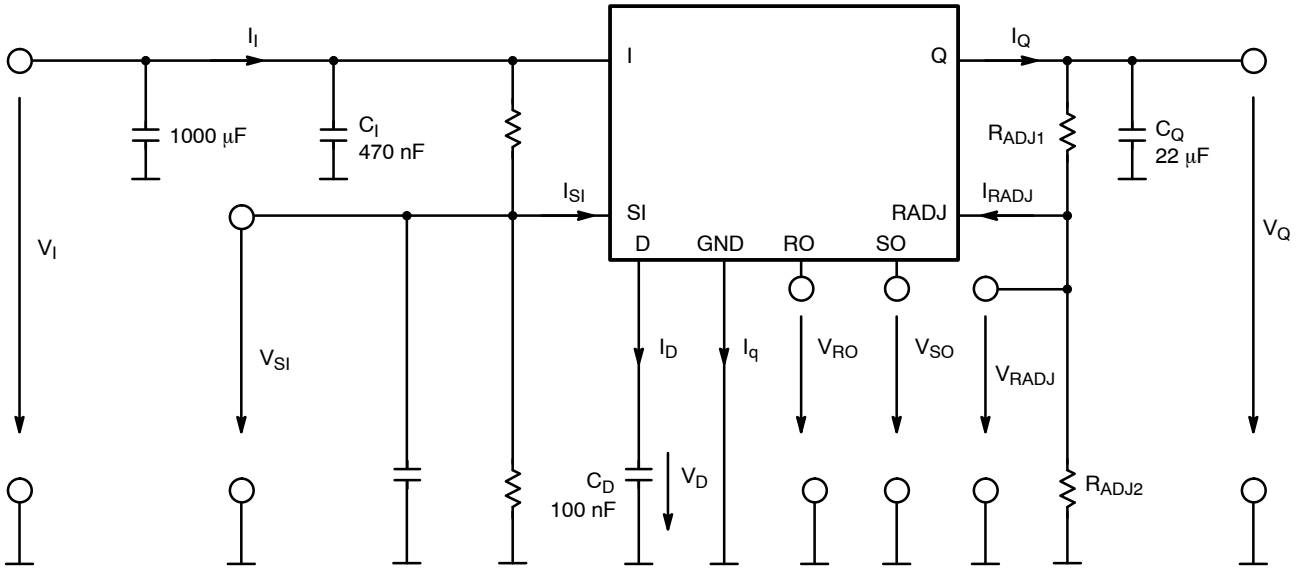


Figure 2. Measuring Circuit

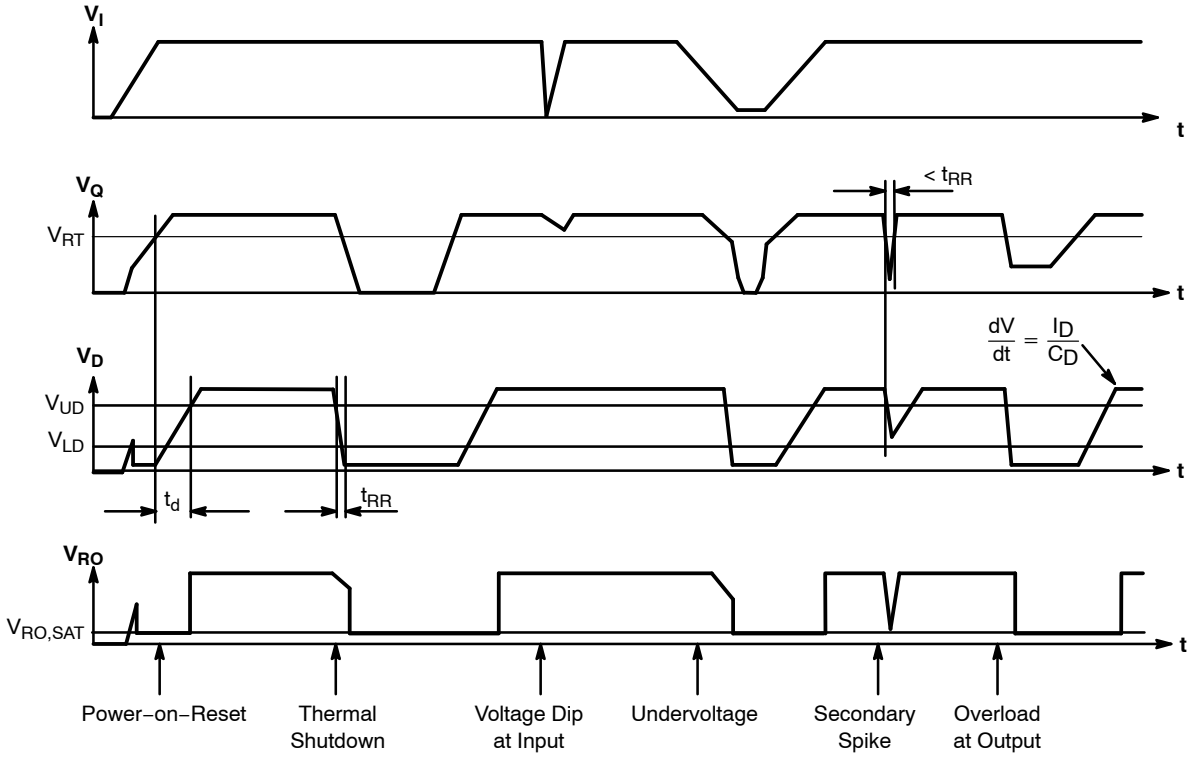


Figure 3. Reset Timing Diagram

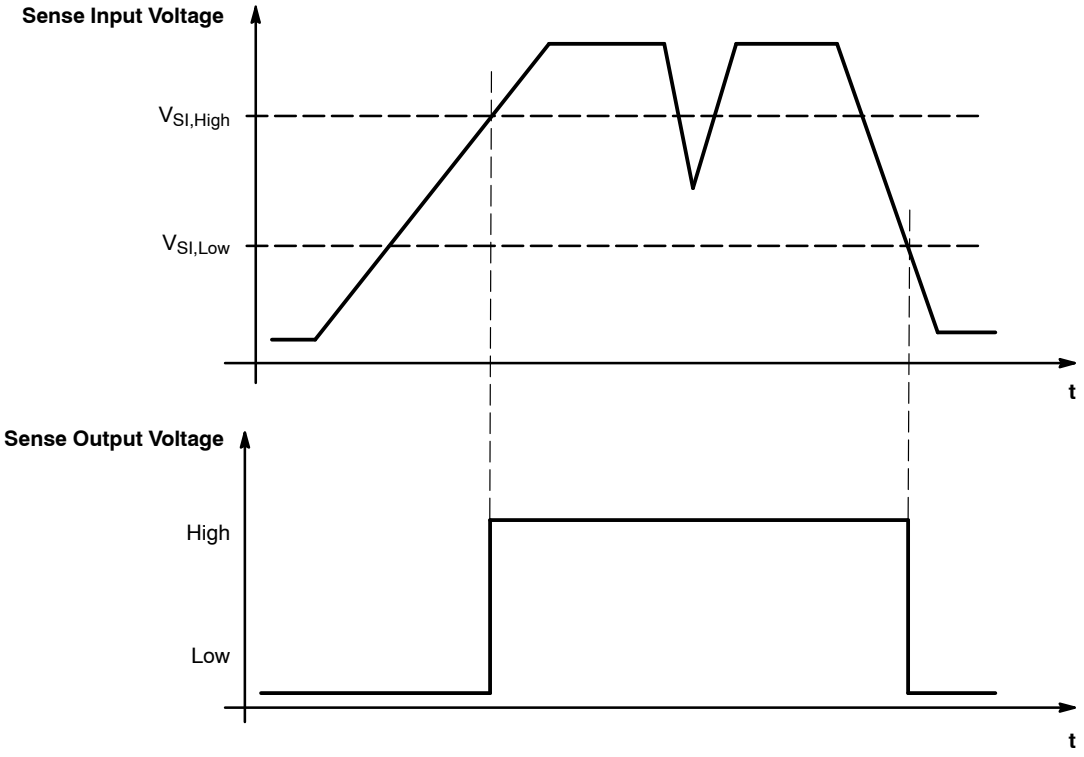


Figure 4. Sense Timing Diagram

TYPICAL PERFORMANCE CHARACTERISTICS

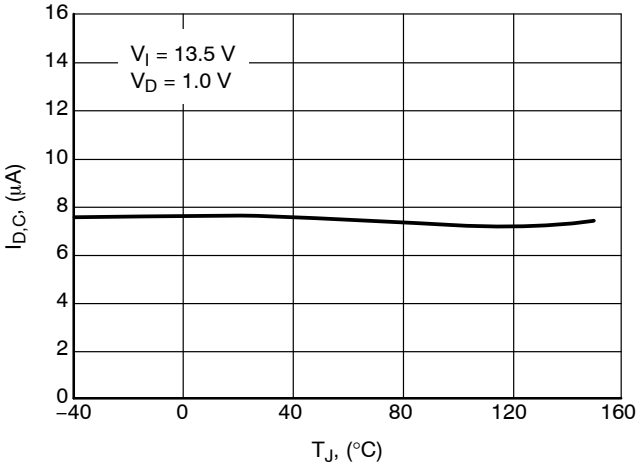


Figure 5. Charge Current $I_{D,C}$ vs. Temperature T_J

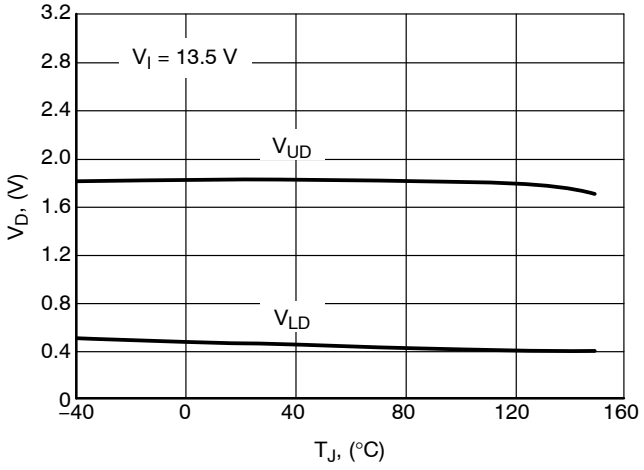


Figure 6. Switching Voltage V_{UD} and V_{LD} vs. Temperature T_J

TYPICAL PERFORMANCE CHARACTERISTICS

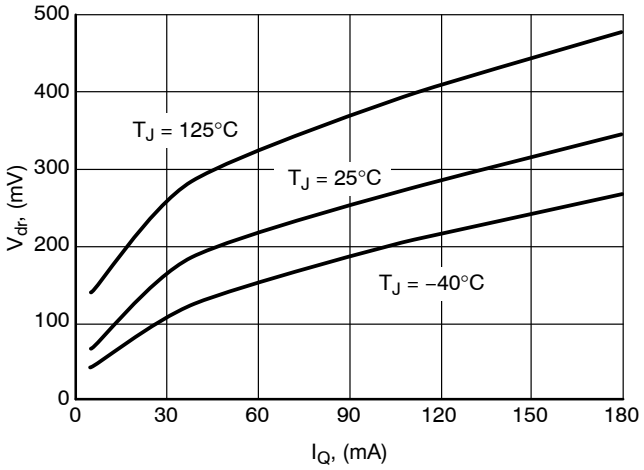


Figure 7. Drop Voltage V_{dr} vs. Output Current I_Q

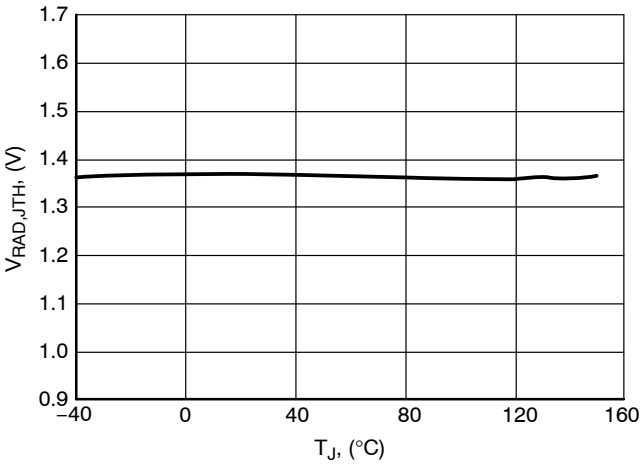


Figure 8. Reset Adjust Switching Threshold, $V_{RADJ,TH}$ vs. Temperature T_J

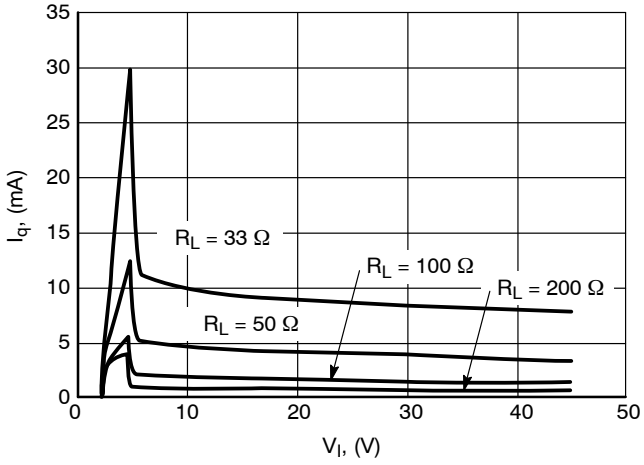


Figure 9. Current Consumption I_q vs. Input Voltage V_I

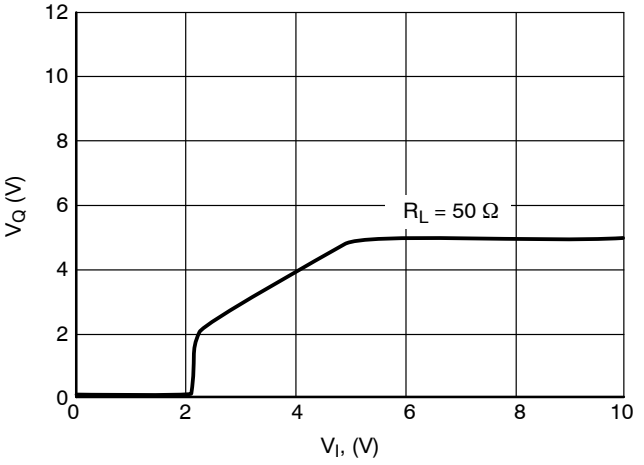


Figure 10. Output Voltage V_Q vs. Input Voltage V_I

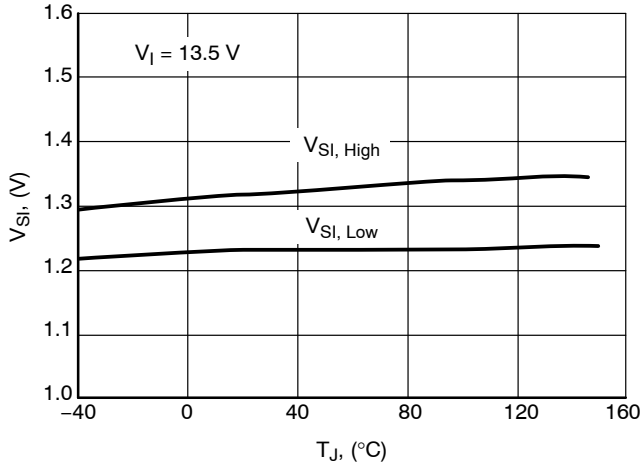


Figure 11. Sense Threshold V_{SI} vs. Temperature T_J

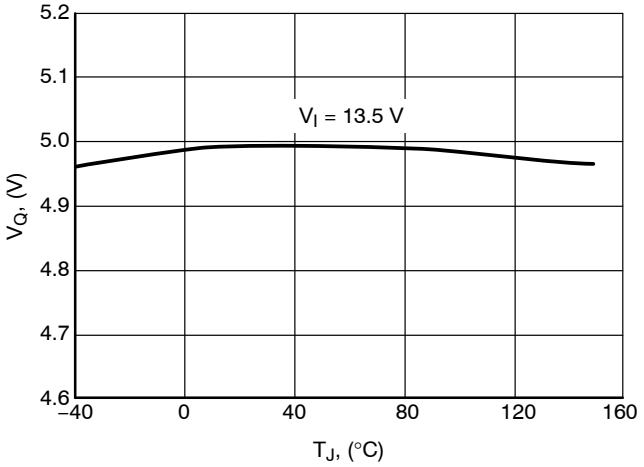


Figure 12. Output Voltage V_Q vs. Temperature T_J

TYPICAL PERFORMANCE CHARACTERISTICS

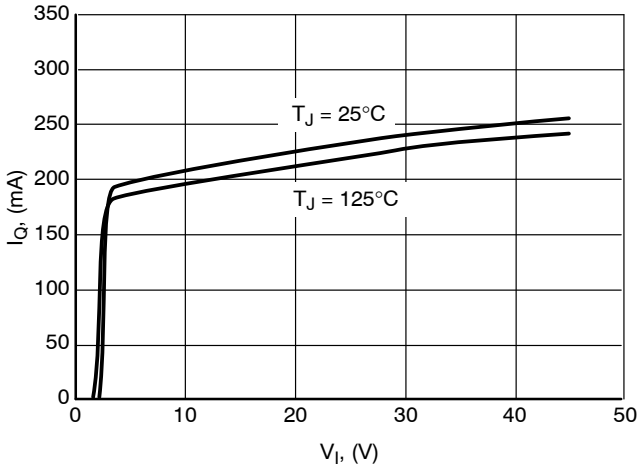


Figure 13. Output Current Limit I_Q vs. Input Voltage V_I

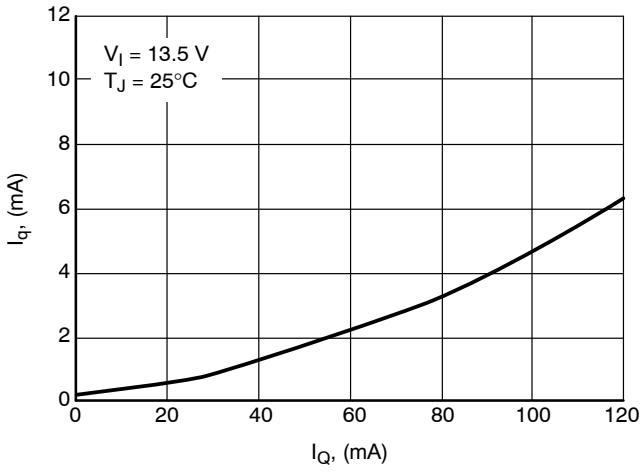


Figure 14. Current Consumption I_q vs. Output Current I_Q

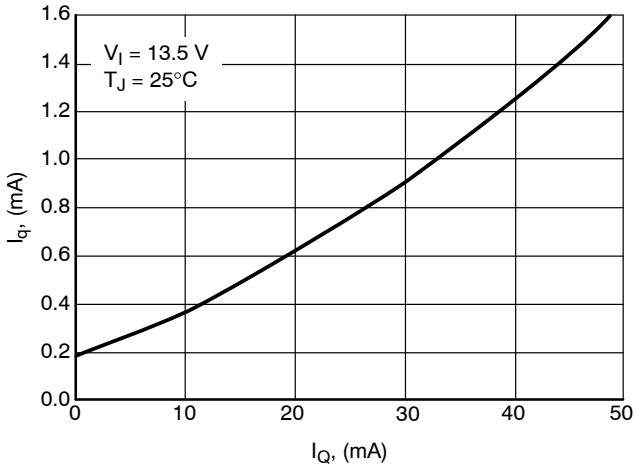


Figure 15. Current Consumption I_q vs. Output Current I_Q

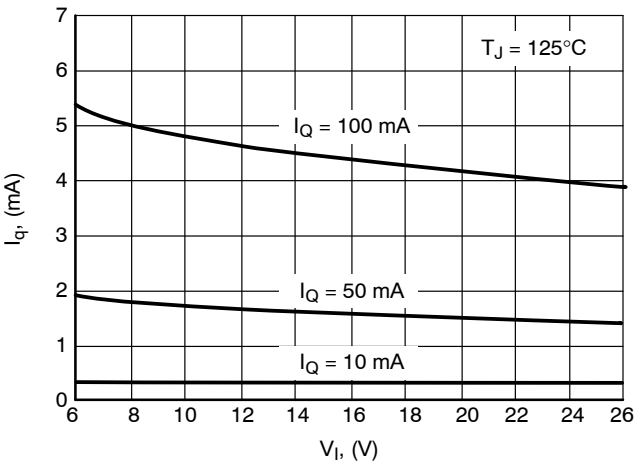


Figure 16. Quiescent Current I_q vs. Input Voltage V_I

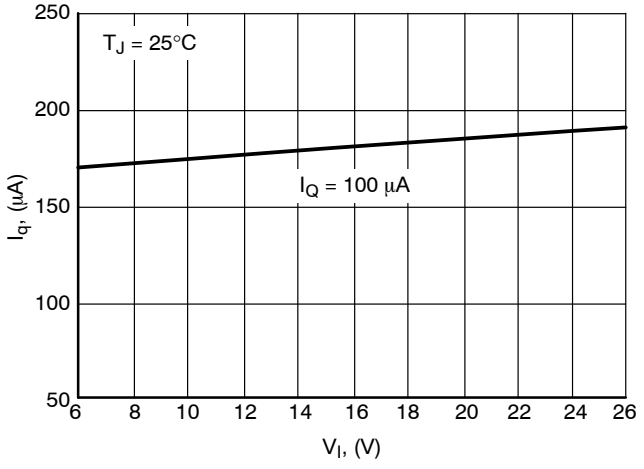


Figure 17. Quiescent Current I_q vs. Input Voltage V_I

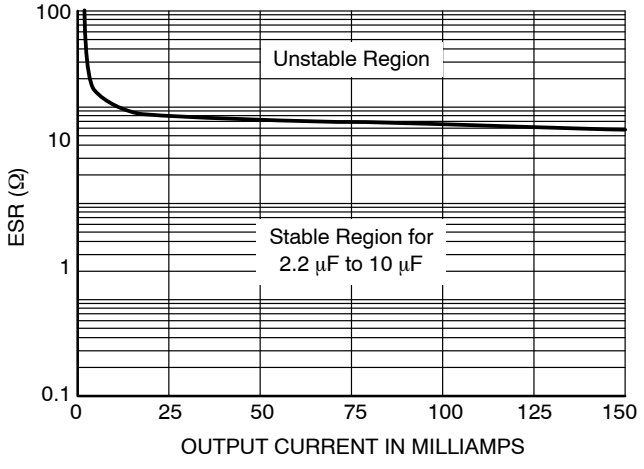


Figure 18. Output Stability, Capacitance ESR vs. Output Load Current

TYPICAL THERMAL CHARACTERISTICS

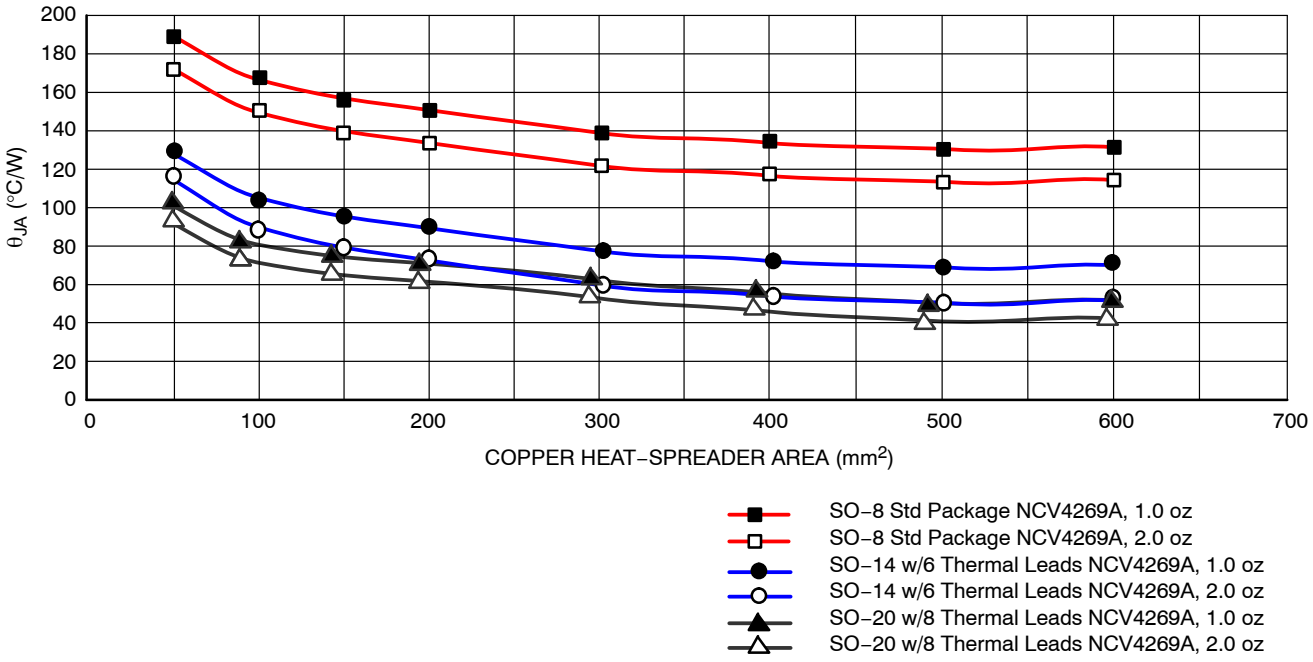


Figure 19. Junction−to−Ambient Thermal Resistance (θ_{JA}) vs. Heat Spreader Area

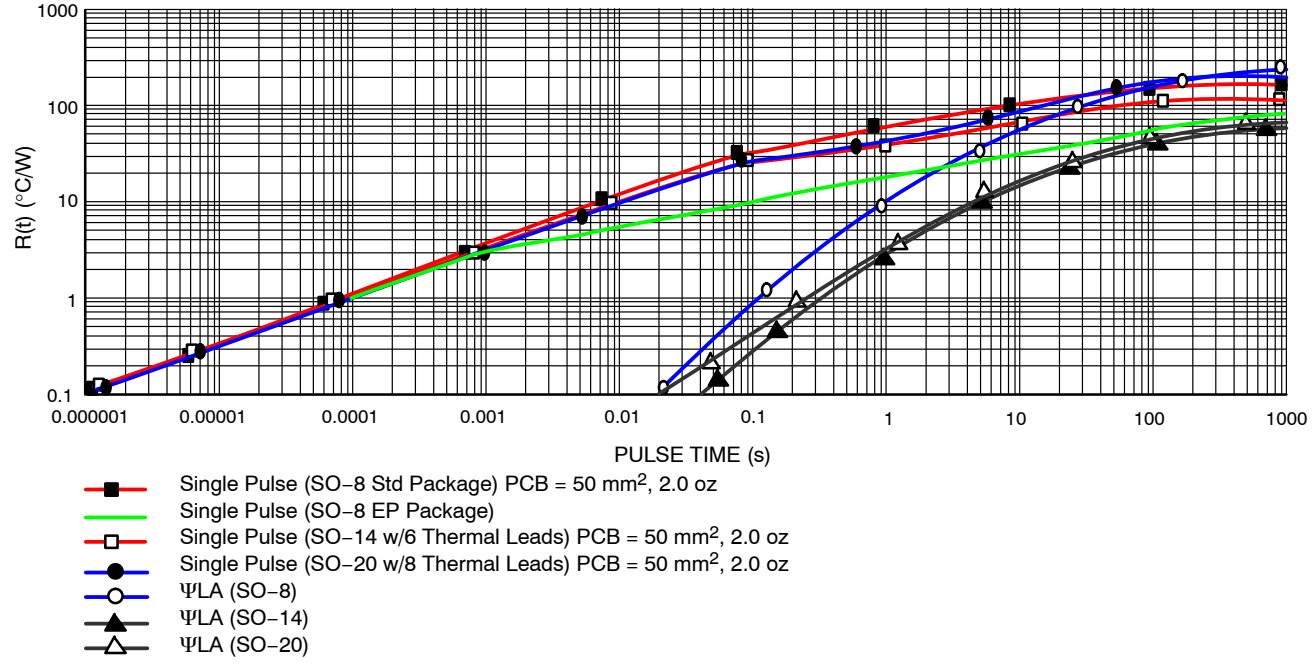


Figure 20. R(t) vs. Pulse Time

APPLICATION DESCRIPTION

OUTPUT REGULATOR

The output is controlled by a precision trimmed reference. The PNP output has base drive quiescent current control for regulation while the input voltage is low, preventing over saturation. Current limit and voltage monitors complement the regulator design to give safe operating signals to the processor and control circuits.

RESET OUTPUT (RO)

A reset signal, Reset Output, RO, (low voltage) is generated as the IC powers up. After the output voltage V_Q increases above the reset threshold voltage V_{RT}, the delay timer D is started. When the voltage on the delay timer V_D passes V_{UD}, the reset signal RO goes high. A discharge of the delay timer V_D is started when V_Q drops and stays below the reset threshold voltage V_{RT}. When the voltage of the delay timer V_D drops below the lower threshold voltage V_{LD} the reset output voltage V_{RO} is brought low to reset the processor.

The reset output RO is an open collector NPN transistor with an internal 20 kΩ pullup resistor connected to the output Q, controlled by a low voltage detection circuit. The circuit is functionally independent of the rest of the IC, thereby guaranteeing that RO is valid for V_Q as low as 1.0 V.

RESET ADJUST (R_{ADJ})

The reset threshold V_{RT} can be decreased from a typical value of 4.65 V to as low as 3.5 V by using an external voltage divider connected from the Q lead to the pin R_{ADJ}, as shown in Figure 21. The resistor divider keeps the voltage above the $V_{RADJ,TH}$ (typical 1.35 V) for the desired input voltages, and overrides the internal threshold detector. Adjust the voltage divider according to the following relationship:

$$V_{RT} = V_{RADJ,TH} \cdot (R_{ADJ1} + R_{ADJ2}) / R_{ADJ2} \quad \text{(eq. 1)}$$

If the reset adjust option is not needed, the R_{ADJ} pin should be connected to GND causing the reset threshold to go to its default value (typically 4.65 V).

RESET DELAY (D)

The reset delay circuit provides a delay (programmable by capacitor C_D) on the reset output lead RO. The delay lead D provides charge current $I_{D,C}$ (typically 6.5 μA) to the external delay capacitor C_D during the following times:

1. During Powerup (once the regulation threshold has been exceeded).
2. After a reset event has occurred and the device is back in regulation. The delay capacitor is set to discharge when the regulation (V_{RT}, reset threshold voltage) has been violated. When the delay capacitor discharges to V_{LD}, the reset signal RO pulls low.

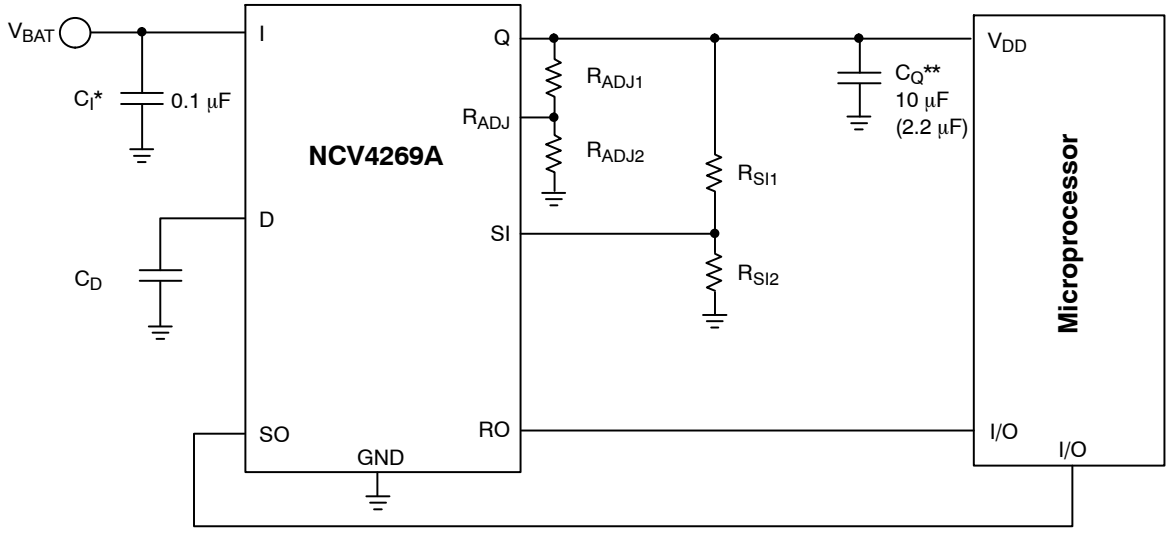
SETTING THE DELAY TIME

The delay time is set by the delay capacitor C_D and the charge current I_D. The time is measured by the delay capacitor voltage charging from the low level of V_{DSAT} to the higher level V_{UD}. The time delay follows the equation:

$$t_d = [C_D (V_{UD} - V_{D,SAT})]/I_{D,C} \quad \text{(eq. 2)}$$

Example:
Using C_D = 100 nF.
Use the typical value for $V_{D,SAT}$ = 0.1 V.
Use the typical value for V_{UD} = 1.8 V.
Use the typical value for Delay Charge Current I_D = 6.5 μA.

$$t_d = [100\ nF\,(1.8 - 0.1\ V)] / 6.5\ \mu A = 26.2\ ms \quad \text{(eq. 3)}$$



*C_I required if regulator is located far from the power supply filter.
** C_Q – minimum cap required for stability is 2.2 μF while higher over/under−shoots may be expected. Cap must operate at minimum temperature expected.

Figure 21. Application Diagram

SENSE INPUT (SI) / SENSE OUTPUT (SO) VOLTAGE MONITOR

An on−chip comparator is available to provide early warning to the microprocessor of a possible reset signal (Figure 4). The output is from an open collector driver with an internal 20 kΩ pull up resistor to output Q. The reset signal typically turns the microprocessor off instantaneously. This can cause unpredictable results with the microprocessor. The signal received from the SO pin will allow the microprocessor time to complete its present task before shutting down. This function is performed by a comparator referenced to the band gap voltage. The actual trip point can be programmed externally using a resistor divider to the input monitor SI (Figure 21). The values for R_{SI1} and R_{SI2} are selected for a typical threshold of 1.20 V on the SI Pin.

SIGNAL OUTPUT

Figure 22 shows the SO Monitor timing waveforms as a result of the circuit depicted in Figure 21. As the output voltage (V_Q) falls, the monitor threshold ($V_{SI,Low}$), is crossed. This causes the voltage on the SO output to go low sending a warning signal to the microprocessor that a reset signal may occur in a short period of time. $T_{WARNING}$ is the time the microprocessor has to complete the function it is currently working on and get ready for the reset shutdown signal. When the voltage on the SO goes low and the RO stays high the current consumption is typically 560 μA at 1 mA load current.

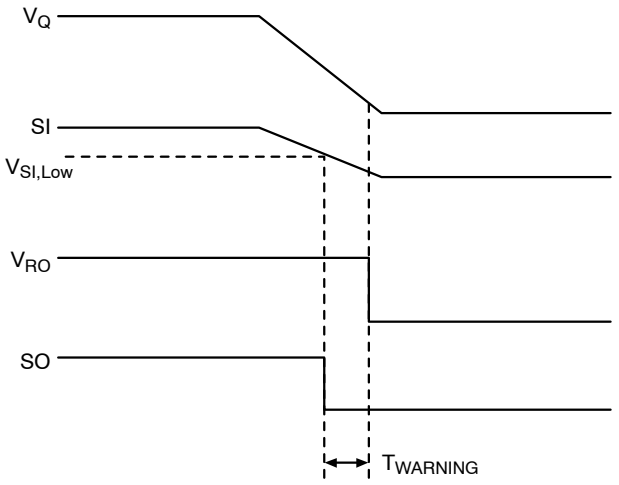


Figure 22. SO Warning Waveform Time Diagram

STABILITY CONSIDERATIONS

The input capacitor C_I in Figure 21 is necessary for compensating input line reactance. Possible oscillations caused by input inductance and input capacitance can be damped by using a resistor of approximately 1.0 Ω in series with C_I.

The output or compensation capacitor helps determine three main characteristics of a linear regulator: startup delay, load transient response and loop stability.

The capacitor value and type should be based on cost, availability, size and temperature constraints. The aluminum electrolytic capacitor is the least expensive solution, but, if the circuit operates at low temperatures (−25°C to −40°C), both the value and ESR of the capacitor will vary considerably. The capacitor manufacturer's data sheet usually provides this information.

The 10 μF output capacitor C_Q shown in Figure 21 should work for most applications; however, it is not necessarily the optimized solution. Stability is guaranteed at C_Q is min 2.2 μF and max ESR is 10 Ω. There is no min ESR limit which was proved with MURATA's ceramic caps GRM31MR71A225KA01 (2.2 μF, 10 V, X7R, 1206) and GRM31CR71A106KA01 (10 μF, 10 V, X7R, 1206) directly soldered between output and ground pins.

CALCULATING POWER DISSIPATION IN A SINGLE OUTPUT LINEAR REGULATOR

The maximum power dissipation for a single output regulator (Figure 21) is:

$$P_{D(max)} = [V_{I(max)} - V_{Q(min)}]I_{Q(max)} + V_{I(max)}I_q \quad \text{(eq. 4)}$$

where:
$V_{I(max)}$ is the maximum input voltage,
$V_{Q(min)}$ is the minimum output voltage,
$I_{Q(max)}$ is the maximum output current for the application, and I_q is the quiescent current the regulator consumes at $I_{Q(max)}$.

Once the value of $P_{D(max)}$ is known, the maximum permissible value of $R_{\theta JA}$ can be calculated:

$$R_{\theta JA} = (150°C - T_A) / P_D \quad \text{(eq. 5)}$$

The value of $R_{\theta JA}$ can then be compared with those in the package section of the data sheet. Those packages with $R_{\theta JA}$'s less than the calculated value in equation 2 will keep the die temperature below 150°C. In some cases, none of the packages will be sufficient to dissipate the heat generated by the IC, and an external heatsink will be required. The current flow and voltages are shown in the Measurement Circuit Diagram.

HEATSINKS

A heatsink effectively increases the surface area of the package to improve the flow of heat away from the IC and into the surrounding air.

Each material in the heat flow path between the IC and the outside environment will have a thermal resistance. Like series electrical resistances, these resistances are summed to determine the value of $R_{\theta JA}$:

$$R_{\theta JA} = R_{\theta JC} + R_{\theta CS} + R_{\theta SA} \quad \text{(eq. 6)}$$

where:
$R_{\theta JC}$ = the junction−to−case thermal resistance,
$R_{\theta CS}$ = the case−to−heat sink thermal resistance, and
$R_{\theta SA}$ = the heat sink−to−ambient thermal resistance.

$R_{\theta JC}$ appears in the package section of the data sheet. Like $R_{\theta JA}$, it too is a function of package type. $R_{\theta CS}$ and $R_{\theta SA}$ are functions of the package type, heatsink and the interface between them. These values appear in data sheets of heatsink manufacturers. Thermal, mounting, and heatsinking considerations are discussed in the ON Semiconductor application note AN1040/D, available on the ON Semiconductor website.

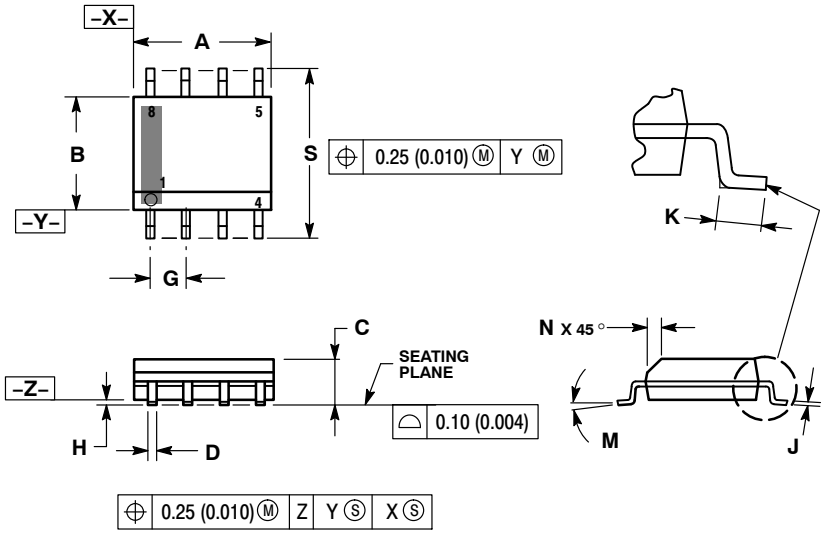
ORDERING INFORMATION

Device	Output Voltage	Package	Shipping†
NCV4269AD150G	5.0 V	SO−8 (Pb−Free)	98 Units/Rail
NCV4269AD150R2G		SO−8 (Pb−Free)	2500 Tape & Reel
NCV4269APD50G		SO−8 EP (Pb−Free)	98 Units/Rail
NCV4269APD50R2G		SO−8 EP (Pb−Free)	2500 Tape & Reel
NCV4269AD250G		SO−14 (Pb−Free)	55 Units/Rail
NCV4269AD250R2G		SO−14 (Pb−Free)	2500 Tape & Reel
NCV4269ADW50G		SO−20L (Pb−Free)	38 Units/Rail
NCV4269ADW50R2G		SO−20L (Pb−Free)	1000 Tape & Reel

†For information on tape and reel specifications,including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

PACKAGE DIMENSIONS

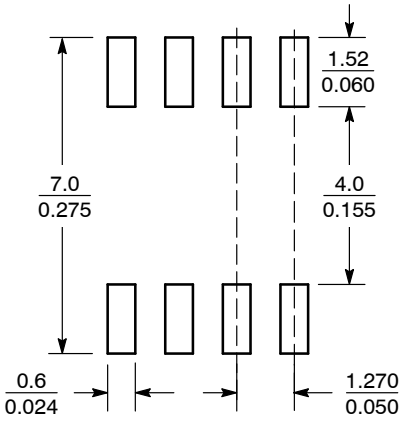
SOIC−8 NB
CASE 751−07
ISSUE AJ



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.
6. 751−01 THRU 751−06 ARE OBSOLETE. NEW STANDARD IS 751−07.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	4.80	5.00	0.189	0.197
B	3.80	4.00	0.150	0.157
C	1.35	1.75	0.053	0.069
D	0.33	0.51	0.013	0.020
G	1.27 BSC		0.050 BSC	
H	0.10	0.25	0.004	0.010
J	0.19	0.25	0.007	0.010
K	0.40	1.27	0.016	0.050
M	0 °	8 °	0 °	8 °
N	0.25	0.50	0.010	0.020
S	5.80	6.20	0.228	0.244

SOLDERING FOOTPRINT*

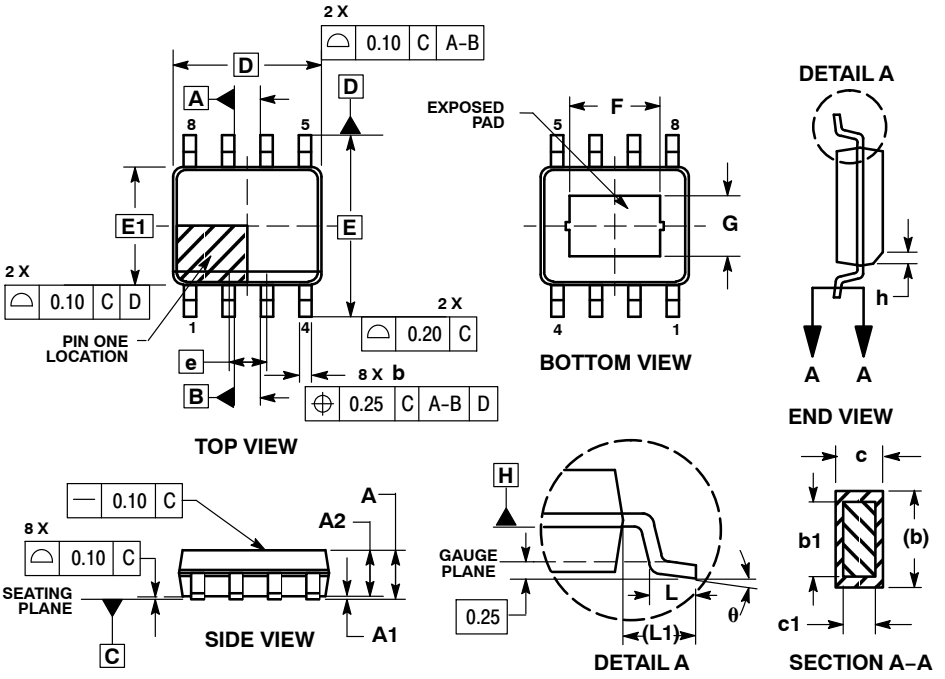


SCALE 6:1 $\left(\frac{\text{mm}}{\text{inches}}\right)$

*For additional information on our Pb−Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

PACKAGE DIMENSIONS

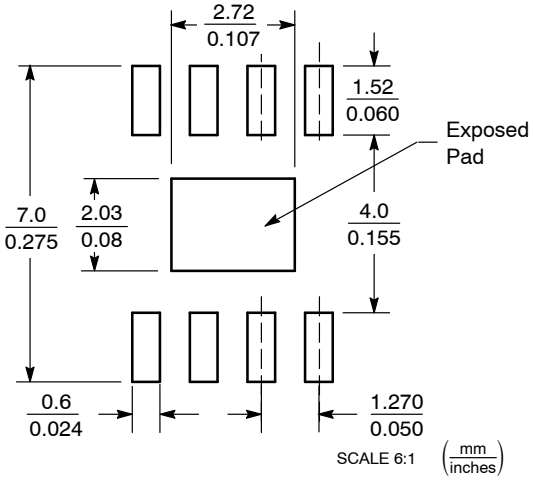
SOIC−8 EP
CASE 751AC−01
ISSUE B



NOTES:
1. DIMENSIONS AND TOLERANCING PER ASME Y14.5M, 1994.
2. DIMENSIONS IN MILLIMETERS (ANGLES IN DEGREES).
3. DIMENSION b DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 MM TOTAL IN EXCESS OF THE “b” DIMENSION AT MAXIMUM MATERIAL CONDITION.
4. DATUMS A AND B TO BE DETERMINED AT DATUM PLANE H.

	MILLIMETERS	
DIM	MIN	MAX
A	1.35	1.75
A1	0.00	0.10
A2	1.35	1.65
b	0.31	0.51
b1	0.28	0.48
c	0.17	0.25
c1	0.17	0.23
D	4.90 BSC	
E	6.00 BSC	
E1	3.90 BSC	
e	1.27 BSC	
L	0.40	1.27
L1	1.04 REF	
F	2.24	3.20
G	1.55	2.51
h	0.25	0.50
θ	0 °	8 °

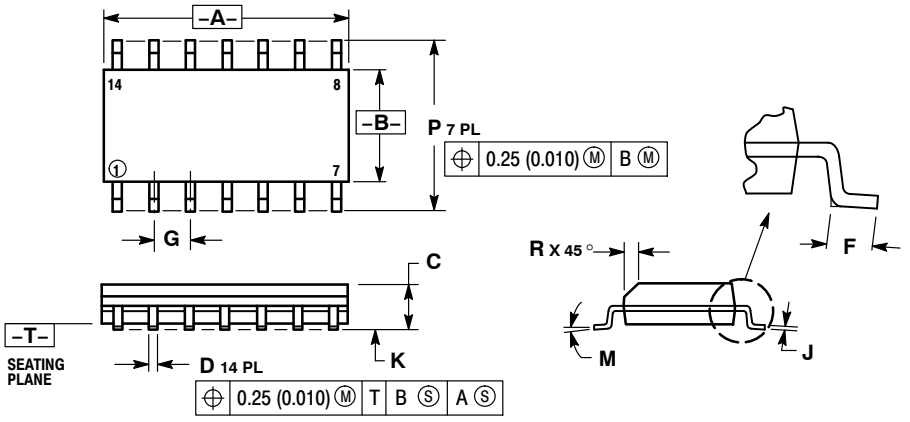
SOLDERING FOOTPRINT*



*For additional information on our Pb−Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

PACKAGE DIMENSIONS

SO−14
CASE 751A−03
ISSUE G

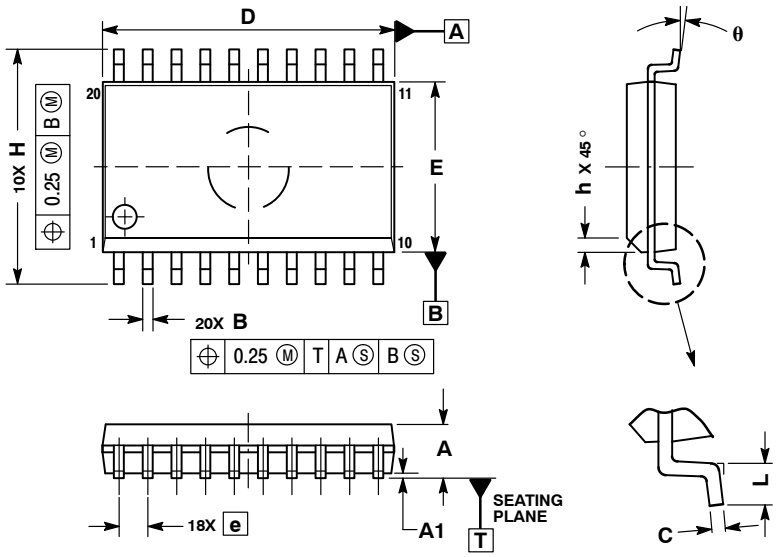


NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	8.55	8.75	0.337	0.344
B	3.80	4.00	0.150	0.157
C	1.35	1.75	0.054	0.068
D	0.35	0.49	0.014	0.019
F	0.40	1.25	0.016	0.049
G	1.27 BSC		0.050 BSC	
J	0.19	0.25	0.008	0.009
K	0.10	0.25	0.004	0.009
M	0 °	7 °	0 °	7 °
P	5.80	6.20	0.228	0.244
R	0.25	0.50	0.010	0.019

PACKAGE DIMENSIONS

SO−20 WB
CASE 751D−05
ISSUE G



NOTES:
1. DIMENSIONS ARE IN MILLIMETERS.
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994.
3. DIMENSIONS D AND E DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 PER SIDE.
5. DIMENSION B DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE PROTRUSION SHALL BE 0.13 TOTAL IN EXCESS OF B DIMENSION AT MAXIMUM MATERIAL CONDITION.

	MILLIMETERS	
DIM	MIN	MAX
A	2.35	2.65
A1	0.10	0.25
B	0.35	0.49
C	0.23	0.32
D	12.65	12.95
E	7.40	7.60
e	1.27 BSC	
H	10.05	10.55
h	0.25	0.75
L	0.50	0.90
θ	0°	7°

SMART REGULATOR is a registered trademark of Semiconductor Components Industries, LLC (SCILLIC).

ON Semiconductor and ON are registered trademarks of Semiconductor Components Industries, LLC (SCILLC). SCILLC reserves the right to make changes without further notice to any products herein. SCILLC makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does SCILLC assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. "Typical" parameters which may be provided in SCILLC data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. SCILLC does not convey any license under its patent rights nor the rights of others. SCILLC products are not designed, intended, or authorized for use as components in systems intended for surgical implant into the body, or other applications intended to support or sustain life, or for any other application in which the failure of the SCILLC product could create a situation where personal injury or death may occur. Should Buyer purchase or use SCILLC products for any such unintended or unauthorized application, Buyer shall indemnify and hold SCILLC and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that SCILLC was negligent regarding the design or manufacture of the part. SCILLC is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT:
Literature Distribution Center for ON Semiconductor
P.O. Box 5163, Denver, Colorado 80217 USA
Phone: 303−675−2175 or 800−344−3860 Toll Free USA/Canada
Fax: 303−675−2176 or 800−344−3867 Toll Free USA/Canada
Email: orderlit@onsemi.com

N. American Technical Support: 800−282−9855 Toll Free USA/Canada
Europe, Middle East and Africa Technical Support:
Phone: 421 33 790 2910
Japan Customer Focus Center
Phone: 81−3−5773−3850

ON Semiconductor Website: **www.onsemi.com**

Order Literature: http://www.onsemi.com/orderlit

For additional information, please contact your local Sales Representative