

NCV8461

Self Protected High Side Driver with Temperature Shutdown and Current Limit

The NCV8461 is a fully protected High-Side driver that can be used to switch a wide variety of loads, such as bulbs, solenoids and other activators. The device is internally protected from an overload condition by an active current limit and thermal shutdown. A diagnostic output reports OFF state open load conditions as well as thermal shutdown.

Features

- Short Circuit Protection
- Thermal Shutdown with Automatic Restart
- CMOS (3 V / 5 V) Compatible Control Input
- Off State Open Load Detection
- Open Drain Diagnostic Output
- Overvoltage Protection
- Undervoltage Shutdown
- Loss of Ground and Loss of V_D Protection
- ESD Protection
- Reverse Battery Protection (with external resistor)
- Very Low Standby Current
- AEC-Q100 Qualified

Typical Applications

- Switch a Variety of Resistive, Inductive and Capacitive Loads
- Can Replace Electromechanical Relays and Discrete Circuits
- Automotive / Industrial

FEATURE SUMMARY

| | | | |
|---|-----------|--------|------------|
| Overvoltage Protection | V_{OV} | 41 | V |
| R_{DSon} (max) $T_J = 25^\circ\text{C}$ | R_{ON} | 350 | m Ω |
| Output Current Limit (typ) | I_{lim} | 1.2 | A |
| Operating Voltage Range | V_{OP} | 5 – 34 | V |



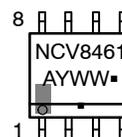
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SOIC-8
CASE 751
STYLE 11

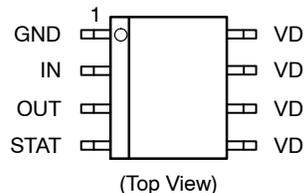
MARKING DIAGRAM



NCV8461 = Specific Device Code
A = Assembly Location
Y = Year
WW = Work Week
▪ = Pb-Free Package

(*Note: Microdot may be in either location)

PIN CONNECTIONS



ORDERING INFORMATION

| Device | Package | Shipping† |
|-------------|---------------------|--------------------|
| NCV8461DR2G | SOIC-8 (Pb-Free) | 2500 / Tape & Reel |

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

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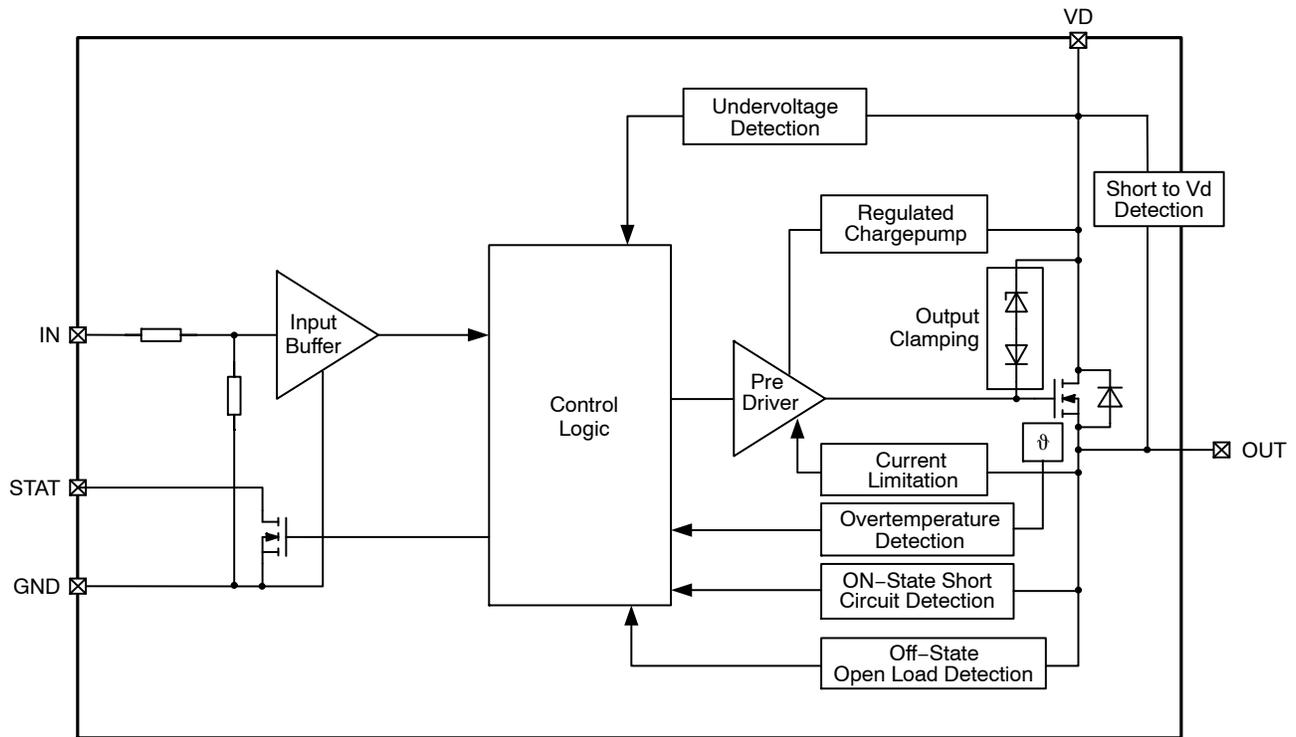


Figure 1. Block Diagram

SO8 PACKAGE PIN DESCRIPTION

| Pin # | Symbol | Description |
|-------|----------------|-------------------|
| 1 | GND | Ground |
| 2 | IN | Logic Level Input |
| 3 | OUT | Output |
| 4 | STAT | Status Output |
| 5 | V _D | Supply Voltage |
| 6 | V _D | Supply Voltage |
| 7 | V _D | Supply Voltage |
| 8 | V _D | Supply Voltage |

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Table 1. MAXIMUM RATINGS

| Rating | Symbol | Value | | Unit |
|--|---------------|-------|--------------------|------------------|
| | | Min | Max | |
| DC Supply Voltage (Note 1) | V_D | -16 | 40 | V |
| Peak Transient Input Voltage (Note 1) (Load Dump XX V, $V_D = 14$ V, ISO7637-2 pulse5) | V_{peak} | | 60 | V |
| Input Voltage | V_{in} | -10 | 16 | V |
| Input Current | I_{in} | -5 | 5 | mA |
| Output Current (Note 1) | I_{out} | - | Internally Limited | A |
| Status Current | I_{status} | -5 | 5 | mA |
| Power Dissipation $T_c = 25^\circ\text{C}$ (Note 1) | P_{tot} | 1.5 | | W |
| Electrostatic Discharge (Note 1) (HBM Model 100 pF / 1500 Ω) | | | | DC |
| Input | | 4 | | kV |
| Status | | 4 | | kV |
| Output | | 5 | | kV |
| V_D | | 5 | | kV |
| Single Pulse Inductive Load Switching Energy (Note 1) $V_D = 13.5$ V; $I_L = 0.5$ A, $T_{Jstart} = 150^\circ\text{C}$ | E_{AS} | - | 300 | mJ |
| Operating Junction Temperature | T_J | -40 | +150 | $^\circ\text{C}$ |
| Storage Temperature | $T_{storage}$ | -55 | +150 | $^\circ\text{C}$ |

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. Not subjected to production testing

Table 2. THERMAL RESISTANCE RATINGS

| Parameter | Symbol | Max. Value | Units |
|---|------------|------------|---------------------------|
| Thermal Resistance (Note 2) | | | $^\circ\text{C}/\text{W}$ |
| Junction-to-Lead | R_{thJL} | 31 | |
| Junction-to-Ambient (6 cm square pad size, FR-4, 2 oz Cu) | R_{thJA} | 84 | |

2. Reverse Output current has to be limited by the load to stay within absolute maximum ratings and thermal performance.

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Table 3. ELECTRICAL CHARACTERISTICS ($V_D = 13.5\text{ V}$; $-40^\circ\text{C} < T_J < 150^\circ\text{C}$ unless otherwise specified)

| Rating | Symbol | Conditions | Value | | | Unit |
|--------------------------|---------------|---|-------|------------|------------|---------------------|
| | | | Min | Typ | Max | |
| Operating Supply Voltage | V_D | | 5 | – | 34 | V |
| Undervoltage Shutdown | V_{UV} | | | | 5 | V |
| Undervoltage Restart | V_{UV_Res} | | | | 5.5 | V |
| Overvoltage Protection | V_{OV} | $I_D = 4\text{ mA}$ | 41 | | | V |
| On Resistance | R_{ON} | $I_{out} = 0.3\text{ A}$; $6\text{ V} < V_D < 40\text{ V}$, $T_J = 25^\circ\text{C}$ $I_{out} = 0.3\text{ A}$; $6\text{ V} < V_D < 40\text{ V}$, $T_J = 150^\circ\text{C}$ | | 250 450 | 350 700 | m Ω |
| Standby Current | I_D | Off State; $V_{in} = V_{out} = 0\text{ V}$ On State; $V_{in} = 5\text{ V}$, $I_{out} = 0\text{ A}$ | | 13 1 | 35 1.7 | μA mA |
| Output Leakage Current | $I_{L(off)}$ | | | | 12 | μA |

INPUT CHARACTERISTICS

| | | | | | | |
|---------------------------|----------------|---|-----------|-----------|-----------|---------------|
| Input Voltage – Low | V_{in_low} | | | | 0.8 | V |
| Input Voltage – High | V_{in_high} | | 2.2 | | | V |
| Input Hysteresis Voltage | V_{hyst} | | | 0.3 | | V |
| Off State Input Current | I_{in_OFF} | $V_{in} = 0.7\text{ V}$ | 1 | | 10 | μA |
| On State Input Current | I_{in_ON} | $V_{in} = 5.0\text{ V}$ | 1 | | 10 | μA |
| Input Resistance (Note 3) | R_I | | 1.5 | 3.5 | | K Ω |
| Input Clamp Voltage | V_{in_cl} | $I_{in} = 1\text{ mA}$ $I_{in} = -1\text{ mA}$ | 14 -18 | 16 -16 | 18 -14 | V |

SWITCHING CHARACTERISTICS

| | | | | | | |
|---------------------|---------------------|---|--|--|-----|-------------------|
| Turn-On Delay Time | t_{d_on} | to 90% V_{out} , $R_L = 47\ \Omega$ | | | 140 | μs |
| Turn-Off Delay Time | t_{d_off} | to 10% V_{out} , $R_L = 47\ \Omega$ | | | 170 | μs |
| Slew Rate On | dV_{out}/dt_{on} | 10% to 30% V_{out} , $R_L = 47\ \Omega$ | | | 2 | V / μs |
| Slew Rate Off | dV_{out}/dt_{off} | 70% to 40% V_{out} , $R_L = 47\ \Omega$ | | | 2 | V / μs |

REVERSE BATTERY (Note 3)

| | | | | | | |
|-----------------|--------|---|--|-----|----|---|
| Reverse Battery | $-V_D$ | Requires a 150 Ω Resistor in GND Connection | | | 32 | V |
| Forward Voltage | V_F | $T_J = 150^\circ\text{C}$ | | 0.6 | | V |

STATUS PIN CHARACTERISTICS

| | | | | | | |
|--|---------------------|---|--|------------|------------|---------------|
| Status Output Voltage Low | V_{stat_low} | $I_{stat} = 1.6\text{ mA}$, $T_J = -40^\circ\text{C}$ to 25°C $I_{stat} = 1.6\text{ mA}$, $T_J = 150^\circ\text{C}$ (Note 3) | | | 0.4 0.6 | V |
| Status Leakage Current | $I_{stat_leakage}$ | $V_{stat} = 5\text{ V}$ | | | 10 | μA |
| Status Invalid Time After Positive Input Slope | $T_{d(STAT)}$ | | | 300 | 700 | μs |
| Status Clamp Voltage | V_{stat_cl} | $I_{stat} = 1\text{ mA}$ $I_{stat} = -1\text{ mA}$ | | 10 -1.4 | | V |

PROTECTION FUNCTIONS (Note 4)

| | | | | | | |
|--|----------------|--|-----|-----|-----|------------------|
| Temperature Shutdown (Note 3) | T_{SD} | | 150 | 175 | 200 | $^\circ\text{C}$ |
| Temperature Shutdown Hysteresis (Note 3) | T_{SD_hyst} | | | 10 | | $^\circ\text{C}$ |
| Output Current Limit Initial Peak | I_{lim} | $T_J = -40^\circ\text{C}$, $V_D = 20\text{ V}$ (Note 3) $T_J = 25^\circ\text{C}$ $T_J = 150^\circ\text{C}$ (Note 3) | 0.7 | 1.2 | 2 | A |

3. Not subjected to production testing

4. To ensure long term reliability under heavy overload or short circuit conditions, protection and related diagnostic signals must be used together with a proper hardware/software strategy. If the devices operates under abnormal conditions this hardware/software solutions must limit the duration and number of activation cycles.

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Table 3. ELECTRICAL CHARACTERISTICS ($V_D = 13.5\text{ V}$; $-40^\circ\text{C} < T_J < 150^\circ\text{C}$ unless otherwise specified)

| Rating | Symbol | Conditions | Value | | | Unit |
|--|---------------|---|------------|------------|-----|---------------|
| | | | Min | Typ | Max | |
| PROTECTION FUNCTIONS (Note 4) | | | | | | |
| Repetitive Short Circuit Current Limit | $I_{lim(SC)}$ | $T_J = T_{Jt}$ (Note 3) | | 1 | | A |
| Switch Off Output Clamp Voltage | V_{clamp} | $I_D = 4\text{ mA}$, $V_{in} = 0\text{ V}$ | $V_D - 41$ | $V_D - 47$ | | V |
| DIAGNOSTICS CHARACTERISTICS | | | | | | |
| Short Circuit Detection Voltage | $V_{OUT(SC)}$ | | | 2.8 | | V |
| Openload Off State Detection Threshold | V_{OL} | $V_{in} = 0\text{ V}$ | 1.5 | | 3.5 | V |
| Openload Detection Current | $I_{L(OL)}$ | | | 5 | | μA |

- Not subjected to production testing
- To ensure long term reliability under heavy overload or short circuit conditions, protection and related diagnostic signals must be used together with a proper hardware/software strategy. If the devices operates under abnormal conditions this hardware/software solutions must limit the duration and number of activation cycles.

Table 4. STATUS PIN TRUTH TABLE

| Conditions | Input | Output | Status |
|----------------------------|-------|--------|--------|
| Normal Operation | L | L | H |
| | H | H | H |
| Short Circuit to GND | L | L | H |
| | H | L* | L |
| Short to V_D (OFF State) | L | H | L |
| | H | H | H |
| Current Limitation | L | L | H |
| | H | H** | H |
| Overtemperature | L | L | H |
| | H | L | L |
| OFF State Open Load | L | H | L |
| | H | H | H |

* Output = "L"; $V_{OUT} < 2\text{ V}$ typ.

** Output = "H"; $V_{OUT} > 2\text{ V}$ typ.

TYPICAL PERFORMANCE CHARACTERISTICS

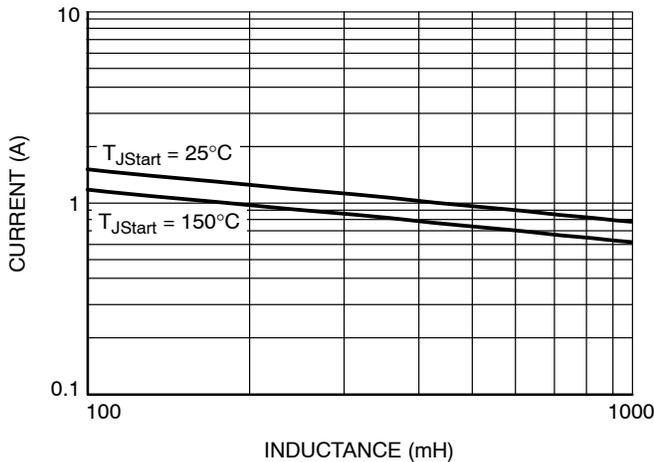


Figure 2. Maximum Single Pulse Switch Off Current vs. Inductance

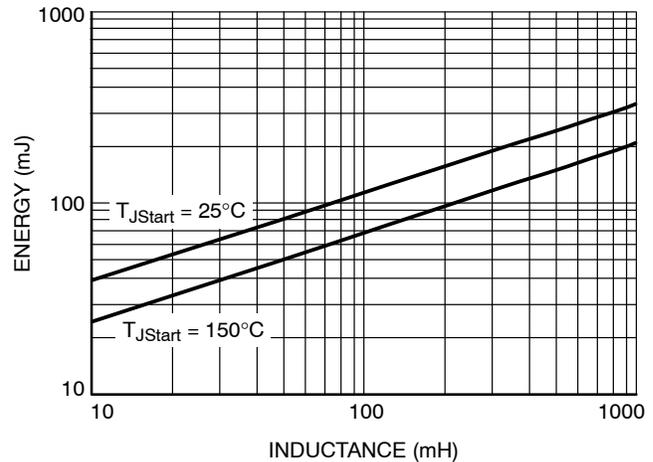


Figure 3. Maximum Single Pulse Switch Off Energy vs. Inductance

TYPICAL PERFORMANCE CHARACTERISTICS

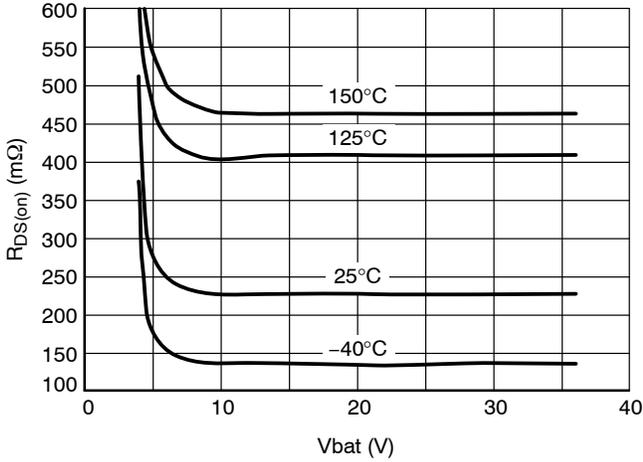


Figure 4. $R_{DS(on)}$ Over Temp and Battery

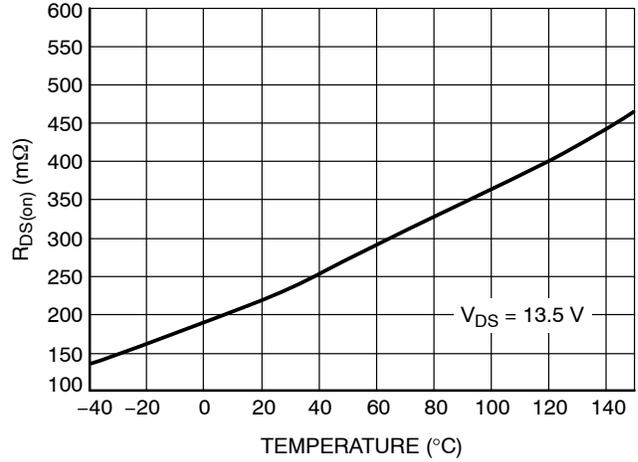


Figure 5. $R_{DS(on)}$ vs. Temperature

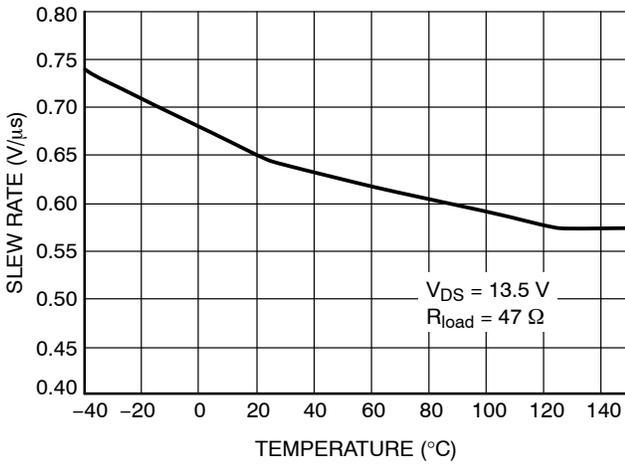


Figure 6. Slew Rate On vs. Temperature

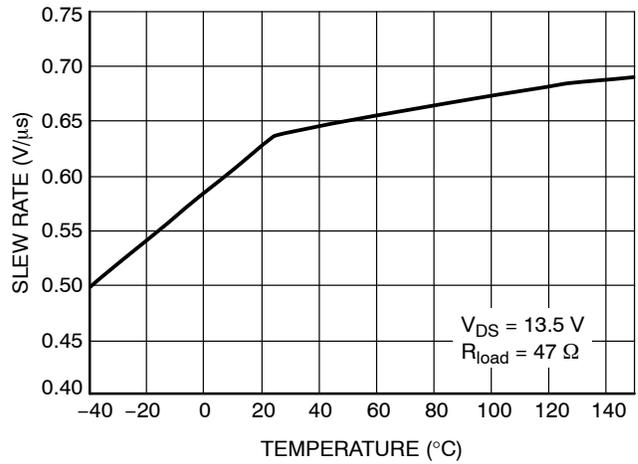


Figure 7. Slew Rate Off vs. Temperature

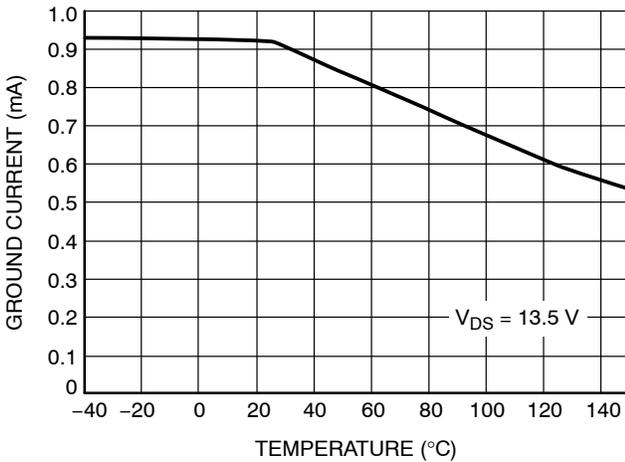


Figure 8. On State Ground Current vs. Temp

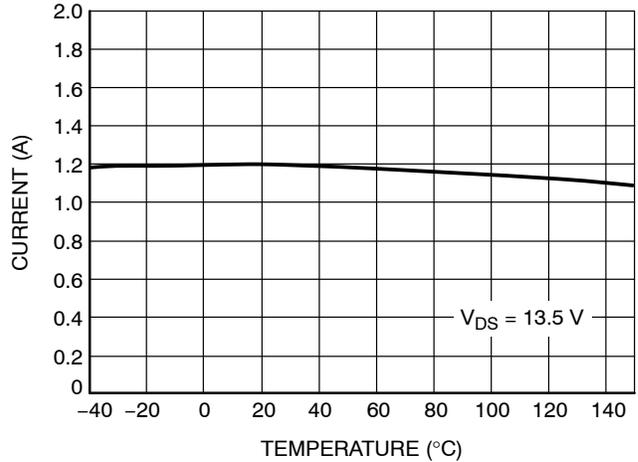
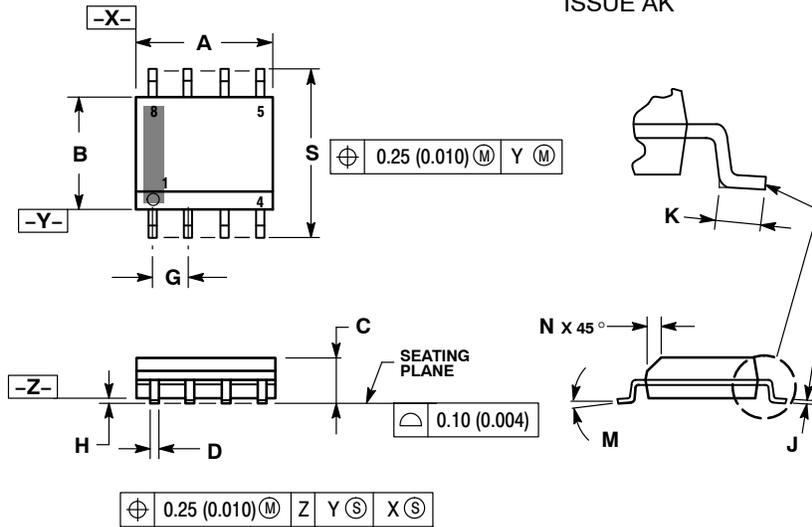


Figure 9. Current Limit vs. Temperature

NCV8461

PACKAGE DIMENSIONS

SOIC-8 NB
CASE 751-07
ISSUE AK



NOTES:

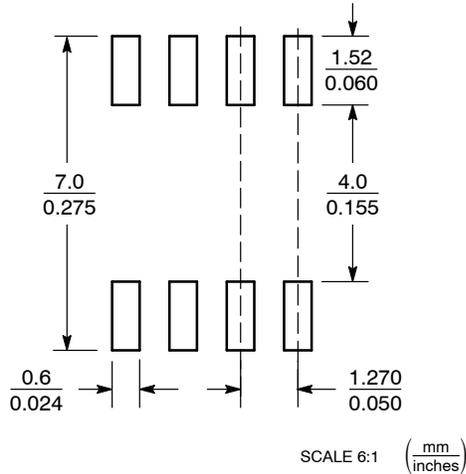
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL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

| DIM | MILLIMETERS | | INCHES | |
|-----|-------------|------|-----------|-------|
| | 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 |

STYLE 11:

- PIN 1. SOURCE 1
2. GATE 1
3. SOURCE 2
4. GATE 2
5. DRAIN 2
6. DRAIN 2
7. DRAIN 1
8. DRAIN 1

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.

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