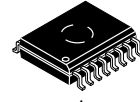


# Isolated High Current IGBT Gate Driver

## NCD57001



1  
SOIC-16 WB  
CASE 751G-03

NCD57001 is a high-current single channel IGBT driver with internal galvanic isolation, designed for high system efficiency and reliability in high power applications. Its features include complementary inputs, open drain FAULT and Ready outputs, active Miller clamp, accurate UVLOs, DESAT protection, and soft turn-off at DESAT. NCD57001 accommodates both 5 V and 3.3 V signals on the input side and wide bias voltage range on the driver side including negative voltage capability. NCD57001 provides > 5 kVrms (UL1577 rating) galvanic isolation and > 1200 V<sub>IORM</sub> (working voltage) capabilities. NCD57001 is available in the wide-body SOIC-16 package with guaranteed 8 mm creepage distance between input and output to fulfill reinforced safety insulation requirements.

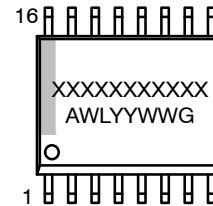
### Features

- High Current Output (+4/-6 A) at IGBT Miller Plateau Voltages
- Low Output Impedance for Enhanced IGBT Driving
- Short Propagation Delays with Accurate Matching
- Active Miller Clamp to Prevent Spurious Gate Turn-on
- DESAT Protection with Programmable Delay
- Negative Voltage (Down to -9 V) Capability for DESAT
- Soft Turn Off During IGBT Short Circuit
- IGBT Gate Clamping During Short Circuit
- IGBT Gate Active Pull Down
- Tight UVLO Thresholds for Bias Flexibility
- Wide Bias Voltage Range including Negative VEE2
- 3.3 V to 5 V Input Supply Voltage
- Designed for AEC-Q100 Certification
- 5000 V Galvanic Isolation (to meet UL1577 Requirements)
- 1200 V Working Voltage (per VDE0884-10 Requirements)
- High Transient Immunity
- High Electromagnetic Immunity
- These Devices are Pb-Free, Halogen Free and are RoHS Compliant

### Typical Applications

- Solar Inverters
- Motor Control
- Uninterruptible Power Supplies (UPS)
- Industrial Power Supplies
- Welding

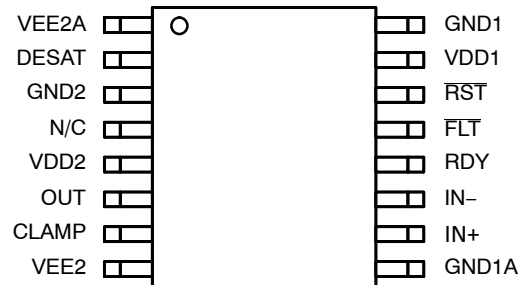
### MARKING DIAGRAM



- XXXXX = Specific Device Code
- A = Assembly Location
- WL = Wafer Lot
- YY = Year
- WW = Work Week
- G = Pb-Free Package

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "▪", may or may not be present.

### PIN ASSIGNMENT



### ORDERING INFORMATION

See detailed ordering and shipping information on page 8 of this data sheet.

# NCD57001

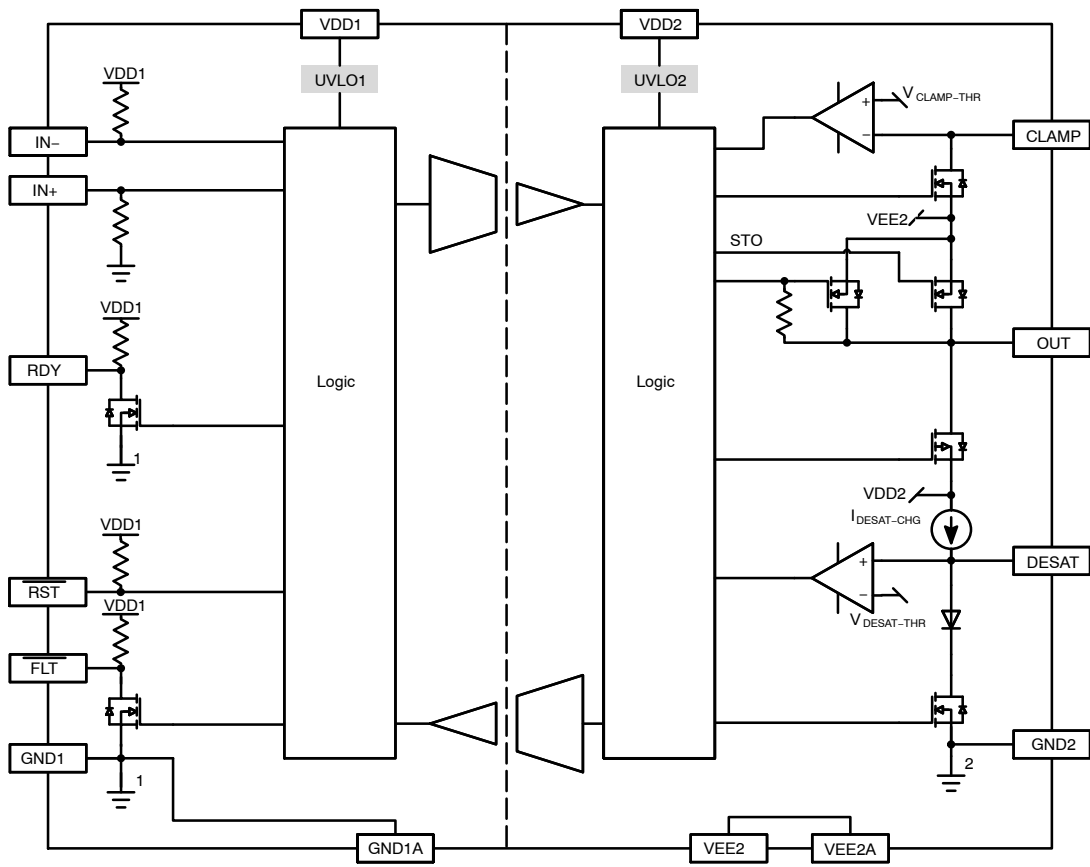


Figure 1. Simplified Block Diagram

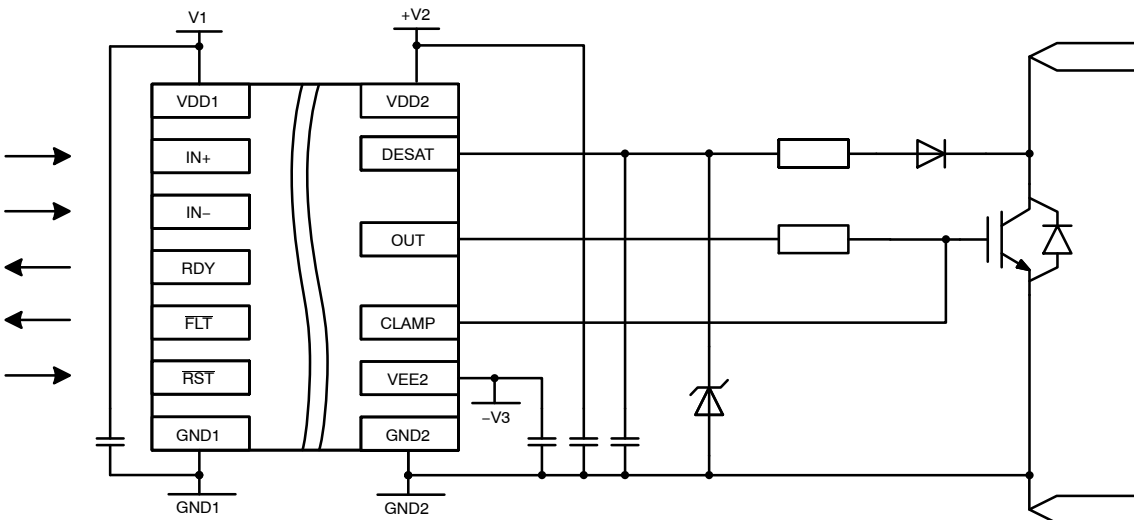


Figure 2. Simplified Application Schematics

# NCD57001

## PIN DESCRIPTION

| Pin Name          | No. | I/O   | Description   |
|-------------------|-----|-------|---|
| V <sub>EE2A</sub> | 1   | Power | Output side negative power supply. A good quality bypassing capacitor is required from these pins to GND2 and should be placed close to the pins for best results. Connect it to GND2 for unipolar supply application.  |
| V <sub>EE2</sub>  | 8   |       |   |
| DESAT             | 2   | I/O   | Input for detecting the desaturation of IGBT due to a short circuit condition. An internal constant current source I <sub>DESAT-CHG</sub> charging an external capacitor connected to this pin allows a programmable blanking delay every ON cycle before DESAT fault is processed, thus preventing false triggering. When the DESAT voltage goes up and reaches V <sub>DESAT-THR</sub> , the output is driven low. Further, the /FLT output is activated, please refer to Figure 5 on page 10.<br><br>A 5 μs mute time apply to IN+ and IN- once DESAT occurs. |
| GND2              | 3   | Power | Output side gate drive reference connecting to IGBT emitter or FET source.  |
| N/C               | 4   | -     | Not connected.  |
| V <sub>DD2</sub>  | 5   | Power | Output side positive power supply. The operating range for this pin is from UVLO2 to its maximum allowed value. A good quality bypassing capacitor is required from this pin to GND2 and should be placed close to the pins for best results.   |
| OUT               | 6   | O     | Driver output that provides the appropriate drive voltage and source/sink current to the IGBT/FET gate. OUT is actively pulled low during start-up and under Fault conditions.  |
| CLAMP             | 7   | I/O   | Provides clamping for the IGBT/FET gate during the off period to protect it from parasitic turn-on. Its internal N FET is turned on when the voltage of this pin falls below V <sub>EE2</sub> + V <sub>CLAMP-THR</sub> . It is to be tied directly to IGBT/FET gate with minimum trace length for best results.   |
| GND1              | 9   | Power | Input side ground reference.  |
|                   | 16  |       |   |
| IN+               | 10  | I     | Non inverted gate driver input. It is internally clamped to V <sub>DD1</sub> and has a pull-down resistor of 50 kΩ to ensure that output is low in the absence of an input signal. A minimum positive going pulse-width is required at IN+ before OUT responds.   |
| IN-               | 11  | I     | Inverted gate driver input. It is internally clamped to V <sub>DD1</sub> and has a pull-up resistor of 50 kΩ to ensure that output is low in the absence of an input signal. A minimum negative going pulse-width is required at IN- before OUT responds.   |
| RDY               | 12  | O     | Power good indication output, active high when V <sub>DD2</sub> is good. There is an internal 50 kΩ pull-up resistor connected to this pin. Multiple of them from different drivers can be "OR"ed together. If a low RDY event is triggered by UVLO2, the maximum low duration for RDY is 200 ns. OUT remains low when RDY is low. Short time delay may apply. See Figure 4 on page 9 for details.  |
| /FLT              | 13  | O     | Fault output (active low) that allows communication to the main controller that the driver has encountered a desaturation condition and has deactivated the output.   |
| /RST              | 14  | I     | Reset input with an internal 50 kΩ pull-up resistor, active low to reset fault latch.   |
| V <sub>DD1</sub>  | 15  | Power | Input side power supply (3.3 V to 5 V).   |

# NCD57001

## SAFETY AND INSULATION RATINGS

| Symbol                | Parameter  | Value                   | Unit             |
|-----------------------|--|-------------------------|------------------|
|                       | Installation Classifications per DIN VDE 0110/1.89<br>Table 1 Rated Mains Voltage  | < 150 V <sub>RMS</sub>  | I – IV           |
|                       |  | < 300 V <sub>RMS</sub>  | I – IV           |
|                       |  | < 450 V <sub>RMS</sub>  | I – IV           |
|                       |  | < 600 V <sub>RMS</sub>  | I – IV           |
|                       |  | < 1000 V <sub>RMS</sub> | I – III          |
| CTI                   | Comparative Tracking Index (DIN IEC 112/VDE 0303 Part 1)   | 600                     |                  |
|                       | Climatic Classification  | 40/100/21               |                  |
|                       | Polution Degree (DIN VDE 0110/1.89)  | 2                       |                  |
| V <sub>PR</sub>       | Input-to-Output Test Voltage, Method b, V <sub>IORM</sub> × 1.875 = V <sub>PR</sub> , 100% Production Test with t <sub>m</sub> = 1 s, Partial Discharge < 5 pC | 2250                    | V <sub>pk</sub>  |
|                       | Input-to-Output Test Voltage, Method a, V <sub>IORM</sub> × 1.6 = V <sub>PR</sub> , Type and Sample Test with t <sub>m</sub> = 10 s, Partial Discharge < 5 pC  | -                       | V <sub>pk</sub>  |
| V <sub>IORM</sub>     | Maximum Repetitive Peak Voltage  | 1200                    | V <sub>pk</sub>  |
| V <sub>IOWM</sub>     | Maximum Working Insulation Voltage   | 870                     | V <sub>RMS</sub> |
| V <sub>IOTM</sub>     | Highest Allowable Over Voltage   | 8400                    | V <sub>pk</sub>  |
| E <sub>CR</sub>       | External Creepage  | 8.0                     | mm               |
| E <sub>CL</sub>       | External Clearance   | 8.0                     | mm               |
| DTI                   | Insulation Thickness   | 17.3                    | um               |
| T <sub>Case</sub>     | Safety Limit Values – Maximum Values in Failure; Case Temperature  | 150                     | °C               |
| P <sub>S,INPUT</sub>  | Safety Limit Values – Maximum Values in Failure; Input Power   | 36                      | mW               |
| P <sub>S,OUTPUT</sub> | Safety Limit Values – Maximum Values in Failure; Output Power  | 1364                    | mW               |
| R <sub>IO</sub>       | Insulation Resistance at TS, V <sub>IO</sub> = 500 V   | 10 <sup>9</sup>         | Ω                |

# NCD57001

## ABSOLUTE MAXIMUM RATINGS (Over operating free-air temperature range unless otherwise noted) (Note 1)

| Symbol                                     | Parameter   | Minimum                | Maximum                | Unit |
|--|---|------------------------|------------------------|------|
| V <sub>DD1-GND1</sub>                      | Supply voltage, input side  | -0.3                   | 6                      | V    |
| V <sub>DD2-GND2</sub>                      | Positive Power Supply, output side  | -0.3                   | 25                     | V    |
| V <sub>EE2-GND2</sub>                      | Negative Power Supply, output side  | -10                    | 0.3                    | V    |
| V <sub>DD2-VEE2</sub> (V <sub>MAX2</sub> ) | Differential Power Supply, output side  | 0                      | 25                     | V    |
| V <sub>OUT</sub>                           | Gate-driver output voltage  | V <sub>EE2</sub> - 0.3 | V <sub>DD2</sub> + 0.3 | V    |
| I <sub>PK-SRC</sub>                        | Gate-driver output sourcing current<br>(maximum pulse width = 10 μs, maximum duty cycle = 0.2%, V <sub>MAX2</sub> = 20 V) | -                      | 7.8                    | A    |
| I <sub>PK-SNK</sub>                        | Gate-driver output sinking current<br>(maximum pulse width = 10 μs, maximum duty cycle = 0.2%, V <sub>MAX2</sub> = 20 V)  | -                      | 7.1                    | A    |
| I <sub>PK-CLAMP</sub>                      | Clamp sinking current<br>(maximum pulse width = 10 μs, maximum duty cycle = 0.2%, V <sub>CLAMP</sub> = 3 V)               | -                      | 2.5                    | A    |
| t <sub>CLP</sub>                           | Maximum Short Circuit Clamping Time (I <sub>OUT_CLAMP</sub> = 500 mA)   | -                      | 10                     | μs   |
| V <sub>LIM-GND1</sub>                      | Voltage at IN+, IN-, /RST, /FLT, RDY  | -0.3                   | V <sub>DD1</sub> + 0.3 | V    |
| I <sub>LIM-GND1</sub>                      | Output current of /FLT, RDY   | -                      | 10                     | mA   |
| V <sub>DESAT-GND2</sub>                    | Desat Voltage (Note 2)  | -9                     | V <sub>DD2</sub> + 0.3 | V    |
| V <sub>CLAMP-GND2</sub>                    | Clamp Voltage   | V <sub>EE2</sub> - 0.3 | V <sub>DD2</sub> + 0.3 | V    |
| P <sub>D</sub>                             | Power Dissipation (Note 3)  | -                      | 1400                   | mW   |
| T <sub>J(max)</sub>                        | Maximum Junction Temperature  | -40                    | 150                    | °C   |
| T <sub>STG</sub>                           | Storage Temperature Range   | -65                    | 150                    | °C   |
| ESD <sub>HBM</sub>                         | ESD Capability, Human Body Model (Note 4)   | -                      | ±2                     | kV   |
| ESD <sub>CDM</sub>                         | ESD Capability, Charged Device Model (Note 4)   | -                      | ±2                     | kV   |
| MSL  | Moisture Sensitivity Level  | -                      | 2                      | -    |
| T <sub>SLD</sub>                           | Lead Temperature Soldering Reflow, Pb-Free Versions (Note 5)  | -                      | 260                    | °C   |

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. Refer to ELECTRICAL CHARACTERISTICS and APPLICATION INFORMATION for Safe Operating Area.
2. The minimum value is verified by characterization with a single pulse of 100 mA for 100 μs.
3. The value is estimated for ambient temperature 25°C and junction temperature 150°C, 650 mm<sup>2</sup>, 1 oz copper, 2 surface layers and 2 internal power plane layers. Power dissipation is affected by the PCB design and ambient temperature.
4. This device series incorporates ESD protection and is tested by the following methods:  
ESD Human Body Model tested per AEC-Q100-002 (EIA/JESD22-A114)  
ESD Charged Device Model tested per AEC-Q100-011 (EIA/JESD22-C101)  
Latchup Current Maximum Rating: ≤100 mA per JEDEC standard: JESD78, 25°C
5. For information, please refer to our Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

## THERMAL CHARACTERISTICS

| Symbol           | Parameter                           | Conditions  | Value | Unit |
|------------------|-------------------------------------|---|-------|------|
| R <sub>θJA</sub> | Thermal Resistance, Junction-to-Air | 100 mm <sup>2</sup> , 1 oz Copper, 1 Surface Layer                                    | 114   | °C/W |
|                  |                                     | 650 mm <sup>2</sup> , 1 oz Copper, 2 Surface Layers and 2 Internal Power Plane Layers | 62    |      |

# NCD57001

## OPERATING RANGES (Note 6)

| Symbol                                   | Parameter                                  | Min                    | Max                    | Unit  |
|--|--|------------------------|------------------------|-------|
| V <sub>DD1-GND1</sub>                    | Supply voltage, input side                 | UVLO1                  | 5.5                    | V     |
| V <sub>DD2-GND2</sub>                    | Positive Power Supply, output side         | UVLO2                  | 24                     | V     |
| V <sub>EE2-GND2</sub>                    | Negative Power Supply, output side         | -10                    | 0                      | V     |
| V <sub>DD2-VEE2 (V<sub>MAX2</sub>)</sub> | Differential Power Supply, output side     | 0                      | 24                     | V     |
| V <sub>IL</sub>                          | Low level input voltage at IN+, IN-, /RST  | 0                      | 0.3 X V <sub>DD1</sub> | V     |
| V <sub>IH</sub>                          | High level input voltage at IN+, IN-, /RST | 0.7 X V <sub>DD1</sub> | V <sub>DD1</sub>       | V     |
| dV <sub>ISO</sub> /dt                    | Common Mode Transient Immunity (1500 V)    | 100                    | -                      | kV/μs |
| T <sub>A</sub>                           | Ambient Temperature                        | -40                    | 125                    | °C    |

Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.

6. Refer to ELECTRICAL CHARACTERISTICS and APPLICATION INFORMATION for Safe Operating Area.

## ISOLATION CHARACTERISTICS

| Symbol                         | Parameter                      | Conditions  | Min  | Typ              | Max | Unit             |
|--------------------------------|--------------------------------|---|------|------------------|-----|------------------|
| V <sub>ISO, input-output</sub> | Input-Output Isolation Voltage | T <sub>A</sub> = 25°C, Relative Humidity < 50%, t = 1.0 minute, I <sub>I-O</sub> 10 A, 50 Hz (See Note 7, 8, 9) | 5000 | -                | -   | V <sub>RMS</sub> |
| R <sub>ISO</sub>               | Isolation Resistance           | V <sub>I-O</sub> = 500 V (See Note 7)   | -    | 10 <sup>11</sup> | -   | Ω                |

7. Device is considered a two-terminal device: pins 1 to 8 are shorted together and pins 9 to 16 are shorted together

8. 5,000 V<sub>RMS</sub> for 1-minute duration is equivalent to 6,000 V<sub>RMS</sub> for 1-second duration.

9. The input-output isolation voltage is a dielectric voltage rating per UL1577. It should not be regarded as an input-output continuous voltage rating. For the continuous working voltage rating, refer to equipment-level safety specification or DIN VDE V 0884-11 Safety and Insulation Ratings Table

**ELECTRICAL CHARACTERISTICS** (V<sub>DD1</sub> = 5 V, V<sub>DD2</sub> = 15 V, V<sub>EE2</sub> = -8 V. For typical values T<sub>A</sub> = 25°C, for min/max values, T<sub>A</sub> is the operating ambient temperature range that applies, unless otherwise noted)

| Symbol | Parameter | Test Condition | Min | Typ | Max | Unit |
|--------|-----------|----------------|-----|-----|-----|------|
|--------|-----------|----------------|-----|-----|-----|------|

### VOLTAGE SUPPLY

|                            |   |                                  |       |      |      |    |
|----------------------------|---|----------------------------------|-------|------|------|----|
| V <sub>UVLO1-OUT-ON</sub>  | UVLO1 Output Enabled                                  |                                  | -     | -    | 3    | V  |
| V <sub>UVLO1-OUT-OFF</sub> | UVLO1 Output Disabled                                 |                                  | 2.4   | -    | -    | V  |
| V <sub>UVLO1-HYST</sub>    | UVLO1 Hysteresis                                      |                                  | 0.125 | -    | -    | V  |
| V <sub>UVLO2-OUT-ON</sub>  | UVLO2 Output Enabled                                  |                                  | 13.2  | 13.5 | 13.8 | V  |
| V <sub>UVLO2-OUT-OFF</sub> | UVLO2 Output Disabled                                 |                                  | 12.2  | 12.5 | 12.8 | V  |
| V <sub>UVLO2-HYST</sub>    | UVLO2 Hysteresis                                      |                                  | -     | 1    |      | V  |
| I <sub>DD1-0</sub>         | Input Supply Quiescent Current Output Low             | IN+ = Low, IN- = Low             | -     | 1    | 2    | mA |
|                            |   | RDY = High, /FLT = High          |       |      |      |    |
| I <sub>DD1-100</sub>       | Input Supply Quiescent Current Output High            | IN+ = High, IN- = Low            | -     | 4.8  | 6    | mA |
|                            |   | RDY = High, /FLT = High          |       |      |      |    |
| I <sub>DD2-0</sub>         | Output Positive Supply Quiescent Current, Output Low  | IN+ = Low, IN- = Low             | -     | 3.3  | 4    | mA |
|                            |   | RDY = High, /FLT = High, no load |       |      |      |    |
| I <sub>DD2-100</sub>       | Output Positive Supply Quiescent Current, Output High | IN+ = High, IN- = Low            | -     | 3.6  | 6    | mA |
|                            |   | RDY = High, /FLT = High, no load |       |      |      |    |
| I <sub>EE2-0</sub>         | Output Negative Supply Quiescent Current, Output Low  | IN+ = High, IN- = Low, no load   | -     | 0.4  | 2    | mA |
| I <sub>EE2-100</sub>       | Output Negative Supply Quiescent Current, Output High | IN+ = High, IN- = Low, no load   | -     | 0.2  | 2    | mA |

# NCD57001

**ELECTRICAL CHARACTERISTICS** ( $V_{DD1} = 5\text{ V}$ ,  $V_{DD2} = 15\text{ V}$ ,  $V_{EE2} = -8\text{ V}$ . For typical values  $T_A = 25^\circ\text{C}$ , for min/max values,  $T_A$  is the operating ambient temperature range that applies, unless otherwise noted) (continued)

| Symbol | Parameter | Test Condition | Min | Typ | Max | Unit |
|--------|-----------|----------------|-----|-----|-----|------|
|--------|-----------|----------------|-----|-----|-----|------|

## LOGIC INPUT AND OUTPUT

|                           |   |                                 |                      |                       |                      |               |
|---------------------------|---|---------------------------------|----------------------|-----------------------|----------------------|---------------|
| $V_{IL}$                  | IN+, IN-, /RST Low Input Voltage                                |                                 | -                    | -                     | $0.3 \times V_{DD1}$ | V             |
| $V_{IH}$                  | IN+, IN-, /RST High Input Voltage                               |                                 | $0.7 \times V_{DD1}$ | -                     | -                    | V             |
| $V_{IN-HYST}$             | Input Hysteresis Voltage  |                                 | -                    | $0.15 \times V_{DD1}$ | -                    | V             |
| $I_{IN-L}$ , $I_{RST-L}$  | IN-, /RST Input Current (50 k $\Omega$ pull-up resistor)        | $V_{IN-}/V_{RST} = 0\text{ V}$  | -                    | -100                  | -                    | $\mu\text{A}$ |
| $I_{IN+H}$                | IN+ Input Current (50 k $\Omega$ pull-down resistor)            | $V_{IN+} = 5\text{ V}$          | -                    | 100                   | -                    | $\mu\text{A}$ |
| $I_{RDY-L}$ , $I_{FLT-L}$ | RDY, /FLT Pull-up Current (50 k $\Omega$ pull-up resistor)      | $V_{RDY}/V_{FLT} = \text{Low}$  | -                    | 100                   | -                    | $\mu\text{A}$ |
| $V_{RDY-L}$ , $V_{FLT-L}$ | RDY, /FLT Low Level Output Voltage                              | $I_{RDY}/I_{FLT} = 5\text{ mA}$ | -                    | -                     | 0.3                  | V             |
| $t_{MIN1}$                | Input Pulse Width of IN+, IN- for No Response at Output         |                                 | -                    | -                     | 10                   | ns            |
| $t_{MIN2}$                | Input Pulse Width of IN+, IN- for Guaranteed Response at Output |                                 | 40                   | -                     | -                    | ns            |
| $t_{RST-MIN}$             | Pulse Width of /RST for Resetting /FLT                          |                                 | 800                  | -                     | -                    | ns            |

## DRIVER OUTPUT

|               |   |  |   |     |     |   |
|---------------|---|--|---|-----|-----|---|
| $V_{OUTL1}$   | Output Low State ( $V_{OUT} - V_{EE2}$ )  | $I_{SINK} = 200\text{ mA}$                           | - | 0.1 | 0.2 | V |
| $V_{OUTL3}$   |   | $I_{SINK} = 1.0\text{ A}$ , $T_A = 25^\circ\text{C}$ | - | 0.5 | 0.8 |   |
| $V_{OUTH1}$   | Output High State ( $V_{DD2} - V_{OUT}$ ) | $I_{SRC} = 200\text{ mA}$                            | - | 0.3 | 0.5 | V |
| $V_{OUTH3}$   |   | $I_{SRC} = 1.0\text{ A}$ , $T_A = 25^\circ\text{C}$  | - | 0.8 | 1   |   |
| $I_{PK-SNK1}$ | Peak Driver Current, Sink (Note 10)       | $V_{OUT} = 7.9\text{ V}$                             | - | 7.1 | -   | A |
| $I_{PK-SRC1}$ | Peak Driver Current, Source (Note 10)     | $V_{OUT} = -5\text{ V}$                              | - | 7.8 | -   | A |

## MILLER CLAMP

|                 |  |   |     |     |     |   |
|-----------------|--|---|-----|-----|-----|---|
| $V_{CLAMP}$     | Clamp Voltage ( $V_{CLAMP} - V_{EE2}$ )              | $I_{CLAMP} = 2.5\text{ A}$ , $T_A = 25^\circ\text{C}$                         | -   | 1.3 | 1.7 | V |
|                 |  | $I_{CLAMP} = 2.5\text{ A}$ , $T_A = -40^\circ\text{C}$ to $125^\circ\text{C}$ | -   | -   | 3   |   |
| $V_{CLAMP-THR}$ | Clamp Activation Threshold ( $V_{CLAMP} - V_{EE2}$ ) |   | 1.5 | 2   | 2.5 | V |

## IGBT SHORT CIRCUIT CLAMPING

|                   |   |  |   |     |     |   |
|-------------------|---|--|---|-----|-----|---|
| $V_{CLAMP-OUT}$   | Clamping Voltage, ( $V_{OUT} - V_{DD2}$ )         | IN+ = Low, IN- = High, $I_{OUT} = 500\text{ mA}$ (pulse test, $t_{CLPmax} = 10\text{ }\mu\text{s}$ )         | - | 0.9 | 1.1 | V |
| $V_{CLAMP-CLAMP}$ | Clamping Voltage, Clamp ( $V_{CLAMP} - V_{DD2}$ ) | IN+ = High, IN- = Low, $I_{CLAMP-CLAMP} = 500\text{ mA}$ (pulse test, $t_{CLPmax} = 10\text{ }\mu\text{s}$ ) | - | 1.4 | 1.6 | V |

## DESAT PROTECTION

|                 |                            |                             |      |     |     |    |
|-----------------|----------------------------|-----------------------------|------|-----|-----|----|
| $V_{DESAT-THR}$ | DESAT Threshold Voltage    |                             | 8.5  | 9   | 9.5 | V  |
| $V_{DESAT-NEG}$ | DESAT Negative Voltage     | $I_{DESAT} = 1.5\text{ mA}$ | -    | -8  | -   | V  |
| $I_{DESAT-CHG}$ | Blanking Charge Current    | $V_{DESAT} = 7\text{ V}$    | 0.45 | 0.5 | 0.6 | mA |
| $I_{DESAT-DIS}$ | Blanking Discharge Current |                             | -    | 50  | -   | mA |

# NCD57001

**ELECTRICAL CHARACTERISTICS** ( $V_{DD1} = 5\text{ V}$ ,  $V_{DD2} = 15\text{ V}$ ,  $V_{EE2} = -8\text{ V}$ . For typical values  $T_A = 25^\circ\text{C}$ , for min/max values,  $T_A$  is the operating ambient temperature range that applies, unless otherwise noted) (continued)

| Symbol                         | Parameter   | Test Condition   | Min | Typ | Max | Unit          |
|--------------------------------|---|--|-----|-----|-----|---------------|
| <b>DYNAMIC CHARACTERISTICS</b> |   |  |     |     |     |               |
| $t_{PD-ON}$                    | IN+, IN- to Output High Propagation Delay                     | $C_{LOAD} = 10\text{ nF}$<br>$V_{IH}$ to 10% of output change for<br>$PW > 150\text{ ns}$ . OUT and CLAMP pins<br>are connected together | 40  | 60  | 90  | ns            |
| $t_{PD-OFF}$                   | IN+, IN- to Output Low Propagation Delay                      | $C_{LOAD} = 10\text{ nF}$<br>$V_{IL}$ to 90% of output change for<br>$PW > 150\text{ ns}$ . OUT and CLAMP pins<br>are connected together | 40  | 66  | 90  | ns            |
| $t_{DISTORT}$                  | Propagation Delay Distortion<br>(= $t_{PD-ON} - t_{PD-OFF}$ ) | $T_A = 25^\circ\text{C}$ , $PW > 150\text{ ns}$  | -15 | -6  | 15  | ns            |
|                                |   | $T_A = -40^\circ\text{C}$ to $125^\circ\text{C}$ , $PW > 150\text{ ns}$  | -25 | -   | 25  |               |
| $t_{DISTORT\_TOT}$             | Prop Delay Distortion between Parts                           | $PW > 150\text{ ns}$   | -30 | 0   | 30  | ns            |
| $t_{RISE}$                     | Rise Time (see Fig. 3) (Note 10)                              | $C_{LOAD} = 1\text{ nF}$ , 10% to 90% of<br>Output Change  | -   | 10  | -   | ns            |
| $t_{FALL}$                     | Fall Time (see Fig. 3) (Note 10)                              | $C_{LOAD} = 1\text{ nF}$ , 90% to 10% of<br>Output Change  | -   | 15  | -   | ns            |
| $t_{LEB}$                      | DESAT Leading Edge Blanking Time<br>(See Fig. 5)              |  | -   | 450 | -   | ns            |
| $t_{FILTER}$                   | DESAT Threshold Filtering Time<br>(see Fig. 5)                |  | -   | 320 | -   | ns            |
| $t_{STO}$                      | Soft Turn Off Time (see Fig. 5)                               | $C_{LOAD} = 10\text{ nF}$ , $R_G = 10\ \Omega$ , $V_{EE2} = 0\text{ V}$  | -   | 1.8 | -   | $\mu\text{s}$ |
|                                |   | $C_{LOAD} = 10\text{ nF}$ , $R_G = 10\ \Omega$   | -   | 2.6 | -   |               |
| $t_{FLT}$                      | Delay after $t_{FILTER}$ to /FLT                              |  | -   | 450 | -   | ns            |
| $t_{RST}$                      | /RST Rise to /FLT Rise Delay                                  |  | -   | 23  | -   | ns            |
| $t_{RDY1O}$                    | RDY High to Output High Delays<br>(see Fig. 4)                |  | -   | 55  | -   | ns            |
| $t_{RDY2O}$                    |   |  |     |     |     |               |
| $t_{RDY1F}$                    | $V_{UVLO2-OUT-OFF}$ to RDY Low<br>Delays (see Fig. 4)         |  | -   | 8   | -   | $\mu\text{s}$ |
| $t_{RDY2F}$                    |   |  |     |     |     |               |

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

10. Values based on design and/or characterization.

## ORDERING INFORMATION

| Device        | Package Type                   | Shipping <sup>†</sup> |
|---------------|--------------------------------|-----------------------|
| NCD57001DWR2G | SOIC-16 Wide Body<br>(Pb-Free) | 1,000 / Tape & Reel   |

<sup>†</sup>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.



# NCD57001

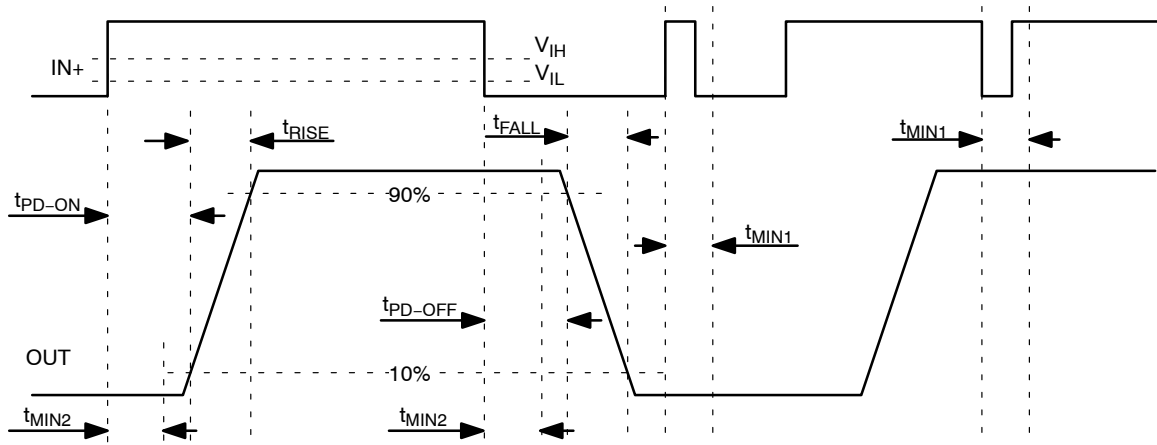


Figure 3. Propagation Delay, Rise and Fall Time

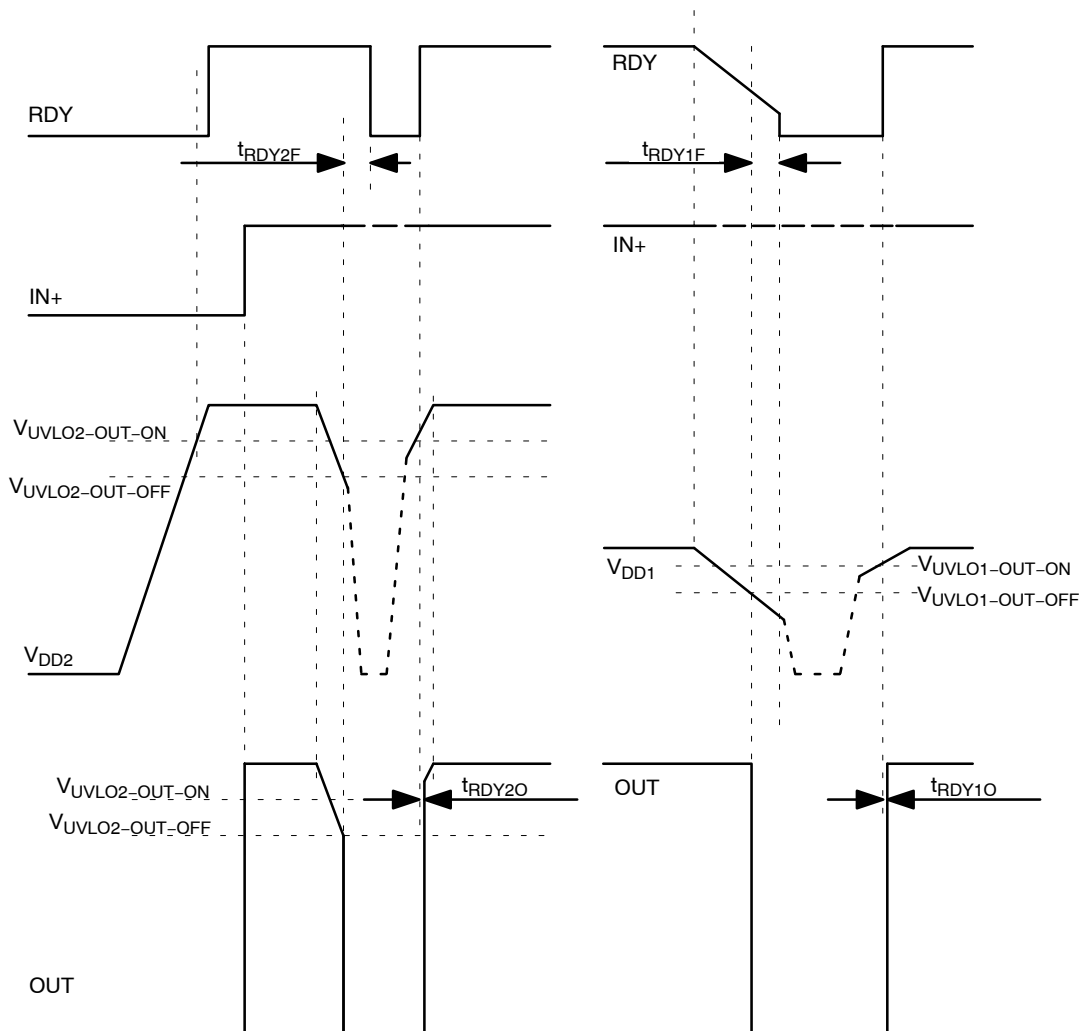


Figure 4. UVLO Waveform

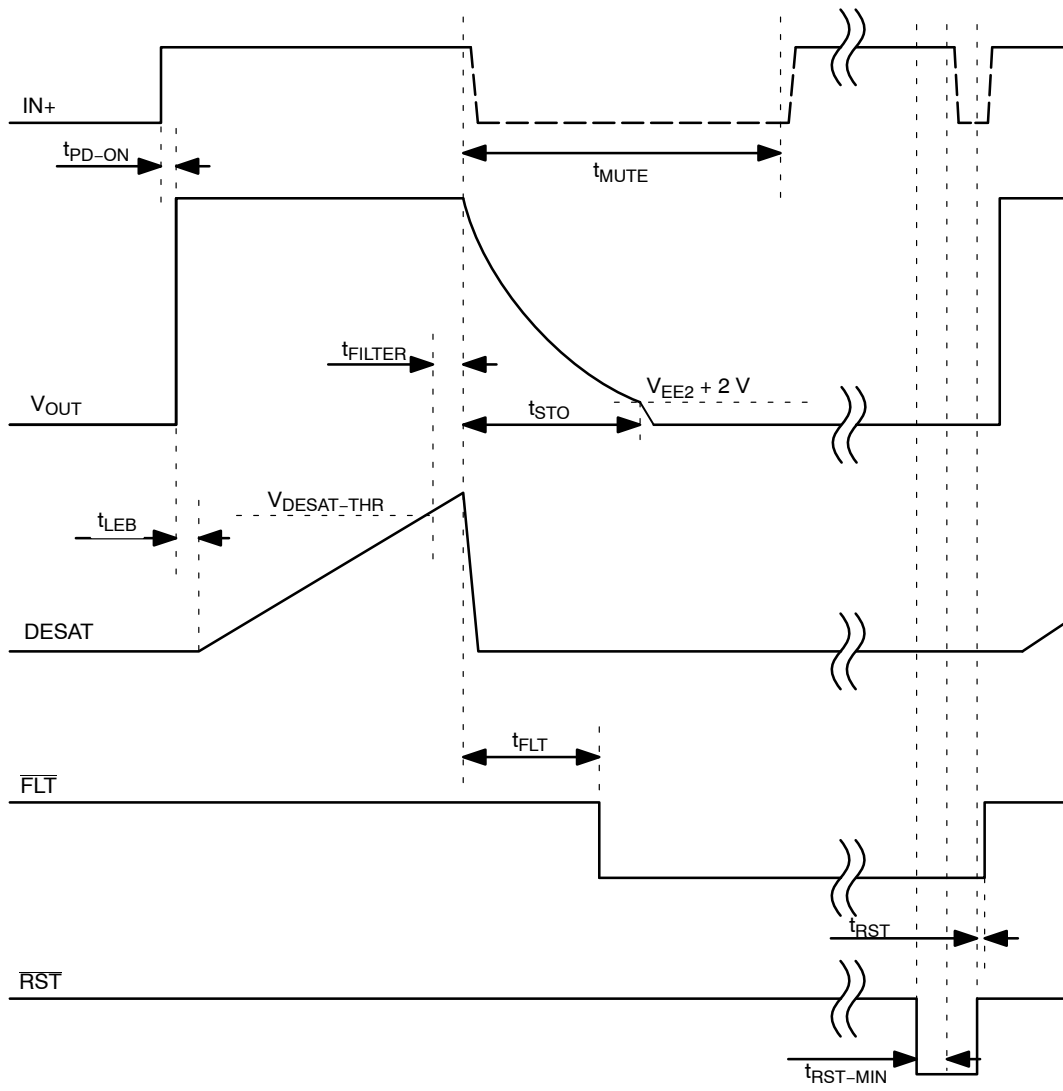


Figure 5. DESAT Response Waveform

TYPICAL CHARACTERISTICS

(Conditions for the following figures are the same as stated for ELECTRICAL CHARACTERISTICS Table unless otherwise noted. Typical and/or average values are used.)

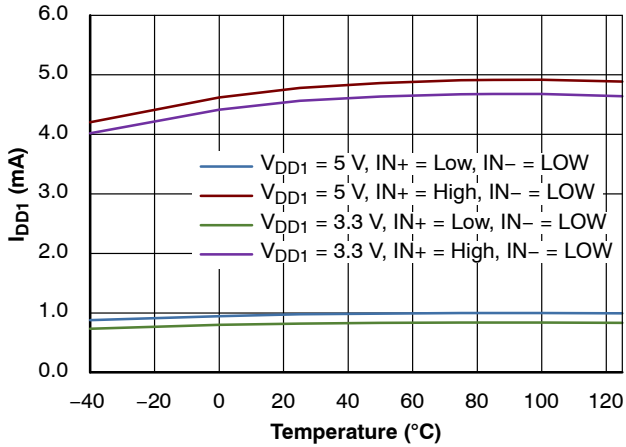


Figure 6.  $V_{DD1}$  Supply Current

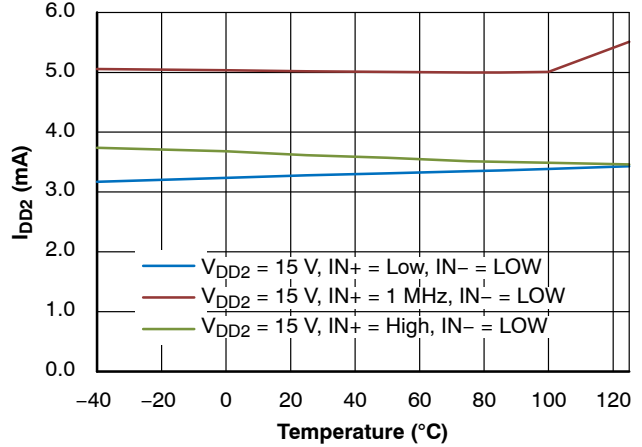


Figure 7.  $V_{DD2}$  Supply Current

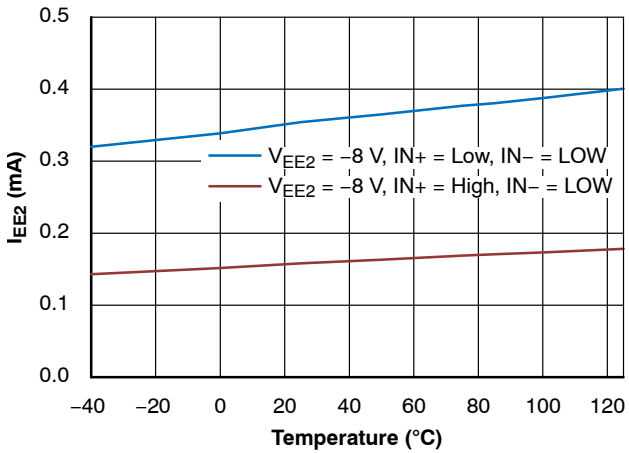


Figure 8.  $V_{EE2}$  Supply Current

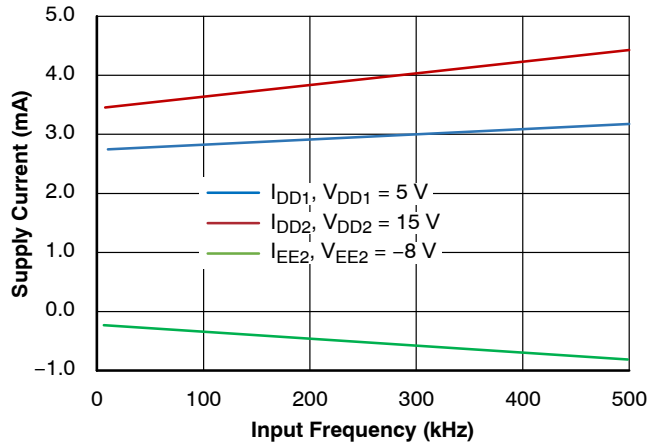


Figure 9. Supply Current vs Frequency

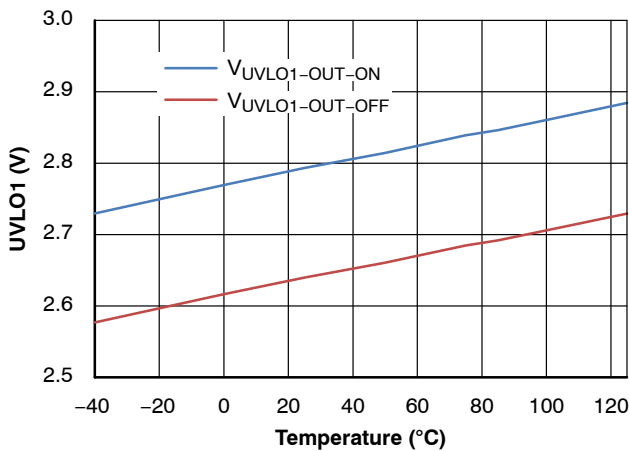


Figure 10. UVLO1 Threshold Voltage

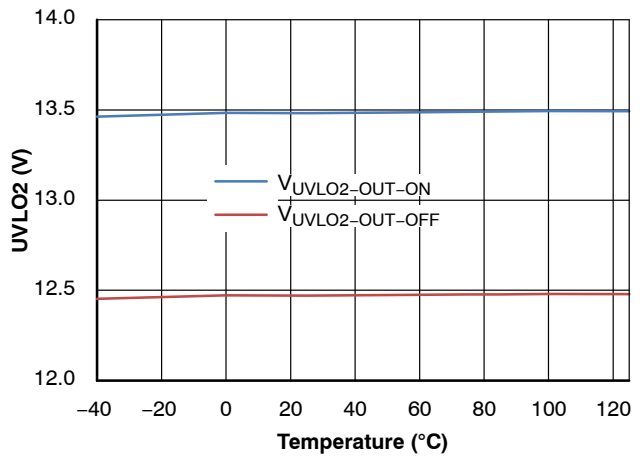


Figure 11. UVLO2 Threshold Voltage

TYPICAL CHARACTERISTICS

(Conditions for the following figures are the same as stated for ELECTRICAL CHARACTERISTICS Table unless otherwise noted. Typical and/or average values are used.) (continued)



Figure 12. Output Voltage Drop, Sourcing



Figure 13. Output Voltage Drop, Sinking

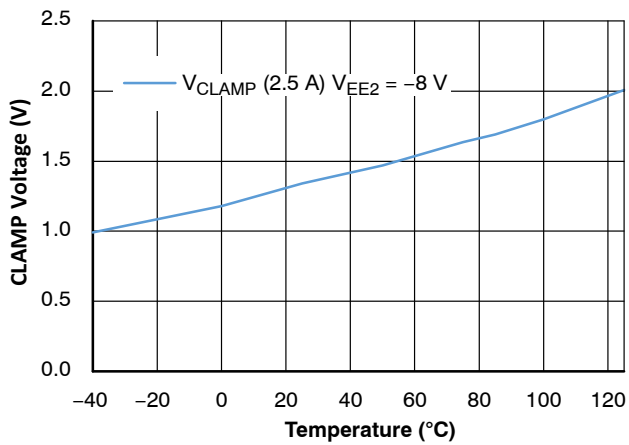


Figure 14. CLAMP Voltage Drop

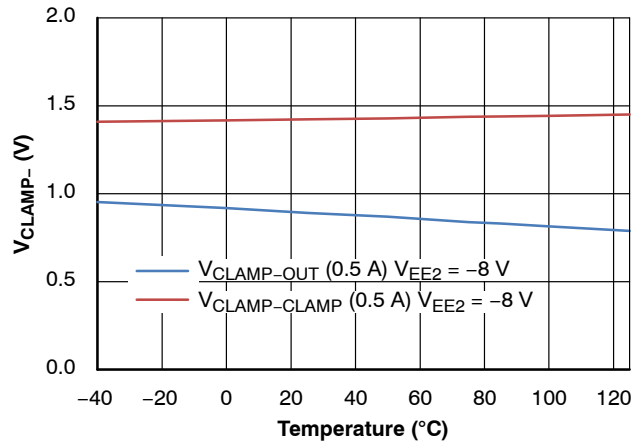


Figure 15. IGBT Short Circuit Clamp Voltage Drop

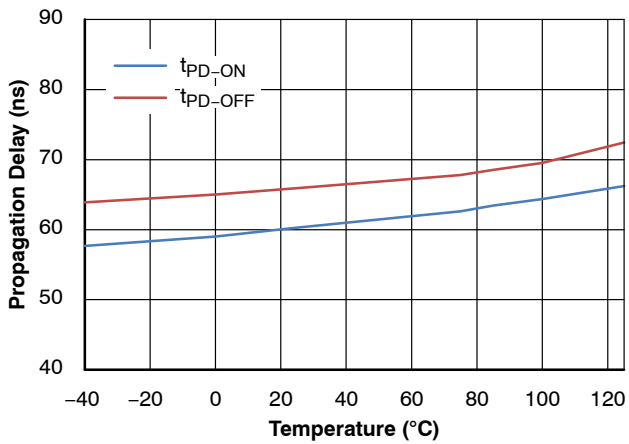


Figure 16. Propagation Delay

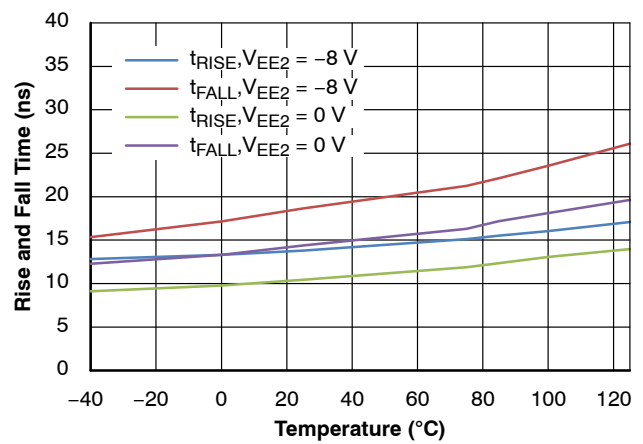


Figure 17. Rise and Fall Time

# NCD57001

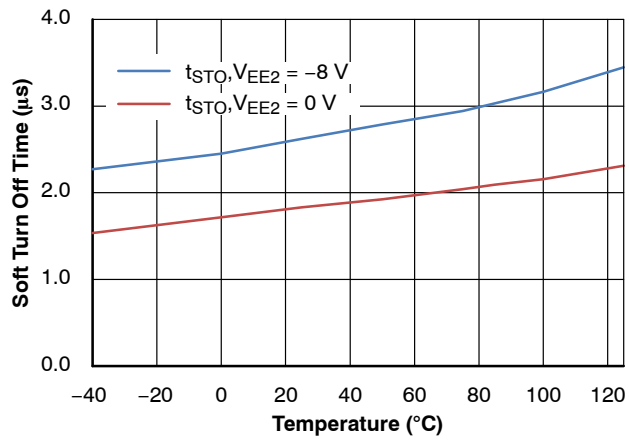


Figure 18. Soft Turn Off Time

FEATURE DESCRIPTIONS

**Under Voltage Lockout (UVLO)**

UVLO ensures correct switching of IGBT connected to the driver output.

- The IGBT is turned-off, if the supply  $V_{CC1}$  drops below  $V_{UVLO1-OUT-OFF}$  and the RDY pin output goes to low.
- The driver output does not start to react to the input signal on  $V_{IN}$  until the  $V_{CC1}$  rises above the  $V_{UVLO1-OUT-ON}$  again. If the supply  $V_{CC1}$  increase over  $V_{UVLO1-OUT-ON}$ , the RDY pin output goes to be open-drain and outputs continue to switch IGBT

- The IGBT is turned-off, if the supply  $V_{CC2}$  drops below  $V_{UVLO2-OUT-OFF}$  and the RDY pin output goes to low.
- The driver output does not start to react to the input signal on  $V_{IN}$  until the  $V_{CC1}$  rises above the  $V_{UVLO1-OUT-ON}$  again. If the supply  $V_{DD1}$  increases over  $V_{UVLO1-OUT-ON}$ , the RDY pin output goes to be open-drain and outputs continue to switch IGBT
- VEE2 is not monitored.



Figure 19. UVLO Diagram

**Active Miller Clamp Protection (CLAMP)**

NCD57001 supports both bipolar and unipolar power supply with active Miller clamp.

For operation with bipolar supplies, the IGBT is turned off with a negative voltage through OUTL with respect to its emitter. This prevents the IGBT from unintentionally turning on because of current induced from its collector to its gate due to Miller effect. In this condition it is not necessary to connect CLAMP output of the gate driver to the IGBT gate, but connecting CLAMP output to the IGBT gate is also not an issue. Typical values for bipolar operation are  $V_{DD2} = 15\text{ V}$  and  $V_{EE2} = -5\text{ V}$  with respect to  $GND_2$ .

For operation with unipolar supply, typically,  $V_{DD2} = 15\text{ V}$  with respect to  $GND_2$ , and  $V_{EE2} = GND_2$ . In this case, the IGBT can turn on due to additional charge from IGBT Miller capacitance caused by a high voltage slew rate transition on the IGBT collector. To prevent IGBT to turn on, the CLAMP pin is connected directly to IGBT gate and Miller current is sunk through a low impedance CLAMP transistor. When the IGBT is turned-off and the gate voltage transitions below  $V_{CLAMP}$ , the CLAMP current output is activated.

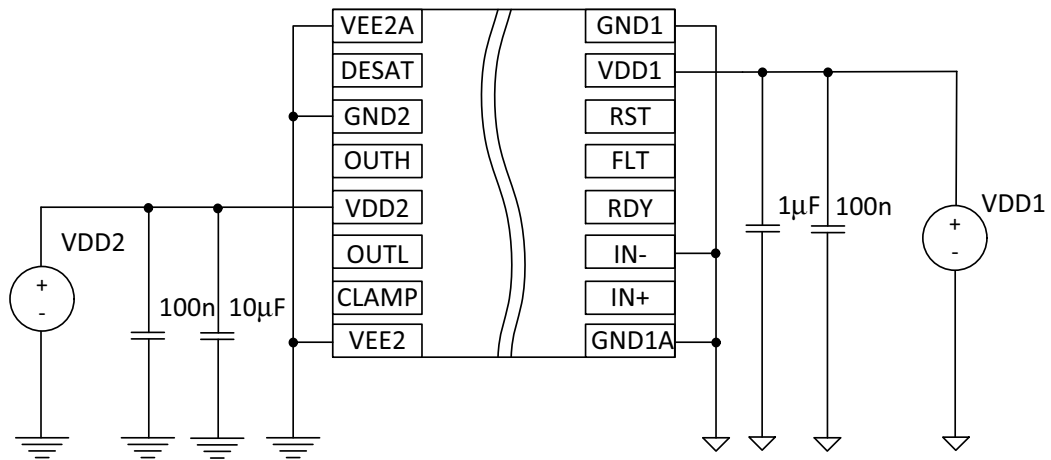






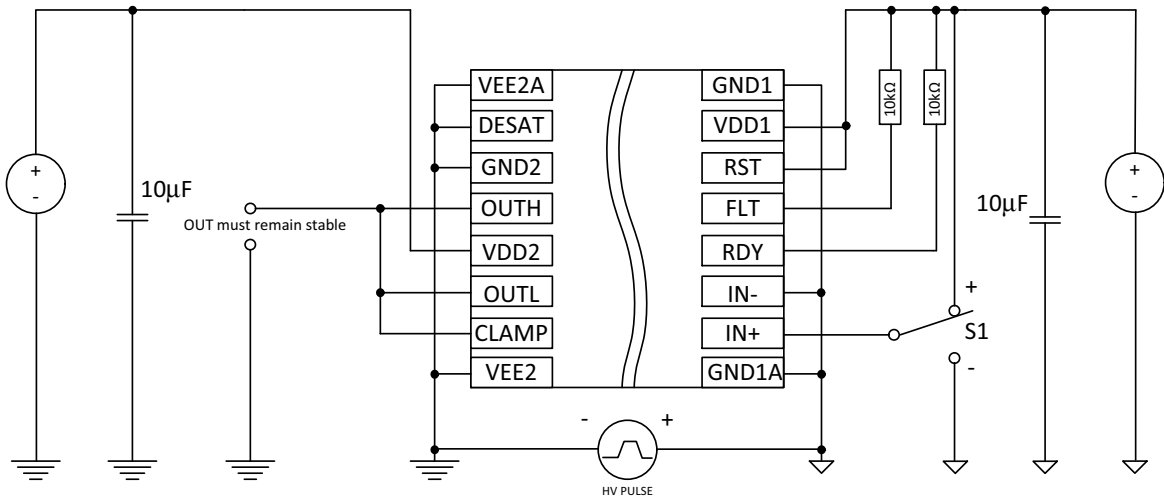


## NCD57001



**Figure 25. Unipolar Power Supply**

### Common Mode Transient Immunity (CMTI)



**Figure 26. Common-Mode Transient Immunity Test Circuit**

# NCD57001

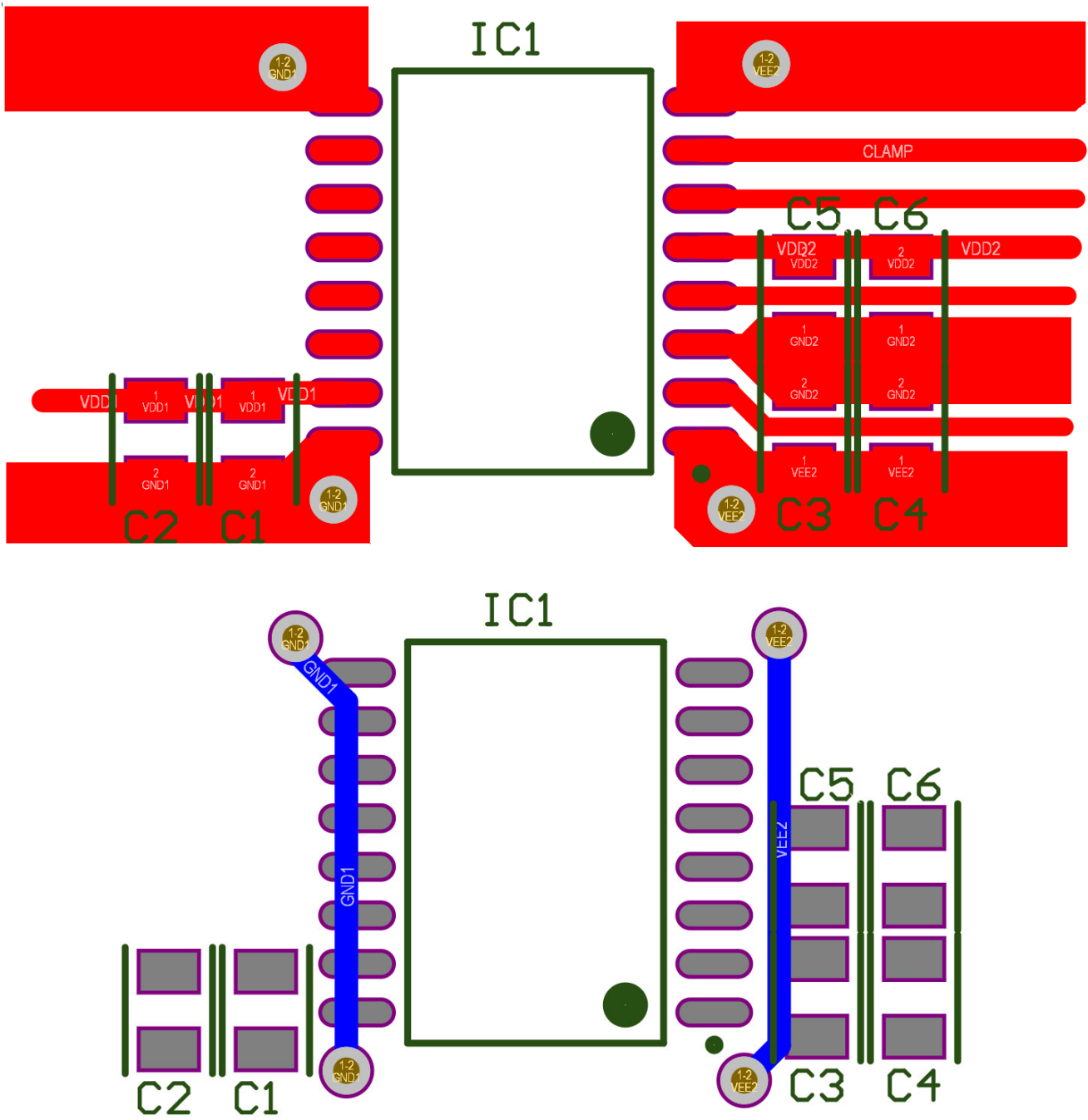


Figure 27. Recommended Basic Bipolar Power Supply PCB Design

# NCD57001



Figure 28. Recommended Layer Stack

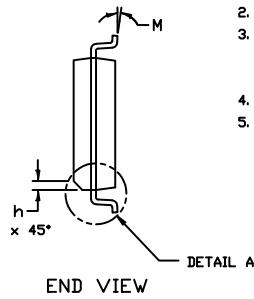
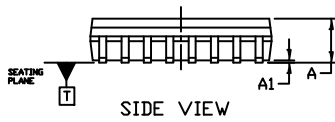
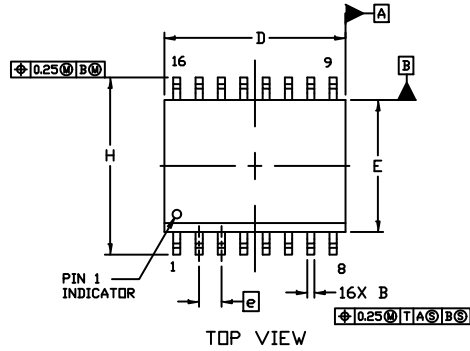
# MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS



1  
SCALE 1:1

SOIC-16 WB  
CASE 751G  
ISSUE E

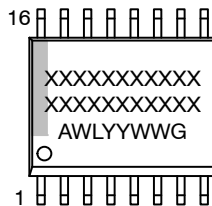
DATE 08 OCT 2021



- NOTES:
- DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
  - CONTROLLING DIMENSION: MILLIMETERS
  - DIMENSION *b* DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE PROTRUSION SHALL BE 0.13 TOTAL IN EXCESS OF *B* DIMENSION AT MAXIMUM MATERIAL CONDITION.
  - DIMENSIONS *D* AND *E* DO NOT INCLUDE MOLD PROTRUSIONS.
  - MAXIMUM MOLD PROTRUSION OR FLASH TO BE 0.15 PER SIDE.

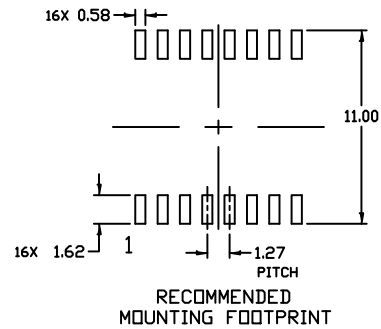
| DIM | MILLIMETERS |       |
|-----|-------------|-------|
|     | MIN.        | MAX.  |
| A   | 2.35        | 2.65  |
| A1  | 0.10        | 0.25  |
| B   | 0.35        | 0.49  |
| C   | 0.23        | 0.32  |
| D   | 10.15       | 10.45 |
| E   | 7.40        | 7.60  |
| e   | 1.27 BSC    |       |
| H   | 10.05       | 10.55 |
| h   | 0.53 REF    |       |
| L   | 0.50        | 0.90  |
| M   | 0°          | 7°    |

### GENERIC MARKING DIAGRAM\*



- XXXXX = Specific Device Code
- A = Assembly Location
- WL = Wafer Lot
- YY = Year
- WW = Work Week
- G = Pb-Free Package

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "▪", may or may not be present. Some products may not follow the Generic Marking.



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