

# NCV7351, NCV7351F

## High Speed CAN, CAN FD Transceiver

The NCV7351 CAN transceiver is the interface between a controller area network (CAN) protocol controller and the physical bus and may be used in both 12 V and 24 V systems. The transceiver provides differential transmit capability to the bus and differential receive capability to the CAN controller.

The NCV7351 is an addition to the CAN high-speed transceiver family complementing NCV734x CAN stand-alone transceivers and previous generations such as AMIS42665, AMIS3066x, etc. The NCV7351F is an addition to the family based on NCV7351 transceiver with improved bit timing symmetry behavior to cope with CAN flexible data rate requirements (CAN FD).

Due to the wide common-mode voltage range of the receiver inputs and other design features, the NCV7351 is able to reach outstanding levels of electromagnetic susceptibility (EMS). Similarly, extremely low electromagnetic emission (EME) is achieved by the excellent matching of the output signals.

### Key Features

- Compatible with the ISO 11898-2 Standard
- High Speed (up to 1 Mbps)
- NCV7351F Version Has Specification for Loop Delay Symmetry (up to 2 Mbps according to ISO11898-2, up to 5 Mbps for information only)
- V<sub>IO</sub> Pin on NCV7351(F)D13 Version Allowing Direct Interfacing with 3 V to 5 V Microcontrollers
- EN Pin on NCV7351D1E Version Allowing Switching the Transceiver to a Very Low Current OFF Mode
- Excellent Electromagnetic Susceptibility (EMS) Level Over Full Frequency Range. Very Low Electromagnetic Emissions (EME) Low EME also Without Common Mode (CM) Choke
- Bus Pins Protected Against >15 kV System ESD Pulses
- Transmit Data (TxD) Dominant Time-out Function
- Under all Supply Conditions the Chip Behaves Predictably. No Disturbance of the Bus Lines with an Unpowered Node
- Bus Pins Short Circuit Proof to Supply Voltage and Ground
- Bus Pins Protected Against Transients in an Automotive Environment
- Thermal Protection
- These are Pb-Free Devices

### Quality

- NCV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q100 Qualified and PPAP Capable

### Typical Applications

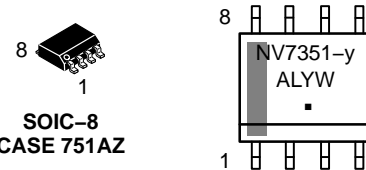
- Automotive
- Industrial Networks



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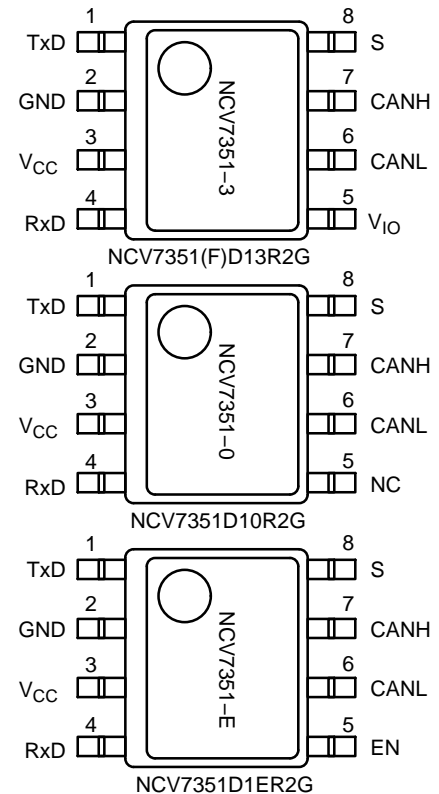
### MARKING DIAGRAM



SOIC-8  
CASE 751AZ

NV7351-y / NV7351Fy  
 y = 3, 0, or E  
 F = Flexible data rate version  
 (no dash used for CAN FD version)  
 A = Assembly Location  
 L = Wafer Lot  
 Y = Year  
 W = Work Week  
 ■ = Pb-Free Package

### PIN ASSIGNMENT



### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 12 of this data sheet.

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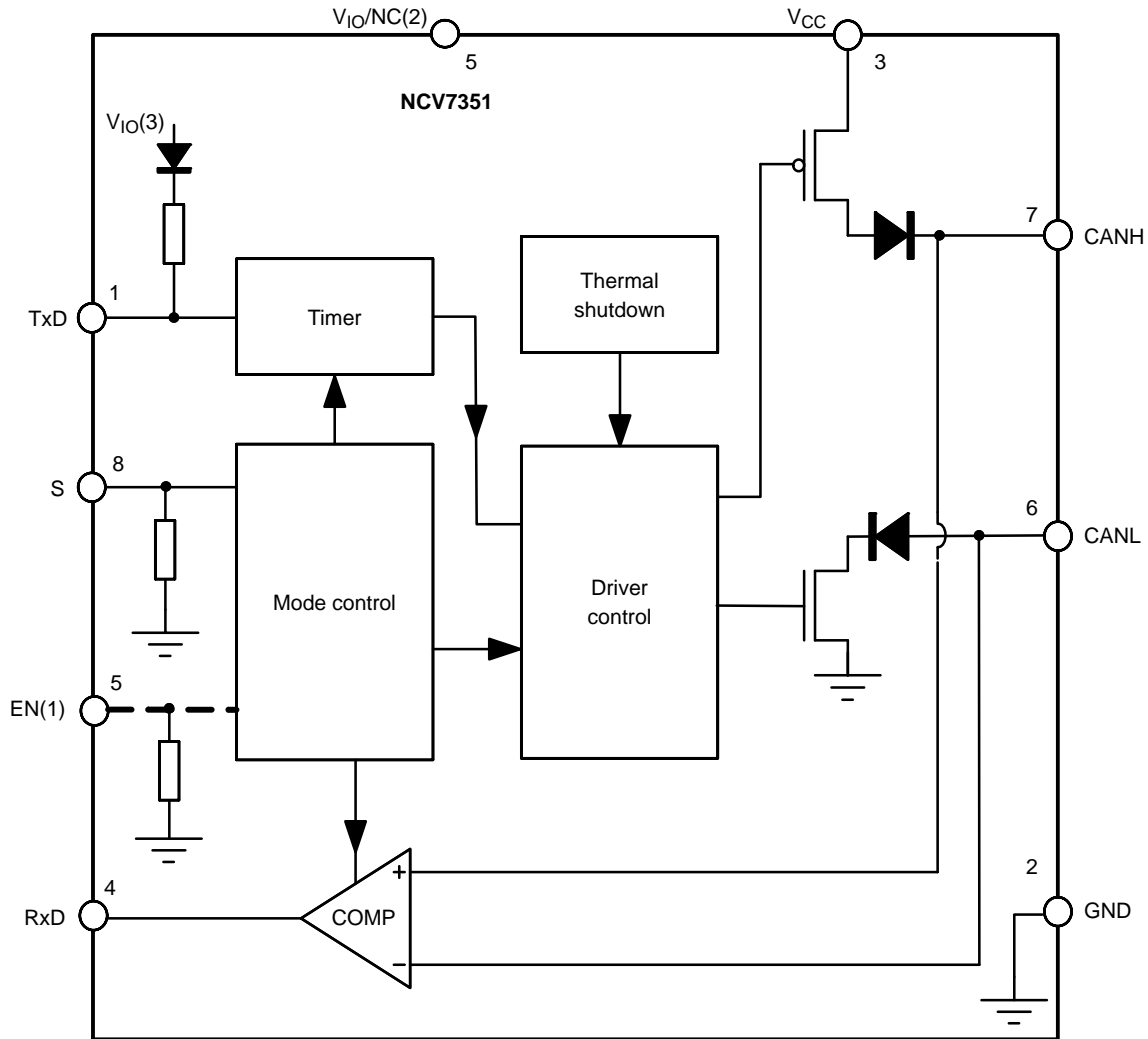
**Table 1. KEY TECHNICAL CHARACTERISTICS AND OPERATING RANGES**

| Symbol                 | Parameter  | Conditions   | Min      | Max       | Unit |
|------------------------|--|--|----------|-----------|------|
| $V_{CC}$               | Power supply voltage                                       |  | 4.5      | 5.5       | V    |
| $V_{UV}$               | Undervoltage detection voltage on pin $V_{CC}$             |  | 3.5      | 4.5       | V    |
| $V_{CANH}$             | DC voltage at pin CANH                                     | $0 < V_{CC} < 5.5$ V; no time limit                            | -50      | +50       | V    |
| $V_{CANL}$             | DC voltage at pin CANL                                     | $0 < V_{CC} < 5.5$ V; no time limit                            | -50      | +50       | V    |
| $V_{CANH,L}$           | DC voltage between CANH and CANL pin                       | $0 < V_{CC} < 5.5$ V   | -50      | +50       | V    |
| $V_{CANH,Lmax}$        | DC voltage at pin CANH and CANL during load dump condition | $0 < V_{CC} < 5.5$ V, less than one second                     | -        | +58       | V    |
| $V_{ESD}$              | Electrostatic discharge voltage                            | IEC 61000-4-2 at pins CANH and CANL                            | -15      | +15       | kV   |
| $V_{O(dif)(bus\_dom)}$ | Differential bus output voltage in dominant state          | $45 \Omega < R_{LT} < 65 \Omega$                               | 1.5      | 3         | V    |
| CM-range               | Input common-mode range for comparator                     | Guaranteed differential receiver threshold and leakage current | -30      | +35       | V    |
| $I_{CC}$               | Supply current   | Dominant; $V_{TxD} = 0$ V<br>Recessive; $V_{TxD} = V_{CC}$     | -<br>2.5 | 72<br>7.5 | mA   |
| $I_{CCS}$              | Supply current in silent mode                              |  | 1.4      | 3.5       | mA   |
| $t_{pd}$               | Propagation delay TxD to RxD                               | See Figure 5   | 45       | 245       | ns   |
| $T_J$                  | Junction temperature                                       |  | -40      | +150      | °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.

# NCV7351, NCV7351F

## BLOCK DIAGRAM



- (1) Only present in the NCV7351D1E  
 (2) VIO for version NCV7351D13  
 NC for version NCV7351D10  
 (3) Internally connected to V<sub>CC</sub> on versions without V<sub>IO</sub> pin

**Figure 1. Block Diagram of NCV7351**

**Table 2. NCV7351: PIN FUNCTION DESCRIPTION**

| Pin Number | Pin Name        | Pin Type                          | Pin Function  |
|------------|-----------------|-----------------------------------|---|
| 1          | TxD             | digital input, internal pull-up   | Transmit data input; low input → dominant driver                  |
| 2          | GND             | ground                            | Ground  |
| 3          | V <sub>CC</sub> | supply                            | Supply voltage  |
| 4          | RxD             | digital output                    | Receive data output; dominant bus → low output                    |
| 5          | NC              | not connected                     | Not connected, NCV7351-0 version only                             |
|            | V <sub>IO</sub> | supply                            | Supply voltage for digital inputs/outputs, NCV7351-3 Version only |
|            | EN              | digital input, internal pull-down | Enable control input, NCV7351-E version only                      |
| 6          | CANL            | high voltage input/output         | Low-level CAN bus line (low in dominant mode)                     |
| 7          | CANH            | high voltage input/output         | High-level CAN bus line (high in dominant mode)                   |
| 8          | S               | digital input, internal pull-down | Silent mode control input   |

# NCV7351, NCV7351F

## APPLICATION INFORMATION

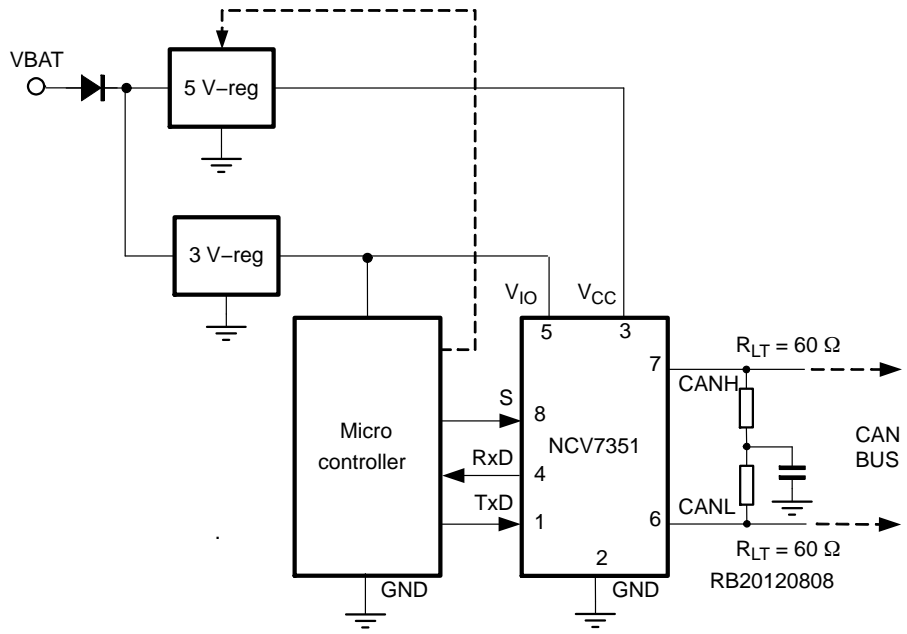


Figure 2. NCV7351-3 Application Diagram

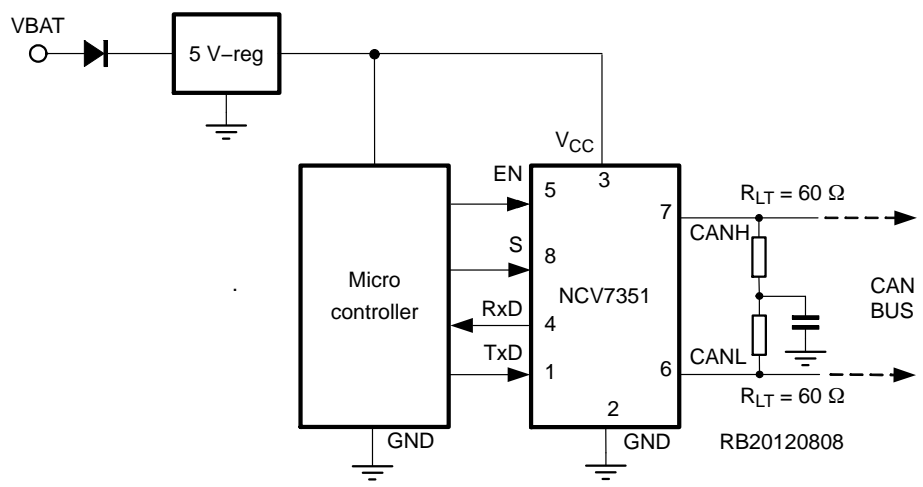


Figure 3. NCV7351-E Application diagram

# NCV7351, NCV7351F

## FUNCTIONAL DESCRIPTION

**NCV7351** has three versions which differ from each other only by function of pin 5. (See also Table 2) Devices marked with F (NCV7351F) are devices compliant to CAN flexible data rate timing specifications as detailed in electrical characteristics section. Except fulfilling these extra CAN FD requirements, all remaining specifications are equal to other devices from NCV7351 family. E.g. all specifications valid for NCV7351–3 versions are also valid for NCV7351F–3 version.

**NCV7351–3:** Pin 5 is  $V_{IO}$  pin, which is supply pin for transceiver digital inputs/output (supplying pins TxD, RxD, S, EN). The  $V_{IO}$  pin should be connected to microcontroller supply pin. By using  $V_{IO}$  supply pin shared with microcontroller the I/O levels between microcontroller and

transceiver are properly adjusted. This allows in applications with microcontroller supply down to 3 V to easy communicate with the transceiver. (See Figure 2)

**NCV7351–0:** Pin 5 is not connected. This version is full replacement of the previous generation CAN transceiver AMIS30660.

**NCV7351–E:** Pin 5 is digital enable pin which allows transceiver to be switched off with very low supply current.

### OPERATING MODES

The NCV7351 modes of operation are provided as illustrated in Table 3. These modes are selectable through pin S and also EN in case of NCV7351–E.

**Table 3. OPERATING MODES**

| Mode         | Pin S | Pin EN (Note 1) | Pin TxD | CANH,L Pins       | RxD      |
|--------------|-------|-----------------|---------|-------------------|----------|
| Normal       | 0     | 1               | 0       | Dominant          | 0        |
|              | 0     | 1               | 1       | Recessive         | 1        |
| Silent       | 1     | 1               | X       | Recessive         | 1        |
|              | 1     | 1               | X       | Dominant (Note 3) | 0        |
| Off (Note 1) | X     | 0               | X       | floating          | floating |

1. Only applicable to NCV7351–E
2. 'X' = don't care
3. CAN bus driven to dominant by another transceiver on the bus

#### Normal Mode

In the normal mode, the transceiver is able to communicate via the bus lines. The signals are transmitted and received to the CAN controller via the pins TxD and RxD. The slopes on the bus lines outputs are optimized to give low EME.

#### Silent Mode

In the silent mode, the transmitter is disabled. The bus pins are in recessive state independent of TxD input. Transceiver listens to the bus and provides data to controller, but controller is prevented from sending any data to the bus.

#### Off Mode

In Off mode, complete transceiver is disabled and consumes very low current. The CAN pins are floating not loading the CAN bus.

#### Over-temperature Detection

A thermal protection circuit protects the IC from damage by switching off the transmitter if the junction temperature exceeds a value of approximately 180°C. Because the transmitter dissipates most of the power, the power dissipation and temperature of the IC is reduced. All other IC functions continue to operate. The transmitter off-state resets when the temperature decreases below the shutdown threshold and pin TxD goes high. The thermal protection

circuit is particularly needed in case of the bus line short circuits.

#### TxD Dominant Time-out Function

A TxD dominant time-out timer circuit prevents the bus lines being driven to a permanent dominant state (blocking all network communication) if pin TxD is forced permanently low by a hardware and/or software application failure. The timer is triggered by a negative edge on pin TxD. If the duration of the low-level on pin TxD exceeds the internal timer value  $t_{dom}$ , the transmitter is disabled, driving the bus into a recessive state. The timer is reset by a positive edge on pin TxD. This TxD dominant time-out time ( $t_{dom(TxD)}$ ) defines the minimum possible bit rate to 12 kbps.

#### Fail Safe Features

A current-limiting circuit protects the transmitter output stage from damage caused by accidental short circuit to either positive or negative supply voltage, although power dissipation increases during this fault condition.

The pins CANH and CANL are protected from automotive electrical transients (according to ISO 7637; Figure 4). Internally, pin TxD is pulled high, pin EN and S low should the input become disconnected. Pins TxD, S, EN and RxD will be floating, preventing reverse supply should the  $V_{CC}$  supply be removed.

## NCV7351, NCV7351F

**Definitions:** All voltages are referenced to GND (pin 2). Positive currents flow into the IC. Sinking current means the current is flowing into the pin; sourcing current means the current is flowing out of the pin.

**Table 4. ABSOLUTE MAXIMUM RATINGS**

| Symbol       | Parameter   | Conditions                          | Min  | Max  | Unit |
|--------------|---|-------------------------------------|------|------|------|
| $V_{sup}$    | Supply voltage $V_{CC}$   |                                     | -0.3 | +6   | V    |
| $V_{CANH}$   | DC voltage at pin CANH  | $0 < V_{CC} < 5.5$ V; no time limit | -50  | +50  | V    |
| $V_{CANL}$   | DC voltage at pin CANL  | $0 < V_{CC} < 5.5$ V; no time limit | -50  | +50  | V    |
| $V_{IOs}$    | DC voltage at pin TxD, RxD, S, EN, $V_{IO}$                                   | Notes 4 and 5                       | -0.3 | +6   | V    |
| $V_{esd}$    | Electrostatic discharge voltage at all pins according to EIA-JESD22           | Note 6                              | -6   | +6   | kV   |
|              | Electrostatic discharge voltage at CANH,CANL, pins according to EIA-JESD22    | Note 6                              | -8   | +8   | kV   |
|              | Electrostatic discharge voltage at CANH, CANL pins According to IEC 61000-4-2 | Note 7                              | -15  | +15  | kV   |
|              | Standardized charged device model ESD pulses according to ESD-STM5.3.1-1999   |                                     | -750 | +750 | V    |
| $V_{schaff}$ | Transient voltage at CANH, CANL pins, See Figure 4                            | Note 8                              | -150 | +100 | V    |
| Latch-up     | Static latch-up at all pins   | Note 9                              |      | +150 | mA   |
| $T_{stg}$    | Storage temperature   |                                     | -55  | +150 | °C   |
| $T_J$        | Maximum junction temperature  |                                     | -40  | +170 | °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.

4. EN pin Only available on NCV7351-E version

5.  $V_{IO}$  pin Only available on NCV7351-3 version

6. Standardized human body model electrostatic discharge (ESD) pulses in accordance to EIA-JESD22. Equivalent to discharging a 100 pF capacitor through a 1.5 k $\Omega$  resistor.

7. System human body model electrostatic discharge (ESD) pulses. Equivalent to discharging a 150 pF capacitor through a 330  $\Omega$  resistor referenced to GND. Verified by external test house

8. Pulses 1, 2a,3a and 3b according to ISO 7637 part 3. Results were verified by external test house.

9. Static latch-up immunity: Static latch-up protection level when tested according to EIA/JESD78.

**Table 5. THERMAL CHARACTERISTICS**

| Symbol             | Parameter  | Conditions | Value | Unit |
|--------------------|--|------------|-------|------|
| $R_{\theta JA\_1}$ | Thermal Resistance Junction-to-Air, 1S0P PCB (Note 10) | Free air   | 125   | K/W  |
| $R_{\theta JA\_2}$ | Thermal Resistance Junction-to-Air, 2S2P PCB (Note 11) | Free air   | 75    | K/W  |

10. Test board according to EIA/JEDEC Standard JESD51-3, signal layer with 10% trace coverage.

11. Test board according to EIA/JEDEC Standard JESD51-7, signal layers with 10% trace coverage.

# NCV7351, NCV7351F

## ELECTRICAL CHARACTERISTICS

$V_{CC} = 4.5\text{ V to }5.5\text{ V}$ ;  $V_{IO} = 2.8\text{ V to }5.5\text{ V}$ ;  $T_J = -40^\circ\text{C to }+150^\circ\text{C}$ ;  $R_{LT} = 60\ \Omega$  unless specified otherwise.  
On chip versions without  $V_{IO}$  pin reference voltage for all digital inputs and outputs is  $V_{CC}$  instead of  $V_{IO}$ .

**Table 6. CHARACTERISTICS**

| Symbol  | Parameter  | Conditions  | Min                 | Typ        | Max                  | Unit             |
|---|--|---|---------------------|------------|----------------------|------------------|
| <b>SUPPLY (Pin <math>V_{CC}</math>)</b>                                 |  |   |                     |            |                      |                  |
| $I_{CC}$  | Supply current in normal mode                                      | Dominant; $V_{TXD} = 0\text{ V}$<br>Recessive; $V_{TXD} = V_{IO}$ | –<br>2.5            | 50<br>4.6  | 72<br>7.5            | mA               |
| $I_{CCS}$   | Supply current in silent mode                                      |   | 1.4                 | 2.3        | 3.5                  | mA               |
| $I_{CCOFF}$   | Supply current in OFF mode on NCV7351–E version only               |   | –                   | 7          | 18                   | $\mu\text{A}$    |
| $I_{CCOFF}$   | Supply current in OFF mode NCV7351–E version only                  | $T_J \leq 100^\circ\text{C}$ ,<br>Note 13                         | –                   | 7          | 10                   | $\mu\text{A}$    |
| $V_{UVDVCC}$  | Undervoltage detection voltage on $V_{CC}$ pin                     |   | 3.5                 | 4          | 4.5                  | V                |
| <b>SUPPLY (Pin <math>V_{IO}</math>) on NCV7351–3 Version Only</b>       |  |   |                     |            |                      |                  |
| $V_{iorange}$   | Supply voltage range on pin $V_{IO}$                               |   | 2.8                 | –          | 5.5                  | V                |
| $I_{IO}$  | Supply current on pin $V_{IO}$ normal mode                         | Dominant; $V_{TXD} = 0\text{ V}$<br>Recessive; $V_{TXD} = V_{IO}$ | 100<br>50           | 240<br>125 | 500<br>265           | $\mu\text{A}$    |
| $I_{IOS}$   | Supply current on pin $V_{IO}$ silent mode                         | Bus is recessive;<br>$V_{TXD} = V_{IO}$                           | –                   | 2          | 16                   | $\mu\text{A}$    |
| $V_{UVDVIO}$  | Undervoltage detection voltage on $V_{IO}$ pin                     |   | 2.1                 | 2.4        | 2.7                  | V                |
| <b>TRANSMITTER DATA INPUT (Pin <math>TxD</math>)</b>                    |  |   |                     |            |                      |                  |
| $V_{IH}$  | High–level input voltage, on NCV7351–3 version only                | Output recessive  | $0.7 \times V_{IO}$ | –          | $V_{IO} + 0.3$       | V                |
| $V_{IH}$  | High–level input voltage, on NCV7351–0 and NCV7351–E versions only | Output recessive  | 2.5                 | –          | $V_{CC} + 0.3$       | V                |
| $V_{IL}$  | Low–level input voltage  | Output dominant   | –0.3                | –          | $+0.3 \times V_{IO}$ | V                |
| $R_{TXD}$   | $TxD$ pin pull up  |   | 22                  | 30         | 50                   | $\text{k}\Omega$ |
| $C_i$   | Input capacitance  | Note 13   | –                   | 5          | 10                   | pF               |
| <b>TRANSMITTER MODE SELECT (Pin <math>S</math> and <math>EN</math>)</b> |  |   |                     |            |                      |                  |
| $V_{IH}$  | High–level input voltage, on NCV7351–3 version only                | Silent mode   | $0.7 \times V_{IO}$ | –          | $V_{IO} + 0.3$       | V                |
| $V_{IH}$  | High–level input voltage on NCV7351–0 and NCV7351–E versions only  | Silent or enable mode   | 2.5                 | –          | $V_{CC} + 0.3$       | V                |
| $V_{IL}$  | Low–level input voltage  | Normal mode   | –0.3                | –          | $+0.3 \times V_{IO}$ | V                |
| $R_{S,EN}$  | $S$ and $EN$ pin pull down   | Note 12   | 0.55                | 1.1        | 1.5                  | $\text{M}\Omega$ |
| $C_i$   | Input capacitance  | Note 13   | –                   | 5          | 10                   | pF               |
| <b>RECEIVER DATA OUTPUT (Pin <math>RxD</math>)</b>                      |  |   |                     |            |                      |                  |
| $I_{OH}$  | High–level output current  | Normal mode<br>$V_{RxD} = V_{IO} - 0.4\text{ V}$                  | –1                  | –0.4       | –0.1                 | mA               |
| $I_{OL}$  | Low–level output current   | $V_{RxD} = 0.4\text{ V}$  | 1.5                 | 6          | 11                   | mA               |
| <b>BUS LINES (Pins <math>CANH</math> and <math>CANL</math>)</b>         |  |   |                     |            |                      |                  |

12.  $EN$  pin Only available on NCV7351–E version

13. Not tested in production. Guaranteed by design and prototype evaluation.

14. Only applicable for version NCV7351F

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**Table 6. CHARACTERISTICS**

| Symbol                                | Parameter   | Conditions   | Min  | Typ  | Max  | Unit          |
|---------------------------------------|---|--|------|------|------|---------------|
| <b>BUS LINES (Pins CANH and CANL)</b> |   |  |      |      |      |               |
| $V_{o(reces)}$<br>(norm)              | Recessive bus voltage on pins CANH and CANL                         | $V_{TxD} = V_{IO}$ ; no load<br>normal mode  | 2.0  | 2.5  | 3.0  | V             |
| $I_{o(reces)}$<br>(CANH)              | Recessive output current at pin CANH                                | $-30\text{ V} < V_{CANH} < +35\text{ V}$ ;<br>$0\text{ V} < V_{CC} < 5.5\text{ V}$                                     | -2.5 | -    | +2.5 | mA            |
| $I_{o(reces)}$ (CANL)                 | Recessive output current at pin CANL                                | $-30\text{ V} < V_{CANL} < +35\text{ V}$ ;<br>$0\text{ V} < V_{CC} < 5.5\text{ V}$                                     | -2.5 | -    | +2.5 | mA            |
| $I_{L}(CANH)$                         | Input leakage current to pin CANH                                   | $0\ \Omega < R(V_{CC}\text{ to GND}) < 1\text{ M}\Omega$<br>$V_{CANL} = V_{CANH} = 5\text{ V}$                         | -10  | 0    | 10   | $\mu\text{A}$ |
| $I_{L}(CANL)$                         | Input leakage current to pin CANL                                   |  | -10  | 0    | 10   | $\mu\text{A}$ |
| $V_{o(dom)}$<br>(CANH)                | Dominant output voltage at pin CANH                                 | $V_{TxD} = 0\text{ V}$ ;<br>$V_{CC} = 4.75\text{ V to } 5.25\text{ V}$   | 3.0  | 3.6  | 4.25 | V             |
| $V_{o(dom)}$ (CANL)                   | Dominant output voltage at pin CANL                                 | $V_{TxD} = 0\text{ V}$ ;<br>$V_{CC} = 4.75\text{ V to } 5.25\text{ V}$   | 0.5  | 1.4  | 1.75 | V             |
| $V_{o(dif)}$<br>(bus_dom)             | Differential bus output voltage<br>( $V_{CANH} - V_{CANL}$ )        | $V_{TxD} = 0\text{ V}$ ; dominant;<br>$V_{CC} = 4.75\text{ V to } 5.25\text{ V}$<br>$45\ \Omega < R_{LT} < 65\ \Omega$ | 1.5  | 2.25 | 3.0  | V             |
| $V_{o(dif)}$ (bus_rec)                | Differential bus output voltage<br>( $V_{CANH} - V_{CANL}$ )        | $V_{TxD} = V_{IO}$ ; recessive;<br>no load   | -120 | 0    | +50  | mV            |
| $V_{o(sym)}$<br>(bus_dom)             | Bus output voltage symmetry<br>$V_{CANH} + V_{CANL}$                | $V_{TxD} = 0\text{ V}$<br>$V_{CC} = 4.75\text{ V to } 5.25\text{ V}$   | 0.9  | -    | 1.1  | $V_{CC}$      |
| $I_{o(sc)}$ (CANH)                    | Short circuit output current at pin CANH                            | $V_{CANH} = 0\text{ V}$ ; $V_{TxD} = 0\text{ V}$   | -90  | -70  | -40  | mA            |
| $I_{o(sc)}$ (CANL)                    | Short circuit output current at pin CANL                            | $V_{CANL} = 36\text{ V}$ ; $V_{TxD} = 0\text{ V}$  | 40   | 70   | 100  | mA            |
| $V_{i(dif)}$ (th)                     | Differential receiver threshold voltage                             | $-12\text{ V} < V_{CANL} < +12\text{ V}$ ;<br>$-12\text{ V} < V_{CANH} < +12\text{ V}$ ;                               | 0.5  | 0.7  | 0.9  | V             |
| $V_{ihcm(dif)}$ (th)                  | Differential receiver threshold voltage for high common-mode        | $-30\text{ V} < V_{CANL} < +35\text{ V}$ ;<br>$-30\text{ V} < V_{CANH} < +35\text{ V}$ ;                               | 0.40 | 0.7  | 1.0  | V             |
| $R_{i(cm)}$ (CANH)                    | Common-mode input resistance at pin CANH                            |  | 15   | 26   | 37   | k $\Omega$    |
| $R_{i(cm)}$ (CANL)                    | Common-mode input resistance at pin CANL                            |  | 15   | 26   | 37   | k $\Omega$    |
| $R_{i(cm)}$ (m)                       | Matching between pin CANH and pin CANL common mode input resistance | $V_{CANH} = V_{CANL}$  | -0.8 | 0    | +0.8 | %             |
| $R_{i(dif)}$                          | Differential input resistance                                       |  | 25   | 50   | 75   | k $\Omega$    |
| $C_{i}(CANH)$                         | Input capacitance at pin CANH                                       | $V_{TxD} = V_{IO}$ ; not tested  | -    | 7.5  | 20   | pF            |
| $C_{i}(CANL)$                         | Input capacitance at pin CANL                                       | $V_{TxD} = V_{IO}$ ; not tested  | -    | 7.5  | 20   | pF            |
| $C_{i}(dif)$                          | Differential input capacitance                                      | $V_{TxD} = V_{IO}$ ; not tested  | -    | 3.75 | 10   | pF            |

**THERMAL SHUTDOWN**

|             |                               |                             |     |     |     |                    |
|-------------|-------------------------------|-----------------------------|-----|-----|-----|--------------------|
| $T_{J(sd)}$ | Shutdown junction temperature | Junction temperature rising | 160 | 180 | 200 | $^{\circ}\text{C}$ |
|-------------|-------------------------------|-----------------------------|-----|-----|-----|--------------------|

**TIMING CHARACTERISTICS (see Figures 5, 6 and 7)**

|                     |   |  |    |     |     |    |
|---------------------|---|--|----|-----|-----|----|
| $t_{d}(TxD-BUSon)$  | Delay TxD to bus active                   | $C_i = 100\text{ pF}$ between CANH to CANL                           | -  | 75  | -   | ns |
| $t_{d}(TxD-BUSoff)$ | Delay TxD to bus inactive                 | $C_i = 100\text{ pF}$ between CANH to CANL                           | -  | 65  | -   | ns |
| $t_{d}(BUSon-RxD)$  | Delay bus active to RxD                   | $C_{rxd} = 15\text{ pF}$   | -  | 70  | -   | ns |
| $t_{d}(BUSoff-RxD)$ | Delay bus inactive to RxD                 | $C_{rxd} = 15\text{ pF}$   | -  | 70  | -   | ns |
| $t_{pd}$            | Propagation delay TxD to RxD (both edges) | $C_i = 100\text{ pF}$ between CANH to CANL, $C_{rxd} = 15\text{ pF}$ | 45 | 140 | 245 | ns |

12. EN pin Only available on NCV7351-E version

13. Not tested in production. Guaranteed by design and prototype evaluation.

14. Only applicable for version NCV7351F



# NCV7351, NCV7351F

**Table 6. CHARACTERISTICS**

| Symbol   | Parameter  | Conditions   | Min | Typ | Max | Unit |
|--|--|--|-----|-----|-----|------|
| <b>TIMING CHARACTERISTICS (see Figures 5, 6 and 7)</b> |  |  |     |     |     |      |
| $t_{dom}(TxD)$   | TxD dominant time for time-out   | $V_{TxD} = 0\text{ V}$   | 1.5 | 2.5 | 5   | ms   |
| $t_{Bit2}(Bus)$  | Transmitted recessive bit width, 2 Mbps  | 2 Mbps (500 ns TxD $t_{bit}$ )<br>4.75 V < $V_{CC}$ < 5.25 V<br>Load: 60 $\Omega$    100 pF (Note 14)                          | 435 | –   | 530 | ns   |
| $t_{Bit2}(RxD)$  | Received recessive bit width, 2 Mbps (RxD pin)   |  | 400 | –   | 550 | ns   |
| $t_{Bit5}(Bus)$  | Transmitted recessive bit width, 5 Mbps<br>Info only   | 5 Mbps (200 ns TxD $t_{bit}$ )<br>4.85 V < $V_{CC}$ < 5.15 V<br>–40°C < $T_J$ < 105°C<br>Load: 60 $\Omega$    100 pF (Note 14) | –   | 172 | –   | ns   |
| $t_{Bit5}(RxD)$  | Received recessive bit width, 5 Mbps (RxD pin)<br>Info only  |  | –   | 156 | –   | ns   |
| $\Delta t_{Rec2}$                                      | Receiver timing symmetry, intended for use up to 2 Mbps<br>$\Delta t_{Rec2} = t_{Bit2}(RxD) - t_{Bit2}(Bus)$           | Calculated parameter based on $t_{bit2}(Bus)$ and $t_{Bit2}(RxD)$ (Note 14)  | –65 | –   | 40  | ns   |
| $\Delta t_{Rec5}$                                      | Receiver timing symmetry, intended for use up to 5 Mbps Info only<br>$\Delta t_{Rec5} = t_{Bit5}(RxD) - t_{Bit5}(Bus)$ | Calculated parameter based on $t_{bit5}(Bus)$ and $t_{Bit5}(RxD)$ (Note 14)  | –   | –16 | –   | ns   |

12. EN pin Only available on NCV7351–E version

13. Not tested in production. Guaranteed by design and prototype evaluation.

14. Only applicable for version NCV7351F

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.

# NCV7351, NCV7351F

## MEASUREMENT SETUPS AND DEFINITIONS

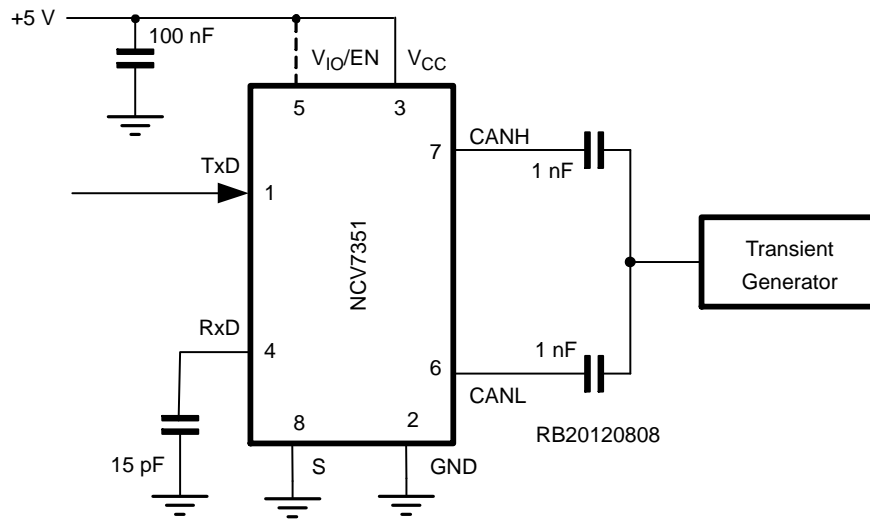


Figure 4. Test Circuit for Automotive Transients

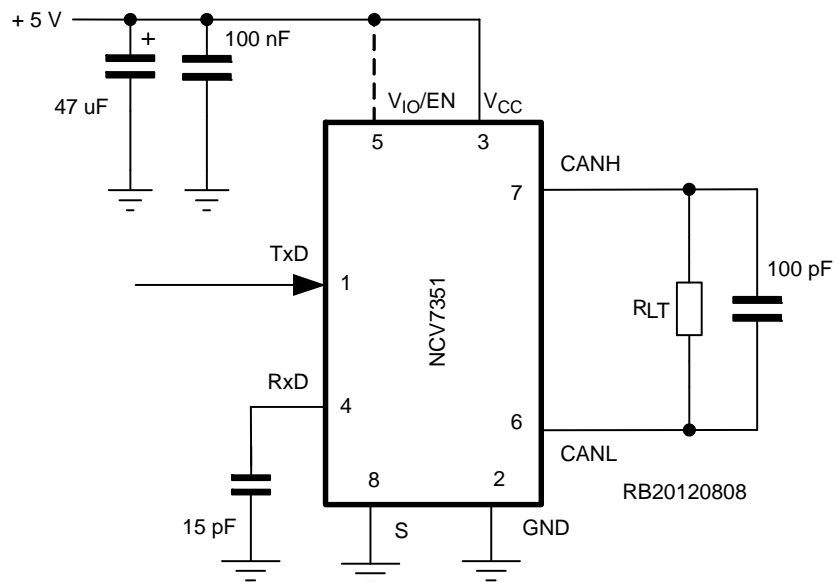


Figure 5. Test Circuit for Timing Characteristics

# NCV7351, NCV7351F

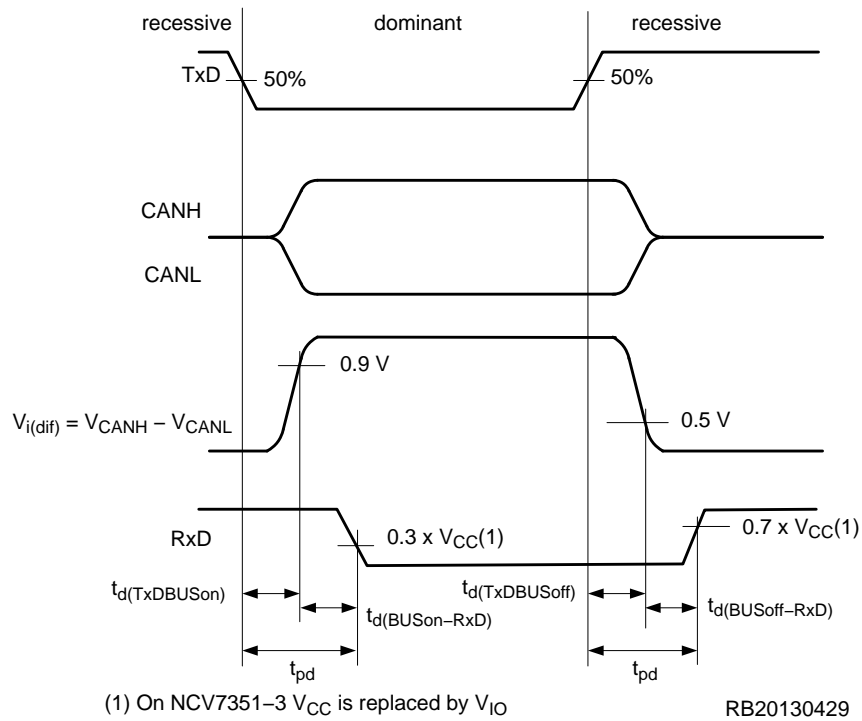


Figure 6. Transceiver Timing Diagram

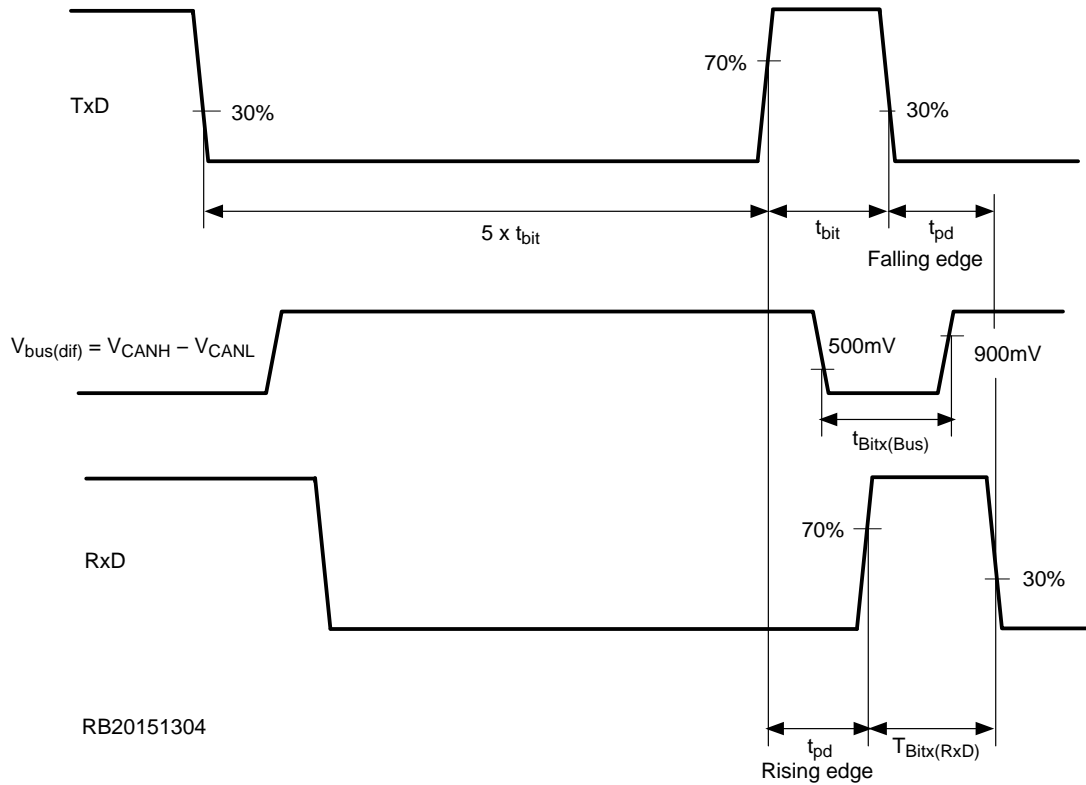


Figure 7. CAN FD Timing Diagram

# NCV7351, NCV7351F

## DEVICE ORDERING INFORMATION

| Part Number    | Description  | Marking   | Temperature Range | Package          | Shipping <sup>†</sup> |
|----------------|--|-----------|-------------------|------------------|-----------------------|
| NCV7351D13R2G  | High Speed CAN Transceiver with V <sub>IO</sub> pin                  | NCV7351-3 | -40°C to +125°C   | SOIC-8 (Pb-Free) | 3000 / Tape & Reel    |
| NCV7351FD13R2G | CAN FD Compliant High Speed CAN Transceiver with V <sub>IO</sub> pin | NCV7351F  |                   |                  |                       |
| NCV7351D10R2G  | High Speed CAN Transceiver with pin 5 NC                             | NCV7351-0 |                   |                  |                       |
| NCV7351D1ER2G  | High Speed CAN Transceiver with EN pin                               | NCV7351-E |                   |                  |                       |

<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.

# MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS

ON Semiconductor®



SCALE 1:1

SOIC-8 NB  
CASE 751-07  
ISSUE AK

DATE 16 FEB 2011



- 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 |

### 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.

### GENERIC MARKING DIAGRAM\*



XXXXXX = Specific Device Code  
 A = Assembly Location  
 L = Wafer Lot  
 Y = Year  
 W = Work Week  
 ■ = Pb-Free Package

XXXXXX = Specific Device Code  
 A = Assembly Location  
 Y = Year  
 WW = Work Week  
 ■ = 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.

### STYLES ON PAGE 2

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**SOIC-8 NB**  
**CASE 751-07**  
**ISSUE AK**

DATE 16 FEB 2011

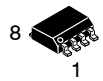
- |  |   |   |   |
|--|---|---|---|
| <p><b>STYLE 1:</b><br/> PIN 1. EMITTER<br/> 2. COLLECTOR<br/> 3. COLLECTOR<br/> 4. EMITTER<br/> 5. EMITTER<br/> 6. BASE<br/> 7. BASE<br/> 8. EMITTER</p>   | <p><b>STYLE 2:</b><br/> PIN 1. COLLECTOR, DIE, #1<br/> 2. COLLECTOR, #1<br/> 3. COLLECTOR, #2<br/> 4. COLLECTOR, #2<br/> 5. BASE, #2<br/> 6. EMITTER, #2<br/> 7. BASE, #1<br/> 8. EMITTER, #1</p>               | <p><b>STYLE 3:</b><br/> PIN 1. DRAIN, DIE #1<br/> 2. DRAIN, #1<br/> 3. DRAIN, #2<br/> 4. DRAIN, #2<br/> 5. GATE, #2<br/> 6. SOURCE, #2<br/> 7. GATE, #1<br/> 8. SOURCE, #1</p>                            | <p><b>STYLE 4:</b><br/> PIN 1. ANODE<br/> 2. ANODE<br/> 3. ANODE<br/> 4. ANODE<br/> 5. ANODE<br/> 6. ANODE<br/> 7. ANODE<br/> 8. COMMON CATHODE</p>   |
| <p><b>STYLE 5:</b><br/> PIN 1. DRAIN<br/> 2. DRAIN<br/> 3. DRAIN<br/> 4. DRAIN<br/> 5. GATE<br/> 6. GATE<br/> 7. SOURCE<br/> 8. SOURCE</p>   | <p><b>STYLE 6:</b><br/> PIN 1. SOURCE<br/> 2. DRAIN<br/> 3. DRAIN<br/> 4. SOURCE<br/> 5. SOURCE<br/> 6. GATE<br/> 7. GATE<br/> 8. SOURCE</p>  | <p><b>STYLE 7:</b><br/> PIN 1. INPUT<br/> 2. EXTERNAL BYPASS<br/> 3. THIRD STAGE SOURCE<br/> 4. GROUND<br/> 5. DRAIN<br/> 6. GATE 3<br/> 7. SECOND STAGE Vd<br/> 8. FIRST STAGE Vd</p>                    | <p><b>STYLE 8:</b><br/> PIN 1. COLLECTOR, DIE #1<br/> 2. BASE, #1<br/> 3. BASE, #2<br/> 4. COLLECTOR, #2<br/> 5. COLLECTOR, #2<br/> 6. EMITTER, #2<br/> 7. EMITTER, #1<br/> 8. COLLECTOR, #1</p>                              |
| <p><b>STYLE 9:</b><br/> PIN 1. EMITTER, COMMON<br/> 2. COLLECTOR, DIE #1<br/> 3. COLLECTOR, DIE #2<br/> 4. EMITTER, COMMON<br/> 5. EMITTER, COMMON<br/> 6. BASE, DIE #2<br/> 7. BASE, DIE #1<br/> 8. EMITTER, COMMON</p> | <p><b>STYLE 10:</b><br/> PIN 1. GROUND<br/> 2. BIAS 1<br/> 3. OUTPUT<br/> 4. GROUND<br/> 5. GROUND<br/> 6. BIAS 2<br/> 7. INPUT<br/> 8. GROUND</p>  | <p><b>STYLE 11:</b><br/> PIN 1. SOURCE 1<br/> 2. GATE 1<br/> 3. SOURCE 2<br/> 4. GATE 2<br/> 5. DRAIN 2<br/> 6. DRAIN 2<br/> 7. DRAIN 1<br/> 8. DRAIN 1</p>   | <p><b>STYLE 12:</b><br/> PIN 1. SOURCE<br/> 2. SOURCE<br/> 3. SOURCE<br/> 4. GATE<br/> 5. DRAIN<br/> 6. DRAIN<br/> 7. DRAIN<br/> 8. DRAIN</p>   |
| <p><b>STYLE 13:</b><br/> PIN 1. N.C.<br/> 2. SOURCE<br/> 3. SOURCE<br/> 4. GATE<br/> 5. DRAIN<br/> 6. DRAIN<br/> 7. DRAIN<br/> 8. DRAIN</p>  | <p><b>STYLE 14:</b><br/> PIN 1. N-SOURCE<br/> 2. N-GATE<br/> 3. P-SOURCE<br/> 4. P-GATE<br/> 5. P-DRAIN<br/> 6. P-DRAIN<br/> 7. N-DRAIN<br/> 8. N-DRAIN</p>   | <p><b>STYLE 15:</b><br/> PIN 1. ANODE 1<br/> 2. ANODE 1<br/> 3. ANODE 1<br/> 4. ANODE 1<br/> 5. CATHODE, COMMON<br/> 6. CATHODE, COMMON<br/> 7. CATHODE, COMMON<br/> 8. CATHODE, COMMON</p>               | <p><b>STYLE 16:</b><br/> PIN 1. EMITTER, DIE #1<br/> 2. BASE, DIE #1<br/> 3. EMITTER, DIE #2<br/> 4. BASE, DIE #2<br/> 5. COLLECTOR, DIE #2<br/> 6. COLLECTOR, DIE #2<br/> 7. COLLECTOR, DIE #1<br/> 8. COLLECTOR, DIE #1</p> |
| <p><b>STYLE 17:</b><br/> PIN 1. VCC<br/> 2. V2OUT<br/> 3. V1OUT<br/> 4. TXE<br/> 5. RXE<br/> 6. VEE<br/> 7. GND<br/> 8. ACC</p>  | <p><b>STYLE 18:</b><br/> PIN 1. ANODE<br/> 2. ANODE<br/> 3. SOURCE<br/> 4. GATE<br/> 5. DRAIN<br/> 6. DRAIN<br/> 7. CATHODE<br/> 8. CATHODE</p>   | <p><b>STYLE 19:</b><br/> PIN 1. SOURCE 1<br/> 2. GATE 1<br/> 3. SOURCE 2<br/> 4. GATE 2<br/> 5. DRAIN 2<br/> 6. MIRROR 2<br/> 7. DRAIN 1<br/> 8. MIRROR 1</p>   | <p><b>STYLE 20:</b><br/> PIN 1. SOURCE (N)<br/> 2. GATE (N)<br/> 3. SOURCE (P)<br/> 4. GATE (P)<br/> 5. DRAIN<br/> 6. DRAIN<br/> 7. DRAIN<br/> 8. DRAIN</p>   |
| <p><b>STYLE 21:</b><br/> PIN 1. CATHODE 1<br/> 2. CATHODE 2<br/> 3. CATHODE 3<br/> 4. CATHODE 4<br/> 5. CATHODE 5<br/> 6. COMMON ANODE<br/> 7. COMMON ANODE<br/> 8. CATHODE 6</p>  | <p><b>STYLE 22:</b><br/> PIN 1. I/O LINE 1<br/> 2. COMMON CATHODE/VCC<br/> 3. COMMON CATHODE/VCC<br/> 4. I/O LINE 3<br/> 5. COMMON ANODE/GND<br/> 6. I/O LINE 4<br/> 7. I/O LINE 5<br/> 8. COMMON ANODE/GND</p> | <p><b>STYLE 23:</b><br/> PIN 1. LINE 1 IN<br/> 2. COMMON ANODE/GND<br/> 3. COMMON ANODE/GND<br/> 4. LINE 2 IN<br/> 5. LINE 2 OUT<br/> 6. COMMON ANODE/GND<br/> 7. COMMON ANODE/GND<br/> 8. LINE 1 OUT</p> | <p><b>STYLE 24:</b><br/> PIN 1. BASE<br/> 2. EMITTER<br/> 3. COLLECTOR/ANODE<br/> 4. COLLECTOR/ANODE<br/> 5. CATHODE<br/> 6. CATHODE<br/> 7. COLLECTOR/ANODE<br/> 8. COLLECTOR/ANODE</p>                                      |
| <p><b>STYLE 25:</b><br/> PIN 1. VIN<br/> 2. N/C<br/> 3. REXT<br/> 4. GND<br/> 5. IOUT<br/> 6. IOUT<br/> 7. IOUT<br/> 8. IOUT</p>   | <p><b>STYLE 26:</b><br/> PIN 1. GND<br/> 2. dv/dt<br/> 3. ENABLE<br/> 4. ILIMIT<br/> 5. SOURCE<br/> 6. SOURCE<br/> 7. SOURCE<br/> 8. VCC</p>  | <p><b>STYLE 27:</b><br/> PIN 1. ILIMIT<br/> 2. OVLO<br/> 3. UVLO<br/> 4. INPUT+<br/> 5. SOURCE<br/> 6. SOURCE<br/> 7. SOURCE<br/> 8. DRAIN</p>  | <p><b>STYLE 28:</b><br/> PIN 1. SW_TO_GND<br/> 2. DASIC OFF<br/> 3. DASIC_SW_DET<br/> 4. GND<br/> 5. V_MON<br/> 6. VBULK<br/> 7. VBULK<br/> 8. VIN</p>  |
| <p><b>STYLE 29:</b><br/> PIN 1. BASE, DIE #1<br/> 2. EMITTER, #1<br/> 3. BASE, #2<br/> 4. EMITTER, #2<br/> 5. COLLECTOR, #2<br/> 6. COLLECTOR, #2<br/> 7. COLLECTOR, #1<br/> 8. COLLECTOR, #1</p>                        | <p><b>STYLE 30:</b><br/> PIN 1. DRAIN 1<br/> 2. DRAIN 1<br/> 3. GATE 2<br/> 4. SOURCE 2<br/> 5. SOURCE 1/DRAIN 2<br/> 6. SOURCE 1/DRAIN 2<br/> 7. SOURCE 1/DRAIN 2<br/> 8. GATE 1</p>                           |   |   |

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# MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS

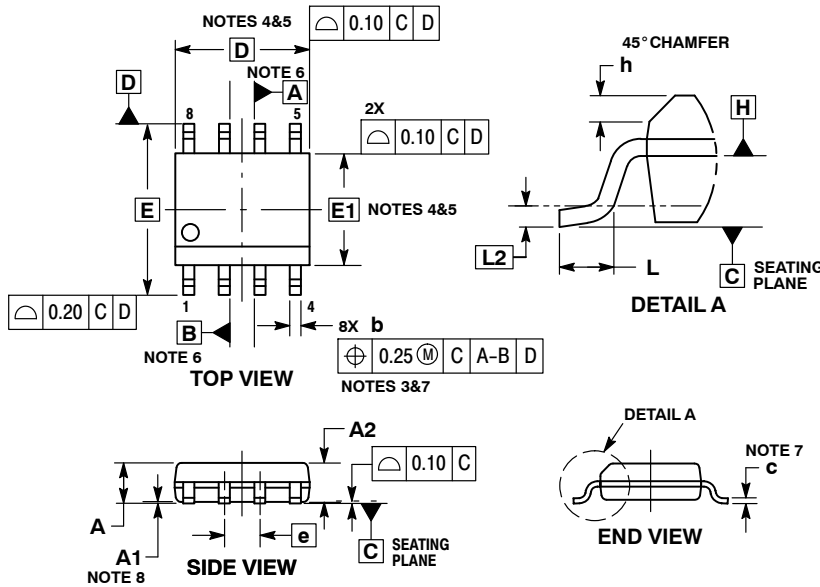
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SCALE 1:1

## SOIC-8 CASE 751AZ ISSUE B

DATE 18 MAY 2015

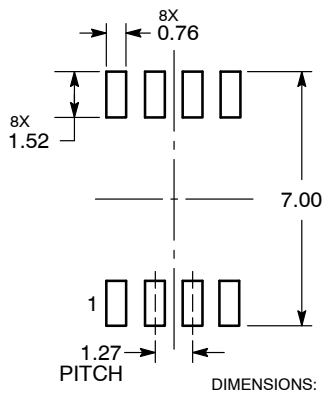


**NOTES:**

- DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
- CONTROLLING DIMENSION: MILLIMETERS.
- DIMENSION b DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE PROTRUSION SHALL BE 0.004 mm IN EXCESS OF MAXIMUM MATERIAL CONDITION.
- DIMENSION D DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH, PROTRUSIONS OR GATE BURRS SHALL NOT EXCEED 0.006 mm PER SIDE. DIMENSION E1 DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.010 mm PER SIDE.
- THE PACKAGE TOP MAY BE SMALLER THAN THE PACKAGE BOTTOM. DIMENSIONS D AND E1 ARE DETERMINED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY AT DATUM H.
- DIMENSIONS A AND B ARE TO BE DETERMINED AT DATUM H.
- DIMENSIONS b AND c APPLY TO THE FLAT SECTION OF THE LEAD BETWEEN 0.10 TO 0.25 FROM THE LEAD TIP.
- A1 IS DEFINED AS THE VERTICAL DISTANCE FROM THE SEATING PLANE TO THE LOWEST POINT ON THE PACKAGE BODY.

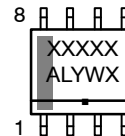
| DIM | MILLIMETERS |      |
|-----|-------------|------|
|     | MIN         | MAX  |
| A   | ---         | 1.75 |
| A1  | 0.10        | 0.25 |
| A2  | 1.25        | ---  |
| b   | 0.31        | 0.51 |
| c   | 0.10        | 0.25 |
| D   | 4.90 BSC    |      |
| E   | 6.00 BSC    |      |
| E1  | 3.90 BSC    |      |
| e   | 1.27 BSC    |      |
| h   | 0.25        | 0.41 |
| L   | 0.40        | 1.27 |
| L2  | 0.25 BSC    |      |

**RECOMMENDED  
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.

**GENERIC  
MARKING DIAGRAM\***



- XXXXX = Specific Device Code
- A = Assembly Location
- L = Wafer Lot
- Y = Year
- W = Work Week
- = Pb-Free Package

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

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