

±15 kV ESD protection 3 to 5.5 V low power, up to 250 kbps, RS-232 drivers and receivers

Datasheet - production data



- Hand-held equipment
- Peripherals and printers

## Description

The ST3232E is a 3 V powered EIA/TIA-232 and V.28/V.24 communication interfaces with low power requirements, high data-rate capabilities and enhanced electrostatic discharge (ESD) protection to ± 8 kV using IEC1000-4-2 contact discharge and ± 15 kV using the human body model. The ST3232E has a proprietary low-dropout transmitter output stage providing true RS-232 performance from 3 to 5 V supplies with a dual charge pump. The charge pump requires only four small 0.1 μF standard external capacitors for operations from 3 V supply.

The ST3232E has two receivers and two drivers.

The device is guaranteed to run at data rates of 250 kbps while maintaining RS-232 output levels.

## Features

- ESD protection for RS-232 I/O pins
- ±15 kV human body model
- ±8 kV IEC 1000-4-2 contact discharge
- 300 μA supply current
- 250 kbps minimum guaranteed data rate
- 6 V/μs minimum guaranteed slew rate
- Meet EIA/TIA-232 specifications down to 3 V
- Available in SO-16 and TSSOP16

## Applications

- Notebook, subnotebook and palmtop computers
- Battery-powered equipment

Table 1. Device summary

| Order code | Temperature range | Package                 |
|------------|-------------------|-------------------------|
| ST3232ECDR | 0 to 70 °C        | SO-16 (tape and reel)   |
| ST3232EBDR | -40 to 85 °C      | SO-16 (tape and reel)   |
| ST3232ECTR | 0 to 70 °C        | TSSOP16 (tape and reel) |
| ST3232EBTR | -40 to 85 °C      | TSSOP16 (tape and reel) |

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# 1 Pin configuration

Figure 1. Pin connection



Table 2. Pin description

| Pin n° | Symbol     | Name and function                                      |
|--------|------------|--|
| 1      | $C_{1+}$   | Positive terminal for the first charge pump capacitor  |
| 2      | $V+$       | Doubled voltage terminal                               |
| 3      | $C_{1-}$   | Negative Terminal for the first charge pump capacitor  |
| 4      | $C_{2+}$   | Positive terminal for the second charge pump capacitor |
| 5      | $C_{2-}$   | Negative terminal for the second charge pump capacitor |
| 6      | $V-$       | Inverted voltage terminal                              |
| 7      | $T2_{OUT}$ | Second transmitter output voltage                      |
| 8      | $R2_{IN}$  | Second receiver input voltage                          |
| 9      | $R2_{OUT}$ | Second receiver output voltage                         |
| 10     | $T2_{IN}$  | Second transmitter input voltage                       |
| 11     | $T1_{IN}$  | First transmitter input voltage                        |
| 12     | $R1_{OUT}$ | First receiver output voltage                          |
| 13     | $R1_{IN}$  | First receiver input voltage                           |
| 14     | $T1_{OUT}$ | First transmitter output voltage                       |
| 15     | GND        | Ground   |
| 16     | $V_{CC}$   | Supply voltage   |

## 2 Absolute maximum ratings

**Table 3. Absolute maximum ratings**

| Symbol             | Parameter   | Value                           | Unit |
|--------------------|---|---------------------------------|------|
| V <sub>CC</sub>    | Supply voltage  | -0.3 to 6                       | V    |
| V+                 | Doubled voltage terminal                                  | (V <sub>CC</sub> - 0.3) to 7    | V    |
| V-                 | Inverted voltage terminal                                 | 0.3 to -7                       | V    |
| V+ + V-            |   | 13                              | V    |
| T <sub>IN</sub>    | Transmitter input voltage range                           | -0.3 to 6                       | V    |
| R <sub>IN</sub>    | Receiver input voltage range                              | ± 25                            | V    |
| T <sub>OUT</sub>   | Transmitter output voltage range                          | ± 13.2                          | V    |
| R <sub>OUT</sub>   | Receiver output voltage range                             | -0.3 to (V <sub>CC</sub> + 0.3) | V    |
| t <sub>SHORT</sub> | Transmitter output short-to-ground time                   | Continuous                      |      |
| T <sub>j</sub>     | Maximum junction temperature                              | 150                             | °C   |
| R <sub>th-jc</sub> | Thermal resistance junction-to-case <sup>(1) (2)</sup>    |                                 | °C/W |
|                    | SO-16   | 30                              |      |
|                    | TSSOP16   | 25                              |      |
| R <sub>th-ja</sub> | Thermal resistance junction-to-ambient <sup>(1) (2)</sup> |                                 |      |
|                    | SO-16   | 95                              |      |
|                    | TSSOP16   | 95                              |      |

1. Short-circuits can cause excessive heating and destructive dissipation.
2. R<sub>th</sub> are typical values.

*Note: Absolute maximum ratings are those values beyond which damage to the device may occur. Functional operation under these condition is not implied.*

*Externally applied V+ and V- can have a maximum magnitude of +7 V, but their absolute addition can not exceed 13 V.*

*Running on internal charge pump, intrinsic self limitation allows exceeding those values without any damage.*

*Start-up voltage sequence (V<sub>CC</sub>, then V+, then V-) is critical, therefore it is not recommended to use this device using externally applied voltage to V+ and V-.*

**Figure 2. ESD performance: transmitter outputs, receiver inputs**

| Symbol | Parameter              | Test conditions  | Min. | Typ. | Max. | Unit |
|--------|------------------------|------------------|------|------|------|------|
| ESD    | ESD protection voltage | Human body model | ±15  |      |      | kV   |
| ESD    | ESD protection voltage | IEC-1000-4-2     | ±8   |      |      | kV   |

### 3 Electrical characteristics

$C_1 - C_4 = 0.1 \mu\text{F}$ ,  $V_{\text{CC}} = 3 \text{ V to } 5.5 \text{ V}$ ,  $T_A = -40 \text{ to } 85 \text{ }^\circ\text{C}$ , unless otherwise specified. Typical values are referred to  $T_A = 25 \text{ }^\circ\text{C}$ .

**Table 4. Electrical characteristics**

| Symbol              | Parameter                            | Test conditions  | Min. | Typ. | Max. | Unit |
|---------------------|--------------------------------------|--|------|------|------|------|
| $I_{\text{SUPPLY}}$ | $V_{\text{CC}}$ Power supply current | No Load, $V_{\text{CC}} = 3 \text{ V or } 5 \text{ V}$ , $T_A = 25 \text{ }^\circ\text{C}$ |      | 0.3  | 1    | mA   |

$C_1 - C_4 = 0.1 \mu\text{F}$ ,  $V_{\text{CC}} = 3 \text{ V to } 5.5 \text{ V}$ ,  $T_A = -40 \text{ to } 85 \text{ }^\circ\text{C}$ , unless otherwise specified. Typical values are referred to  $T_A = 25 \text{ }^\circ\text{C}$ .

**Table 5. Logic input**

| Symbol           | Parameter                    | Test conditions                 | Min. | Typ.       | Max.    | Unit          |
|------------------|------------------------------|---------------------------------|------|------------|---------|---------------|
| $V_{\text{TIL}}$ | Input logic threshold low    | T-IN                            |      |            | 0.8     | V             |
| $V_{\text{HYS}}$ | Transmitter input hysteresis |                                 |      | 0.25       |         | V             |
| $V_{\text{TIH}}$ | Input logic threshold high   | $V_{\text{CC}} = 3.3 \text{ V}$ | 2    |            |         | V             |
|                  |                              | $V_{\text{CC}} = 5 \text{ V}$   | 2.4  |            |         |               |
| $I_{\text{IL}}$  | Input leakage current        | T-IN                            |      | $\pm 0.01$ | $\pm 1$ | $\mu\text{A}$ |

$C_1 - C_4 = 0.1 \mu\text{F}$  tested at  $3.3 \text{ V} \pm 10 \%$ ,  $V_{\text{CC}} = 3 \text{ V to } 5.5 \text{ V}$ ,  $T_A = -40 \text{ to } 85 \text{ }^\circ\text{C}$ , unless otherwise specified. Typical values are referred to  $T_A = 25 \text{ }^\circ\text{C}$ .

**Table 6. Transmitter**

| Symbol            | Parameter                     | Test conditions  | Min.    | Typ.      | Max.     | Unit          |
|-------------------|-------------------------------|--|---------|-----------|----------|---------------|
| $V_{\text{TOUT}}$ | Output voltage swing          | All transmitter outputs are loaded with $3 \text{ k}\Omega$ to GND   | $\pm 5$ | $\pm 5.4$ |          | V             |
| $R_{\text{TOUT}}$ | Transmitter output resistance | $V_{\text{CC}} = 0 \text{ V}$ , $V_{\text{OUT}} = \pm 2 \text{ V}$   | 300     | 10M       |          | W             |
| $I_{\text{SC}}$   | Output short-circuit current  |  |         | $\pm 60$  |          | mA            |
| $I_{\text{TOL}}$  | Output leakage current        | $V_{\text{CC}} = 0 \text{ V or } 3.3 \text{ V to } 5.5 \text{ V}$<br>$V_{\text{OUT}} = \pm 12 \text{ V}$<br>Transmitters disable |         |           | $\pm 25$ | $\mu\text{A}$ |

C<sub>1</sub> - C<sub>4</sub> = 0.1 μF tested at 3.3 V ± 10%, V<sub>CC</sub> = 3 V to 5.5 V, T<sub>A</sub> = -40 to 85 °C, unless otherwise specified. Typical values are referred to T<sub>A</sub> = 25 °C.

**Table 7. Receiver**

| Symbol             | Parameter                              | Test conditions                                 | Min.                 | Typ.                 | Max. | Unit |
|--------------------|--|---|----------------------|----------------------|------|------|
| V <sub>RIN</sub>   | Receiver input voltage operating range |   | -25                  |                      | 25   | V    |
| V <sub>RIL</sub>   | RS-232 input threshold low             | T <sub>A</sub> = 25 °C, V <sub>CC</sub> = 3.3 V | 0.6                  | 1.1                  |      | V    |
|                    |  | T <sub>A</sub> = 25 °C, V <sub>CC</sub> = 5 V   | 0.8                  | 1.5                  |      |      |
| V <sub>RIH</sub>   | RS-232 input threshold high            | T <sub>A</sub> = 25 °C, V <sub>CC</sub> = 3.3 V |                      | 1.4                  | 2.4  | V    |
|                    |  | T <sub>A</sub> = 25 °C, V <sub>CC</sub> = 5 V   |                      | 1.8                  | 2.4  |      |
| V <sub>RIHYS</sub> | Input hysteresis                       |   |                      | 0.5                  |      | V    |
| R <sub>RIN</sub>   | Input resistance                       | T <sub>A</sub> = 25 °C                          | 3                    | 5                    | 7    | kΩ   |
| V <sub>ROL</sub>   | TTL/CMOS Output voltage low            | I <sub>OUT</sub> = 1.6 mA                       |                      |                      | 0.4  | V    |
| V <sub>ROH</sub>   | TTL/CMOS Output voltage high           | I <sub>OUT</sub> = -1 mA                        | V <sub>CC</sub> -0.6 | V <sub>CC</sub> -0.1 |      | V    |

C<sub>1</sub> - C<sub>4</sub> = 0.1 μF tested at 3.3 V ± 10%, V<sub>CC</sub> = 3 V to 5.5 V, T<sub>A</sub> = -40 to 85 °C, unless otherwise specified. Typical values are referred to T<sub>A</sub> = 25 °C

**Table 8. Timing characteristics**

| Symbol                                  | Parameter                                | Test conditions   | Min.   | Typ. | Max.     | Unit         |
|---|--|---|--------|------|----------|--------------|
| D <sub>R</sub>                          | Data transfer rate                       | R <sub>L</sub> = 3 kΩ, C <sub>L2</sub> = 1000 pF<br>one transmitter switching   | 250    |      |          | kbps         |
| t <sub>PHLR</sub><br>t <sub>PLHR</sub>  | Propagation delay input to output        | R <sub>XIN</sub> = R <sub>XOUT</sub> , C <sub>L</sub> = 150 pF  |        | 0.15 |          | μs           |
| t <sub>OER</sub>                        | Receiver output enable time              | Normal operation  |        | 50   |          | ns           |
| t <sub>ODR</sub>                        | Receiver output disable time             | Normal operation  |        | 50   |          | ns           |
| t <sub>PHLT</sub><br>- t <sub>THL</sub> | Transmitter propagation delay difference | (1)   |        | 200  |          | ns           |
| t <sub>PHLR</sub><br>- t <sub>THR</sub> | Receiver propagation delay difference    |   |        | 50   |          | ns           |
| S <sub>RT</sub>                         | Transition slew rate                     | T <sub>A</sub> = 25 °C R <sub>L</sub> = 3 kΩ to 7 kΩ V <sub>CC</sub> =<br>3.3 V measured from +3 V to -3 V or -3 V<br>to +3 V<br>C <sub>L</sub> = 150 pF to 1000 pF<br>C <sub>L</sub> = 150 pF to 2500 pF | 6<br>4 |      | 30<br>30 | V/μs<br>V/μs |

1. Transmitter skew is measured at the transmitter zero-cross points.

# 4 Application

Figure 3. Application circuits

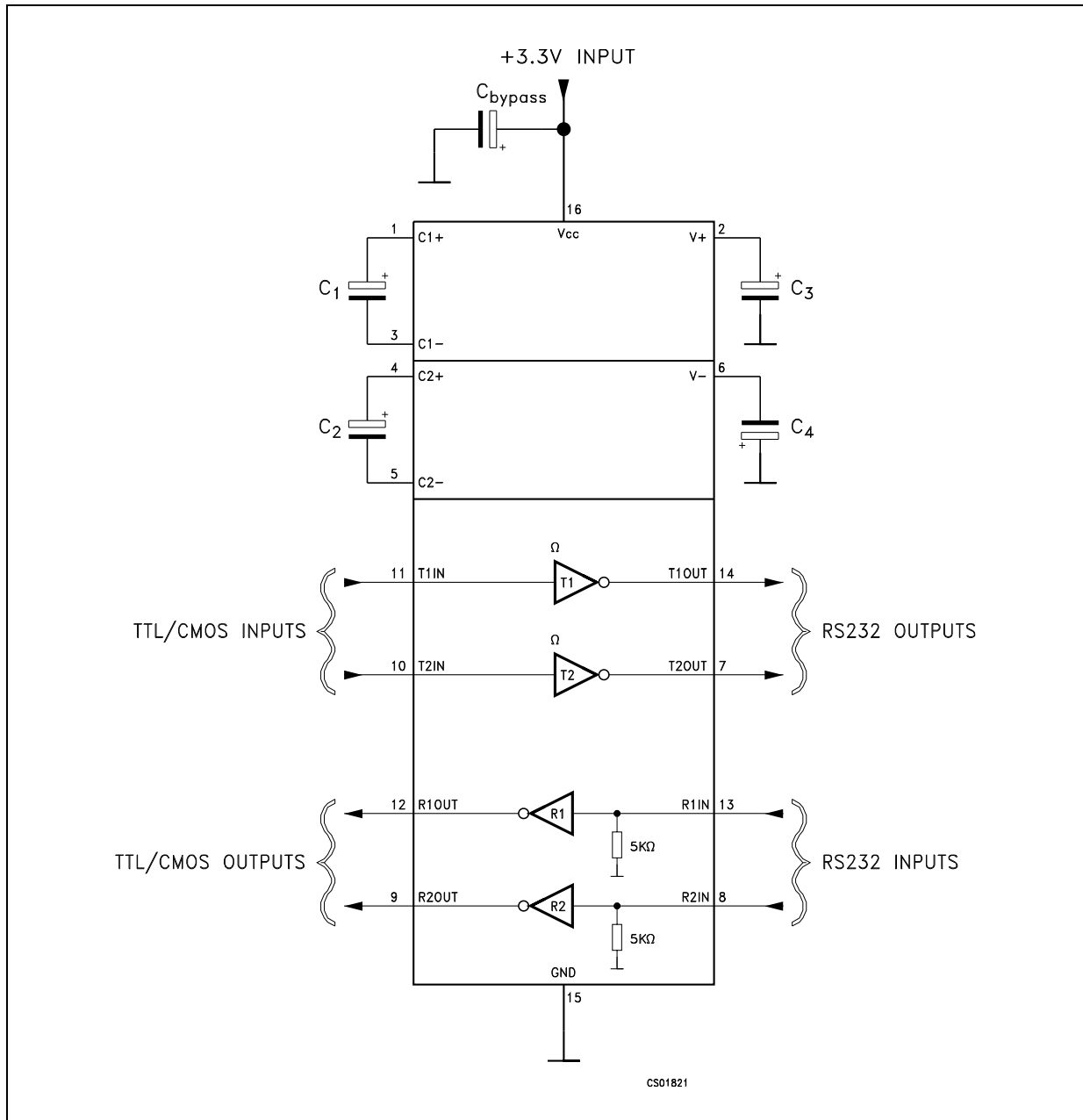


Table 9. Capacitance value (µF)

| V <sub>CC</sub> | C1    | C2   | C3   | C4   | C <sub>bypass</sub> |
|-----------------|-------|------|------|------|---------------------|
| 3.0 to 3.6      | 0.1   | 0.1  | 0.1  | 0.1  | 0.1                 |
| 4.5 to 5.5      | 0.047 | 0.33 | 0.33 | 0.33 | 0.1                 |
| 3.0 to 5.5      | 0.1   | 0.47 | 0.47 | 0.47 | 0.1                 |

## 5 Typical performance characteristics

Unless otherwise specified  $T_J = 25\text{ }^\circ\text{C}$ .

**Figure 4. Output current vs. output high voltage** **Figure 5. Output current vs. output high voltage**



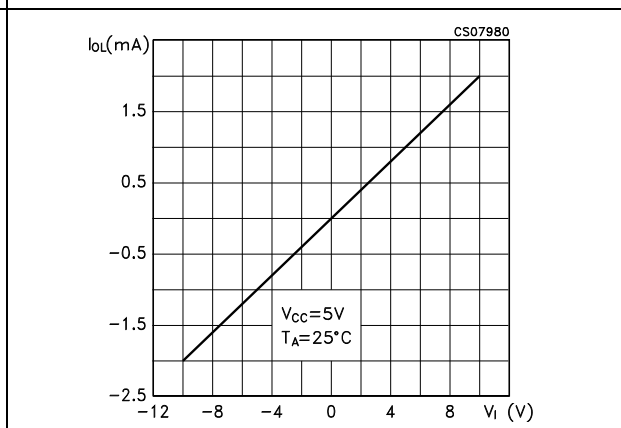
**Figure 6. Output current vs. output low voltage** **Figure 7. Output current vs. output low voltage**



**Figure 8. Voltage transfer characteristics for transmitter inputs**



**Figure 9. Receiver input resistance**





## 6 Package information

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK<sup>®</sup> packages, depending on their level of environmental compliance. ECOPACK<sup>®</sup> specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK<sup>®</sup> is an ST trademark.

### 6.1 SO-16 package information

Figure 10. SO-16 package outline



Table 10. SO-16 package mechanical data

| Ref. | Dimensions (mm) |      |       |
|------|-----------------|------|-------|
|      | Min.            | Typ. | Max.  |
| A    |                 |      | 1.75  |
| A1   | 0.10            |      | 0.25  |
| A2   | 1.25            |      |       |
| b    | 0.31            |      | 0.51  |
| c    | 0.17            |      | 0.25  |
| D    | 9.80            | 9.90 | 10.00 |
| E    | 5.80            | 6.00 | 6.20  |
| E1   | 3.80            | 3.90 | 4.00  |
| e    |                 | 1.27 |       |
| h    | 0.25            |      | 0.50  |
| L    | 0.40            |      | 1.27  |
| k    | 0               |      | 8     |
| ccc  |                 |      | 0.10  |

Dimension D does not include mold flash, protrusions or gate burrs. Mold flash, protrusions or gate burrs shall not exceed 0.15 mm in total (both side).

Dimension "E1" does not include interlead flash or protrusions. Interlead flash or protrusions shall not exceed 0.25mm per side.

Dimensions referred to the bottom side of the package.

Figure 11. SO-16 recommended footprint



## 6.2 TSSOP-16 package information

Figure 12. TSSOP-16 package outline

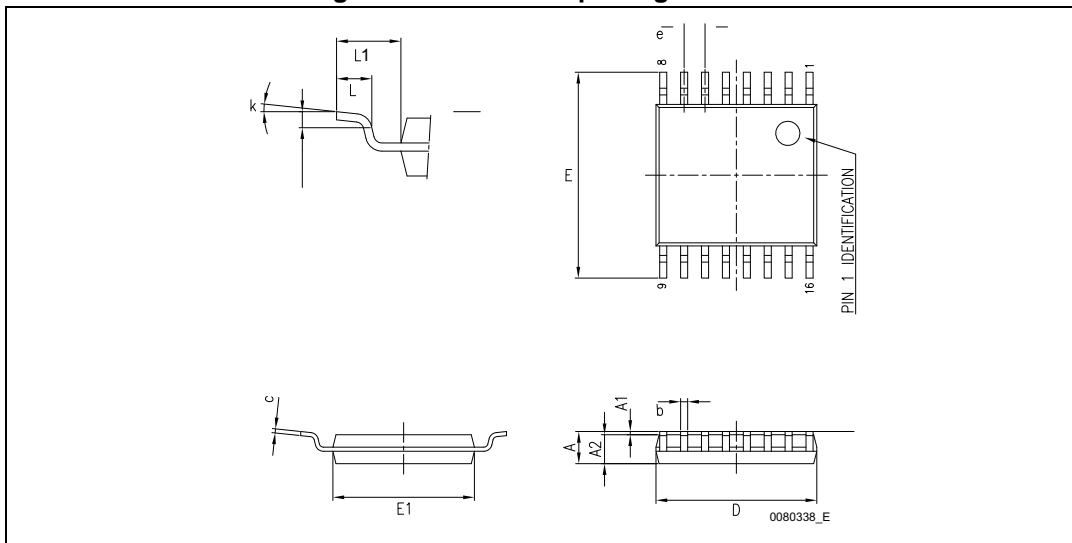


Table 11. TSSOP-16 package mechanical data

| Ref. | Dimensions |      |      |
|------|------------|------|------|
|      | mm         |      |      |
|      | Min.       | Typ. | Max. |
| A    |            |      | 1.20 |
| A1   | 0.05       |      | 0.15 |
| A2   | 0.80       | 1.00 | 1.05 |
| b    | 0.19       |      | 0.30 |
| c    | 0.09       |      | 0.20 |
| D    | 4.90       | 5.00 | 5.10 |
| E    | 6.20       | 6.40 | 6.60 |
| E1   | 4.30       | 4.40 | 4.50 |
| e    |            | 0.65 |      |
| L    | 0.45       | 0.60 | 0.75 |
| L1   |            | 1.00 |      |
| k    | 0          |      | 8    |
| aaa  |            |      | 0.10 |

TSSOP stands for thin shrink small outline package. Dimension “D” does not include mold flash, protrusions or gate burrs. Mold flash, protrusions or gate burrs shall not exceed 0.15 mm per side. Dimension “E1” does not include interlead flash or protrusions. Interlead flash or protrusions shall not exceed 0.25 mm per side.

## 7 Revision history

Table 12. Document revision history

| Date        | Revision | Changes  |
|-------------|----------|--|
| 06-Sep-2006 | 3        | Order codes updated.   |
| 21-Jan-2008 | 4        | Added: <i>Table 1</i> and note on <i>Table 3</i> .   |
| 08-Feb-2008 | 5        | Modified: <i>Table 1</i> on page 1.  |
| 05-Jan-2010 | 6        | Modified: <i>Table 1</i> on page 1.  |
| 04-Jul-2018 | 7        | Updated <i>Table 3: Absolute maximum ratings</i> and <i>Section 6: Package information</i> . |

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