

## Hi-Rel PNP bipolar transistor 80 V - 5 A

Datasheet – production data

### Features

|                             |                 |
|-----------------------------|-----------------|
| $BV_{CEO}$                  | 80 V            |
| $I_C$ (max)                 | 5 A             |
| $H_{FE}$ at 10 V - 150 mA   | > 70            |
| Operating temperature range | -65°C to +200°C |

- Hi-Rel PNP bipolar transistor
- Linear gain characteristics
- ESCC qualified
- European preferred part list - EPPL
- Radiation level: lot specific total dose contact marketing for specified level

### Description

The 2N5153HR is a silicon planar epitaxial PNP transistor in TO-39, TO-257 and SMD.5 packages. It is specifically designed for aerospace Hi-Rel applications and ESCC qualified according to the 5204-002 specification. In case of conflict between this datasheet and ESCC detailed specification, the latter prevails.

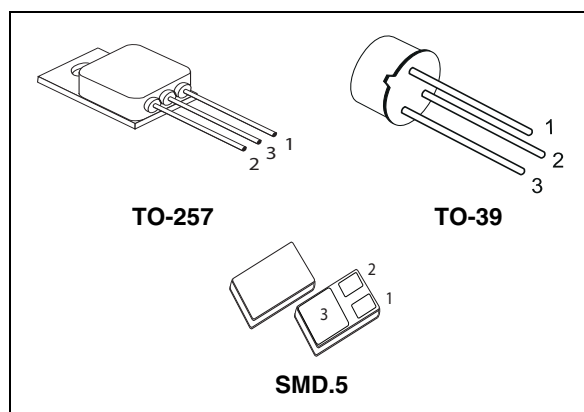


Figure 1. Internal schematic diagram

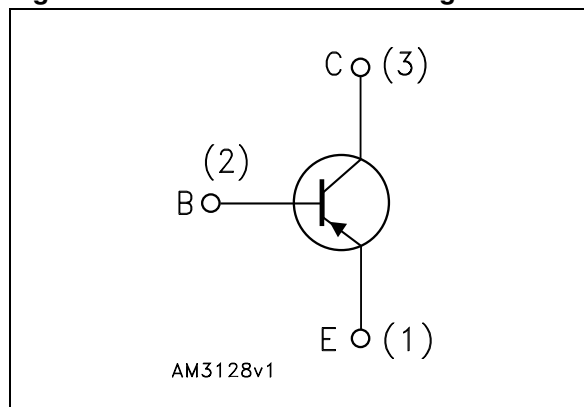


Table 1. Device summary

| Order codes | Packages | Lead finish     | Marking                | Type              | EPPL | Packaging  |
|-------------|----------|-----------------|------------------------|-------------------|------|------------|
| 2N5153HR    | TO-39    | Gold Solder Dip | 520400201<br>520400202 | ESCC Flight       |      | Strip pack |
| 2N5153SHR   | SMD.5    | Gold            | 520400206              | ESCC Flight       | Yes  | Strip pack |
| 2N5153ESYHR | TO-257   | Gold Solder Dip | 520400204<br>520400205 | ESCC Flight       |      | Strip pack |
| 2N5153T1    | TO-39    | Gold            | 2N5153T1               | Engineering model |      | Strip pack |
| 2N5153S1    | SMD.5    | Gold            | 2N5153S1               | Engineering model |      | Strip pack |
| 2N5153ESY   | TO-257   | Gold            | 2N5153ESY              | Engineering model |      | Strip pack |

# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

| Symbol    | Parameter                                                        | Value      | Unit |
|-----------|------------------------------------------------------------------|------------|------|
| $V_{CBO}$ | Collector-base voltage ( $I_E = 0$ )                             | -100       | V    |
| $V_{CEO}$ | Collector-emitter voltage ( $I_B = 0$ )                          | -80        | V    |
| $V_{EBO}$ | Emitter-base voltage ( $I_C = 0$ )                               | -5.5       | V    |
| $I_C$     | Collector current                                                | -5         | A    |
| $P_{TOT}$ | Total dissipation at $T_{amb} \leq 25\text{ °C}$<br>for 2N5153HR | 1          | W    |
|           | for 2N5153ESYHRB                                                 | 3.3        | W    |
|           | for Root part number 2                                           | 3.3        | W    |
|           | $T_C \leq 25\text{ °C}$<br>for 2N5153HR                          | 10         | W    |
|           | for 2N5153ESYHRB                                                 | 35         | W    |
|           | for Root part number 2                                           | 35         | W    |
| $T_{STG}$ | Storage temperature                                              | -65 to 200 | °C   |
| $T_J$     | Max. operating junction temperature                              | 200        | °C   |

**Table 3. Thermal data for through-hole packages**

| Symbol     | Parameter                               | TO-39 | TO-257 | Unit |
|------------|-----------------------------------------|-------|--------|------|
| $R_{thJC}$ | Thermal resistance junction-case max    | 17.5  | 5      | °C/W |
| $R_{thJA}$ | Thermal resistance junction-ambient max | 175   | 53     | °C/W |

**Table 4. Thermal data for SMD package**

| Symbol     | Parameter                            | SMD.5 | Unit |
|------------|--------------------------------------|-------|------|
| $R_{thJC}$ | Thermal resistance junction-case max | 5     | °C/W |

## 2 Electrical characteristics

$T_{\text{case}} = 25\text{ }^{\circ}\text{C}$  unless otherwise specified

**Table 5. Electrical characteristics**

| Symbol                            | Parameter                                                  | Test conditions                                                                                                                                                                                                                                                                                              | Min.                 | Typ. | Max.          | Unit                           |
|-----------------------------------|------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|------|---------------|--------------------------------|
| $I_{\text{CES}}$                  | Collector cut-off current ( $I_{\text{E}} = 0$ )           | $V_{\text{CB}} = -60\text{ V}$<br>$V_{\text{CB}} = -60\text{ V}$ $T_{\text{amb}} = 150\text{ }^{\circ}\text{C}$                                                                                                                                                                                              |                      |      | -1<br>-10     | $\mu\text{A}$<br>$\mu\text{A}$ |
| $I_{\text{EBO}}$                  | Emitter cut-off current ( $I_{\text{C}} = 0$ )             | $V_{\text{EB}} = -4\text{ V}$<br>$V_{\text{EB}} = -5.5\text{ V}$                                                                                                                                                                                                                                             |                      |      | -1<br>-1      | $\mu\text{A}$<br>$\text{mA}$   |
| $I_{\text{CEO}}$                  | Collector cut-off current ( $I_{\text{B}} = 0$ )           | $V_{\text{CE}} = -40\text{ V}$                                                                                                                                                                                                                                                                               |                      |      | -50           | $\mu\text{A}$                  |
| $V_{(\text{BR})\text{CEO}}^{(1)}$ | Collector-emitter breakdown voltage ( $I_{\text{B}} = 0$ ) | $I_{\text{C}} = -100\text{ mA}$                                                                                                                                                                                                                                                                              | -80                  |      |               | V                              |
| $V_{\text{CE(sat)}}^{(1)}$        | Collector-emitter saturation voltage                       | $I_{\text{C}} = -5\text{ A}$ $I_{\text{B}} = -0.5\text{ A}$                                                                                                                                                                                                                                                  |                      |      | -1.5          | V                              |
| $V_{\text{BE(sat)}}^{(1)}$        | Base-emitter saturation voltage                            | $I_{\text{C}} = -2.5\text{ A}$ $I_{\text{B}} = -0.25\text{ A}$<br>$I_{\text{C}} = -5\text{ A}$ $I_{\text{B}} = -0.5\text{ A}$                                                                                                                                                                                |                      |      | -1.45<br>-2.2 | V<br>V                         |
| $h_{\text{FE}}^{(1)}$             | DC current gain                                            | $I_{\text{C}} = -50\text{ mA}$ $V_{\text{CE}} = -5\text{ V}$<br>$I_{\text{C}} = -2.5\text{ A}$ $V_{\text{CE}} = -5\text{ V}$<br>$I_{\text{C}} = -5\text{ A}$ $V_{\text{CE}} = -5\text{ V}$<br>$I_{\text{C}} = -2.5\text{ A}$ $V_{\text{CE}} = -5\text{ V}$<br>$T_{\text{amb}} = -55\text{ }^{\circ}\text{C}$ | 50<br>70<br>40<br>35 |      | 200           |                                |
| $h_{\text{fe}}$                   | AC forward current transfer ratio                          | $V_{\text{CE}} = -5\text{ V}$ $I_{\text{C}} = -500\text{ mA}$<br>$f = 20\text{ MHz}$                                                                                                                                                                                                                         | 3.5                  |      |               |                                |
| $C_{\text{OBO}}$                  | Output capacitance                                         | $I_{\text{E}} = 0$ $V_{\text{CB}} = -10\text{ V}$<br>$f = 1\text{ MHz}$                                                                                                                                                                                                                                      |                      |      | 250           | pF                             |
| $t_{\text{on}}$                   | Turn-on time                                               | $V_{\text{CC}} = -30\text{ V}$ $V_{\text{BB}} = -4\text{ V}$<br>$V_{\text{in}} \cong -51\text{ V}$ $I_{\text{C}} = 5\text{ A}$<br>$I_{\text{B1}} = -I_{\text{B2}} = -0.5\text{ A}$                                                                                                                           |                      |      | 0.5           | $\mu\text{s}$                  |
| $t_{\text{off}}$                  | Turn-off time                                              | $V_{\text{CC}} = -30\text{ V}$ $V_{\text{BB}} = -4\text{ V}$<br>$V_{\text{in}} \cong -51\text{ V}$ $I_{\text{C}} = -5\text{ A}$<br>$I_{\text{B1}} = -I_{\text{B2}} = -0.5\text{ A}$                                                                                                                          |                      |      | 1.3           | $\mu\text{s}$                  |

1. Pulsed duration = 300  $\mu\text{s}$ , duty cycle  $\leq 1.5\%$

## 2.1 Electrical characteristics (curves)

Figure 2.  $h_{FE}$  @  $V_{CE} = 5\text{ V}$

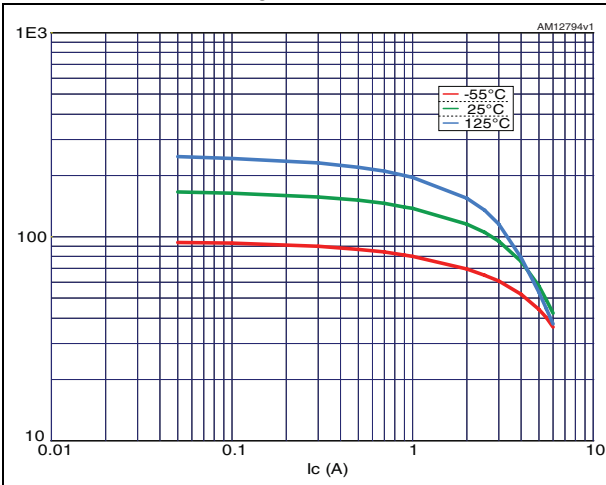


Figure 3.  $V_{CEsat}$  @  $h_{FE} = 10$

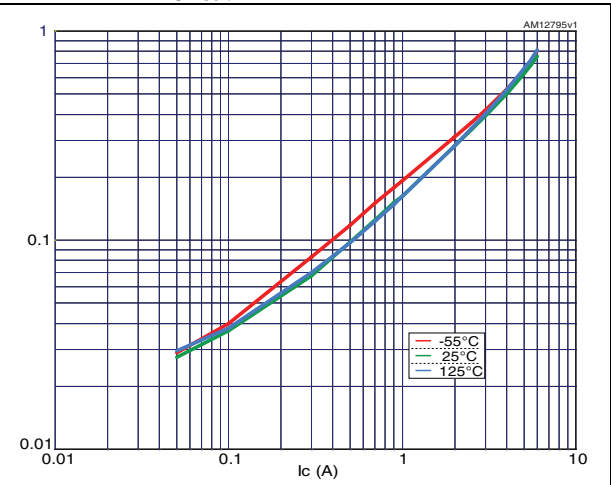


Figure 4.  $V_{BEsat}$  @  $h_{FE} = 10$

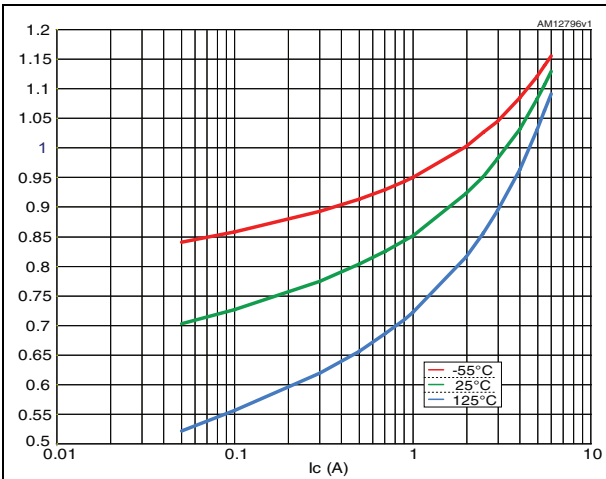
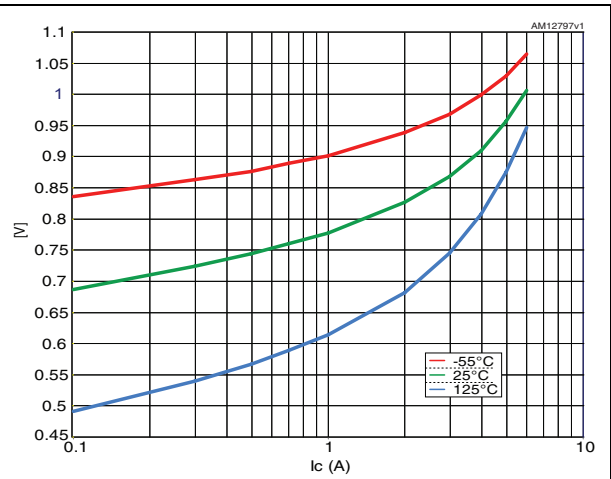
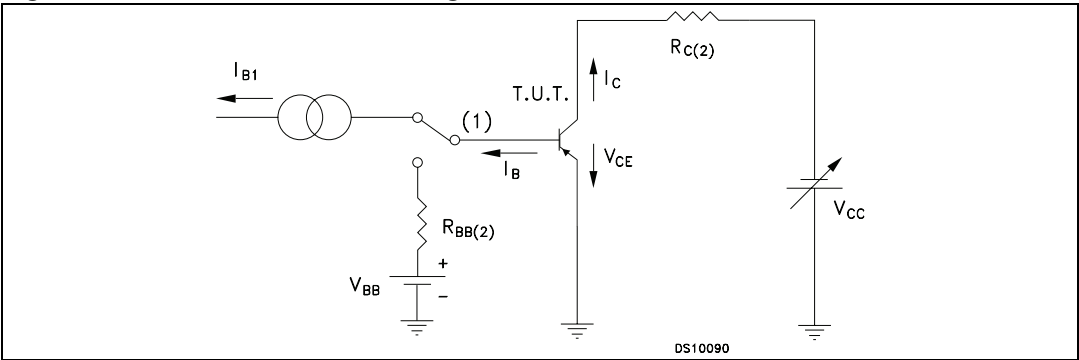


Figure 5.  $V_{BEON}$  @  $V_{CE} = 5\text{ V}$



## 2.2 Test circuit

Figure 6. Resistive load switching test circuit

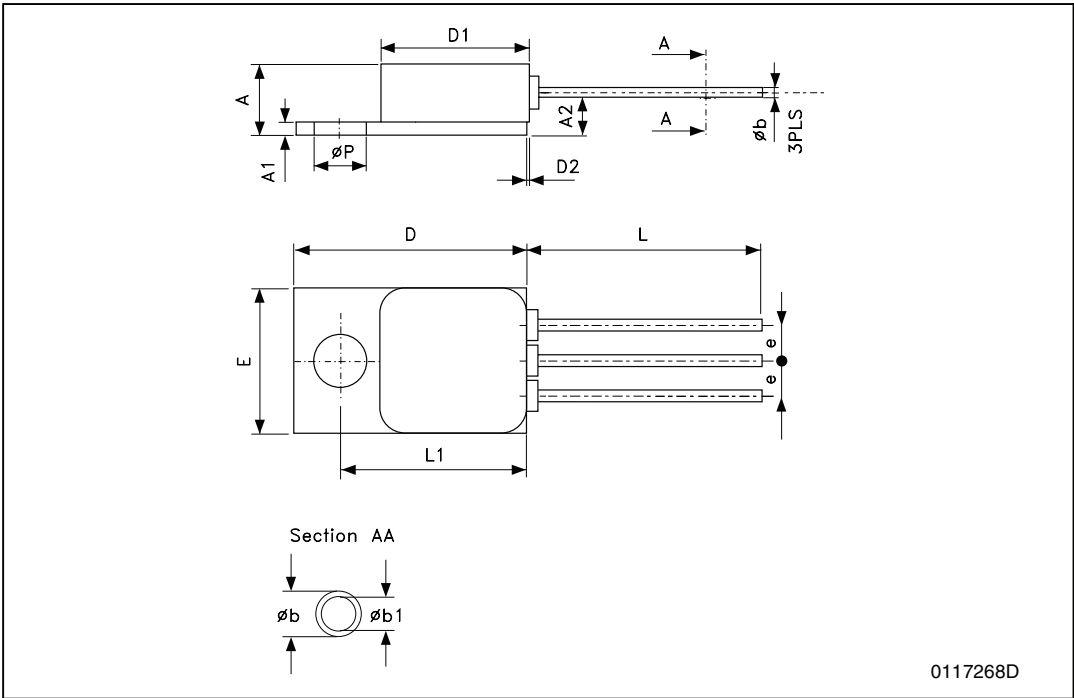


1. Fast electronic switch
2. Non-inductive resistor

### 3      **Package mechanical data**

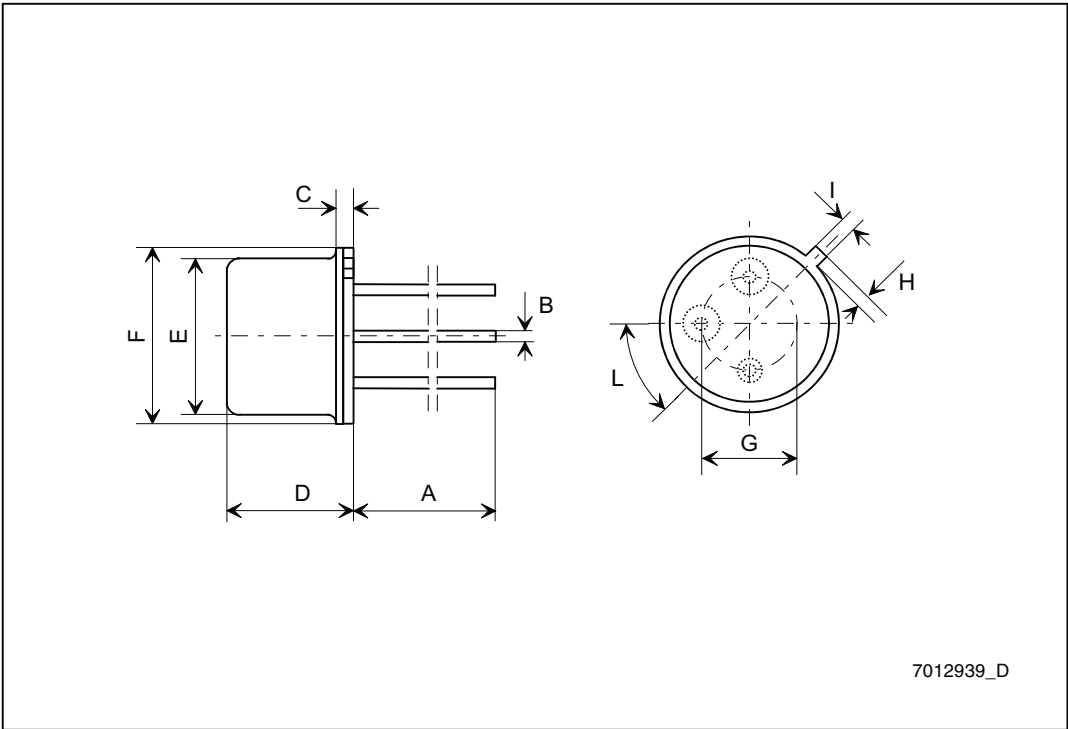
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| TO-257 mechanical data |       |      |       |
|------------------------|-------|------|-------|
| DIM.                   | mm.   |      |       |
|                        | Min.  | Typ. | Max.  |
| A                      | 4.83  |      | 5.08  |
| A1                     | 0.89  |      | 1.14  |
| A2                     |       | 3.05 |       |
| b                      | 0.64  |      | 1.02  |
| b1                     | 0.64  | 0.76 | 0.89  |
| D                      | 16.38 |      | 16.89 |
| D1                     | 10.41 |      | 10.92 |
| D2                     |       |      | 0.97  |
| e                      |       | 2.54 |       |
| E                      | 10.41 |      | 10.67 |
| L                      | 12.70 |      | 19.05 |
| L1                     | 13.39 |      | 13.64 |
| P                      | 3.56  |      | 3.81  |



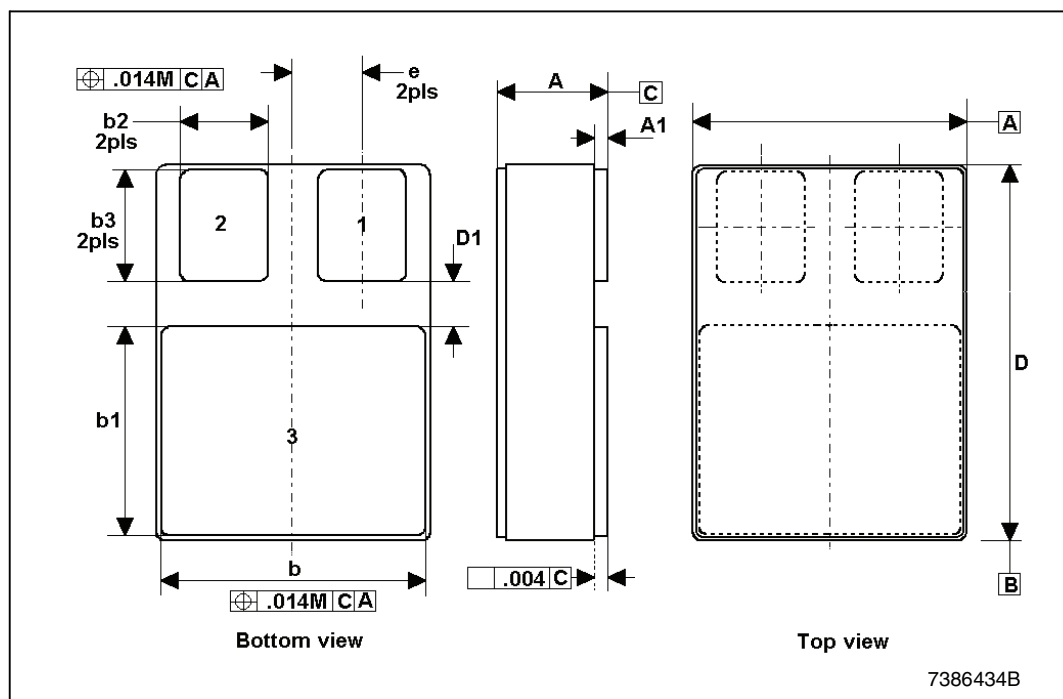
TO-39 mechanical data

| DIM. | mm.   |      |      |
|------|-------|------|------|
|      | Min.  | Typ. | Max. |
| A    | 12.70 |      |      |
| B    |       |      | 0.49 |
| D    |       |      | 6.60 |
| E    |       |      | 8.51 |
| F    |       |      | 9.40 |
| G    |       | 5.08 |      |
| H    |       |      | 1.02 |
| I    |       |      | 0.86 |
| L    |       | 45°  |      |



## SMD.5 mechanical data

| Dim. | mm.   |       |       |
|------|-------|-------|-------|
|      | Min.  | Typ.  | Max.  |
| A    | 2.84  | 3.00  | 3.15  |
| A1   | 0.25  | 0.38  | 0.51  |
| b    | 7.13  | 7.26  | 7.39  |
| b1   | 5.58  | 5.72  | 5.84  |
| b2   | 2.28  | 2.41  | 2.54  |
| b3   | 2.92  | 3.05  | 3.18  |
| D    | 10.03 | 10.16 | 10.28 |
| D1   |       | 0.76  |       |
| E    | 7.39  | 7.52  | 7.64  |
| e    |       | 1.91  |       |



## 4 Revision history

**Table 6. Document revision history**

| Date        | Revision | Changes                                                                           |
|-------------|----------|-----------------------------------------------------------------------------------|
| 10-Dec-2008 | 1        | Initial release                                                                   |
| 08-Jan-2010 | 2        | Modified <a href="#">Table 1 on page 1</a>                                        |
| 12-Sep-2012 | 3        | Added: <a href="#">Section 2.1: Electrical characteristics (curves) on page 4</a> |

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