

BAP70Q

Quad PIN diode attenuator

Rev. 2 — 6 March 2012

Product data sheet

1. Product profile

1.1 General description

Quad PIN diode in a SOT753 package.

1.2 Features and benefits

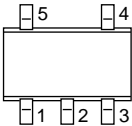
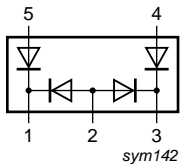
- 4 PIN diodes in a SOT753 package
- 300 kHz to 4 GHz
- High linearity
- Low insertion loss
- reduction in part count
- Low diode capacitance
- Low diode forward resistance

1.3 Applications

- Broadband system applications i.e. WCDMA, CATV, etc.
- General purpose Voltage Controlled Attenuators for high linearity applications

2. Pinning information

Table 1. Discrete pinning

| Pin | Description | Simplified outline | Graphic symbol |
|-----|--------------|---|---|
| 1 | RF in |  |  sym142 |
| 2 | series bias | | |
| 3 | RF out | | |
| 4 | shunt 1 bias | | |
| 5 | shunt 2 bias | | |

3. Ordering information

Table 2. Ordering information

| Type number | Package | | |
|-------------|---------|--|---------|
| | Name | Description | Version |
| BAP70Q | SC-74A | plastic surface-mounted package; 5 leads | SOT753 |



4. Marking

Table 3. Marking

| Type number | Marking code |
|-------------|--------------|
| BAP70Q | A2 |

5. Limiting values

Table 4. Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134).

| Symbol | Parameter | Conditions | Min | Max | Unit |
|-----------|-------------------------|-----------------------------|-----|------|------|
| V_R | reverse voltage | [1] | - | 50 | V |
| I_F | forward current | [1] | - | 100 | mA |
| P_{tot} | total power dissipation | $T_{sp} = 90\text{ °C}$ [1] | - | 125 | mW |
| T_{stg} | storage temperature | | -65 | +150 | °C |
| T_j | junction temperature | | -65 | +150 | °C |

[1] single diode.

6. Thermal characteristics

Table 5. Thermal characteristics

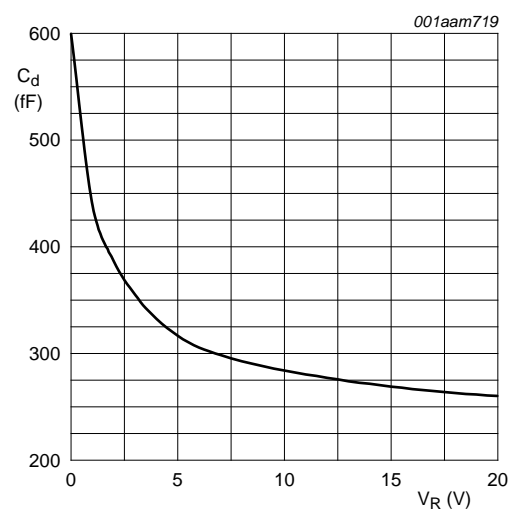
| Symbol | Parameter | Conditions | Typ | Unit |
|----------------|--|------------|-----|------|
| $R_{th(j-sp)}$ | thermal resistance from junction to solder point | | 350 | K/W |

7. Characteristics

Table 6. Characteristics

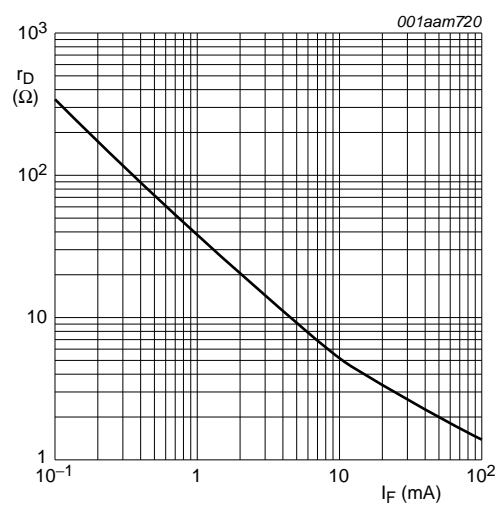
$T_j = 25\text{ °C}$ unless otherwise specified.

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|------------------|--------------------------|--|-----|------|-----|---------------|
| Per diode | | | | | | |
| V_F | forward voltage | $I_F = 50\text{ mA}$ | - | 0.95 | 1.1 | V |
| I_R | reverse current | $V_R = 50\text{ V}$ | - | - | 100 | nA |
| C_d | diode capacitance | see Figure 1; $f = 1\text{ MHz}$; | | | | |
| | | $V_R = 0\text{ V}$ | - | 600 | - | fF |
| | | $V_R = 1\text{ V}$ | - | 430 | - | fF |
| | | $V_R = 20\text{ V}$ | - | 250 | 300 | fF |
| r_D | diode forward resistance | see Figure 2; $f = 100\text{ MHz}$; | | | | |
| | | $I_F = 0.5\text{ mA}$ | - | 77 | 100 | Ω |
| | | $I_F = 1\text{ mA}$ | - | 40 | 50 | Ω |
| | | $I_F = 10\text{ mA}$ | - | 5.4 | 7 | Ω |
| | | $I_F = 100\text{ mA}$ | - | 1.4 | 1.9 | Ω |
| τ_L | charge carrier life time | when switched from $I_F = 10\text{ mA}$ to $I_R = 6\text{ mA}$; $R_L = 100\text{ }\Omega$; measured at $I_R = 3\text{ mA}$ | - | 1.25 | - | μs |



$f = 1\text{ MHz}$; $T_j = 25\text{ }^\circ\text{C}$.

Fig 1. Diode capacitance as a function of reverse voltage; typical values.



$f = 100\text{ MHz}$; $T_j = 25\text{ }^\circ\text{C}$.

Fig 2. Diode forward resistance as a function of forward current; typical values.

8. Application information

8.1 Application circuit

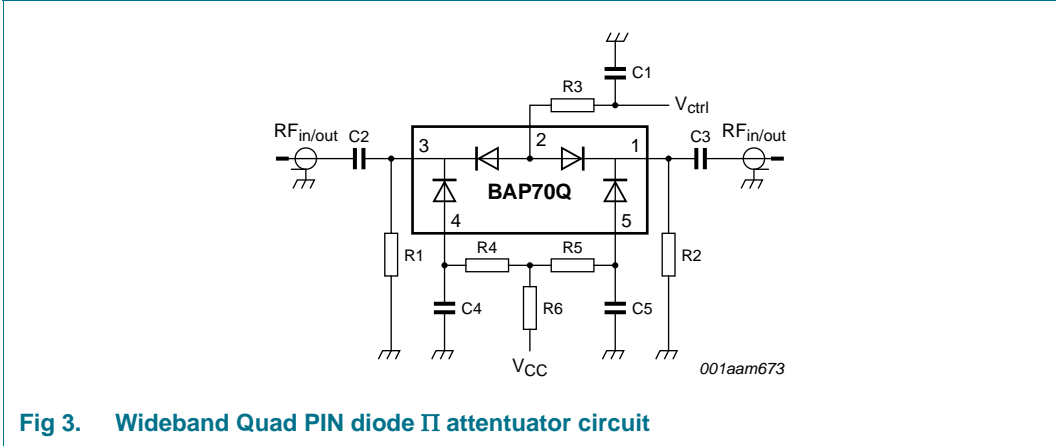


Fig 3. Wideband Quad PIN diode II attenuator circuit

Table 7. List of components used for the typical application

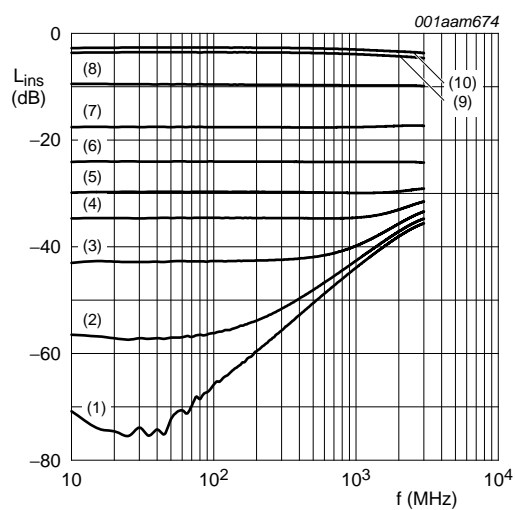
| Component | Description | Conditions | Value |
|--------------------|----------------|-------------------------|--------|
| C1, C2, C3, C4, C5 | chip capacitor | V _{CC} = 3.7 V | 47 nF |
| | | V _{CC} = 5 V | 47 nF |
| R1, R2 | chip resistor | V _{CC} = 3.7 V | 560 Ω |
| | | V _{CC} = 5 V | 910 Ω |
| R3 | chip resistor | V _{CC} = 3.7 V | 330 Ω |
| | | V _{CC} = 5 V | 1000 Ω |
| R4, R5 | chip resistor | V _{CC} = 3.7 V | 1500 Ω |
| | | V _{CC} = 5 V | 2000 Ω |
| R6 | chip resistor | V _{CC} = 3.7 V | 680 Ω |
| | | V _{CC} = 5 V | 1000 Ω |

8.2 Quad PIN pi attenuator characteristics

Table 8. Typical performance for BAP70Q quad PIN diode Π attenuator

$V_{CC} = 3.7\text{ V}$; $T_{amb} = 25\text{ }^{\circ}\text{C}$ unless otherwise specified.

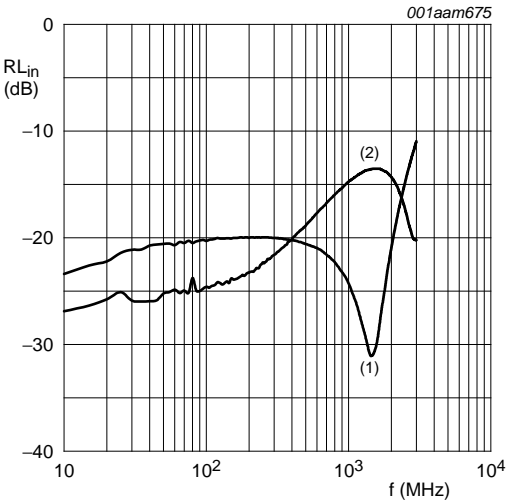
| Symbol | Parameter | Test Conditions | Typ | Units |
|-----------|-----------------------------------|--|-----|-------|
| L_{ins} | insertion loss | $V_C = 10\text{ V}$; $f = 1\text{ GHz}$ | 3 | dB |
| RL_{in} | input return loss | $V_C = 0\text{ V}$; $f = 1\text{ GHz}$ | 24 | dB |
| α | attenuation | $V_C = 0\text{ V}$; $f = 1\text{ GHz}$ | 44 | dB |
| $IP3_i$ | input third-order intercept point | $f = 0.1\text{ GHz}$ | | |
| | | $V_{ctrl} = 2\text{ V}$ | 38 | dBm |
| | | $V_{ctrl} = 10\text{ V}$ | 45 | dBm |
| | | $f = 0.9\text{ GHz}$ | | |
| | | $V_{ctrl} = 2\text{ V}$ | 45 | dBm |
| | | $V_{ctrl} = 10\text{ V}$ | 45 | dBm |
| | | $f = 1.8\text{ GHz}$ | | |
| | | $V_{ctrl} = 2\text{ V}$ | 45 | dBm |
| | | $V_{ctrl} = 10\text{ V}$ | 45 | dBm |
| | | $f = 2.1\text{ GHz}$ | | |
| | | $V_{ctrl} = 2\text{ V}$ | 44 | dBm |
| | | $V_{ctrl} = 10\text{ V}$ | 44 | dBm |



$V_{CC} = 3.7 \text{ V}$; $T_{amb} = 25 \text{ }^{\circ}\text{C}$.

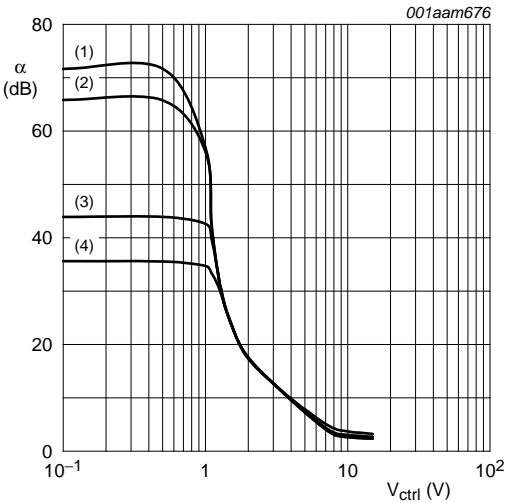
- (1) $V_{ctrl} = 0 \text{ V}$
- (2) $V_{ctrl} = 1 \text{ V}$
- (3) $V_{ctrl} = 1.1 \text{ V}$
- (4) $V_{ctrl} = 1.2 \text{ V}$
- (5) $V_{ctrl} = 1.3 \text{ V}$
- (6) $V_{ctrl} = 1.5 \text{ V}$
- (7) $V_{ctrl} = 2 \text{ V}$
- (8) $V_{ctrl} = 4 \text{ V}$
- (9) $V_{ctrl} = 7.5 \text{ V}$
- (10) $V_{ctrl} = 10 \text{ V}$

Fig 4. Insertion loss as function of frequency; typical values



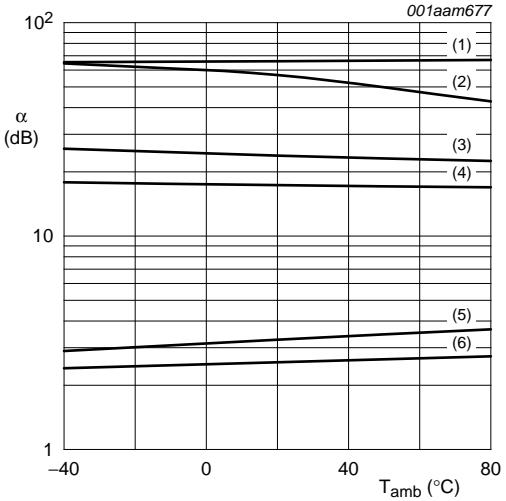
$V_{CC} = 3.7\text{ V}; T_{amb} = 25\text{ }^{\circ}\text{C}.$
(1) $V_{ctrl} = 0\text{ V}$
(2) $V_{ctrl} = 15\text{ V}$

Fig 5. Return loss as function of frequency; typical values



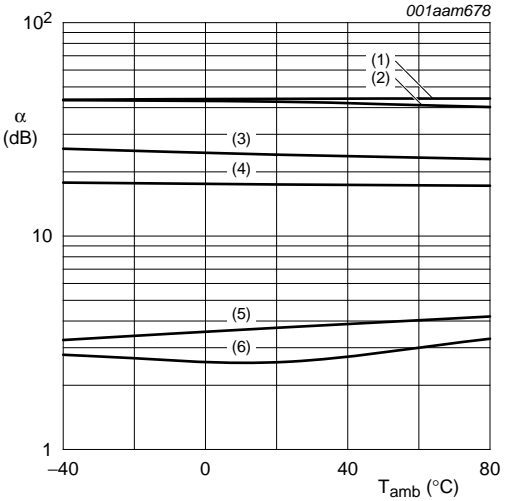
$V_{CC} = 3.7\text{ V}; T_{amb} = 25\text{ }^{\circ}\text{C}.$
(1) $f = 10\text{ MHz}$
(2) $f = 100\text{ MHz}$
(3) $f = 1000\text{ MHz}$
(4) $f = 3000\text{ MHz}$

Fig 6. Attenuation as function of control voltage; typical values



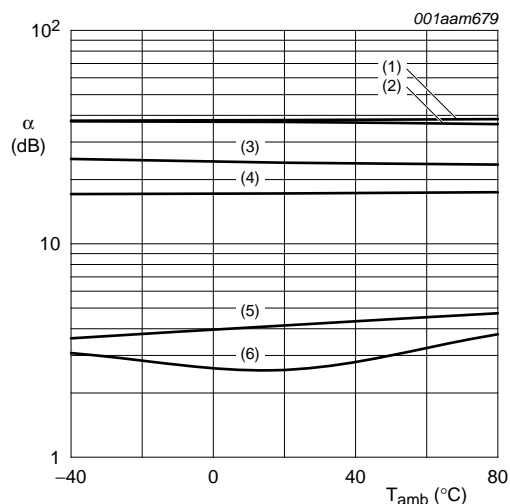
$V_{CC} = 3.7\text{ V}; f = 100\text{ MHz}.$
(1) $V_{ctrl} = 0\text{ V}$
(2) $V_{ctrl} = 1\text{ V}$
(3) $V_{ctrl} = 1.5\text{ V}$
(4) $V_{ctrl} = 2\text{ V}$
(5) $V_{ctrl} = 7.5\text{ V}$
(6) $V_{ctrl} = 10\text{ V}$

Fig 7. Attenuation as function of temperature; typical values



$V_{CC} = 3.7\text{ V}; f = 1000\text{ MHz}.$
(1) $V_{ctrl} = 0\text{ V}$
(2) $V_{ctrl} = 1\text{ V}$
(3) $V_{ctrl} = 1.5\text{ V}$
(4) $V_{ctrl} = 2\text{ V}$
(5) $V_{ctrl} = 7.5\text{ V}$
(6) $V_{ctrl} = 10\text{ V}$

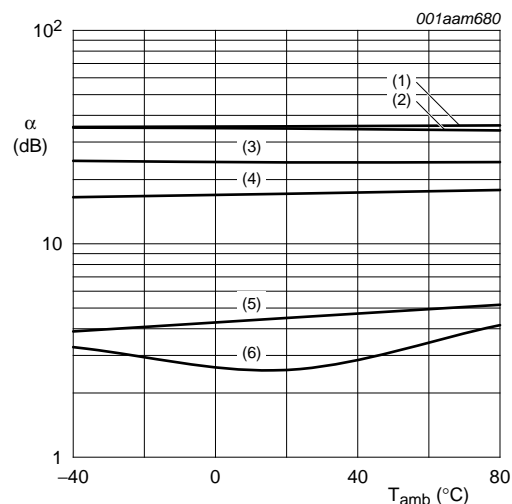
Fig 8. Attenuation as function of temperature; typical values



$V_{CC} = 3.7 \text{ V}$; $f = 2000 \text{ MHz}$.

- (1) $V_{ctrl} = 0 \text{ V}$
- (2) $V_{ctrl} = 1 \text{ V}$
- (3) $V_{ctrl} = 1.5 \text{ V}$
- (4) $V_{ctrl} = 2 \text{ V}$
- (5) $V_{ctrl} = 7.5 \text{ V}$
- (6) $V_{ctrl} = 10 \text{ V}$

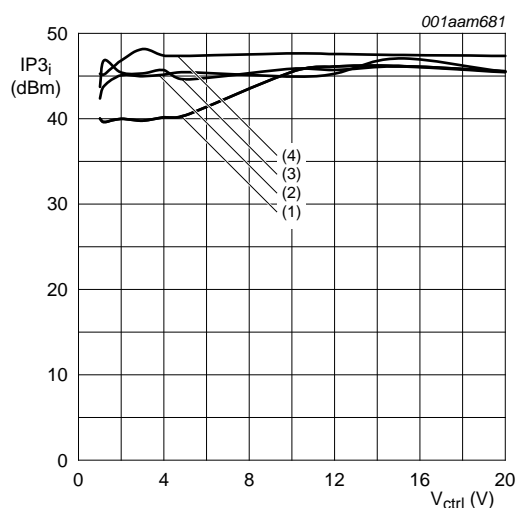
Fig 9. Attenuation as function of temperature; typical values



$V_{CC} = 3.7 \text{ V}$; $f = 3000 \text{ MHz}$.

- (1) $V_{ctrl} = 0 \text{ V}$
- (2) $V_{ctrl} = 1 \text{ V}$
- (3) $V_{ctrl} = 1.5 \text{ V}$
- (4) $V_{ctrl} = 2 \text{ V}$
- (5) $V_{ctrl} = 7.5 \text{ V}$
- (6) $V_{ctrl} = 10 \text{ V}$

Fig 10. Attenuation as function of temperature; typical values



$V_{CC} = 3.7 \text{ V}$; $T_{amb} = 25 \text{ °C}$.

- (1) $f = 100 \text{ MHz}$
- (2) $f = 900 \text{ MHz}$
- (3) $f = 1800 \text{ MHz}$
- (4) $f = 2100 \text{ MHz}$

Fig 11. Input third-order intercept point as control voltage; typical values

9. Package outline

Plastic surface-mounted package; 5 leadsSOT753

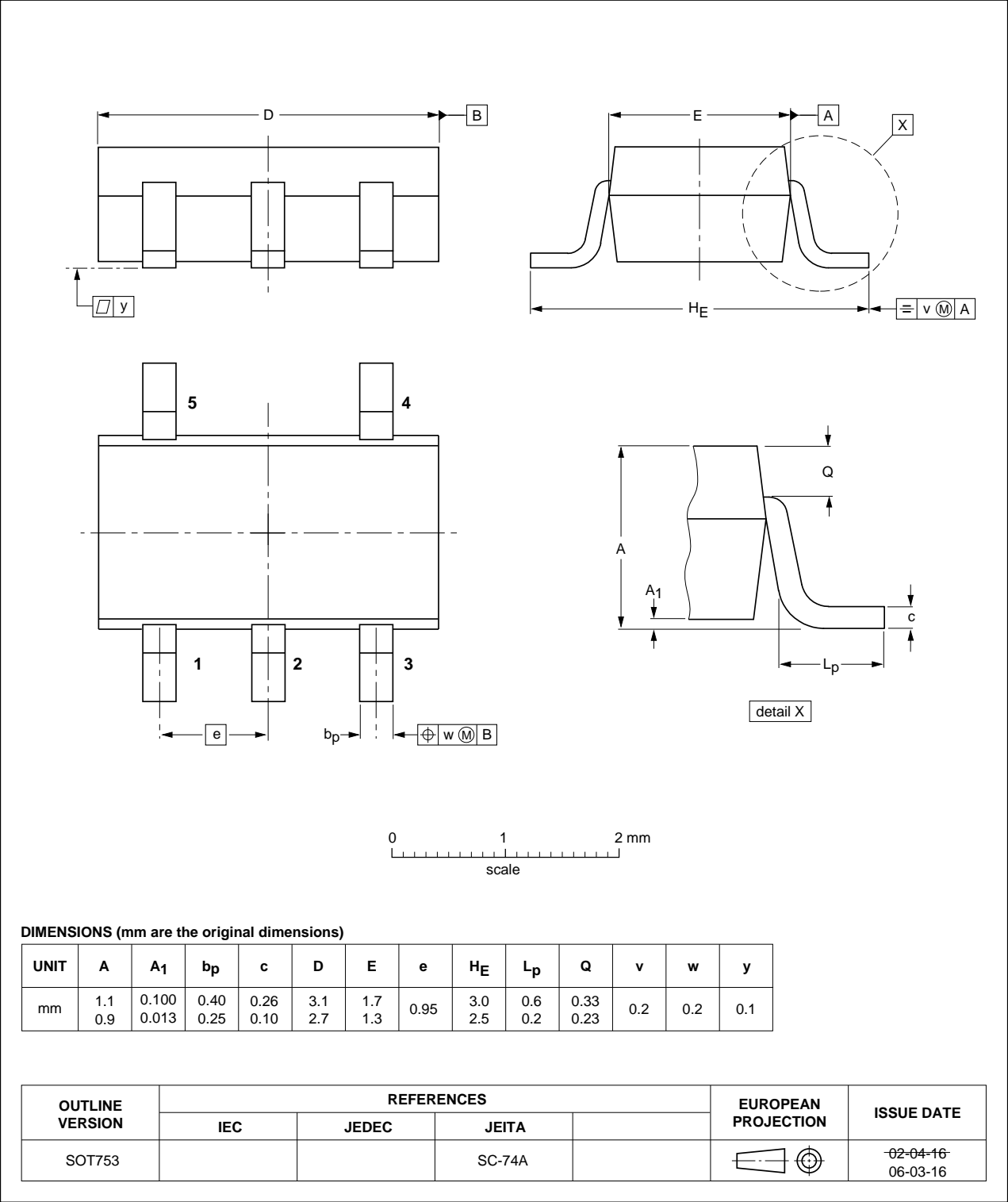


Fig 12. Package outline SOT753

10. Abbreviations

Table 9. Abbreviations

| Acronym | Description |
|---------|---------------------------|
| PIN | P-type, Intrinsic, N-type |
| RF | Radio Frequency |

11. Revision history

Table 10. Revision history

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|----------------|--|--------------------|---------------|------------|
| BAP70Q v.2 | 20120306 | Product data sheet | - | BAP70Q v.1 |
| Modifications: | <ul style="list-style-type: none">• Table 8: updated the title | | | |
| BAP70Q v.1 | 20101006 | Product data sheet | - | - |

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|-----------------------------------|-------------------------------|---|
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