



# BC56PA-Q series

80 V, 1 A NPN medium power transistors

Rev. 2 — 24 June 2022

Product data sheet

## 1. General description

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NPN medium power transistor in a SOT1061 (DFN2020-3) leadless very small Surface-Mounted Device (SMD) plastic package.

## 2. Features and benefits

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- High collector current capability  $I_C$  and  $I_{CM}$
- Three current gain selections
- High power dissipation capability
- Exposed heatsink for excellent thermal and electrical conductivity
- Leadless very small SMD plastic package with medium power capability
- Qualified according to AEC-Q101 and recommended for use in automotive applications

## 3. Applications

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- Linear voltage regulators
- MOSFET drivers
- Low-side switches
- Power management
- Amplifiers
- Battery-driven devices

## 4. Quick reference data

**Table 1. Quick reference data**

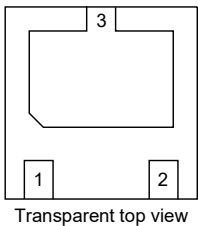
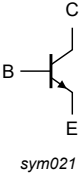
$T_{amb} = 25\text{ °C}$  unless otherwise specified.

| Symbol    | Parameter                 | Conditions                                 | Min | Typ | Max | Unit |
|-----------|---------------------------|--|-----|-----|-----|------|
| $V_{CEO}$ | collector-emitter voltage | open base                                  | -   | -   | 80  | V    |
| $I_C$     | collector current         |  | -   | -   | 1   | A    |
| $I_{CM}$  | peak collector current    | single pulse; $t_p \leq 1\text{ ms}$       | -   | -   | 2   | A    |
| $h_{FE}$  | DC current gain           |  |     |     |     |      |
|           | BC56PA-Q                  | $V_{CE} = 2\text{ V}; I_C = 150\text{ mA}$ | [1] | 63  | -   | 250  |
|           | BC56-10PA-Q               |  | [1] | 63  | -   | 160  |
|           | BC56-16PA-Q               |  | [1] | 100 | -   | 250  |

[1] pulsed;  $t_p \leq 300\text{ }\mu\text{s}$ ;  $\delta \leq 0.02$

## 5. Pinning information

**Table 2. Pinning**

| Pin | Symbol | Description | Simplified outline  | Graphic symbol   |
|-----|--------|-------------|---|--|
| 1   | B      | base        |  <p>Transparent top view</p> |  <p>sym021</p> |
| 2   | E      | emitter     |   |  |
| 3   | C      | collector   |   |  |

## 6. Ordering information

**Table 3. Ordering information**

| Type number | Package   |   |         |
|-------------|-----------|---|---------|
|             | Name      | Description   | Version |
| BC56PA-Q    | DFN2020-3 | plastic, thermal enhanced ultra thin small outline package; no leads; 3 Terminals; body 2 x 2 x 0.65 mm | SOT1061 |
| BC56-10PA-Q |           |   |         |
| BC56-16PA-Q |           |   |         |

## 7. Marking

**Table 4. Marking**

| Type number | Marking code |
|-------------|--------------|
| BC56PA-Q    | AZ           |
| BC56-10PA-Q | BK           |
| BC56-16PA-Q | BL           |

## 8. Limiting values

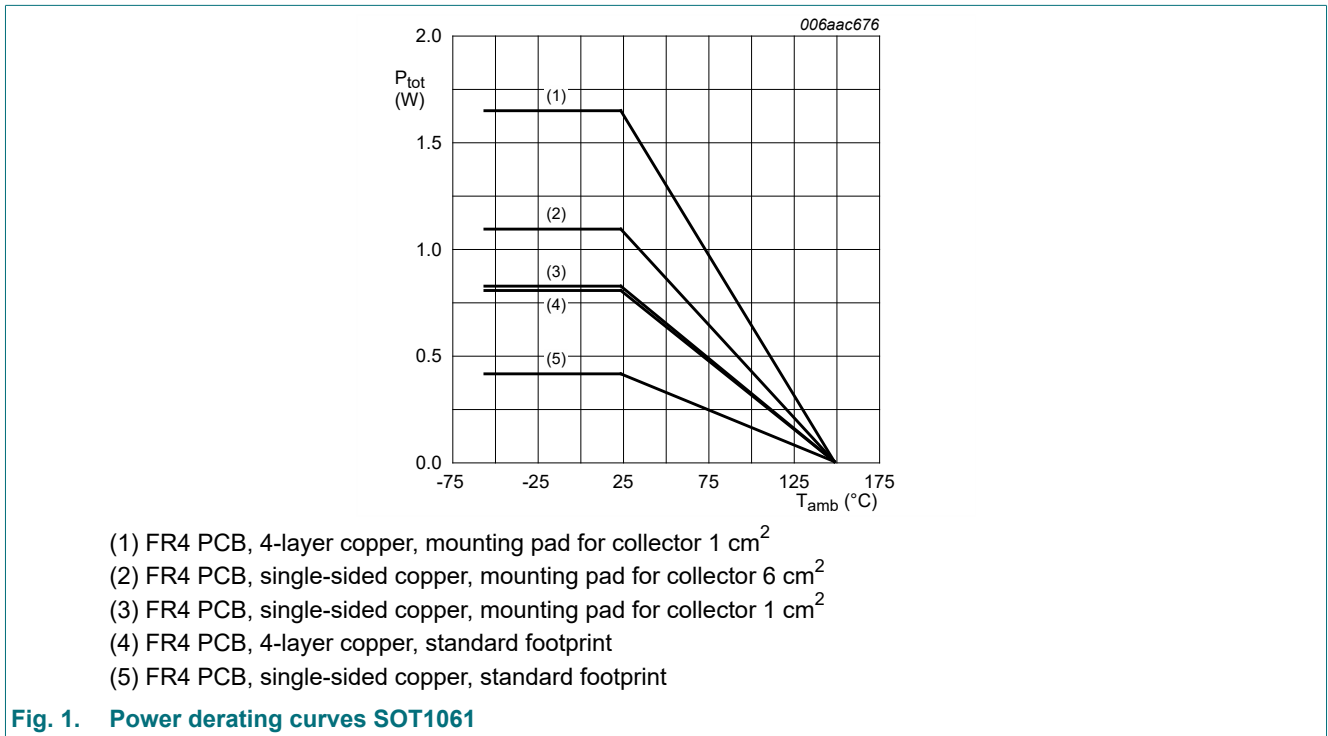
**Table 5. Limiting values**

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

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

| Symbol    | Parameter                 | Conditions                           | Min | Max | Unit |   |
|-----------|---------------------------|--------------------------------------|-----|-----|------|---|
| $V_{CBO}$ | collector-base voltage    | open emitter                         | -   | 100 | V    |   |
| $V_{CEO}$ | collector-emitter voltage | open base                            | -   | 80  | V    |   |
| $V_{EBO}$ | emitter-base voltage      | open collector                       | -   | 5   | V    |   |
| $I_C$     | collector current         |                                      | -   | 1   | A    |   |
| $I_{CM}$  | peak collector current    | single pulse; $t_p \leq 1\text{ ms}$ | -   | 2   | A    |   |
| $I_B$     | base current              |                                      | -   | 0.3 | A    |   |
| $I_{BM}$  | peak base current         | single pulse; $t_p \leq 1\text{ ms}$ | -   | 0.3 | A    |   |
| $P_{tot}$ | total power dissipation   | $T_{amb} \leq 25\text{ °C}$          | [1] | -   | 0.42 | W |
|           |                           |                                      | [2] | -   | 0.83 | W |
|           |                           |                                      | [3] | -   | 1.10 | W |
|           |                           |                                      | [4] | -   | 0.81 | W |
|           |                           |                                      | [5] | -   | 1.65 | W |
| $T_j$     | junction temperature      |                                      | -   | 150 | °C   |   |
| $T_{amb}$ | ambient temperature       |                                      | -55 | 150 | °C   |   |
| $T_{stg}$ | storage temperature       |                                      | -65 | 150 | °C   |   |

- [1] Device mounted on an FR4 Printed-Circuit-Board (PCB); single-sided copper; tin-plated and standard footprint.
- [2] Device mounted on an FR4 PCB; single-sided copper; tin-plated; mounting pad for collector  $1\text{ cm}^2$ .
- [3] Device mounted on an FR4 PCB; single-sided copper; tin-plated; mounting pad for collector  $6\text{ cm}^2$ .
- [4] Device mounted on an FR4 PCB; 4-layer copper; tin-plated and standard footprint.
- [5] Device mounted on an FR4 PCB; 4-layer copper; tin-plated; mounting pad for collector  $1\text{ cm}^2$ .



**Fig. 1. Power derating curves SOT1061**

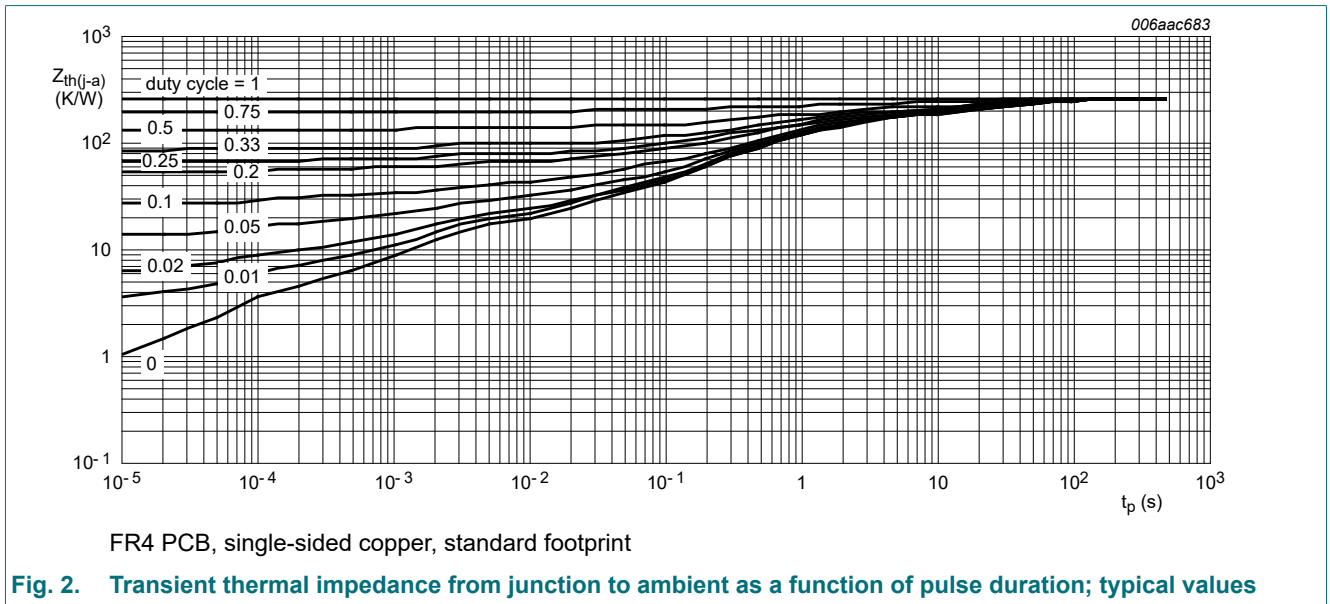
## 9. Thermal characteristics

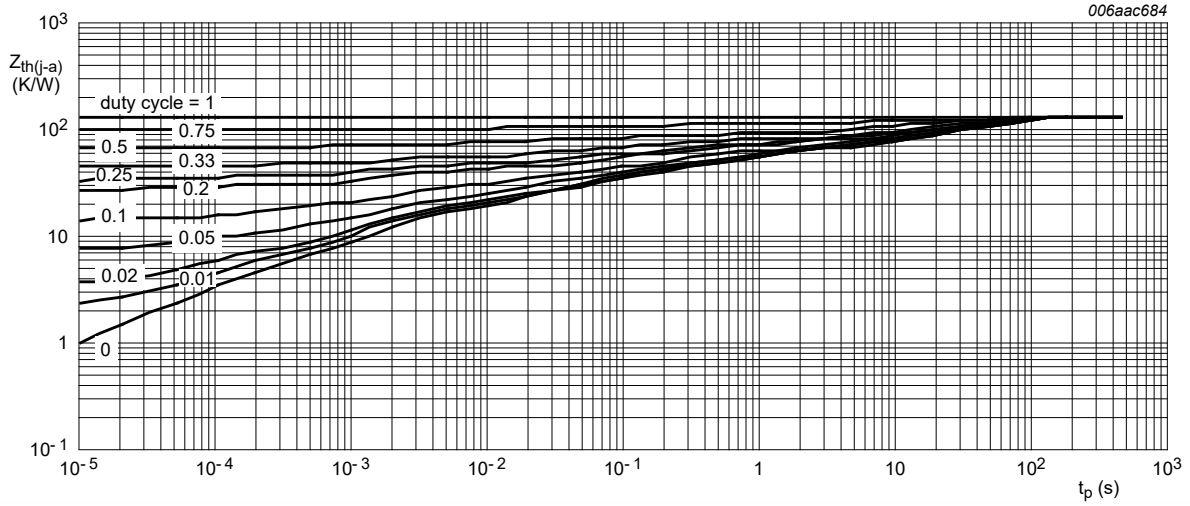
**Table 6. Thermal characteristics**

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

| Symbol        | Parameter  | Conditions  |     | Min | Typ | Max | Unit |
|---------------|--|-------------|-----|-----|-----|-----|------|
| $R_{th(j-a)}$ | thermal resistance from junction to ambient      | in free air | [1] | -   | -   | 298 | K/W  |
|               |  |             | [2] | -   | -   | 151 | K/W  |
|               |  |             | [3] | -   | -   | 114 | K/W  |
|               |  |             | [4] | -   | -   | 154 | K/W  |
|               |  |             | [5] | -   | -   | 76  | K/W  |
| $R_{(j-sp)}$  | thermal resistance from junction to solder point |             |     | -   | -   | 20  | K/W  |

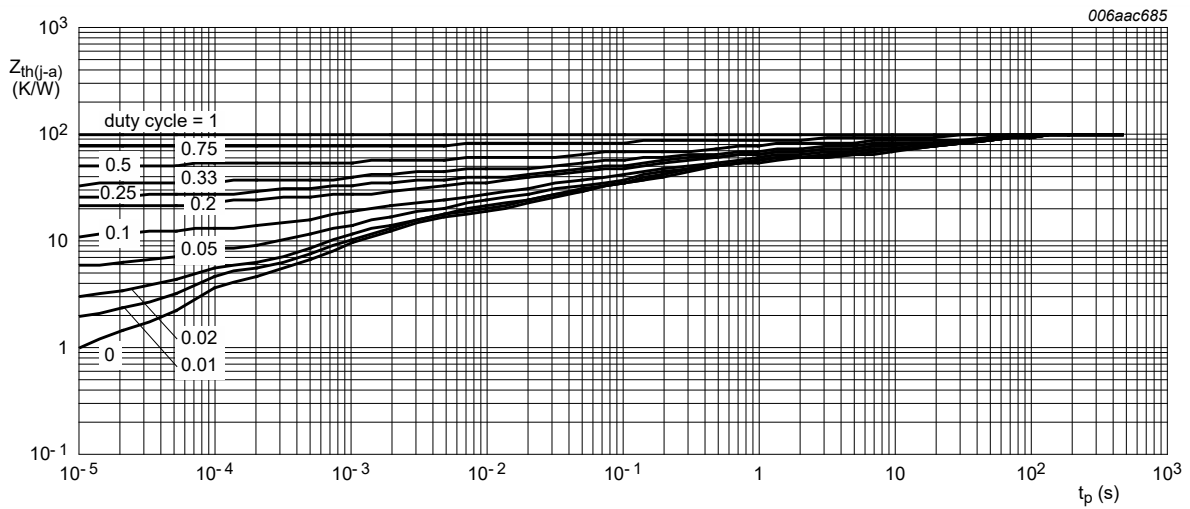
- [1] Device mounted on an FR4 PCB; single-sided copper; tin-plated and standard footprint.
- [2] Device mounted on an FR4 PCB; single-sided copper; tin-plated; mounting pad for collector 1 cm<sup>2</sup>.
- [3] Device mounted on an FR4 PCB; single-sided copper; tin-plated; mounting pad for collector 6 cm<sup>2</sup>.
- [4] Device mounted on an FR4 PCB; 4-layer copper; tin-plated and standard footprint.
- [5] Device mounted on an FR4 PCB; 4-layer copper; tin-plated; mounting pad for collector 1 cm<sup>2</sup>.





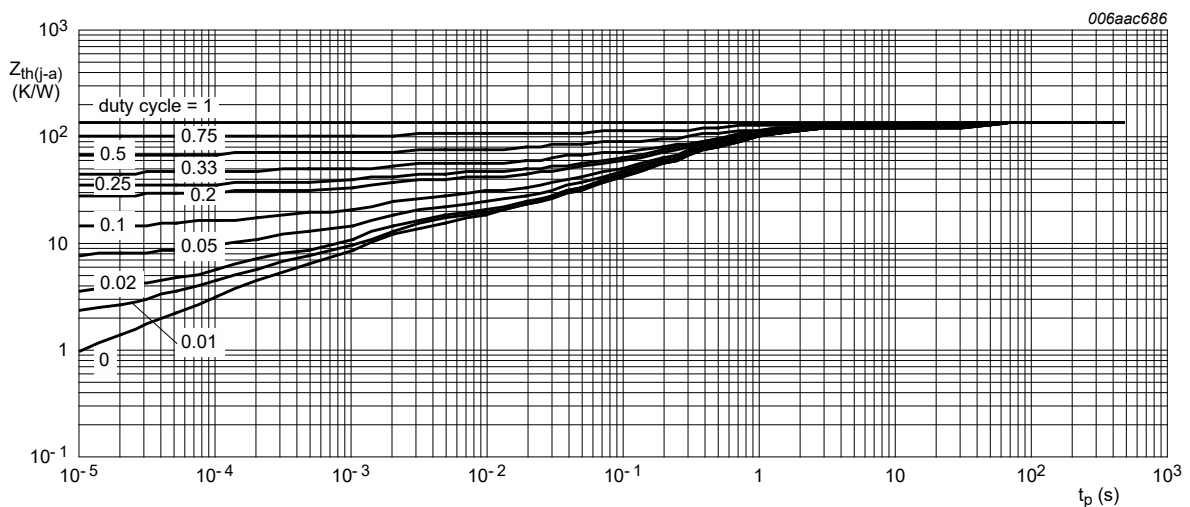
FR4 PCB, single-sided copper, mounting pad for collector 1 cm<sup>2</sup>

Fig. 3. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values



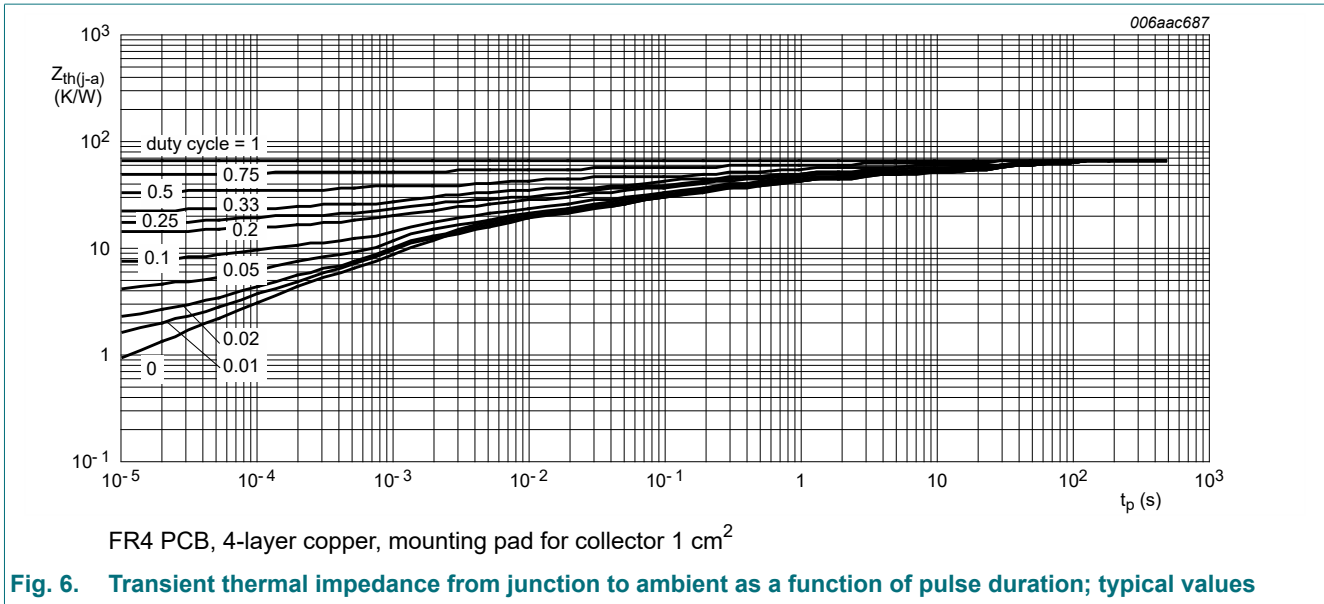
FR4 PCB, single-sided copper, mounting pad for collector 6 cm<sup>2</sup>

Fig. 4. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values



FR4 PCB, 4-layer copper, standard footprint

Fig. 5. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

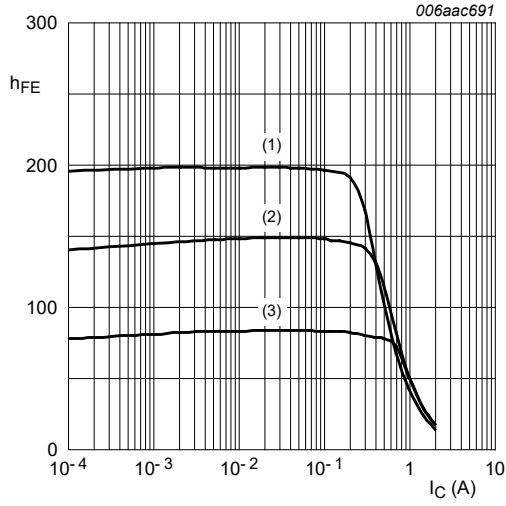


## 10. Characteristics

**Table 7. Characteristics**
 $T_{amb} = 25\text{ °C}$  unless otherwise specified.

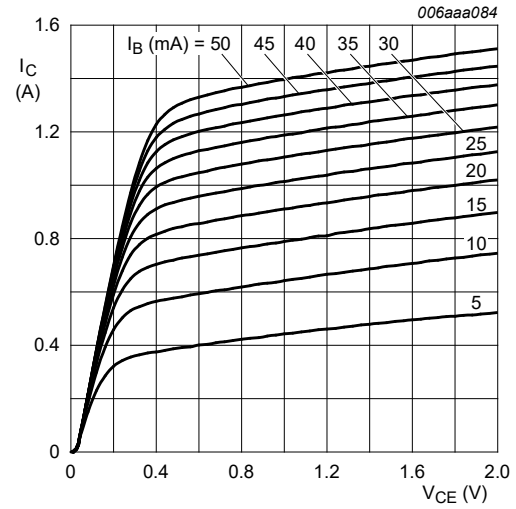
| Symbol                                       | Parameter                            | Conditions  | Min | Typ | Max | Unit          |  |
|--|--------------------------------------|---|-----|-----|-----|---------------|--|
| $V_{(BR)CBO}$                                | collector-base breakdown voltage     | $I_C = 100\ \mu\text{A}; I_E = 0\ \text{A}$                         | 100 | -   | -   | V             |  |
| $V_{(BR)CEO}$                                | collector-emitter breakdown voltage  | $I_C = 2\ \text{mA}; I_B = 0\ \text{A}$                             | 80  | -   | -   | V             |  |
| $V_{(BR)EBO}$                                | emitter-base breakdown voltage       | $I_E = 100\ \mu\text{A}; I_C = 0\ \text{A}$                         | 5   | -   | -   | V             |  |
| $I_{CBO}$                                    | collector-base cut-off current       | $V_{CB} = 30\ \text{V}; I_E = 0\ \text{A}$                          | -   | -   | 100 | nA            |  |
|  |                                      | $V_{CB} = 30\ \text{V}; I_E = 0\ \text{A}; T_J = 150\text{ °C}$     | -   | -   | 10  | $\mu\text{A}$ |  |
| $I_{EBO}$                                    | emitter-base cut-off current         | $V_{EB} = 5\ \text{V}; I_C = 0\ \text{A}$                           | -   | -   | 100 | nA            |  |
| $h_{FE}$                                     | DC current gain                      |   |     |     |     |               |  |
|  | BC56PA-Q                             | $V_{CE} = 2\ \text{V}; I_C = 5\ \text{mA}$                          | [1] | 63  | -   | -             |  |
|  |                                      | $V_{CE} = 2\ \text{V}; I_C = 150\ \text{mA}$                        | [1] | 63  | -   | 250           |  |
|  |                                      | $V_{CE} = 2\ \text{V}; I_C = 500\ \text{mA}$                        | [1] | 40  | -   | -             |  |
|  | BC56-10PA-Q                          | $V_{CE} = 2\ \text{V}; I_C = 5\ \text{mA}$                          | [1] | 63  | -   | -             |  |
|  |                                      | $V_{CE} = 2\ \text{V}; I_C = 150\ \text{mA}$                        | [1] | 63  | -   | 160           |  |
|  |                                      | $V_{CE} = 2\ \text{V}; I_C = 500\ \text{mA}$                        | [1] | 40  | -   | -             |  |
|  | BC56-16PA-Q                          | $V_{CE} = 2\ \text{V}; I_C = 5\ \text{mA}$                          | [1] | 63  | -   | -             |  |
|  |                                      | $V_{CE} = 2\ \text{V}; I_C = 150\ \text{mA}$                        |     | 100 | -   | 250           |  |
| $V_{CE} = 2\ \text{V}; I_C = 500\ \text{mA}$ |                                      |   | 40  | -   | -   |               |  |
| $V_{CEsat}$                                  | collector-emitter saturation voltage | $I_C = 500\ \text{mA}; I_B = 50\ \text{mA}$                         | [1] | -   | 500 | mV            |  |
| $V_{BE}$                                     | base-emitter voltage                 | $V_{CE} = 2\ \text{V}; I_C = 500\ \text{mA}$                        | [1] | -   | 1   | V             |  |
| $C_C$  | collector capacitance                | $V_{CB} = 10\ \text{V}; I_E = i_e = 0\ \text{A}; f = 1\ \text{MHz}$ | -   | 6   | -   | pF            |  |
| $f_T$  | transition frequency                 | $V_{CE} = 5\ \text{V}; I_C = 50\ \text{mA}; f = 100\ \text{MHz}$    | 100 | 180 | -   | MHz           |  |

[1] pulsed;  $t_p \leq 300\ \mu\text{s}$ ;  $\delta \leq 0.02$



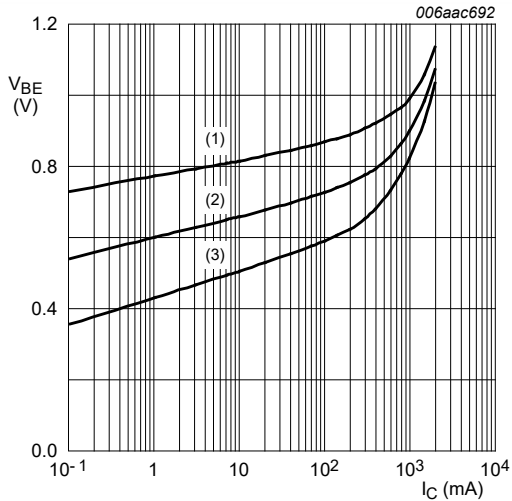
$V_{CE} = 2\text{ V}$   
 (1)  $T_{amb} = 100\text{ °C}$   
 (2)  $T_{amb} = 25\text{ °C}$   
 (3)  $T_{amb} = -55\text{ °C}$

**Fig. 7. DC current gain as a function of collector current; typical values**



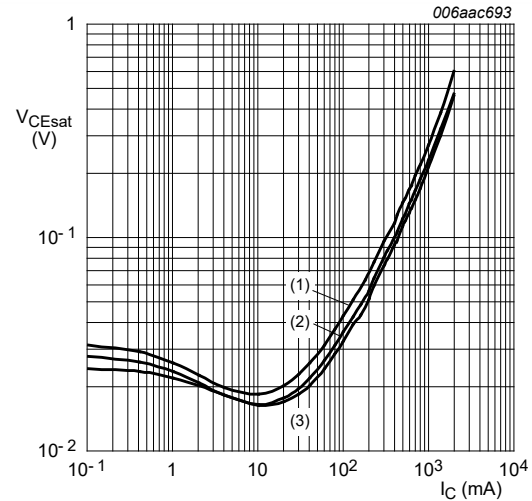
$T_{amb} = 25\text{ °C}$

**Fig. 8. Collector current as a function of collector-emitter voltage; typical values**



$V_{CE} = 2\text{ V}$   
 (1)  $T_{amb} = -55\text{ °C}$   
 (2)  $T_{amb} = 25\text{ °C}$   
 (3)  $T_{amb} = 100\text{ °C}$

**Fig. 9. Base-emitter voltage as a function of collector current; typical values**



$V_{CE} = 2\text{ V}$   
 (1)  $T_{amb} = 100\text{ °C}$   
 (2)  $T_{amb} = 25\text{ °C}$   
 (3)  $T_{amb} = -55\text{ °C}$

**Fig. 10. Collector-emitter saturation voltage as a function of collector current; typical values**



## 11. Test information

### 11.1. Quality information

This product has been qualified in accordance with the Automotive Electronics Council (AEC) standard Q101 - Stress test qualification for discrete semiconductors, and is suitable for use in automotive applications.

## 12. Package outline

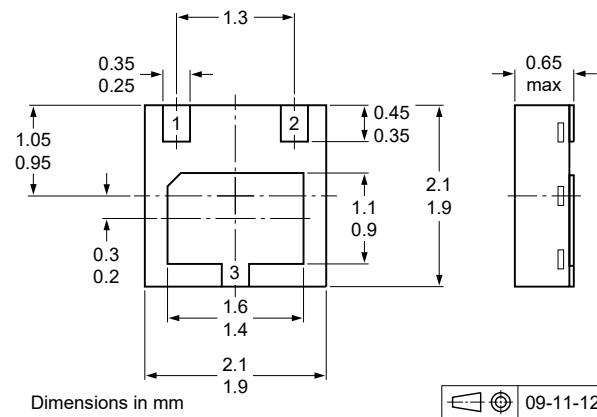


Fig. 11. Package outline SOT1061 (DFN2020-3)

### 13. Soldering

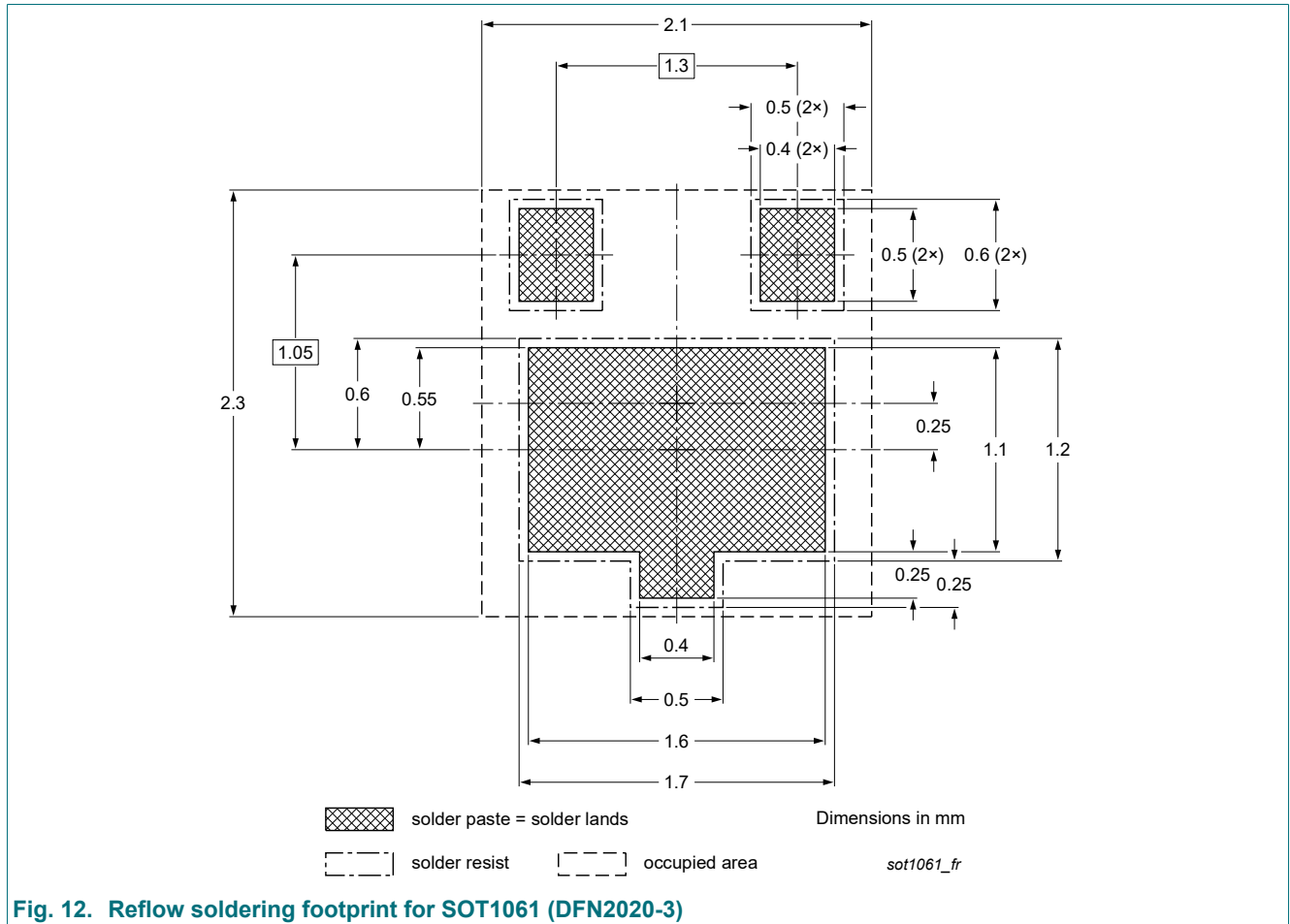


Fig. 12. Reflow soldering footprint for SOT1061 (DFN2020-3)

## 14. Revision history

Table 8. Revision history

| Document ID      | Release date  | Data sheet status  | Change notice | Supersedes       |
|------------------|---|--------------------|---------------|------------------|
| BC56PA-Q_SER v.2 | 20220624  | Product data sheet | -             | BC56PA-Q_SER v.1 |
| Modifications:   | • Characteristics at $V_{(BR)CEO}$ : Conditions corrected |                    |               |                  |
| BC56PA-Q_SER v.1 | 20220119  | Product data sheet | -             | -                |

## 15. Legal information

### Data sheet status

| Document status [1][2]         | Product status [3] | Definition  |
|--------------------------------|--------------------|---|
| Objective [short] data sheet   | Development        | This document contains data from the objective specification for product development. |
| Preliminary [short] data sheet | Qualification      | This document contains data from the preliminary specification.                       |
| Product [short] data sheet     | Production         | This document contains the product specification.                                     |

- [1] Please consult the most recently issued document before initiating or completing a design.
- [2] The term 'short data sheet' is explained in section "Definitions".
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Date of release: 24 June 2022

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