# BC56PAST-Q series

## 80 V, 1 A NPN medium power transistors

Rev. 2 — 27 November 2024 Product data sheet

## 1. General description

NPN medium power transistors in an ultra thin DFN2020D-3 (SOT1061D) leadless small Surface-Mounted Device (SMD) plastic package with medium power capability and Side-Wettable Flanks (SWF).

**Table 1. Product overview**

| Type number | Package | PNP complement |
|---|---|---|
| BC56PAST-Q | DFN2020D-3 (SOT1061D) | BC53PAST-Q |
| BC56-10PAST-Q | | BC53-10PAST-Q |
| BC56-16PAST-Q | | BC53-16PAST-Q |

## 2. Features and benefits

- High collector current capability $I_C$ and $I_{CM}$
- Three current gain selections
- Reduced Printed-Circuit Board (PCB) area requirements
- Leadless small SMD plastic package with solderable side pads
- Exposed heat sink for excellent thermal and electrical conductivity
- Suitable for Automatic Optical Inspection (AOI) of solder point
- Qualified according to AEC-Q101 and recommended for use in automotive applications

## 3. Applications

- Linear voltage regulators
- MOSFET drivers
- High-side switches
- Power management
- Amplifiers
- Bettery driven devices

## 4. Quick reference data

**Table 2. Quick reference data**

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

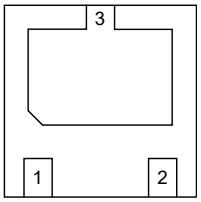
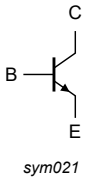
| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $V_{CEO}$ | collector-emitter voltage | open base | | - | - | 80 | V |
| $I_C$ | collector current | | | - | - | 1 | A |
| $I_{CM}$ | peak collector current | single pulse; $t_p \leq 1$ ms | | - | - | 2 | A |

| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $h_{FE}$ | DC current gain | | | | | | |
| | BC56PAST-Q | $V_{CE}$ = 2 V; $I_C$ = 150 mA | [1] | 63 | - | 250 | |
| | BC56-10PAST-Q | | [1] | 63 | - | 160 | |
| | BC56-16PAST-Q | | [1] | 100 | - | 250 | |

[1] pulsed; $t_p \leq 300$ µs; $\delta \leq 0.02$

## 5. Pinning information

**Table 3. Pinning**

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

## 6. Ordering information

**Table 4. Ordering information**

| Type number | Package | | |
|---|---|---|---|
| | Name | Description | Version |
| BC56PAST-Q | DFN2020D-3 | plastic, leadless thermal enhanced ultra thin small outline package with side-wettable flanks (SWF); no leads; 3 terminals; 1.3 mm pitch; 2 mm x 2 mm x 0.65 mm body | SOT1061D |
| BC56-10PAST-Q | | | |
| BC56-16PAST-Q | | | |

## 7. Marking

**Table 5. Marking**

| Type number | Marking code |
|---|---|
| BC56PAST-Q | F7 |
| BC56-10PAST-Q | F6 |
| BC56-16PAST-Q | F5 |

# 8. Limiting values

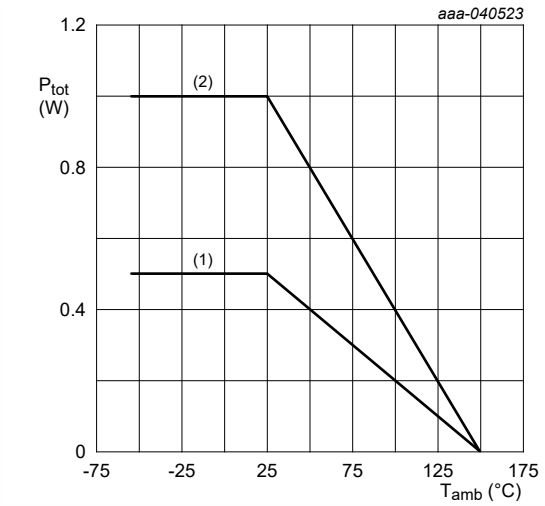
**Table 6. Limiting values**

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

*$T_{amb}$ = 25 °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; $t_p \leq 1$ ms | | - | 2 | A |
| $I_B$ | base current | | | - | 0.2 | A |
| $I_{BM}$ | peak base current | single pulse; $t_p \leq 1$ ms | | - | 0.3 | A |
| $P_{tot}$ | total power dissipation | $T_{amb} \leq 25$ °C | [1] | - | 0.5 | W |
| | | | [2] | - | 1 | 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 Printed-Circuit-Board (PCB); single-sided copper; tin-plated; mounting pad for collector 1 $cm^2$.




(1) FR4 PCB; single-sided copper; standard footprint
(2) FR4 PCB; single-sided copper; 1 $cm^2$

**Fig. 1. Power derating curves**

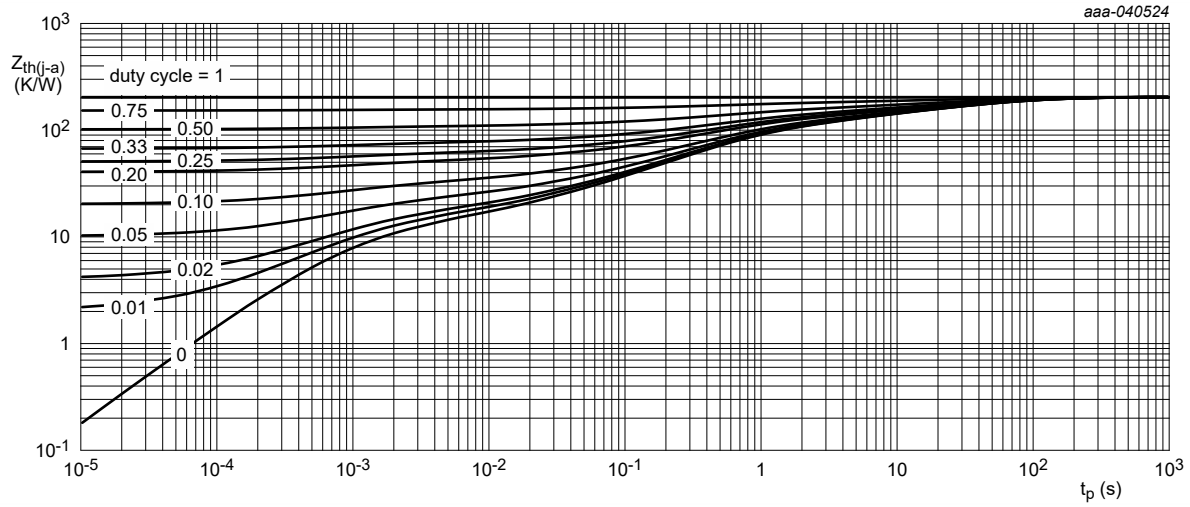
# 9. Thermal characteristics

**Table 7. Thermal characteristics**

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

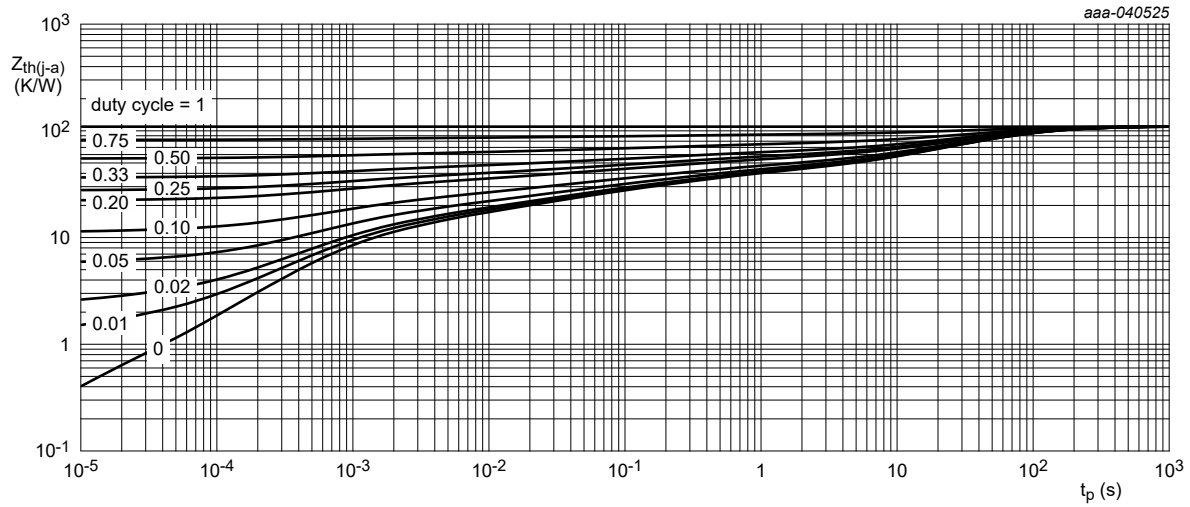
| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $R_{th(j-a)}$ | thermal resistance from junction to ambient | in free air | [1] | - | - | 235 | K/W |
| | | | [2] | - | - | 124 | K/W |
| $R_{th(j-sp)}$ | thermal resistance from junction to solder point | | | - | - | 15 | K/W |

[1] Device mounted on an FR4 Printed-Circuit-Board (PCB); single-sided copper; tin-plated and standard footprint.
[2] Device mounted on an FR4 Printed-Circuit-Board (PCB); single-sided copper; tin-plated; mounting pad for collector 1 $cm^2$.




FR4 PCB; single-sided copper; tin-plated and standard footprint

**Fig. 2. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values**




FR4 PCB; single-sided copper; tin-plated; mounting pad for collector 1 $cm^2$

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

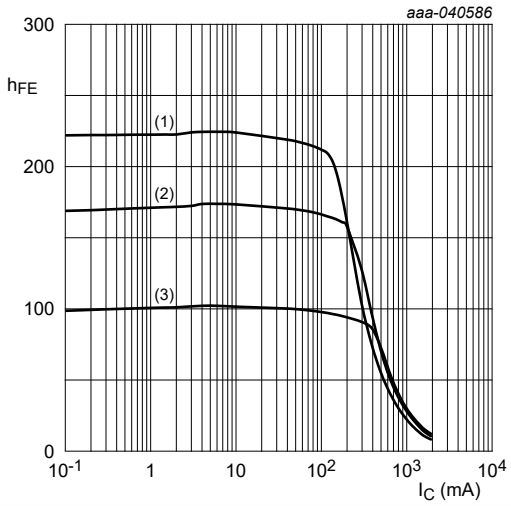
# 10. Characteristics

**Table 8. Characteristics**

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

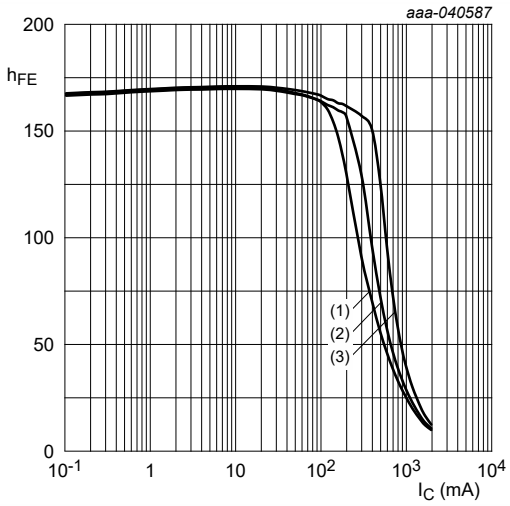
| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $V_{(BR)CBO}$ | collector-base breakdown voltage | $I_C$ = 100 µA; $I_E$ = 0 A | | 100 | - | - | V |
| $V_{(BR)CEO}$ | collector-emitter breakdown voltage | $I_C$ = 2 mA; $I_B$ = 0 A | | 80 | - | - | V |
| $V_{(BR)EBO}$ | emitter-base breakdown voltage | $I_E$ = 100 µA; $I_C$ = 0 A | | 5 | - | - | V |
| $I_{CBO}$ | collector-base cut-off current | $V_{CB}$ = 30 V; $I_E$ = 0 A | | - | - | 100 | nA |
| | | $V_{CB}$ = 30 V; $I_E$ = 0 A; $T_j$ = 150 °C | | - | - | 10 | µA |
| $I_{EBO}$ | emitter-base cut-off current | $V_{EB}$ = 5 V; $I_C$ = 0 A | | - | - | 100 | nA |
| $h_{FE}$ | DC current gain | | | | | | |
| | BC56PAST-Q | $V_{CE}$ = 2 V; $I_C$ = 5 mA | [1] | 63 | - | - | |
| | | $V_{CE}$ = 2 V; $I_C$ = 150 mA | [1] | 63 | - | 250 | |
| | | $V_{CE}$ = 2 V; $I_C$ = 500 mA | [1] | 40 | - | - | |
| | BC56-10PAST-Q | $V_{CE}$ = 2 V; $I_C$ = 5 mA | [1] | 63 | - | - | |
| | | $V_{CE}$ = 2 V; $I_C$ = 150 mA | [1] | 63 | - | 160 | |
| | | $V_{CE}$ = 2 V; $I_C$ = 500 mA | [1] | 40 | - | - | |
| | BC56-16PAST-Q | $V_{CE}$ = 2 V; $I_C$ = 5 mA | [1] | 63 | - | - | |
| | | $V_{CE}$ = 2 V; $I_C$ = 150 mA | [1] | 100 | - | 250 | |
| | | $V_{CE}$ = 2 V; $I_C$ = 500 mA | [1] | 40 | - | - | |
| $V_{CEsat}$ | collector-emitter saturation voltage | $I_C$ = 500 mA; $I_B$ = 50 mA | [1] | - | - | 500 | mV |
| $V_{BE}$ | base-emitter voltage | $V_{CE}$ = 2 V; $I_C$ = 500 mA | [1] | - | - | 1 | V |
| $C_c$ | collector capacitance | $V_{CB}$ = 10 V; $I_E$ = $i_e$ = 0 A; f = 1 MHz | | - | 4.5 | - | pF |
| $f_T$ | transition frequency | $V_{CE}$ = 5 V; $I_C$ = 50 mA; f = 100 MHz | | 100 | - | - | MHz |

[1] pulsed; $t_p \leq 300$ µs; $\delta \leq 0.02$



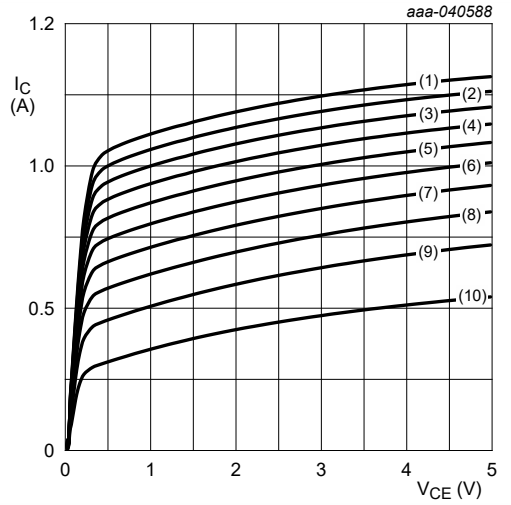

$V_{CE}$ = 2 V
(1) $T_{amb}$ = 100 °C
(2) $T_{amb}$ = 25 °C
(3) $T_{amb}$ = -55 °C

**Fig. 4. DC current gain as a function of collector current; typical values**



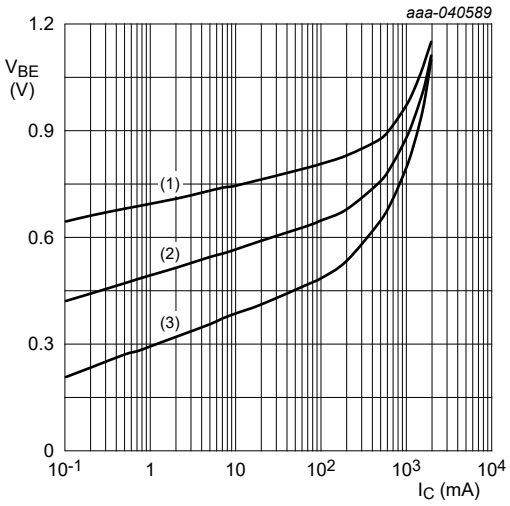

$T_{amb}$ = 25 °C
(1) $V_{CE}$ = 1 V
(2) $V_{CE}$ = 2 V
(3) $V_{CE}$ = 5 V

**Fig. 5. DC current gain as a function of collector current; typical values**



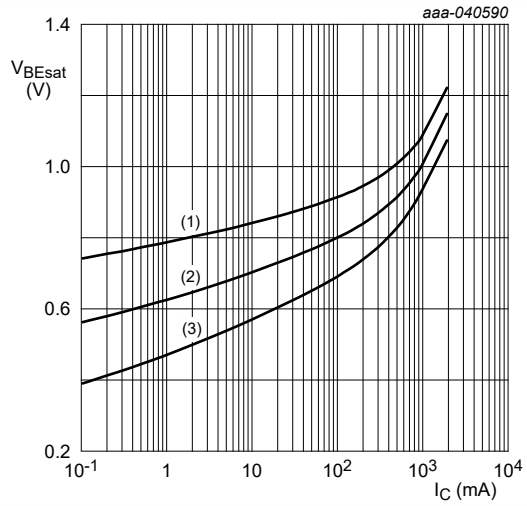

$T_{amb}$ = 25 °C
(1) $I_B$ = 30.0 mA
(2) $I_B$ = 27 mA
(3) $I_B$ = 24 mA
(4) $I_B$ = 21 mA
(5) $I_B$ = 18 mA
(6) $I_B$ = 15 mA
(7) $I_B$ = 12 mA
(8) $I_B$ = 9 mA
(9) $I_B$ = 6 mA
(10) $I_B$ = 3 mA

**Fig. 6. Collector current as a function of collector-emitter voltage; typical values**



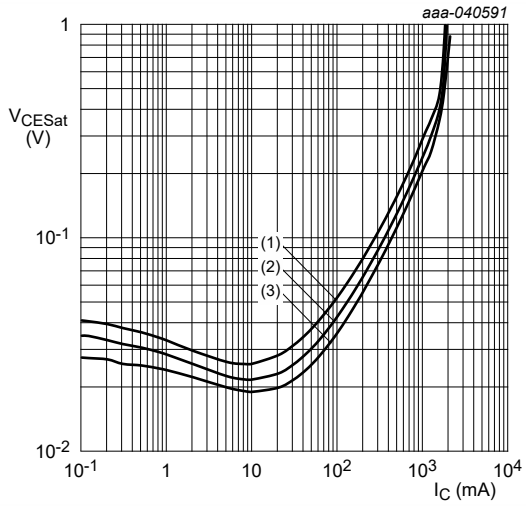

$V_{CE}$ = 2 V
(1) $T_{amb}$ = -55 °C
(2) $T_{amb}$ = 25 °C
(3) $T_{amb}$ = 100 °C

**Fig. 7. Base-emitter voltage as a function of collector current; typical values**



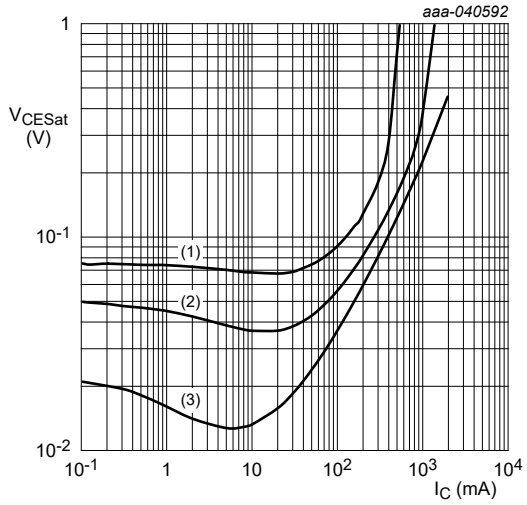

$I_C/I_B$ = 10
(1) $T_{amb}$ = -55 °C
(2) $T_{amb}$ = 25 °C
(3) $T_{amb}$ = 100 °C

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



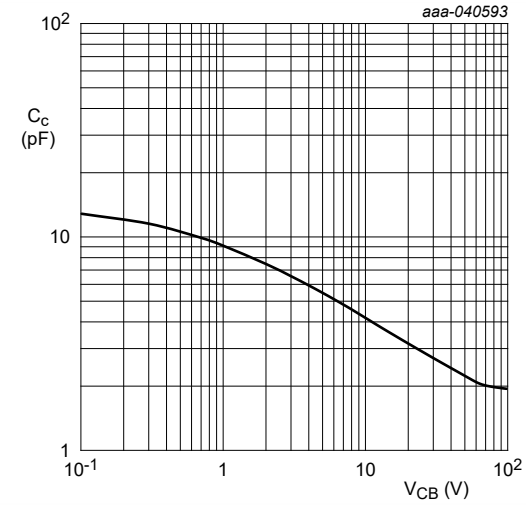

$I_C/I_B$ = 10
(1) $T_{amb}$ = 100 °C
(2) $T_{amb}$ = 25 °C
(3) $T_{amb}$ = -55 °C

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



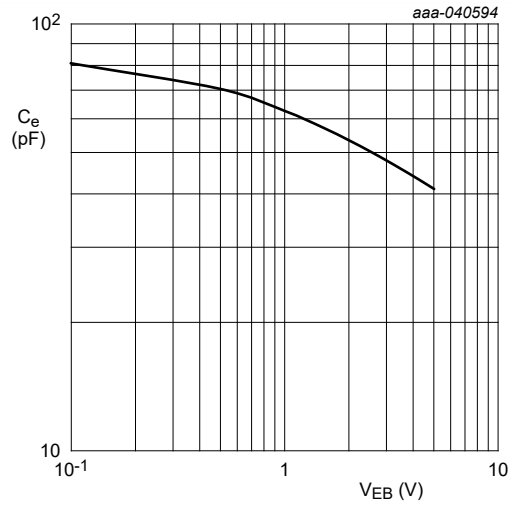

$T_{amb}$ = 25 °C
(1) $I_C/I_B$ = 50
(2) $I_C/I_B$ = 20
(3) $I_C/I_B$ = 5

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



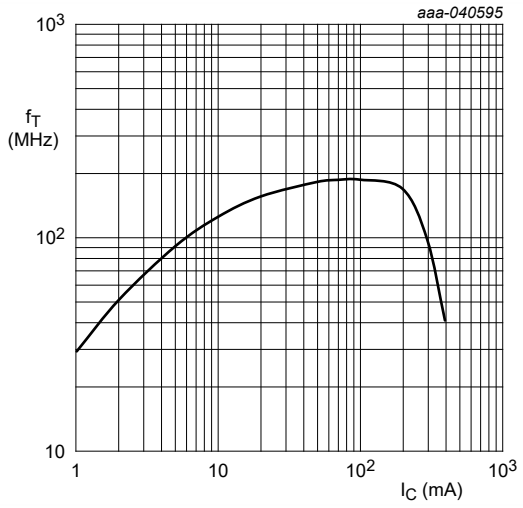

f = 1 MHz; $T_{amb}$ = 25 °C

**Fig. 11. Collector capacitance as a function of collector-base voltage; typical values**




f = 1 MHz; $T_{amb}$ = 25 °C

**Fig. 12. Emitter capacitance as a function of emitter-base voltage; typical values**




$V_{CE}$ = 5 V

f = 100 MHz; $T_{amb}$ = 25 °C

**Fig. 13. Transition frequency 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

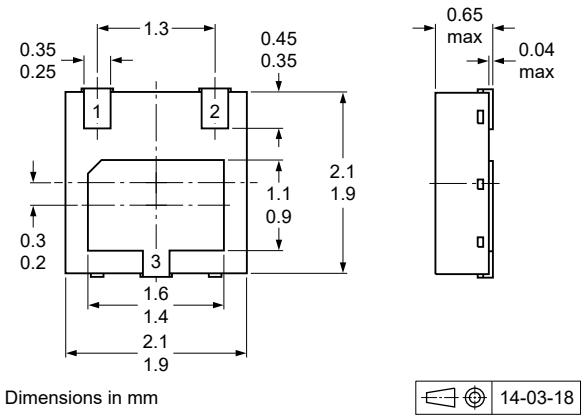



**Fig. 14. Package outline DFN2020D-3 (SOT1061D)**

## 13. Soldering

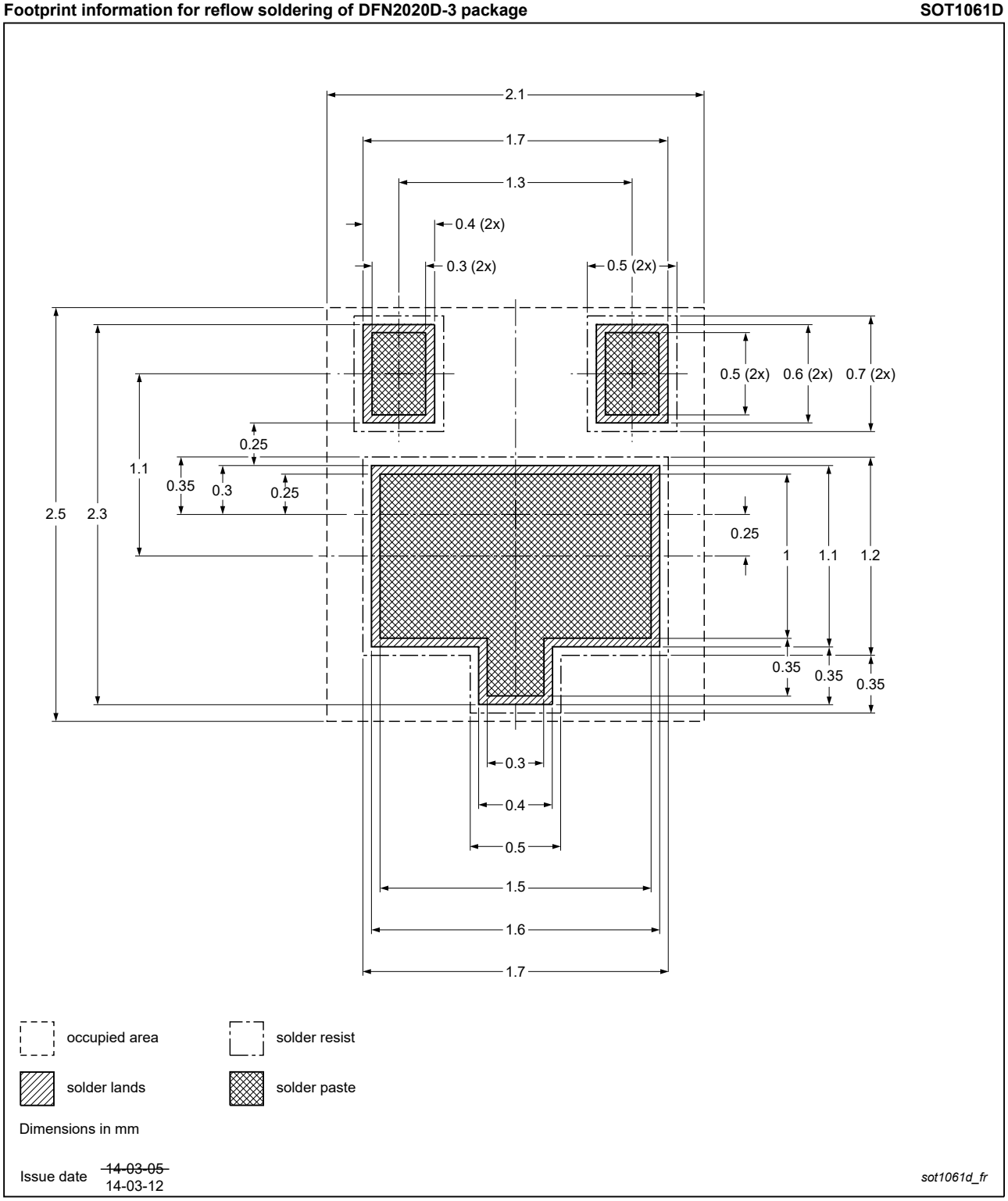



**Fig. 15. Reflow soldering footprint for DFN2020D-3 (SOT1061D**

## 14. Revision history

**Table 9. Revision history**

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|---|---|---|---|---|
| BC56PAST-Q_SER v.2 | 20241127 | Product data sheet | - | BC56PAST-Q_SER v.1 |
| Modifications: | • General description: Product overview corrected | | | |
| BC56PAST_SER-Q v.1 | 20240823 | 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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# Contents





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**Date of release: 27 November 2024**