



# PHPT61006NY-Q

100 V, 6 A NPN high power bipolar transistor

14 October 2024

Product data sheet

## 1. General description

NPN high power bipolar transistor in a SOT669 (LFAK56) Surface-Mounted Device (SMD) power plastic package.

PNP complement: PHPT61006PY-Q

## 2. Features and benefits

- High thermal power dissipation capability
- High temperature applications up to 175 °C
- Reduced Printed Circuit Board (PCB) requirements comparing to transistors in DPAK
- High energy efficiency due to less heat generation
- Qualified according to AEC-Q101 and recommended for use in automotive applications

## 3. Applications

- Power management
- Load switch
- Linear mode voltage regulator
- Backlighting applications
- Motor drive
- Relay replacement

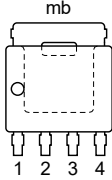
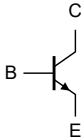
## 4. Quick reference data

Table 1. Quick reference data

| Symbol      | Parameter                               | Conditions                                                                                          | Min | Typ | Max | Unit       |
|-------------|-----------------------------------------|-----------------------------------------------------------------------------------------------------|-----|-----|-----|------------|
| $V_{CE0}$   | collector-emitter voltage               | open base                                                                                           | -   | -   | 100 | V          |
| $I_C$       | collector current                       |                                                                                                     | -   | -   | 6   | A          |
| $I_{CM}$    | peak collector current                  | single pulse; $t_p \leq 1$ ms                                                                       | -   | -   | 12  | A          |
| $R_{CEsat}$ | collector-emitter saturation resistance | $I_C = 6$ A; $I_B = 600$ mA; pulsed; $t_p \leq 300$ $\mu$ s; $\delta \leq 0.02$ ; $T_{amb} = 25$ °C | -   | 35  | 57  | m $\Omega$ |

5. Pinning information

Table 2. Pinning information

| Pin | Symbol | Description | Simplified outline                                                                                                      | Graphic symbol                                                                                       |
|-----|--------|-------------|-------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|
| 1   | E      | emitter     | <br><b>LFPAK56; Power-SO8 (SOT669)</b> | <br><i>sym123</i> |
| 2   | E      | emitter     |                                                                                                                         |                                                                                                      |
| 3   | E      | emitter     |                                                                                                                         |                                                                                                      |
| 4   | B      | base        |                                                                                                                         |                                                                                                      |
| mb  | C      | collector   |                                                                                                                         |                                                                                                      |

6. Ordering information

Table 3. Ordering information

| Type number                   | Package            |                                                            |                        |
|-------------------------------|--------------------|------------------------------------------------------------|------------------------|
|                               | Name               | Description                                                | Version                |
| <a href="#">PHPT61006NY-Q</a> | LFPAK56; Power-SO8 | plastic, single-ended surface-mounted package; 4 terminals | <a href="#">SOT669</a> |

7. Marking

Table 4. Marking codes

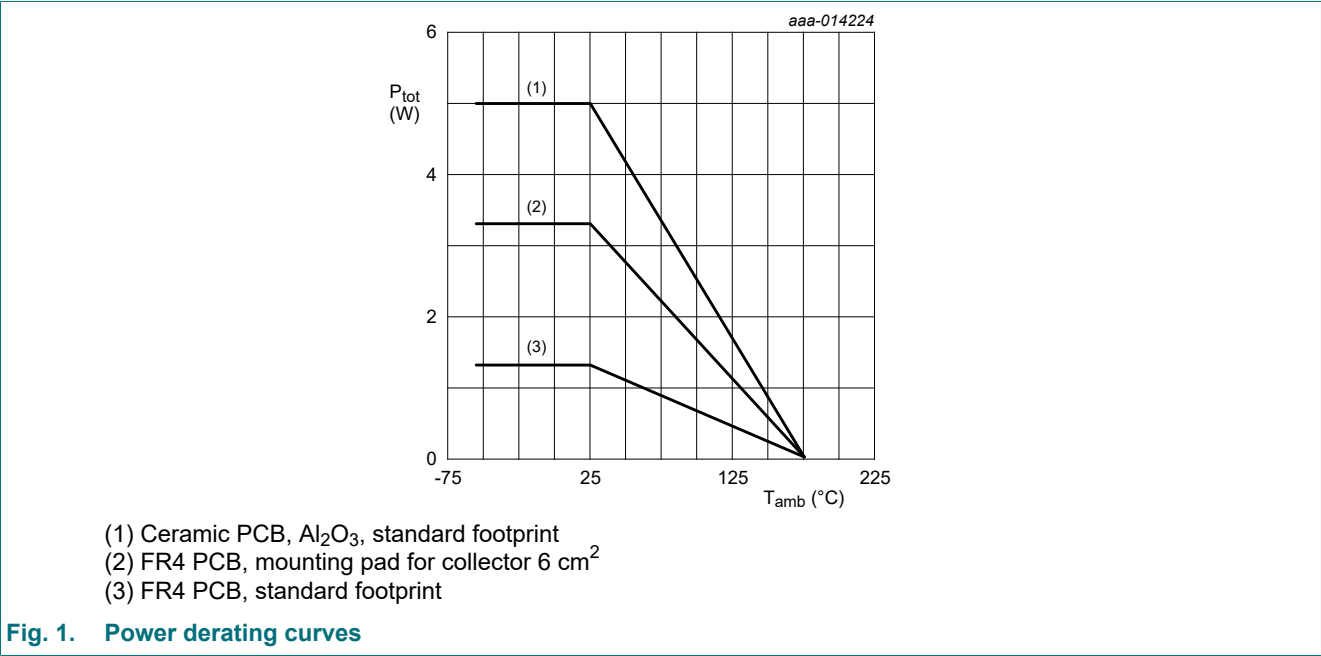
| Type number   | Marking code |
|---------------|--------------|
| PHPT61006NY-Q | 1006NAB      |

8. Limiting values

Table 5. Limiting values  
In accordance with the Absolute Maximum Rating System (IEC 60134).

| Symbol           | Parameter                 | Conditions                          |     | Min | Max | Unit |
|------------------|---------------------------|-------------------------------------|-----|-----|-----|------|
| V <sub>CBO</sub> | collector-base voltage    | open emitter                        |     | -   | 100 | V    |
| V <sub>CEO</sub> | collector-emitter voltage | open base                           |     | -   | 100 | V    |
| V <sub>EBO</sub> | emitter-base voltage      | open collector                      |     | -   | 7   | V    |
| I <sub>C</sub>   | collector current         |                                     |     | -   | 6   | A    |
| I <sub>CM</sub>  | peak collector current    | single pulse; t <sub>p</sub> ≤ 1 ms |     | -   | 12  | A    |
| I <sub>B</sub>   | base current              |                                     |     | -   | 1   | A    |
| I <sub>BM</sub>  | peak base current         | single pulse; t <sub>p</sub> ≤ 1 ms |     | -   | 2   | A    |
| P <sub>tot</sub> | total power dissipation   | T <sub>amb</sub> ≤ 25 °C            | [1] | -   | 1.3 | W    |
|                  |                           |                                     | [2] | -   | 3.3 | W    |
|                  |                           |                                     | [3] | -   | 5   | W    |
|                  |                           |                                     | [4] | -   | 25  | W    |
| T <sub>j</sub>   | junction temperature      |                                     |     | -   | 175 | °C   |
| T <sub>amb</sub> | ambient temperature       |                                     |     | -55 | 175 | °C   |
| T <sub>stg</sub> | storage temperature       |                                     |     | -65 | 175 | °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 and mounting pad for collector 6 cm<sup>2</sup>.
- [3] Device mounted on an ceramic PCB; Al<sub>2</sub>O<sub>3</sub>, standard footprint.
- [4] Power dissipation from junction to mounting base.



9. Thermal characteristics

Table 6. Thermal characteristics

| Symbol         | Parameter                                         | Conditions  |     | Min | Typ | Max | Unit |
|----------------|---------------------------------------------------|-------------|-----|-----|-----|-----|------|
| $R_{th(j-a)}$  | thermal resistance from junction to ambient       | in free air | [1] | -   | -   | 115 | K/W  |
|                |                                                   |             | [2] | -   | -   | 45  | K/W  |
|                |                                                   |             | [3] | -   | -   | 30  | K/W  |
| $R_{th(j-mb)}$ | thermal resistance from junction to mounting base |             |     | -   | -   | 6   | 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 6 cm<sup>2</sup>.  
[3] Device mounted on an ceramic Printed-Circuit Board (PCB), Al<sub>2</sub>O<sub>3</sub>, standard footprint.

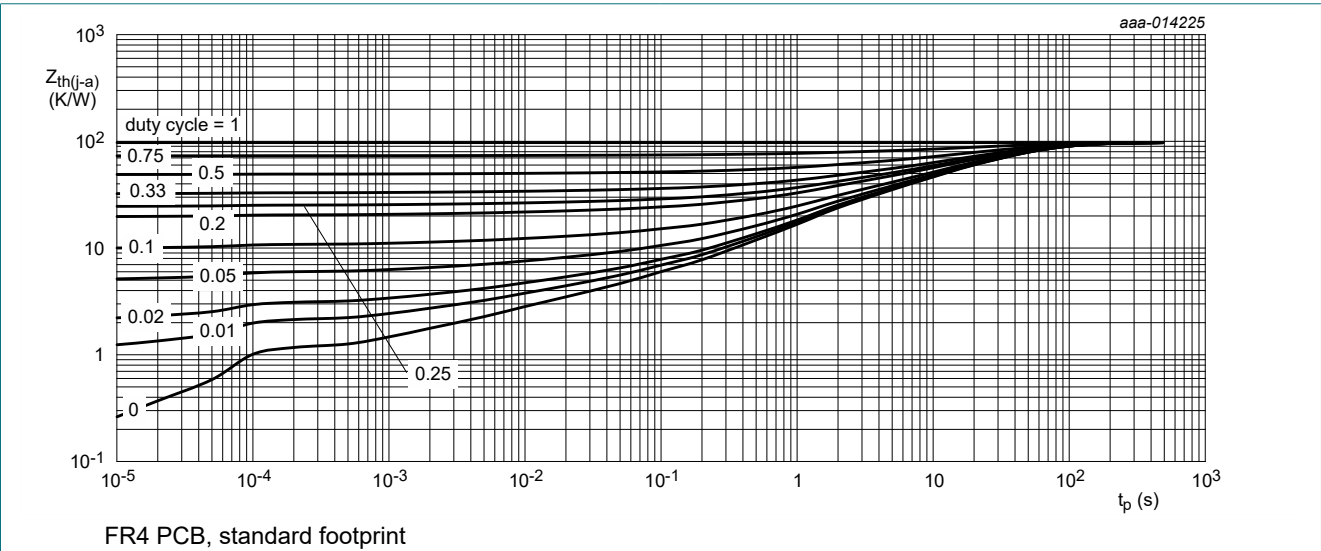


Fig. 2. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

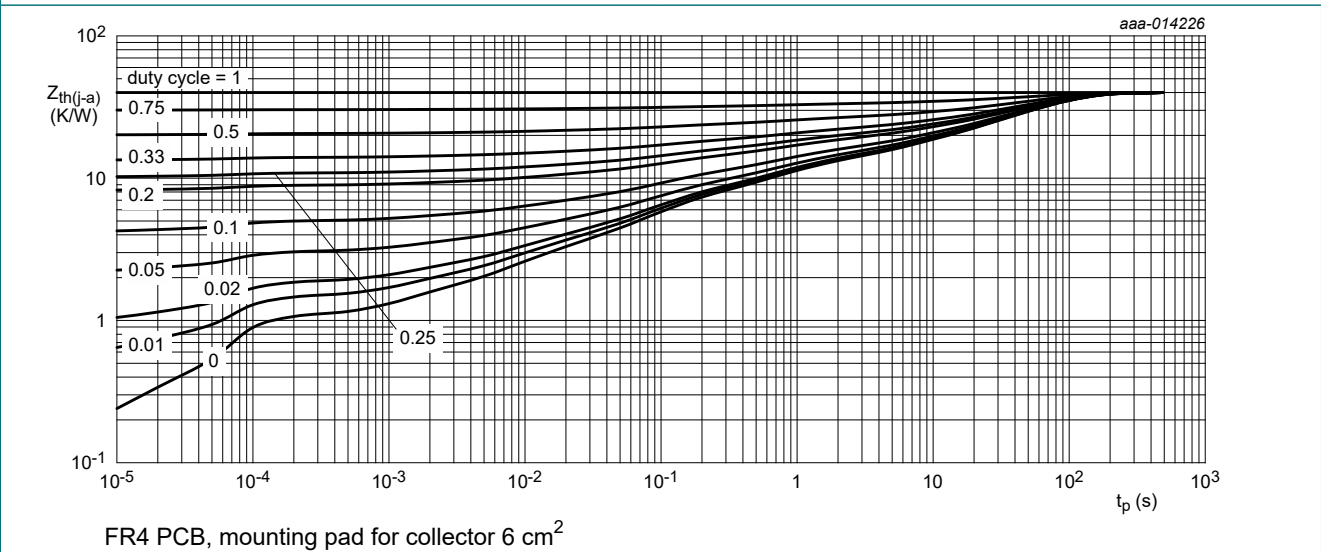


Fig. 3. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

10. Characteristics

Table 7. Characteristics

| Symbol             | Parameter                               | Conditions                                                                                                                       | Min | Typ  | Max | Unit |
|--------------------|-----------------------------------------|----------------------------------------------------------------------------------------------------------------------------------|-----|------|-----|------|
| I <sub>CBO</sub>   | collector-base cut-off current          | V <sub>CB</sub> = 80 V; I <sub>E</sub> = 0 A; T <sub>amb</sub> = 25 °C                                                           | -   | -    | 100 | nA   |
|                    |                                         | V <sub>CB</sub> = 80 V; I <sub>E</sub> = 0 A; T <sub>j</sub> = 150 °C                                                            | -   | -    | 50  | μA   |
| I <sub>CES</sub>   | collector-emitter cut-off current       | V <sub>CE</sub> = 80 V; V <sub>BE</sub> = 0 V; T <sub>amb</sub> = 25 °C                                                          | -   | -    | 100 | nA   |
| I <sub>EBO</sub>   | emitter-base cut-off current            | V <sub>EB</sub> = 7 V; I <sub>C</sub> = 0 A; T <sub>amb</sub> = 25 °C                                                            | -   | -    | 100 | nA   |
| h <sub>FE</sub>    | DC current gain                         | V <sub>CE</sub> = 2 V; I <sub>C</sub> = 500 mA; T <sub>amb</sub> = 25 °C                                                         | 140 | 260  | -   |      |
|                    |                                         | V <sub>CE</sub> = 2 V; I <sub>C</sub> = 1 A; t <sub>p</sub> ≤ 300 μs; δ ≤ 0.02; T <sub>amb</sub> = 25 °C                         | 120 | 210  | -   |      |
|                    |                                         | V <sub>CE</sub> = 2 V; I <sub>C</sub> = 3 A; t <sub>p</sub> ≤ 300 μs; δ ≤ 0.02; T <sub>amb</sub> = 25 °C                         | 50  | 90   | -   |      |
|                    |                                         | V <sub>CE</sub> = 2 V; I <sub>C</sub> = 6 A; t <sub>p</sub> ≤ 300 μs; δ ≤ 0.02; T <sub>amb</sub> = 25 °C; pulsed                 | 25  | 40   | -   |      |
| V <sub>CEsat</sub> | collector-emitter saturation voltage    | I <sub>C</sub> = 1 A; I <sub>B</sub> = 50 mA; t <sub>p</sub> ≤ 300 μs; δ ≤ 0.02; T <sub>amb</sub> = 25 °C; pulsed                | -   | 45   | 65  | mV   |
|                    |                                         | I <sub>C</sub> = 3 A; I <sub>B</sub> = 300 mA; pulsed; t <sub>p</sub> ≤ 300 μs; δ ≤ 0.02; T <sub>amb</sub> = 25 °C               | -   | 100  | 150 | mV   |
|                    |                                         | I <sub>C</sub> = 6 A; I <sub>B</sub> = 600 mA; pulsed; t <sub>p</sub> ≤ 300 μs; δ ≤ 0.02; T <sub>amb</sub> = 25 °C               | -   | 210  | 340 | mV   |
| R <sub>CEsat</sub> | collector-emitter saturation resistance |                                                                                                                                  | -   | 35   | 57  | mΩ   |
| V <sub>BEsat</sub> | base-emitter saturation voltage         | I <sub>C</sub> = 1 A; I <sub>B</sub> = 50 mA; pulsed; t <sub>p</sub> ≤ 300 μs; δ ≤ 0.02; T <sub>amb</sub> = 25 °C                | -   | 0.85 | 1   | V    |
|                    |                                         | I <sub>C</sub> = 3 A; I <sub>B</sub> = 300 mA; pulsed; t <sub>p</sub> ≤ 300 μs; δ ≤ 0.02; T <sub>amb</sub> = 25 °C               | -   | 1.05 | 1.3 | V    |
|                    |                                         | I <sub>C</sub> = 6 A; I <sub>B</sub> = 600 mA; pulsed; t <sub>p</sub> ≤ 300 μs; δ ≤ 0.02; T <sub>amb</sub> = 25 °C               | -   | 1.1  | 1.3 | V    |
| V <sub>BEon</sub>  | base-emitter turn-on voltage            | V <sub>CE</sub> = 2 V; I <sub>C</sub> = 500 mA; T <sub>amb</sub> = 25 °C                                                         | -   | 0.7  | 0.9 | V    |
| t <sub>d</sub>     | delay time                              | V <sub>CC</sub> = 12.5 V; I <sub>C</sub> = 3 A; I <sub>Bon</sub> = 150 mA; I <sub>Boff</sub> = -150 mA; T <sub>amb</sub> = 25 °C | -   | 10   | -   | ns   |
| t <sub>r</sub>     | rise time                               |                                                                                                                                  | -   | 365  | -   | ns   |
| t <sub>on</sub>    | turn-on time                            |                                                                                                                                  | -   | 375  | -   | ns   |
| t <sub>s</sub>     | storage time                            |                                                                                                                                  | -   | 285  | -   | ns   |
| t <sub>f</sub>     | fall time                               |                                                                                                                                  | -   | 385  | -   | ns   |
| t <sub>off</sub>   | turn-off time                           |                                                                                                                                  | -   | 670  | -   | ns   |
| f <sub>T</sub>     | transition frequency                    | V <sub>CE</sub> = 10 V; I <sub>C</sub> = 500 mA; f = 100 MHz; T <sub>amb</sub> = 25 °C                                           | -   | 170  | -   | MHz  |
| C <sub>c</sub>     | collector capacitance                   | V <sub>CB</sub> = 10 V; I <sub>E</sub> = 0 A; i <sub>e</sub> = 0 A; f = 1 MHz; T <sub>amb</sub> = 25 °C                          | -   | 22   | -   | pF   |

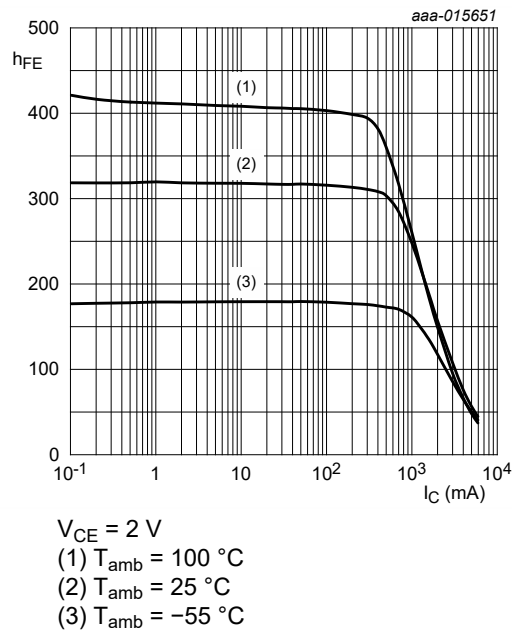


Fig. 4. DC current gain as a function of collector current; typical values

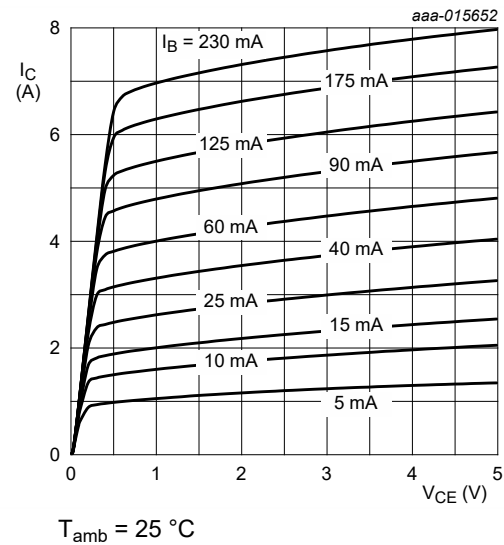


Fig. 5. Collector current as a function of collector-emitter voltage; typical values

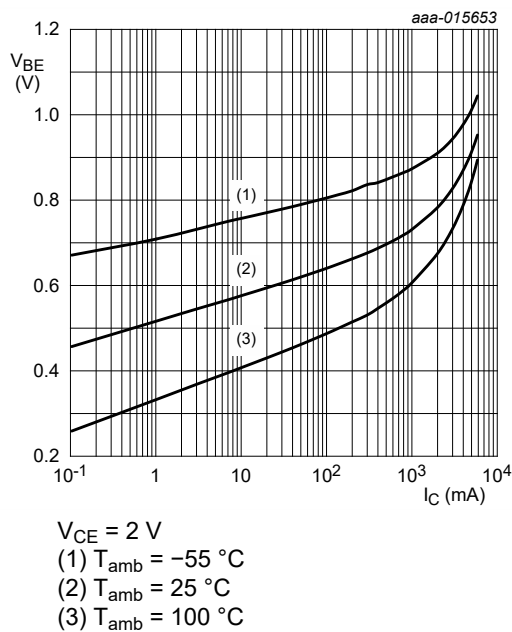


Fig. 6. Base-emitter voltage as a function of collector current; typical values

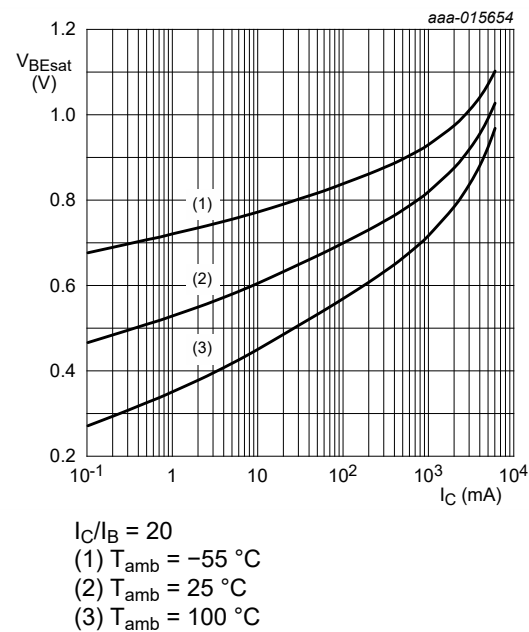


Fig. 7. Base-emitter saturation voltage as a function of collector current; typical values

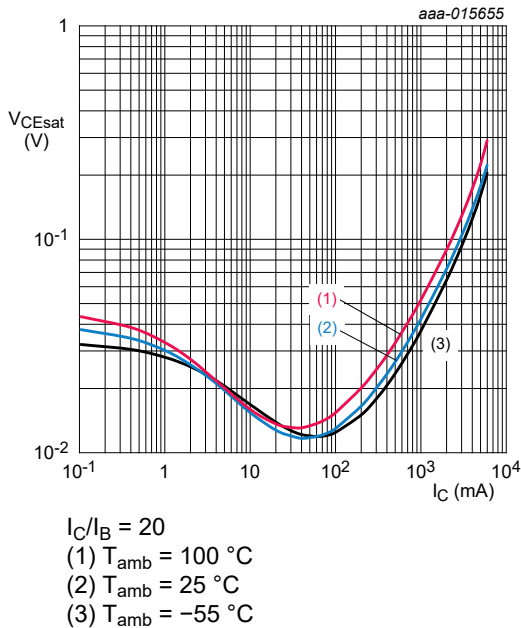


Fig. 8. Collector-emitter saturation voltage as a function of collector current; typical values

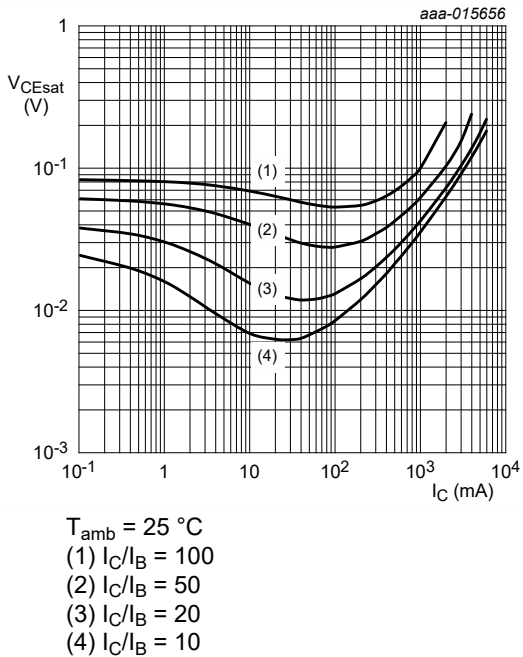


Fig. 9. Collector-emitter saturation voltage as a function of collector current; typical values

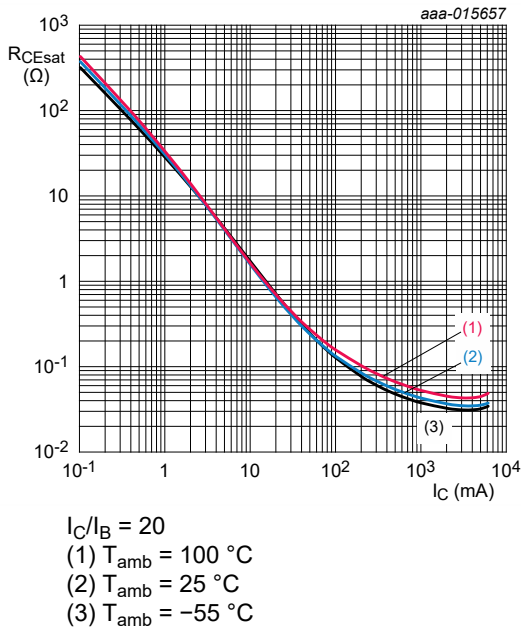


Fig. 10. Collector-emitter saturation resistance as a function of collector current; typical values

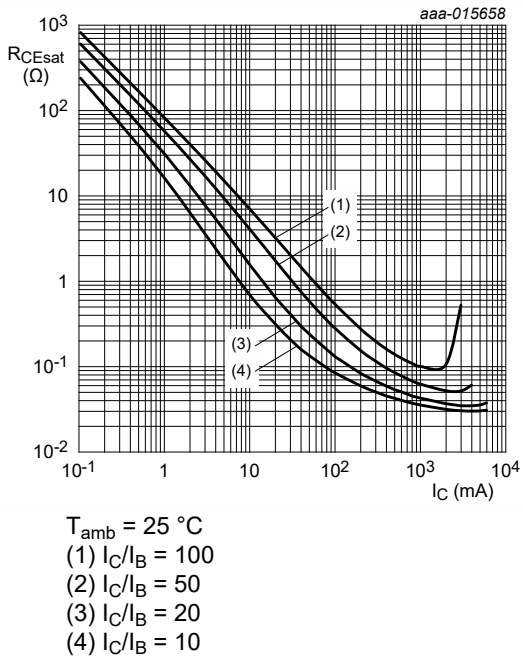


Fig. 11. Collector-emitter saturation resistance as a function of collector current; typical values

11. Test information

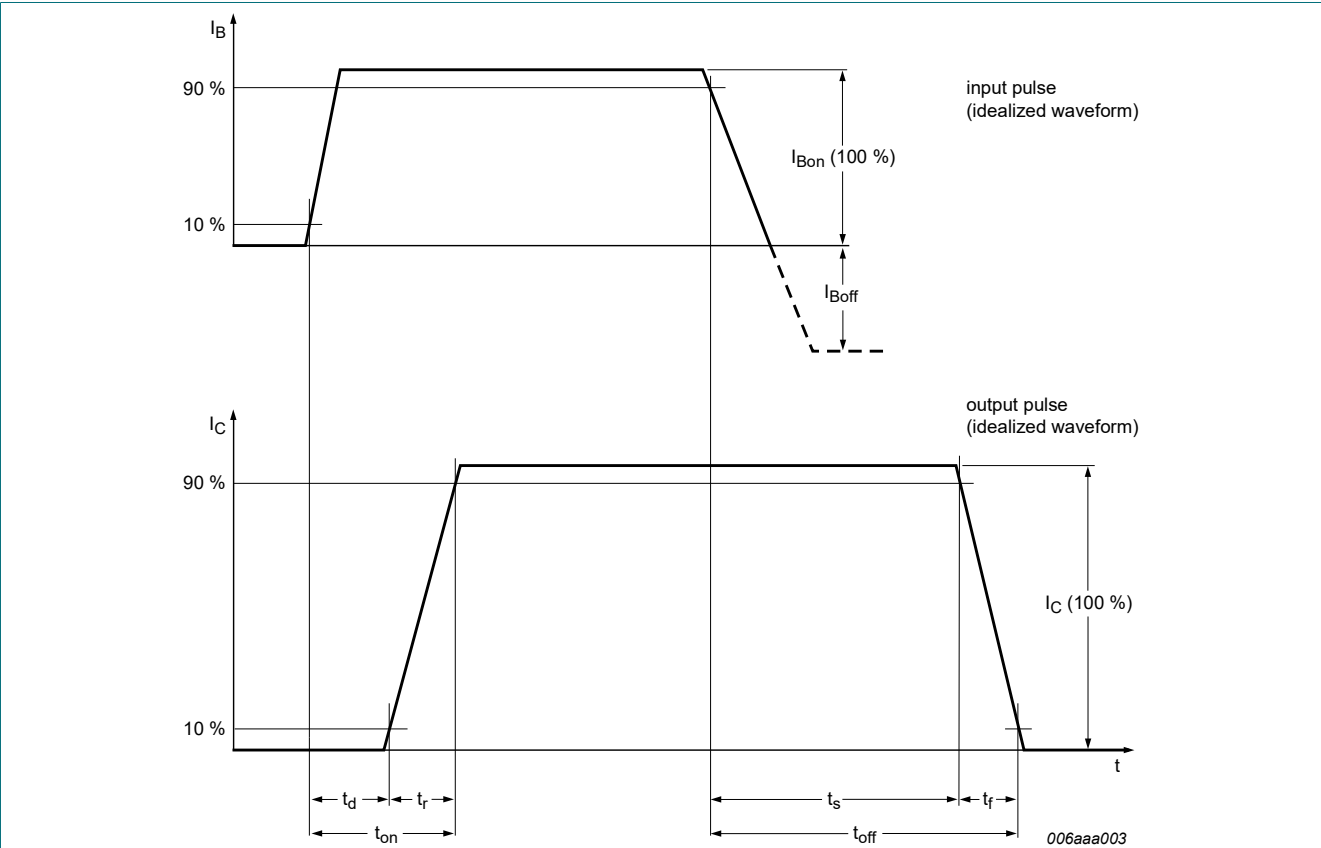


Fig. 12. Switching time definition

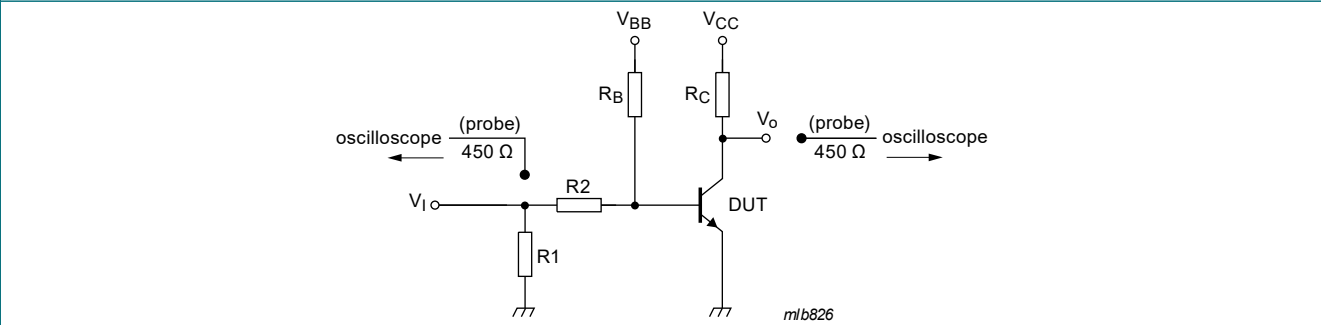


Fig. 13. Test circuit for switching times

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

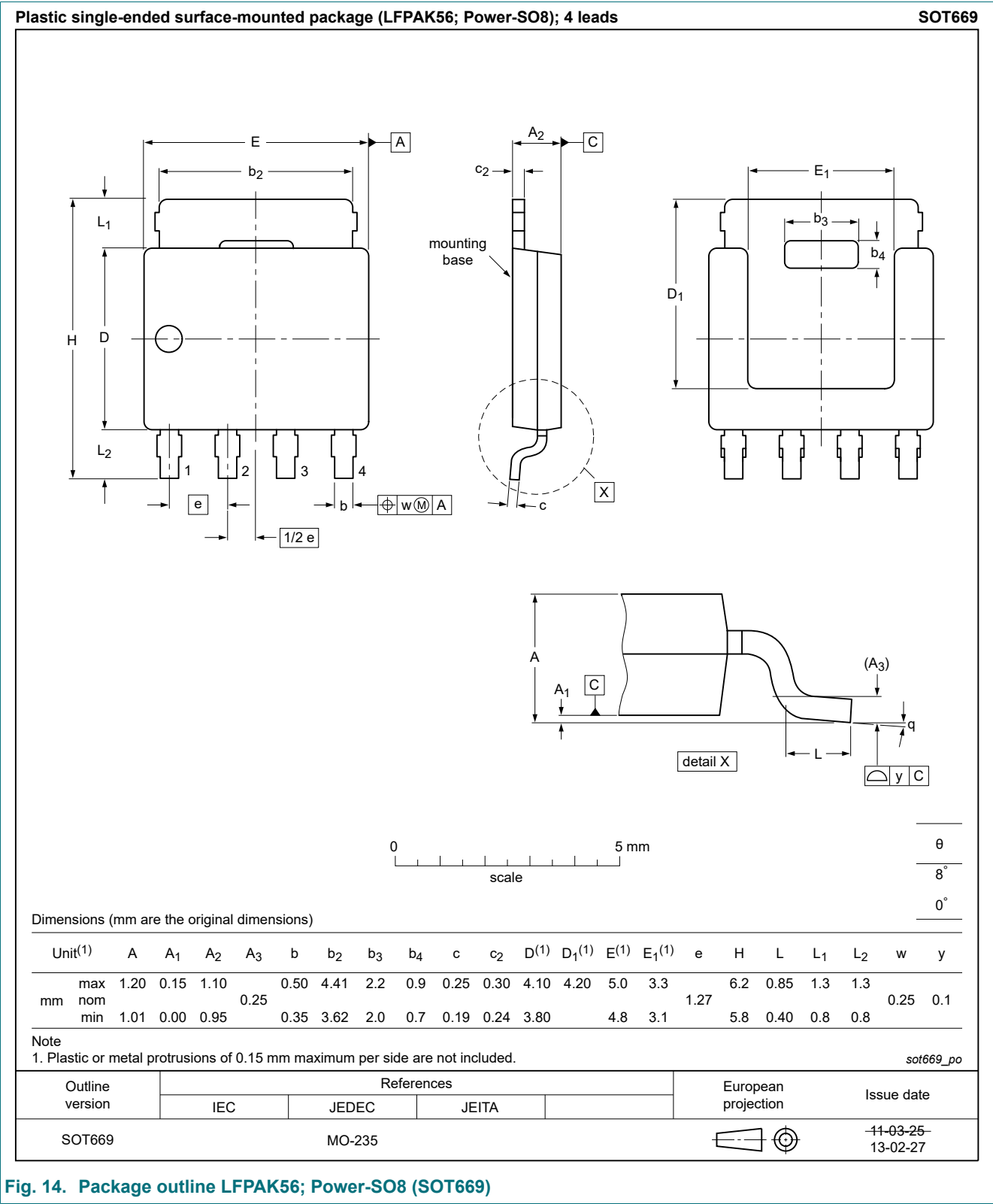
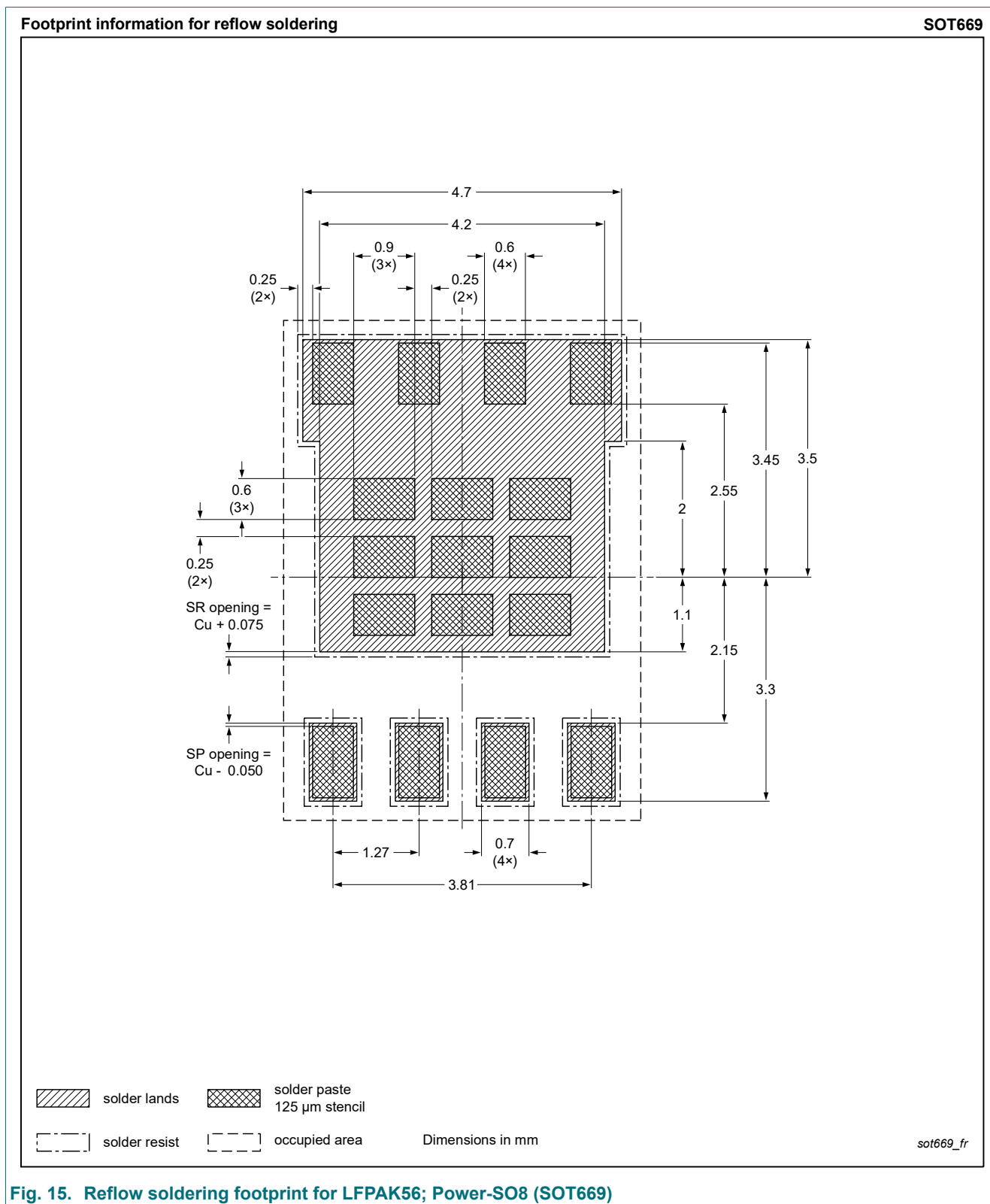


Fig. 14. Package outline LFAK56; Power-SO8 (SOT669)

## 13. Soldering



Wave soldering footprint information for LFPAK56 package

SOT669

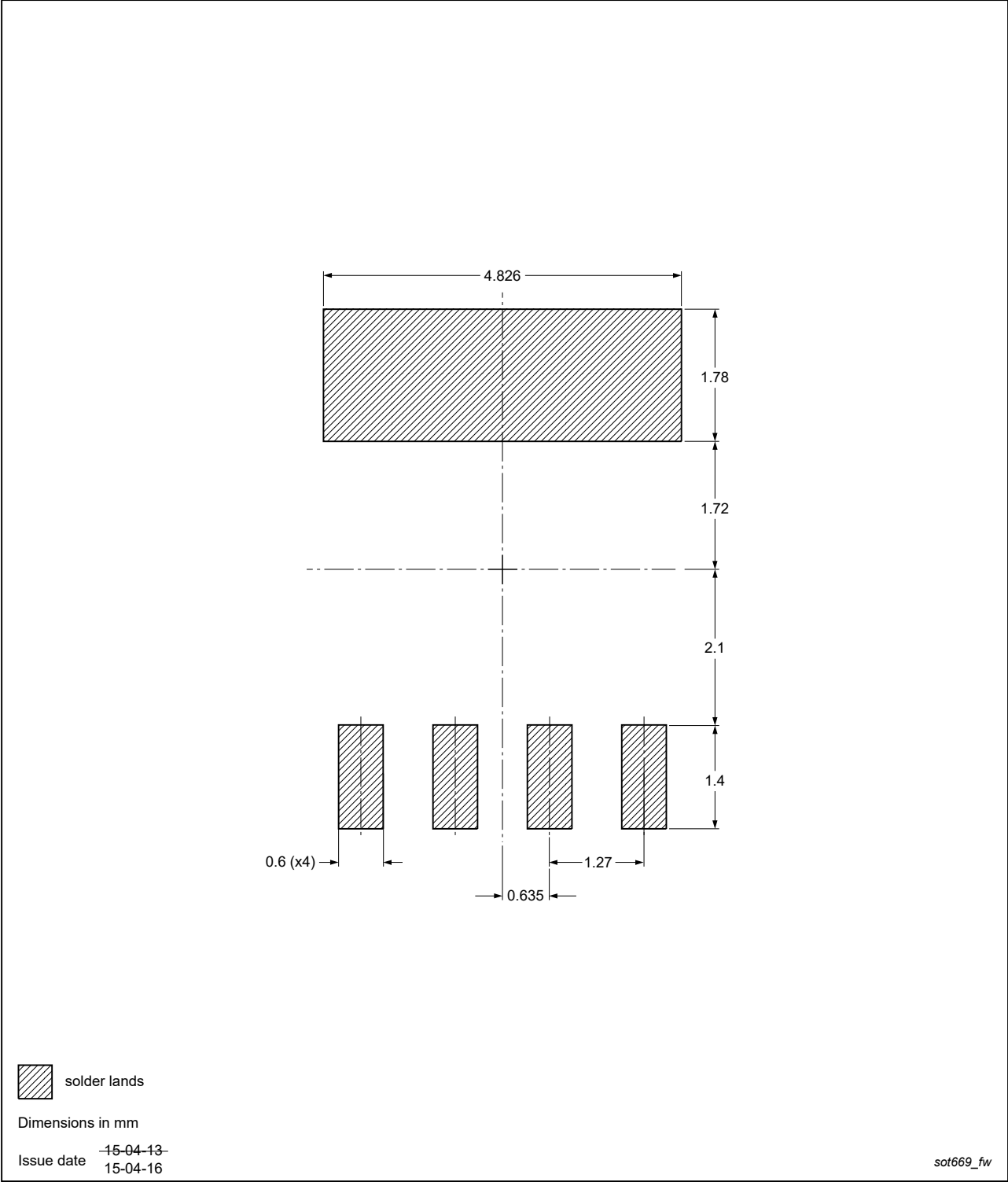


Fig. 16. Wave soldering footprint for LFPAK56; Power-SO8 (SOT669)

14. Revision history

Table 8. Revision history

| Data sheet ID     | Release date | Data sheet status  | Change notice | Supersedes |
|-------------------|--------------|--------------------|---------------|------------|
| PHPT61006NY-Q v.1 | 20241014     | Product data sheet | -             | -          |

## 15. Legal information

### Data sheet status

| Document status<br>[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: 14 October 2024