



# PHPT60410NY-Q

40 V, 10 A NPN high power bipolar transistor

27 September 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: PHPT60410PY-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

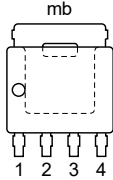
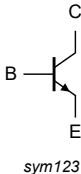
## 4. Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{CEO}$	collector-emitter voltage	open base	-	-	40	V
$I_C$	collector current		-	-	10	A
$I_{CM}$	peak collector current	single pulse; $t_p \leq 1$ ms	-	-	20	A
$R_{CEsat}$	collector-emitter saturation resistance	$I_C = 10$ A; $I_B = 1$ A; pulsed; $t_p \leq 300$ $\mu$ s; $\delta \leq 0.02$ ; $T_{amb} = 25$ °C	-	28	40	m $\Omega$

5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	E	emitter	 <b>LFPAK56; Power-SO8 (SOT669)</b>	 <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="#">PHPT60410NY-Q</a>	LFPAK56; Power-SO8	plastic, single-ended surface-mounted package; 4 terminals	<a href="#">SOT669</a>

7. Marking

Table 4. Marking codes

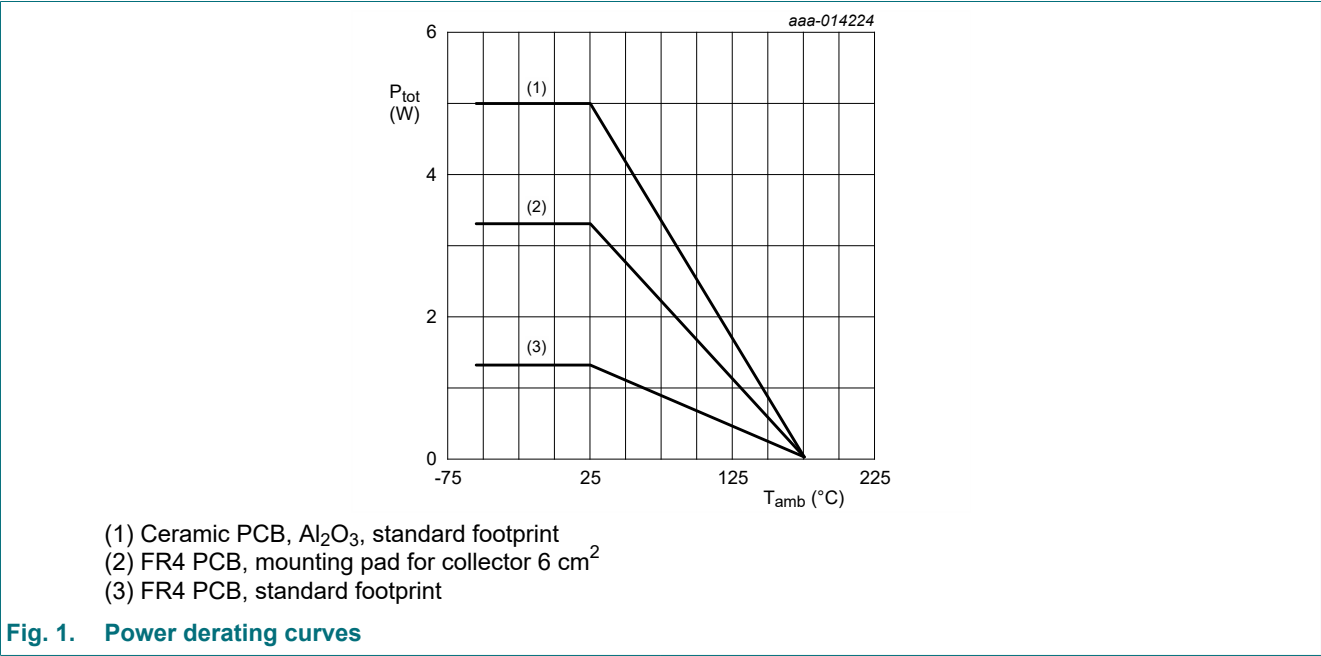
Type number	Marking code
PHPT60410NY-Q	0410NAB

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		-	40	V
V <sub>CEO</sub>	collector-emitter voltage	open base		-	40	V
V <sub>EBO</sub>	emitter-base voltage	open collector		-	7	V
I <sub>C</sub>	collector current			-	10	A
I <sub>CM</sub>	peak collector current	single pulse; t <sub>p</sub> ≤ 1 ms		-	20	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 a ceramic Printed-Circuit Board (PCB), Al<sub>2</sub>O<sub>3</sub>, standard footprint.

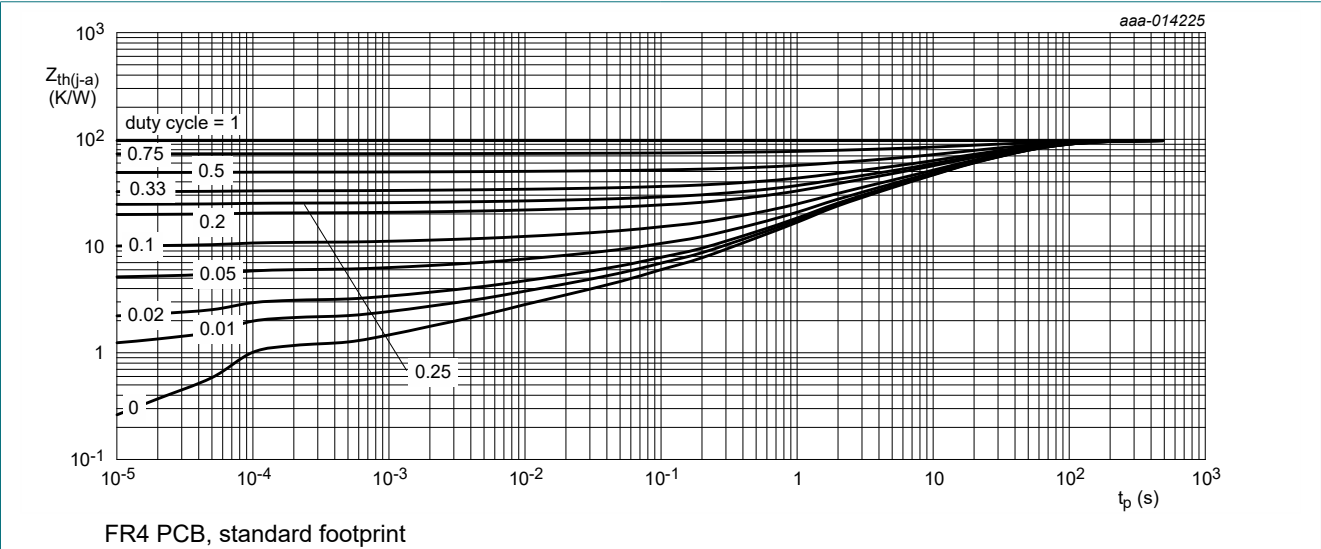


Fig. 2. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

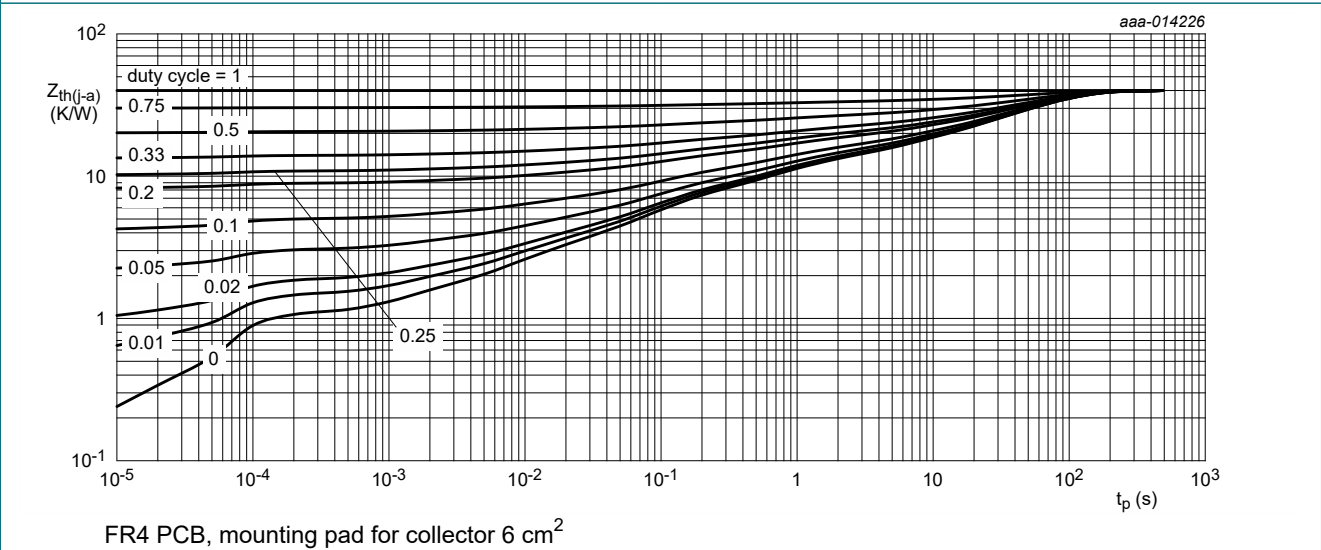


Fig. 3. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

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> = 32 V; I <sub>E</sub> = 0 A; T <sub>amb</sub> = 25 °C		-	-	100	nA
		V <sub>CB</sub> = 32 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> = 32 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		230	370	-	
		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		220	360	-	
		V <sub>CE</sub> = 2 V; I <sub>C</sub> = 5 A; t <sub>p</sub> ≤ 300 µs; δ ≤ 0.02; T <sub>amb</sub> = 25 °C		140	230	-	
		V <sub>CE</sub> = 2 V; I <sub>C</sub> = 10 A; t <sub>p</sub> ≤ 300 µs; δ ≤ 0.02; T <sub>amb</sub> = 25 °C; pulsed		55	90	-	
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		-	35	50	mV
		I <sub>C</sub> = 5 A; I <sub>B</sub> = 500 mA; pulsed; t <sub>p</sub> ≤ 300 µs; δ ≤ 0.02; T <sub>amb</sub> = 25 °C		-	140	200	mV
		I <sub>C</sub> = 10 A; I <sub>B</sub> = 500 mA; pulsed; t <sub>p</sub> ≤ 300 µs; δ ≤ 0.02; T <sub>amb</sub> = 25 °C		-	330	460	mV
R <sub>CEsat</sub>	collector-emitter saturation resistance	I <sub>C</sub> = 10 A; I <sub>B</sub> = 1 A; pulsed; t <sub>p</sub> ≤ 300 µs; δ ≤ 0.02; T <sub>amb</sub> = 25 °C		-	28	40	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		-	-	0.95	V
		I <sub>C</sub> = 5 A; I <sub>B</sub> = 500 mA; pulsed; t <sub>p</sub> ≤ 300 µs; δ ≤ 0.02; T <sub>amb</sub> = 25 °C		-	-	1.2	V
		I <sub>C</sub> = 10 A; I <sub>B</sub> = 500 mA; pulsed; t <sub>p</sub> ≤ 300 µs; δ ≤ 0.02; T <sub>amb</sub> = 25 °C		-	-	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		-	-	0.8	V
t <sub>d</sub>	delay time	V <sub>CC</sub> = 12.5 V; I <sub>C</sub> = 5 A; I <sub>Bon</sub> = 250 mA; I <sub>Boff</sub> = -250 mA; T <sub>amb</sub> = 25 °C		-	15	-	ns
t <sub>r</sub>	rise time			-	130	-	ns
t <sub>on</sub>	turn-on time			-	145	-	ns
t <sub>s</sub>	storage time			-	310	-	ns
t <sub>f</sub>	fall time			-	95	-	ns
t <sub>off</sub>	turn-off time			-	405	-	ns
f <sub>T</sub>	transition frequency			-	128	-	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		-	57	-	pF

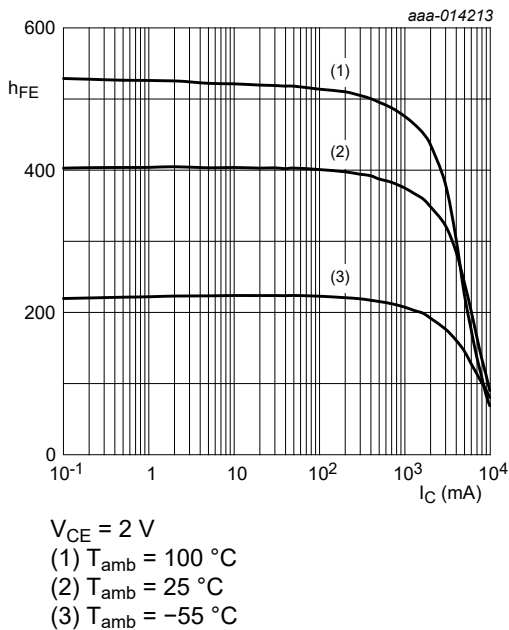


Fig. 4. DC current gain as a function of collector current; typical values

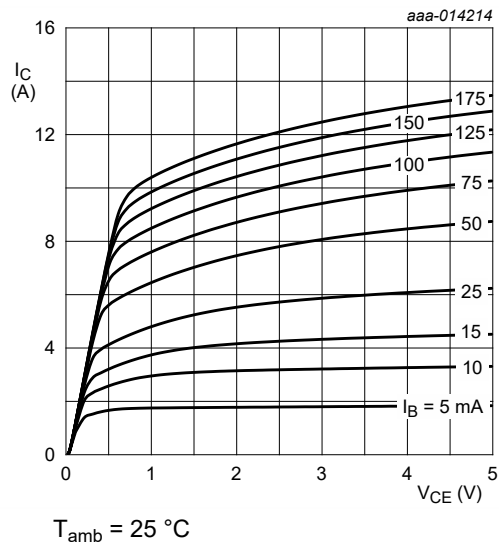


Fig. 5. Collector current as a function of collector-emitter voltage; typical values

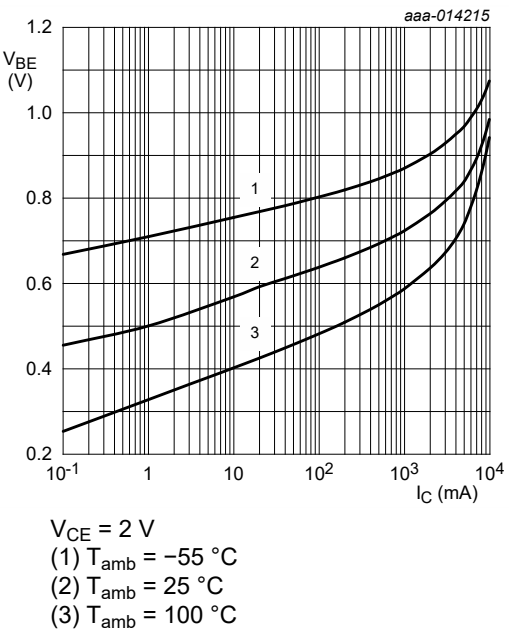


Fig. 6. Base-emitter voltage as a function of collector current; typical values

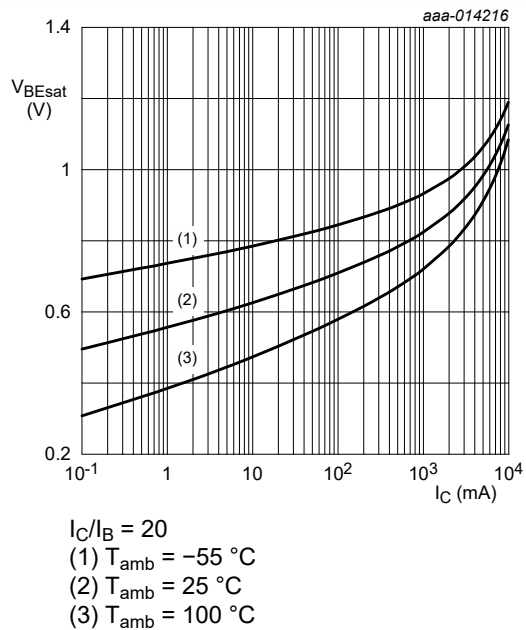


Fig. 7. Base-emitter saturation voltage as a function of collector current; typical values

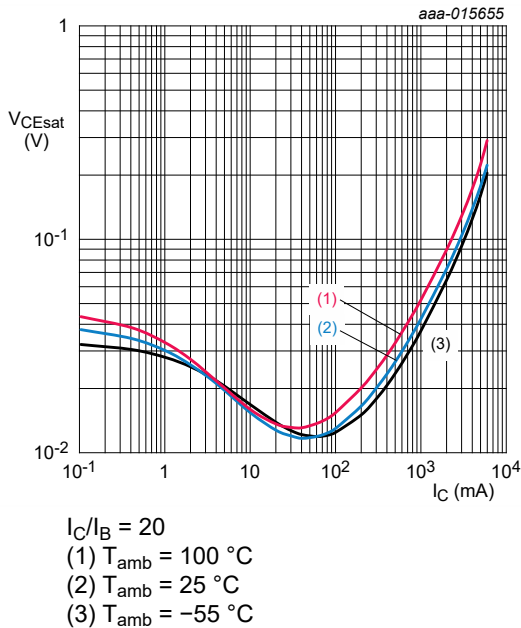


Fig. 8. Collector-emitter saturation voltage as a function of collector current; typical values

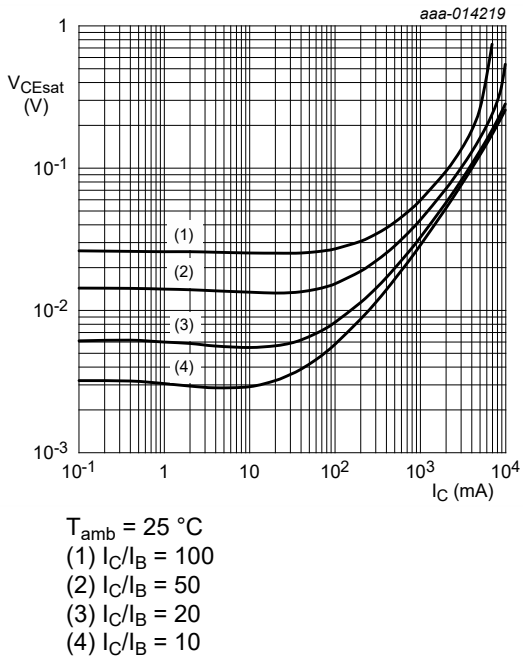


Fig. 9. Collector-emitter saturation voltage as a function of collector current; typical values

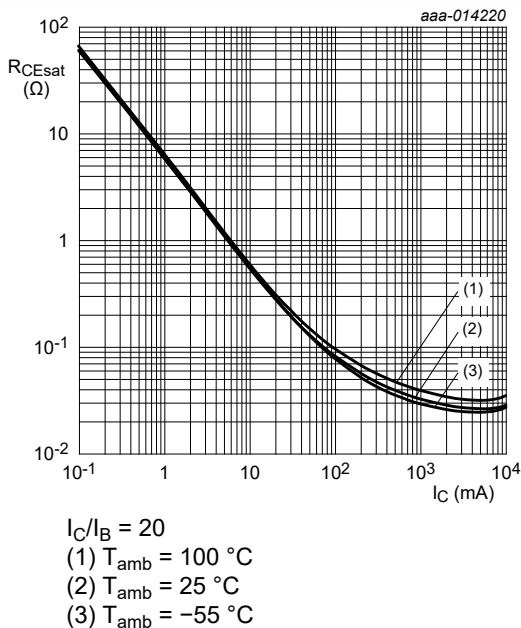


Fig. 10. Collector-emitter saturation resistance as a function of collector current; typical values

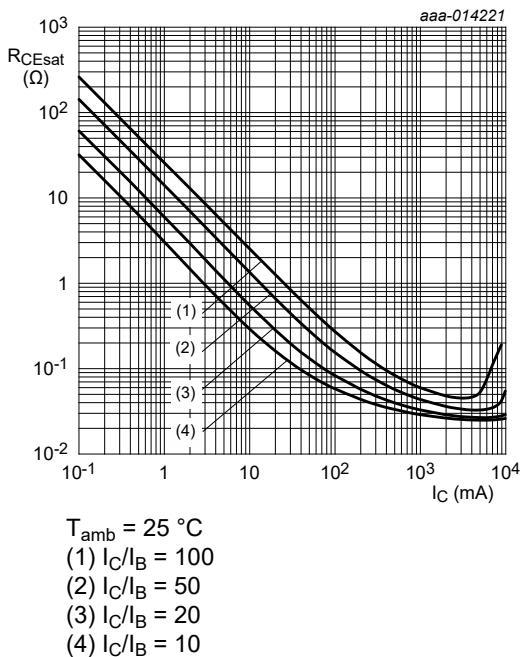


Fig. 11. Collector-emitter saturation resistance as a function of collector current; typical values

11. Test information

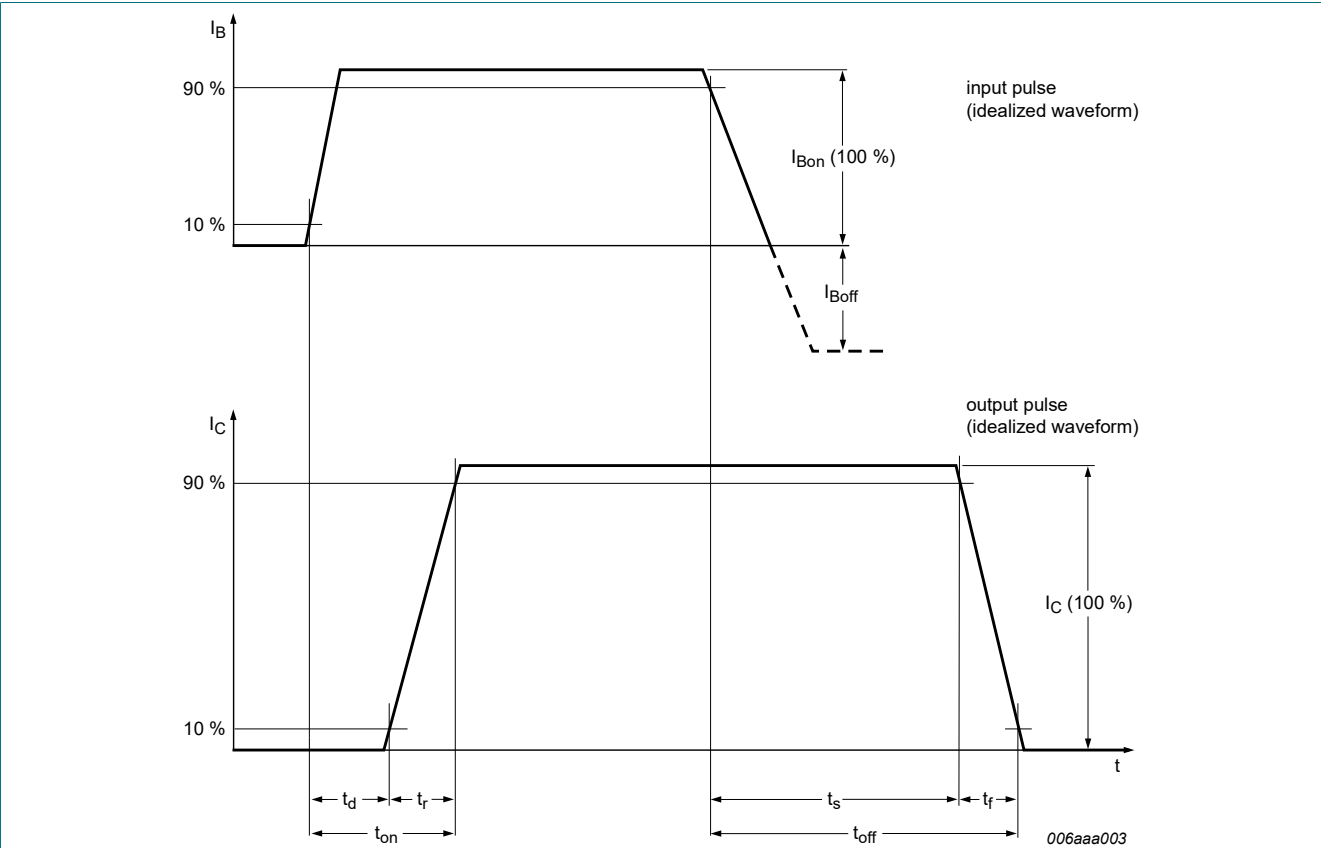


Fig. 12. Switching time definition

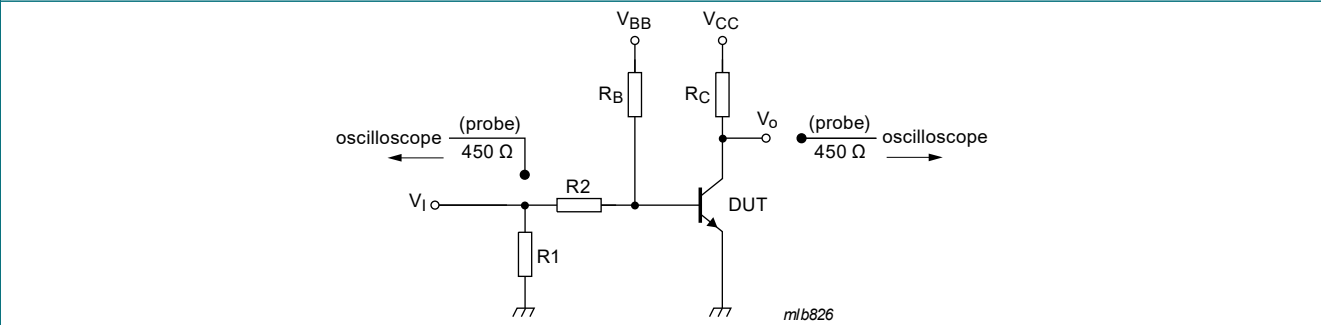


Fig. 13. Test circuit for switching times

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

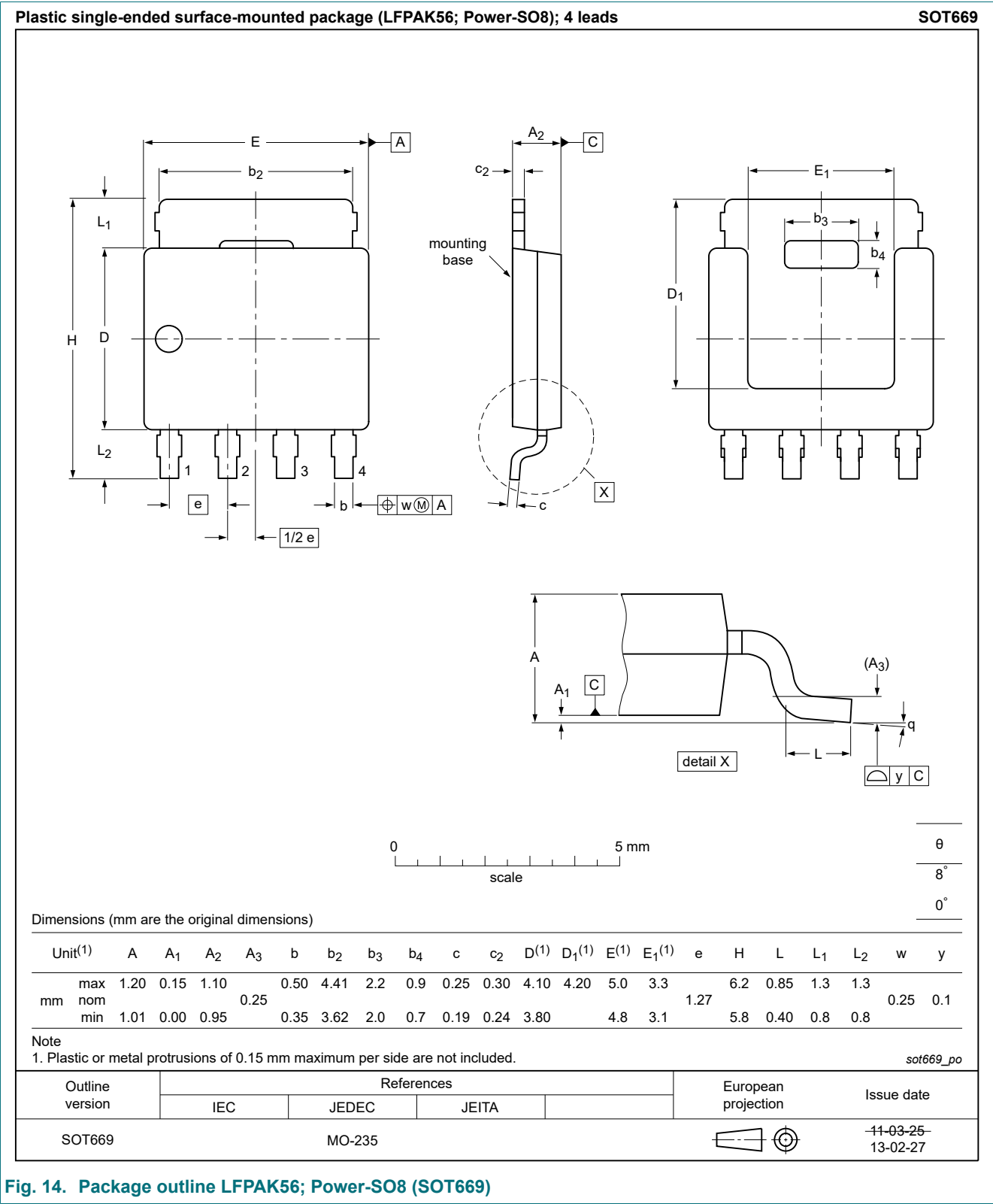


Fig. 14. Package outline LFAK56; Power-SO8 (SOT669)

13. Soldering

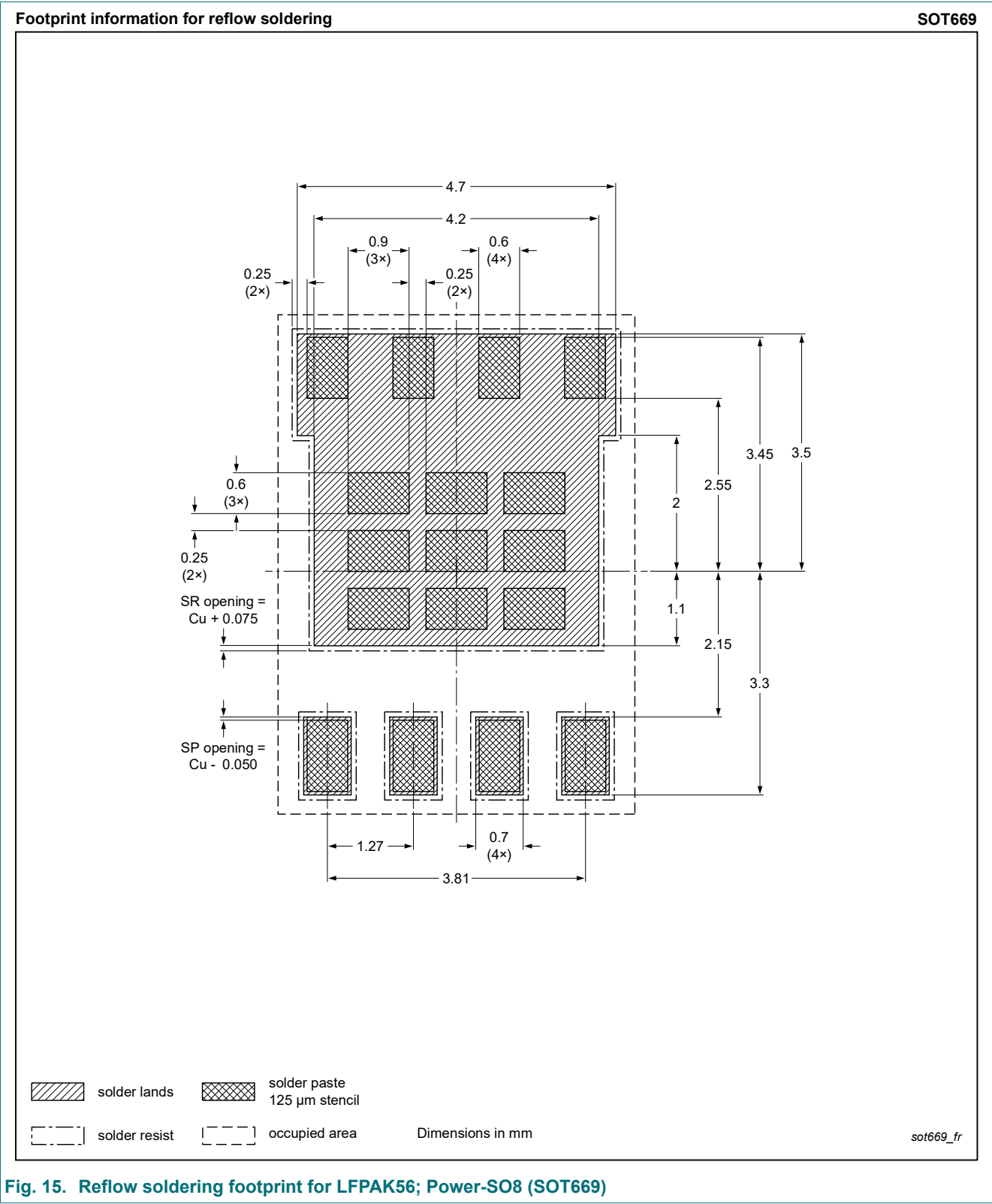


Fig. 15. Reflow soldering footprint for LFPAK56; Power-SO8 (SOT669)

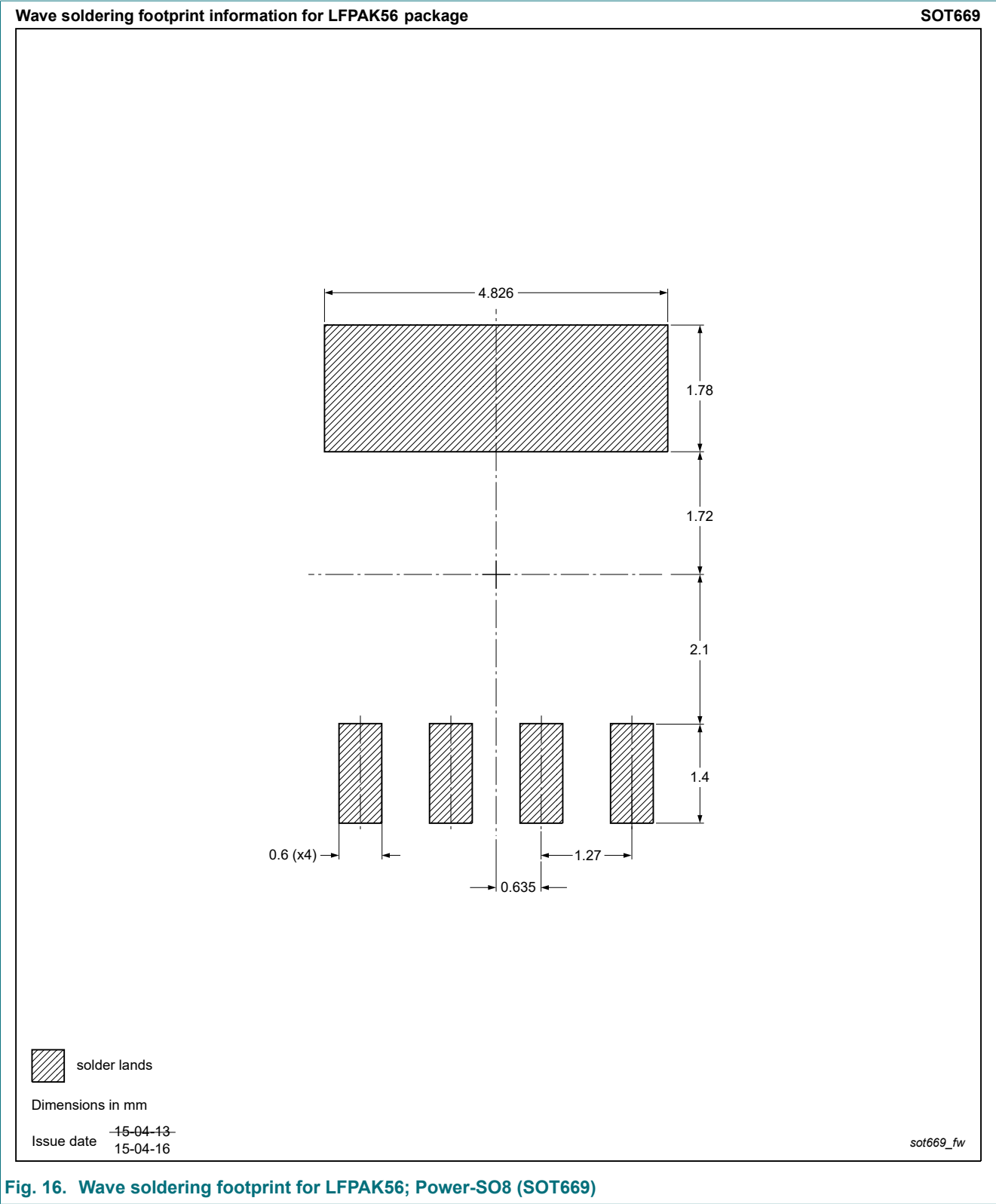


Fig. 16. Wave soldering footprint for LFPAK56; Power-SO8 (SOT669)

14. Revision history

Table 8. Revision history

Data sheet ID	Release date	Data sheet status	Change notice	Supersedes
PHPT60410NY-Q v.1	20240927	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.

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- [2] The term 'short data sheet' is explained in section "Definitions".
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