# PCF2120

## Quartz oscillator

Rev. 01 — 5 February 2008 | Product data sheet

## 1. General description

The PCF2120 is a CMOS quartz oscillator optimized for low power consumption. The 32 kHz output signal is gated using an enable signal.

## 2. Features

- Clock operating voltage: 1.5 V to 5.5 V
- Low backup current: typical 0.85 μA at $V_{DD}$ = 3.0 V and $T_{amb}$ = 25 °C
- 32.768 kHz output for peripheral devices
- Two integrated oscillator capacitors
- Push-pull output
- Internal power-on reset

## 3. Applications

- Portable instruments
- Industrial products
- Battery powered products

## 4. Quick reference data

**Table 1. Quick reference data**

| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $V_{DD}$ | supply voltage | | [1] | 1.5 | - | 5.5 | V |
| $I_{DD}$ | supply current | clock output disabled | | | | | |
| | | $V_{DD}$ = 2.0 V; $T_{amb}$ = 25 °C | | - | 210 | 450 | nA |
| | | $V_{DD}$ = 3.0 V; $T_{amb}$ = –40 °C to +85 °C | | - | 265 | 650 | nA |
| | | clock output enabled at 32 kHz | | | | | |
| | | $V_{DD}$ = 2.0 V; $T_{amb}$ = 25 °C | | - | 615 | 900 | nA |
| | | $V_{DD}$ = 3.0 V; $T_{amb}$ = –40 °C to +85 °C | | - | 875 | 1100 | nA |
| $T_{stg}$ | storage temperature | | | –65 | - | +150 | °C |

[1] For reliable oscillator start-up at power-up: $V_{DD} > V_{DD(min)} + 0.3$ V.

founded by Philips

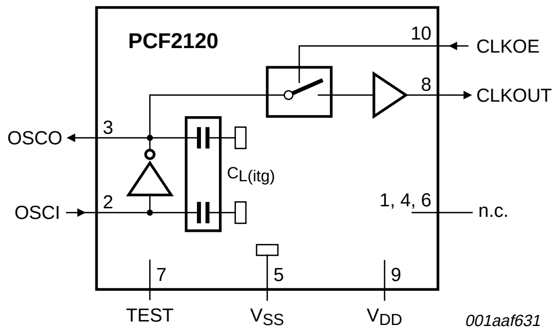
# 5. Ordering information

**Table 2. Ordering information**

| Type number | Package | | |
|---|---|---|---|
| | Name | Description | Version |
| PCF2120TK | HVSON10 | plastic thermal enhanced very thin small outline package; no leads; 10 terminals; body 3 × 3 × 0.85 mm | SOT650-1 |
| PCF2120U[1] | - | wire bond die; 7 bonding pads; 0.57 × 1.1 × 0.2 mm | PCF2120U |

[1] Packing method: sawn wafer on Film Frame Carrier (FFC).

# 6. Block diagram

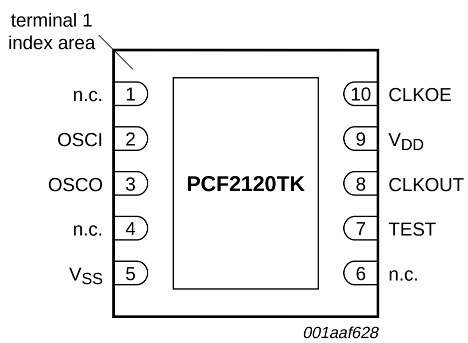



Pin numbers shown for HVSON10 package.

**Fig 1. Block diagram**

# 7. Pinning information

## 7.1 Pinning




Transparent top view

**Fig 2. Pin configuration HVSON10 package**

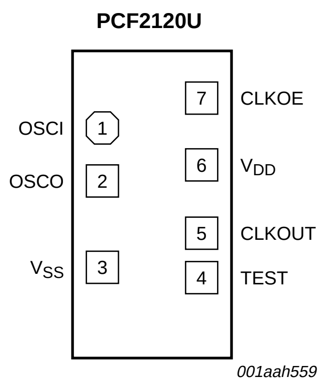



**Fig 3. Pad configuration wire bond die**

### 7.2 Pin description

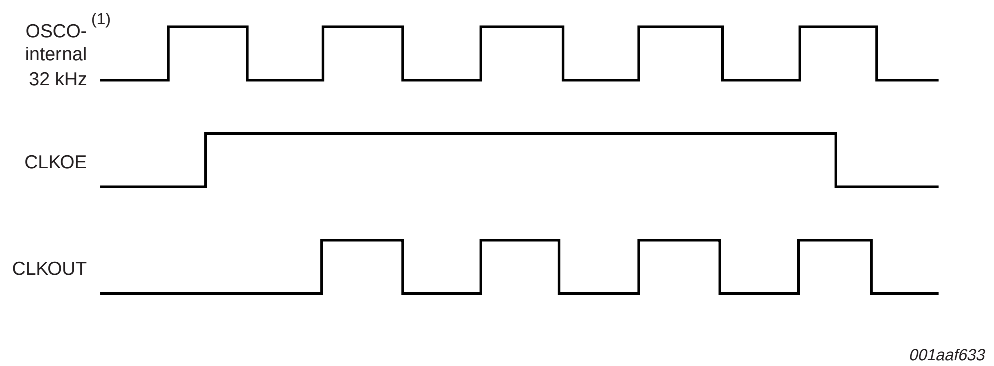
**Table 3. Pin description**

| Symbol | Pin HVSON10 | Pad Wire bond die | Description |
|---|---|---|---|
| n.c. | 1 | - | not connected |
| OSCI | 2 | 1 | oscillator input |
| OSCO | 3 | 2 | oscillator output |
| n.c. | 4 | - | not connected |
| $V_{SS}$ | 5 | 3 | ground |
| n.c. | 6 | - | not connected |
| TEST | 7 | 4 | test pin |
| CLKOUT | 8 | 5 | clock output (push-pull) |
| $V_{DD}$ | 9 | 6 | supply voltage |
| CLKOE | 10 | 7 | clock output enable input |

## 8. Functional description

The 32 kHz quartz oscillator is optimized for directly connecting to a 32 kHz tuning fork quartz crystal. No additional tuning capacitors are required. Laser tuning of the quartz or quartz selection for matching is used to tune the oscillator if required.

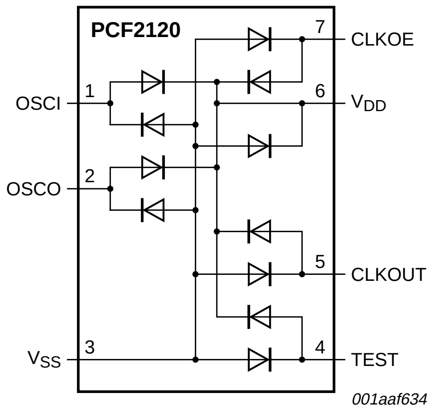
A digital 32 kHz signal is available on pin CLKOUT. The signal on pin CLKOE is used to gate and synchronize the 32 kHz CLKOUT signal. Pin CLKOUT is a CMOS push-pull output. If disabled, it goes to LOW level.




(1) OSCO-internal 32 kHz signal: internal signal after the Schmitt trigger connected to pin OSCO.

**Fig 4. CLKOUT output signal**

## 9. Internal circuitry




Pin numbers shown for HSVON10 package.

**Fig 5. Device diode protection diagram**

## 10. Limiting values

**Table 4. Limiting values**

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

| Symbol | Parameter | Conditions | | Min | Max | Unit |
|---|---|---|---|---|---|---|
| $V_{DD}$ | supply voltage | | | –0.5 | +6.5 | V |
| $I_{DD}$ | supply current | | | –50 | +50 | mA |
| $V_I$ | input voltage | | | –0.5 | +6.5 | V |
| $V_O$ | output voltage | | | –0.5 | +6.5 | V |
| $I_I$ | input current | at any input | | –10 | +10 | mA |
| $I_O$ | output current | at any output | | –10 | +10 | mA |
| $P_{tot}$ | total power dissipation | | | - | 300 | mW |
| $T_{stg}$ | storage temperature | | | –65 | +150 | °C |
| $V_{esd}$ | electrostatic discharge voltage | HBM | [1] | - | ±2000 | V |
| | | MM | [2] | - | ±200 | V |
| | | CDM | [3] | - | ±2000 | V |
| $I_{lu}$ | latch-up current | | [4] | - | 100 | mA |

[1] Human Body Model (HBM) according to JESD22-A114.

[2] Machine Model (MM) according to JESD22-A115.

[3] Charged-Device Model (CDM) according to JESD22-C101.

[4] Latch-up testing according to JESD78.

## 11. Static characteristics

**Table 5. Static characteristics**

*$V_{DD}$ = 1.5 V to 5.5 V; $V_{SS}$ = 0 V; $T_{amb}$ = −40 °C to +85 °C; $f_{osc}$ = 32.768 kHz; quartz $R_s$ = 40 kΩ; $C_L$ = 8 pF; unless otherwise specified.*

| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| **Supply** | | | | | | | |
| $V_{DD}$ | supply voltage | | [1] | 1.5 | - | 5.5 | V |
| $I_{DD}$ | supply current | clock output disabled | | | | | |
| | | $T_{amb}$ = 25 °C | | | | | |
| | | $V_{DD}$ = 5.0 V | | - | 300 | 550 | nA |
| | | $V_{DD}$ = 3.0 V | | - | 235 | 500 | nA |
| | | $V_{DD}$ = 2.0 V | | - | 210 | 450 | nA |
| | | $T_{amb}$ = −40 °C to +85 °C | | | | | |
| | | $V_{DD}$ = 5.0 V | | - | 345 | 750 | nA |
| | | $V_{DD}$ = 3.0 V | | - | 265 | 650 | nA |
| | | $V_{DD}$ = 2.0 V | | - | 230 | 600 | nA |
| | | clock output enabled at 32 kHz | [2] | | | | |
| | | $T_{amb}$ = 25 °C | | | | | |
| | | $V_{DD}$ = 5.0 V | | - | 1310 | 1700 | nA |
| | | $V_{DD}$ = 3.0 V | | - | 845 | 1100 | nA |
| | | $V_{DD}$ = 2.0 V | | - | 615 | 900 | nA |
| | | $T_{amb}$ = −40 °C to +85 °C | | | | | |
| | | $V_{DD}$ = 5.0 V | | - | 1385 | 1700 | nA |
| | | $V_{DD}$ = 3.0 V | | - | 875 | 1100 | nA |
| | | $V_{DD}$ = 2.0 V | | - | 635 | 900 | nA |
| **Inputs** | | | | | | | |
| Pin OSCI | | | | | | | |
| $V_I$ | input voltage | | | −0.5 | - | $V_{DD}$ + 0.5 | V |
| Pin CLKOE | | | | | | | |
| $V_I$ | input voltage | | | −0.5 | - | $V_{DD}$ + 0.5 | V |
| $V_{IL}$ | LOW-level input voltage | | | - | - | $0.3V_{DD}$ | V |
| $V_{IH}$ | HIGH-level input voltage | | | $0.7V_{DD}$ | - | - | V |
| $I_{LI}$ | input leakage current | $V_I$ = $V_{DD}$ or $V_{SS}$ | | −1 | 0 | +1 | µA |
| **Outputs** | | | | | | | |
| Pin OSCO | | | | | | | |
| $V_O$ | | | | −0.5 | - | $V_{DD}$ + 0.5 | V |
| Pin CLKOUT | | | | | | | |
| $V_O$ | output voltage | | | −0.5 | - | $V_{DD}$ + 0.5 | V |
| $I_{OL}$ | LOW-level output current | $V_{OL}$ = 0.4 V; $V_{DD}$ = 5 V | | −1 | - | - | mA |
| $I_{OH}$ | HIGH-level output current | $V_{OH}$ = 4.6 V; $V_{DD}$ = 5 V | | - | - | 1 | mA |
| $I_{LO}$ | output leakage current | $V_O$ = $V_{DD}$ or $V_{SS}$ | | −1 | 0 | +1 | µA |

[1] For reliable oscillator start-up at power-up: $V_{DD} > V_{DD(min)} + 0.3$ V.

[2] Pin CLKOUT is loaded with a 7.5 pF capacitor.

When pin CLKOUT is enabled the current consumption is a function of the load on that pin, the output frequency and the supply voltage. The additional current consumption for a given load can be calculated from the formula $I_{DD} = C_{CLKOUT} \times V_{DD} \times f_{CLKOUT}$

Where:

$I_{DD}$ = supply current

$C_{CLKOUT}$ = capacitance on pin CLKOUT

$V_{DD}$ = supply voltage

$f_{CLKOUT}$ = output frequency on pin CLKOUT

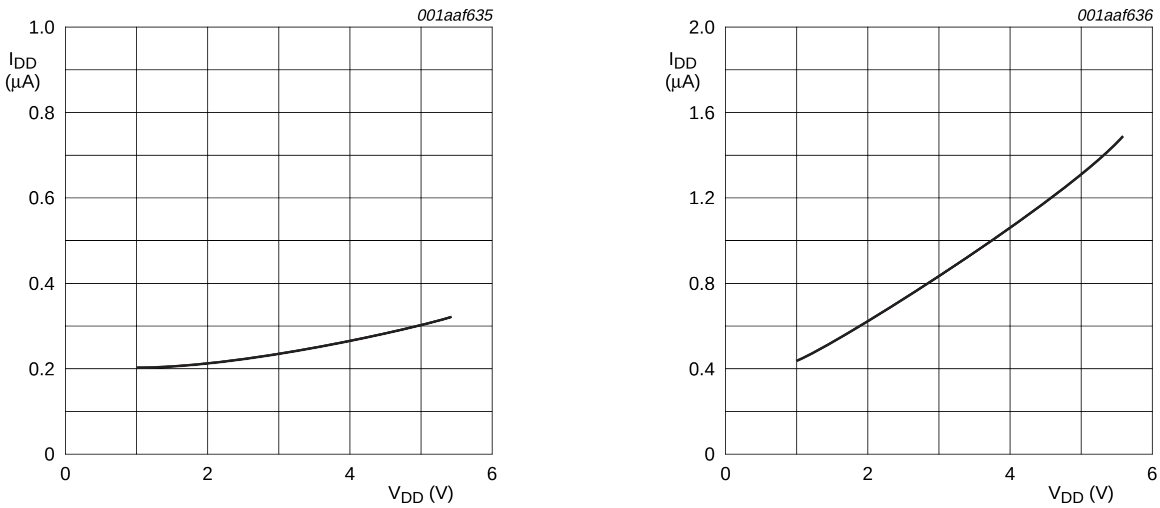
## 12. Dynamic characteristics

**Table 6. Dynamic characteristics**

*$V_{DD}$ = 1.5 V to 5.5 V; $V_{SS}$ = 0 V; $T_{amb}$ = −40 °C to +85 °C; $f_{osc}$ = 32.768 kHz; quartz $R_s$ = 40 kΩ and $C_L$ = 8 pF; unless otherwise specified.*

| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| **Oscillator** | | | | | | | |
| $C_{L(itg)}$ | integrated load capacitance | | [1] | 6 | 8 | 10 | pF |
| $\Delta f_{osc}/f_{osc}$ | relative oscillator frequency variation | $\Delta V_{DD}$ = 200 mV; $T_{amb}$ = 25 °C | | - | 0.2 | - | ppm |

[1] $C_{L(itg)}$ is the combined equivalent integrated oscillator input and output capacitances.



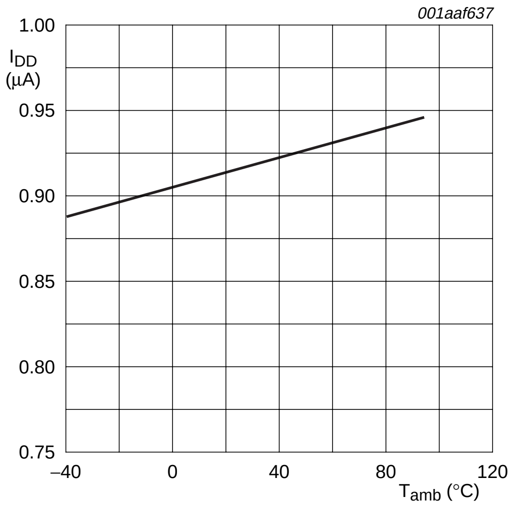

a. CLKOUT disabled

$T_{amb}$ = 25 °C.

b. CLKOUT enabled at 32 kHz

$T_{amb}$ = 25 °C.

**Fig 6. Supply current as a function of supply voltage**

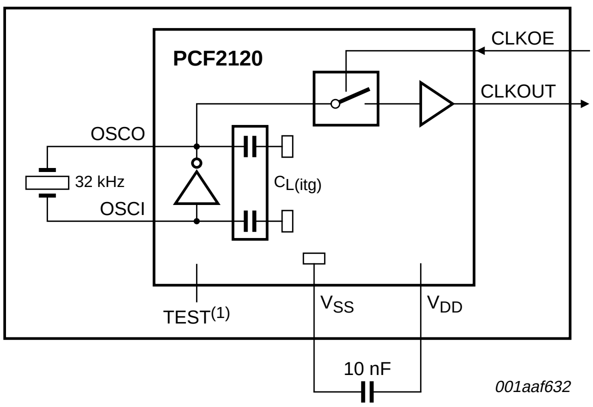



$V_{DD}$ = 3 V; CLKOUT enabled at 32 kHz

**Fig 7. Supply current as a function of ambient temperature**

## 13. Application information

You can mount the PCF2120 oscillator together with the quartz crystal as an accurate and pre-tuned quartz oscillator in one package.

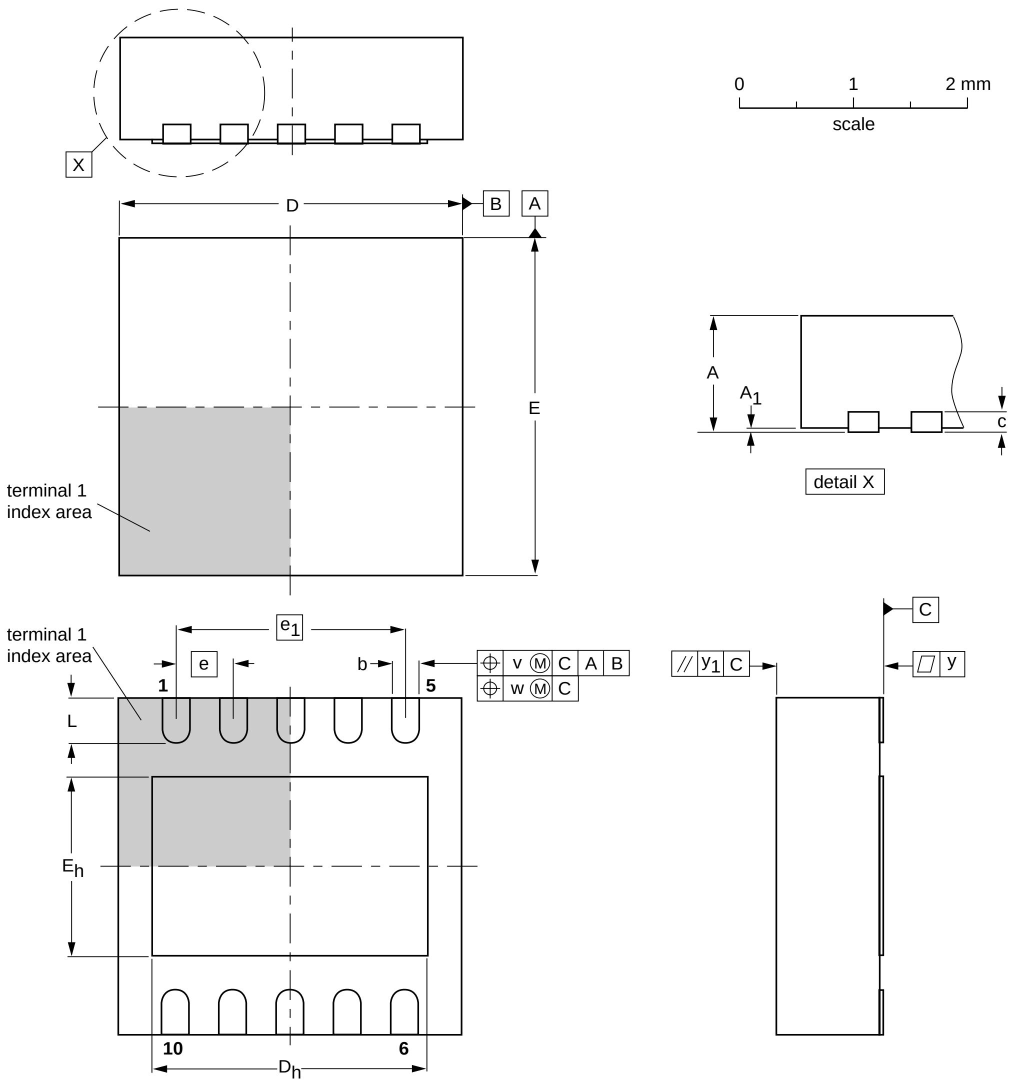



(1) Do not connect pin TEST; it is chip-internally connected.

**Fig 8. Application diagram**

# 14. Package outline

**HVSON10: plastic thermal enhanced very thin small outline package; no leads; 10 terminals; body 3 x 3 x 0.85 mm** **SOT650-1**




**DIMENSIONS (mm are the original dimensions)**

| UNIT | $A^{(1)}$ max. | $A_1$ | b | c | $D^{(1)}$ | $D_h$ | $E^{(1)}$ | $E_h$ | e | $e_1$ | L | v | w | y | $y_1$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 1 | 0.05<br>0.00 | 0.30<br>0.18 | 0.2 | 3.1<br>2.9 | 2.55<br>2.15 | 3.1<br>2.9 | 1.75<br>1.45 | 0.5 | 2 | 0.55<br>0.30 | 0.1 | 0.05 | 0.05 | 0.1 |

**Note**

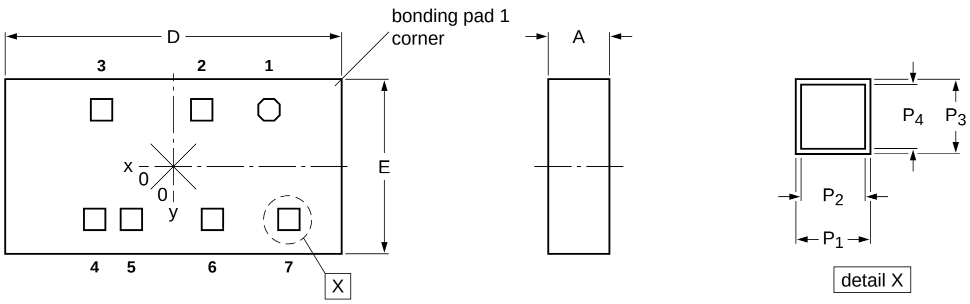
1. Plastic or metal protrusions of 0.075 mm maximum per side are not included.

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| SOT650-1 | - - - | MO-229 | - - - | | | ~~01-01-22~~<br>02-02-08 |

**Fig 9. Package outline SOT650-1 (HVSON10)**

## 15. Bare die outline

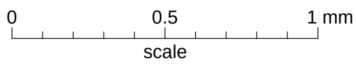
**Wire bond die; 7 bonding pads; 0.57 x 1.1 x 0.2 mm** **PCF2120U**




**DIMENSIONS (mm are the original dimensions)**

| UNIT | A | D | E | $P_1$ | $P_2$ | $P_3$ | $P_4$ |
|---|---|---|---|---|---|---|---|
| mm | 0.212<br>0.188 | 1.1 | 0.57 | 0.07 | 0.06 | 0.07 | 0.06 |

$P_1$ and $P_3$: pad size
$P_2$ and $P_4$: passivation opening




| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| PCF2120U | | | | | | ~~07-12-07~~<br>08-02-01 |

**Fig 10. Bare die outline PCF2120U**

**Table 7. Bonding pad coordinates**

*Values x and y in µm.*

| Pad | x | y |
|---|---|---|
| 1 | +313 | +187 |
| 2 | +93 | +187 |
| 3 | –236 | +187 |
| 4 | –259 | –172 |
| 5 | –137 | –172 |
| 6 | +127 | –172 |
| 7 | +380 | –172 |

## 16. Soldering of SMD packages

This text provides a very brief insight into a complex technology. A more in-depth account of soldering ICs can be found in Application Note *AN10365 "Surface mount reflow soldering description"*.

## 16.1 Introduction to soldering

Soldering is one of the most common methods through which packages are attached to Printed Circuit Boards (PCBs), to form electrical circuits. The soldered joint provides both the mechanical and the electrical connection. There is no single soldering method that is ideal for all IC packages. Wave soldering is often preferred when through-hole and Surface Mount Devices (SMDs) are mixed on one printed wiring board; however, it is not suitable for fine pitch SMDs. Reflow soldering is ideal for the small pitches and high densities that come with increased miniaturization.

## 16.2 Wave and reflow soldering

Wave soldering is a joining technology in which the joints are made by solder coming from a standing wave of liquid solder. The wave soldering process is suitable for the following:

- Through-hole components
- Leaded or leadless SMDs, which are glued to the surface of the printed circuit board

Not all SMDs can be wave soldered. Packages with solder balls, and some leadless packages which have solder lands underneath the body, cannot be wave soldered. Also, leaded SMDs with leads having a pitch smaller than ~0.6 mm cannot be wave soldered, due to an increased probability of bridging.

The reflow soldering process involves applying solder paste to a board, followed by component placement and exposure to a temperature profile. Leaded packages, packages with solder balls, and leadless packages are all reflow solderable.

Key characteristics in both wave and reflow soldering are:

- Board specifications, including the board finish, solder masks and vias
- Package footprints, including solder thieves and orientation
- The moisture sensitivity level of the packages
- Package placement
- Inspection and repair
- Lead-free soldering versus SnPb soldering

## 16.3 Wave soldering

Key characteristics in wave soldering are:

- Process issues, such as application of adhesive and flux, clinching of leads, board transport, the solder wave parameters, and the time during which components are exposed to the wave
- Solder bath specifications, including temperature and impurities

## 16.4 Reflow soldering

Key characteristics in reflow soldering are:

- Lead-free versus SnPb soldering; note that a lead-free reflow process usually leads to higher minimum peak temperatures (see Figure 11) than a SnPb process, thus reducing the process window

- Solder paste printing issues including smearing, release, and adjusting the process window for a mix of large and small components on one board
- Reflow temperature profile; this profile includes preheat, reflow (in which the board is heated to the peak temperature) and cooling down. It is imperative that the peak temperature is high enough for the solder to make reliable solder joints (a solder paste characteristic). In addition, the peak temperature must be low enough that the packages and/or boards are not damaged. The peak temperature of the package depends on package thickness and volume and is classified in accordance with Table 8 and 9

**Table 8. SnPb eutectic process (from J-STD-020C)**

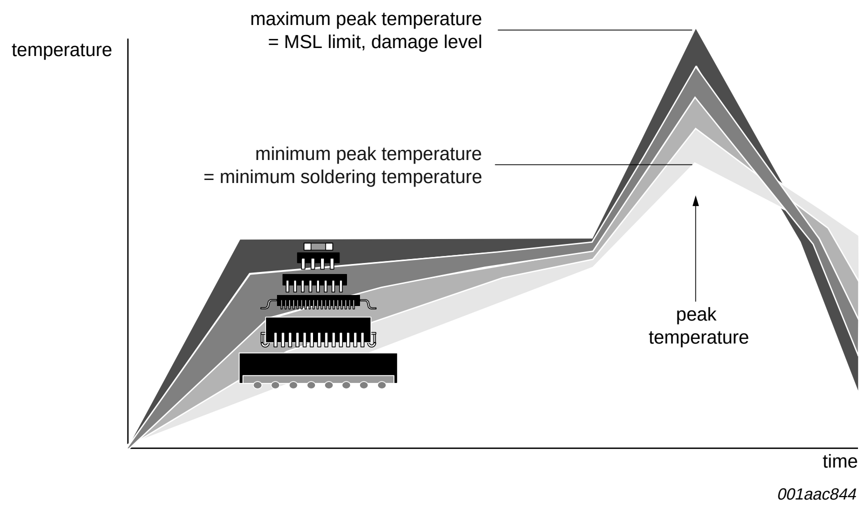
| Package thickness (mm) | Package reflow temperature (°C) | |
|---|---|---|
| | Volume (mm³) | |
| | < 350 | ≥ 350 |
| < 2.5 | 235 | 220 |
| ≥ 2.5 | 220 | 220 |

**Table 9. Lead-free process (from J-STD-020C)**

| Package thickness (mm) | Package reflow temperature (°C) | | |
|---|---|---|---|
| | Volume (mm³) | | |
| | < 350 | 350 to 2000 | > 2000 |
| < 1.6 | 260 | 260 | 260 |
| 1.6 to 2.5 | 260 | 250 | 245 |
| > 2.5 | 250 | 245 | 245 |

Moisture sensitivity precautions, as indicated on the packing, must be respected at all times.

Studies have shown that small packages reach higher temperatures during reflow soldering, see Figure 11.




MSL: Moisture Sensitivity Level

**Fig 11. Temperature profiles for large and small components**

For further information on temperature profiles, refer to Application Note *AN10365 "Surface mount reflow soldering description"*.

## 17. Revision history

**Table 10. Revision history**

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|---|---|---|---|---|
| PCF2120_1 | 20080205 | Product data sheet | - | - |

# 18. Legal information

## 18.1 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".

[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL http://www.nxp.com.

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## 20. Contents





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