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LD6806 series

Ultra low-dropout regulator, low noise, 200 mA

Rev. 3 — 9 December 2011 Product data sheet

1. Product profile

1.1 General description

The LD6806 series is a small-size Low-DropOut regulator (LDO) family with a typical voltage drop of 60 mV at 200 mA current rating.

The device is available in three different surface-mounted packages, one 0.4 mm pitch CSP, one leadless plastic package SOT886 and one gull wing package SOT753.

The operating voltage ranges from 2.3 V to 5.5 V and the output voltage ranges from 1.2 V to 3.6 V.

LD6806x/xxH devices show a high-ohmic state at the output pin, while the LD6806x/xxP contains a pull-down switching transistor, to provide a low-ohmic output stage when the device is disabled. All devices use the same regulator design and are manufactured in monolithic silicon technology.

These features make the LD6806 series ideal for use in applications requiring component miniaturization, such as mobile phone handsets, cordless telephones and personal digital devices.

1.2 Features and benefits

- Input voltage range 2.3 V to 5.5 V
- Output voltage range 1.2 V to 3.6 V
- Dropout voltage 60 mV at 200 mA output rating
- Low quiescent current in shutdown mode (typical 1.0 μA)
- 30 μV RMS output noise voltage (typical value) at 10 Hz to 100 kHz
- Turn-on time just 200 μs
- 55 dB Power Supply Rejection Ratio (PSRR) at 1 kHz
- Temperature watchdog
- Current limiter
- LD6806xxxH: high-ohmic (3-state) output state when disabled
- LD6806xxxP: low-ohmic output state when disabled
- Integrated ESD protection of 10 kV Human Body Model
- WLCSP with 0.4 mm pitch and package size of 0.76 mm × 0.76 mm × 0.47 mm
- SOT886 leadless package 1.0 mm × 1.45 mm × 0.5 mm
- SOT753 plastic surface-mounted device
- Pb-free, RoHS compliant and free of Halogen and Antimony (dark green compliant)

1.3 Applications

- Analog and digital interfaces requiring lower than standard supply voltage in mobile appliances such as mobile phones, media players and so on.

2. Pinning information

2.1 Pinning

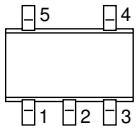
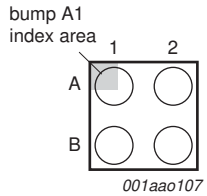
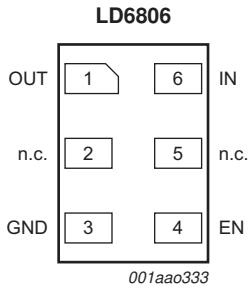


Fig 1. Configuration for SOT753



transparent top view,
solder balls facing down

Fig 2. Configuration for WLCSP4



Transparent top view

Fig 3. Configuration for SOT886

2.2 Pin description

Table 1. Pin description for SOT753

Symbol	Pin	Description
IN	1	supply voltage input
GND	2	supply ground
EN	3	device enable input; active HIGH
n.c.	4	not connected
OUT	5	regulator output voltage

Table 2. Pin description for WLCSP4

Symbol	Pin	Description
GND	A1	supply ground
EN	A2	device enable input; active HIGH
OUT	B1	regulator output voltage
IN	B2	supply voltage input

Table 3. Pin description for SOT886

Symbol	Pin	Description
OUT	1	regulator output voltage
n.c.	2	not connected
GND	3	supply ground

Table 3. Pin description for SOT886

Symbol	Pin	Description
EN	4	device enable input; active HIGH
n.c.	5	not connected
IN	6	supply voltage input

3. Ordering information

Table 4. Ordering information

Type number	Package		
	Name	Description	Version
LD6806CX4/xxx	WLCSP4	wafer level chip-size package; 4 bumps (2 × 2)[1]	-
LD6806CX4/C/xxx	WLCSP4	wafer level chip-size package; 4 bumps (2 × 2) with backside coating[1]	-
LD6806F/xxx	XSON6	plastic extremely thin small outline package; no leads; 6 terminals; body 1 × 1.45 × 0.5 mm	SOT886
LD6806TD/xxx	TSOP5	plastic surface-mounted package; 5 leads	SOT753

[1] Size 0.76 mm × 0.76 mm.

3.1 Ordering options

Further information on output voltage is available on request; see Section 21 “Contact information”.

Table 5. Type number and nominal output voltage of high-ohmic output

Type number	Nominal output voltage	Type number	Nominal output voltage
LD6806[CX4, CX4/C, F, TD]/12H	1.2 V	LD6806[CX4, CX4/C, F, TD]/23H	2.3 V
LD6806[CX4, CX4/C, F, TD]/13H	1.3 V	LD6806[CX4, CX4/C, F, TD]/25H	2.5 V
LD6806[CX4, CX4/C, F, TD]/14H	1.4 V	LD6806[CX4, CX4/C, F, TD]/28H	2.8 V
LD6806[CX4, CX4/C, F, TD]/16H	1.6 V	LD6806[CX4, CX4/C, F, TD]/29H	2.9 V
LD6806[CX4, CX4/C, F, TD]/18H	1.8 V	LD6806[CX4, CX4/C, F, TD]/30H	3.0 V
LD6806[CX4, CX4/C, F, TD]/20H	2.0 V	LD6806[CX4, CX4/C, F, TD]/33H	3.3 V
LD6806[CX4, CX4/C, F, TD]/22H	2.2 V	LD6806[CX4, CX4/C, F, TD]/36H	3.6 V

Table 6. Type number and nominal output voltage of low.ohmic output

Type number	Nominal output voltage	Type number	Nominal output voltage
LD6806[CX4, CX4/C, F, TD]/12P	1.2 V	LD6806[CX4, CX4/C, F, TD]/23P	2.3 V
LD6806[CX4, CX4/C, F, TD]/13P	1.3 V	LD6806[CX4, CX4/C, F, TD]/25P	2.5 V
LD6806[CX4, CX4/C, F, TD]/14P	1.4 V	LD6806[CX4, CX4/C, F, TD]/28P	2.8 V
LD6806[CX4, CX4/C, F, TD]/16P	1.6 V	LD6806[CX4, CX4/C, F, TD]/29P	2.9 V

Table 6. Type number and nominal output voltage of low.ohmic output *…continued*

Type number	Nominal output voltage	Type number	Nominal output voltage
LD6806[CX4, CX4/C, F, TD]/18P	1.8 V	LD6806[CX4, CX4/C, F, TD]/30P	3.0 V
LD6806[CX4, CX4/C, F, TD]/20P	2.0 V	LD6806[CX4, CX4/C, F, TD]/33P	3.3 V
LD6806[CX4, CX4/C, F, TD]/22P	2.2 V	LD6806[CX4, CX4/C, F, TD]/36P	3.6 V

4. Block diagram

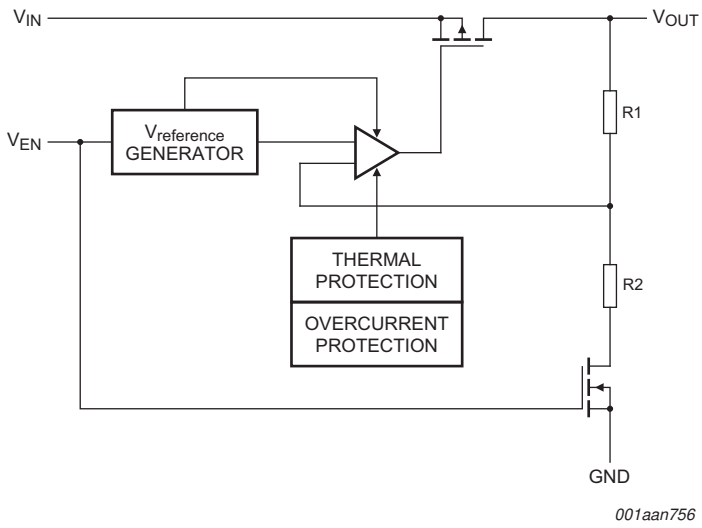


Fig 4. Block diagram of LD6806x/xxH

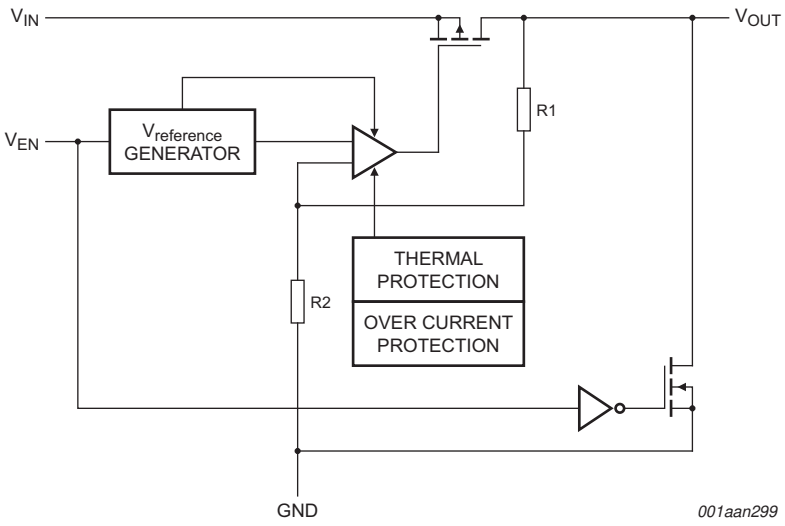


Fig 5. Block diagram of LD6806x/xxP

5. Limiting values

Table 7. Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134). Voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions		Min	Max	Unit
V_{IN}	voltage on pin IN	4 ms transient		−0.5	+6.0	V
P_{tot}	total power dissipation	LD6806CX4/xxx, LD6806CX4/Cxxx	[1]	-	770	mW
		LD6806F/xxx	[1]	-	450	mW
		LD6806TD/xxx	[1]	-	800	mW
T_{stg}	storage temperature			−55	+150	°C
T_j	junction temperature			−40	+125	°C
T_{amb}	ambient temperature			−40	+85	°C
V_{ESD}	electrostatic discharge voltage	human body model level 6	[2]		±10	kV
		machine model class 3	[3]	-	±400	V

[1] The (absolute) maximum power dissipation depends on the junction temperature T_j. Higher power dissipation is allowed with lower ambient temperatures. The conditions to determine the specified values are T_{amb} = 25 °C and the use of a two layer PCB.

[2] According to IEC 61340-3-1.

[3] According to JESD22-A115C.

6. Recommended operating conditions

Table 8. Operating conditions

Voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions		Min	Max	Unit
T_{amb}	ambient temperature			−40	+85	°C
T_j	junction temperature			-	+125	°C
Pin IN						
V_{IN}	voltage on pin IN			2.3	5.5	V
Pin EN						
V_{EN}	voltage on pin EN			0	V_{IN}	V
Pin OUT						
$C_{L(ext)}$	external load capacitance		[1]	1.0	-	µF

[1] See Section 10.1 “Output capacitor values”.

7. Thermal characteristics

Table 9. Thermal characteristics

Symbol	Parameter	Conditions		Typ	Unit
$R_{th(j-a)}$	thermal resistance from junction to ambient	LD6806CX4/xxx, LD6806CX4/Cxxx	[1][2]	130	K/W
		LD6806F/xxx	[1][2]	220	K/W
		LD6806TD/xxx	[1][2]	125	K/W

[1] The overall $R_{th(j-a)}$ can vary depending on the board layout. To minimize the effective $R_{th(j-a)}$, all pins must have a solid connection to larger Cu layer areas for example to the power and ground layer. In multi-layer PCB applications, the second layer should be used to create a large heat spreader area directly below the LDO. If this layer is either ground or power, it should be connected with several vias to the top layer connecting to the device ground or supply. Avoid the use of solder-stop varnish under the chip.

[2] Use the measurement data given for a rough estimation of the $R_{th(j-a)}$ in your application. The actual $R_{th(j-a)}$ value can vary in applications using different layer stacks and layouts.

8. Characteristics

Table 10. Electrical characteristics

At recommended input voltages and T_{amb} = −40 °C to +85 °C; voltages are referenced to GND (ground = 0 V); unless otherwise specified.

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
ΔV_O	output voltage variation	V_{OUT} < 1.8 V; I_{OUT} = 1 mA					
		T_{amb} = +25 °C		−3	±0.5	+3	%
		−30 °C ≤ T_{amb} ≤ +85 °C		−4	-	+4	%
		V_{OUT} ≥ 1.8 V; I_{OUT} = 1 mA					
		T_{amb} = +25 °C		−2	±0.5	+2	%
		−30 °C ≤ T_{amb} ≤ +85 °C		−3	-	+3	%
Line regulation error							
$\Delta V_O/(V_O x \Delta V_I)$	relative output voltage variation with input voltage	V_{IN} = ($V_{O(nom)}$ + 0.2 V) to 5.5 V	[1]	−0.1	-	+0.1	%/V
Load regulation error							
$\Delta V_O/(V_O x \Delta I_O)$	relative output voltage variation with output current	1 mA ≤ I_{OUT} ≤ 200 mA					
		LD6806CX4/xxx, LD6806CX4/Cxxx		-	0.0025	0.01	%/mA
		LD6806F/xxx, LD6806TD/xxx		-	0.005	0.02	%/mA
V_{do}	dropout voltage	I_{OUT} = 200 mA; V_{IN} > $V_{O(nom)}$	[1]				
		LD6806CX4/xxx, LD6806CX4/Cxxx		-	60	100	mV
		LD6806F/xxx, LD6806TD/xxx		-	80	130	mV
V_{IL}	LOW-level input voltage	pin EN		0	-	0.4	V
V_{IH}	HIGH-level input voltage	pin EN		1.4	-	5.5	V
I_{OUT}	current on pin OUT			-	-	200	mA
I_{OM}	peak output current	V_{IN} = ($V_{O(nom)}$ + 0.2 V) to 5.5 V	[1]				
		$V_{O(nom)}$ > 1.8 V; V_{OUT} = 0.95 × $V_{O(nom)}$		300	-	-	mA
		$V_{O(nom)}$ < 1.8 V; V_{OUT} = 0.9 × $V_{O(nom)}$		300	-	-	mA

Table 10. Electrical characteristics *...continued*

At recommended input voltages and T_{amb} = −40 °C to +85 °C; voltages are referenced to GND (ground = 0 V); unless otherwise specified.

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
I_{sc}	short-circuit current	pin OUT		-	600	-	mA
I_q	quiescent current	V_{EN} = 1.4 V; I_{OUT} = 0 mA		-	70	100	µA
		V_{EN} = 1.4 V; 1 mA ≤ I_{OUT} ≤ 200 mA		-	155	250	µA
		V_{EN} ≤ 0.4 V		-	0.1	1.0	µA
T_{sd}	shutdown temperature			-	160	-	°C
$T_{sd(hys)}$	shutdown temperature hysteresis		[2]	-	20	-	°K
PSRR	power supply rejection ratio	$V_{IN} = V_{O(nom)}$ + 1 V; I_{OUT} = 30 mA; f_{ripple} = 1 kHz	[1]	-	−55	-	dB
$V_{n(o)(RMS)}$	RMS output noise voltage	bandwidth = 10 Hz to 100 kHz; $C_{L(ext)}$ = 1 µF		-	30	-	µV
$t_{startup(reg)}$	regulator start-up time	V_{IN} = 5.5 V; $V_{OUT} = 0.95 \times V_{O(nom)}$; I_{OUT} = 200 mA; $C_{L(ext)}$ = 1 µF	[1]	-	-	200	µs
$t_{sd(reg)}$	regulator shutdown time	V_{IN} = 5.5 V; $C_{L(ext)}$ = 1 µF	[3]	-	300	-	µs
R_{pd}	pull-down resistance		[3]	-	100	-	Ω

[1] $V_{O(nom)}$ = nominal output voltage (device specific).

[2] The junction temperature must decrease by $T_{sd(hys)}$ to enable the device after T_{sd} was reached and the device was disabled.

[3] LD6806x/xxP only.

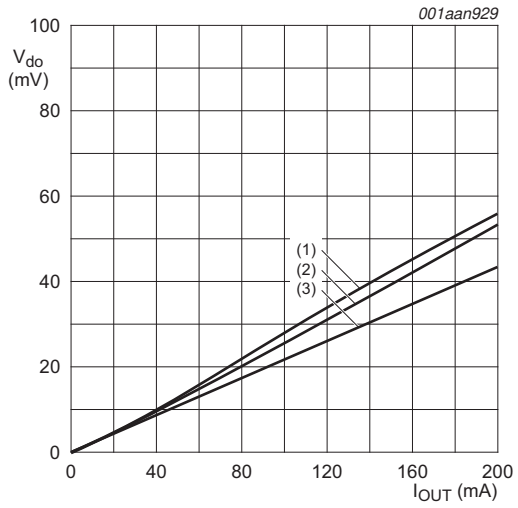
9. Dynamic behavior

All results described in Section 9 are based on measurements of types LD6806CX4xxx and LD6806Fxxx from the LD6806 product series within Section 6 “Recommended operating conditions”.

9.1 Dropout

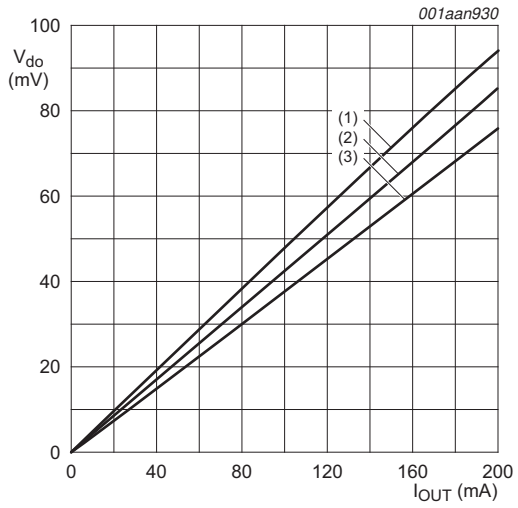
The dropout voltage is defined as the smallest input to output voltage difference at a specified load current when the regulator operates within its linear region with the pass transistor functioning as a plain resistor. This means that the input voltage is below the nominal output voltage value.

A small dropout voltage guaranties lower power consumption and efficiency maximization.



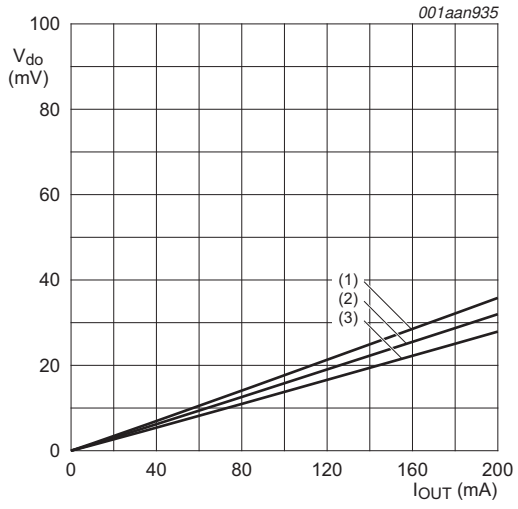
(1) +85 °C
(2) +25 °C
(3) −40 °C

Fig 6. Dropout as a function of temperature for LD6806CX4/25H



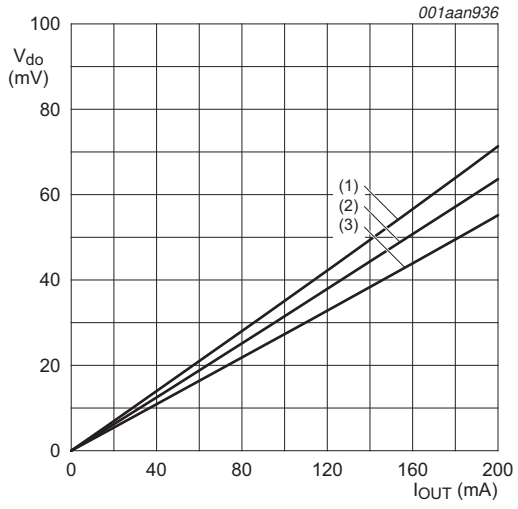
(1) +85 °C
(2) +25 °C
(3) −40 °C

Fig 7. Dropout as a function of temperature for LD6806F/25H



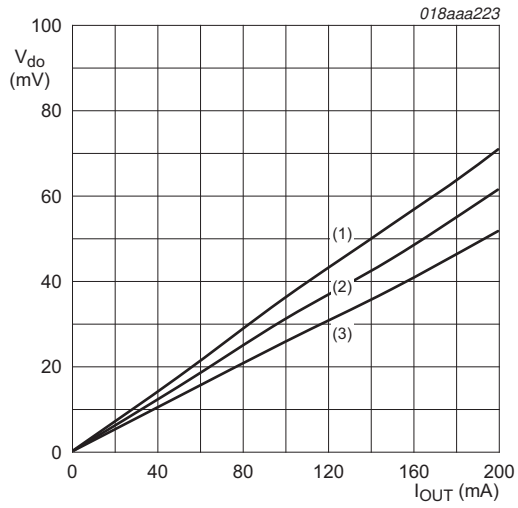
(1) +85 °C
(2) +25 °C
(3) −40 °C

Fig 8. Dropout as a function of temperature for LD6806CX4/36H



(1) +85 °C
(2) +25 °C
(3) −40 °C

Fig 9. Dropout as a function of temperature for LD6806F/36H

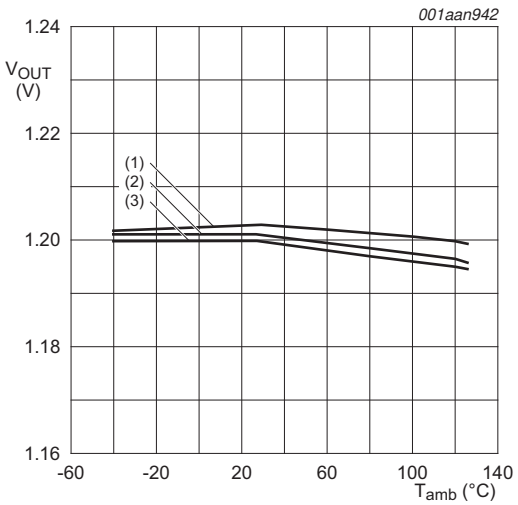


(1) +85 °C
(2) +25 °C
(3) −40 °C

Fig 10. Dropout as a function of temperature for LD6806TD/36P

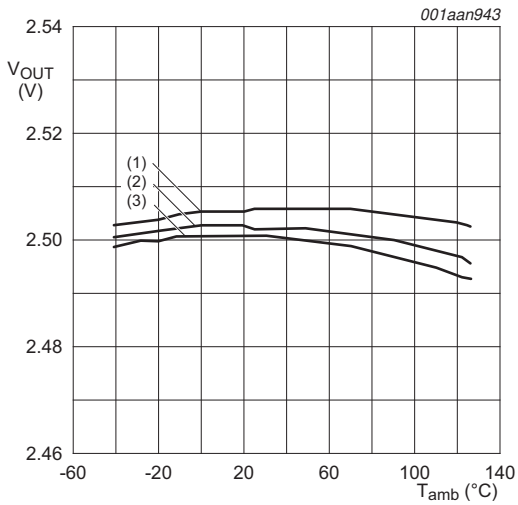
9.2 Output voltage variation

The guaranteed output voltages are specified in Table 10.



(1) I_{OUT} = 1 mA
(2) I_{OUT} = 100 mA
(3) I_{OUT} = 200 mA

Fig 11. Output voltage variation for LD6806CX4/12H

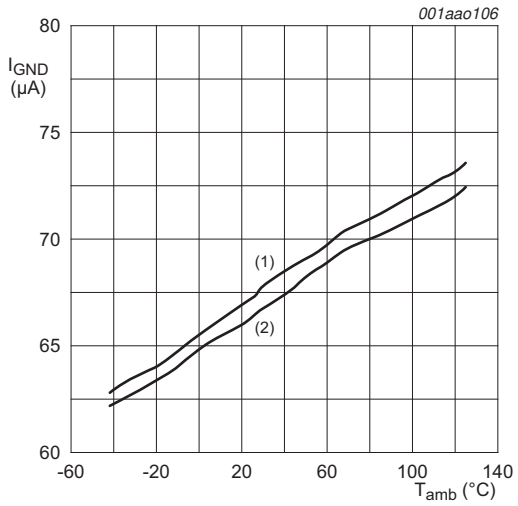


(1) I_{OUT} = 1 mA
(2) I_{OUT} = 100 mA
(3) I_{OUT} = 200 mA

Fig 12. Output voltage variation for LD6806CX4/25H

9.3 Quiescent current

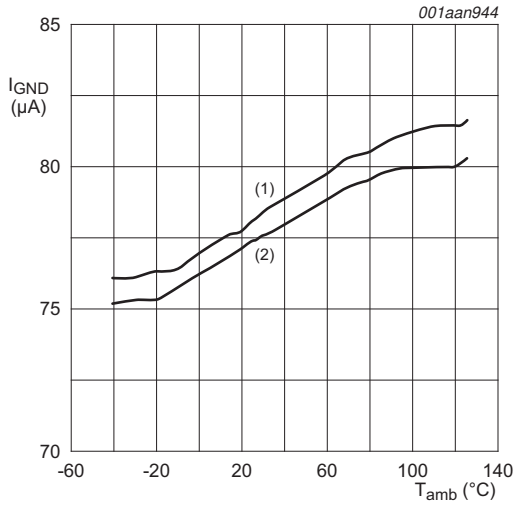
Quiescent or ground current is the difference between the input and the output current of the regulator.



(1) I_{OUT} = 10 mA

(2) I_{OUT} = 0 mA

Fig 13. Quiescent current for LD6806CX4/12H



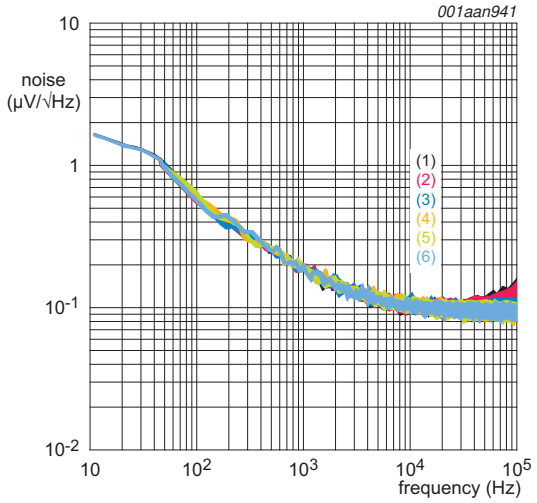
(1) I_{OUT} = 10 mA

(2) I_{OUT} = 0 mA

Fig 14. Quiescent current for LD6806CX4/25H

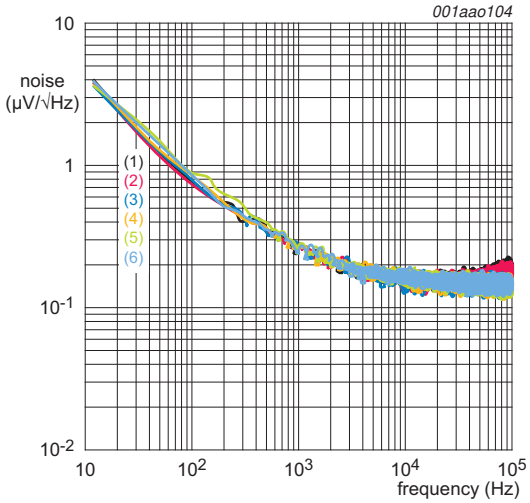
9.4 Noise

Output noise voltage of an LDO circuit is given as noise density or RMS output noise voltage over a defined range of frequencies (10 Hz to 100 kHz). Permanent conditions are a constant output current and a ripple-free input voltage. The output noise voltage is generated by the LDO regulator.



(1) 0 mA
(2) 1 mA
(3) 50 mA
(4) 100 mA
(5) 150 mA
(6) 200 mA

Fig 15. Noise density for LD6806CX4/25H



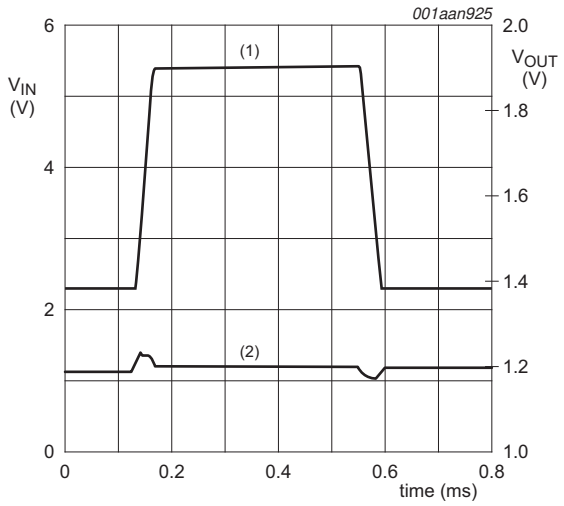
(1) 0 mA
(2) 1 mA
(3) 50 mA
(4) 100 mA
(5) 150 mA
(6) 200 mA

Fig 16. Noise density for LD6806CX4/36H

9.5 Line regulation

Line regulation response is the capability of the circuit to maintain the nominal output voltage while varying the input voltage.

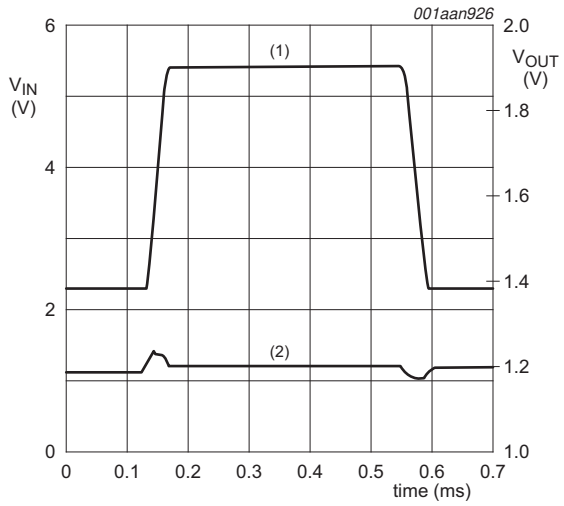
$$Regulation[\%/V] = \frac{\Delta V_{OUT}}{\Delta V_{IN}} \times \frac{100}{V_{OUT}}$$



(1) V_{IN}

(2) V_{OUT}

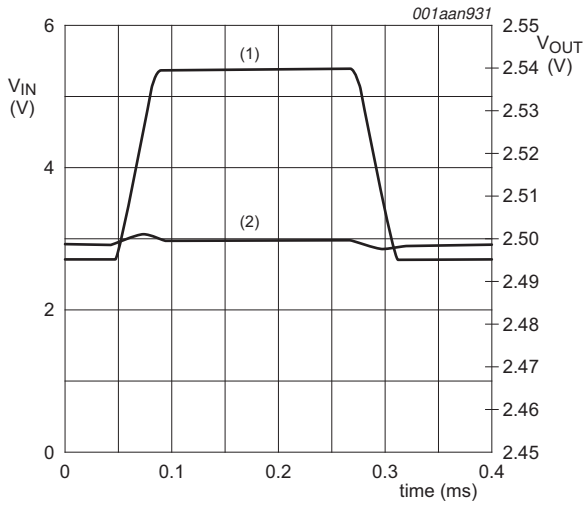
Fig 17. Line regulation for LD6806CX4/12H



(1) V_{IN}

(2) V_{OUT}

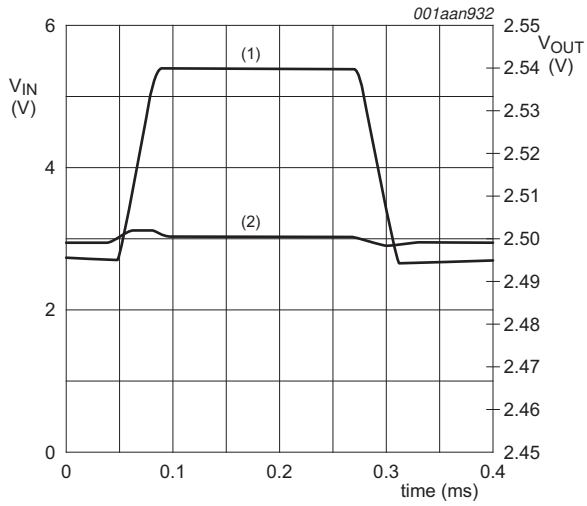
Fig 18. Line regulation for LD6806F/12H



(1) V_{IN}

(2) V_{OUT}

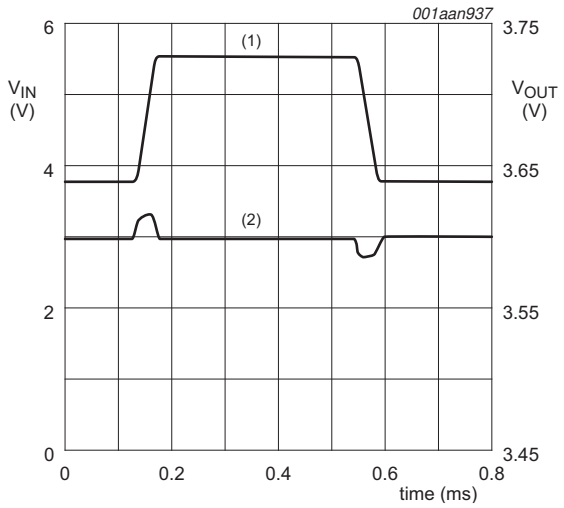
Fig 19. Line regulation for LD6806CX4/25H



(1) V_{IN}

(2) V_{OUT}

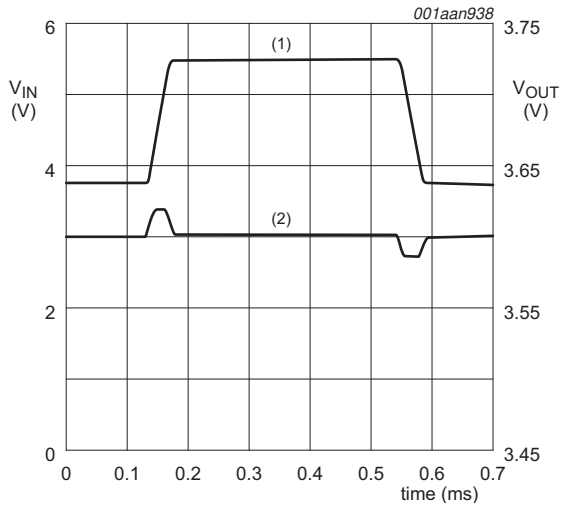
Fig 20. Line regulation for LD6806F/25H



(1) V_{IN}

(2) V_{OUT}

Fig 21. Line regulation for LD6806CX4/36H



(1) V_{IN}

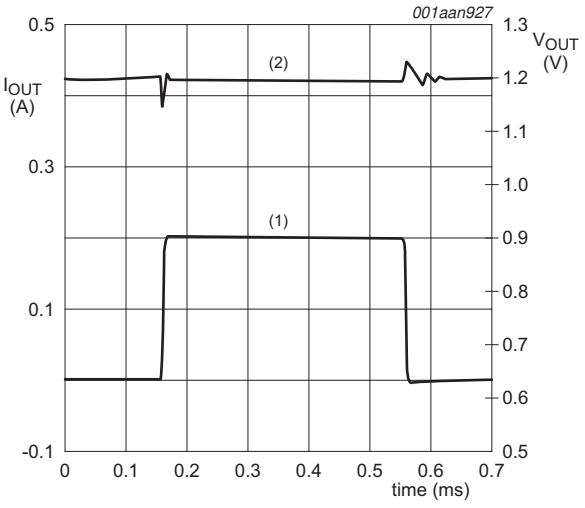
(2) V_{OUT}

Fig 22. Line regulation for LD6806F/36H

9.6 Load regulation

Load regulation is the capability of the circuit to maintain the nominal output voltage while varying the output load current.

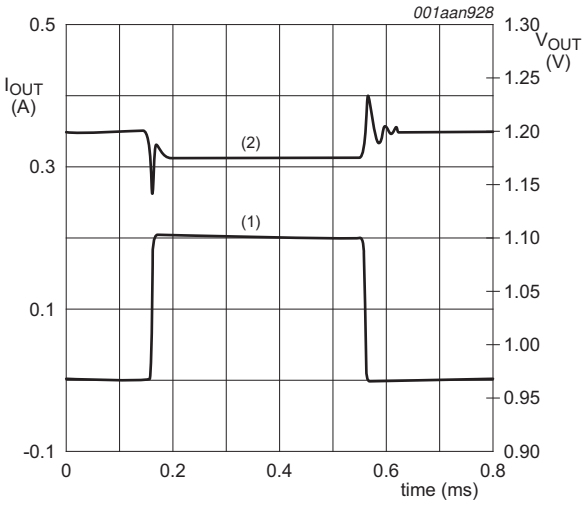
$$Load\ regulation[\%/mA] = \frac{\frac{\Delta V_{OUT}}{V_{O(nom)}} \times 100}{I_{OUT(max)}}$$



(1) I_{OUT}

(2) V_{OUT}

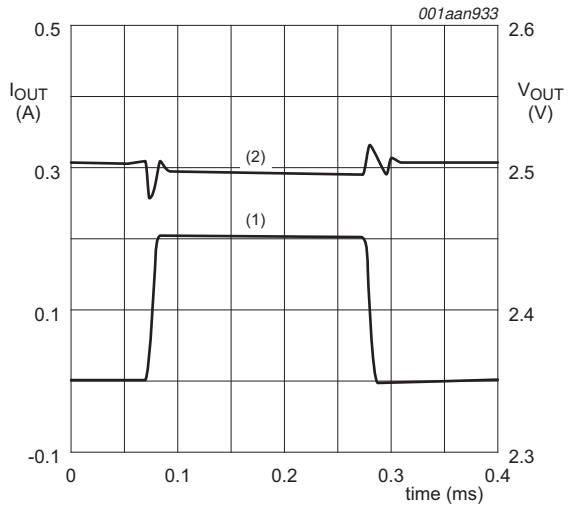
Fig 23. Load regulation for LD6806CX4/12H



(1) I_{OUT}

(2) V_{OUT}

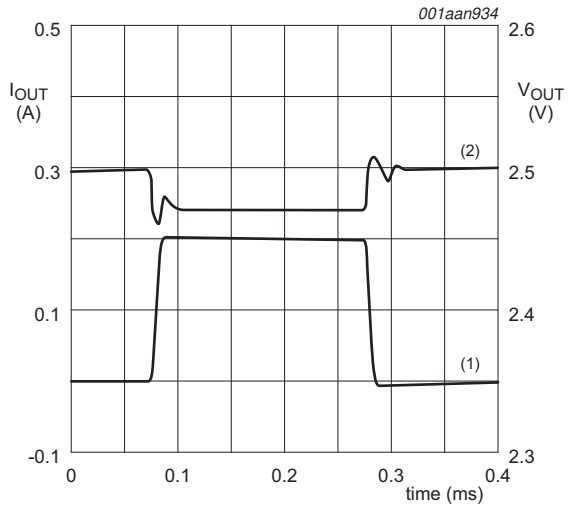
Fig 24. Load regulation for LD6806F/12H



(1) I_{OUT}

(2) V_{OUT}

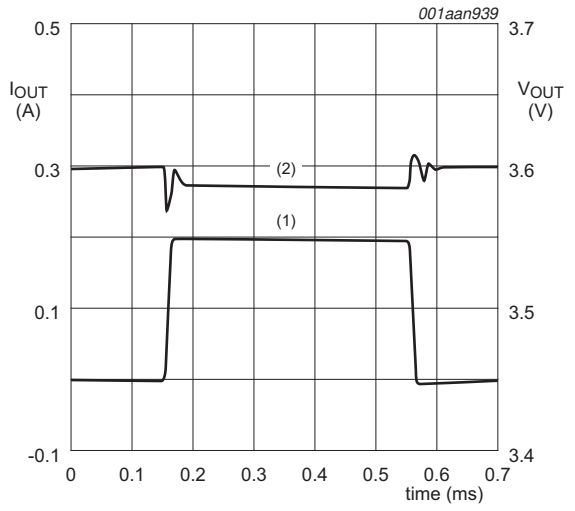
Fig 25. Load regulation for LD6806CX4/25H



(1) I_{OUT}

(2) V_{OUT}

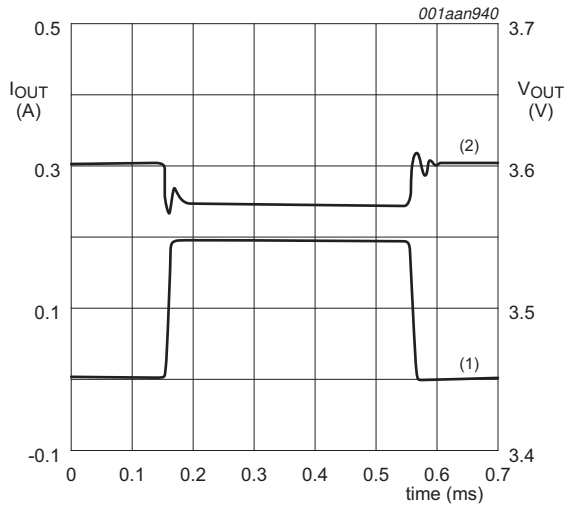
Fig 26. Load regulation for LD6806F/25H



(1) I_{OUT}

(2) V_{OUT}

Fig 27. Load regulation for LD6806CX4/36H



(1) I_{OUT}

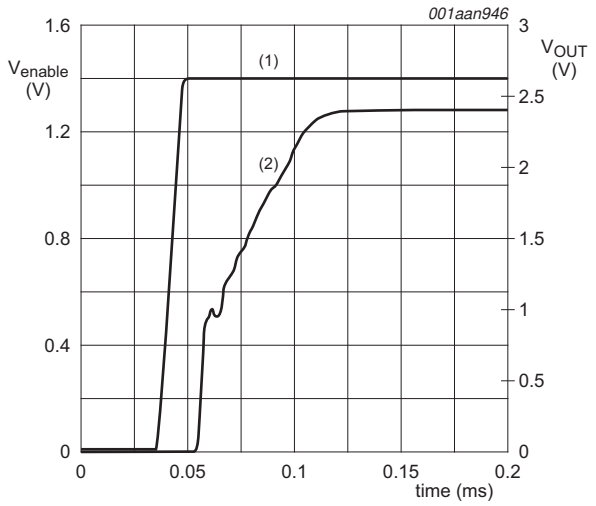
(2) V_{OUT}

Fig 28. Load regulation for LD6806F/36H

9.7 Start-up and shut down

Start-up time defines the time needed for the LDO to achieve 95 % of its typical output voltage level after activation via the enable pin.

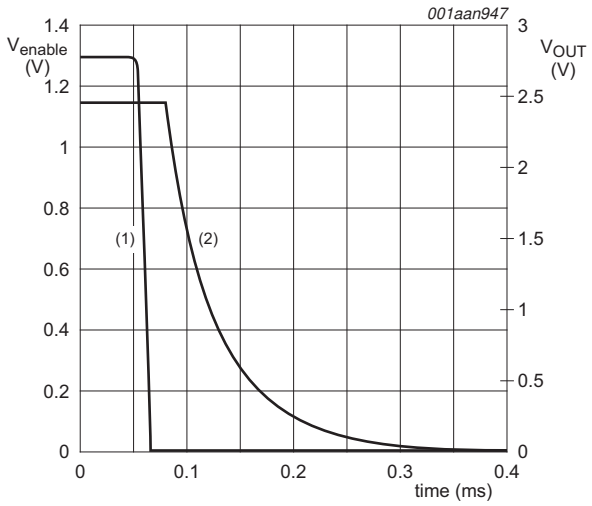
Shut down time defines the time needed for the LDO to pull-down the output voltage to 10% of its nominal output voltage after deactivation via the enable pin.



(1) V_{EN}.

(2) V_{OUT}.

Fig 29. Start-up for LD6806CX4/23H



(1) V_{EN}.

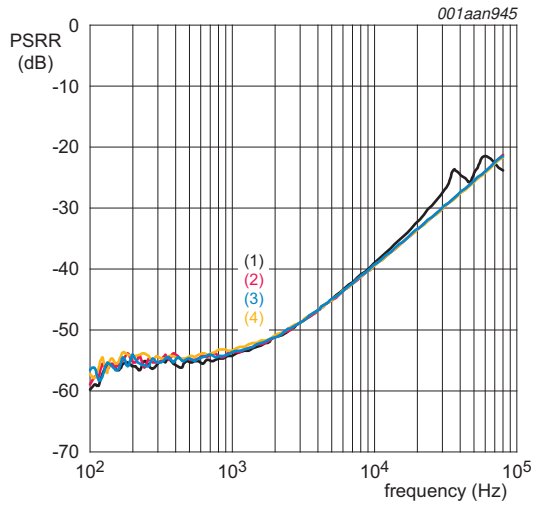
(2) V_{OUT}.

Fig 30. Shut down for LD6806F/25P

9.8 Power Supply Rejection Ratio (PSRR)

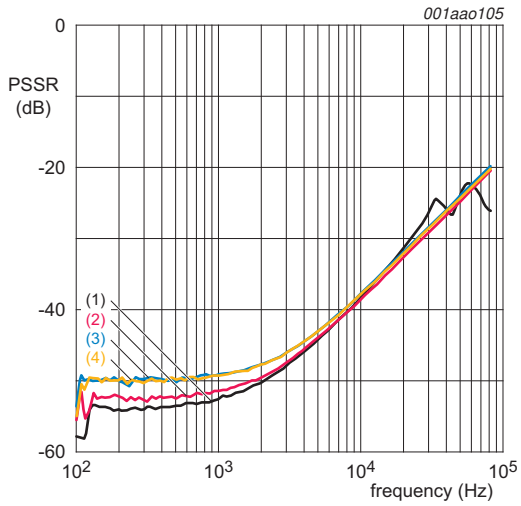
PSRR stands for the capability of the regulator to suppress unwanted signals on the input voltage like noise or ripples.

$$PSRR[dB] = 20log\frac{V_{out(ripple)}}{V_{in(ripple)}}$$ for all frequencies



(1) 1 mA
(2) 50 mA
(3) 100 mA
(4) 200 mA

Fig 31. PSRR for LD6806CX4/25H

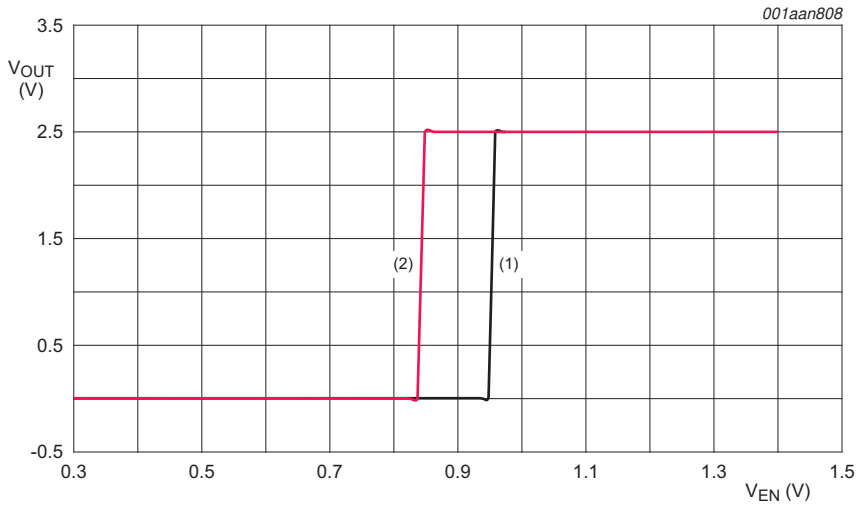


(1) 1 mA
(2) 50 mA
(3) 100 mA
(4) 200 mA

Fig 32. PSRR for LD6806CX4/36H

9.9 Enable threshold voltage

An active HIGH signal enables the LDO when the signal exceeds the minimum input HIGH voltage threshold. The device is in Off state as long the signal is below the maximum LOW threshold. The input voltage threshold is independent from the LDO supply voltage.



(1) LOW to HIGH

(2) HIGH to LOW

Fig 33. Enable threshold voltage

10. Application information

10.1 Output capacitor values

The LD6806 series requires external capacitors at the output to guarantee a stable regulator behavior. Also an input capacitor is recommended to keep the input voltage stable. These capacitors should not under-run the specified minimum Equivalent Series Resistance (ESR).

The absolute value of the total capacitance attached to the output pin OUT influences the shutdown time ($t_{sd(reg)}$) of the LD6806 series.

Table 11. External load capacitor

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
$C_{L(ext)}$	external load capacitance		[1]	-	1.0	-	µF
ESR	equivalent series resistance			5	-	500	mΩ

[1] The minimum value of capacitance for stability and correct operation is 0.7 µF. The capacitor tolerance should be ±30 % or better over the temperature range. The full range of operating conditions for the capacitor in the application should be considered during device selection to ensure that this minimum capacitance specification is met. The recommended capacitor type is X7R to meet the full device temperature specification of −40 °C to +125 °C.

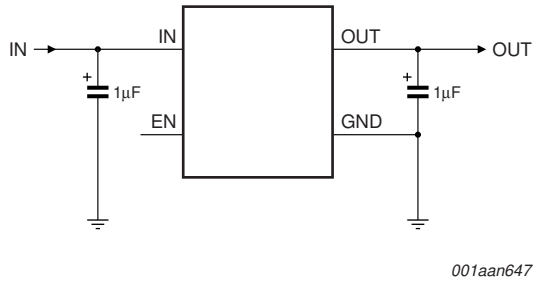


Fig 34. Application diagram

11. Test information

11.1 Quality information

This product has been qualified in accordance with *NX2-00001 NXP Semiconductors Quality and Reliability Specification* and is suitable for use in consumer applications.

12. Package outline

WLCSP4: wafer level chip-size package; 4 bumps (2 x 2)

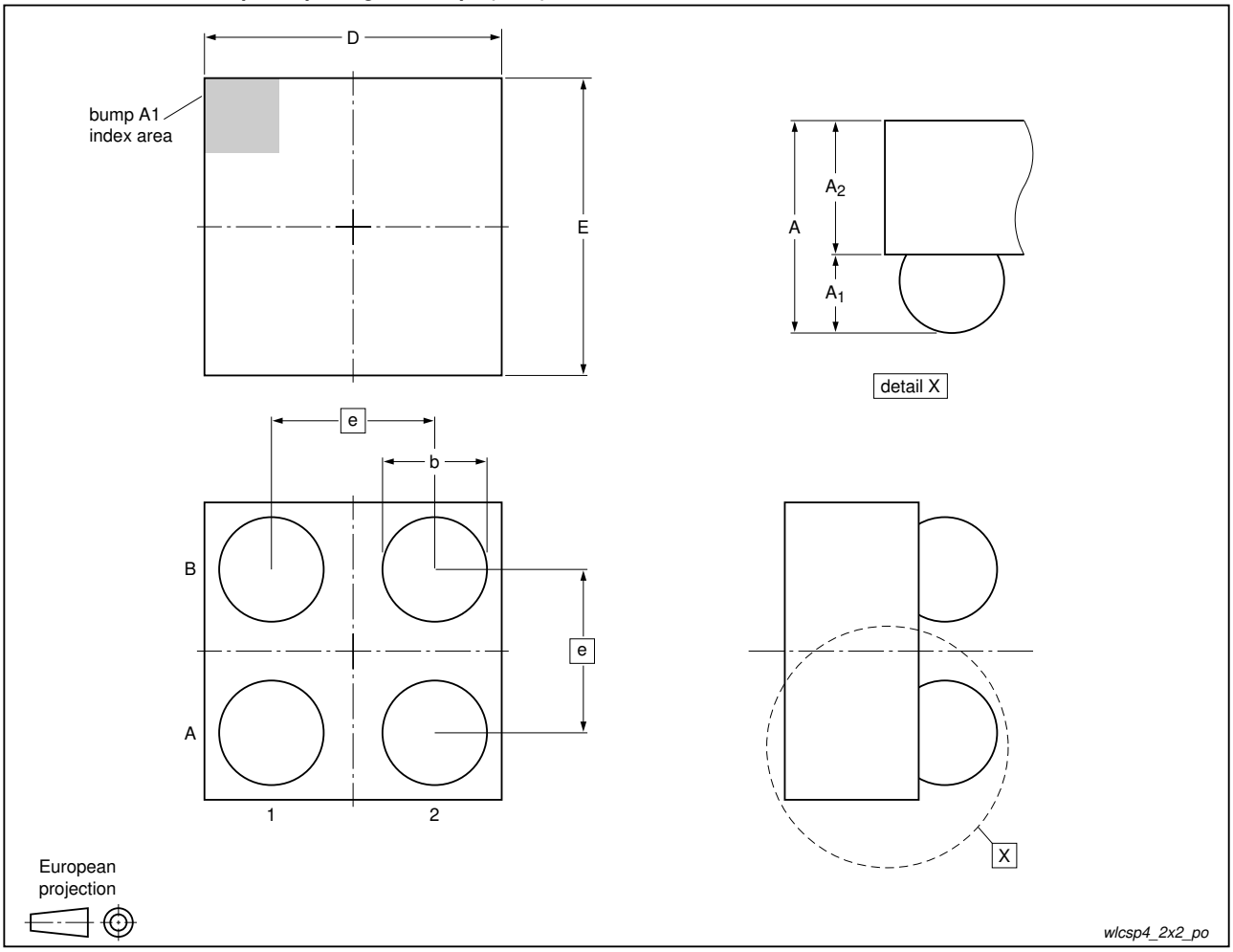


Fig 35. Package outline WLCSP4

Table 12. Dimensions of LD6806CX4/xxx for package outline WLCSP4; see Figure 35

Symbol	Min	Typ	Max	Unit
A	0.44	0.47	0.50	mm
A_1	0.18	0.20	0.22	mm
A_2	0.26	0.27	0.28	mm
b	0.21	0.26	0.31	mm
D	0.71	0.76	0.81	mm
E	0.71	0.76	0.81	mm
e	-	0.4	-	mm

WLCSP4: wafer level chip-size package with backside coating; 4 bumps (2 x 2)

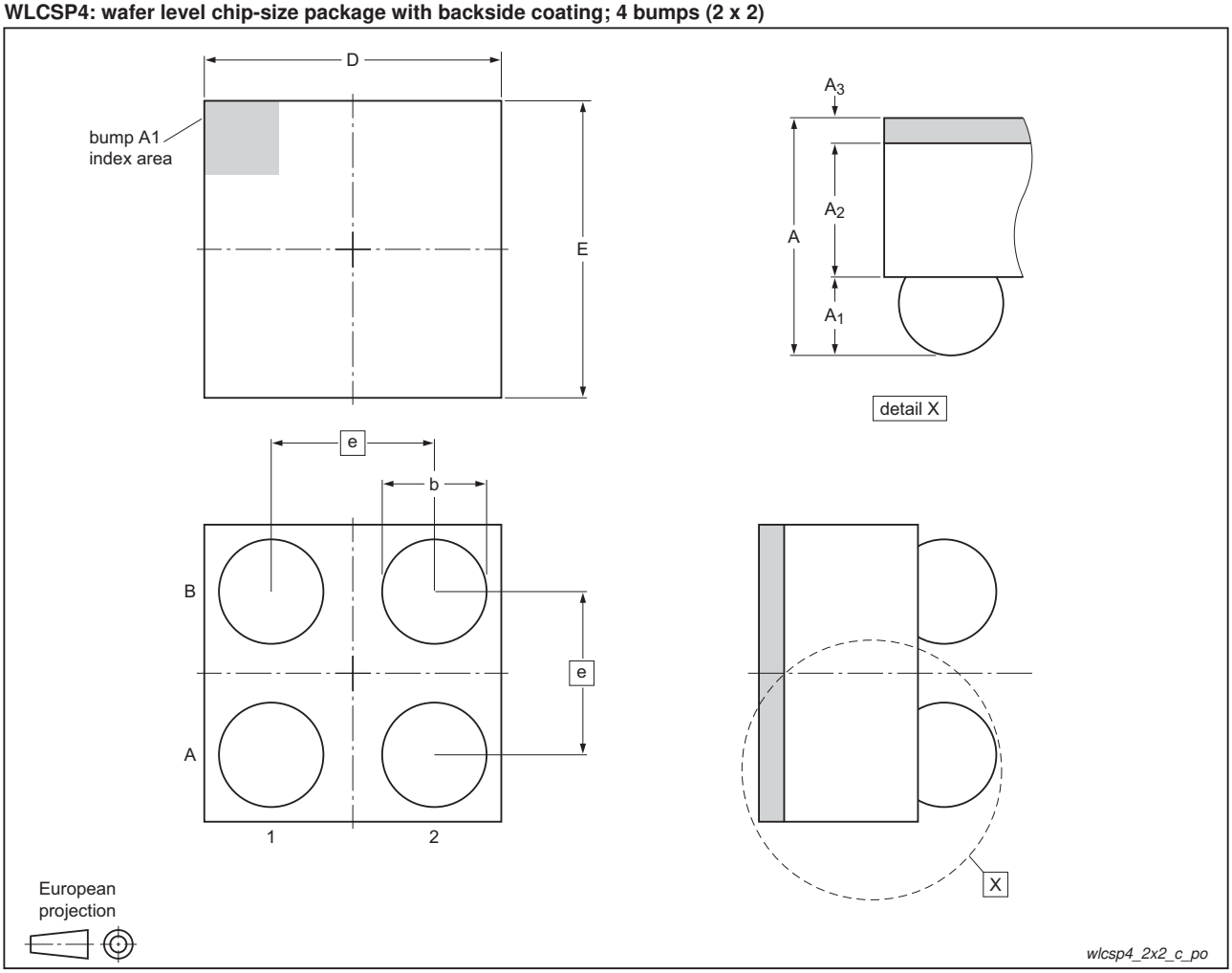
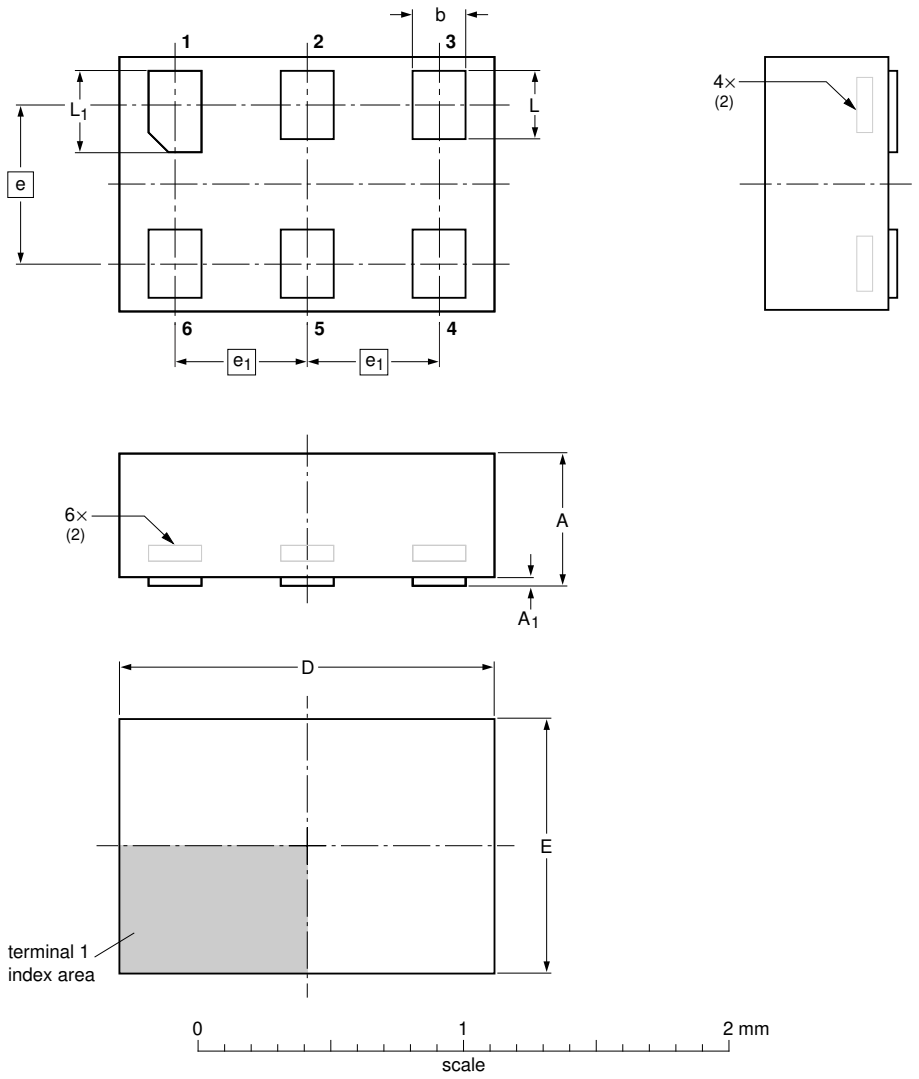


Fig 36. Package outline WLCSP4 with backside coating

Table 13. Dimensions of LD6806CX4/Cxxx for package outline WLCSP4 with backside coating; see Figure 36

Symbol	Min	Typ	Max	Unit
A	0.47	0.51	0.55	mm
A_1	0.18	0.20	0.22	mm
A_2	0.26	0.27	0.28	mm
A_3	0.03	0.04	0.05	mm
b	0.21	0.26	0.31	mm
D	0.71	0.76	0.81	mm
E	0.71	0.76	0.81	mm
e	-	0.4	-	mm

XSON6: plastic extremely thin small outline package; no leads; 6 terminals; body 1 x 1.45 x 0.5 mm **SOT886**



DIMENSIONS (mm are the original dimensions)

UNIT	A(1) max	A1 max	b	D	E	e	e1	L	L1
mm	0.5	0.04	0.25 0.17	1.5 1.4	1.05 0.95	0.6	0.5	0.35 0.27	0.40 0.32

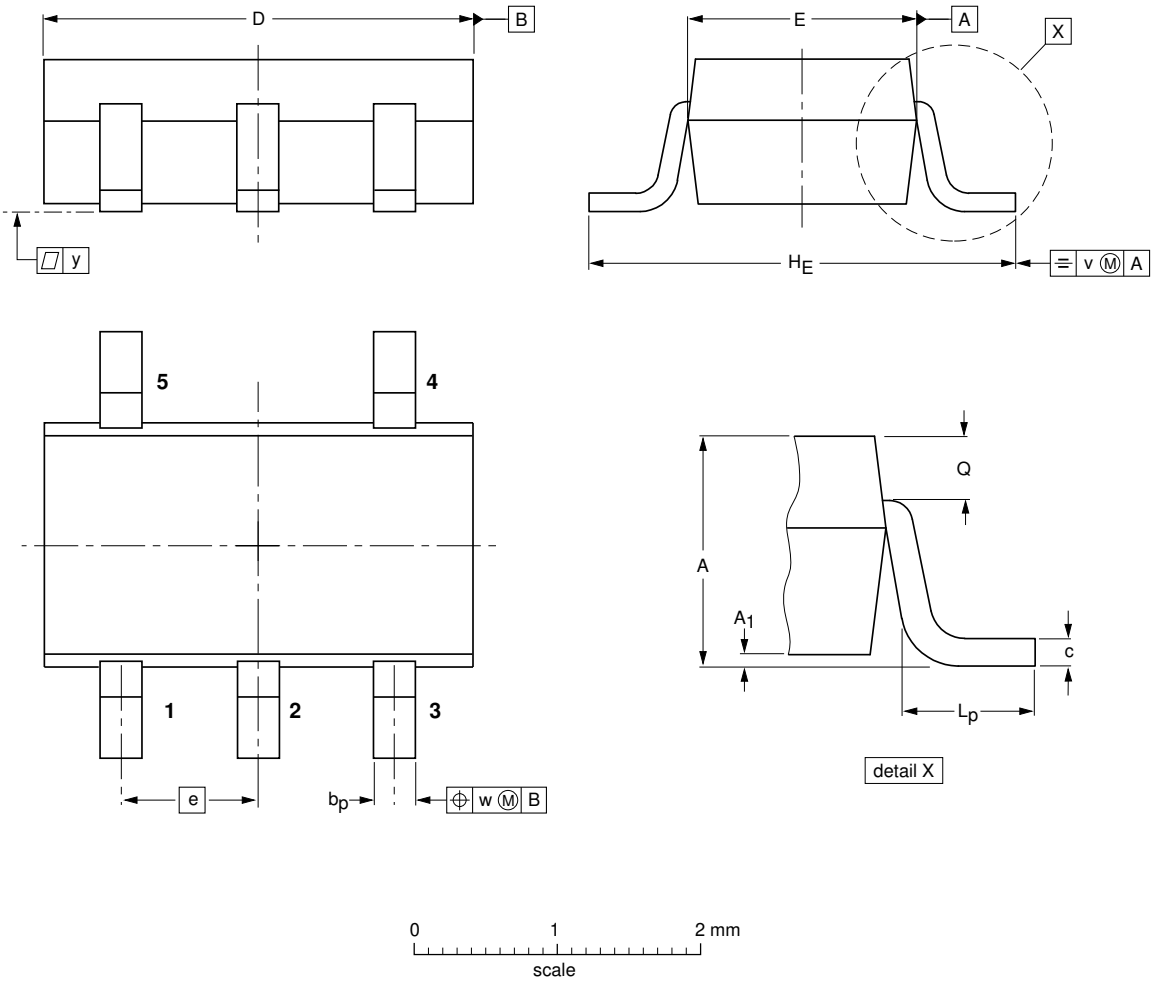
Notes

1. Including plating thickness.
2. Can be visible in some manufacturing processes.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT886		MO-252				~~04-07-15~~ 04-07-22

Fig 37. Package outline SOT886 (XSON6)

Plastic surface-mounted package; 5 leads **SOT753**



DIMENSIONS (mm are the original dimensions)

UNIT	A	A_1	b_p	c	D	E	e	H_E	L_p	Q	v	w	y
mm	1.1 0.9	0.100 0.013	0.40 0.25	0.26 0.10	3.1 2.7	1.7 1.3	0.95	3.0 2.5	0.6 0.2	0.33 0.23	0.2	0.2	0.1

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT753			SC-74A			~~02-04-16~~ 06-03-16

Fig 38. SOT753; Plastic surface-mounted package; 5 leads

13. Soldering

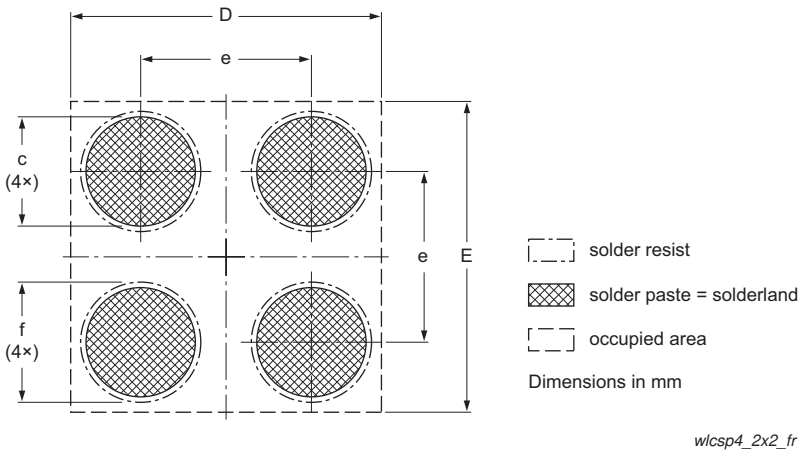


Fig 39. Soldering footprint WLCSP4

Table 14. Dimensions of soldering footprint WLCSP4; see Figure 39

Symbol	Min	Typ	Max	Unit
c	-	0.25	-	mm
D	0.71	0.76	0.81	mm
E	0.71	0.76	0.81	mm
e	-	0.4	-	mm
f	-	0.325	-	mm

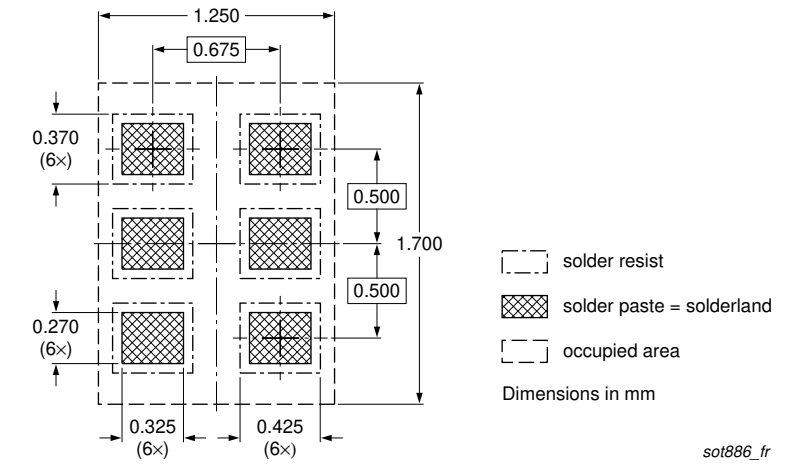


Fig 40. Soldering footprint SOT886 (XSON6)

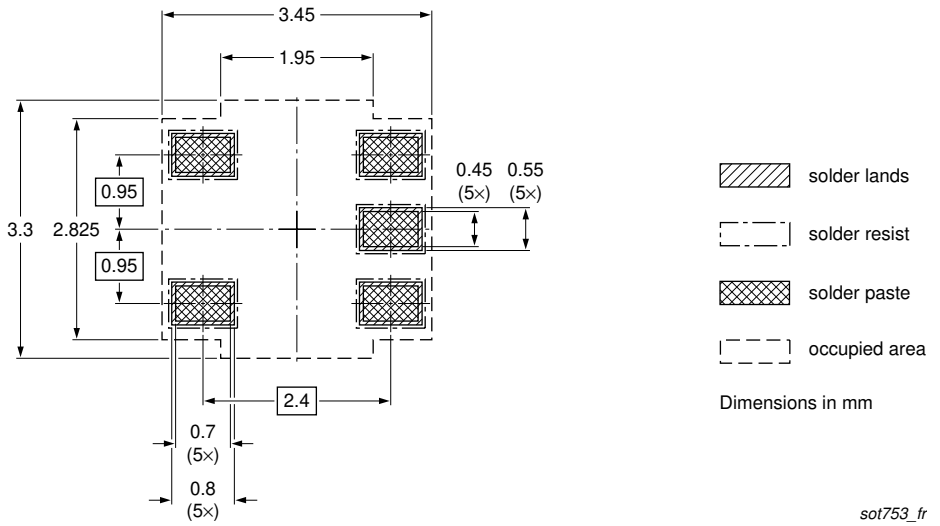


Fig 41. SOT753 (TSOP5); Reflow soldering footprint

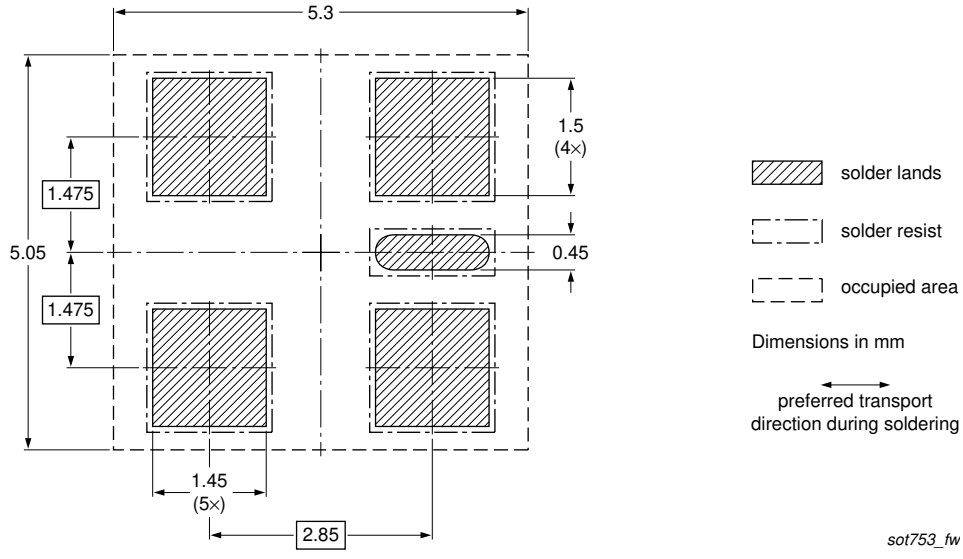


Fig 42. SOT753 (TSOP5); Wave soldering footprint

14. Soldering of WLCSP packages

14.1 Introduction to soldering WLCSP packages

This text provides a very brief insight into a complex technology. A more in-depth account of soldering WLCSP (Wafer Level Chip-Size Packages) can be found in application note *AN10439 "Wafer Level Chip Scale Package"* and in application note *AN10365 "Surface mount reflow soldering description"*.

Wave soldering is not suitable for this package.

All NXP WLCSP packages are lead-free.

14.2 Board mounting

Board mounting of a WLCSP requires several steps:

1. Solder paste printing on the PCB
2. Component placement with a pick and place machine
3. The reflow soldering itself

14.3 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 43) than a PbSn process, thus reducing the process window
- Solder paste printing issues, such as 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) while being 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 15.

Table 15. Lead-free process (from J-STD-020C)

Package thickness (mm)	Package reflow temperature (°C)		
	Volume (mm^3)		
	< 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 43.