

# UBA2080; UBA2080A; UBA2081

## Half-bridge driver IC

Rev. 3 — 18 June 2012

Product data sheet

## 1. General description

The UBA2080(A) and UBA2081 are high voltage monolithic integrated circuits made using the latch-up free Silicon-On-Insulator (SOI) process. The circuit is designed for driving MOSFETs in a half-bridge configuration.

## 2. Features and benefits

- Latch-up free and robust half bridge driver
- Output driver capability:  $I_{O(sink)} = 400\text{ mA}$  and  $I_{O(source)} = 200\text{ mA}$
- Maximum frequency 800 kHz
- UBA2080:
  - ◆ Outputs in phase with HIN and LIN inputs
  - ◆ Overlap protection
- UBA2081:
  - ◆ Outputs in phase with CLK input
  - ◆ Adjustable dead-time
  - ◆ Low active shutdown input

## 3. Applications

- Driver (via external MOSFETs) for any kind of load in a half-bridge configuration
- UBA2080A:
  - ◆ Selectable between UBA2080 and UBA2081 functionality
  - ◆ Thermally enhanced package for high frequency operation.

## 4. Ordering information

Table 1. Ordering information

| Type number | Package |                                         |          |
|-------------|---------|-----------------------------------------|----------|
|             | Name    | Description                             | Version  |
| UBA2080P    | DIP8    | plastic dual in-line package; 8 leads   | SOT97-1  |
| UBA2081P    |         |                                         |          |
| UBA2080T    | SO8     | plastic small outline package; 8 leads  | SOT96-1  |
| UBA2081T    |         |                                         |          |
| UBA2080AT   | SO14    | plastic small outline package; 14 leads | SOT108-1 |



## 5. Block diagram

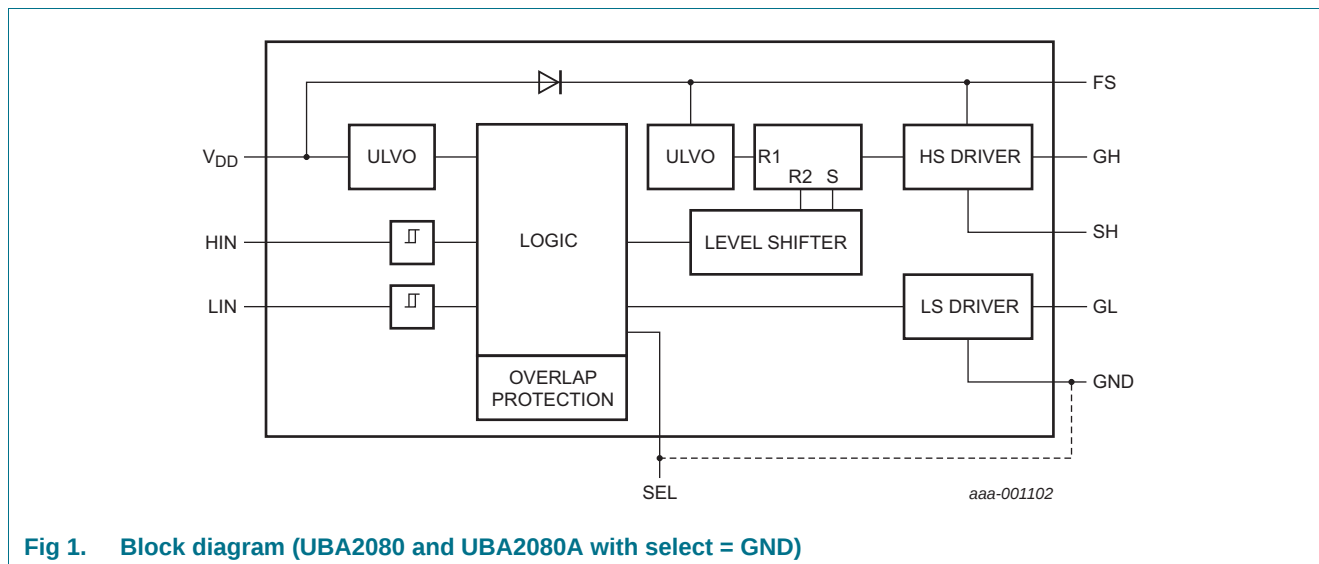


Fig 1. Block diagram (UBA2080 and UBA2080A with select = GND)

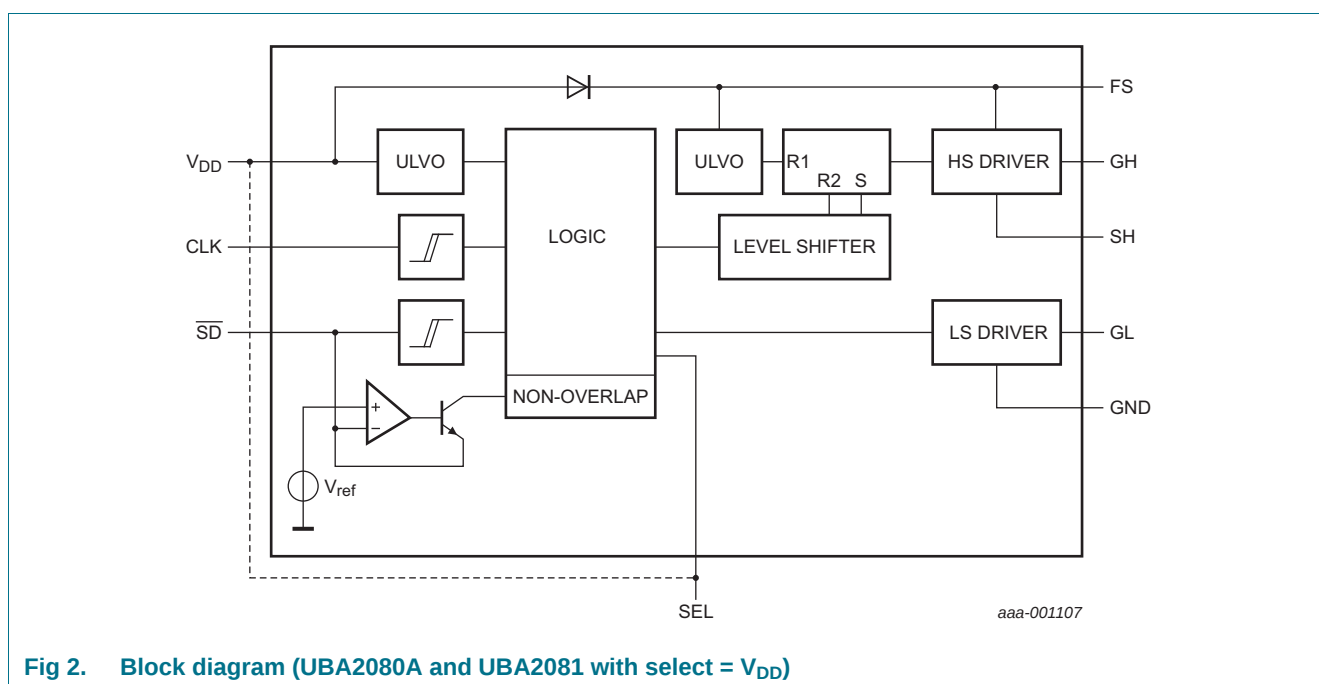
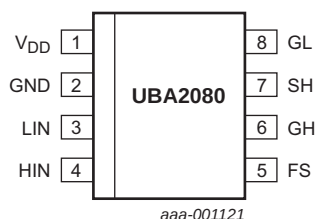


Fig 2. Block diagram (UBA2080A and UBA2081 with select =  $V_{DD}$ )

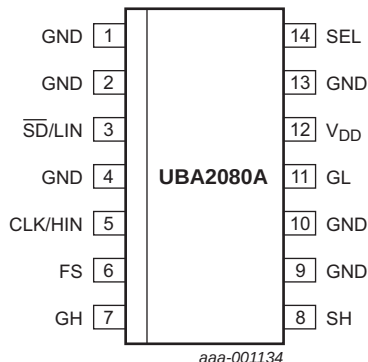
Refer to [Figure 7](#) and [Figure 8](#) for detailed information on the required application components.

## 6. Pinning information

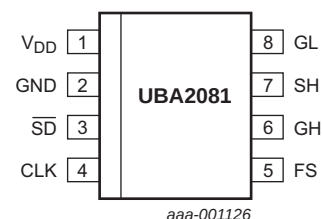
### 6.1 Pinning



**Fig 3. UBA2080: Pin configuration DIP8 and SO8 package**



**Fig 4. UBA2080A: Pin configuration SO14 package**



**Fig 5. UBA2081: Pin configuration DIP8 and SO8 package**

### 6.2 Pin description

**Table 2. Pin description UBA2080/UBA2081 DIP8 and SO8**

| Symbol                 | Pin                |                    | Description                                                   |
|------------------------|--------------------|--------------------|---------------------------------------------------------------|
|                        | UBA2080 (DIP8/SO8) | UBA2081 (DIP8/SO8) |                                                               |
| V <sub>DD</sub>        | 1                  |                    | IC supply                                                     |
| GND                    | 2                  |                    | IC ground and low-side driver return                          |
| LIN                    | 3                  | -                  | low-side driver logic input                                   |
| $\overline{\text{SD}}$ | -                  | 3                  | low active analog shutdown input and non-overlap time setting |
| HIN                    | 4                  | -                  | high-side driver logic input                                  |
| CLK                    | -                  | 4                  | clock logic input                                             |
| FS                     | 5                  |                    | floating supply voltage                                       |
| GH                     | 6                  |                    | high-side MOSFET gate                                         |
| SH                     | 7                  |                    | high-side MOSFET source                                       |
| GL                     | 8                  |                    | low-side MOSFET gate                                          |

**Table 3. Pin description UBA2080AT (SO14)**

| Symbol                      | Pin                | Description                                                                     |
|-----------------------------|--------------------|---------------------------------------------------------------------------------|
| GND                         | 1, 2, 4, 9, 10, 13 | IC ground and low side driver return                                            |
| $\overline{\text{SD}}$ /LIN | 3                  | low-side driver logic input or low active shutdown and non-overlap time setting |
| CLK/HIN                     | 5                  | high-side driver logic input or clock logic input                               |
| FS                          | 6                  | floating supply voltage                                                         |
| SH                          | 8                  | high-side MOSFET source                                                         |

Table 3. Pin description UBA2080AT (SO14) ...continued

| Symbol          | Pin | Description                                                                     |
|-----------------|-----|---------------------------------------------------------------------------------|
| GH              | 7   | high-side MOSFET gate                                                           |
| GL              | 11  | low-side MOSFET gate                                                            |
| V <sub>DD</sub> | 12  | IC supply                                                                       |
| SEL             | 14  | select UBA2080 or UBA2081 functionality; only connect to GND or V <sub>DD</sub> |

## 7. Functional description

### 7.1 Start-up state

The IC enters the start-up state when the supply voltage on pin V<sub>DD</sub> increases. In the start-up state, the high-side power transistor is non-conducting and the low-side power transistor is switched on. The internal circuit is reset and the capacitor on the bootstrap pin FS is charged. The start-up state is defined until the value of V<sub>DD</sub> = the V<sub>DD(start)</sub> value. After which the IC switches to the oscillation state.

The circuit enters the start-up state again when the voltage on pin V<sub>DD</sub> < V<sub>DD(stop)</sub>.

### 7.2 UBA2080 oscillation state

In the oscillation state, the output voltage of the GL and GH drivers depend on the logical signals HIN and LIN (see [Table 4](#)).

To prevent cross conduction in the half-bridge MOSFETs, the combination HIN = LIN = 1 is not allowed. Both GL and GH are LOW under this condition.

Table 4. UBA2080 Logic table

| State       | HIN | LIN | GH   | GL   |
|-------------|-----|-----|------|------|
| Start-up    | -   | -   | LOW  | HIGH |
| Oscillation | 0   | 0   | LOW  | LOW  |
| Oscillation | 0   | 1   | LOW  | HIGH |
| Oscillation | 1   | 0   | HIGH | LOW  |
| Oscillation | 1   | 1   | LOW  | LOW  |

### 7.3 UBA2081 oscillation state

In the oscillation state, the output voltage of the GL and GH drivers depend on the logical signals CLK and SD (see [Table 5](#)).

Table 5. UBA2081 Logic table

| State       | CLK | SD | GH   | GL   |
|-------------|-----|----|------|------|
| Start-up    | -   | -  | LOW  | HIGH |
| Oscillation | 0   | 0  | LOW  | HIGH |
| Oscillation | 1   | 0  | HIGH | LOW  |
| Oscillation | 0   | 1  | LOW  | LOW  |
| Oscillation | 1   | 1  | LOW  | LOW  |

## 7.4 UBA2081 non-overlap time

The external resistor ( $R_{SD}$ ) on pin SD sets the non-overlap time of the UBA2081. The relationship between this resistor value and actual dead-time is listed in [Figure 6](#).

It is essential to add a 10 nF to 100 nF decoupling capacitor across  $R_{SD}$  to ensure a noise immune dead-time system.

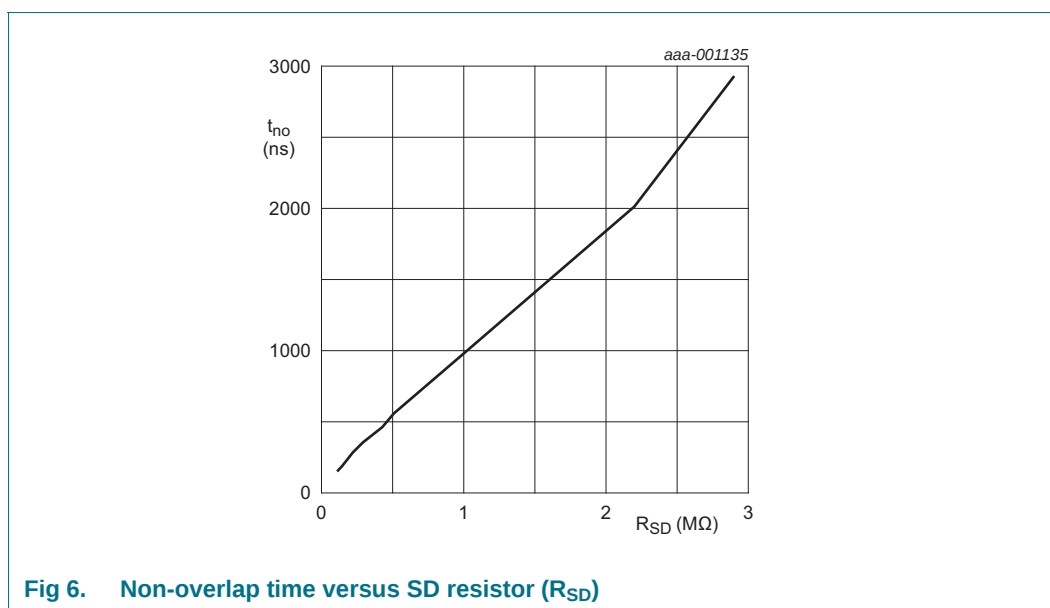


Fig 6. Non-overlap time versus SD resistor ( $R_{SD}$ )

## 7.5 UBA2081 shutdown protection

When the voltage at pin  $\overline{SD}$  is pulled below  $V_{IH}$ , the internal sink drivers of the pins GL and GH are immediately enabled to switch off the external power MOSFETs.

The shutdown comparator has a hysteresis of  $V_{hys}(\overline{SD})$  to avoid multiple switching.

Preferably, pin  $\overline{SD}$  is pulled low via a collector of a transistor (see application schematic) to avoid loading of this pin (Influences the non-overlap time settings) at normal operation.

## 7.6 UBA2080 overlap protection

The internal logic takes care that the GL driver and GH driver are both set to LOW in this situation to avoid that  $HIN = LIN = 1$  causes a cross current in the external half-bridge.

## 7.7 UBA2080A select function

Pin SEL enables the selection of either the UBA2080 or the UBA2081 functionality.

SEL = 0 gives the UBA2080 functionality. SEL =  $V_{DD}$  gives the UBA2081 functionality.

## 8. Limiting values

**Table 6. Limiting values**

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

| Symbol              | Parameter                       | Conditions                                                              | Min                 | Max                    | Unit |
|---------------------|---------------------------------|-------------------------------------------------------------------------|---------------------|------------------------|------|
| V <sub>DD</sub>     | supply voltage                  | nominal                                                                 | 0                   | 15.5                   | V    |
| V <sub>FS</sub>     | voltage on pin FS               |                                                                         | V <sub>SH</sub>     | V <sub>SH</sub> + 15.5 | V    |
| V <sub>SH</sub>     | voltage on pin SH               | source high-side MOSFET                                                 | −3                  | +600                   | V    |
|                     |                                 | t < 1 μs                                                                | −14                 | +600                   | V    |
| V <sub>i(HIN)</sub> | input voltage on pin HIN        | logic input for high-side driver                                        | 0                   | 15.5                   | V    |
| V <sub>i(LIN)</sub> | input voltage on pin LIN        | logic input for low-side driver                                         | 0                   | 15.5                   | V    |
| V <sub>i(SEL)</sub> | input voltage on pin SEL        |                                                                         | 0                   | 15.5                   | V    |
| V <sub>CLK</sub>    | voltage on pin CLK              | logic input for output drivers                                          | 0                   | 15.5                   | V    |
| V <sub>i(SD)</sub>  | input voltage on pin SD         | logic input for output drivers and analog input for non-overlap setting | 0                   | 15.5                   | V    |
| SR                  | slew rate                       | on pin SH; repetitive                                                   | −6                  | +6                     | V/ns |
| T <sub>j</sub>      | junction temperature            |                                                                         | −40                 | +150                   | °C   |
| T <sub>amb</sub>    | ambient temperature             |                                                                         | −40                 | +150                   | °C   |
| T <sub>stg</sub>    | storage temperature             |                                                                         | −55                 | +150                   | °C   |
| V <sub>ESD</sub>    | electrostatic discharge voltage | human body model:                                                       | <a href="#">[1]</a> |                        |      |
|                     |                                 | pins FS, GH and SH                                                      | -                   | 1                      | kV   |
|                     |                                 | pins V <sub>DD</sub> , HIN, LIN, SD, CLK, SEL                           | -                   | 2                      | kV   |
|                     |                                 | machine model:                                                          | <a href="#">[2]</a> |                        |      |
|                     |                                 | all pins                                                                | -                   | 250                    | V    |

[1] In accordance with the Human Body Model (HBM): equivalent to discharging a 100 pF capacitor through a 1.5 kΩ series resistor.

[2] In accordance with the Machine Model (MM): equivalent to discharging a 200 pF capacitor through a 1.5 kΩ series resistor and a 0.75 μH inductor.

## 9. Thermal characteristics

**Table 7. Thermal characteristics**

| Symbol               | Parameter                                   | Conditions  | Typ                     | Unit |
|----------------------|---------------------------------------------|-------------|-------------------------|------|
| <b>SO8</b>           |                                             |             |                         |      |
| R <sub>th(j-a)</sub> | thermal resistance from junction to ambient | in free air | <a href="#">[1]</a> 160 | K/W  |
| <b>SO14 and DIP8</b> |                                             |             |                         |      |
| R <sub>th(j-a)</sub> | thermal resistance from junction to ambient | in free air | <a href="#">[1]</a> 100 | K/W  |

[1] In accordance with IEC 60747-1.

## 10. Characteristics

**Table 8. Characteristics**

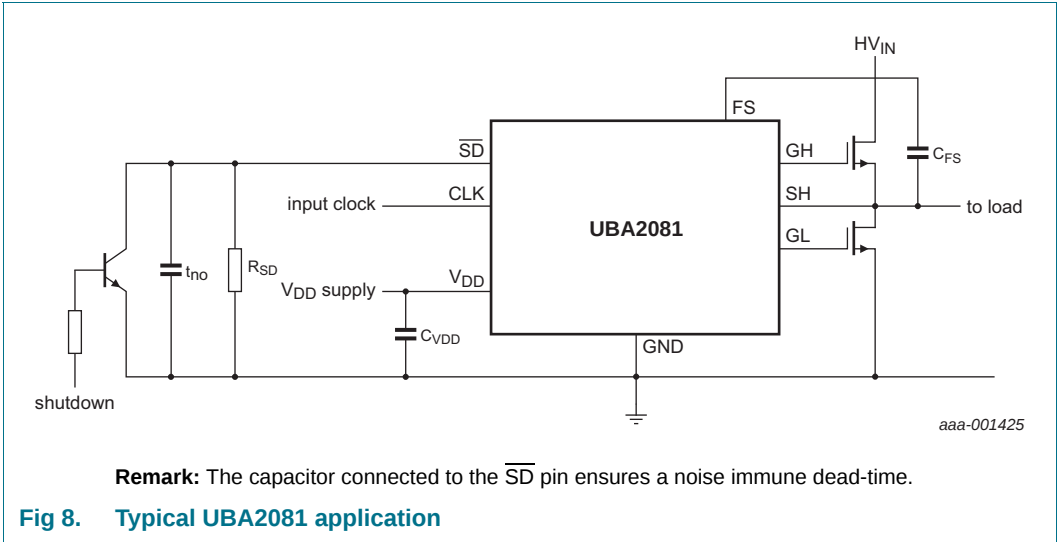
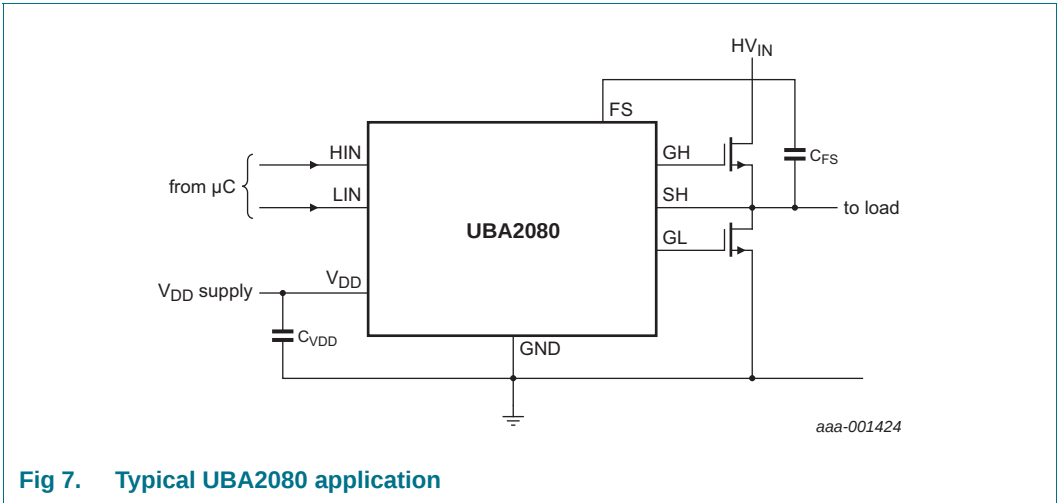
$T_j = 25\text{ }^{\circ}\text{C}$ ; all voltages are measured with respect to SGND;  $V_{DD} = 12.8\text{ V}$ ; positive currents flow into the IC.

| Symbol                       | Parameter                     | Conditions                                                                                          | Min | Typ | Max | Unit          |
|------------------------------|-------------------------------|-----------------------------------------------------------------------------------------------------|-----|-----|-----|---------------|
| <b>High-voltage supply</b>   |                               |                                                                                                     |     |     |     |               |
| $I_{\text{leak}}$            | leakage current               | FS = GH = SH = 600 V                                                                                | -   | -   | 10  | $\mu\text{A}$ |
| <b>Start-up state</b>        |                               |                                                                                                     |     |     |     |               |
| $I_{VDD}$                    | current on pin $V_{DD}$       |                                                                                                     | 420 | 520 | 620 | $\mu\text{A}$ |
| $V_{DD(\text{start})}$       | start supply voltage          |                                                                                                     | 11  | 12  | 13  | V             |
| $V_{DD(\text{stop})}$        | stop supply voltage           |                                                                                                     | 8   | 8.5 | 9   | V             |
| $V_{DD(\text{hys})}$         | hysteresis of supply voltage  | start-to-stop                                                                                       | 3   | 3.5 | 4   | V             |
| <b>Pin LIN input</b>         |                               |                                                                                                     |     |     |     |               |
| $V_{IH}$                     | HIGH-level input voltage      |                                                                                                     | 1.6 | 2.2 | 2.8 | V             |
| $V_{\text{hys}(\text{LIN})}$ | hysteresis voltage on pin LIN |                                                                                                     | -   | 400 | -   | mV            |
| $I_{I(\text{LIN})}$          | input current on pin LIN      |                                                                                                     | -   | 0   | 1   | $\mu\text{A}$ |
| <b>Pin HIN input</b>         |                               |                                                                                                     |     |     |     |               |
| $V_{IH}$                     | HIGH-level input voltage      |                                                                                                     | 1.6 | 2.2 | 2.8 | V             |
| $V_{\text{hys}(\text{HIN})}$ | hysteresis voltage on pin HIN |                                                                                                     | -   | 400 | -   | mV            |
| $I_{I(\text{HIN})}$          | input current on pin HIN      |                                                                                                     | -   | 0   | 1   | $\mu\text{A}$ |
| <b>Pin CLK input</b>         |                               |                                                                                                     |     |     |     |               |
| $V_{IH}$                     | HIGH-level input voltage      |                                                                                                     | 2.7 | -   | -   | V             |
| $V_{IL}$                     | LOW-level input voltage       |                                                                                                     | -   | -   | 0.8 | V             |
| $I_{I(\text{CLK})}$          | input current on pin CLK      |                                                                                                     | -   | 0   | 1   | $\mu\text{A}$ |
| <b>Pin SD input</b>          |                               |                                                                                                     |     |     |     |               |
| $V_{IH}$                     | HIGH-level input voltage      | to activate shutdown                                                                                | 1.6 | 2.2 | 2.8 | V             |
| $V_{\text{hys}(\text{SD})}$  | hysteresis voltage on pin SD  |                                                                                                     | -   | 400 | -   | mV            |
| $t_{\text{no}}$              | non-overlap time              | $R_{SD} = 100\text{ k}\Omega$ ; typical minimum                                                     | -   | 140 | -   | ns            |
|                              |                               | $R_{SD} = 3\text{ M}\Omega$ ; typical maximum                                                       | -   | 2.4 | -   | $\mu\text{s}$ |
| <b>Pin SEL input</b>         |                               |                                                                                                     |     |     |     |               |
| $I_{I(\text{SEL})}$          | input current on pin SEL      |                                                                                                     | -   | 0   | 1   | $\mu\text{A}$ |
| <b>gate drivers</b>          |                               |                                                                                                     |     |     |     |               |
| $I_{O(\text{source})}$       | output source current         | $V_{FS} = V_{VDD} = 12\text{ V}$ ; $V_{SH} = 0\text{ V}$ ;<br>$V_{GH} = V_{GL} = 8\text{ V}$        | -   | 200 | -   | mA            |
| $I_{O(\text{sink})}$         | output sink current           | $V_{FS} = V_{VDD} = 12\text{ V}$ ; $V_{SH} = 0\text{ V}$ ;<br>$V_{GH} = V_{GL} = 4\text{ V}$        | -   | 400 | -   | mA            |
| $V_{d(\text{bs})}$           | bootstrap diode voltage       | $I_{d(\text{bs})} = 20\text{ mA}$                                                                   | -   | 2.3 | -   | V             |
| $V_{UVLO}$                   | undervoltage lockout voltage  | reset                                                                                               | 3.6 | 4.2 | 4.8 | V             |
| $I_{FS}$                     | current on pin FS             | $V_{FS} = V_{VDD} = 12\text{ V}$ ; $V_{SH} = 0\text{ V}$                                            | 27  | 32  | 37  | $\mu\text{A}$ |
| <b>Timing</b>                |                               |                                                                                                     |     |     |     |               |
| $t_{PD}$                     | propagation delay             | UBA2080; matching;<br>$C_{(GL)} = C_{(GH)} = 0$ , propagation time<br>difference between GL and GH. | -   | 50  | -   | ns            |

**Table 8. Characteristics ...continued**  
*T<sub>j</sub> = 25 °C; all voltages are measured with respect to SGND; V<sub>DD</sub> = 12.8 V; positive currents flow into the IC.*

| Symbol                  | Parameter                        | Conditions                        | Min | Typ | Max | Unit |
|-------------------------|----------------------------------|-----------------------------------|-----|-----|-----|------|
| t <sub>PD(LIN-GL)</sub> | propagation delay from LIN to GL | UBA2080; C <sub>(GL)</sub> = 0 pF | -   | 240 | -   | ns   |
| t <sub>PD(HIN-GH)</sub> | propagation delay from HIN to GH | UBA2080; C <sub>(GH)</sub> = 0 pF | -   | 180 | -   | ns   |
| f <sub>max</sub>        | maximum frequency                |                                   | 800 | -   | -   | kHz  |

11. Application information



12. Package outline

SO8: plastic small outline package; 8 leads; body width 3.9 mm

SOT96-1

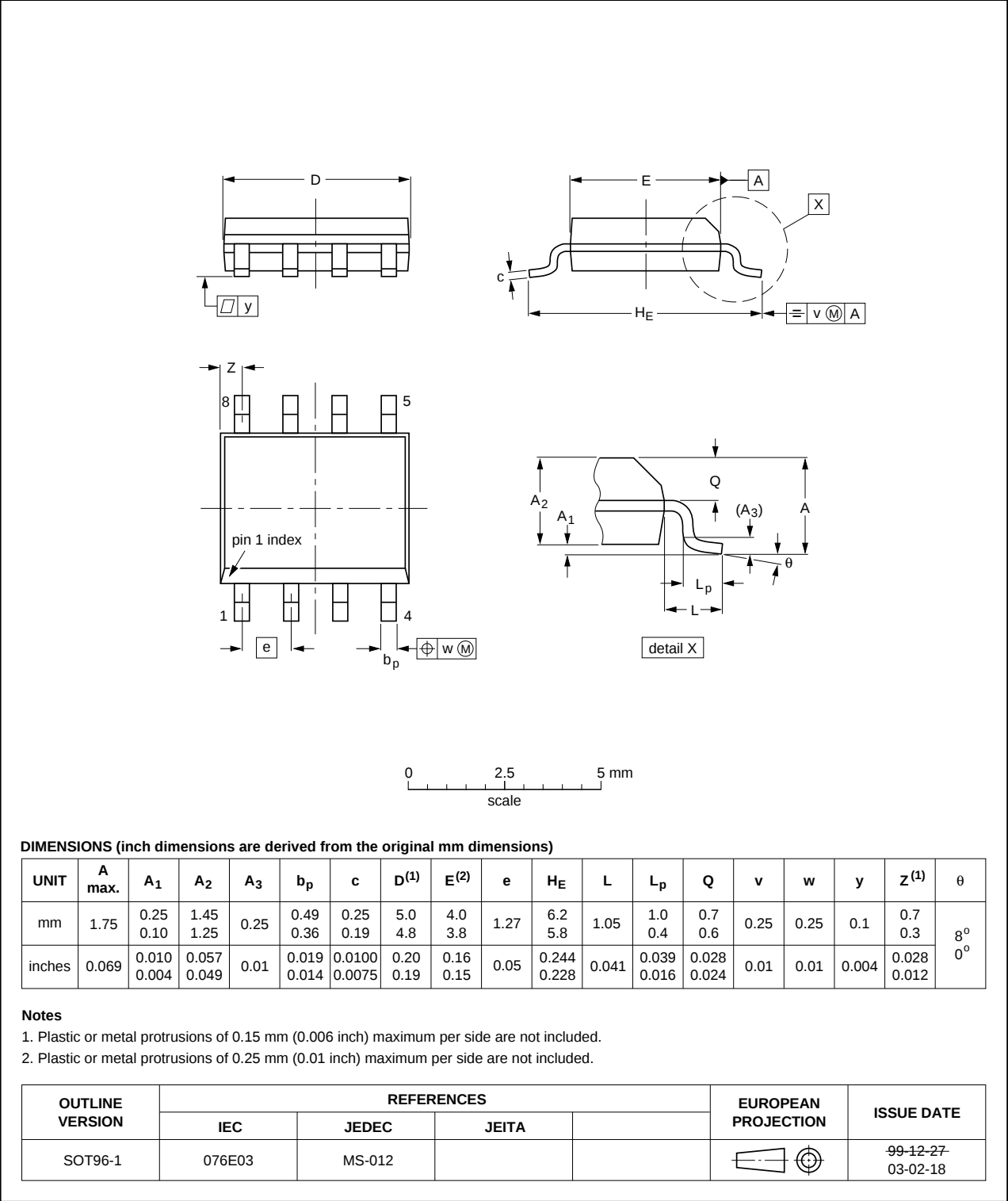
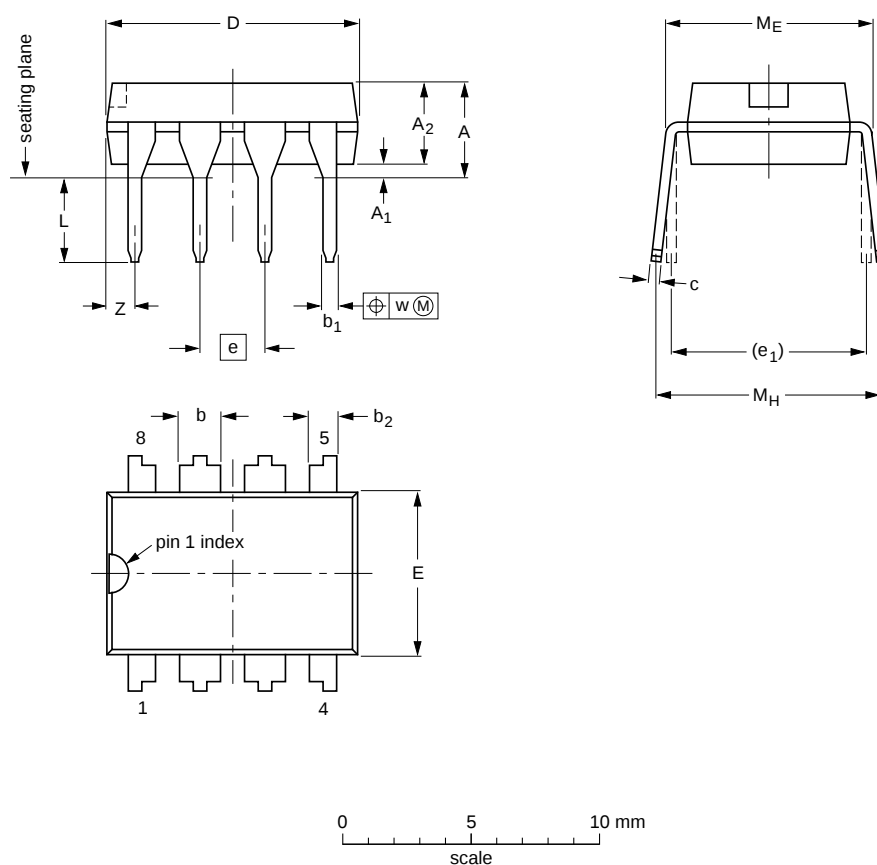


Fig 9. Package outline SOT96-1 (SO8)

DIP8: plastic dual in-line package; 8 leads (300 mil)

SOT97-1



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

| UNIT   | A<br>max. | A <sub>1</sub><br>min. | A <sub>2</sub><br>max. | b              | b <sub>1</sub> | b <sub>2</sub> | c              | D <sup>(1)</sup> | E <sup>(1)</sup> | e    | e <sub>1</sub> | L            | M <sub>E</sub> | M <sub>H</sub> | w     | Z <sup>(1)</sup><br>max. |
|--------|-----------|------------------------|------------------------|----------------|----------------|----------------|----------------|------------------|------------------|------|----------------|--------------|----------------|----------------|-------|--------------------------|
| mm     | 4.2       | 0.51                   | 3.2                    | 1.73<br>1.14   | 0.53<br>0.38   | 1.07<br>0.89   | 0.36<br>0.23   | 9.8<br>9.2       | 6.48<br>6.20     | 2.54 | 7.62           | 3.60<br>3.05 | 8.25<br>7.80   | 10.0<br>8.3    | 0.254 | 1.15                     |
| inches | 0.17      | 0.02                   | 0.13                   | 0.068<br>0.045 | 0.021<br>0.015 | 0.042<br>0.035 | 0.014<br>0.009 | 0.39<br>0.36     | 0.26<br>0.24     | 0.1  | 0.3            | 0.14<br>0.12 | 0.32<br>0.31   | 0.39<br>0.33   | 0.01  | 0.045                    |

**Note**

1. Plastic or metal protrusions of 0.25 mm (0.01 inch) maximum per side are not included.

| OUTLINE<br>VERSION | REFERENCES |        |          |  | EUROPEAN<br>PROJECTION | ISSUE DATE           |
|--------------------|------------|--------|----------|--|------------------------|----------------------|
|                    | IEC        | JEDEC  | JEITA    |  |                        |                      |
| SOT97-1            | 050G01     | MO-001 | SC-504-8 |  |                        | 99-12-27<br>03-02-13 |

Fig 10. Package outline SOT97-1 (DIP8)

SO14: plastic small outline package; 14 leads; body width 3.9 mm

SOT108-1

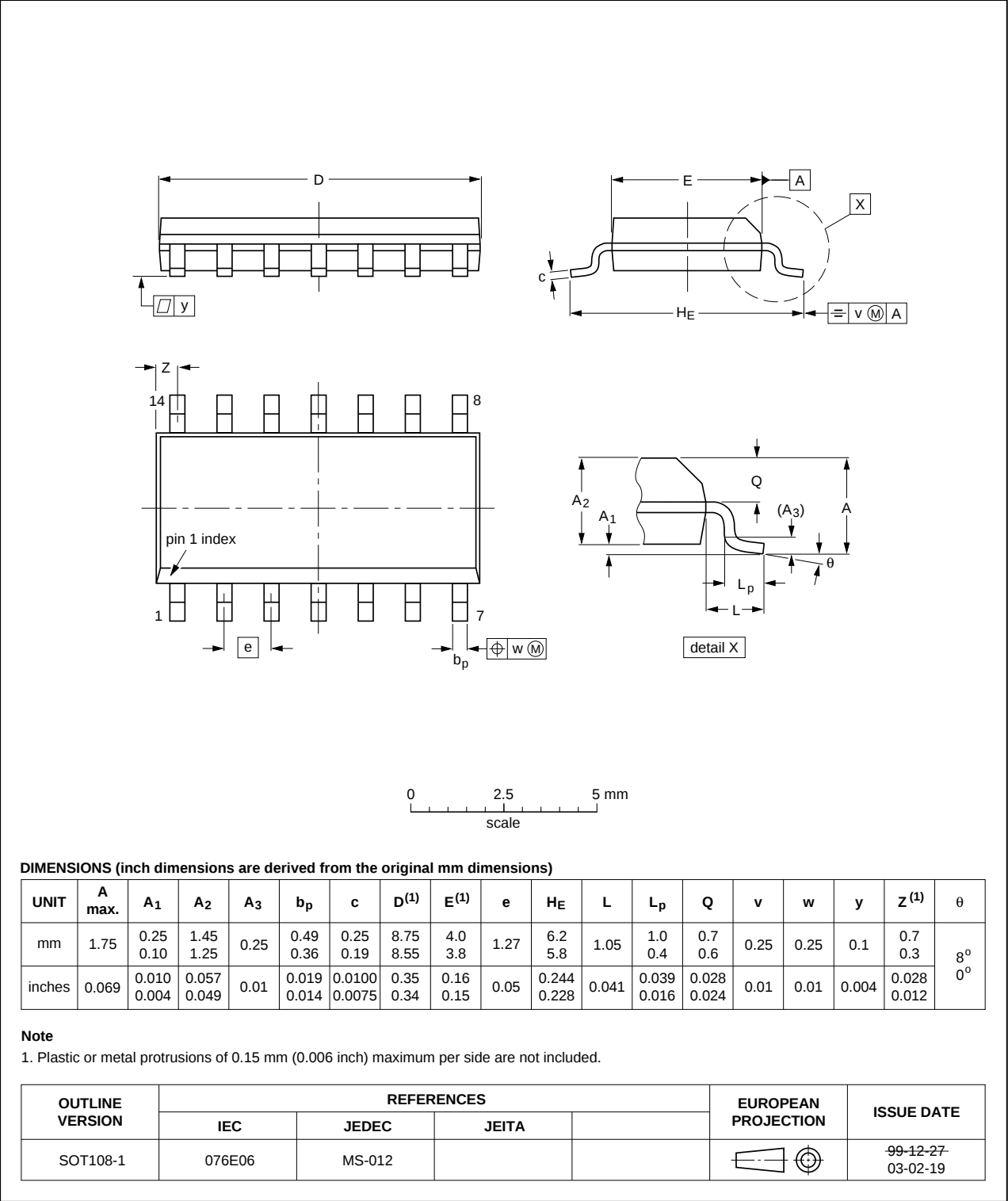


Fig 11. Package outline SOT108-1 (SO14)

## 13. Revision history

**Table 9.** Revision history

| Document ID           | Release date                                                                                                                                                                   | Data sheet status      | Change notice | Supersedes            |
|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|---------------|-----------------------|
| UBA2080_UBA2081 v.3   | 20120618                                                                                                                                                                       | Product data sheet     | -             | UBA2080_UBA2081 v.2   |
| Modifications:        | <ul style="list-style-type: none"><li>• Data sheet status changed from Preliminary to Product.</li><li>• <a href="#">Table 6 "Limiting values"</a> has been updated.</li></ul> |                        |               |                       |
| UBA2080_UBA2081 v.2   | 20120426                                                                                                                                                                       | Preliminary data sheet | -             | UBA2080_UBA2081 v 1.1 |
| UBA2080_UBA2081 v.1.1 | 20111206                                                                                                                                                                       | Objective data sheet   | -             | UBA2080_UBA2081 v.1   |
| UBA2080_UBA2081 v.1   | 20111116                                                                                                                                                                       | Objective data sheet   | -             |                       |

## 14. Legal information

### 14.1 Data sheet status

| Document status <sup>[1][2]</sup> | Product status <sup>[3]</sup> | 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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