



# PM6681A

## Dual step-down controller with adjustable LDO

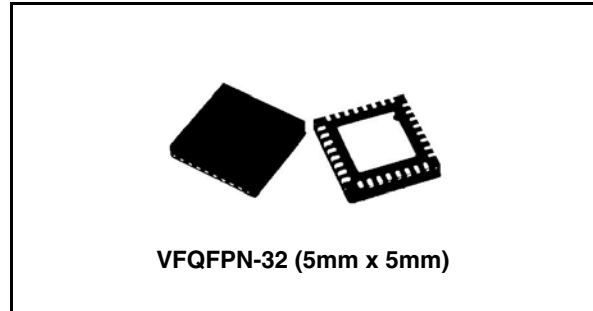
Target Specification

### Features

- 6V to 36V input voltage range
- Adjustable output voltages
- 0.9-3.3V LDO adjustable delivers 100mA peak current
- 5V LDO delivers 100mA peak current
- 1.237V  $\pm 1\%$  reference voltage available
- NO  $R_{SENSE}$  current sensing using low side MOSFETs'  $R_{DS(on)}$
- Negative current limit
- Soft start internally fixed at 2ms
- Soft output discharge
- Latched UVP
- Not-latched OVP
- Selectable pulse skipping at light loads
- Selectable minimum frequency(33kHz) in pulse skip mode
- 5mW maximum quiescent power
- Independent power good signals
- Output voltage ripple compensation

### Applications

- Embedded computer system
- FPGA system power
- Industrial applications on 24V
- High performance and high density DC/DC modules



### Description

PM6681A is a dual step-down controller specifically designed to provide extremely high efficiency conversion, with lossless current sensing technique. The constant on-time architecture assures fast load transient response and the embedded voltage feed-forward provides nearly constant switching frequency operation. An embedded integrator control loop compensates the DC voltage error due to the output ripple. Pulse skipping technique increases efficiency at very light load. Moreover a minimum switching frequency of 33kHz is selectable to avoid audio noise issues. The PM6681A provides a selectable switching frequency, allowing three different values of switching frequencies for the two switching sections. The output voltages OUT1 and OUT2 can be adjusted from 0.9V to 5V and from 0.9V to 3.3V respectively. The device provides also 2 LDOs, 5V fixed and 0.9V-3.3V adjustable.

### Order codes

Part number	Package	Packaging
PM6681A	VFQFPN-32 (5mm x 5mm)	Tube
PM6681ATR	VFQFPN-32 (5mm x 5mm)	Tape and Reel

November 2006

Rev 1

1/12

This is preliminary information on a new product foreseen to be developed. Details are subject to change without notice.

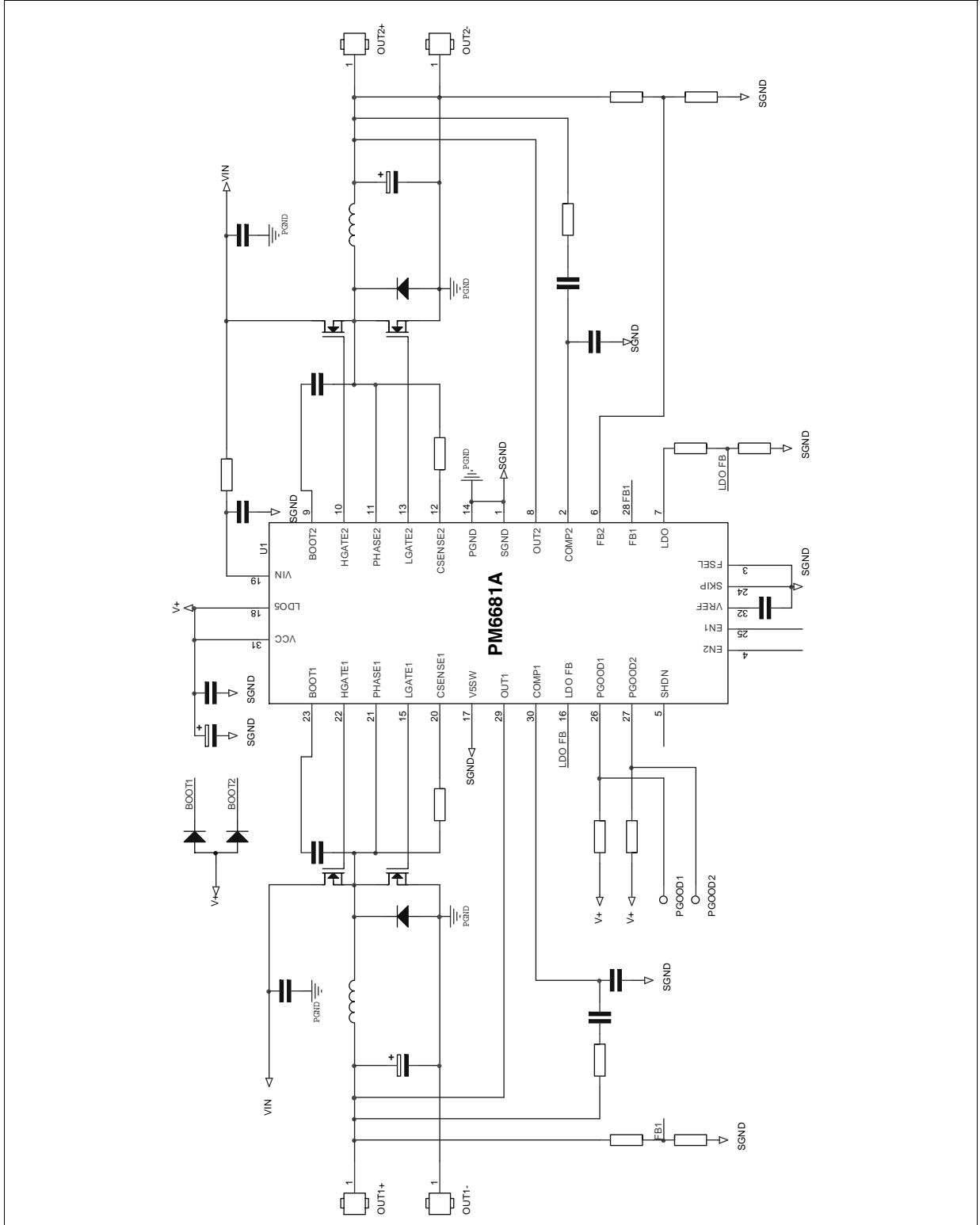
[www.st.com](http://www.st.com)

# Contents

<b>1</b>	<b>Simplified application schematic</b> .....	<b>3</b>
<b>2</b>	<b>Pin settings</b> .....	<b>4</b>
	2.1 Connections .....	4
	2.2 Functions .....	5
<b>3</b>	<b>Functional block diagram</b> .....	<b>8</b>
<b>4</b>	<b>Package mechanical data</b> .....	<b>9</b>
<b>5</b>	<b>Revision history</b> .....	<b>11</b>

# 1 Simplified application schematic

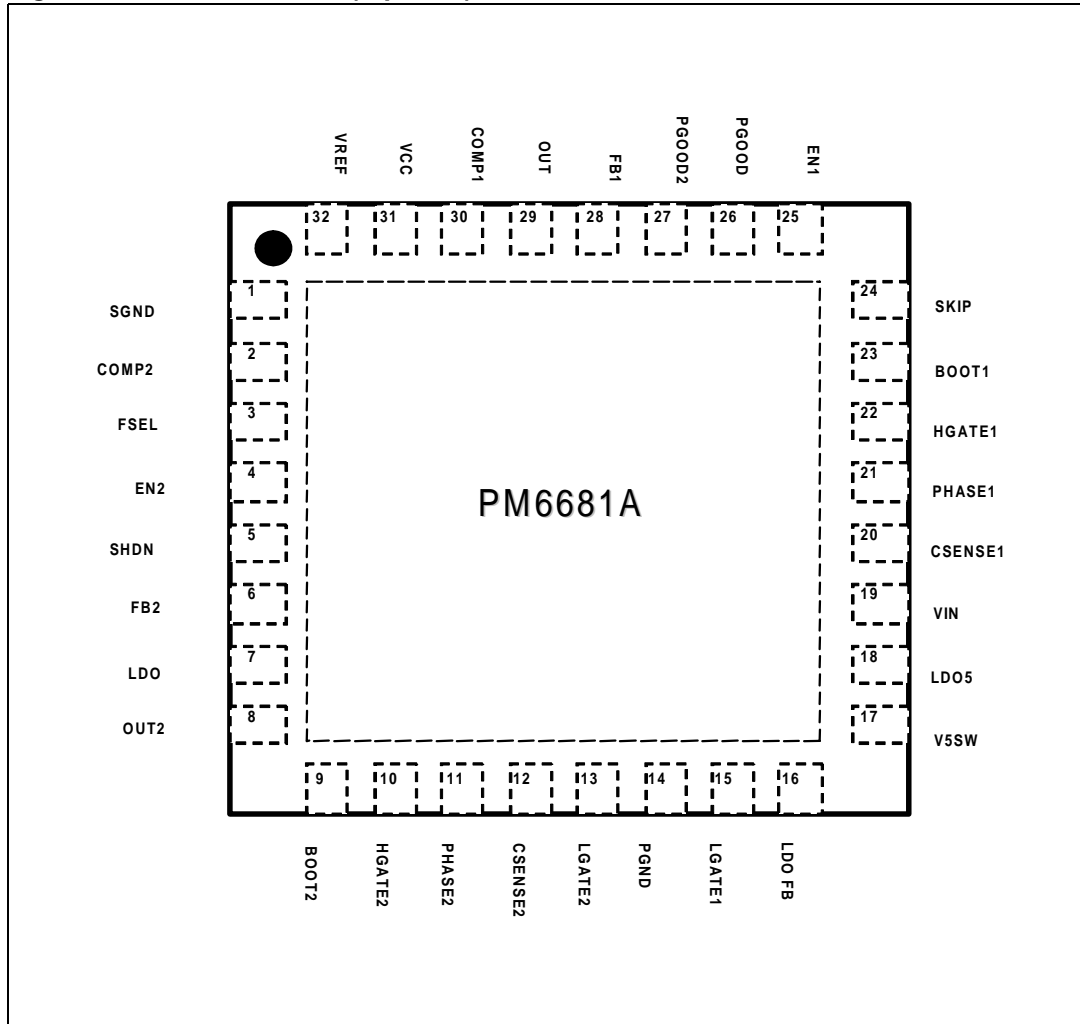
Figure 1. Simplified application schematic



## 2 Pin settings

### 2.1 Connections

Figure 2. Pin connection (top view)



## 2.2 Functions

**Table 1. Pin functions**

N°	Pin	Function
1	SGND1	Signal ground. Reference for internal logic circuitry. It must be connected to the signal ground plan of the power supply. The signal ground plan and the power ground plan must be connected together in one point near the PGND pin.
2	COMP2	DC voltage error compensation pin for the switching section 2
3	FSEL	Frequency selection pin. It provides a selectable switching frequency, allowing three different values of switching frequencies for the switching sections.
4	EN2	Enable input for the switching section 2. <ul style="list-style-type: none"> <li>– The section 2 is enabled applying a voltage greater than 2.4V to this pin.</li> <li>– The section 2 is disabled applying a voltage lower than 0.8V.</li> </ul> When the section is disabled the High Side gate driver goes low and Low Side gate driver goes high. If both EN1 and EN2 pins are low and SHDN pin is high the device enters in standby mode.
5	SHDN	Shutdown control input. <ul style="list-style-type: none"> <li>– The device switch off if the SHDN voltage is lower than the device off threshold (Shutdown mode)</li> <li>– The device switch on if the SHDN voltage is greater than the device on threshold.</li> </ul> The SHDN pin can be connected to the battery through a voltage divider to program an undervoltage lockout. In shutdown mode, the gate drivers of the two switching sections are in high impedance (high-Z).
6	FB2	Feedback input for the switching section 2 This pin is connected to a resistive voltage-divider from OUT2 to PGND to adjust the output voltage from 0.9V to 3.3V.
7	LDO	Adjustable internal regulator output. It can be set from 0.9V to 3.3V. LDO pin can provide a 100mA peak current.
8	OUT2	Output voltage sense for the switching section 2. This pin must be directly connected to the output voltage of the switching section.
9	BOOT2	Bootstrap capacitor connection for the switching section 2. It supplies the high-side gate driver.
10	HGATE2	High-side gate driver output for section 2. This is the floating gate driver output.
11	PHASE2	Switch node connection and return path for the high side driver for the section 2. It is also used as negative current sense input.
12	CSENSE2	Positive current sense input for the switching section 2. This pin must be connected through a resistor to the drain of the synchronous rectifier to obtain a positive current limit threshold for the power supply controller.
13	LGATE2	Low-side gate driver output for the section 2.
14	PGND	Power ground. This pin must be connected to the power ground plan of the power supply.
15	LGATE1	Low-side gate driver output for the section 1.

Table 1. Pin functions (continued)

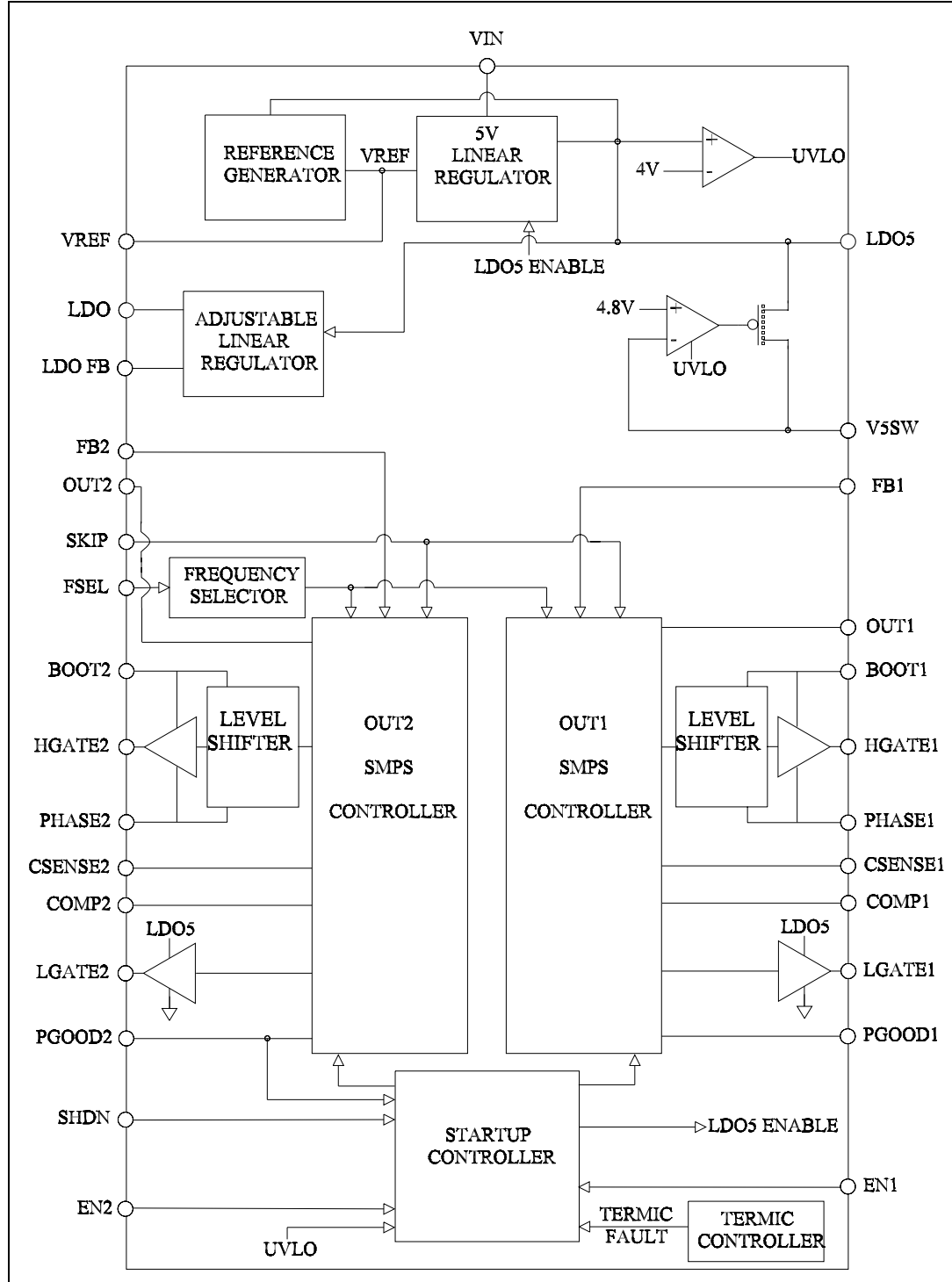
N°	Pin	Function
16	LDO FB	Feedback input for the adjustable internal linear regulator. This pin is connected to a resistive voltage-divider from LDO to SGND to adjust the output voltage from 0.9V to 3.3V.
17	V5SW	Internal 5V regulator bypass connection. – If V5SW is connected to OUT5 (or to an external 5V supply) and V5SW is greater than 4.9V, the LDO5 regulator shuts down and the LDO5 pin is directly connected to OUT5 through a 3W (max) switch. If V5SW is connected to GND, the LDO5 linear regulator is always on.
18	LDO5	5V internal regulator output. It can provide up to 100mA peak current. LDO5 pin supplies embedded low side gate drivers and an external load.
19	VIN	Device supply voltage input and battery voltage sense. A bypass filter (4Ω and 4.7mF) between the battery and this pin is recommended.
20	CSENSE1	Positive current sense input for the switching section 1. This pin must be connected through a resistor to the drain of the synchronous rectifier to obtain a positive current limit threshold for the power supply controller.
21	PHASE1	Switch node connection and return path for the high side driver for the section 1. It is also used as negative current sense input.
22	HGATE1	High-side gate driver output for section 1. This is the floating gate driver output.
23	BOOT1	Bootstrap capacitor connection for the switching section 1. It supplies the high-side gate driver.
24	SKIP	Pulse skipping mode control input. – If the pin is connected to LDO5 the PWM mode is enabled. – If the pin is connected to GND, the pulse skip mode is enabled. – If the pin is connected to VREF the pulse skip mode is enabled but the switching frequency is kept higher than 33KHz (No-audible pulse skip mode).
25	EN1	Enable input for the switching section 1. – The section 1 is enabled applying a voltage greater than 2.4V to this pin. – The section 1 is disabled applying a voltage lower than 0.8V. When the section is disabled the High Side gate driver goes low and Low Side gate driver goes high.
26	PGOOD1	Power Good output signal for the section 1. This pin is an open drain output and when the output of the switching section 1 is out of +/- 10% of its nominal value. It is pulled down.
27	PGOOD2	Power Good output signal for the section 2. This pin is an open drain output and when the output of the switching section 2 is out of +/- 10% of its nominal value. It is pulled down.
28	FB1	Feedback input for the switching section 1. This pin is connected to a resistive voltage-divider from OUT1 to PGND to adjust the output voltage from 0.9V to 5.5V.
29	OUT1	Output voltage sense for the switching section 1. This pin must be directly connected to the output voltage of the switching section.

**Table 1. Pin functions (continued)**

N°	Pin	Function
30	COMP1	DC voltage error compensation pin for the switching section 1.
31	VCC	Device Supply Voltage pin. It supplies all the internal analog circuitry except the gate drivers (see LDO5). Connect this pin to LDO5.
32	VREF	Internal 1.237V high accuracy voltage reference. It can deliver 50uA. Bypass to SGND with a 100nF capacitor to reduce noise.

### 3 Functional block diagram

Figure 3. Functional block diagram





## 4 Package mechanical data

In order to meet environmental requirements, ST offers these devices in ECOPACK<sup>®</sup> packages. These packages have a Lead-free second level interconnect. The category of second Level Interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings related to soldering conditions are also marked on the inner box label. ECOPACK is an ST trademark. ECOPACK specifications are available at: [www.st.com](http://www.st.com).

**Table 2. VFQFPN 5x5x1.0 32L Pitch 0.50**

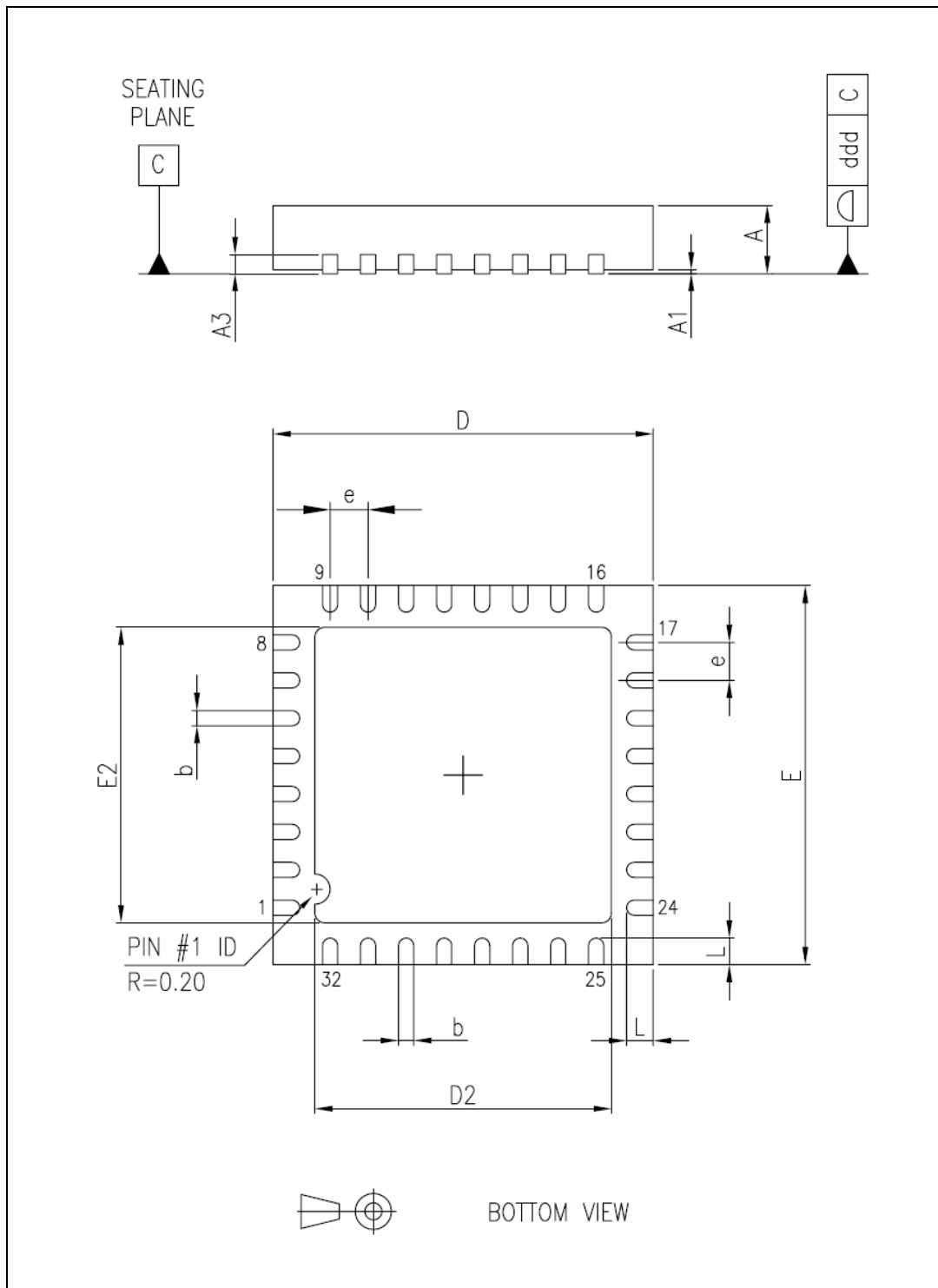
Dim.	Databook (mm)		
	Min	Typ	Max
A	0.8	0.9	1
A1	0	0.02	0.05
A3		0.2	
b	0.18	0.25	0.3
D	4.85	5	5.15
D2	See exposed pad variations <sup>(2)</sup>		
E	4.85	5	5.15
E2	See exposed pad variations <sup>(2)</sup>		
e		0.5	
L	0.3	0.4	0.5
ddd			0.05

**Table 3. Exposed pad variations**

D2			E2		
Min	Typ	Max	Min	Typ	Max
2.90	3.10	3.20	2.90	3.10	3.20

1. VFQFPN stands for Thermally Enhanced Very thin Fine pitch Quad Flat Package No lead. Very thin: A = 1.00mm Max.
2. Dimensions D2 & E2 are not in accordance with JEDEC.

Figure 4. Package dimensions



## 5 Revision history

**Table 4. Revision history**

Date	Revision	Changes
02-Nov-2006	1	Initial release

**Please Read Carefully:**

Information in this document is provided solely in connection with ST products. STMicroelectronics NV and its subsidiaries ("ST") reserve the right to make changes, corrections, modifications or improvements, to this document, and the products and services described herein at any time, without notice.

All ST products are sold pursuant to ST's terms and conditions of sale.

Purchasers are solely responsible for the choice, selection and use of the ST products and services described herein, and ST assumes no liability whatsoever relating to the choice, selection or use of the ST products and services described herein.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted under this document. If any part of this document refers to any third party products or services it shall not be deemed a license grant by ST for the use of such third party products or services, or any intellectual property contained therein or considered as a warranty covering the use in any manner whatsoever of such third party products or services or any intellectual property contained therein.

**UNLESS OTHERWISE SET FORTH IN ST'S TERMS AND CONDITIONS OF SALE ST DISCLAIMS ANY EXPRESS OR IMPLIED WARRANTY WITH RESPECT TO THE USE AND/OR SALE OF ST PRODUCTS INCLUDING WITHOUT LIMITATION IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE (AND THEIR EQUIVALENTS UNDER THE LAWS OF ANY JURISDICTION), OR INFRINGEMENT OF ANY PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHT.**

**UNLESS EXPRESSLY APPROVED IN WRITING BY AN AUTHORIZED ST REPRESENTATIVE, ST PRODUCTS ARE NOT RECOMMENDED, AUTHORIZED OR WARRANTED FOR USE IN MILITARY, AIR CRAFT, SPACE, LIFE SAVING, OR LIFE SUSTAINING APPLICATIONS, NOR IN PRODUCTS OR SYSTEMS WHERE FAILURE OR MALFUNCTION MAY RESULT IN PERSONAL INJURY, DEATH, OR SEVERE PROPERTY OR ENVIRONMENTAL DAMAGE. ST PRODUCTS WHICH ARE NOT SPECIFIED AS "AUTOMOTIVE GRADE" MAY ONLY BE USED IN AUTOMOTIVE APPLICATIONS AT USER'S OWN RISK.**

Resale of ST products with provisions different from the statements and/or technical features set forth in this document shall immediately void any warranty granted by ST for the ST product or service described herein and shall not create or extend in any manner whatsoever, any liability of ST.

ST and the ST logo are trademarks or registered trademarks of ST in various countries.

Information in this document supersedes and replaces all information previously supplied.

The ST logo is a registered trademark of STMicroelectronics. All other names are the property of their respective owners.

© 2006 STMicroelectronics - All rights reserved

STMicroelectronics group of companies

Australia - Belgium - Brazil - Canada - China - Czech Republic - Finland - France - Germany - Hong Kong - India - Israel - Italy - Japan - Malaysia - Malta - Morocco - Singapore - Spain - Sweden - Switzerland - United Kingdom - United States of America

[www.st.com](http://www.st.com)