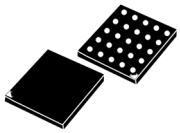
ST6G3237B

Dual supply level translator for SD/ MINISD / T-FLASH

Features

- High speed:
  - t_{PD} = 6.2ns (Max.) at T_A = 85°C
  - V_{CCB} = 3.0V
  - V_{CCA} = 2.3V
- Low power dissipation:
  - $I_{CCA} = I_{CCB}$ = 5µA (Max.) at T_A = 85°C
- Balanced propagation delays:
  - $T_{PLH} \approx T_{PHL}$
- Power down protections on inputs and outputs
- 26Ω series resistor on A-Side
- Operating voltage range:
  - V_{CCA} (OPR) = 1.4V to V_{CCB}
  - V_{CCB} (OPR) = 1.4V to 3.6V
- Latch-up performance exceeds 500mA (JESD17)
- ESD performance:
  - HBM > 2kV (MIL STD 883 method 3015);
- R_OHS compliant for µTFBGA25 package



µTFBGA25

Description

The ST6G3237B is a dual supply low voltage CMOS Level Translator for SD/MiniSD/T-Flash fabricated with sub-micron silicon gate and five-layer metal wiring C^2MOS technology. Designed for use as an interface between a 3.3V bus and a 2.5V or 1.8V bus in a mixed 3.3V/1.8V, 3.3V/2.5V and 2.5V/1.8V supply systems, it achieves high speed operation while maintaining the CMOS low power dissipation.

The A port is designed to track $V_{CCA.}$ The B port is designed to track V_{CCB}.

This IC is intended for two-way asynchronous communication between data buses and the direction of data transmission is determined by CMD-dir/DATA0-dir/DAT123-dir inputs. The B-port interfaces with the 3V bus, the A-port with the 2.5V and 1.8V bus.

All inputs are equipped with protection circuits against static discharge, giving them ±2kV ESD immunity and transient excess voltage.

The ST6G3237B is V_{CCB} = 0V tolerant, achieving very low current consumption when the V_{CCB} is grounded.

Figure 1. Device summary

Part number	Package	Packaging
ST6G3237BTBR	µTFBGA25	Tape and reel

Contents

1 Logic diagram and truth table

Figure 1. Logic diagram

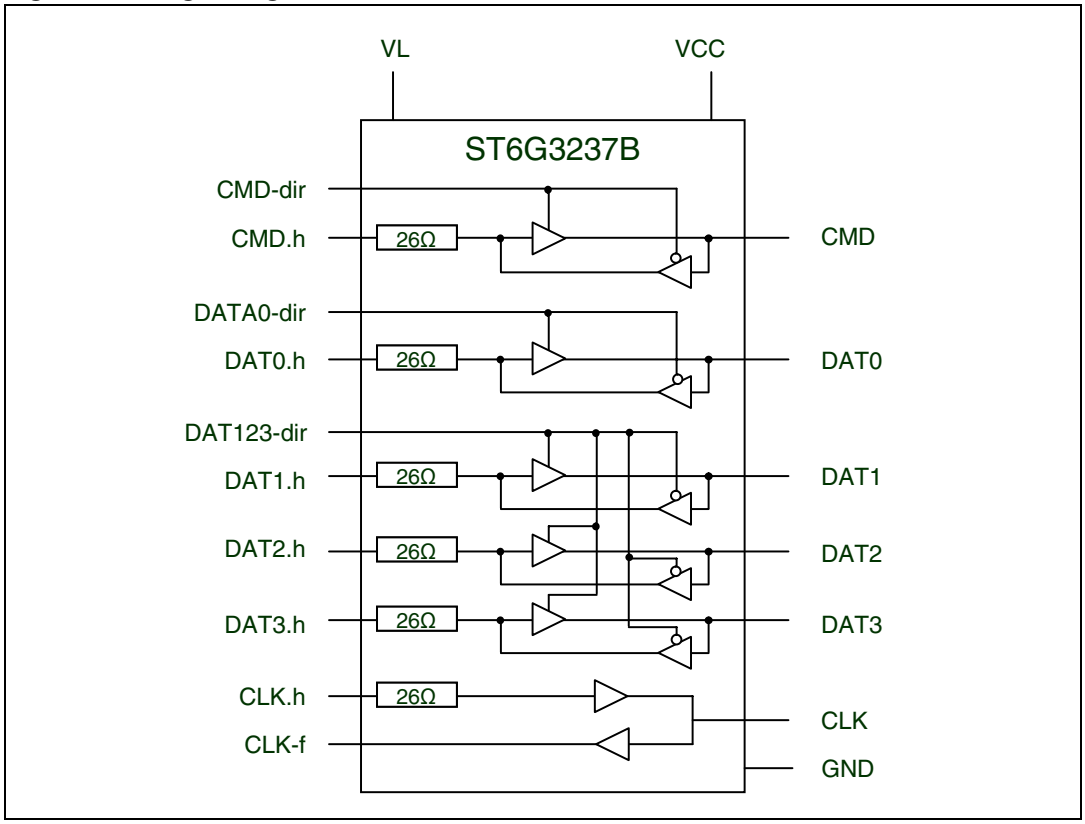


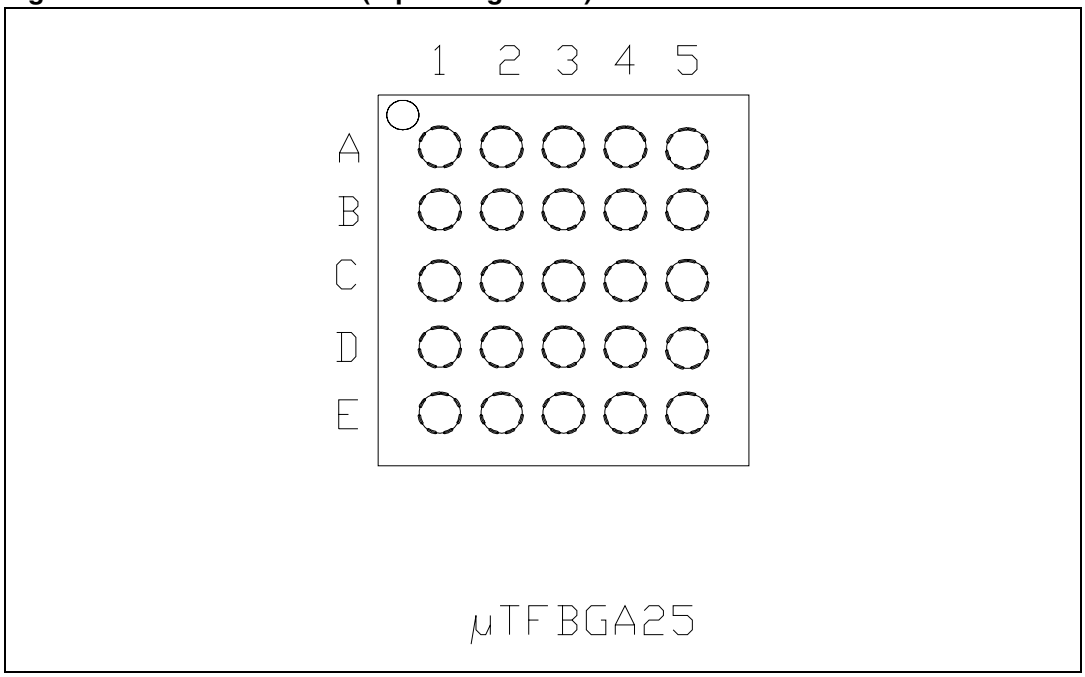
Table 2. Truth table

Function									Output
CMD-dir	**DAT0-dir**	**DAT123-dir**	**CMD.h**	**CMD**	**DAT0.h**	**DAT0**	**DAT1.h DAT2.h DAT3.h**	**DAT1 DAT2 DAT3**	
H	X	X	I	O	X	X	X	X	B = A
L	X	X	O	I	X	X	X	X	A = B
X	H	X	X	X	I	O	X	X	B = A
X	L	X	X	X	O	I	X	X	A = B
X	X	H	X	X	X	X	I	O	B = A
X	X	L	X	X	X	X	O	I	A = B

2 Pin settings

2.1 Pin connections

Figure 2. Pin connections (top through view)



2.2 Pin descriptions

Table 3. Pin descriptions

Pin Nº µTFBGA25	Type	Side	Symbol	Name and function
A2	I	A-side	CMD-dir	Command direction HIGH = A to B LOW = B to A
D2	I/O	A-side	CMD.h	A-side Command
D4	I/O	B-Side	CMD	B-side Command
A3	I	A-Side	DAT0-dir	Data Direction HIGH = A to B (write) LOW = B to A (read)
D1	I/O	A-Side	DAT0.h	Data Input / Output
D5	I/O	B-Side	DAT0	Data Input / Output
E3	I	A-Side	DAT123-dir	Data Direction HIGH = A to B (write) LOW = B to A (read)
E1	I/O	A-Side	DAT1.h	Data Input / Output
A1	I/O	A-Side	DAT2.h	Data Input / Output
B1	I/O	A-Side	DAT3.h	Data Input / Output
E5	I/O	B-Side	DAT1	Data Input / Output
A5	I/O	B-Side	DAT2	Data Input / Output
B5	I/O	B-Side	DAT3	Data Input / Output
C1	I	A-Side	CLK.h	Clock Input
C5	O	B-Side	CLK	Clock Output
E2	O	A-Side	CLK-f	Clock Feedback
B3	-	A-Side	V_{CCA}	Power supply
B4	-	B-Side	V_{CCB}	Power supply
C3, C4	-	-	GND	Ground (0V)
A4, B2, C2, D3, E4	-	-	NC	No connect

- **CMD, Command** is a bidirectional line. The host and card drivers are operating in push-pull.
- **DAT0-3, Data lines** are bi-directional lines. Host and card drivers are operating in push-pull mode.
- **CLK, Clock** is a host to card signal. CLK operates in push-pull mode.
- **Feedback (return) Clock** is feedback clock signal from level shifter to host for controlling delays.

3 Electrical ratings

Stressing the device above the rating listed in the “Absolute Maximum Ratings” table may cause permanent damage to the device. These are stress ratings only and operation of the device at these or any other conditions above those indicated in the Operating sections of this specification is not implied. Exposure to Absolute Maximum Rating conditions for extended periods may affect device reliability. Refer also to the STMicroelectronics SURE Program and other relevant quality documents.

Table 4. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{CCA}	Supply voltage	-0.5 to 4.6	V
V_{CCB}	Supply voltage	-0.5 to 4.6	V
V_I	DC input voltage	-0.5 to 4.6	V
$V_{I/OA}$	DC I/O voltage (output disabled)	-0.5 to 4.6	V
$V_{I/OB}$	DC I/O voltage (output disabled)	-0.5 to 4.6	V
$V_{I/OA}$	DC output voltage	-0.5 to V_{CCA} + 0.5	V
$V_{I/OB}$	DC output voltage	-0.5 to V_{CCB} + 0.5	V
I_{IK}	DC input diode current	-20	mA
I_{OK}	DC output diode current	-50	mA
I_{OA}	DC output current	±50	mA
I_{OB}	DC output current	±50	mA
I_{CCA}	DC V_{CC} or ground current	±100	mA
I_{CCB}	DC V_{CC} or ground current	±100	mA
P_D	Power dissipation	400	mW
T_{STG}	Storage temperature	-65 to +150	°C
T_L	Lead temperature (10 sec)	260	°C

Table 5. Recommended operating conditions

Symbol	Parameter	Value	Unit
V_{CCA}	Supply Voltage	1.4 to V_{CCB}	V
V_{CCB}	Supply Voltage	1.4 to 3.6	V
V_I	Input Voltage (CMD-dir/DAT0-dir/DAT123-dir)	0 to V_{CCA}	V
$V_{I/OA}$	I/O Voltage	0 to V_{CCA}	V
$V_{I/OB}$	I/O Voltage	0 to V_{CCB}	V
T_{op}	Operating Temperature	-40 to +85	°C
dt/dv	Input Rise and Fall Time (1)	0 to 10	ns/V

1. V_{IN} from 0.8V to 2.0V at V_{CC} = 3.0V

4 Electrical characteristics

4.1 DC electrical characteristics

Table 6. DC specifications

Symbol	Parameter	Test Conditions		Value					Unit
		Vcc (V)		T_A = 25°C			-40 to 85°C		
				Min	Typ	Max	Min	Max	
V_{IH} (A port)	High Level Input Voltage	1.4 – 1.95	V_{CCA} to 3.6	$0.65V_{CCA}$			$0.65V_{CCA}$		V
		1.95 – 2.7		1.7			1.7		
		2.7 – 3.6		2.0			2.0		
V_{IL} (A port)	Low Level Input Voltage	1.4 – 1.95	V_{CCA} to 3.6			$0.35V_{CCA}$		$0.35V_{CCA}$	V
		1.95 – 2.7				0.7		0.7	
		2.7 – 3.6				0.8		0.8	
V_{IH} (B port)	High Level Input Voltage	1.4 to V_{CCB}	1.4 – 1.95	$0.65V_{CCB}$			$0.65V_{CCB}$		V
			1.95 – 2.7	1.7			1.7		
			2.7 – 3.6	2.0			2.0		
V_{IL} (B port)	Low Level Input Voltage	1.4 to V_{CCB}	1.4 – 1.95			$0.35V_{CCB}$		$0.35V_{CCB}$	V
			1.95 – 2.7			0.7		0.7	
			2.7 – 3.6			0.8		0.8	

- All A-port I/Os and control inputs are powered by V_{CCA}
- All B-port I/Os are powered by V_{CCB}

Table 7. DC specifications

Symbol	Parameter	Test conditions			Value					Unit
		V_{CCA} (V)	V_{CCB} (V)		T_A = 25°C			-40 to 85°C		
					Min	Typ	Max	Min	Max	
V_{OH} (A port)	High level output voltage	1.4-3.6	1.4-3.6	I_{OH} = -100µA	V_{CCA} - 0.1					V
		1.4	1.4	I_{OH} = -1 mA	1.20					
		1.65	1.65	I_{OH} = -2 mA	1.40					
		2.3	2.3	I_{OH} = -4 mA	1.90					
		3	3	I_{OH} = -8 mA	2.45					
V_{OL} (A port)	Low level output voltage	1.4-3.6	1.4-3.6	I_{OL} = 100µA			0.10			V
		1.4	1.4	I_{OL} = 1 mA			0.20			
		1.65	1.65	I_{OL} = 2 mA			0.25			
		2.3	2.3	I_{OL} = 4 mA			0.40			
		3	3	I_{OL} = 8 mA			0.55			
V_{OH} (B port)	High level output voltage	1.4-3.6	1.4-3.6	I_{OH} = -100µA	VCCA - 0.1					V
		1.4	1.4	I_{OH} = -2 mA	1.25					
		1.65	1.65	I_{OH} = -4 mA	1.45					
		2.3	2.3	I_{OH} = -8 mA	1.90					
		3	3	I_{OH} = -24 mA	2.45					
V_{OL} (B port)	Low level output voltage	1.4-3.6	1.4-3.6	I_{OL} = 100µA			0.10			V
		1.4	1.4	I_{OL} = 2 mA			0.15			
		1.65	1.65	I_{OL} = 4 mA			0.20			
		2.3	2.3	I_{OL} = 8 mA			0.30			
		3	3	I_{OL} = 24 mA			0.55			
I_{IA}, I_{IB}	Input leakage current	2.7	3.6	V_I = V_{CC} or GND			±0.1		±1	µA
I_{OFF}	Power OFF leakage current	0	0	V_{IA} = GND to 3.6 V_{IB} = GND to 3.6			±1.0		±10	µA
I_{CCA}	Quiescent supply current for A-side	1.4	1.4-3.6	V_{IA} = V_{CCA} or GND V_{IB} = V_{CCB} or GND DIR = A to B			0.5		5	µA
		1.4 - 3.6	0							
		1.4 - 3.6	3.6							
I_{CCB}	Quiescent supply current	1.4	1.4-3.6	V_{IA} = V_{CCA} or GND V_{IB} = V_{CCB} or GND DIR = B to A			0.5		5	µA
		1.4 - 3.6	3.6							
I_{OZ}	Leakage current when I/O are in High-Z	3.6	3.6	V_{IOA} = V_{CCA} or GND			±0.5		±5	µA

4.2 AC electrical characteristics

Table 8. AC electrical characteristics f = 1MHz, 50% duty cycle, C_L = 30pF, R_L = 500Ω

Symbol		Parameter	Test condition T_A = -40 to 85 °C						Unit
			V_{CCA}=1.8 ± 0.15V		V_{CCA}=1.8 ± 0.15V		V_{CCA}=2.5 ± 0.2V		
			V_{CCB}=2.5 ± 0.2V		V_{CCB}=3.0 ± 0.3V		V_{CCB}=3.0 ± 0.3V		
			Min.	Max.	Min.	Max.	Min.	Max.	
t_{PLH} t_{PHL}		Propagation delay time A to B (CMD)	1.0	3.7	1.0	3.8	1.0	3.6	ns
		Propagation delay time B to A (CMD)	1.0	3.6	1.0	3.9	1.0	3.6	
		Propagation delay time A to B (CLK)	1.0	3.2	1.0	3.4	1.0	3.2	
		Propagation delay time B to A (CLK-f)	1.0	7.6	1.0	7.7	1.0	7.5	
		Propagation delay time An to Bn (DATn)	1.0	6.2	1.0	6.2	1.0	6.2	
		Propagation delay time Bn to An (DATn)	1.0	5.3	1.0	5.3	1.0	5.3	
t_{PZL} t_{PZH}		Output enable time from An to Bn	1.0	2.9	1.0	3.0	1.0	2.9	ns
		Output enable time from Bn to An	1.0	4.3	1.0	4.5	1.0	4.2	
t_{PLZ} t_{PHZ}		Output disable time from An to Bn	1.0	7.8	1.0	8	1.0	7.8	ns
		Output disable time from Bn to An	1.0	5.4	1.0	5.5	1.0	5.3	
t_{OSLH} t_{OSHL}		Output to output skew time (note 1,2)		0.5		0.5		0.5	ns
t_{CDLH} t_{CDHL}		Clock and data skew time		0.5		0.5		0.5	ns
f_{max}	Clock	From A to B	52		52		52		MHz
		From B to A	52		52		52		
	Data	From A to B	52		52		52		Mbps
		From B to A	52		52		52		

4.3 Output slew rate

Table 9. Output slew rate (f = 1MHz, 50% duty cycle, C_L = 30pF, R_L = 500Ω)

Symbol	Parameter	From	To	V_{CCA} = 1.8V ± 0.15V V_{CCB} = 3V ± 0.3V		Unit
				Min.	Max.	
t_r	Rise time	20%	80%		3	ns
t_f	Fall time	80%	20%		3	ns

4.4 Capacitance characteristics

Table 10. Capacitance characteristics

Symbol	Parameter	Test condition			Value			Unit
		V_{CCB} (V)	V_{CCA} (V)		T_A = 25 °C			
					Min.	Typ.	Max.	
C_{INB}	Input capacitance	Open	Open			5		pF
$C_{I/O}$	Input/Output capacitance	3.0	1.8			6		pF
C_{PD} (1)	Power dissipation capacitance	3.0	2.5	f=10MHz		29		pF
		3.0	1.8			29		

1. C_{PD} is defined as the value of the IC's internal equivalent capacitance which is calculated from the operating current consumption without load. (Refer to Test Circuit). Average current can be obtained by the following equation. $I_{CC}(opr) - C_{PD} \times V_{CC} \times f_{IN} + I_{CC}/16$ (per circuit)

5 Test circuit

Figure 3. Test circuit

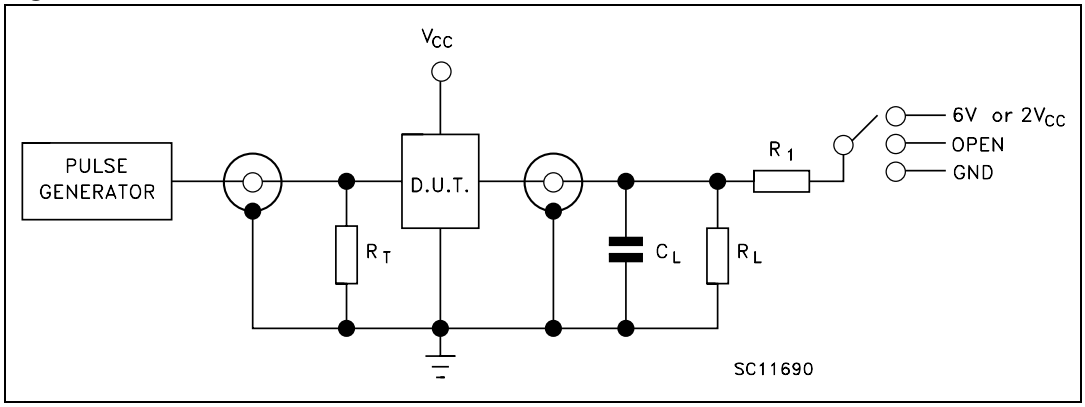


Table 11. Test values

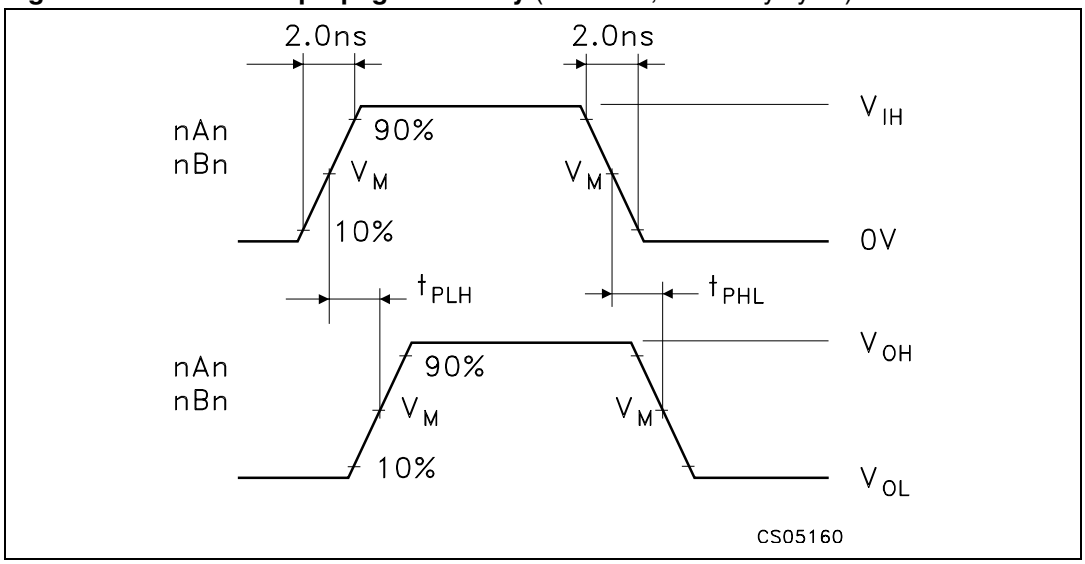
Test	Switch
t_{PLH}, t_{PHL}	Open
$t_{PZ}L$, t_{PLZ} (V_{CC} = 3.0 to 3.6V)	6V
t_{PZL}, t_{PLZ} (V_{CC} = 2.3 to 2.7V or V_{CC} = 1.6 to 1.95V)	$2V_{CC}$
t_{PZH}, t_{PHZ}	GND

Table 12. Waveform symbol value

Symbol	V_{CC}		
	3.0 to 3.6V	2.3 to 2.7V	1.65 to 1.95V
V_{IH}	V_{CC}	V_{CC}	V_{CC}
V_M	1.5V	$V_{CC}/2$	$V_{CC}/2$
V_X	V_{OL} + 0.3V	V_{OL} + 0.15V	V_{OL} + 0.15V
V_Y	V_{OL} - 0.3V	V_{OL} - 0.15V	V_{OL} - 0.15V

- C_L = 30pF or equivalent (includes jig and probe capacitance)
- R_L = R_1 = 500Ω or equivalent
- R_T = Z_{OUT} of pulse generator (typically 50Ω)

Figure 4. Waveform - propagation delay (f = 1MHz, 50% duty cycle)



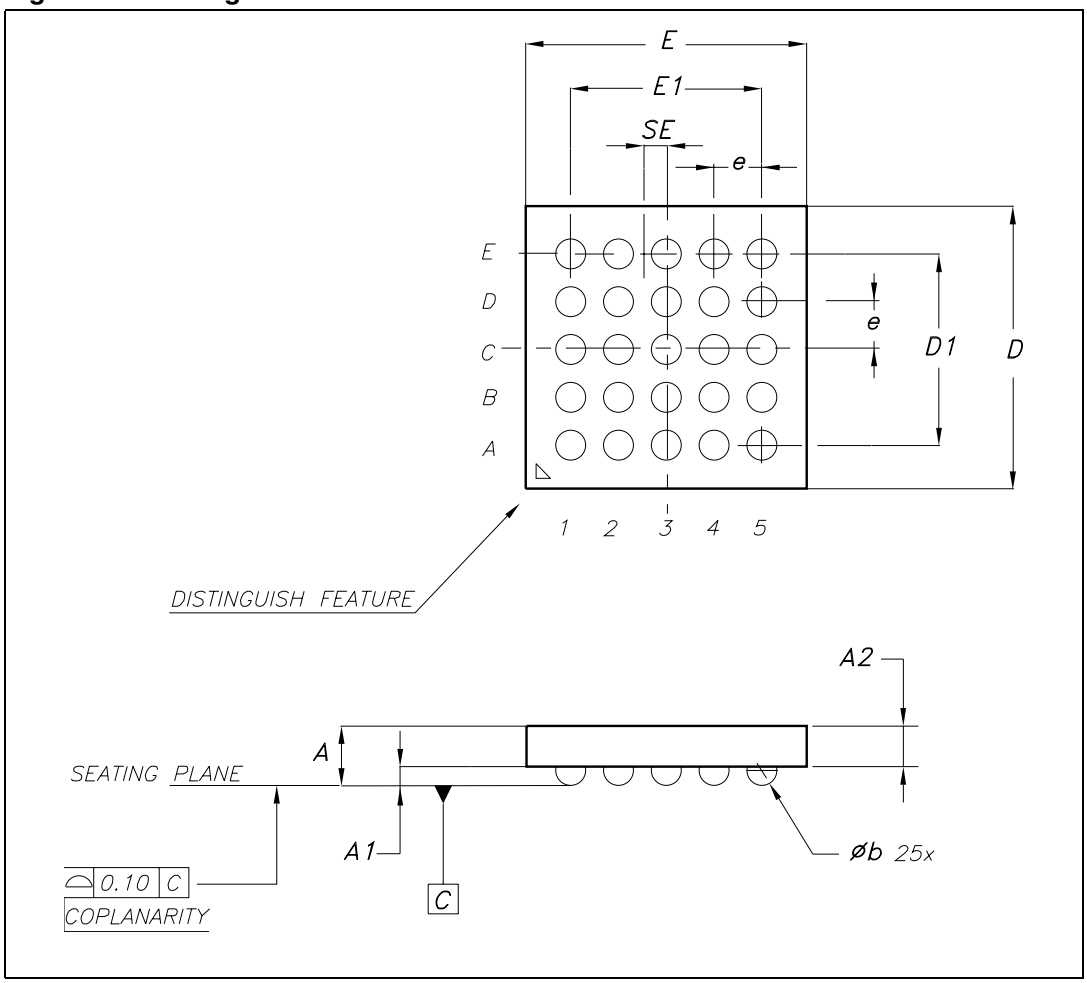
6 Package mechanical data

In order to meet environmental requirements, ST offers these devices in ECOPACK® 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

Table 13. µTFBGA25 Mechanical data

Dim.	mm.			mils		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	1.0	1.1	1.16	39.4	43.3	45.7
A1			0.25			9.8
A2	0.78		0.86	30.7		33.9
b	0.25	3.0	3.1	114.2	118.1	122.0
D	2.9	3.0	3.1	114.2	118.1	122.0
D1		2			78.8	
E	2.9	3.0	3.1	114.2	118.1	122.0
E1		2			78.8	
e		0.5			19.7	
SE		0.25			9.8	

Figure 5. Package dimensions



7 Revision history

Table 14. Revision history

Date	Revision	Changes
14-Jun-2007	1	First release

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