Contents

1 General description

Figure 1. Logic diagram

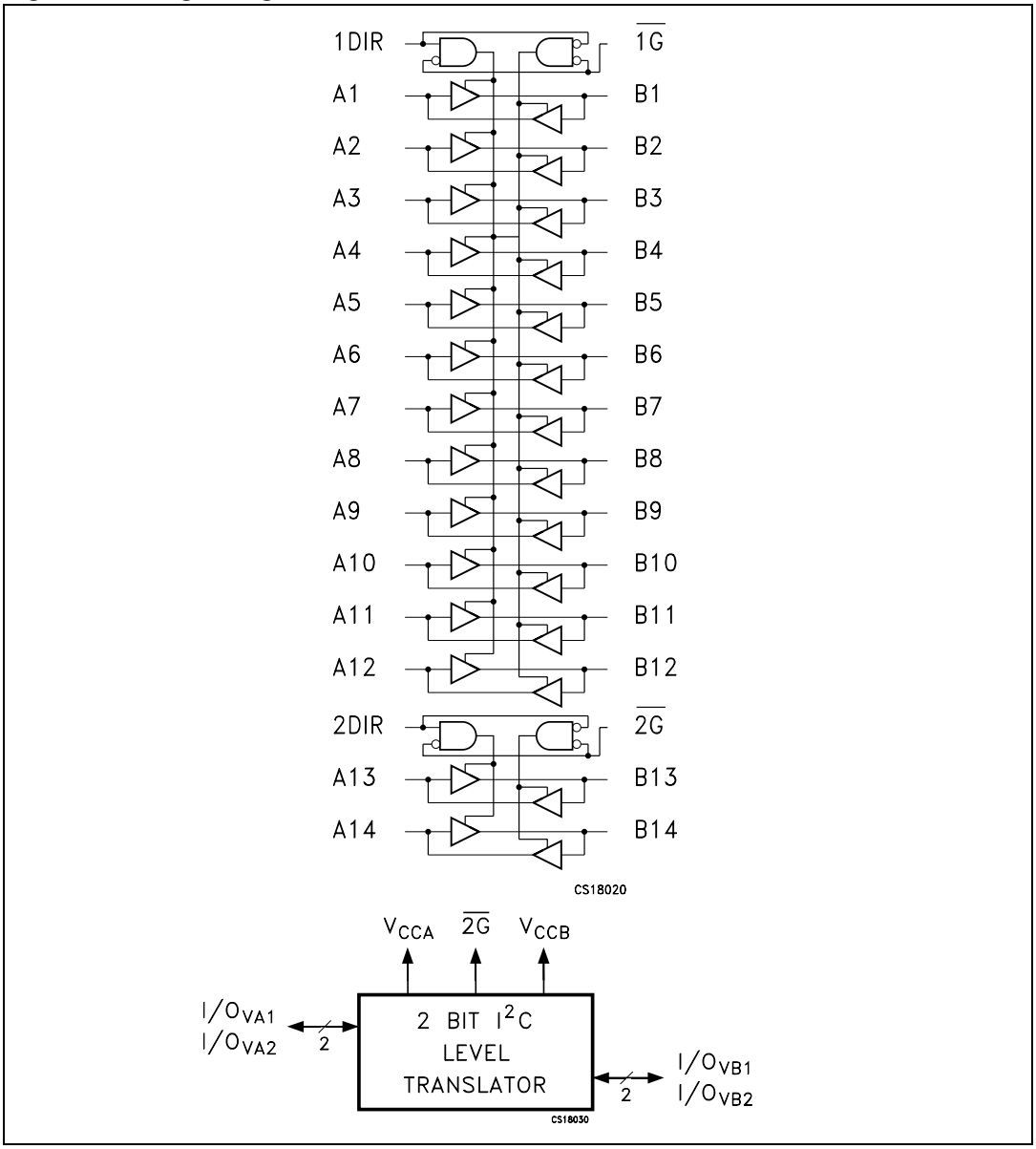
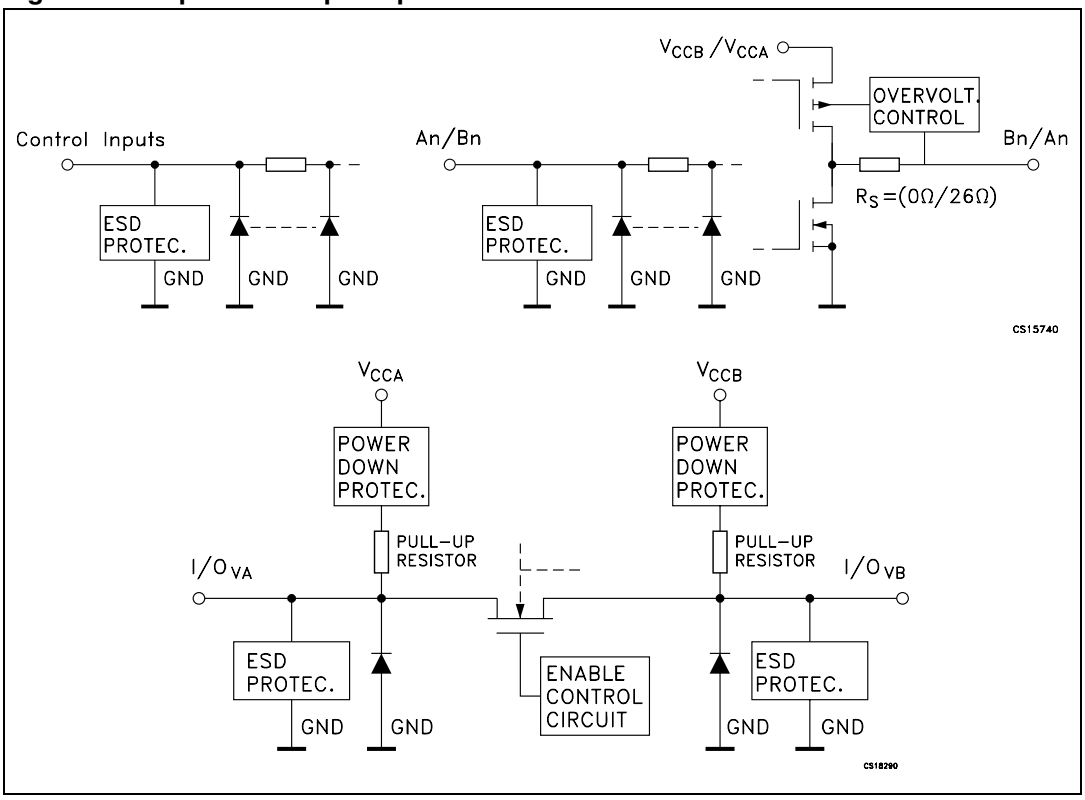


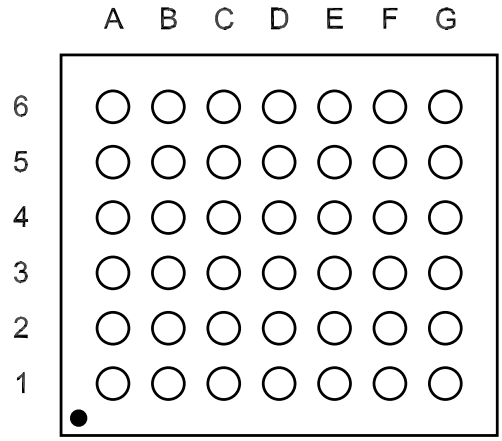
Figure 2. Input and output equivalent circuit



2 Pin settings

2.1 Pin connection

Figure 3. Pin connection (top through view)



µTFBGA42

Table 2. Pin description

Pin number	Symbol	Name and function
B3	1DIR	Directional controls
F3	2DIR	Directional controls
A4, A5, A6, B5, B6, C5, C6, D5	A1, A2, A3, A4, A5, A6, A7, A8	Data Inputs/outputs
D6, E5, E6, F5, F6, G6	A9, A10, A11, A12, A13, A14	Data Inputs/outputs
A3, A2, A1, B2, B1, C2, C1, D2	B1, B2, B3, B4, B5, B6, B7, B8	Data Inputs/outputs
D1, E2, E1, F2, F1, G1	B9, B10, B11, B12, B13, B14	Data Inputs/outputs
F4	$\overline{2G}$	Output enable inputs
B4	$\overline{1G}$	Output enable inputs
C3, C4, E3, E4	GND	Ground (0V)
-	NC	No connected
D4	V_{CCA}	Positive supply voltage
D3	V_{CCB}	Positive supply voltage
G5, G4	I/O_{VA1}, I/O_{VA2}	I^2C Line (V_{CCA} referred)
G2, G3	I/O_{VB1}, I/O_{VB2}	I^2C Line (V_{CCB} referred)

Table 3. Truth table

Inputs		Function		Output
$\overline{G}$	DIR	A bus	B bus	
L	L	Output	Input	A = B
L	H	Input	Output	B = A
H	X	Z	Z	Z

Note: X = don't care; Z = high Impedance

2.2 I^2C bus function

Table 4. I^2C Bus function table

$\overline{2G}$	$\overline{1G}$, 1DIR, 2DIR	I/O input		Function
		I/O_{VA}	I/O_{VB}	
H	X	Z	Z	I^2C disabled
L	X	L	L	I^2C comm.
L	X	V_{CCA}	V_{CCB}	I^2C comm.
L	X	Open	V_{CCB}	I^2C comm.
L	X	V_{CCA}	Open	I^2C comm.

Note: Open: If I/O_{VA} is not driven then the I/O_{VB} goes in high level V_{CCB} by embedded 10 kΩ pull-up resistor. If I/O_{VB} is not driven then the I/O_{VA} will go in high level V_{CCB} by embedded 10 kΩ pull-up resistor.

3 Maximum rating

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.

Table 5. 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 I/O voltage	-0.5 to V_{CCA} + 0.5	V
$V_{I/OB}$	DC I/O voltage	-0.5 to V_{CCB} + 0.5	V
$V_{I/OVA}$	Level input voltage (I/O_{VA})	-0.5 to V_{CCA} + 0.5	V
$V_{I/OVB}$	Level input voltage (I/O_{VB})	-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

3.1 Recommended operating conditions

Table 6. Recommended operating conditions

Symbol	Parameter	Value	Unit
V_{CCA}	Supply voltage	2.3 to 3.6	V
V_{CCB}	Supply voltage	1.65 to 2.7	V
V_I	Input voltage (Dir, $\overline{G}$)	0 to V_{CCB}	V
$V_{I/OA}$	I/O voltage	0 to V_{CCA}	V
$V_{I/OB}$	I/O voltage	0 to V_{CCB}	V
$V_{I/OVA}$	Level input voltage (I\O$_{VA}$)	0 to V_{CCA}	V
$V_{I/OVB}$	Level input voltage (I\O$_{VB}$)	0 to V_{CCB}	V
T_{op}	Operating temperature	-40 to +85	°C
dt/dv	Input rise and fall time	0 to 10	ns/V

4 Electrical characteristics

Table 7. DC specification for V_{CCA}

Symbol	Parameter	Test condition			Value				Unit
		V_{CCB} (V)	V_{CCA} (V)		T_A = 25 °C		-40 to 85°C		
					Min	Max	Min	Max	
V_{IHA}	High level input voltage (An)(1)	1.8	2.5		1.6		1.6		V
		1.8	3.3		2.0		2.0		
		2.5	3.3		2.0		2.0		
V_{ILA}	Low level input voltage (An)(1)	1.8	2.5			0.7		0.7	V
		1.8	3.3			0.8		0.8	
		2.5	3.3			0.8		0.8	
V_{OHA}	High level output voltage	2.3	3.0	I_O = -100 µA	2.8		2.8		V
		2.3	3.0	I_O = -8 mA	2.4		2.4		
		1.65	3.0	I_O = -8 mA	2.4		2.4		
		1.65	2.3	I_O = -6 mA	1.8		1.8		
V_{OLA}	Low level output voltage	2.3	3.0	I_O = 100 µA		0.2		0.2	V
		2.3	3.0	I_O = 8 mA		0.55		0.55	
		1.65	3.0	I_O = 8 mA		0.55		0.55	
		1.65	2.3	I_O = 6 mA		0.40		0.40	
I_{IA}	Input leakage current	2.7	3.6	V_I = V_{CC} or GND		±0.5		±5	µA
$I_{IA(HOLD)}$	Input hold current	1.65	2.3	V_I = 0.7 V	45		45		µA
		1.65	2.3	V_I = 1.6 V	-45		-45		
		1.65	3.0	V_I = 0.8 V	75		75		
		1.65	3.0	V_I = 2.0 V	-75		-75		
		2.3	3.0	V_I = 0.8 V	75		75		
		2.3	3.0	V_I = 2.0 V	-75		-75		
		2.7	3.6	V_I = 0 to 3.6 V				±500	
I_{OZA}	High impedance output leakage current	2.7	3.6	V_{IA} = GND or 3.6 V V_{IB} = V_{IHB} or V_{ILB} $\overline{G}$ = V_{CCB}		±1.0		±10	µA
I_{OFF}	Power off leakage current	0	0	V_{IA} = GND to 3.6 V V_{IB} = GND to 3.6 V $\overline{G}$, Dir = GND to 3.6 V		±1.0		±10	µA

Table 7. DC specification for V_{CCA} (continued)

Symbol	Parameter	Test condition			Value				Unit
		V_{CCB} (V)	V_{CCA} (V)		T_A = 25 °C		-40 to 85°C		
					Min	Max	Min	Max	
I_{OFFI2C}	Power Off I^2C line leakage current	1.65 to 2.7	0	$I/O_{VA1,2}$ = GND or V_{CCA}; $I/O_{VB1,2}$ = GND or V_{CCB}; $\overline{2G}$ = V_{CCB}		1.0		5	µA
I_{CCtA}	Quiescent supply current	1.95	3.6	V_{IA} = V_{CCA} or GND V_{IB} = V_{CCB} or GND $I/O_{VA1,2}$ = V_{CCA} or Open; Dir, $\overline{G}$ = GND or V_{CCB}		2		20	µA
		1.95	2.7						
		2.7	3.6						
ΔI_{CCtA}	Maximum quiescent supply current / Input (An)	2.7	3.6	V_{IA} =V_{CCA} - 0.6V V_{IB} =V_{CCB} or GND				0.75	mA
		1.95	3.6						
		1.95	2.7						

1. V_{CC} range = 3.3±0.3; 2.5±0.2V and 2.8±0.1V; 1.8±0.15V

Table 8. DC specification for V_{CCB}

Symbol	Parameter	Test condition			Value				Unit
		V_{CCB} (V)	V_{CCA} (V)		T_A = 25 °C		-40 to 85°C		
					Min	Max	Min	Max	
V_{IHB}	High level input voltage (Bn, Dir, $\overline{G}$)(1)	1.8	2.5		0.65V_{CCB}		0.65V_{CCB}		V
		1.8	3.3		0.65V_{CCB}		0.65V_{CCB}		
		2.5	3.3		1.6		1.6		
V_{ILB}	Low level input voltage (Bn, Dir, $\overline{G}$) (1)	1.8	2.5			0.35V_{CCB}		0.35V_{CCB}	V
		1.8	3.3			0.35V_{CCB}		0.35V_{CCB}	
		2.5	3.3			0.7		0.7	
V_{OHB}	High level output voltage	2.3	3.0	I_O=-100µA	2.1		2.1		V
		2.3	3.0	I_O=-18mA	1.7		1.7		
		1.65	3.0	I_O=-6mA	1.25		1.25		
		1.65	2.3	I_O=-6mA	1.25		1.25		
V_{OLB}	Low level output voltage	2.3	3.0	I_O=100µA		0.2		0.2	V
		2.3	3.0	I_O=18mA		0.60		0.60	
		1.65	3.0	I_O=6mA		0.30		0.30	
		1.65	2.3	I_O=6mA		0.30		0.30	
I_{IB}	Input leakage current	2.7	3.6	V_I = V_{CC} or GND		±0.5		±5	µA

Table 8. DC specification for V_{CCB} (continued)

Symbol	Parameter	Test condition			Value				Unit
		V_{CCB} (V)	V_{CCA} (V)		T_A = 25 °C		-40 to 85°C		
					Min	Max	Min	Max	
$I_{IB(HOLD)}$	Input hold current	1.65	2.3	V_I = 0.57 V	25		25		µA
		1.65	2.3	V_I = 1.07 V	-25		-25		
		1.65	3.0	V_I = 0.57 V	25		25		
		1.65	3.0	V_I = 1.07 V	-25		-25		
		2.3	3.0	V_I = 0.7 V	45		45		
		2.3	3.0	V_I = 1.6 V	-45		-45		
		2.7	3.6	V_I = 0 to 2.7 V				±500	
I_{OZB}	High impedance output leakage current	2.7	3.6	V_{IA} = V_{IHA} or V_{ILA} V_{IB} = GND or 2.7V $\overline{G}$ = V_{CCB}		±1.0		±10	µA
I_{CCtB}	Quiescent supply current	1.95	3.6	V_{IA} =V_{CCA} or GND V_{IB} =V_{CCB} or GND Dir or $\overline{G}$=V_{CCB} or GND $I/O_{VA1,2}$=V_{CCA} or Open		2		20	µA
		1.95	2.7						
		2.7	3.6						
ΔI_{CCtB}	Maximum quiescent supply current / Input (Bn, DIR, $\overline{G}$)	2.7	3.6	V_{IB} =V_{CCB} - 0.6V V_{IA} =V_{CCA} or GND				0.75	mA
		1.95	3.6						
		1.95	2.7						

1. V_{CC} range = 3.3±0.3; 2.5±0.2V and 2.8±0.1V; 1.8±0.15V

Table 9. Dynamic switching characteristics

Symbol	Parameter	Test condition			Value					Unit
		V_{CCB} (V)	V_{CCA} (V)		T_A = 25 °C			-40 to 85 °C		
					Min	Typ	Max	Min	Max.	
V_{OLPA}	Dynamic low level quiet An output	1.8	2.5	C_L = 30 pF V_{IL} = 0 V V_{IH} = V_{CC}		0.25				V
		1.8	3.3			0.35				
		2.5	3.3			0.35				
V_{OLPB}	Dynamic low level quiet Bn output	1.8	2.5	C_L = 30 pF V_{IL} = 0 V V_{IH} = V_{CC}		0.25				V
		1.8	3.3			0.25				
		2.5	3.3			0.6				
V_{OLVA}	Dynamic low level quiet An output	1.8	2.5	C_L = 30 pF V_{IL} = 0 V V_{IH} = V_{CC}		-0.25				V
		1.8	3.3			-0.35				
		2.5	3.3			-0.35				
V_{OLVB}	Dynamic low level quiet Bn output	1.8	2.5	C_L = 30 pF V_{IL} = 0 V V_{IH} = V_{CC}		-0.25				V
		1.8	3.3			-0.25				
		2.5	3.3			-0.6				
V_{OHVA}	Dynamic high level quiet An output	1.8	2.5	C_L = 30 pF V_{IL} = 0 V V_{IH} = V_{CC}		2.1				V
		1.8	3.3			2.6				
		2.5	3.3			2.6				
V_{OHVB}	Dynamic high level quiet Bn output	1.8	2.5	C_L = 30 pF V_{IL} = 0 V V_{IH} = V_{CC}		1.7				V
		1.8	3.3			1.7				
		2.5	3.3			2.0				

Table 10. DC specification I^2C lines

Symbol	Parameter	Test condition			Value				Unit
		V_{CCB} (V) (1)	V_{CCA} (V)		T_A = 25 °C		-40 to 85 °C		
					Min.	Max.	Min.	Max.	
V_{IH2}	High level input voltage (I/O_{VB1}, I/O_{VB2})	1.8	2.65 to 3.6		0.7 V_{CCB}	V_{CCB}	0.7 V_{CCB}	V_{CCB}	V
		1.8	2.65 to 3.6		0.7 V_{CCB}	V_{CCB}	0.7 V_{CCB}	V_{CCB}	
	High level input voltage (I/O_{VA1}, I/O_{VA2})	1.8	2.65 to 3.6		0.7 V_{CCA}	V_{CCA}	0.7 V_{CCA}	V_{CCA}	
		1.8	2.65 to 3.6		0.7 V_{CCA}	V_{CCA}	0.7 V_{CCA}	V_{CCA}	
V_{IL2}	Low level input voltage (I/O_{VB1}, I/O_{VB2})	1.8	2.65 to 3.6		0	0.25	0	0.25	V
		1.8	2.65 to 3.6		0	0.25	0	0.25	
	Low level input voltage (I/O_{VA1}, I/O_{VA2})	1.8	2.65 to 3.6		0	0.25	0	0.25	
		1.8	2.65 to 3.6		0	0.25	0	0.25	
V_{OH2}	High level output voltage (I/O_{VB1}, I/O_{VB2})	1.65	2.3	I_{OH} = -20 µA; $V_{I/OVA}$=V_{CCA}	V_{CCB}-0.4		V_{CCB}-0.4		V
	High level output voltage (I/O_{VA1}, I/O_{VA2})	1.65	2.3	I_{OH} = -20 µA; $V_{I/OVB}$=V_{CCB}	V_{CCA}-0.4		V_{CCA}-0.4		
V_{OL2}	Low level output voltage (I/O_{VB1}, I/O_{VB2}), (I/O_{VA1}, I/O_{VA2})	1.65	2.3	I_{OL} = 1 mA; $V_{I/OVB}$ or $V_{I/OVA}$=GND		0.35		0.35	V

1. V_{CC} range = 1.8±0.15 V

Table 11. AC electrical characteristics

Symbol	Parameter	Test condition			Value		Unit
		V_{CCB} (V)	V_{CCA} (V)		-40 to 85 °C		
					Min	Max	
t_{PLH} t_{PHL}	Propagation delay time An to Bn	1.8 ±0.15	2.5 ±0.2	C_L = 30 pF R_L = 500 Ω	1.0	5.8	ns
		1.8 ±0.15	3.3 ±0.3		1.0	6.2	
		2.5 ±0.2	3.3 ±0.3		1.0	4.4	
t_{PLH} t_{PHL}	Propagation delay time Bn to An (1)	1.8 ±0.15	2.5 ±0.2	C_L = 30 pF R_L = 500 Ω	1.0	5.5	ns
		1.8 ±0.15	3.3 ±0.3		1.0	5.1	
		2.5 ±0.2	3.3 ±0.3		1.0	4.0	
t_{PZL} t_{PZH}	Output enable time $\overline{G}$ to An	1.8 ±0.15	2.5 ±0.2	C_L = 30 pF R_L = 500 Ω	1.0	5.3	ns
		1.8 ±0.15	3.3 ±0.3		1.0	5.1	
		2.5 ±0.2	3.3 ±0.3		1.0	4.0	
t_{PZL} t_{PZH}	Output enable time $\overline{G}$ to Bn	1.8 ±0.15	2.5 ±0.2	C_L = 30 pF R_L = 500 Ω	1.0	8.3	ns
		1.8 ±0.15	3.3 ±0.3		1.0	8.2	
		2.5 ±0.2	3.3 ±0.3		1.0	4.6	
t_{PLZ} t_{PHZ}	Output disable time $\overline{G}$ to An	1.8 ±0.15	2.5 ±0.2	C_L = 30 pF R_L = 500 Ω	1.0	5.2	ns
		1.8 ±0.15	3.3 ±0.3		1.0	5.6	
		2.5 ±0.2	3.3 ±0.3		1.0	4.8	
t_{PLZ} t_{PHZ}	Output disable time $\overline{G}$ to Bn	1.8 ±0.15	2.5 ±0.2	C_L = 30 pF R_L = 500 Ω	1.0	4.6	ns
		1.8 ±0.15	3.3 ±0.3		1.0	4.5	
		2.5 ±0.2	3.3 ±0.3		1.0	4.4	
t_{OSLH} t_{OSHL}	Output to output skew time (2) (3)	1.8 ±0.15	2.5 ±0.2	C_L = 30 pF R_L = 500 Ω		0.5	ns
		1.8 ±0.15	3.3 ±0.3			0.5	
		2.5 ±0.2	3.3 ±0.3			0.75	

1. To add 2.5 ns at t_{PLH}, t_{PHL} max propagation delay time Bn to An at V_{CCB} =1.8 ±0.15 V; V_{CCA}= 2.8 ±0.1 V; R_L= 500 Ω, when C_L=60 pF.
2. Skew is defined as the absolute value of the difference between the actual propagation delay for any two outputs of the same device switching in the same direction, either HIGH or LOW (t_{OSLH} = | t_{PLHm} - t_{PLHn}|, t_{OSHL} = | t_{PHLm} - t_{PHLn}|.
3. Parameter guaranteed by design.

Table 12. AC I^2C electrical characteristics

Symbol	Parameter	Test condition			Value		Unit
		V_{CCB} (V)(1)	V_{CCA} (V)(1)		-40 to 85 °C		
					Min.	Max.	
$t_{rI/O}$	Rise time I^2C input/output voltage (20% to 80%)	1.8 ±0.15	2.5 ±0.2	C_L = 15 pF $t_{rI/O}$ = 15 ns		250	ns
		1.8 ±0.15	3.3 ±0.3				
		2.5 ±0.2	3.3 ±0.3				
$t_{fI/O}$	Fall time I^2C input/output voltage (80% to 20%)	1.8 ±0.15	2.5 ±0.2	C_L = 15 pF $t_{rI/O}$ = 15 ns		250	ns
		1.8 ±0.15	3.3 ±0.3				
		2.5 ±0.2	3.3 ±0.3				
t_{PLH}	Propagation delay time I^2C I/O voltage (20% to 80%) (low to high)	1.8 ±0.15	2.5 ±0.2	C_L = 15 pF $t_{rI/O}$ = 15 ns		100	ns
		1.8 ±0.15	3.3 ±0.3				
		2.5 ±0.2	3.3 ±0.3				
t_{PHL}	Propagation delay time I^2C I/O voltage (20% to 80%) high to low)	1.8 ±0.15	2.5 ±0.2	C_L = 15 pF $t_{rI/O}$ = 15 ns		100	ns
		1.8 ±0.15	3.3 ±0.3				
		2.5 ±0.2	3.3 ±0.3				
$f_{I/OVA}$, $f_{I/OVB}$	I^2C lines data rate	1.8 ±0.15	2.5 ±0.2	C_L = 15 pF $t_{rI/O}$ = 15 ns	400		KHz
		1.8 ±0.15	3.3 ±0.3				
		2.5 ±0.2	3.3 ±0.3				

1. V_{CC} range = 3.3±0.3; 2.5±0.2 V and 2.8 ±0.1 V; 1.8 ±0.15 V

Table 13. Capacitance characteristics

Symbol	Parameter	Test condition			Value					Unit
		V_{CCB} (V)	V_{CCA} (V)		T_A = 25 °C			-40 to 85 °C		
					Min	Typ	Max	Min	Max	
C_{INB}	Input capacitance	open	open			5				pF
$C_{I/O}$	Input/Output capacitance	2.5	3.3			6				pF
C_{PD} (1)	Power dissipation capacitance	2.5	3.3	f = 10MHz		28				pF
		1.8	3.3			28				pF

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. $I_{CC(opr)} = C_{PD} \times V_{CC} \times f_{IN} + I_{CC}/14$ (per circuit)

5 Test circuit

Figure 4. Test circuit

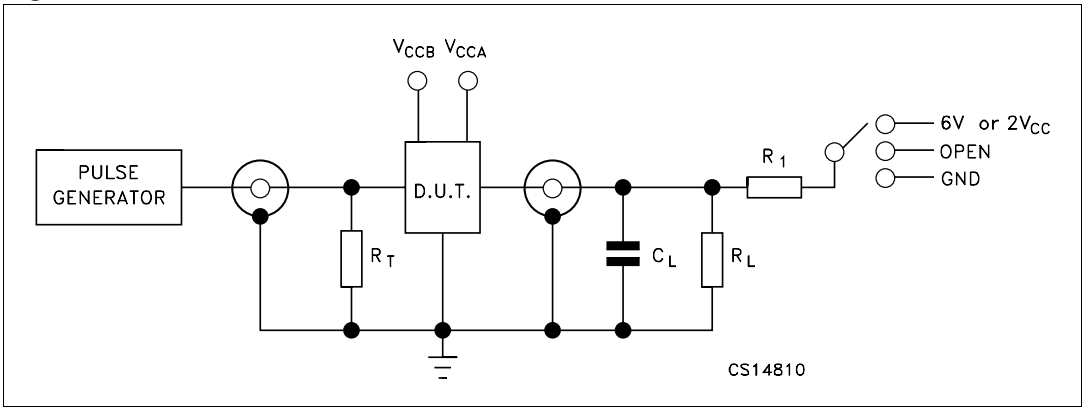


Table 14. Test circuit

Test	Switch
t_{PLH}, t_{PHL}	Open
t_{PZL}, t_{PLZ} (V_{CC} = 3.0 to 3.6 V)	6 V
t_{PZL}, t_{PLZ} (V_{CC} = 2.3 to 2.7 V or V_{CC} = 1.65 to 1.95 V)	$2V_{CC}$
t_{PZH}, t_{PHZ}	GND

C_L = 10/30 pF or equivalent (includes jig and probe capacitance)

R_L = R_1 = 500Ω or equivalent

R_T = Z_{OUT} of pulse generator (typically 50Ω)

6 Waveforms

Table 15. Waveform symbol value

Symbol	V_{CC}		
	3.0 to 3.6 V	2.3 to 2.7 V	1.65 to 1.95 V
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

Figure 5. Waveform - propagation delay (f = 1 MHz; 50% duty cycle)

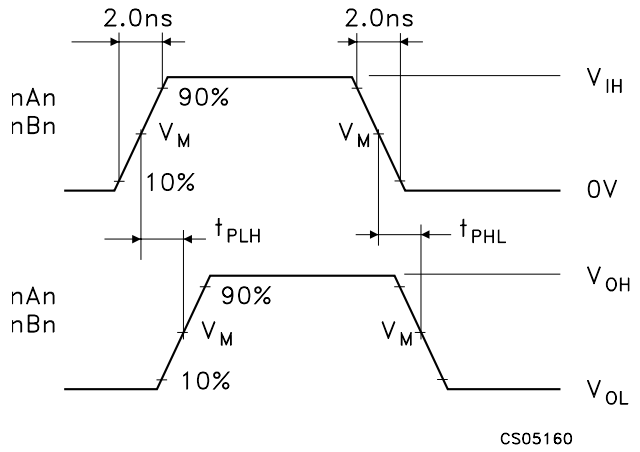


Figure 6. Waveform - output enable and disable time (f = 1 MHz; 50% duty cycle)

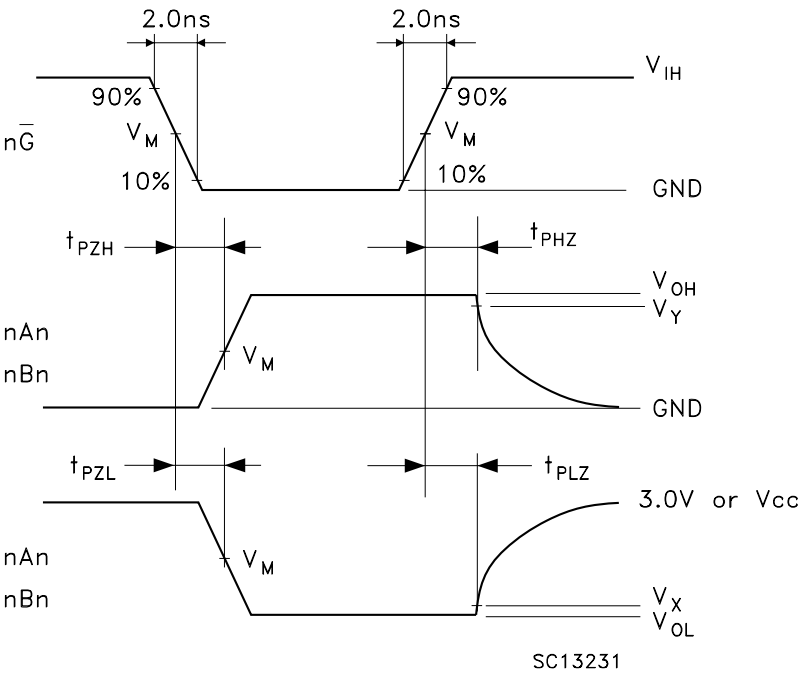
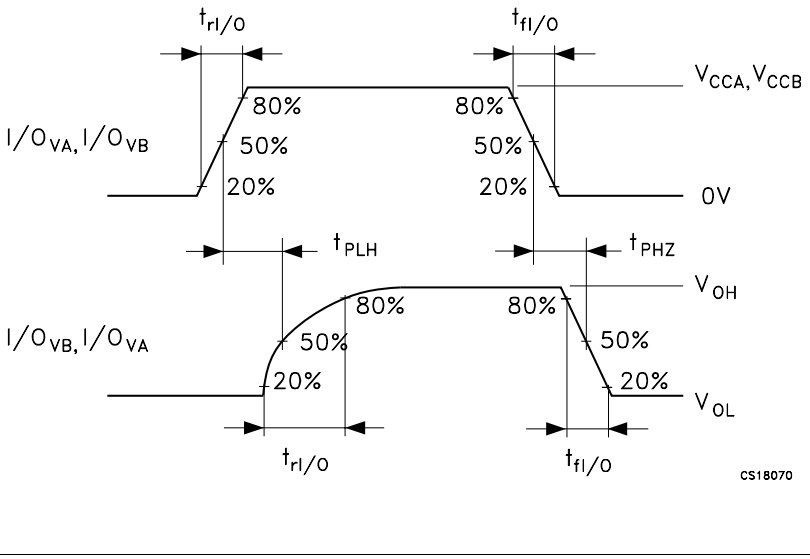


Figure 7. Waveform - I^2C propagation delay time (f = 400 KHz; 50% duty cycle, C_L = 15 pF)



7 Package mechanical data

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: www.st.com. ECOPACK® is an ST trademark.

Figure 8. µTFBGA42 mechanical data

µTFBGA42 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	0.30	0.35	9.8	11.8	13.8
D	3.9	4.0	4.1	153.5	157.5	161.4
D1		3			118.1	
E	3.4	3.5	3.6	133.9	137.8	141.7
E1		2.5			98.4	
e		0.5			19.7	
SE		0.25			9.8	

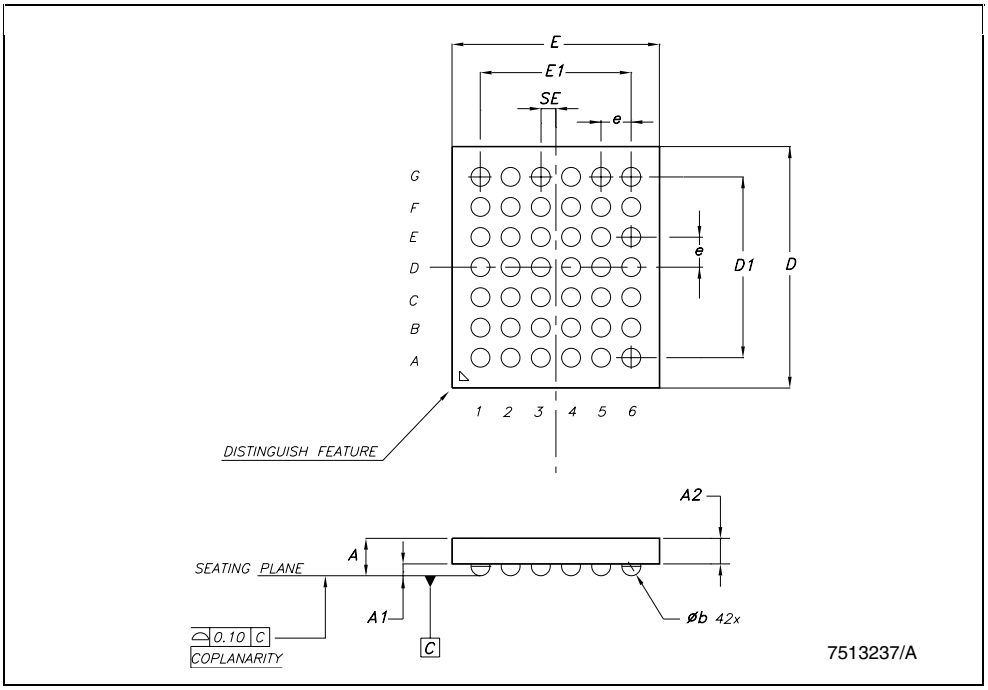
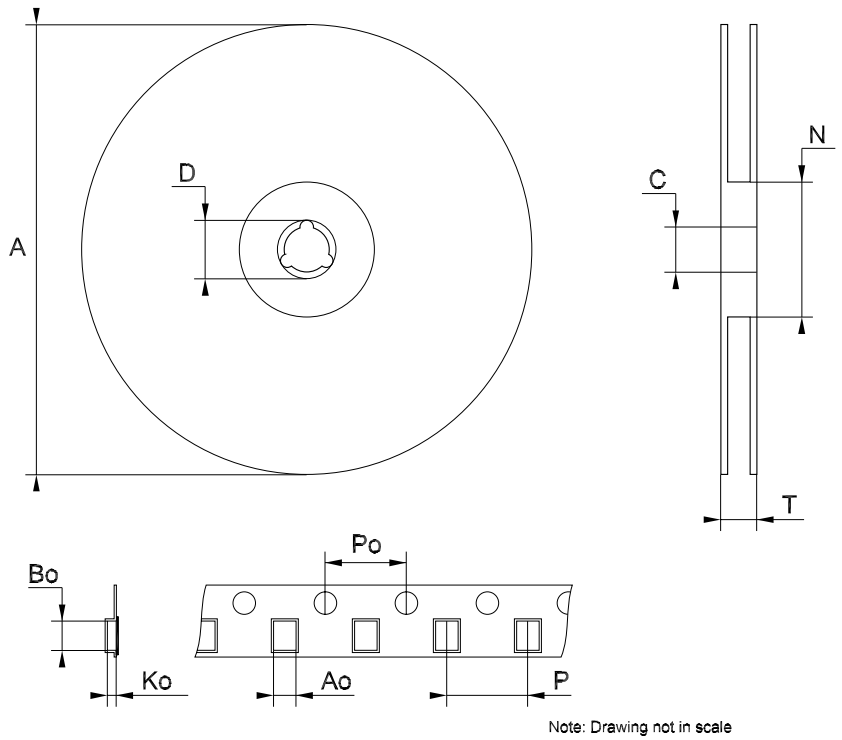


Figure 9. µTFBGA42 tape and reel

Tape & Reel TFBGA42 MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A			330			12.992
C	12.8		13.2	0.504		0.519
D	20.2			0.795		
N	60			2.362		
T			14.4			0.567
Ao		3.8			0.149	
Bo		4.3			0.169	
Ko		1.05			0.041	
Po	3.9		4.1	0.153		0.161
P	7.9		8.1	0.311		0.319



Note: Drawing not in scale

8 Revision history

Table 16. Document revision history

Date	Revision	Changes
01-Oct-2004	1	Initial release.
31-Mar-2005	2	Document status promoted from preliminary data to datasheet.
04-Mar-2009	3	Document reformatted. TSSOP and TFBGA54 packages removed.

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