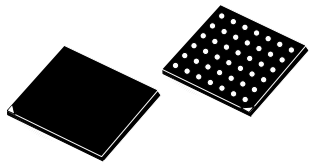
ST16C32245

14-bit dual supply bus transceiver level translator A side series resistor, 2-bit I²C lines

Datasheet - production data



µTFBGA42

Features

- High speed: t_{PD} = 4.4 ns (max) at T_A = 85 °C
  V_{CCA} = 3.0 V and V_{CCB} = 2.3 V
- Low power dissipation:
  I_{CCA} = I_{CCB} = 20 µA (max) at T_A = 85 °C
- Symmetrical output impedance:
  $|I_{OHA}|$ = I_{OLA} = 8 mA min
  (V_{CCA} = 3.0 V; V_{CCB} = 1.65 V or 2.3 V)
  $|I_{OHB}|$ = I_{OLB} = 6 mA min
  (V_{CCB} = 1.65 V V_{CCA} = 3.0 V;)
- Balanced propagation delays: $t_{PLH} \cong t_{PHL}$
- Power down protection on inputs and outputs
- 26 Ω series resistor on A side outputs
- Operating voltage range:
  V_{CCA} (opr) = 2.3 V to 3.6 V
  V_{CCB} (opr) = 1.65 V to 2.7 V
- Fast I²C lines 1.8 V/2.8 V level translator:
  400 kHz guaranteed data rate at C_L = 15 pF
- Bus hold provided on data input both side
- Latch-up performance exceeds 500 mA (JESD 17)
- ESD performance:
  HBM > 2000 V (MIL STD 883 method 3015);
  MM > 200 V

Description

The ST16C32245 is a dual supply low voltage CMOS 14-bit bus transceiver fabricated with sub-micron silicon gate and five-layer metal wiring C²MOS technology. Designed for use as an interface between a 3.3 V bus and a 2.5 V or 1.8 V bus in a mixed 3.3 V/1.8 V,3.3 V/2.5 V and 2.5 V/1.8 V supply systems, it achieves high speed operation while maintaining the CMOS low power dissipation. It also includes 2-bit I²C level translation.

This IC is intended for two-way asynchronous communication between data buses and the direction of data transmission is determined by nDIR inputs. The enable inputs n$\overline{G}$ can be used to disable the device so that the buses are effectively isolated. The A-port interfaces with the 3 V bus, the B-port with the 2.5 V and 1.8 V bus.

All inputs are equipped with protection circuits against static discharge, giving them 2 kV ESD immunity and transient excess voltage. All floating bus terminals during high Z state do not need an external pull-up or pull-down resistor.

Table 1. Device summary

Order code	Package	Packaging
ST16C32245TBR-E	µTFBGA42	Tape and reel

Contents

1 General description

Figure 1. Logic diagram

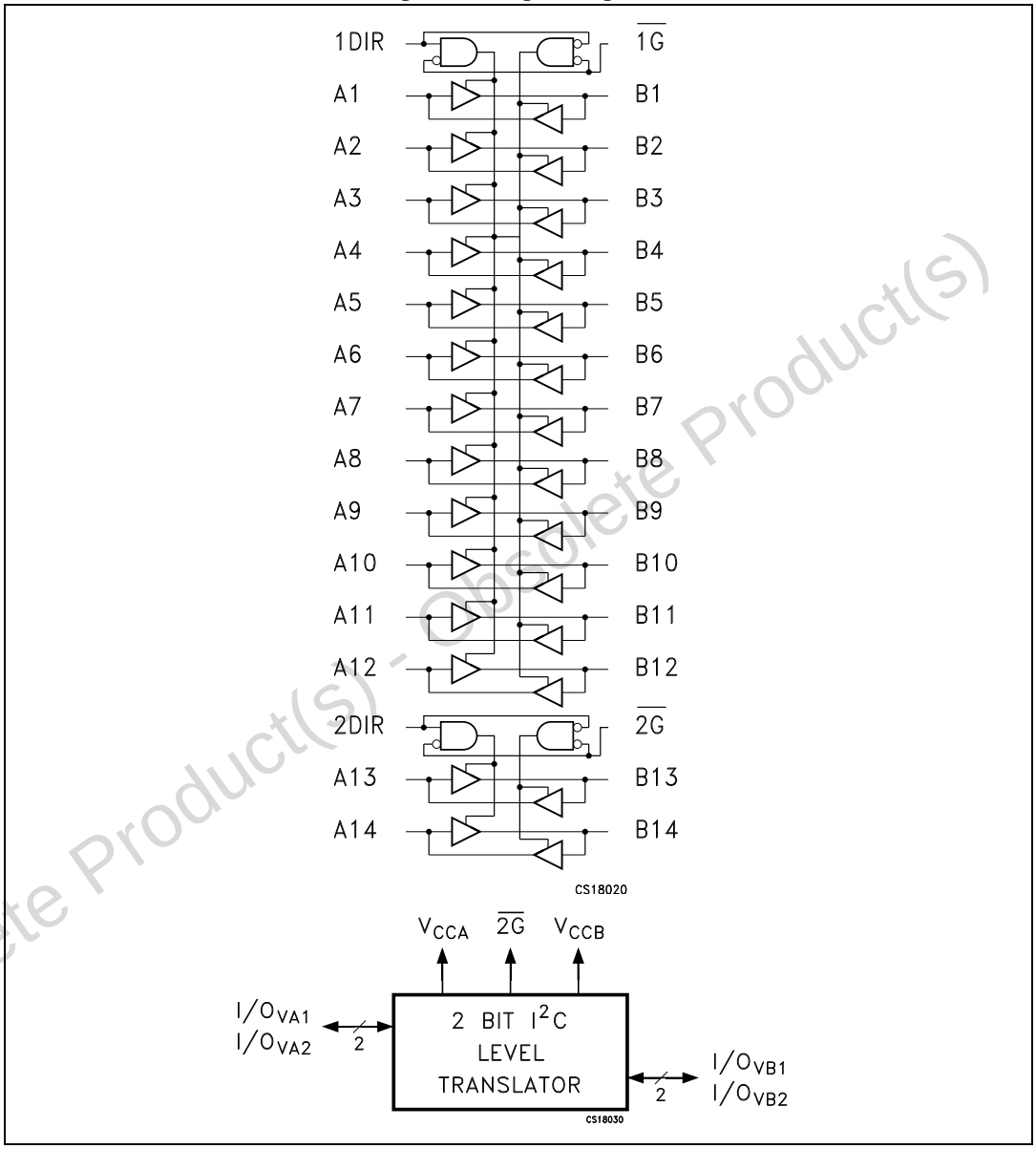
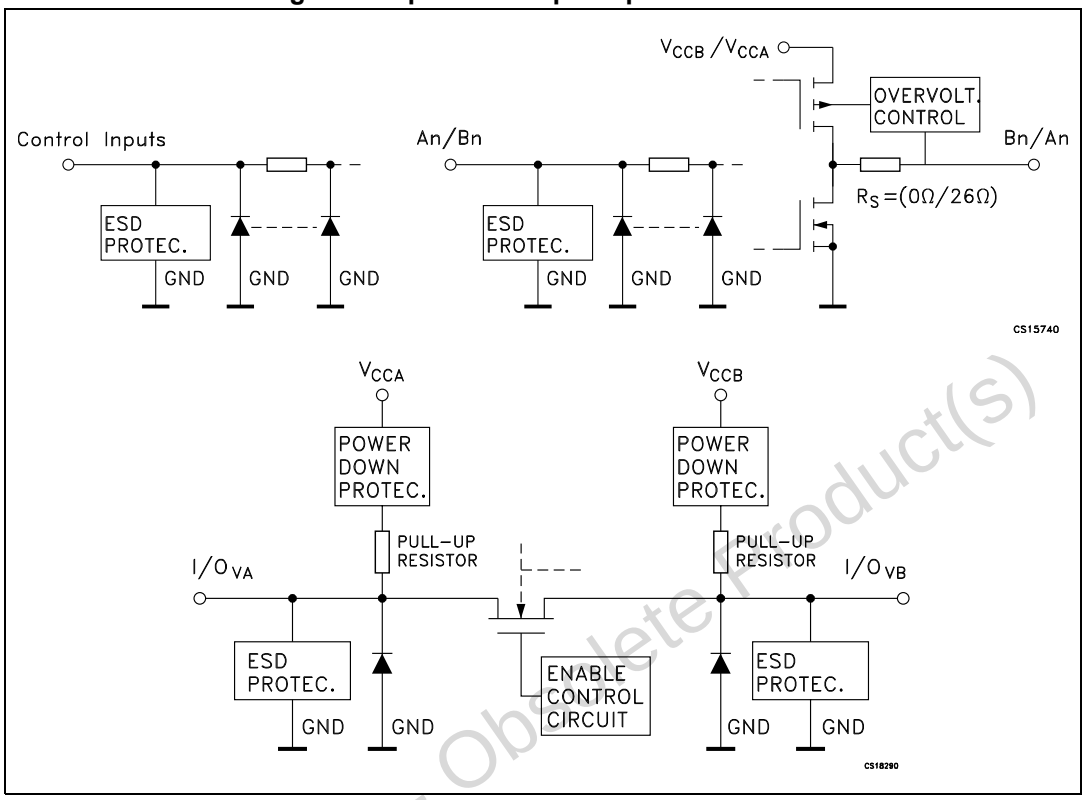


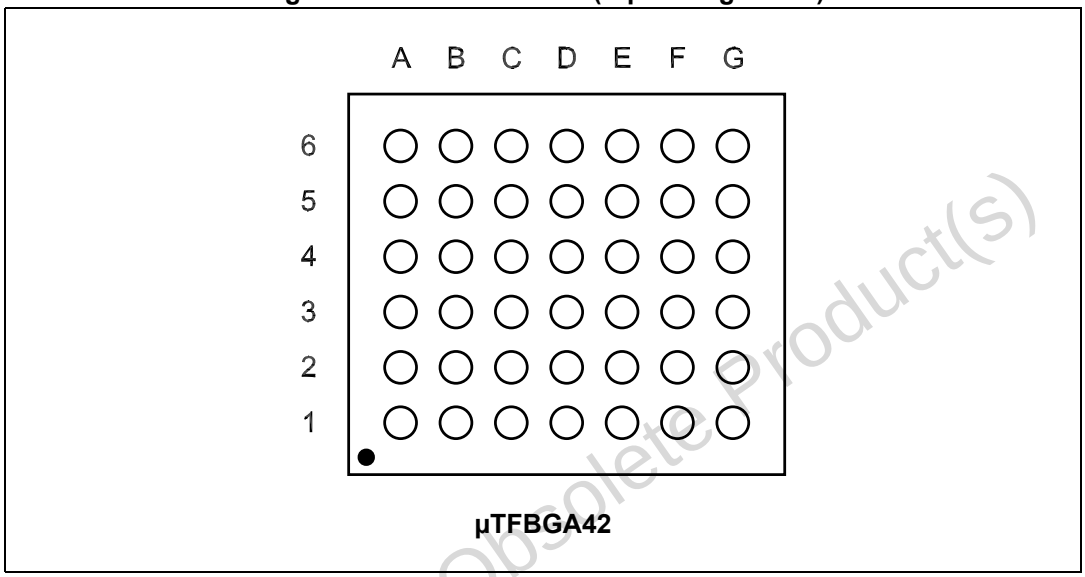
Figure 2. Input and output equivalent circuit



2 Pin settings

2.1 Pin connection

Figure 3. Pin connections (top through view)



µTFBGA42

Table 2. Pin description

Pin number	Symbol	Name and function
B3	1DIR	Directional controls
F3	2DIR	
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	
A3, A2, A1, B2, B1, C2, C1, D2	B1, B2, B3, B4, B5, B6, B7, B8	
D1, E2, E1, F2, F1, G1	B9, B10, B11, B12, B13, B14	
F4	$\overline{2G}$	Output enable inputs
B4	$\overline{1G}$	
C3, C4, E3, E4	GND	Ground (0 V)
-	NC	Not connected
D4	V_{CCA}	Positive supply voltage
D3	V_{CCB}	
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(1)	Z(2)	Z(2)	Z(2)

1. X = don't care
2. Z = high impedance

2.2 I²C bus function

Table 4. I²C bus function table

$\overline{2G}$	$\overline{1G}$, 1DIR, 2DIR	I/O input		Function
		I/O_{VA}	I/O_{VB}	
H	X	Z	Z	I²C disabled
L	X	L	L	I²C comm.
L	X	V_{CCA}	V_{CCB}	I²C comm.
L	X	Open	V_{CCB}	I²C comm.
L	X	V_{CCA}	Open	I²C comm.

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

3 Maximum 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.

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 ($I\backslash O_{VA}$)	0 to V_{CCA}	V
$V_{I/OVB}$	Level input voltage ($I\backslash O_{VB}$)	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} - 0.6 V 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 ± 0.2 V and 2.8 ± 0.1 V; 1.8 ± 0.15 V

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 = -100 µA	2.1		2.1		V
		2.3	3.0	I_O = -18 mA	1.7		1.7		
		1.65	3.0	I_O = -6 mA	1.25		1.25		
		1.65	2.3	I_O = -6 mA	1.25		1.25		
V_{OLB}	Low level output voltage	2.3	3.0	I_O = 100 µA		0.2		0.2	V
		2.3	3.0	I_O = 18 mA		0.60		0.60	
		1.65	3.0	I_O = 6 mA		0.30		0.30	
		1.65	2.3	I_O = 6 mA		0.30		0.30	
I_{IB}	Input leakage current	2.7	3.6	V_I = V_{CC} or GND		±0.5		±5	µA
$I_{IB(HOLD)}$	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						

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	
ΔI_{CCtB}	Maximum quiescent supply current / Input (Bn, DIR, $\overline{G}$)	2.7	3.6	$V_{IB} = V_{CCB}$ - 0.6 V $V_{IA} = V_{CCA}$ or GND	—	—	—	0.75	mA
		1.95	3.6						
		1.95	2.7						

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

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 ± 0.1 5 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

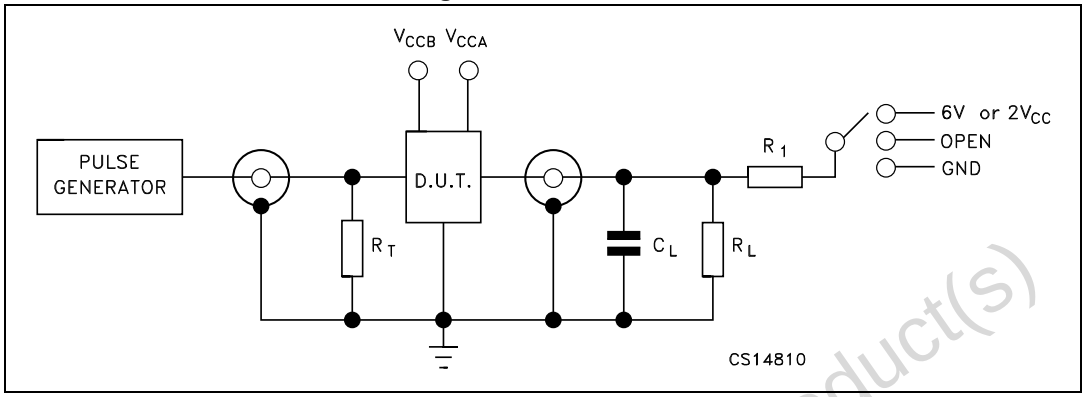
Table 13. Capacitance characteristics

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 = 10 MHz	—	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



1. C_L = 10/30 pF or equivalent (includes jig and probe capacitance)
2. $R_L = R_1 = 500\ \Omega$ or equivalent
3. $R_T = Z_{OUT}$ of pulse generator (typically 50 Ω)

Table 14. Test circuit description

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

6 Waveforms

Table 15. Waveform symbol values

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	1.5 V	$V_{CC}/2$	$V_{CC}/2$
V_X	V_{OL} +0.3 V	V_{OL} +0.15 V	V_{OL} +0.15 V
V_Y	V_{OL} -0.3 V	V_{OL} -0.15 V	V_{OL} -0.15 V

Figure 5. Propagation delay waveform (f = 1 MHz; 50 % duty cycle)

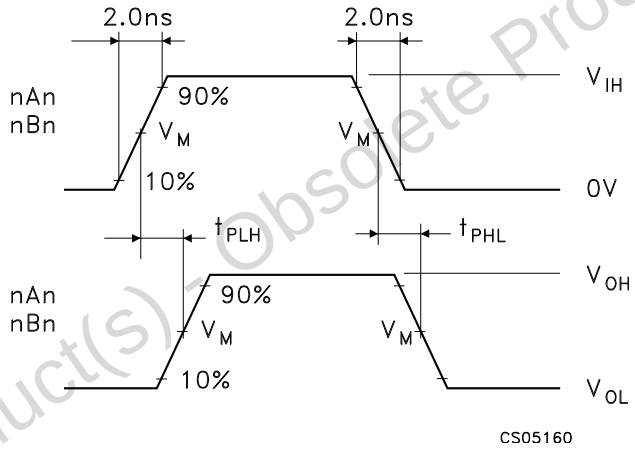


Figure 6. Output enable and disable time waveform (f = 1 MHz; 50 % duty cycle

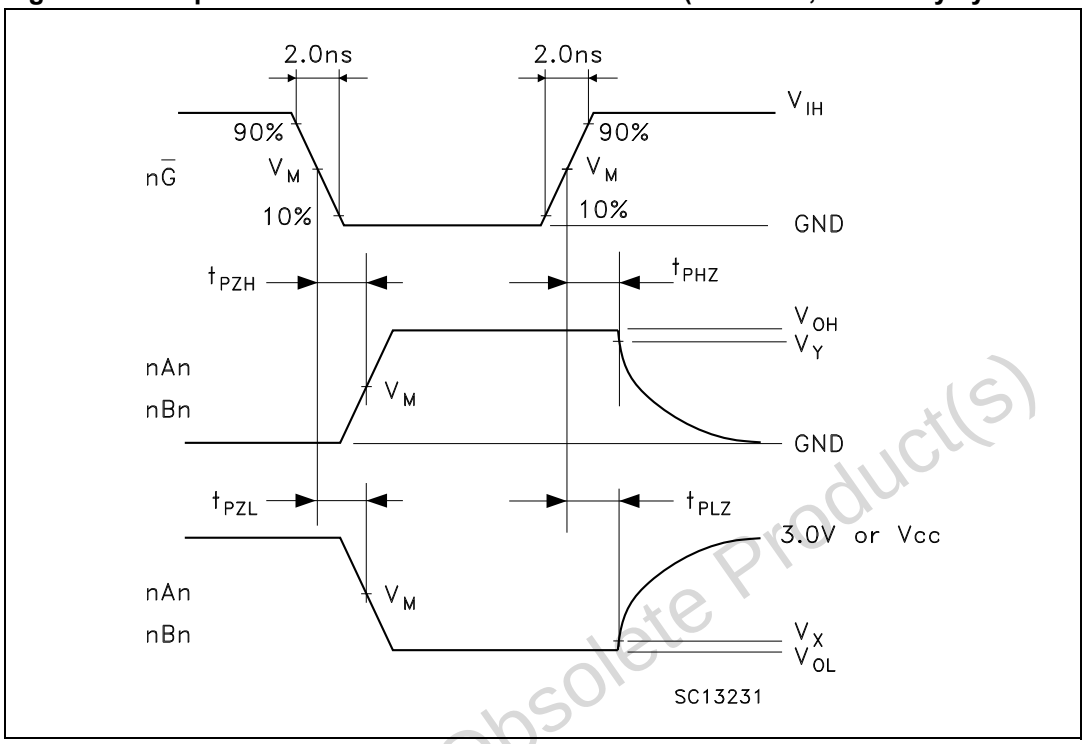
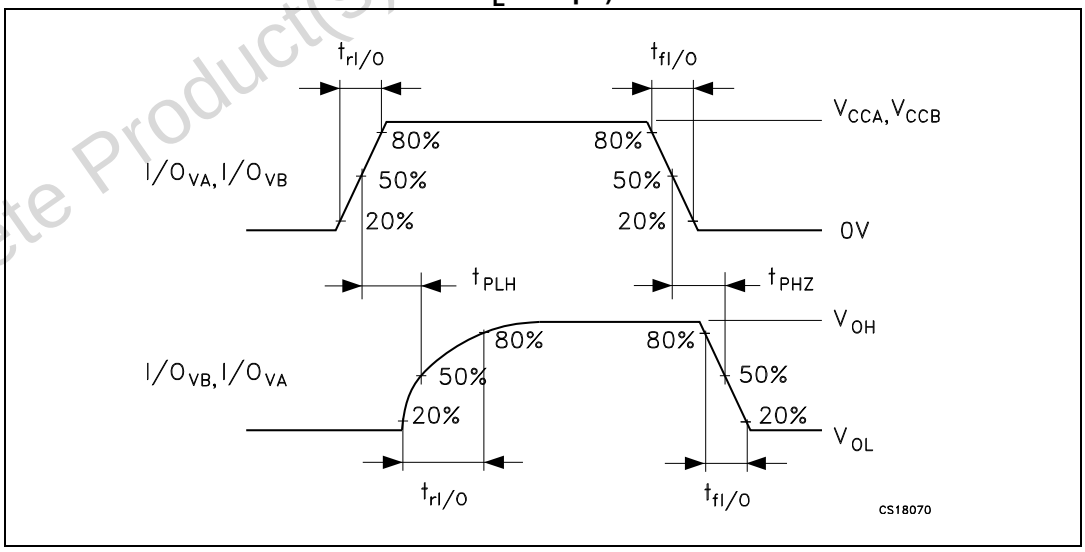


Figure 7. I^2C propagation delay time waveform (f = 400 kHz; 50 % duty cycle, C_L = 15 pF)



7 Package information

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.

7.1 µTFBGA42 package information

Figure 8. µTFBGA42 package mechanical drawing

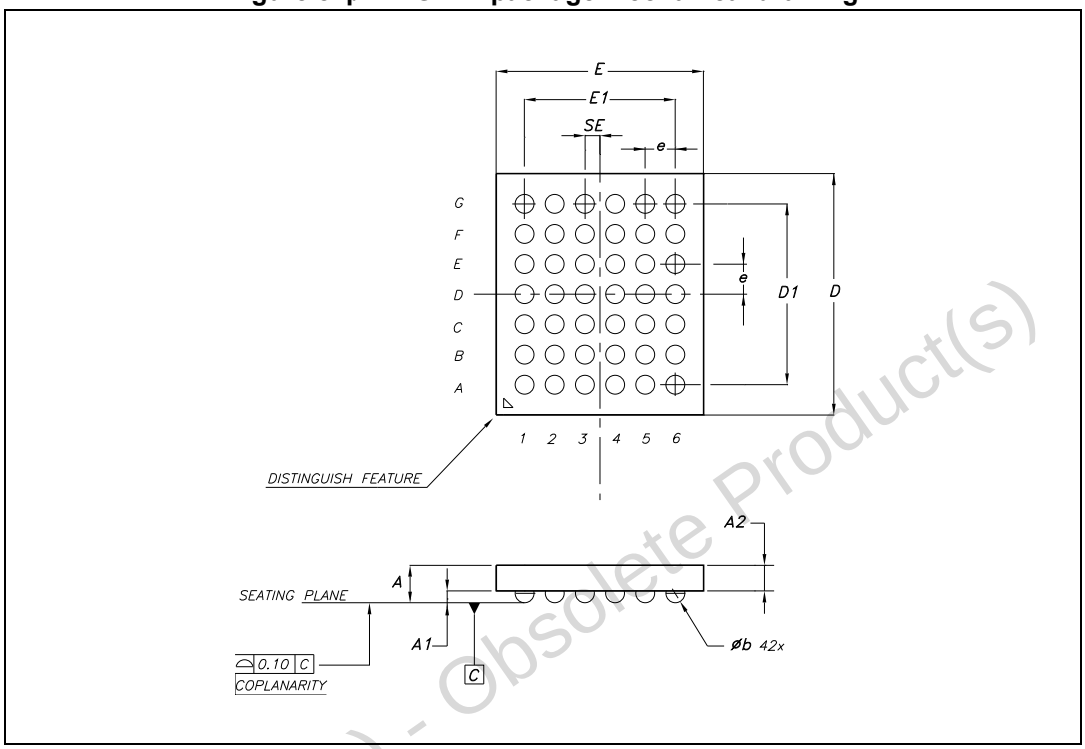
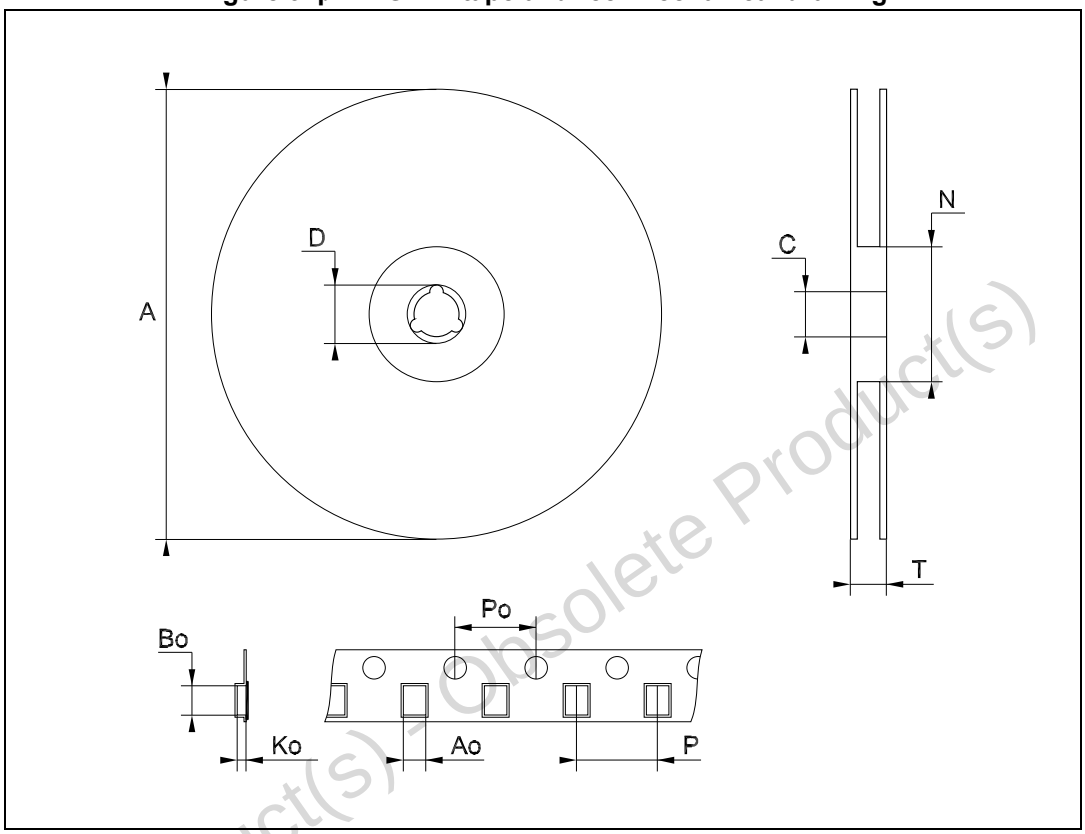


Table 16. µTFBGA42 package mechanical data

Ref	Dimensions					
	Millimeters			Inches		
	Min	Typ	Max	Min	Typ	Max
A	1.0	1.1	1.16	0.039	0.043	0.046
A1			0.25			0.010
A2	0.78		0.86	0.031		0.034
b	0.25	0.30	0.35	0.010	0.012	0.014
D	3.9	4.0	4.1	0.154	0.157	0.161
D1		3.0			0.118	
E	3.4	3.5	3.6	0.134	0.138	0.142
E1		2.5			0.098	
θ		0.5			0.020	
SE		0.25			0.010	

7.2 µTFBGA42 tape and reel information

Figure 9. µTFBGA42 tape and reel mechanical drawing



1. Drawing not to scale

Table 17. µTFBGA42 tape and reel mechanical data

Ref	Dimensions					
	Millimeters			Inches		
	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

8 Revision history

Table 18. 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.
12-Aug-2014	4	*Table 1: Device summary*: replaced order code ST16C32245TBR by ST16C32245TBR-E. Updated disclaimer

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