CBTW28DD14

14-bit bus switch/multiplexer for DDR2/DDR3/DDR4 applications

Rev. 7.1 — 3 August 2015 **Product data sheet**

1. General description

This 14-bit bus switch/multiplexer (MUX) is designed for 1.5 V or 1.8 V supply voltage operation, POD_12, SSTL_12, SSTL_135, SSTL_15 or SSTL_18 signaling and CMOS select input levels. It is designed for operation in DDR2, DDR3 or DDR4 memory bus systems.

The CBTW28DD14 has a 1 : 2 switch or 2 : 1 multiplex topology and offers a 14-bit wide bus. Each 14-bit wide A-port can be switched to one of two ports B and C, for all bits simultaneously. The selection of the port is by a simple CMOS input (SELect). Another CMOS input (ENable) is available to allow all ports to be disconnected. Each port is non-directional due to the use of FET switches, allowing a multitude of applications requiring high-bandwidth switching or multiplexing.

The SEL and EN input signals are designed to operate transparently as CMOS input level signals in both 1.5 V and 1.8 V supply voltage conditions.

CBTW28DD14 uses NXP proprietary high-speed switch architecture providing high bandwidth, very little insertion loss at low frequency, and very low propagation delay, allowing use in many applications requiring switching or multiplexing of high-speed signals. It is available in a 4.5 mm $\times$ 4.5 mm TFBGA48 package with 0.5 mm ball pitch, for optimal size versus board layout density considerations. It is characterized for operation from −10 °C to +85 °C.

2. Features and benefits

2.1 Topology

- 14-bit bus width
- 1 : 2 switch/MUX topology
- Bidirectional operation
- Simple CMOS select pin (SEL)
- Simple CMOS enable pin (EN)

2.2 Performance

- 2.5 GHz bandwidth
- Low ON insertion loss
- Low crosstalk
- High OFF isolation
- POD_12, SSTL_12, SSTL_135, SSTL_15 or SSTL_18 signaling

- Low R_{ON} (10 Ω typical)

2.3 General attributes

- 1.5 V or 1.8 V supply voltage operation
- Very low supply current (300 μA typical)
- ESD robustness exceeds 3 kV HBM, 1 kV CDM
- Available in TFBGA48 package, 4.5 mm × 4.5 mm × 0.8 mm size, 0.5 mm pitch, Pb-free/Dark Green

3. Applications

- DDR2/DDR3/DDR4 memory bus systems
- Systems requiring high-speed multiplexing

4. Ordering information

Table 1. Ordering information

Type number	Topside marking	Package		
		Name	Description	Version
CBTW28DD14ET	W2814	TFBGA48	plastic thin fine-pitch ball grid array package; 48 balls; body 4.5 × 4.5 × 0.8 mm	SOT1155-1
CBTW28DD14AET	2814A	TFBGA48	plastic thin fine-pitch ball grid array package; 48 balls; body 4.5 × 4.5 × 0.8 mm, Cu-OSP leadframe	SOT1155-1

4.1 Ordering options

Table 2. Ordering options

Type number	Orderable part number	Package	Packing method	Minimum order quantity	Temperature
CBTW28DD14ET	CBTW28DD14ET,118	TFBGA48	Reel 13” Q1/T1 *Standard mark SMD	4000	T_{amb} = −10 °C to +85 °C
CBTW28DD14AET	CBTW28DD14AETJ	TFBGA48	Reel 13” Q1/T1 *Standard mark SMD	4000	T_{amb} = −10 °C to +85 °C

5. Functional diagram

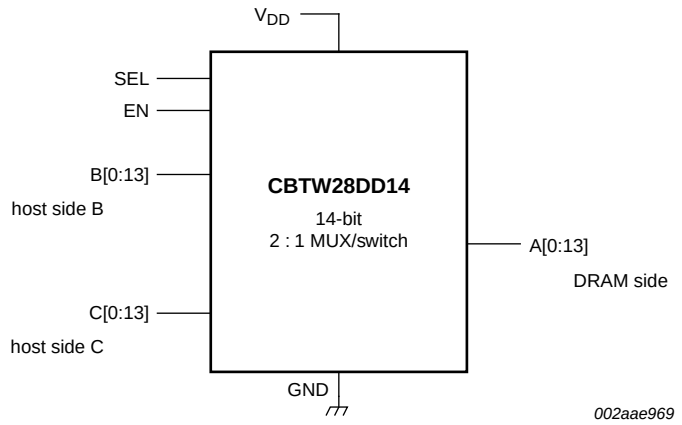
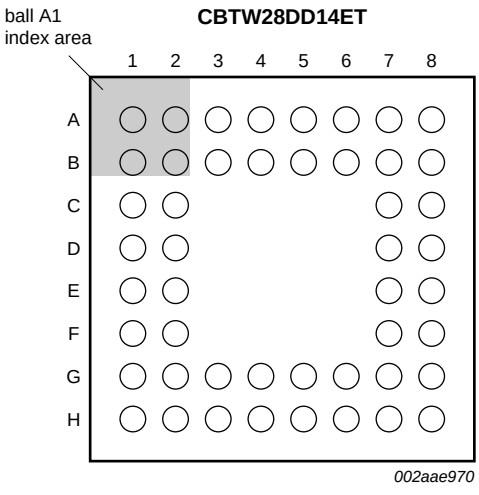


Fig 1. Functional diagram

6. Pinning information

6.1 Pinning



Transparent top view

Fig 2. Pin configuration for TFBGA48

	1	2	3	4	5	6	7	8
A	B9	B8	B7	C7	V_{DD}	B6	B5	B4
B	B10	C9	C8	GND	V_{DD}	C5	C4	B3
C	B11	C10					C3	B2
D	C11	EN					SEL	C2
E	B12	C12					C1	B1
F	B13	C13					C0	B0
G	A13	A11	A9	GND	V_{DD}	A4	A2	A0
H	A12	A10	A8	A7	A6	A5	A3	A1

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Transparent top view

Fig 3. Ball mapping

6.2 Pin description

Table 3. Pin description

Symbol	Pin	Type	Description
A[0:13]	G8, H8, G7, H7, G6, H6, H5, H4, H3, G3, H2, G2, H1, G1	high-speed I/O	14-bit wide input/output, port A
B[0:13]	F8, E8, C8, B8, A8, A7, A6, A3, A2, A1, B1, C1, E1, F1	high-speed I/O	14-bit wide input/output, port B
C[0:13]	F7, E7, D8, C7, B7, B6, A5, A4, B3, B2, C2, D1, E2, F2	high-speed I/O	14-bit wide input/output, port C
SEL	D7	CMOS input	CMOS input signal. When SEL = LOW, port A and port B are mutually connected. When SEL = HIGH, port A and port C are mutually connected.
EN	D2	CMOS input	CMOS input signal. When LOW, all ports are mutually isolated. When HIGH, connection is set using the SEL input signal.
V_{DD}	B5, G5	supply	supply voltage connection
GND	B4, G4	ground	ground connection

7. Functional description

Refer to Figure 1 “Functional diagram”.

The CBTW28DD14 uses a 1.5 V or 1.8 V power supply. All signal paths are implemented using high-bandwidth pass-gate technology and are non-directional. No clock or reset signal is needed for the multiplexer to function. The switch position for the channels is selected using the select signal SEL. The detailed operation is described in Section 7.1.

7.1 Function selection

The internal multiplexer switch position is controlled by two logic inputs, SEL and EN, as described in Table 4.

When a channel is not being used, Port B and Port C of this channel should be tied to ground. For example, if Channel 2 is not used, B2 and C2 should be tied to ground and A2 should be left open.

Table 4. Function selection

X = don’t care.

Inputs		Switch position	
EN	**SEL**	**A ↔ B**	**A ↔ C**
LOW	X	OFF (isolating)	OFF (isolating)
HIGH	LOW	ON (conducting)	OFF (isolating)
HIGH	HIGH	OFF (isolating)	ON (conducting)

8. Limiting values

Table 5. Limiting values

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

Symbol	Parameter	Conditions	Min	Max	Unit
V_{DD}	supply voltage		–0.3	+2.5	V
T_{case}	case temperature	for operation within specification	–40	+85	°C
V_{ESD}	electrostatic discharge voltage	HBM [1]	-	3000	V
		CDM [2]	-	1000	V

[1] Human Body Model: ANSI/EOS/ESD-S5.1-1994, standard for ESD sensitivity testing. Human Body Model - Component level; Electrostatic Discharge Association, Rome, NY, USA.

[2] Charged-Device Model: ANSI/EOS/ESD-S5.3-1-1999, standard for ESD sensitivity testing, Charged-Device Model - Component level; Electrostatic Discharge Association, Rome, NY, USA.

9. Recommended operating conditions

Table 6. Operating conditions

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{DD}	supply voltage		1.4	1.5 or 1.8	2.0	V
V_I	input voltage	all inputs	–0.3	-	V_{DD} + 0.3	V
T_{amb}	ambient temperature	operating in free air	–10	-	+85	°C

10. Static characteristics

Table 7. Static characteristics

V_{DD} = 1.4 V to 2.0 V; T_{amb} = –10 °C to +85 °C; unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ[1]	Max	Unit
I_{DD}	supply current	EN = HIGH; V_{DD} = 1.8 V	-	0.3	1	mA
		EN = LOW; V_{DD} = 1.8 V	-	-	10	µA
I_{IH}	HIGH-level input current	V_{DD} = 2.0 V; V_I = V_{DD}	-	-	±5	µA
I_{IL}	LOW-level input current	V_{DD} = 2.0 V; V_I = GND	-	-	±5	µA
V_{IH}	HIGH-level input voltage	SEL, EN pins	0.8V_{DD}	-	-	V
V_{IL}	LOW-level input voltage	SEL, EN pins	-0.5	-	0.2V_{DD}	V
V_{IK}	input clamping voltage	V_{DD} = 2.0 V; I_I = –18 mA	-	–0.7	–1.2	V

[1] Typical values are at V_{DD} = 1.8 V, T_{amb} = 25 °C, and maximum loading.

11. Dynamic characteristics

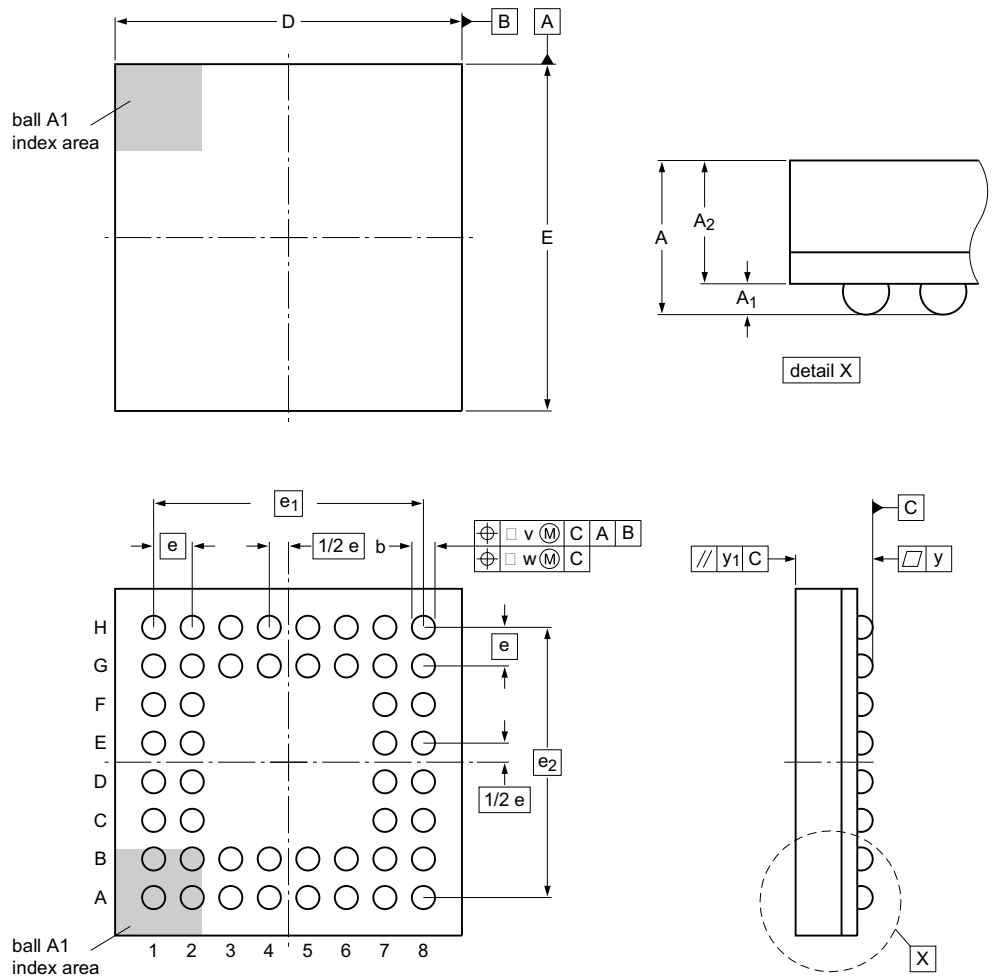
Table 8. Dynamic characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$t_{startup}$	start-up time	supply voltage valid or EN going HIGH to channel specified operating characteristics	-	-	1	ms
t_{rcfg}	reconfiguration time	SEL state change to channel specified operating characteristics	-	-	25[1]	ns
V_I	input voltage		–0.3	-	V_{DD} + 0.3	V
$V_{bias(DC)}$	bias voltage (DC)		0	-	2.0	V
α_{il}	insertion loss	channel is on; 0 Hz ≤ f ≤ 1.0 GHz	–2.5	–1.5	-	dB
		channel is on; f = 2.5 GHz	–4.5	-	-	dB
		channel is off; 0 Hz ≤ f ≤ 3.0 GHz	-	-	–20	dB
RL_{in}	input return loss	channel is on; 0 Hz ≤ f ≤ 1.0 GHz	-	-	–10	dB
α_{ct}	crosstalk attenuation	adjacent channels are on; 0 Hz ≤ f ≤ 1.0 GHz	-	-	–25	dB
B	bandwidth	–3.0 dB intercept	-	2.5	-	GHz
t_{PD}	propagation delay	from A port to B port or C port or vice versa	-	80	-	ps
t_{sk}	skew time	from any output to any output	-	-	20	ps

[1] Guaranteed by design.

12. Package outline

TFBGA48: plastic thin fine-pitch ball grid array package; 48 balls; body 4.5 x 4.5 x 0.8 mm **SOT1155-1**



Dimensions

Unit		A	A_1	A_2	b	D	E	e	e_1	e_2	v	w	y	y_1
mm	max	1.1	0.25	0.85	0.35	4.6	4.6	0.5	3.5	3.5	0.15	0.05	0.08	0.1
	nom	1.0	0.20	0.80	0.30	4.5	4.5							
	min	0.9	0.15	0.75	0.25	4.4	4.4							

sot1155-1_po

Outline version	References				European projection	Issue date
	IEC	JEDEC	JEITA			
SOT1155-1		- - -				~~09-10-15~~ 09-11-27

Fig 4. Package outline TFBGA48 (SOT1155-1)

13. Soldering of SMD packages

This text provides a very brief insight into a complex technology. A more in-depth account of soldering ICs can be found in Application Note *AN10365 "Surface mount reflow soldering description"*.

13.1 Introduction to soldering

Soldering is one of the most common methods through which packages are attached to Printed Circuit Boards (PCBs), to form electrical circuits. The soldered joint provides both the mechanical and the electrical connection. There is no single soldering method that is ideal for all IC packages. Wave soldering is often preferred when through-hole and Surface Mount Devices (SMDs) are mixed on one printed wiring board; however, it is not suitable for fine pitch SMDs. Reflow soldering is ideal for the small pitches and high densities that come with increased miniaturization.

13.2 Wave and reflow soldering

Wave soldering is a joining technology in which the joints are made by solder coming from a standing wave of liquid solder. The wave soldering process is suitable for the following:

- Through-hole components
- Leaded or leadless SMDs, which are glued to the surface of the printed circuit board

Not all SMDs can be wave soldered. Packages with solder balls, and some leadless packages which have solder lands underneath the body, cannot be wave soldered. Also, leaded SMDs with leads having a pitch smaller than ~0.6 mm cannot be wave soldered, due to an increased probability of bridging.

The reflow soldering process involves applying solder paste to a board, followed by component placement and exposure to a temperature profile. Leaded packages, packages with solder balls, and leadless packages are all reflow solderable.

Key characteristics in both wave and reflow soldering are:

- Board specifications, including the board finish, solder masks and vias
- Package footprints, including solder thieves and orientation
- The moisture sensitivity level of the packages
- Package placement
- Inspection and repair
- Lead-free soldering versus SnPb soldering

13.3 Wave soldering

Key characteristics in wave soldering are:

- Process issues, such as application of adhesive and flux, clinching of leads, board transport, the solder wave parameters, and the time during which components are exposed to the wave
- Solder bath specifications, including temperature and impurities

13.4 Reflow soldering

Key characteristics in reflow soldering are:

- Lead-free versus SnPb soldering; note that a lead-free reflow process usually leads to higher minimum peak temperatures (see Figure 5) than a SnPb process, thus reducing the process window
- Solder paste printing issues including smearing, release, and adjusting the process window for a mix of large and small components on one board
- Reflow temperature profile; this profile includes preheat, reflow (in which the board is heated to the peak temperature) and cooling down. It is imperative that the peak temperature is high enough for the solder to make reliable solder joints (a solder paste characteristic). In addition, the peak temperature must be low enough that the packages and/or boards are not damaged. The peak temperature of the package depends on package thickness and volume and is classified in accordance with Table 9 and 10

Table 9. SnPb eutectic process (from J-STD-020D)

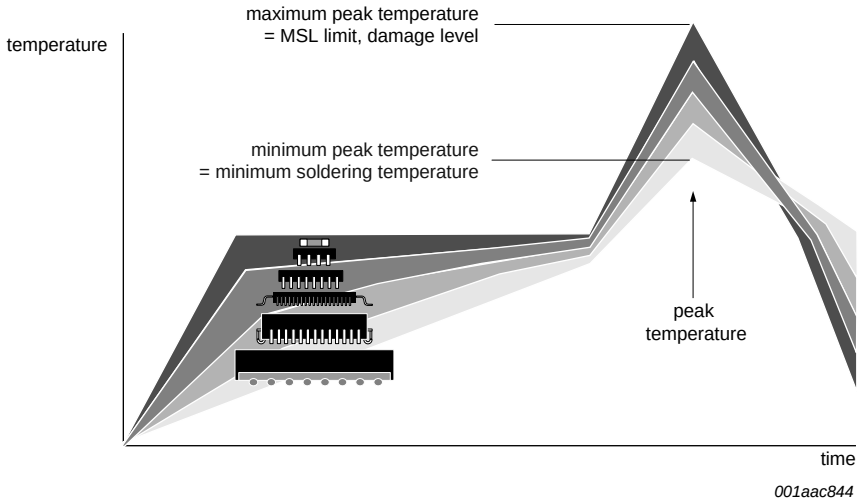
Package thickness (mm)	Package reflow temperature (°C)	
	Volume (mm^3)	
	< 350	≥ 350
< 2.5	235	220
≥ 2.5	220	220

Table 10. Lead-free process (from J-STD-020D)

Package thickness (mm)	Package reflow temperature (°C)		
	Volume (mm^3)		
	< 350	350 to 2000	> 2000
< 1.6	260	260	260
1.6 to 2.5	260	250	245
> 2.5	250	245	245

Moisture sensitivity precautions, as indicated on the packing, must be respected at all times.

Studies have shown that small packages reach higher temperatures during reflow soldering, see Figure 5.



MSL: Moisture Sensitivity Level

Fig 5. Temperature profiles for large and small components

For further information on temperature profiles, refer to Application Note *AN10365 "Surface mount reflow soldering description"*.

14. Abbreviations

Table 11. Abbreviations

Acronym	Description
CDM	Charged-Device Model
CMOS	Complementary Metal-Oxide Semiconductor
DDR2	Double Data Rate 2
DDR3	Double Data Rate 3
DDR4	Double Data Rate 4
DRAM	Dynamic Random Access Memory
ESD	ElectroStatic Discharge
FET	Field-Effect Transistor
HBM	Human Body Model
I/O	Input/Output
MT/s	Mega Transfers per second
POD_12	1.2 V Pseudo Open Drain interface
SSTL_12	Stub Series Terminated Logic for 1.2 V
SSTL_135	Stub Series Terminated Logic for 1.35 V
SSTL_15	Stub Series Terminated Logic for 1.5 V
SSTL_18	Stub Series Terminated Logic for 1.8 V

15. Revision history

Table 12. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
CBTW28DD14 v.7.1	20150803	Product data sheet	-	CBTW28DD14 v.7
Modifications:	• Section 4 “Ordering information”: Corrected type number from “CBTW28DD14ETA” to “CBTW28DD14AET”; corrected orderable part number from “CBTW28DD14ETAJ” to “CBTW28DD14AETJ”.			
CBTW28DD14 v.7	20150730	Product data sheet	-	CBTW28DD14 v.6
Modifications:	• Section 4 “Ordering information”: Added part number and ordering information for CBTW28DD14A version. This version uses a Cu-OSP leadframe.			
CBTW28DD14 v.6	20140725	Product data sheet	-	CBTW28DD14 v.5
Modifications:	• Table 8 “Dynamic characteristics”: – Changed t_{rcfg} max from 1 μs to 25 ns; added table note [1].			
CBTW28DD14 v.5	20140528	Product data sheet	-	CBTW28DD14 v.4
CBTW28DD14 v.4	20130812	Product data sheet	-	CBTW28DD14 v.3
CBTW28DD14 v.3	20130805	Product data sheet	-	CBTW28DD14 v.2
CBTW28DD14 v.2	20120726	Product data sheet	-	CBTW28DD14 v.1
CBTW28DD14 v.1	20100720	Product data sheet	-	-

16. Legal information

16.1 Data sheet status

Document status[1][2]	Product status[3]	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.

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[2] The term 'short data sheet' is explained in section "Definitions".

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18. Contents

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