CBTL05023

Multiplexer/demultiplexer switch for Thunderbolt applications

Rev. 5 — 15 July 2013 Product data sheet

1. General description

The CBTL05023 is a multiplexer/demultiplexer switch chip for DisplayPort v1.2 signals and the control signals of a 10 Gbit/s channel. The 10 Gbit/s channel does not pass through this switch. This chip provides BIASOUT output control signal, and the DC-biasing pull-down resistors to facilitate an external 10 Gbit/s channel.

The AUX MUX is a 2 : 1 switch with CA_DETect pin selecting between AUX and DDC (Direct Display Control) signals.

The DP MUX is a 2 : 1 switch that selects between DPML (DisplayPort Main Link) and LSTX/LSRX signals.

This chip also includes three control signal buffers: HPDOUT, CA_DETOUT and BIASOUT.

CBTL05023 is powered by a 3.3 V supply and it is available in 3 mm × 3 mm HVQFN24 package with 0.4 mm pitch.

2. Features and benefits

2.1 AUX MUX 2 : 1 switch

- This 2 : 1 switch is controlled by CA_DET signal multiplexing of the 1 Mbit/s differential AUX and DDC (Direct Display Control) signals
  - When CA_DET is HIGH, DDC path is selected
- Differential AUX channel:
  - Low insertion loss: −0.5 dB at 5 MHz
  - Low return loss: −19 dB at 5 MHz
  - Low ON-state resistance: 7.5 Ω
  - Bandwidth: 5 GHz
  - Low off-state isolation: −75 dB at 5 MHz
  - Low crosstalk: −40 dB at 5 MHz
  - Common-mode input voltage V_{IC}: 0 V to 3.3 V
  - Differential input voltage V_{ID}: 1.4 V (maximum)
- DDC channel has DDC_CLK and DDC_DAT I^2C signals
  - 100 kHz 3.3 V voltage swing
- Both AUXIO+ and AUXIO− outputs have 900 Ω (±20 %) pull-down resistor that is enabled by the status of the BIASOUT output pin
  - These pull-down resistors provide DC bias for the 10 Gbit/s channel

2.2 DP MUX 2 : 1 switch

The DP MUX is a 2:1 switch that is controlled by DP_PD pin multiplexing of a differential DPML signal and LSTX/LSRX signals

- The DPML (DisplayPort Main Link) runs up to HBR2 data rate of 5.4 Gbit/s
- The low speed DC coupled signals LSTX and LSRX are 3.3 V single-ended signals that operated at 1 Mbit/s
- 5.4 Gbit/s DPML channel:
  - Low insertion loss for DP-DPMLO path: −2.0 dB at 2.5 GHz
  - Low insertion loss for LS-DPMLO path: −2.0 dB at 2.5 GHz
  - Low return loss for DP-DPMLO path: −15 dB at 2.5 GHz
  - Low return loss for LS-DPMLO path: −14 dB at 2.5 GHz
  - Low ON-state resistance for DP-DPMLO path: 9 Ω
  - Low ON-state resistance for LS-DPMLO path: 13 Ω
  - High bandwidth: 7 GHz
  - Low off-state isolation: −20 dB at 2.5 GHz
  - Low crosstalk: −25 dB at 2.5 GHz
  - Common-mode input voltage V_{IC}: 0 V to 3.3 V
  - Differential input voltage V_{ID}: 1.4 V (maximum)

2.3 General

- The input of the HPDOUT (Hot Plug Detect output) buffer is 5 V tolerant
- HPDOUT, CA_DETOUT and BIASOUT buffers
  - CA_DET input leakage current < 0.1 μA to prevent driving the 1 MΩ pull-down to a HIGH level
  - BIASOUT buffer is able to provide enough current to drive the bias circuit for the PIN diode path
  - BIASOUT buffer can drive up to six sets of bias circuits for the 10 Gbit/s paths
- When AUXIO_EN is LOW or (BIASIN = 0 and DP_PD = 1), this chip is in Sleep mode
  - AUXIO+ and AUXIO− of AUX MUX are disabled
  - CA_DETOUT and HPDOUT buffers are on
  - When the chip is in Sleep mode, CBTL05023 consumes < 3.5 mW
- Patent-pending high-bandwidth analog pass-gate technology
- Very low intra-pair differential skew (5 ps typical)
- All channels have back current protection
- All channels support rail-to-rail input voltage
- CMOS input buffer with hysteresis
- Single 3.3 V ± 10 % power supply
- HVQFN24 3 mm × 3 mm package, 0.4 mm pitch, with exposed center pad for thermal relief and electrical ground
- ESD: 2500 V HBM, 1250 V CDM
- Operating temperature range: 0 °C to 85 °C

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3. Ordering information

Table 1. Ordering information

Type number	Topside marking	Package		
		Name	Description	Version
CBTL05023BS	023	HVQFN24	plastic thermal enhanced very thin quad flat package; no leads; 24 terminals; body 3 × 3 × 0.85 mm[1]	SOT905-1

[1] Maximum package height is 1 mm.

3.1 Ordering options

Table 2. Ordering options

Type number	Orderable part number	Package	Packing method	Minimum order quantity	Temperature
CBTL05023BS	CBTL05023BS,118	HVQFN24	Reel 13" Q1/T1 *standard mark SMD	6000	T_{amb} = 0 °C to +85 °C

4. Block diagram

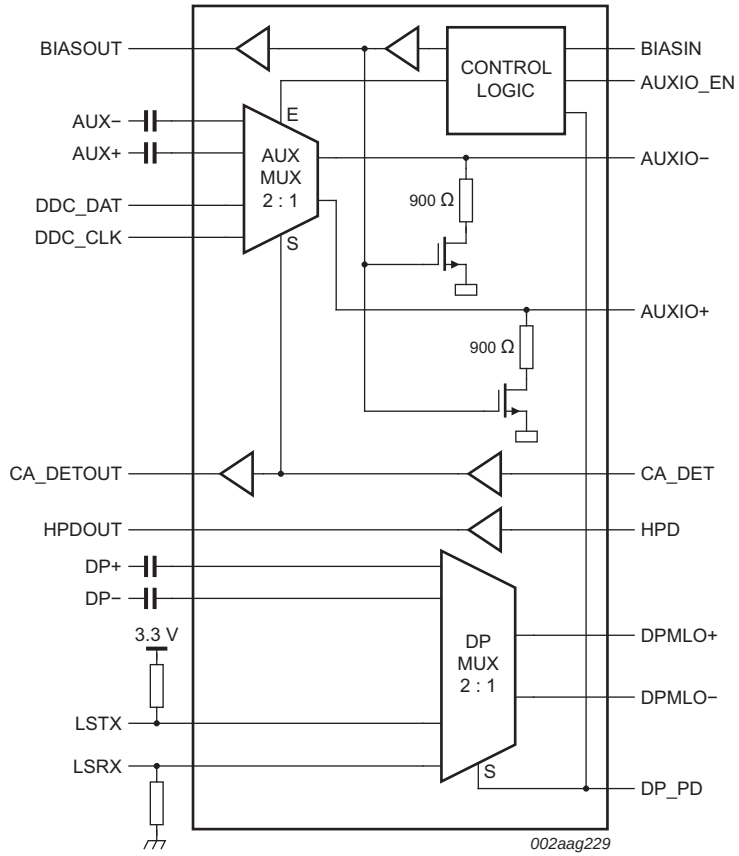


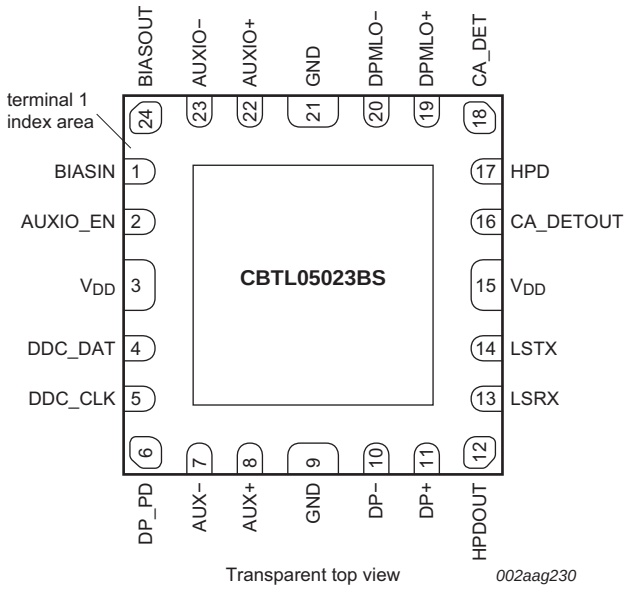
Fig 1. Block diagram of CBTL05023

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5. Pinning information

5.1 Pinning



Center pad is connected to printed-circuit board ground plane for electrical grounding and thermal relief.

Refer to Section 10 and Section 11 for package-related information.

Fig 2. Pin configuration for HVQFN24

5.2 Pin description

Table 3. Pin description

Symbol	Pin	Type	Description
Data path signals			
AUX−	7	differential I/O	AUX differential signals. The input to this pin must be AC-coupled externally.
AUX+	8	differential I/O	
AUXIO−	23	differential I/O	Differential pairs that are DC-coupled to 3.3 V and ground. These two pins are internally connected to 1 kΩ pull-down resistors that are enabled by the status of BIASOUT output pin (see Table 18 for details).
AUXIO+	22	differential I/O	
DDC_CLK	5	single-ended I/O	Pair of single-ended terminals for DDC clock and data signals.
DDC_DAT	4	single-ended I/O	
DP−	10	differential I/O	High speed differential pair. The input to this pin must be AC-coupled externally.
DP+	11	differential I/O	
DPMLO−	20	differential I/O	Differential pair that is DC-coupled to 3.3 V and ground.
DPMLO+	19	differential I/O	
LSRX	13	single-ended I/O	Single-ended signal with DC coupled to 3.3 V.
LSTX	14	single-ended I/O	Single-ended signal with DC coupled to ground.

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Table 3. Pin description *...continued*

Symbol	Pin	Type	Description
Control signals			
HPDOUT	12	CMOS output	3.3 V CMOS output buffer for HPD.
HPD	17	CMOS input	CMOS input with 5 V tolerance.
CA_DET	18	CMOS input	When CA_SET is HIGH, the DDC_CLK and DDC_DAT replace AUX differential pair.
CA_DETOUT	16	CMOS output	3.3 V CMOS output buffer for CA_DET.
BIASIN	1	CMOS input	CMOS input buffer.
BIASOUT	24	CMOS output	This output enables the 1 kΩ pull-down resistors for both AUXIO+ and AUXIO–. It enables the DC bias of the 10 Gbit/s data path. It provides power through six sets of 3.2 kΩ bias circuits for 10 Gbit/s paths.
AUXIO_EN	2	CMOS input	If AUXIO_EN is LOW, then AUXIO+ and AUXIO– are in high-impedance state for Sleep mode.
DP_PD	6	CMOS input	If DP_PD is LOW, then DPMLO+ and DPMLO– are connected to DP+ and DP–. If DP_PD is HIGH, then DPMLO+ and DPMLO– are connected to LSTX and LSRX. This multiplexer must work during initial power-up that might have V_{DD} = 2.3 V.
3.3 V supply option			
V_{DD}	3, 15	power	3.3 V supply. Both pin 3 and pin 15 must be connected to system power supply.
Ground connections			
GND	9, 21[1]	ground	0 V (ground).
GND	center pad	ground	The center pad must be connected to GND plane for both electrical grounding and thermal relief.

[1] HVQFN24 package die supply ground is connected to both GND pins and exposed center pad. GND pins and the exposed center pad must be connected to supply ground for proper device operation. For enhanced thermal, electrical, and board level performance, the exposed pad needs to be soldered to the board using a corresponding thermal pad on the board and for proper heat conduction through the board, thermal vias need to be incorporated in the printed-circuit board in the thermal pad region.

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6. Functional description

Refer to Figure 1 “Block diagram of CBTL05023”.

The following sections describe the individual block functions and capabilities of the device in more detail.

6.1 Buffer function tables

Table 4. BIASOUT buffer

X = don’t care.

AUXIO_EN	BIASIN	BIASOUT
0	X	0
1	0	0
1	1	1

Table 5. HPD buffer

HPD input	HPDOUT output
0	0
1	1

Table 6. CA_DET buffer

CA_DET input	CA_DETOUT output
0	0
1	1

6.2 AUX MUX state and function tables

The 2 : 1 AUXIO+ and AUXIO− are controlled by three signals: AUXIO_EN, CA_DET and BIASIN.

Table 7. AUX MUX state

X = don’t care.

AUXIO_EN input	BIASIN input	DP_PD input	AUX MUX	State
0	X	X	3-state	sleep
1	0	0	ON	DP/DP++
1	0	1	3-state	sleep
1	1	0	3-state	illegal
1	1	1	3-state	10 Gbit/s mode

Table 8. AUX MUX function

CA_DET input	AUXIO
0	AUX
1	DDC

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6.3 Operation modes of both DPML MUX and AUX MUX

Table 9. DPML MUX function

DP_PD input	DPMLO outputs
0	DP+ and DP−
1	LSRX and LSTX

Table 10. Operation modes

X = don't care.

AUXIO_EN	BIASIN	DP_PD	CA_DET	BIASOUT	AUXIO	DPMLO	State
0	X	0	X	0	3-state	DP input	sleep
0	X	1	X	0	3-state	LS	sleep
1	0	0	0	0	AUX input	DP input	DP mode
1	0	0	1	0	DDC	DP input	DP++ mode
1	0	1	X	0	3-state	LS	detect
1	1	0	X	1	1 kΩ pull-down	DP input	illegal
1	1	1	X	1	1 kΩ pull-down	LS	10 Gbit/s mode

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7. Limiting values

Table 11. Limiting values

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

Symbol	Parameter	Conditions		Min	Max	Unit
V_{DD}	supply voltage		[1]	–0.3	+4.6	V
V_I	input voltage		[1]	–0.3	+5.5	V
T_{stg}	storage temperature			–65	+150	°C
V_{ESD}	electrostatic discharge voltage	HBM	[2]	-	2500	V
		CDM	[3]	-	1250	V

[1] All voltage values, except differential voltages, are with respect to network ground terminal.

[2] 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.

[3] 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.

8. Recommended operating conditions

Table 12. Operating conditions

Over operating free-air temperature range, unless specified otherwise.

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
V_{DD}	supply voltage	3.3 V supply option		3.0	3.3	3.6	V
		initial supply voltage before power supply negotiation done	[1]	2.3	-	-	V
V_I	input voltage	CMOS inputs		–0.3	-	V_{DD} + 0.3	V
		MUX I/O pins		–0.3	-	V_{DD} + 0.3	V
T_{amb}	ambient temperature	operating in free air		0	-	85	°C

[1] During power supply negotiation only a limited supply voltage is available. The control logic and multiplexers must be in full function with degraded performance. The channel between LSTX/LSRX and DPMLO+/DPMLO– must work. The initial R_{on} of DP MUX in Table 15 should be < 50 Ω.

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9. Characteristics

9.1 Device general characteristics

Table 13. General characteristics

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
I_{DD}	supply current	V_{DD} = 3.6 V with no load on BIASOUT		-	-	2.8	mA
P_{cons}	power consumption	V_{DD} = 3.6 V with no load on BIASOUT		-	-	10	mW
		Sleep mode; AUXIO_EN = 0 or (BIASIN = 0 and DP_PD = 1)		-	-	3.5	mW
$t_{startup}$	start-up time	supply voltage valid to channel specified operating characteristics		-	-	10	ms
t_{rcfg}	reconfiguration time	DP_PD, AUXIO_EN, BIASIN or CA_DET state change to channel specified operating characteristics	[1]	-	2	4	µs

[1] Outputs are undefined during reconfiguration, including enable and disable time of the multiplexers.

9.2 AUX/DDC channel characteristics

Table 14. AUX/DDC channel characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
DDIL	differential insertion loss	channel is OFF; f = 5 MHz	-	–75	-	dB
		channel is ON; f = 5 MHz	-	–0.5	-	dB
DDRL	differential return loss	f = 5 MHz	-	–19	-	dB
DDNEXT	differential near-end crosstalk	adjacent channels are ON; f = 5 MHz	-	–40	-	dB
R_{on}	ON-state resistance	V_{DD} = 3.3 V; V_I = 3.3 V; I_I = 20 mA	-	7.5	-	Ω
B_{-3dB}	–3 dB bandwidth		-	5	-	GHz
t_{PD}	propagation delay	from DDC to AUXIO	-	70	-	ps
		from AUX to AUXIO	-	70	-	ps
$t_{sk(dif)}$	differential skew time	intra-pair	-	5	-	ps
V_I	input voltage	AUX+/AUX– and AUXIO+/AUXIO–	0	-	V_{DD}	V
V_{IC}	common-mode input voltage	AUX+/AUX– and AUXIO+/AUXIO–	0	-	V_{DD}	V
V_{ID}	differential input voltage	AUX+/AUX– and AUXIO+/AUXIO–; peak-to-peak value	-	-	1.4	V
I_{LIH}	HIGH-level input leakage current	V_{DD} = max.; V_I = V_{DD}	-	-	±0.5	µA
I_{LIL}	LOW-level input leakage current	V_{DD} = max.; V_I = GND	-	-	±0.5	µA

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9.3 DisplayPort Main Link (DPML) channel characteristics

Table 15. DPML channel characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
DDIL	differential insertion loss	DP-DPMLO path; channel is OFF				
		f = 2.5 GHz	-	–20	-	dB
		f = 1.35 GHz	-	–26	-	dB
		DP-DPMLO path; channel is ON				
		f = 2.5 GHz	-	–2.0	-	dB
		f = 1.35 GHz	-	–1.0	-	dB
		f = 100 MHz	-	–0.5	-	dB
		LS-DPMLO path; channel is OFF				
		f = 2.5 GHz	-	–20	-	dB
		f = 1.35 GHz	-	–26	-	dB
		LS-DPMLO path; channel is ON				
		f = 2.5 GHz	-	–2.0	-	dB
		f = 1.35 GHz	-	–1.5	-	dB
		f = 100 MHz	-	–1.5	-	dB
DDRL	differential return loss	DP-DPMLO path				
		f = 2.5 GHz	-	–15	-	dB
		f = 100 MHz	-	–24	-	dB
		LS-DPMLO path				
		f = 2.5 GHz	-	–14	-	dB
		f = 100 MHz	-	–18	-	dB
DDNEXT	differential near-end crosstalk	adjacent channels are ON				
		f = 2.5 GHz	-	–25	-	dB
		f = 100 MHz	-	–60	-	dB
R_{on}	ON-state resistance	V_{DD} = 3.3 V; V_I = 3.3 V; I_I = 10 mA				
		DP-DPMLO path	-	9	-	Ω
		LS-DPMLO path	-	13	-	Ω
		initial ON-state resistance before power supply negotiation done; V_{DD} = 2.3 V; V_I = 2.3 V; I_I = 10 mA	-	-	50	Ω
B_{-3dB}	–3 dB bandwidth		-	7.0	-	GHz
t_{PD}	propagation delay	from DP+/DP– to DPMLO+/DPMLO–	-	100	-	ps
$t_{sk(dif)}$	differential skew time	intra-pair	-	5	-	ps
V_I	input voltage	LSTX/LSRX to DPMLO+/DPMLO– channel	–0.3	-	V_{DD} + 0.6	V
V_{IC}	common-mode input voltage	DP+/DP– and DPMLO+/DPMLO–	0	-	V_{DD}	V
V_{ID}	differential input voltage	DP+/DP– and DPMLO+/DPMLO– channel; peak-to-peak value	-	-	1.4	V
I_{LIH}	HIGH-level input leakage current	V_{DD} = max.; V_I = V_{DD}	-	-	±0.5	μA
I_{LIL}	LOW-level input leakage current	V_{DD} = max.; V_I = GND	-	-	±0.5	μA

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9.4 Control signals characteristics

Table 16. CA_DET input buffer characteristics

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
V_{IH}	HIGH-level input voltage			$0.7 \times V_{DD}$	-	-	V
V_{IL}	LOW-level input voltage			-	-	$0.3 \times V_{DD}$	V
I_{LI}	input leakage current	measured with input at $V_{IH(max)}$ and $V_{IL(min)}$	[1]	-	-	0.1	μA

[1] The leakage current on CA_DET pin must not drive the 1 MΩ pull-down to a HIGH level.

Table 17. HPD, BIASIN, DP_PD, AUXIO_EN input buffer characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{IH}	HIGH-level input voltage	CMOS inputs	$0.7 \times V_{DD}$	-	-	V
V_{IL}	LOW-level input voltage	CMOS inputs	-	-	$0.3 \times V_{DD}$	V
I_{LI}	input leakage current	measured with input at $V_{IH(max)}$ and $V_{IL(min)}$	-	-	1	μA

Table 18. BIASOUT output buffer characteristics

This buffer provides the power supply current for the PIN diode bias path and it drives six sets of bias resistors for the 10 Gbit/s signal paths.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
I_{pd}	pull-down current	$V_O = 0.4$ V	5	-	-	mA
I_{pu}	pull-up current	$V_O = V_{DD} - 0.4$ V	-	-	–9	mA
t_{PD}	propagation delay		-	40	60	ns

Table 19. CA_DETOUT, HPDOUT output buffer characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
I_{pd}	pull-down current	$V_O = 0.4$ V	2	-	-	mA
I_{pu}	pull-up current	$V_O = V_{DD} - 0.4$ V	-	-	–2	mA
t_{PD}	propagation delay		-	70	100	ns

Table 20. AUXIO+ and AUXIO- pins in 10 Gbit/s mode (AUXIO_EN = BIASIN = DP_PD = 1) characteristics

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
V_{OL}	LOW-level output voltage	$I_O = 1$ mA	[1]	0.72	0.90	1.1	V

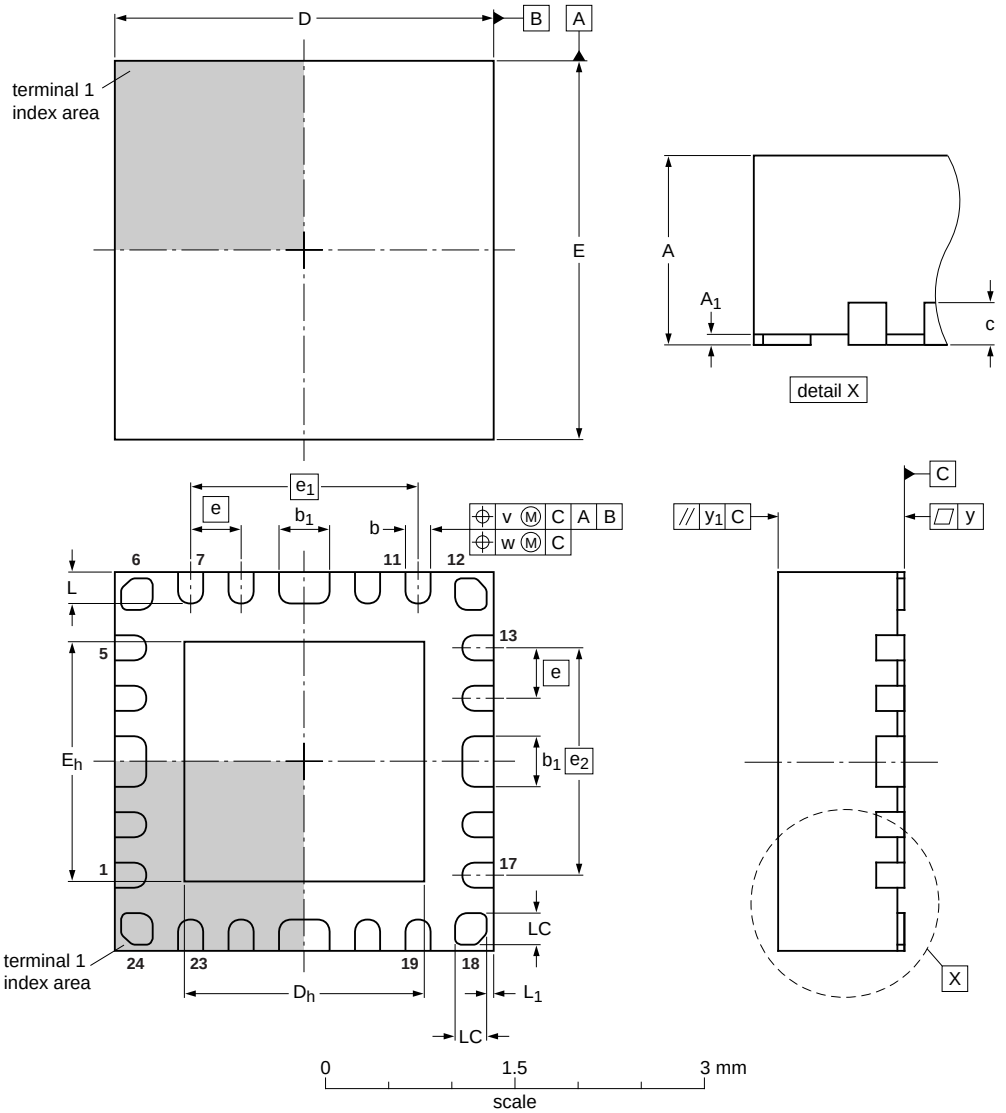
[1] This V_{OL} is contributed from the 900 Ω pull-down resistors on these two pins.

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10. Package outline

HVQFN24: plastic thermal enhanced very thin quad flat package; no leads; 24 terminals; body 3 x 3 x 0.85 mm **SOT905-1**



DIMENSIONS (mm are the original dimensions)

UNIT	A(1) max	A_1	b	b_1	c	D(1)	D_h	E(1)	E_h	e	e_1	e_2	L	L_1	LC	v	w	y	y_1
mm	1	0.05 0.00	0.25 0.15	0.45 0.35	0.2	3.1 2.9	2.05 1.75	3.1 2.9	2.05 1.75	0.4	1.8	1.8	0.35 0.15	0.1 0.0	0.3 0.2	0.1	0.05	0.05	0.1

Note

1. Plastic or metal protrusions of 0.075 mm maximum per side are not included

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT905-1	- - -	- - -	- - -			~~06-03-13~~ 06-03-31

Fig 3. Package outline SOT905-1 (HVQFN24)

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11. 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"*.

11.1 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.

11.2 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

11.3 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

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11.4 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 4) 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 21 and 22

Table 21. 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 22. Lead-free process (from J-STD-020D)

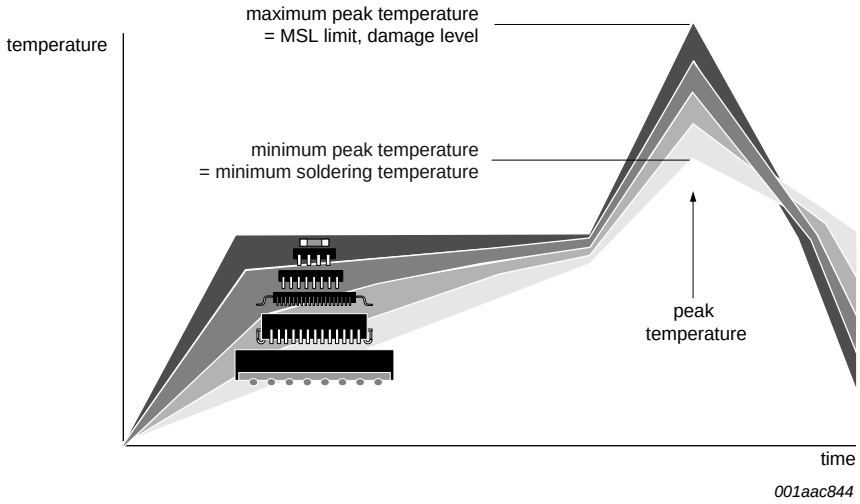
Package thickness (mm)	Package reflow temperature (°C)		
	Volume (mm^3)		
	< 350	350 to 2000	> 2000
< 1.6	260	260	260
1.6 to 2.5	260	250	245
> 2.5	250	245	245

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 4.

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MSL: Moisture Sensitivity Level

Fig 4. Temperature profiles for large and small components

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

12. Abbreviations

Table 23. Abbreviations

Acronym	Description
CDM	Charged-Device Model
CMOS	Complementary Metal-Oxide Semiconductor
DDC	Direct Display Control
DP	DisplayPort
DPML	DisplayPort Main Link
ESD	ElectroStatic Discharge
HBM	Human Body Model
HBR2	High Bit Rate 2
ML	Main Link
MUX	Multiplexer
PIN	P-type, Intrinsic, N-type

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13. Revision history

Table 24. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
CBTL05023 v.5	20130715	Product data sheet	-	CBTL05023 v.4
Modifications:	• Section 2.3 “General”, first bullet item: corrected term from “Hug Plug Detect” to “Hot Plug Detect” • Table 1 “Ordering information”: added column “Topside marking” • Added Section 3.1 “Ordering options” • De-activated hyper links in previous revision history			
CBTL05023 v.4	20121031	Product data sheet	-	CBTL05023 v.3
Modifications:	• Descriptive title of data sheet changed from “Multiplexer/demultiplexer switch chip” to “Multiplexer/demultiplexer switch for Thunderbolt applications” • Table 13 “AUX/DDC channel characteristics”: – I_{LIH} Max value changed from “±5 μA” to “±0.5 μA” – I_{LIL} Max value changed from “±5 μA” to “±0.5 μA” • Table 14 “DPML channel characteristics”: – I_{LIH} Max value changed from “±5 μA” to “±0.5 μA” – I_{LIL} Max value changed from “±5 μA” to “±0.5 μA” • Table 16 “HPD, BIASIN, DP_PD, AUXIO_EN input buffer characteristics”: – I_{LI} Max value changed from “10 μA” to “1 μA”			
CBTL05023 v.3	20120621	Product data sheet	-	CBTL05023 v.2
Modifications:	• Table 2 “Pin description”, last row: “Type” for Pin “center pad” corrected from “power” to “ground”			
CBTL05023 v.2	20120515	Product data sheet	-	CBTL05023 v.1
Modifications:	• Section 2.2 “DP MUX 2 : 1 switch”, third bullet, ninth sub-bullet: changed from “–50 dB” to “–25 dB” • Section 2.3 “General”, fourth bullet: inserted “Patent-pending” • Table 14 “DPML channel characteristics”, DDNEXT characteristic: – Typ value for condition f = 2.5 GHz changed from “–50 dB” to “–25 dB” – Typ value for condition f = 100 MHz changed from “–65 dB” to “–60 dB”			
CBTL05023 v.1	20111104	Product data sheet	-	-

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Document status[1][2]	Product status[3]	Definition
Objective [short] data sheet	Development	This document contains data from the objective specification for product development.
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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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