13-Bit to 26-Bit Registered Buffer PC2700-/PC3200-Compliant

Features

- **Differential clock inputs up to 280 MHz**
- **Supports LVTTL switching levels on the RESET# pin**
- **Output drivers have controlled edge rates, so no external resistors are required.**
- **Two KV ESD protection**
- **Latch-up performance exceeds 100 mA per JESD78, Class II**
- **64-pin TSSOP/JEDEC and 56-pin QFN package availability**
- **JEDEC specification supported**

Description

This 13-bit to 26-bit registered buffer is designed for 2.3V to 2.7 VDD operations.

All inputs are compatible with the JEDEC Standard for SSTL-2, except the LVCMOS reset (RESET#) input. All outputs are SSTL_2, Class II compatible.

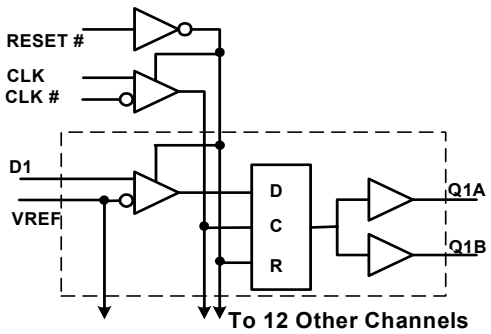
The CY2SSTV16859 operates from a differential clock (CLK and CLK#) of frequency up to 280 MHz. Data are registered at crossing of CLK going high and CLK# going low.

When RESET# is low, the differential input receivers are disabled, and undriven (floating) data and clock inputs are allowed. The LVCMOS RESET# input must always be held at a valid logic high or low level.

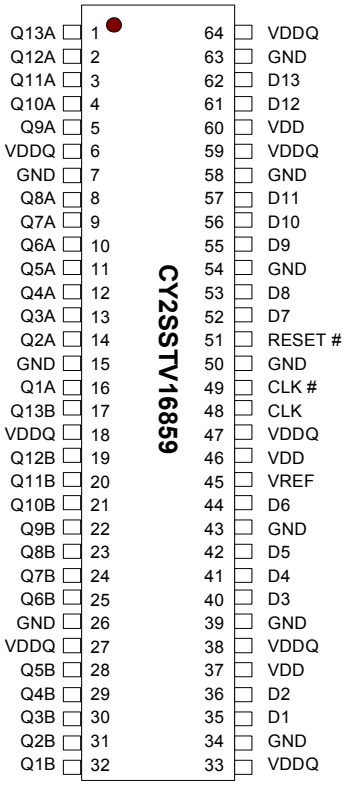
To ensure defined outputs from the register before a stable clock has been supplied, RESET# must be held in the low state during power up.

In the DDR DIMM application, RESET# is completely asynchronous with respect to CLK# and CLK. Therefore, no timing relationship can be guaranteed between the two. When entering reset, the register is cleared and the outputs are driven low quickly, relative to the time to disable the differential input receivers, thus ensuring no glitches on the output. However, when coming out of reset, the register becomes active quickly, relative to the time to enable the differential input receivers.

Block Diagram

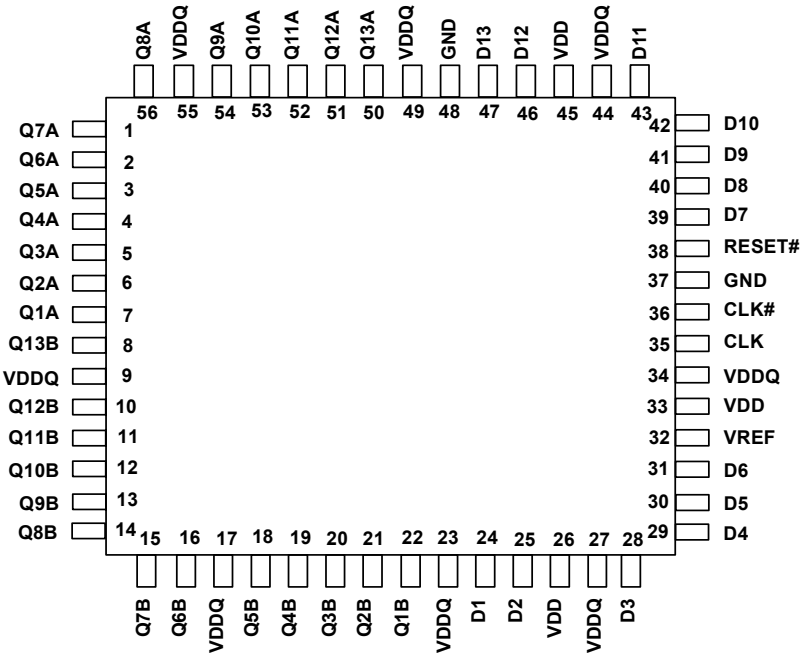


Pin Configuration



64 TSSOP Package

Pin Configuration (continued)



56 QFN Package

Pin Description

Pin		Name	Description
TSSOP	**QFN**		
51	38	RESET#	**Disable Clocking and Reset Latch**
7,15,34,39,43,50,54,58,63	37,48	GND	**Ground**
37,46,60	26,33,45	VDD	**Supply Voltage**
6,18,27,33,38,47,59,64	9,17,23,27,34,44,49,55	VDDQ	**Supply Voltage, Quiet**
45	32	VREF	**Reference Voltage for Data Inputs D(1:13)**
16,14,13,12,11,10,9,8,5,4,3,2,1	7,6,5,4,3,2,1,56,54,53,52,51,50	QA(1:13)	**Data Outputs**
32,31,30,29,28,25,24,23,22,21,20, 19,17	22,21,20,19,18,16,15,14,13,12 11,10,8	QB(1:13)	**Data Outputs**
35,36,40,41,42,44,52,53,55,56,57, 61,62	24,25,28,29,30,31,39,40,41,42 43,46,47	D(1:13)	**Data Inputs**
48,49	35,36	CLK, CLK#	**Differential Clock Signals**

Table 1. Function Table[1,2,3]

INPUTS				OUTPUT
RESET#	**CLK**	**CLK#**	**D**	**Q**
H	↑	↓	L	L
H	↑	↓	H	H
H	L or H	L or H	X	Q_0
L	X or floating	X or floating	X or floating	L

Notes:
1. H = High voltage level.
2. L = Low voltage level.
3. X = Don't care.

Absolute Maximum Conditions[4,5]

Parameter	Description	Condition	Min.	Max.	Unit
V_{TERM}[6]	Terminal Voltage with respect to V_{SS}		–0.5	3.6	V
V_{TERM}[7]	Terminal Voltage with respect to V_{SS}		–0.5	V_{DD} + 0.5	V
T_{STG}	Storage Temperature		–65°	150°C	°C
I_{OUT}	DC Output Current		–50	50	mA
I_{IK}	Continuous Clamp Current	V_I<0 or V_I>V_{SS}	–50	50	mA
I_{OK}	Continuous Clamp Current	V_O<0 or V_O>V_{DD}	–50	50	mA
I_{dd} I_{SS}	Continuous Current through each V_{DD}, V_{DDQ} or V_{SS}		–100	100	mA

Recommended Operating Conditions[8]

Parameter	Description		Min.	Typ.	Max.	Unit
V_{DD}	Supply voltage		2.3	2.5	2.7	V
V_{DDQ}	Output supply voltage	PC1600,PC2100,PC2700	2.3	2.5	2.7	V
		PC3200	2.5	2.6	2.7	V
V_{REF}	Reference voltage (V_{REF} = V_{DDQ}/2)	PC1600,PC2100,PC2700	1.15	1.25	1.35	V
		PC3200	1.25	1.3	1.35	V
V_{TT}	Termination voltage		V_{REF} – 40 mV	V_{REF}	V_{REF} + 40 mV	V
V_I	Input voltage		0	–	V_{DD}	V
V_{IH}	AC Data Input high-level voltage		V_{REF} + 310 mV	–	–	V
V_{IL}	AC Data Input low-level voltage		–	–	V_{REF} – 310 mV	V
V_{IH}	DC Data Input high-level voltage		V_{REF} + 150 mV	–	–	V
V_{IL}	DC Data Input low-level voltage		–	–	V_{REF} – 150 mV	V
V_{IH}	RESET# Input high-level voltage		1.7	–	–	V
V_{IL}	RESET# Input low-level voltage		–	–	0.7	V
V_{ICR}	CLK, CLK# Common-mode input voltage range		0.97	–	1.53	V
$V_{I(PP)}$	CLK, CLK# Peak-to-peak input voltage		360	–	–	mV
I_{OH}	High-level output current		–	–	–20	mA
I_{OL}	Low-level output current		–	–	20	mA
T_A	Operating free-air temperature		0	–	85	°C

DC Electrical Specifications

Parameter	Description	Condition		VDD	Min.	Typ.[9]	Max.	Unit
V_{IK}	Clamp Voltage	I_I = –18 mA		2.3V	–	–	–1.2	V
V_{OH}	High level output voltage	I_{OH} = –100 µA		2.3 to 2.7V	V_{DD} – 0.2	–	–	V
		I_{OH} = –16 mA		2.3V	1.95	–	–	V
V_{OL}	Low level output voltage	I_{OL} = 100 µA		2.3 to 2.7V	–	–	0.2	V
		I_{OL} = 16 mA		2.3	–	–	0.35	V
I_I	All Inputs	V_I = V_{DD} or V_{SS}		2.7V	–	–	± 5	µA
I_{DD}	Static Standby	RESET# = V_{SS}	I_O = 0	2.7V	–	–	10	µA
	Static Operating	RESET# = V_{DD}, V_I = $V_{IH(AC)}$ or $V_{IL(AC)}$		2.7	–	–	40.0	mA

Notes:

4. The voltage on any input or I/O pin cannot exceed the power pin during power-up. Power supply sequencing is NOT required.
5. Stresses greater than those listed under Absolute Maximum Conditions may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended period may affect reliability.
6. V_{DD}/V_{DDQ} terminals.
7. All terminals except V_{DD}.
8. The RESET# input of the device must be held at V_{DD} or V_{SS} to ensure proper device operation.
9. All typical values are measured at T_{AMB} = 25°C

DC Electrical Specifications (continued)

Parameter	Description	Condition		VDD	Min.	Typ.[9]	Max.	Unit
I_{DDD}	Dynamic operating – clock only	RESET# = V_{DD}, V_I = $V_{IH(AC)}$ or $V_{IL(AC)}$, CLK and CLK# switching 50% duty cycle	I_O = 0	2.7V	–	30.0	–	µA/ clock MHz
	Dynamic operating – per each data input	RESET# = V_{DD}, V_I = $V_{IH(AC)}$ or $V_{IL(AC)}$, CLK and CLK# switching 50% duty cycle. One data input switching at half clock frequency, 50% duty cycles.		2.7	–	15.0	–	µA/ clock MHz /data input
r_{OH}	Output high	I_{OH} = –20 mA		2.3 to 2.7V	7	–	20	Ω
r_{OL}	Output low	I_{OL} = 20 mA		2.3 to 2.7V	7	–	20	Ω
$r_{O(\Delta)}$	$\lvert r_{OH} - r_{OL} \rvert$ each separate bit	I_O = 20 mA, T_A = 25°C		2.5V	–	–	4	Ω
C_i	Data Inputs	V_I = V_{REF} ± 310 mV		2.5	2.5	–	3.5	pF
	CLK and CLK#	V_{ICR} = 1.25V, $V_{I(PP)}$ = 360 mV		2.5	2.5	–	3.5	pF
	RESET#	V_I = V_{DD} or V_{SS}		2.5	2.5	–	3.5	pF

AC Electrical Specifications

Parameter	Description		V_{DD} = 2.5V± 0.2V		Unit
			Min.	Max.	
f_{clock}	Clock Frequency		–	280	MHz
t_w	Pulse duration, CLK, CLK# high or low		2.0	–	ns
t_{act}	Differential inputs active time (data inputs must be held low after RESET# is taken high).		–	22	ns
t_{inact}	Differential inputs inactive time (data and clock inputs must be held at valid levels (not floating) after RESET# is taken low).		–	22	ns
t_{su}	Set-up time, fast slew rate[10, 12]	Data before CLK↑, CLK#↓	0.75	–	ns
	Set-up time, slow slew rate[11, 12]		0.9	–	ns
t_h	Hold time, fast slew rate[10, 12]	Data after CLK ↑, CLK#↓	0.75	–	ns
	Hold time, slow slew rate[11, 12]		0.9	–	ns

Table 2. Switching Characteristics Over Recommended Operating Conditions[13]

Parameter	From (Input)	To (Output)	V_{DD} = 2.5V ± 0.2V		Unit
			Min.	Max.	
f_{max}			280	–	MHz
t_{PHL}	RESET#	Q		5	ns
t_{PD}	CLK and CLK#	Q	1.1	2.8	ns

Notes:
10. For data signal input slew rate ≥ 1 V/ns.
11. For data signal input slew rate ≥ V/ns and < 1V/ns.
12. CLK and CLK# signals input slew rates are ≥ 1 V/ns.
13. See test circuits and waveforms. TA = 0°C to +85°C.

Output Buffer Characteristics

Table 3. Output Buffer Voltage vs. Current (V/I) Characteristics

Voltage (V)	Pull-Down		Pull-Up	
	Min. I(mA)	Max. I(mA)	Min. I(mA)	Max. I(mA)
0	0	0	–55	–162
0.1	6	13	–55	–161
0.2	10	25	–54	–160
0.3	15	38	–54	–159
0.4	19	49	–54	–157
0.5	23	60	–54	–156
0.6	27	71	–53	–154
0.7	30	81	–53	–152
0.8	34	91	–53	–149
0.9	36	100	–52	–146
1.0	38	108	–52	–143
1.1	40	115	–52	–140
1.2	42	123	–51	–137
1.3	43	130	–50	–134
1.4	44	137	–48	–130
1.5	44	144	–46	–125
1.6	45	150	–44	–120
1.7	45	158	–40	–112
1.8	45	165	–38	–104
1.9	45	172	–35	–96
2.0	45	179	–31	–83
2.1	46	185	–28	–72
2.2	46	191	–23	–60
2.3	46	196	–19	–49
2.4	46	201	–15	–38
2.5	46	206	–10	–27
2.6	46	211	–5	–15
2.7	46	216	0	0

Table 4. Output Buffer Slew-Rate Characteristics

dV/dt	Min.	Max.
Rise	0.85 V/ns	15.9 V/ns
Fall	1.00 V/ns	18.9 V/ns

Parameter Measurement Information[14]

V_{DD} = 2.5V ± 0.2V

Timing Diagrams

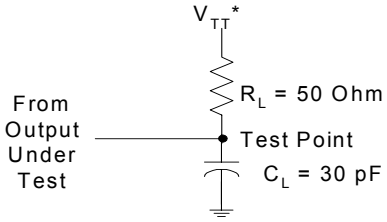


Figure 1. Load Circuit[15]

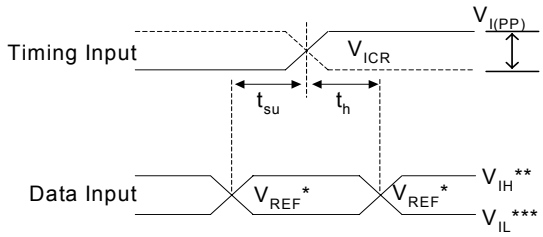


Figure 2. Voltage Waveforms Set-up and Hold Times

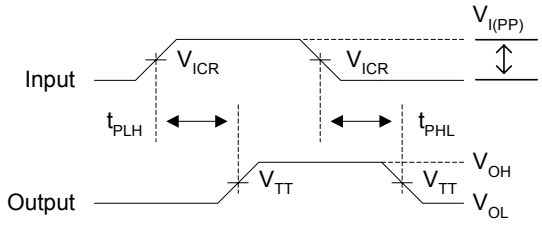


Figure 3. Voltage Waveforms Propagation Delay Times[16, 17]

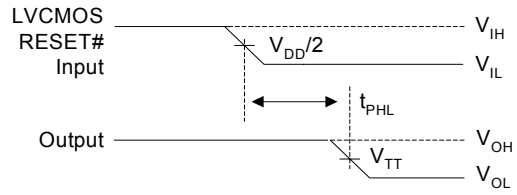


Figure 4. Voltage Waveforms Propagation Delay Times

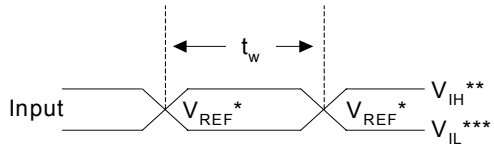


Figure 5. Voltage Waveforms Pulse Duration[18,19]

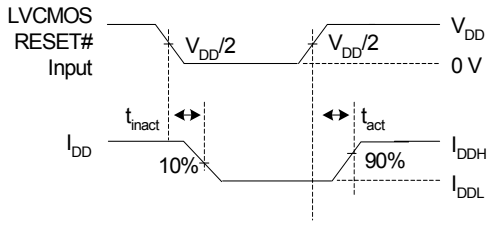


Figure 6. Voltage Waveforms Enable and Disable Times Low- and High-level Enabling

Ordering Information

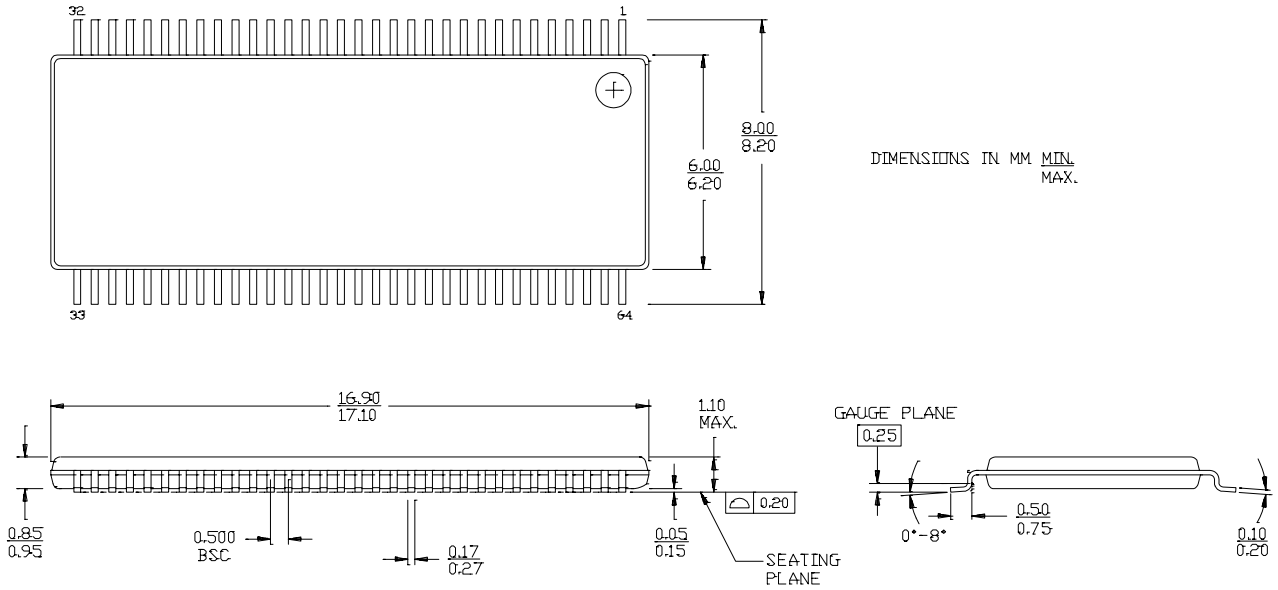
Part Number	Package Type	Product Flow
CY2SSTV16859ZC	64-pin TSSOP	Commercial, 0° to 70°C
CY2SSTV16859ZCT	64-pin TSSOP– Tape and Reel	Commercial, 0° to 70°C
CY2SSTV16859ZI	64-pin TSSOP	Industrial, –40° to 85°C
CY2SSTV16859ZIT	64-pin TSSOP – Tape and Reel	Industrial, –40° to 85°C
CY2SSTV16859LFC	56-pin QFN	Commercial, 0° to 70°C
CY2SSTV16859LFCT	56-pin QFN – Tape and Reel	Commercial, 0° to 70°C
CY2SSTV16859LFI	56-pin QFN	Industrial, –40° to 85°C
CY2SSTV16859LFIT	56-pin QFN– Tape and Reel	Industrial, –40° to 85°C

Notes:

14. All input pulses are supplied by generators having the following characteristics: PRR < 10 MHz, ZO = 50-ohm output slew rate = 1 V/ns ±20% (unless otherwise specified).
15. C_L includes probe and jig capacitance.
16. the outputs are measured one at a time with one transition per measurement.
17. $*V_{TT} = V_{REF} = V_{DDQ}/2$.
18. $**V_{IH} = V_{REF} + 350$ mV (AC voltage levels).
19. $***V_{IL} = V_{REF} - 350$ mV (AC voltage levels).

Package Drawing and Dimension

64-lead Thin Shrunk Small Outline Package (6 mm x 17 mm) Z64



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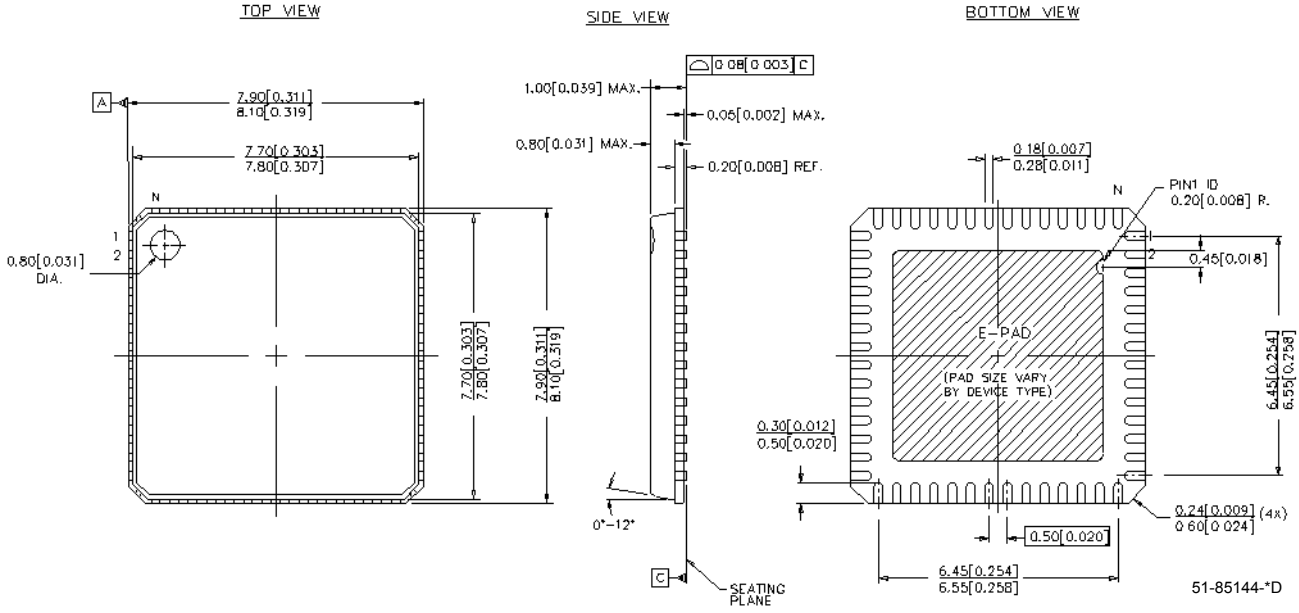
56-Lead QFN 8 x 8 MM LF56A



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Document History Page

Document Title:CY2SSTV16859 13-Bit to 26-Bit Registered Buffer PC2700-/PC3200-Compliant Document Number: 38-07463				
REV.	**ECN No.**	**Issue Date**	**Orig. of Change**	**Description of Change**
**	123052	04/14/03	RGL	New Data Sheet
*A	126277	04/21/02	KKV	Added commercial information to ordering information table, was not added in previous rev ** Added to title “PC2700-/PC3200- Compliant“
*B	128326	07/30/03	RGL	Added 56 QFN packages (Industrial and Commercial) in the device