

Timing-Safe™ Peak EMI reduction IC

General Features

- Clock distribution with Timing-Safe™ Peak EMI Reduction
- Input frequency range: 20MHz - 50MHz
- Zero input - output propagation delay
- Low-skew outputs
 - Output-output skew less than 250pS
 - Device-device skew less than 700pS
- Less than 200pS cycle-to-cycle jitter
- Available in 16pin, 150mil SOIC, 4.4mm TSSOP (PCS5P23Z09B), and in 8pin, 150 mil SOIC, 4.4mm TSSOP Packages (PCS5P23Z05B)
- 3.3V Operation
- Industrial temperature range
- Advanced CMOS technology
- The First True Drop-in Solution

eight-pin version and accepts one reference input and drives out five low-skew clocks.

All parts have on-chip PLLs that lock to an input clock on the CLKIN pin. The PLL feedback is on-chip and is obtained from the CLKOUT pad, internal to the device.

Multiple PCS5P23Z05B/09B devices can accept the same input clock and distribute it. In this case, the skew between the outputs of the two devices is guaranteed to be less than 700pS.

All outputs have less than 200pS of cycle-to-cycle jitter. The input and output propagation delay is guaranteed to be less than ± 350 pS, and the output-to-output skew is guaranteed to be less than 250pS.

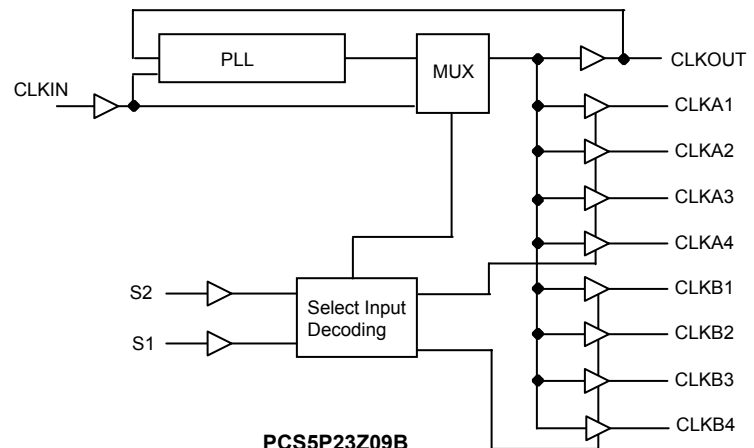
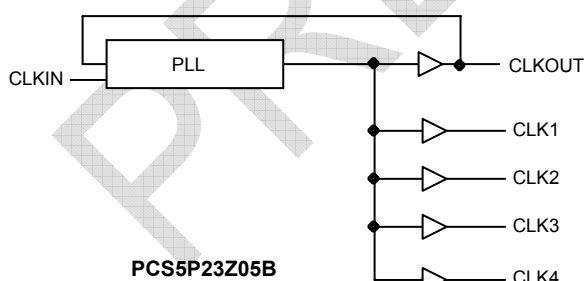
Functional Description

PCS5P23Z05B/09B is a versatile, 3.3V zero-delay buffer designed to distribute high-speed Timing-Safe™ clocks with Peak EMI Reduction. PCS5P23Z09B accepts one reference input and drives out nine low-skew clocks. It is available in a 16pin Package. The PCS5P23Z05B is the

Refer “Spread Spectrum Control and Input-Output Skew Table” for deviations and Input-Output Skew for PCS5P23Z05B and PCS5P23Z09B devices

The PCS5P23Z05B and PCS5P23Z09B are available in two different packages, as shown in the ordering information table.

Block Diagram



rev 0.2

Spread Spectrum Frequency Generation

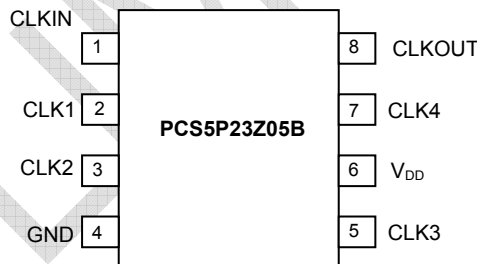
The clocks in digital systems are typically square waves with a 50% duty cycle and as frequencies increase the edge rates also get faster. Analysis shows that a square wave is composed of fundamental frequency and harmonics. The fundamental frequency and harmonics generate the energy peaks that become the source of EMI. Regulatory agencies test electronic equipment by measuring the amount of peak energy radiated from the equipment. In fact, the peak level allowed decreases as the frequency increases. The standard methods of reducing EMI are to use shielding, filtering, multi-layer

PCBs etc. These methods are expensive. Spread spectrum clocking reduces the peak energy by reducing the Q factor of the clock. This is done by slowly modulating the clock frequency. The PCS5P23Z05B/09B uses the center modulation spread spectrum technique in which the modulated output frequency varies above and below the reference frequency with a specified modulation rate. With center modulation, the average frequency is the same as the unmodulated frequency and there is no performance degradation

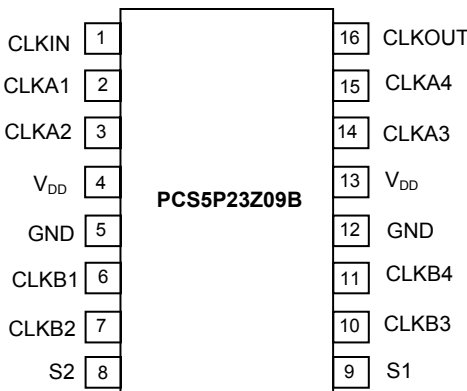
Timing-Safe™ technology

Timing-Safe™ technology is the ability to modulate a clock source with Spread Spectrum technology and maintain synchronization with any associated data path.

Pin Configuration (8 Pin Device)



Pin Configuration (16 Pin Device)



Pin Description for PCS5P23Z05B

Pin #	Pin Name	Description
1	CLKIN	Input reference frequency, 5V-tolerant input
2	CLK1 ¹	Buffered clock output
3	CLK2 ¹	Buffered clock output
4	GND	Ground
5	CLK3 ¹	Buffered clock output
6	V _{DD}	3.3V supply
7	CLK4 ¹	Buffered clock output
8	CLKOUT ^{1,2}	Buffered clock output, internal feedback on this pin

Notes: 1. Weak pull-down on these outputs.
 2. This output is driven and has an internal feedback for the PLL.
 3. All Buffered clock outputs are Timing-Safe™.

Pin Description for PCS5P23Z09B

Pin #	Pin Name	Description
1	CLKIN	Input reference frequency, 5V tolerant input
2	CLKA1 ¹	Buffered clock output
3	CLKA2 ¹	Buffered clock output
4	V _{DD}	3.3V supply
5	GND	Ground
6	CLKB1 ¹	Buffered clock output
7	CLKB2 ¹	Buffered clock output
8	S2 ²	Select Input, bit 2
9	S1 ²	Select Input, bit 1
10	CLKB3 ¹	Buffered clock output
11	CLKB4 ¹	Buffered clock output
12	GND	Ground
13	V _{DD}	3.3V supply
14	CLKA3 ¹	Buffered clock output
15	CLKA4 ¹	Buffered clock output
16	CLKOUT ^{1,3}	Buffered output, Internal feedback on this pin

Notes: 1. Weak pull-down on all outputs.
 2. Weak pull-up on these Inputs.
 3. This output is driven and has an internal feedback for the PLL.
 4. All Buffered clock outputs are Timing-Safe™.

Spread Spectrum Control and Input-Output Skew Table

(Note: The values given in the table are for an input frequency of 32MHz)

Device	Deviation	Input-Output Skew($\pm T_{SKEW}$)
PCS5P23Z05B	$\pm 0.25\%$	0.125
PCS5P23Z09B	$\pm 0.25\%$	0.125

Note: T_{SKEW} is measured in units of the Clock Period

Absolute Maximum Ratings

Symbol	Parameter	Rating	Unit
VDD	Voltage on any pin with respect to Ground	-0.5 to +4.6	V
T _{STG}	Storage temperature	-65 to +125	°C
T _s	Max. Soldering Temperature (10 sec)	260	°C
T _J	Junction Temperature	150	°C
T _{DV}	Static Discharge Voltage (As per JEDEC STD22- A114-B)	2	KV

Note: These are stress ratings only and are not implied for functional use. Exposure to absolute maximum ratings for prolonged periods of time may affect device reliability.

Operating Conditions for PCS5P23Z05B and PCS5P23Z09B Devices

Parameter	Description	Min	Max	Unit
V _{DD}	Supply Voltage	3.0	3.6	V
T _A	Operating Temperature (Ambient Temperature)	-40	+85	°C
C _L	Load Capacitance		30	pF
C _{IN}	Input Capacitance		7	pF

Electrical Characteristics for PCS5P23Z05B and PCS5P23Z09B

Parameter	Description	Test Conditions	Min	Typ	Max	Unit
V _{IL}	Input LOW Voltage ¹				0.8	V
V _{IH}	Input HIGH Voltage ¹		2.0			V
I _{IL}	Input LOW Current	V _{IN} = 0V			50	μA
I _{IH}	Input HIGH Current	V _{IN} = V _{DD}			100	μA
V _{OL}	Output LOW Voltage ²	I _{OL} = 8mA			0.4	V
V _{OH}	Output HIGH Voltage ²	I _{OH} = -8mA	2.4			V
I _{DD}	Supply Current	Unloaded outputs		15		mA
Z _o	Output Impedance			23		Ω

Note: 1. CLKIN input has a threshold voltage of V_{DD}/2

2. Parameter is guaranteed by design and characterization. Not 100% tested in production

Switching Characteristics for PCS5P23Z05B and PCS5P23Z09B

Parameter	Description	Test Conditions	Min	Typ	Max	Unit
$1/t_1$	Output Frequency	30pF load	20		50	MHz
	Duty Cycle ² = $(t_2 / t_1) * 100$	Measured at $V_{DD}/2$	40	50	60	%
t_3	Output Rise Time ^{1, 2}	Measured between 0.8V and 2.0V			2.5	nS
t_4	Output Fall Time ^{1, 2}	Measured between 2.0V and 0.8V			2.5	nS
t_5	Output-to-output skew ²	All outputs equally loaded			250	pS
t_6	Delay, CLKIN Rising Edge to CLKOUT Rising Edge ²	Measured at $V_{DD} / 2$			±350	pS
t_7	Device-to-Device Skew ²	Measured at $V_{DD}/2$ on the CLKOUT pins of the device			700	pS
t_j	Cycle-to-cycle jitter ²	Loaded outputs			200	pS
t_{LOCK}	PLL Lock Time ²	Stable power supply, valid clock presented on CLKIN pin			1.0	mS

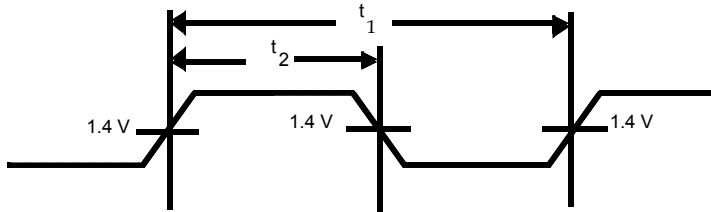
Note: 1. The parameters are specified with loaded outputs.

2. Parameter is guaranteed by design and characterization. Not 100% tested in production

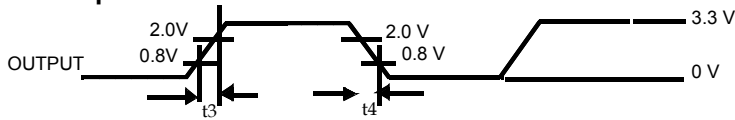
PRELIMINARY

Switching Waveforms

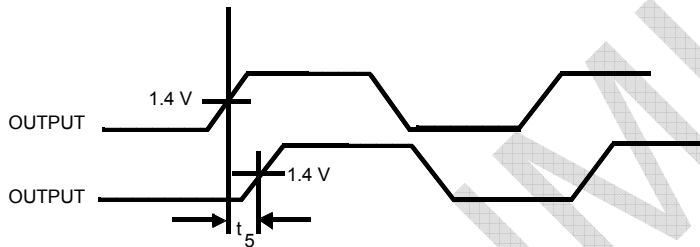
Duty Cycle Timing



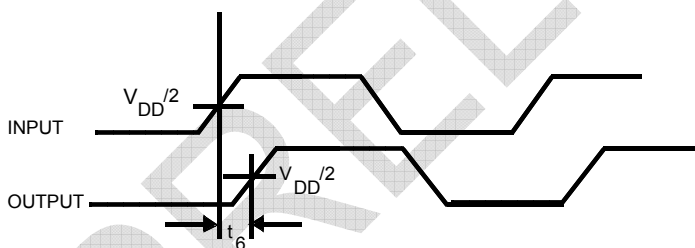
All Outputs Rise/Fall Time



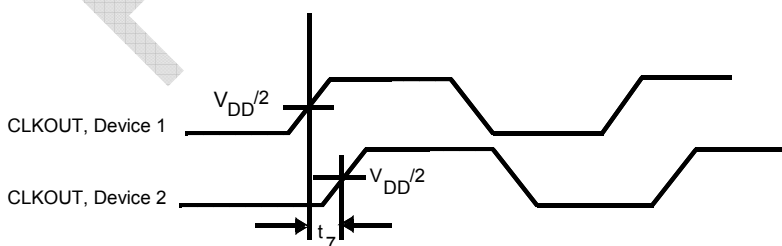
Output - Output Skew



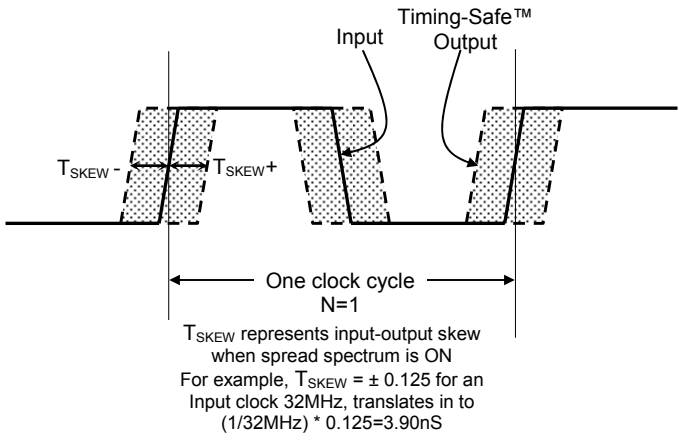
Input - Output Propagation Delay



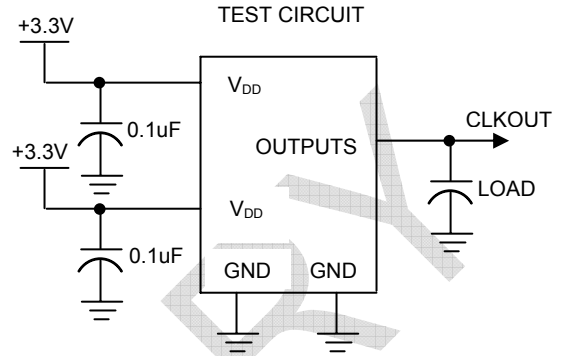
Device - Device Skew



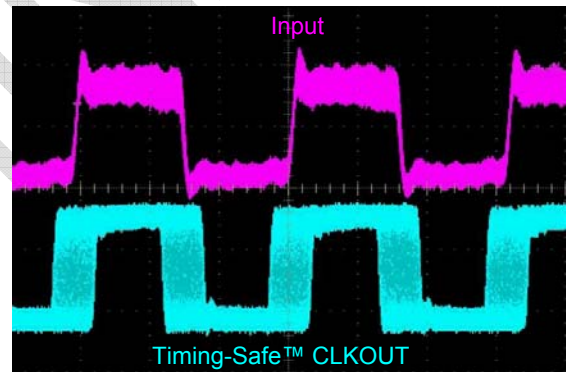
Input-Output Skew



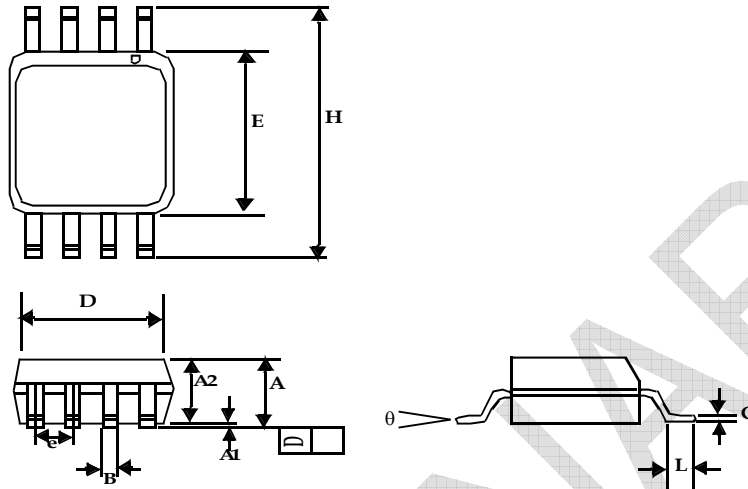
Test Circuit



A Typical example of Timing-Safe™ waveform

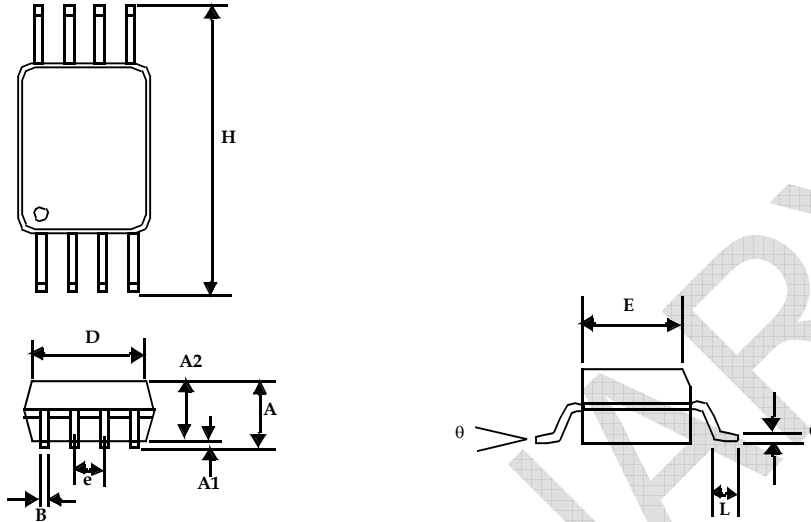


8-lead (150-mil) SOIC Package



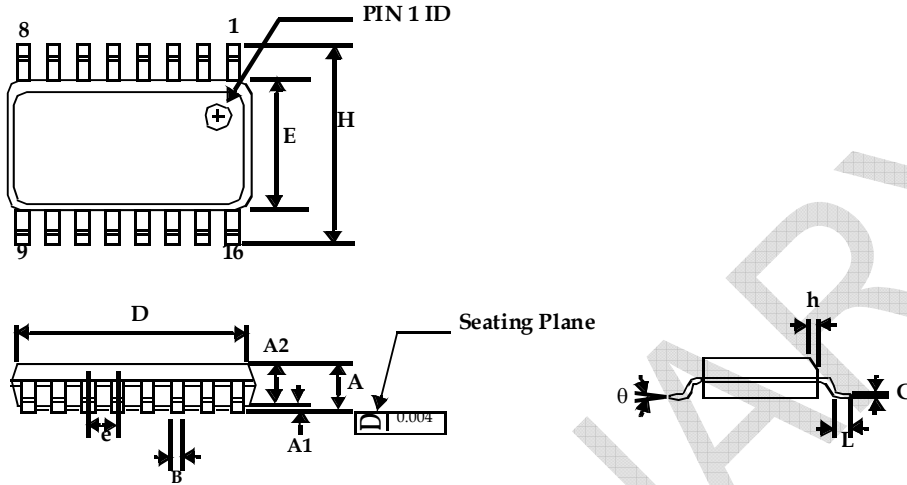
Symbol	Dimensions			
	Inches		Millimeters	
	Min	Max	Min	Max
A1	0.004	0.010	0.10	0.25
A	0.053	0.069	1.35	1.75
A2	0.049	0.059	1.25	1.50
B	0.012	0.020	0.31	0.51
C	0.007	0.010	0.18	0.25
D	0.193 BSC		4.90 BSC	
E	0.154 BSC		3.91 BSC	
e	0.050 BSC		1.27 BSC	
H	0.236 BSC		6.00 BSC	
L	0.016	0.050	0.41	1.27
θ	0°	8°	0°	8°

8-lead TSSOP (4.40-MM Body)



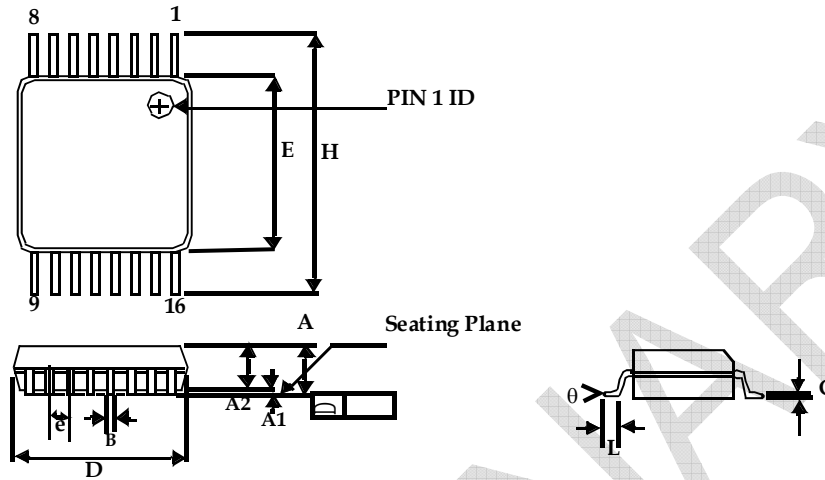
Symbol	Dimensions			
	Inches		Millimeters	
	Min	Max	Min	Max
A		0.043		1.10
A1	0.002	0.006	0.05	0.15
A2	0.033	0.037	0.85	0.95
B	0.008	0.012	0.19	0.30
c	0.004	0.008	0.09	0.20
D	0.114	0.122	2.90	3.10
E	0.169	0.177	4.30	4.50
e	0.026 BSC		0.65 BSC	
H	0.252 BSC		6.40 BSC	
L	0.020	0.028	0.50	0.70
θ	0°	8°	0°	8°

16-lead (150 Mil) Molded SOIC Package



Symbol	Dimensions			
	Inches		Millimeters	
	Min	Max	Min	Max
A	0.053	0.069	1.35	1.75
A1	0.004	0.010	0.10	0.25
A2	0.049	0.059	1.25	1.50
B	0.013	0.022	0.33	0.53
C	0.008	0.012	0.19	0.27
D	0.386	0.394	9.80	10.01
E	0.150	0.157	3.80	4.00
e	0.050 BSC		1.27 BSC	
H	0.228	0.244	5.80	6.20
h	0.010	0.016	0.25	0.41
L	0.016	0.035	0.40	0.89
θ	0°	8°	0°	8°

16-lead TSSOP (4.40-MM Body)



Symbol	Dimensions			
	Inches		Millimeters	
	Min	Max	Min	Max
A		0.043		1.20
A1	0.002	0.006	0.05	0.15
A2	0.031	0.041	0.80	1.05
B	0.007	0.012	0.19	0.30
C	0.004	0.008	0.09	0.20
D	0.193	0.201	4.90	5.10
E	0.169	0.177	4.30	4.50
e	0.026 BSC		0.65 BSC	
H	0.252 BSC		6.40 BSC	
L	0.020	0.030	0.50	0.75
θ	0°	8°	0°	8°

May 2007

rev 0.2

Ordering Codes

Ordering Code	Marking	Package Type	Temperature
PCS5P23Z09BF-16-ST	5P23Z09BF	16-pin 150-mil SOIC-TUBE, Pb Free	Commercial
PCS5I23Z09BF-16-ST	5I23Z09BF	16-pin 150-mil SOIC-TUBE, Pb Free	Industrial
PCS5P23Z09BF-16-SR	5P23Z09BF	16-pin 150-mil SOIC-TAPE & REEL, Pb Free	Commercial
PCS5I23Z09BF-16-SR	5I23Z09BF	16-pin 150-mil SOIC-TAPE & REEL, Pb Free	Industrial
PCS5P23Z09BF-16-TT	5P23Z09BF	16-pin 4.4-mm TSSOP - TUBE, Pb Free	Commercial
PCS5I23Z09BF-16-TT	5I23Z09BF	16-pin 4.4-mm TSSOP - TUBE, Pb Free	Industrial
PCS5P23Z09BF-16-TR	5P23Z09BF	16-pin 4.4-mm TSSOP - TAPE & REEL, Pb Free	Commercial
PCS5I23Z09BF-16-TR	5I23Z09BF	16-pin 4.4-mm TSSOP - TAPE & REEL, Pb Free	Industrial
PCS5P23Z05BF-08-ST	5P23Z05BF	8-pin 150-mil SOIC-TUBE, Pb Free	Commercial
PCS5I23Z05BF-08-ST	5I23Z05BF	8-pin 150-mil SOIC-TUBE, Pb Free	Industrial
PCS5P23Z05BF-08-SR	5P23Z05BF	8-pin 150-mil SOIC-TAPE & REEL, Pb Free	Commercial
PCS5I23Z05BF-08-SR	5I23Z05BF	8-pin 150-mil SOIC-TAPE & REEL, Pb Free	Industrial
PCS5P23Z05BF-08-TT	5P23Z05BF	8-pin 4.4-mm TSSOP - TUBE, Pb Free	Commercial
PCS5I23Z05BF-08-TT	5I23Z05BF	8-pin 4.4-mm TSSOP - TUBE, Pb Free	Industrial
PCS5P23Z05BF-08-TR	5P23Z05BF	8-pin 4.4-mm TSSOP - TAPE & REEL, Pb Free	Commercial
PCS5I23Z05BF-08-TR	5I23Z05BF	8-pin 4.4-mm TSSOP - TAPE & REEL, Pb Free	Industrial
PCS5P23Z09BG-16-ST	5P23Z09BG	16-pin 150-mil SOIC-TUBE, Green	Commercial
PCS5I23Z09BG-16-ST	5I23Z09BG	16-pin 150-mil SOIC-TUBE, Green	Industrial
PCS5P23Z09BG-16-SR	5P23Z09BG	16-pin 150-mil SOIC-TAPE & REEL, Green	Commercial
PCS5I23Z09BG-16-SR	5I23Z09BG	16-pin 150-mil SOIC-TAPE & REEL, Green	Industrial
PCS5P23Z09BG-16-TT	5P23Z09BG	16-pin 4.4-mm TSSOP - TUBE, Green	Commercial
PCS5I23Z09BG-16-TT	5I23Z09BG	16-pin 4.4-mm TSSOP - TUBE, Green	Industrial
PCS5P23Z09BG-16-TR	5P23Z09BG	16-pin 4.4-mm TSSOP - TAPE & REEL, Green	Commercial
PCS5I23Z09BG-16-TR	5I23Z09BG	16-pin 4.4-mm TSSOP - TAPE & REEL, Green	Industrial
PCS5P23Z05BG-08-ST	5P23Z05BG	8-pin 150-mil SOIC-TUBE, Green	Commercial
PCS5I23Z05BG-08-ST	5I23Z05BG	8-pin 150-mil SOIC-TUBE, Green	Industrial
PCS5P23Z05BG-08-SR	5P23Z05BG	8-pin 150-mil SOIC-TAPE & REEL, Green	Commercial
PCS5I23Z05BG-08-SR	5I23Z05BG	8-pin 150-mil SOIC-TAPE & REEL, Green	Industrial
PCS5P23Z05BG-08-TT	5P23Z05BG	8-pin 4.4-mm TSSOP - TUBE, Green	Commercial
PCS5I23Z05BG-08-TT	I23Z05BG	8-pin 4.4-mm TSSOP - TUBE, Green	Industrial
PCS5P23Z05BG-08-TR	5P23Z05BG	8-pin 4.4-mm TSSOP - TAPE & REEL, Green	Commercial
PCS5I23Z05BG-08-TR	5I23Z05BG	8-pin 4.4-mm TSSOP - TAPE & REEL, Green	Industrial

rev 0.2

Device Ordering Information

PCS5P23Z05BF-08-TR

Tape & Reel, T = Tube or Tray

O = SOT	U = MSOP
S = SOIC	E = TQFP
T = TSSOP	L = LQFP
A = SSOP	U = MSOP
V = TVSOP	P = PDIP
B = BGA	D = QSOP
Q = QFN	X = SC-70

DEVICE PIN COUNT

F = LEAD FREE AND RoHS COMPLIANT PART
G = GREEN PACKAGE, LEAD FREE, and RoHS

PART NUMBER

X= Automotive (-40C to +125C)	I= Industrial (-40C to +85C)	P or n/c = Commercial (0C to +70C)
1 = Reserved	6 = Power Management	
2 = Non PLL based	7 = Power Management	
3 = EMI Reduction	8 = Power Management	
4 = DDR support products	9 = Hi Performance	
5 = STD Zero Delay Buffer	0 = Reserved	

PulseCore Semiconductor Mixed Signal Product

PRELIMINARY

Licensed under US patent #5,488,627, #6,646,463 and #5,631,920.



PulseCore Semiconductor Corporation
1715 S. Bascom Ave Suite 200
Campbell, CA 95008
Tel: 408-879-9077
Fax: 408-879-9018
www.pulsecoresemi.com

Copyright PulseCore Semiconductor
All Rights Reserved
Preliminary Information
Part Number: PCS5P23Z05B/09B
Document Version: 0.2

Note: This product utilizes US Patent # 6,646,463 Impedance Emulator Patent issued to PulseCore Semiconductor, dated 11-11-2003
Timing-Safe™ US Patent Pending.

© Copyright 2006 PulseCore Semiconductor Corporation. All rights reserved. Our logo and name are trademarks or registered trademarks of PulseCore Semiconductor. All other brand and product names may be the trademarks of their respective companies. PulseCore reserves the right to make changes to this document and its products at any time without notice. PulseCore assumes no responsibility for any errors that may appear in this document. The data contained herein represents PulseCore's best data and/or estimates at the time of issuance. PulseCore reserves the right to change or correct this data at any time, without notice. If the product described herein is under development, significant changes to these specifications are possible. The information in this product data sheet is intended to be general descriptive information for potential customers and users, and is not intended to operate as, or provide, any guarantee or warranty to any user or customer. PulseCore does not assume any responsibility or liability arising out of the application or use of any product described herein, and disclaims any express or implied warranties related to the sale and/or use of PulseCore products including liability or warranties related to fitness for a particular purpose, merchantability, or infringement of any intellectual property rights, except as express agreed to in PulseCore's Terms and Conditions of Sale (which are available from PulseCore). All sales of PulseCore products are made exclusively according to PulseCore's Terms and Conditions of Sale. The purchase of products from PulseCore does not convey a license under any patent rights, copyrights; mask works rights, trademarks, or any other intellectual property rights of PulseCore or third parties. PulseCore does not authorize its products for use as critical components in life-supporting systems where a malfunction or failure may reasonably be expected to result in significant injury to the user, and the inclusion of PulseCore products in such life-supporting systems implies that the manufacturer assumes all risk of such use and agrees to indemnify PulseCore against all claims arising from such use.