Low Frequency Timing-Safe™ Peak EMI reduction IC

General Features

- Low Frequency Clock Distribution with Timing-Safe™ Peak EMI Reduction
- Input frequency range: 4MHz - 20MHz
- 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 (PCS5P23Z09A), and in 8pin, 150 mil SOIC, 4.4mm TSSOP Packages (PCS5P23Z05A).
- 3.3V Operation
- Industrial temperature range
- Advanced 0.35µ CMOS technology
- The First True Drop-in Solution

Functional Description

PCS5P23Z05A/09A is a versatile, 3.3V Zero-delay buffer designed to distribute low frequency Timing-Safe™ clocks with Peak EMI Reduction. PCS5P23Z09A accepts one reference input and drives out nine low-skew clocks. It is available in a 16 pin Package. The PCS5P23Z05A is the eight-pin version and accepts one reference input and drives out five low-skew clocks.

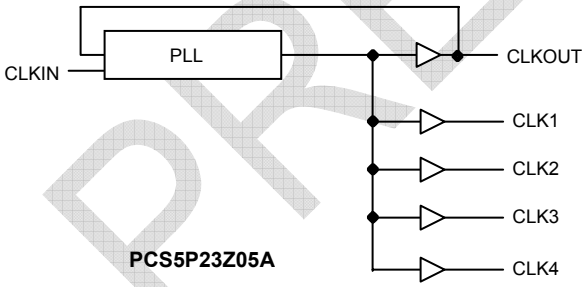
All parts have on-chip PLLs that lock to an input clock on the XIN/CLKIN pin. The PLL feedback is on-chip and is obtained from the CLKOUT pad, internal to the device.

Multiple PCS5P23Z05/09A 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.

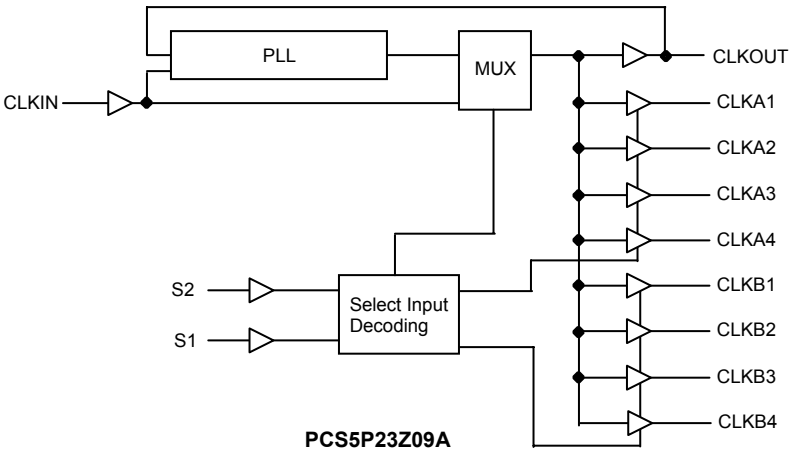
All outputs have less than 200pS of Cycle-to-cycle jitter. The input and output propagation delay is guaranteed to be less than 350pS, and the output-to-output skew is guaranteed to be less than 250pS.

Please refer "Differential Cycle Slips and Spread Spectrum Control Table" for deviations and differential Cycle Slips for PCS5P23Z05A and PCS5P23Z09A devices

Block Diagram



PCS5P23Z05A



PCS5P23Z09A

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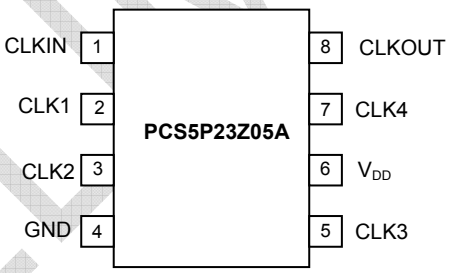
Spread Spectrum Frequency Generation

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. PCS5P23Z05A/09A 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

Cycle Slip

Cycle slip occurs when the output clock edge 'wanders' away from the corresponding input clock edge. There are two types of cycle slips – a Differential cycle slip and an Integral cycle slip. The differential cycle slip is caused due the clock edge variation over one modulation cycle. It is defined by the maximum amount of 'wander' the clock edge will have within one modulation cycle. Integral cycle slip occurs due to the accumulation of the cycle slip over successive modulation cycles. In PCS5P23Z05A/09A the differential cycle slip is within the value mentioned in the "Differential Cycle Slips and Spread Spectrum Control Table" and the Integral Cycle Slip is 'Zero'.

Pin Configuration (8 Pin Device)

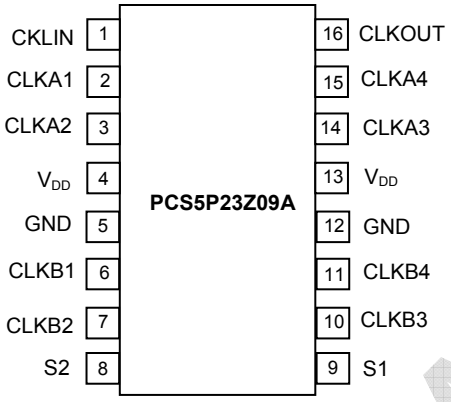


Pin Description for PCS5P23Z05A

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]	Buffered clock output, internal feedback on this pin

Notes: 1. Weak pull-down on all outputs. 2. Buffered clock outputs are Timing-Safe™

Pin Configuration (16 Pin Device)



Pin Description for PCS5P23Z09A

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

Notes: 1. Weak pull-down on all outputs.
2. Weak pull-up on these Inputs.
3. Buffered clock outputs are Timing-Safe™

Select Input Decoding for PCS5P23Z09A

S2	S1	Clock A1 - A4	Clock B1 - B4	CLKOUT[1]	Output Source	PLLShut-Down
0	0	Three-state	Three-state	Driven	PLL	N
0	1	Driven	Three-state	Driven	PLL	N
1	0	Driven	Driven	Driven	Reference	Y
1	1	Driven	Driven	Driven	PLL	N

Notes:
1. This output is driven and has an internal feedback for the PLL. The load on this output can be adjusted to change the skew between the reference and the output.

Differential Cycle Slips and Spread Spectrum Control Table

Device	Input Frequency	SS %	Deviation	Differential Cycle Slips (Nd)
PCS5P23Z05A/09A	12MHz	0	±0.25 %	0.063
		1	±0.50 %	0.125

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 PCS5P23Z05A/09A 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 PCS5P23Z05A/09A

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		TBD		mA
Z_o	Output Impedance			23		Ω

Note: 1. REF input has a threshold voltage of $V_{DD}/2$
2. Parameter is guaranteed by design and characterization. Not 100% tested in production

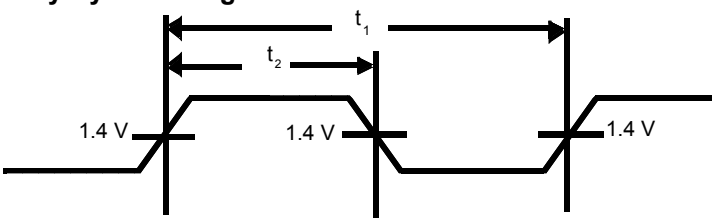
Switching Characteristics for PCS5P23Z05A/09A[1]

Parameter	Description	Test Conditions	Min	Typ	Max	Unit
$1/t_1$	Output Frequency	30pF load	4		20	MHz
	Duty Cycle [2] = (t_2 / t_1) * 100	Measured at $V_{DD}/2$	40	50	60	%
t_3	Output Rise Time [2]	Measured between 0.8V and 2.0V			2.5	nS
t_4	Output Fall Time [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, REF 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 REF pin			1.0	mS

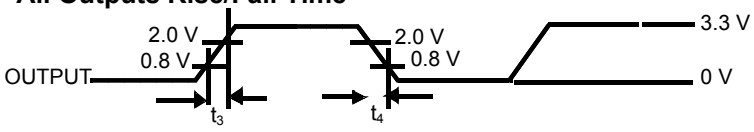
Note: 1. All parameters specified with loaded outputs.
2. Parameter is guaranteed by design and characterization. Not 100% tested in production

Switching Waveforms

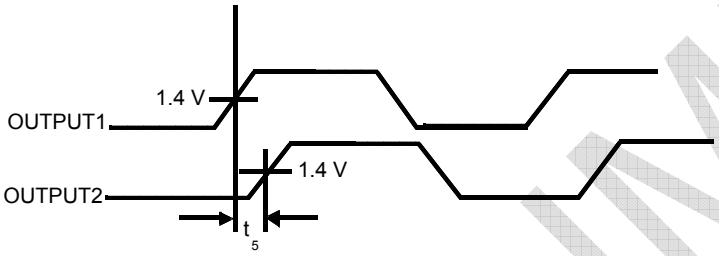
Duty Cycle Timing



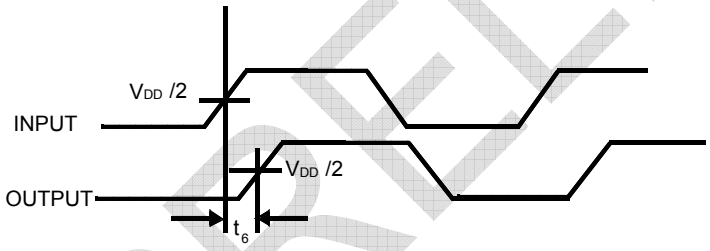
All Outputs Rise/Fall Time



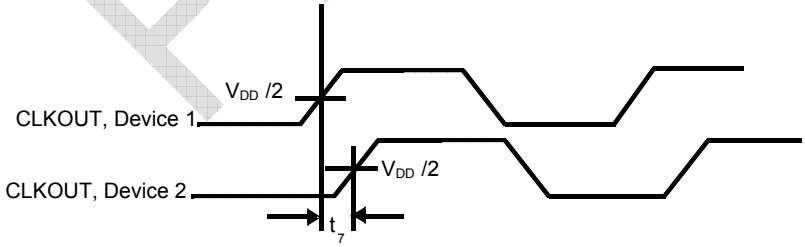
Output - Output Skew



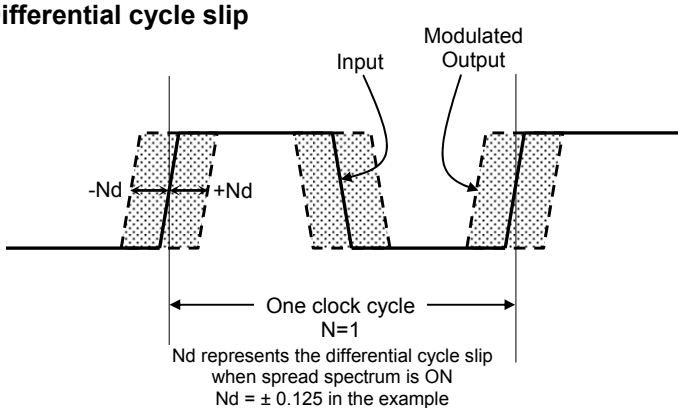
Input - Output Propagation Delay



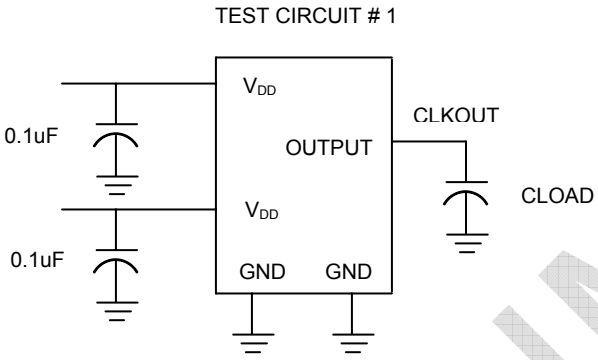
Device - Device Skew



Differential cycle slip

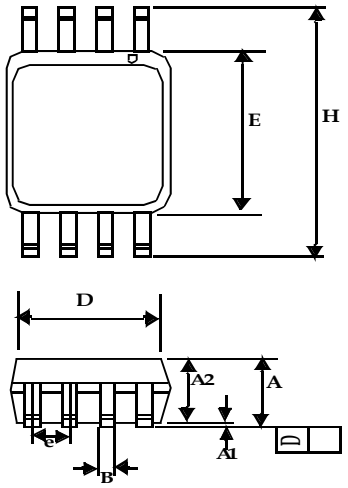


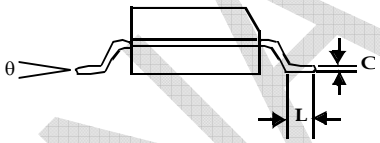
Test Circuits



Package Information

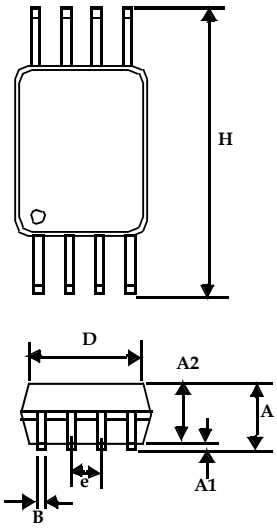
8-lead (150-mil) SOIC Package

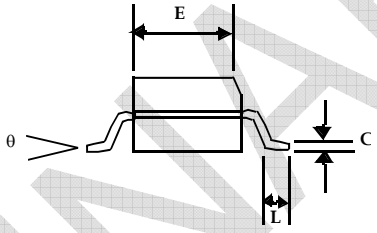




Symbol	Dimensions			
	Inches		Millimeters	
	Min	Max	Min	Max
A1	0.004	0.010	0.10	0.25
A	0.053	0.069	1.35	1.75
A2	0.049	0.059	1.25	1.50
B	0.012	0.020	0.31	0.51
C	0.007	0.010	0.18	0.25
D	0.193 BSC		4.90 BSC	
E	0.154 BSC		3.91 BSC	
e	0.050 BSC		1.27 BSC	
H	0.236 BSC		6.00 BSC	
L	0.016	0.050	0.41	1.27
θ	0°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

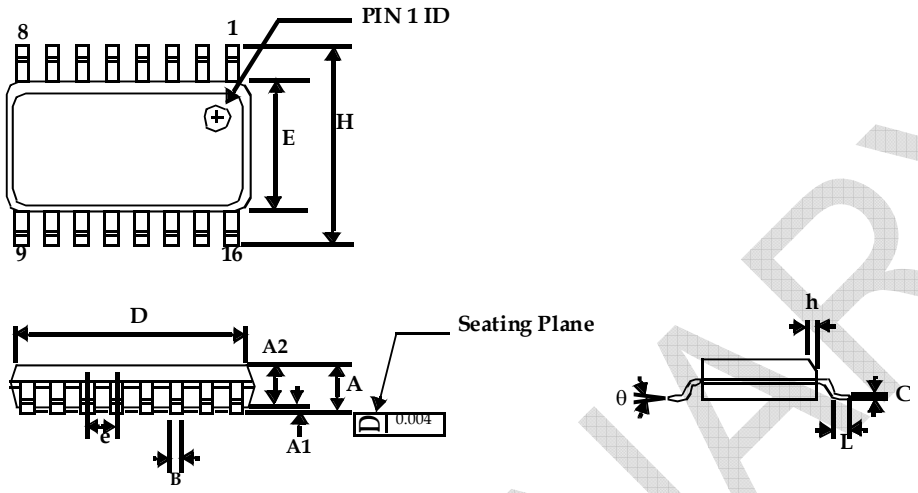
8-lead Thin Shrunk Small Outline Package (4.40-MM Body)





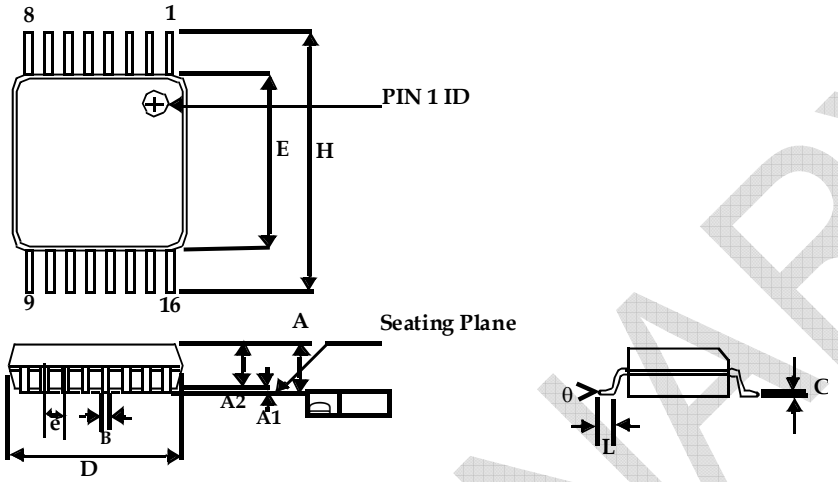
Symbol	Dimensions			
	Inches		Millimeters	
	Min	Max	Min	Max
A		0.043		1.10
A1	0.002	0.006	0.05	0.15
A2	0.033	0.037	0.85	0.95
B	0.008	0.012	0.19	0.30
c	0.004	0.008	0.09	0.20
D	0.114	0.122	2.90	3.10
E	0.169	0.177	4.30	4.50
e	0.026 BSC		0.65 BSC	
H	0.252 BSC		6.40 BSC	
L	0.020	0.028	0.50	0.70
θ	0°	8°	0°	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 Thin Shrunk Small Outline Package (4.40-MM Body)



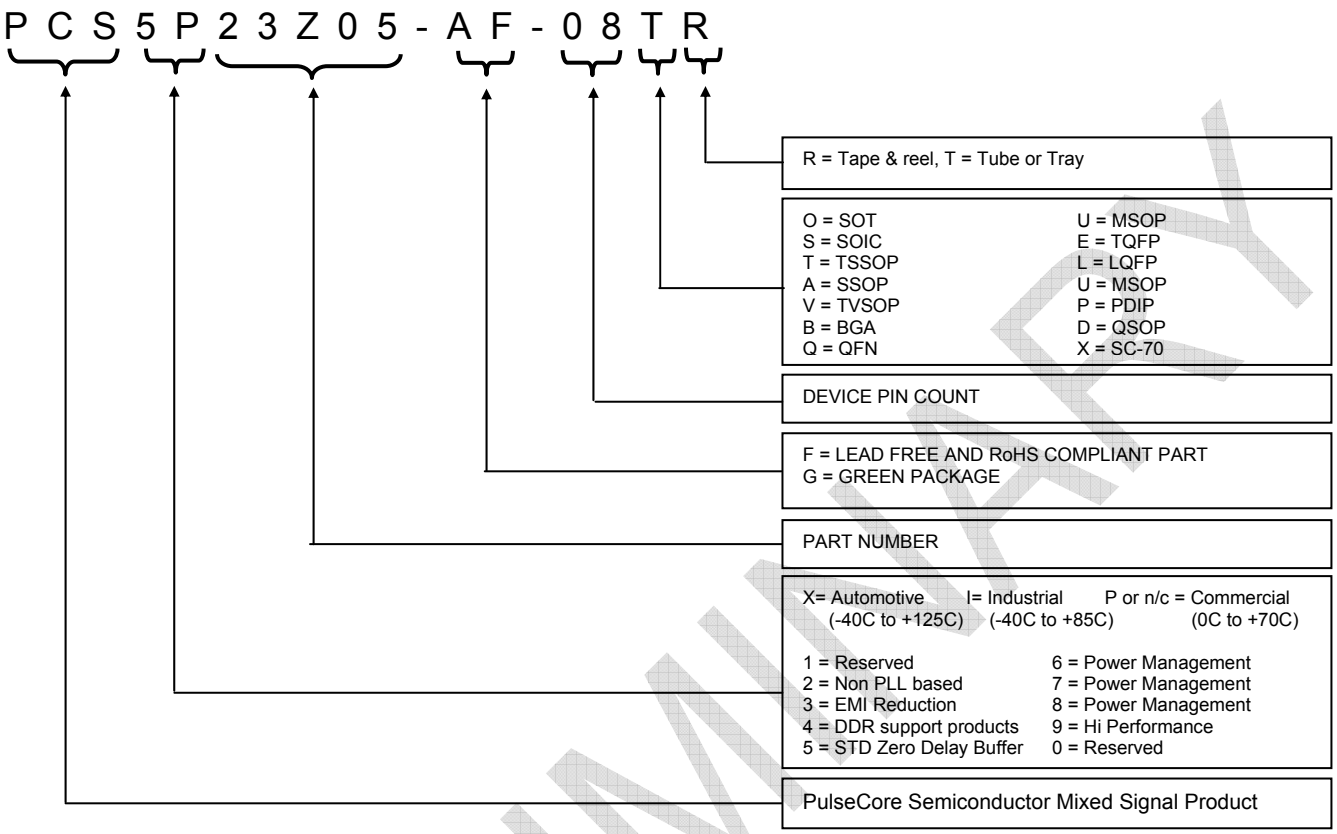
Symbol	Dimensions			
	Inches		Millimeters	
	Min	Max	Min	Max
A		0.043		1.20
A1	0.002	0.006	0.05	0.15
A2	0.031	0.041	0.80	1.05
B	0.007	0.012	0.19	0.30
C	0.004	0.008	0.09	0.20
D	0.193	0.201	4.90	5.10
E	0.169	0.177	4.30	4.50
e	0.026 BSC		0.65 BSC	
H	0.252 BSC		6.40 BSC	
L	0.020	0.030	0.50	0.75
θ	0°	8°	0°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

Ordering Codes

Ordering Code	Marking	Package Type	Temperature
PCS5P23Z05AF-08-ST	5P23Z05AF	8-pin 150-mil SOIC-TUBE, Pb Free	Commercial
PCS5I23Z05AF-08-ST	5I23Z05AF	8-pin 150-mil SOIC-TUBE, Pb Free	Industrial
PCS5P23Z05AF-08-SR	5P23Z05AF	8-pin 150-mil SOIC-TAPE & REEL, Pb Free	Commercial
PCS5I23Z05AF-08-SR	5I23Z05AF	8-pin 150-mil SOIC-TAPE & REEL, Pb Free	Industrial
PCS5P23Z05AF-08-TT	5P23Z05AF	8-pin 4.4-mm TSSOP - TUBE, Pb Free	Commercial
PCS5I23Z05AF-08-TT	5I23Z05AF	8-pin 4.4-mm TSSOP - TUBE, Pb Free	Industrial
PCS5P23Z05AF-08-TR	5P23Z05AF	8-pin 4.4-mm TSSOP - TAPE & REEL, Pb Free	Commercial
PCS5I23Z05AF-08-TR	5I23Z05AF	8-pin 4.4-mm TSSOP - TAPE & REEL, Pb Free	Industrial
PCS5P23Z05AG-08-ST	5P23Z05AG	8-pin 150-mil SOIC-TUBE, Green	Commercial
PCS5I23Z05AG-08-ST	5I23Z05AG	8-pin 150-mil SOIC-TUBE, Green	Industrial
PCS5P23Z05AG-08-SR	5P23Z05AG	8-pin 150-mil SOIC-TAPE & REEL, Green	Commercial
PCS5I23Z05AG-08-SR	5I23Z05AG	8-pin 150-mil SOIC-TAPE & REEL, Green	Industrial
PCS5P23Z05AG-08-TT	5P23Z05AG	8-pin 4.4-mm TSSOP - TUBE, Green	Commercial
PCS5I23Z05AG-08-TT	5I23Z05AG	8-pin 4.4-mm TSSOP - TUBE, Green	Industrial
PCS5P23Z05AG-08-TR	5P23Z05AG	8-pin 4.4-mm TSSOP - TAPE & REEL, Green	Commercial
PCS5I23Z05AG-08-TR	5I23Z05AG	8-pin 4.4-mm TSSOP - TAPE & REEL, Green	Industrial
PCS5P23Z09AF-16-ST	5P23Z09AF	16-pin 150-mil SOIC-TUBE, Pb Free	Commercial
PCS5I23Z09AF-16-ST	5I23Z09AF	16-pin 150-mil SOIC-TUBE, Pb Free	Industrial
PCS5P23Z09AF-16-SR	5P23Z09AF	16-pin 150-mil SOIC-TAPE & REEL, Pb Free	Commercial
PCS5I23Z09AF-16-SR	5I23Z09AF	16-pin 150-mil SOIC-TAPE & REEL, Pb Free	Industrial
PCS5P23Z09AF-16-TT	5P23Z09AF	16-pin 4.4-mm TSSOP - TUBE, Pb Free	Commercial
PCS5I23Z09AF-16-TT	5I23Z09AF	16-pin 4.4-mm TSSOP - TUBE, Pb Free	Industrial
PCS5P23Z09AF-16-TR	5P23Z09AF	16-pin 4.4-mm TSSOP - TAPE & REEL, Pb Free	Commercial
PCS5I23Z09AF-16-TR	5I23Z09AF	16-pin 4.4-mm TSSOP - TAPE & REEL, Pb Free	Industrial
PCS5P23Z09AG-16-ST	3P22S09AG	16-pin 150-mil SOIC-TUBE, Green	Commercial
PCS5I23Z09AG-16-ST	5I23Z09AG	16-pin 150-mil SOIC-TUBE, Green	Industrial
PCS5P23Z09AG-16-SR	3P22S09AG	16-pin 150-mil SOIC-TAPE & REEL, Green	Commercial
PCS5I23Z09AG-16-SR	5I23Z09AG	16-pin 150-mil SOIC-TAPE & REEL, Green	Industrial
PCS5P23Z09AG-16-TT	5P23Z09AG	16-pin 4.4-mm TSSOP - TUBE, Green	Commercial
PCS5I23Z09AG-16-TT	5I23Z09AG	16-pin 4.4-mm TSSOP - TUBE, Green	Industrial
PCS5P23Z09AG-16-TR	5P23Z09AG	16-pin 4.4-mm TSSOP - TAPE & REEL, Green	Commercial
PCS5I23Z09AG-16-TR	5I23Z09AG	16-pin 4.4-mm TSSOP - TAPE & REEL, Green	Industrial

rev 0.1

Device Ordering Information



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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.