

### 3.3V 1:10 LVCMOS PLL Clock Generator

#### Features

- Output frequency range: 25 MHz to 200 MHz
- Input frequency range: 6.25 MHz to 31.25 MHz
- 2.5V or 3.3V operation
- Split 2.5V/3.3V outputs
- $\pm 2.5\%$  max Output duty cycle variation
- Nine Clock outputs: Drive up to 18 clock lines
- Two reference clock inputs: Xtal or LVCMOS
- 150pS max output-output skew
- Phase-locked loop (PLL) bypass mode
- 'SpreadTrak'
- Output enable/disable
- Pin-compatible with MPC9350 and CY29350.
- Industrial temperature range:  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$
- 32-pin 1.0mm TQFP & LQFP Packages

#### Functional Description

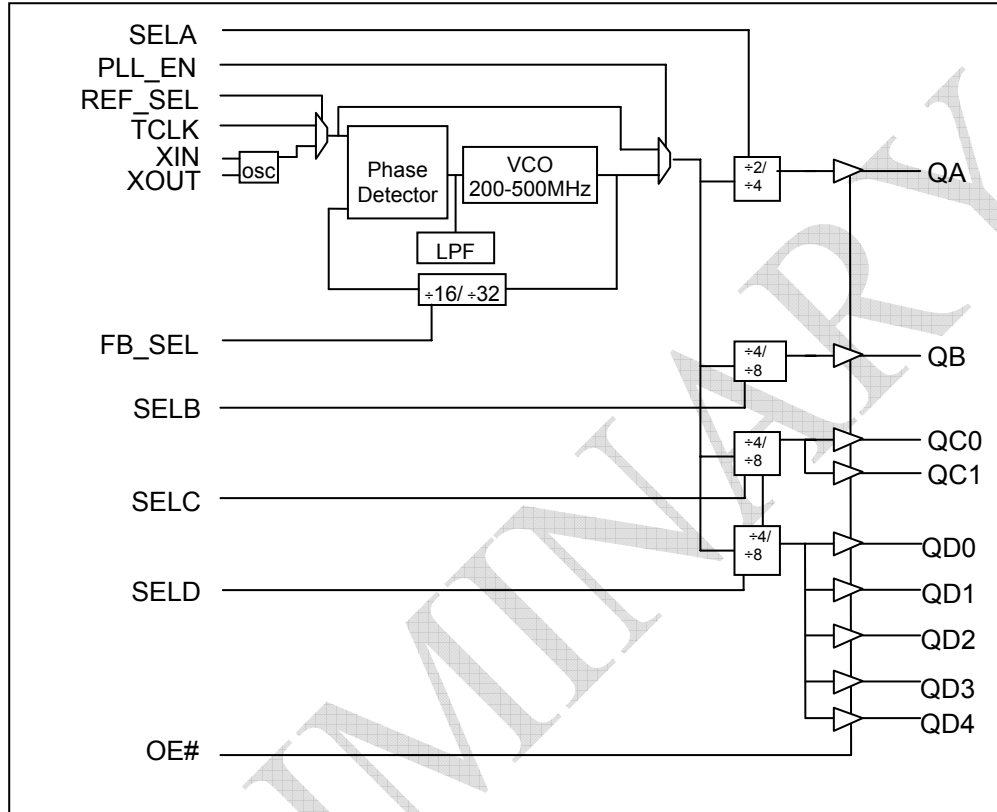
The PCS5I9350 is a low-voltage high-performance 200MHz PLL-based clock driver designed for high speed clock distribution applications.

The PCS5I9350 features Xtal and LVCMOS reference clock inputs and provides nine outputs partitioned in four banks of 1, 1, 2, and 5 outputs. Bank A divides the VCO output by 2 or 4 while the other banks divide by 4 or 8 per SEL(A:D) settings, see Table 2. These dividers allow output to input ratios of 16:1, 8:1, 4:1, and 2:1. Each LVCMOS compatible output can drive  $50\Omega$  series or parallel terminated transmission lines. For series terminated transmission lines, each output can drive one or two traces giving the device an effective fanout of 1:18.

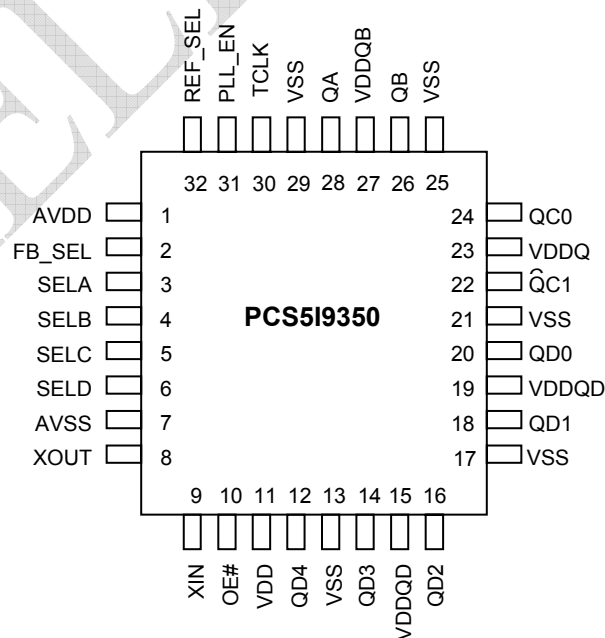
The PLL is ensured stable given that the VCO is configured to run between 200MHz to 500MHz. This allows a wide range of output frequencies from 25MHz to 200MHz. The internal VCO is running at multiples of the input reference clock set by the feedback divider, see Table 1.

When PLL\_EN is LOW, PLL is bypassed and the reference clock directly feeds the output dividers. This mode is fully static and the minimum input clock frequency specification does not apply.

Block Diagram



Pin Configuration



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Pin Discription<sup>1</sup>

Pin #	Pin Name	I/O	Type	Description
8	XOUT	O	Analog	<b>Oscillator Output.</b> Connect to a crystal.
9	XIN	I	Analog	<b>Oscillator Input.</b> Connect to a crystal.
30	TCLK	I, PD	LVC MOS	<b>LVC MOS/LVTTL reference clock input</b>
28	QA	O	LVC MOS	<b>Clock output bank A</b>
26	QB	O	LVC MOS	<b>Clock output bank B</b>
22, 24	QC(1:0)	O	LVC MOS	<b>Clock output bank C</b>
12, 14, 16, 18, 20	QD(4:0)	O	LVC MOS	<b>Clock output bank D</b>
2	FB_SEL	I, PD	LVC MOS	<b>Internal Feedback Select Input.</b> See Table 1.
10	OE#	I, PD	LVC MOS	<b>Output enable/disable input.</b> See Table 2.
31	PLL_EN	I, PU	LVC MOS	<b>PLL enable/disable input.</b> See Table 2.
32	REF_SEL	I, PD	LVC MOS	<b>Reference select input.</b> See Table 2.
3, 4, 5, 6	SEL(A:D)	I, PD	LVC MOS	<b>Frequency select input, Bank (A:D).</b> See Table 2.
27	VDDQB	Supply	VDD	<b>2.5V or 3.3V Power supply for bank B output clock<sup>2,3</sup></b>
23	VDDQC	Supply	VDD	<b>2.5V or 3.3V Power supply for bank C output clocks<sup>2,3</sup></b>
15, 19	VDDQD	Supply	VDD	<b>2.5V or 3.3V Power supply for bank D output clocks<sup>2,3</sup></b>
1	AVDD	Supply	VDD	<b>2.5V or 3.3V Power supply for PLL<sup>2,3</sup></b>
11	VDD	Supply	VDD	<b>2.5V or 3.3V Power supply for core, inputs, and bank A output clock<sup>2,3</sup></b>
7	AVSS	Supply	Ground	<b>Analog ground</b>
13, 17, 21, 25, 29	VSS	Supply	Ground	<b>Common ground</b>

Note: 1. PU = Internal pull-up, PD = Internal pull-down.

2. A 0.1µF bypass capacitor should be placed as close as possible to each positive power pin (<0.2"). If these bypass capacitors are not close to the pins their high frequency filtering characteristics will be cancelled by the lead inductance of the traces.

3. AVDD and VDD pins must be connected to a power supply level that is at least equal or higher than that of VDDQB, VDDQC, and VDDQD output power supply pins.

Table 1: Frequency Table

FB_SEL	Feedback Divider	VCO	Input Frequency Range (AVDD = 3.3V)	Input Frequency Range (AVDD = 2.5V)
0	÷32	Input Clock * 32	6.25 MHz to 15.625MHz	6.25 MHz to 11.875MHz
1	÷16	Input Clock * 16	12.5 MHz to 31.25MHz	12.5 MHz to 23.75MHz

Table 2: Function Table

Control	Default	0	1
REF_SEL	0	Xtal	TCLK
PLL_EN	1	Bypass mode, PLL disabled. The input clock connects to the output dividers	PLL enabled. The VCO output connects to the output dividers
OE#	0	Outputs enabled	Outputs disabled (three-state)
FB_SEL	0	Feedback divider ÷32	Feedback divider ÷16
SELA	0	÷2 (Bank A)	÷ 4 (Bank A)
SELB	0	÷4 (Bank B)	÷ 8 (Bank B)
SELC	0	÷4 (Bank C)	÷ 8 (Bank C)
SELD	0	÷4 (Bank D)	÷ 8 (Bank D)

Absolute Maximum Ratings

Parameter	Description	Condition	Min	Max	Unit
VDD	DC Supply Voltage		-0.3	5.5	V
VDD	DC Operating Voltage	Functional	2.375	3.465	V
VIN	DC Input Voltage	Relative to Vss	-0.3	VDD+ 0.3	V
VOUT	DC Output Voltage	Relative to Vss	-0.3	VDD+ 0.3	V
VTT	Output termination Voltage			VDD ÷2	V
LU	Latch Up Immunity	Functional	200		mA
RPS	Power Supply Ripple	Ripple Frequency < 100 kHz		150	mVp-p
Ts	Temperature, Storage	Non-functional	-65	+150	°C
TA	Temperature, Operating Ambient	Functional	-40	+85	°C
TJ	Temperature, Junction	Functional		+150	°C
ØJC	Dissipation, Junction to Case	Functional		42	°C/W
ØJA	Dissipation, Junction to Ambient	Functional		105	°C/W
ESDH	ESD Protection (Human Body Model)		2000		Volts
FIT	Failure in Time	Manufacturing test		10	ppm

**DC Electrical Specifications** ( $V_{CC} = 2.5V \pm 5\%$ ,  $T_A = -40^\circ C$  to  $+85^\circ C$ )

Parameter	Description	Condition	Min	Typ	Max	Unit
V <sub>IL</sub>	Input Voltage, Low	LVC MOS	-	-	0.7	V
V <sub>IH</sub>	Input Voltage, High	LVC MOS	1.7	-	V <sub>DD</sub> +0.3	V
V <sub>OL</sub>	Output Voltage, Low <sup>1</sup>	I <sub>OL</sub> = 15mA	-	-	0.6	V
V <sub>OH</sub>	Output Voltage, High <sup>1</sup>	I <sub>OH</sub> = -15mA	1.8	-	-	V
I <sub>IL</sub>	Input Current, Low <sup>2</sup>	V <sub>IL</sub> = V <sub>SS</sub>	-	-	-100	μA
I <sub>IH</sub>	Input Current, High <sup>2</sup>	V <sub>IL</sub> = V <sub>DD</sub>	-	-	100	μA
I <sub>DDA</sub>	PLL Supply Current	AV <sub>DD</sub> only	-	5	10	mA
I <sub>DDQ</sub>	Quiescent Supply Current	All V <sub>DD</sub> pins except AV <sub>DD</sub>	-	-	7	mA
I <sub>DD</sub>	Dynamic Supply Current	Outputs loaded @ 100MHz	-	180	-	mA
		Outputs loaded @ 200MHz	-	210	-	
C <sub>IN</sub>	Input Pin Capacitance		-	4	-	pF
Z <sub>OUT</sub>	Output Impedance		14	18	22	Ω

Note: 1. Driving one 50Ω parallel terminated transmission line to a termination voltage of V<sub>TT</sub>. Alternatively, each output drives up to two 50Ω series terminated transmission lines.

2. Inputs have pull-up or pull-down resistors that affect the input current.

**DC Electrical Specifications** ( $V_{CC} = 3.3V \pm 5\%$ ,  $T_A = -40^\circ C$  to  $+85^\circ C$ )

Parameter	Description	Condition	Min	Typ	Max	Unit
V <sub>IL</sub>	Input Voltage, Low	LVC MOS	-	-	0.8	V
V <sub>IH</sub>	Input Voltage, High	LVC MOS	2.0	-	V <sub>DD</sub> +0.3	V
V <sub>OL</sub>	Output Voltage, Low <sup>1</sup>	I <sub>OL</sub> = 24 mA	-	-	0.55	V
		I <sub>OL</sub> = 12 mA	-	-	0.30	
V <sub>OH</sub>	Output Voltage, High <sup>1</sup>	I <sub>OH</sub> = -24 mA	2.4	-	-	V
I <sub>IL</sub>	Input Current, Low <sup>2</sup>	V <sub>IL</sub> = V <sub>SS</sub>	-	-	-100	μA
I <sub>IH</sub>	Input Current, High <sup>2</sup>	V <sub>IL</sub> = V <sub>DD</sub>	-	-	100	μA
I <sub>DDA</sub>	PLL Supply Current	AV <sub>DD</sub> only	-	5	10	mA
I <sub>DDQ</sub>	Quiescent Supply Current	All V <sub>DD</sub> pins except AV <sub>DD</sub>	-	-	7	mA
I <sub>DD</sub>	Dynamic Supply Current	Outputs loaded @ 100MHz	-	270	-	mA
		Outputs loaded @ 200MHz	-	300	-	
C <sub>IN</sub>	Input Pin Capacitance		-	4	-	pF
Z <sub>OUT</sub>	Output Impedance		12	15	18	Ω

Note: 1. Driving one 50Ω parallel terminated transmission line to a termination voltage of V<sub>TT</sub>. Alternatively, each output drives up to two 50Ω series terminated transmission lines.

2. Inputs have pull-up or pull-down resistors that affect the input current.

**AC Electrical Specifications** ( $V_{CC} = 2.5V \pm 5\%$ ,  $T_A = -40^\circ C$  to  $+85^\circ C$ )<sup>1</sup>

Parameter	Description	Condition	Min	Typ	Max	Unit
f <sub>VCO</sub>	VCO Frequency		200	-	380	MHz
f <sub>in</sub>	Input Frequency	÷16 Feedback	12.5	-	23.75	MHz
		÷32 Feedback	6.25	-	11.87	
		Bypass mode (PLL_EN = 0)	0	-	200	
f <sub>xTAL</sub>	Crystal Oscillator Frequency		10	-	23.75	MHz
f <sub>refDC</sub>	Input Duty Cycle		25	-	75	%
t <sub>r</sub> , t <sub>f</sub>	TCLK Input Rise/FallTime	0.7V to 1.7V	-	-	1.0	nS
f <sub>MAX</sub>	Maximum Output Frequency	÷2 Output	100	-	190	MHz
		÷4 Output	50	-	95	
		÷8 Output	25	-	47.5	
DC	Output Duty Cycle	f <sub>MAX</sub> < 100MHz	47.5	-	52.5	%
		f <sub>MAX</sub> > 100MHz	45	-	55	
t <sub>r</sub> , t <sub>f</sub>	Output Rise/Fall times	0.6V to 1.8V	0.1	-	1.0	nS
t <sub>sk(O)</sub>	Output-to-Output Skew		-	-	150	pS
t <sub>PLZ, HZ</sub>	Output Disable Time		-	-	10	nS
t <sub>PZL, ZH</sub>	Output Enable Time		-	-	10	nS
BW	PLL Closed Loop Bandwidth (-3dB)	÷16 Feedback	-	0.7 - 0.9	-	MHz
		÷32 Feedback	-	0.6 - 0.8	-	
t <sub>JIT(CC)</sub>	Cycle-to-Cycle Jitter	Same frequency	-	-	150	pS
		Multiple frequencies	-	-	250	
t <sub>JIT(PER)</sub>	Period Jitter	Same frequency	-	-	100	pS
		Multiple frequencies	-	-	175	
t <sub>LOCK</sub>	Maximum PLL Lock Time		-	-	1	mS

Note: 1. AC characteristics apply for parallel output termination of 50Ω to V<sub>TT</sub>. Parameters are guaranteed by characterization and are not 100% tested.

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**AC Electrical Specifications** (VCC = 3.3V ± 5%, TA = -40°C to +85°C)<sup>1</sup>

Parameter	Description	Condition	Min	Typ	Max	Unit
f <sub>VCO</sub>	VCO Frequency		200	-	500	MHz
f <sub>in</sub>	Input Frequency	÷16 Feedback	12.5	-	31.25	MHz
		÷32 Feedback	6.25	-	15.625	
		Bypass mode (PLL_EN = 0)	0	-	200	
f <sub>X TAL</sub>	Crystal Oscillator Frequency		10	-	25	MHz
f <sub>refDC</sub>	Input Duty Cycle		25	-	75	%
t <sub>r</sub> , t <sub>f</sub>	TCLK Input Rise/FallTime	0.8V to 2.0V	-	-	1.0	nS
f <sub>MAX</sub>	Maximum Output Frequency	÷2 Output	100	-	200	MHz
		÷4 Output	50	-	125	
		÷8 Output	25	-	62.5	
DC	Output Duty Cycle	f <sub>MAX</sub> < 100MHz	47.5	-	52.5	%
		f <sub>MAX</sub> > 100MHz	45	-	55	
t <sub>r</sub> , t <sub>f</sub>	Output Rise/Fall times	0.8V to 2.4V	0.1	-	1.0	nS
t <sub>sk(O)</sub>	Output-to-Output Skew	Banks at same voltage	-	-	150	pS
t <sub>sk(B)</sub>	Bank-to-Bank Skew	Banks at different voltages	-	-	350	pS
t <sub>PLZ, HZ</sub>	Output Disable Time		-	-	10	nS
t <sub>PZL, ZH</sub>	Output Enable Time		-	-	10	nS
BW	PLL Closed Loop Bandwidth (-3dB)	÷16 Feedback	-	0.7 – 0.9	-	MHz
		÷32 Feedback	-	0.6 – 0.8	-	
t <sub>JIT(CC)</sub>	Cycle-to-Cycle Jitter	Same frequency	-	-	150	pS
		Multiple frequencies	-	-	250	
t <sub>JIT(PER)</sub>	Period Jitter	Same frequency	-	-	100	pS
		Multiple frequencies	-	-	150	
t <sub>LOCK</sub>	Maximum PLL Lock Time		-	-	1	mS

Note: 1. AC characteristics apply for parallel output termination of 50Ω to VTT. Parameters are guaranteed by characterization and are not 100% tested.

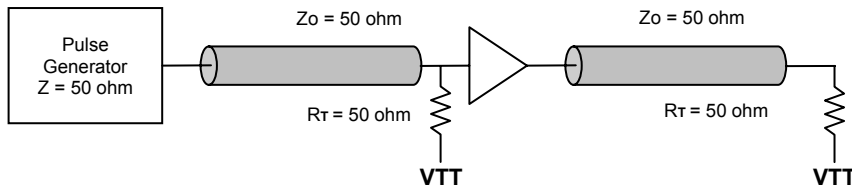


Figure 1. AC Test Reference for VDD = 3.3V / 2.5V

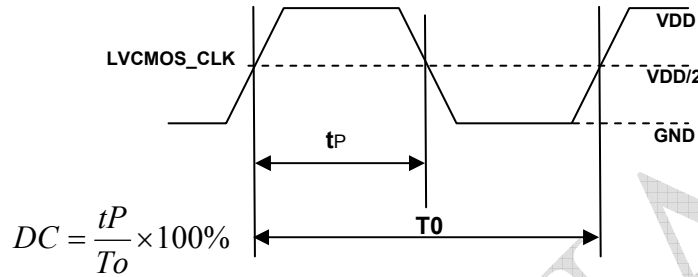


Figure 2. Output Duty Cycle (DC)

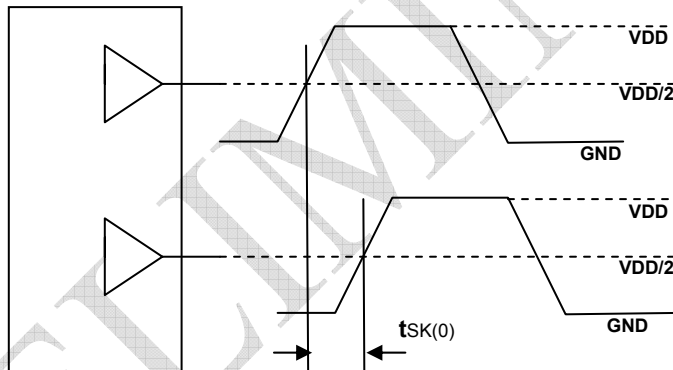


Figure 3. Output-to-Output Skew , tsk(0)

Table 3. Suggested Oscillator Crystal Parameters

Characteristic	Symbol	Conditions	Min	Typ	Max	Units
Frequency Tolerance	Tc		-	-	±100	ppm
Frequency Temperature Stability	Ts	(TA-10 +60C)	-	-	±00	ppm
Aging	TA	First three years @ 25°C	-	-	5	ppm/yr
Load Capacitance	CL	Crystal's rated load	-	20	-	pF
Effective Series Resistance	RESR		-	40	80	Ω

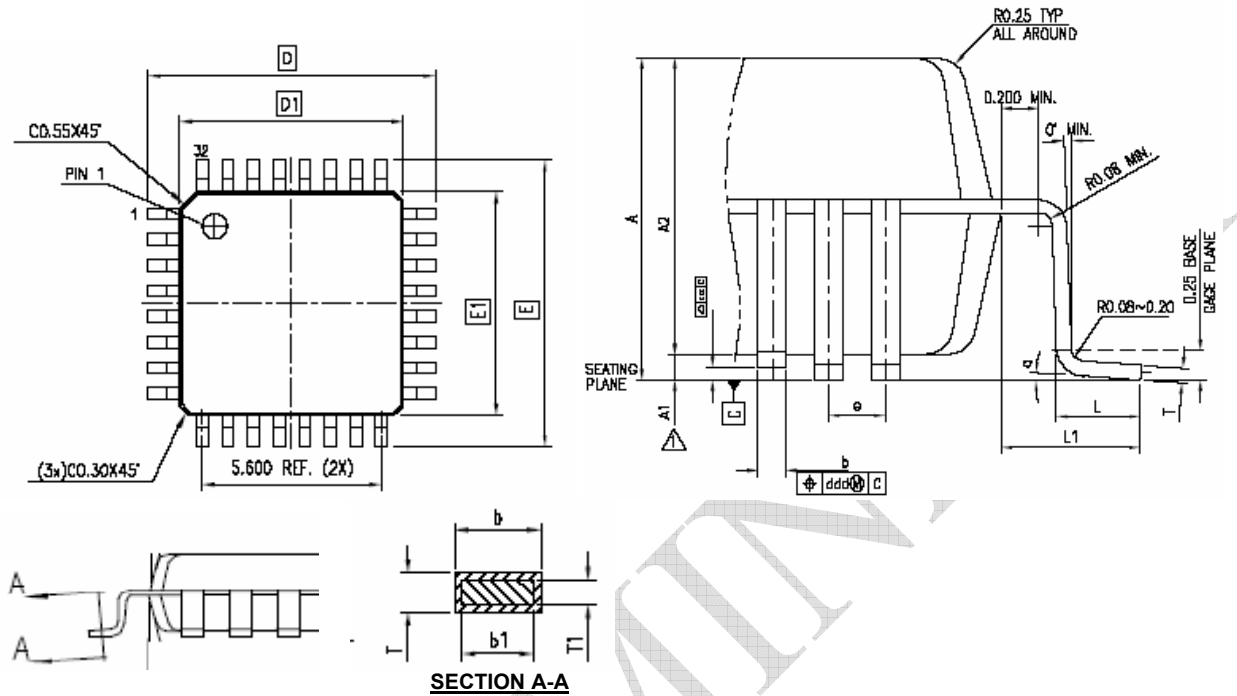


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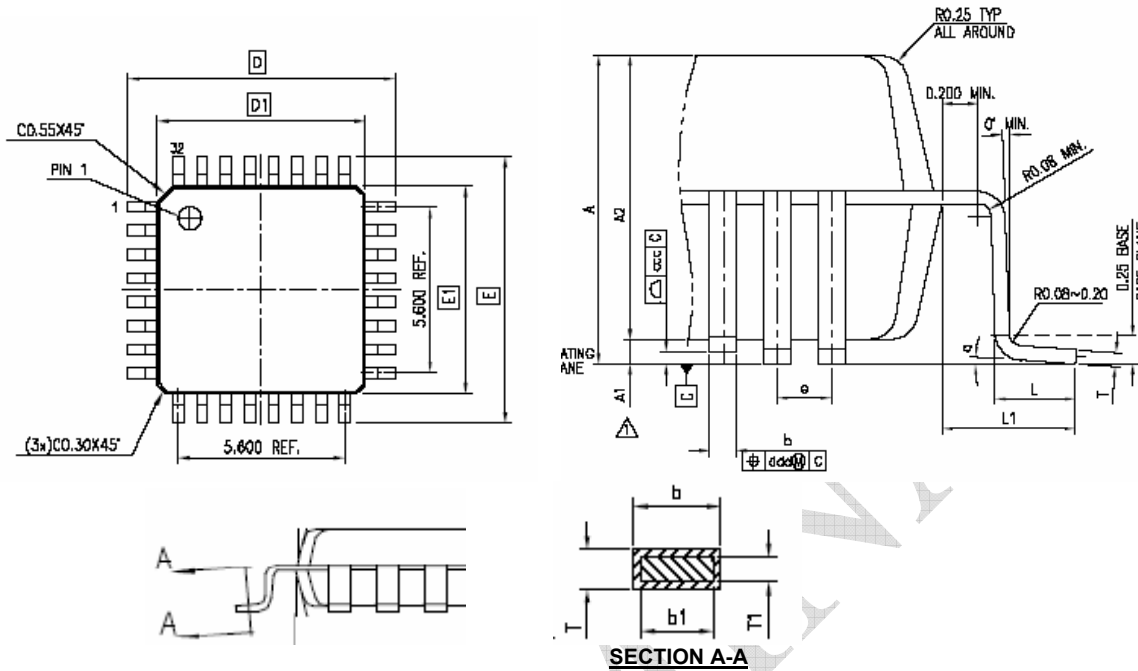
Package Diagram

32-lead TQFP



Symbol	Dimensions			
	Inches		Millimeters	
	Min	Max	Min	Max
A	...	0.0472	...	1.2
A1	0.0020	0.0059	0.05	0.15
A2	0.0374	0.0413	0.95	1.05
D	0.3465	0.3622	8.8	9.2
D1	0.2717	0.2795	6.9	7.1
E	0.3465	0.3622	8.8	9.2
E1	0.2717	0.2795	6.9	7.1
L	0.0177	0.0295	0.45	0.75
L1	0.03937 REF		1.00 REF	
T	0.0035	0.0079	0.09	0.2
T1	0.0038	0.0062	0.097	0.157
b	0.0118	0.0177	0.30	0.45
b1	0.0118	0.0157	0.30	0.40
R0	0.0031	0.0079	0.08	0.2
a	0°	7°	0°	7°
e	0.031 BASE		0.8 BASE	

32-lead LQFP

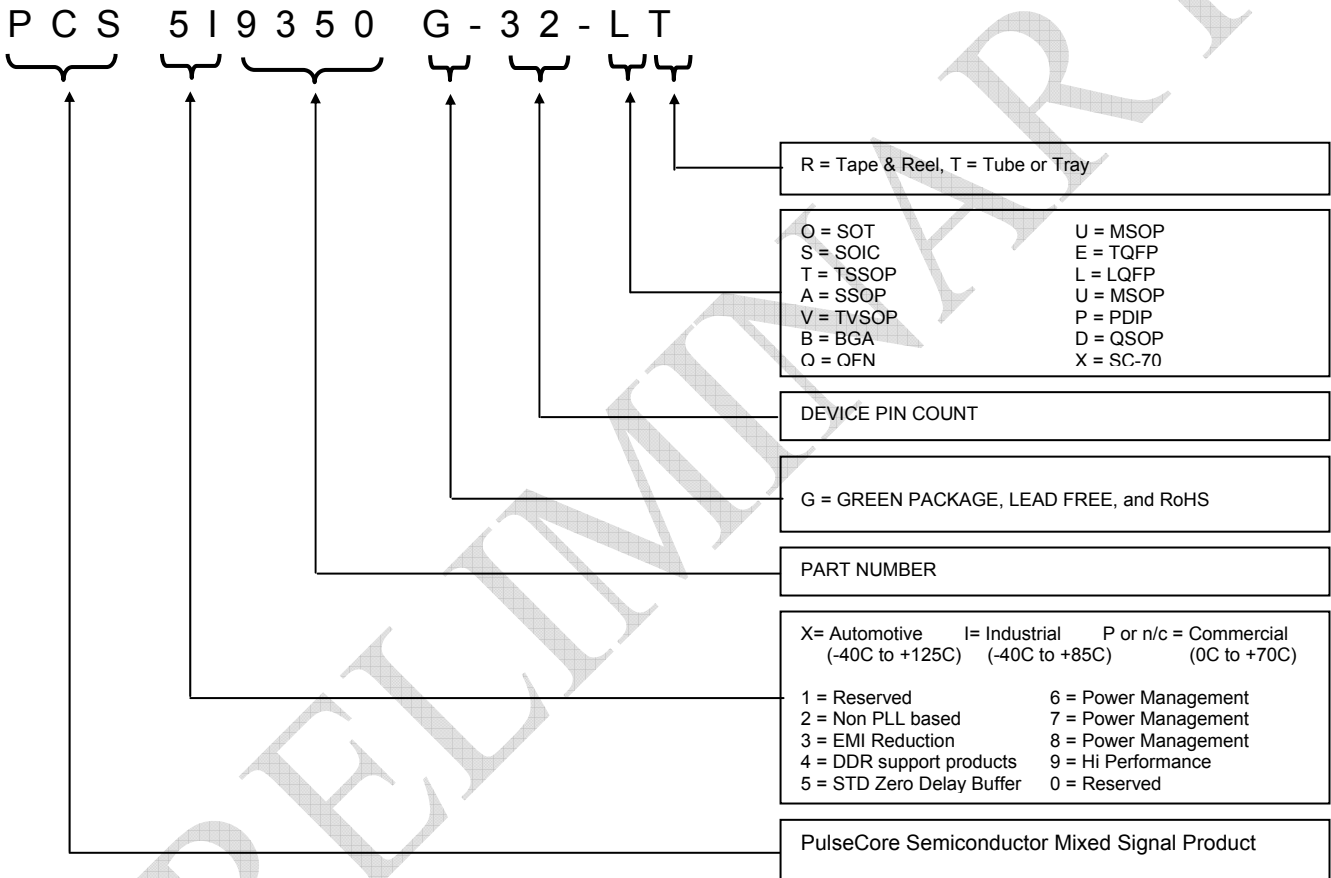


Symbol	Dimensions			
	Inches		Millimeters	
	Min	Max	Min	Max
A	....	0.0630	...	1.6
A1	0.0020	0.0059	0.05	0.15
A2	0.0531	0.0571	1.35	1.45
D	0.3465	0.3622	8.8	9.2
D1	0.2717	0.2795	6.9	7.1
E	0.3465	0.3622	8.8	9.2
E1	0.2717	0.2795	6.9	7.1
L	0.0177	0.0295	0.45	0.75
L1	0.03937 REF		1.00 REF	
T	0.0035	0.0079	0.09	0.2
T1	0.0038	0.0062	0.097	0.157
b	0.0118	0.0177	0.30	0.45
b1	0.0118	0.0157	0.30	0.40
R0	0.0031	0.0079	0.08	0.20
e	0.031 BASE		0.8 BASE	
a	0°	7°	0°	7°

Ordering Information

Part Number	Marking	Package Type	Temperature
PCS5I9350G-32-ET	PCS5I9350G	32-pin TQFP, Green	Industrial
PCS5I9350G-32-LT	PCS5I9350G	32-pin LQFP –Tape and Reel, Green	Industrial

Device Ordering Information



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



Giving you the edge

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PCS5I9350

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

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