DATA SHEET

PCK2021

CK00 (100/133 MHz) spread spectrum differential system clock generator

Product data

2001 Oct 11

File under Integrated Circuits, ICL03

Philips Semiconductors

PHILIPS

CK00 (100/133 MHz) spread spectrum differential system clock generator

PCK2021

FEATURES

- 3.3 V operation
- Six differential CPU clock pairs
- Two PCI clocks at 33 MHz and one 3V66 clock
- Two 48 MHz clocks at 3.3 V
- One 14.318 MHz reference clock
- Power management control pins
- Host clock jitter less than 200 ps cycle-to-cycle
- Host clock skew less than 150 ps pin-to-pin
- Spread Spectrum capability
- Optimized frequency and spread spectrum performance

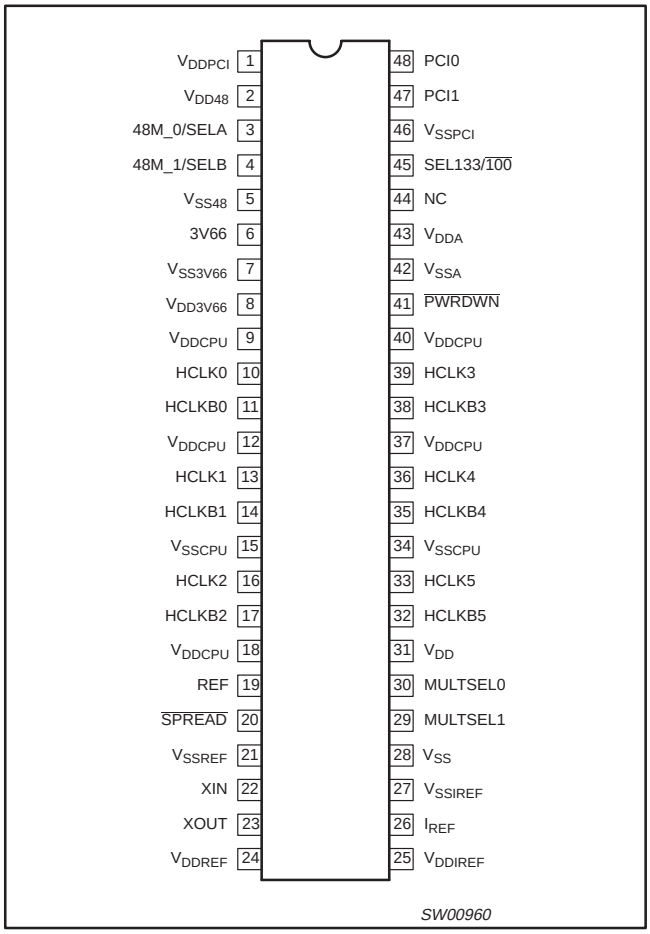
DESCRIPTION

The PCK2021 is a clock synthesizer/driver for a Pentium III™ and other similar processors.

The PCK2021 has six differential pair CPU current source outputs, two 33 MHz outputs, one 3V66 output, and two 48 MHz clocks which can be disabled on power-up, and one 3.3 V reference clock at 14.318 MHz which can also be disabled on power-up.

The part possesses a dedicated power-down input pin for power management control. This input is synchronized on chip, and ensures glitch-free output transitions. In addition, the part can be configured to disable the 48 MHz outputs for lower power operation and an increase in the performance of the functioning outputs. The REF and PCI outputs can also be disabled for the highest performance of the Host outputs.

PIN CONFIGURATION



ORDERING INFORMATION

PACKAGES	TEMPERATURE RANGE	ORDER CODE	DRAWING NUMBER
48-Pin Plastic TSSOP	0 to +70 °C	PCK2021DGG	SOT362-1
48-Pin Plastic SSOP	0 to +70 °C	PCK2021DL	SOT370-1

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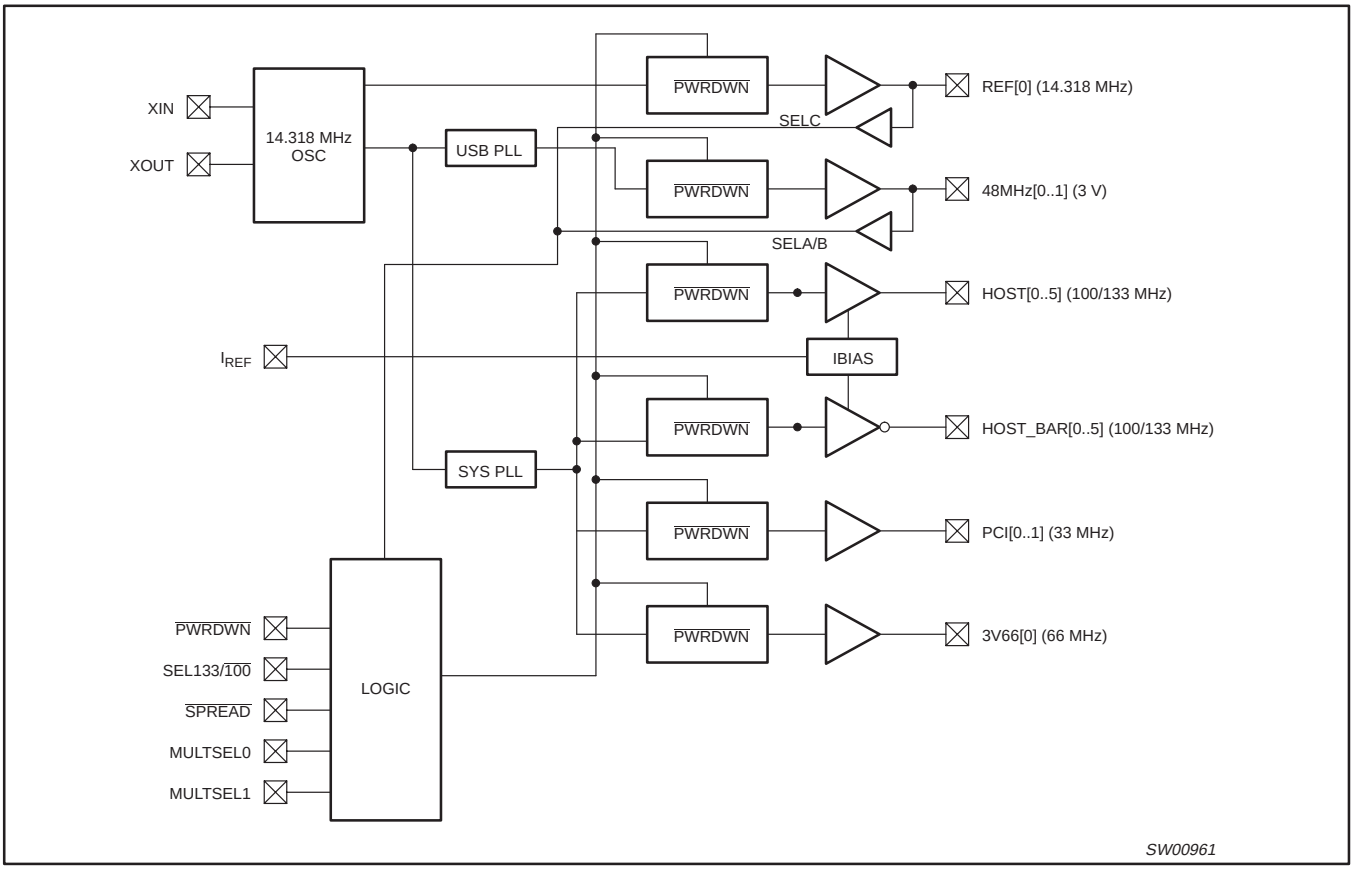
PIN DESCRIPTION

PIN(S)	SYMBOL	FUNCTION
1, 2, 8, 9, 12, 18, 24, 25, 31, 37, 40	V_{DD}	3.3 V power supply Pins 9, 12, and 18 supply host output pairs 0, 1, and 2. Pins 37 and 40 supply host output pairs 3, 4, and 5.
3, 4	48M_0/SELA 48M_1/SELB	3.3 V fixed 48 MHz clock outputs. During power-up pins function as latched inputs that enable SELA and SELB prior to the pins being used for output of 3 V at 48 MHz. Part must be clocked to latch data in.
6	3V66	66 MHz clock: 66 MHZ reference clock
10, 11	HCLK0 HCLKB0	Host output pair 0
13, 14	HCLK1 HCLKB1	Host output pair 1
16, 17	HCLK2 HCLKB2	Host output pair 2
47, 48	PCI0 PCI1	33 MHz clocks: 33 MHz reference clocks
39, 38	HCLK3 HCLKB3	Host output pair 3
36, 35	HCLK4 HCLKB4	Host output pair 4
33, 32	HCLK5 HCLKB5	Host output pair 5
19	REF	3.3 V fixed 14.318 MHz output
20	$\overline{\text{SPREAD}}$	Enables spread spectrum mode when held LOW on differential host outputs, 3V66 and PCI clocks. Asserts LOW.
22	XIN	Crystal input
23	XOUT	Crystal output
26	I_{REF}	This pin controls the reference current for the host pairs. This pin requires a fixed precision resistor tied to ground in order to establish the correct current.
29, 30	MULTSEL0 MULTSEL1	Select input pin used to control the scaling of the HCLK and HCLKB output current.
41	$\overline{\text{PWRDWN}}$	Device enters power-down mode when held LOW. Asserts LOW.
45	SEL133/$\overline{100}$	Select input pin for enabling 133 MHz or 100 MHz CPU outputs
5, 7, 15, 21, 27, 28, 34, 46	V_{SS}	Ground
43	V_{DDA}	3.3 V power supply for analog circuits
42	V_{SSA}	Ground for analog circuits

BLOCK DIAGRAM



FUNCTION TABLE

SEL100/133	SELA	SELB	HOST	48MHz	PCI33MHz	66MHz	REFCLK
0	0	0	100 MHz	48 MHz	33.3 MHz	66.7 MHz	14.3 MHz
0	0	1	100 MHz	Disable/Low	33.3 MHz	66.7 MHz	14.3 MHz
0	1	0	100 MHz	Disable/Low	Disable/Low	66.7 MHz	Disable/Low
0	1	1	Hi-Z	Hi-Z	Hi-Z	Hi-Z	Hi-Z
1	0	0	133 MHz	48 MHz	33.3 MHz	66.7 MHz	14.3 MHz
1	0	1	133 MHz	Disable/Low	33.3 MHz	66.7 MHz	14.3 MHz
1	1	0	200 MHz	48 MHz	33.3 MHz	66.7 MHz	14.3 MHz

Table 1. Host swing select functions

MULTSEL0	MULTSEL1	BOARD IMPEDANCE	I_{REF}	I_{OH}	V_{OH} @ IREF = 2.32 mA
0	0	60 Ω	R_{REF} = 475 1% I_{REF} = 2.32 mA	$I_{OH} = 5*I_{REF}$	0.71 V
0	0	50 Ω	R_{REF} = 475 1% I_{REF} = 2.32 mA	$I_{OH} = 5*I_{REF}$	0.59 V
0	1	60 Ω	R_{REF} = 475 1% I_{REF} = 2.32 mA	$I_{OH} = 6*I_{REF}$	0.85 V
0	1	50 Ω	R_{REF} = 475 1% I_{REF} = 2.32 mA	$I_{OH} = 6*I_{REF}$	0.71 V
1	0	60 Ω	R_{REF} = 475 1% I_{REF} = 2.32 mA	$I_{OH} = 4*I_{REF}$	0.56 V
1	0	50 Ω	R_{REF} = 475 1% I_{REF} = 2.32 mA	$I_{OH} = 4*I_{REF}$	0.47 V
1	1	60 Ω	R_{REF} = 475 1% I_{REF} = 2.32 mA	$I_{OH} = 7*I_{REF}$	0.99 V
1	1	50 Ω	R_{REF} = 475 1% I_{REF} = 2.32 mA	$I_{OH} = 7*I_{REF}$	0.82 V
0	0	30 Ω	R_{REF} = 221 1% I_{REF} = 5 mA	$I_{OH} = 5*I_{REF}$	0.75 V
0	0	25 Ω	R_{REF} = 221 1% I_{REF} = 5 mA	$I_{OH} = 5*I_{REF}$	0.62 V
0	1	30 Ω	R_{REF} = 221 1% I_{REF} = 5 mA	$I_{OH} = 6*I_{REF}$	0.90 V
0	1	25 Ω	R_{REF} = 221 1% I_{REF} = 5 mA	$I_{OH} = 6*I_{REF}$	0.75 V
1	0	30 Ω	R_{REF} = 221 1% I_{REF} = 5 mA	$I_{OH} = 4*I_{REF}$	0.60 V
1	0	25 Ω	R_{REF} = 221 1% I_{REF} = 5 mA	$I_{OH} = 4*I_{REF}$	0.50 V
1	1	30 Ω	R_{REF} = 221 1% I_{REF} = 5 mA	$I_{OH} = 7*I_{REF}$	1.05 V
1	1	25 Ω	R_{REF} = 221 1% I_{REF} = 5 mA	$I_{OH} = 7*I_{REF}$	0.84 V

NOTE:
The outputs are optimized for the configurations shown shaded.

	CONDITIONS	CONFIGURATION	LOAD	MIN.	MAX.
I_{OUT}	V_{DD} = 3.3 V	All combinations; see Table 1 above	Nominal test load for given configuration	–7% of I_{OH} see Table 1 above	+7% of I_{OH} see Table 1 above
I_{OUT}	V_{DD} = 3.3 V ±5%	All combinations; see Table 1 above	Nominal test load for given configuration	–12% of I_{OH} see Table 1 above	+12% of I_{OH} see Table 1 above

POWER-DOWN MODE

PWRDWN	HCLK/HCLKB	3V66	PCI	48MHz	REFCLK
Asserts LOW 0 = Active	Host = $2*I_{REF}$ Host_bar = undriven	LOW	LOW	LOW	LOW

NOTE:
The differential outputs should have a voltage forced across them when power-down is asserted.

SPREAD SPECTRUM FUNCTION

SPREAD #	FUNCTION	48 MHz PLL REFCLK
1	Host, PCI, and 3V66 No Spread	No Spread
0	Host, PCI, and 3V66 spread < 0.5%	No Spread

ABSOLUTE MAXIMUM RATINGS

SYMBOL	PARAMETER	CONDITIONS	LIMITS		UNIT
			MIN	MAX	
V_{DD3}	DC 3.3 V supply		–0.5	4.6	V
I_{IK}	DC input diode current	$V_I < 0$	—	–50	mA
V_I	DC input voltage	Note 2	–0.5	V_{DD}	V
I_{OK}	DC output diode current	$V_O > V_{DD}$ or $V_O < 0$	—	±50	mA
V_O	DC output voltage	Note 2	–0.5	V_{DD}+0.5	V
I_O	DC output source or sink current	V_O = 0 to V_{DD}	—	±50	mA
T_{stg}	Storage temperature range		–65	+150	°C
P_{tot}	Power dissipation per package plastic medium-shrink (TSSOP)	For temperature range 0 °C to +70 °C; above +55 °C derate linearly with 11.3 mW/K	—	850	mW

NOTES:
1. Stresses beyond those listed may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other condition beyond those indicated under “recommended operating condition” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
2. The input and output voltage rating may be exceeded if the input and output current ratings are observed.

RECOMMENDED OPERATING CONDITIONS

SYMBOL	PARAMETER	CONDITIONS	LIMITS		UNIT
			MIN	MAX	
V_{DD3}	DC 3.3 V supply voltage		3.135	3.465	V
AV_{DD}	DC 3.3 V analog supply voltage		3.135	3.465	V
C_L	Capacitive load on:				
	3V666	1 device load, possible 2	10	30	pF
	PCI	Must meet JEDEC PCI 2.1 Spec. Requirements	10	30	pF
	48 MHz clock	1 device load	10	20	pF
	REF	1 device load	10	20	pF
f_{ref}	Reference frequency, oscillator normal value		14.31818	14.31818	MHz
T_{amb}	Operating ambient temperature range in free air		0	+70	°C

POWER MANAGEMENT

CONDITION	**MAXIMUM 3.3 V SUPPLY CONSUMPTION MAXIMUM DISCRETE CAPACITANCE LOADS V_{DDL} = 3.465 V ALL STATIC INPUTS = V_{DD3} OR V_{SS}**
Power-down mode (PWRDWN = 0)	60 mA
Full active 100/133 MHz	250 mA

DC ELECTRICAL CHARACTERISTICS

T_{amb} = 0 to +70 °C

SYMBOL	PARAMETER	CONDITIONS			LIMITS			UNIT
		V_{DD} (V)	OTHER		MIN	TYP	MAX	
V_{IH}	HIGH level input voltage	3.135 to 3.465			2.0	—	V_{DD}+0.3	V
V_{IL}	LOW level input voltage	3.135 to 3.465			V_{SS}–0.3	—	0.8	V
V_{OH3}	3.3 V output HIGH voltage REF, 48M	3.135 to 3.465	I_{OH} = –1 mA		2.0	—	—	V
V_{OL3}	3.3 V output LOW voltage REF, 48M	3.135 to 3.465	I_{OH} = 1 mA		—	—	0.4	V
V_{OHP}	3.3 V output HIGH voltage 3V66/PCI	3.135 to 3.465	I_{OH} = –1 mA		2.4	—	—	V
V_{OLP}	3.3 V output LOW voltage 3V66/PCI	3.135 to 3.465	I_{OH} = 1 mA		—	—	0.55	V
I_{OH}	Output HIGH current 3V66/PCI	3.135	V_{OUT} = 1.0 V	Type 5 12 – 55 Ω	–33	—	—	mA
		3.465	V_{OUT} = 3.135 V		—	—	–33	mA
I_{OH}	Output HIGH current 48 MHz, REF	3.135	V_{OUT} = 1.0 V	Type 3 20 – 60 Ω	–29	—	—	mA
		3.465	V_{OUT} = 3.135 V		—	—	–23	mA
I_{OH}	Output HIGH current HOST/HOST_BAR	3.135 to 3.465	0.66 V	Type X1	11	—	—	mA
			0.76 V		—	—	12.7	mA
I_{OL}	Output LOW current 3V66/PCI	3.135	V_{OUT} = 1.95 V	Type 5 12 – 55 Ω	30	—	—	mA
		3.465	V_{OUT} = 0.4 V		—	—	38	mA
I_{OL}	Output LOW current 48 MHz, REF	3.135	V_{OUT} = 1.95 V	Type 3 20 – 60 Ω	29	—	—	mA
		3.465	V_{OUT} = 0.4 V		—	—	27	mA
V_{OL}	HOST/HOST_BAR	V_{SS} = 0 V	R_S = 33.2 Ω R_P = 49.9 Ω	Type X1	—	—	0.05	V
$\pm I_I$	Input leakage current	3.465	0 < V_{IN} < V_{DD3}		–50	—	50	µA
$\pm I_{OZ}$	3-State output OFF-State current	3.465	V_{OUT} = V_{DD} or GND	I_O = 0	—	—	10[1]	µA
C_{in}	Input pin capacitance				—	—	5	pF
C_{out}	Output pin capacitance				—	—	6	pF
C_{xtal}	Crystal input capacitance				13.5	—	22.5	pF

NOTE:
1. REF output limit is 100 µA.

AC ELECTRICAL CHARACTERISTICS

V_{DD3} = 3.3 V ±5%; $f_{crystal}$ = 14.31818 MHz

Host clock outputs

T_{amb} = 0 to +70 °C; see Figure 1 for waveforms and Figure 6 for test setup.

SYMBOL	PARAMETER	LIMITS				UNITS	NOTES
		133 MHz MODE		100 MHz MODE			
		MIN	MAX	MIN	MAX		
t_{PERIOD}	HOST CLK average period	7.5	7.65	10.0	10.2	ns	11, 14, 19
Abs Min Period	Absolute minimum host clock period	7.35	N/A	9.85	N/A	ns	11, 14, 19
t_{RISE}	HOST CLK rise time	175	700	175	700	ns	11, 15, 19
t_{FALL}	HOST CLK fall time	175	700	175	700	ps	11, 15, 19
t_{JITTER}	HOST_CLK cycle-to-cycle jitter	—	150	—	150	ps	11, 12, 14, 19
DUTY CYCLE	Output duty cycle	45	55	45	55	%	11, 14, 19
t_{SKEW}	HOST CLK pin-to-pin skew	—	150	—	110	ps	11, 14, 19
$V_{crossover}$		45% V_{OH}	55% V_{OH}	45% V_{OH}	55% V_{OH}	V	11, 14, 19

REFER TO NOTES ON PAGE 10.

USB clock output, 48MHz

T_{amb} = 0 to +70 °C; lump capacitance test load = 20 pF

SYMBOL	PARAMETER	LIMITS		UNITS	NOTES
		48 MHz MODE			
		MIN	MAX		
f	Frequency, actual	48.000		MHz	4
f_D	Deviation from 48 MHz	–0	+167	ppm	4
t_{RISE}	3V48MHZCLK rise time	1.0	4.0	ns	8, 19
t_{FALL}	3V48MHZCLK fall time	1.0	4.0	ns	8, 19
t_{JITTER}	Cycle-to-cycle jitter	—	450	ps	17, 19
DUTY CYCLE	Output duty cycle	45	55	%	17, 19

REFER TO NOTES ON PAGE 10.

PCI Outputs

T_{amb} = 0 to +70 °C

SYMBOL	PARAMETER	LIMITS		UNITS	NOTES
		MIN	MAX		
t_{PERIOD}	Period	30.0	N/A	ns	2, 3, 9, 19
t_{HIGH}	High time	12.0	N/A	ns	5, 10, 19
t_{LOW}	Low time	12.0	N/A	ns	6, 10, 19
t_{RISE}	Rise time	0.5	2.0	ns	8, 19
t_{FALL}	Fall time	0.5	2.0	ns	17, 19
DUTY CYCLE	Duty cycle	45	55	%	17, 19
t_{JITTER}	Cycle-to-cycle jitter	—	200	ps	17, 19
t_{SKEW}	Pin-to-pin skew	—	150	ps	2

REFER TO NOTES ON PAGE 10.

3V66 Outputs

T_{amb} = 0 to +70 °C

SYMBOL	PARAMETER	LIMITS		UNITS	NOTES
		MIN	MAX		
t_{PERIOD}	Period	15.0	16.0	ns	2, 3, 9, 19
t_{HIGH}	High time	5.25	N/A	ns	5, 10, 19
t_{LOW}	Low time	5.05	N/A	ns	6, 10, 19
t_{RISE}	Rise time	0.5	2.0	ns	8, 19
t_{FALL}	Fall time	0.5	2.0	ns	17, 19
DUTY CYCLE	Duty cycle	45	55	%	17, 19
t_{JITTER}	Cycle-to-cycle jitter	—	400	ps	17, 19

REFER TO NOTES ON PAGE 10.

REF clock output

T_{amb} = 0 to +70 °C; lump capacitance test load = 20 pF

SYMBOL	PARAMETER	LIMITS		UNITS	NOTES
		48 MHz MODE			
		MIN	MAX		
f	Frequency, actual	14.318		MHz	16, 19
t_{JITTER}	Cycle-to-cycle jitter	—	300	ps	17, 19
DUTY CYCLE	Output duty cycle	45	55	%	17, 19

REFER TO NOTES ON PAGE 10.

All outputs

T_{amb} = 0 to +70 °C

SYMBOL	PARAMETER	LIMITS				UNITS	NOTES
		133 MHz MODE		100 MHz MODE			
		MIN	MAX	MIN	MAX		
t_{PZL}, t_{PZH}	Output enable delay (all outputs)	1.0	10.0	1.0	10.0	ns	19
t_{PZL}, t_{PZH}	Output disable delay (all outputs)	1.0	10.0	1.0	10.0	ns	19
t_{STABLE}	All clock stabilization from power-up	—	3	—	3	ms	7, 19

REFER TO NOTES ON PAGE 10.

Group offset limits

GROUP	OFFSET	MEASUREMENT LOADS (LUMPED)	MEASUREMENT POINTS	NOTES
3V66 to PCI	0–500 ps, 3V66 leads	30 pF	1.5 V	18, 19

NOTES TO THE AC TABLES:

1. Output drivers must have monotonic rise/fall times through the specified V_{OL}/V_{OH} levels.
2. Period, jitter, offset, and skew measured on rising edge at 1.5 V for 3.3 V clocks.
3. PCI is a fixed 33 MHz and 3V66 is a fixed 66 MHz.
4. Frequency accuracy of 48 MHz must be +167 ppm to match USB default.
5. t_{HIGH} is measured at 2.4 V for 3.3 V outputs, as shown in Figure 7.
6. t_{LOW} is measured at 0.4 V for all outputs as shown in Figure 7.
7. the time is specified from when V_{DDQ} achieves its normal operating level (typical condition V_{DDQ} = 3.3 V) until the frequency output is stable and operating within specification.
8. t_{RISE} and t_{FALL} are measured as a transition through the threshold region V_{OL} = 0.4 V and V_{OH} = 2.4 V (1 mA) JEDEC specification.
9. The average period over any 1 μs period of time must be greater than the minimum specified period.
10. Calculated at minimum edge rate (1 V/ns) to guarantee 45–55% duty cycle. Pulse width is required to be wider at faster edge rate to ensure duty specification is met.
11. Test load is R_S = 33.2 Ω, R_P = 49.9 Ω.
12. Must be guaranteed in a realistic system environment.
13. Configured for V_{OH} = 0.71 V in a 50 Ω environment.
14. Measured at crossing points.
15. Measured at 20% to 80%.
16. Frequency generated by crystal oscillator
17. Voltage measure point (V_M = 1.5 V).
18. All offsets are to be measured at rising edges.
19. Parameters are guaranteed by design.

AC WAVEFORMS

V_M = 1.25 V @ V_{DDL} and 1.5 V @ V_{DD3}
$V_X = V_{OL}$ + 0.3 V
$V_Y = V_{OH}$ – 0.3 V
V_{OL} and V_{OH} are the typical output voltage drop that occur with the output load.

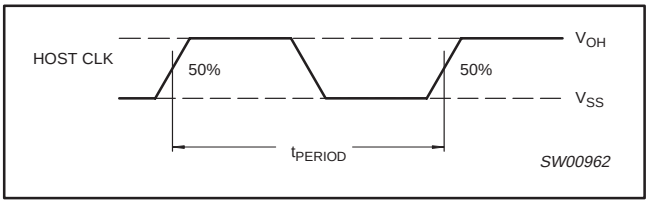


Figure 1. HOST CLOCK

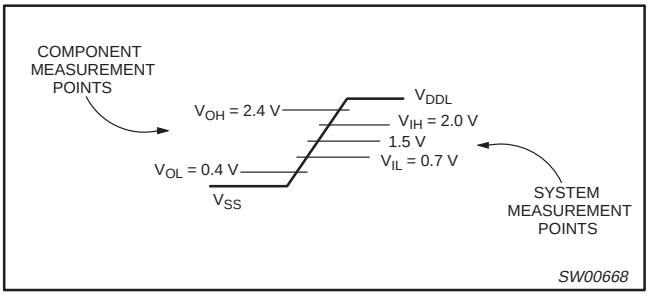


Figure 2. 3.3 V clock waveforms

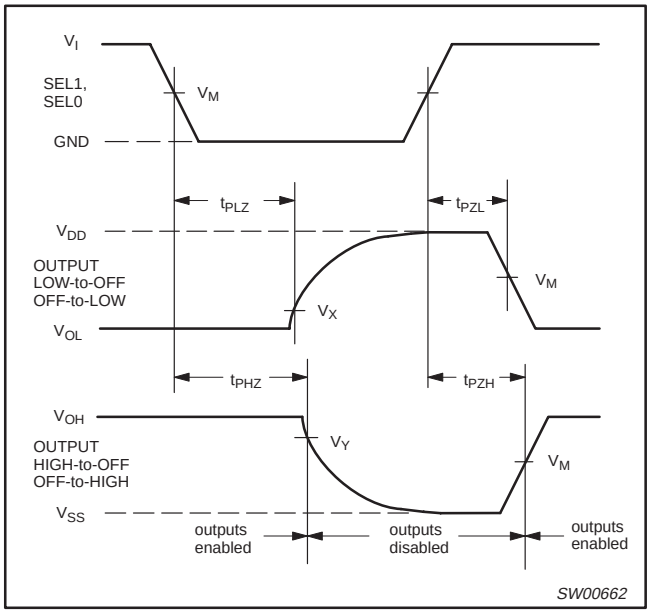
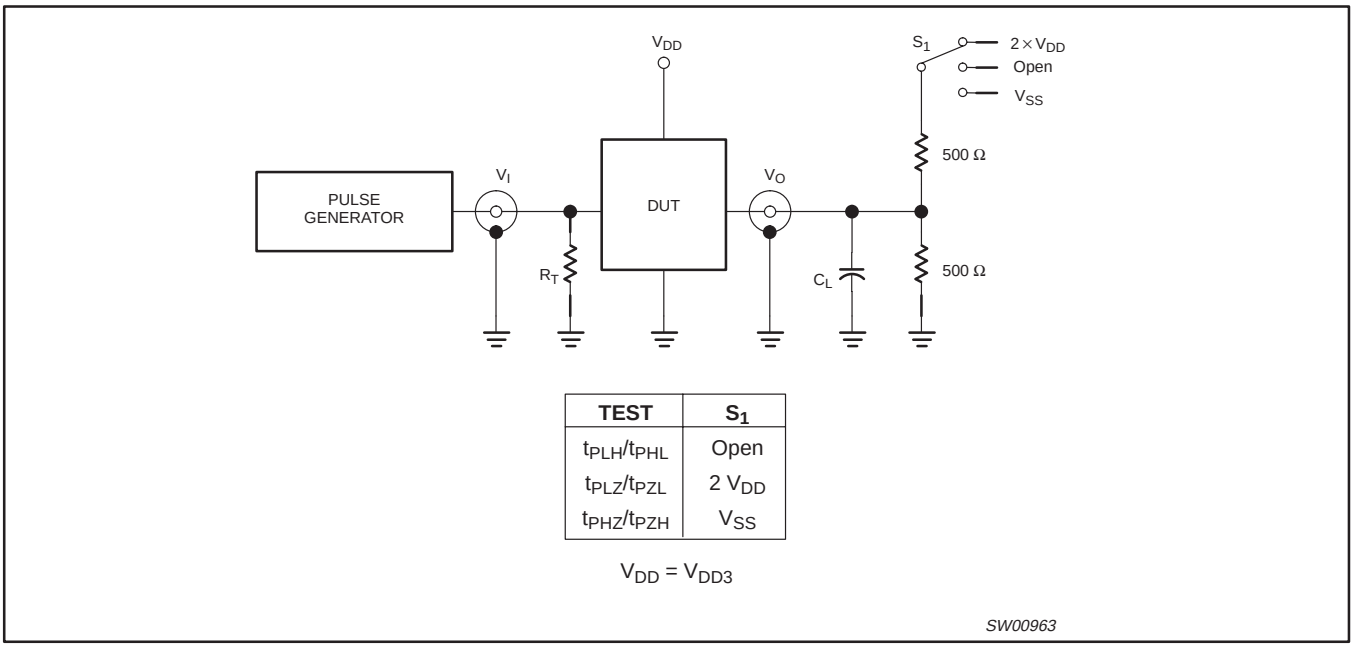


Figure 3. State enable and disable times



TEST	S_1
t_{PLH}/t_{PHL}	Open
t_{PLZ}/t_{PZL}	2 V_{DD}
t_{PHZ}/t_{PZH}	V_{SS}

$V_{DD} = V_{DD3}$

Figure 4. Load circuitry for switching times

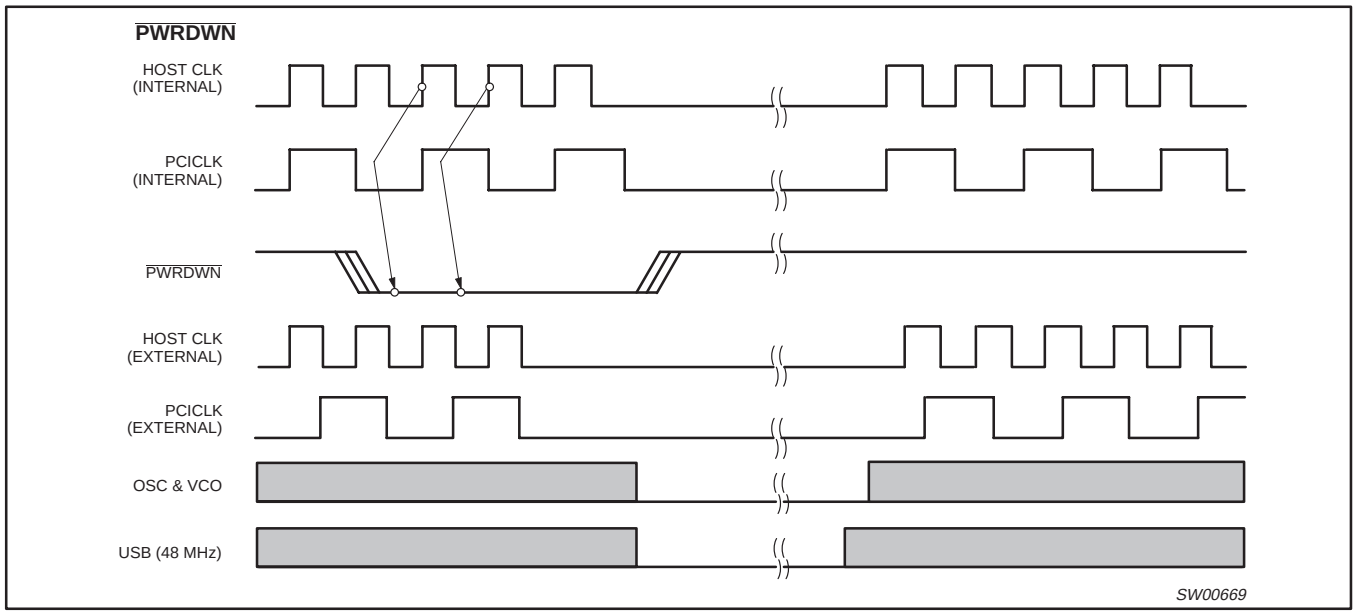


Figure 5. Power management

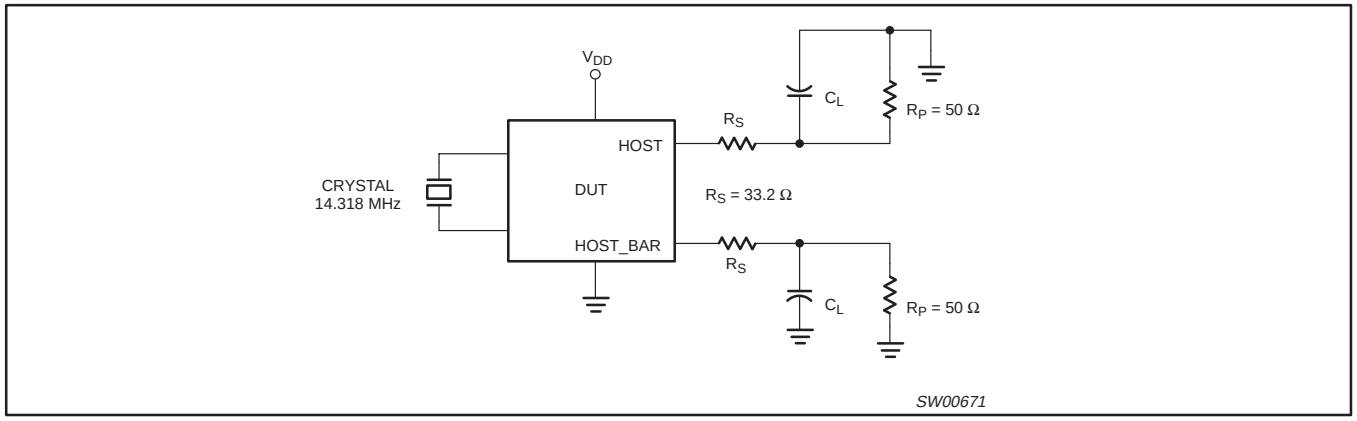


Figure 6. HOST CLOCK measurements

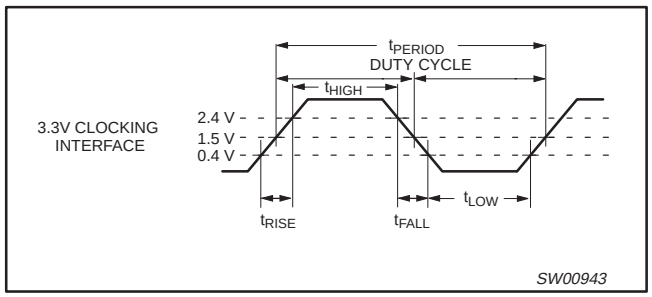
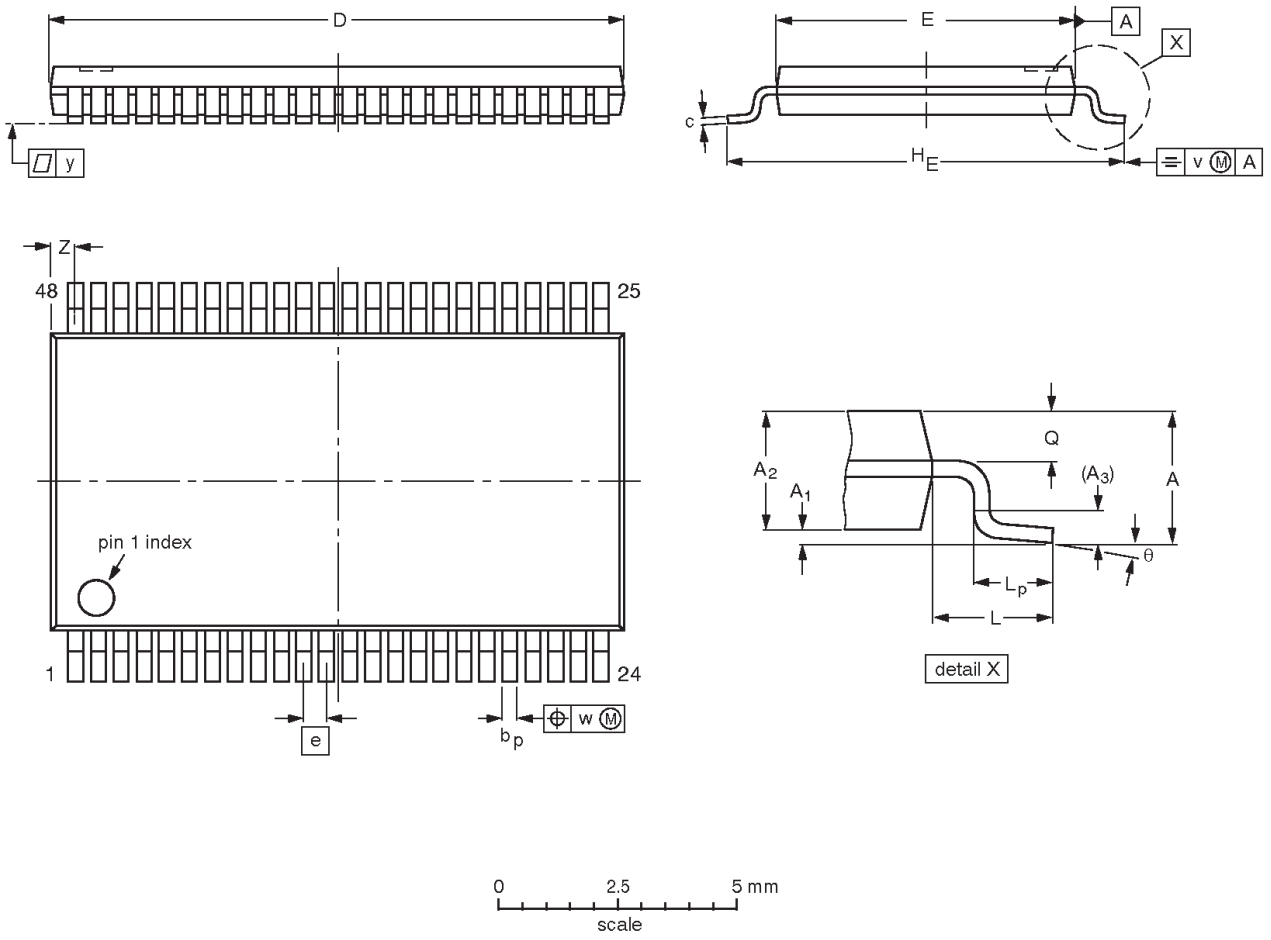


Figure 7. 3.3 V clock waveforms

TSSOP48: plastic thin shrink small outline package; 48 leads; body width 6.1 mm SOT362-1



DIMENSIONS (mm are the original dimensions).

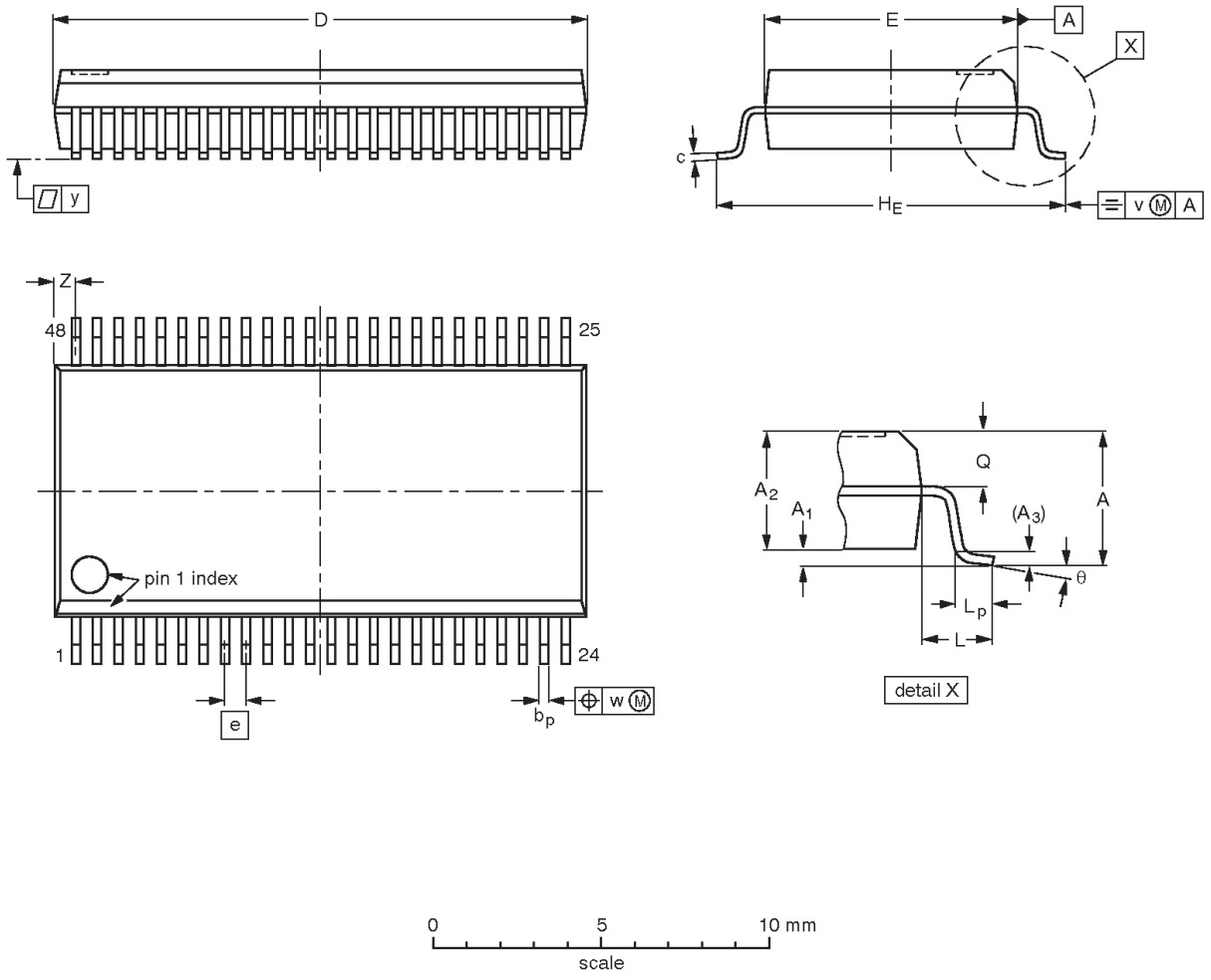
UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(2)}$	e	H_E	L	L_p	Q	v	w	y	Z	θ
mm	1.2	0.15 0.05	1.05 0.85	0.25	0.28 0.17	0.2 0.1	12.6 12.4	6.2 6.0	0.5	8.3 7.9	1	0.8 0.4	0.50 0.35	0.25	0.08	0.1	0.8 0.4	8^o 0^o

Notes

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.
2. Plastic interlead protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES					EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ				
SOT362-1		MO-153					~~95-02-10~~ 99-12-27

SSOP48: plastic shrink small outline package; 48 leads; body width 7.5 mm **SOT370-1**



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A_1	A_2	A_3	b_p	c	D (1)	E (1)	e	H_E	L	L_p	Q	v	w	y	Z (1)	θ
mm	2.8	0.4 0.2	2.35 2.20	0.25	0.3 0.2	0.22 0.13	16.00 15.75	7.6 7.4	0.635	10.4 10.1	1.4	1.0 0.6	1.2 1.0	0.25	0.18	0.1	0.85 0.40	8^o 0^o

Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT370-1		MO-118				~~95-02-04~~ 99-12-27

CK00 (100/133 MHz) spread spectrum differential system clock generator

PCK2021

Data sheet status

Data sheet status [1]	Product status [2]	Definitions
Objective data	Development	This data sheet contains data from the objective specification for product development. Philips Semiconductors reserves the right to change the specification in any manner without notice.
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Date of release: 10-01

Document order number: 9397 750 08953

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