



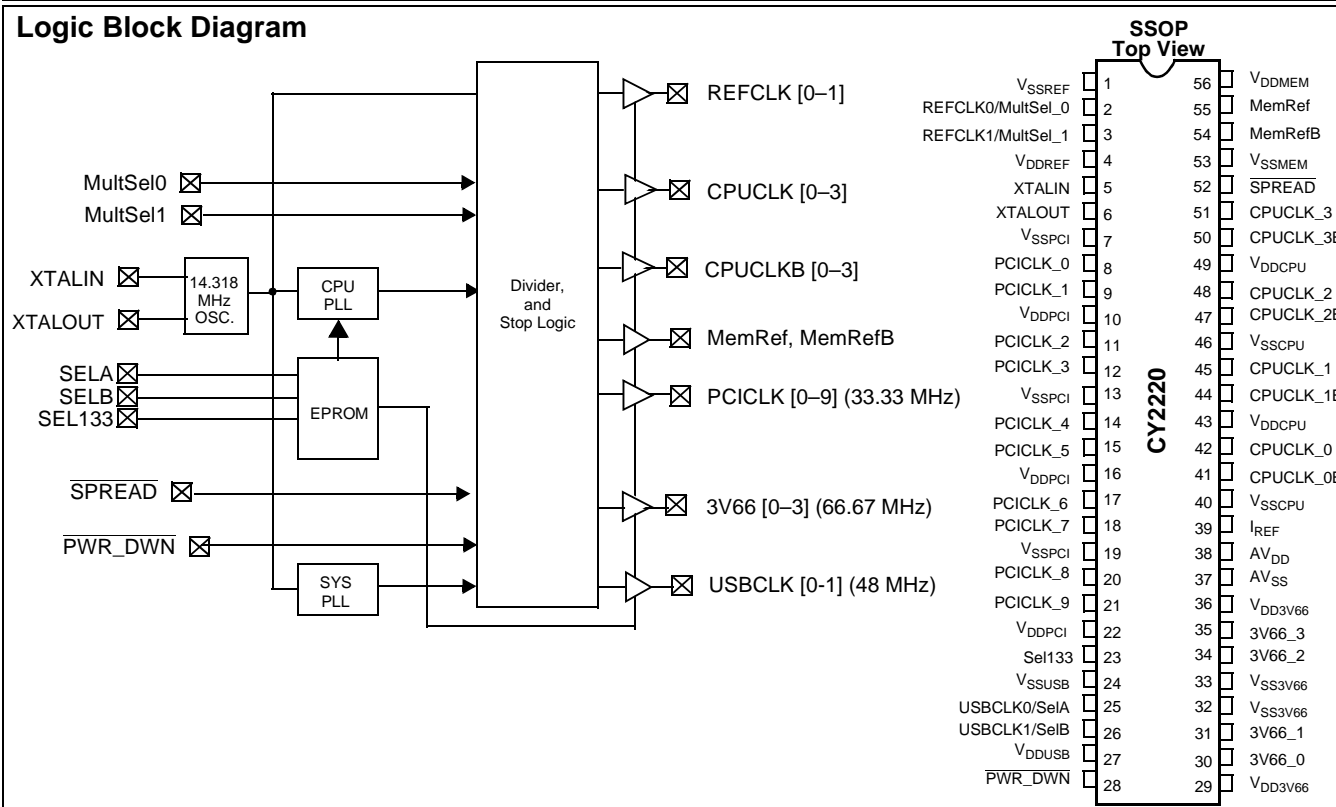
CYPRESS

CY2220

133-MHz Spread Spectrum Clock Synthesizer/Driver with Differential CPU Outputs

Features	Benefits
<ul style="list-style-type: none">• Compliant to Intel® CK00 Clock Synthesizer/Driver Specifications	Supports next generation Pentium® processors using differential clock drivers
<ul style="list-style-type: none">• Multiple output clocks at different frequencies<ul style="list-style-type: none">— Four pairs of differential CPU outputs, up to 133 MHz— Ten synchronous PCI clocks— Two Memory Reference clocks, 180 degrees out of phase— Four AGP and Hub Link clocks at 66 MHz— Two 48-MHz clocks— Two reference clocks at 14.318 MHz	Motherboard clock generator <ul style="list-style-type: none">— Support Multiple CPUs and a chipset— Support for PCI slots and chipset— Drives up to two Direct Rambus™ Clock Generators (DRCG)— Supports USB host controller and SuperI/O chip— Supports ISA slots and I/O chip
<ul style="list-style-type: none">• Spread Spectrum clocking<ul style="list-style-type: none">— 31 kHz modulation frequency— Default is -0.6%, which is recommended by Intel	Enables reduction of EMI and overall system cost
<ul style="list-style-type: none">• Power-down features	Enables ACPI compliant designs
<ul style="list-style-type: none">• Three Select inputs	Supports up to eight CPU clock frequencies
<ul style="list-style-type: none">• Low-skew and low-jitter outputs	Meets tight system timing requirements at high frequency
<ul style="list-style-type: none">• OE and Test Mode support	Enables ATE and “bed of nails” testing
<ul style="list-style-type: none">• 56-pin SSOP package	Widely available, standard package enables lower cost

Logic Block Diagram



Intel and Pentium are registered trademarks of Intel Corporation.
Direct Rambus is a trademark of Rambus, Inc.

Pin Summary

Name	Pins	Description
V _{SSREF}	1	3.3V Reference ground
V _{DDREF}	4	3.3V Reference voltage supply
V _{SSPCI}	7, 13, 19	3.3V PCI ground
V _{DDPCI}	10, 16, 22	3.3V PCI voltage supply
V _{SS3V66}	32, 33	3.3V AGP and Hub Link ground
V _{DD3V66}	29, 36	3.3V AGP and Hub Link voltage supply
V _{SSUSB}	24	3.3V USB ground
V _{DDUSB}	27	3.3V USB voltage supply
V _{SSCPU}	40, 46	3.3V CPU ground
V _{DDCPU}	43, 49	3.3V CPU voltage supply
V _{SSMEM}	53	3.3V Memory ground
V _{DDMEM}	56	3.3V Memory voltage supply
AV _{SS}	37	Analog ground for PLL and Core
AV _{DD}	38	Analog voltage supply to PLL and Core
I _{REF}	39	Reference current for external biasing
XTALIN ^[1]	5	Reference crystal input
XTALOUT ^[1]	6	Reference crystal feedback
CPUCLK [0–3]	42, 45, 48, 51	CPU clock outputs
CPUCLK [0–3]B	41, 44, 47, 50	Inverse CPU clock outputs
PCICLK [0–9]	8, 9, 11, 12, 14, 15, 17, 18, 20, 21	PCI clock outputs, synchronously running at 33.33 MHz
MemRef	55	MemRef clock output, drives memory clock generator
MemRefB	54	MemRefB clock output 180 degrees out of phase with MemRef
3V66_ [0–3]	30, 31, 34, 35	AGP and Hub Link clock outputs, running at 66 MHz
USBCLK [0–1]/Sel[A–B]	25, 26	Sel [A–B] inputs are sensed then internally latched on power-up before the pins are used for 48-MHz USB clock outputs
REFCLK[0–1]/MultSel[0–1]	2, 3	MultSel[0–1] inputs are sensed then internally latched on power-up before the pins are Reference clock outputs, 14.318 MHz
PWR_DWN	28	Active LOW input, powers down part when asserted
SPREAD ^[2]	52	Active LOW input, enables spread spectrum when asserted
SEL133	23	CPU frequency select input (See Function Table)

Notes:

- For best accuracy, use a parallel-resonant crystal, C_{LOAD} = 18 pF. For crystals with different C_{LOAD}, please refer to the appnote, "Crystal Oscillator Topics."
- Input is static HIGH or LOW. Frequency of toggling cannot exceed 30 MHz..

Function Table ^[3]

SEL133	SELA	SELB	CPUCLK (MHz)	MemRef (MHz)	3V66CLK (MHz)	PCICLK (MHz)	USBCLK (MHz)	REFCLK (MHz)
0	0	0	100	50	66	33	48	14.318
0	0	1	N/A	N/A	N/A	N/A	N/A	N/A
0	1	0	N/A	N/A	N/A	N/A	N/A	N/A
0	1	1	Hi-Z	Hi-Z	Hi-Z	Hi-Z	Hi-Z	Hi-Z
1	0	0	133	66	66	33	48	14.318
1	0	1	N/A	N/A	N/A	N/A	N/A	N/A
1	1	0	N/A	N/A	N/A	N/A	N/A	N/A
1	1	1	TCLK/2	TCLK/4	TCLK/4	TCLK/8	TCLK/2	TCLK

Actual Clock Frequency Values

Clock Output	Target Frequency (MHz)	CY2220-1		CY2220-2	
		CY2220-1 Actual Frequency (MHz)	PPM	CY2220-2 Actual Frequency (MHz)	PPM
CPUCLK	100	99.126	-8741	100.227	+2270
CPUCLK	133	132.769	-1740	133.269	+2022
USBCLK	48	48.008	167	48.008	167

Swing Select Functions

MultSel0	MultSel1	Board Target	Reference R, I _{REF} =	Output Current	V _{OH} @ Z, I _{ref} = 2.32mA
0	0	60Ω	R _r = 475 ± 1%, I _{ref} = 2.32mA	I _{OH} = 5*I _{ref}	0.71 @ 60
0	0	50Ω	R _r = 475 ± 1%, I _{ref} = 2.32mA	I _{OH} = 5*I _{ref}	0.59 @ 50
0	1	60Ω	R _r = 475 ± 1%, I _{ref} = 2.32mA	I _{OH} = 6*I _{ref}	0.85 @ 60
0	1	50Ω	R _r = 475 ± 1%, I _{ref} = 2.32mA	I _{OH} = 6*I _{ref}	0.71 @ 50
1	0	60Ω	R _r = 475 ± 1%, I _{ref} = 2.32mA	I _{OH} = 4*I _{ref}	0.56 @ 60
1	0	50Ω	R _r = 475 ± 1%, I _{ref} = 2.32mA	I _{OH} = 4*I _{ref}	0.47 @ 50
1	1	60Ω	R _r = 475 ± 1%, I _{ref} = 2.32mA	I _{OH} = 7*I _{ref}	0.99 @ 60
1	1	50Ω	R _r = 475 ± 1%, I _{ref} = 2.32mA	I _{OH} = 7*I _{ref}	0.82 @ 50

Clock Driver Impedances

Buffer Name	V _{DD} Range	Buffer Type	Impedance		
			Minimum Ω	Typical Ω	Maximum Ω
CPUCLK, CPUCLKB		Type X1			
USB, REF	3.135–3.465	Type 3	20	40	60
PCI, 3V66	3.135–3.465	Type 5	12	30	55
MemRef, MemRefB	3.135–3.465	Type 5	12	30	55

Note:

- TCLK is a test clock driven in on the XTALIN input in test mode.

Maximum Ratings

(Above which the useful life may be impaired. For user guidelines, not tested.)

Supply Voltage—0.5 to +7.0V

Input Voltage—0.5V to $V_{DD}+0.5$

Storage Temperature (Non-Condensing)— -65°C to $+150^{\circ}\text{C}$

Max. Soldering Temperature (10 sec) $+260^{\circ}\text{C}$

Junction Temperature $+150^{\circ}\text{C}$

Package Power Dissipation 1W

Static Discharge Voltage
(per JEDEC EIA/JESD22-A114-A) 2000V

Operating Conditions Over which Electrical Parameters are Guaranteed

Parameter	Description	Min.	Max.	Unit
V_{DDREF} , V_{DDPCI} , AV_{DD} , V_{DD3V66} , V_{DDUSB} , V_{DDCPU} , V_{DDMEM}	3.3V Supply Voltages	3.135	3.465	V
T_A	Operating Temperature, Ambient	0	70	$^{\circ}\text{C}$
C_{in}	Input Pin Capacitance Nominal Value	18 pF	18 pF	pF
C_{XTAL}	XTAL Pin Capacitance		22.5	pF
C_L	Max. Capacitive Load on MemRef, USBCLK, REF PCICLK, 3V66		20 30	pF
$f_{(REF)}$	Reference Frequency, Oscillator Nominal Value	14.318	14.318	MHz

Electrical Characteristics Over the Operating Range

Parameter	Description	Test Conditions		Min.	Max.	Unit
V_{IH}	High-level Input Voltage	Except Crystal Pads. Threshold voltage for crystal pads = $V_{DD}/2$		2.0		V
V_{IL}	Low-level Input Voltage	Except Crystal Pads			0.8	V
V_{OH}	High-level Output Voltage	MemRef, USB, REF, 3V66	$I_{OH} = -1 \text{ mA}$	2.4		V
		PCI	$I_{OH} = -1 \text{ mA}$	2.4		V
V_{OL}	Low-level Output Voltage	MemRef, USB, REF, 3V66	$I_{OL} = 1 \text{ mA}$		0.4	V
		PCI	$I_{OL} = 1 \text{ mA}$		0.55	V
I_{IH}	Input High Current	$0 \leq V_{IN} \leq V_{DD}$		-5	5	μA
I_{IL}	Input Low Current	$0 \leq V_{IN} \leq V_{DD}$		-5	5	μA
I_{OH}	High-level Output Current	CPU For $I_{OH} = 6 \cdot I_{Ref}$ Configuration	Type X1, $V_{OH} = 0.65\text{V}$	-12.9	-14.9	mA
		USB, REF	Type 3, $V_{OH} = 2.4\text{V}$	-15	-51	
		3V66, PCI, MemRef, MemRefB	Type 5, $V_{OH} = 2.4\text{V}$	-30	-100	
I_{OL}	Low-level Output Current	USB, REF	Type 3, $V_{OL} = 0.4\text{V}$	10	24	mA
		3V66, PCI, MemRef, MemRefB	Type 5, $V_{OL} = 0.4\text{V}$	20	49	
I_{OZ}	Output Leakage Current	Three-state			10	μA
I_{DD3}	3.3V Power Supply Current	$AV_{DD}/V_{DD33} = 3.465\text{V}$, $F_{CPU} = 133 \text{ MHz}$			250	mA
I_{DDPD3}	3.3V Shutdown Current	$AV_{DD}/V_{DDQ3} = 3.465\text{V}$			60	mA

Switching Characteristics^[4] Over the Operating Range

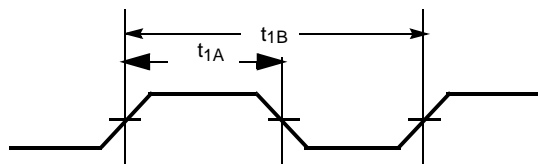
Parameter	Output	Description	Test Conditions	Min.	Max.	Unit
t_1	All	Output Duty Cycle ^[5]	$t_{1A}/(t_{1B})$	45	55	%
t_2	CPU	Rise Time	Measured at 20% to 80% of V_{oh}	175	700	ps
t_2	USB, REF	Rising Edge Rate	Between 0.4V and 2.4V	0.5	2.0	V/ns
t_2	PCI, 3V66, MemRef	Rising Edge Rate	Between 0.4V and 2.4V	1.0	4.0	V/ns
t_3	CPU	Fall Time	Measured at 80% to 20% of V_{oh}	175	700	ps
t_3	USB, REF	Falling Edge Rate	Between 2.4V and 0.4V	0.5	2.0	V/ns
t_3	PCI, 3V66, MemRef	Falling Edge Rate	Between 2.4V and 0.4V	1.0	4.0	V/ns
t_4	CPU	CPU-CPU Skew	Measured at Crossover		150	ps
t_5	3V66	3V66-3V66 Skew	Measured at 1.5V		250	ps
t_6	PCI	PCI-PCI Skew	Measured at 1.5V		500	ps
t_7	3V66, PCI	3V66-PCI Clock Skew	3V66 leads. Measured at 1.5V	1.5	3.5	ns
t_8	CPU	Cycle-Cycle Clock Jitter	Measured at Crossover $t_8 = t_{8A} - t_{8B}$ With all outputs running		200	ps
t_9	Mref	Cycle-Cycle Clock Jitter	Measured at 1.5V $t_9 = t_{9A} - t_{9B}$		250	ps
t_9	3V66	Cycle-Cycle Clock Jitter	Measured at 1.5V $t_9 = t_{9A} - t_{9B}$		300	ps
t_9	USB	Cycle-Cycle Clock Jitter	Measured at 1.5V $t_9 = t_{9A} - t_{9B}$		350	ps
t_9	PCI	Cycle-Cycle Clock Jitter	Measured at 1.5V $t_9 = t_{9A} - t_{9B}$		500	ps
t_9	REF	Cycle-Cycle Clock Jitter	Measured at 1.5V $t_9 = t_{9A} - t_{9B}$		1000	ps
	CPU, PCI	Settle Time	CPU and PCI clock stabilization from power-up		3	ms
	CPU	Rise/Fall Matching	Measured with test loads ^[6, 7]		20%	
	CPU	Overshoot	Measured with test loads ^[7]		$V_{oh} + 0.2$	V
	CPU	Undershoot	Measured with test loads ^[7]	-0.2		V
V_{oh}	CPU	High-level Output Voltage	Measured with test loads ^[7]	0.65	0.74	V
V_{ol}	CPU	Low-level Output Voltage	Measured with test loads ^[7]	0.0	0.05	V
$V_{crossover}$	CPU	Crossover Voltage	Measured with test loads ^[7]	45% of V_{OH}	55% of V_{OH}	V

Notes:

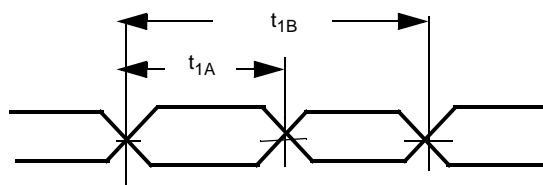
4. All parameters specified with loaded outputs. Parameters not tested in production, but are guaranteed by design characterization.
5. Duty cycle is measured at 1.5V with V_{DD} at 3.3V on all output except CPU. Duty Cycle on CPU is measured at $V_{crossover}$.
6. Determined as a fraction of $2 \cdot (Trp - Trn) / (Trp + Trn)$ Where Trp is a rising edge and Trn is an intersecting falling edge.
7. The test load is specified in test circuit.

Switching Waveforms

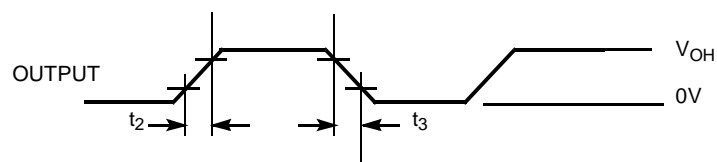
Duty Cycle Timing (Single Ended Output)



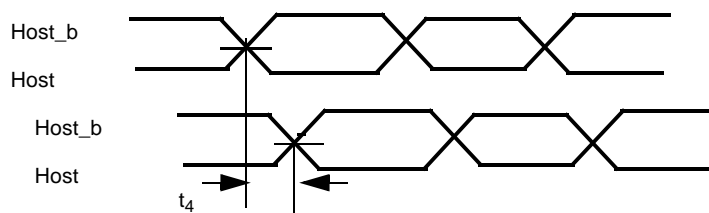
Duty Cycle Timing (CPU Differential Output)



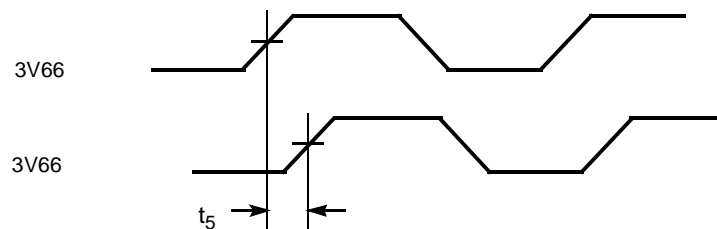
All Outputs Rise/Fall Time



CPU-CPU Clock Skew

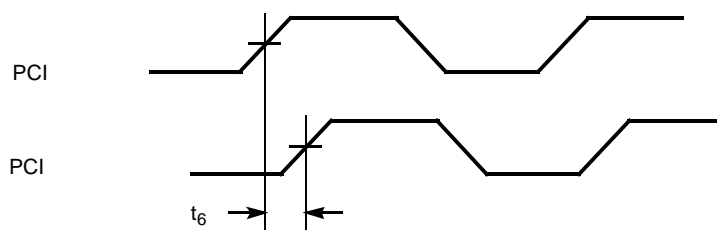


3V66-3V66 Clock Skew

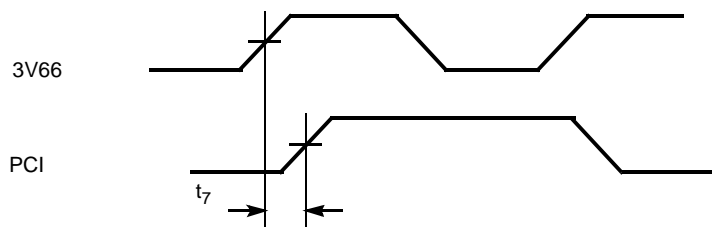


Switching Waveforms (continued)

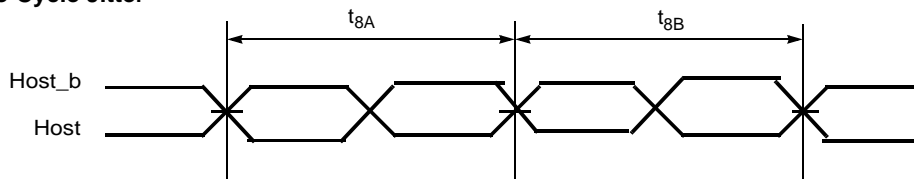
PCI-PCI Clock Skew



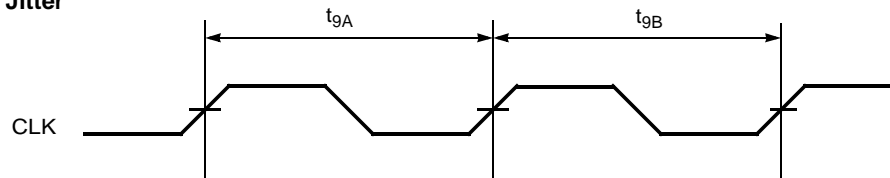
3V66-PCI Clock Skew



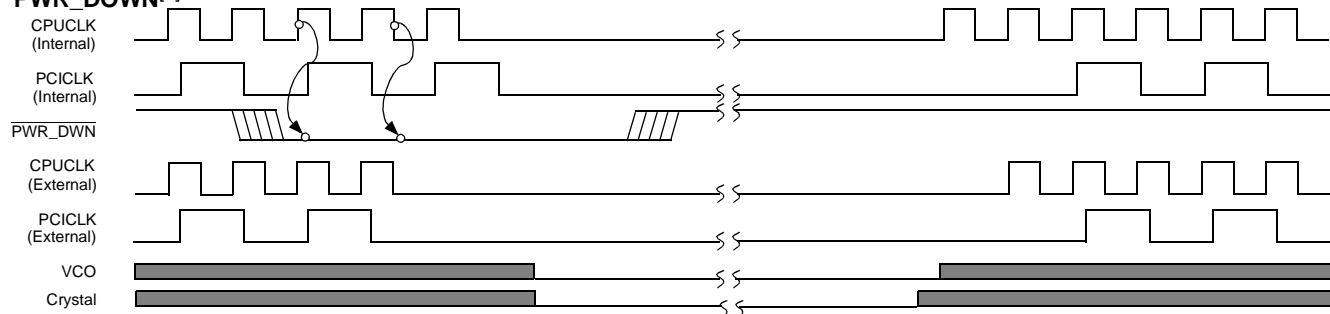
CPU Clock Cycle-Cycle Jitter



Cycle-Cycle Clock Jitter

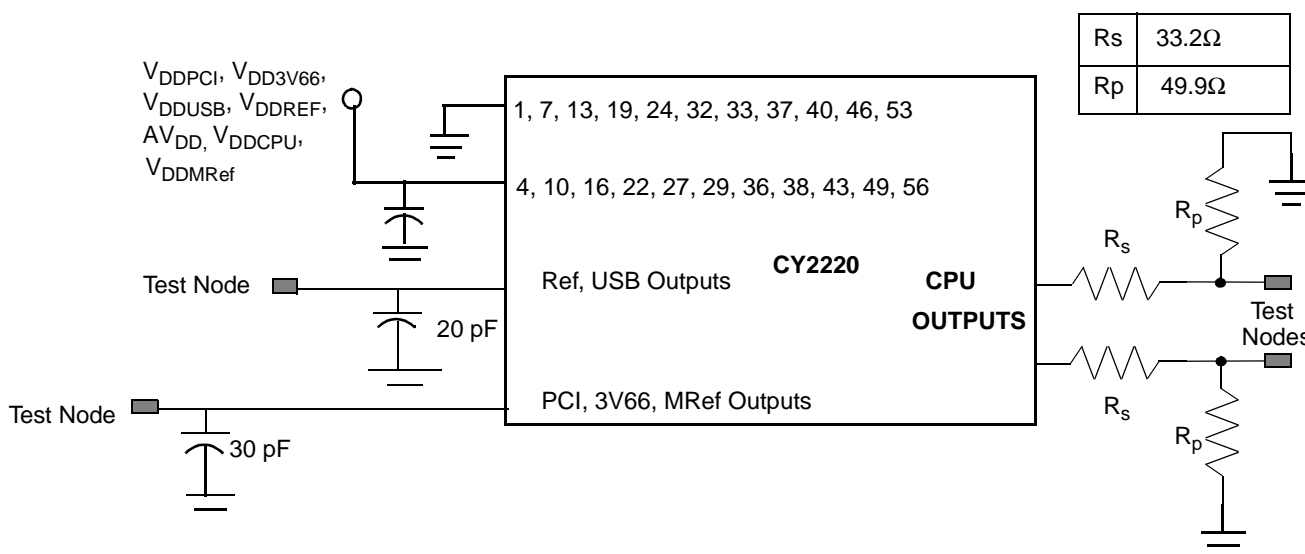


PWR_DOWN^[8]



Note:

8. Shaded section on the VCO and Crystal waveforms indicates that the VCO and crystal oscillator are active, and there is a valid clock.

Test Circuit^[9, 10]

Ordering Information

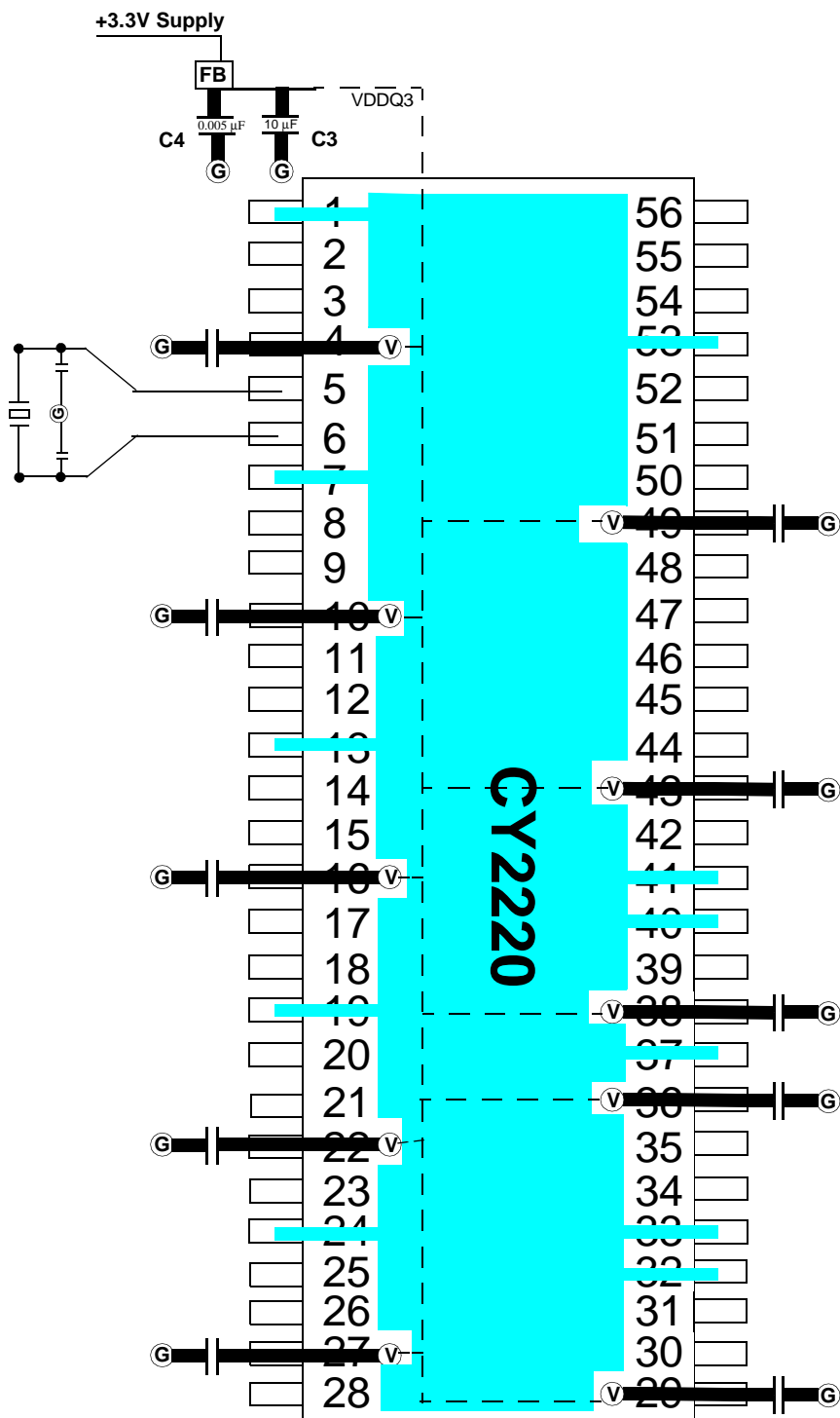
Ordering Code	Package Name	Package Type	Operating Range
CY2220PVC-1	O56	56-Pin SSOP	Commercial
CY2220PVC-2	O56	56-Pin SSOP	Commercial

Document #: 38-00813-*B

Note:

9. Each supply pin must have an individual decoupling capacitor.
10. All capacitors must be placed as close to the pins as is physically possible.

Layout Example



FB = Dale ILB1206 - 300 (300Ω @ 100 MHz)

Cermaic Caps C3 = 10 – 22 µF C4 = 0.005 µF

⊗ = VIA to GND plane layer ⊙ = VIA to respective supply plane layer

Note: Each supply plane or strip should have a ferrite bead and capacitors
All bypass caps = 0.01 µf ceramic



© Cypress Semiconductor Corporation, 2001. The information contained herein is subject to change without notice. Cypress Semiconductor Corporation assumes no responsibility for the use of any circuitry other than circuitry embodied in a Cypress Semiconductor product. Nor does it convey or imply any license under patent or other rights. Cypress Semiconductor does not authorize its products for use as critical components in life-support systems where a malfunction or failure may reasonably be expected to result in significant injury to the user. The inclusion of Cypress Semiconductor products in life-support systems application implies that the manufacturer assumes all risk of such use and in doing so indemnifies Cypress Semiconductor against all charges.