



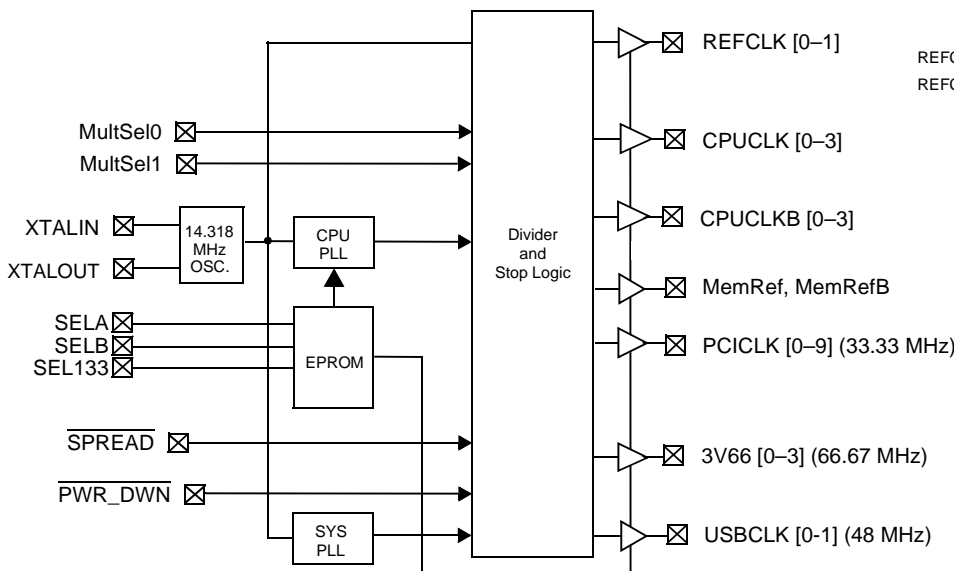
CYPRESS

CY2220

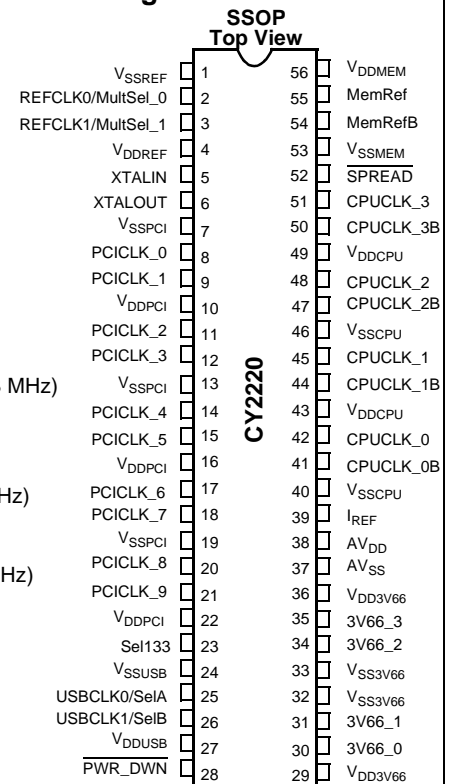
133-MHz Spread Spectrum Clock Synthesizer/Driver with Differential CPU Outputs

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



Pin Configuration



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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 application note, "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	
		Actual Frequency (MHz)	PPM	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} = 2.32 mA
0	0	60Ω	R _r = 475 ± 1%, I _{ref} = 2.32 mA	I _{OH} = 5*I _{ref}	0.71 @ 60
0	0	50Ω	R _r = 475 ± 1%, I _{ref} = 2.32 mA	I _{OH} = 5*I _{ref}	0.59 @ 50
0	1	60Ω	R _r = 475 ± 1%, I _{ref} = 2.32 mA	I _{OH} = 6*I _{ref}	0.85 @ 60
0	1	50Ω	R _r = 475 ± 1%, I _{ref} = 2.32 mA	I _{OH} = 6*I _{ref}	0.71 @ 50
1	0	60Ω	R _r = 475 ± 1%, I _{ref} = 2.32 mA	I _{OH} = 4*I _{ref}	0.56 @ 60
1	0	50Ω	R _r = 475 ± 1%, I _{ref} = 2.32 mA	I _{OH} = 4*I _{ref}	0.47 @ 50
1	1	60Ω	R _r = 475 ± 1%, I _{ref} = 2.32 mA	I _{OH} = 7*I _{ref}	0.99 @ 60
1	1	50Ω	R _r = 475 ± 1%, I _{ref} = 2.32 mA	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:

3. 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°C
 Junction Temperature.....
 +150°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	°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
t_{PU}	Power-up time for all VDD's to reach minimum specified voltage (power ramps must be monotonic)	0.05	50	ms

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	$I_{OH} = -1$ mA	2.4	V	
		PCI	$I_{OH} = -1$ mA	2.4	V	
V_{OL}	Low-level Output Voltage	MemRef, USB, REF, 3V66	$I_{OL} = 1$ mA	0.4	V	
		PCI	$I_{OL} = 1$ 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, $V_{OH} = 0.65$ V	-12.9	-14.9	mA
		USB, REF	Type 3, $V_{OH} = 2.4$ V	-15	-51	
		3V66, PCI, MemRef, MemRefB	Type 5, $V_{OH} = 2.4$ V	-30	-100	
I_{OL}	Low-level Output Current	USB, REF	Type 3, $V_{OL} = 0.4$ V	10	24	mA
		3V66, PCI, MemRef, MemRefB	Type 5, $V_{OL} = 0.4$ V	20	49	
I_{OZ}	Output Leakage Current	Three-state		10	μA	
I_{DD3}	3.3V Power Supply Current	$AV_{DD}/V_{DD33} = 3.465$ V, $F_{CPU} = 133$ MHz		250	mA	
I_{DDP3}	3.3V Shutdown Current	$AV_{DD}/V_{DDQ3} = 3.465$ V		60	mA	

Switching Characteristics^[4] Over the Operating Range

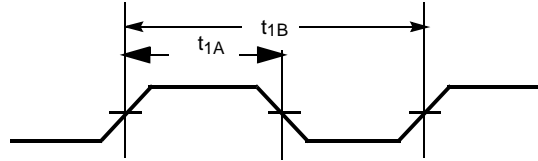
Parameter	Output	Description	Test Conditions	Min.	Max.	Unit
t ₁	All	Output Duty Cycle ^[5]	t _{1A} /(t _{1B})	45	55	%
t ₂	CPU	Rise Time	Measured at 20% to 80% of V _{OH}	175	700	ps
t ₂	USB, REF	Rising Edge Rate	Between 0.4V and 2.4V	0.5	2.0	V/ns
t ₂	PCI, 3V66, MemRef	Rising Edge Rate	Between 0.4V and 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:

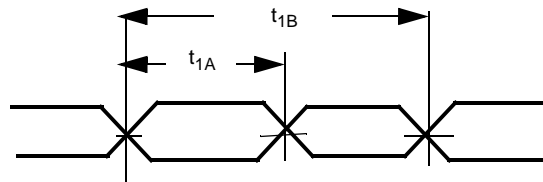
4. All parameters specified with loaded outputs. Parameters not tested in production, but are guaranteed by design characterization.
5. Duty cycle is measured at 1.5V with V_{DD} at 3.3V on all output except CPU. Duty Cycle on CPU is measured at V_{Crossover}.
6. Determined as a fraction of 2*(t_{RP}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

Switching Waveforms

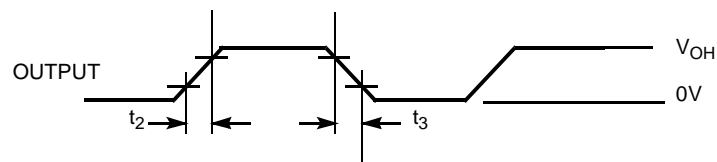
Duty Cycle Timing (Single Ended Output)



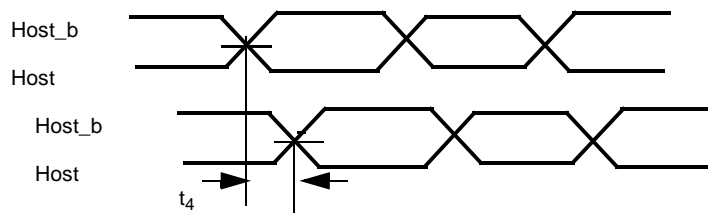
Duty Cycle Timing (CPU Differential Output)



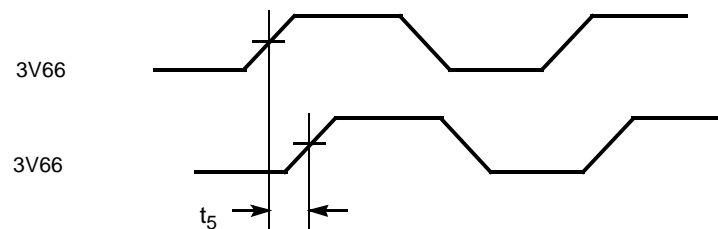
All Outputs Rise/Fall Time

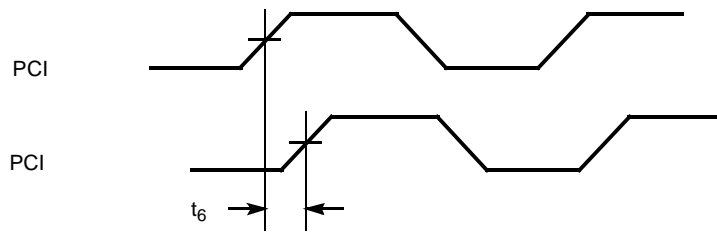
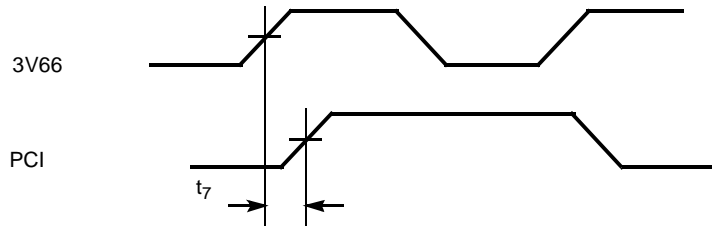
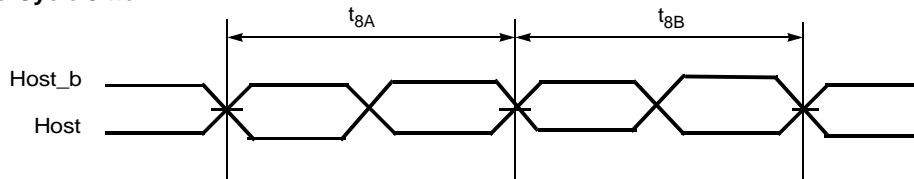
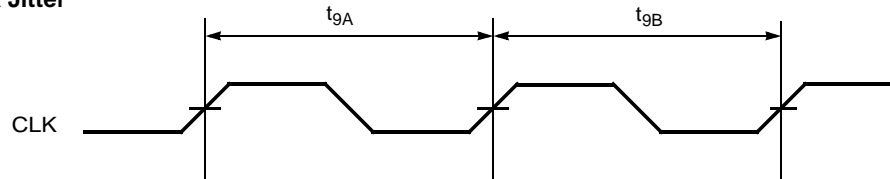
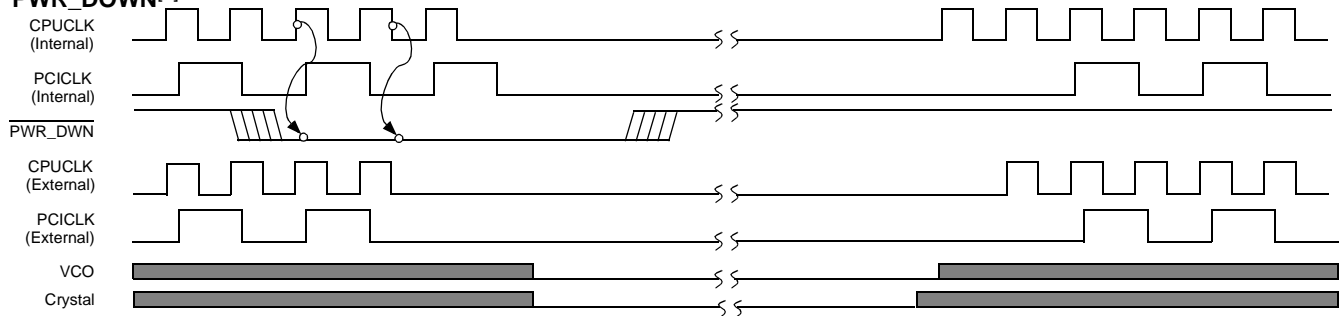


CPU-CPU Clock Skew

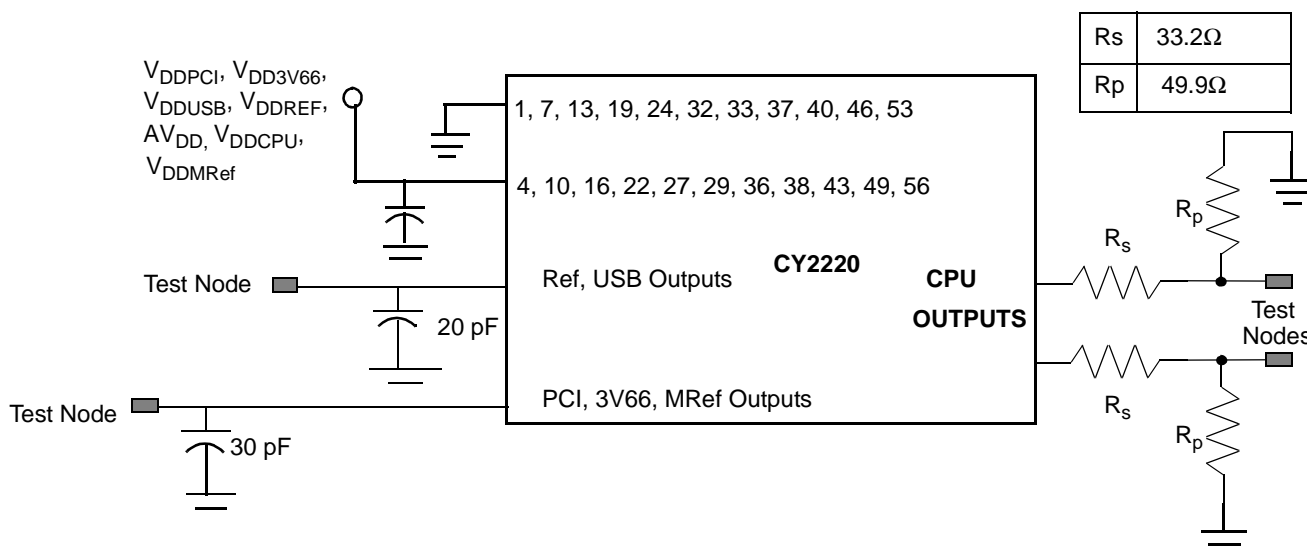


3V66-3V66 Clock Skew



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

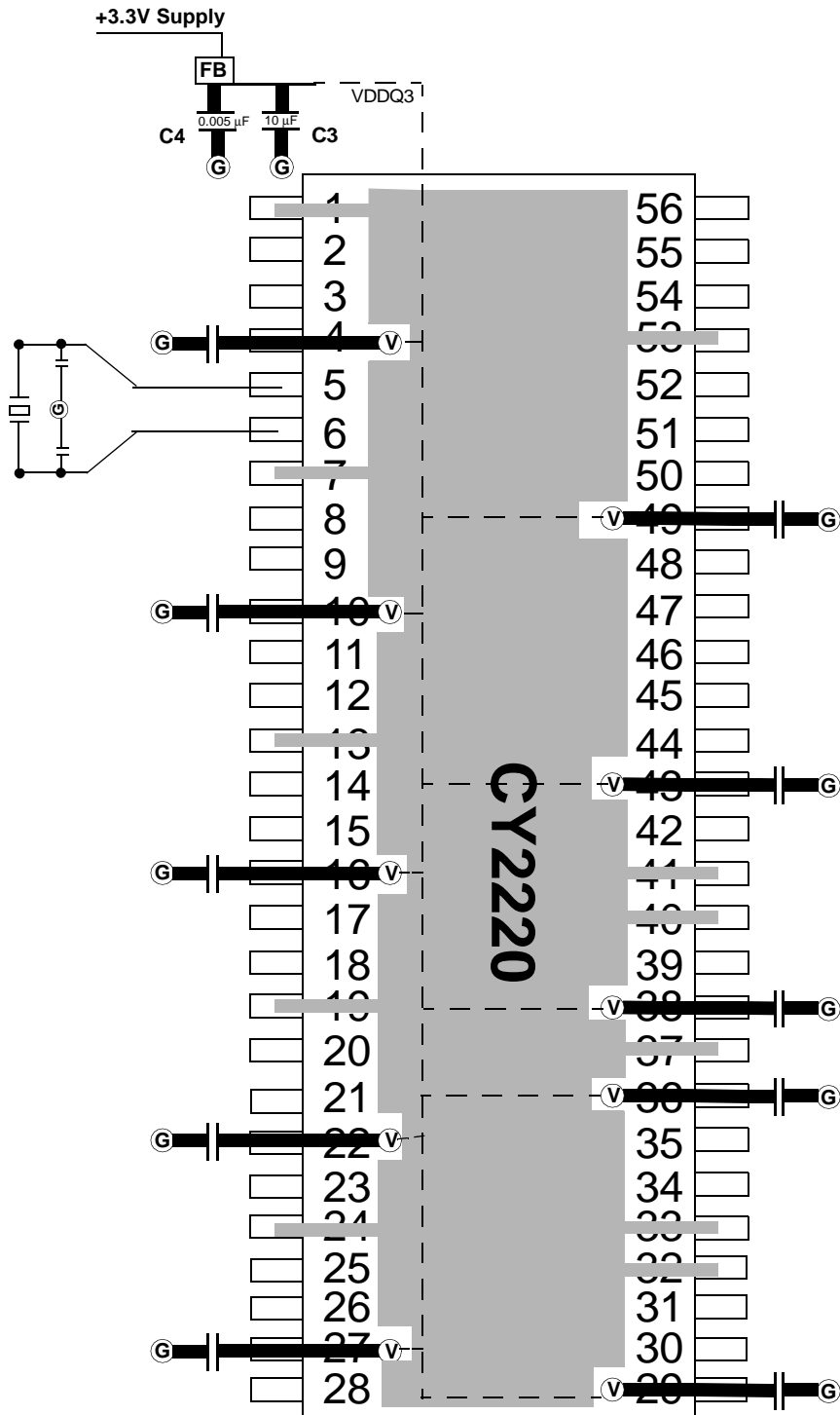
Ordering Code	Package Name	Package Type	Operating Range
CY2220PVC-1	O56	56-Pin SSOP	Commercial
CY2220PVC-2	O56	56-Pin SSOP	Commercial

Notes:

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 (30Ω @ 100 MHz)

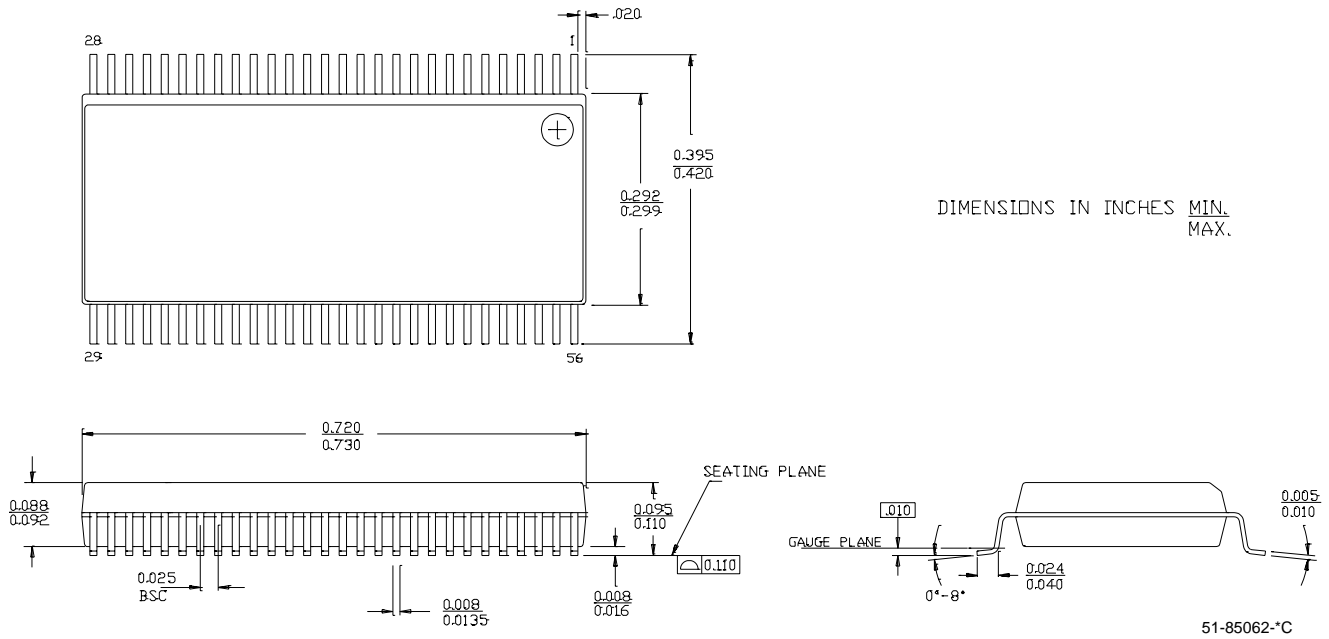
Ceramic Caps C3 = 10–22 µF C4 = 0.005 µF

ⓐ = 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

Package Diagram

56-Lead Shrunken Small Outline Package O56



Document Title: CY2220 133-MHz Spread Spectrum Clock Synthesizer/Driver with Differential CPU Outputs				
Document Number: 38-07206				
REV.	ECN NO.	Issue Date	Orig. of Change	Description of Change
**	111730	01/17/02	DSG	Change from Spec number: 38-00813 to 38-07206
*A	121841	12/30/02	RBI	Power up requirements added to Operating Conditions Information