



**Integrated
Circuit
Systems, Inc.**

ICS9132

Advance Information

32 kHz Motherboard Frequency Generator

Features

- Single 32.768 kHz crystal generates all PC motherboard clocks
- Four independent clock generators
- Generate CPU clock from 12.5 to 100 MHz
- Up to 6 output clocks
- Each clock can be individually powered down
- Separate VDD for 32 kHz clock
- Output enable tri-states outputs
- On-chip loop filter components
- Operates from +3.3V or 5.0V supply
- Skew controlled 2x and 1x CPU clocks
- 20 pin PDIP or SOIC package

General Description

The ICS9132 is designed to generate clocks for all 286, 386, 486, Pentium and RISC based motherboards, including laptops and notebook computers. The only external components required are a 32.768 kHz crystal, crystal components, and decoupling capacitors. The device generates the 14.318 MHz system clock, eliminating the need for a 14.318 MHz crystal. High performance applications may require high speed clock termination components. The chip includes four independent clock generators plus the 32.768 kHz reference clock to produce all necessary frequencies, including real time clock/DRAM refresh, master clock, CPU clock, twice CPU clock frequency, keyboard clock, floppy disk controller clock, serial communications clock and bus clocks. Different frequencies from clocks #2, #3, and #4 can be selected using the frequency select pins, however clock #1 will be at 14.318 MHz for all standard versions.

Applications

Notebook/Palmtop Computers: The ICS9132-01 works with +3V and +5V and a single 32.768 kHz crystal, making it the ideal solution for generating clocks in portables with minimum board space. The user can save power by using this single part instead of oscillators or other frequency generators. The ICS9132 further reduces the current consumption by having the ability to completely shut down the individual clocks when not in use, while still maintaining the separately powered 32.768 kHz clock.

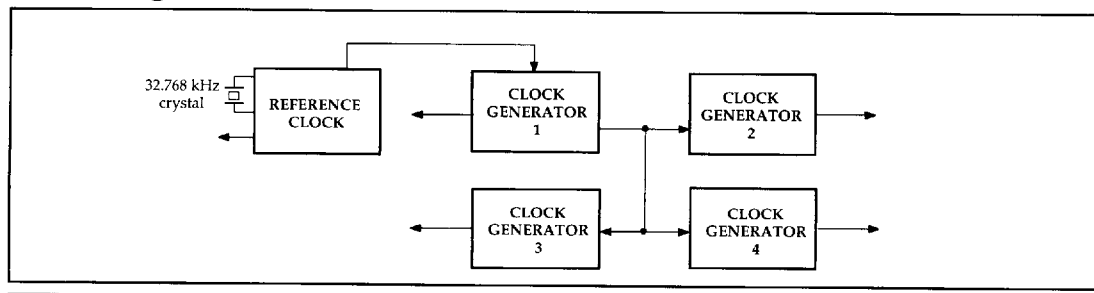
Desktop Computers: The ICS9132-03 works at 5V while saving the cost and space of oscillators. Using a single 32.768 kHz crystal, the ICS9132-03 generates all CPU and peripheral clocks found on a motherboard.

VDD32 SUPPLY

The ICS9132 has a separate power supply for the 32.768 kHz oscillator circuitry. This allows the 32 kHz clock to run from a battery or other source while the main power to the chip is disconnected. The VDD32 supply is guaranteed to operate down to +2.0V, with the clock consuming less than 10μA at +3.3V with the main VDD at 0V.

Part	Description
ICS9132-01	Notebook version
ICS9132-03	Desktop version
ICS9132-16	Pentium version with SCUZZY clock
ICS9132-18	Pentium version

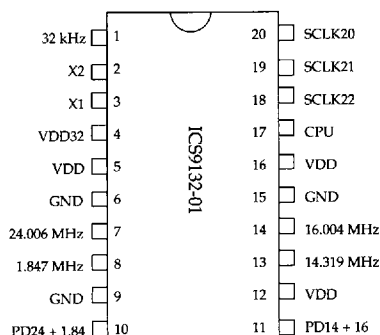
Block Diagram





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Pin Configuration



ICS9132-01 Decoding Table for CPU CLOCK

SCLK22 Pin 18	SCLK21 Pin 19	SCLK20 Pin 20	CPU (MHz) Pin 17
0	0	0	OFF
0	0	1	4.010 MHz
0	1	0	25.059
0	1	1	33.258
1	0	0	40.095
1	0	1	50.119
1	1	0	66.641*
1	1	1	80.060*

* Only at 5V supply voltage

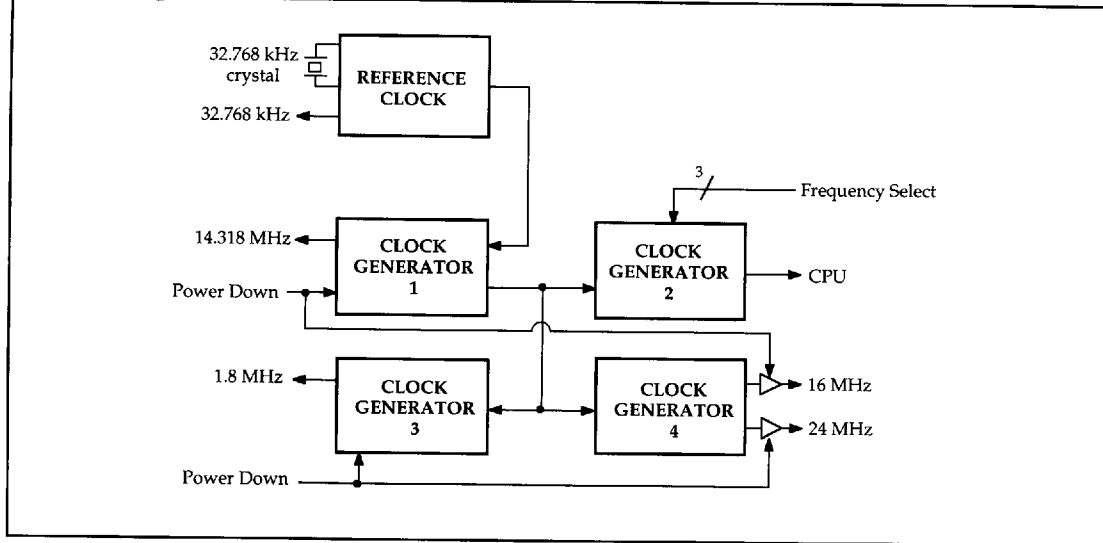
Pin Description for ICS9132-01

Pin Name	Pin #	Pin type	Description
32kHz	1	Output	32.768 kHz output
X2	2	Output	Connect 32 kHz crystal
X1	3	Input	Connect 32 kHz crystal
VDD32	4	-	Power supply for 32 kHz oscillator only
VDD	5	-	Power supply (+3.3 - +5.0V)
GND	6	-	GROUND
24.006 MHz	7	Output	24.006 MHz clock output
1.847 MHz	8	Output	1.847 MHz clock output
GND	9	-	GROUND
PD24.006 & 1.847 MHz	10	Input	POWER DOWN. Shuts off 24.006 & 1.847 MHz clocks when low
PD14 & 16 MHz	11	Input	POWER DOWN. Shuts off 14.319 & 16.004 MHz clocks when low
VDD	12	-	Power Supply (+3.3 to +5.0V)
14.319 MHz	13	Output	14.319 MHz clock output
16.004 MHz	14	Output	16.004 MHz clock output
GND	15	-	GROUND
VDD	16	-	Power Supply (+3.3 to +5.0V)
CPU	17	Output	CPU clock output (see decoding table)
SCLK22	18	Input	CPU clock frequency SELECT 2
SCLK21	19	Input	CPU clock frequency SELECT 1
SCLK20	20	Input	CPU clock frequency SELECT 0



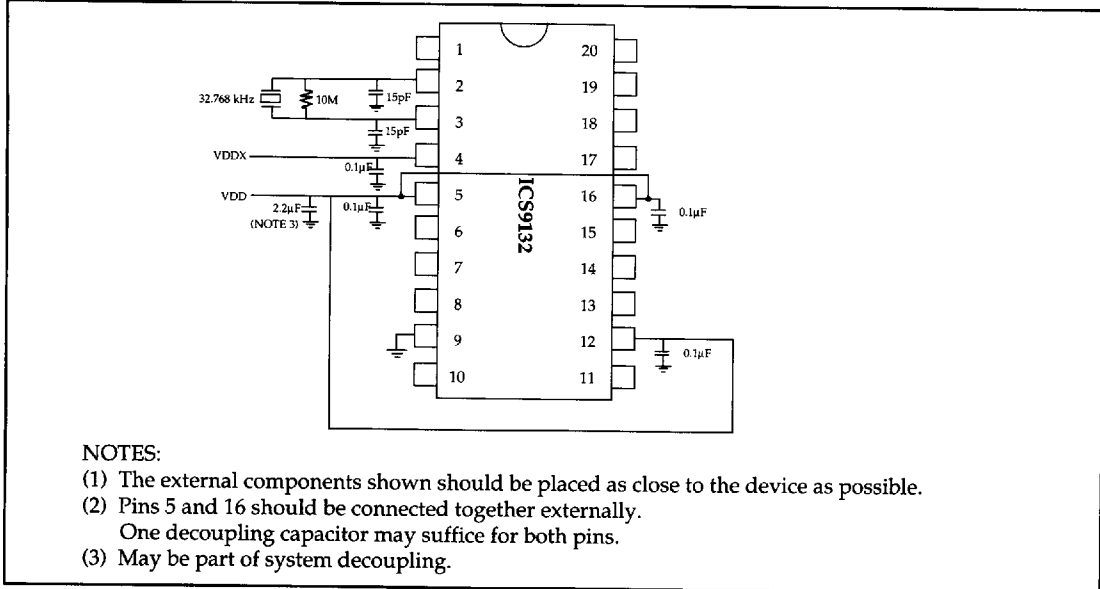
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Block Diagram for ICS9132-01



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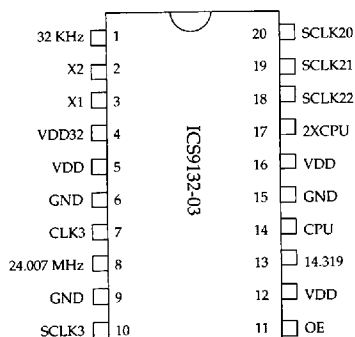
Recommended External Circuit





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Pin Configuration



ICS9132-03 Decoding Tables

CPU CLOCK

SCLK22 Pin 18	SCLK21 Pin 19	SCLK20 Pin 20	2x CPU (MHz) Pin 17	CPU (MHz) Pin 14
0	0	0	100.226	50.113
0	0	1	32.005	16.003
0	1	0	25.059	12.530
0	1	1	33.293	16.647
1	0	0	40.006	20.003
1	0	1	50.119	25.059
1	1	0	66.586	33.293
1	1	1	80.012*	40.006

KBD CLOCK

SCLK3	CLK3
0	8.002
1	12.082

* Only at 5V supply voltage

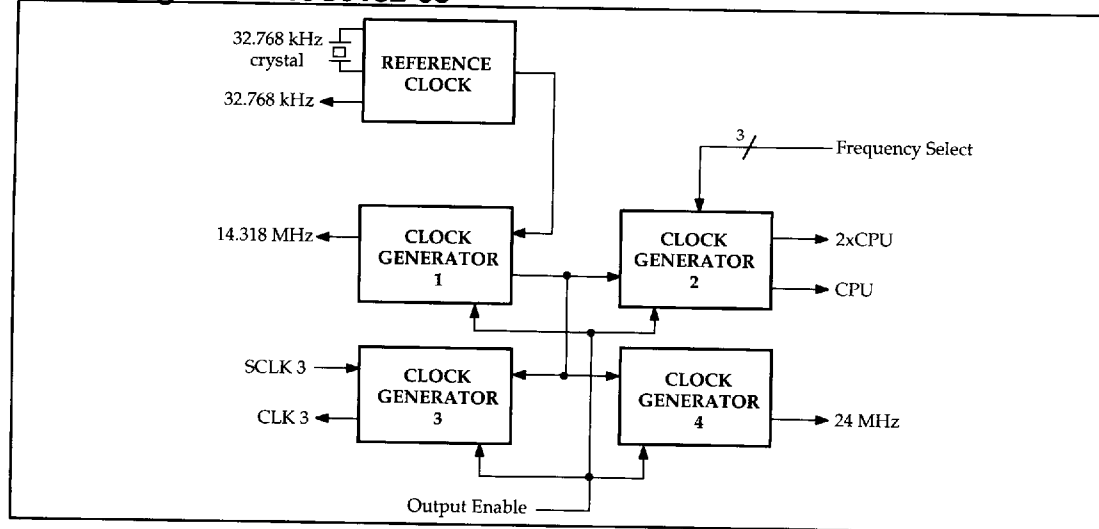
Pin Description for ICS9132-03 (5V operation. 3V available upon request)

Pin Name	Pin #	Pin type	Description
32kHz	1	Output	32.768 kHz output
X2	2	Output	Connect 32 kHz crystal
X1	3	Input	Connect 32 kHz crystal
VDD32	4	-	Power supply for 32 kHz oscillator only
VDD	5	-	Power supply (+5.0V)
GND	6	-	GROUND
CLK3	7	Output	Keyboard CLOCK 3 8 or 12 MHz output
24.007 MHz	8	Output	24.007 MHz clock output
GND	9	-	GROUND
SCLK3	10	Input	Keyboard CLOCK 3 Frequency Select. Pull-up resistor connected
OE	11	Input	OUTPUT ENABLE. A low tri-states clock outputs. Pull-up resistor connected
VDD	12	-	Power Supply (+5.0V)
14.319MHz	13	Output	14.319 MHz clock output
CPU	14	Output	CPU clock output (see decoding table)
GND	15	-	GROUND
VDD	16	-	Power Supply (+5.0V)
2xCPU	17	Output	Double frequency CPU clock output
SCLK22	18	Input	CPU clock frequency SELECT 2. Pull-up resistor connected
SCLK21	19	Input	CPU clock frequency SELECT 1. Pull-up resistor connected
SCLK20	20	Input	CPU clock frequency SELECT 0. Pull-up resistor connected



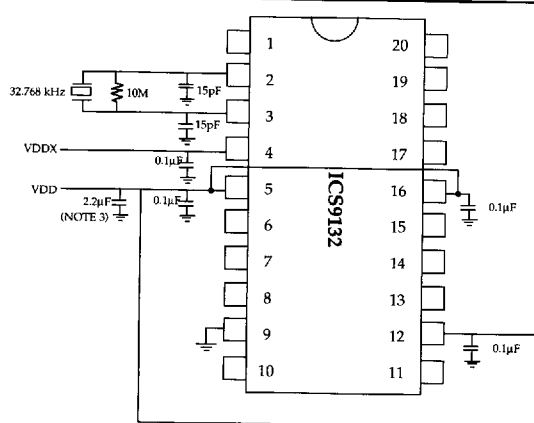
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Block Diagram for ICS9132-03



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Recommended External Circuit



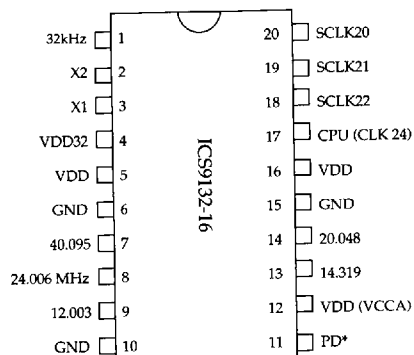
NOTES:

- (1) The external components shown should be placed as close to the device as possible.
- (2) Pins 5 and 16 should be connected together externally.
One decoupling capacitor may suffice for both pins.
- (3) May be part of system decoupling.



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Pin Configuration



ICS9132-16 Decoding Tables

CPU CLOCK

SCLK22 Pin 18	SCLK21 Pin 19	SCLK20 Pin 20	CPU (MHz) Pin 17
0	0	0	OFF
0	0	1	8.055
0	1	0	9.980
0	1	1	11.858
1	0	0	OFF
1	0	1	50.119
1	1	0	60.006
1	1	1	66.617

smooth
transitions

smooth
transitions

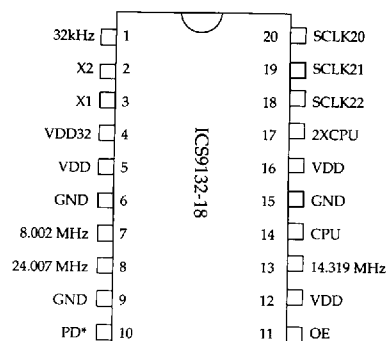
Pin Description for ICS9132-16 (5V operation. 3V available upon request)

Pin Name	Pin #	Pin type	Description
32kHz	1	Output	32.768 kHz output
X2	2	Output	Connect 32 kHz crystal
X1	3	Input	Connect 32 kHz crystal
VDD32	4	-	Power supply for 32 kHz oscillator only
VDD	5	-	Power supply (+5.0V)
GND	6	-	GROUND
40.095 MHz	7	Output	40.095 MHz SCUZZY clock output
24.006 MHz	8	Output	24.007 MHz clock output
12.003 MHz	9	Output	12.003 MHz keyboard clock output
GND	10	-	GROUND
PD*	11	Input	POWER DOWN. Forces all outputs low except 32 kHz
VDD	12	-	Power Supply (+5.0V)
14.319 MHz	13	Output	14.319 MHz clock output
20.048 MHz	14	Output	20.048 MHz clock output
GND	15	-	GROUND
VDD	16	-	Power Supply (+5.0V)
CPU	17	Output	CPU clock output (see decoding table)
SCLK22	18	Input	CPU clock frequency SELECT 2. Pull-up resistor connected
SCLK21	19	Input	CPU clock frequency SELECT 1. Pull-up resistor connected
SCLK20	20	Input	CPU clock frequency SELECT 0. Pull-up resistor connected



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Pin Configuration



ICS9132-18 Decoding Tables

CPU CLOCK

SCLK22 Pin 18	SCLK21 Pin 19	SCLK20 Pin 20	2x CPU (MHz) Pin 17	CPU (MHz) Pin 14
0	0	0	59.999	29.999
0	0	1	16.002	8.001
0	1	0	25.056	12.528
0	1	1	33.255	16.627
1	0	0	39.992	19.996
1	0	1	49.896	24.948
1	1	0	66.610	33.305
1	1	1	80.012	40.006

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Pin Description for ICS9132-18 (5V operation. 3V available upon request)

Pin Name	Pin #	Pin type	Description
32kHz	1	Output	32.768 kHz output
X2	2	Output	Connect 32 kHz crystal
X1	3	Input	Connect 32 kHz crystal
VDD32	4	-	Power supply for 32 kHz oscillator only
VDD	5	-	Power supply (+5.0V)
GND	6	-	GROUND
8.002 MHz	7	Output	8.002 MHz keyboard clock output
24.007 MHz	8	Output	24.007 MHz clock output
GND	9	-	GROUND
PD*	10	Input	POWER DOWN. All outputs go low except 32 kHz
OE	11	Input	OUTPUT ENABLE. A low tri-states clock outputs. Pull-up resistor connected
VDD	12	-	Power Supply (+5.0V)
14.319 MHz	13	Output	14.319 MHz clock output
CPU	14	Output	CPU clock output (see decoding table)
GND	15	-	GROUND
VDD	16	-	Power Supply (+5.0V)
2xCPU	17	Output	Double frequency CPU clock output
SCLK22	18	Input	CPU clock frequency SELECT 2. Pull-up resistor connected
SCLK21	19	Input	CPU clock frequency SELECT 1. Pull-up resistor connected
SCLK20	20	Input	CPU clock frequency SELECT 0. Pull-up resistor connected



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Absolute Maximum Ratings

V_{DD} referenced to GND.....7V
 Operating temperature under bias.....0°C to +70°C

Storage temperature.....-40°C to +150°C
 Voltage on I/O pins referenced to GND..... GND -0.5V to V_{DD} +0.5V
 Power dissipation.....0.5 Watts

Note: Stresses above those listed under Absolute Maximum ratings may cause permanent damage to the device. This is a stress rating only and functional operation of the devices at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum conditions for extended periods may affect devices reliability.

Electrical Characteristics

(V_{DD} = +3.0 to 3.7V, T_A = 0°C to 70°C unless otherwise stated)

Symbol	Parameter	Min	Typ	Max	Units	Conditions
DC Characteristics						
V _{IL}	Input Low Voltage	-	-	0.2V _{DD}	V	V _{DD} = 3.3V
V _{IH}	Input High Voltage	0.7V _{DD}	-	-	V	V _{DD} = 3.3V
I _{IL}	Input Low Current	-	-	-2*	μA	V _{IN} = 0V
I _{IH}	Input High Current	-	-	2*	μA	V _{IN} = V _{DD}
V _{OL}	Output Low Voltage	-	-	0.1	V	I _{OL} = 4mA
V _{OH}	Output High Voltage	V _{DD} - 1V	-	-	V	I _{OH} = -1mA, V _{DD} = 3.3V
V _{OH}	Output High Voltage	-	-	-	V	I _{OH} = -4mA, V _{DD} = 3.3V
V _{OH}	Output High Voltage	2.4	-	-	V	I _{OH} = -8mA
F _D	Output Frequency Change over Supply and Temperature	-	.005	0.05	%	1. With respect to typical frequency
I _{SC}	Short circuit current	-	15	-	mA	Each output clock
I _{CC}	Supply Current	-	10	-	mA	No load, 40 MHz
R _{PU}	Pull-up resistor value	-	620	-	kΩ	
AC Characteristics						
t _{ICr}	Input Clock Rise Time	-	-	5	μs	
t _{ICf}	Input Clock Fall Time	-	-	5	μs	
t _r	Output Rise time, 0.8 to 2.0V	-	1.5	2	ns	15 pf load
t _r	Rise time, 20% to 80% V _{DD}	-	2.5	4	ns	15 pf load
t _f	Output Fall time, 2.0 to 0.8V	-	1.5	2	ns	15 pf load
t _f	Fall time, 80% to 20% V _{DD}	-	2.5	4	ns	15 pf load
d _i	Duty cycle	43/57	48/52	57/43	%	15 pf load
d _i	Duty cycle, reference clocks	40/60	43/57	60/40	%	15 pf load (Note 1)
j _{1s}	Jitter, one sigma	-	1	3	%	As compared with clock period
j _{ab}	Jitter, absolute	-	2	5	%	
f _i	Input Frequency	25	32.768	40	kHz	
T _{sk}	Clock skew between any Clock #2 outputs	-	100	500	ps	
t _{pu}	Power up time	-	10	-	ms	From off to 40 MHz

Note 1: 32 kHz output duty cycle is dependent on crystal used.



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Electrical Characteristics

($V_{DD} = +5V \pm 10\%$, $T_A = 0^\circ C$ to $70^\circ C$ unless otherwise stated)

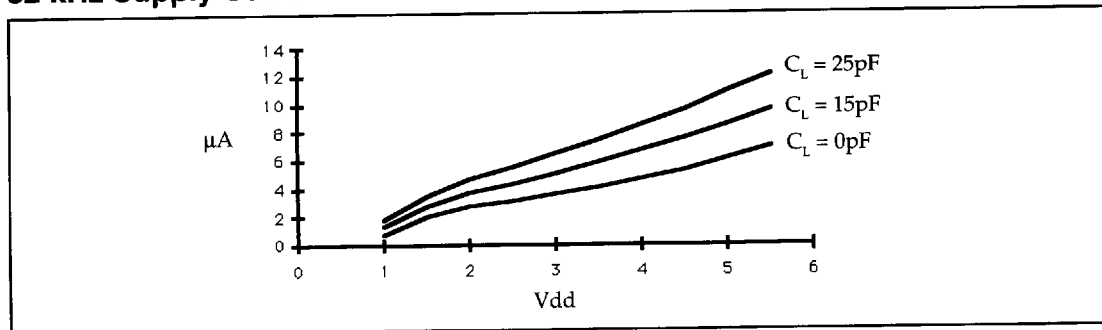
Symbol	Parameter	Min	Typ	Max	Units	Conditions
DC Characteristics						
V_{IL}	Input Low Voltage	-	-	$0.2V_{DD}$	V	$V_{DD} = 3.3V$
V_{IH}	Input High Voltage	$0.7V_{DD}$	-	-	V	$V_{DD} = 3.3V$
I_{IL}	Input Low Current	-	-	-2*	μA	$V_{IN} = 0V$
I_{IH}	Input High Current	-	-	2*	μA	$V_{IN} = V_{DD}$
V_{OL}	Output Low Voltage	-	-	0.1	V	$I_{OL} = 4mA$
V_{OH}	Output High Voltage	$V_{DD} - 1V$	-	-	V	$I_{OH} = -1mA, V_{DD} = 3.3V$
V_{OH}	Output High Voltage	-	-	-	V	$I_{OH} = -4mA, V_{DD} = 3.3V$
V_{OH}	Output High Voltage	2.4	-	-	V	$I_{OH} = -8mA$
F_D	Output Frequency Change over Supply and Temperature	-	.005	0.05	%	With respect to typical frequency
I_{SC}	Short circuit current	-	33	-	mA	Each output clock
I_{CC}	Supply Current	-	17	-	mA	No load, 40 MHz
R_{PU}	Pull-up resistor value	-	380	-	k Ω	
AC Characteristics						
t_{ICr}	Input Clock Rise Time	-	-	5	μs	
t_{ICf}	Input Clock Fall Time	-	-	5	μs	
t_r	Output Rise time, 0.8 to 2.0V	-	1	1.5	ns	25 pf load
t_r	Rise time, 20% to 80% V_{DD}	-	2	3	ns	25 pf load
t_f	Output Fall time, 2.0 to 0.8V	-	1	1.5	ns	25 pf load
t_f	Fall time, 80% to 20% V_{DD}	-	2	3	ns	25 pf load
d_t	Duty cycle	43/57	48/52	57/43	%	25 pf load
d_t	Duty cycle, reference clocks	40/60	43/57	60/40	%	25 pf load (Note 1)
t_{jls}	Jitter, one sigma	-	1	3	%	As compared with clock period
t_{jab}	Jitter, absolute	-	2	5	%	
f_i	Input Frequency	25	32.768	40	kHz	
T_{sk}	Clock skew between any Clock #2 outputs	-	100	500	ps	
t_{pu}	Power up time	-	5	-	ms	From off to 80 MHz

Note 1: 32 kHz output duty cycle is dependent on crystal used.



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32 kHz Supply Current



Ordering Information

Part Number	Temperature Range	Package Type
ICS9132-xxCN20 ICS9132-xxCW20	0°C to +70°C 0°C to +70°C	20 lead Plastic DIP 20 lead SOIC

-xx	Application	Features
-01 -03	Notebook Desktop	Contains power down Tri-state outputs, 2xCPU