Integrated Circuit Systems, Inc.

ICS9133

Advance Information

32 kHz Motherboard Frequency Generator

Features

- Single 32.768 kHz crystal generates all PC motherboard clocks
- Cost-reduced version of popular ICS9132
- 3 independent clock generators
- Generates CPU clocks from 12.5 to 100 MHz
- Up to 7 output clocks
- Separate VDD for 32 kHz clock
- Output enable tri-states outputs
- Power down options available
- Operates from 3.3V or 5.0V supply
- Operates up to 66 MHz at 3.3V
- Skew controlled 2x and 1x CPU clocks
- 20 pin PDIP or SOIC package

General Description

The ICS9133 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 three 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 and #3 can be selected using the frequency select pins, but clock #1 will be at 14.318 MHz for all standard versions.

VDD32 Supply

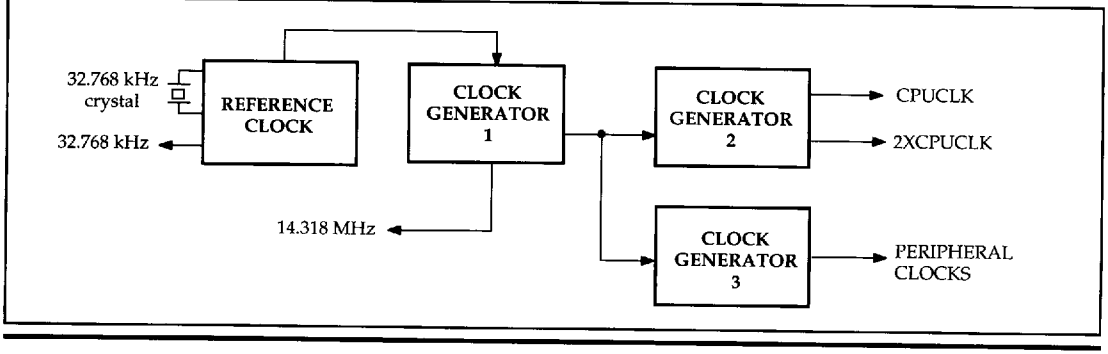
The ICS9133 has a separate power supply for the 32.768 kHz oscillator circuitry. This allows the 32 kHz clock to run from a battery or other source while the main power to the chip is disconnected. The VDD32 supply is guaranteed to operate down to +2.0V, with the clock consuming less than 10µA at +3.3V with the main VDD at 0V.

The frequencies and power down options in the ICS9133 are mask programmable. Customer specific masks can be made and prototypes delivered within 6 - 8 weeks from receipt of order. Integrated Circuit Systems also offers standard versions, such as that described in this data sheet.

Applications

Notebook / Palmtop Computers: The ICS9133 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 ICS9133 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.

Block Diagram



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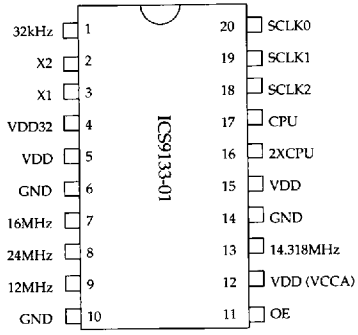
Pin Configuration



Decoding Table for CPU Clock

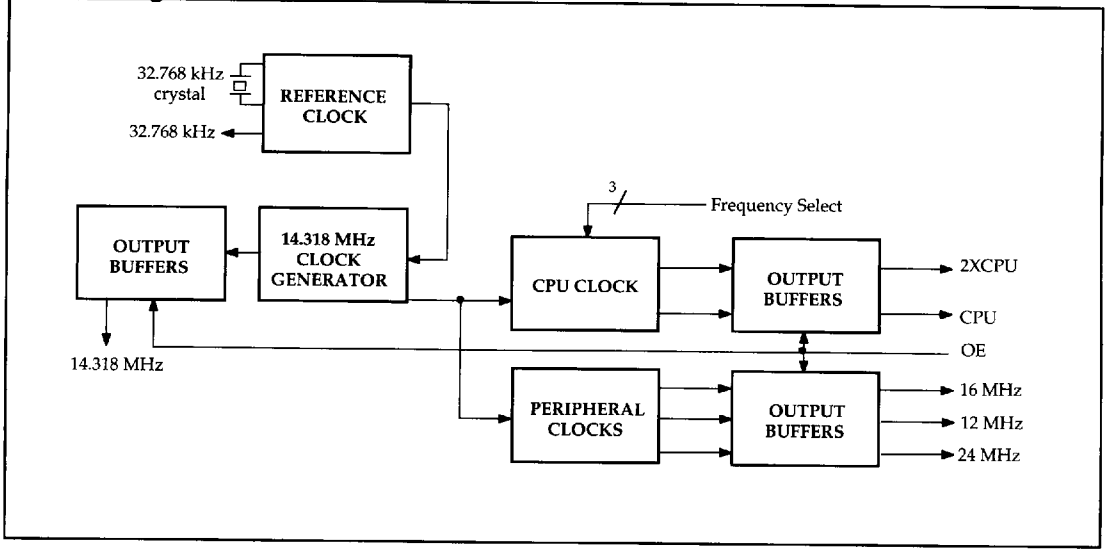
SCLK22	SCLK21	SCLK20	2XCPU	CPU
0	0	0	8	4
0	0	1	16	8
0	1	0	32	16
0	1	1	40	20
1	0	0	50	25
1	0	1	66.6	33.3
1	1	0	80*	40*
1	1	1	100*	50*

* Only at 5V supply voltage

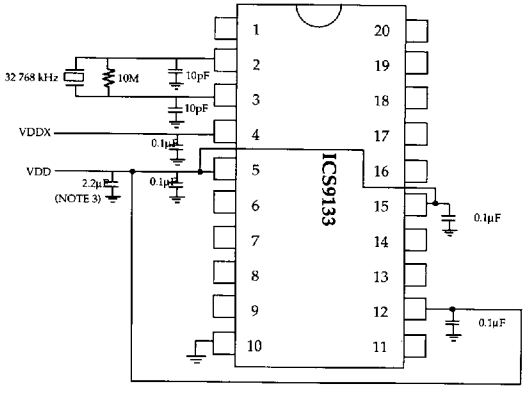
Pin Description for ICS9133

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
16MHz	7	Output	16 MHz clock output
24MHz	8	Output	24 MHz clock output
12MHz	9	Output	12 MHz clock output
GND	10	-	GROUND
OE	11	Input	OE tristate outputs when low
VDD	12	-	Power Supply (+3.3 to +5.0V)
14.318MHz	13	Output	14.318 MHz clock output
GND	14	-	GROUND
VDD	15	-	Power Supply (+3.3 to +5.0V)
2XCPU	16	Output	2XCPU clock output (see decoding table)
CPU	17	Output	CPU clock output (see decoding table)
SCLK2	18	Input	CPU clock frequency SELECT 2
SCLK1	19	Input	CPU clock frequency SELECT 1
SCLK0	20	Input	CPU clock frequency SELECT 0

Block Diagram for ICS9133-01



Recommended External Circuit



NOTES:
(1) The external components shown should be placed as close to the device as possible.
(2) Pins 5 and 15 should be connected together externally.
One decoupling capacitor may suffice for both pins.
(3) May be part of system decoupling.

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ABSOLUTE MAXIMUM RATINGS

VDD 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 VDD +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	1I_{OH} = -8mA
F_D	Output Frequency Change over Supply and Temperature	-	.005	0.05	%	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_t	Duty cycle	43/57	48/52	57/43	%	15 pf load
d_t	Duty cycle, reference clocks	40/60	43/57	60/40	%	15 pf load (Note 1)
t_{jls}	Jitter, one sigma		1	3	%	As compared with
t_{jab}	Jitter, absolute		2	5	%	clock period
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.

Electrical Characteristics

(V_{DD} = +5V± 10%, 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		33		mA	Each output clock
I_{CC}	Supply Current		17		mA	No load, 40 MHz
R_{PU}	Pull-up resistor value		380		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	1.5	ns	15 pf load
t_r	Rise time, 20% to 80% V_{DD}	-	2	3	ns	15 pf load
t_f	Output Fall time, 2.0 to 0.8V	-	1	1.5	ns	15 pf load
t_f	Fall time, 80% to 20% V_{DD}	-	2	3	ns	15 pf load
d_t	Duty cycle	43/57	48/52	57/43	%	15 pf load
d_t	Duty cycle, reference clocks	40/60	43/57	60/40	%	15 pf load (Note 1)
t_{jis}	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		10		ms	From off to 80 MHz

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

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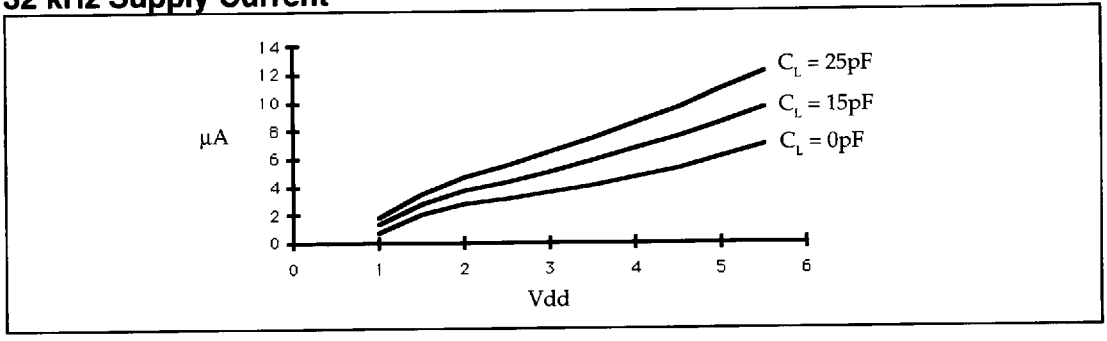
32 kHz Supply Current



Ordering Information

Part Number	Temperature Range	Package Type
ICS9133-01CN20	0°C to +70°C	20 lead Plastic DIP
ICS9133-01CW20	0°C to +70°C	20 lead SOIC