Integrated Circuit Systems, Inc.

ICS9131

32 KhZ Motherboard Frequency Generator

General Description

The **ICS9131** offers a tiny footprint solution for generating a selectable CPU clock from a 32.768 kHz crystal. The device allows a variety of microprocessors to be clocked by changing the state of address lines FS0, FS1, and FS2. The **ICS9131** is the ideal solution for replacing high speed oscillators and for reducing clock speeds to save power in computers. The device provides smooth, glitch-free frequency transitions so that the CPU can continue to operate during slow down or speed up. The rate of frequency change makes the **ICS9131** compatible with all 386DX, 386SX, 486DX, 486DXZ, 486SX and Pentium™ microprocessors.

The **ICS9131** is driven from a single 32.768 kHz crystal. The only external components required are the crystal and a 10M ohm resistor. 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.

VDD32 Supply

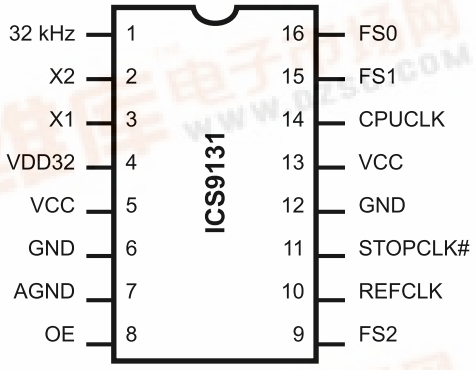
The **ICS9131** has a separate power supply for the 32.768 kHz oscillator circuitry. This allows the 32 kHz clock to run from a battery or other source while the main power to the chip is disconnected. The VDD32 supply is guaranteed to operate down to +2.0V, with the clock consuming less than 10µA at +3.3V and the main VDD at 0V.

The frequencies and power-down options in the **ICS9131** are mask programmable. Customer specific masks can be made and prototypes delivered within 6-8 weeks from receipt of order. ICS also offers standard versions, such as those described in this data sheet.

Features

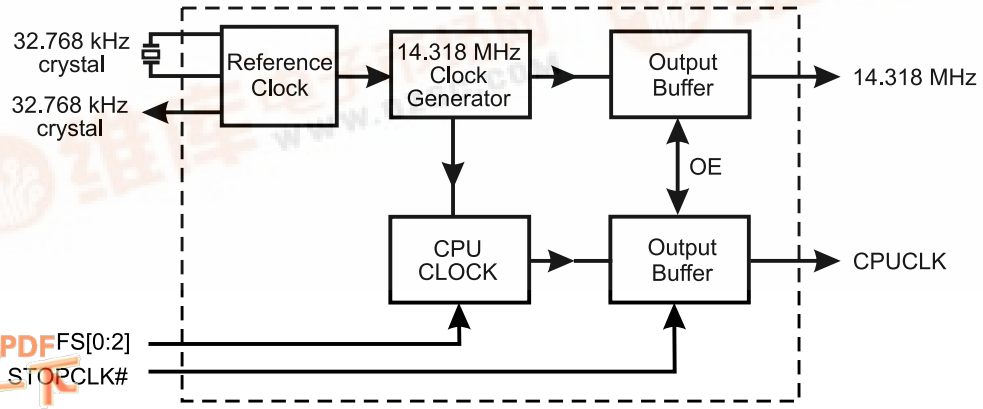
- Single 32.768 kHz crystal generates system clock and selectable CPU clock
- Generates CPU clocks from 8 MHz to 100 MHz.
- Operates from 3.3V or 5.0V supply
- Operates up to 66 MHz at 3.3V
- Separate VDD for 32 kHz clock enables it to run from battery
- STOPCLK feature allows for a glitch-free turn-on and Pen-turn-off of the CPU clock to static processors
- Output enable tristates outputs
- 16-pin PDIP or SOIC package
- Frequency selects allow for a smooth transition of the CPUCLK

Pin Configuration



16-Pin DIP or SOIC

Block Diagram



Pentium is a trademark of Intel.

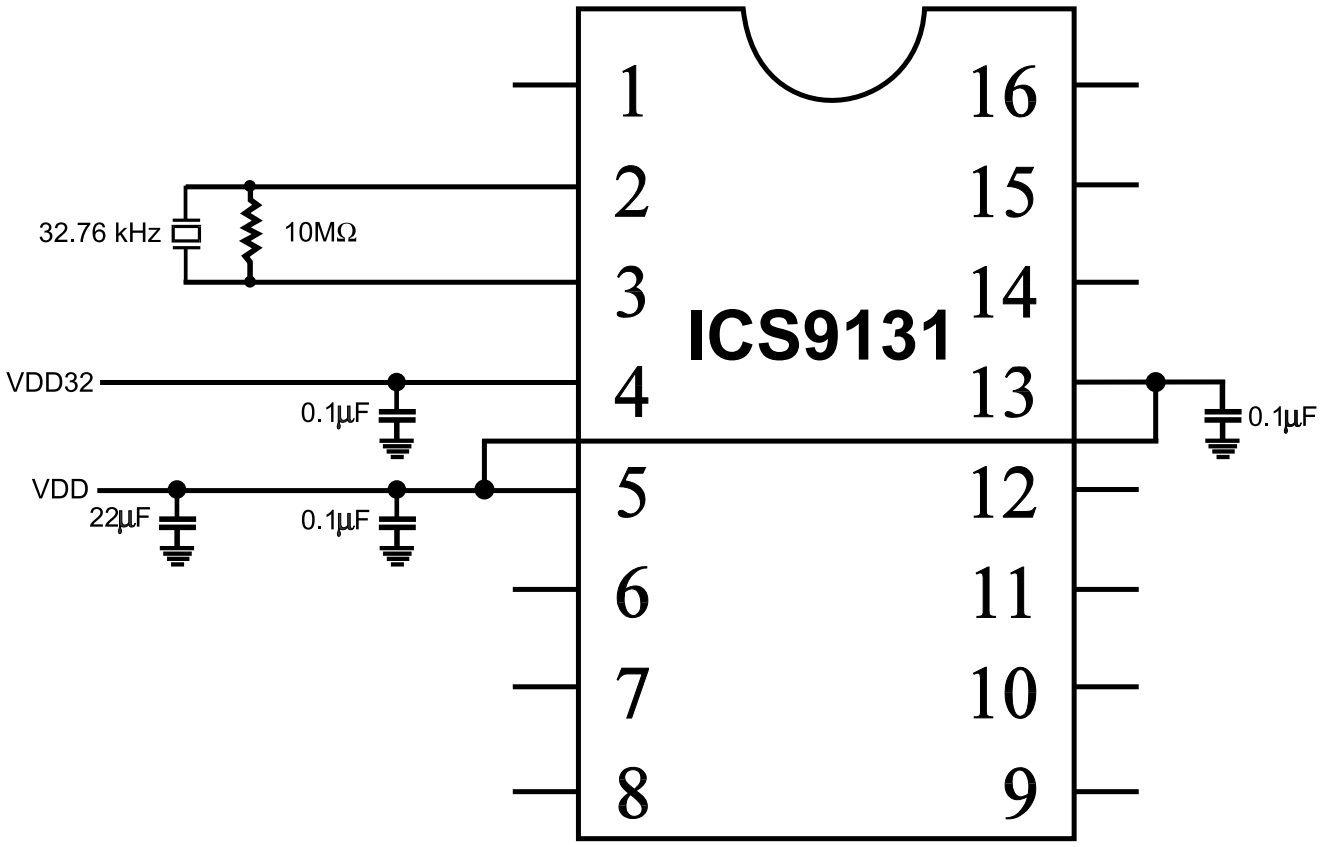
Pin Descriptions

PIN NUMBER	PIN NAME	TYPE	DESCRIPTION
1	32 kHz	Output	32.768 kHz output.
2	X2	Output	Connect 32 kHz crystal, this input includes internal load capacitor for crystal.
3	X1	Input	Connect 32 kHz crystal, this input includes internal load capacitor for crystal.
4	VDD32	--	Power Supply for 32 kHz oscillator.
5	VCC	--	Power Supply.
6	VSS	--	Ground.
7	AGND	--	Analog Ground.
8	OE	Input	OE tristates outputs when low.
9	FS2	Input	CPU clock frequency select 2.
10	REFCLK	Output	14.318 MHz output.
11	STOPCLK#	Input	Stops CPU clock when low.
12	VSS	--	Ground.
13	VCC	--	Power supply.
14	CPUCLK	Output	CPU clock output (see Decoding table).
15	FS1	Input	CPU clock frequency select 1.
16	FS0	Input	CPU clock frequency select 0.

Functionality

FS2	FS1	FS0	CPUCLK	ACTUALS
0	0	0	16	16.004
0	0	1	25	25.059
0	1	0	33.3	33.412
0	1	1	40	40.095
1	0	0	50	50.119
1	0	1	60	60.142
1	1	0	66.6	66.484
1	1	1	80	80.190

Recommended External Circuit



Notes:
1) The external components shown should be placed as close to the device as possible.
2) Pins 5 and 13 should be connected together externally. One decoupling capacitor may suffice for both pins.

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

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 device at these or any other conditions above those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect product reliability.

Electrical Characteristics at 5V

Operating V_{DD} = +4.5V to +5.5V; T_A =0°C to 70°C unless otherwise stated

DC Characteristics						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Input Low Voltage	V_{IL}		-	-	0.8	V
Input High Voltage	V_{IH}		2.0	-	-	V
Input Low Current	I_{IL}	V_{IN}=0V	-15.0	-6.0		µA
Input High Current	I_{IH}	V_{IN}=V_{DD}	-2.0	-	2.0	µA
Pull-up Resistor, Note 1	R_{pu}	V_{IN}=V_{DD}-1V	-	400	700	k ohms
Output Low Current, Note 1	I_{OL}	V_{OUT}=0. 8V	25	45	-	mA
Output High Current, Note 1	I_{OH}	V_{OUT}=2.0V	-	-53	-35	mA
Output Low Voltage	V_{OL}	I_{OL}=10mA	-	0.15	0.4	V
Output High Voltage, Note 1	V_{OH}	I_{OH}=-30mA	2.4	3.7	-	V
Supply Current	I_{DD}	No load, at 50 MHz	-	18	35	mA
Output Frequency Change over Supply and Temperature, Note 1	F_d	With respect to typical frequency	-	0.002	0.05	%
Standby Supply Current, Note 2	$I_{DDSTDBY}$	Unloaded	-	12	25	mA

Note 1: Parameter is guaranteed by design and characterization. Not 100% tested in production.
Note 2: With the STOPCLK pin low (active).
Note 3: Absolute Jitter measured as the shortest and longest period difference to the mean period of the sample set.

Electrical Characteristics at 5V

Operating V_{DD} = +4.5V to +5.5V; T_A =0°C to 70°C unless otherwise stated

AC Characteristics						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Output Frequency, Note 1	f_o	Clock1	12.0	-	100	MHz
Input Frequency, Note 1	f_i		2.0	32	38	kHz
Output Rise time, Note 1	t_r	15pF load, 0.8 to 2.0V	-	0.60	1.4	ns
Rise time, Note 1	t_r	15pF load, 20% to 80% V_{DD}	-	1.6	3.0	ns
Output Fall time, Note 1	t_f	15pF load, 2.0 to 0.8V	-	0.50	1.2	ns
Fall time, Note 1	t_f	15pF load, 80% to 20% V_{DD}	-	0.9	2.5	ns
Duty cycle, Note 1	d_t	15pF load @1.4V	45	50	55	%
Jitter, 1 sigma from 33-80 MHz, Note 1	T_{jis}	10,000 samples	-	50	150	ps
Jitter, Absolute from 33-80 MHz, Notes 1, 3	T_{jabs}	10,000 samples	-250	-	250	ps
Jitter, 1 sigma from 16-25 MHz, Note 1	T_{jis}	10,000 samples		60	150	ps
Jitter, Absolute from 16-25 MHz, Note 1, 3	T_{jabs}	10,000 samples	-600	-	600	ps
Jitter, 1 sigma from 14 to below, Note 1	T_{jis}	10,000 samples	-	1	3	%
Jitter, Absolute from 14 to below, Note 1, 3	T_{jabs}	10,000 samples	-	2	5	%
Frequency Transition time, Note 1	t_{ft}		2.0	5.0	10.0	ms
Power-up time, Note 1	t_{pu}		3.0	7.5	15	ms

Note 1: Parameter is guaranteed by design and characterization. Not 100% tested in production.
Note 2: With the STOPCLK pin low (active).
Note 3: Absolute Jitter measured as the shortest and longest period difference to the mean period of the sample set.

Electrical Characteristics at 3.3V

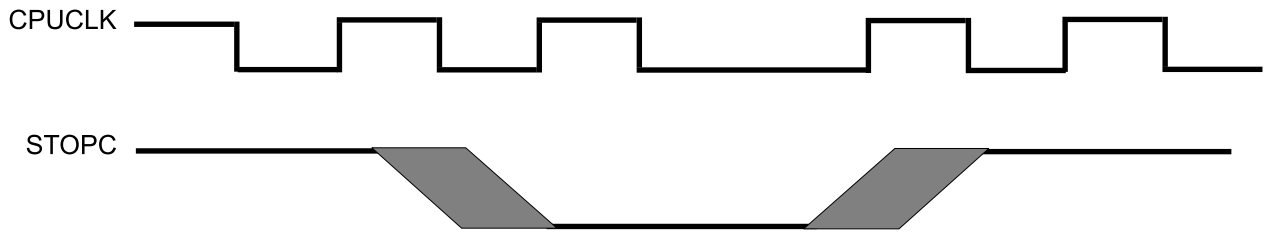
Operating V_{DD} = +3.3V to +3.7V; T_A =0°C to 70°C unless otherwise stated

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNITS
DC Characteristics						
Input Low Voltage	V_{IL}		-	-	0.2 V_{DD}	V
Input High Voltage	V_{IH}		0.7 V_{DD}	-	-	V
Input Low Current	I_{IL}	V_{IN}=0V	-7.0	-2.5		µA
Input High Current	I_{IH}	V_{IN}=V_{DD}	-2.0	-	2.0	µA
Pull-up Resistor, Note 1	R_{pu}	V_{IN}=V_{DD}-1V	-	600	900	k ohms
Output Low Current, Note 1	I_{OL}	V_{OUT}=0.2V	15	24	-	mA
Output High Current, Note 1	I_{OH}	V_{OUT}=0.7V	-	-13	-8	mA
Output Low Voltage, Note 1	V_{OL}	I_{OL}=60mA	-	0.05 V_{DD}	0.1 V_{DD}	V
Output High Voltage, Note 1	V_{OH}	I_{OH}=-4.0mA	6.85 V_{DD}	0.94 V_{DD}	-	V
Supply Current	I_{DD}	No load, at 50 MHz	-	13	25	mA
Output Frequency Change over Supply and Temperature, Note 1	F_d	With respect to typical frequency	-	0.002	0.05	%
Standby Supply Current, Note 2	$I_{DDSTDBY}$	No load	-	8	15	mA
AC Characteristics						
Output Frequency, Note 1	f_o	Clock1	12.0	-	100	MHz
Input Frequency, Note 1	f_i		2.0	32	38	kHz
Rise time, Note 1	t_r	15pF load, 20% to 80% V_{DD}	-	2.2	3.5	ns
Fall time, Note 1	t_f	15pF load, 80% to 20% V_{DD}	-	1.2	2.5	ns
Duty cycle, Note 1	d_t	15pF load @50% V_{DD}	43	-	53	%
Jitter, 1 sigma , Note 1	T_{jis}	10,000 samples	-	50	150	ps
Jitter, Absolute, Note 1, 3	T_{jabs}	10,000 samples	-250		250	ps
Jitter, 1 sigma from 16-25 MHz	T_{jis}	10,000 samples	-	60	150	ps
Jitter, Absolute from 16-25 MHz	T_{jabs}	10,000 samples	-600	-	600	ps
Jitter, 1 sigma from 14 to below	T_{jis}	10,000 samples	-	1	3	%
Jitter, Absolute from 14 to below	T_{jabs}	10,000 samples	-	2	5	%
Frequency Transition time, Note 1	t_{ft}			6.7	14.0	ms
Power-up time, Note 1	t_{pu}		-	8.55	17.0	ms

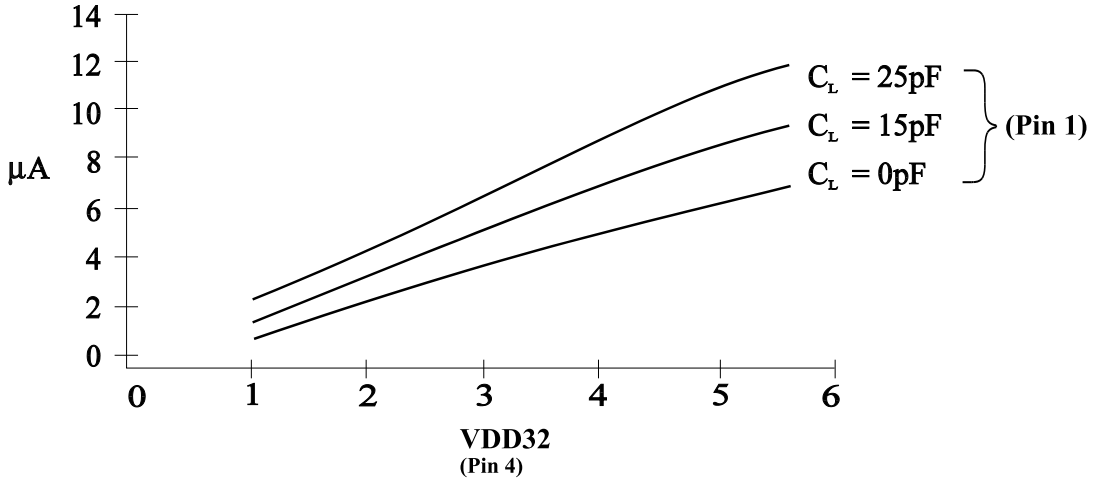
Note 1: Parameter is guaranteed by design and characterization. Not 100% tested in production.
Note 2: With the STOPCLK pin low (active).
Note 3: Absolute Jitter measured as the shortest and longest period difference to the mean period of the sample set.

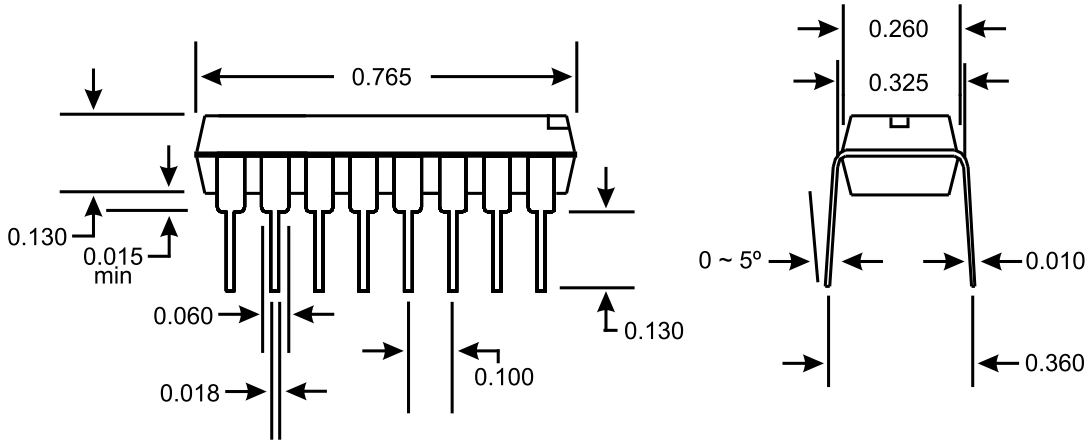
Stop Clock Feature

The **ICS9131** incorporates a unique stop clock feature compat-ible with static logic processors. When the stop clock pin goes low, the CPUCLK will go low after the next occuring falling edge. When STOPCLK again goes high, CPUCLK resumes on the next rising edge of the internal clock. This feature enables fast, glitch-free starts and stops of the CPUCLK and is useful in Energy Star motherboard applications.

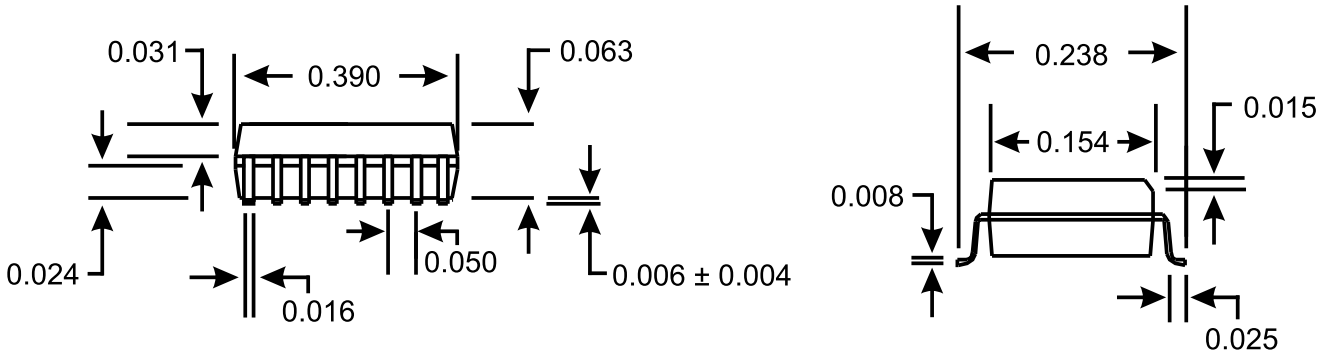


32 kHz Supply Current





16-Pin DIP Package



16-Pin SOIC Package

Ordering Information

ICS9131-01CN16 or ICS9131-01CS16

Example:

ICS XXXX M X#W

Lead Count & Package Width
Lead Count=1, 2 or 3 digits
W=.3" SOIC or .6" DIP; None=Standard Width

Package Type
N=DIP (Plastic)
S=SOIC

Device Type (consists of 3 or 4 digit numbers)

Prefix
ICS, AV=Standard Device