Integrated Circuit Systems, Inc.

ICS9158

Advance Information

Integrated Buffer and Motherboard Frequency Generator

Features

- Eight skew free, high drive CPU clock outputs
- Up to 100 MHz output at 5V, 66 MHz at 3.3V
- ± 250psec skew between CPU outputs
- Outputs can drive up to 30pF load
- 25mA output drivers
- Typical 50/50 duty cycle
- Compatible with 486 and Pentium CPUs
- Glitch-free start and stop clock feature
- Optional power-down mode supports Energy Star ("green") PCs
- On chip loop filter components
- Low power, high speed 0.8 µ CMOS technology
- 24 pin PDIP or SOIC package

General Description

The ICS9158 is a low cost frequency generator designed specifically for desktop and notebook PC applications. Eight high drive, skew controlled copies of the CPU clock are available, eliminating the need for an external buffer.

Each high drive (25 mA) output is capable of driving a 30pF load and has a typical duty cycle of 50/50. The CPU clock ouputs are skew controlled to within ±250psec.

The CPU clocks provide all necessary frequencies for 286, 386, 486, and Pentium systems, including support for the latest speeds of processors.

The CPU clock offers the unique feature of smooth, glitch-free transitions from one frequency to the next, making this the ideal device to use whenever slowing the CPU speed. The ICS9158 makes a gradual transition between frequencies, so that it meets the Intel cycle to cycle timing specification for 486 systems.

ICS has been shipping Motherboard Frequency Generators since April 1990, and is the leader in the area of multiple output clocks on a single chip. The ICS9158 is a third generation device, and uses ICS' patented analog CMOS Phase Locked Loop technology for low phase jitter. ICS offers a broad family of frequency generators for motherboards, graphics and other applications, including cost effective versions with only one or two output clocks. Consult ICS for all of your clock generation needs.

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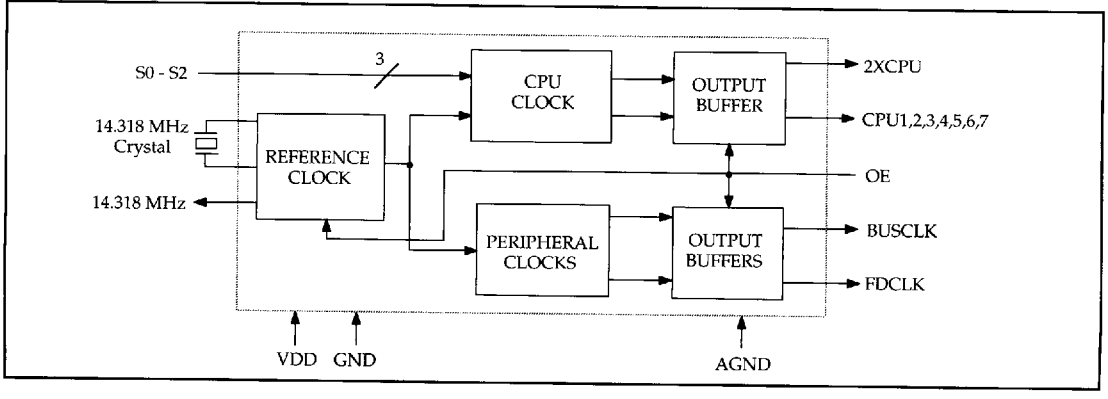
Clock Table (in MHz)

Clock	AV9158-01
BUSCLK	16
FDCLK	24
14.318	14.318
CPUCLK	4,8,30,20,25,33.3,40, or 50
2XCPUCLK	8,16,60,40,50,66.6,80, or 100

Block Diagram



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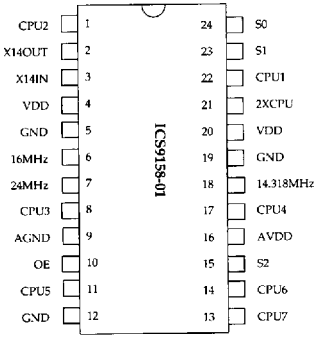
Pin Configuration



ICS9158-01 Pin Description

Pin Name	Pin #	Pin Type	Description
CPU2	1	Output	CPU clock output
X14OUT	2	-	Crystal connection
X14IN	3	-	Crystal connection
VDD	4	-	Digital POWER SUPPLY (+5V)
GND	5	-	Digital GROUND
16MHz	6	Output	16 MHz clock output
24MHz	7	Output	24 MHz floppy disk/combination I/O clock output
CPU3	8	Output	CPU clock output
AGND	9	-	ANALOG GROUND
OE	10	Input	OUTPUT ENABLE. Tri-states all outputs when low
CPU5	11	Output	CPU clock output
GND	12	-	Digital GROUND
CPU7	13	Output	CPU clock output
CPU6	14	Output	CPU clock output
S2	15	Input	CPU clock frequency select 2
AVDD	16	-	ANALOG power supply (+5V)
CPU4	17	Output	CPU clock output
14.318MHz	18	Output	14.318 MHz clock output
GND	19	-	Digital GROUND
VDD	20	-	Digital POWER SUPPLY (+5V)
2XCPU	21	Output	2X CPU clock output
CPU1	22	Output	CPU clock output
S1	23	Input	CPU clock frequency select #1
S0	24	Input	CPU clock frequency select #0

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Absolute Maximum Ratings

AVDD, 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} = +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			0.8	V	V_{DD} = 5V
V_{IH}	Input High Voltage	2.0			V	V_{DD} = 5V
I_{IL}	Input Low Current			-40	µA	V_{IN} = 0V
I_{IH}	Input High Current			+40	µA	V_{IN} = V_{DD}
V_{OL}	Output Low Voltage			0.4	V	I_{OL} = 4mA
V_{OH}	Output High Voltage	V_{DD}-.4V			V	I_{OH} = -1mA,V_{DD}=5.0V
V_{OH}	Output High Voltage	V_{DD}-.8V			V	I_{OH} = -4mA,V_{DD}=5.0V
V_{OH}	Output High Voltage	2.4			V	I_{OH} = -8mA
I_{CC}	Supply Current		70		mA	[1]No load
F_D	Output Frequency Change over Supply and Temperature		0.002	0.01	%	With respect to typical frequency
I_{SC}	Short circuit current	25	56		mA	Each output clock
R_{PU}	Pull-up resistor value		680		kΩ	Input pin
C_i	Input Capacitance			8	pF	Except X1, X2
C_L	Load Capacitance		30		pF	Pins X1, X2
AC Characteristics						
t_r	Output Rise time, 0.8 to 2.0V	-	1	2	ns	30 pf load
t_r	Rise time, 20% to 80% V_{DD}	-	2.5	3	ns	30 pf load
t_f	Output Fall time, 2.0 to 0.8V	-	0.5	1	ns	30 pf load
t_f	Fall time, 80% to 20% V_{DD}	-	1.5	2	ns	30 pf load
d_t	Duty cycle	40/60	48/52	60/40	%	30 pf load
d_t	Duty cycle, reference clocks	40/60	43/57	60/40	%	30 pf load
t_{jls}	Jitter, one sigma		0.5	2.0	%	As compared with
t_{jab}	Jitter, absolute		2	5	%	clock period
t_{jab}	Jitter, absolute			500	ps	16-100 MHz clocks
f_i	Input Frequency		14.318		MHz	
T_{sk}	Clock skew between CPU and 2XCPU outputs		100	250	ps	
t_{ft}	Frequency Transition time		13	20	ms	From 3.79 to 50.1 MHz

Notes:
1. All clocks on ICS9158 running at highest possible frequencies. Power supply current can change substantially with different mask configurations. Consult ICS.

ICS9158-01 CPU Clock Decoding Table (using 14.318 MHz input. All frequencies in MHz)

CLOCK#2 CPU and 2XCPU

S2 (Pin 15)	S1 (Pin 23)	S0 (Pin 24)	2XCPU (Pin 21)	CPU
0	0	0	7.580	3.790
0	0	1	15.511	7.756
0	1	0	59.875	29.938
0	1	1	40.090	20.045
1	0	0	50.113	25.057
1	0	1	66.476	33.238
1	1	0	79.772	39.886
1	1	1	100.226	50.113

PERIPHERAL CLOCKS

BUSCLK (Pin 6)	FDCLK (Pin 7)
16.002	24.003

REFERENCE CLOCK

REFCLK1 (Pin 18)
14.318

Frequency Transitions

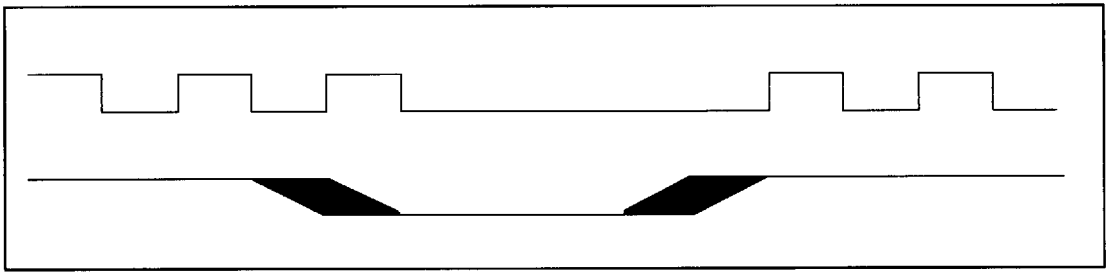
A key feature of the ICS9158 is its ability to provide smooth, glitch-free frequency transitions on the CPU and 2XCPU clocks when the frequency select pins are changed. The frequency transition rate does not violate the Intel 486 specification of less than 0.1% frequency change per clock period.

Using an Input Clock as a Reference

The ICS9158 is designed to accept a 14.318 MHz crystal as the input reference. With some external changes, it is possible to use a crystal oscillator or other clock sources. Please see application note AAN04 for details on driving the ICS9158 with a clock.

Stop Clock Feature

The ICS9158 incorporates a unique stop clock feature compatible 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.



Ordering Information

Part Number	Temperature Range	Package Type
ICS9158-xxCN24	0°C to +70°C	24 lead Plastic DIP
ICS9158-xxCW24	0°C to +70°C	24 lead Plastic SOIC