Integrated Circuit Systems, Inc.

ICS9133X

32 kHz Motherboard Frequency Generator

General Description

The **ICS9133X** 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 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 clock #2 can be selected using the frequency select pins, but clock #1 will be at 14.318 MHz for all standard versions.

VDD32 Supply

The **ICS9133X** 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 **ICS9133X** 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.
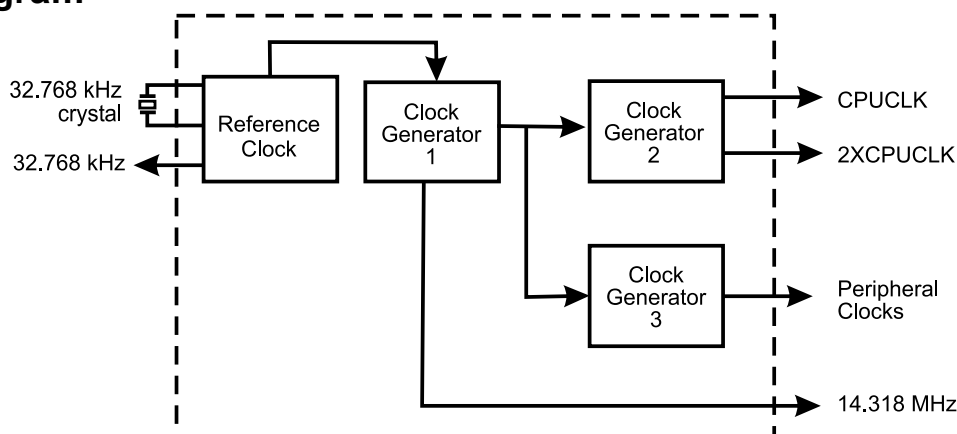
Features

- Single 32.768 kHz crystal generates all PC motherboard clocks
- Cost-reduced version of popular ICS9132
- Contains internal crystal load capacitors and feedback bias
- 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 tristates outputs
- Power-down options available
- Operates from 3.3V or 5.0V supply
- Operates up to 66 MHz at 3.3V
- Skew controlled 1X and 2X CPU clocks
- 20-pin PDIP or SOIC package

Applications

Notebook/Palmtop Computers: The **ICS9133X** 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 **ICS9133X** 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.
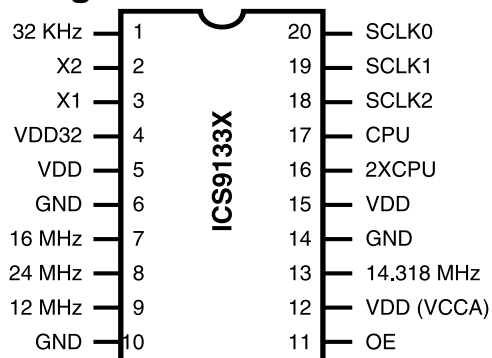
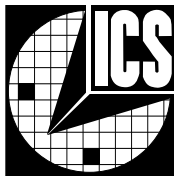## Block Diagram

ICS9133X

Pin Configuration

32 KHz	1		20	SCLK0
X2	2		19	SCLK1
X1	3		18	SCLK2
VDD32	4	ICS9133X	17	CPU
VDD	5		16	2XCPU
GND	6		15	VDD
16 MHz	7		14	GND
24 MHz	8		13	14.318 MHz
12 MHz	9		12	VDD (VCCA)
GND	10		11	OE

20-Pin PDIP or SOIC

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 Descriptions

| PIN NUMBER	PIN NAME	TYPE	DESCRIPTION
1	32 kHz	Output	32.768 kHz buffered output, powered by VDD32.
2	X2	Output	Connect 32.768 kHz crystal. Includes internal XTAL load capacitance.
3	X1	Input	Connect 32.768 kHz crystal. This pin includes internal XTAL load capacitance and feedback bias for a 32.768 kHz crystal.
4	VDD32	-	Power supply for 32 kHz oscillator only.
5	VDD	-	Power supply (+3.3 to +5.0V).
6	GND	-	GROUND.
7	16 MHz	Output	16 MHz clock output.
8	24 MHz	Output	24 MHz clock output.
9	12 MHz	Output	12 MHz clock output.
10	GND	-	GROUND.
11	OE	Input	OE tristate outputs when low. Has internal pull-up.
12	VDD	-	Power supply (+3.3 to +5.0V).
13	14.318 MHz	Output	14.318 MHz clock output.
14	GND	-	GROUND.
15	VDD	-	Power supply (+3.3 to +5.0V).
16	2XCPU	Output	2XCPU clock output (see decoding table).
17	CPU	Output	CPU clock output (see decoding table).
18	SCLK2	Input	CPU clock frequency SELECT2. Has internal pull-up.
19	SCLK1	Input	CPU clock frequency SELECT1. Has internal pull-up.
20	SCLK0	Input	CPU clock frequency SELECT0. Has internal pull-up.

Block Diagram for ICS9133X
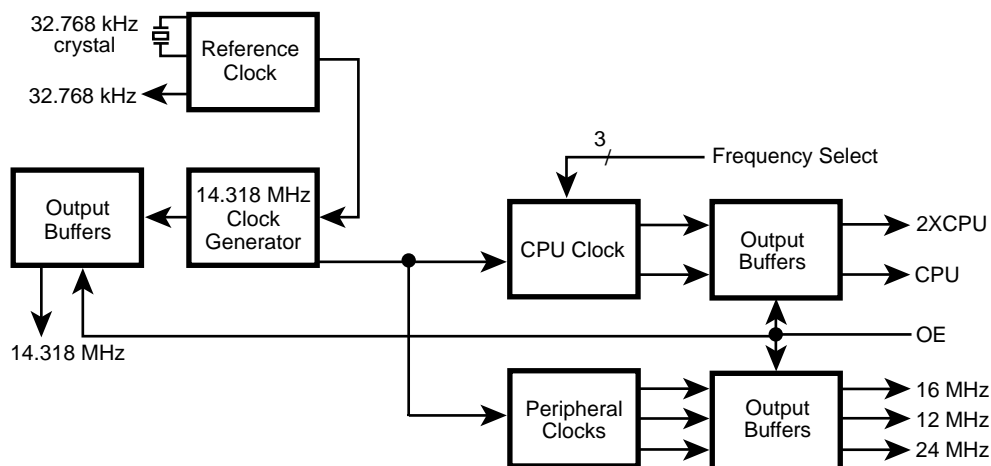
Recommended External Circuit
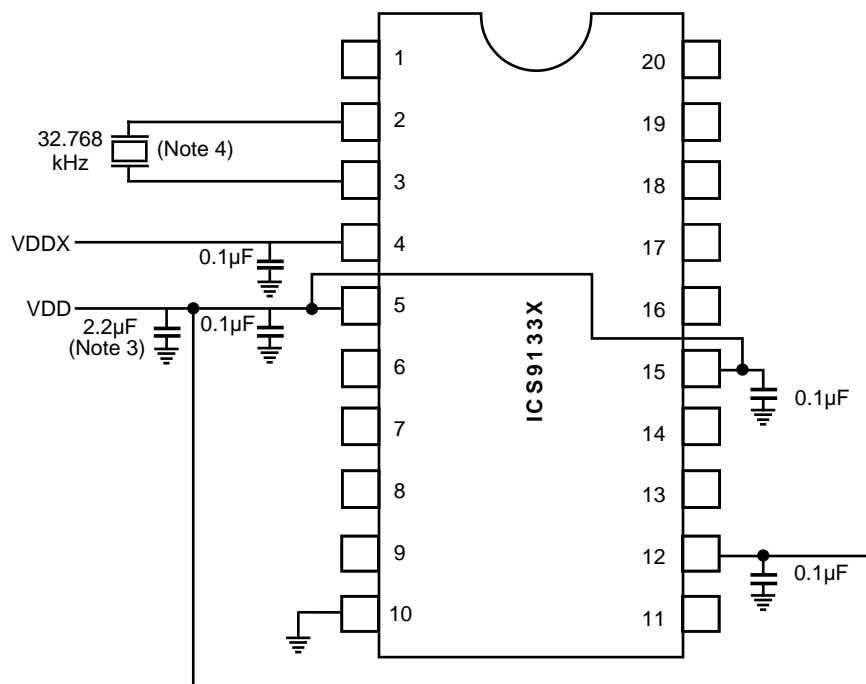
Notes:
1. The external components shown should be placed as close to the device as possible.
2. Pins 5 and 15 should be connected together externally. One decoupling capacitor may suffice for both pins.
3. May be part of system decoupling.
4. Crystal load capacitance and feedback bias contained internally on the X1, X2 pins.

ICS9133X
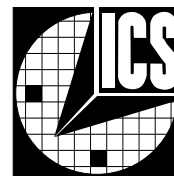
Absolute Maximum Ratings

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 3.3V

Operating V_{DD} = +3.0V 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}		-	-	$0.2V_{DD}$	V
Input High Voltage	V_{IH}		$0.7V_{DD}$	-	-	V
Input Low Current	I_{IL}	V_{IN}=0V (Pull-up)	-12	-	-	µA
Input High Current	I_{IH}	$V_{IN}=V_{DD}$	-2	-	2	µA
Output Low Voltage[1]	V_{OL}	I_{OL}=4mA	-	-	0.1	V
Output High Voltage[1]	V_{OH}	I_{OH}=-1mA	V_{DD}-.1V	-	-	V
Output High Current[1]	V_{OH}	I_{OH}=-4mA	-	-	-	V
Output High Current[1]	V_{OH}	I_{OH}=-8mA	2.4	-	-	V
Output Frequency Change over Supply and Temperature[1]	F_D	With respect to typical frequency[1]	-	.005	0.05	%
Short Circuit Current[1]	I_{SC}	Each output clock	-	15	-	mA
Supply Current	I_{DD}	No load, 40 MHz	-	10	-	mA
VDD32 Supply Current	I_{DD} 32	No load, VDD32=3.7V	-	5	12	µA
VDD32 Supply Voltage	V_{DD} 32	VDD=0 to 3.7V, 32 kHz output operating	2.0	-	-	V
Pull-up Resistor Value	Rpu		-	620	-	k½
AC Characteristics						
Input Clock Rise Time[1]	t_{ICr}		-	-	5	µs
Input Clock Fall Time[1]	t_{ICf}		-	-	5	µs
Output Rise Time[1]	t_r	15pF load, 0.8 to 2.0V	-	1.5	2	ns
Rise Time[1]	t_f	15pF load, 20% to 80% VDD	-	2.5	4	ns
Output Fall Time[1]	t_f	15pF load, 2.0 to 0.8V	-	1.5	2	ns
Fall Time[1]	t_f	15pF load, 80% to 20% VDD	-	2.5	4	ns
Duty Cycle[1]	d_t	15pF load @ V_{th}=1.4V	43/57	48/52	57/43	%
Duty Cycle, reference clocks[1]	d_t	15pF load @ $1.4V^2$	40/60	43/57	60/40	%
Jitter, One Sigma[1]		As compared with clock period.	-	1	3	%
Jitter, Absolute[1]	t_{jab}		-	2	5	%
Input Frequency[1]	f_i		25	32.768	40	kHz
Clock Skew between any Clock #2 outputs[1]	T_{sk}		-	100	500	ps
Power-up Time[1]	t_{pu}	From off to 40 MHz	-	1,000	-	ms

Note: 1. Parameter is guaranteed by design and characterization. Not 100% tested in production.
      2. 32 kHz output duty cycle is dependent on crystal used.
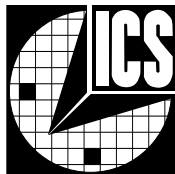
Electrical Characteristics at 5V

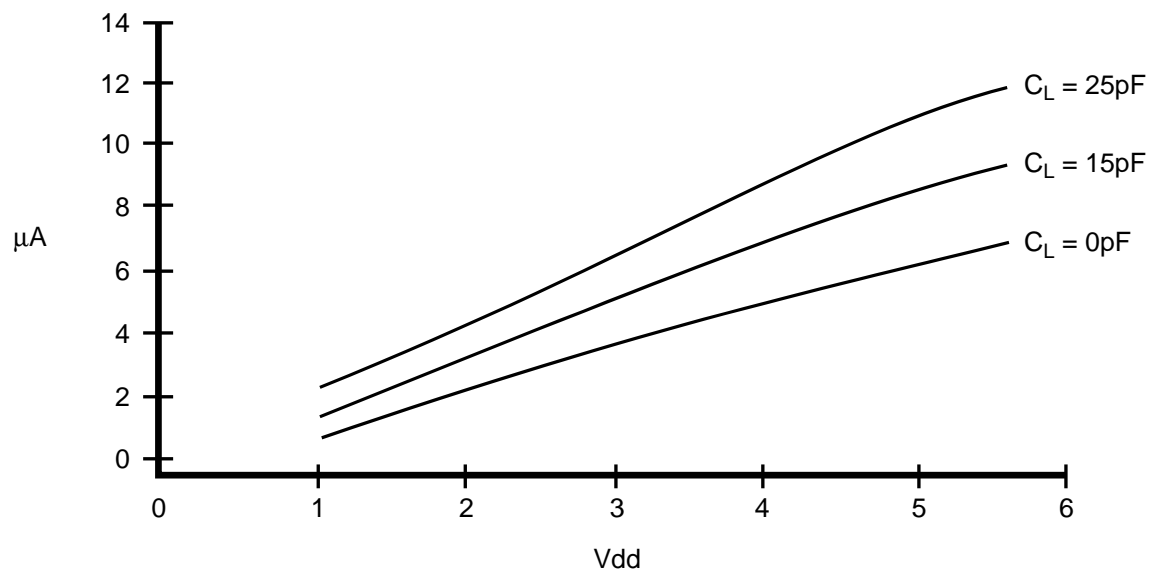$V_{DD} = +5.0V \pm 10\%$; $T_A = 0°C$ to $70°C$ unless otherwise stated

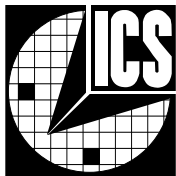| PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNITS
DC Characteristics						
Input Low Voltage	V_{IL}		-	-	$0.2V_{DD}$	V
Input High Voltage	V_{IH}		$0.7V_{DD}$	-	-	V
Input Low Current	I_{IL}	$V_{IN}=0V$ (Pull-up)	-15	-	-	µA
Input High Current	I_{IH}	$V_{IN}=V_{DD}$	-2	-	2	µA
Output Low Voltage[1]	V_{OL}	$I_{OL}=4mA$	-	-	0.1	V
Output High Voltage[1]	V_{OH}	$I_{OH}=-1mA$	$V_{DD}-.1V$	-	-	V
Output High Voltage[1]	V_{OH}	$I_{OH}=-4mA$	-	-	-	V
Output High Voltage[1]	V_{OH}	$I_{OH}=-8mA$	2.4	-	-	V
Output Frequency Change over Supply and Temperature[1]	F_D	With respect to typical frequency[1]	-	.005	0.05	%
Short Circuit Current[1]	I_{SC}	Each output clock	-	33	-	mA
Supply Current	I_{DD}	No load, 40 MHz	-	17	-	mA
$V_{DD}32$ Supply Current	$I_{DD}32$	No load, $V_{DD}32=5.5V$	-	7.5	20	µA
$V_{DD}32$ Supply Voltage	$V_{DD}32$	$V_{DD}=0$ to 5.5V, 32 kHz output operating	2.0	-	-	V
Pull-up Resistor Value	R_{pu}		-	380	-	k½
AC Characteristics						
Input Clock Rise Time[1]	t_{ICr}		-	-	5	µs
Input Clock Fall Time[1]	t_{ICf}		-	-	5	µs
Output Rise Time[1]	t_r	15pF load, 0.8 to 2.0V	-	1	1.5	ns
Rise Time[1]	t_r	15pF load, 20% to 80% V_{DD}	-	2	3	ns
Output Fall Time[1]	t_f	15pF load, 2.0 to 0.8V	-	1	1.5	ns
Fall Time[1]	t_f	15pF load, 80% to 20% V_{DD}	-	2	3	ns
Duty Cycle[1]	d_t	15pF load @ $V_{th}=1.4V$	43/57	48/52	57/43	%
Duty Cycle, reference clocks[1]	d_t	15pF load @ $1.4V$[2]	40/60	43/57	60/40	%
Jitter, One Sigma[1]	t_{j1s}	As compared with clock period.	-	1	3	%
Jitter, Absolute[1]	t_{jab}		-	2	5	%
Input Frequency[1]	f_i		25	32.768	40	kHz
Clock Skew between any Clock #2 outputs[1]	T_{sk}		-	100	500	ps
Power-up Time[1]	t_{pu}	From off to 40 MHz	-	10	-	ms

Note: 1. Parameter is guaranteed by design and characterization. Not 100% tested in production.
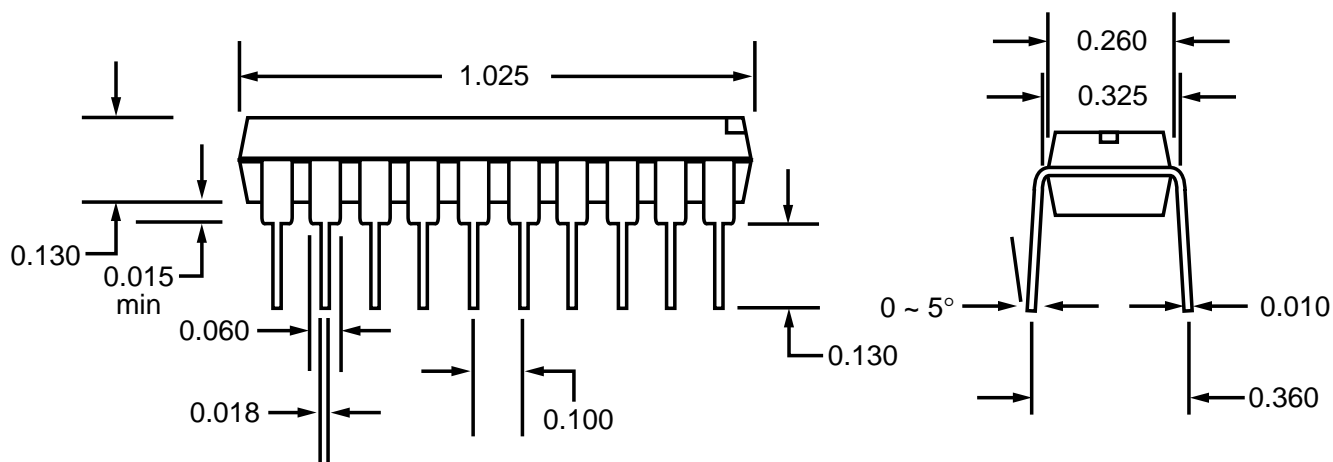2. 32 kHz output duty cycle is dependent on crystal used.

Typical 32 kHz Supply Current

Package Information

1.025

0.130

0.015 min

0.060

0.018

0.100

0.130

0.260

0.325

0 ~ 5°

0.010

0.360

20-Pin DIP Package

Ordering Information

Example:

ICS XXXX-PPP M X#W

Lead Count & Package Width
Lead Count=1,2, or 3 digits
W=0.3" SOIC or 0.6" DIP; None=Standard Width

Package Type
N=DIP (Plastic)

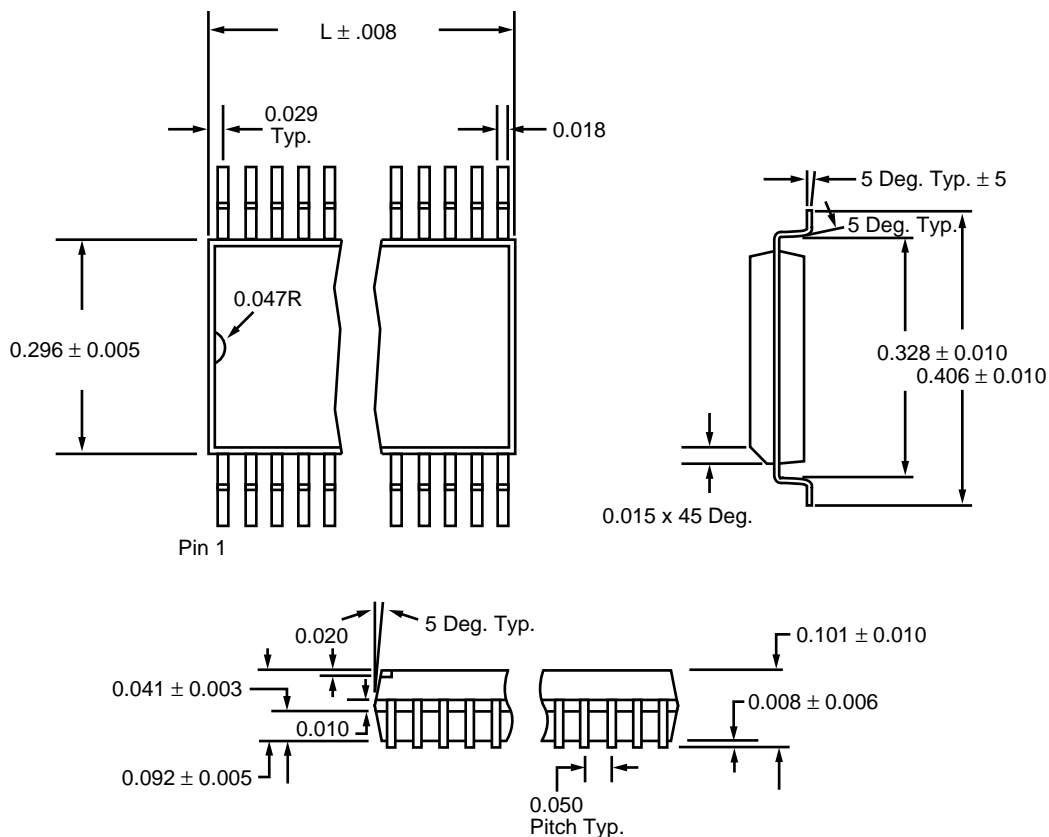**Pattern Number (2 or 3-digit number for parts with ROM code patterns)**

Device Type (consists of 3 or 4-digit numbers)

Prefix
ICS, AV=Standard Device

L ± .008

0.029 Typ.

0.018

0.047R

0.296 ± 0.005

Pin 1

5 Deg. Typ. ± 5

5 Deg. Typ.

0.328 ± 0.010
0.406 ± 0.010

0.015 x 45 Deg.

0.020

5 Deg. Typ.

0.041 ± 0.003

0.010

0.092 ± 0.005

0.050
Pitch Typ.

0.101 ± 0.010

0.008 ± 0.006

LEAD COUNT	20L
DIMENSION L	.504

SOIC Packages (Widebody)

Ordering Information
ICS9133X-01CW20

Example:

ICS XXXX-PPP M X#W

Lead Count & Package Width
  Lead Count=1,2, or 3 digits
  W=0.3" SOIC or 0.6" DIP; None=Standard Width

Package Type
  W=DIP (Plastic)

Pattern Number (2 or 3-digit number for parts with ROM code patterns)

Device Type (consists of 3 or 4-digit numbers)

Prefix
  ICS, AV=Standard Device