

## 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.

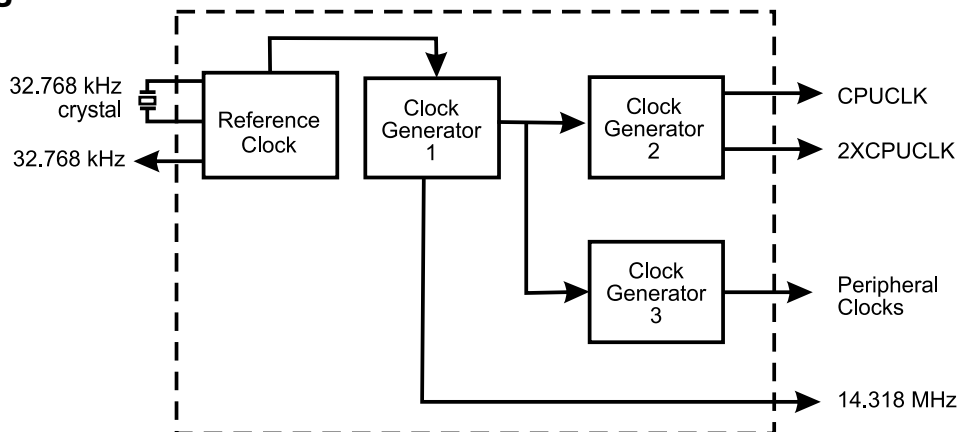
### Features

- 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.

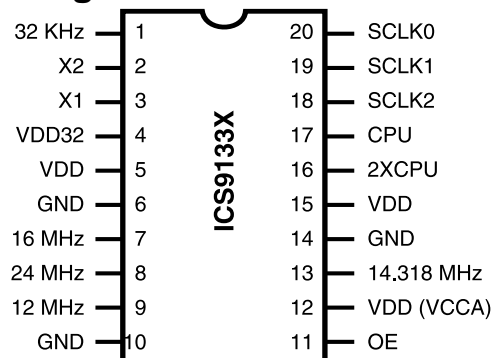
### Block Diagram





# ICS9133X

## Pin Configuration



### 20-Pin PDIP or SOIC

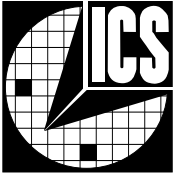
## Decoding Table for CPU Clock

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*

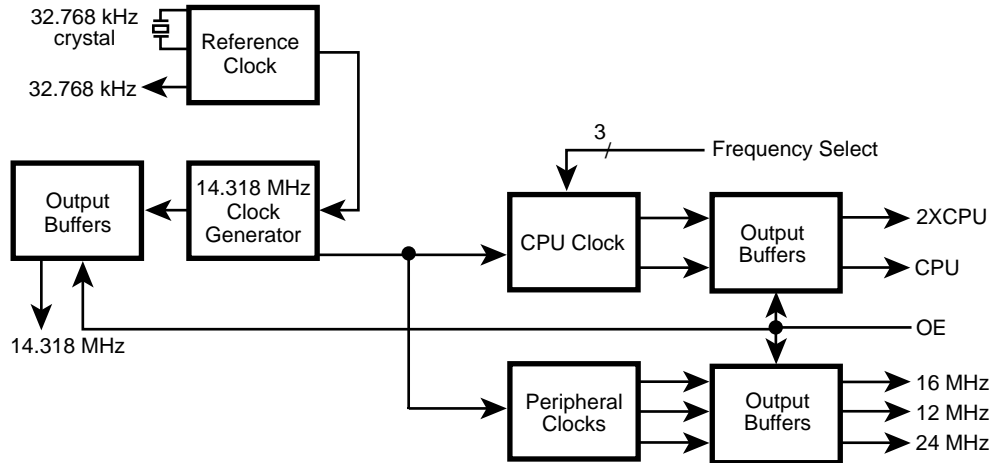
\* Only at 5V supply voltage

## Pin Descriptions

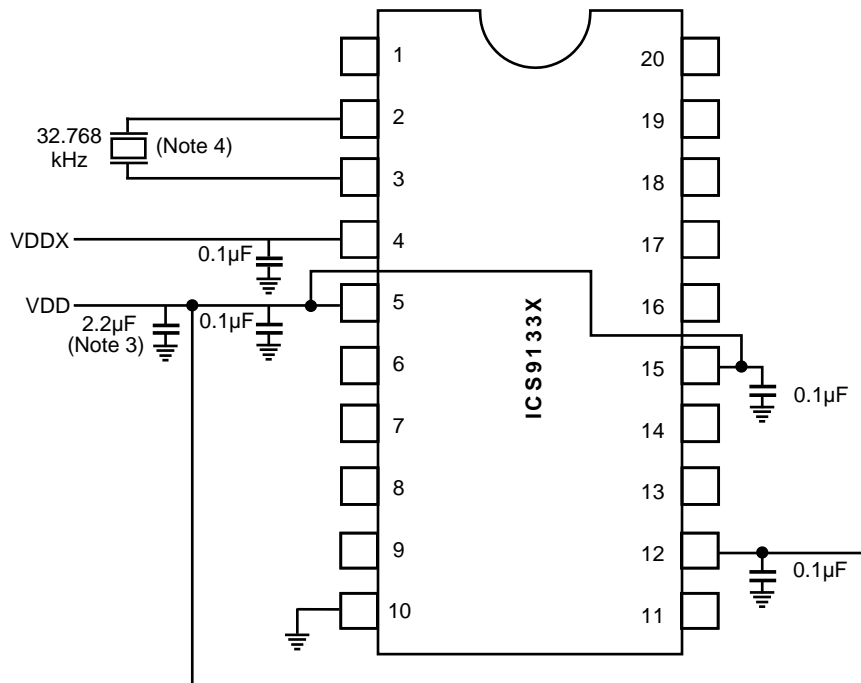
PIN NUMBER	PIN NAME	TYPE	DESCRIPTION
1	32 kHz	Output	32.768 kHz buffered output, powered by VDD32.
2	X2	Output	Connect 32.768 kHz crystal. Includes internal XTAL load capacitance.
3	X1	Input	Connect 32.768 kHz crystal. This pin includes internal XTAL load capacitance and feedback bias for a 32.768 kHz 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

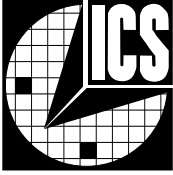
Stresses above those listed under Absolute Maximum Ratings may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of the specifications is not implied. Exposure to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

## Electrical Characteristics at 3.3V

Operating V<sub>DD</sub> = +3.0V to 3.7V; T<sub>A</sub> = 0°C to 70°C unless otherwise stated

DC Characteristics						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Input Low Voltage	V <sub>IL</sub>		-	-	0.2V <sub>DD</sub>	V
Input High Voltage	V <sub>IH</sub>		0.7V <sub>DD</sub>	-	-	V
Input Low Current	I <sub>IL</sub>	V <sub>IN</sub> =0V (Pull-up)	-12	-	-	μA
Input High Current	I <sub>IH</sub>	V <sub>IN</sub> =V <sub>DD</sub>	-2	-	2	μA
Output Low Voltage <sup>1</sup>	V <sub>OL</sub>	I <sub>OL</sub> =4mA	-	-	0.1	V
Output High Voltage <sup>1</sup>	V <sub>OH</sub>	I <sub>OH</sub> =-1mA	V <sub>DD</sub> -1V	-	-	V
Output High Current <sup>1</sup>	V <sub>OH</sub>	I <sub>OH</sub> =-4mA	-	-	-	V
Output High Current <sup>1</sup>	V <sub>OH</sub>	I <sub>OH</sub> =-8mA	2.4	-	-	V
Output Frequency Change over Supply and Temperature <sup>1</sup>	F <sub>D</sub>	With respect to typical frequency <sup>1</sup>	-	.005	0.05	%
Short Circuit Current <sup>1</sup>	I <sub>SC</sub>	Each output clock	-	15	-	mA
Supply Current	I <sub>DD</sub>	No load, 40 MHz	-	10	-	mA
V <sub>DD32</sub> Supply Current	I <sub>DD 32</sub>	No load, V <sub>DD32</sub> =3.7V	-	5	12	μA
V <sub>DD32</sub> Supply Voltage	V <sub>DD 32</sub>	V <sub>DD</sub> =0 to 3.7V, 32 kHz output operating	2.0	-	-	V
Pull-up Resistor Value	R <sub>pu</sub>		-	620	-	k½
AC Characteristics						
Input Clock Rise Time <sup>1</sup>	t <sub>ICr</sub>		-	-	5	μs
Input Clock Fall Time <sup>1</sup>	t <sub>ICf</sub>		-	-	5	μs
Output Rise Time <sup>1</sup>	t <sub>r</sub>	15pF load, 0.8 to 2.0V	-	1.5	2	ns
Rise Time <sup>1</sup>	t <sub>r</sub>	15pF load, 20% to 80% V <sub>DD</sub>	-	2.5	4	ns
Output Fall Time <sup>1</sup>	t <sub>f</sub>	15pF load, 2.0 to 0.8V	-	1.5	2	ns
Fall Time <sup>1</sup>	t <sub>f</sub>	15pF load, 80% to 20% V <sub>DD</sub>	-	2.5	4	ns
Duty Cycle <sup>1</sup>	d <sub>t</sub>	15pF load @ V <sub>th</sub> =1.4V	43/57	48/52	57/43	%
Duty Cycle, reference clocks <sup>1</sup>	d <sub>t</sub>	15pF load @ 1.4V <sup>2</sup>	40/60	43/57	60/40	%
Jitter, One Sigma <sup>1</sup>		As compared with clock period.	-	1	3	%
Jitter, Absolute <sup>1</sup>	t <sub>jab</sub>		-	2	5	%
Input Frequency <sup>1</sup>	f <sub>i</sub>		25	32.768	40	kHz
Clock Skew between any Clock #2 outputs <sup>1</sup>	T <sub>sk</sub>		-	100	500	ps
Power-up Time <sup>1</sup>	t <sub>pu</sub>	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.

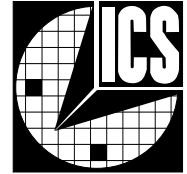


Electrical Characteristics at 5V

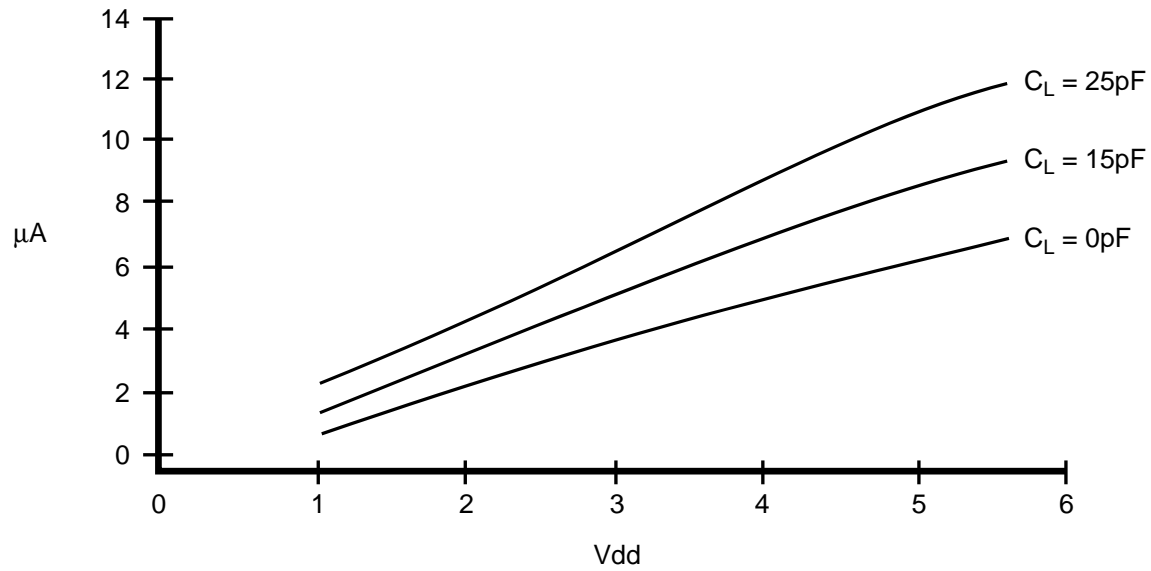
V<sub>DD</sub> = +5.0V ±10%; T<sub>A</sub> = 0°C to 70°C unless otherwise stated

DC Characteristics						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Input Low Voltage	V <sub>IL</sub>		-	-	0.2V <sub>DD</sub>	V
Input High Voltage	V <sub>IH</sub>		0.7V <sub>DD</sub>	-	-	V
Input Low Current	I <sub>IL</sub>	V <sub>IN</sub> =0V (Pull-up)	-15	-	-	μA
Input High Current	I <sub>IH</sub>	V <sub>IN</sub> =V <sub>DD</sub>	-2	-	2	μA
Output Low Voltage <sup>1</sup>	V <sub>OL</sub>	I <sub>OL</sub> =4mA	-	-	0.1	V
Output High Voltage <sup>1</sup>	V <sub>OH</sub>	I <sub>OH</sub> =-1mA	V <sub>DD</sub> -1V	-	-	V
Output High Voltage <sup>1</sup>	V <sub>OH</sub>	I <sub>OH</sub> =-4mA	-	-	-	V
Output High Voltage <sup>1</sup>	V <sub>OH</sub>	I <sub>OH</sub> =-8mA	2.4	-	-	V
Output Frequency Change over Supply and Temperature <sup>1</sup>	F <sub>D</sub>	With respect to typical frequency <sup>1</sup>	-	.005	0.05	%
Short Circuit Current <sup>1</sup>	I <sub>SC</sub>	Each output clock	-	33	-	mA
Supply Current	I <sub>DD</sub>	No load, 40 MHz	-	17	-	mA
V <sub>DD32</sub> Supply Current	I <sub>DD 32</sub>	No load, V <sub>DD32</sub> =5.5V	-	7.5	20	μA
V <sub>DD32</sub> Supply Voltage	V <sub>DD 32</sub>	V <sub>DD</sub> =0 to 5.5V, 32 kHz output operating	2.0	-	-	V
Pull-up Resistor Value	R <sub>pu</sub>		-	380	-	k½
AC Characteristics						
Input Clock Rise Time <sup>1</sup>	t <sub>ICr</sub>		-	-	5	μs
Input Clock Fall Time <sup>1</sup>	t <sub>ICf</sub>		-	-	5	μs
Output Rise Time <sup>1</sup>	t <sub>r</sub>	15pF load, 0.8 to 2.0V	-	1	1.5	ns
Rise Time <sup>1</sup>	t <sub>r</sub>	15pF load, 20% to 80% V <sub>DD</sub>	-	2	3	ns
Output Fall Time <sup>1</sup>	t <sub>f</sub>	15pF load, 2.0 to 0.8V	-	1	1.5	ns
Fall Time <sup>1</sup>	t <sub>f</sub>	15pF load, 80% to 20% V <sub>DD</sub>	-	2	3	ns
Duty Cycle <sup>1</sup>	d <sub>t</sub>	15pF load @ V <sub>th</sub> =1.4V	43/57	48/52	57/43	%
Duty Cycle, reference clocks <sup>1</sup>	d <sub>t</sub>	15pF load @ 1.4V <sup>2</sup>	40/60	43/57	60/40	%
Jitter, One Sigma <sup>1</sup>	t <sub>j1s</sub>	As compared with clock period.	-	1	3	%
Jitter, Absolute <sup>1</sup>	t <sub>jab</sub>		-	2	5	%
Input Frequency <sup>1</sup>	f <sub>i</sub>		25	32.768	40	kHz
Clock Skew between any Clock #2 outputs <sup>1</sup>	T <sub>sk</sub>		-	100	500	ps
Power-up Time <sup>1</sup>	t <sub>pu</sub>	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.

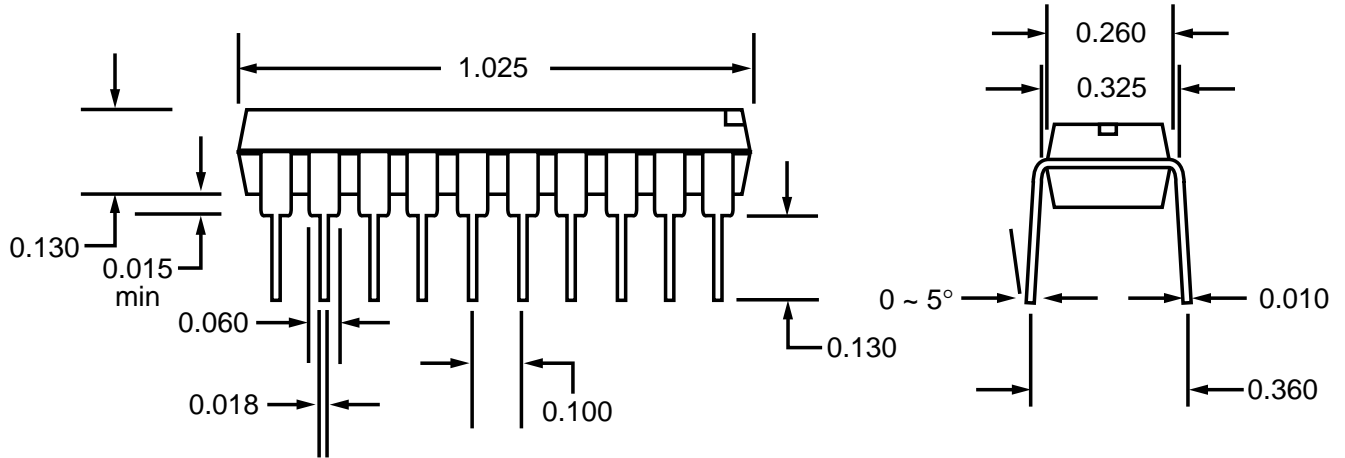


## Typical 32 kHz Supply Current





Package Information

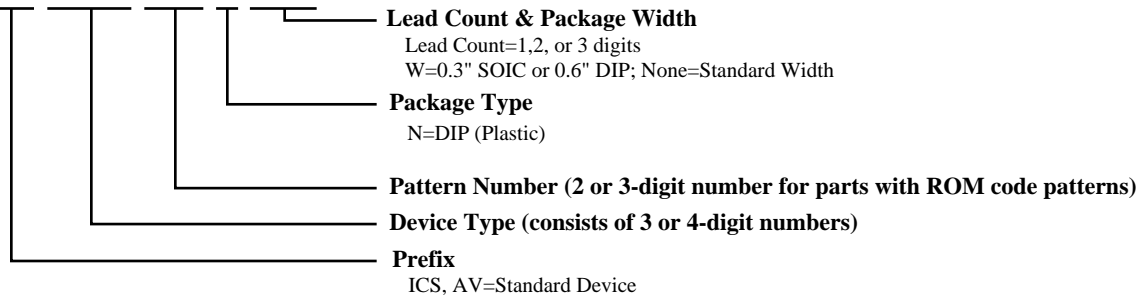


20-Pin DIP Package

Ordering Information

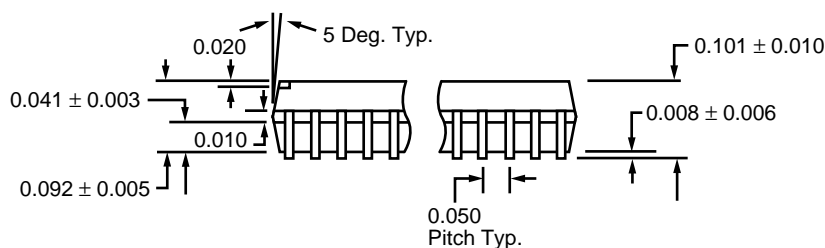
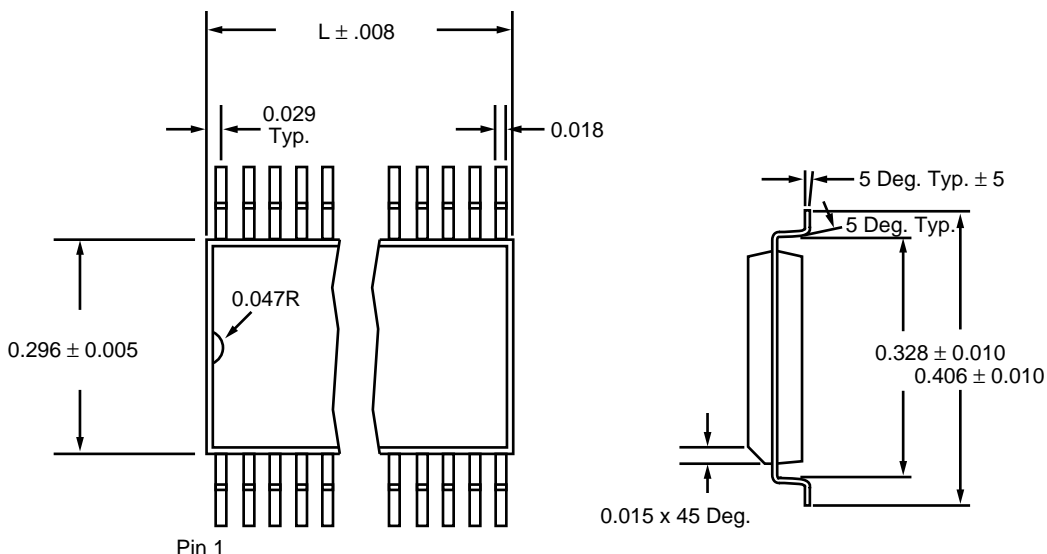
Example:

ICS XXXX-PPP M X#W





# ICS9133X



LEAD COUNT	20L
DIMENSION L	.504

## SOIC Packages (Widebody)

### Ordering Information ICS9133X-01CW20

Example:

#### ICS XXXX-PPP M X#W

