Integrated Circuit Systems, Inc.

ICS9248-81

Frequency Generator & Integrated Buffers

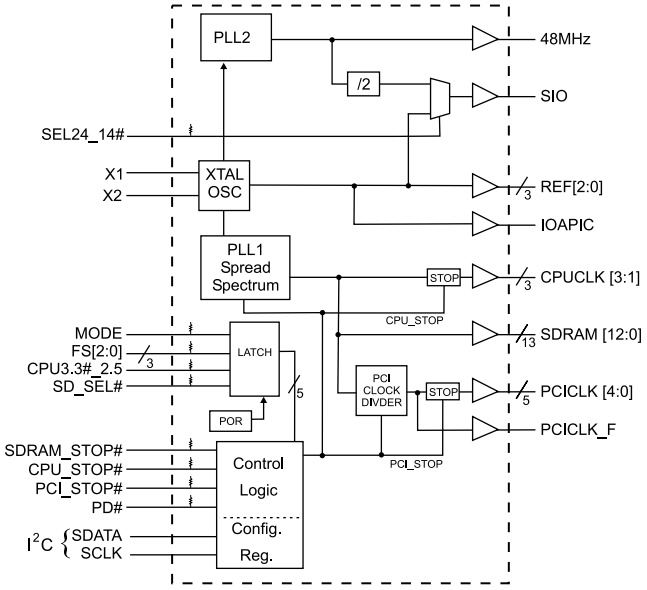
General Description

The **ICS9248-81** is the single chip clock solution for Desktop/ Notebook designs using the SIS style chipset. It provides all necessary clock signals for such a system.

Spread spectrum may be enabled through I^2C programming. Spread spectrum typically reduces system EMI by 8dB to 10dB. This simplifies EMI qualification without resorting to board design iterations or costly shielding. The **ICS9248-81** employs a proprietary closed loop design, which tightly controls the percentage of spreading over process and temperature variations.

Serial programming I^2C interface allows changing functions, stop clock programming and frequency selection. The SD_SEL latched input allows the SDRAM frequency to follow the CPUCLK frequency(SD_SEL=1) or other clock frequencies (SD_SEL=0)

Block Diagram



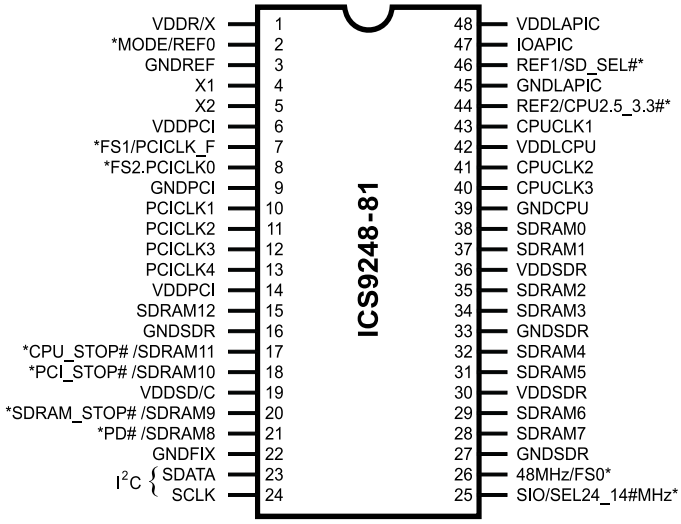
Power Groups

VDDREF = REF [2:0], X1, X2
VDDPCI = PCICLK_F, PCICLK [4:0]
VDDSD/C = SDRAM [11:0], supply for PLL core, 24 MHz, 48MHz
VDD/CPU = CPUCLK [3:1]
VDDLAPIC = IOAPIC
GNDFIX = Ground for fixed clock PLL and output buffers

Features

- Generates the following system clocks:
  - 3 CPU(2.5V/3.3V) up to 133.3MHz.
  - 6 PCI(3.3V) (including 1 free-running)
  - 13 SDRAMs(3.3V) up to 133.3MHz.
  - 3 REF (3.3V) @ 14.318MHz
  - 1 clock @ 24/14.3 MHz selectable output for SIO
  - 1 Fixed clock at 48MHz (3.3V)
  - 1 IOAPIC @ 2.5V / 3.3V
- Skew characteristics:
  - CPU – CPU<175ps
  - SDRAM – SDRAM < 250ps
  - CPU–SDRAM < 500ps
  - CPU(early) – PCI : 1-4ns (typ. 3ns)
  - PCI – PCI <500ps
- Supports Spread Spectrum modulation ±0.25 & ±0.5% center spread
- Serial I^2C interface for Power Management, Frequency Select, Spread Spectrum.
- Efficient Power management scheme through PCI, SDRAM, CPU STOP CLOCKS and PD#.
- Uses external 14.318MHz crystal
- 48 pin 300mil SSOP.

Pin Configuration



48-Pin SSOP

* Internal Pull-up Resistor of 120K to 3.3V on indicated inputs

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I^2C is a trademark of Philips Corporation

Pin Descriptions

Pin number	Pin name	Type	Description
1	VDDR/X	Power	Isolated 3.3 V power for crystal & reference
2[1,2]	REF0	Output	3.3V, 14.318 MHz reference clock output.
	Mode	Input	Function select pin, 1=desk top mode, 0=mobile mode. Latched input.
3,9,16,22, 27,33,39	GND	Power	3.3 V Ground
4	X1	Input	14.318 MHz crystal input
5	X2	Output	14.318 MHz crystal output
6,14	VDDPCI	Power	3.3 V power for the PCI clock outputs
7[1,2]	FS1	Input	Logic input frequency select bit. Input latched at power-on.
	PCICLK_F	Output	3.3 V free running PCI clock output, will not be stopped by the PCI_STOP#
8[1,2]	PCICLK 0	Output	3.3 V PCI clock outputs, generating timing requirements for Pentium II
	FS2	Input	Logic input frequency select bit. Input latched at power-on.
13, 12, 11, 10	PCICLK [4:1]	Output	3.3 V PCI clock outputs, generating timing requirements for Pentium II
15,28,29,31,32, 34,35,37,38	SDRAM 12, SDRAM [7:0]	Output	SDRAM clock outputs. Frequency is selected by SD-Sel latched input.
17 [1]	SDRAM 11	Output	SDRAM clock outputs. Frequency is selected by SD-Sel latched input.
	CPU_STOP#	Input	Asynchronous active low input pin used to stop the CPUCLK in low state, all other clocks will continue to run. The CPUCLK will have a "Turnon" latency of at least 3 CPU clocks.
18 [1]	SDRAM 10	Output	SDRAM clock outputs. Frequency is selected by SD-SEL latched input.
	PCI-STOP#	Input	Synchronous active low input used to stop the PCICLK in a low state. It will not effect PCICLK_F or any other outputs.
19	VDDSD/C	Power	3.3 V power for SDRAM outputs and core
20 [1]	SDRAM 9	Output	SDRAM clock outputs. Frequency is selected by SD-Sel latched input.
	SDRAM_STOP#	Input	Asynchronous active low input used to stop the SDRAM in a low state. It will not effect any other outputs.
21 [1]	SDRAM 8	Output	SDRAM clock outputs. Frequency is selected by SD-Sel latched input.
	PD#	Input	Asynchronous active low input pin used to power down the device into a low power state. The internal clocks are disabled and the VCO and the crystal are stopped. The latency of the power down will not be greater than 3ms.
23	SDATA	Input	Data input for I^2C serial input.
24	SCLK	Input	Clock input of I^2C input
25 [1,2]	SEL24_14#	Input	This input pin controls the frequency of the SIO. If logic 0 at power on SIO=14.318 MHz . If logic 1 at power-on SIO=24MHz.
	SIO	Output	Super I/O output. 24 or 14.318 MHz. Selectable at power-up by SEL24_14MHz
26 [1,2]	FS0	Input	Logic input frequency select bit. Input latched at power-on.
	48 MHz	Output	3.3 V 48 MHz clock output, fixed frequency clock typically used with USB devices
30,36	VDDSDR	Power	3.3 V power for SDRAM outputs
40,41,43	CPUCLK [3:1]	0utput	2.5 V CPU and Host clock outputs
42	VDDLCPU	Power	2.5 V power for CPU
44 [1,2]	REF2	Output	3.3V, 14.318 MHz reference clock output.
	CPU3.3#_2.5	Input	This pin selects the operating voltage for the CPU. If logic 0 at power on CPU=3.3 V and if logic 1 at power on CPU=2.5 V operating voltage.
45	GNDL	Power	2.5 V Ground for the IOAPIC or CPU
46 [1,2]	REF1	Output	3.3V, 14.318 MHz reference clock output.
	SD_SEL	Input	This input pin controls the frequency of the SDRAM.
47	IOAPIC	Output	2.5V fixed 14.318 MHz IOAPIC clock outputs
48	VDDLAPIC	Power	2.5 V power for IOAPIC

Notes:

1: Internal Pull-up Resistor of 120K to 3.3V on indicated inputs

2: Bidirectional input/output pins, input logic levels are latched at internal power-on-reset. Use 10Kohm resistor to program logic Hi to VDD or GND for logic low.

Mode Pin - Power Management Input Control

MODE, Pin 2 (Latched Input)	Pin 17	Pin 18	Pin 20	Pin 21
0	CPU_STOP# (INPUT)	PCI_STOP# (INPUT)	SDRAM_STOP# (INPUT)	PD# (INPUT)
1	SDRAM 11 (OUTPUT)	SDRAM 10 (OUTPUT)	SDRAM9 (OUTPUT)	SDRAM8 (OUTPUT)

Power Management Functionality

PD#	CPU_STOP#	PCI_STOP#	SDRAM_STOP	PCICLK (0:4)	SDRAM (0:12)	PCICLK_F	CPUCLK	Crystal OSC	VCO
0	X	X	X	Stopped Low	Stopped Low	Stopped Low	Stopped Low	Stopped Low	Stopped Low
1	1	1	1	Running	Running	Running	Running	Running	Running
1	1	1	0	Running	Stopped Low	Running	Running	Running	Running
1	1	0	1	Stopped Low	Running	Running	Running	Running	Running
1	1	0	0	Stopped Low	Stopped Low	Running	Running	Running	Running
1	0	1	1	Running	Running	Running	Stopped Low	Running	Running
1	0	1	0	Running	Stopped Low	Running	Stopped Low	Running	Running
1	0	0	1	Stopped Low	Running	Running	Stopped Low	Running	Running
1	0	0	0	Stopped Low	Stopped Low	Running	Stopped Low	Running	Running

CPU 3.3#_2.5V Buffer selector for CPUCLK drivers.

CPU3.3#_2.5 Input level (Latched Data)	Buffer Selected for operation at:
1	2.5V VDD
0	3.3V VDD

Functionality

V_{DD}1, 2, 3, 4 = 3.3V±5%, V_{DDL} = 2.5V ±5% or 3.3 ±5%, TA= 0 to 70°C
Crystal (X1, X2) = 14.31818MHz

SD_SEL	FS2	FS1	FS0	CPU MHZ	SDRAM MHZ	PCI MHZ	REF, IOAPIC MHZ
0	0	0	0	90.00	90.00	30.00	14.318
0	0	0	1	66.70	100.05	33.35	14.318
0	0	1	0	95.00	63.33	31.66	14.318
0	0	1	1	100.00	66.66	33.33	14.318
0	1	0	0	100.00	75.00	30.00	14.318
0	1	0	1	112.00	74.66	37.33	14.318
0	1	1	0	124.00	82.66	31.00	14.318
0	1	1	1	133.30	88.86	33.32	14.318
1	0	0	0	66.70	66.70	33.35	14.318
1	0	0	1	75.00	75.00	30.00	14.318
1	0	1	0	83.30	83.30	33.32	14.318
1	0	1	1	95.00	95.00	31.66	14.318
1	1	0	0	100.00	100.00	33.33	14.318
1	1	0	1	112.00	112.00	37.33	14.318
1	1	1	0	124.00	124.00	31.00	14.318
1	1	1	1	133.30	133.30	33.33	14.318

General I²C serial interface information

The information in this section assumes familiarity with I²C programming.
For more information, contact ICS for an I²C programming application note.

How to Write:

- Controller (host) sends a start bit.
- Controller (host) sends the write address D2 (H)
- ICS clock will ***acknowledge***
- Controller (host) sends a dummy command code
- ICS clock will ***acknowledge***
- Controller (host) sends a dummy byte count
- ICS clock will ***acknowledge***
- Controller (host) starts sending first byte (Byte 0) through byte 5
- ICS clock will ***acknowledge*** each byte ***one at a time***.
- Controller (host) sends a Stop bit

How to Write:	
Controller (Host)	**ICS (Slave/Receiver)**
Start Bit	
Address $D2_{(H)}$	
	ACK
Dummy Command Code	
	ACK
Dummy Byte Count	
	ACK
Byte 0	
	ACK
Byte 1	
	ACK
Byte 2	
	ACK
Byte 3	
	ACK
Byte 4	
	ACK
Byte 5	
	ACK
Stop Bit	

How to Read:

- Controller (host) will send start bit.
- Controller (host) sends the read address D3 (H)
- ICS clock will ***acknowledge***
- ICS clock will send the ***byte count***
- Controller (host) acknowledges
- ICS clock sends first byte ***(Byte 0) through byte 5***
- Controller (host) will need to acknowledge each byte
- Controller (host) will send a stop bit

How to Read:	
Controller (Host)	**ICS (Slave/Receiver)**
Start Bit	
Address $D3_{(H)}$	
	ACK
	Byte Count
ACK	
	Byte 0
ACK	
	Byte 1
ACK	
	Byte 2
ACK	
	Byte 3
ACK	
	Byte 4
ACK	
	Byte 5
ACK	
Stop Bit	

Notes:

1. The ICS clock generator is a slave/receiver, I²C component. It can read back the data stored in the latches for verification. **Read-Back will support Intel PIIX4 "Block-Read" protocol**.
2. The data transfer rate supported by this clock generator is 100K bits/sec or less (standard mode)
3. The input is operating at 3.3V logic levels.
4. The data byte format is 8 bit bytes.
5. To simplify the clock generator I²C interface, the protocol is set to use only "**Block-Writes**" from the controller. The bytes must be accessed in sequential order from lowest to highest byte with the ability to stop after any complete byte has been transferred. The Command code and Byte count shown above must be sent, but the data is ignored for those two bytes. The data is loaded until a Stop sequence is issued.
6. At power-on, all registers are set to a default condition, as shown.

Serial Configuration Command Bitmap

Byte 0: Functionality and frequency select register (Default = 0)

Bit	Description				PWD
Bit 7	0 - ±0.25% Center Spread Spectrum				1
	1 - ±0.5% Center Spread Spectrum				
Bit (2, 6:4)	Bit (2, 6:4)	CPUCLK	SDRAM	PCICLK	XXXX Note 1
	0000	90.00	90.00	30.00	
	0001	66.70	100.05	33.35	
	0010	95.00	63.33	31.66	
	0011	100.00	66.66	33.33	
	0100	100.00	75.00	30.00	
	0101	112.00	74.66	37.33	
	0110	124.00	82.66	31.00	
	0111	133.30	88.86	33.32	
	1000	66.70	66.70	33.35	
	1001	75.00	75.00	30.00	
	1010	83.30	83.30	33.32	
	1011	95.00	95.00	31.66	
	1100	100.00	100.00	33.33	
	1101	112.00	112.00	37.33	
	1110	124.00	124.00	31.00	
	1111	133.30	133.30	33.33	
Bit 3	0 - Frequency is selected by hardware select, latched inputs 1 - Frequency is selected by Bit 2, 6:4				0
Bit 1	0 - Normal 1 - Spread spectrum enabled				1
Bit 0	0 - Running 1 - Tristate all outputs				0

Note 1: Default at power-up will be for latched logic inputs to define frequency.

Note 2: PWD = Power-Up Default

Byte 1: CPU, Active/Inactive Register
(1 = enable, 0 = disable)

Bit	Pin #	PWD	Description
Bit 7	-	1	(Reserved)
Bit 6	-	1	(Reserved)
Bit 5	-	1	(Reserved)
Bit 4	-	1	(Reserved)
Bit 3	40	1	CPUCLK3
Bit 2	41	1	CPUCLK2
Bit 1	43	1	CPUCLK1
Bit 0	-	X	FS0#

Notes:
1. Inactive means outputs are held LOW and are disabled from switching.

Byte 2: PCI Active/Inactive Register
(1 = enable, 0 = disable)

Bit	Pin #	PWD	Description
Bit 7	-	X	FS1#
Bit 6	7	1	PCICLK_F
Bit 5	-	1	(Reserved)
Bit 4	13	1	PCICLK4
Bit 3	12	1	PCICLK3
Bit 2	11	1	PCICLK2
Bit 1	10	1	PCICLK1
Bit 0	8	1	PCICLK0

Notes:
1. Inactive means outputs are held LOW and are disabled from switching.

Byte 3: SDRAM Active/Inactive Register
(1 = enable, 0 = disable)

Bit	Pin #	PWD	Description
Bit 7	28	1	SDRAM7
Bit 6	29	1	SDRAM6
Bit 5	31	1	SDRAM5
Bit 4	32	1	SDRAM4
Bit 3	34	1	SDRAM3
Bit 2	35	1	SDRAM2
Bit 1	37	1	SDRAM1
Bit 0	38	1	SDRAM0

Notes:
1. Inactive means outputs are held LOW and are disabled from switching.

Byte 4: SDRAM Active/Inactive Register
(1 = enable, 0 = disable)

Bit	Pin #	PWD	Description
Bit 7	-	1	(Reserved)
Bit 6	25	1	24/14MHz
Bit 5	26	1	48MHz
Bit 4	15	1	SDRAM12
Bit 3	17	1	SDRAM11
Bit 2	18	1	SDRAM10
Bit 1	20	1	SDRAM9
Bit 0	21	1	SDRAM8

Notes:
1. Inactive means outputs are held LOW and are disabled from switching.

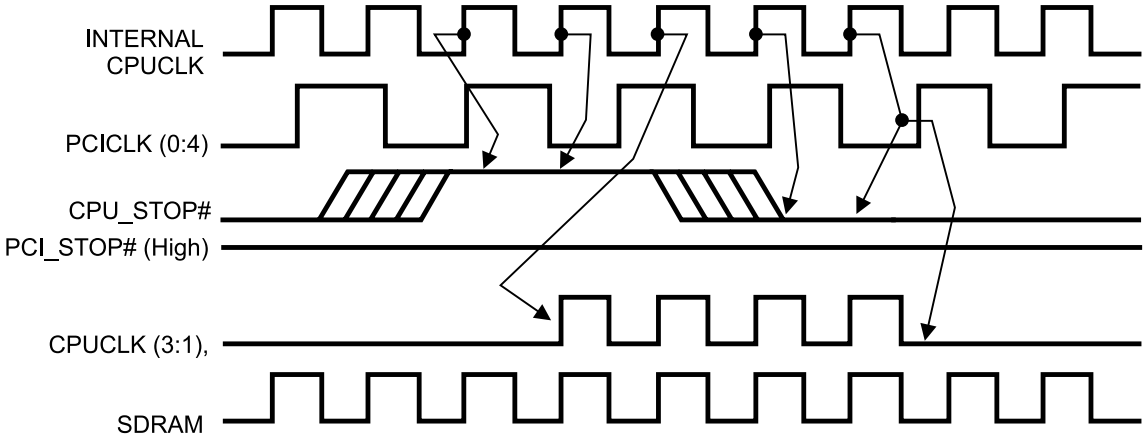
Byte 5: Peripheral Active/Inactive Register (1 = enable, 0 = disable)

Bit	Pin #	PWD	Description
Bit 7	-	1	(Reserved)
Bit 6	-	X	FS2#
Bit 5	-	1	(Reserved)
Bit 4	47	1	IOAPIC
Bit 3	-	X	SD_SEL#
Bit 2	44	1	REF2
Bit 1	46	1	REF1
Bit 0	2	1	REF0

Notes:
1. Inactive means outputs are held LOW and are disabled from switching.

CPU_STOP# Timing Diagram

CPU_STOP# is an asychronous input to the clock synthesizer. It is used to turn off the CPU clocks for low power operation. CPU_STOP# is synchronized by the **ICS9248-81**. The minimum that the CPU clock is enabled (CPU_STOP# high pulse) is 100 CPU clocks. All other clocks will continue to run while the CPU clocks are disabled. The CPU clocks will always be stopped in a low state and start in such a manner that guarantees the high pulse width is a full pulse. CPU clock on latency is less than 4 CPU clocks and CPU clock off latency is less than 4 CPU clocks.

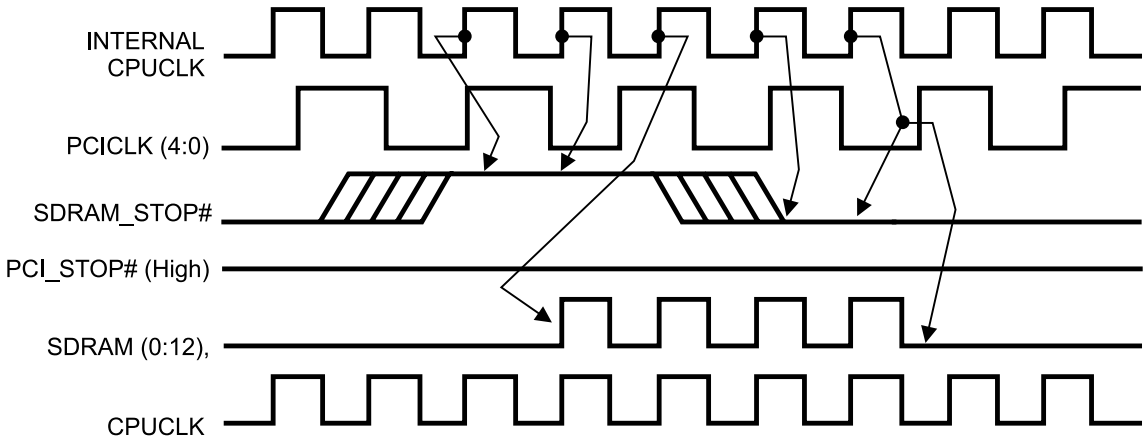


Notes:

1. All timing is referenced to the internal CPU clock.
2. CPU_STOP# is an asynchronous input and metastable conditions may exist. This signal is synchronized to the CPU clocks inside the ICS9248-81.
3. All other clocks continue to run undisturbed. (including SDRAM outputs).

SDRAM_STOP# Timing Diagram

SDRAM_STOP# is an sychronous input to the clock synthesizer. It is used to turn off the CPU clocks for low power operation. SDRAM_STOP# is synchronized by the **ICS9248-81**. All other clocks will continue to run while the SDRAM clocks are disabled. The SDRAM clocks will always be stopped in a low state and start in such a manner that guarantees the high pulse width is a full pulse.

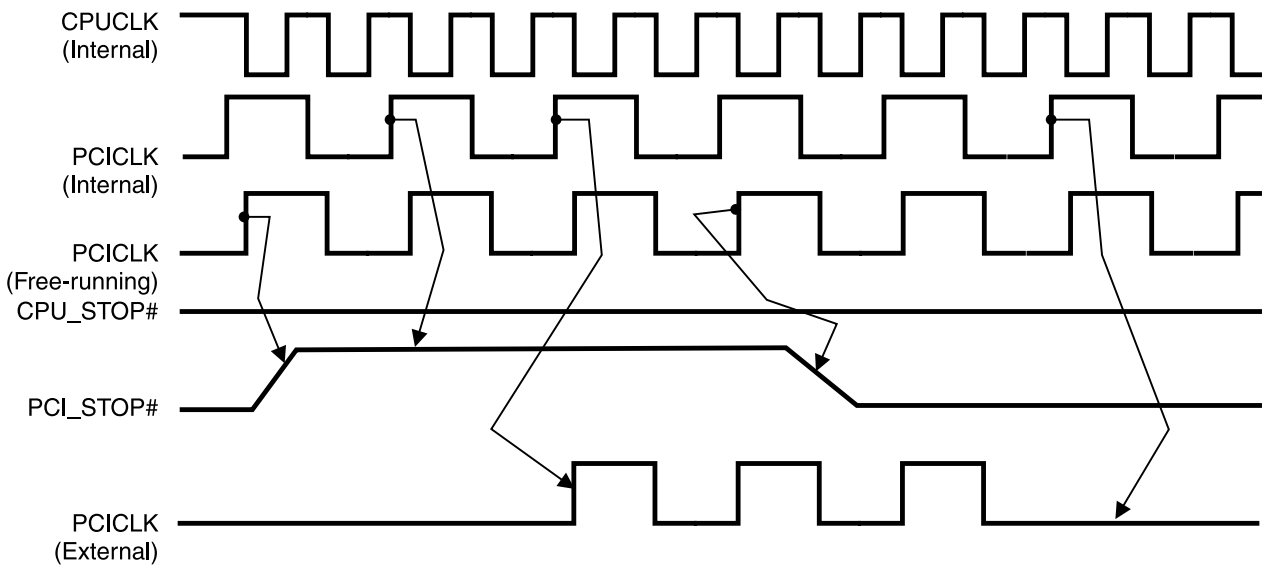


Notes:

1. All timing is referenced to the internal CPU clock.
2. SDRAM is an asynchronous input and metastable conditions may exist. This signal is synchronized to the SDRAM clocks inside the ICS9248-81.
3. All other clocks continue to run undisturbed.

PCI_STOP# Timing Diagram

PCI_STOP# is an synchronous input to the **ICS9248-81**. It is used to turn off the PCICLK (0:4) clocks for low power operation. PCI_STOP# is synchronized by the **ICS9248-81** internally. The minimum that the PCICLK (0:4) clocks are enabled (PCI_STOP# high pulse) is at least 10 PCICLK (0:4) clocks. PCICLK (0:4) clocks are stopped in a low state and started with a full high pulse width guaranteed. PCICLK (0:4) clock on latency cycles are only one rising PCICLK clock off latency is one PCICLK clock.



Notes:

1. All timing is referenced to the Internal CPUCLK (defined as inside the ICS9248 device.)
2. PCI_STOP# is an asynchronous input, and metastable conditions may exist. This signal is required to be synchronized inside the ICS9248.
3. All other clocks continue to run undisturbed.
4. CPU_STOP# is shown in a high (true) state.

Shared Pin Operation - Input/Output Pins

The I/O pins designated by (input/output) on the **ICS9248-81** serve as dual signal functions to the device. During initial power-up, they act as input pins. The logic level (voltage) that is present on these pins at this time is read and stored into a 4-bit internal data latch. At the end of Power-On reset, (see AC characteristics for timing values), the device changes the mode of operations for these pins to an output function. In this mode the pins produce the specified buffered clocks to external loads.

To program (load) the internal configuration register for these pins, a resistor is connected to either the VDD (logic 1) power supply or the GND (logic 0) voltage potential. A 10 Kilohm(10K) resistor is used to provide both the solid CMOS programming voltage needed during the power-up programming period and to provide an insignificant load on the output clock during the subsequent operating period.

Figs. 1 and 2 show the recommended means of implementing this function. In Fig. 1 either one of the resistors is loaded onto the board (selective stuffing) to configure the device's internal logic. Figs. 2a and b provide a single resistor loading option where either solder spot tabs or a physical jumper header may be used.

These figures illustrate the optimal PCB physical layout options. These configuration resistors are of such a large ohmic value that they do not effect the low impedance clock signals. The layouts have been optimized to provide as little impedance transition to the clock signal as possible, as it passes through the programming resistor pad(s).

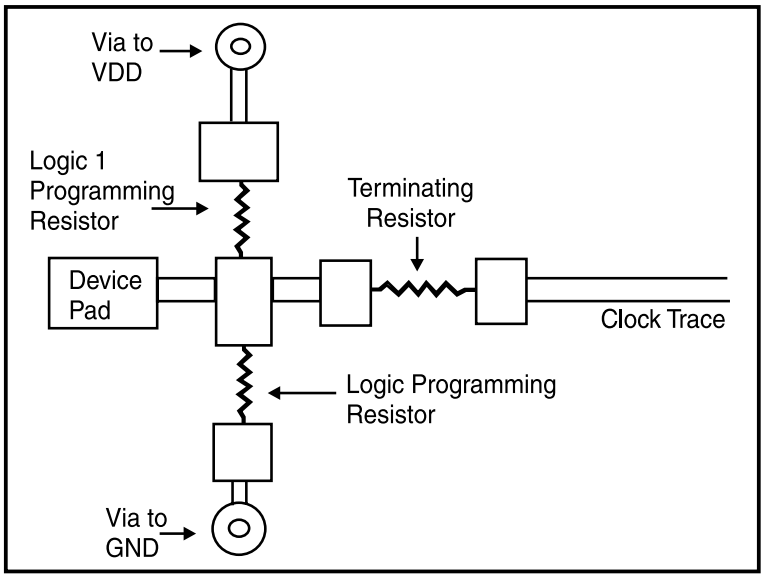


Fig. 1

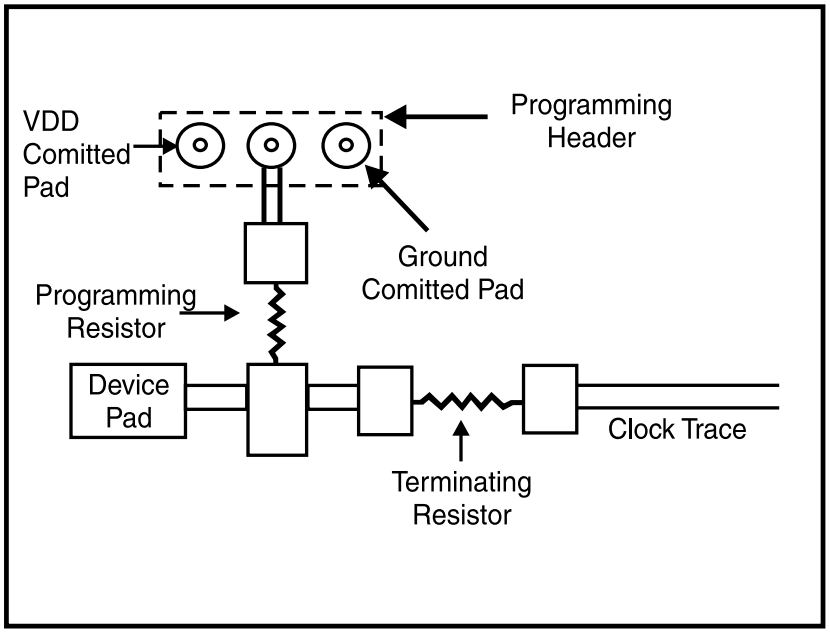

VDD
Comitted
Pad
Programming
Header
Ground
Comitted Pad
Programming
Resistor
Device
Pad
Clock Trace
Terminating
Resistor

Fig. 2a

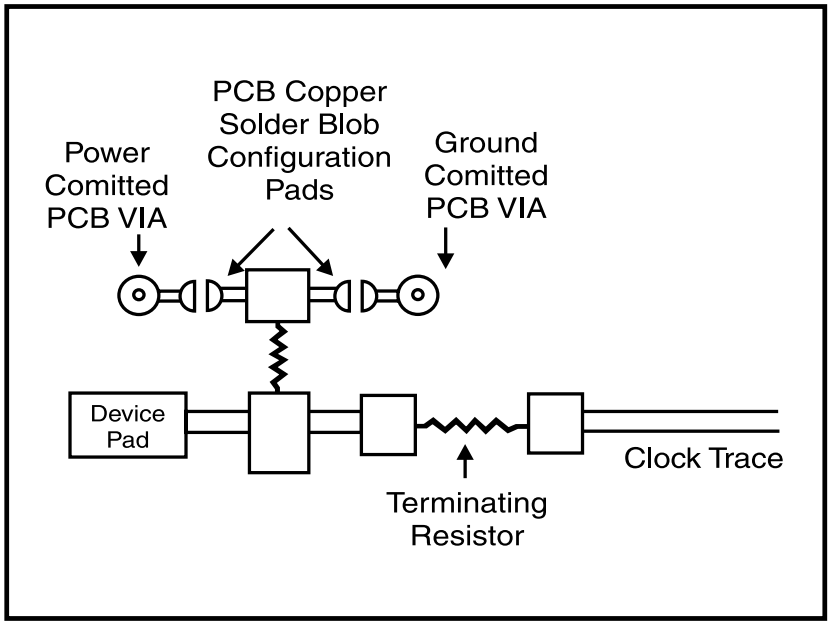

PCB Copper
Solder Blob
Configuration
Pads
Power
Comitted
PCB VIA
Ground
Comitted
PCB VIA
Device
Pad
Clock Trace
Terminating
Resistor

Fig. 2b

Absolute Maximum Ratings

Supply Voltage	5.5 V
Logic Inputs	GND –0.5 V to V_{DD} +0.5 V
Ambient Operating Temperature	0°C to +70°C
Storage Temperature	–65°C to +150°C
Case Temperature	115°C

Stresses above those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These ratings are stress specifications only and functional operation of the device at these or any other conditions above those listed 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 - Input/Supply/Common Output Parameters

T_A = 0 - 70C; Supply Voltage V_{DD} = V_{DDL} = 3.3 V +/-5% (unless otherwise stated)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Input High Voltage	V_{IH}		2		V_{DD}+0.3	V
Input Low Voltage	V_{IL}		V_{SS}-0.3		0.8	V
Input High Current	I_{IH}	V_{IN} = V_{DD}		0.1	5	µA
Input Low Current	I_{IL1}	V_{IN} = 0 V; Inputs with no pull-up resistors	-5	2.0		µA
Input Low Current	I_{IL2}	V_{IN} = 0 V; Inputs with pull-up resistors	-200	-100		µA
Operating Supply Current	$I_{DD3.3OP66}$	C_L = 0 pF; Select @ 66MHz		60	180	mA
	$I_{DD3.3OP100}$	C_L = 0 pF; Select @ 100MHz		66	180	mA
Power Down Supply Current	$I_{DD3.3PD}$	C_L = 0 pF; With input address to Vdd or GND		70	600	µA
Input frequency	F_i	V_{DD} = 3.3 V;	11	14.318	16	MHz
Input Capacitance[1]	C_{IN}	Logic Inputs			5	pF
	C_{INX}	X1 & X2 pins	27	36	45	pF
Transition Time[1]	T_{trans}	To 1st crossing of target Freq.			3	ms
Clk Stabilization[1]	T_{STAB}	From V_{DD} = 3.3 V to 1% target Freq.			3	ms
Skew[1]	$t_{CPU-SDRAM1}$	V_T = 1.5 V		200	500	ps
	$t_{CPU-PCI1}$	V_T = 1.5 V	1	3	4	ns

[1]Guaranteed by design, not 100% tested in production.

Electrical Characteristics - Input/Supply/Common Output Parameters

T_A = 0 - 70C; Supply Voltage V_{DD} = 3.3 V +/-5%, V_{DDL} = 2.5 V +/-5% (unless otherwise stated)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Operating Supply Current	$I_{DD2.5OP66}$	C_L = 0 pF; Select @ 66.8 MHz		16	72	mA
	$I_{DD2.5OP100}$	C_L = 0 pF; Select @ 100 MHz		23	100	mA
Skew[1]	$t_{CPU-SDRAM2}$	V_T = 1.5 V; V_{TL} = 1.25 V		200	500	ps
	$t_{CPU-PCI2}$	V_T = 1.5 V; V_{TL} = 1.25 V	1	3	4	ns

[1]Guaranteed by design, not 100% tested in production.

Electrical Characteristics - CPUCLK

T_A = 0 - 70C; V_{DD} = VDDL = 3.3 V +/-5%; C_L = 10 - 20 pF (unless otherwise stated)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Output High Voltage	V_{OH1a}	I_{OH} = -12.0 mA	2.4	2.6		V
Output Low Voltage	V_{OL1a}	I_{OL} = 12 mA		0.2	0.4	V
Output High Current	I_{OH1a}	V_{OH} = 2 V		-41	-19	mA
Output Low Current	I_{OL1a}	V_{OL} = 0.8 V	19	37		mA
Rise Time	t_{r1a}[1]	V_{OL} = 0.4 V, V_{OH} = 2.4 V		1.5	2	ns
Fall Time	t_{f1a}[1]	V_{OH} = 2.4 V, V_{OL} = 0.4 V		1.5	2	ns
Duty Cycle	d_{t1a}[1]	V_T = 1.5 V	45	48	55	%
Skew	t_{sk1a}[1]	V_T = 1.5 V		30	175	ps
Jitter, Cycle-to-cycle	$t_{jcyc-cyc1a}$[1]	V_T = 1.5 V		150	250	ps
Jitter, One Sigma	t_{j1s1a}[1]	V_T = 1.5 V		40	150	ps
Jitter, Absolute	t_{jabs1a}[1]	V_T = 1.5 V	-250	140	+250	ps

[1]Guaranteed by design, not 100% tested in production.

Electrical Characteristics - CPUCLK

T_A = 0 - 70C; V_{DD} = 3.3 V +/-5%, V_{DDL} = 2.5 V +/-5%; C_L = 10 - 20 pF (unless otherwise stated)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Output High Voltage	V_{OH1B}	I_{OH} = -12.0 mA	2	2.3		V
Output Low Voltage	V_{OL1B}	I_{OL} = 12 mA		0.2	0.4	V
Output High Current	I_{OH1B}	V_{OH} = 1.7 V		-41	-19	mA
Output Low Current	I_{OL1B}	V_{OL} = 0.7 V	19	37		mA
Rise Time	t_{r1B}[1]	V_{OL} = 0.4 V, V_{OH} = 2.0 V		1.25	1.6	ns
Fall Time	t_{f1B}[1]	V_{OH} = 2.0 V, V_{OL} = 0.4 V		1	1.6	ns
Duty Cycle	d_{t1B}[1]	V_T = 1.25 V	45	48	55	%
Skew	t_{sk1B}[1]	V_T = 1.25 V		30	175	ps
Jitter, Cycle-to-cycle	$t_{jcyc-cyc1B}$[1]	V_T = 1.25 V		150	250	ps
Jitter, One Sigma	t_{j1s1B}[1]	V_T = 1.25 V		40	150	ps
Jitter, Absolute	t_{jabs1B}[1]	V_T = 1.25 V	-250	140	+250	ps

[1]Guaranteed by design, not 100% tested in production.

Electrical Characteristics - PCICLK

T_A = 0 - 70C; V_{DD} = 3.3 V +/-5%; V_{DDL} = 2.5 V +/-5%; C_L = 30 pF

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Output High Voltage	V_{OH2}	I_{OH} = -11 mA	2.4	3.1		V
Output Low Voltage	V_{OL2}	I_{OL} = 9.4 mA		0.1	0.4	V
Output High Current	I_{OH2}	V_{OH} = 2.0 V		-62	-22	mA
Output Low Current	I_{OL2}	V_{OL} = 0.8 V	16	57		mA
Rise Time[1]	t_{r2}	V_{OL} = 0.4 V, V_{OH} = 2.4 V		1.5	2.6	ns
Fall Time[1]	t_{f2}	V_{OH} = 2.4 V, V_{OL} = 0.4 V		1.1	2	ns
Duty Cycle[1]	d_{t2}	V_T = 1.5 V	45	50	55	%
Skew[1]	t_{sk2}	V_T = 1.5 V		140	500	ps
Jitter, Cycle-to-cycle	$t_{jcyc-cyc2}$	V_T = 1.25 V		250	500	ps
Jitter, One Sigma[1]	t_{j1s2}	V_T = 1.5 V		17	150	ps
Jitter, Absolute[1]	t_{jabs2}	V_T = 1.5 V	-350	70	350	ps

[1]Guaranteed by design, not 100% tested in production.

Electrical Characteristics -SDRAM

T_A = 0 - 70C; V_{DD} = 3.3 V +/-5%; V_{DDL} = 2.5 V +/-5%; C_L = 30 pF

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Output High Voltage	V_{OH3}	I_{OH} = -11 mA	2.4	3.1		V
Output Low Voltage	V_{OL3}	I_{OL} = 9.4 mA		0.1	0.4	V
Output High Current	I_{OH3}	V_{OH} = 2.0 V		-62	-22	mA
Output Low Current	I_{OL3}	V_{OL} = 0.8 V	16	57		mA
Rise Time[1]	t_{r3}	V_{OL} = 0.4 V, V_{OH} = 2.4 V		1.5	2.6	ns
Fall Time[1]	t_{f3}	V_{OH} = 2.4 V, V_{OL} = 0.4 V		1.1	2.2	ns
Duty Cycle[1]	d_{t3a}	V_T = 1.5 V; Divide by 2 seclects<124MHz	47%		57%	
	d_{t3b}	V_T = 1.5 V; Divide by 3 seclects	45		55	
	d_{t3c}	V_T = 1.5 V; Selects >= 124MHz	43	50	53	%
Skew[1] (Window)	t_{sk3a}	V_T = 1.5 V; SDRAM0,8,9		140	250	ps
	t_{sk3b}	V_T = 1.5 V; All except SDRAM8 and 9				
	t_{sk3c}	V_T = 1.5 V; All SDRAMs		200	400	
Jitter, Cycle-to-cycle	$t_{jcyc-cyc3}$	V_T = 1.25 V		250	500	ps
Jitter, One Sigma[1]	t_{j1s3}	V_T = 1.5 V		17	150	ps
Jitter, Absolute[1]	t_{jabs3}	V_T = 1.5 V	-250	70	250	ps

[1]Guaranteed by design, not 100% tested in production.

Electrical Characteristics - REF/48MHz/SIO

T_A = 0 - 70C; V_{DD} = 3.3 V +/-5%; V_{DDL} = 2.5 V +/-5%; C_L = 20 pF

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Output High Voltage	V_{OH4}	I_{OH} = -12 mA	2.4	2.6		V
Output Low Voltage	V_{OL4}	I_{OL} = 10 mA		0.3	0.4	V
Output High Current	I_{OH4}	V_{OH} = 2.0 V		-32	-22	mA
Output Low Current	I_{OL4}	V_{OL} = 0.8 V	16	25		mA
Rise Time[1]	t_{r4}	V_{OL} = 0.4 V, V_{OH} = 2.4 V		2	4	ns
Fall Time[1]	t_{f4}	V_{OH} = 2.4 V, V_{OL} = 0.4 V		1.9	4	ns
Duty Cycle[1]	d_{t4}	V_T = 1.5 V	45	53	55	%
Jitter, One Sigma[1]	t_{j1s4}	V_T = 1.5 V		500	650	ps
Jitter, Absolute[1]	t_{jabs4}	V_T = 1.5 V	-1		1	ns

[1]Guaranteed by design, not 100% tested in production.

General Layout Precautions:

1) Use a ground plane on the top layer of the PCB in all areas not used by traces.

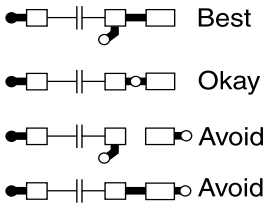
2) Make all power traces and ground traces as wide as the via pad for lower inductance.

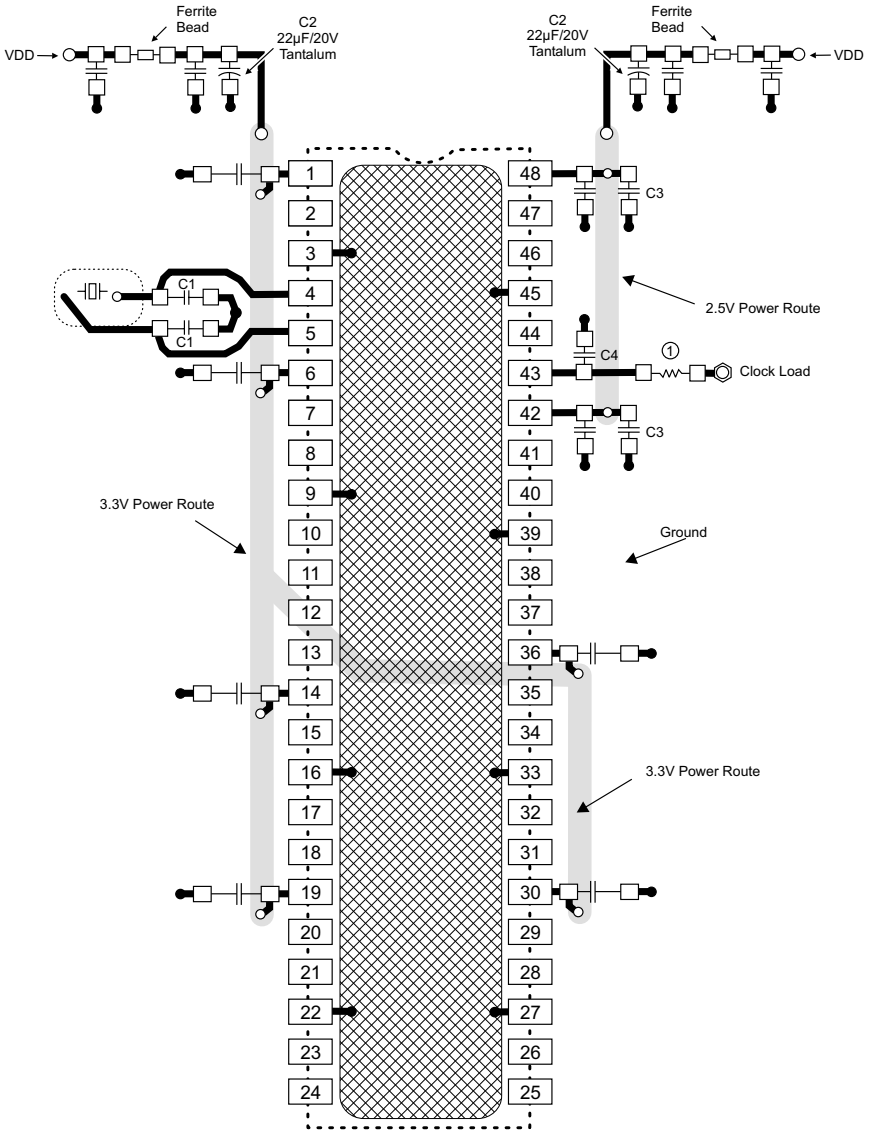
Notes:

1) All clock outputs should have a series terminating resistor, and a 20pF capacitor to ground between the resistor and clock pin. Not shown in all places to improve readibility of diagram.

2) Optional crystal load capacitors are recommended. They should be included in the layout but not inserted unless needed.

Connections to VDD:





= Routed Power

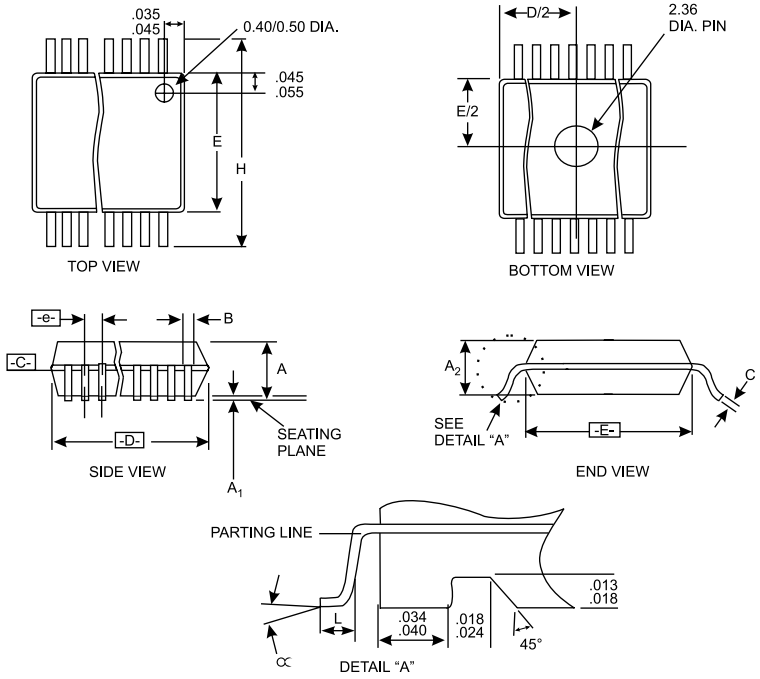
= Ground Connection Key (component side copper)

= Ground Plane Connection

= Power Route Connection

= Solder Pads

= Clock Load



SYMBOL	COMMON DIMENSIONS			VARIATIONS	D			N
	MIN.	NOM.	MAX.		MIN.	NOM.	MAX.	
A	.095	.101	.110	AC	.620	.625	.630	48
A1	.008	.012	.016					
A2	.088	.090	.092					
B	.008	.010	.0135					
C	.005	-	.010					
D	See Variations							
E	.292	.296	.299					
e	0.025 BSC							
H	.400	.406	.410					
h	.010	.013	.016					
L	.024	.032	.040					
N	See Variations							
∝	0°	5°	8°					
X	.085	.093	.100					

SSOP Package

Ordering Information

ICS9248yF-81

Example:

ICS XXXX y F - PPP

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

Package Type
F=SSOP

Revision Designator

Device Type (consists of 3 or 4 digit numbers)

Prefix
ICS, AV = Standard Device